Equatorial ExB drifts during sudden stratospheric warming events

J. L. Chau	extsuperscript{1}, F. R. Galindo	extsuperscript{1}, B. G. Fejer	extsuperscript{2}, and L. P. Goncharenko	extsuperscript{3}

	extsuperscript{1}Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima
	extsuperscript{2}Center for Atmospheric and Space Sciences, Utah State University, Logan, UT
	extsuperscript{3}Massachusetts Institute of Technology, Haystack Observatory, Westford, MA

CEDAR 2009, Santa Fe, NW, July 2 2009
SSW Jan 2008: ExB Daytime Drifts

Average + variability from 35 years of ISR data

[from Chau et al., 2009]
SSW Jan 2008: $\Delta$SSW vs $\Delta$ExB

- $\Delta$ExB: Morning amplitude ExB difference with respect to expected averages, after fitting a semidiurnal wave.
- $\Delta$SSW: differences with respect to 30-year median values.
- High correlation/anticorrelation: $\Delta$ExB vs. $\Delta$T/$\Delta$U during SSW.
- Note the “persistence” of the ExB drift pattern during SSW period.
- Comparing peaks (Highest temperature difference and Highest ExB difference), ExB drift peak occurs ~1 day after SSW temperature peak.

[from Chau et al., 2009]
Jan 2009: SSW vs Jicamarca Drifts

**ISR**

- NCEP/CPC ΔT 60-90°N 10 hPa
- NCEP/CPC ΔU 60°N 10 hPa
- NCEP/CPC ΔZ1 60°N 10 hPa

**150-km**

- NCEP/CPC ΔT 60-90°N 10 hPa
- NCEP/CPC ΔU 60°N 10 hPa
- NCEP/CPC ΔZ1 60°N 10 hPa

**ΔH**

- NCEP/CPC ΔT 60-90°N 10 hPa
- NCEP/CPC ΔU 60°N 10 hPa
- NCEP/CPC ΔZ1 60°N 10 hPa

From: 2-Dec-2008 (337) to: 30-Jan-2009 (30)
Again, comparing peaks we find:

- The highest ExB drift amplitude difference occurs ~4 days after the peak in SSW temperature occurs.
- Once the highest value is reached, a moderate amplitude persist for few days, in a correspondence with the SSW temperature behavior.
Jan 2009: 3-month behavior

NCEP/CPC ΔT 60-90°N 10 hPa

NCEP/CPC ΔU 60°N 10 hPa

Delay: ~4 days

NCEP/CPC ΔZ1 60°N 10 hPa

From: 2-Dec-2008 (337) to: 28-Feb-2009 (59)
Jan 2003: SSW vs. Jicamarca Drifts

- Minor (?) SSW, westerly wind decreased
- Moderate to high solar conditions
- Magnetically quiet and active conditions.
- Semidiurnal pattern between Jan 2-6, showing “persistence”.
- ExB peak difference occurs after ~4-5 days the occurrence of the highest SSW Temp.
Conclusions

- Based on three campaigns, Jan 2003, Jan 2008 and Jan 2009, it is clear that indeed the equatorial ionosphere behavior is closely correlated to the occurrence of SSW events, specifically:
  - The morning ExB drift differences are amplified more than 3 times the expected standard deviations
  - Such behavior persists for many days in close association with the duration of the stratospheric warming and the reversal of the zonal wind.
  - The peak of the equatorial disturbances occurs between 1 to 5 days after the peak of high-latitude temperature at 10 hPa level. At lower levels the temperature increase later as the event propagates downward
  - During the Jan 2009, the SSW lasted unusually long time and the associated ExB amplitudes differences were predominantly larger than previous to the SSW event.