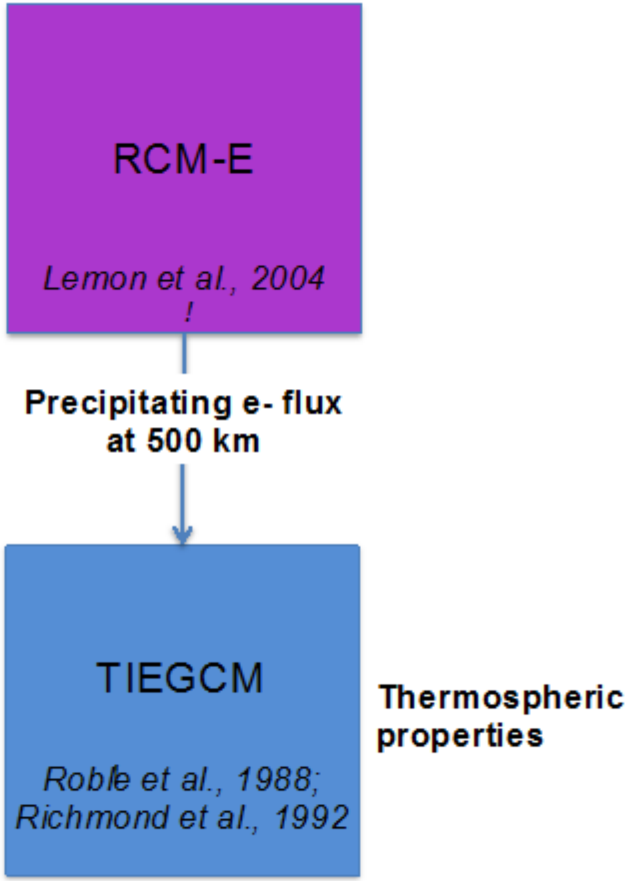
# The use of RCME auroral fluxes in the TIEGCM for the 17 March 2013 storm

[1]R. L. Walterscheid, M. W. Chen, C. Lemon
[2]C.-C. Chao, S. J. Gegenheim

1. The Aerospace Corporation, Space Science Applications Laboratory
2. The Aerospace Corporation, Astrodynamics Department

# What is the result of using RCME auroral fluxes in the TIEGCM for the 17 March 2013 storm?



RCM-E

*Lemon et al., 2004*
!

**Precipitating e- flux at 500 km**

TIEGCM

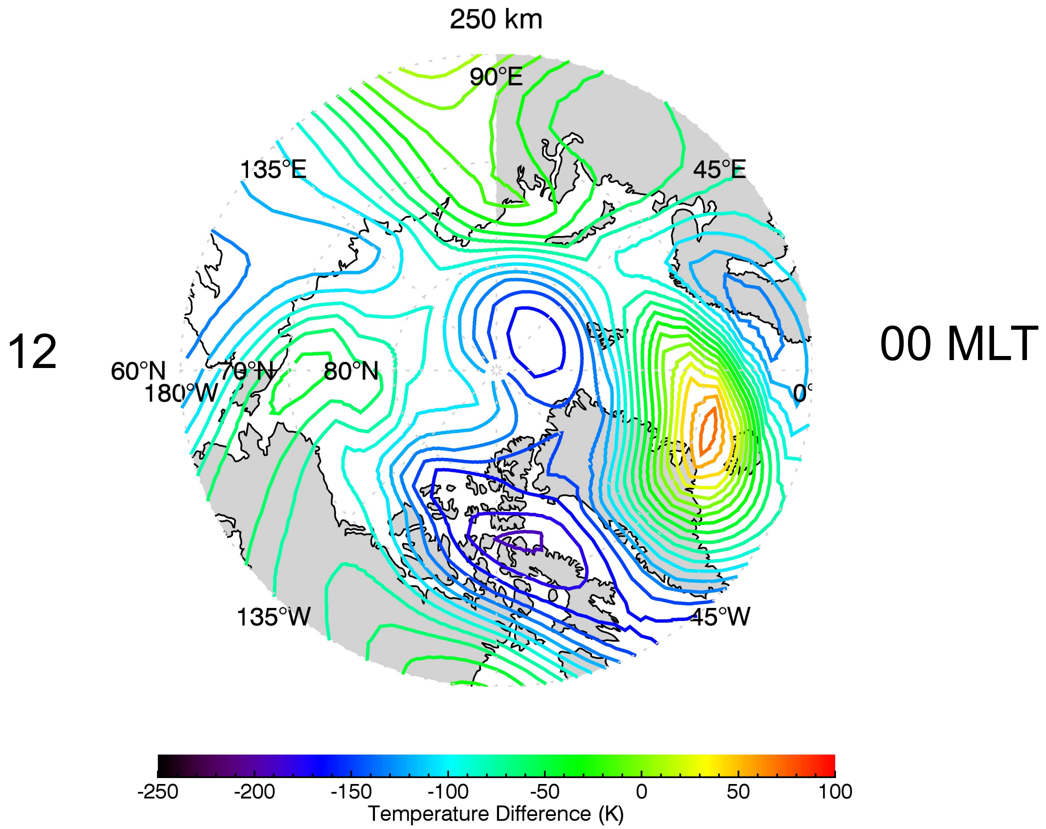
*Roble et al., 1988; Richmond et al., 1992*

**Thermospheric properties**

## RCM-E:

- **Kp- and MLT-parameterized electron scattering due to whistler chorus** [*Orlova and Shprits, 2014*] **& plasmaspheric hiss** [*Orlova et al.*, 2014]
- **RCM-E trapped and precipitating electron fluxes agree fairly well with in-situ observations for 10 August 2000 storm** [*Chen et al.*, 2015] **and this storm.**

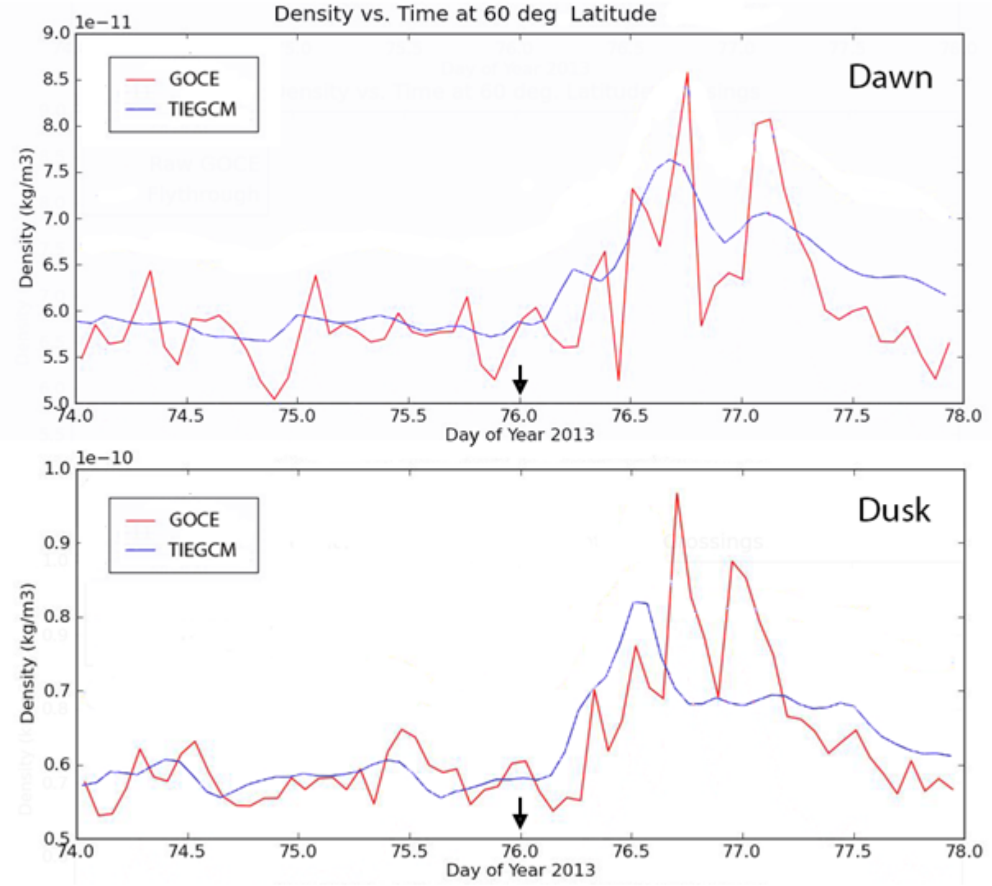
# TIEGCM temperature difference between results with RCME auroral inputs and model default values at 250 km



*<u>Cooling</u>: Greater RCME CE gives heating deeper in the atmosphere where heat capacity is greater*
*<u>Heating</u>: Intense morning-side antcyclonic gyre gives heating via dynamical adjustment of mass field to winds [Walterscheid and Crowley, 2015]*

| | **TIEGCM Kp Dependent Defaults** | | **RCME** | |
|---|---|---|---|---|
| | Nightside | Dayside | Nightside | Dayside |
| **Flux (erg cm$^2$ s$^1$)** | 15.3 | 4.2 | 5.56 | 3.62 |
| **CE (keV)** | 2.0 | 1.5 | 7.84 | 9.76 |

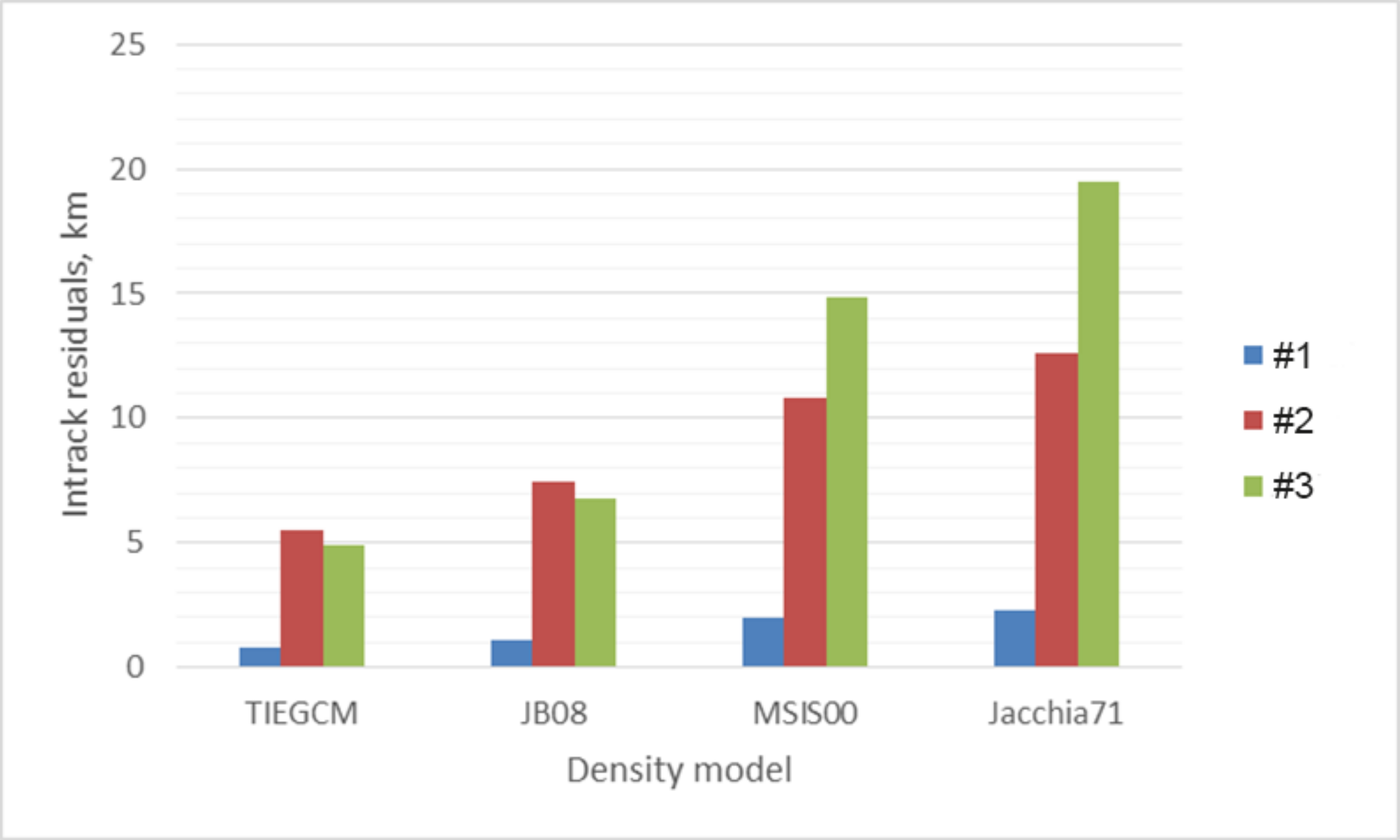
# RCME-TIEGCM density predictions vs. GOCE observations


Density vs. Time at 60 deg Latitude

- Density versus time for GOCE and RCME-TIEGCM at 250 km during 17 March 2013 storm
- Shows good agreement on dawn side and reasonable agreement on dusk side

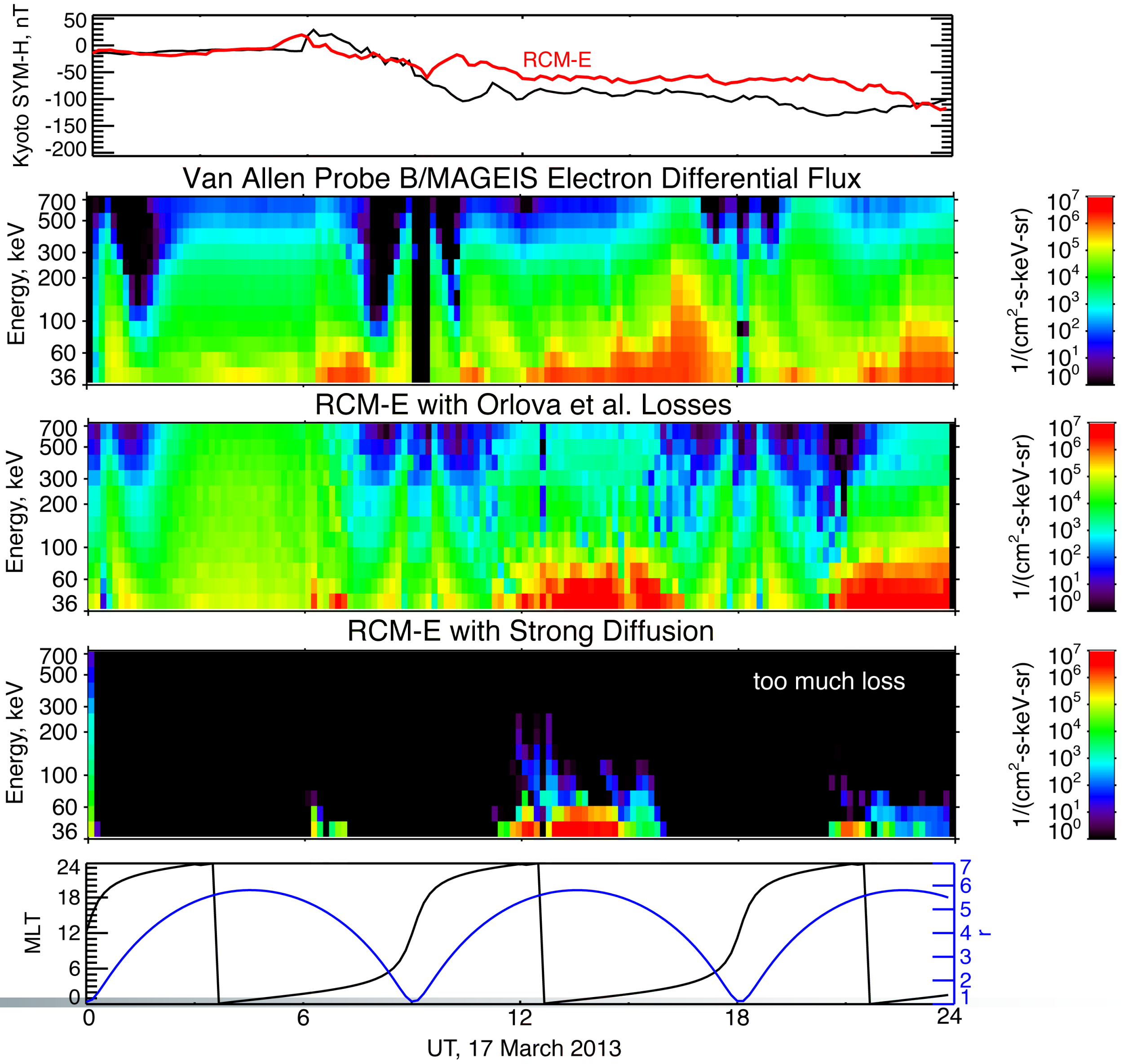
Gravity Field and Steady-State Ocean Circulation Explorer (GOCE) data produced by ESA and provided by Dr. Eric Sutton, AFRL

# Comparison of In-track Residual Errors (6-day fit of TLE)



# Backup up Slides

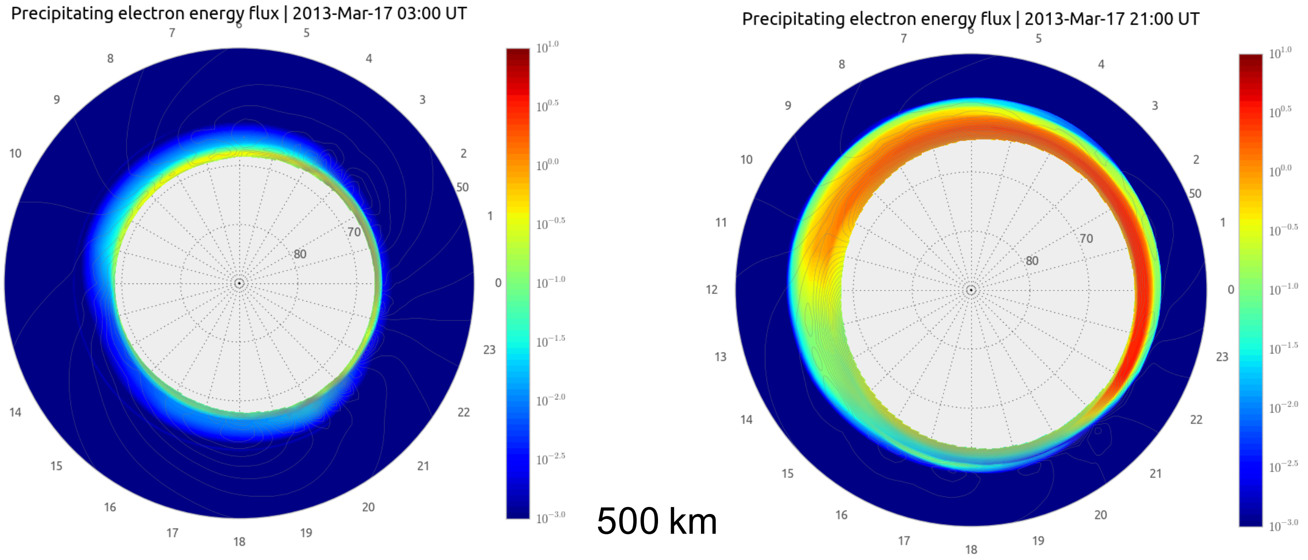
# Comparison of RCM-E and MagEIS Electron Fluxes



Van Allen Probe B apogee at 5.8 $R_E$ and perigee at 1.1 $R_E$

Reasonably good agreement between RCM-E & MagEIS electron fluxes with *Orlova et al*. [2014] electron losses

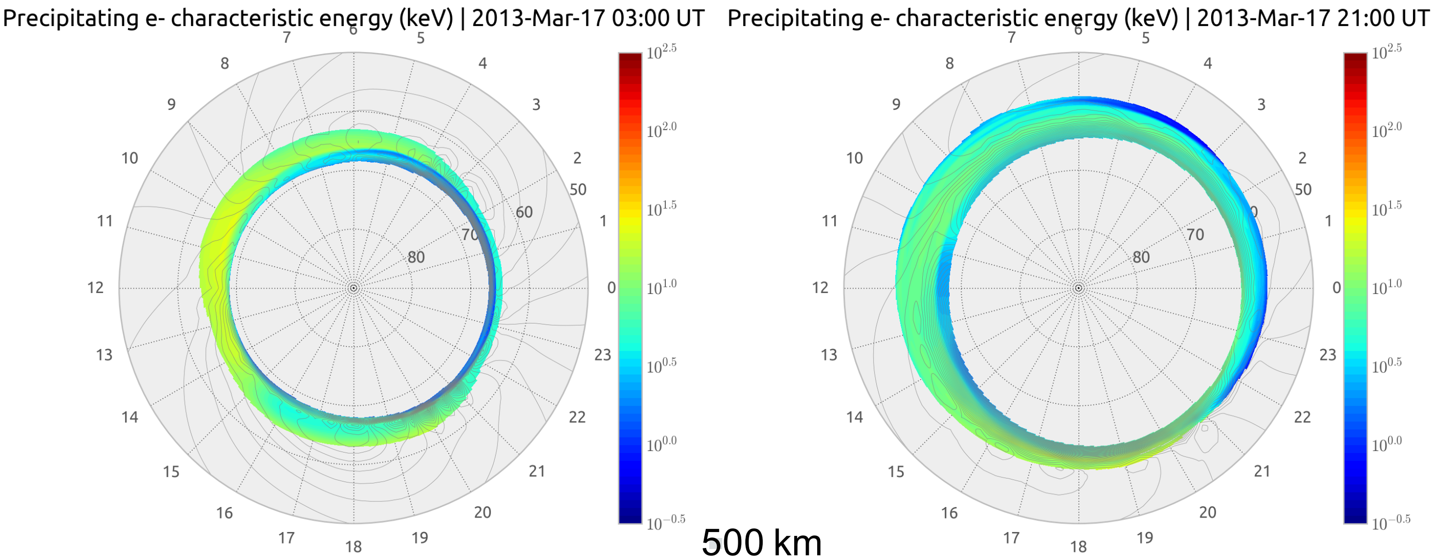
# Precipitating Electron Energy Flux, ergs/cm$^2$



Precipitating electron energy flux | 2013-Mar-17 03:00 UT

Precipitating electron energy flux | 2013-Mar-17 21:00 UT

# Characteristic Energy, keV



Precipitating e- characteristic energy (keV) | 2013-Mar-17 03:00 UT

Precipitating e- characteristic energy (keV) | 2013-Mar-17 21:00 UT

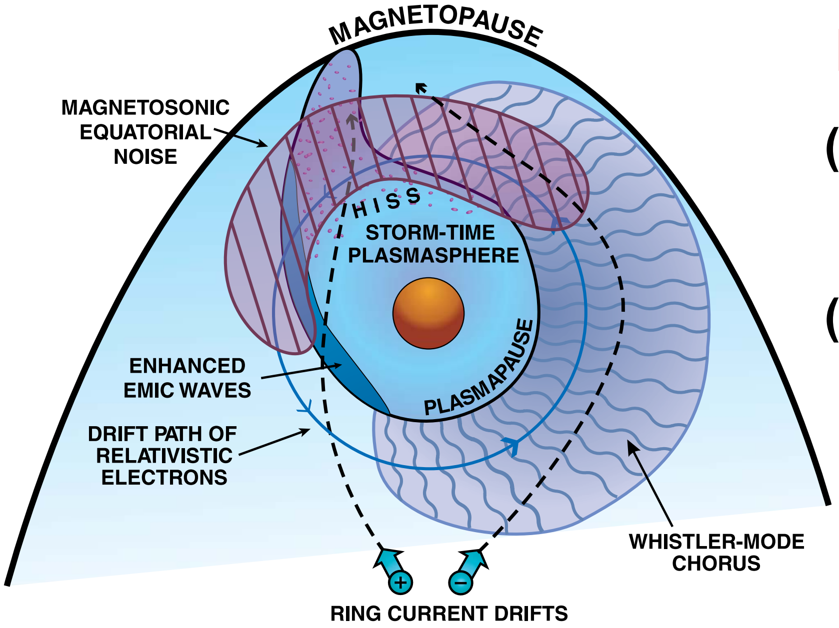
Pre-storm (03:00 UT)

Stormtime (21:00 UT)

Use RCM-E precipitating electron number flux and characteristic energy to specify auroral heating input to pre-storm and stormtime TIEGCM runs.

# RCM-E (Aerospace's Version)

- Computes bounce-averaged guiding center drift of isotropic ions and electrons [*Toffoletto et al*., 2002]
- Electric field & magnetic field are self-consistent with the plasma [*Lemon et al*., 2003].
- Includes a simple plasmasphere model based on simulated electron density



From *Thorne* [*GRL*, 2010]

## Electron loss models:

**(1) Strong pitch-angle scattering** [*Schulz*, 1974]

**(2) Kp- and MLT-parameterized scattering due to whistler chorus** [*Orlova and Shprits, 2014*] **and plasmaspheric hiss** [*Orlova et al.*, 2014]

Fitted quasi-linear p. a. diffusion coefficients calculated using statistical wave properties from CRRES & Polar to functions.

# Simple Plasmasphere Model:

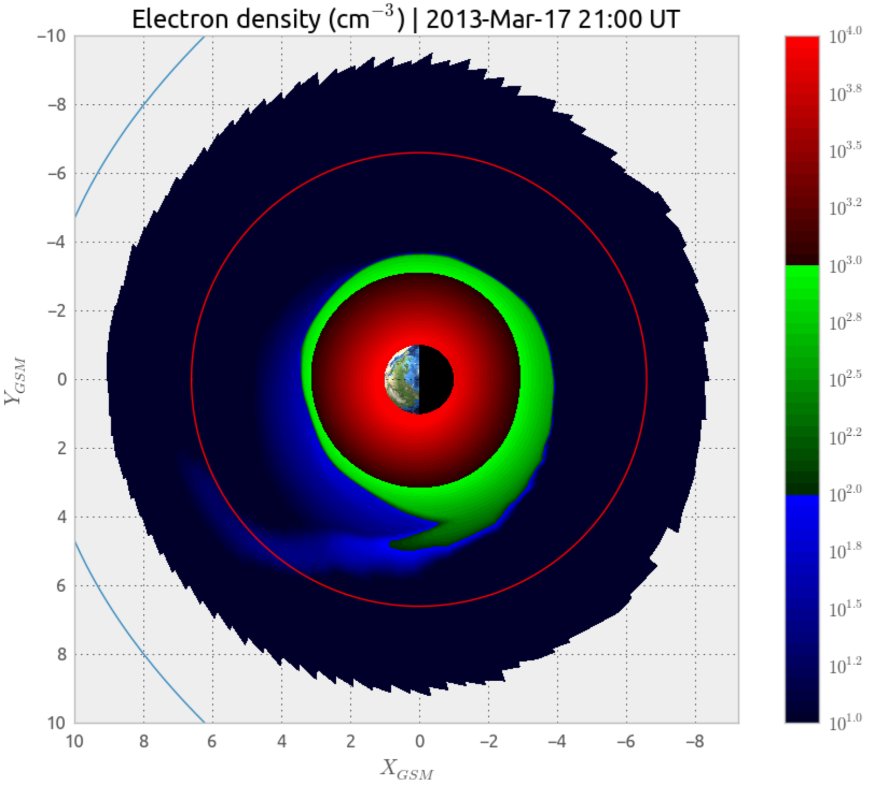
We include a cold electron energy channel in the RCM-E.

Initial plasmasphere density is specified by *Berube et al*. [2005].

Initial plasmapause location is specified by *Moldwin et al*. [2002].

Mean plasmasphere refilling rate for solar maximum, in units of $cm^{-3}$/day (eq. 16 of *Denton et al*. [2012])

$$\log_{10}(dn_{e,eq}/dt) = 3.01 - 0.322\,L$$



Inside plasmasphere: $n_e > 100$/cc

Plasmapause region: $10/cc < n_e < 100/cc$

Outside plasmasphere: $n_e < 10$/cc