Ring Current in Solar Minimum: TWINS Observations

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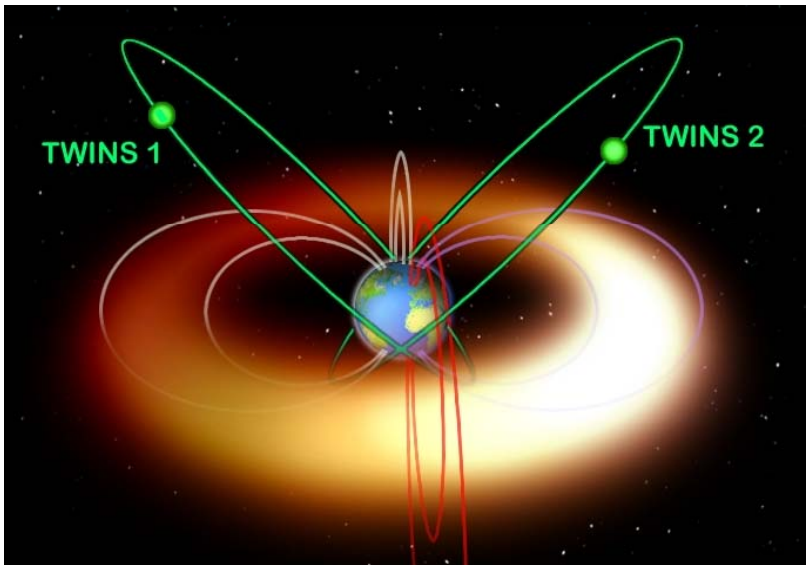
2009 GEM Workshop
June 21 - 26
Snowmass, Colorado

The TWINS Mission

Two **W**ide-angle **I**maging **N**eutral-atom **S**pectrometers

First Stereoscopic Magnetospheric Imaging Mission
TWINS proposed in 1997, MoO (AO 97-OSS-03)
2 nadir-viewing Molniya-orbit spacecraft
7.2 RE apogee, 63.4˚ inclination, 12 hour orbit
Actuator replaced S/C spinning

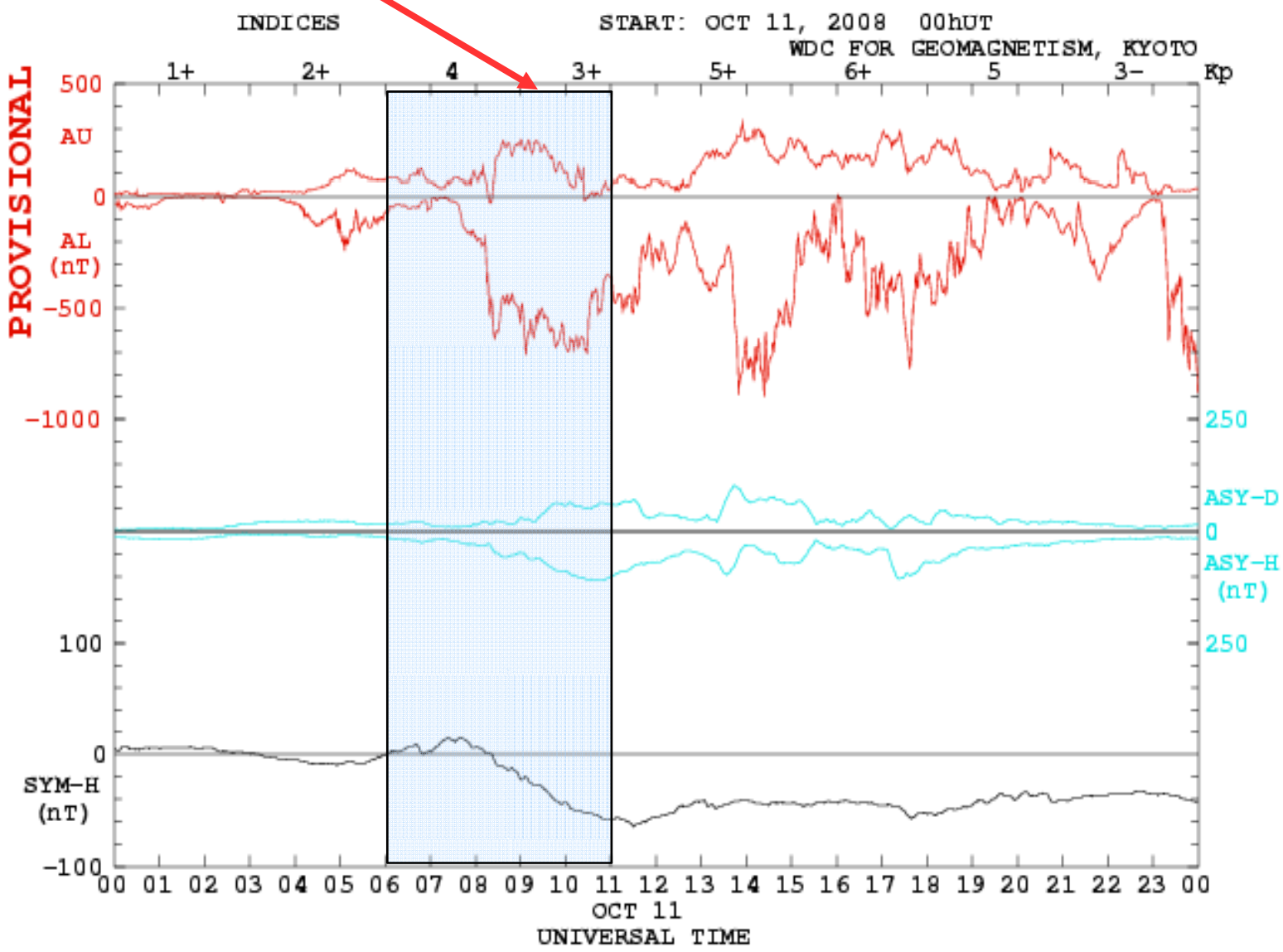


Stero Imaging began in summer of 2008
Available at http://twins.swri.edu

TWINS Team:
PI: Dave McComas (SwRI)
Project Scientist: Mei-Ching Fok (NASA)
Program Scientist: Barbara Giles (NASA)
Science Analysis Lead: Jerry Goldstein (SwRI)

11 October 2008 moderate storm (Dst/SYMH ~ -60nT)

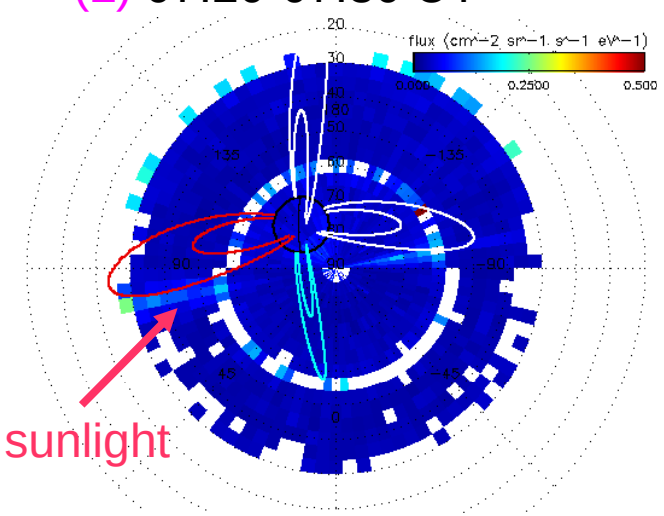
TWINS data



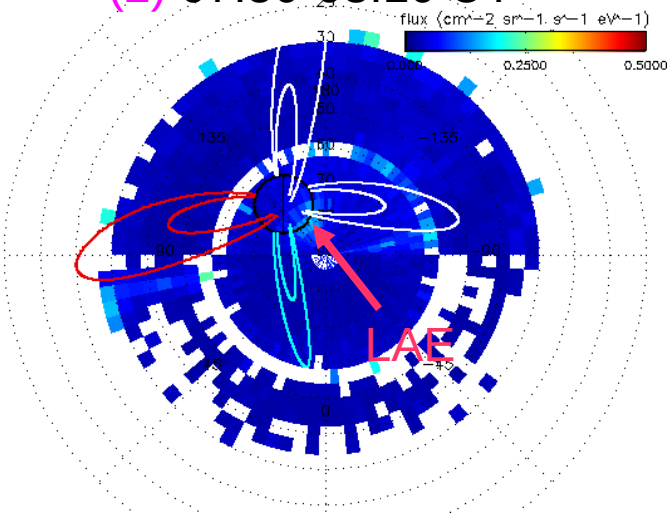
11 October 2008
Early Main Phase: Ring Current Buildup
TWINS 2: ENA intensity; E = 12 keV

Linear scale 0.0-0.5 (cm^2 sr s eV)$^{-1}$

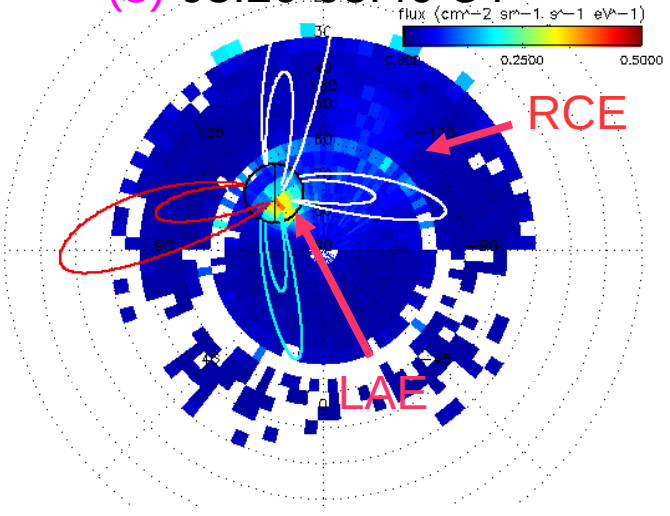
(1) 07:20-07:30 UT



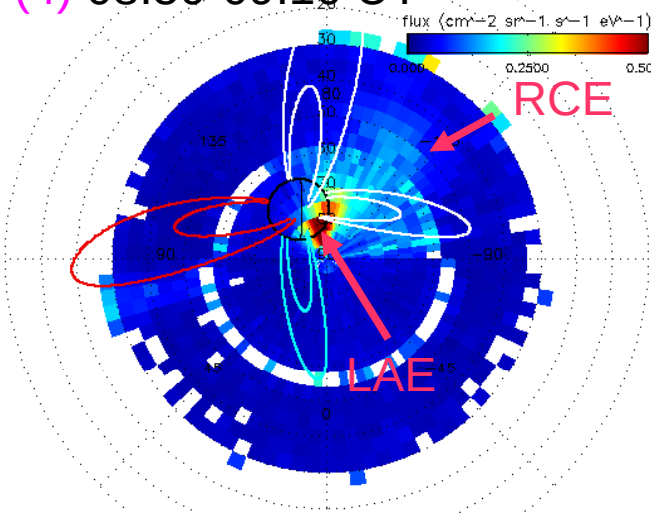
(2) 07:50-08:10 UT

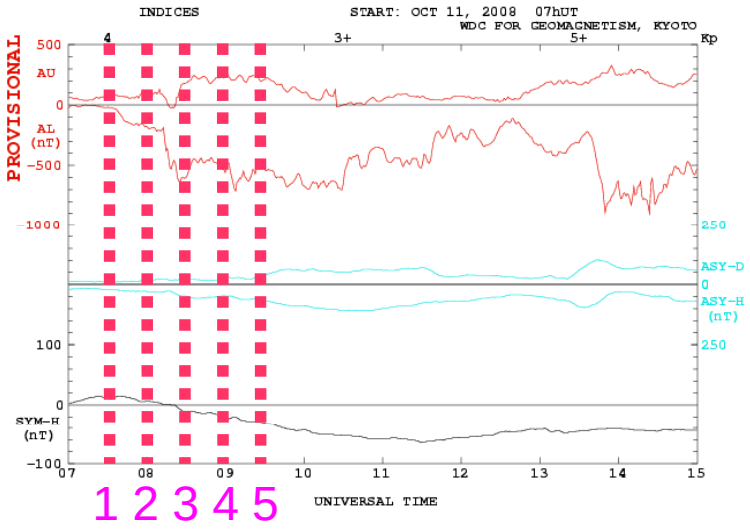


(3) 08:20-08:40 UT

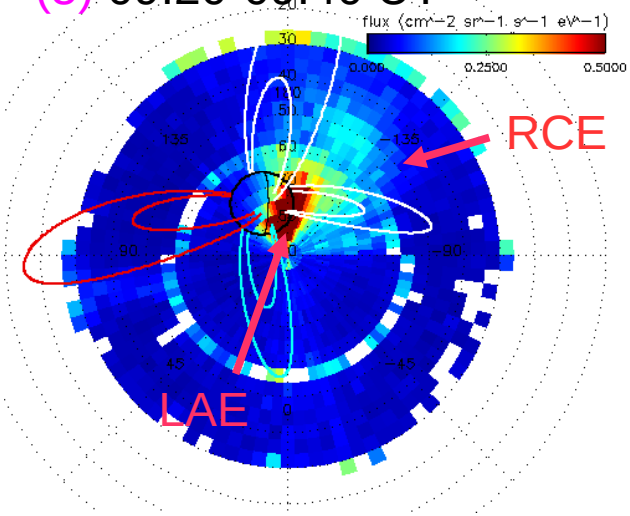


(4) 08:50-09:10 UT





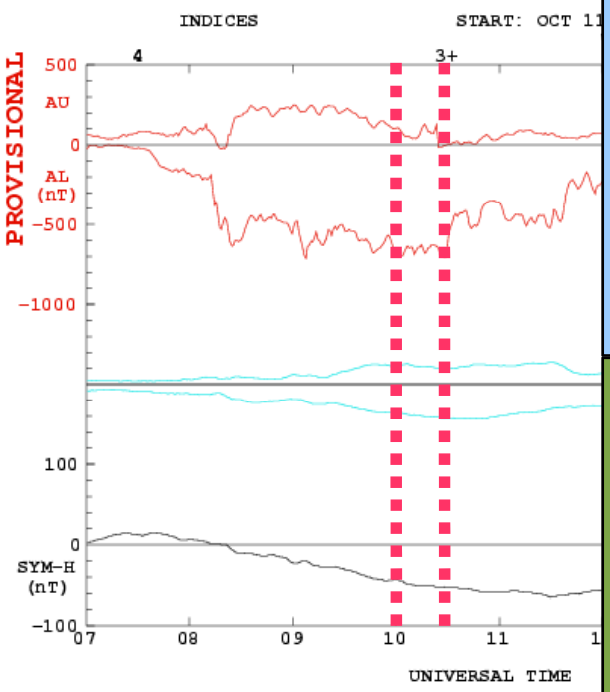
(5) 09:20-09:40 UT

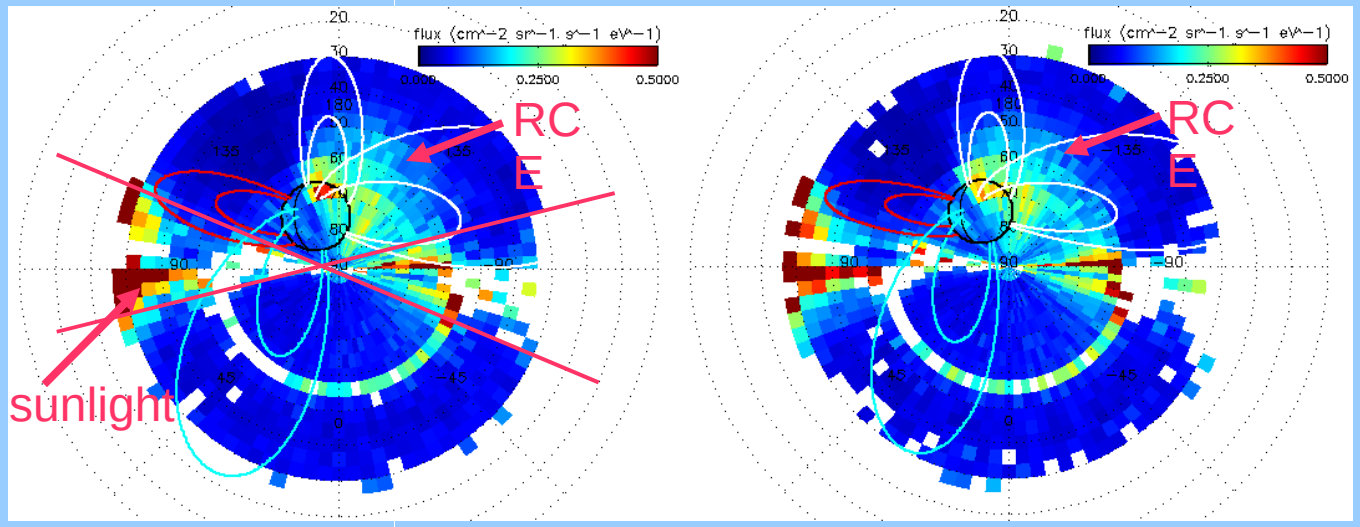


11 October 2008
Middle of the Main Phase
TWINS 1 and TWINS 2 stereoscopic observations

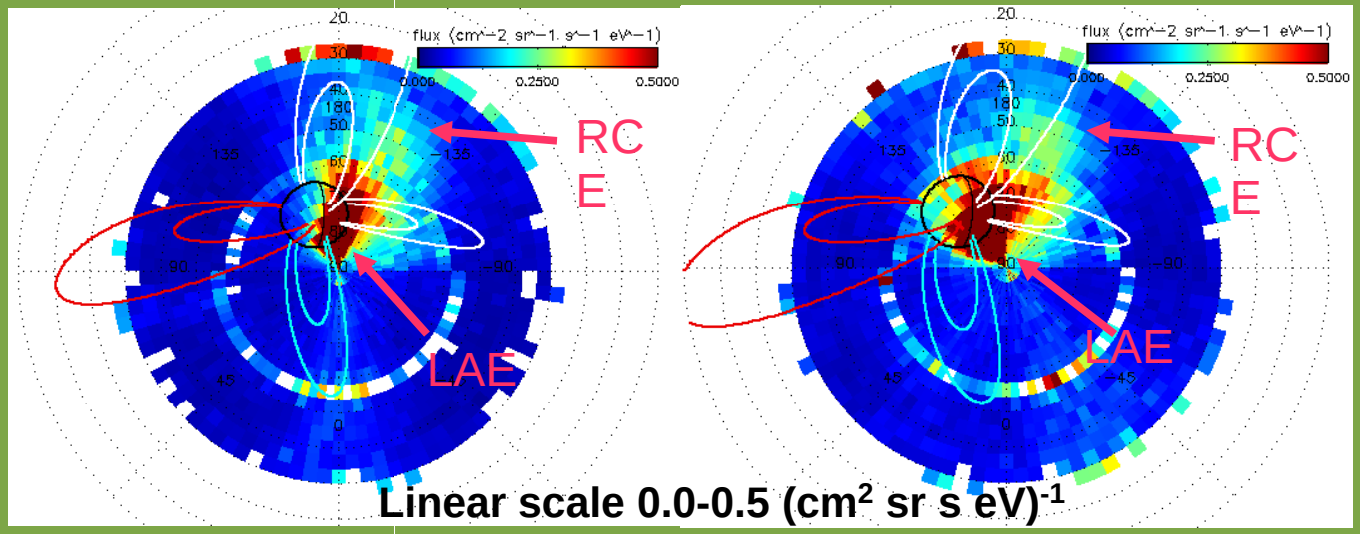
12 keV 09:50-10:10 UT 10:20-10:40 UT

TWINS 1





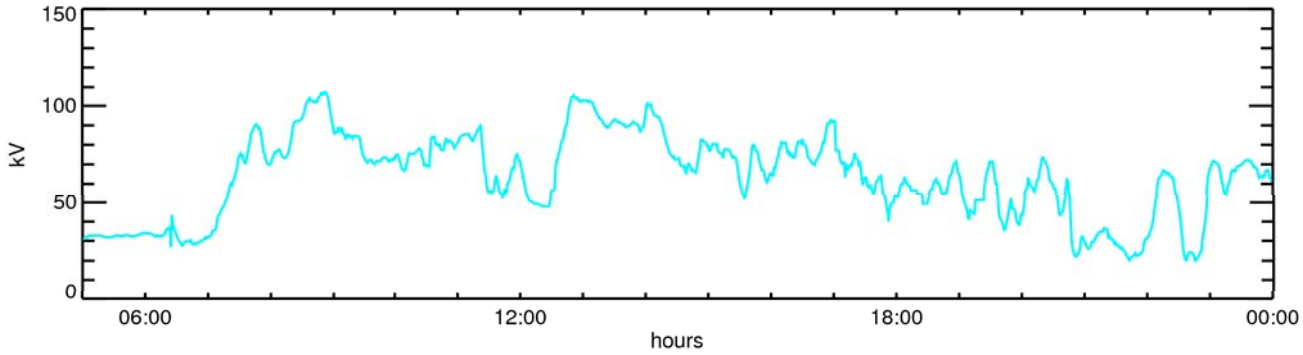
TWINS 2



Linear scale 0.0-0.5 (cm^2 sr s eV)$^{-1}$

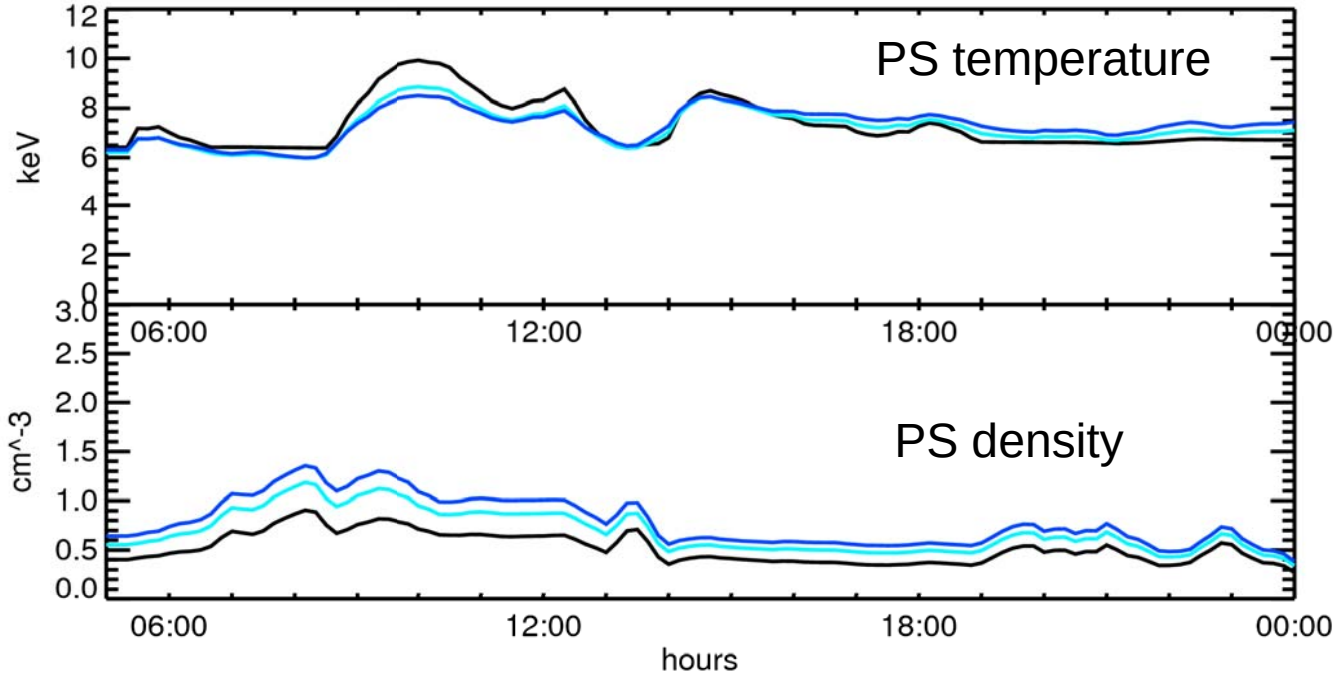
CRCM main drivers: convection and plasma sheet parameters

Weimer-2000
cross polar cap potential

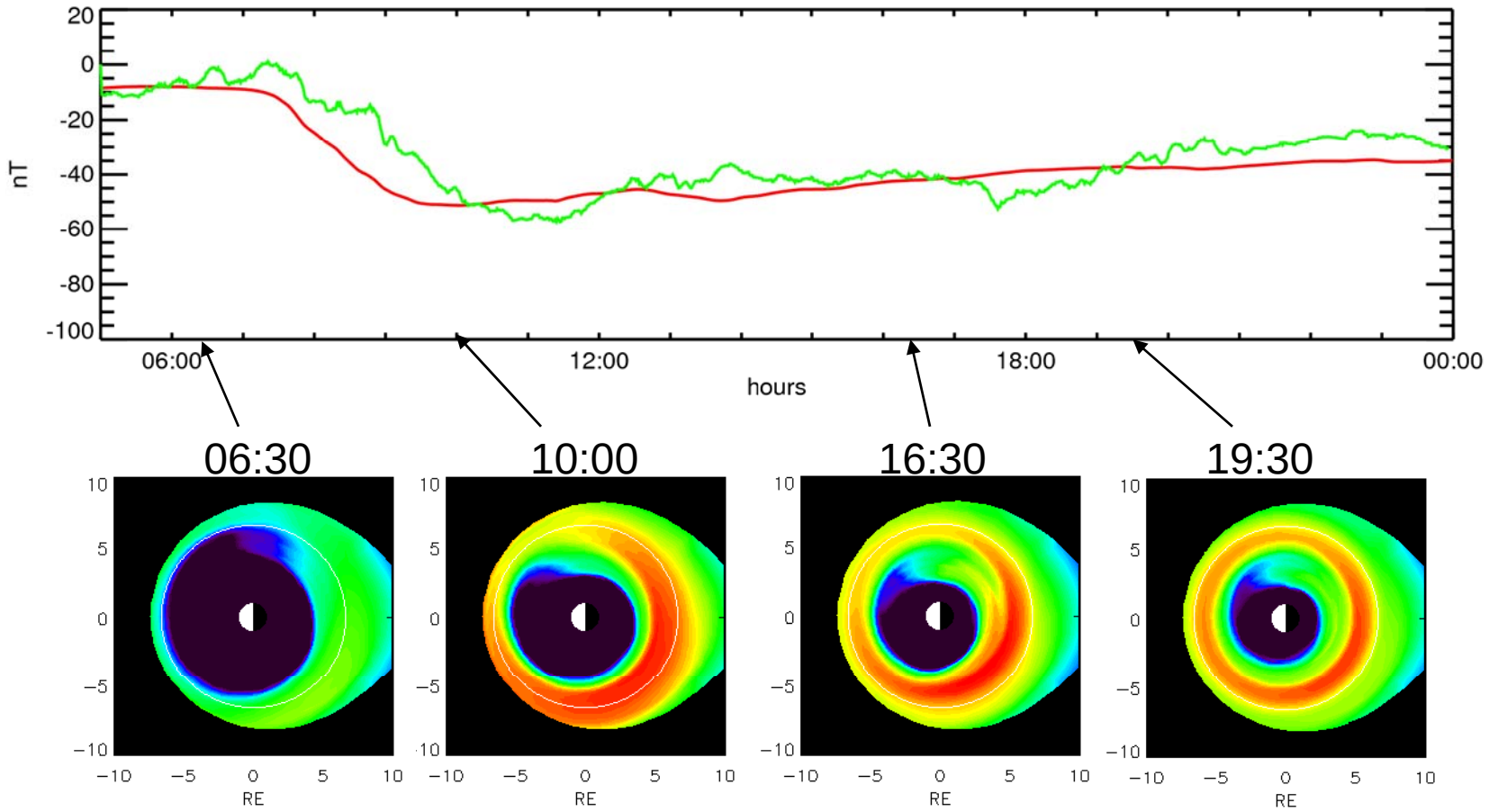


Temperature and density at polar boundary from Tsyganenko&Mukai-2003 PS model, R_b=10 R_E

(different colors correspond **00 MLT**, **03/21 MLT**, **06/18 MLT**)

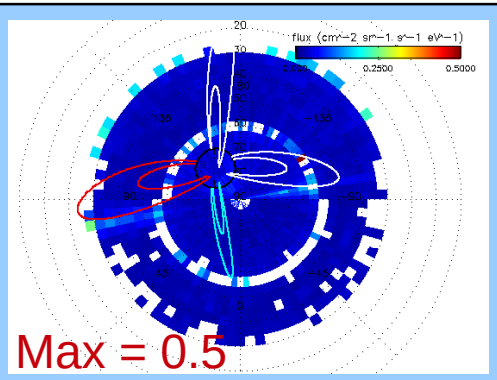
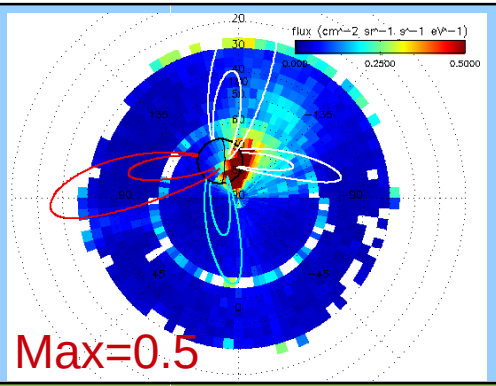
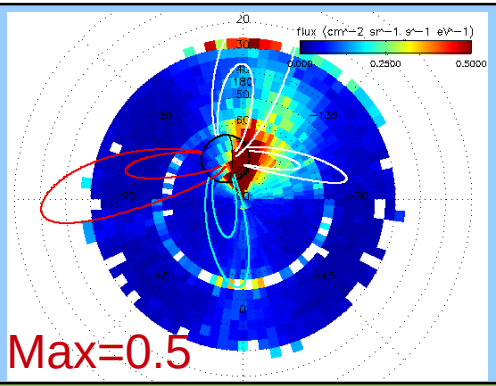
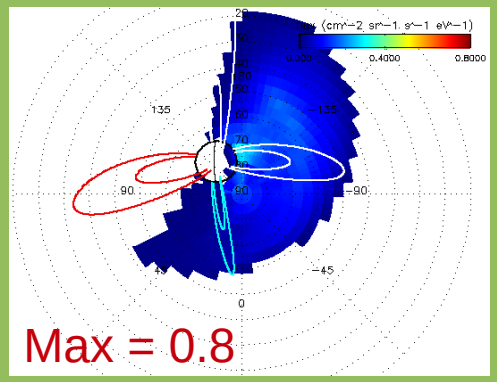
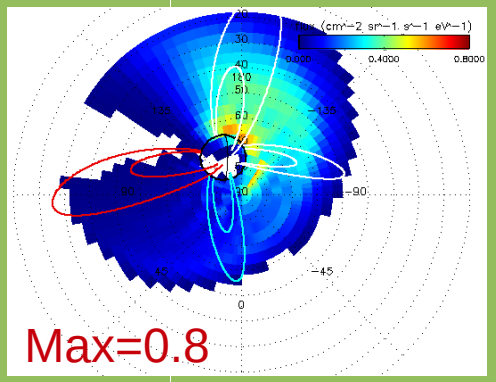
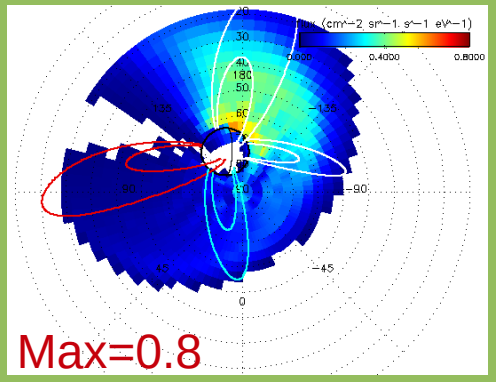
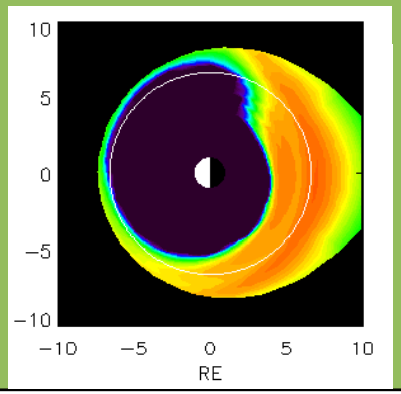
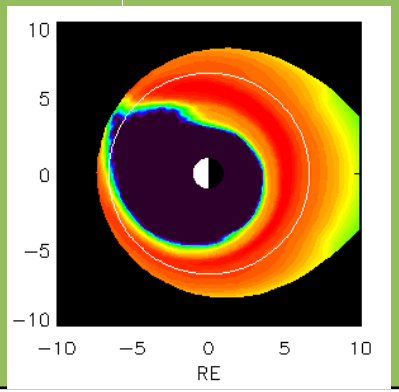
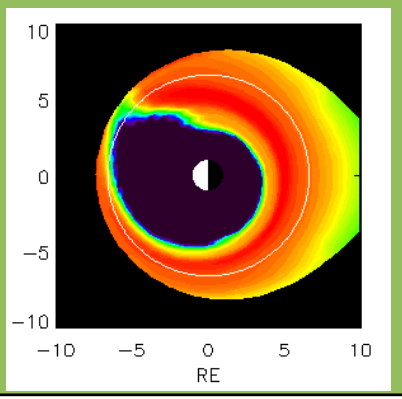


SYMH* index and Ring Current Pressure
red – CRCM (Dessler-Parker-Scopke)
green – WDCG, Kyoto + correction



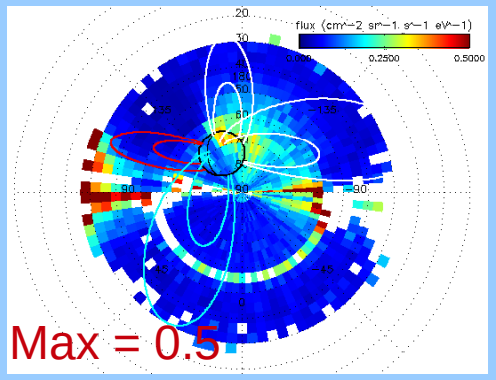
Correction to SYMH: SYMH* = SYMH/1.3 – $0.2p^{1/2}$ + 20 (nT) ;
p – SW pressure (eV cm^{-3})
(Burton et al., 1975; Gonzalez et al., 1994; Kozyra et al., 2002)

TWINS 1 – CRCM Data-model comparison: ring current buildup (12 keV H+)

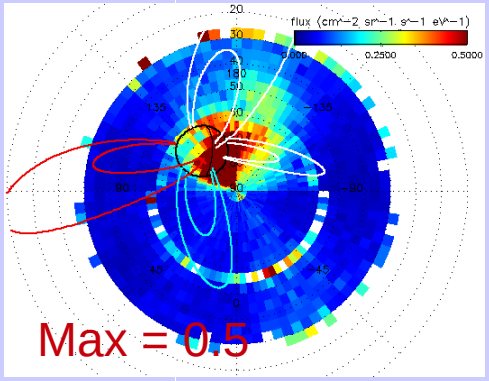
	07:30 UT	09:30 UT	10:00 UT
TWINS1	 Max = 0.5	 Max=0.5	 Max=0.5
CRCM ENA	 Max = 0.8	 Max=0.8	 Max=0.8
CRCM H+ flux			

TWINS 1 / TWINS 2 - CRCM Data-model comparison: stereoscopic view (12 keV) at ~10:30 UT (main phase)

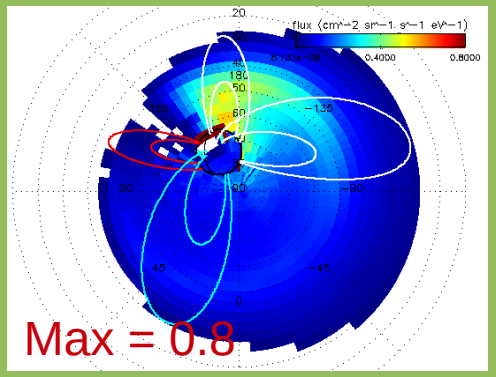
TWINS 1

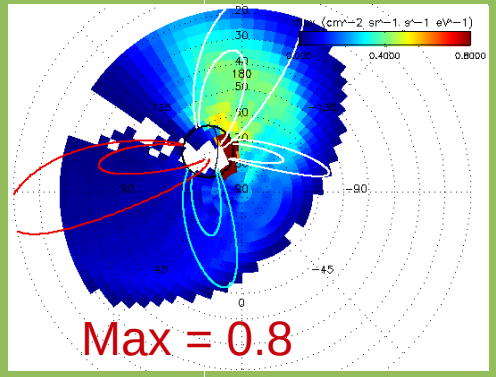


TWINS 2

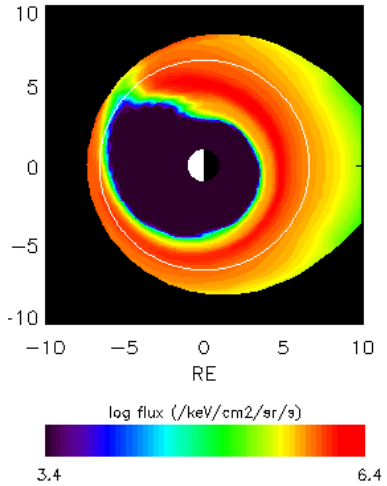


CRCM ENA

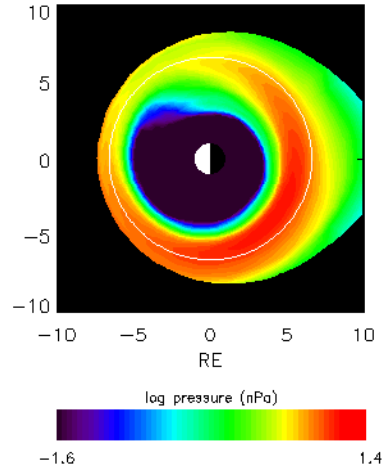




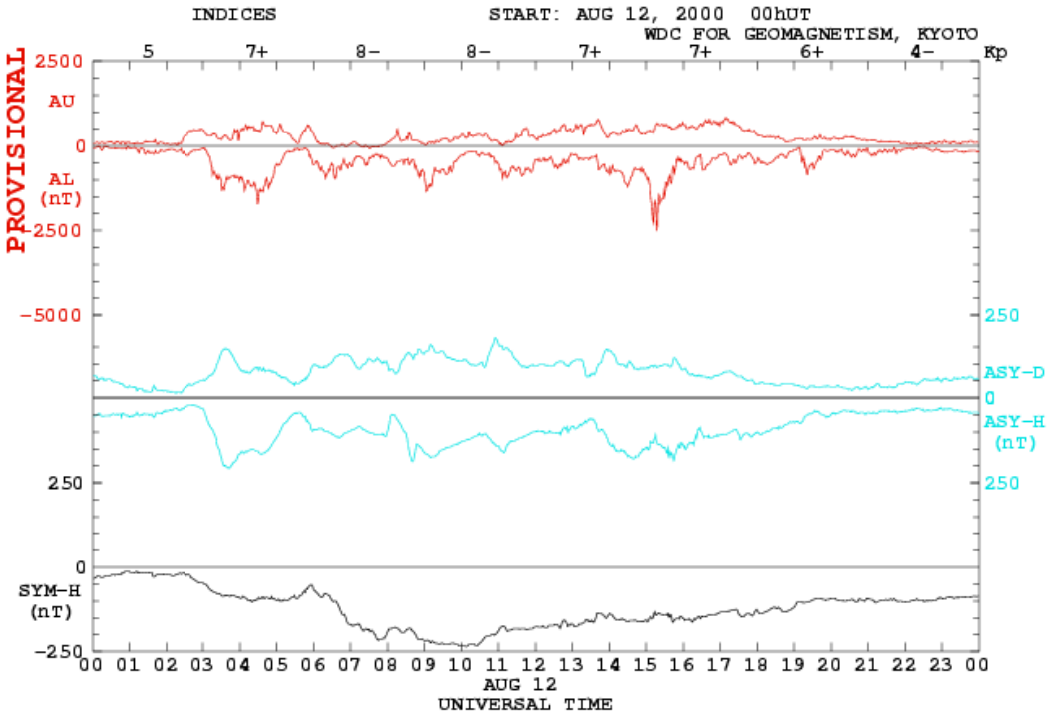
12 keV H+ flux



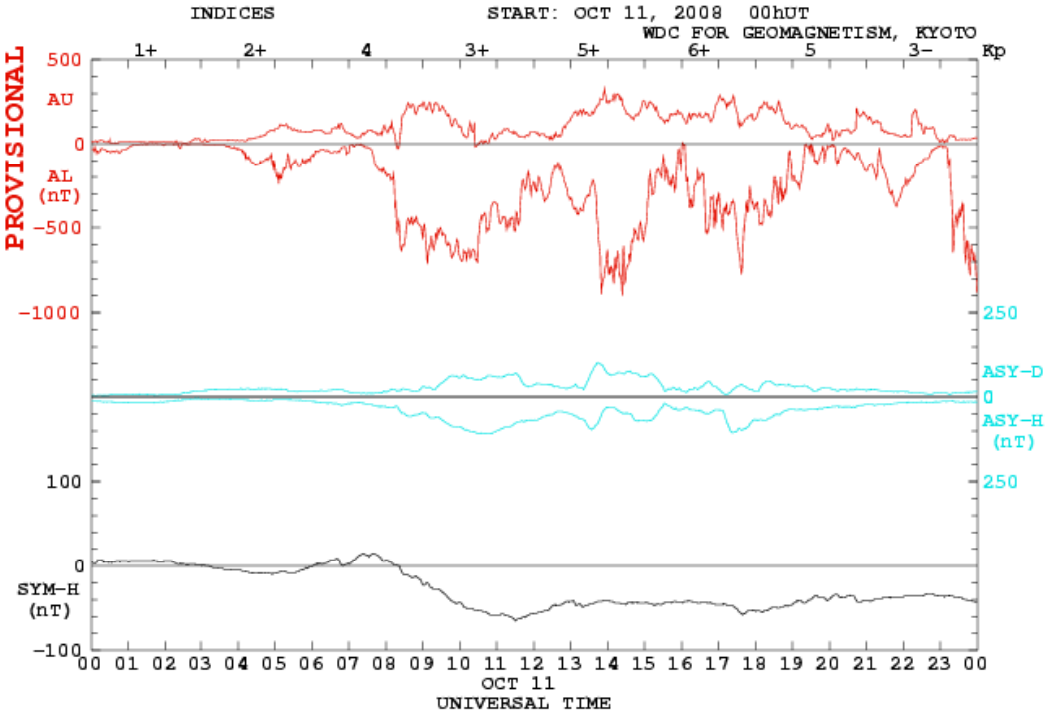
Total RC pressure



12 August 2000 storm:
Dst/SYMH(min) ~ -250 nT
AL(min) ~ - 2000 nT

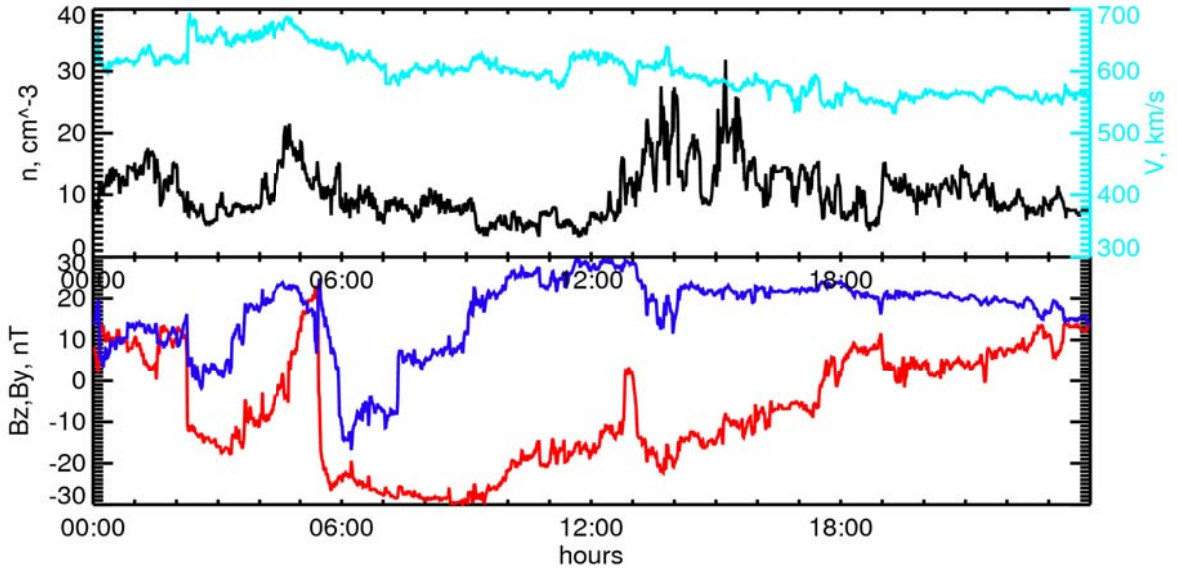


11 October 2000 storm:
Dst/SYMH(min) ~ -60 nT
AL(min) ~ - 800 nT

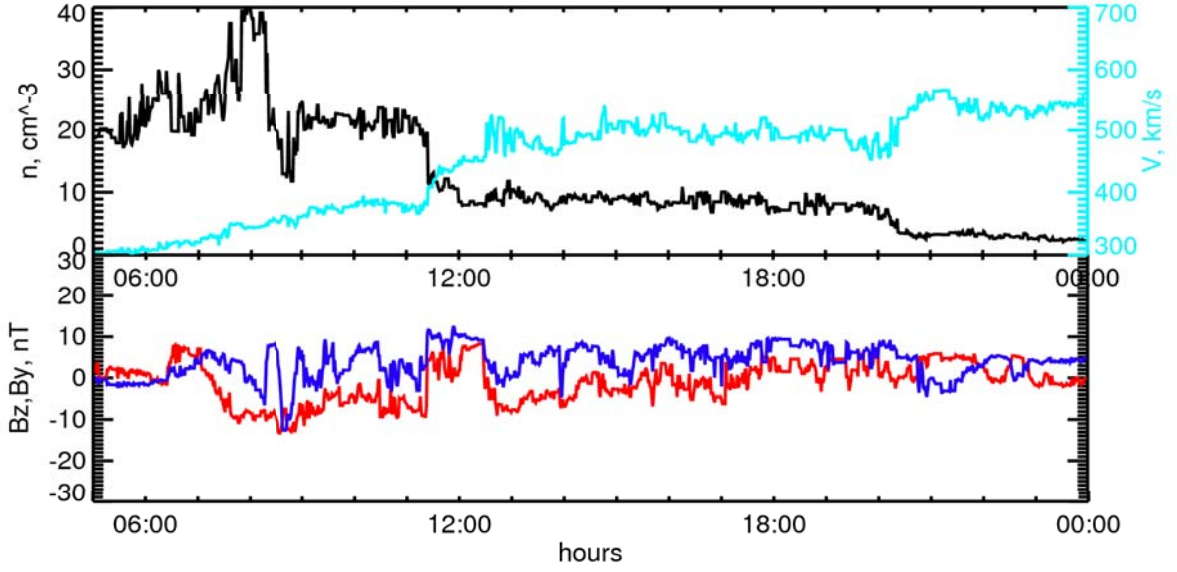


Solar wind / IMF conditions: n, V, Bz, By

12 August 2000

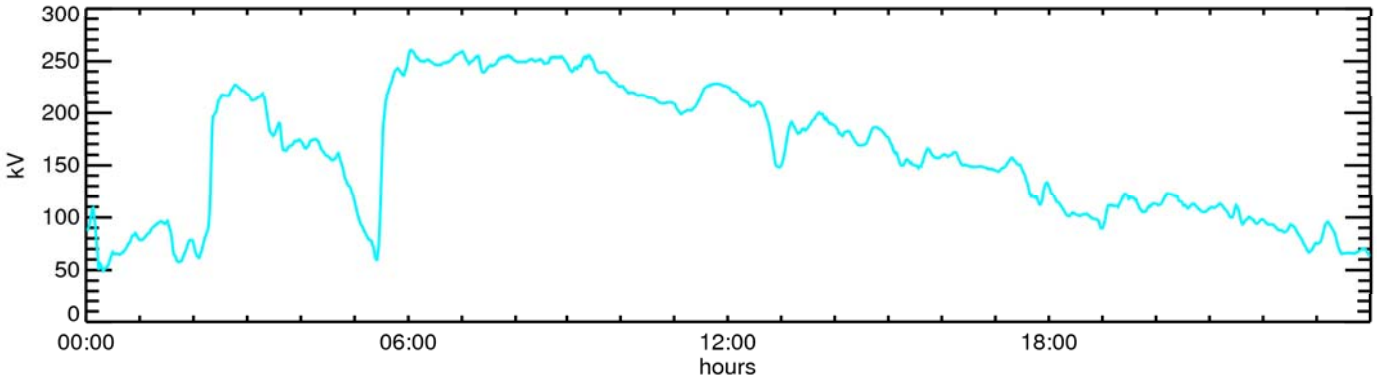


11 October 2008

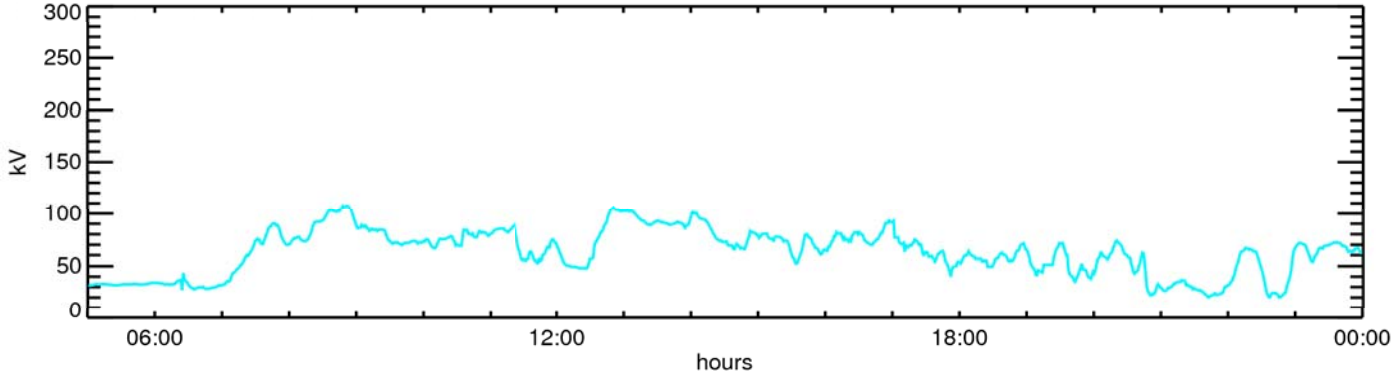


Weimer-2000 cross polar cap potential: CRCM input

12 August 2000

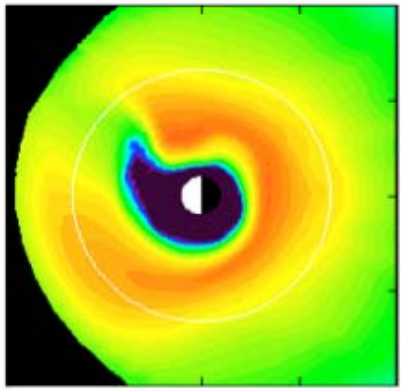


11 October 2008

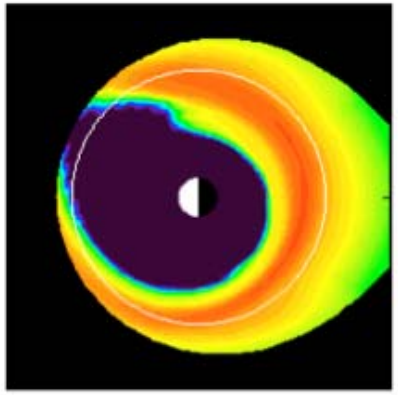


CRCM H+ flux **12 August 2000** **11 October 2008**

10-15 keV

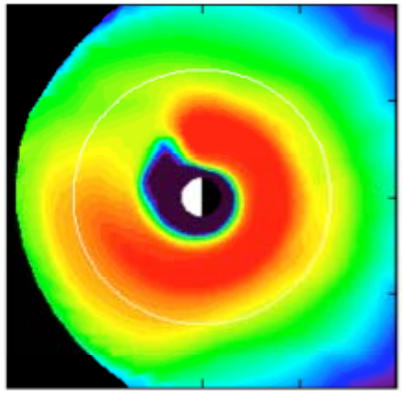


9:02



9:00

25-38 keV



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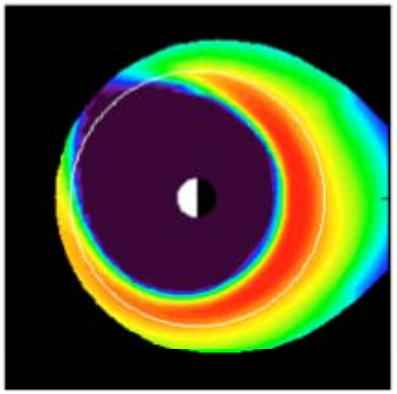
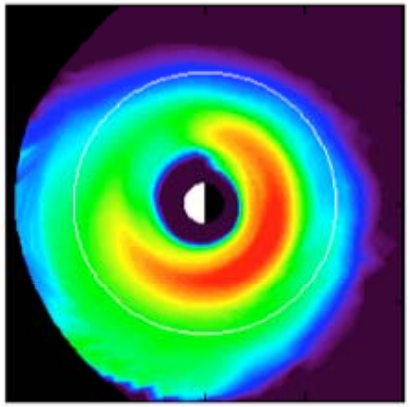
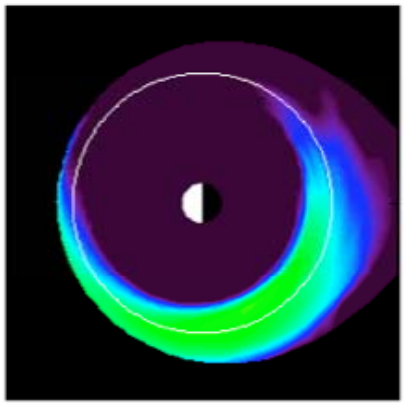
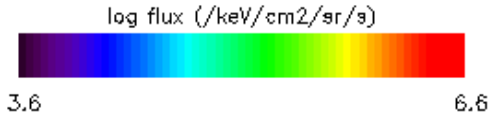


9:00

60-120 keV

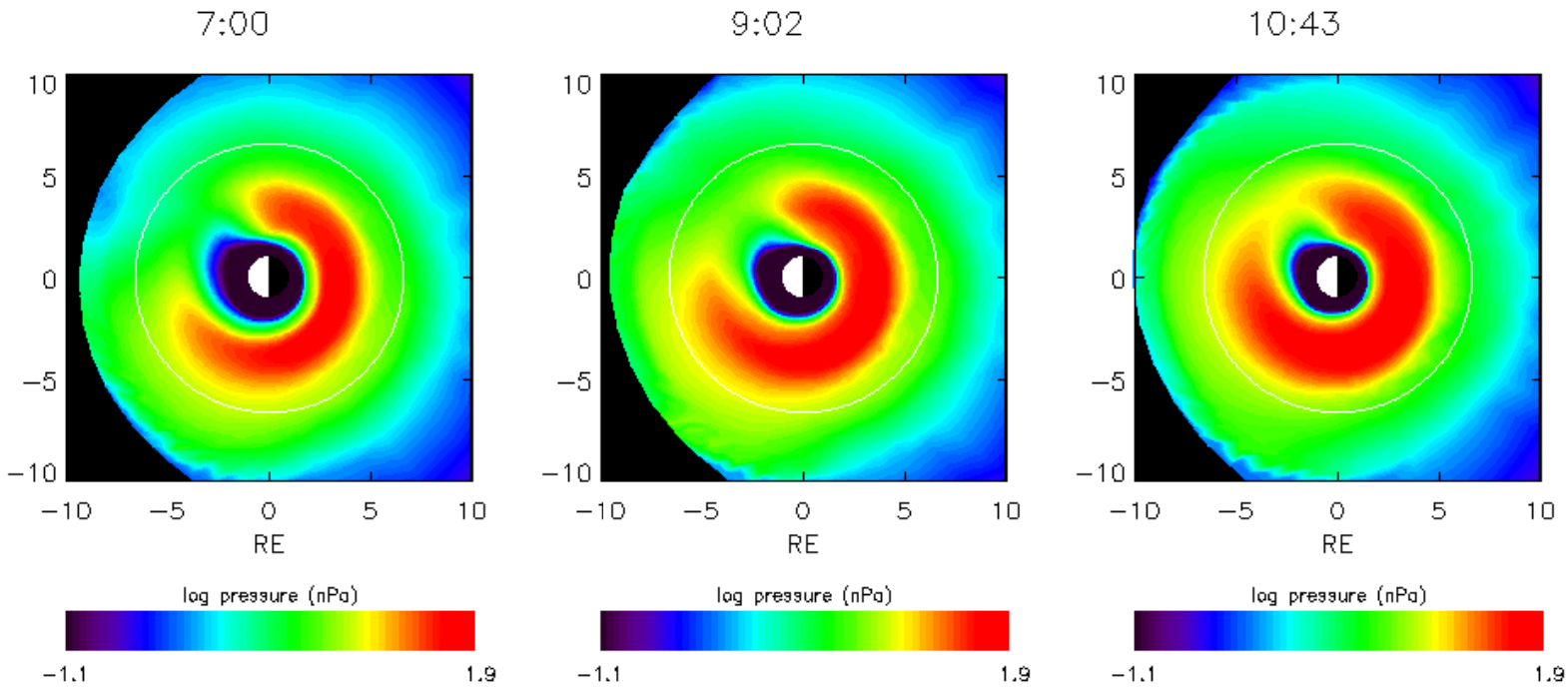




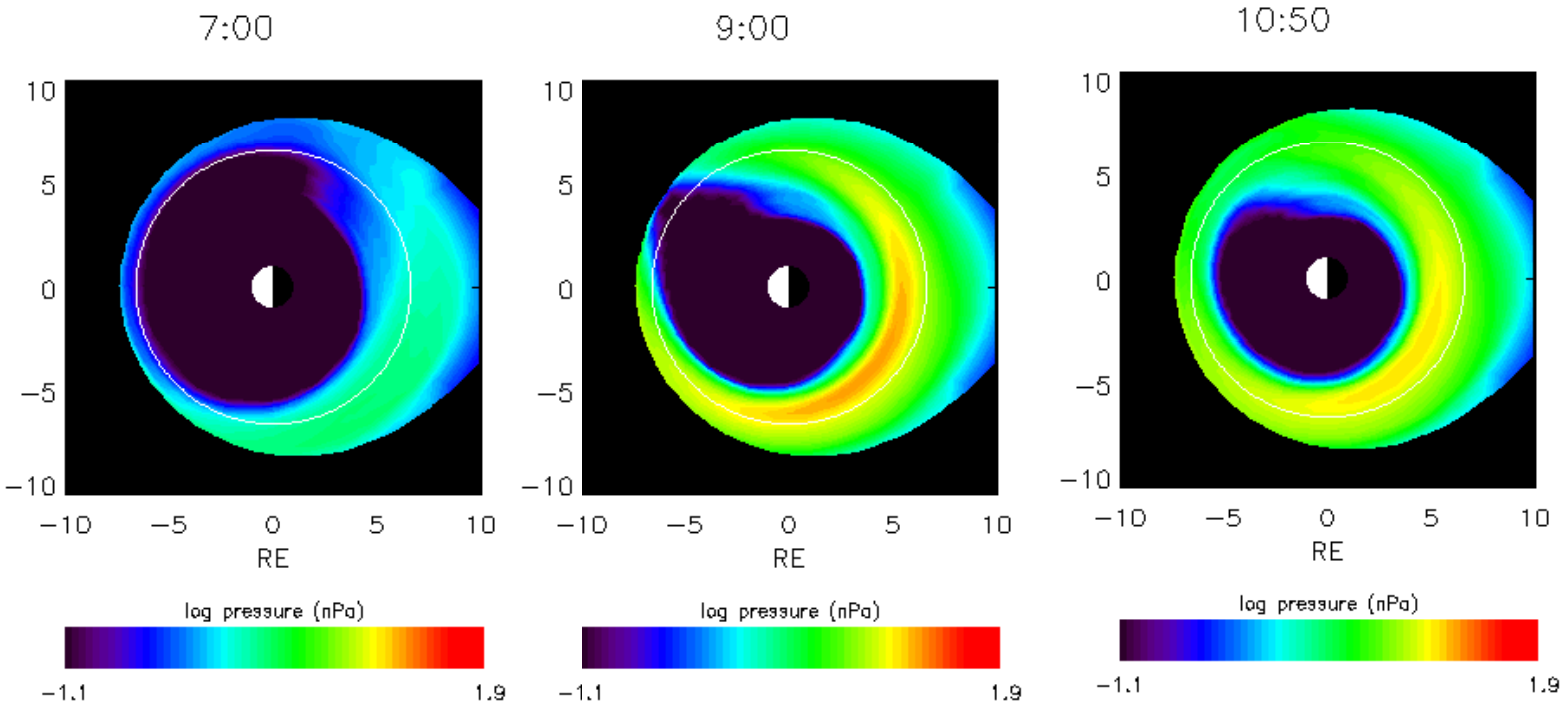


CRCM TOTAL H+ PRESSURE (1-180 keV)

12 August 2000 storm main phase



11 October 2008 storm main phase



Summary

- Moderate ring current seen by TWINS
- CRCM shows good spatial agreement with TWINS
- ENA peak at post-midnight, Ion pressure peak at pre-midnight
- Convection is a key factor determining storm size
- Large storm → deeper ion penetration → strong pressure
- Large storm → stronger $J_{||}$ → stronger eastward skewing