

The Equatorial Ionosphere over Jicamarca during the January 2009 Sudden Stratospheric Warming

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Acknowledgements

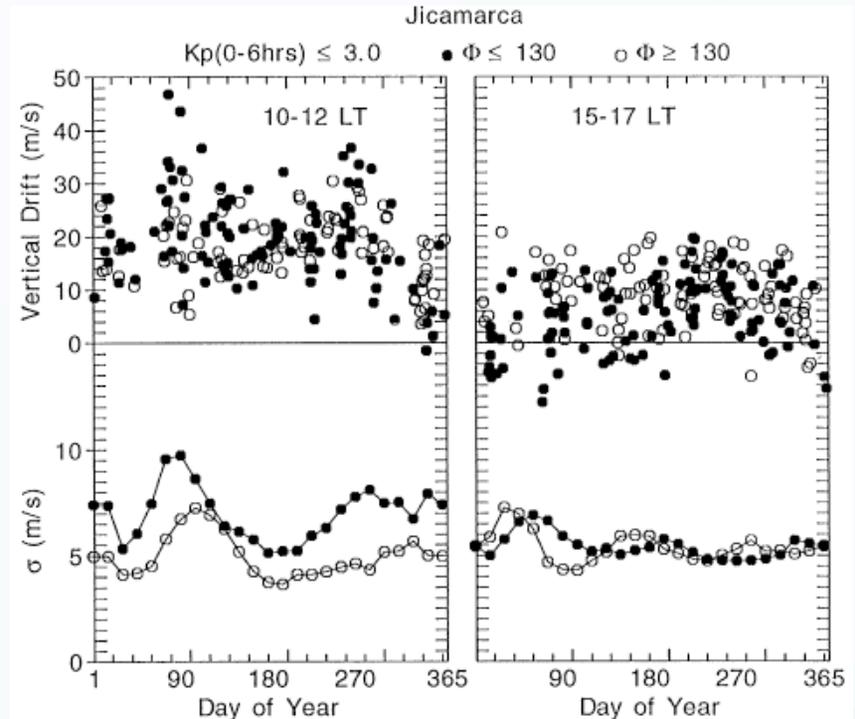
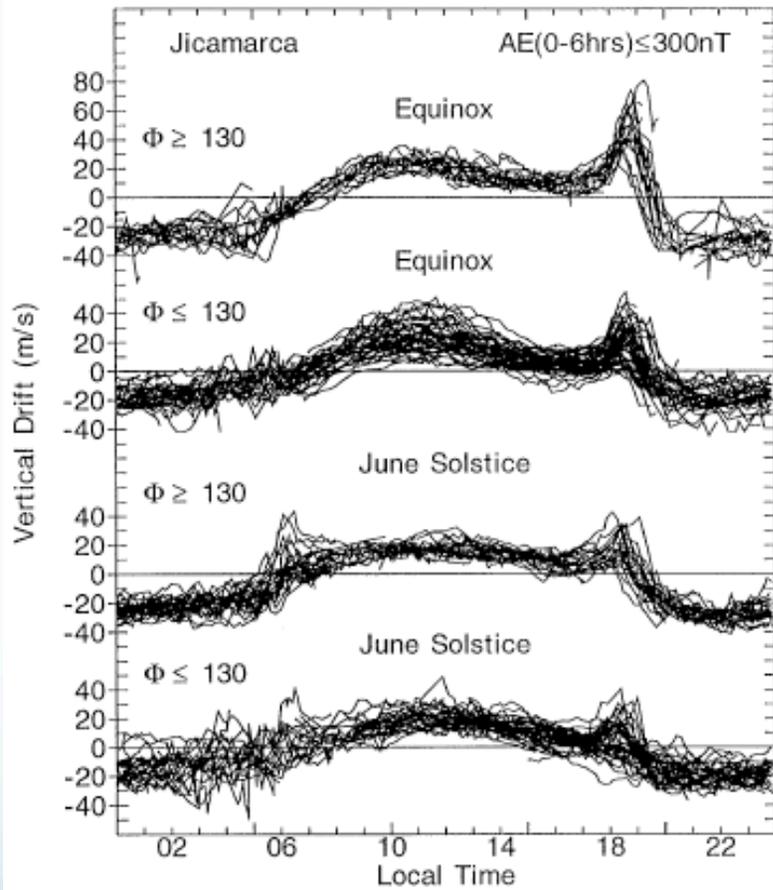
H. Pinedo

A. Anghel

Outline

- Equatorial ExB drifts
- Stratospheric warming events and Equatorial ExB drifts
 - Jan 2008
 - Jan 2009
 - Jan 2003
- Conclusions
 - Peak of ionospheric disturbances occur 1-4 days after SSW peak
 - After Jan 2009 SSW event, the equatorial drift amplitude were predominantly larger than before the SSW event, at least for a couple of weeks

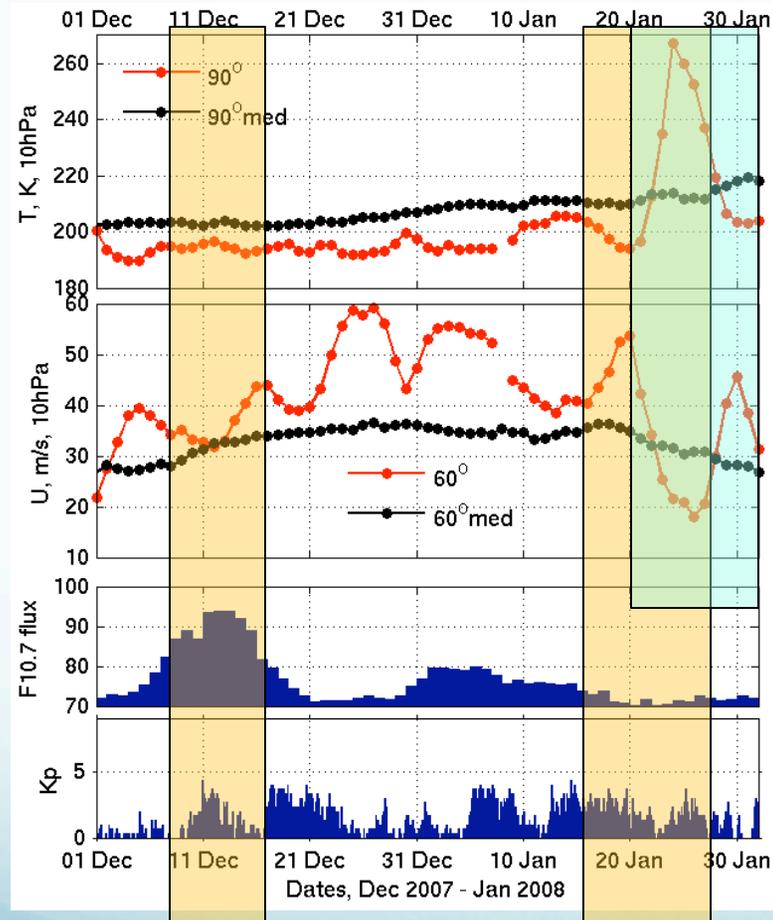
ExB: Daytime and Quiet-time average and variability (1)



- Daytime **average** drifts do not vary much with solar activity.
- **Variability** is local time, seasonal, solar cycle dependent.
- Variability is **largest** in the **dawn-noon** sector and during solar-**minimum** conditions

[from Fejer and Scherliess, 2001]

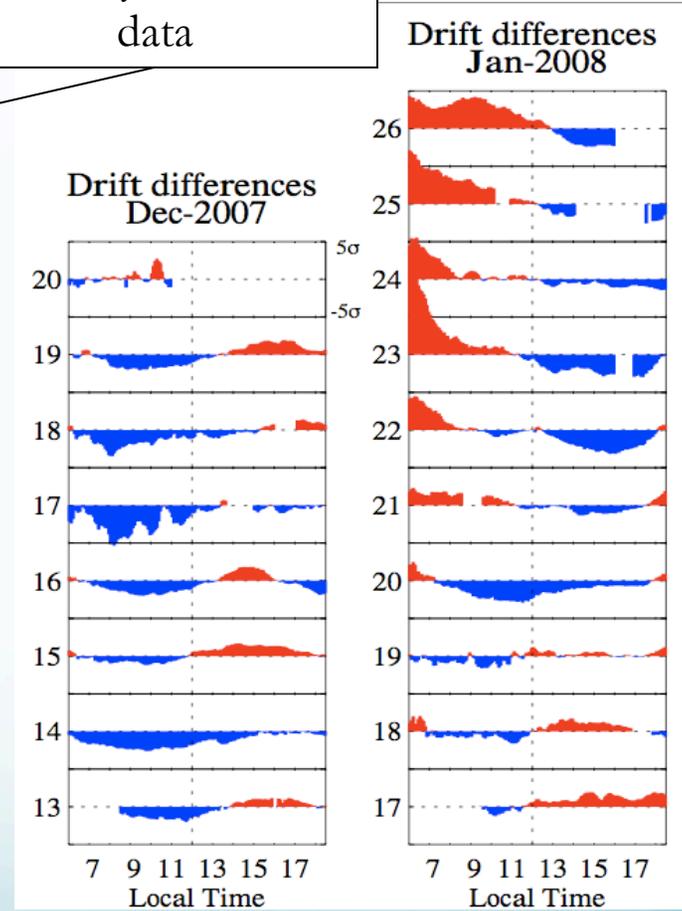
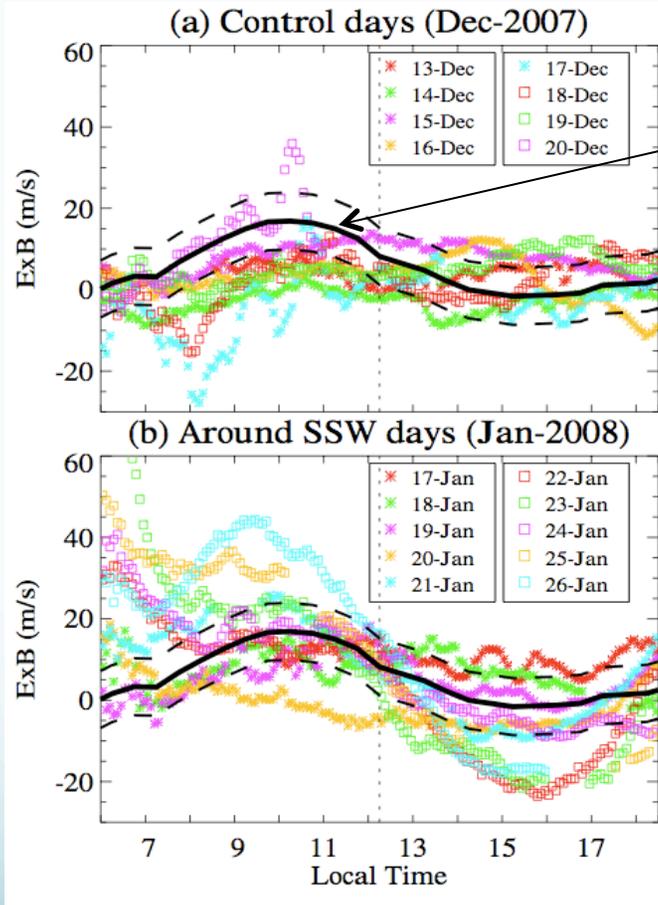
SSW Jan 2008: SSW Main parameters



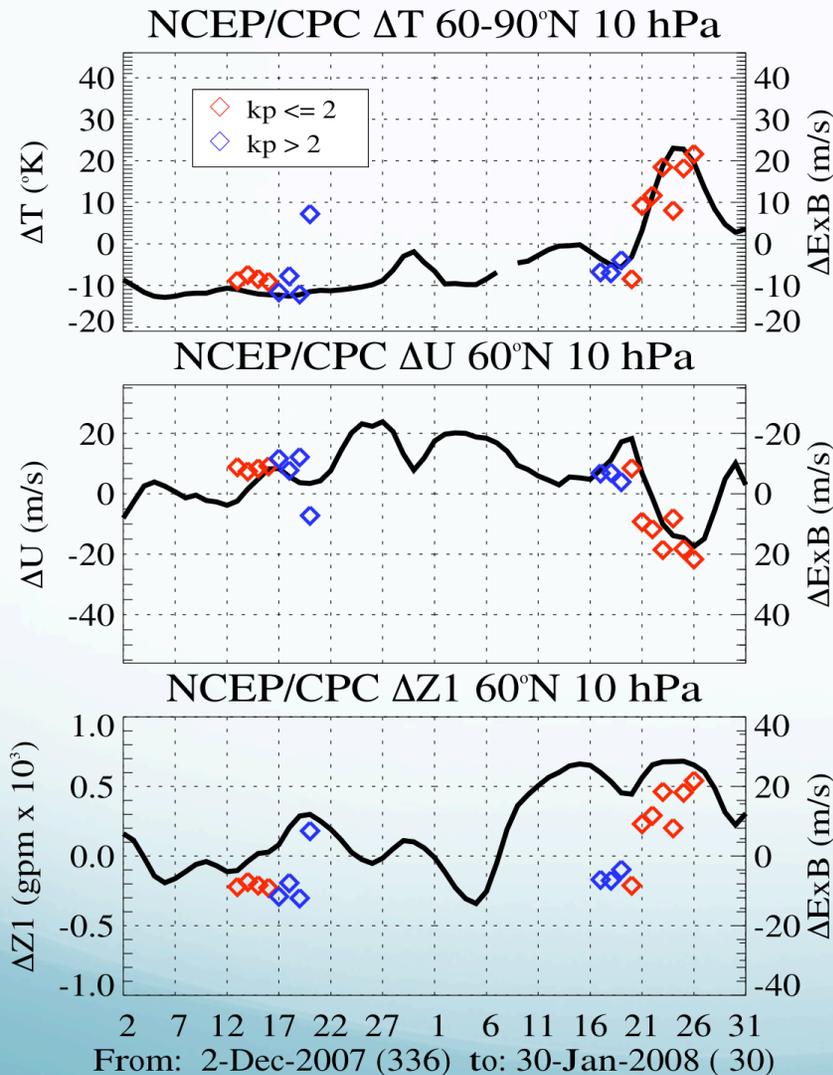
- Minor SSW event. Westerly winds slowed down
- One of the largest temperature increases in the last 30 years.
- Low solar flux (close to 70)
- Magnetically quiet conditions
- Many ground-based instruments operated 8-10 days in December 2007 and 10-14 days in January 2008.

SSW Jan 2008: ExB Daytime Drifts

Average + variability
from 35 years of ISR
data

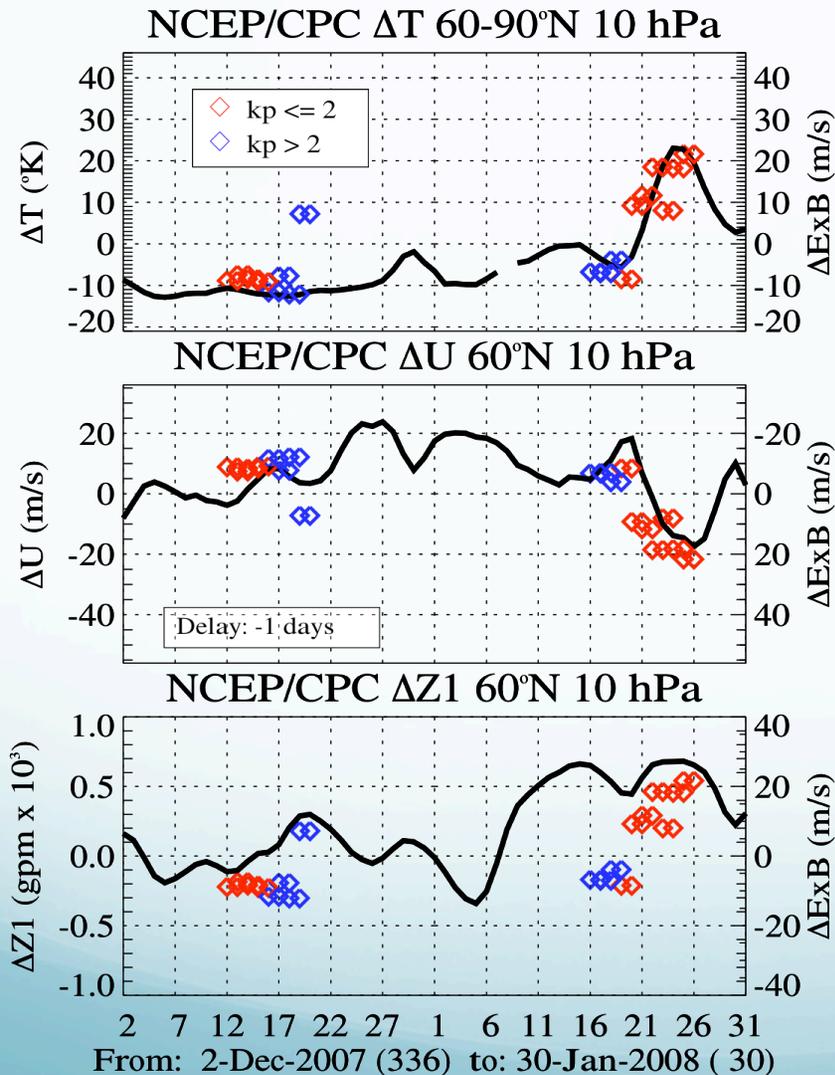


SSW Jan 2008: Δ SSW vs Δ ExB



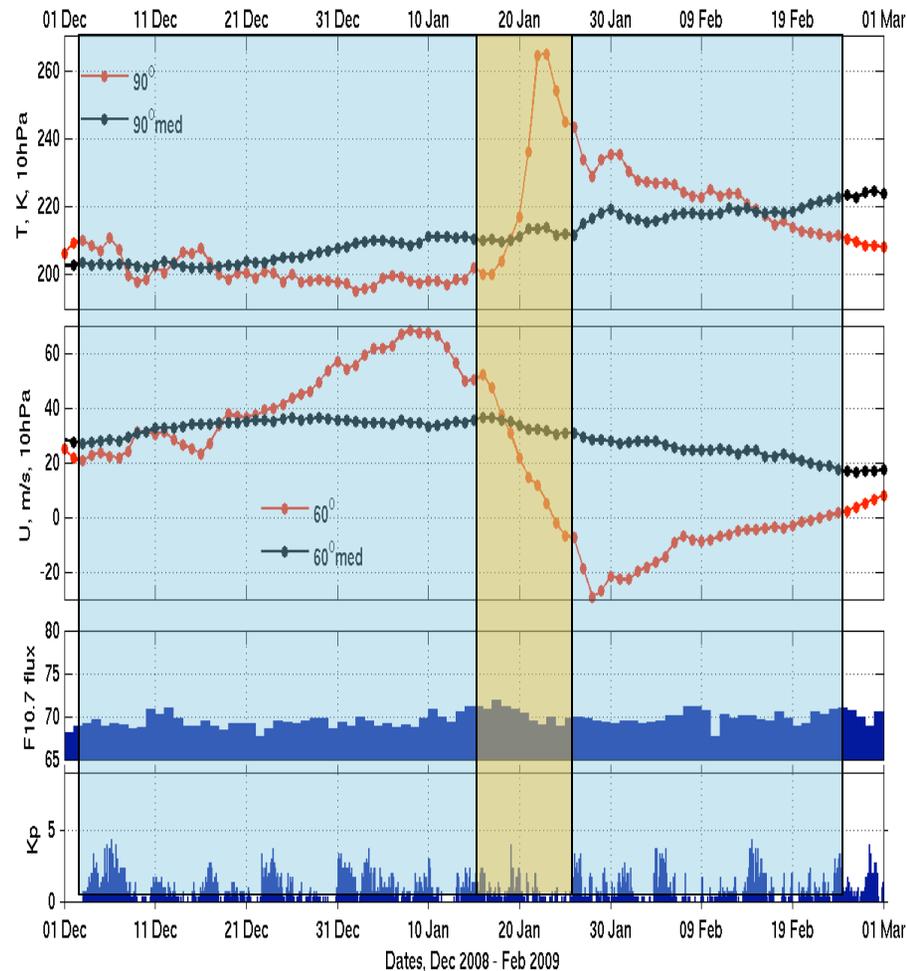
- ΔExB : Morning amplitude ExB difference with respect to expected averages, after fitting a semidiurnal wave.
- ΔSSW : differences with respect to 30-year median values.
- High correlation/anticorrelation: ΔExB vs. $\Delta T/\Delta U$ during SSW.
- Note the “persistence” of the ExB drift pattern during SSW period.

SSW Jan 2008: ~1 day delay



- Comparing peaks (Highest temperature difference and Highest ExB difference), ExB drift peak occurs ~1 day after SSW temperature peak.

SSW Jan 2009: SSW Main parameters



- Major SSW event. Westerly winds slowed down and reversed direction
- The largest temperature increase in the last 30 years and the longest lasting.
- Low solar flux (close to 70)
- Magnetically quiet conditions
- 11 days coverage with ISR drifts and densities, and mesospheric dynamics.
- More than 30 days ExB drifts from ground-based magnetometers and 150-km echoes.

SSW Jan 2009: Jicamarca Drifts

ISR

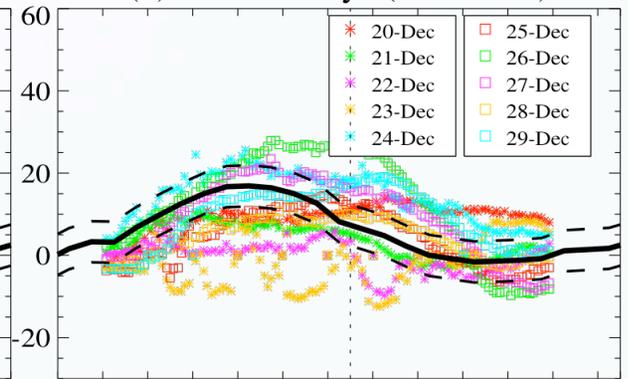
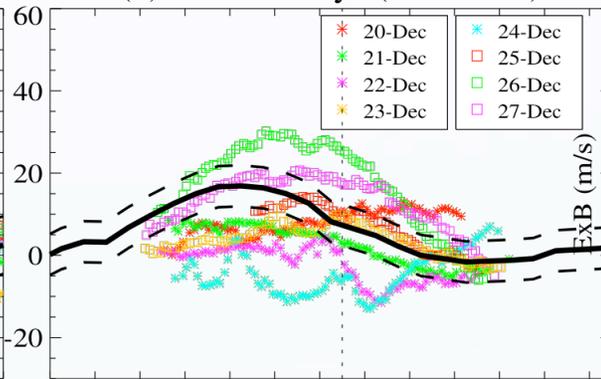
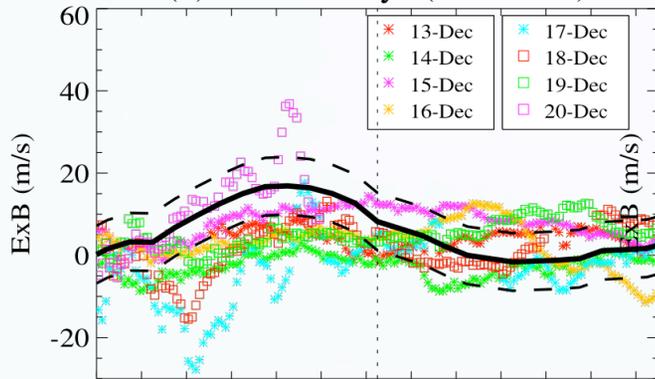
150-km

ΔH

(a) Control days (Dec-2007)

(a) Control days (Dec-2008)

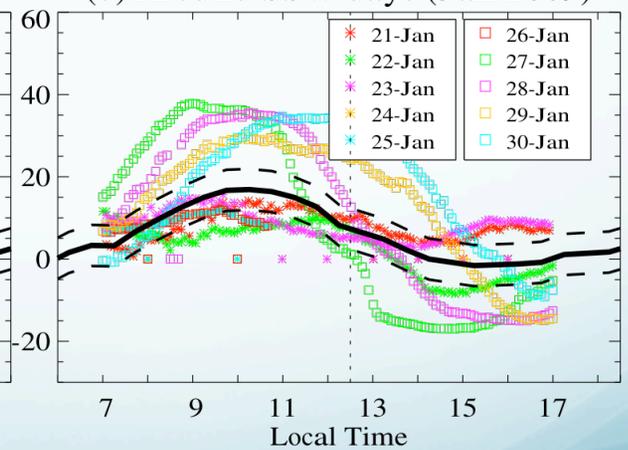
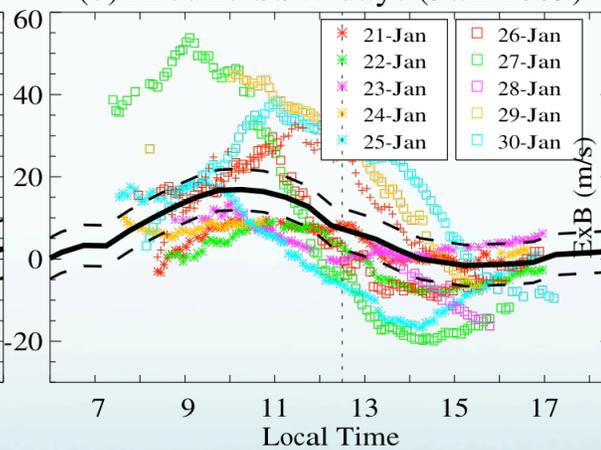
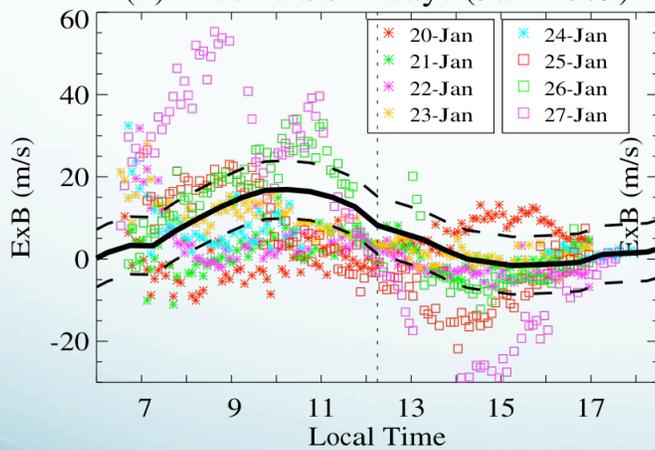
(a) Control days (Dec-2008)



(b) Around SSW days (Jan-2009)

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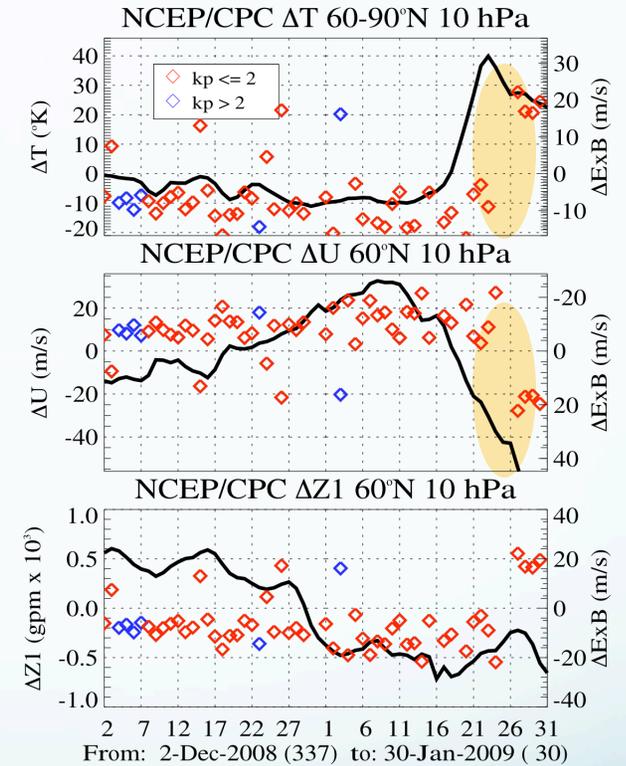
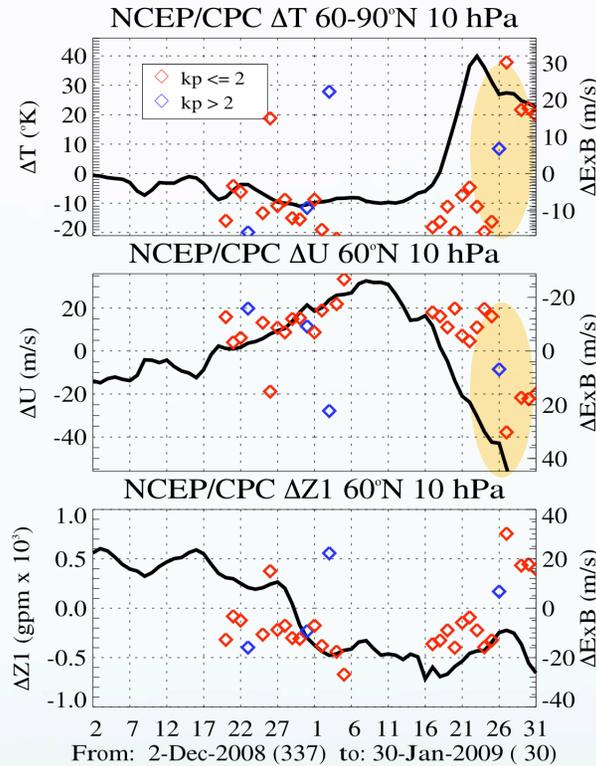
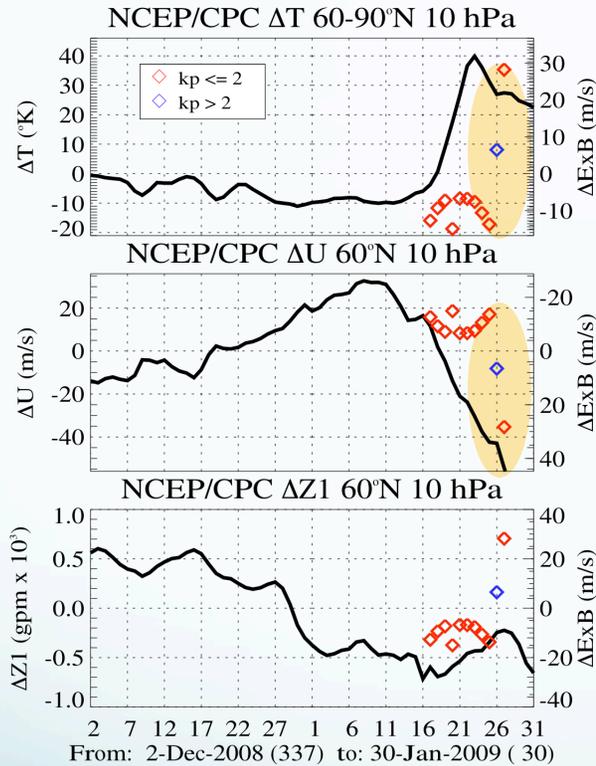


Jan 2009: SSW vs Jicamarca Drifts

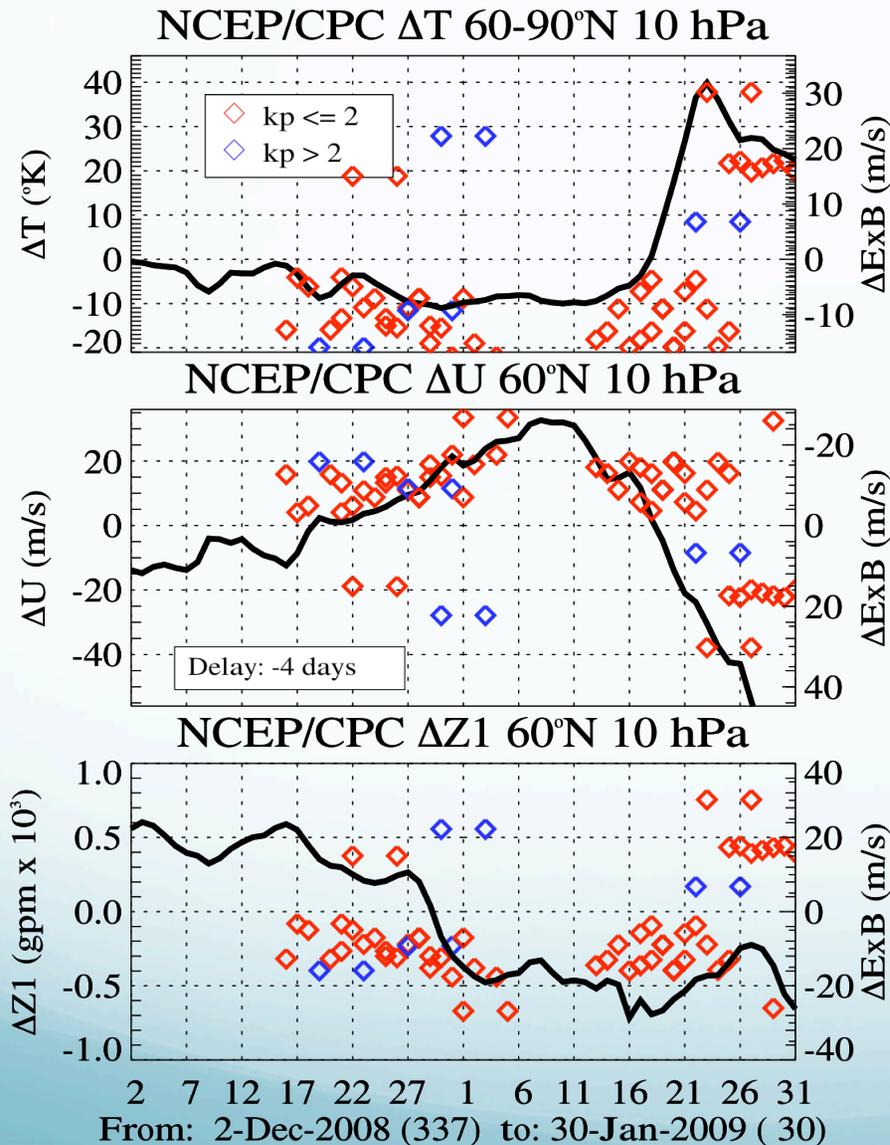
ISR

150-km

ΔH

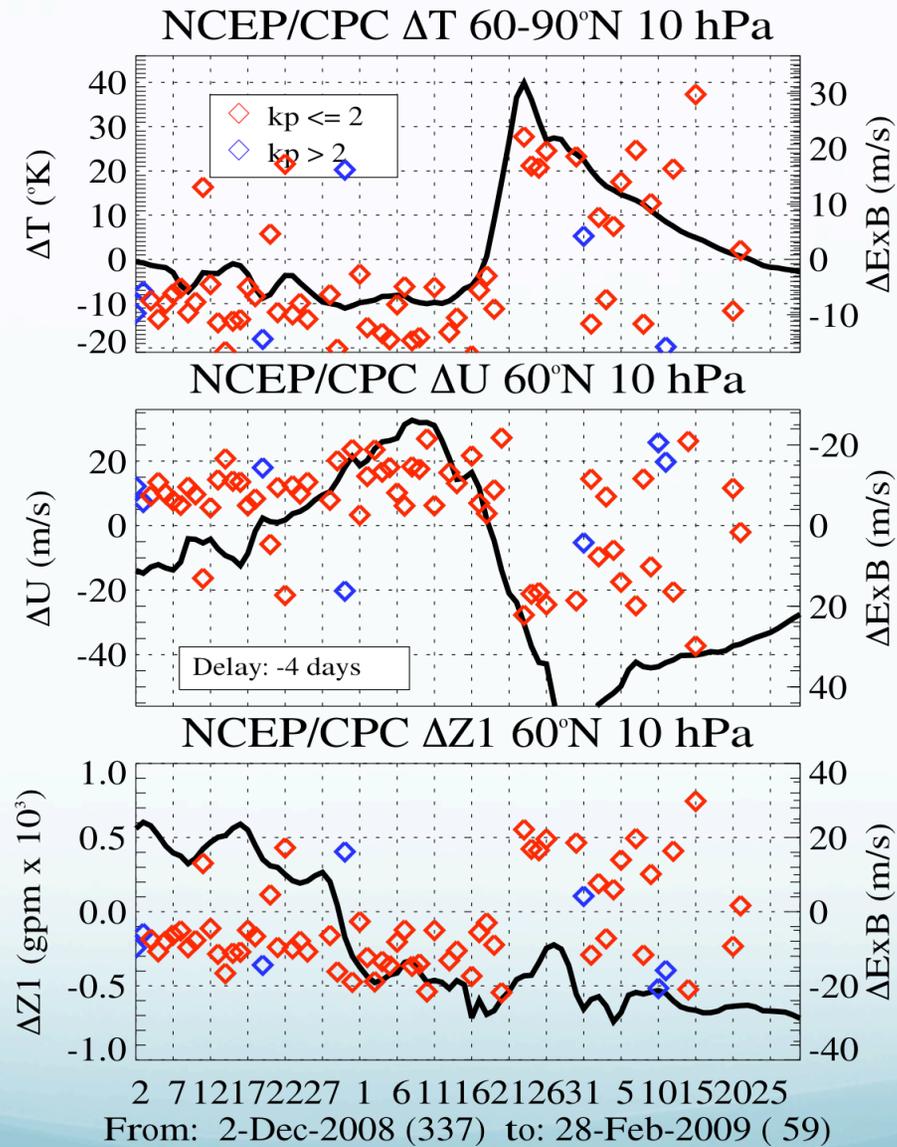


SSW Jan 2009: ~4 days delay

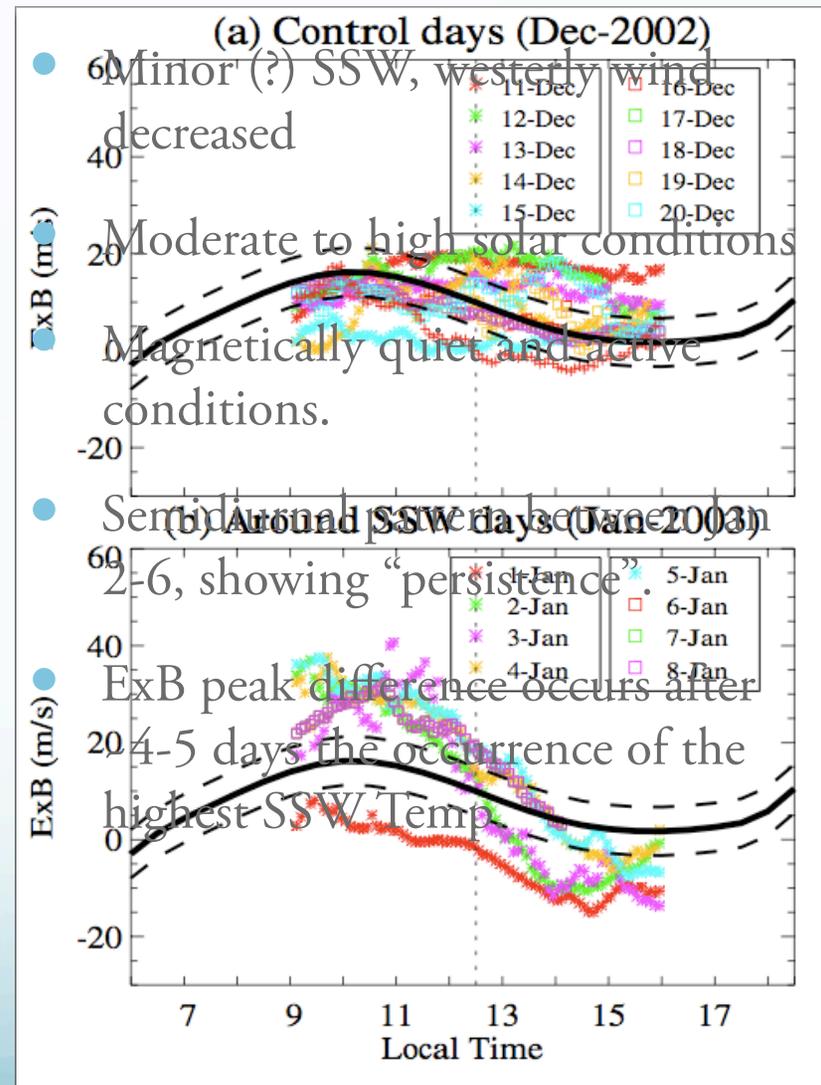
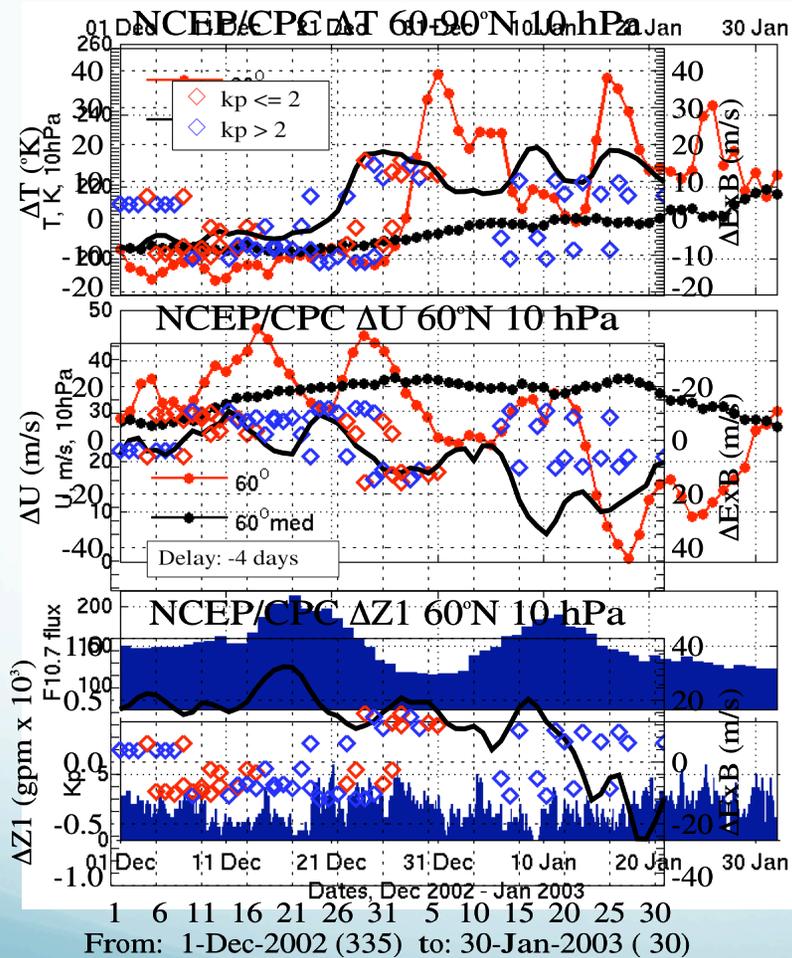


- Again, comparing peaks we find:
 - The highest ExB drift amplitude difference occurs ~4 days after the peak in SSW temperature occurs.
 - Once the highest value is reached, a moderate amplitude persists for few days, in a correspondence with the SSW temperature behavior.

Jan 2009: 3-month behavior



Jan 2003: SSW vs. Jicamarca Drifts



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.