Extreme Mountain Gap Winds Events in the Isthmus of Tehuantepec

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Motivation
• The mountain gap in the southern part of Mexico funnels wind from the Gulf of Mexico into the EPAC.
• Winter. The flow is accelerated due to cold surges forming in the Great Plains.
• Summer. The flow is weak and other factors of tropical origin modulate it, also show sporadic episodes of relative intense winds. These mechanisms have not been studied in detail.
• What would be a summer version of a winter gap flow? What drives it?

Gap Wind Extreme Events
- Defined by peaks above the monthly 99th percentile. The beginning (end) is defined as the first minimum below 95 before (after) the peak.

Variability of KE*
Waves in the synoptic domain are modulated year around and reach their minimum during summer. Also, during July and August the diurnal component is as important as the synoptic one.

Data and Methodology
• Wind fields and Pmsl from the Climate Forecast System reanalysis (CFSr, 79-16).
• Six-hourly mass averaged (1000-800 hPa) kinetic energy (KE) and meridional (V) winds in the Isthmus of Tehuantepec region diagnoses the gap flow intensity.
• Synoptic analysis of 2-10 days filtered Wind fields and vorticity.

Gap Wind Characteristics
- The gap wind shows a coherent annual cycle, with maxima in winter and summer. In summer, the diurnal oscillations are as important as oscillations in the synoptic time scale.
- During winter and autumn the pmsl in the Gulf of Mexico correlates well with KE*, in agreement with literature. The region where the maximum correlation occurs is persistent throughout the year.
- BUT, in summer, when the correlation weakens other factors of tropical origin in the EPAC also appear to be important for gap wind activity.
- More work is needed to assess the role of the EPAC in influencing the gap flow.

Conclusions

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References

Fig. 1. Standardized anomaly of KE (KE*) and V climatological monthly values.
A secondary maximum (minimum) in Summer is found in the KE (V). Variability increases in late Autumn.

Fig. 2. Cross section (17N) of mean seasonal value of KE and probability of maximum KE. The flow weakens in JJA and is less localized.

Fig. 3. Correlation between KE* and the Pmsl for each season. The correlation maximizes along the coast.

Fig. 4. KE* Extreme events of 2008 (Sample year).

Fig. 5. Duration of extreme events as a function of time.

Fig. 6. Annual frequency of extreme events. The series show a quasi-periodic signal of 7 years.

Fig. 7. Climatological wavelet power spectrum of KE*.
The bandwidth broadens during summer and diurnal cycle becomes predominant.

Fig. 8. Mean values of power spectrum of extreme events. For comparison purposes the climatological value and the 75th percentile are also shown.

Fig. 9. Inset of figure 4.

Fig. 10. Power spectrum for the extreme event.

Fig. 11. Inset of figure 4.

Fig. 12. Black area represents the region of the gap wind event, white is the base region.

Fig. 13. Power spectrum for the extreme event.

Fig. 14. Domain of the extreme event.

Case study of an extreme event (July 2006/00 UTC 2008)
As an EW that crossed Central America triggered a gap wind in conjunction with a ridge in the Gulf of Mexico ahead of Dolly. The event showed a large power spectrum in KE* with periods of 3 to 6 days and is consistent with the passage of the EW.
As the northerlies weaken after the passage of Dolly in the Gulf of Mexico the gap wind weakens.