Electric Field Variability and Impact on the Thermosphere

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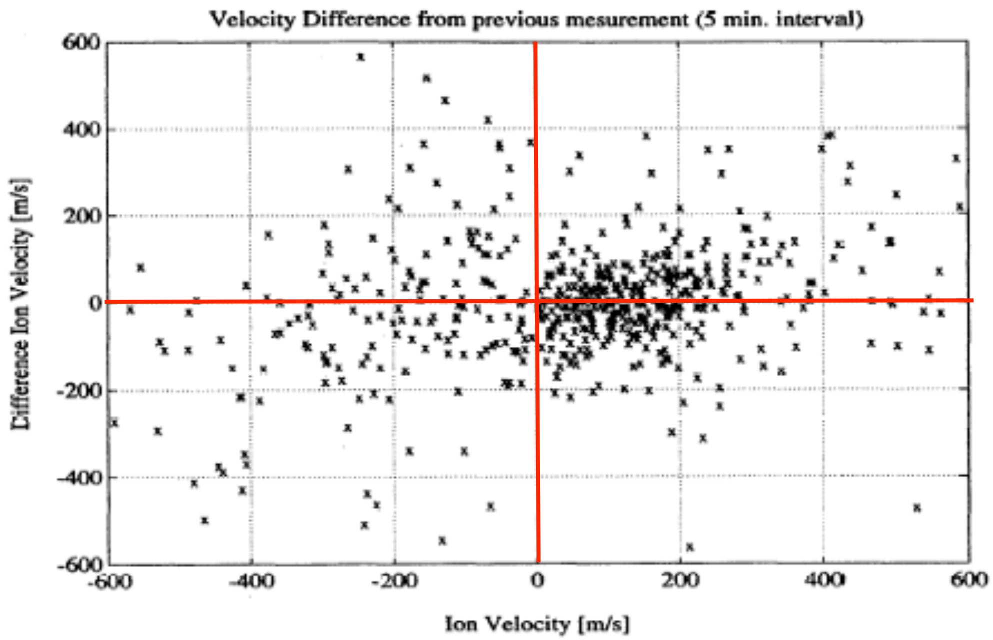
Motivation:



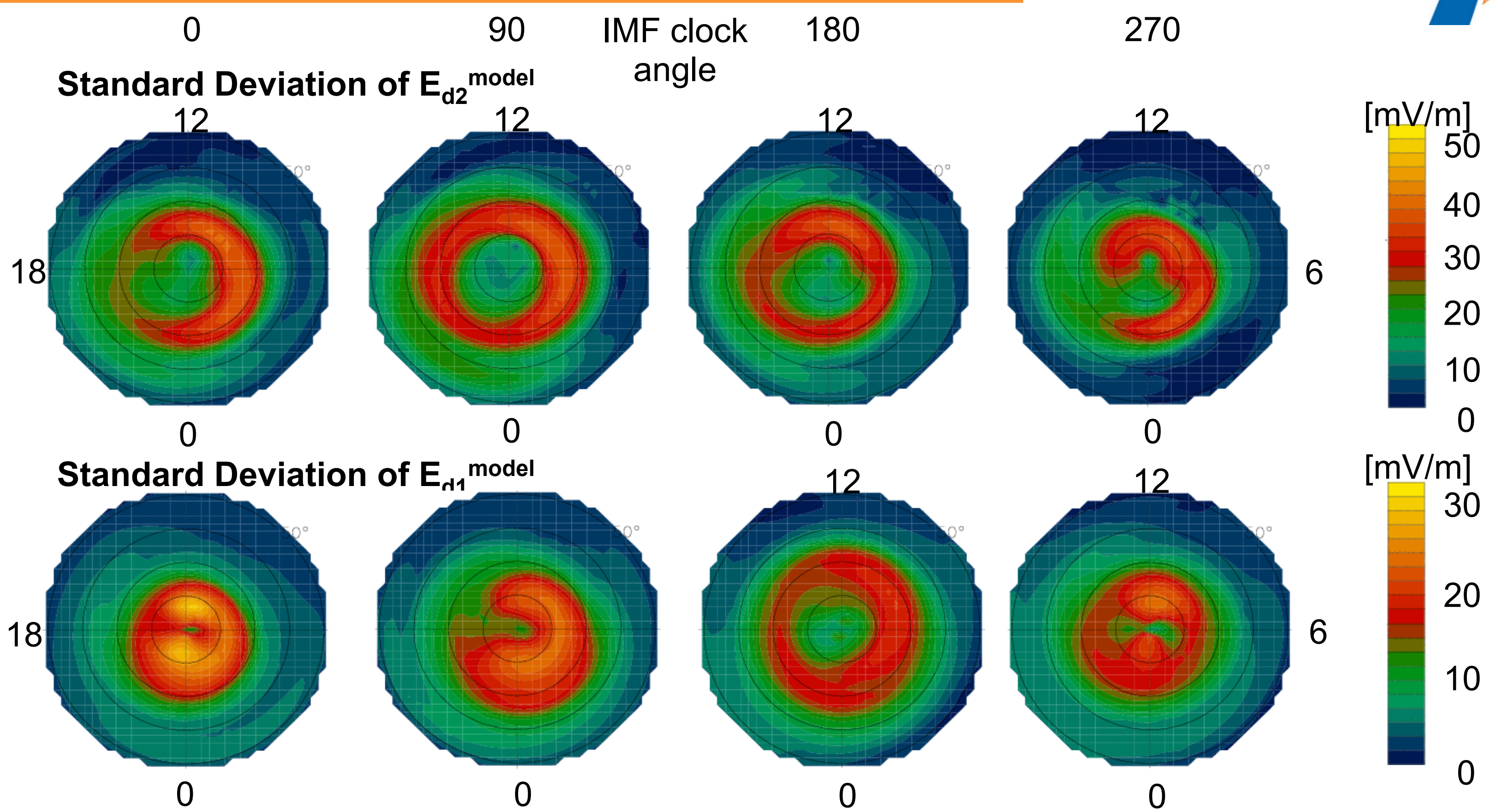
$$Q_J \propto \overline{E^2} = \bar{E}^2 + \sigma_E^2$$

Codrescu et al., [1995]

➢The quantitative application of GCMs for predictive purposes is limited by uncertainties in the energy inputs

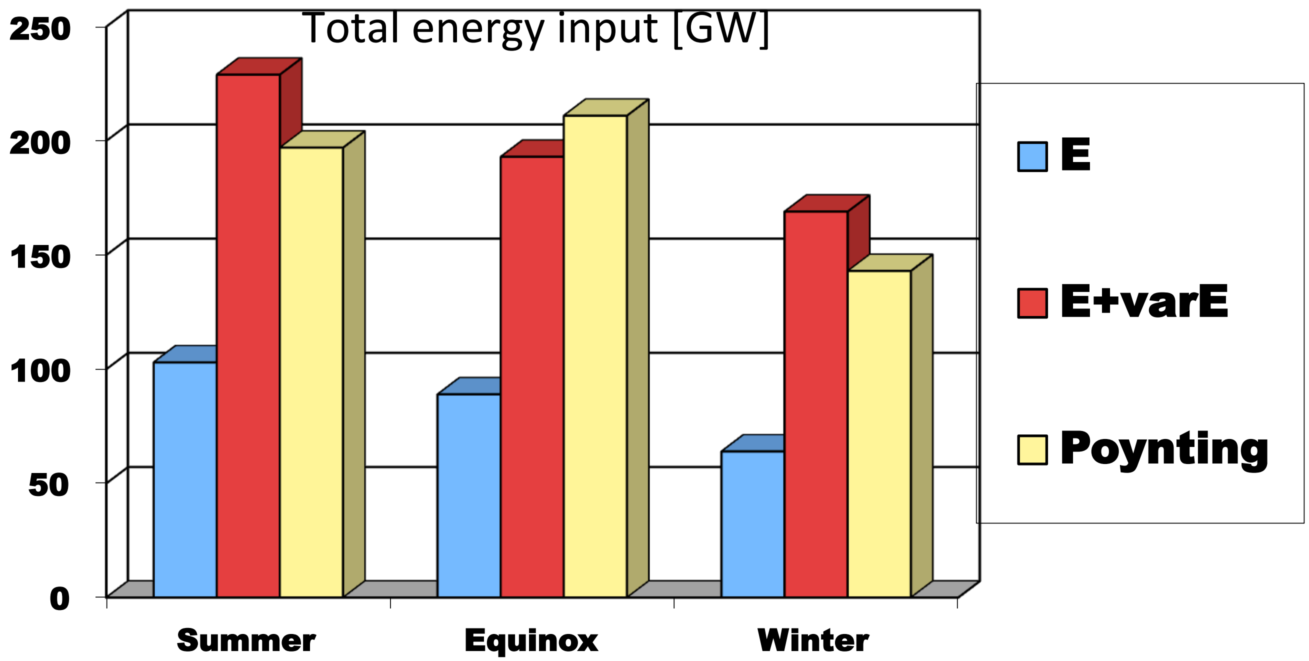
➢How big is the E-field variability and what's the effect to the energy input? (Codrescu et al., [1995], Crowley & Hackert, [2001], Matsuo et al., [2003] and so on.)

Empirical model of the Electric Field variability:



- ➢ Based on the DE2 E-field data set
- ➢ E-field variability/standard deviation of East and North components referred to the average empirical model
- ➢ IMF clock angle dependence with Bt=5 nT at equinox

Comparison of energy input into GCM:

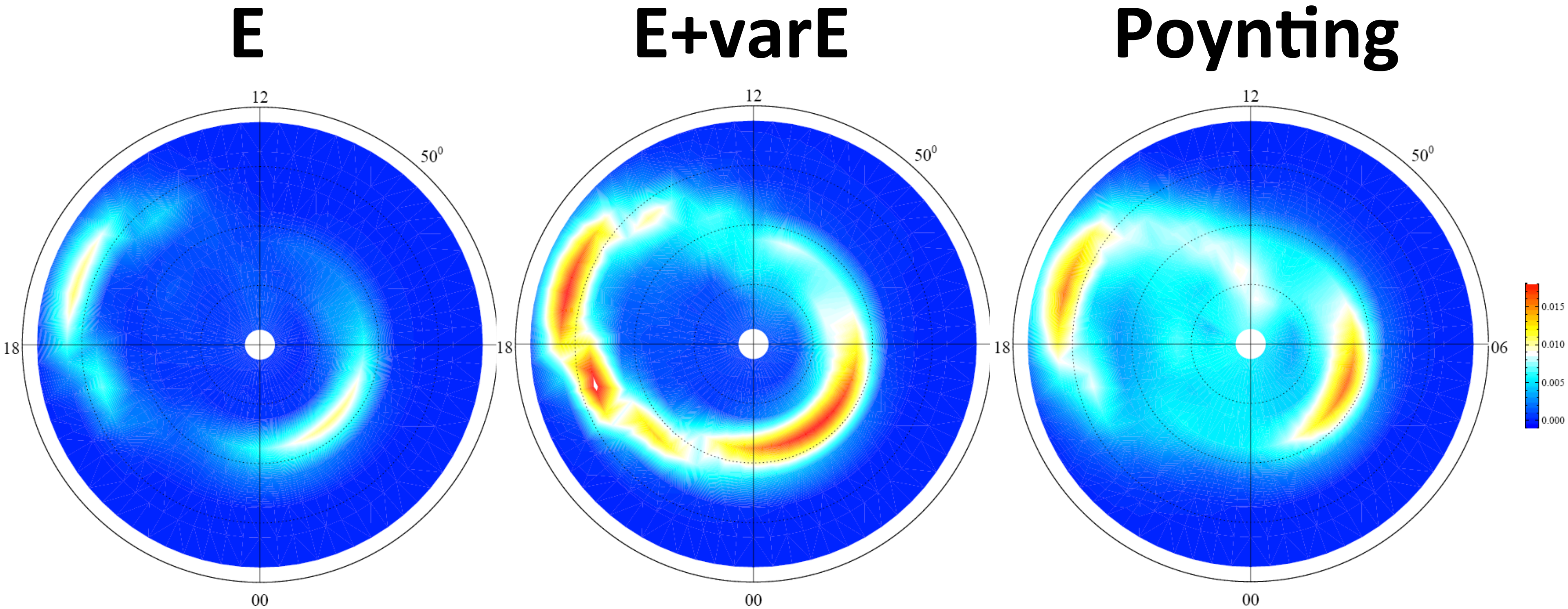


By = 0
Bz= -5nT
SW=400km/s
HP=30GW

- Coupled E-field variability model into TIEGCM
- The E-field variability increases the energy input by > 100%.
- The total Joule heating has a good agreement with Poynting flux.
- The inconsistent particle precipitation makes the JH higher than Poynting flux in the solstice.

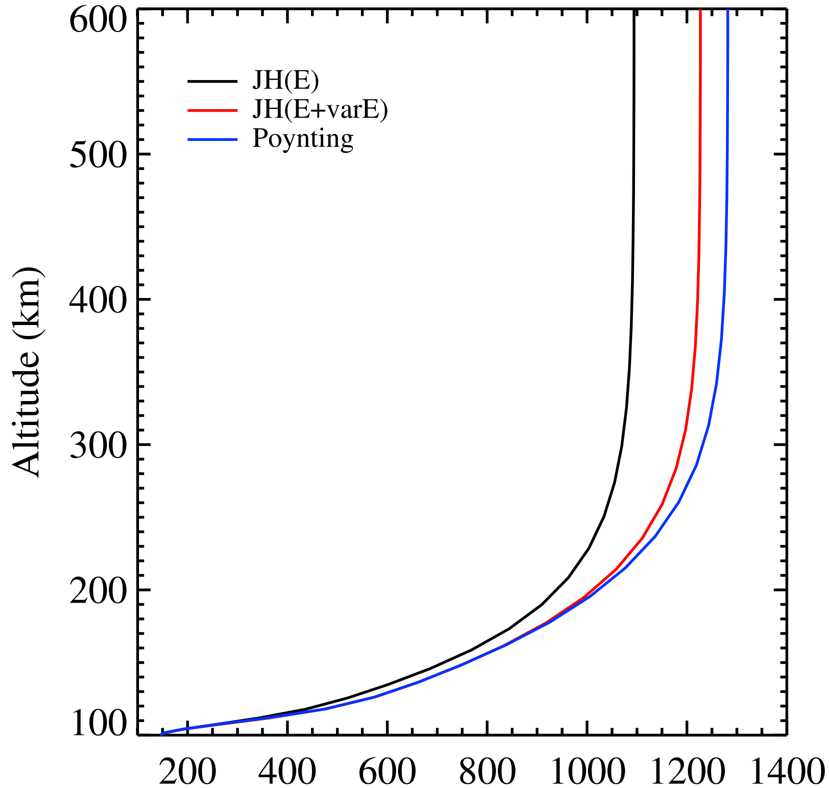
[Deng et al., 2008]

Energy distribution (Equinox):



- Altitude integrated Joule heating and Poynting flux from the topside.
- E-field variability increases JH significantly.
- Total Joule heating has a similar distribution as Poynting flux, with some detailed difference at the polar cap, cusp and nightside.

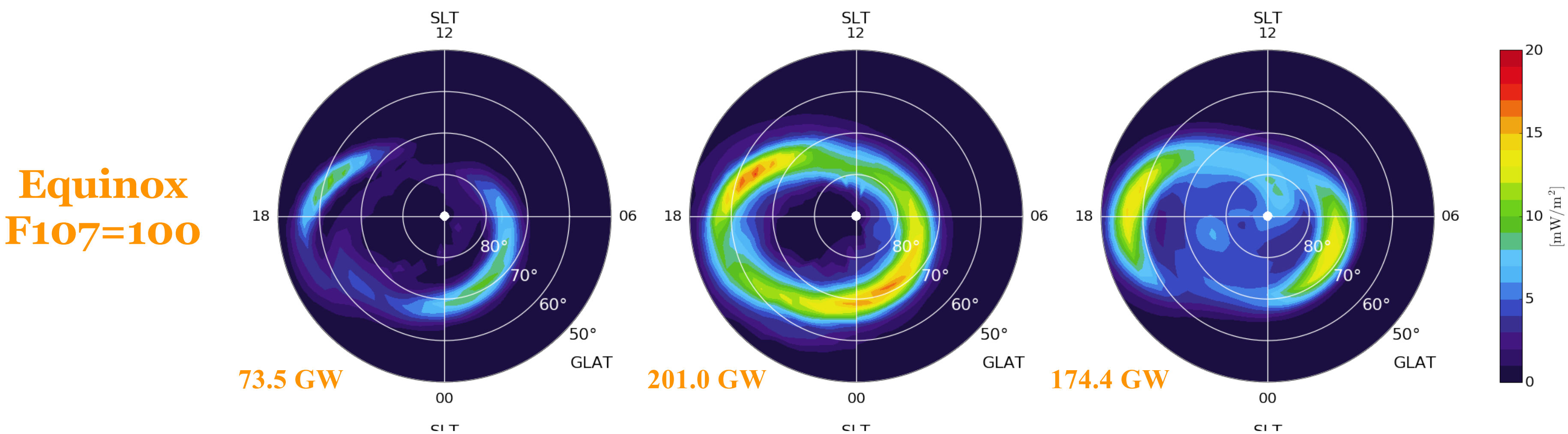
Temperature response:



- Polar average (Lat > 47.5^0) at equinox.
- E-field variation causes >100 K temperature increase above 300 km.
- Spatial dependency of the E-field variation phase doesn't matter much for the temperature.

Conclusion :

- The E-field variability increases the energy input by > 100%. The total Joule heating has a good agreement with Poynting flux.
- The total Joule heating has a similar distribution as Poynting flux, with some detailed differences at the polar cap, cusp and nightside.
- E-field variation causes >100 K temperature increase at 400 km.



Qingyu Zhu's poster on Wednesday