Determination of Groundwater Withdrawal and Subsidence in Harris and Galveston Counties – 2020

by
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Harris-Galveston Subsidence District Report 2021-01

Harris – Galveston Subsidence District
Friendswood, TX
2021

MICHAEL J. TURCO

GENERAL MANAGER

The Harris-Galveston Subsidence District (District) has been monitoring water use, groundwater levels, and subsidence in Harris, Galveston, and adjacent counties since 1975. Subsidence, the lowering of land-surface elevation, is caused by the depressurization of our aquifers due to wide-spread use of groundwater as a primary water source. The mission of the District is to cease on-going subsidence and prevent the occurrence of future subsidence. As part of this effort, it is important for the District to provide consistent, high-quality information to the public regarding ground water use, aquifer water-levels, and subsidence.

The information contained within this report is the compilation of the largest multi-agency effort in the State of Texas that leverages the resources of both the Harris-Galveston and Fort Bend Subsidence Districts with the City of Houston, the U.S. Geological Survey, the Brazoria County Groundwater Conservation District, and the Lone Star Groundwater Conservation District. This year this multi-agency partnership will publish the 45th volume of this important data compilation. This report is intended to exceed the requirements of section 8801.117 of the District's enabling legislation.

On behalf of the Board of Directors of the Harris-Galveston Subsidence District, I would like to thank you for your interest in the District. We look forward to continuing to provide timely, accurate, high-quality data and research to inform the District's Regulatory Planning efforts to prevent subsidence and water planning throughout the region.

Sincerely,

Michael J. Turco
General Manager

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Acknowledgements

The compilation of the data and analysis contained within this report would not be possible without the concerted effort of many that contributed to the 2020 Annual Groundwater Report. The authors would like to thank the staff of the Harris-Galveston Subsidence District for their diligent field work in collecting GPS data, Robert Thompson, Stacey Bension, Ronald Geesing, Brian Ladd, Ana Ruiz-Flores, and Vanson Truong (Harris-Galveston Subsidence District) for their processing and validation of water use data; Dr. Guoquan Wang (University of Houston) and his students for processing and archiving raw GPS data, Joseph Turco (Northeastern University) for the development of computer scripts to aid in the interpretation and visualization of the GPS data; and the engineers, staff, and owners of the nearly 8,400 permitted wells in the District that submitted detailed water use information contained in this report.

Public Hearing Notice was posted on:	March 15, 2021
Draft Presentation Posted on District Website on:	April 26, 2021
Public Hearing held on:	April 29, 2021
Hearing Examiner:	Ms. Helen Truscott
Hearing Record held open for public comment until:	May 6, 2021
Approved by the Board of Directors:	May 12, 2021

Conversions Factors and Datums

Multiply	By	To obtain
inch (in)	2.54	centimeter (cm)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
gallon (gal)	3.785	liter (L)
million gallons per day (MGD)	3785.41	cubic meter (m^3)
million gallons per day (MGD)	3.0688	acre-feet (acre-ft)

List of Acronyms

BCGCD	Brazoria County Groundwater Conservation District
CORS	continuously operating reference station
FBSD	Fort Bend Subsidence District
GNSS	global navigation satellite system
GPS	global positioning system
GRP	groundwater reduction plan
HGSD	Harris-Galveston Subsidence District
LSGCD	Lone Star Groundwater Conservation District
MGD	million gallons per day
NGS	National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PAM	periodically measured GPS station
POR	period of record
TXDOT	Texas Department of Transportation
UH	University of Houston
USGS	United States Geological Survey

Executive Summary

Groundwater was the primary source of water for the municipal, agricultural, and industrial users over the last century. Rapid increase in population in the 1950s, due to the expansion of the industrial complex in the Houston Ship Channel area, led to a dramatic increase in water demand and groundwater withdrawal. The reliance on groundwater and subsequent subsidence that was caused by its regional development resulted in the creation of the Harris-Galveston Subsidence District (District) in 1975 and the Fort Bend Subsidence District in 1989. The District's mission is to regulate the use of groundwater in Harris and Galveston counties to cease ongoing and prevent future subsidence that can lead to infrastructure damage and contribute to flooding.

This report comprises the 45th Annual Groundwater Report for the District. Pursuant to District Resolution No. 2021-1071 passed on February 10, 2021, the Board of Directors held a public hearing at 9:00 a.m. on April 29, 2021 to present climatic conditions, groundwater use, groundwater levels and measured subsidence within the District through December 31, 2020. This report provides an overview of the information presented during the Public Hearing.

Climate

Annual variations in precipitation can significantly impact the total water demand in the District. Groundwater use patterns fluctuate during periods of climatic variation, which results in changes in aquifer water-levels and potentially in subsidence rates. During periods of excessive rainfall, total water demand can decline; conversely, during periods of drought, water use can increase resulting in declining water-levels in the aquifer and increased rates of subsidence. The 2020 calendar year started out with normal to below normal rainfall accumulations, followed by Tropical Storm Beta that resulted in heavy rainfall across the Galveston, Harris, and Fort Bend counties flooding roadways, bayous, and creeks in September. Towards the end of the year, rainfall accumulations averaged below normal. Overall, rainfall totals in 2020 were below normal for the majority of the District.

Water Use

Since 1976, water users in the District have been working to change their source water from primarily groundwater to alternative sources of water, primarily treated surface water in an effort to prevent subsidence. The percent of total water demand sourced from groundwater has dropped from about 60 percent in 1976 to about 21 percent in 2020. Most of the current groundwater use occurs in Regulatory Area Three where the regulatory compliance timeline will not be completed until 2035. The three-primary water uses in the District are public supply, industrial, and irrigation. The overall groundwater use within the District in 2020 is 208.0 MGD, which is a nine percent decrease in pumpage from 2019. Public supply groundwater use remains the largest single use category at 190.2 million gallons per day (MGD), a nine percent decrease from 2019, and accounts for 91 percent of groundwater used in the District. Since the last regulatory conversion milestone in 2010, public supply and industrial uses are generally unchanged where irrigation uses have decreased by about 48 percent.

The District's Regulatory Plan requires permittees to convert to alternative water supplies in order to reduce their reliance on groundwater. The primary alternative water supply used in our region is surface water sourced from three river basins: the Brazos River Basin, the San Jacinto River Basin and the Trinity

River Basin. In 2020, the total alternative water use was 770.5 MGD, with the Trinity River remaining the single largest source of alternative water providing a total of 534.7 MGD in surface water supply. Groundwater remains the second largest source of water supply within the District as a whole. The total water use for the District was 978.6 MGD in 2020, which is 0.4 percent lower than the reported water use in 2019.

Groundwater Levels

Annually, since 1975, the United States Geological Survey (USGS) has measured the water level in hundreds of wells throughout the Houston region in cooperation with the District through a joint funding agreement along with additional cities, subsidence districts and groundwater conservation districts to monitor and provide reports on groundwater level altitude data for the Chicot/Evangeline and Jasper aquifers. Since aquifer water level is the best measure of the pressure in the aquifer, this information is also of vital importance to understanding the impact of changes in water use on subsidence.

The change in water-level in the Chicot/Evangeline aquifers since 1977 clearly shows the impact of District regulation on the aquifers. Generally, Regulatory Areas One and Two have seen a significant rise in the potentiometric water-level up to 352 feet in the Chicot/Evangeline aquifers. The area of rise is a result of the reduction of groundwater use required by the District's Regulatory Plan. Conversely, in Regulatory Area Three and nearby in southern Montgomery County, water-levels continue to be significantly lower than the historical benchmark, declines of nearly 370 feet in the Chicot/Evangeline aquifers. These areas are growing rapidly and the conversion to alternative sources of water will not be completed in the District until 2035 and in the Fort Bend Subsidence District until 2025.

Subsidence

Since the 1990s, the District has utilized global positioning system (GPS) technology to monitor the land surface deformation in the area. Working collaboratively with the University of Houston researchers, the subsidence monitoring network has grown to over 250 GPS stations throughout the region. These stations are operated by the District, the Fort Bend Subsidence District (FBSD), the University of Houston (UH), the Lone Star Groundwater Conservation District (LSGCD), the Brazoria County Groundwater Conservation District (BCGCD), Texas Department of Transportation (TXDOT), and other local entities.

The average annual rate of movement is a useful measure to show current conditions at a GPS station. The annual rates of subsidence observed in Regulatory Areas One and Two are generally stable, since both areas have reached their full regulatory conversion level (1990 and 1995, respectively) and Chicot/Evangeline water-levels have risen. Subsidence rates are generally above 0.5 centimeters (cm) per year throughout Regulatory Area Three as this area is still undergoing conversion to alternative water supply.

Introduction

The Houston region has relied on groundwater as a primary source of water since the early 1900s. During and following the economic boom of the 1940s, rapid population expansion and increased water use resulted in potentiometric water-level declines in the Chicot and Evangeline aquifers of 250 and 300 feet (76 and 91 meters), respectively from 1943 to 1977 (Gabrysch, 1982).The potentiometric surface is the level to which water rises in a well. In a confined aquifer, this surface is above the top of the aquifer unit; whereas, in an unconfined aquifer, it is the same as the water table.

The reliance on groundwater and subsequent subsidence that was caused by regional development resulted in the creation of the Harris-Galveston Subsidence District (District) in 1975 and the Fort Bend Subsidence District in 1989. The District's mission is to regulate the use of groundwater in Harris and Galveston counties in order to cease ongoing and prevent future subsidence that can contribute to flooding, faulting, and lead to infrastructure damage.

Description of Study Area

The following section provides an overview of the study area, including the hydrogeology and an overview of the District's regulatory planning areas.

Hydrogeology

The Gulf Coast Aquifer exists as an accretionary wedge of unconsolidated sediments composed primarily of sand, silt, and clay. Indicative of a transgressive-regressive shoreline, the interbedded sands and clays are not horizontally or vertically continuous at larger than a local scale. From youngest to oldest, these hydrogeologic units include the Chicot, Evangeline, Burkeville, Jasper, and Catahoula Sandstone aquifers.

The three-primary water-bearing units located within the District include the Chicot, Evangeline, and Jasper aquifers. The Chicot and the Evangeline aquifers comprise the shallow system of aquifers. These aquifers are hydrologically connected, allowing for the free flow of water between the two units. Historically, nearly all of the groundwater production in the Gulf Coast Aquifer System in the District occurred in the shallow system. Recently, an updated stratigraphic approach incorporated new data from approximately 650 geophysical logs and adjusted the bottom of the Chicot aquifer by extending it deeper (Young & Draper, 2020). This updated approach changed aquifer designations such that wells that were previously defined as screened in the Evangeline are now considered to be screened in the Chicot. As a result of this update, the Chicot and Evangeline aquifers have been combined into an undifferentiated shallow aquifer system called the Chicot/Evangeline in this report as shown in **Figure 1**.

The Jasper aquifer is the deepest of the three primary water bearing units and is isolated by the regionally persistent Burkeville confining unit. In the region, the Catahoula Sandstone, the deepest water bearing unit in the Gulf Coast Aquifer system and the Burkeville confining unit are utilized as a groundwater supply in areas to the north and west of the District where these units may produce appreciable amounts of water.

Most of the subsidence that has occurred in the District can be sourced to clay compaction in the shallow water bearing units associated with long-term water use and the decline in the aquifers' potentiometric surface. Because of the significant amount of clay material in the primary water bearing units of the aquifer, the risk of compaction is high in areas where the developed portions of the aquifers are within about 2,000 feet of land surface under high stress from groundwater development, and have had sustained potentiometric water-level declines (Yu, et al., 2014).

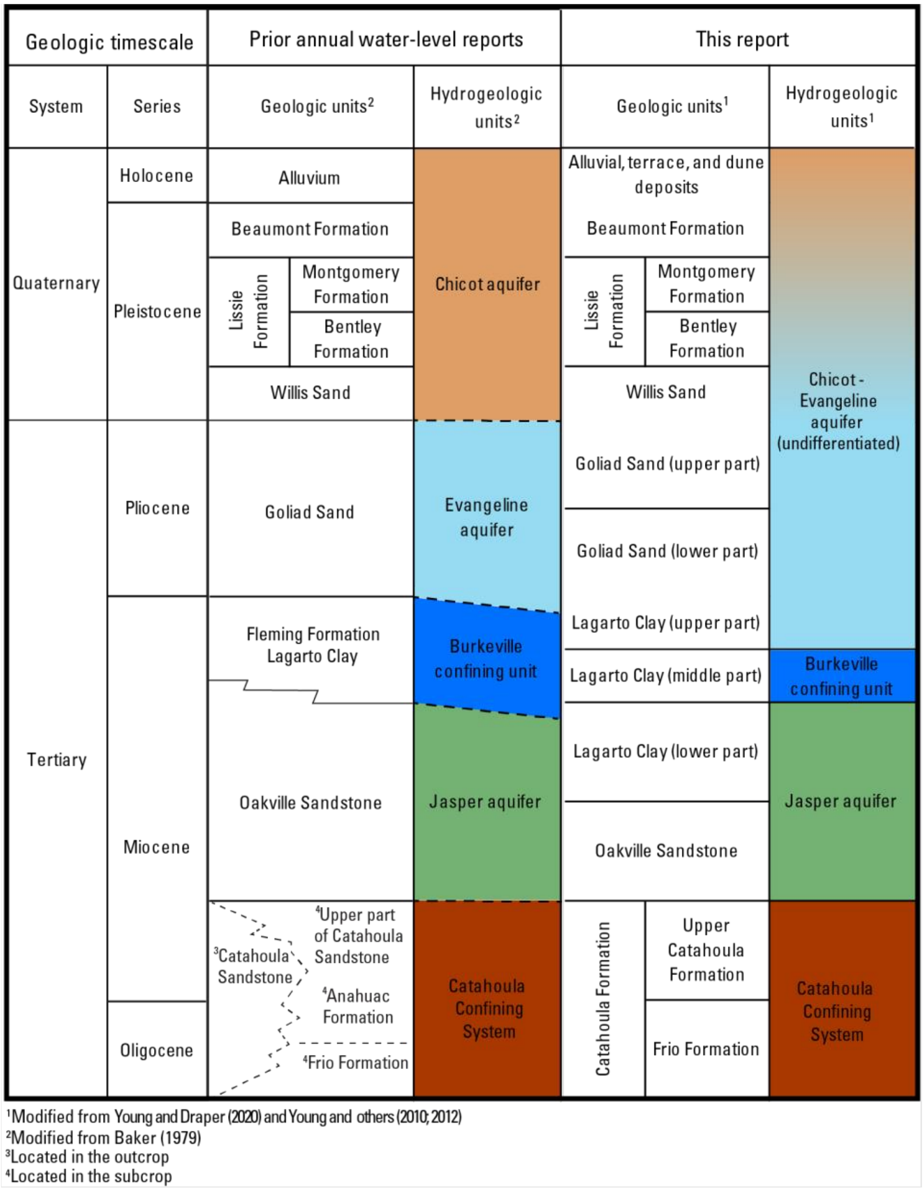


Figure 1. Updated stratigraphic column of the Gulf Coast Aquifer System in Harris and adjacent counties, Texas (Source: USGS preliminary and subject to revision).

Regulatory Planning

The District's Regulatory Plan was developed to reduce groundwater withdrawal to a level that ceases ongoing subsidence and prevents future subsidence within the District. The District utilizes a novel approach to regulate groundwater withdrawal in order to prevent subsidence by allowing a portion of the total water demand of a water user to be sourced from groundwater. Total water demand is defined as the total amount of water used by an entity from all sources including groundwater, treated surface water, reclaimed water, etc. The District adopted the most recent Regulatory Plan on January 9, 2013 and it was subsequently amended on May 08, 2013 and April 14, 2021 (Harris-Galveston Subsidence District, Amended 2021).

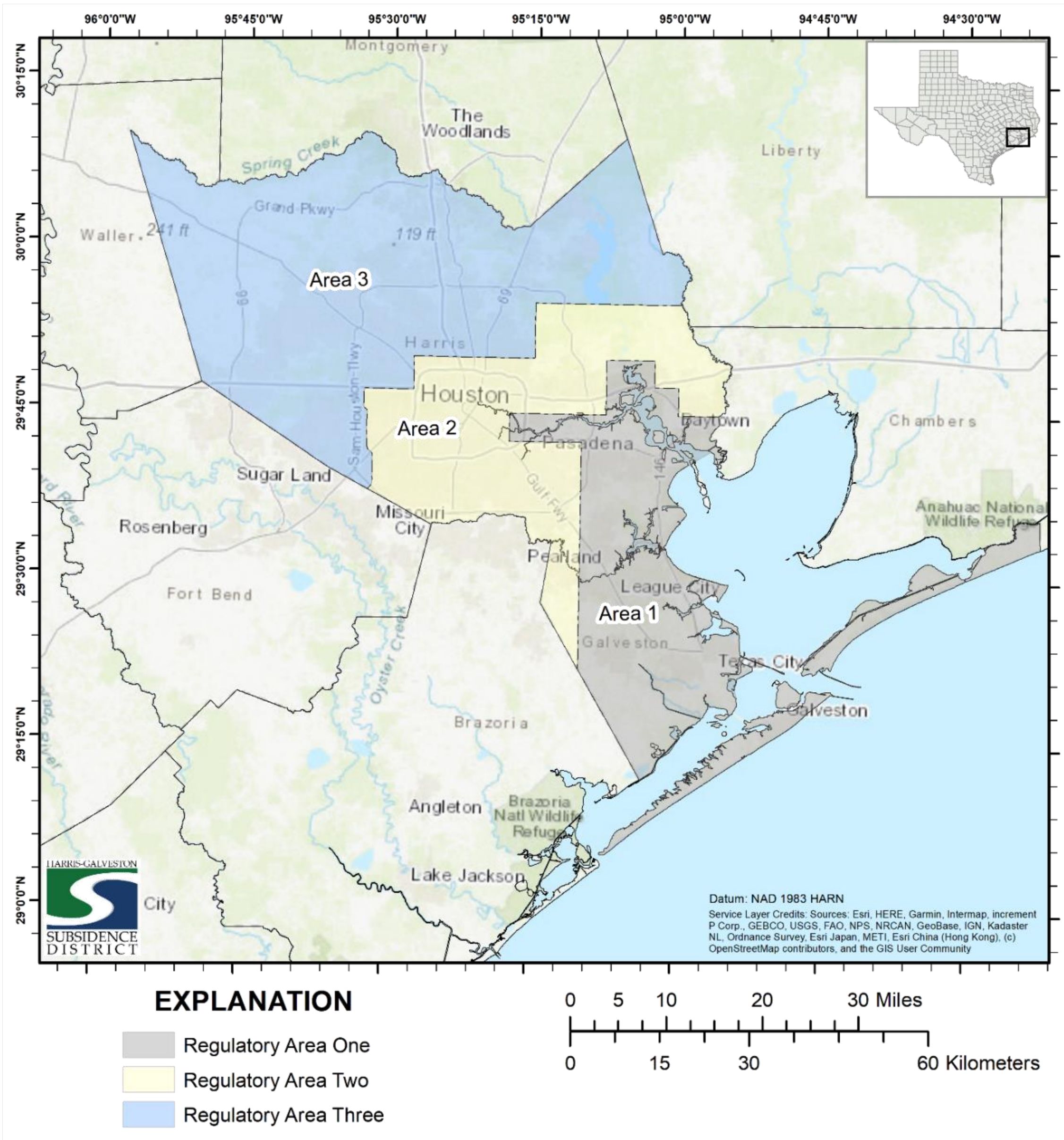


Figure 2. Location of the Harris-Galveston Subsidence District Regulatory Areas.

The District has historically used regulatory areas to guide groundwater conversion deadlines and regulations. The 2013 Regulatory Plan has subdivided Harris and Galveston counties into three regulatory areas (**Figure 2**). Regulatory Area One includes the Houston Ship Channel, Industrial Corridor, and coastal areas of Galveston and Harris Counties. Regulatory Area Two is primarily an urban intermediate area that includes downtown, the Texas Medical Center, and parts of eastern Harris County. Regulatory Area Three covers the remaining areas of the District in northern and western Harris County

Permittees in Regulatory Area One are required to have no more than 10% of their total water demand come from groundwater sources. Permittees in Regulatory Area Two must have no more than 20% of their total water demand come from groundwater sources. Reduction in groundwater use for both Regulatory Area One and Two began once the District was created in 1975, and by 1990 most of those areas had been fully converted to using alternative sources of water.

Regulatory Area Three is still undergoing conversion from groundwater to surface water sources. This area completed its first conversion in 2010 reducing groundwater use from 100% to 70% of total water demand. The District's Regulatory Plan allows permittees with more than ten million gallons per year of total water demand the option to establish groundwater reduction plans (GRPs) that provide a phased approach to conversion in Area Three with additional conditions in Area Two. For those permittees operating under a GRP in Area Three, permittees are required to adhere to the following future conversion deadlines:

- In 2025, groundwater withdrawals must not comprise more than 40 percent of the permittee's total water demand.
- In 2035, groundwater withdrawals must not comprise more than 20 percent of the permittee's total water demand.

All other permittees in Regulatory Area Three (i.e., those without GRPs) are required to reduce their groundwater withdrawals so that no more than 20 percent of their total water demand was sourced from groundwater.

Surficial Hydrology

The District's Regulatory Plan requires permittees to convert to alternative water supplies in order to reduce their reliance on groundwater sources. The primary alternative water supplies used in the Houston region is surface water sourced from three river basins: the Brazos River Basin, the San Jacinto River Basin and the Trinity River Basin (**Figure 3**).

The Brazos River Basin is the second largest river basin in Texas, covering over 45,000 square miles (116,550 sq km) (TWDB, 2020). The headwaters of the Brazos River are located near the Texas-New Mexico border and the river travels over 800 miles (1,287 km) to discharge into the Gulf of Mexico near Freeport, Texas. The Brazos River Authority manages the eleven reservoirs within this basin, eight of which are owned by the Brazos River Authority and three are owned by the U. S. Army Corps of Engineers (Region H Water Planning Group, 2016).

The San Jacinto River Basin is the smallest river basin in Texas, covering almost 4,000 square miles (10,360 sq km) according to Texas Water Development Board (2020). Lake Conroe and Lake Houston are the two water supply reservoirs located within the San Jacinto River Basin. Lake Conroe is jointly owned by the City of Houston and the San Jacinto River Authority. The San Jacinto River Authority operates Lake Conroe and provides water supply to Harris and Montgomery Counties. Lake Houston is owned by the City of Houston and operated by the Coastal Water Authority.

The Trinity River Basin covers almost 18,000 square miles (46,619 sq km), with headwaters of the basin located in north central Texas (TWDB, 2020). The Trinity River flows through the Dallas-Fort Worth metroplex, traversing 550 miles (885 km) until the river discharges into Trinity Bay near Anahuac, Texas. There are numerous reservoirs located on the Trinity River that are owned and operated by several different agencies, including Lake Livingston which is owned and operated by Trinity River Authority.

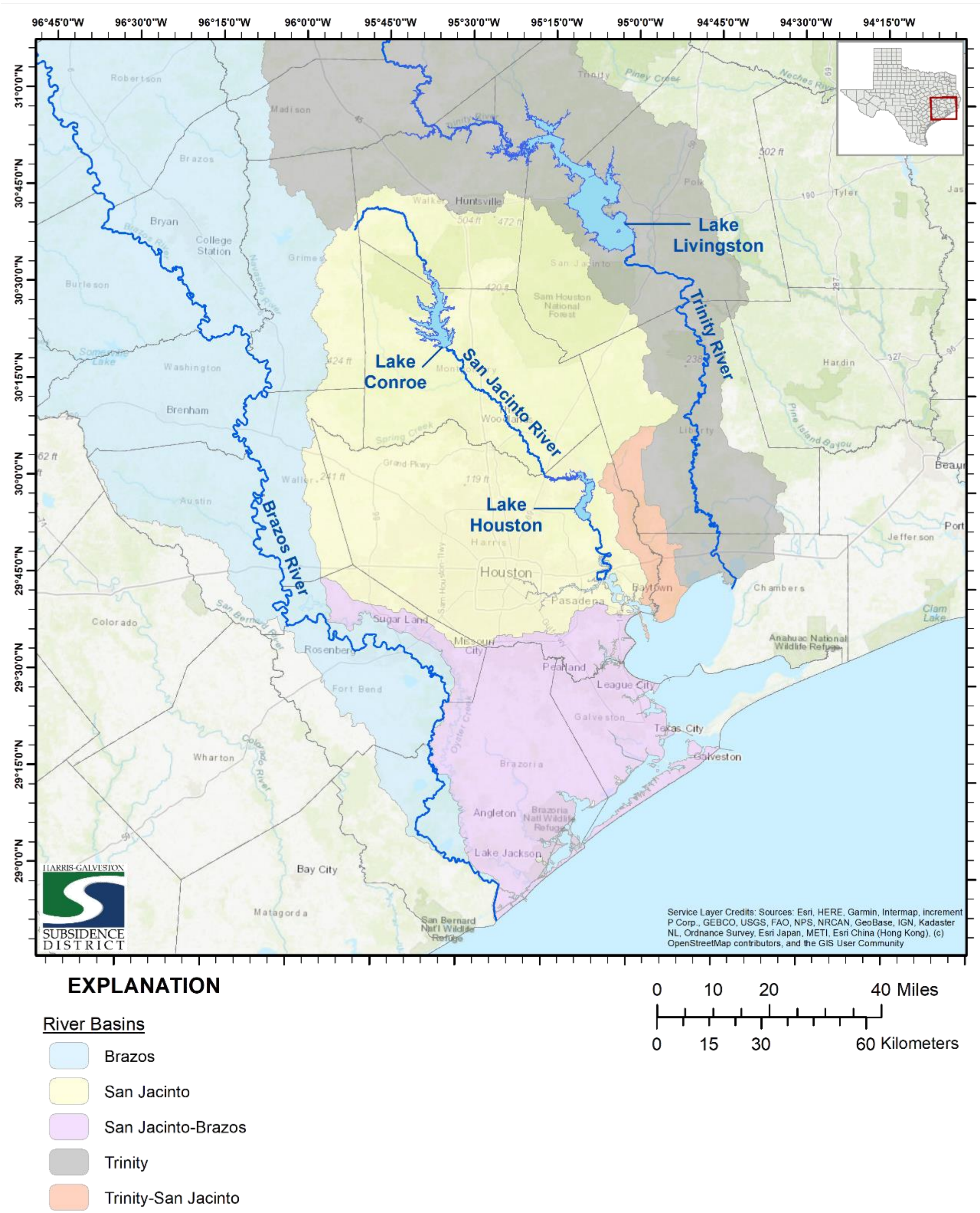


Figure 3: River basins that supply alternative water to Harris and Galveston counties, Texas.

Alternative Source Waters

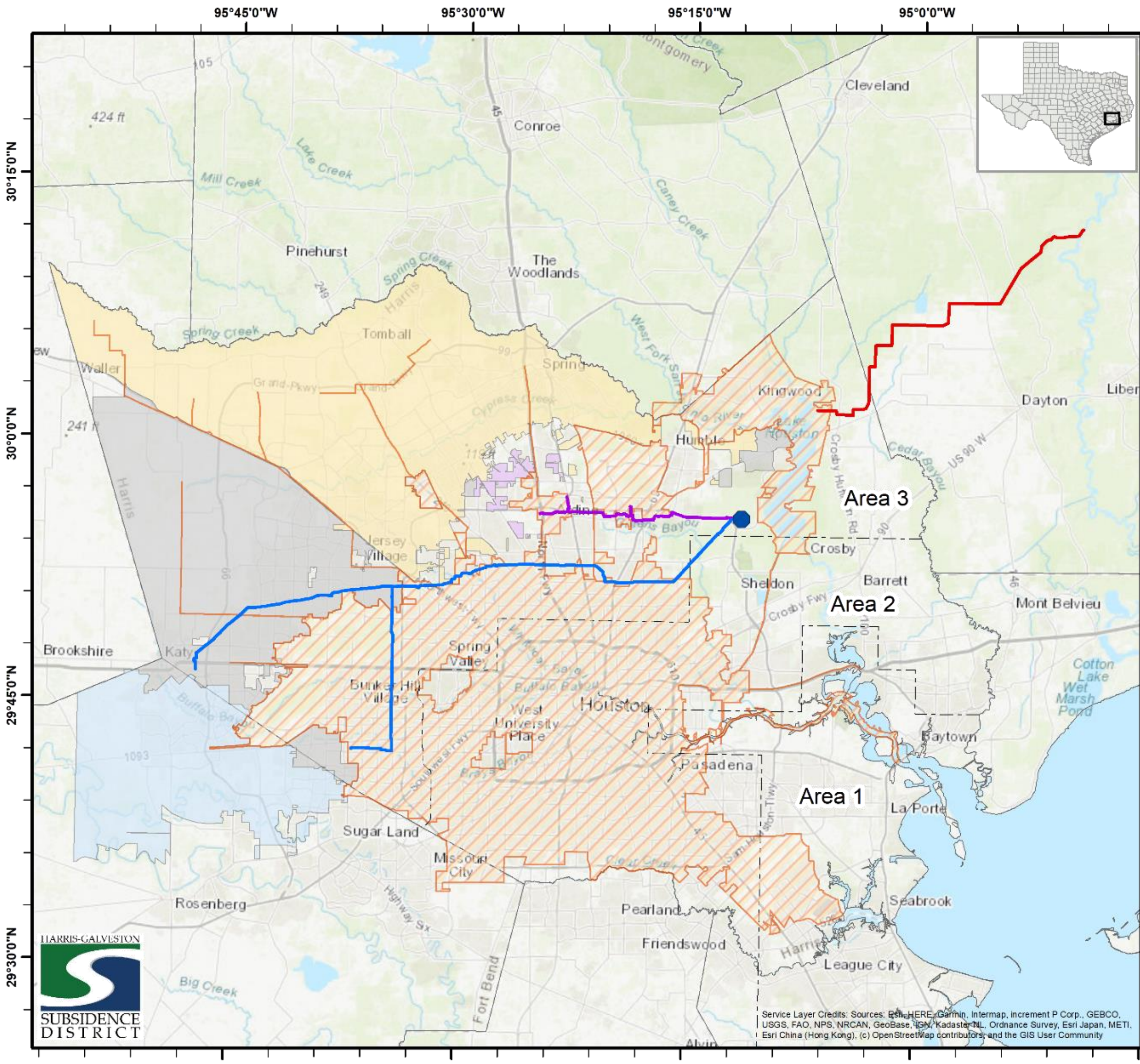
In the 1950s, the City of Houston along with other entities in the region began the development of several water supply reservoirs within the San Jacinto and Trinity River Basins to provide water for the rapidly growing region. Today, water treatment plants served by these surface water sources and the Brazos River Basin are operated by the City of Houston, City of Sugar Land, City of Richmond, the Gulf Coast Water Authority, the Brazosport Water Authority, and others.

To meet the Harris-Galveston and Fort Bend Subsidence Districts' regulatory requirements to convert from groundwater to surface water, the City of Houston and four regional water authorities—the Central Harris County Regional Water Authority, North Fort Bend Water Authority, North Harris County Regional Water Authority, West Harris County Regional Water Authority, and Coastal Water Authority (collectively, the Water Authorities) began working together to implement a GRP for the planning, design, financing, and construction of several major infrastructure projects.

Four projects are underway to develop the necessary alternative water supply and distribution infrastructure to facilitate the District's future conversion requirements:

- Luce Bayou Interbasin Transfer: will pump untreated surface water from the Trinity River through a series of canals and water pipelines along Luce bayou to Lake Houston.
- Northeast Water Purification Plant Expansion: will expand the existing surface water treatment plant located on Lake Houston from 80 MGD up to 400 MGD, in order to treat the raw surface water conveyed by the Luce Bayou Interbasin Transfer project.
- Northeast Transmission Line Project: will provide for the conveyance of the additional treated surface water from Lake Houston into central and northern Harris County.
- The Surface Water Supply Project: will convey treated water from the expanded Northeast Water Purification Plant into western Harris County and northeastern Fort Bend County.

In addition to the four projects described above, the City of Houston and the Water Authorities are each designing and constructing their own distribution systems to convey the treated surface water to their customers. These interrelated regional projects are planned to be completed by 2025, when the next conversion requirements of Harris-Galveston and Fort Bend Subsidence Districts go into effect. **Figure 4** shows the extent of these projects.



EXPLANATION

- Northeast Water Purification Plant
- Luce Bayou InterBasin Transfer Project
- Northeast Transmission Line
- Surface Water Supply Project
- City of Houston

Water Authorities
- CHCRWA
- NFBWA
- NHCRWA
- WHCRWA

0 5 10 20 Miles
0 10 20 40 Kilometers

Figure 4: Alternative water supply and infrastructure distribution projects in the greater Houston region.

Purpose and Scope of Report

This document comprises the 46th Annual Groundwater Report for the District. Pursuant to District Resolution No. 2021-1071 passed on February 10, 2021, the Board of Directors held the Annual Groundwater Hearing beginning at 9:00 a.m. on April 29, 2021. The Public Hearing was held as a virtual meeting to comply with best practices and directions provided by the State of Texas for the COVID-19 public health emergency. The public hearing fulfills the requirements of Section 8801.117, Texas Special Districts Local Laws Code, which states that each year, the Board of Directors shall hold a public hearing for the purpose of taking testimony concerning the effects of groundwater withdrawals on the subsidence of land within the District during the preceding year.

Approximately 42 people registered the Hearing including members of the USGS staff, members of the District's staff, four Directors, representatives from neighboring groundwater conservation Districts and the public. Those giving testimony were Dr. Christina (Tina) Petersen and Ms. Ashley Greuter of the District and Mr. Jason Ramage, Hydrologist, Gulf Coast Programs Office, Texas-Oklahoma Water Science Center, United States Geological Survey, Department of the Interior. District staff submitted in total, 19 exhibits including topics of precipitation, groundwater withdrawal, alternate-water usage, and subsidence measurements. Mr. Ramage presented 18 exhibits including topics of water-level altitudes, water-level changes, and aquifer compaction.

This report provides an overview of the information presented during the Public Hearing, including climatic conditions, groundwater use, groundwater levels and measured subsidence within the District through December 31, 2020. Appendix A of this report includes the exhibits presented at the public hearing held on April 29, 2021.

2020 Climate Summary

The District reviews local climatic data provided from the National Oceanic and Atmospheric Administration (NOAA) – National Weather Service (NWS) climate stations within the District boundary (**Figure 5**). Variation in local precipitation, specifically deviation from historical normal, is important to the District because it has a direct impact on the magnitude of the total water demand from water users in the region as well as the availability of alternative water supplies, such as surface water. During period of above normal precipitation in the region, total water demand remains typically near normal or below normal due to reduced municipal and agricultural water uses. Conversely, during period of below normal precipitation, the total water demand of the region will typically increase due to increased water use. Additionally, during prolonged periods of below normal precipitation, natural limits on alternative supplies may require additional groundwater use – and subsequently result in additional lowering of groundwater aquifer levels, compaction of the aquifer materials, and subsidence observed at land surface.

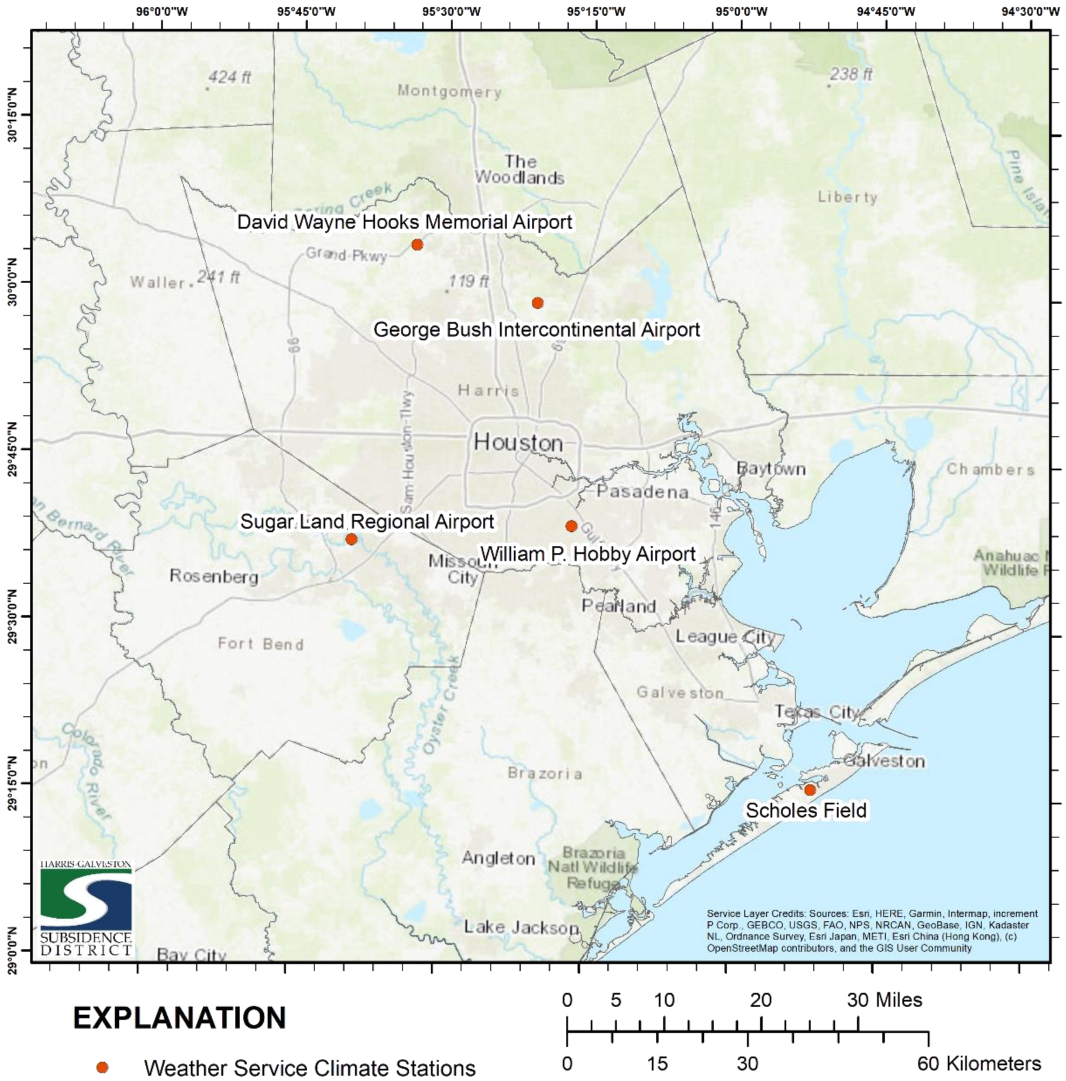


Figure 5. Location of NOAA-NWS climate stations, Houston Region, TX.

As shown in **Figure 6**, precipitation throughout 2020 is marked by periods of below rainfall interrupted with a period of significant rainfall associated with Tropical Storm Beta and prolonged below normal rainfall in the spring and early summer months. The cumulative precipitation departure from 1981-2010 normal precipitation is referenced to the George Bush Intercontinental Airport values for each NWS climate station displayed in **Figure 6**.

Generally normal to below normal precipitation in the winter through summer was observed at all climate stations. Following a large regional storm system in September, below normal precipitation continued through October where most stations were below normal cumulative precipitation. This caused a departure from normal precipitation at Hobby Airport in Houston, TX over 7 inches (18.6 cm).

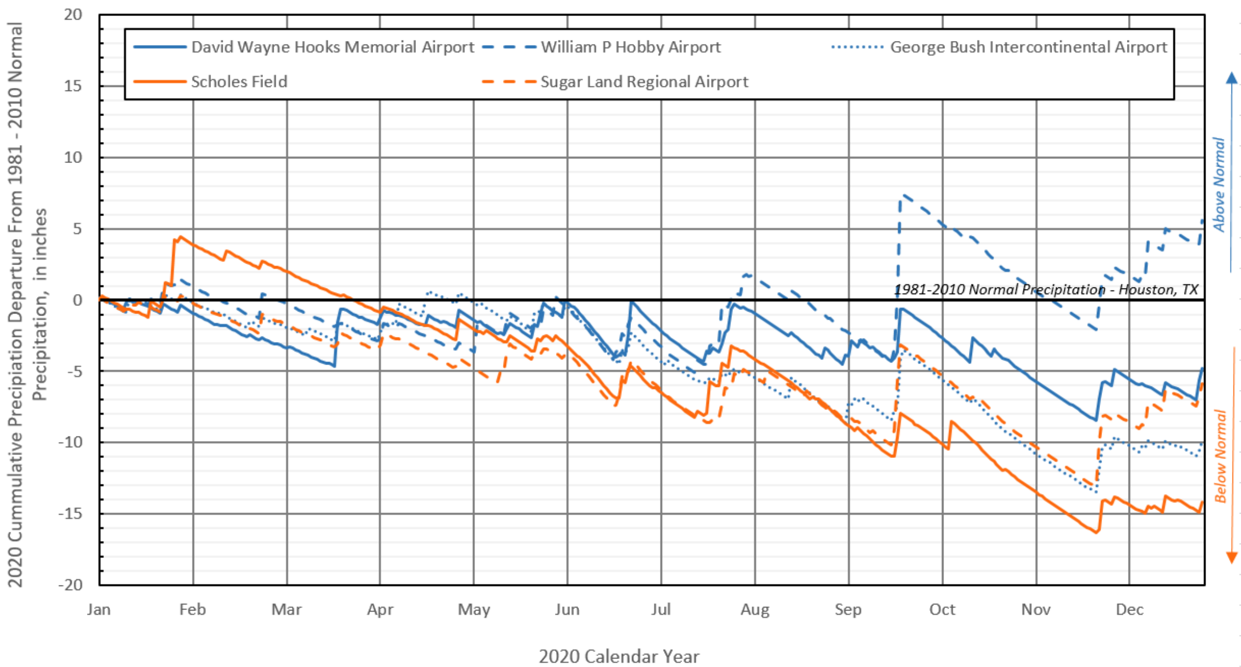


Figure 6. Cumulative precipitation departure, in inches, from 1981-2010 normal precipitation (Arguez, et al., 2010) at selected NOAA-NWS Climate Stations in the Houston region, 2020 (Menne et al., 2012a, 2012b, 2012c, 2012d, 2012e).

As the Houston-Galveston area was below to significantly-below normal precipitation totals in early September, Tropical Storm Beta produced large amounts of rainfall over much of the region. This was a short-lived tropical storm that made landfall near the Matagorda Peninsula of Texas. It developed as a depression in the Gulf of Mexico on September 16, 2020 and strengthened into a tropical storm while slowly moving northward (Fowler, 2021). The system produced significant rainfall totals causing coastal flooding and dangerous marine conditions over portions of Southeastern Texas. Flooding of creeks, bayous, and roads was prevalent throughout Galveston, Fort Bend, and southern Harris counties.

Except for Tropical Storm Beta in September, precipitation was generally below normal through the remainder of 2020. The largest cumulative rainfall recorded at the selected NOAA-NWS climate stations was 60.25 inches (153.04 cm) at Hobby Airport in Houston, Texas which is 5.6 inches (14.2 cm) above the 1981-2010 normal annual precipitation. The lowest cumulative rainfall of 40.47 inches (102.79cm) was recorded at Scholes Field, Galveston, Texas which is 14.18 inches (36.02 cm) below normal.

2020 Water Use

The District collects groundwater and alternative water supply use annually from permittees. This information provides an understanding of how much groundwater is being used, how permittees are using groundwater, and perspective on the conversion from groundwater to surface water for the various regulatory areas.

In 2020, there were a total of 8,397 permitted wells in the District. As of April 2021, a total of 7,344 of these permittees had submitted their annual water use data for the District to compile and use in this report. The groundwater withdrawals associated with these missing reports were estimated based on permitted allocations to be 4.92 MGD which equates to about 2.4 percent of the reported withdrawals.

In addition to providing water use data for 2020, this report also provides updated groundwater withdrawal totals for the previously reported year of 2019. These changes are made during the normal permitting and reporting process as part of the exchange between the District and its permittees. The changes include updating estimated amounts with actual amounts, correction of data entry errors, and errors in the submitted data. The reported 2019 groundwater withdrawal total increased by 0.2 MGD to a new total of 228.3 MGD.

The following sections provide a summary of the information presented at the Public Hearing held on April 29, 2021. The exhibits used to provide testimony during the hearing are included in **Appendix A – Exhibits Presented at Public Hearing held on April 29, 2021.**

Overall Water Use

The three primary water uses in the District are public supply, industrial, and irrigation. The total amount of groundwater withdrawal for 2020 is 208.0 MGD, a nine percent decrease over 2019 (**Table 1**), with public supply being reported to be 91 percent of the overall use. As a result of the District's Regulatory Plan, groundwater withdrawals have decreased since the District's inception in 1975 (**Figure 7**), with a 54 percent decline from 456.3 MGD in 1976 to 208.0 MGD in 2020. Patterns in groundwater use have shifted over time, resulting in reduced groundwater use for industrial and agricultural needs compared with the 1970s, 1980s and 1990s.

The District is divided into three regulatory areas that define how much groundwater may be utilized as a percentage of the total water demand. The groundwater withdrawals are grouped by regulatory area in **Figure 8**. This chart shows the impact of the District's Regulatory Plan, requiring conversion from groundwater to alternative water over time and as a result the reduction in groundwater withdrawals in regulatory areas that have fully converted to alternative water (i.e., Regulatory Areas One and Two). As a result, the majority of groundwater use within the District is occurring within Regulatory Area Three. The following sections provide additional information regarding groundwater withdrawals in each Regulatory Area.

Table 1. Summary of Reported Groundwater Water Use (in MGD) by Regulatory Area.

Water Use Category	Area 1			Area 2			Area 3			Total		
	2019	2020	Change between 2019 and 2020	2019	2020	Change between 2019 and 2020	2019	2020	Change between 2019 and 2020	2019	2020	Change between 2019 and 2020
Public	2.9	2.4	-17%	31.1	18.8	-40%	175.4	169.0	-4%	209.4	190.2	-9%
Industrial	6.5	5.5	-15%	2.6	2.7	4%	2.4	2.1	-13%	11.5	10.3	-10%
All Irrigation	0.12	0.12	3%	0.84	0.87	4%	6.5	6.5	0%	7.5	7.5	0%
Total	9.5	8.0	-16%	34.5	22.4	-35%	184.3	177.6	-4%	228.4	208.0	-9%

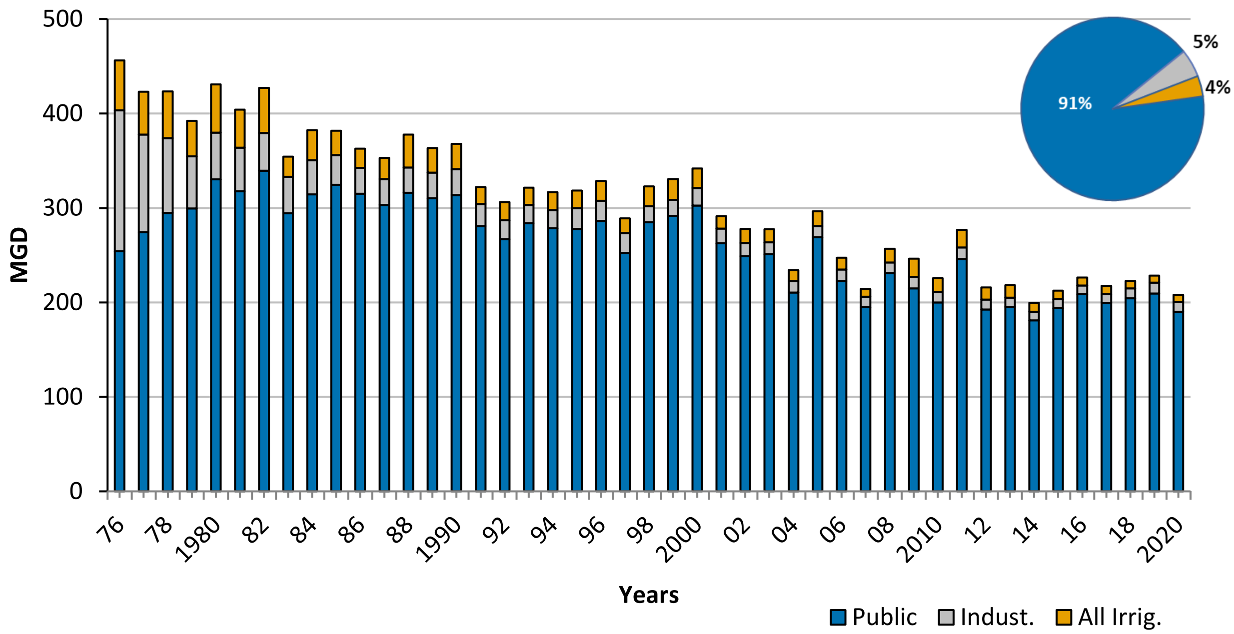


Figure 7: Groundwater withdrawals, in million gallons per day, by water use category from 1976 to 2020. The total groundwater used in the District was 208.0 MGD in 2020, with 91 percent as public supply.

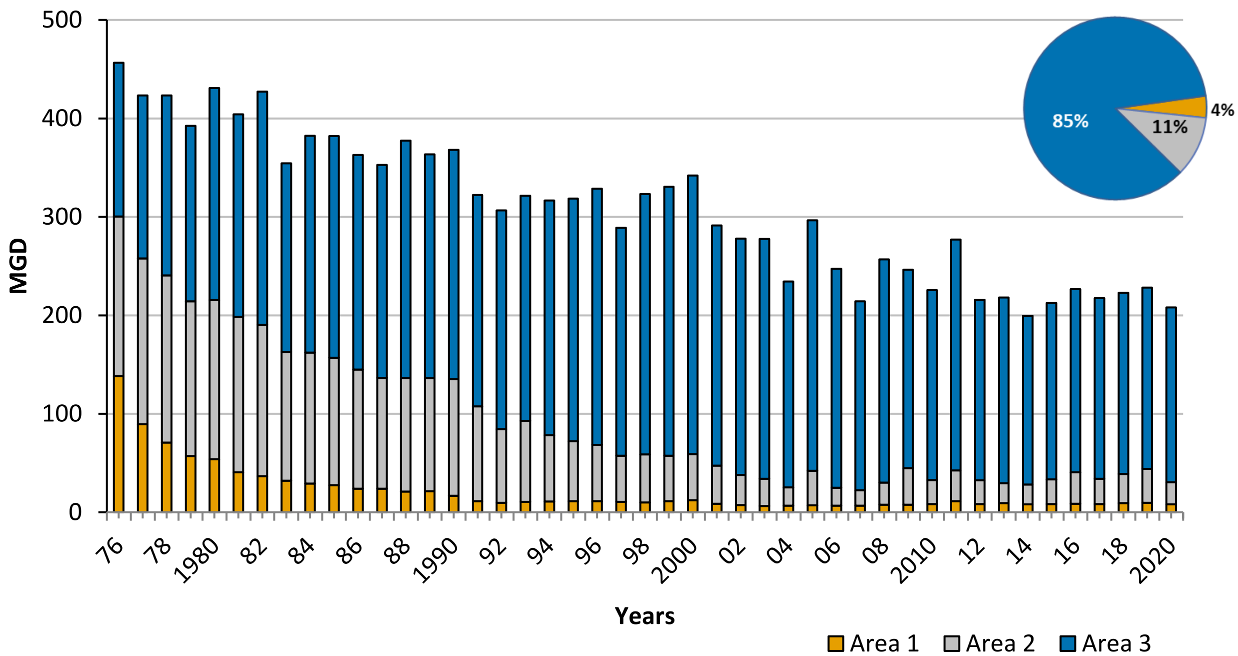


Figure 8: Groundwater withdrawals, in million gallons per day, by regulatory area from 1976 to 2020. In 2020, a total of 8.0 MGD of groundwater was used in Regulatory Area One, with 22.4 MGD used in Regulatory Area Two and 177.6 MGD used in Regulatory Area Three.

Regulatory Area One

Regulatory Area One covers most of Galveston County and the southeastern portion of Harris County. Cities and villages included are Bacliff, Baytown, Bayou Vista, Channelview, Clear Lake Shores, Deer Park, Dickinson, El Lago, Galena Park, Galveston, Highlands, Hitchcock, Kemah, La Marque, La Porte, League City, Morgan's Point, Nassau Bay, Pasadena, San Leon, Santa Fe, Texas City, Seabrook, Shoreacres, Taylor Lake Village, Tiki Island, and Webster. Also included are Clear Lake, Johnson Space Center, and Bolivar Peninsula Areas. This area converted to alternate water sources back in the 1970s, 1980s and early 1990s.

In 2020, total groundwater withdrawal in Regulatory Area One was 8.0 MGD, a 16 percent decrease from the previous year (**Figure 9**). The majority of groundwater use in Regulatory Area One is associated with industrial use, which comprises 69 percent of the use in the area. Industrial use has been relatively stable since 1990 and groundwater use for public supply has remained generally stable since 2001. Irrigation water use is typically correlated to climate and rainfall patterns. The amount of groundwater used for irrigation increased by 2 percent in 2020 to 0.12 MGD. Historically, groundwater withdrawals have declined in Regulatory Area One from a maximum of 138.1 MGD in 1976 to 8.0 MGD in 2020.

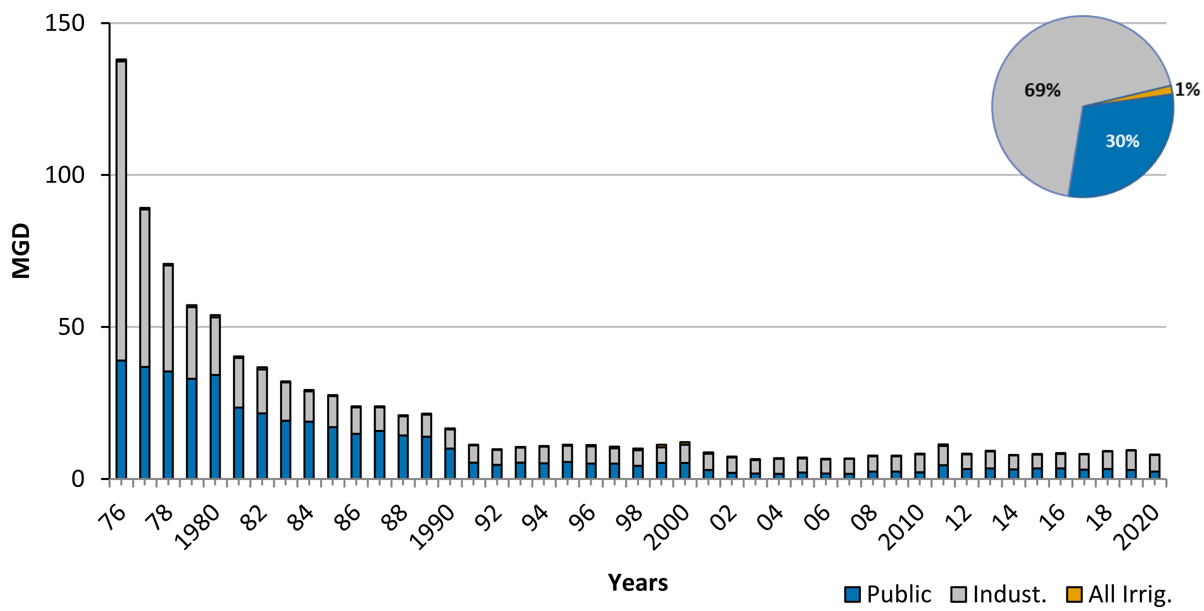


Figure 9: Groundwater withdrawals for Regulatory Area One, in million gallons per day, by water use category from 1976 to 2020. A total of 8.0 MGD of groundwater was used in Regulatory Area One in 2020, with 69% of the withdrawals being used for industrial use.

Regulatory Area Two

Regulatory Area Two covers a small northwestern slice of Galveston County and southern and eastern Harris County. Cities, entities, and areas included are Bellaire, Cloverleaf, Crosby, Friendswood, Highlands, Hobby Airport, Pasadena, Sheldon, South Houston, the Villages, West University, and large portions of the City of Houston. Like Regulatory Area One, Regulatory Area Two has been converted to alternate water sources since the early 1990s, where possible.

Total groundwater withdrawal decreased in Regulatory Area Two from 34.5 MGD in 2019 to 22.4 MGD in 2020 with public supply use accounting for most of the decrease (**Figure 10**). Public supply groundwater use decreased by 40 percent in 2019 to 18.8 MGD in 2020. Industrial groundwater use increased by four percent to 2.7 MGD and irrigation use increased by four percent to 0.87 MGD. Groundwater withdrawals have declined in Regulatory Area Two from a maximum of 169.8 MGD in 1978 to 22.4 MGD in 2020.

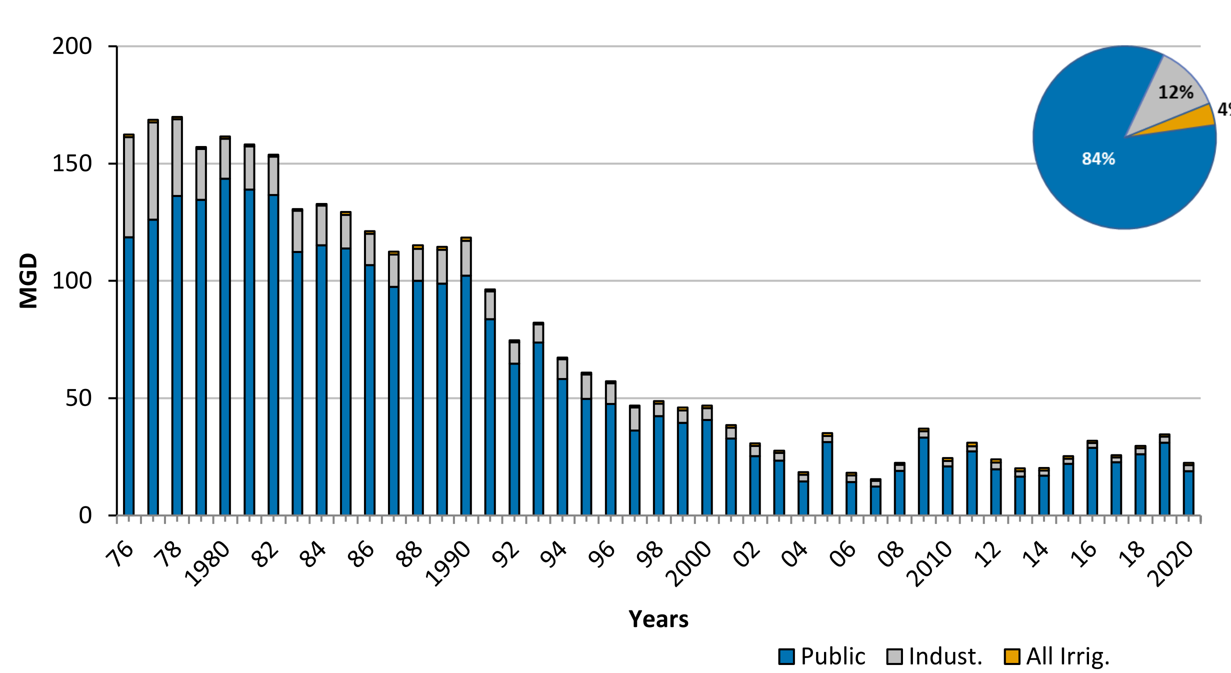


Figure 10: Groundwater withdrawals for Regulatory Area Two, in million gallons per day, by water use category from 1976 to 2020. A total of 22.4 MGD of groundwater was used in Regulatory Area Two in 2020, with 84% of the withdrawals being used for public supply.

Regulatory Area Three

Regulatory Area Three covers north and west Harris County. Cities, entities and areas included are the Jersey Village, Humble, Kingwood, Huffman, Tomball, Cypress, Hockley, Spring, and parts of Katy. Entities in this regulatory area were required to convert to alternate water beginning in 2010, with this conversion facilitated by the City of Houston and the Regional Water Authorities. Two subsequent conversion deadlines in 2025 and 2035 remain for permittees with groundwater reduction plans.

Groundwater pumpage in Regulatory Area Three decreased by four percent from 184.3 MGD in 2019 to 177.6 MGD in 2020 (**Figure 11**). The largest category of water use is public supply use, which was reported at 169.0 MGD and accounts for 95 percent of the groundwater use in the area. Industrial water use decreased by 13 percent to 2.1 MGD, while irrigation water use remained unchanged at 6.5 MGD.

Groundwater withdrawals in Regulatory Area Three show a generally increasing trend beginning in 1976 through 2000, reflecting the impacts of climate and population increase as development progressed in northern and western Harris County. As shown in **Figure 11** , groundwater use has remained relatively constant since 2012, varying between 171.4 MGD and 188.8 MGD.

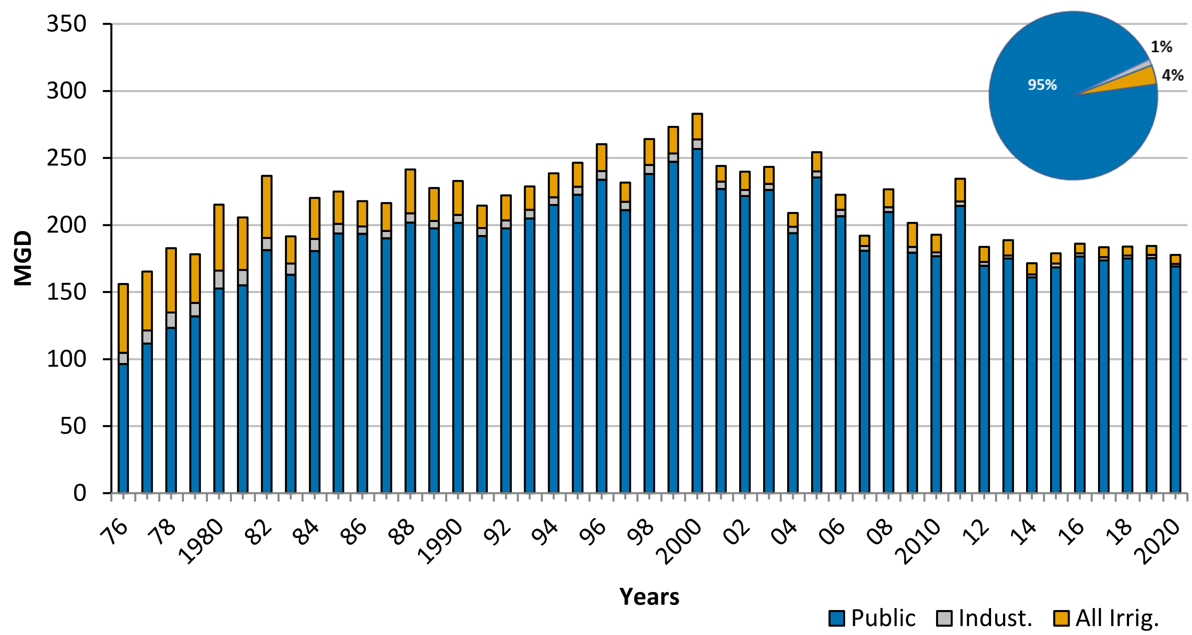


Figure 11: Groundwater withdrawals for Regulatory Area Three, in million gallons per day, by water use category from 1976 to 2020. A total of 177.6 MGD of groundwater was used in Regulatory Area Three in 2020, with 95% of the withdrawals being used for public supply.

Alternative Water Supply and Total Water Use

The District's Regulatory Plan requires permittees to convert to alternative water supplies in order to reduce their reliance on groundwater sources. The primary alternative water supply used in our region is surface water sourced from three river basins: the Brazos River Basin, the San Jacinto River Basin and the Trinity River Basin (**Table 2**).

Since 1992, the Trinity River Basin is still the single largest source of alternative water used within the District. Groundwater remains the second largest source of water supply within the District as a whole. Reclaimed water is also used as an alternative water supply and increased by 700 percent from 0.3 MGD in 2019 to 2.4 MGD in 2020. Compared with 2019, use of the San Jacinto River Basin supply increased by 14 percent.

Table 2. Summary of Reported Alternative Water Supply Use and Total Water Use (in MGD)

Source		2019	2020	Change between 2019 and 2020
Alternative Supplies	Brazos River Basin	70.3	68.8	-2%
	San Jacinto River Basin	144.6	164.6	14%
	Trinity River Basin	531.5	534.7	1%
	Reclaimed Water	0.3	2.4	700%
	Subtotal	746.7	770.5	3%
Groundwater		228.3	208.0	-9%
Total Water Use		975.0	978.5	0.4%

Use of the Trinity River Basin supply has increased over time, from 8.7 MGD in 1976 to 534.7 MGD in 2020 (**Figure 12**). The Brazos River Basin supply has stayed relatively constant over the years, with an average use over the District's 46-year history of 76 MGD. The total water use for the District was determined to be 978.5 MGD in 2020, which is 0.4 percent increase from 2019.

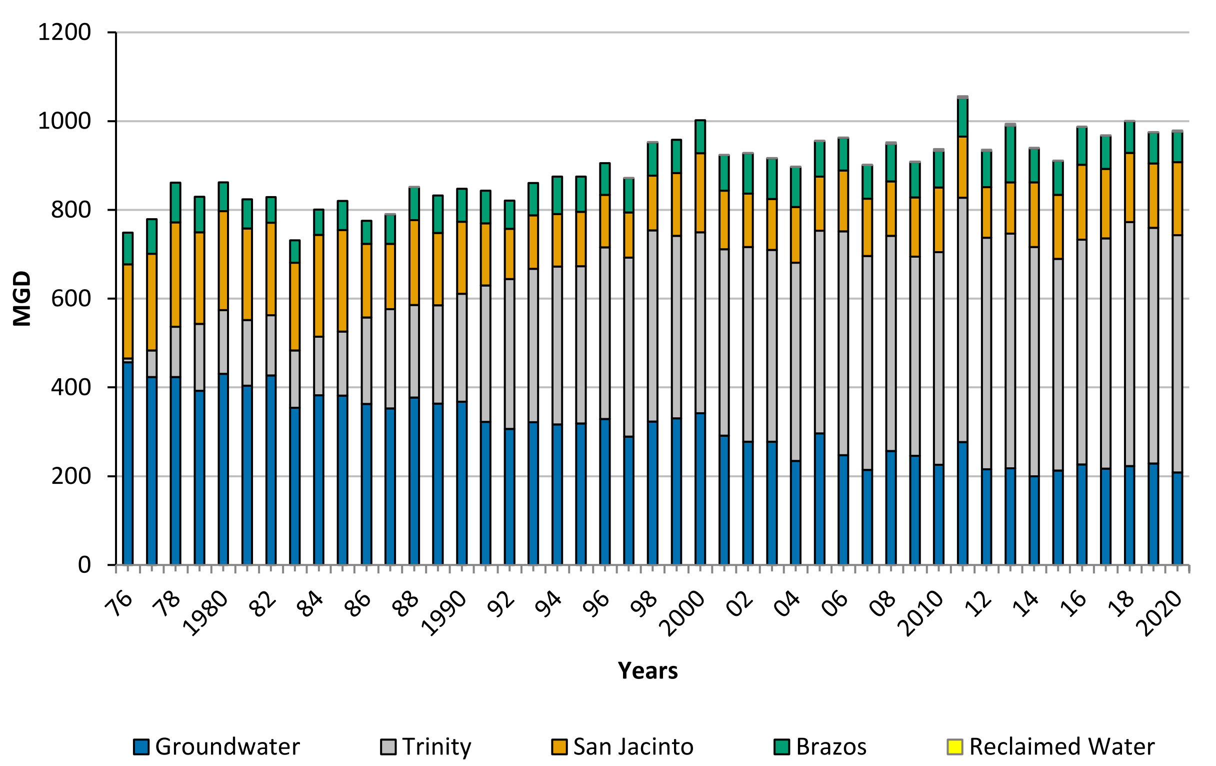


Figure 12: Total water use for District, in million gallons per day, by source water, from 1976 to 2020. The reported total water use for the District in 2020 was 978.5 MGD.

2020 Groundwater Level Summary

All groundwater used in the District is sourced from the Gulf Coast Aquifer System, which is comprised of three primary water bearing units. The two units most widely used in the District are the Chicot and Evangeline aquifers. The Chicot is the shallowest aquifer in the District which is directly connected to the Evangeline aquifer immediately below. The Burkeville confining unit lies beneath the Evangeline aquifer and isolates the third primary aquifer, the Jasper aquifer. The Jasper aquifer is not widely used in the District but is a primary source of water for Montgomery County.

Annually, since 1975, the USGS has measured the water level in hundreds of wells throughout the Houston region in cooperation with the District through a joint funding agreement along with additional cities, subsidence districts and groundwater conservation districts to monitor and provide reports on groundwater level altitude data for the Chicot/Evangeline and Jasper aquifers. Since aquifer water level is the best measure of the pressure in the aquifer, this information is essential to understand the impact of changes in water use on subsidence.

In 2020, the hydrostratigraphy of the Gulf Coast Aquifer was updated by the District as part of the Joint Regulatory Plan Review (Young & Draper, 2020). This information was used to support the development of an updated groundwater-flow model, named GULF 2023, for southeastern Texas in a project funded by the District and the Fort Bend Subsidence District (FBSD), incorporated new data from approximately 650 geophysical logs, and adjusted the bottom of the Chicot aquifer by extending it deeper. As a result of this update, the Chicot and Evangeline aquifers have been combined into an undifferentiated shallow aquifer system called the Chicot/Evangeline in this report. This updated approach also changed aquifer designations for several wells measured annually as part of the groundwater level survey.

The 2021 potentiometric surface (i.e., the interpolated surface from water level data) for the Chicot/Evangeline aquifer shows the areas of primary stress on the undifferentiated aquifer occur in northern and western Harris County and southern Montgomery County (**Figure 13**). The change in water-level in the Chicot/Evangeline aquifer since 1977 clearly demonstrates the impact of District regulation on the aquifers (**Figure 14**). Generally, Regulatory Areas One and Two have seen a significant rise in the potentiometric water-level up to 242 feet (73.8 meters) in the Chicot/Evangeline aquifer. The areas of rise are a result of the reduction of groundwater use required by the District's Regulatory Plan. Conversely, in Regulatory Area Three and nearby in southern Montgomery Counties, water-levels continue to be significantly lower than the historical benchmark, reaching declines of nearly 370 feet (112.8 meters) in the Chicot/Evangeline aquifer. These areas are growing rapidly and the conversion to alternative sources of water will not be completed in the District until 2035.

Groundwater levels in southern Montgomery County are of particular concern. The primary cone of depression in both the Chicot/Evangeline and Jasper aquifers exists just across the county line in southern Montgomery County near The Woodlands. Recent changes in the management plan of Montgomery County's LSGCD will lead to de-regulation of the groundwater use in Montgomery County and result in additional potentiometric water level declines in these aquifers in southern Montgomery County and northern Harris County.

The information presented in this section are a brief summary of the provisional data presented at the Public Hearing held on April 29, 2021. The exhibits used to provide testimony during the hearing are included in **Appendix A – Exhibits Presented at Public Hearing held on April 29, 2021**. A USGS Scientific Investigation Report will be released later this year documenting the status of groundwater level altitudes and the long-term changes in the Chicot/Evangeline and Jasper aquifers.

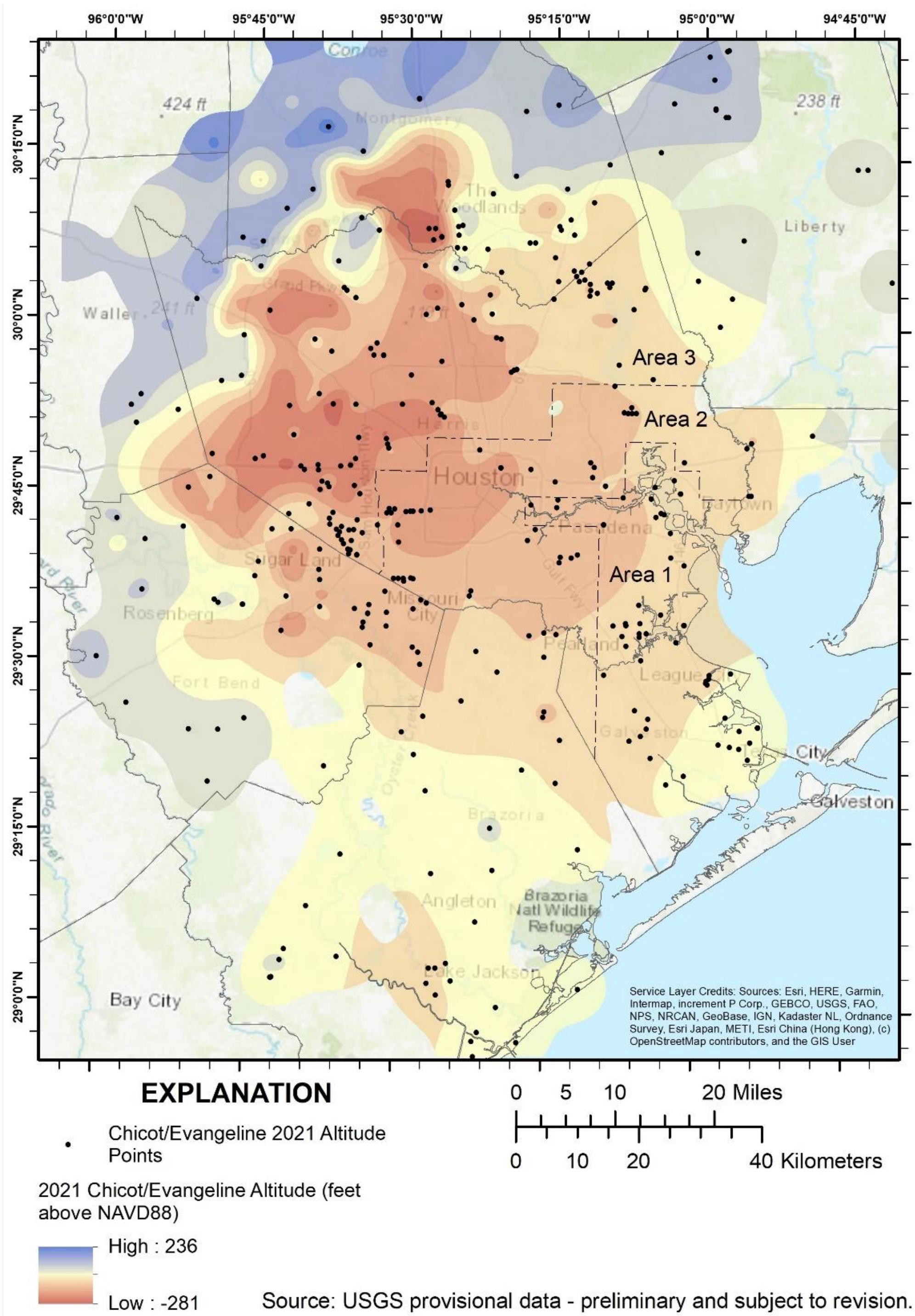


Figure 13: Altitude of the potentiometric surface determined from water-levels measured in tightly cased wells screened in the Chicot/Evangeline undifferentiated aquifer, Houston region, Texas, 2021 (Source: USGS provisional data – preliminary and subject to change).

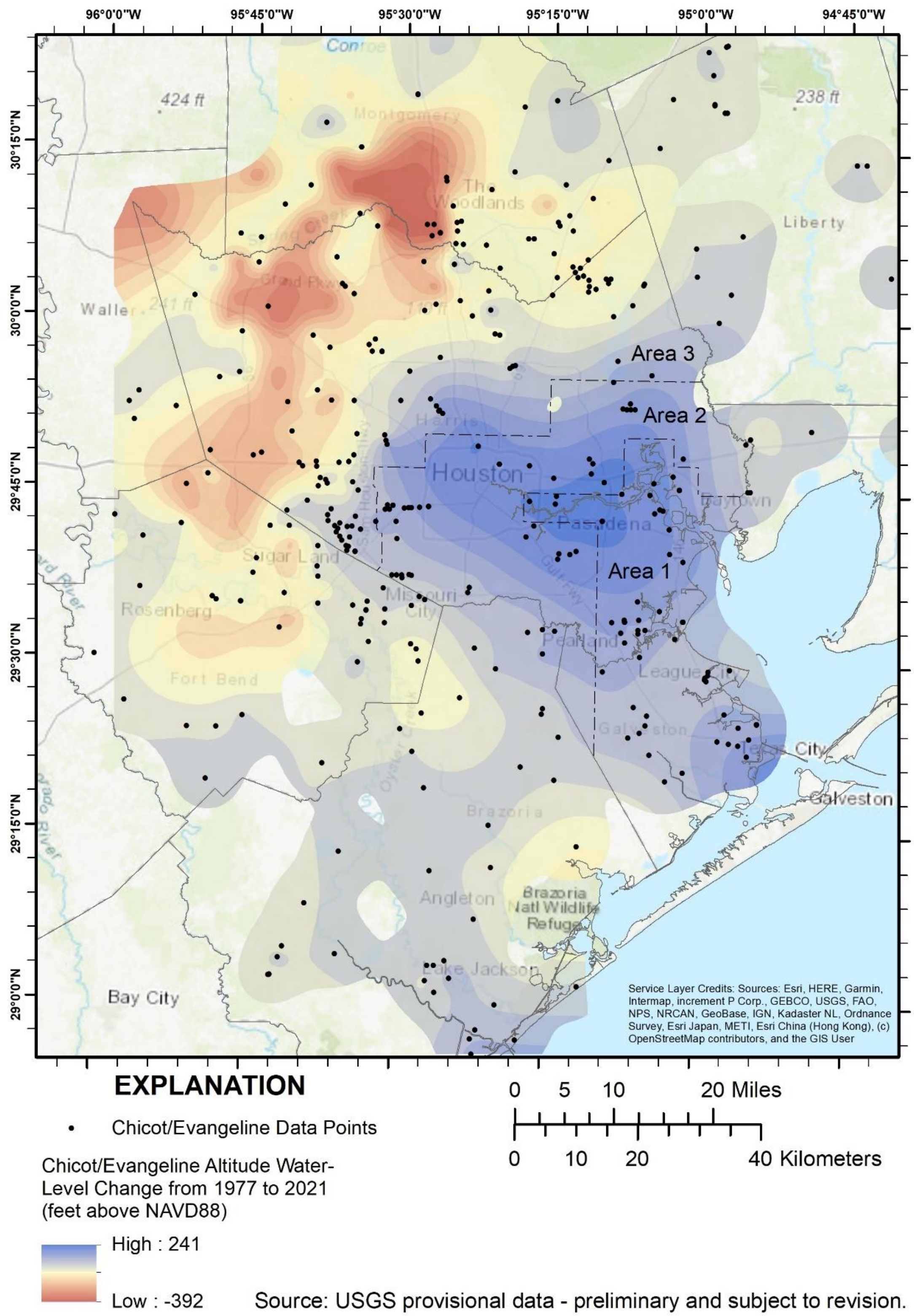


Figure 14: Potentiometric water-level change at wells screened in the Chicot/Evangeline aquifer, Houston region, Texas, 1977 to 2021 (Source: USGS provisional data – preliminary and subject to change).

Subsidence Trend Analysis

Subsidence is the lowering of land surface elevation. In the Houston-Galveston region, subsidence occurs from the compaction of clays due to groundwater withdrawal for municipal, industrial, and irrigation water supply. As the water level of the aquifer declines, fine-grained sediments, such as silt and clay, in the aquifer depressurize and compact. This compaction results in the lowering of overlying stratigraphic units and is observed as subsidence at the land surface.

Global positioning system (GPS) stations have been installed in various locations across southeast Texas in order to track subsidence since the 1990s. This GPS network consists of a collaboration between the District, FBSD, UH, LSGCD, Brazoria County Groundwater Conservation District (BCGCD), the National Geodetic Survey (NGS), the USGS, the City of Houston, and the Texas Department of Transportation (TXDOT). The GPS network has grown to over 250 sites throughout the region. Additional information on the GPS network is provided in **Appendix B – Subsidence Monitoring Network Overview and Data** and **Appendix C – Period of Record Data.**

Satellite signals are collected every thirty seconds and averaged over 24 hours by global navigation satellite system (GNSS) antenna and receiver into one raw data file. Raw data files are processed by Dr. Guoquan Wang at the UH and are compared to a stable regional reference frame designated as Houston20 that uses 25 continuously operating GPS stations which have a long history (greater than eight years) and are located outside the greater Houston area (Agudelo, et al., 2020). The District uses these GPS data in two ways: 1) period of record and 2) as an average annual subsidence rate to understand subsidence trends within the GPS network. Additional information on the average annual subsidence rate and period of record data for each GPS station are provided in **Appendix C**.

Period of Record Data

The period of record includes GPS measurements of the ellipsoidal height that are collected over the lifespan of each GPS station. It is used to track the full history of subsidence and is represented as a vertical displacement time series. The vertical displacement is determined by the change in ellipsoidal height, which is the distance from a point on the earth's surface to the reference ellipsoid. The reference ellipsoid is a mathematical representation of the earth's surface. Period of record plots give a historical context to understand local to regional subsidence trends. Period of record plots for each GPS station are provided in **Appendix C**.

Average Annual Subsidence Rate

The average annual subsidence rate is a useful measure to show the recent change in land surface elevation at each GPS station. The subsidence rate, presented in this report, is determined by using linear regression (i.e., the statistically determined best fit straight line through a scatter plot of data points) of the last five years of data for GPS station with at least three years of GPS data. **Figure 15** depicts the average annual subsidence rate from 2016 to 2020 for 201 GPS stations in the greater Houston area.

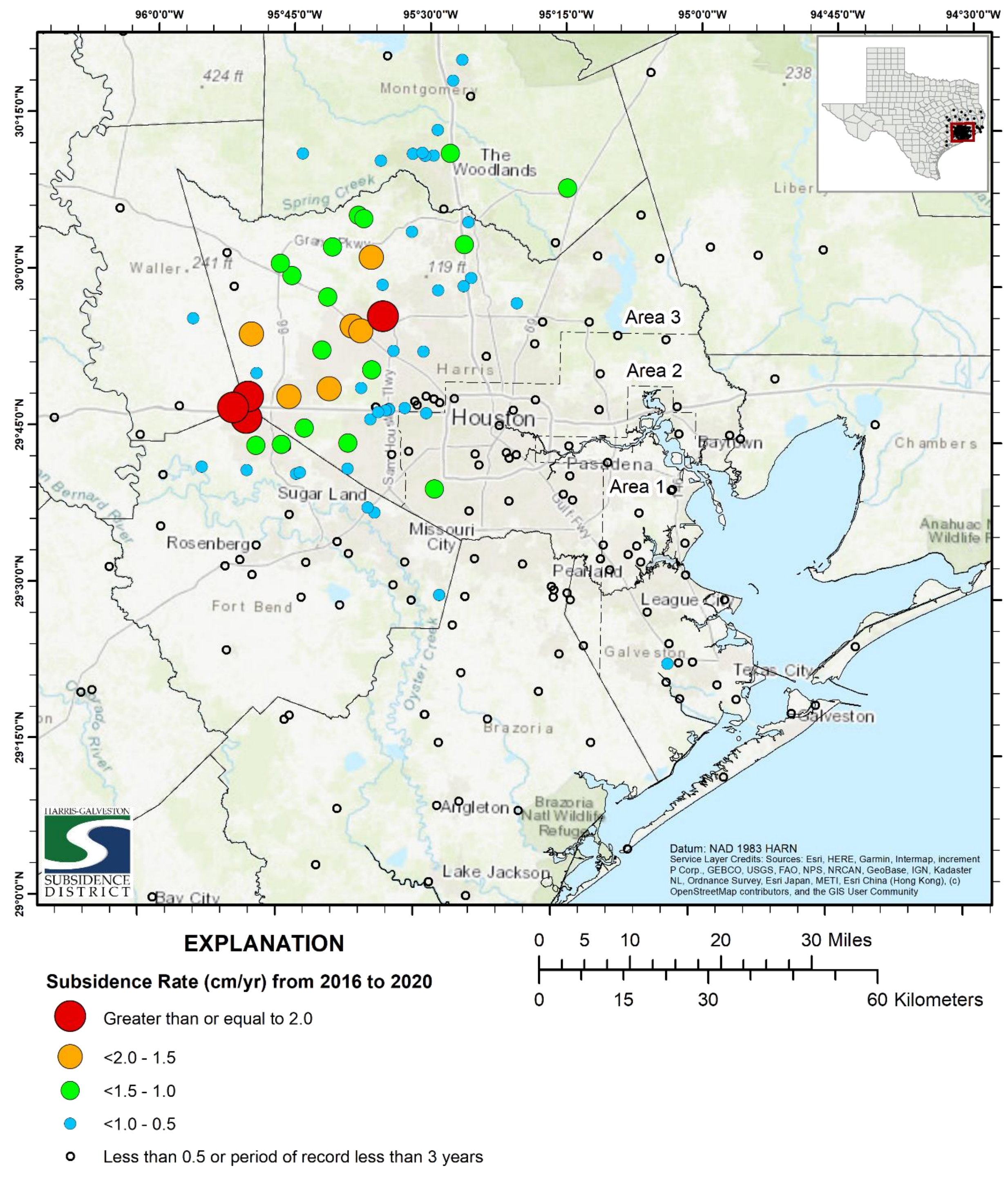


Figure 15: Annual subsidence rate, measured in centimeters per year, referenced to Houston20 and estimated from three or more years of GPS data collected from GPS stations in Harris and surrounding counties, Texas, averaged from 2016 to 2020.

Regulatory Areas One and Two show similar subsidence rates as both areas have been fully converted since the 1990s and USGS monitoring data show that potentiometric water levels have risen. The majority of the GPS stations in Regulatory Area One show little to no subsidence with rates under 0.5 cm per year and even some uplift is observed. GPS stations in Regulatory Area Two also recorded very low subsidence rates (under 0.5 cm per year), with one exception in the southwest area at P041 with a subsidence rate of 1.31 cm per year (**Figure 16**). GPS station P041 is located southwest of the intersection between South Loop Freeway West and South Post Oak Road. The subsidence rate observed at P041 was generally about zero between 2007 and 2015, then began to decrease in 2016, and became generally stable in mid-2018.

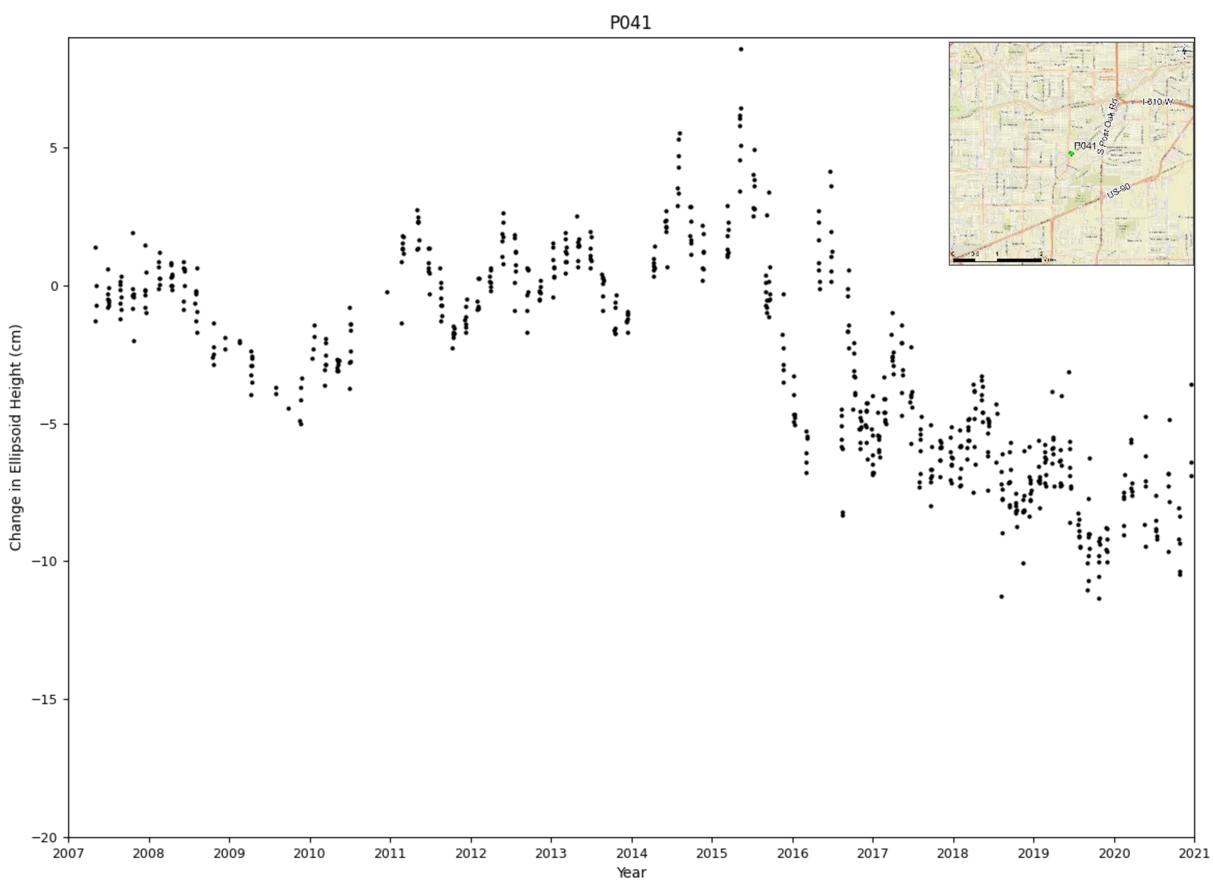


Figure 16: Period of record data from GPS station P041 located in Westbury neighborhood (Brays Oak district of Southwest Houston), Texas, 2007 to 2020. Inset map shows the location of P041, the green circle.

The highest subsidence rates (greater than 2 centimeters per year) occur in Regulatory Area Three within northwestern and western Harris County as well as southeastern Waller County and northeastern Fort Bend County. GPS station P097, located in Katy within Waller County, has the highest subsidence rate estimated at 3.26 cm per year (**Figure 17**). GPS station P098, located in Katy in Harris County, has a subsidence rate of 2.35 cm per year. Other neighborhoods in Regulatory Area Three such as Jersey Village and the Addicks area have subsidence rates ranging from 2.17 to 1.69 cm per year.

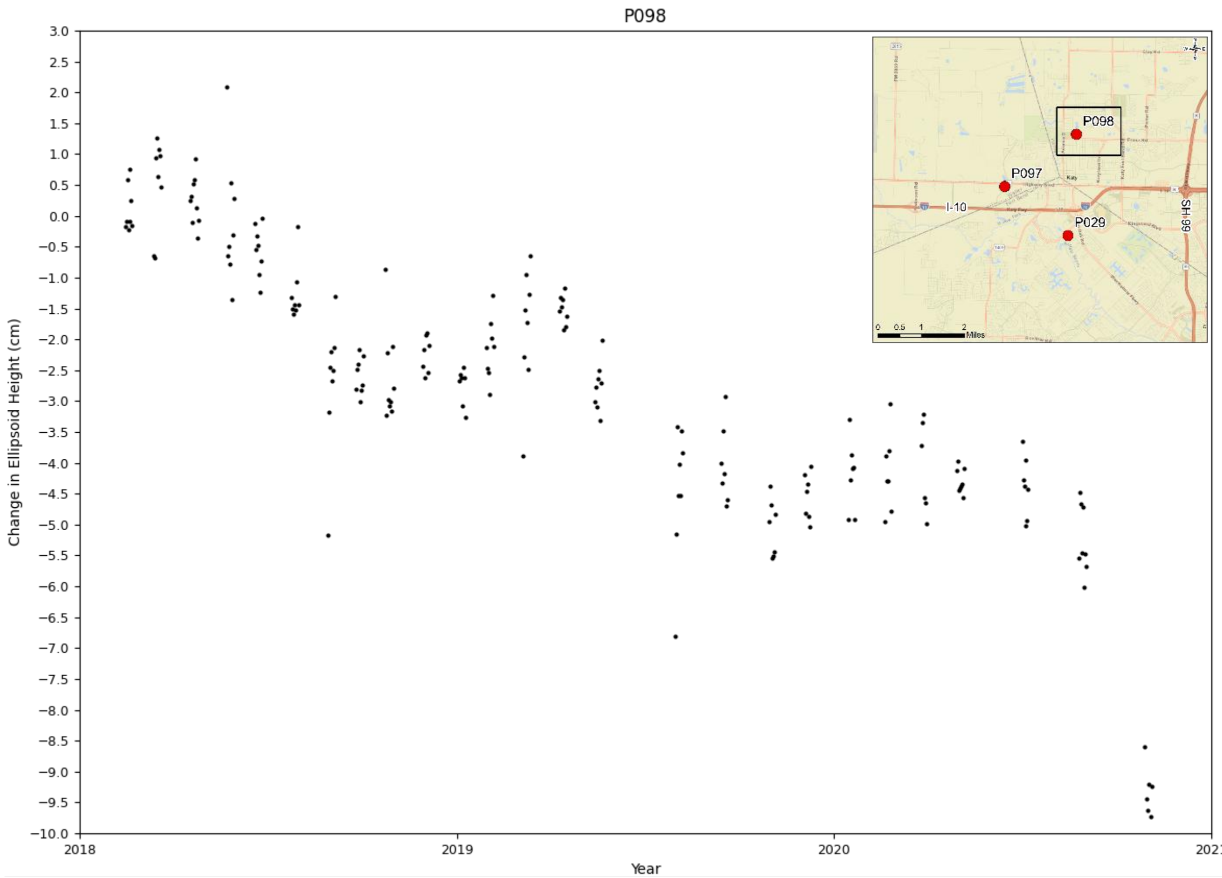


Figure 17: Period of record data from GPS station P098 located in Katy, Texas, 2018-2020. Inset map shows the location of P098, the red circle in the black box northwest of the intersection between SH 99 and I-10.

Based on the GPS data collected in the greater Houston area, subsidence is occurring in Regulatory Area Three, as this area is still undergoing conversion to alternative water supplies. The average of the annual subsidence rate for the 54 GPS stations in Regulatory Area Three is 0.8 cm per year and the highest rates are observed in western and northwestern Harris County.

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Appendix A – Exhibits Presented at Public Hearing held on April 29, 2021

Welcome to the Public Hearing for the 2020 Annual Groundwater Report

- Participants will be muted upon joining the meeting.
- We will open the meeting to public testimony at the end of the hearing. If you would like to provide testimony on the information presented in the presentation, please use the chat to let the organizer know, or raise your hand.
- The meeting is being recorded including all chat between participants.
- For any problems, please chat with the organizer.

HARRIS-GALVESTON SUBSIDENCE DISTRICT

2020 ANNUAL GROUNDWATER REPORT

Public Hearing – April 29, 2021

Subsidence District Mission

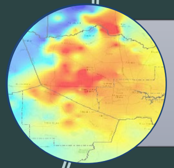
- The Subsidence District was created in 1975 to prevent land subsidence in Harris and Galveston counties through the management of groundwater.
- Land subsidence contributes to flooding, threatening the economic health of the area
- Efforts to prevent subsidence by the District and the regulated community have required significant investment in order to create a more resilient infrastructure to mitigate flooding while securing reliable water sources for future needs
- Annual groundwater hearing required by enabling act to receive testimony regarding the effects of groundwater withdrawals on subsidence

HARRIS-GALVESTON SUBSIDENCE DISTRICT

Agenda


Climate


Groundwater Use


Groundwater Levels

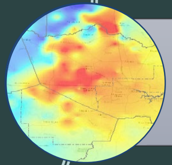

Subsidence Data

GALVESTON SUBSIDENCE DISTRICT

Agenda


Climate


Groundwater Use


Groundwater Levels


Subsidence Data

GALVESTON
SUBSIDENCE
DISTRICT

Weather Service Climate Stations

Location of weather service climate stations that were used for rainfall data.

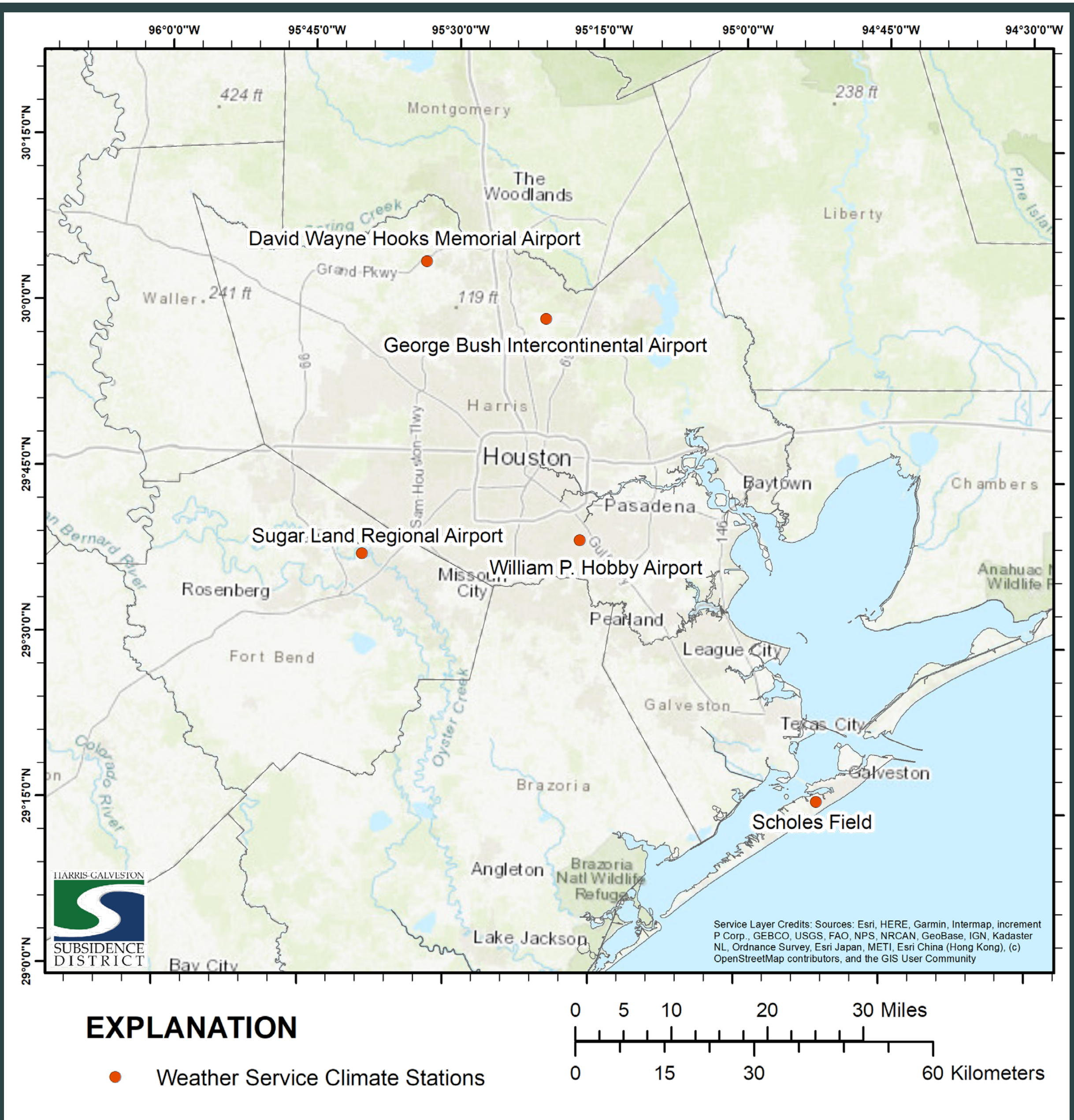
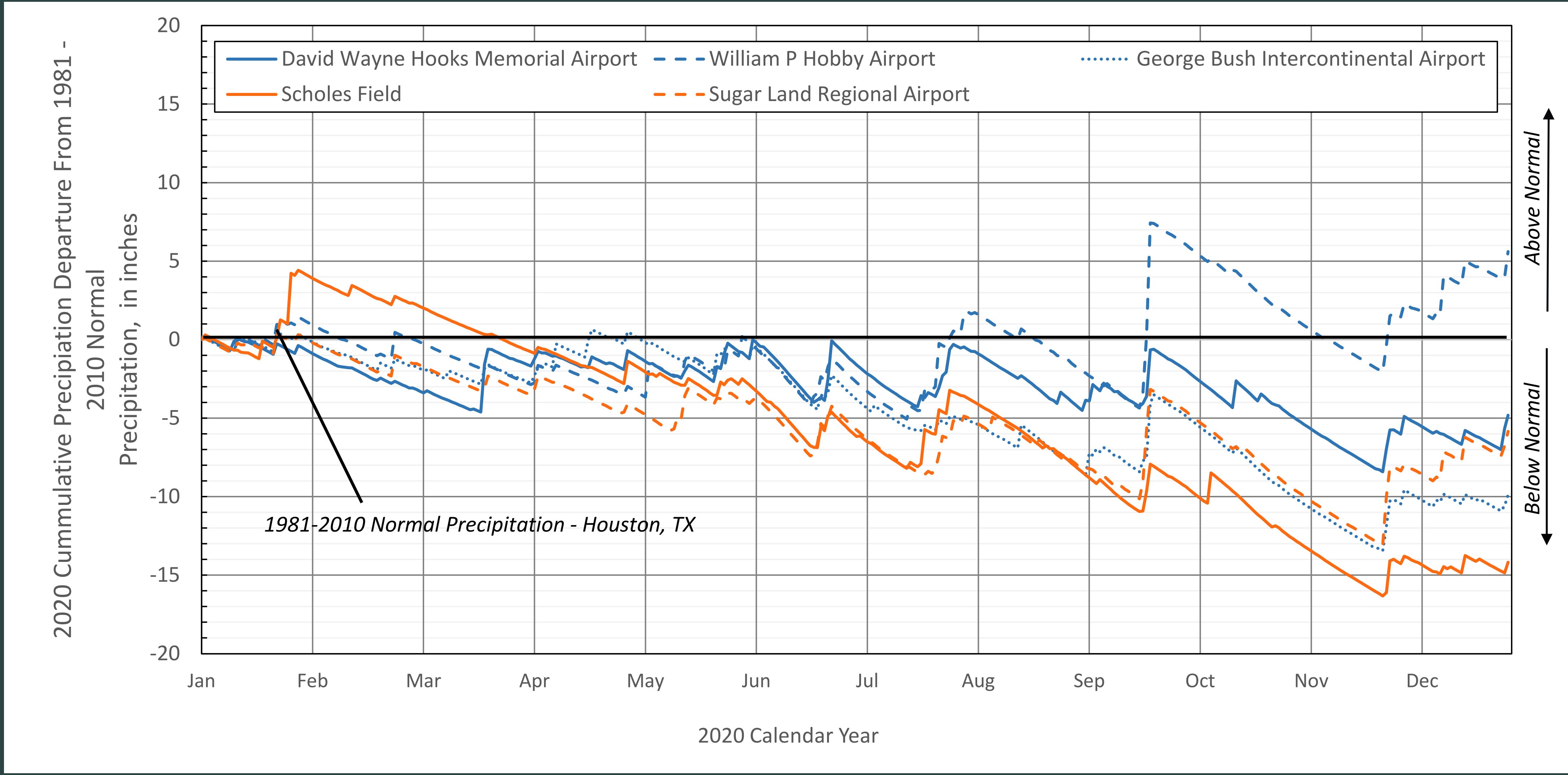


Exhibit 1



Data source: NOAA NWS

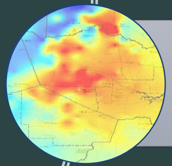
Exhibit 2

PROVISIONAL - SUBJECT TO CHANGE

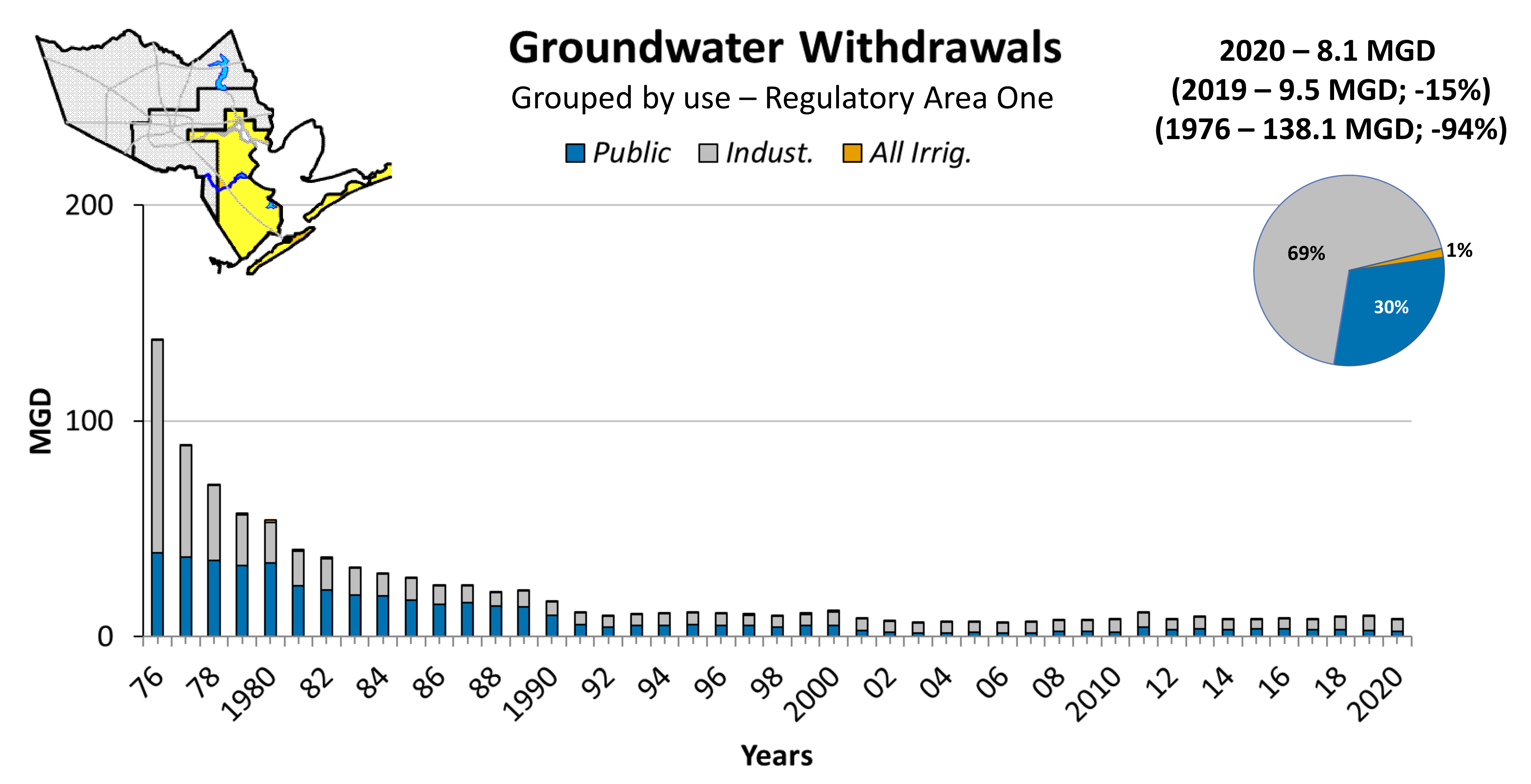
Agenda


Climate


Groundwater Use

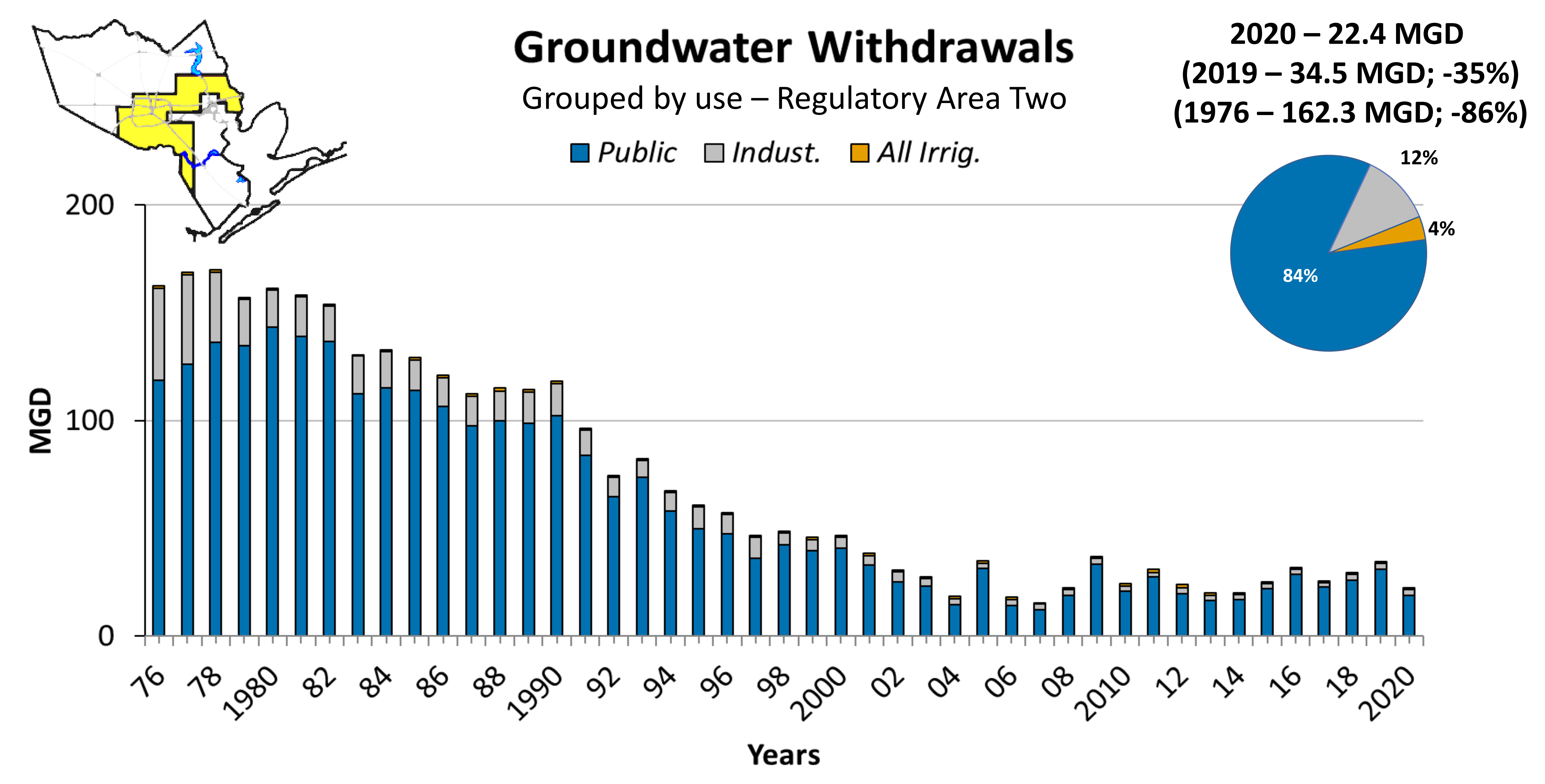

Groundwater Levels


Subsidence Data



Groundwater Withdrawals
Grouped by use – Regulatory Area One
Public
Indust.
All Irrig.
2020 – 8.1 MGD
(2019 – 9.5 MGD; -15%)
(1976 – 138.1 MGD; -94%)
69%
1%
30%
200
100
0
MGD
76
78
1980
82
84
86
88
1990
92
94
96
98
2000
02
04
06
08
2010
12
14
16
18
2020
Years

Exhibit 3



Groundwater Withdrawals
Grouped by use – Regulatory Area Two
Public
Indust.
All Irrig.
2020 – 22.4 MGD
(2019 – 34.5 MGD; -35%)
(1976 – 162.3 MGD; -86%)
12%
4%
84%
200
100
0
MGD
76
78
1980
82
84
86
88
1990
92
94
96
98
2000
02
04
06
08
2010
12
14
16
18
2020
Years

Exhibit 4

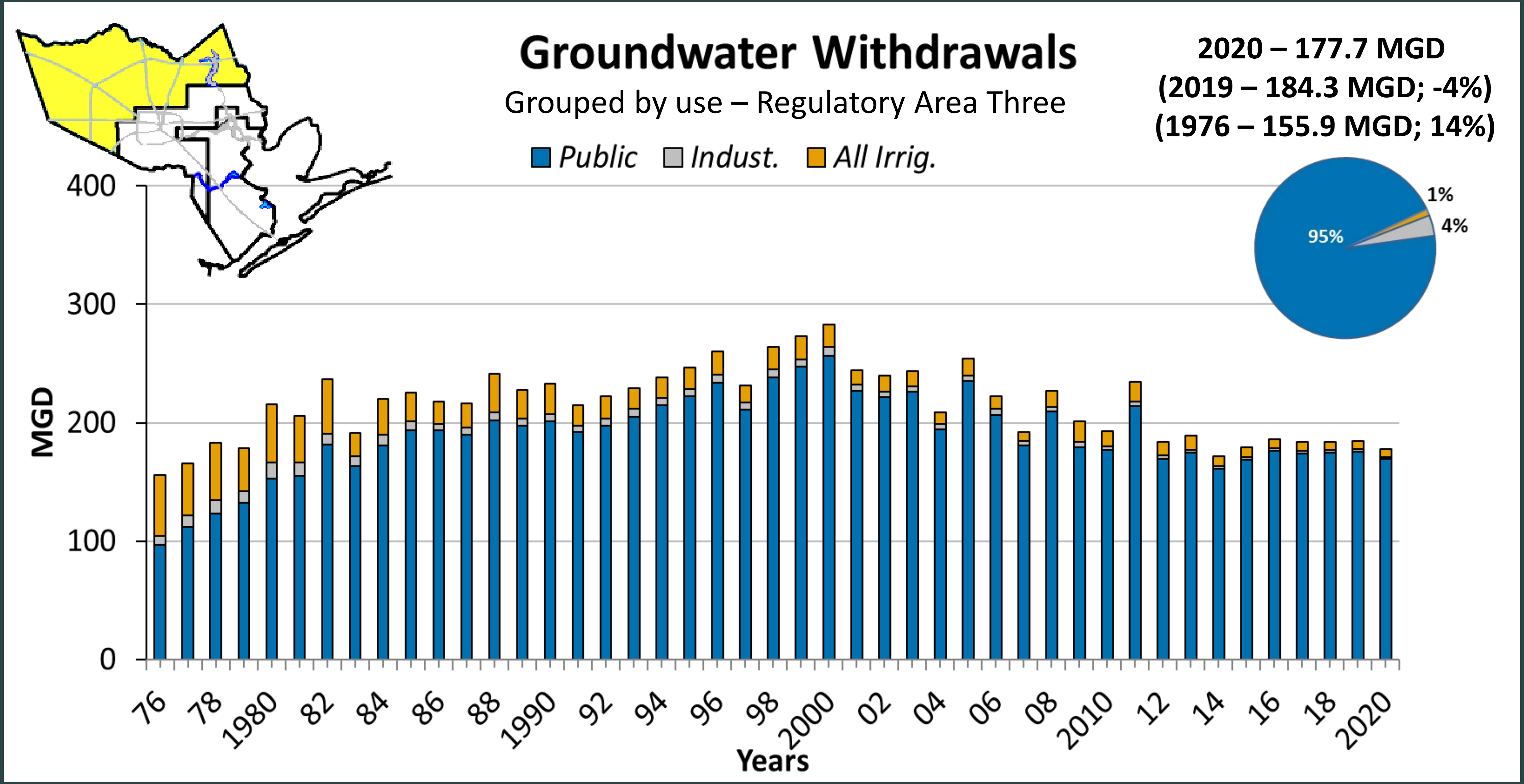
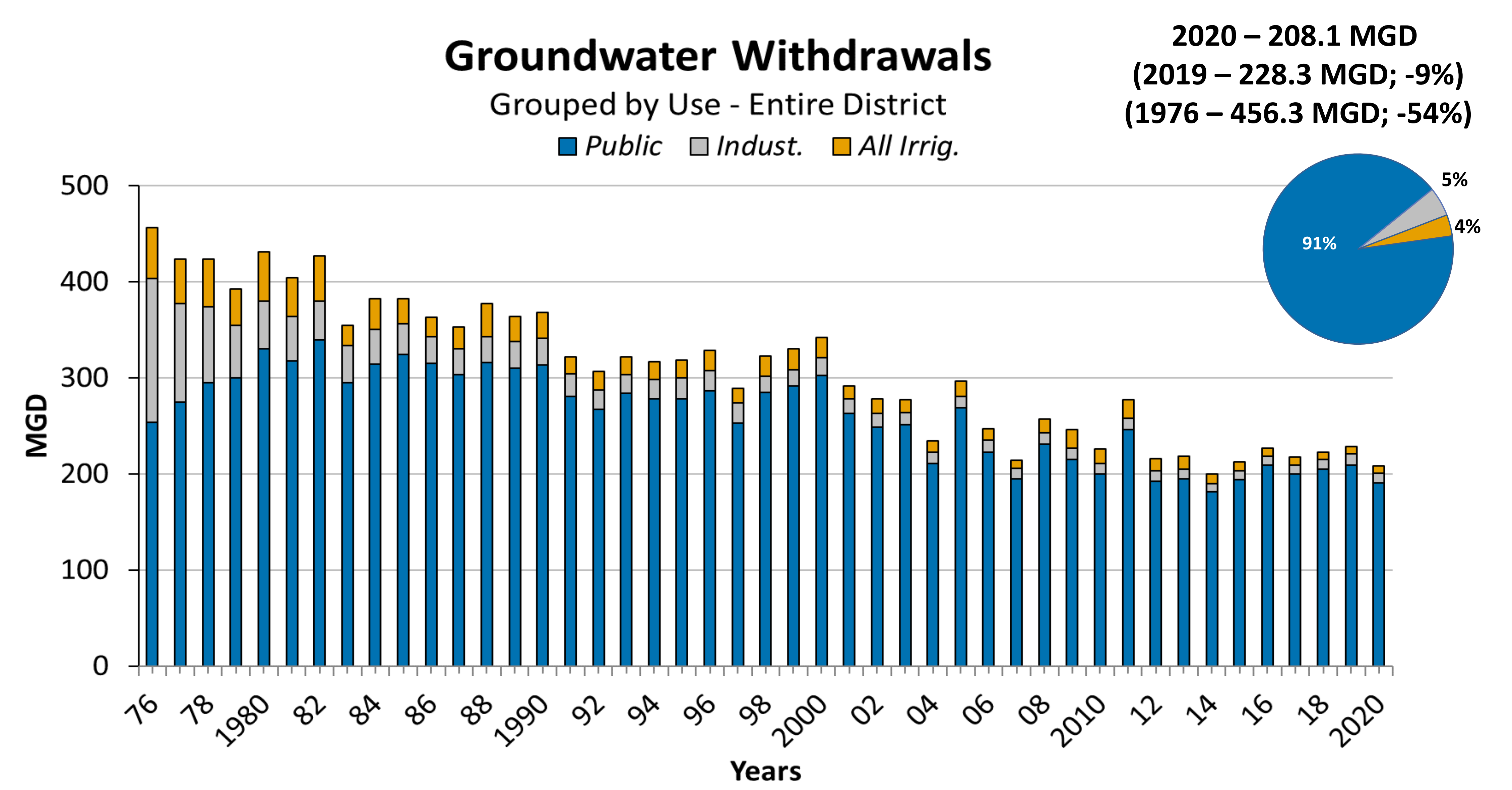

Groundwater Withdrawals
Grouped by use – Regulatory Area Three
Public
Indust.
All Irrig.
2020 – 177.7 MGD
(2019 – 184.3 MGD; -4%)
(1976 – 155.9 MGD; 14%)
95%
1%
4%
MGD
0
100
200
300
400
76
78
1980
82
84
86
88
1990
92
94
96
98
2000
02
04
06
08
2010
12
14
16
18
2020
Years

Exhibit 5



Groundwater Withdrawals
Grouped by Use - Entire District
Public
Indust.
All Irrig.
2020 – 208.1 MGD
(2019 – 228.3 MGD; -9%)
(1976 – 456.3 MGD; -54%)
5%
4%
91%
MGD
500
400
300
200
100
0
76
78
1980
82
84
86
88
1990
92
94
96
98
2000
02
04
06
08
2010
12
14
16
18
2020
Years

Exhibit 6

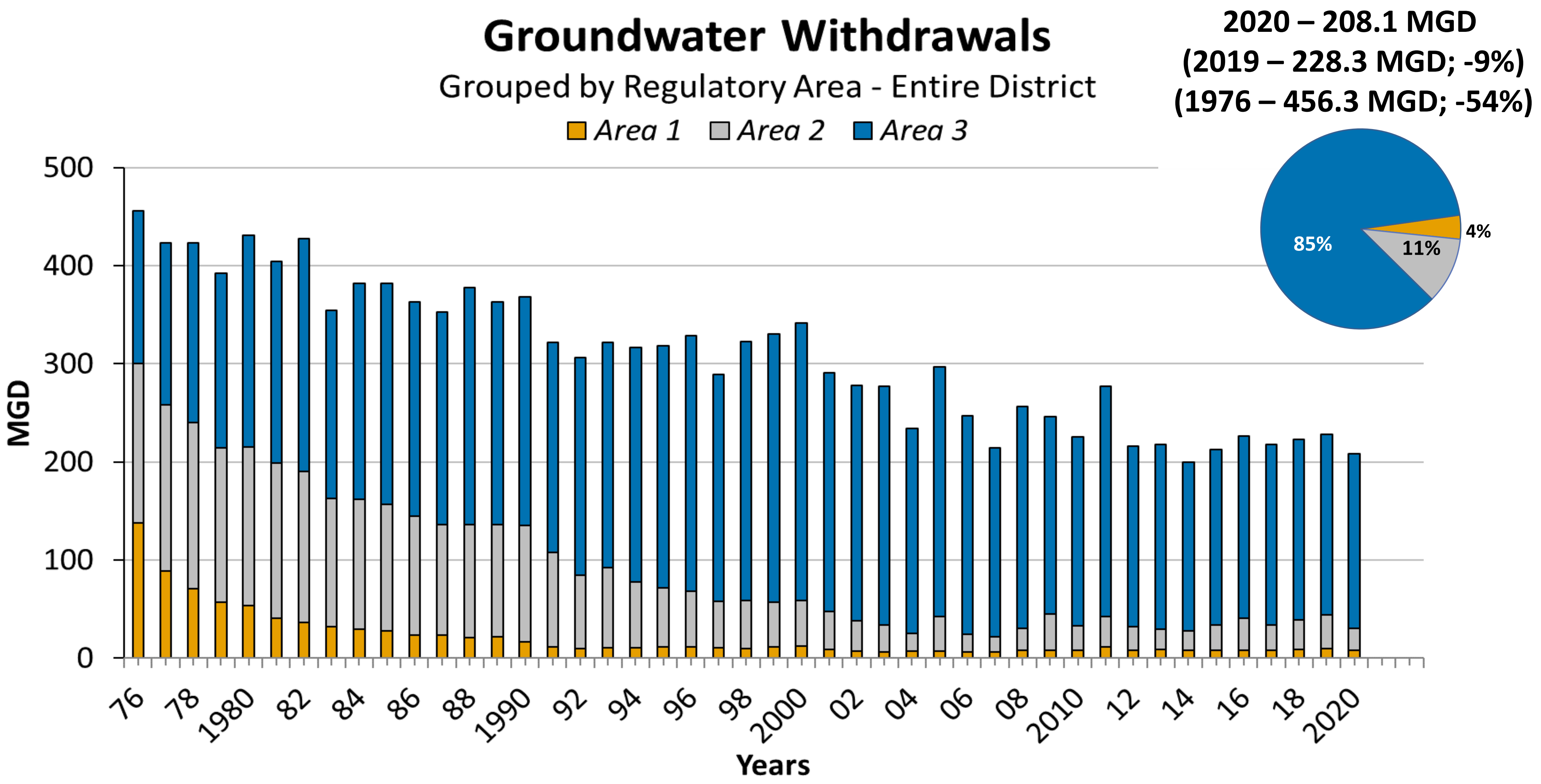
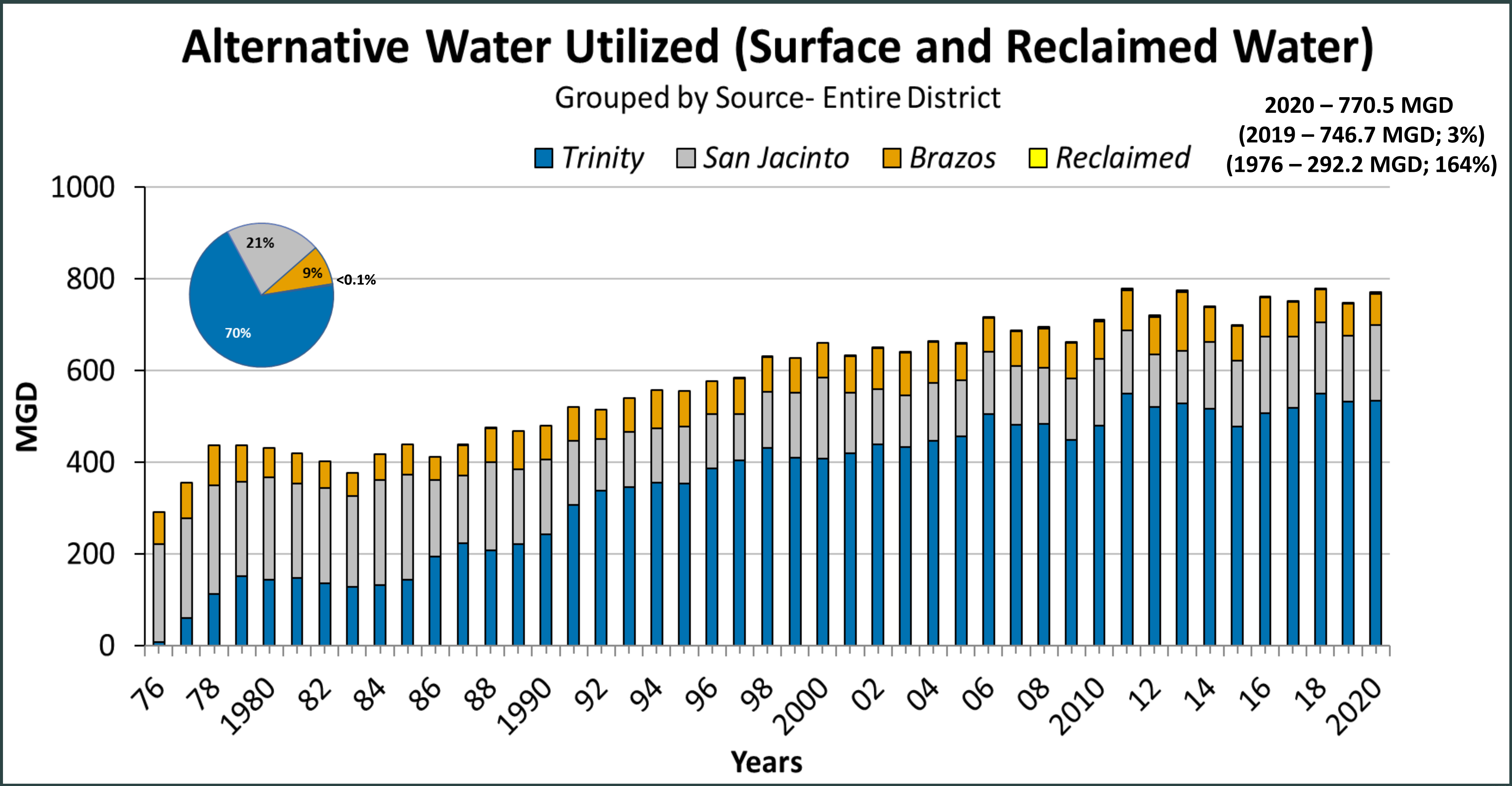

Groundwater Withdrawals
Grouped by Regulatory Area - Entire District
Area 1
Area 2
Area 3
500
400
300
200
100
0
MGD
76
78
1980
82
84
86
88
1990
92
94
96
98
2000
02
04
06
08
2010
12
14
16
18
2020
Years
2020 – 208.1 MGD
(2019 – 228.3 MGD; -9%)
(1976 – 456.3 MGD; -54%)
85%
11%
4%

Exhibit 7



Alternative Water Utilized (Surface and Reclaimed Water)
Grouped by Source- Entire District
Trinity
San Jacinto
Brazos
Reclaimed
2020 – 770.5 MGD
(2019 – 746.7 MGD; 3%)
(1976 – 292.2 MGD; 164%)
21%
9%
<0.1%
70%
MGD
1000
800
600
400
200
0
76
78
1980
82
84
86
88
1990
92
94
96
98
2000
02
04
06
08
2010
12
14
16
18
2020
Years

Exhibit 8

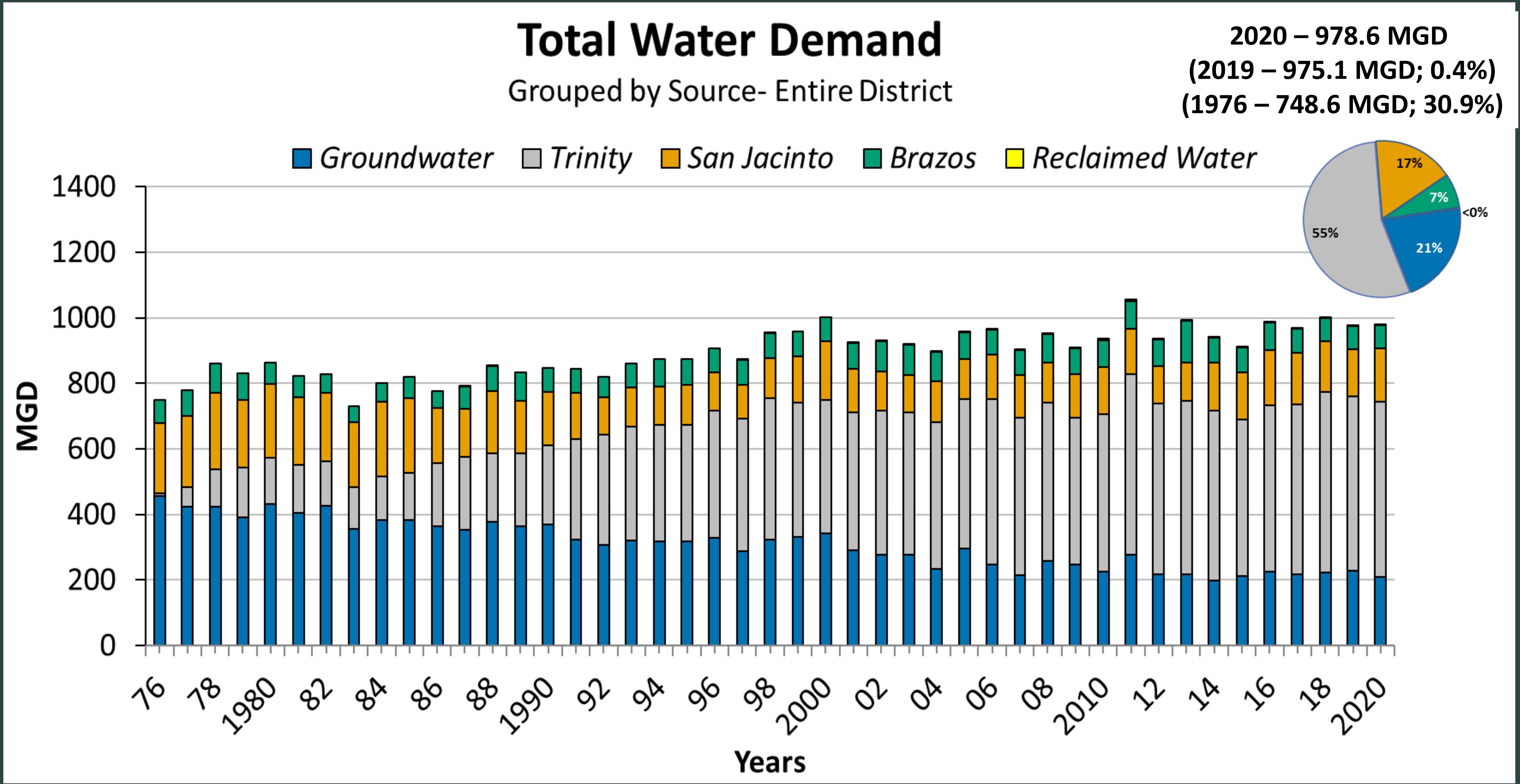


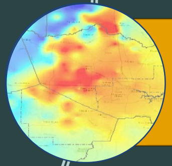
Exhibit 9

PROVISIONAL - SUBJECT TO CHANGE

Agenda


- Climate


- Groundwater Use


- Groundwater Levels


- Subsidence Data

USGS Presentation

Groundwater-level Altitudes (2021) and Changes Over Time in the Chicot-Evangeline (undifferentiated) and Jasper Aquifers and Compaction in the Chicot and Evangeline Portions of the Undifferentiated Aquifer (1973-2020)

For the Houston-Galveston Region

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John Ellis, Hydrologist | Studies Chief - jellis@usgs.gov

4/29/2021

HARRIS-GALVESTON SUBSIDENCE DISTRICT

Fort Bend Subsidence District

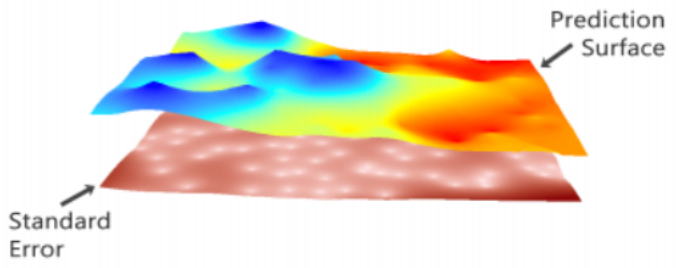
Brazoria County Groundwater Conservation District

2021 Water-Level Altitude Map Series

- Chicot-Evangeline Aquifer (undifferentiated)
  - *2021 Water-Level Altitude*
  - *2020 to 2021 Water-Level Change*
  - *2016 to 2021 Water-Level Change*
  - *1990 to 2021 Water-Level Altitude Change*
  - *1977 to 2021 Water-Level Altitude Change*
- Jasper Aquifer
  - *2021 Water-Level Altitude*
  - *2020 to 2021 Water-Level Change*
  - *2016 to 2021 Water-Level Change*
  - *2000 to 2021 Water-Level Altitude Change*
- Compaction 1973-2020
  - *Compaction Data from 14 Extensometers*

Important Updates for 2021

- Chicot-Evangeline aquifer (undifferentiated) have been combined into a “shallow” aquifer system
  - *GULF 2023 model - updated tops and bases*
  - *Chicot thickened significantly in much of the region, particularly in central and south-east Harris County*
  - *Many of the wells previously designated as Evangeline are now designated as Chicot*
  - *Re-creation of the Chicot-Evangeline 1977 and 1990 and the Jasper 2000 needed*
- Altitude and Change maps are now represented by shaded grids (Kriging)

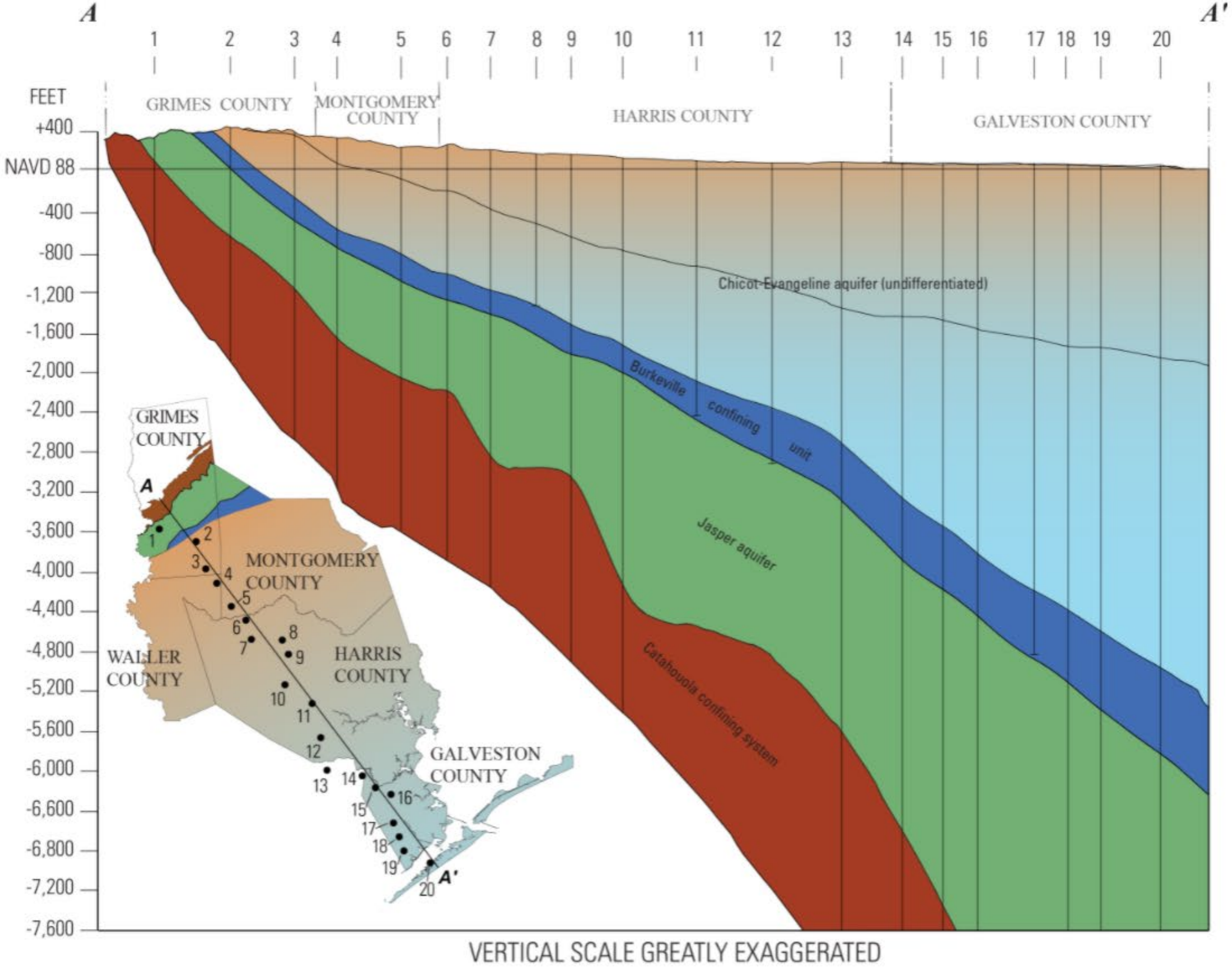


Geologic timescale		Prior to 2021		In 2021 and Moving Forward	
System	Series	Geologic units	Hydrogeologic units	Geologic units[1]	Hydrogeologic units[1]
Quaternary	Holocene	Alluvium	Chicot aquifer	Alluvial, terrace, and dune deposits	Chicot-Evangeline aquifer (undifferentiated)
	Pleistocene	Beaumont Formation		Beaumont Formation	
		Lissie Formation: Montgomery Formation		Lissie Formation: Montgomery Formation	
		Lissie Formation: Bentley Formation		Lissie Formation: Bentley Formation	
		Willis Sand		Willis Sand	
Tertiary	Pliocene	Goliad Sand	Evangeline aquifer	Goliad Sand (upper part)	
				Goliad Sand (lower part)	
	Miocene	Fleming Formation Lagarto Clay	Burkeville confining unit	Lagarto Clay (upper part)	
				Lagarto Clay (middle part)	Burkeville confining unit
		Oakville Sandstone	Jasper aquifer	Lagarto Clay (lower part)	Jasper aquifer
				Oakville Sandstone	
		Catahoula Sandstone: Upper part of Catahoula Sandstone; Anahuac Formation	Catahoula Confining System	Catahoula Formation: Upper Catahoula Formation	Catahoula Confining System
	Oligocene	Frio Formation		Catahoula Formation: Frio Formation	

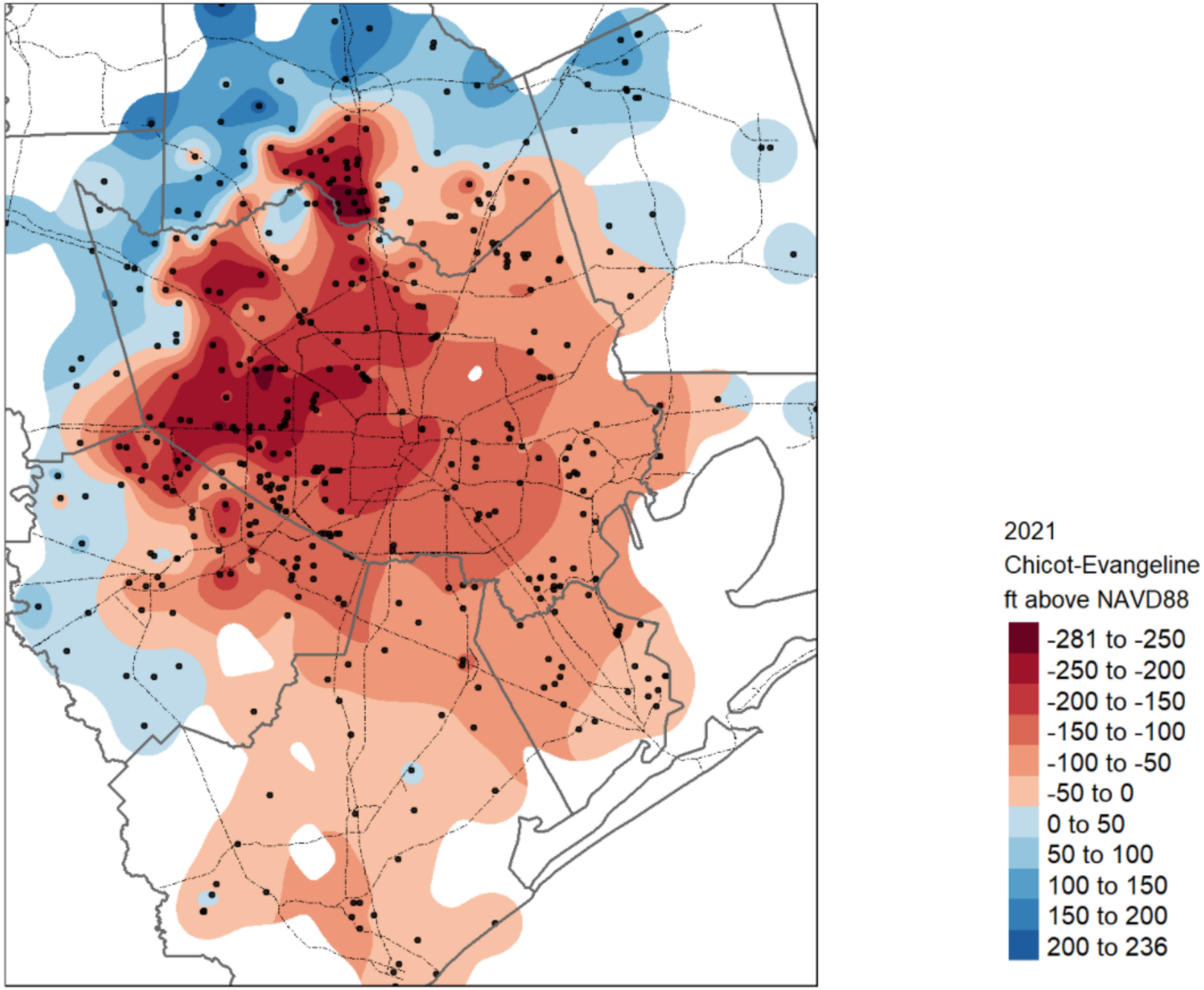
Network

- Data were collected across 11 counties (Harris and surrounding) from 2020-11-23 to 2021-03-11
- Requires collaboration and agreements with well owners and operators (MUDs)
- Variety of well types including public supply, irrigation, industrial and observation
- Number of Chicot-Evangeline water-levels collected: **527**
- Number of Jasper water-levels collected: **105**
- Number of wells used to create 2021 Altitude maps
  - *Chicot-Evangeline: 434*
  - *Jasper: 93*

Stratigraphic cross section

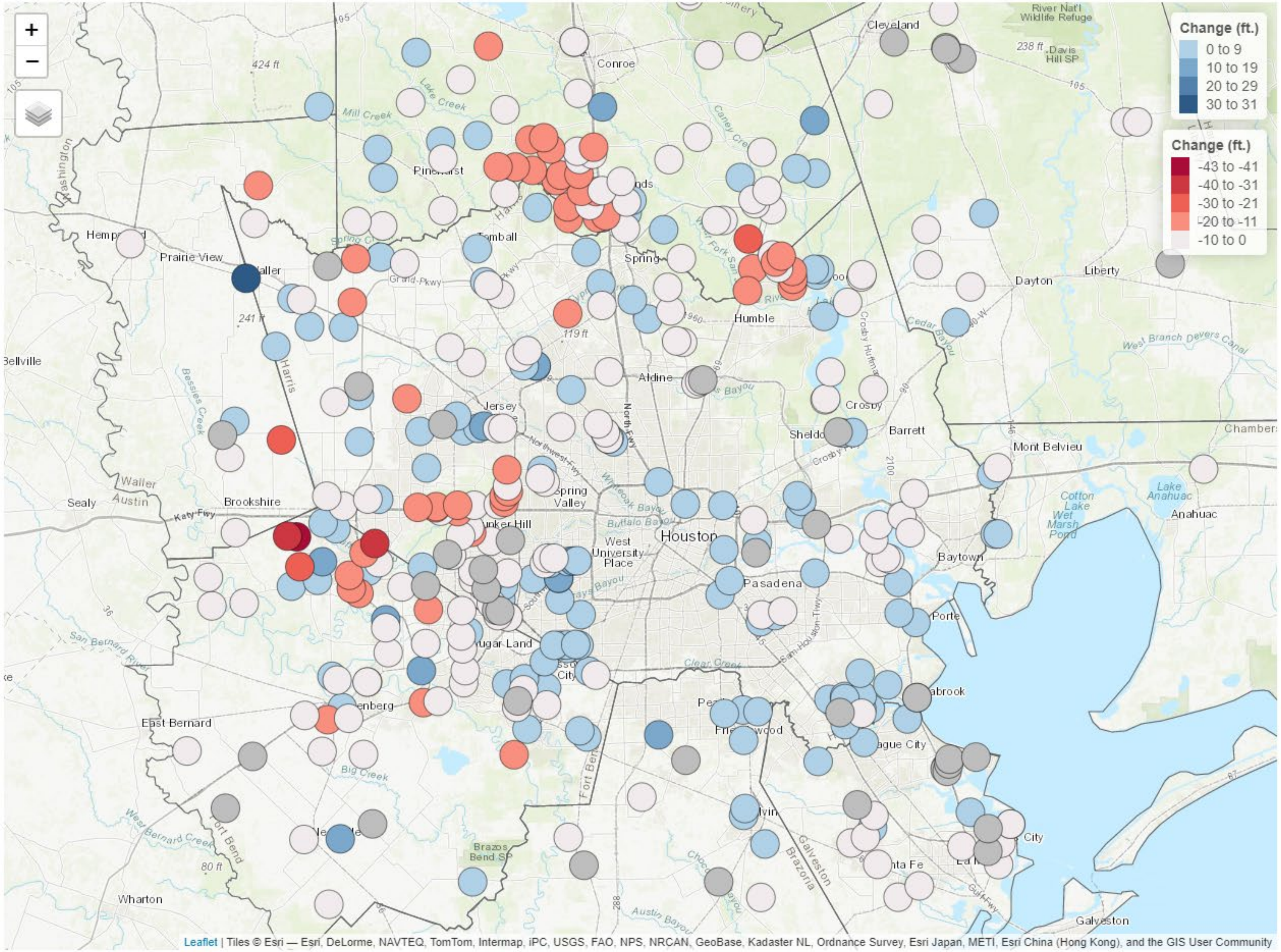


Chicot-Evangeline 2021 Altitude



- Data Summary:
  Min : **-281**
  Mean : **-46**
  Max : **236**
- Highest areas of usage in western Harris County, and the south-central portion of Montgomery County

Chicot-Evangeline 1 year change



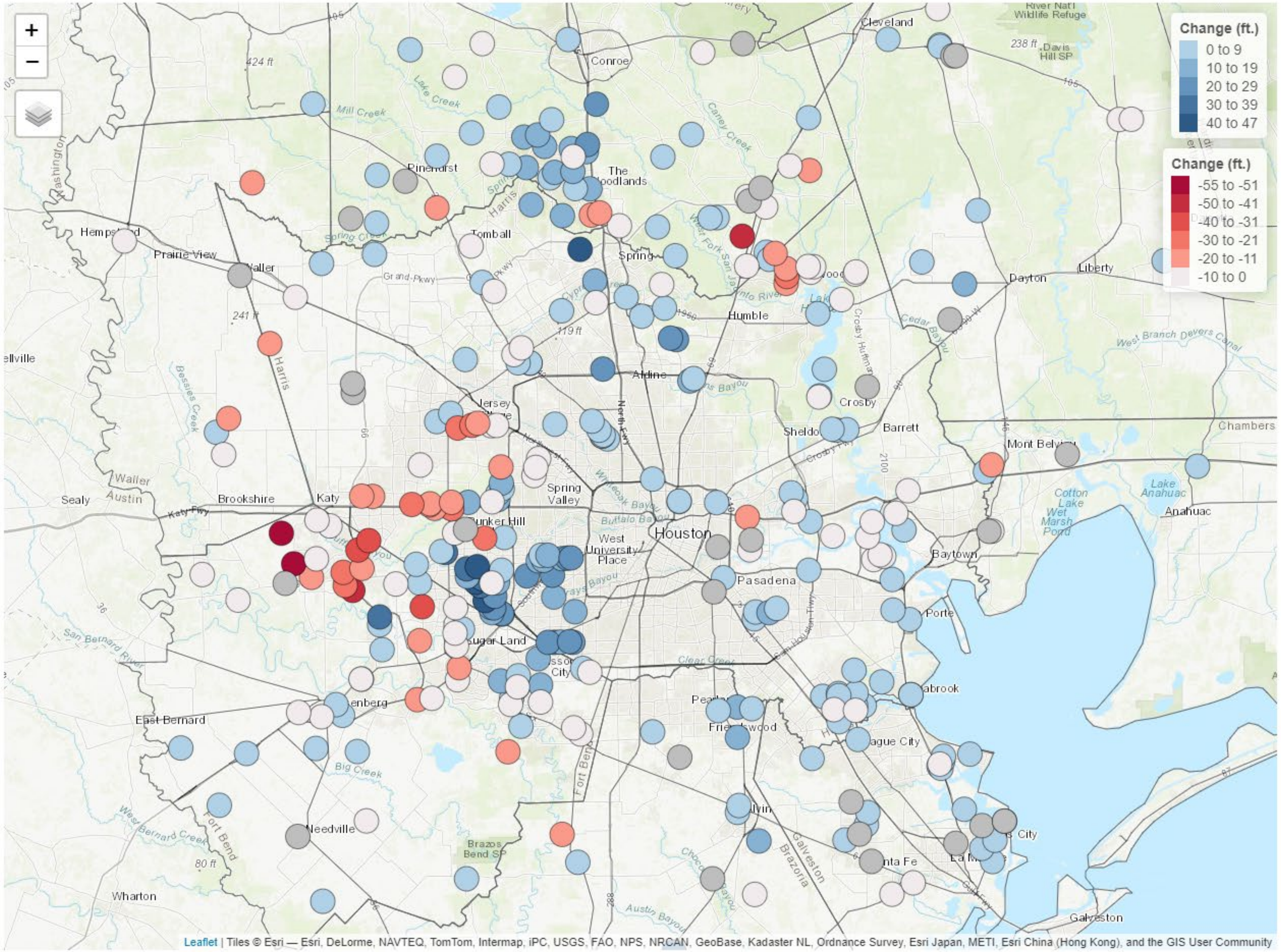
Number of wells: **409**

Rises: **35.2%**

Declines: **55%**

No Change: **9.8%**

Chicot-Evangeline 5 year change



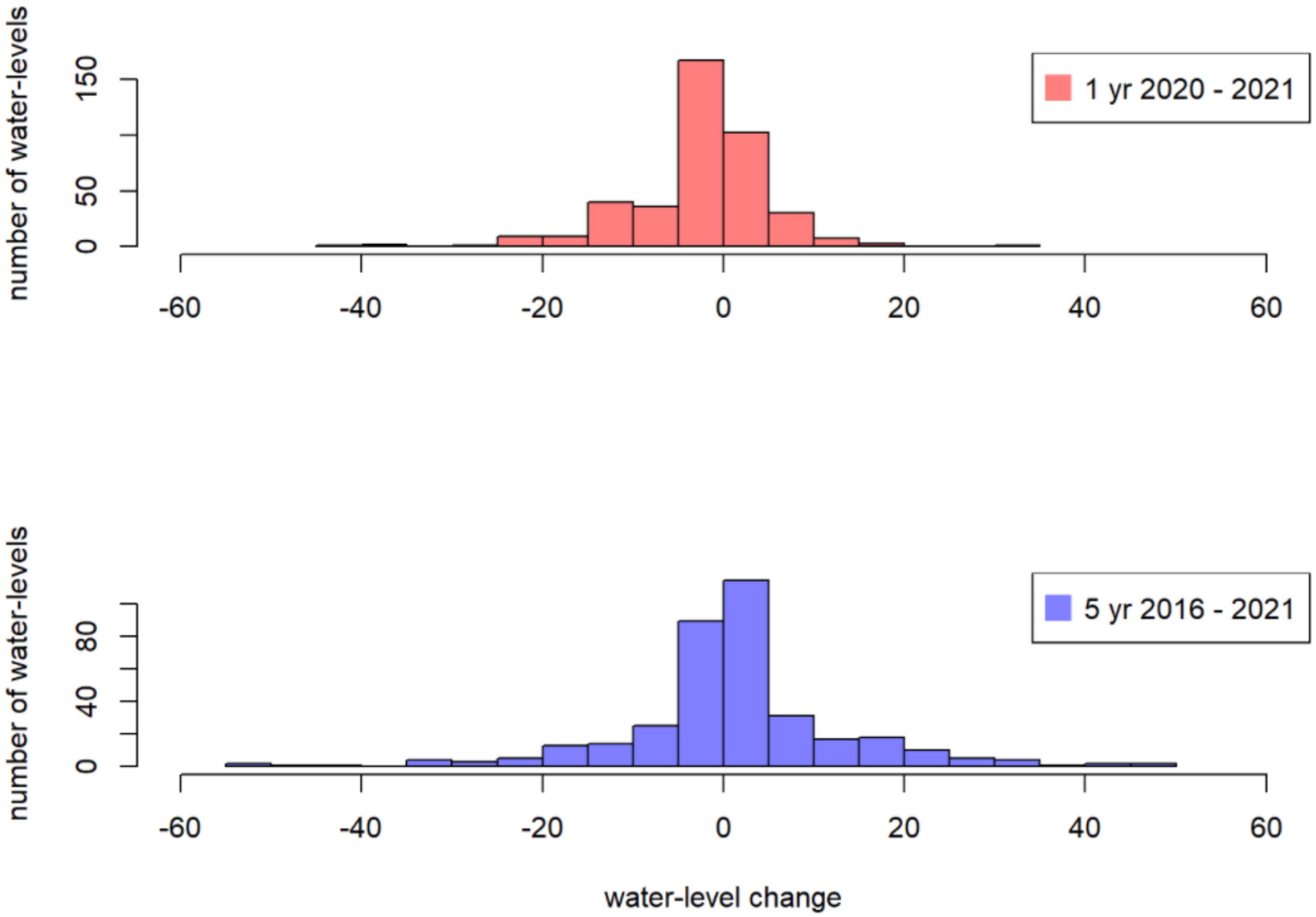
Number of wells: **361**

Rises: **56.5%**

Declines: **34.6%**

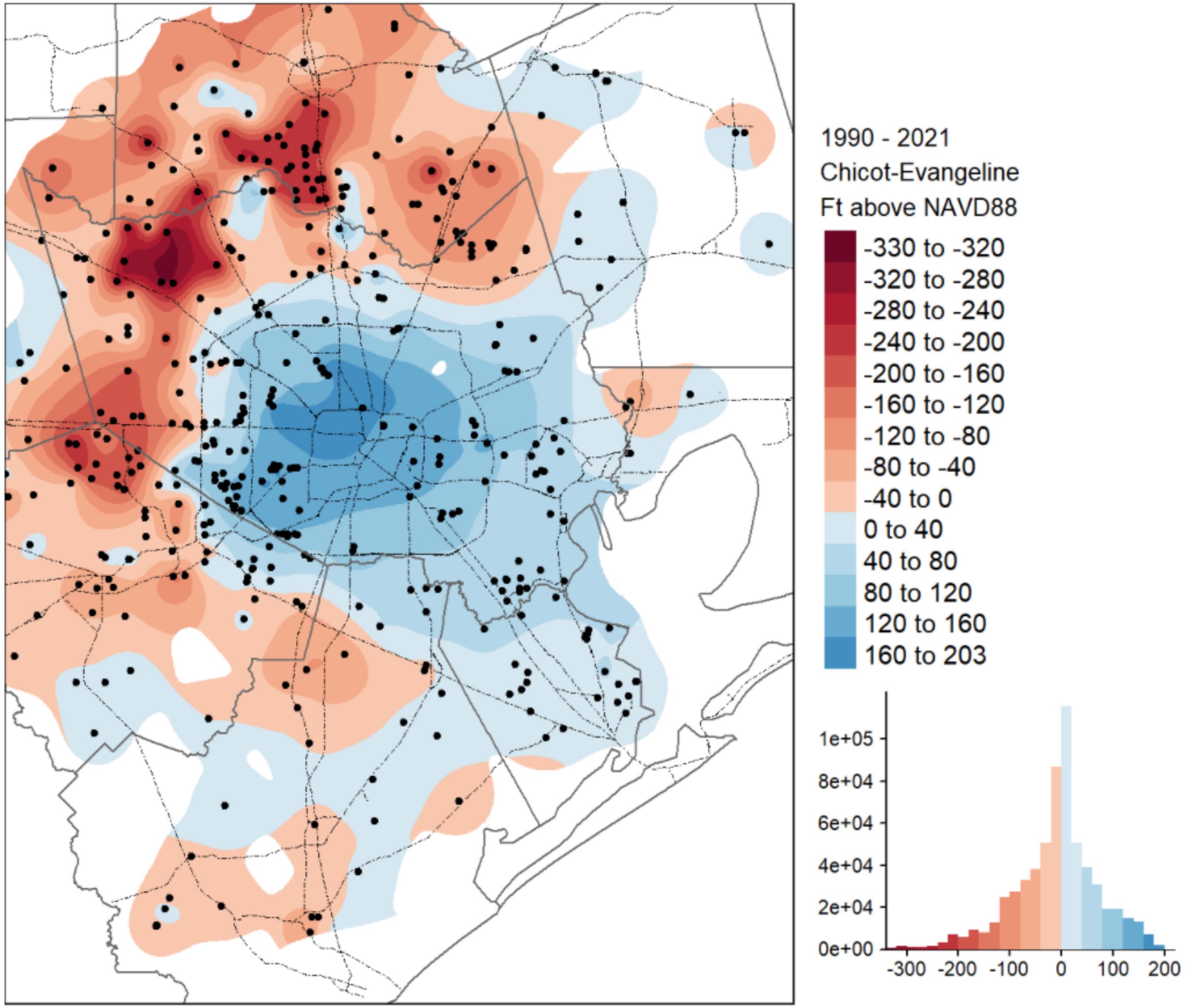
No Change: **8.9%**

Chicot-Evangeline 1 and 5 year comparison



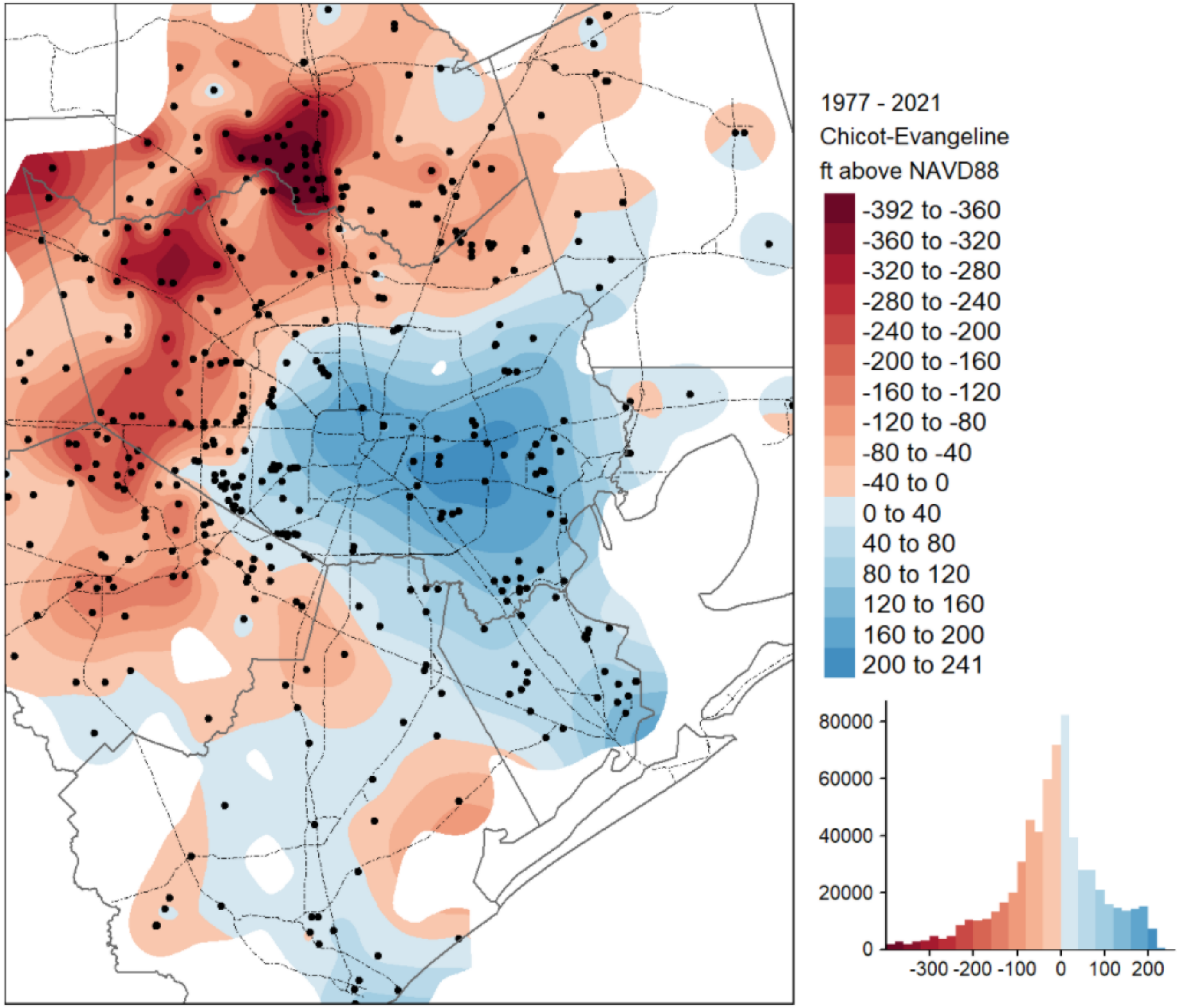
- 2020 - 2021 Changes
  - *35% rises, 55% declines, 10% no change*
  - *~ 41% (167) - declines in the 0 - 5 ft range*
  - *~ 25% (102) - rises in the 0 - 5 ft range*
- 2016 - 2021 Changes
  - *57% rises, 35% declines, 9% no change*
  - *~ 32% (114) - rises in the 0 - 5 ft range*
  - *~ 25% (89) - declines in the 0 - 5 ft range*

Chicot-Evangeline water-level change since 1990



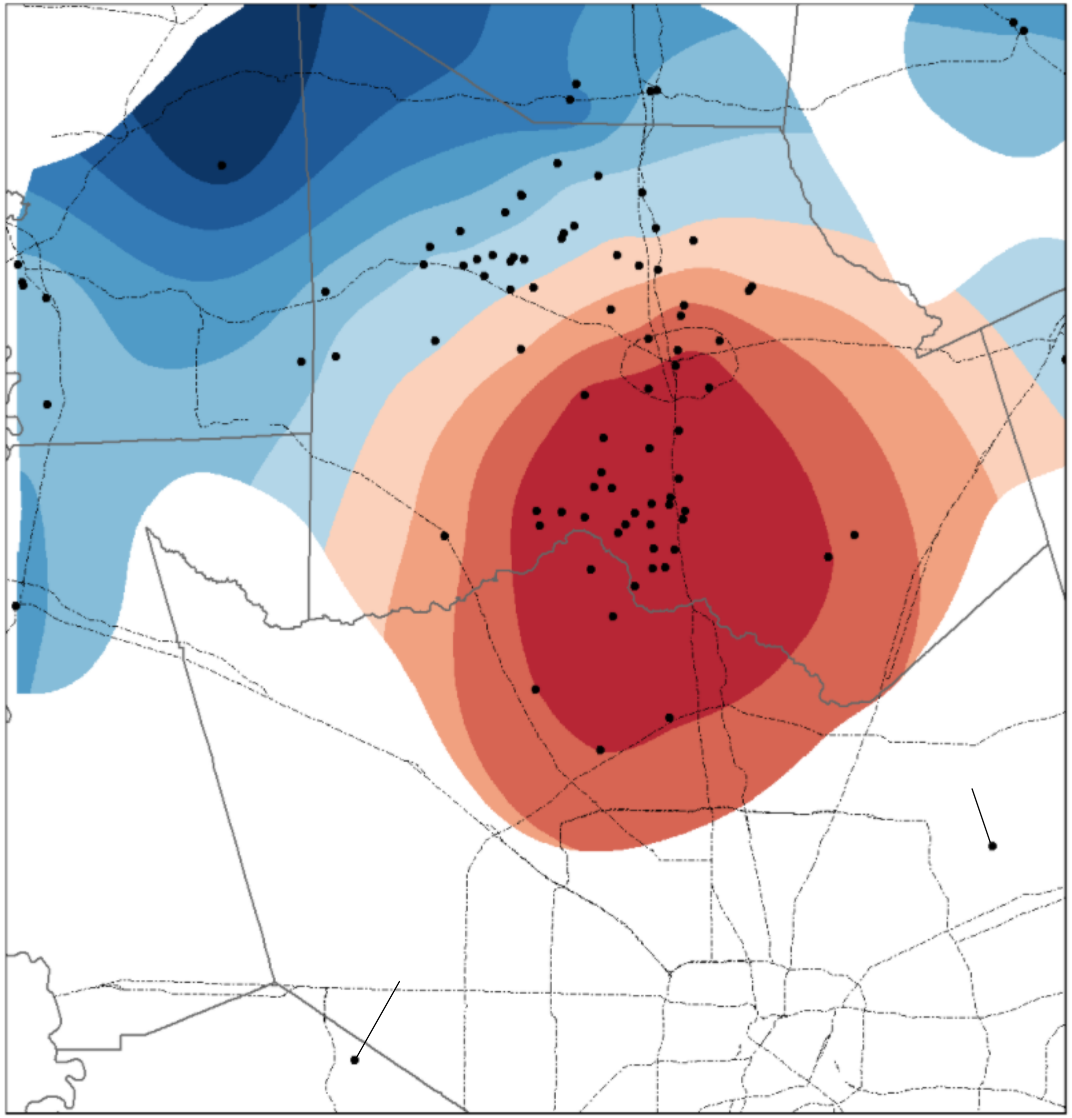
- Data Summary:
  Min : **-330**
  Mean : **-9**
  Max : **203**
- Water-level rises across most of central and eastern Harris County as well as Galveston and Brazoria Counties
- Water-level declines in the Northern part of Fort Bend County, NW portions of Harris County, and most of Montgomery County
- Data points are those that were collected this year (2021), and fall within the bounds of the 1990 overall mean variance for the 1990 Chicot-Evangeline altitude

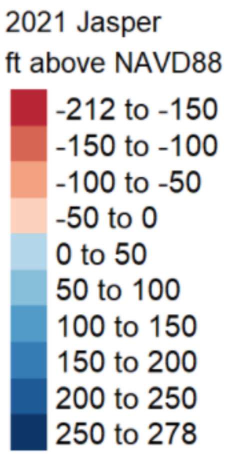
Chicot-Evangeline water-level change since 1977



- Data Summary:
  Min : **-392**
  Mean : **-19**
  Max : **241**
- Water-level rises across most of central and eastern Harris County as well as Galveston County
- Water-level declines in the Northern part of Fort Bend County, NW portions of Harris County, and most of Montgomery County
- Data points are those that were collected this year (2021), and fall within the bounds of the overall mean variance for the 1977 Chicot-Evangeline altitude

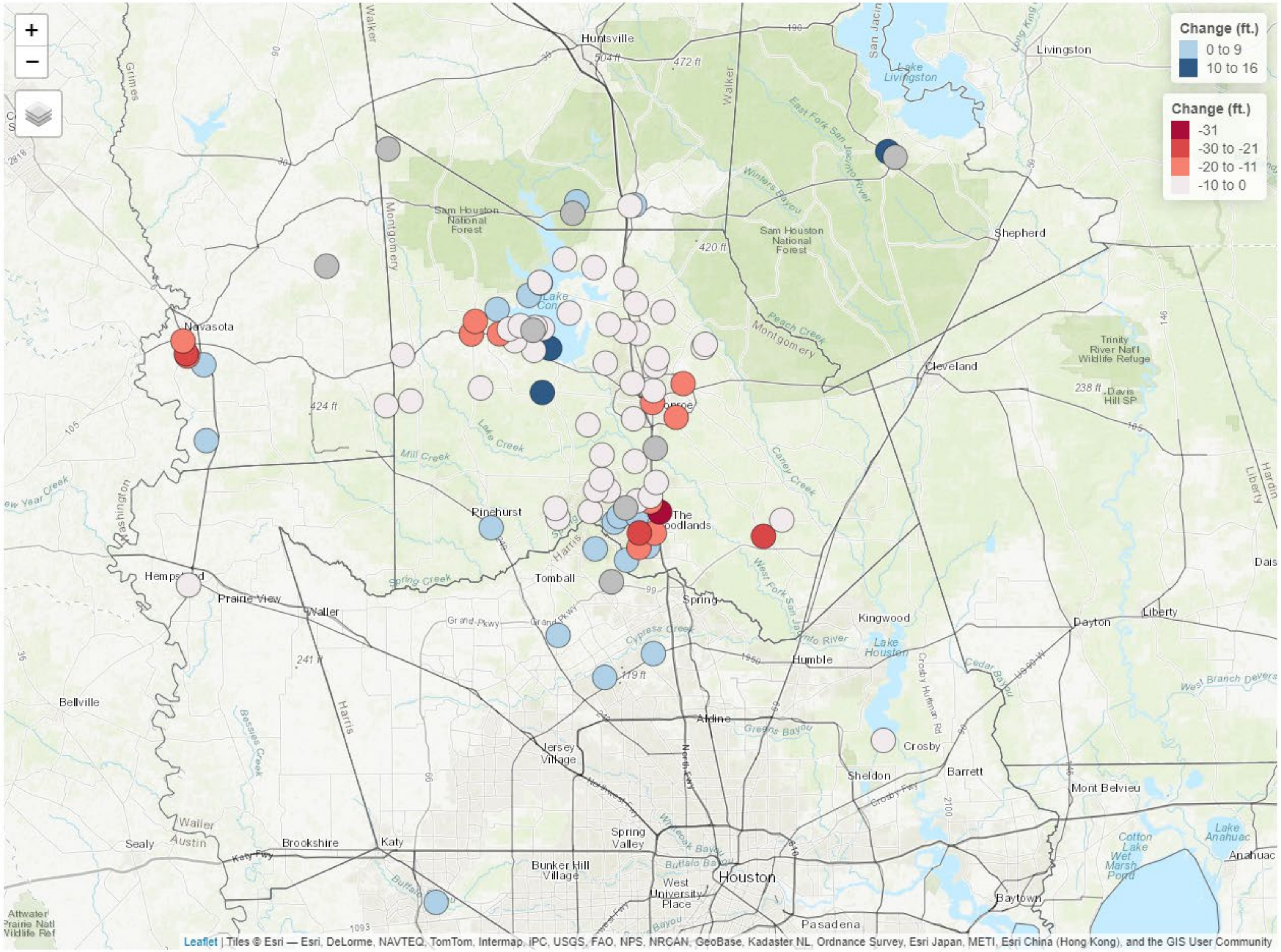
Jasper 2021 Altitude





- Data Summary:
  Min : **-212**
  Mean : **2**
  Max : **278**
- General trend of deepening water levels in downdip (NW - SE) direction
- Deepest water levels in south-central Montgomery County along border with Harris County

Jasper 1 year change



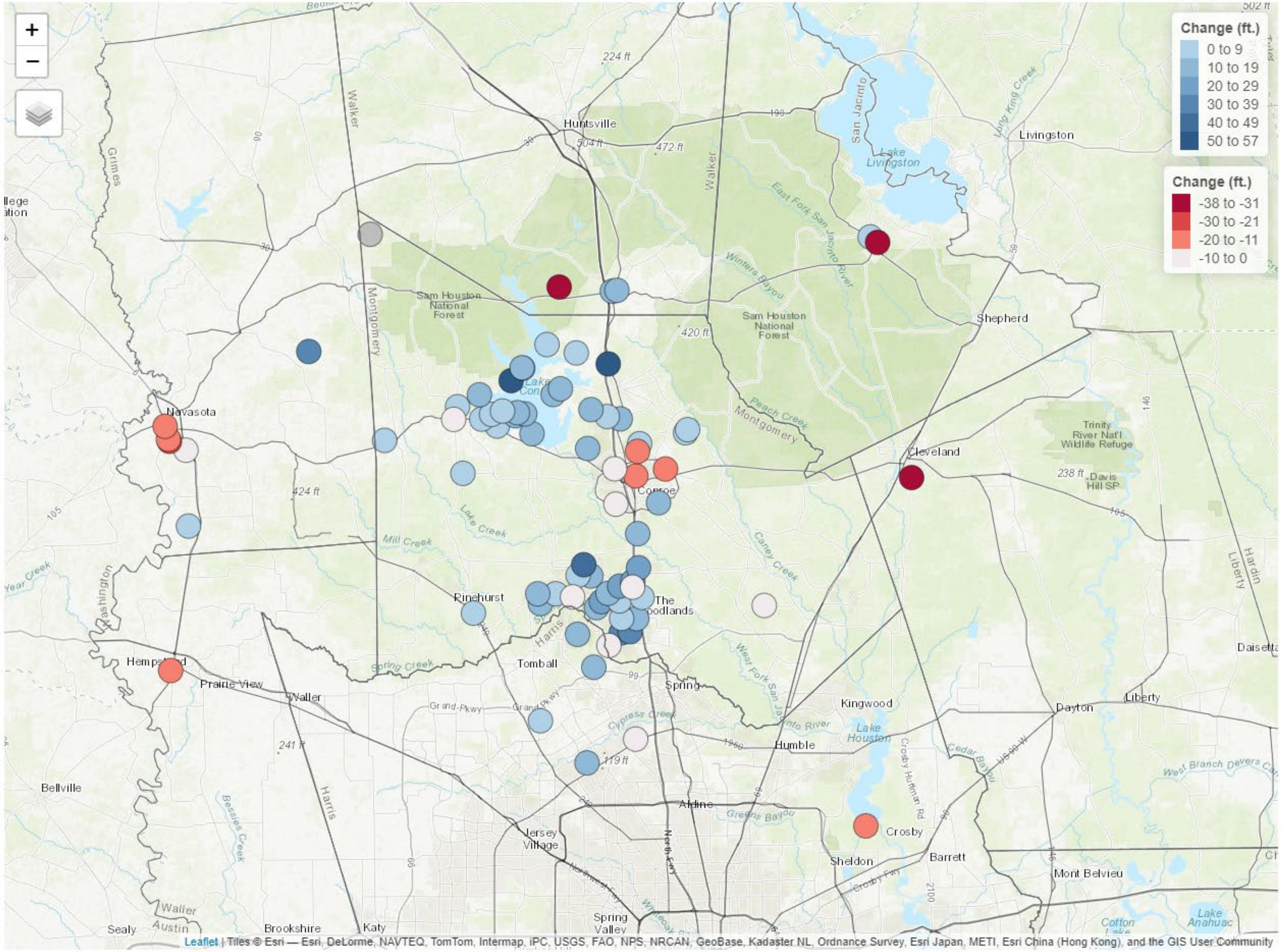
Number of wells: **88**

Rises: **22.7%**

Declines: **68.2%**

No Change: **9.1%**

Jasper 5 year change



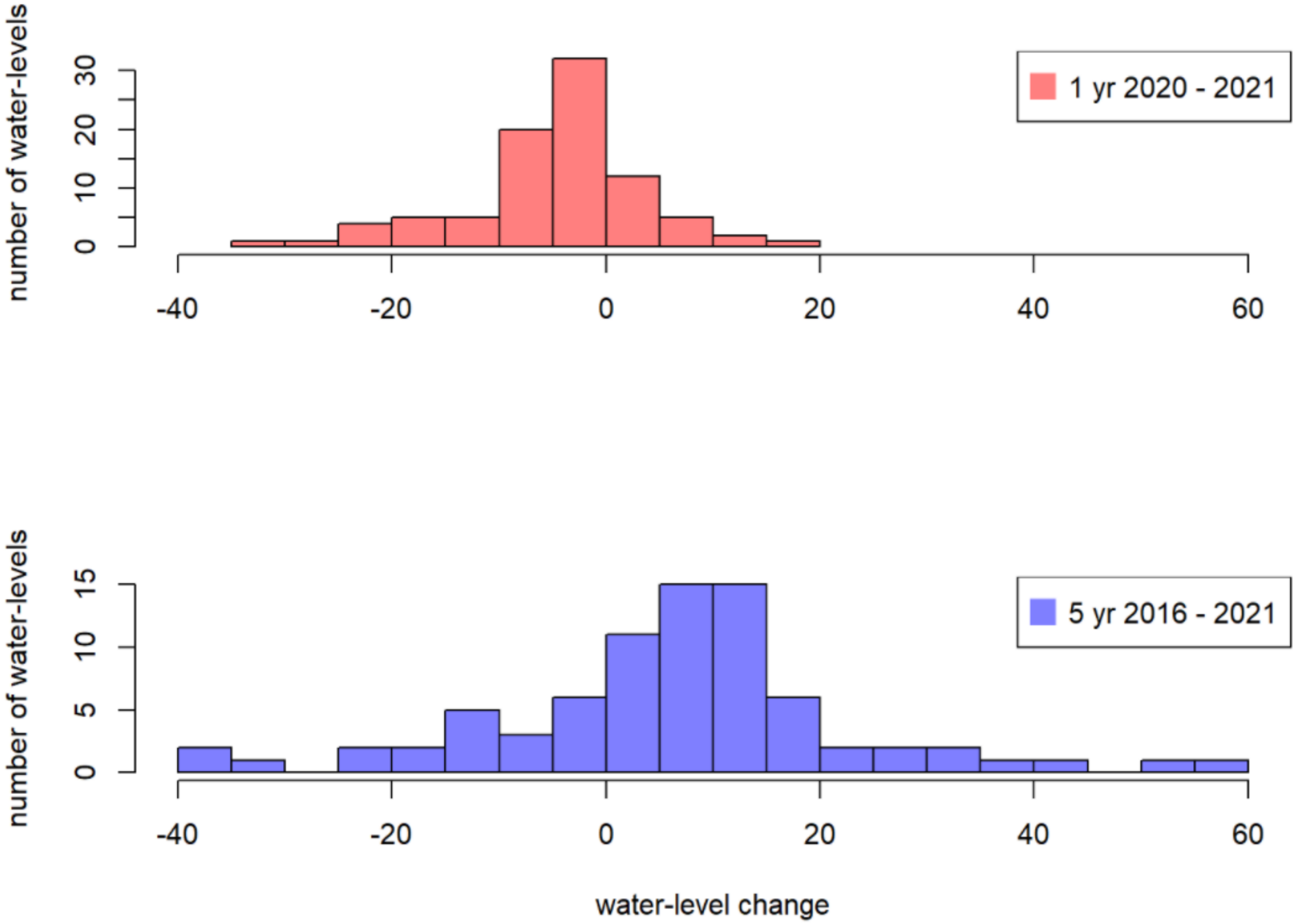
Number of wells: **78**

Rises: **73.1%**

Declines: **25.6%**

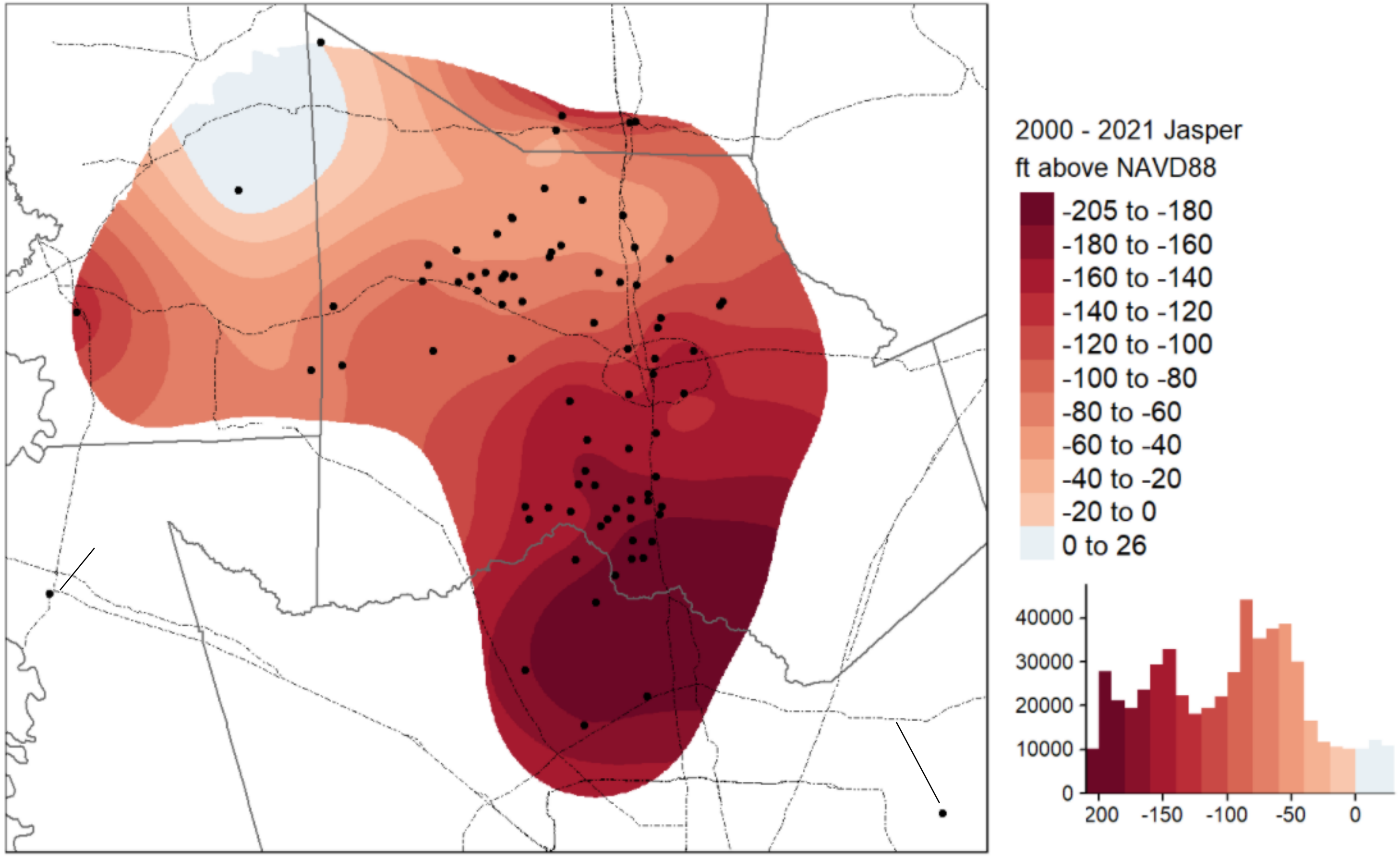
No Change: **1.3%**

Jasper 1 and 5 year change comparison



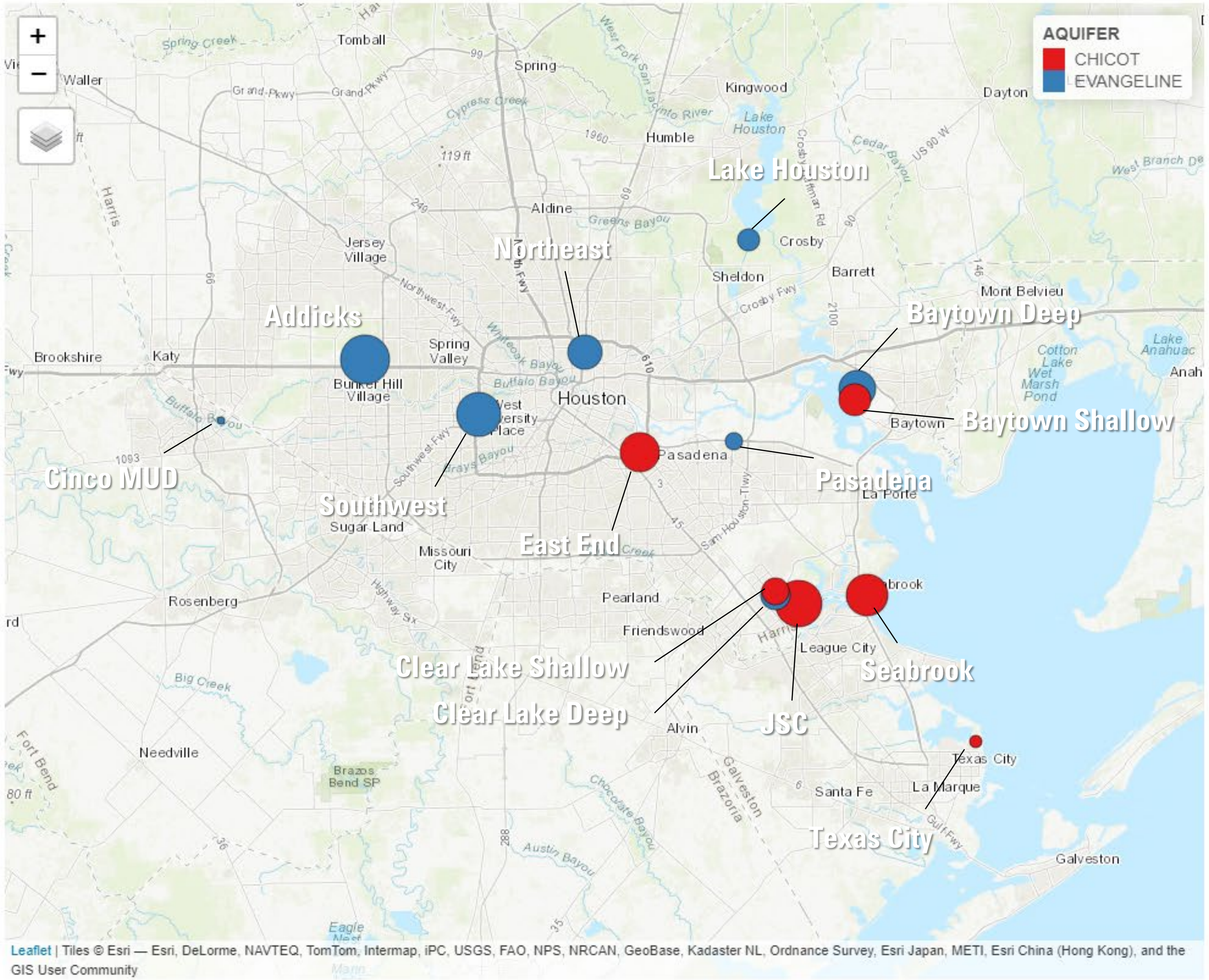
- 2020 - 2021 Changes
  - *Primarily water-level declines (~ 67%)*
  - *~ 37% (33) - declines in the 0 - 5 ft range*
  - *~ 22% (20) - declines in the 6 - 10 ft range*
- 2016 - 2021 Changes
  - *Primarily water-level rises (~ 73%)*
  - *~ 65% (41) - rises in the 0 - 15 ft range*

Jasper water-level change since 2000



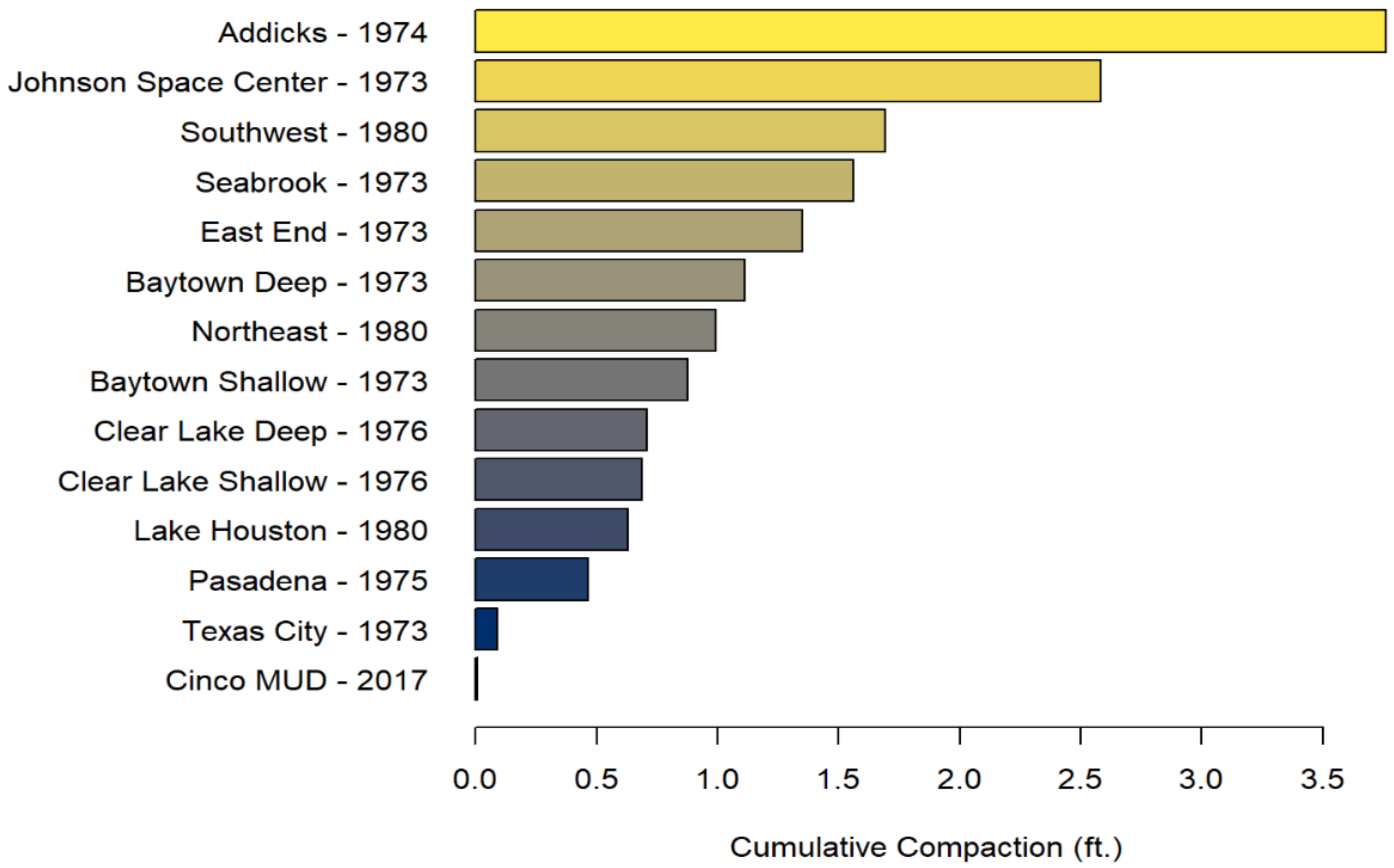
- Data Summary:
  Min : **-205**
  Mean : **-98**
  Max : **26**
- General trend of declining water levels in downdip (NW - SE) direction
- Area with greatest declines near Harris - Montgomery County border
- Data points are those that were collected this year (2021), and fall within the bounds of the overall mean variance for the 2000 Jasper altitude

Compaction

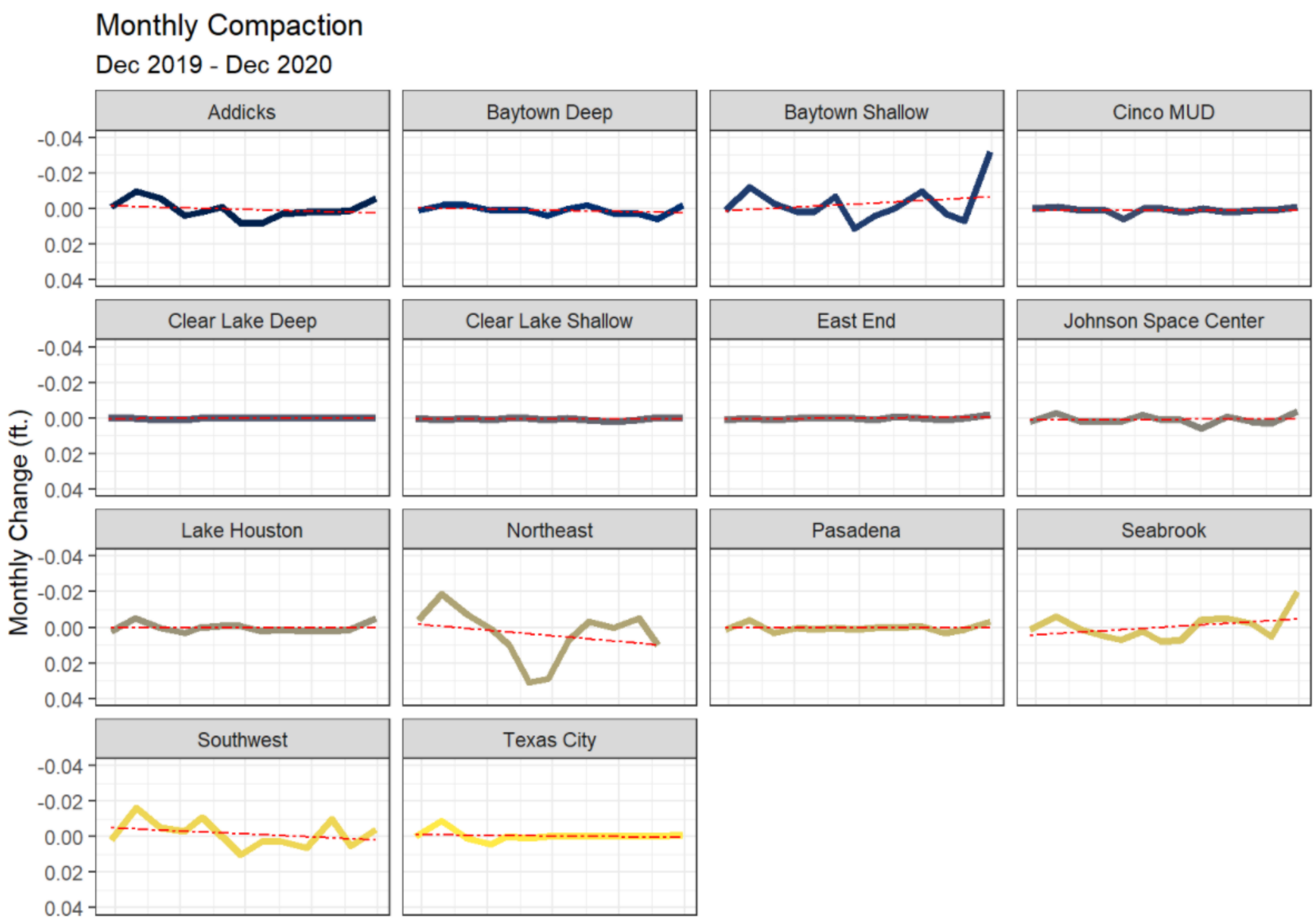


- **Cumulative compaction recorded at each location as of December 2020**
  - *1974-Addicks-3.760 ft.*
  - *1973-Baytown Deep-1.110 ft.*
  - *1973-Baytown Shallow-0.875 ft.*
  - *2017-Cinco MUD-0.006 ft.*
  - *1976-Clear Lake Deep-0.706 ft.*
  - *1976-Clear Lake Shallow-0.685 ft.*
  - *1973-East End-1.350 ft.*
  - *1973-Johnson Space Center-2.580 ft.*
  - *1980-Lake Houston-0.628 ft.*
  - *1980-Northeast-0.990 ft.*
  - *1975-Pasadena-0.464 ft.*
  - *1973-Seabrook-1.560 ft.*
  - *1980-Southwest-1.690 ft.*
  - *1973-Texas City-0.090 ft.*

Compaction (cont.)



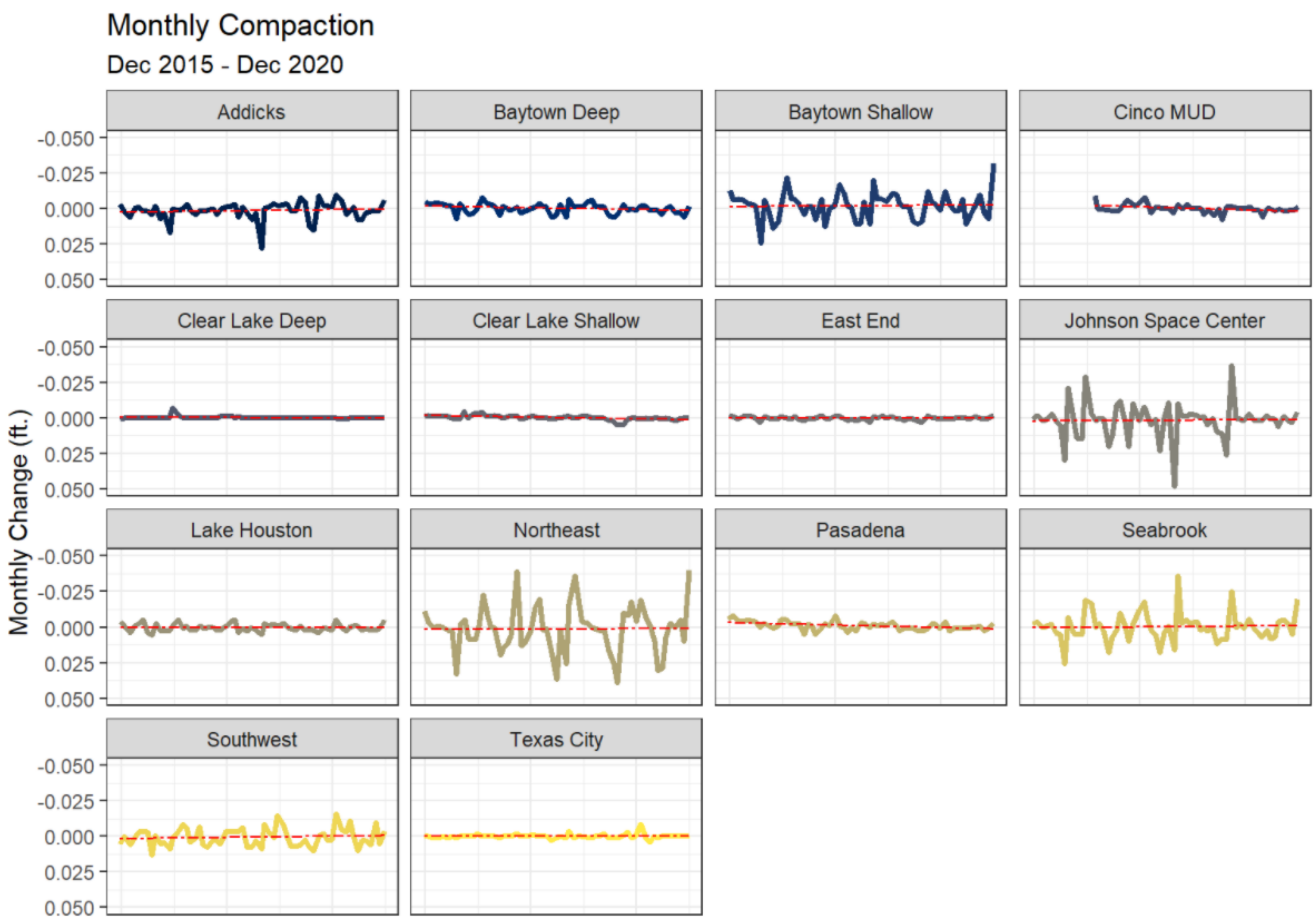
Compaction 1 year monthly changes



Monthly change in land surface elevation at each location

- Slight increase (compaction) in trend
  - *Addicks*
  - *Northeast*
  - *Southwest*
  - *Baytown Deep*
- Slight decrease (uplift) in trend
  - *Baytown Shallow*
  - *Seabrook*

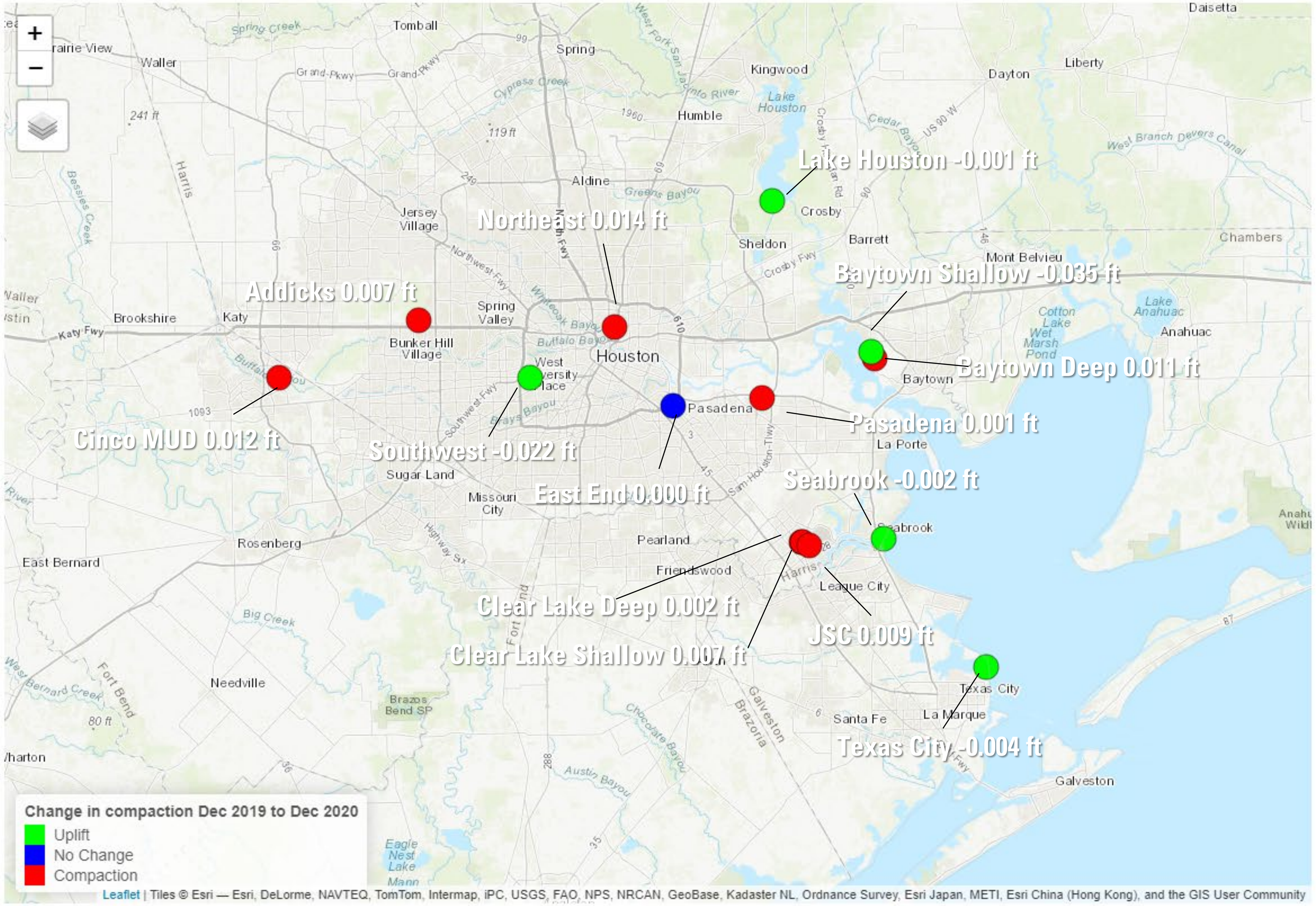
Compaction 5 year monthly changes



Monthly change in land surface elevation at each location

- Slight increase (compaction) in trend
  - *Pasadena*
  - *Cinco MUD*
- Slight decrease (uplift) in trend
  - *Addicks*
  - *Seabrook*
  - *Baytown Shallow*

Summary: Compaction



Absolute changes for the period December 2019 through December 2020, in ft.

- 5 sites recorded uplift ranging from 0.001 ft. to 0.035 ft.
- 8 sites recorded compaction ranging from 0.001 ft. to 0.014 ft.
- 1 site recorded no change

2021 Water-Level Altitude Map Series

Jason Ramage, Hydrologist - jkramage@usgs.gov

Christopher Braun, Hydrologist | Groundwater Specialist - clbraun@usgs.gov

John Ellis, Hydrologist | Studies Chief - jellis@usgs.gov

HARRIS-GALVESTON SUBSIDENCE DISTRICT

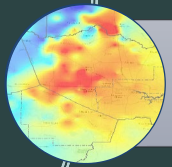
Fort Bend Subsidence District

Brazoria County Groundwater Conservation District

Agenda

- Climate

- Groundwater Use



- Groundwater Levels

- Subsidence Data

Exhibit 10

Subsidence Measurement Method

Global positioning system (GPS) station P051, located in Humble, is constructed in the Port-a-Measure (PAM) design and collects GPS data periodically.

Subsidence Monitoring Network

Location and operator of GPS stations that monitor land-surface elevation periodically or continuously within the greater Houston-Galveston region 2020.

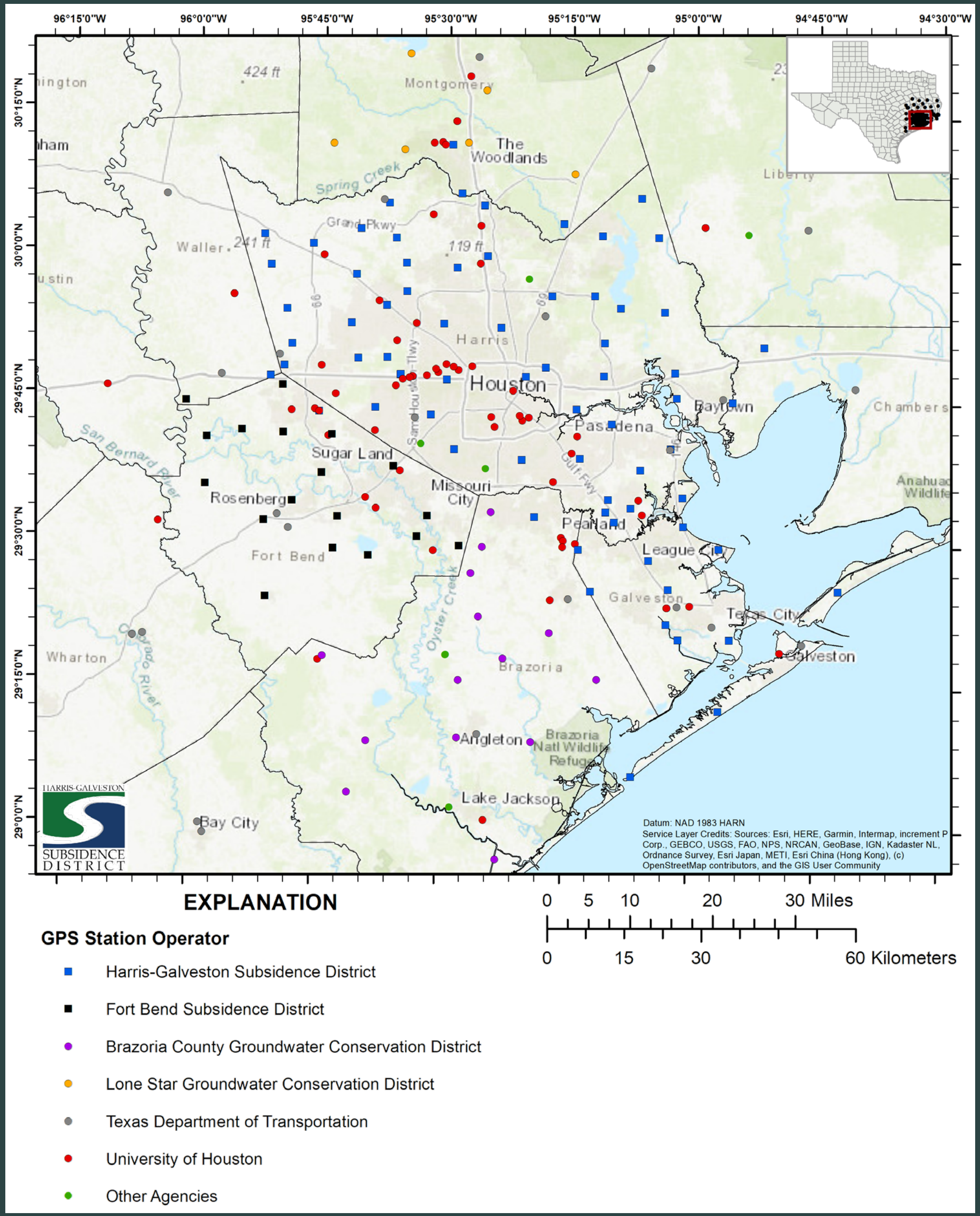


Exhibit 11

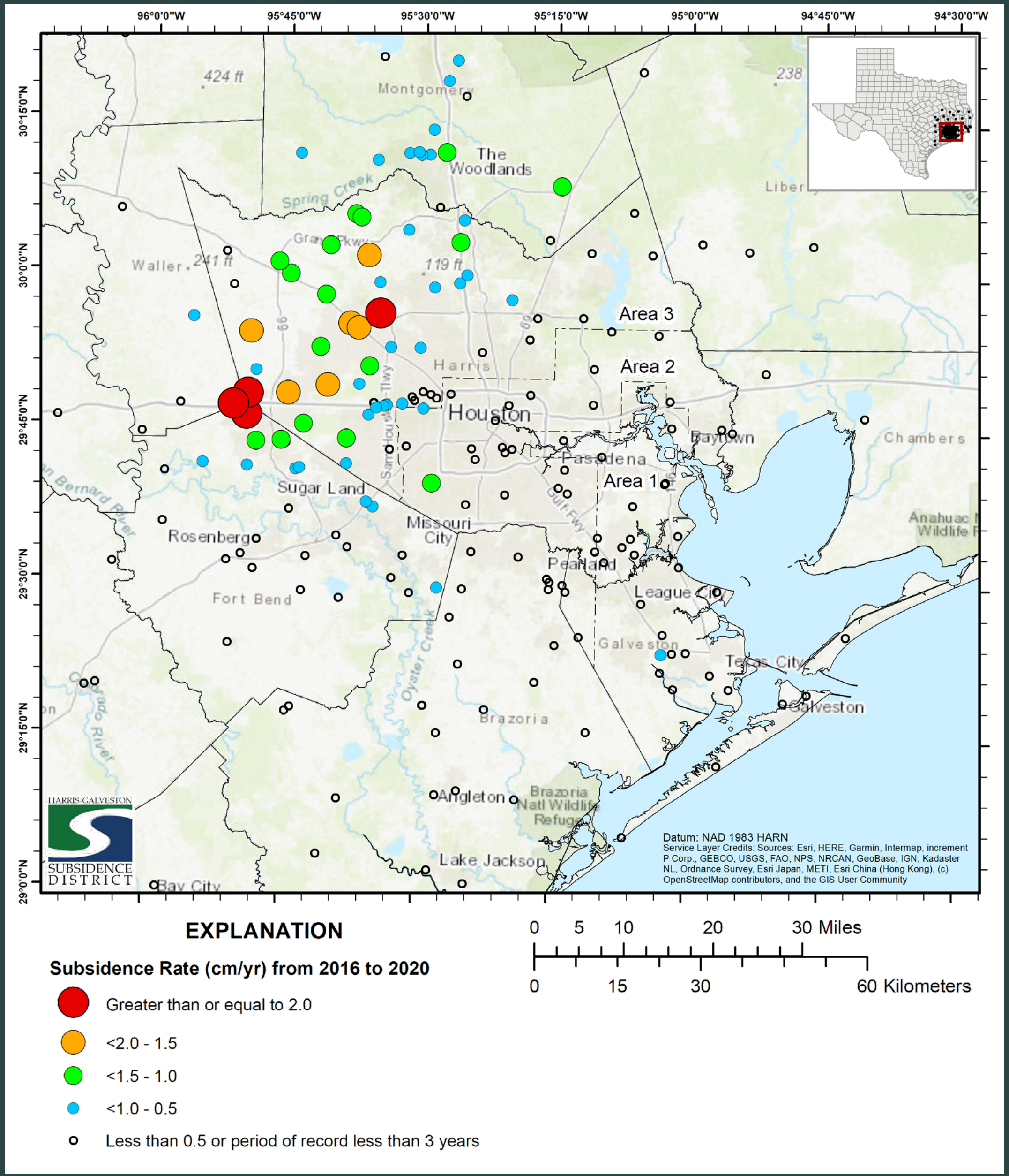


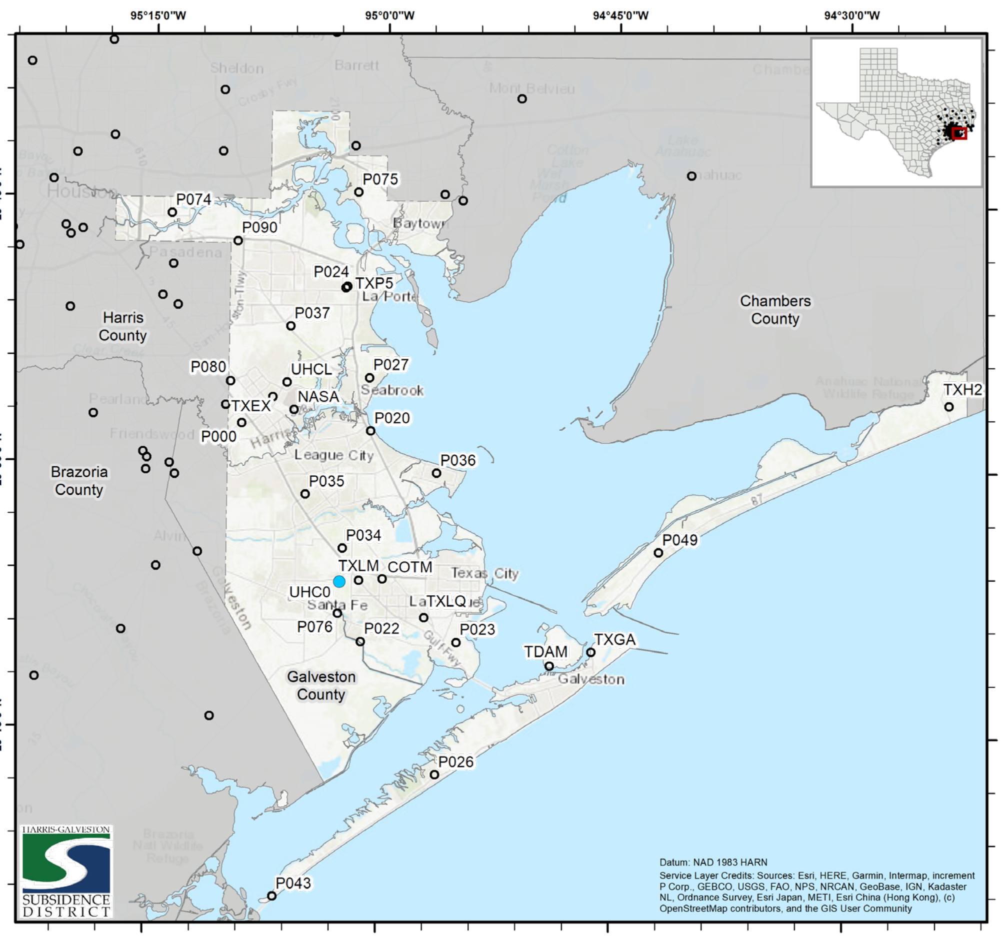
Exhibit 12

Annual Subsidence Rate

Annual subsidence rate, in centimeters per year (cm/yr), measured at GPS stations with three more years of periodic or continuous GPS data in Harris and Surrounding Counties, Texas, 2016-2020.

Regulatory Area One

Annual subsidence rate (cm/yr) estimated from three or more years of periodic or continuous GPS data measured at GPS stations in Harris and Galveston Counties, Texas, 2016-2020.

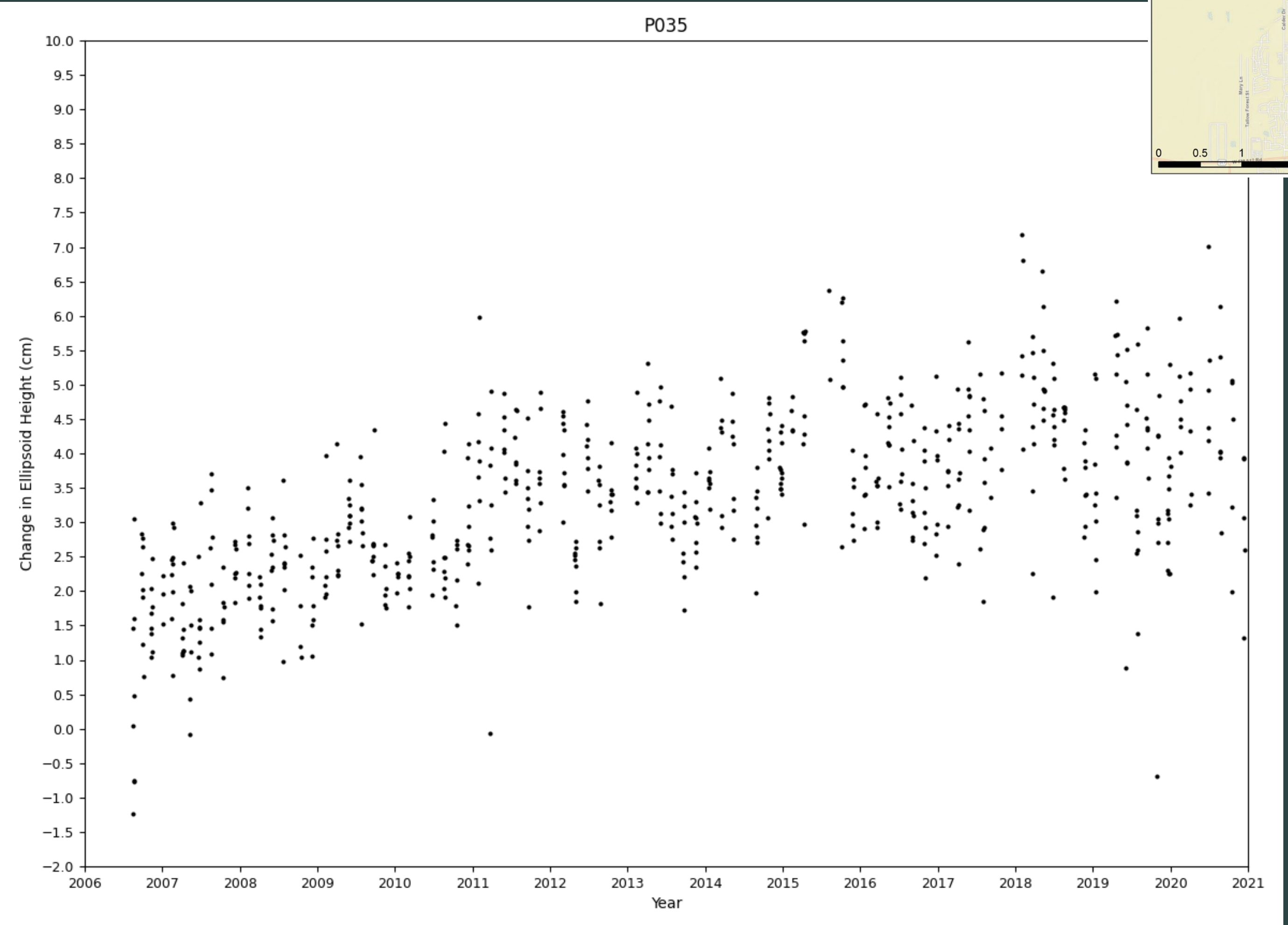


EXPLANATION

Subsidence Rate (cm/yr) from 2016 to 2020

- Greater than or equal to 2.0
- <2.0 - 1.5
- <1.5 - 1.0
- <1.0 - 0.5
- Less than 0.5 or period of record less than 3 years

Exhibit 13



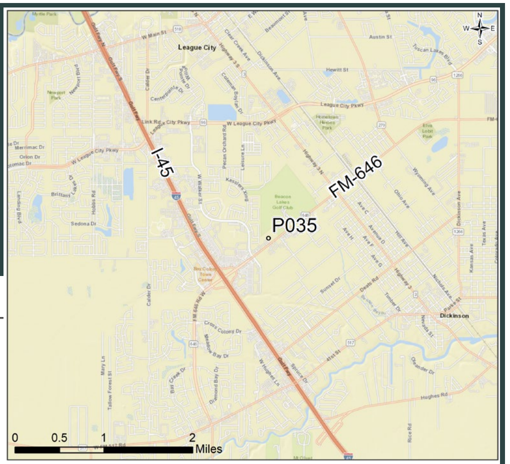


Exhibit 14

P035 Period of Record Plot

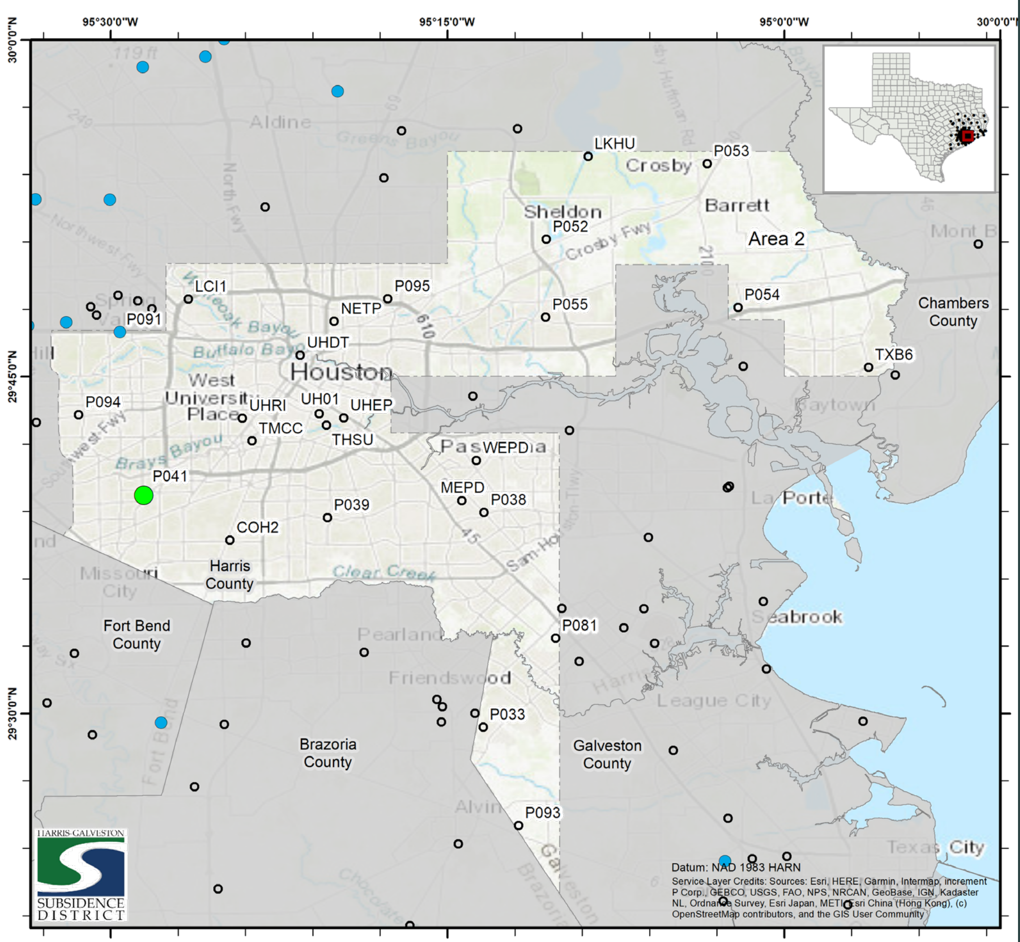
GPS station P035, located in Dickinson, shows a generally flat trend with approximately 4 cm of uplift over 14 years.

HARRIS-GALVESTON SUBSIDENCE DISTRICT

Regulatory Area Two

Annual subsidence rate (cm/yr) estimated from three or more years of periodic or continuous GPS data measured at GPS stations in Harris and Galveston Counties, Texas, 2016 - 2020.

Exhibit 15



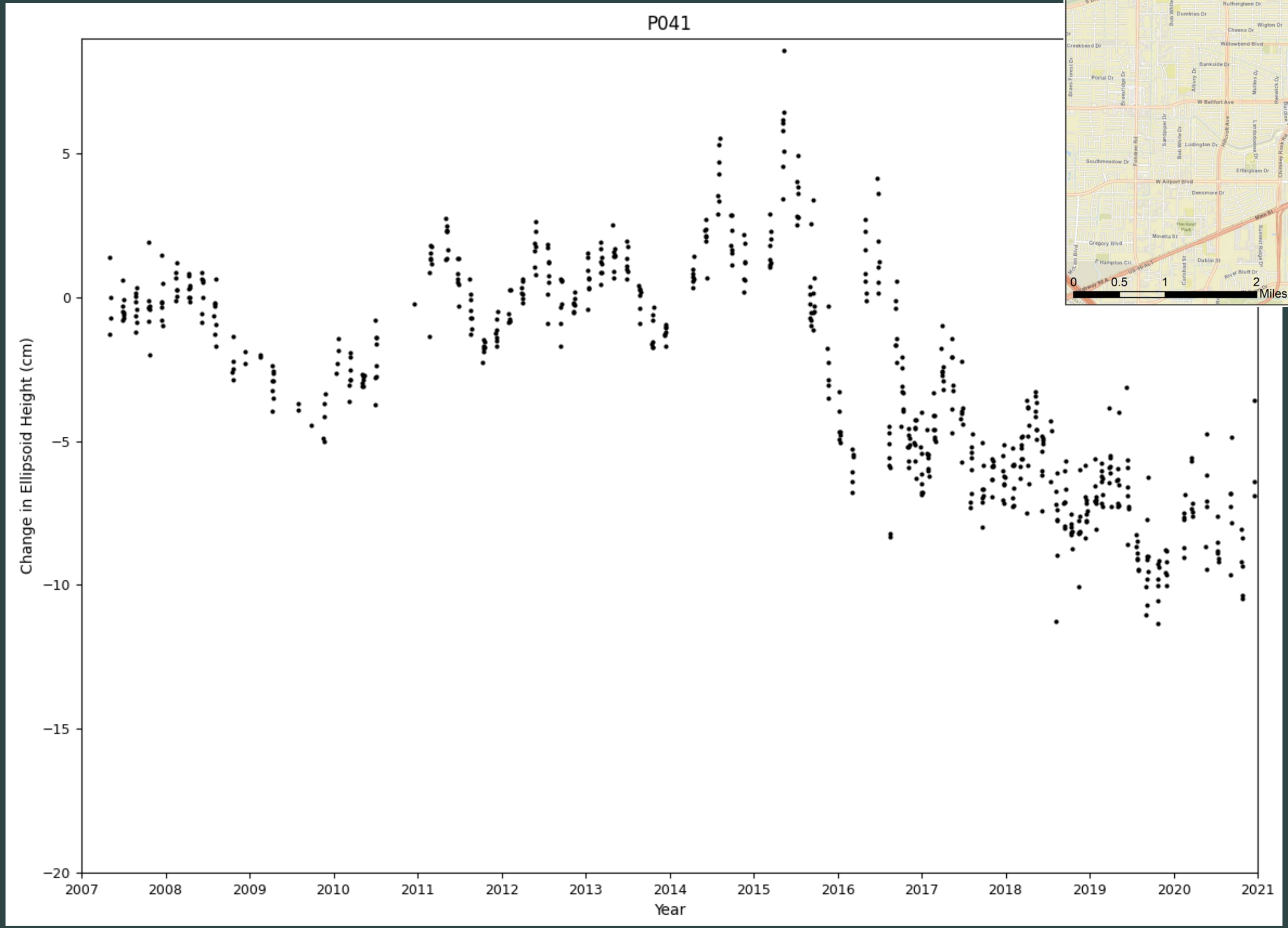
EXPLANATION

0 3 6 12 18 Miles

0 5 10 20 Kilometers

Subsidence Rate (cm/yr) from 2016 to 2020

- Greater than or equal to 2.0
- <2.0 - 1.5
- <1.5 - 1.0
- <1.0 - 0.5
- Less than 0.5 or period of record less than 3 years



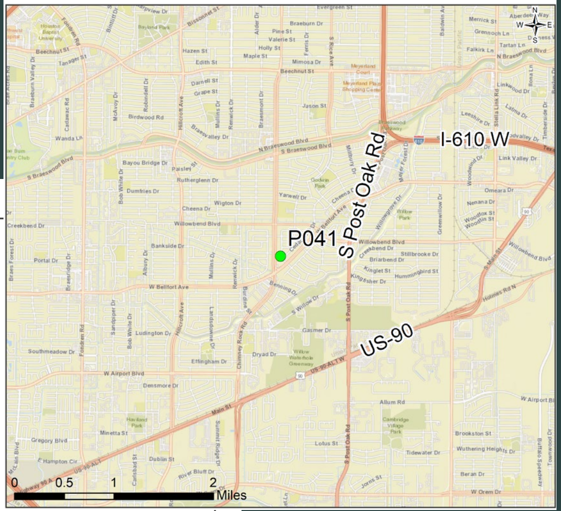


Exhibit 16

P041 Period of Record Plot

GPS station P041, located in the Brays Oak District, has measured about 9 cm of subsidence since 2007.

HARRIS-GALVESTON SUBSIDENCE DISTRICT

Regulatory Area Three

Annual subsidence rate (cm/yr) estimated from three or more years of periodic or continuous GPS data measured at GPS stations in Harris County, Texas, 2016-2020.

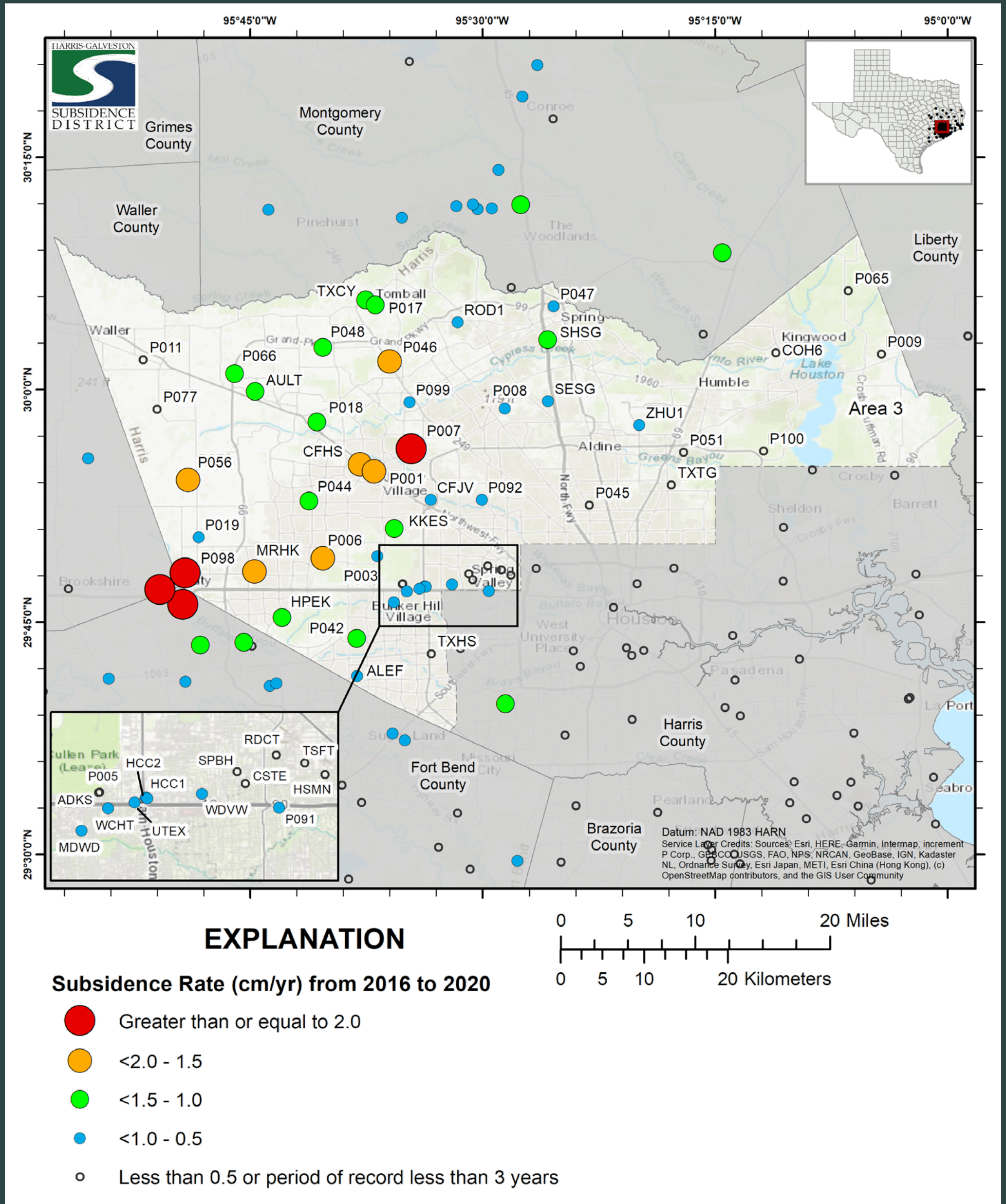
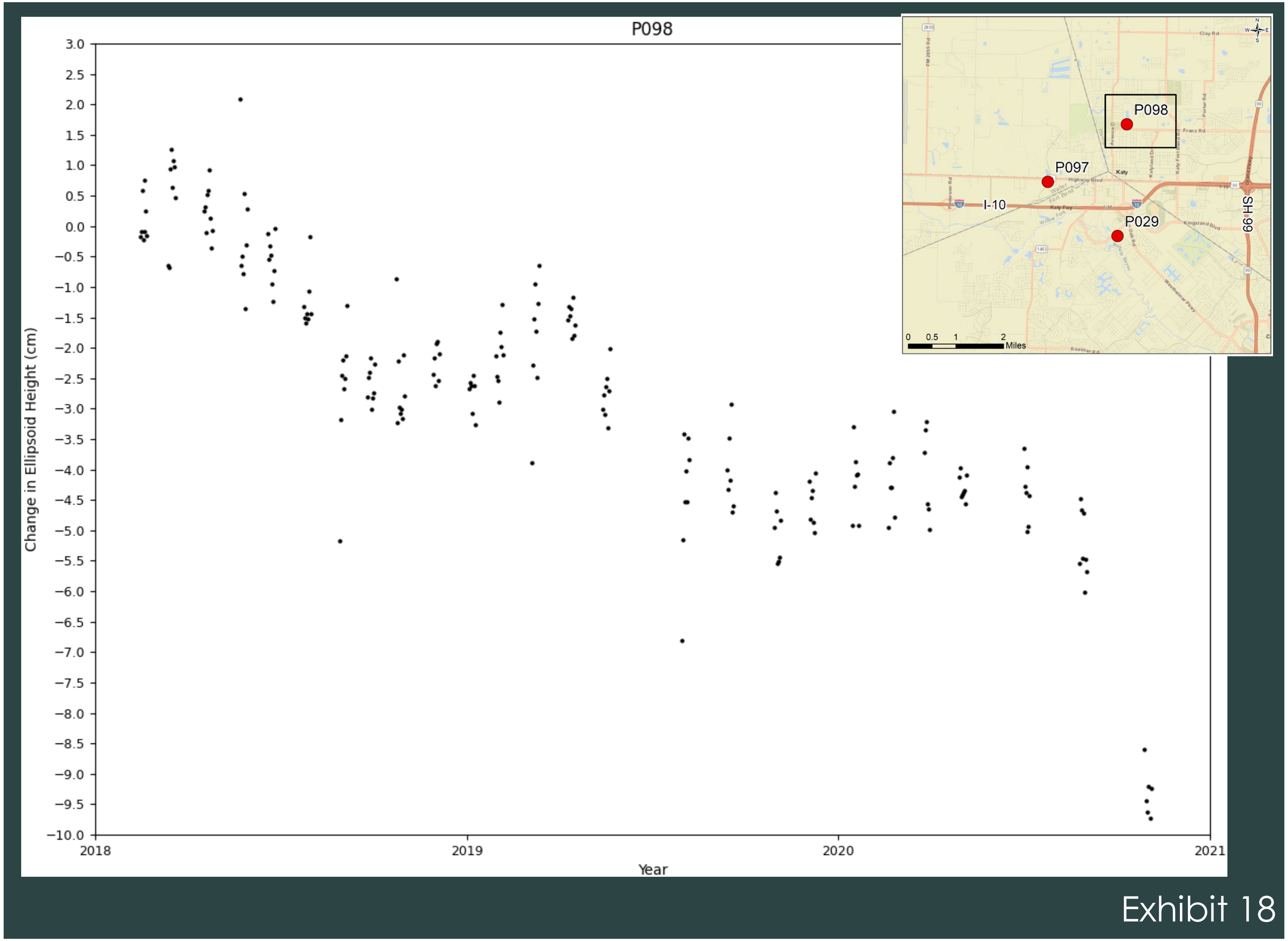


Exhibit 17



P098 Period of Record Plot

GPS station P098, located in Katy, has subsided about 6 cm since 2018.

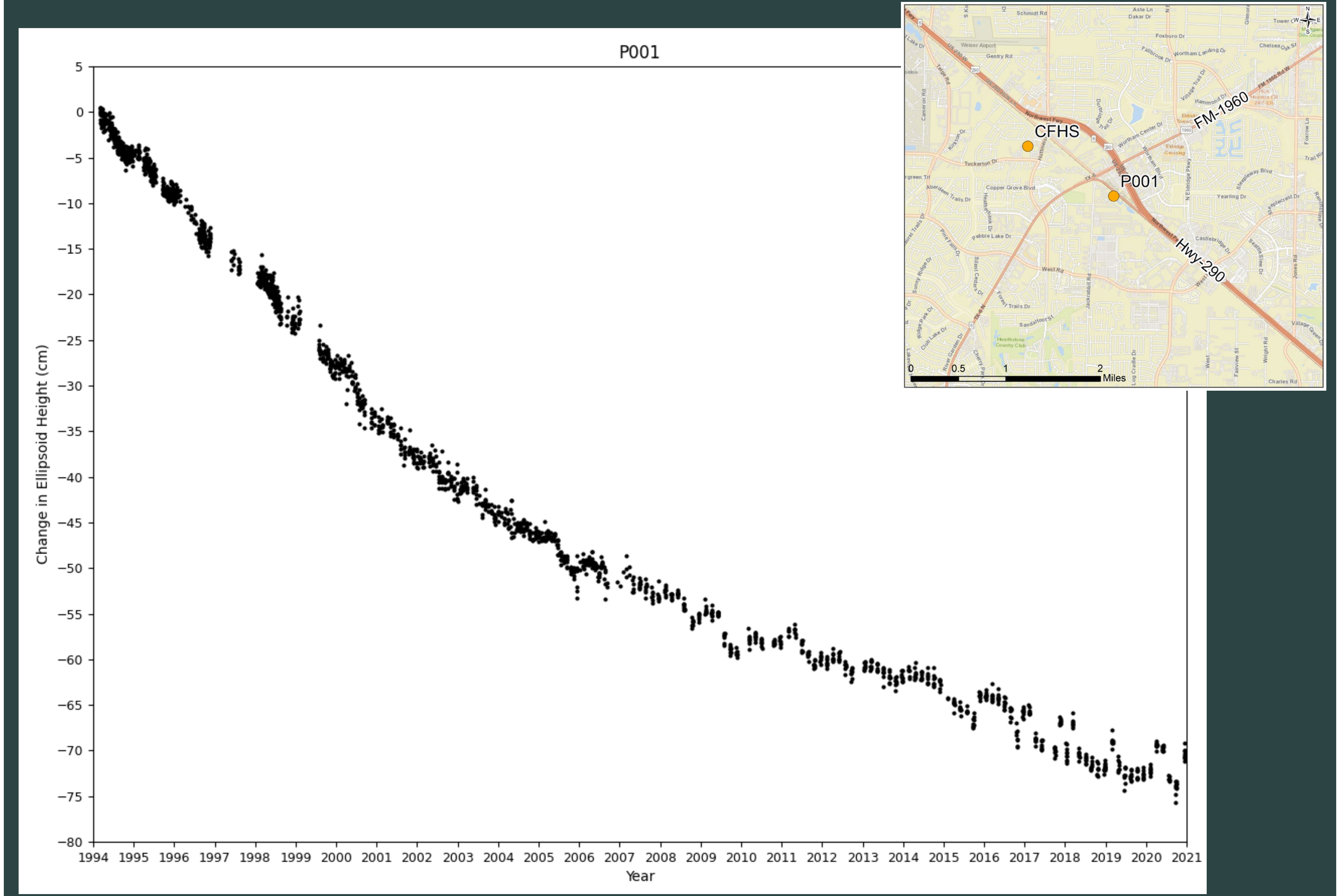


Exhibit 19

P001 Period of Record Plot

GPS station P001, located in Jersey Village, has the greatest subsidence measuring about 71 cm since 1994.

Testimony and Public Comment

- Any person who wishes to appear at the hearing and present testimony, evidence, exhibits or other information may do so in person, by counsel, via email to info@subsidence.org or any combination of these.

HARRIS-GALVESTON SUBSIDENCE DISTRICT

Thank you for attending the Public Hearing for the 2020 Annual Groundwater Report

- Record will be open until May 6, 2021. You may provide comments by sending an email to info@subsidence.org.
- The 2020 Annual Groundwater Report will be presented to the Harris-Galveston Subsidence District Board of Directors on May 12, 2021.
- The 2020 Annual Groundwater Report will be posted on the District's website once approved by the District's Board of Directors.

HARRIS-GALVESTON SUBSIDENCE DISTRICT

2020 ANNUAL GROUNDWATER REPORT

Public Hearing – April 29, 2021

Appendix B – Subsidence Monitoring Network and Data

Table of Contents

List of Figures

Subsidence Monitoring Network

GPS Station Overview

The Harris-Galveston Subsidence District (the District) currently operates and maintains 70 global positioning system (GPS) stations in the greater Houston region with approximately 64 stations located in Harris and Galveston counties and the remaining six stations within Brazoria, Waller, Montgomery, and Chambers counties. Fort Bend Subsidence District (FBSD) operates and maintains 20 GPS stations with 19 stations in Fort Bend County and one in Waller County. Surrounding groundwater conservation districts (GCDs) such as Brazoria County GCD and Lone Star GCD operate and maintain 14 and seven GPS stations, respectively. The University of Houston (UH) operates 69 GPS stations and the Texas Department of Transportation (TXDOT) operates 52 GPS stations spread across southeast Texas. **Figure 1** includes the location and operators of GPS stations within the greater Houston-Galveston area.

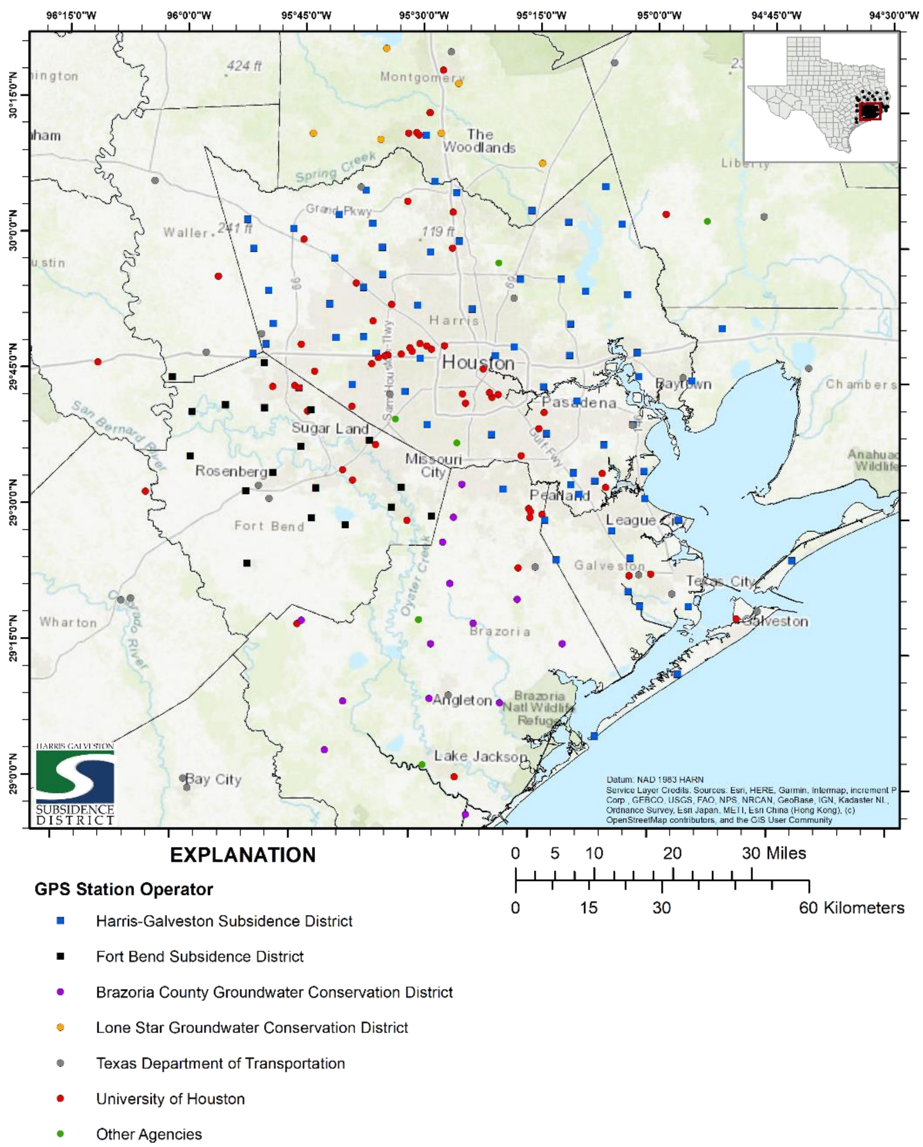


Figure 1: Location of GPS stations designated by operator in the greater Houston region.

The GPS stations are constructed in different ways based on when they were installed and operator preferences. The monitoring types are described in the section below. Two main designs of permanent GPS stations utilized by the District are a periodically measured (PAM) GPS station and an extensometer. Another type of permanent GPS station is a building mount, which is primarily used by UH.

The District designed a permanent GPS station in the mid-1990s to apply a consistent measurement method across multiple counties. This design is known as a PAM and is named after the original port-a-measure method utilized by the District in the early 1990s when the GPS station was not a permanent structure and each location collected data periodically. The PAM design consists of two-inch galvanized pipe drilled approximately 34 feet below ground surface and extends eight feet above the ground surface. The pipe is anchored in a concrete plug at the base and enclosed by centering bands and PVC pipe near the surface to reduce movement. The exposed pipe (i.e., the section of pipe that extends eight-feet above the ground surface) is mounted with an antenna adapter to secure the global navigation satellite system (GNSS) antenna. A separate two-inch pipe is installed within a few feet from the antenna pipe in order to hold an enclosure box, which stores a battery and GNSS receiver, and a mounted solar panel. Both pipes are surrounded by four bollards and encased in a concrete slab for protection. **Figure 2** depicts a schematic of the District's PAM design.

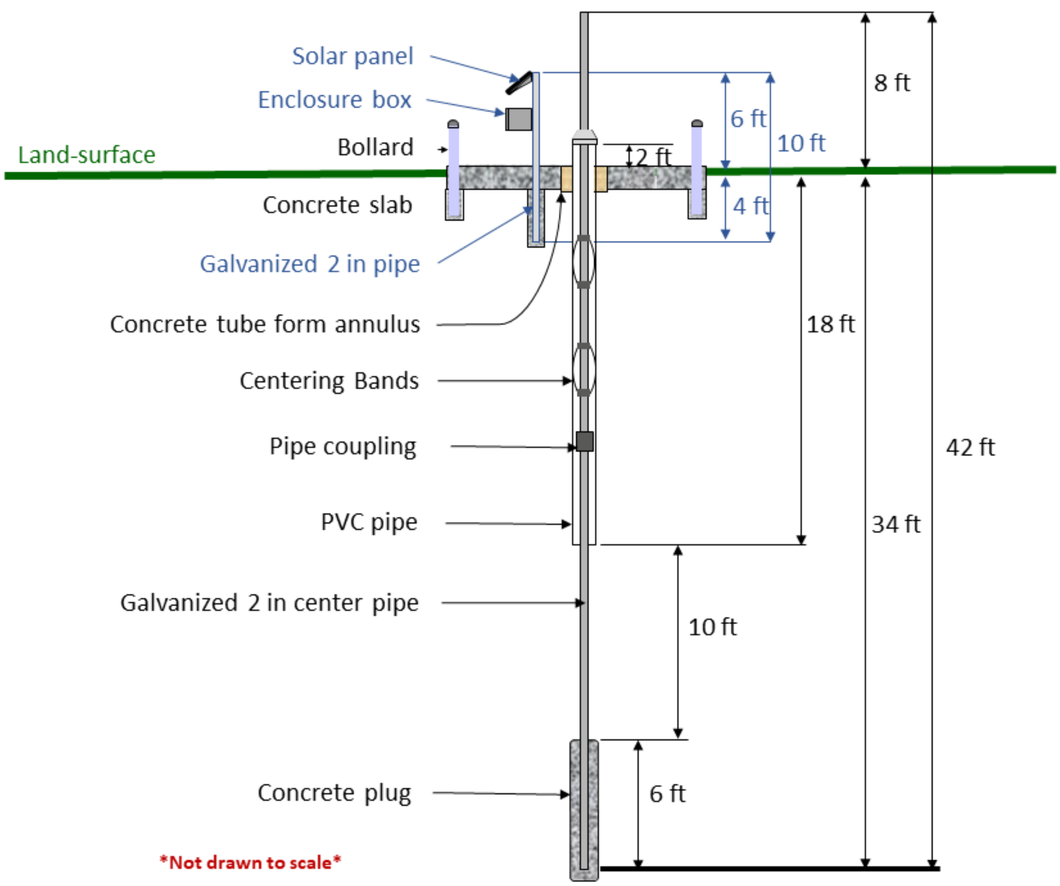


Figure 2: Schematic of the District's PAM design for a permanent GPS station. Note the schematic is not drawn to scale and is intended for visual purposes only. All numbers are provided in US standard measurement.

The USGS operates and maintains 14 borehole extensometers, which are wells drilled to various depths (650 to 3,300 feet below ground surface) and anchored with a concrete plug in order to measure compaction within different aquifers (Kasmarek, et al., 2015). **Figure 3** illustrates the extensometer design that includes an outer casing equipped with slip-joints to maintain well integrity by preventing damage from subsidence and the inner pipe attached to a concrete plug at the bottom of the borehole. Such extensometers use digital recorders, which are connected to the inner pipe, to continuously measure the change between the inner pipe and the land-surface elevation. The District operates four GPS stations (i.e., ADKS, LKHU, NETP, and TXEX) that include a GNSS antenna mounted on the extended inner pipe.

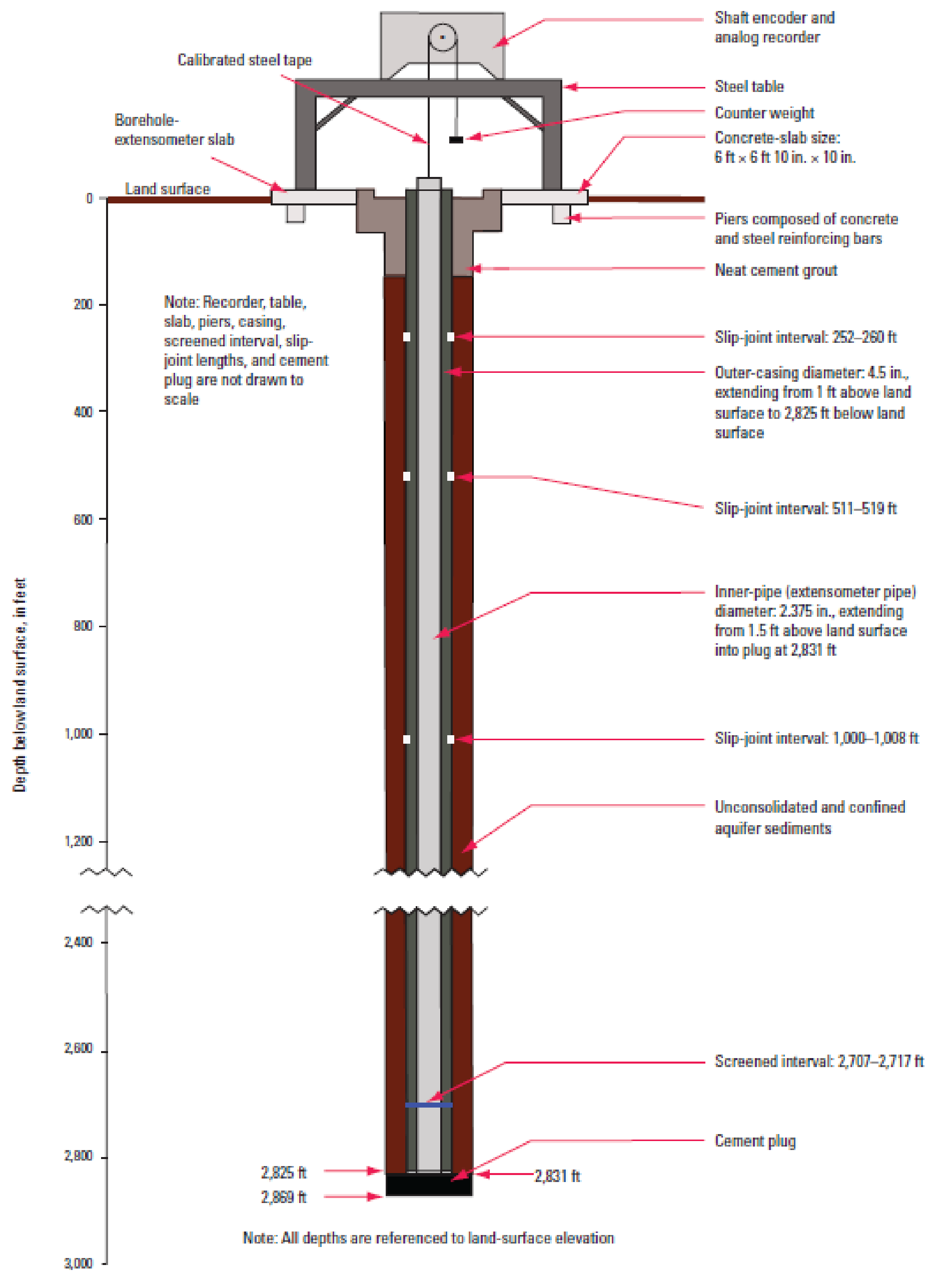


Figure 3: Cross-sectional view of an extensometer adapted from (Kasmarek, et al., 2016).

The building mount is another design for a GPS station. Building mounts have a GNSS antenna mounted on or near the building's roof. Buildings with deep foundation as well as clear sky views are selected as optimal locations to measure land-surface elevation change and limit interference. This building mount design is used by UH throughout the greater Houston area.

Subsidence Monitoring Types

GPS data are collected at each of the GPS stations every thirty seconds during the duration of monitoring, which varies from periodic to continuous. The District operates both periodic and continuous monitoring GPS stations. Other operators, such as UH and TXDOT, operate continuous monitoring stations.

Periodic monitoring stations collect GPS data for approximately seven days every two months at the GPS station. These stations are constructed in the PAM design and use a Trimble GNSS antenna and receiver to gather land-surface data.

Continuous monitoring stations collect GPS data every day of the year and some are designated as continuously operating reference stations (CORS). CORS are designed in two ways: 1) the PAM design or 2) mounted on preexisting structures. The District operates seven CORS (i.e., P026, P034, P043, P049, P080, P081, and YORS) that are constructed in the PAM design. Additionally, the District operates four CORS (i.e., ADKS, LKHU, NETP, and TXEX) that are mounted to the extended inner stem of an extensometer.

Subsidence Data

As of 2020, the District uses GPS data from 256 GPS stations spread across 30 counties in southeast Texas. The District collects GPS data from other agencies like FBSD, Brazoria County GCD, Lone Star GCD, and TxDOT as well as the UH to understand local to regional subsidence trends.

The GPS data collected by the District measure the land-surface as a three-component displacement time series involving the horizontal (East-West), vertical (North-South), and the ellipsoidal height (up-down) components. GPS data are processed and converted to the Stable Houston Reference Frame 2020 (Houston20). The subsidence rate of a GPS station is estimated using the linear regression of the most recent five-year GPS observation data (i.e., 2016-2020), at stations that have a minimum of three years of data.

The collaboration between the District, UH, FBSD, Brazoria County GCD, and Lone Star GCD creates a subsidence monitoring network in the Harris-Galveston area. Additionally, GPS stations, which are operated by TXDOT, are located in the outer surrounding counties to establish the stable Houston reference frame and also provide more coverage across the region. **Figure 4** depicts the subsidence monitoring network with a map identification number for each GPS station and two map insets to provide greater detail in the denser areas. Additional information for each map identification number is included as a table within **Appendix C.**

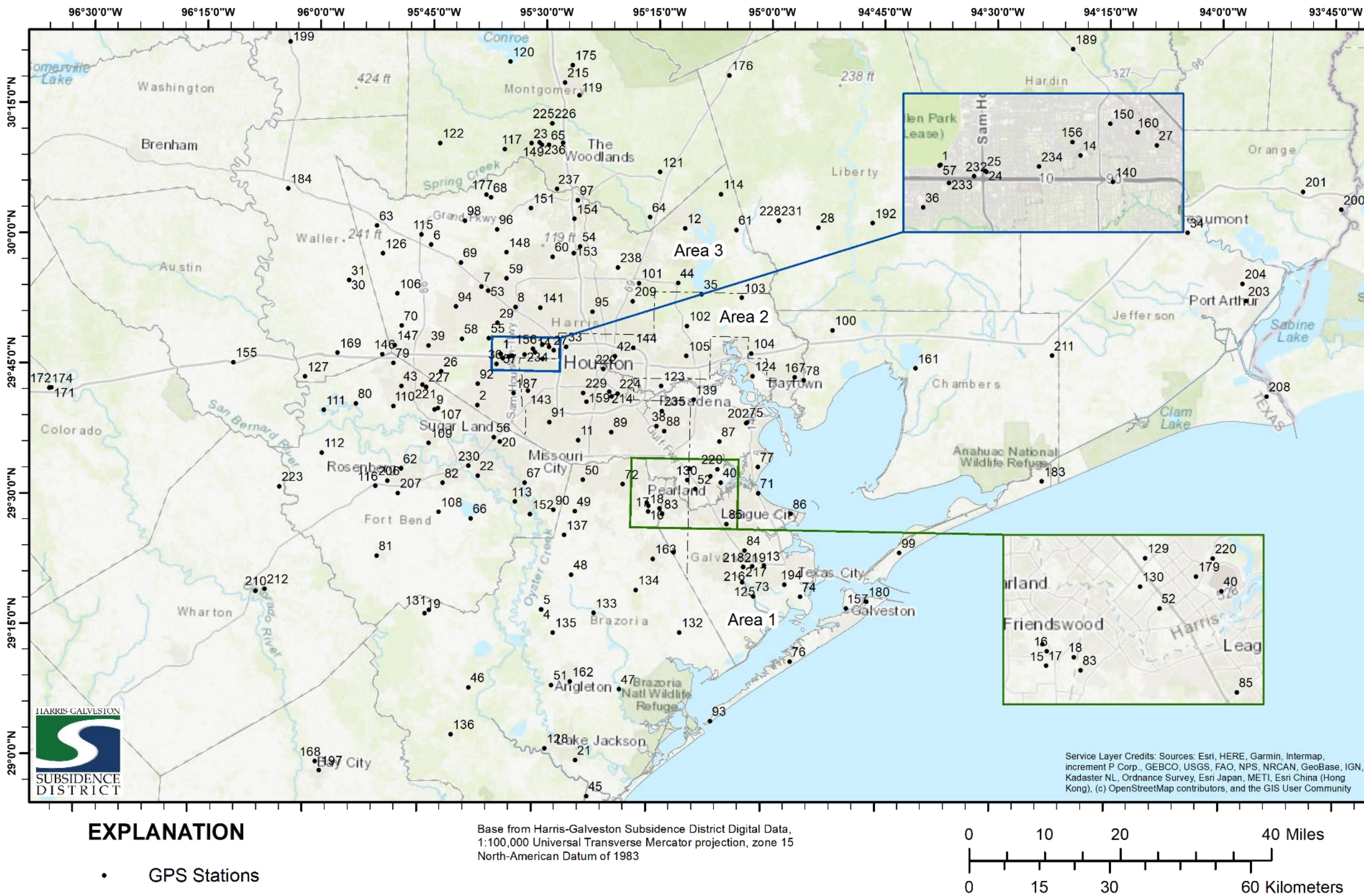


Figure 4: Location and map identification number of GPS stations that monitor periodically or continuously within Harris and surrounding Counties, Texas, 2020. The map insets show the map identification number of the higher density areas to provide greater detail.

Regulatory Area One

Regulatory Area One achieved full regulatory level conversion in 1990. GPS stations have been operating since 1996 within this area to measure subsidence. Regulatory Area One contains 32 GPS stations and has a maximum subsidence rate of 0.83 cm per year. There are 12 GPS stations that show uplift ranging from 0.02 cm per year to 0.69 cm per year of uplift. **Figure 5** displays the GPS stations in Regulatory Area One with labels identifying the name of each station.

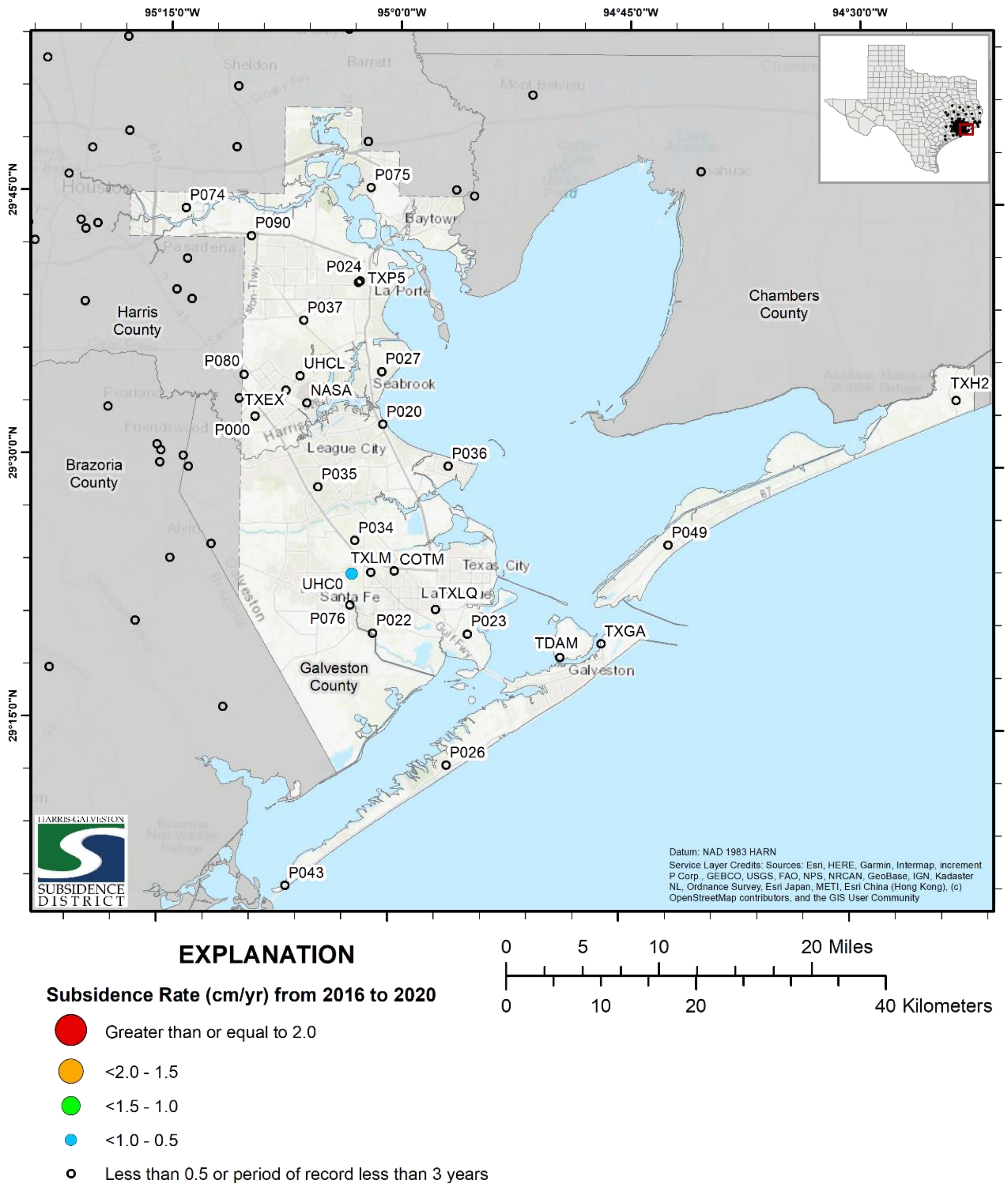


Figure 5: Annual subsidence rate in cm per year estimated from periodic and continuous GPS data measured from GPS stations within Regulatory Area One in Harris and Galveston Counties, Texas, 2016-2020.

Approximately 97 percent of GPS stations in Regulatory Area One have experienced uplift or remained stable (i.e., subsidence rate below 0.5 cm per year) based upon the 2016-2020 annual subsidence rate. GPS station P035, which is located in Dickinson, shows a gradually increasing trend and a subsidence rate of 0.06 cm per year (**Figure 6**).

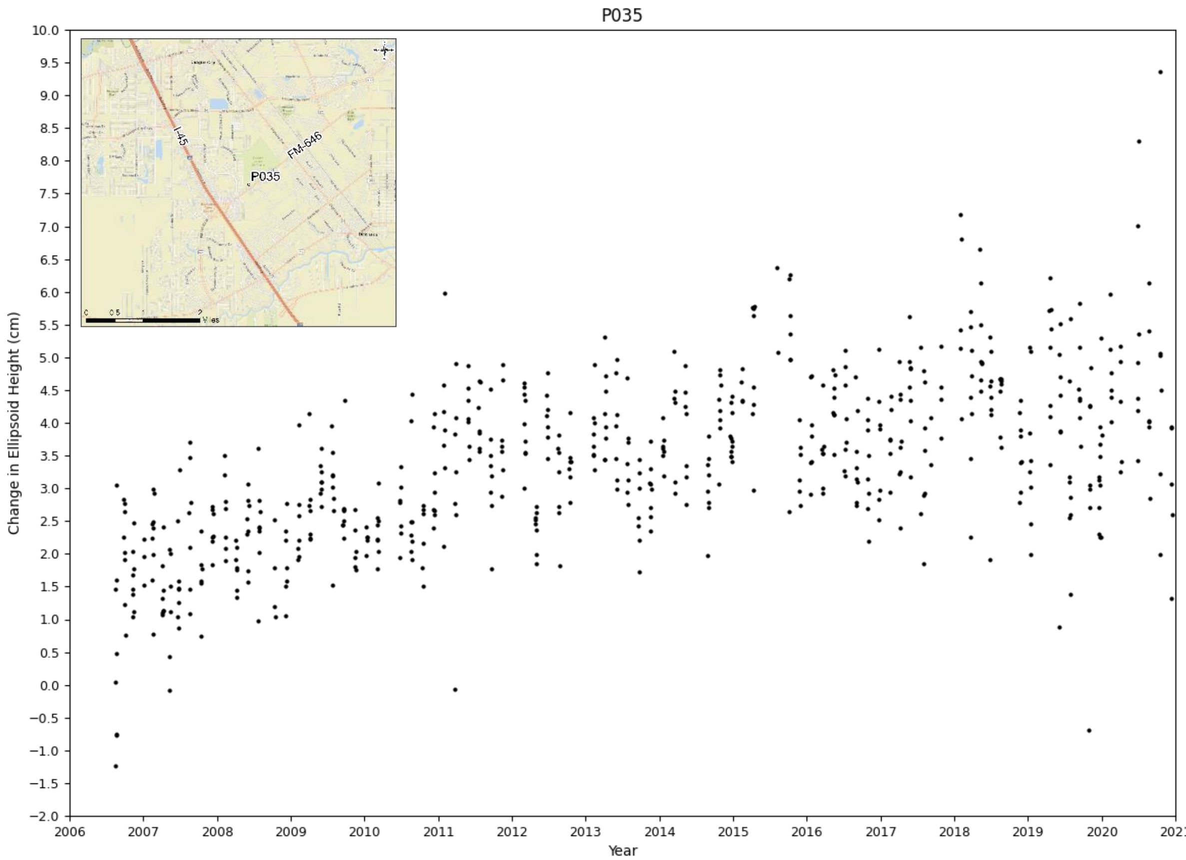


Figure 6: Period of record data for GPS station P035 located in Dickinson, Texas. Inset map shows the location of P035, which is the black circle east of I-45 and north of FM-646.

Regulatory Area Two

Regulatory Area Two achieved full regulatory level conversion in 1995. GPS stations have been operating since 1993 within this area to measure subsidence. Regulatory Area Two contains 26 GPS stations and have a maximum subsidence rate of 1.31 cm per year. There are 12 GPS stations that show uplift with the rate of change ranging from 0.01 cm per year to 1.13 cm per year of uplift. **Figure 7** displays the GPS stations in Regulatory Area Two with labels identifying the name of each station.

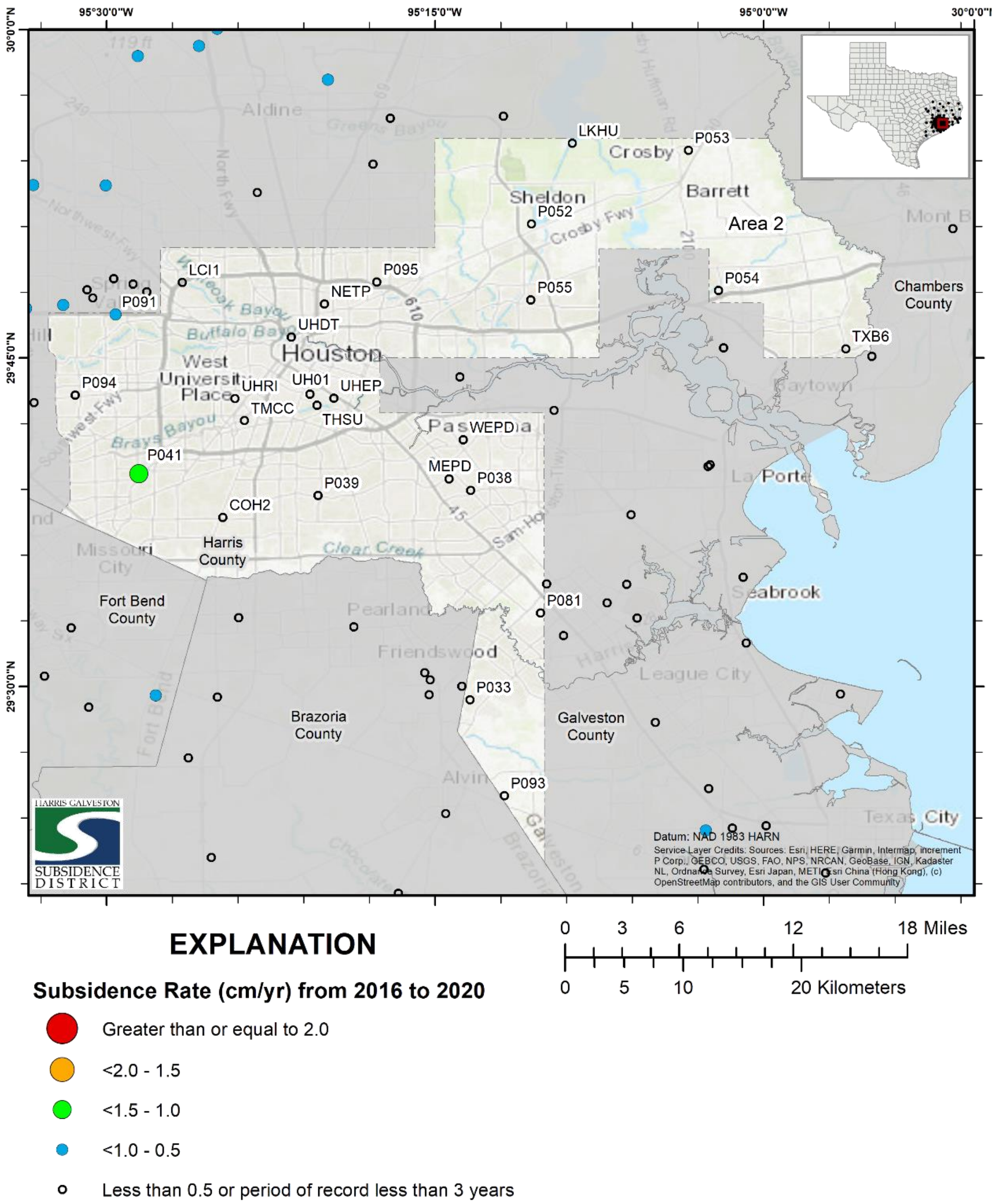


Figure 7: Annual subsidence rate in cm per year estimated from periodic and continuous GPS data measured from GPS stations within Regulatory Area Two in Harris and Galveston Counties, Texas, 2016-2020.

Approximately 92 percent of GPS stations in Regulatory Area Two have remained relatively stable or experienced minor uplift based upon the 2016-2020 annual subsidence rate. GPS station P041 located in the Westbury neighborhood (Brays Oak district in southwest Houston) shows a relatively stable rate from 2007 to 2015, a decline beginning in 2016, and then a flattening in 2019 to present (**Figure 8**). P041 has measured approximately 5.6 cm of subsidence since 2007 with an annual subsidence rate of 1.31 cm per year.

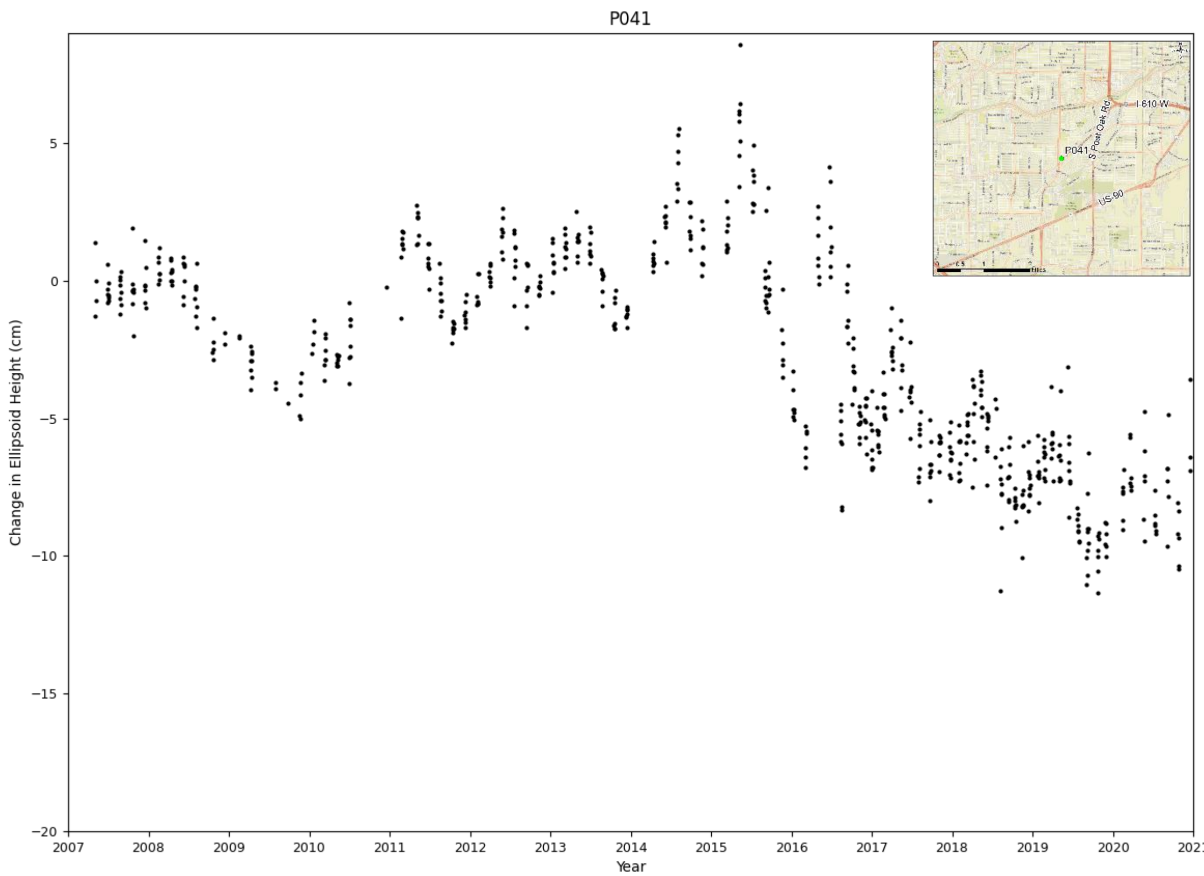


Figure 8: Period of record data for GPS station P041 located in the Westbury neighborhood (Brays Oak district in Southwest Houston) from 2007 to 2020. P041 measured 5.6 cm of subsidence since 2007 with an annual subsidence rate of 1.31 cm/yr.

Regulatory Area Three

Regulatory Area Three has not been fully converted; although some entities such as the City of Houston and Regional Water Authorities have been transitioning to alternative water sources since 2010. Regulatory Area Three contains 54 GPS stations and has a maximum subsidence rate of 2.35 cm per year. **Figure 9** displays the GPS stations in Regulatory Area Three with labels identifying the name of each station.

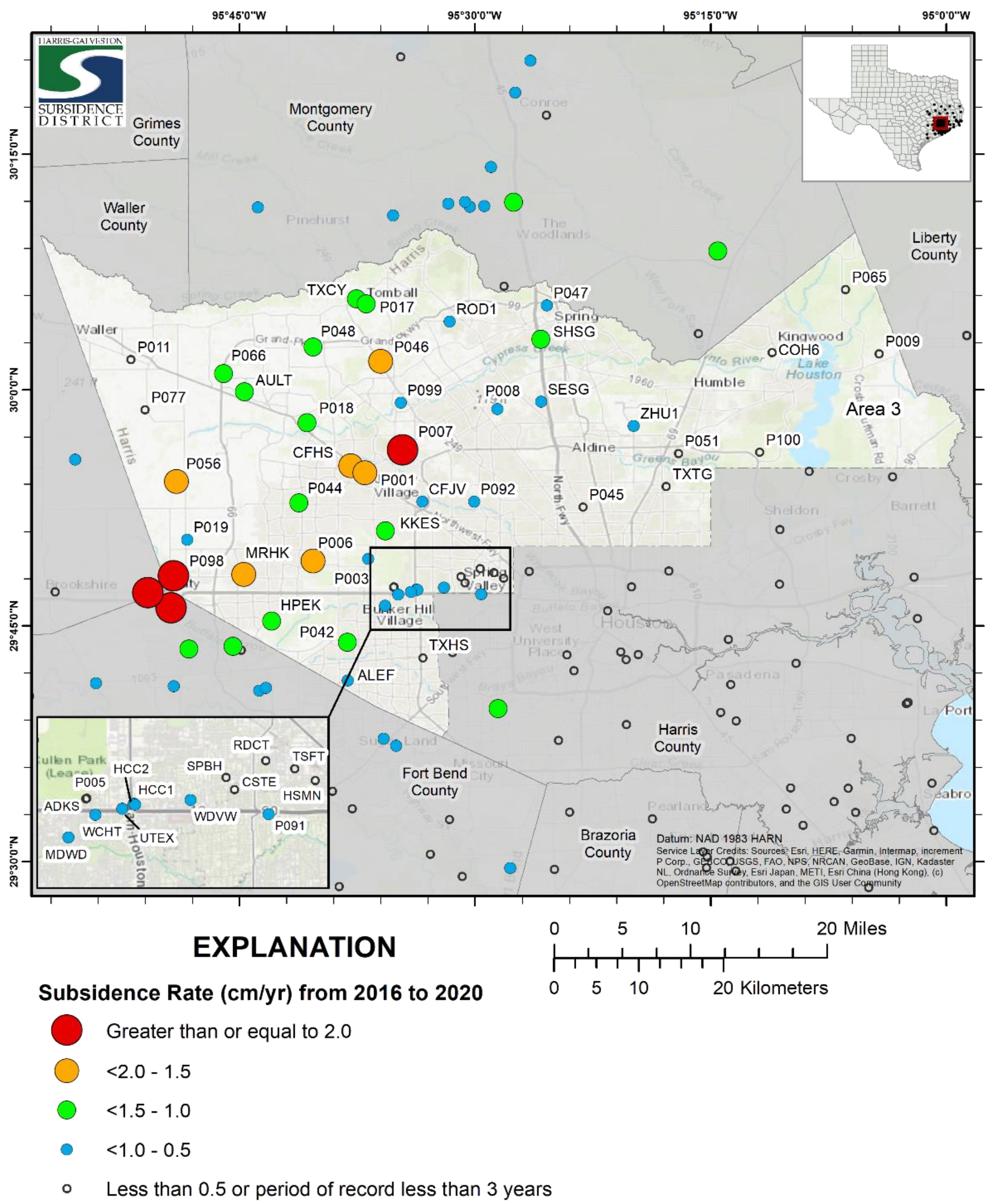


Figure 9: Annual subsidence rate in cm per year estimated from periodic and continuous GPS data measured from GPS stations within Regulatory Area Three in Harris and Galveston Counties, Texas, 2016-2020.

Approximately 69 percent of GPS stations in Regulatory Area Three have measured subsidence greater than 0.5 cm per year. GPS station P098, which is located in Katy, has measured the highest subsidence rate in Harris County at 2.35 cm per year in Regulatory Area Three. As displayed in **Figure 10**, the GPS data for P098 show a generally declining trend with minor seasonal variation.

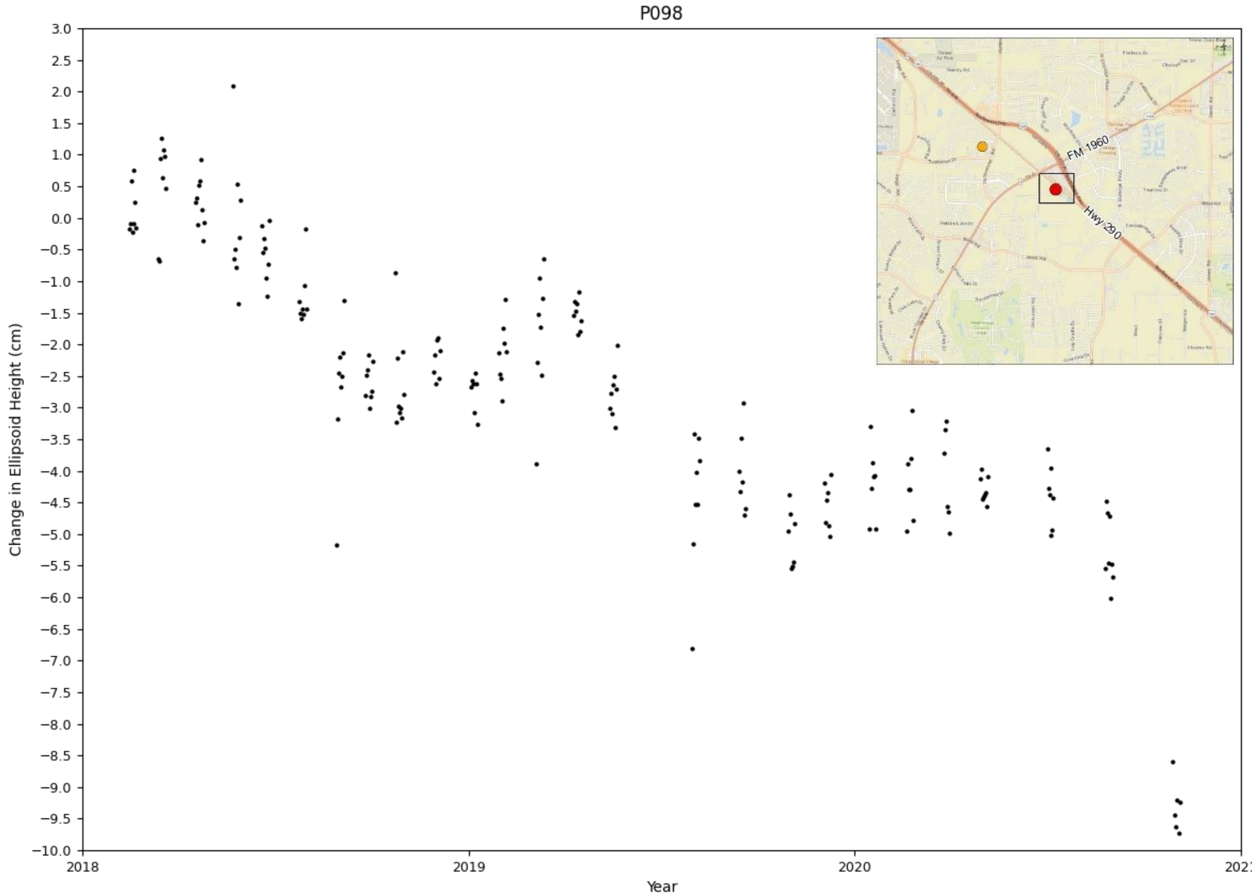


Figure 10: Period of record data from GPS station P098 located in Katy, Texas, 2018-2020. P098 measured 5.7cm of subsidence since 2018 and an annual subsidence rate of 2.35 cm/yr. Inset map shows the location of P098, the red circle in the black box northwest of the intersection between SH 99 and I-10.

GPS station P001, located in Jersey Village, has measured the greatest total subsidence with approximately 71 cm over 26 years. **Figure 11** contains the period of record plot for P001 that shows a consistently declining trend since monitoring began in 1994. P001 has a subsidence rate of 1.71 cm per year from 2016 to 2020.

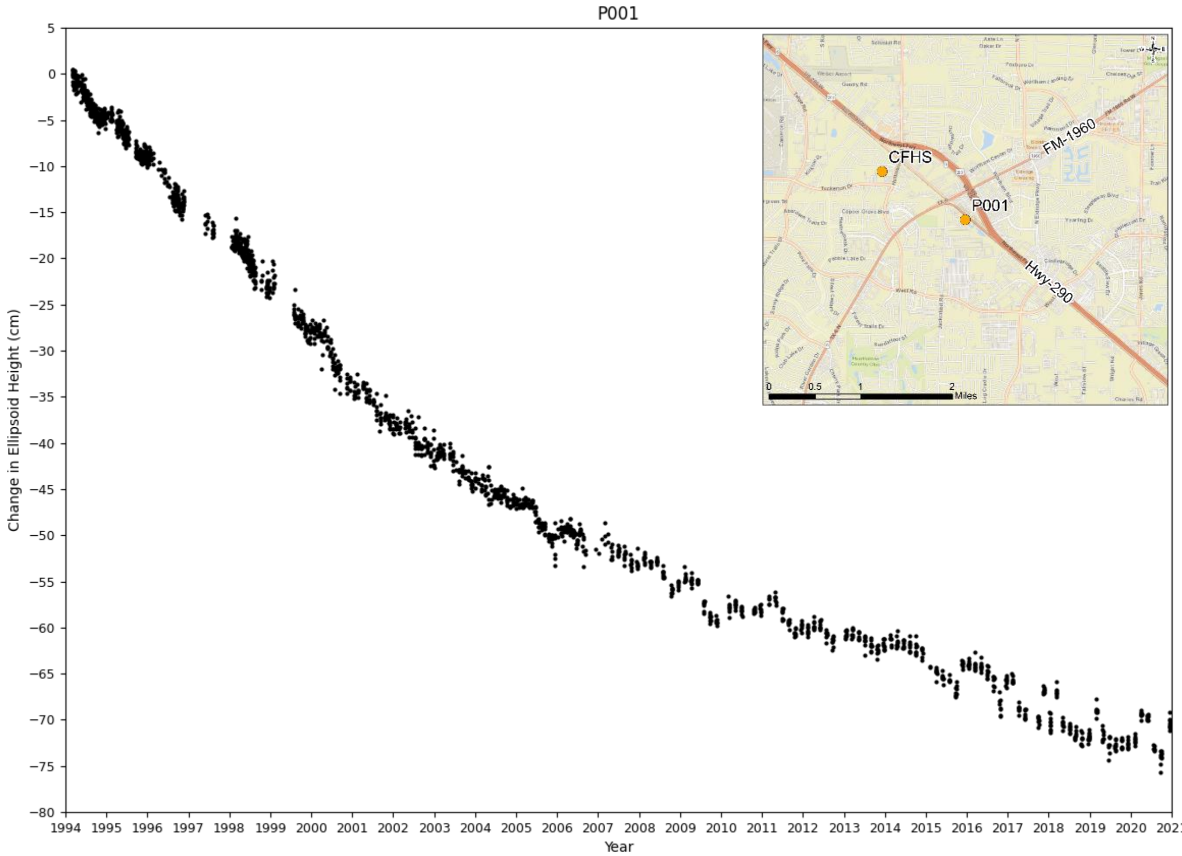


Figure 11: Period of record plot for GPS station P001 located in Jersey Village, Texas, 1994-2020. This station measured 70 cm of subsidence over 26 years and the annual subsidence rate is 1.71 cm per year. The inset map shows the location of P001, the orange circle southwest of the intersection between FM-1960 and Hwy 290.

Surrounding Counties

Counties that surround the District include Brazoria, Fort Bend, Waller, Montgomery, Liberty, and Chambers. The majority of GPS stations in these counties are operated by FBSD and GCDs as well as the UH and TXDOT and their GPS data are included in the subsidence monitoring network. **Figure 12** displays the GPS stations located in the surrounding counties.

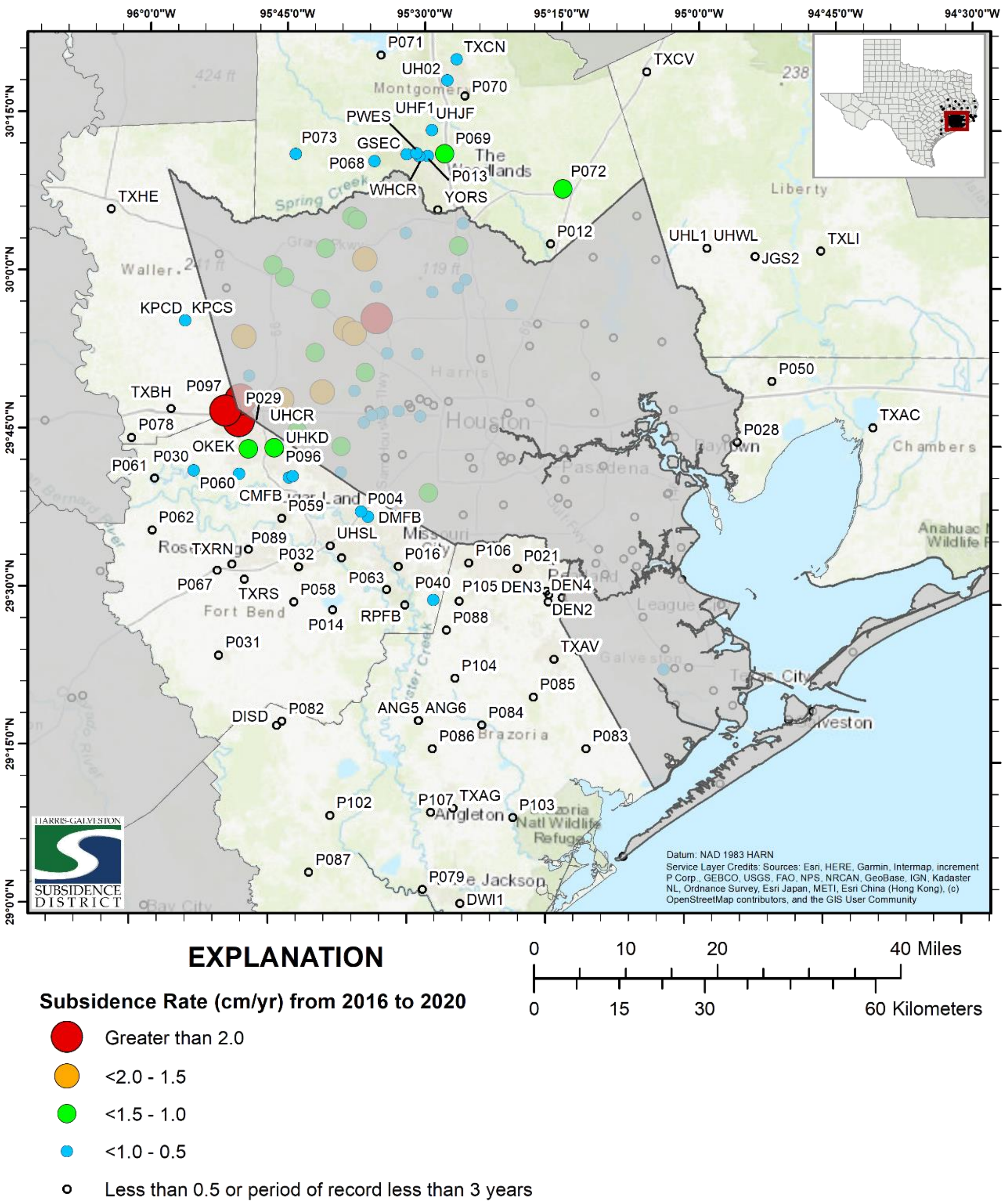


Figure 12: Annual subsidence rate in cm per year estimated from periodic and continuous GPS data measured from GPS stations within Brazoria, Fort Bend, Waller, Montgomery, Liberty, and Chambers Counties, Texas, 2016-2020.

Fort Bend County contains 29 GPS stations operated by Fort Bend Subsidence District, UH, and TXDOT. Approximately 34 percent of these stations have measured subsidence greater than 0.5 cm per year. GPS station P029, located in Katy, has the highest subsidence rate at 2.16 cm per year in Fort Bend County. Since monitoring began in 2007, P029 has measured 21.47 cm of subsidence (**Figure 13**).

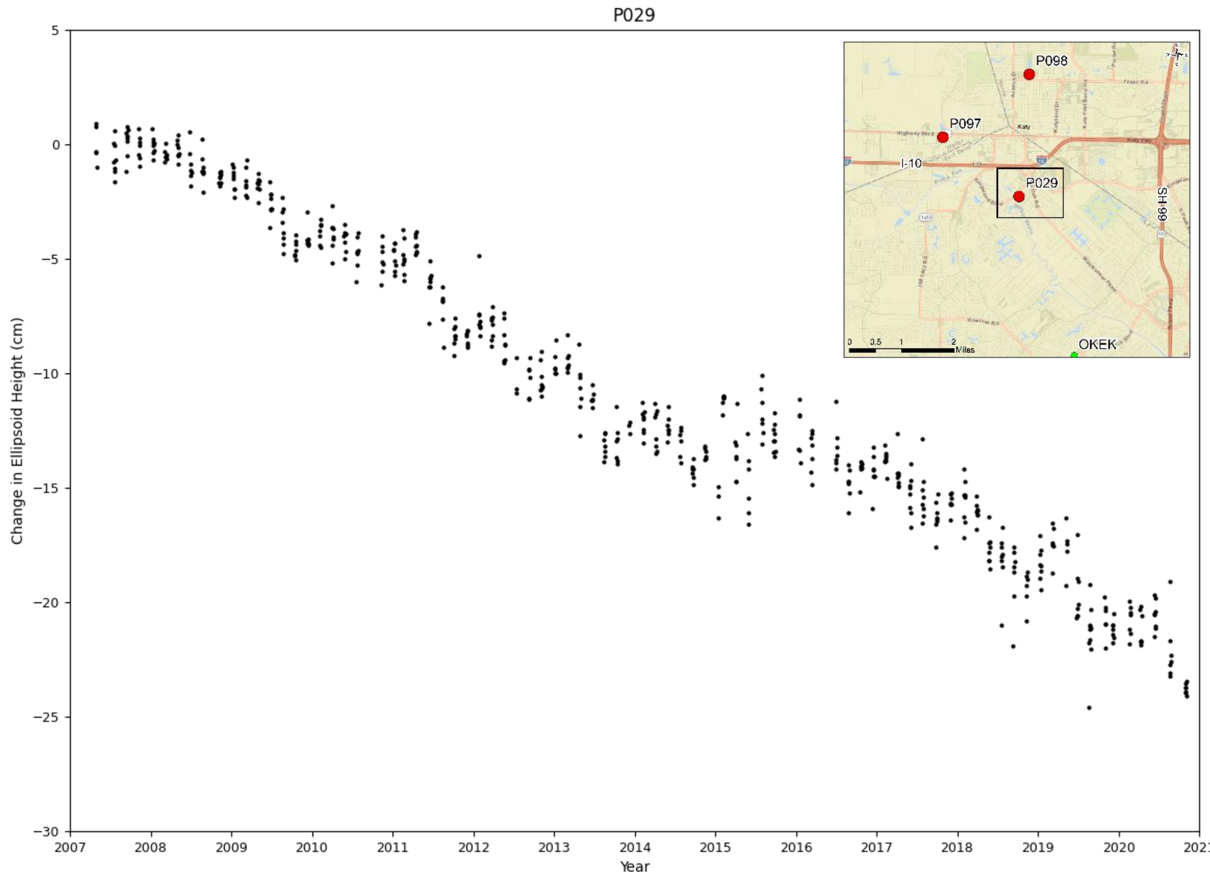


Figure 13: Period of record plot for P029 located in Katy, Texas, 2007 to 2020. This site measured 21.47 cm of subsidence over 13 years and the annual subsidence rate is 2.16 cm per year. The inset map shows the location of P029, the red circle in the black bounding box.

Montgomery County contains 16 GPS stations operated by the LSGCD, the UH, the District, and TXDOT. Roughly 69 percent of these stations have measured a subsidence rate greater than 0.5 cm per year. GPS station P072, located in New Caney, has the highest subsidence rate at 1.08 cm per year in Montgomery County. Since monitoring began in 2011, P072 has measured 5.8 cm of subsidence (**Figure 14**).

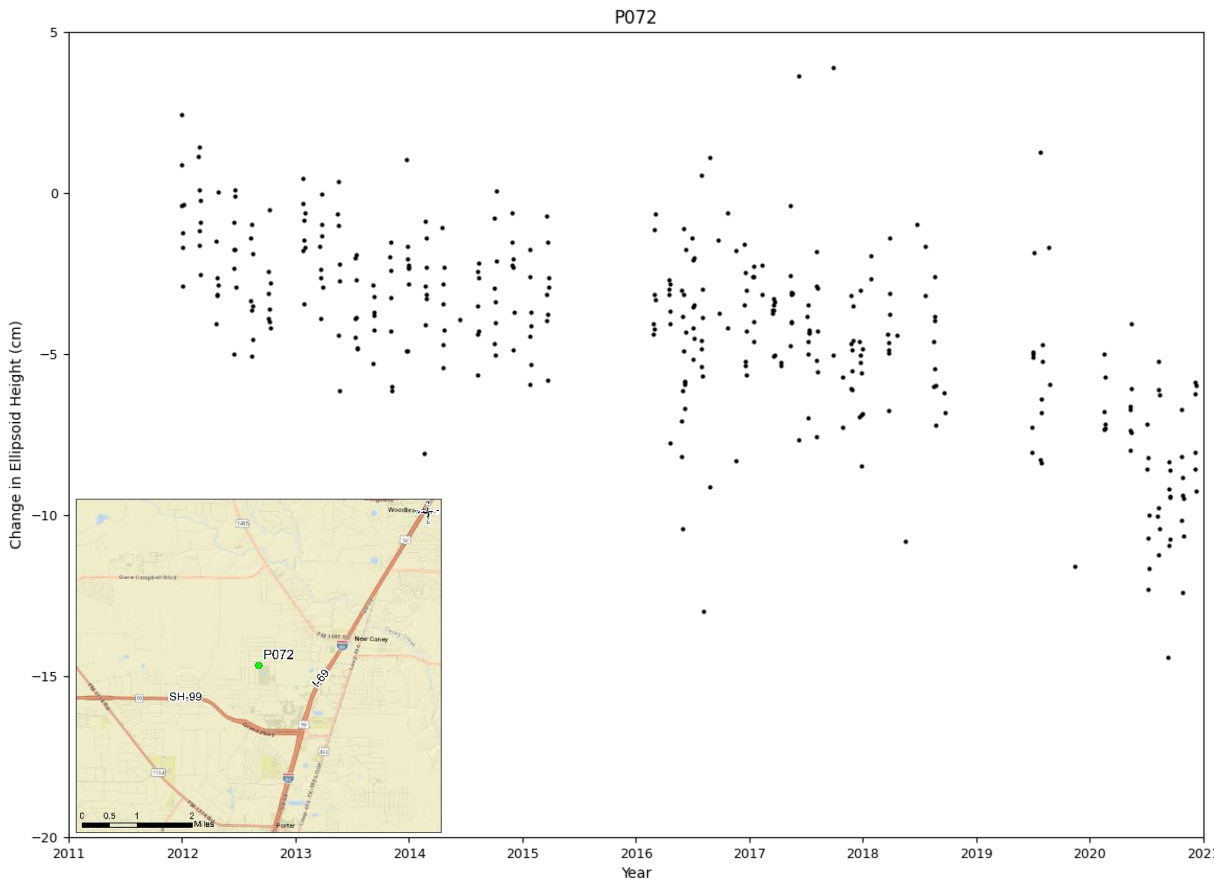


Figure 14: Period of record plot for P072 located in New Caney, Texas, 2011-2019. This station measured 5.8 cm of subsidence over 9 years and the annual subsidence rate is 1.08 cm per year. The inset map shows the location of P072, the green circle northwest of the intersection between Grand Parkway (SH-99) and I-69.

Another station in Montgomery County that has measured the greatest total subsidence is P013 located in The Woodlands. P013 has recorded 25.6 cm over 20 years and has a subsidence rate of 0.67 cm per year. GPS station P013 showed a change in the rate in 2015 from a decline to relatively flat trend (**Figure 15**). Alternative water supply began in 2015 in this area of The Woodlands and as such the subsidence trend has remained generally flat from 2015 through 2019.

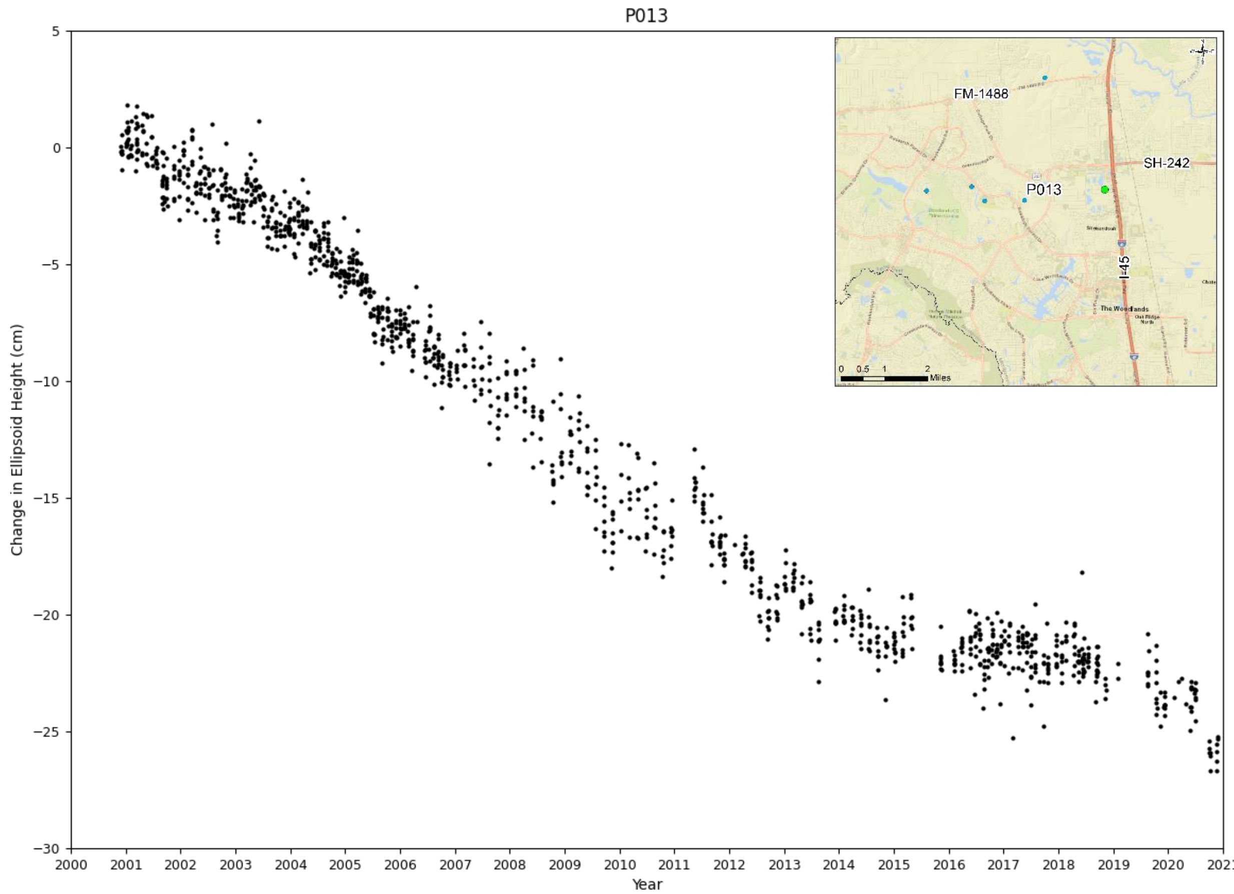


Figure 15: Period of record plot for P013 located in The Woodlands, Texas, 2000-2020. This station measured 25.6 cm of subsidence over 20 years and the annual subsidence rate is 0.67 cm per year. The inset map shows the location of P013, the blue circle southwest of the intersection between SH-242 and I-45.

Brazoria County contains 26 GPS stations operated by Brazoria County GCD, the UH, the District, and TXDOT. The majority of GPS stations in Brazoria County are relatively young (i.e., less than 5 years in operation). All of these stations have remained relatively stable with an annual subsidence rate under 0.5 cm per year. GPS station P021, located in Pearland, has the highest subsidence rate at 0.46 cm per year in Brazoria County. GPS station P085, located in Alvin, displays a trend that is consistently observed in stations throughout Brazoria County and has a subsidence rate of 0.07 cm per year. (**Figure 16**).

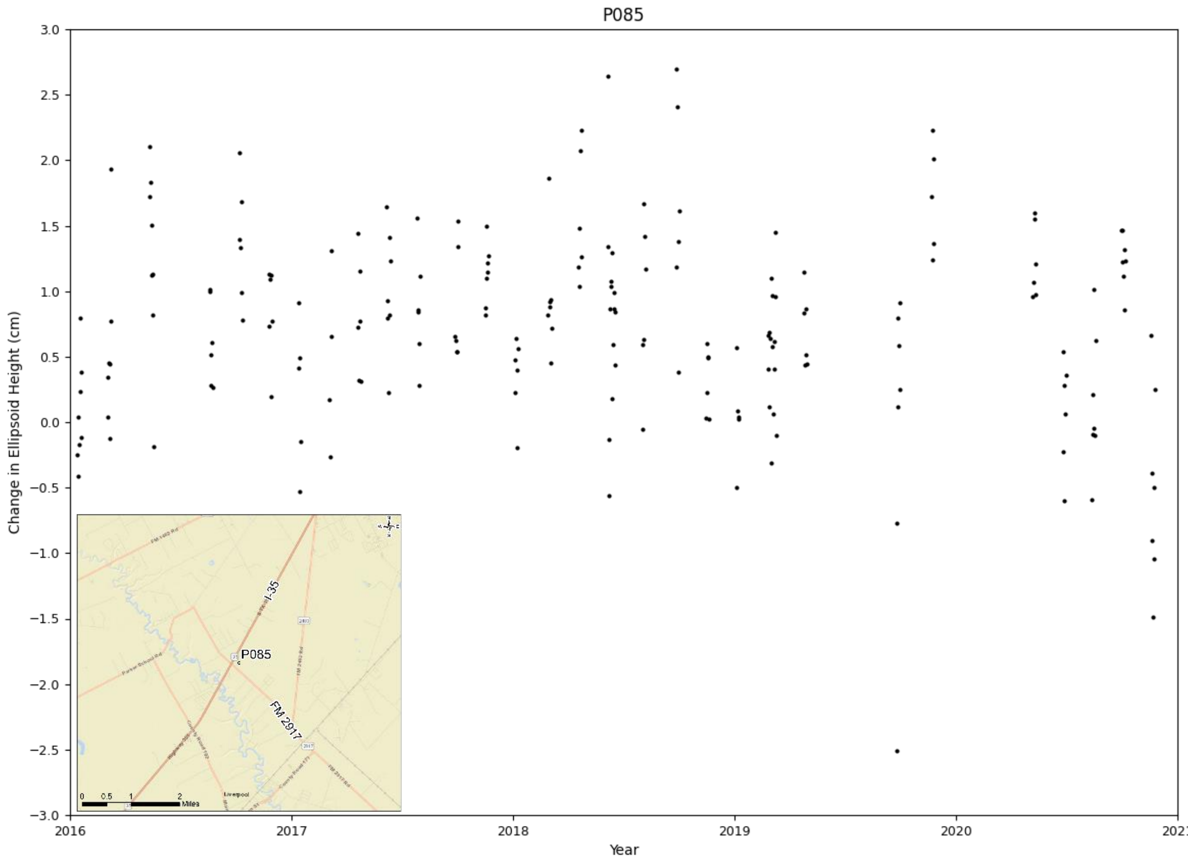


Figure 16: Period of record plot for P085, located in Alvin, Texas 2016-2020. This station measured 0.59 cm of subsidence over 5 years and the annual subsidence rate is 0.07 cm per year. The inset map shows the location of P085, the circle east of the intersection between I-35 and FM-2917.

Other surrounding counties, which include Waller, Liberty and Chambers, show very little subsidence, with observed rates of less than 0.5 cm per year. Waller County contains six GPS stations operated by UH, TxDOT, and the District. In Waller County, roughly 83 percent of these stations have measured subsidence rates under 0.5 cm per year. Waller County also has GPS station P097, which has the highest subsidence rate in the subsidence monitoring network at 3.26 cm per year. Liberty County includes five GPS stations operated by the UH and TXDOT and Chambers County has four GPS stations operated by the District and TxDOT. In Liberty County, 100 percent of the GPS stations have experienced very little subsidence with rates below 0.5 cm per year. Chambers County has approximately 75 percent of GPS stations with subsidence rates below 0.5 cm per year.

GPS station P097, located in Katy, has measured the highest subsidence rate for the entire subsidence monitoring network as well as for Waller County at 3.26 cm per year. Monitoring at P097 began in 2018 and has shown 9 cm of subsidence over three years (**Figure 17**).

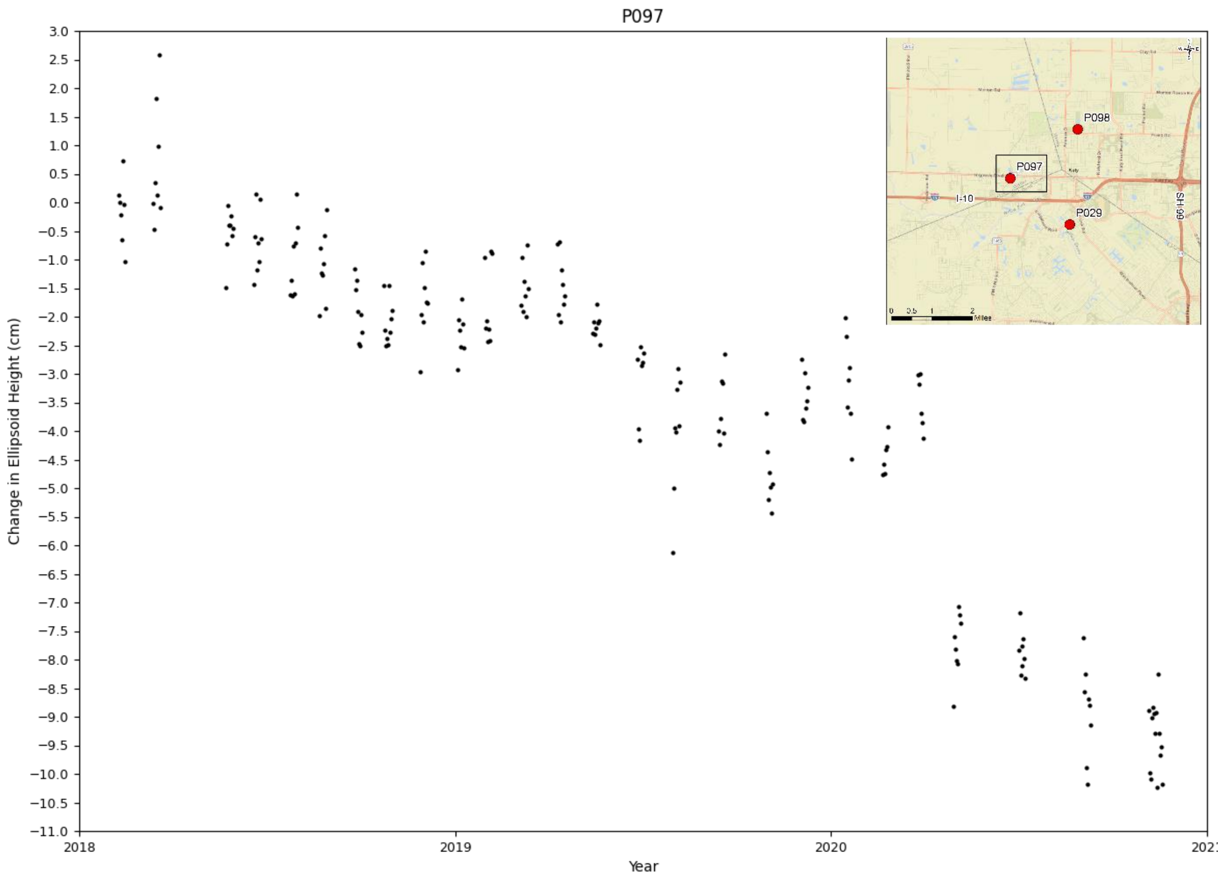


Figure 17: Period of record data for P097, located in Katy, Texas 2018-2020. This station measured 9 cm of subsidence over three years and the annual subsidence rate is 3.26 cm per year. The inset map shows the location of P097, the red circle in the black box north of the intersection between I-10 and Cane Island Parkway.

Appendix C – Period of Record Data

A comprehensive table is provided which includes the Map ID (Figure 1 in Appendix B), GPS station name, coordinates, dates of operation, sample count, total vertical displacement, change in ellipsoidal height over the period of record, and annual rate of change in ellipsoidal height from 2016 to 2020. A period of record plot is also included for each GPS station.

Map ID (Figure 1)	Site Name	Latitude (Decimal degrees)	Longitude (Decimal degrees)	Start of POR (Decimal year)	End of POR (Decimal Year)	Length of POR (Years)	Number of Samples (Days)	Total Vertical Displacement over POR (cm)	Total Change in Ellipsoidal Height over POR (cm)*	Annual Rate of Change in Ellipsoidal Height 2016-2020 (cm)*
1	ADKS	29.79097	-95.58641	1993.52	2021.002	27.482	8068	-1.62	-0.04	-0.03
2	ALEF	29.69183	-95.63505	2014.259	2021.043	6.784	2478	-3.88	-0.75	-0.62
3	ALVN	29.40066	-95.27762	2012.463	2017.24	4.778	1714	-1.79	-0.32	0
4	ANG5	29.30148	-95.48508	2003.447	2019.518	16.071	5148	-4.44	-0.25	-0.18
5	ANG6	29.30165	-95.48487	2003.428	2019.518	16.09	5260	-4.31	-0.2	-0.02
6	AULT	29.99777	-95.74467	2015.557	2021.043	5.487	1937	-5.49	-1.04	-1.07
7	CFHS	29.91923	-95.63193	2015.595	2021.043	5.448	1936	-8.2	-1.5	-1.51
8	CFJV	29.88165	-95.55584	2015.773	2021.043	5.27	1925	-4.61	-0.88	-0.87
9	CMFB	29.68136	-95.72879	2014.409	2021.043	6.634	2392	-3.46	-0.51	-0.5
10	COH1	29.67034	-95.54261	2009.019	2017.719	8.701	2734	-2.98	-0.16	0
11	COH2	29.62853	-95.41161	2009.005	2021.043	12.038	3908	-2.48	-0.06	-0.25
n/a	COH3	29.64345	-95.26303	2004.249	2008.884	4.635	913	0.76	0.29	n/a
n/a	COH4	29.78317	-95.21517	2009.005	2011.691	2.686	739	0.25	0.36	n/a
n/a	COH5	29.84452	-95.27498	2004.274	2007.309	3.036	633	0.4	0.13	n/a
12	COH6	30.03974	-95.18481	2009.005	2015.494	6.489	2084	-4.02	-0.56	0
n/a	COH7	29.87726	-95.49661	2004.249	2008.794	4.545	850	-2.92	-0.8	n/a
13	COTM	29.39384	-94.9982	2015.097	2021.043	5.947	2172	-1.44	-0.27	-0.21
n/a	CSTA	29.79587	-95.5116	2013.147	2015.324	2.177	751	0.08	0.1	n/a
14	CSTE	29.79564	-95.51074	2015.387	2021.043	5.656	2065	-3.01	-0.49	-0.43
15	DEN1	29.51041	-95.25801	2011.778	2020.734	8.955	3137	-2.12	-0.28	-0.26
16	DEN2	29.50488	-95.25396	2011.778	2020.75	8.972	1942	-0.87	-0.1	-0.09
17	DEN3	29.49372	-95.25464	2011.778	2019.666	7.888	2679	0.09	-0.13	-0.03
18	DEN4	29.50023	-95.22964	2015.825	2020.717	4.892	1639	-1.1	-0.09	-0.09
19	DISD	29.28927	-95.74041	2015.48	2021.043	5.563	1895	0.44	0.06	0.1
20	DMFB	29.62265	-95.58374	2014.771	2021.043	6.272	2291	-3.36	-0.69	-0.61
21	DWI1	29.0136	-95.40366	2009.399	2021.043	11.644	3876	-2.24	-0.13	0.04
22	FSFB	29.55618	-95.63045	2014.371	2021.043	6.672	2436	-0.62	-0.13	-0.18
n/a	GAL1	29.32988	-94.73681	1995.745	2003.523	7.778	2734	-2.37	-0.38	n/a
n/a	GAL2	29.33007	-94.73668	2000.055	2003.061	3.006	467	-0.33	0.09	n/a
n/a	GAL7	29.32988	-94.73681	1996.033	2003.521	7.488	2678	-2.76	-0.37	n/a
23	GSEC	30.1973	-95.52809	2015.756	2021.043	5.287	1931	-2.95	-0.7	-0.75
24	HCC1	29.78787	-95.56122	2012.914	2021.043	8.129	2961	-5.18	-0.75	-0.54
25	HCC2	29.78839	-95.56202	2013.139	2020.846	7.707	2639	-6.89	-0.78	-0.53
n/a	HOUS	29.77942	-95.43299	1996.049	2003.022	6.973	1431	-3.77	-0.72	n/a
n/a	HOUX	29.77987	-95.4351	2010.271	2013.988	3.717	824	0.25	-0.42	n/a
26	HPEK	29.75488	-95.71572	2014.396	2020.63	6.234	1643	-8.61	-1.26	-1.24

Map ID (Figure 1)	Site Name	Latitude (Decimal degrees)	Longitude (Decimal degrees)	Start of POR (Decimal year)	End of POR (Decimal Year)	Length of POR (Years)	Number of Samples (Days)	Total Vertical Displacement over POR (cm)	Total Change in Ellipsoidal Height over POR (cm)*	Annual Rate of Change in Ellipsoidal Height 2016-2020 (cm)*
27	HSMN	29.80035	-95.46962	2013.298	2021.043	7.745	2824	-2.9	-0.48	-0.36
28	JGS2	30.04538	-94.89054	2012.463	2021.043	8.58	2856	-0.79	0.01	0.13
29	KKES	29.85033	-95.59493	2015.598	2021.043	5.446	1863	-7.05	-1.16	-1.14
30	KPCD	29.92601	-95.92397	2016.441	2020.846	4.405	1565	-2.63	-0.5	-0.5
31	KPCS	29.92597	-95.92397	2016.441	2020.846	4.405	1417	-2.2	-0.42	-0.42
32	LCBR	30.18236	-96.60192	2010.538	2016.09	5.552	1949	-0.72	-0.13	0
33	LCI1	29.80747	-95.4425	2012.463	2021.043	8.58	2694	-2.37	-0.32	-0.14
34	LGC1	30.0446	-94.07455	2013.531	2020.539	7.009	2558	-0.02	-0.11	-0.01
35	LKHU	29.91346	-95.14576	1994.2	2020.979	26.779	8954	2.03	0.08	0.01
36	MDWD	29.77138	-95.59521	2013.303	2021.043	7.74	2788	-5.69	-0.65	-0.63
37	ME01	29.60754	-95.27571	2015.466	2017.665	2.198	791	-0.8	-0.03	0
38	MEPD	29.65808	-95.23959	2014.04	2021.043	7.003	2558	1.29	0.07	0.06
39	MRHK	29.80414	-95.74515	2014.396	2021.043	6.647	2337	-11.8	-1.67	-1.69
40	NASA	29.55195	-95.09622	2014.201	2020.873	6.672	2337	-0.78	-0.11	-0.01
41	NBRY	30.66643	-96.46705	2012.463	2021.043	8.58	3043	-1.97	-0.1	-0.08
42	NETP	29.79116	-95.33422	1993.517	2020.999	27.482	7704	1.2	0.03	0.12
43	OKEK	29.72503	-95.80331	2014.576	2021.043	6.467	2295	-5.13	-0.92	-1.02
44	P100	29.93405	-95.19815	2019.309	2020.939	1.63	120	0.32	n/a	0
45	P101	28.94458	-95.37812	2019.712	2021.002	1.29	47	0.53	n/a	0
46	P102	29.14871	-95.64084	2019.797	2020.208	0.411	6	-9.5	n/a	0
47	P103	29.15123	-95.31116	2019.714	2021.002	1.287	37	-0.53	n/a	0
48	P104	29.36981	-95.42054	2019.98	2020.98	1	22	-1.34	n/a	0
49	P105	29.4918	-95.41569	2019.654	2020.975	1.32	63	0.95	n/a	0
50	P106	29.55236	-95.3996	2019.693	2020.994	1.301	70	0.11	n/a	0
51	P107	29.15673	-95.45949	2019.616	2020.936	1.32	65	-1.07	n/a	0
52	P000	29.53862	-95.15224	1996.003	2020.266	24.263	1593	-2.05	0	-0.44
53	P001	29.91188	-95.61662	1994.164	2020.958	26.794	2062	-70.15	-2.8	-1.71
54	P002	30.00065	-95.41587	1994.318	2020.999	26.682	2048	-63.25	-2.51	-0.7
55	P003	29.82081	-95.61338	1994.328	2020.898	26.569	1643	-55.12	-2.06	-0.78
56	P004	29.63039	-95.59686	1994.66	2020.824	26.164	1928	-27.6	-1.18	-0.68
57	P005	29.79121	-95.58591	1996.698	2020.955	24.257	1610	-30.27	-1.36	-0.05
58	P006	29.8185	-95.67189	2014.274	2020.901	6.627	308	-10.54	-1.78	-1.86
59	P007	29.9363	-95.57665	1999.115	2019.961	20.846	1319	-60.25	-2.71	-2.17
60	P008	29.97968	-95.47627	1999.61	2020.999	21.389	1300	-38.45	-1.76	-0.59
61	P009	30.03812	-95.07147	1999.345	2020.898	21.553	1381	-5.66	-0.2	-0.12
62	P010	29.56639	-95.79918	1999.266	2020.92	21.654	1622	-7.33	-0.4	-0.34

Map ID (Figure 1)	Site Name	Latitude (Decimal degrees)	Longitude (Decimal degrees)	Start of POR (Decimal year)	End of POR (Decimal Year)	Length of POR (Years)	Number of Samples (Days)	Total Vertical Displacement over POR (cm)	Total Change in Ellipsoidal Height over POR (cm)*	Annual Rate of Change in Ellipsoidal Height 2016-2020 (cm)*
63	P011	30.03216	-95.86523	1999.342	2020.999	21.657	1448	-11.34	-0.58	-0.25
64	P012	30.0597	-95.26308	2000.895	2020.769	19.874	1297	-11.71	-0.59	-0.44
65	P013	30.19481	-95.48999	2000.914	2020.898	19.984	1247	-25.64	-1.36	-0.67
66	P014	29.47366	-95.64411	2000.879	2020.958	20.079	1164	-4.72	-0.3	-0.04
67	P016	29.54446	-95.52724	2000.86	2020.802	19.943	1217	-6.3	-0.4	0.04
68	P017	30.09116	-95.6153	2000.895	2020.996	20.101	1173	-33.13	-1.84	-1.3
69	P018	29.96493	-95.67823	2000.862	2020.556	19.693	1181	-35.66	-1.85	-1.3
70	P019	29.84112	-95.80535	2000.892	2020.846	19.953	1085	-18.84	-0.92	-0.89
71	P020	29.53291	-95.01324	2002.041	2021.002	18.961	1143	-0.54	-0.01	-0.16
72	P021	29.54547	-95.31208	2002.082	2020.936	18.854	1083	1.88	-0.22	-0.46
73	P022	29.33452	-95.02071	2002.041	2020.991	18.95	1100	-3.98	-0.17	-0.31
74	P023	29.33508	-94.91778	2002.06	2020.994	18.934	1169	1.82	0.14	0.02
75	P024	29.6688	-95.04078	2002.118	2020.898	18.78	1131	4.48	0.21	0.43
76	P026	29.21032	-94.93833	2002.194	2020.958	18.764	2191	-1.25	0	-0.15
77	P027	29.58314	-95.01555	2002.367	2020.881	18.515	1099	-4.41	-0.25	-0.42
78	P028	29.75122	-94.91763	2002.194	2020.977	18.783	1077	1.47	0.1	0.51
79	P029	29.76902	-95.82219	2007.32	2020.843	13.523	622	-21.47	-1.64	-2.16
80	P030	29.68925	-95.90192	2007.35	2020.862	13.512	606	-5.19	-0.39	-0.66
81	P031	29.39802	-95.84838	2007.35	2020.958	13.608	616	2.42	0.18	-0.39
82	P032	29.5406	-95.70731	2007.35	2020.939	13.589	624	-0.32	-0.01	-0.06
83	P033	29.48991	-95.22357	2006.323	2020.939	14.616	759	-1.42	-0.15	-0.13
84	P034	29.42219	-95.04167	2010.353	2020.996	10.643	3722	-3.06	-0.39	-0.15
85	P035	29.47262	-95.08244	2006.621	2020.493	13.871	616	3.92	0.24	0.06
86	P036	29.49418	-94.94163	2006.966	2021.002	14.036	656	-0.55	-0.17	-0.36
87	P037	29.63071	-95.10101	2007.37	2020.884	13.515	676	4.54	0.34	0.1
88	P038	29.64927	-95.22295	2007.356	2020.92	13.564	680	5.17	0.2	-0.3
89	P039	29.64525	-95.33928	2011.093	2020.917	9.824	478	1.8	0.13	-0.09
90	P040	29.4933	-95.4625	2007.353	2020.996	13.643	570	-6.66	-0.55	-0.57
91	P041	29.66191	-95.4755	2007.337	2020.964	13.627	677	-5.61	-0.56	-1.31
92	P042	29.73249	-95.63535	2007.334	2020.936	13.602	639	-7.44	-0.63	-1.12
93	P043	29.09325	-95.1106	2006.545	2021.002	14.457	1882	-0.47	-0.04	-0.11
94	P044	29.88013	-95.68686	2007.32	2020.92	13.6	625	-18.72	-1.26	-1.49
95	P045	29.8759	-95.38545	2007.331	2020.994	13.663	658	-3.31	-0.36	0.26
96	P046	30.02997	-95.60006	2007.323	2020.63	13.307	662	-21.8	-1.55	-1.71
97	P047	30.08955	-95.42354	2007.337	2020.898	13.561	625	-26.17	-1.77	-0.87
98	P048	30.04536	-95.67171	2007.32	2020.98	13.66	637	-15.19	-1.2	-1.04

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99	P049	29.42245	-94.70153	2006.279	2020.953	14.674	1619	-1.11	-0.12	-0.28
100	P050	29.84834	-94.85604	2006.835	2020.977	14.142	693	-0.19	-0.09	0.23
101	P051	29.93254	-95.2842	2007.339	2020.939	13.6	636	-5.38	-0.39	0.19
102	P052	29.85202	-95.17674	2007.339	2020.958	13.619	627	0.53	-0.04	0.67
103	P053	29.90803	-95.05729	2007.339	2020.996	13.657	577	1.51	-0.1	1.13
104	P054	29.80147	-95.03439	2006.816	2020.994	14.178	679	0.49	-0.01	0.07
105	P055	29.79419	-95.1772	2006.797	2020.975	14.178	670	3.05	0.19	0.36
106	P056	29.90262	-95.81677	2007.32	2020.484	13.164	589	-8.03	-0.55	-1.59
107	P057	29.68406	-95.72182	2009.137	2020.824	11.687	508	-3.34	-0.37	-0.66
108	P058	29.48476	-95.71493	2010.591	2020.939	10.348	471	-2.17	-0.05	-0.24
109	P059	29.61666	-95.74042	2010.572	2020.92	10.348	465	0.25	-0.18	-0.32
110	P060	29.68591	-95.81955	2012.068	2020.843	8.775	367	-6.28	-0.65	-0.57
111	P061	29.67539	-95.97244	2011.129	2020.881	9.753	470	-2.58	-0.22	-0.31
112	P062	29.59329	-95.97419	2011.131	2020.895	9.764	430	-4.17	-0.37	-0.35
113	P063	29.50787	-95.54741	2011.432	2020.996	9.564	440	0.49	-0.16	-0.03
114	P065	30.10646	-95.10694	2012.432	2020.898	8.465	381	-5.64	-0.71	-0.19
115	P066	30.01717	-95.76665	2011.167	2021.002	9.835	469	-13.58	-1.24	-1.37
116	P067	29.53177	-95.85479	2011.109	2020.898	9.788	448	-2.24	-0.25	-0.3
117	P068	30.18483	-95.58681	2011.799	2021.002	9.203	518	-9.29	-0.92	-0.94
118	P069	30.19897	-95.45894	2011.747	2020.92	9.172	527	-9.66	-0.94	-1.03
119	P070	30.29111	-95.42432	2011.761	2020.958	9.197	444	-6.1	-0.51	-0.31
120	P071	30.35301	-95.57886	2011.78	2020.977	9.197	527	-4.13	-0.38	-0.31
121	P072	30.14703	-95.24249	2011.994	2020.936	8.943	335	-5.8	-0.31	-1.08
122	P073	30.19343	-95.73022	2012.052	2020.996	8.944	538	-7.41	-0.74	-0.65
123	P074	29.73556	-95.23121	2011.972	2020.975	9.003	439	0.36	0.22	0.65
124	P075	29.75779	-95.03057	2012.432	2020.994	8.561	406	0.27	0	0.69
125	P076	29.36089	-95.04547	2012.641	2020.975	8.334	357	-3.48	-0.47	-0.34
126	P077	29.97904	-95.85037	2013.197	2020.824	7.627	372	-2.63	-0.52	-0.46
127	P078	29.7387	-96.01566	2014.331	2020.881	6.55	323	-2.52	-0.32	-0.23
128	P079	29.0348	-95.47127	2014.827	2021.002	6.175	1643	0.67	0.05	-0.05
129	P080	29.5781	-95.16514	2014.862	2021.002	6.14	2121	1.74	0.17	0.08
130	P081	29.55577	-95.1698	2014.854	2021.002	6.148	2091	1.43	0.15	0
131	P082	29.29566	-95.73135	2016.109	2020.955	4.846	216	2.15	0.21	0.26
132	P083	29.26241	-95.18152	2016.014	2020.63	4.616	201	-1.05	-0.09	-0.31
133	P084	29.29685	-95.37031	2016.052	2020.92	4.868	225	7.65	1.09	0.35
134	P085	29.34258	-95.27815	2016.033	2020.898	4.865	205	0.59	0.17	-0.07

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135	P086	29.25773	-95.45848	2016.071	2020.917	4.846	190	2.48	0.22	0.03
136	P087	29.05808	-95.67676	2016.09	2020.944	4.854	211	-0.72	0	0.01
137	P088	29.44563	-95.43788	2016.129	2020.975	4.846	220	0.03	-0.21	-0.44
138	P089	29.5664	-95.79915	2015.766	2020.92	5.153	239	0.41	0.11	-0.14
139	P090	29.71018	-95.1596	2015.975	2020.901	4.926	335	4.05	0.35	0.09
140	P091	29.78319	-95.4932	2016.32	2020.775	4.454	328	-1.25	-0.88	-0.98
141	P092	29.88139	-95.50076	2016.32	2020.783	4.463	282	-2.55	-0.54	-0.61
142	P093	29.41676	-95.19742	2017.238	2020.977	3.739	203	-0.14	0.44	0.21
143	P094	29.7217	-95.52398	2017.298	2020.955	3.657	271	-1.22	-0.04	-0.34
144	P095	29.80787	-95.2944	2017.2	2020.994	3.794	261	1.93	0.23	-0.09
145	P096	29.72429	-95.74814	2017.553	2020.964	3.411	1151	1.56	-0.5	-0.34
146	P097	29.78501	-95.84699	2018.104	2020.881	2.777	200	-9	-3.23	-3.26
147	P098	29.80316	-95.81989	2018.12	2020.846	2.726	198	-5.69	-1.95	-2.35
148	P099	29.98636	-95.57858	2018.14	2020.977	2.838	195	-3.82	-1.42	-0.77
149	PWES	30.19899	-95.51057	2015.22	2021.043	5.823	2128	-6.11	-0.88	-0.94
150	RDCT	29.81042	-95.49472	2013.561	2021.043	7.483	2492	-2.5	-0.5	-0.38
151	ROD1	30.07235	-95.5268	2007.003	2021.043	14.04	4809	-16.94	-1.09	-0.64
152	RPFB	29.48417	-95.51365	2014.773	2021.043	6.27	2291	-0.53	-0.17	-0.15
153	SESG	29.98747	-95.42962	2014.678	2021.043	6.365	2324	-5.95	-0.91	-0.85
n/a	SG32	30.60246	-96.35886	2003.209	2014.122	10.913	3963	-0.93	-0.01	n/a
154	SHSG	30.05361	-95.43005	2014.721	2021.043	6.322	2309	-7.15	-1.11	-1.09
155	SISD	29.76219	-96.17388	2015.176	2021.043	5.867	2054	-0.6	-0.19	-0.16
156	SPBH	29.8019	-95.51504	2013.303	2021.043	7.74	2827	-3.81	-0.53	-0.42
n/a	STS1	29.91444	-93.94472	2012.463	2015.305	2.842	1010	-1	-0.25	n/a
157	TDAM	29.31406	-94.81695	2013.435	2020.892	7.458	2619	-2.72	-0.28	-0.18
158	THSU	29.71401	-95.33991	2012.953	2021.043	8.09	2664	0.02	0.03	0.01
159	TMCC	29.70232	-95.39524	2003.271	2020.996	17.725	4180	-0.62	-0.06	-0.14
160	TSFT	29.80629	-95.47996	2013.38	2021.043	7.663	2753	-4.35	-0.41	-0.1
161	TXAC	29.7778	-94.67146	2011.124	2021.043	9.919	3546	-2.5	-0.08	-0.1
162	TXAG	29.16416	-95.41902	2005.58	2020.558	14.979	5422	-1.54	-0.07	-0.09
163	TXAV	29.40309	-95.24203	2017.147	2021.043	3.896	966	-1.05	-0.35	-0.35
164	TXB1	30.16139	-94.18089	2013.191	2021.043	7.852	2573	0.48	0.14	0.36
165	TXB2	30.08978	-94.19176	2012.463	2021.043	8.58	2790	-9.93	-0.97	-0.5
166	TXB5	31.47218	-96.04607	2014.078	2020.838	6.76	2211	-0.83	-0.05	0.09
167	TXB6	29.75691	-94.93736	2012.463	2018.234	5.771	2054	-0.85	-0.18	0.05
168	TXBC	28.99981	-95.97237	2009.405	2021.043	11.639	4202	-2.82	-0.16	-0.2

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169	TXBH	29.78584	-95.94554	2017.15	2021.043	3.893	1382	-1.91	-0.48	-0.48
n/a	TXBM	30.16172	-94.17971	1996.145	2013.804	17.659	5928	-4.25	-0.19	n/a
170	TXBX	30.71784	-96.39662	2013.191	2021.043	7.852	2805	5.45	0.59	0.26
n/a	TXBY	30.68583	-96.37054	2005.092	2012.375	7.283	2488	-0.41	-0.06	n/a
171	TXC5	29.70354	-96.57253	2017.213	2021.043	3.83	1362	-0.17	-0.05	-0.05
172	TXCF	29.70354	-96.57253	2017.065	2021.043	3.978	1407	0.12	-0.04	-0.04
173	TXCK	31.32263	-95.43591	2012.022	2021.043	9.021	3207	0.95	0.04	0.11
174	TXCM	29.70284	-96.57732	2010.437	2021.043	10.606	3817	-0.45	-0.16	-0.05
175	TXCN	30.34895	-95.44121	2005.58	2021.043	15.463	5611	-16.11	-1.15	-0.53
176	TXCV	30.33505	-95.09359	2012.665	2021.043	8.378	2781	-3.63	-0.47	-0.38
177	TXCY	30.09642	-95.62587	2017.391	2021.043	3.652	1170	-4.42	-1.18	-1.18
178	TXED	28.96824	-96.63404	2009.429	2019.63	10.201	2797	-0.48	-0.01	0.05
179	TXEX	29.56366	-95.11919	2010.881	2020.996	10.115	3391	3.34	0.38	0.27
180	TXGA	29.32787	-94.77264	2005.58	2021.043	15.463	5425	-3.69	-0.2	-0.17
181	TXGN	31.06098	-95.13568	2012.022	2021.043	9.021	2982	-1.68	-0.23	-0.08
n/a	TXGV	29.28514	-94.7893	2007.129	2011.548	4.419	1268	0.14	0.09	n/a
182	TXH1	30.89253	-96.60173	2013.191	2021.043	7.852	2573	-0.28	-0.05	0.07
183	TXH2	29.56347	-94.39086	2016.09	2021.043	4.953	1556	0.51	-0.03	-0.03
184	TXHE	30.09902	-96.06349	2005.58	2021.043	15.463	5596	-7.62	-0.65	-0.26
185	TXHN	30.74238	-95.59616	2010.584	2021.043	10.459	3487	0.6	-0.06	0.13
186	TXHP	31.33386	-93.8649	2012.022	2021.043	9.021	3207	-0.69	-0.22	0.22
187	TXHS	29.71608	-95.55551	2012.463	2021.043	8.58	2919	-5.04	-0.67	-0.46
n/a	TXHU	29.77942	-95.43299	1997.216	2007.962	10.746	2722	-2.71	-0.3	n/a
188	TXHV	30.72071	-95.55259	2015.463	2021.043	5.58	1998	1.05	0.2	0.23
189	TXKO	30.39547	-94.33236	2011.77	2021.043	9.273	3336	-0.56	0.01	0.08
190	TXKY	29.82202	-95.8294	2012.463	2017.24	4.778	1580	-5.39	-1.09	0
191	TXLF	31.35635	-94.71832	2005.58	2021.043	15.463	5588	0.97	0.06	0.14
192	TXLI	30.05589	-94.77103	2005.58	2021.043	15.463	5549	0.91	0.07	0.07
193	TXLM	29.39222	-95.02369	2005.58	2021.043	15.463	5606	-3.37	-0.29	-0.04
194	TXLQ	29.35796	-94.95285	2013.059	2020.988	7.929	2839	0.09	0.02	0.07
195	TXLV	30.7452	-94.92173	2011.778	2021.043	9.265	3338	-0.88	-0.07	0.03
196	TXMD	30.96002	-95.91522	2010.584	2021.043	10.459	3503	1.73	0.06	0.04
197	TXMG	28.9829	-95.96355	2013.309	2021.043	7.734	2434	-2.56	-0.24	-0.13
198	TXNE	30.8477	-93.77521	2013.191	2021.043	7.852	2511	-0.89	-0.12	0.04
199	TXNV	30.38162	-96.06673	2012.463	2021.043	8.58	3063	-2.93	-0.33	-0.25
200	TXO1	30.0914	-93.73603	2012.471	2021.043	8.572	2958	-3.26	-0.32	-0.44

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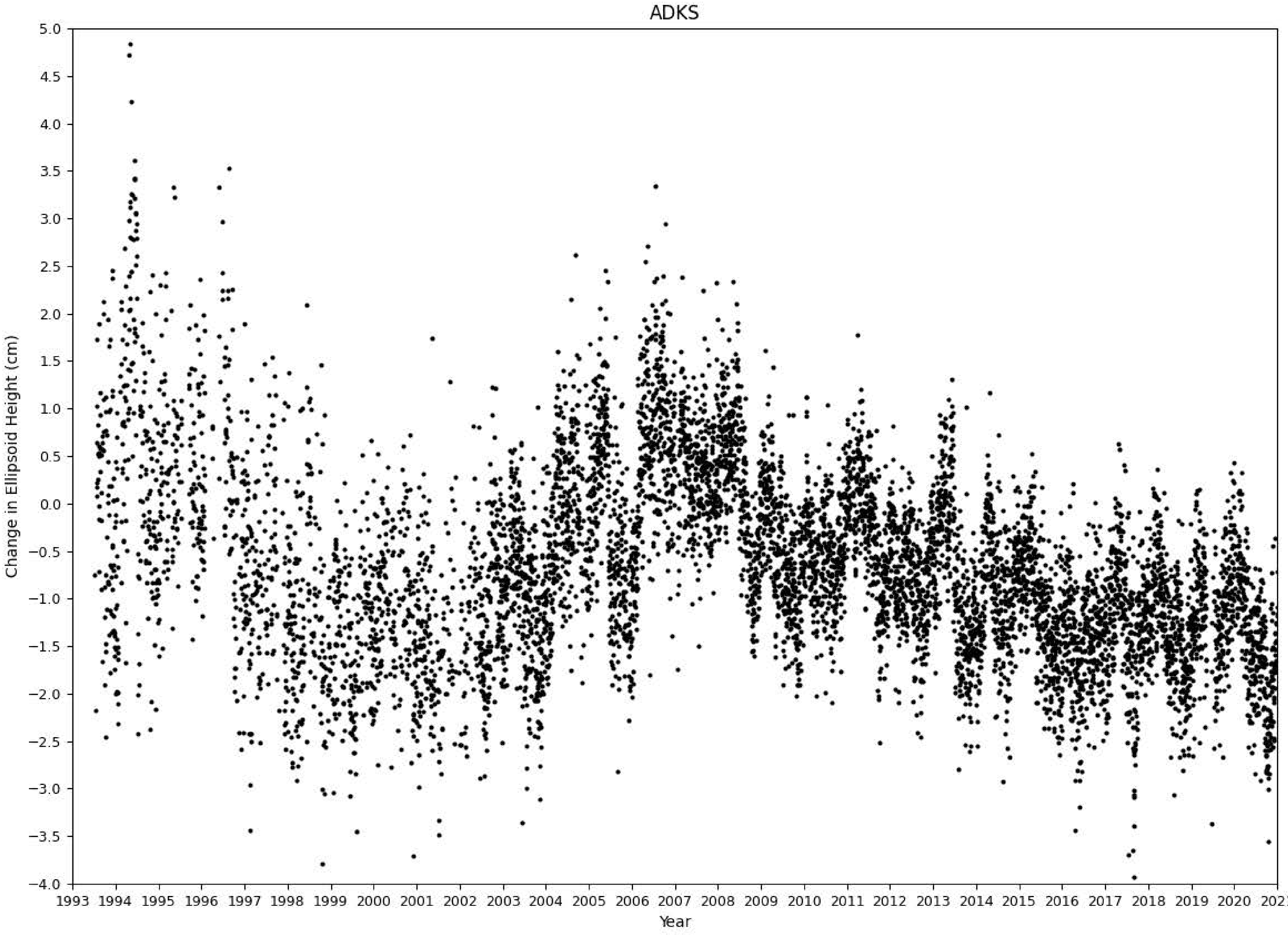
201	TXOR	30.1252	-93.82041	2011.789	2020.967	9.177	3335	-0.91	-0.1	-0.04
202	TXP5	29.66752	-95.0424	2019.181	2021.043	1.862	549	0.23	n/a	0
203	TXPH	29.91447	-93.94499	2015.313	2021.043	5.73	2016	-1.12	-0.11	-0.08
204	TXPT	29.94742	-93.95293	2011.264	2021.043	9.78	3513	-1.92	-0.21	-0.05
205	TXPV	28.63818	-96.61853	2010.292	2021.043	10.751	3879	0.55	-0.02	0.06
206	TXRN	29.54251	-95.82854	2015.206	2021.043	5.837	2090	-1.01	-0.13	-0.08
n/a	TXRO	29.5191	-95.80749	2005.58	2011.439	5.859	2125	-6.87	-1.47	n/a
207	TXRS	29.5192	-95.8053	2011.447	2021.043	9.596	3456	-3.89	-0.41	-0.23
208	TXSP	29.73094	-93.89723	2016.454	2021.043	4.589	1408	0.02	-0.02	-0.02
209	TXTG	29.89752	-95.29738	2015.466	2021.043	5.577	1976	-1.76	-0.29	-0.28
210	TXWH	29.32462	-96.11175	2010.426	2021.043	10.617	3803	-2.61	-0.35	-0.29
211	TXWI	29.80577	-94.37147	2015.48	2020.917	5.437	1947	-1.74	-0.36	-0.34
212	TXWN	29.32876	-96.09205	2015.003	2021.043	6.04	2150	-0.09	-0.04	0
213	TXWO	30.78199	-94.42364	2013.191	2021.043	7.852	2370	-1.22	-0.13	-0.01
214	UH01	29.72246	-95.3454	2012.745	2020.077	7.332	2589	-0.01	-0.09	-0.15
215	UH02	30.31522	-95.45715	2015.003	2021.043	6.04	2041	-3.74	-0.61	-0.62
216	UHC0	29.39037	-95.04385	2014.138	2021.043	6.905	2442	-3.29	-0.74	-0.83
217	UHC1	29.39037	-95.04397	2014.138	2021.043	6.905	2458	-1.75	-0.29	-0.22
218	UHC2	29.39037	-95.04393	2014.138	2021.043	6.905	2457	-1.97	-0.33	-0.24
219	UHC3	29.39037	-95.04389	2014.141	2021.043	6.902	2458	-2.71	-0.47	-0.38
220	UHCL	29.57774	-95.10417	2014.242	2021.043	6.801	2279	0.33	0.05	0.1
221	UHCR	29.72807	-95.75677	2014.125	2020.616	6.491	2372	-6.91	-1.09	-1.16
222	UHDT	29.76596	-95.35944	2013.563	2021.043	7.48	2733	-0.52	-0.12	-0.07
223	UHEB	29.52631	-96.06604	2014.595	2020.441	5.845	2135	-0.21	-0.09	0
224	UHEP	29.71946	-95.32712	2014.365	2021.043	6.678	2399	-0.85	-0.15	-0.06
225	UHF1	30.23625	-95.4831	2014.39	2020.665	6.275	2258	-5.57	-0.59	-0.53
226	UHJF	30.23627	-95.48307	2014.39	2020.479	6.089	1963	-4.3	-0.43	-0.45
227	UHKD	29.72424	-95.74812	2018.969	2020.849	1.88	603	-2.6	n/a	0
n/a	UHKS	29.7243	-95.74813	2018.412	2020.846	2.434	889	-2.89	-0.65	n/a
228	UHL1	30.05765	-94.97846	2014.357	2021.043	6.686	2321	1.6	0.13	-0.04
229	UHRI	29.71923	-95.40252	2014.33	2021.043	6.713	2439	-1.87	-0.29	-0.13
230	UHSL	29.57467	-95.65154	2014.185	2021.043	6.858	2372	-1.6	-0.33	-0.29
231	UHWL	30.05764	-94.97843	2014.357	2021.043	6.686	2069	-0.93	-0.13	-0.11
232	UTEX	29.78589	-95.56782	2012.496	2020.69	8.194	2784	-4.81	-0.78	-0.58
233	WCHT	29.78283	-95.58142	2013.295	2021.043	7.748	2720	-7.19	-0.86	-0.68
234	WDVW	29.79039	-95.53307	2013.32	2021.043	7.724	2758	-4.15	-0.58	-0.5

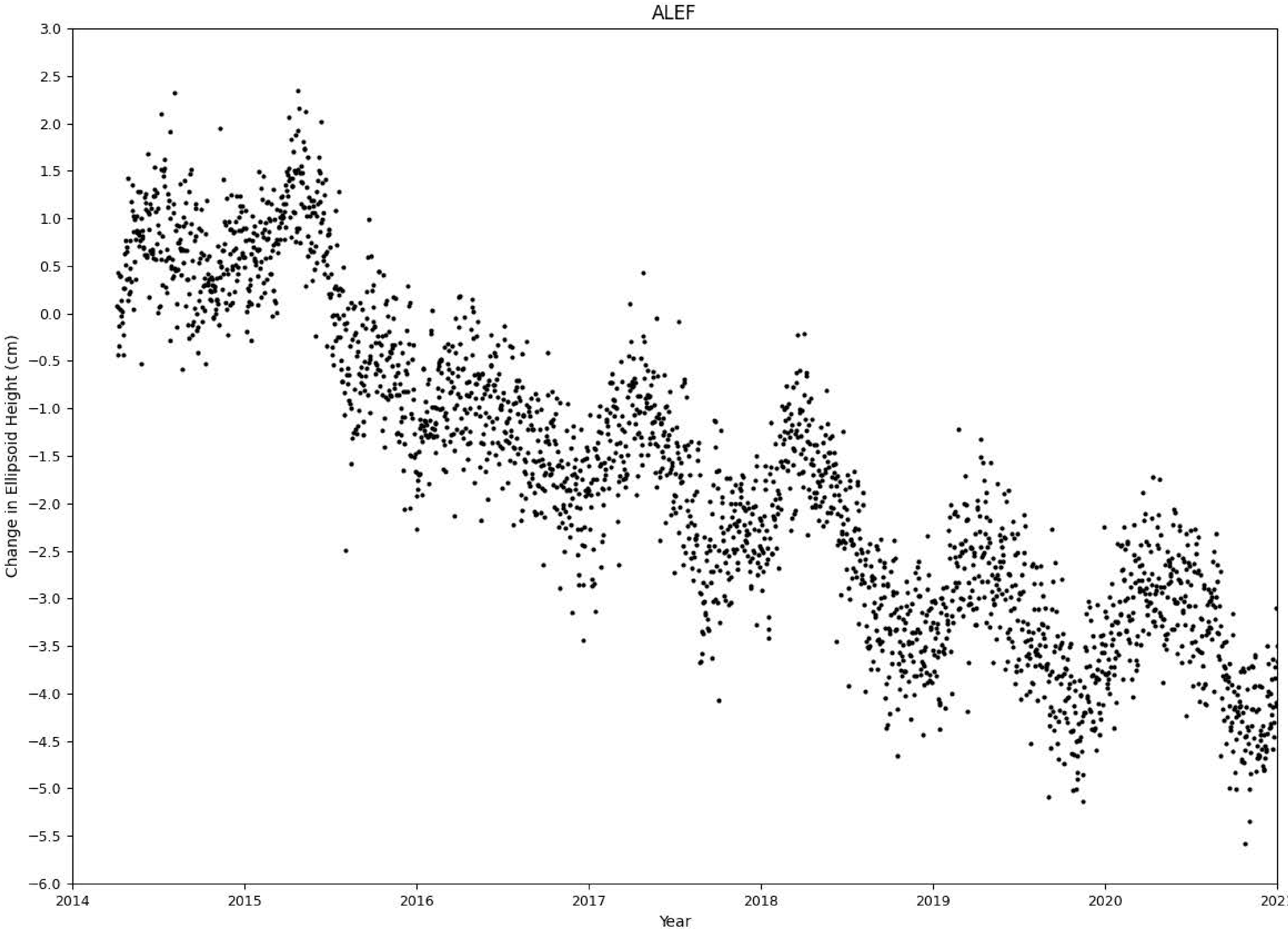
Map ID (Figure 1)	Site Name	Latitude (Decimal degrees)	Longitude (Decimal degrees)	Start of POR (Decimal year)	End of POR (Decimal Year)	Length of POR (Years)	Number of Samples (Days)	Total Vertical Displacement over POR (cm)	Total Change in Ellipsoidal Height over POR (cm)*	Annual Rate of Change in Ellipsoidal Height 2016-2020 (cm)*
235	WEPD	29.68773	-95.22873	2014.075	2021.043	6.968	2461	1.34	0.14	0.08
236	WHCR	30.19432	-95.5054	2014.779	2021.043	6.264	2286	-3.59	-0.6	-0.71
237	YORS	30.11003	-95.46948	2020.829	2021.002	0.172	61	4.79	n/a	0
238	ZHU1	29.9619	-95.33143	2003.042	2021.043	18.001	6208	-12.59	-0.71	-0.56

Notes:

* n/a: rate of change in ellipsoidal height not calculated



ADKS
Change in Ellipsoid Height (cm)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year



ALEF
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
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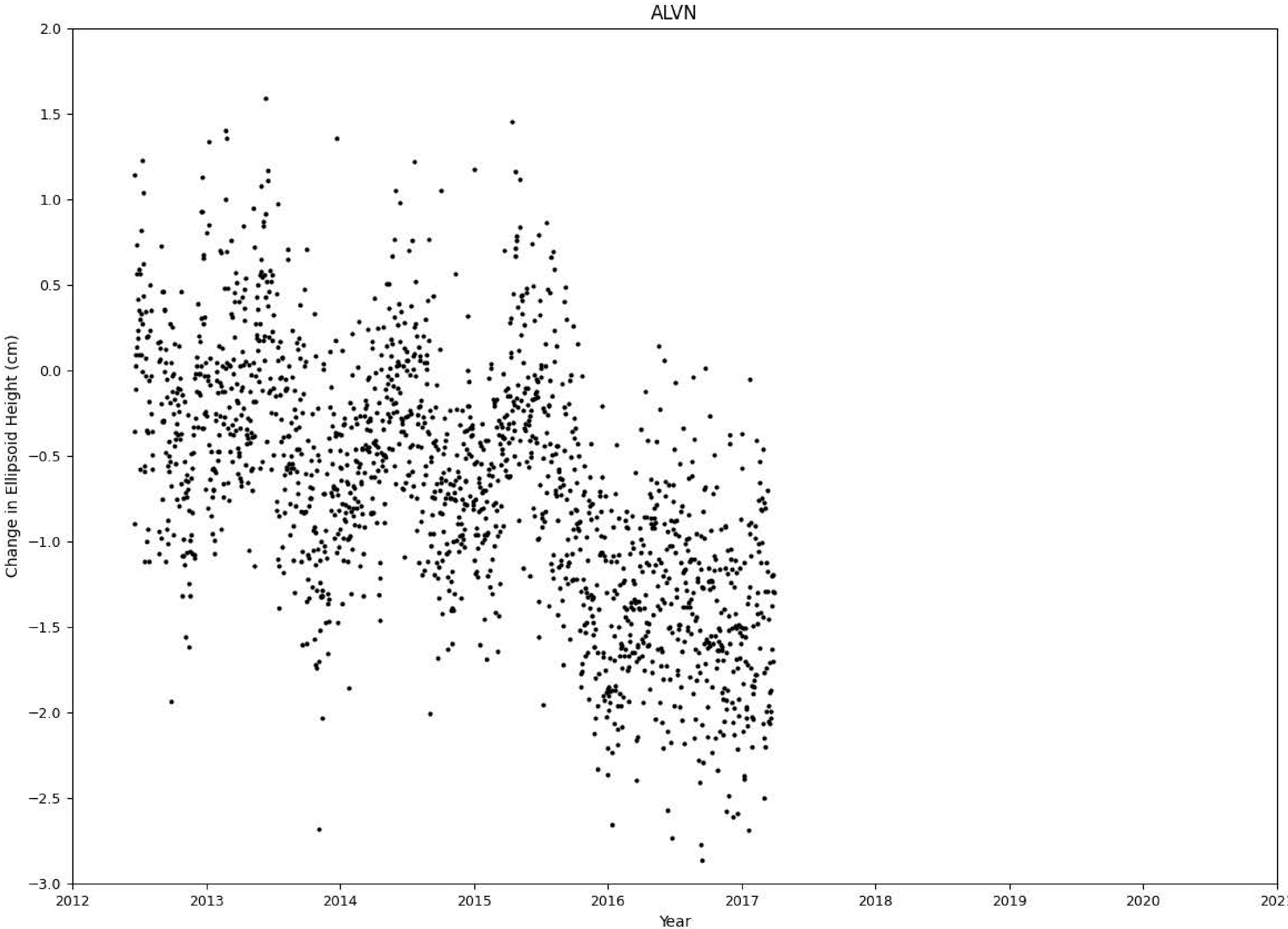
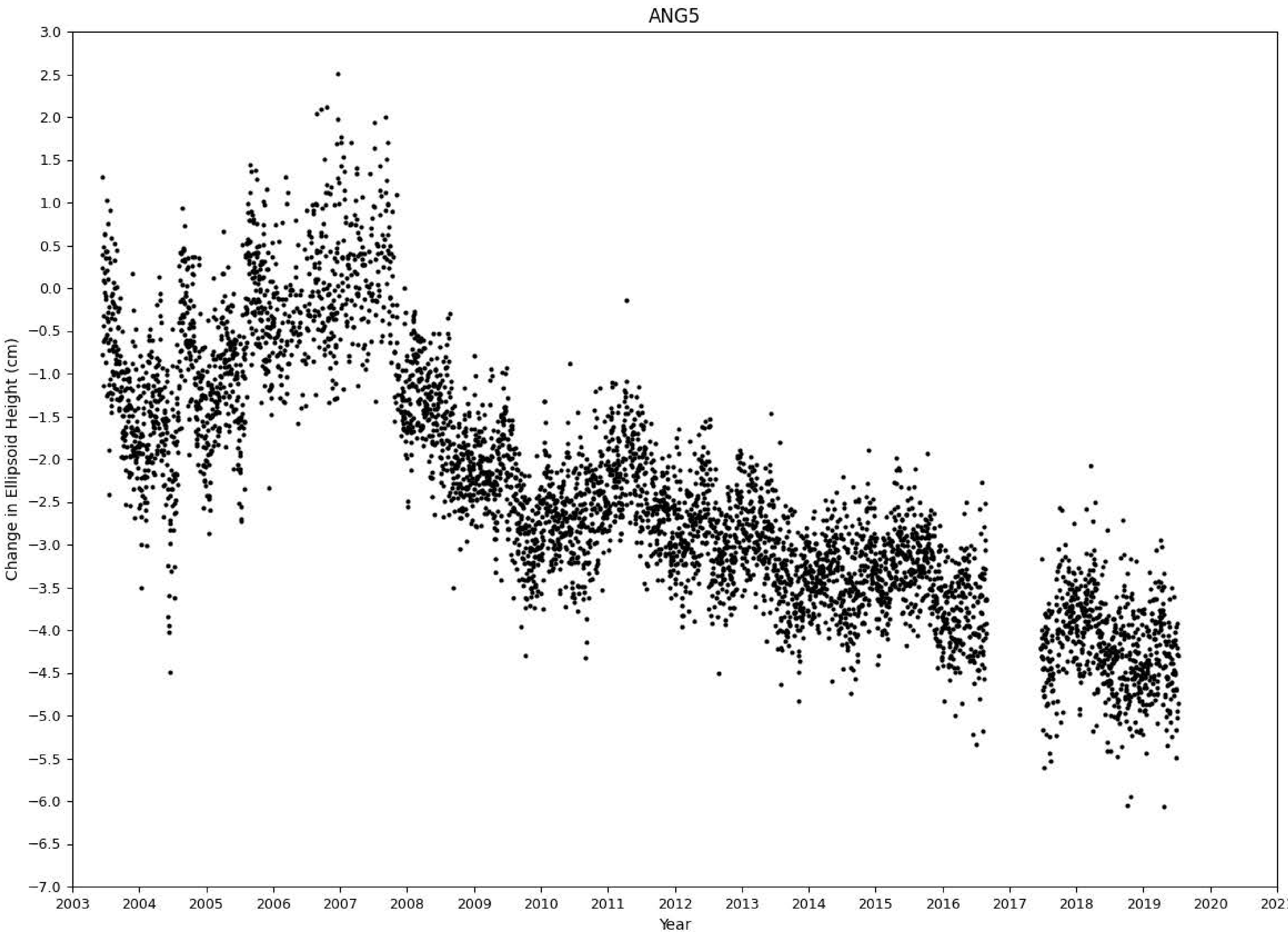
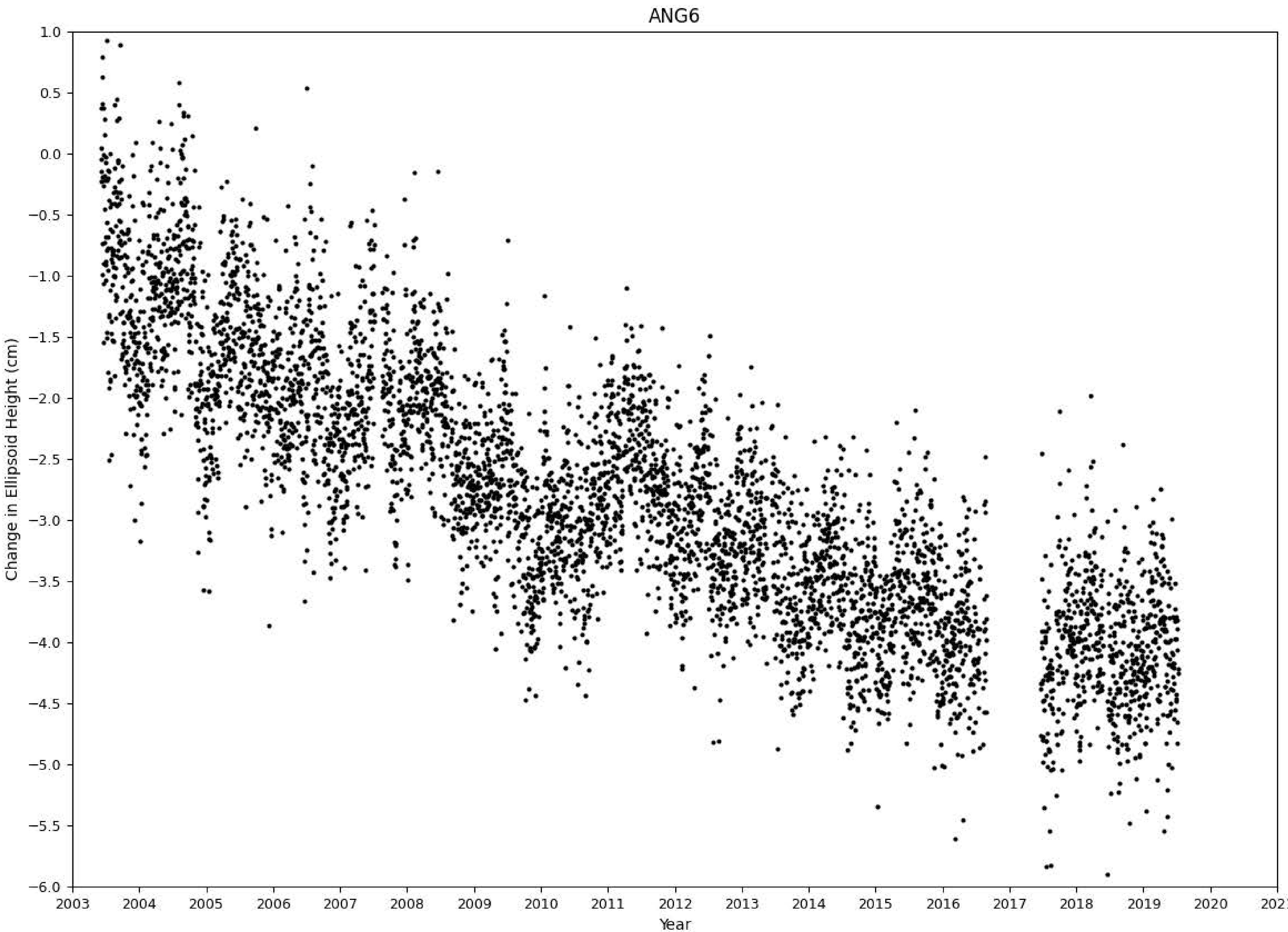
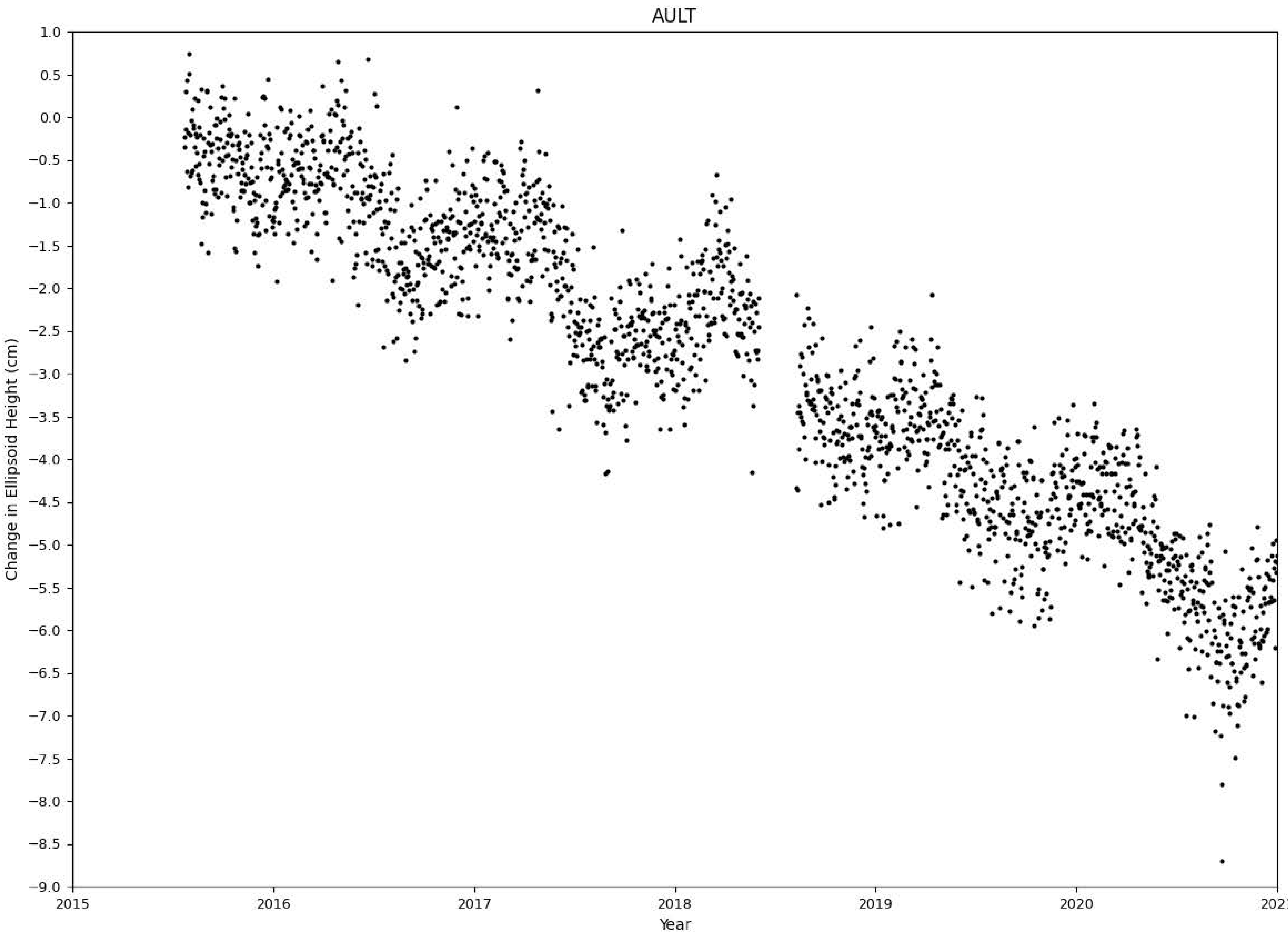
2017
2018
2019
2020
2021

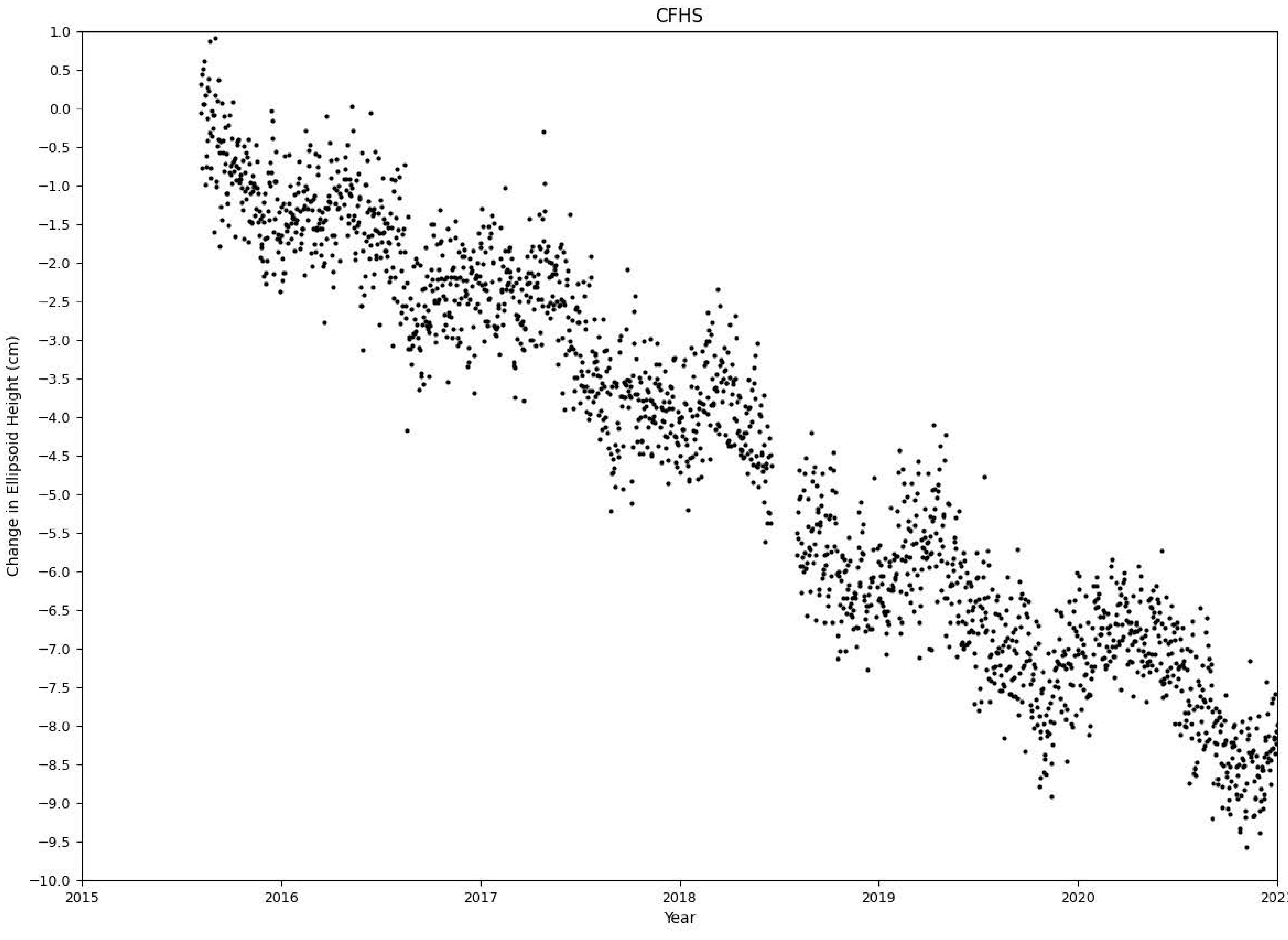


ALVN
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


ANG5
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year


ANG6
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


AULT
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
2015
2016
2017
2018
2019
2020
2021



CFHS
Change in Ellipsoid Height (cm)
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
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2016
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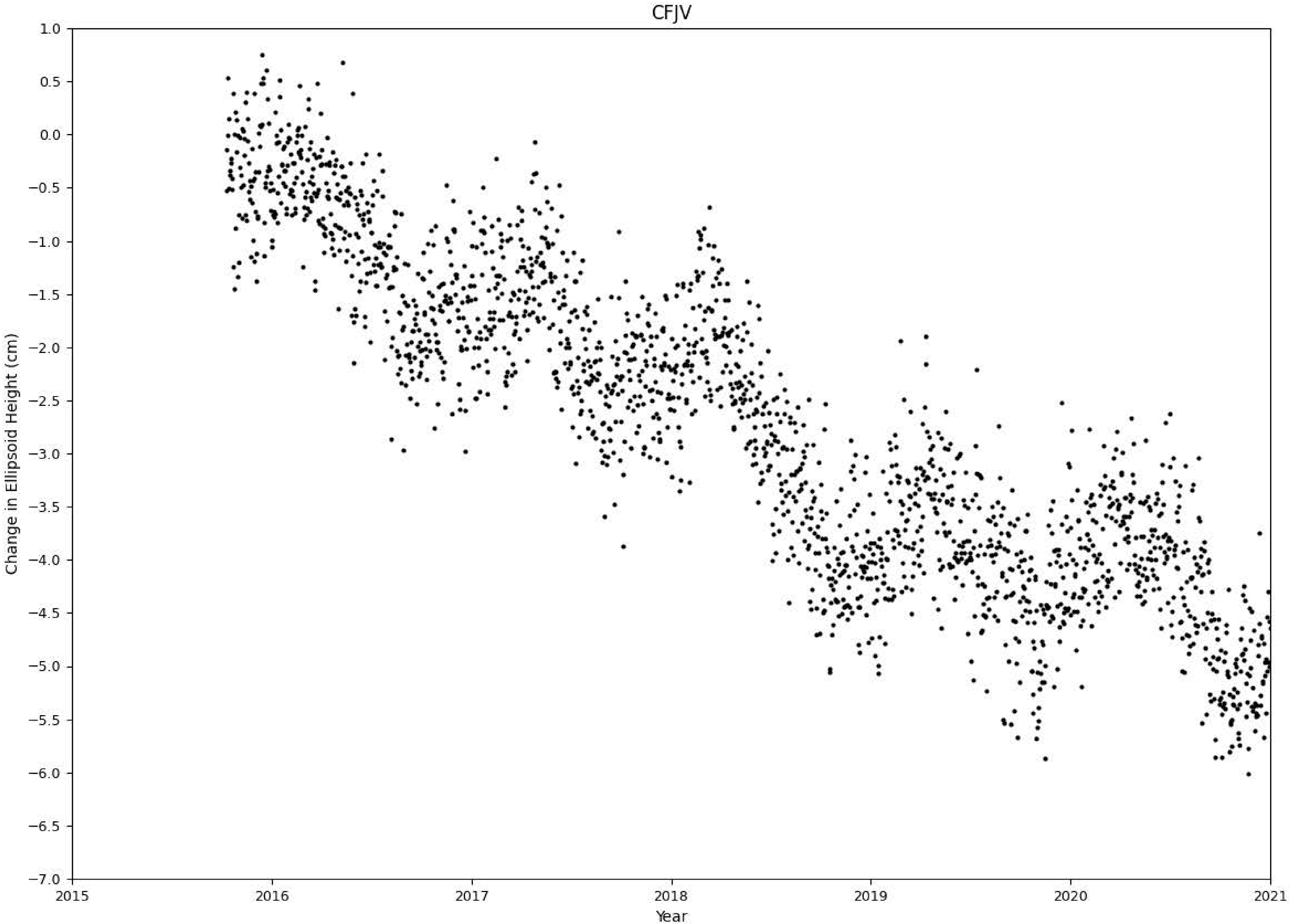
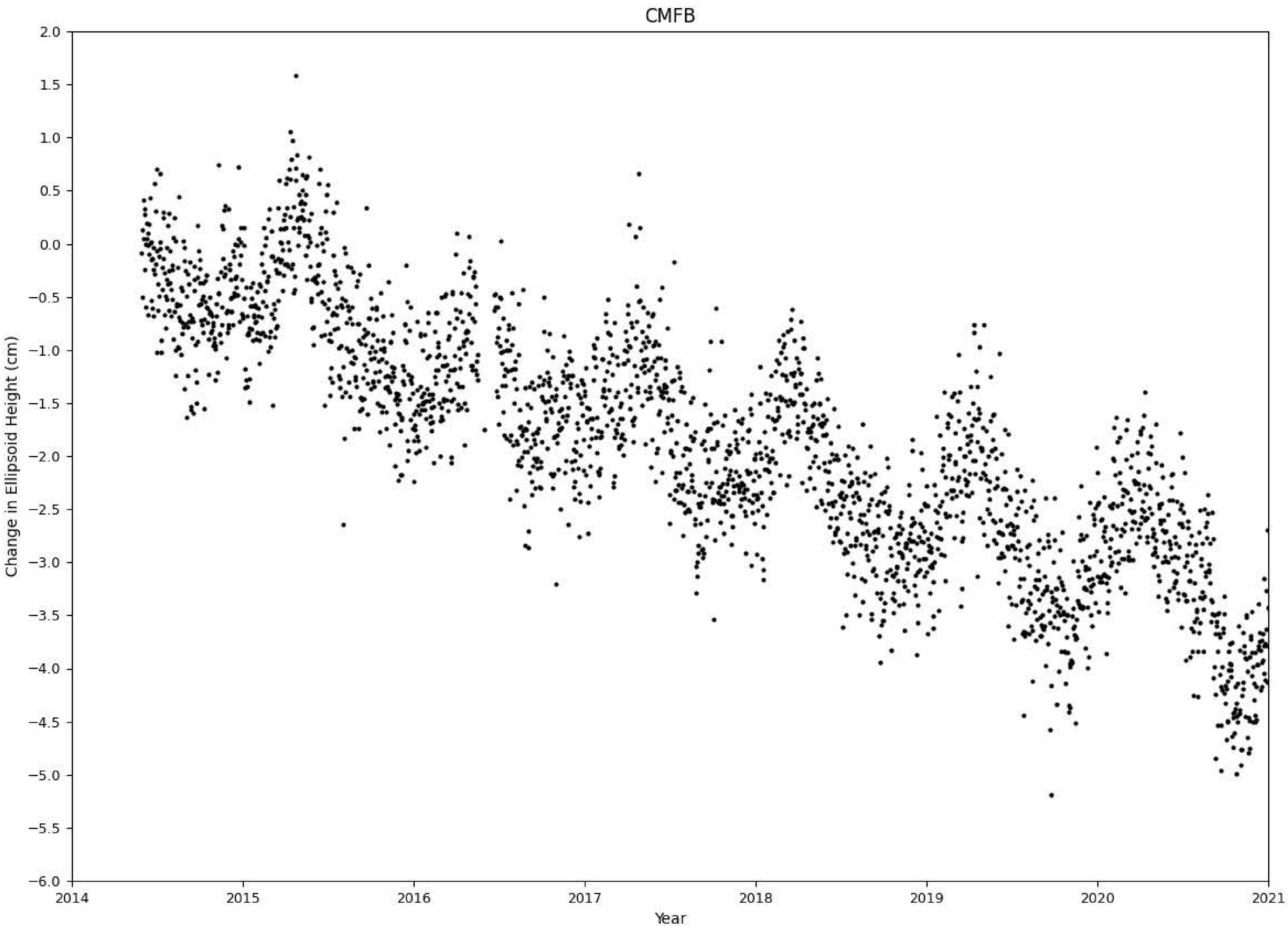
2018
2019
2020
2021
Year



CFJV
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2015
2016
2017
2018
2019
2020
2021


CMFB
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
2014
2015
2016
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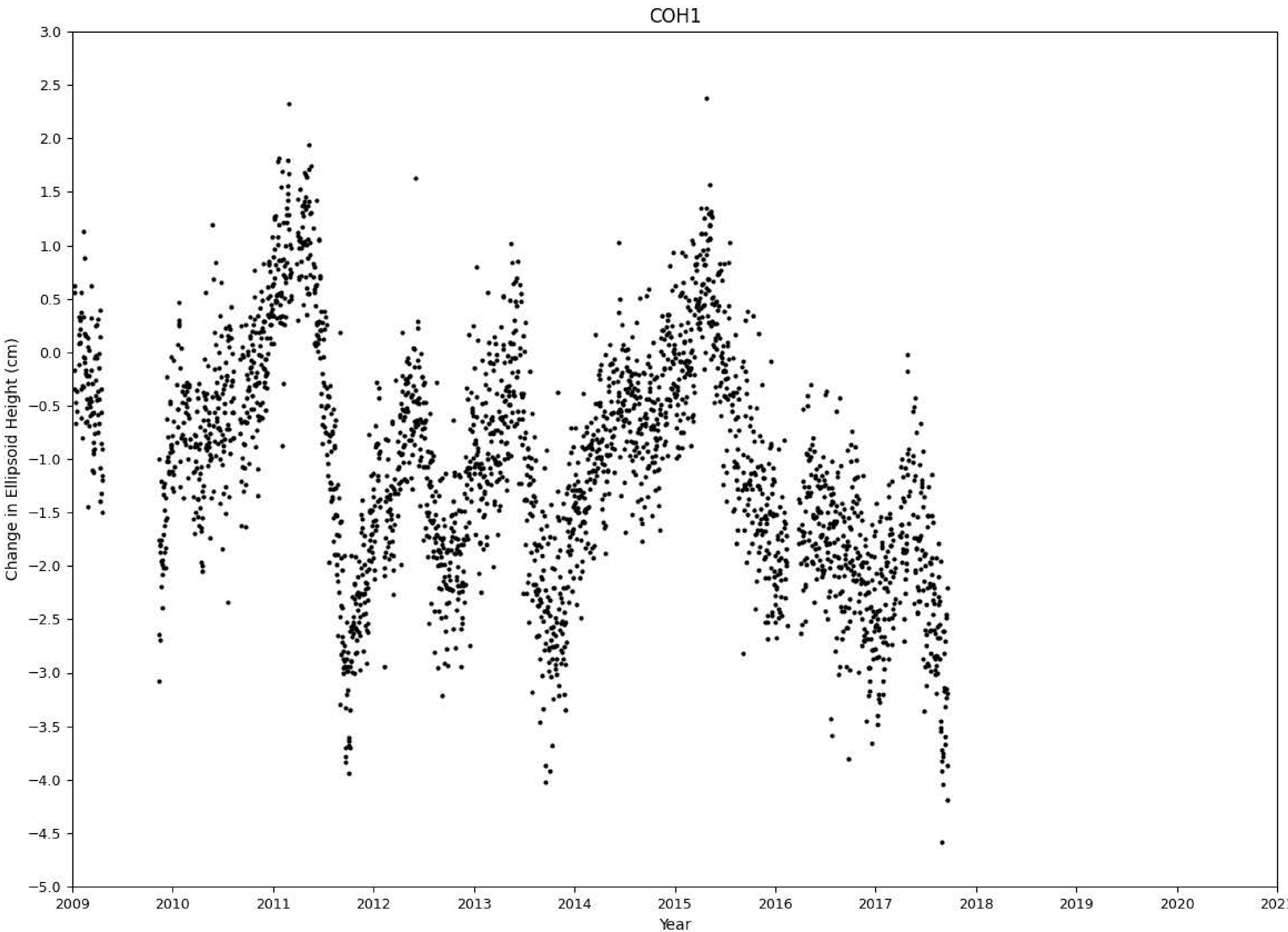
2018
2019
2020
2021



COH1
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2009
2010
2011
2012
2013
2014
2015
2016
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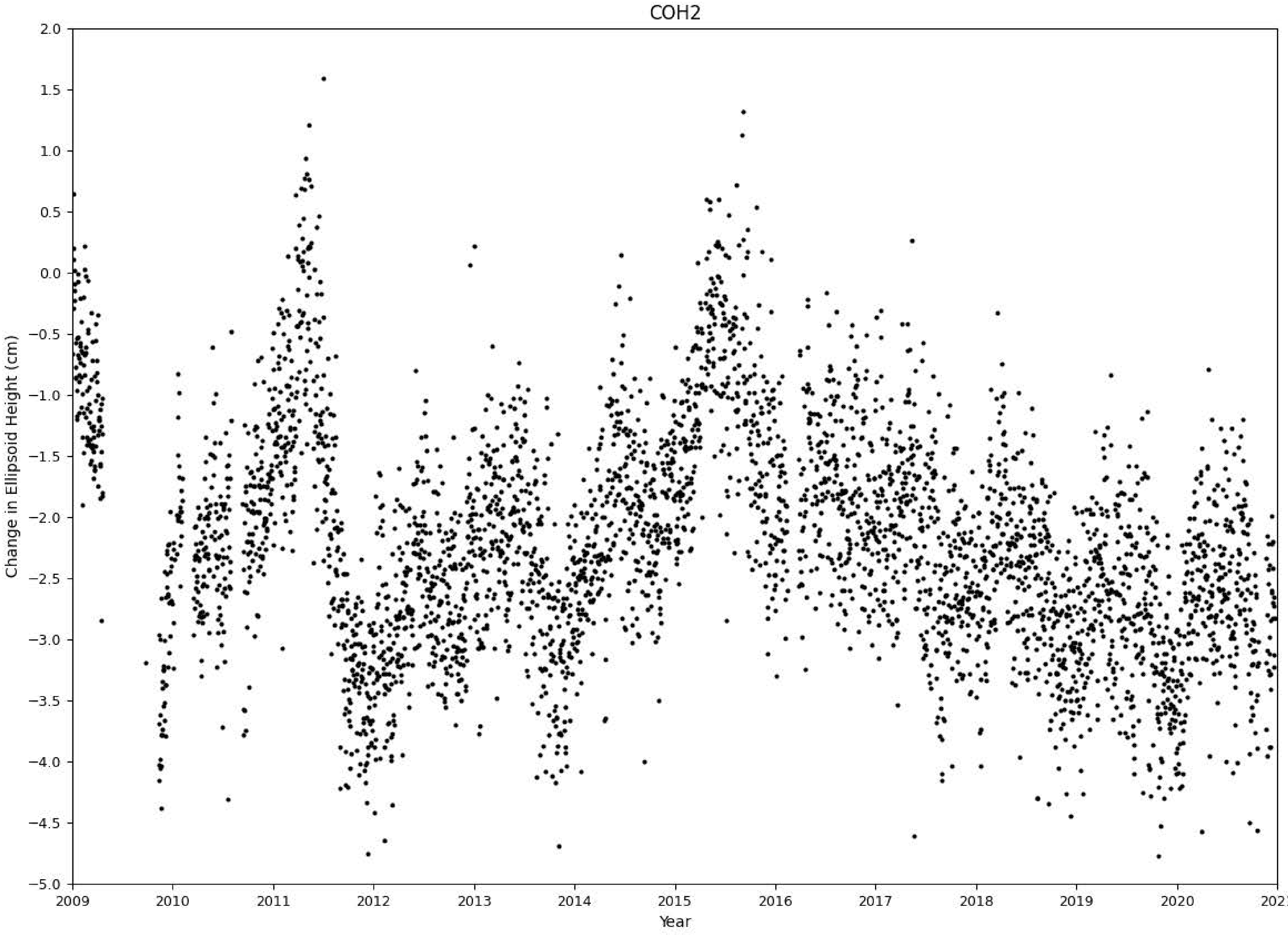
2020
2021



COH2
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
2009
2010
2011
2012
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2014
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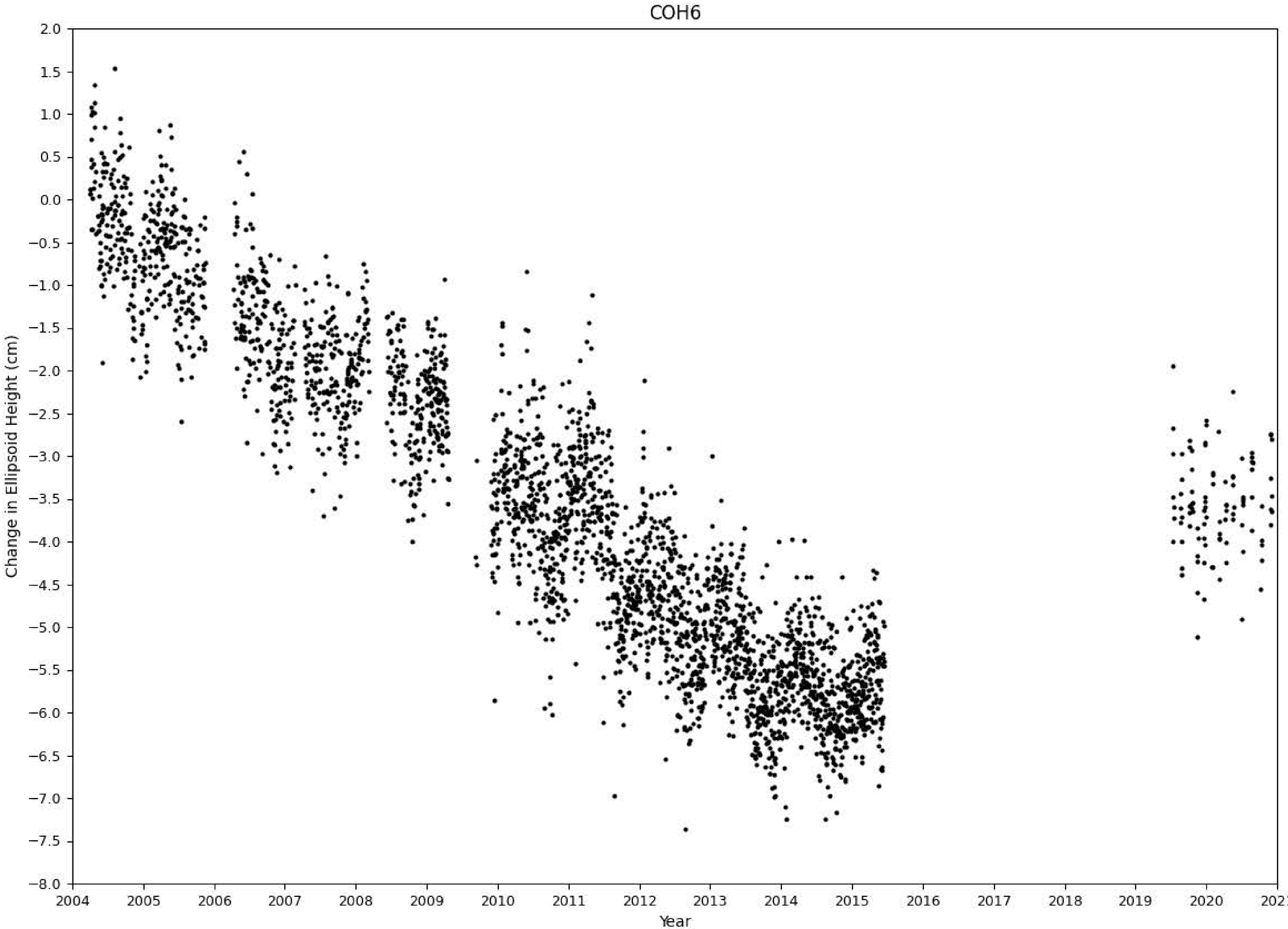
2020
2021



COH6
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
2004
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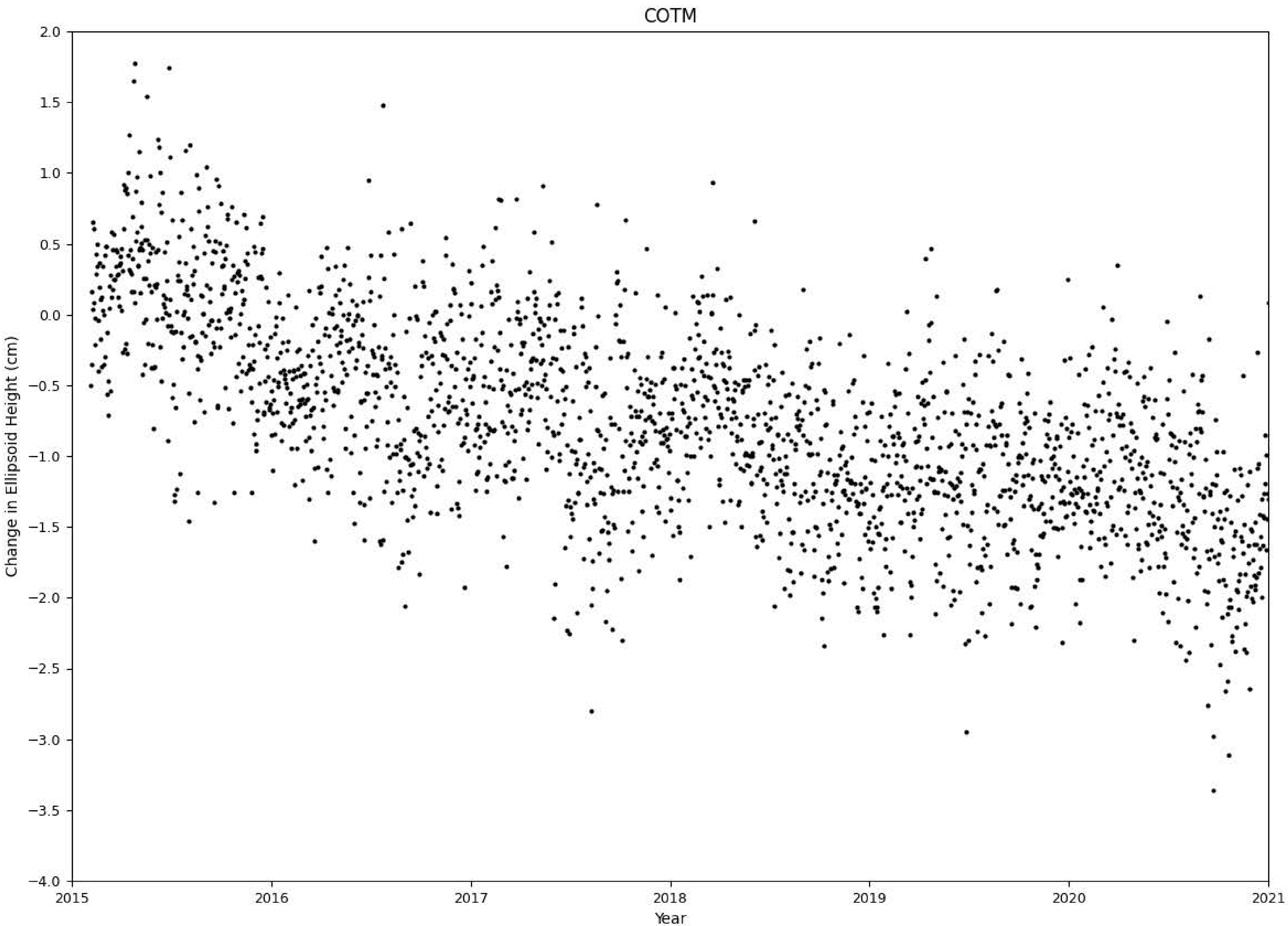
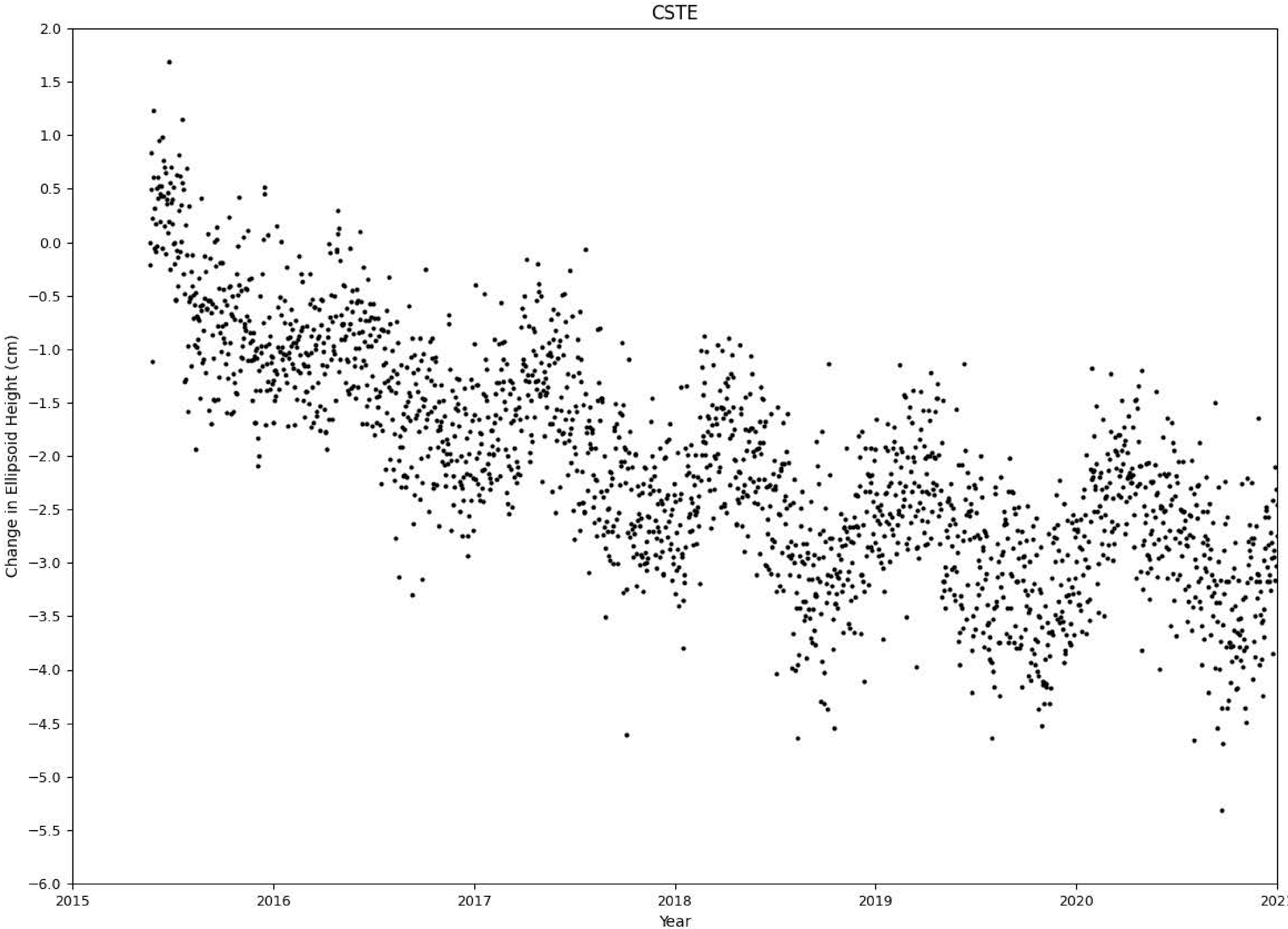
2020
2021


COTM
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2015
2016
2017
2018
2019
2020
2021



CSTE
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
2015
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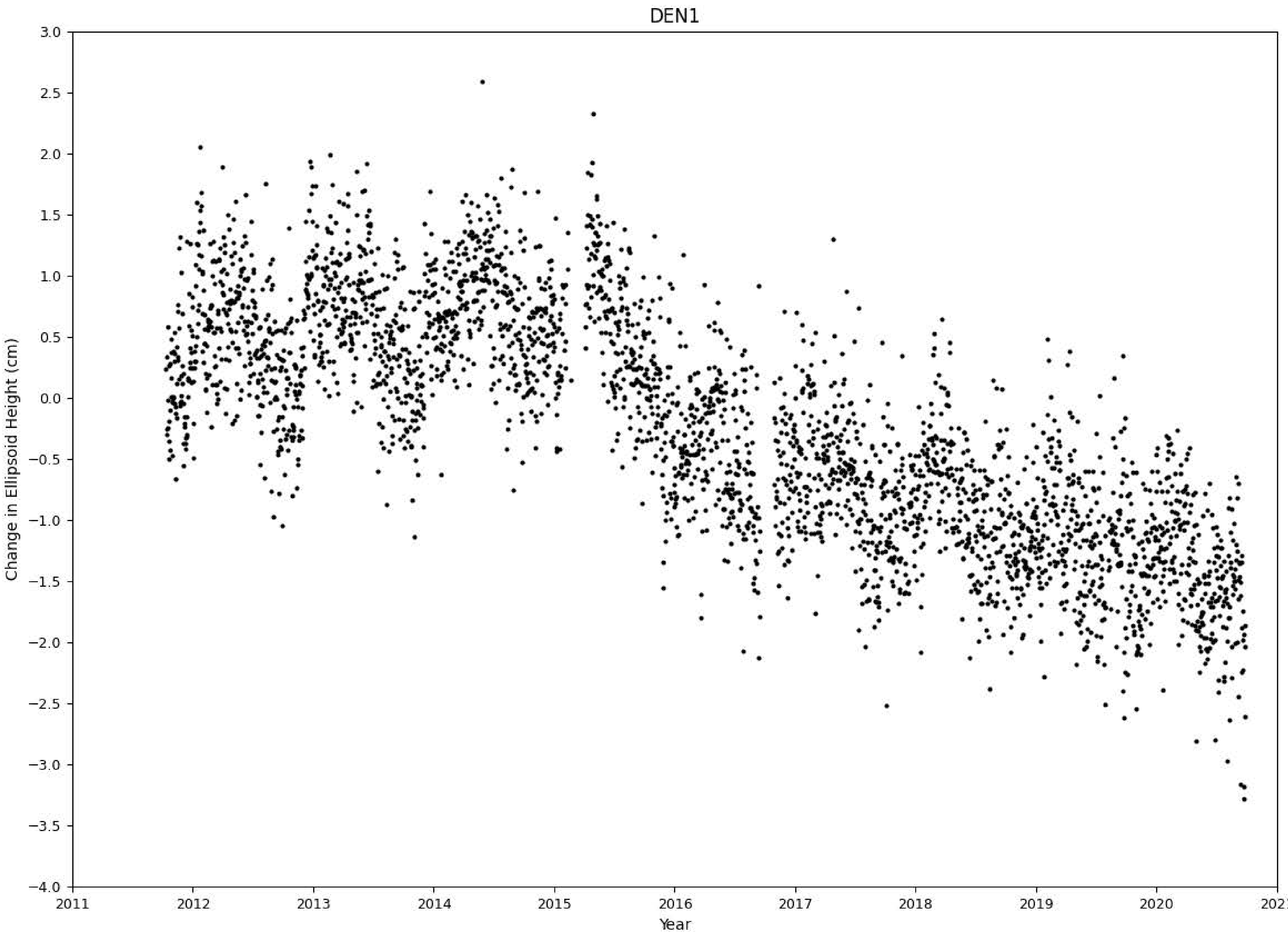
2017
2018
2019
2020
2021


DEN1
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2011
2012
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2015
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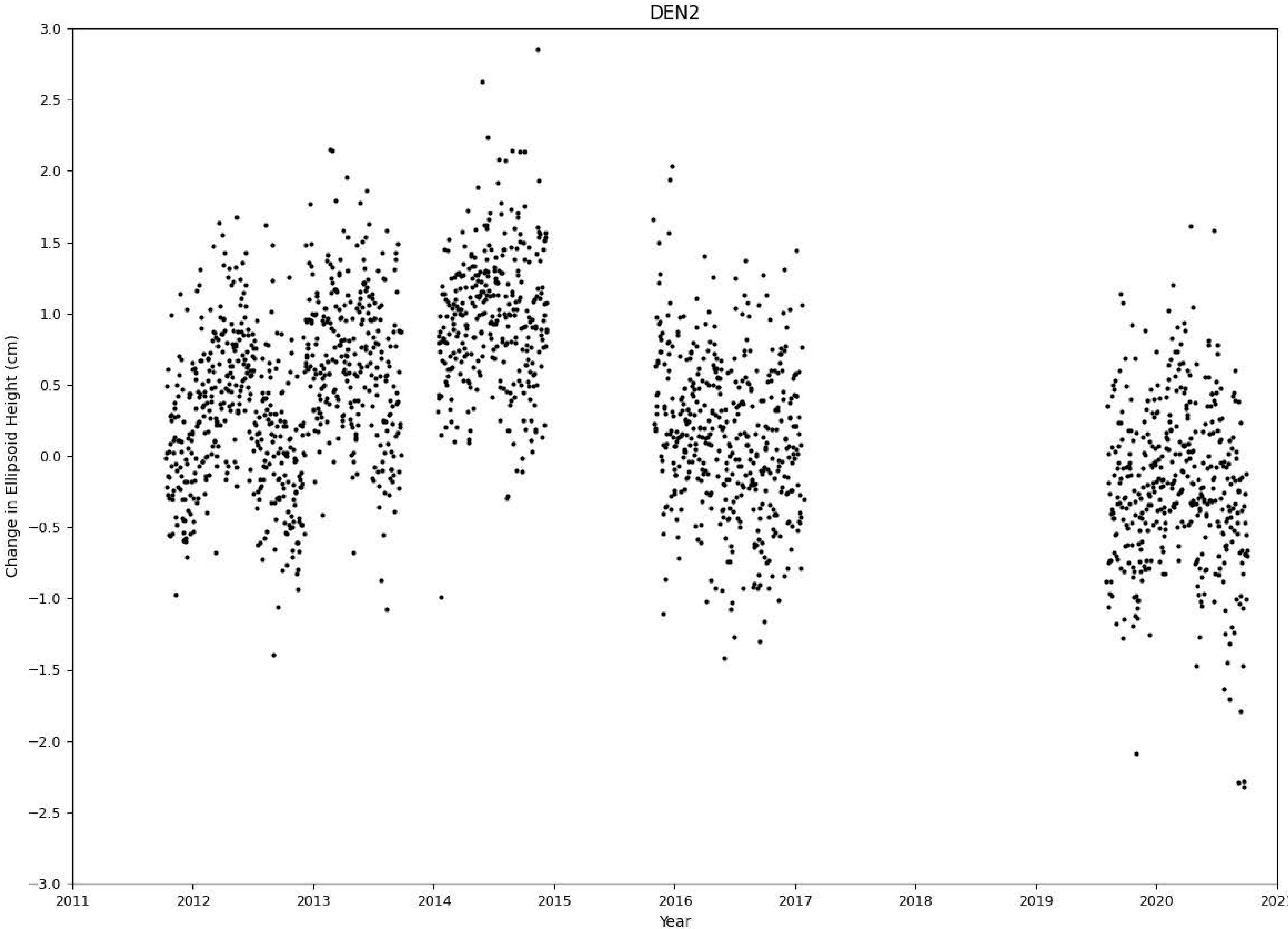
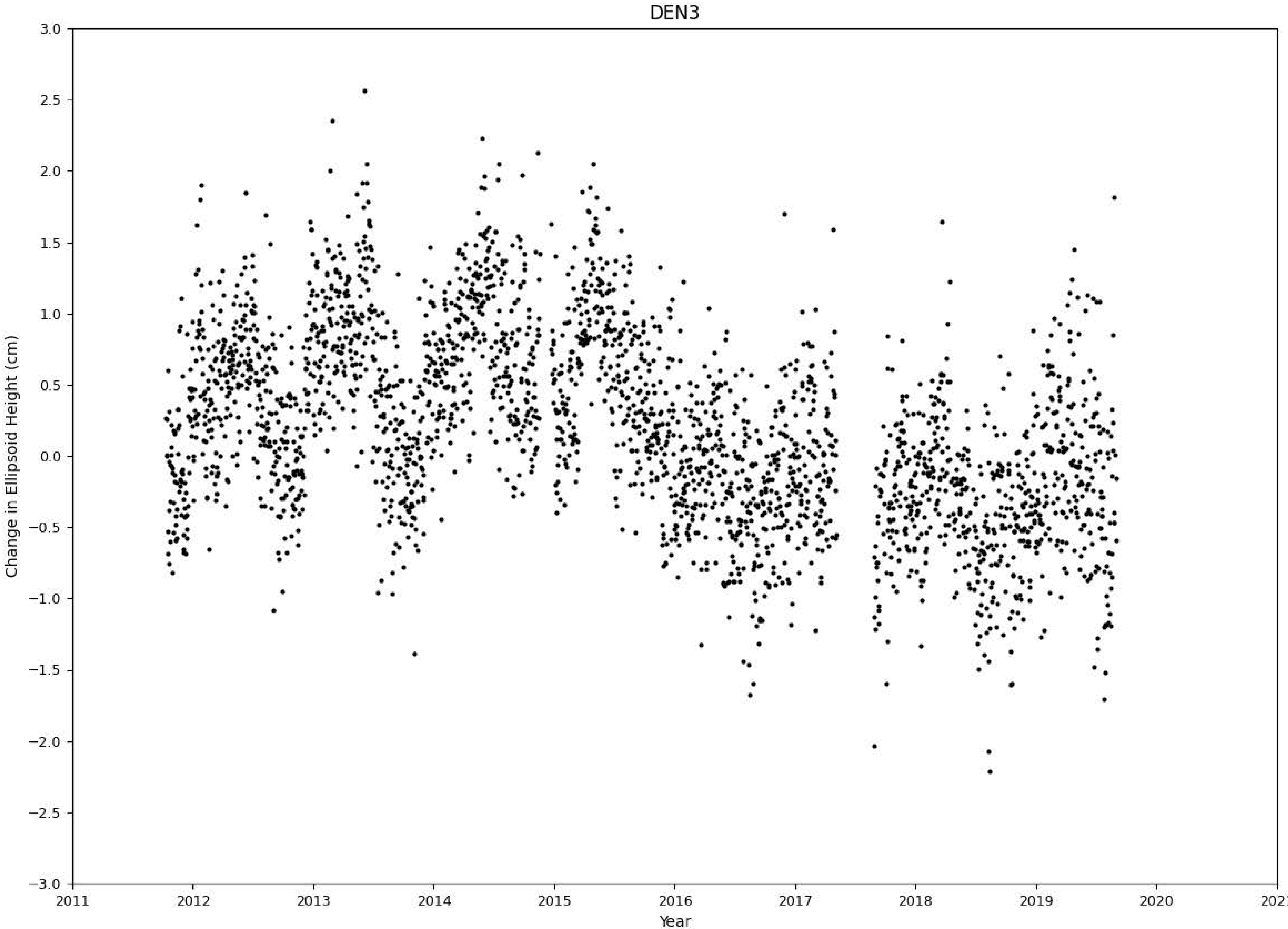
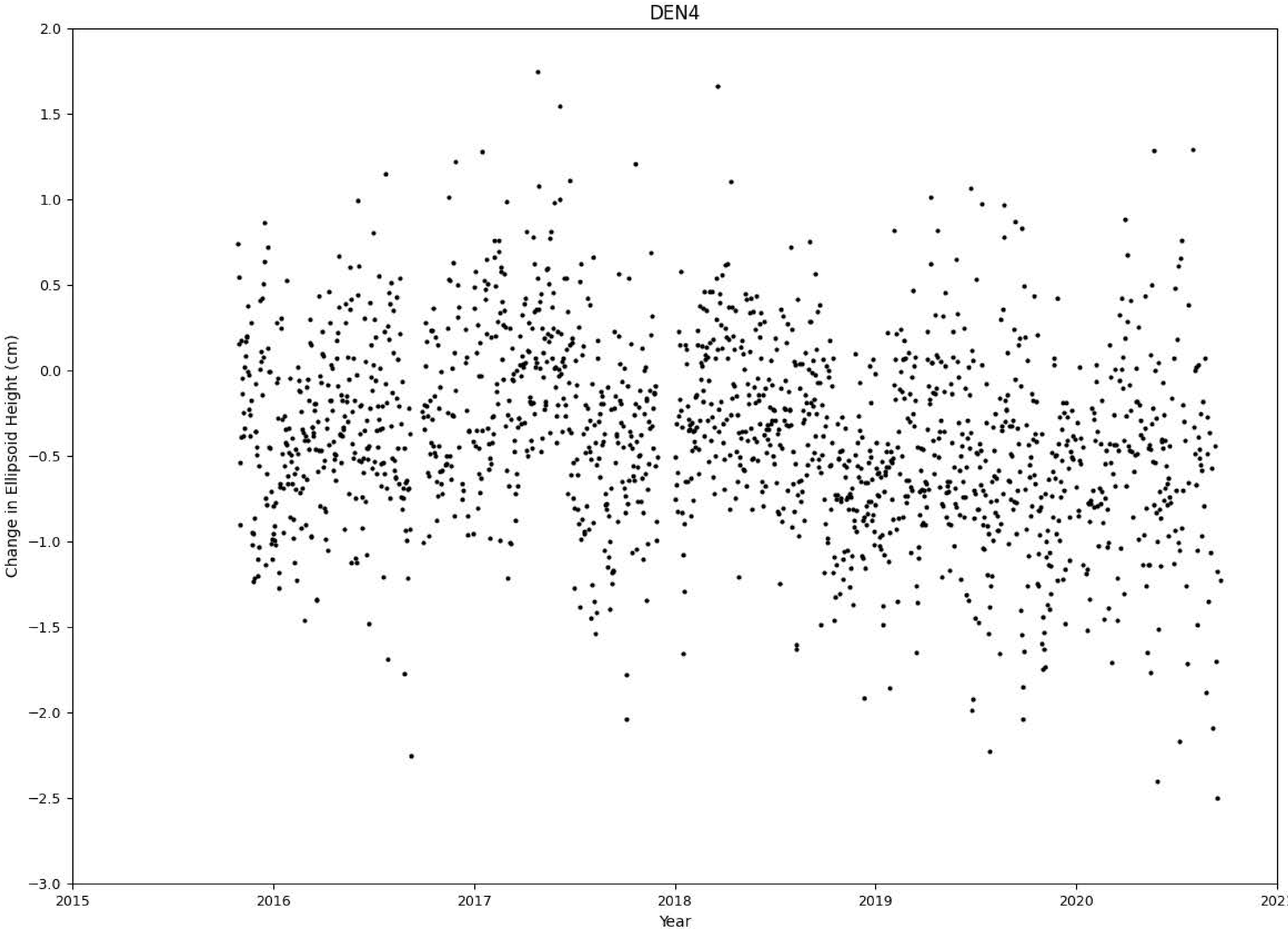
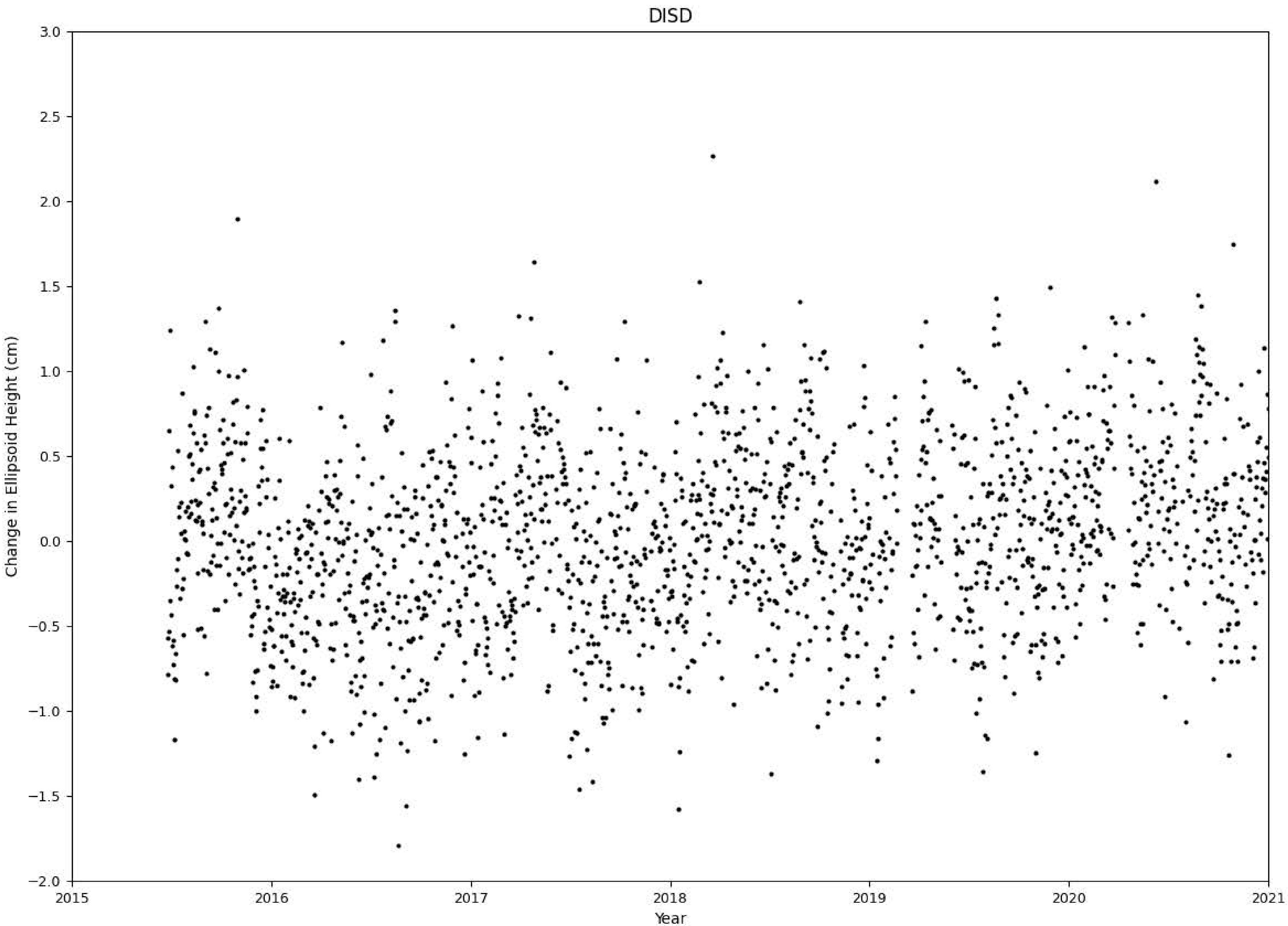
2017
2018
2019
2020
2021

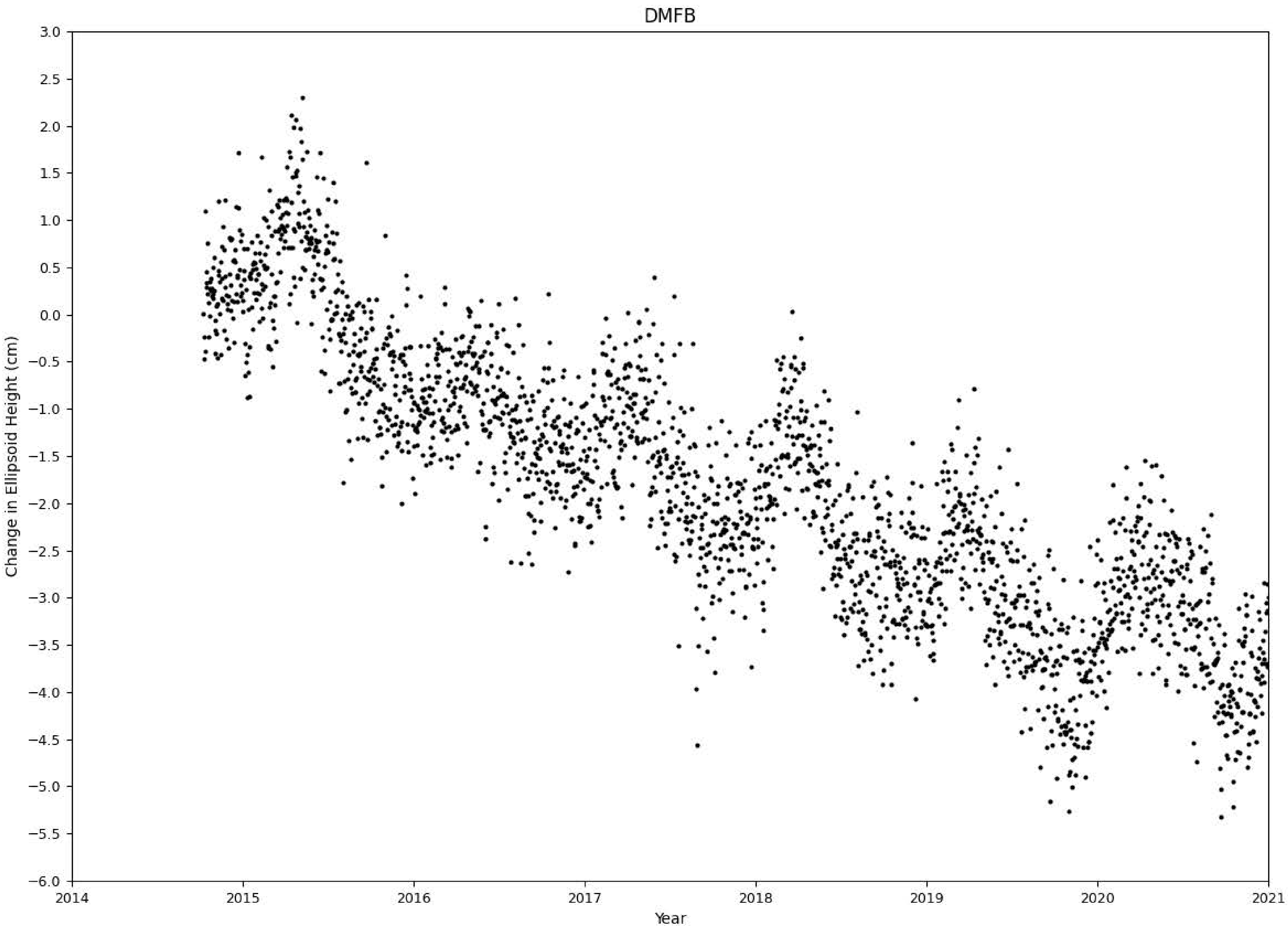


DEN2
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year


DEN3
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year


DEN4
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2015
2016
2017
2018
2019
2020
2021
Year


DISD
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2015
2016
2017
2018
2019
2020
2021
Year



DMFB
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
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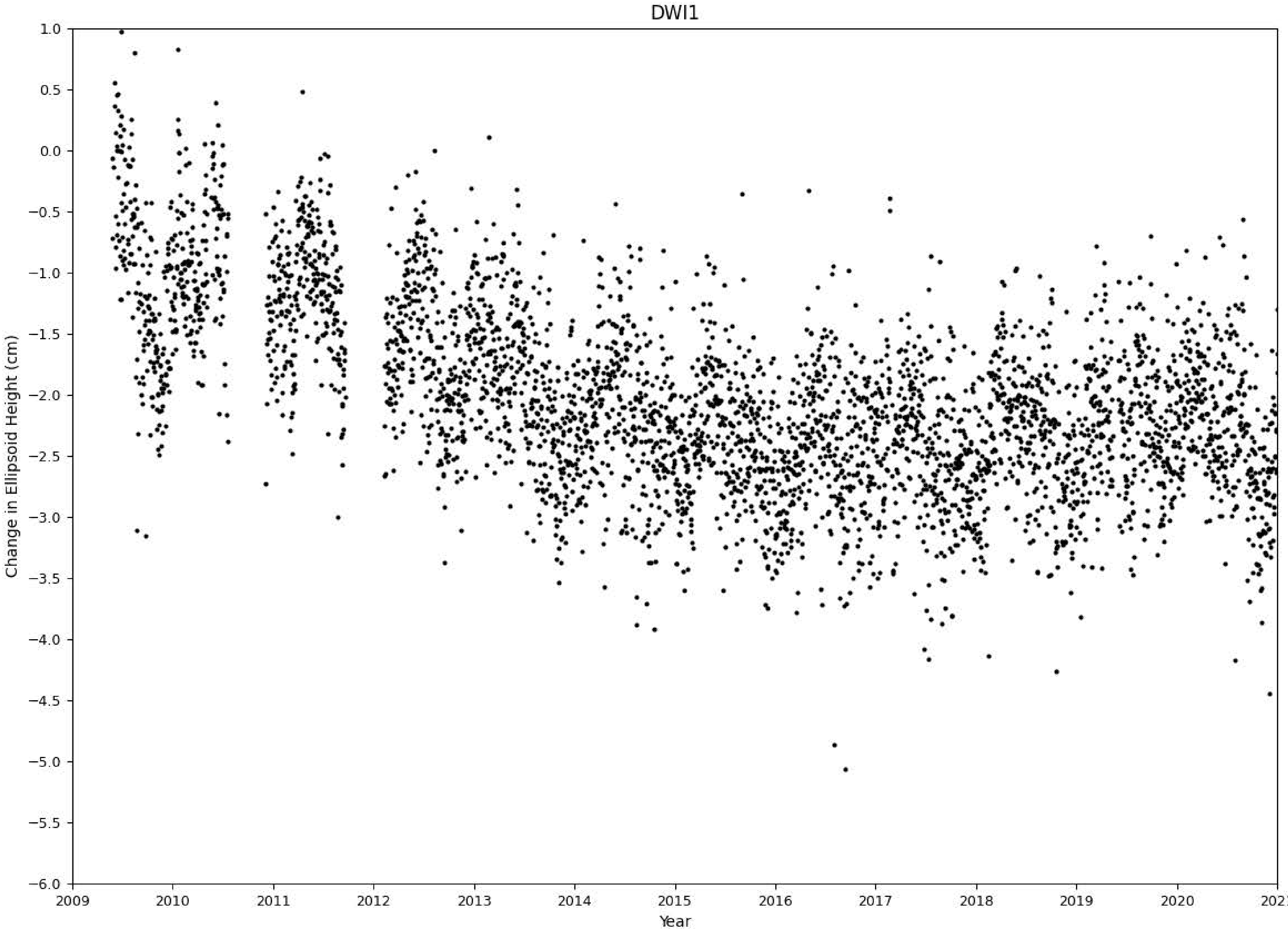
2017
2018
2019
2020
2021



DWI1
Change in Ellipsoid Height (cm)
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
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2018
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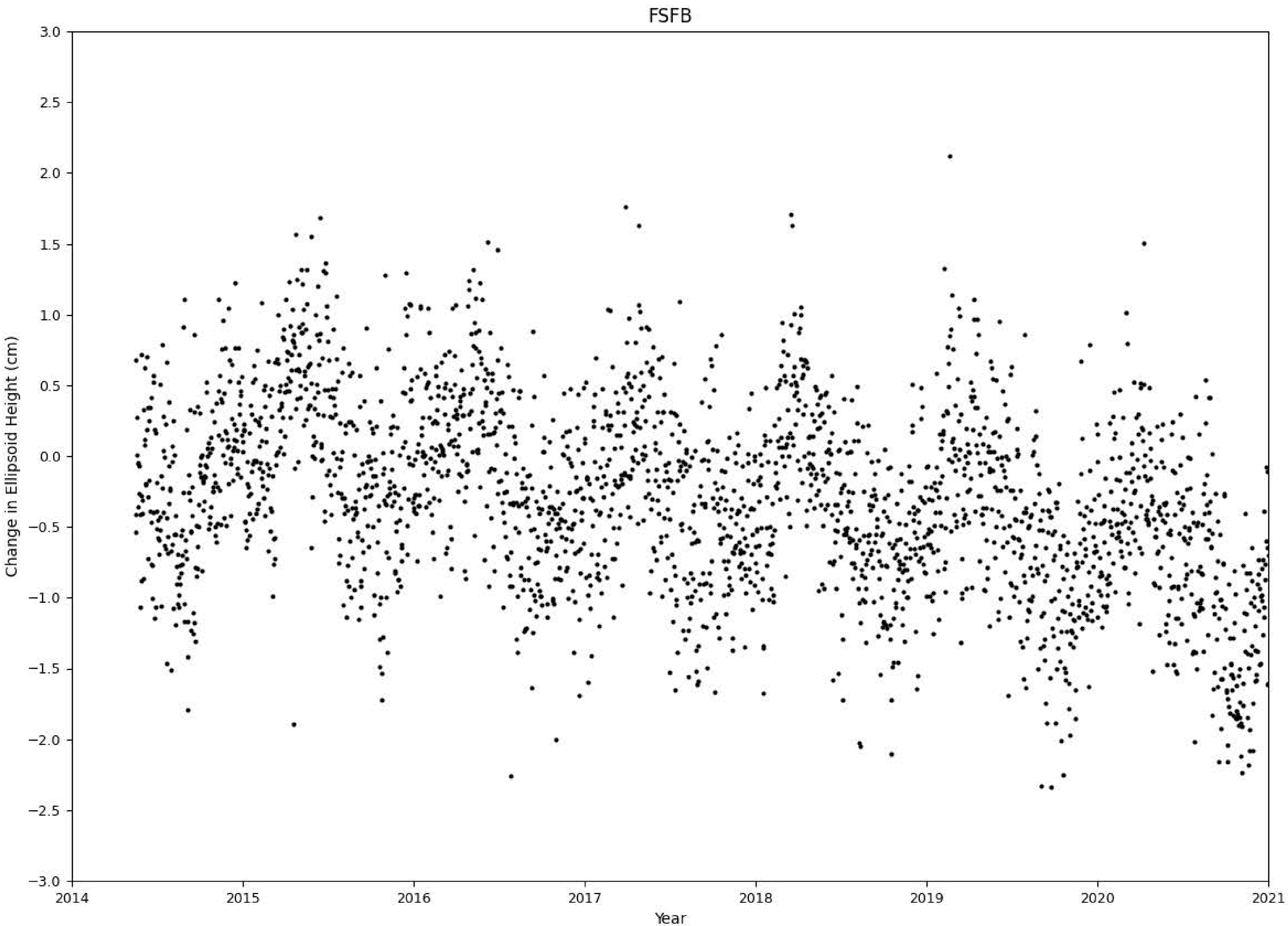
2020
2021
Year



FSFB
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
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−1.0
−1.5
−2.0
−2.5
−3.0
2014
2015
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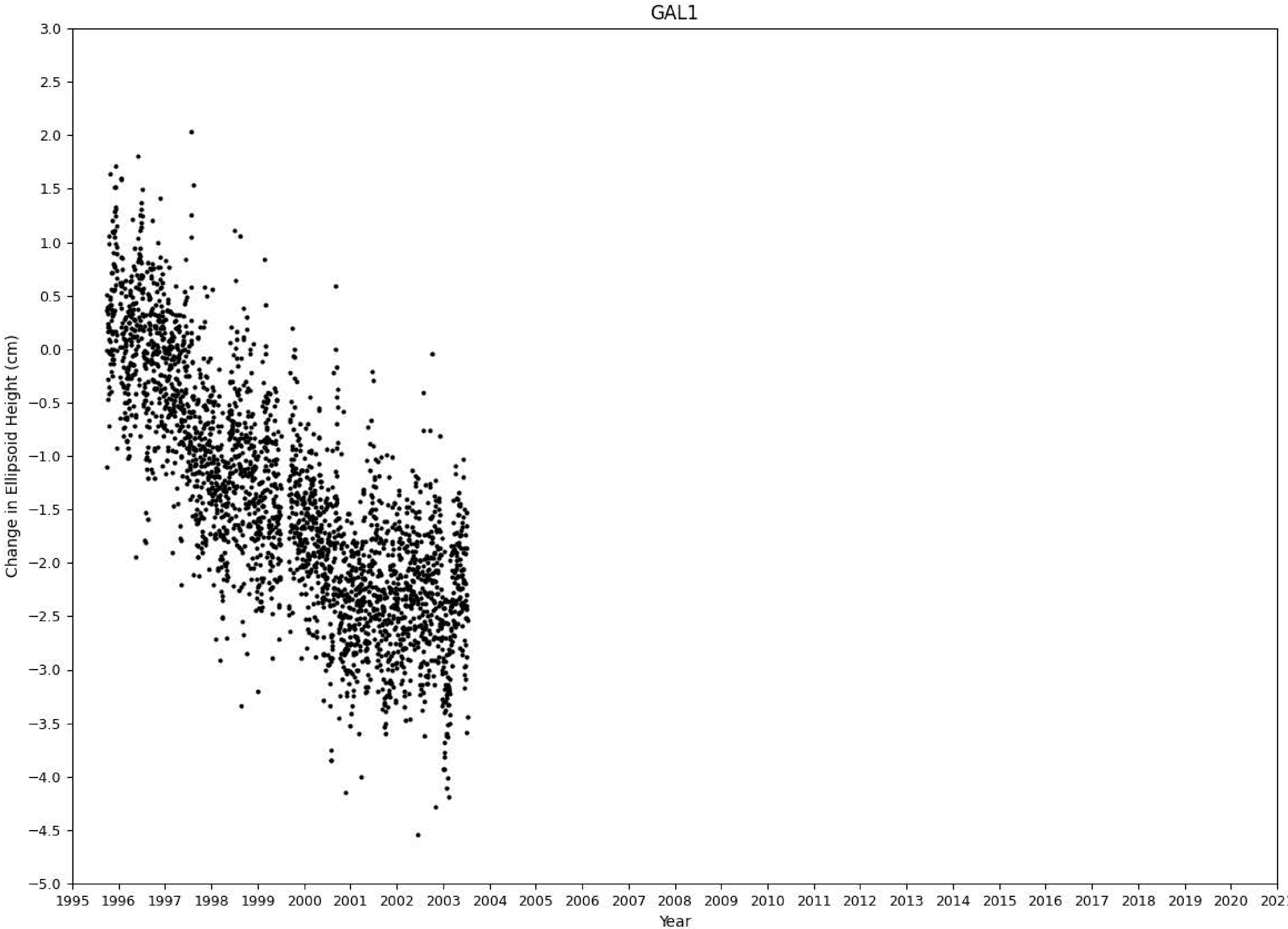
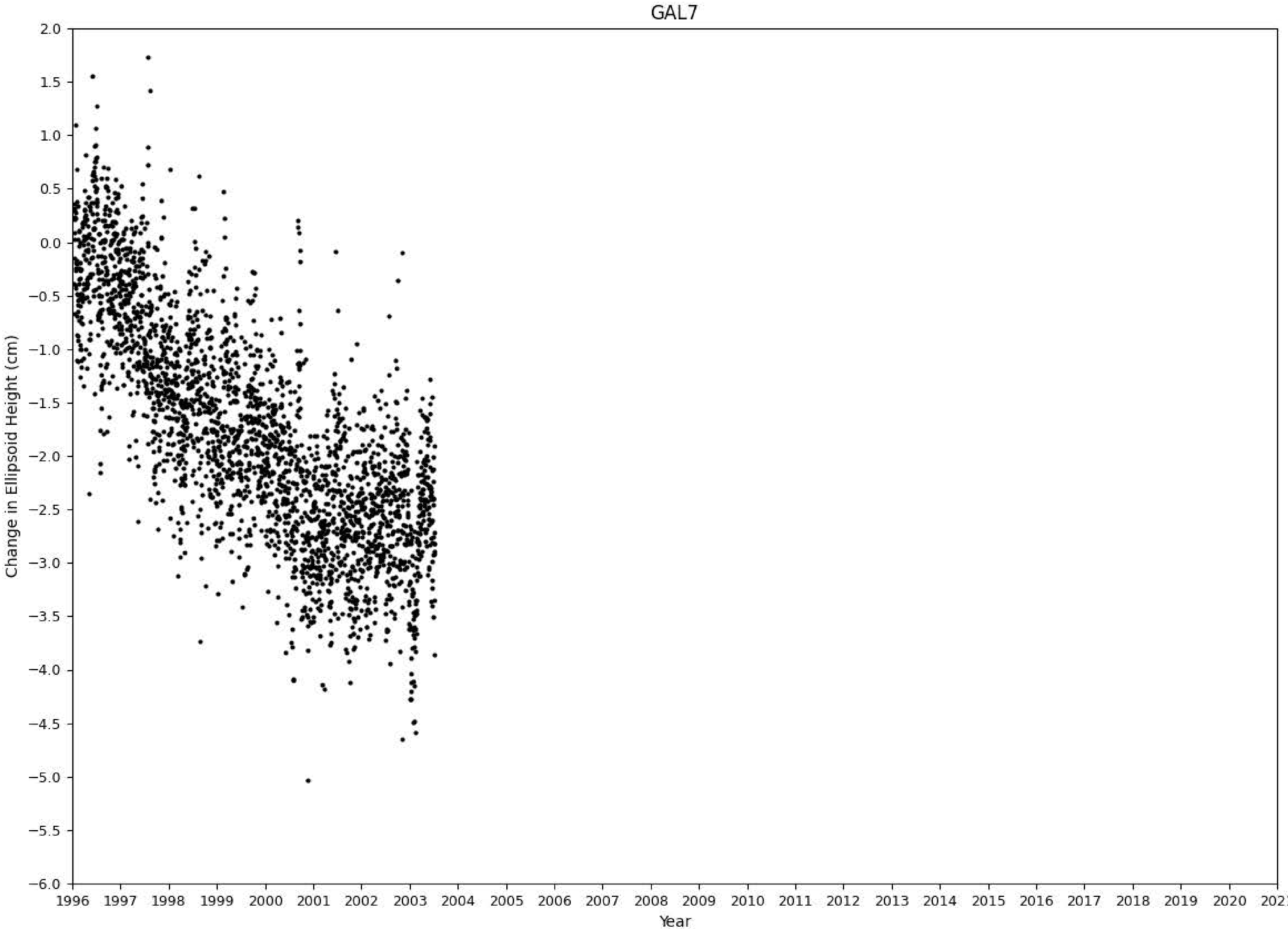
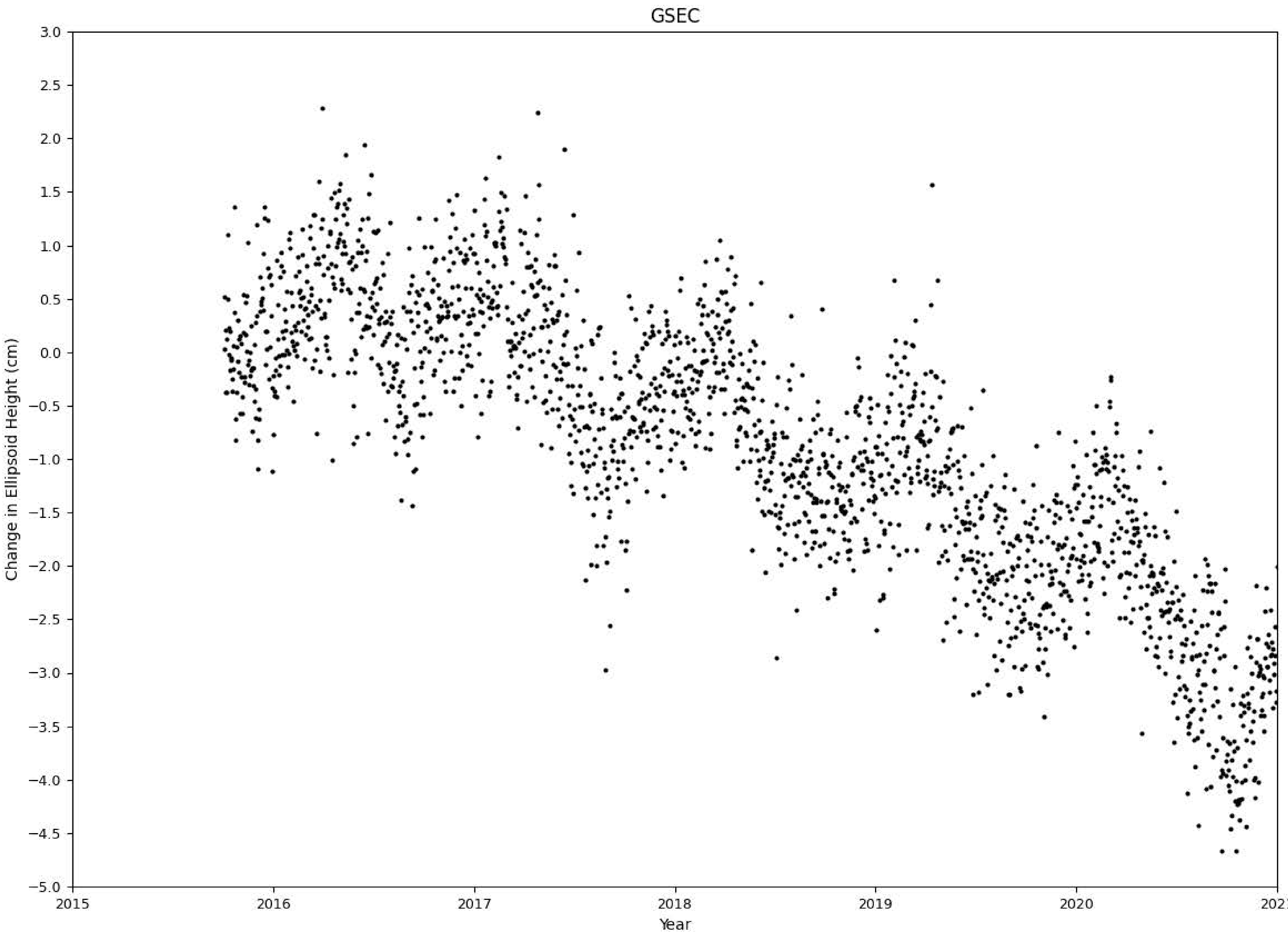
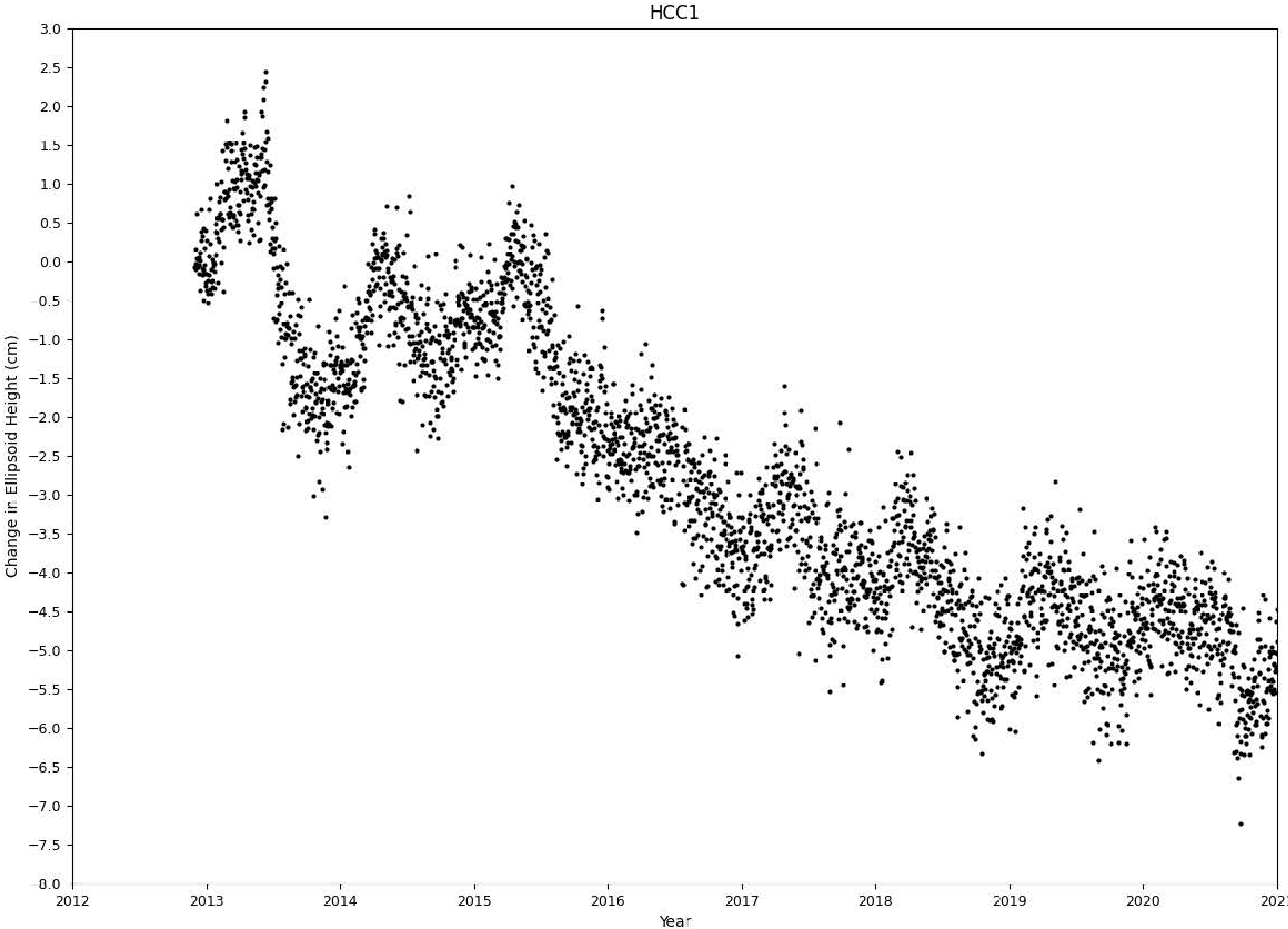
2020
2021


GAL1
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


GAL7
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


GSEC
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
2015
2016
2017
2018
2019
2020
2021
Year



HCC1
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
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−7.5
−8.0
2012
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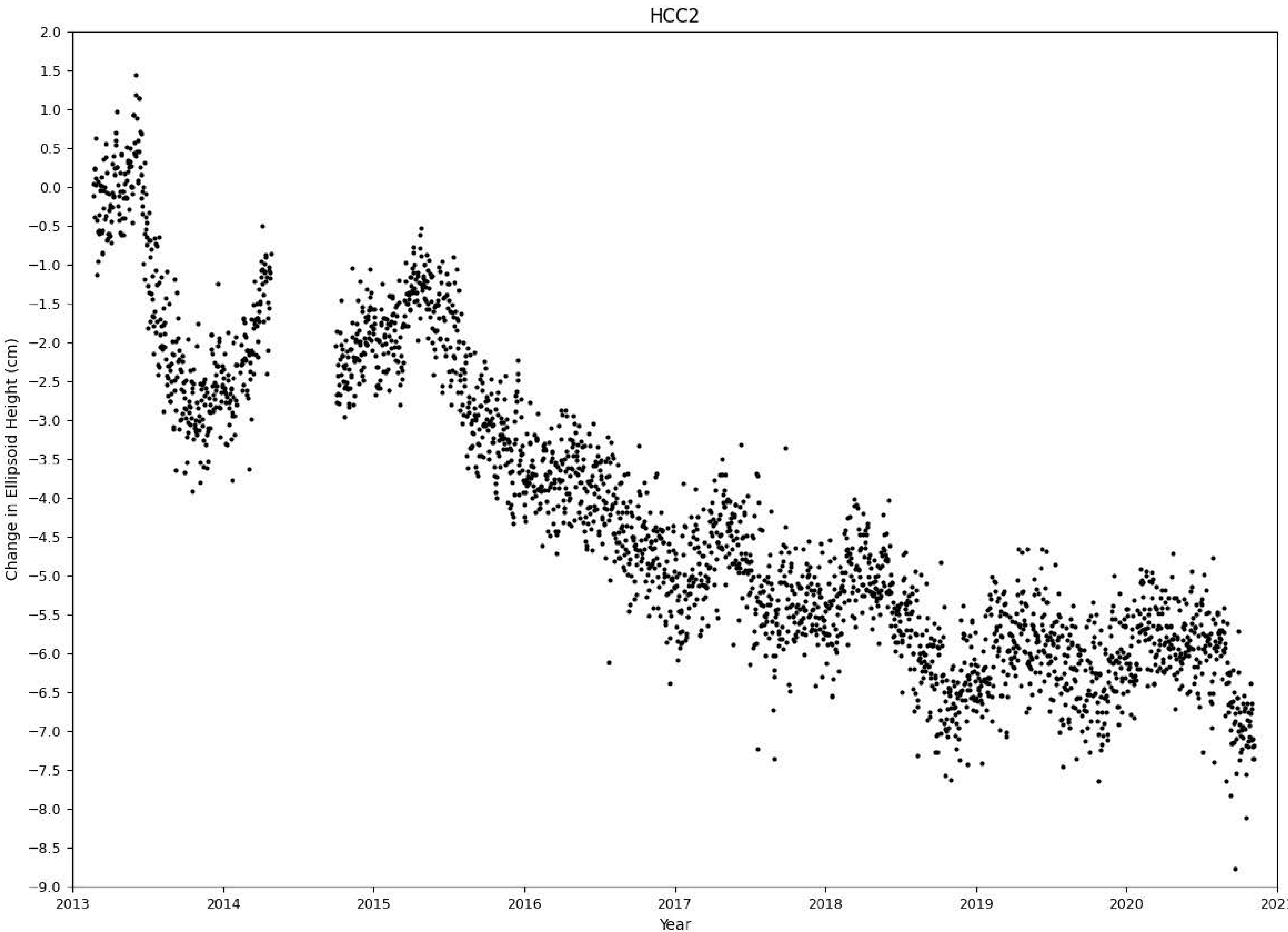
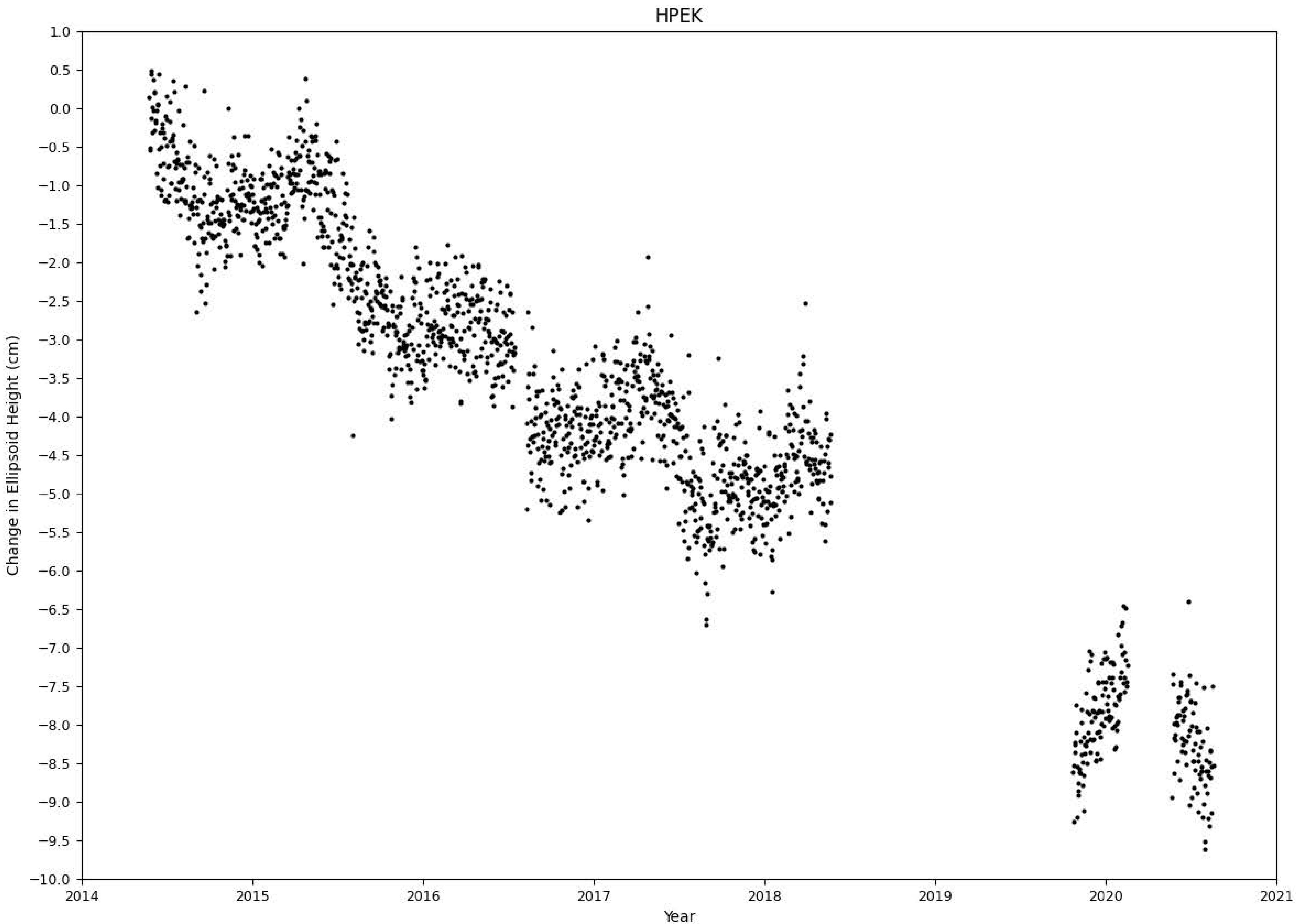
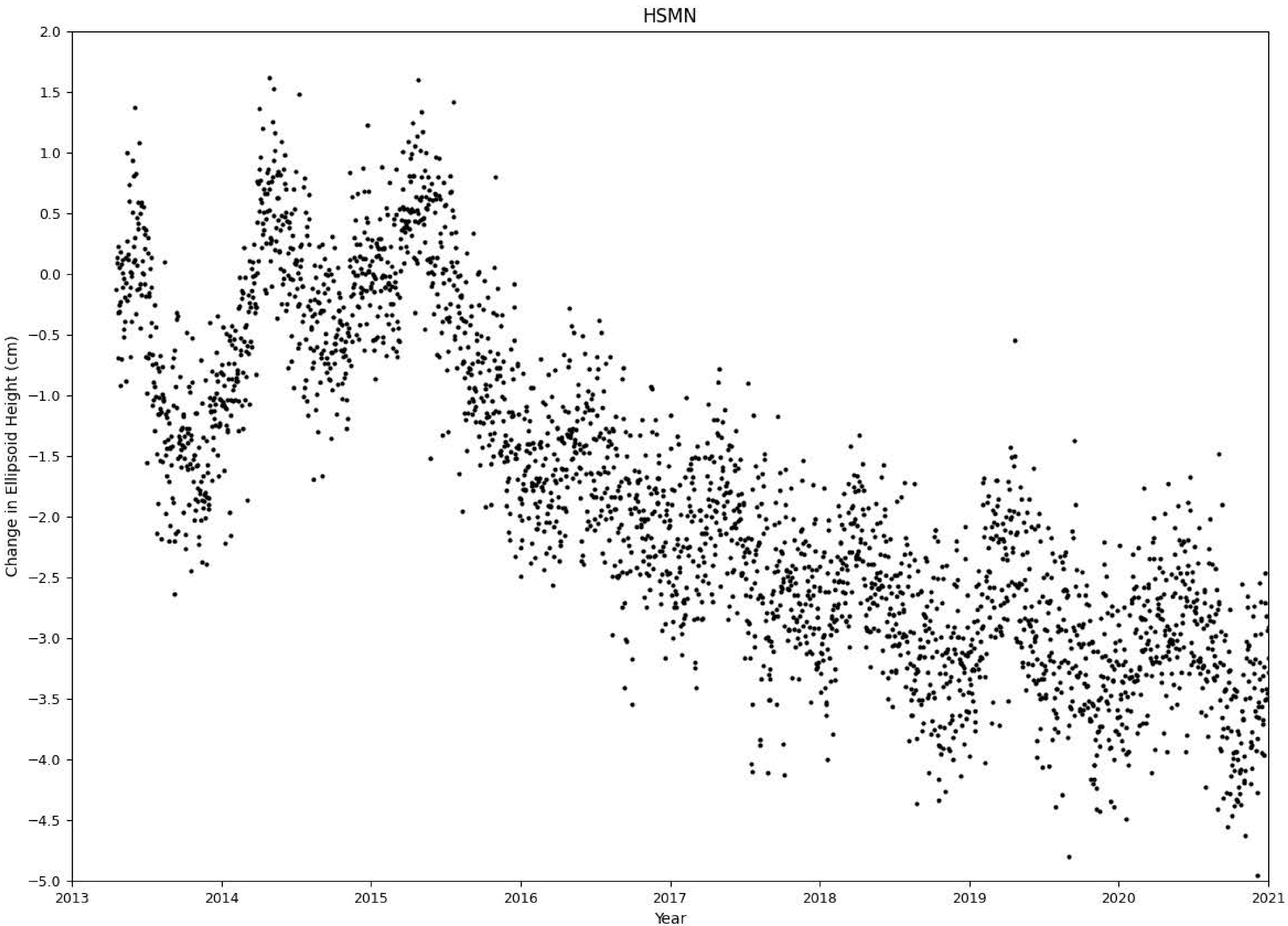
2017
2018
2019
2020
2021

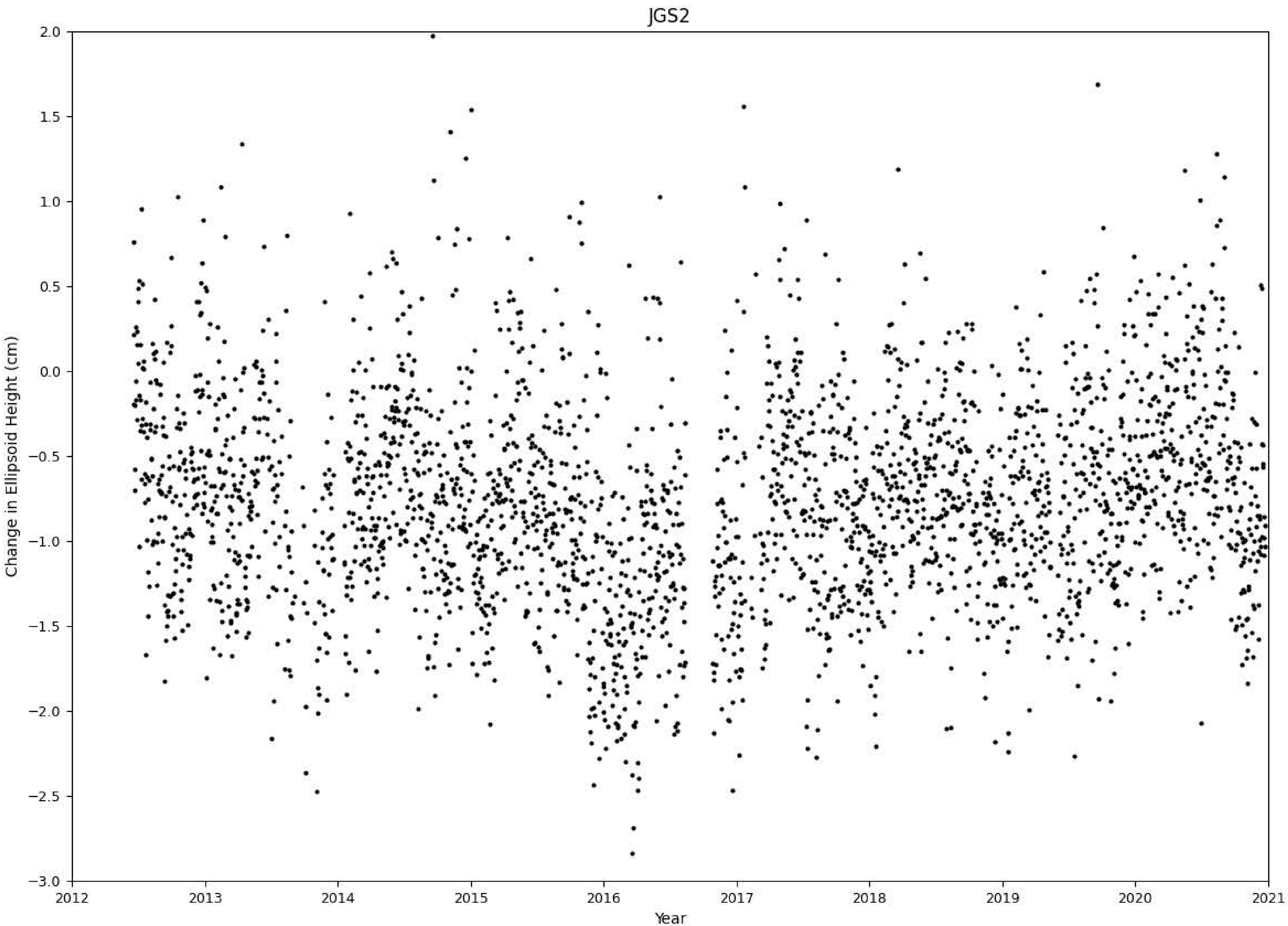


HCC2
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
2013
2014
2015
2016
2017
2018
2019
2020
2021


HPEK
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
-0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
-6.5
−7.0
−7.5
−8.0
−8.5
−9.0
−9.5
−10.0
2014
2015
2016
2017
2018
2019
2020
2021



HSMN
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2013
2014
2015
2016
2017
2018
2019
2020
2021



JGS2
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2012
2013
2014
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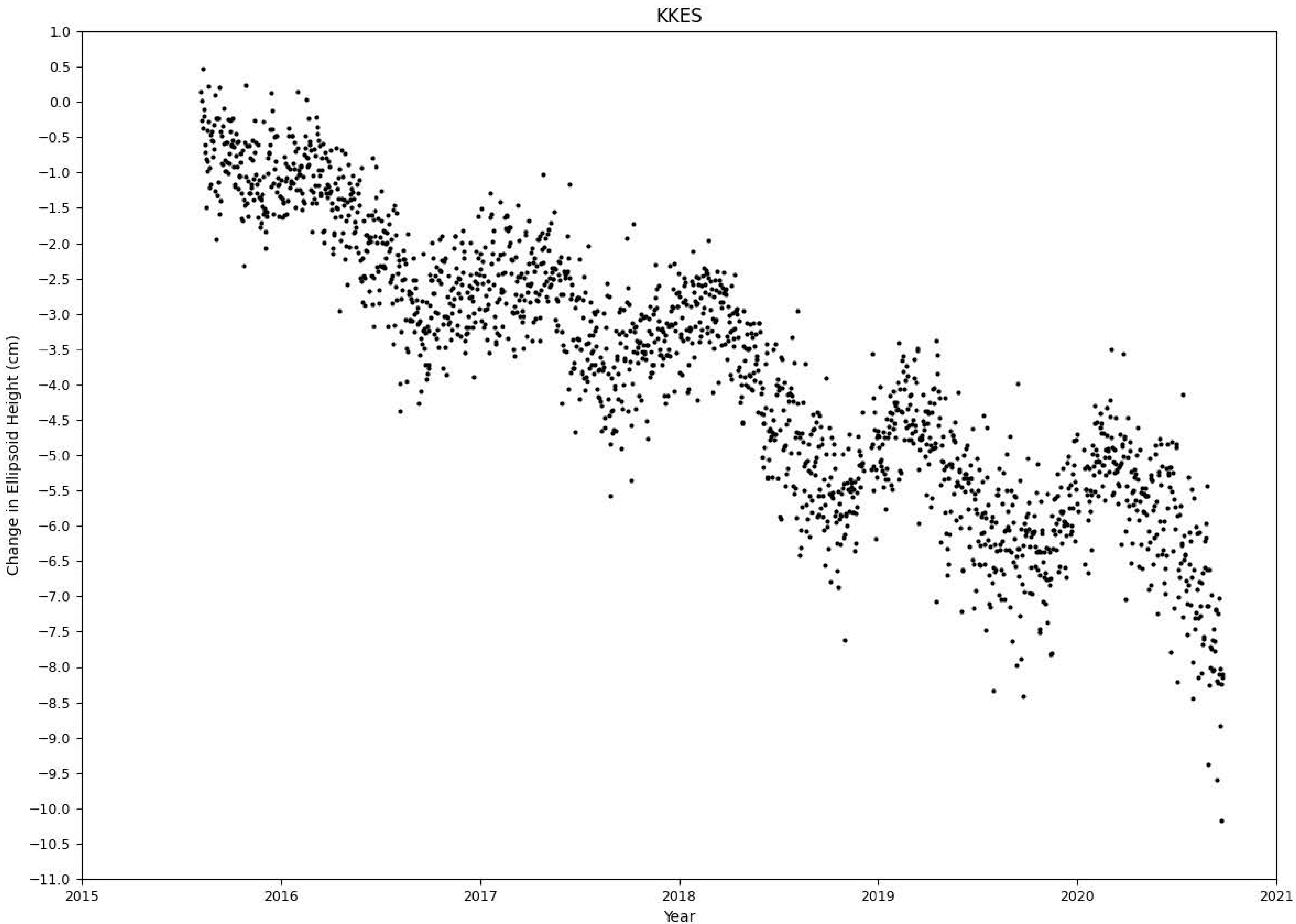
2021


KKES
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
−9.5
−10.0
−10.5
−11.0
2015
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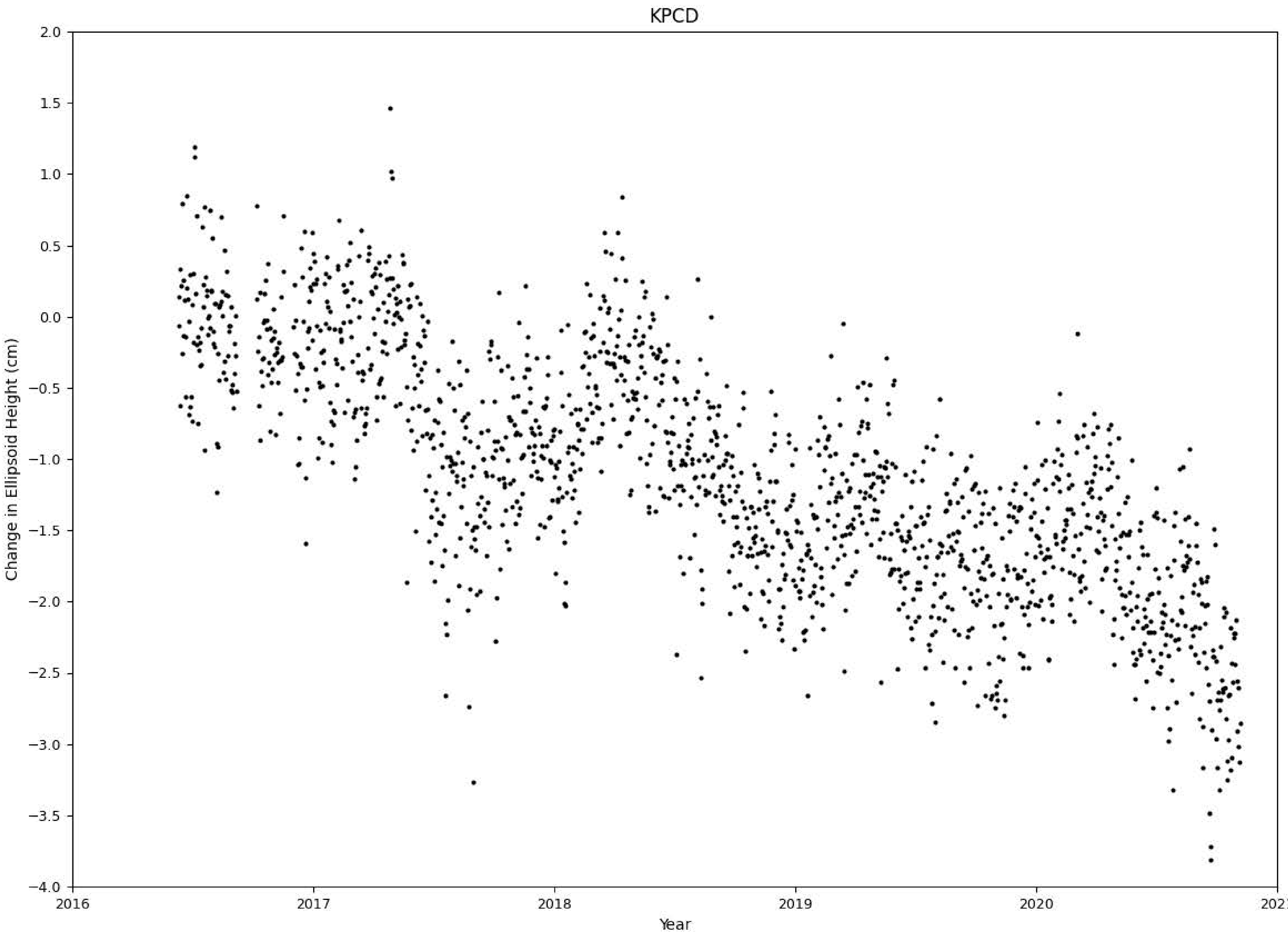
2020
2021


KPCD
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2016
2017
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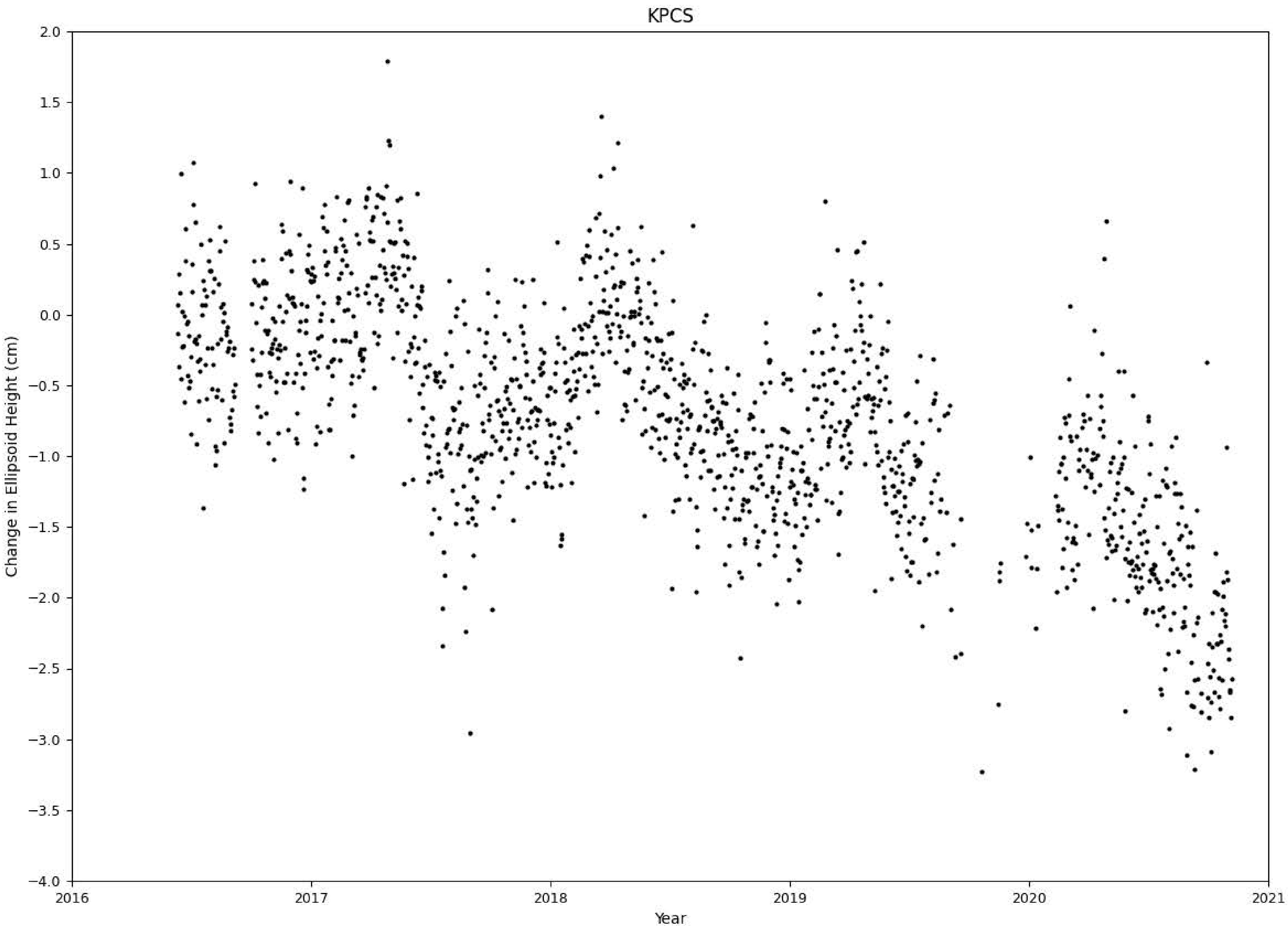
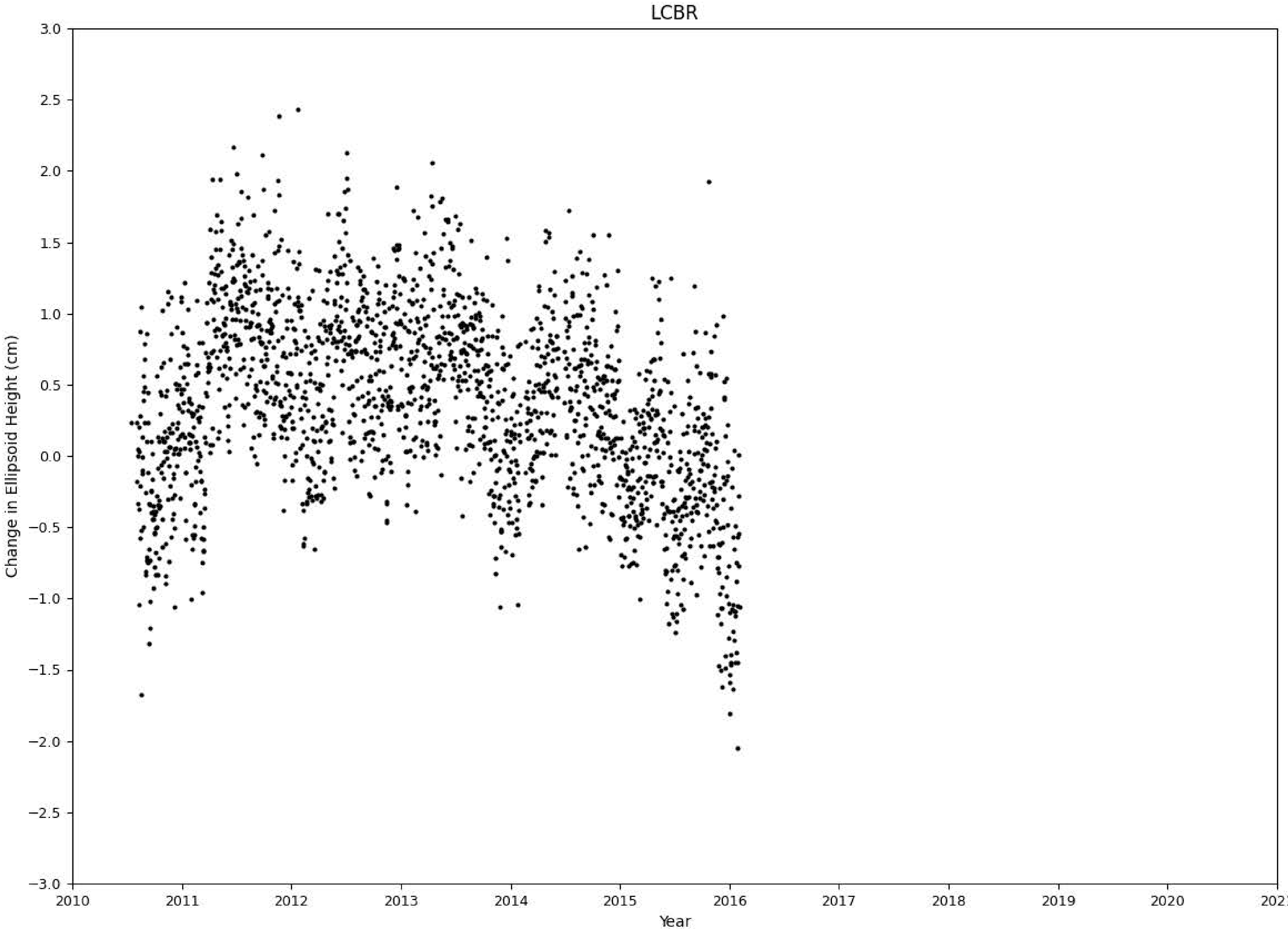
2019
2020
2021


KPCS
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
Change in Ellipsoid Height (cm)
2016
2017
2018
2019
2020
2021
Year


LCBR
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2010
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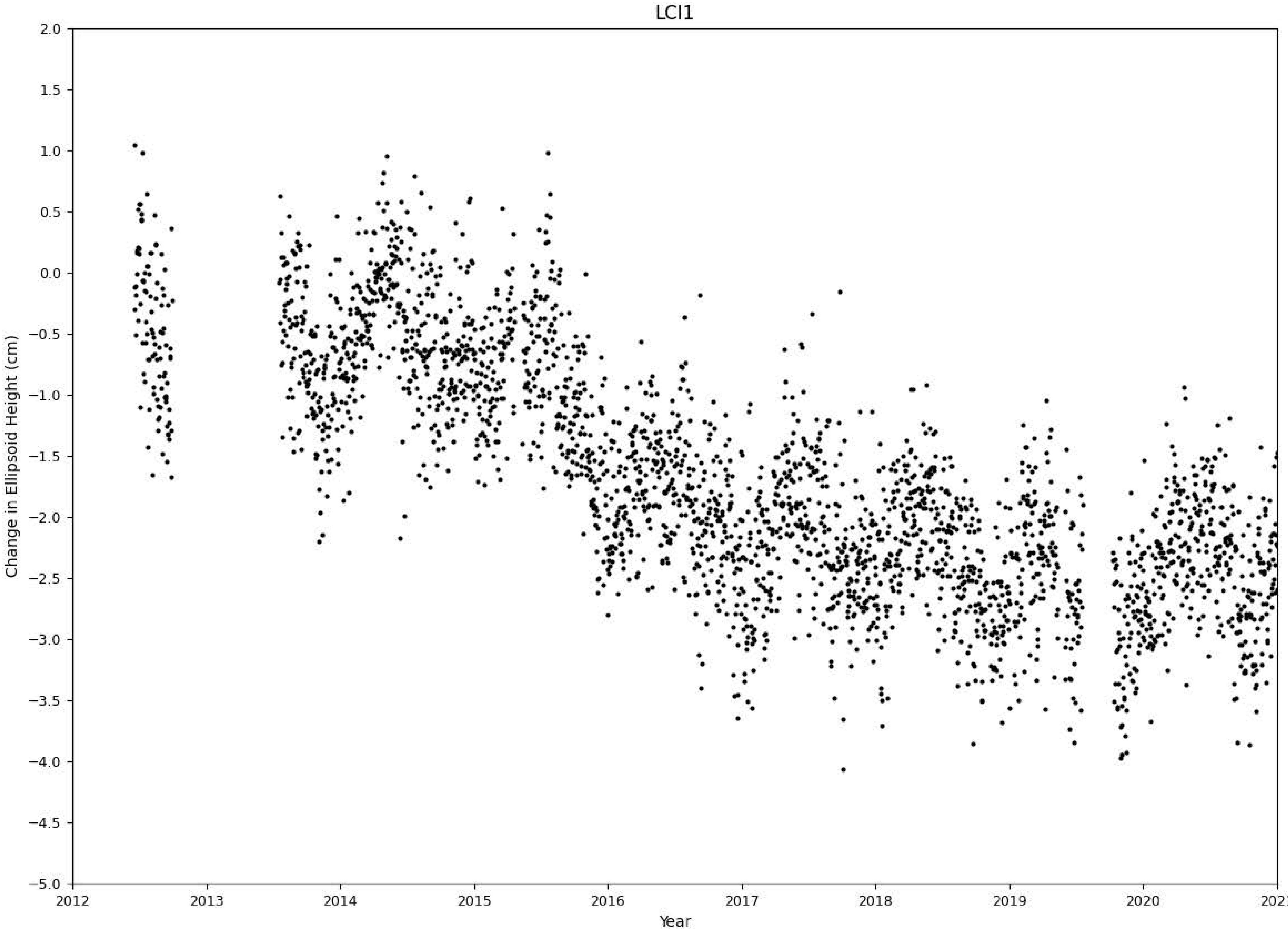

LCI1
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2012
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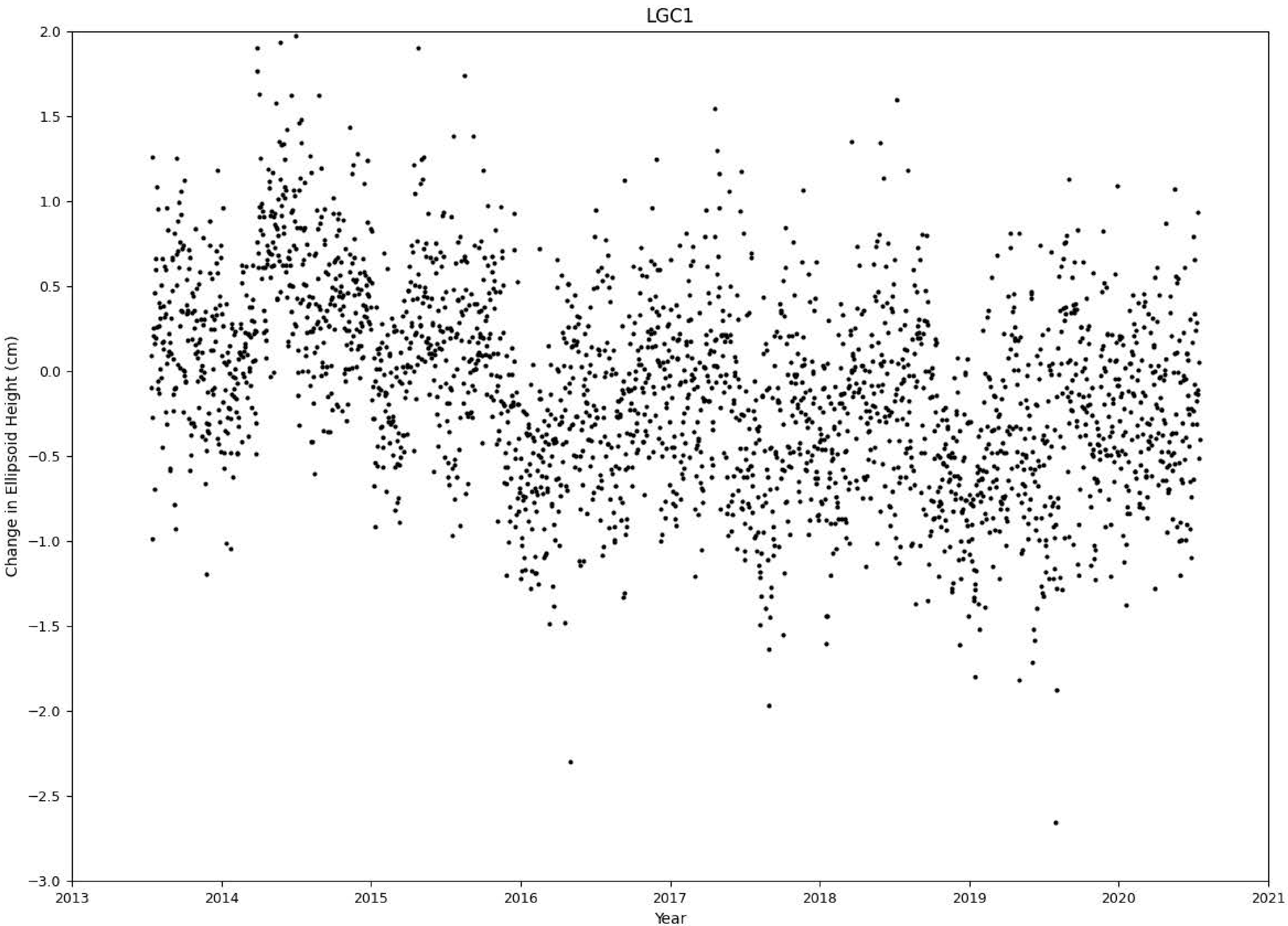
2021
Year



LGC1
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2013
2014
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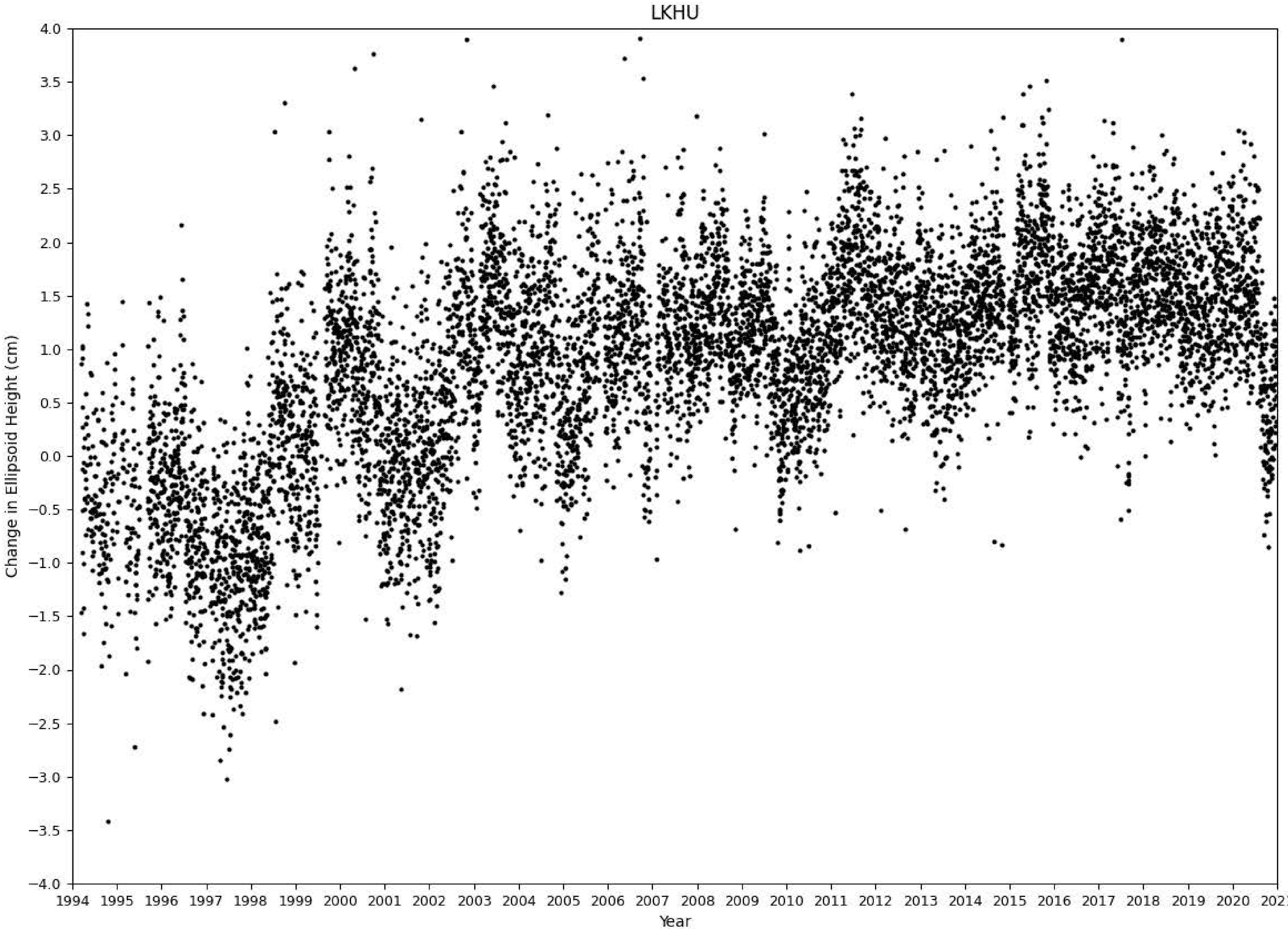
2021
Year



LKHU
Change in Ellipsoid Height (cm)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
1994
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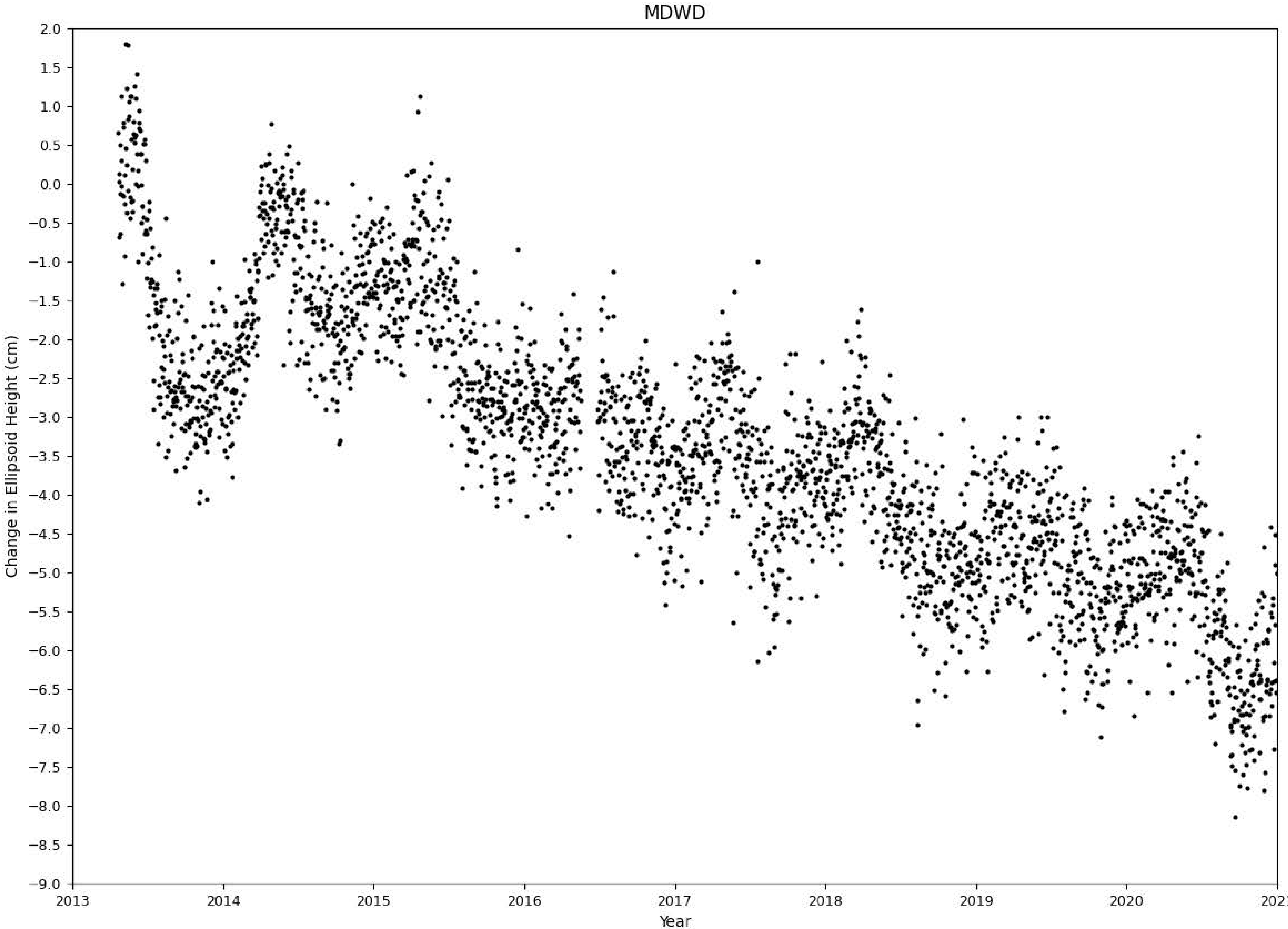
2021
Year



MDWD
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
2013
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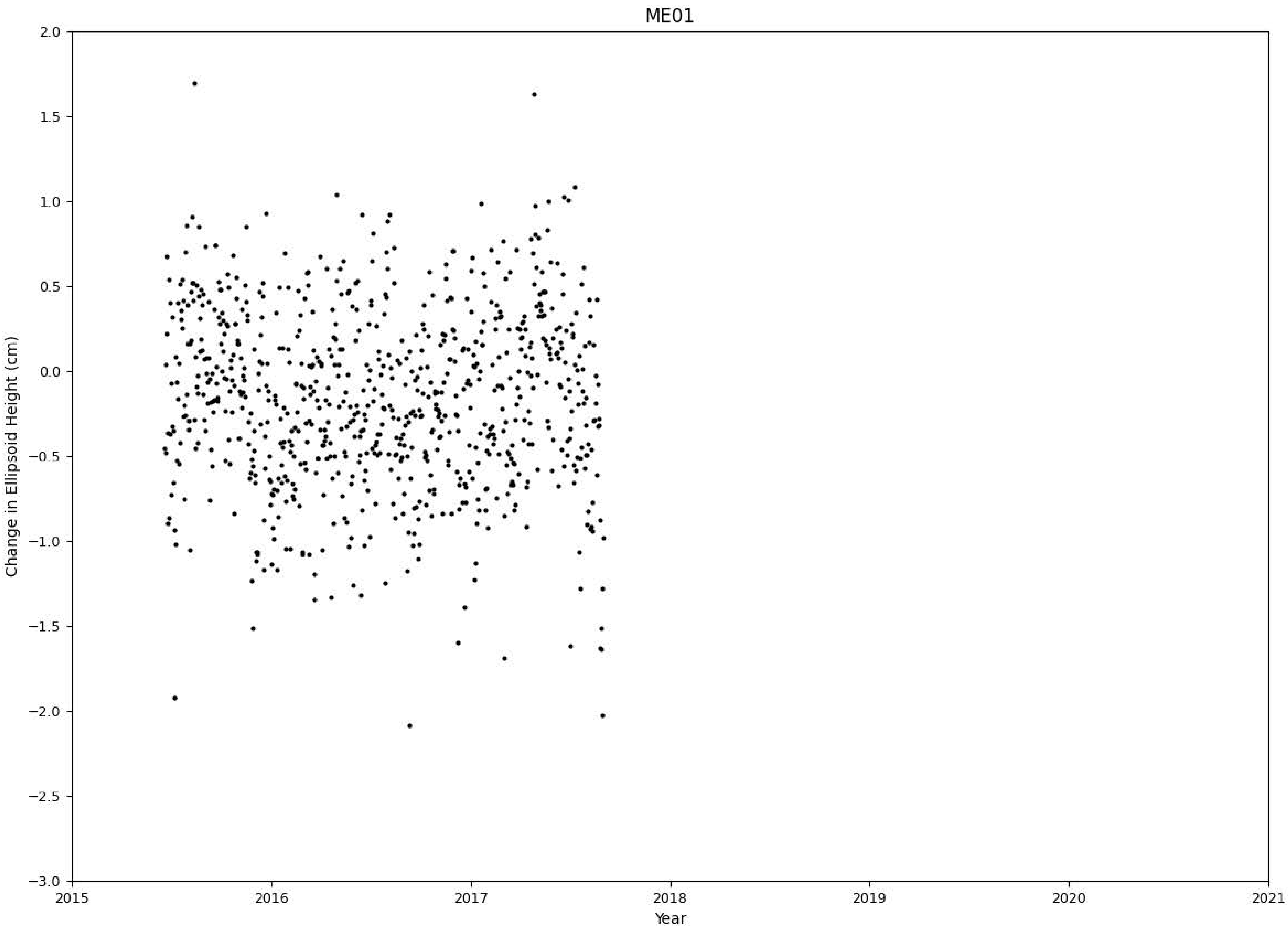
2020
2021
Year


ME01
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2015
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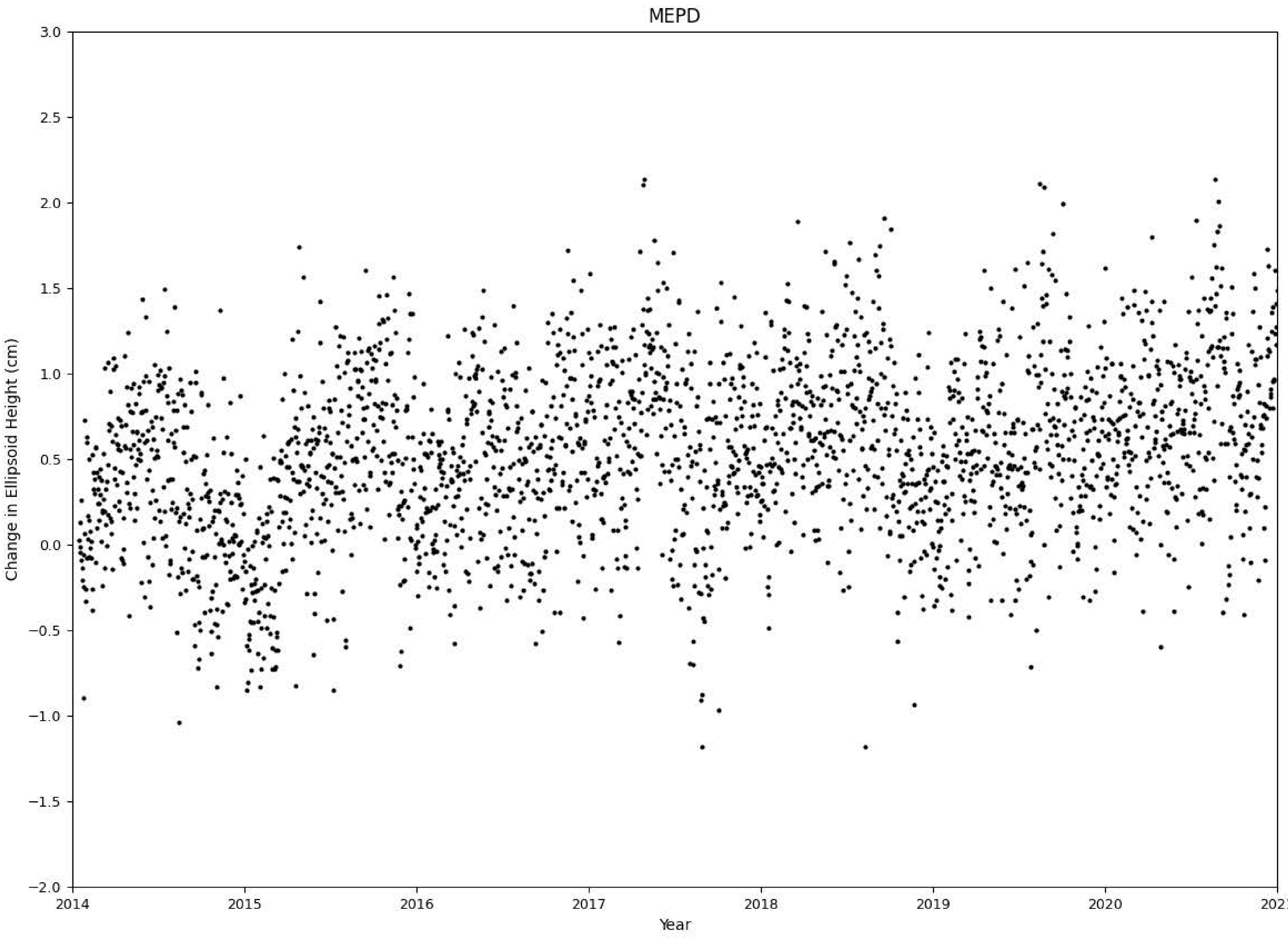
2020
2021


MEPD
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2014
2015
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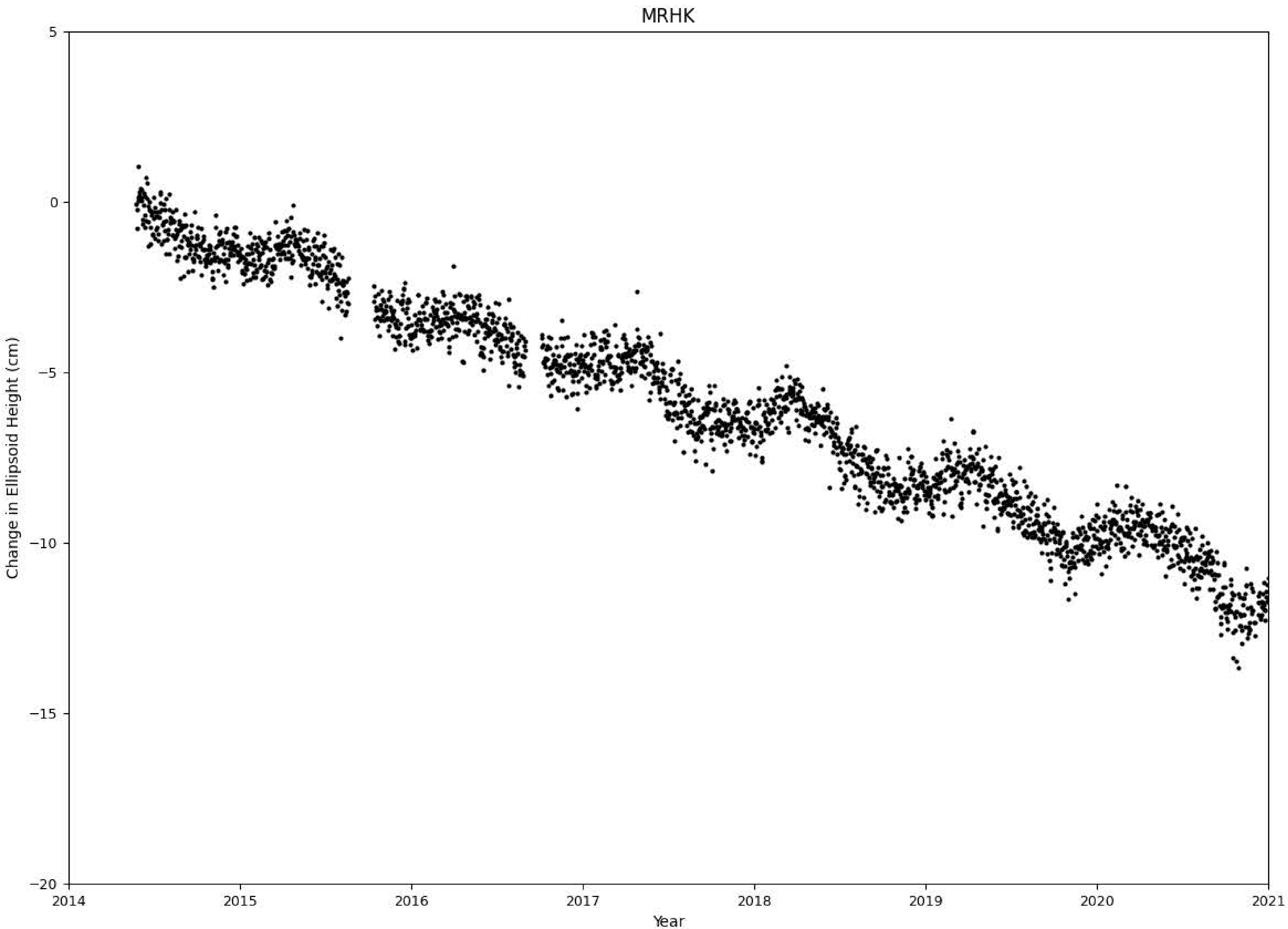
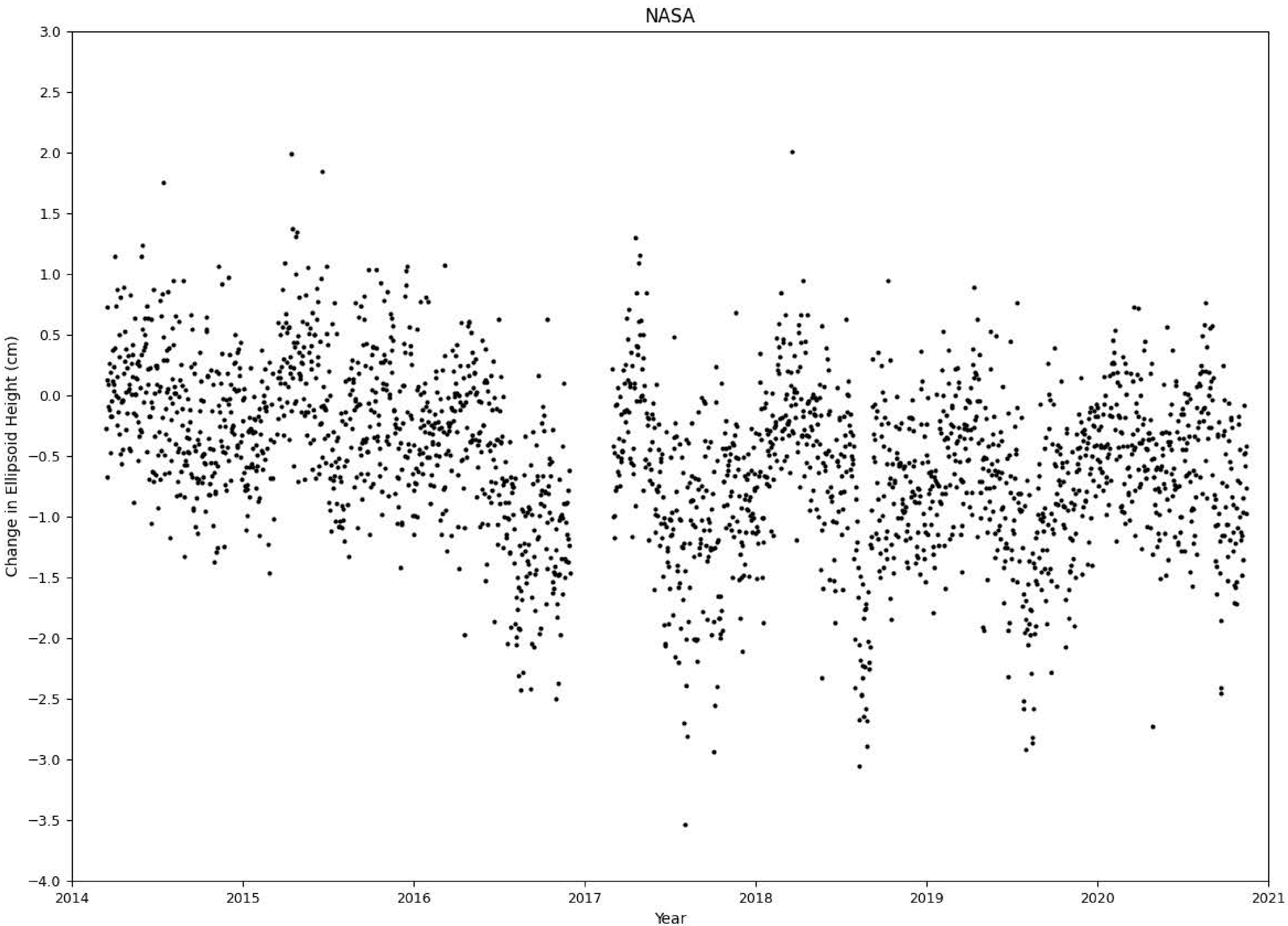
2020
2021


MRHK
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
2014
2015
2016
2017
2018
2019
2020
2021


NASA
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2014
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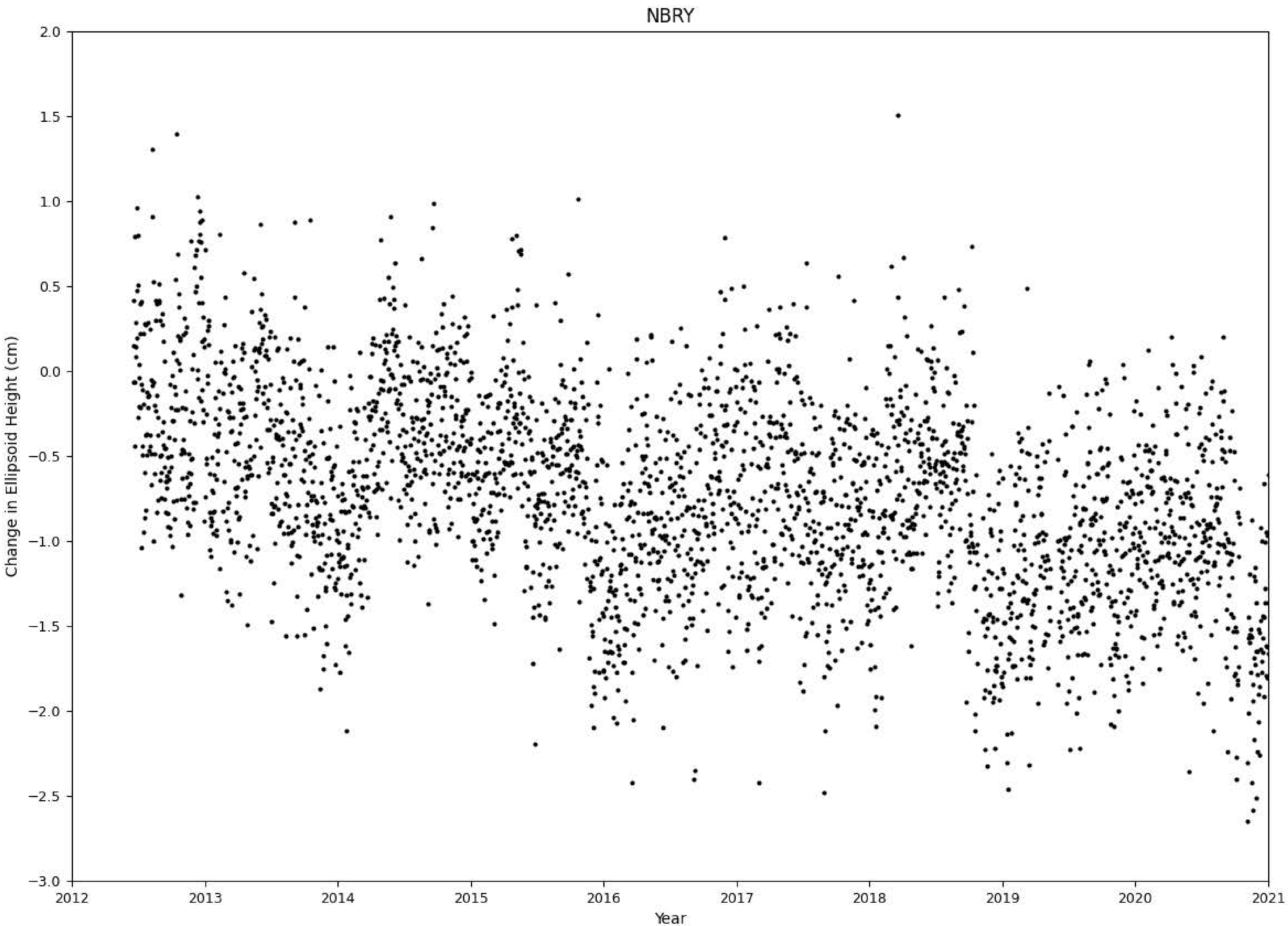

NBRY
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
Change in Ellipsoid Height (cm)
2012
2013
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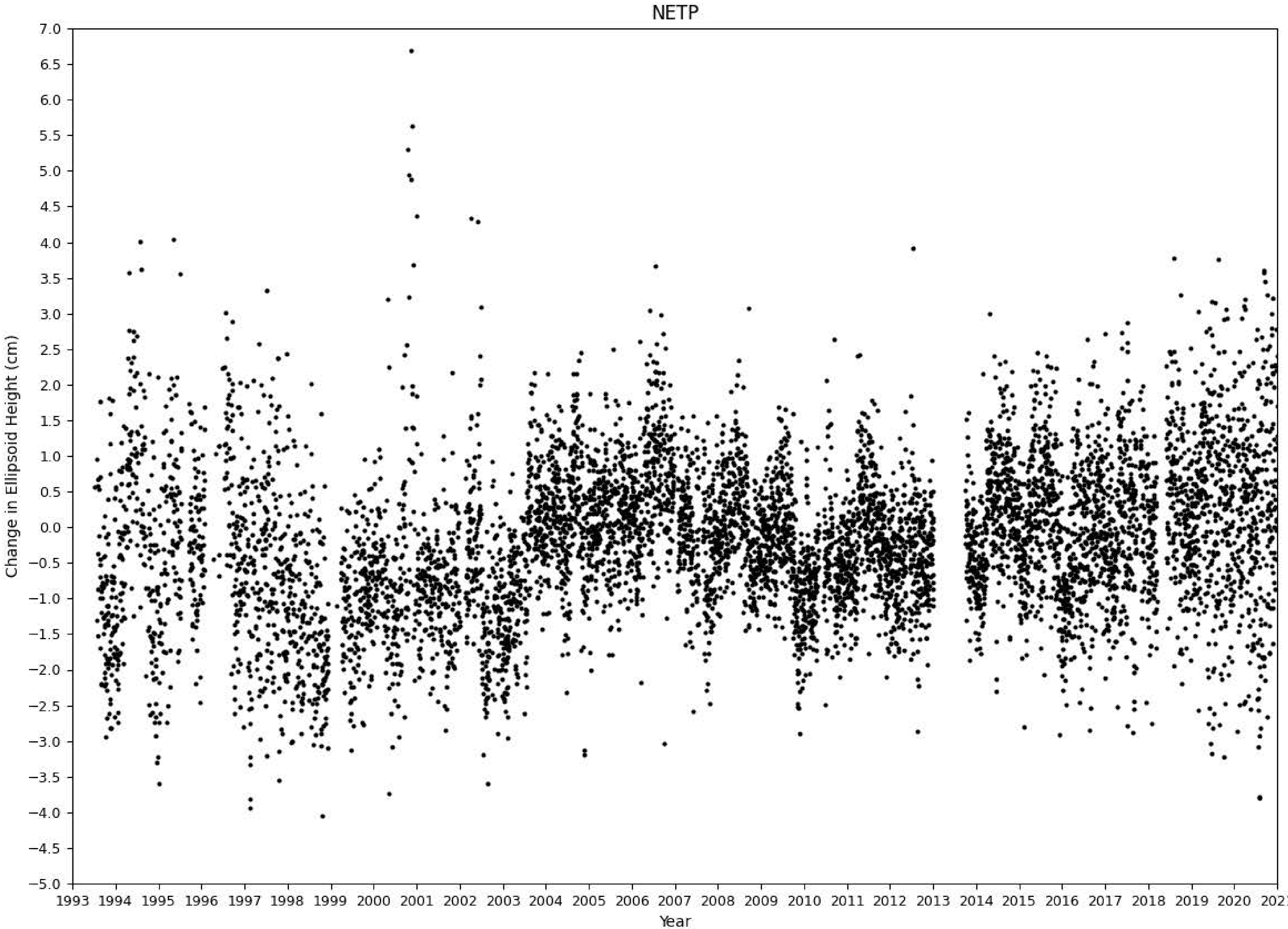
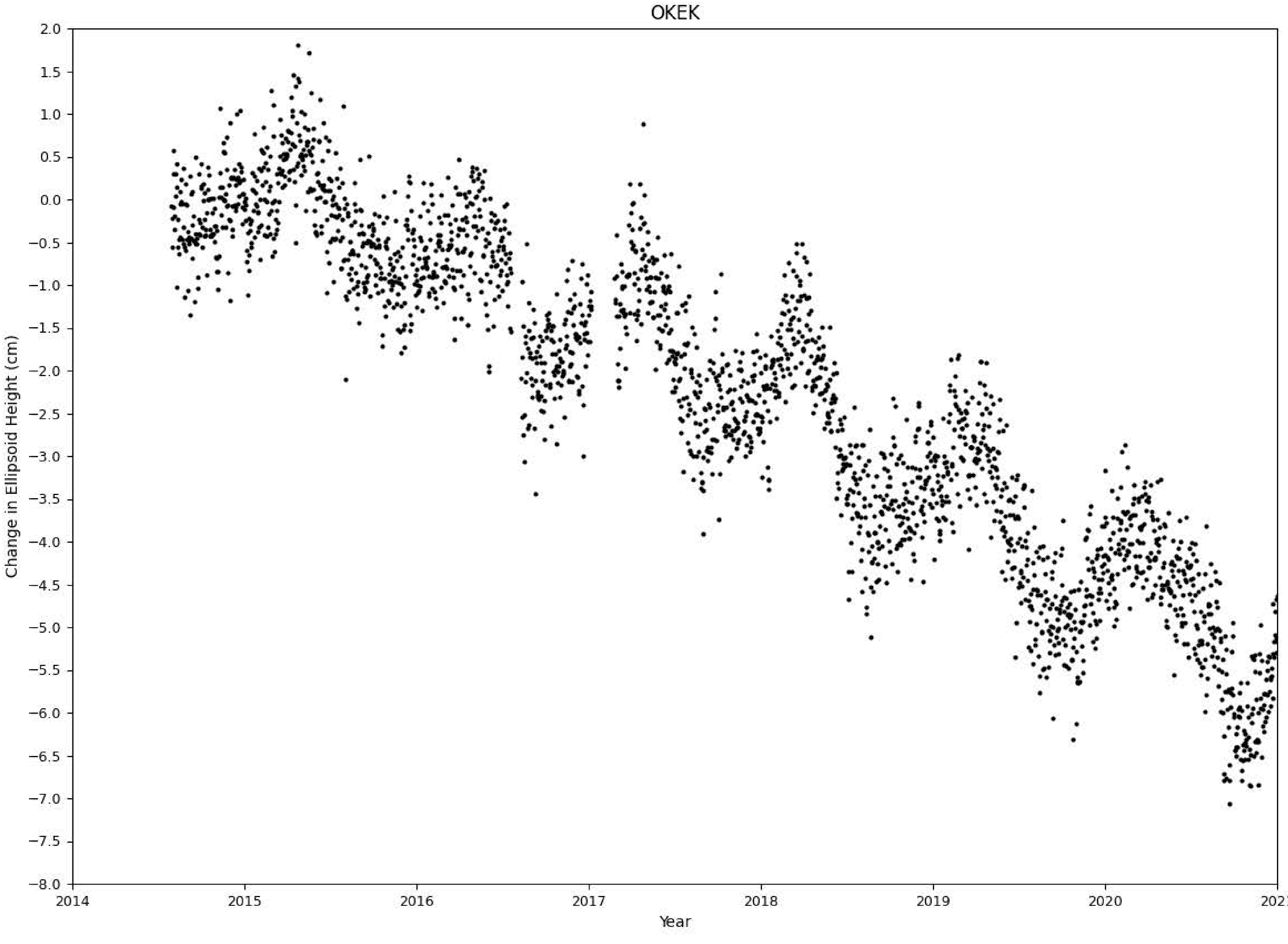
2020
2021
Year


NETP
Change in Ellipsoid Height (cm)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Year



OKEK
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
2014
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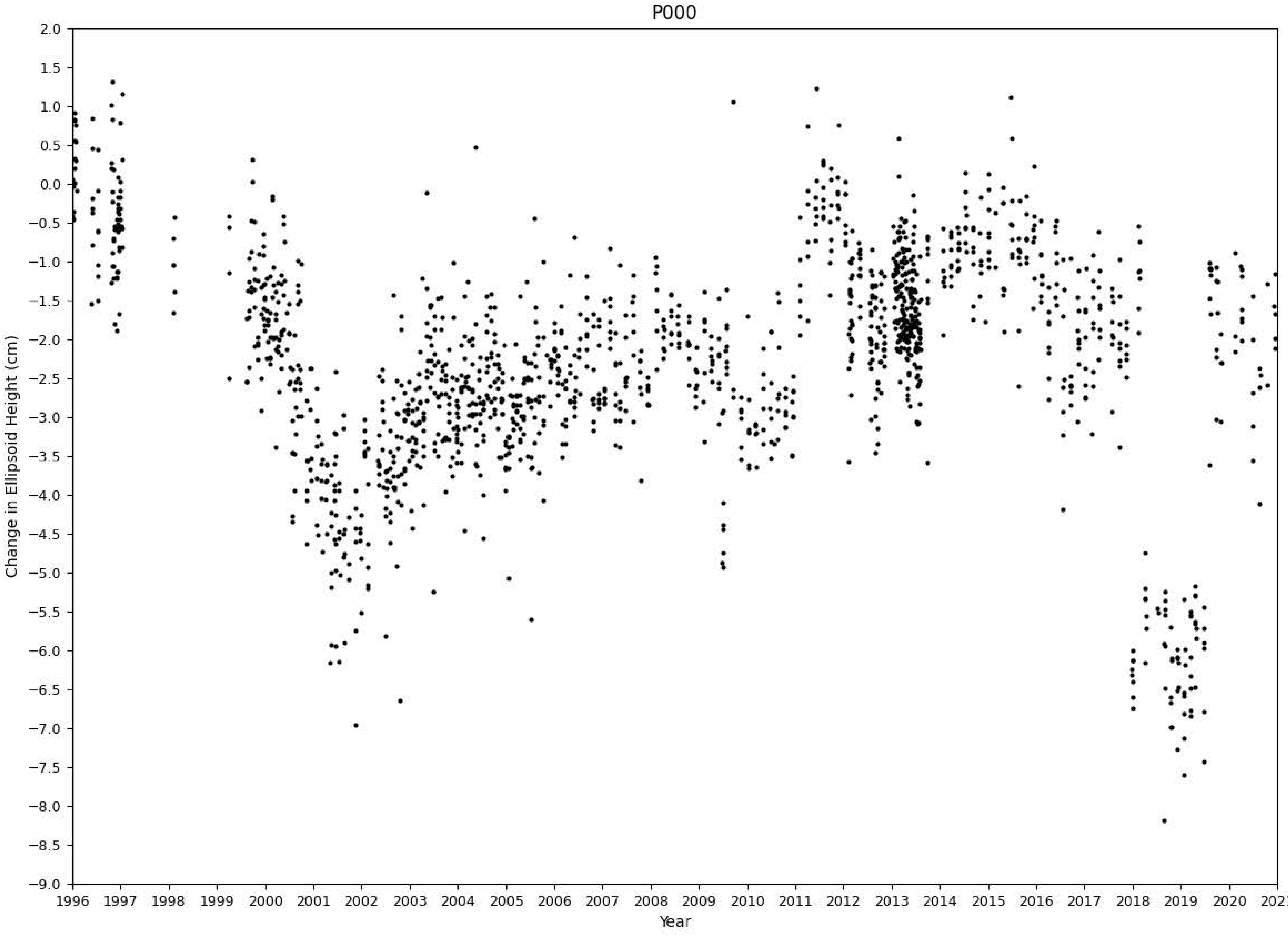
2021



P000
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
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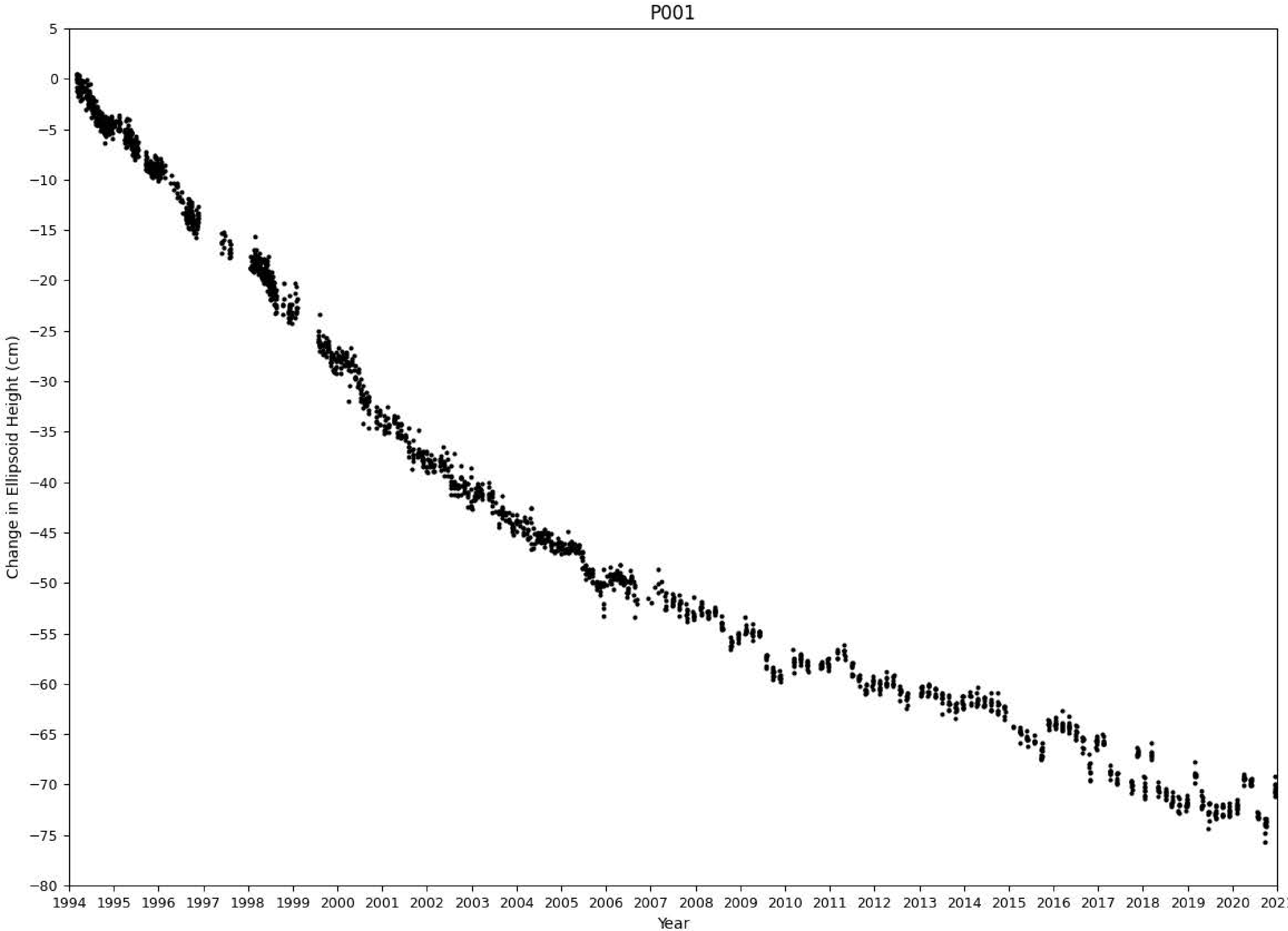
2021


P001
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
−50
−55
−60
−65
−70
−75
−80
1994
1995
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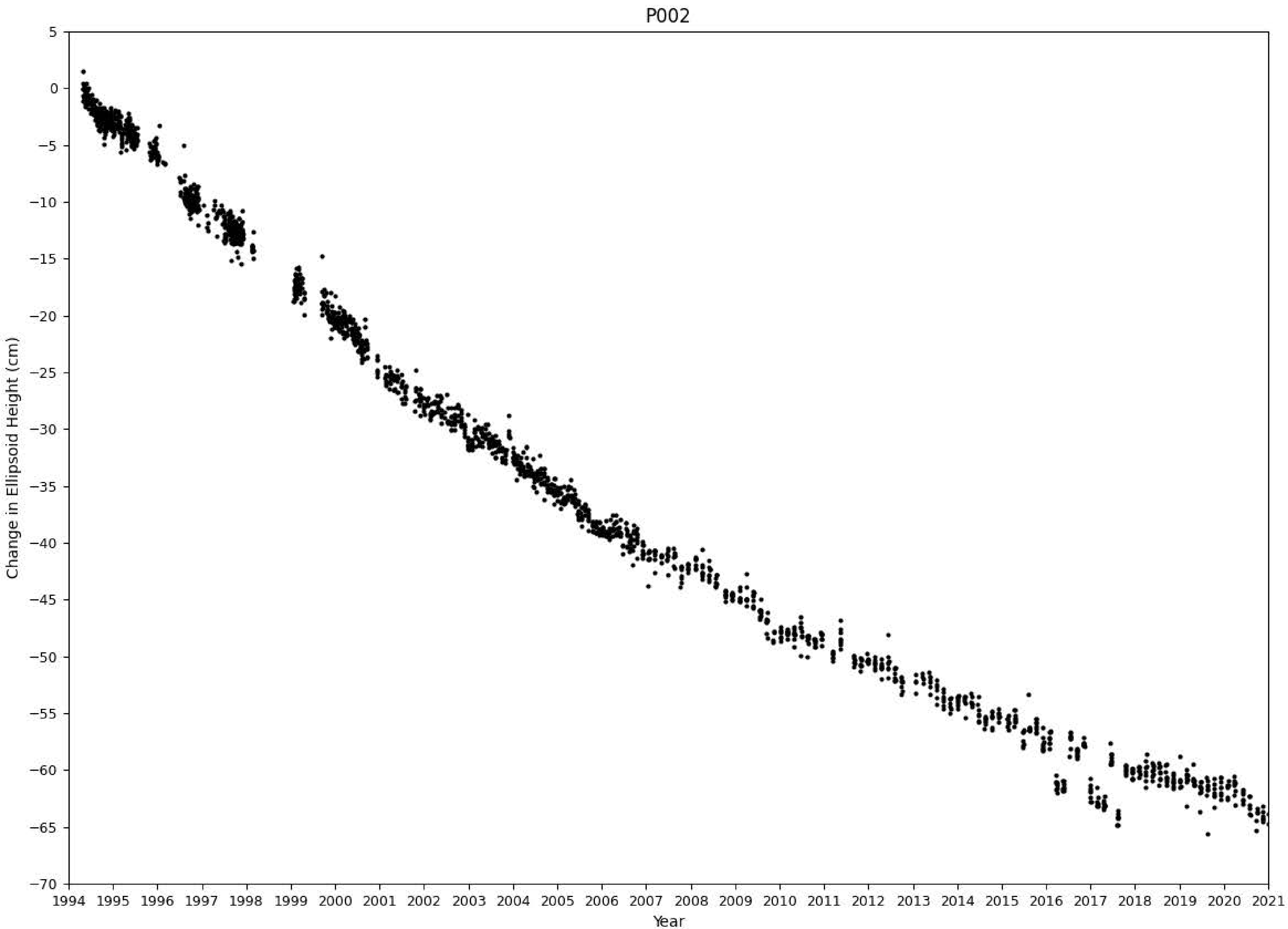
2021



P002
Change in Ellipsoid Height (cm)
Year
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
1994
1995
1996
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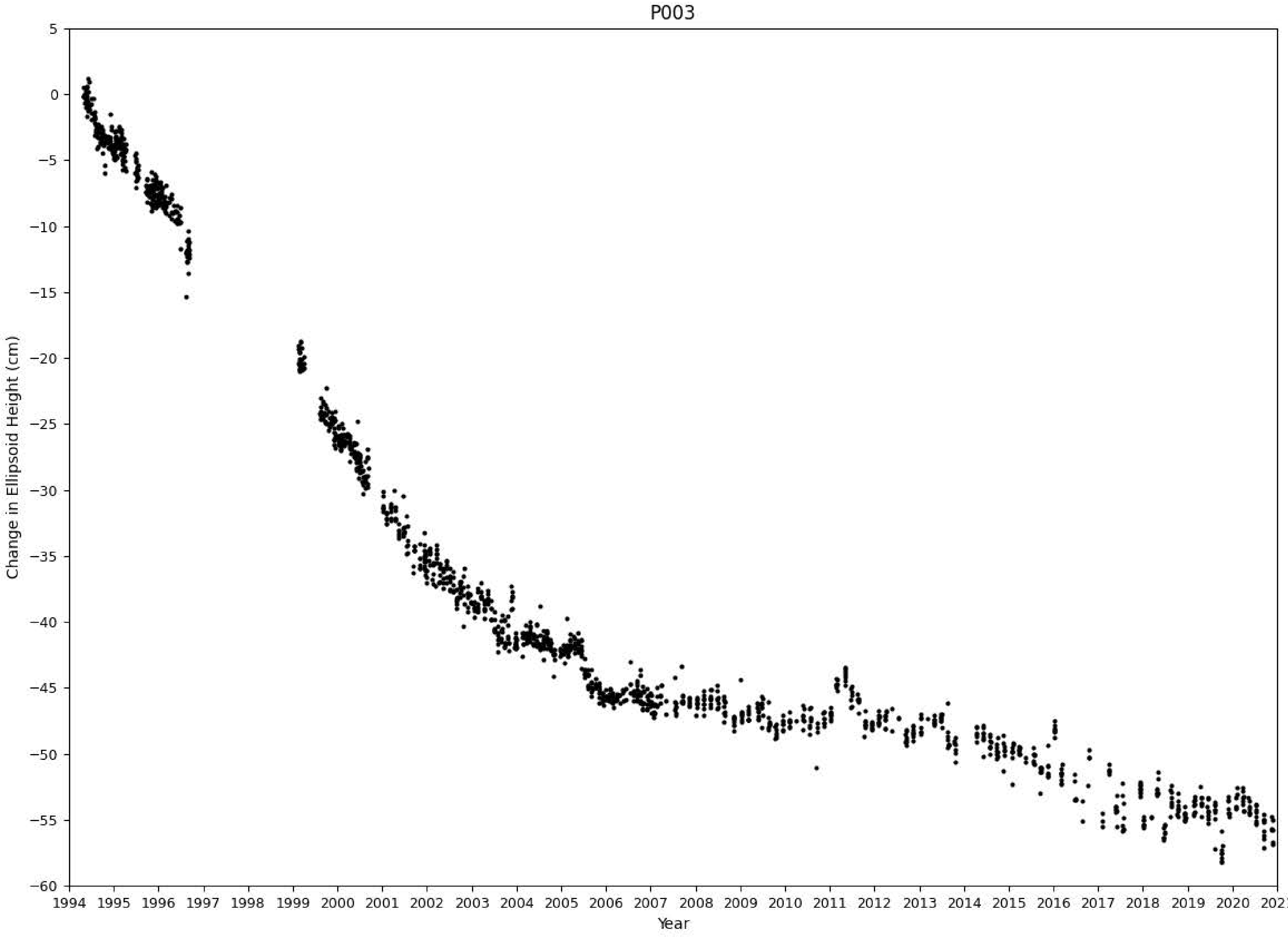
P003
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
−50
−55
−60
1994
1995
1996
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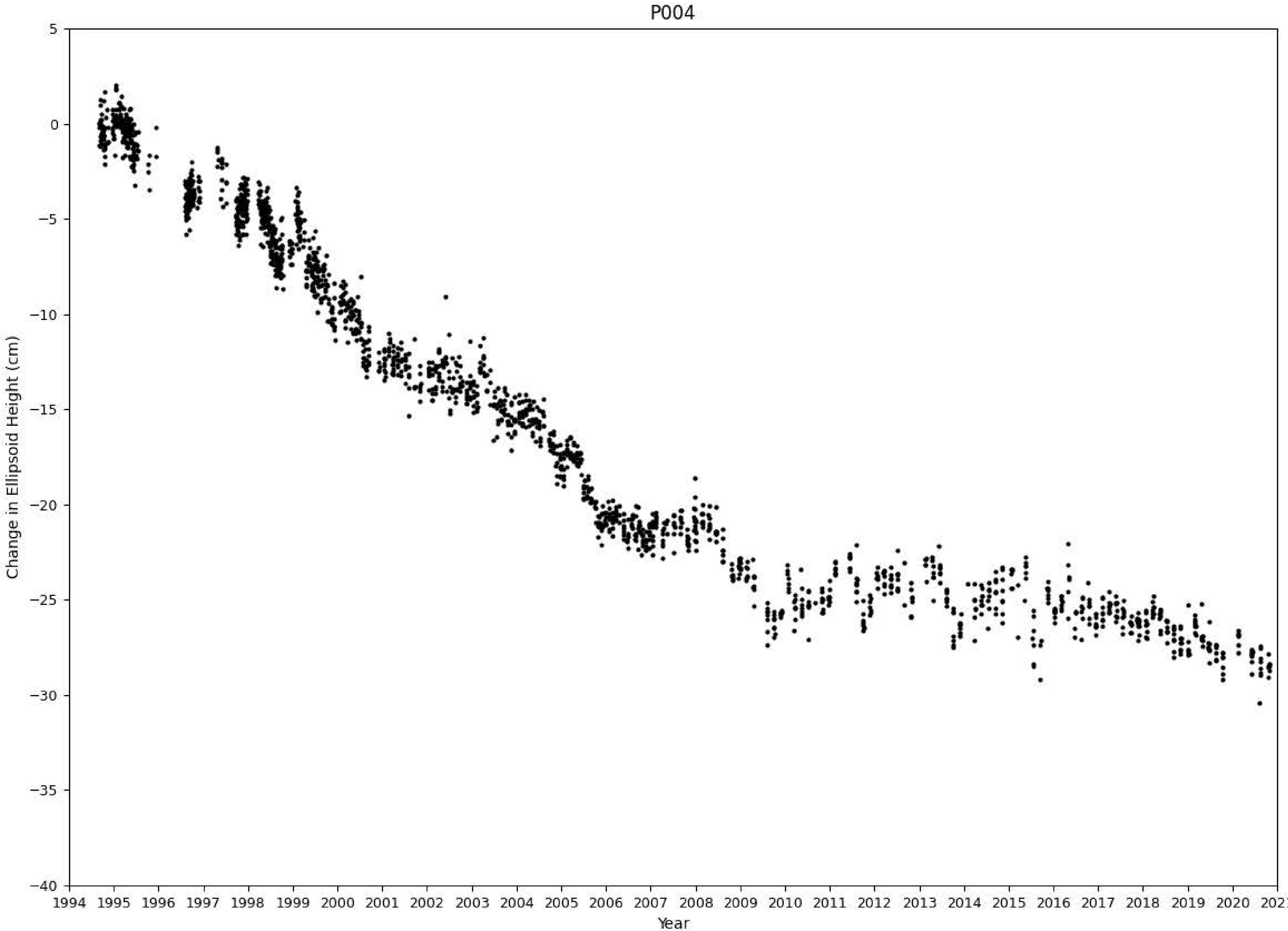

P004
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
−35
−40
1994
1995
1996
1997
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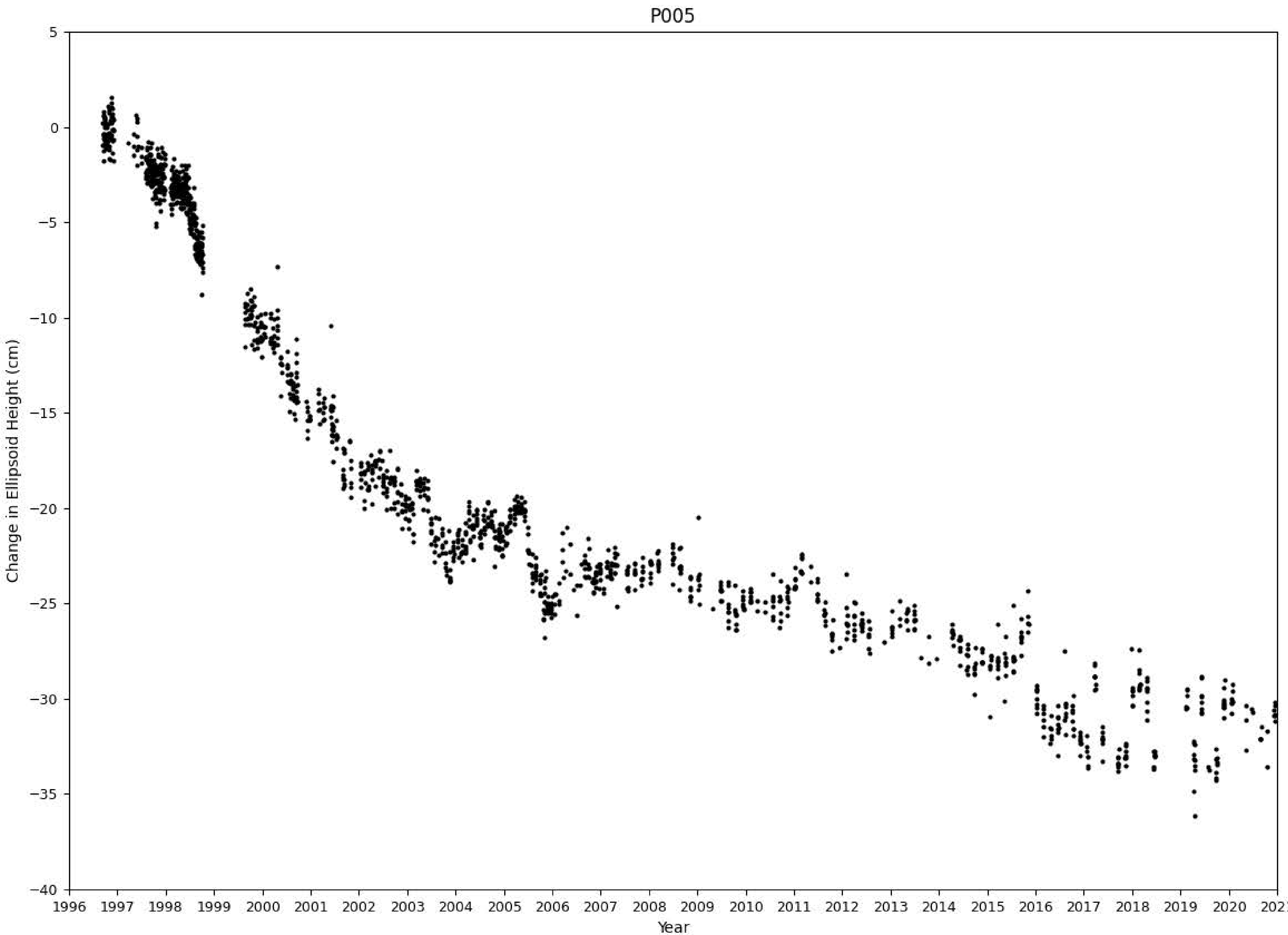

P005
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
−25
−30
−35
−40
1996
1997
1998
1999
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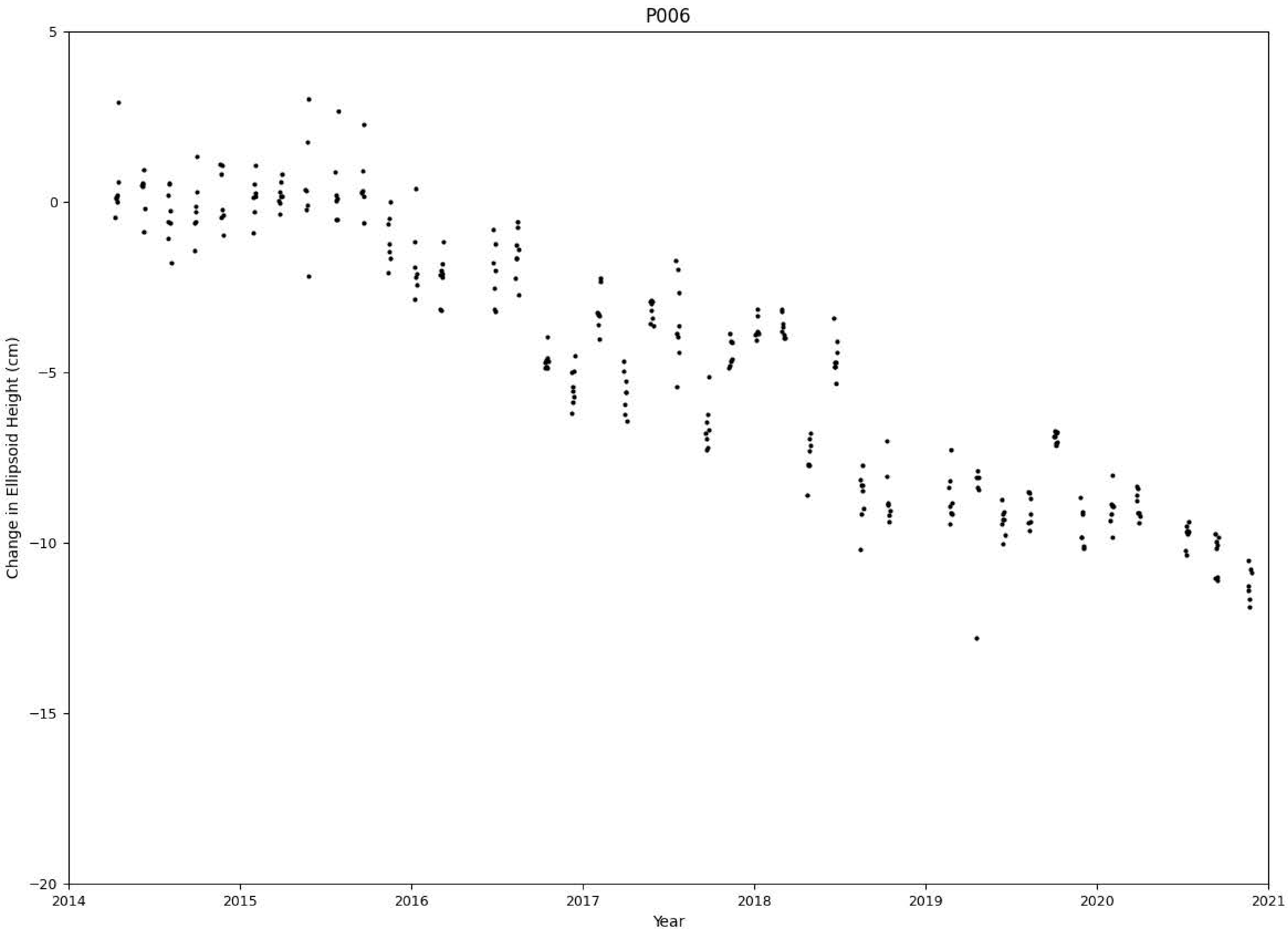
2021
Year



P006
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
2014
2015
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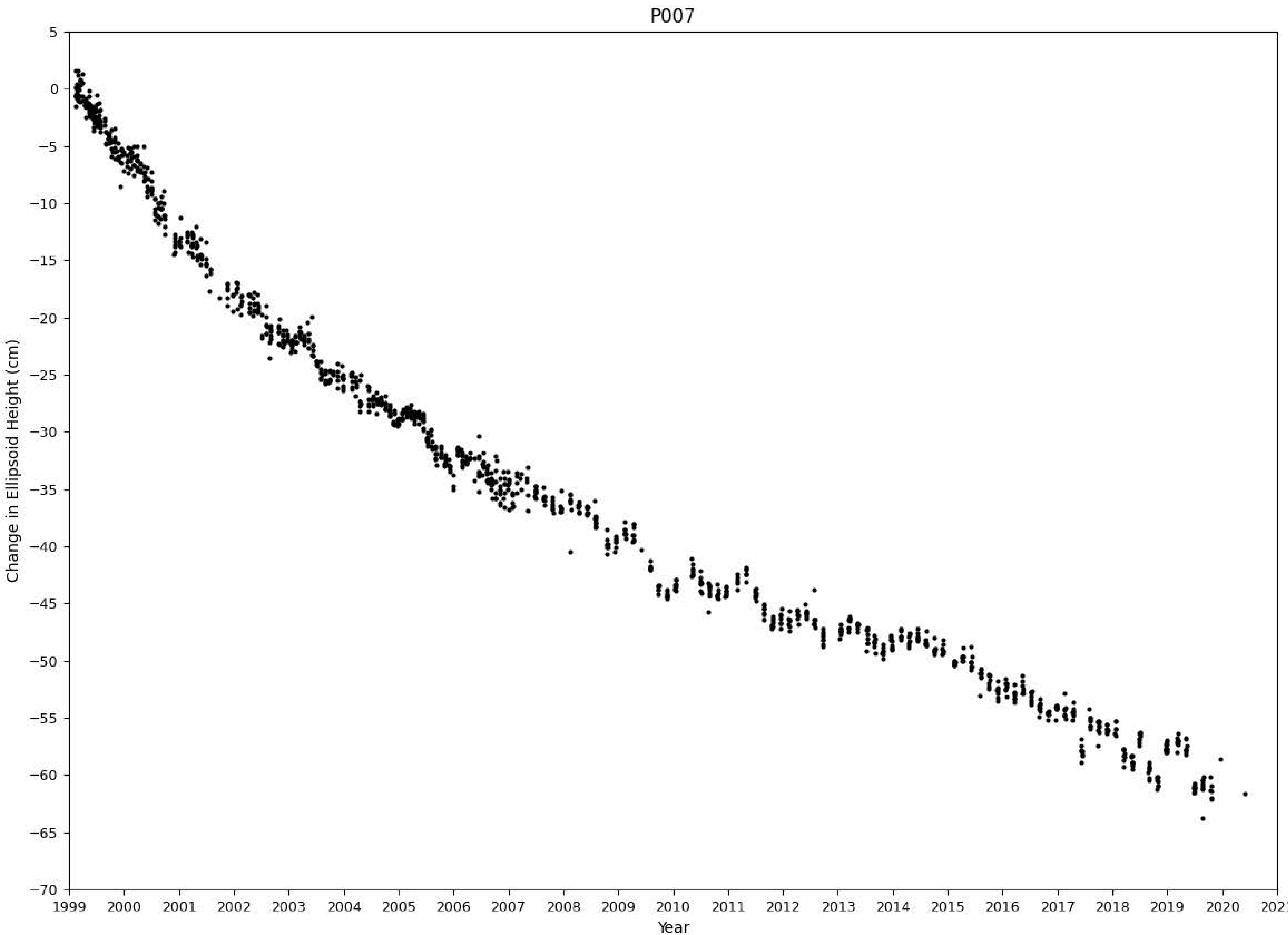
2021



P007
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
−50
−55
−60
−65
−70
1999
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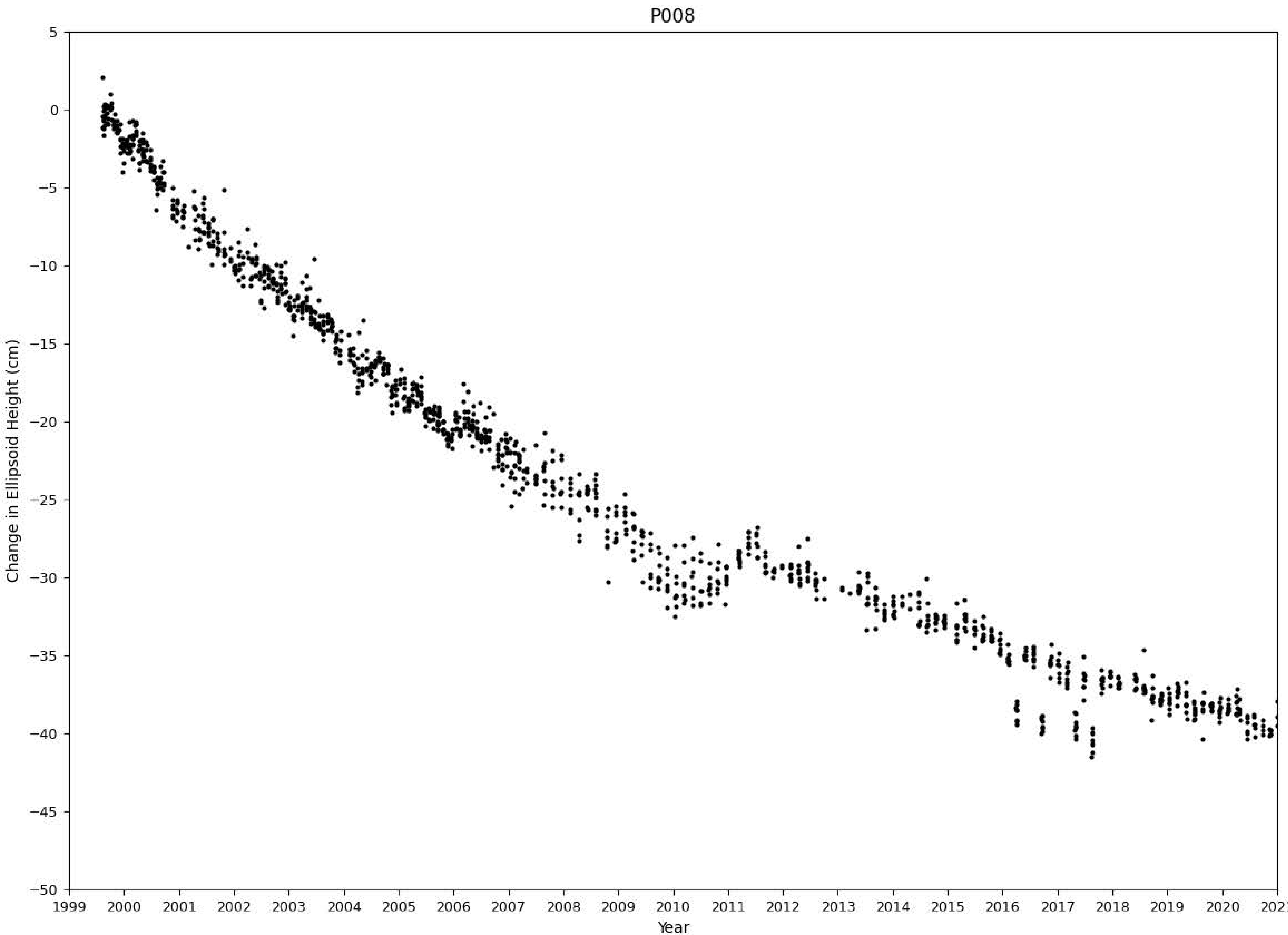
P008
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
−50
1999
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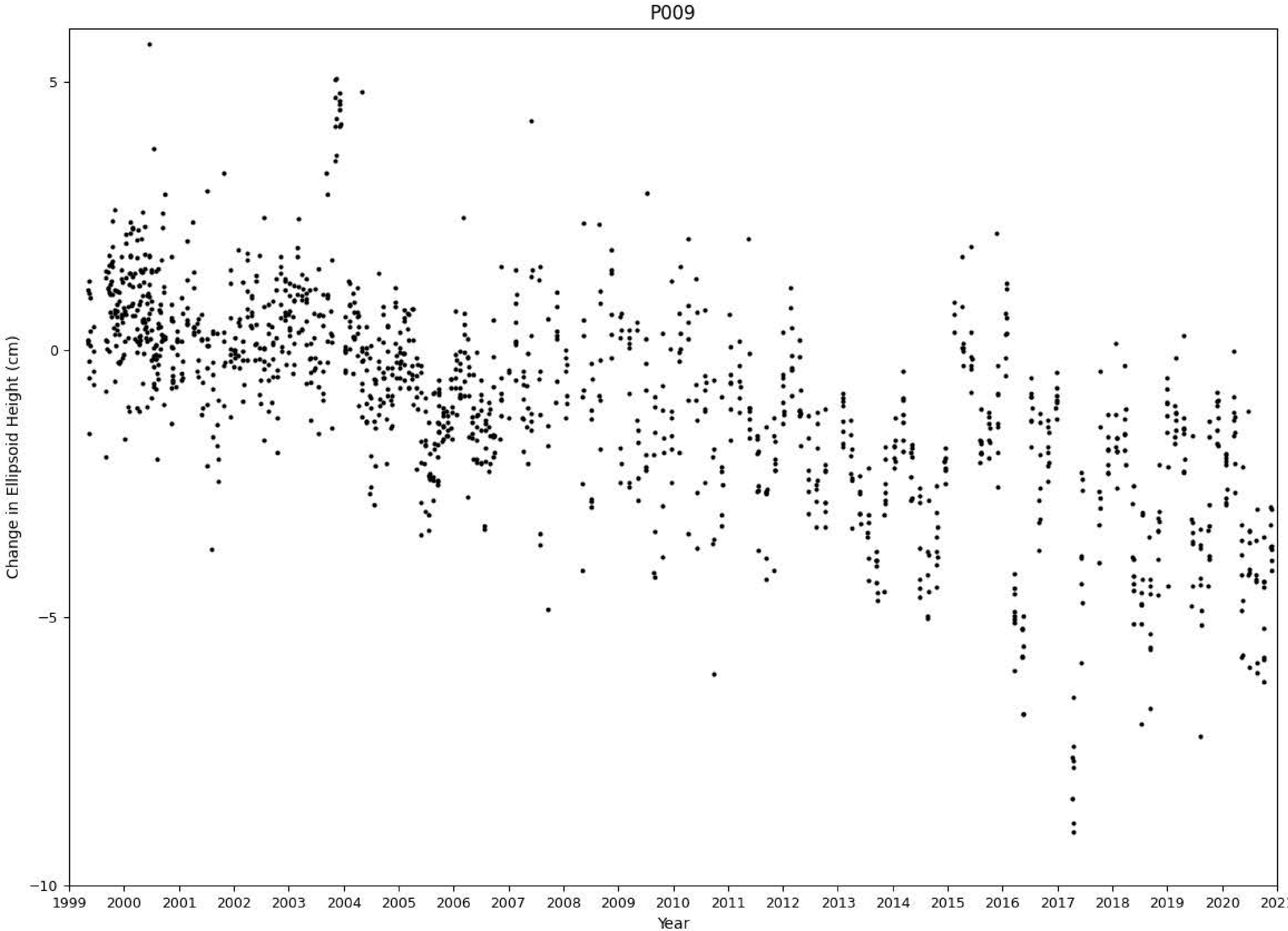

P009
Change in Ellipsoid Height (cm)
Year
5
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−5
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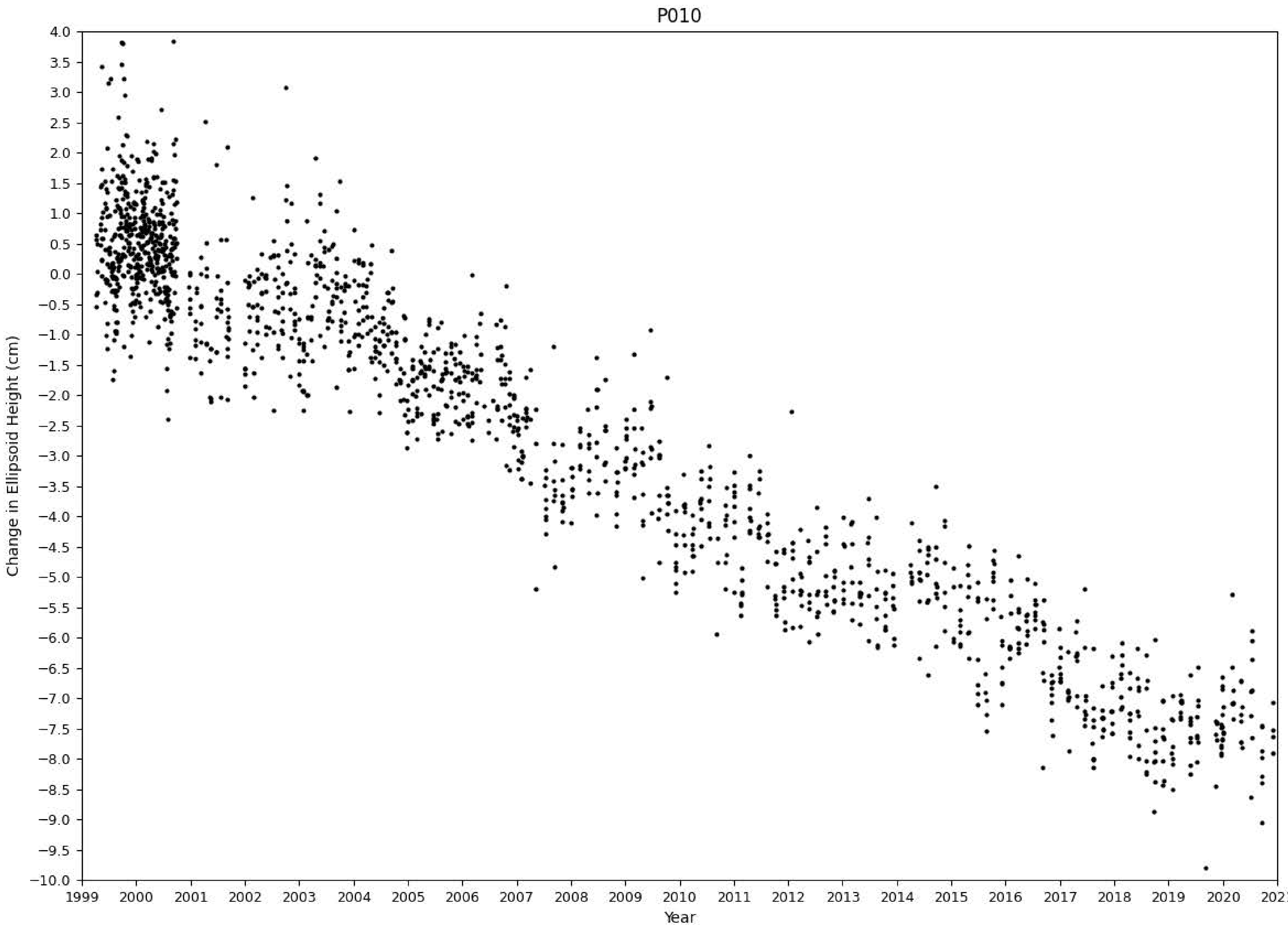
2021



P010
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
−9.5
−10.0
1999
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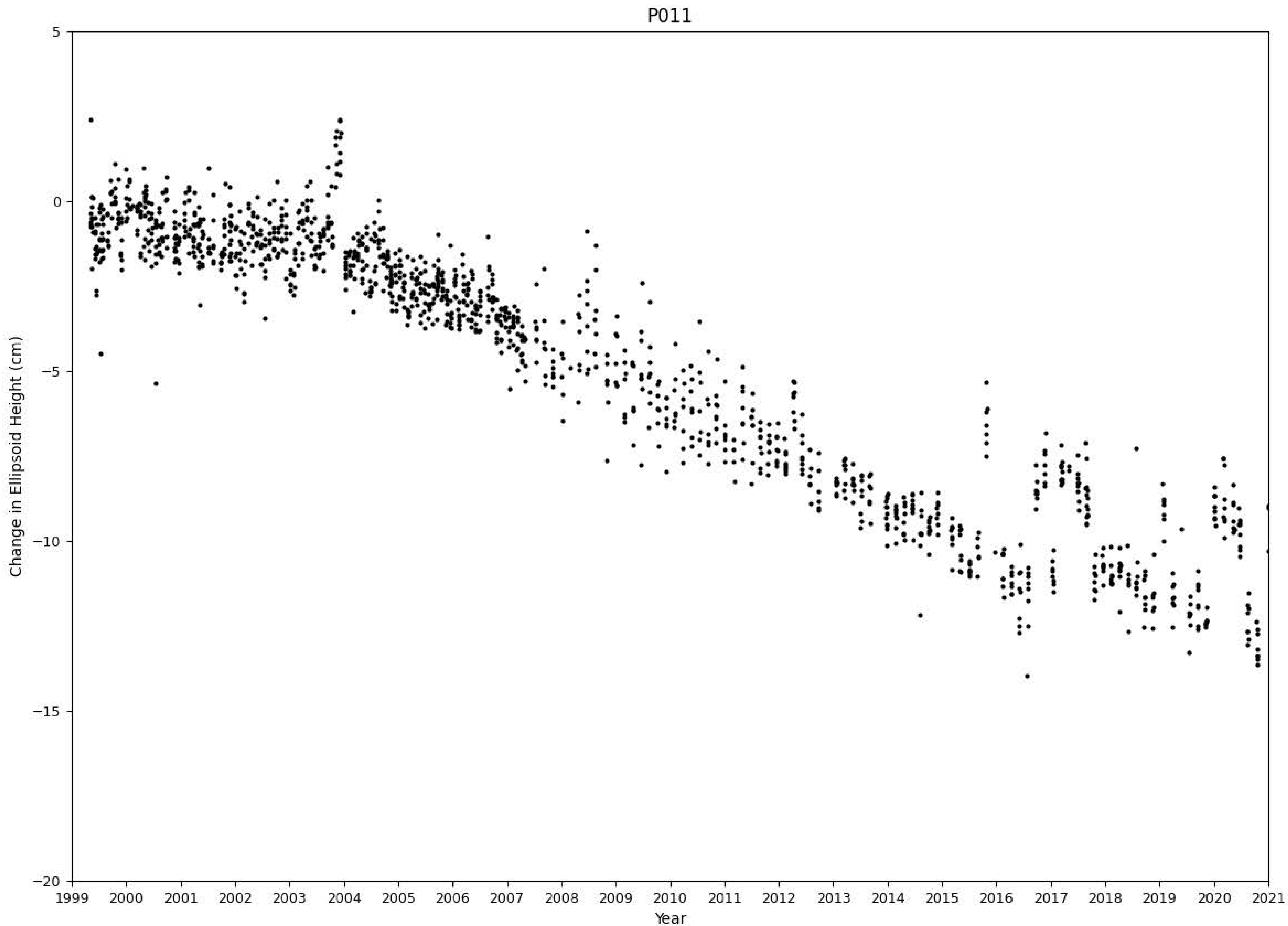
2021



P011
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
1999
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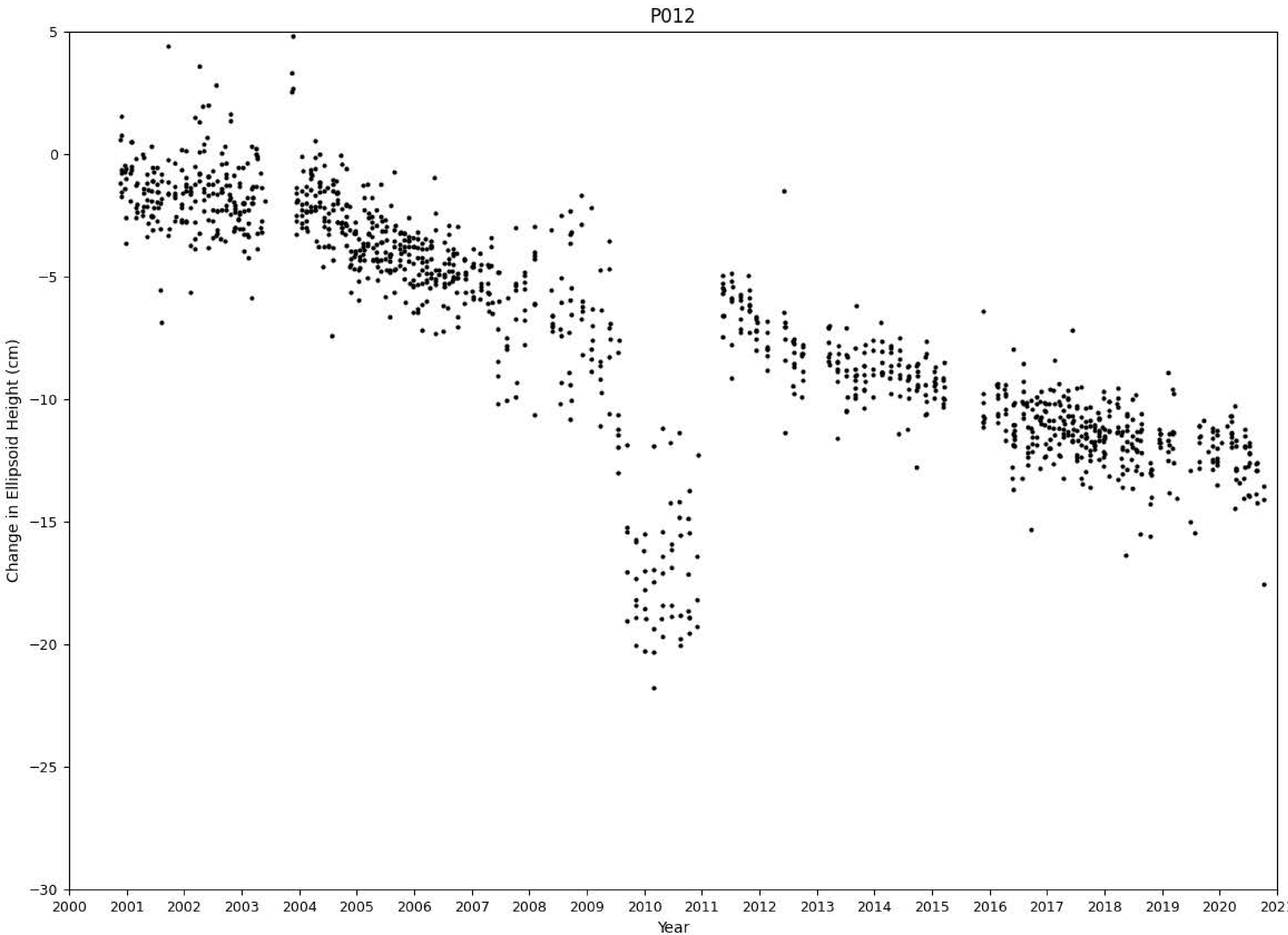
2021
Year



P012
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
−25
−30
2000
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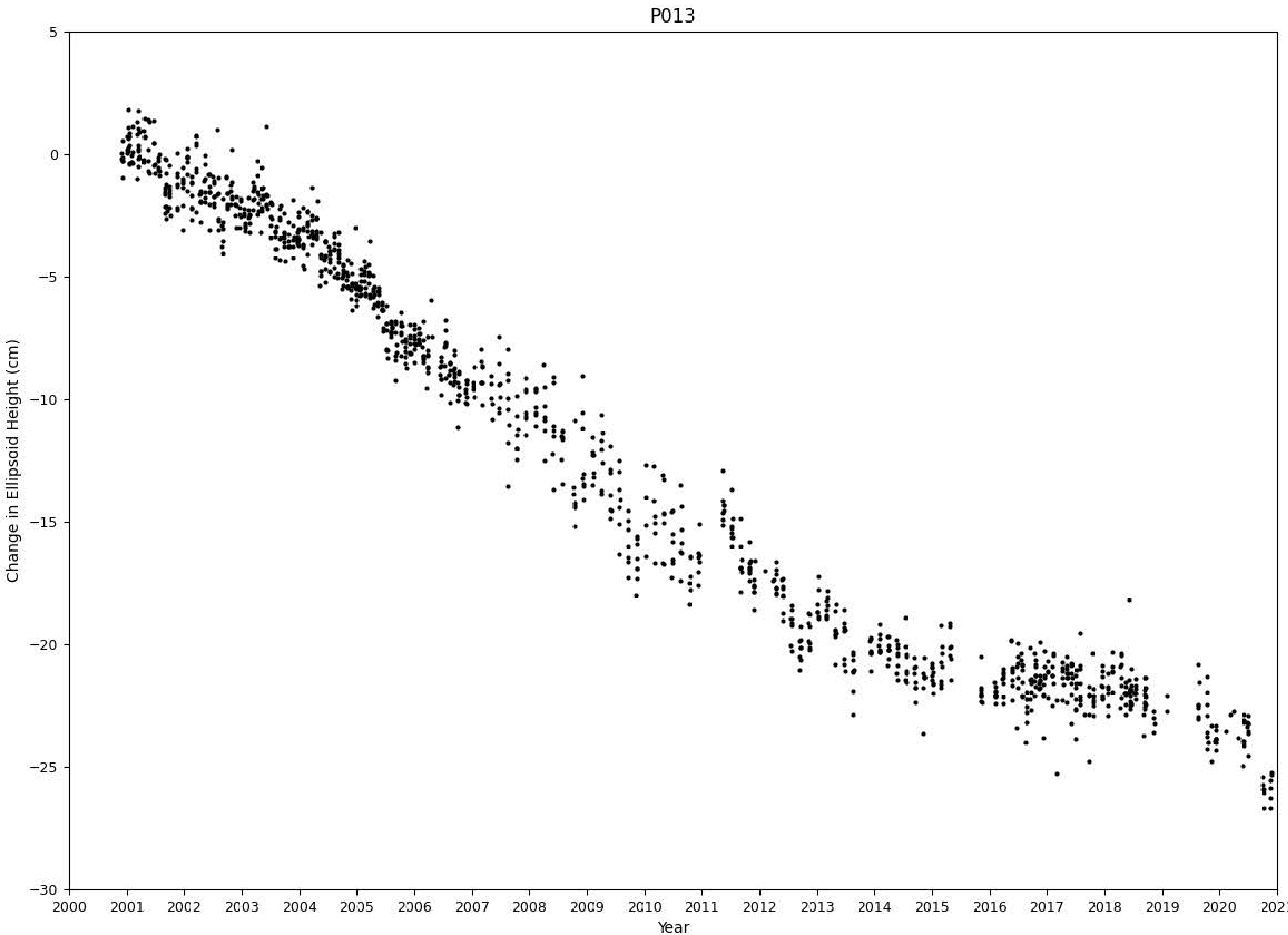
2021
Year



P013
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
−25
−30
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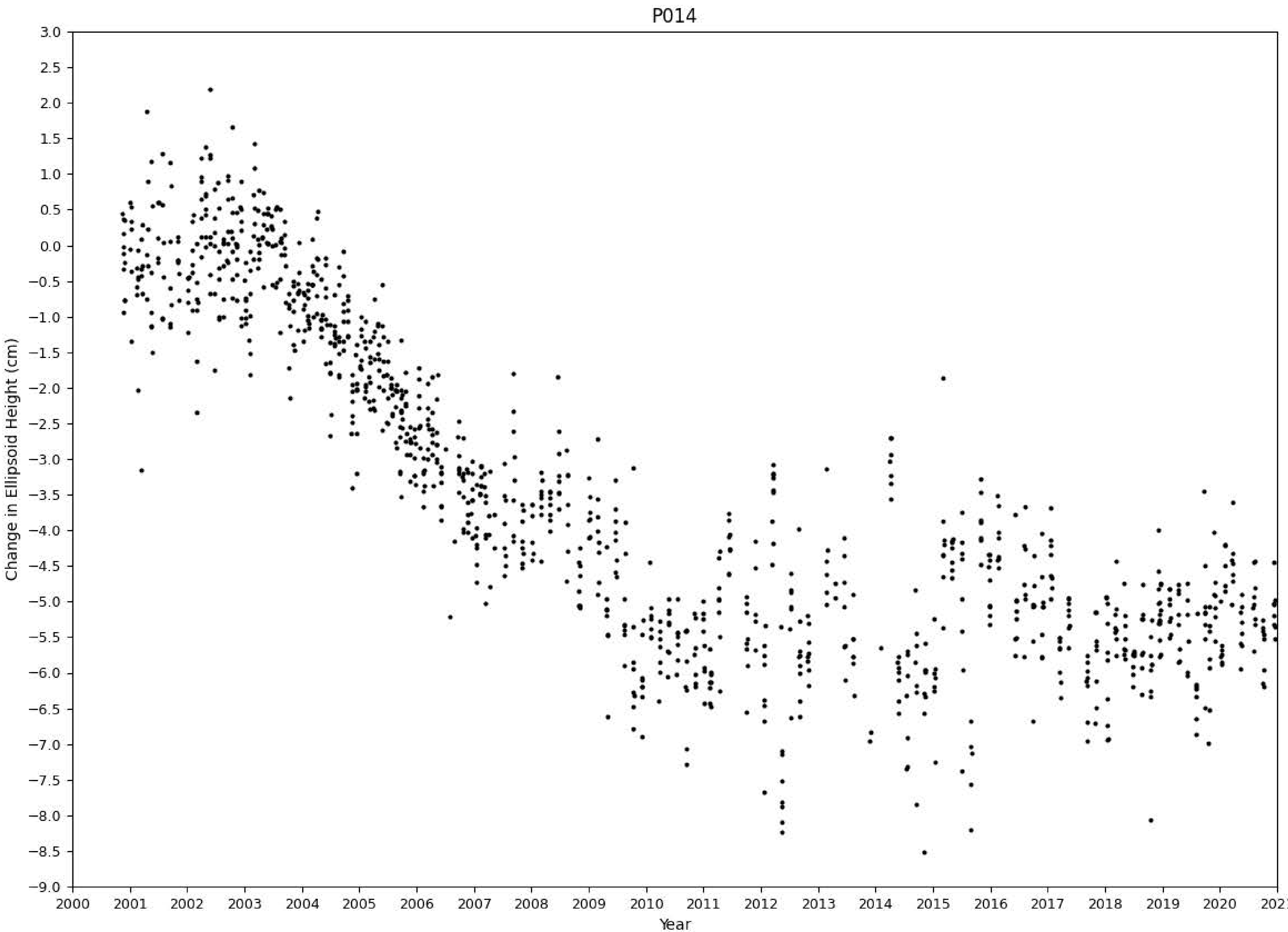
2021
Year


P014
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
2000
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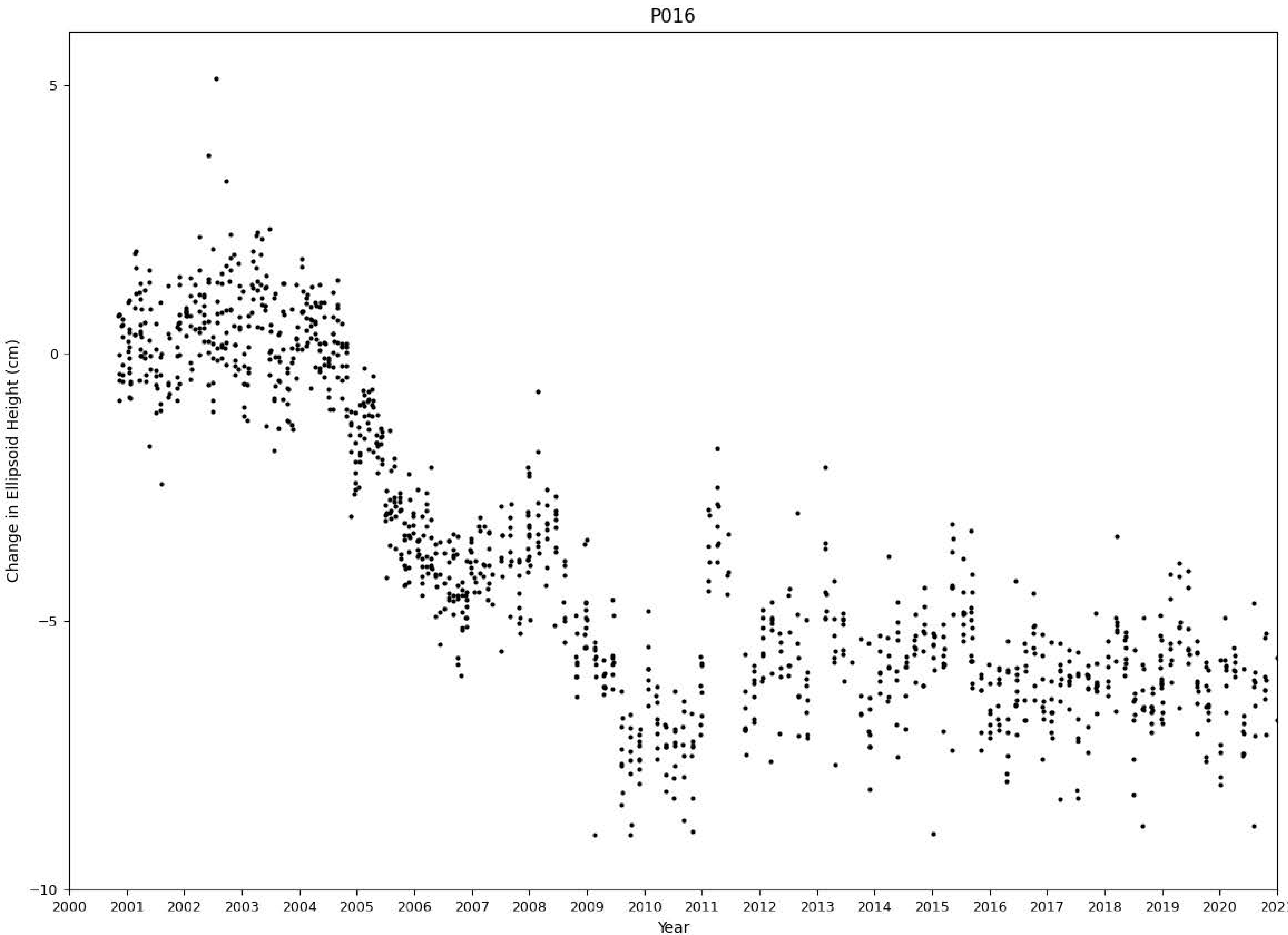
2021
Year



P016
Change in Ellipsoid Height (cm)
5
0
−5
−10
2000
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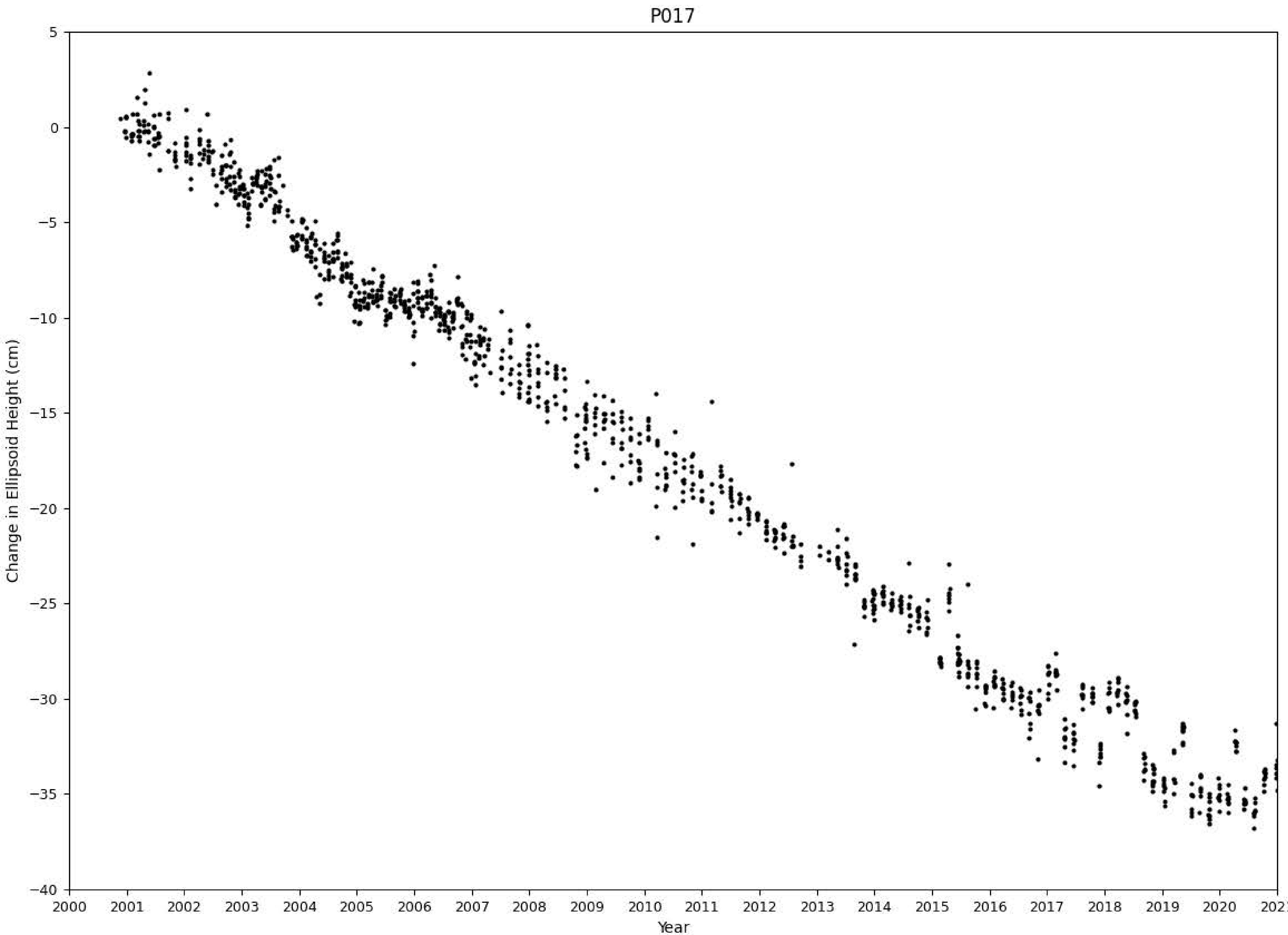
2020
2021
Year



P017
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
−35
−40
2000
2001
2002
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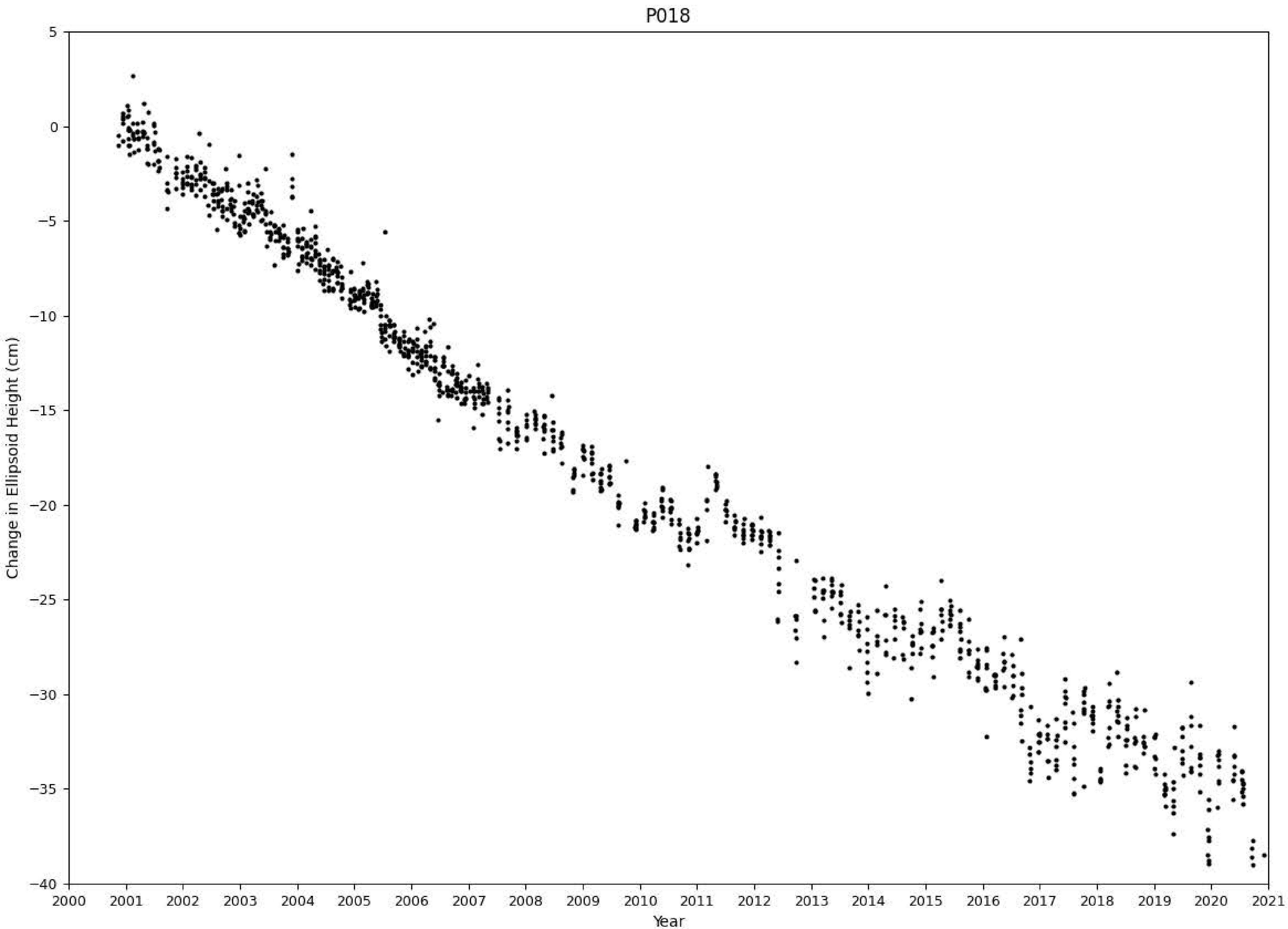
2021



P018
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
−25
−30
−35
−40
2000
2001
2002
2003
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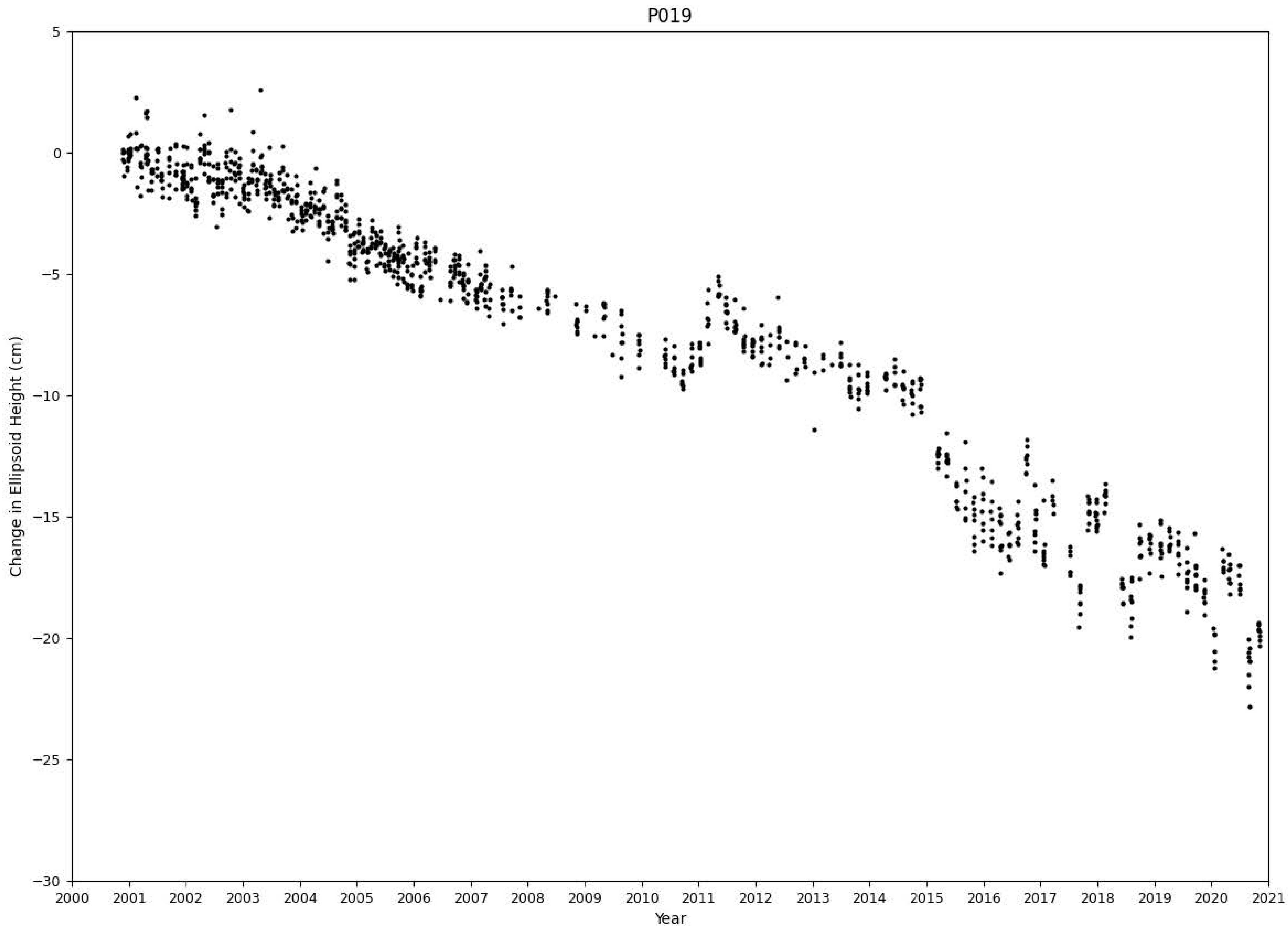
2020
2021
Year



P019
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
2000
2001
2002
2003
2004
2005
2006
2007
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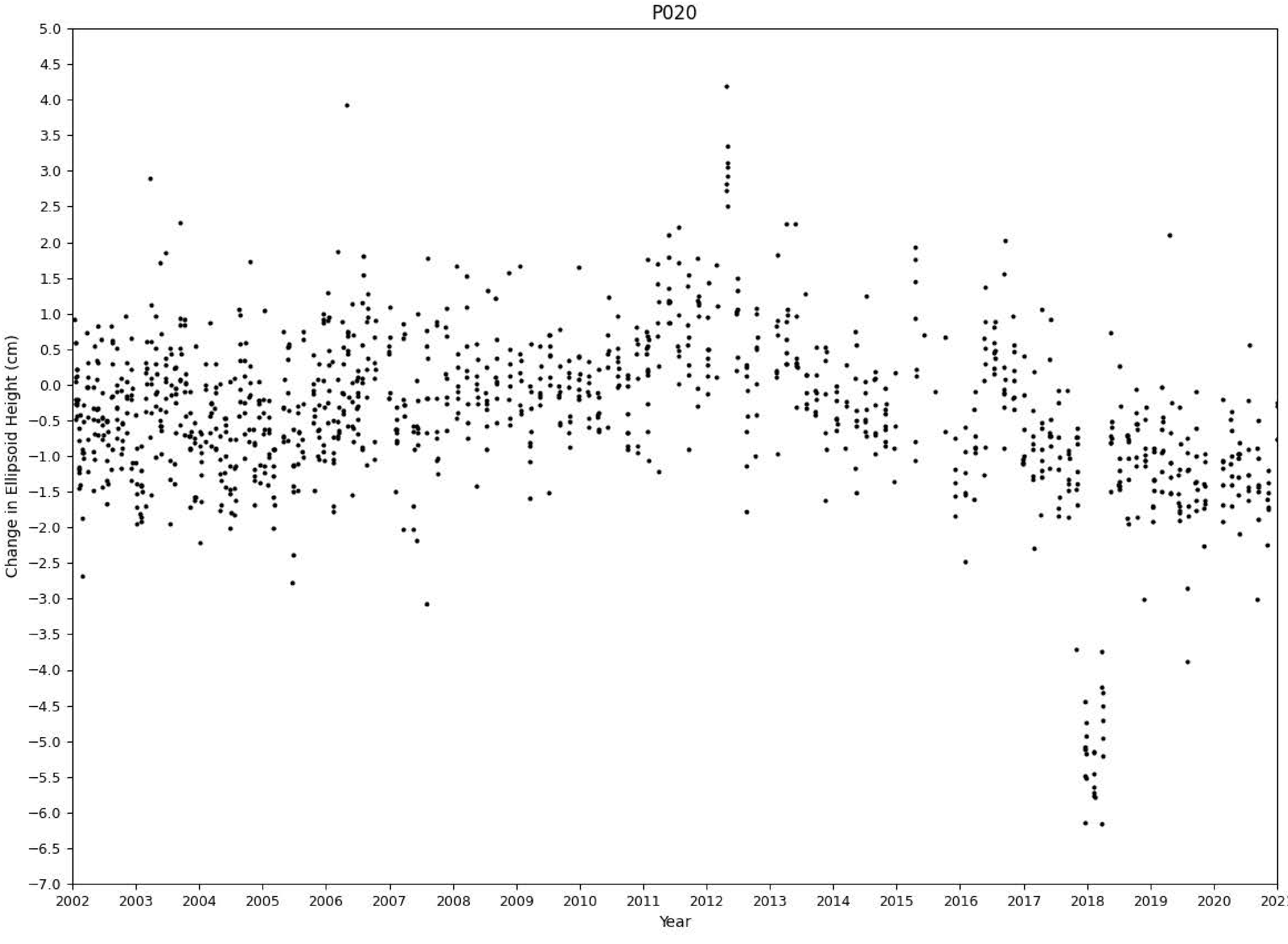
2018
2019
2020
2021



P020
Change in Ellipsoid Height (cm)
Year
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2002
2003
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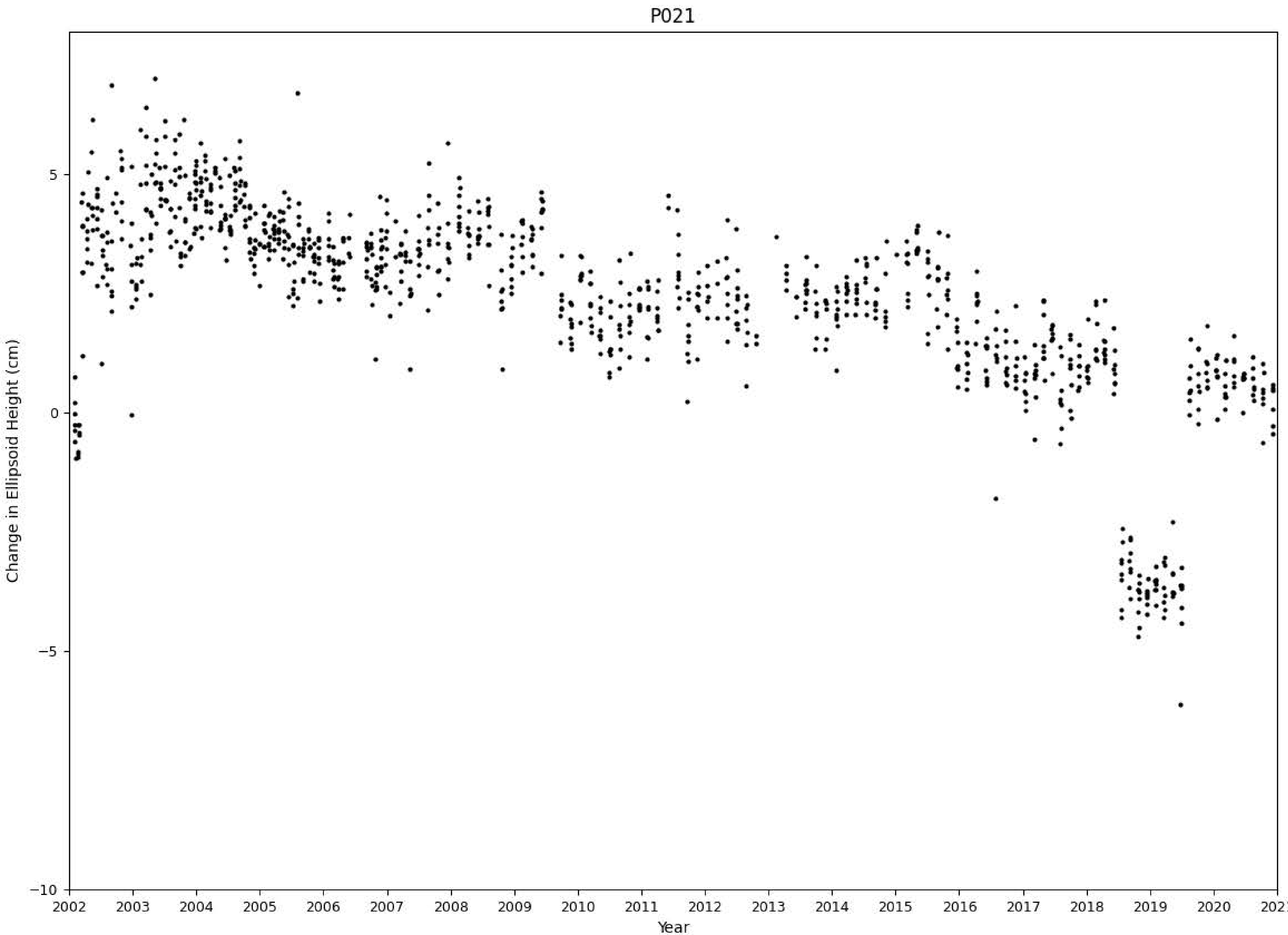
2019
2020
2021


P021
Change in Ellipsoid Height (cm)
5
0
−5
−10
2002
2003
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2005
2006
2007
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2011
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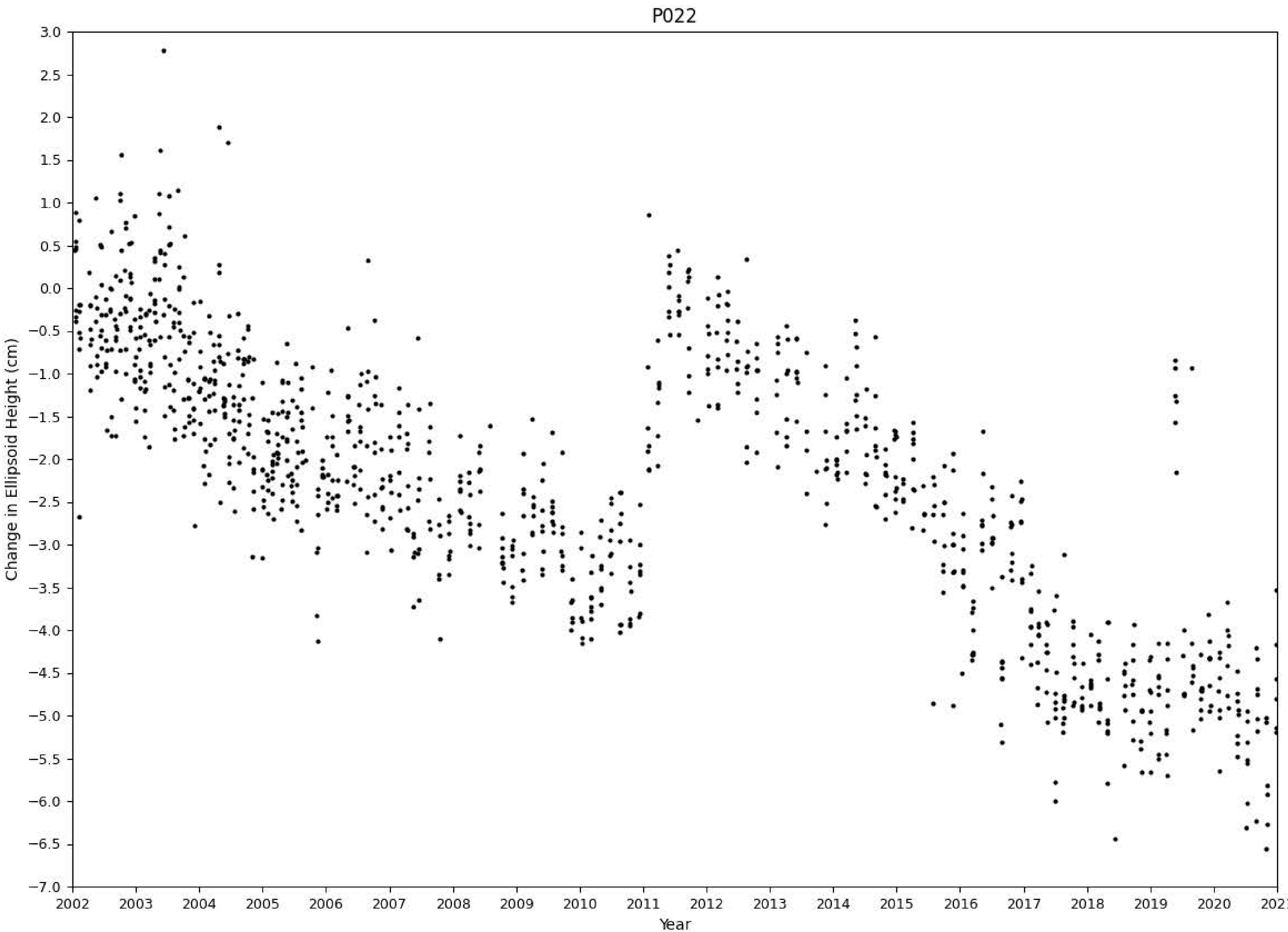
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year


P022
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2002
2003
2004
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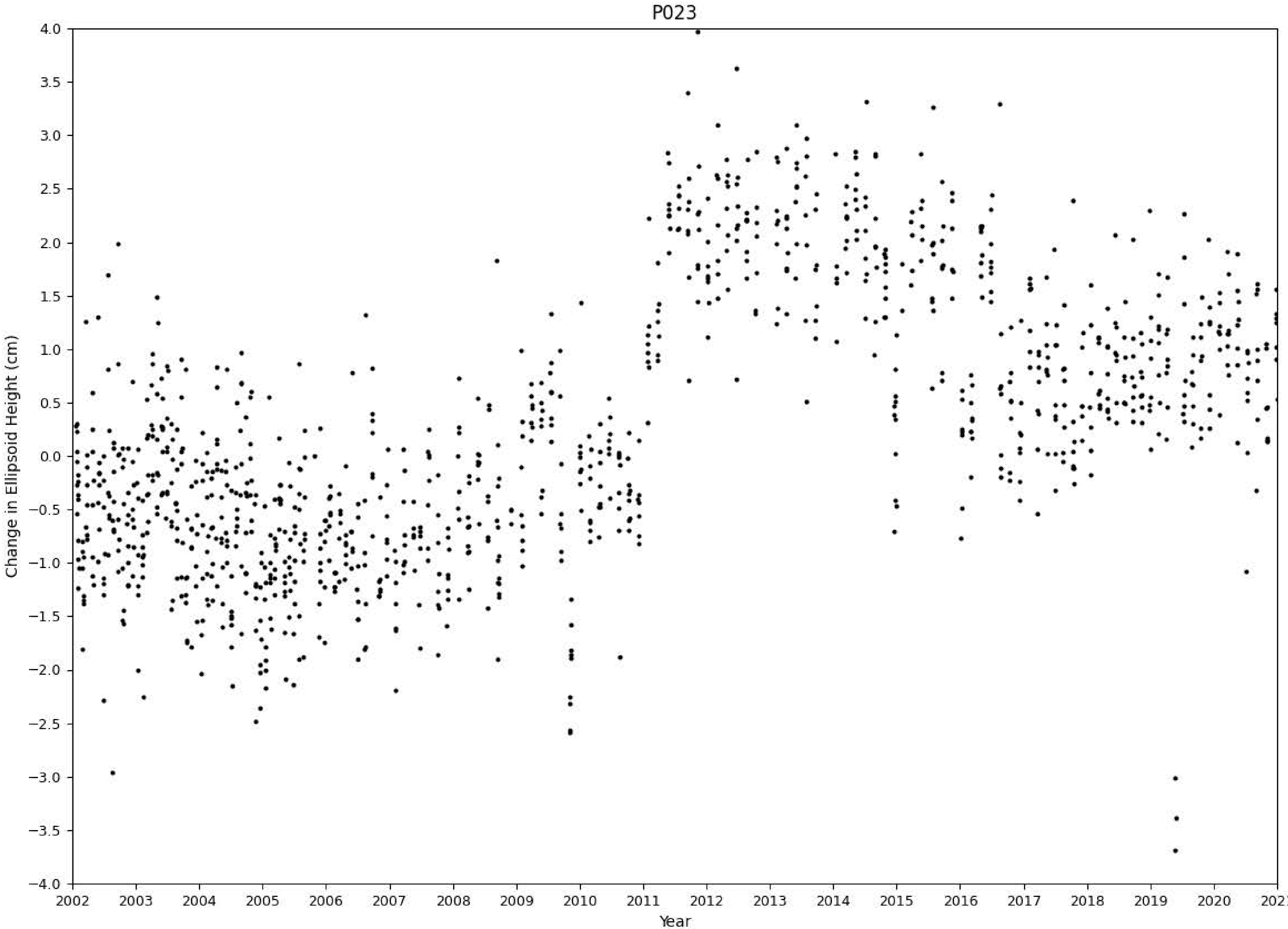
2021



P023
Change in Ellipsoid Height (cm)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2002
2003
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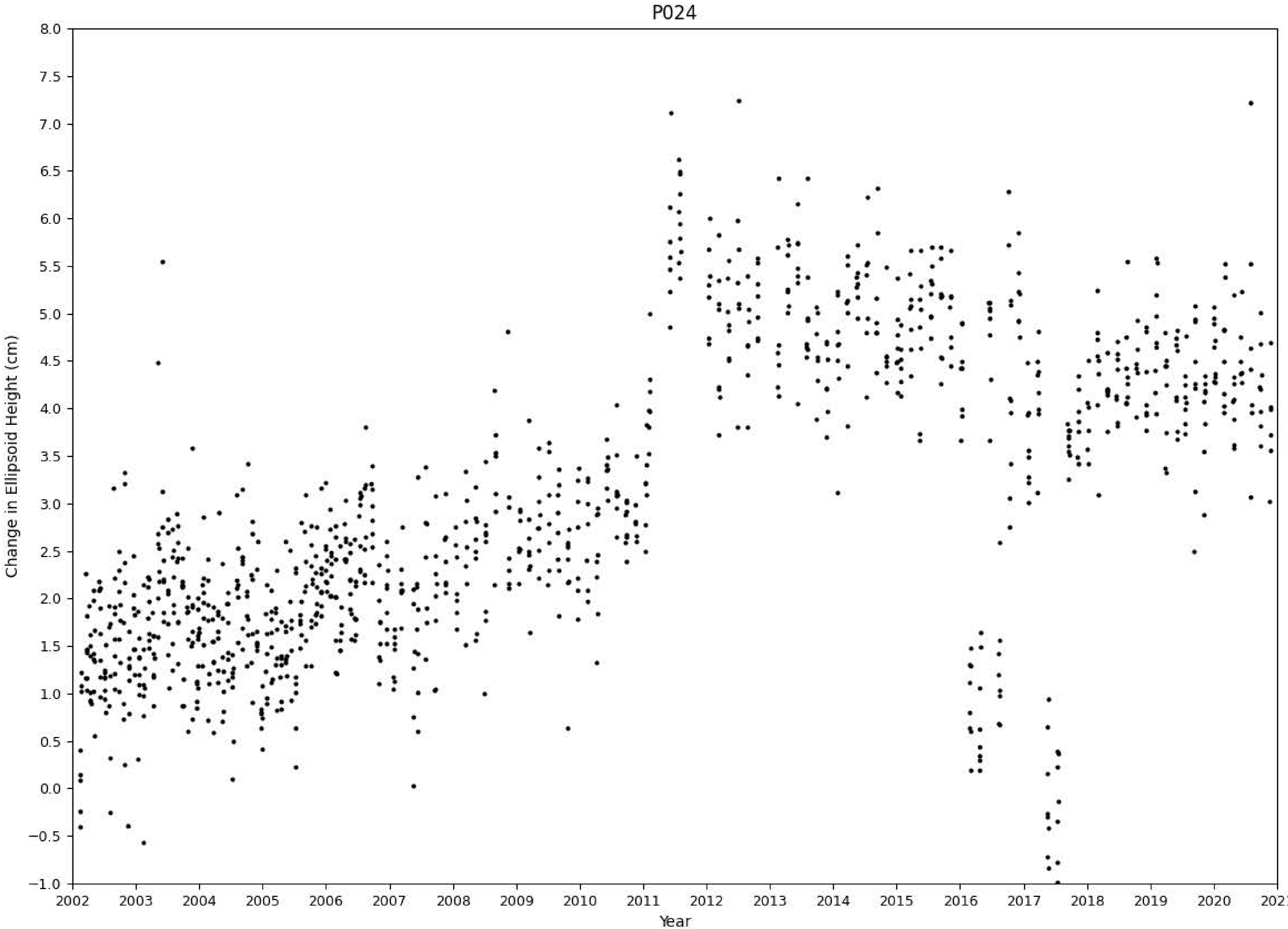
2021
Year



P024
Change in Ellipsoid Height (cm)
Year
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
2002
2003
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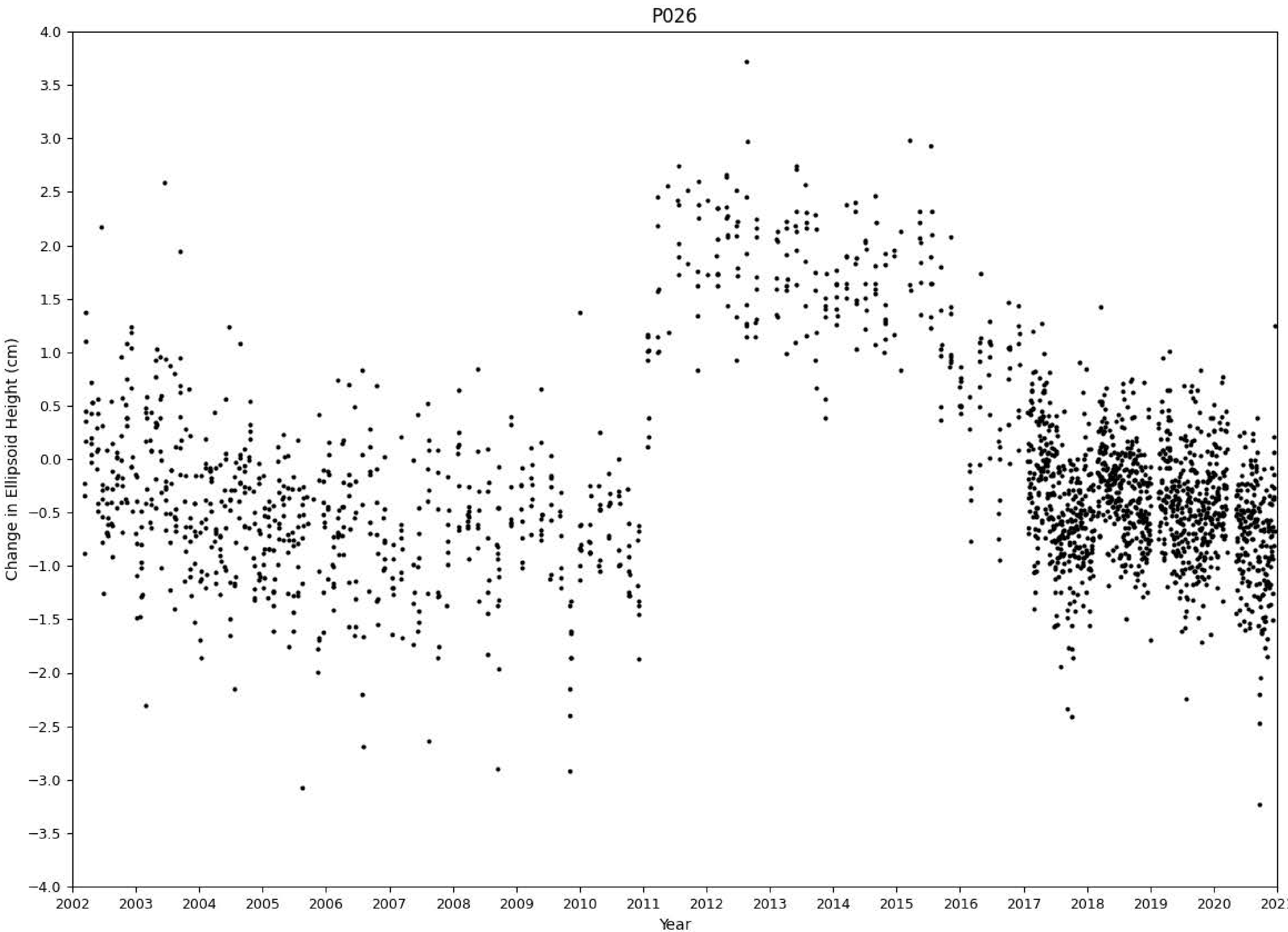
2021



P026
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2002
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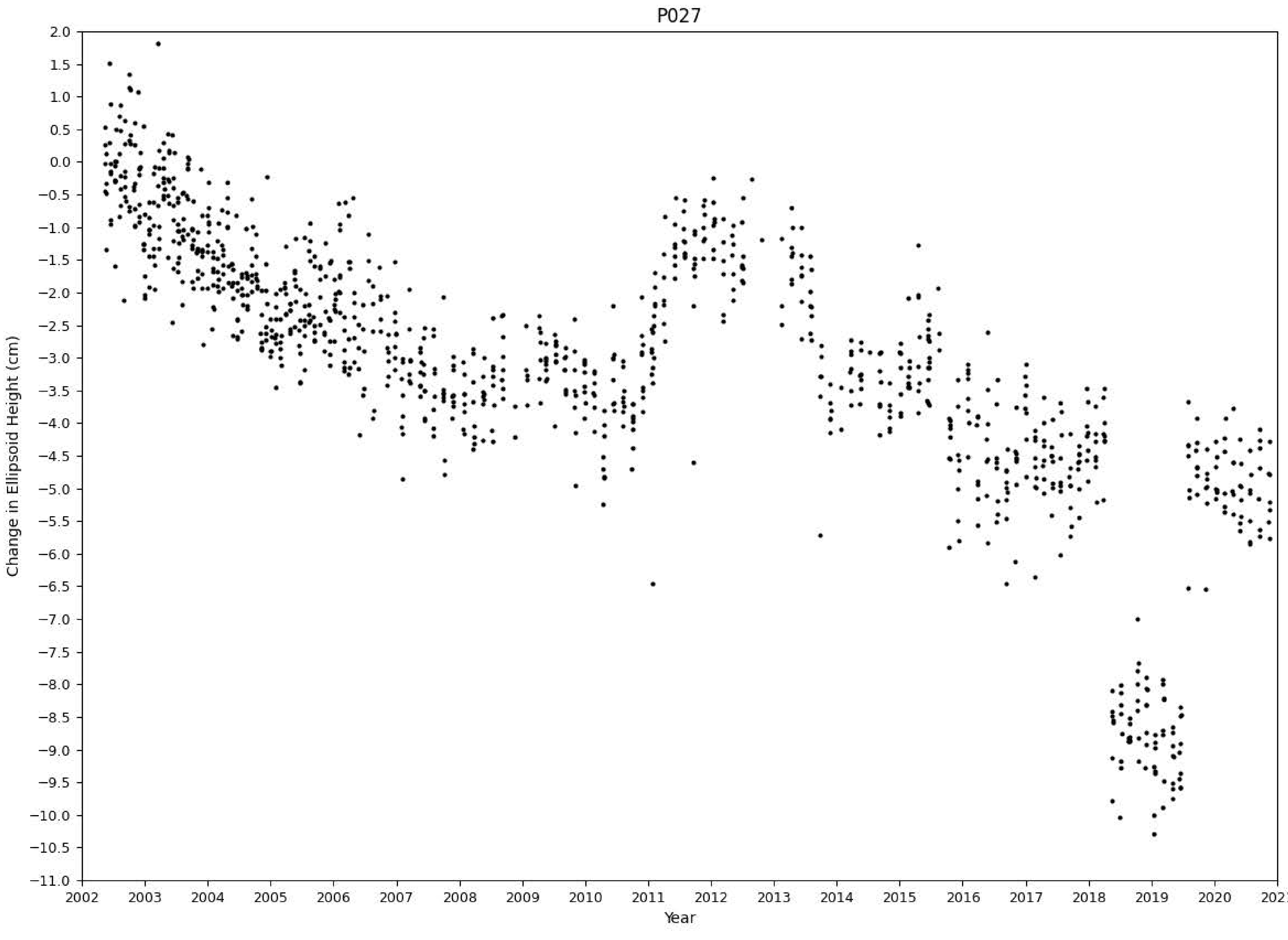
2021



P027
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
-10.5
-11.0
2002
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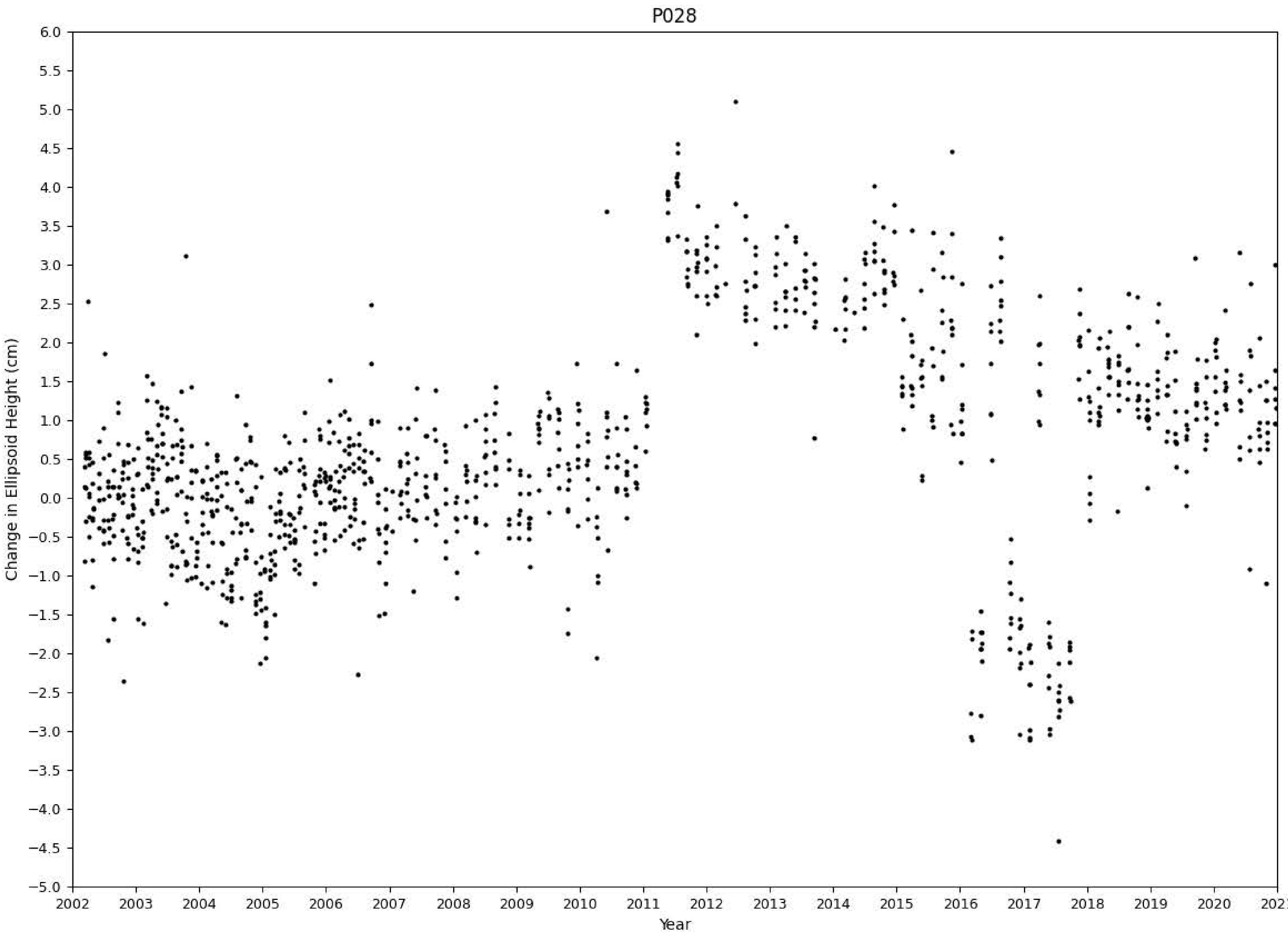
2021



P028
Change in Ellipsoid Height (cm)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2002
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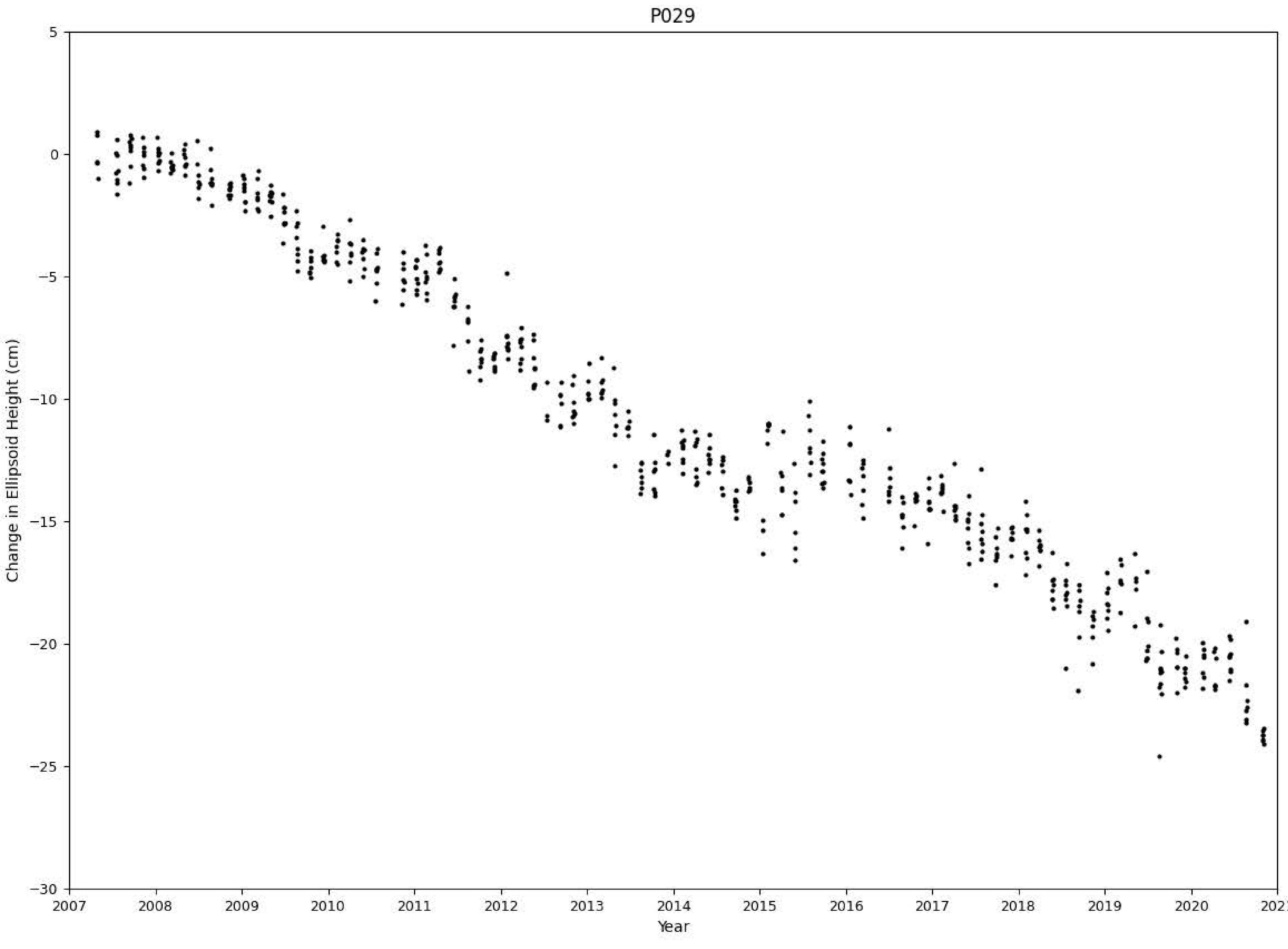
2021
Year



P029
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
−25
−30
2007
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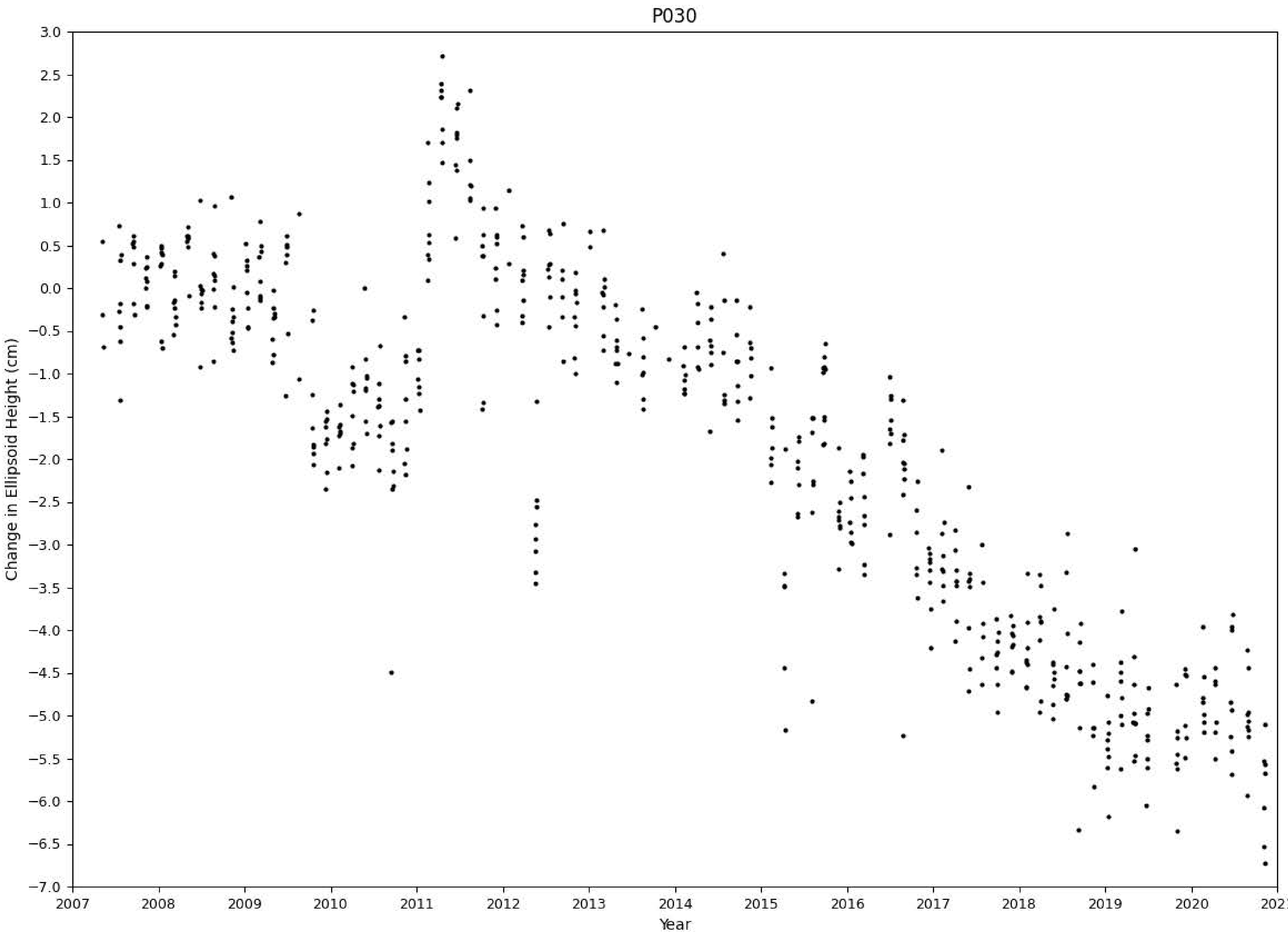
2020
2021
Year


P030
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2007
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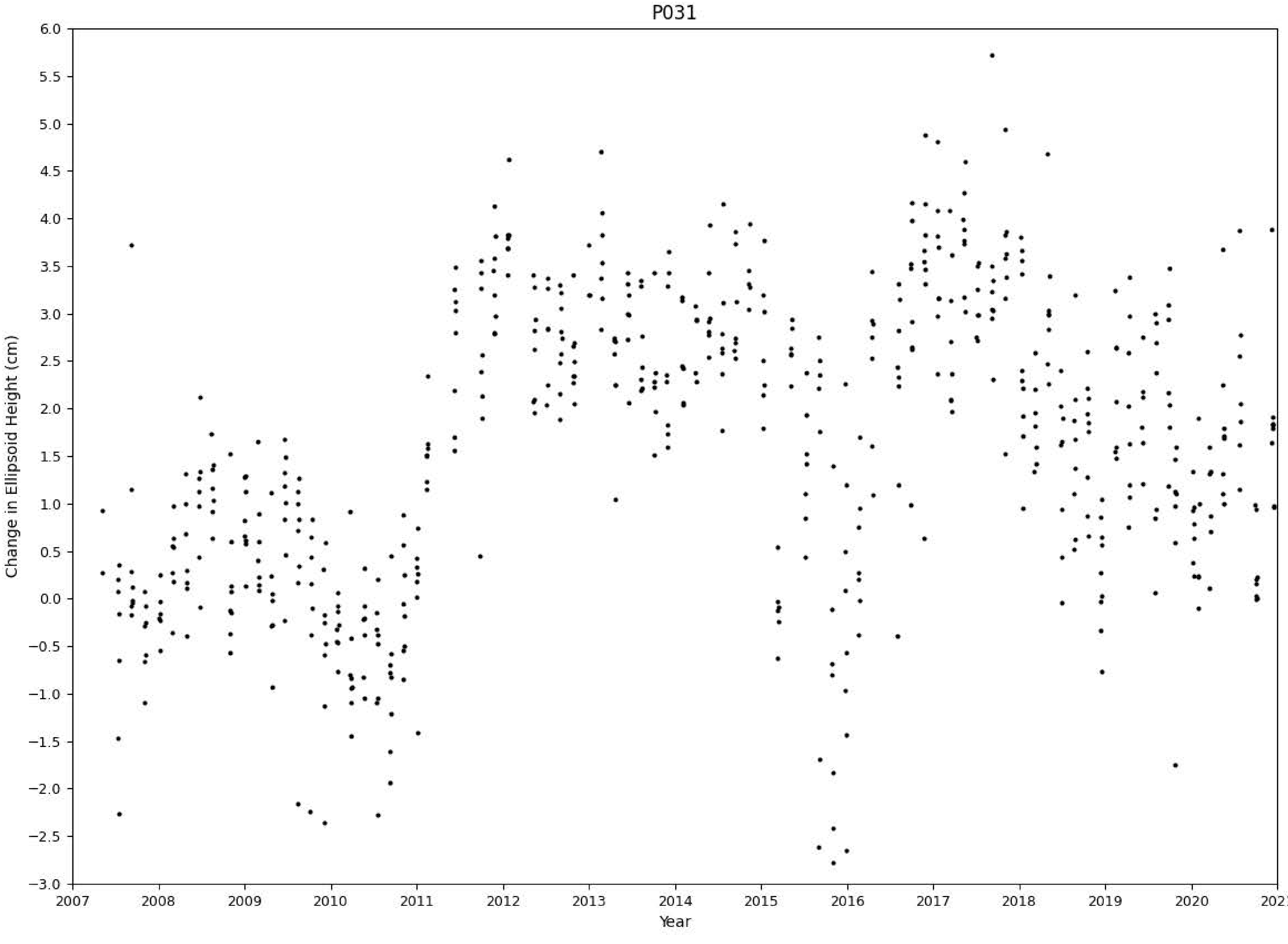
P031
Change in Ellipsoid Height (cm)
Year
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2007
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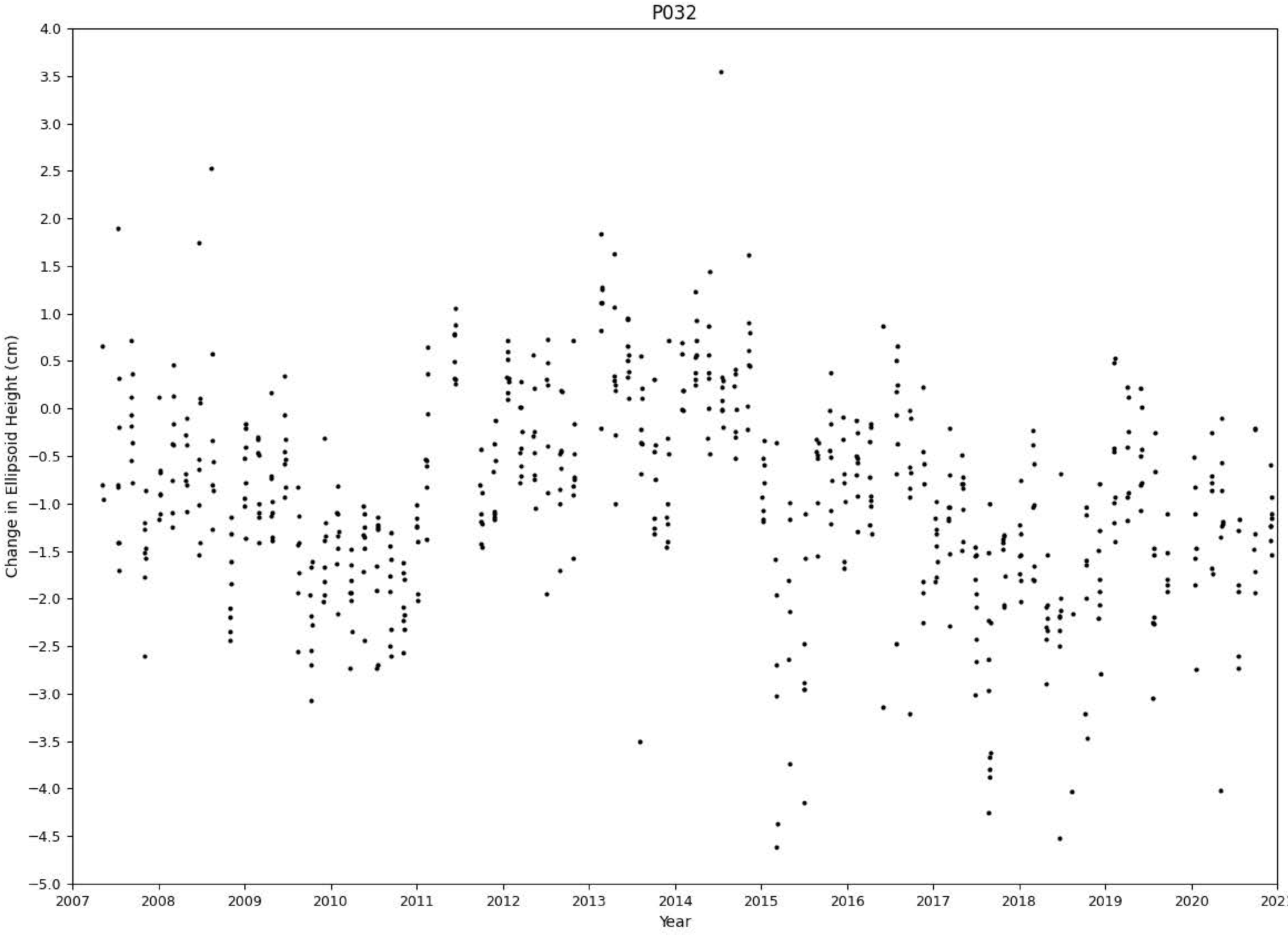
2021



P032
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2007
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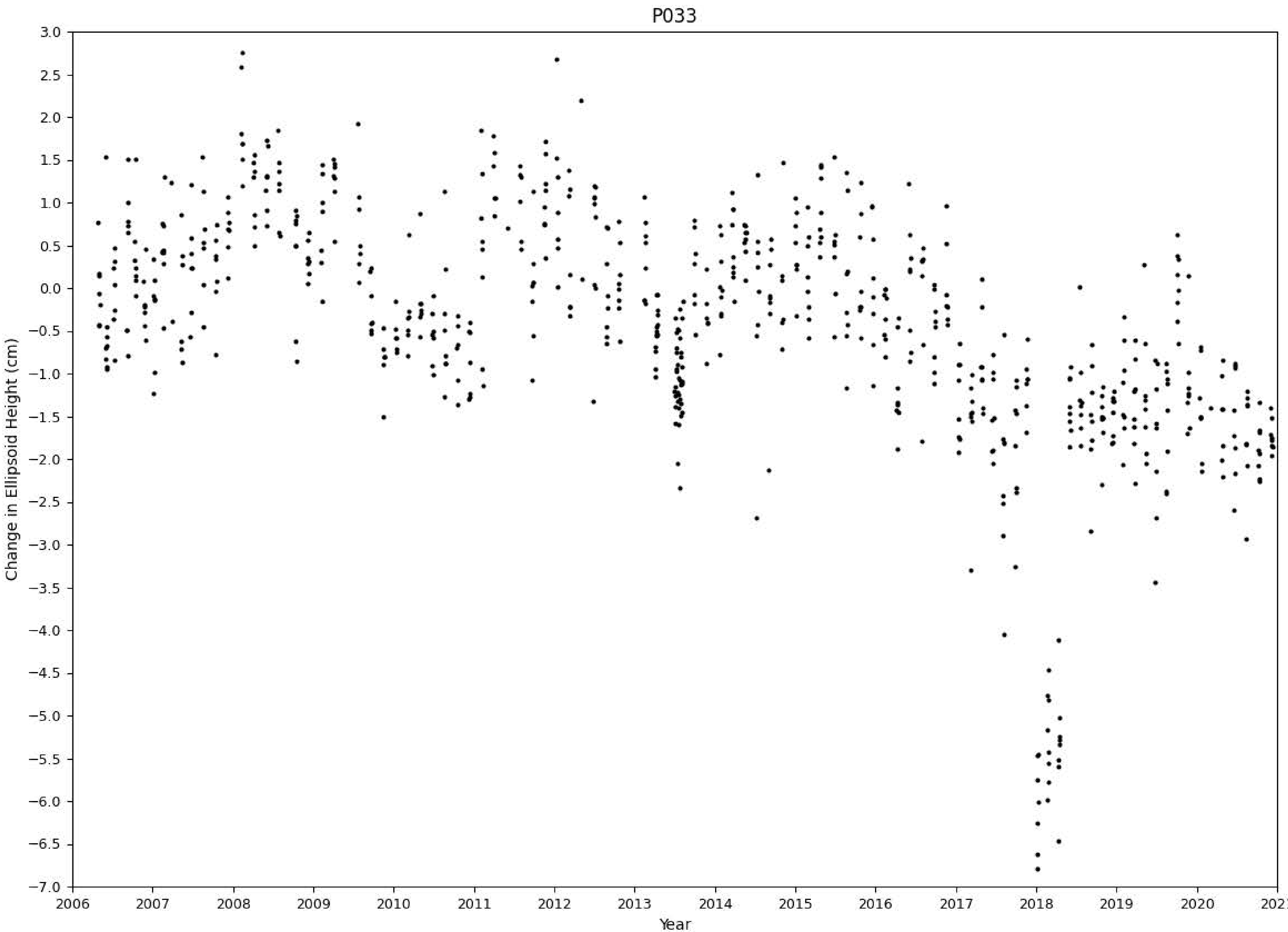
P033
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2006
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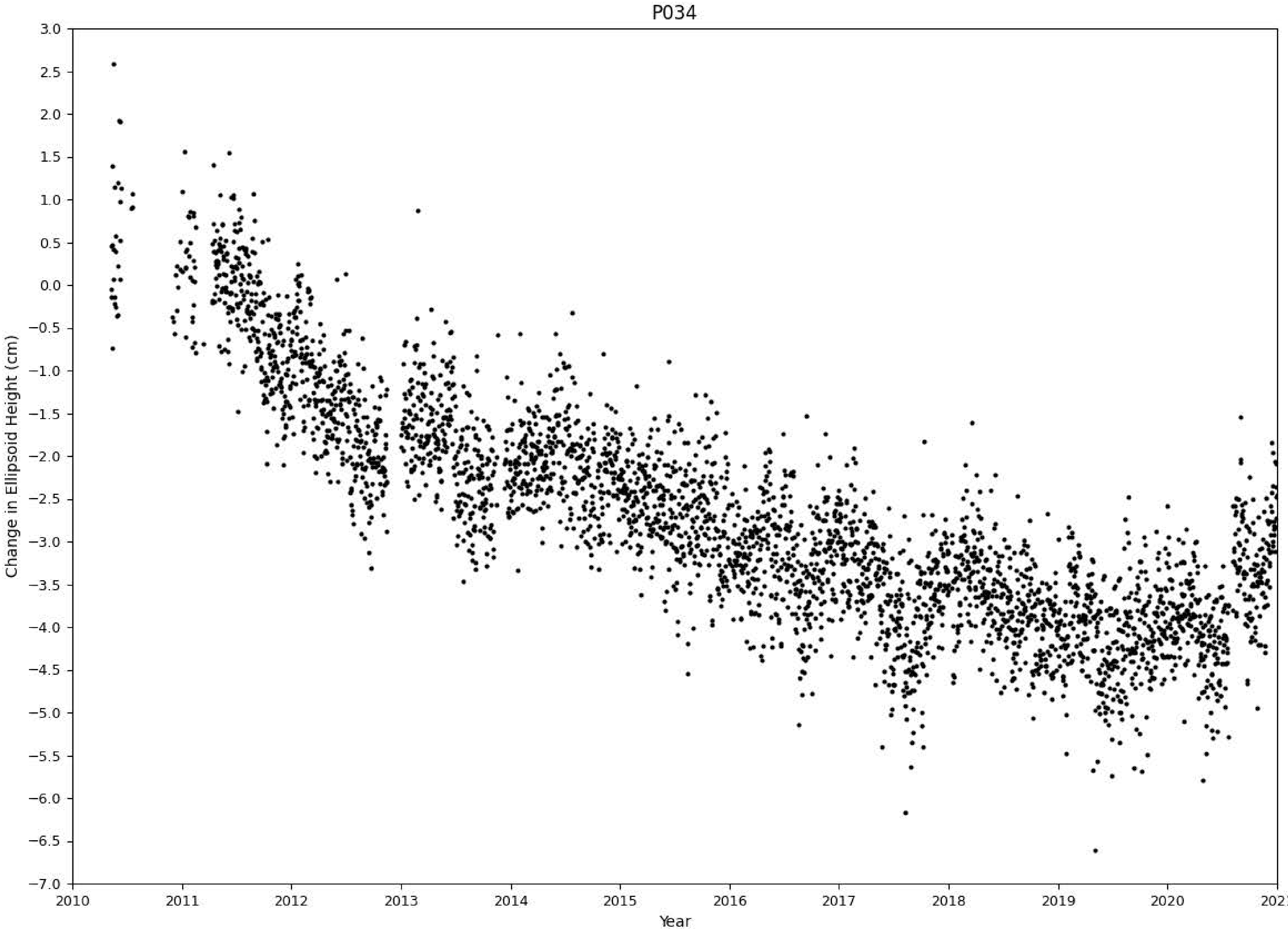
P034
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2010
2011
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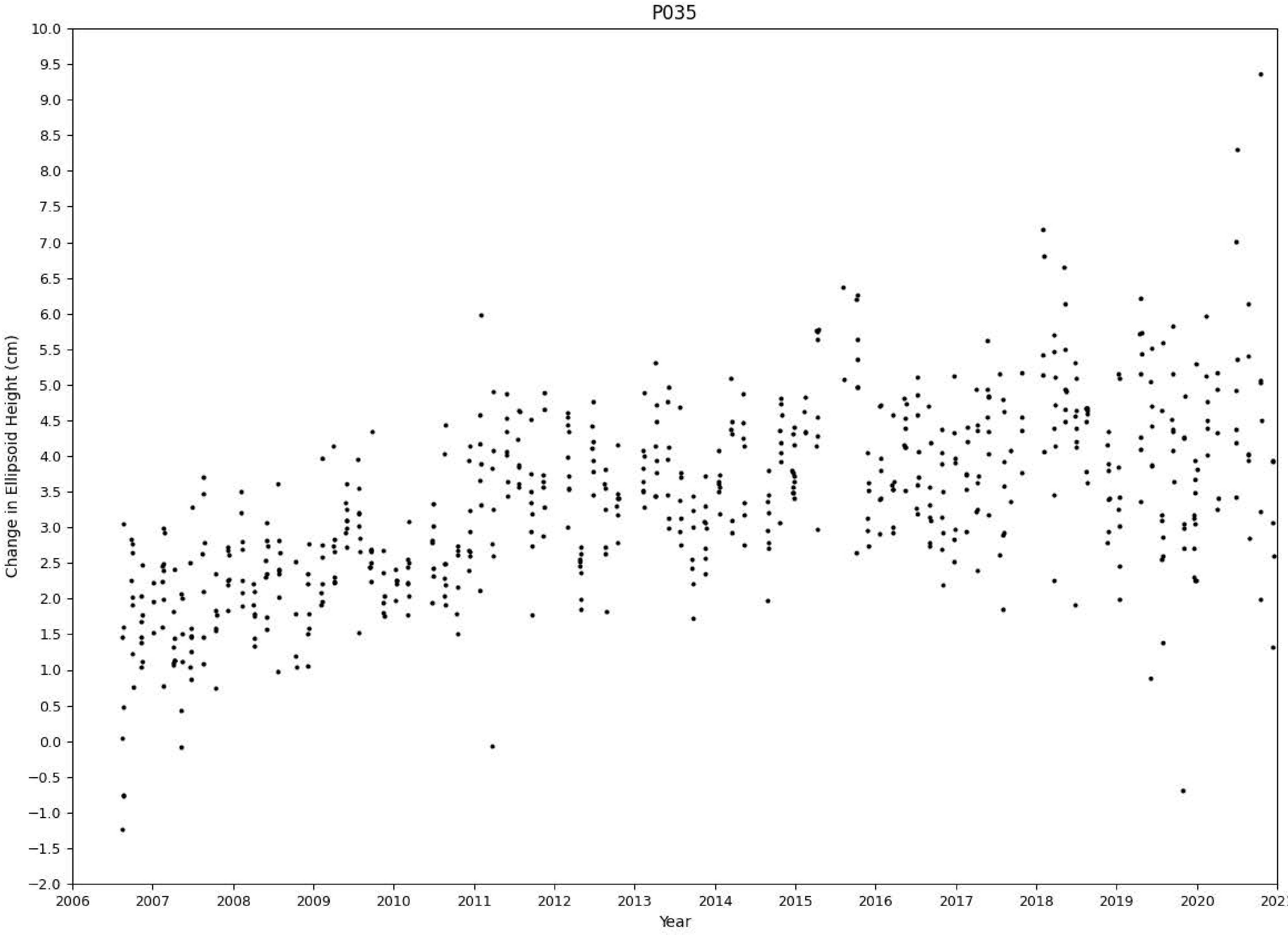
2020
2021
Year


P035
Change in Ellipsoid Height (cm)
Year
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2006
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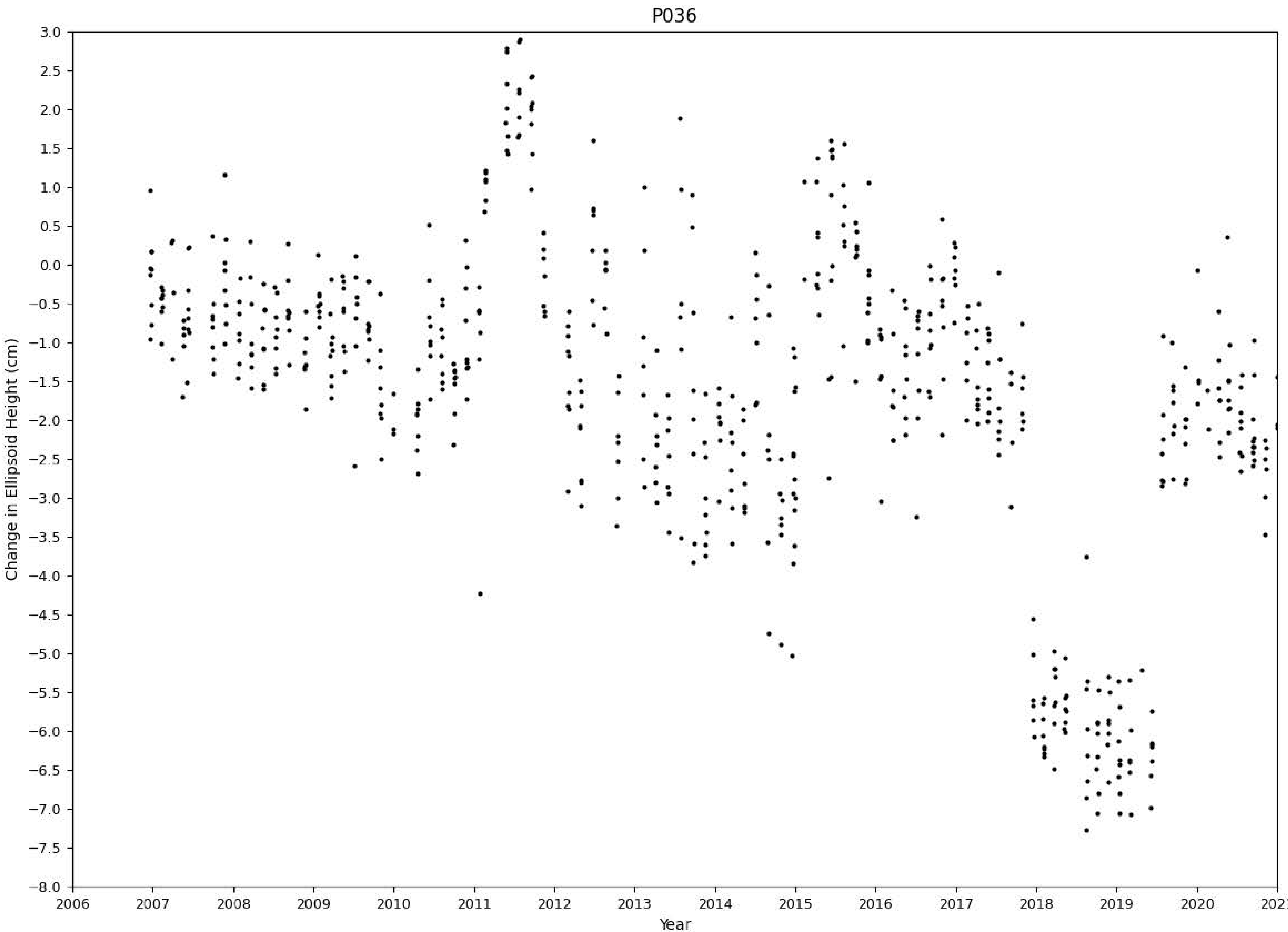
2020
2021



P036
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
2006
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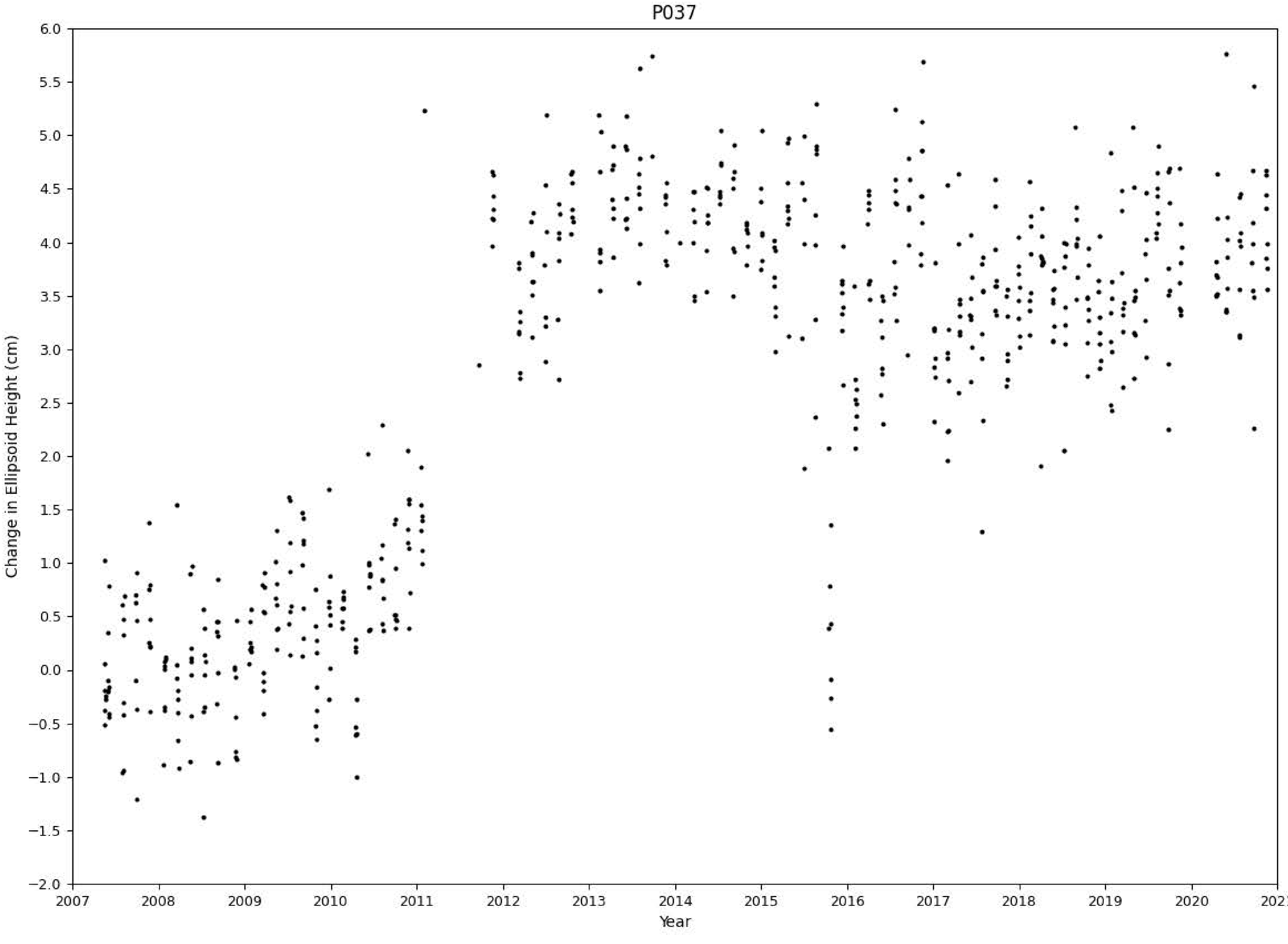
2021



P037
Change in Ellipsoid Height (cm)
Year
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2007
2008
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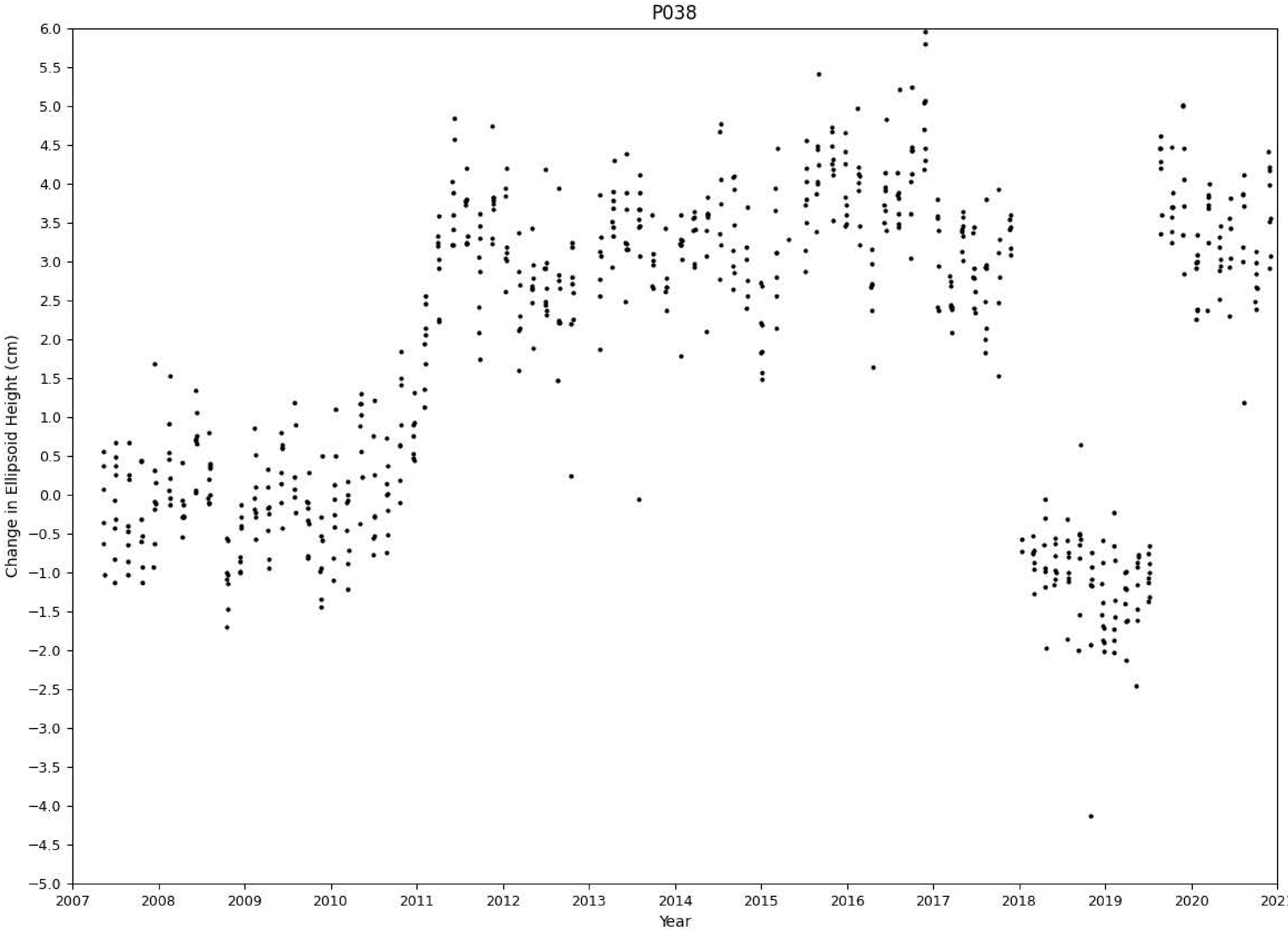
2021



P038
Change in Ellipsoid Height (cm)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2007
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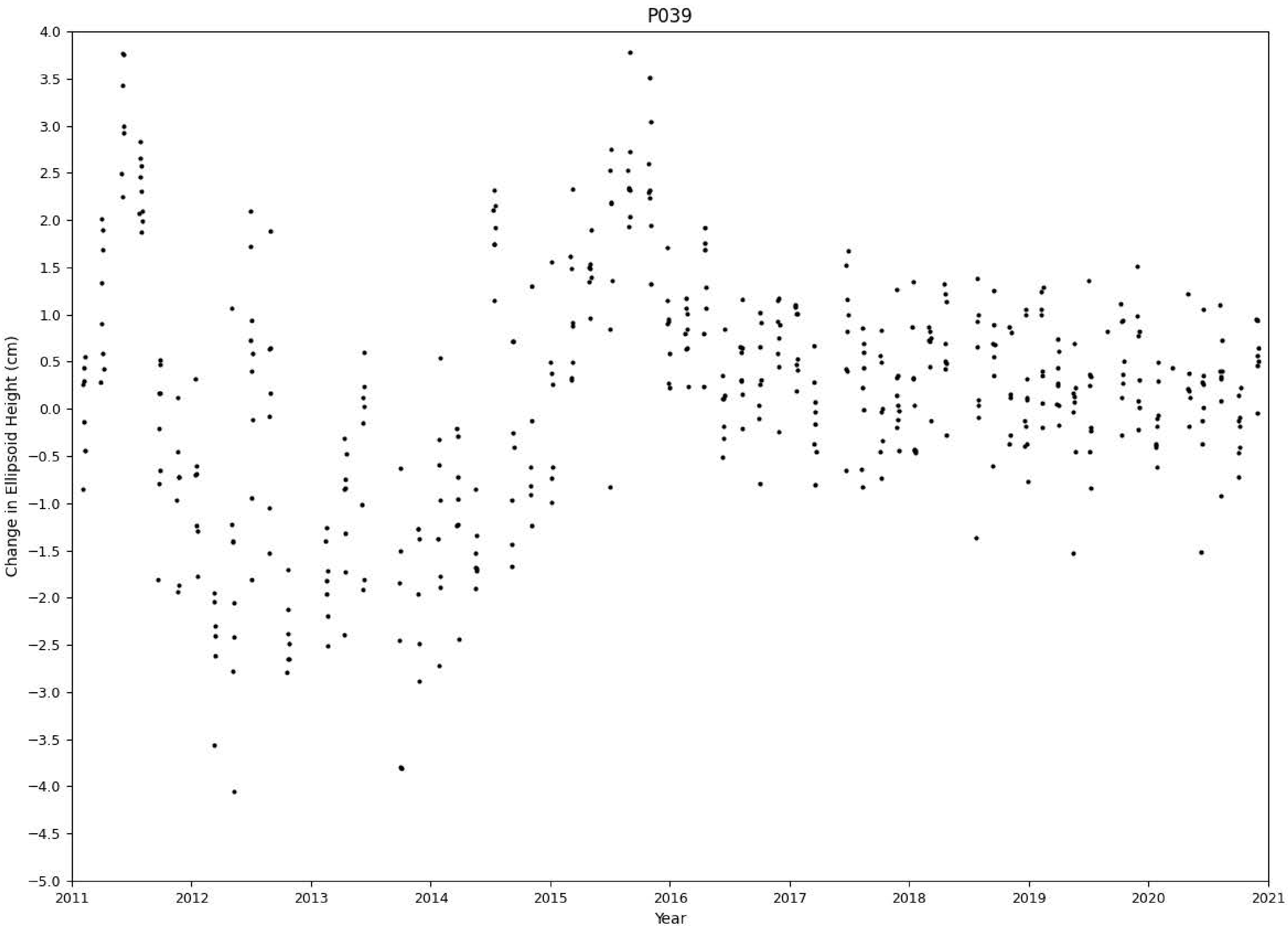
2020
2021
Year



P039
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2011
2012
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2014
2015
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2017
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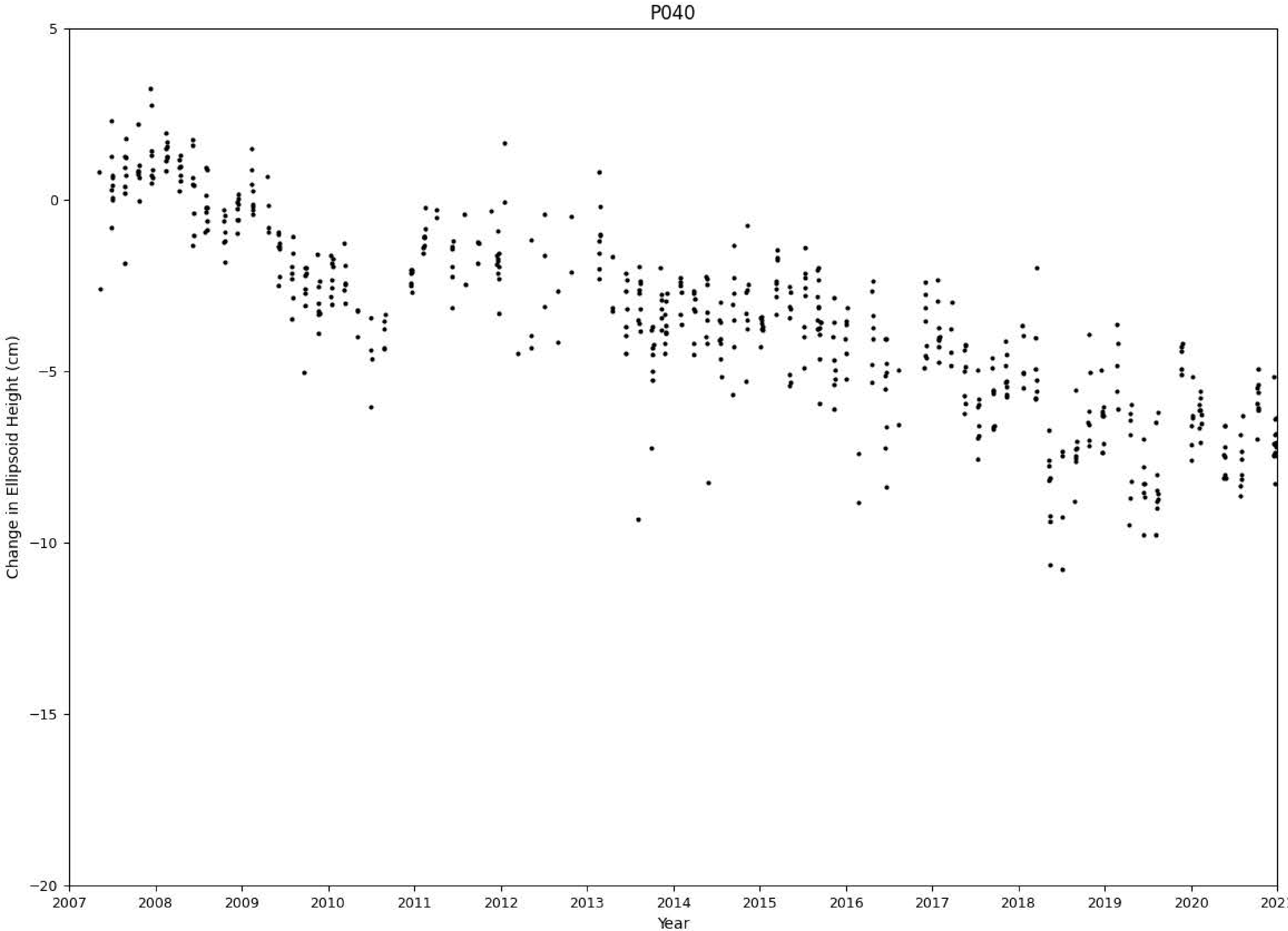
2019
2020
2021



P040
5
0
−5
−10
−15
−20
Change in Ellipsoid Height (cm)
2007
2008
2009
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2011
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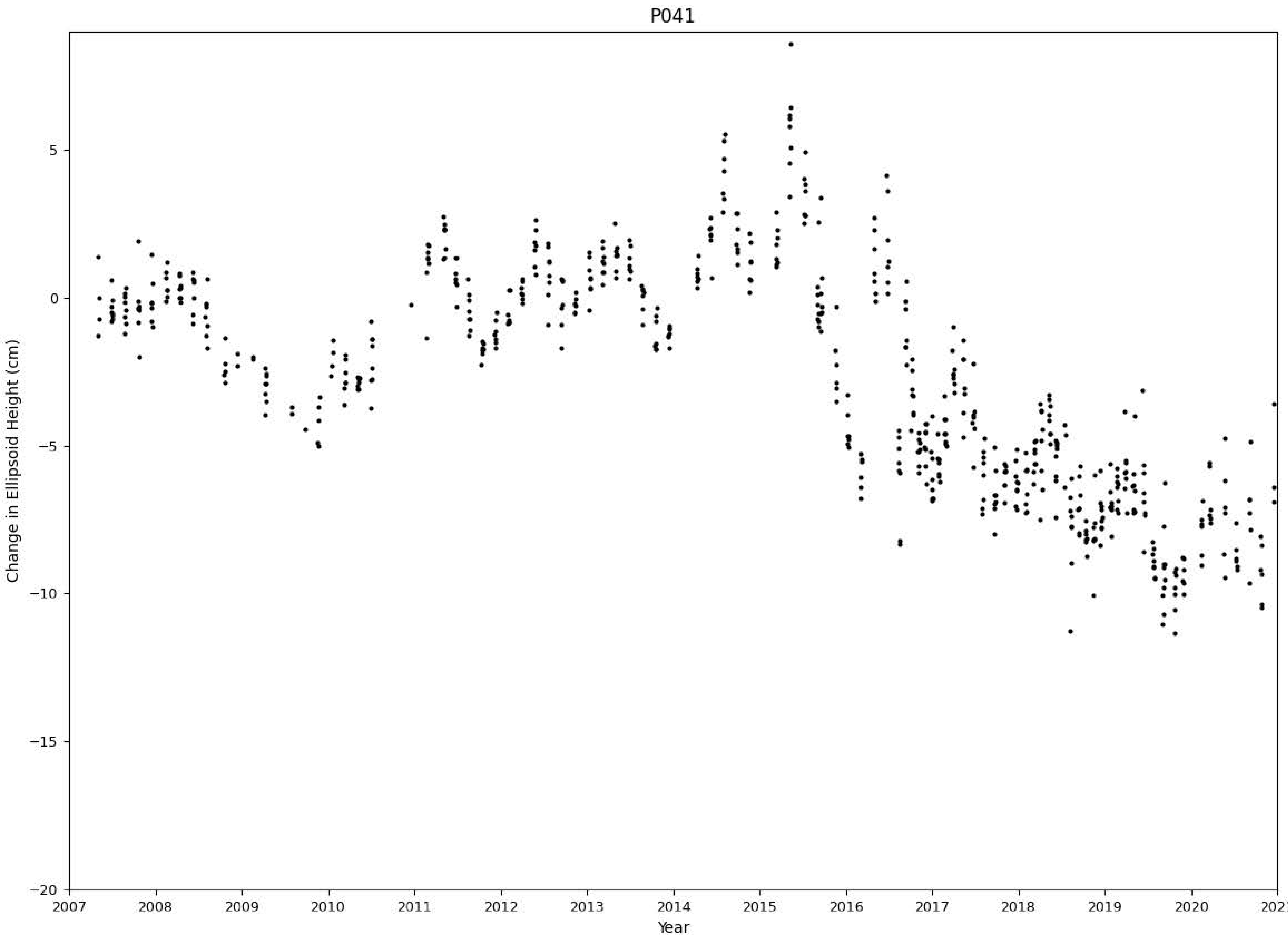
2019
2020
2021
Year



P041
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
2007
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2011
2012
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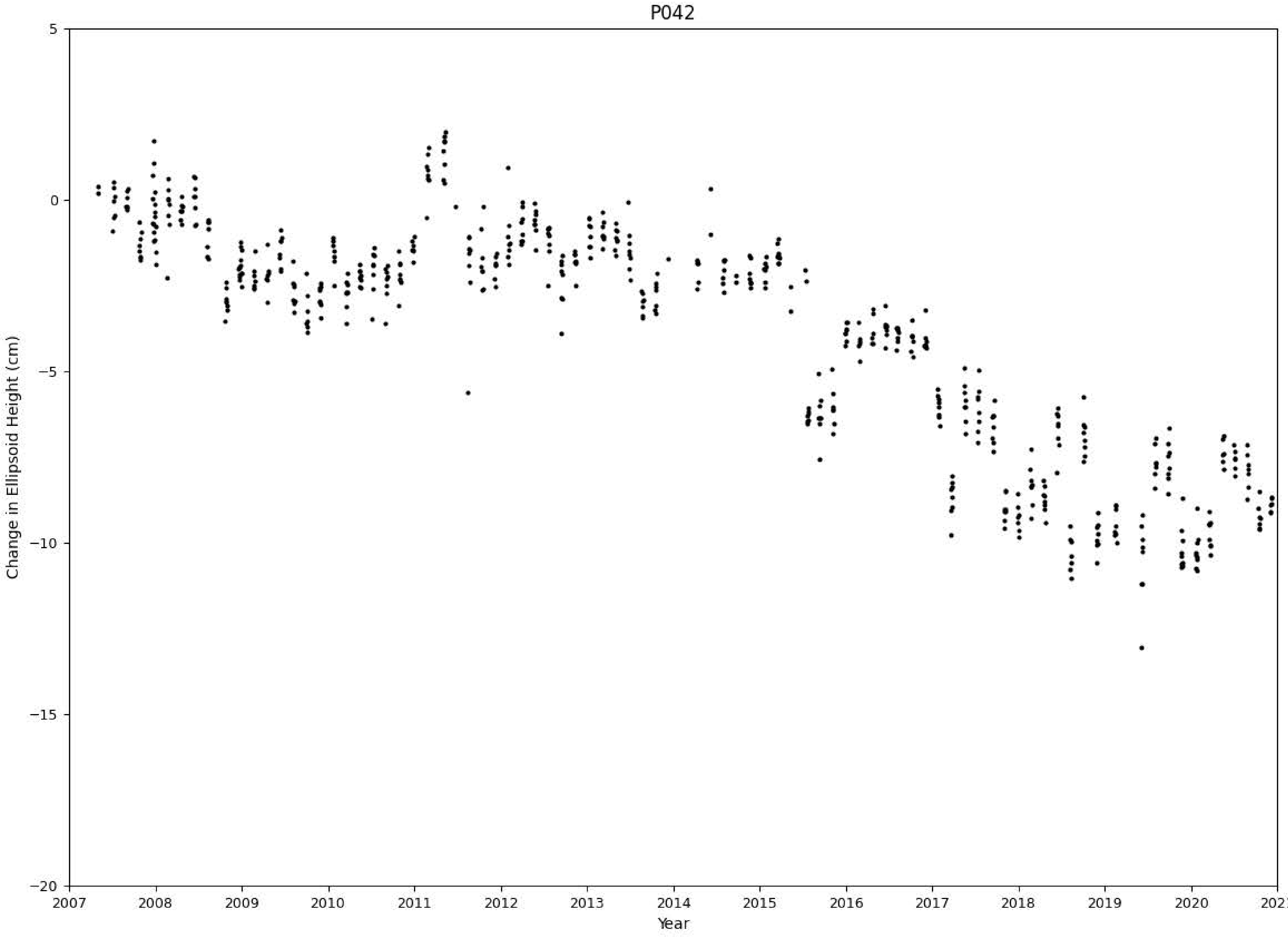
2021
Year



P042
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
2007
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2012
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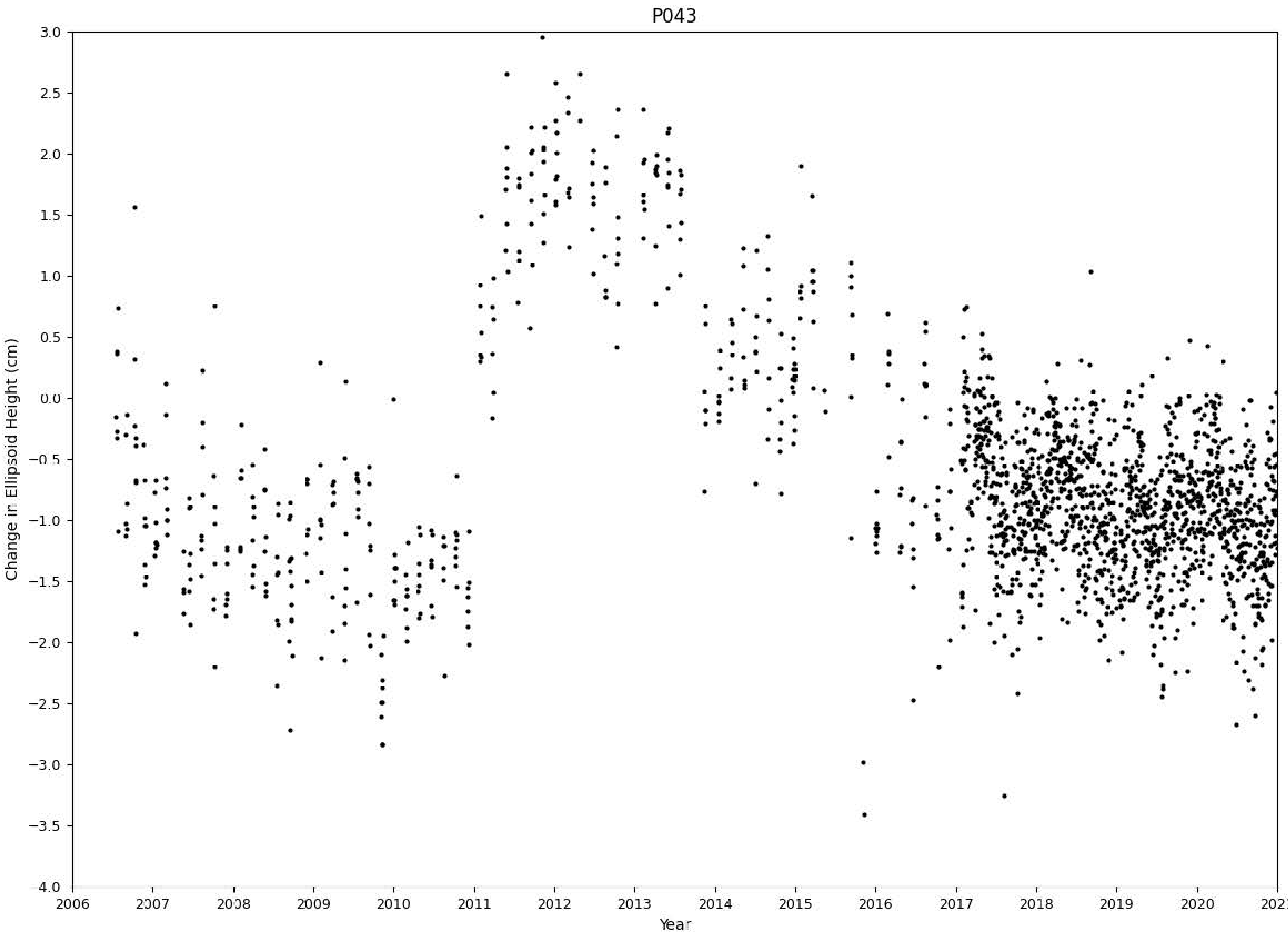
2021


P043
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2006
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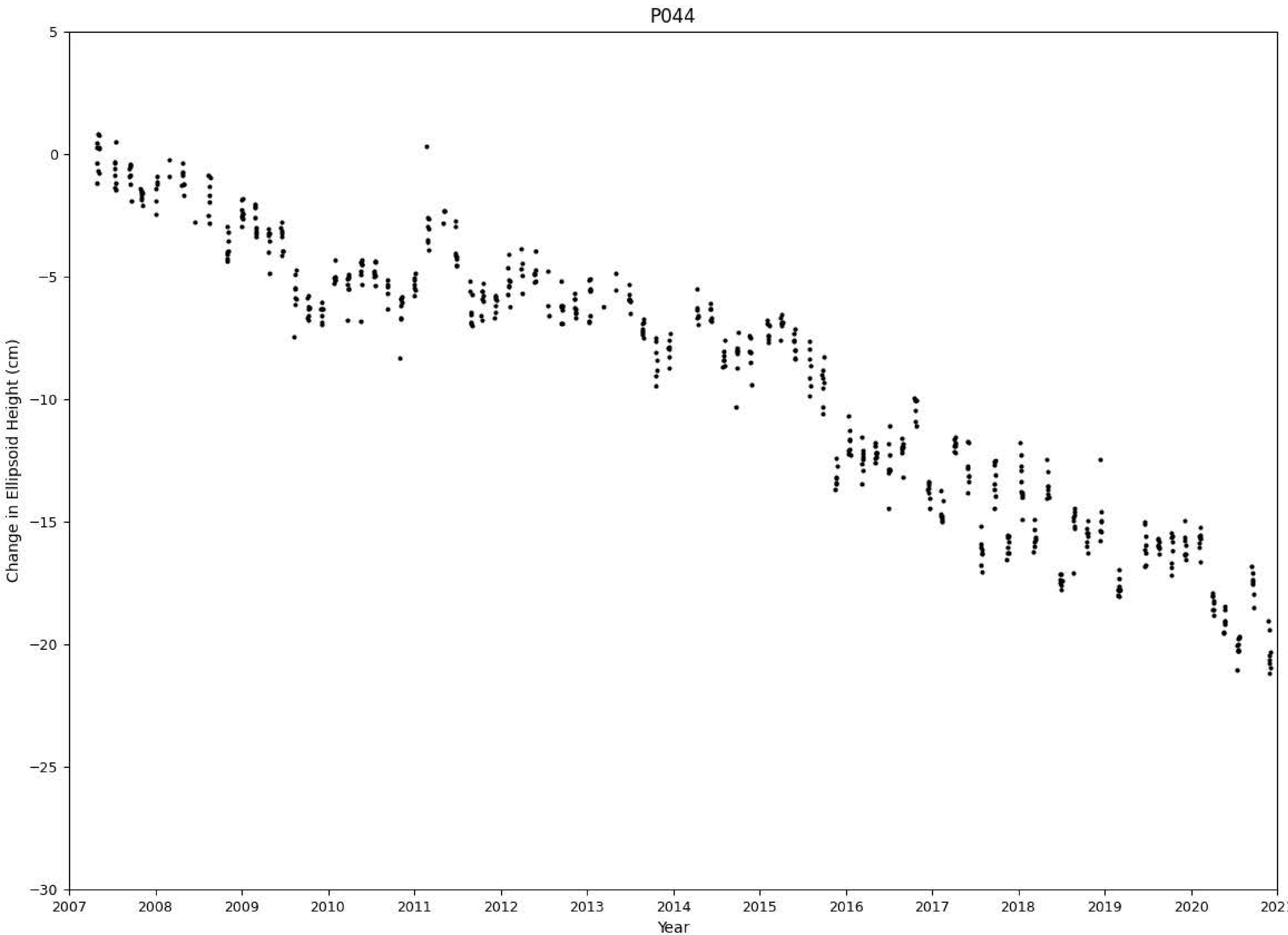
2021


P044
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
2007
2008
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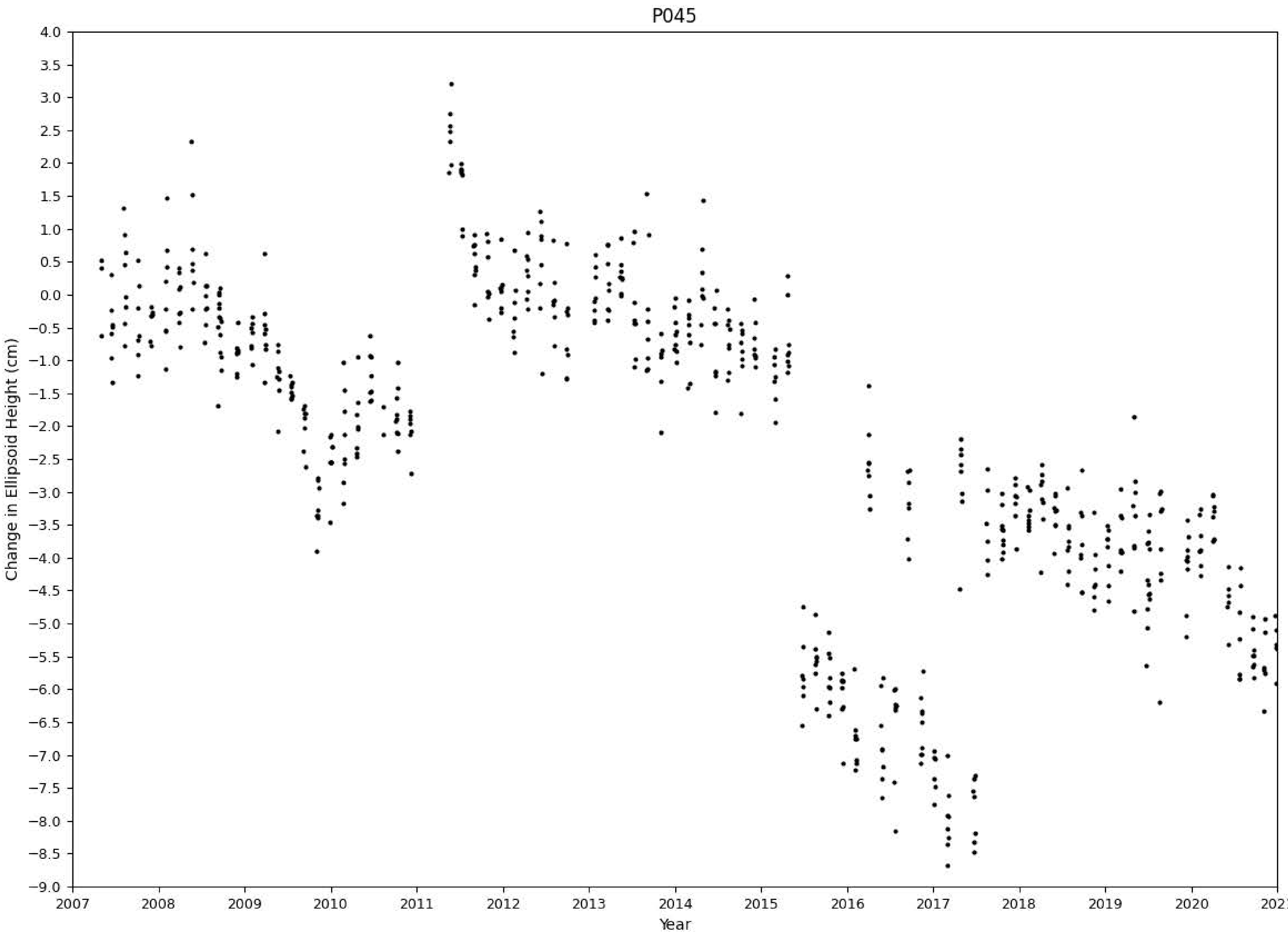
2021


P045
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
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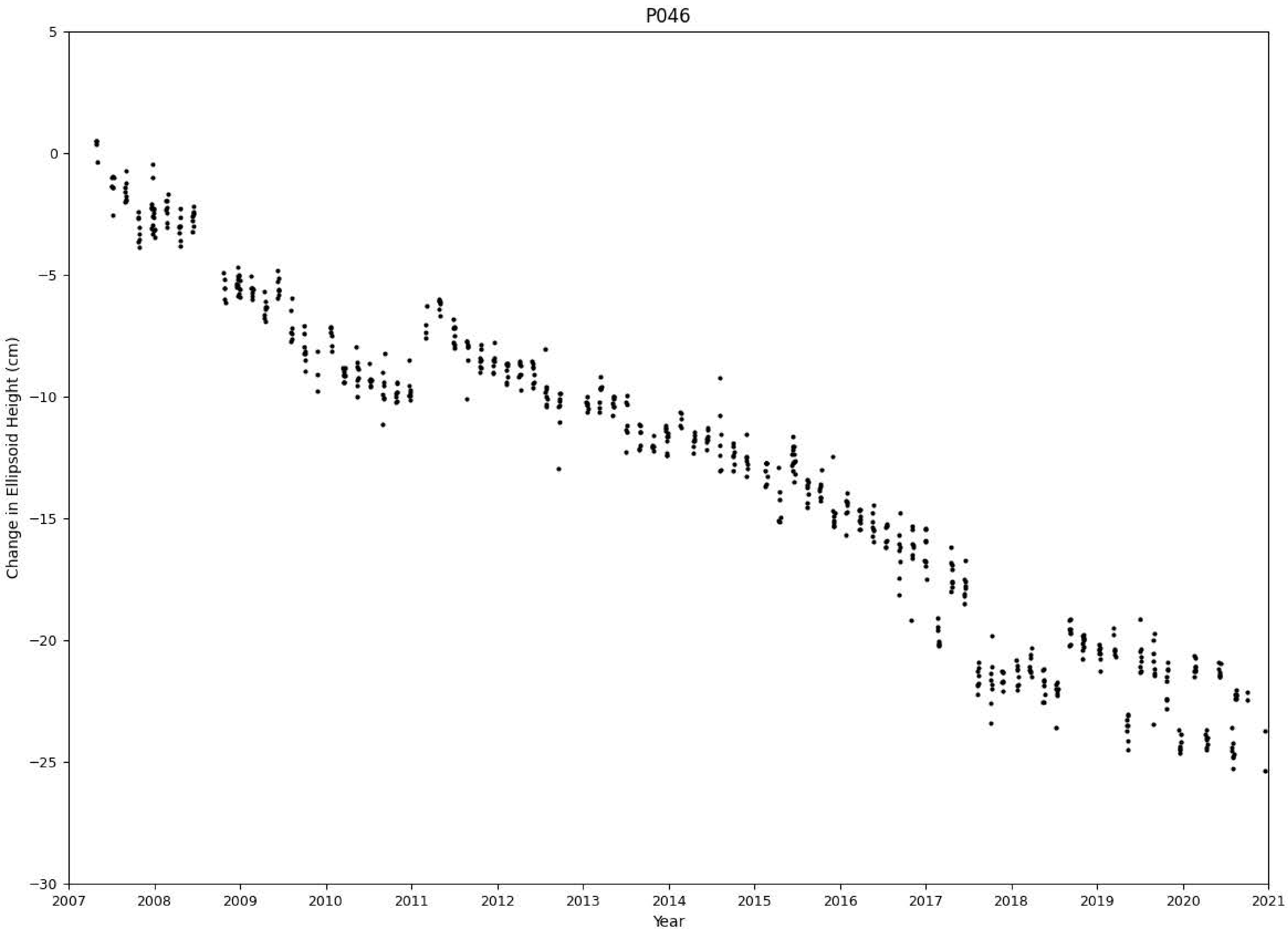
2021



P046
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
−25
−30
2007
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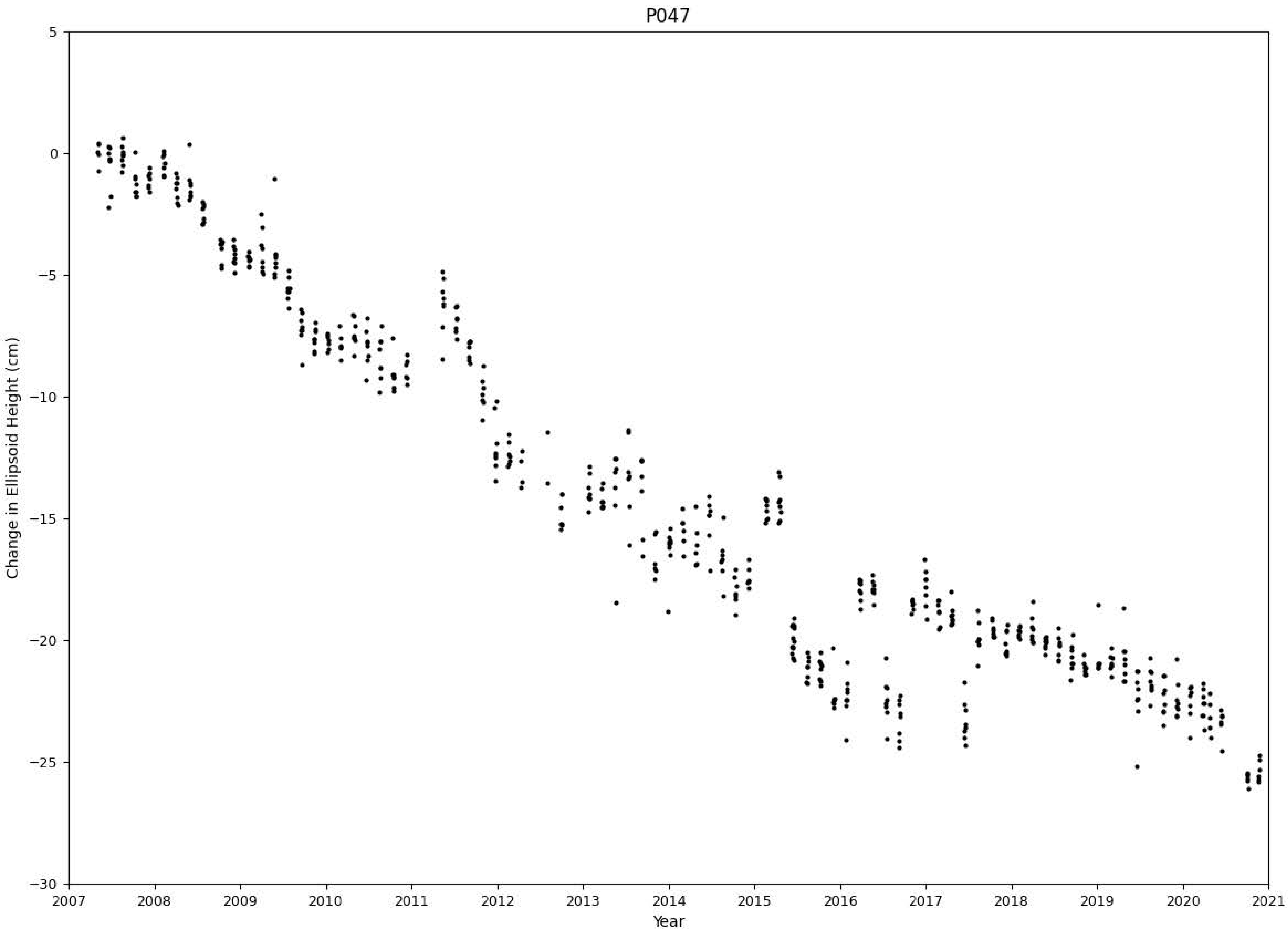

P047
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
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−25
−30
2007
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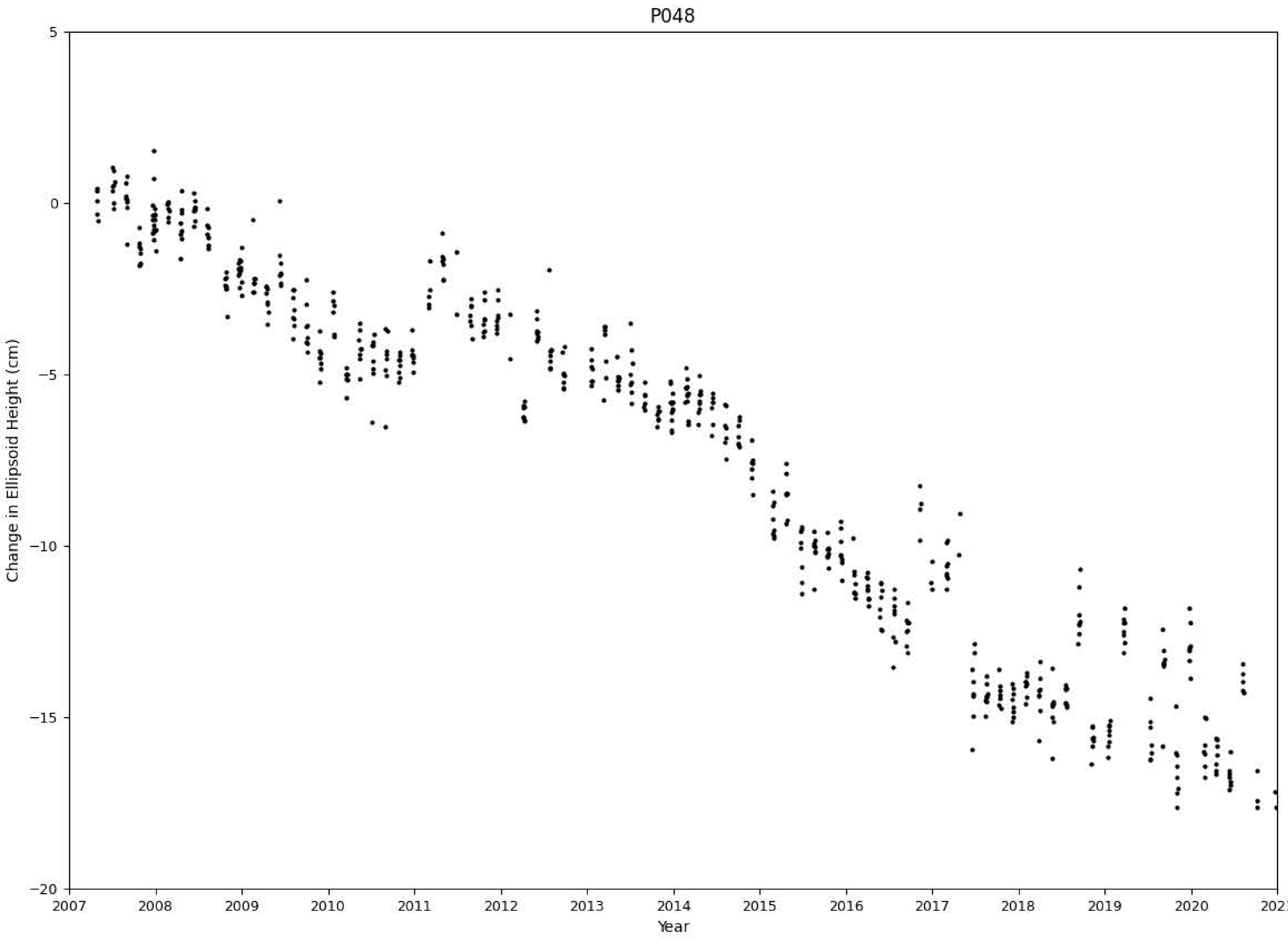
2021


P048
Change in Ellipsoid Height (cm)
Year
5
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−5
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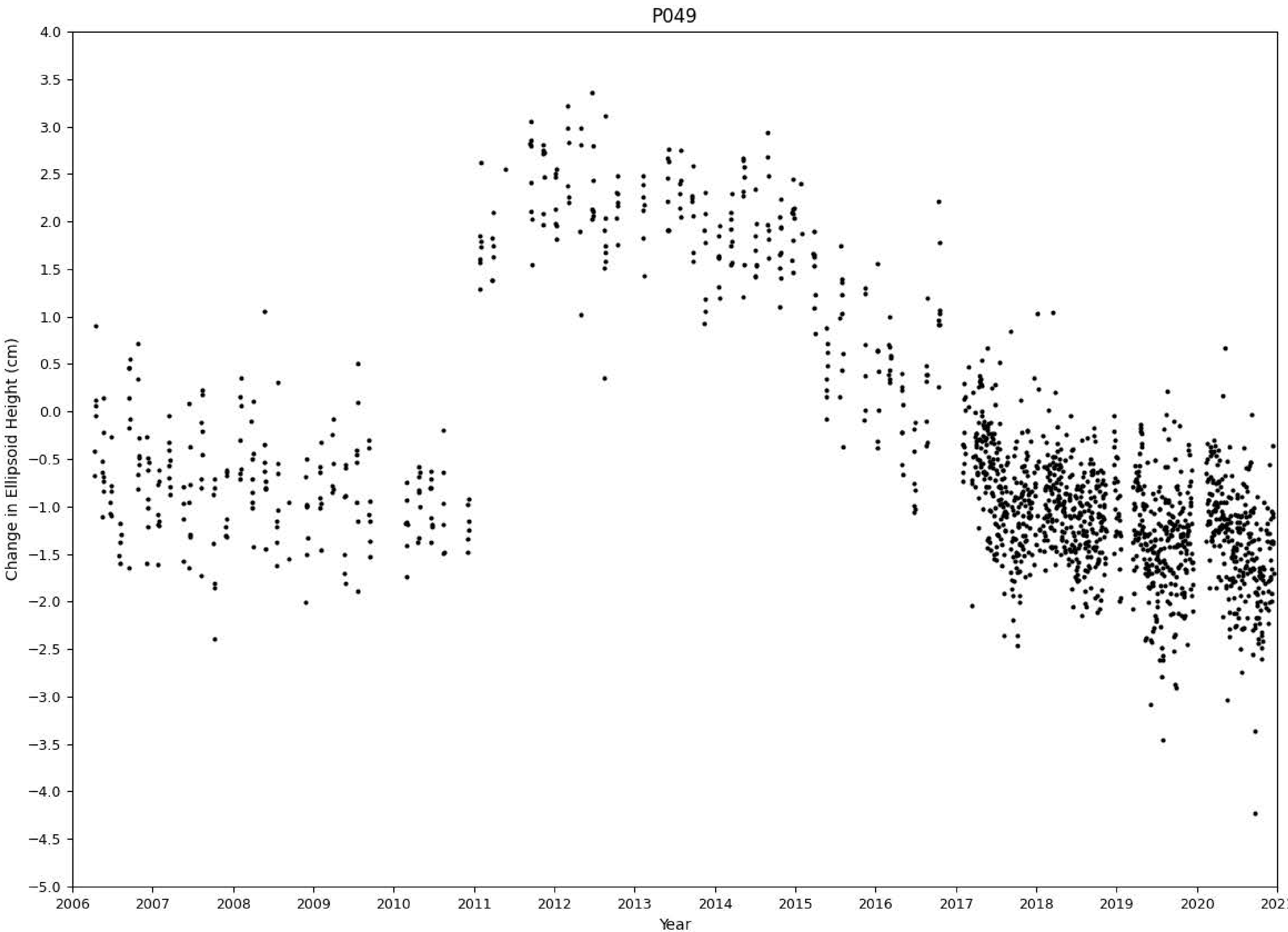
2021



P049
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2006
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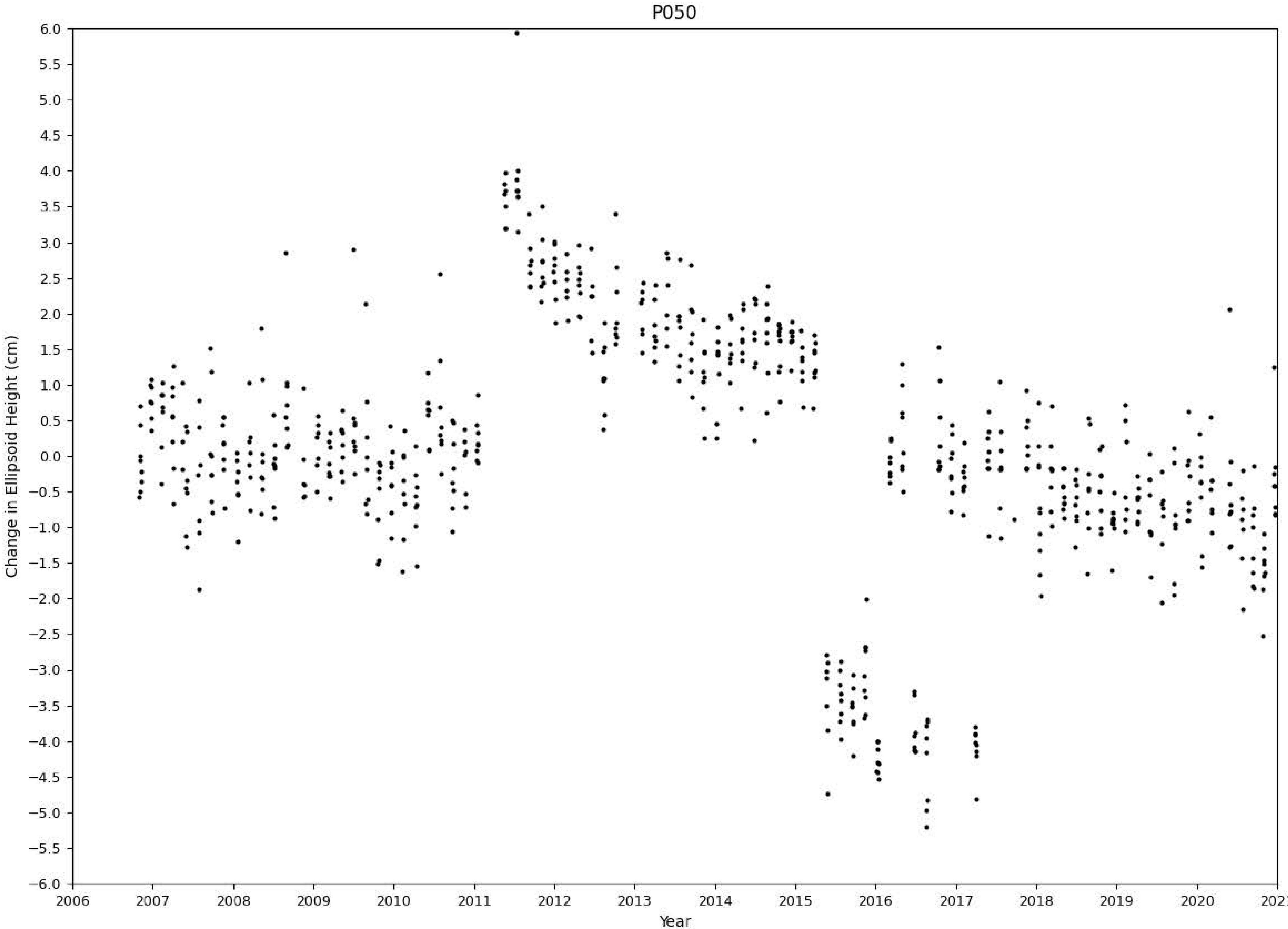
2021



P050
Change in Ellipsoid Height (cm)
Year
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
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−3.5
−4.0
−4.5
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−5.5
−6.0
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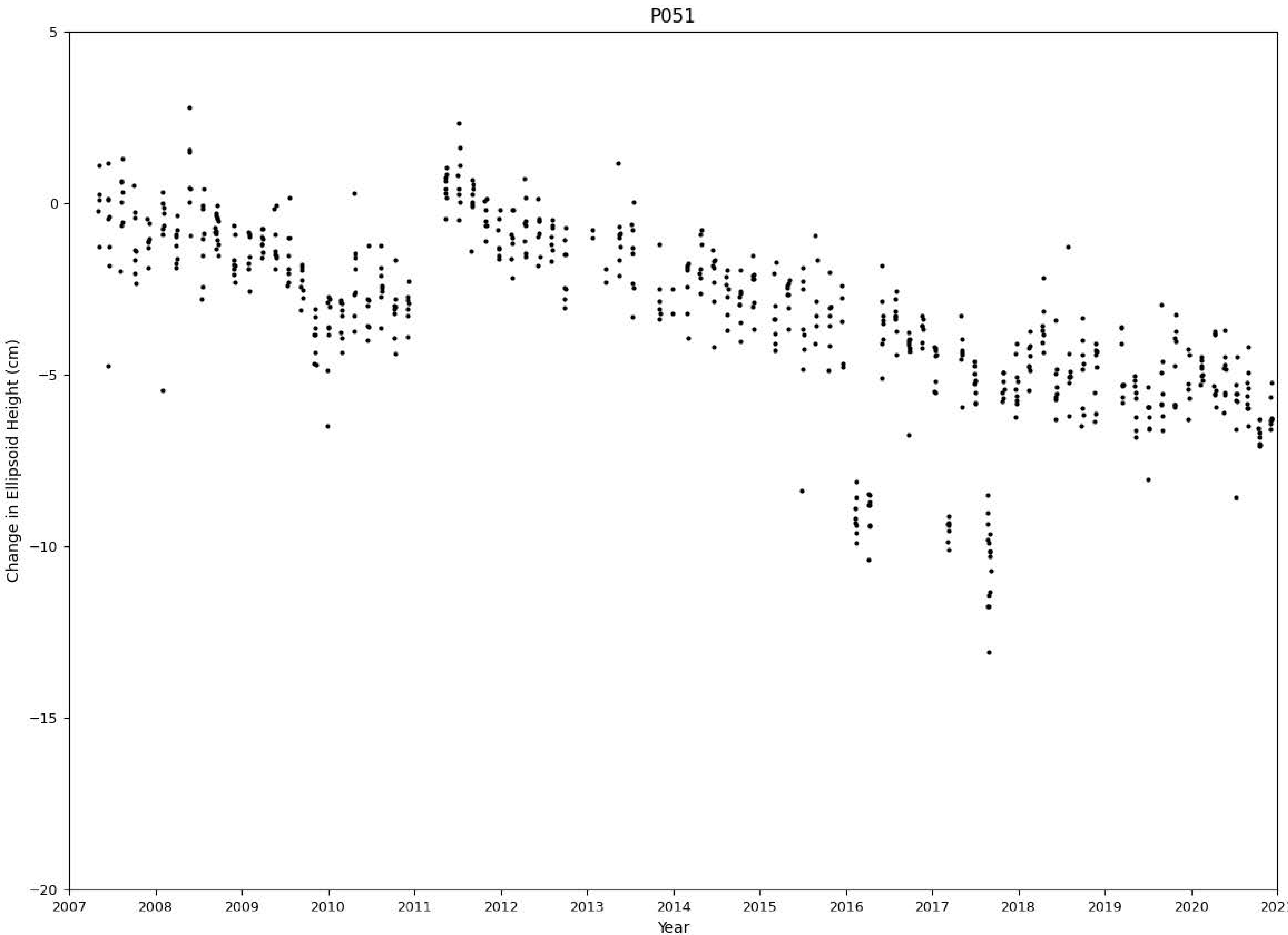

P051
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
2007
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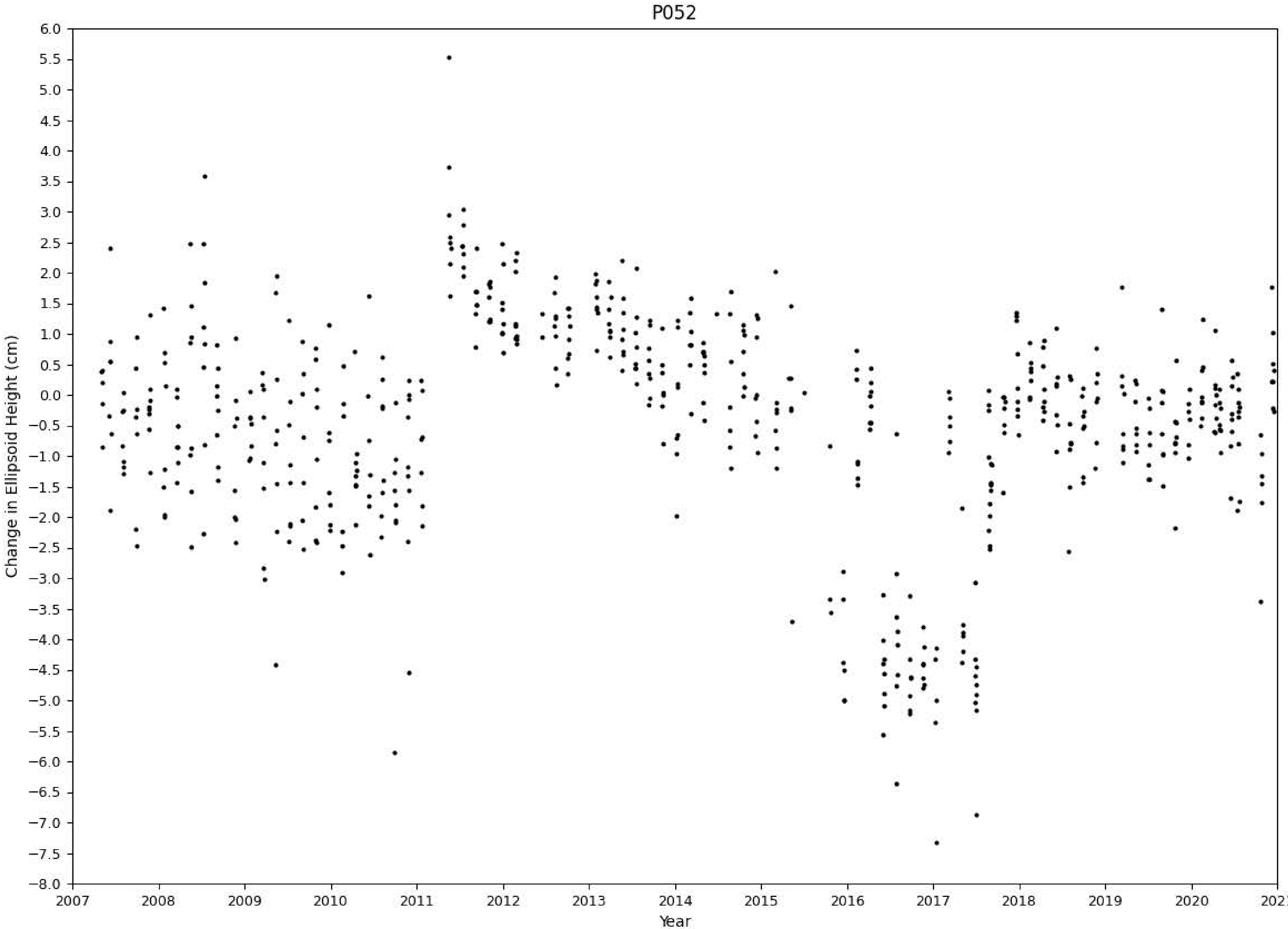

P052
Change in Ellipsoid Height (cm)
Year
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
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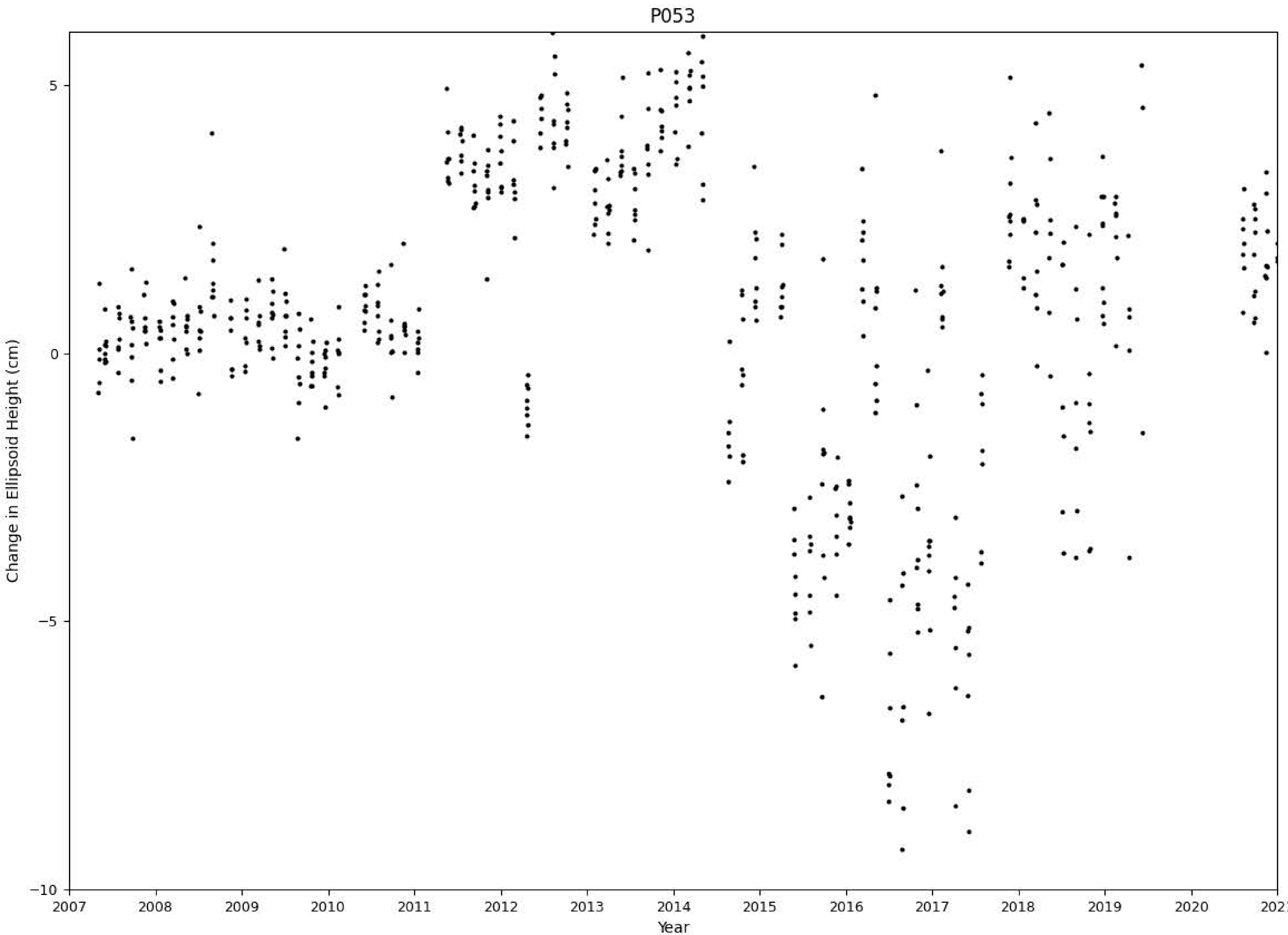

P053
Change in Ellipsoid Height (cm)
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−5
−10
2007
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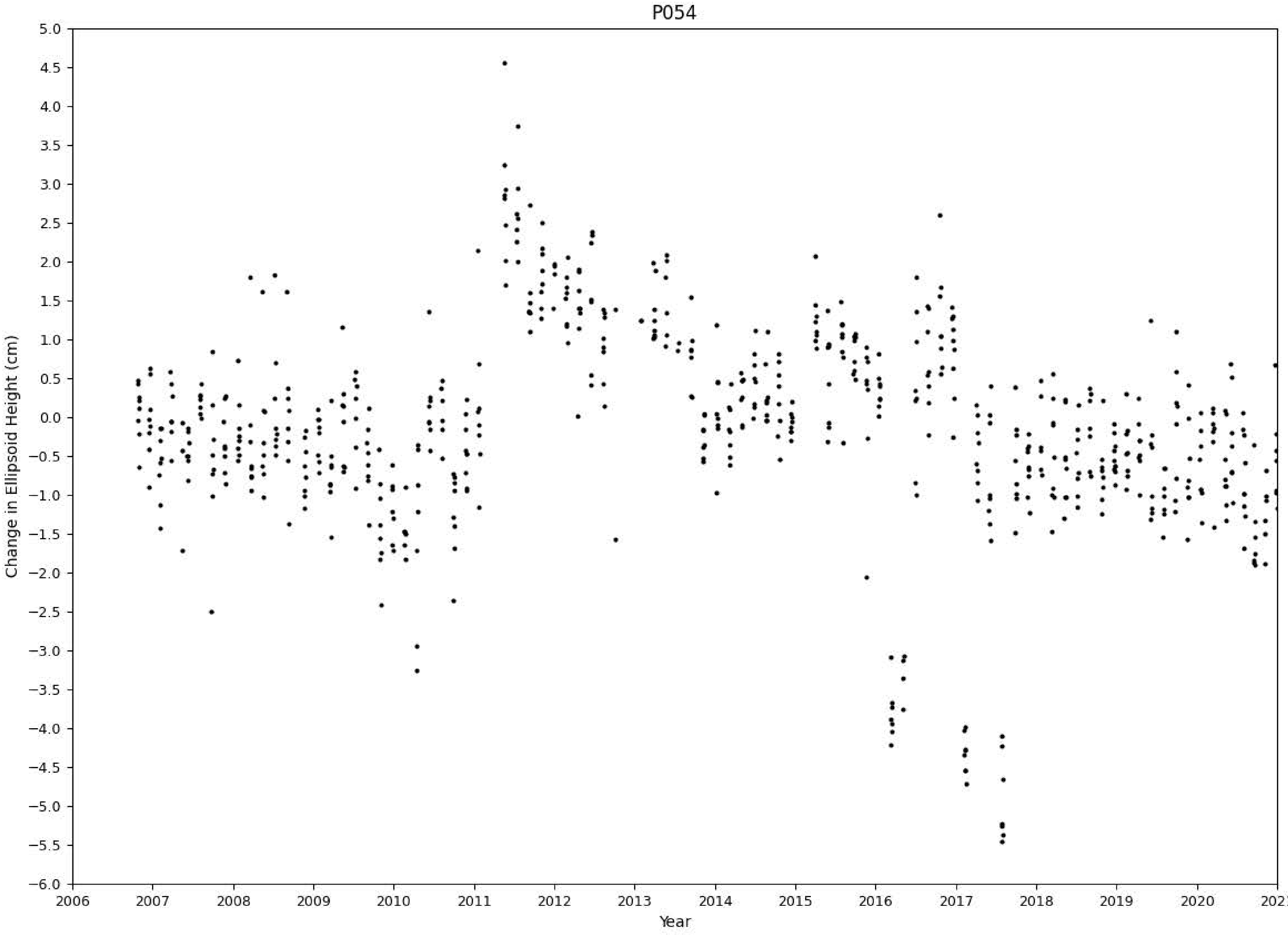
Year



P054
Change in Ellipsoid Height (cm)
Year
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
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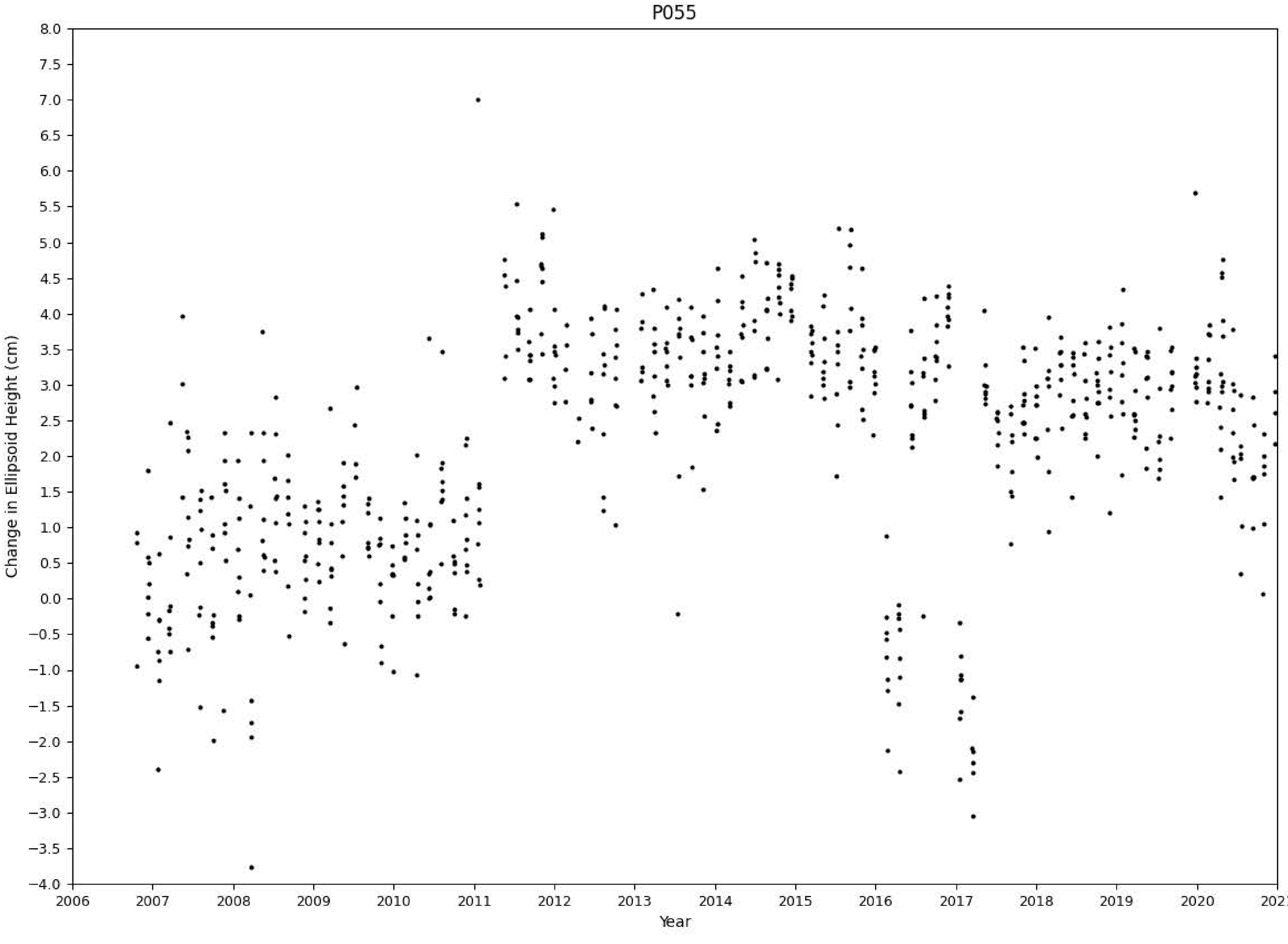

P055
Change in Ellipsoid Height (cm)
Year
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2006
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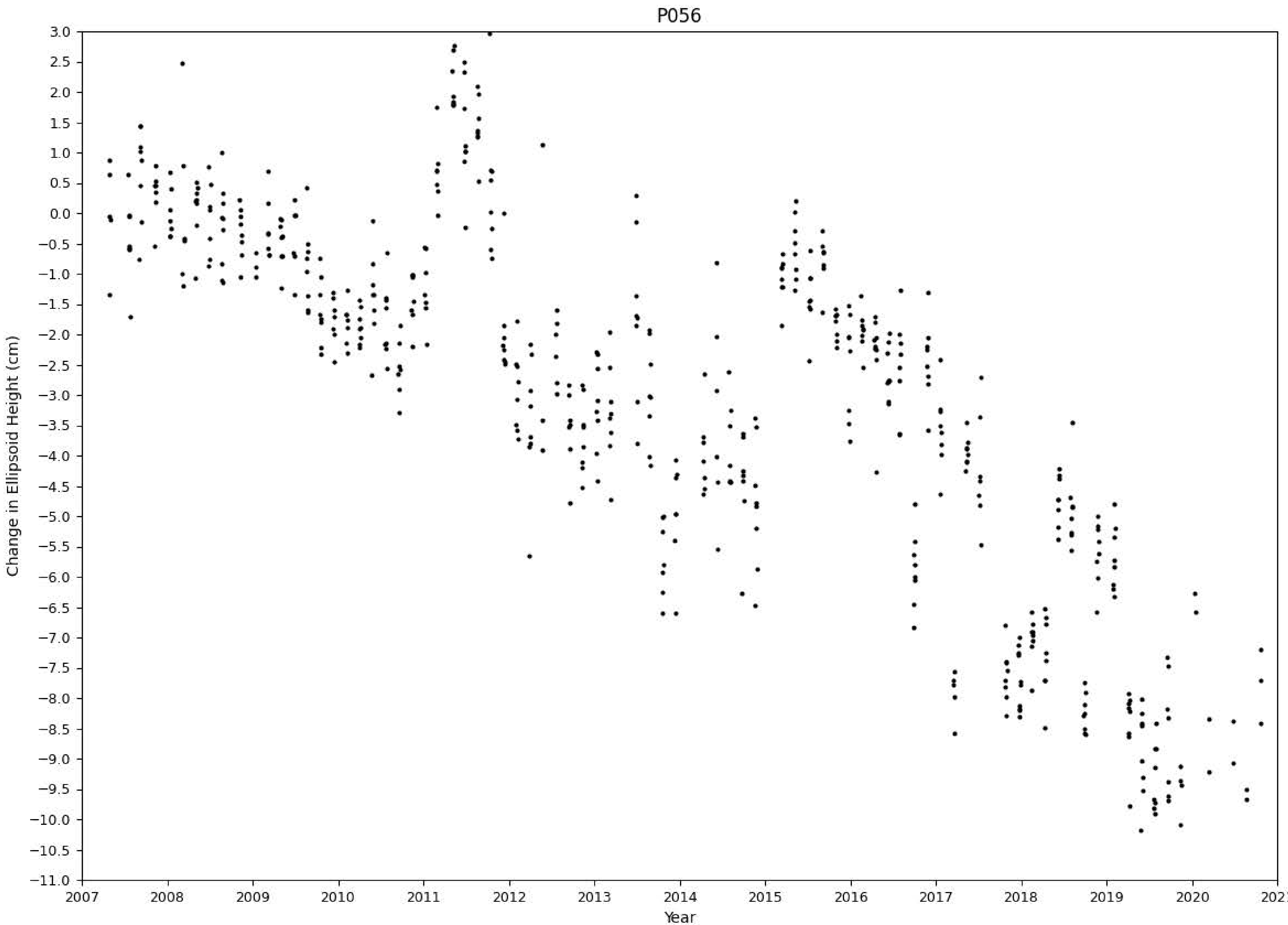
P056
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
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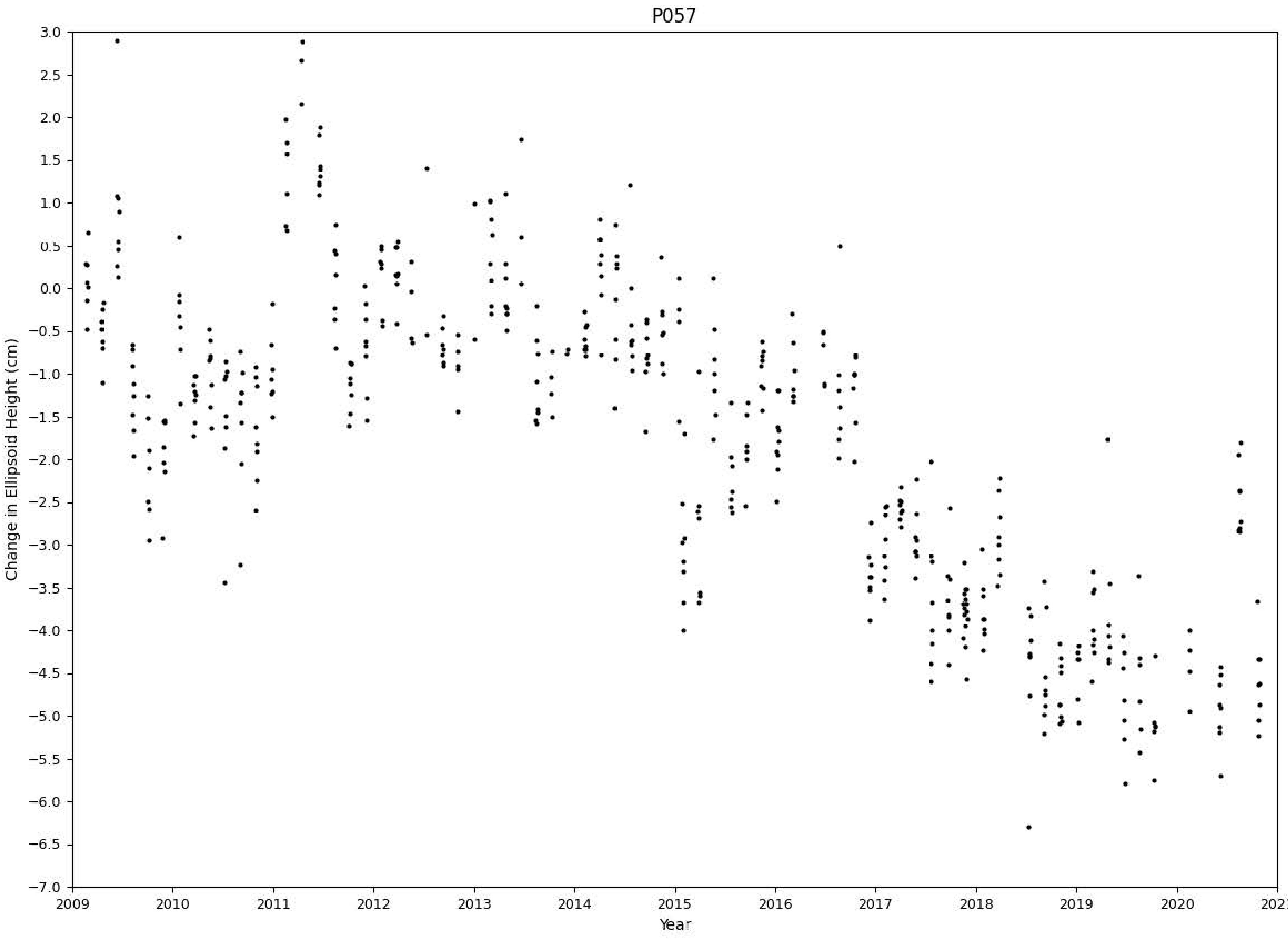

P057
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
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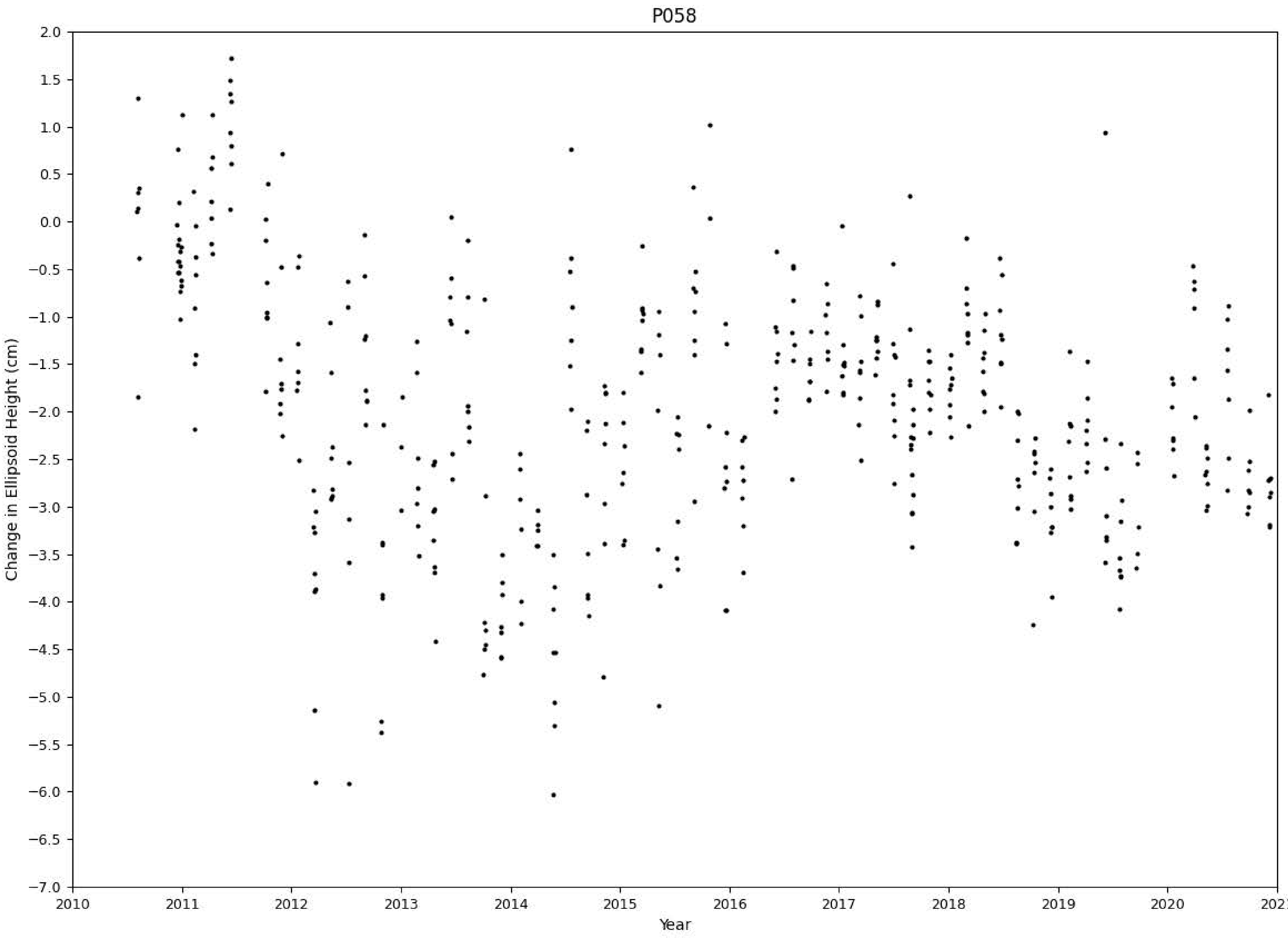
P058
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
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−5.0
−5.5
−6.0
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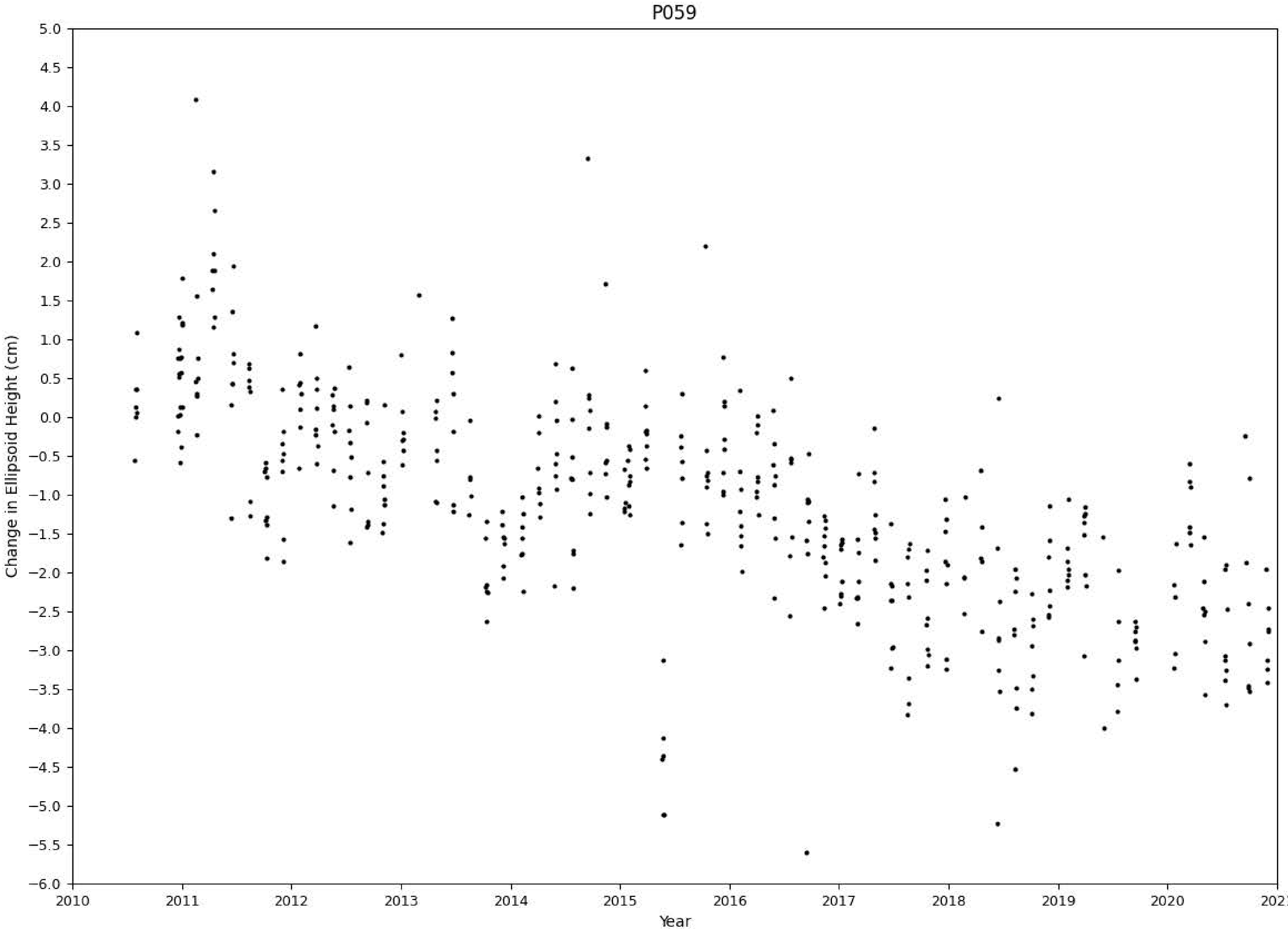

P059
Change in Ellipsoid Height (cm)
Year
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
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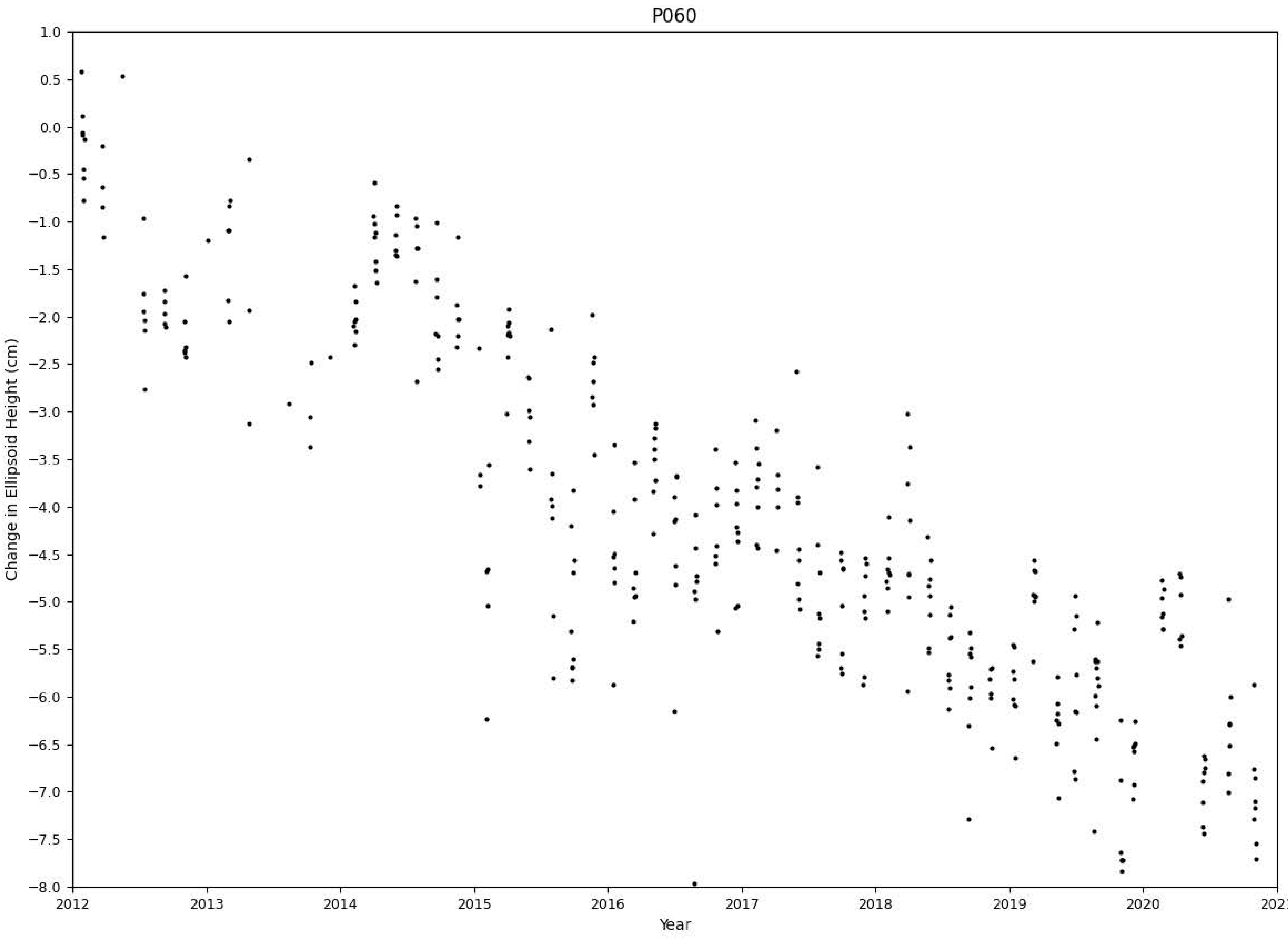
P060
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
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−5.0
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−6.0
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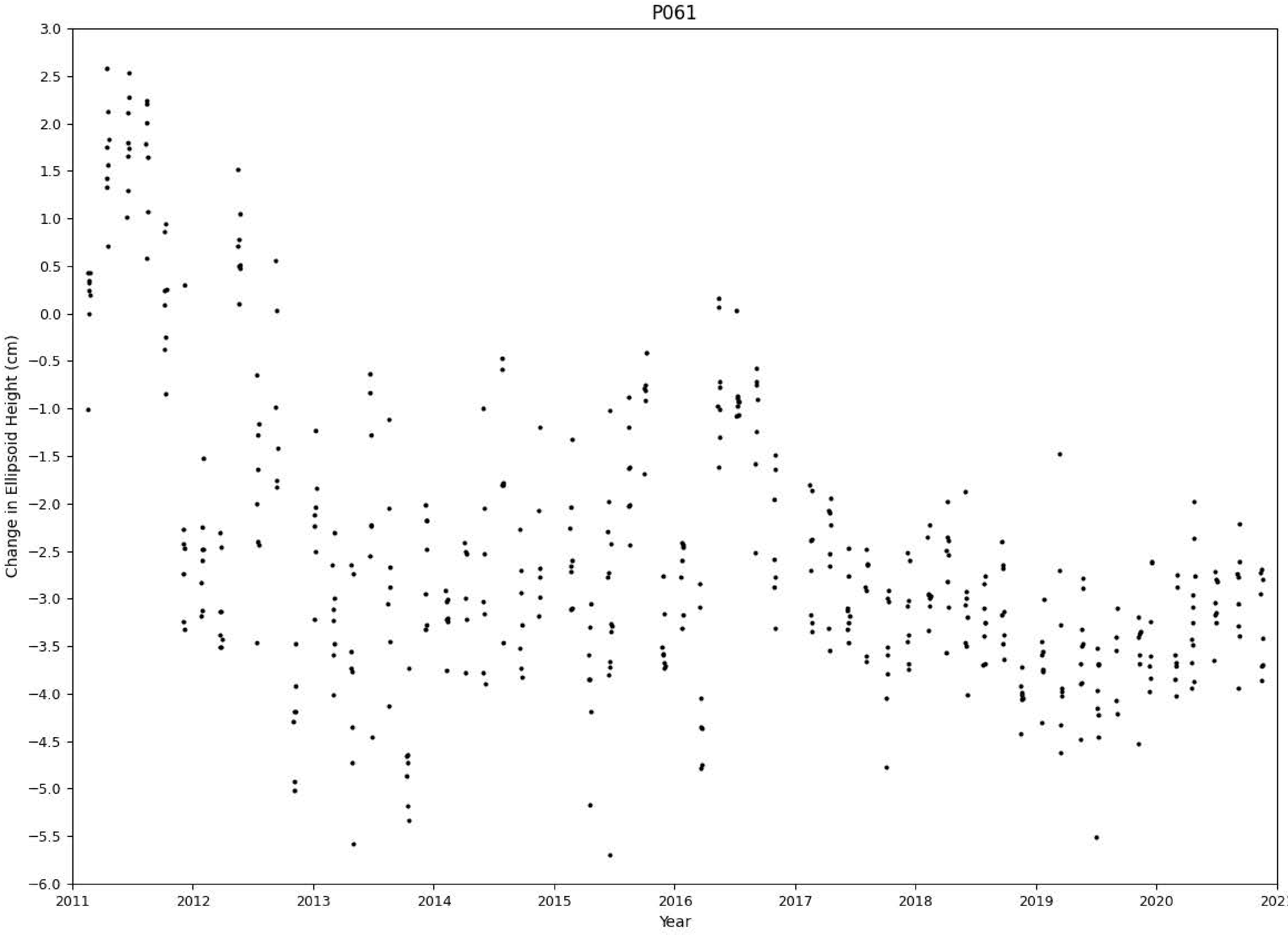

P061
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
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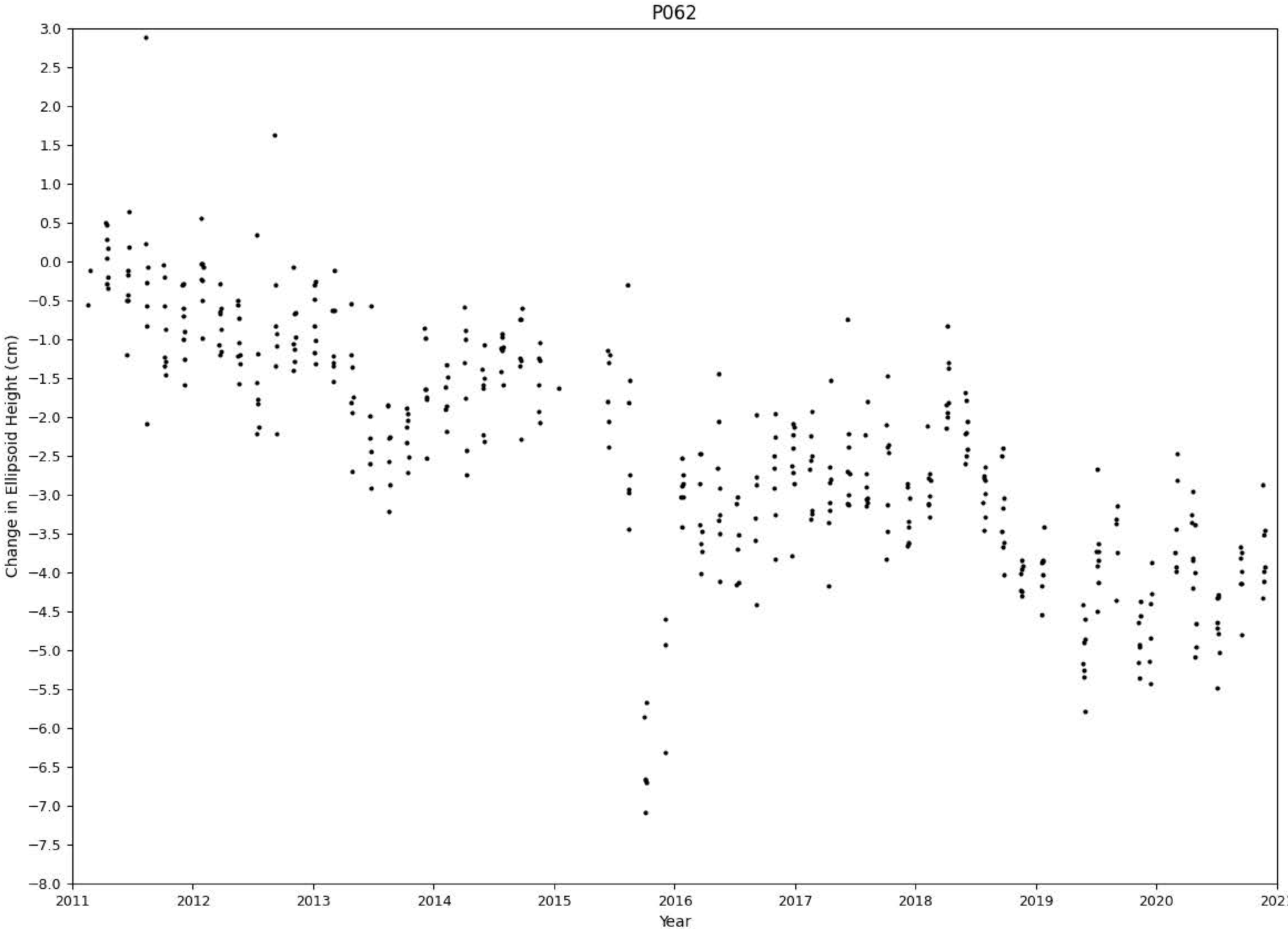
P062
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
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−1.5
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−2.5
−3.0
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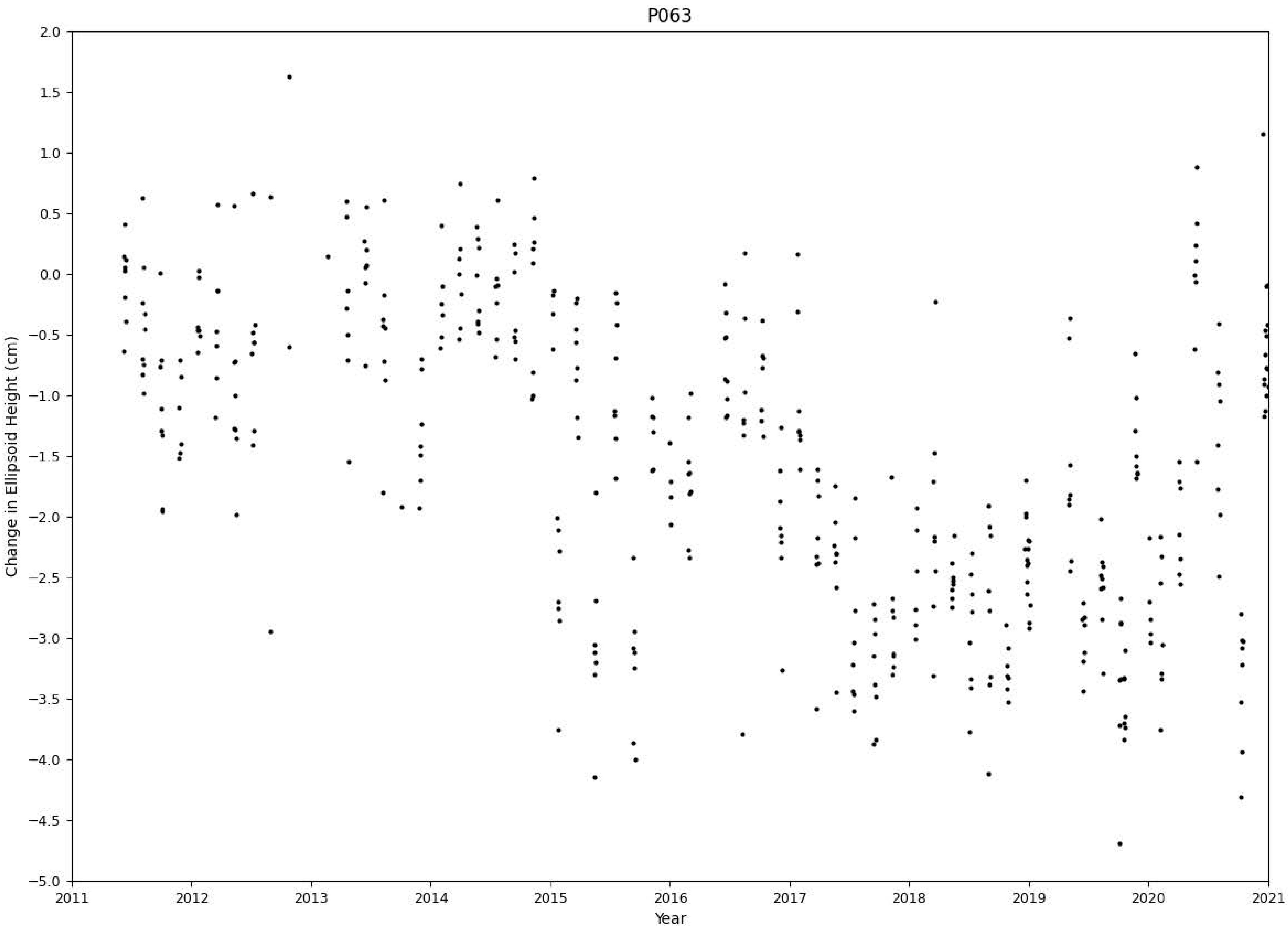
P063
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
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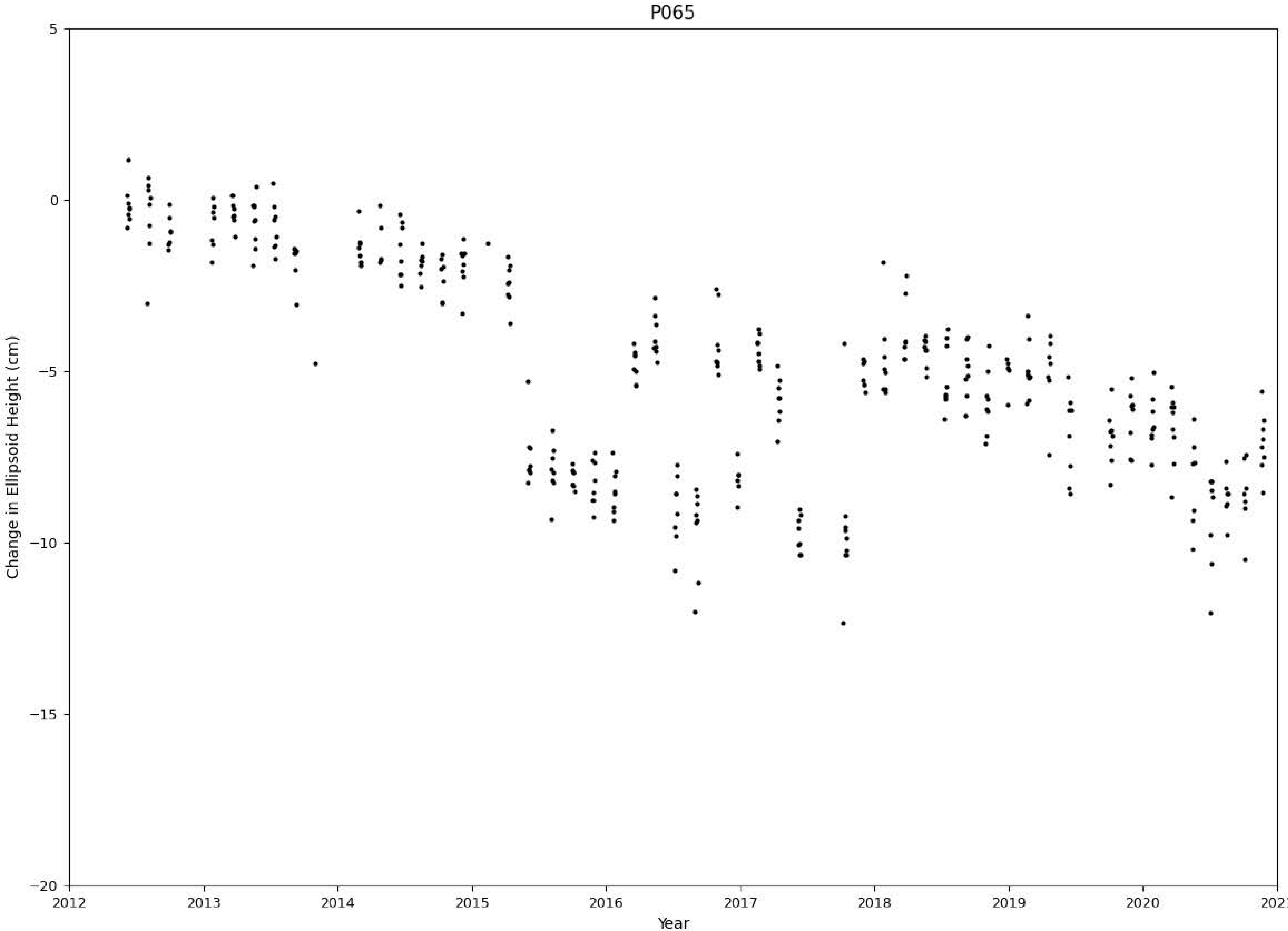
P065
Change in Ellipsoid Height (cm)
Year
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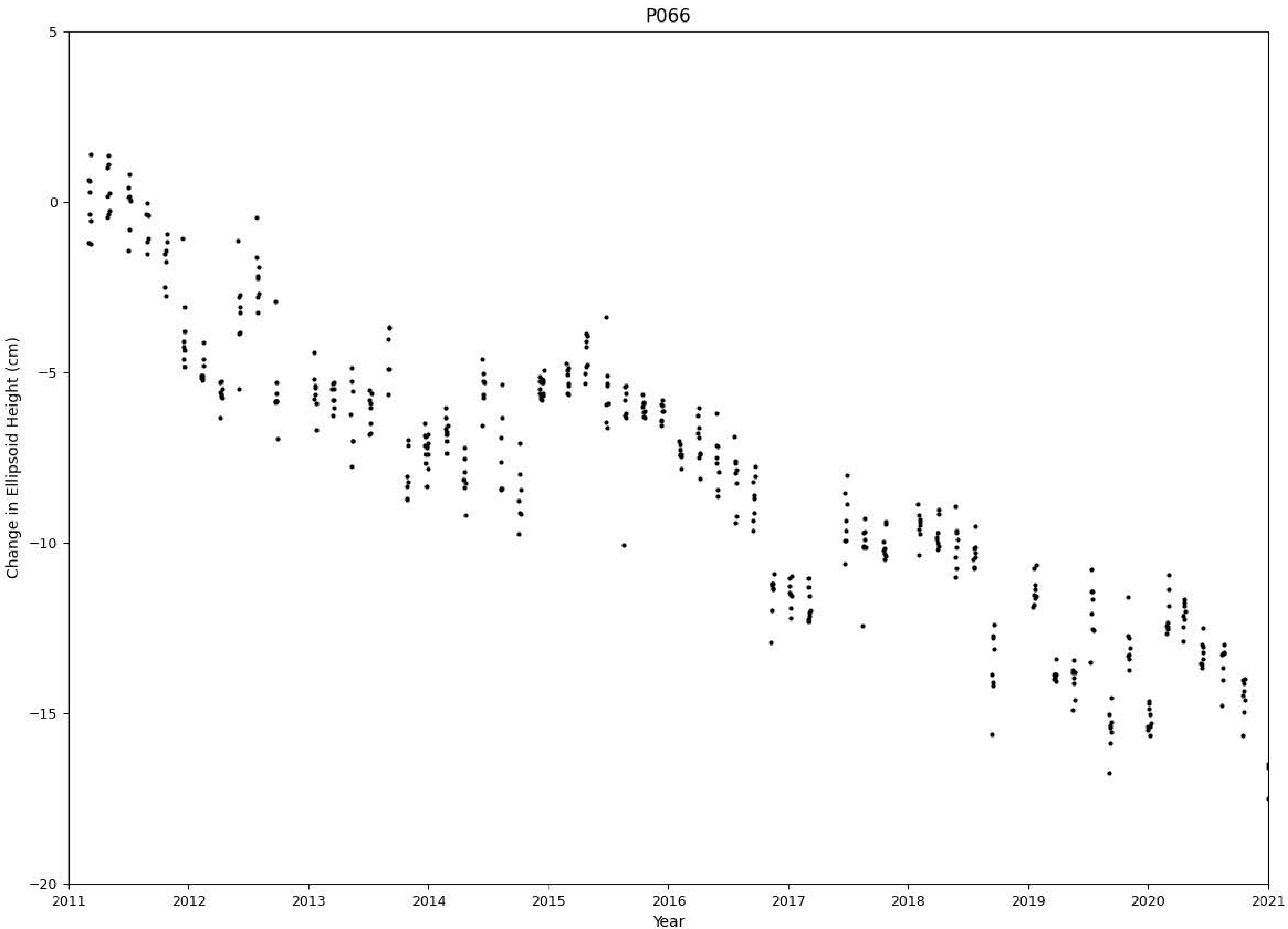
P066
Change in Ellipsoid Height (cm)
Year
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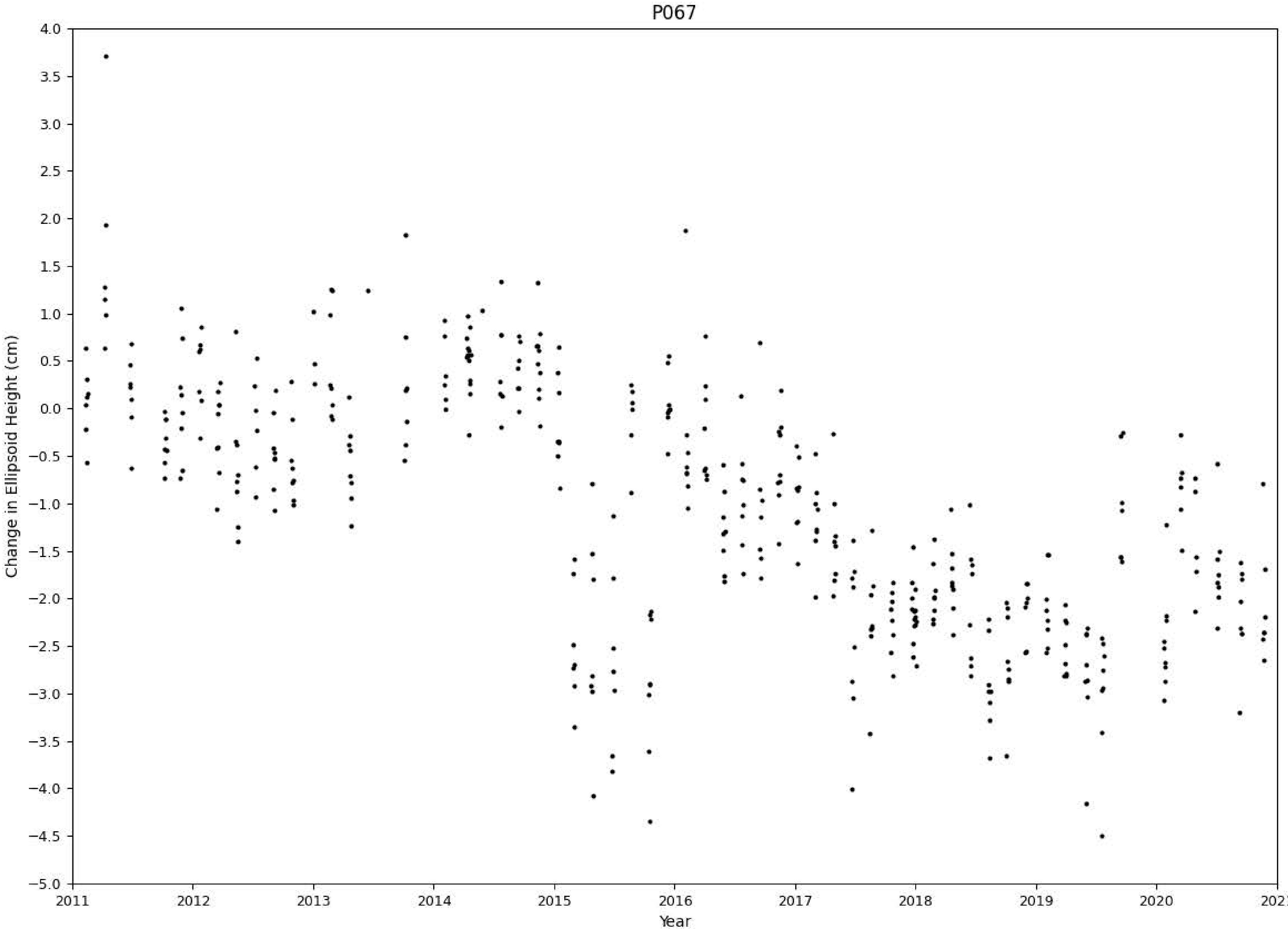

P067
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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−1.5
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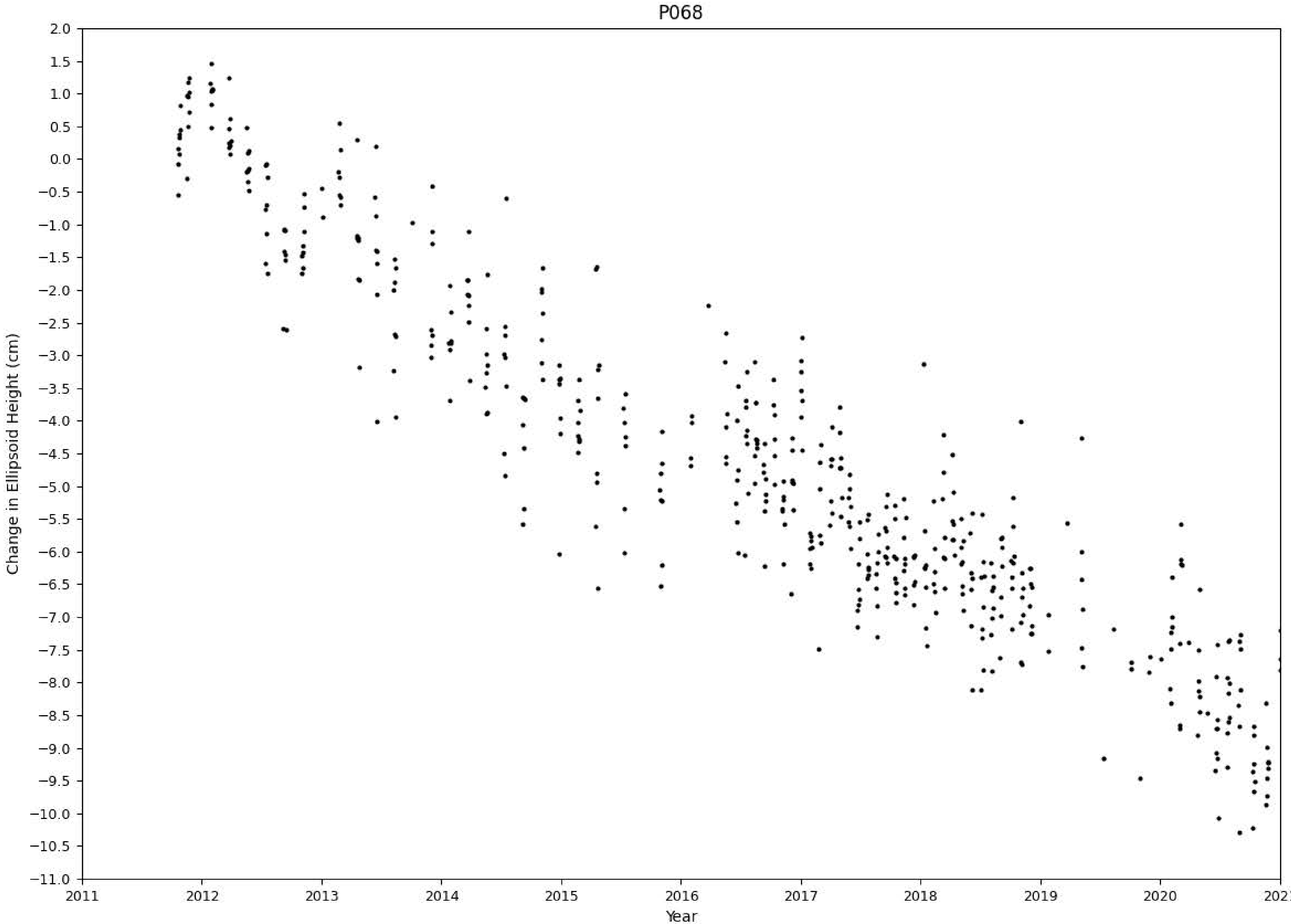

P068
Change in Ellipsoid Height (cm)
Year
2.0
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1.0
0.5
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-0.5
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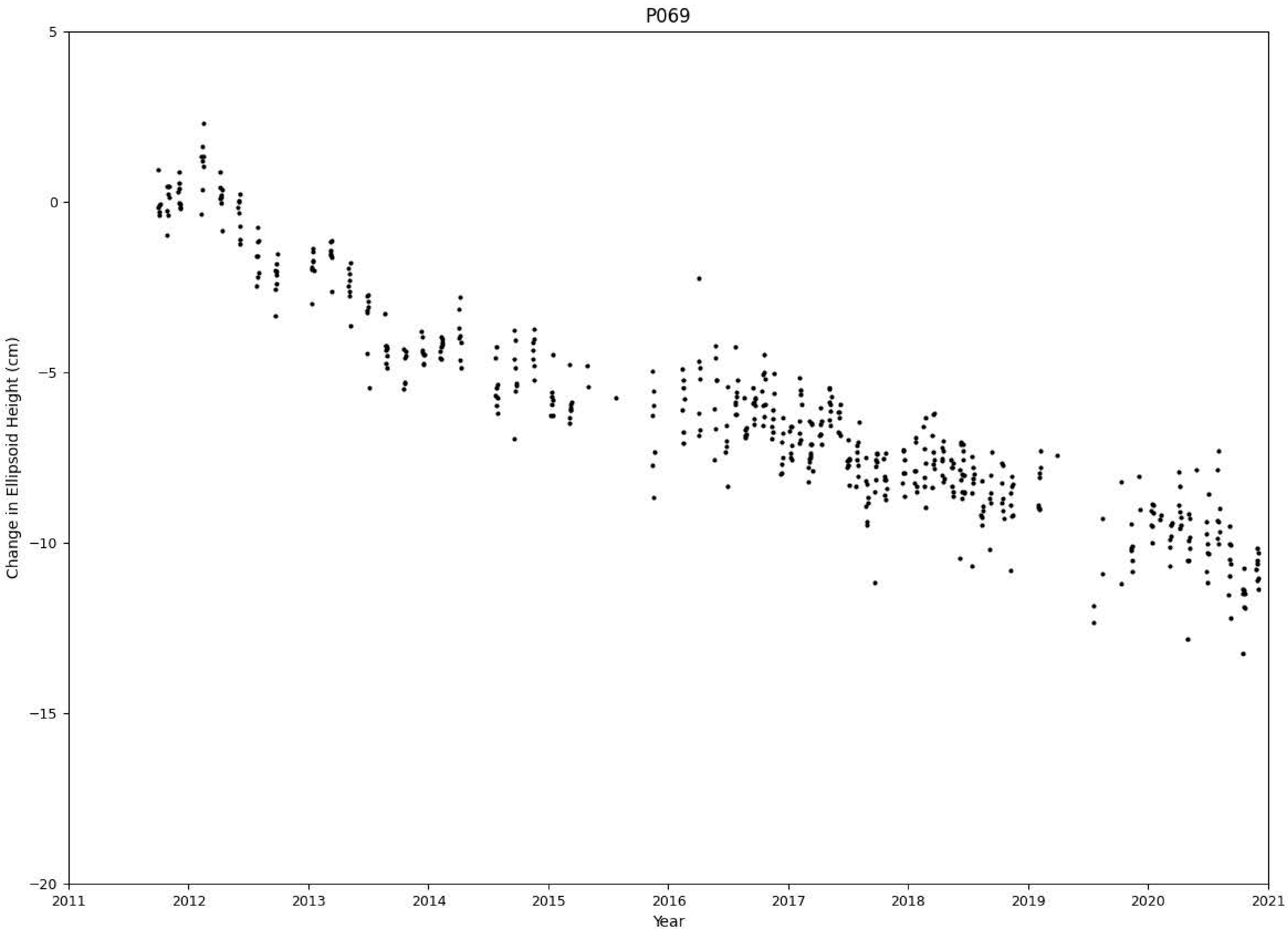
P069
Change in Ellipsoid Height (cm)
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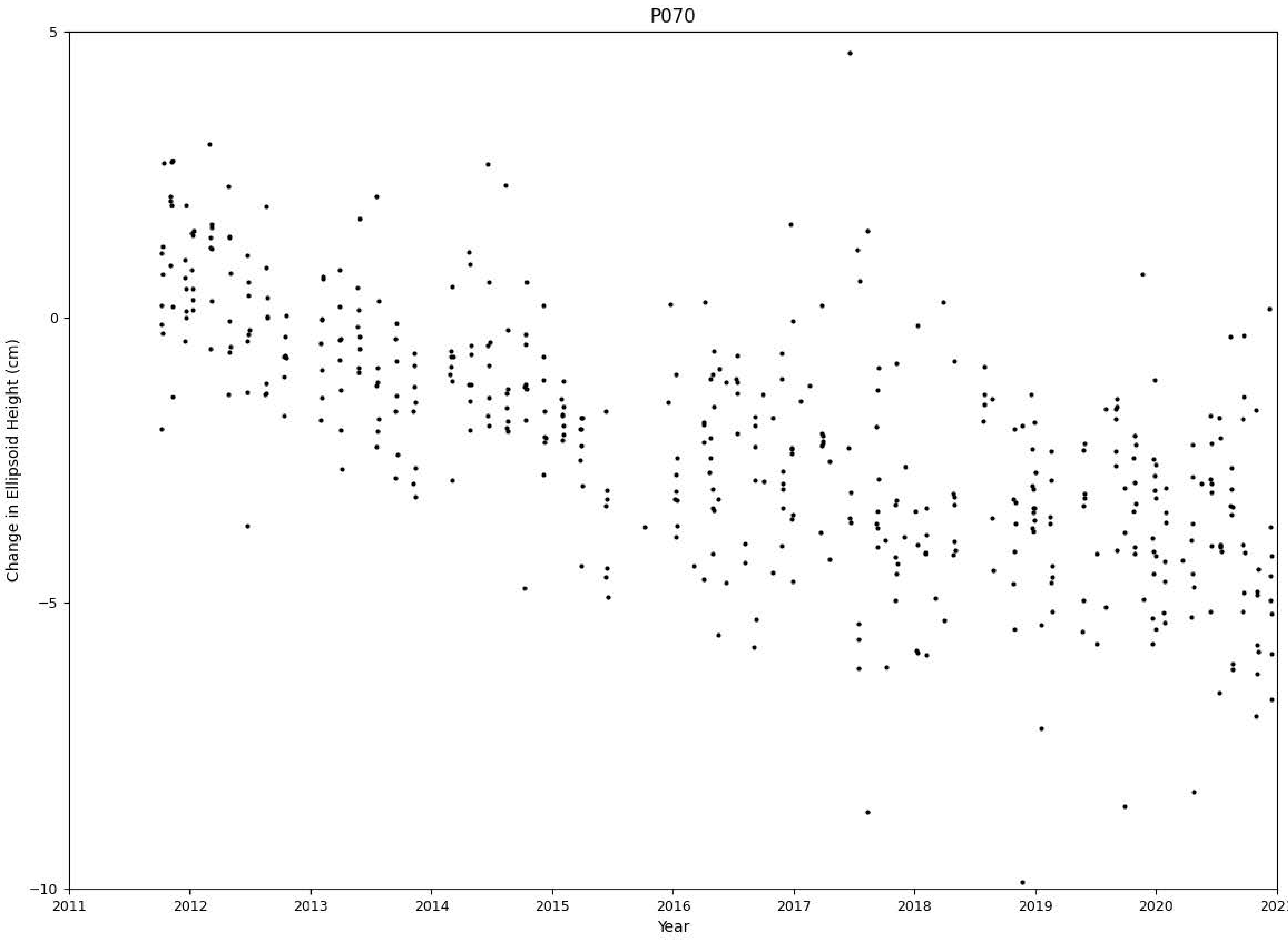
P070
Change in Ellipsoid Height (cm)
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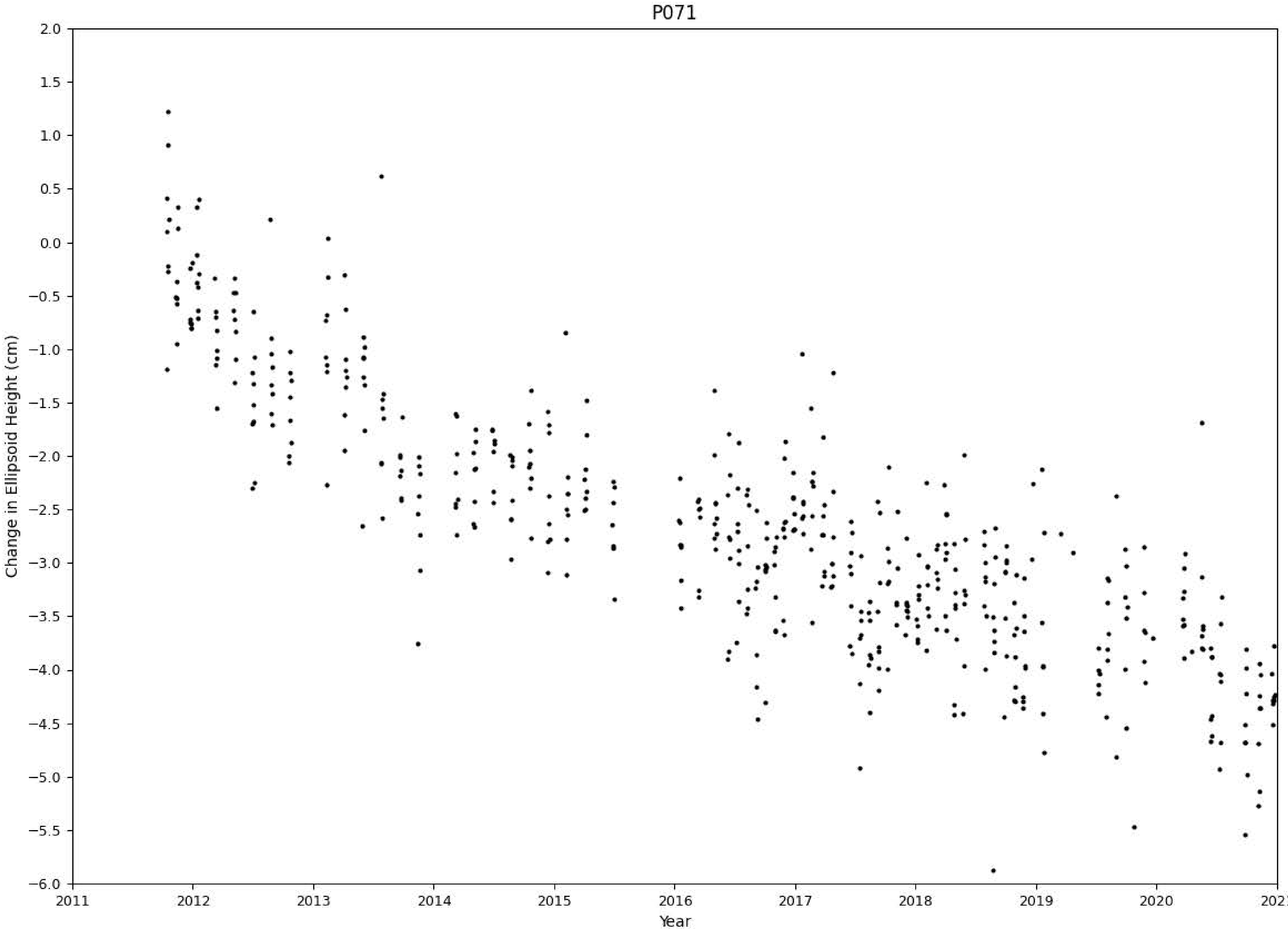
P071
Change in Ellipsoid Height (cm)
Year
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1.5
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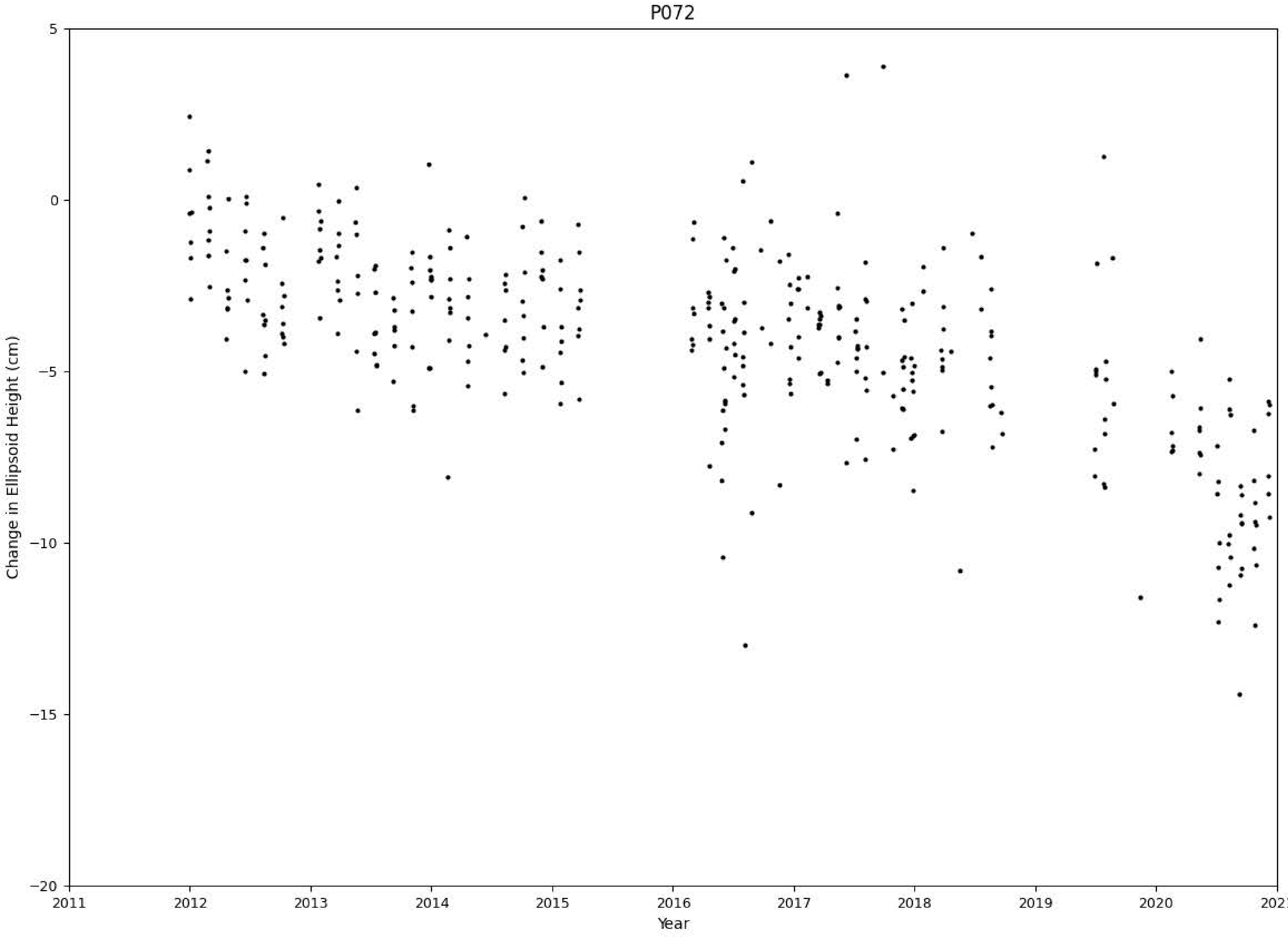
P072
Change in Ellipsoid Height (cm)
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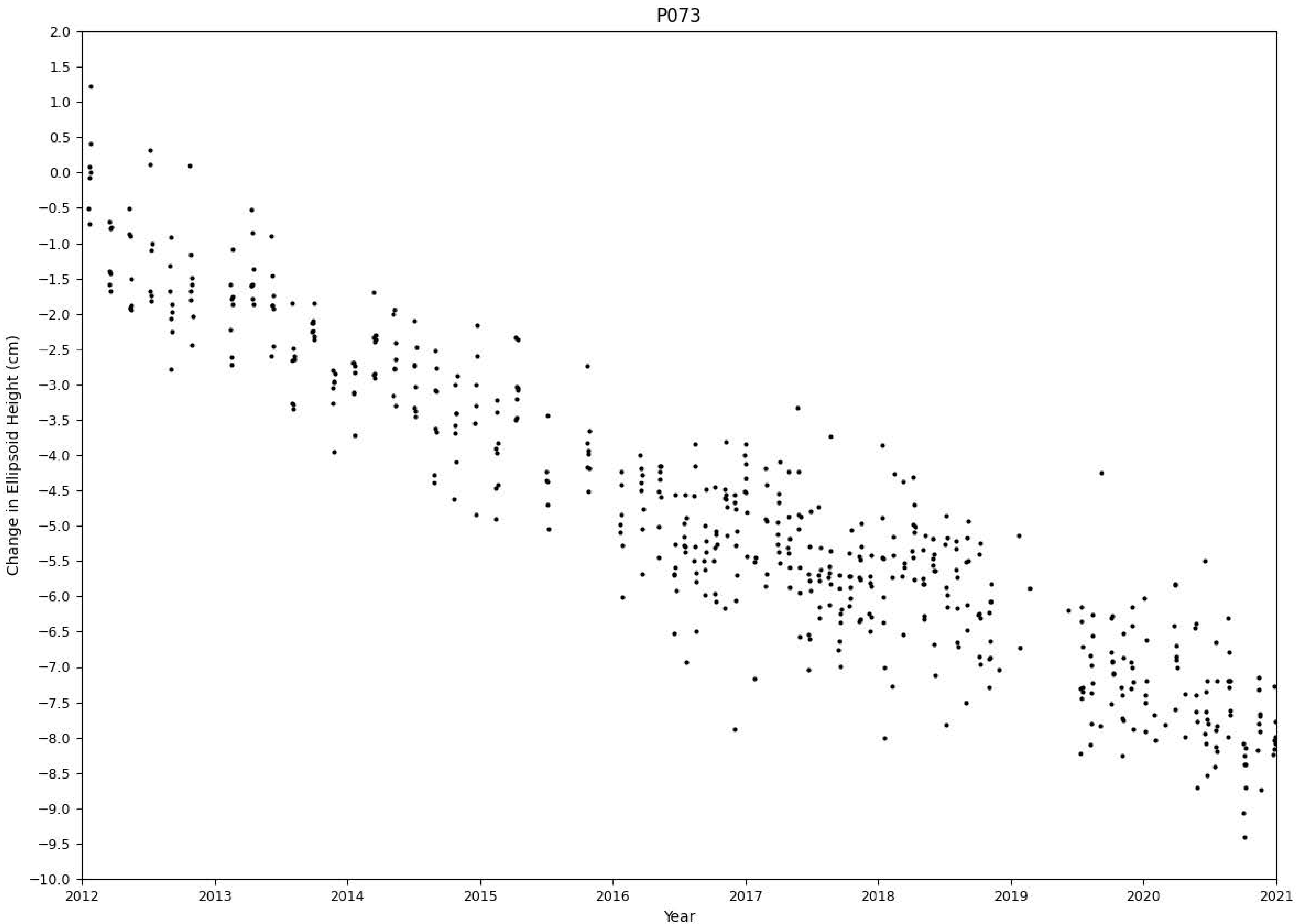

P073
Change in Ellipsoid Height (cm)
Year
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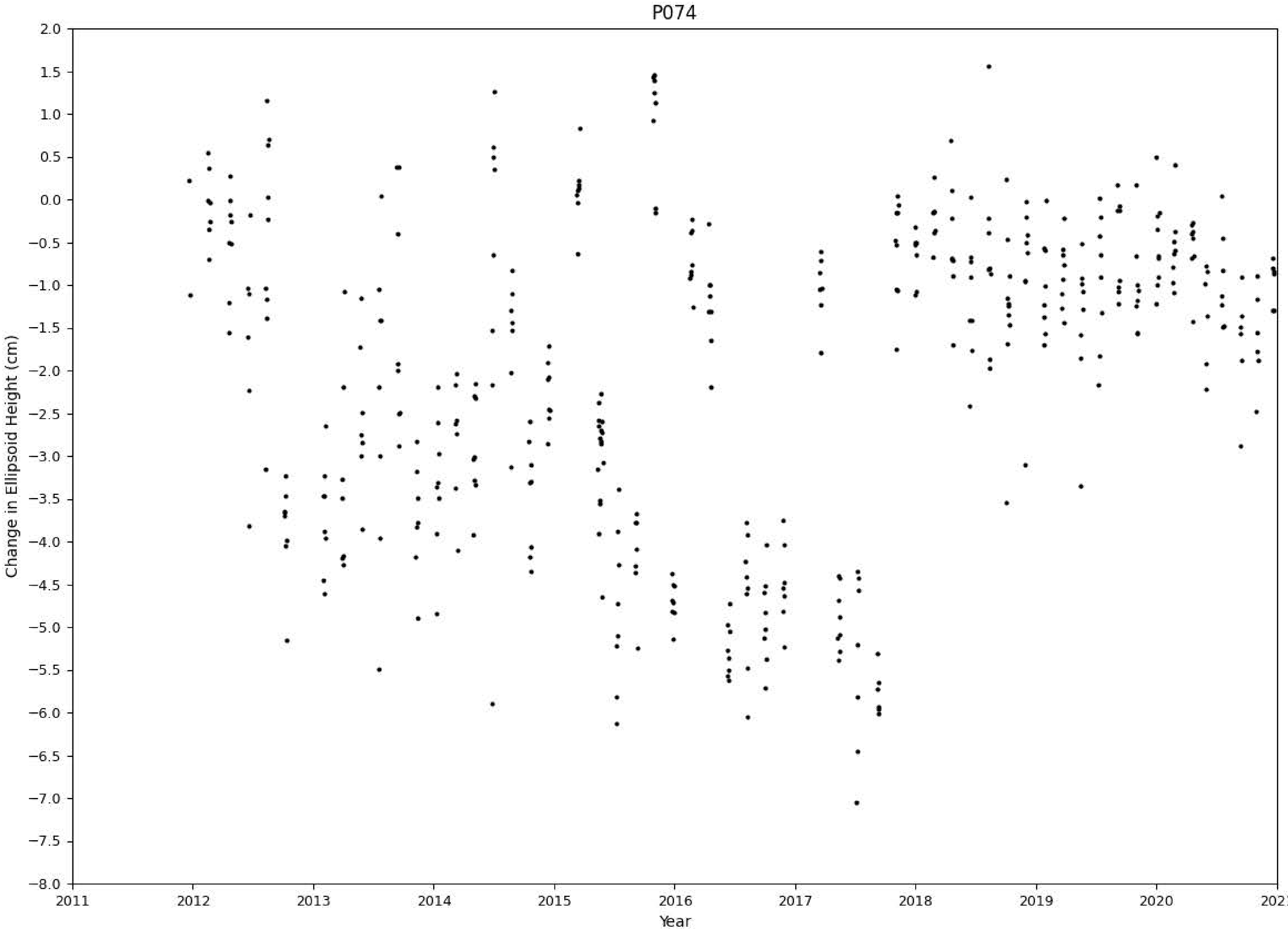

P074
Change in Ellipsoid Height (cm)
Year
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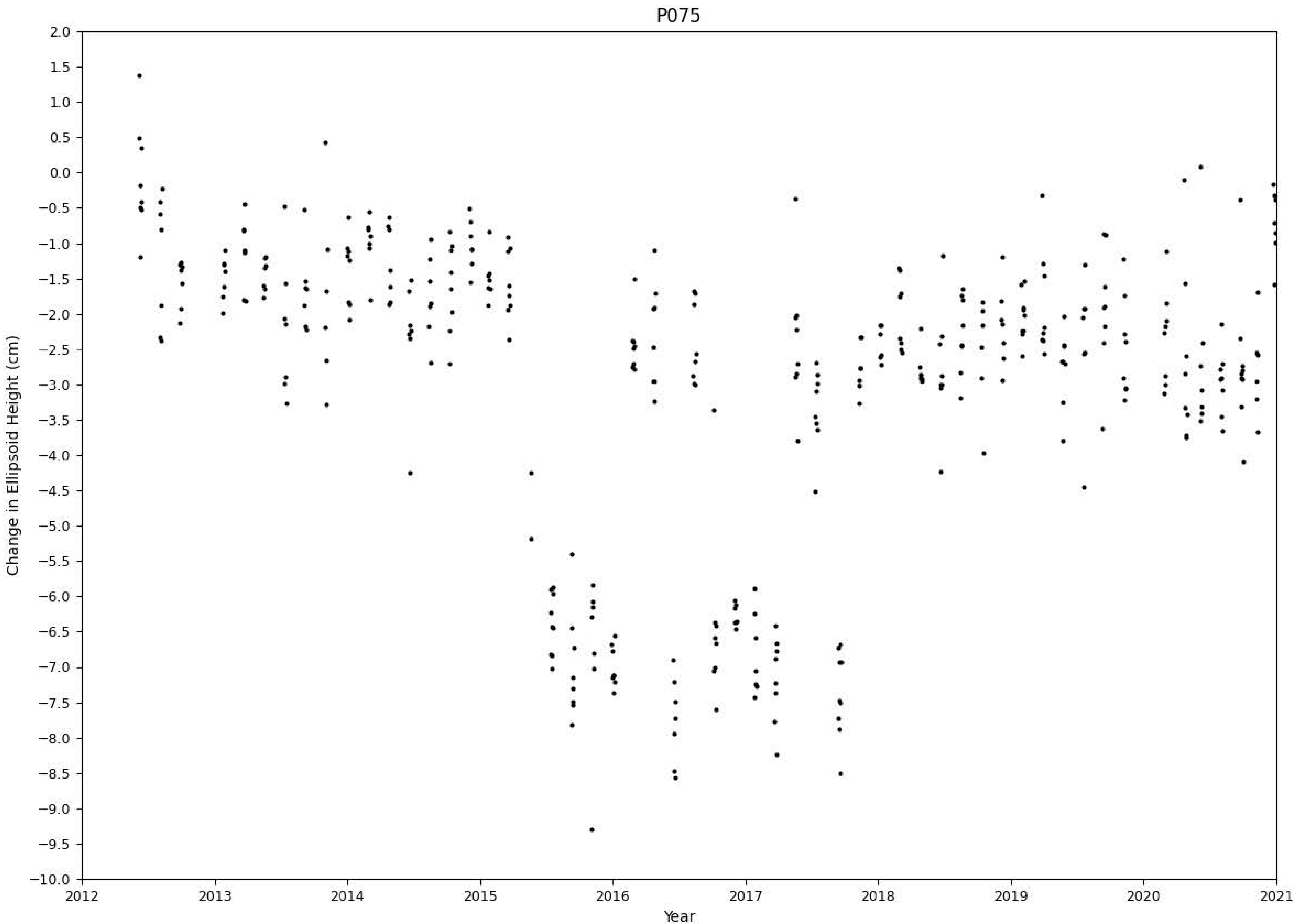
P075
Change in Ellipsoid Height (cm)
Year
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−1.5
−2.0
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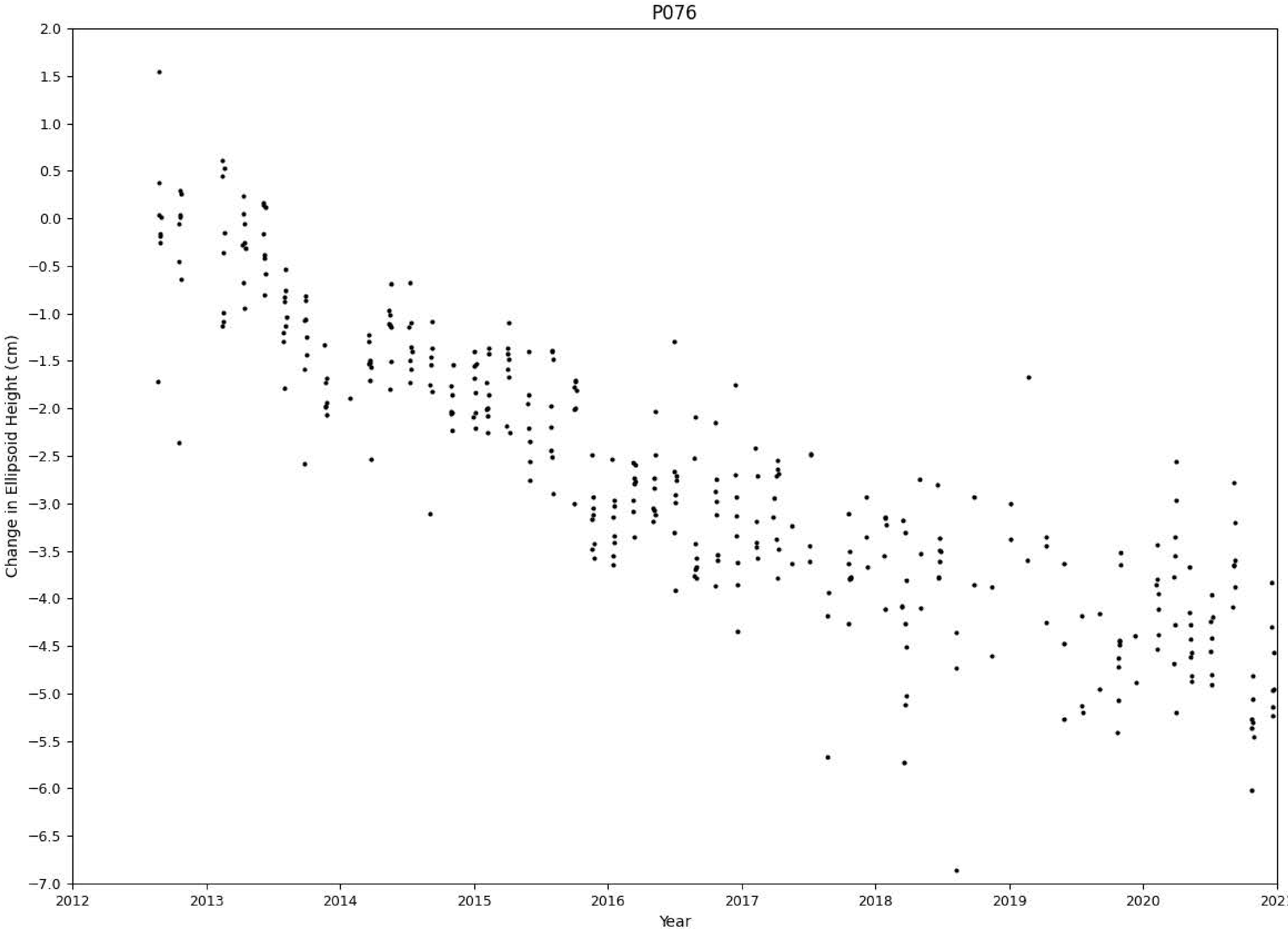

P076
Change in Ellipsoid Height (cm)
Year
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1.5
1.0
0.5
0.0
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−1.5
−2.0
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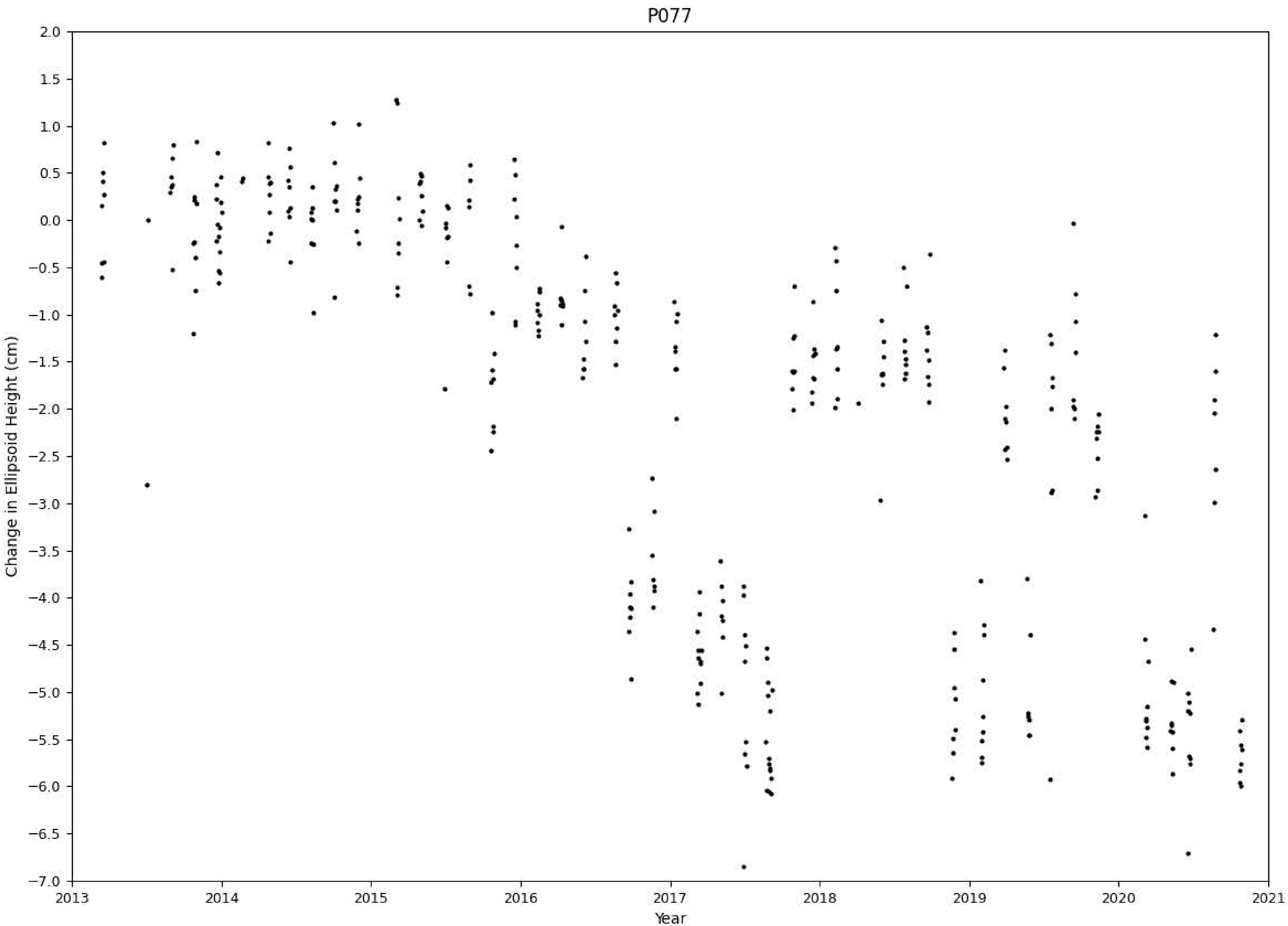

P077
Change in Ellipsoid Height (cm)
Year
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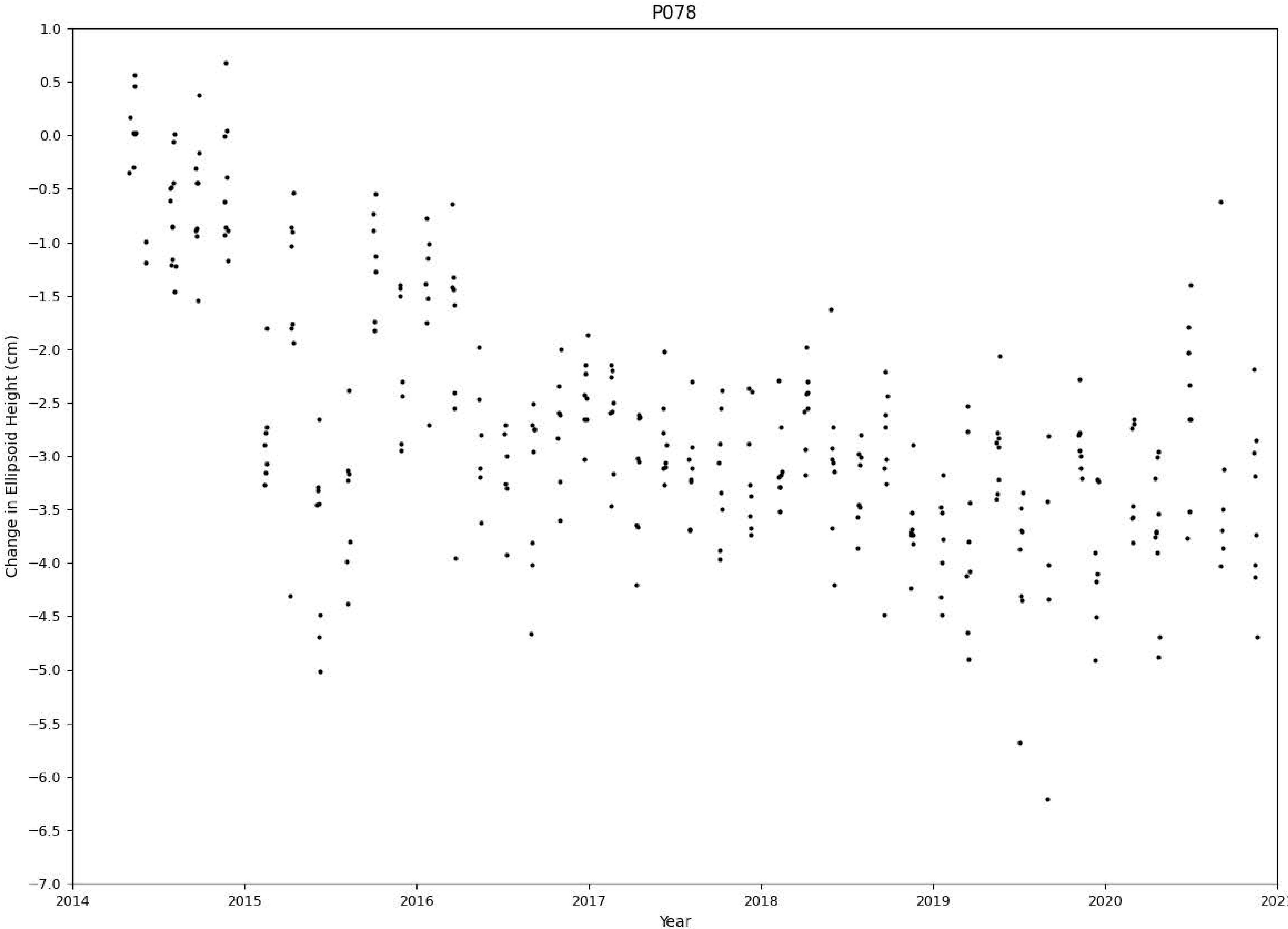
P078
Change in Ellipsoid Height (cm)
Year
1.0
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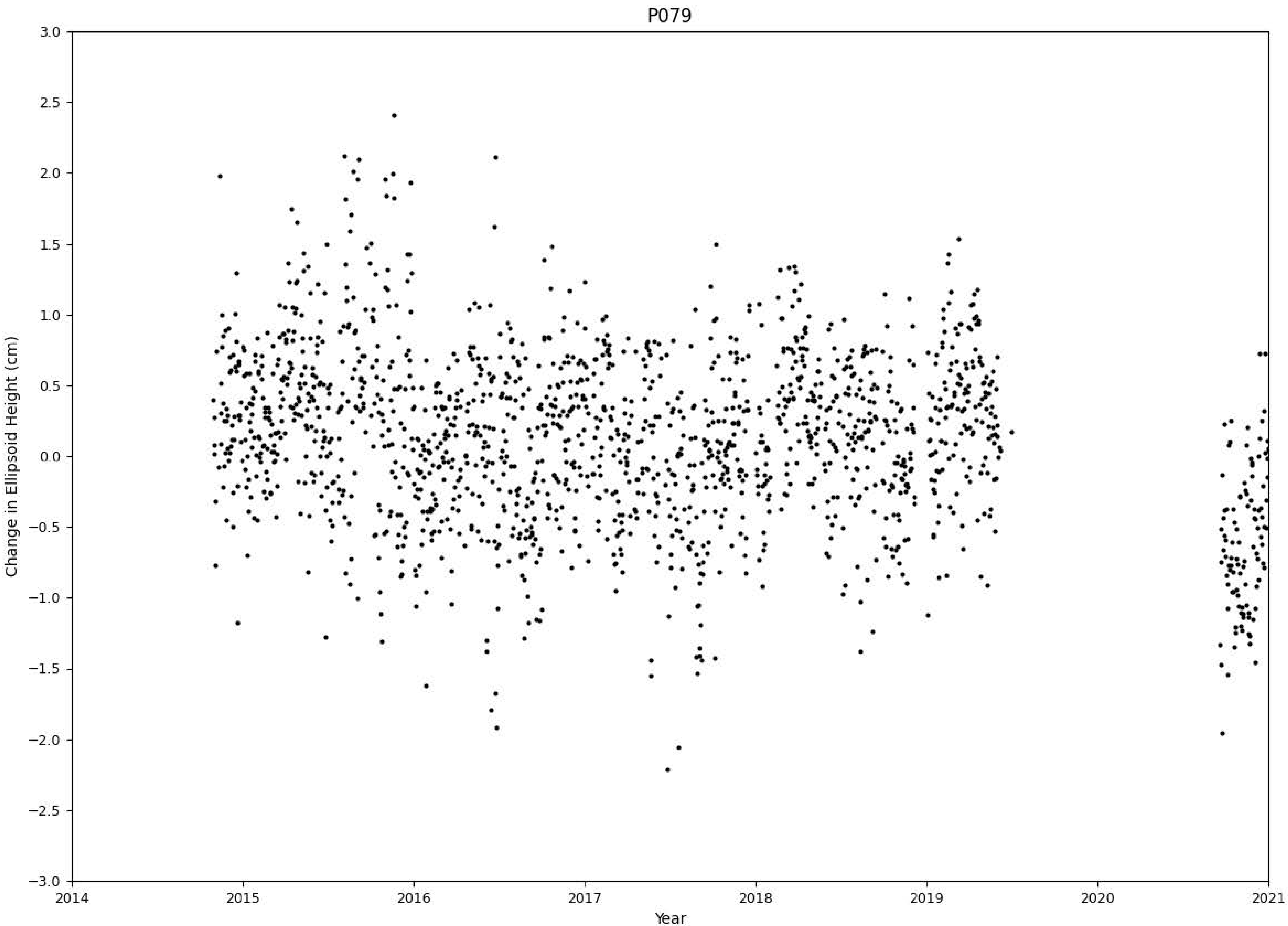

P079
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
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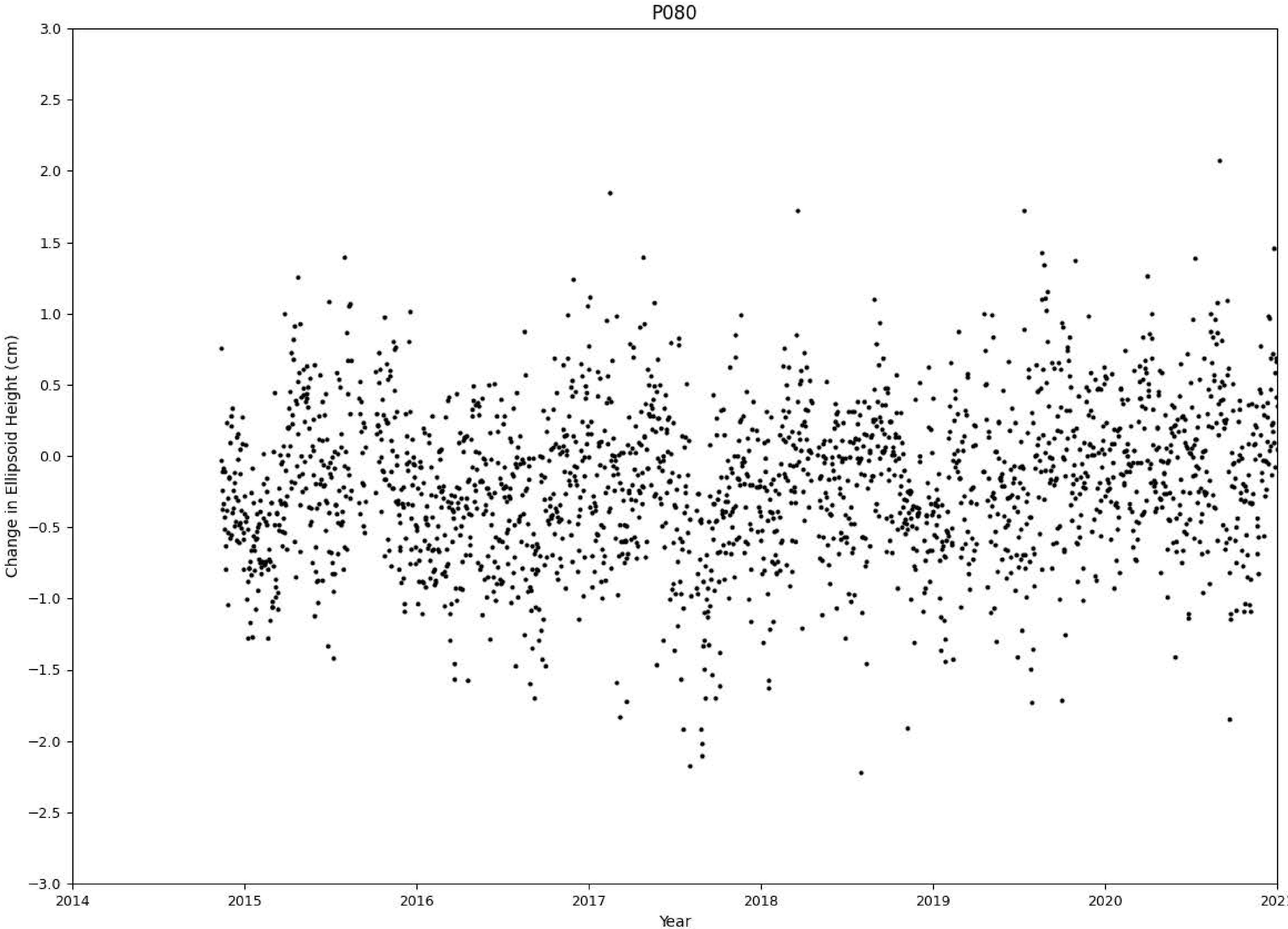
Year



P080
Change in Ellipsoid Height (cm)
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2.0
1.5
1.0
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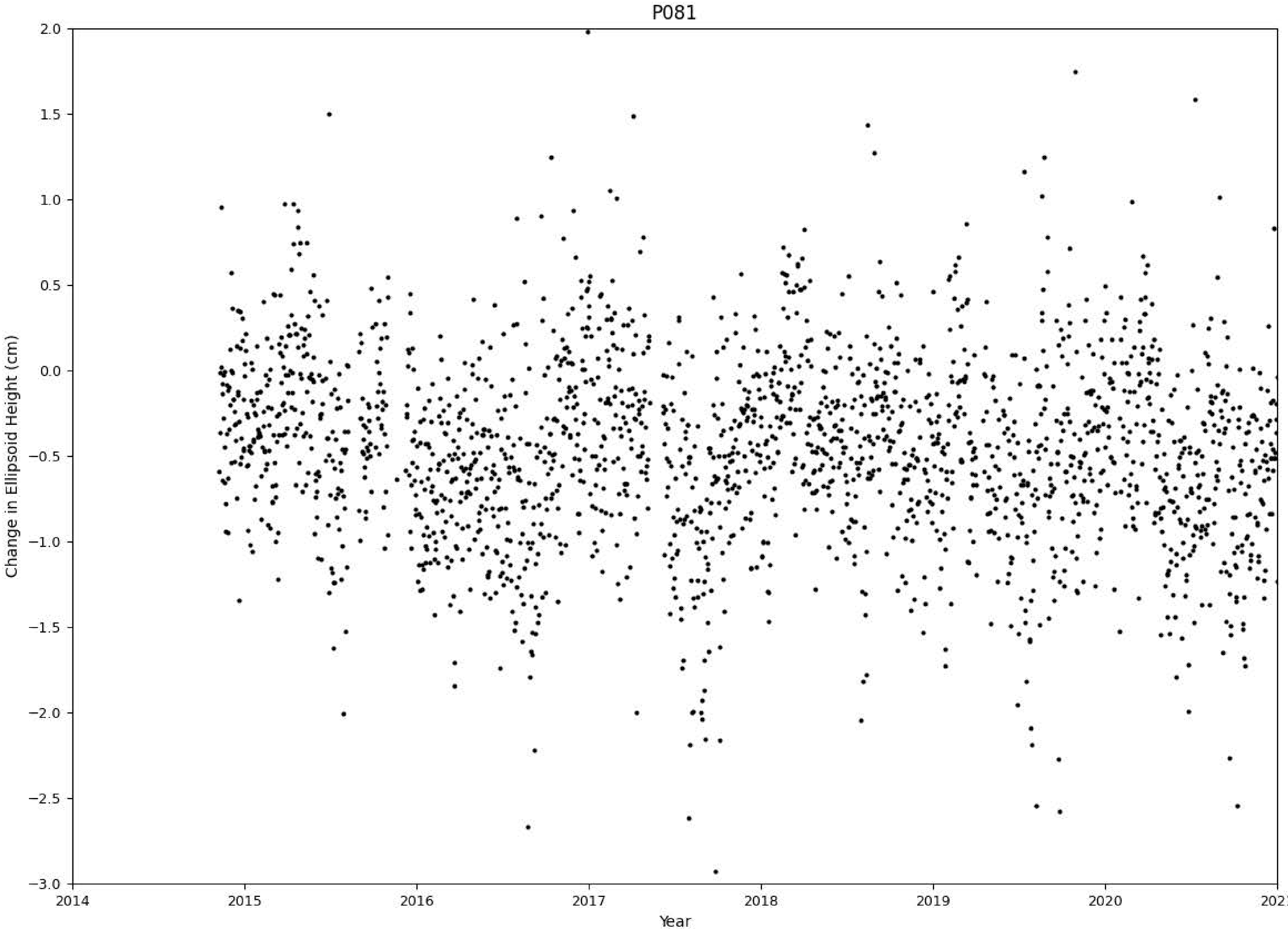
P081
Change in Ellipsoid Height (cm)
Year
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1.5
1.0
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−1.5
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−2.5
−3.0
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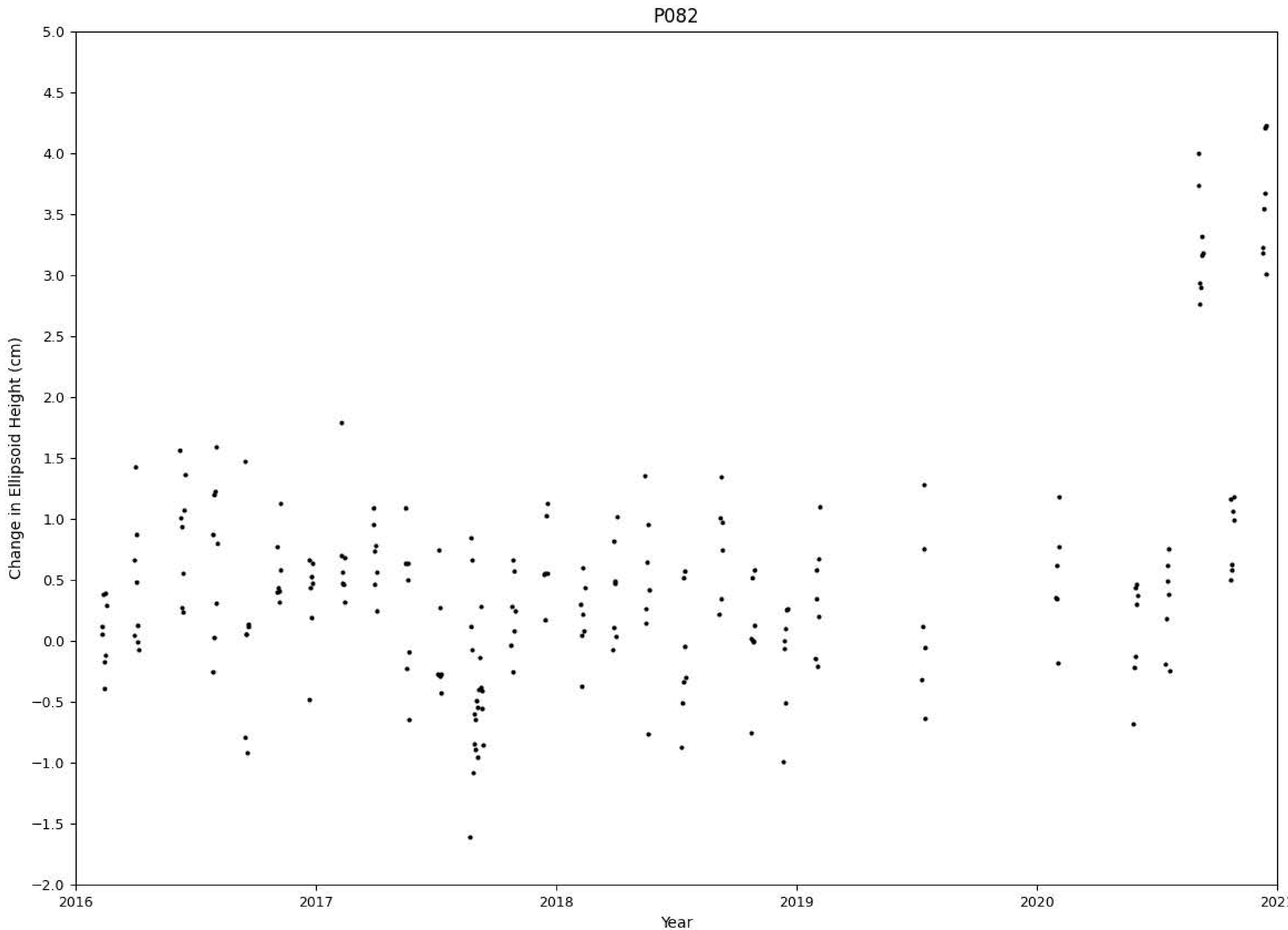

P082
Change in Ellipsoid Height (cm)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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−0.5
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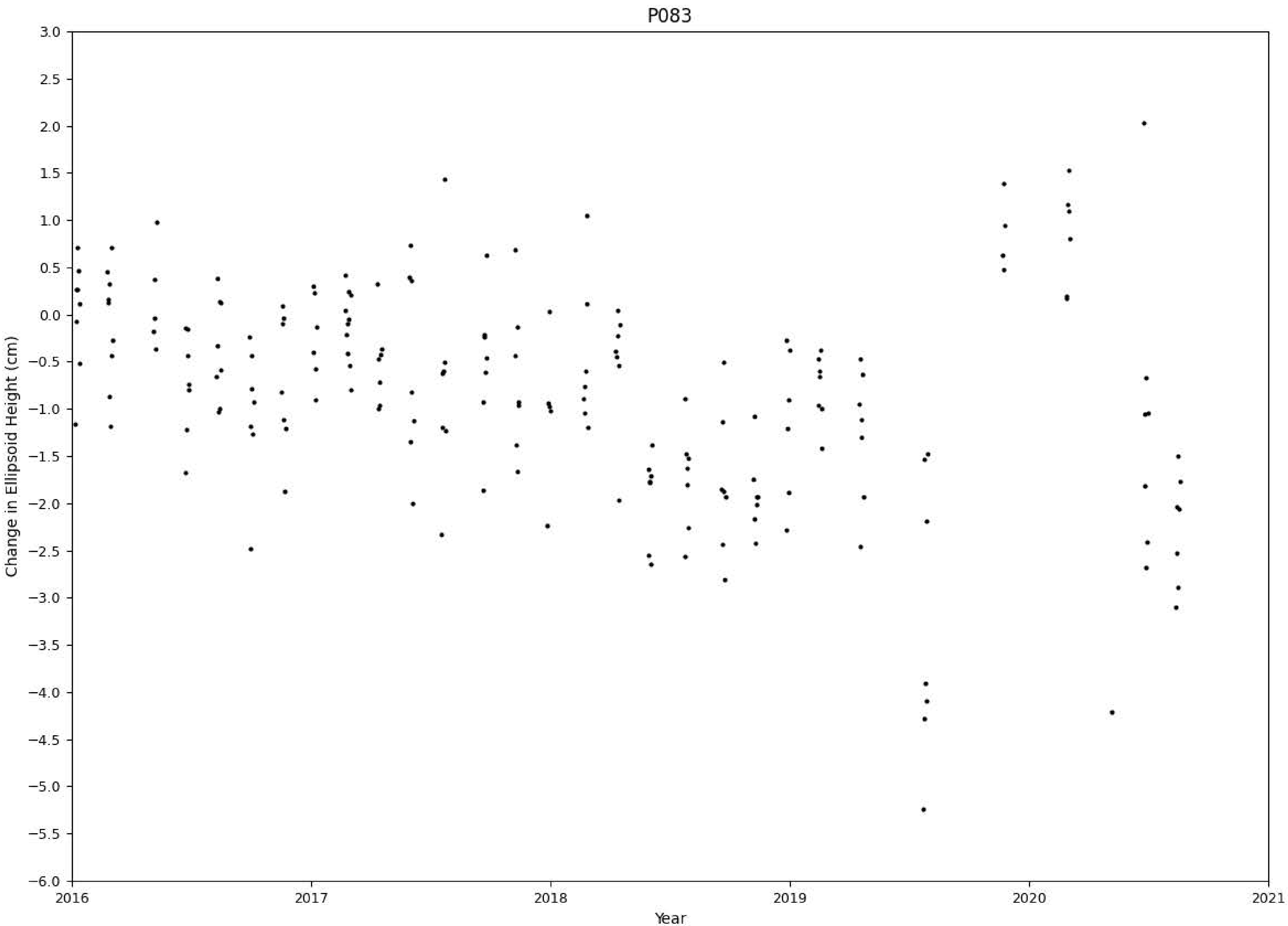
2021
Year



P083
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
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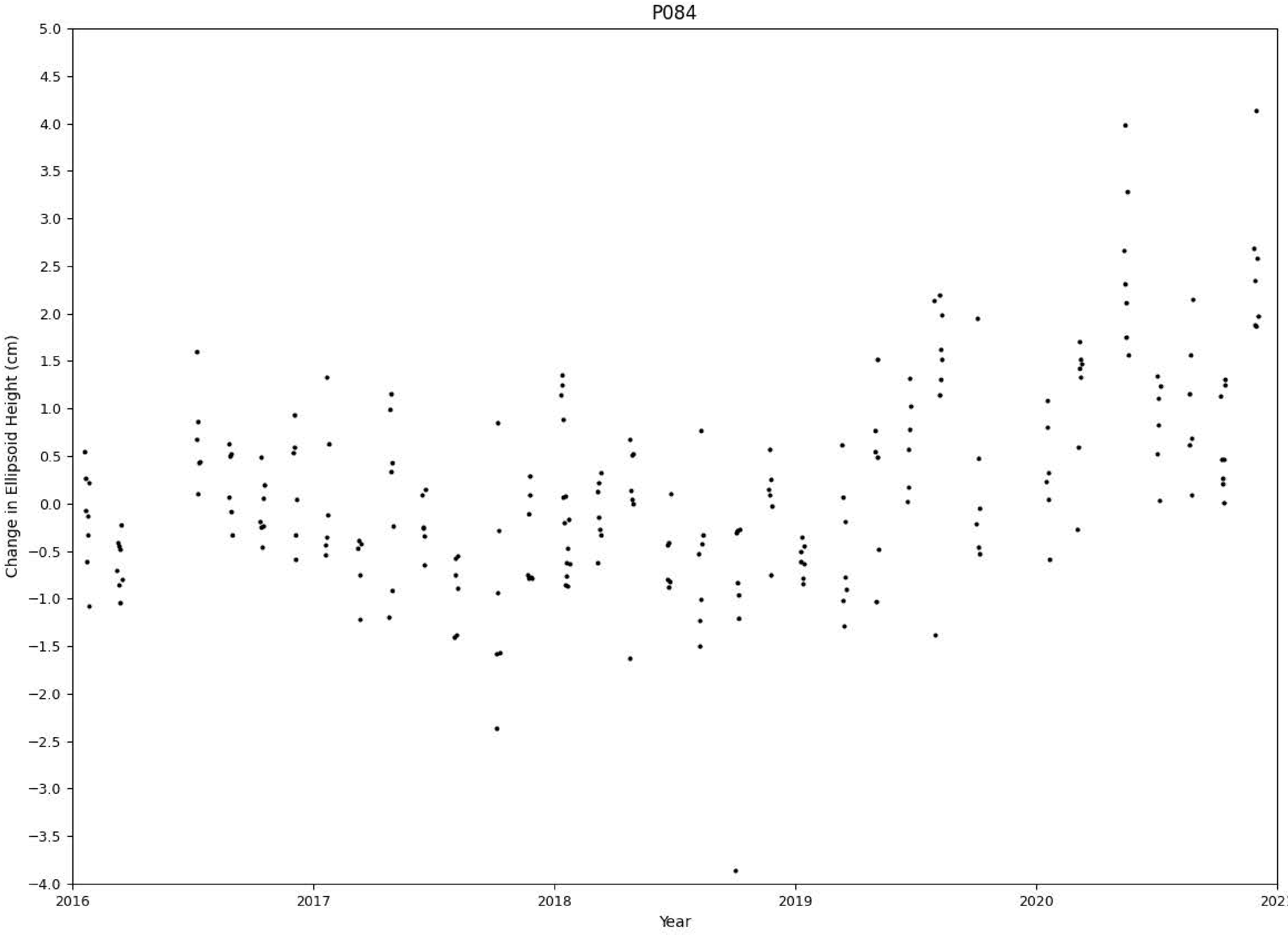
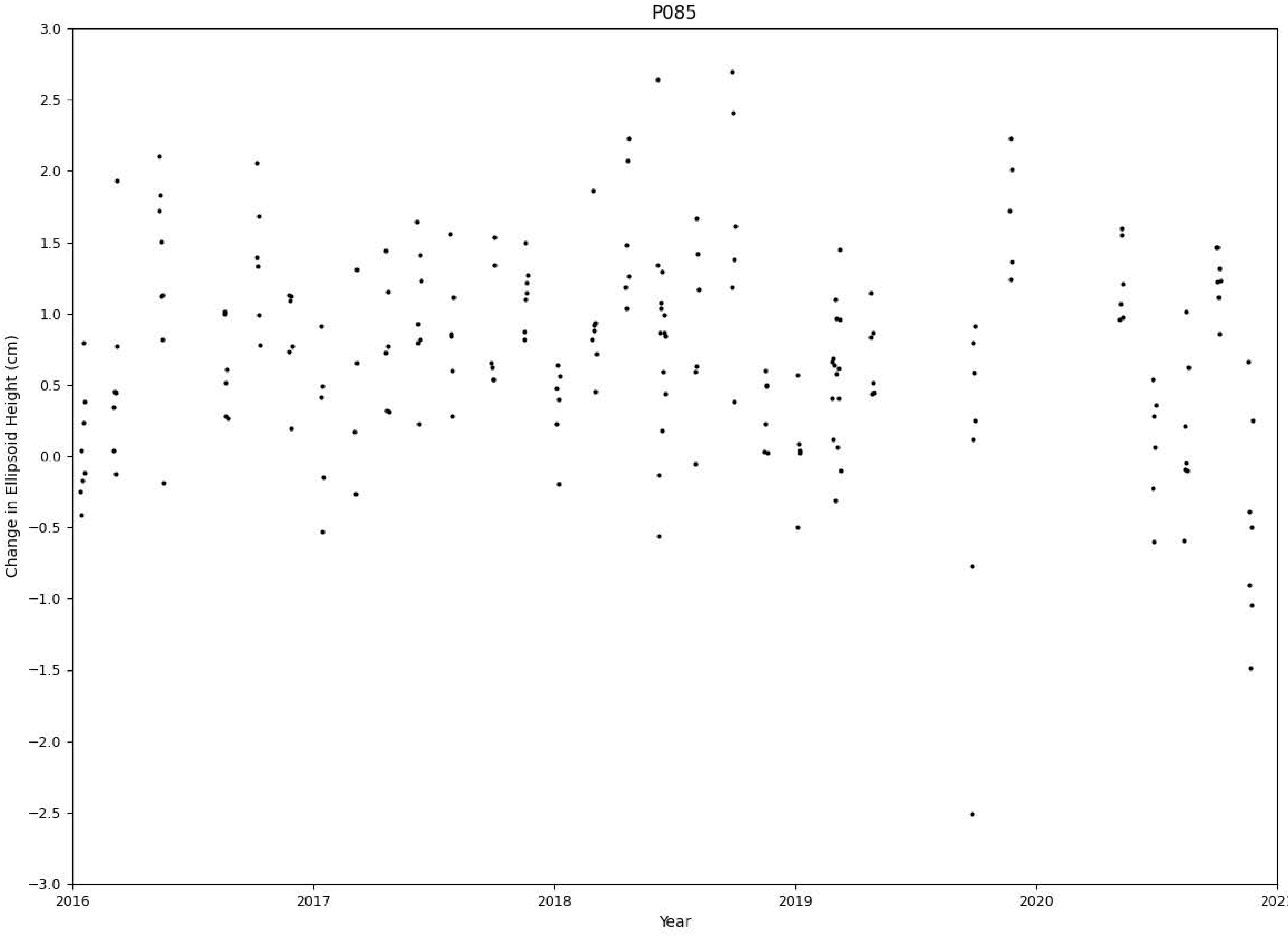
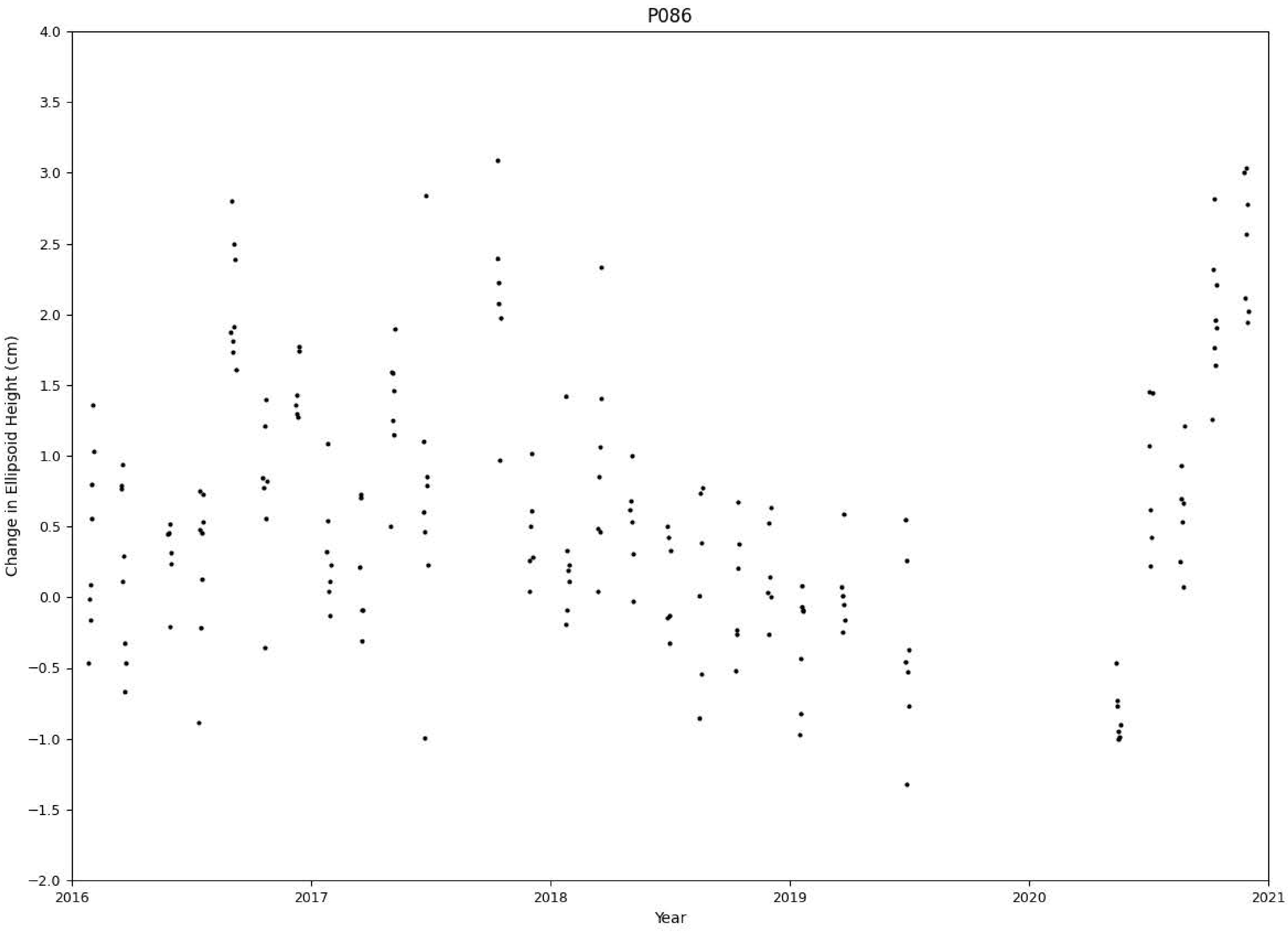
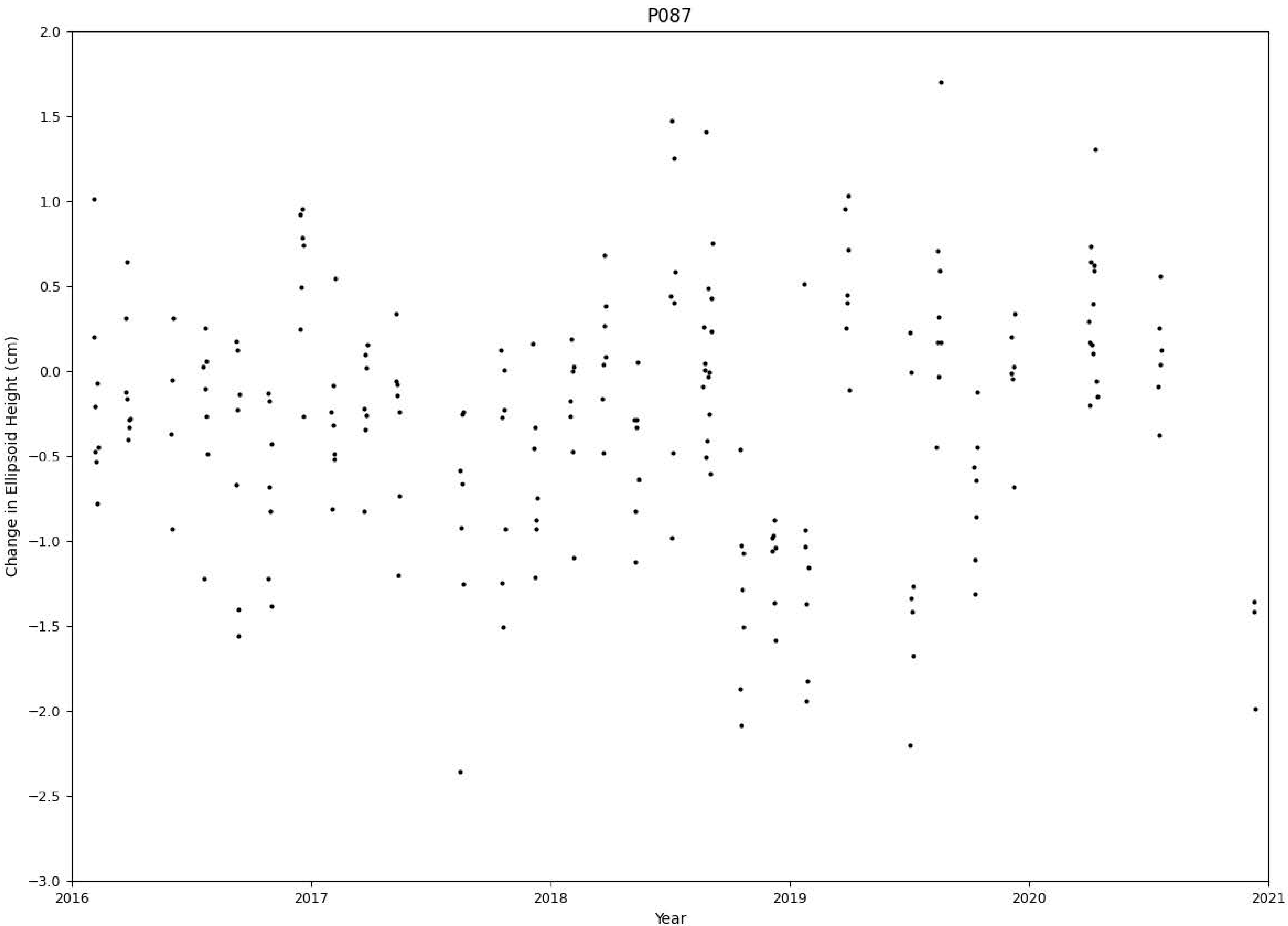
2020
2021


P084
Change in Ellipsoid Height (cm)
Year
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2016
2017
2018
2019
2020
2021

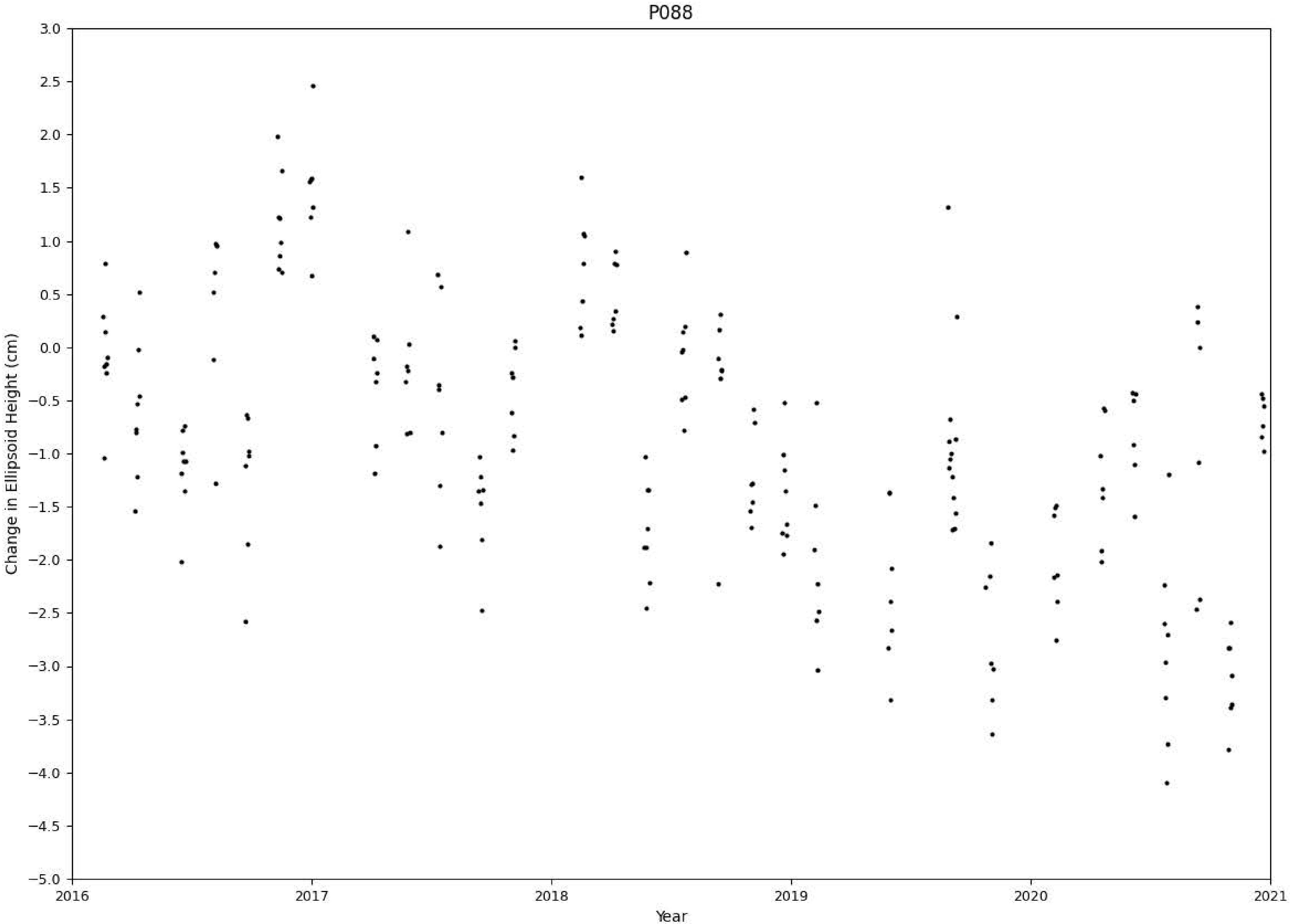

P085
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2016
2017
2018
2019
2020
2021



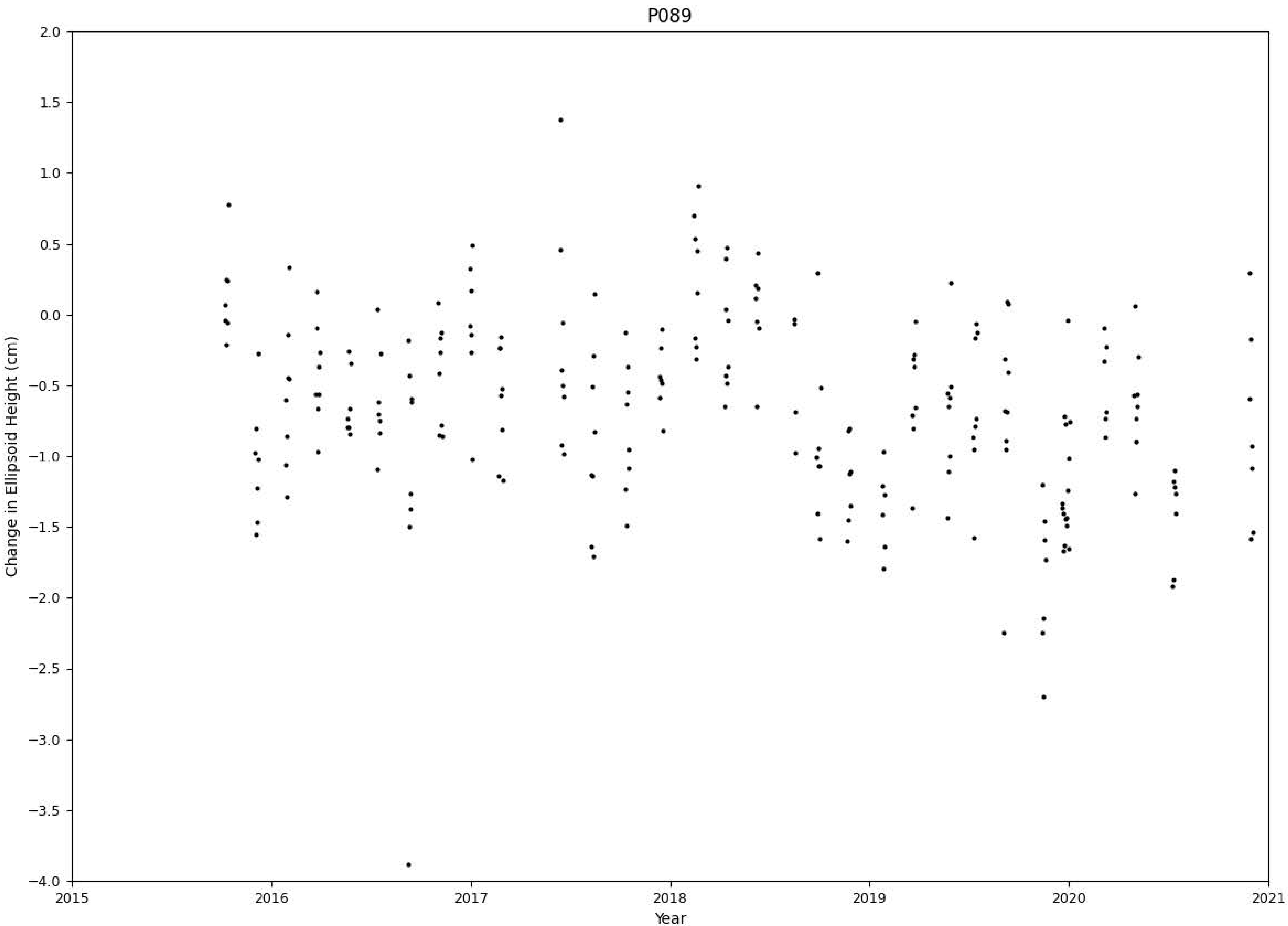
P086
Change in Ellipsoid Height (cm)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2016
2017
2018
2019
2020
2021
Year



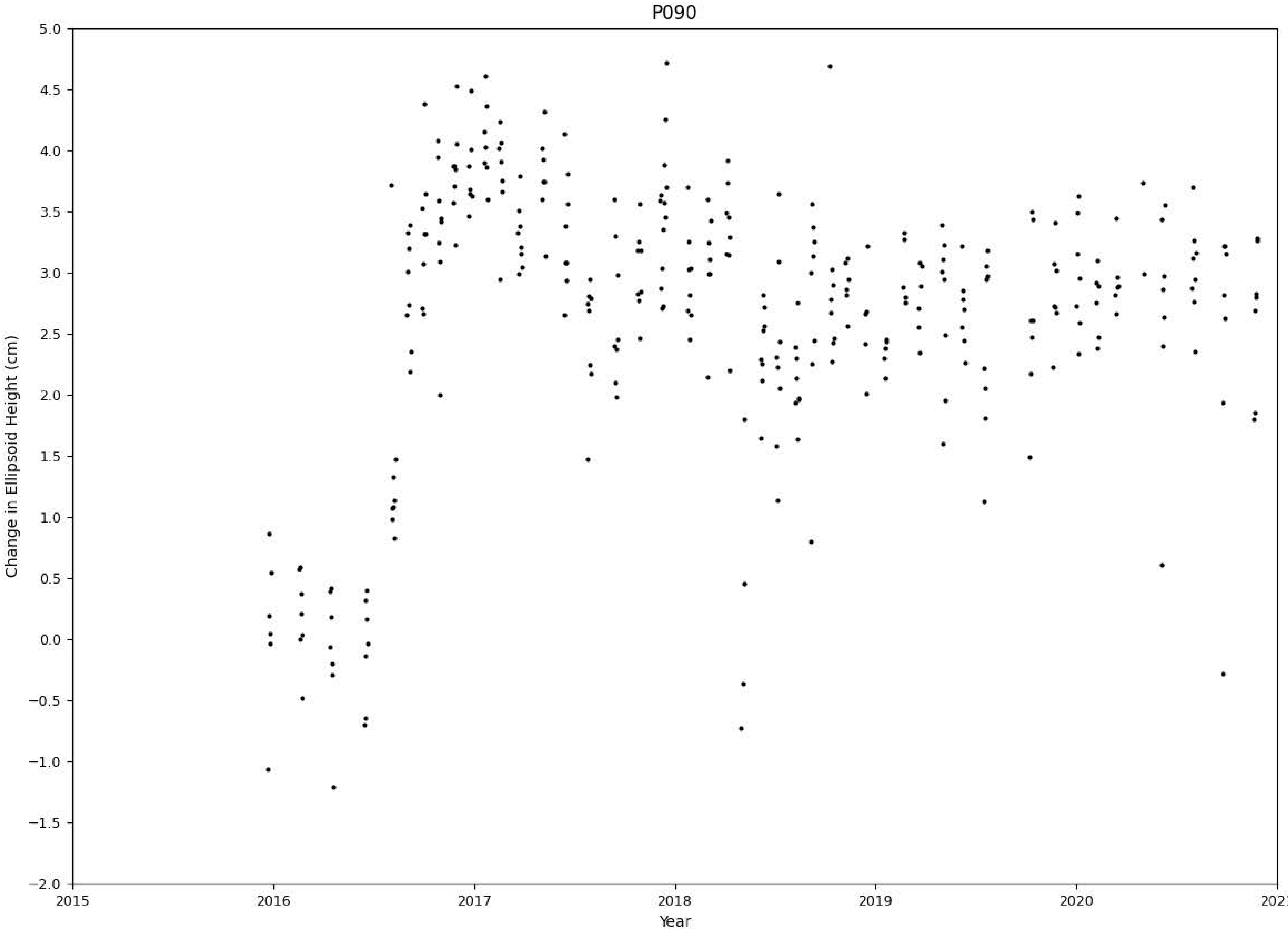
P087
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2016
2017
2018
2019
2020
2021



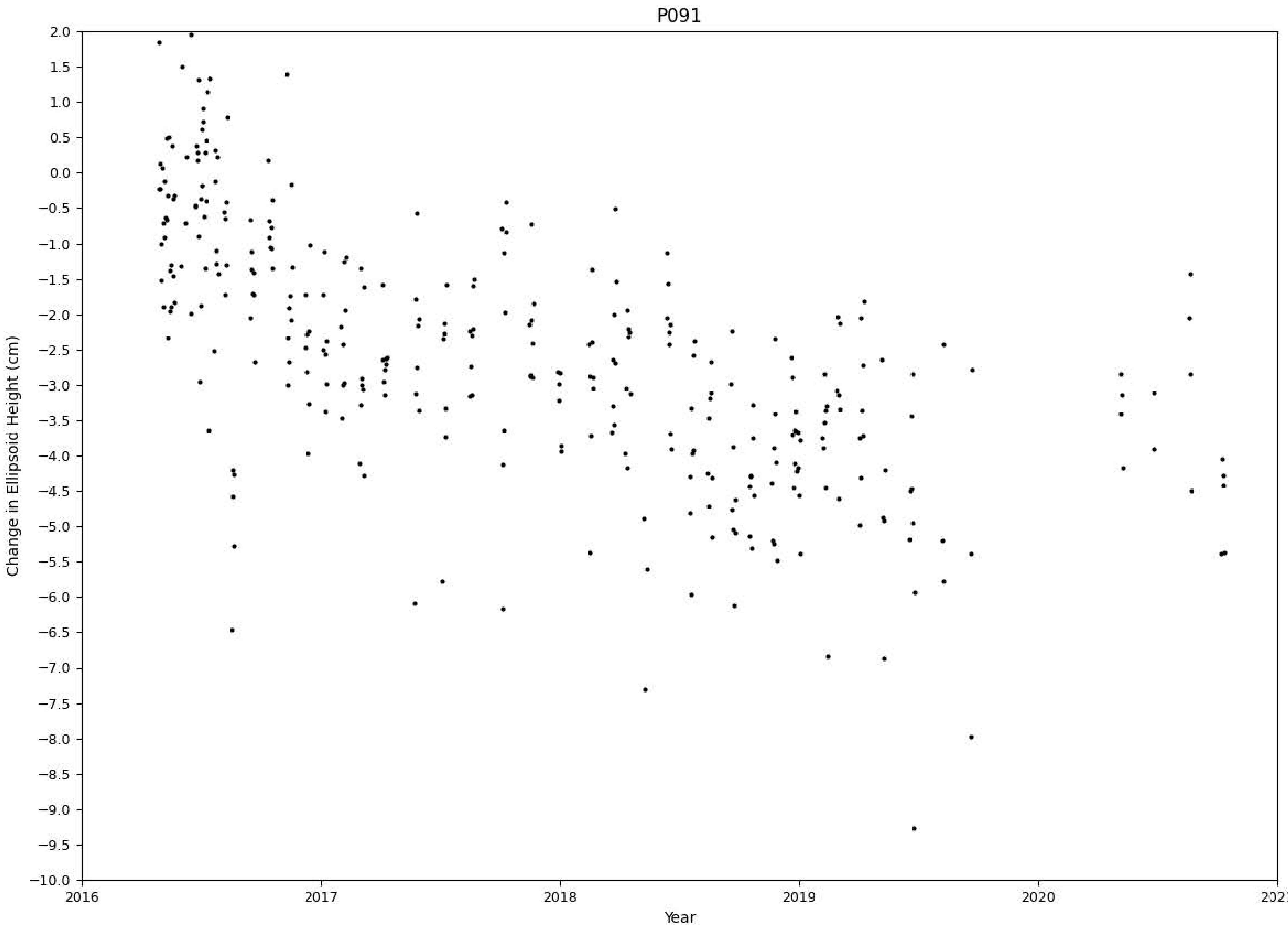
P088
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2016
2017
2018
2019
2020
2021

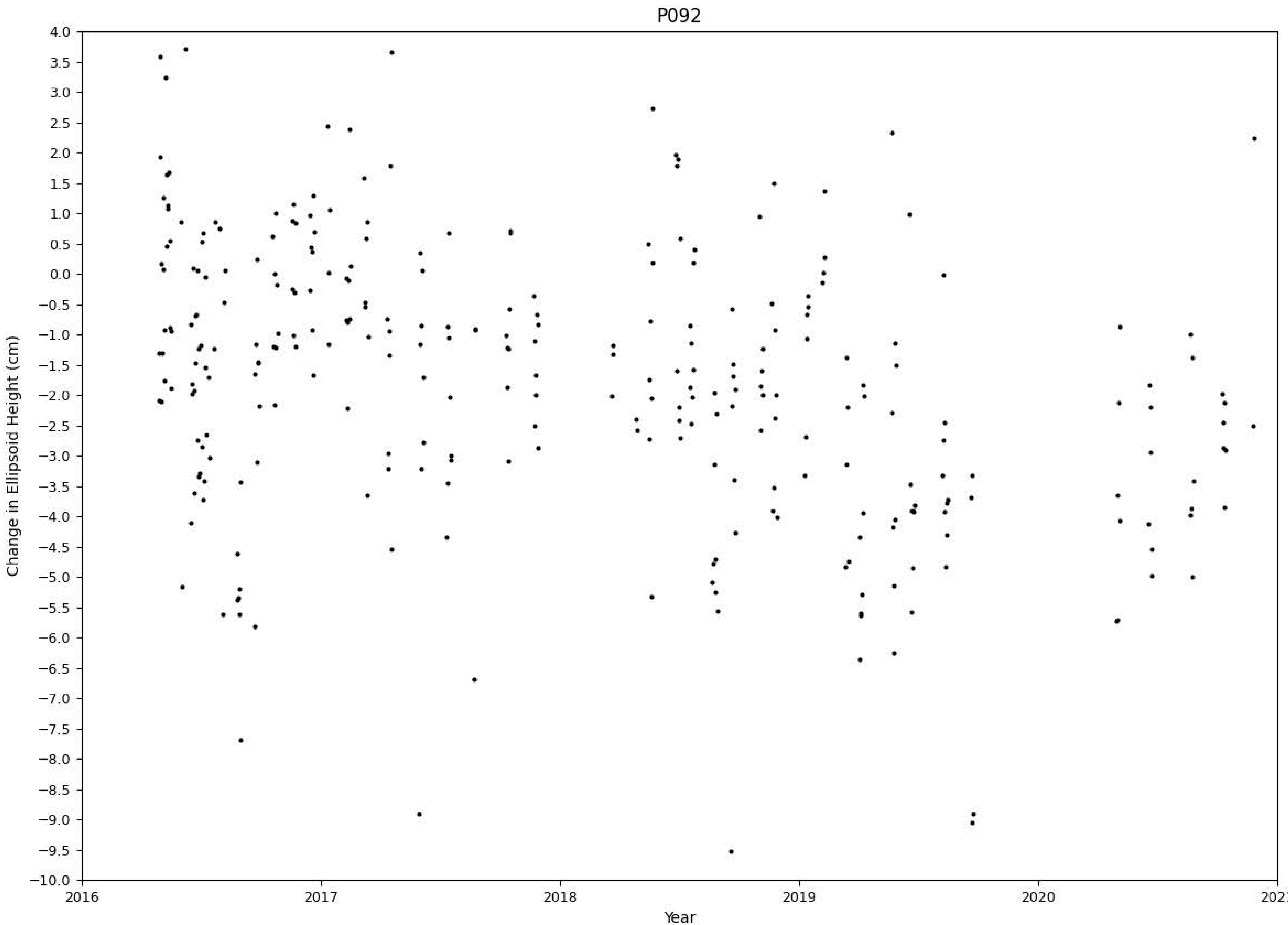


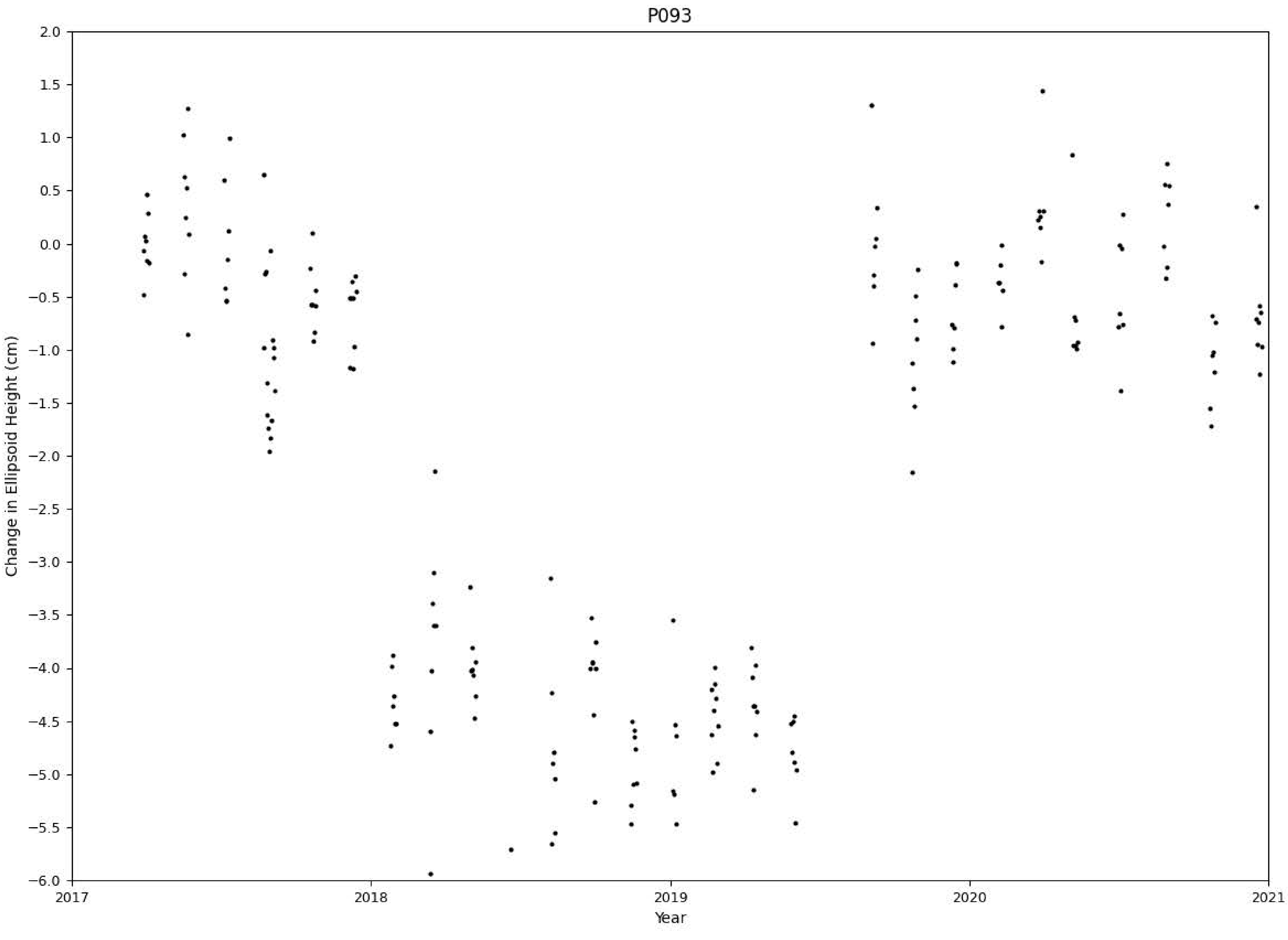
P089
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2015
2016
2017
2018
2019
2020
2021

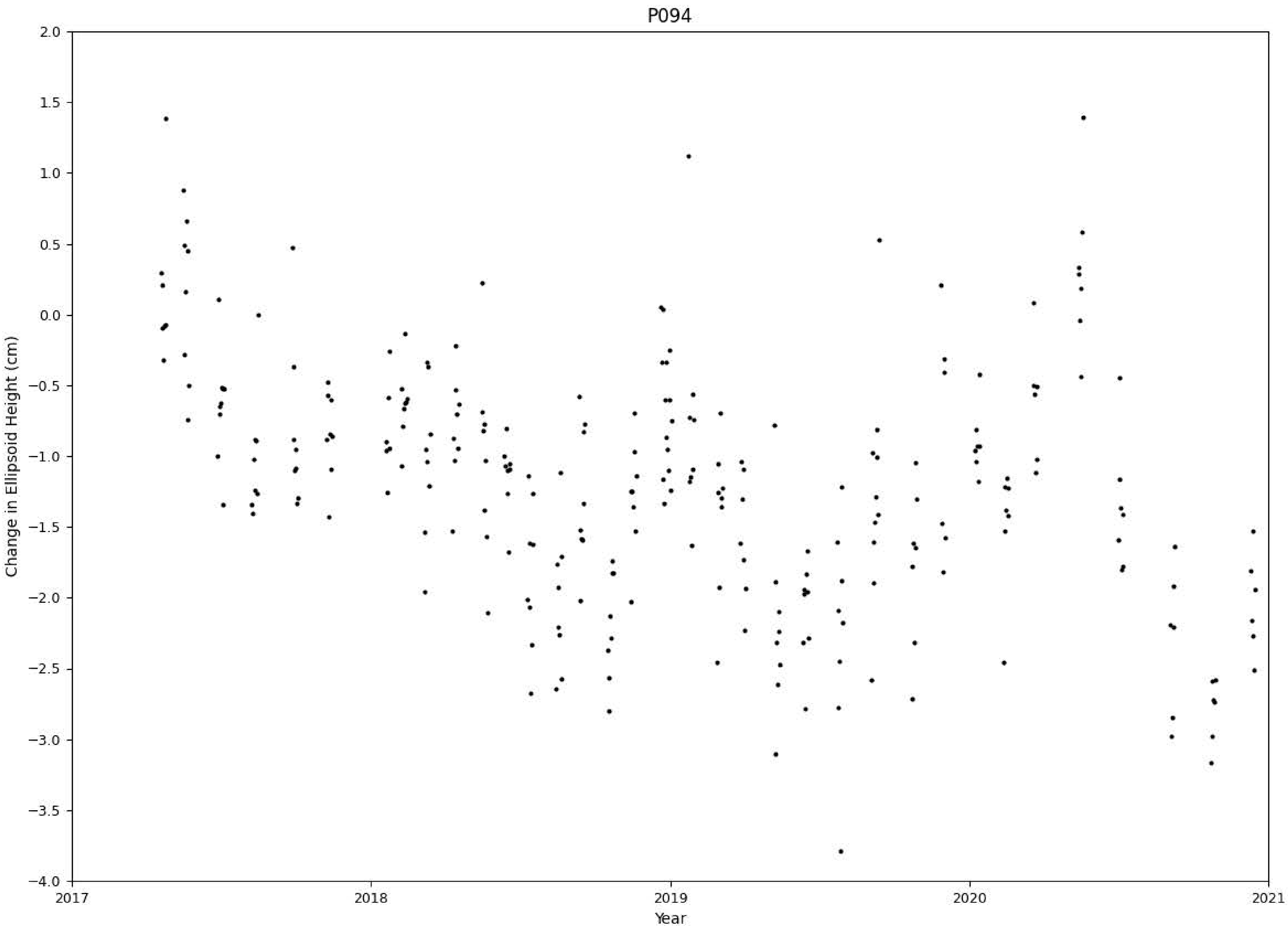


P090
Change in Ellipsoid Height (cm)
Year
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2015
2016
2017
2018
2019
2020
2021

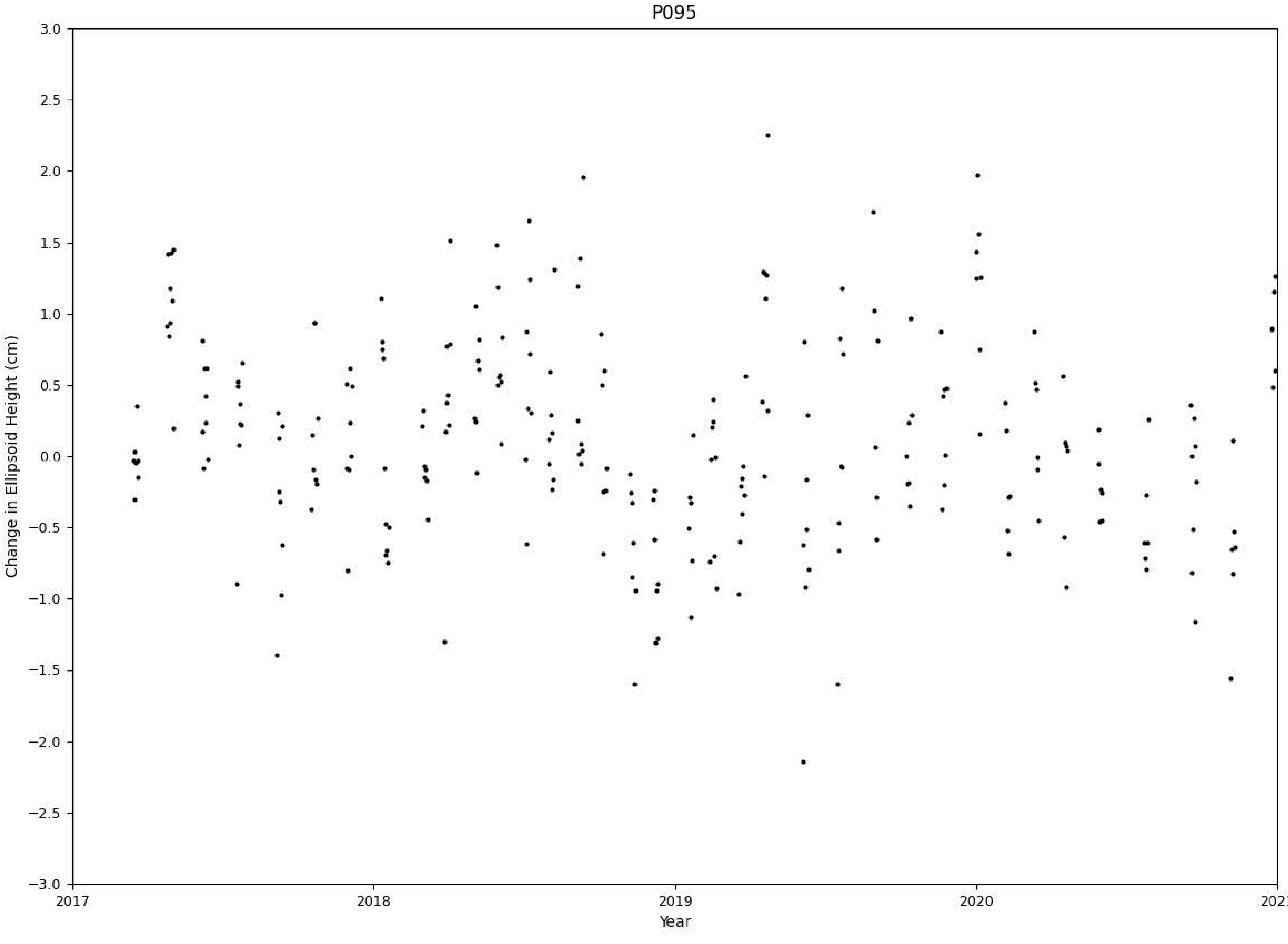

P091
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
−9.5
−10.0
2016
2017
2018
2019
2020
2021


P092
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
−9.5
−10.0
2016
2017
2018
2019
2020
2021

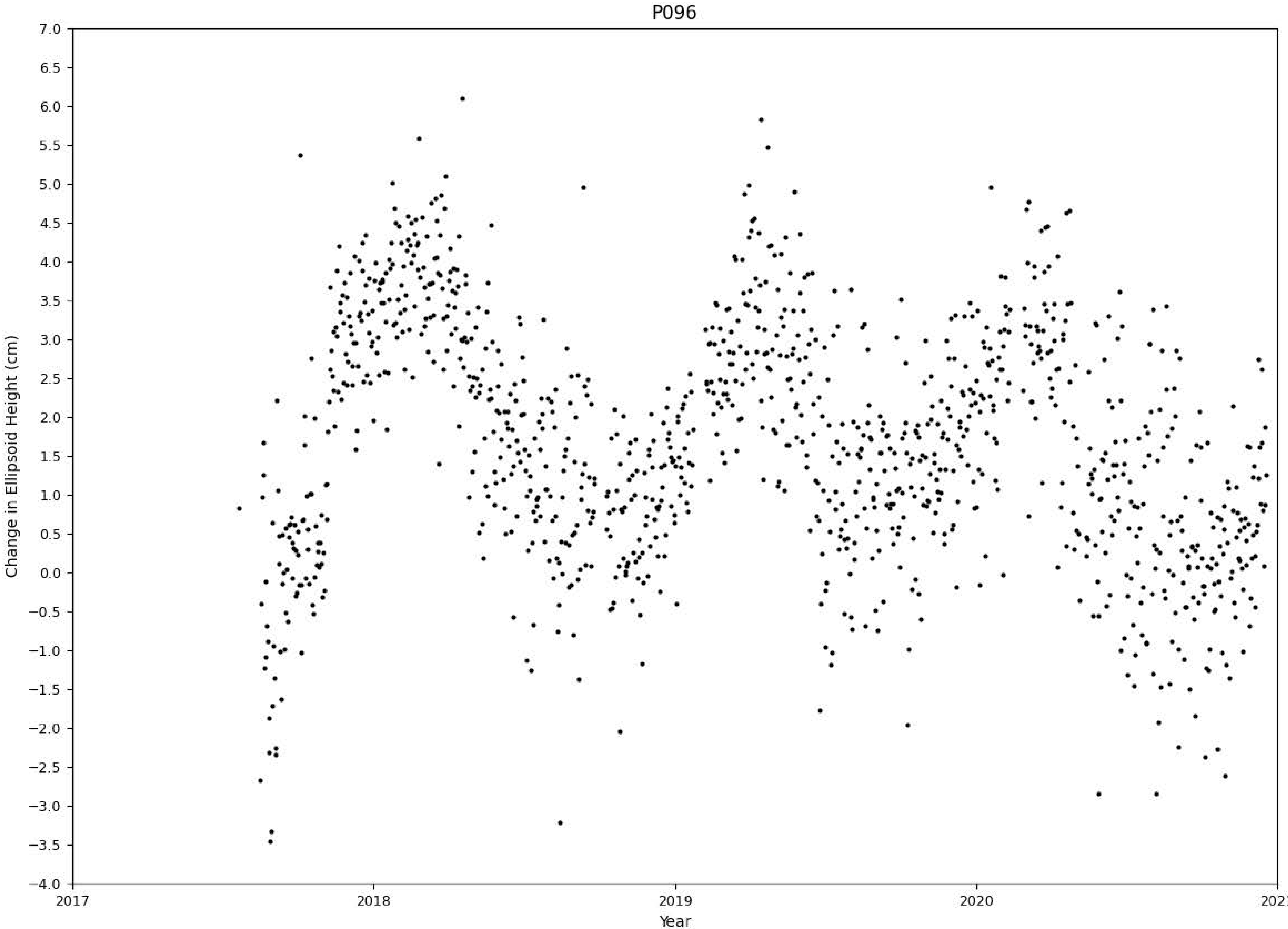

P093
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
2017
2018
2019
2020
2021
Year



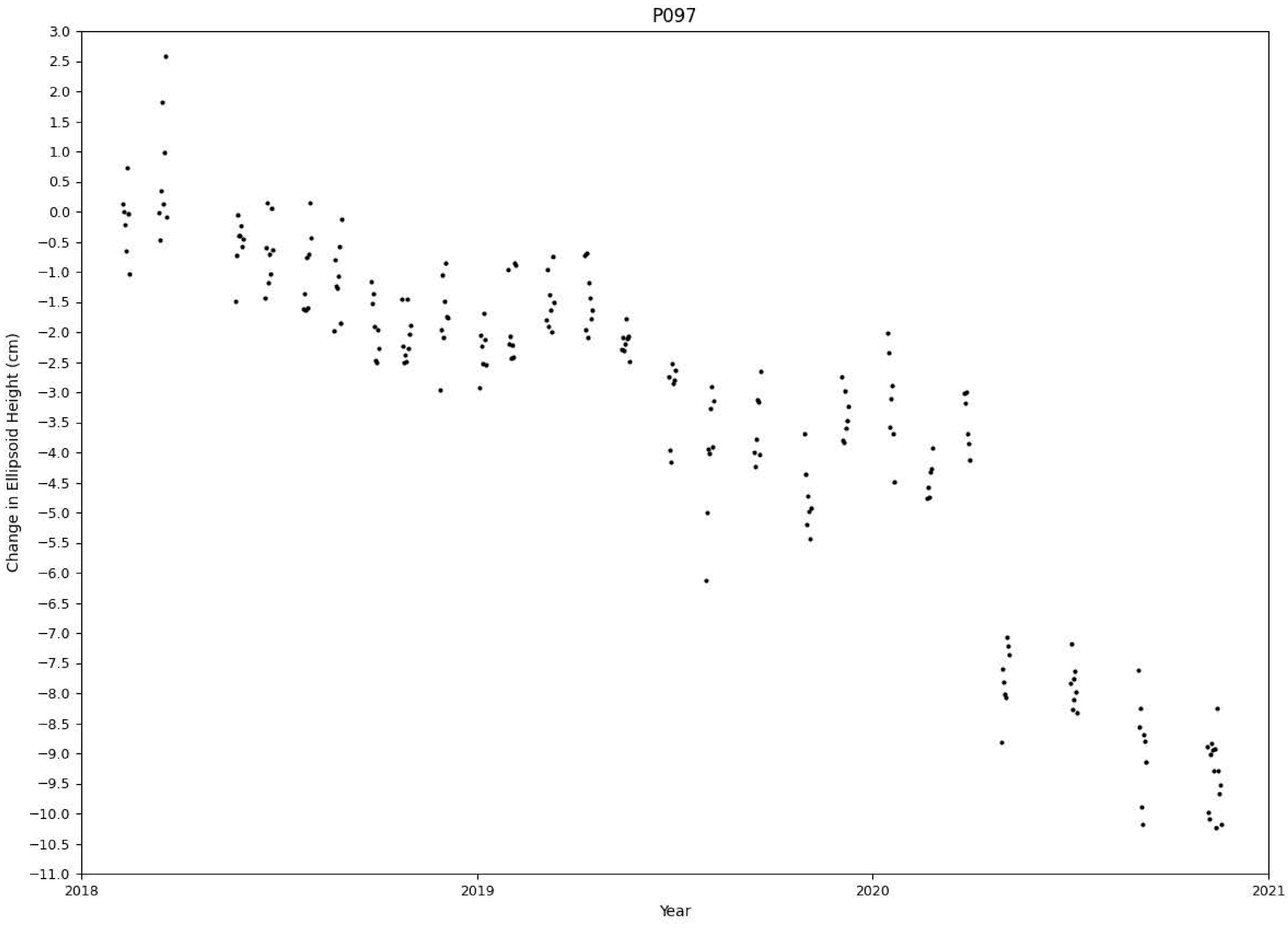
P094
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
Change in Ellipsoid Height (cm)
2017
2018
2019
2020
2021
Year



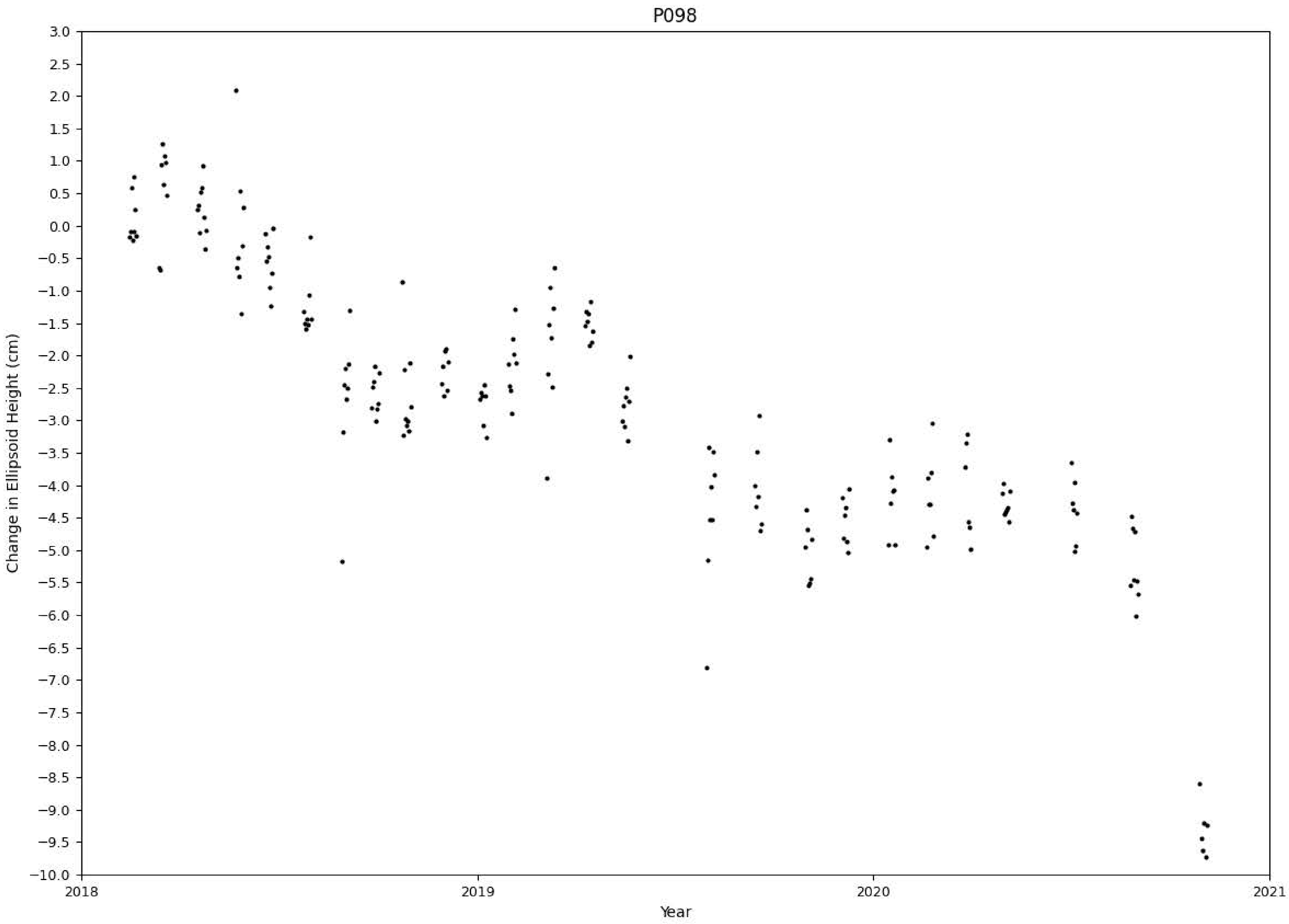
P095
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2017
2018
2019
2020
2021



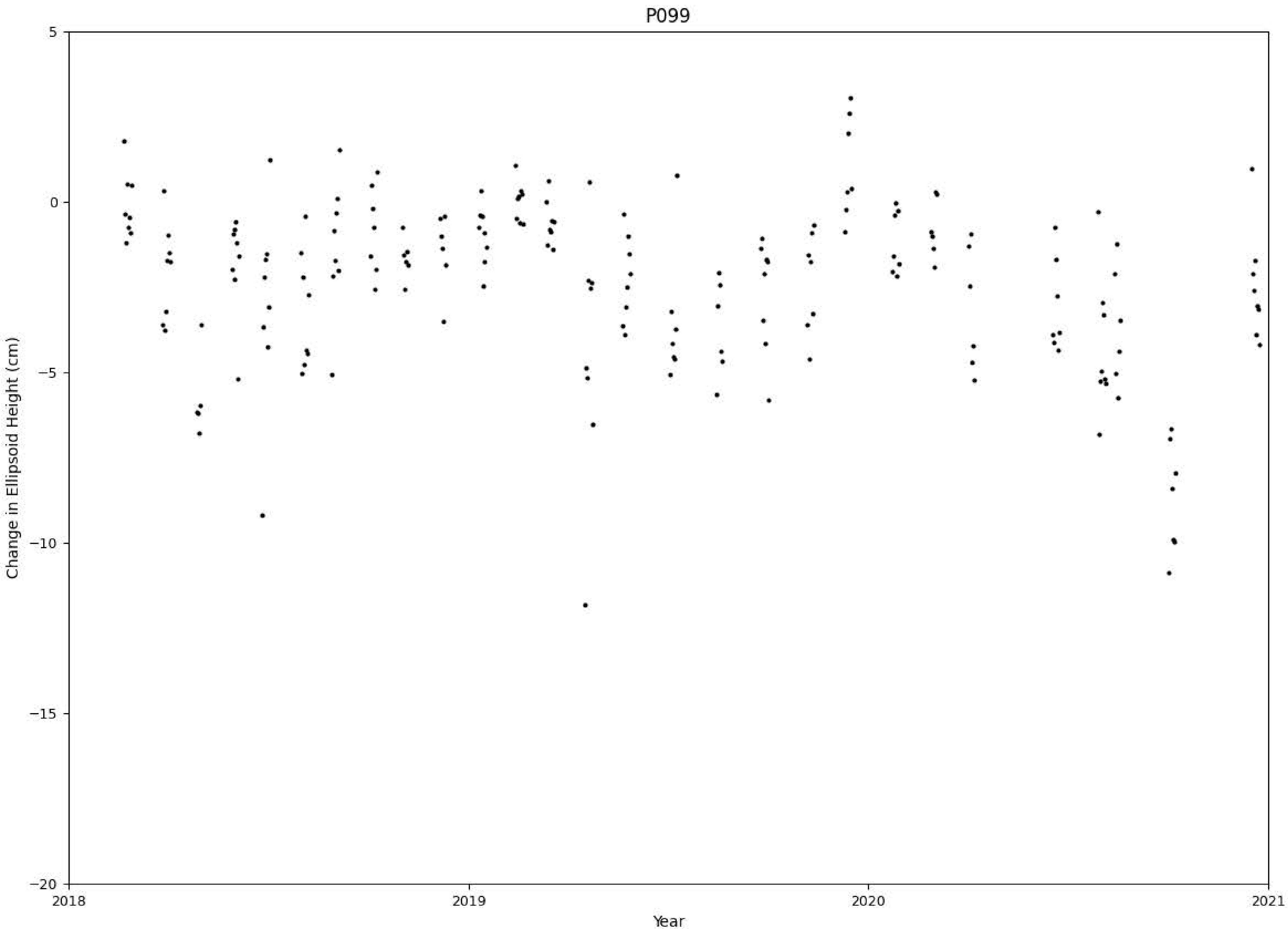
P096
Change in Ellipsoid Height (cm)
Year
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2017
2018
2019
2020
2021

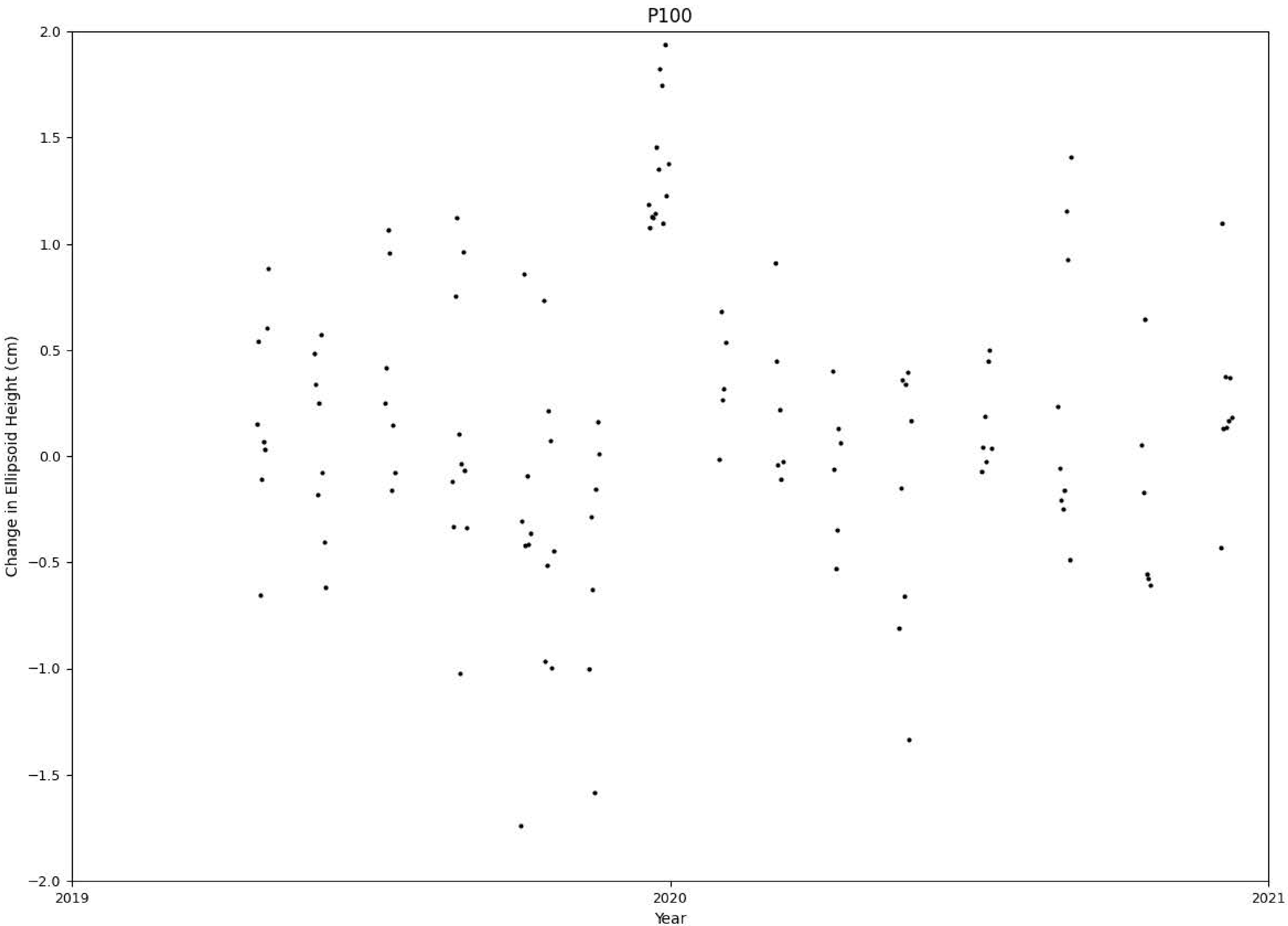


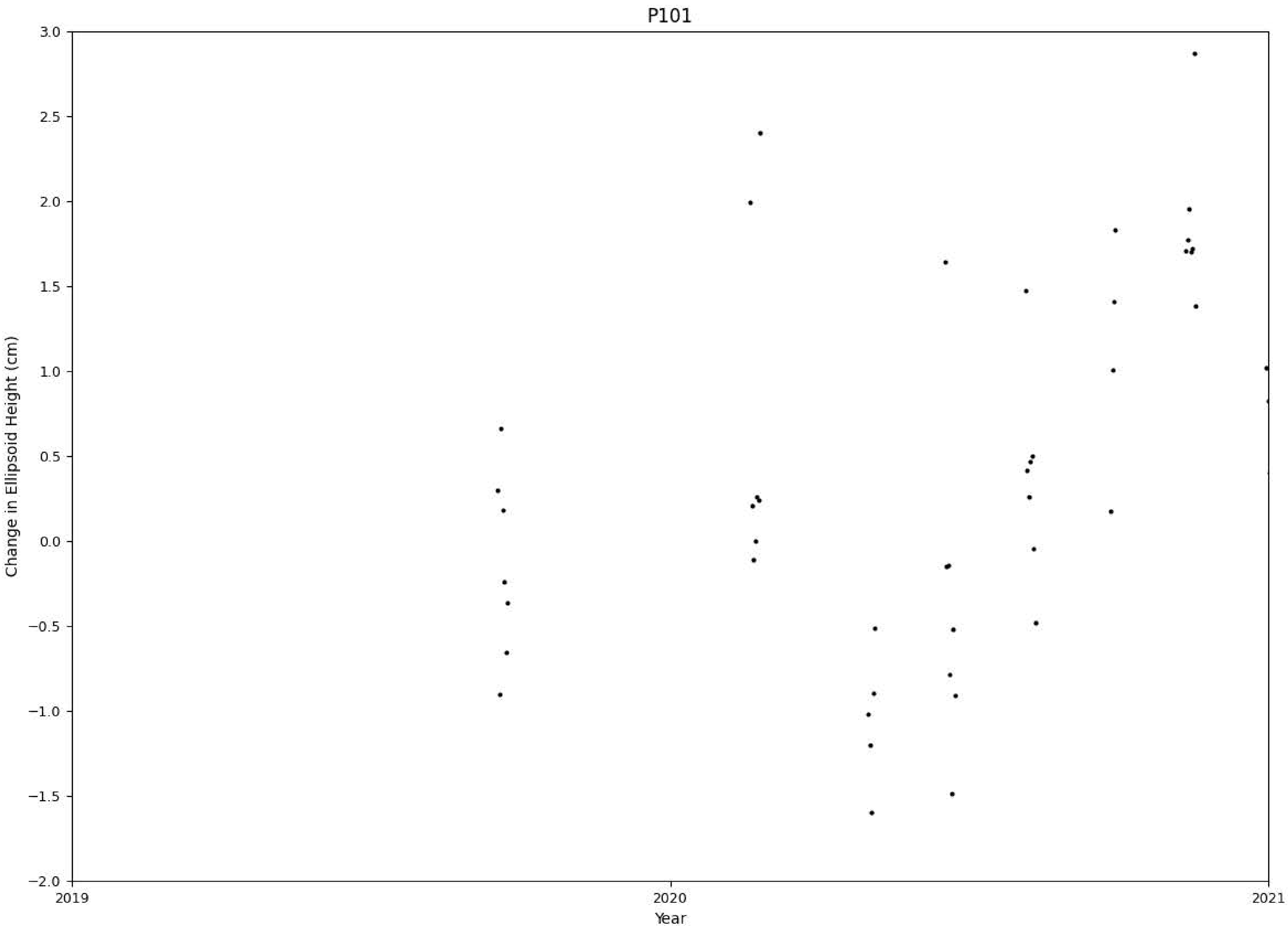
P097
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
−9.5
−10.0
−10.5
−11.0
2018
2019
2020
2021

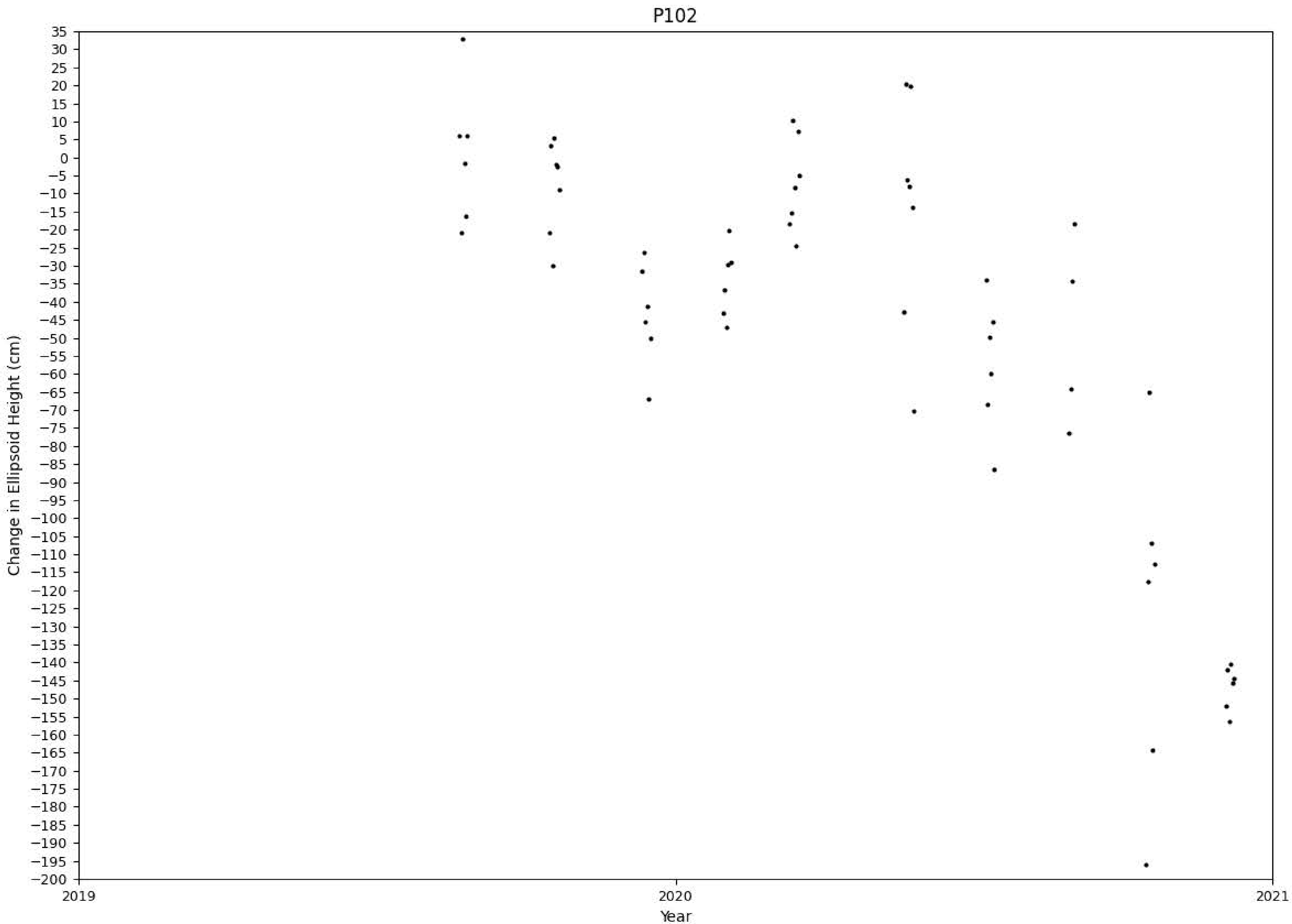


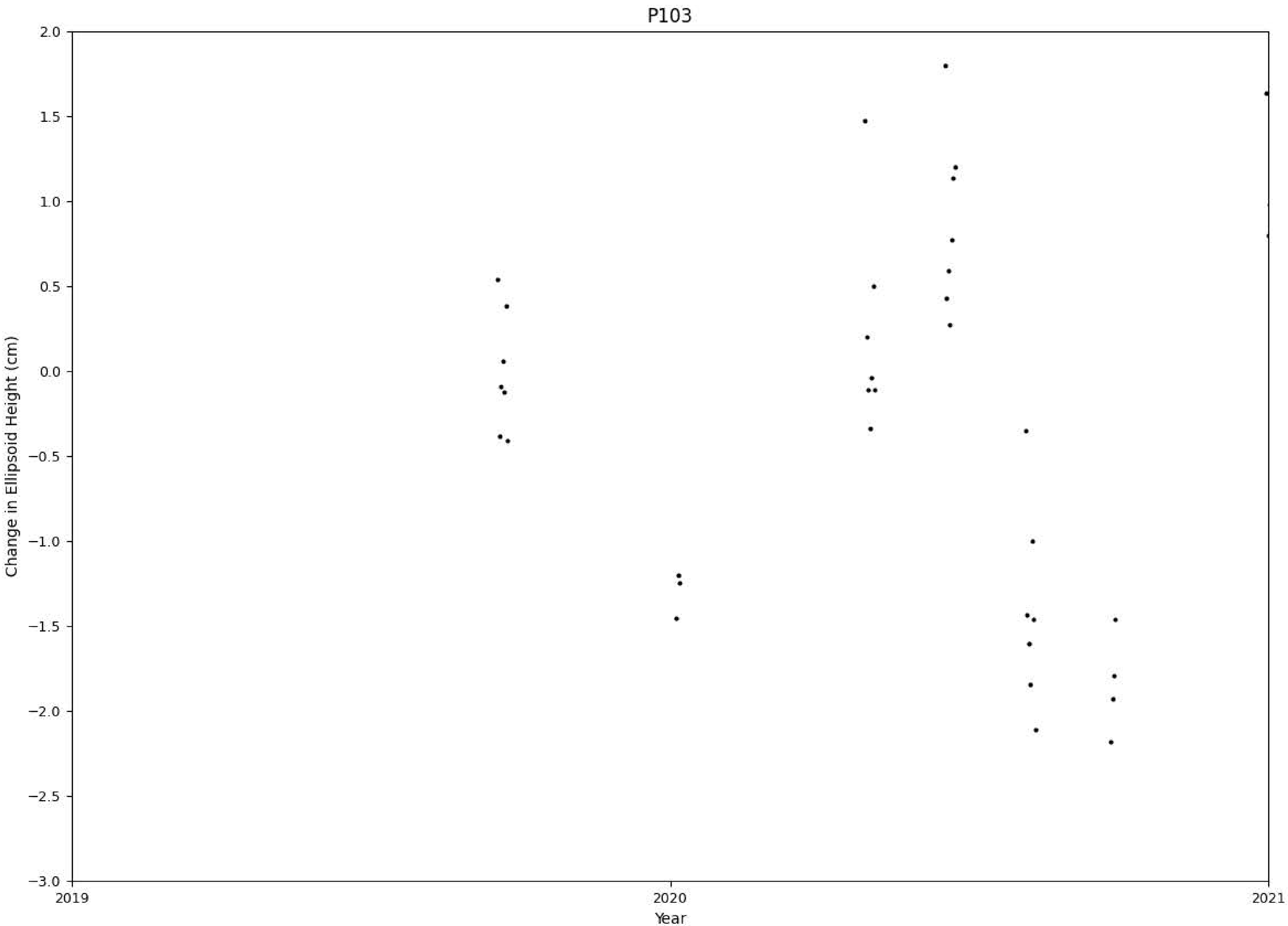
P098
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
−9.5
−10.0
2018
2019
2020
2021

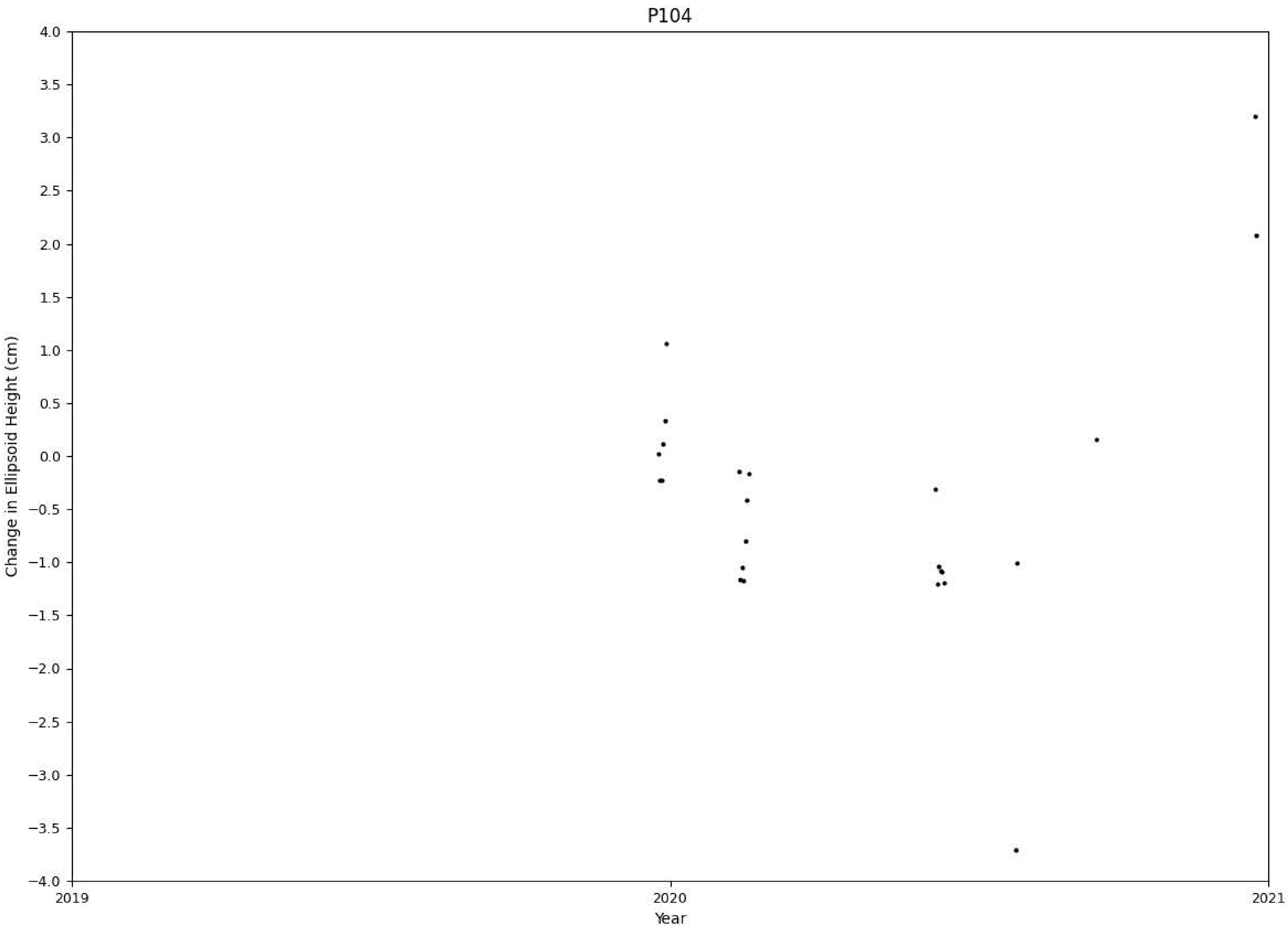

P099
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
2018
2019
2020
2021
Year


P100
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
Change in Ellipsoid Height (cm)
2019
2020
2021
Year

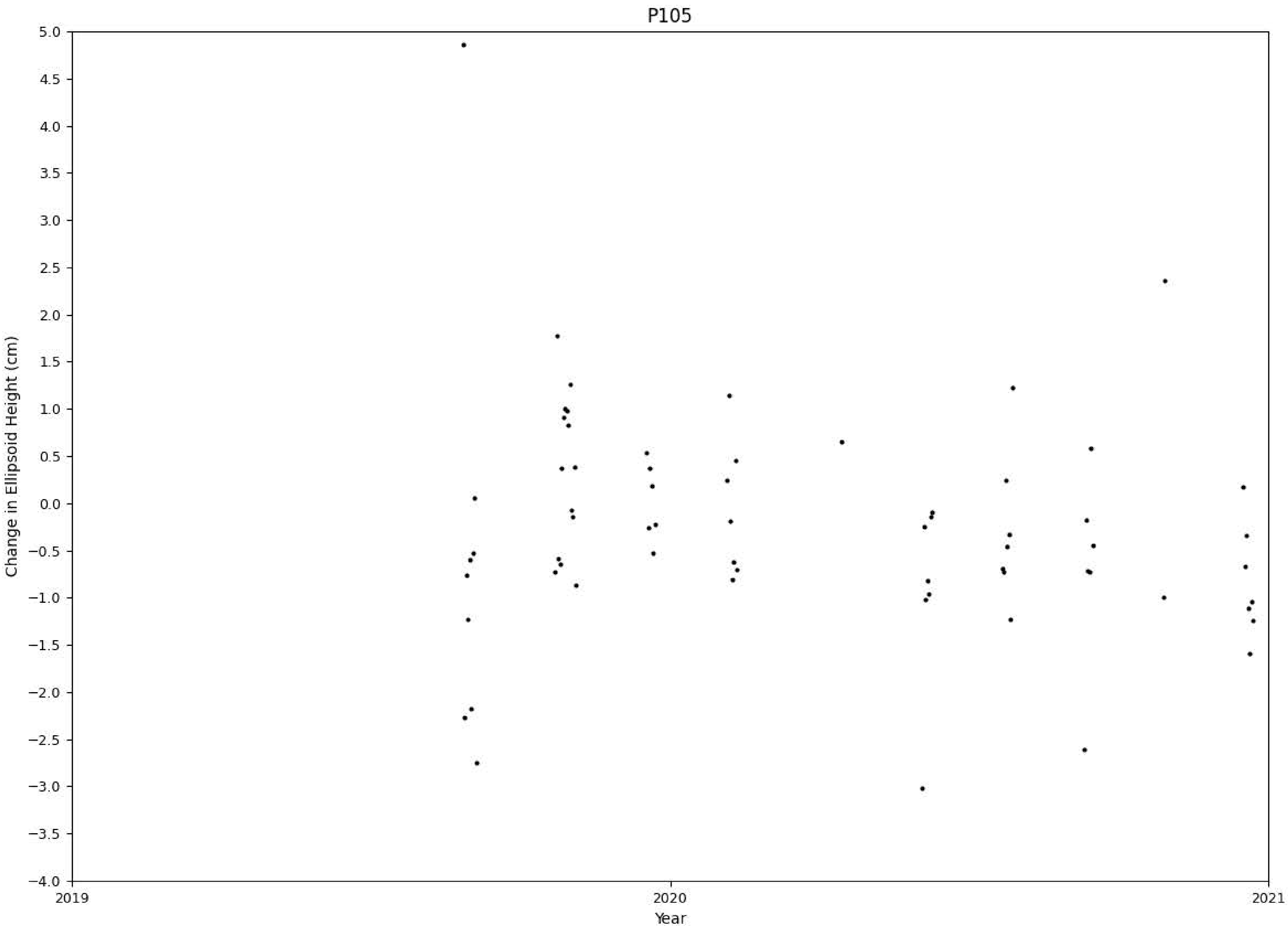

P101
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
Change in Ellipsoid Height (cm)
2019
2020
2021
Year

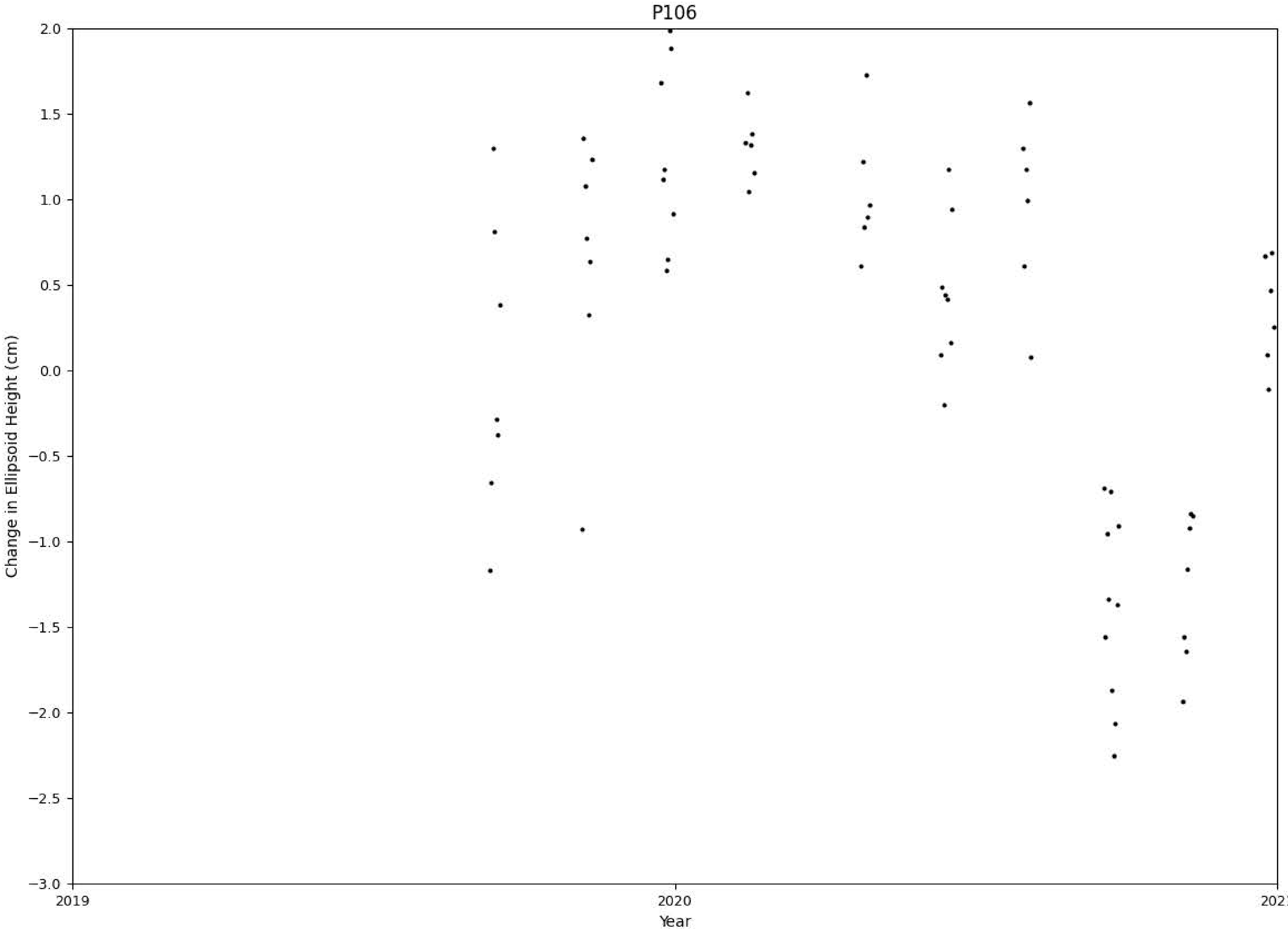

P102
Change in Ellipsoid Height (cm)
Year
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
−50
−55
−60
−65
−70
−75
−80
−85
−90
−95
−100
−105
−110
−115
−120
−125
−130
−135
−140
−145
−150
−155
−160
−165
−170
−175
−180
−185
−190
−195
−200
2019
2020
2021


P103
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2019
2020
2021
Year

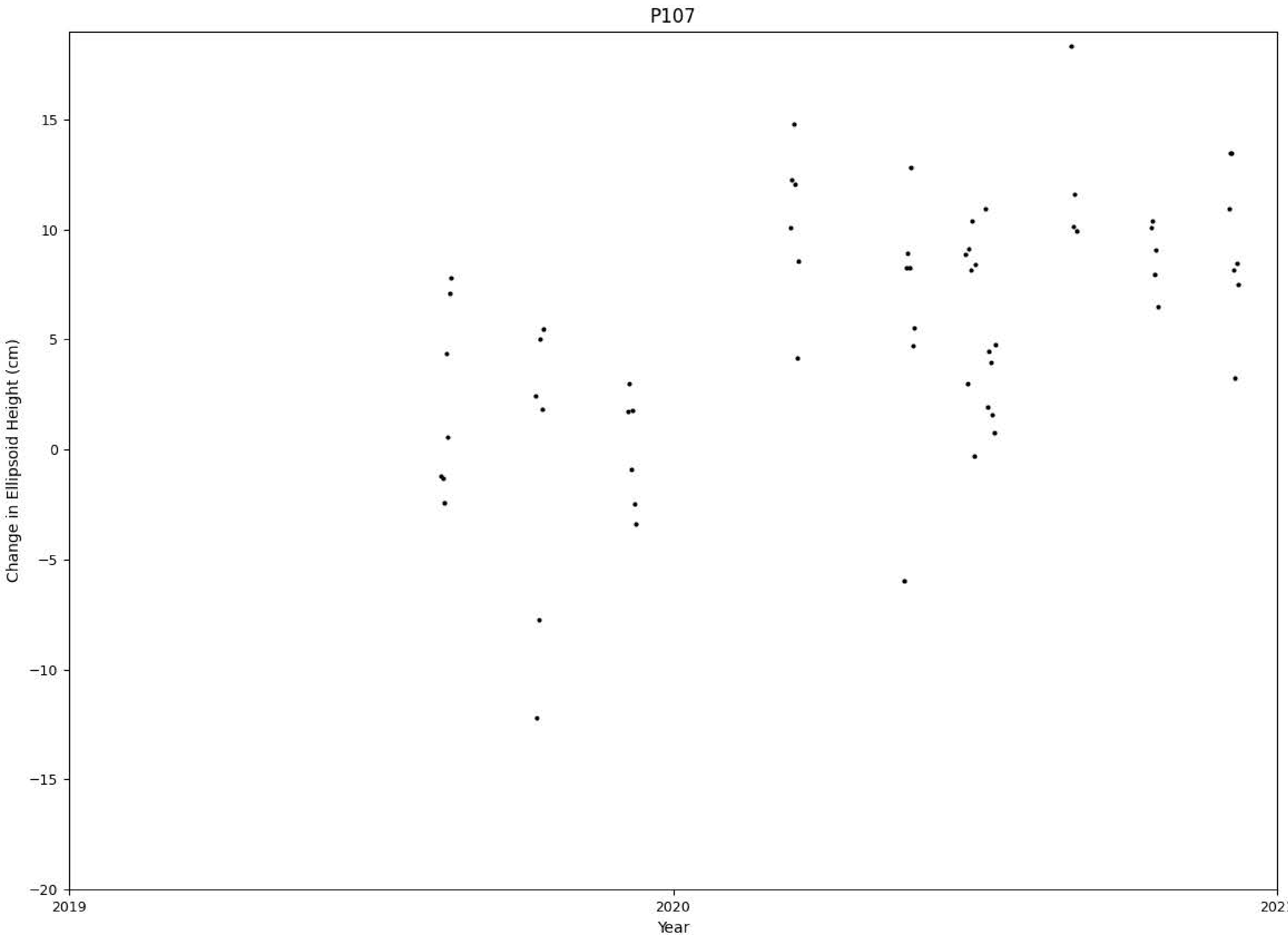


P104
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
Change in Ellipsoid Height (cm)
2019
2020
2021
Year

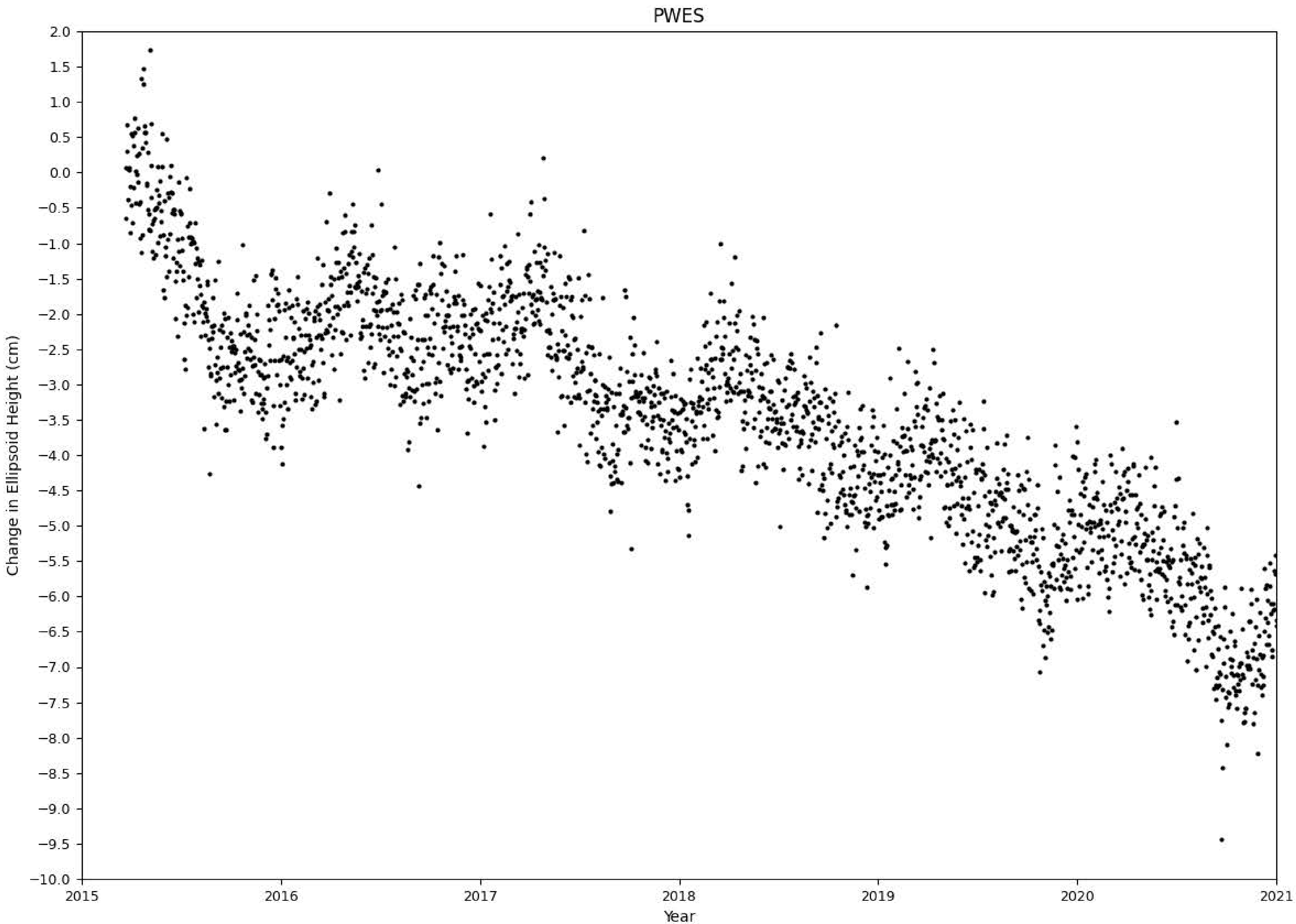

P105
Change in Ellipsoid Height (cm)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2019
2020
2021
Year



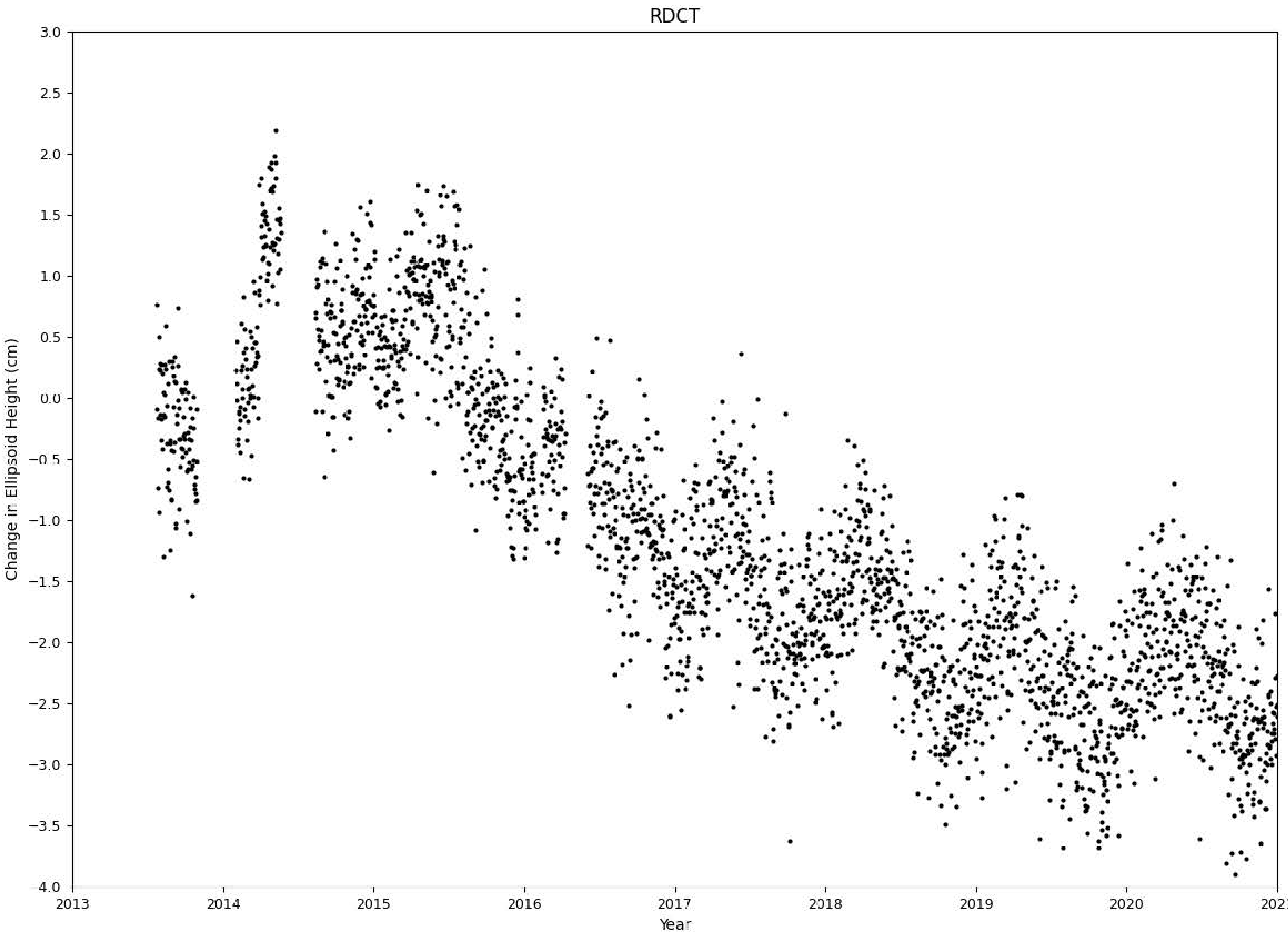
P106
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2019
2020
2021
Year

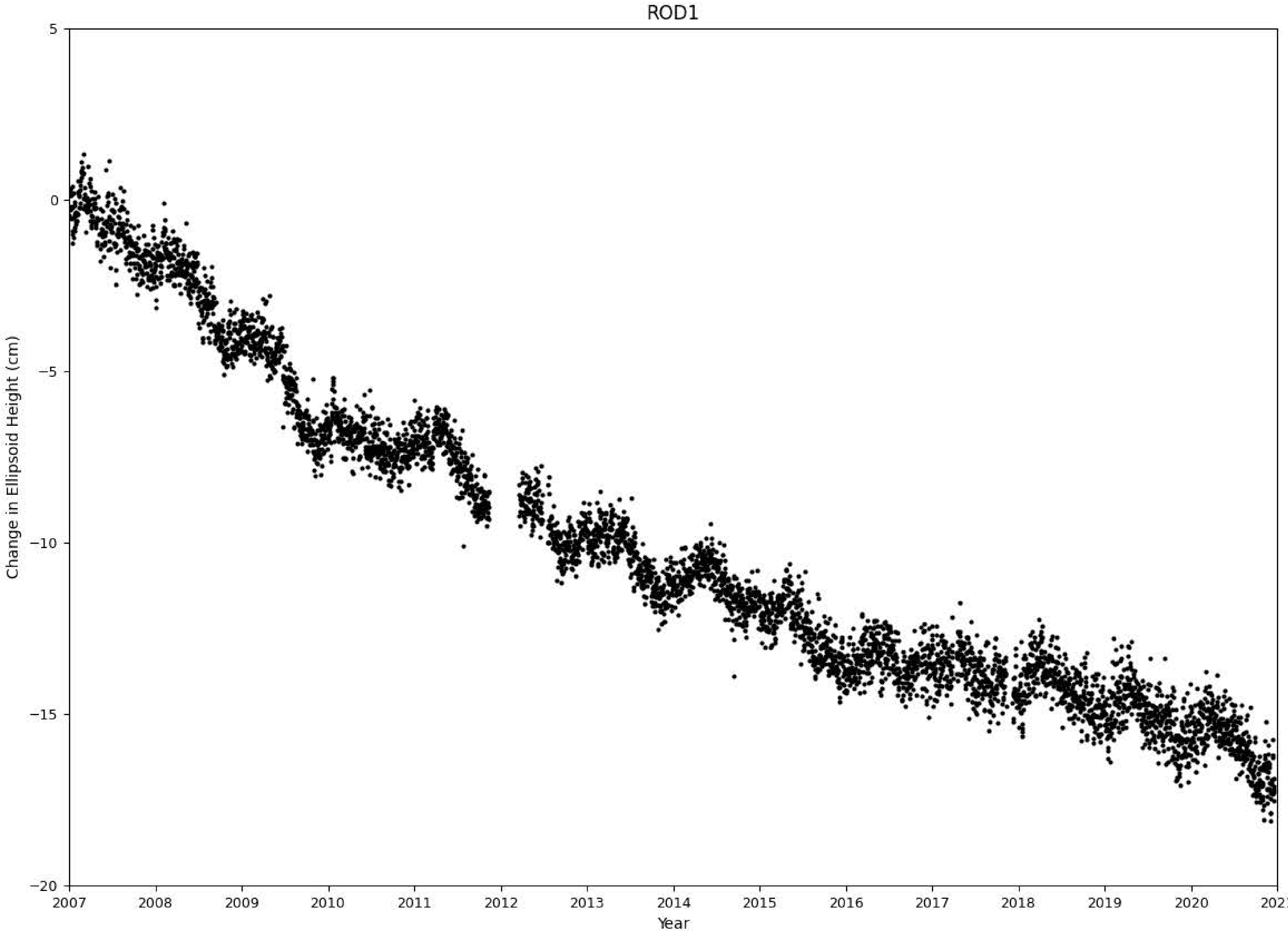


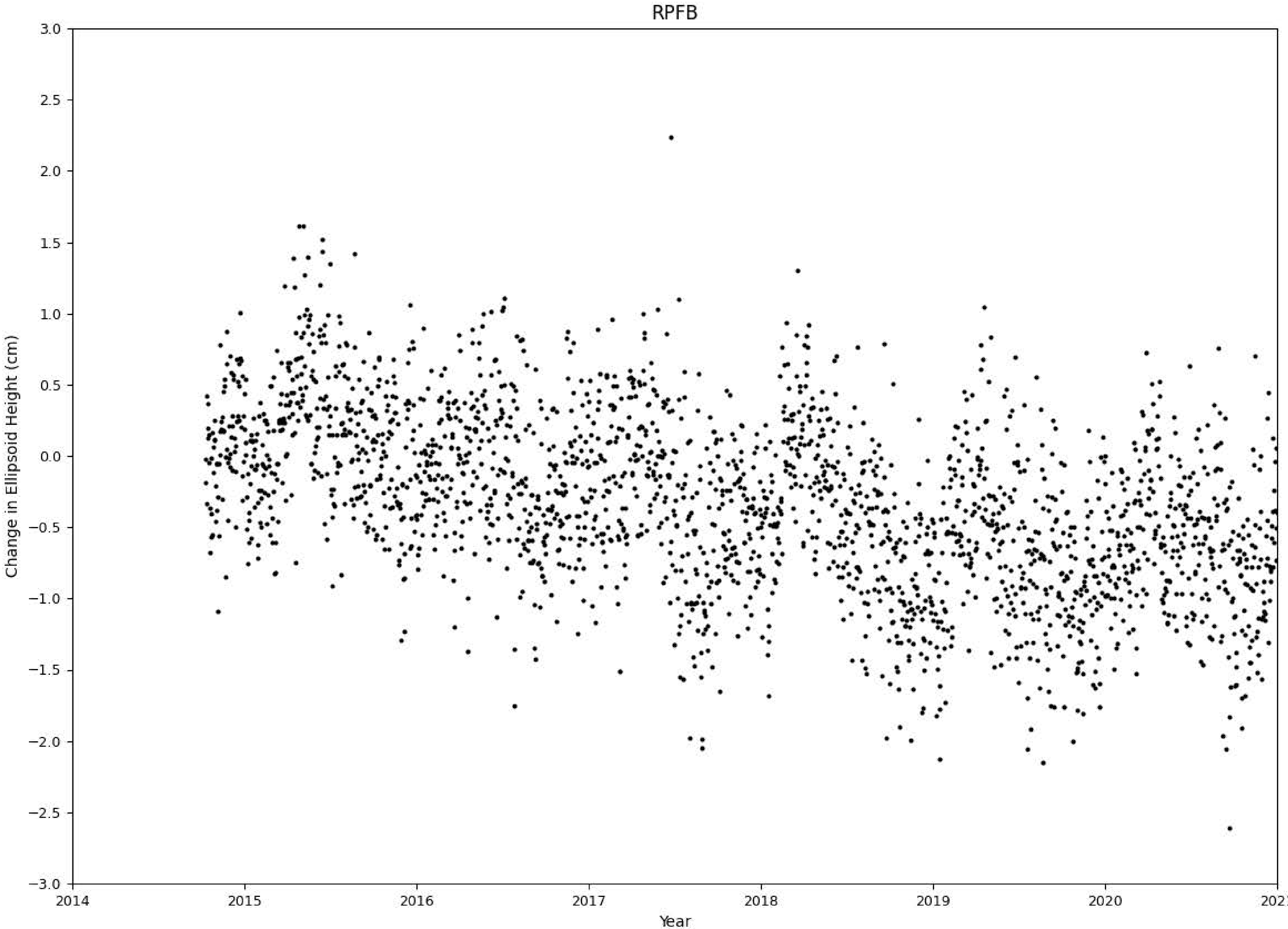
P107
Change in Ellipsoid Height (cm)
15
10
5
0
−5
−10
−15
−20
2019
2020
2021
Year



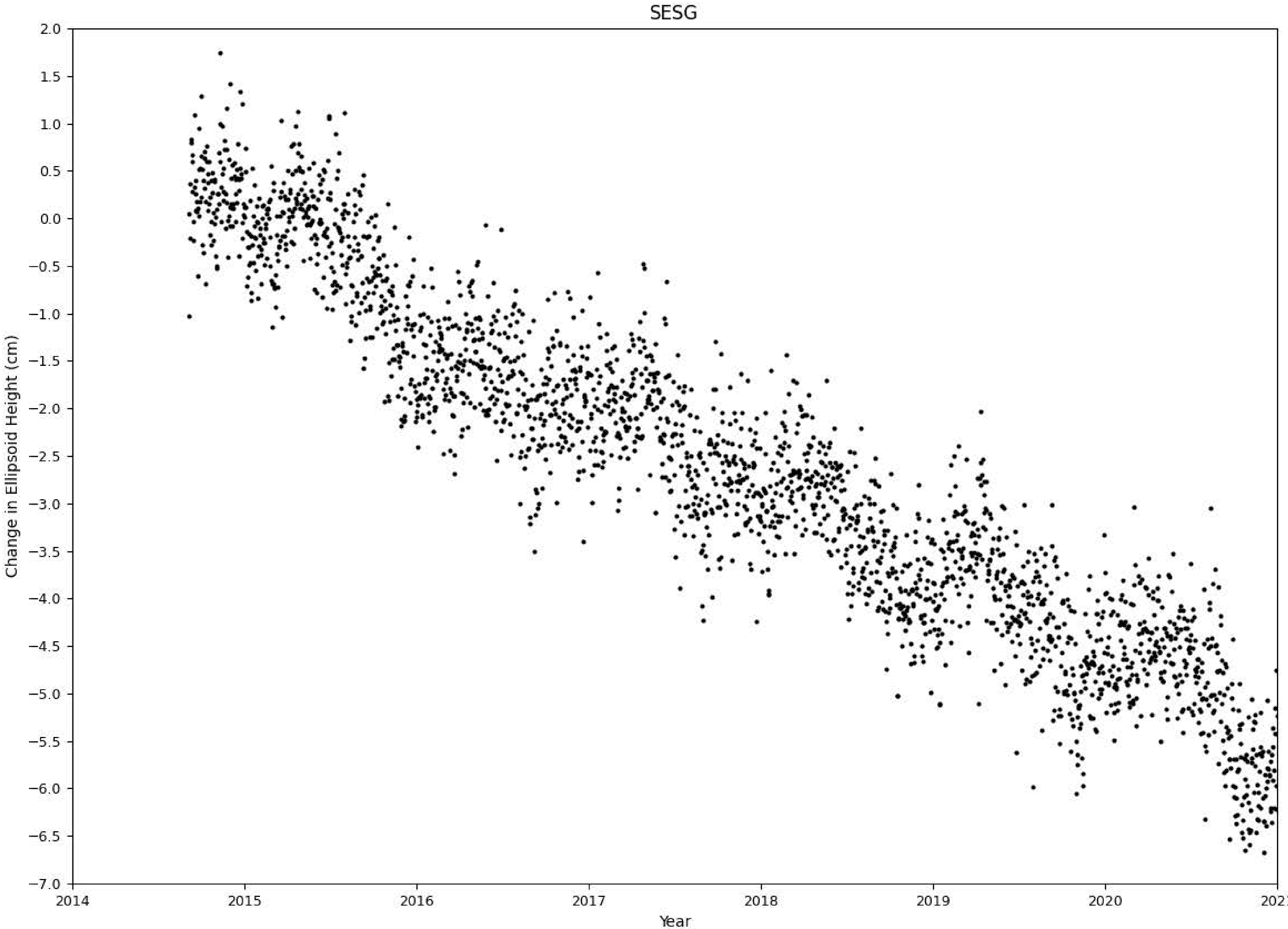
PWES
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
2015
2016
2017
2018
2019
2020
2021


RDCT
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

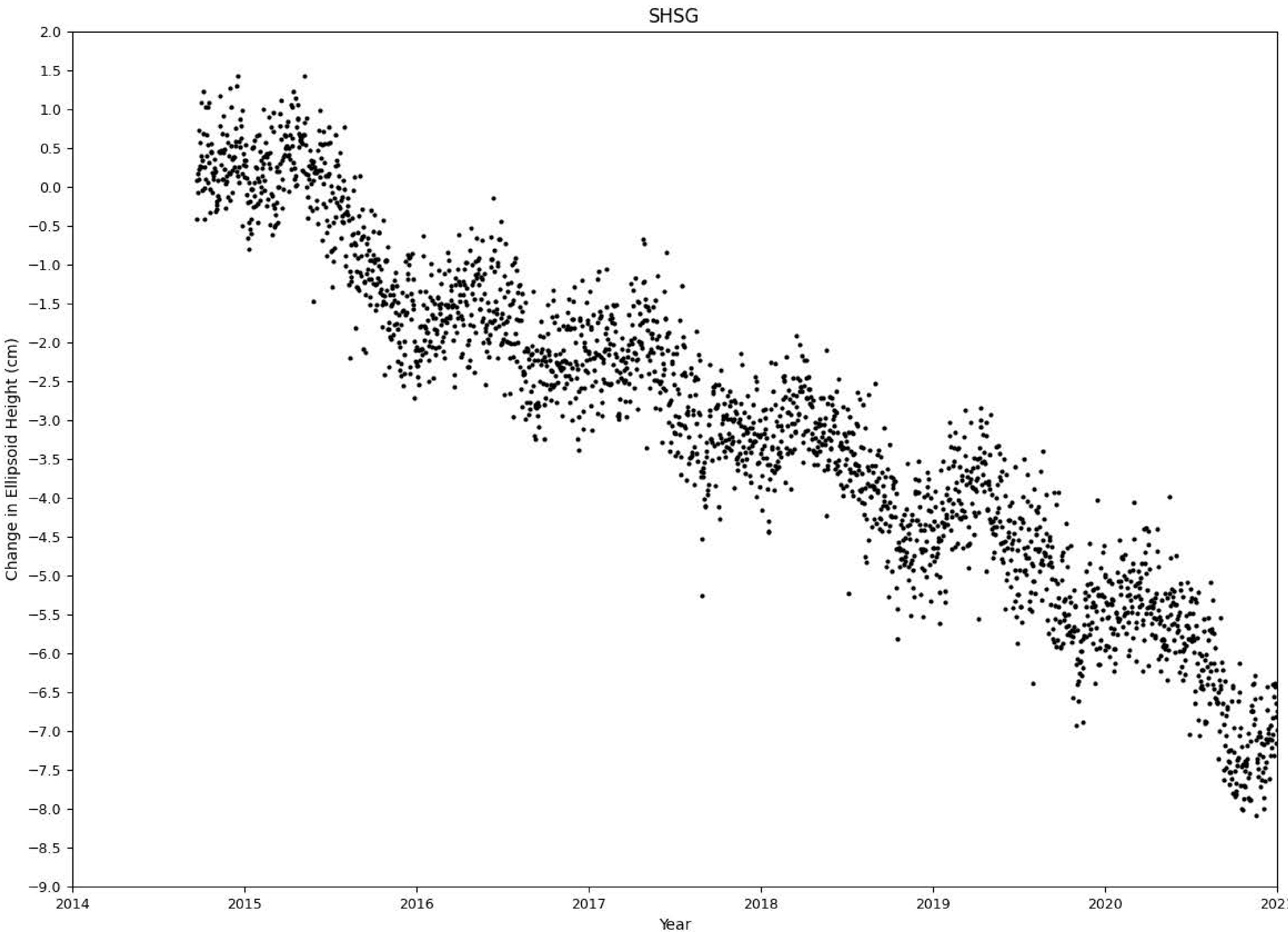

ROD1
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

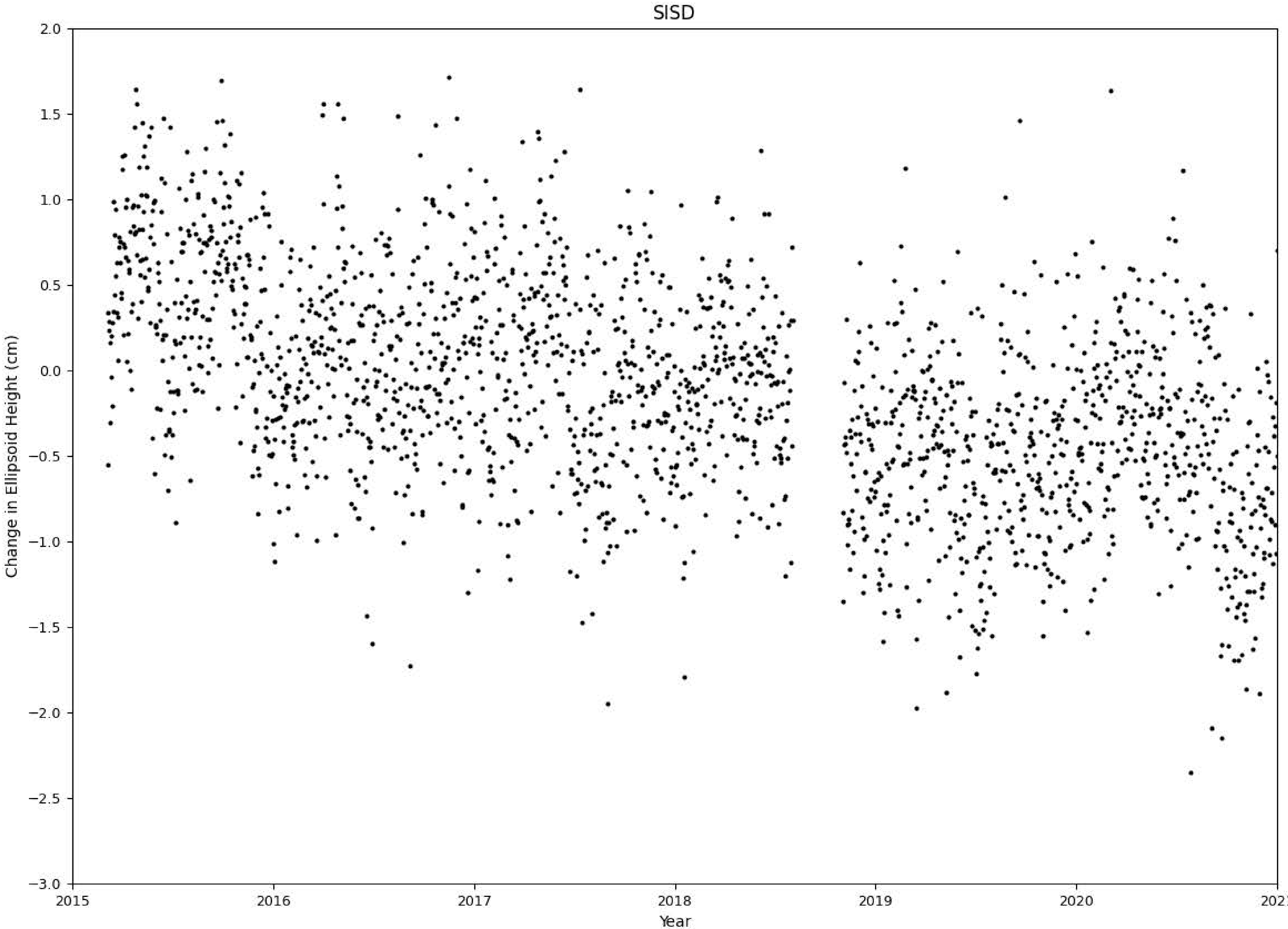


RPFB
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2014
2015
2016
2017
2018
2019
2020
2021

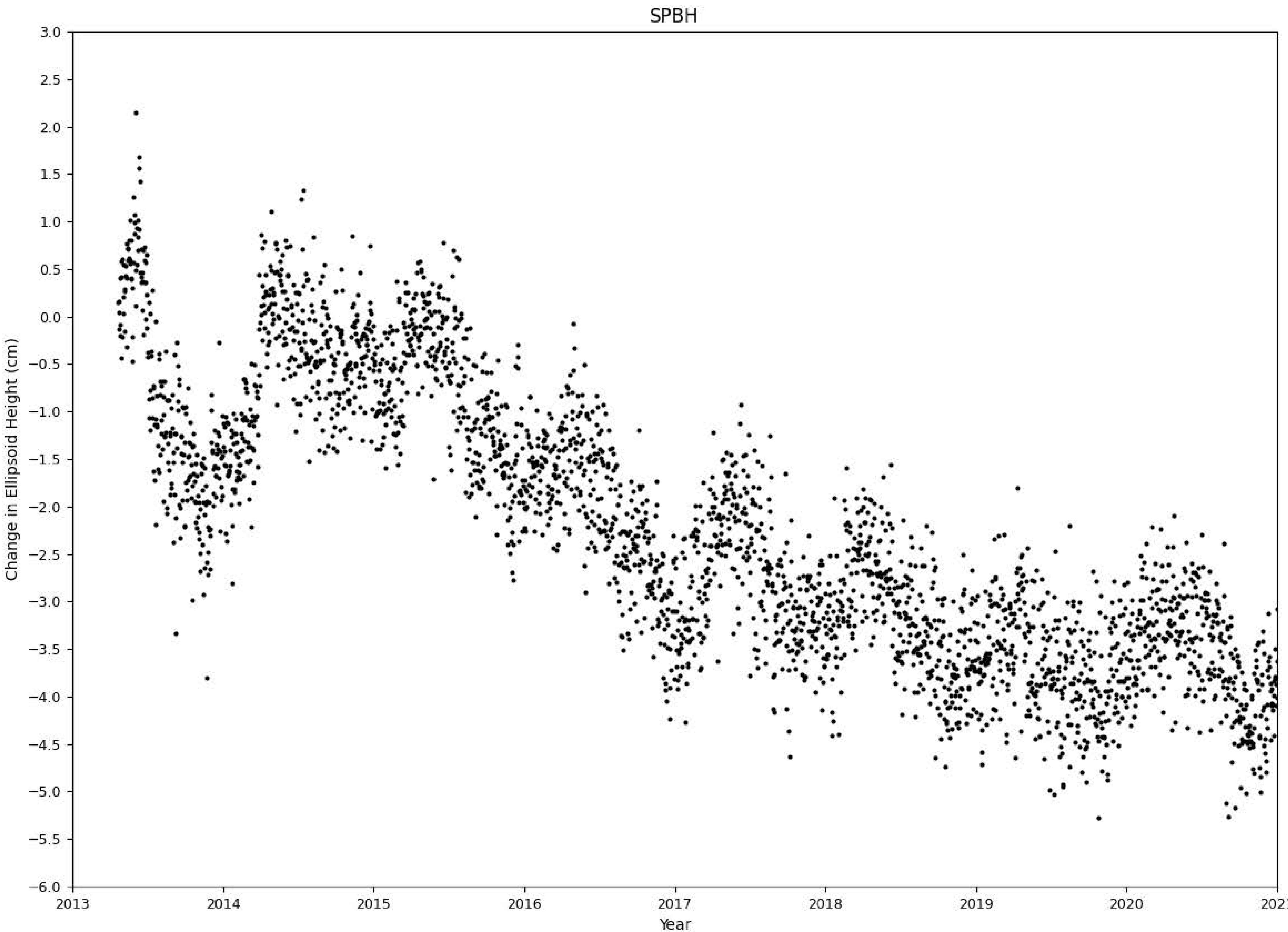


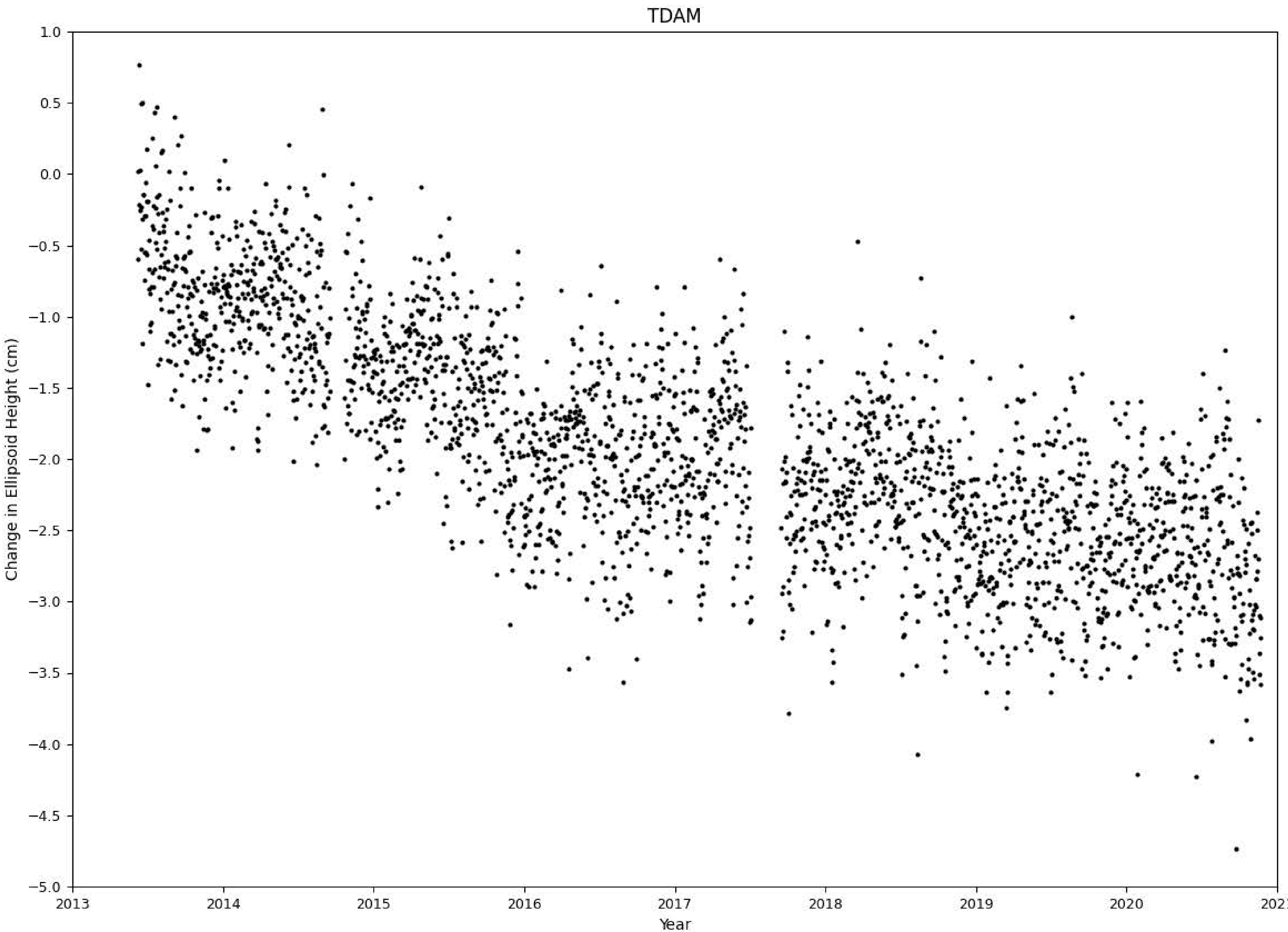
SESG
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2014
2015
2016
2017
2018
2019
2020
2021

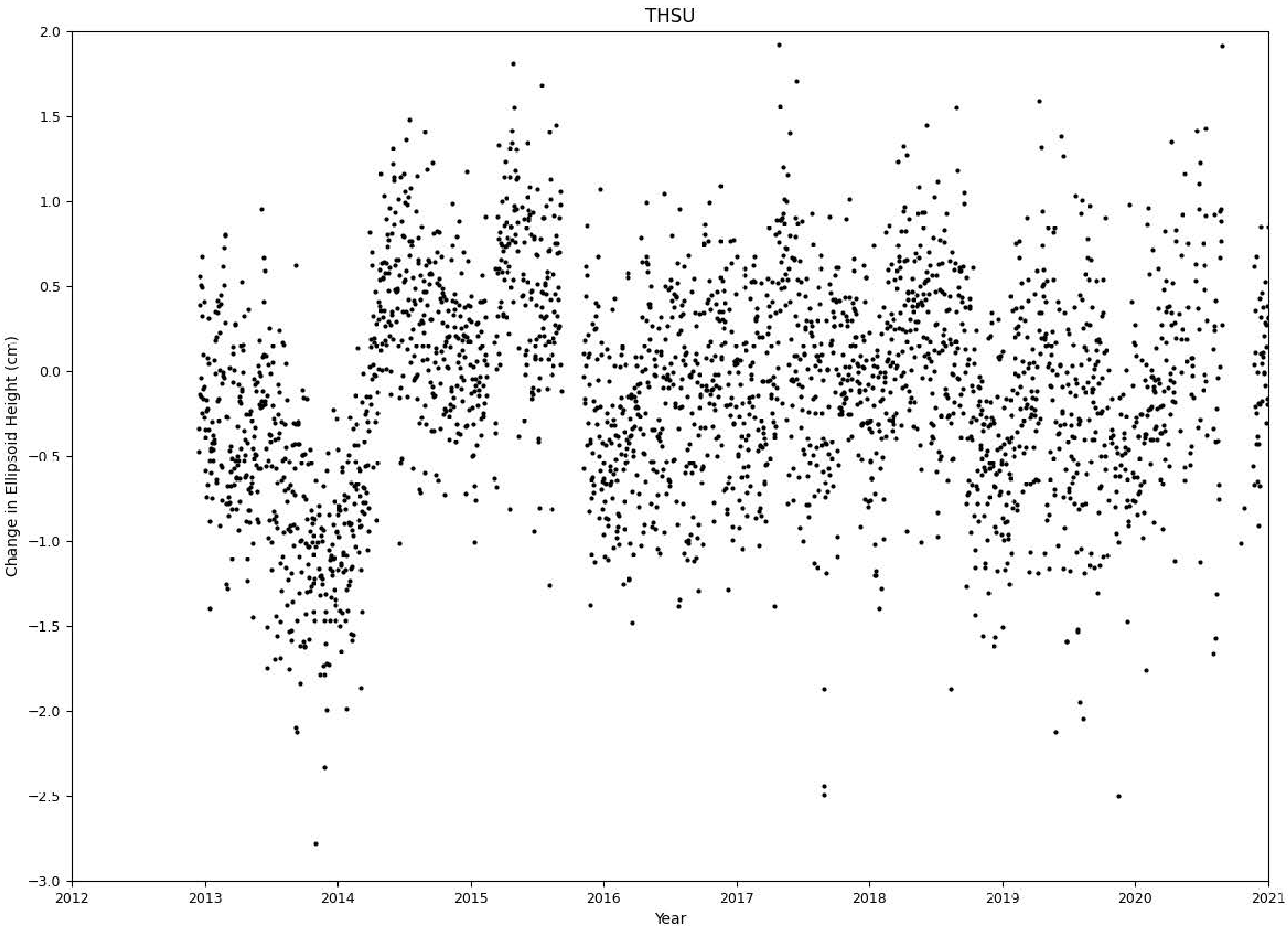

SHSG
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
−7.5
−8.0
−8.5
−9.0
2014
2015
2016
2017
2018
2019
2020
2021



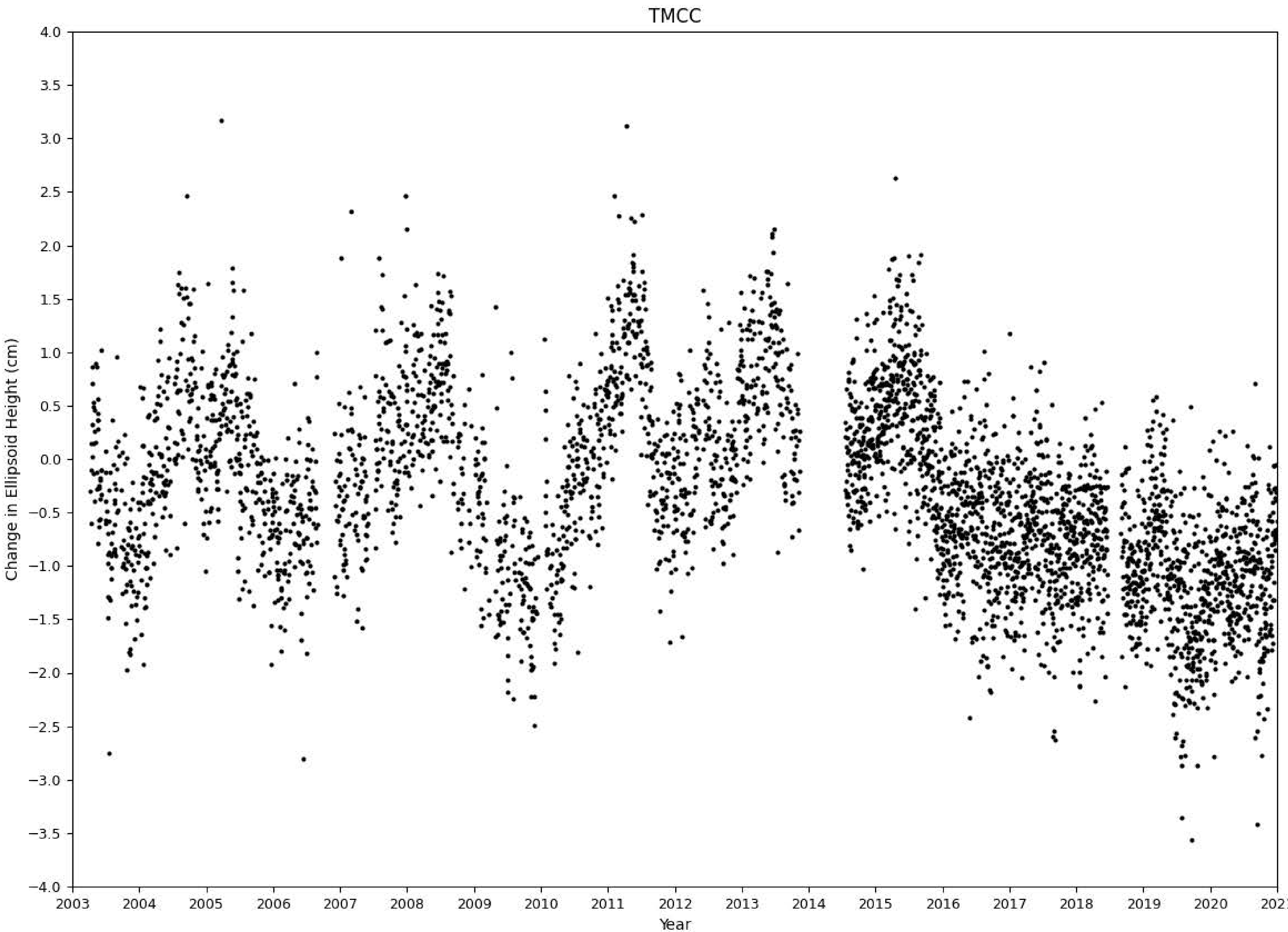
SISD
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2015
2016
2017
2018
2019
2020
2021


SPBH
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
2013
2014
2015
2016
2017
2018
2019
2020
2021

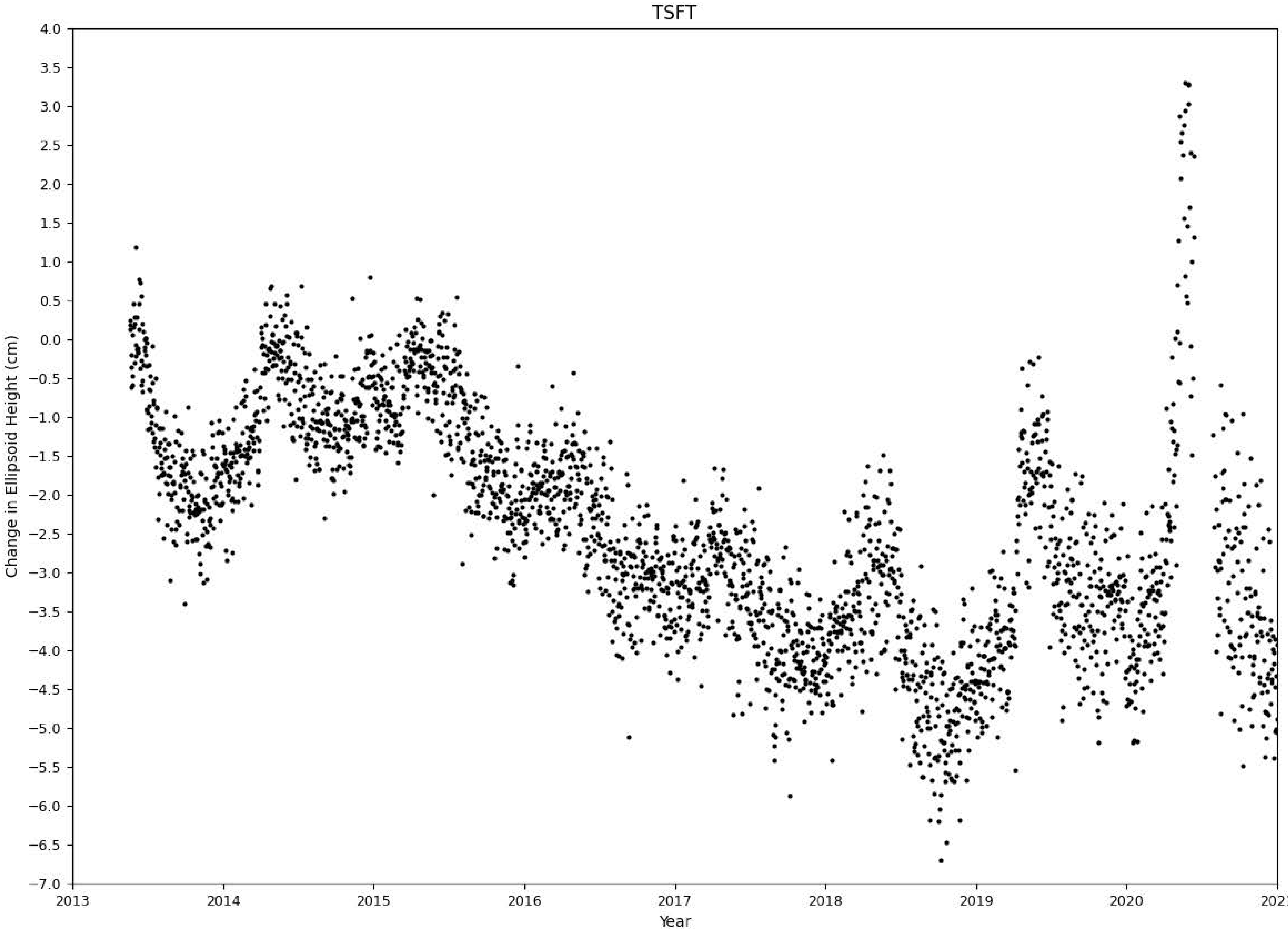

TDAM
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
2013
2014
2015
2016
2017
2018
2019
2020
2021



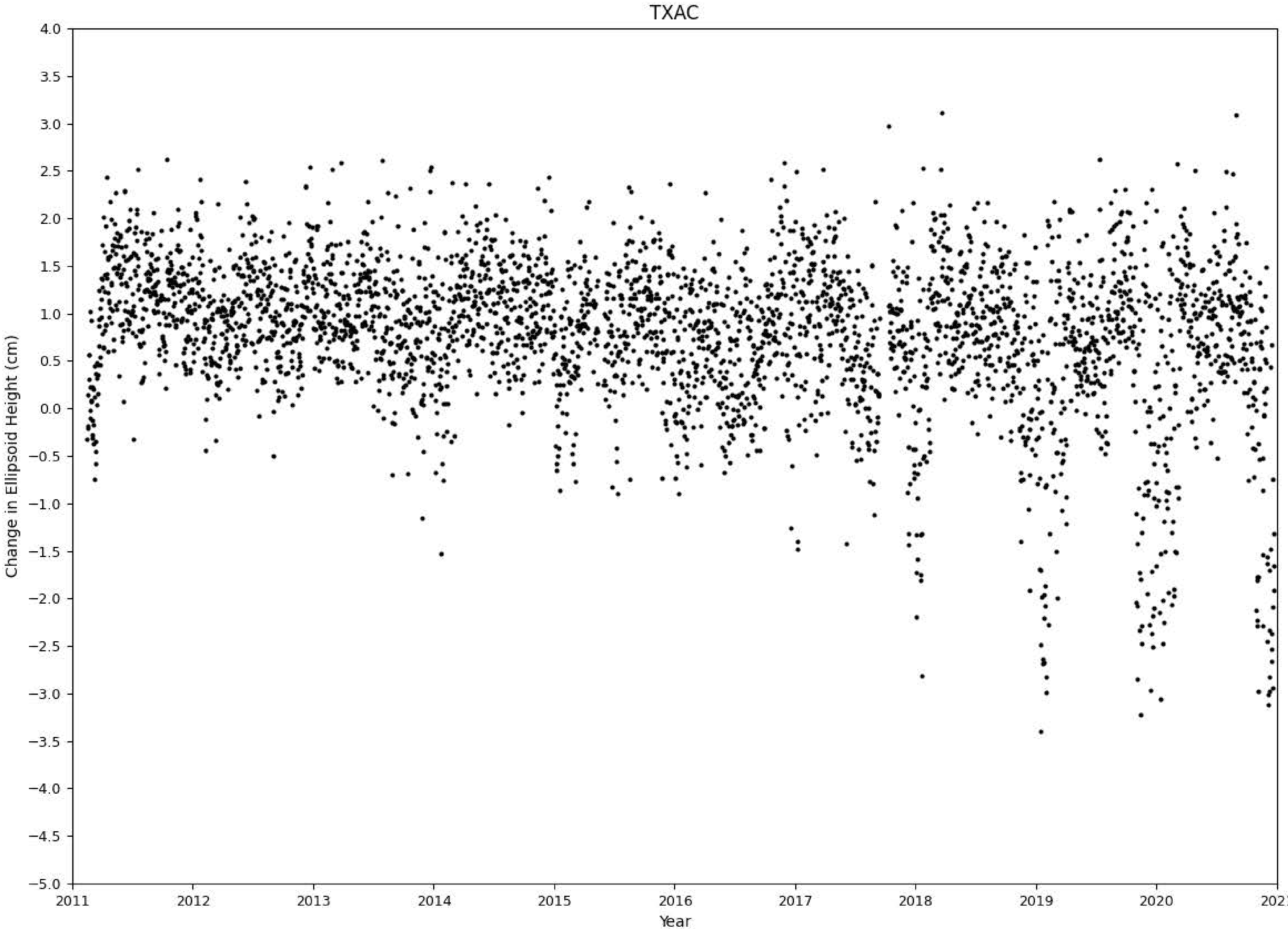
THSU
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021



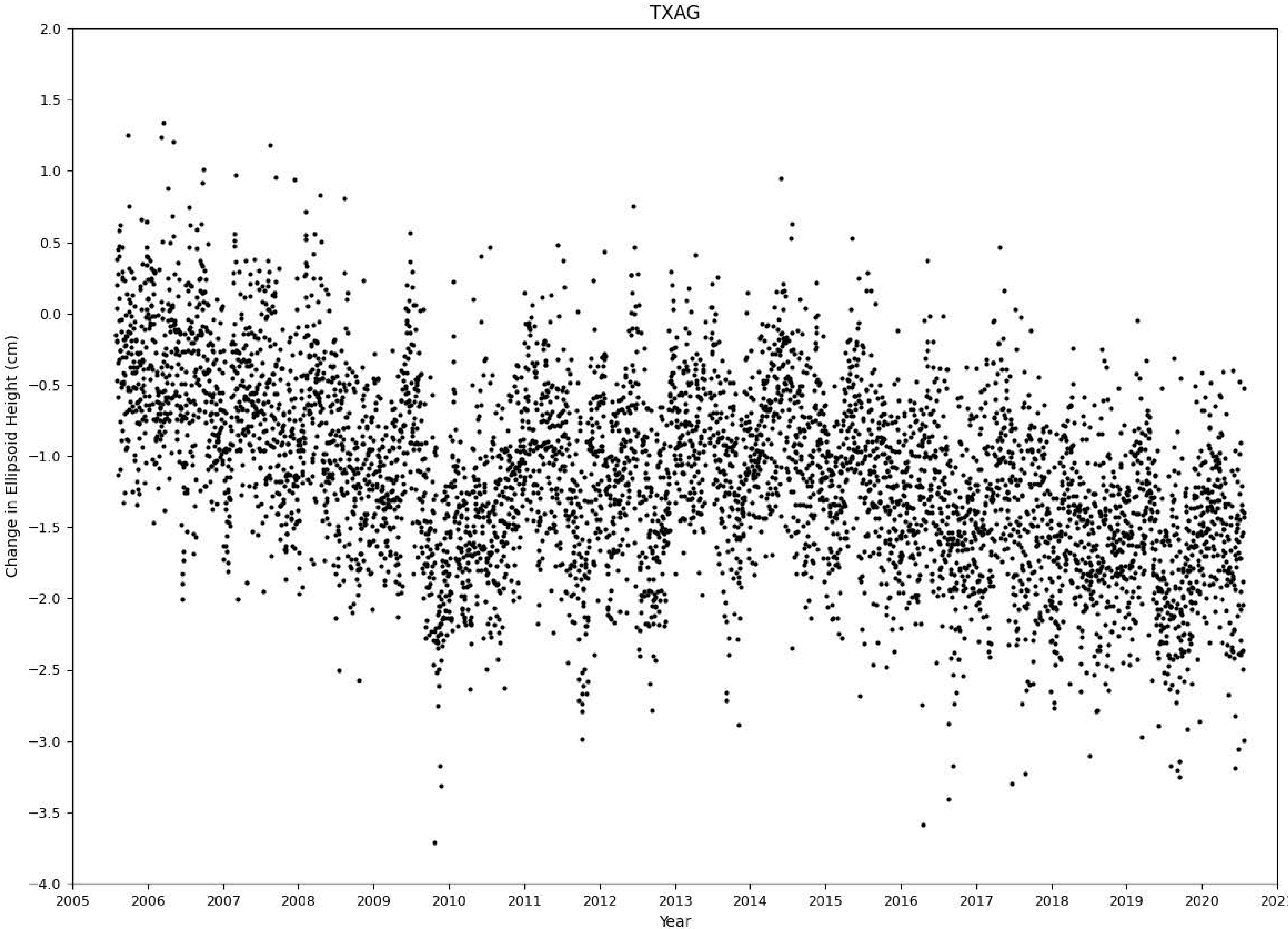
TMCC
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021



TSFT
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
2013
2014
2015
2016
2017
2018
2019
2020
2021



TXAC
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021



TXAG
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2005
2006
2007
2008
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2012
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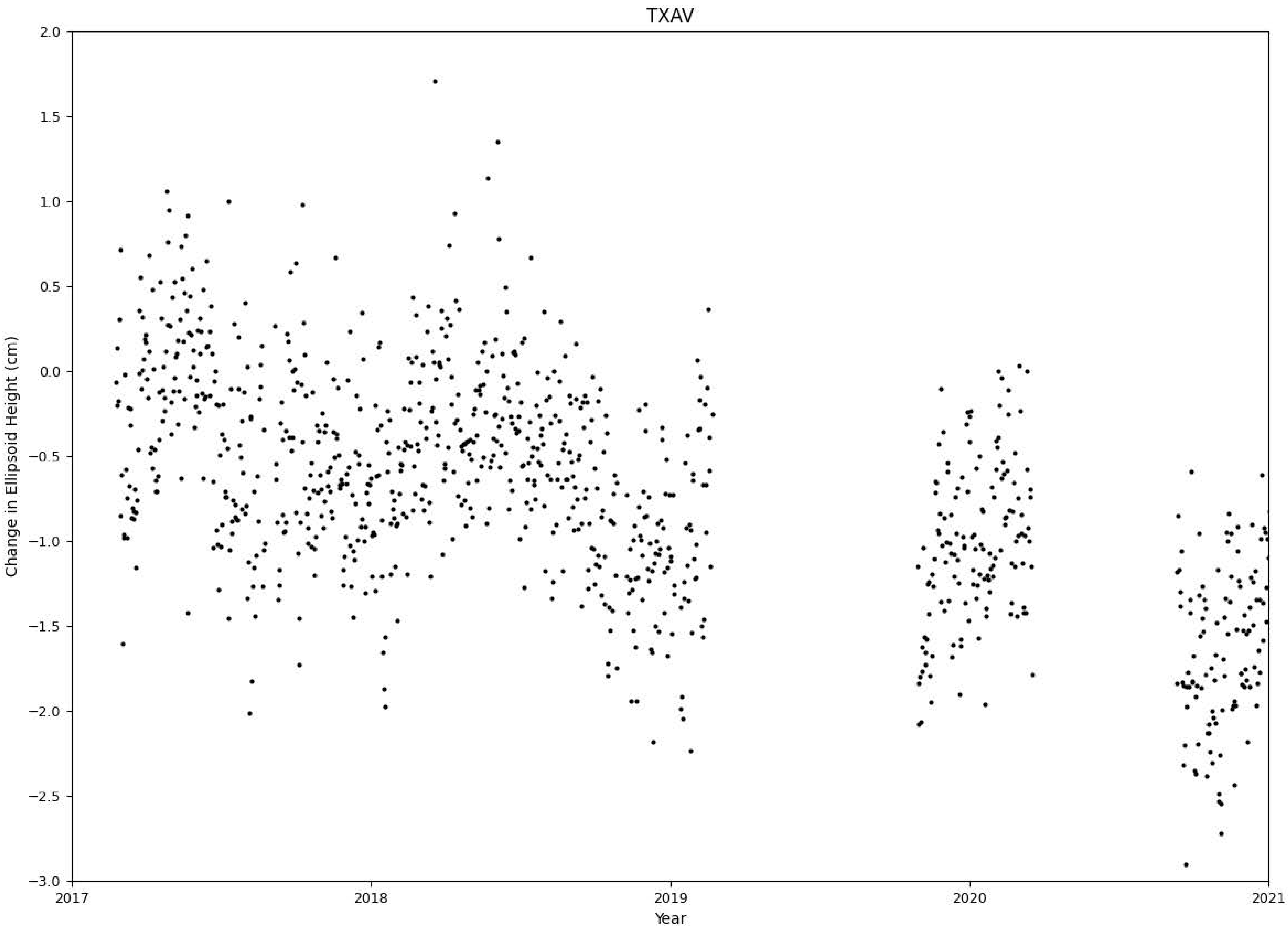
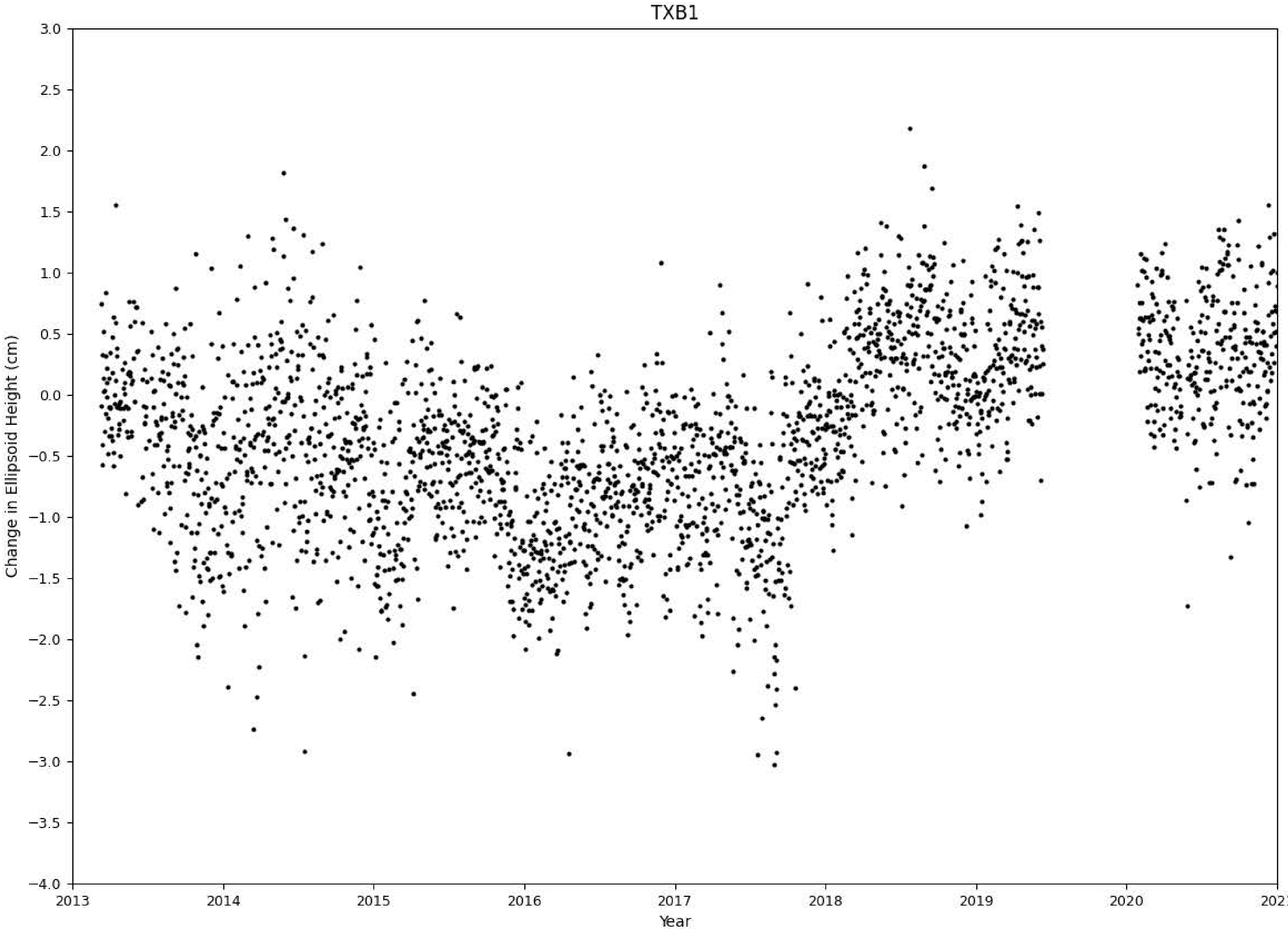
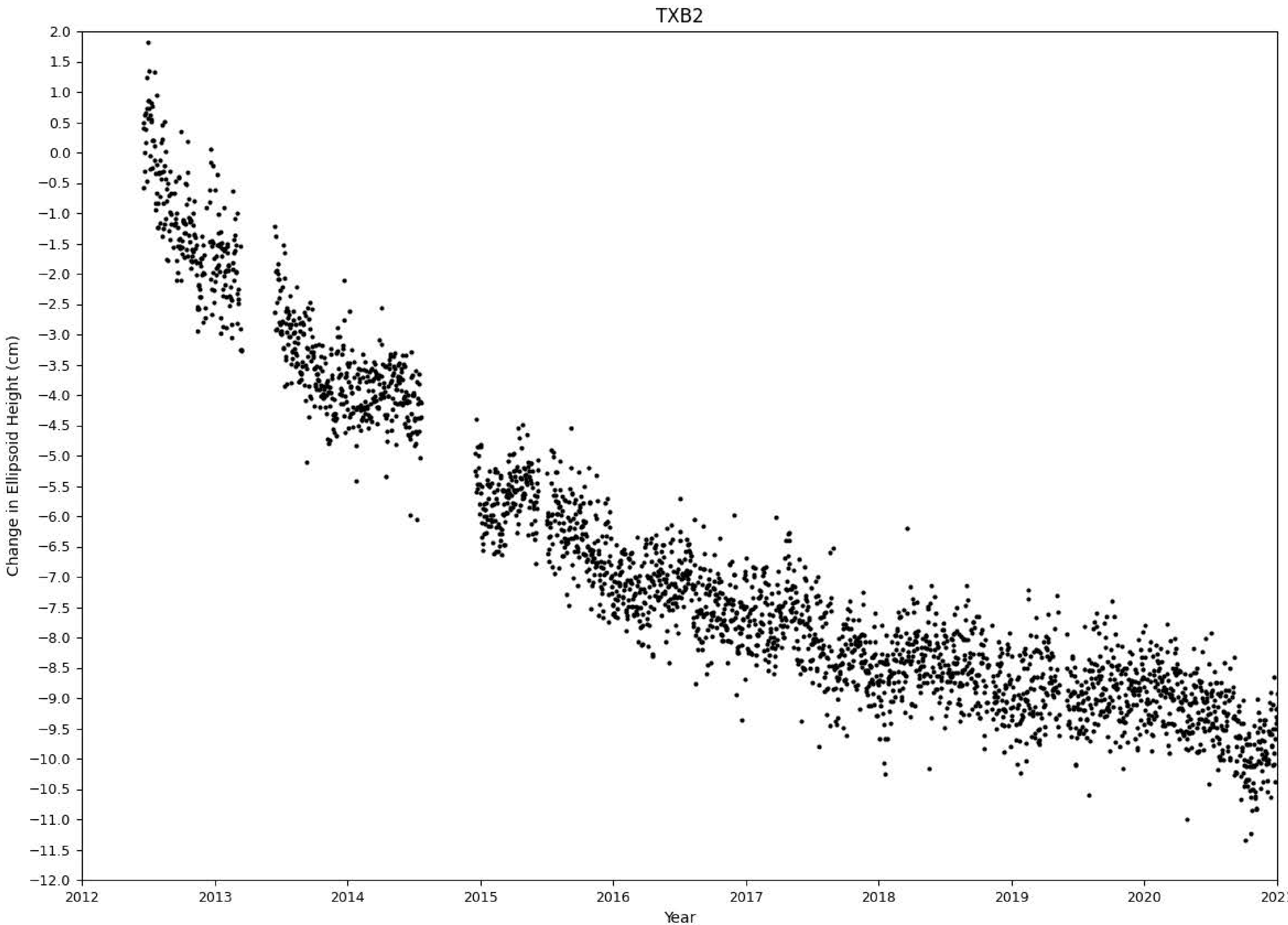
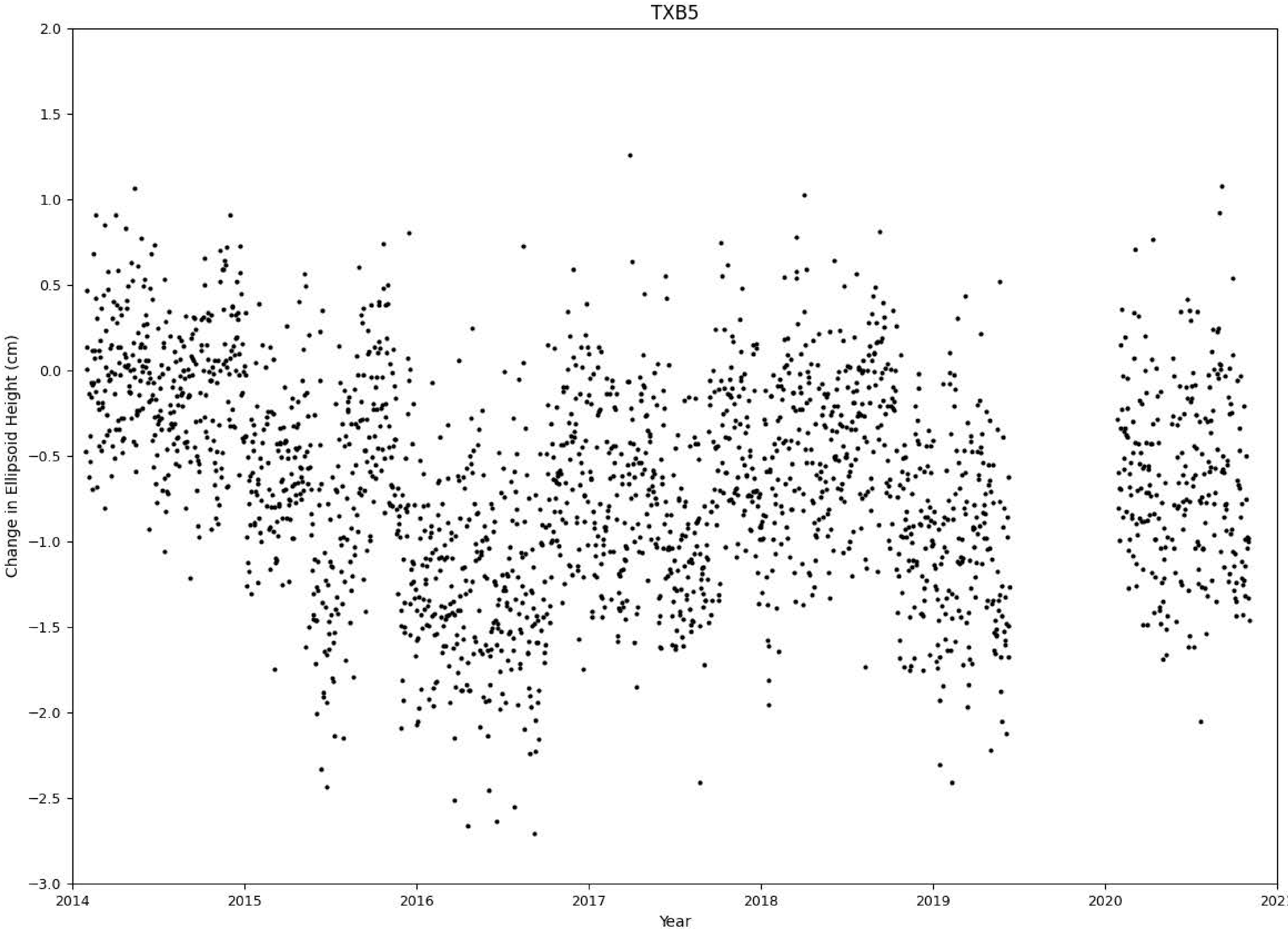
2018
2019
2020
2021


TXAV
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
2017
2018
2019
2020
2021
Year

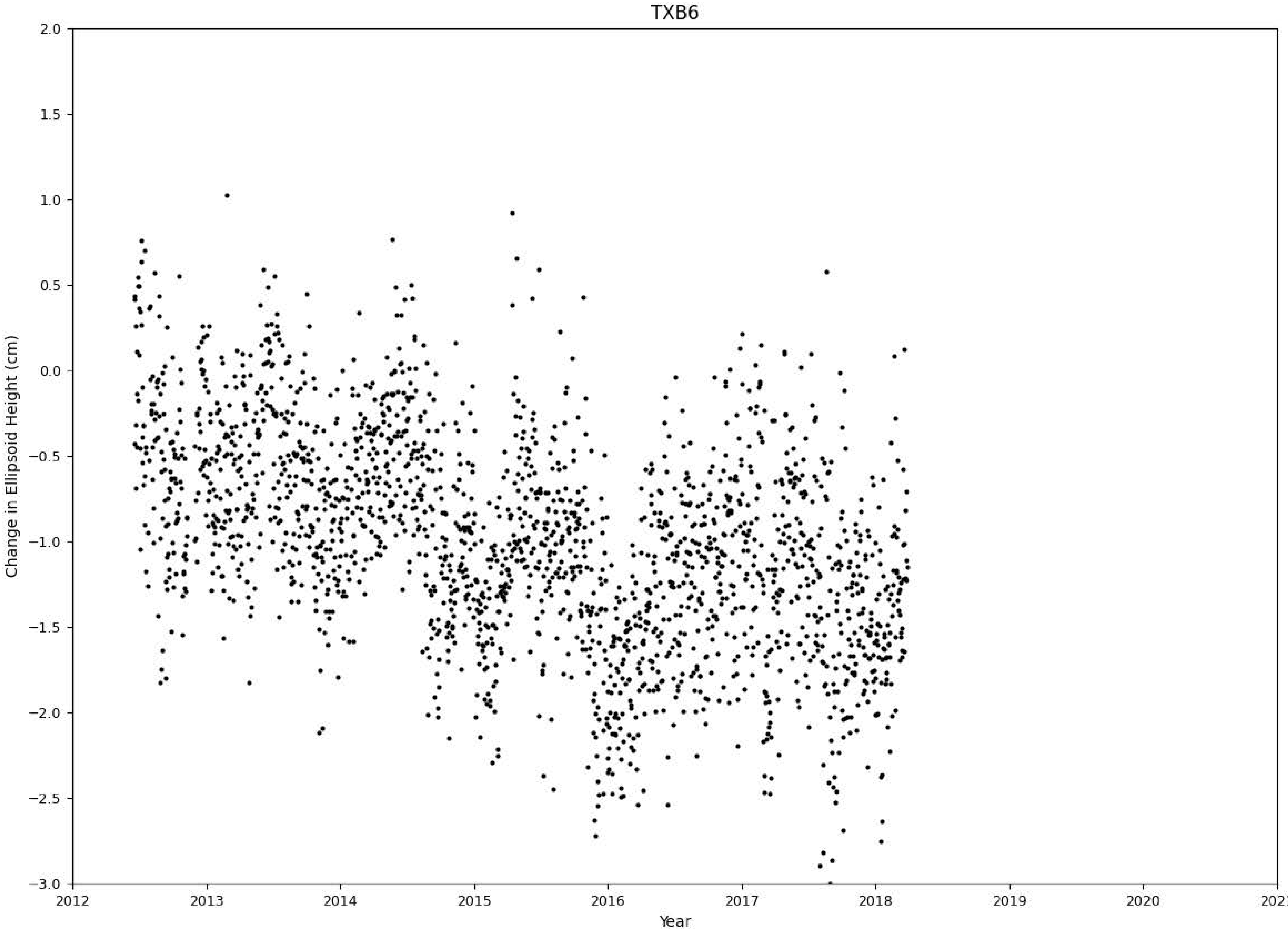


TXB1
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2013
2014
2015
2016
2017
2018
2019
2020
2021

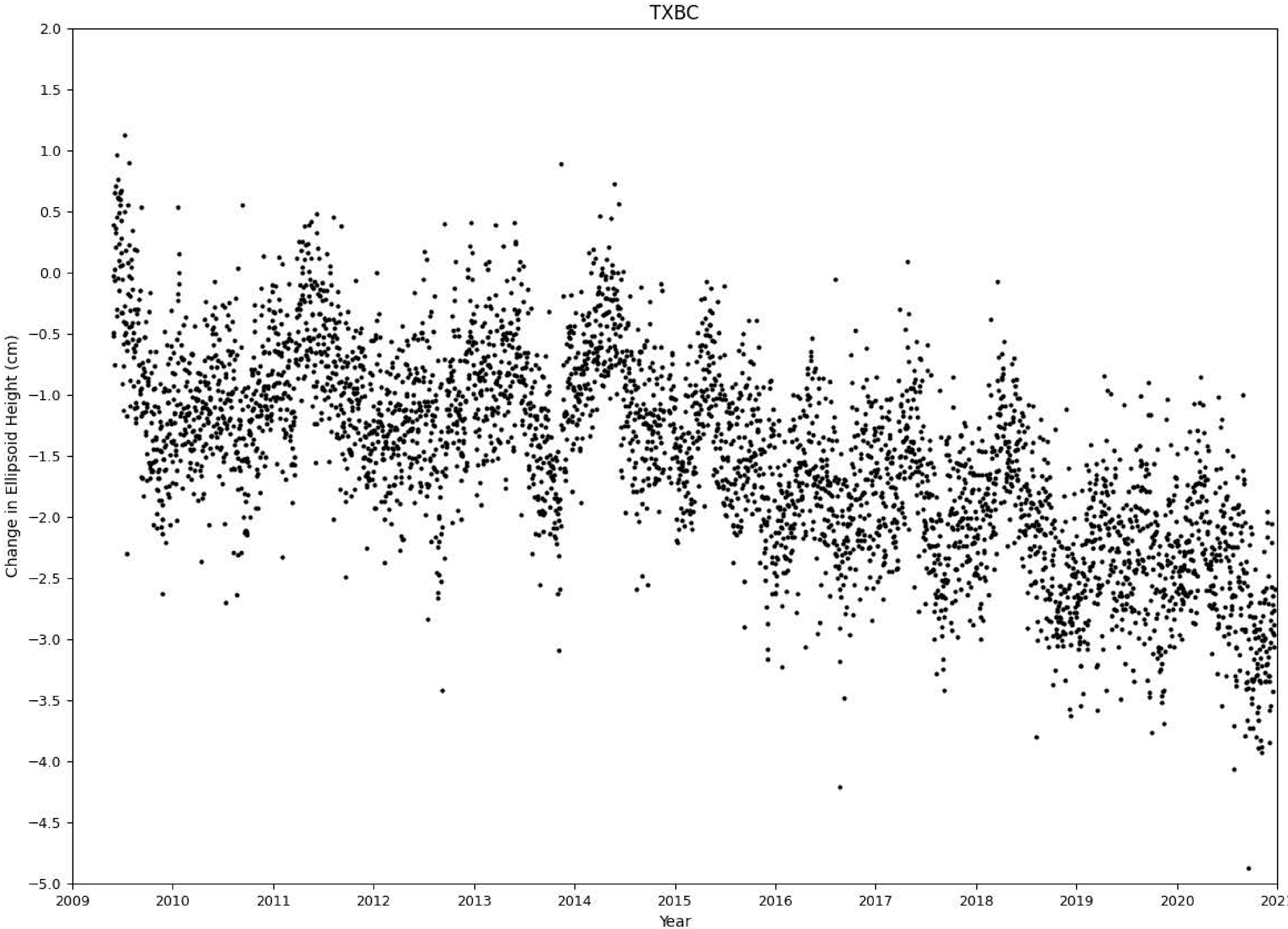

TXB2
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
-10.5
-11.0
-11.5
-12.0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

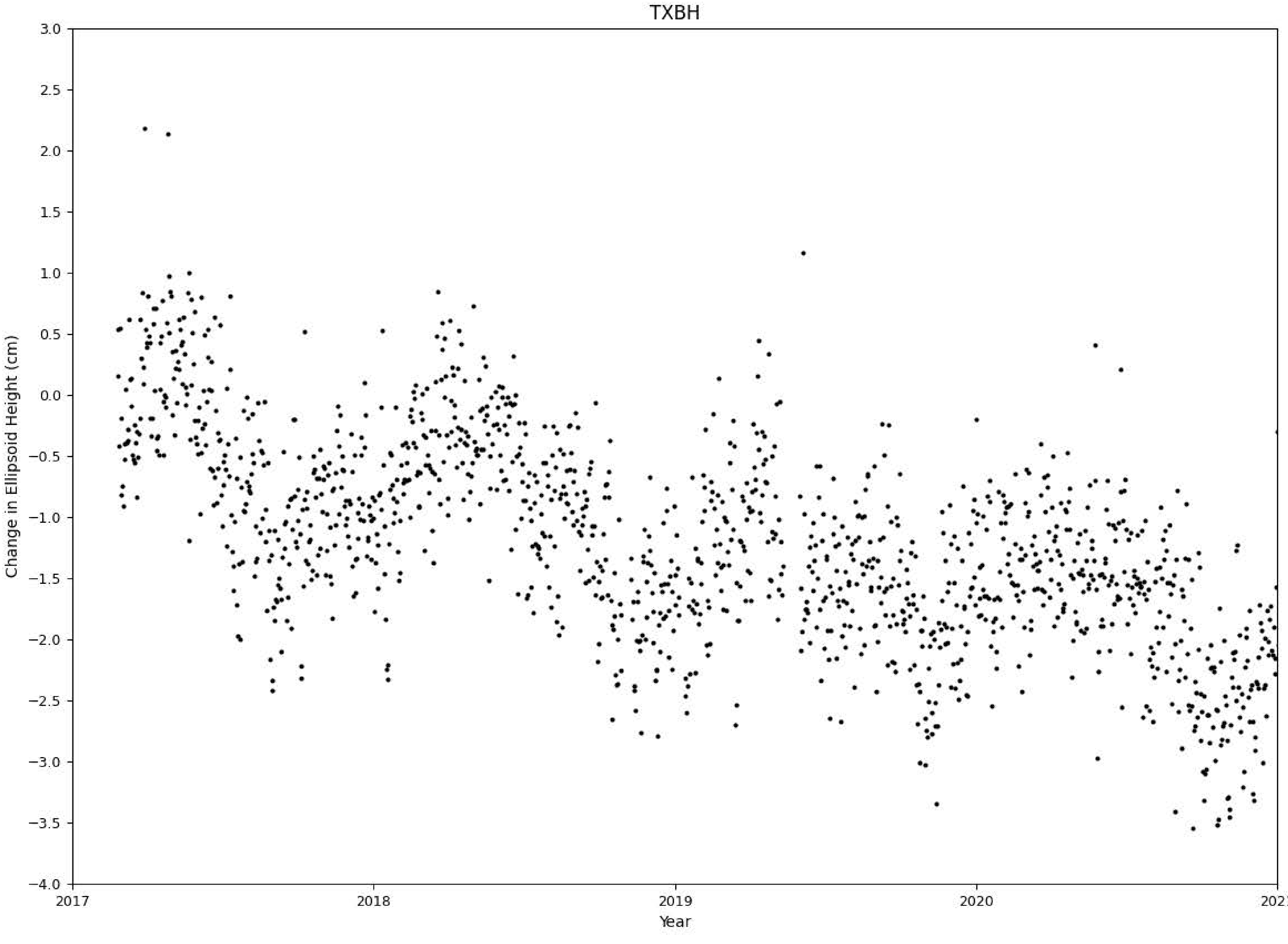


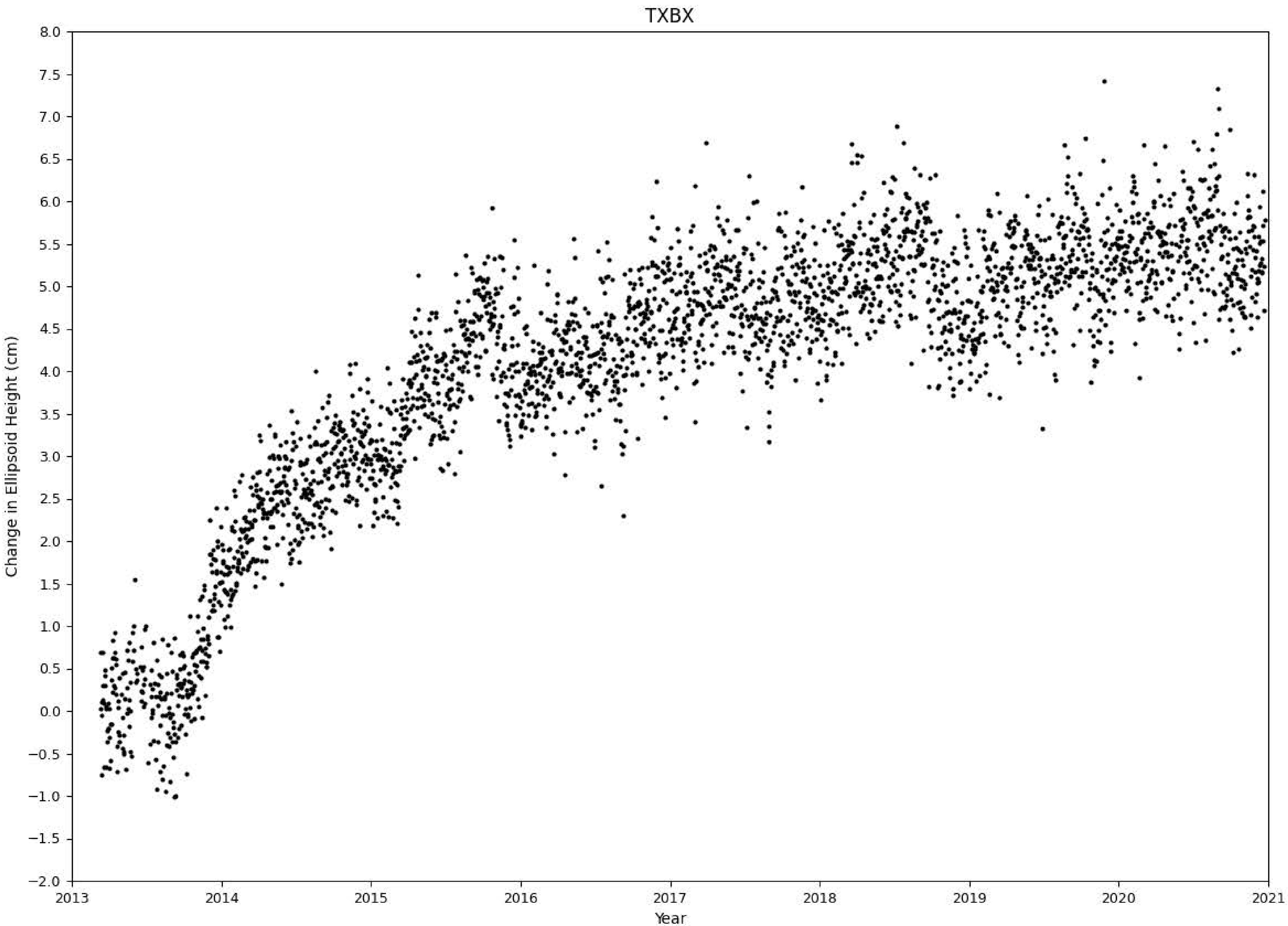
TXB5
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2014
2015
2016
2017
2018
2019
2020
2021

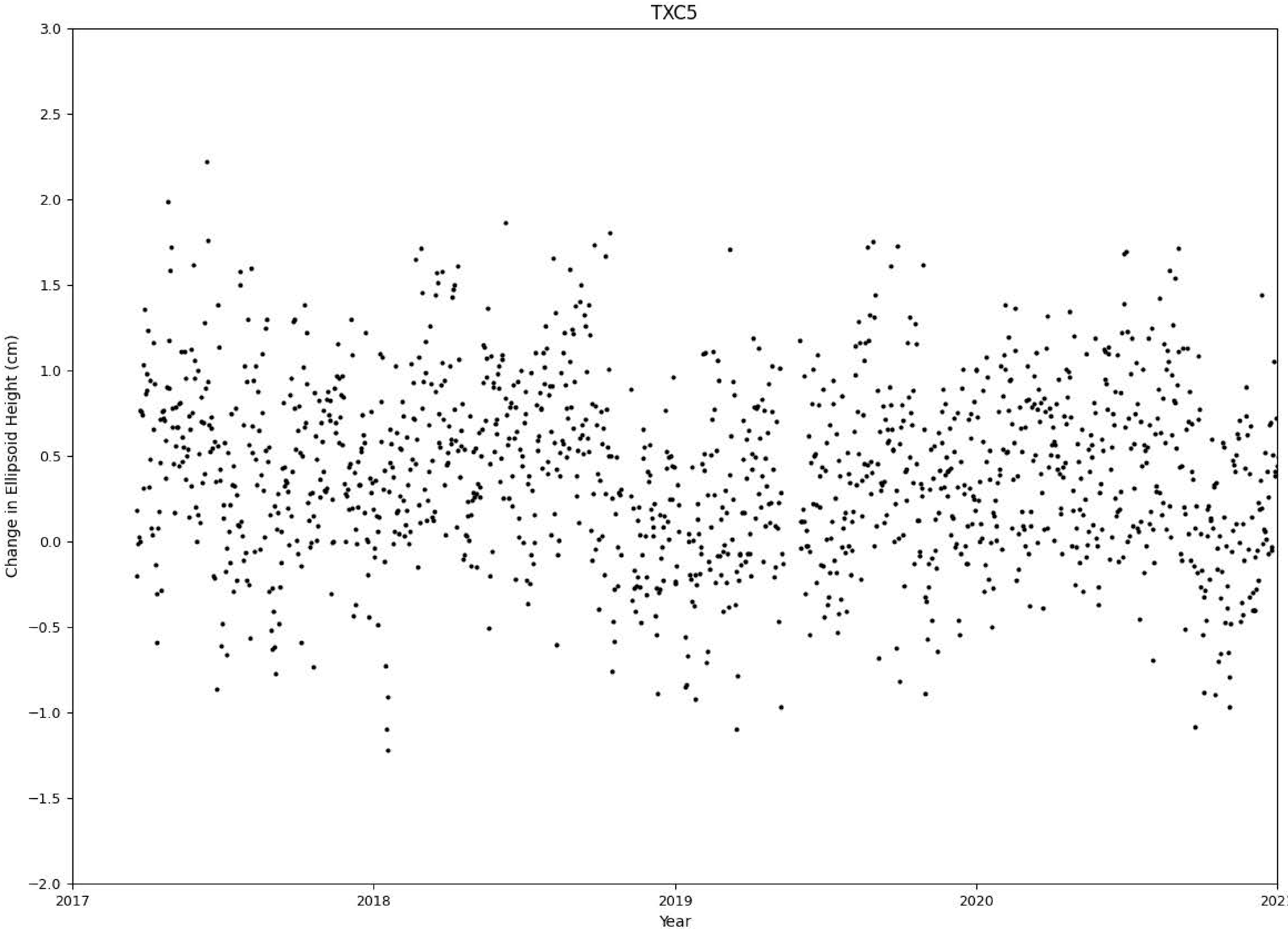


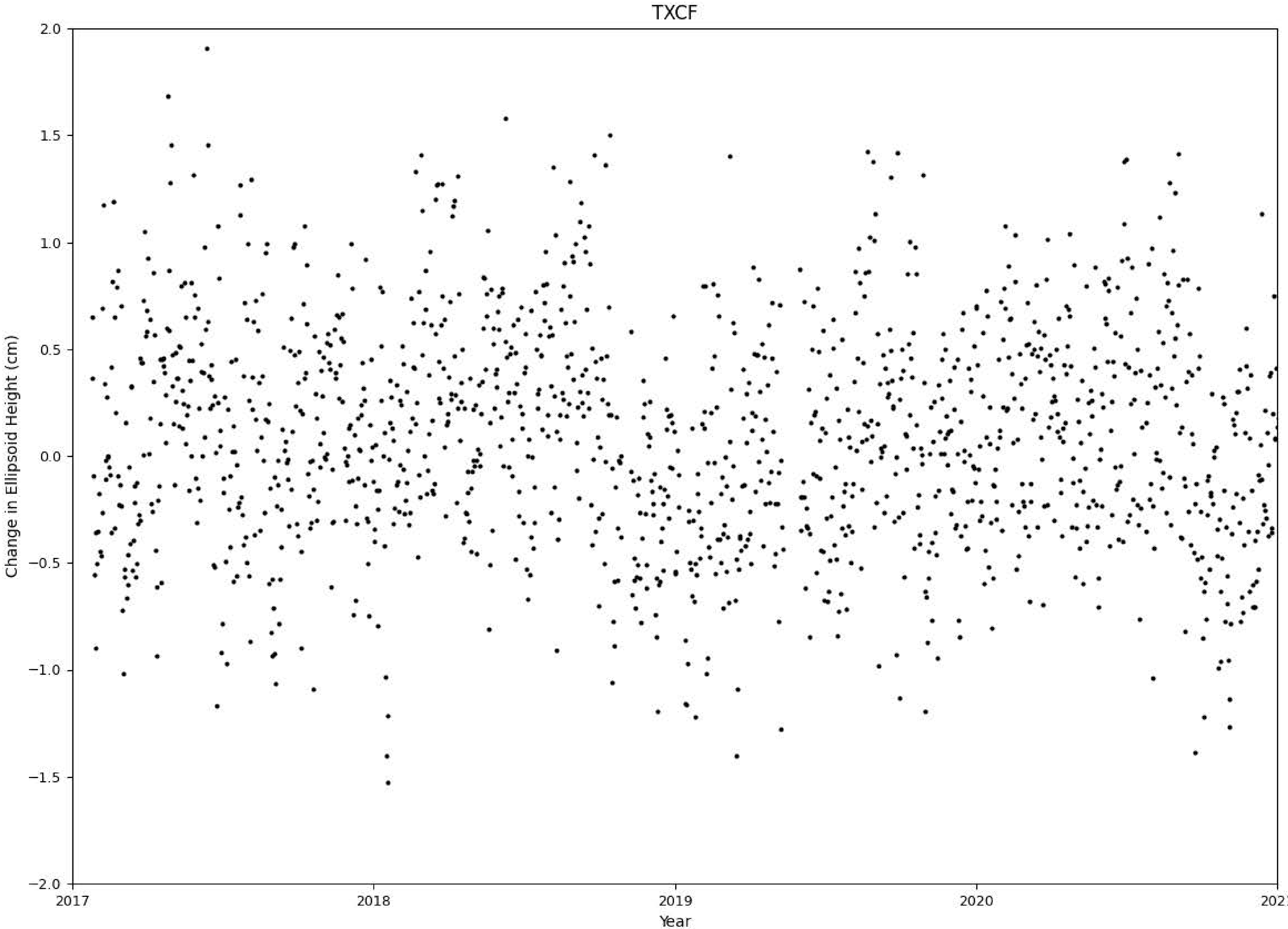
TXB6
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


TXBC
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
Change in Ellipsoid Height (cm)
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

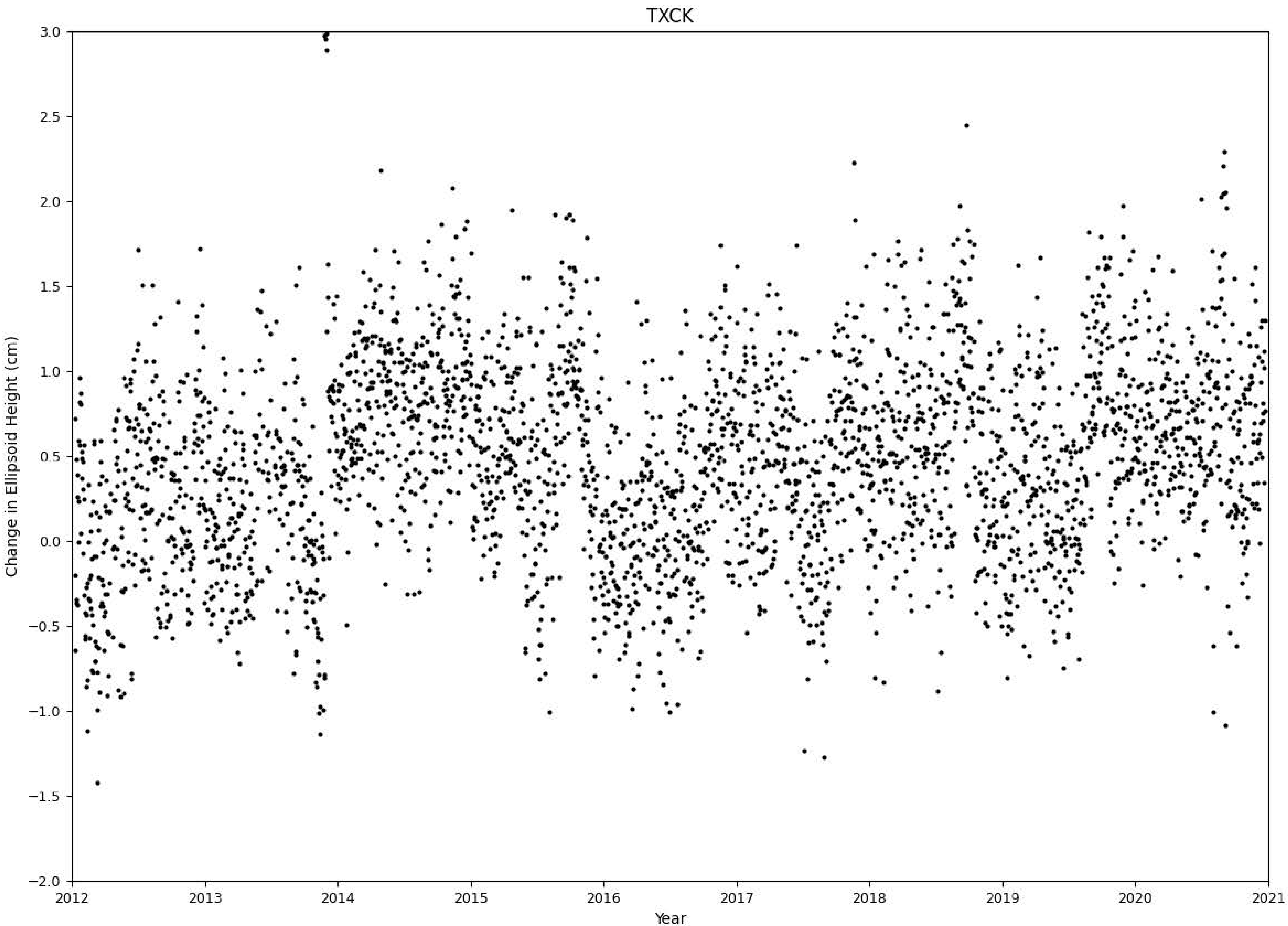

TXBH
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2017
2018
2019
2020
2021
Year

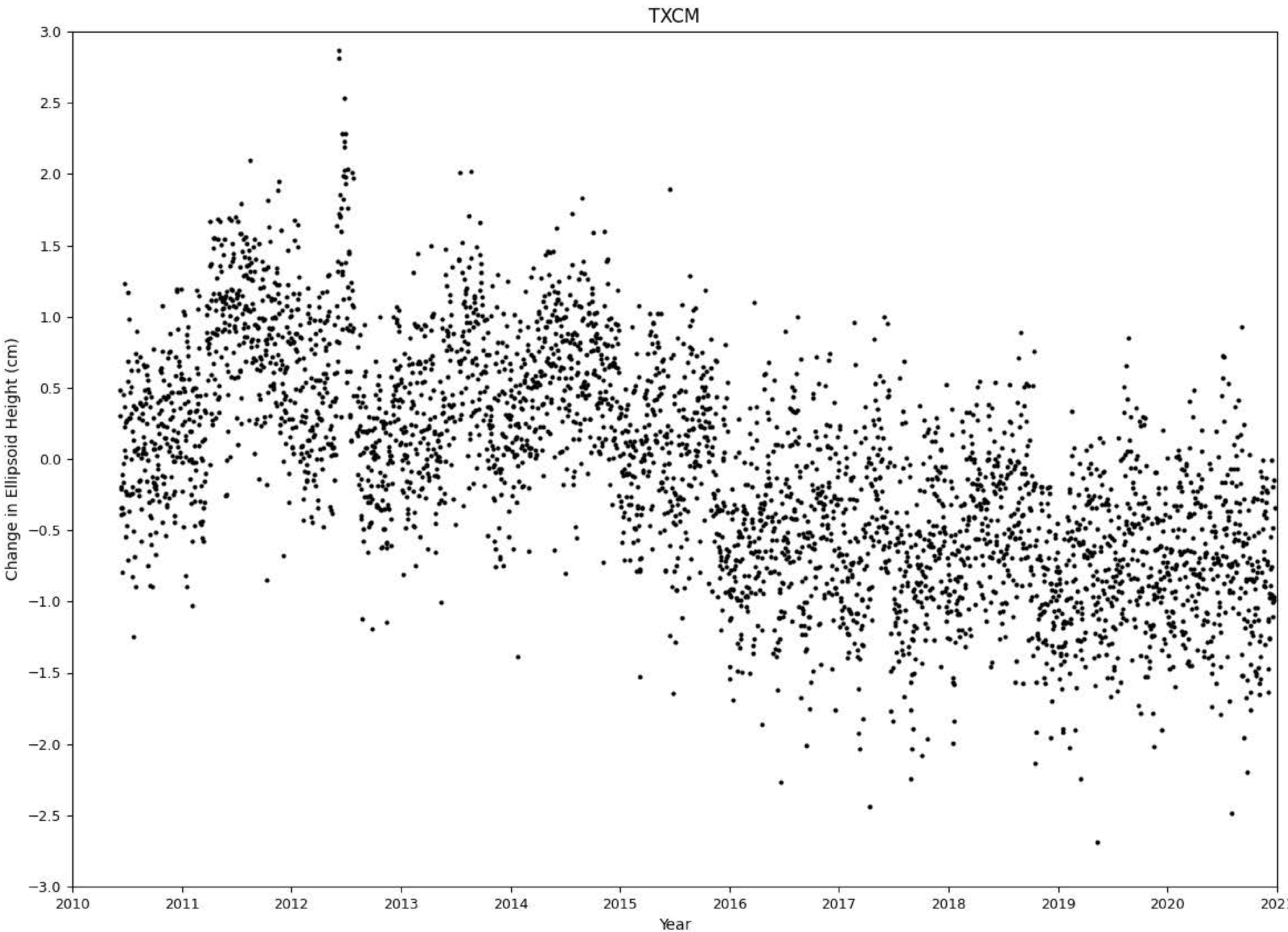

TXBX
Change in Ellipsoid Height (cm)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

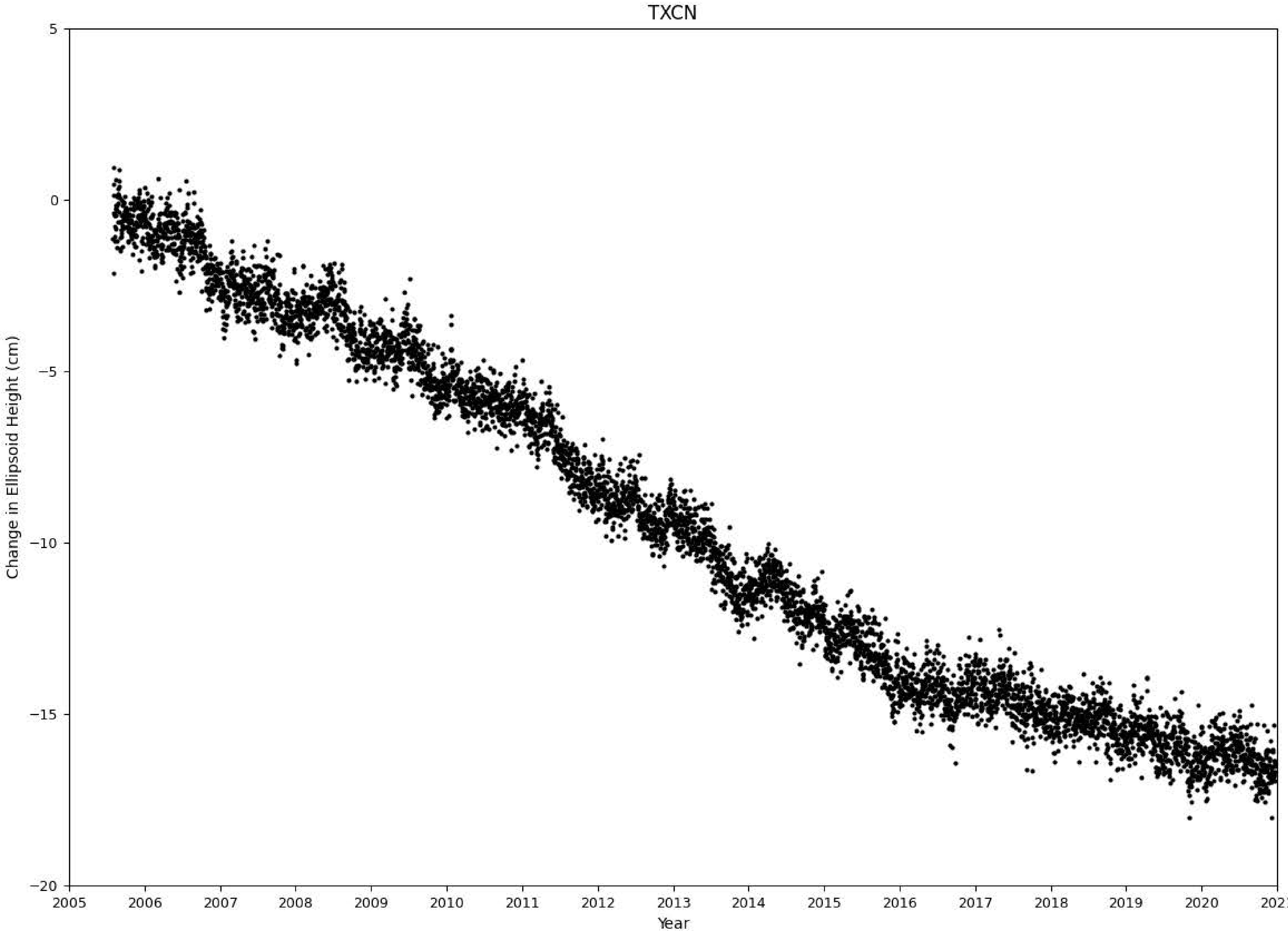

TXC5
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2017
2018
2019
2020
2021

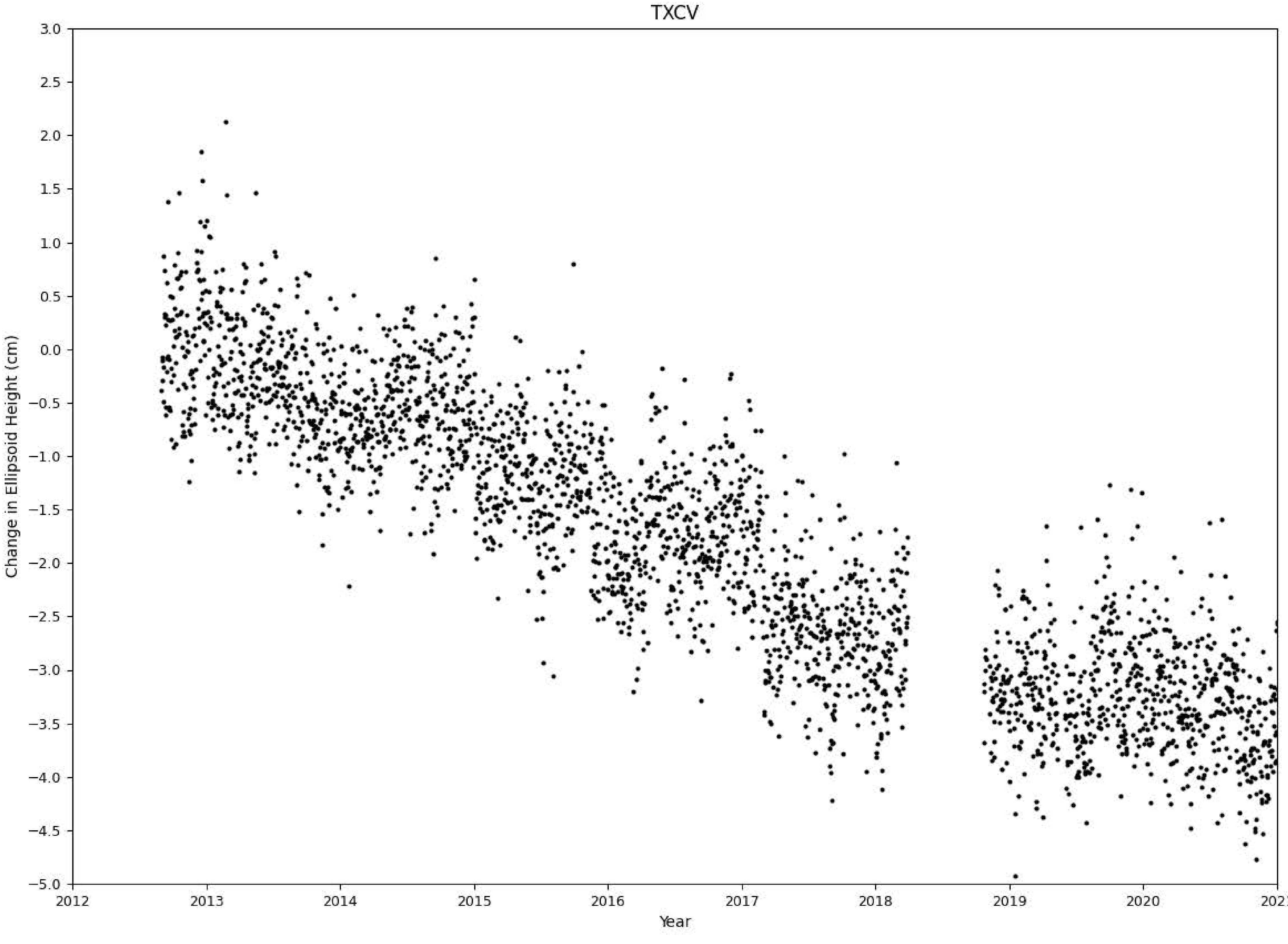


TXCF
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2017
2018
2019
2020
2021

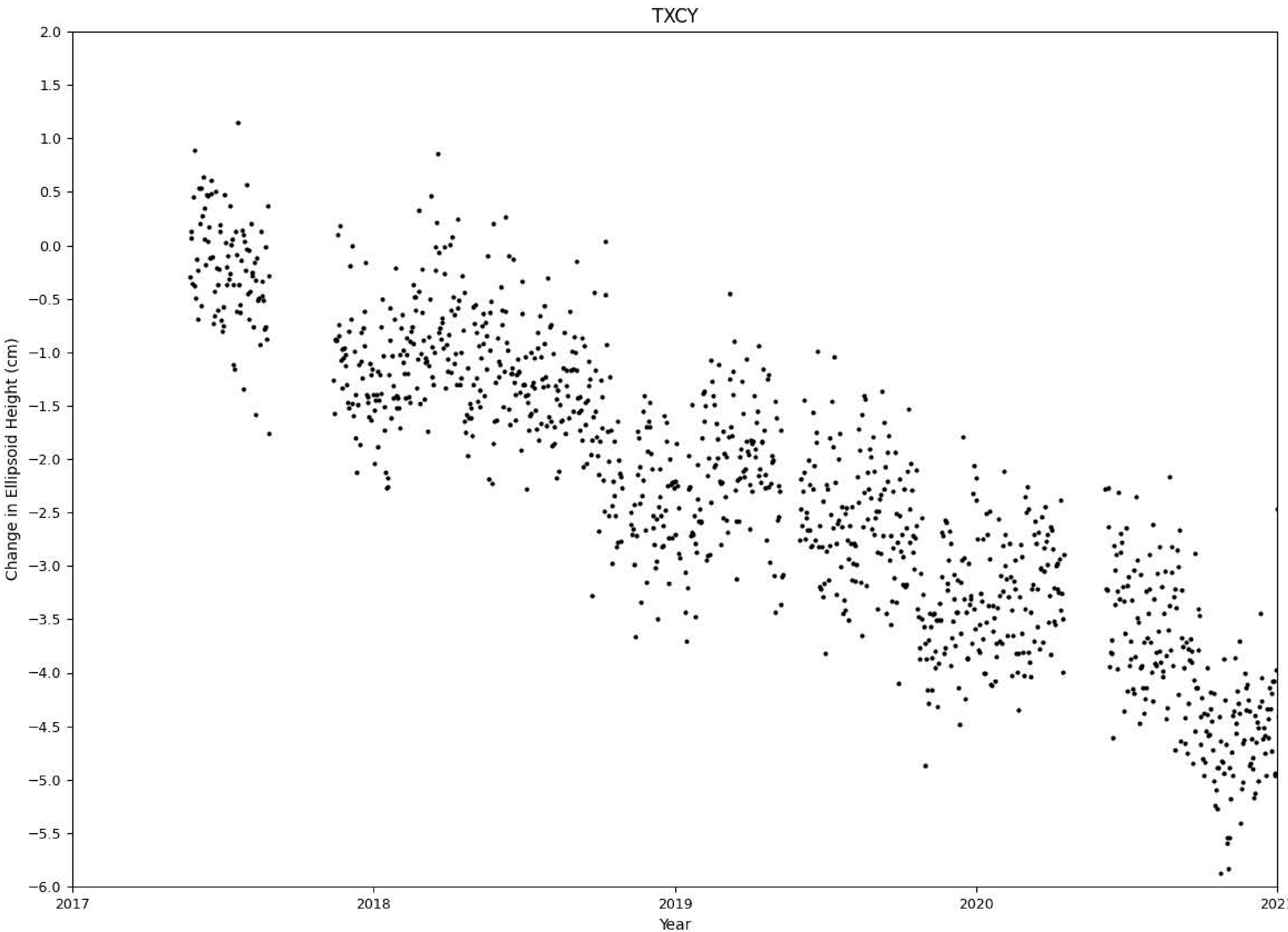

TXCK
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


TXCM
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

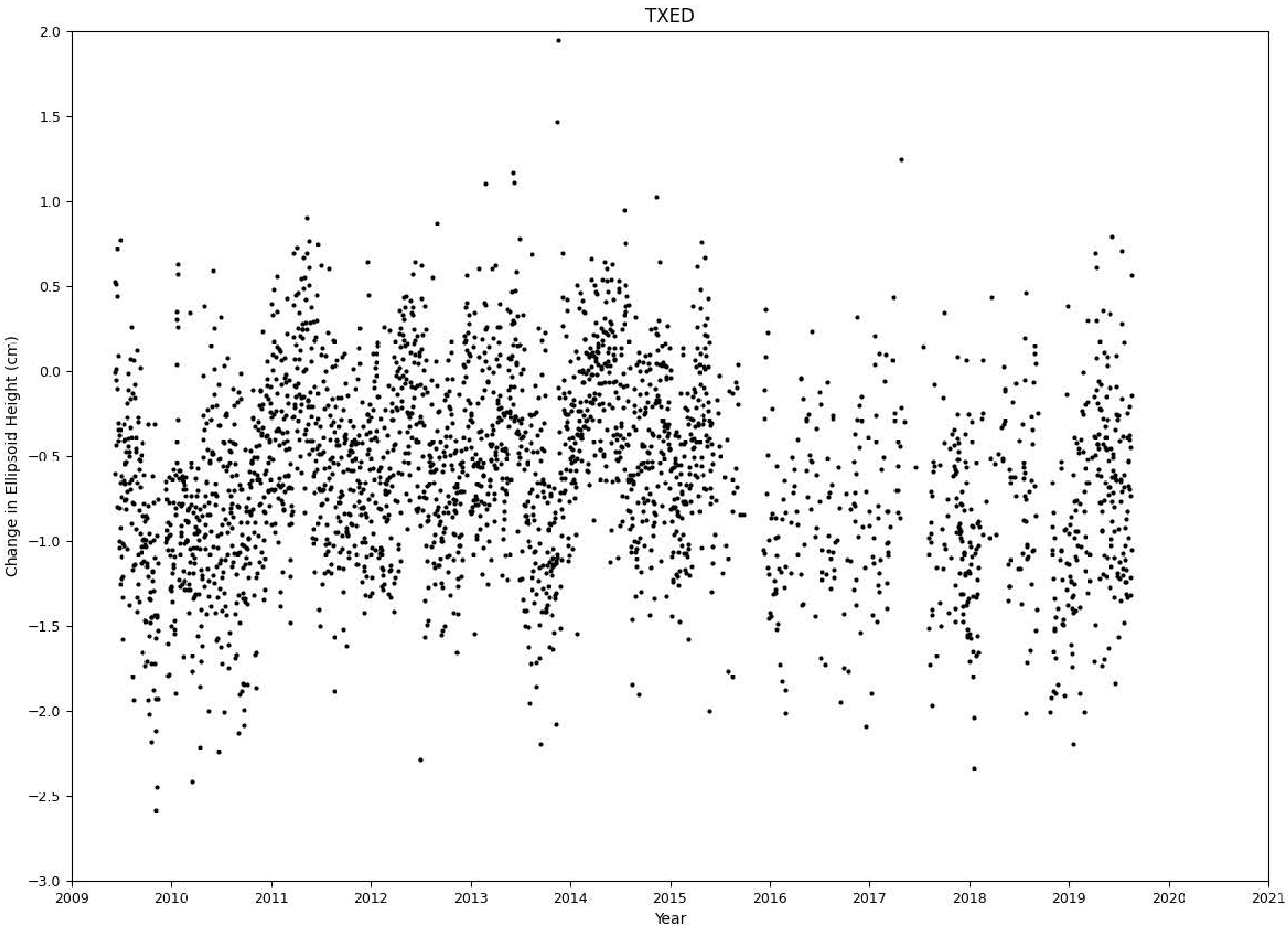

TXCN
Change in Ellipsoid Height (cm)
5
0
−5
−10
−15
−20
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year



TXCV
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
Change in Ellipsoid Height (cm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year



TXCY
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
2017
2018
2019
2020
2021
Year


TXED
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2009
2010
2011
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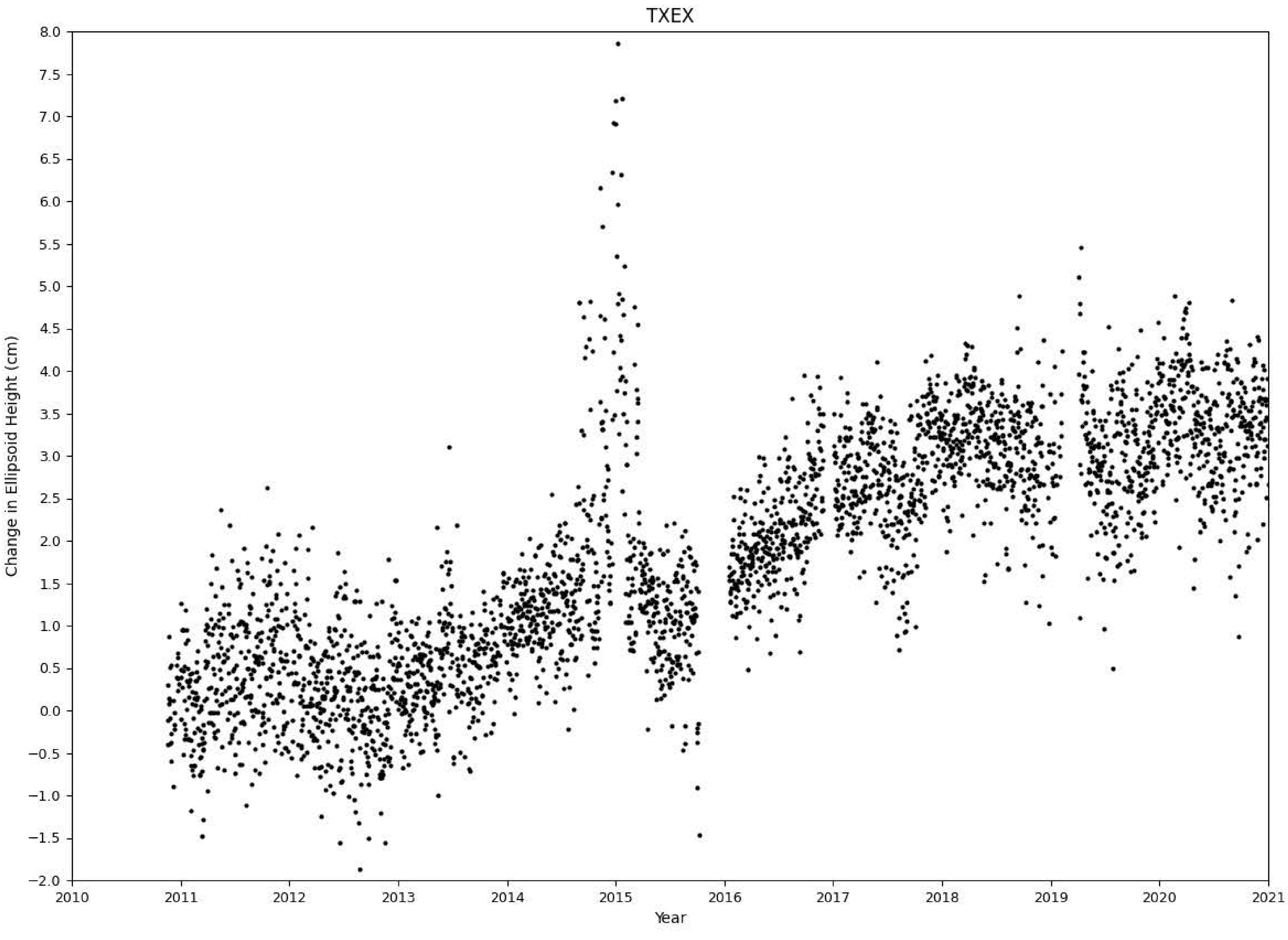
2019
2020
2021


TXEX
Change in Ellipsoid Height (cm)
Year
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2010
2011
2012
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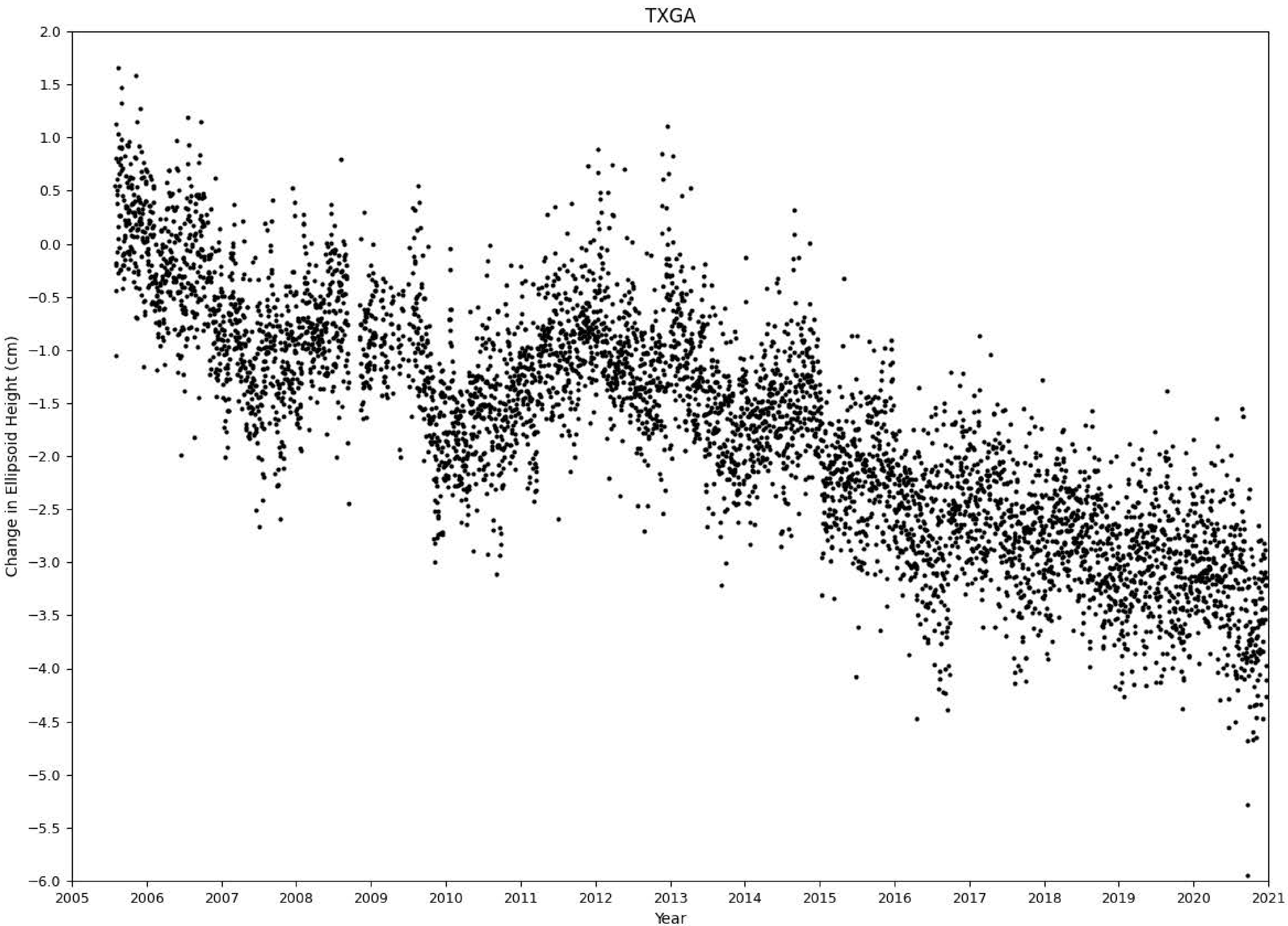
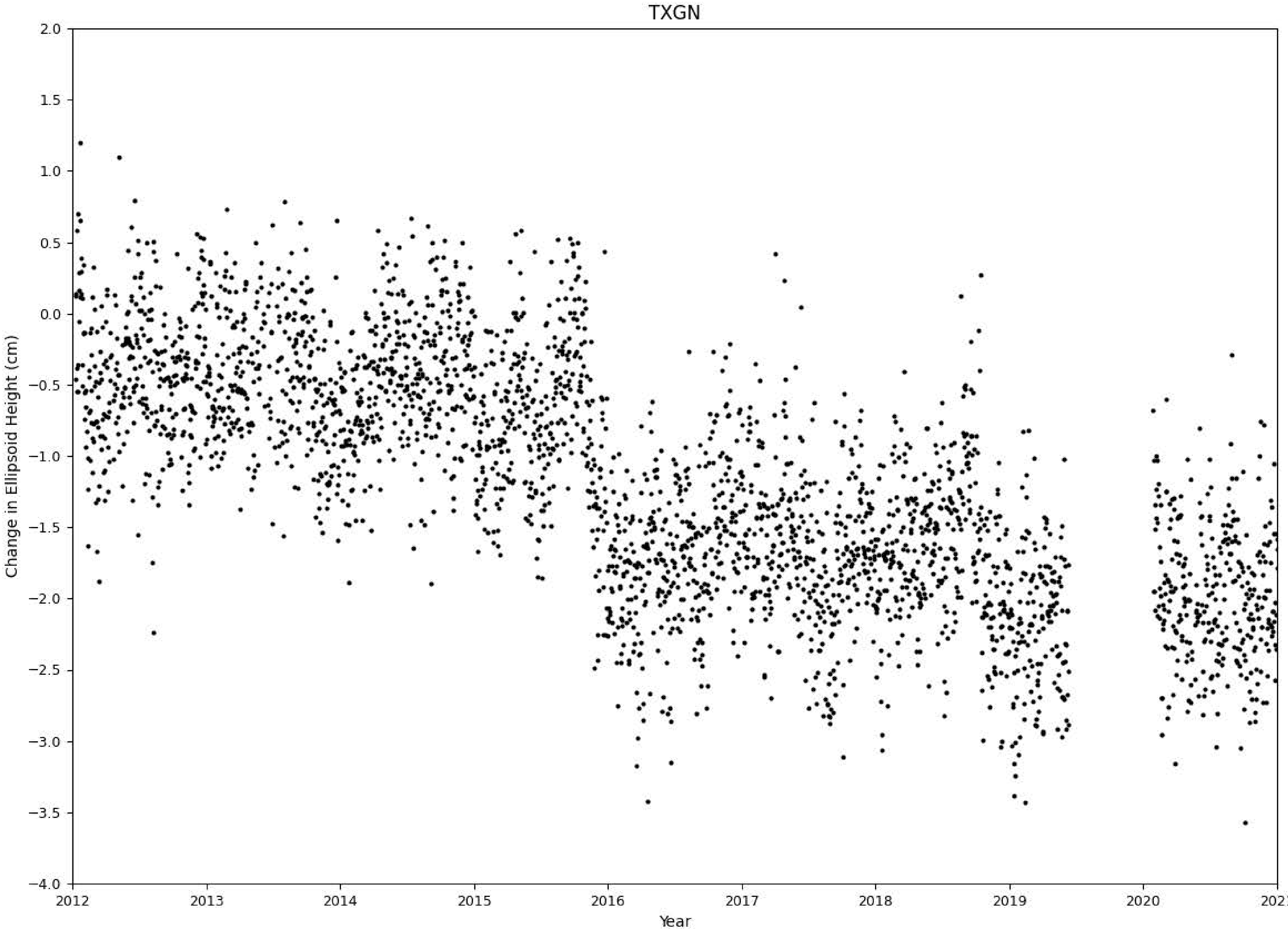
2019
2020
2021



TXGA
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
Change in Ellipsoid Height (cm)
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year



TXGN
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2012
2013
2014
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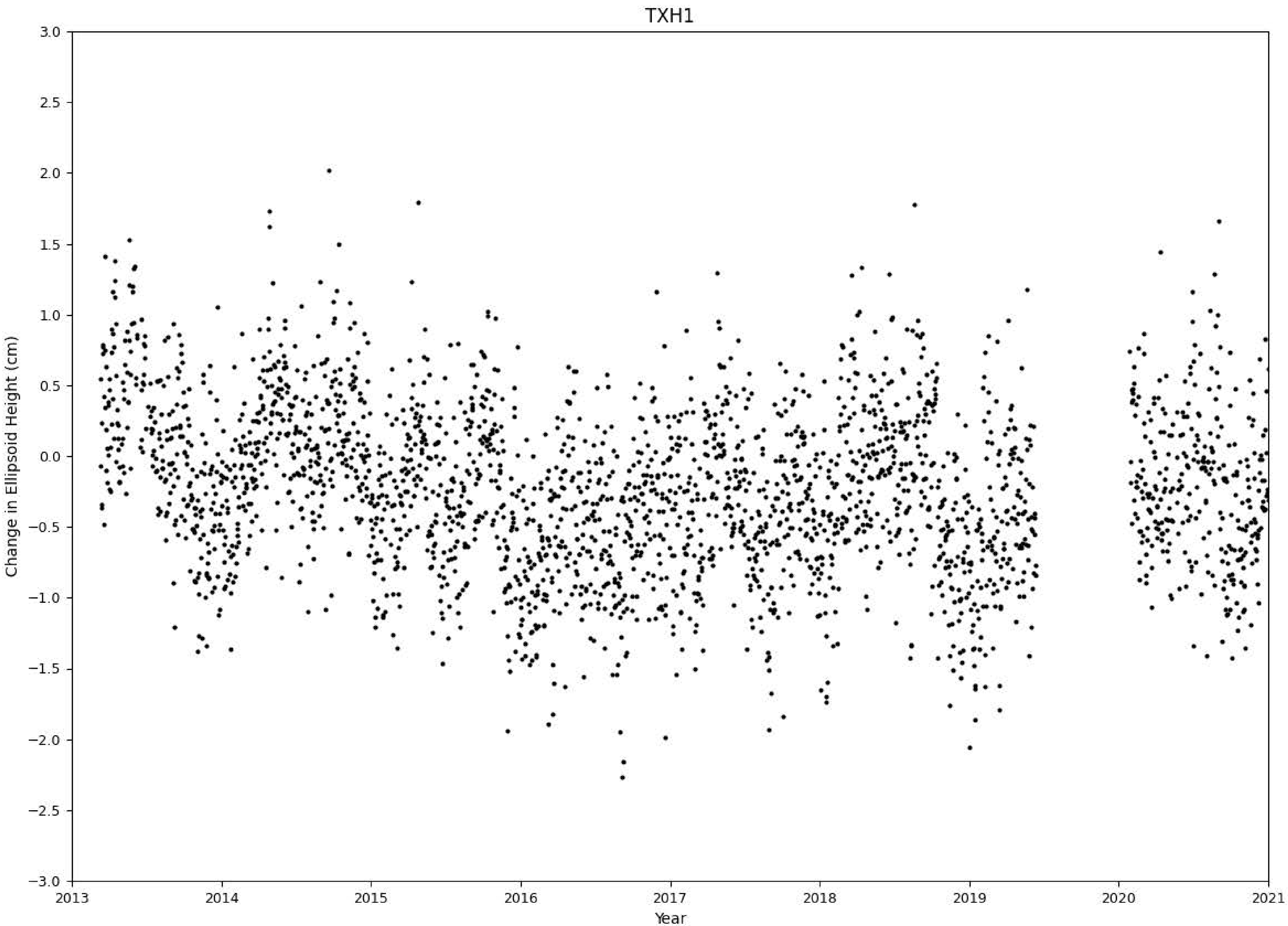
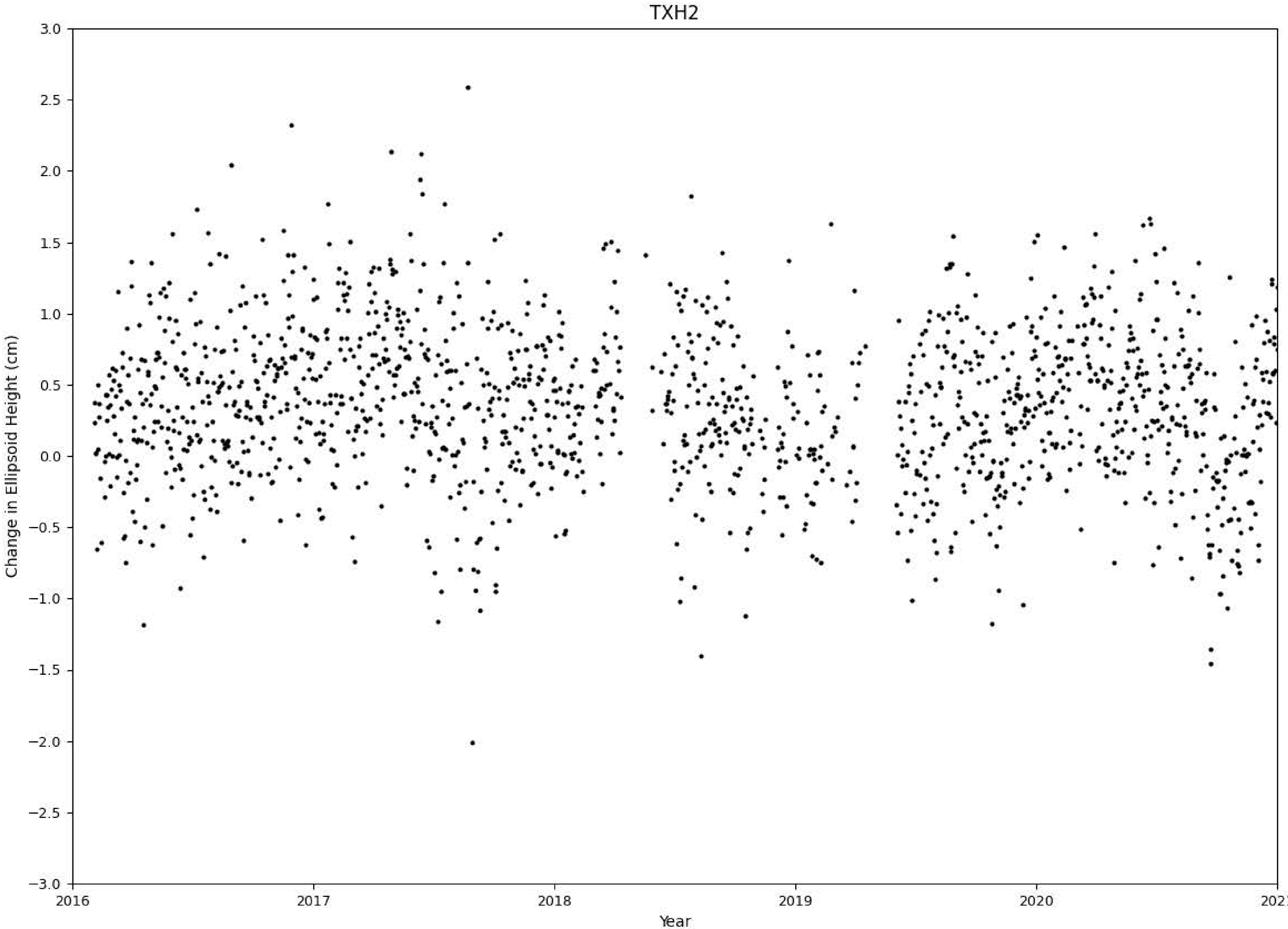
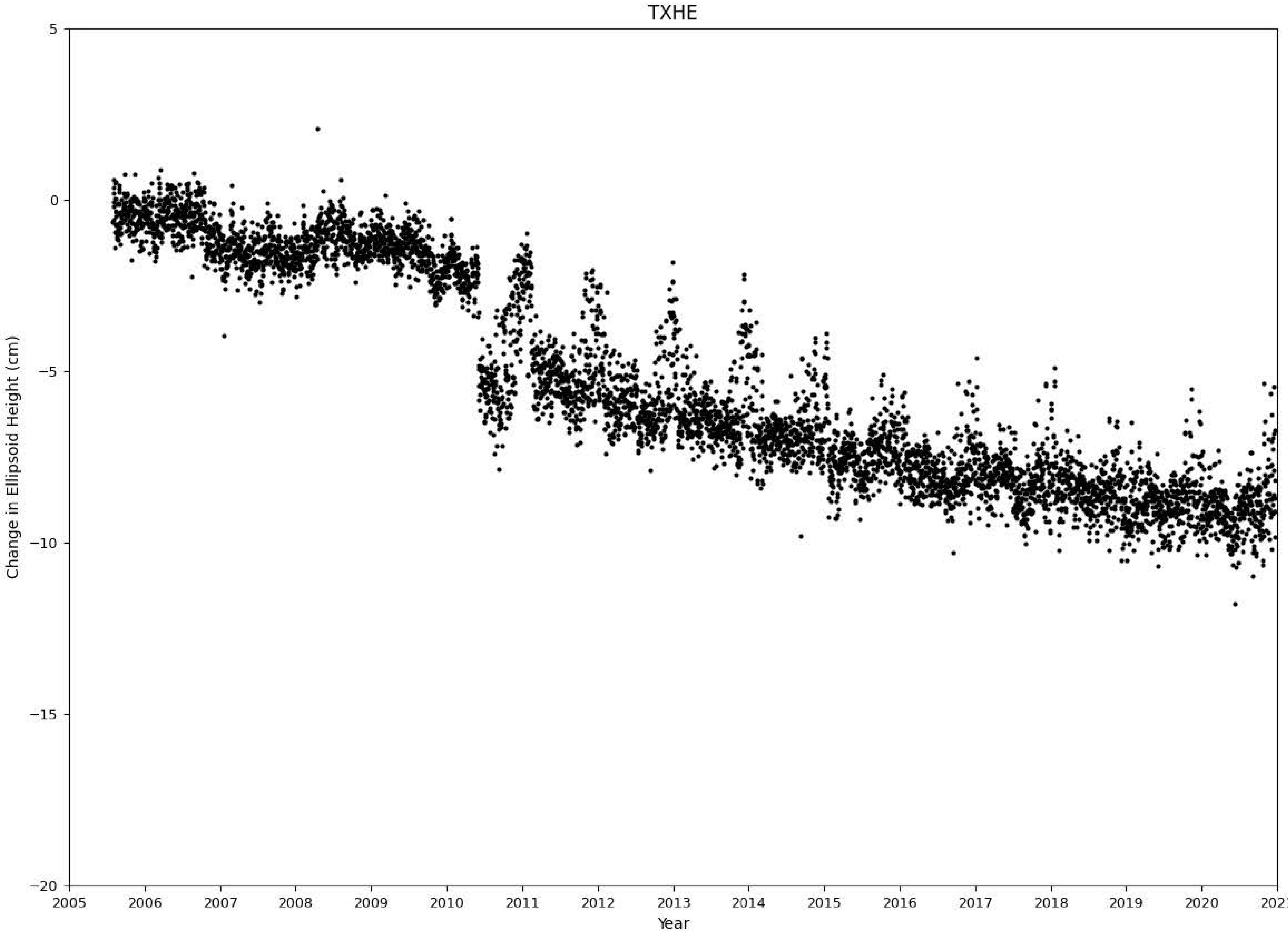
2016
2017
2018
2019
2020
2021
Year



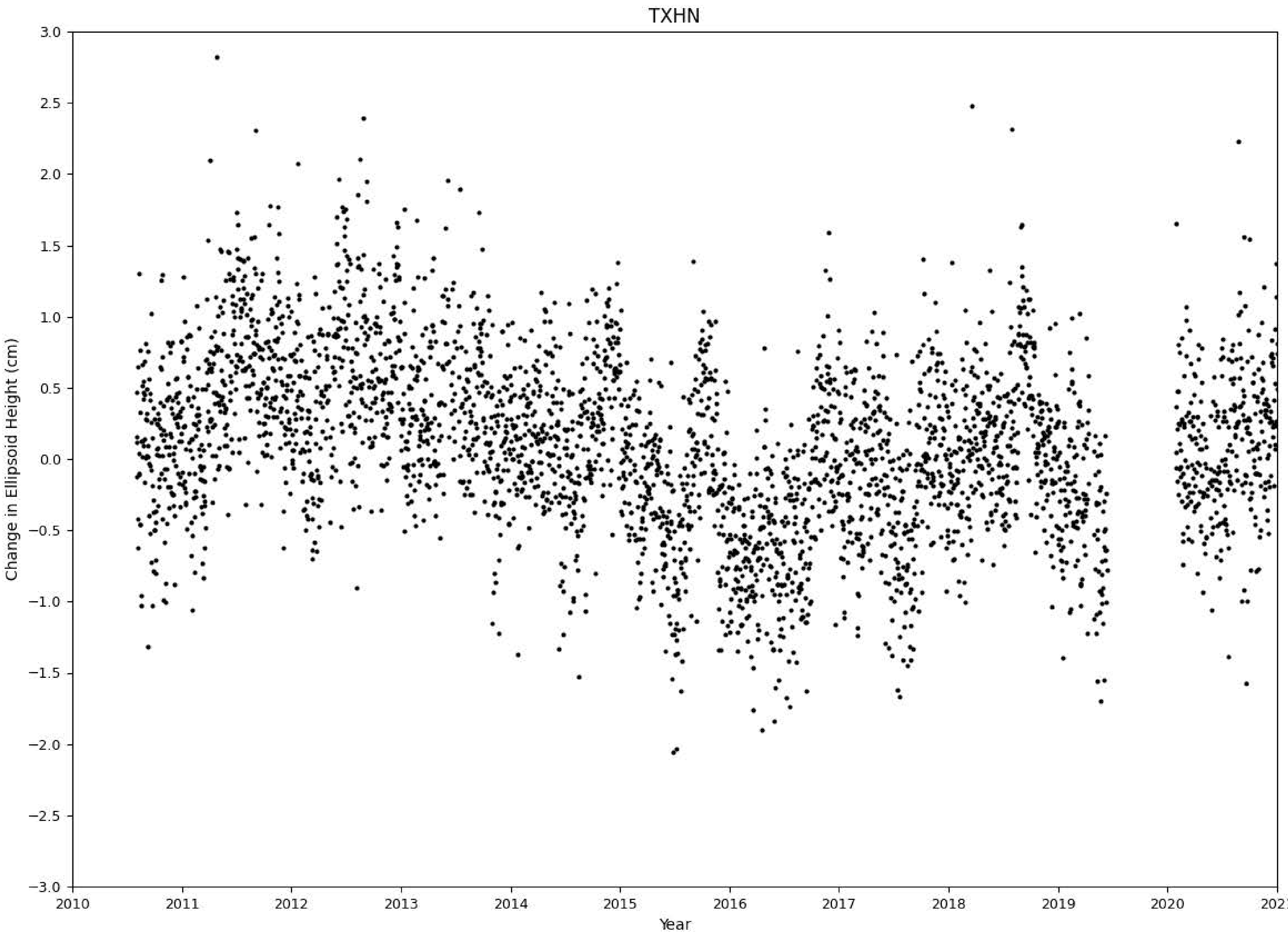
TXH1
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2013
2014
2015
2016
2017
2018
2019
2020
2021



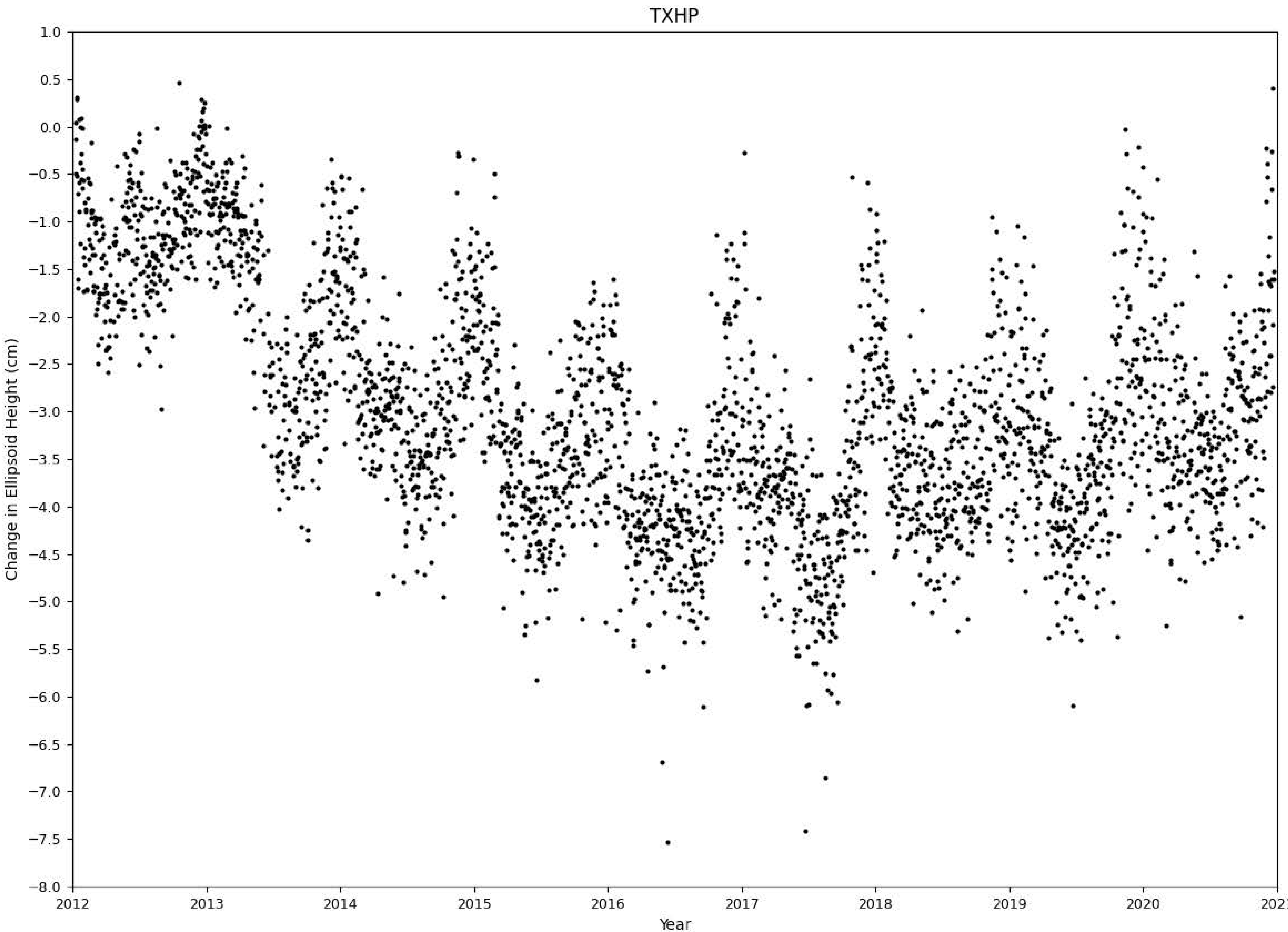
TXH2
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2016
2017
2018
2019
2020
2021



TXHE
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021



TXHN
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


TXHP
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
2012
2013
2014
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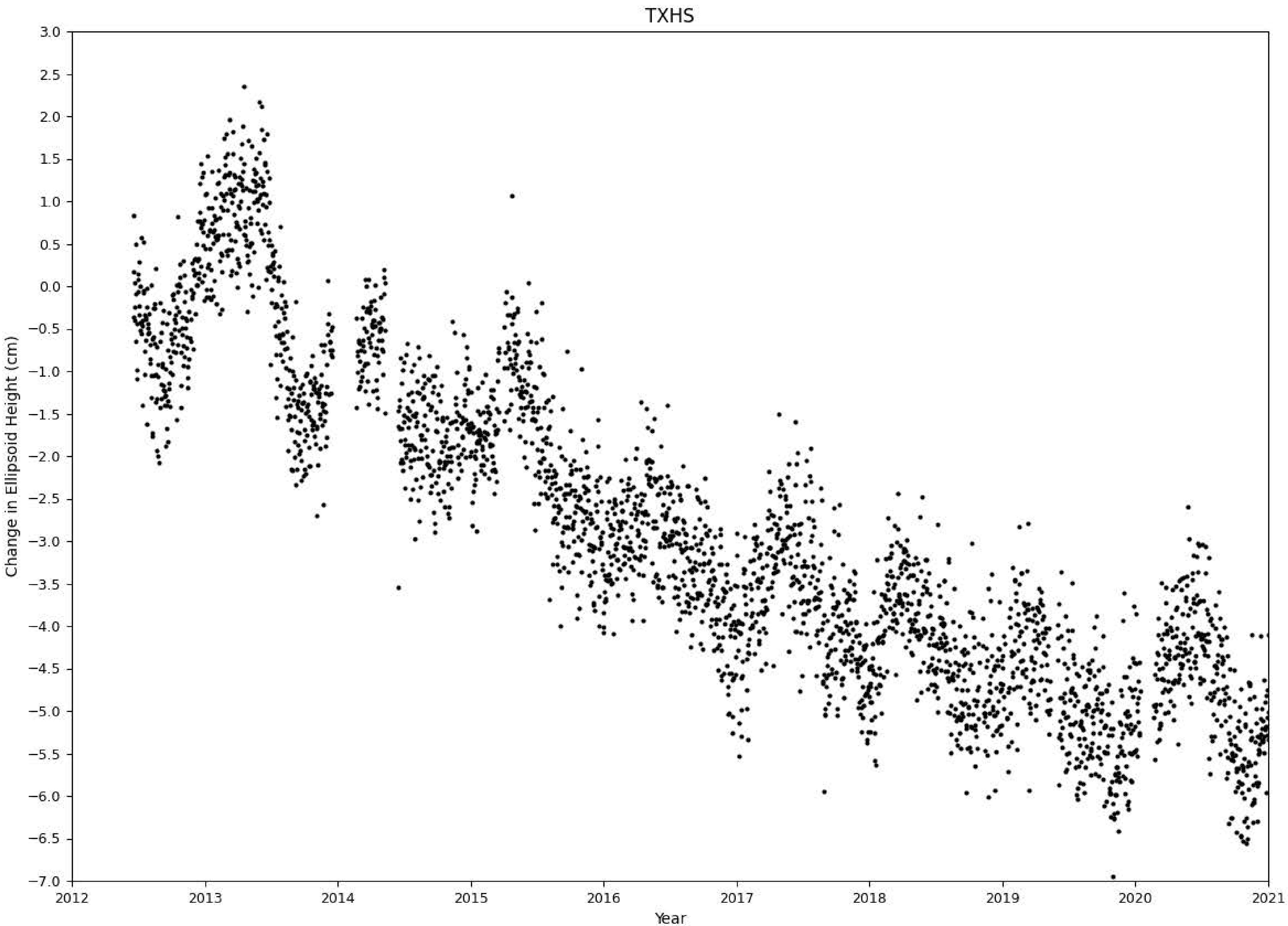
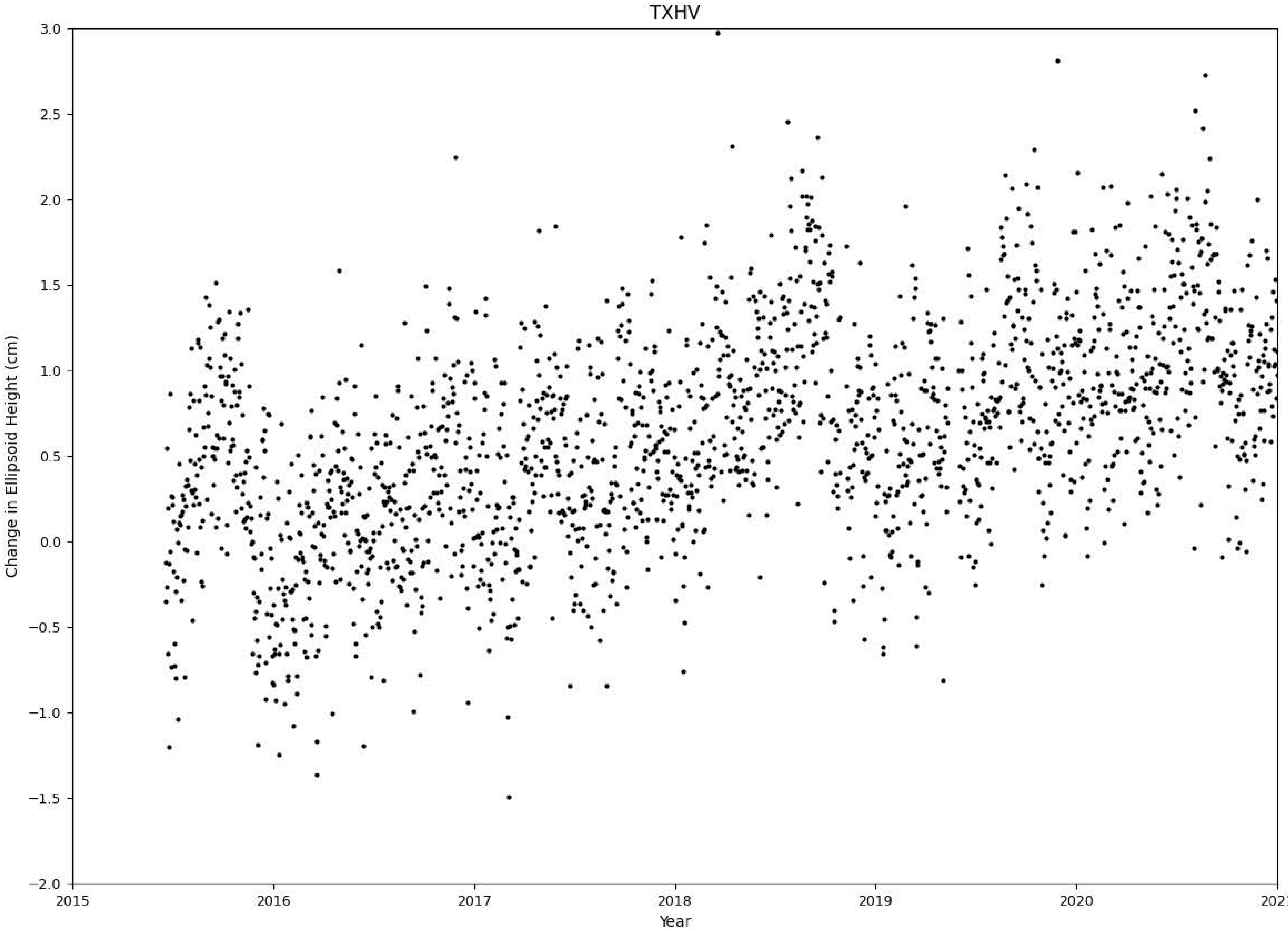
2019
2020
2021


TXHS
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year



TXHV
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2015
2016
2017
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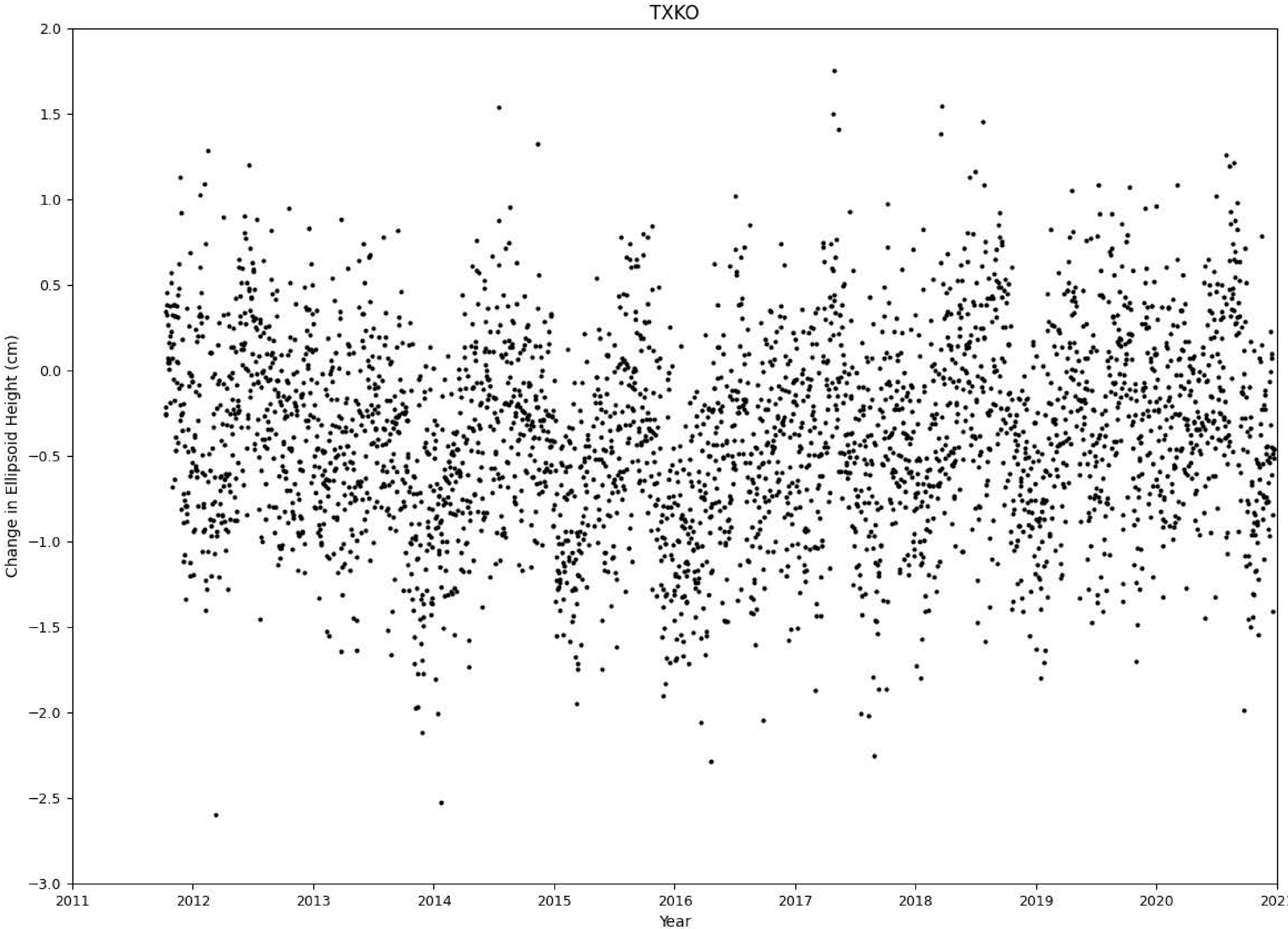
2019
2020
2021


TXKO
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2011
2012
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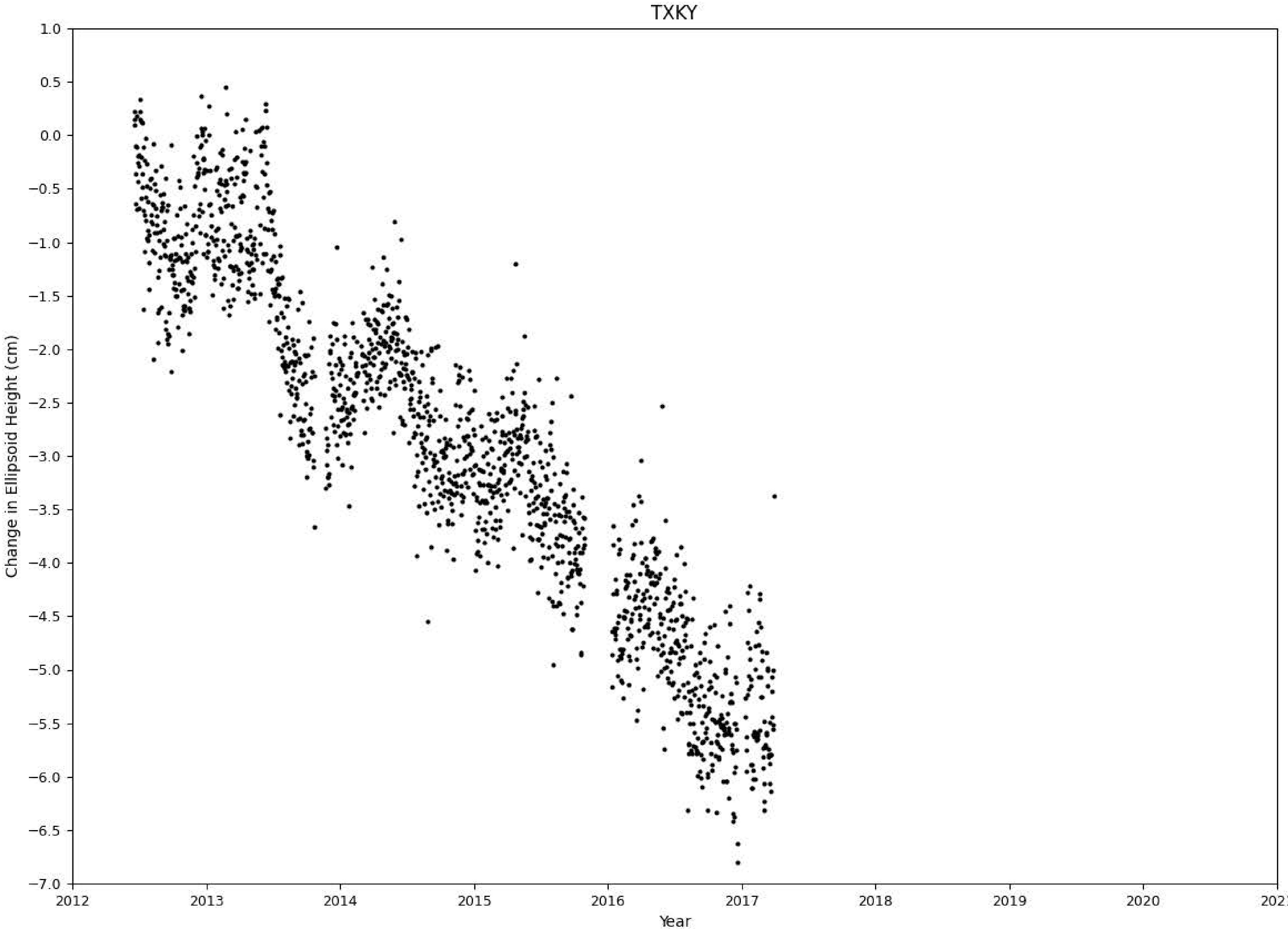
2020
2021



TXKY
Change in Ellipsoid Height (cm)
Year
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2012
2013
2014
2015
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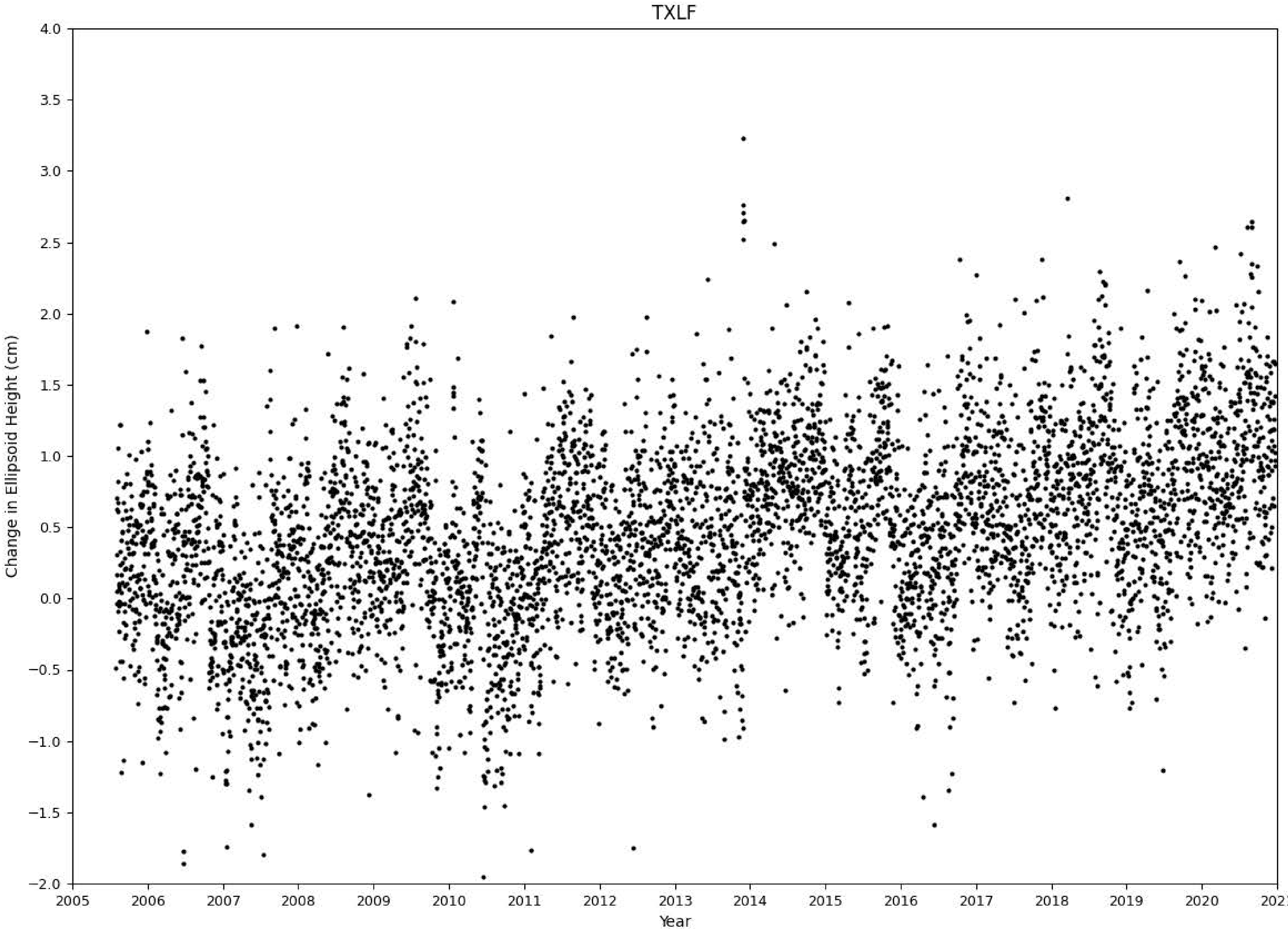
2019
2020
2021


TXLF
Change in Ellipsoid Height (cm)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2005
2006
2007
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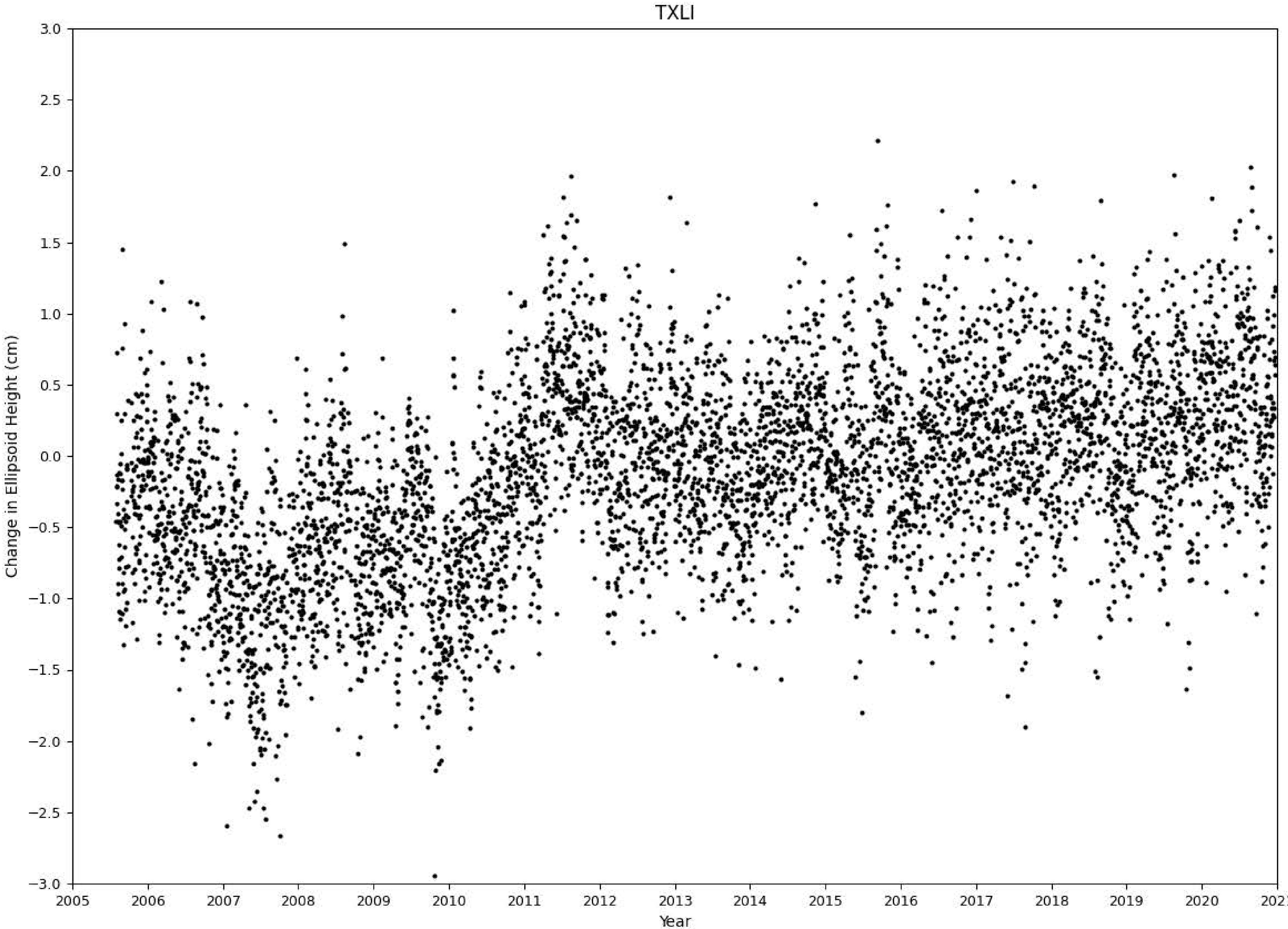
2016
2017
2018
2019
2020
2021
Year


TXLI
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2005
2006
2007
2008
2009
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2011
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2015
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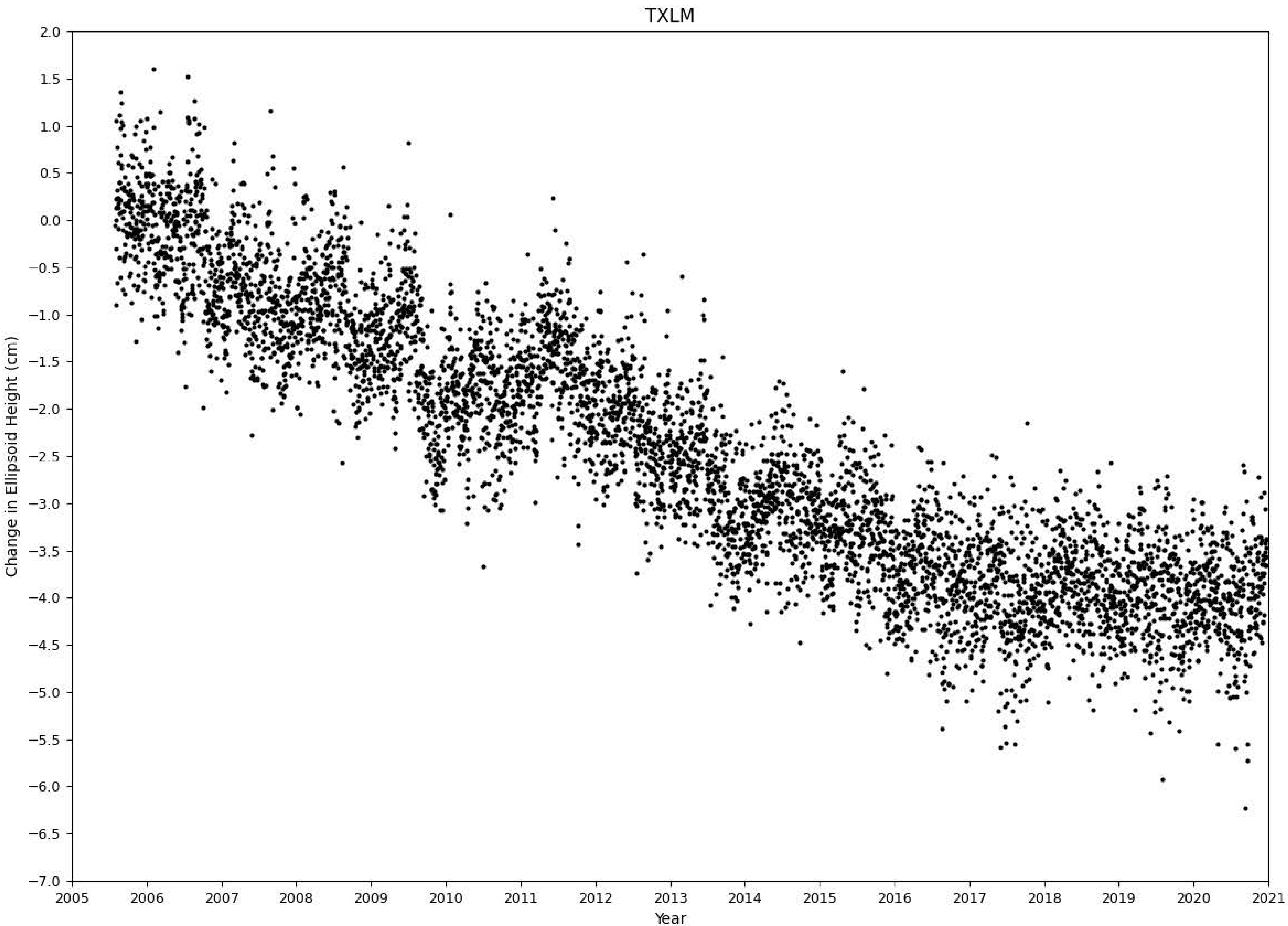
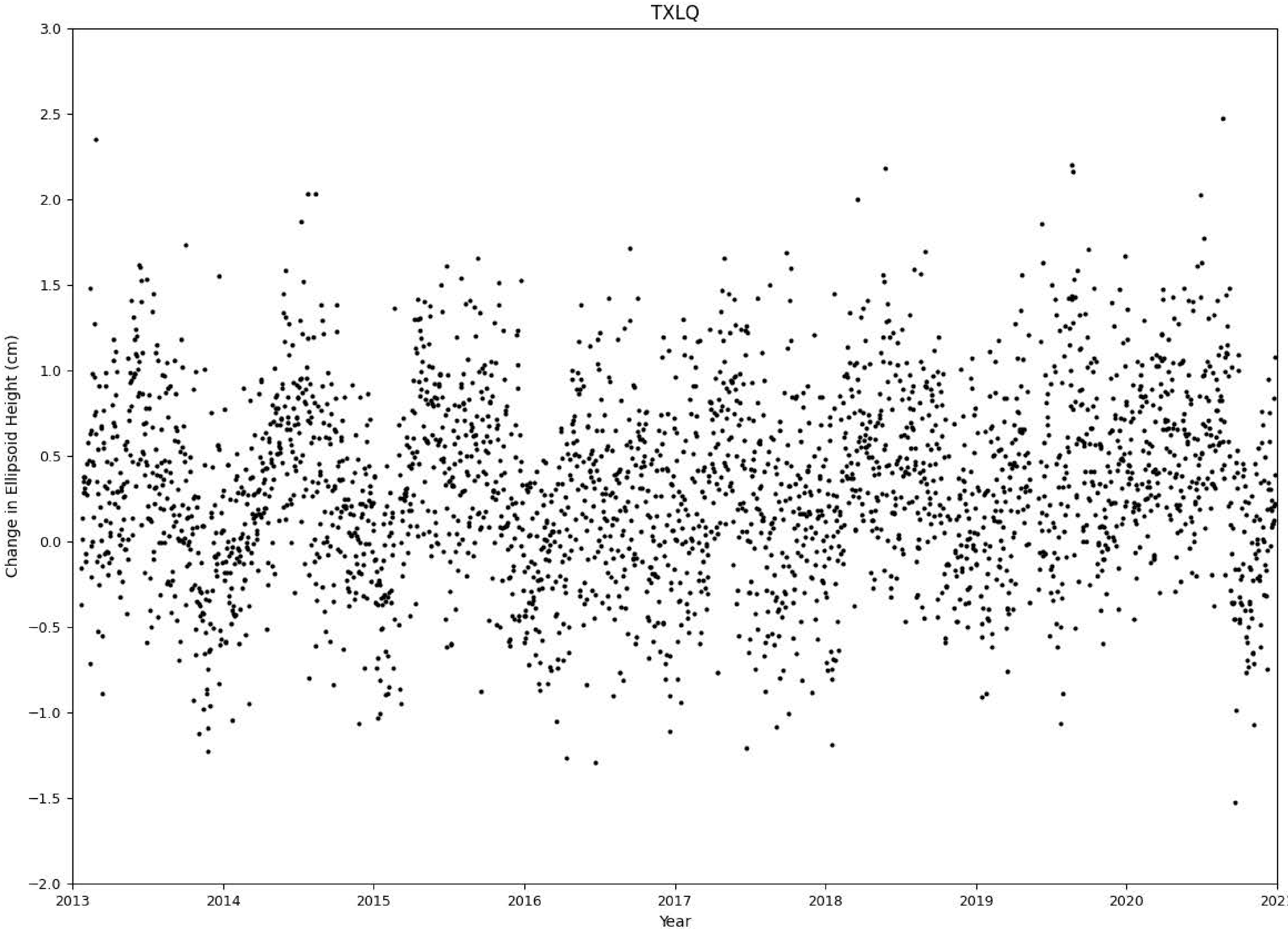
2018
2019
2020
2021



TXLM
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
Change in Ellipsoid Height (cm)
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year


TXLQ
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2013
2014
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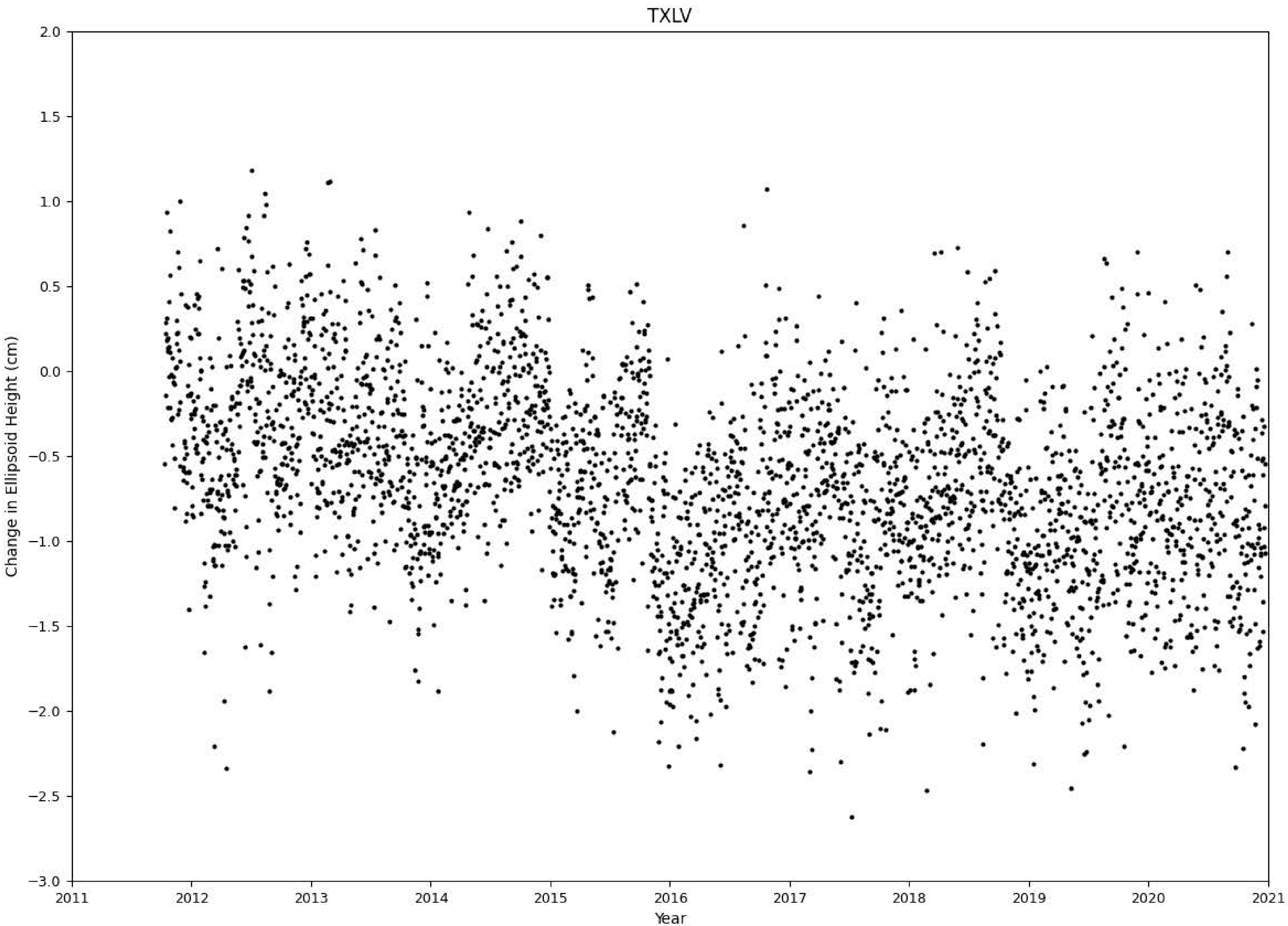
2020
2021


TXLV
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2011
2012
2013
2014
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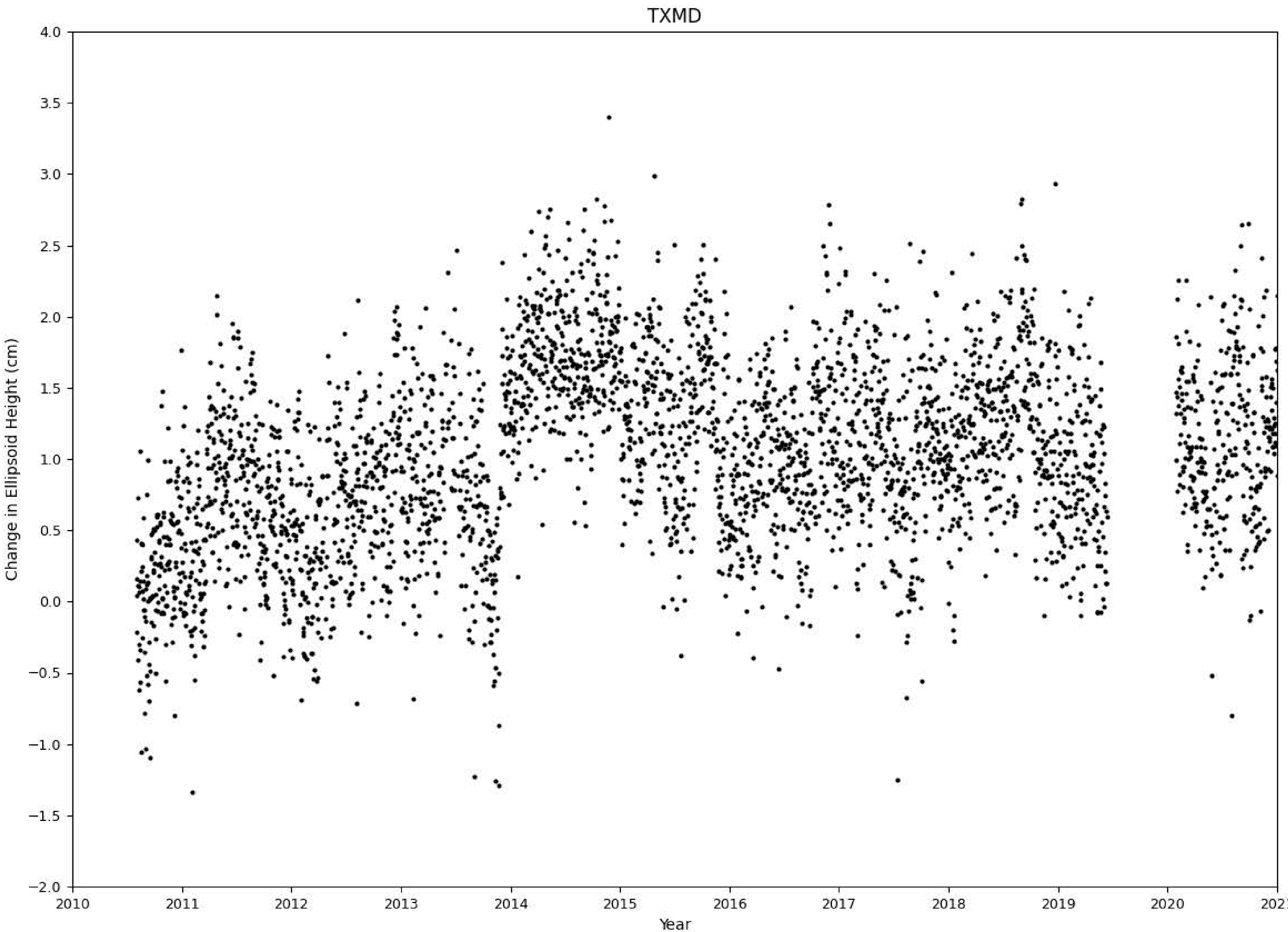
2019
2020
2021
Year



TXMD
Change in Ellipsoid Height (cm)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2010
2011
2012
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2015
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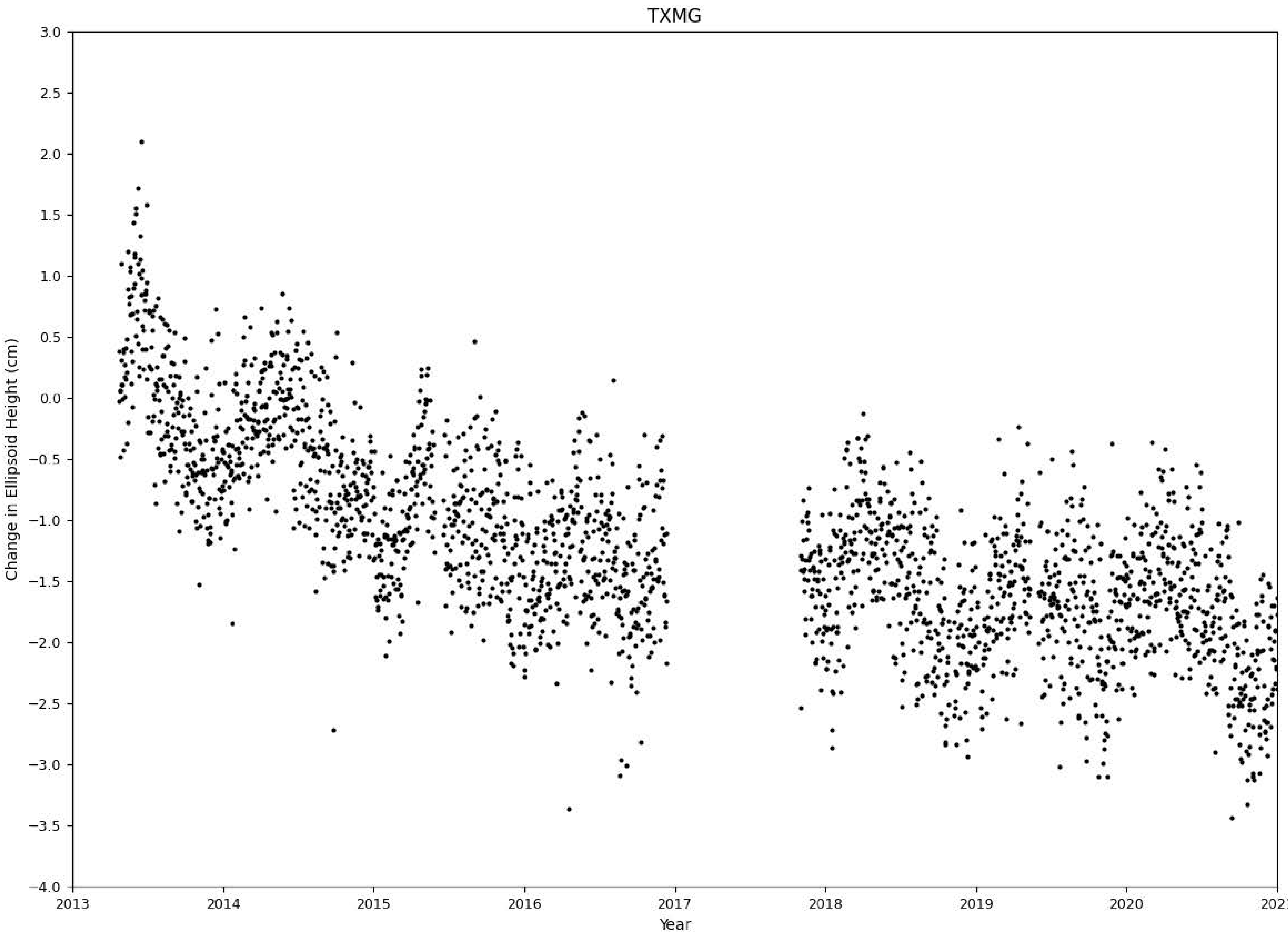
2020
2021



TXMG
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2013
2014
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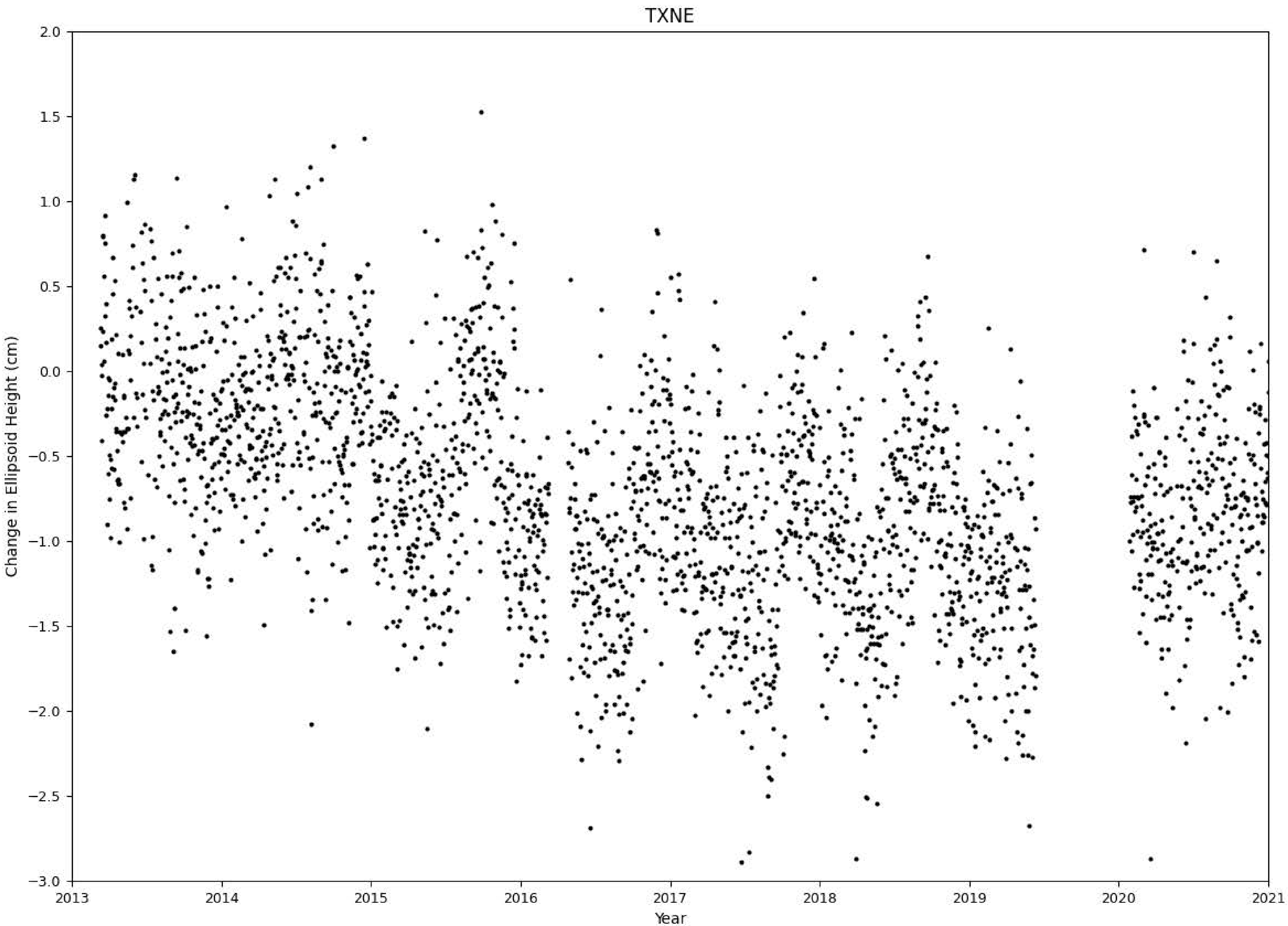
2020
2021


TXNE
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
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−2.0
−2.5
−3.0
2013
2014
2015
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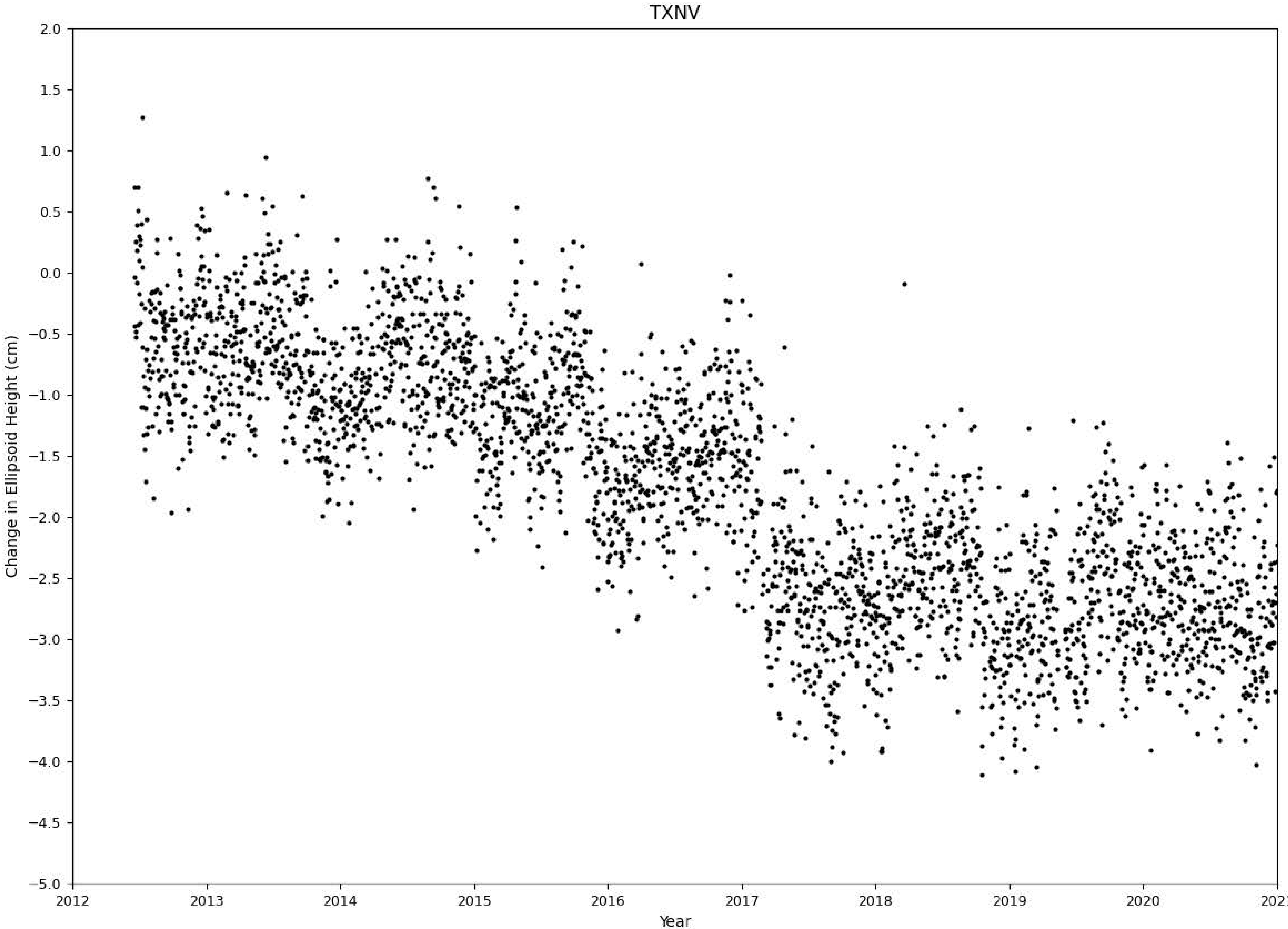
2019
2020
2021



TXNV
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2012
2013
2014
2015
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2017
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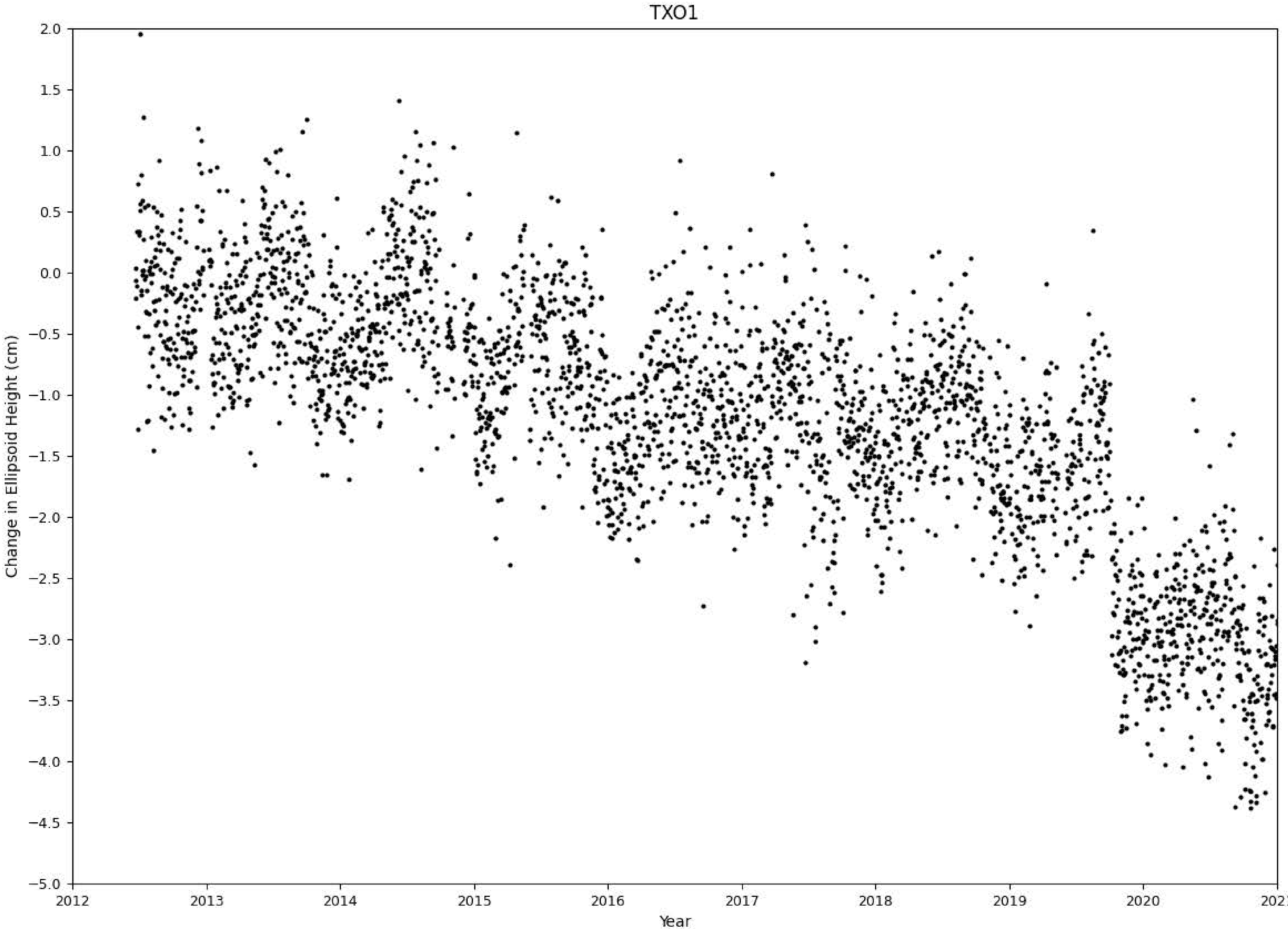
2019
2020
2021


TXO1
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2012
2013
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2015
2016
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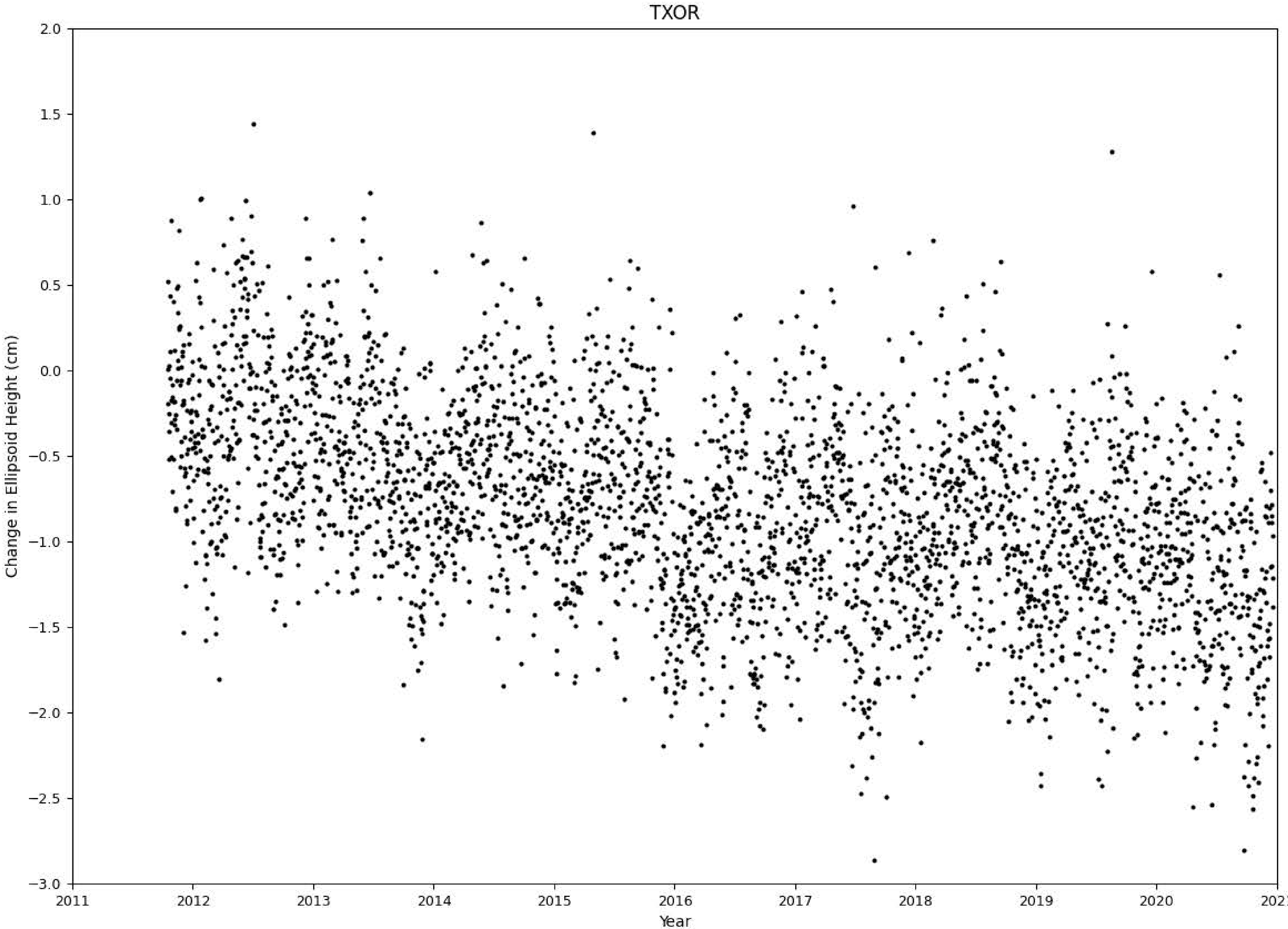
2019
2020
2021


TXOR
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2011
2012
2013
2014
2015
2016
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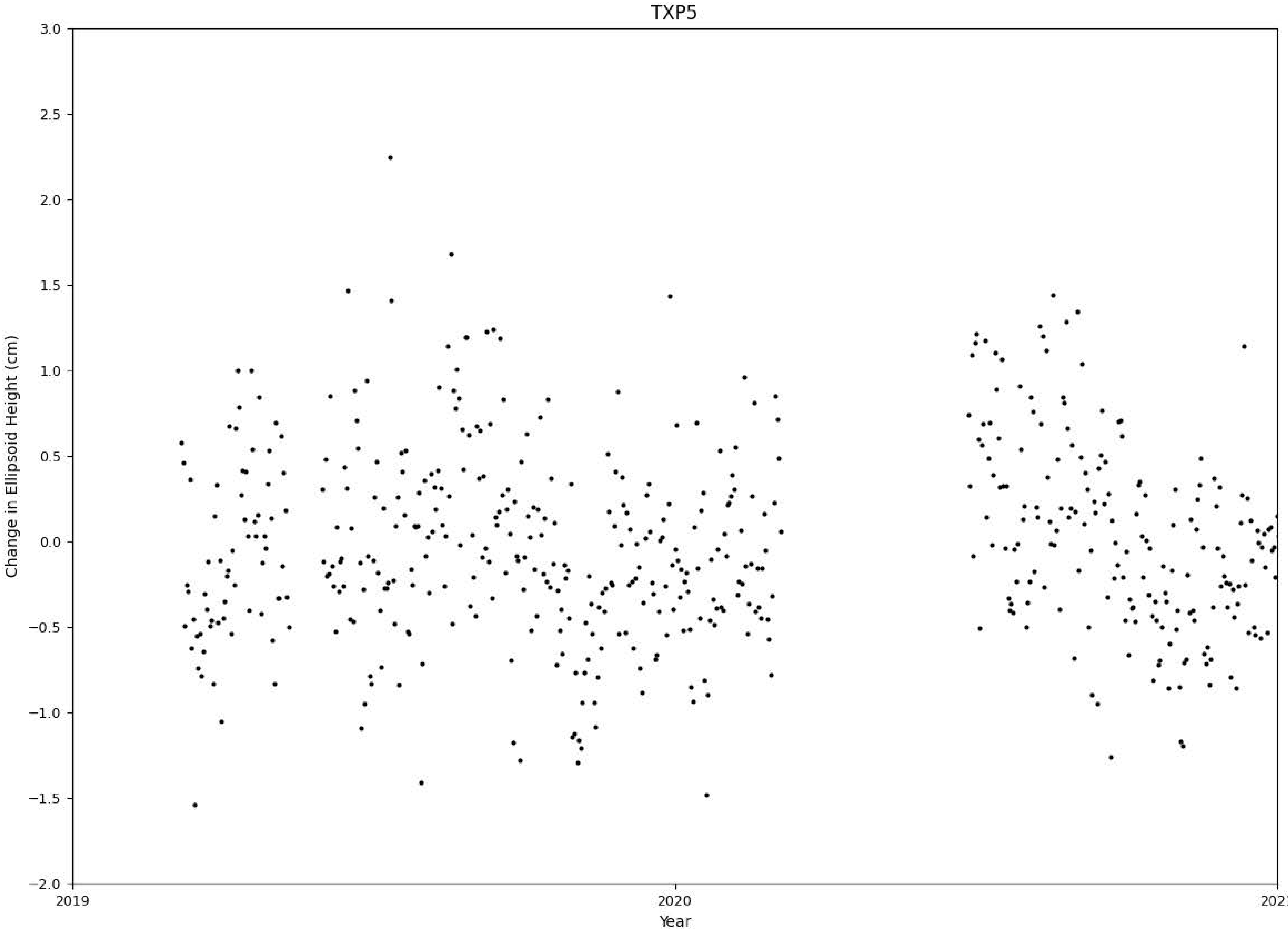
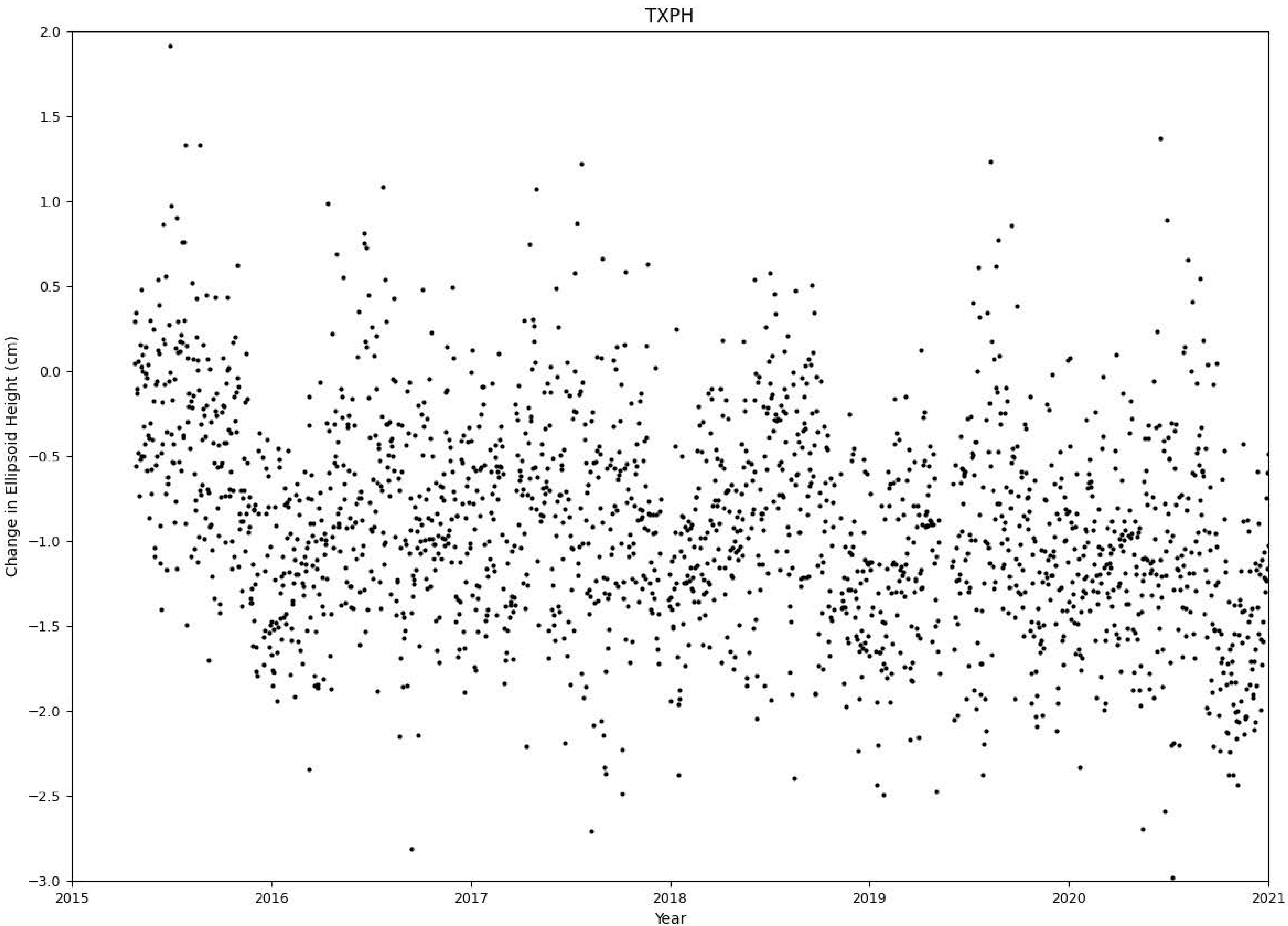
2019
2020
2021
Year



TXP5
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2019
2020
2021
Year


TXPH
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2015
2016
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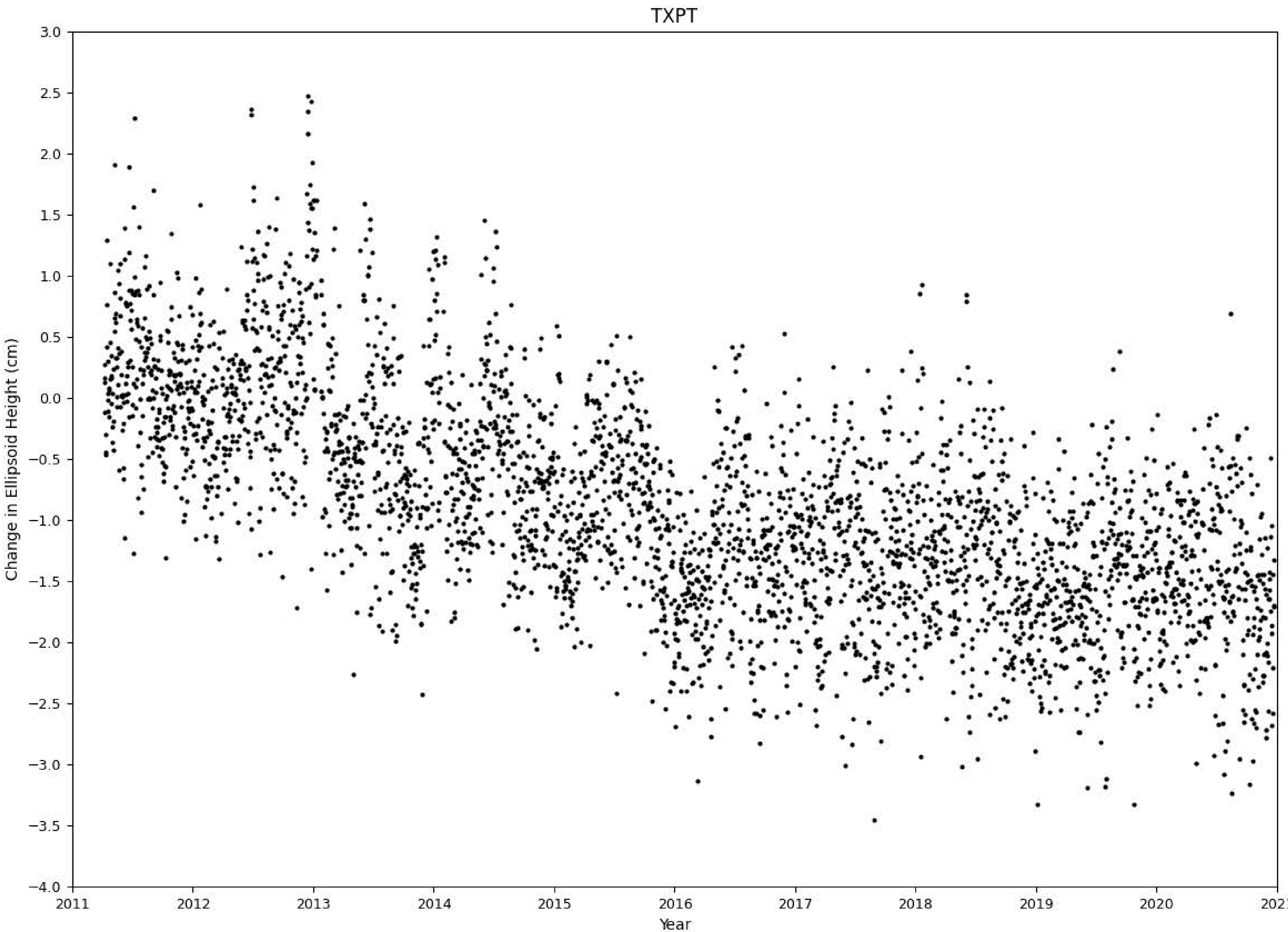
2020
2021


TXPT
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2011
2012
2013
2014
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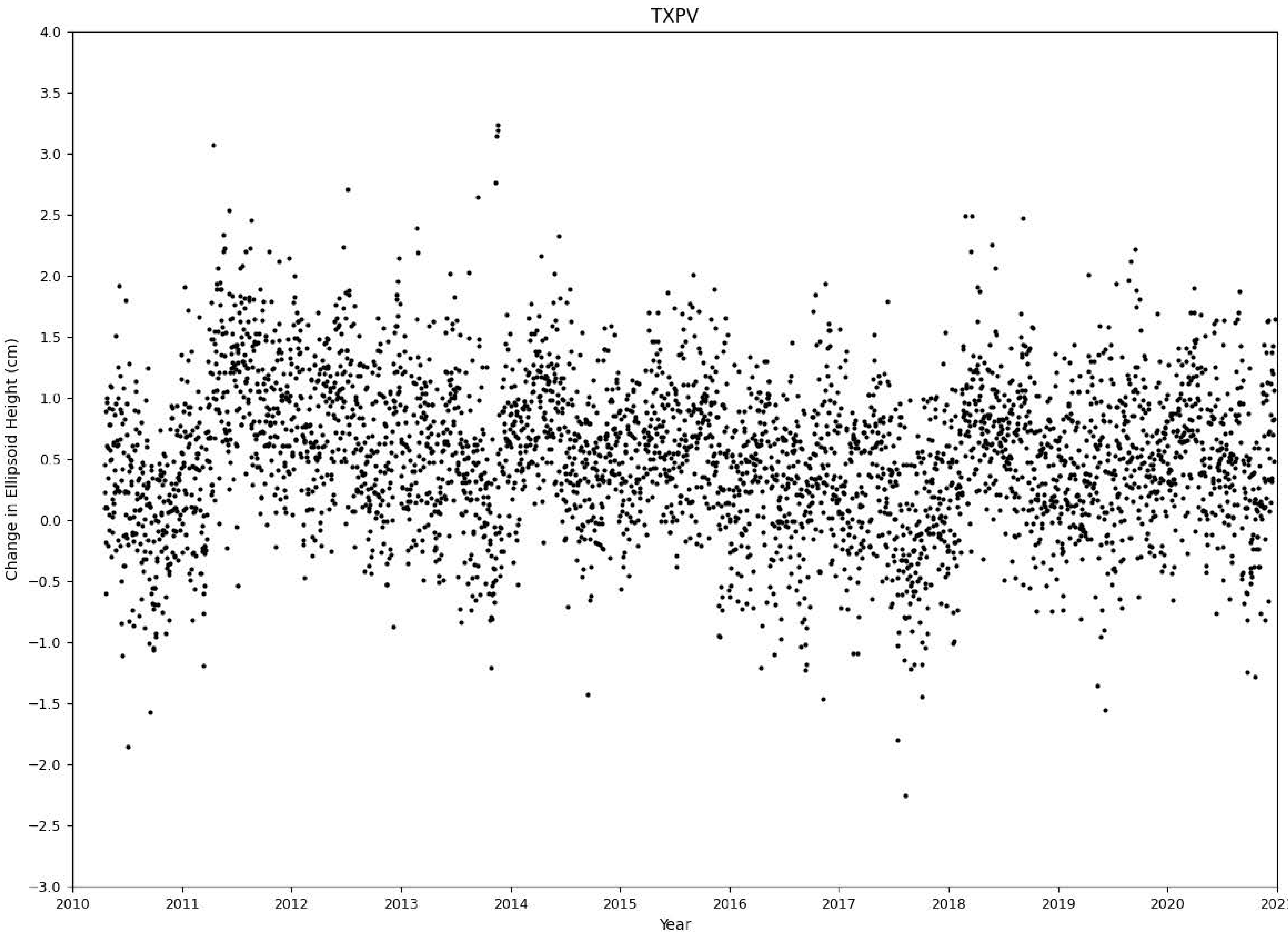
2018
2019
2020
2021
Year


TXPV
Change in Ellipsoid Height (cm)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2010
2011
2012
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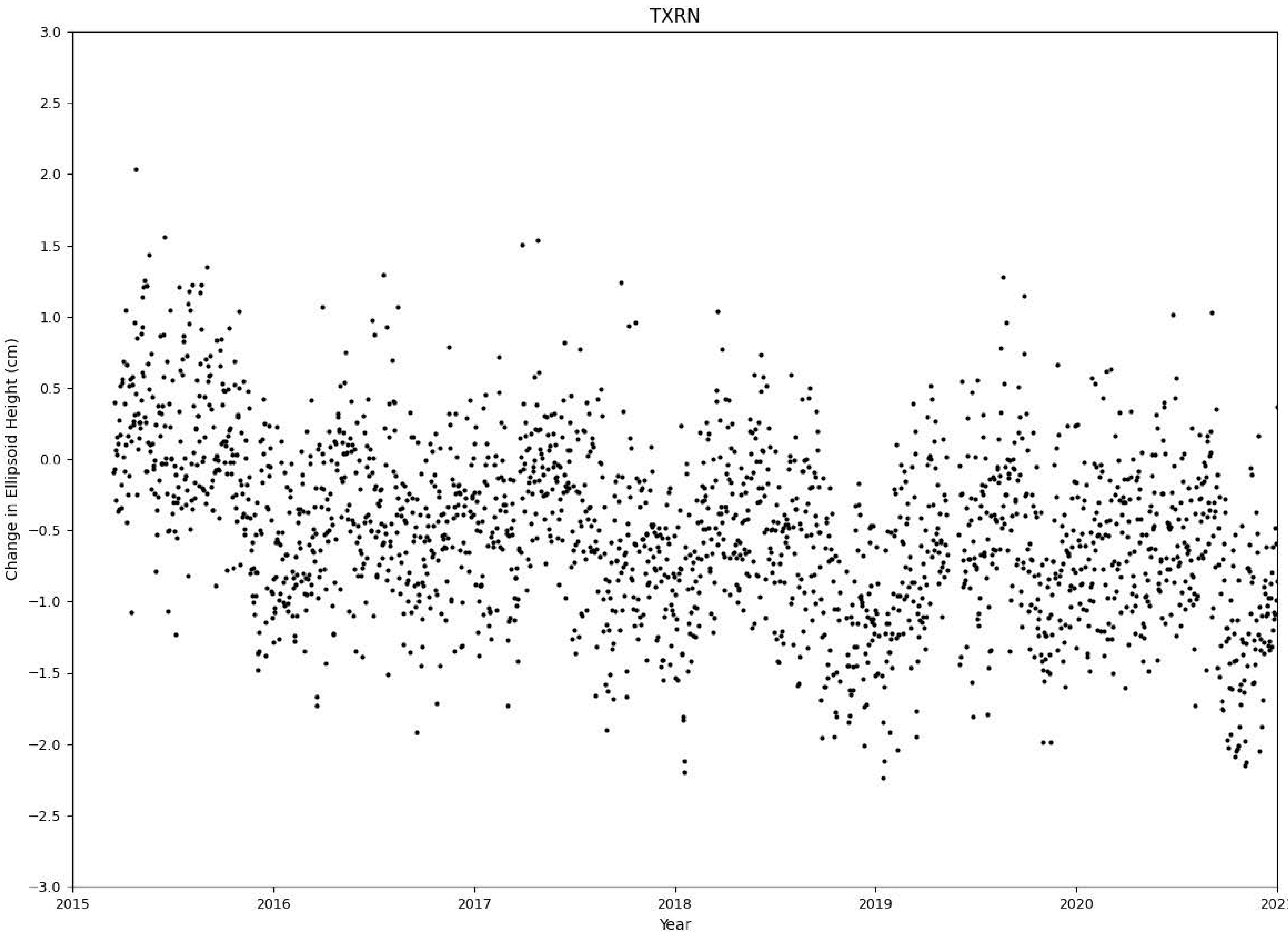
2020
2021
Year



TXRN
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2015
2016
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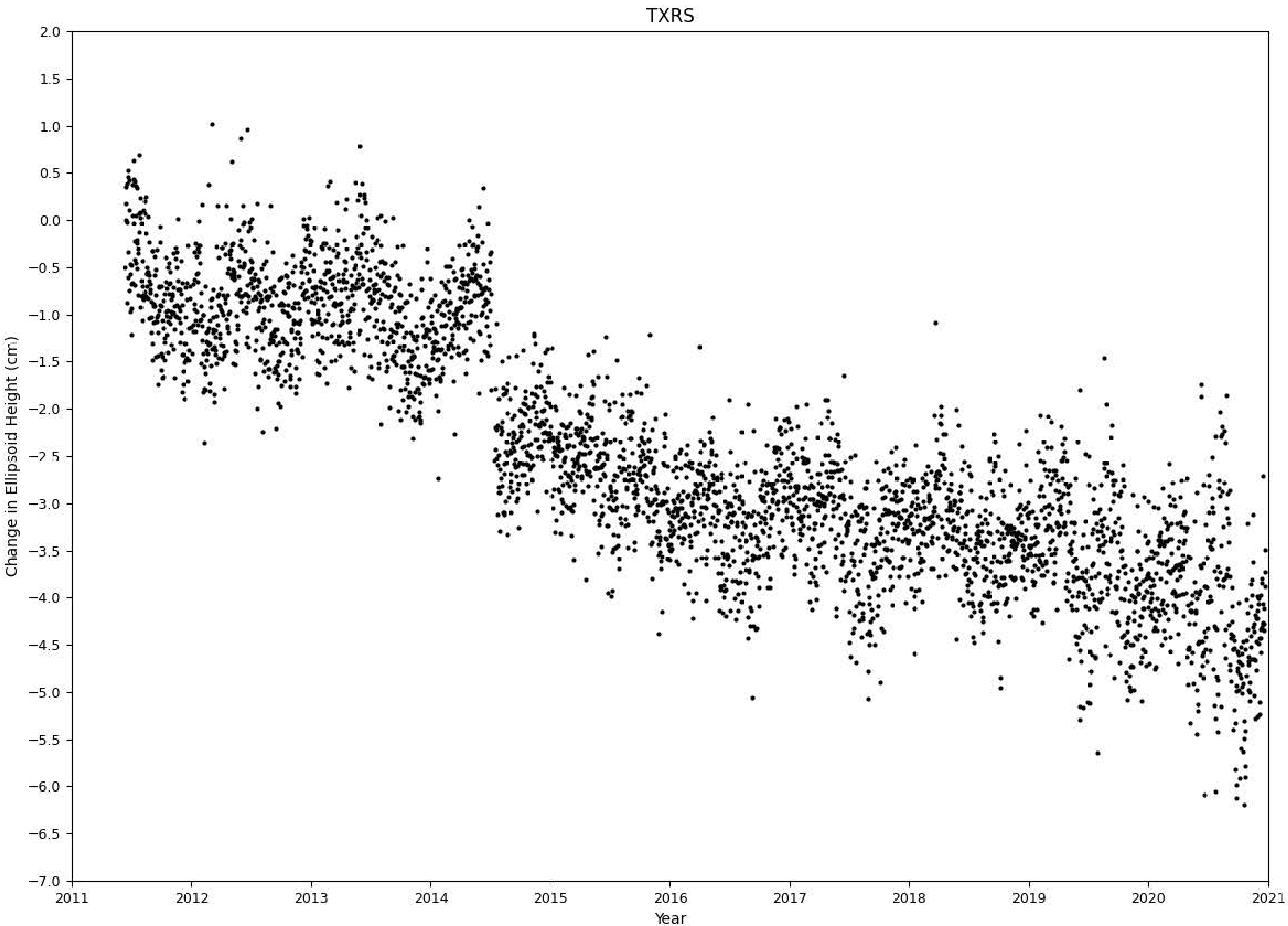
2018
2019
2020
2021



TXRS
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
2011
2012
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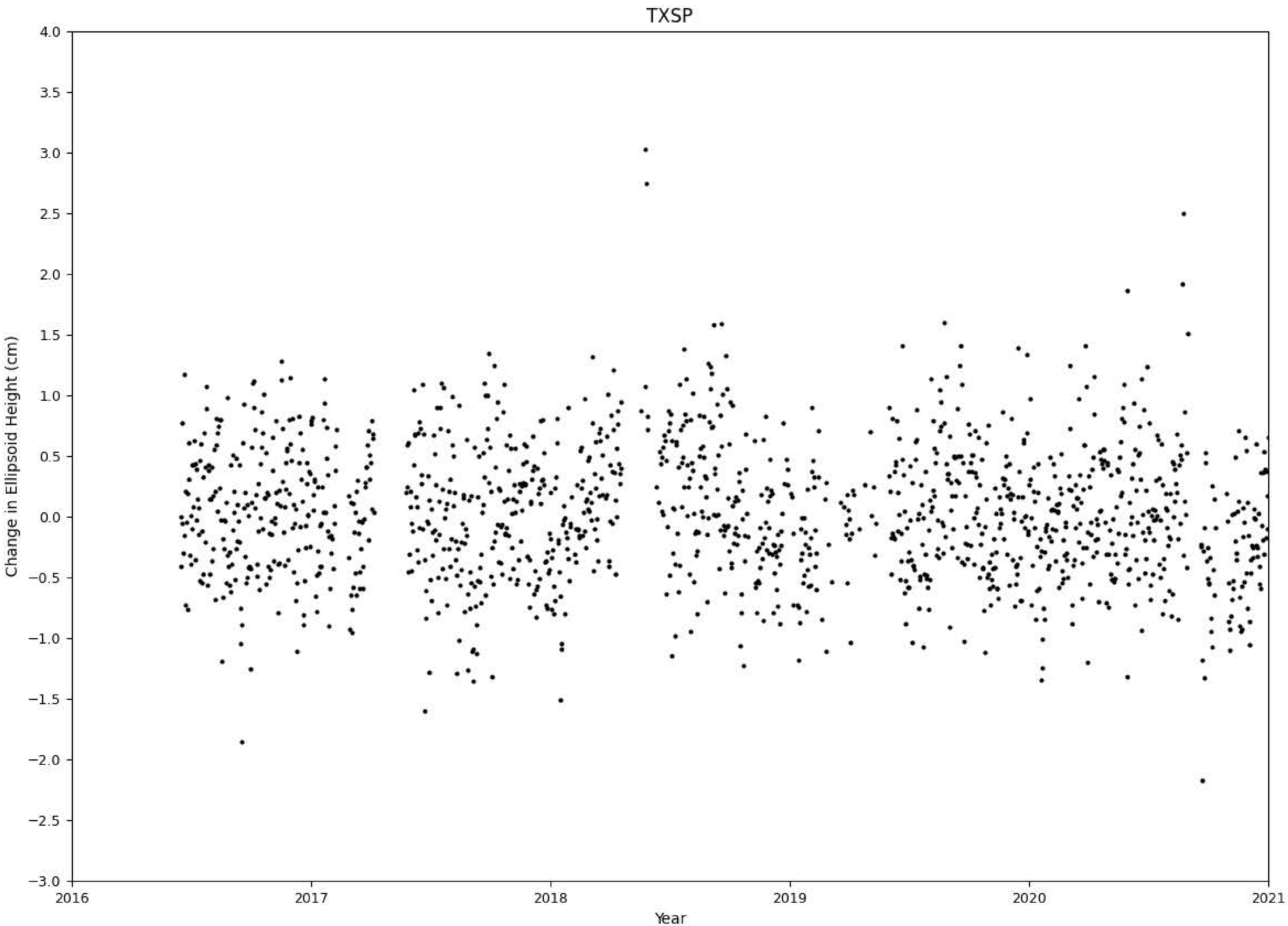
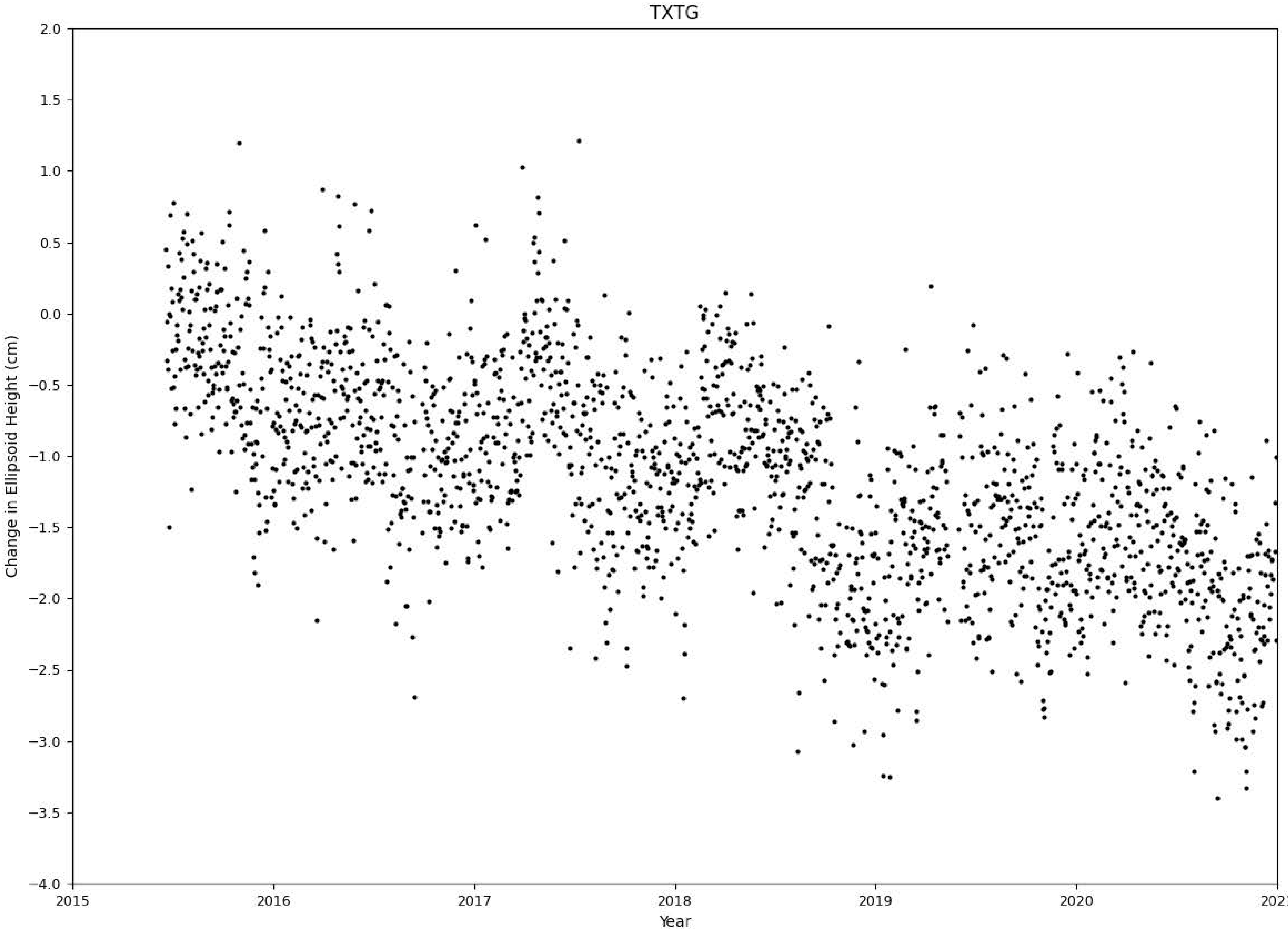
2020
2021
Year



TXSP
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
Change in Ellipsoid Height (cm)
2016
2017
2018
2019
2020
2021
Year



TXTG
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2015
2016
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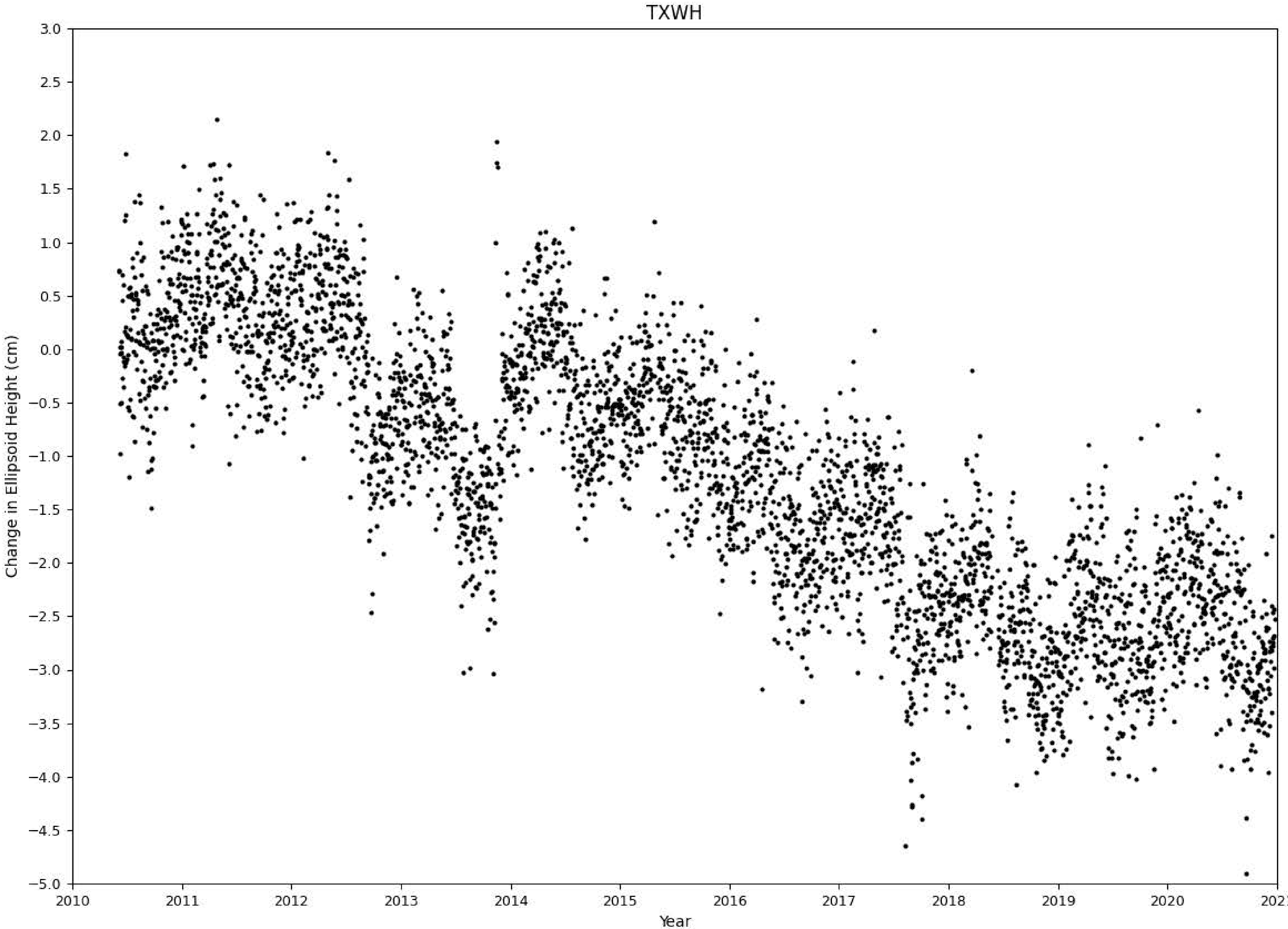
2020
2021



TXWH
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2010
2011
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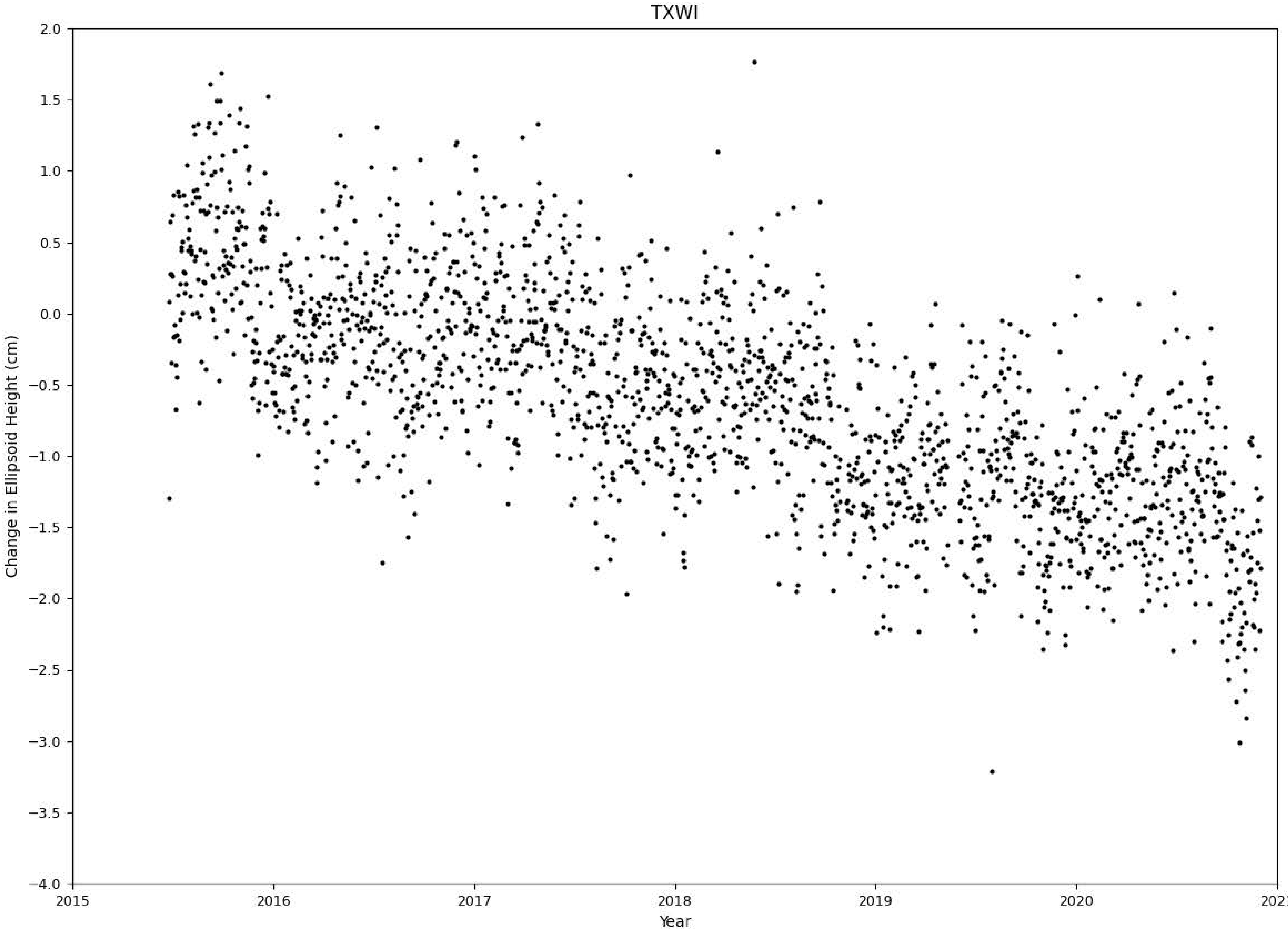
2021


TXWI
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
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−3.5
−4.0
2015
2016
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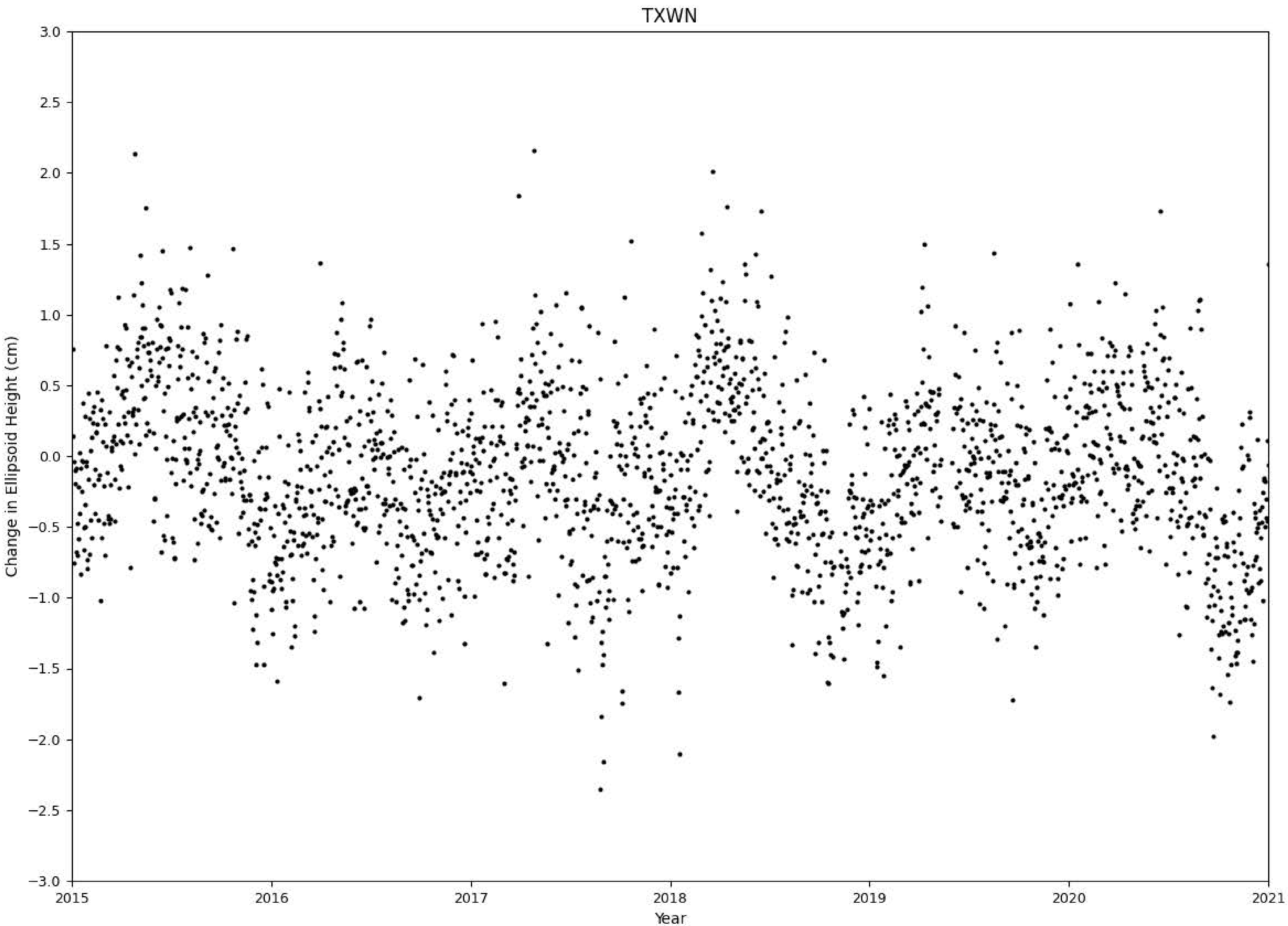
2021



TXWN
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2015
2016
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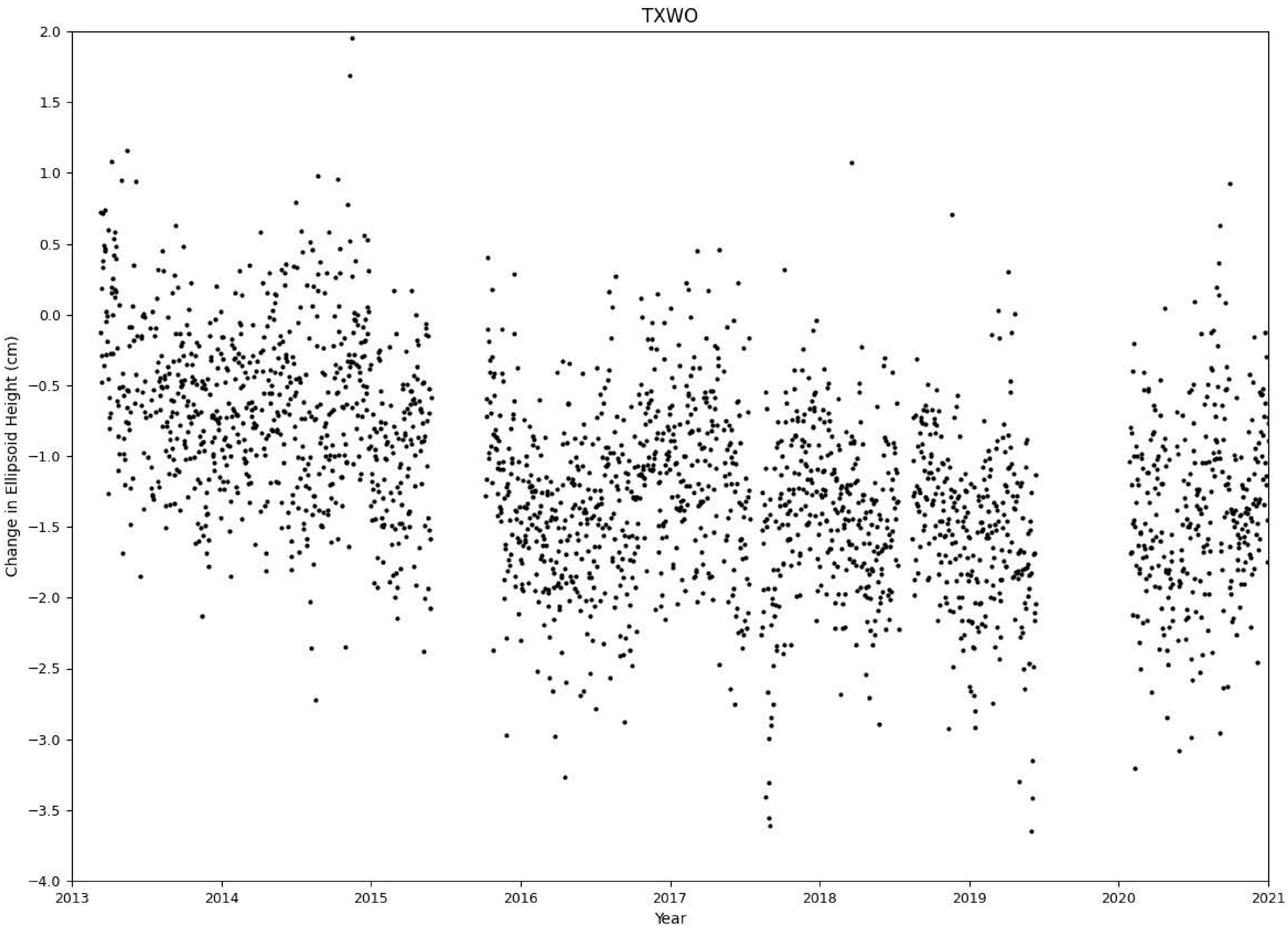
2020
2021



TXWO
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2013
2014
2015
2016
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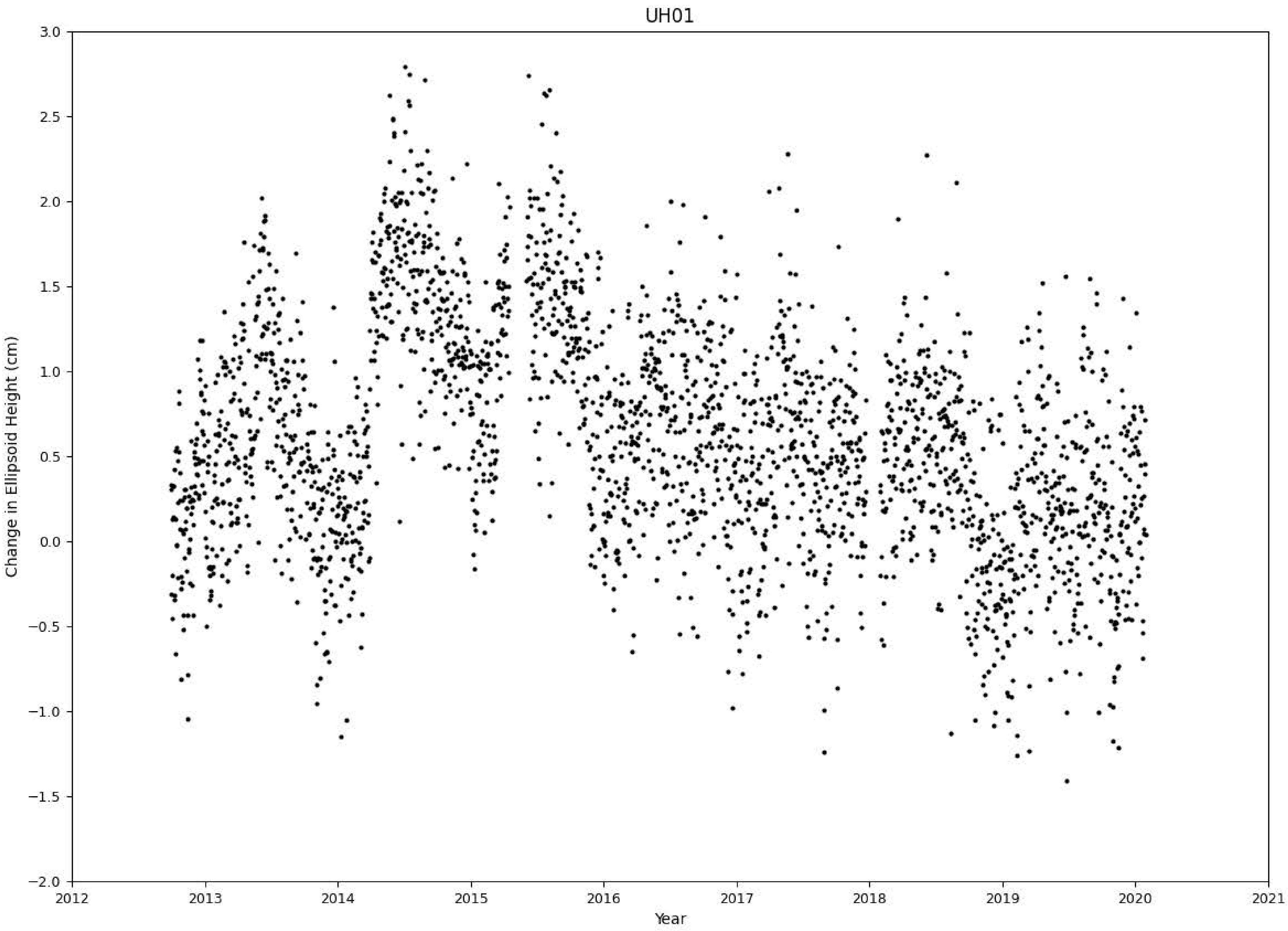
2019
2020
2021
Year


UH01
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2012
2013
2014
2015
2016
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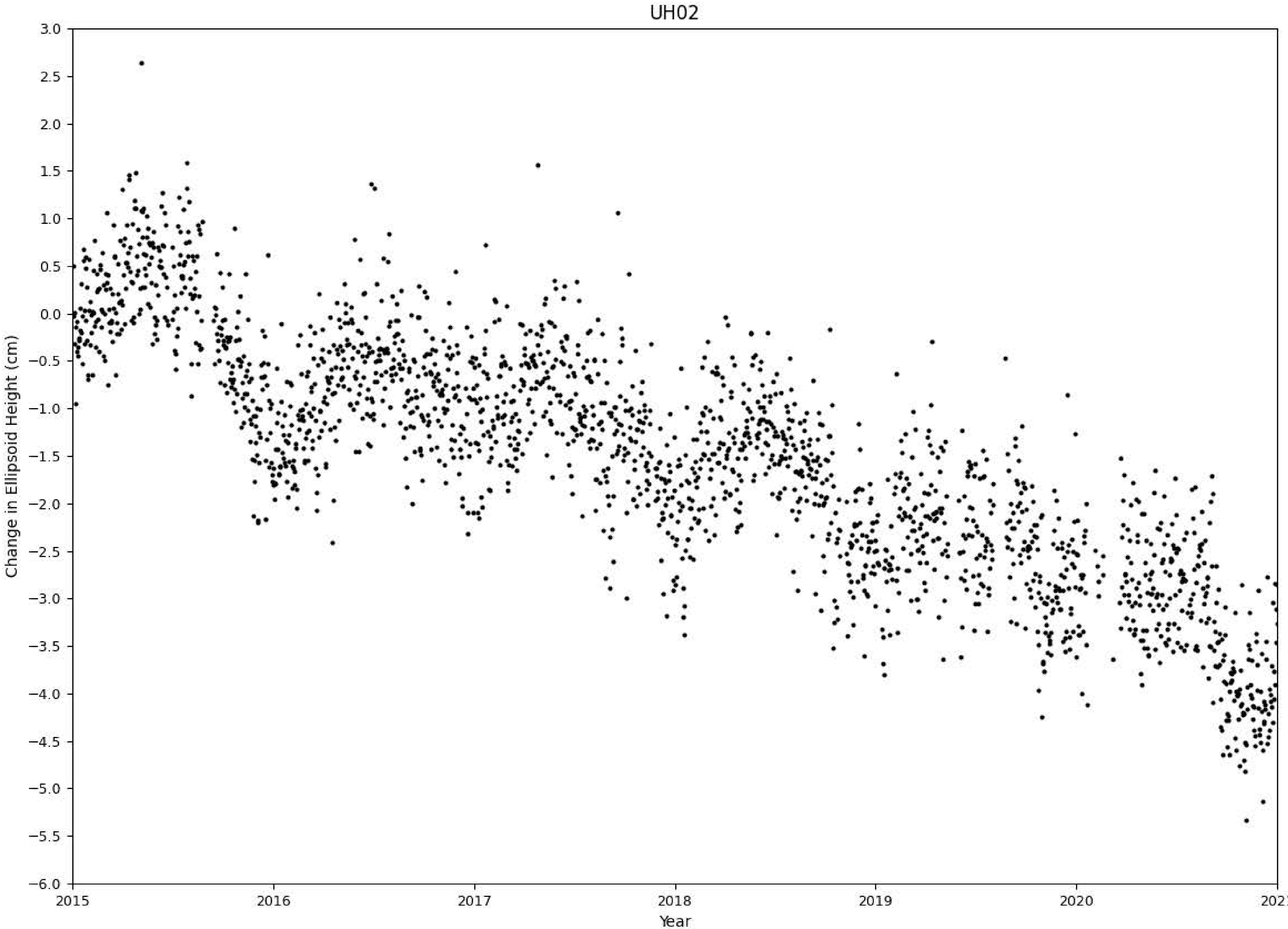
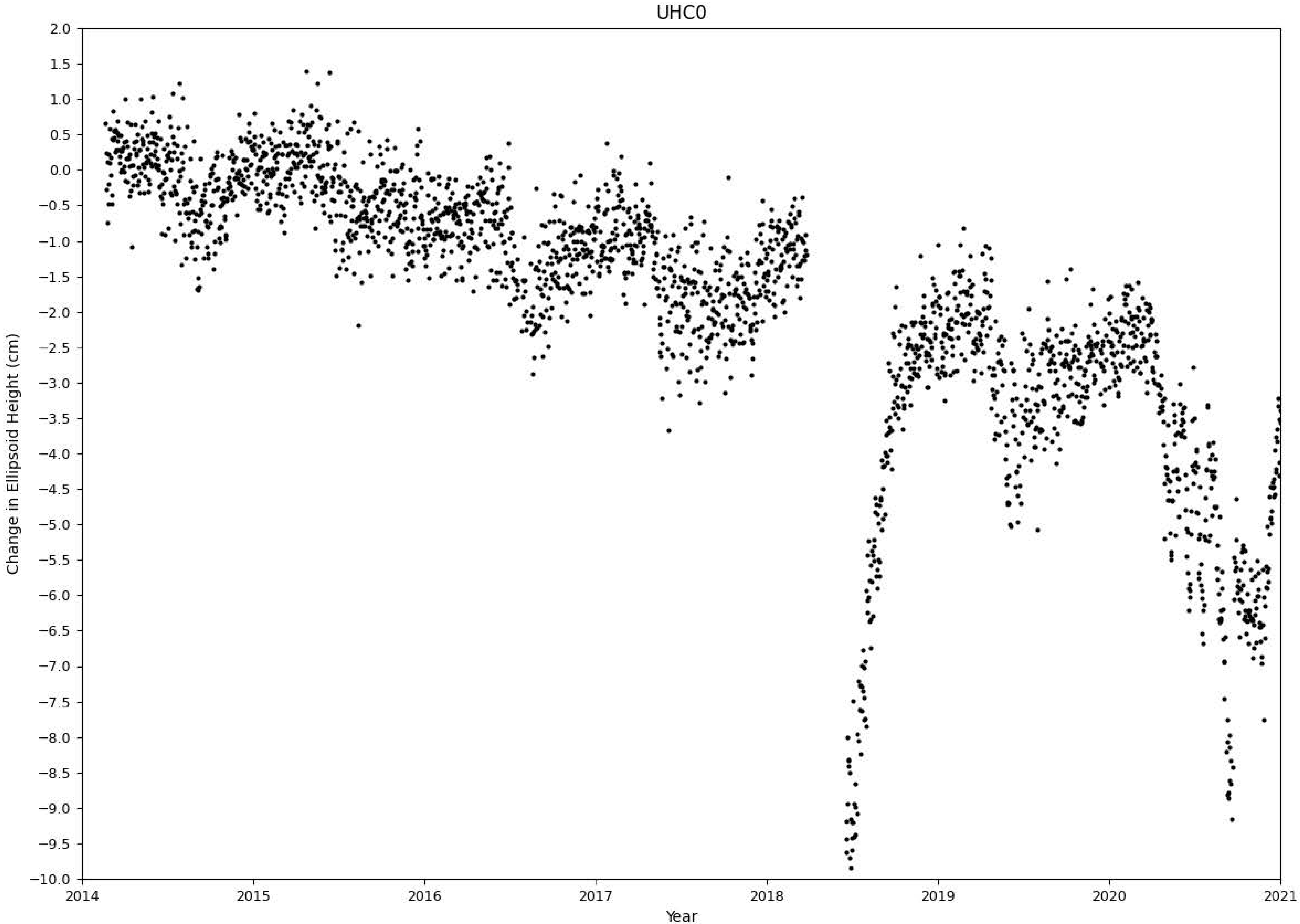
2019
2020
2021



UH02
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
Change in Ellipsoid Height (cm)
2015
2016
2017
2018
2019
2020
2021
Year



UHC0
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
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-8.5
-9.0
-9.5
-10.0
2014
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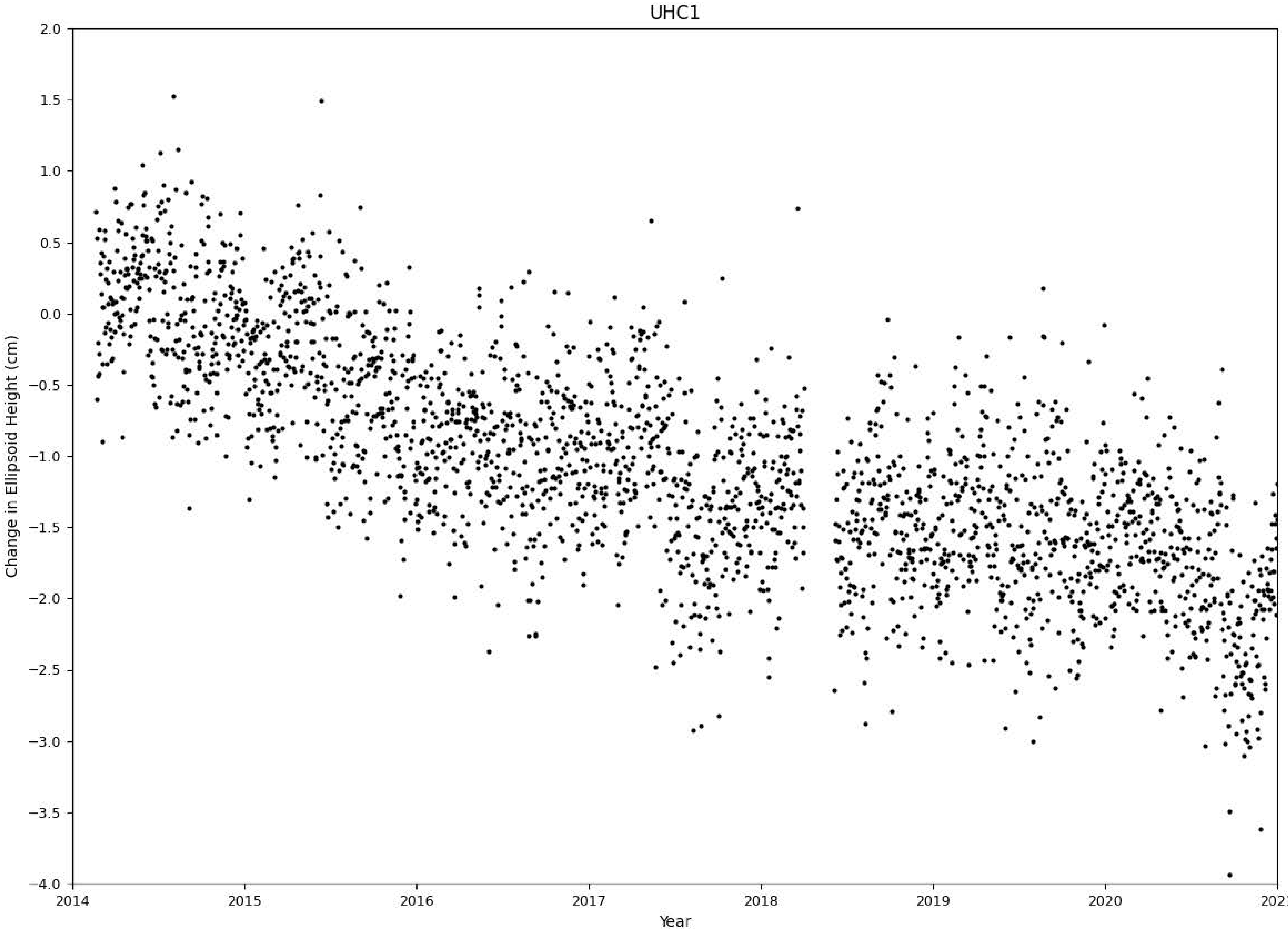
2019
2020
2021



UHC1
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2014
2015
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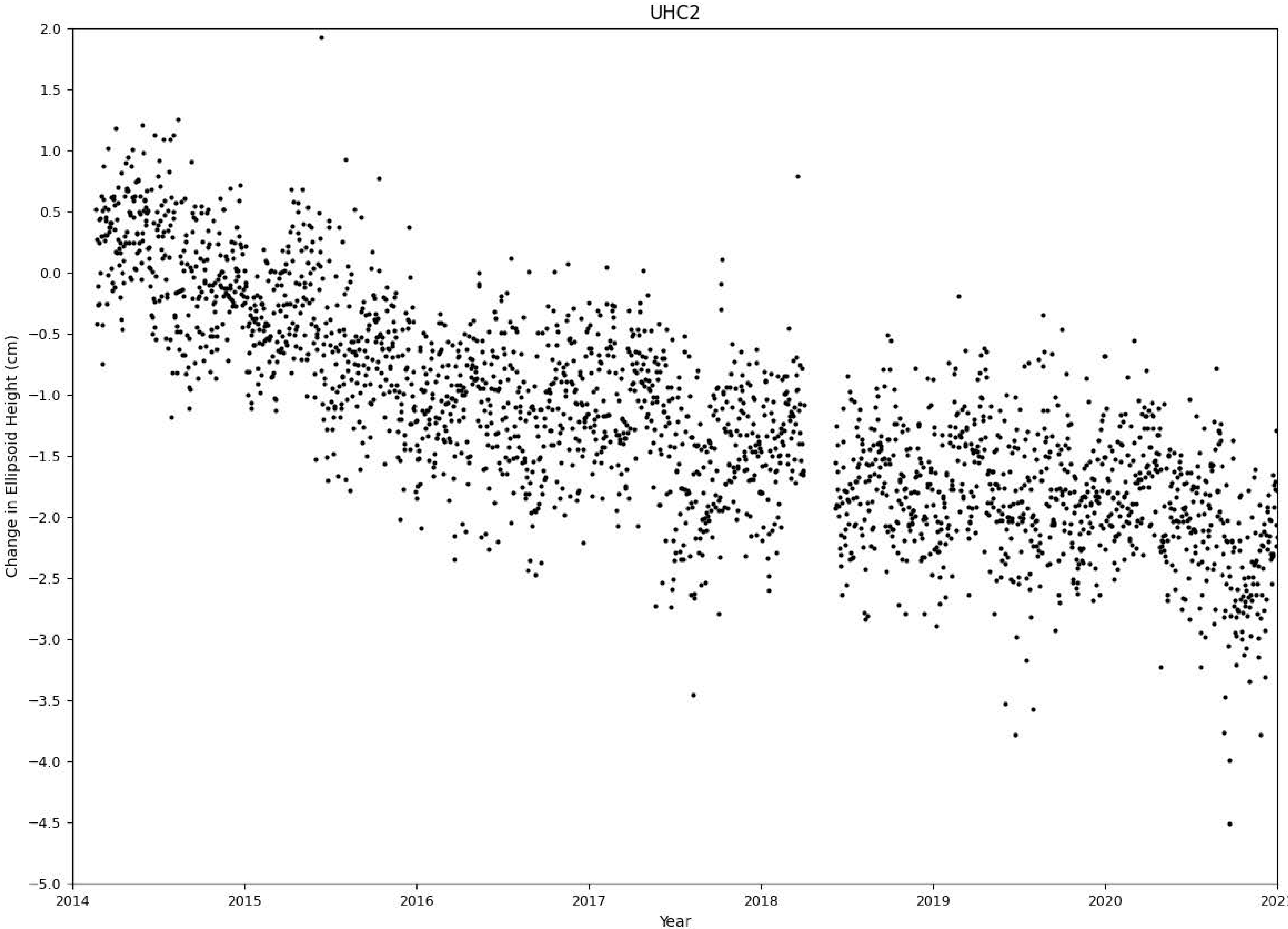
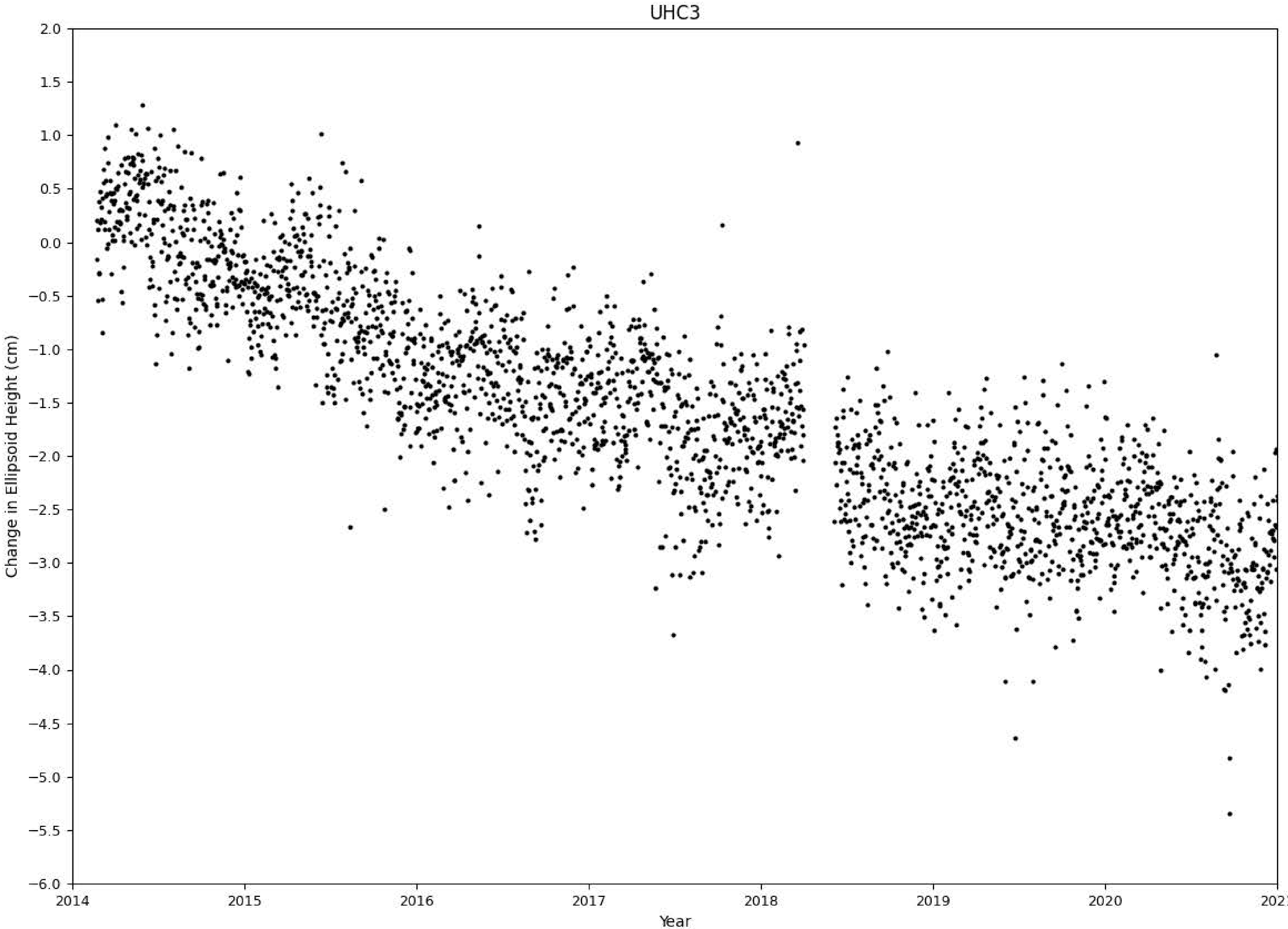
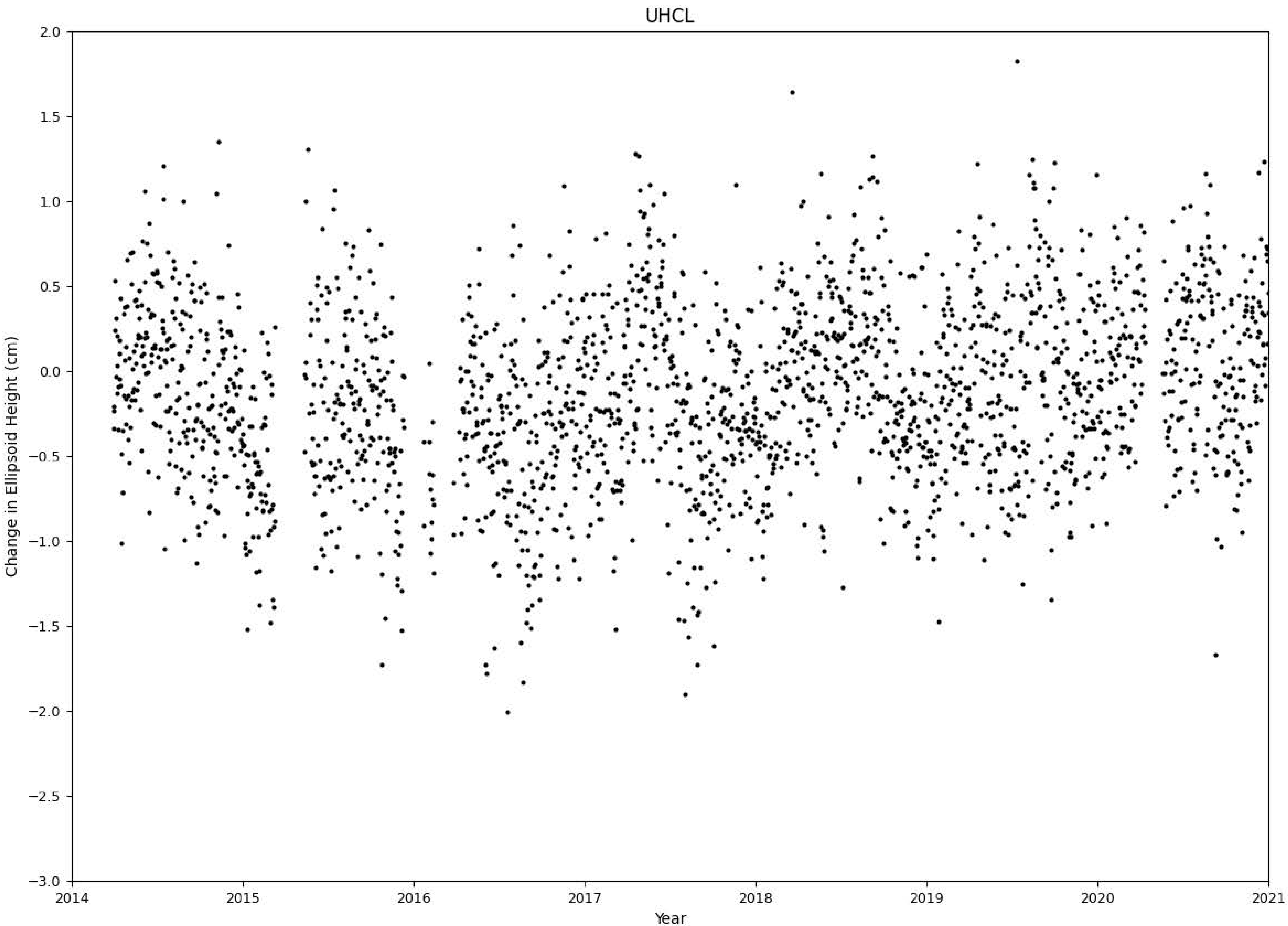
2019
2020
2021

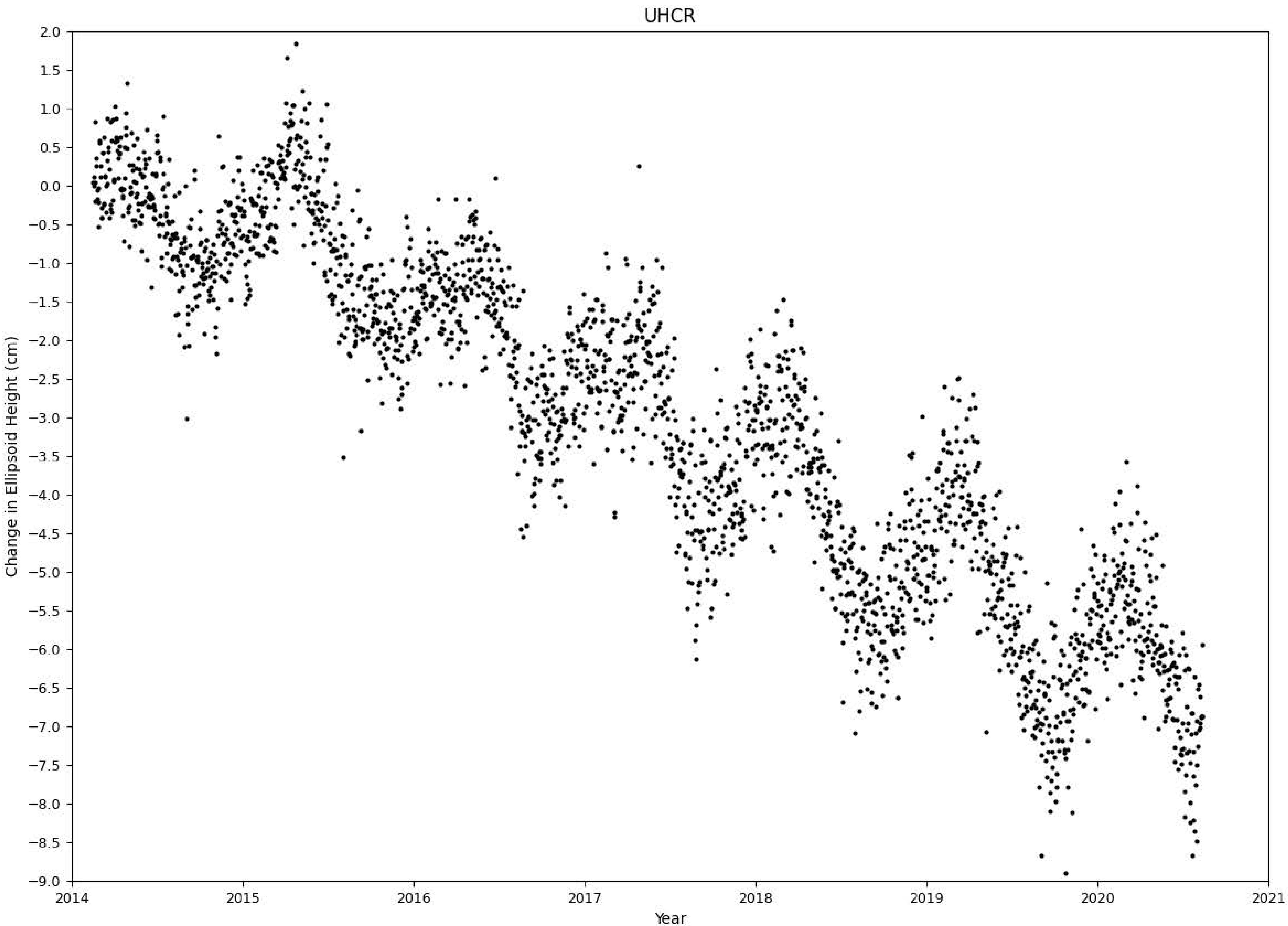

UHC2
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2014
2015
2016
2017
2018
2019
2020
2021



UHC3
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
2014
2015
2016
2017
2018
2019
2020
2021



UHCL
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
Change in Ellipsoid Height (cm)
2014
2015
2016
2017
2018
2019
2020
2021
Year


UHCR
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
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−7.5
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−8.5
−9.0
2014
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2017
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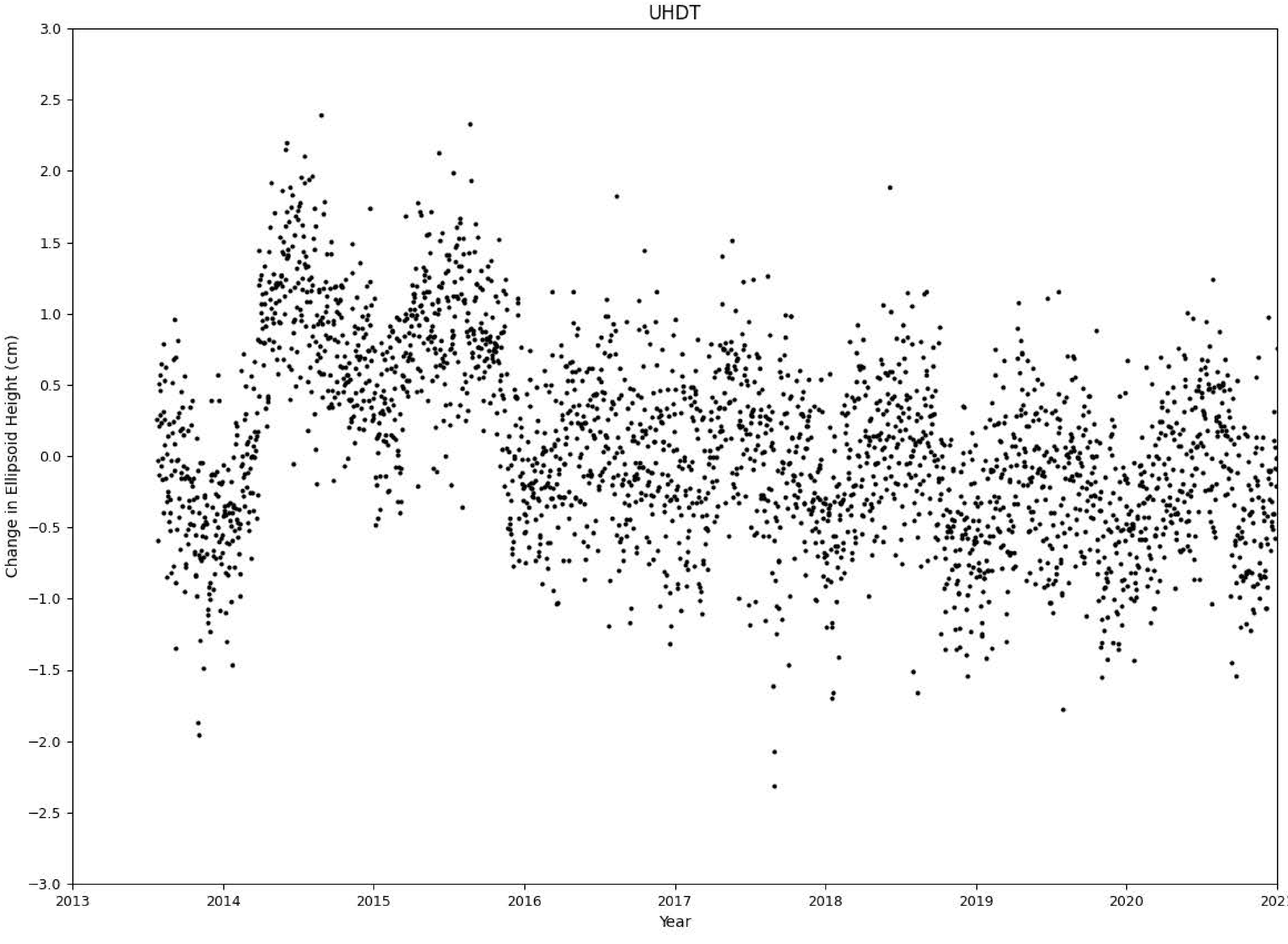
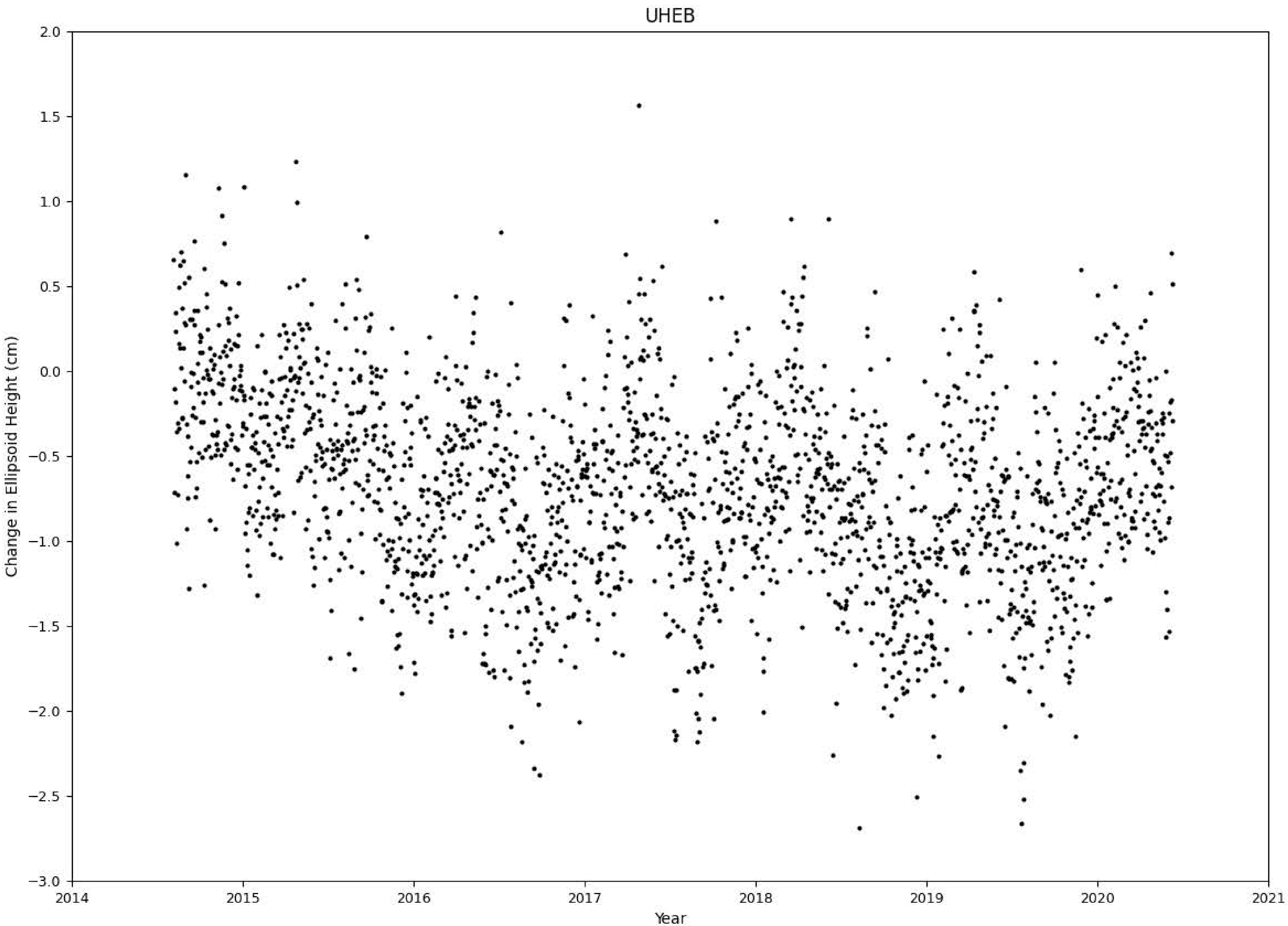
2019
2020
2021



UHDT
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2013
2014
2015
2016
2017
2018
2019
2020
2021


UHEB
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2014
2015
2016
2017
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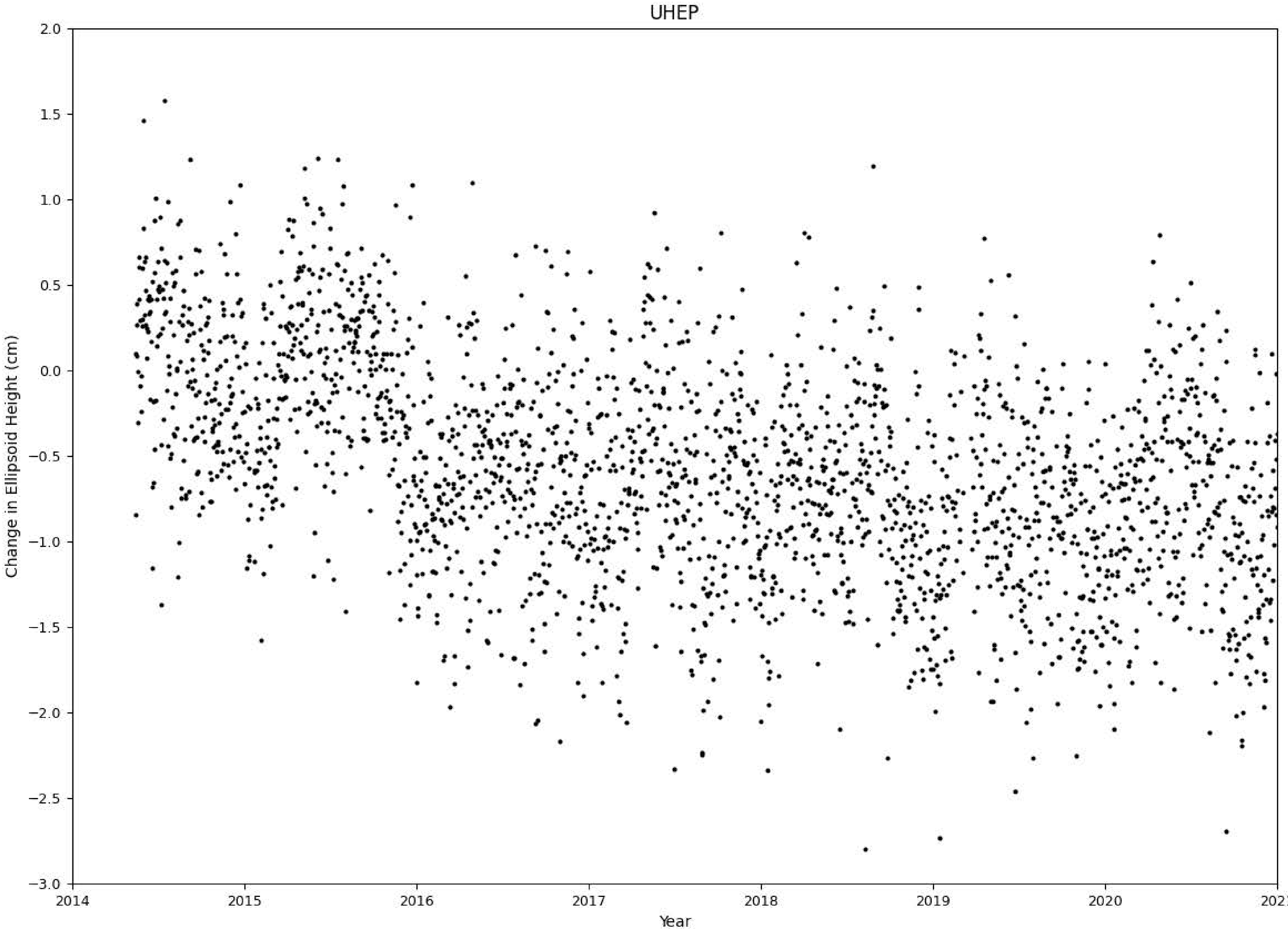
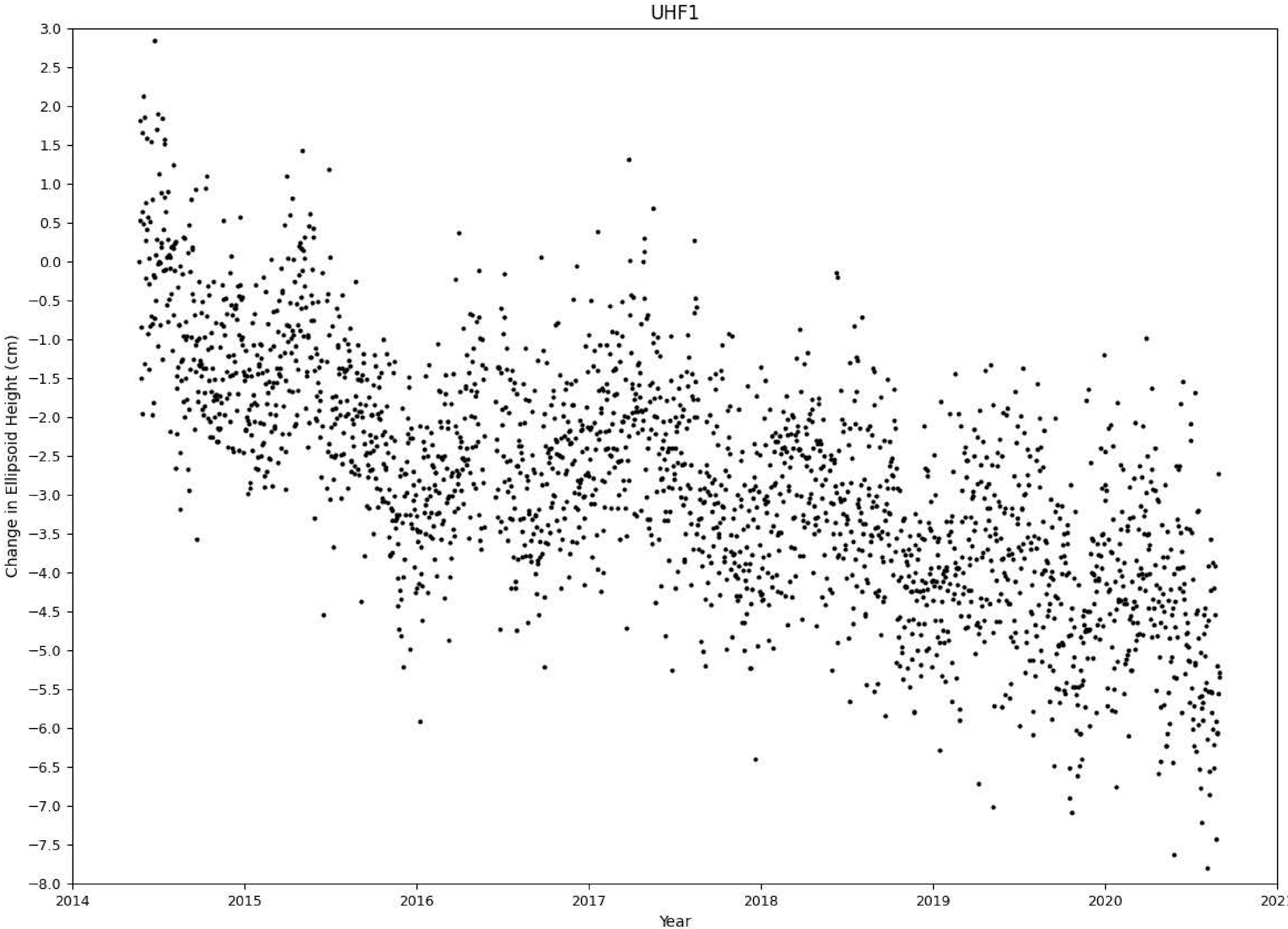
2019
2020
2021



UHEP
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
2014
2015
2016
2017
2018
2019
2020
2021


UHF1
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
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Change in Ellipsoid Height (cm)
2014
2015
2016
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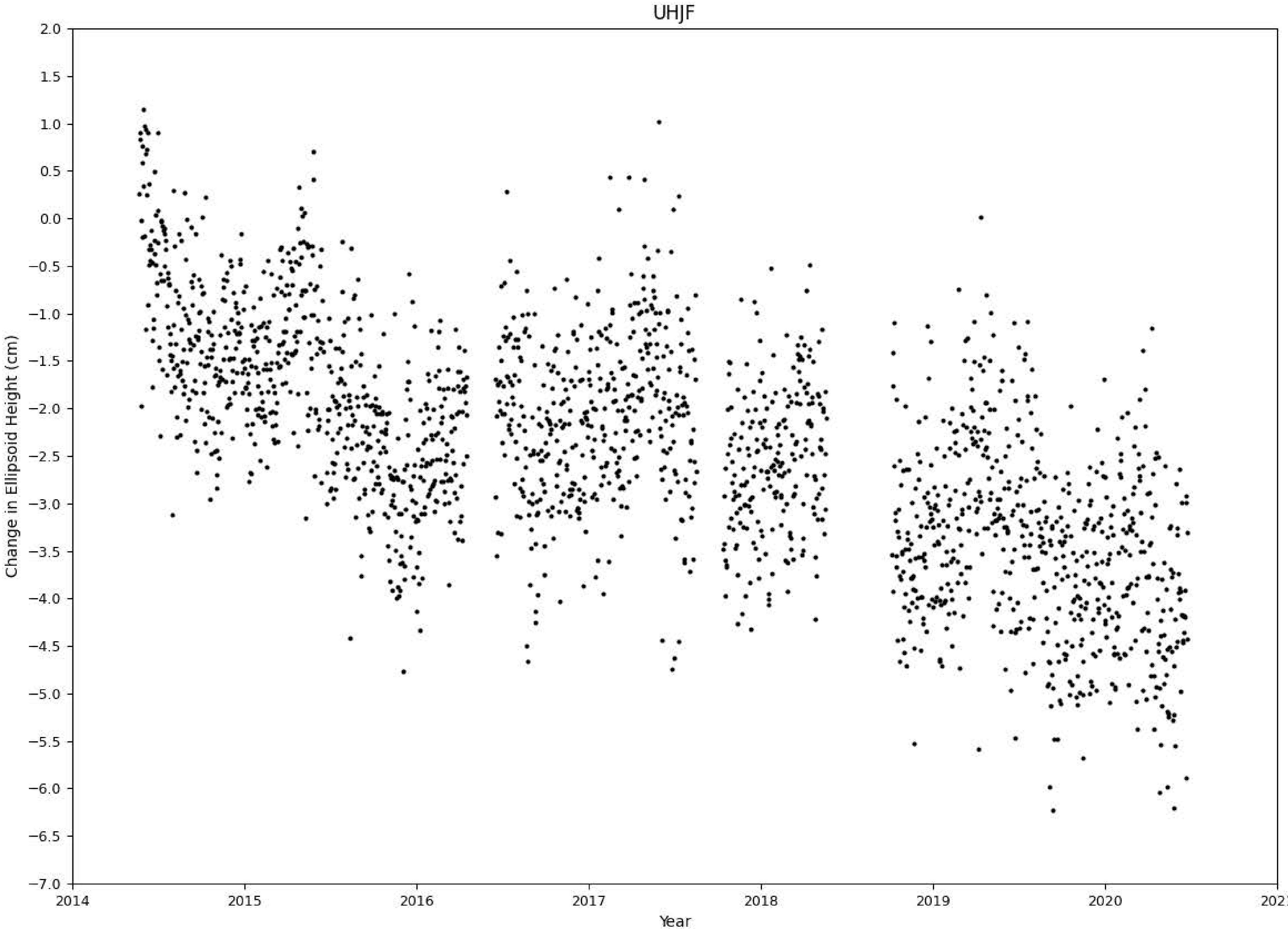
2018
2019
2020
2021
Year


UHJF
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
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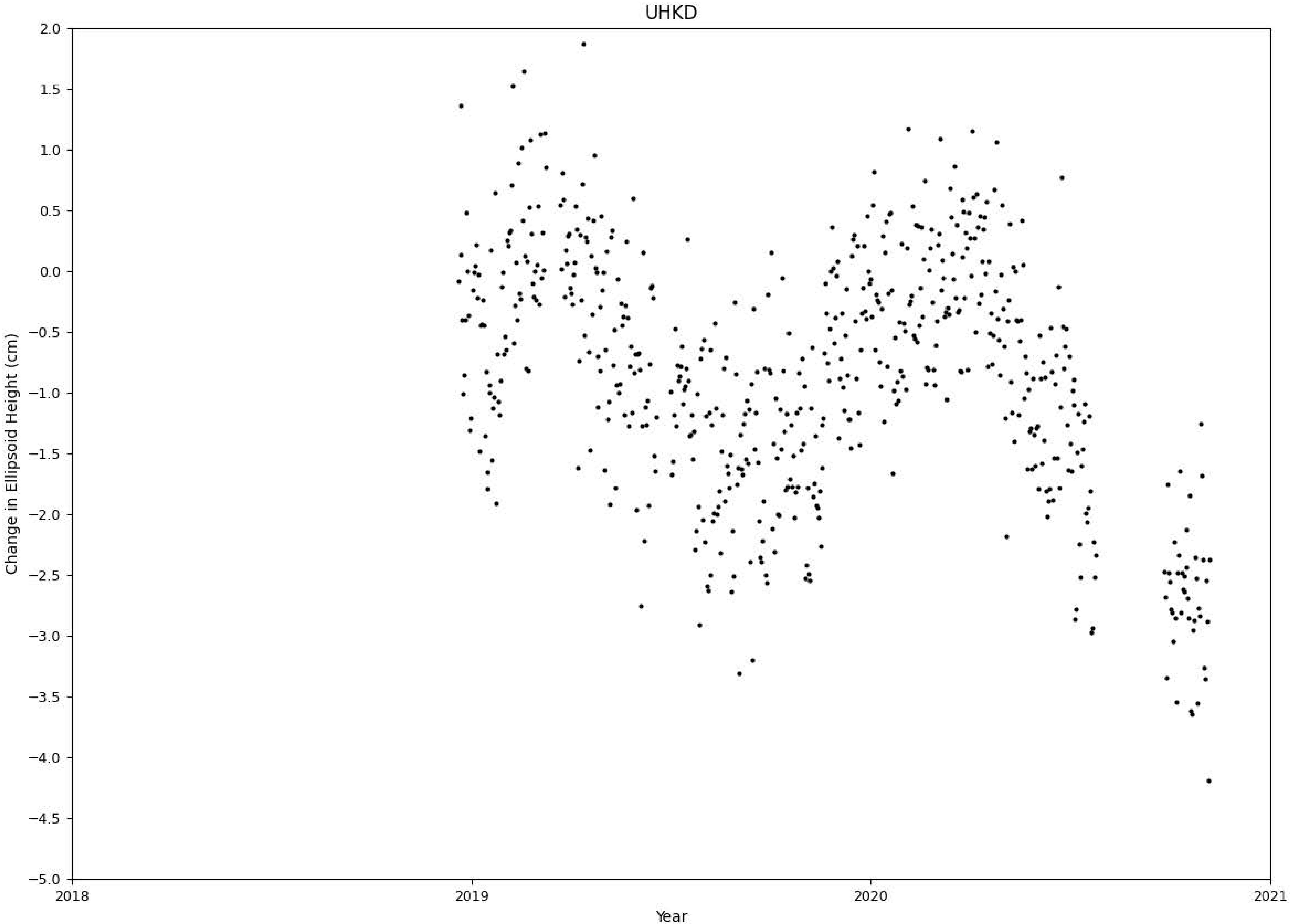
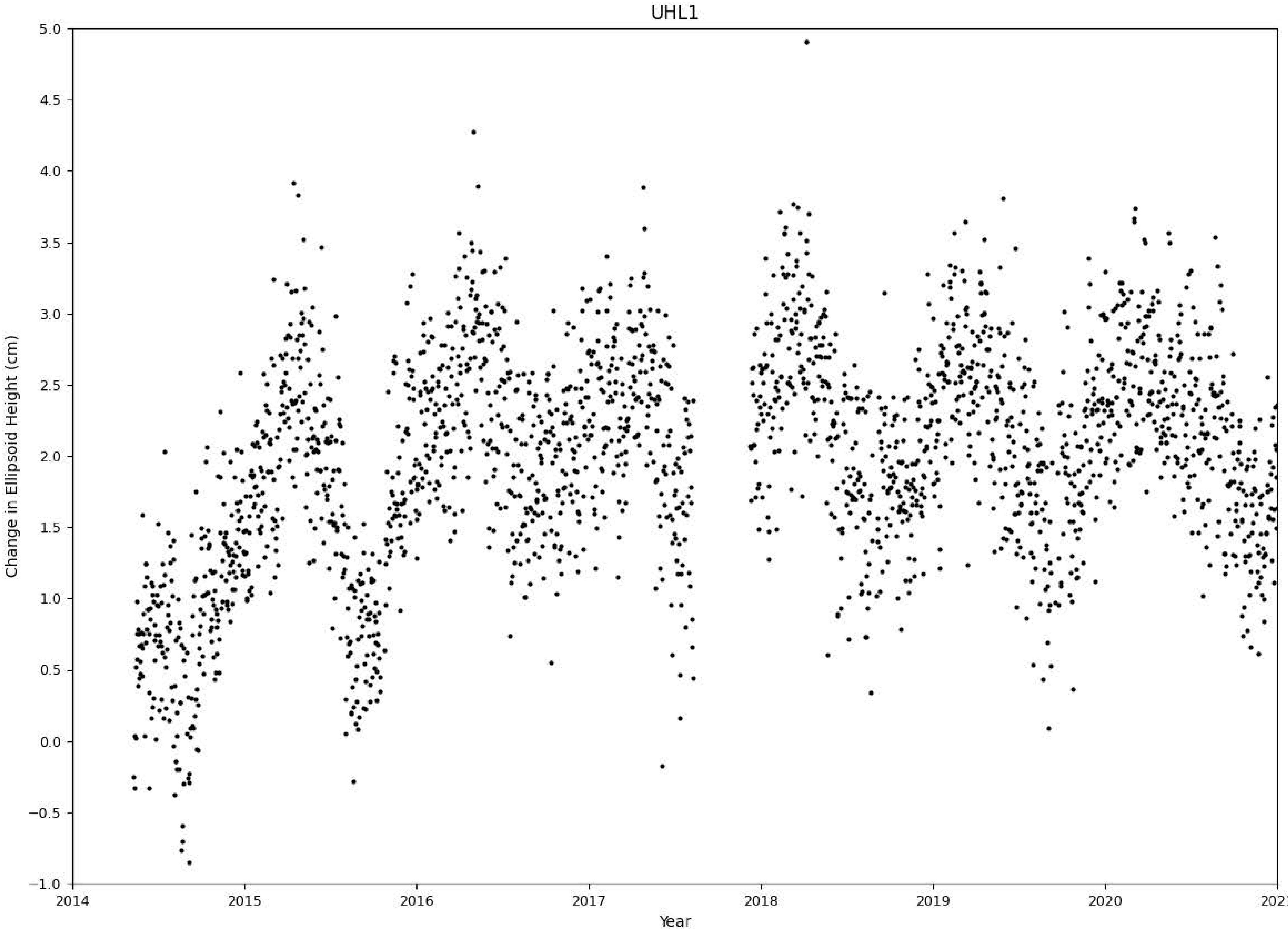
2019
2020
2021



UHKD
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2018
2019
2020
2021
Year


UHL1
Change in Ellipsoid Height (cm)
Year
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
2014
2015
2016
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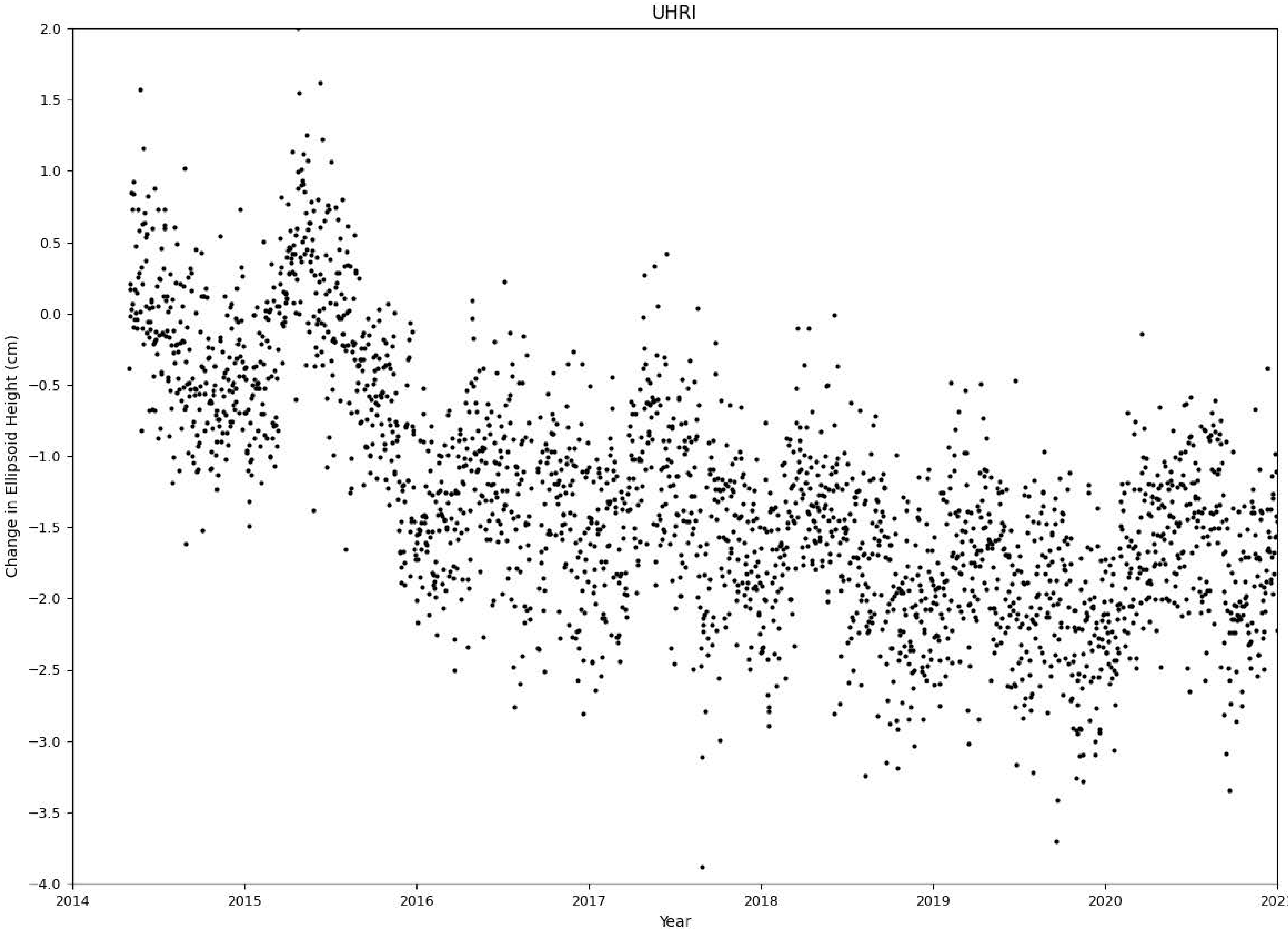
2018
2019
2020
2021



UHRI
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2014
2015
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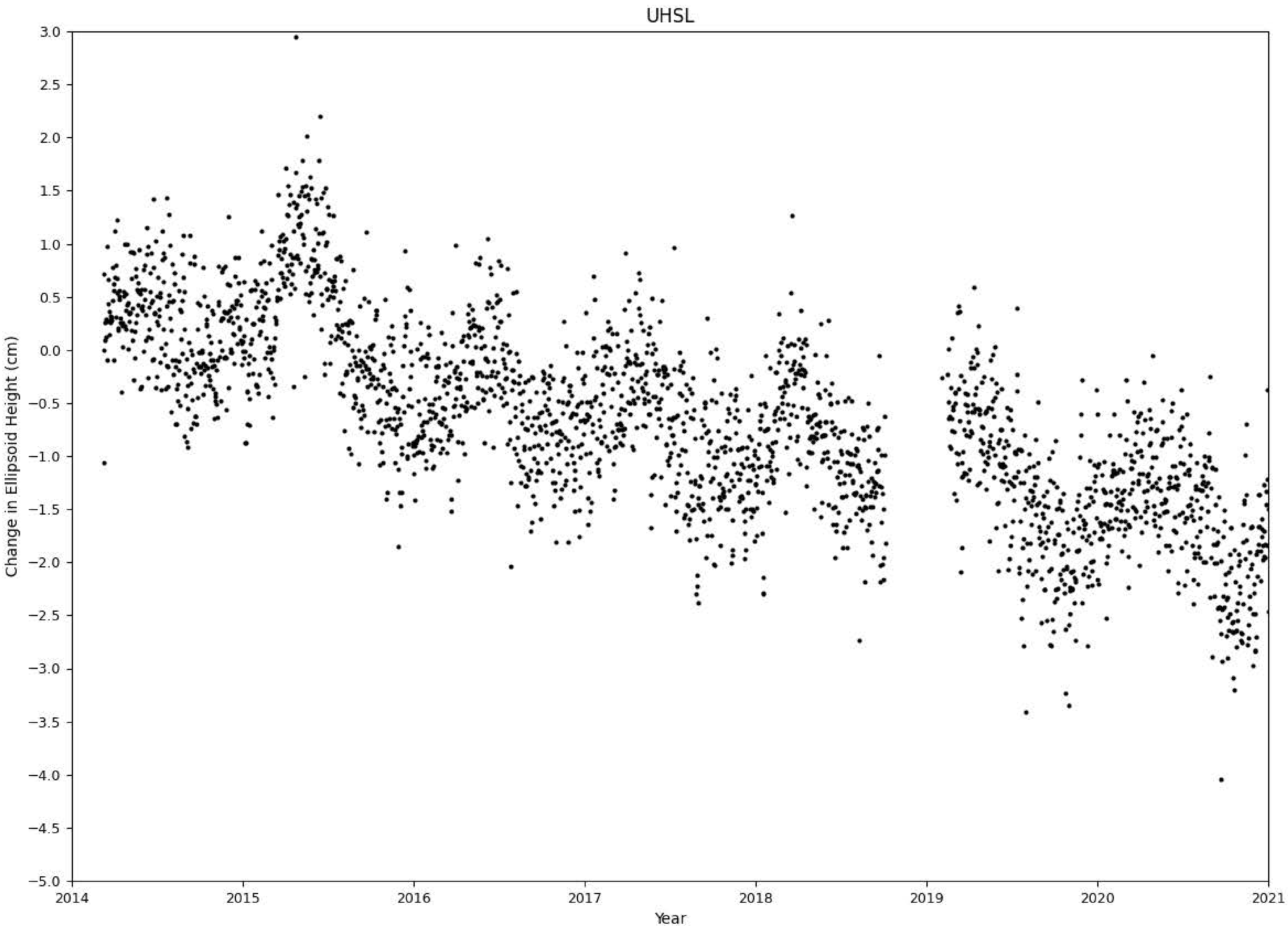
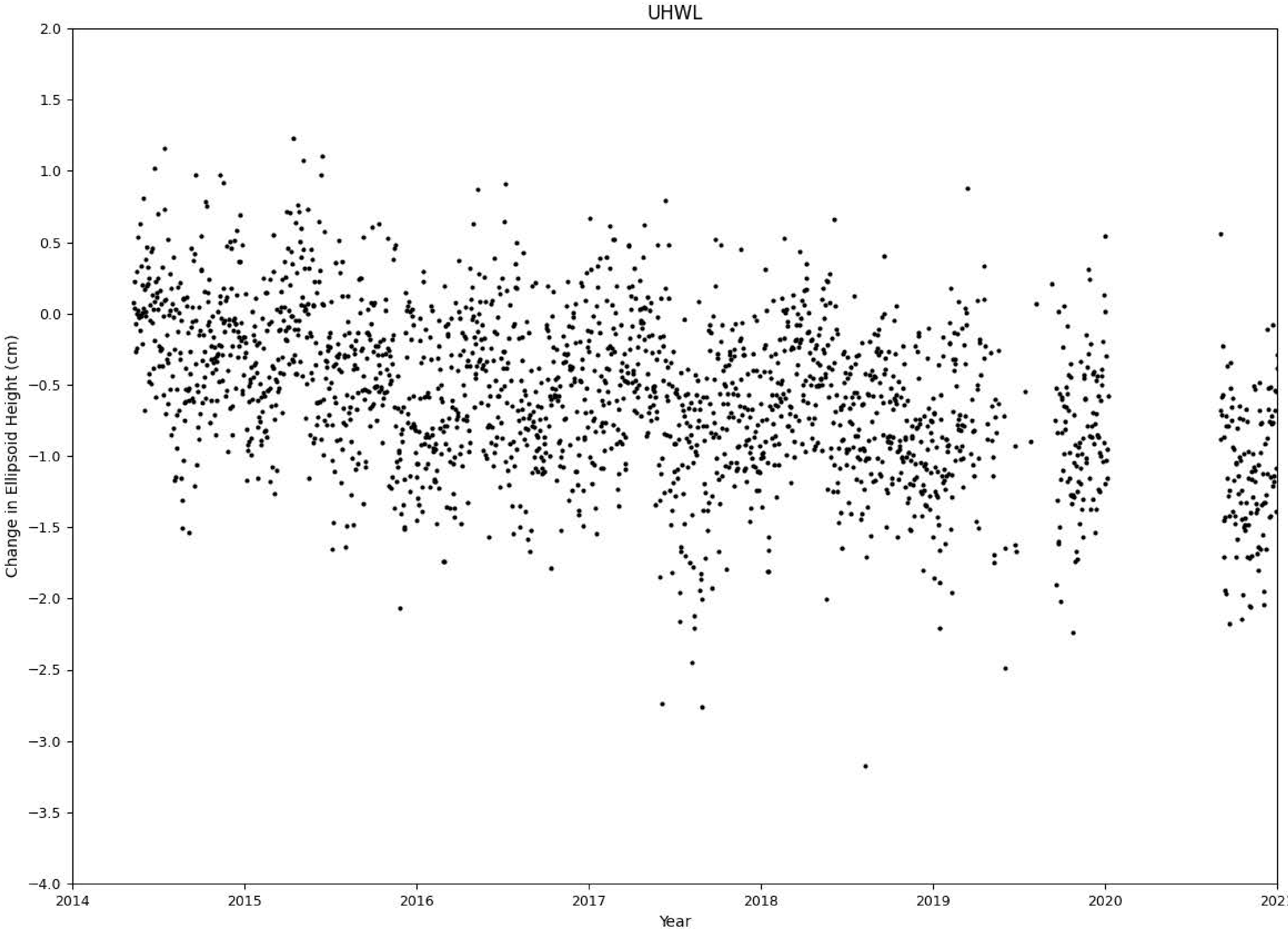
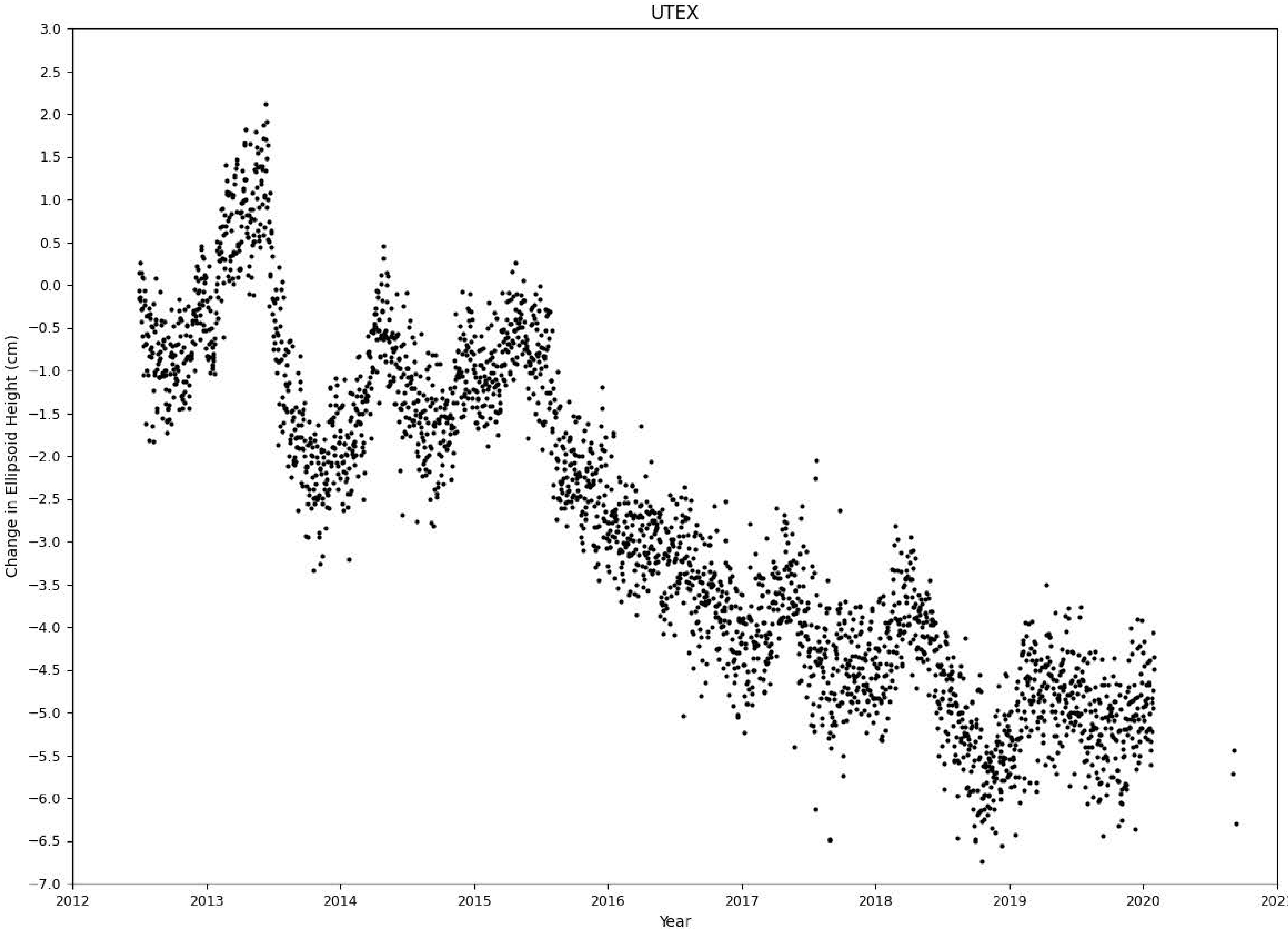
2020
2021

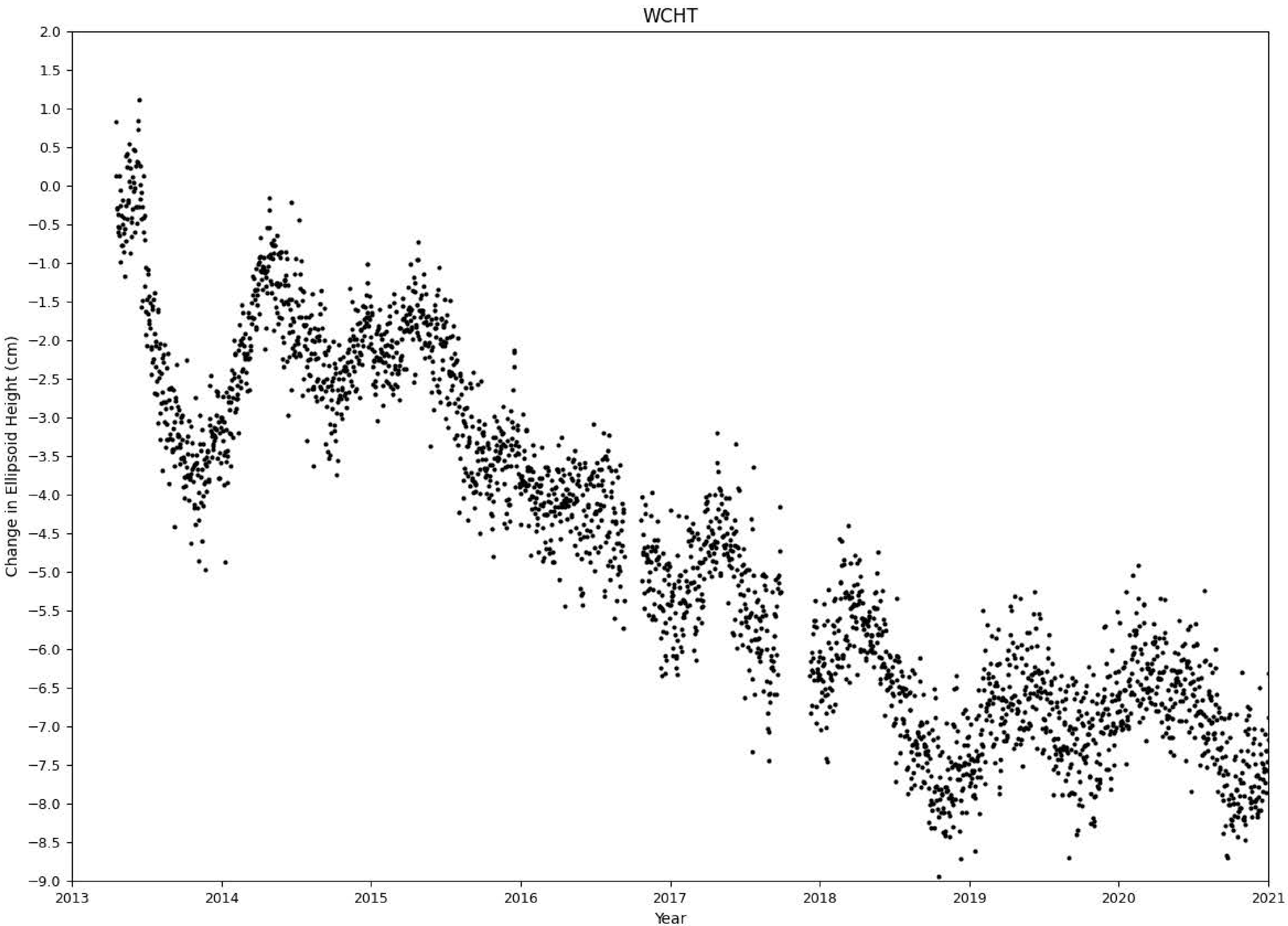

UHSL
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
2014
2015
2016
2017
2018
2019
2020
2021



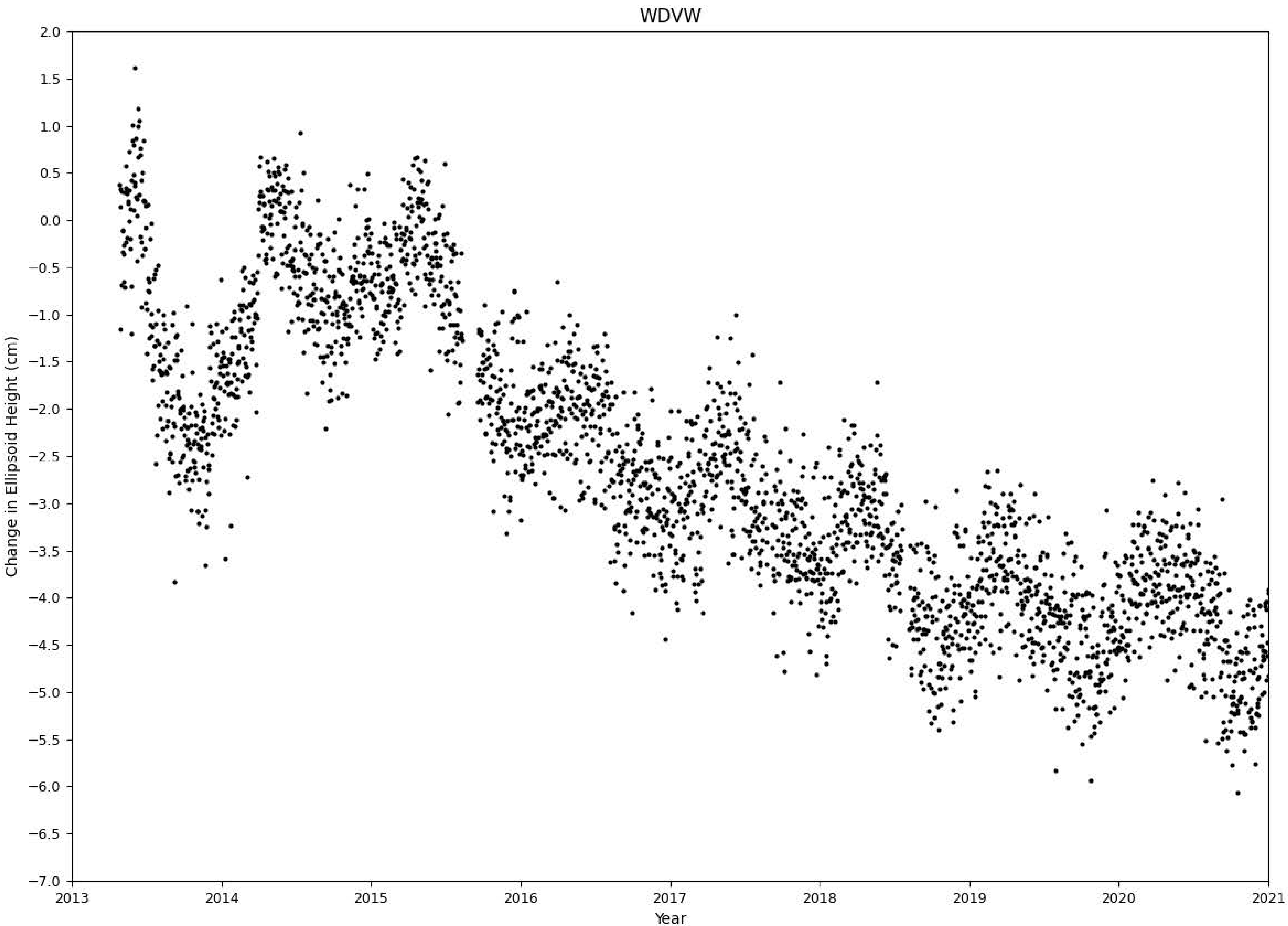
UHWL
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2014
2015
2016
2017
2018
2019
2020
2021

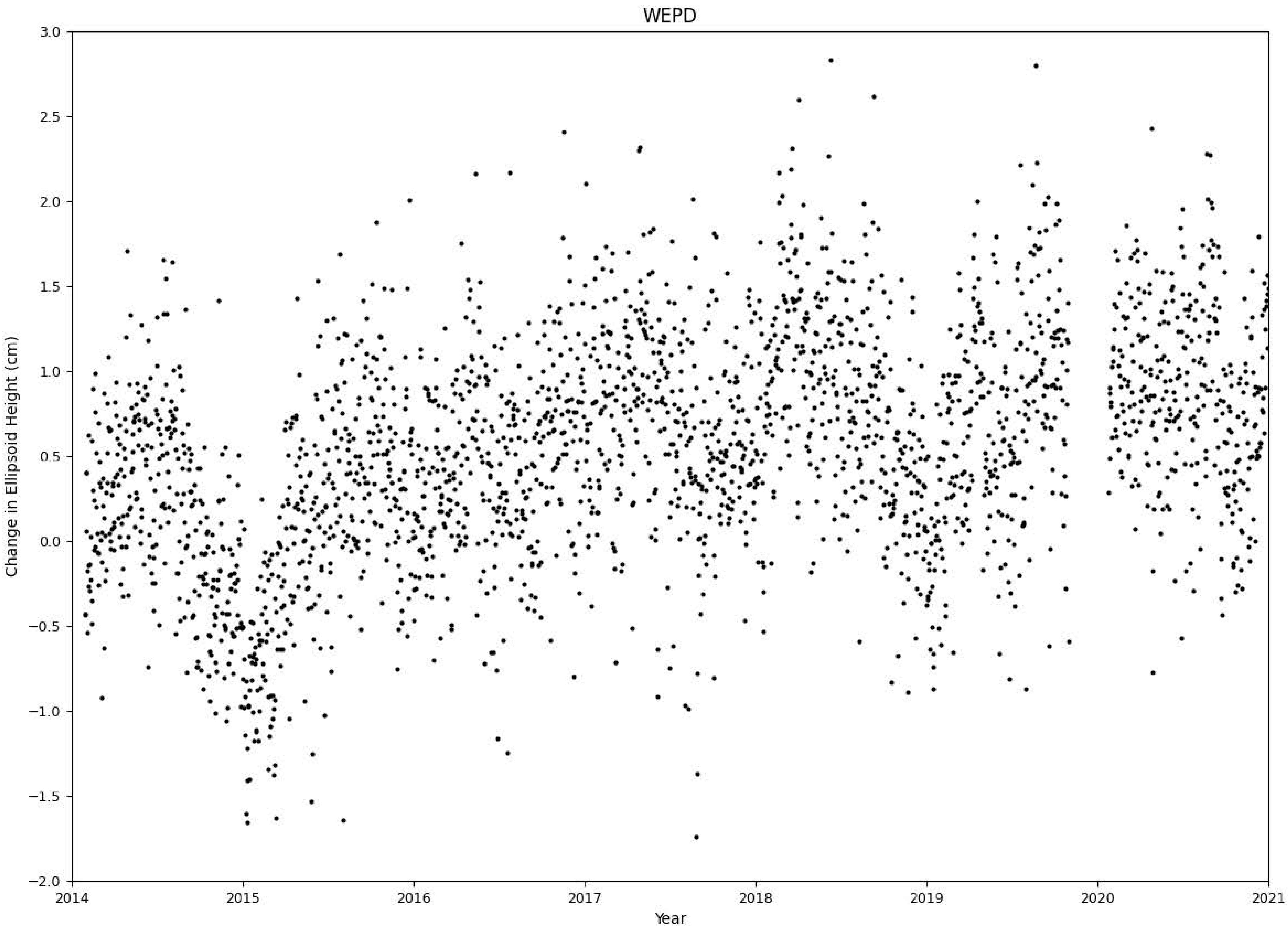


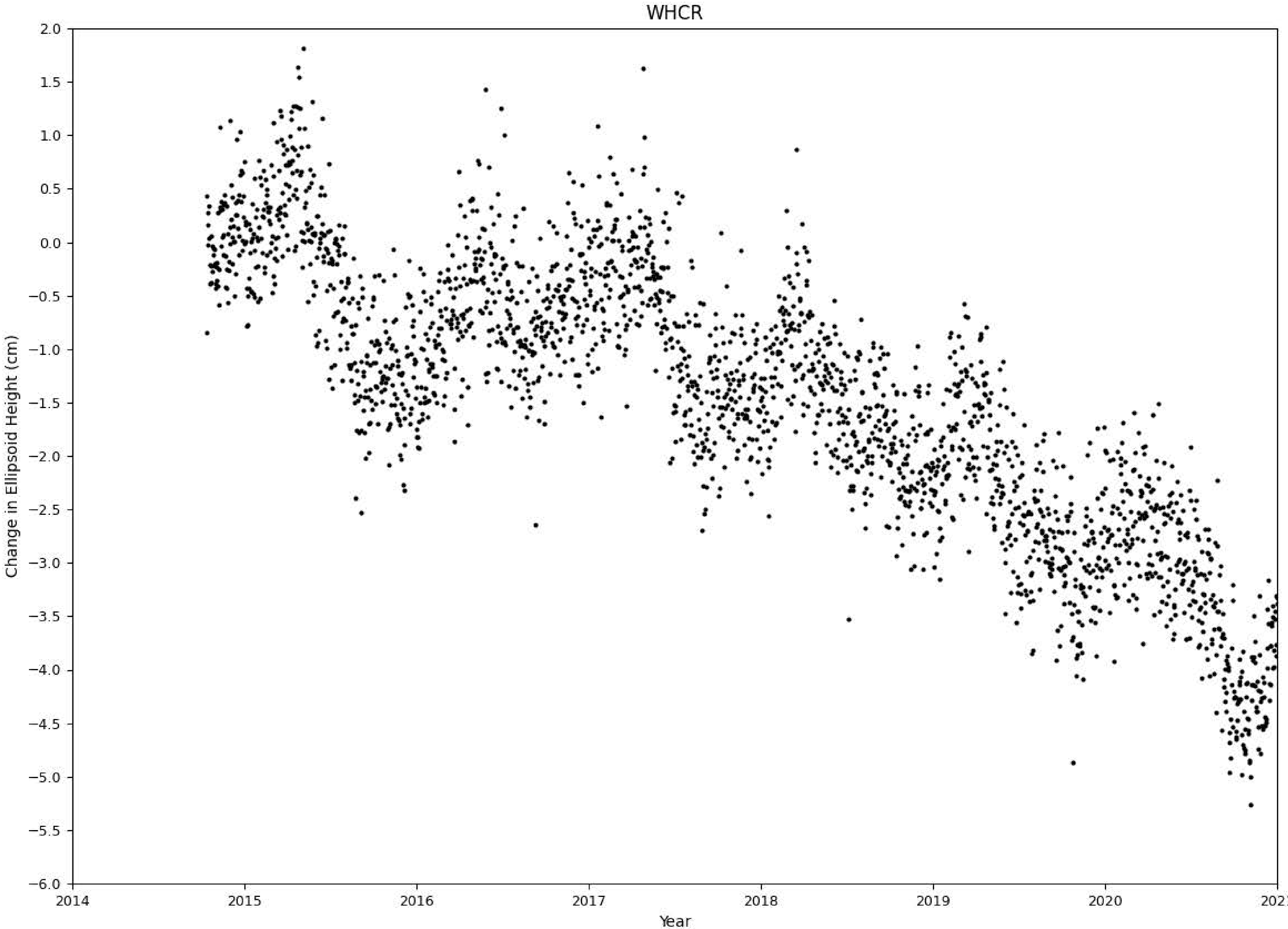
UTEX
Change in Ellipsoid Height (cm)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021



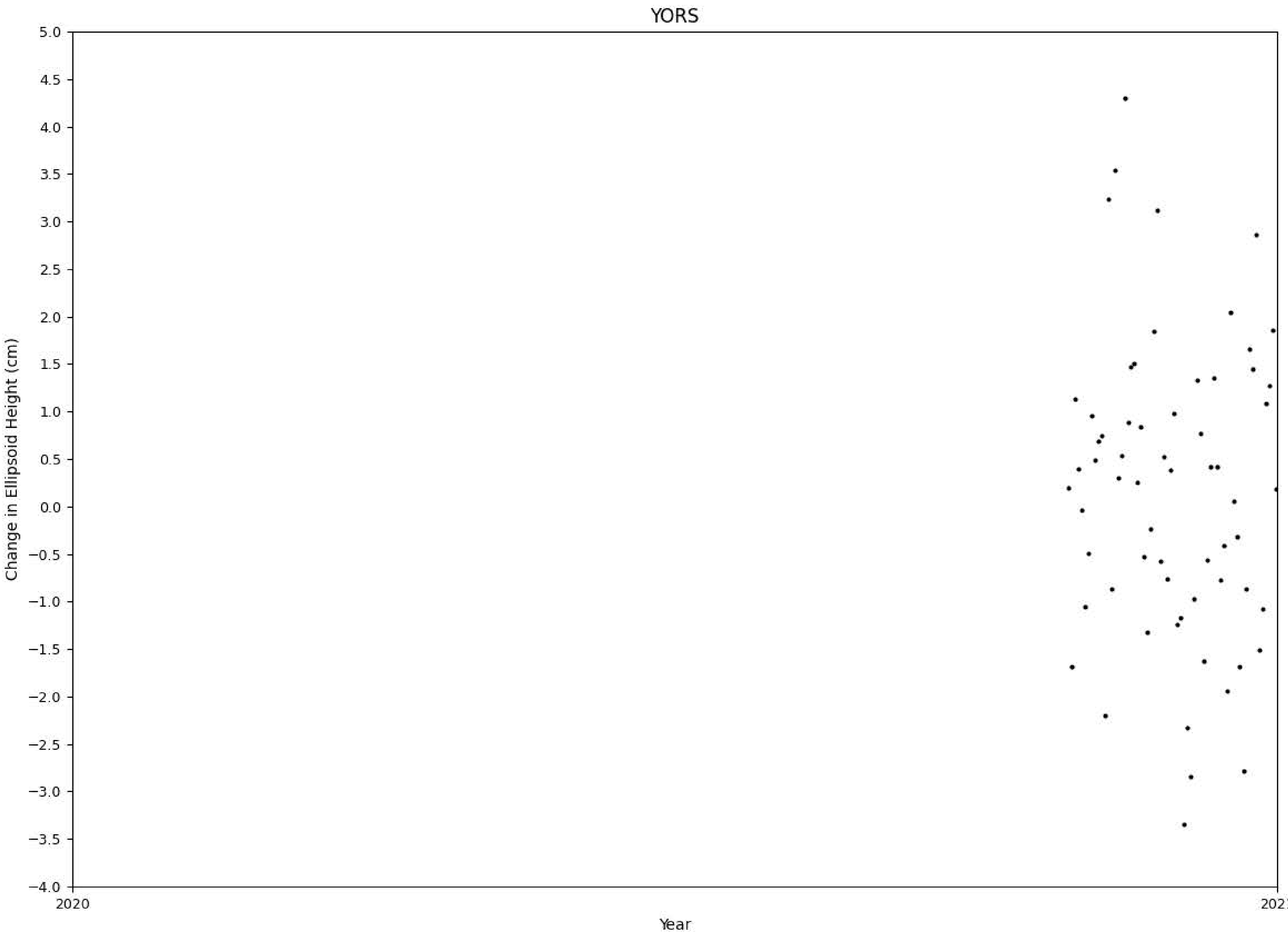
WCHT
Change in Ellipsoid Height (cm)
Year
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
2013
2014
2015
2016
2017
2018
2019
2020
2021


WDVW
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
−6.5
−7.0
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

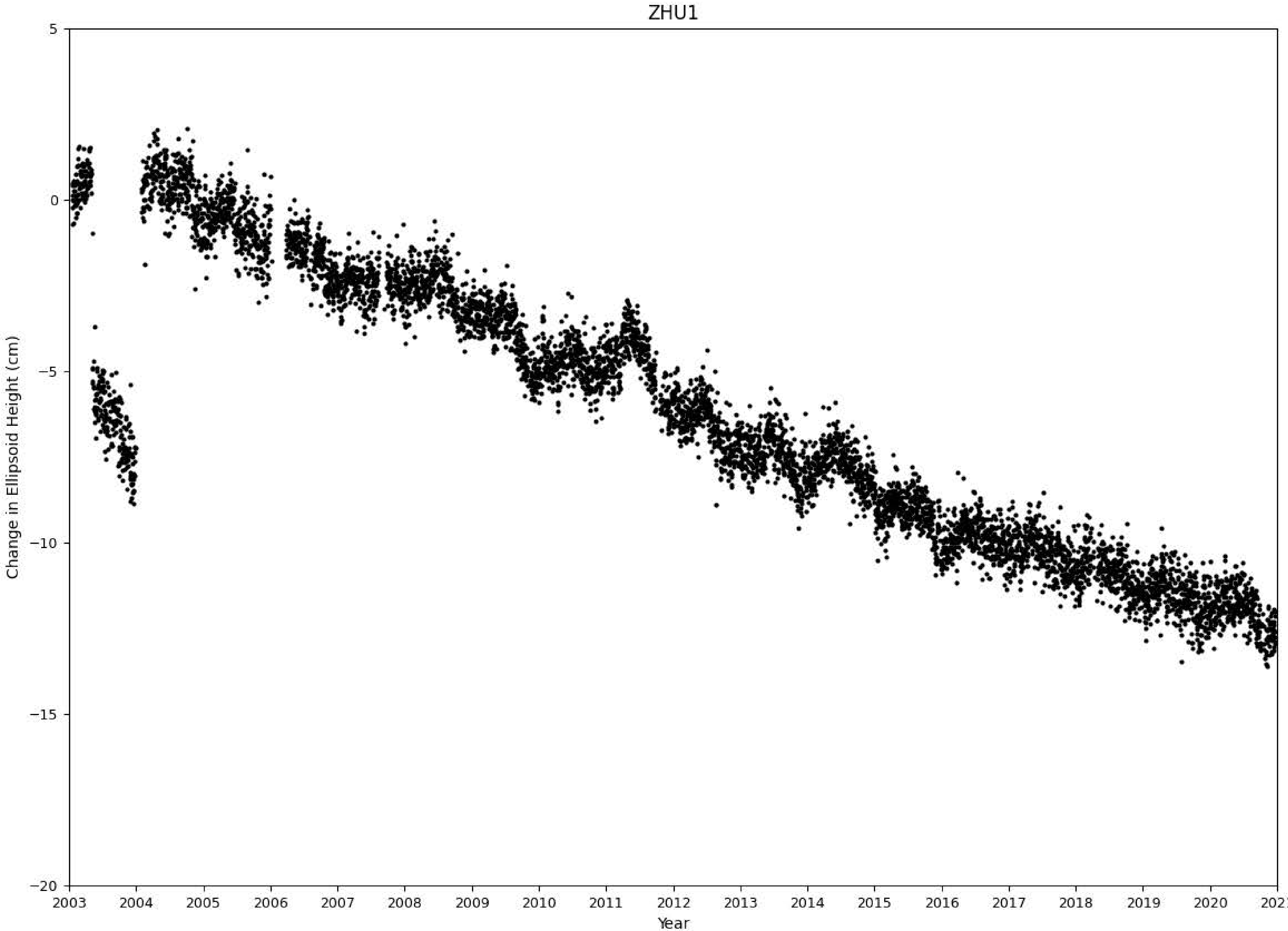

WEPD
Change in Ellipsoid Height (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
2014
2015
2016
2017
2018
2019
2020
2021
Year



WHCR
Change in Ellipsoid Height (cm)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5
−5.0
−5.5
−6.0
2014
2015
2016
2017
2018
2019
2020
2021
Year



YORS
Change in Ellipsoid Height (cm)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2020
2021
Year



ZHU1
Change in Ellipsoid Height (cm)
Year
5
0
−5
−10
−15
−20
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021