

Global S4 Index Max in the Ionosphere Observed by FORMOSAT-3/COSMIC

Tiger J.Y. Liu^{1,2}, S.P. Chen², G.S. Chang¹, C.H. Lin³, T. Y. Liu¹

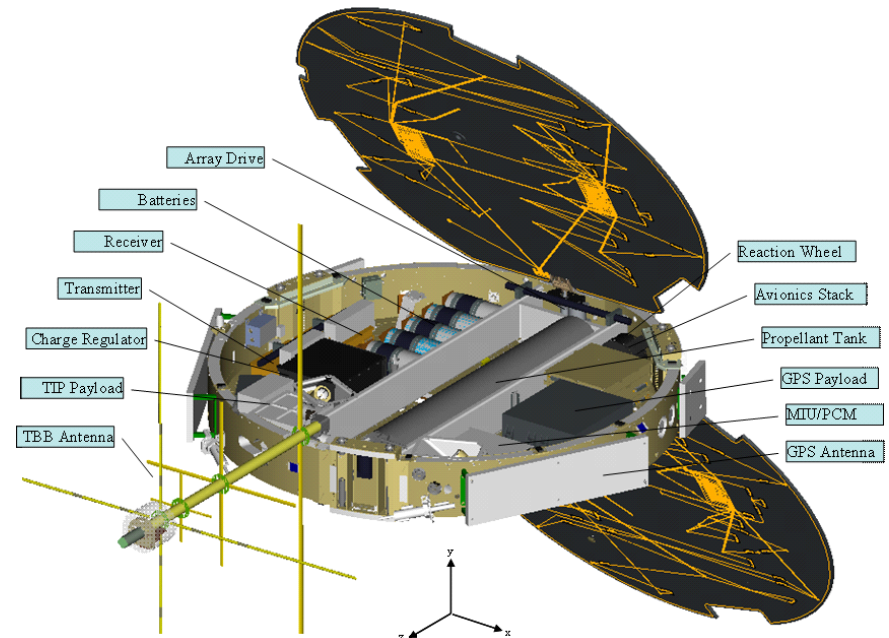
¹*National Space Organization, TAIWAN*

²*Institute of Space Science, National Central University, TAIWAN*

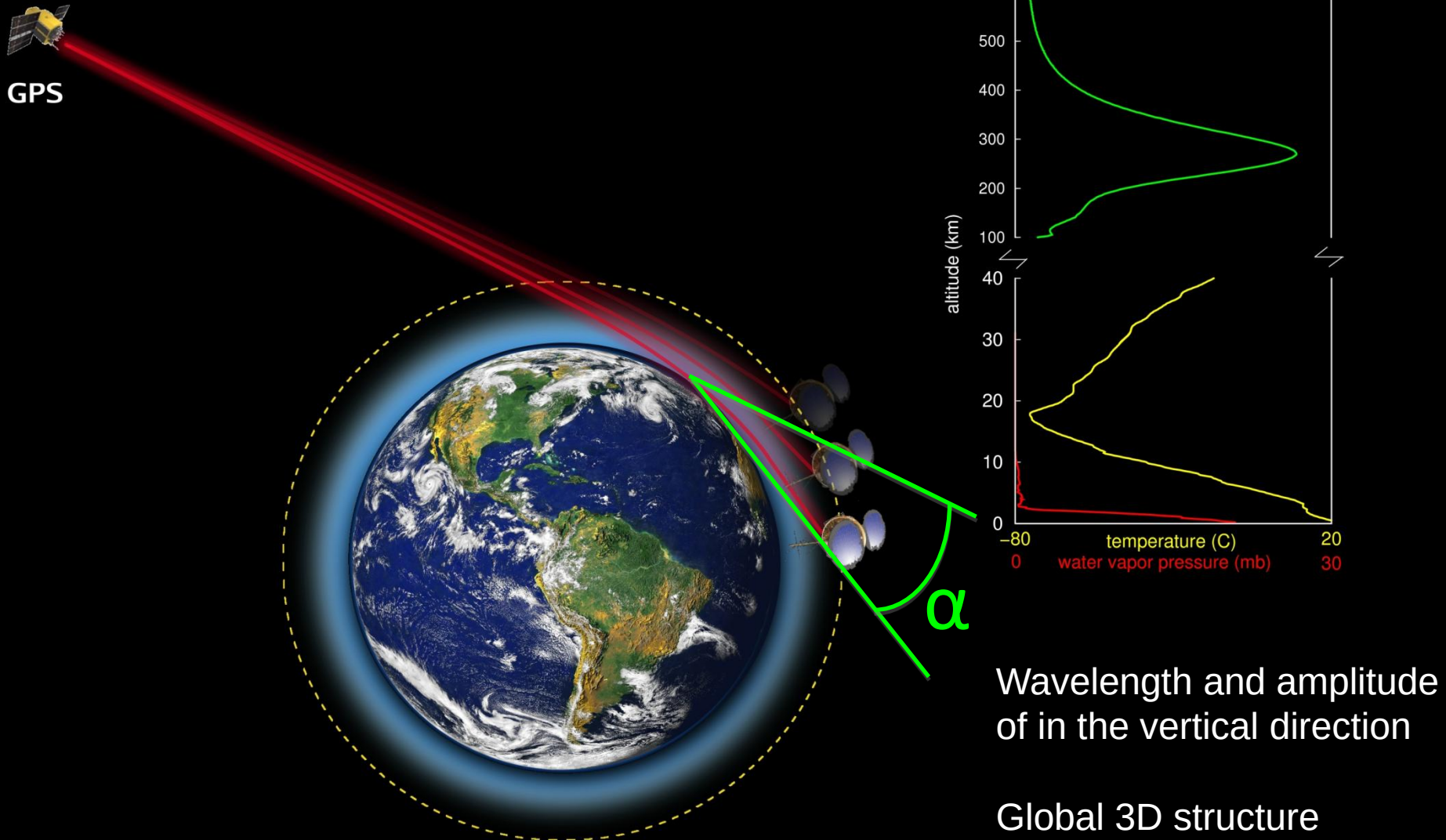
³*Department of Earth Sciences, Cheng Kung University, TAIWAN*

Content

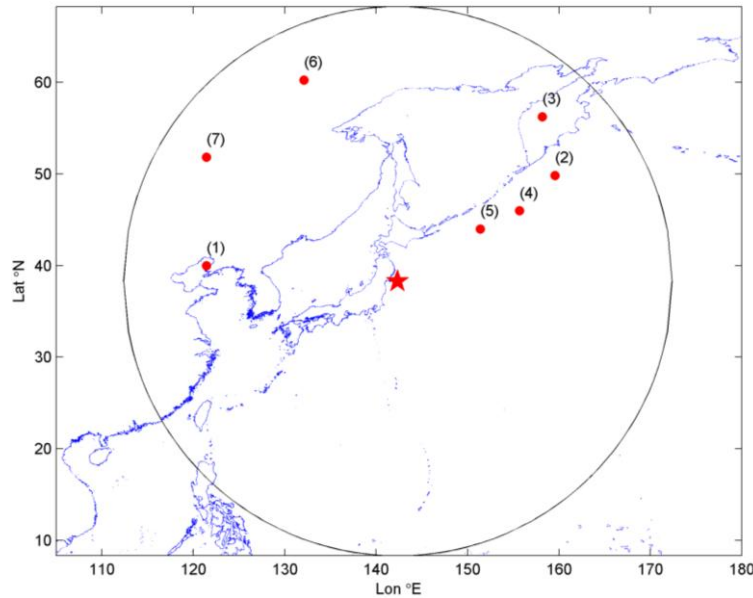
- Ionospheric Scintillation
- F3/C 3-D S4 index max
- F3/C S4 index max in the E-region
- F3/C S4 index max in the F-region
- Summary



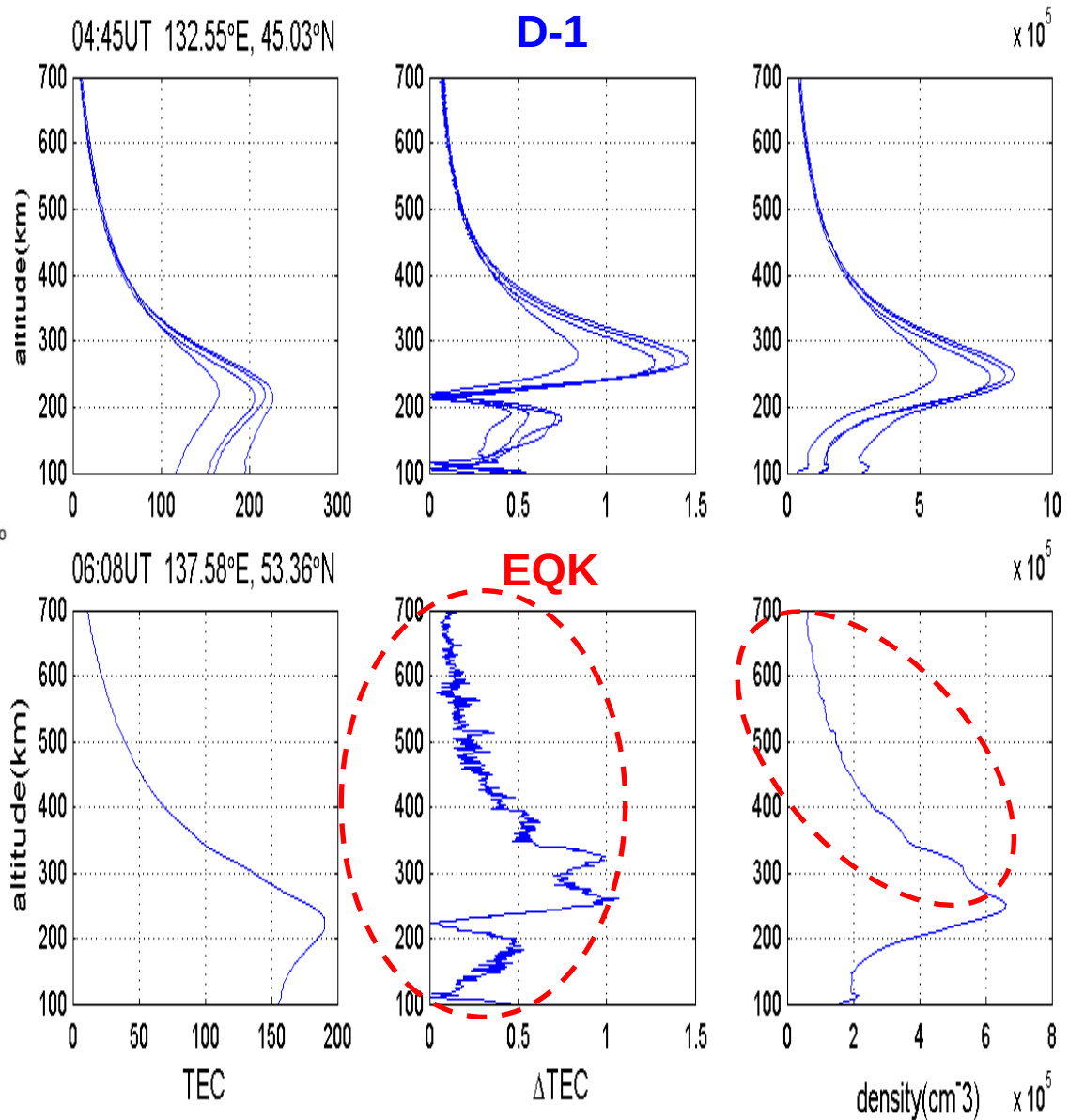
GPS Radio Occultation



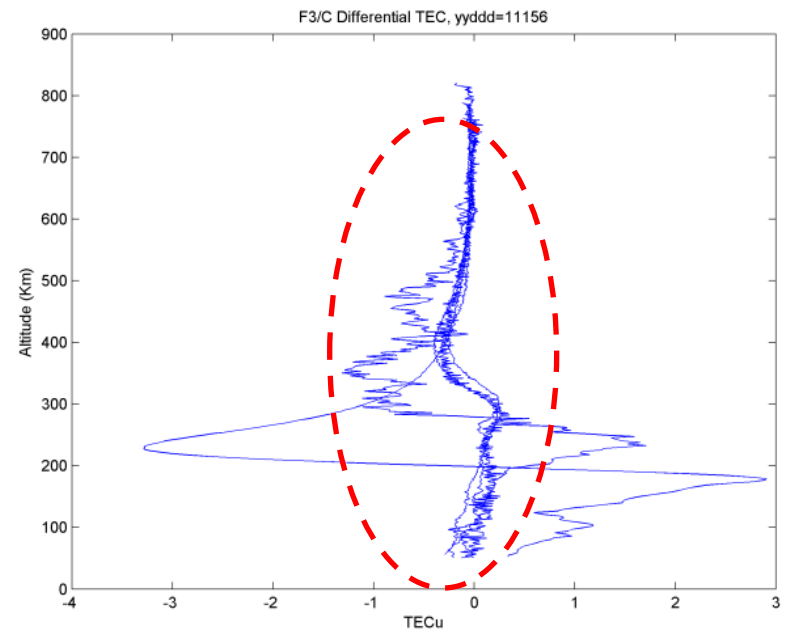
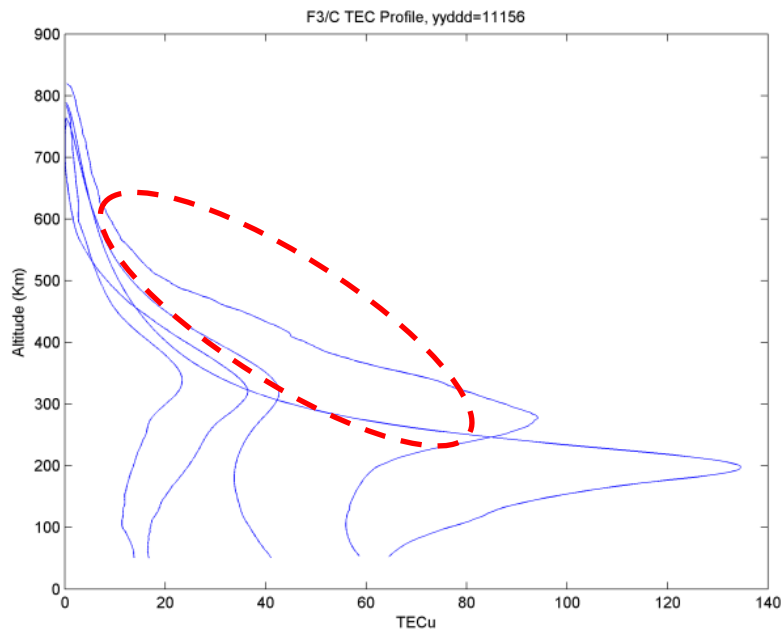
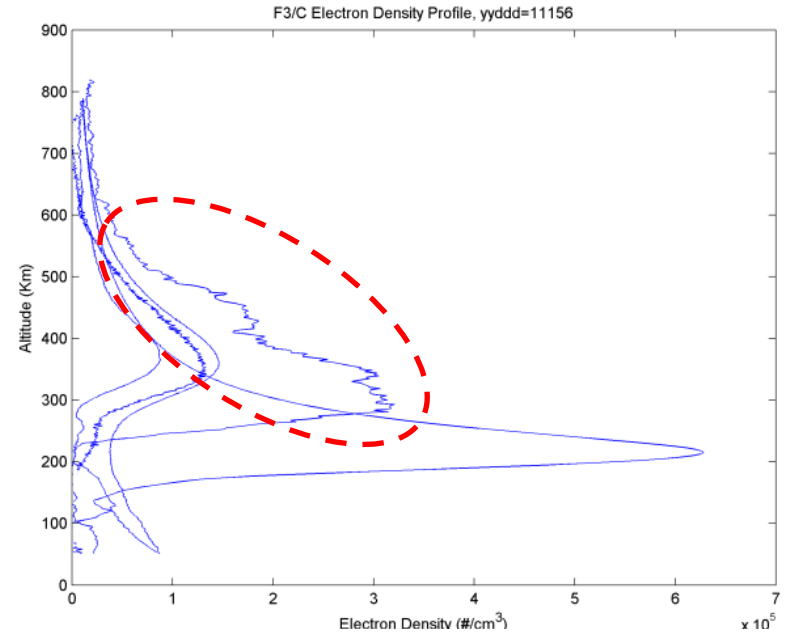
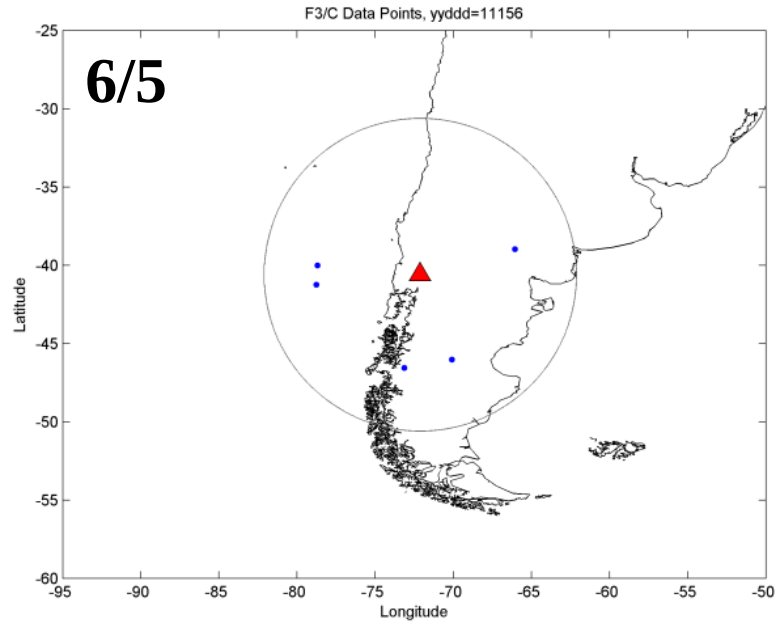
The 2011 M9.0 Tohoku earthquake



The disturbances
observed at 06:08UT
and 1581km from the
epicenter result from
the Rayleigh waves of
the 2011 M9.0
Tohoku earthquake.



The 4 June 2011 Puyehue-Cordón Caulle Volcano



Ionospheric Scintillation

S. Basu et al. / Journal of Atmospheric and Solar-Terrestrial Physics 64 (2002) 1745–1754

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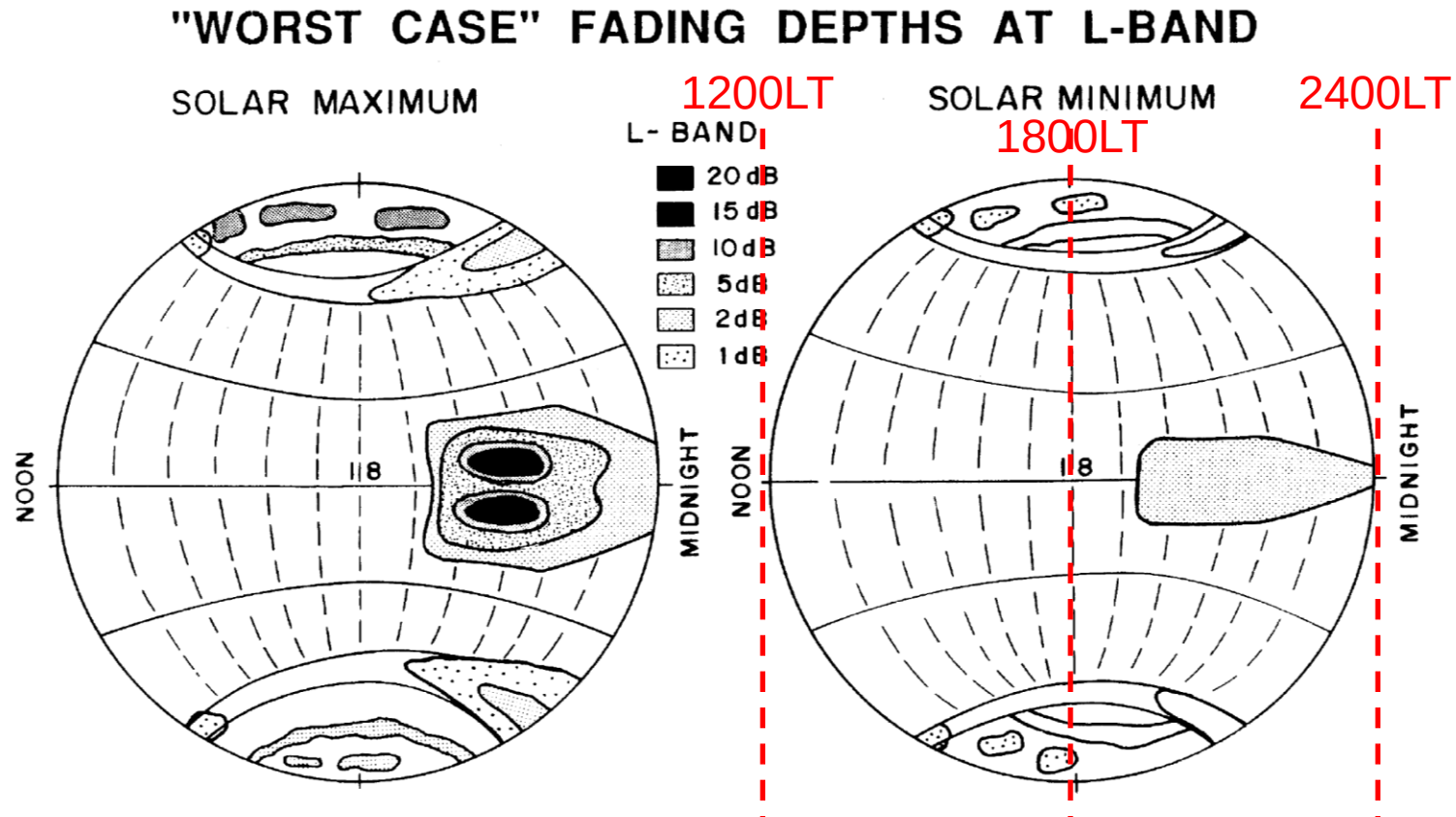
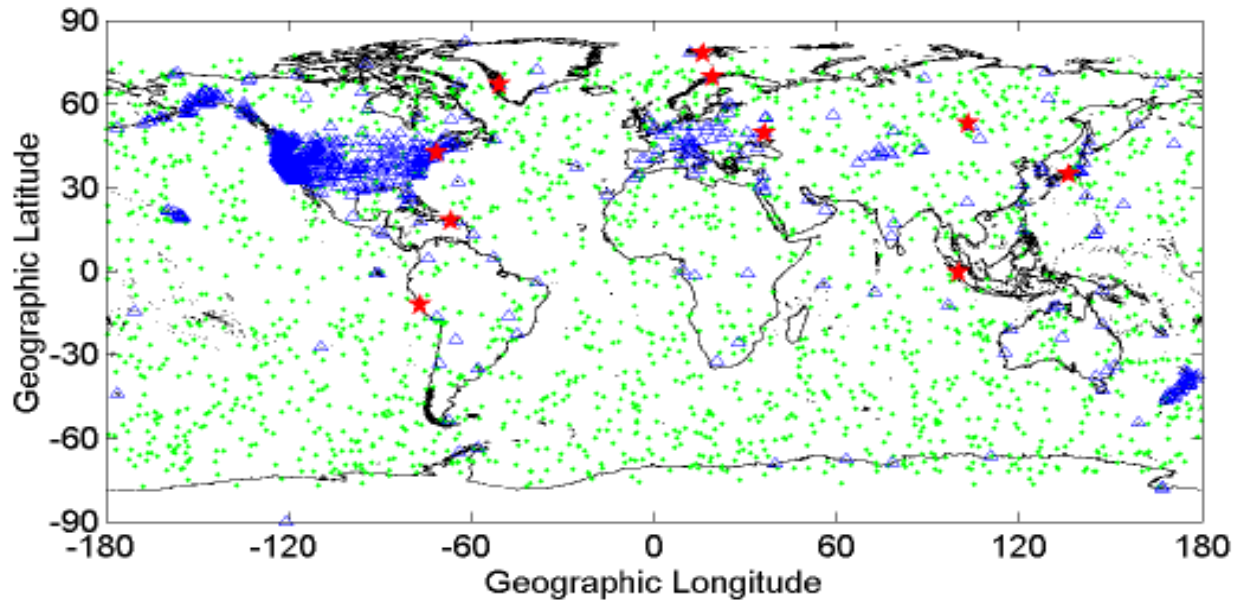
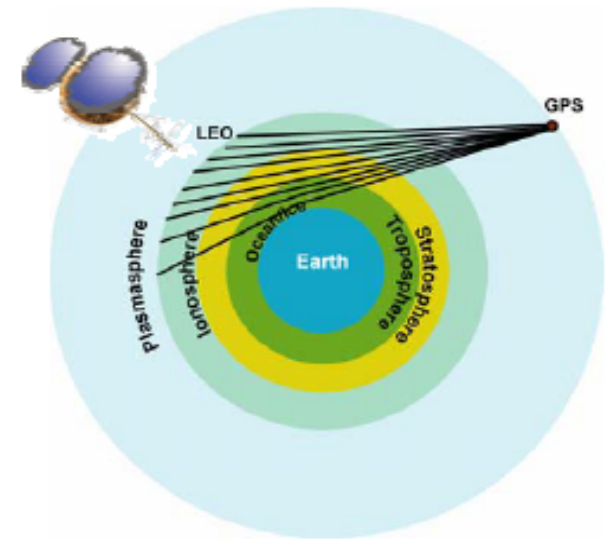


Fig. 1. Schematic of the global morphology of scintillations at L-band frequencies during the solar maximum (left panel) and solar minimum (right panel) conditions. Reproduced from S. Basu and K.M. Groves, Specification and forecasting of outages on satellite communication and navigation systems, Space Weather, Geophysical Monograph 125, 424–430, 2001. Published 2001 by the American Geophysical Union. Reproduced/modified by permission of American Geophysical Union.

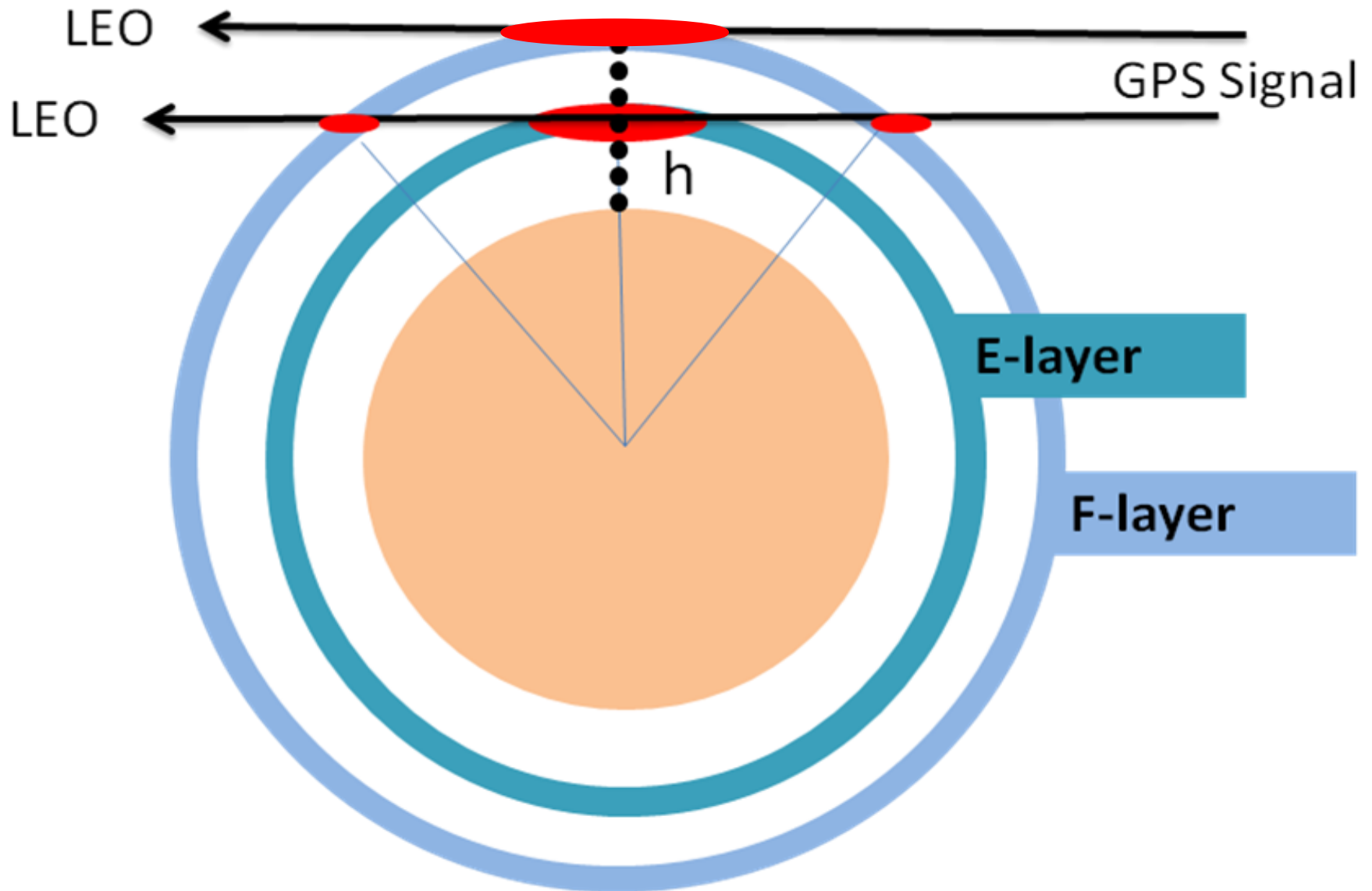
Distribution of occultation events observed by FORMOSAT-3



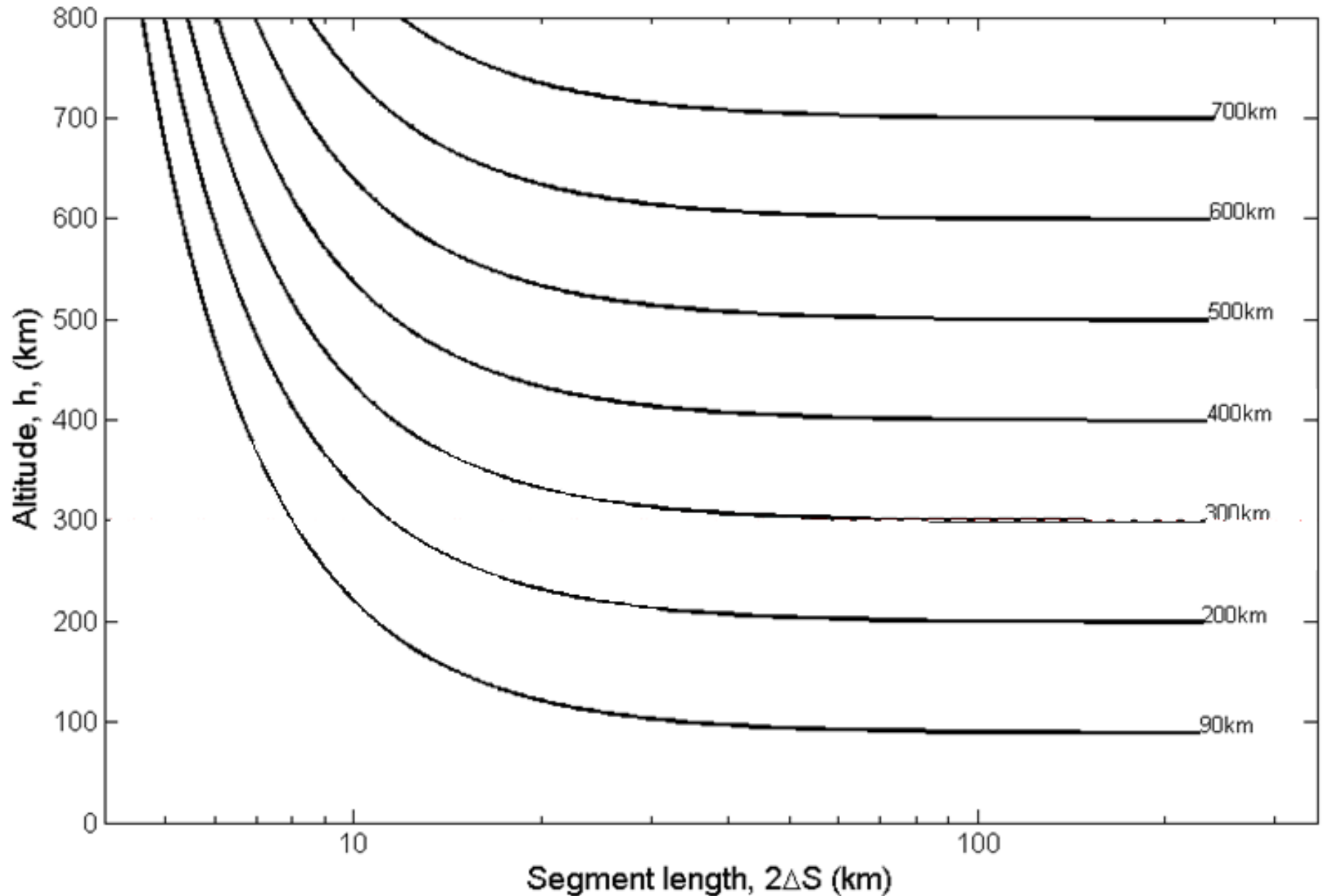
GOX



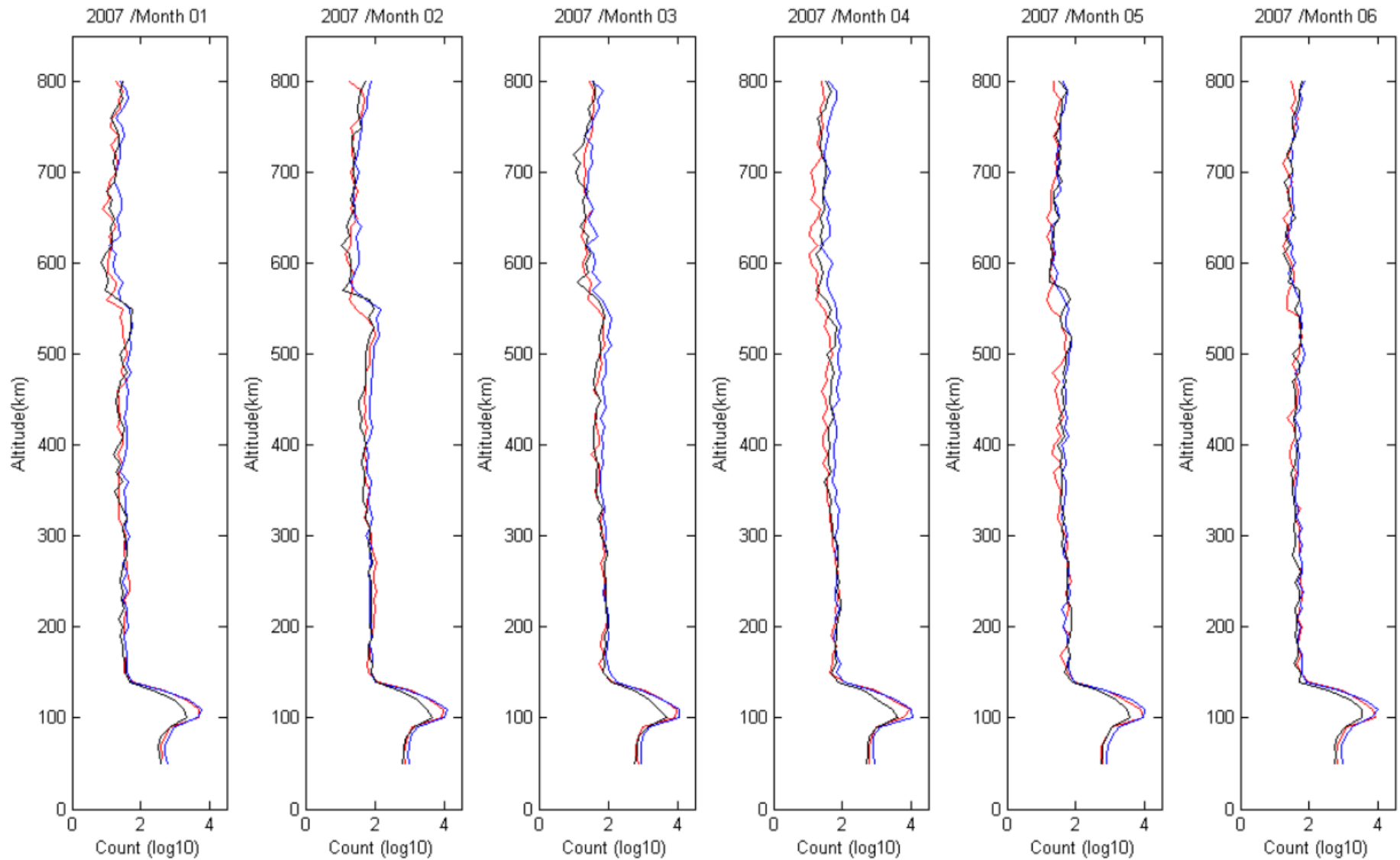
F3/C S4 index sounding



F3/C S4 sounding weighting

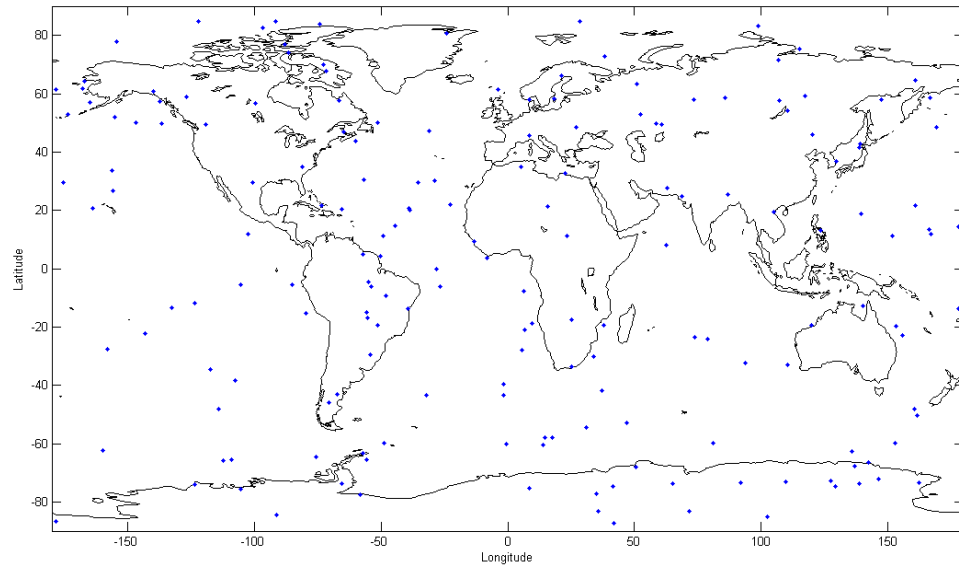


F3/C S4 max monthly altitude distribution

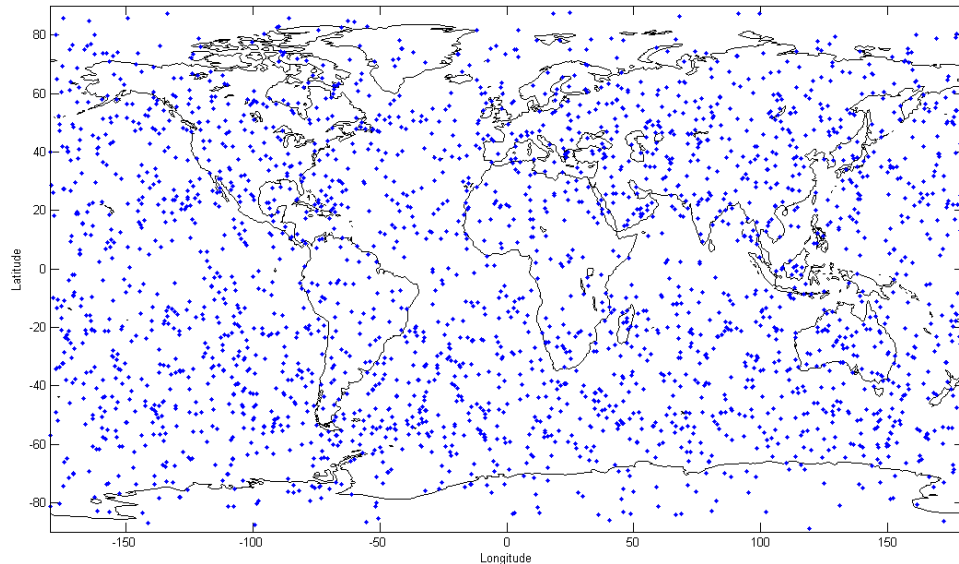


F3/C S4max Daily Observation

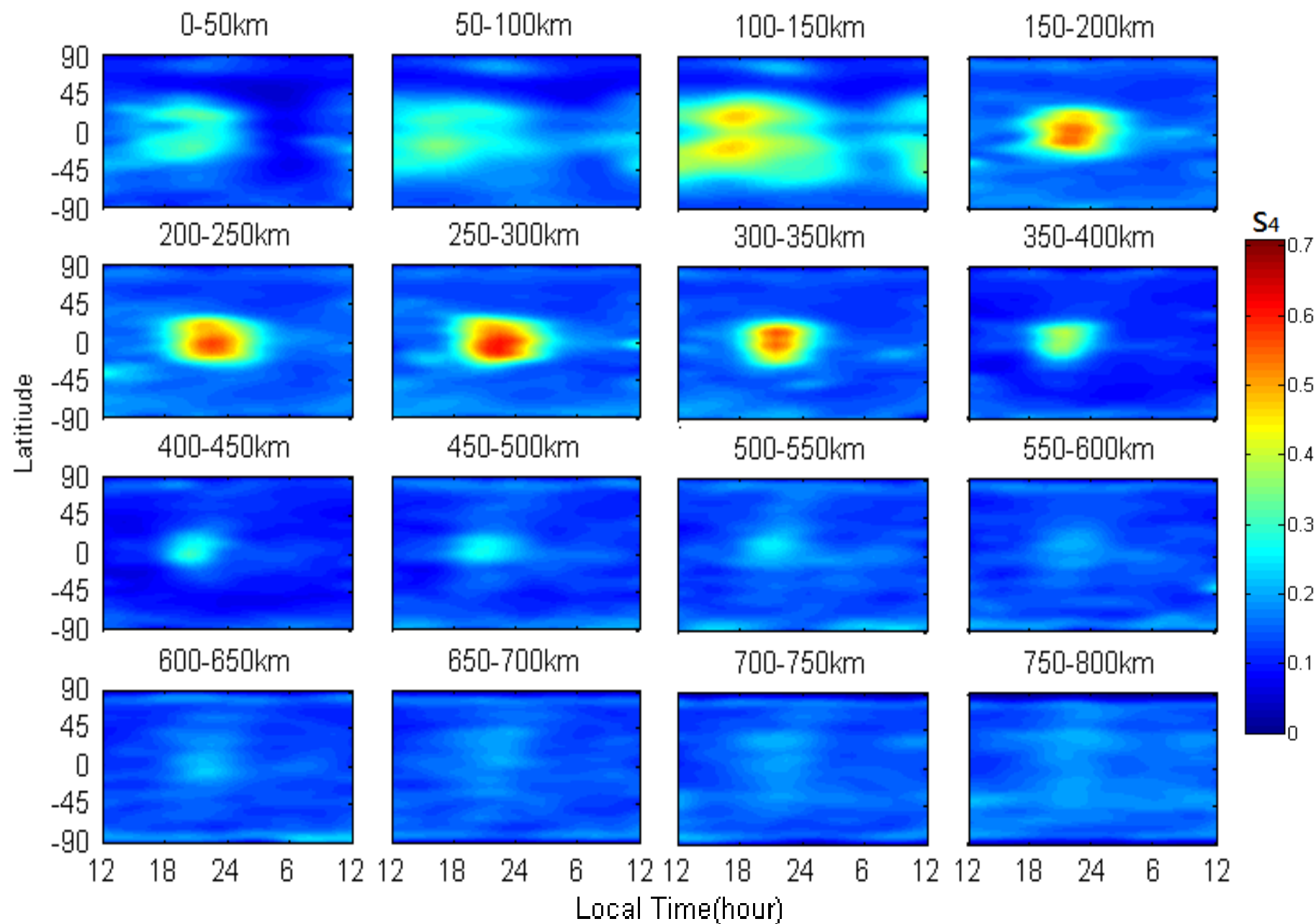
(a) F-Region
(150-350 km)



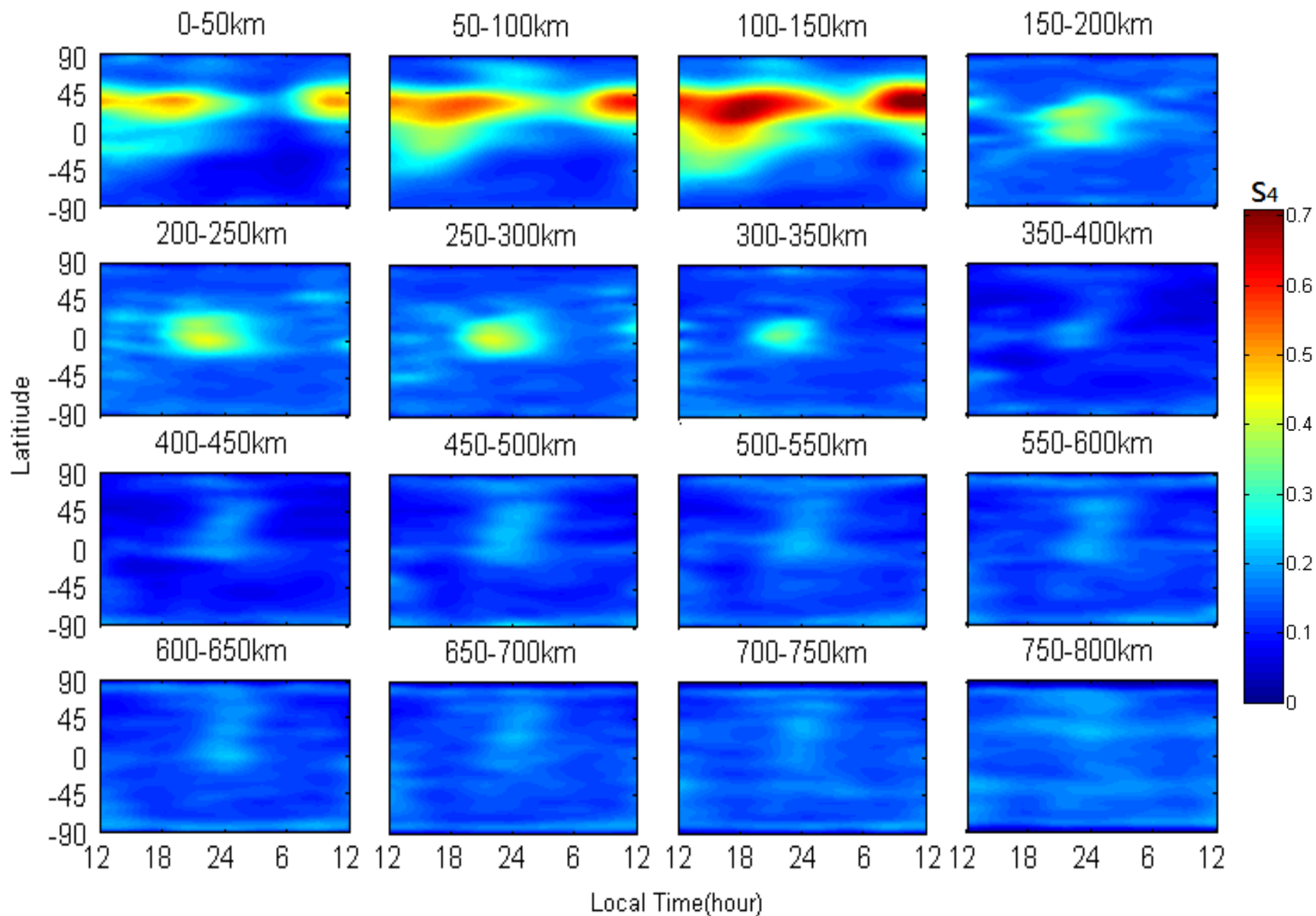
(b) E-Region
(80-130 km)



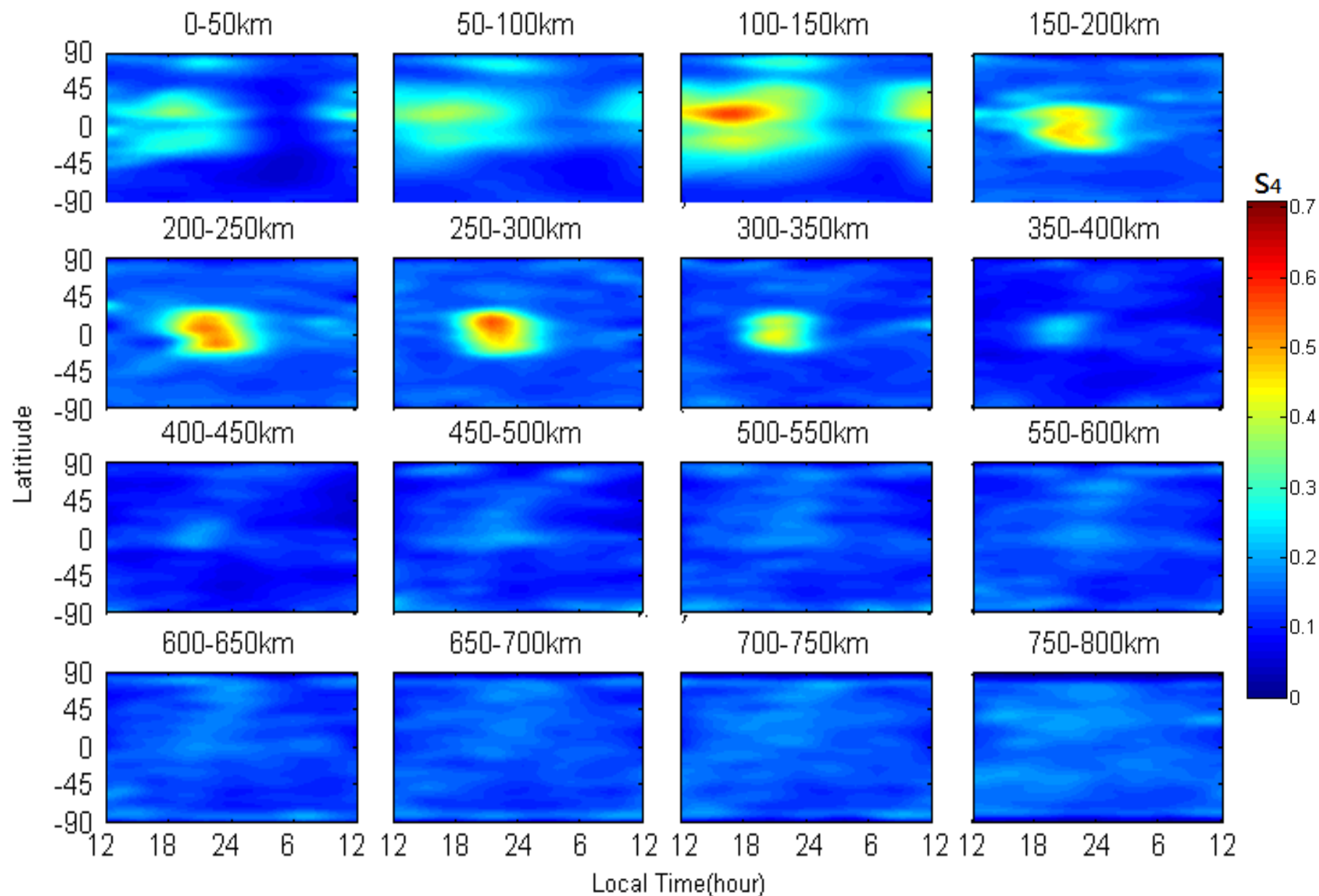
M-month



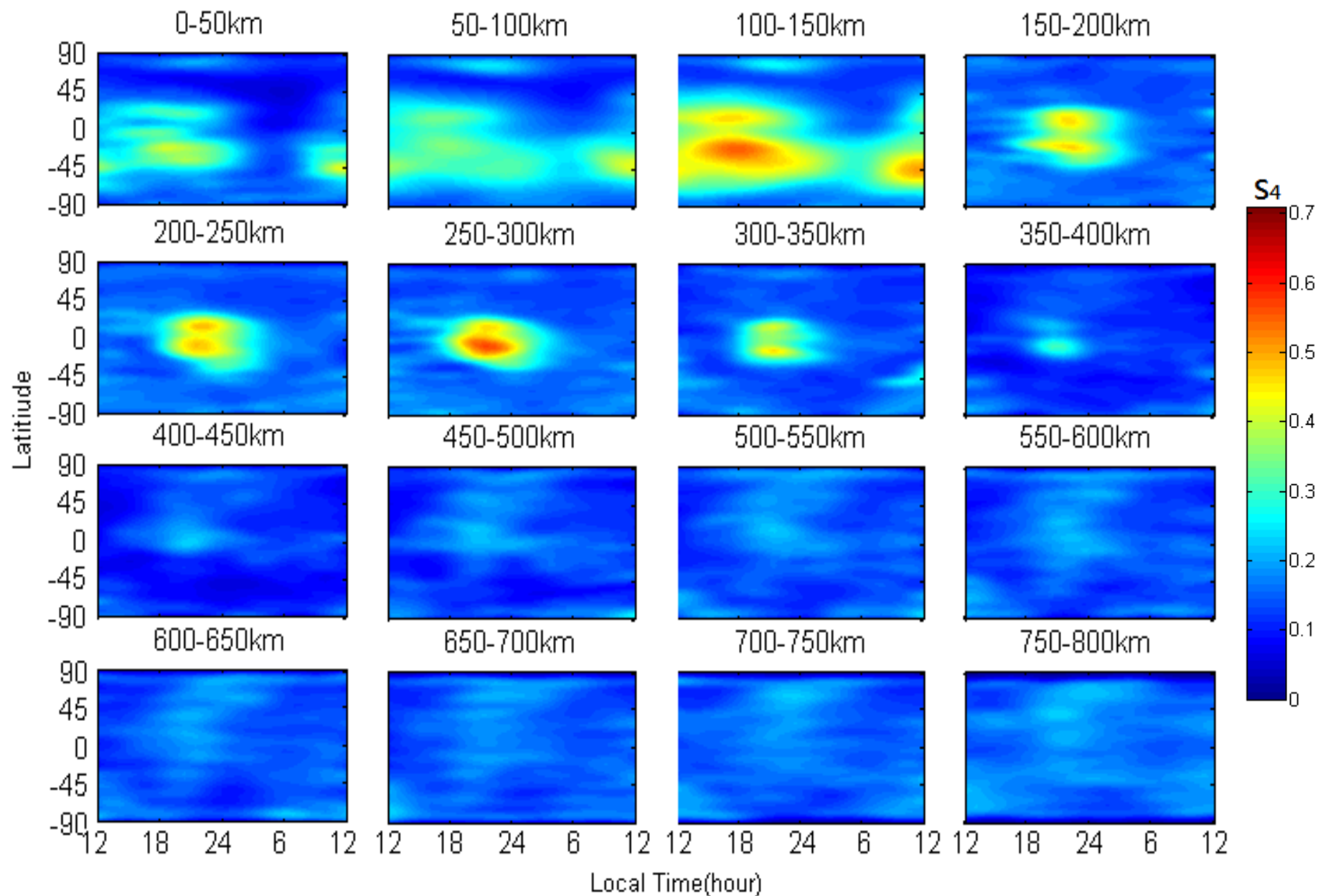
J-month



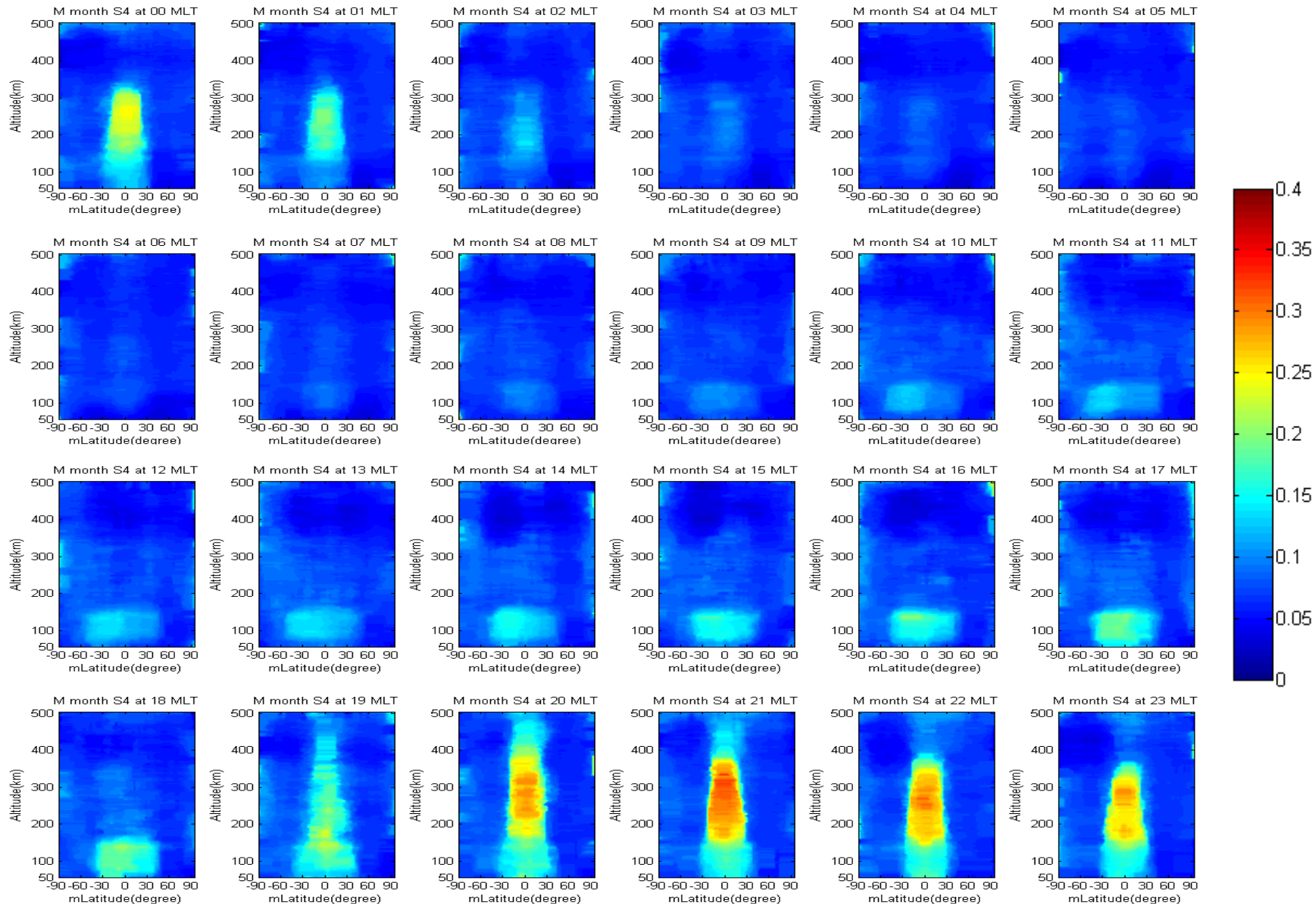
S-month



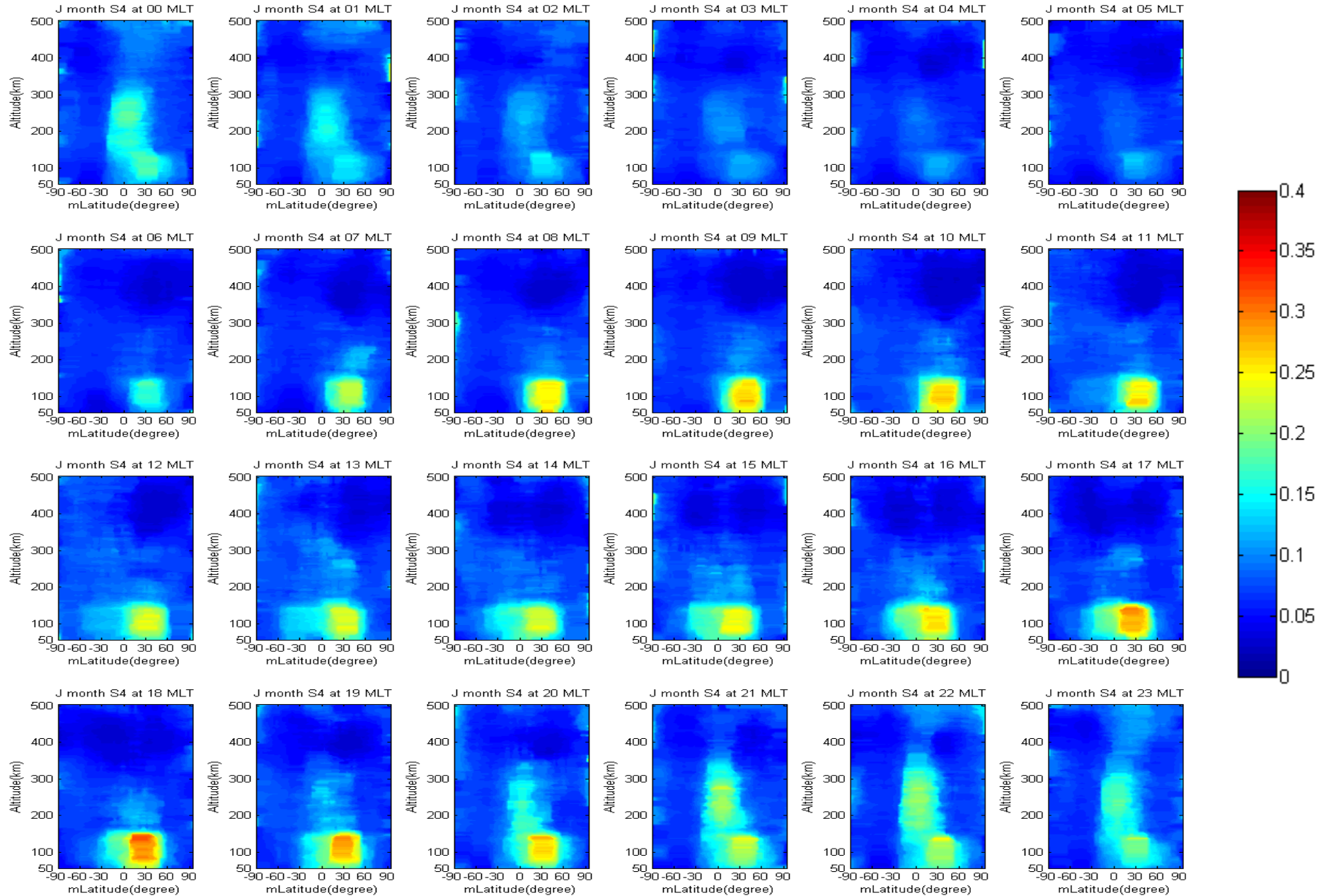
D-month



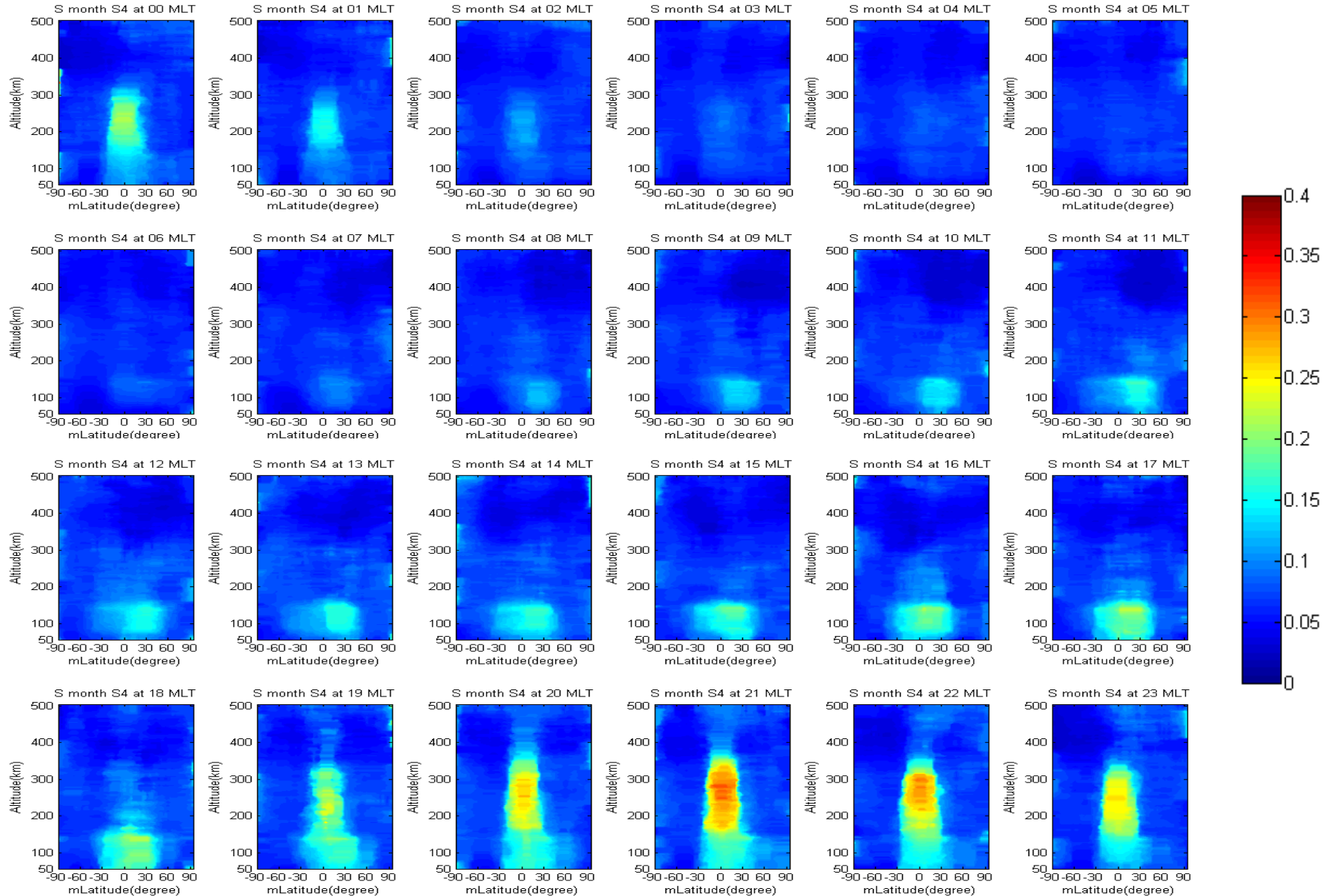
Diurnal Variations of the S4 Max Alt vs. Mlat in M-month



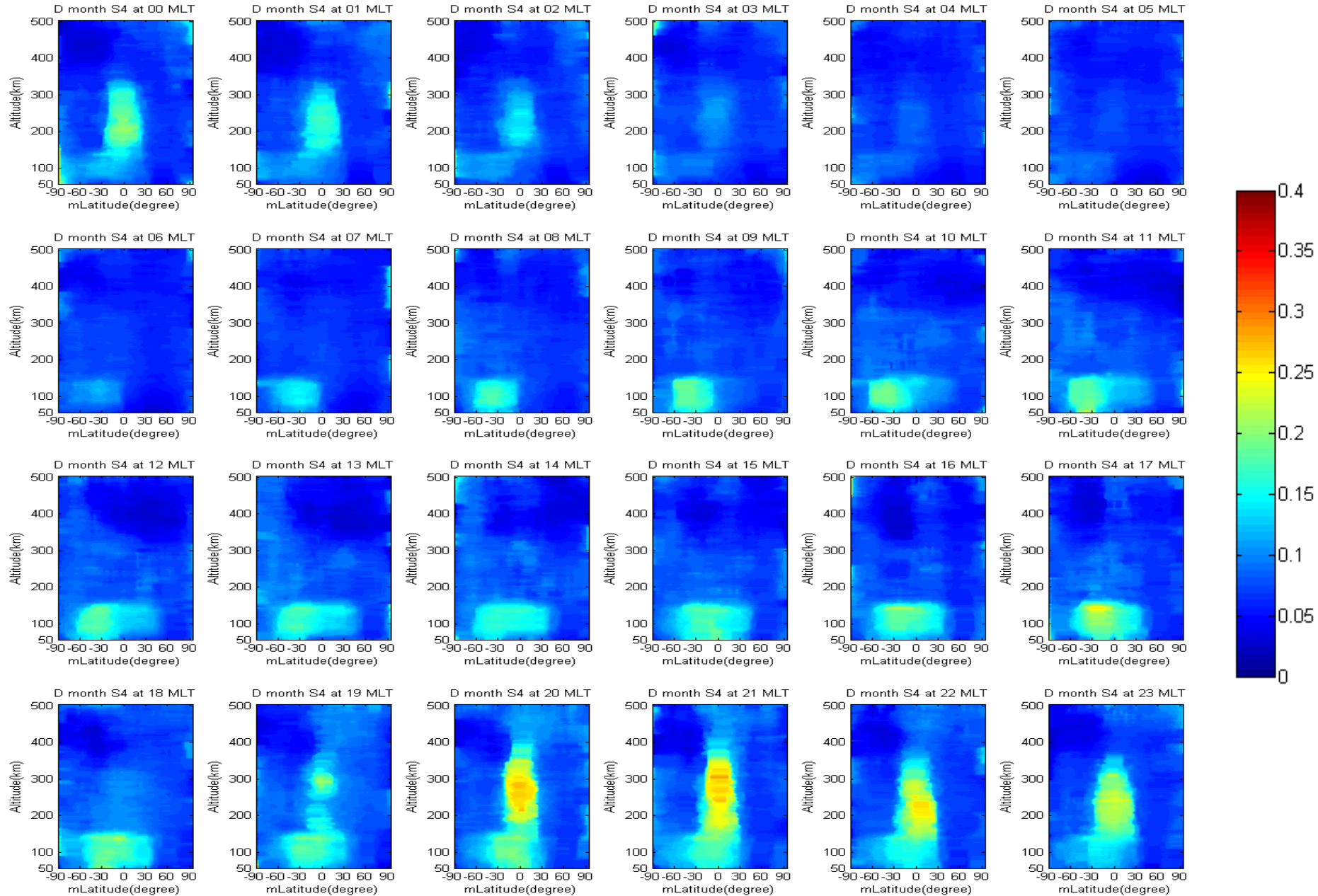
Diurnal Variations of the S4 Max Alt vs. Mlat in J-month



Diurnal Variations of the S4 Max Alt vs. Mlat in S-month



Diurnal Variations of the S4 Max Alt vs. Mlat in D-month



Ionospheric Scintillation

S. Basu et al. / Journal of Atmospheric and Solar-Terrestrial Physics 64 (2002) 1745–1754

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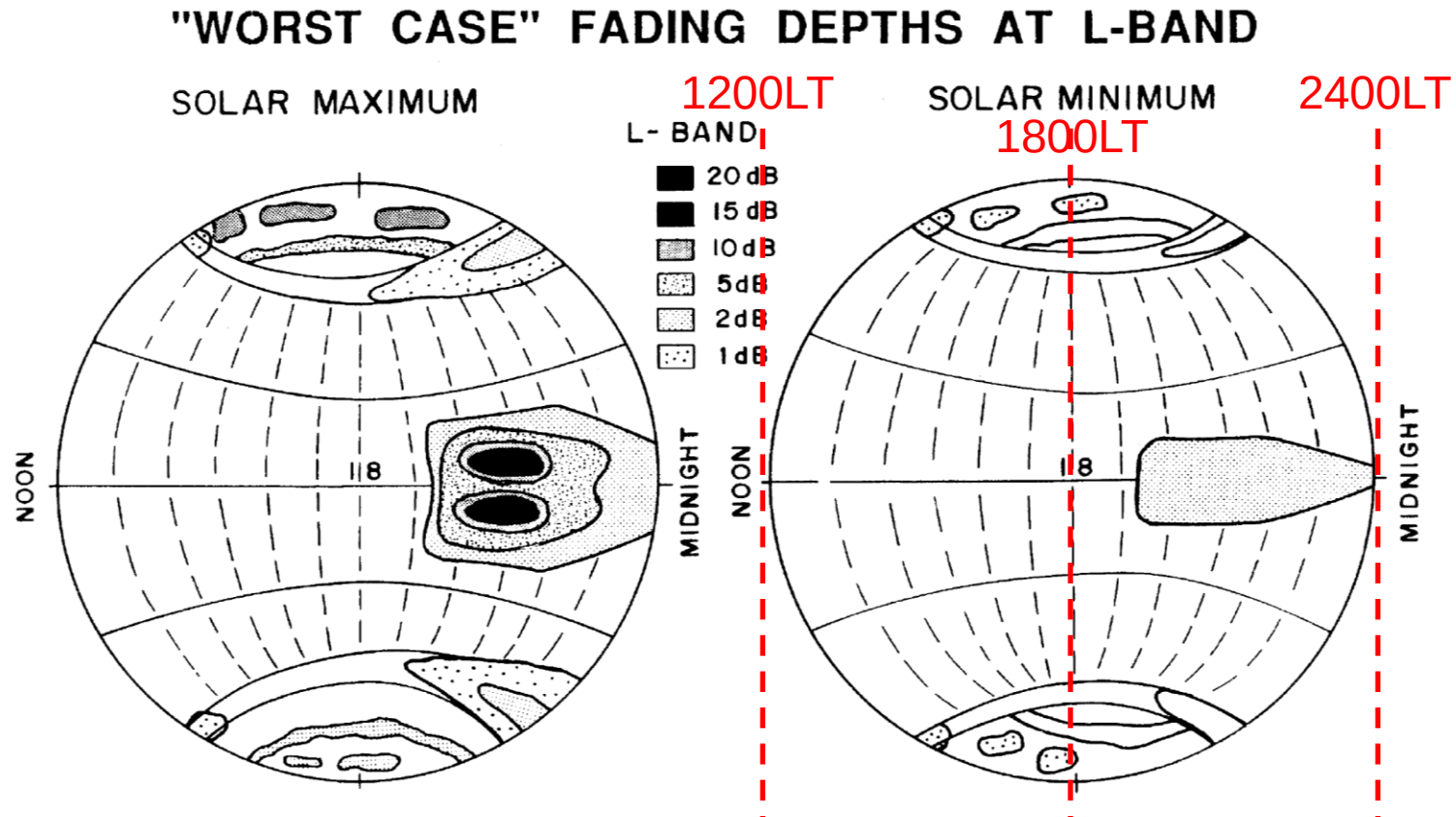
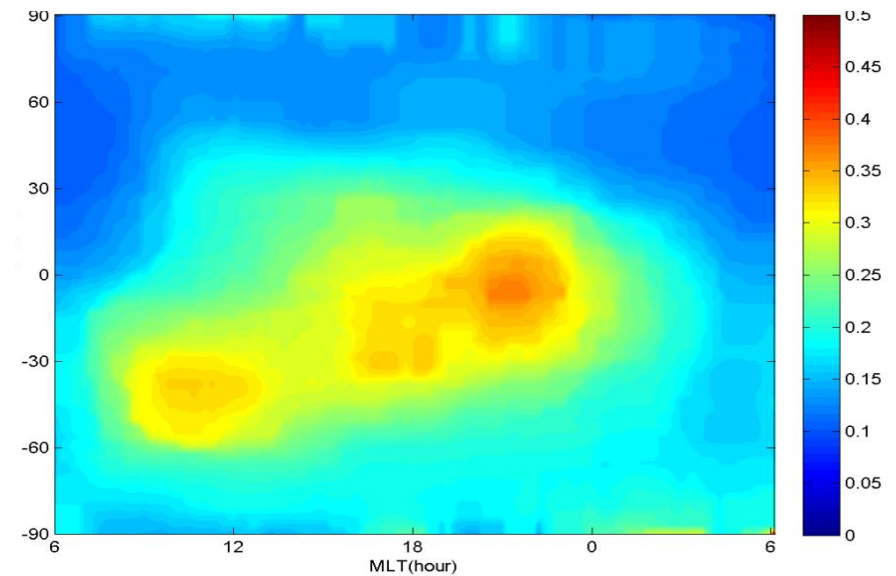
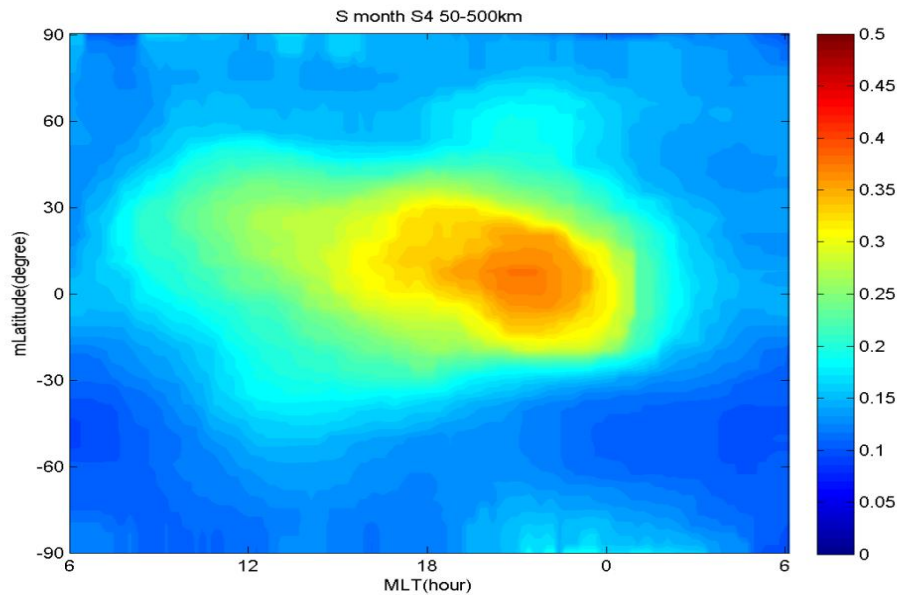
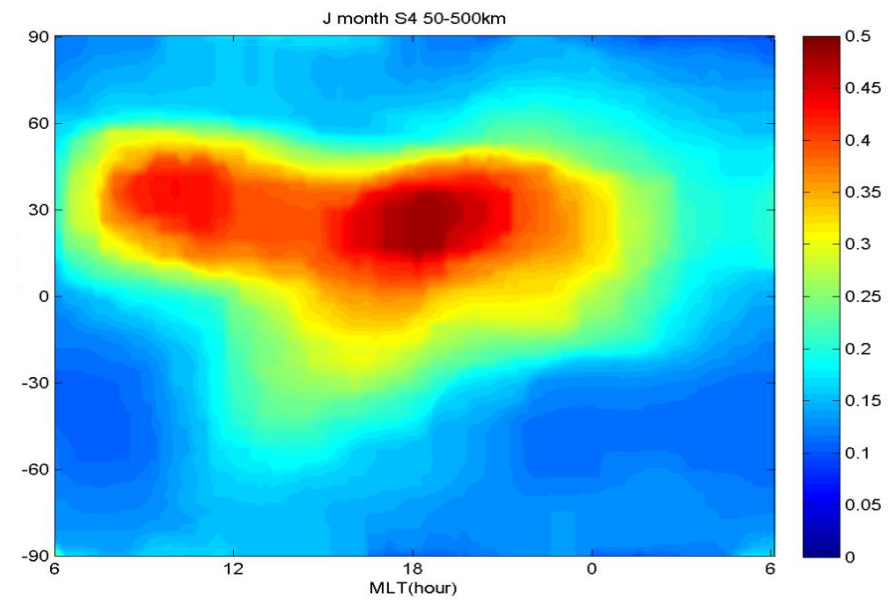
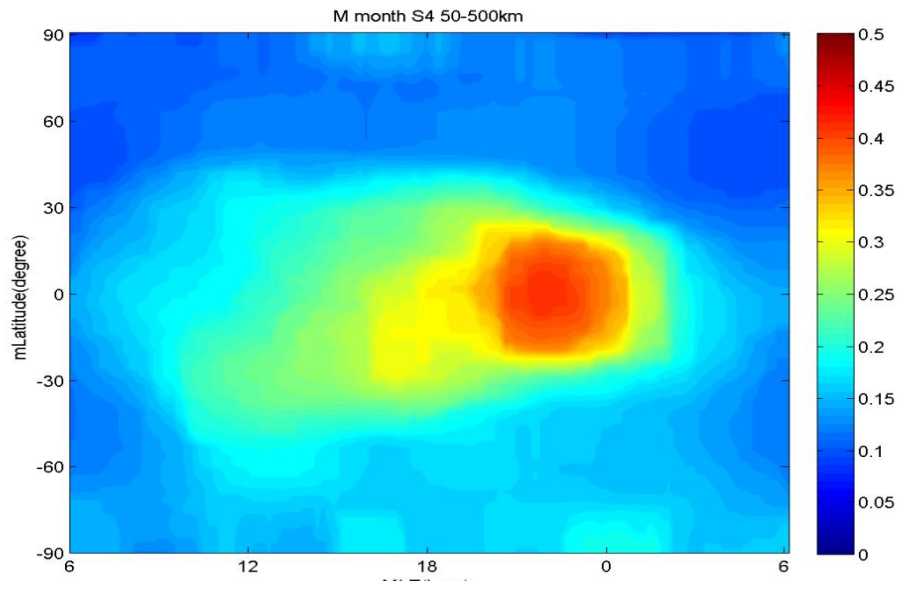


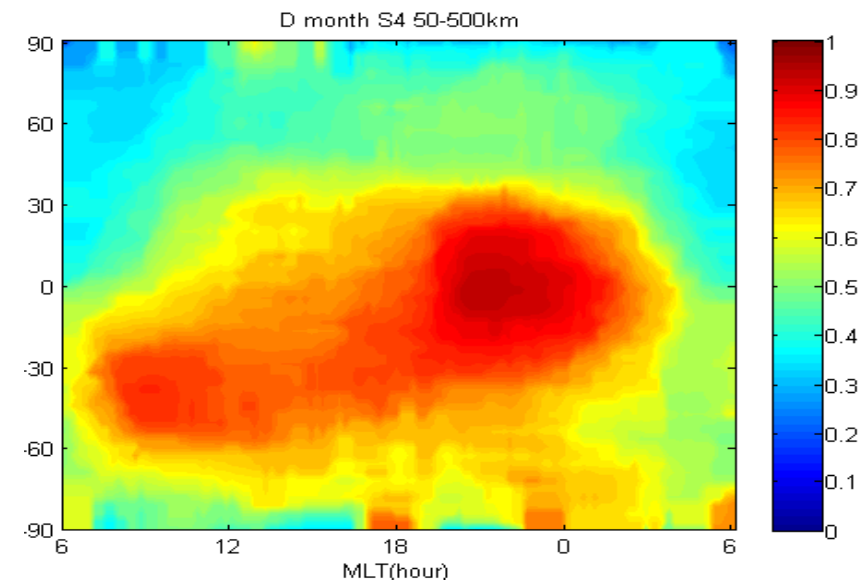
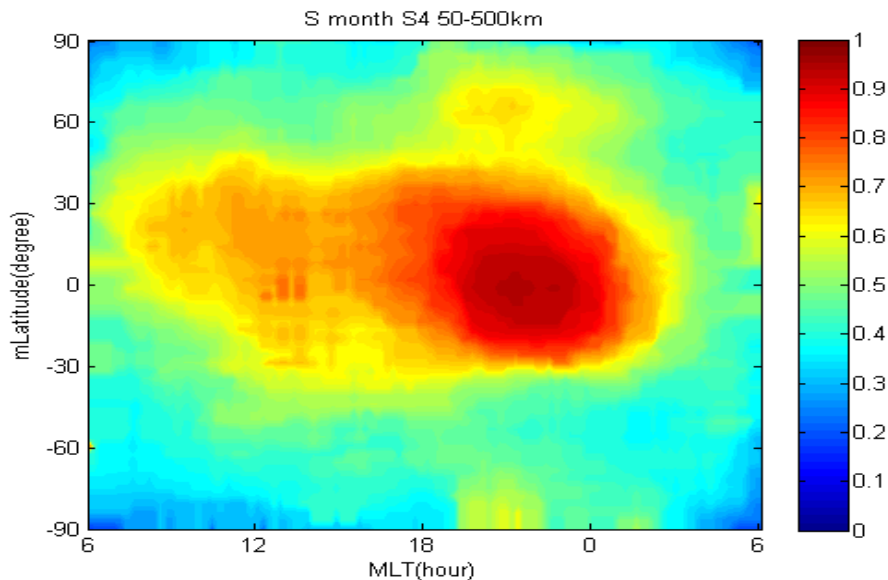
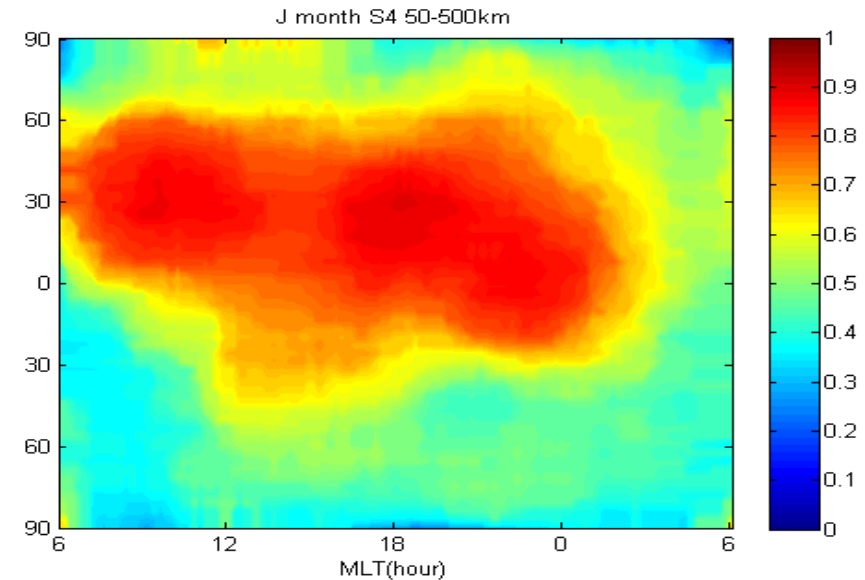
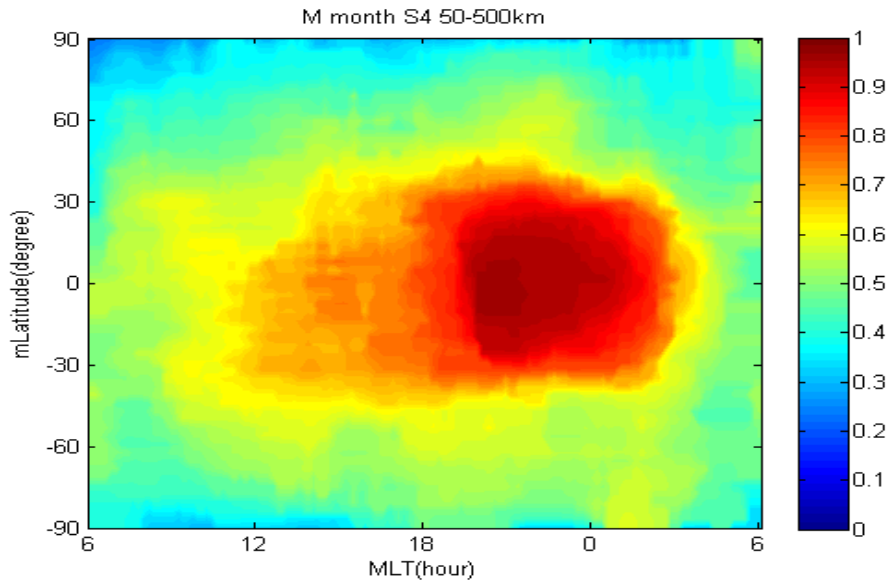
Fig. 1. Schematic of the global morphology of scintillations at L-band frequencies during the solar maximum (left panel) and solar minimum (right panel) conditions. Reproduced from S. Basu and K.M. Groves, Specification and forecasting of outages on satellite communication and navigation systems, Space Weather, Geophysical Monograph 125, 424–430, 2001. Published 2001 by the American Geophysical Union. Reproduced/modified by permission of American Geophysical Union.

S4 max median in the 4 months

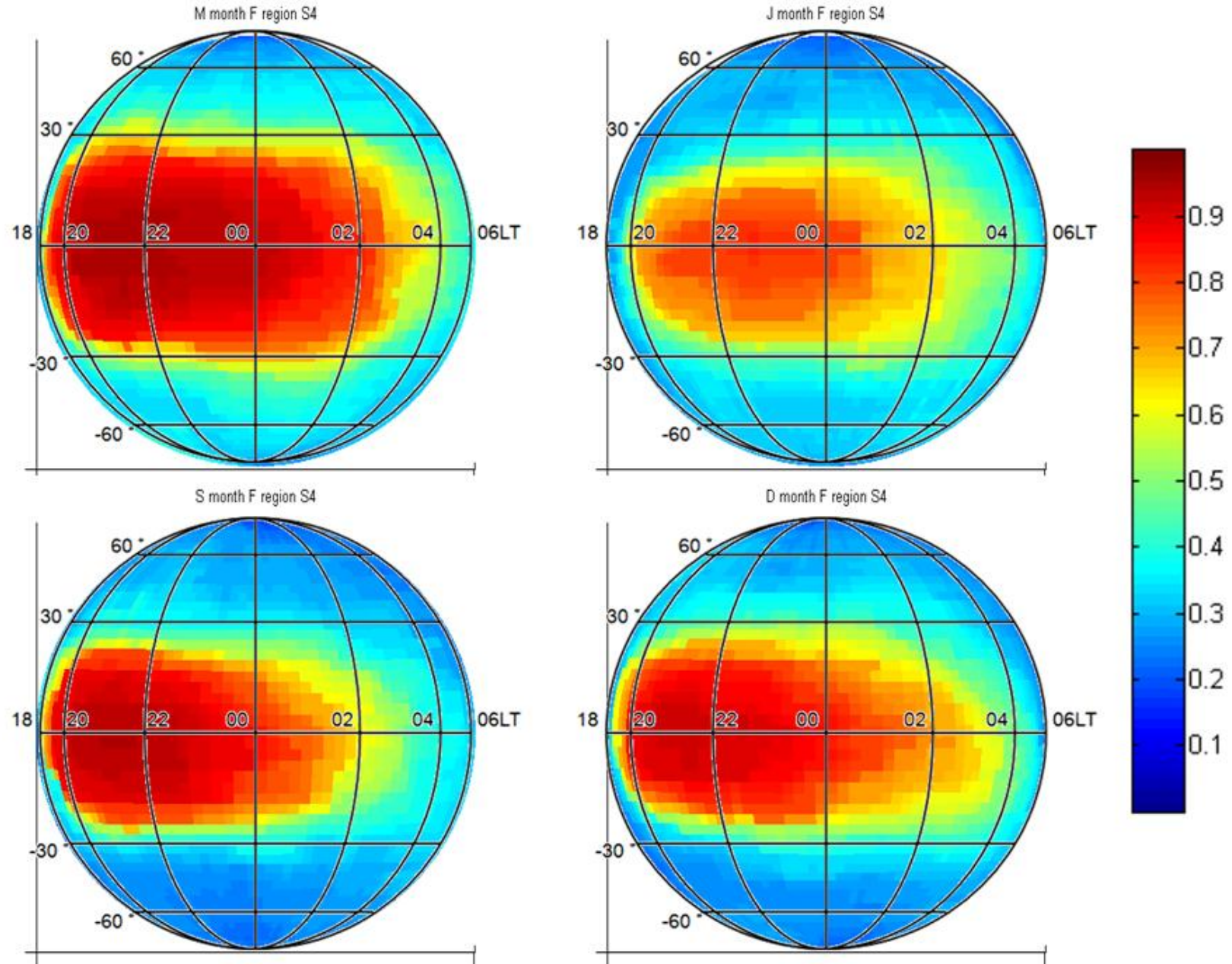


S4 max maximum in the 4 months

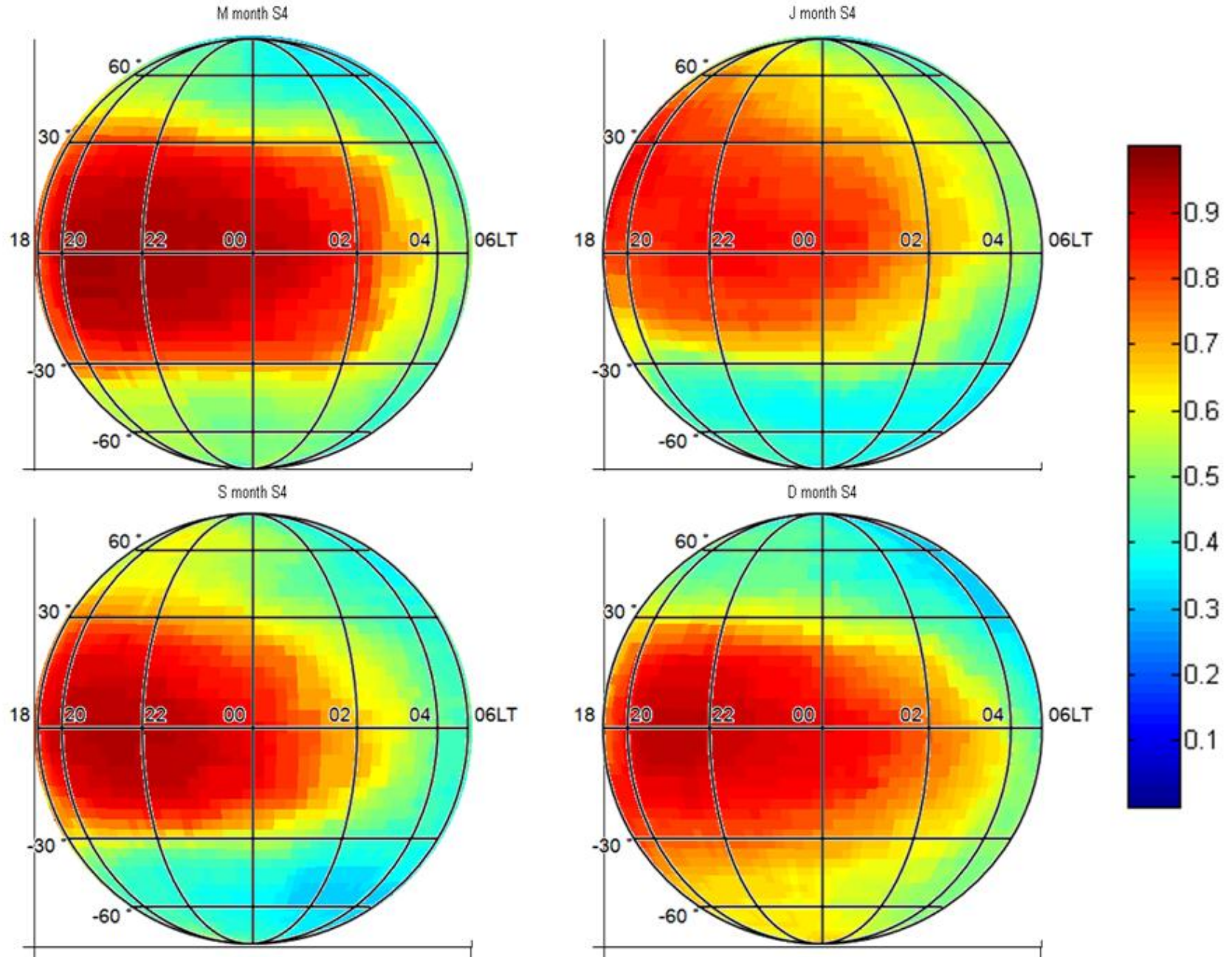
“Worst Case”



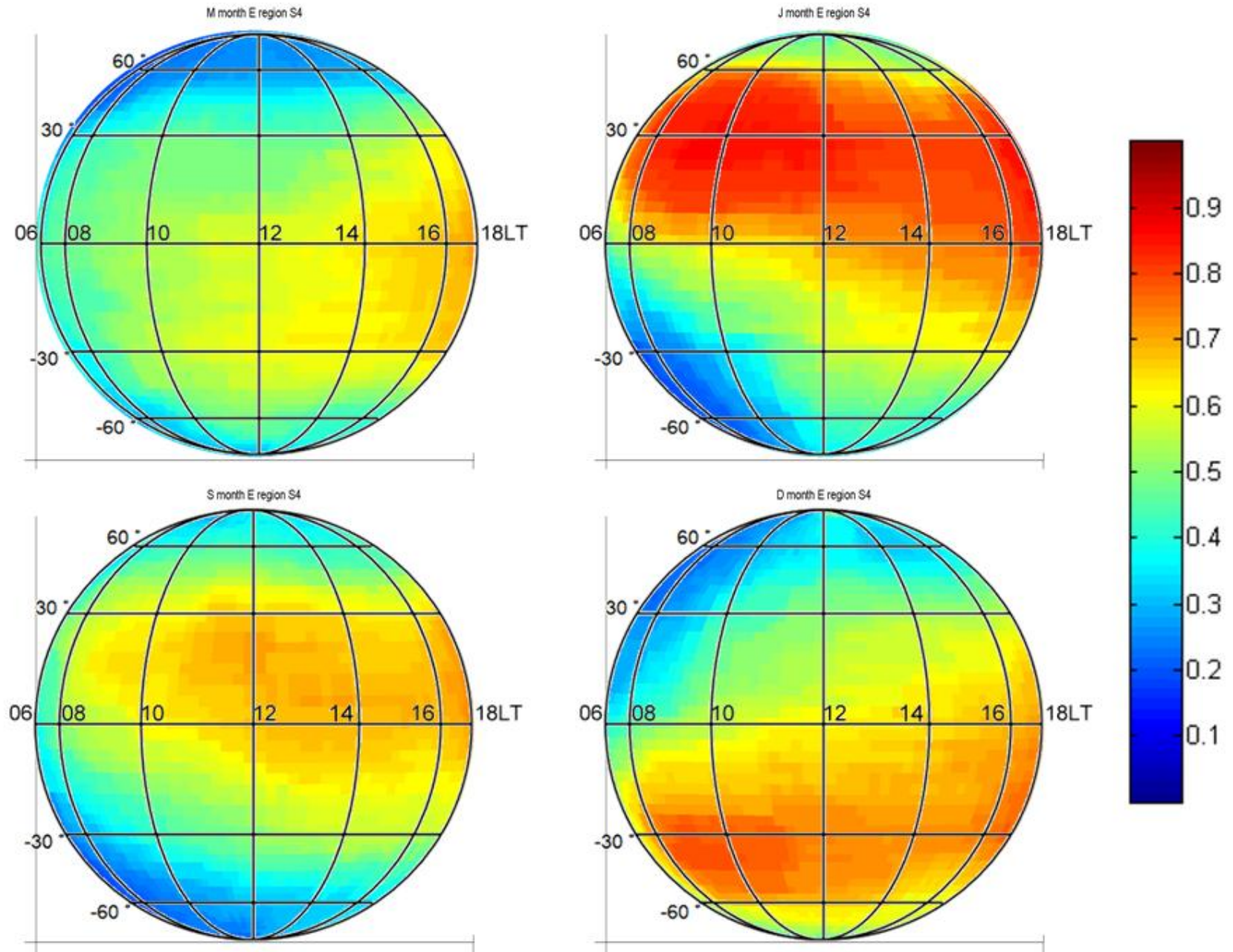
“Worst Case” in F-region S4 Found by F3/C



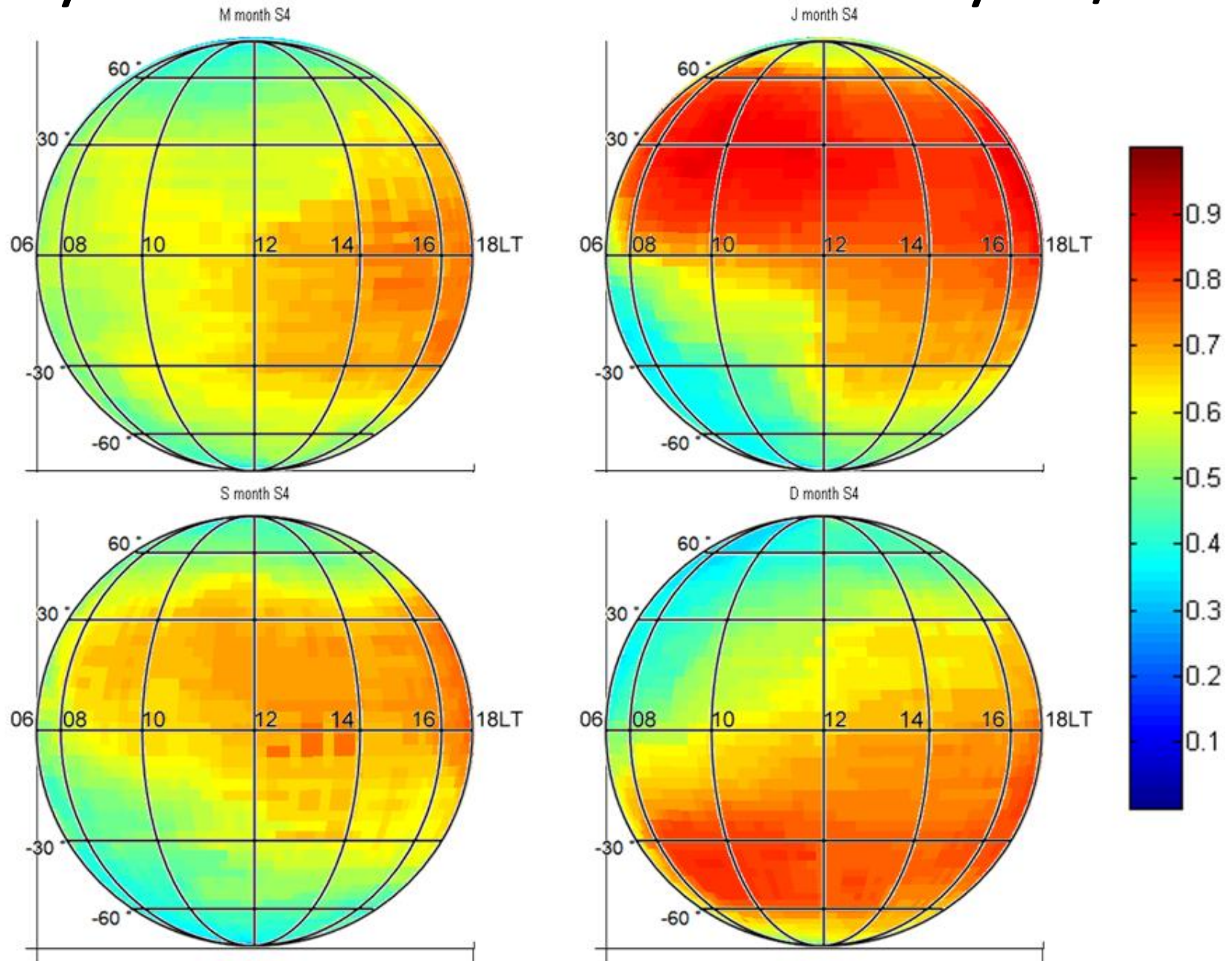
Nighttime “Worst Case” Found by F3/C S4



“Worst Case” in E-region S4 Found by F3/C

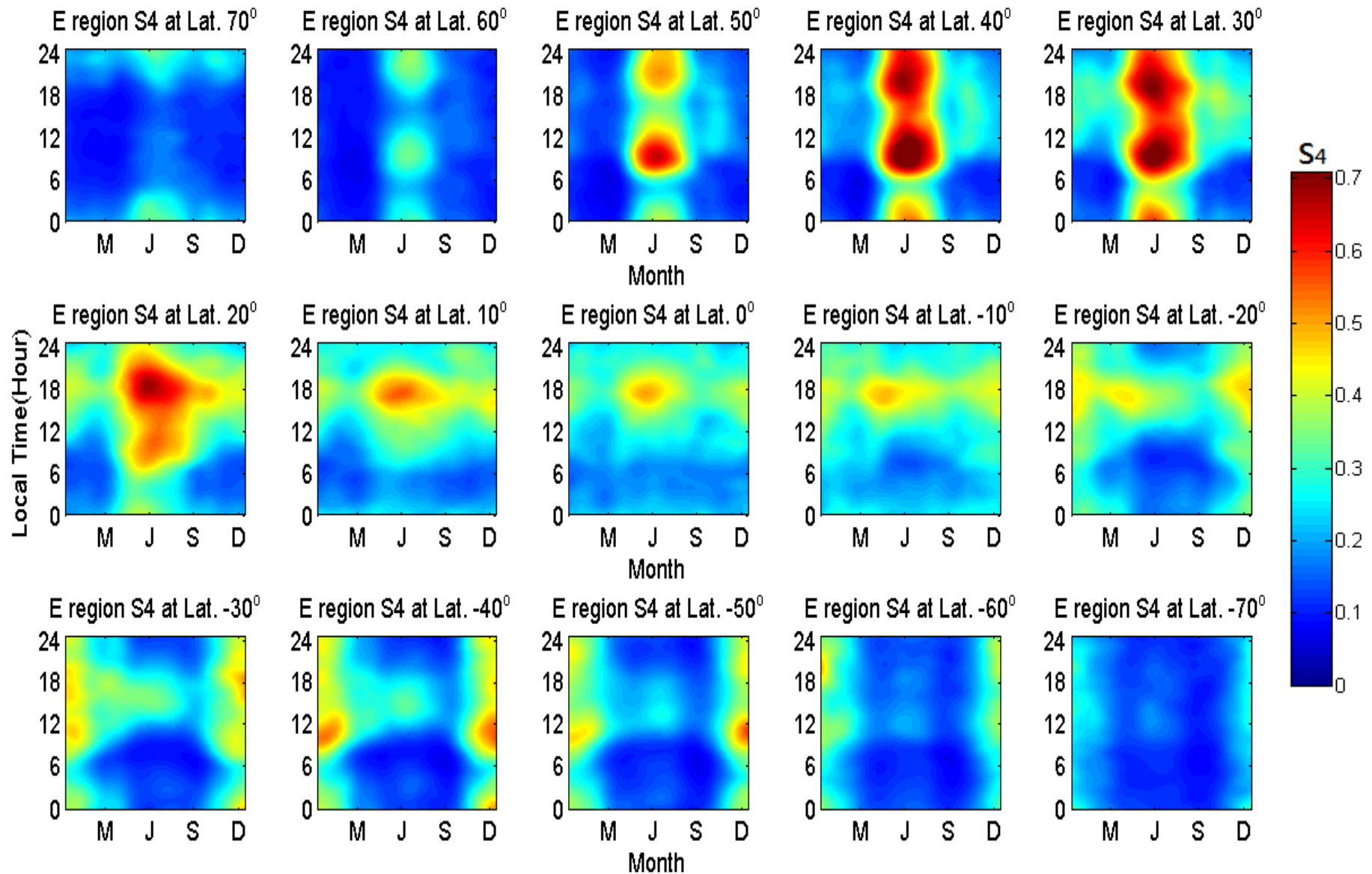


Daytime “Worst Case” Found by F3/C S4

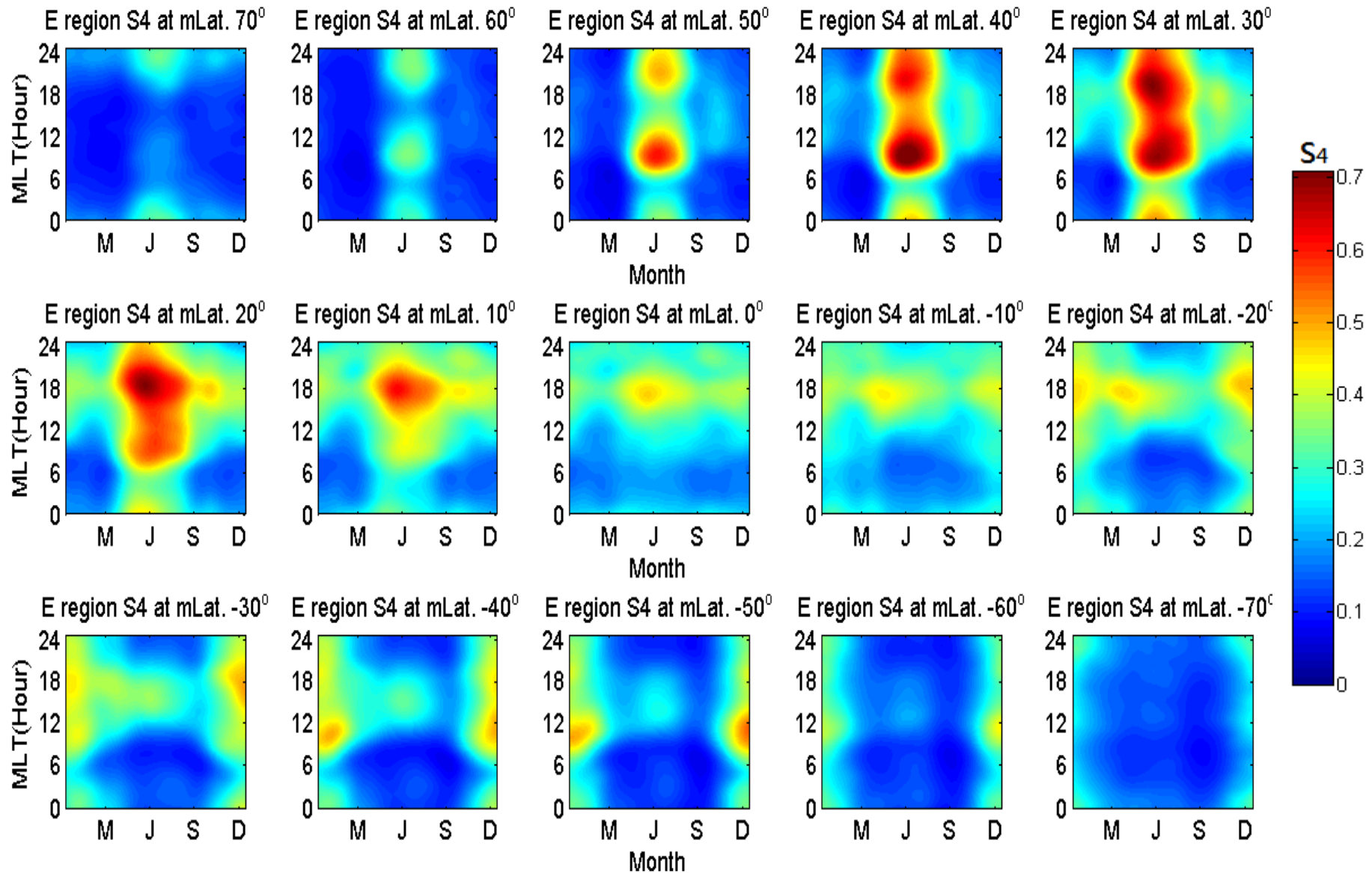


F3/C S4 max in the E-region

E region S4 max LT vs. month in various Lats

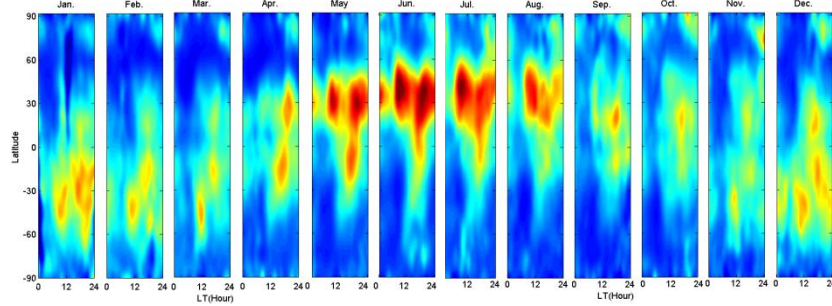


E region S4 max MLT vs. month in various MLats

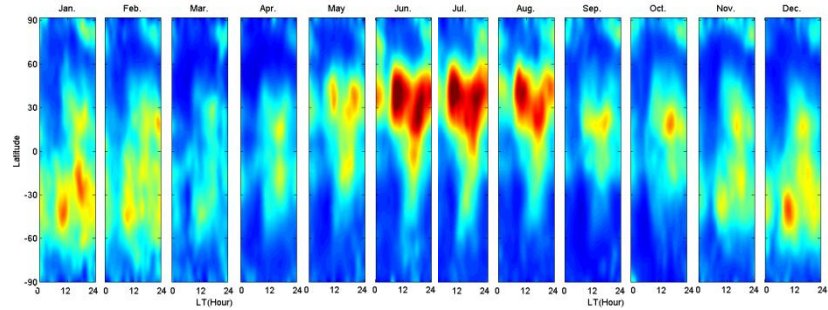


S4 max in the E-region during 2007-2011

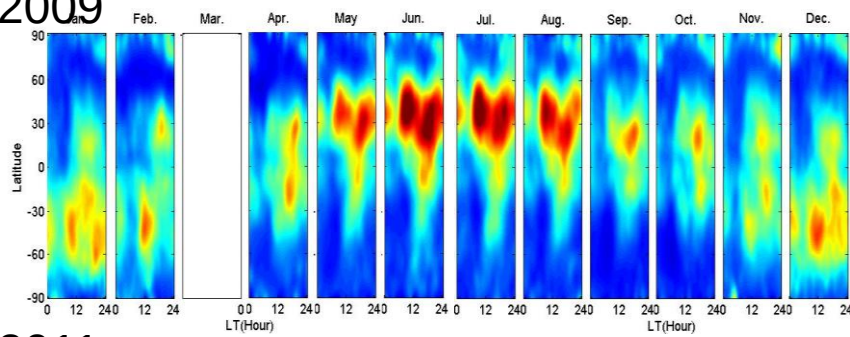
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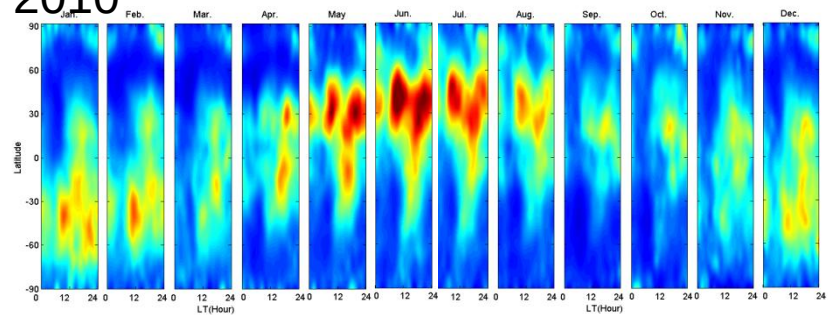
2008



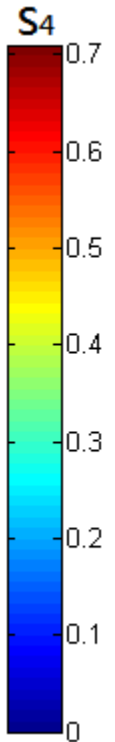
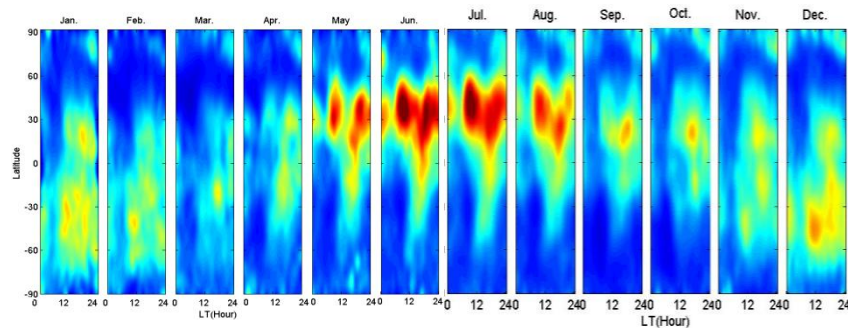
2009



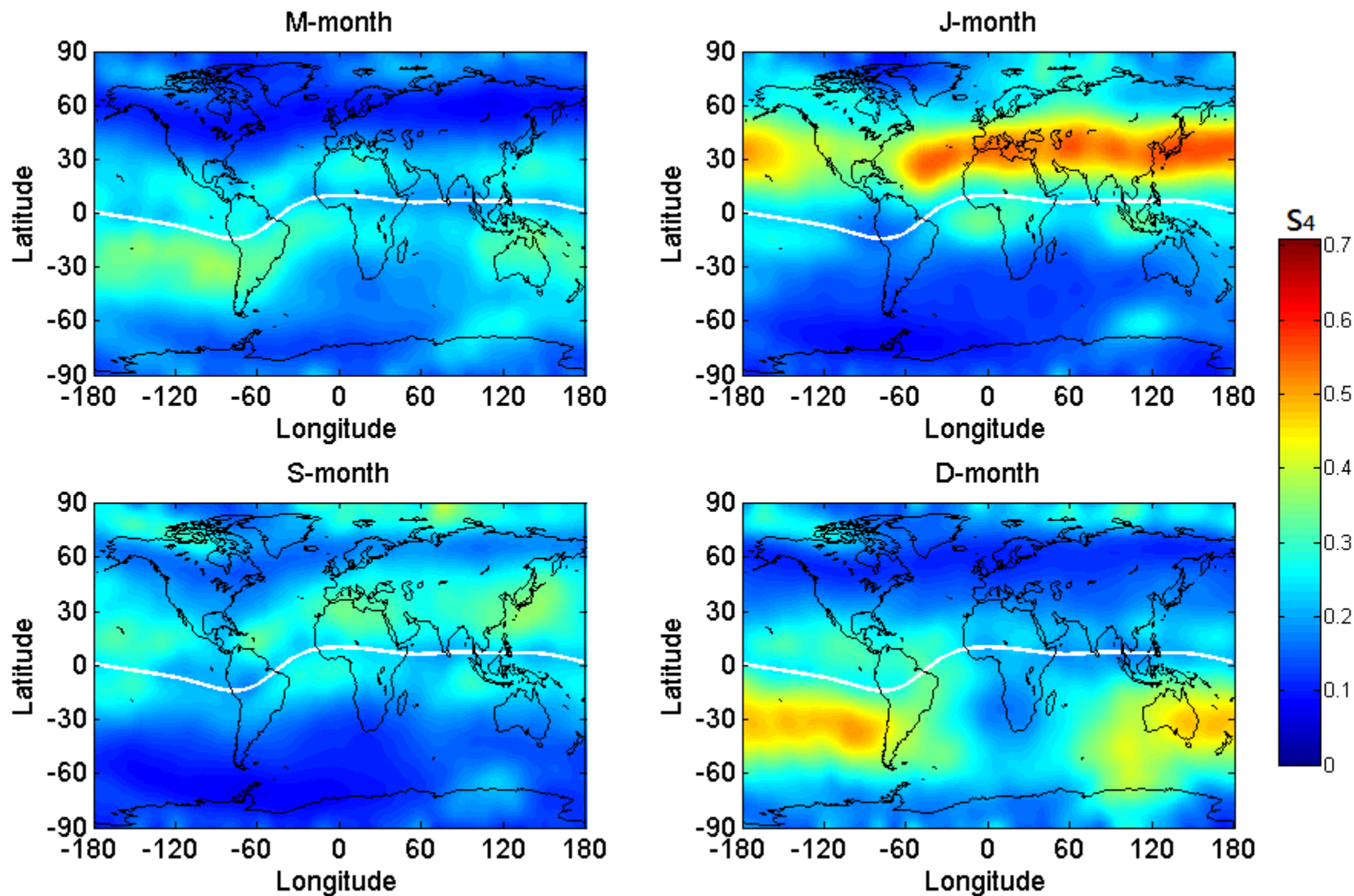
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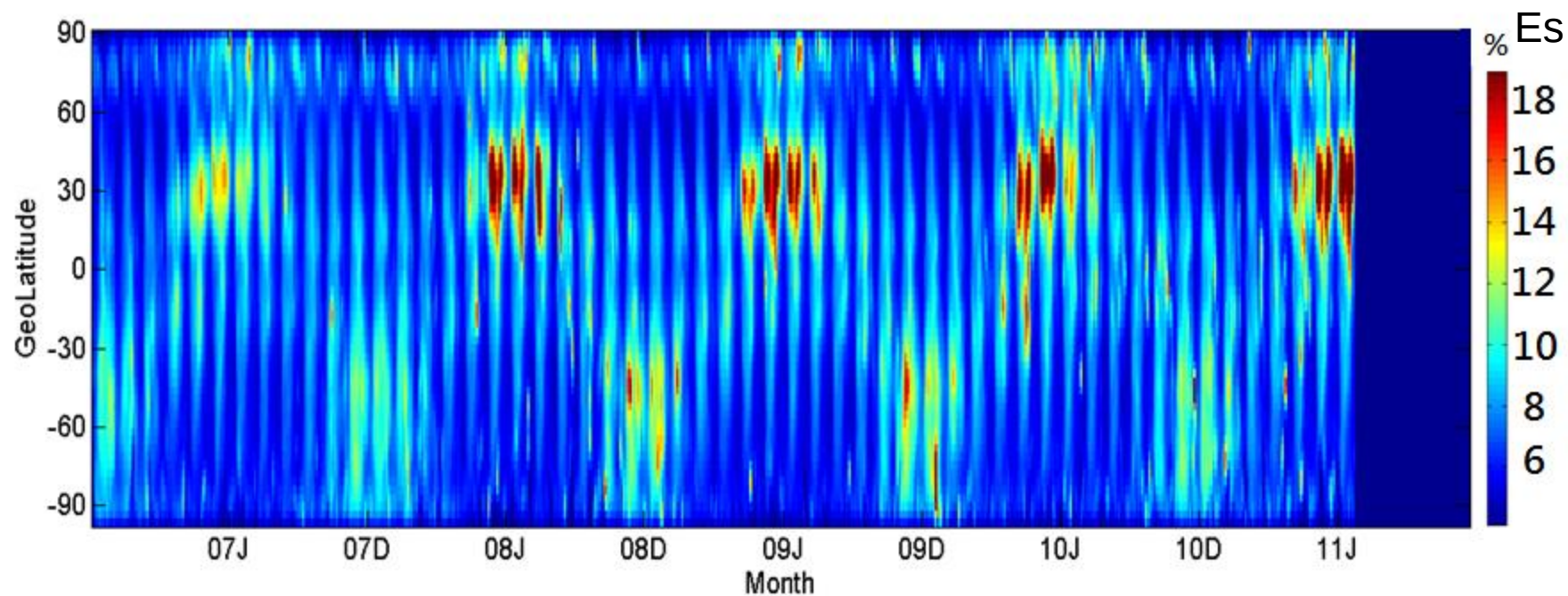
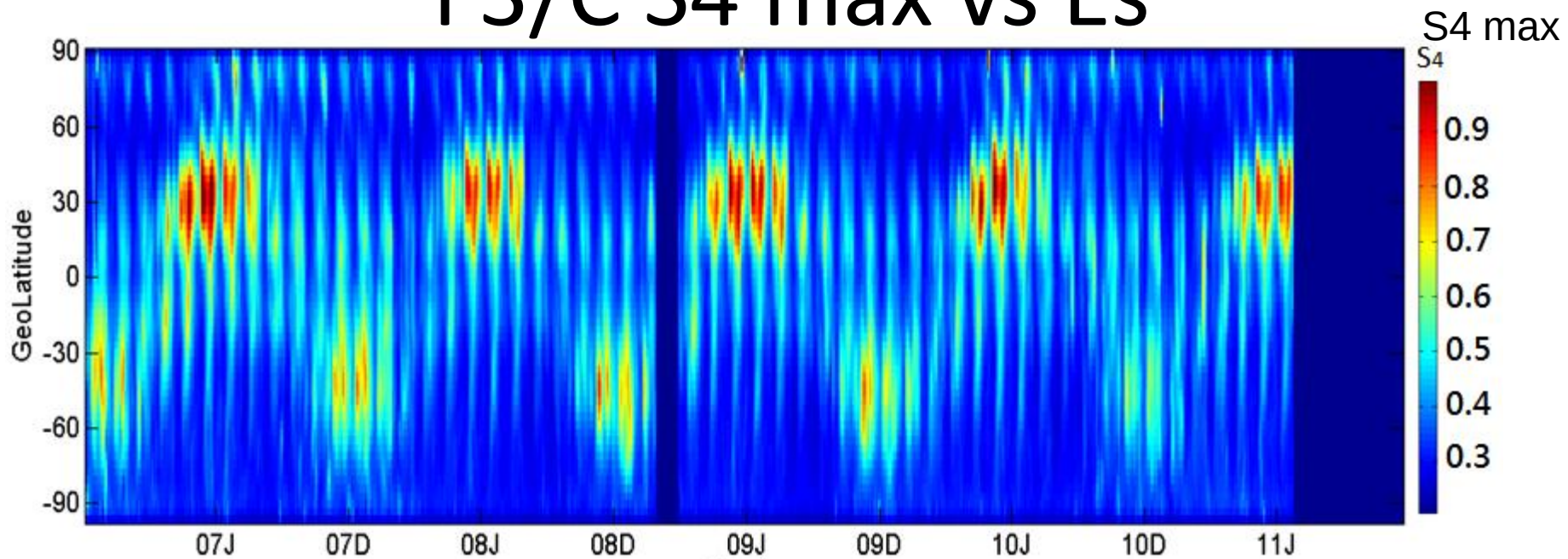
2011



Global Distribution of E-region S4 max

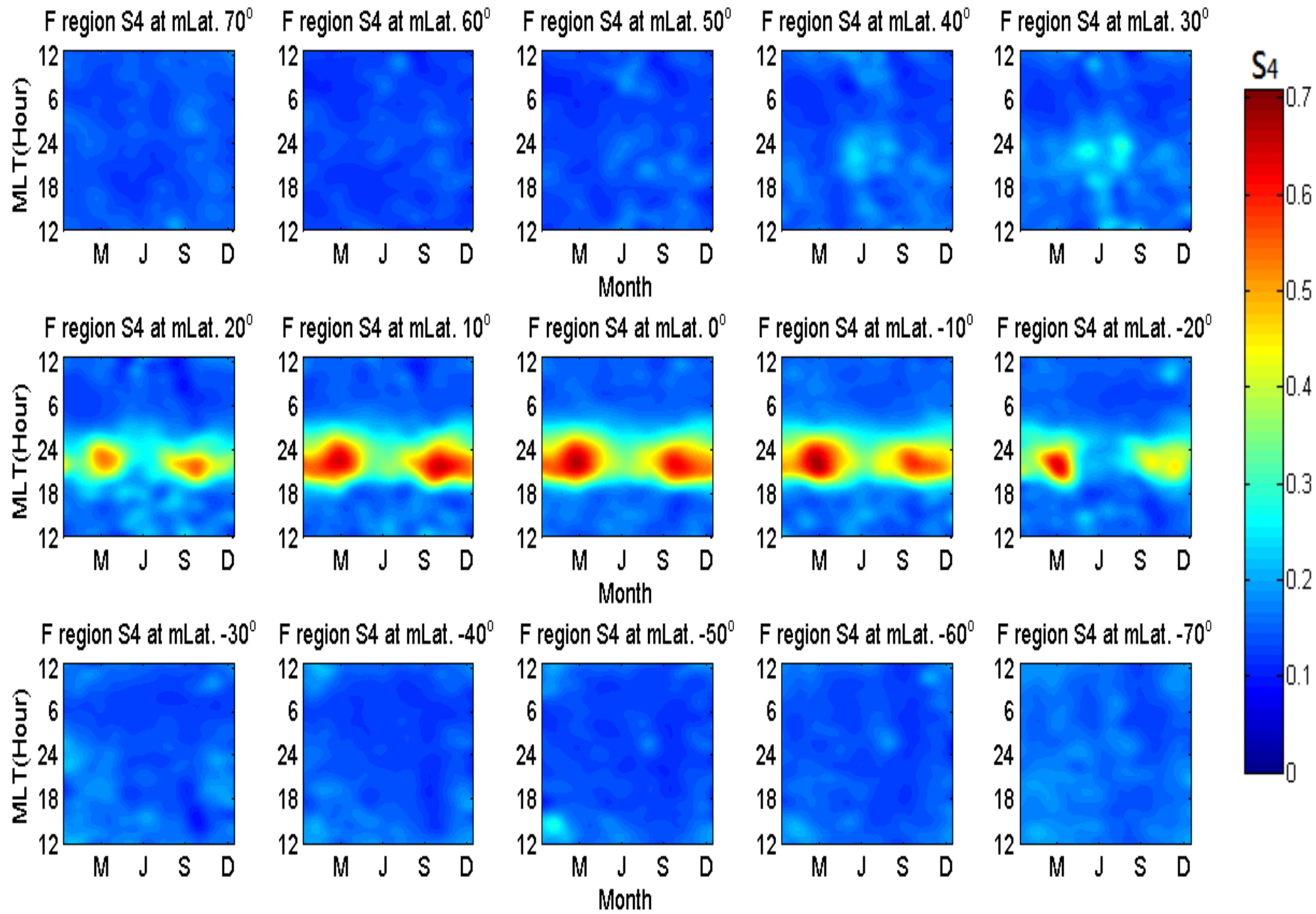


F3/C S4 max vs Es



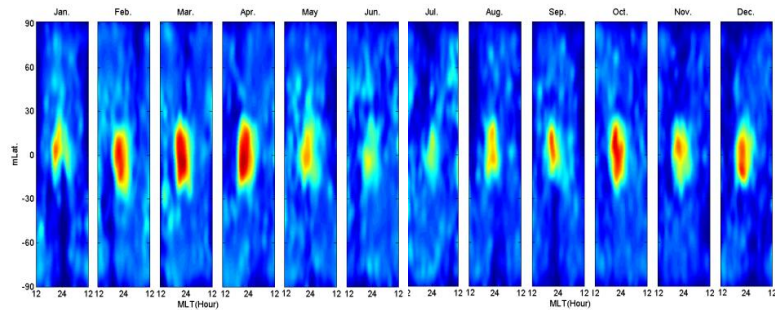
F3/C S4 max in the F-region

F region S4 max MLT vs. month in various MLats

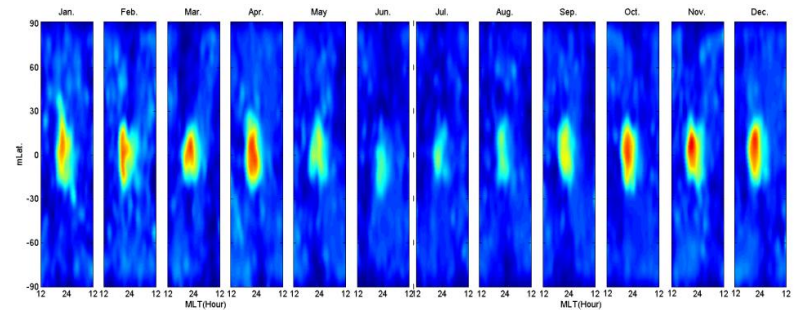


S4 max in the F-region during 2007-2011

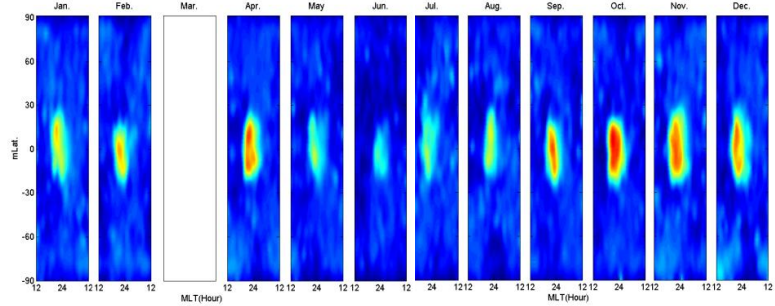
2007



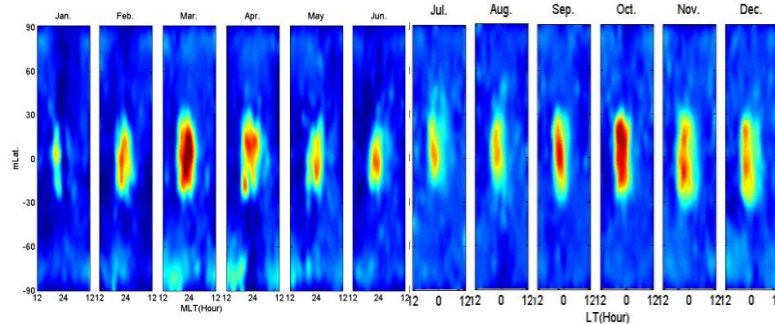
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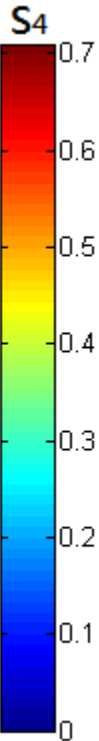
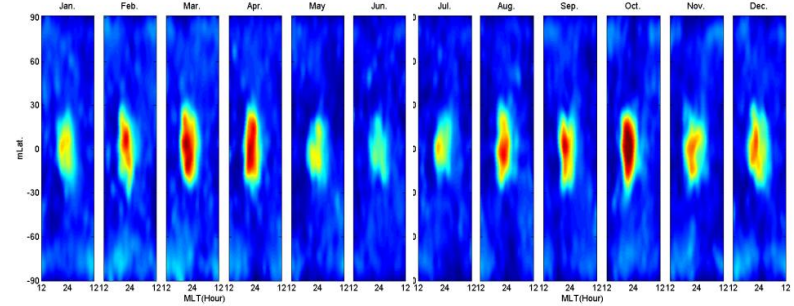
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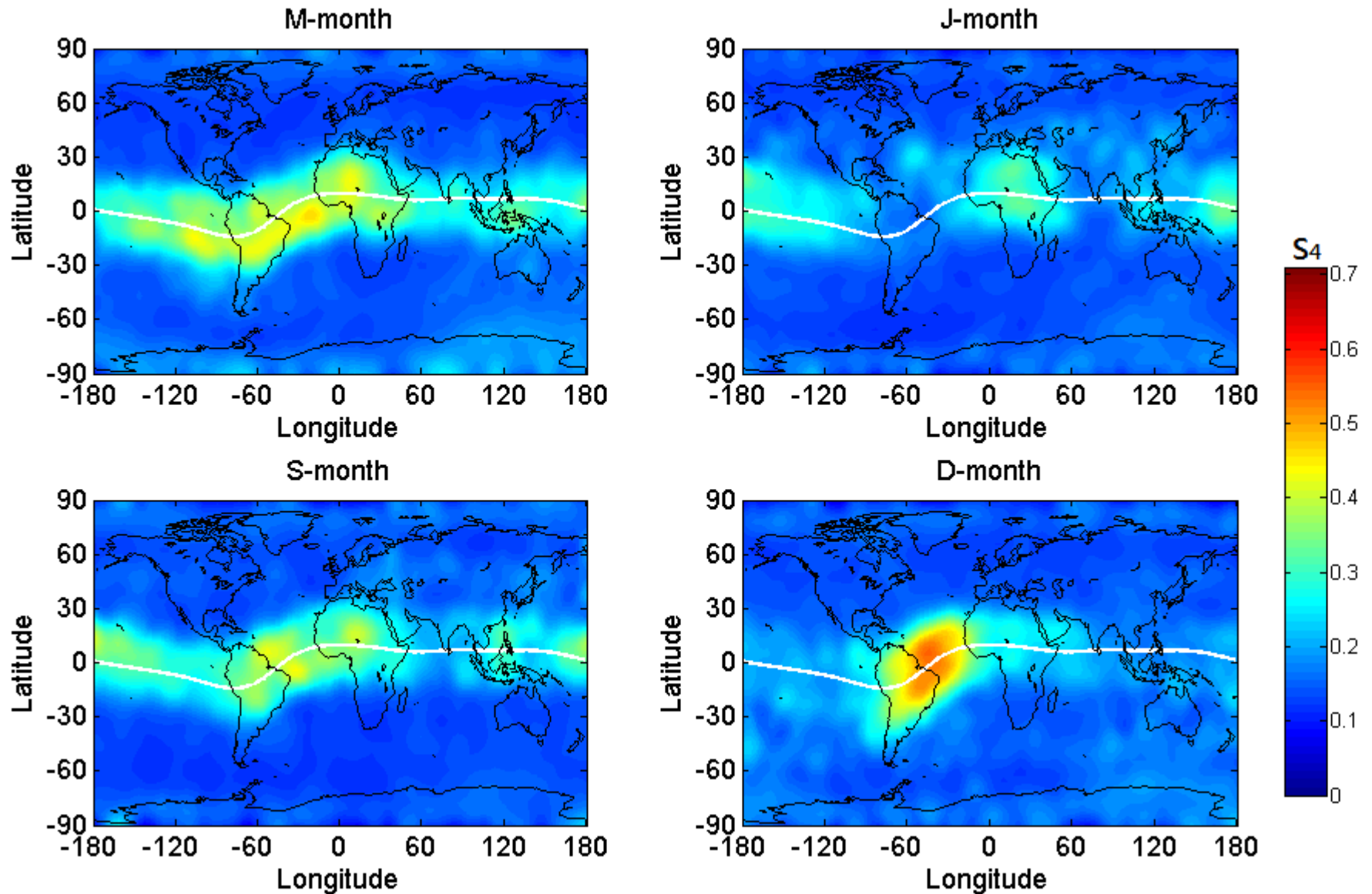
2011



2010



Global Distribution of F-region S4 max



Summary (I)

- The most prominent signatures of the F3/C S4 max in the E- (F-)region are in middle (equatorial-low) latitudes of the Summer J-month (equinox) months.
- The F3/C S4 max in the E-region becomes prominent in middle latitudes during the morning and evening period.
- The F3/C S4 max in the E-region yields the strongest in the summer months (especially J-month), 2nd in the equinox months, and weakest in the winter months.
- The F3/C S4 max in the E-region can be observed in the polar regions during 2007-2011.
- The F3/C S4 max in the E-region is mainly contributed by the Es (sporadic-E) layer. Neutral wind is essential!

Summary (II)

- The F3/C S4 max in the F-region lies between 20N and 20S and extends to higher latitudes in the equinox and D months. **ExB plasma fountain is essential!**
- The F3/C S4 max in the F-region becomes prominent in equatorial/low latitudes from the post sunset to **the post midnight** period.
- The F3/C S4 max in the F-region becomes more intense and reaches higher altitude in the equinox and D months.
- The F3/C S4 max in the F-region yields the greatest value in the American sector. **Geomagnetic control!**
- The F3/C S4 max in the F-region in the polar region seems to be insignificant during 2007-2011.
- **The F3/C RO provides global 3-D S4 index observations.**

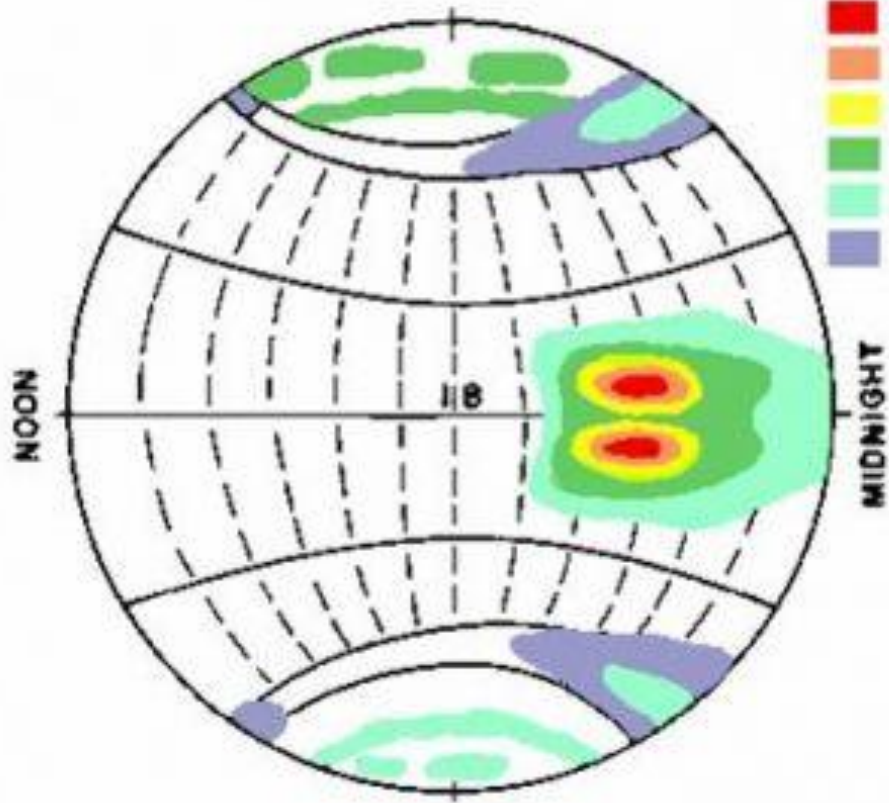


Thank you!!!



Ionospheric Scintillation

SOLAR MAXIMUM



L- BAND



SOLAR MINIMUM

