Extreme Mountain Gap Winds Events in the Isthmus of Tehuantepec

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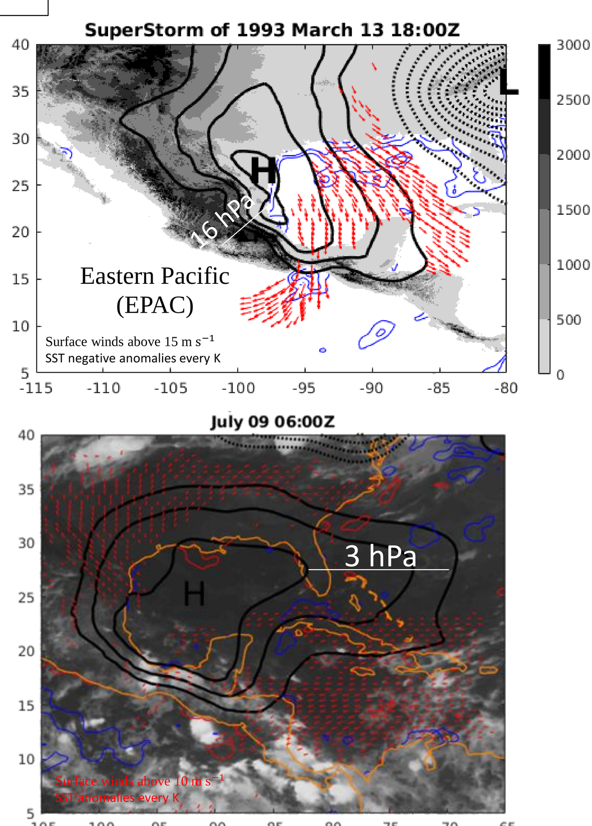
Motivation

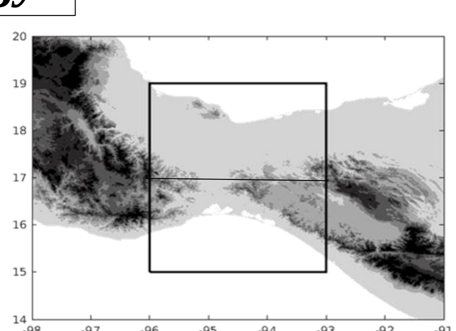
- The mountain gap in the southern part of Mexico ***funnels wind from the Gulf of Mexico into the EPAC***.
- ***Winter***. The flow is accelerated due to cold surges forming in the Great Planes.
- ***Summer***. The flow is weak and other factors of tropical origin modulate it, also show sporadic episodes 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?



A. Surface High Pressure anomaly.

Data and Methodology

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



B. Isthmus of Tehuantepec

Gap Wind Extreme Events

- Defined by **peaks above the monthly 95th percentile**. The *beginning* (end) is defined as the first *minimum below* $\bar{\sigma}$ before (after) the peak.

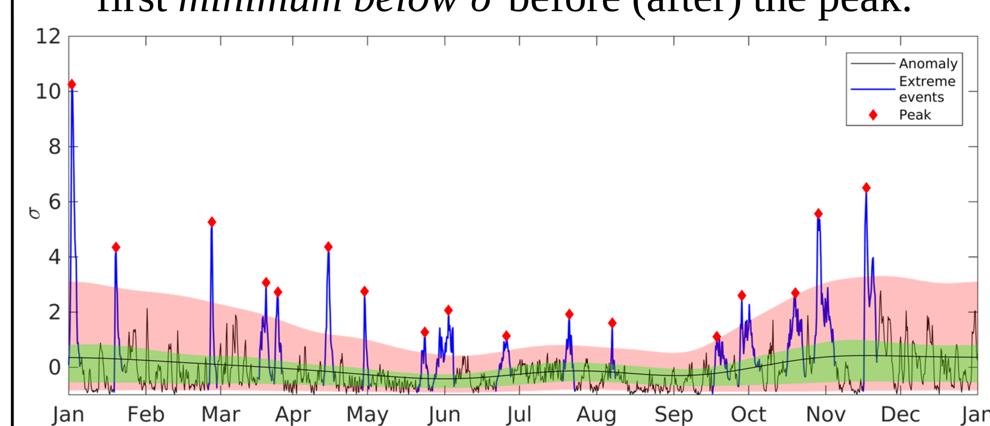


Fig. 4. ***KE**** Extreme events of 2008 (Sample year).

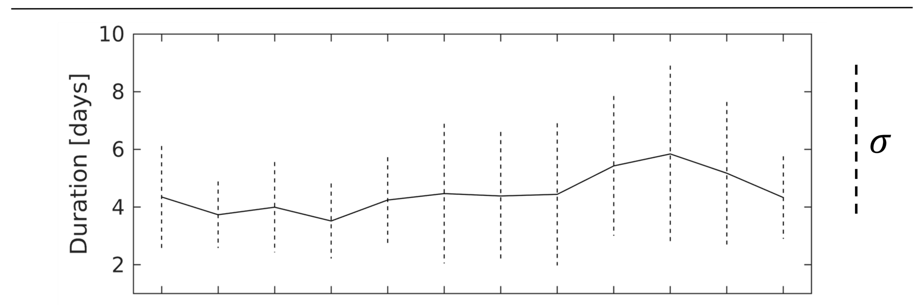


Fig. 5. Duration of extreme events as a function of time.

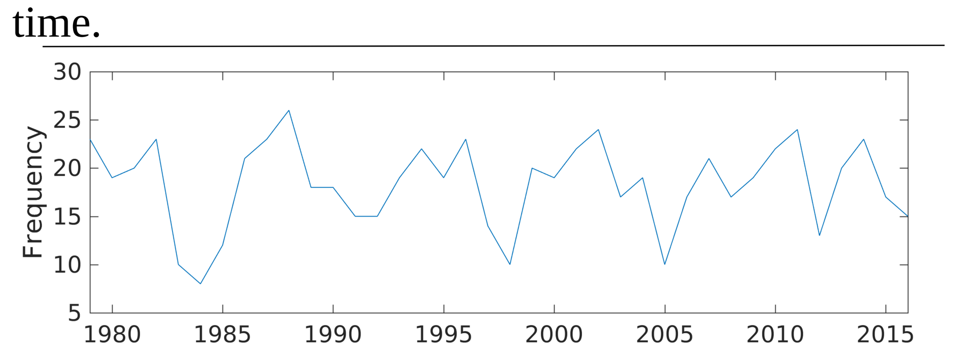
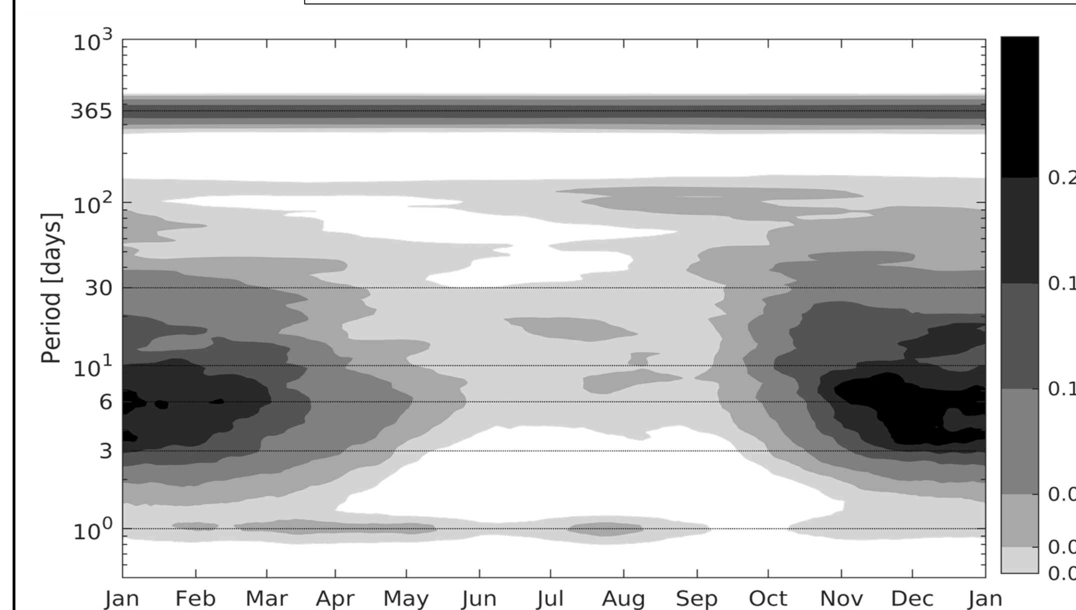


Fig. 6. Annual frequency of extreme events. The series show a quasi-periodic signal of 7 years.

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.

Fig. 7. Climatological wavelet power spectrum of ***KE****.

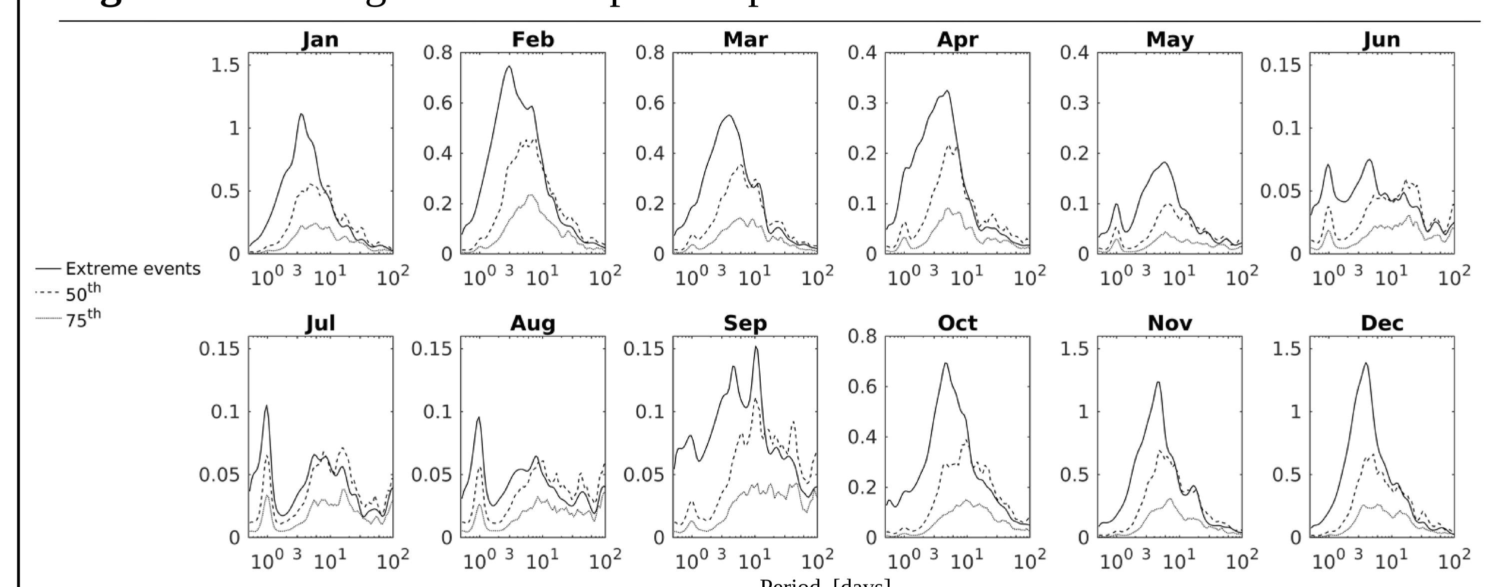
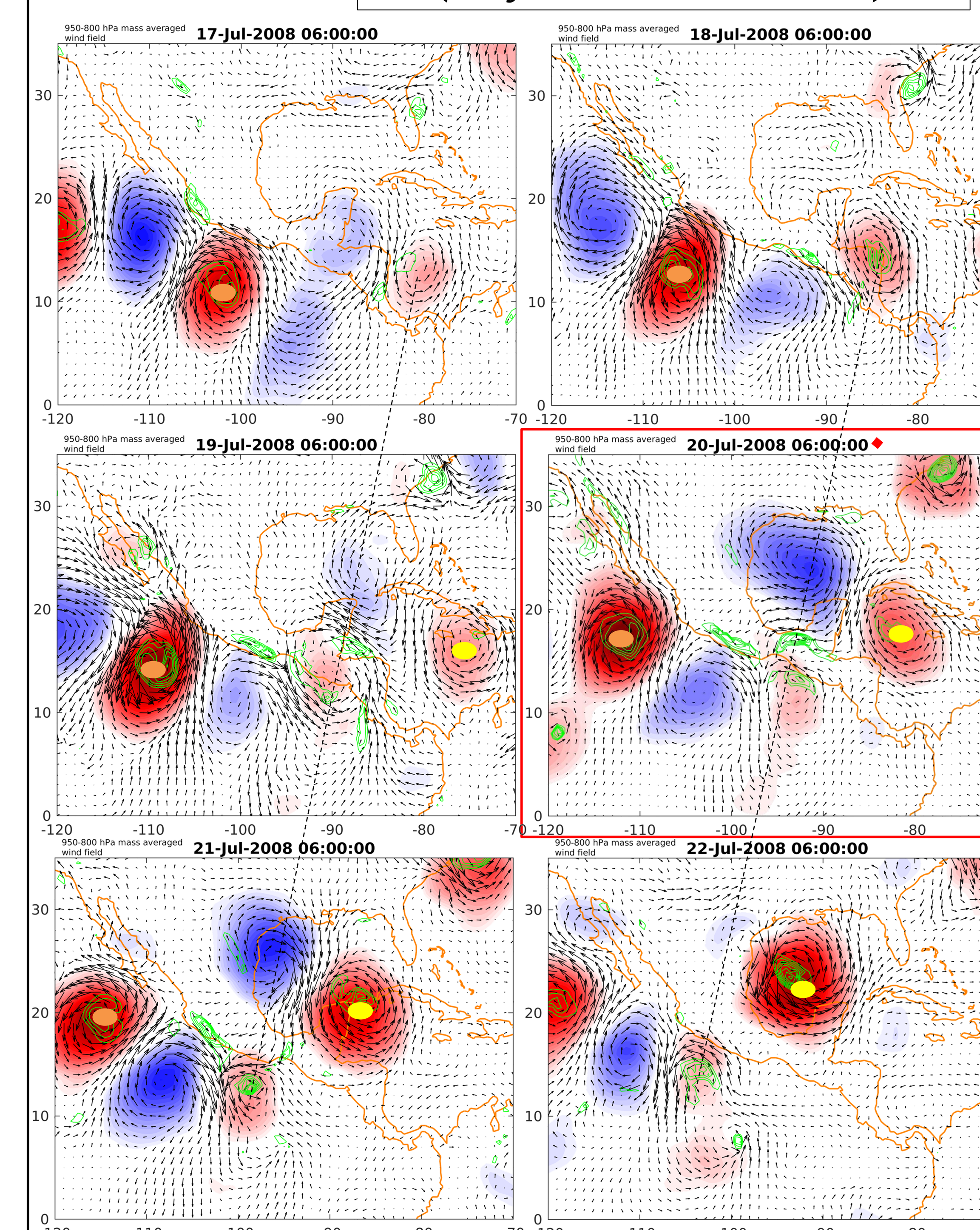


Fig. 8. Mean values of power spectrum of extreme events. For comparison purposes the climatological value and the 75th percentile are also shown.

The bandwidth broadens during summer and diurnal cycle becomes predominant.

Case study of an extreme event (July 20 0600UTC 2008)



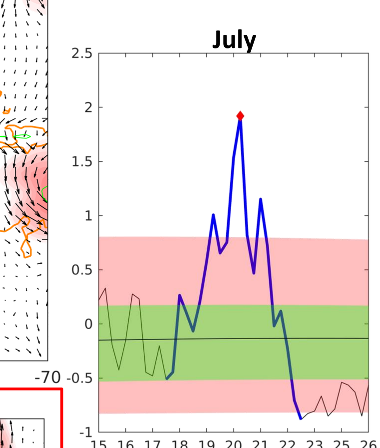


Fig. 9. Inset of figure 4

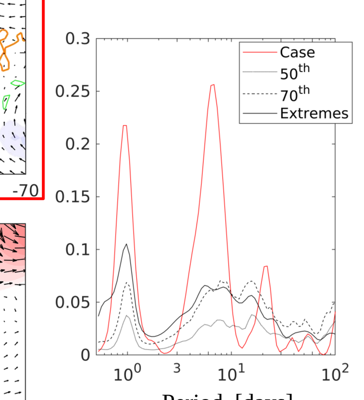


Fig. 10. Power spectrum for the extreme event

Fig. 8. Evolution of the synoptic winds during an extreme gap wind event. Curvature vorticity (shaded colors), and positive shear vorticity (green contours). Motion of the trough every two days (dashed lines). HR Dolly and Fausto (yellow and orange).

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 north-easterlies weaken after the passage of Dolly in the Gulf of Mexico the gap wind *weakens*.

Gap Wind Characteristics

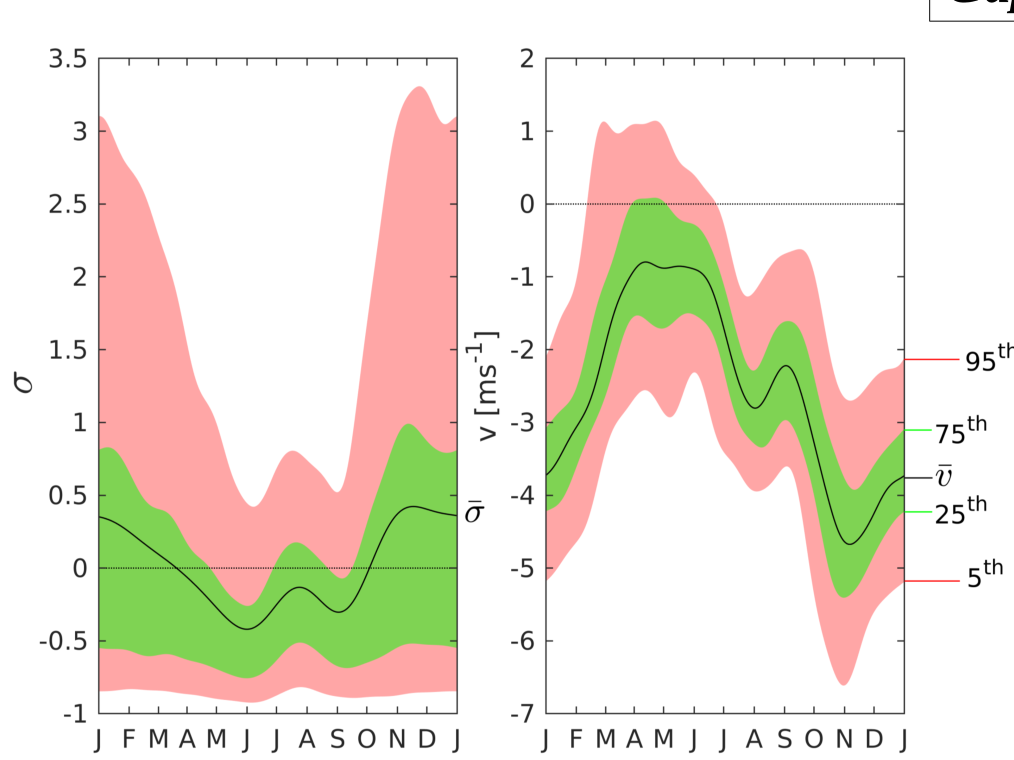


Fig. 1. Standardized anomaly of ***KE*** (***KE****) and ***V*** climatological monthly values.

A secondary maximum (minimum) in Summer is found in the ***KE*** (***V***). Variability increases in late Autumn.

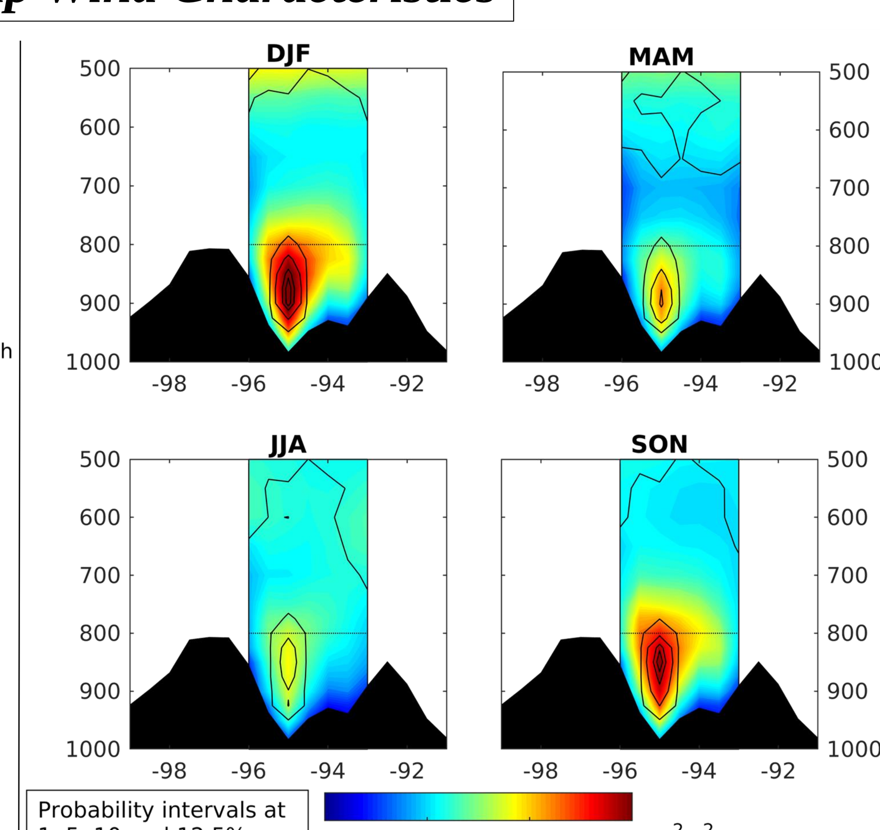


Fig. 2. Cross section (17N) of mean seasonal value of ***KE*** and probability of maximum ***KE***.

The flow weakens in JJA and is less localized.

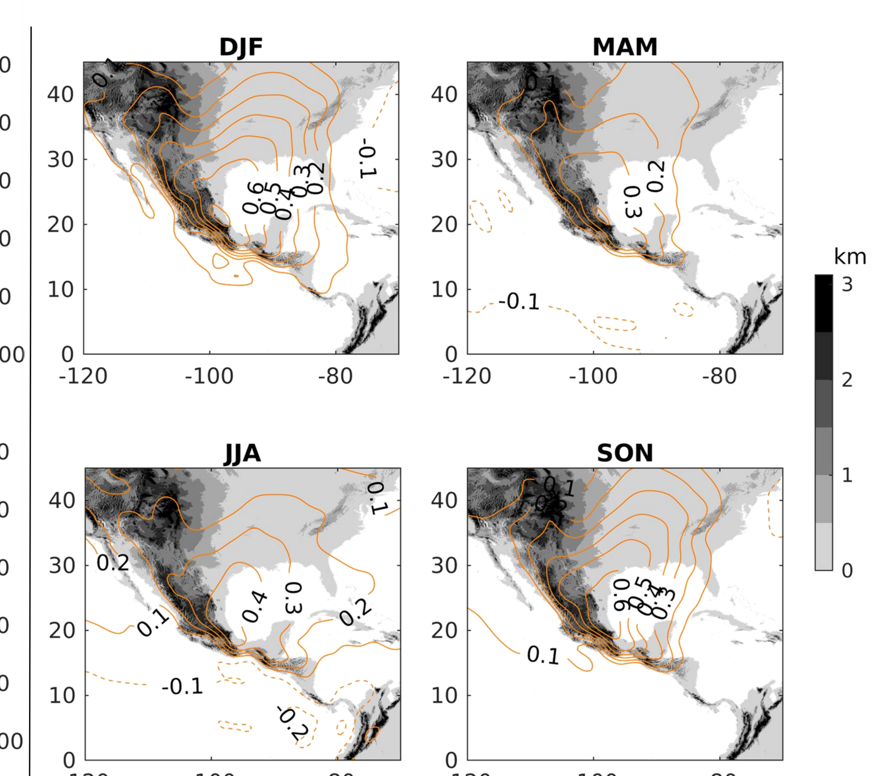


Fig. 3. Correlation between ***KE**** and the **Pmsl** for each season.

The correlation maximizes along the coast.

Conclusions

- 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.

Acknowledgements

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