



Riometers and Solar proton events

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Presented by **Juan Rodriguez** for
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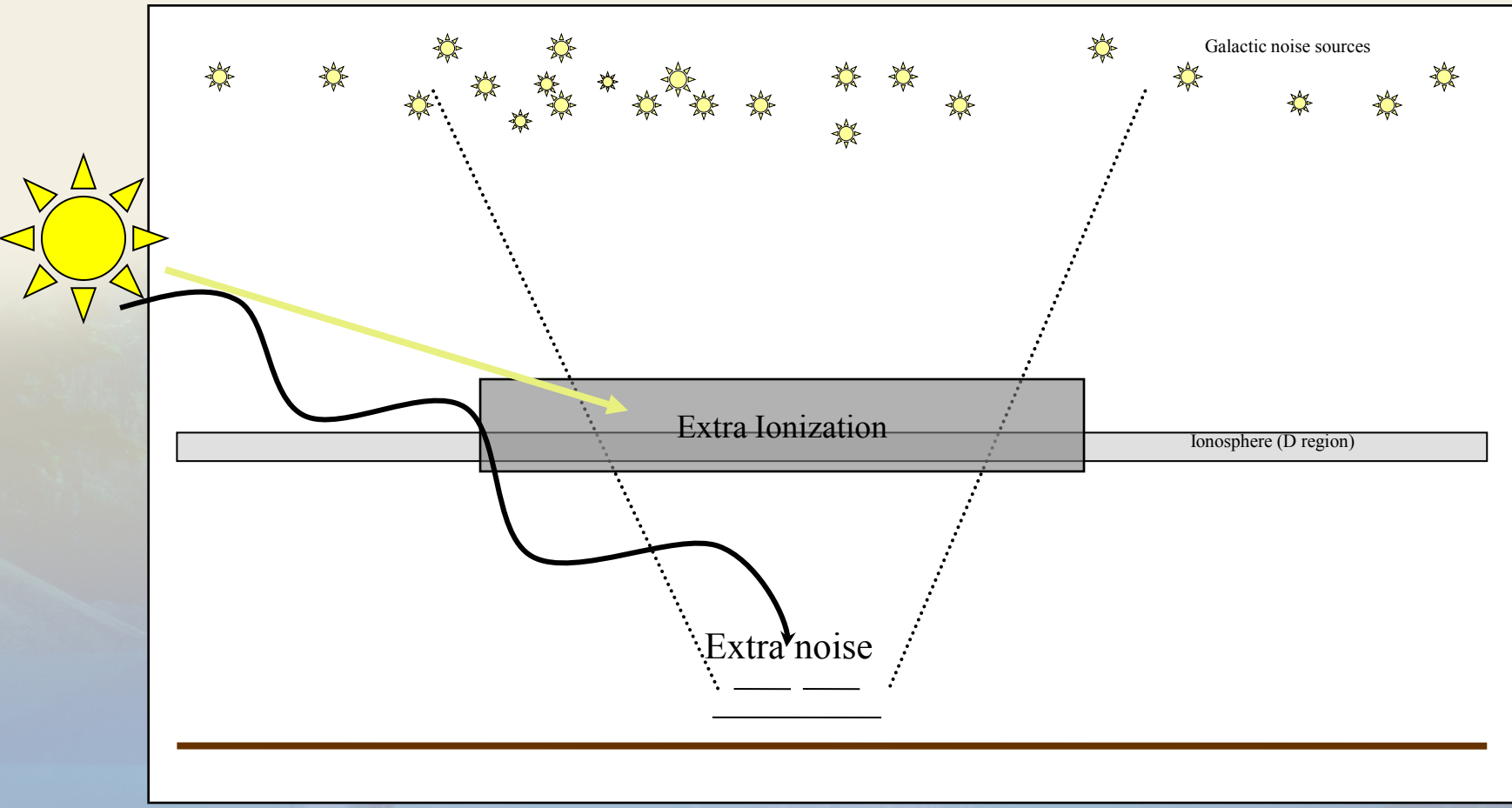
Introduction

- The Canadian Riometer array is a partnership between the University of Calgary and Natural Resources Canada.
- Enhanced levels of ~ 10 MeV protons can cause absorption of radio waves in the D region ($\sim 60 - 90$ km) of the ionosphere.
- Absorption caused by protons are highly asymmetric, with an intensification in the sunlit ionosphere as compared with dark period.
- Data from the Canadian riometer network and GOES satellites are used to evaluate how much absorption.





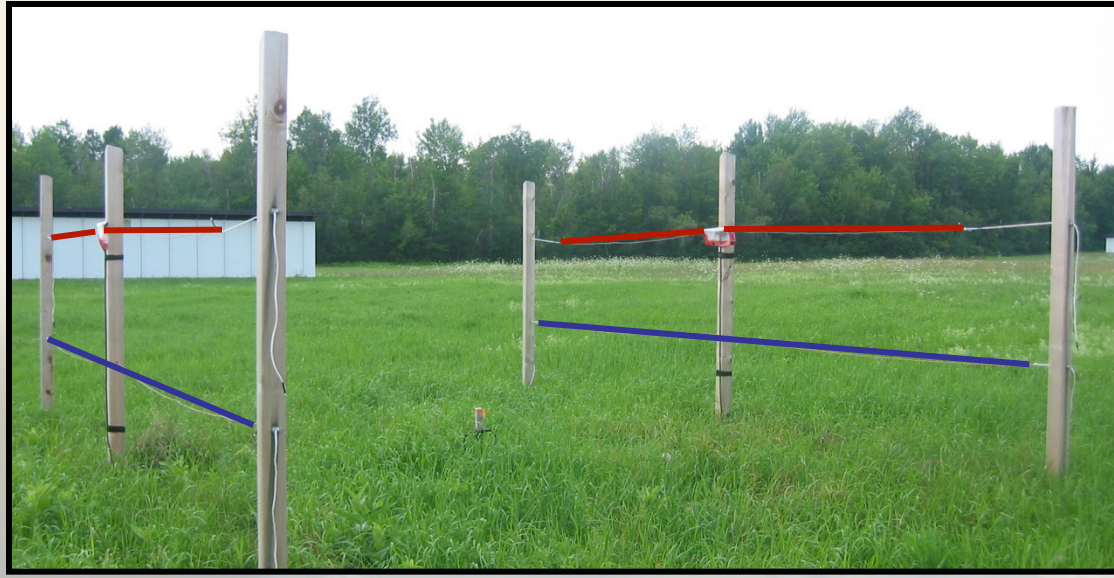
How a riometer works





Riometer Equipment

Data sampler



Antenna



Computer and Riometer





Saskatoon



Resolute



Ottawa



DRAO - Penticton



Hall Beach





What does a Riometer measure?

Ionospheric absorption (in the D region ~90 km)

- Auroral absorption
- Solar radio noise bursts
- X-ray induced absorption
- Polar cap absorption (solar protons)

Typical riometer frequencies are 30.0, 38.2, and ~50 MHz.



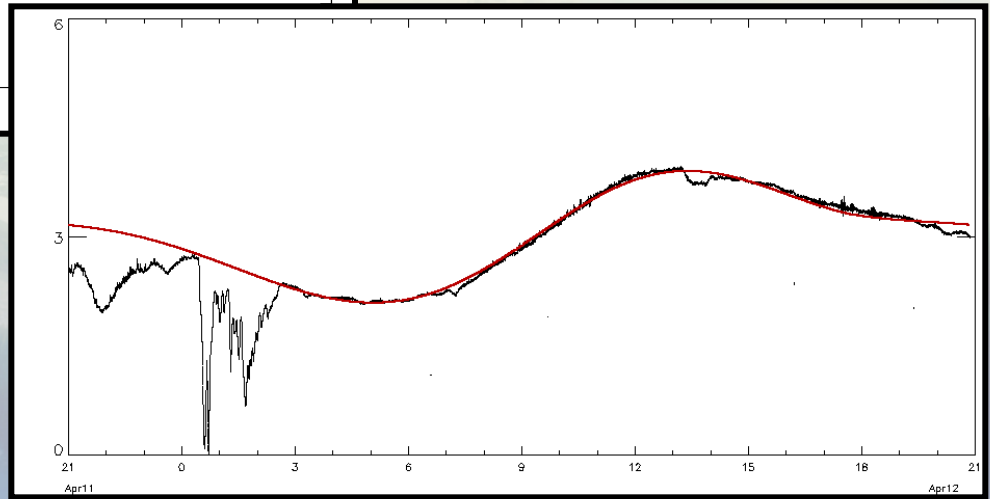
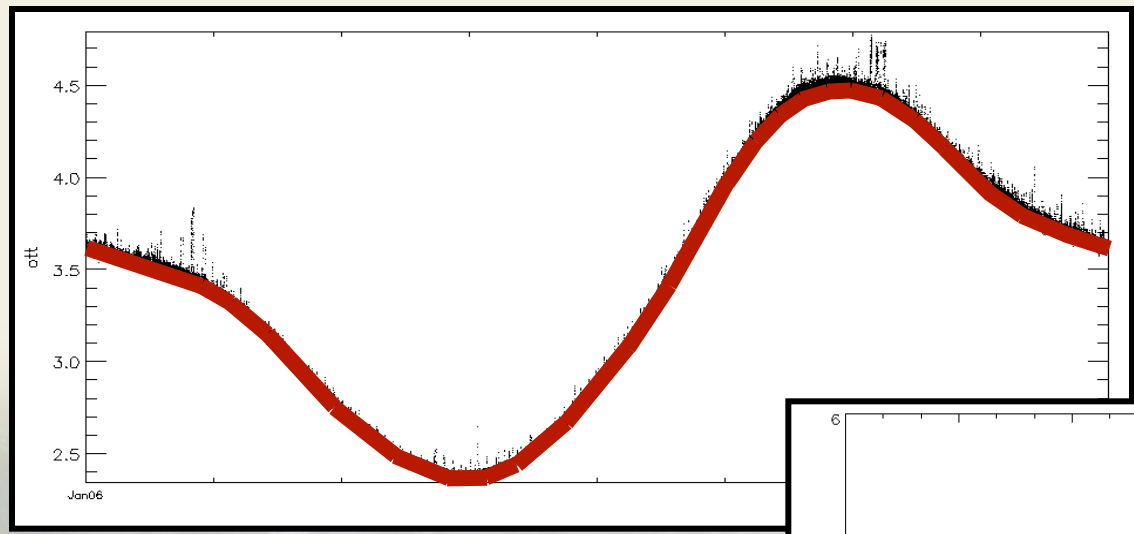


Canadian Riometer Array





Quiet day curve

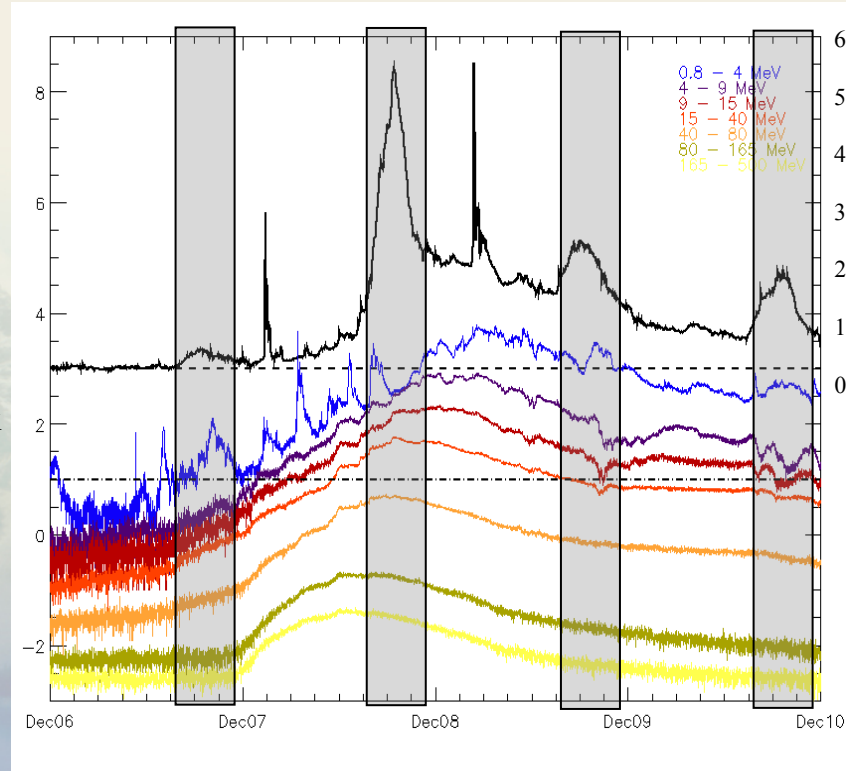


Galactic noise variation over a sidereal day





PCA monitoring



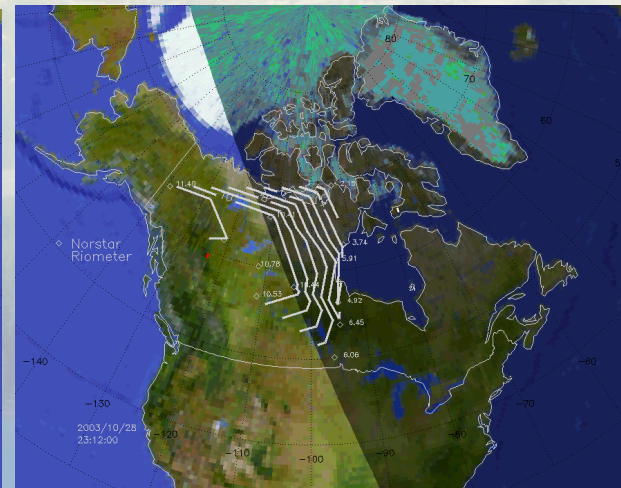
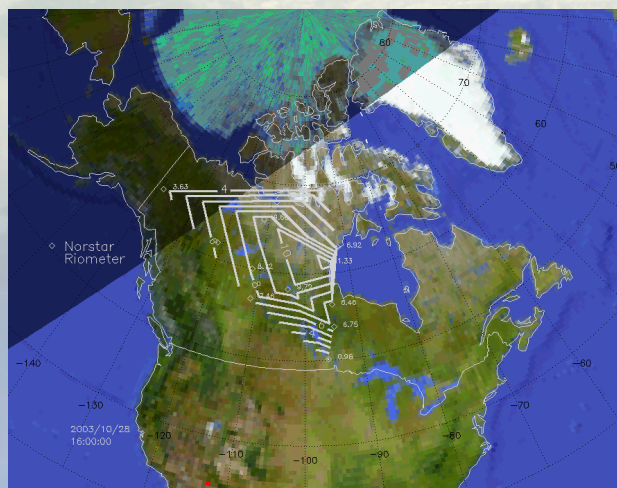
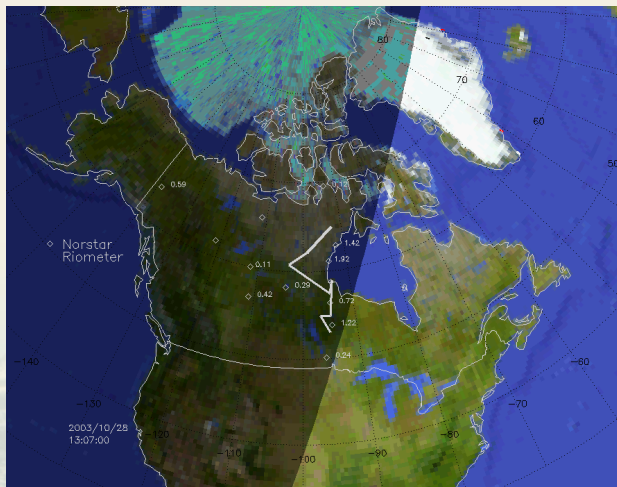
Dec 6, 2006 event

Shaded areas are daytime periods

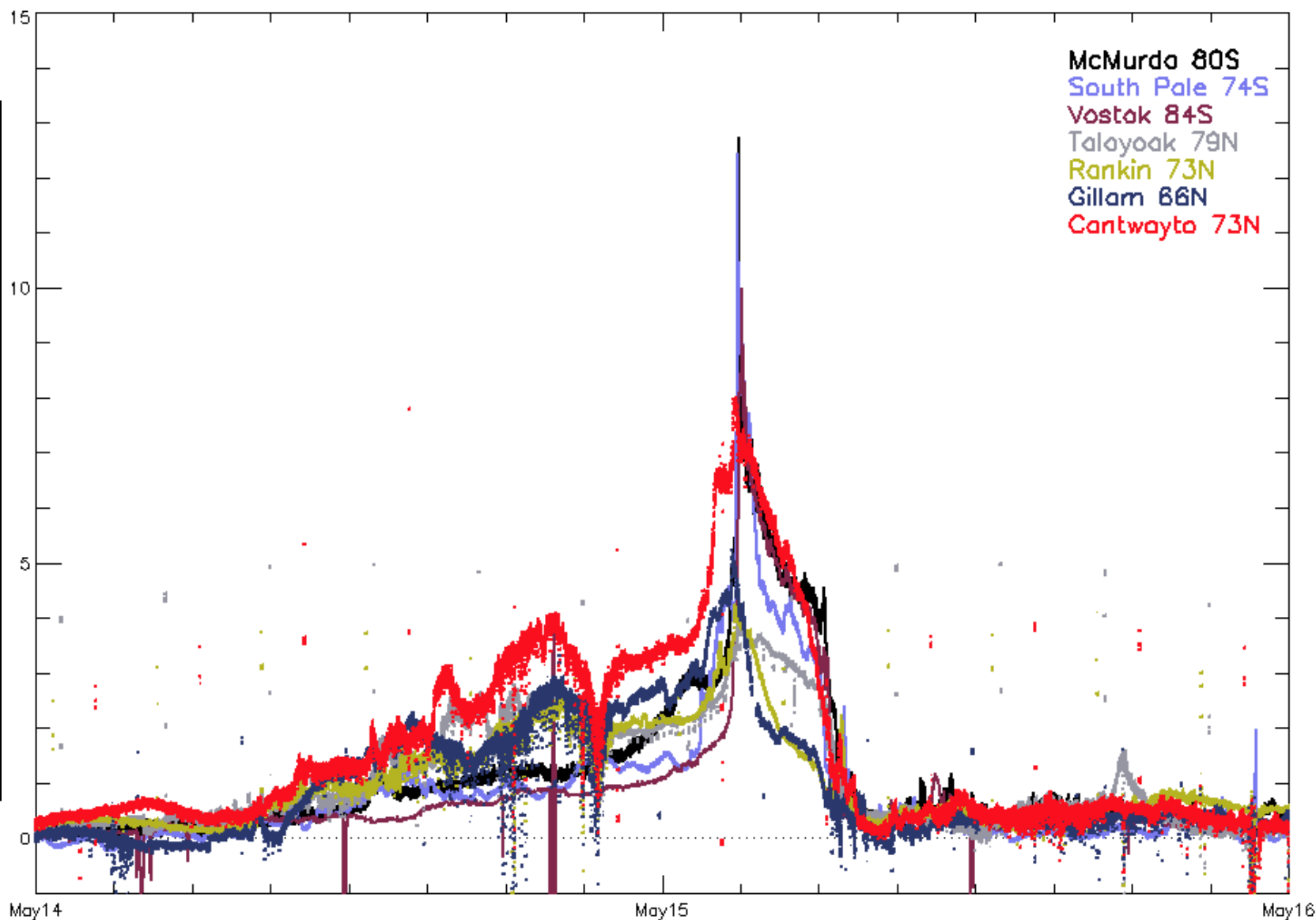


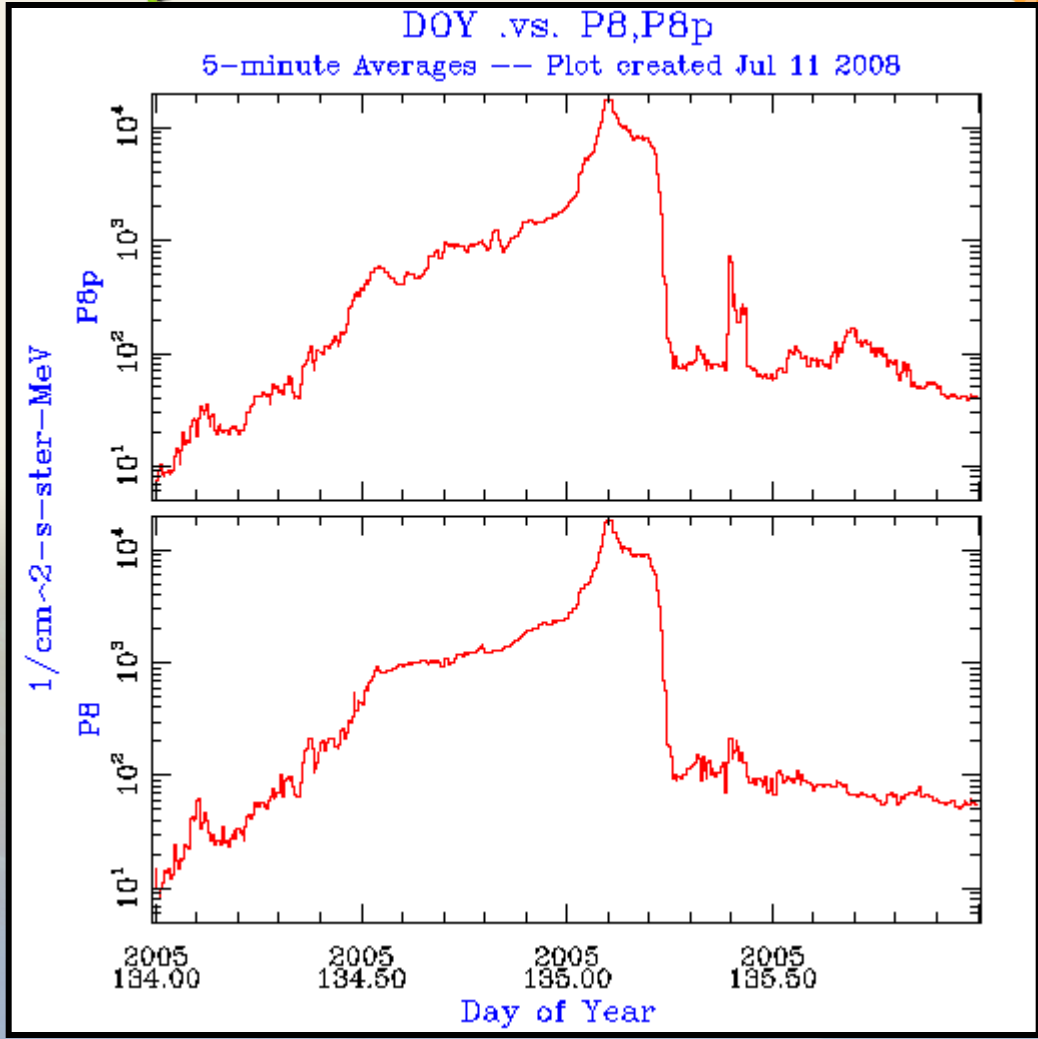


PCA day-night effect Oct 28, 2003



Effective 30 MHz absorption, dB



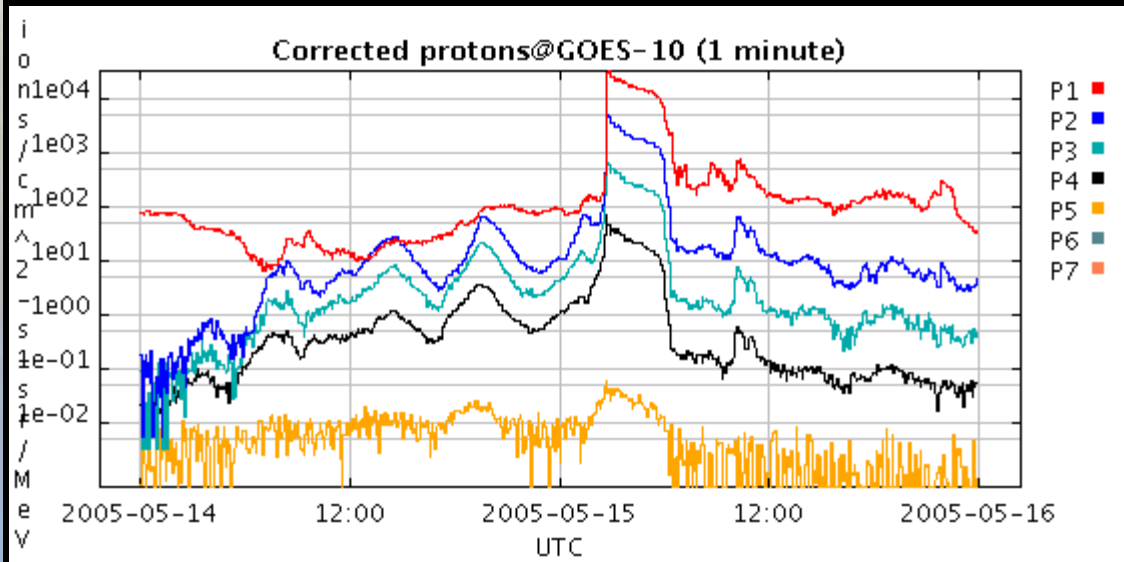
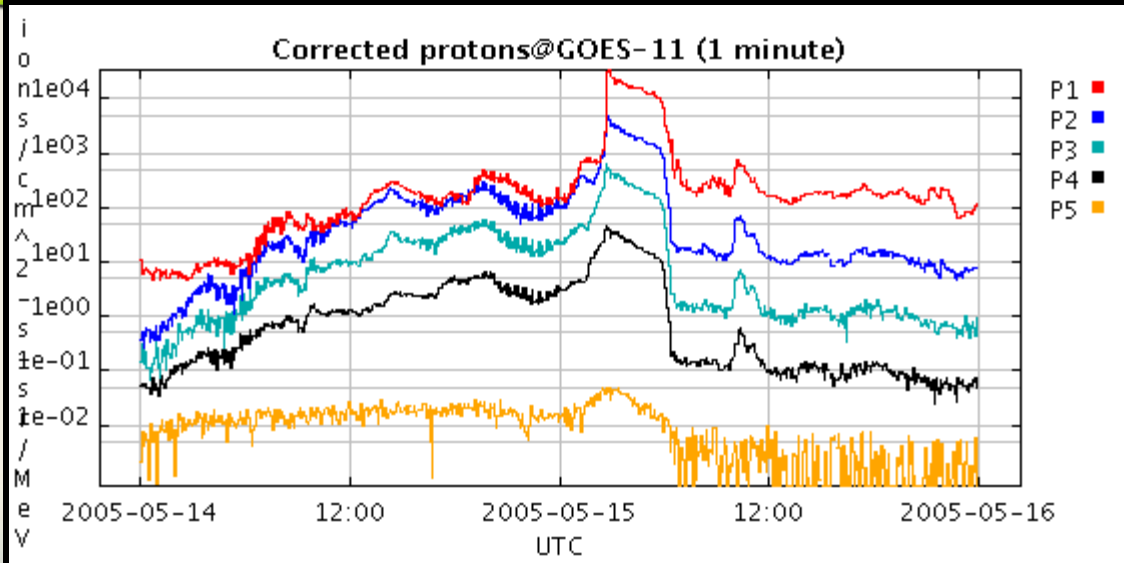


ACE energetic protons

*We thank the ACE
EPAM instrument team
and the ACE Science
Center for providing the
ACE data.*



GOES protons

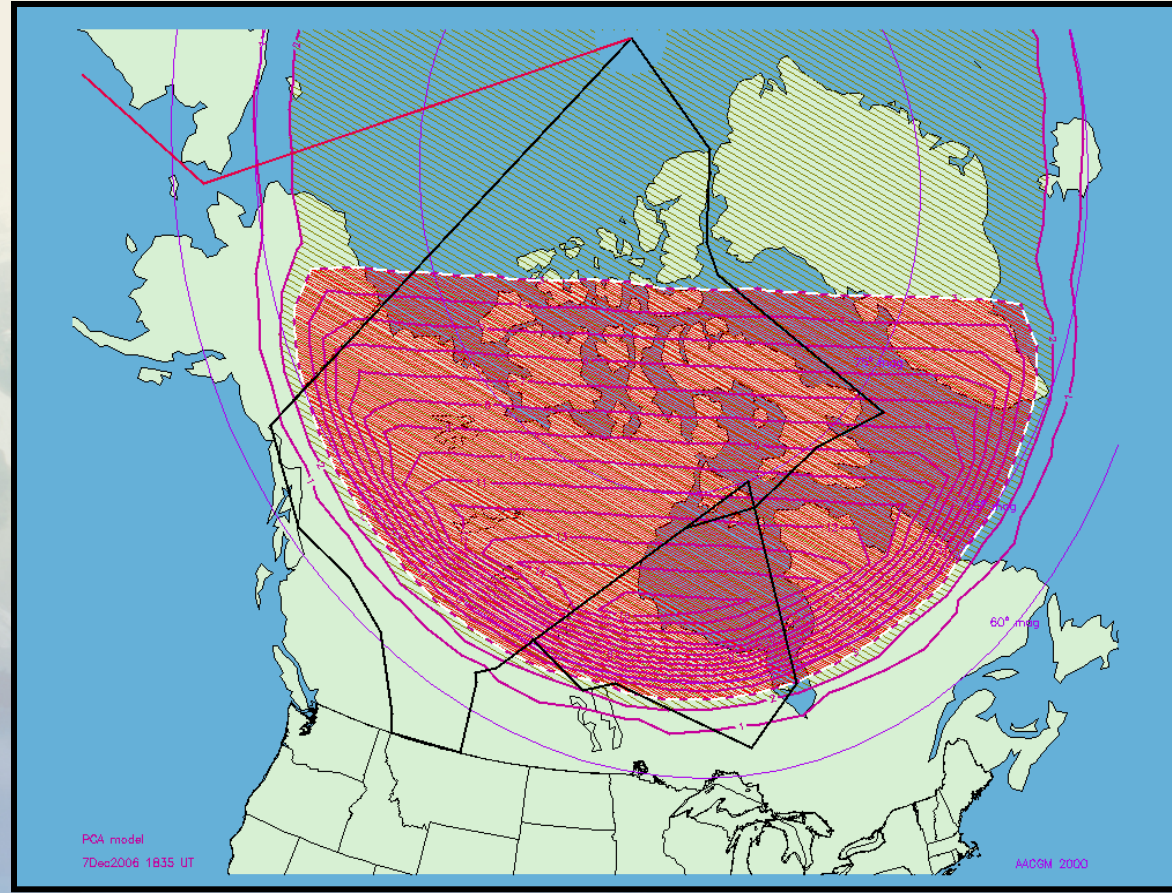


P1	Corrected protons: 0.8 - 4 MeV
P2	Corrected protons: 4 - 9 MeV
P3	Corrected protons: 9 - 15 MeV
P4	Corrected protons: 15 - 40 MeV
P5	Corrected protons: 40 - 80 MeV

We thank the National Geophysical Data Center for the GOES data.
<http://spidr.ngdc.noaa.gov/spidr/index.jsp>



Polar Cap Absorption





Conclusion

- Riometer data has been collected since ~1990 under CANOPUS.
- NRCan riometers were installed after 2006
- A new website will be available for accessing absorption values
- For further information/ clarification / data send email to: ddanskin@NRCan.gc.ca

Canadian Riometer Array is funded in part by the Canadian Space Agency through Go-Canada grants. E. Spanswick is the principal investigator for the Go-Riometer part of the array, D. Danskin manages the NRCan riometers.

