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Long Term Monitoring of the GOME Thermal Environment

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1. Introduction

The Global Ozone Monitoring Experiment (GOME) was launched on ERS-2 in April 1995 and has been continuously operational since then. It is a scanning nadir-viewing spectrometer, with its primary scientific objective being to retrieve total column ozone globally. A more detailed description of the instrument can be found in *[1]*.

The Digital Data Handling Unit (DDHU) and the scan mirror electronics assembly have radiative surfaces for their own thermal control. All the remainder of the instrument is wrapped in MLI blankets.

The behaviour of the GOME thermal environment was studied and is presented in this document.

2. Algorithm Descriptions

The monitoring of the GOME thermal environment was performed on:

- the Polarisation Unit Temperature (PMD)
- the Optical Bench (Centre) Temperature
- the Predisperser Prism Temperature

The data used for the analysis are mean values per Orbit, which are determined and stored into a database by the tool Extended Rascals for GOME (ERGO) *[2]*.

The lifetime trend was analysed as follows:

- discarding the data of the commissioning phase (data until Orbit 1250)
- discarding low values caused by instrument switch-offs
- smoothing the resulting values over a number of 450 orbits (~1 month)
- linear fit of the resulting data set against orbits

3. Results

3.1 Thermal Behaviour During Lifetime And Periods Of Life

3.1.1 During Life-time (April 1995 - January 2000)

In Fig. 1 the temperature for the Polarisation Unit is shown during the whole lifetime without discarding any values. Qualitatively the temperatures of the whole thermal environment show the same behaviour during life.

Typical characteristics for the GOME thermal environment for different instrument operations and time periods can be recognized:

- The data until orbit ~1250 are representing the GOME *commissioning phase*.
- During the operations of *one year*, a *seasonal variation* of temperatures can be seen in shape of a parabola.

- Equidistant spikes (~+1.5K) are visible on top of the main curve. These are increased values during the *monthly calibration* operations.
- The irregular occurring spikes with decreased values are caused by *instrument switch-offs*. (see also switch-off plot Fig. 7)

The GOME thermal environment shows an increase of temperature during life time. The trend during lifetime is determined as described in 2. The results for the three analysed temperatures are as follows:

- PMD temperature: +0.19% accordingly +0.55K
- Optical Bench: +0.27% accordingly +0.48 K
- Predisperser Prism: +0.19% accordingly 0.54 K

The results are shown in Fig. 2-4. The red colour shows the smoothed values, that are used to determine the trend. The values in blue, green, magenta are the values after discarding the commissioning period and the low values caused by switch-offs.

3.1.2 During one Year

During the operations of one year a seasonal variation of temperatures occurs in shape of a parabola. The minimum is reached during the months June/July, the maximum during December/January, when the sun is closest to the earth. The yearly variation is ~1.5 K.

3.1.3 During one Month

Depending on which calendar month is monitored, the thermal environment has an either positive or negative trend. The shape is a segment of a parabola (see 3.1.2). The variation is ~1.0 K during a month. A spike (~1.5 K) appears during the 5 orbits of the monthly calibration measurements. During this period the GOME internal calibration lamp is switched on and consequently the thermal environment is warmed up. In figure 5 an example is given for July 1999. The red values are smoothed values over 14 orbits, representing one day.

3.1.4 During one Orbit

During one orbit the GOME temperatures of it's thermal environment increase during the day - side and decrease during the eclipse - side. The orbital variation is ~ 0.8 K. See Fig. 6.

3.2 Thermal behaviour during/after special events

3.2.1 After a GOME switch-off

The electronic boxes and the optical bench are equipped with thermostat switched heater mats, which keep temperatures above 248K. During a GOME switch-off the temperature of the thermal environment drops down by up to 20K, depending on the length of the switch-off this value varies. *[GOME User Manual]* The nominal status is reached again about two days (~30 Orbits) after the instrument was switched on. Again this varies depending on the value the temperature decreased during the switch-off.

3.2.2 During a Monthly Calibration Sequence

During 5 orbits once a month (usually day 28), the internal calibration lamp is switched on, which causes a warming of the thermal environment. The temperature increases by ~1.5K.

4. Conclusions

Over a period of about 4.5 years, the following conclusions regarding trends and special operations in the GOME thermal environment can be drawn:

- The temperatures of all parameters analysed, increase during life by ~0.5 K.
- The temperatures show a seasonal variation: towards months June/July the thermal environment shows a minimum which is ~1.5 K lower than in months December/January.
- The monthly variation is ~ 1.0 K.
- The orbital variation, caused by eclipse, is ~ 0.8 K
- During an instrument switch-off the thermal environment decreases by ~5 - ~20 K, depending on the length of the switch-off. It is back to nominal after around maximum 2 days after switch-on.
- The increase of the thermal environment during the 5 orbits of the monthly calibration sequence is ~1.5 K

5. References

[1]: GOME User's Manual SP-1182
ESA Publications Division September 1995.

[3]: ERGO Software User's Manual
DOR-GO-QA-SUM Issue 2.0 27/03/1997

Figures

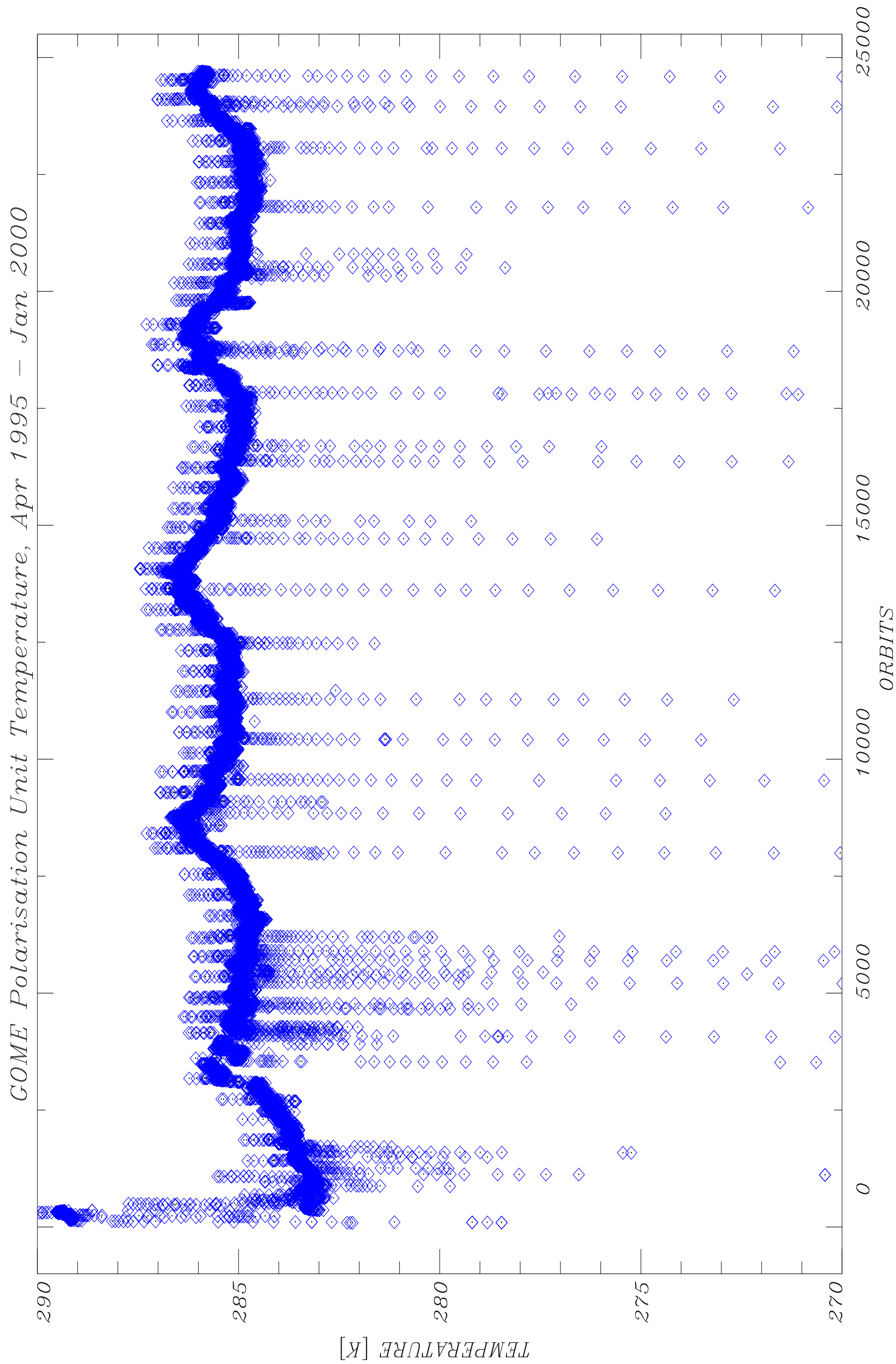

Figure 1: GOME PMD temperature April 1995 - January 2000

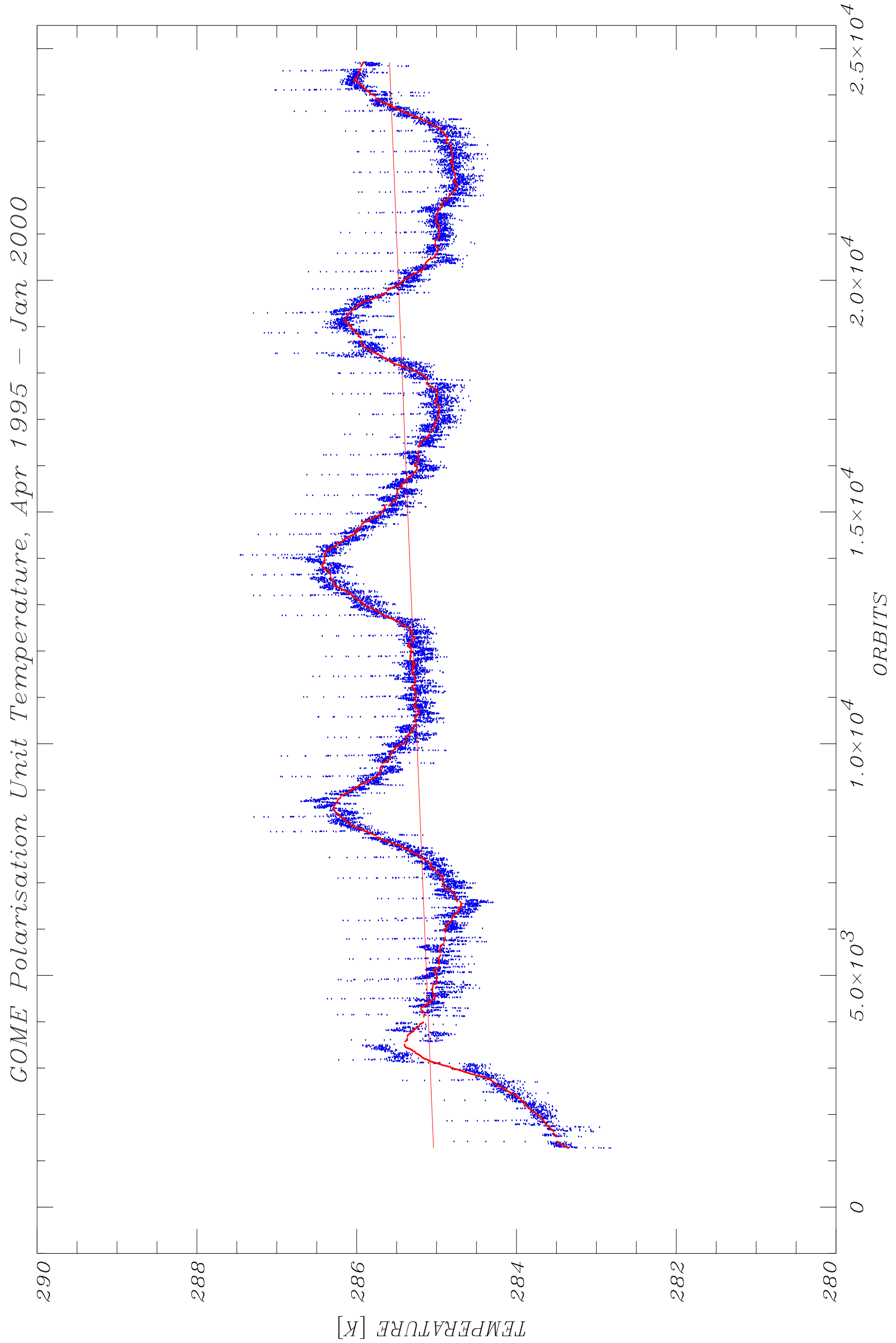

Figure 2: PMD temperature trend

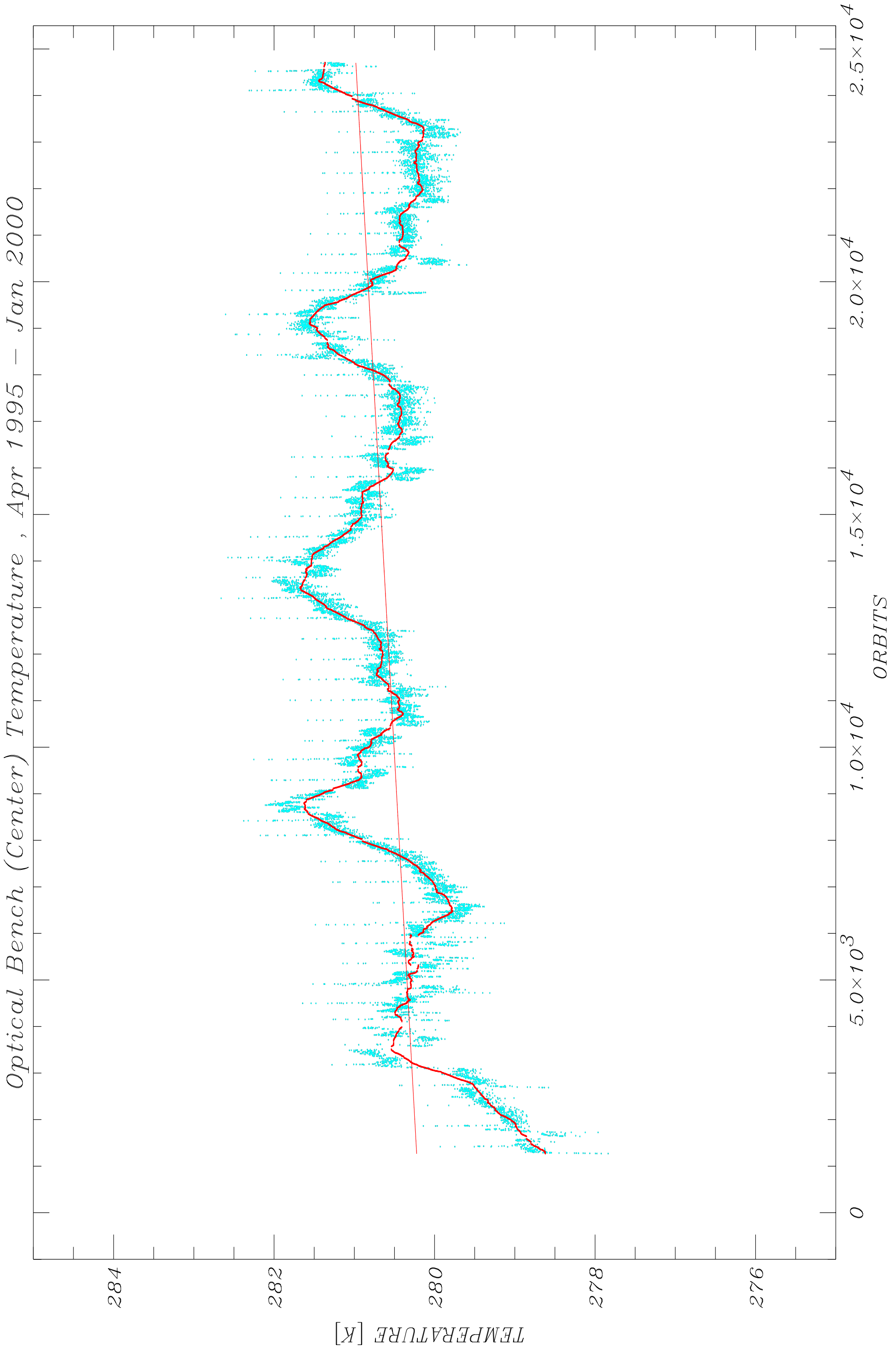

Figure 3: Optical Bench (centre) temperature trend

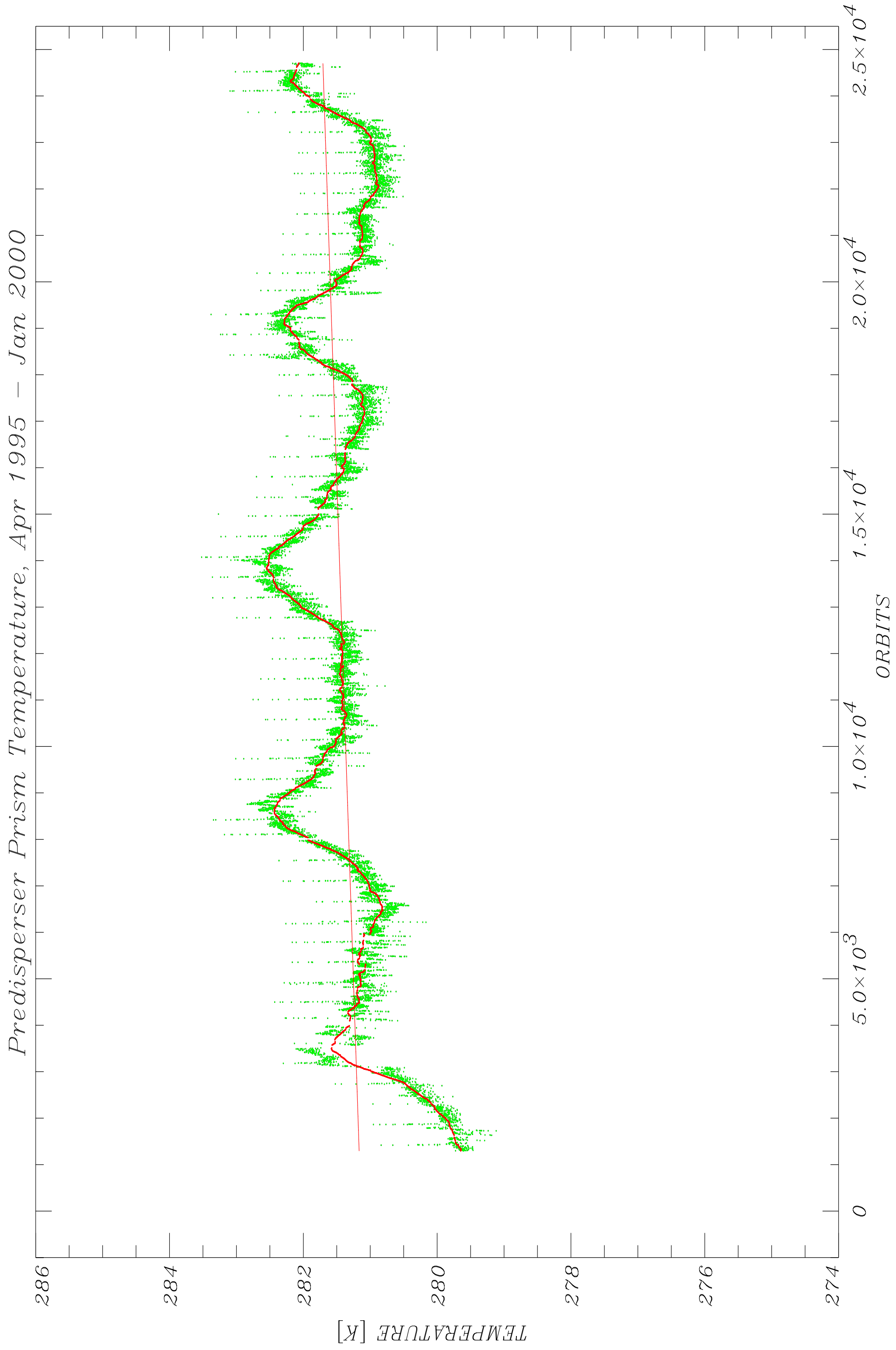

Figure 4: Predisperser Prism temperature trend

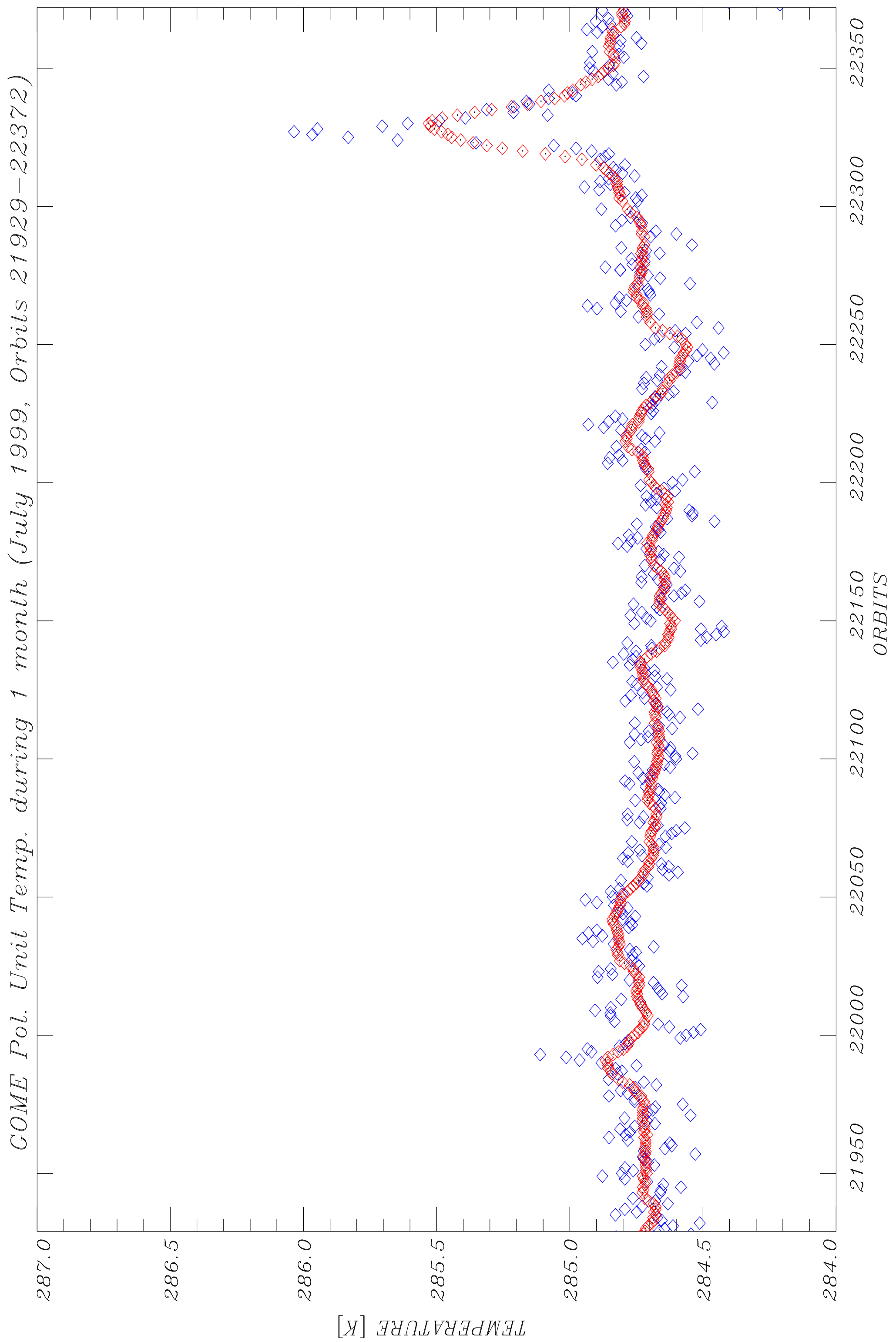

Figure 5: temperature during one month

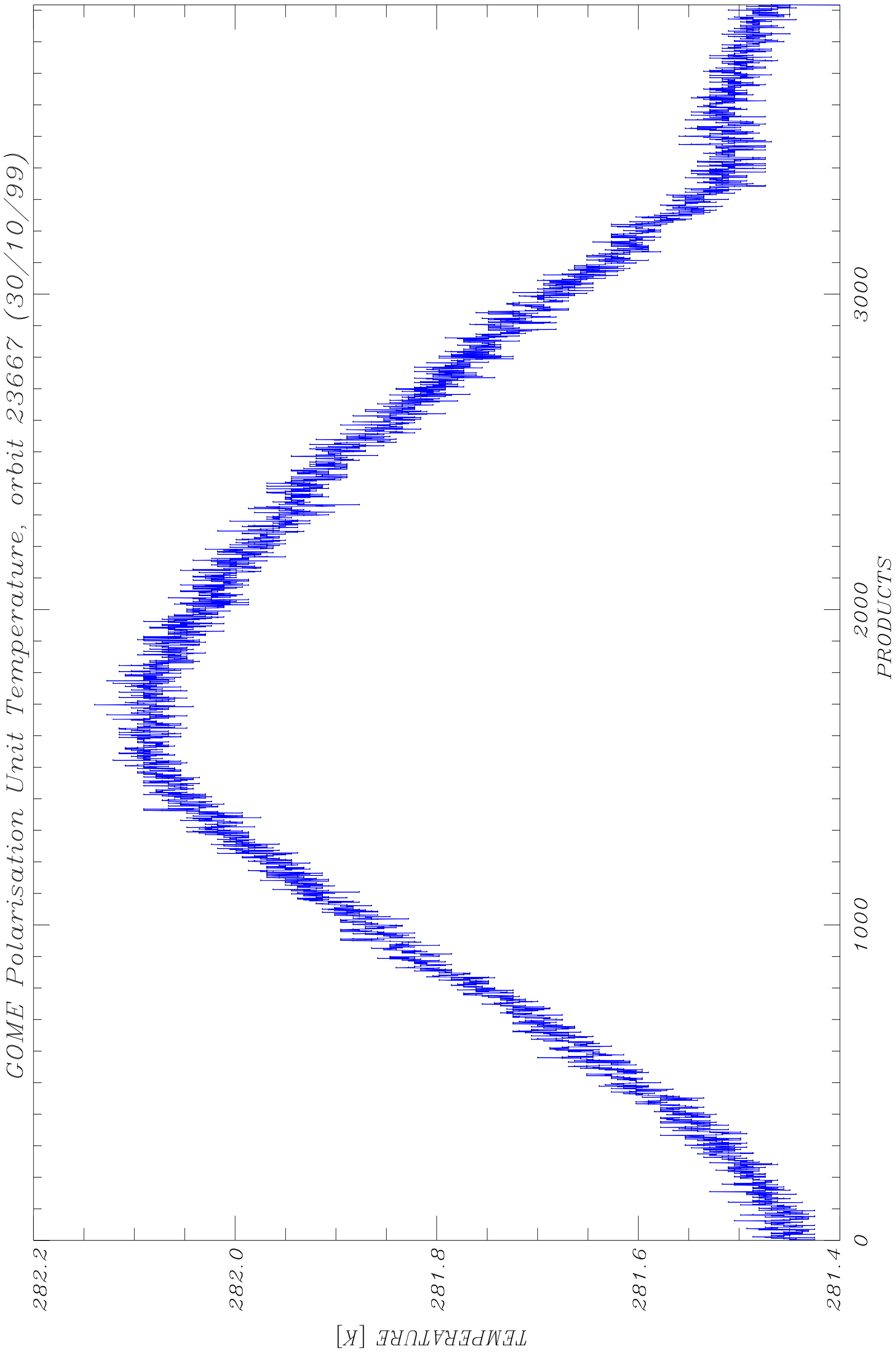

Figure 6: temperature during one orbit

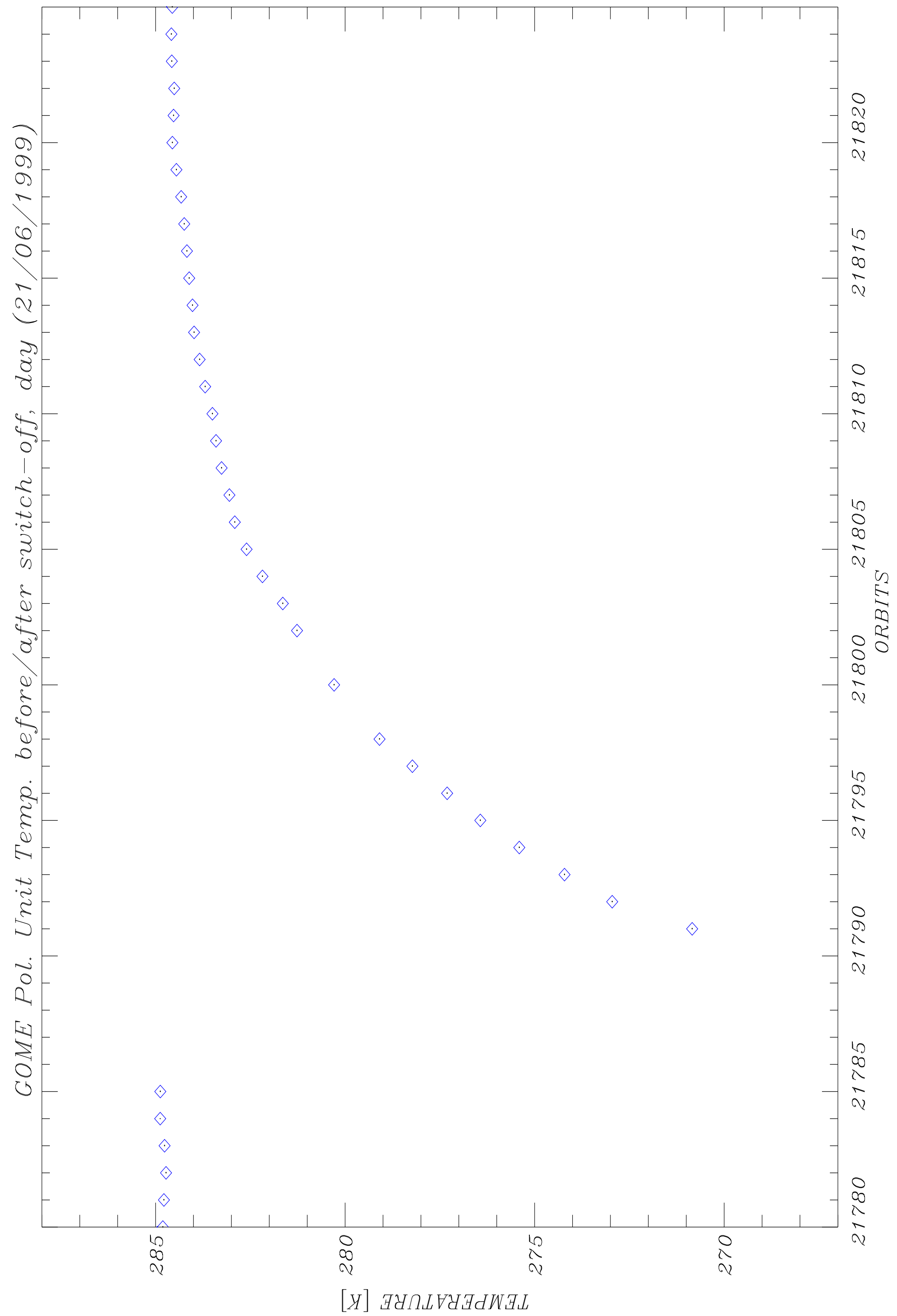

Figure 7: temperature before/after instrument switch-off