

Stratospheric Sudden Warming Effects on the Ionospheric Migrating Tides during 2008-2010 Observed by FORMOSAT-3/COSMIC

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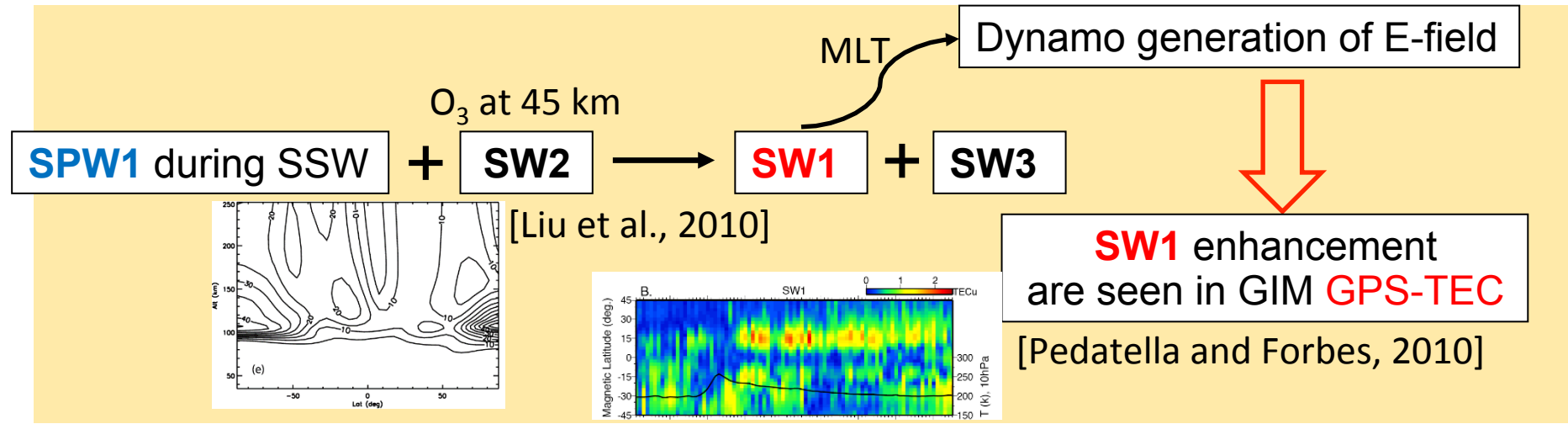
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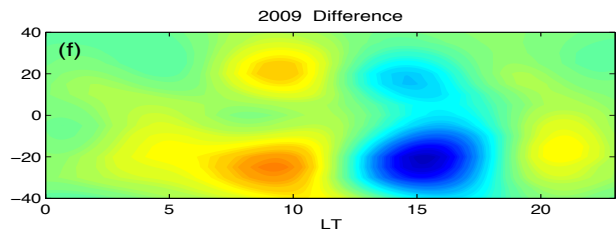
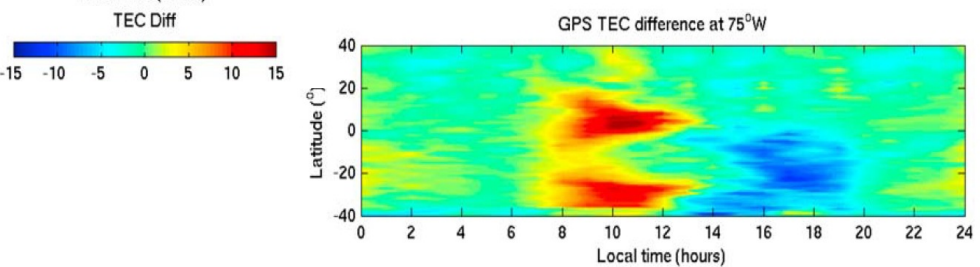
NSPO

Motivations for the Present Study

- Ion and electron temperatures modification. [Goncharenko and Zhang, 2008]



- Using the WAM. Terdiurnal migrating tide (TW3) significantly increased at ionospheric dynamo region. [Fang et al., 2012]



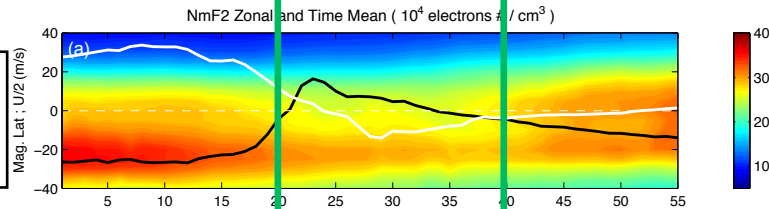
The typical SSW ionospheric feature of semi-diurnal (morning enhancement/afternoon reduction) variation. [Goncharenko et al., 2012]

Migrating tidal components play a important role than nonmigrating. [Lin et al., 2012]

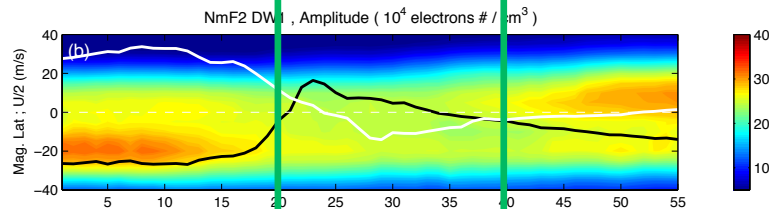
Amplitude modification of Ionospheric Migrating tides during the 2009 SSW

- The peak electric density (NmF2) obtained from radio occultation soundings of COSMIC are decomposed into their various constituent for studying the stratwarm.

Zonal and Time Mean (ZaTM)

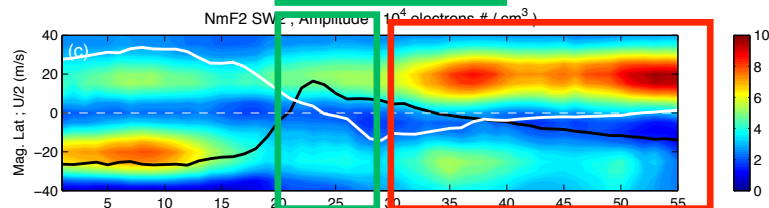


DW1

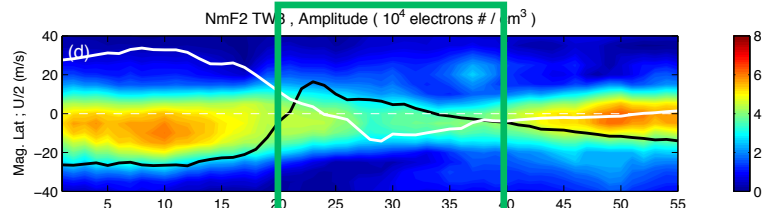


Migrating tides

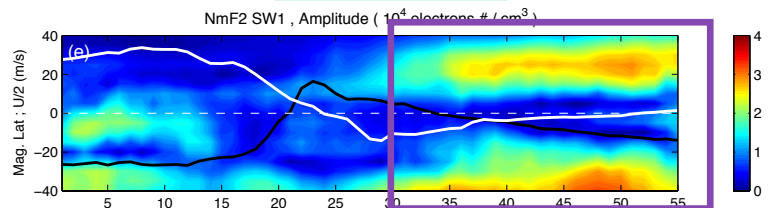
SW2



TW3



SW1
nonmigrating tide



ZaTM, DW1, SW2 and TW3

decreased during the SSW

- Contraction of thermospheric density [Liu et al., 2011]

SW2 intensification after SSW peak

- Mean wind condition in the MLT [Pedatella and Forbes, 2010]
- Enhanced Ozone in the tropical stratosphere. [Goncharenko et al., 2012]

SW1 intensification accompany with SW2 after SSW peak

- Nonlinear interaction between PW1 and SW2. [Cheng et al., 2009 ; Pedatella and Forbes, 2010]

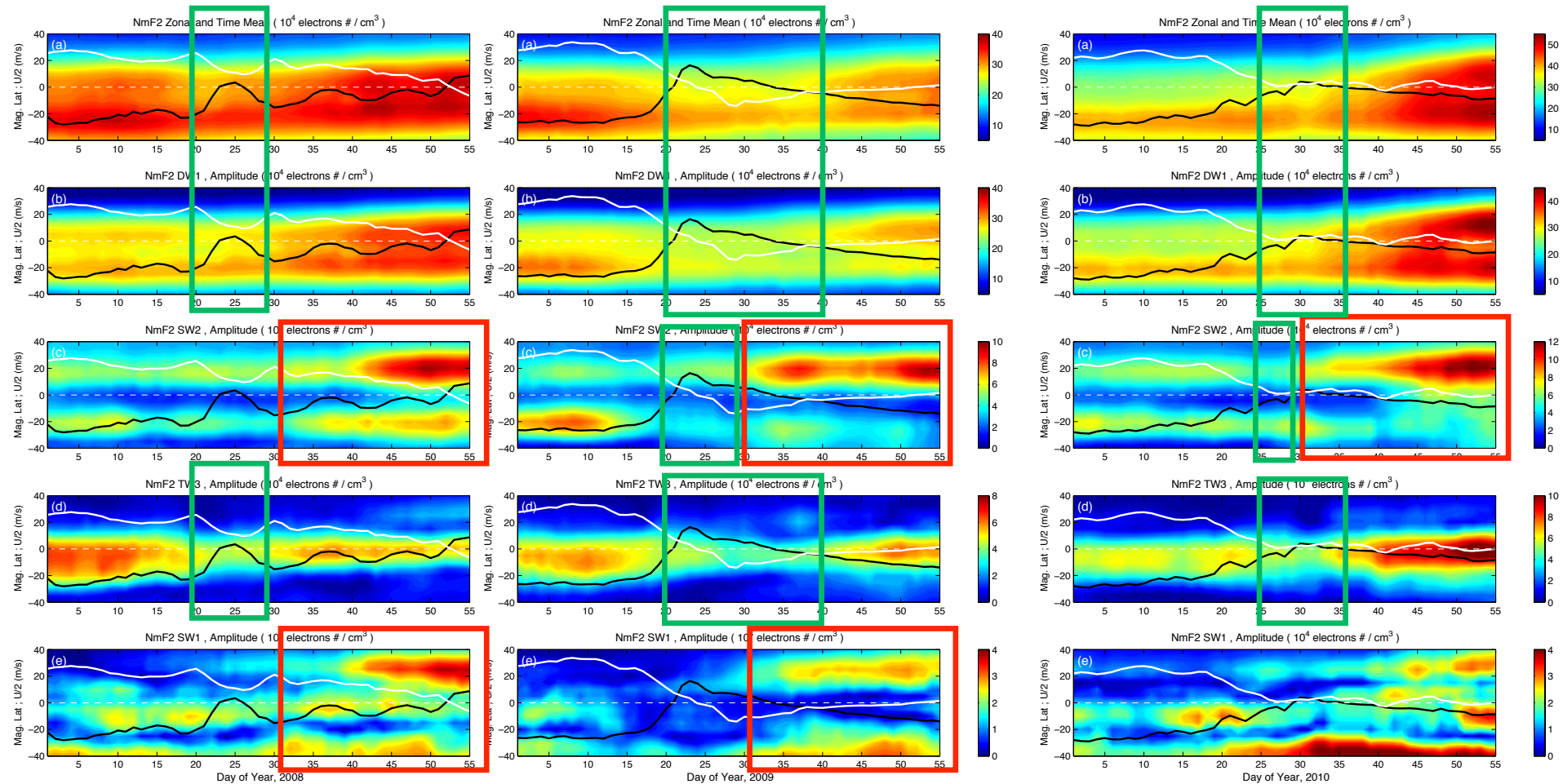
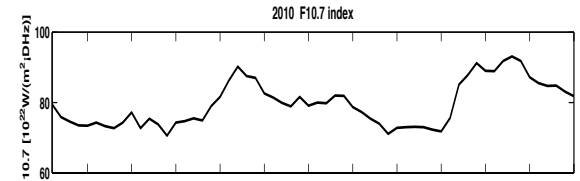
Comparison of SSW events from 2008-2010

Decrease of ZaTM, DW1, SW2 and TW3 are well match to the SSW peak every year

2008 SSW

2009 SSW

2010 SSW

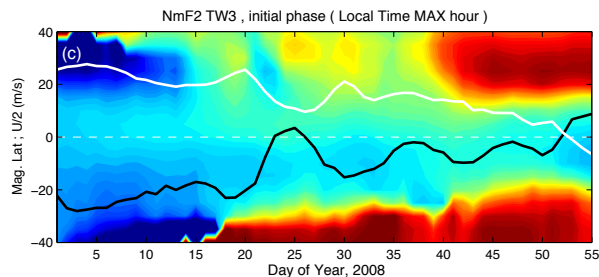
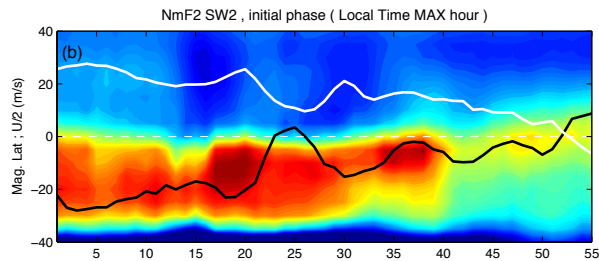
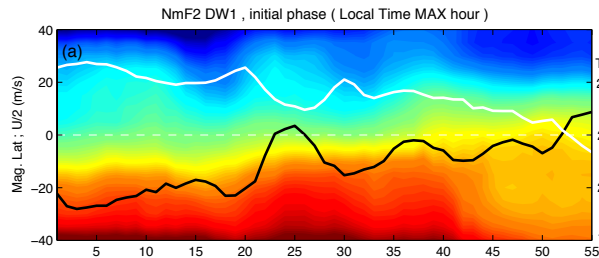


Phase modifications of ionospheric migrating tides during the SSW events

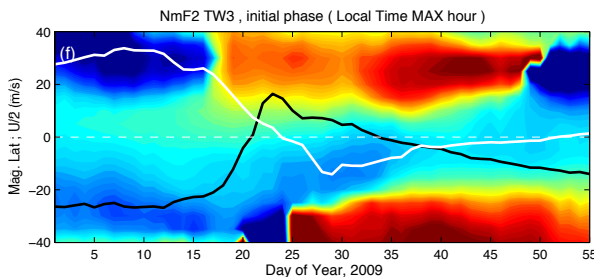
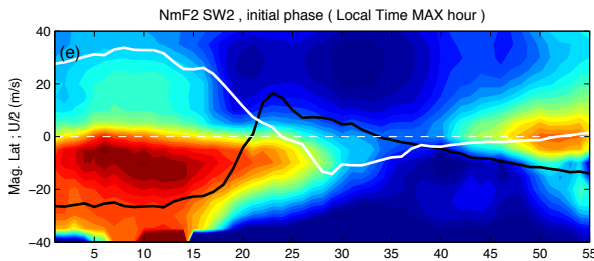
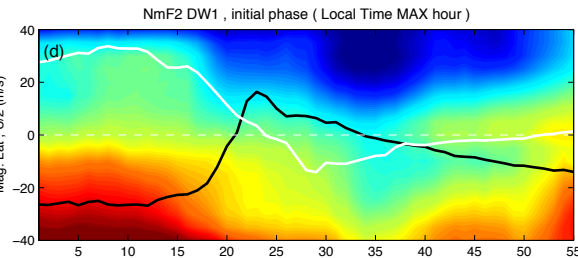
- Three distinct phase shifts follow the temperature variation.

- The phase shifts appear good relationship with stratospheric temperature
 - Earlier time shift of DW1 are seen in all latitude
 - Earlier time shift of SW2 and TW3 are seen in EIA

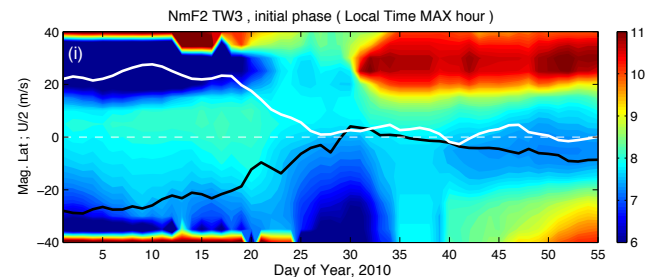
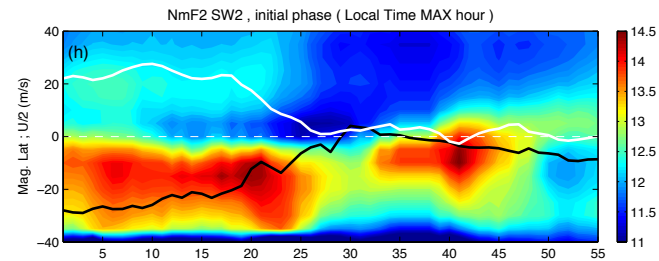
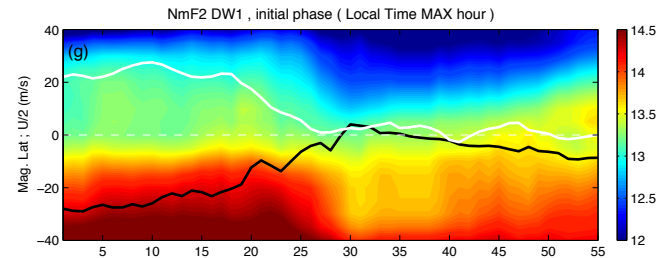
2008 SSW



2009 SSW



2010 SSW



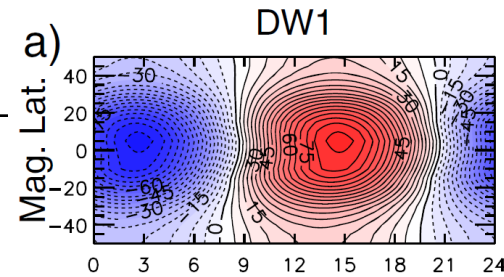
Discussion - Physical meaning of ionospheric migrating tides

- Chang et al. (2013) investigate the physical meaning of these migrating tides.

□ DW1

- Forming the equatorial daytime peak in TEC

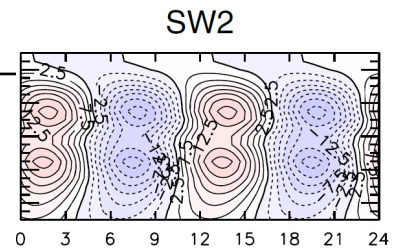
➤ Still could be modified by tidal forcing from below



□ SW2

- The strength of EIA crests

➤ Influenced strongly by the MLT SW2 forcing



Conclusions

- Although the PWs and mean wind conditions at MLT region for 2008-2010 events may be different, there exist clear similarities in responses of ionospheric tidal components.
- Decreases of Za_{TM} , DW1, SW2 and TW3 occur during SSW.
- Simultaneous enhancements of SW2 and SW1 occur after SSW peak
- The phase shift of ionospheric migrating tides is also a prominent indicator of ionospheric SSW effect.
- It is possibly the PWs during the SSW period modify the amplitudes and phases of migrating tides at MLT region and further lead to variation of the ionospheric migrating tidal components.

Thanks you for attention

Backup

