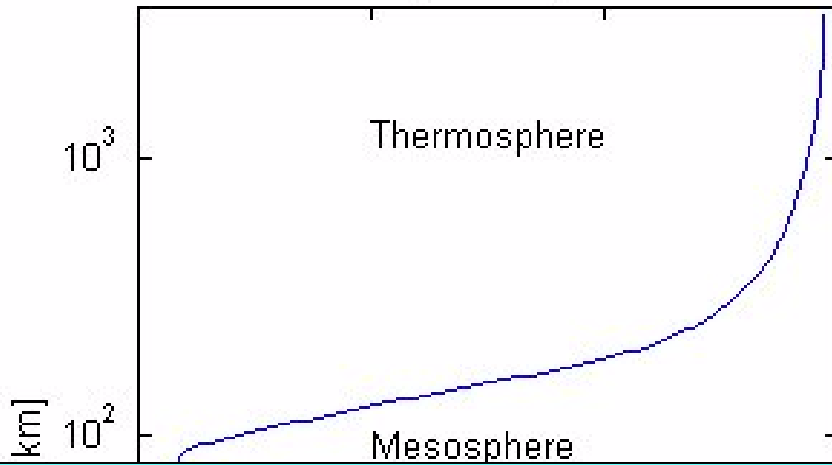


Interplay between Equatorial Geophysical Processes

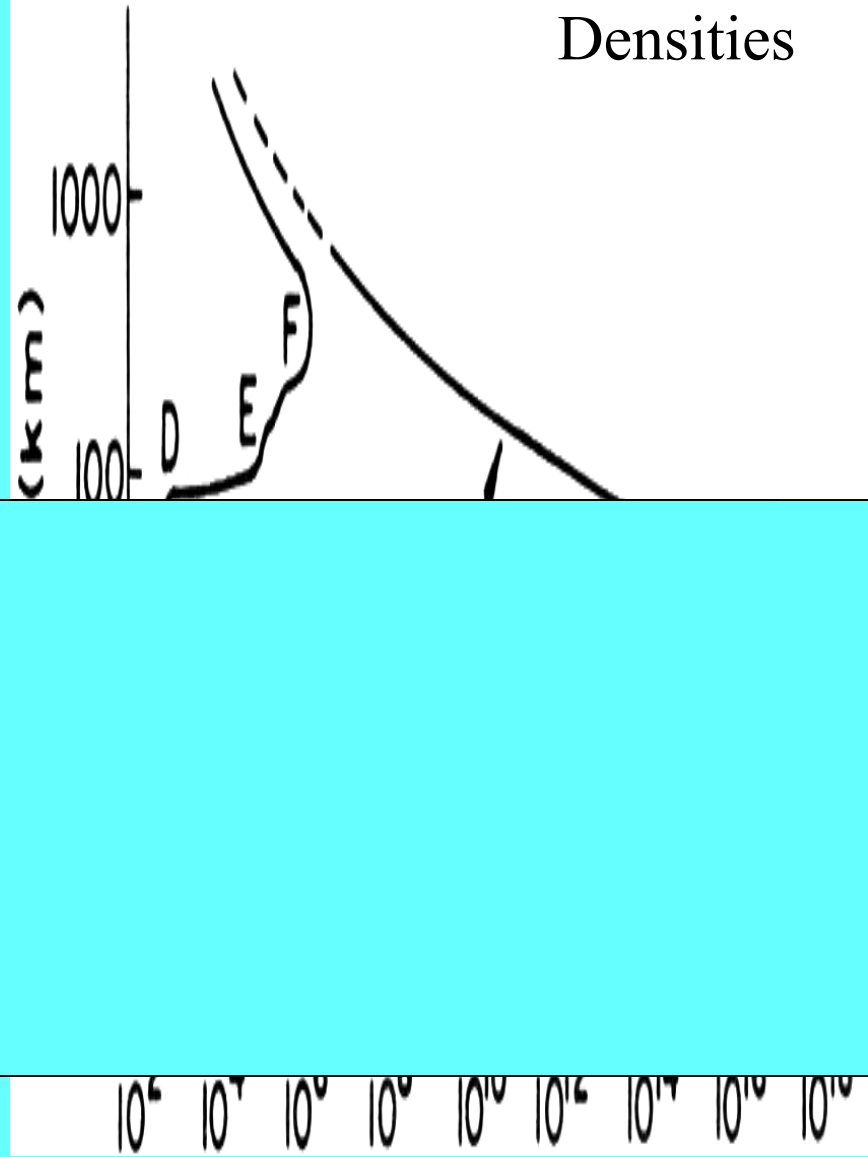
- R.Sridharan
- Space Physics Laboratory
- Vikram Sarabhai Space Centre

28 Nov '06

Neutral gas temperature

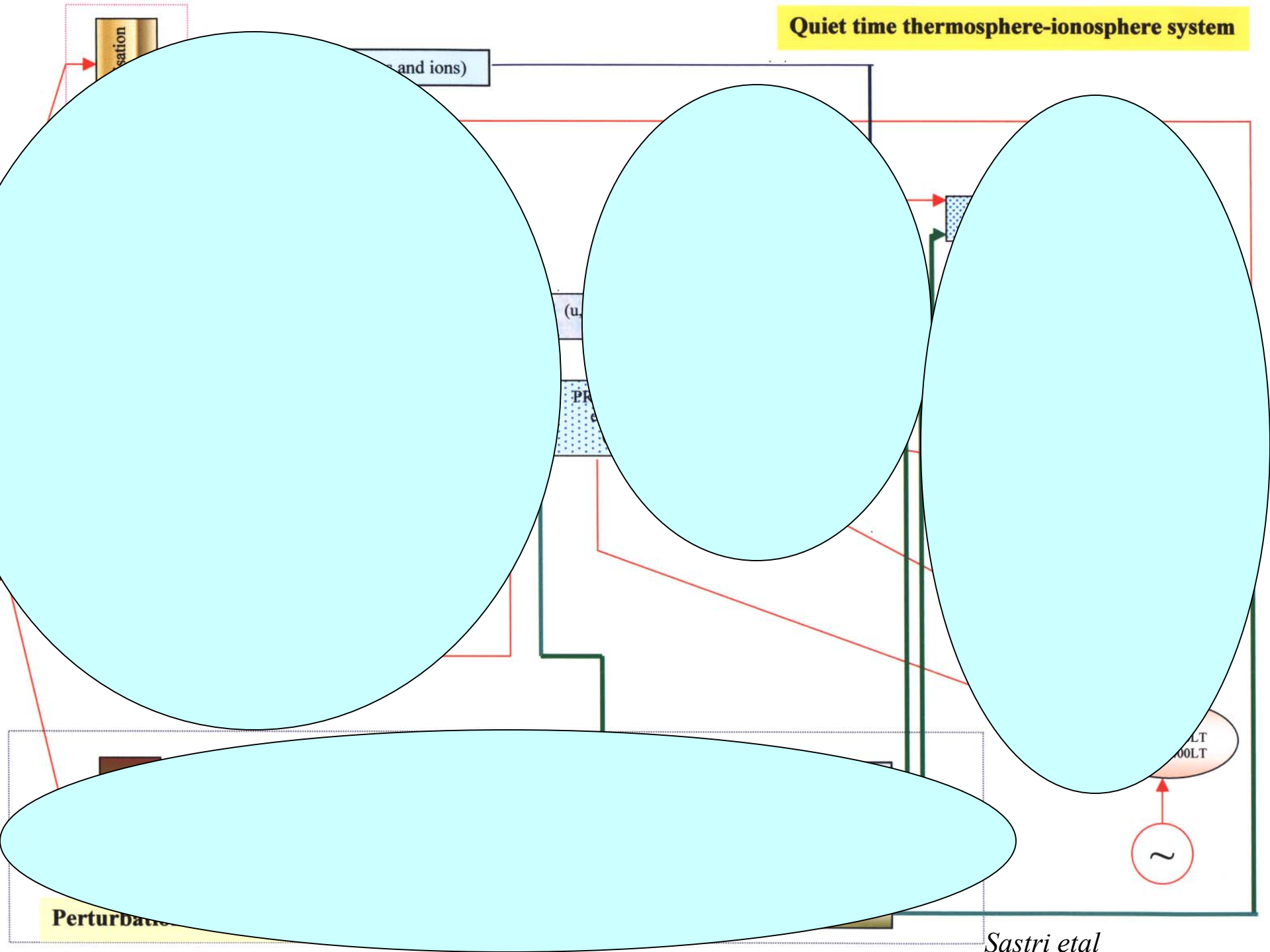


Densities



K

Quiet time thermosphere-ionosphere system



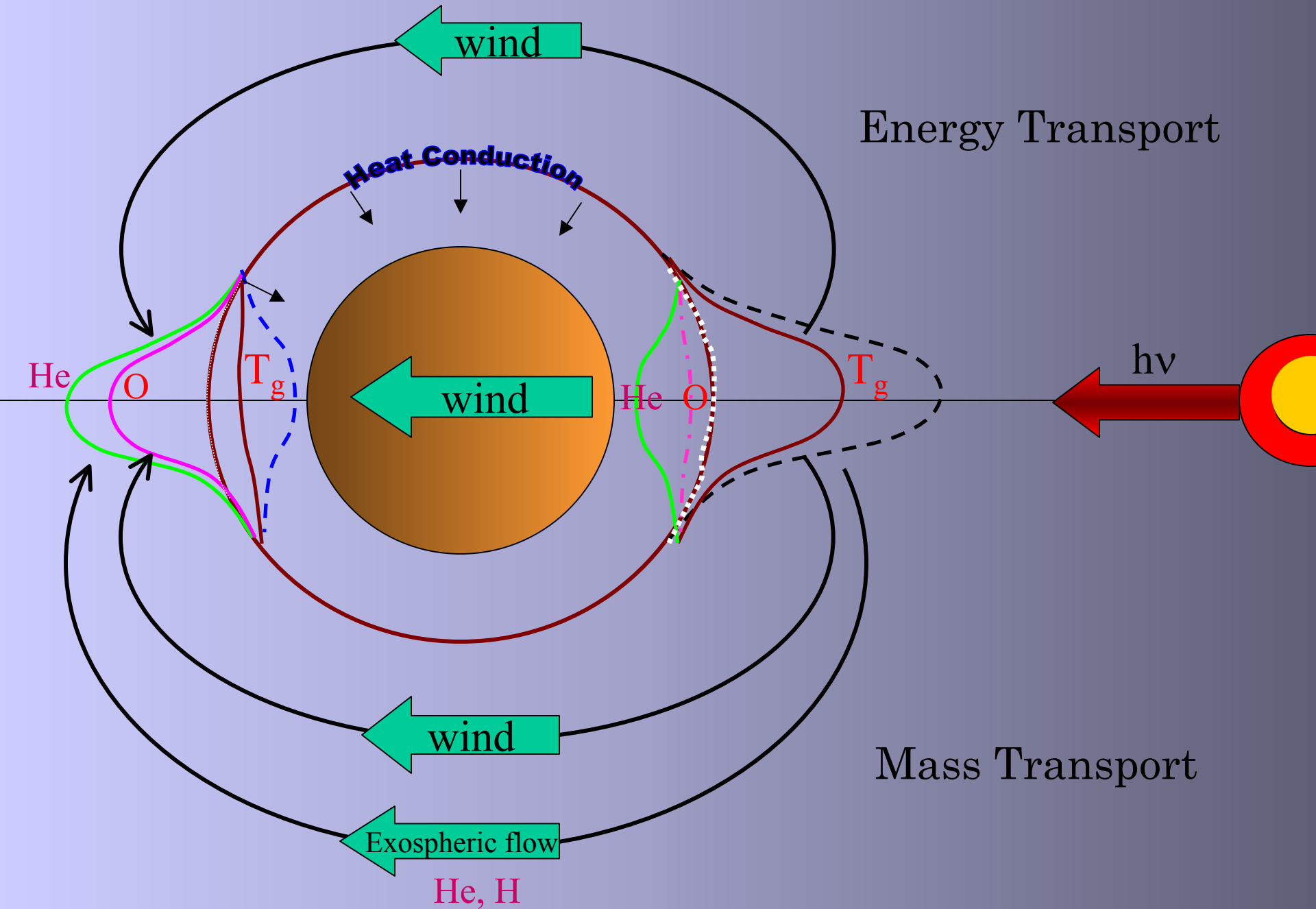
Perturbatio

Sastri et al

Three basic categories:

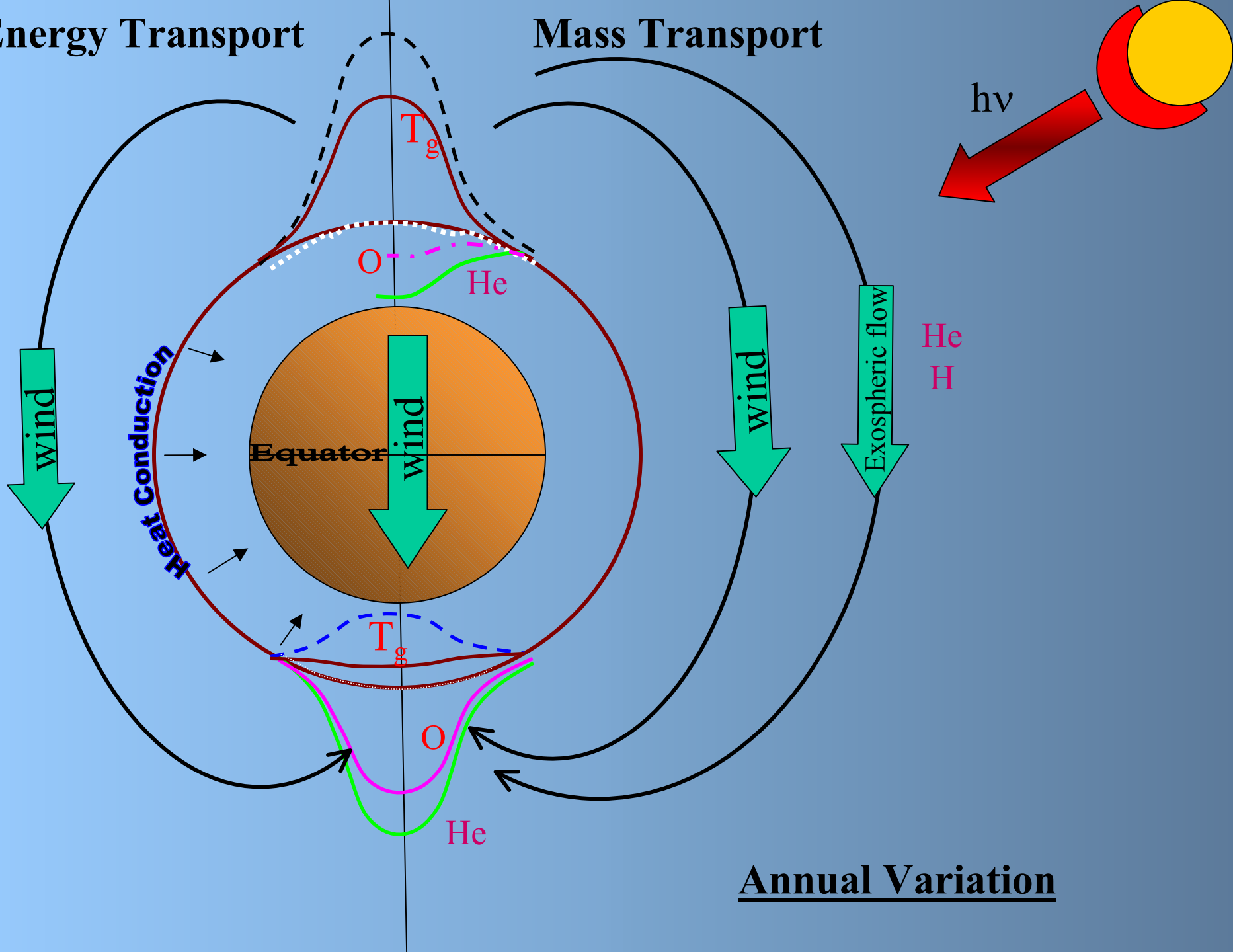
- Common driving force
 - Cause and effect
 - Strong modulation

Diurnal Variation



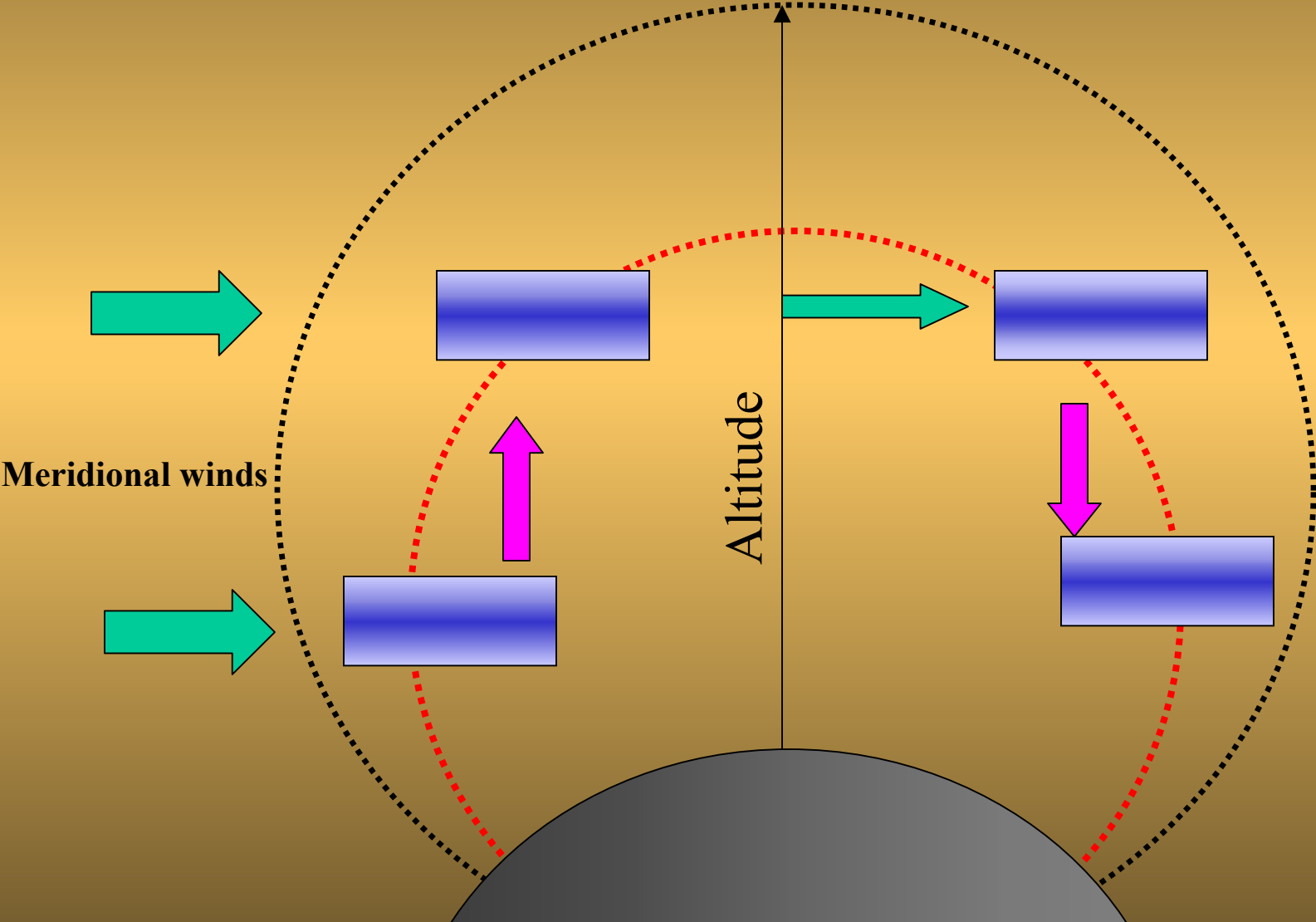
Energy Transport

Mass Transport

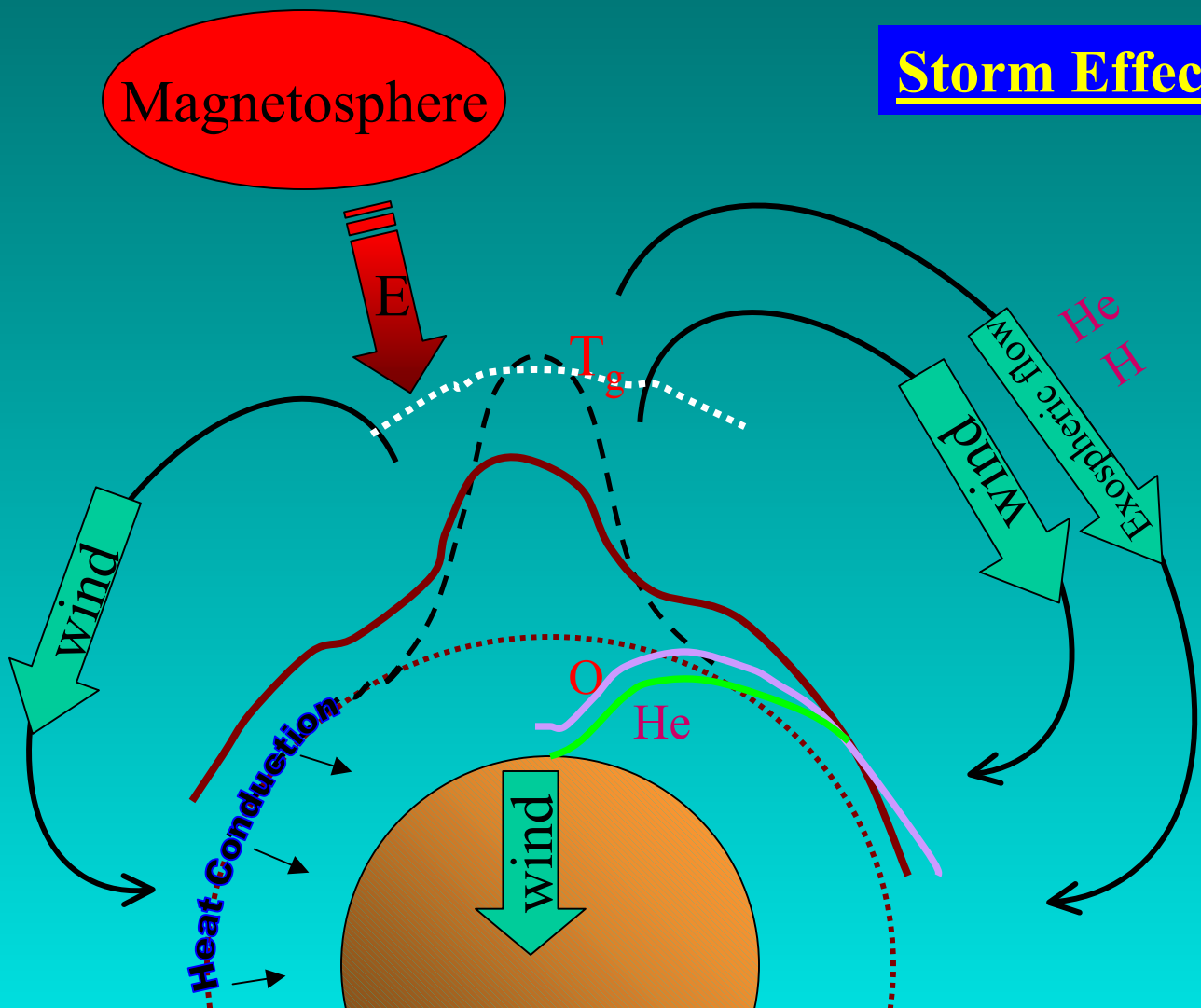


Annual Variation

Effect of Meridional Wind



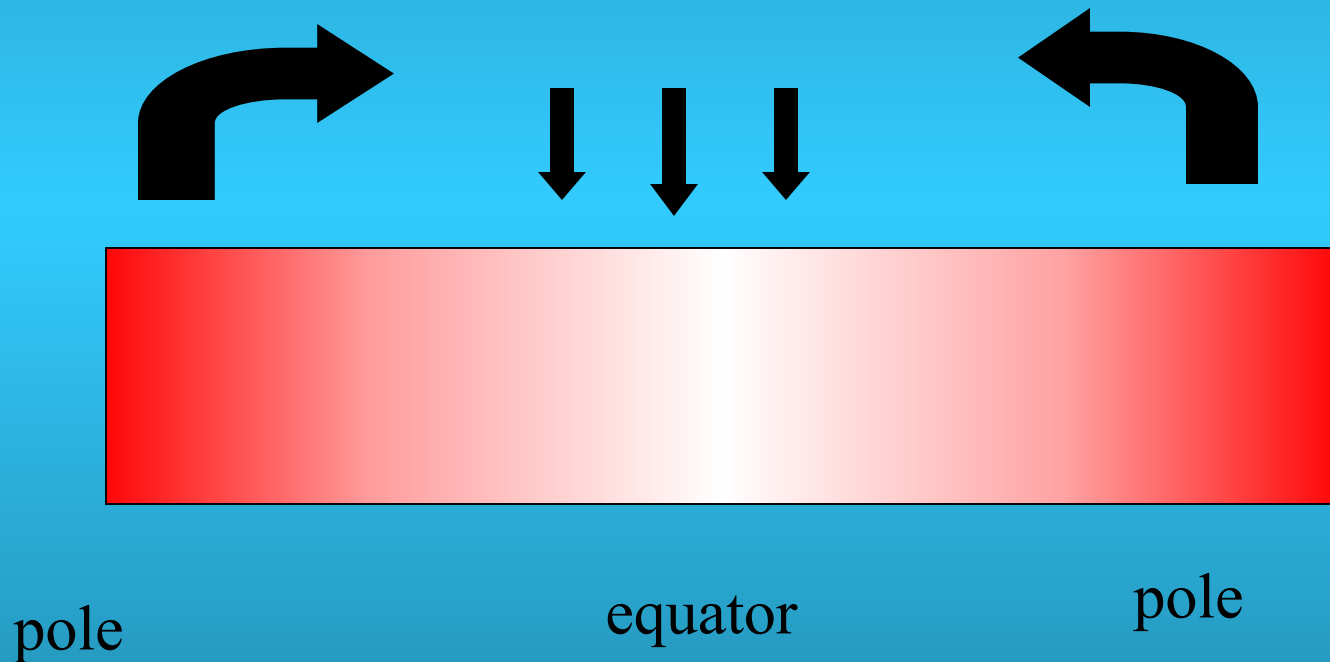
Storm Effects

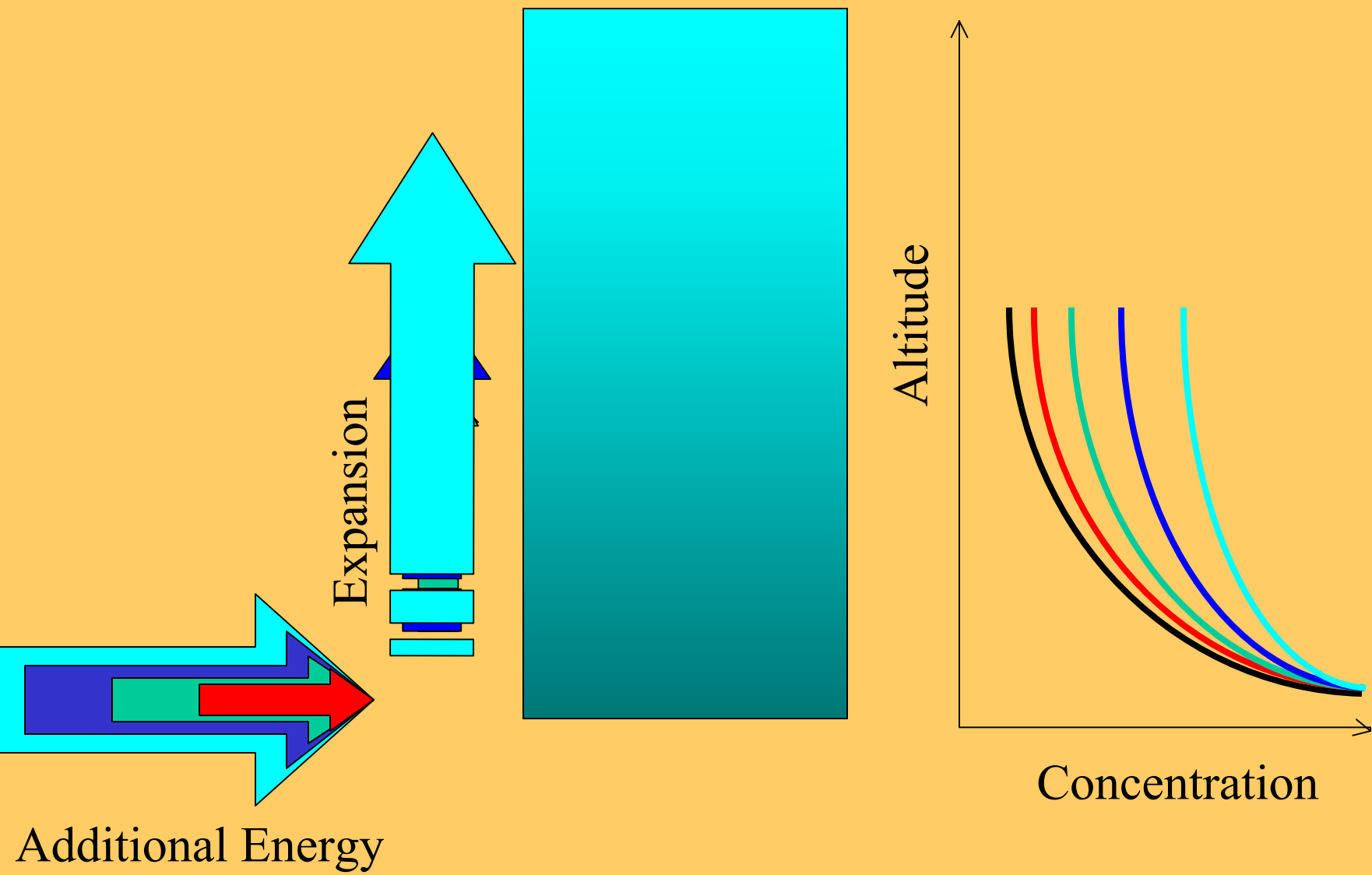


Energy Transport

Mass Transport

Disturbed time circulation





Tidal oscillations propagate upward and the associated wind speed grows in amplitude as they do so.

(Diurnal tides are important < 30 deg latitude. Higher above they get trapped in the stratosphere).

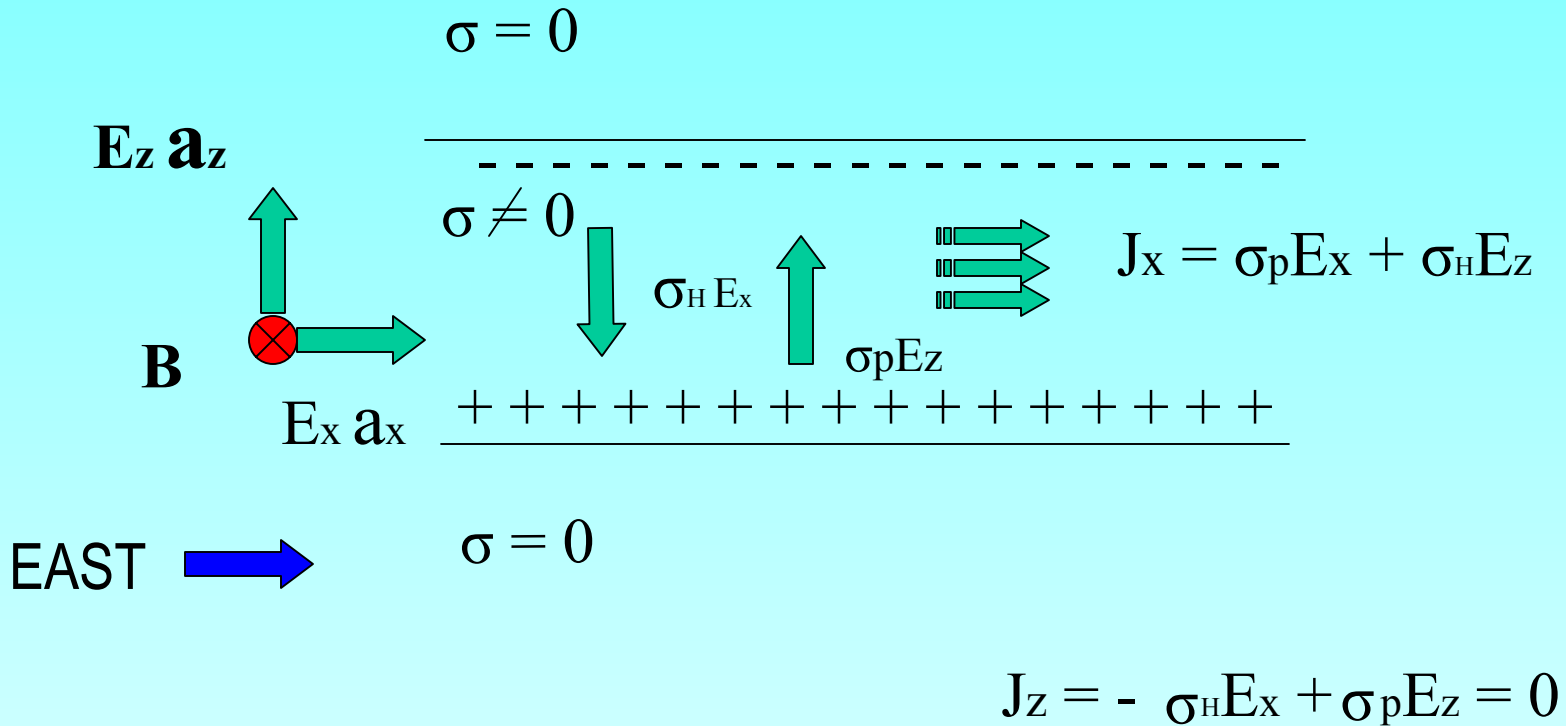
The entire dayside ionosphere is a good electrical conductor in which currents are driven by lower thermospheric tides that are global in nature. In order to make the current system divergent free an Electric field gets set up which is rich and complex as the driving wind field and the conductivity pattern that produce it.

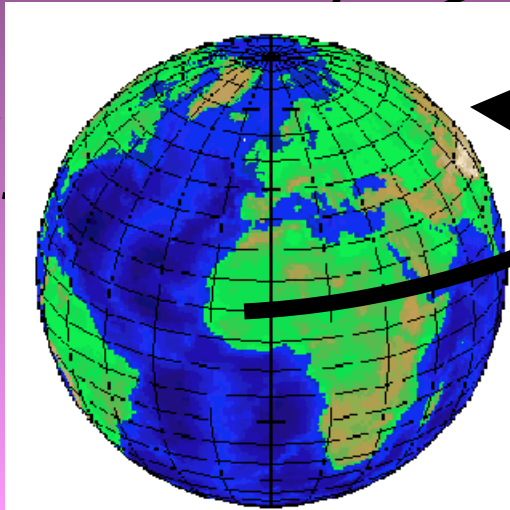
(At first cut one may expect to see a diurnally varying E field over low latitude and a mixture of diurnal and semi diurnal E field over higher latitudes).

Equatorial Electrojet in a slab geometry

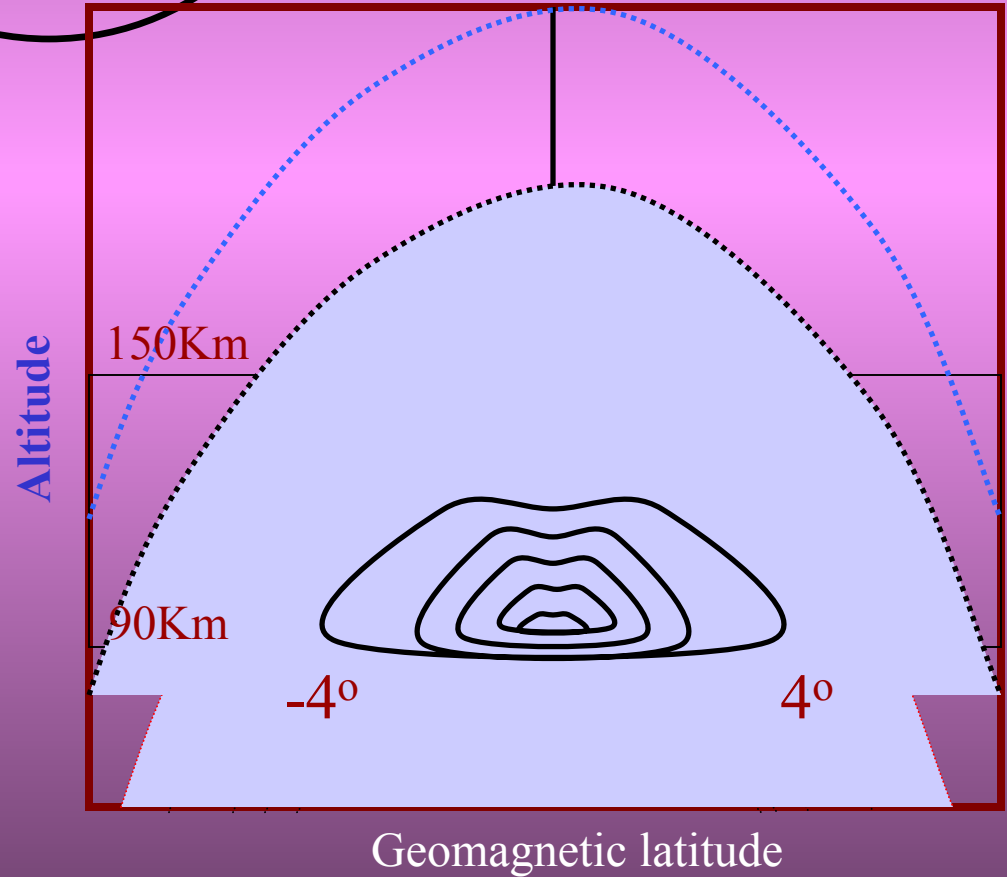


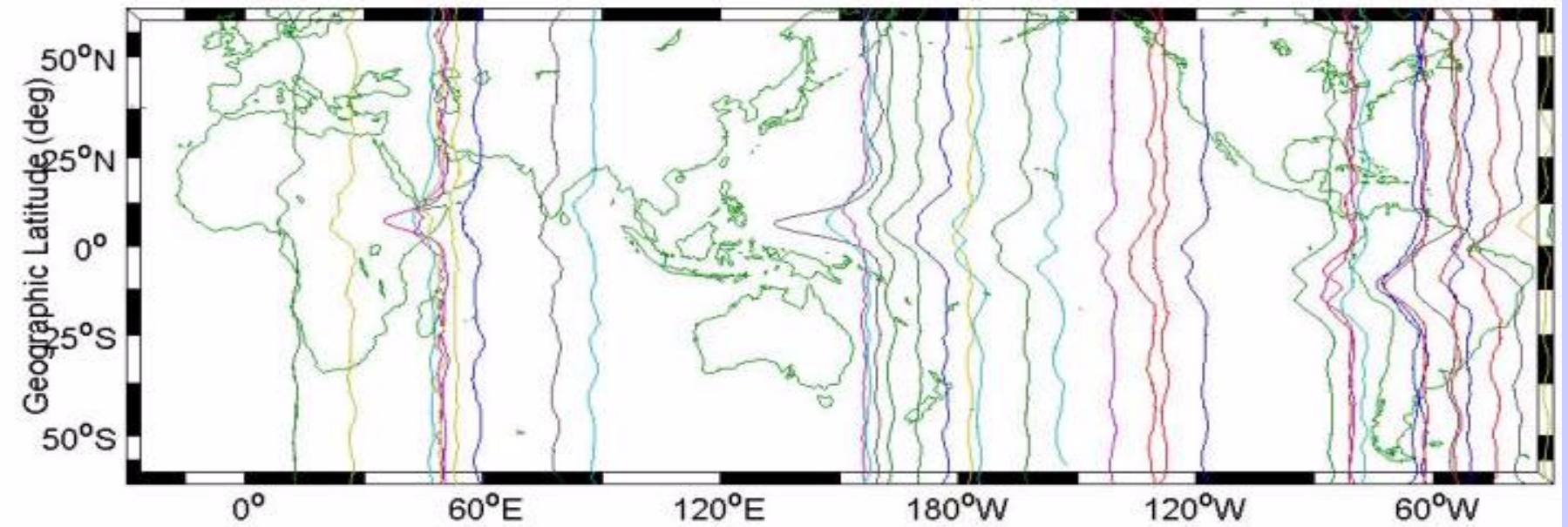
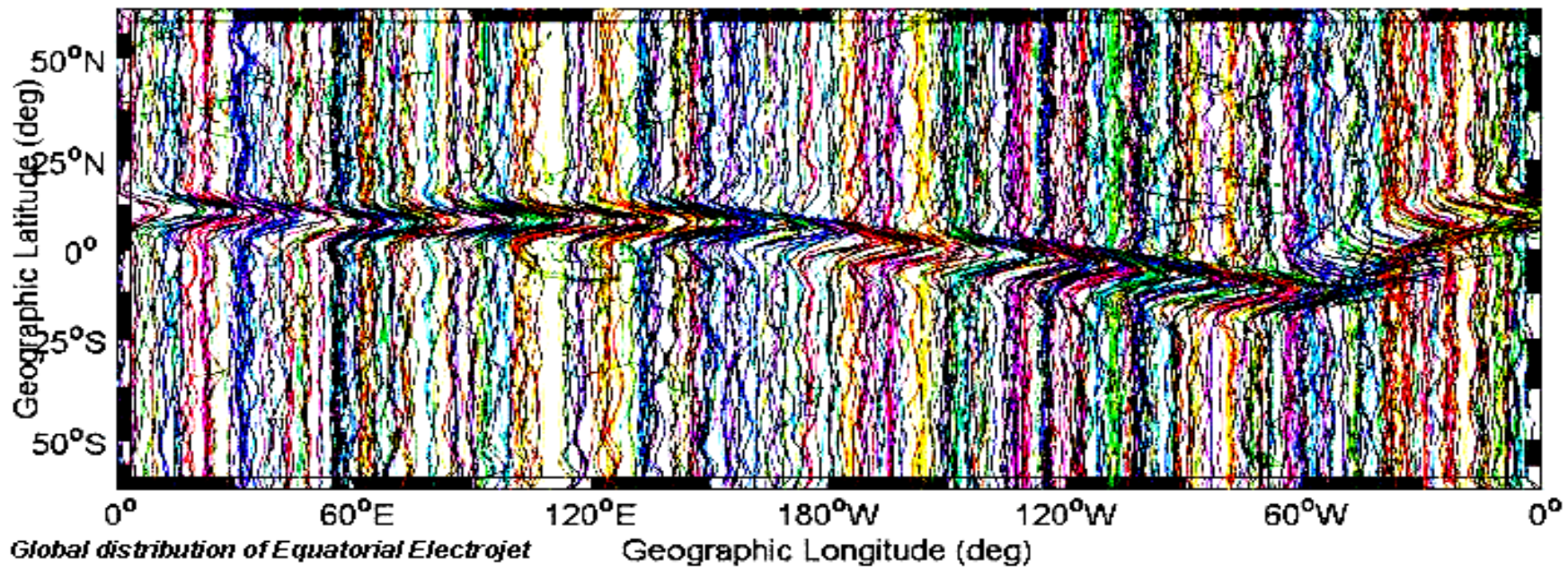
Global scale dynamo: tidal forcings
E-Field driven EEJ





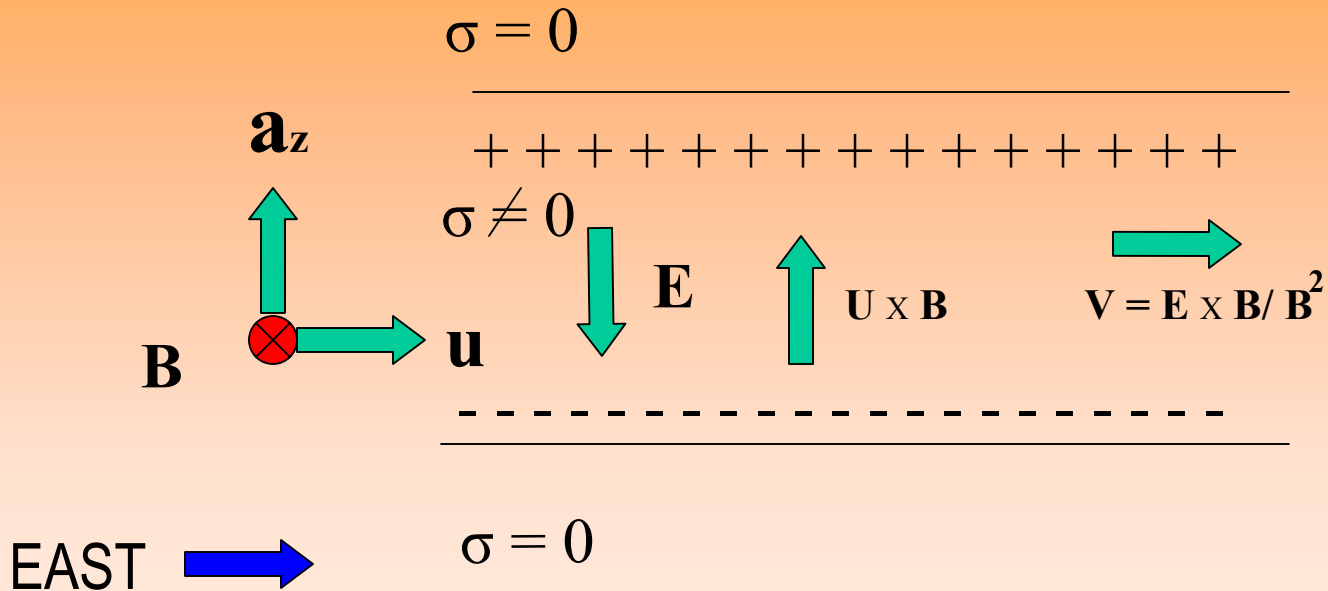
Equatorial Electrojet



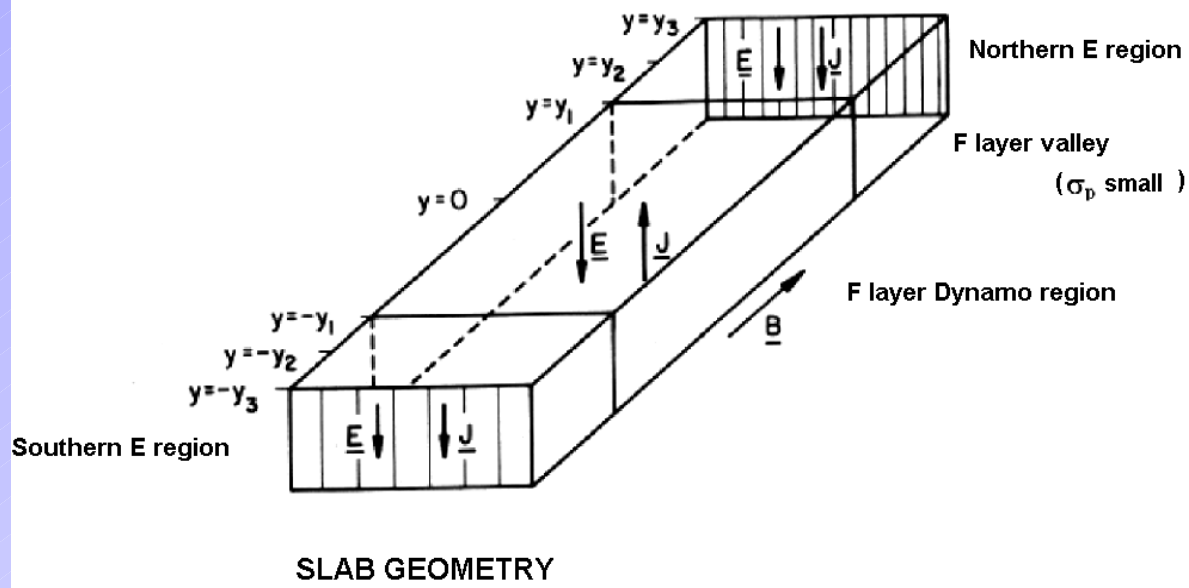
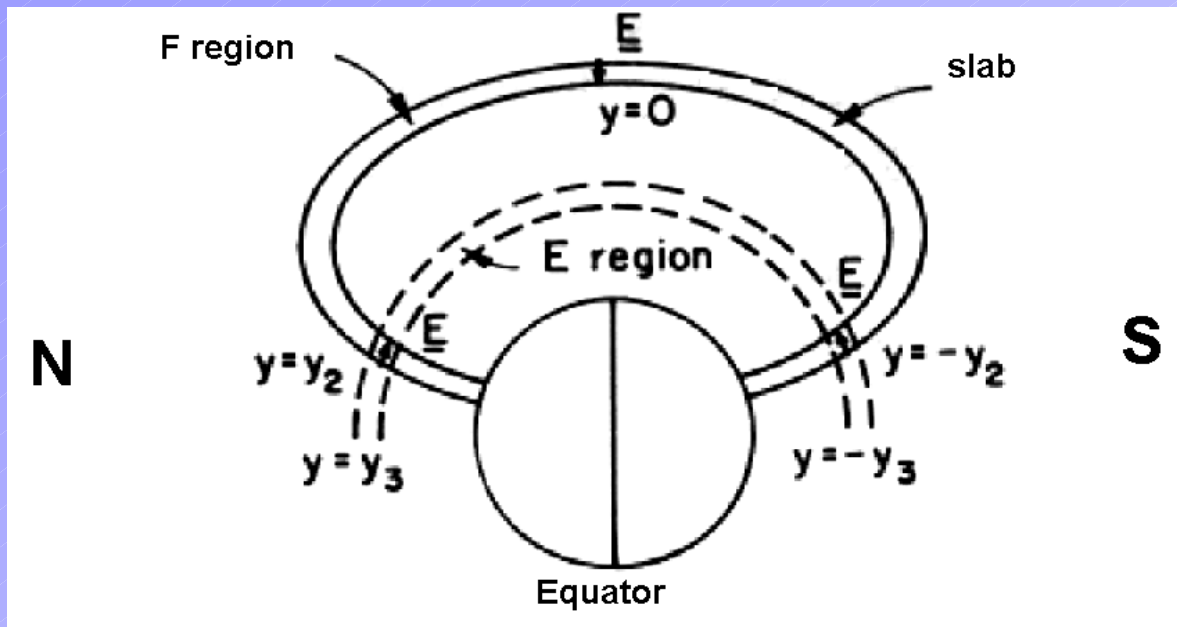


Equatorial F-region dynamo

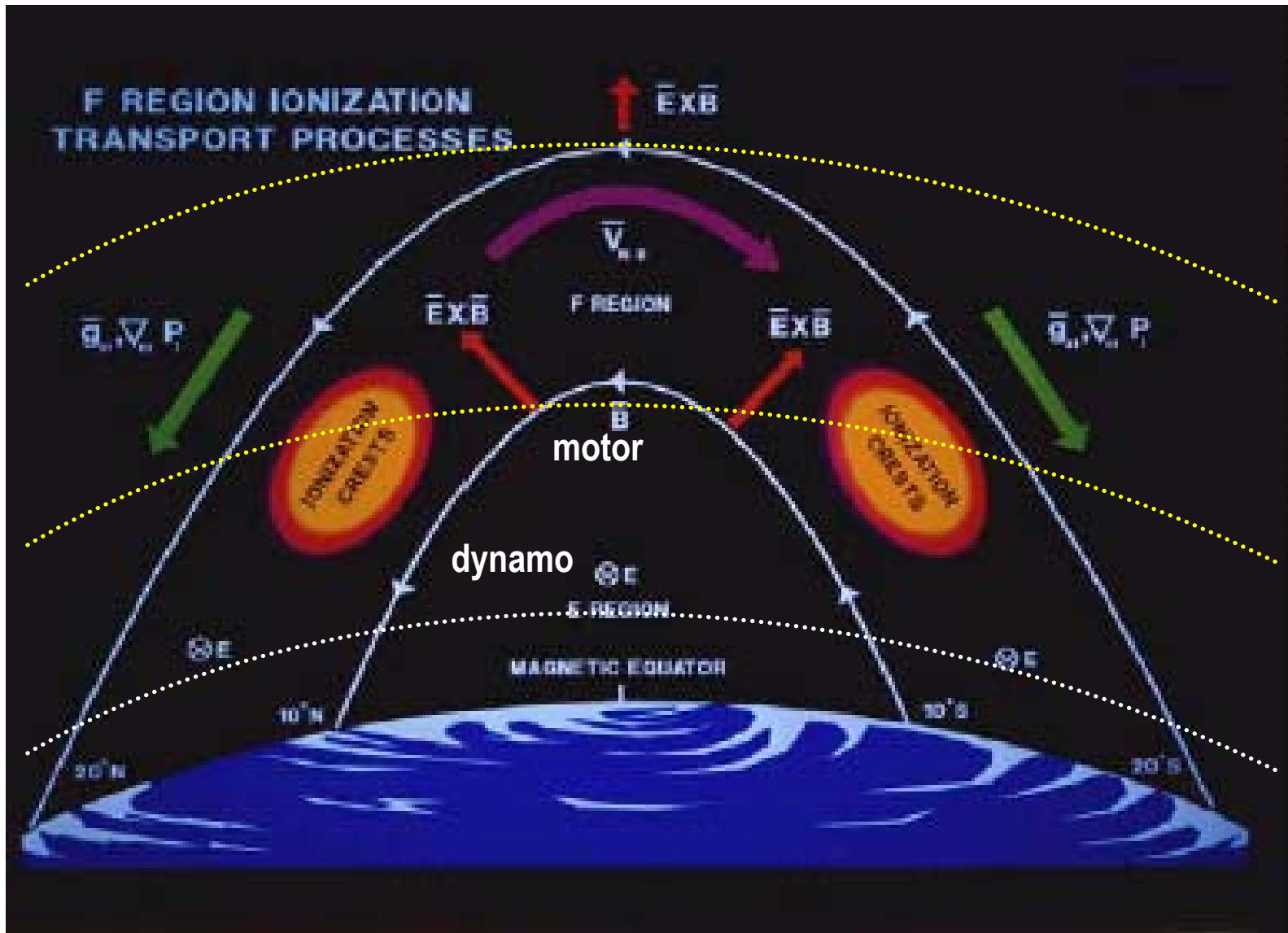
Direct Wind driven – insitu winds



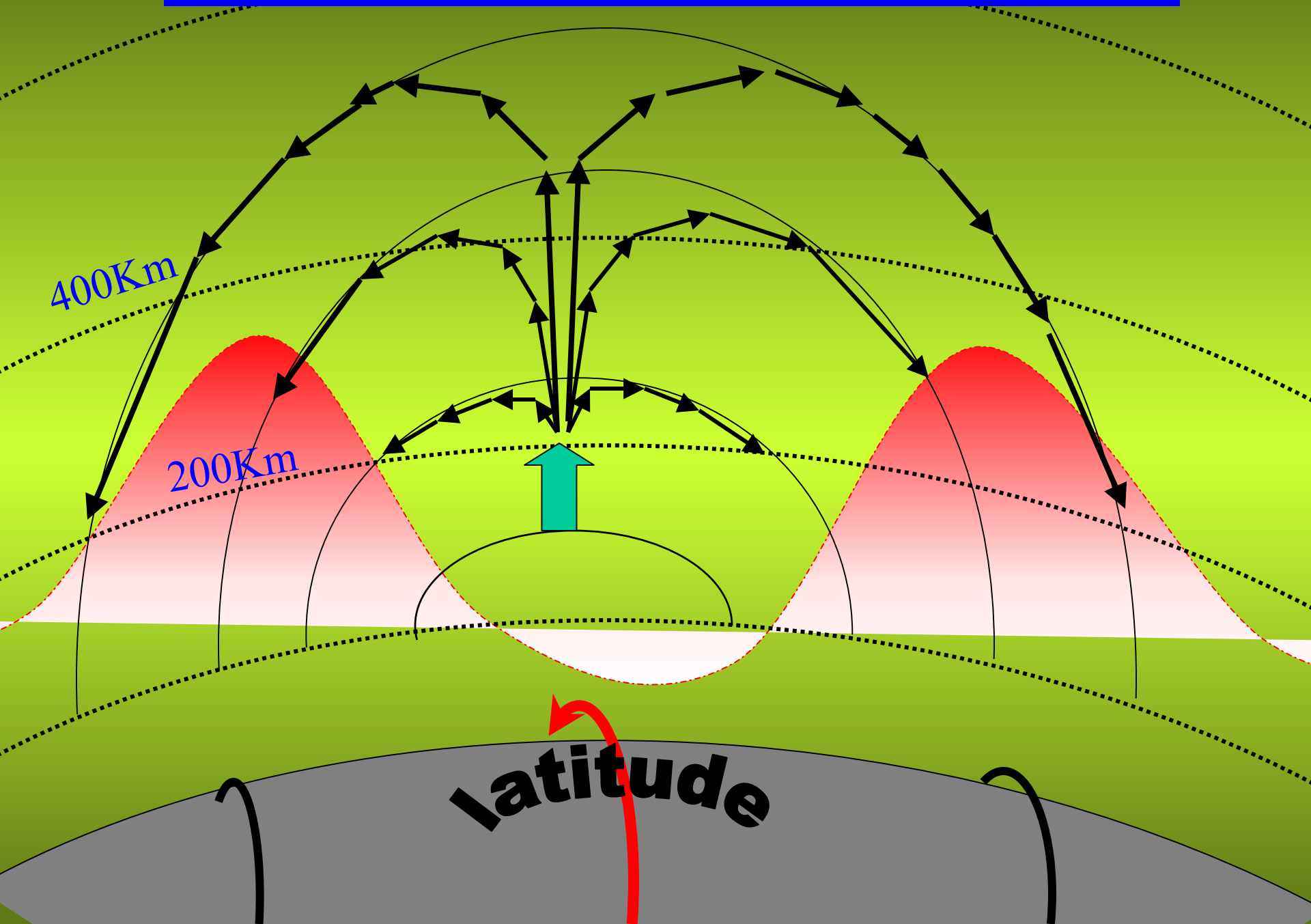
Essentially a post sunset phenomenon

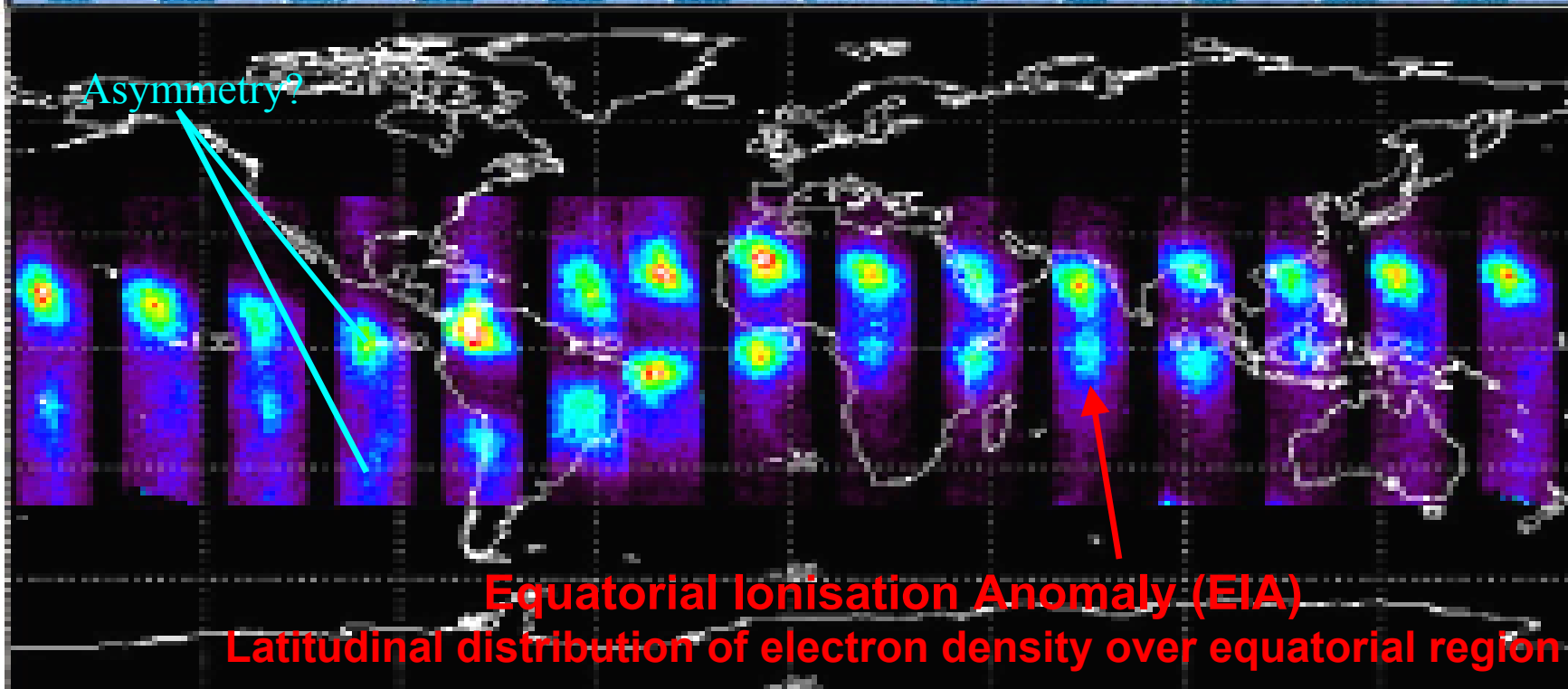
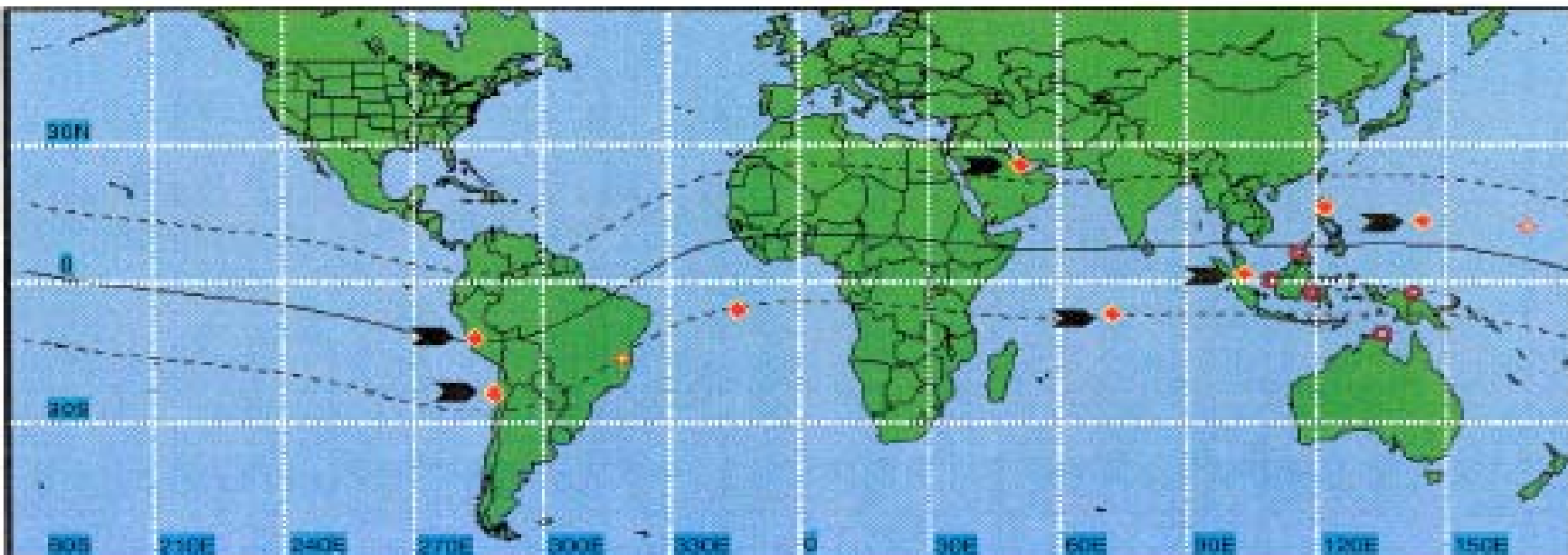


EIA



Generation of Equatorial Ionisation Anomaly (EIA)



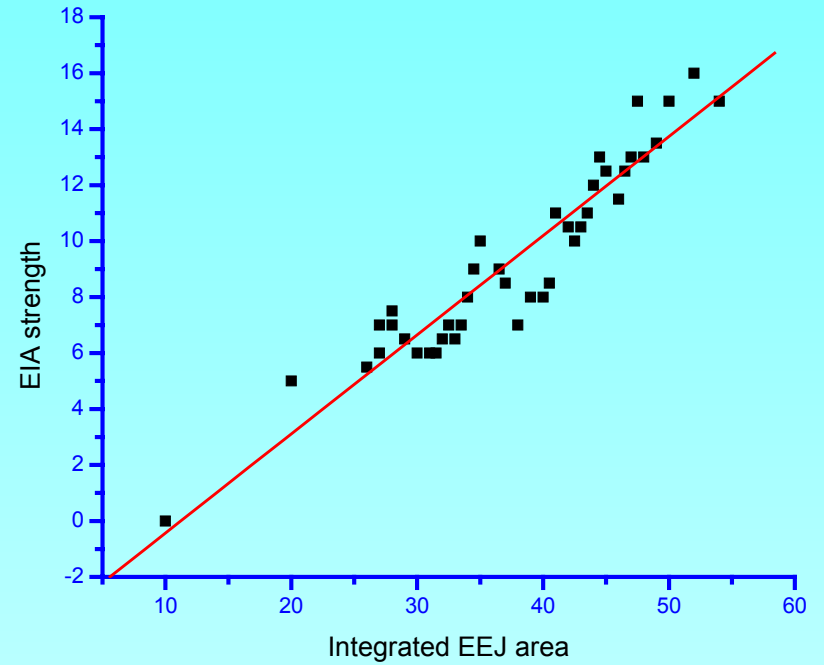
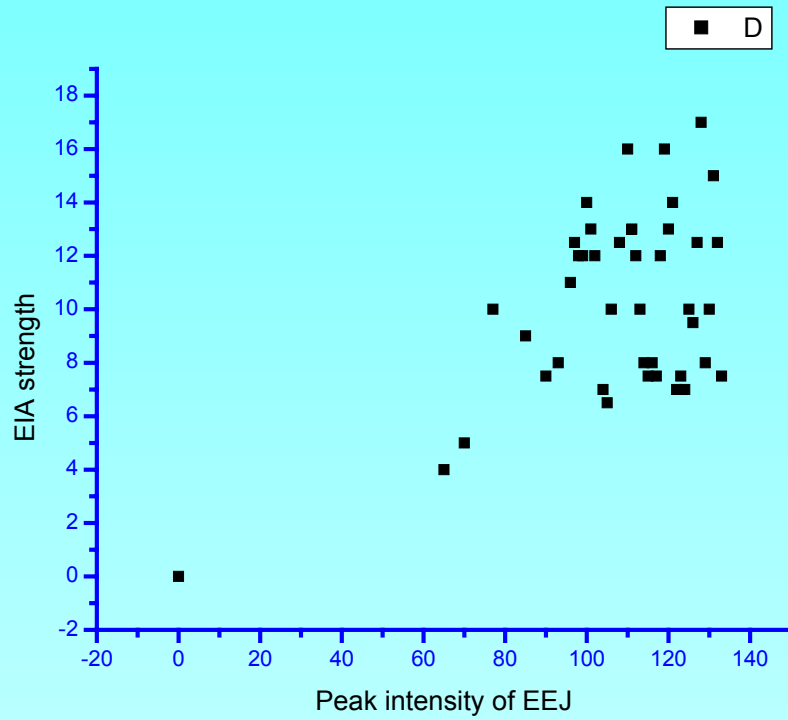


Asymmetry?

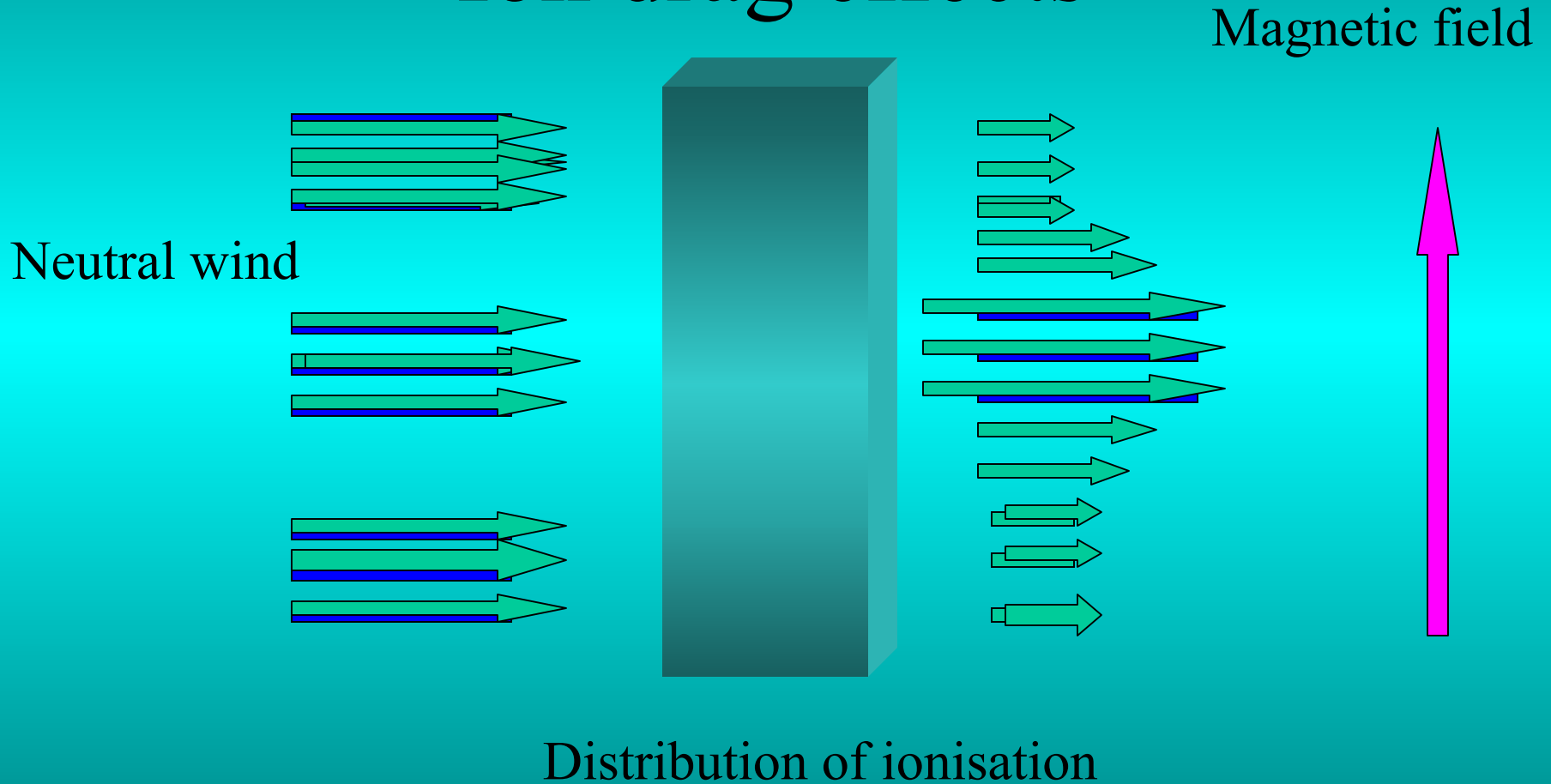
Equatorial Ionisation Anomaly (EIA)

Latitudinal distribution of electron density over equatorial region

Common driving force for EEJ and EIA

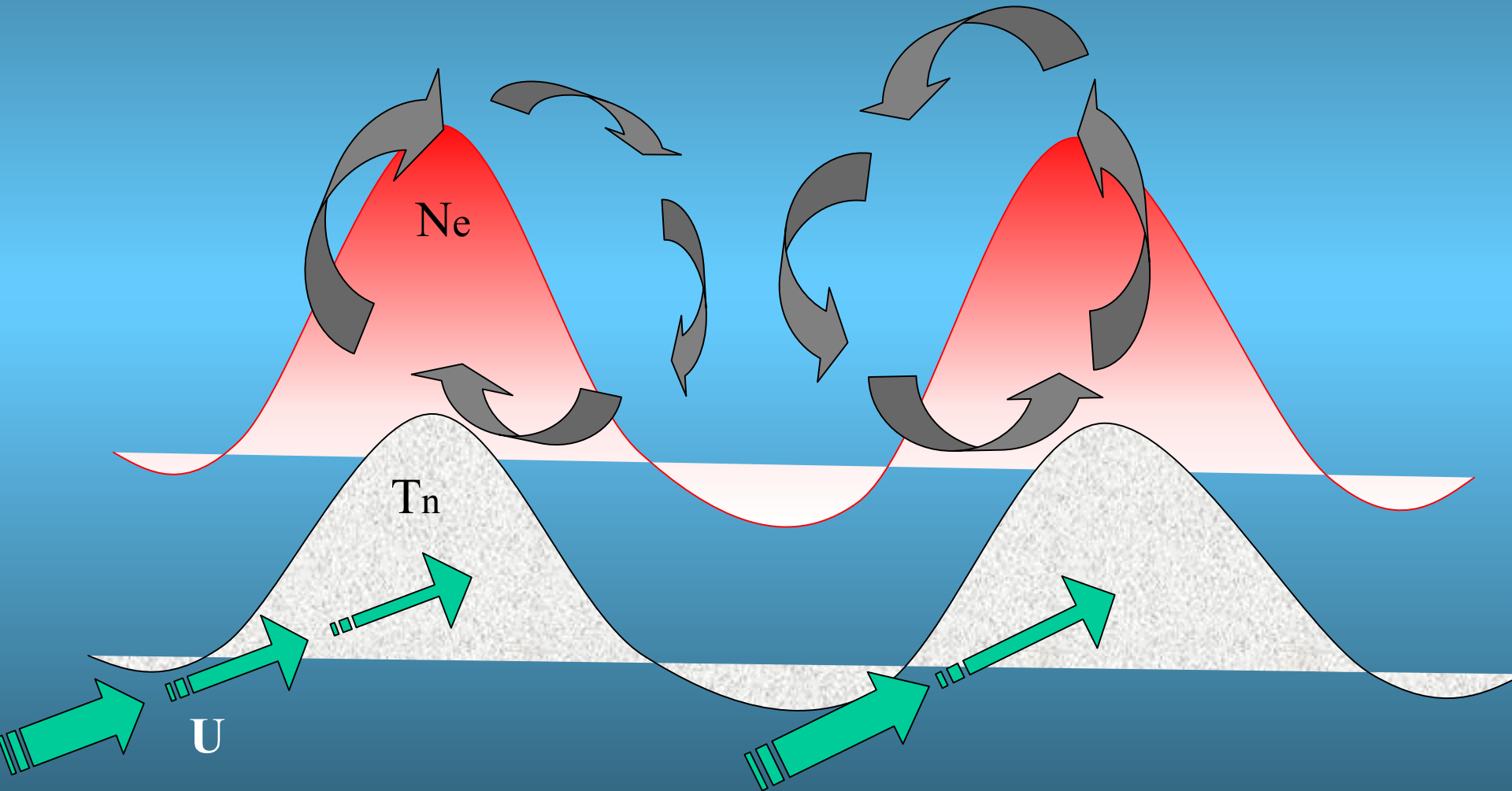


Ion drag effects



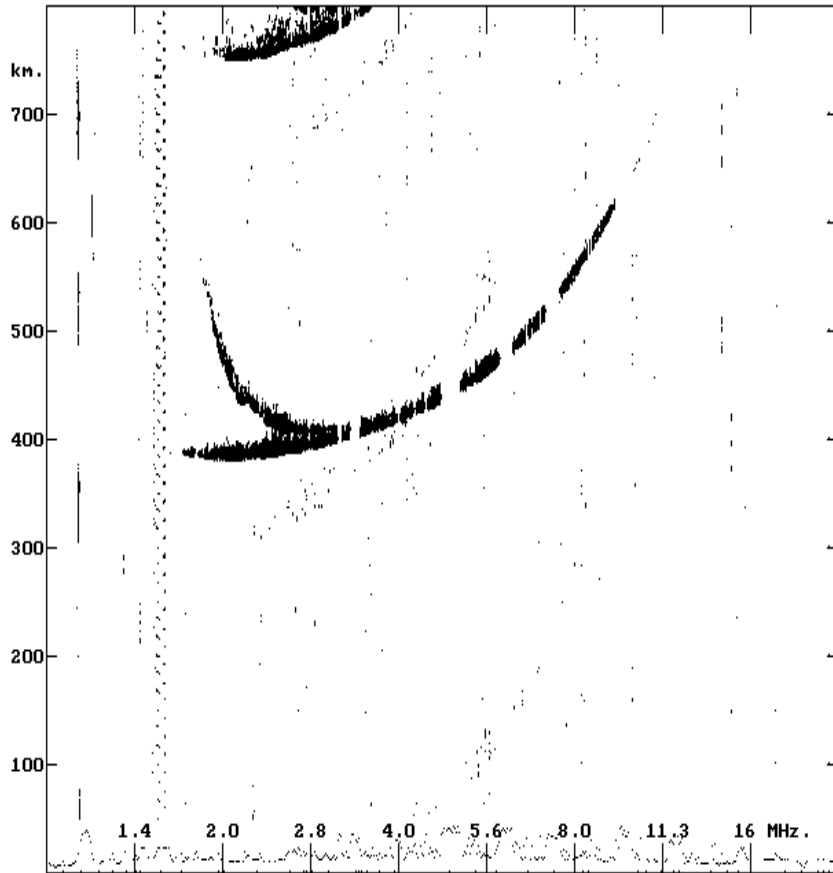
Equatorial Temperature And Wind Anomaly (ETWA)

Exothermic reaction and frictional heating due to ion drag

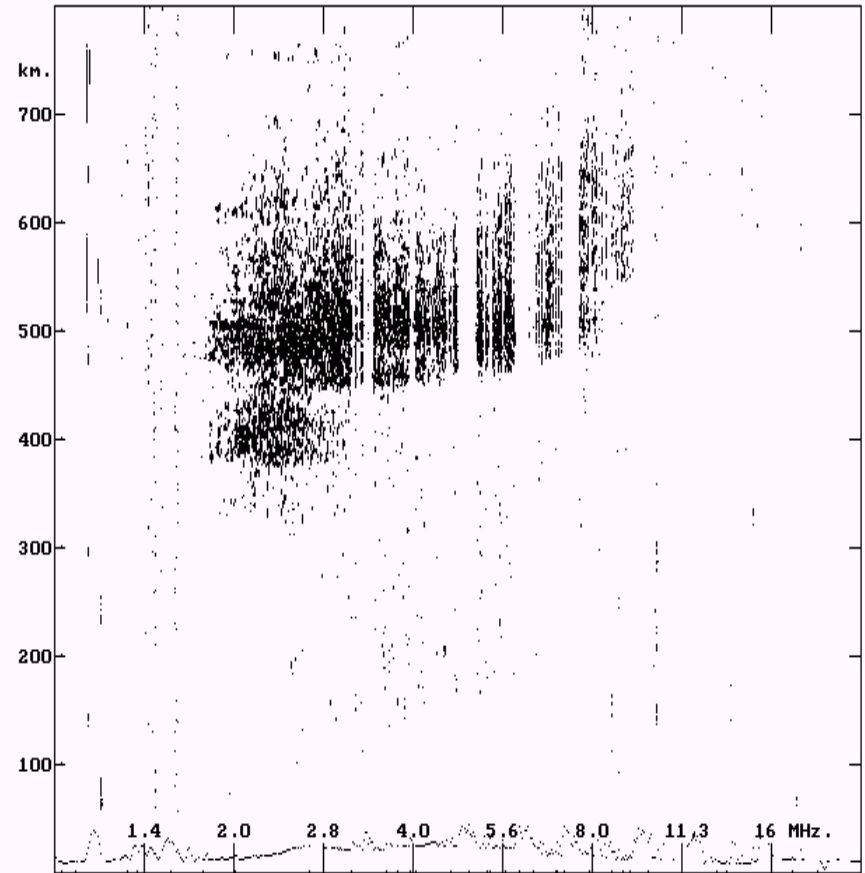


Equatorial Spread-F (ESF)

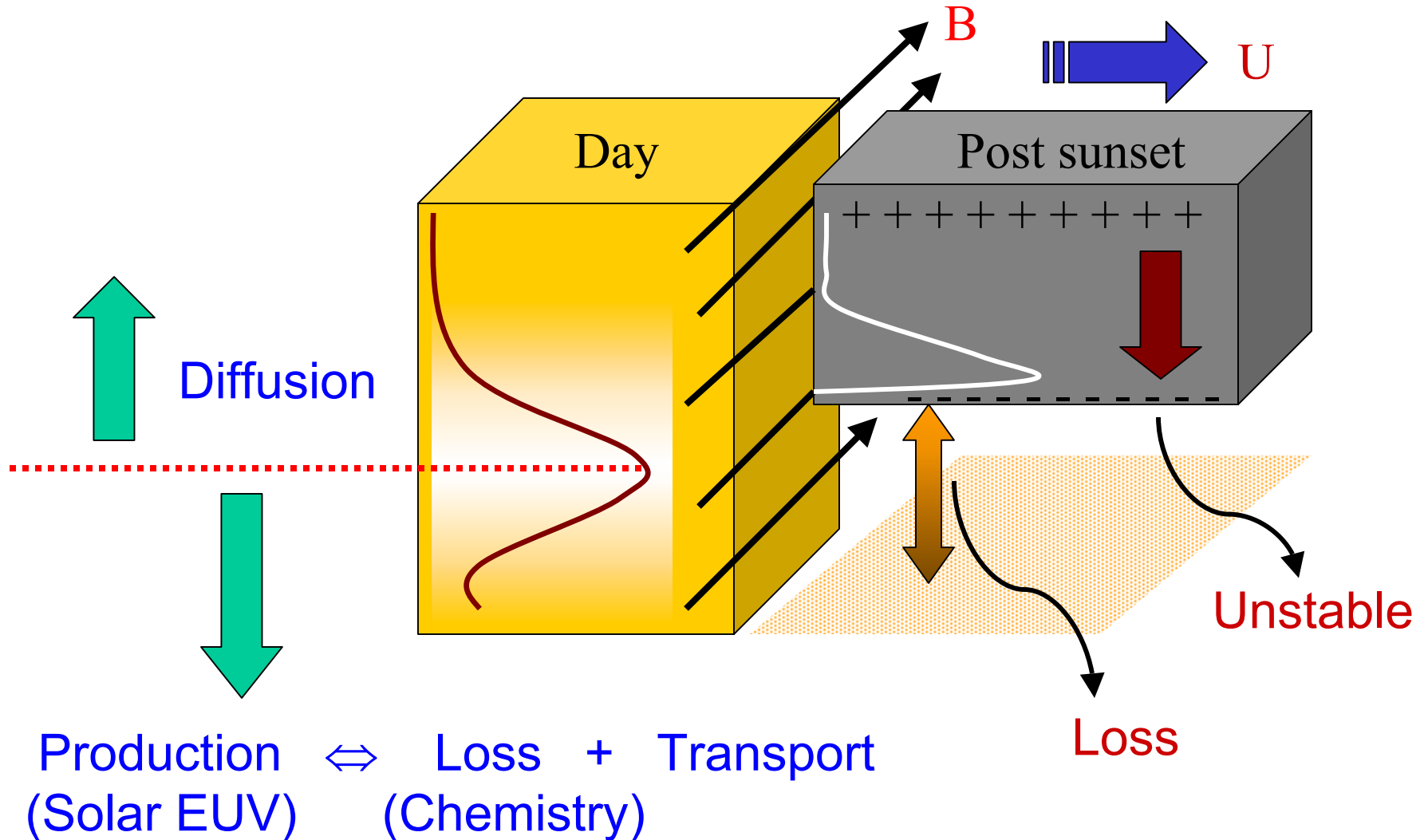
TRIVANDRUM 03/03/02 at 19:00.1

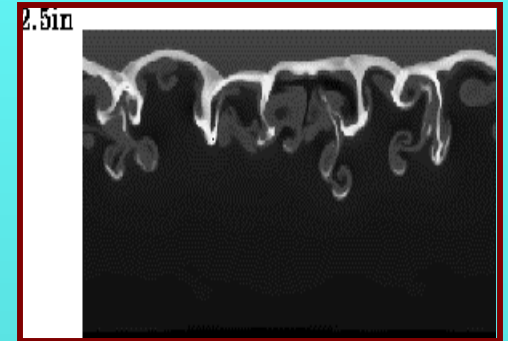
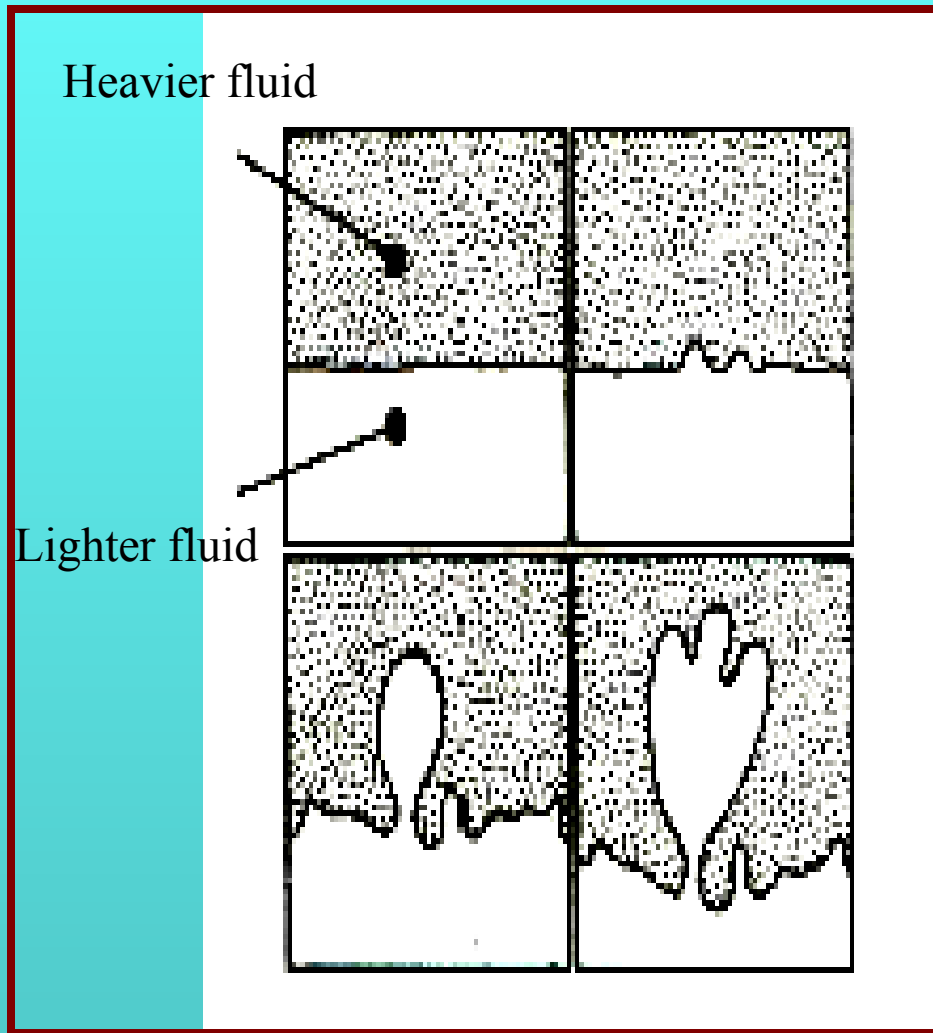


TRIVANDRUM 03/03/02 at 21:00.1

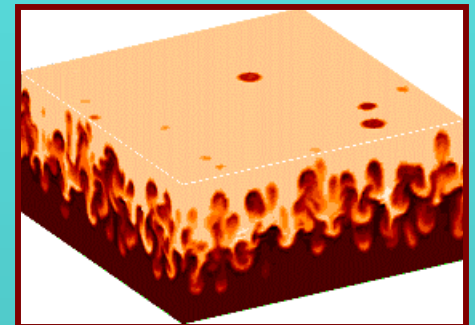


The Unstable Ionosphere





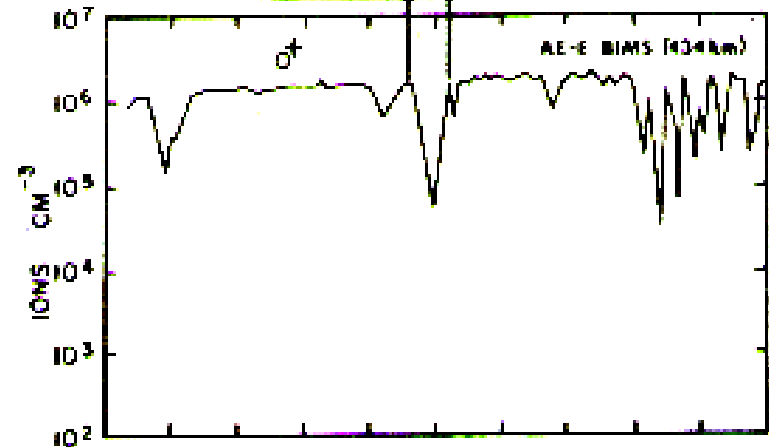
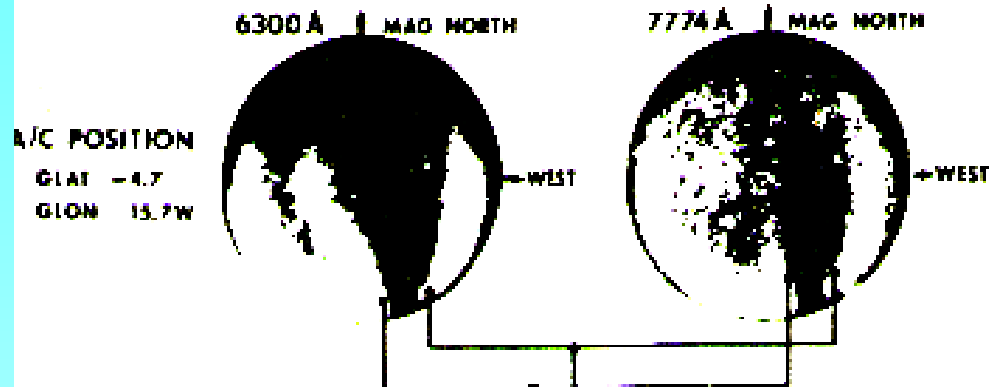
$$\Gamma = 1/L \text{ (g/vin)}$$



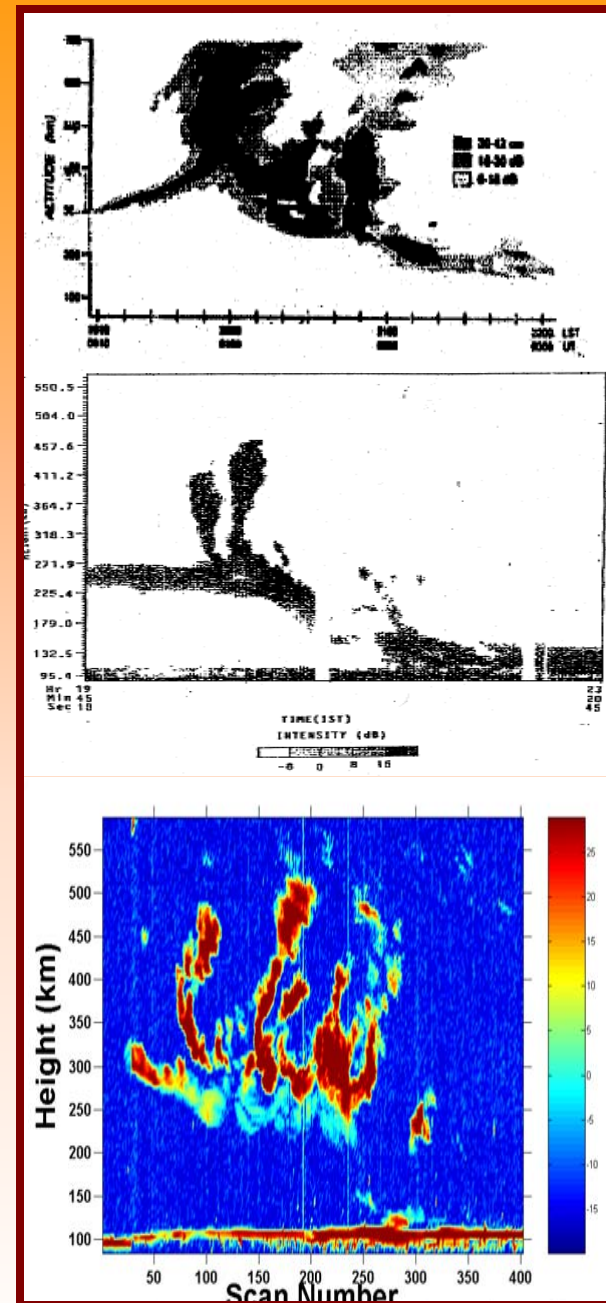
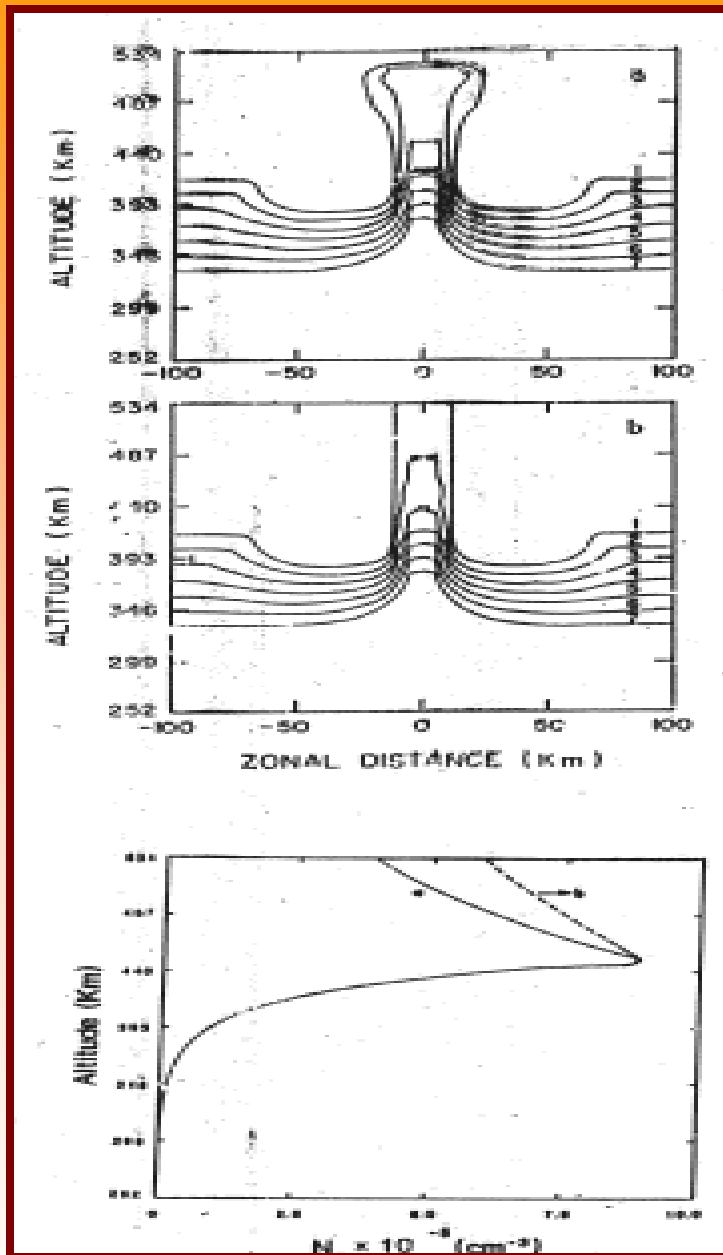
Basic Concept of RT instability

Various manifestations....

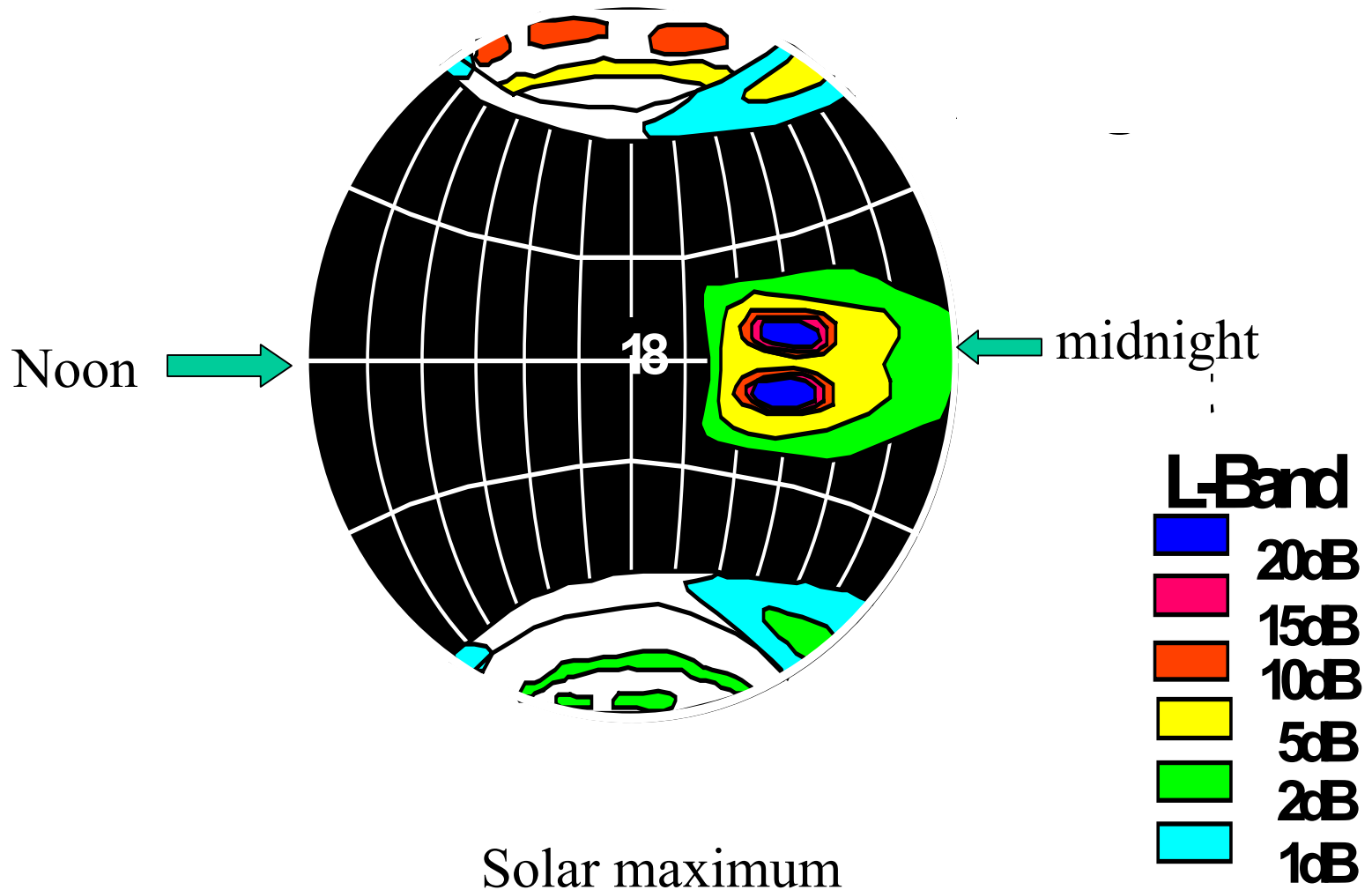
15 DECEMBER 1979



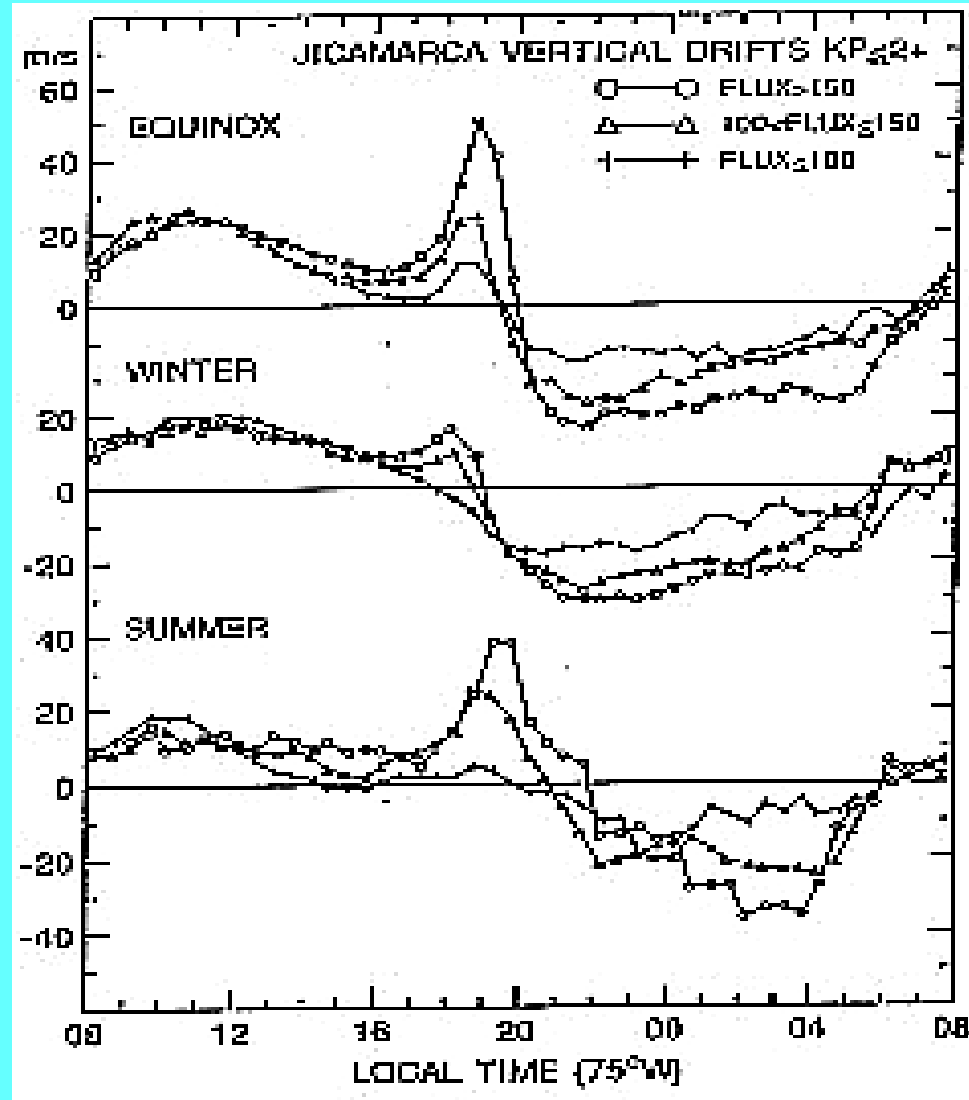
0035	0033	0031	0029	0027	0025	UT					
-12.9	-13.8	-14.4	-14.7	-14.4	-13.9	-13.1	-12.2	-11.1	-10.0	MLAT	
-2.1	-3.4	-4.6	-5.9	-7.1	-8.3	-9.5	-10.6	-11.7	-12.7	-13.7	GLAT
0.3	3.6	7.0	10.4	13.8	17.3	20.7	24.2	27.8	31.3	34.4	GLON (W)
0034	0005	2336	2306	2236	2208						LT (H:M)

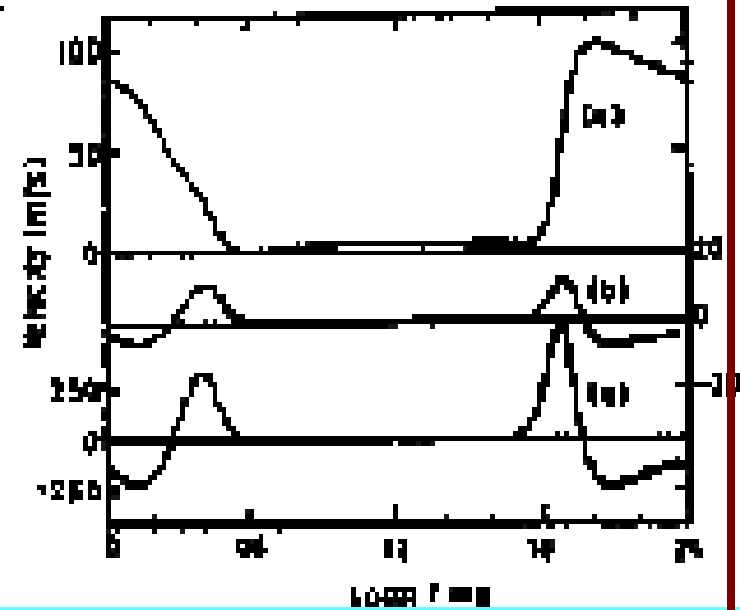
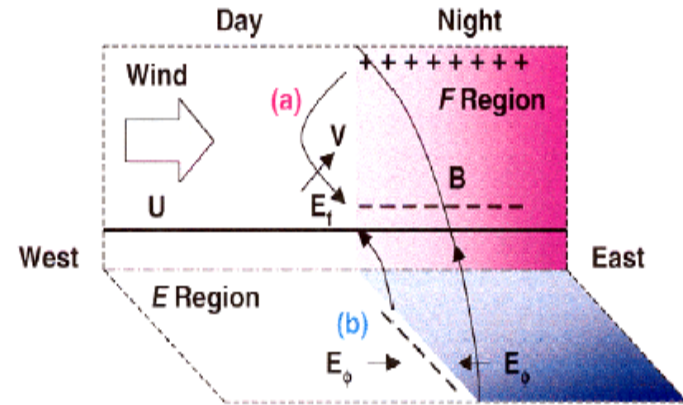
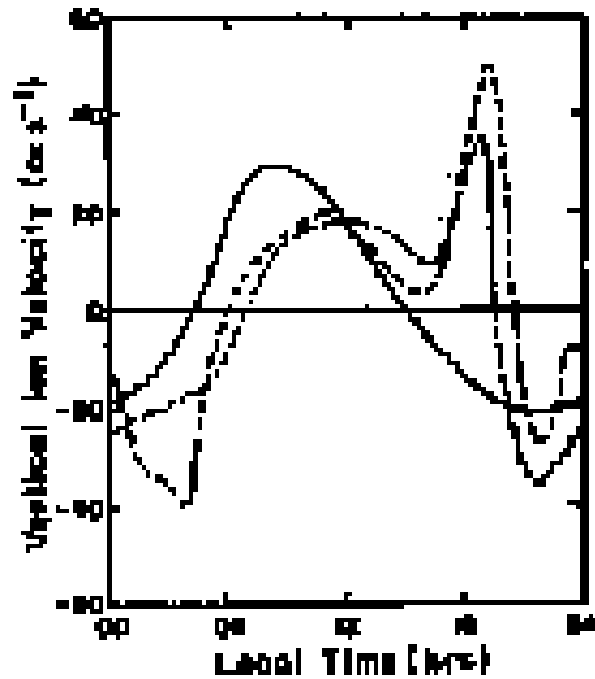
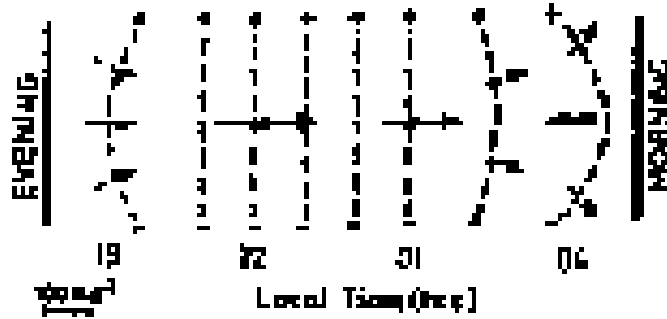


Occurrence pattern of average scintillations

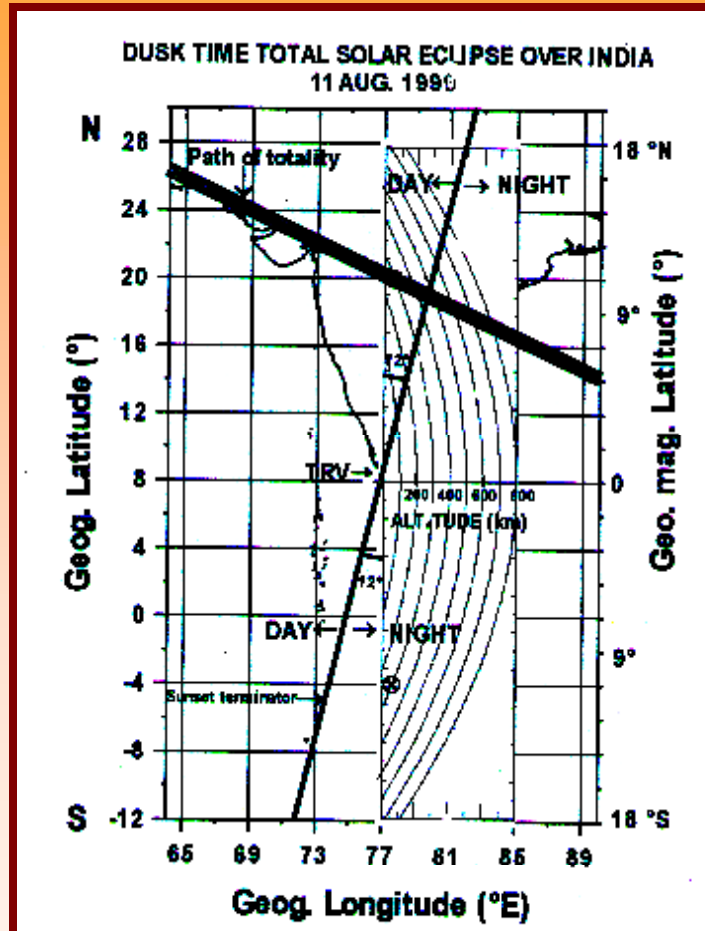


Pre-requisite for ESF - PRE



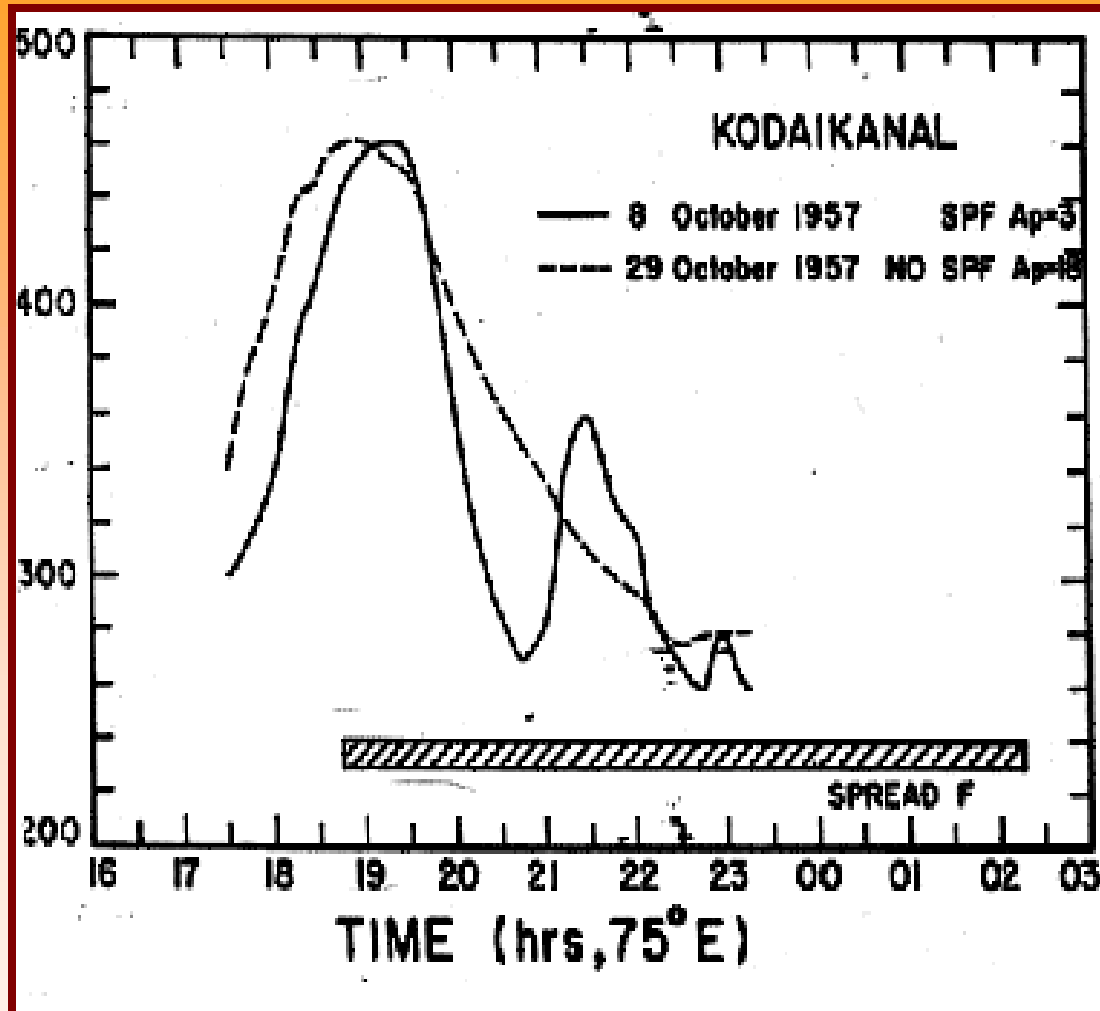


Rishbeth, Heelis, Farley ..



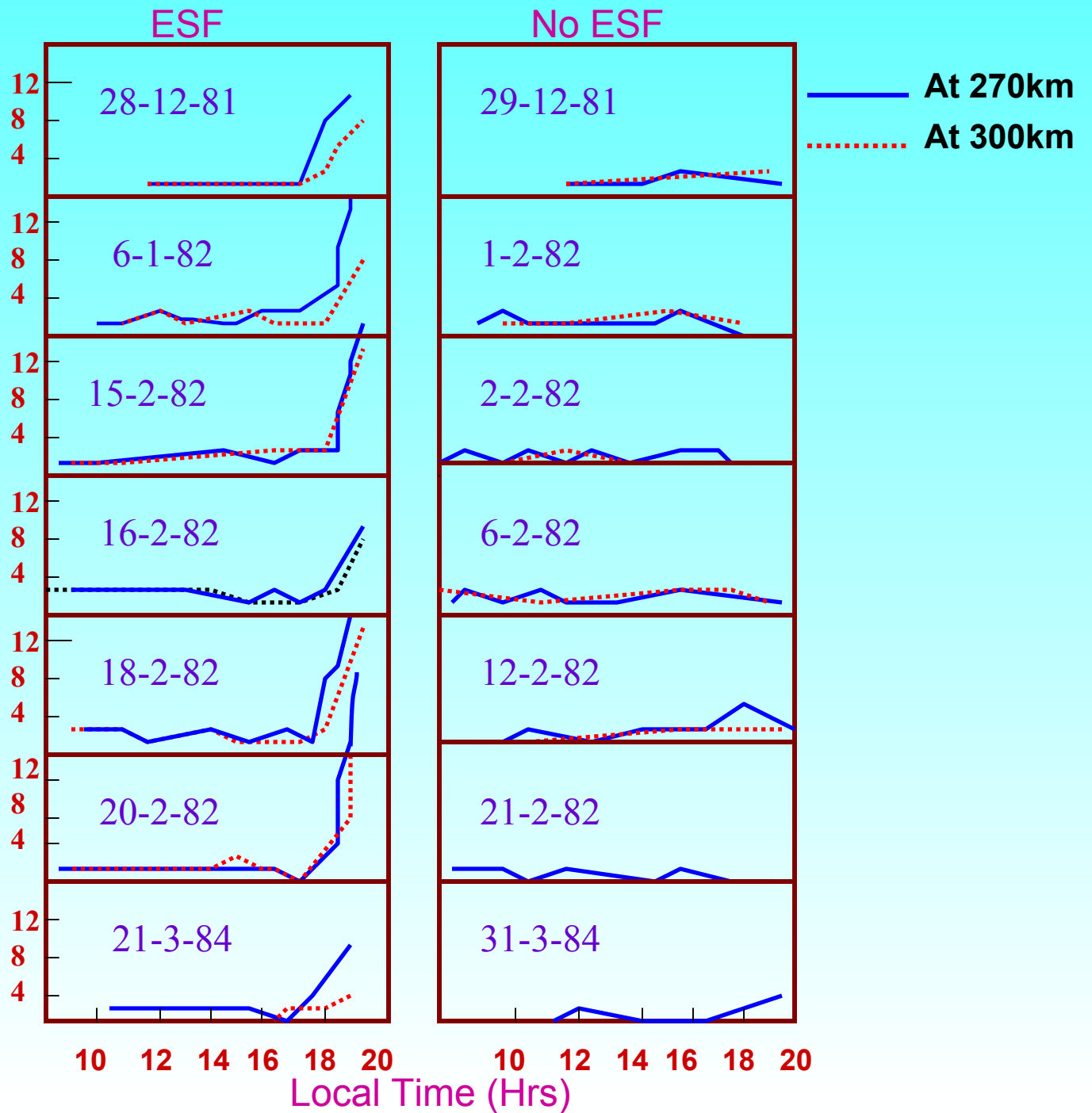
Causative mechanism for the post sunset enhancement

Enigma :

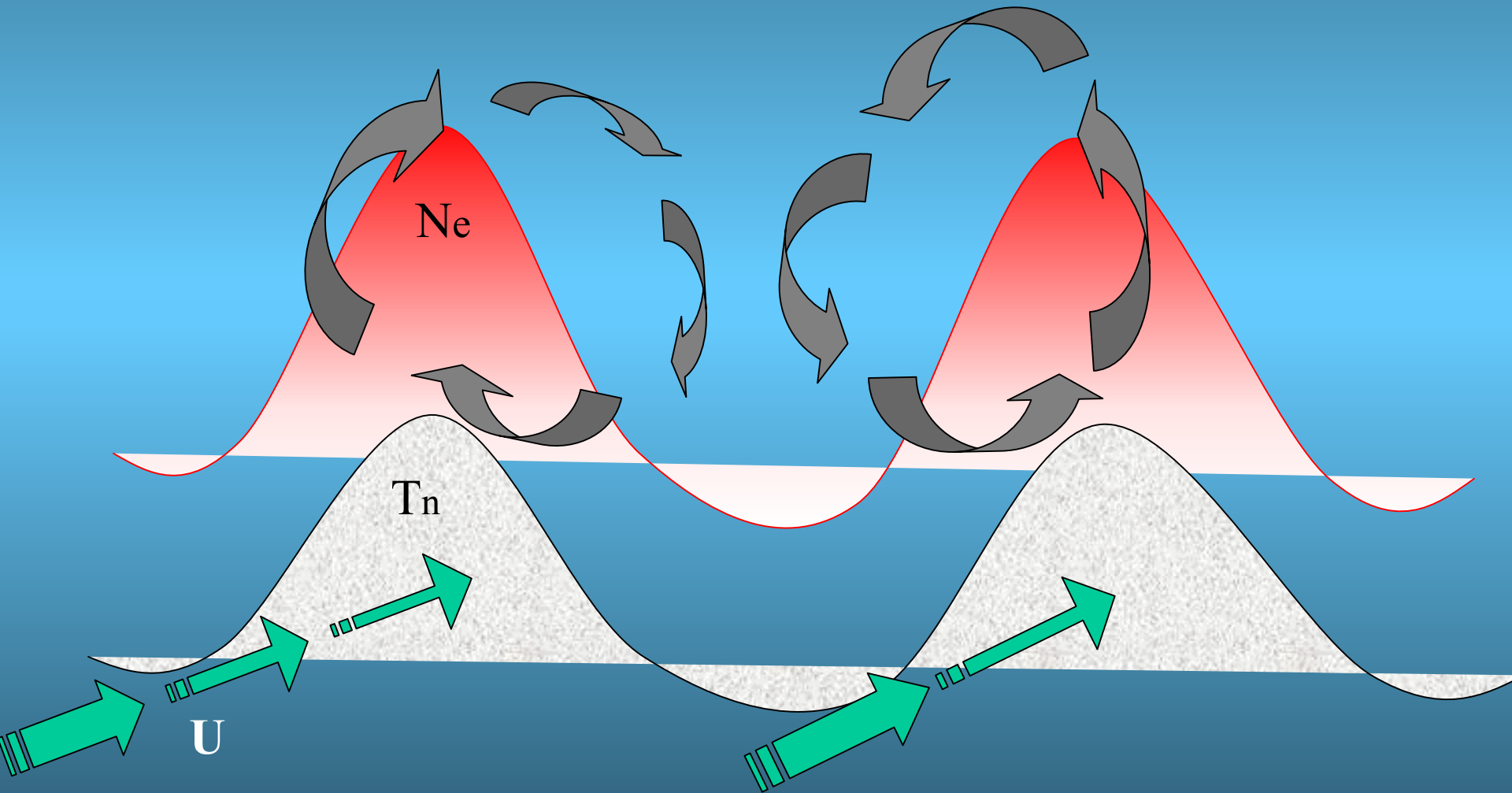


Need for other forcings

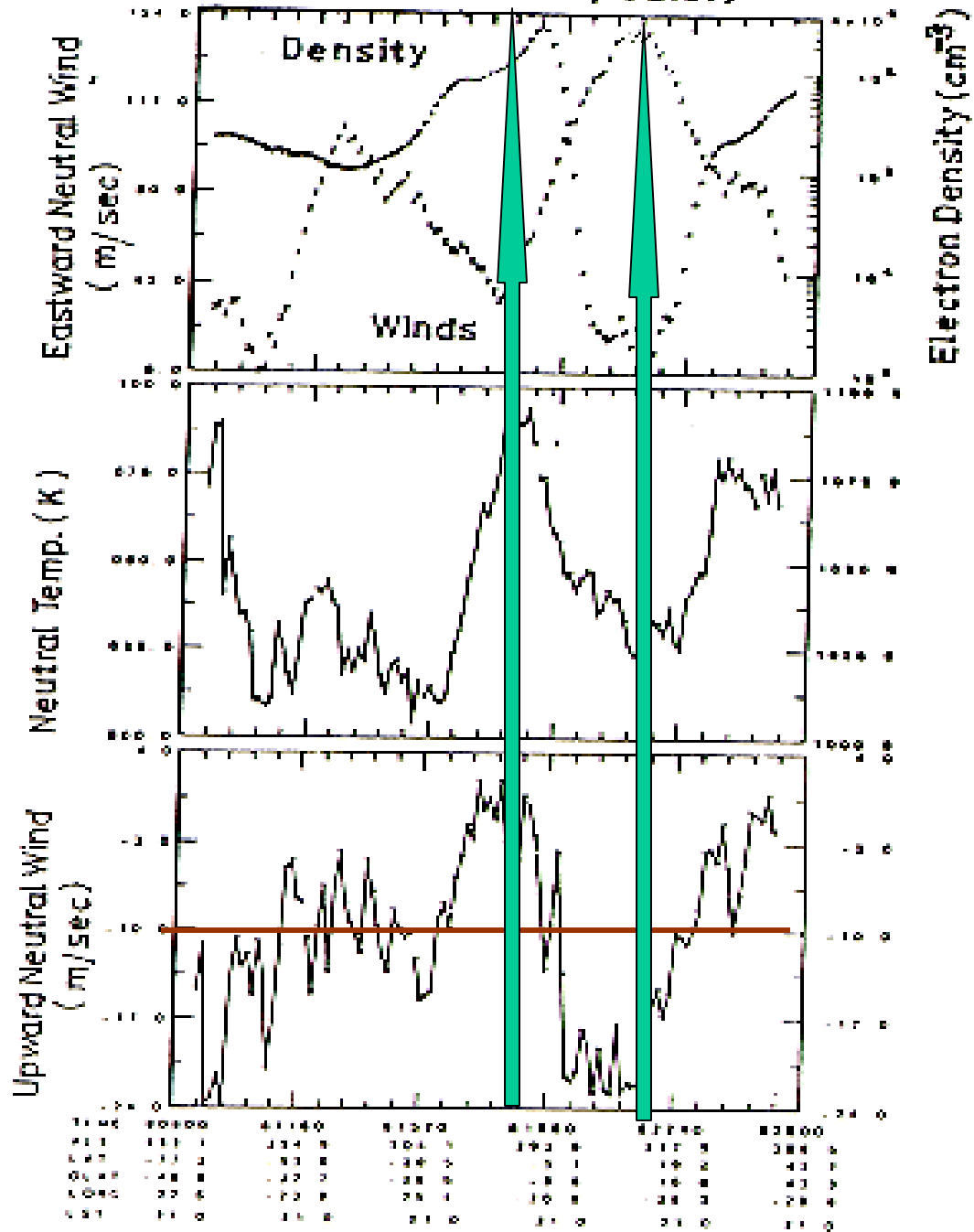
Electron Density Ratio (N_A/N_W)



Equatorial Temperature And Wind Anomaly (ETWA)

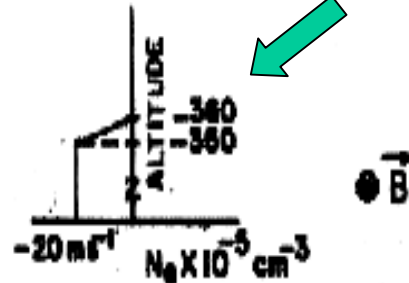
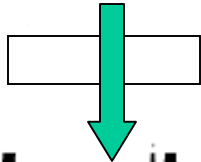


DE-2 (Orbit 3838, Day 82107)

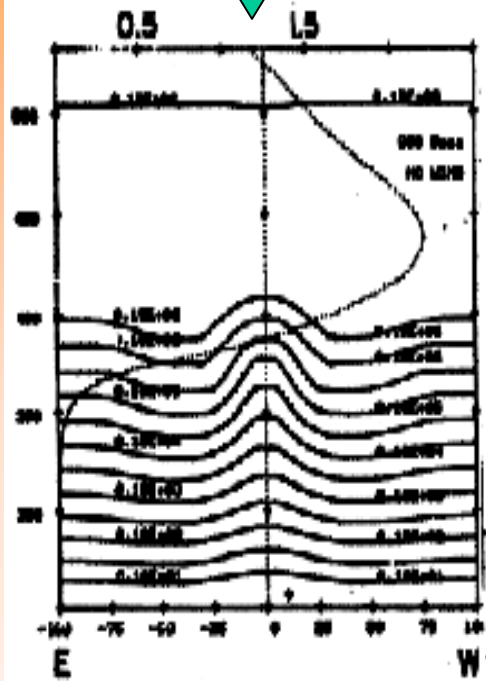


Vertical wind

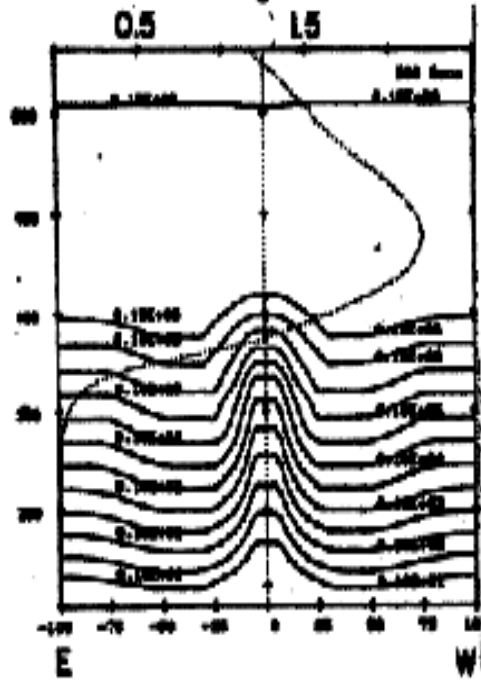
No wind



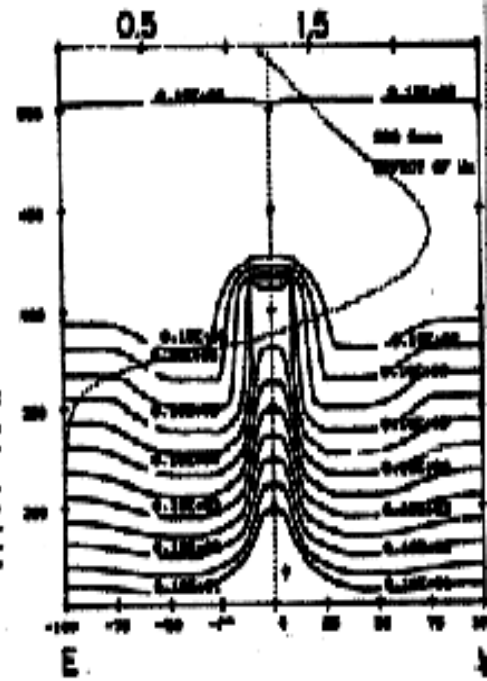
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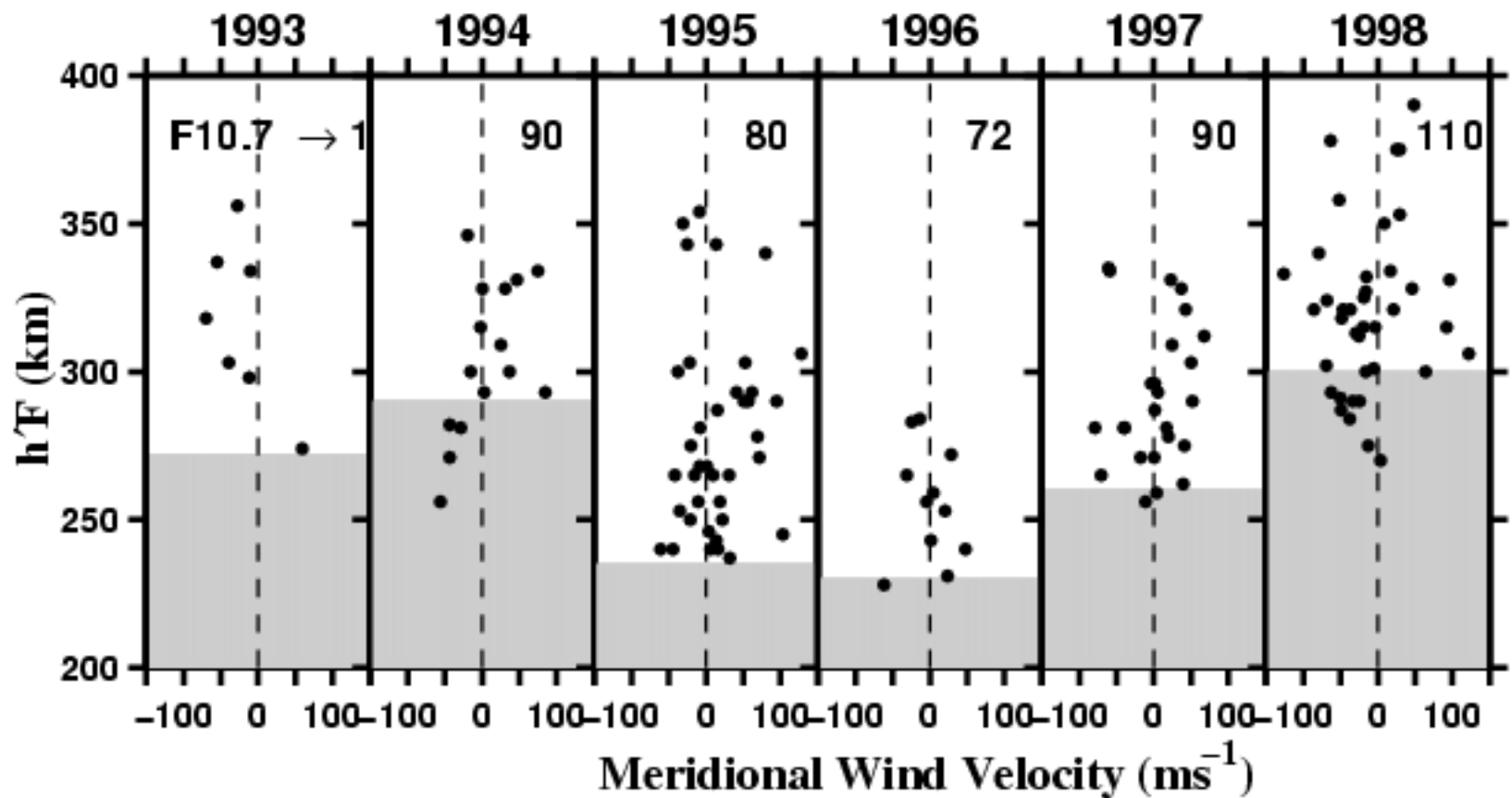
Zonal distance



Zonal distance



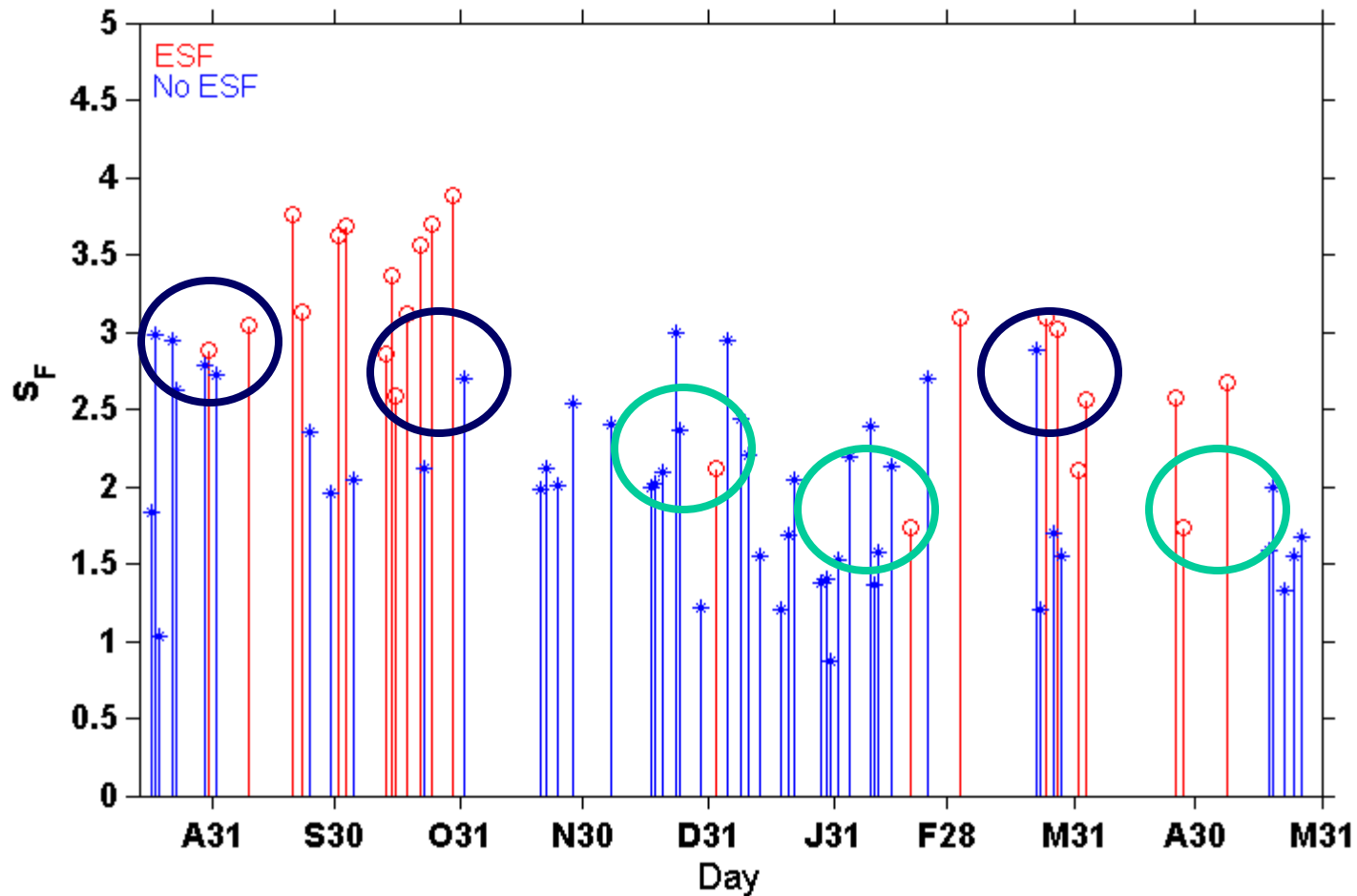
Zonal distance



EIA strength and the occurrence of post-sunset ESF

Strength of EIA in terms of gradients

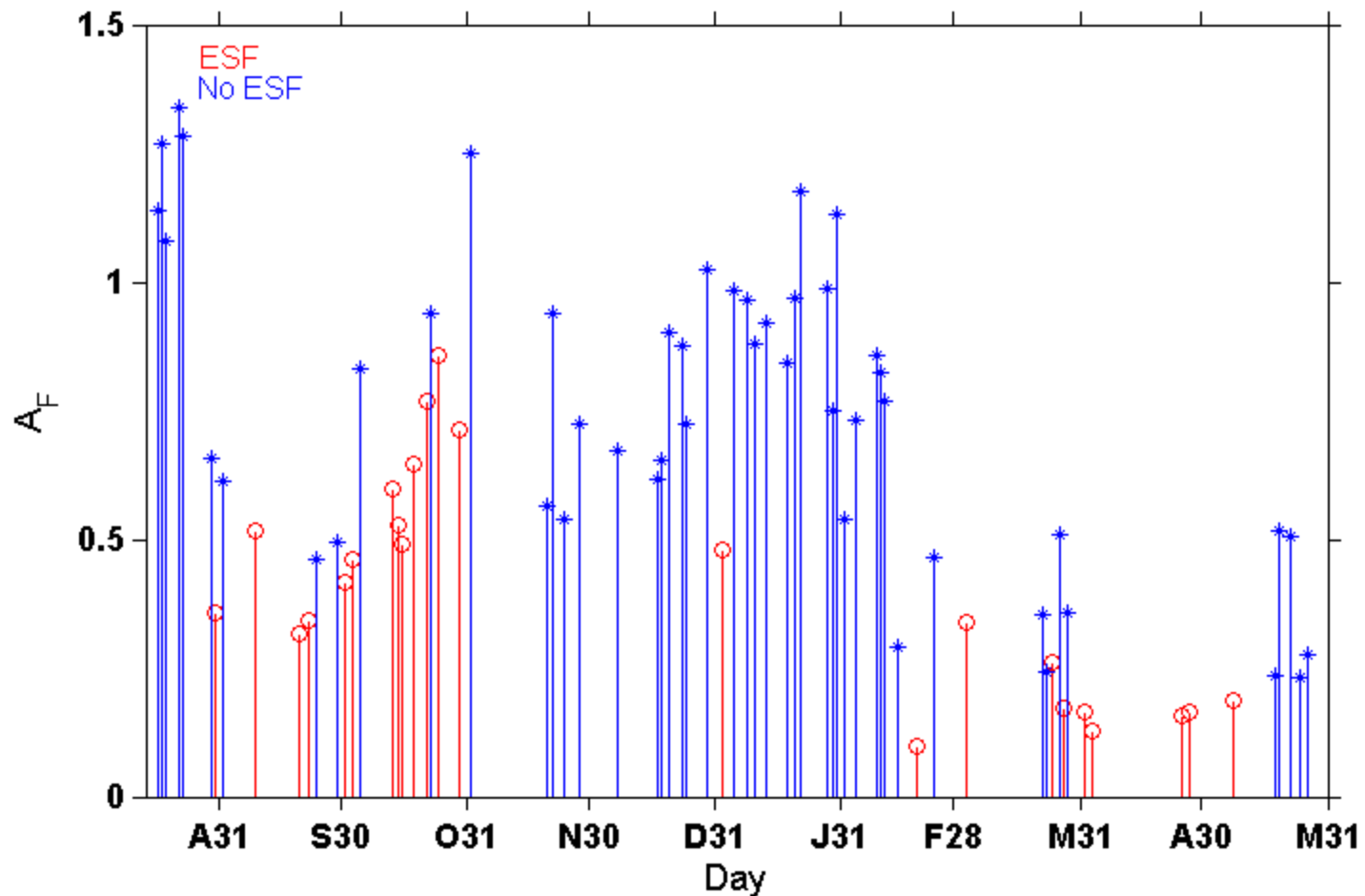
$$S_F = \left(\frac{N + S}{2} \right)$$



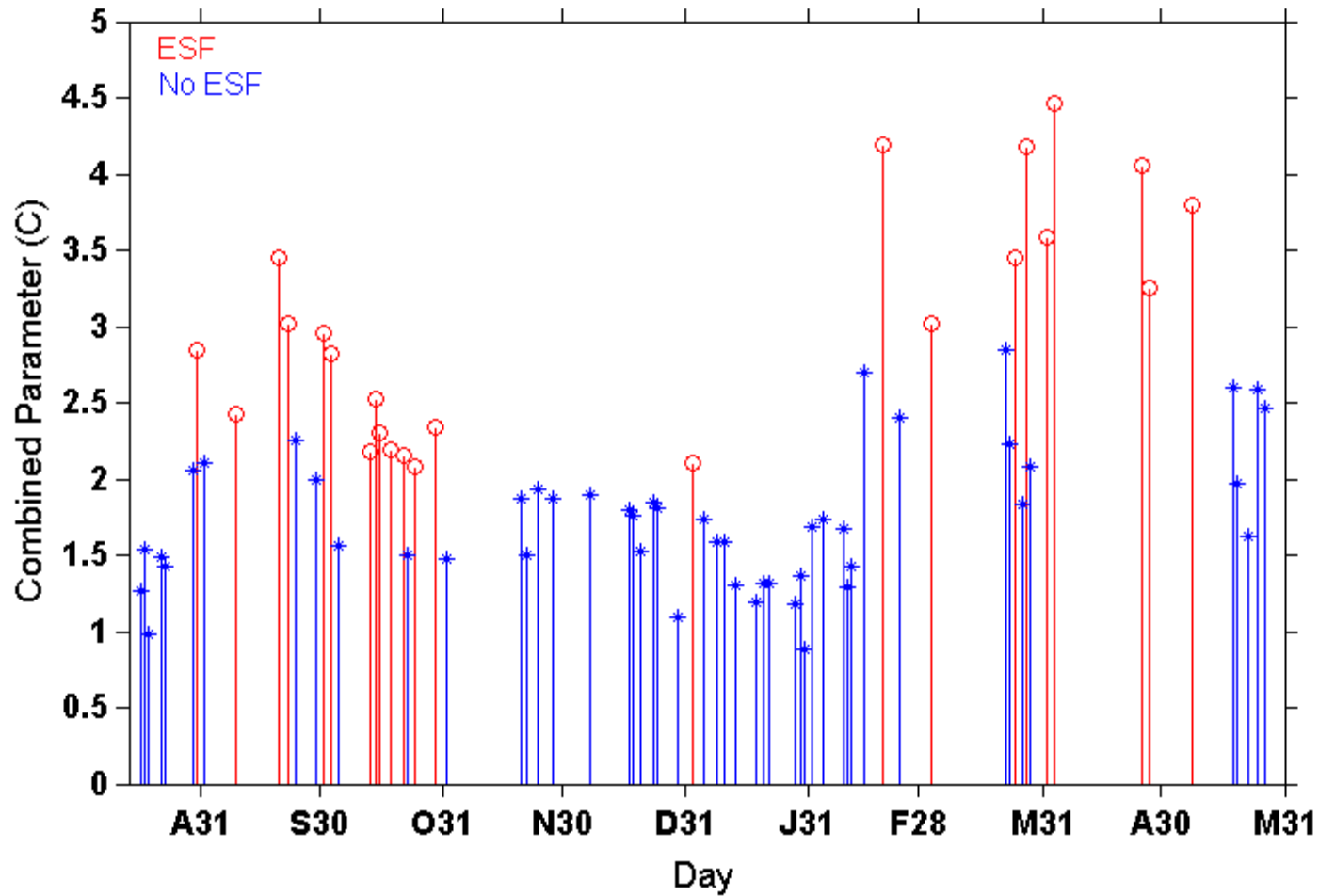
EIA Asy. and the occurrence of post-sunset ESF

$$A_F = \left(\frac{N - S}{S_F} \right)$$

Asymmetry of EIA in terms of gradients

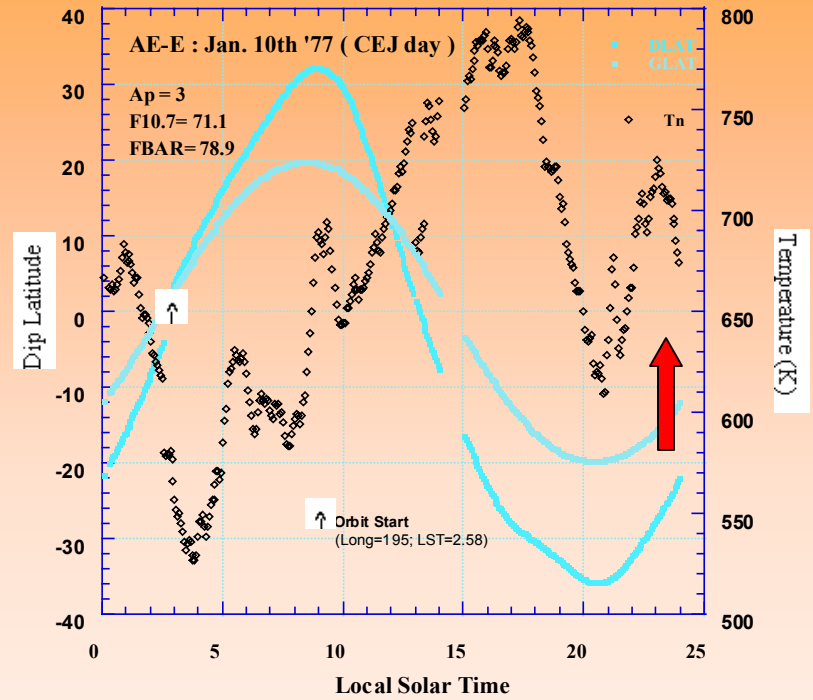
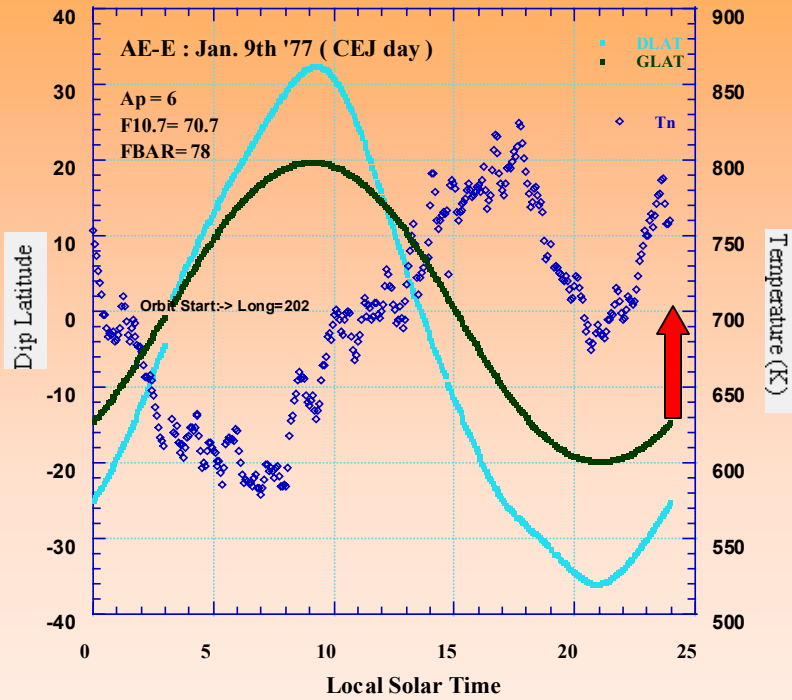


$$C = \sqrt{\frac{S_F}{abs(A_F)}} = \frac{S_F}{\sqrt{abs(N - S)}}$$

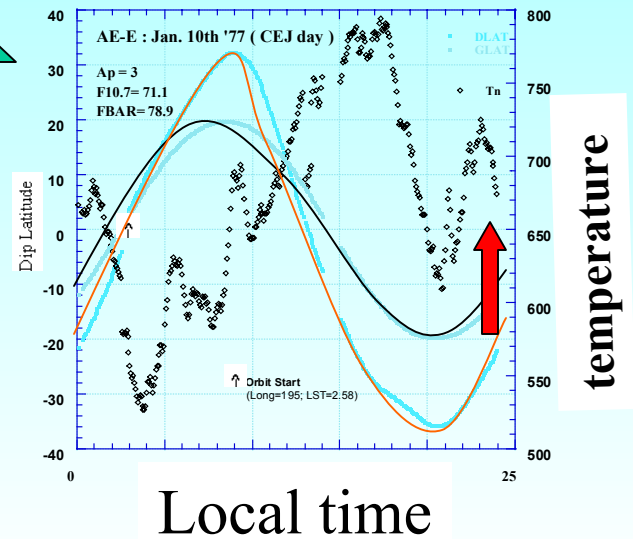
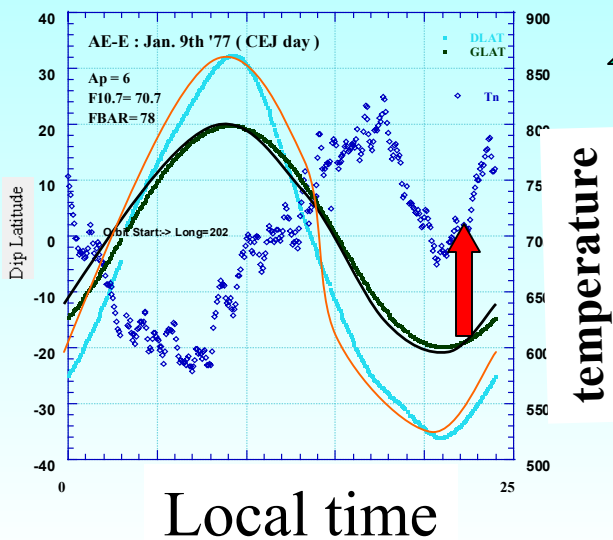
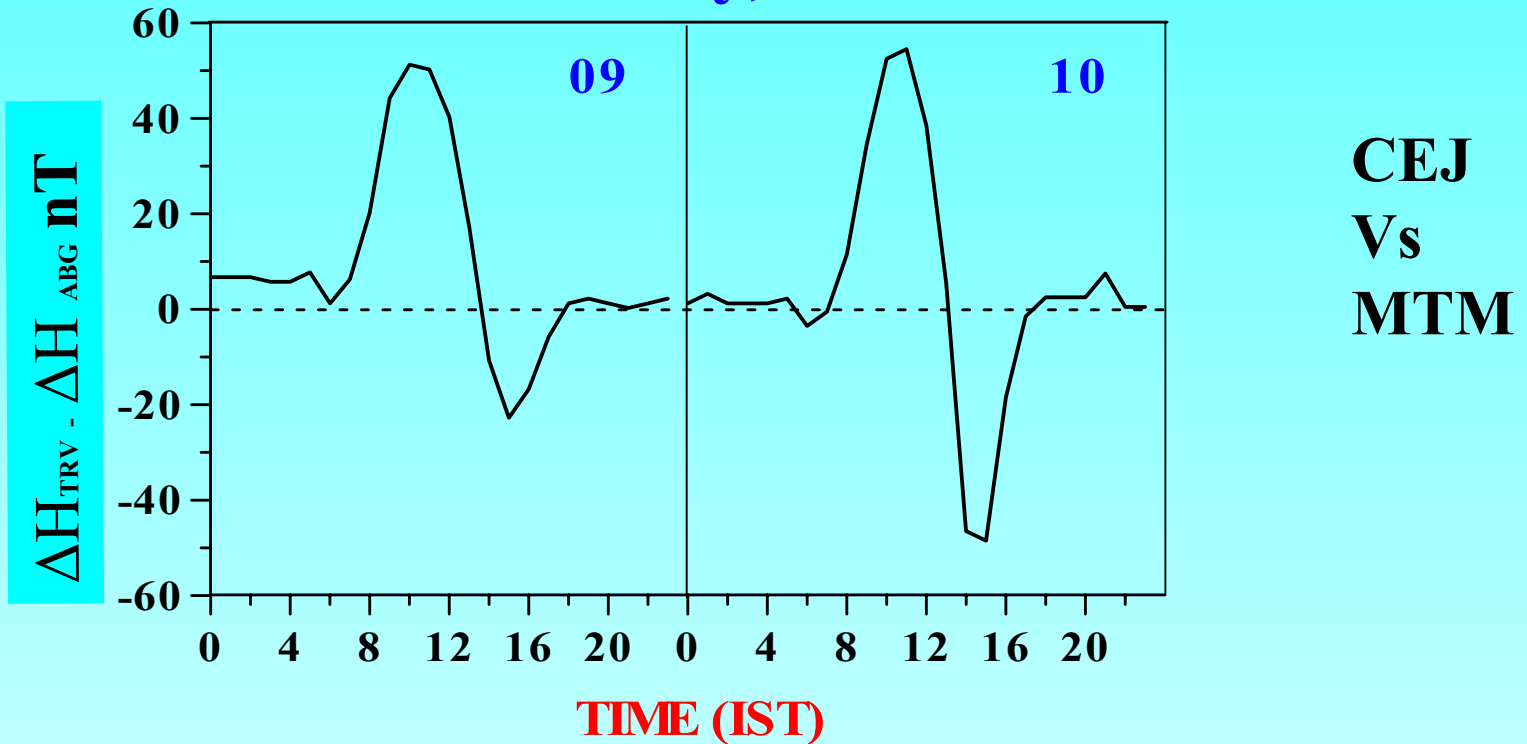


Thampi et al., GRL 2006

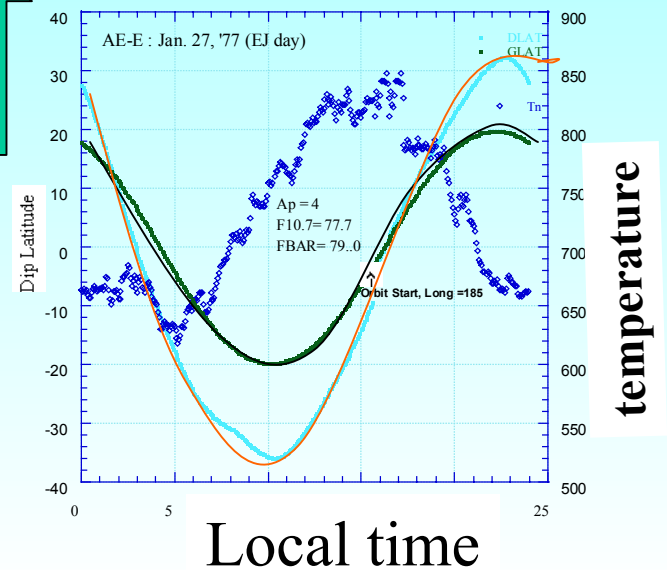
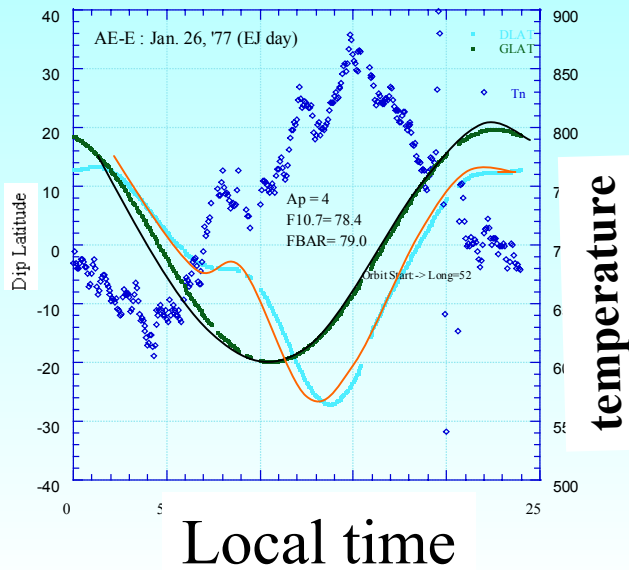
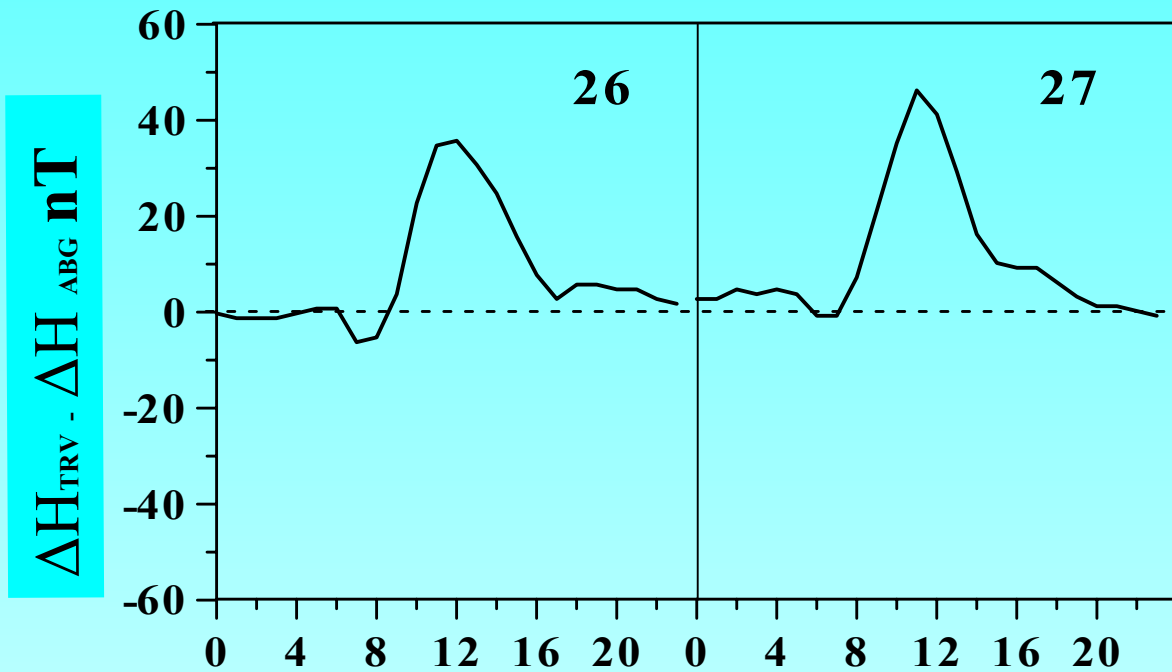
Mid night temperature maximum



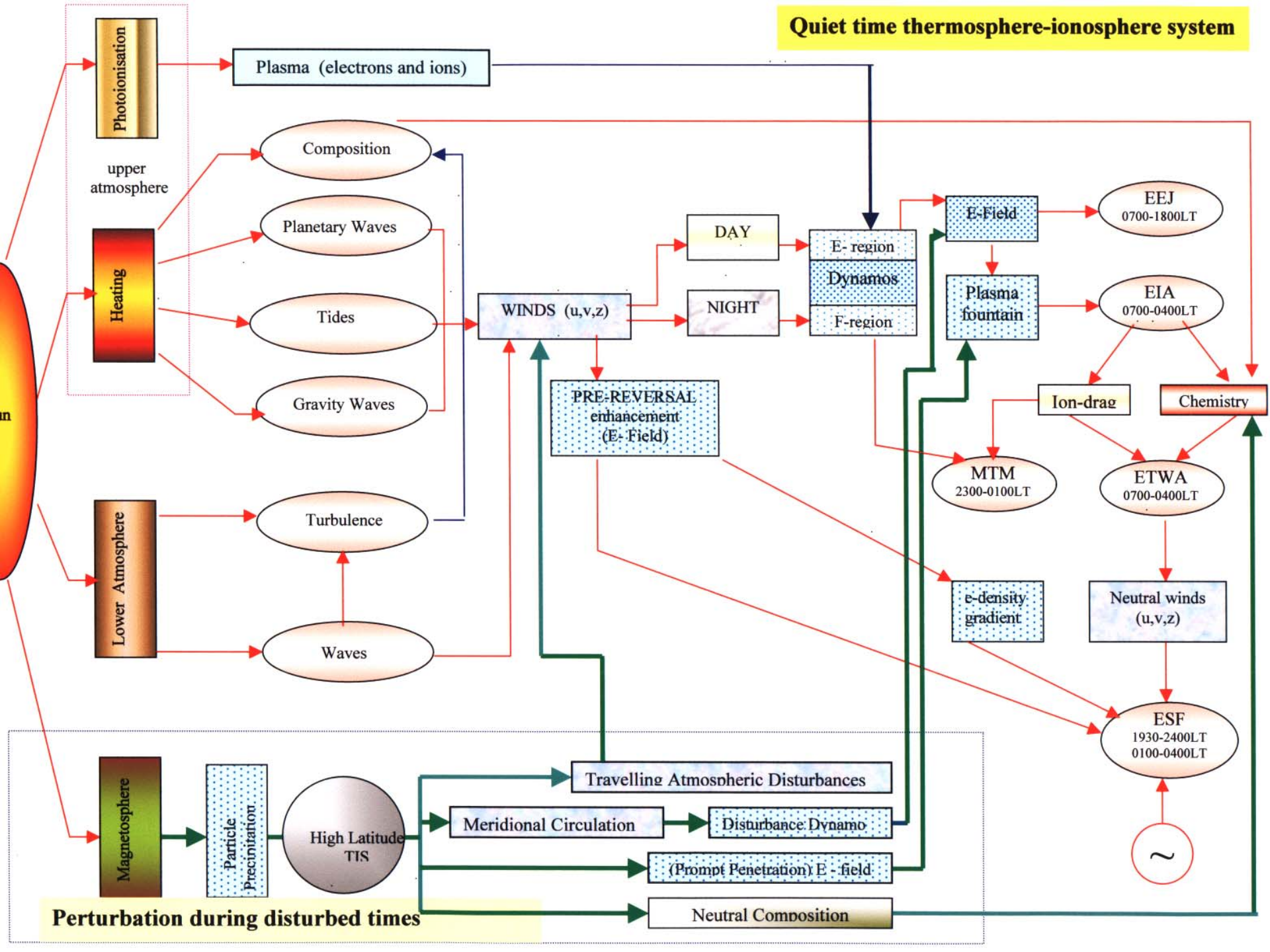
January, 1977



January, 1977



Quiet time thermosphere-ionosphere system



Thank you