

The warm winter of 2014 in the entrance to the Gulf of California



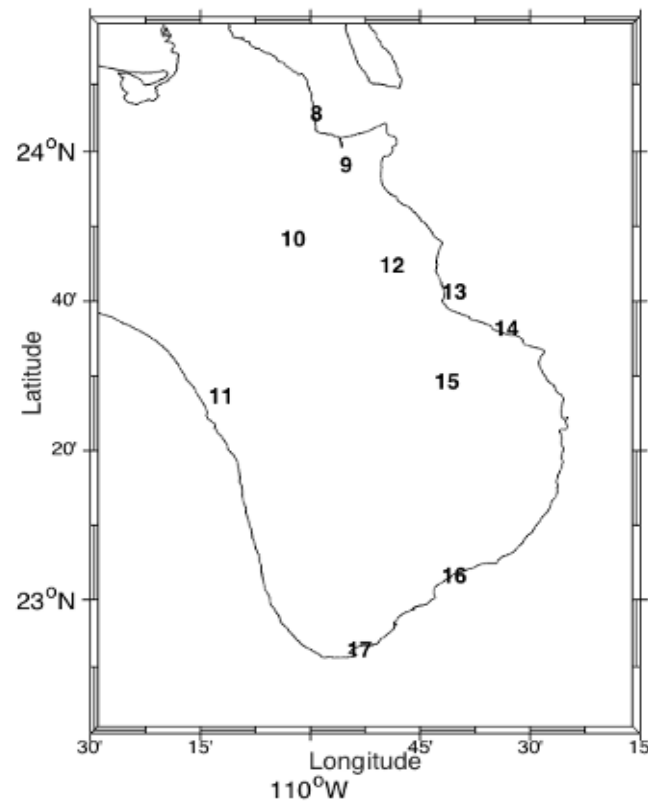
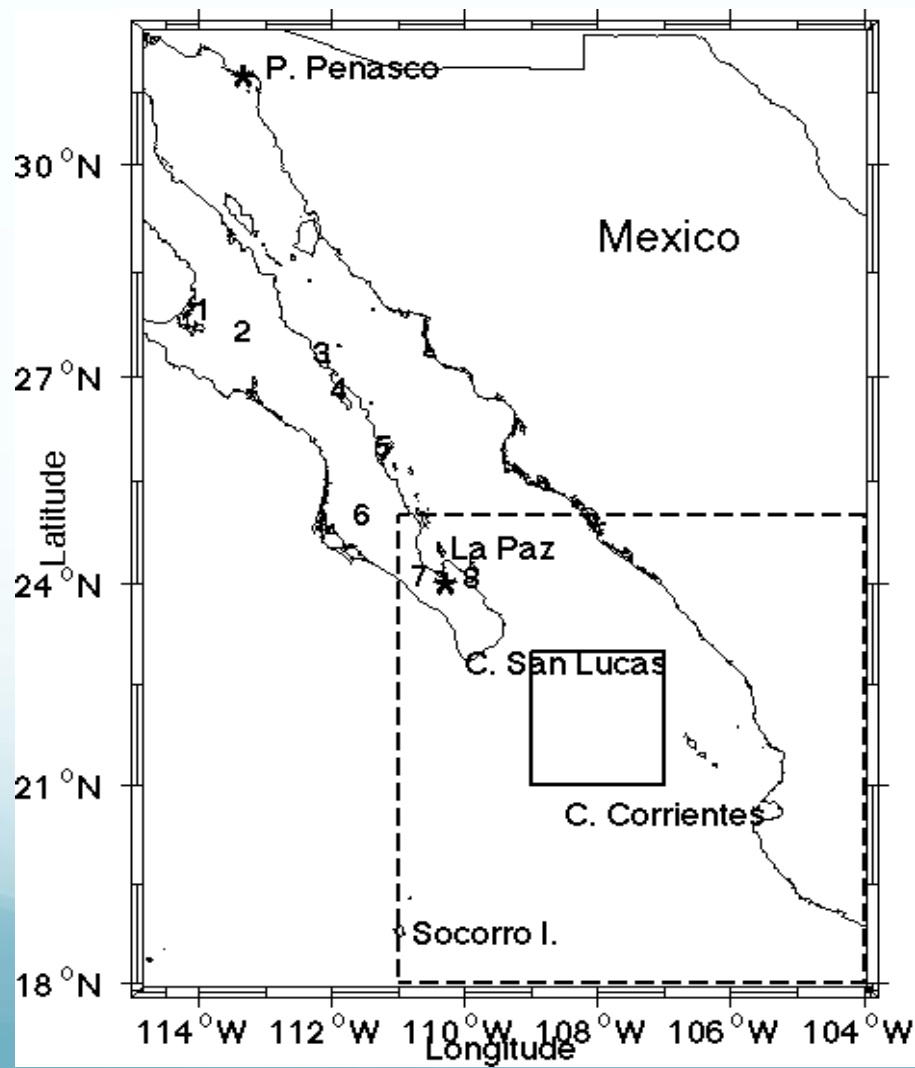
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Unidad La Paz, CICESE, La Paz, BCS, Mexico*

The Entrance to the Gulf of California (dashed rectangle).

Automatic weather stations marked with a star (Puerto Peñasco and La Paz).

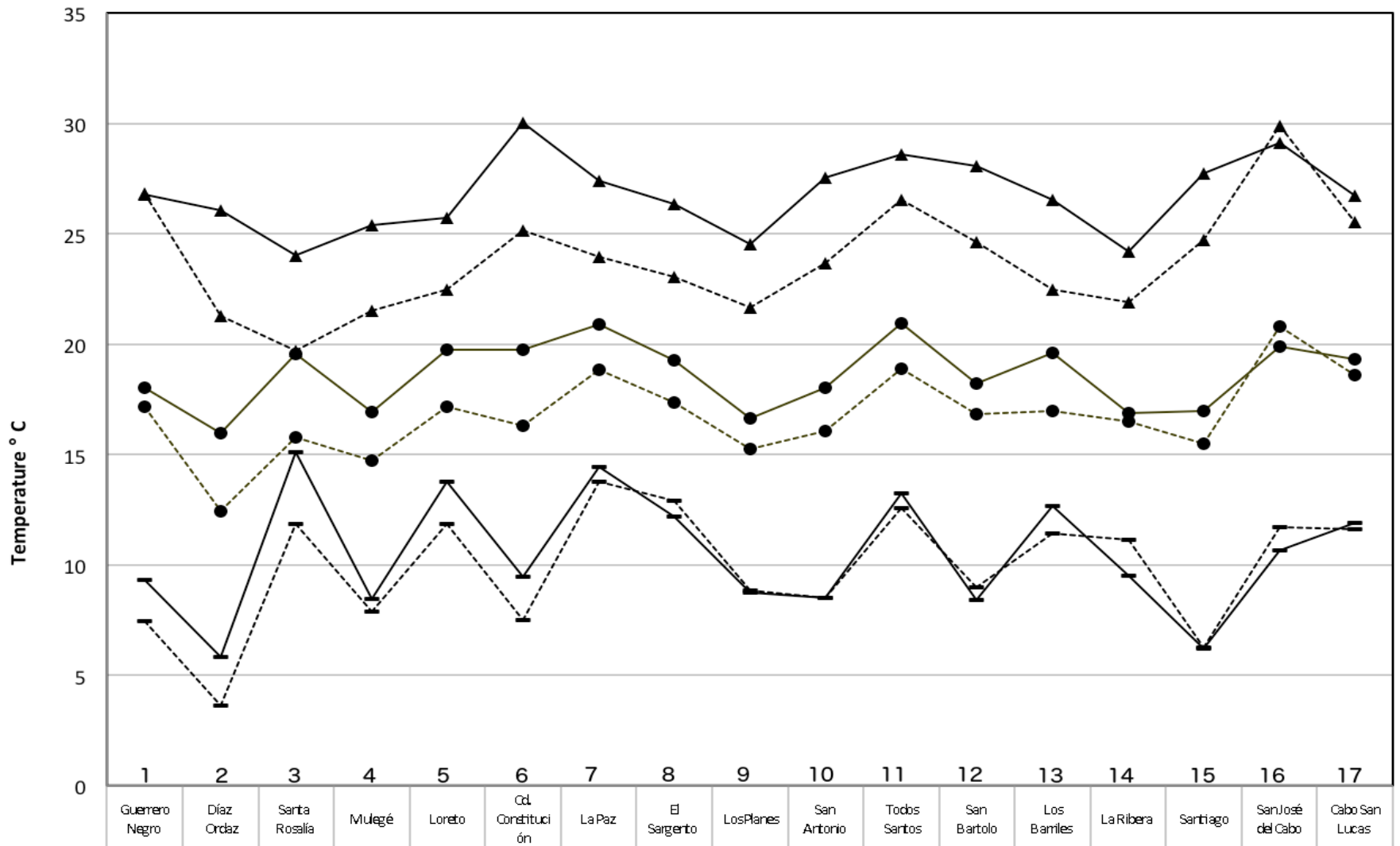
*Consecutive numbers indicate climatological stations
(inset shows southern network).*

*The central square is the area chosen to obtain mean SSTs from satellite
imagery.*



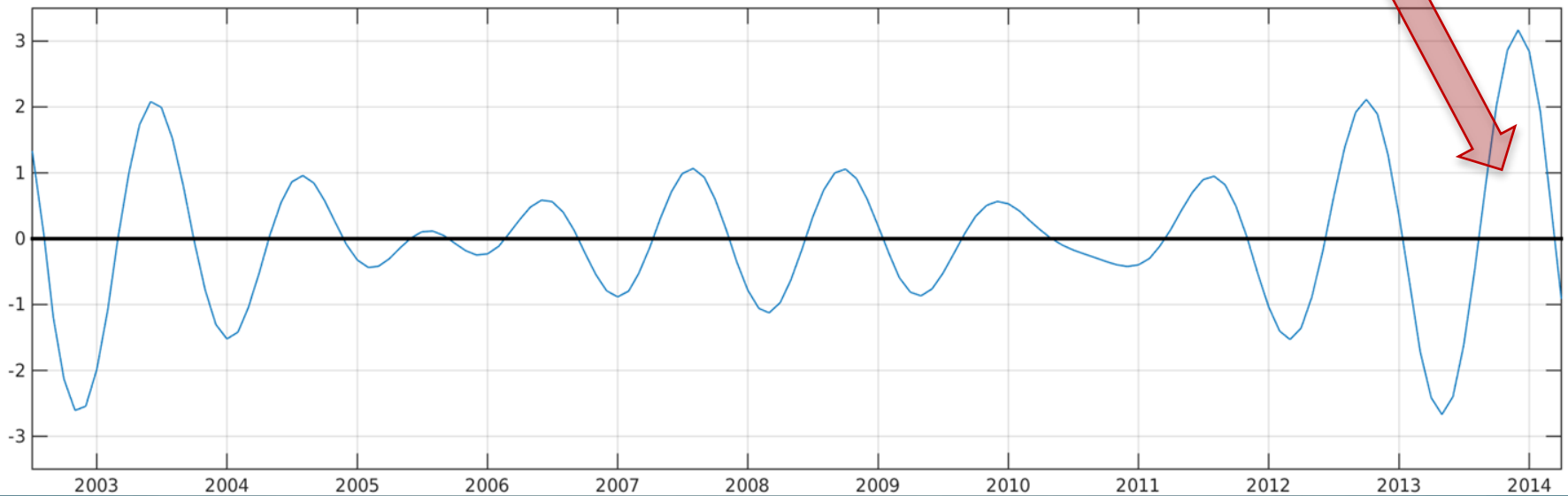
Maximum (triangles), mean (circles) and minimum (dash) air temperatures in January 2013 (broken line) and 2014 (continuous line)

From 17 climatological stations in Southern Baja California



Spatial mean of the SST anomaly time series after subtracting the annual harmonic.

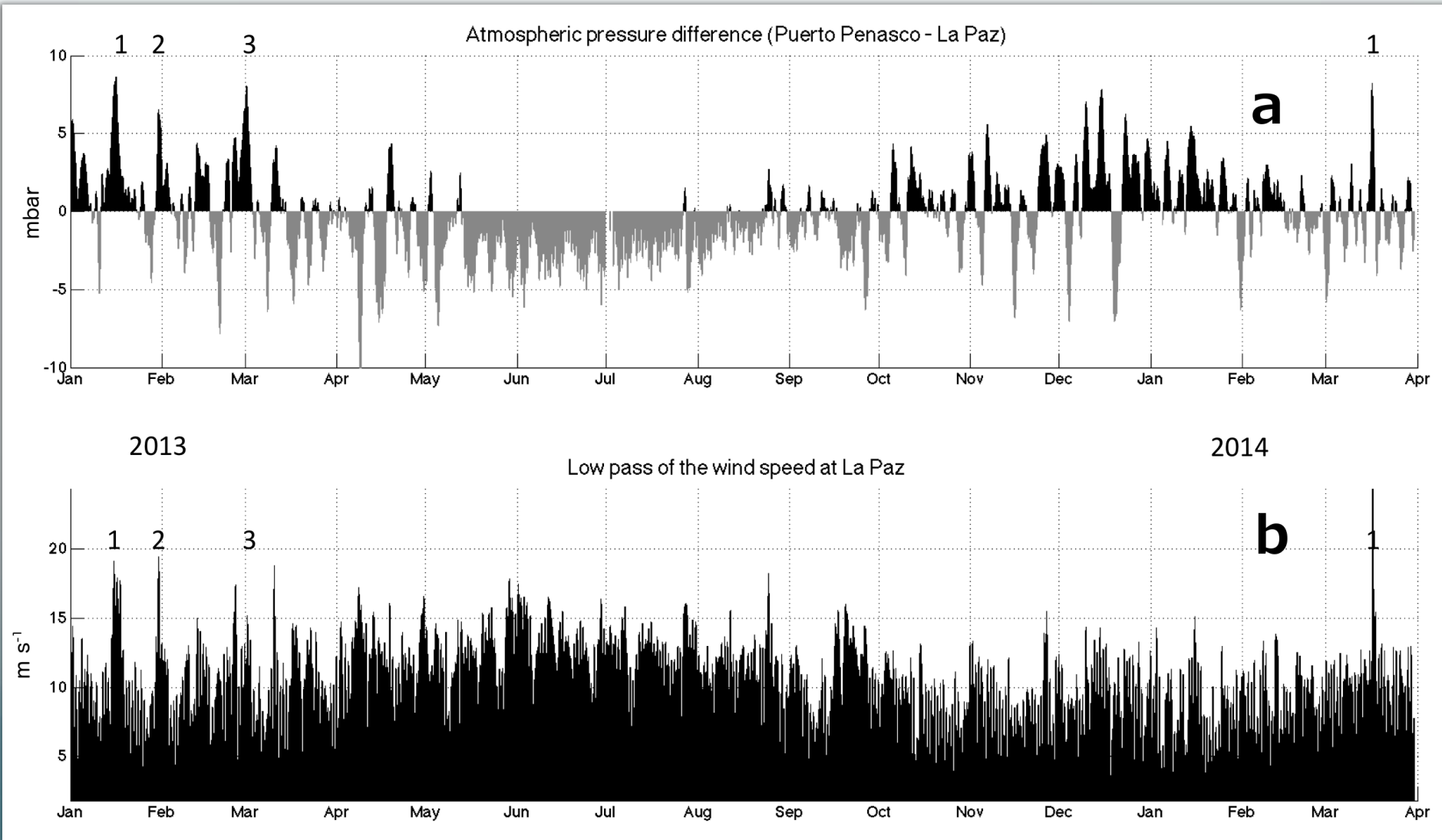
Obtained from MODIS data, level 2 from July 2002 to April 2014.



a) Atmospheric pressure difference (Puerto Peñasco - La Paz)

b) Low-pass of the wind speed at La Paz

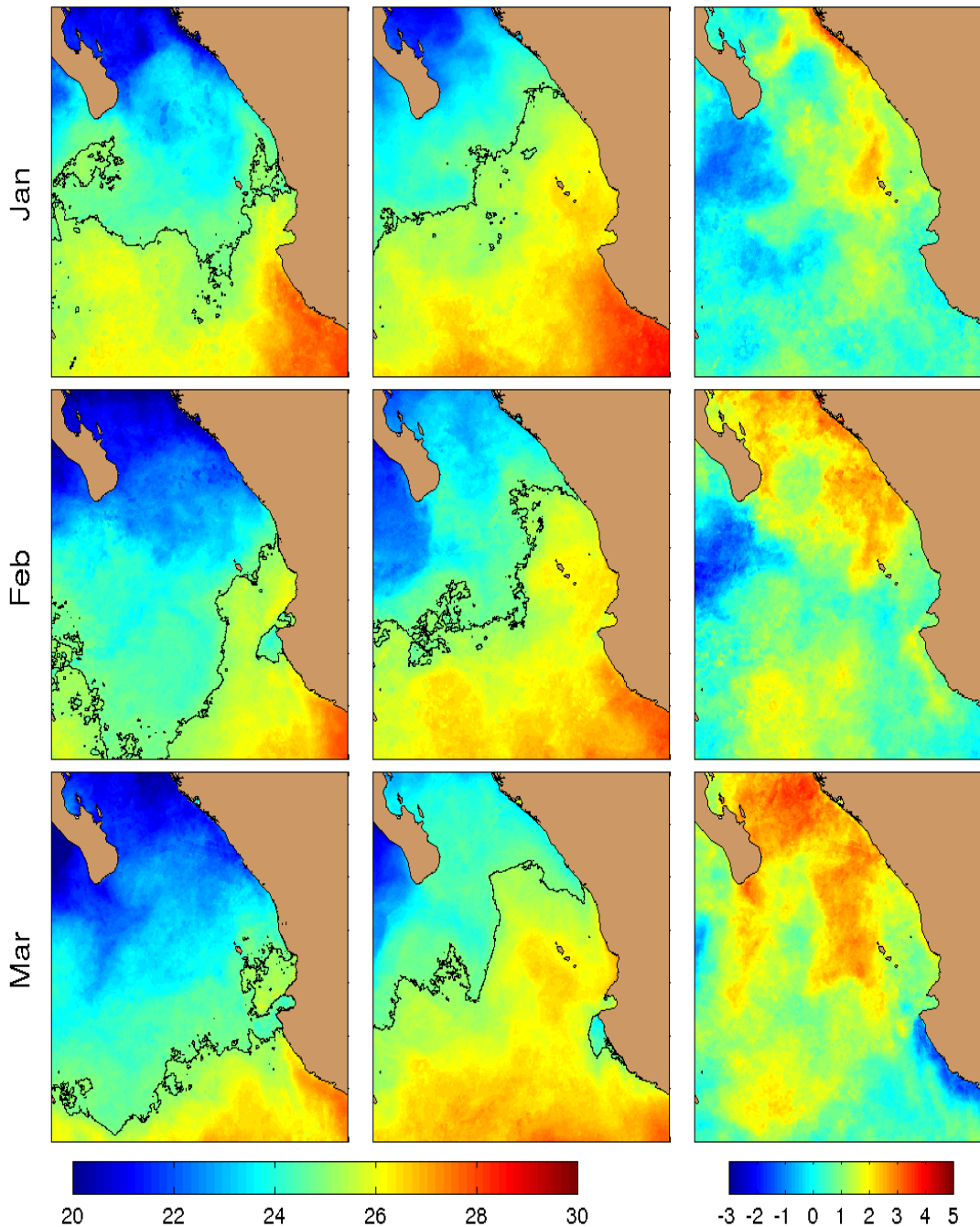
Numbers mark winds events that coincide with positive events in pressure



2013

2014

Diff



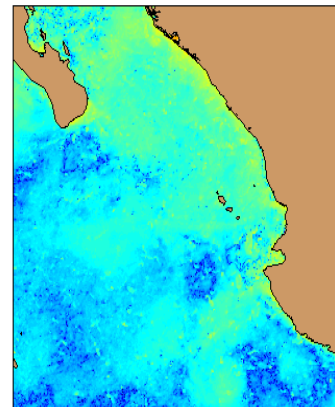
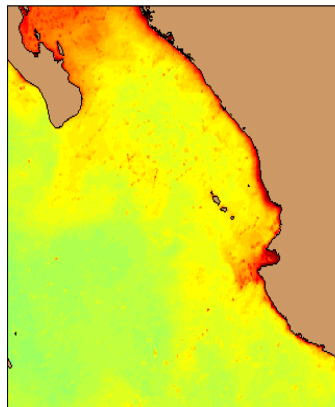
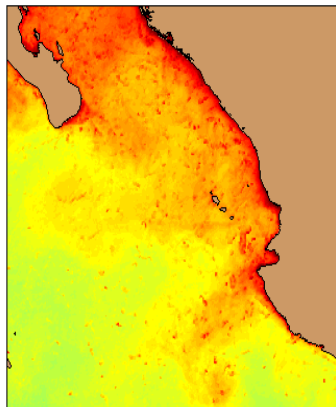
Effect on SSTs

2013

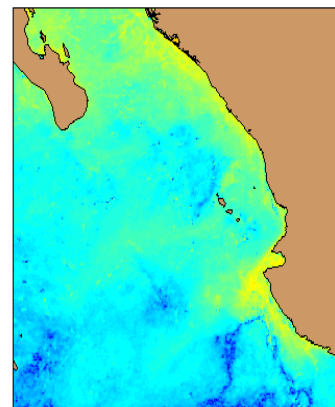
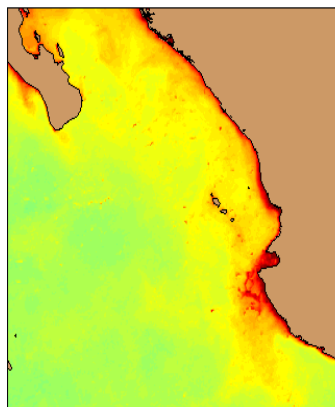
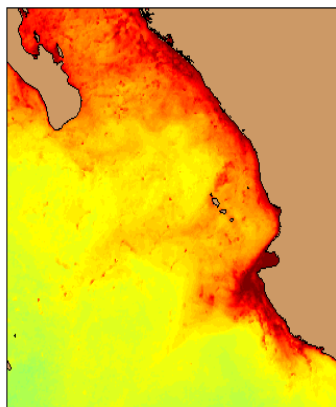
2014

Diff

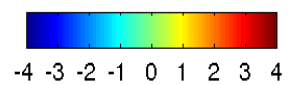
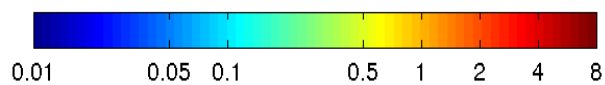
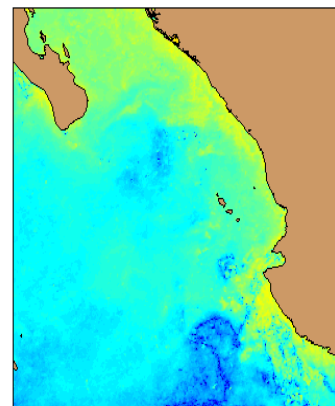
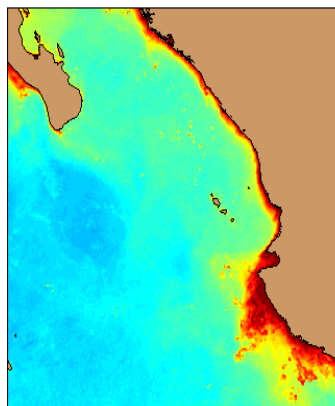
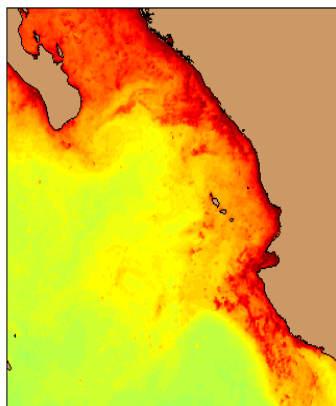
Jan



Feb

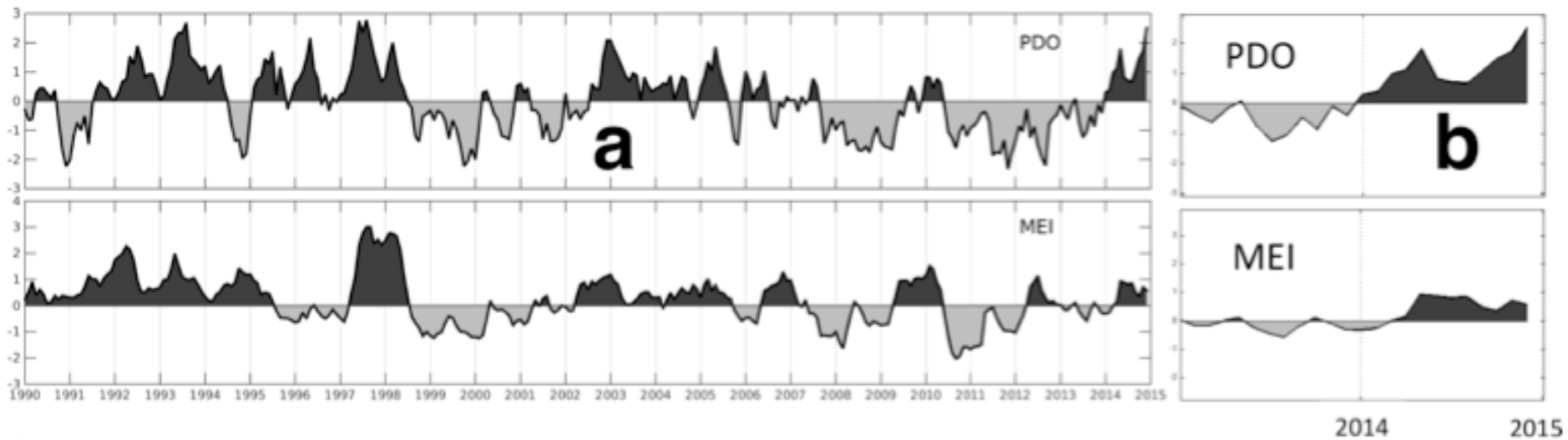


Mar

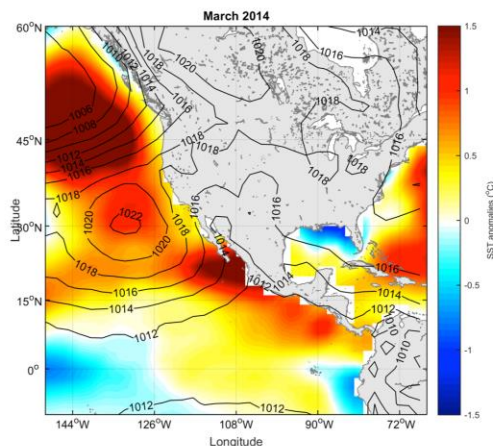
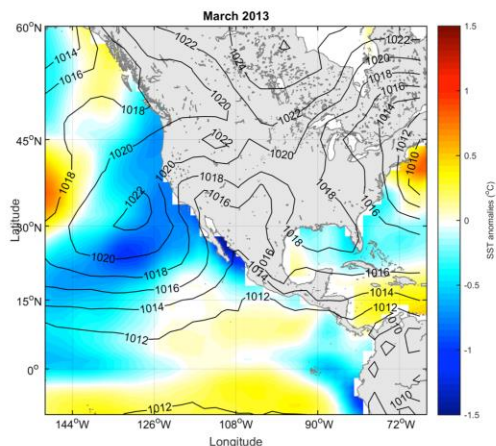
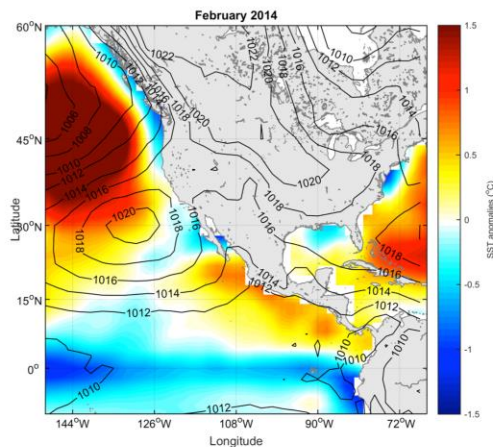
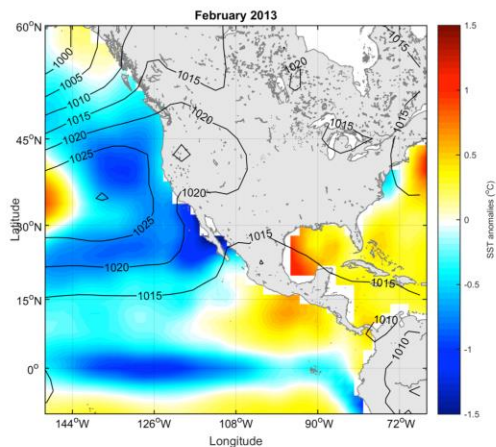
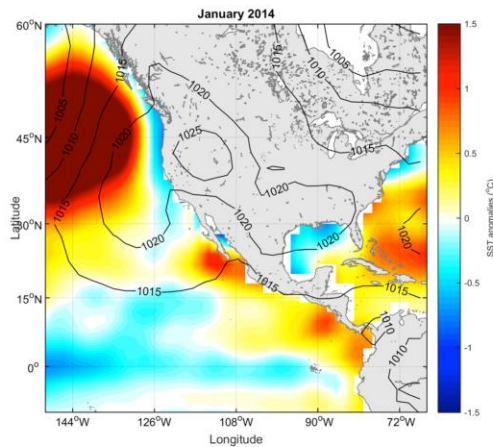
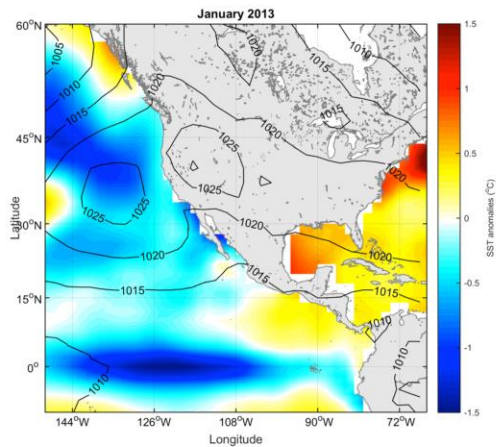


Effect on Chla

MEI and PDO are both negative prior to this phenomenon



Pacific Decadal Oscillation index (PDO) and the Multivariate ENSO Index (MEI), a) for the period starting in 1990 to the end of 2014; b) PDO and MEI during 2013 and 2014.



SST anomalies from the Extended Reconstruction of Sea Surface Temperatures and atmospheric pressure.

SSTa maps 1x1° resolution.

Anomalies relative to the 65-year mean (1950 to 2014).

On the left/right are the months of 2013/2014.

(blue/red) indicate (-/+)
1.5 °C temperature anomalies.

Conclusions

The data reveal a very anomalous winter in 2014: the warmer in 10 years or more.

The entrance and the southern Gulf of California experienced relaxation of wind forcing, significant warming of sea surface temperatures and anomalously low upper-ocean chlorophyll concentrations.

Also, an anomalous tendency occurs in 2014: chlorophyll concentrations typically tend to increase from January to March, whereas in 2014 March is the least productive in terms of chlorophyll.

In the past, similar SST anomalies have been reported during ENSO (Lavin et al., 2003), only this time the equatorial Pacific experienced neutral conditions.

The relaxation of the wind in the Gulf of California appears directly related to the observed warming and productivity deficit. This is consistent with an atmospheric teleconnection with higher latitude processes.

Main ocean processes involved are:

1. Weaker coastal upwelling
2. A deficit in southward advection of cooler waters from within the gulf, or the California Current, or both.
3. Smaller heat loss to the atmosphere, due to weaker winds.