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Long-term changes in the magnetosheath: *Solar wind drivers and magnetospheric effects*

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Introduction

Solar wind – magnetosheath – ionosphere coupling

- Coupling efficiency
- Key driving parameters

Two solar cycles

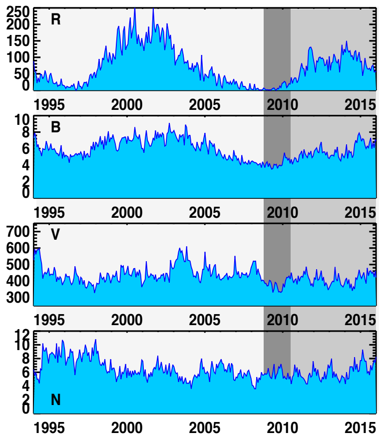
- IMAGE data 1994 – 2015

One solar cycle

- Themis data 2008 – 2016

Deep solar minimum

- Themis and IMAGE 2008-2010



27-day averages

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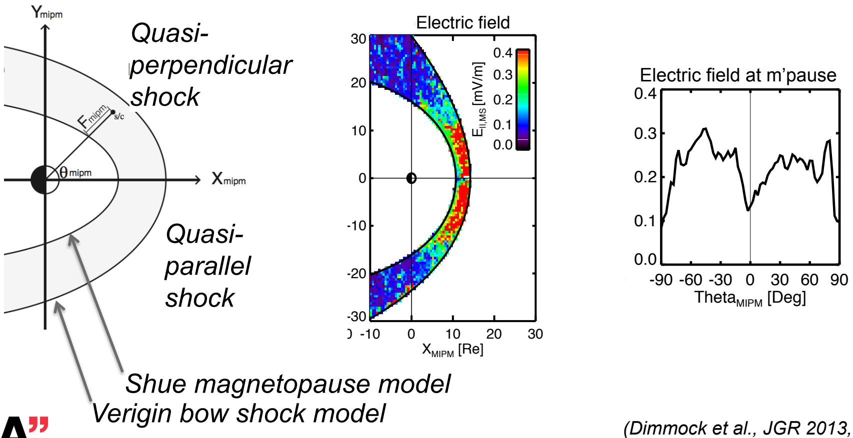
THEMIS in the magnetosheath



(Dimmock et al., JGR 2013, Pulkkinen et al., GRL 2015)

Solar wind driver *Magnetosheath response*

Themis analysis:

- 12-month sliding averages at 3-month intervals
- Measurements close to the magentopause (20% of magnetosheath thickness)
- Integration over dayside longitudes -> magnetopause average

Gray: Solar min 2008-2010

Red: $<E_{SW}>$ > 1.8 mV/m

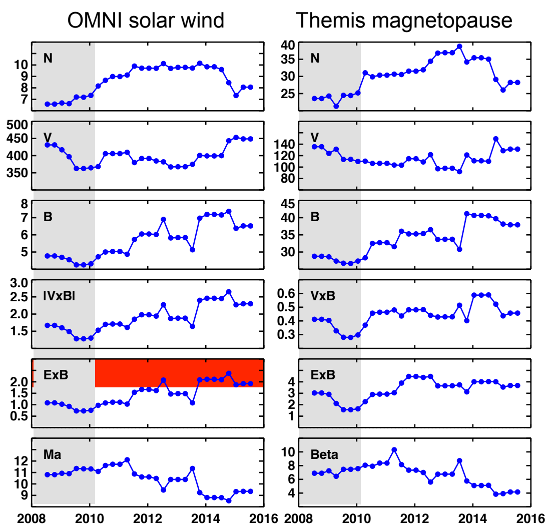


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IMAGE magnetometer chain

33 magnetometer stations
Data coverage 1994-2014

Data processed with baseline removal
- IU, IL indices (equivalent to AU, AL)
- Electrojet peak intensity (mA/m)
- Electrojet peak intensity latitude (Deg)
- Electrojet total current (MA)

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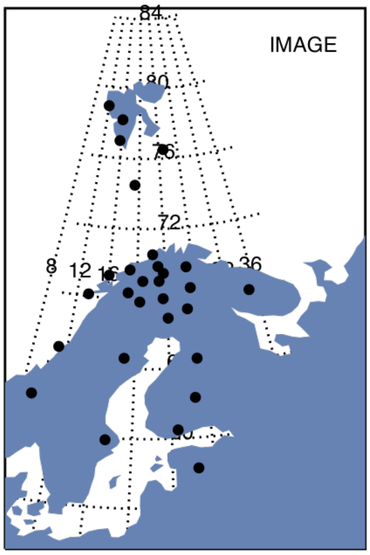

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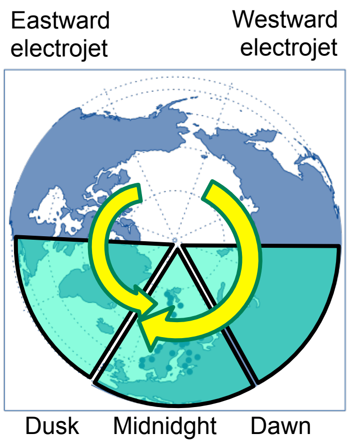
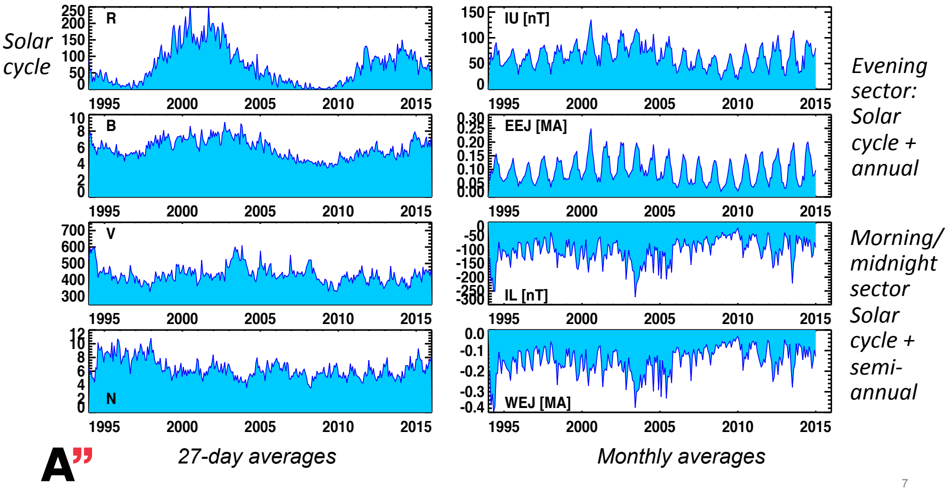


(Amm, J Geomag. Geoelectr., 1997. Amm and Viljanen, Earth Planets Space, 1999)



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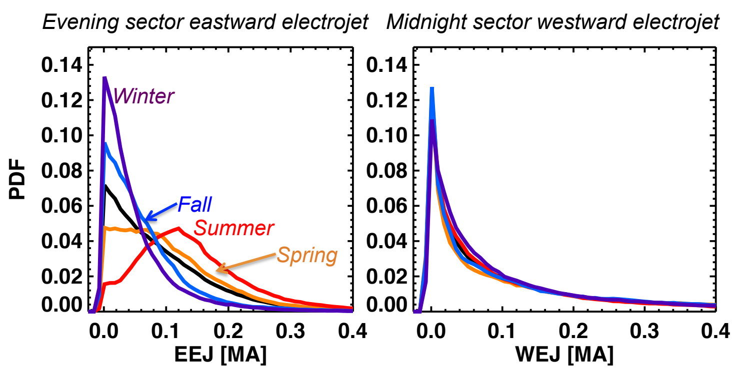
Probability distribution functions
Seasonal variability



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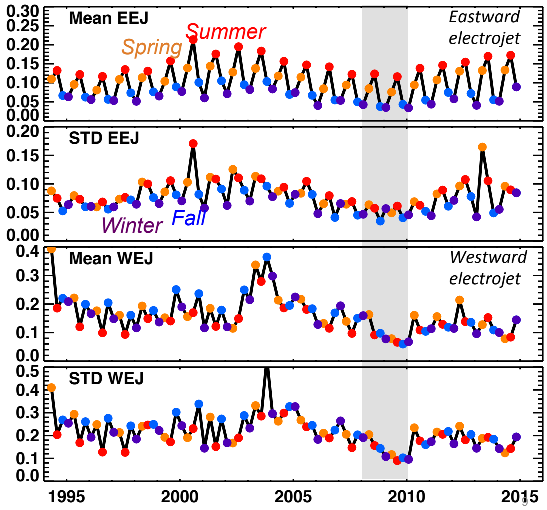
Electrojet moments
Seasonal variability

Eastward electrojet
- Strong annual variability
- Spring activity higher than fall

Westward electrojet
- Semiannual variability, which disappears during 2008-2010
- Spring maximum higher than fall during most years

Spring: Mar, Apr, May
Summer: Jun, Jul, Aug
Fall: Sep, Oct, Nov
Winter: Dec, Jan, Feb

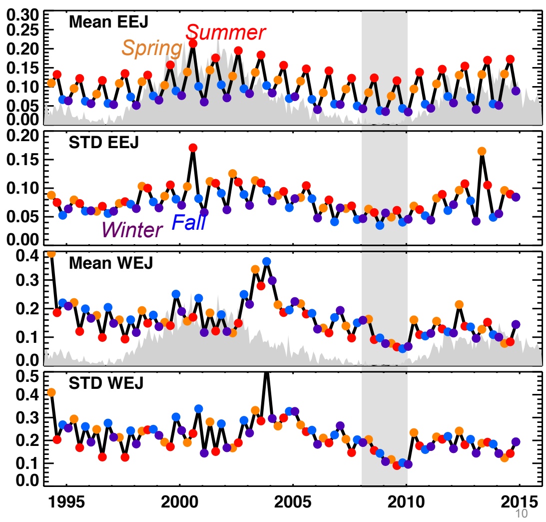


Electrojet moments
Solar cycle variability

Eastward electrojet
- Clear solar cycle dependence with minima/maxima during sunsport minima/maxima

Westward electrojet
- Maximum during declining phase, minima during sunspot minima

Spring: Mar, Apr, May
Summer: Jun, Jul, Aug
Fall: Sep, Oct, Nov
Winter: Dec, Jan, Feb



Conclusions

Solar minimum period 2008 – 2010

- semiannual variation disappears during minimum; not observed during other minima
- very close to linear driving by Poynting flux incident at the magnetopause

Eastward and westward electrojet distribution functions qualitatively different

- WEJ peak does not change by season, pdf width varies with driver intensity
- EEJ peak and width vary with season (ionospheric conductivity & driver intensity)
- in both, spring activity higher than fall

Energy transfer from solar wind to magnetopause depends on activity

- electric field and Poynting flux seem to saturate for high driving
- lower values of solar wind driving produce linear response at the magnetopause

Energy transfer from magnetopause to ionosphere close to linear

- large scatter introduced by seasonal variability
- scatter remains for higher activity summer and spring seasons

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Thank You !

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