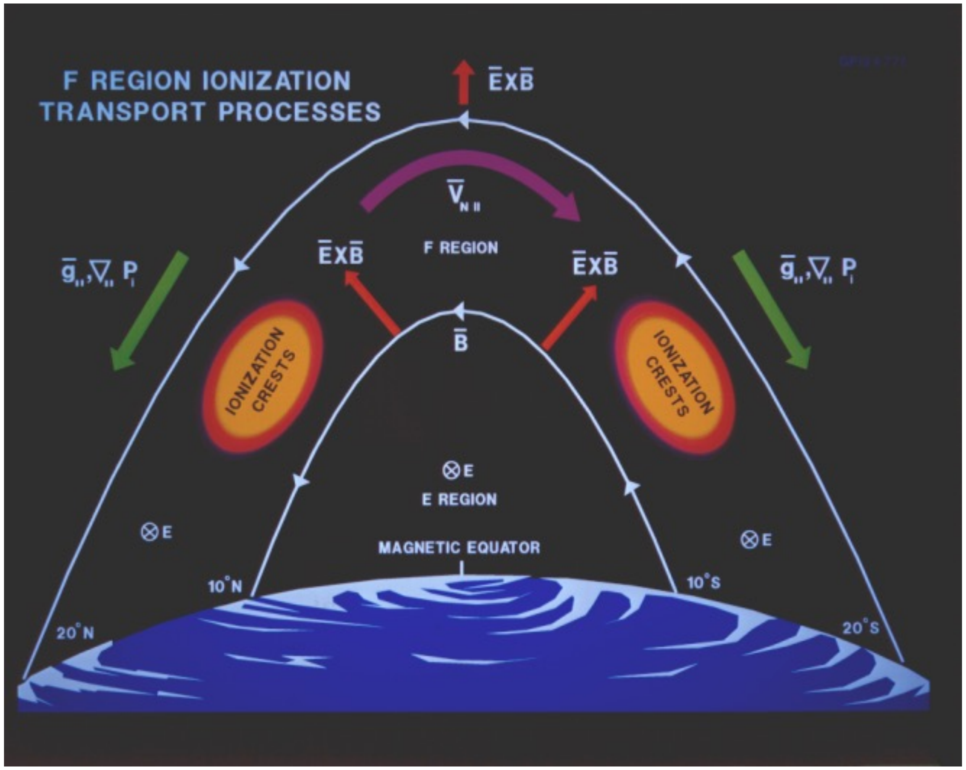
Agenda of Equatorial-PRIMO

(Problems Related to Ionospheric Models and Observations)

13:30 – 13:45	**Introduction of Equatorial-PRIMO**
13:45 – 14:15	**Model Strengths and Weaknesses, Recent Developments**
14:15 – 14:45	**Discuss Results for the Coupled Models**
14:45 – 15:30	**General Discussion and Future Plans**

Motivation: We do not fully understand all the relevant physics of the equatorial ionosphere, so that current models do not completely agree with each other and are not able to accurately reproduce observations.

Objective: To understand the strengths and the limitations of theoretical, time-dependent, low-latitude ionospheric models in representing observed ionospheric structure and variability under low to moderate solar activity and geomagnetic quiet conditions, in order to better understand the underlying ionospheric physics and improve models.



Transport Processes in the Equatorial Ionosphere

Non-coupled Models: A set of theoretical ionospheric models that require neutral atmospheric densities and temperatures, neutral winds, E×B drift velocities as inputs and calculate Ion and electron densities as a function of altitude, latitude and local time. The calculations are not self-consistent.

Models	Full Names	Participated Modelers
IPM	**Ionosphere-Plasmasphere Model**	**Ludger Scherliess, Jan Sojka** (Utah State University)
IFM	**Ionospheric Forecast Model**	**Ludger Scherliess** (Utah State University) **Vince Eccles** (Space Environment Corporation)
LLIONS	**Low Latitude IONosphere Sector model**	**Vince Eccles** (Space Environment Corporation)
PBMOD	**Physics Based MODel**	**John Retterer** (Boston College)
GIP	**Global Ionosphere and Plasmasphere model**	**Tzu-Wei Fang, George Millward** (CU/CIRES & NOAA SWPC)
SAMI2	**Sami2 is Another Model of the Ionosphere**	**Joe Huba** (NRL)

Coupled Models: The other set of ionosphere-thermosphere models are time dependent, three dimensional, non-linear models which solve the fully coupled, thermodynamic, and continuity equations of the neutral gas, self-consistently, with the ion energy, ion momentum, and ion continuity equations.

Models	Full Names	Participated Modelers
SAMI3	**SAMI3 is Also a Model of the Ionosphere**	**Joe Huba** **Jonathan Krall** (NRL)
TIEGCM	**Thermosphere Ionosphere Electrodynamics General Circulation Model**	**Astrid Maute** **Art Richmond** (NCAR)
TIMEGCM	**Thermosphere Ionosphere Mesosphere Electrodynamics General Circulation Model**	**Geoff Crowley** (ASTRA)
GITM	**Global Ionosphere-Thermosphere Model**	**Aaron Ridley** **Angeline Burrell** (University of Michigan)
CTIPe	**Coupled Thermosphere Ionosphere Plasmasphere Electrodynamics Model**	**Mariangel Fedrizzi** **Tim Fuller-Rowell** **Mihail Codrescu** (CU/CIRES & NOAA SWPC)

TASK I (All participated models):

Simulating Conditions

- To carry out very preliminary comparisons, these two sets of models theoretically calculated ionospheric parameters at the Peruvian longitude (~ 284°E) in March equinox for an F10.7 cm flux value of 120 and geomagnetic quiet (e.g. Ap<5). The Burnside factor is set to 1.

  Non-self consistent models: Scherliess-Fejer E×B drift model, NRLMSISE-00, and HWM93 are used as drivers.

  Self-consistent models: solar energy input (EUVAC) and magnetic Apex coordinates are used, if applicable.

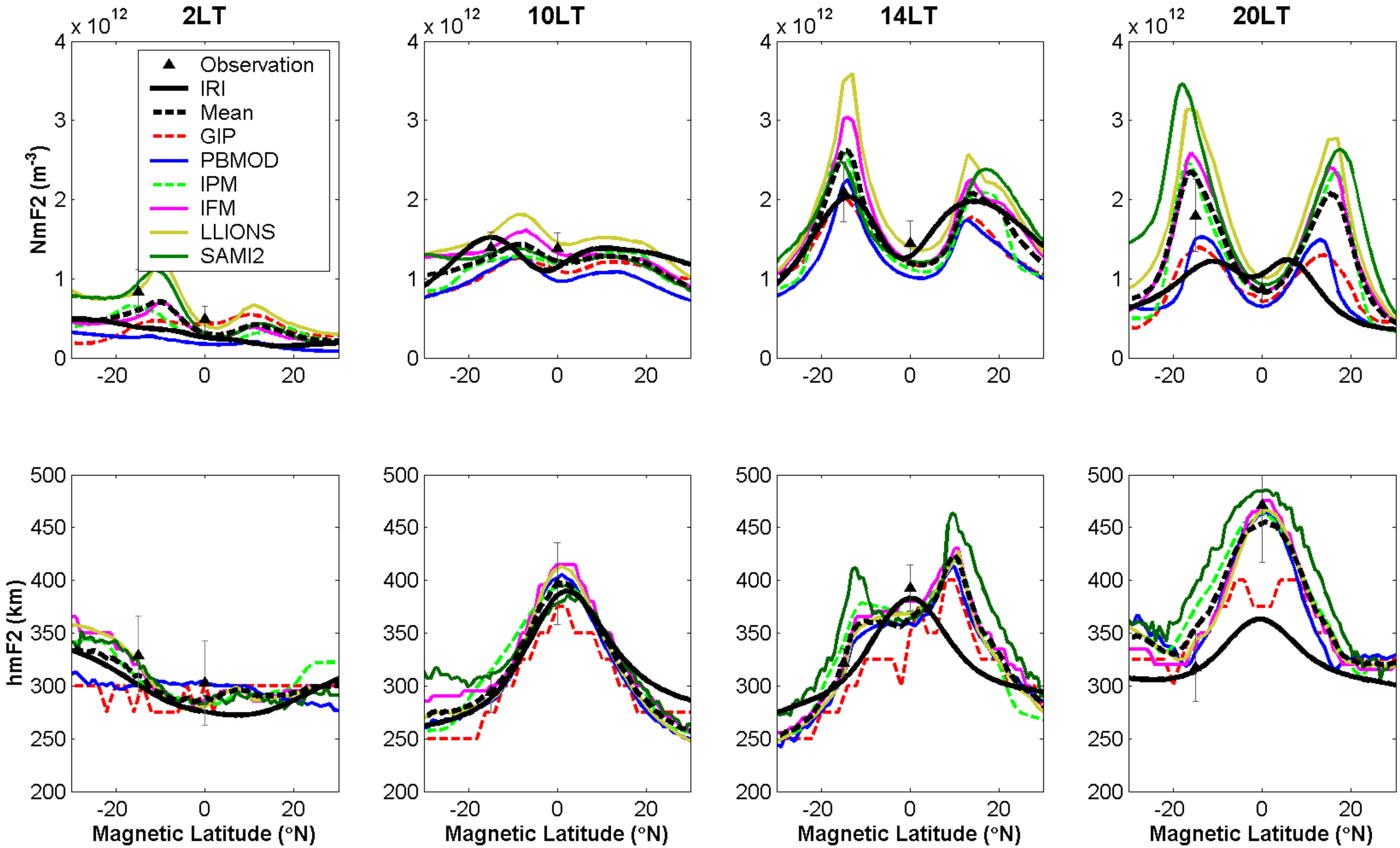
- International Reference Ionosphere (IRI) model is run in March 20, 2004.

Observations

- Observations of NmF2 and hmF2 are averaged values during March 16 to 26, 2004 at Jicamarca Peru (magnetic equator) and Tucuman Argentina (15°S, geomagnetic). The mean F10.7 during this period is 116.

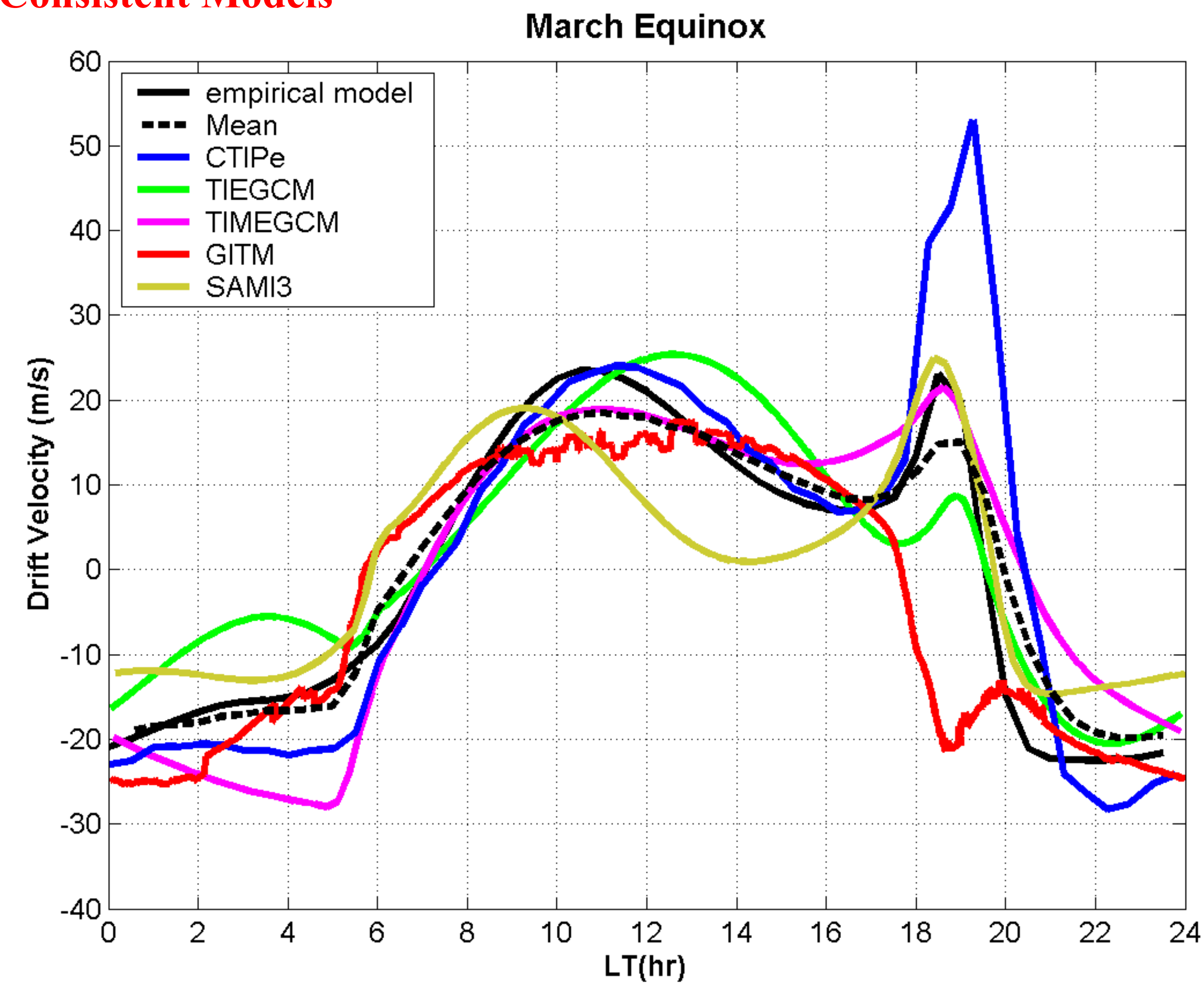
Published in AGU Monograph on Modeling the IT System!

Non-Self-Consistent Models

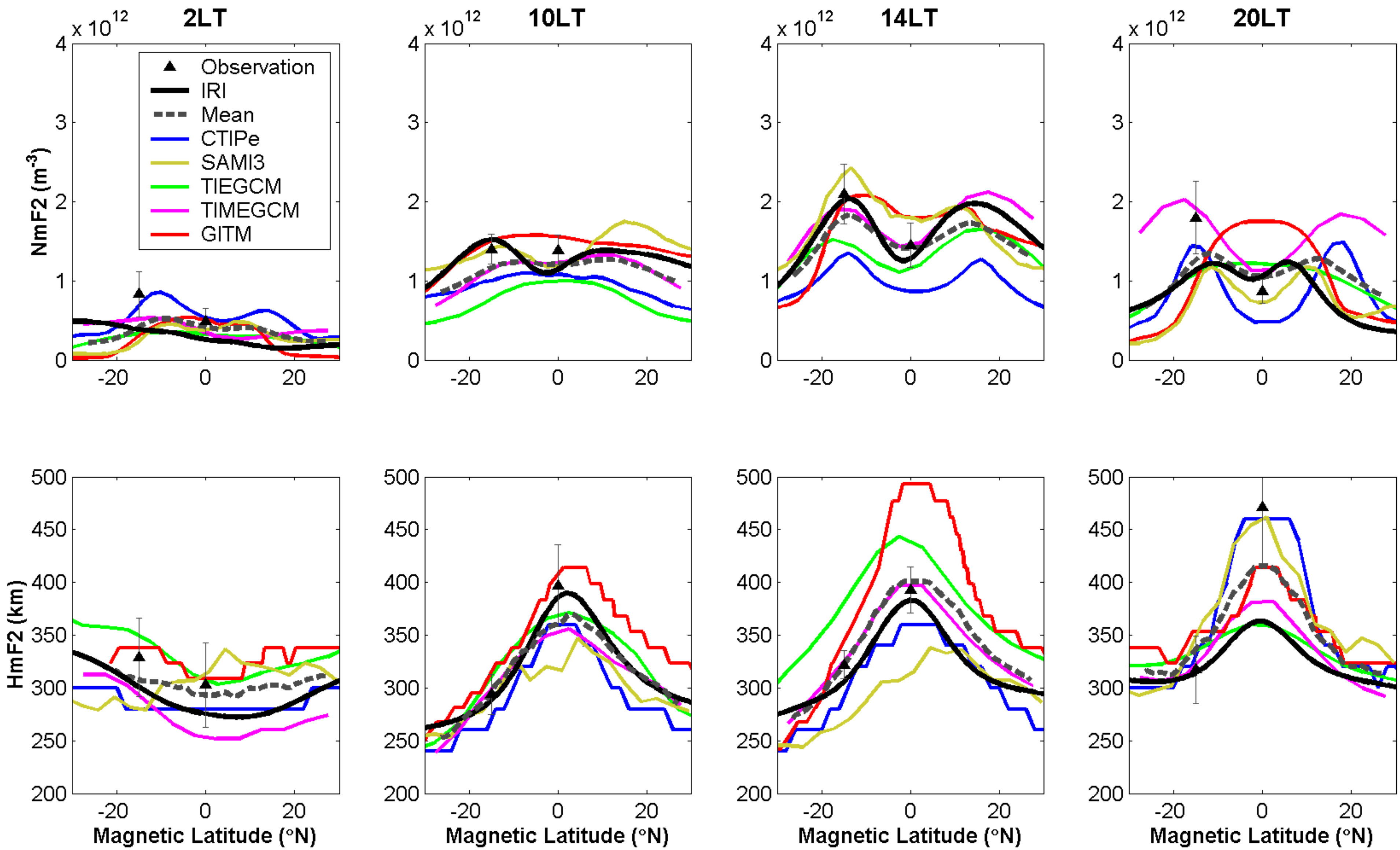


Mean (black dashed line) stands for the averaged values from the theoretical models.

Self-Consistent Models



Self-Consistent Models



TASK II (Non-coupled models):

Simulating Conditions:

S&F E×B drift model, NRLMSISE-00, and HWM93 as inputs

March equinox, $F_{10.7}$=120, geomagnetic quiet, at longitude 120°E

Case 1: No E×B drift, no neutral wind (Production & Loss, diffusion)

Case 2: With E×B drift, no neutral wind (P&L, drift, diffusion)

Case 3: With E×B drift and neutral wind (P&L, wind, drift, diffusion)

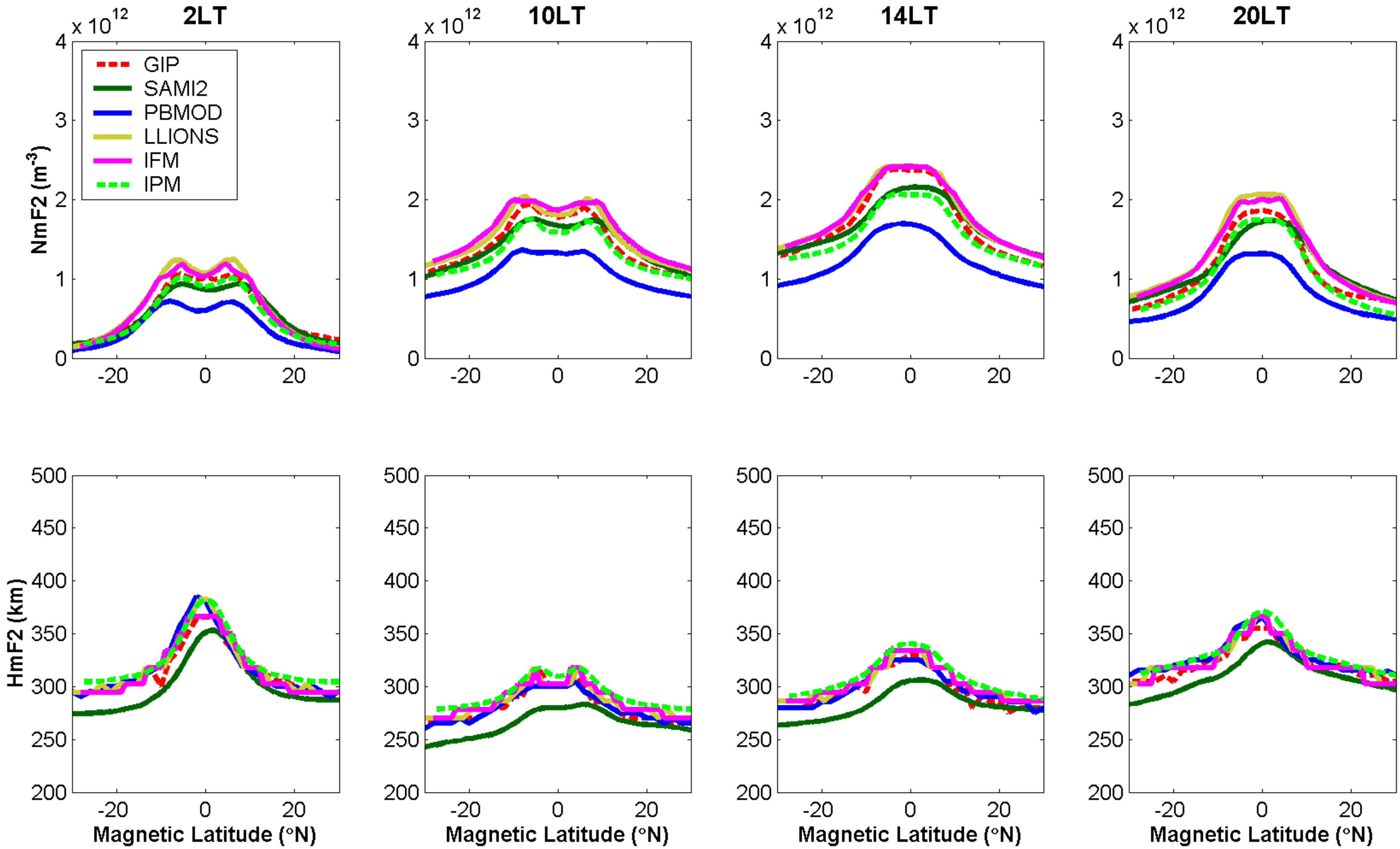
Continuity Equation

$$\underbrace{\partial N/\partial t = q}_{\text{Production}} - \underbrace{\beta(N)}_{\text{Loss}} - \underbrace{div(NV_{\parallel} + NV_{\perp})}_{\text{Transport}}$$

Production Loss Transport

- Perpendicular transport ($V_{\perp}$)
  - E×B drift
- Parallel transport ($V_{\parallel}$)
  - Neutral wind effect
  - Plasma diffusion
  - Thermo expansion/contraction
- Zonal transport (neglect here)

Case 1: No ExB drift, no neutral wind ➔ Production and Loss



Case 3: With ExB drift and neutral wind ➔ P&L, wind, drift, diffusion