

## Space weather induced thermosphere disturbances

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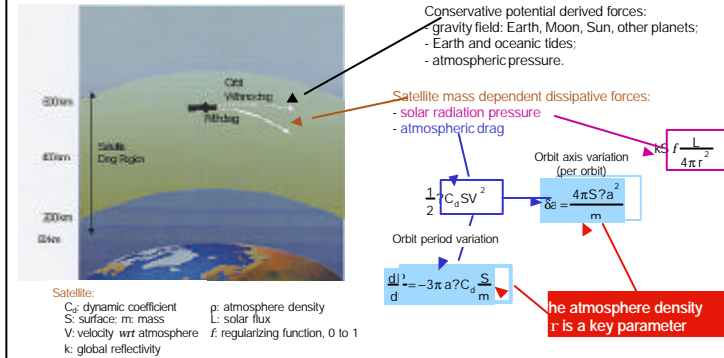
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- > Thermosphere perturbations and orbitography
- > WINDII data
- > Impact of magnetic activity on thermosphere temperature

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## Thermosphere perturbations and orbitography (1)

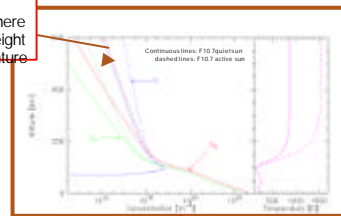
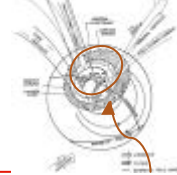


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## Thermosphere perturbations and orbitography (2)

The vertical concentration profiles of atmosphere components is governed by their scale height that depends on the exosphere temperature



(Courtesy of J. Liliensten)

Joule deposit in the auroral zone related to the field aligned currents/auroral electrojets system result in a significant thermosphere heating

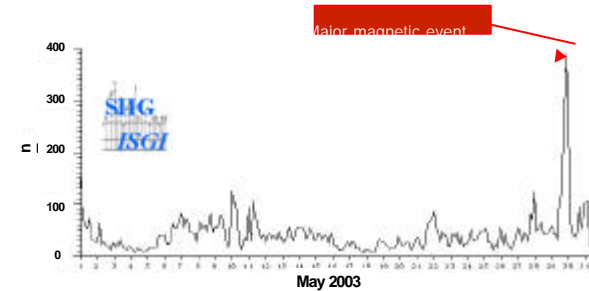
The magnetic activity impacts on the vertical thermosphere density profile

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## Thermosphere perturbations: a case history (1)

Geomagnetic activity (3-hour am indices)

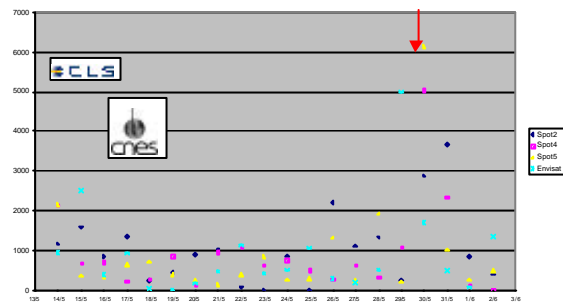


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## Thermosphere perturbations: a case history (2)

Along-track component - comparison predicted 1 day / adjusted DORIS orbits



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## WINDII data

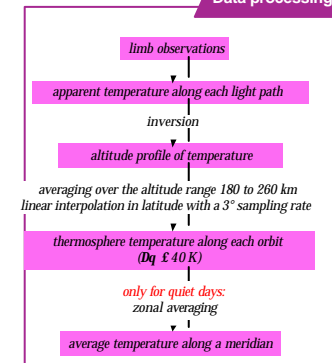


WINDII experiment  
onboard  
UARS Satellite

- Michelson interferometer developed by a French Canadian team;
- observes the natural airglow at 5 different wavelengths, at the Earth limb;
- among them the red line (at 630 nm) and the green line (at 557,7 nm) of atomic oxygen
- thermosphere temperature profiles have been retrieved from the red line data (the red line emission maximizes around 220 km altitude);
- data are available between 1992 and 1996 (declining phase of Solar Cycle 22).

9 disturbed days ( $A_p > 13$ ;  $\max(A_p) = 65$ );  
33 quiet days ( $A_p < 12$ ).

Data processing



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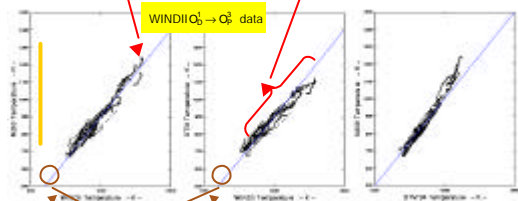
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## Quiet magnetic situations

MSIS and DTM-94 account well for WINDII temperatures

One day of data  
LT / Latitudinal variation

Seasonal and solar cycle variation



100 K bias present in the observations

Scattered plots showing the zonal mean temperatures as given by the two empirical models and as measured by WINDII (left and middle panels). Right panel: scattering between the two empirical models for comparison. Each point corresponds to a given latitude.

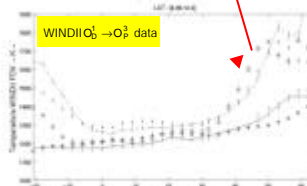
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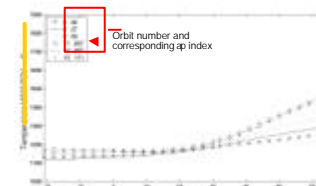
## Disturbed magnetic situations

MSIS and DTM-94 do not account for WINDII temperatures

One orbit data



Observed WINDII temperatures along different orbits.



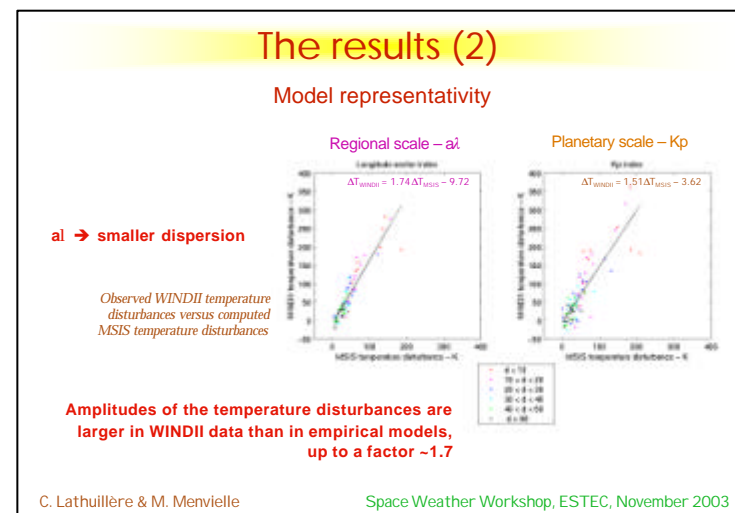
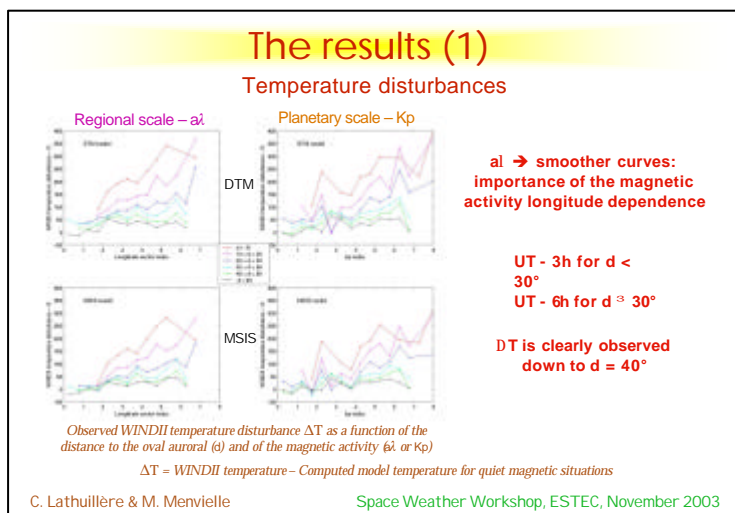
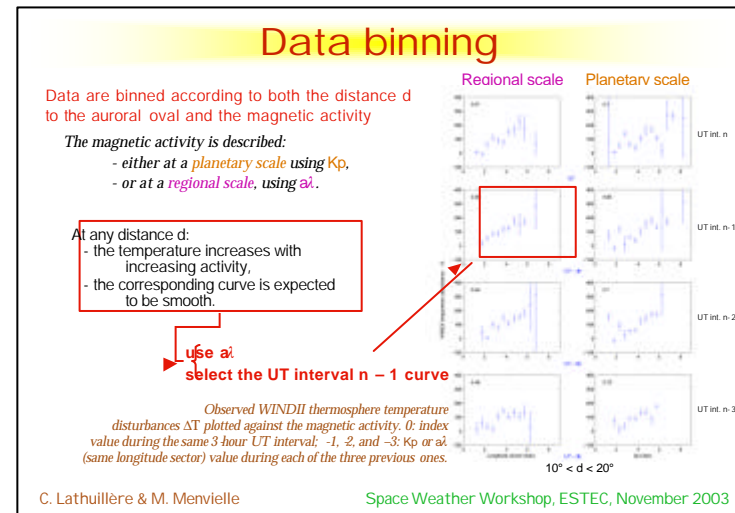
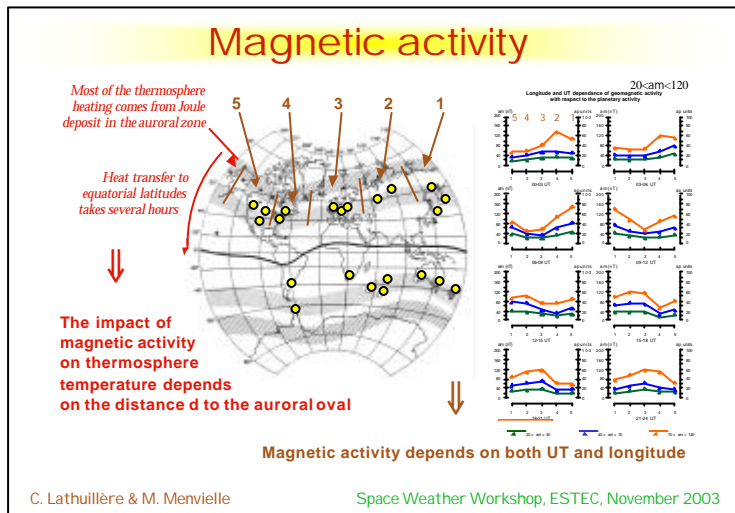
Computed temperatures (MSIS model) along the same orbits

DAY 0168 (1992, February 26)  $A_p = 65$  Different orbits Altitudes [220 260 km]

Similar variations have already been observed (Burns et al., 1995, DE2 satellite data; Killeen et al., 1995, Thule Fabry Perot data)

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## Perspectives

Study of new proxies for semi-empirical thermosphere models.

e.g.: magnetic activity longitude sector indices;  
magnetic indices over shorter time intervals  
Mg II instead of F<sub>10.7</sub>

Improvement of existing semi-empirical thermosphere models, and  
development of new ones.

New set of data on thermosphere total density (CHAMP, GRACE) and  
temperature (???)