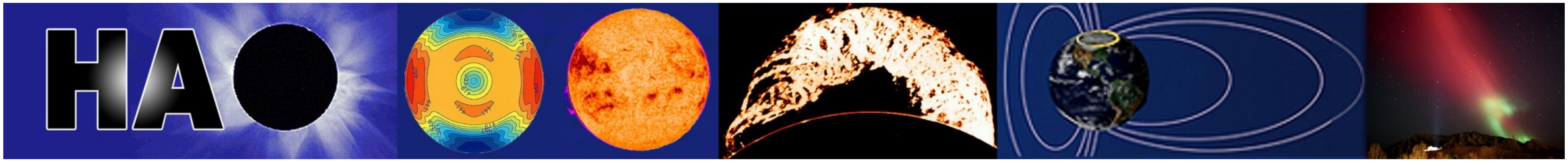


AMPERE-Driven TIEGCM

Arthur D. Richmond, NCAR-HAO

Santiago Marsal, Observatori de l'Ebre

How can observed field-aligned currents above the ionosphere be used to model global ionospheric electrodynamics using the NCAR Thermosphere-Ionosphere-Electrodynamics General-Circulation Model (TIEGCM)?

$$\frac{1}{R^2\cos\lambda_m}\left[\frac{\partial}{\partial\phi_m}\left(\frac{\Sigma^T_{\phi\phi}}{\cos\lambda_m}\frac{\partial\Phi}{\partial\phi_m}+\Sigma^T_{\phi\lambda}\frac{\partial\Phi}{\partial|\lambda_m|}\right)+\frac{\partial}{\partial|\lambda_m|}\left(\Sigma^T_{\lambda\phi}\frac{\partial\Phi}{\partial\phi_m}+\Sigma^T_{\lambda\lambda}\cos\lambda_m\frac{\partial\Phi}{\partial|\lambda_m|}\right)\right]$$

[Convergence of electric-field-driven current]

$$=\frac{1}{R\cos\lambda_m}\left[\frac{\partial K^{DT}_{m\phi}}{\partial\phi_m}+\frac{\partial(K^{DT}_{m\lambda}\cos\lambda_m)}{\partial|\lambda_m|}\right]+J_{Mr} \tag{1}$$

[Divergence of wind-driven current] [Magnetospheric source]

R = Earth radius + 90 km

λ_m = Modified Magnetic Apex latitude

ϕ_m = Modified Magnetic Apex longitude

Φ = Electric potential

$\Sigma^T_{\phi\phi}, \Sigma^T_{\phi\lambda}, \Sigma^T_{\lambda\phi}, \Sigma^T_{\lambda\lambda}$ = field-line-integrated conductivities (NS sum)

$K^{DT}_{m\phi}$ = field-line-integrated wind-driven eastward current (NS sum)

$K^{DT}_{m\lambda}$ = field-line-integrated wind-driven poleward current (NS sum)

J_{Mr} = upward current at top of ionosphere (NS sum)

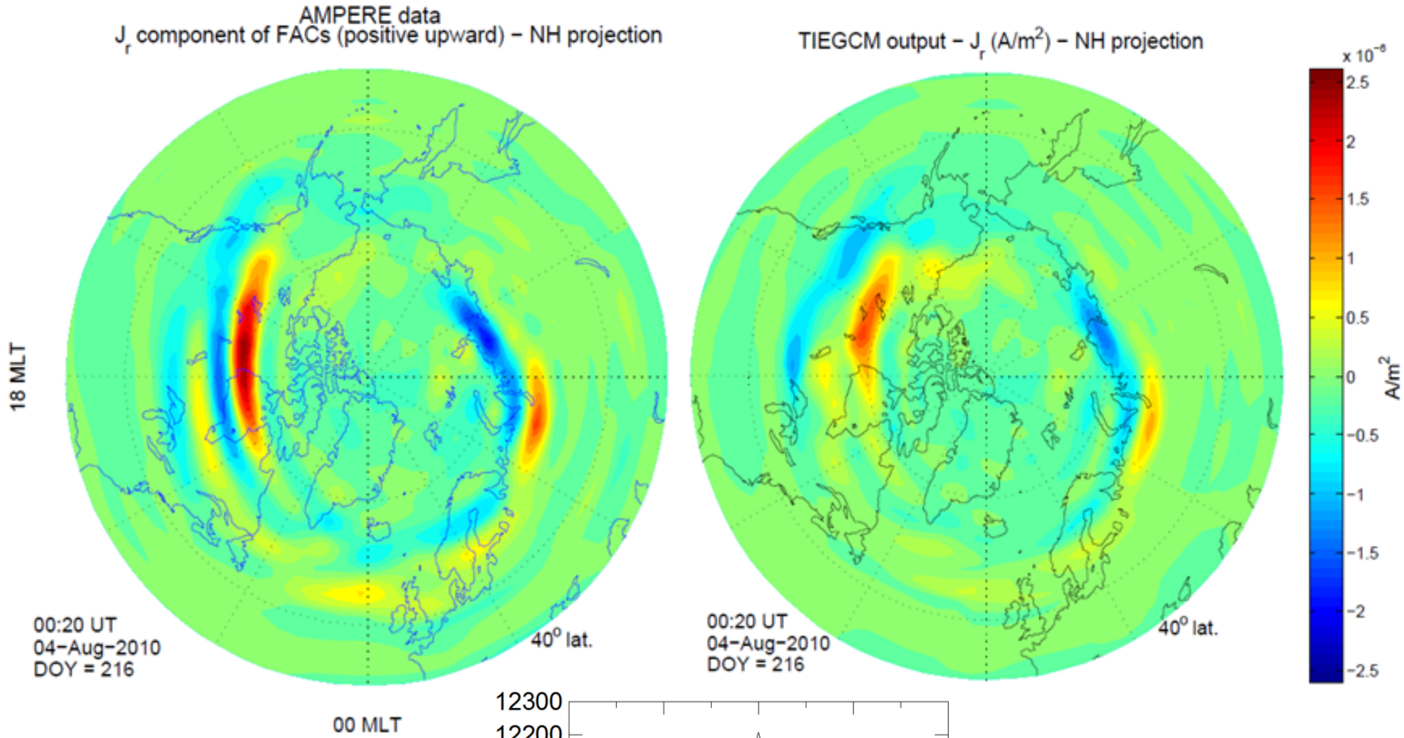
J_{Mr} in the TIEGCM is modelled in terms of a spatially varying reference potential Φ^R as

$$J_{Mr}=\frac{(1-p)\sigma^R}{pR}(\Phi-\Phi^R) \tag{2}$$

σ^R = scaling constant

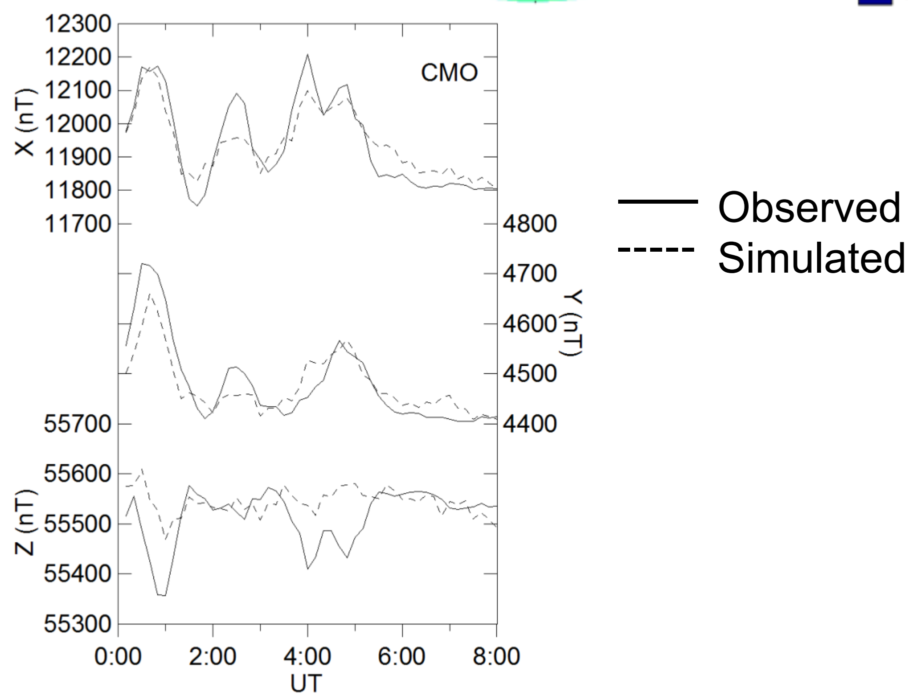
p = spatial variable between 0 and 1

If $p=1$, $J_{Mr}=0$ (middle and low latitudes).
If $p=0$, $\Phi=\Phi^R$ (polar region).



AMPERE FAC in the TIEGCM can generate observed ground magnetic perturbations

Marsal et al. (2012)



Possibilities for Improvements

The solution for Φ is symmetric between the N and S hemispheres. Santi Marsal approximated the asymmetry by obtaining separate hemispheric solutions, where the FAC and conductances from one hemisphere were mirrored to the opposite hemisphere.

Santi found modest improvements to simulations of ground magnetometer data when auroral conductances were modified by using AMPERE FAC together with the Knight [1973] relations.

Under steady ion-drag forcing, winds can generate potentials on the order of 30% those due to FAC. Wind modeling can improve assimilative mapping of ionospheric electrodynamics.