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UNB - Nav Canada

# Atmospheric Investigations for WAAS

## Ionosphere

*Peter Stewart and Richard Langley*

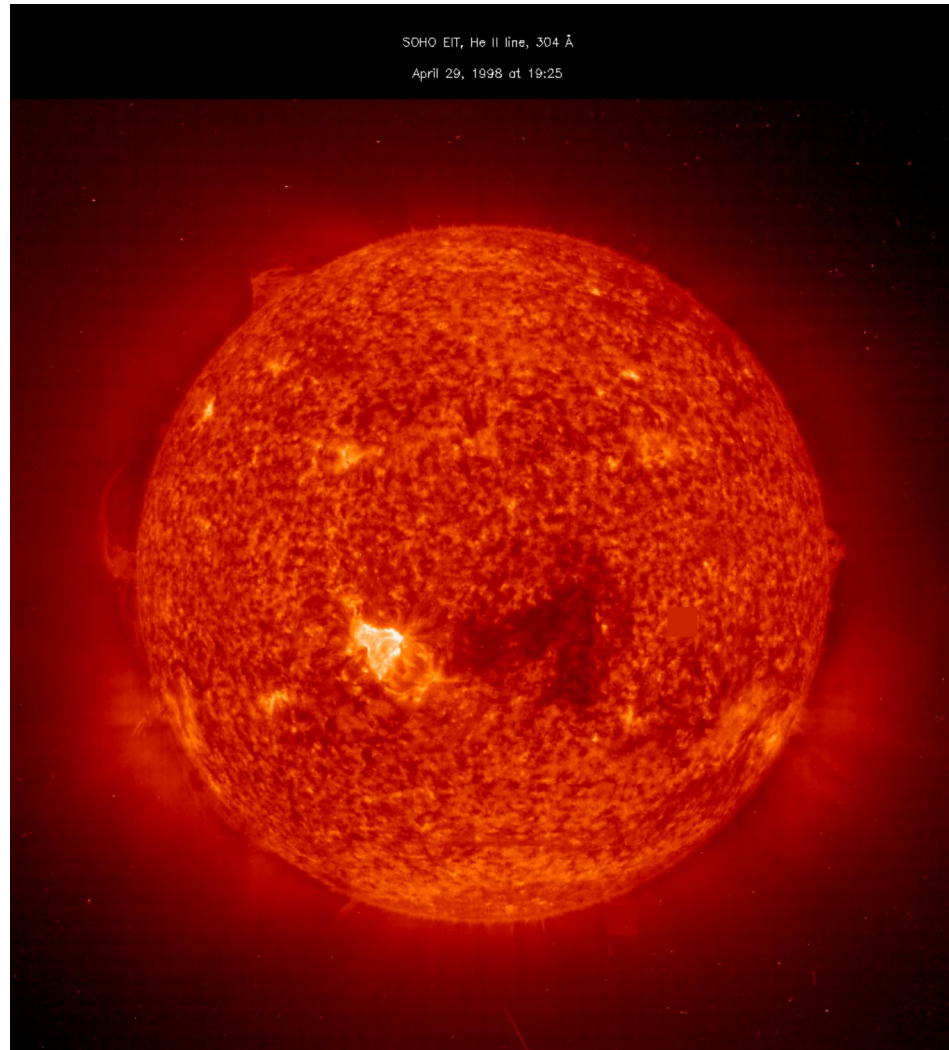
*Presentation at the*  
FAA Tech Center  
*Atlantic City, NJ*  
*June 29th - 30th, 1998*

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*Geodetic Research Laboratory, Department of Geodesy and Geomatics Engineering, University of New Brunswick,*

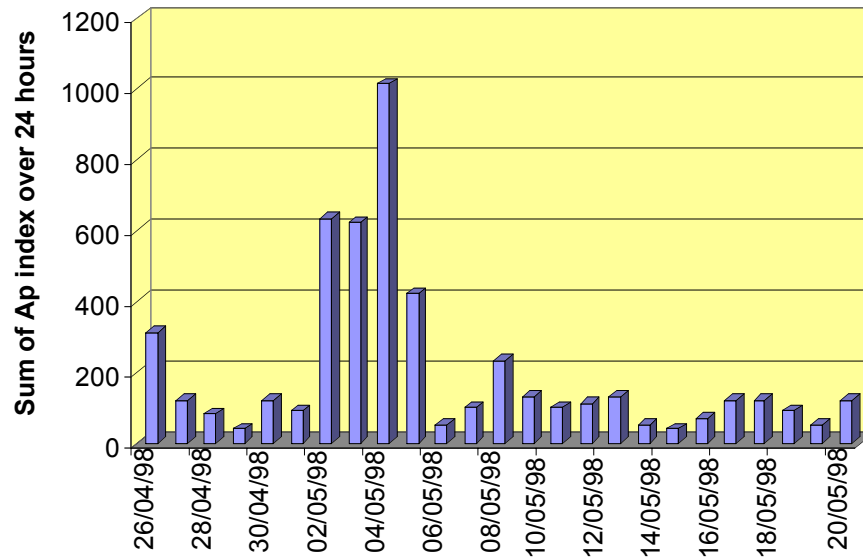


## Solar Image from SOHO, April 29th 1998



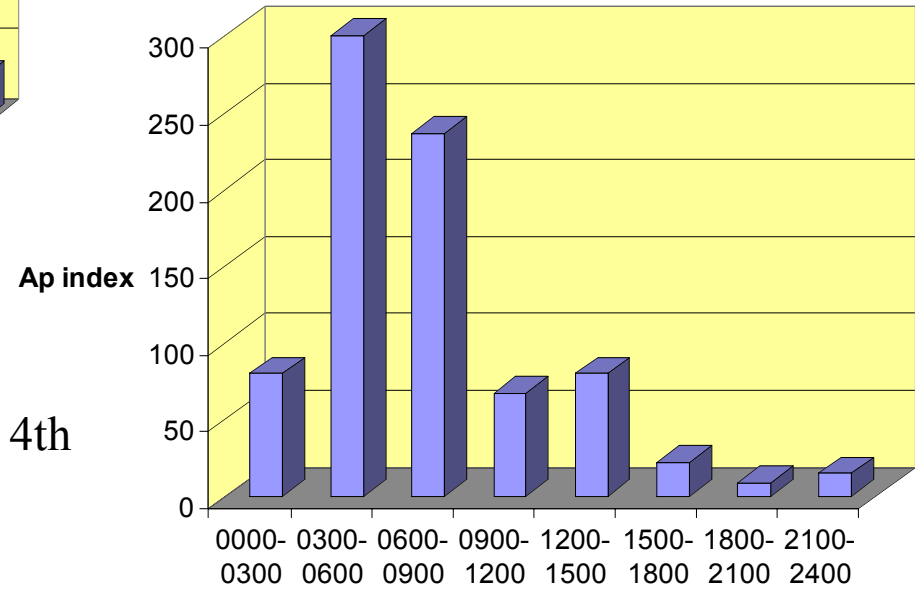


# Ap Index



24 hour sum, April 26th to May 20th

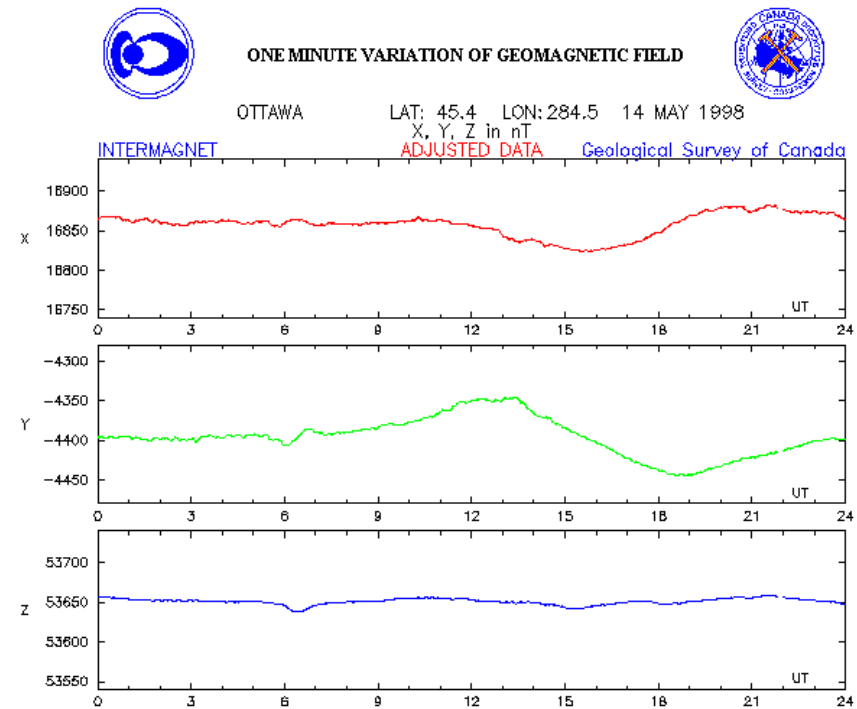
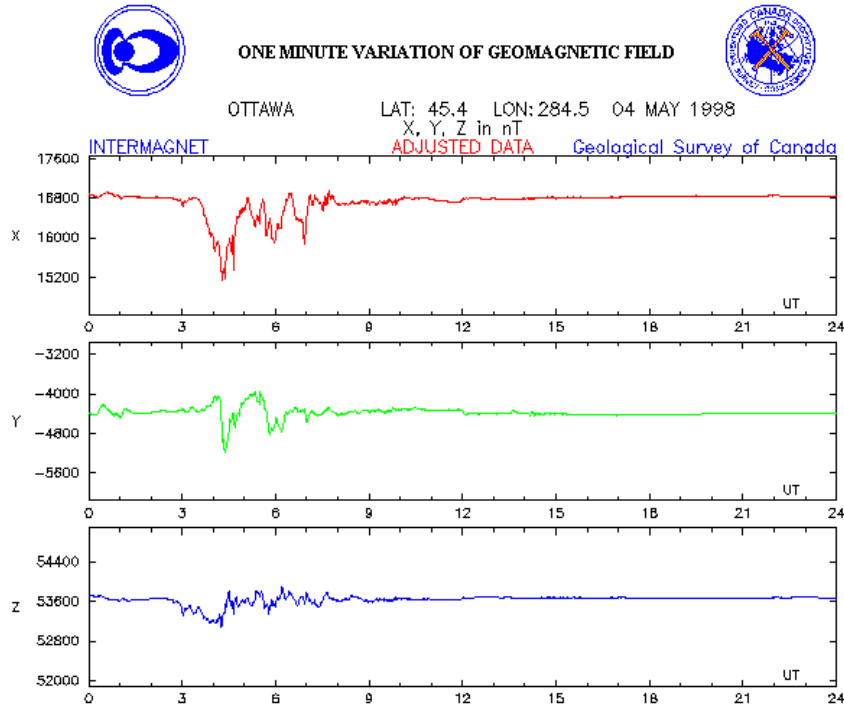
Three hourly values, May 4th



Source: NOAA  
[ftp://ftp.ngdc.noaa.gov/STP/GEOMAGNETIC\\_DATA/INDICES/KP\\_AP/](ftp://ftp.ngdc.noaa.gov/STP/GEOMAGNETIC_DATA/INDICES/KP_AP/)



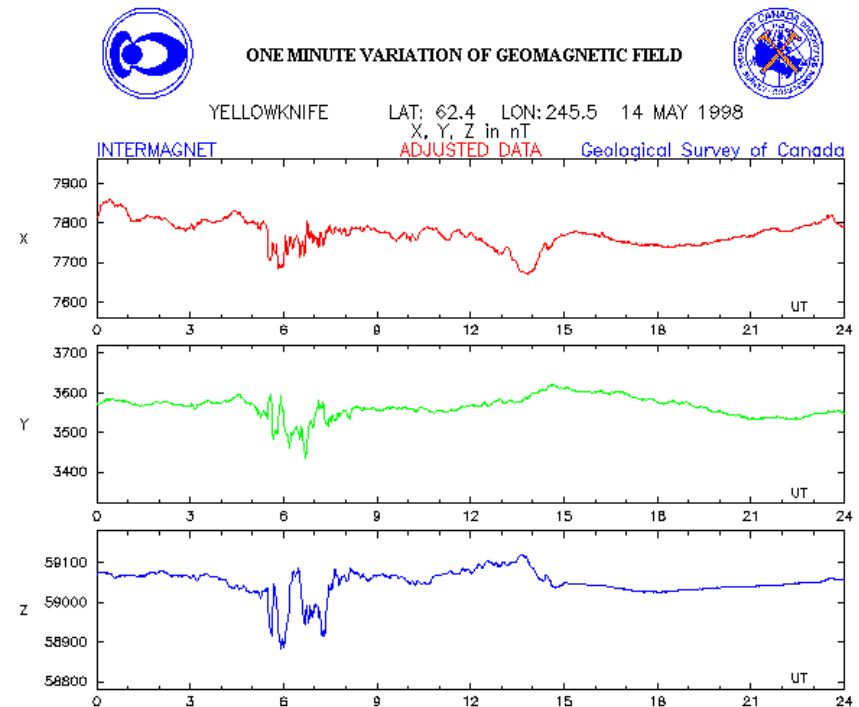
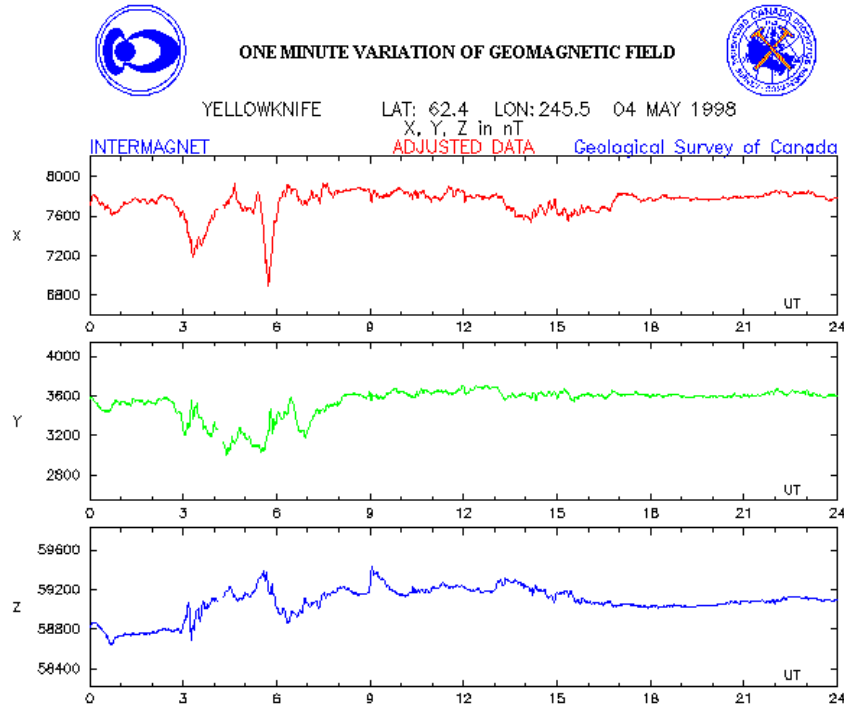
# Variation of Geomagnetic Field, May 4th and 14th, 1998 at Ottawa



Source: Natural Resources Canada  
[http://www.geolab.nrcan.gc.ca/geomag/e\\_digdat.html](http://www.geolab.nrcan.gc.ca/geomag/e_digdat.html)



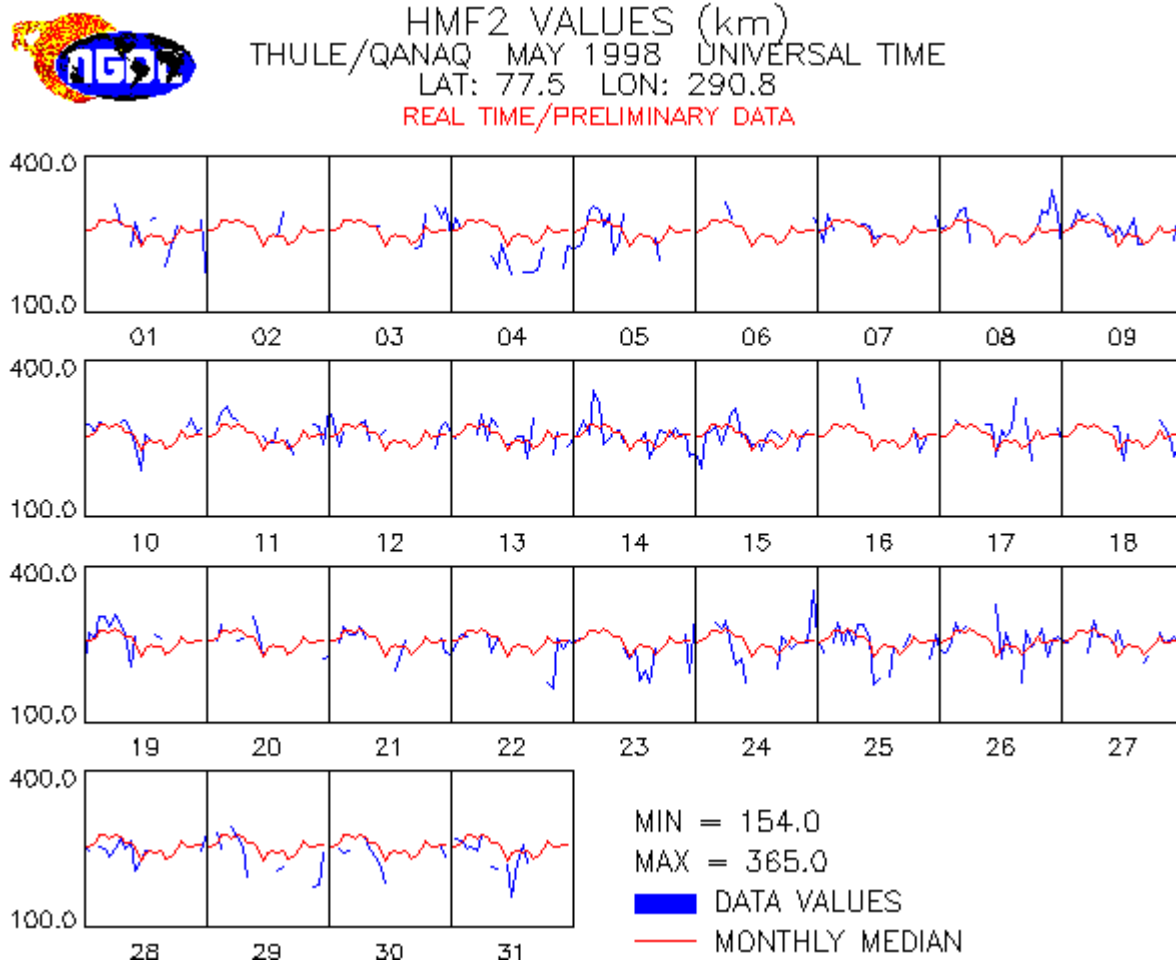
# Variation of Geomagnetic Field, May 4th and 14th, 1998 at Yellowknife



Source: Natural Resources Canada  
[http://www.geolab.nrcan.gc.ca/geomag/e\\_digdat.html](http://www.geolab.nrcan.gc.ca/geomag/e_digdat.html)



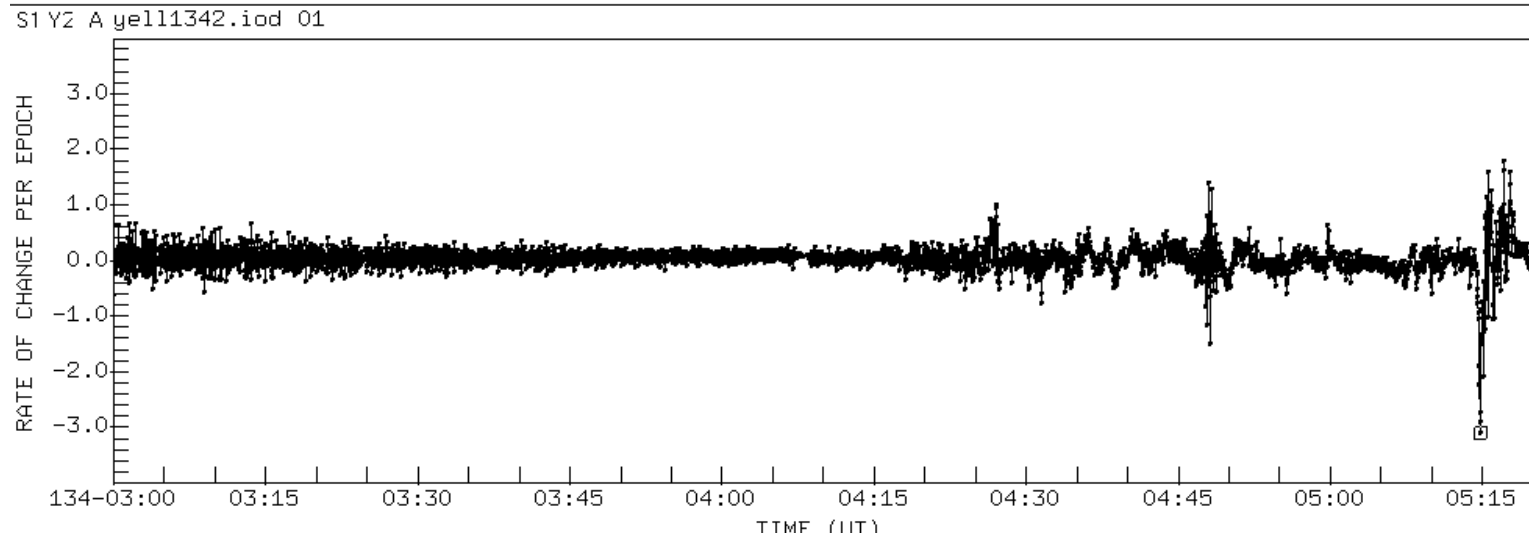
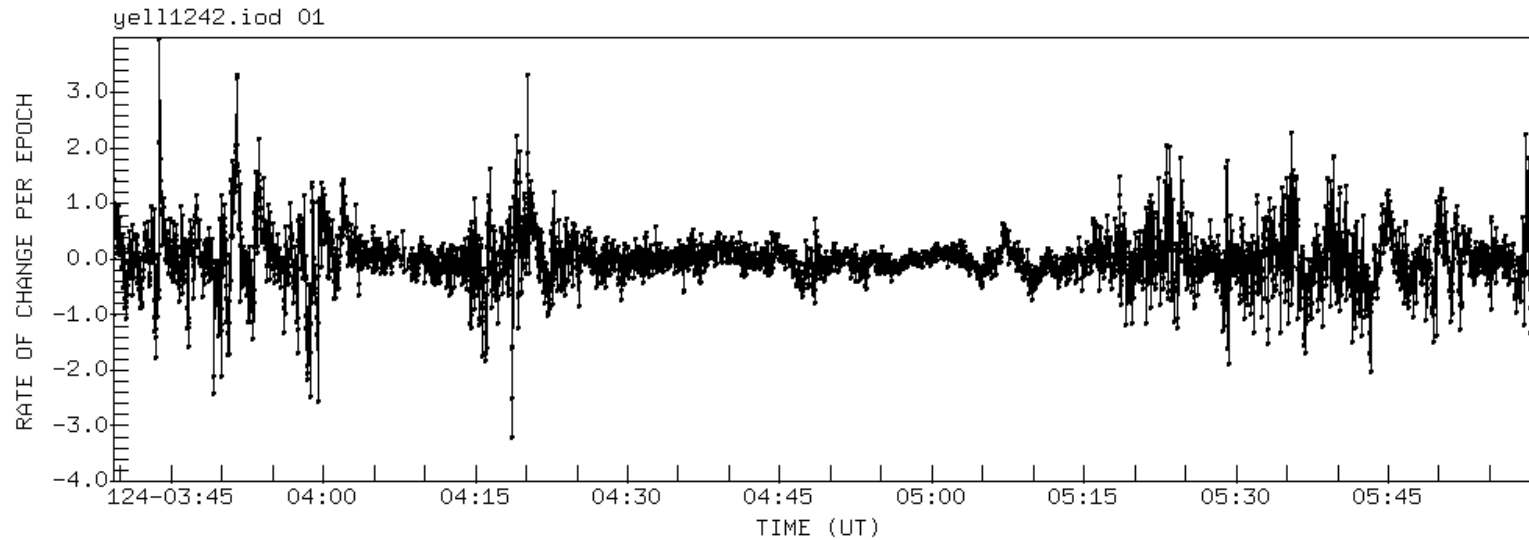
# hmF2 values from Thule, Greenland



Source: Space Physics Interactive Data Resource (SPIDR)

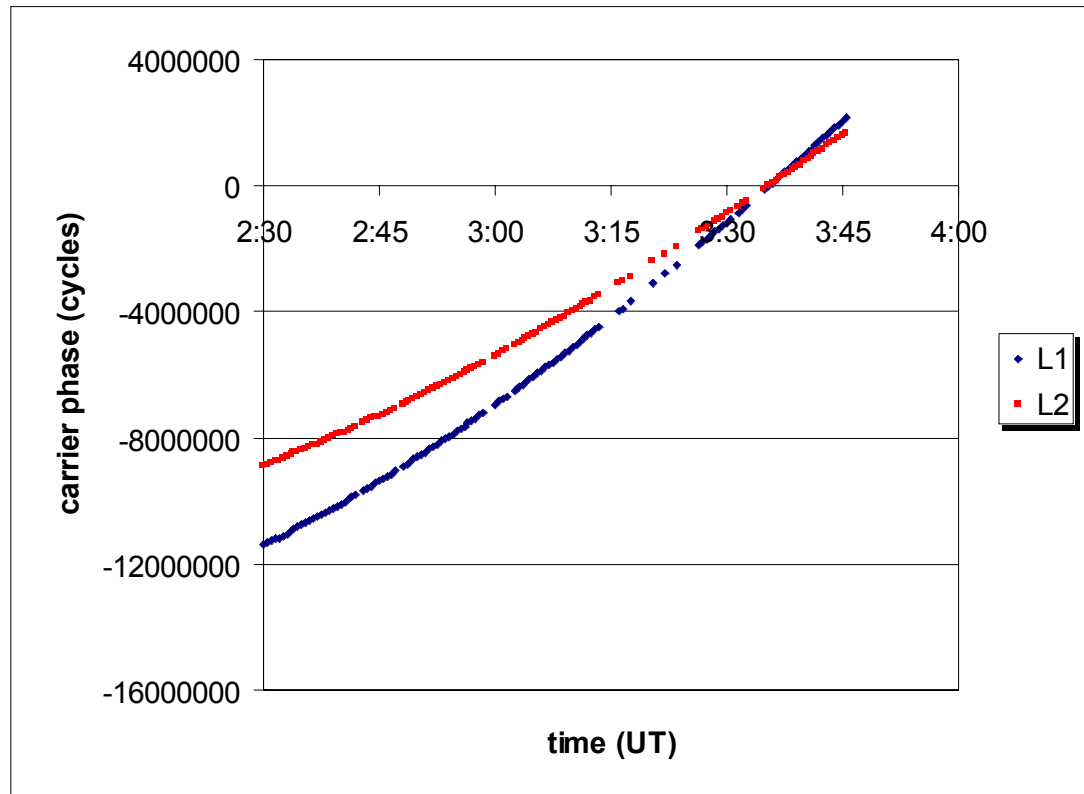


# Rate of Change of Ionospheric delay for May 4th and 14th, 1998 at Yellowknife





## Carrier Phase Observations for PRN26 on May 4th, 1998 at Yellowknife

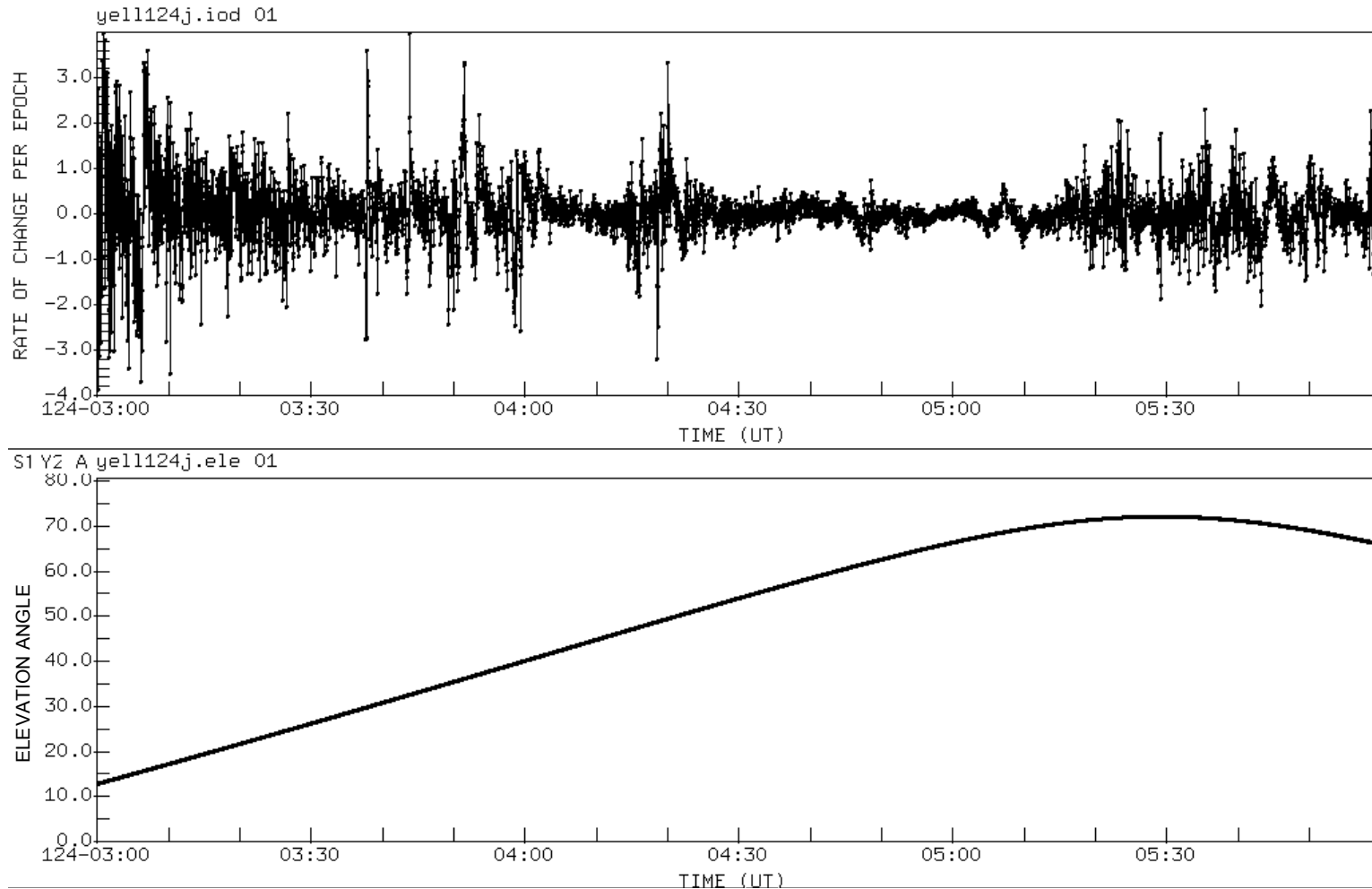


Note that there is no evidence of cycle slippage, despite the fact that the NRCan produced RINEX files do not contain data for this satellite at certain epochs. This suggests that the receiver did indeed continue to track this satellite (i.e. no “loss of lock” at the hardware level), and that the data gaps are a function of later data processing.



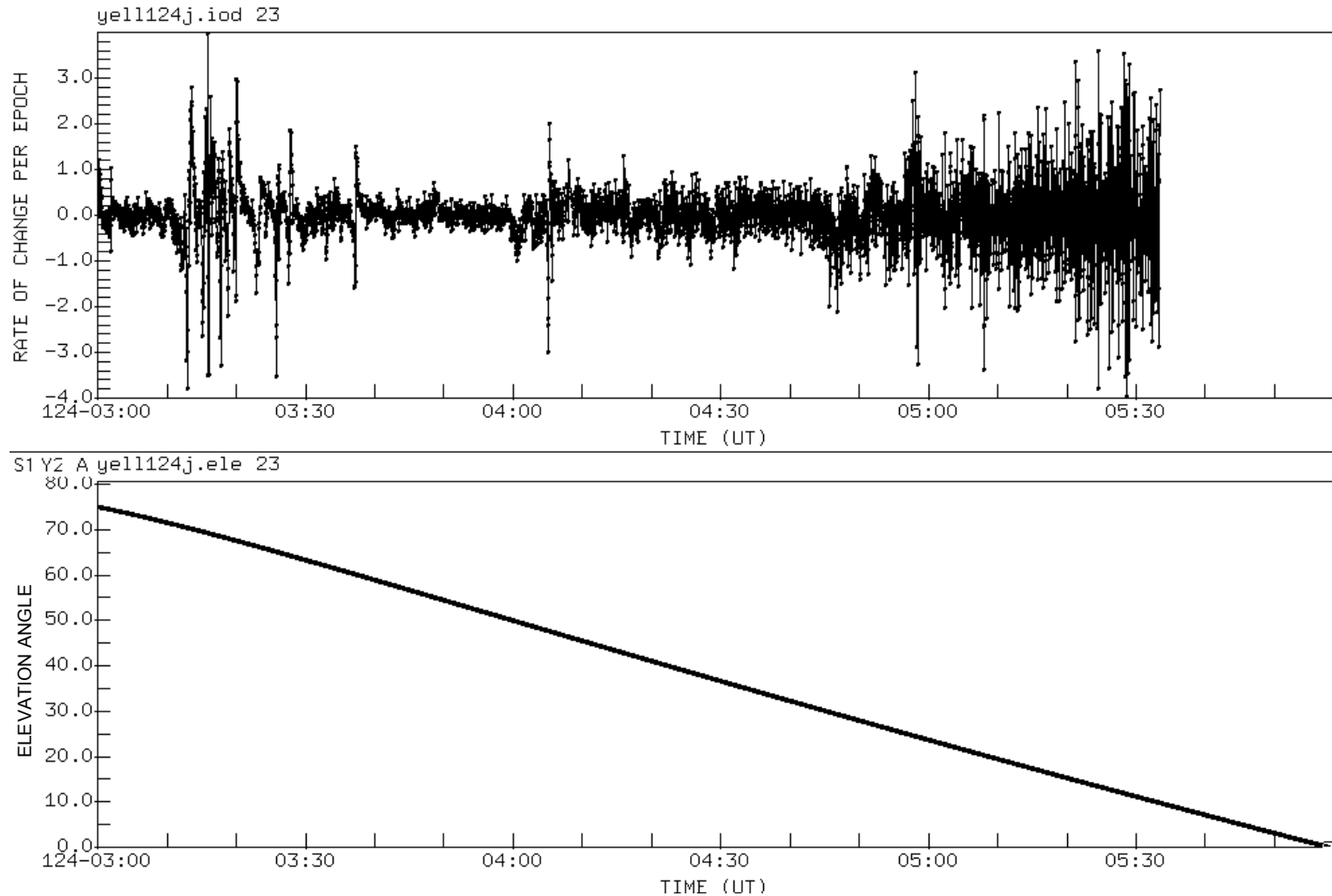


# Rate of change of ionospheric delay plotted with elevation angle for PRN 1





# Rate of change of ionospheric delay plotted with elevation angle for PRN 23





## Summary



- TurboRogue receivers able to track through severe geomagnetic storm
  - *Complete* data gaps (up to 20 seconds) need to be further investigated
- Global indices (Kp, Ap) not reliable indicators of ionospheric activity in the auroral zone
- Processing of “raw” data is preferable
- Data snooping techniques at NRCan (and possibly other processing centres) should be reviewed
  - current quality checking appears to remove high elevation satellites during periods of high ionospheric activity