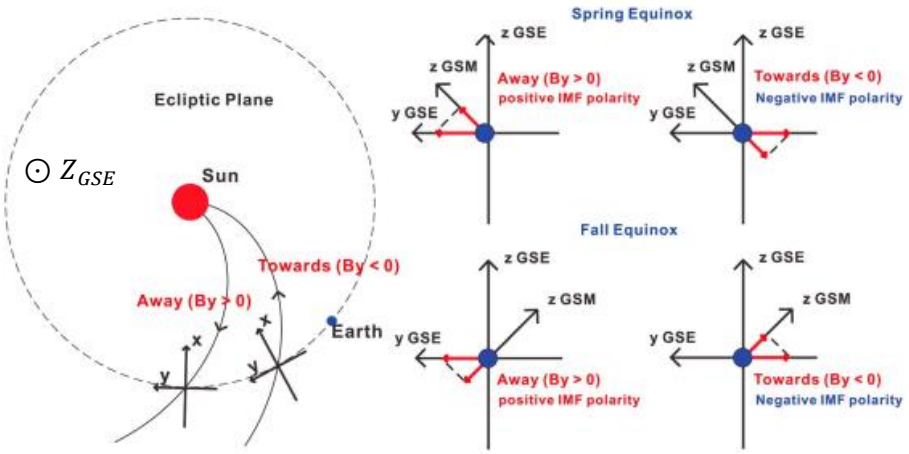
Russel-McPherron, Equinoctial and Axial effects on geomagnetic activity

DLR-SO SKP PhD Seminar

November 18, 2021

Russel-McPherron Effect

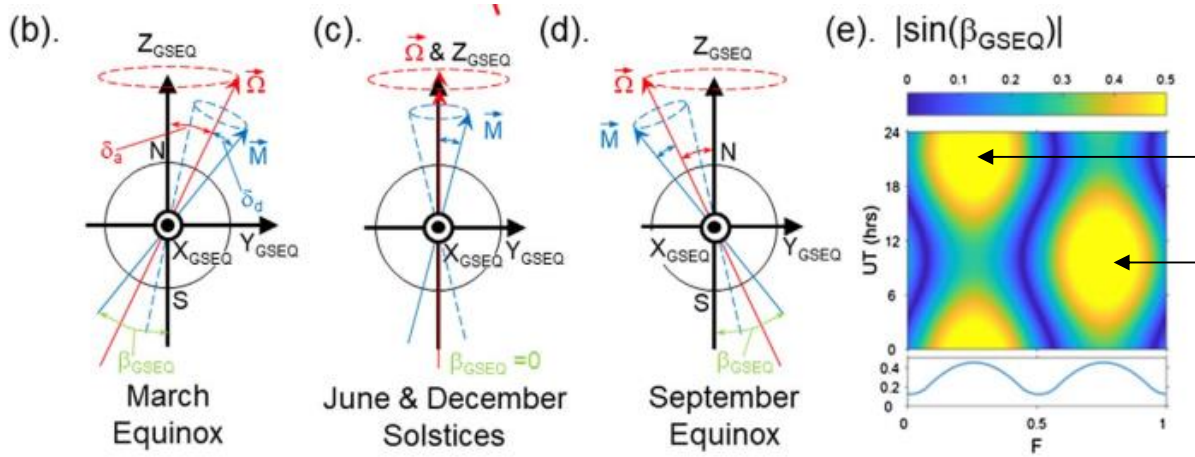


GSE ↔ GSEQ (small angle)

Assumption: $[B_z]_{GSEQ} = 0$

Problems:

- $[B_z]_{GSE} \ll 0$ events are dominant cause of $[B_z]_{GSM} < 0$
- $F - UT$ pattern not observed in geomagnetic activity indices



local dusk at earth northern geomagnetic pole

local dawn at earth northern geomagnetic pole

$LT \approx UTC - 5$

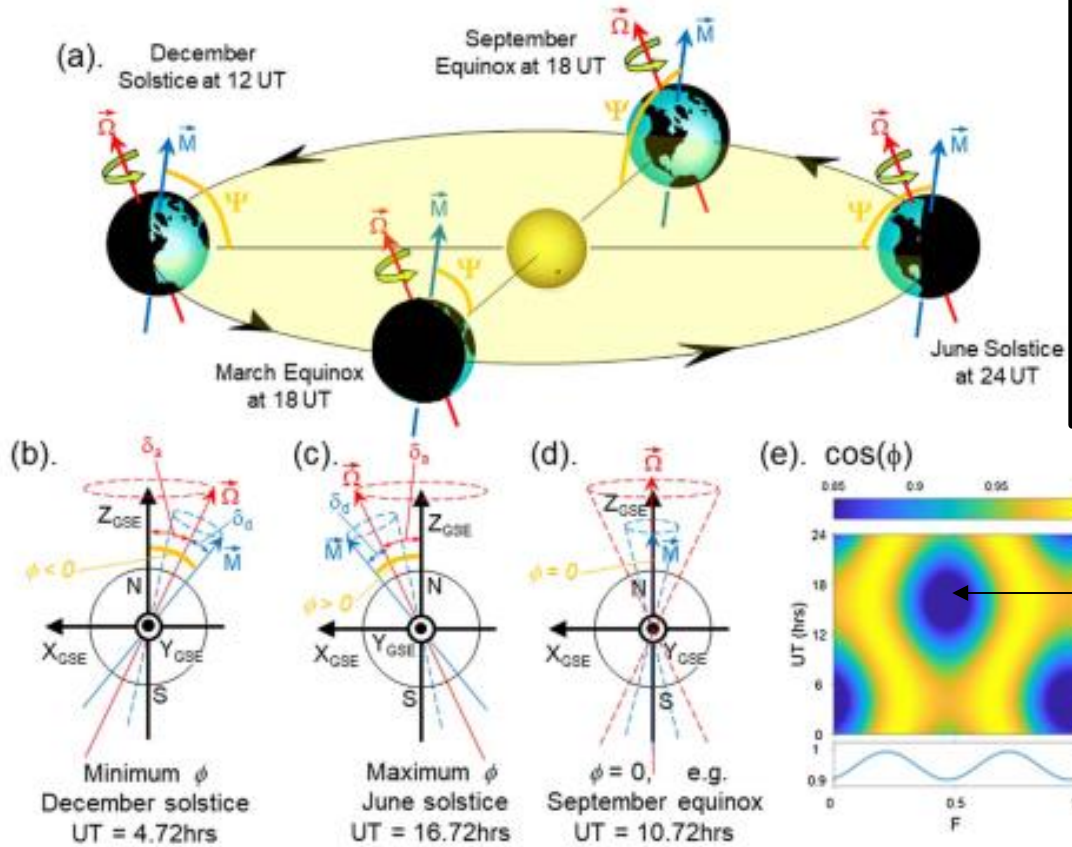
The Equinoctial effect

Geomagnetic activity indices fit $F - UT$ pattern well

Suggested effects that depend on ϕ:

- Kelvin-Helmholtz instability of magnetopause
- stand-off distance of solar wind
- reconnection voltage of dayside magnetic field lines
- tilt-induce changes in ionospheric conductivities
- …

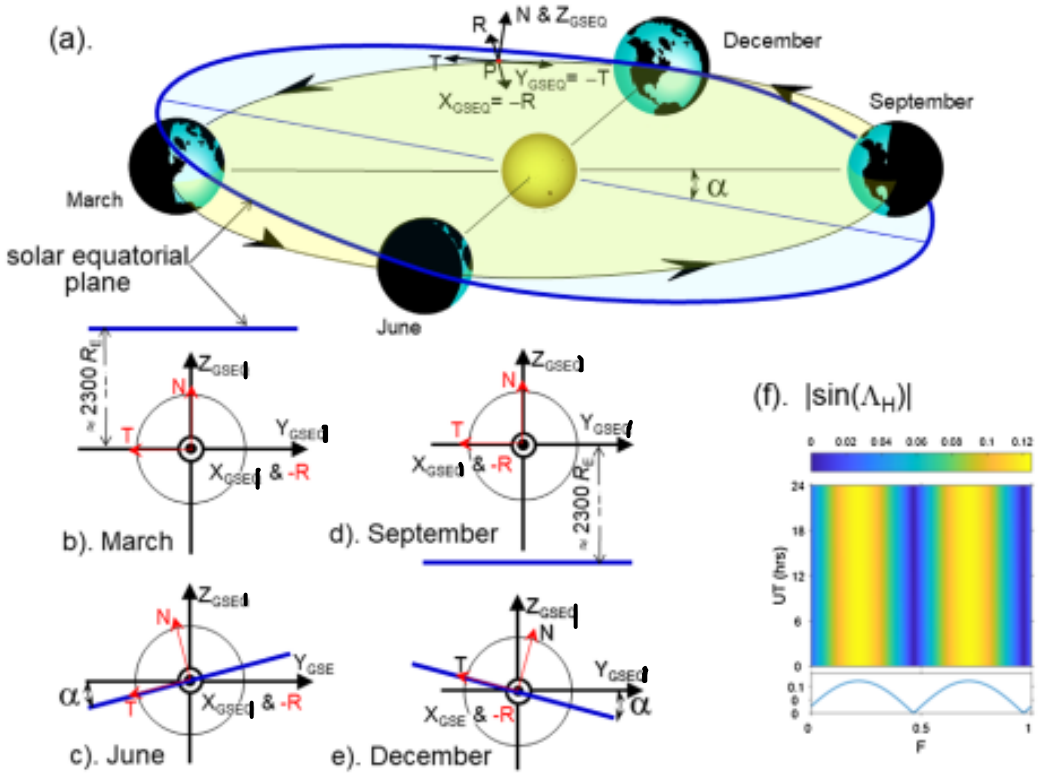
➔ remains open to debate



local noon at earth northern geomagnetic pole

local midnight at earth northern geomagnetic pole

The Axial effect



- difference between GSE and GSEQ becomes important now
- higher chance to encounter fast solar wind at higher solar magnetic latitudes
- no UT, only F variation
- appears to be seen in *Dst* index, but *Dst* responds to storms which have a 'recharge' time that smooths out UT variation

$$X_{GSEQ} = -R = X_{GSE} \qquad Y_{GSEQ} = -T \qquad Z_{GSEQ} = N$$

Summary and Contradictions

Russel-McPherron effect	Equinoctial effect
• maxima at April 4 and October 7 (2019) • explains southward IMF occurrence during solar quiet times • geomagnetic activity after sudden storm commencements (SSCs) follows R-M pattern	• maxima at equinoxes • geomagnetic indices seem to follow equinoctial effect pattern • explains part(?) of the geomagnetic activity after SSC

➔ strongly contradicting conclusions of different papers

➔ probably both effects contribute (60% Equinoctial, 40% R-M has been suggested?)