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Oskarshamn site investigation

Groundwater monitoring program

Report for December 2002 – October 2004

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Geosigma

November 2005

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Abstract

This document reports data obtained within the groundwater monitoring program, which is one of the activities performed within the site investigation at Oskarshamn. The objective of the groundwater monitoring is to support the hydrogeological characterization of the area and to document the groundwater conditions before a possible excavation.

Data presented in this report is collected from the beginning of the activity, i.e. from December 2002 until October 2004 and consists of groundwater level in boreholes. Meteorological and hydrological variables are also monitored within the framework of the site investigations but reported separately.

The data collecting system in HMS (Hydro Monitoring System) consists of two measurement stations (computers) which communicate with and collect data from a number of dataloggers. The computers are connected to the SKB Ethernet LAN. All data is collected by means of different transducers connected to different types of data loggers: Minitroll, Mitec and Datataker.

In order to calibrate registrations from the data loggers, manual levelling of all sections is made, normally once every month. The logger data is converted to water levels using the calibration constants. All data collected are subjected to a quality check, during which obviously erroneous data are removed and calibration constants are corrected so that the monitored data are consistent with the manual levelling. The status of the equipment is also controlled and service might be initiated.

Annual diagrams of groundwater levels for the years 2002–2004 (one data point per section and twenty-four hours is displayed) are presented in Appendix. The original results are stored in the primary data base SICADA. The data in this data base may then be used for further analysis.

There are no nonconformities with respect to the activity plan or the method description.

Sammanfattning

Denna rapport redovisar data erhållna inom grundvattenmoniteringsprogrammet, vilket är en av aktiviteterna inom platsundersökningen i Oskarshamn. Syftet med grundvattenmoniteringen är att stödja hydrogeologiska karakteriseringen av platsen och att dokumentera grundvattenförhållanden före en eventuell byggnation.

Data presenterade i rapporten är insamlade från början av aktiviteten, december 2002, till och med oktober 2004 och består av grundvattennivå i borrhål. Inom ramen för platsundersökningarna moniteras aven meteorologiska och ythydrologiska variabler, men dessa presenteras i en annan rapport.

Datainsamlingssystemet i HMS (Hydro Monitoring System) består av två mätstationer (datorer) vilka kommunicerar med och samlar in data från ett antal dataloggers. Datorn är förbunden med SKB:s nätverk. Alla data samlas in med hjälp av olika givare förbundna med olika typer av dataloggrar: Minitroll, Mitec och Datataker.

För att kunna kalibrera registreringarna från dataloggrarna utförs, vanligtvis en gång i månaden, manuell nivåregistrering (lodning) i alla sektioner. Loggerdata omvandlas till vattennivåer genom användande av kalibreringskonstanter. Alla insamlade data kvalitetskontrolleras. Under detta arbete tas uppenbart felaktiga data bort och kalibreringskonstanterna korrigeras så att automatiskt registrerade data överensstämmer med manuella nivåregistreringar. Vid dessa tillfällen kontrolleras utrustningens status och service kan initieras.

Årliga diagram över grundvattennivåerna för åren 2002–2004 (en datapunkt per sektion och 24 timmar redovisas) visas i Appendix. Ursprungsresultatet lagras i primärdatabasen SICADA. Data från denna databas kan användas för vidare analyser.

Aktiviteten har utförts i överensstämmelse med aktivitetsplanen och metodbeskrivningen.

Contents

1 Introduction

This document reports data collected within the groundwater monitoring program, which is one of the activities performed within the site investigation at Oskarshamn. The work was carried out in accordance with activity plan SKB AP PS 400-04-095. In Table 1-1, controlling documents for this activity are listed. Both the activity plan and the method descriptions are SKB's internal controlling documents.

Data presented in this report are collected from the beginning of the activity, i.e. December 2002, until October 2004. Groundwater levels from boreholes are collected.

The HMS (Hydro Monitoring System) is used to collect and store all data.

Table 1-1. Controlling documents.

Activity plan	**Number**	**Version**
Platsundersökning i Oskarshamn - Grundvattenmonitering 2004	AP PS 400-04-095	1.0 (in prep.)
Method descriptions	**Number**	**Version**
Metodbeskrivning för grundvattenmonitering vid SKB:s platsundersökningar	SKB MD 360.002	1.0

2 Objective and scope

The objective of the groundwater monitoring program during the site investigation is to establish normal baseline conditions of the natural variations of the groundwater levels prior to the potential excavation for a nuclear waste repository and to support the hydrogeological characterization of the site. Data collected within this activity are:

- groundwater level and pressure in boreholes.

There are also some parameters that are used for monitoring of the function of the measurement system itself. However, these are not reported herein.

The following numbers of boreholes were monitored at the end of October 2004 in the Oskarshamn site investigation:

- 12 core boreholes,
- 21 percussion boreholes,
- 19 soil wells.

The locations of the boreholes monitored during the reporting period are shown in Figure 2-1. A list of these boreholes along with some basic information is compiled in Table 2-1 and in Table 5-1.

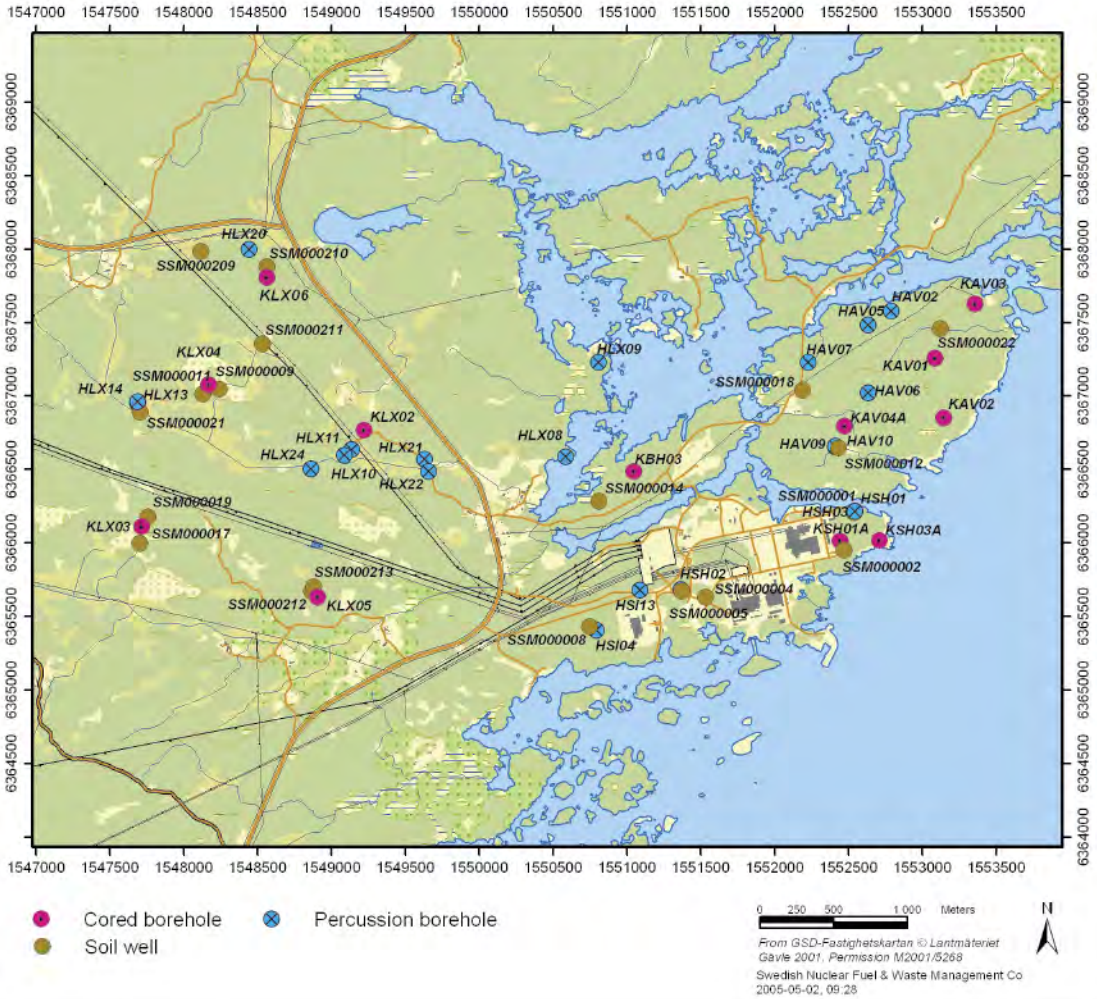


Figure 2-1. *General overview over the Oskarshamn site investigation area showing the location of monitored boreholes and soil wells.*

Table 2-1. Borehole length, inclination, elevation at top of casing (TOC) and date for the completion of drilling.

Borehole	Borehole length (m)	Inclination at ground (°)	Elevation at TOC (m a s l)	Drilling completed	Length of casing (m)	Comment
HAV02	163	–89.1	6.11	1986-08-21	?	
HAV05	100	–54.5	6.86	1987-07-28	1.00	
HAV06	100	–59.5	12.42	1987-07-30	1.20	
HAV07	100	–56.2	4.17	1987-07-28	4.00	
HAV09	200.2	–68.0	2.17	2003-10-16	14.90	
HAV10	100	–68.5	2.23	2003-10-22	11.90	
HLX08	40	–47.8	2.22	1991-11-14	6.00	
HLX09	151	–61.3	3.31	1991-11-21	3.00	
HLX10	85	–68.7	11.74	1992-09-30	3.00	Drilling-water well 04-03-18 – *
HLX11	70	68.5	13.15	1992-10-01	6.00	
HLX13	200.2	–58.1	17.39	2004-02-26	11.85	
HLX14	115.9	–68.6	17.11	2004-03-11	11.90	Drilling-water well 04-06-01 – 04-10-06 *
HLX20	202.2	–60.4	11.18	2004-06-21	9.03	Drilling-water well 04-10-06 – 05-04-06 *
HLX21	150.3	–57.0	10.31	2004-09-02	9.03	
HLX22	163.2	–59.4	10.06	2004-08-26	9.03	
HLX24	175.2	–58.4	12.77	2004-09-09	9.03	
HSH01	200	–70.0	2.86	2002-07-02	12.00	
HSH02	200	–80.1	6.65	2002-07-08	12.00	
HSH03	201	–79.5	2.52	2002-07-09	12.00	Drilling-water well 02-12-04 – 04-05-25 *
HSI04	37	–58.5	6.63	1995-02-02	?	
HSI13	4.0	–90.0	5.54	1980-02-02	?	
KAV01	502.0			1977-05-16		
	746.6			1986-11-16		
	757.31	–89.2	14.1	2004-01-10	68.04	
KAV02	97.1	–89.5	7.55	1977-05-31	12.40	
KAV03	248.4	–89.4	8.74	1986-10-05	2.80	
KAV04A	1,004	–84.9	10.35	2004-05-03	100.00	
KBH03	100.43	–84.7	7.82	2004-02-13	24.97	
KLX02	1,700.5	–85.0	18.4	1992-11-29	202.95	
KLX03	1,000.42	–74.9	18.49	2004-09-07	100.05	
KLX04	993.49	–84.7	24.09	2004-06-28	12.24	
KLX05	1,000.16	65.1	17.61	2005-01-22	15.00	
KLX06	994.94	–65.2	17.68	2004-11-25	11.88	
KSH01A	1,003	–80.8	5.32	2002-12-18	12.10	
KSH03A	1,000.7	–59.4	4.17	2003-11-07	100.05	
SSM000001	3.0	–86.7	2.79	2002-10-08		
SSM000002	3.0	–87.0	2.40	2002-10-08		
SSM000004	3.0	–74.3	5.49	2002-12-12		
SSM000005	2.2	–67.5	6.98	2002-12-12		
SSM000008	7.6	–88.2	4.64	2003-12-08		

Borehole	Borehole length (m)	Inclination at ground (°)	Elevation at TOC (m a s l)	Drilling completed	Length of casing (m)	Comment
SSM000009	5.7	–88.7	15.32	2004-01-29		
SSM000011	3.8	–88.6	16.50	2004-01-29		
SSM000012	9.5	–86.0	1.77	2004-01-22		
SSM000014	6.4	–85.9	1.64	2003-12-09		
SSM000017	2.15	–81.2	10.98	2004-05-04		
SSM000018	6.4	–86.2	0.78	2003-12-11		
SSM000019	3.1	–82.8	13.21	2004-05-04		
SSM000021	4.15	–86.4	12.63	2004-05-04		
SSM000022	11.4	–87.7	5.03	2004-01-12		
SSM000209	4.5	–87.8	10.85	2004-06-29		
SSM000210	4.1	–87.7	11.31	2004-06-28		
SSM000211	5.2	–83.0	15.27	2004-06-30		
SSM000212	4.1	–87.8	13.58	2004-07-05		
SSM000213	4.0	–85.0	12.38	2004-07-06		

* During this period water level data is stored in the DMS (Drilling Monitoring System) and is not presented in this report.

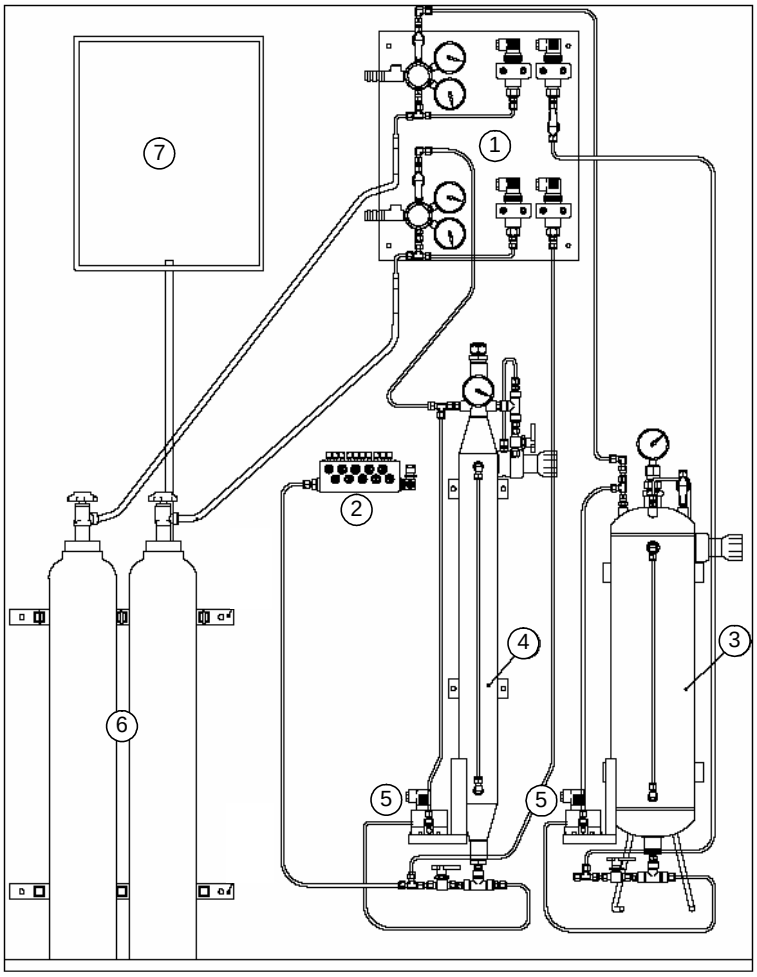
3 Equipment

3.1 Description

A drawing of the ground surface equipment used for percussion and core boreholes is shown in Figure 3-1.

A drawing of the downhole borehole equipment for permanent instrumentation in core boreholes is presented in Figure 3-2. Instrumentation in percussion boreholes is shown in Figure 3-3.

In open boreholes, a transducer or data logger is submerged in the groundwater without any other equipment. No drawing is presented.



Regulator panel with pressure transducers for supervision of packer pressure in borehole packers and mini-packers (1)

Branching unit for mini-packer system (2)

Pressure vessels for borehole packer (3) and mini-packer system (4)

Differential pressure transducers measuring level in pressure vessels (5)

Gas bottles for borehole packer and mini-packer system (6)

Electrical distribution box (7)

Figure 3-1. *Example of ground surface equipment for percussion and core boreholes.*

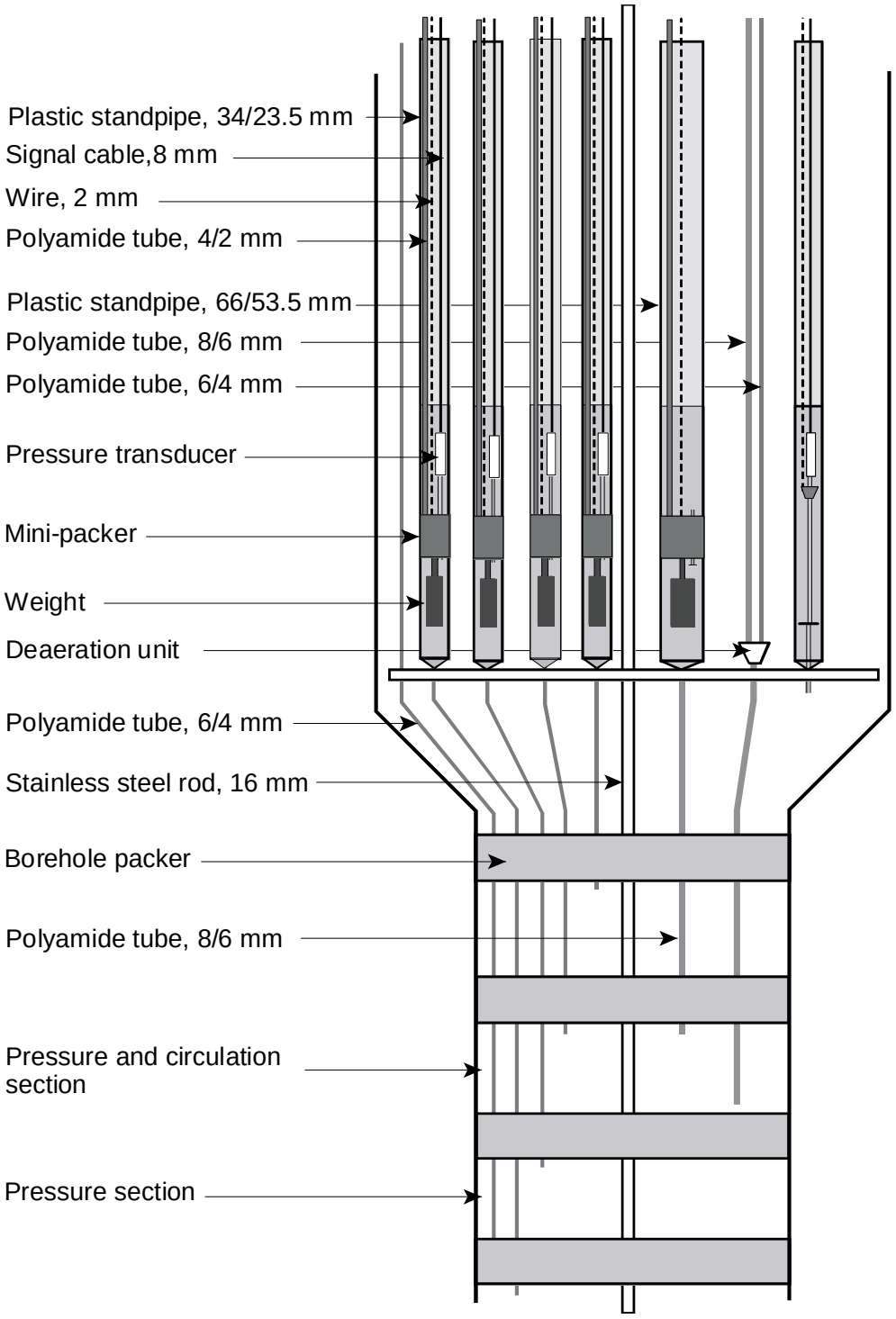


Figure 3-2. *Example of permanent instrumentation in core boreholes with a circulation section.*

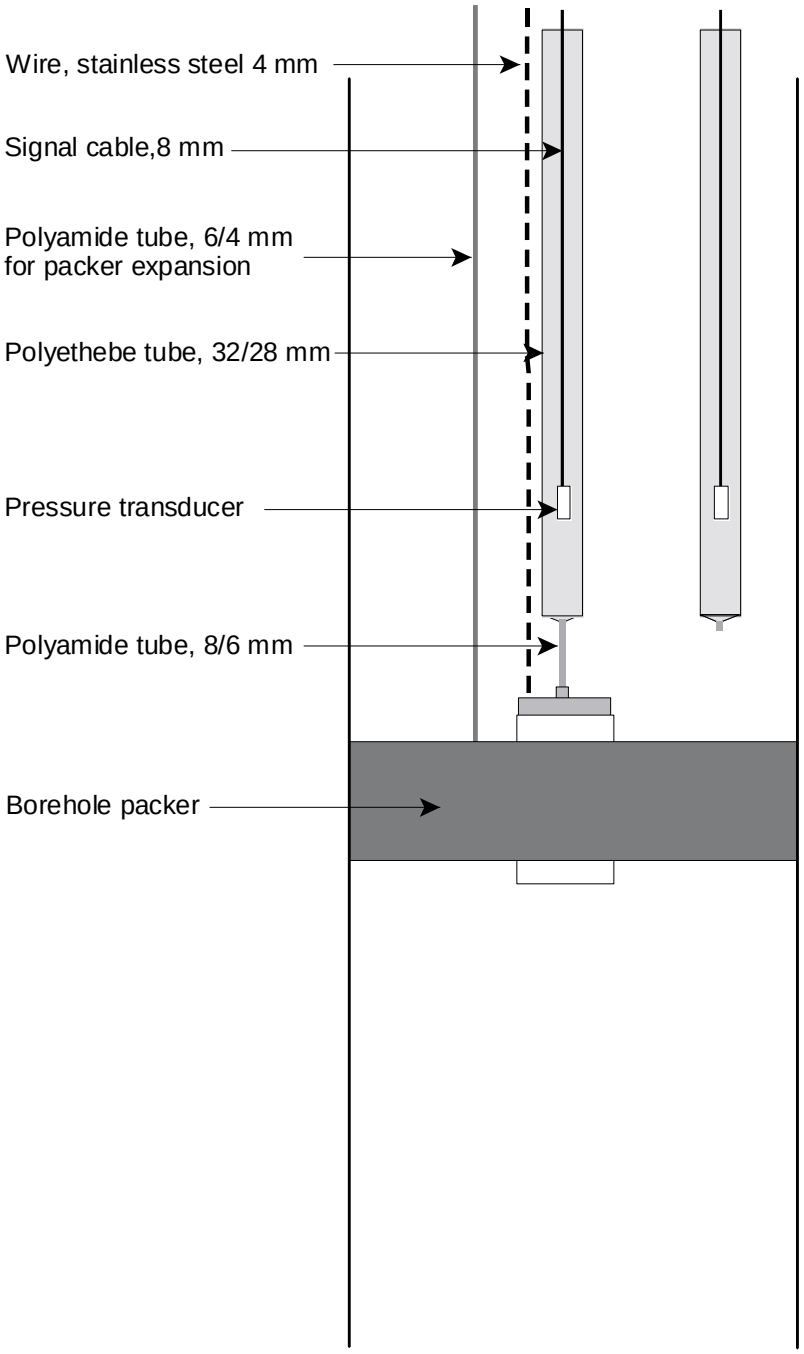


Figure 3-3. *Example of instrumentation in percussion boreholes.*

3.2 Data collection

The data collecting system, which is a part of the Hydro Monitoring System (HMS), consists of two measurement stations (computers). A measurement station collects data from a number of data sources, see Figure 3-4. The computers are connected to the SKB Ethernet LAN.

The on-line system is designed to be able to handle short interruptions in the communication. Data can be stored for at least a couple of hours in the loggers. All data are finally stored in the main measurement station. Tape backup is made of all data.

All data is collected by means of different types of pressure transducers connected to different types of data loggers or by manual levelling. The following data loggers are used:

Minitroll: a single channel data logger of stand-alone type where the transducer is integrated in the logger. The logger is submerged in the groundwater.

Mitec: a data logger connected on-line by means of GSM telephony. A pressure transducer of the type Druck PTX is connected to the logger. Only the transducer is submerged in the groundwater. The logger has two or four channels. During monitoring in boreholes, one channel is used for monitoring of the battery voltage and the other ones can be used for pressure monitoring.

Datataker: a data logger connected on-line by means of radio or network. The logger has 42 channels and is used only for monitoring in percussion and cored boreholes.

Monitored data which has been quality assured is to be transferred quarterly to the site characterization database, SICADA. This function is still under development.

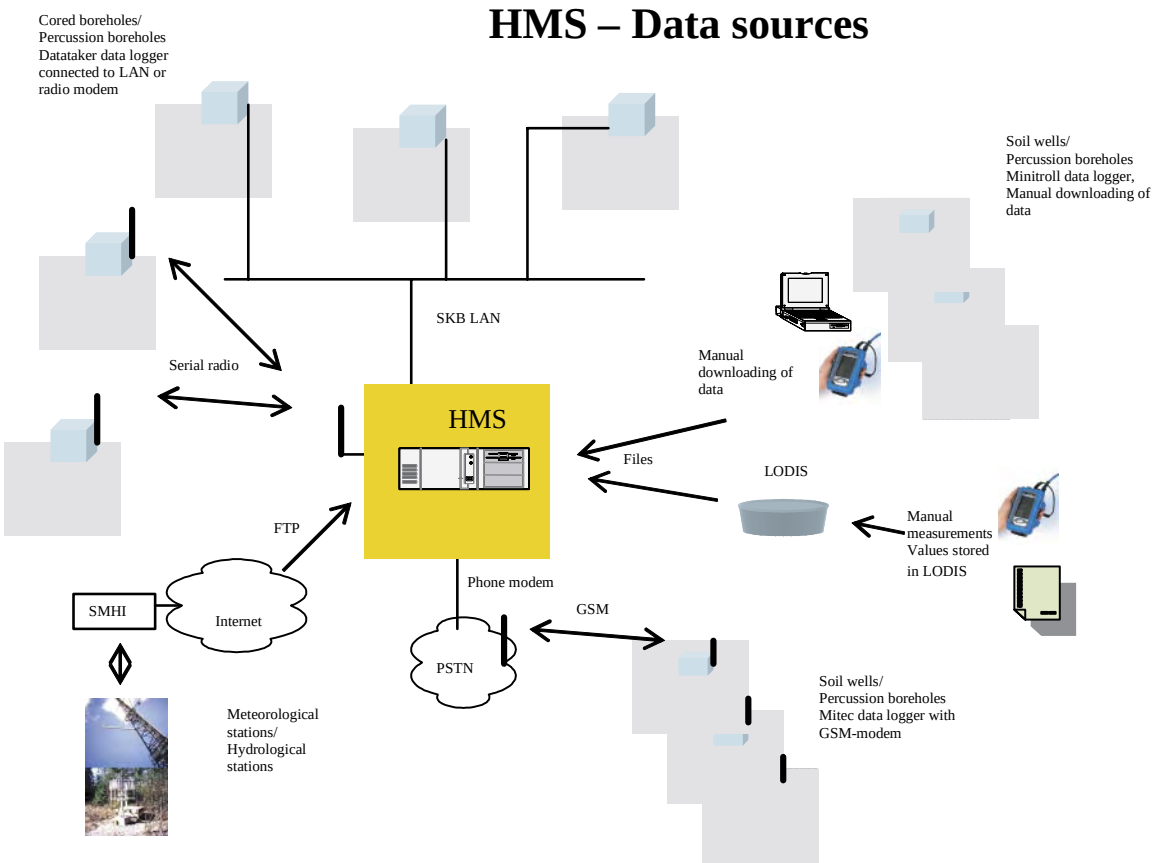


Figure 3-4. *HMS data sources.*

4 Execution

4.1 General

Data is collected to the measurement system, HMS, as described in Chapter 3.

4.2 Field work

Manual levelling is generally performed once a month. At the same time, the equipment is checked and maintenance is performed.

All data from stand-alone type loggers are manually dumped into a portable PC or PDA and then transmitted to the measurement station.

4.3 Data handling

4.3.1 Calibration method

Manual levelling of all sections is made, normally once every month, in order to calibrate the registrations from the data loggers.

The logger data is transformed to water levels by means of a linear calibration equation and also by subtracting the air pressure since all transducers give the absolute pressure. Converted logger data are then compared with results from manual levelling. If the two differs, calibration constants are adjusted until an acceptable agreement is obtained.

4.3.2 Recording interval

For stand-alone loggers, measurements of the groundwater level are normally made with one minute intervals and for GSM-connected data loggers with ten minute intervals. For all other data loggers connected on-line, levels are normally measured once every minute.

Measured values are not stored unless they differ from the previously stored value by more than 0.1 m for percussion and core boreholes, and 0.05 m for probing boreholes. In addition to this, a value is stored every two hours.

4.4 Quality assurance

Once every week a preliminary inspection of all collected data is performed. The purpose of this is to certify that all loggers are sending data and that all transducers are functioning.

Quarterly, all data collected is subject to a quality check. During this Q/A, obviously erroneous data are removed and calibration constants are corrected so that the monitored data correspond with the manual levelling data (see section 4.3.1). At this occasion, the status of the equipment is also checked and service might be initiated by means of e-mailing the client.

4.5 Nonconformities

There are no nonconformities with respect to the activity plan or the method description.

5 Results

5.1 General

The results are stored in the primary data base SICADA. The data in this data base may then be used for further analysis.

5.2 Groundwater levels

Annual diagrams of groundwater levels are presented in Appendix. All levels in the diagrams are given as meters above sea level in the national elevation system (RT90-RHB70).

In the diagrams, one data point per section and twenty-four hours is displayed. The data point shown is the first stored data point after midnight. When registrations are missing, manually levelled data, if available, are inserted.

A list of monitored borehole sections is presented in Table 5-1, where the lengths along the boreholes to top and bottom of each section are given.

Table 5-1. Monitored sections.

Borehole	Section no	Section installed		Borehole Length **		Comment
		from	to	from (m)	to (m)	
HAV02	1	2004-05-17		16.0	163.0	
	2	2004-05-17		0.0	15.0	Not monitored
HAV05	1	2004-05-17	2004-11-18	16.0	100.0	
	2	2004-05-17	2004-11-18	0.0	15.0	Not monitored
HAV06	1	2004-05-04		17.0	100.0	
	2	2004-05-04		0.0	16.0	
HAV07	1	1987-08-24	2004-06-11	0.0	100.0	
HAV09	1	2003-10-17		0.0	200.0	
HAV10	1	2004-02-26	2004-11-18	0.0	100.0	
HLX08	1	2004-06-21		0.0	40.0	
HLX09	1	2004-05-05		17.0	151.0	
	2	2004-05-05		0.0	16.0	
HLX10	1	n/a		3.0[1/]	85.0	Manual levelling when used as drilling-water well
HLX11	1	2004-05-06		14.0	70.0	
	2	2004-05-06		0.0	13.0	
HLX13	1	2004-02-27		0.0	202.2	
HLX14	1	2004-11-15		11.0	115.9	
	2	2004-11-15		0.0	10.0	Not monitored
HLX20	1	2004-09-02	2004-10-06	0.0	202.0	
HLX21	1	2004-09-06	2004-11-03	0.0	150.3	
	1	2004-11-03	2004-12-15	11.0	150.2	
	2	2004-11-03	2004-12-15	0.0	10.0	Not monitored
	1	2004-12-16		81.0	150.2	

Borehole	Section no	Section installed from	to	Borehole Length ** from (m)	to (m)	Comment
	2	2004-12-16		0.0	80.0	
HLX22	1	2004-09-06	2004-12-17	0.0	163.2	
	1	2004-12-17		86.0	163.2	
	2	2004-12-17		0.0	85.0	
HLX24	1	2004-09-16	2004-11-04	0.0	175.2	
	1	2004-11-04	2004-12-10	11.0	175.2	
	2	2004-11-04	2004-12-10	0.0	10.0	Not monitored
	1	2004-12-10		41.0	175.2	
	2	2004-12-10		0.0	40.0	
HSH01	1	2004-04-01		25.0	200.0	
	2	2004-04-01		0.0	24.0	
HSH02	1	2003-06-06		0.0	200.0	
HSH03	1	n/a		12.0[1/]	201.0	Manual levelling when used as drilling-water well
HSI04	1	2004-06-23		0.0	37.0	
HSI13	1	2004-06-23		0.0	4.0	
KAV01	1	1996-05-06	2004-04-19	0.0	744.0	
	1	2004-04-19		83.0	757.31	
	2	2004-04-19		0.0	82.0	
KAV02	1	2004-05-07	2005-01-14	17.0	97.1	
	2	2004-05-07	2005-01-14	0.0	16.0	
	1	2005-01-14		0.0	97.1	
KAV03	1	1987-10-01	2004-05-10	0.0	248.4	
	1	2004-05-11	2004-07-01	16.0	248.4	
	2	2004-05-11	2004-07-01	0.0	15.0	Not monitored
	1	2004-07-01		0.0	248.4	
KAV04A	1	2003-10-10		0.0	1,004.0	
KBH03	1	2004-06-23		0.0	100.43	
KLX02	1	1992-12-17	2004-04-27	0.0	1,700.5	
	1	2004-04-28	2004-10-04	256.4	1,700.0	
	2	2004-04-28	2004-10-04	207.9	255.4	
	3	2004-04-28	2004-10-04	0.0	206.9	
KLX03	1	n/a	2004-09-07	n/a	n/a	Manual levelling during drilling
KLX04	1	n/a	2004-06-28	n/a	n/a	Manual levelling during drilling
KLX05	1	n/a	2005-01-22	n/a	n/a	Manual levelling during drilling
KLX06	1	n/a	2004-11-25	n/a	n/a	Manual levelling during drilling
KSH01A	1	2003-09-18	2003-11-28	104.0	1,003.0	
	2	2003-09-18	2003-11-28	0.0	103.0	
	1	2004-10-07		800.0	1,003.0	
	2	2004-10-07		671.0	799.0	
	3	2004-10-07		573.0	670.0	
	4	2004-10-07		532.0	572.0	
	5	2004-10-07		331.0	531.0	
	6	2004-10-07		278.0	330.0	
	7	2004-10-07		238.0	277.0	

Borehole	Section no	Section installed from	to	Borehole Length ** from (m)	to (m)	Comment
	8	2004-10-07		181.0	237.0	
	9	2004-10-07		0.0	180.0	
KSH03A	1	2004-06-01		281.15	1,000.7	
	2	2004-06-01		180.65	280.15	
	3	2004-06-01		0.0	179.65	
SSM000001	1	2002-12-04		0.0	3.1*	
	screen			2.0	3.0	from report P-03-80
SSM000002	1	2003-03-24		0.0	3.1*	
	screen			2.0	3.0	from report P-03-80
SSM000004	1	2003-03-24		0.0	3.0*	
	screen			2.0	3.0	from report P-03-80
SSM000005	1	2003-03-24		0.0	2.0*	
	screen			1.0	2.0	from report P-03-80
SSM000008	1	2004-09-02		0.0	5.1*	
	screen			3.0	5.0	from report P-04-121
SSM000009	1	2004-04-05		0.0	4.1*	
	screen			3.0	5.0	from report P-04-121
SSM000011	1	2004-04-05		0.0	3.1*	
	screen			1.0	3.0	from report P-04-121
SSM000012	1	2004-08-27		0.0	6.1*	
	screen			5.0	6.0	from report P-04-121
SSM000014	1	2004-09-14		0.0	3.1*	
	screen			2.0	3.0	from report P-04-121
SSM000017	1	2004-08-26		0.0	2.1*	see also field notes
	screen			1.0	2.0	from field notes
SSM000018	1	2004-08-27		0.0	3.1*	
	screen			2.0	3.0	from report P-04-121
SSM000019	1	2004-08-26		0.0	3.1*	see also field notes
	screen			2.0	3.0	from field notes
SSM000021	1	2004-08-26		0.0	4.1*	see also field notes
	screen			3.0	4.0	from field notes
SSM000022	1	2004-09-02		0.0	7.1*	
	screen			5.0	7.0	from report P-04-121
SSM000209	1	2004-08-27		0.0	4.1*	
	screen			2.0	4.0	from report P-04-317
SSM000210	1	2004-08-27		0.0	4.1*	
	screen			2.0	4.0	from report P-04-317
SSM000211	1	2004-08-27		0.0	4.1*	
	screen			2.0	3.0	from report P-04-317
SSM000212	1	2004-10-02		0.0	2.1*	
	screen			1.0	2.0	from report P-04-317
SSM000213	1	2004-09-02		0.0	2.1*	
	screen			1.0	2.0	from report P-04-317

* For the soil wells (SSM-boreholes), the bottom of the section refers to the bottom of the plastic pipe installed in the borehole. The plastic pipe is screened.

** Borehole length is set to 0.0 at centre of top of casing. If there is only one section in the borehole and the given borehole length is from 0.0 m it implies that no packers are installed and that it is an open borehole.

1/ : Borehole length to lower end of borehole casing.

n/a: not applicable.

5.2.1 General comments

Results from the measurements in surface boreholes are presented in annually based diagrams. Level data from all sections in each borehole are presented in annual diagrams for the years 2002 (only SSM000001), 2003 and 2004. Only a few boreholes have data from all three years and if all data for one year is missing, the diagram is not presented.

The symbols used in the diagrams are:

The lowest section =	Section 1	○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○
	Section 2	+ + + + + + + + + + + +
	Section 3	× × × × × × × × × ×
	Section 4	□ □ □ □ □ □ □ □ □ □
	Section 5	◇ ◇ ◇ ◇ ◇ ◇ ◇
	Section 6	Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ
	Section 7	◁ ◁ ◁ ◁ ◁ ◁ ◁ ◁ ◁ ◁
	Section 8	▽ ▽ ▽ ▽ ▽ ▽ ▽ ▽ ▽ ▽
	Section 9	▷ ▷ ▷ ▷ ▷ ▷ ▷ ▷ ▷ ▷
	Section 10	✧ ✧ ✧ ✧ ✧ ✧ ✧ ✧
	Section 11	✧ ✧ ✧ ✧ ✧ ✧ ✧ ✧
	Section 12	∘∘∘∘∘∘∘∘∘∘∘∘∘∘∘∘∘∘∘∘

Sometimes it is difficult to differentiate registrations from individual sections in the diagrams. However, since the main purpose of this report is to present an overall view of the long-term changes, it was not found to be advantageous to show more detailed diagrams from individual sections. More detailed diagrams during test periods are presented in reports from the different tests.

5.2.2 Comments on some of the diagrams

Due to failures in the mechanical or electronic equipment, data is sometimes missing for longer or shorter periods. This is not commented on below.

Remarks are given when the registration for some reason has a deviating appearance. When registrations are missing, manually levelled data, if available, are inserted.

In many boreholes, the groundwater level shows large and rapid variations. This is often due to nearby drilling.

Packers may deflate due to leakage, which can be difficult to discover. If a section in a borehole suddenly shows a pressure that is close to the pressure in a neighbouring section, the reason might be deflated packers.

HAV10: This is an artesian borehole with a lid mounted on the casing top to prevent water outflow. Because of the lid, manual levelling has not been possible. The pressure transducer is mounted on the lid instead of submerged in the borehole. The absolute level has been calculated instead of corrected to manual levelling data.

HSH01: During the considerable drawdowns that occurred from the middle of April to the middle of May 2004, the pressure transducers were sometimes hanging in the air. The drawdowns occurred when a nearby borehole, HSH03, was used for drilling water supply.

KAV02: It has not been possible to perform manual levelling in section 2, therefore the absolute level has been estimated.

SSM000212: Registration was started in the beginning of September 2004 but at the manual levelling occasions the borehole was reported to be dry. However, at the end of October a water level was registered after rain. Since no manual levelling data was available, the absolute level has been calculated.

Appendix 1

Groundwater level

Percussion boreholes:

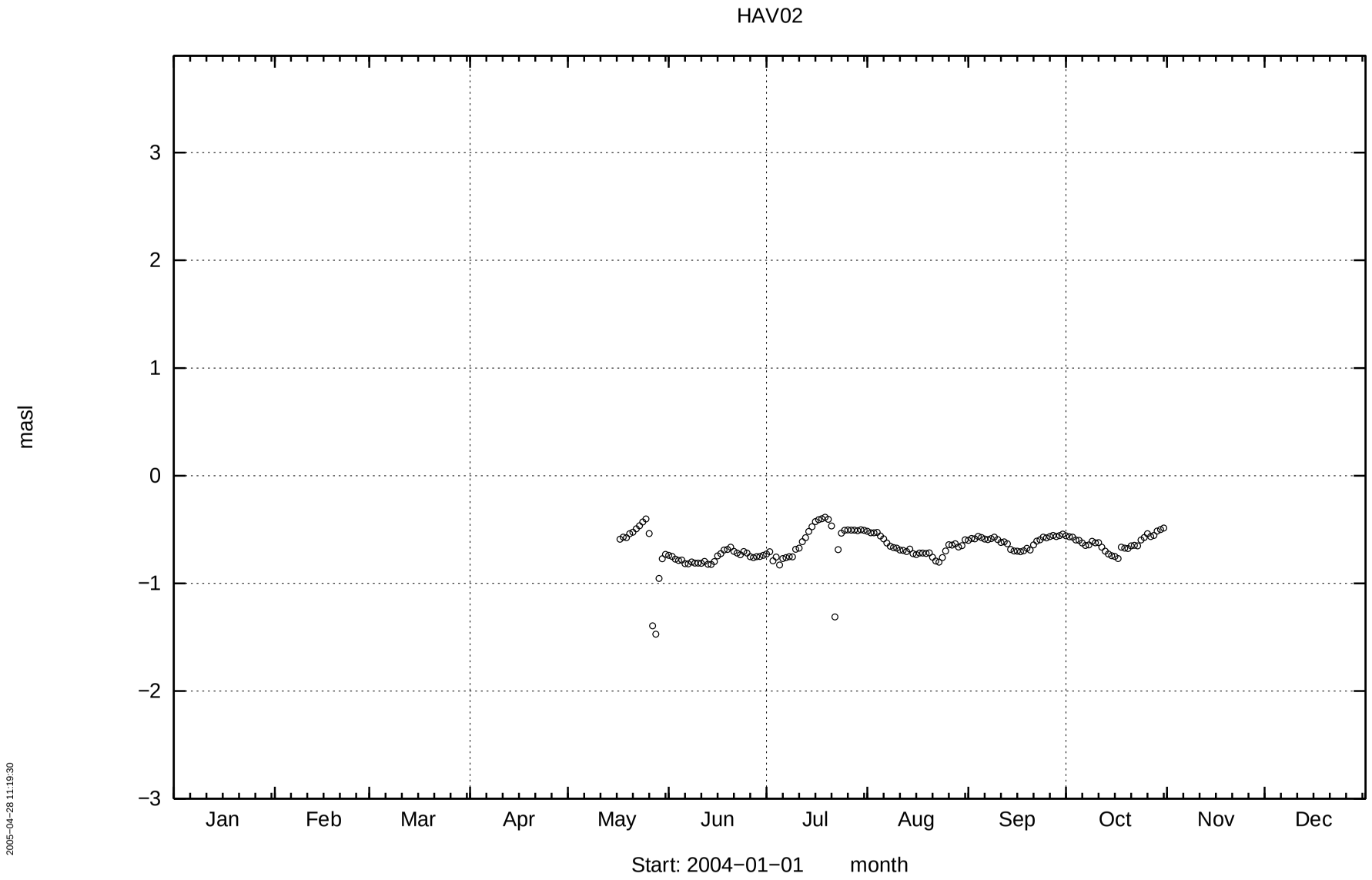
HAV02
HAV05 - HAV07
HAV09
HAV10
HLX08 - HLX11
HLX13
HLX14
HLX20 - HLX22
HLX24
HSH01 - HSH03
HSI04
HSI13

Cored boreholes:

KAV01 - KAV03
KAV04A
KBH03
KLX02 - KLX06
KSH01A
KSH03A

Soil wells:

SSM000001
SSM000002
SSM000004
SSM000005
SSM000008
SSM000009
SSM000011
SSM000012
SSM000014
SSM000017-SSM000019
SSM000021
SSM000022
SSM000209 – SSM000213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masl
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month
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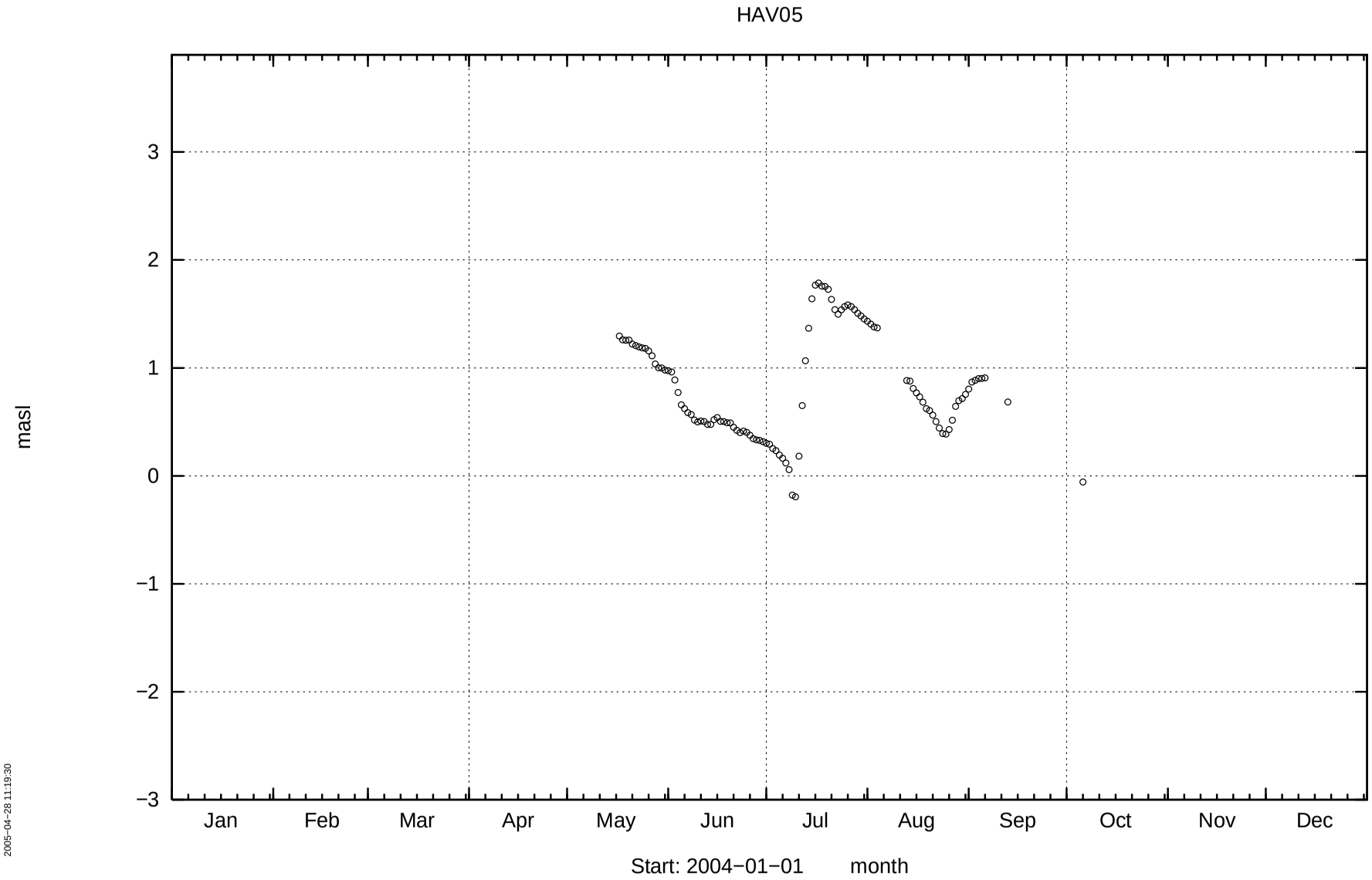
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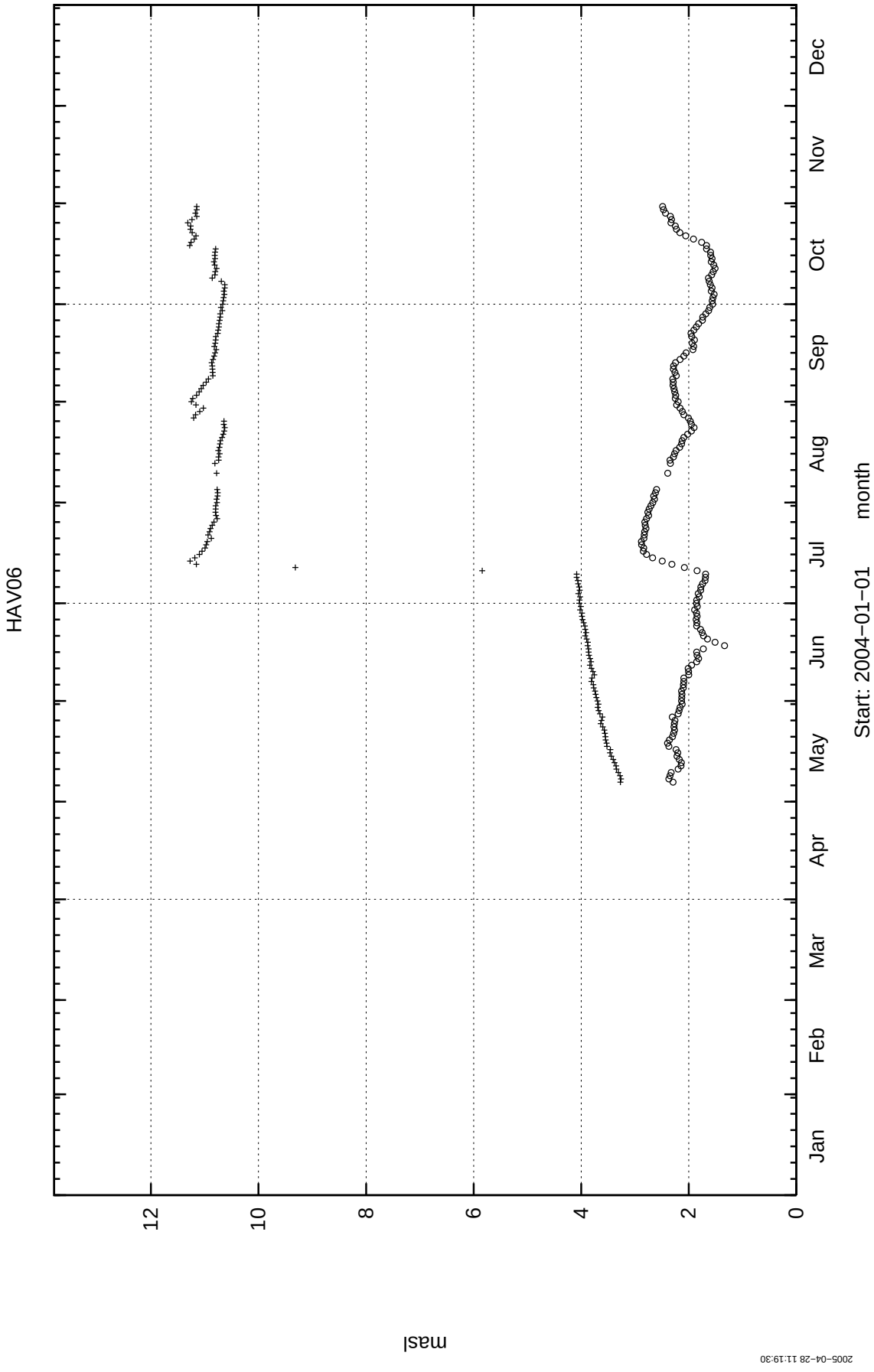
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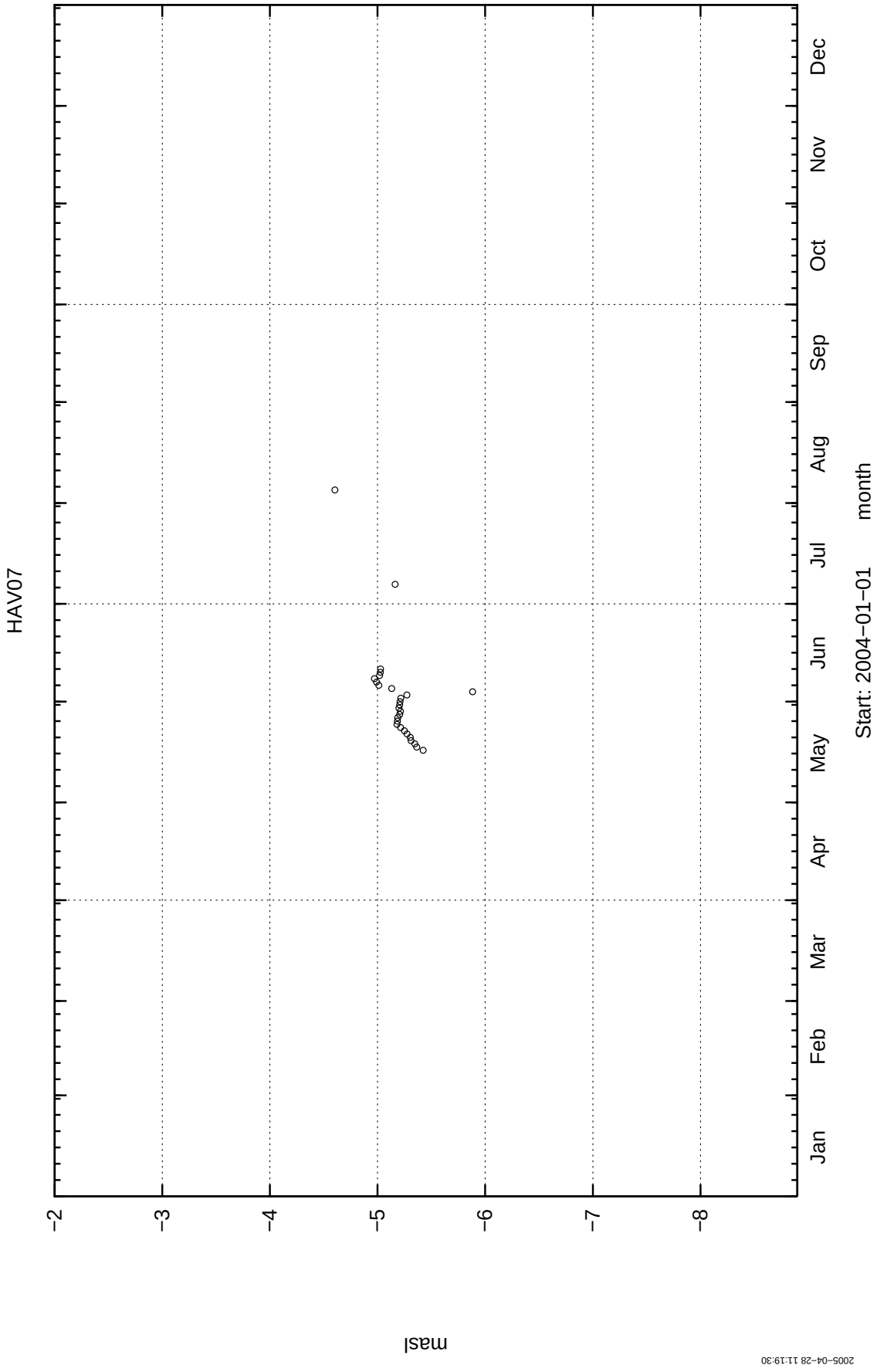
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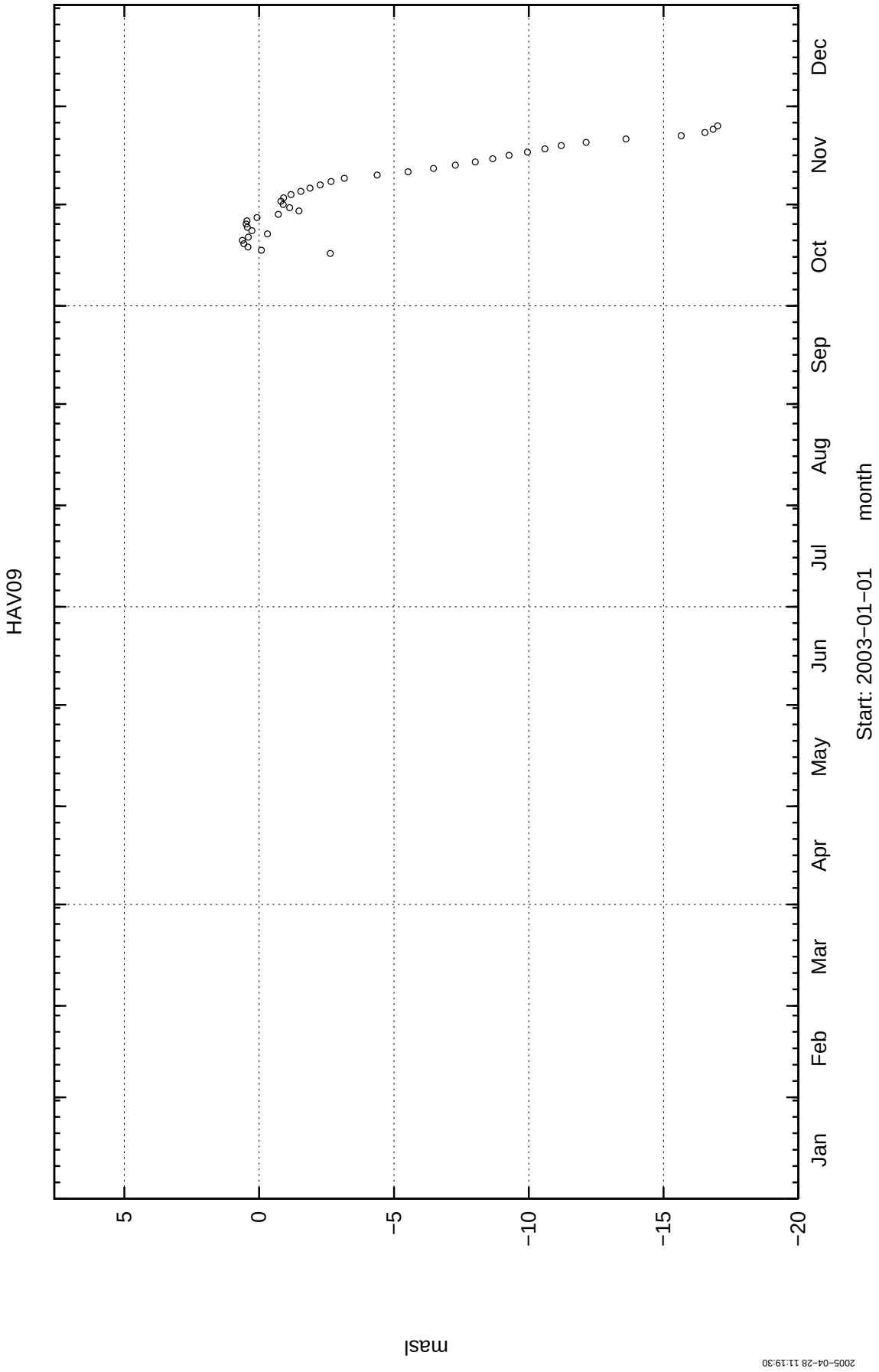
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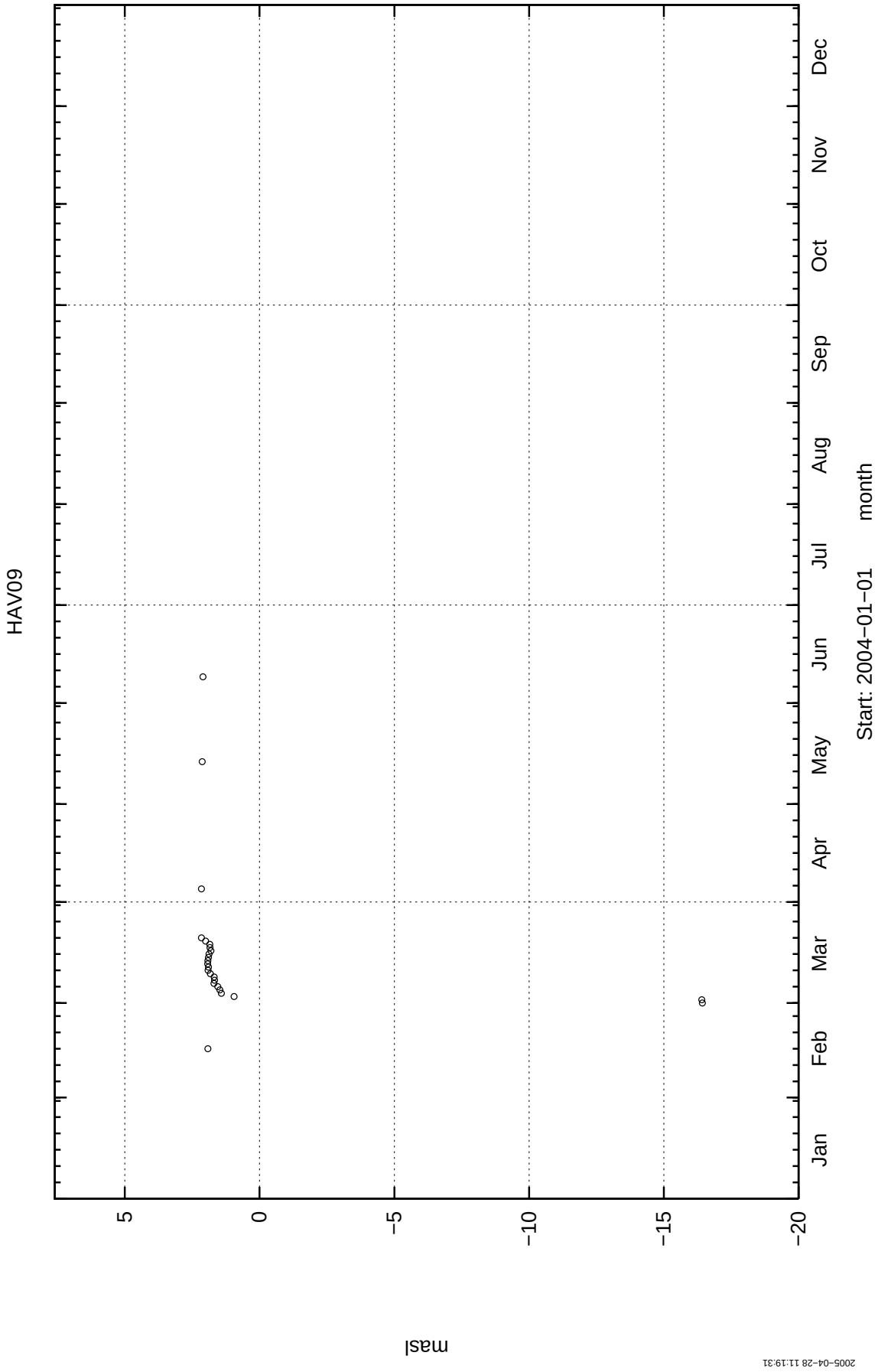
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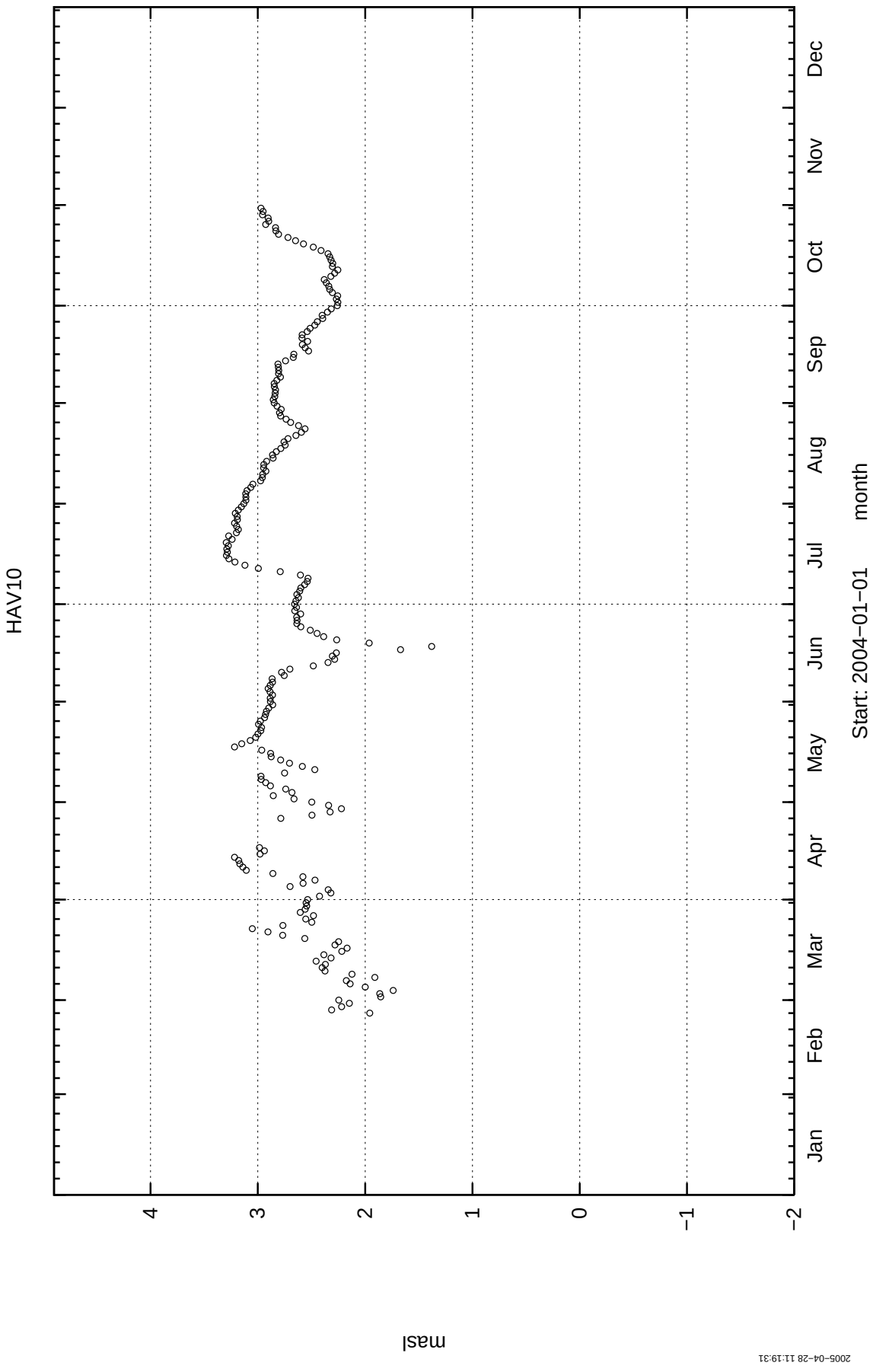
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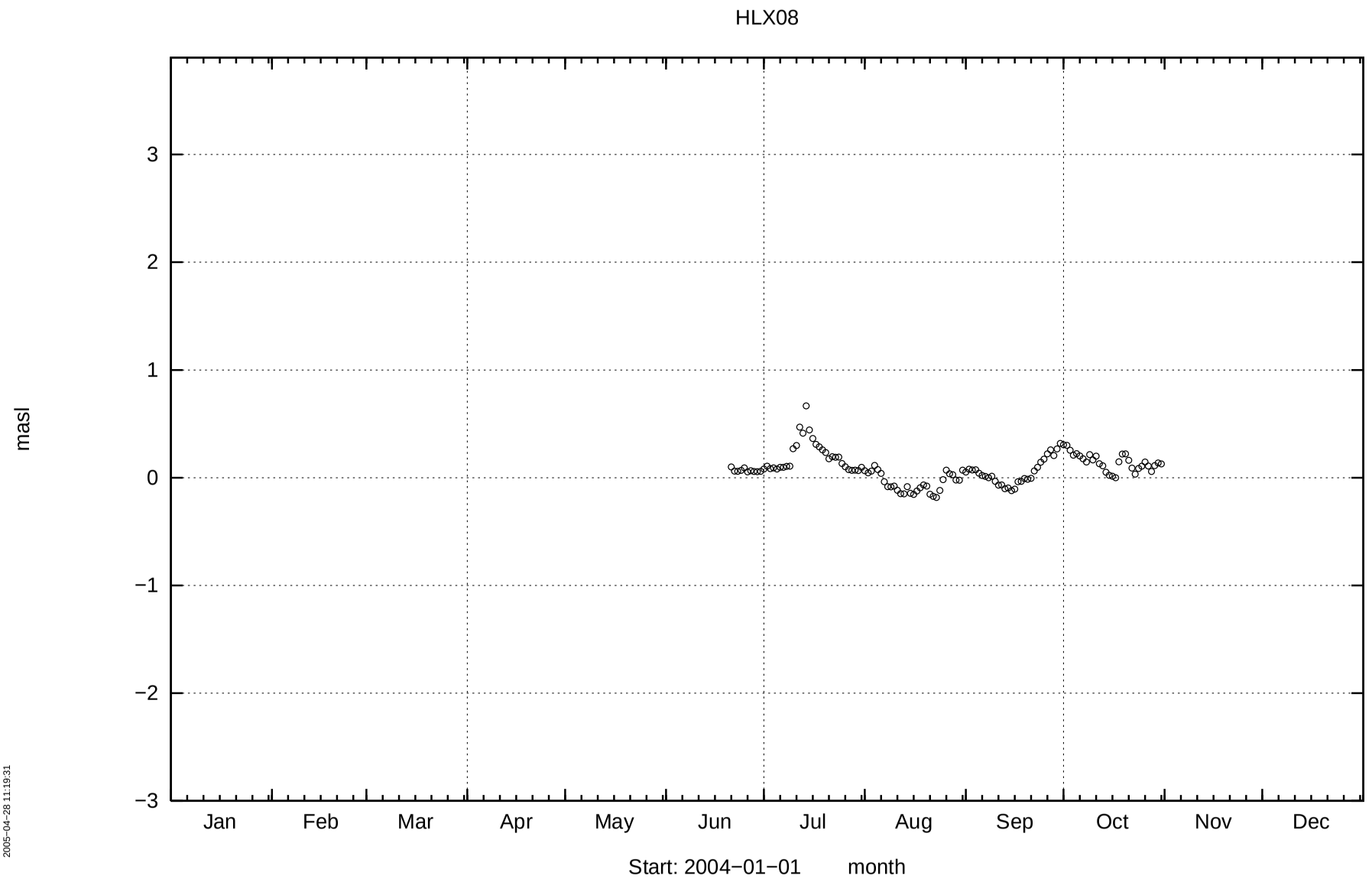
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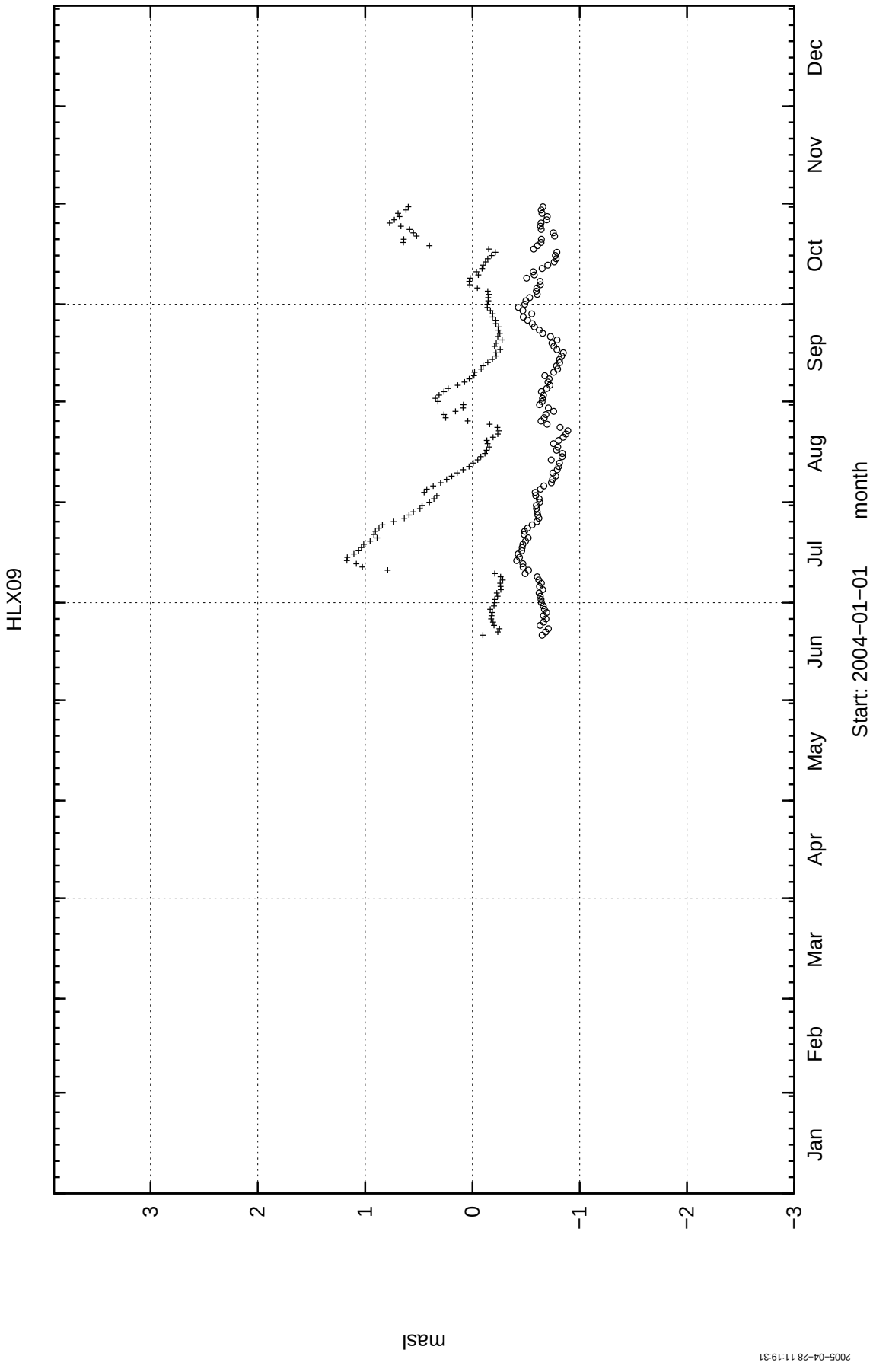
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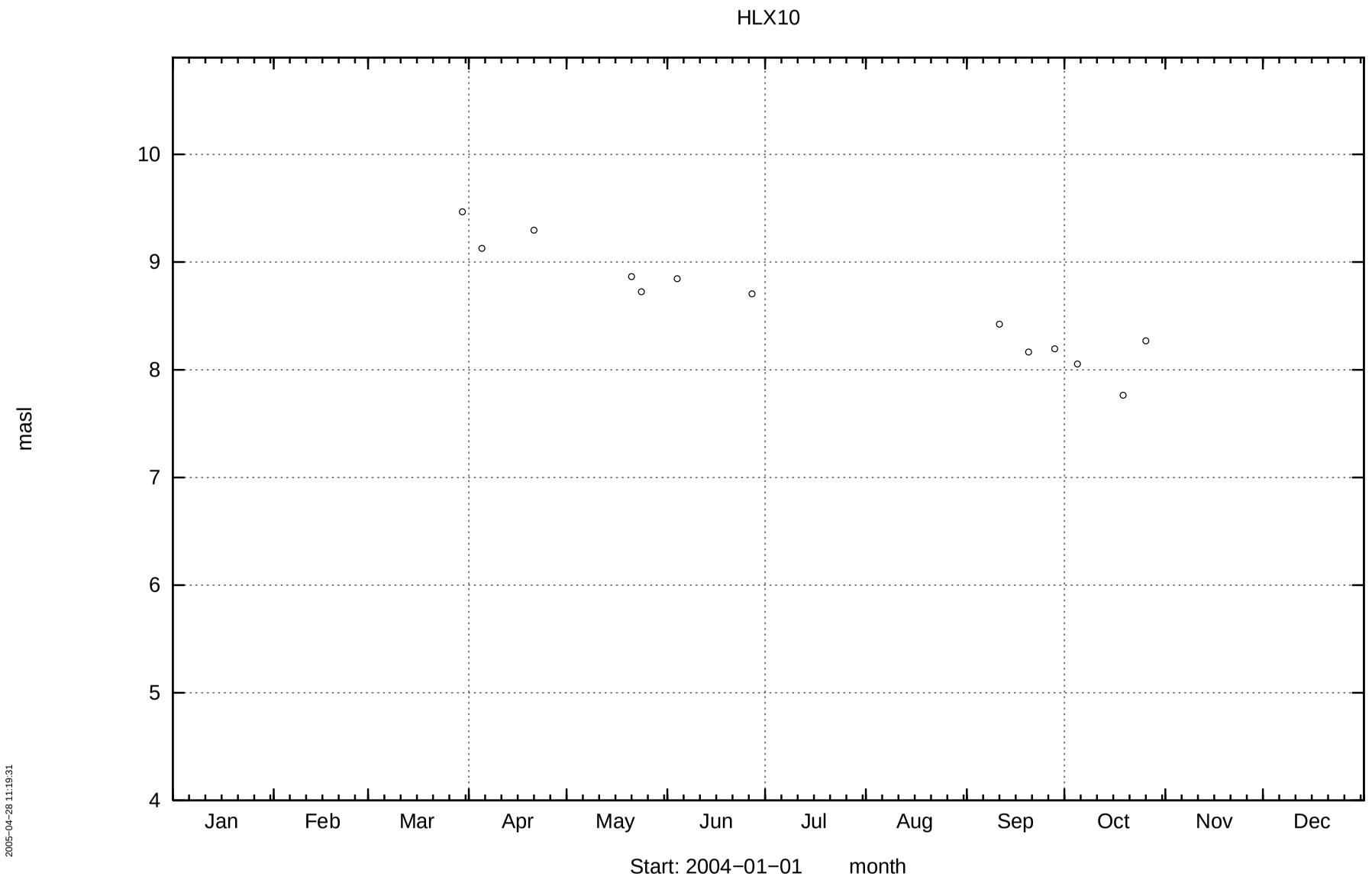
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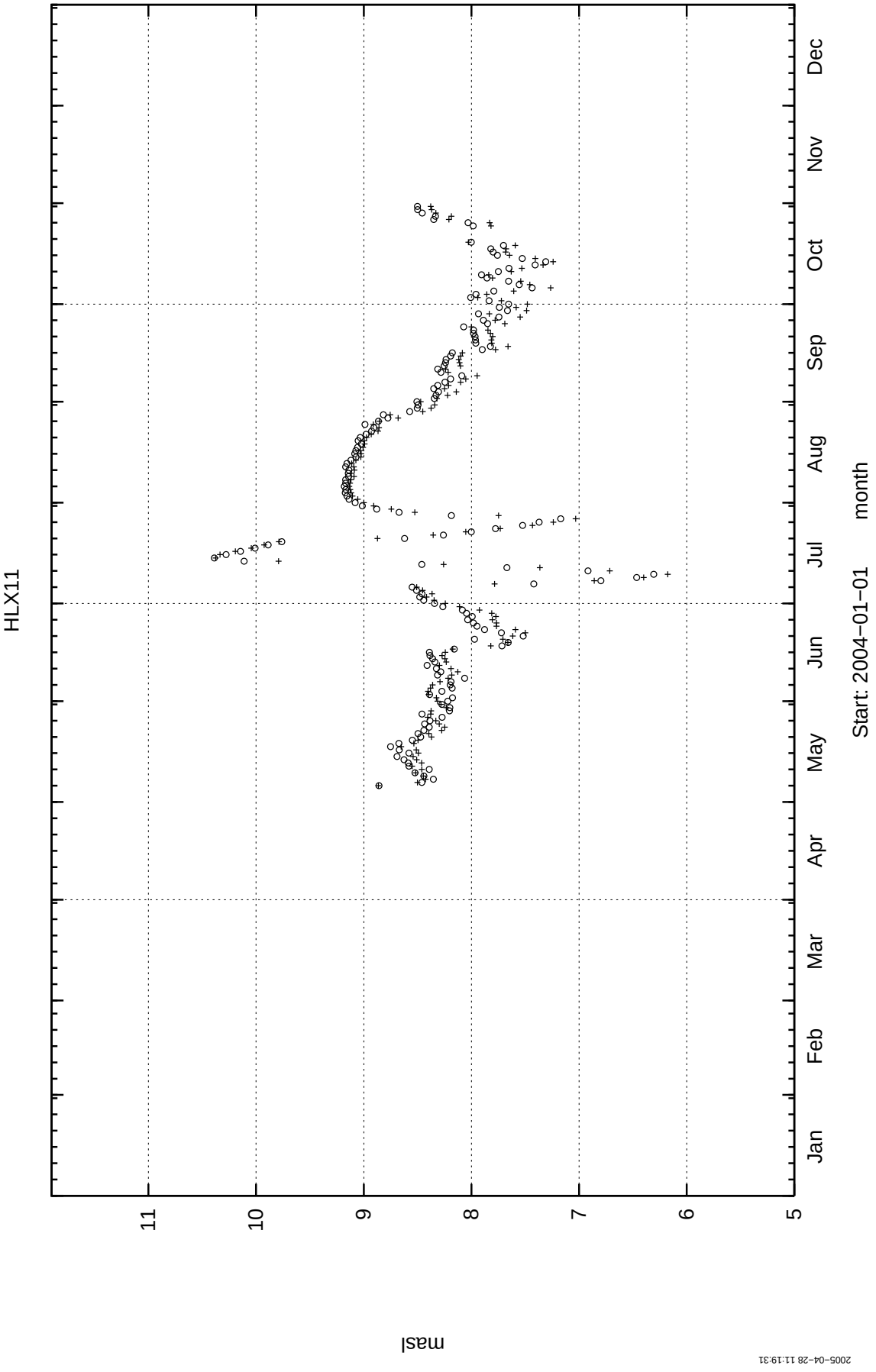
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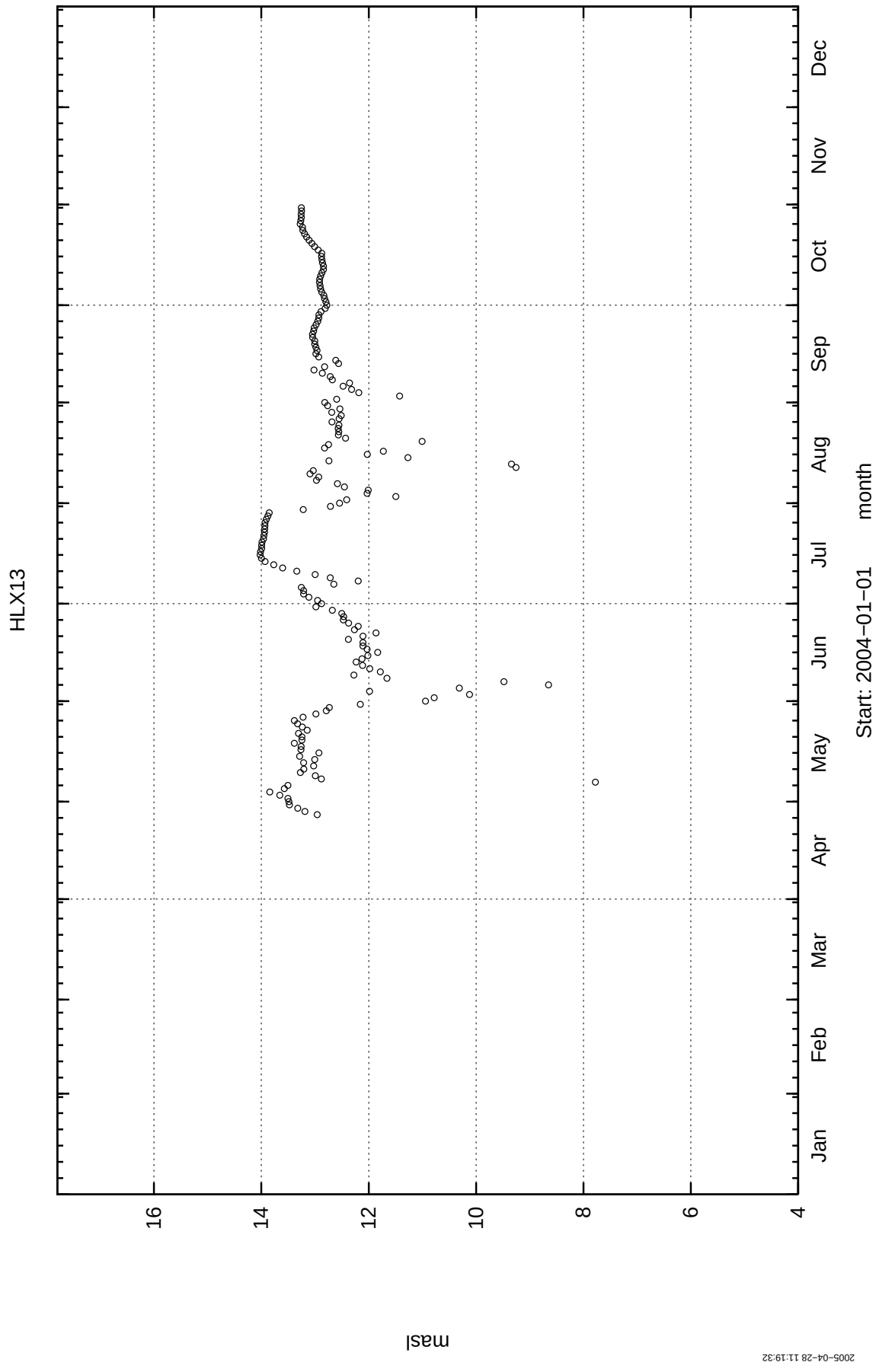
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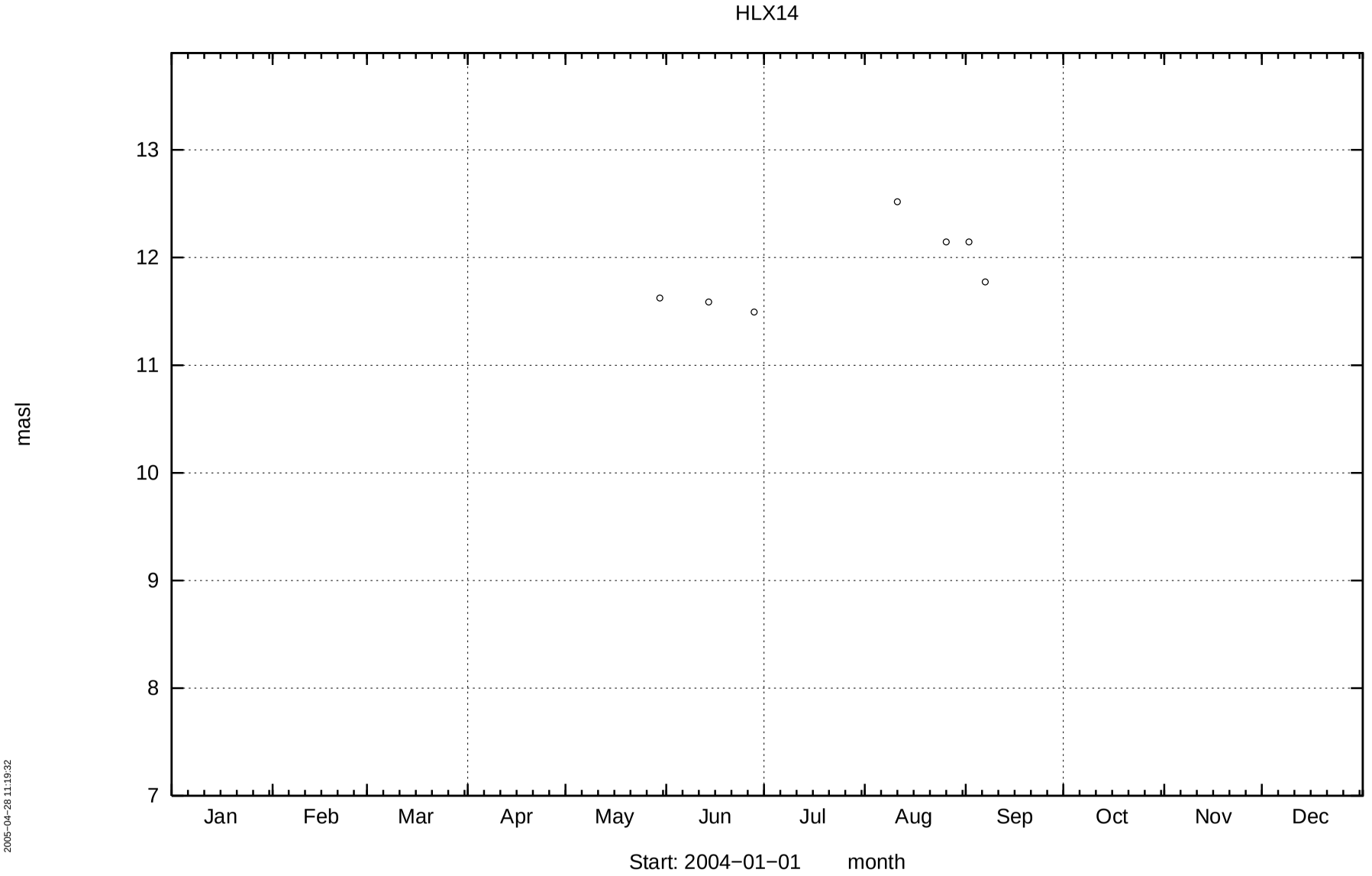
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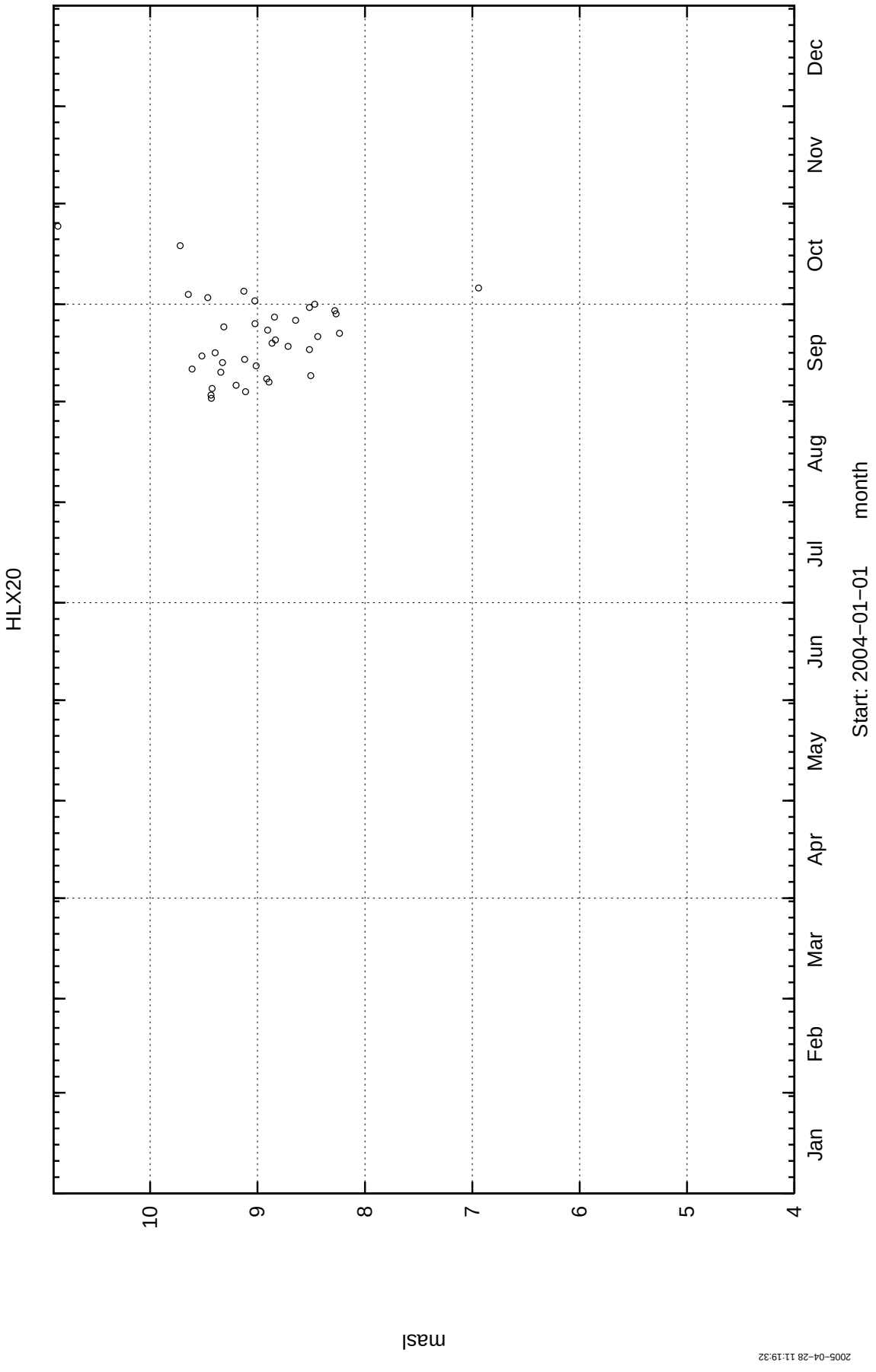
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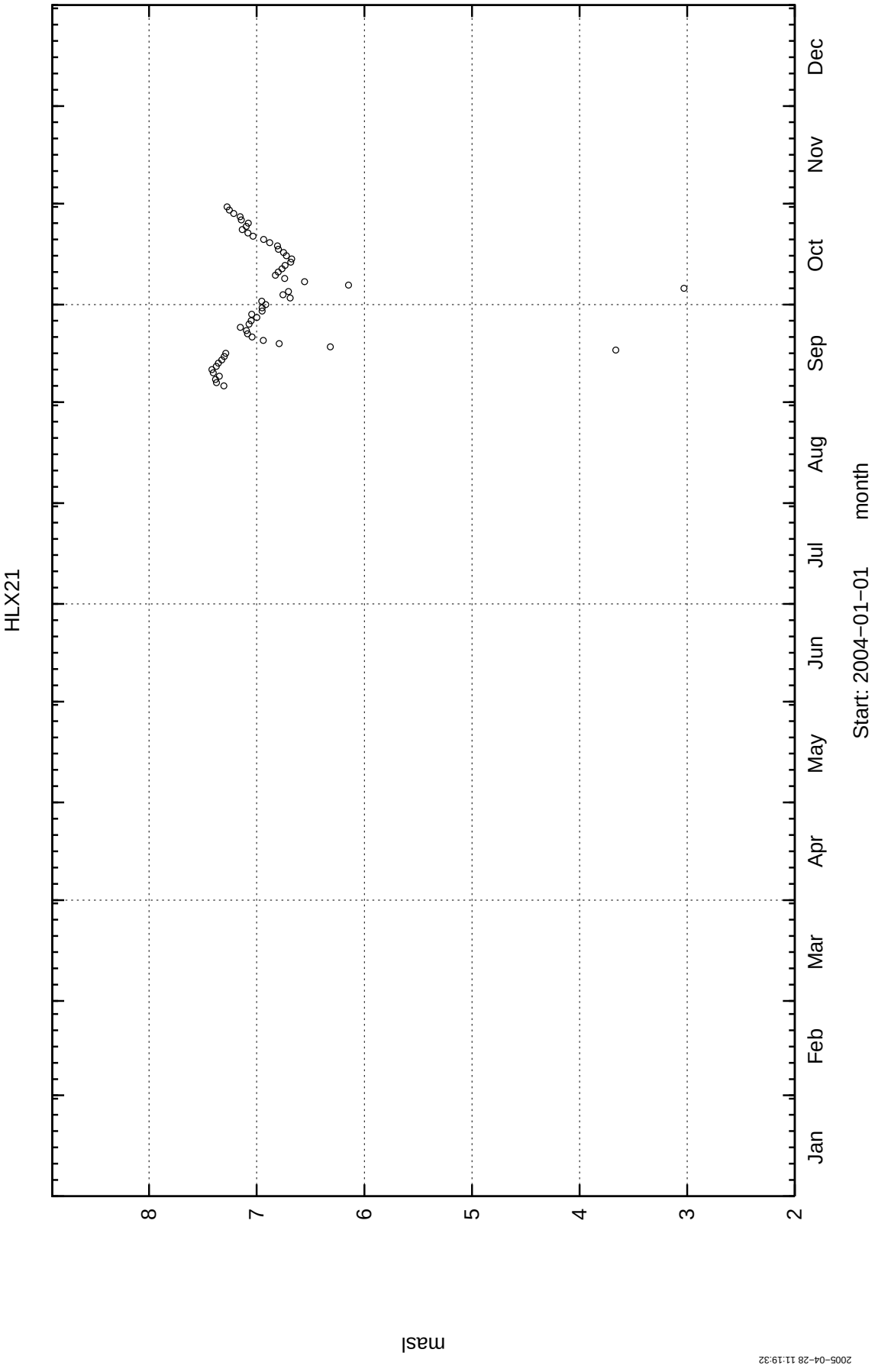
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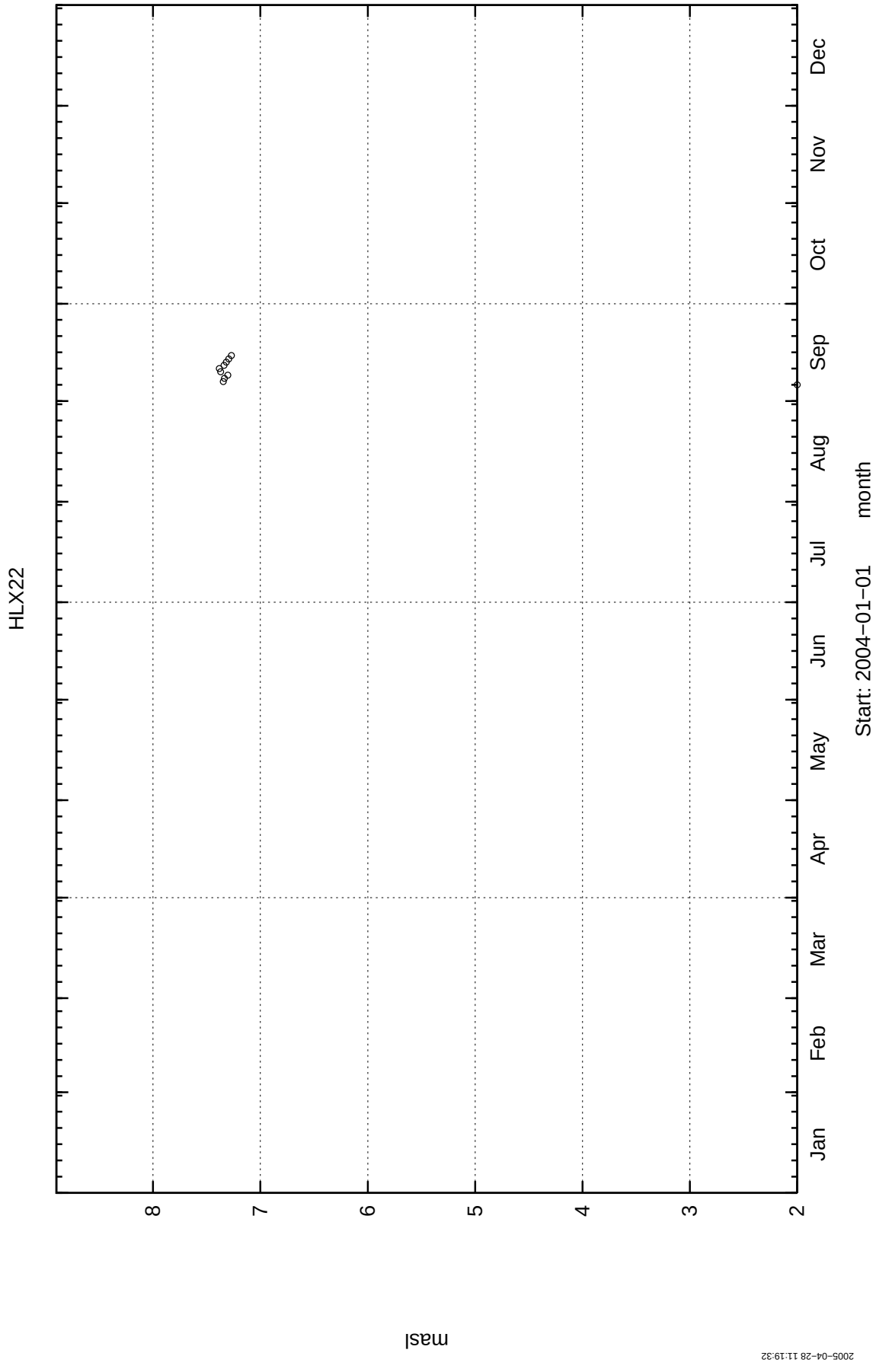
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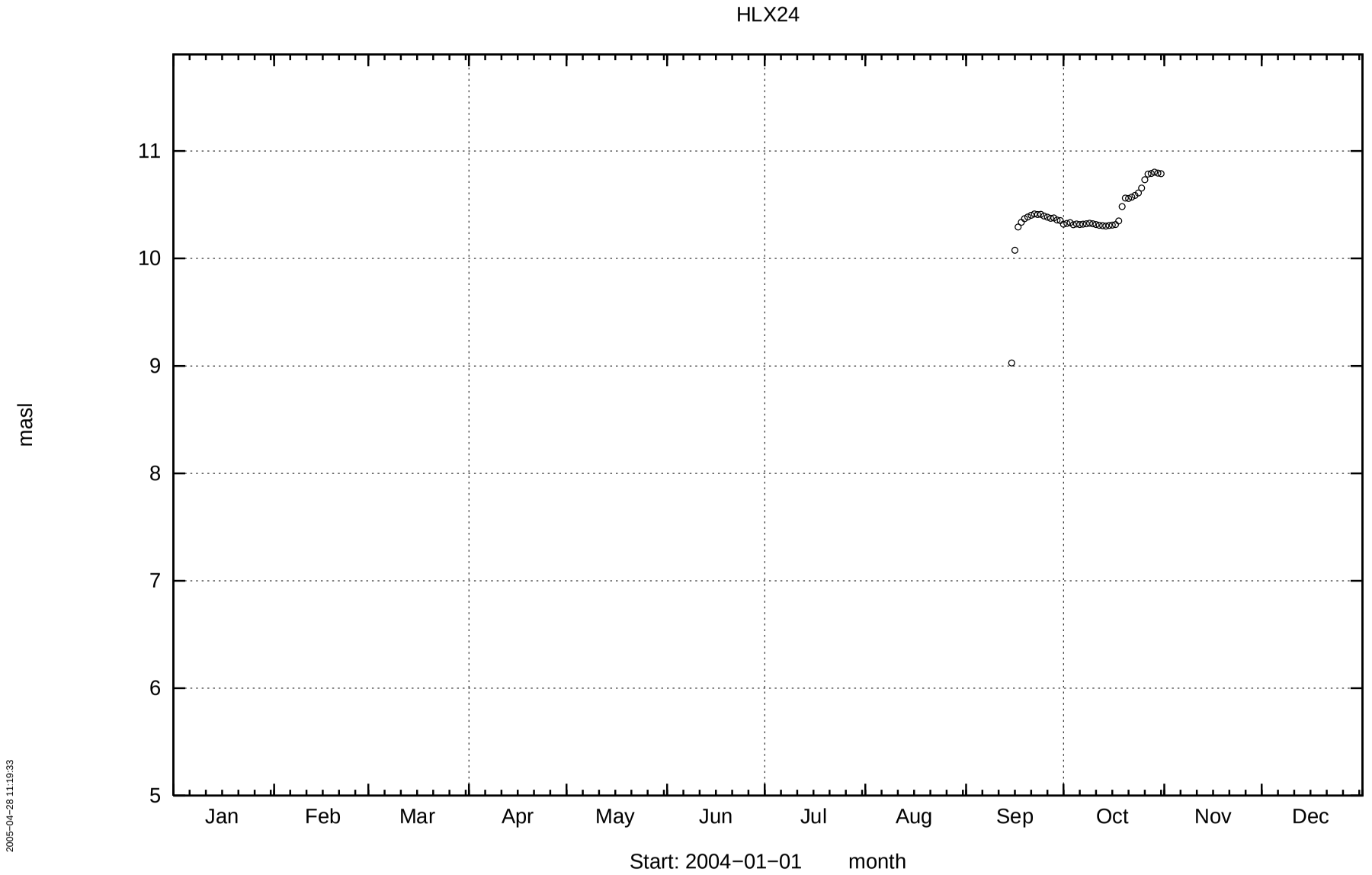
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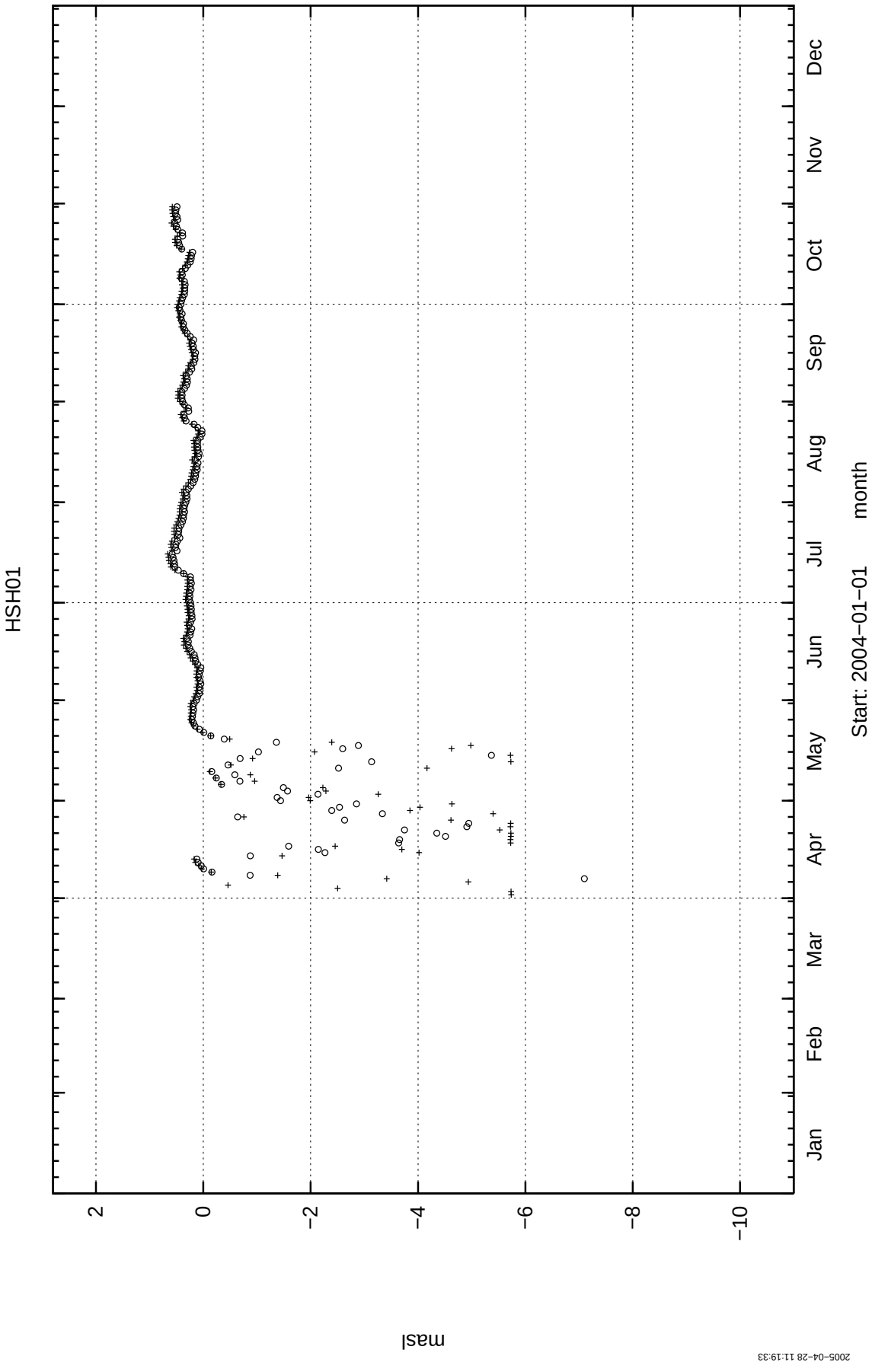
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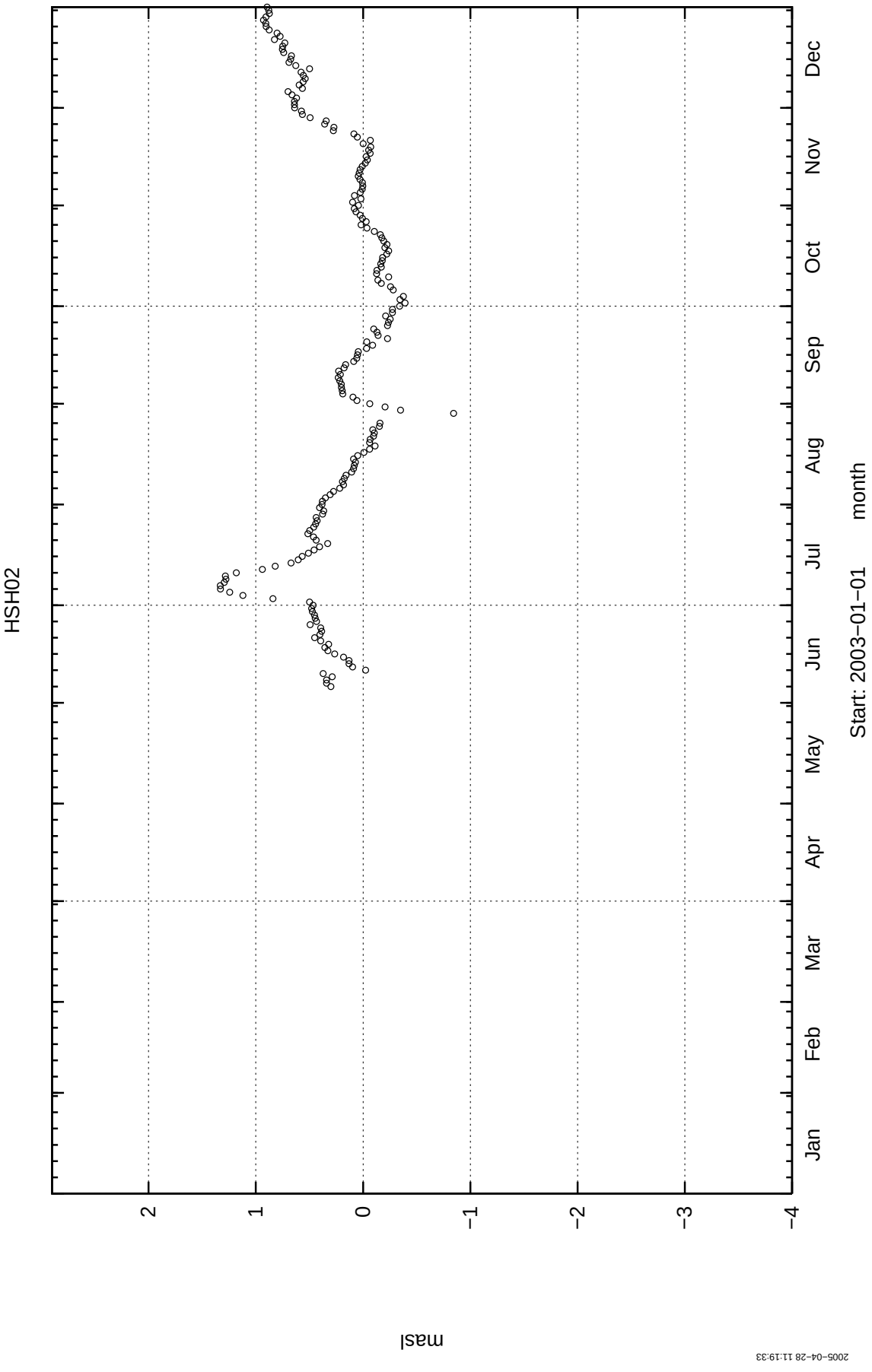
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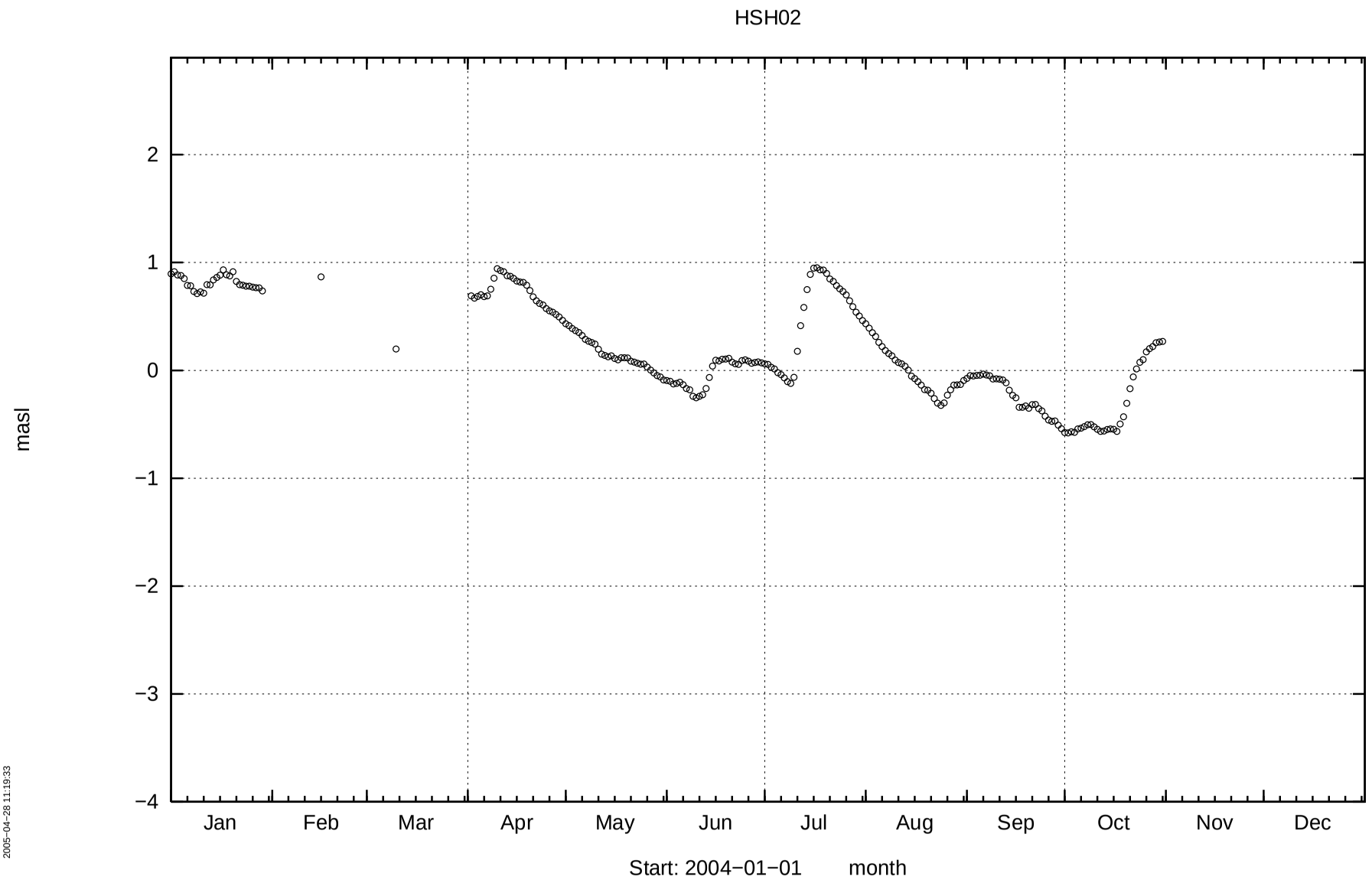
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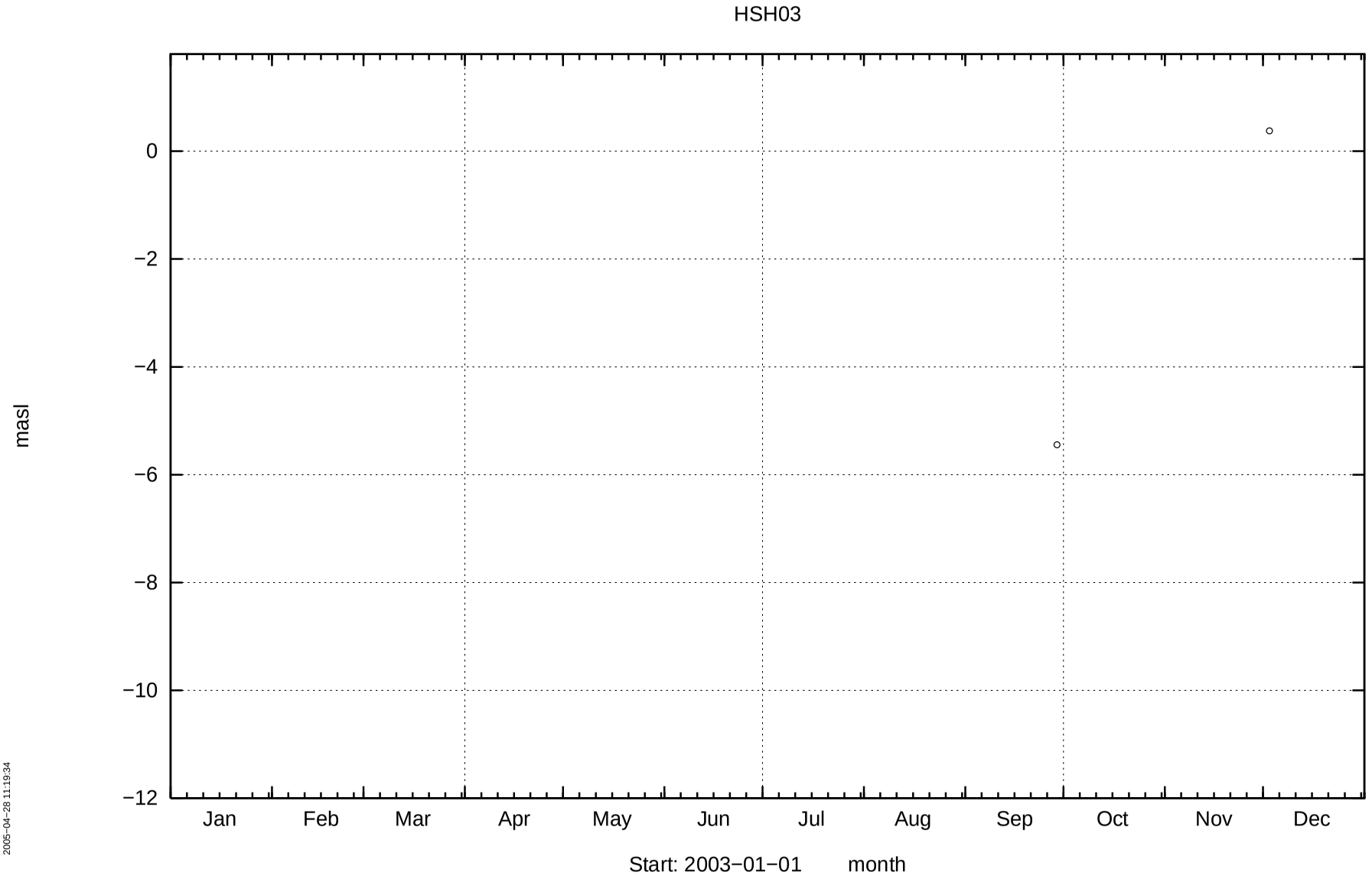
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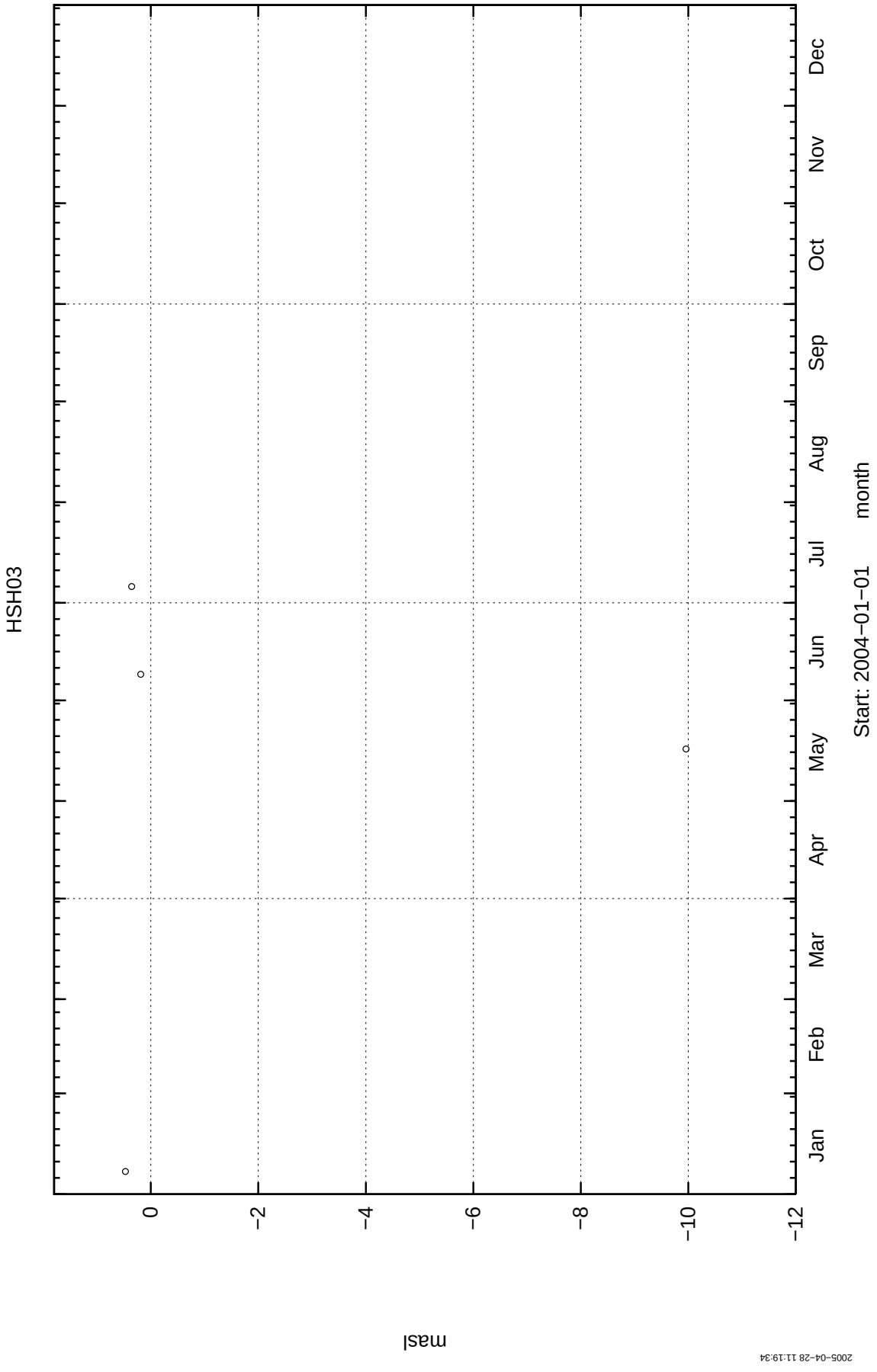
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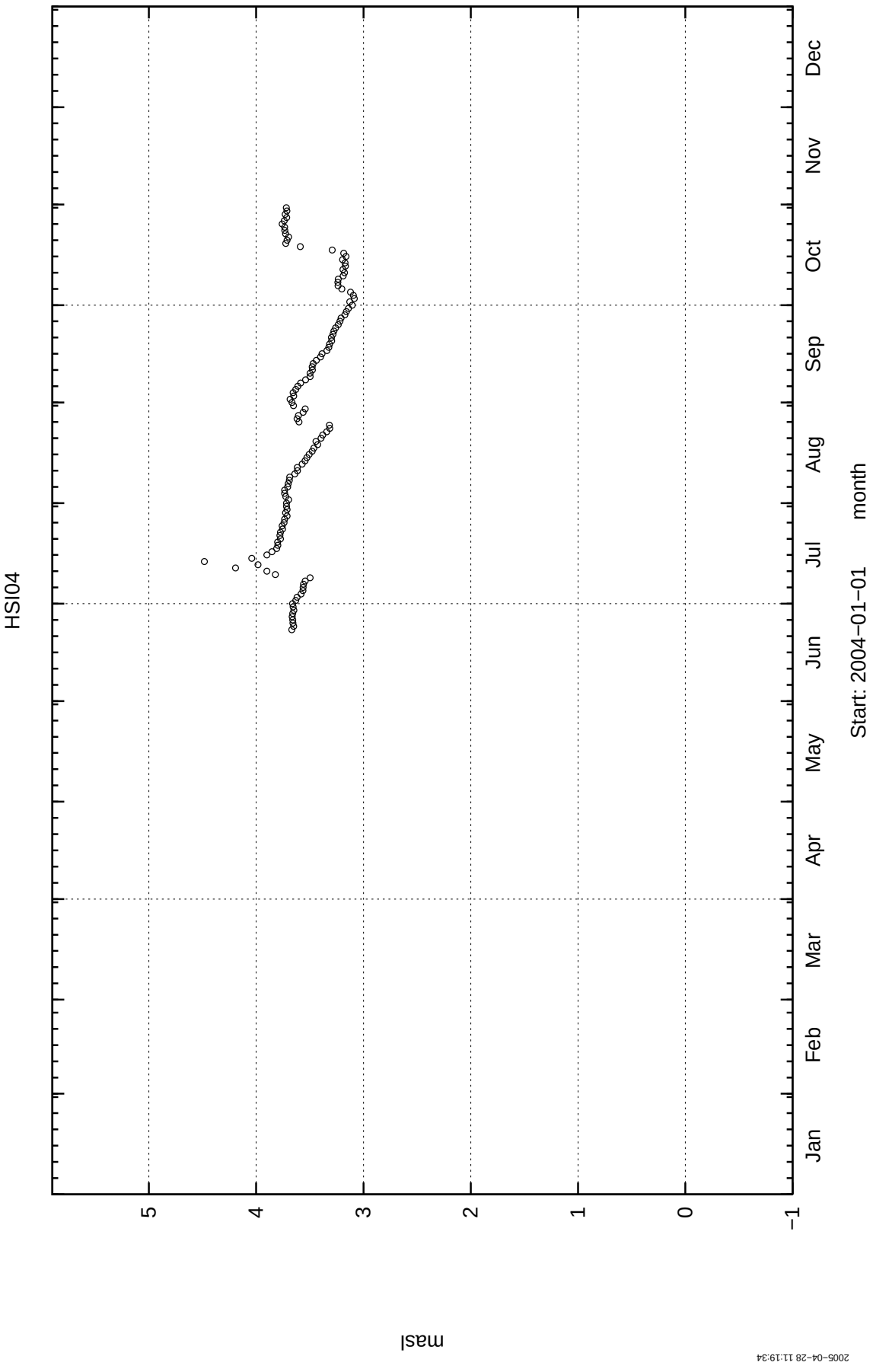
HSI04
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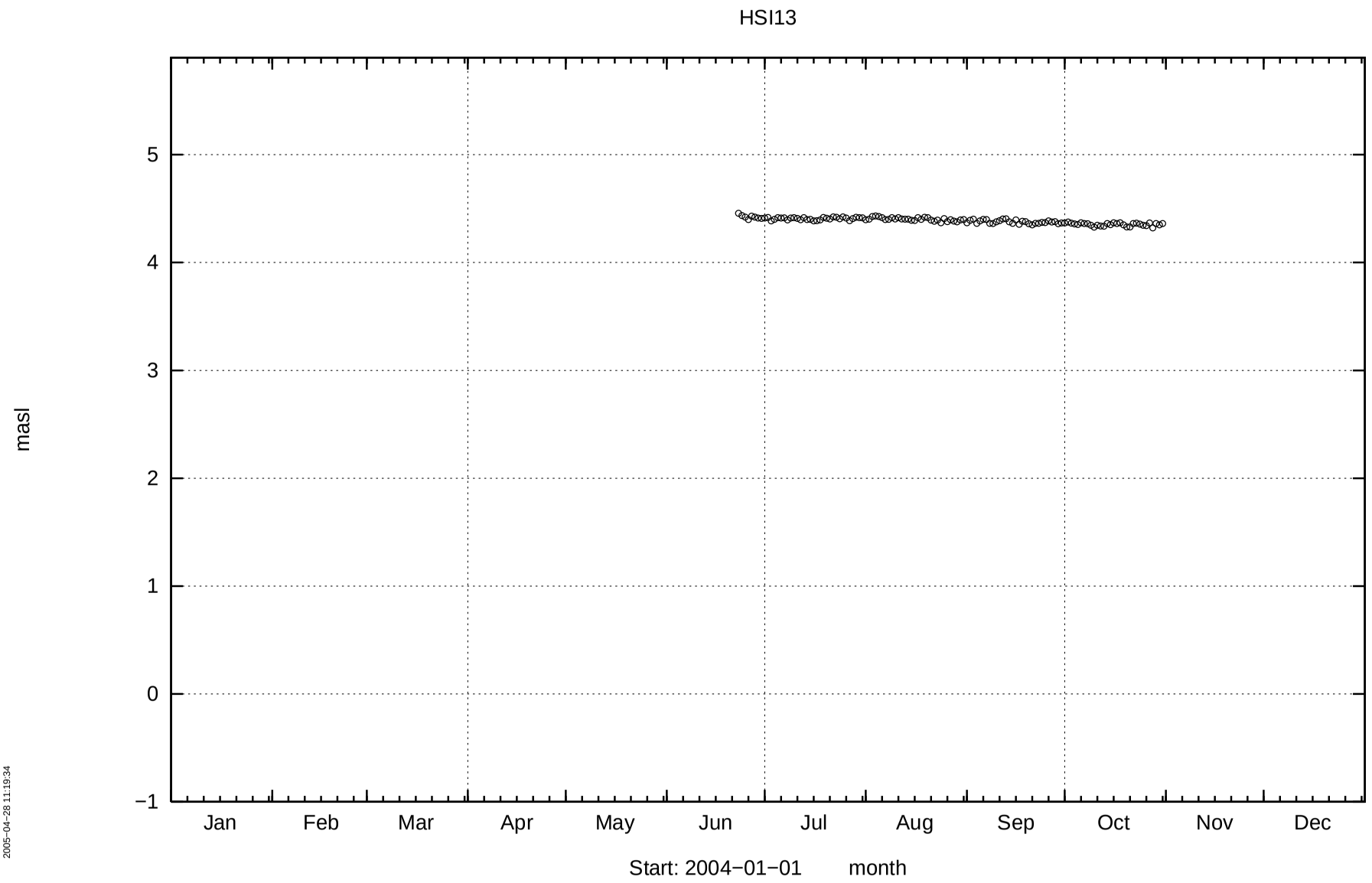
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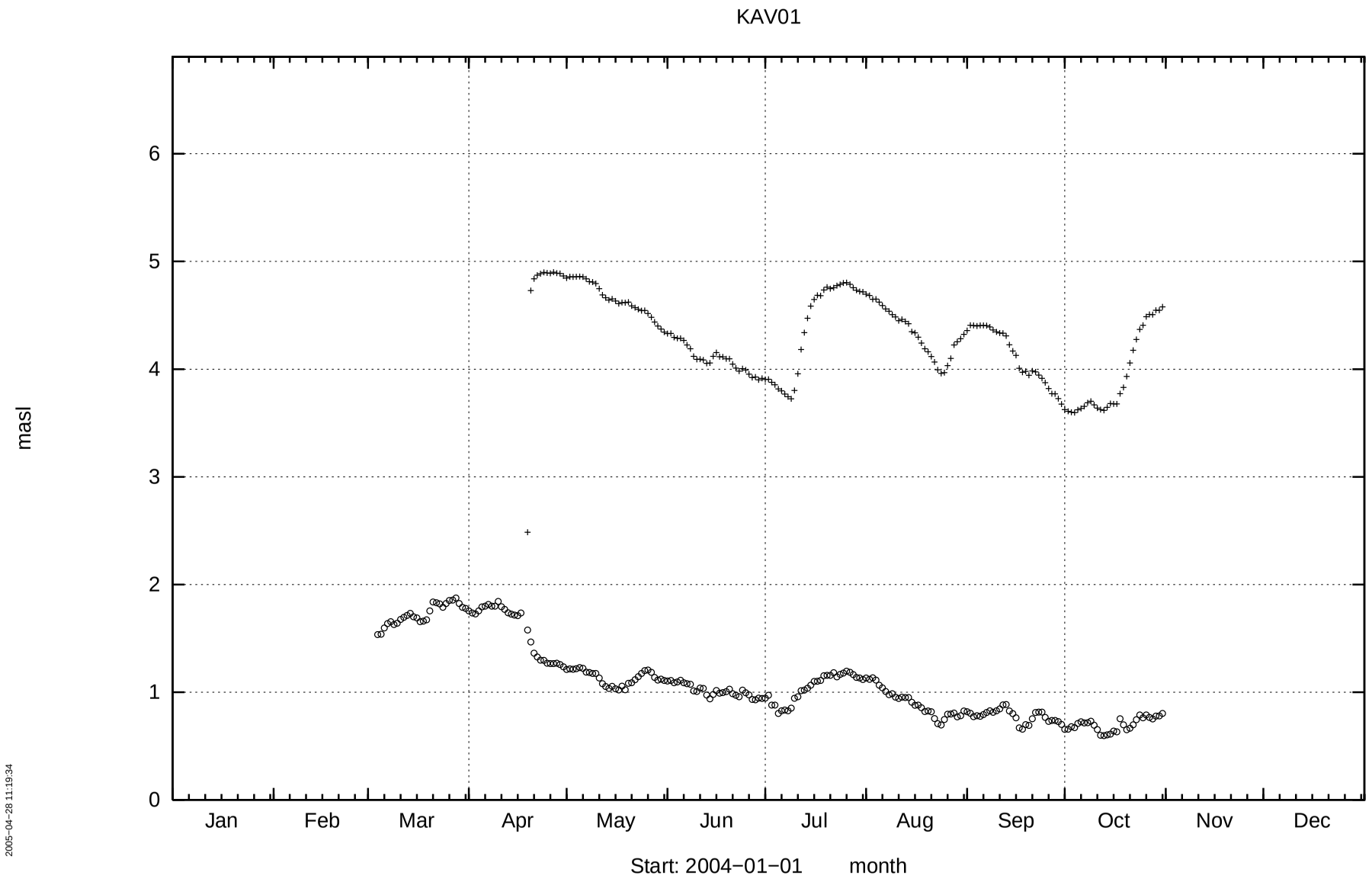
KAV01
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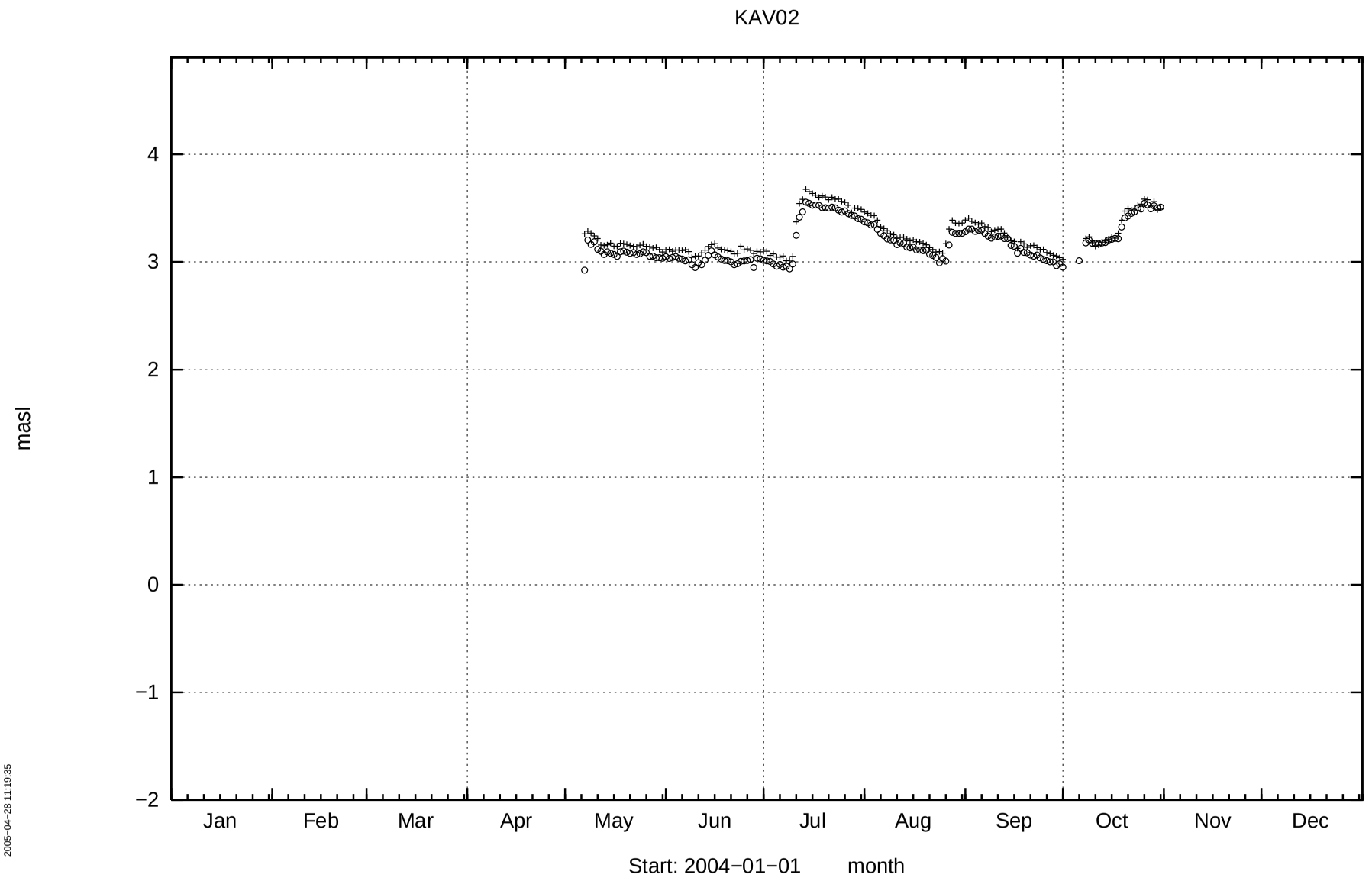
KAV02
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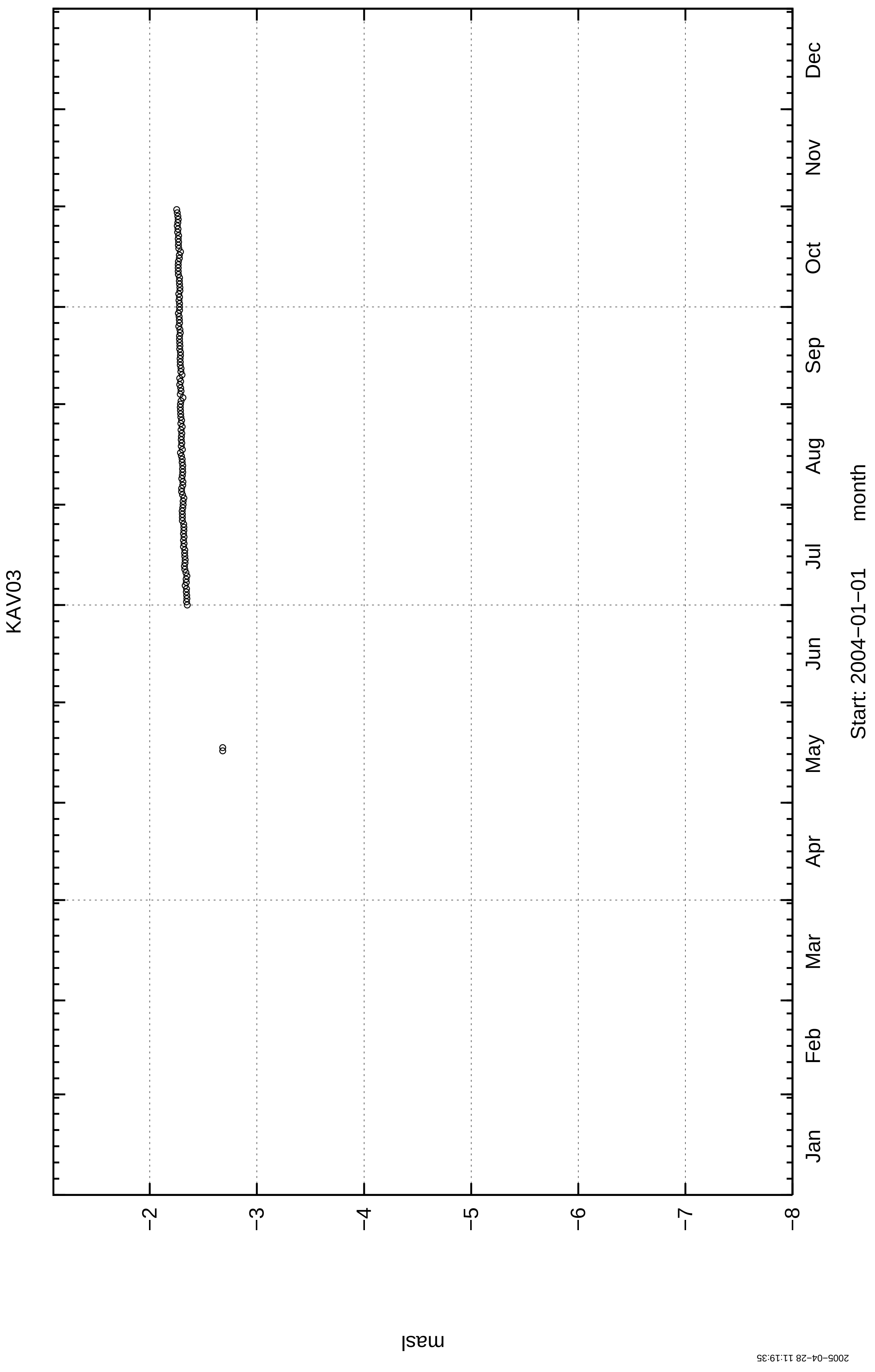
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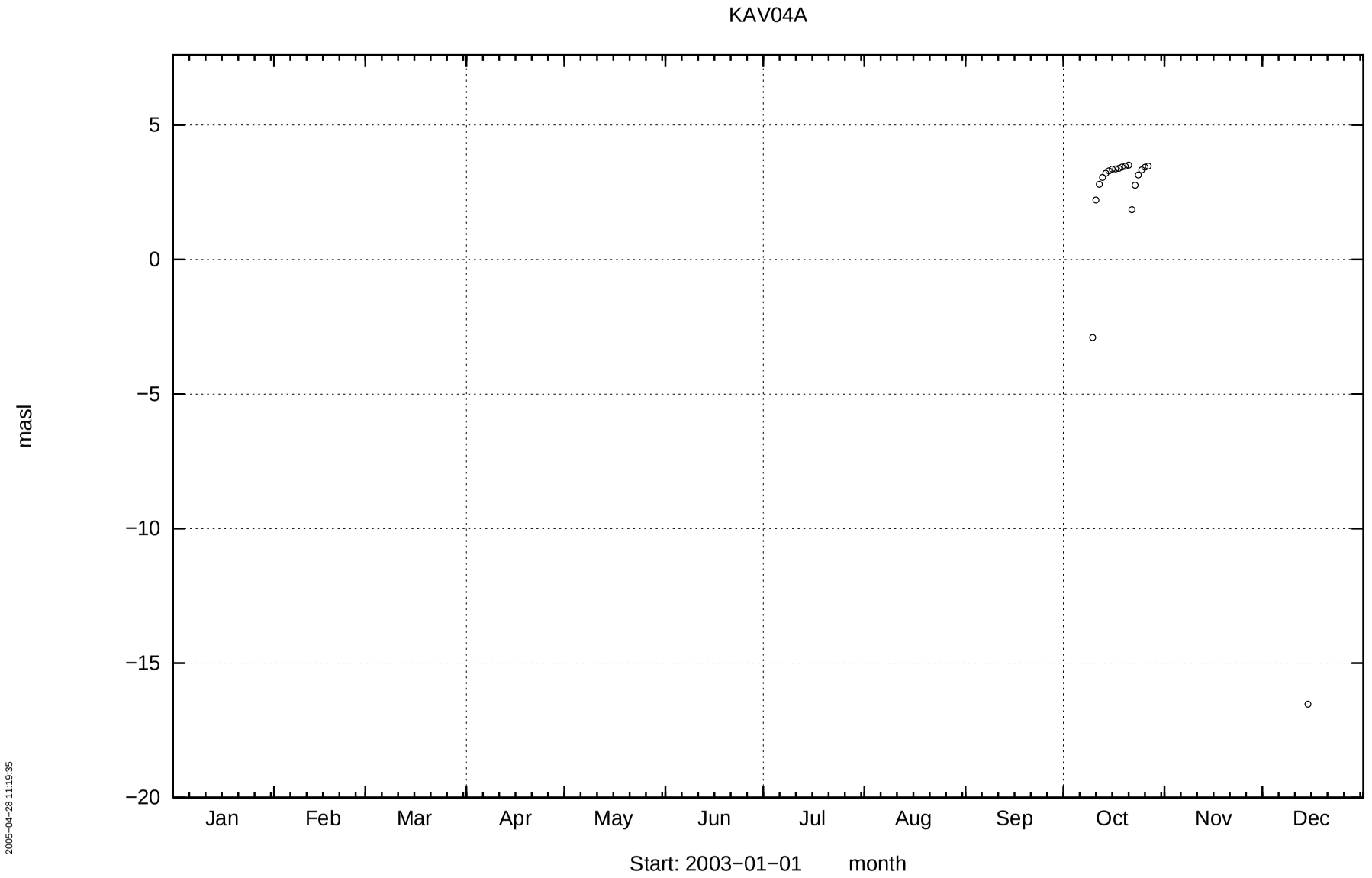
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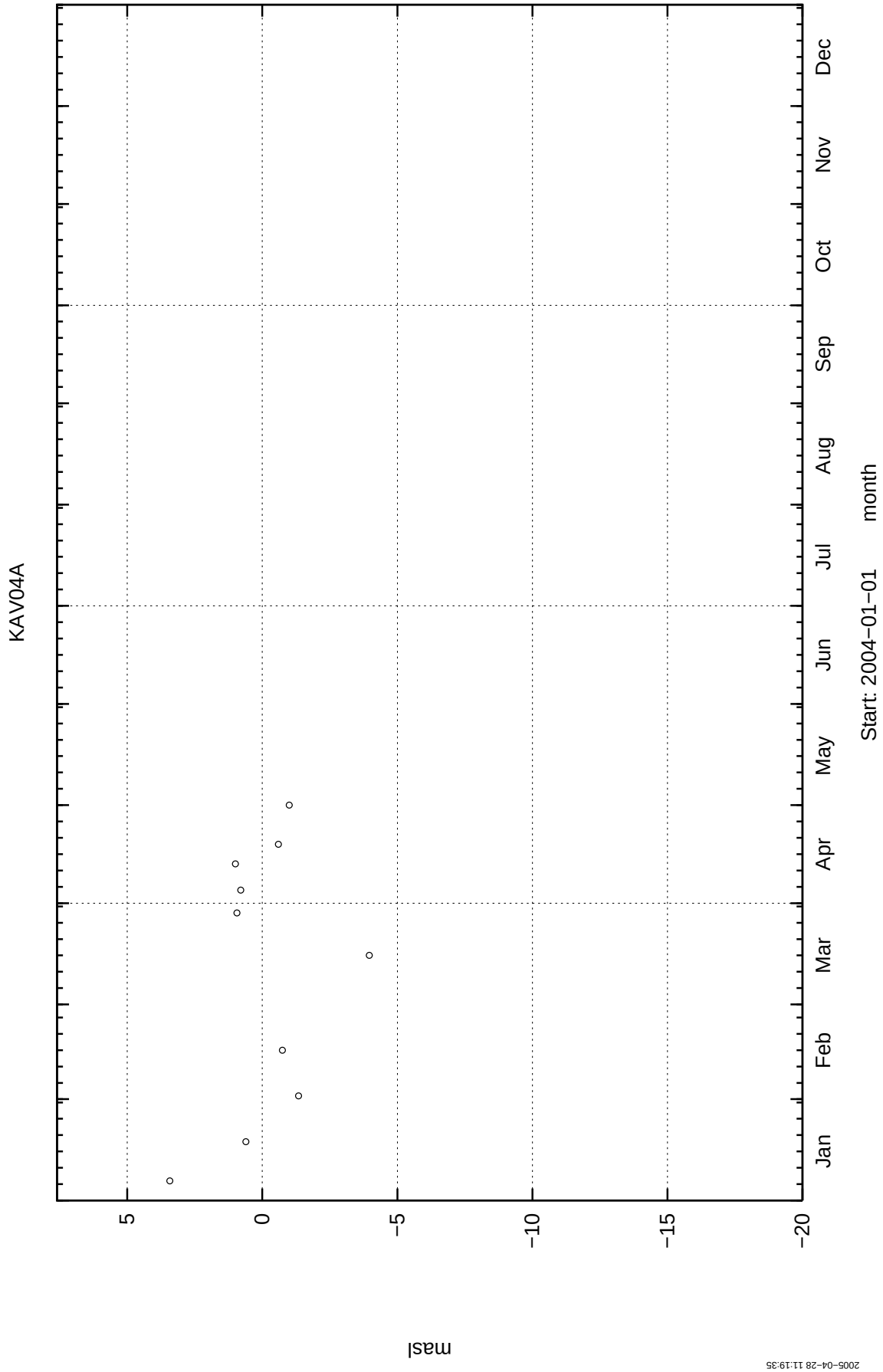
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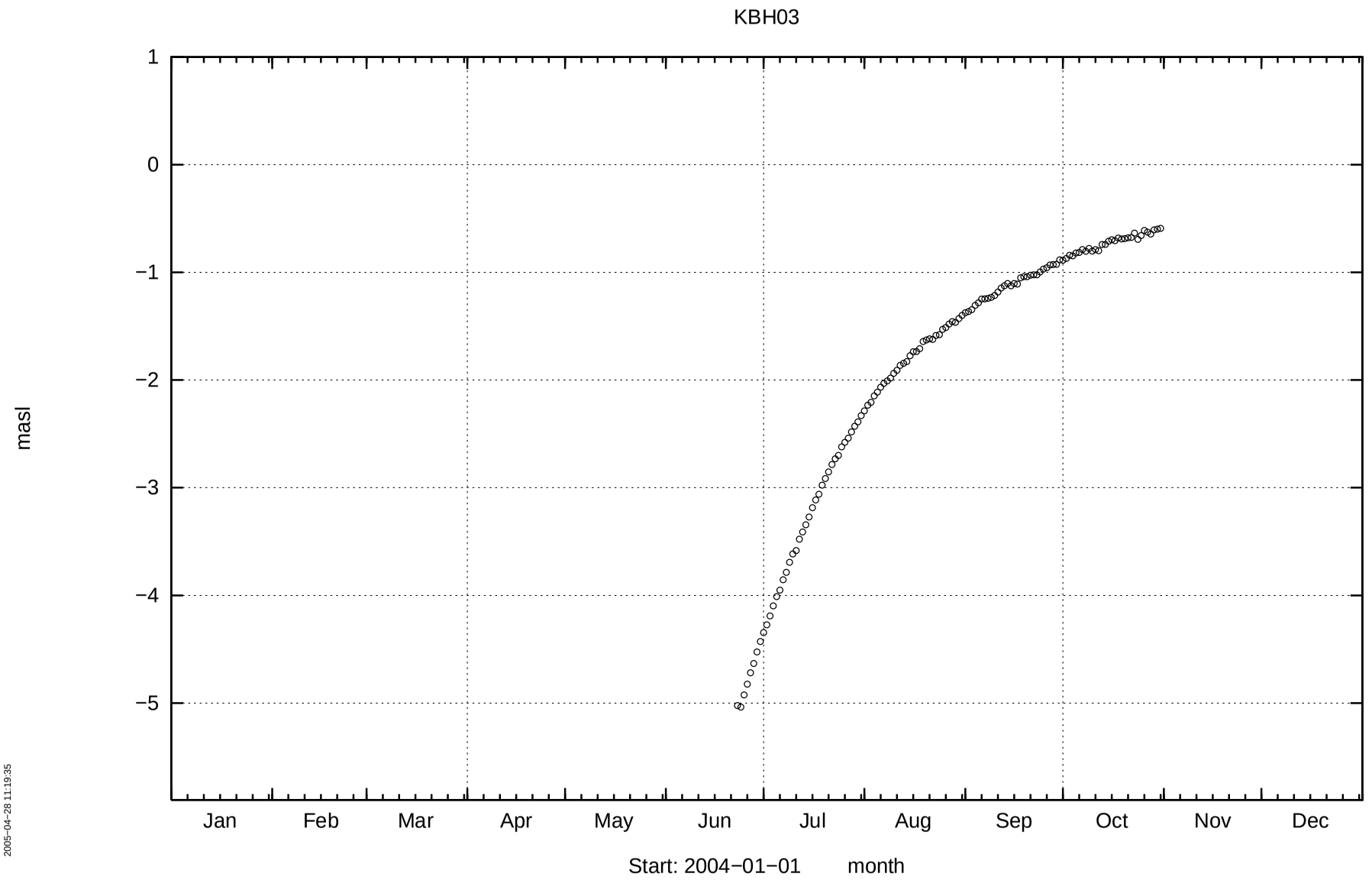
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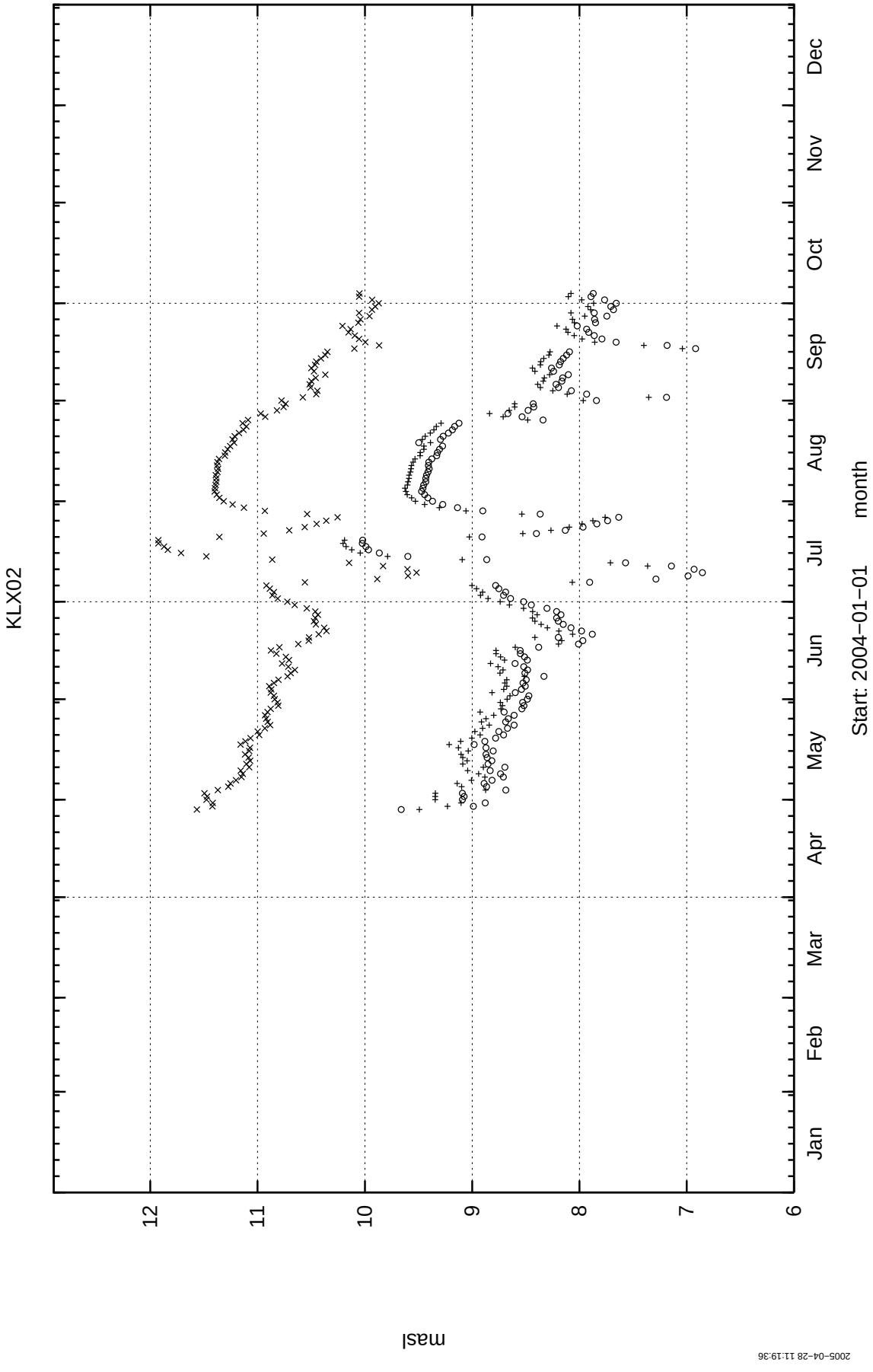
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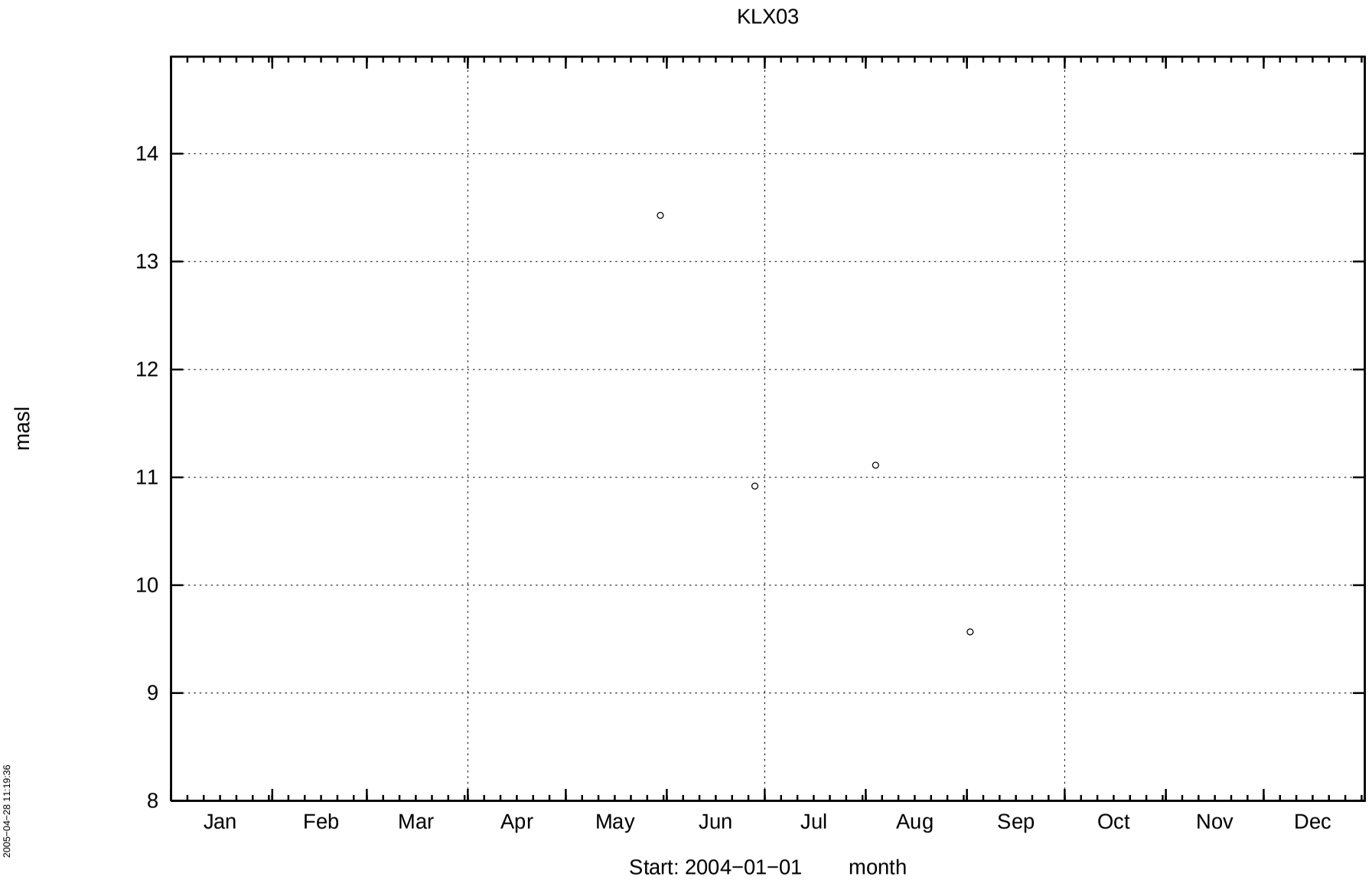
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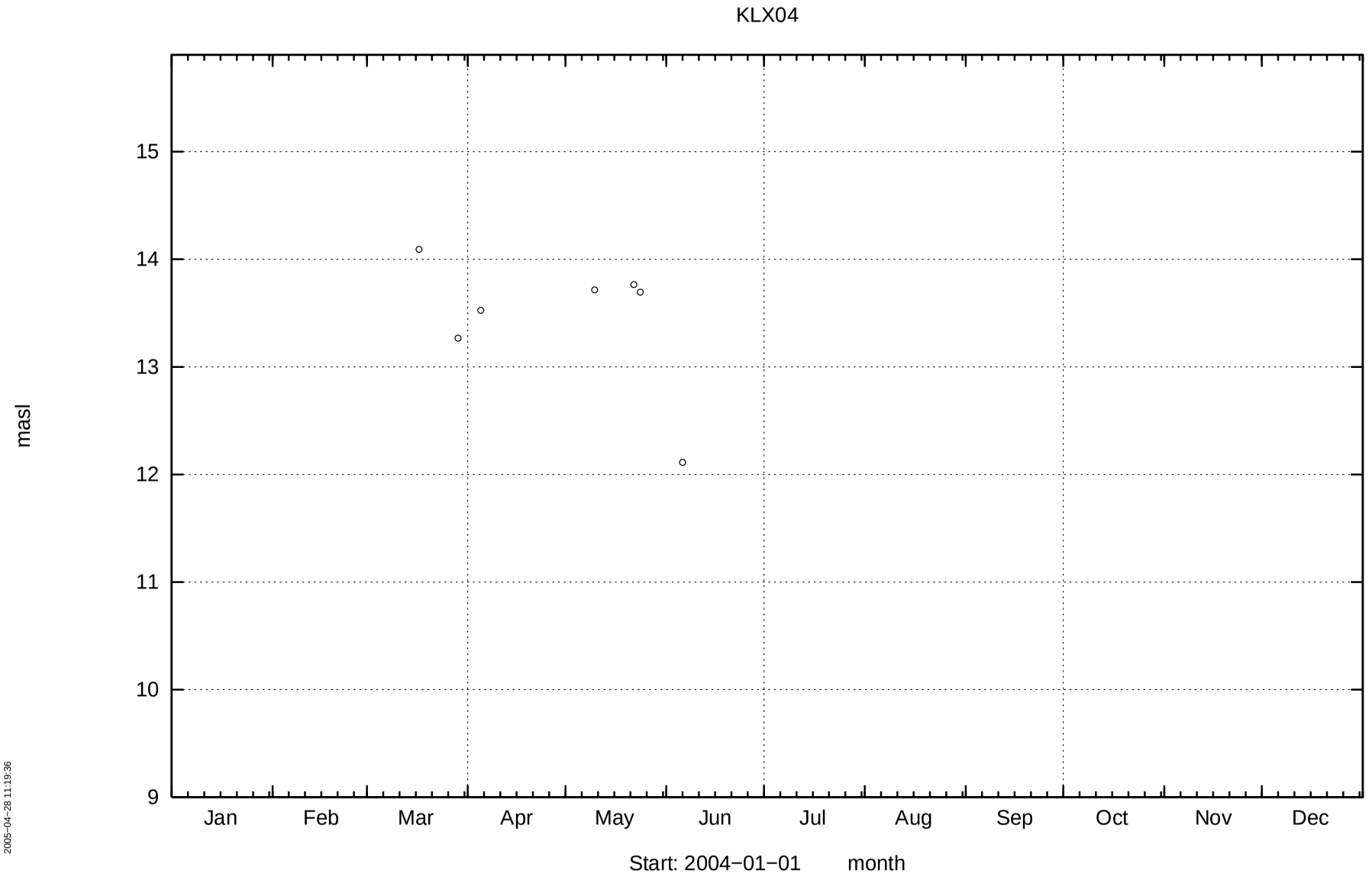
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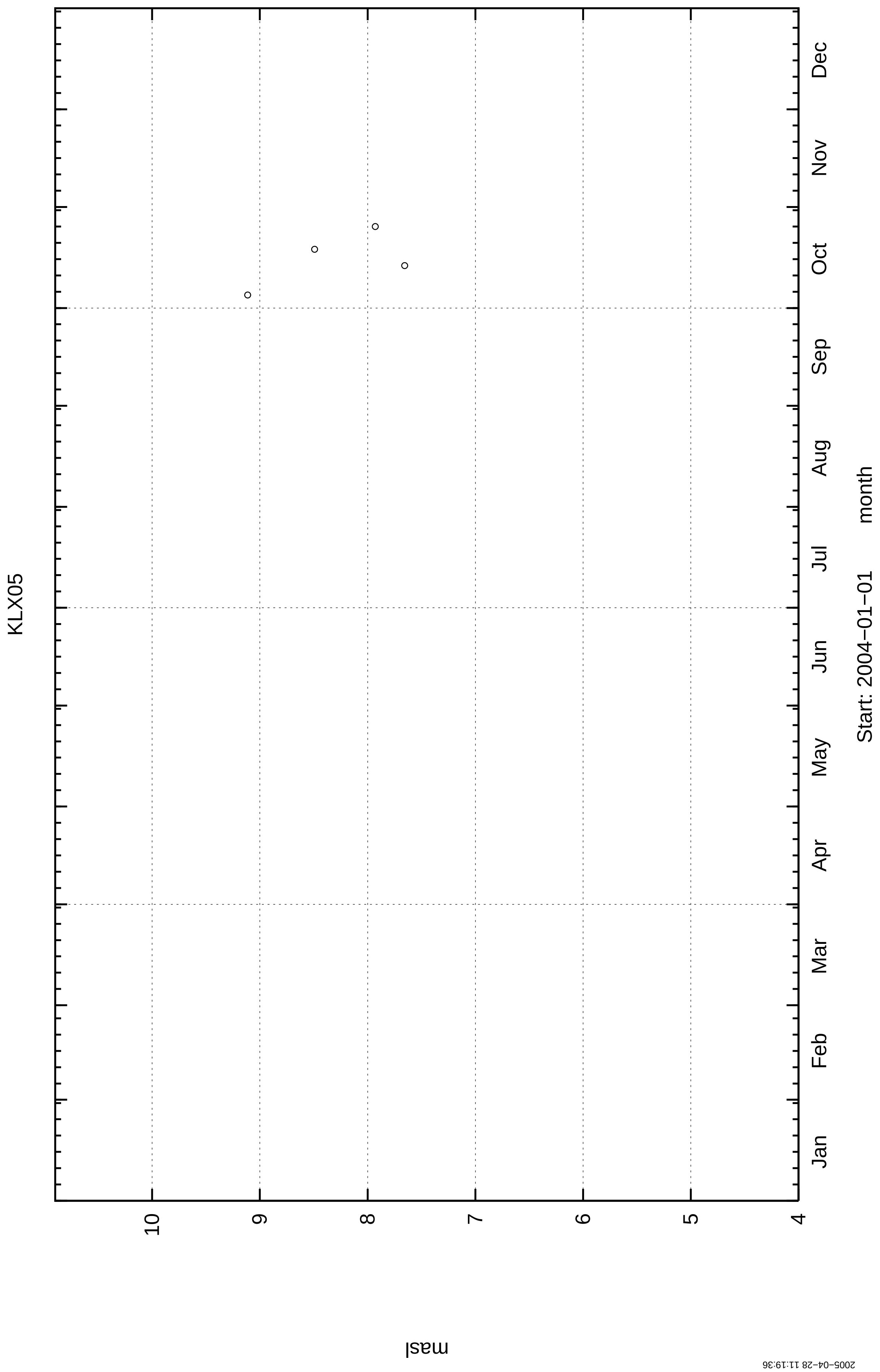
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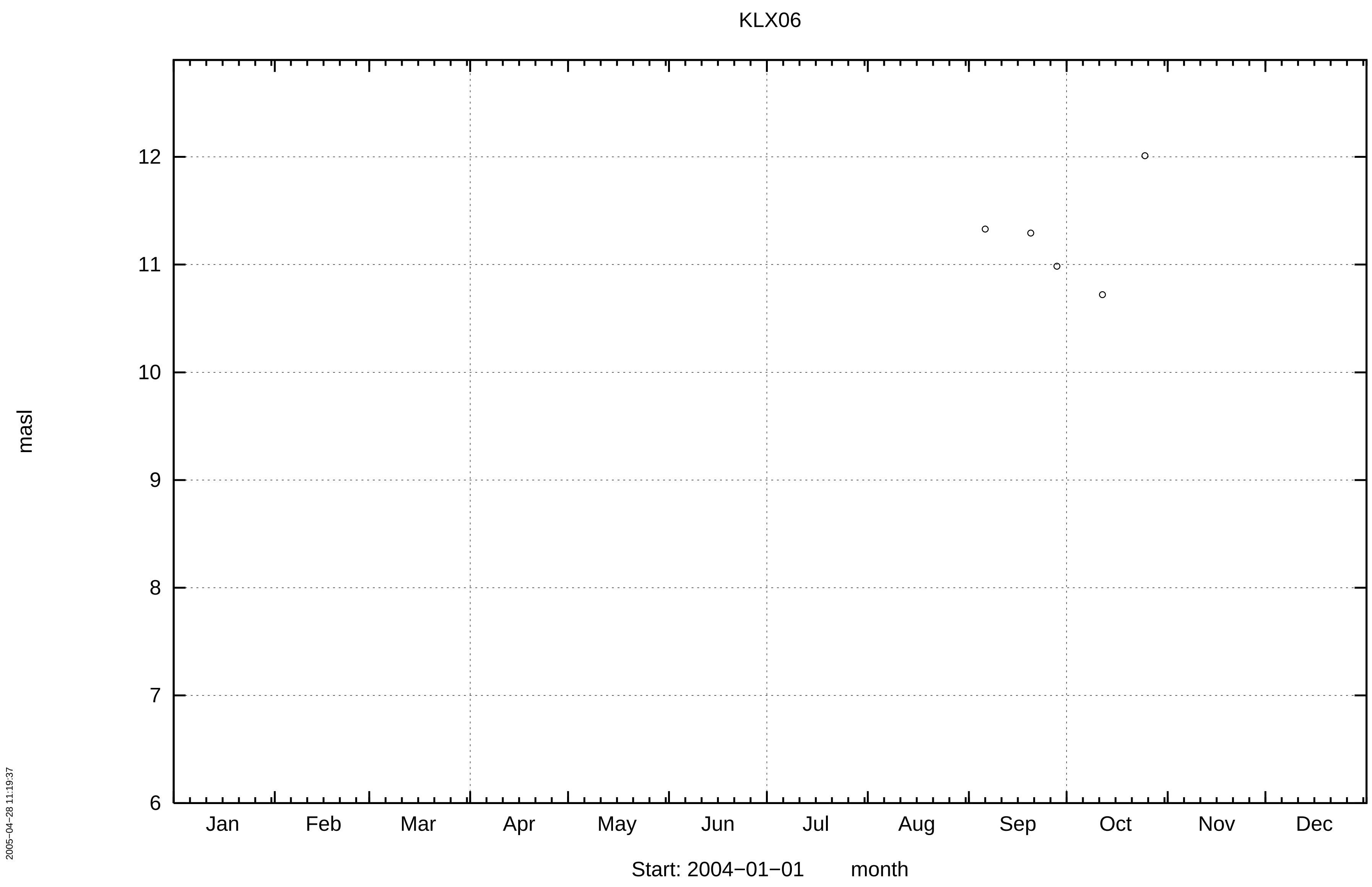
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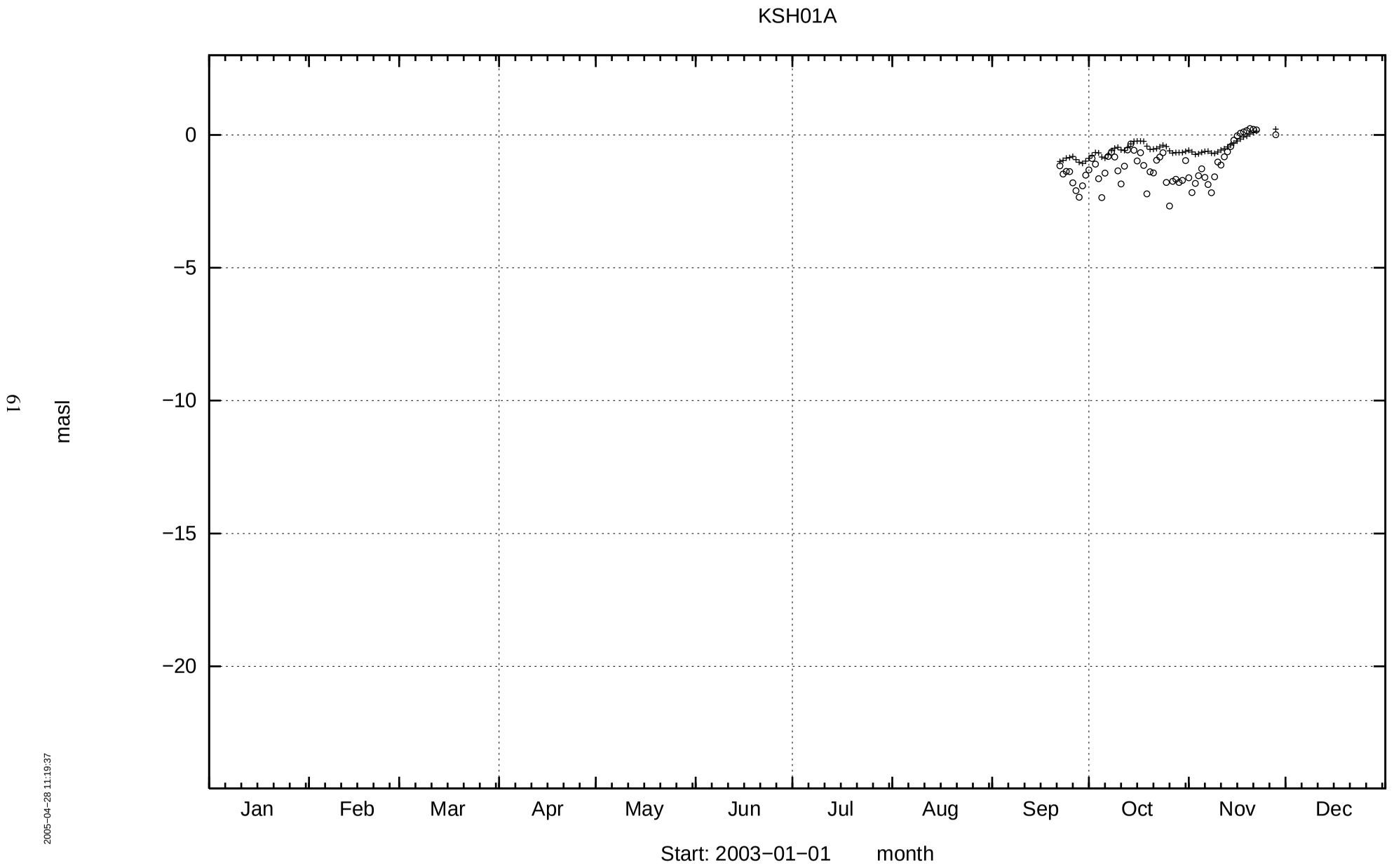
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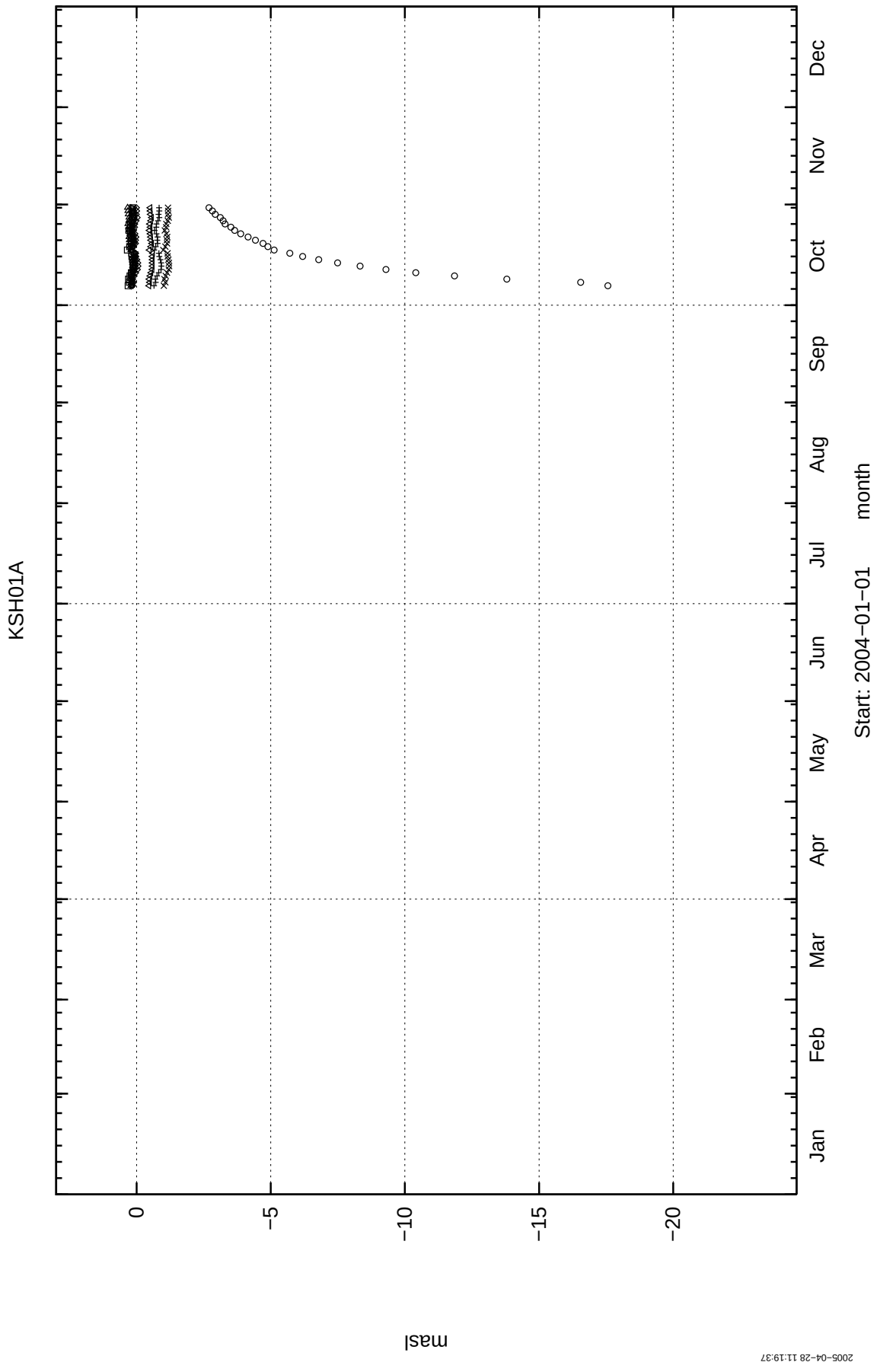
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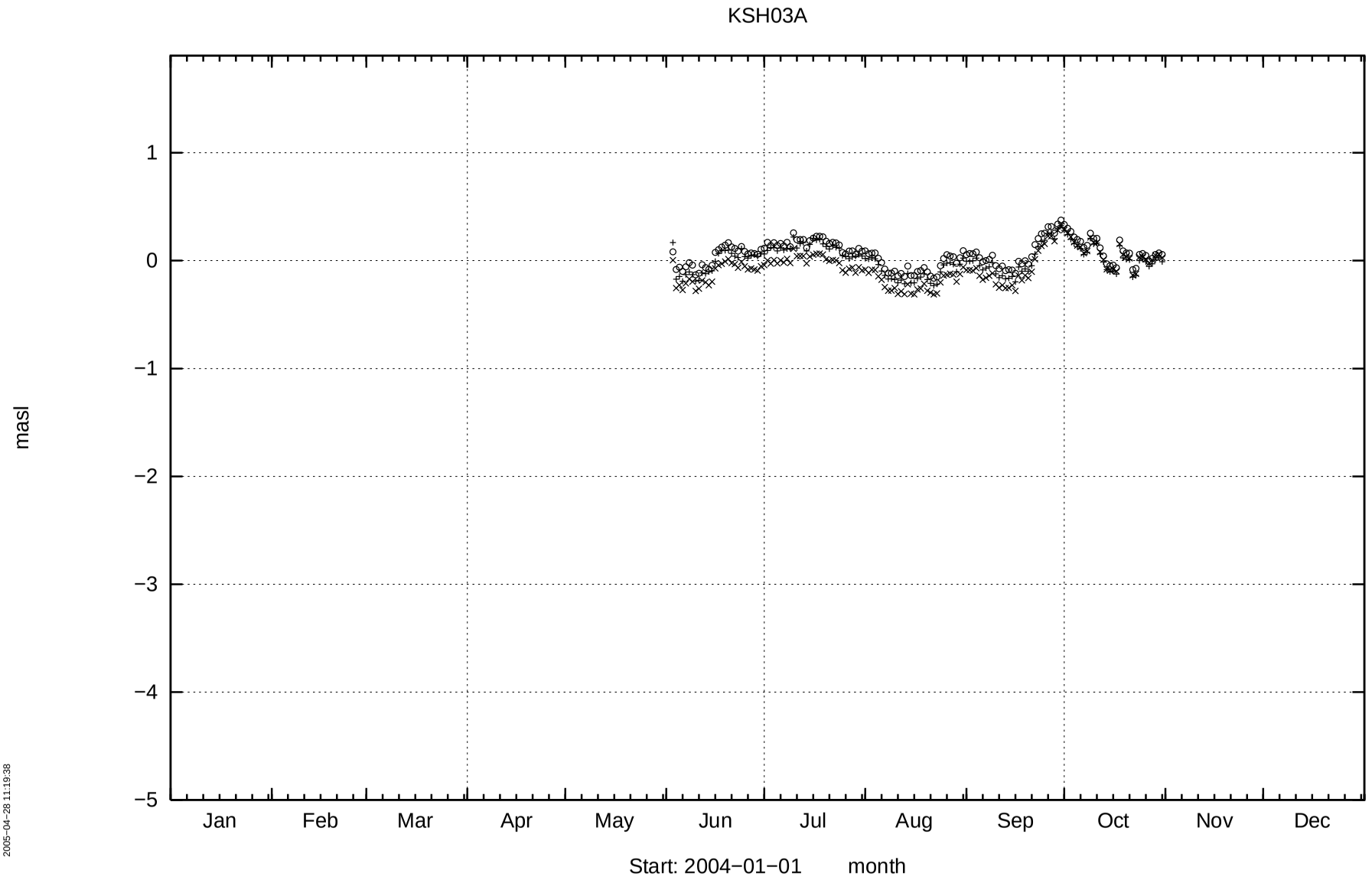
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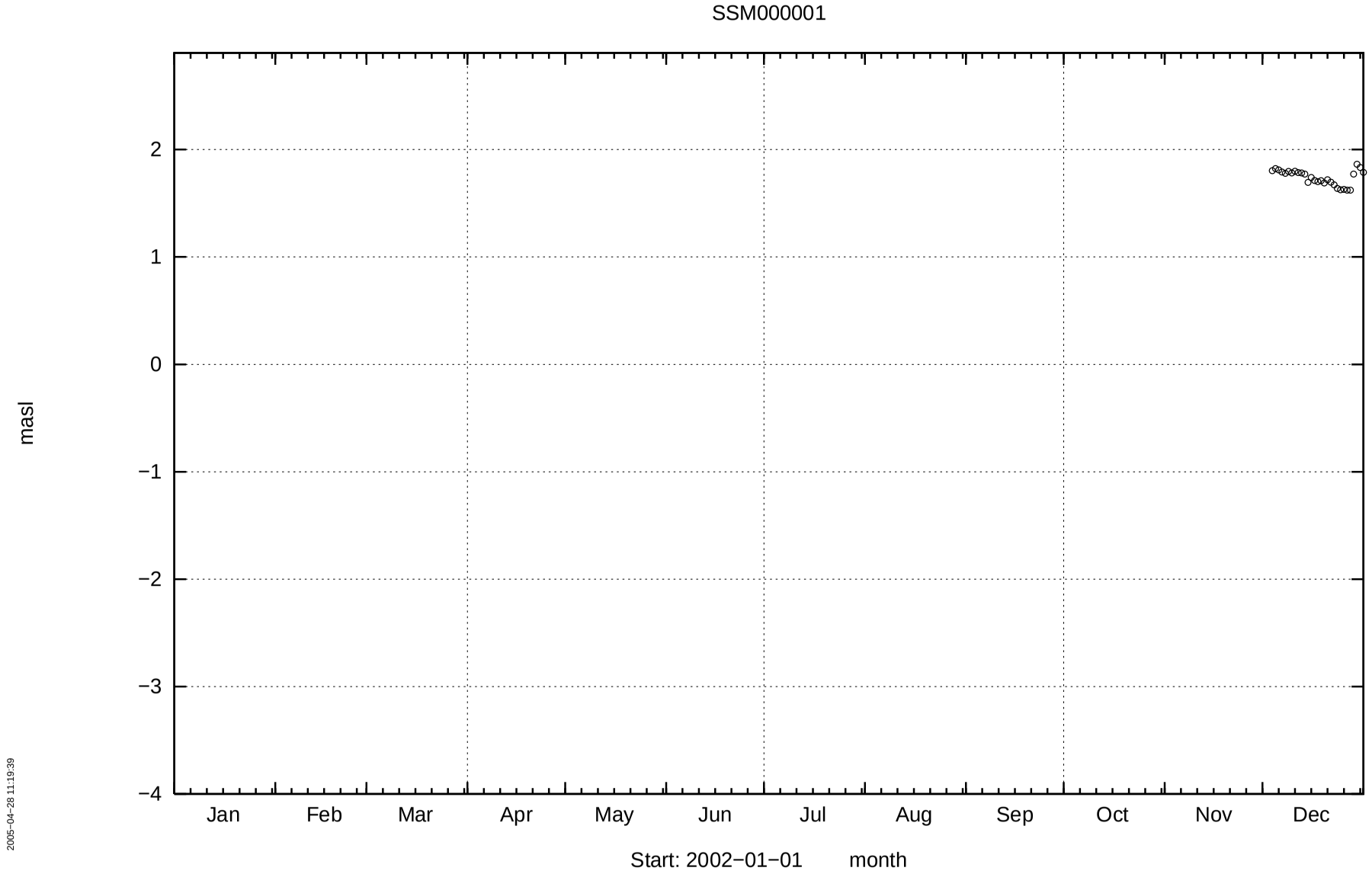
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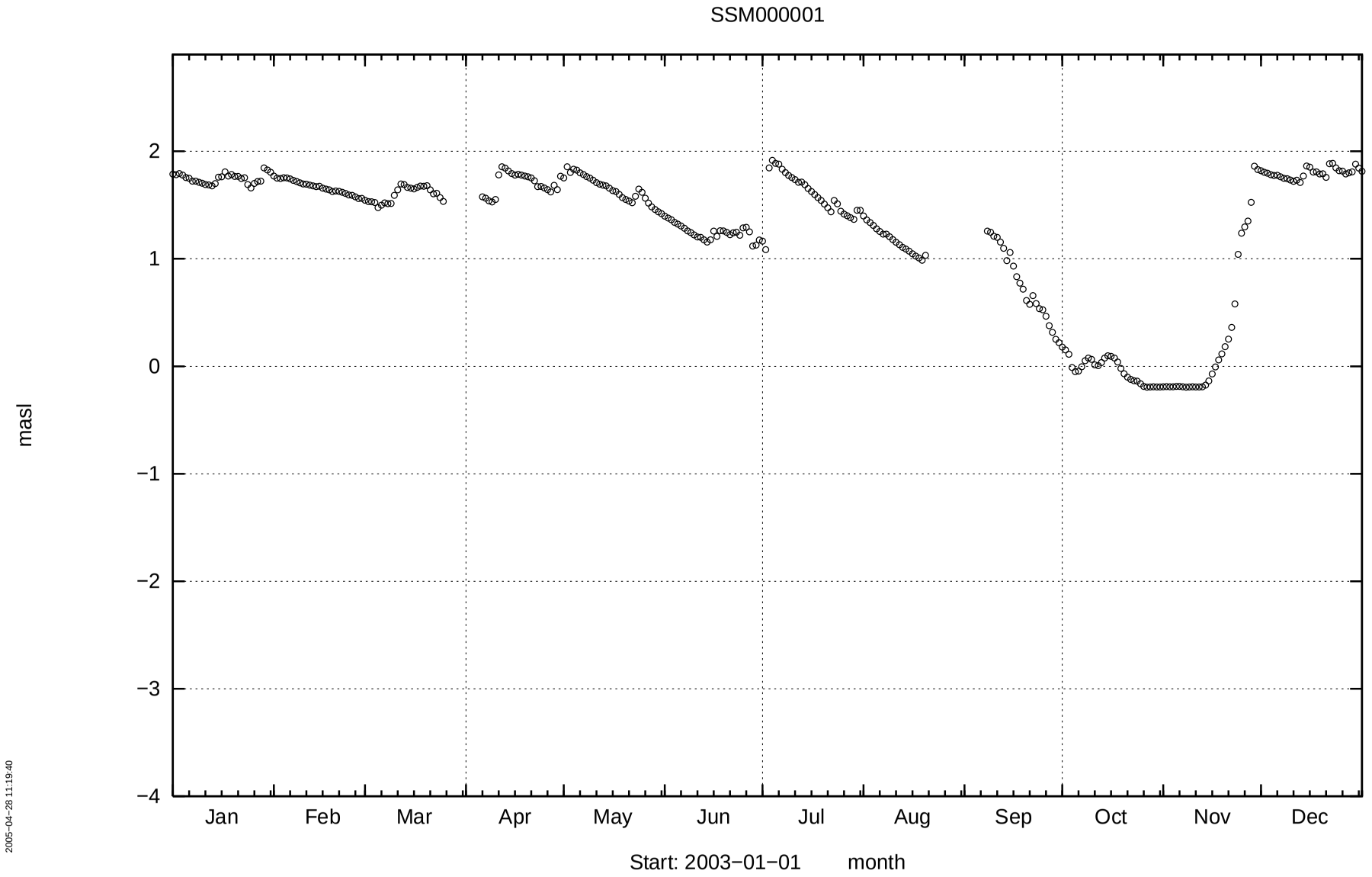
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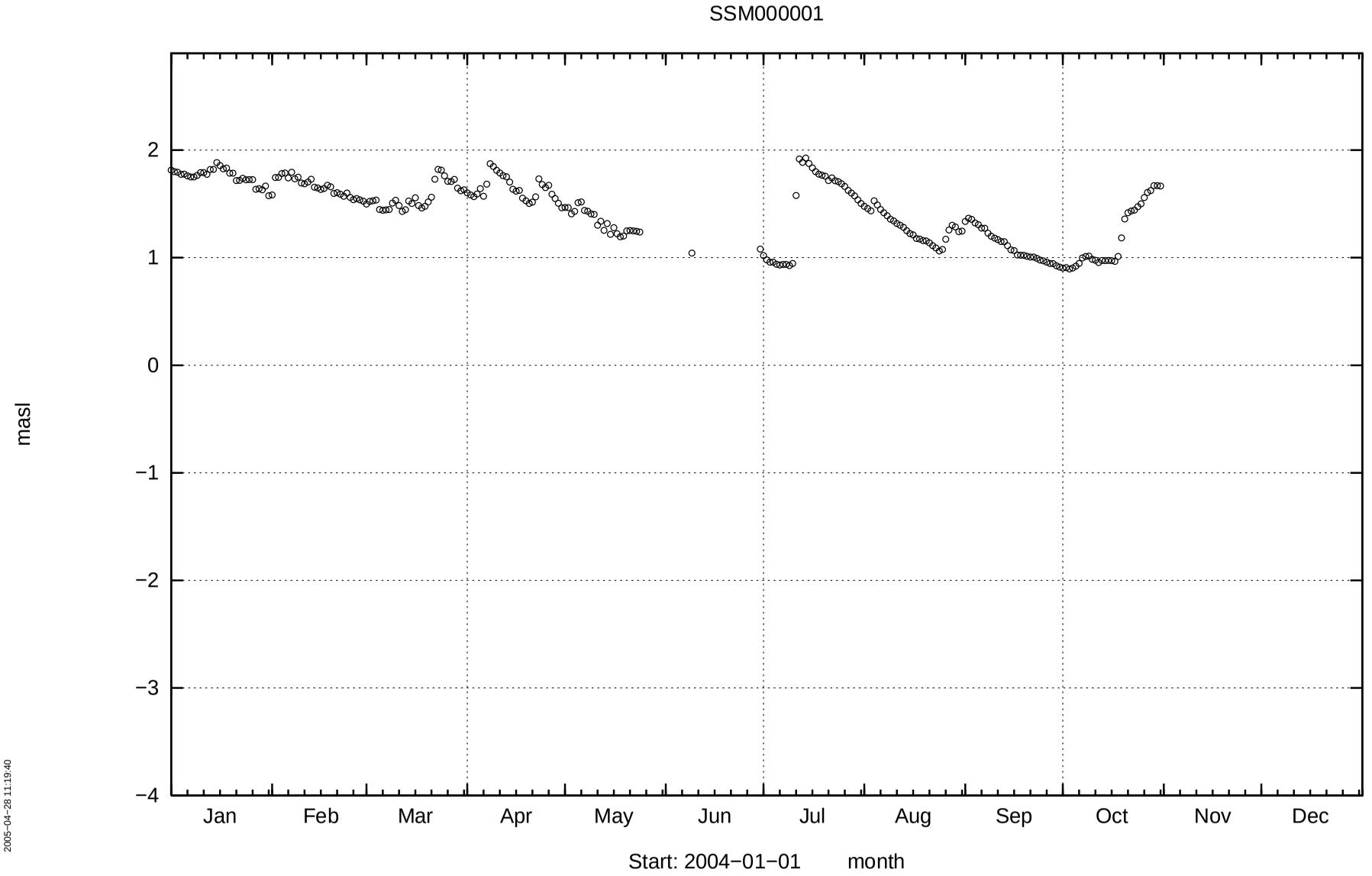
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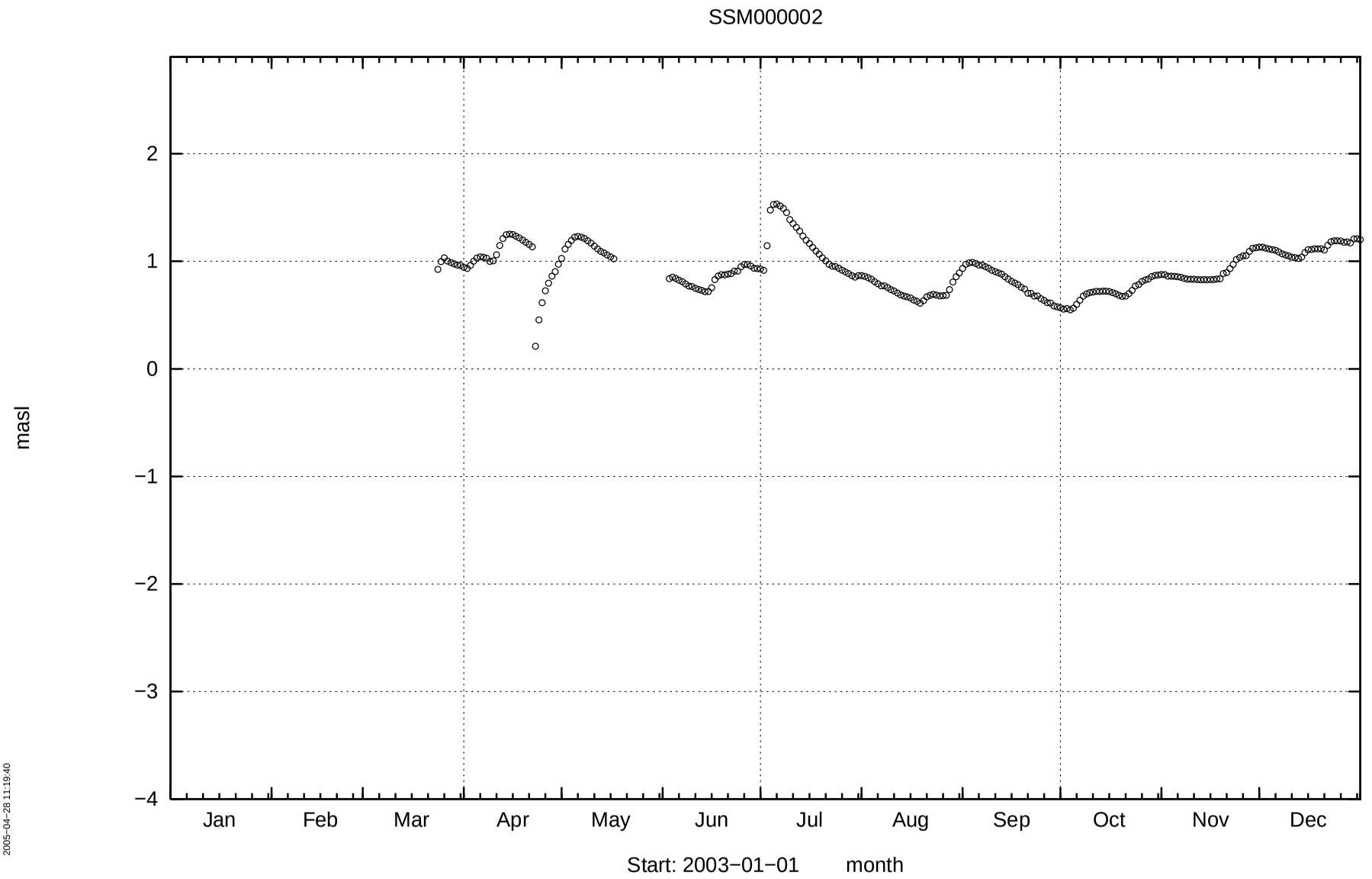
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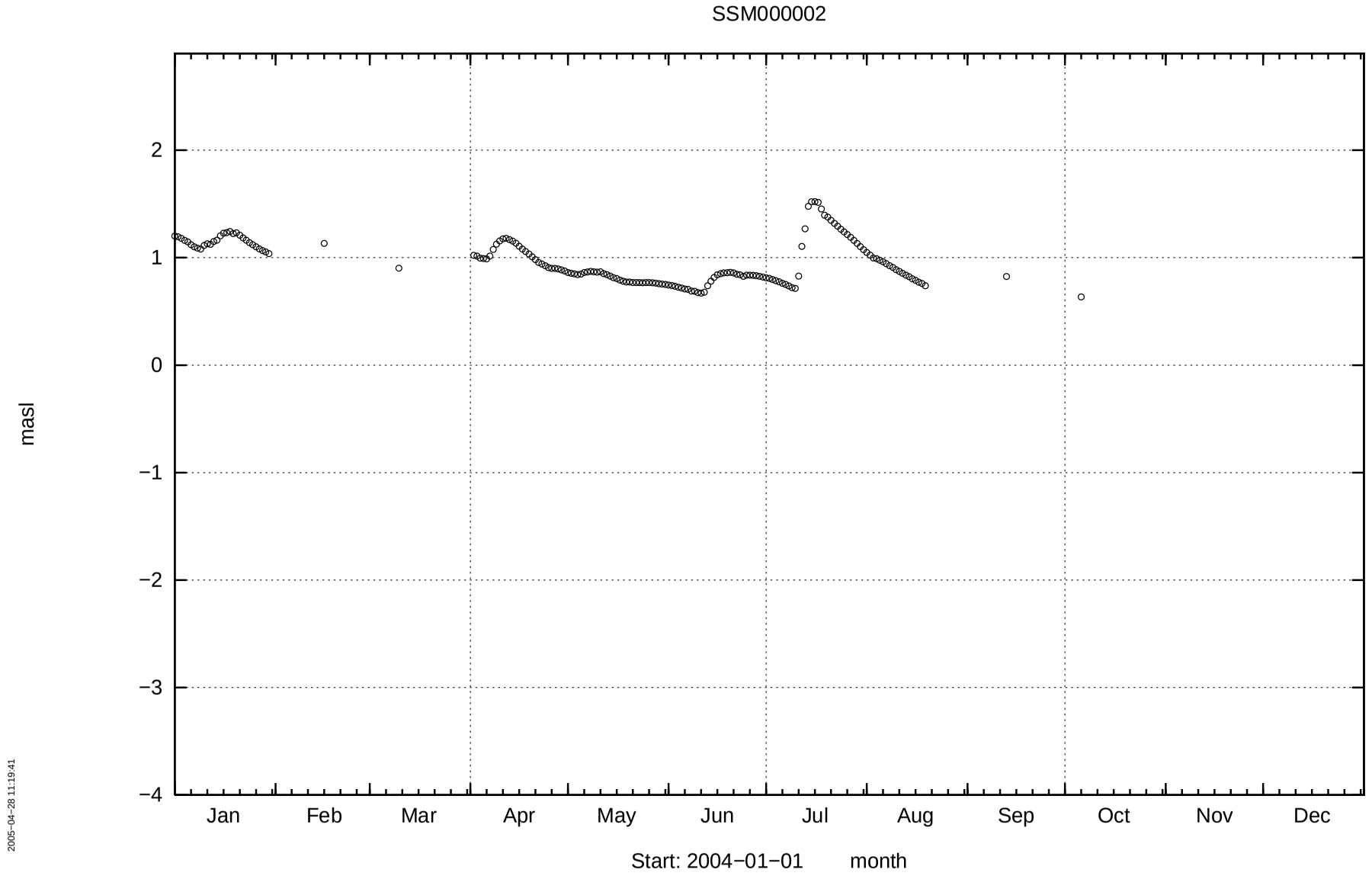
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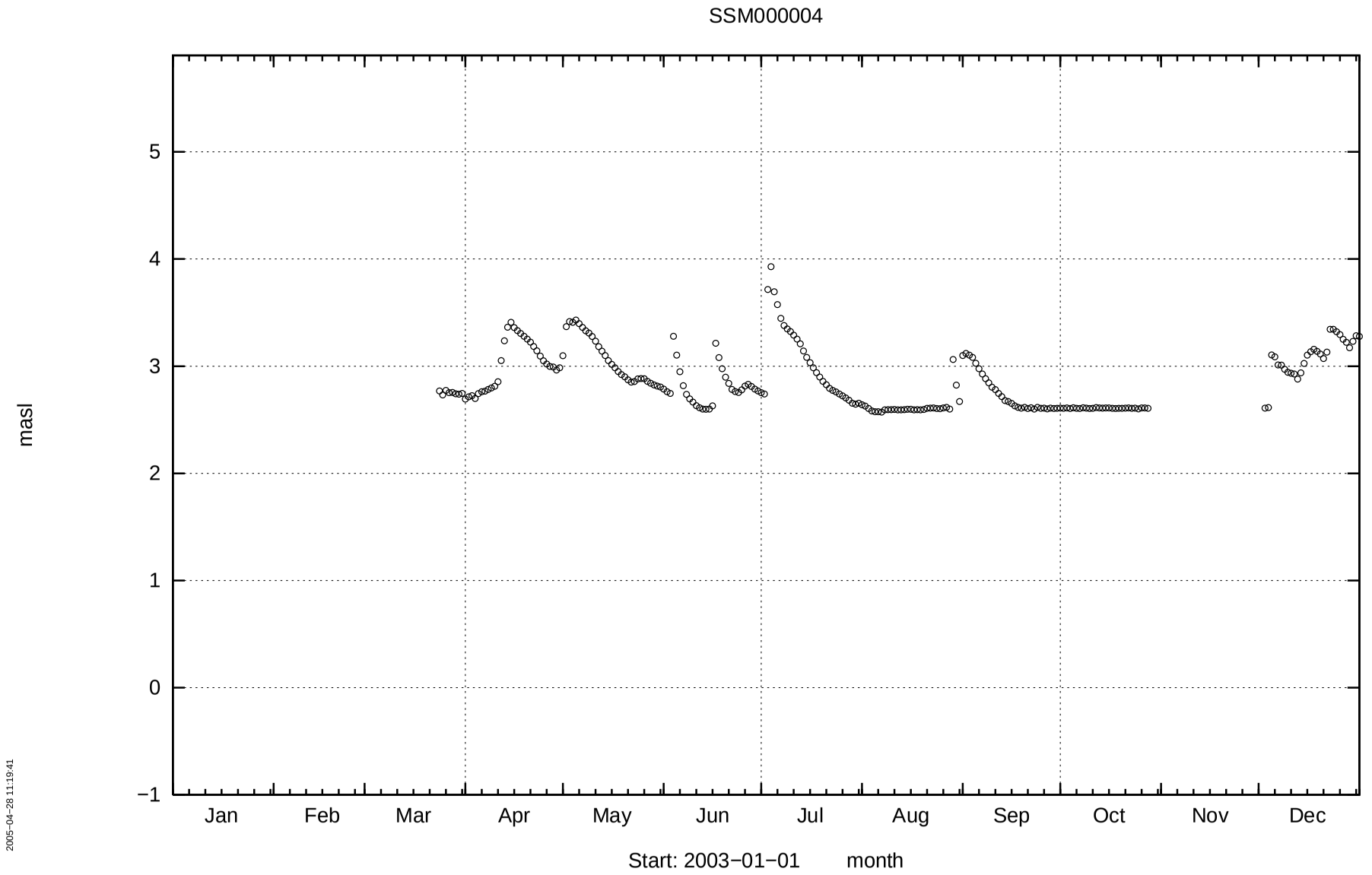
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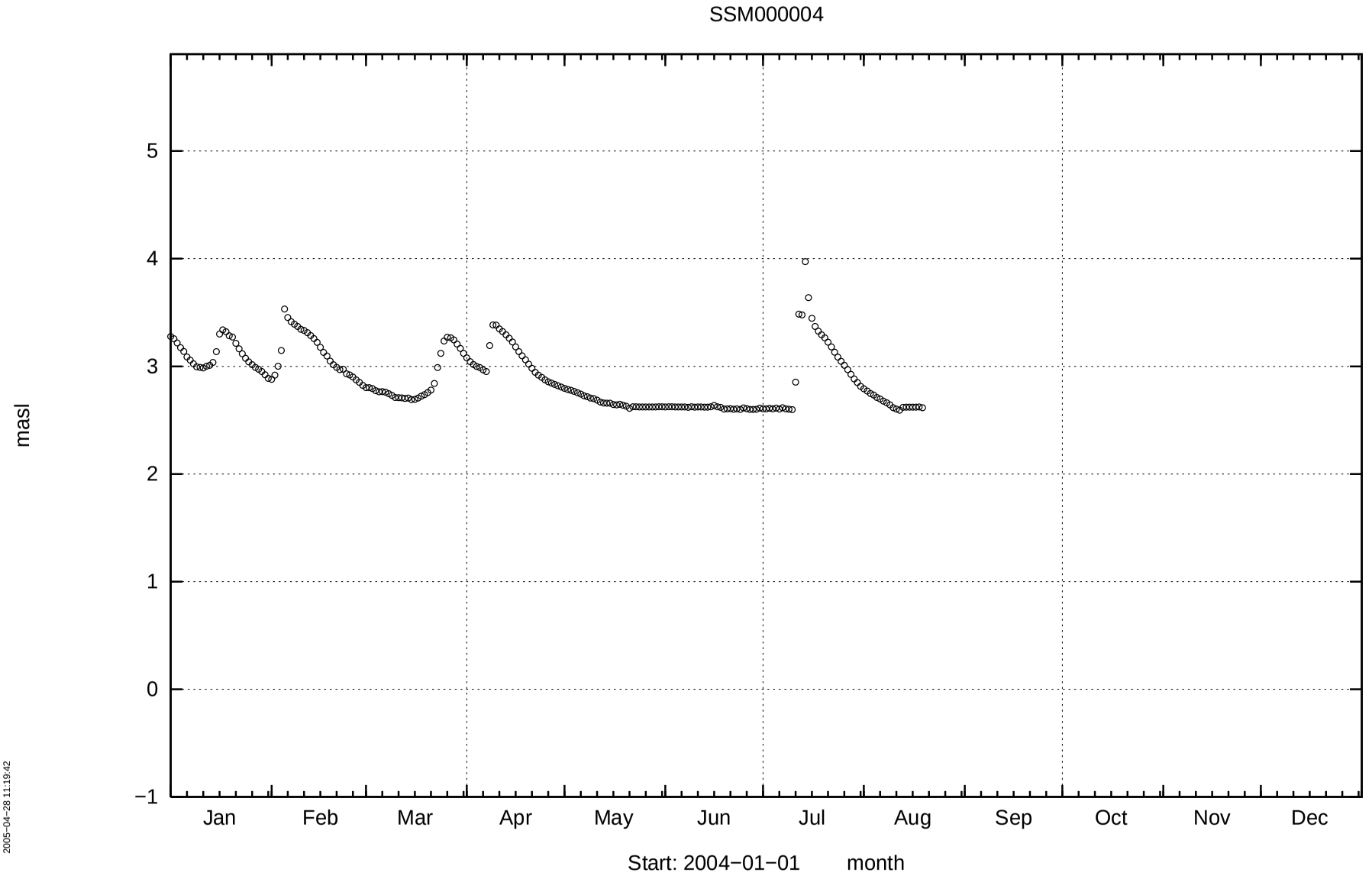
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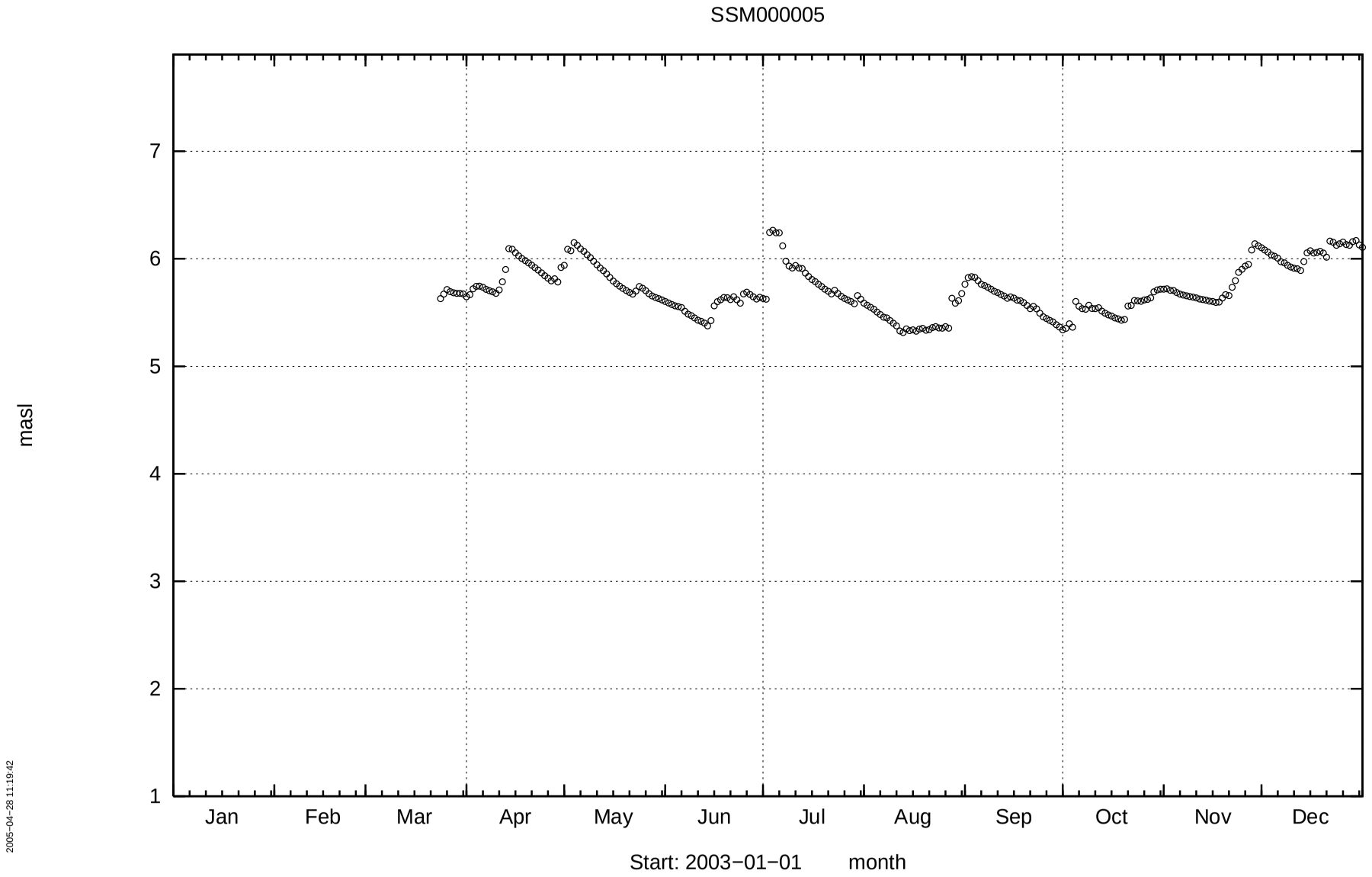
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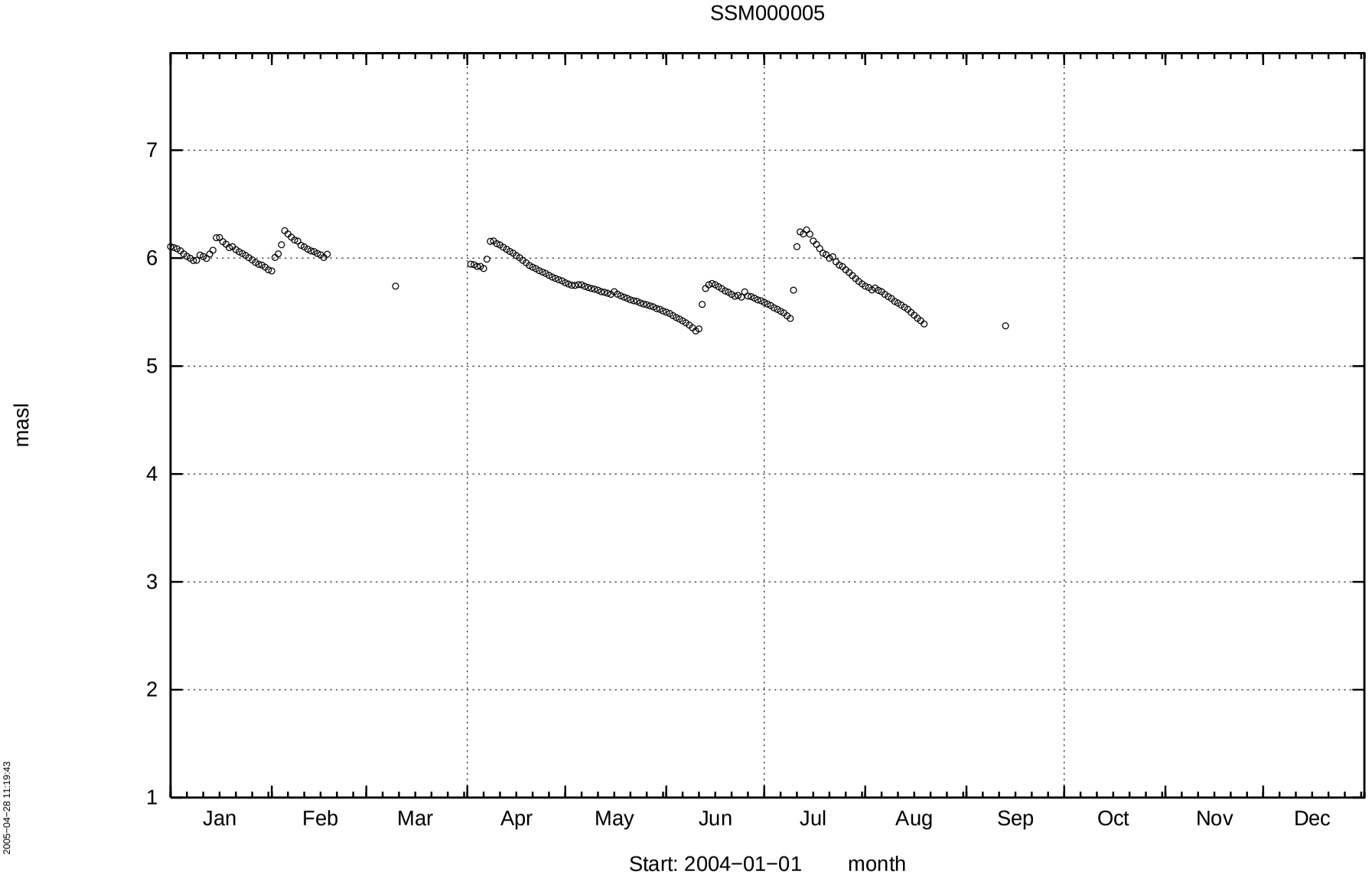
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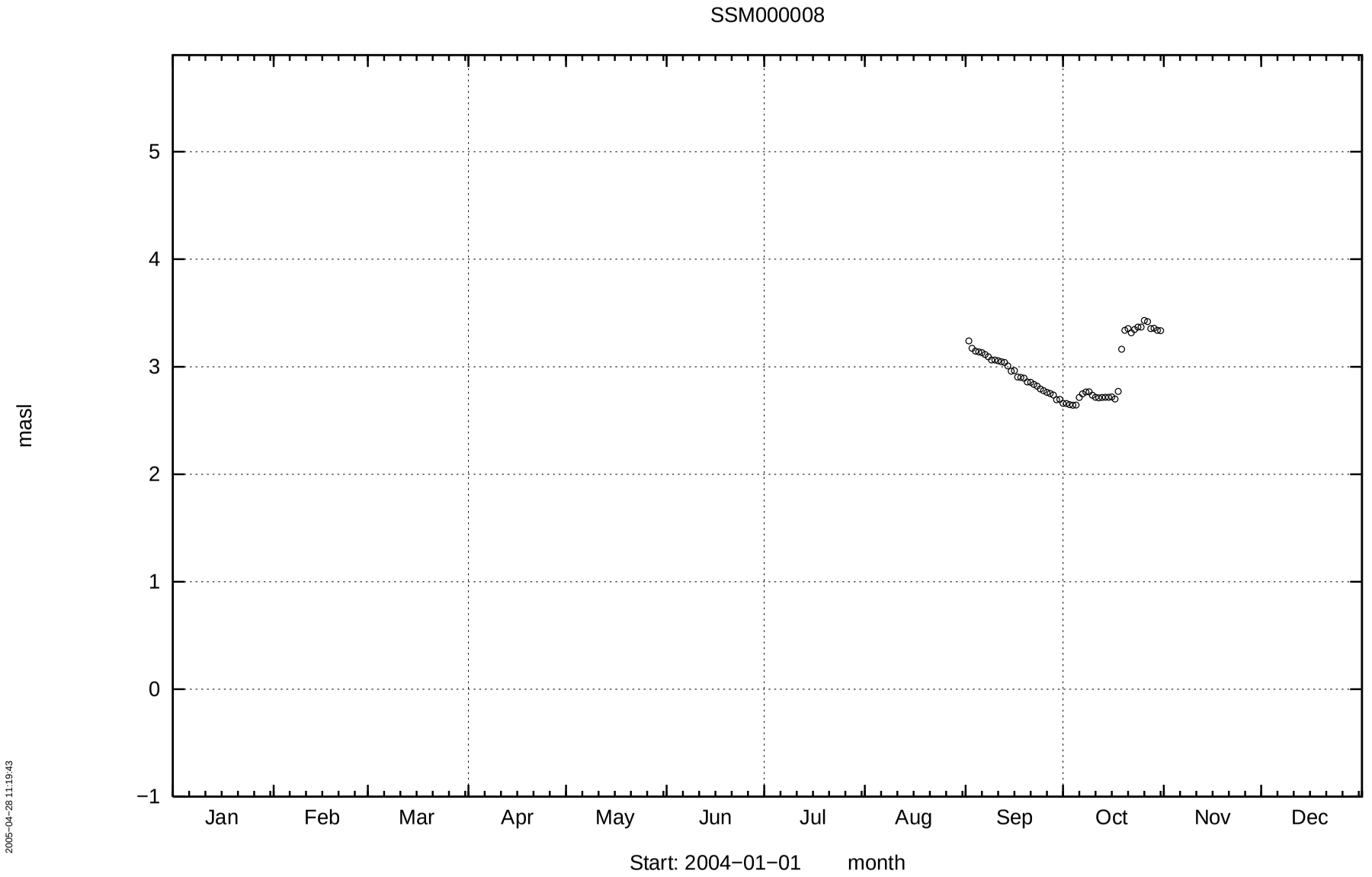
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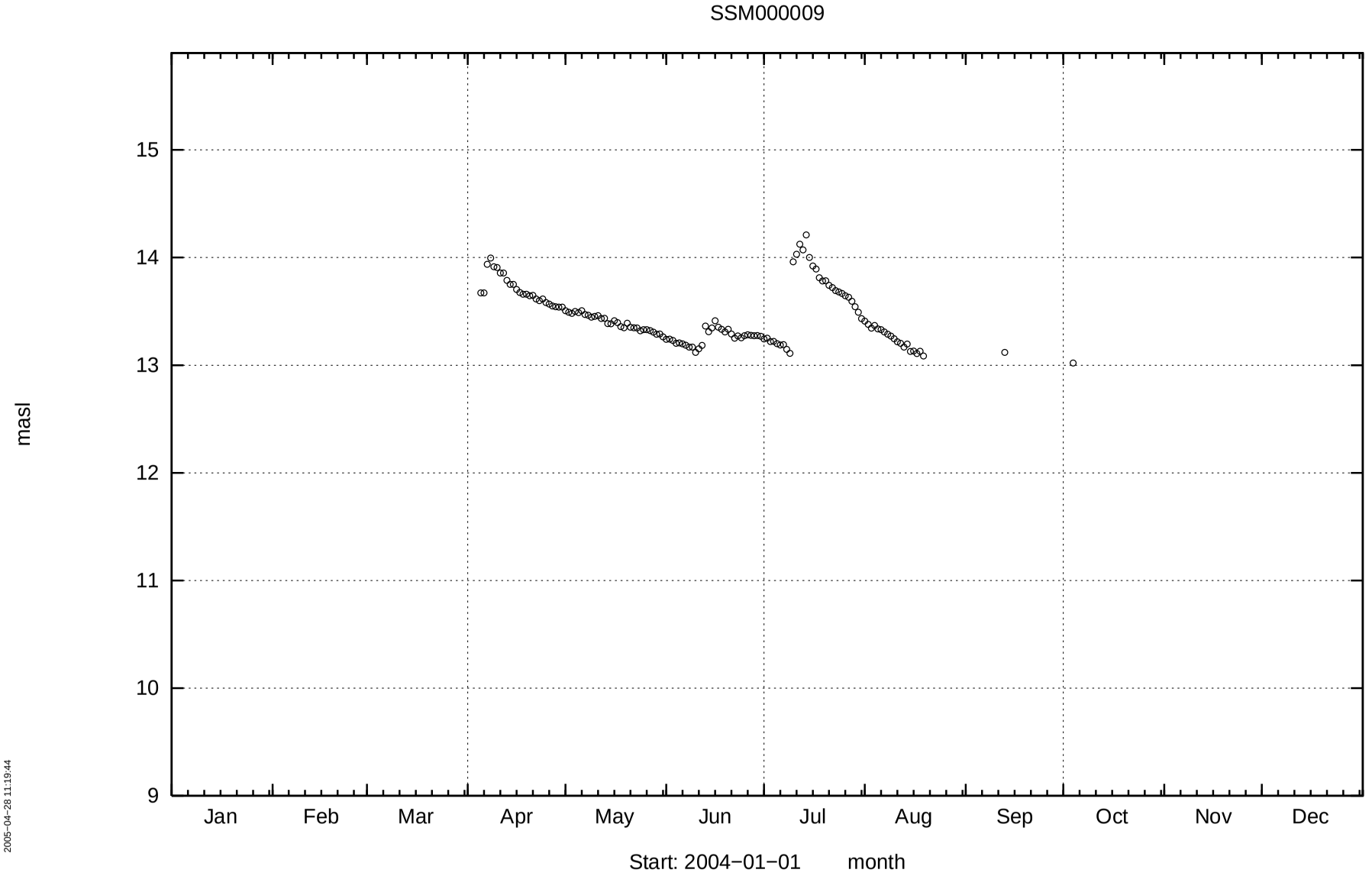
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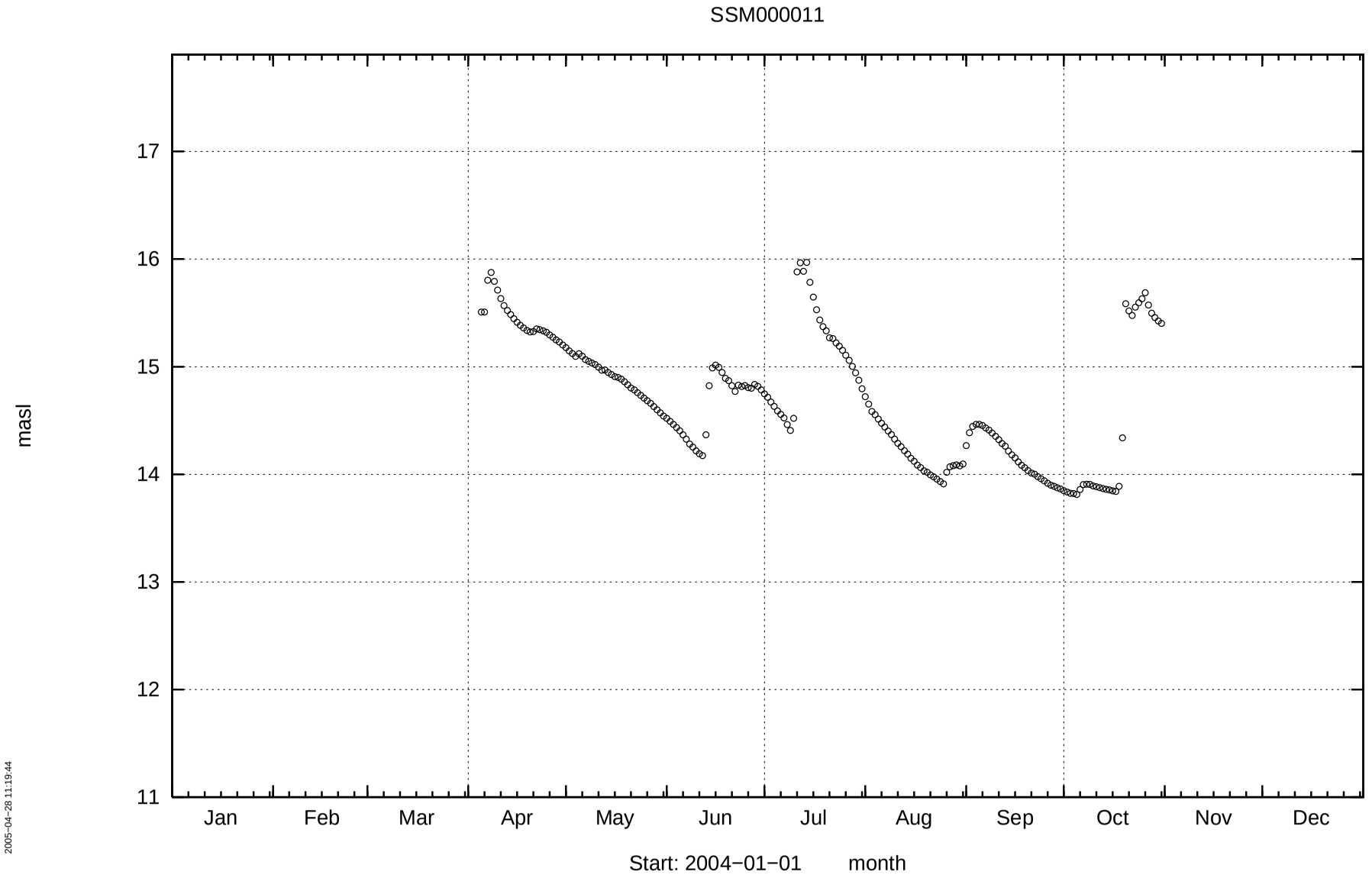
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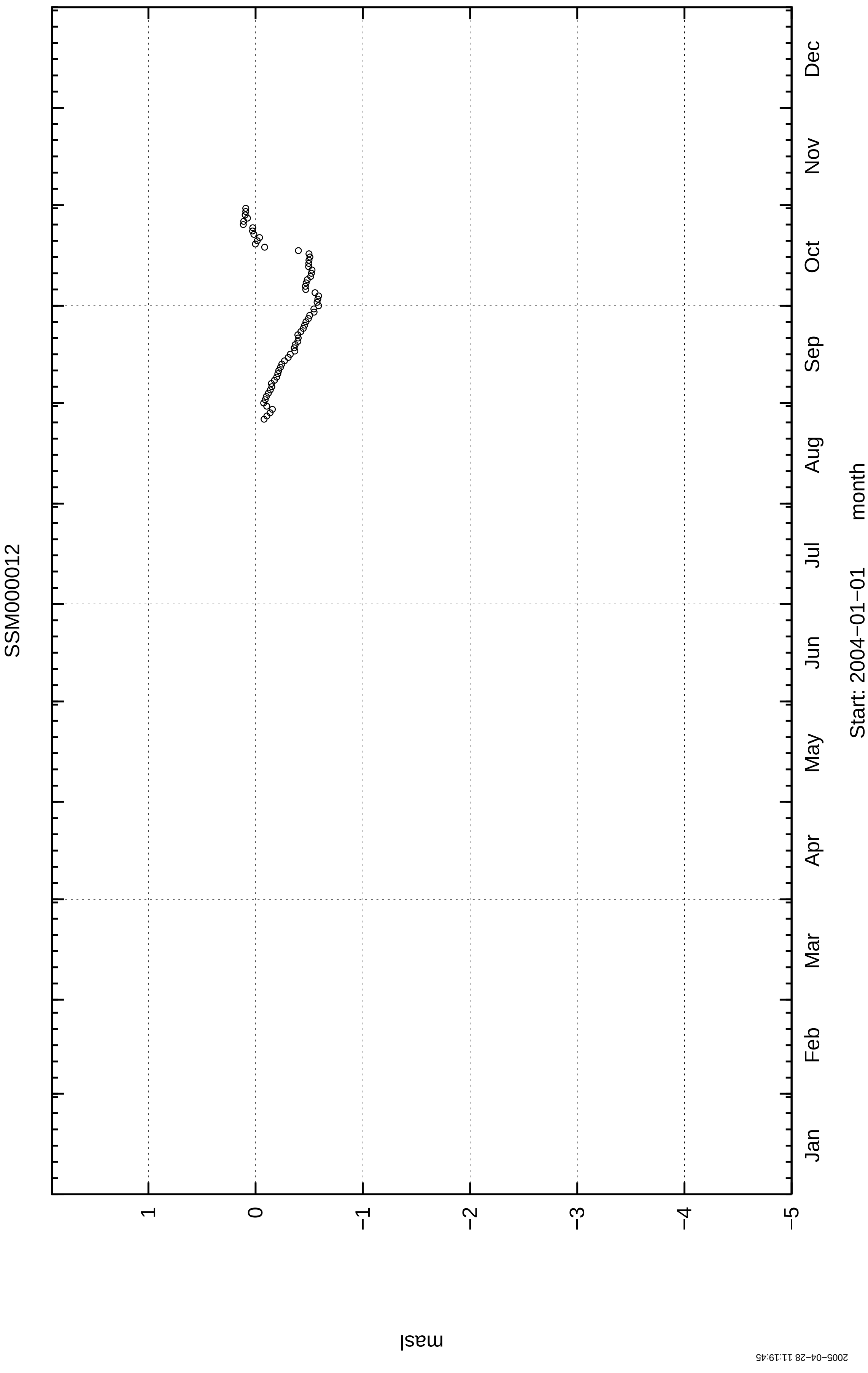
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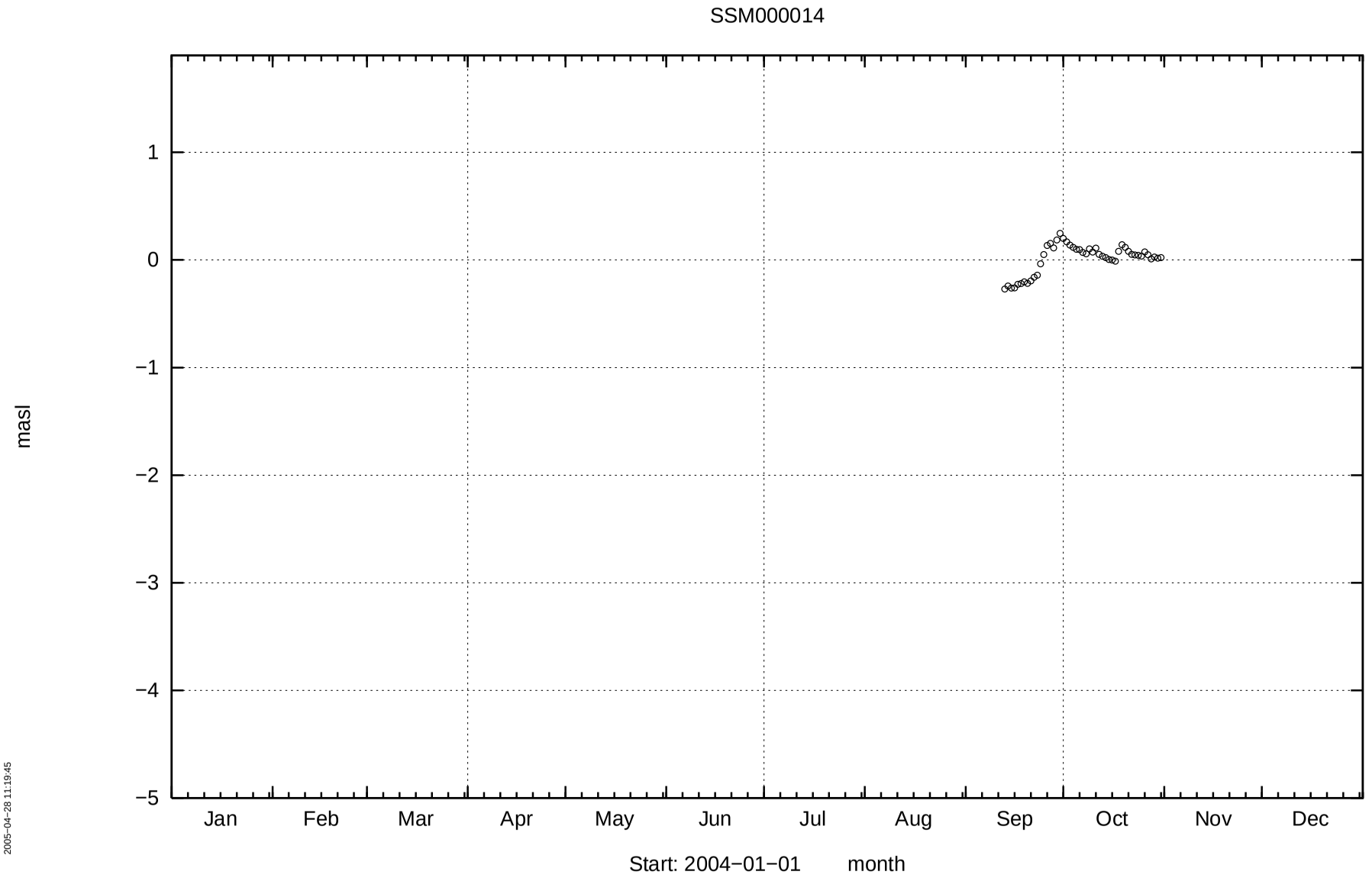
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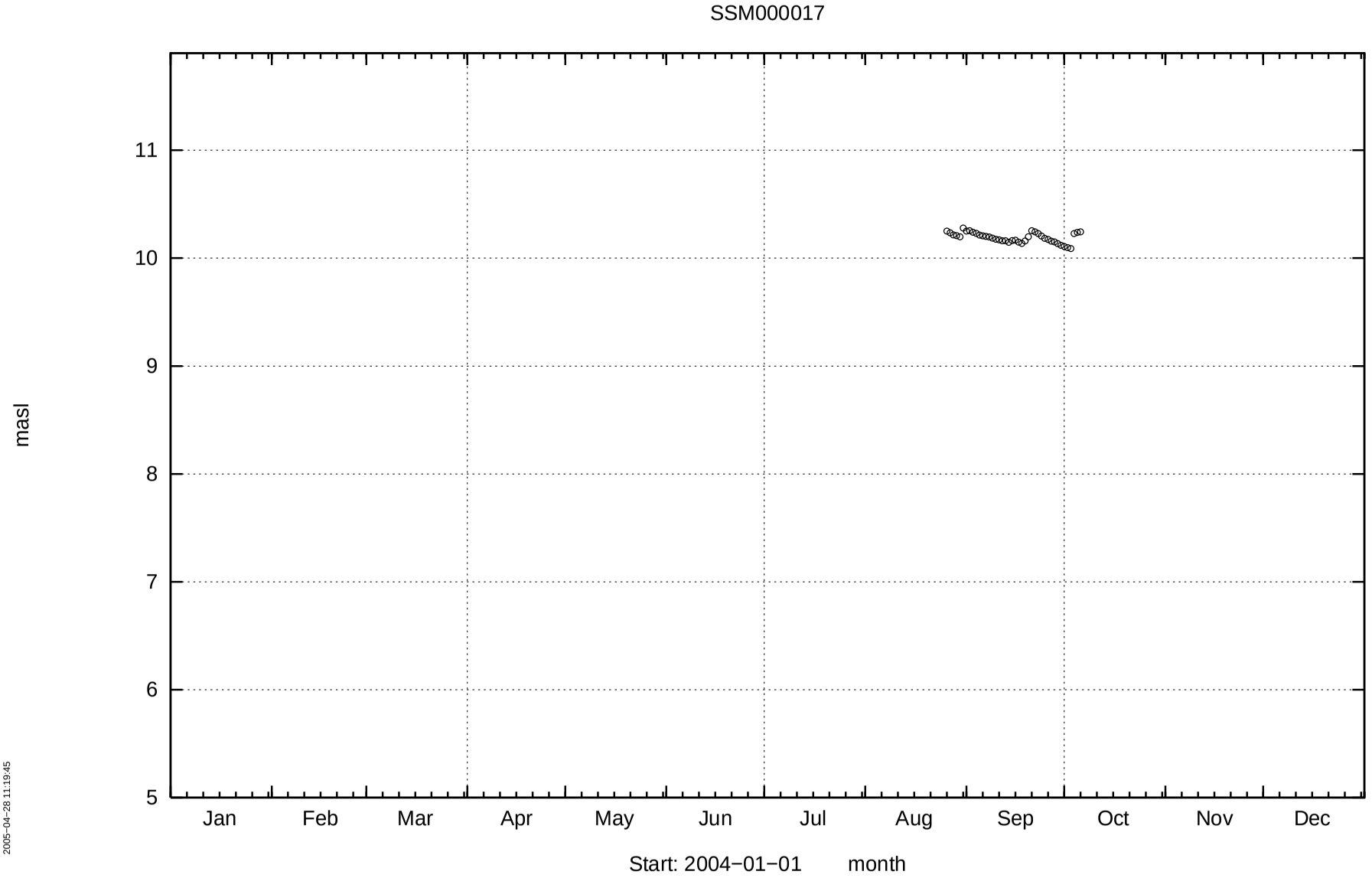
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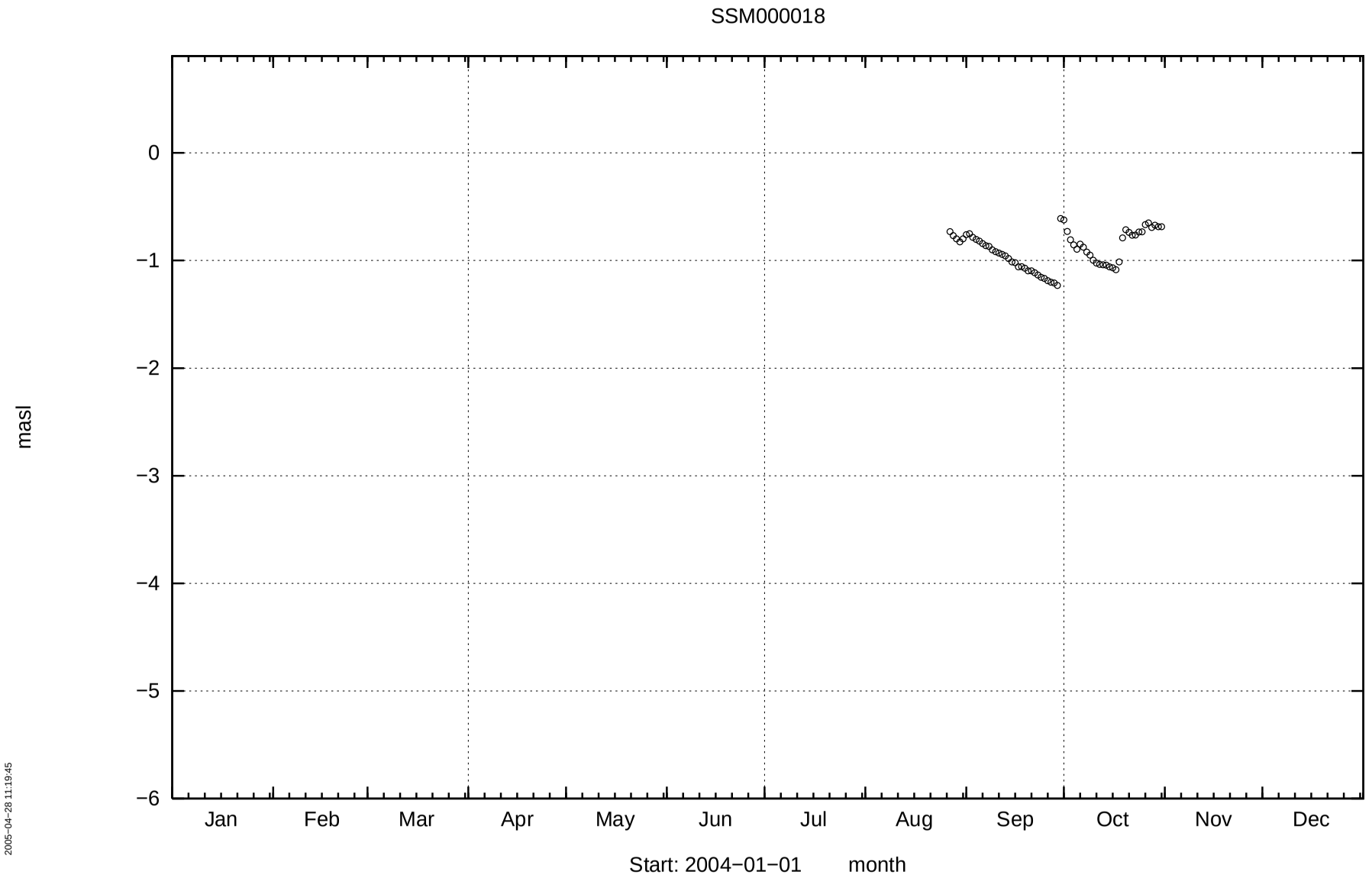
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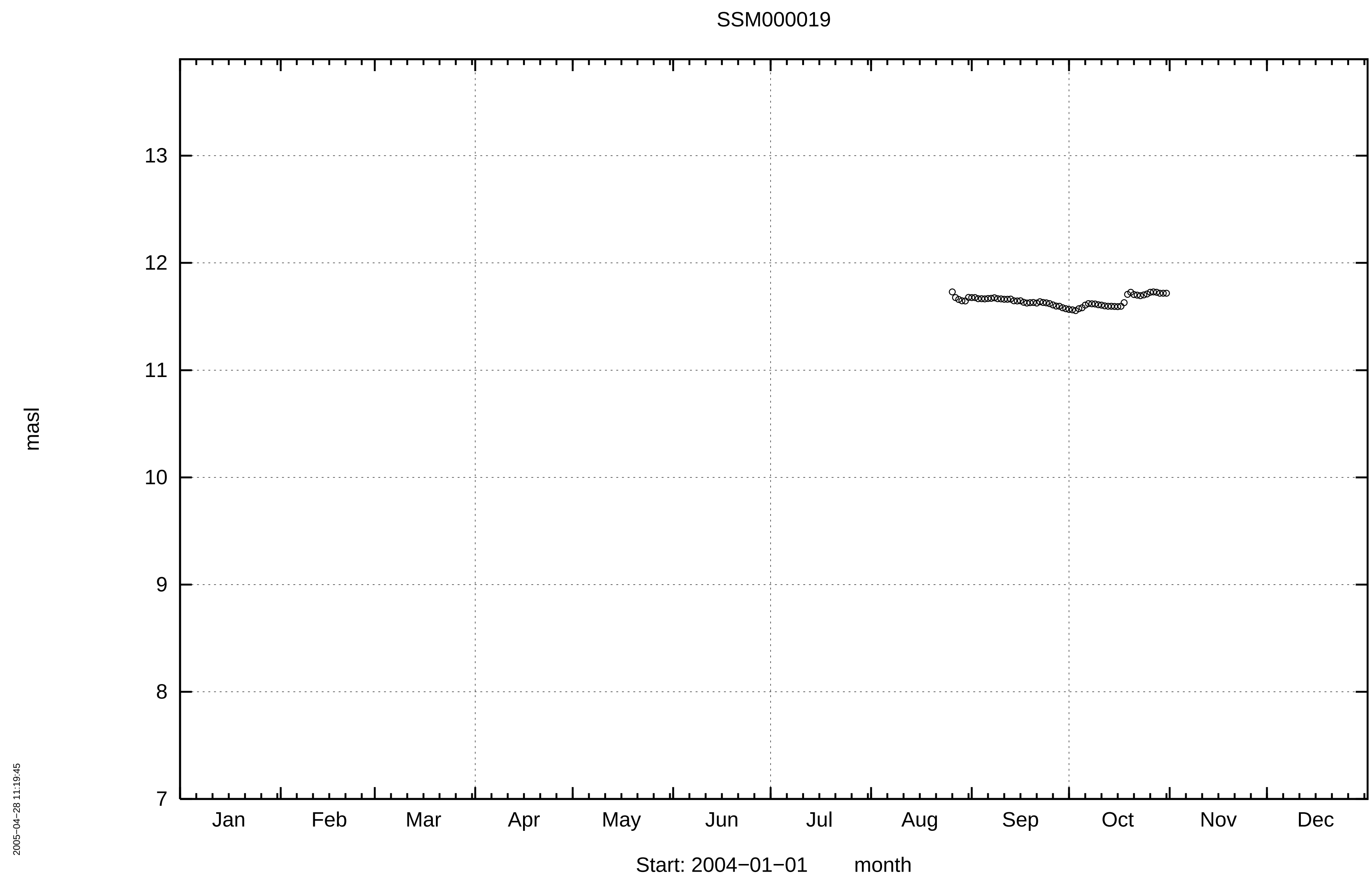
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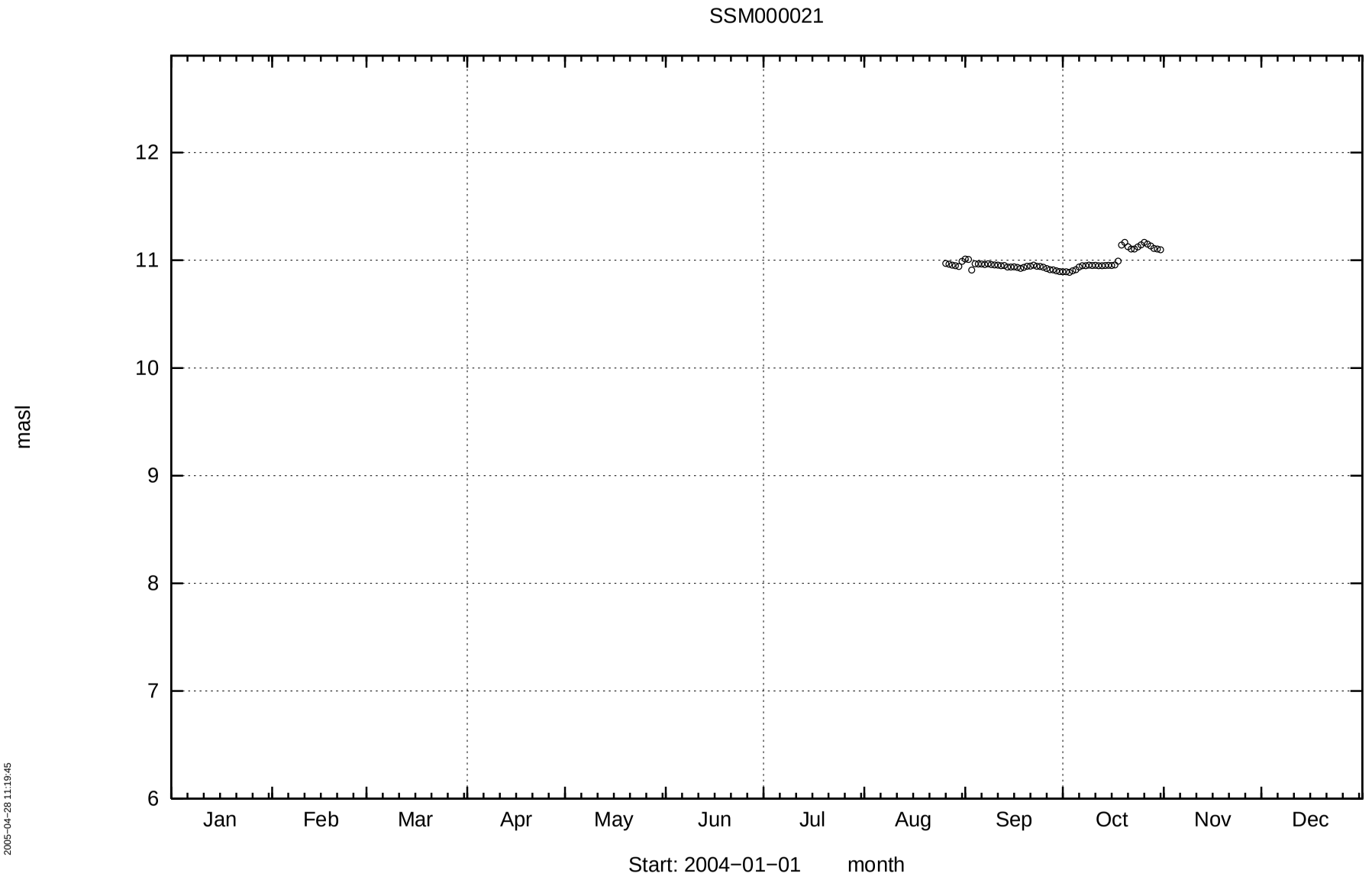
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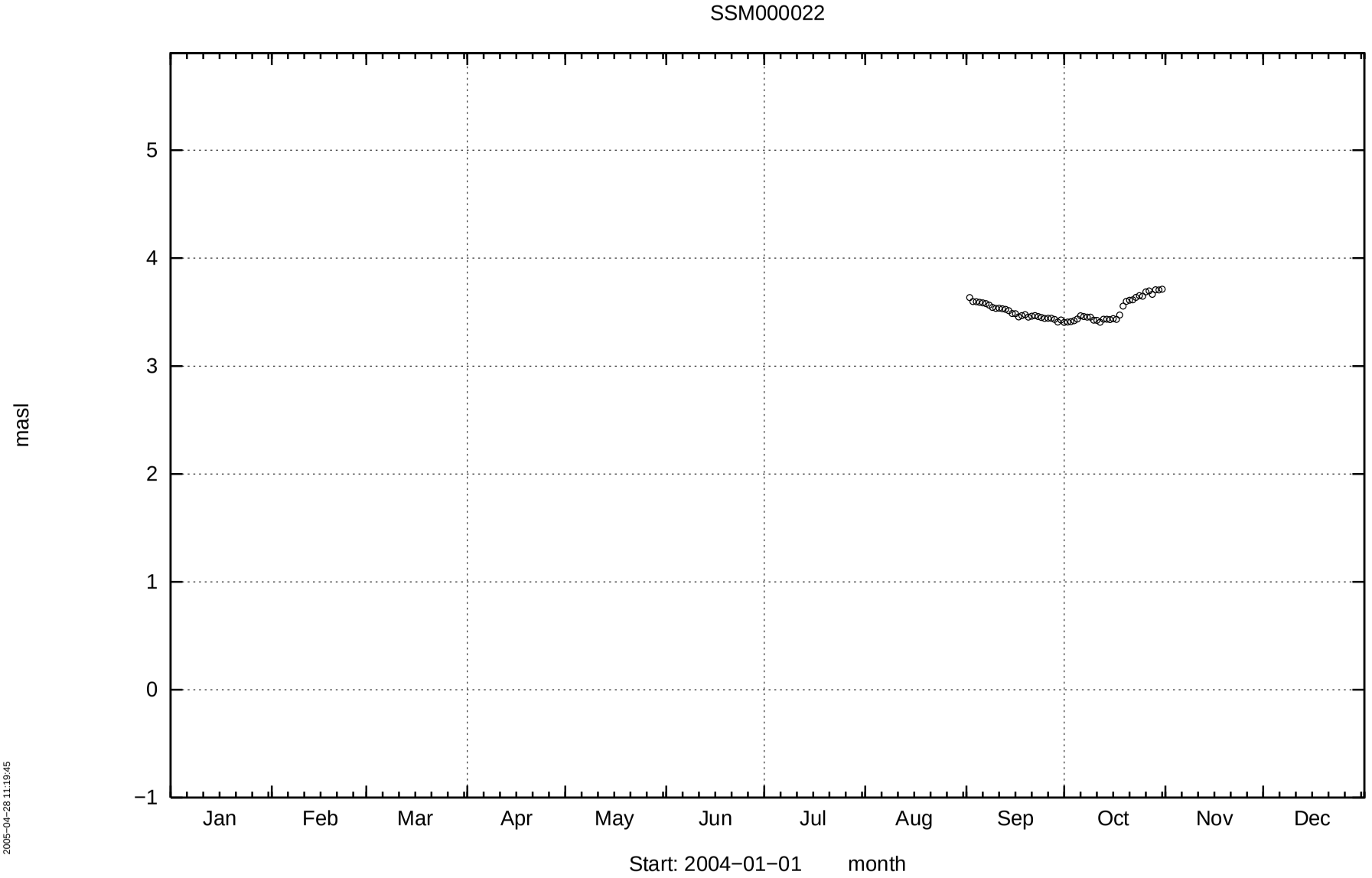
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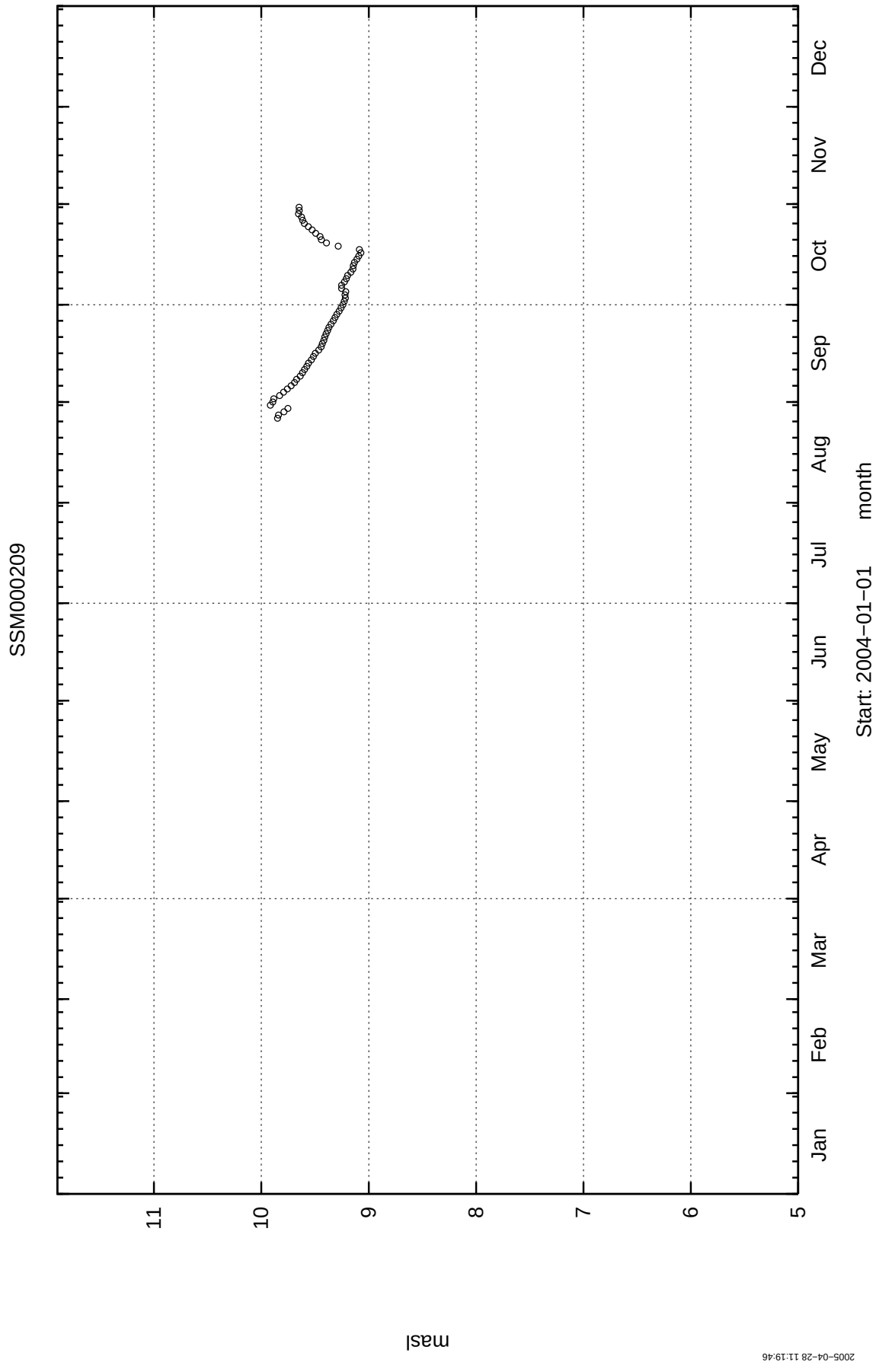
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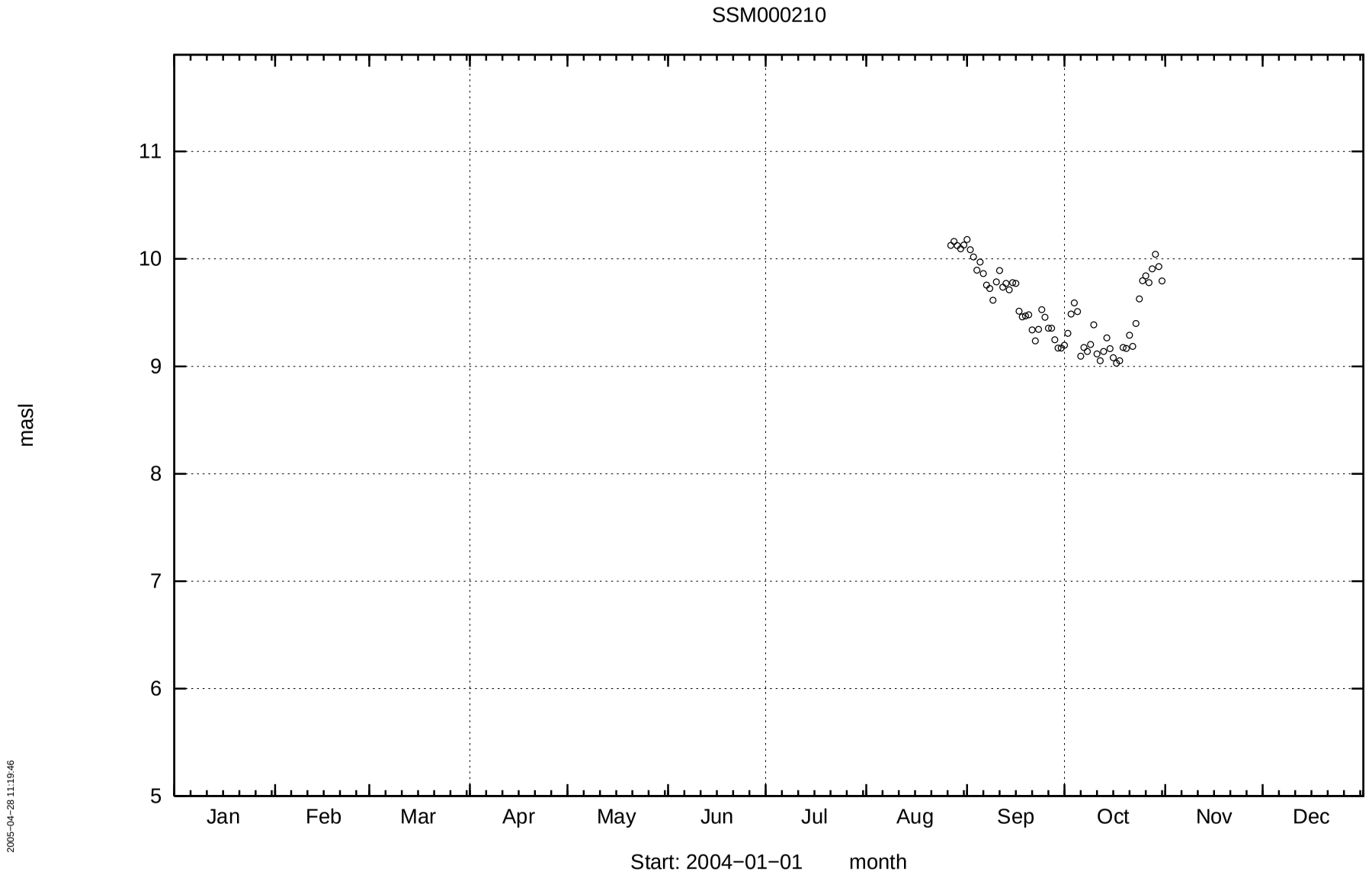
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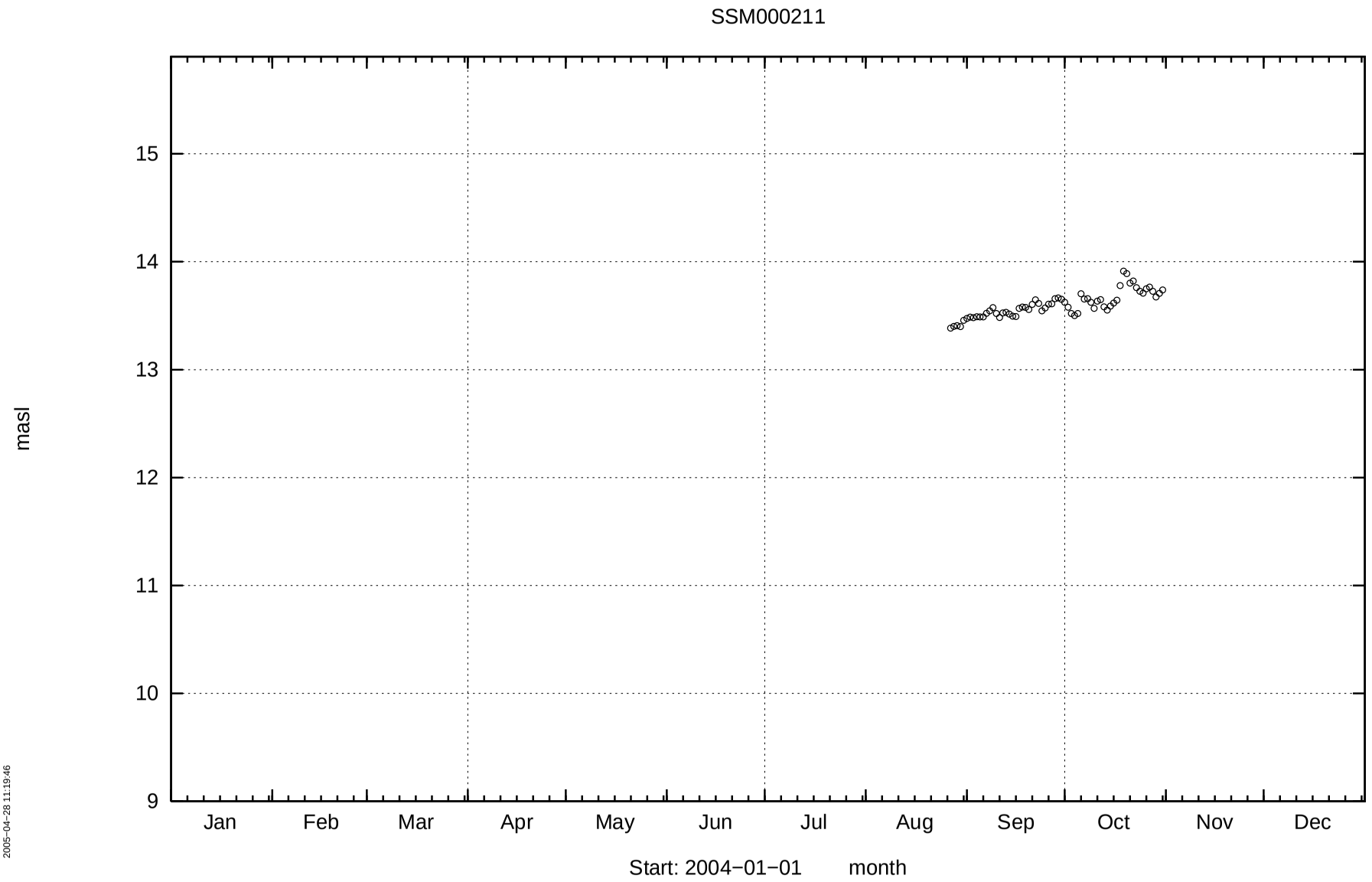
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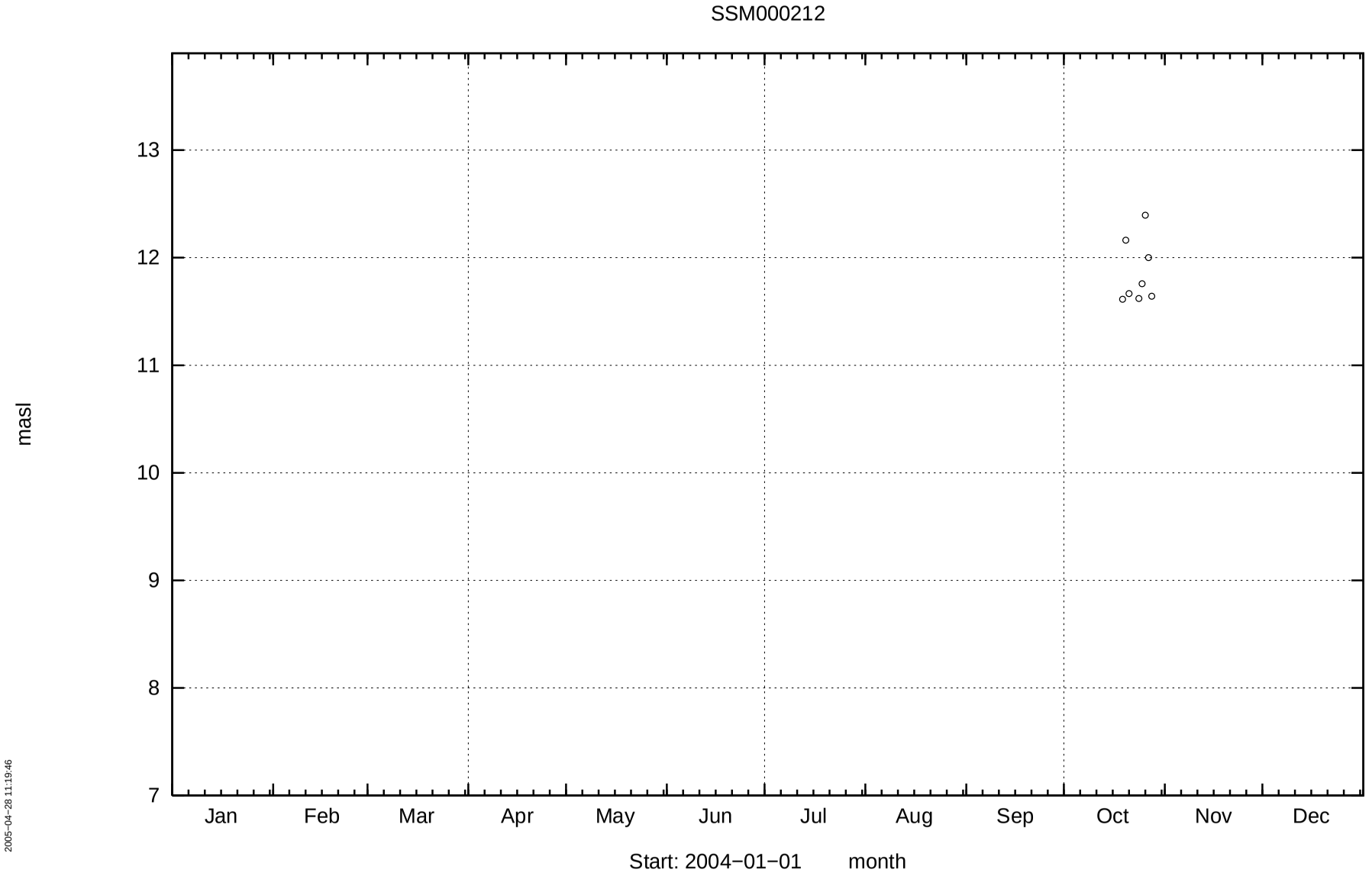
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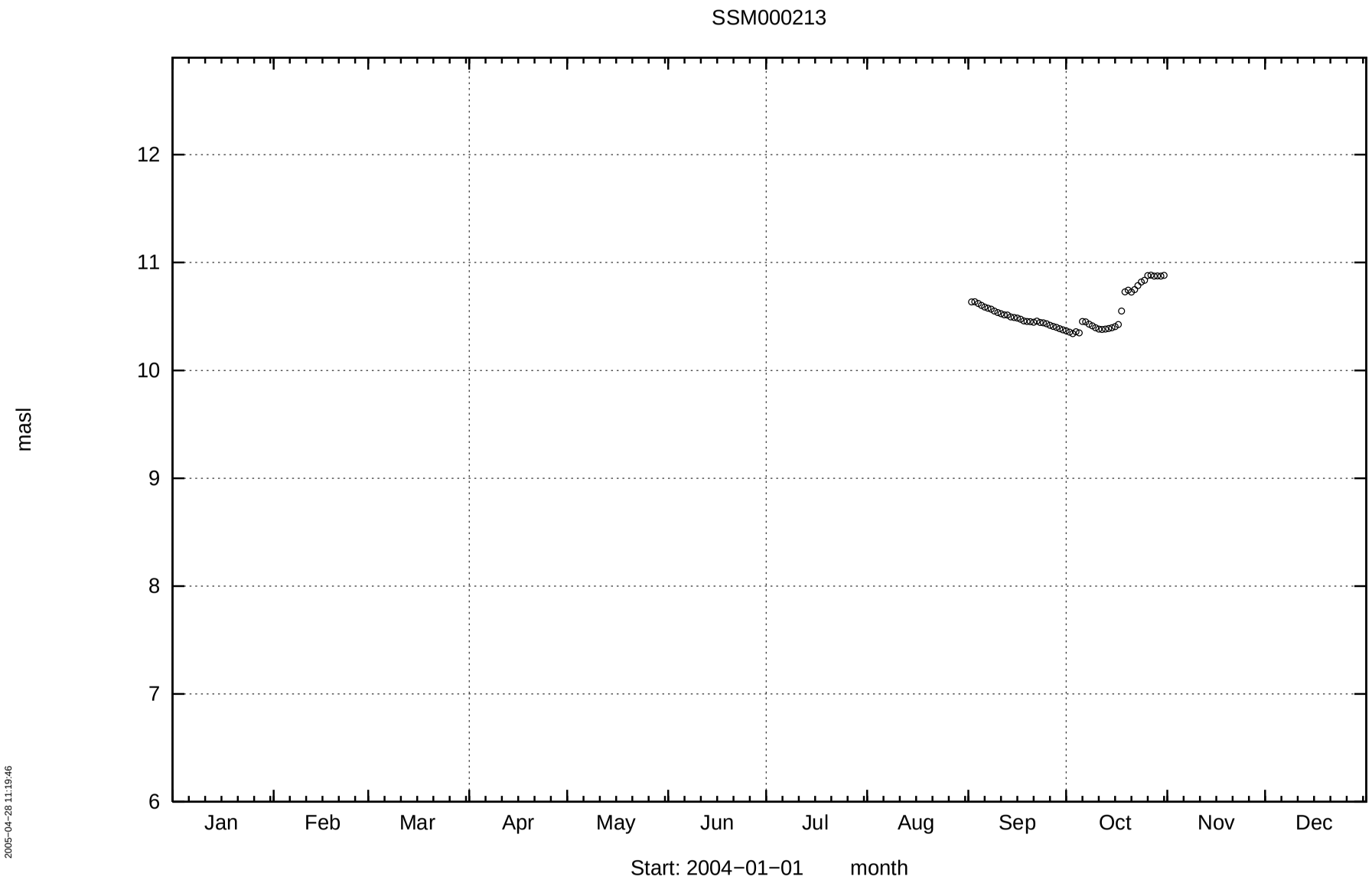
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