

Community Coordinated
Modeling Center

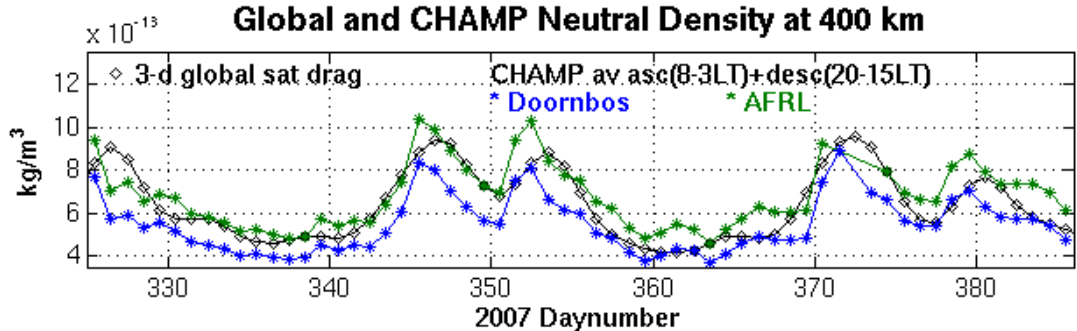
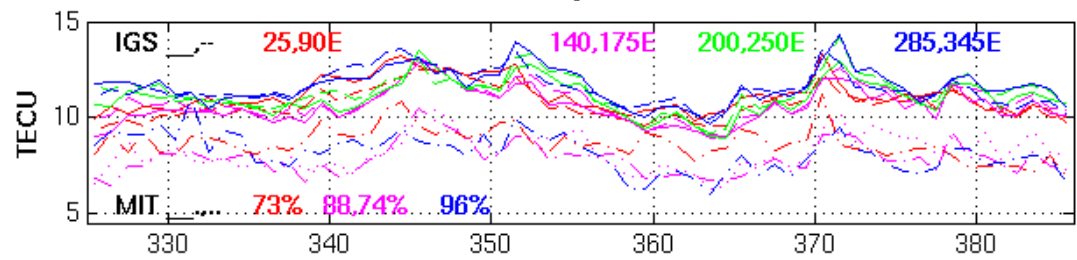
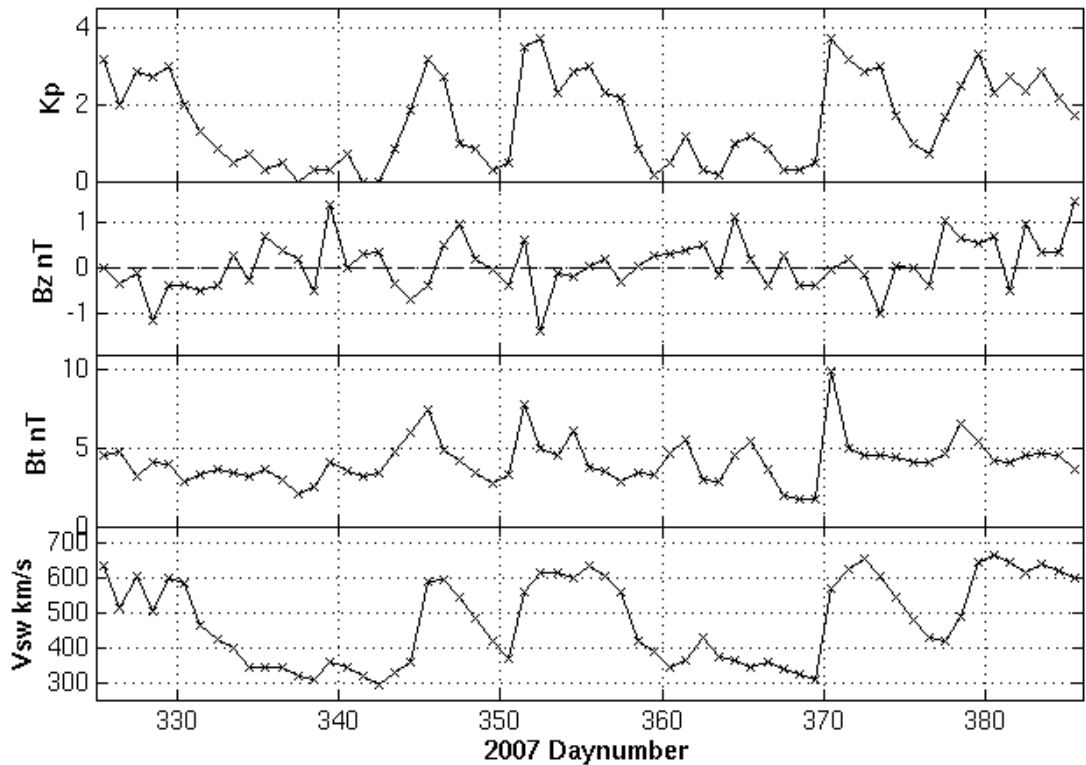


Climatology Assessment of Ionosphere/Thermosphere Models in Low Solar Flux Conditions for the CCMC CEDAR Challenge: Status, Lessons Learned, and Future Plans

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*CEDAR ETI Modeling Challenge, CEDAR Workshop,
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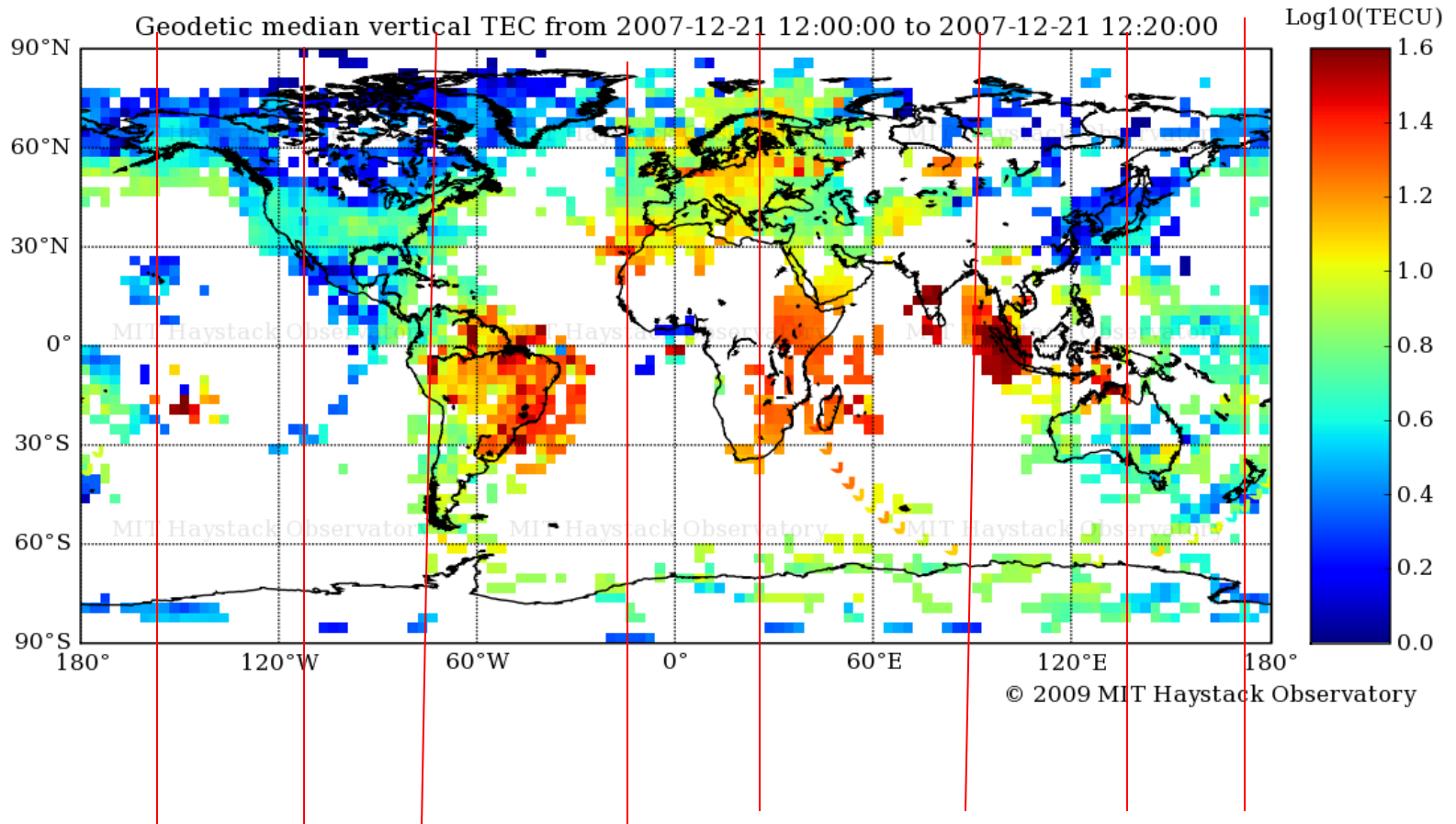
Median Daily Geophysical Indices



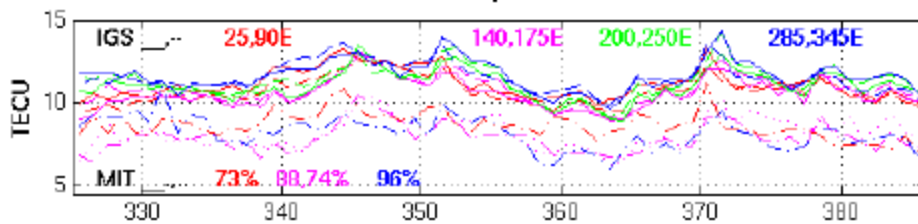
Solar Wind and Global TEC and Neutral Density at 400 km

The conditions from **07325-08020** included 5 periods of High Speed Streams (HSS) in the solar wind velocity (Vsw). Kp values were usually ≥ 2 for the HSS and ≤ 1 for slow Vsw. The HSS prompted high daily TEC along 8 longitudes and high 400 km neutral densities in satellite drag data from Emmert [2009, JGR] and in two calibrations of the CHAMP satellite at 2 LTs.

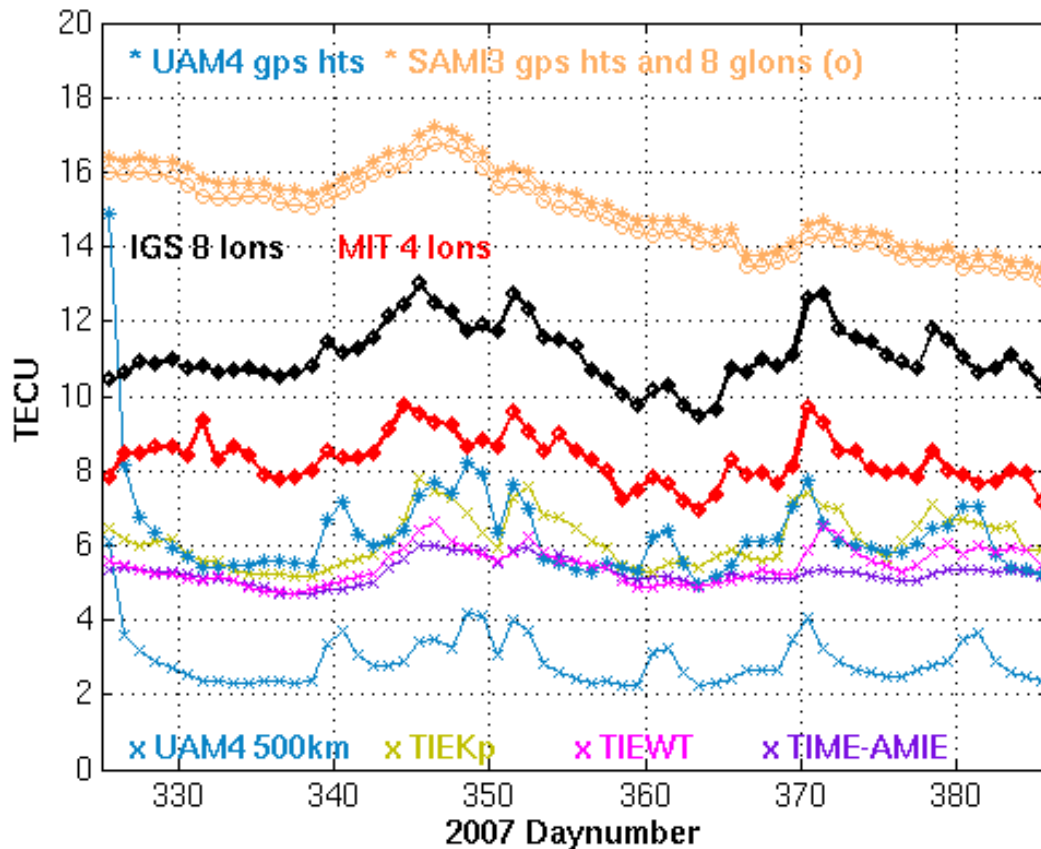
Choose 8 Longitude Slices from GPS TEC



5 deg lat and 5 deg lon bins for 20 min in December solstice 07355. Longitudes chosen: 25E, 90E, 140E, 175E, 200E (160W), 250E (110W), 285E (75W), 345E (15W).



Global TEC 07325-08020



Metrics for Comparison

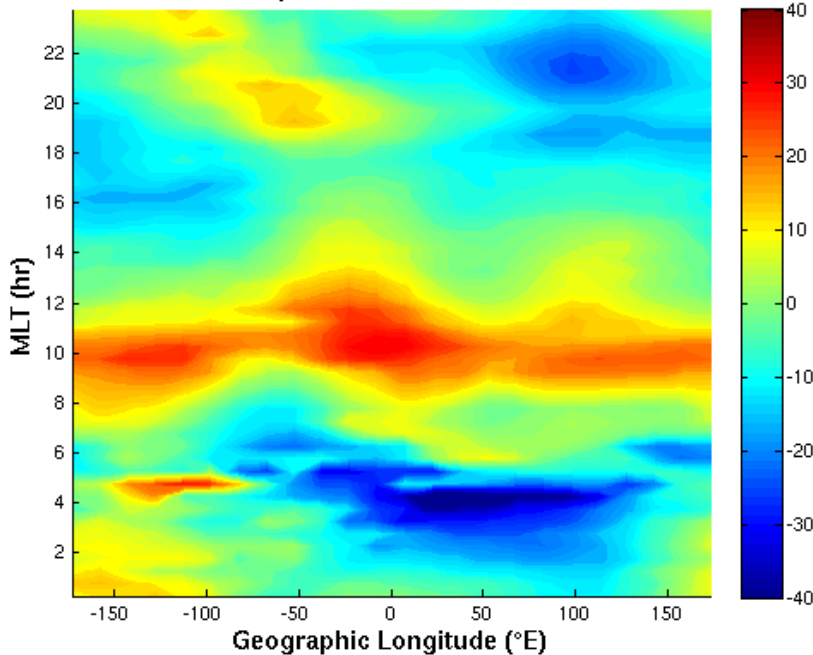
Because of the difference in baselines of the data, the first metric used is (1) the **baseline**. The other two metrics are (2) **max-min** (or the **range**), and (3) the **root mean square rms** from the satellite drag observations minus the 58-d averages.

GITM missing

Average the 8 glons for IGS and the 4 'good' ones for MIT to get estimated global TEC from the data to compare with the models. There are obvious differences in TEC baselines, where the two UAM4 lines show approximately 3 TECU between 500 km and 20,100 km.

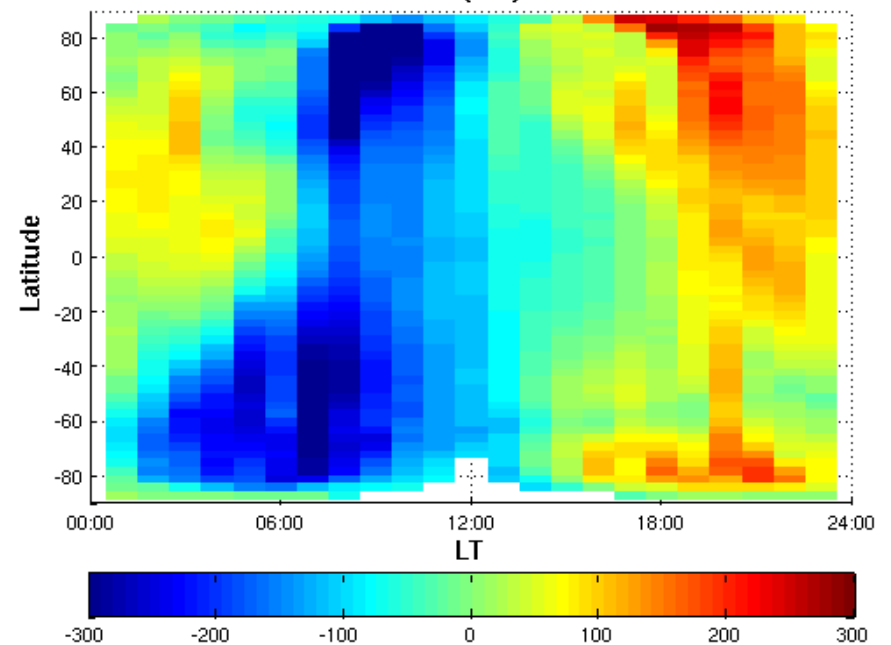
New ~December Solar Min Data

Vi+up IVM Winter 2008-2009



C/NOFS IVM ion drifts meridional to B, which is vertical at the magnetic equator (Viz, 67 days for all LTs). Also IVM Ti, O+; PLP Ne, Te; VEFI Ui; ~400-800km

All CHAMP Haeusler av Un (m/s) at ~348km 07290-08055



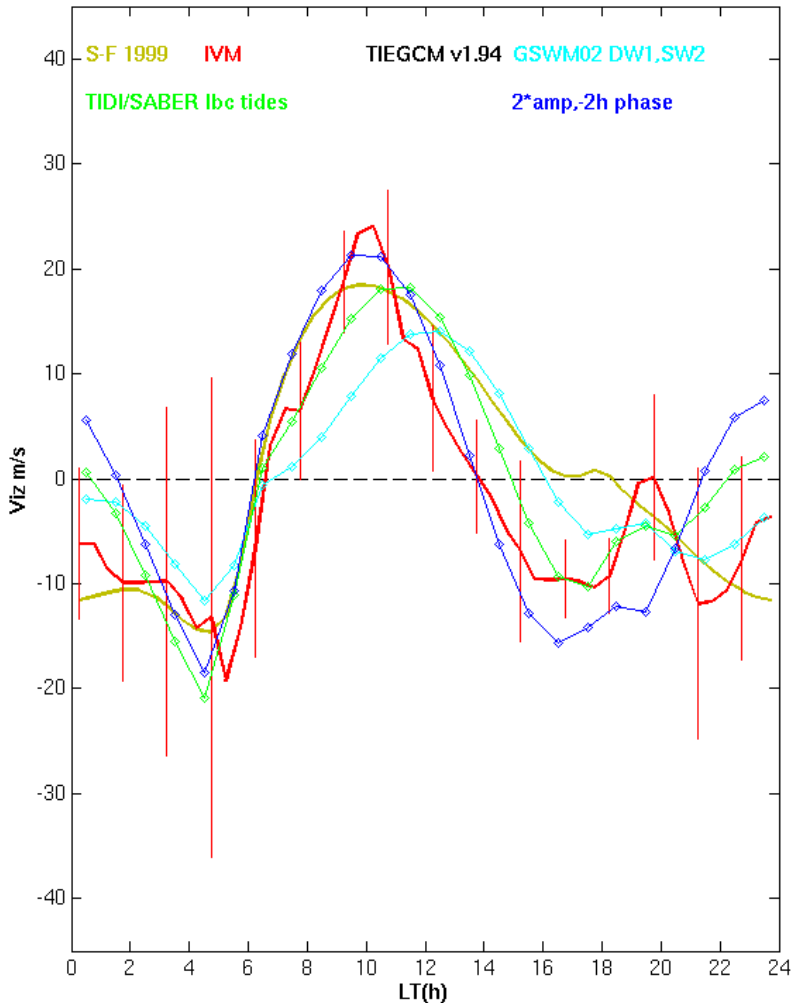
CHAMP Cross-track neutral winds (mostly zonal Un +/- 65glat, 131 days for all LTs). Also Ne and Te ~400km

Vertical Ion Drift (Viz) Mapped to Magnetic Equ

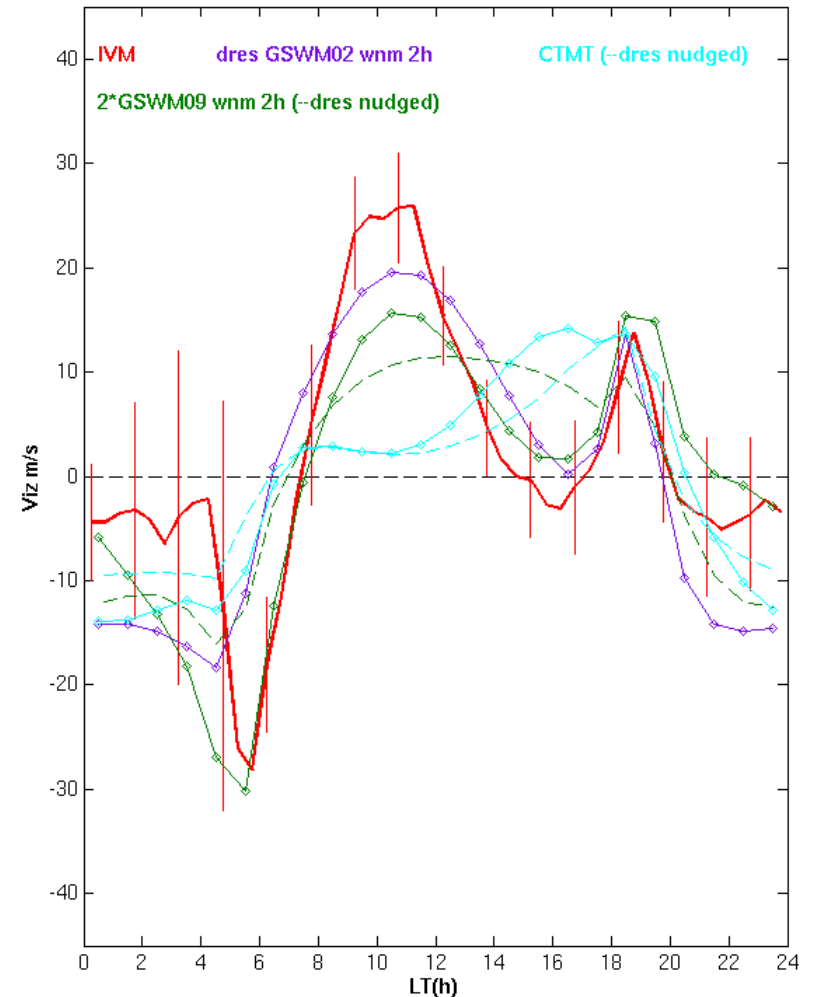
December F107~73

March F107 ~120

+/-13glat win09 400-550km Zonal av meridional (Viz) Drifts



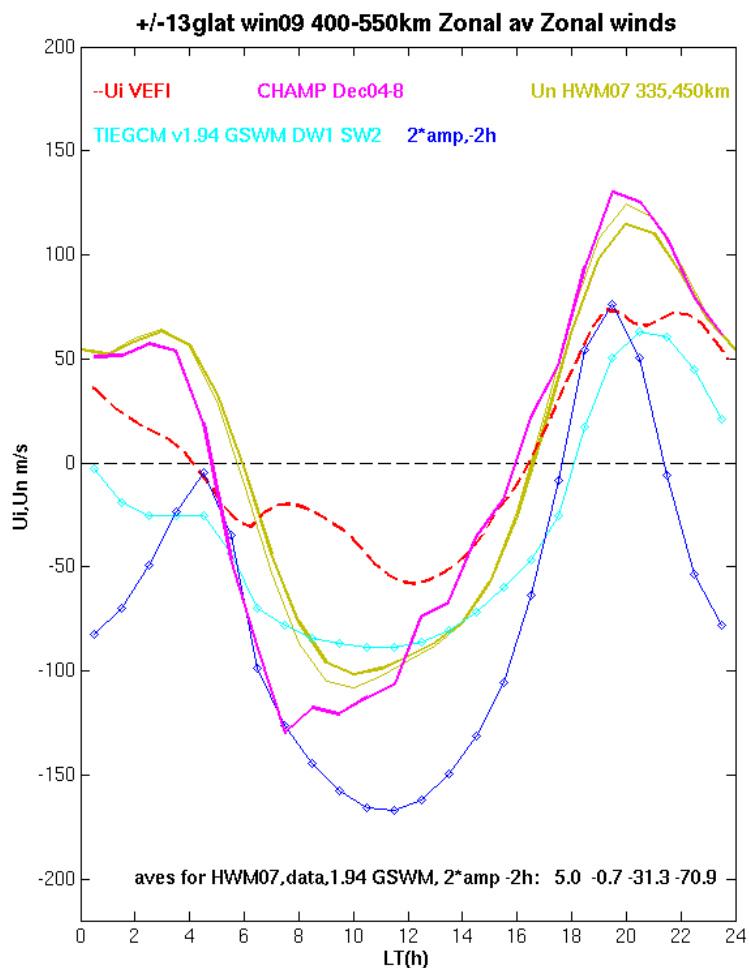
+/-13glat spr12 Zonal av meridional (Viz) drifts



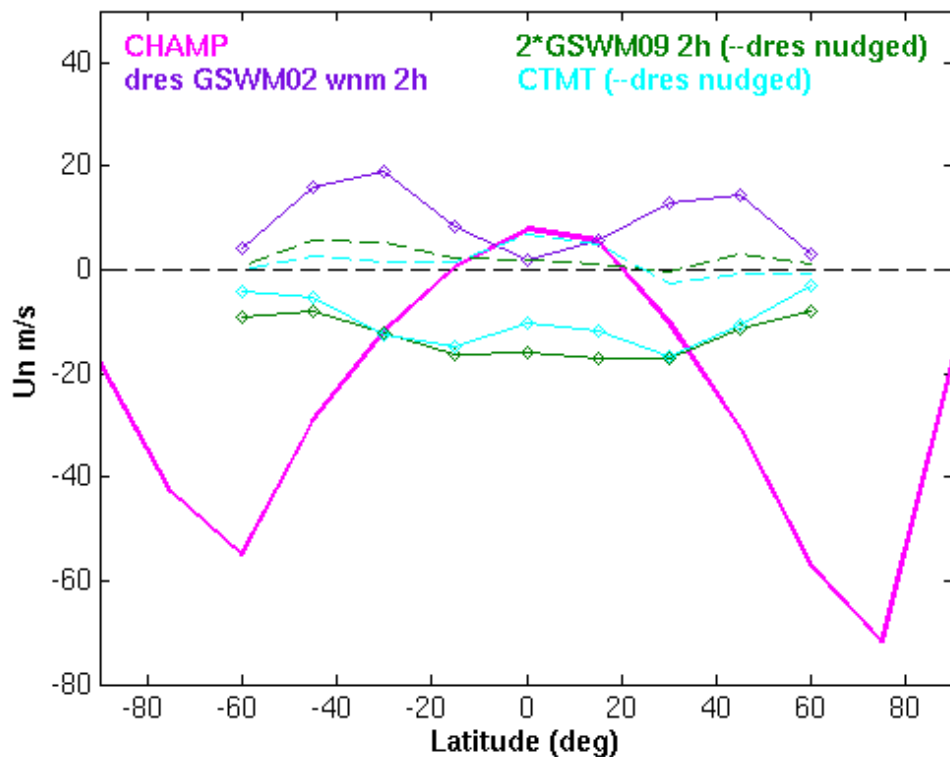
Neutral Zonal Winds +/-15glat and Zonal Aves

December 2007

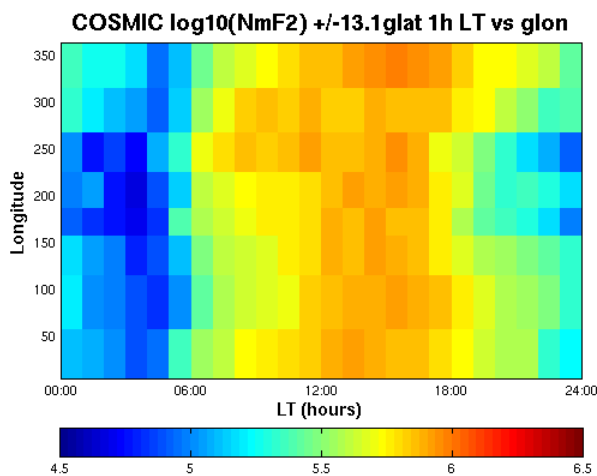
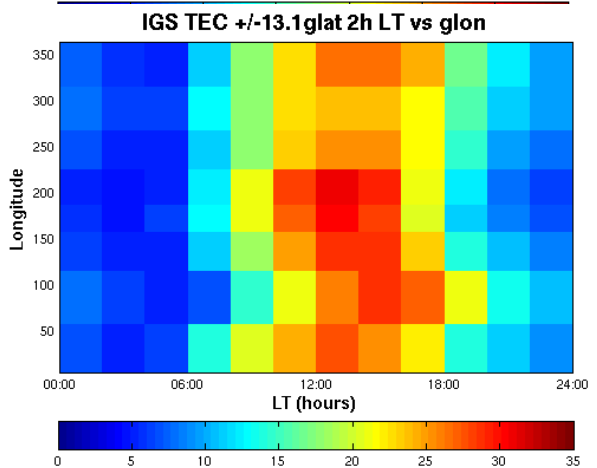
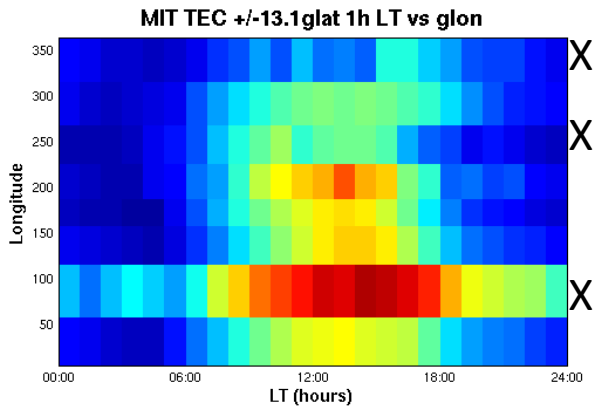
Obs show superrotation (+E) at the equator and subrotation at higher latitudes. Different March tides at 97 km lb mostly +W. Nudging model with tides and zonal means to 102 km is better.



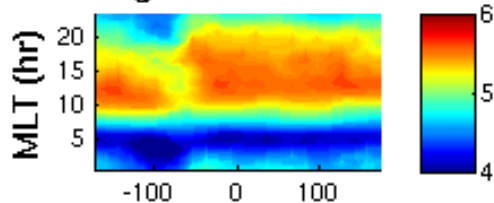
Zonal Av Neutral Zonal Winds (m/s) ~350km March F107~120



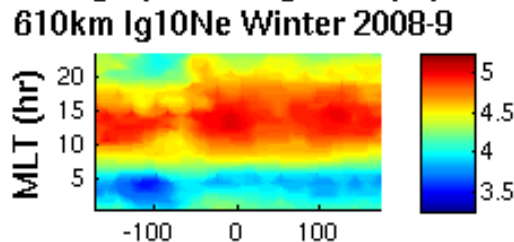
Average $\pm 13.1^\circ$ lat for LT vs Longitude and compare to C/NOFS PLP Ne with 3 peaks from DE2 waves from the lower atmosphere. The PLP Ne minimum at -80 (or $+280^\circ$ E) shows in all but MIT TEC (but MIT is poor for $90, 250, 345^\circ$ E), but PLP peaks $\sim 120^\circ$ E, 210° E and 340° E are best seen in hmF2.



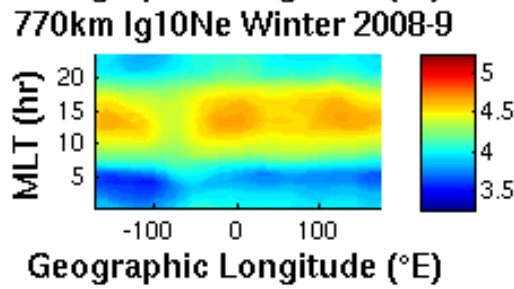
450km $Ig_{10}Ne$ Winter 2008-9



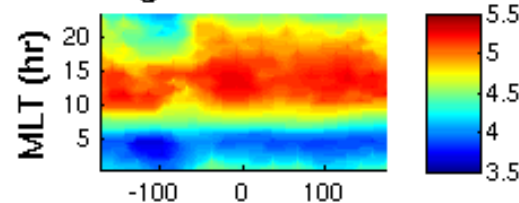
610km $Ig_{10}Ne$ Winter 2008-9



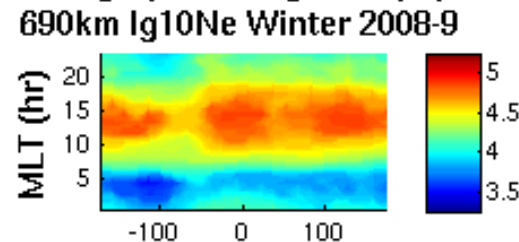
770km $Ig_{10}Ne$ Winter 2008-9



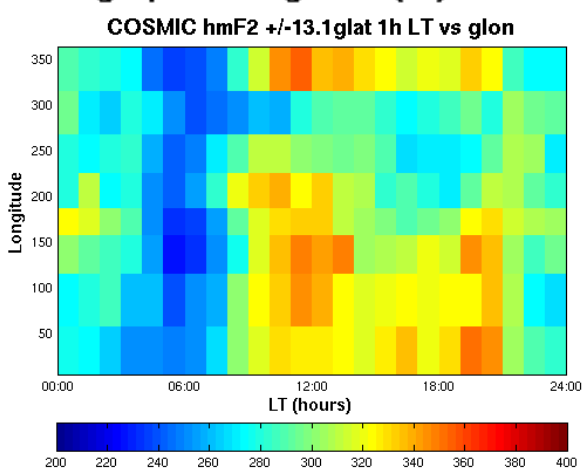
530km $Ig_{10}Ne$ Winter 2008-9



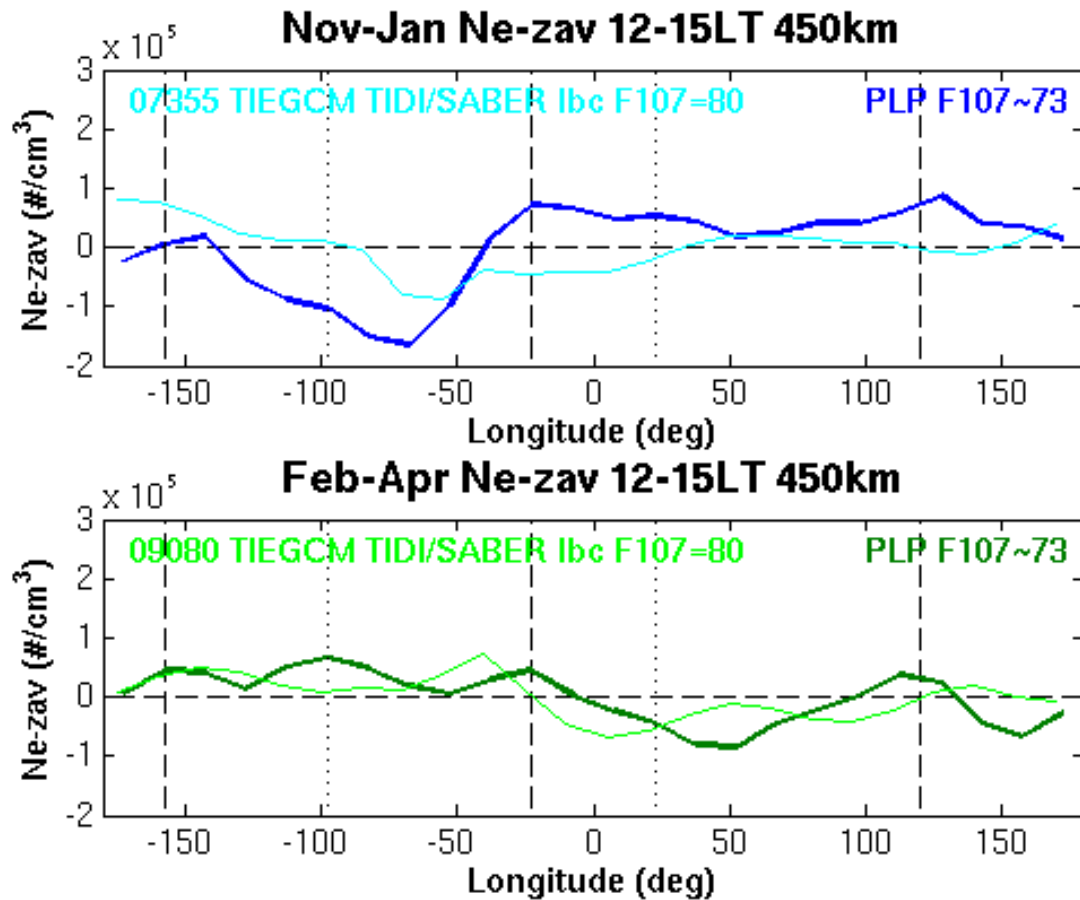
690km $Ig_{10}Ne$ Winter 2008-9



COSMIC hmF2 $\pm 13.1^\circ$ lat 1h LT vs glon

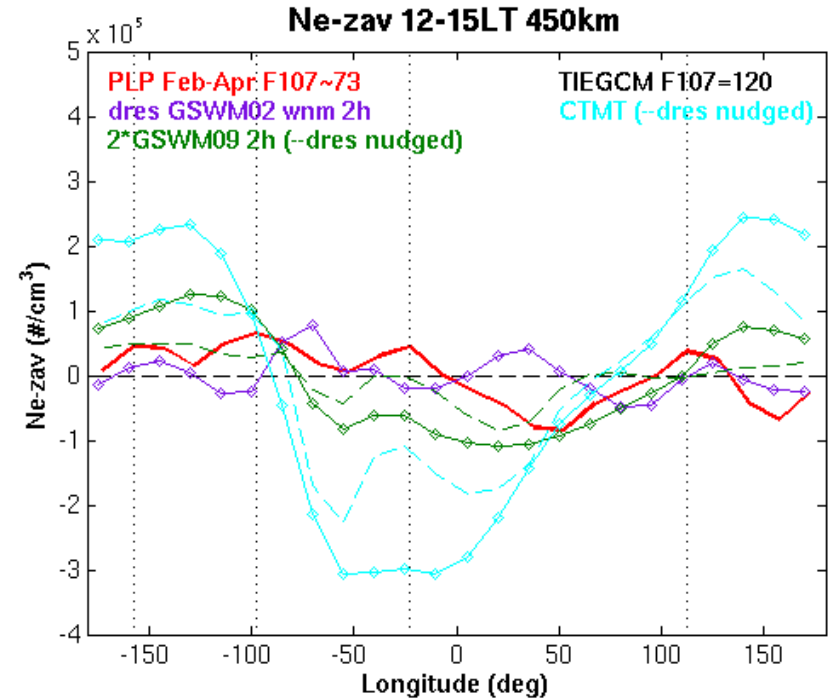
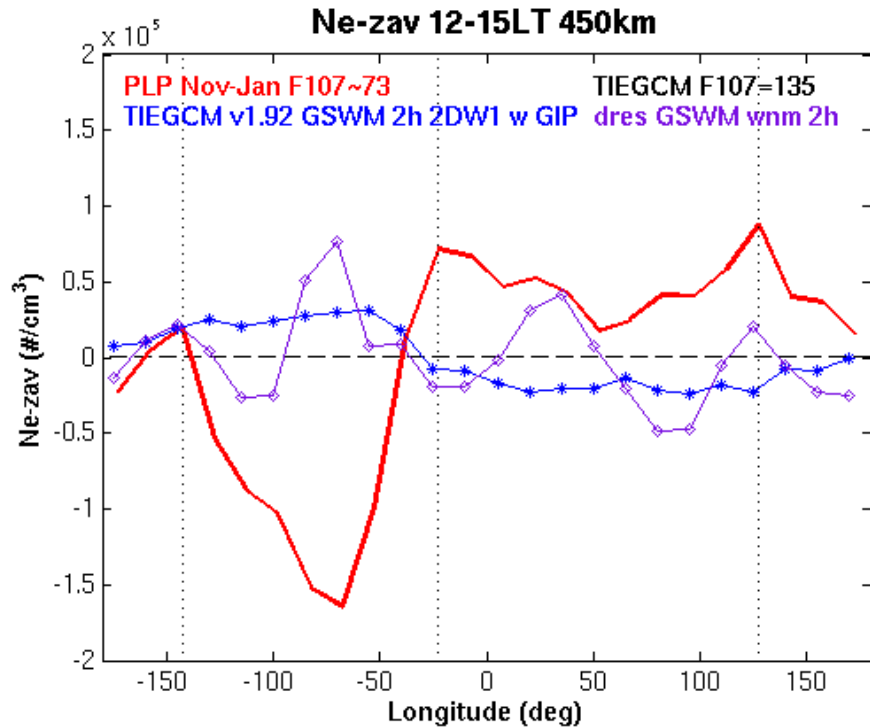


12-15 LT Ne minus zonal ave at 450 km from C/NOFS PLP and from TIDI/SABER LBC Tides



The best tides are specific daily TIDI/SABER tides for the lower boundary condition (lbc) ~97km. These double resolution runs for specific solar minimum days similar to the C/NOFS PLP periods show 3-5 peaks in Ne ~450 km for December and March similar to the data. Peaks at 50E in the TIEGCM are at a minimum in C/NOFS data, but close to a minor max at 22E.

12-15 LT Ne minus zonal av at 450 km



Only GSWM with non-migrating tides (purple) has 4 peaks in March and December from DE3 for Ne at 450 km. The single resolution CTMT(cyan) and GSWM09 (dark green) tides at the lower boundary have approximately 1 peak, where their double resolution nudged runs have multiple peaks where GSWM09 is 'best'. DE3 is too big in the December GSWM02 run.

Summary of the CCMC Climatology Study

- Because of data baseline uncertainties, the 3 metrics used were:
 - Baseline (ave over LT or 61-d becomes AV used in RMS)
 - Range (max-min can become R in RMS)
 - Root-Mean Square (RMS)
- Model rankings changed with parameter studied or with different versions of the same parameter.
- Can we include data from C/NOFS, CHAMP, etc for similar ~December solar minimum quiet conditions?
- Study of TIEGCM tides at the lower boundary (~97km) showed the best results to match Ne longitudinal peaks in December or March were double resolution runs (2.5 deg instead of 5 deg glat/glon grid), with improvements in the zonal mean neutral zonal winds when the model was “nudged” with the tides and zonal means from 97 to 102 km.
 - Get output from other models to compare to these observations
 - 8 glons in TEC or Nmf2 is inadequate to find longitudinal structure
 - Should we choose a second period (~Feb-Apr 2012?) to study with finer resolution from the TEC maps, etc?