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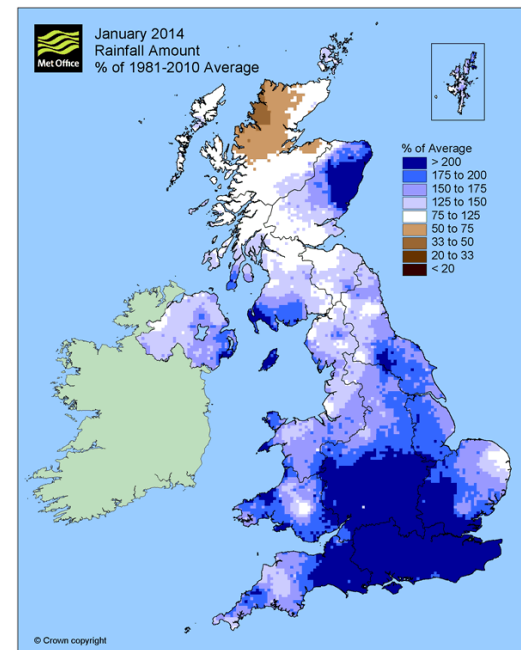
**Was the extreme storm season  
over the North Atlantic and the UK  
in winter 2013/14  
triggered by changes in the  
West Pacific Warm Pool?**

B

**Simon Wild, Daniel J. Befort, Gregor C. Leckebusch**

## Windy and wet UK in Winter 2013/14:

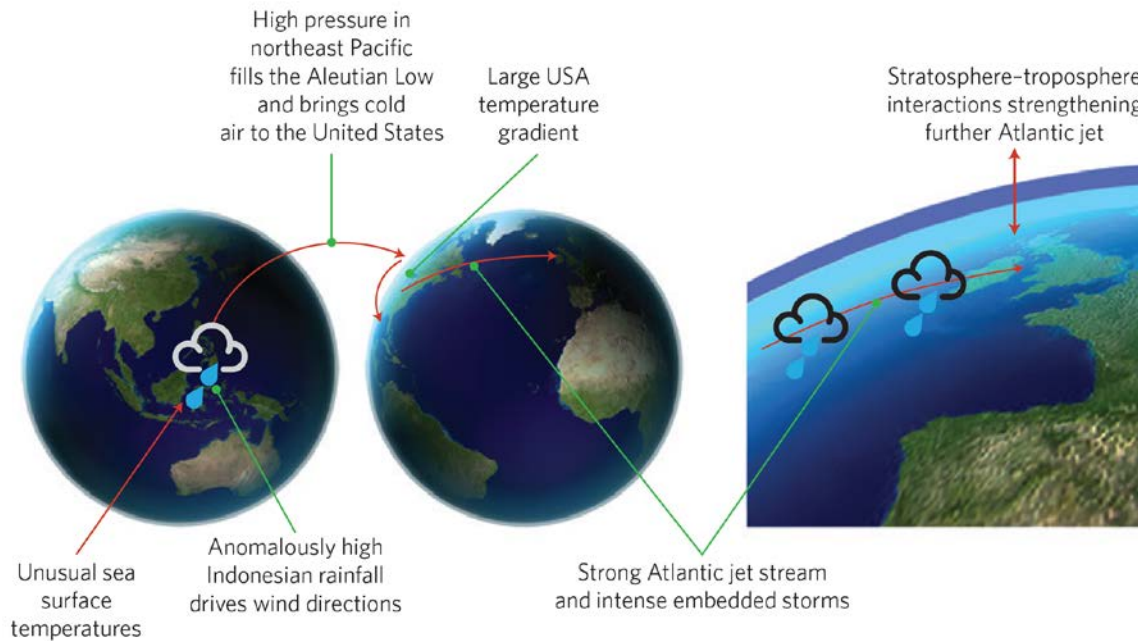
- “*stormiest for at least 20 years*” (Met Office)
- stormiest since 1871 (Matthews et al. 2014; CRU 2014, online)



from  
Slingo et al  
2014

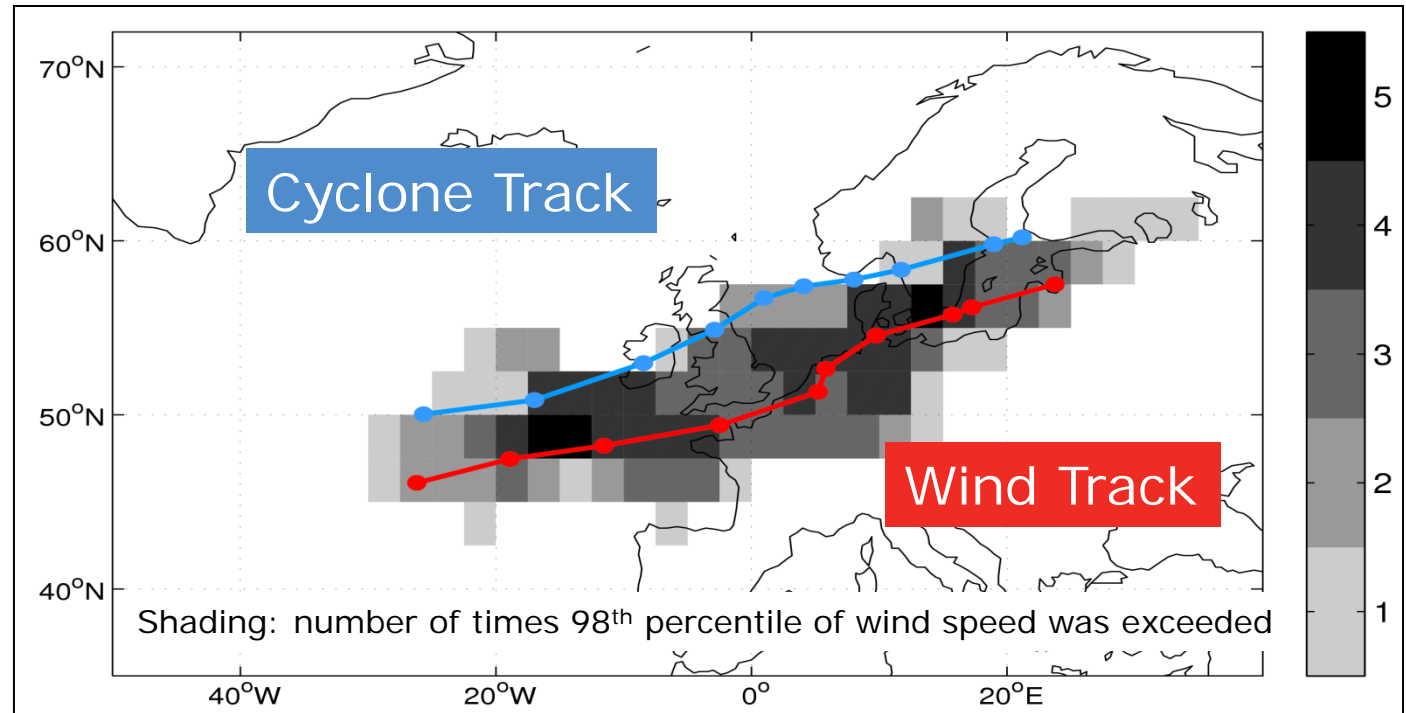
What was the cause for the exceptional winter 2013/14?

Possible linkage suggested by  
Huntingford et al. 2014, Slingo et al. 2014, Kendon &  
McCarthy 2015:



from  
Huntingford et al. 2014, NCC  
their figure 6

- **Cyclone Tracking**  
(MSLP, Murray and Simmonds, 1991)
- **Wind Storm**  
Tracking  
(10m wind speeds,  
Leckebusch et al.,  
2008)



1. Wind storm frequency and upstream conditions in winter 2013/14
2. Test hypothesis of the suggested mechanism for recent decades:  
Connection of West Pacific Warm Pool anomalies to  
wind storm frequency over North Atlantic

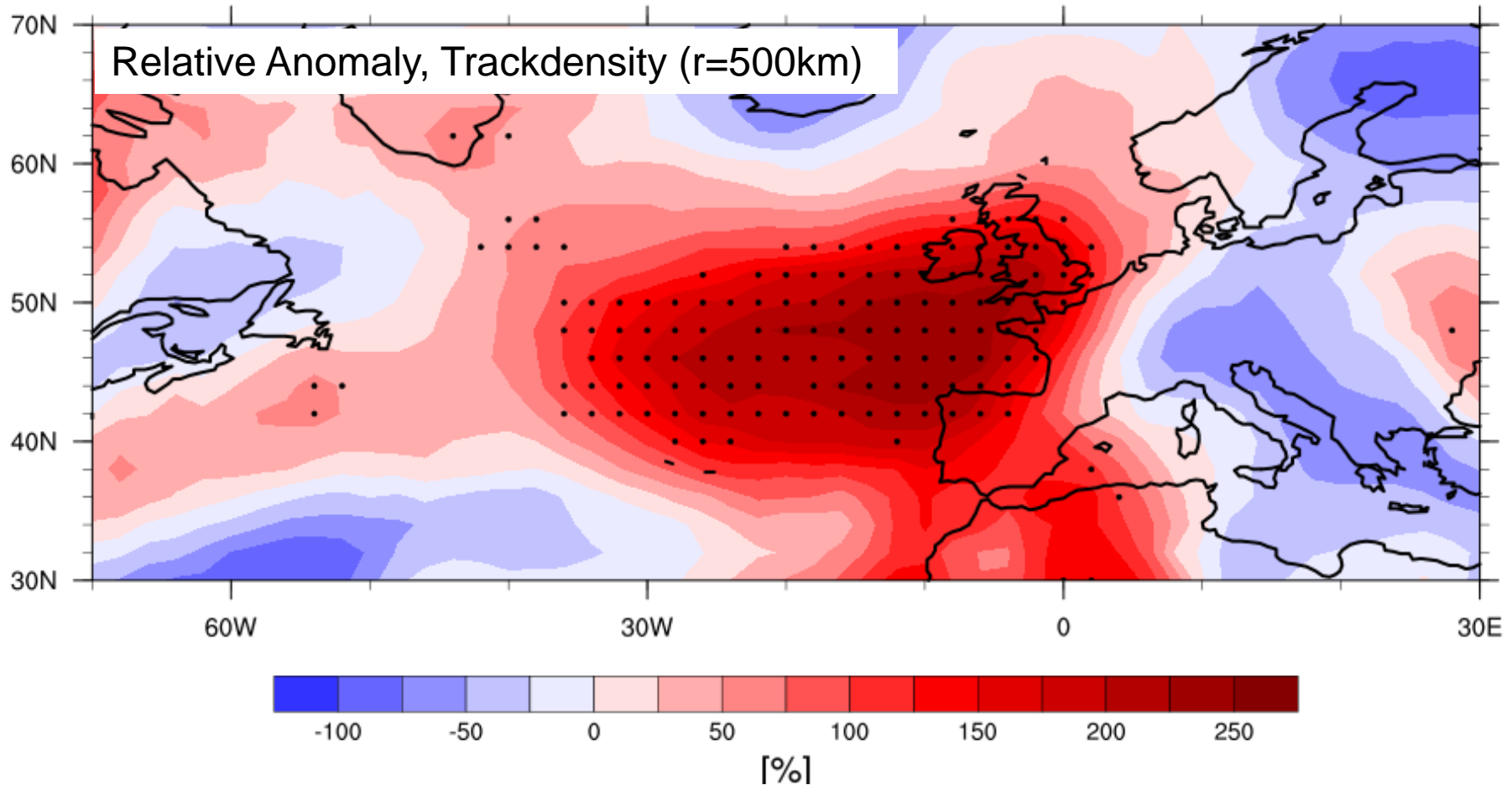


# 1. Wind storm frequency over the North Atlantic and upstream conditions in winter 2013/14

# 1. Conditions in DJF 2013/14

## Wind Storm Frequency

ERA Interim  
1979-2014

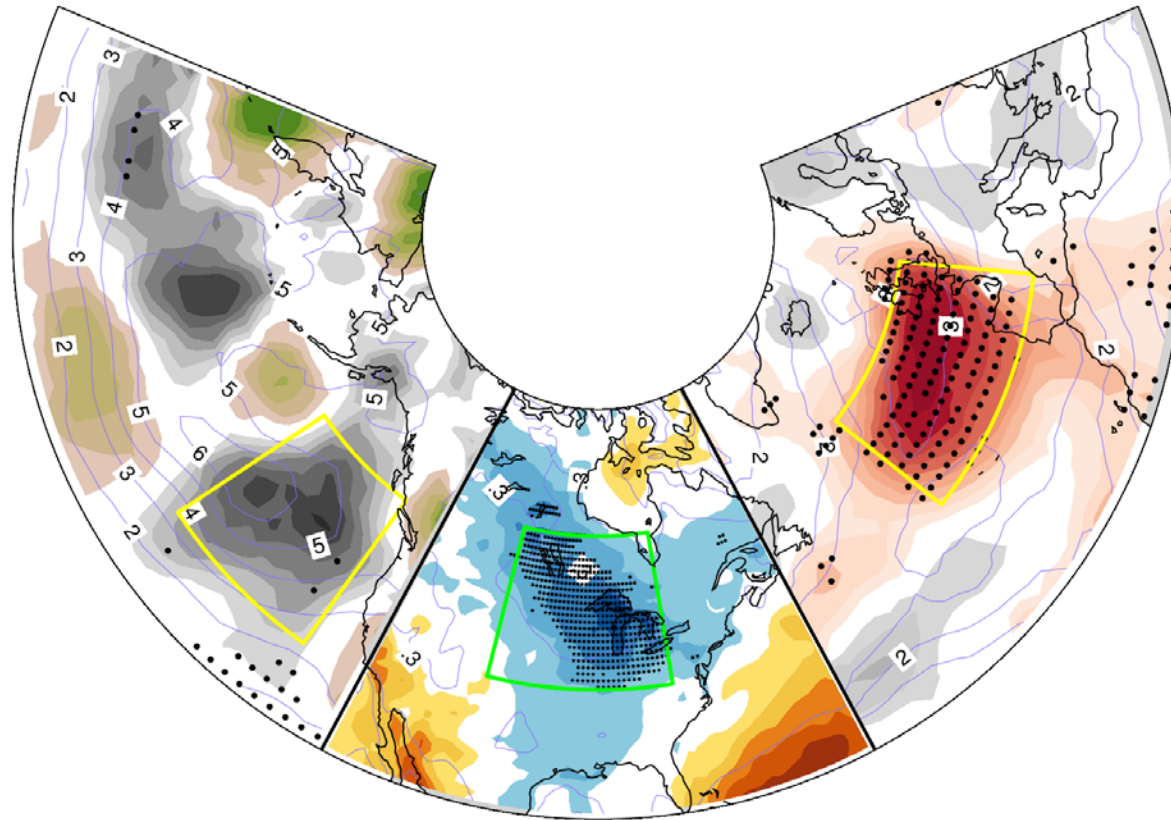
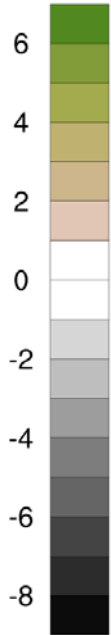


Shadings: relative anomalies in DJF 2013/14 compared to long-term climatology (1979–2014)  
Black dots: maximum in wind storm counts in winter 2013/14.

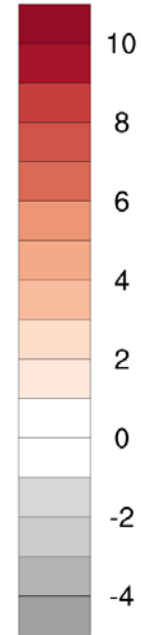
# 1. Conditions in DJF 2013/14



Cyclone Events Anomaly



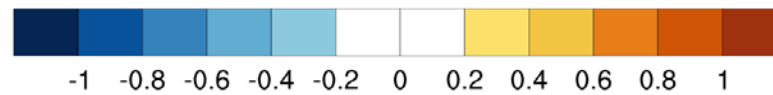
Wind Storm Events Anomaly



Shadings: anomalies in DJF 2013/14 compared to long-term climatology (1979–2014)

Contours: interannual standard deviation

Normalized Temperature Anomaly



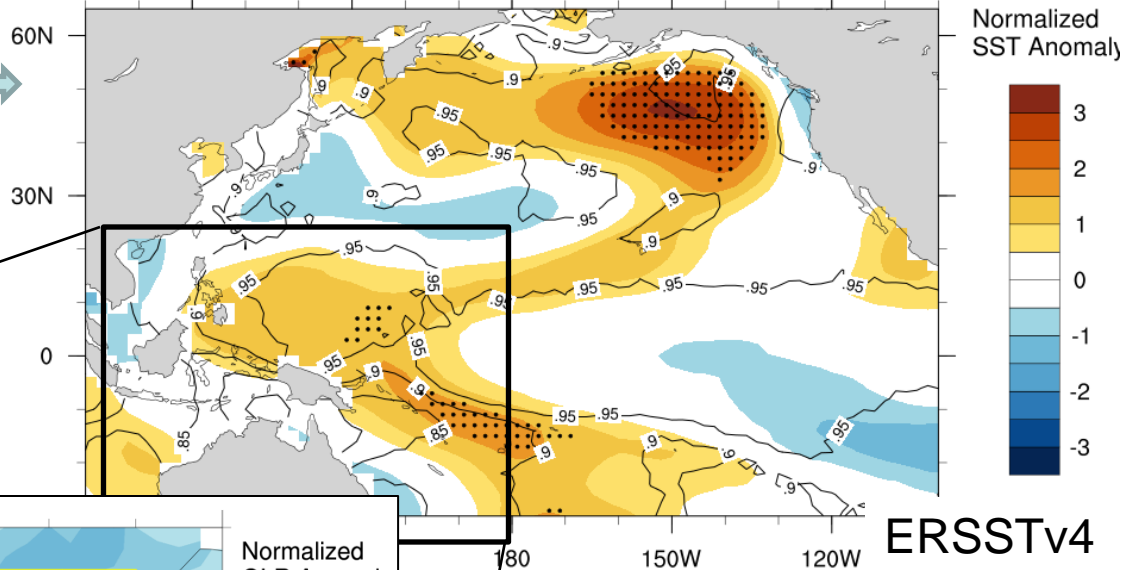
Black dots (right): maximum in wind storm counts in winter 2013/14.

Black dots (centre/left): minimum in 2m temperature/cyclone counts in winter 2013/14

# 1. Conditions in DJF 2013/14

## Pacific SST Anomaly

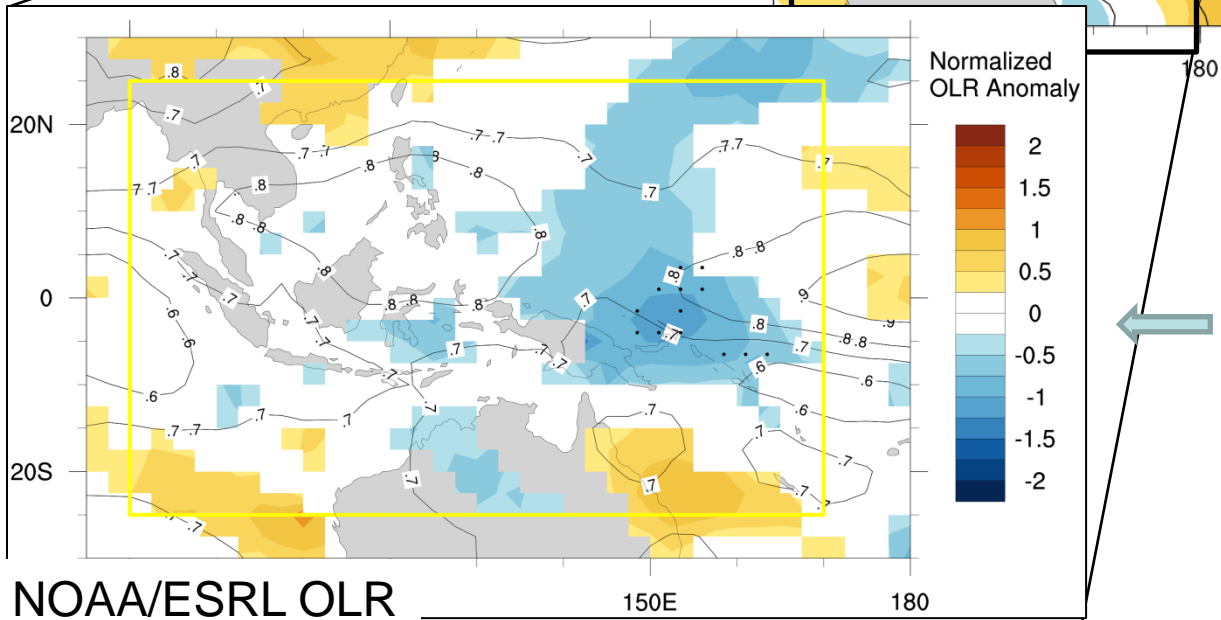
Black dots: maximum in winter 2013/14



## Normalized OLR Anomaly

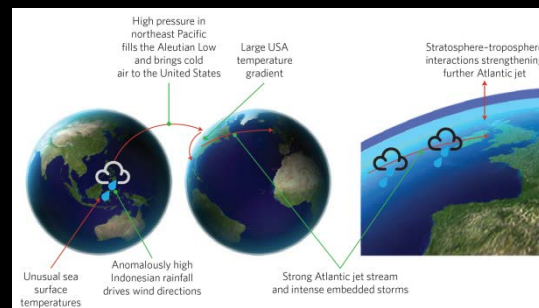
## Tropical West Pacific OLR Anomaly

Black dots: minimum in winter 2013/14

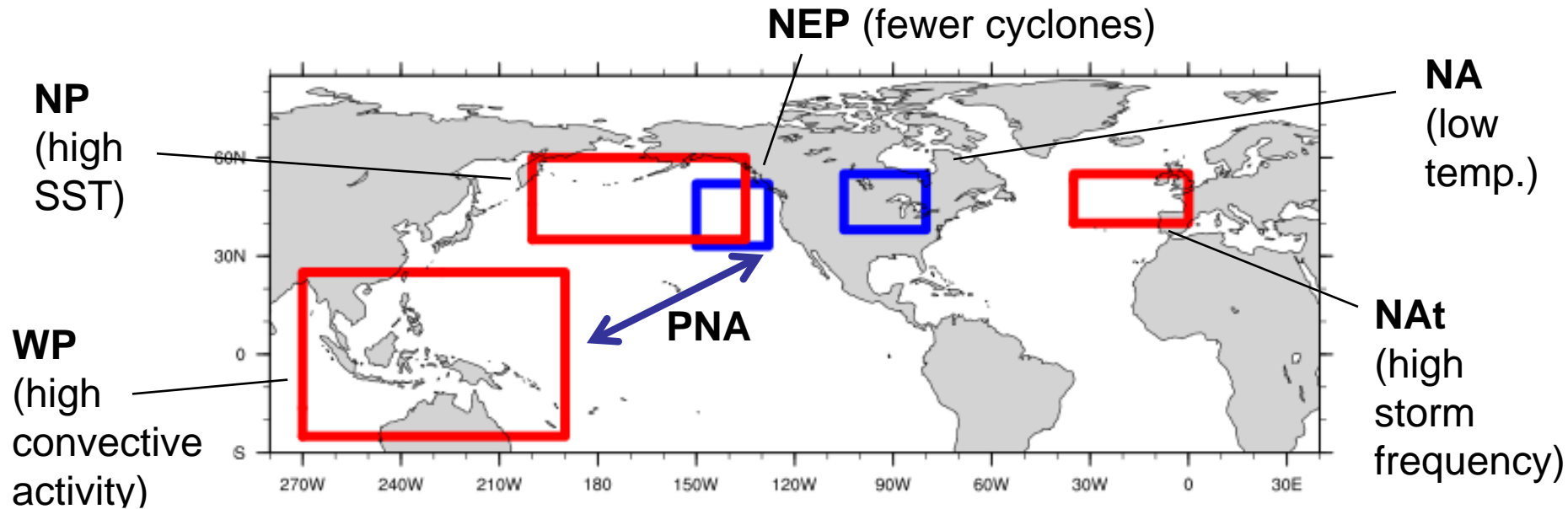




## 2. Hypothesis testing: Link between West Pacific Warm Pool anomalies and wind storm frequency over North Atlantic in recent decades



# 2. Testing Hypothesis

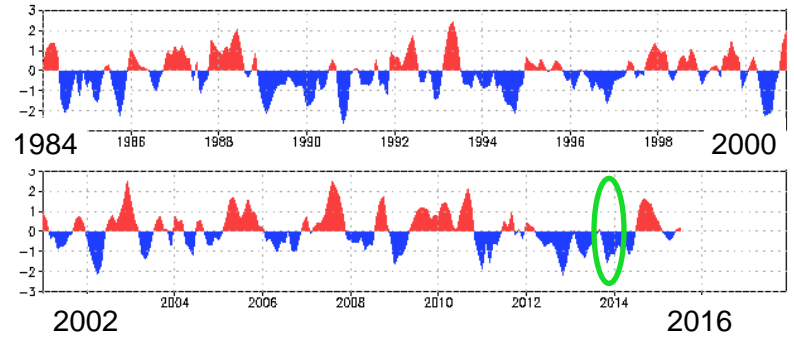
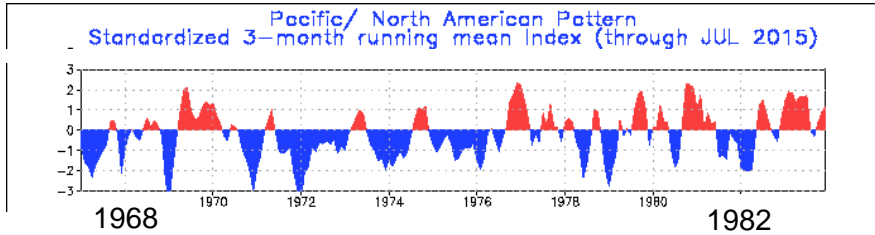


	<b>PNA</b>
1979-2014; bold: $p < 0.05$	
<b>Convective Activity (-OLR)</b>	<b>-0.36</b>

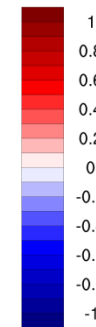
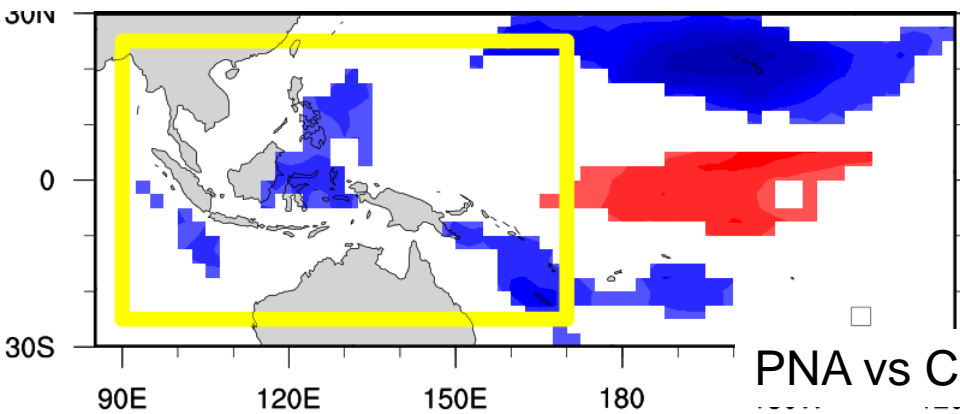
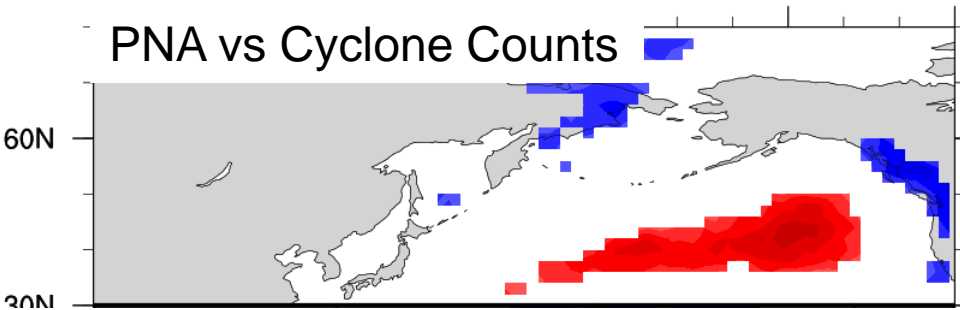
# 2. Testing Hypothesis



## Role of the PNA



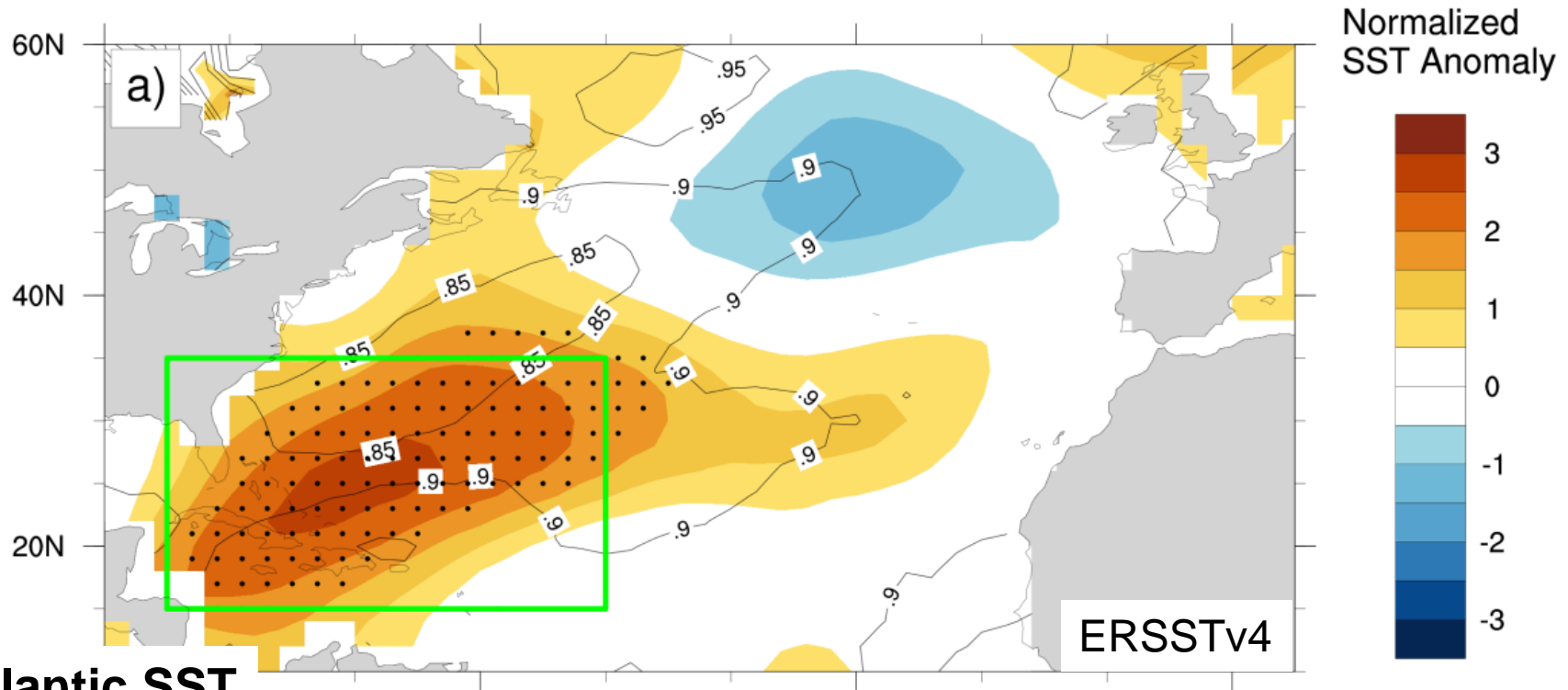
## PNA vs Cyclone Counts



Correlation,  
1979-2014,  
 $p < 0.05$

## PNA vs Convective Activity

## Atlantic SST



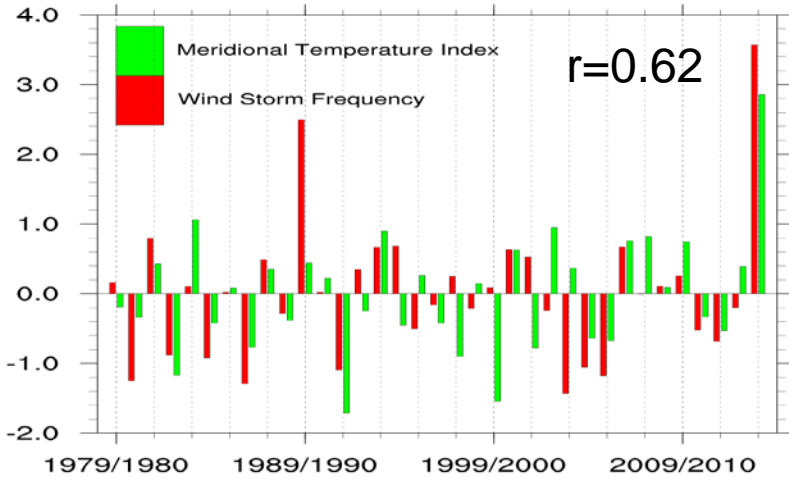
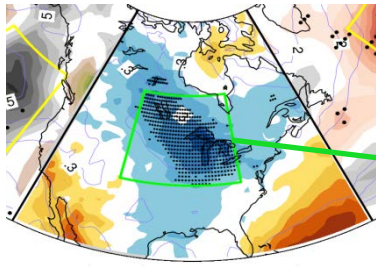
## Atlantic SST

Shadings: anomalies in DJF 2013/14 compared to long-term climatology (1979–2014)

Contours: interannual standard deviation

Black dots: maximum in winter 2013/14

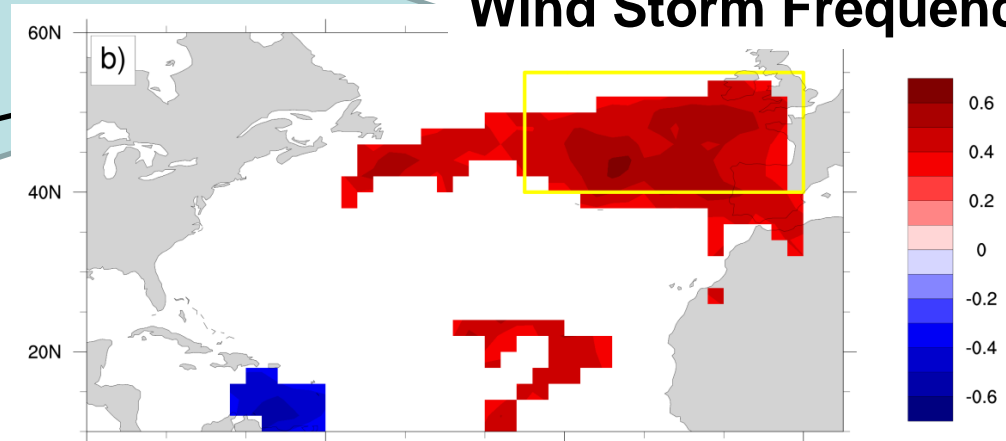
## NA, Surface Temperature



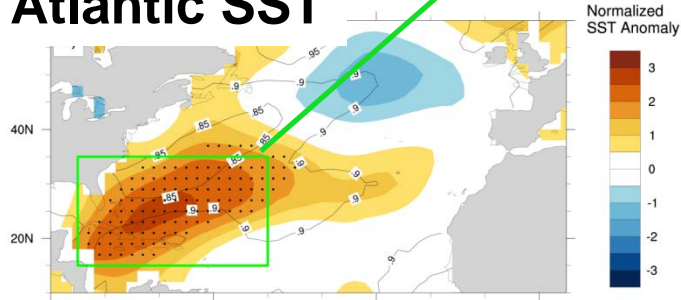
very weak correlation

weak correlation

## Wind Storm Frequency



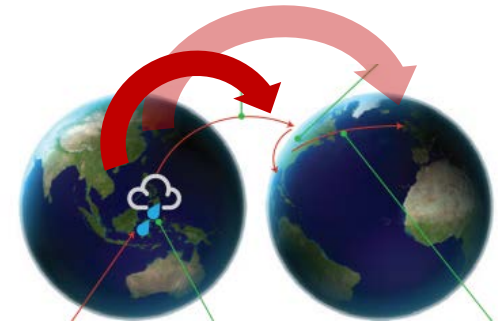
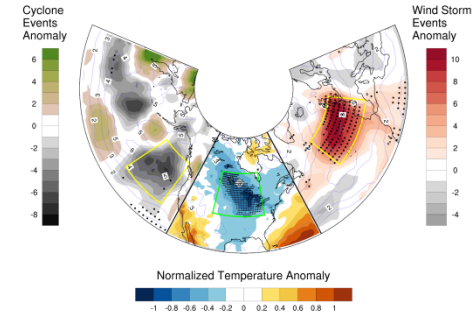
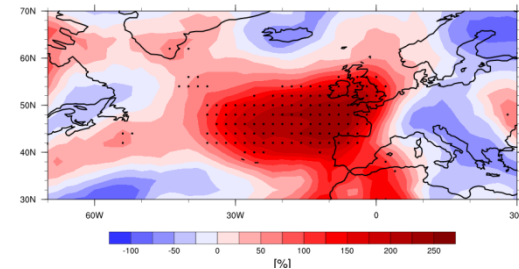
## Atlantic SST



Correlation: Meridional temperature gradient index vs. wind storm frequency ( $p > 0.05$  omitted)

# Summary

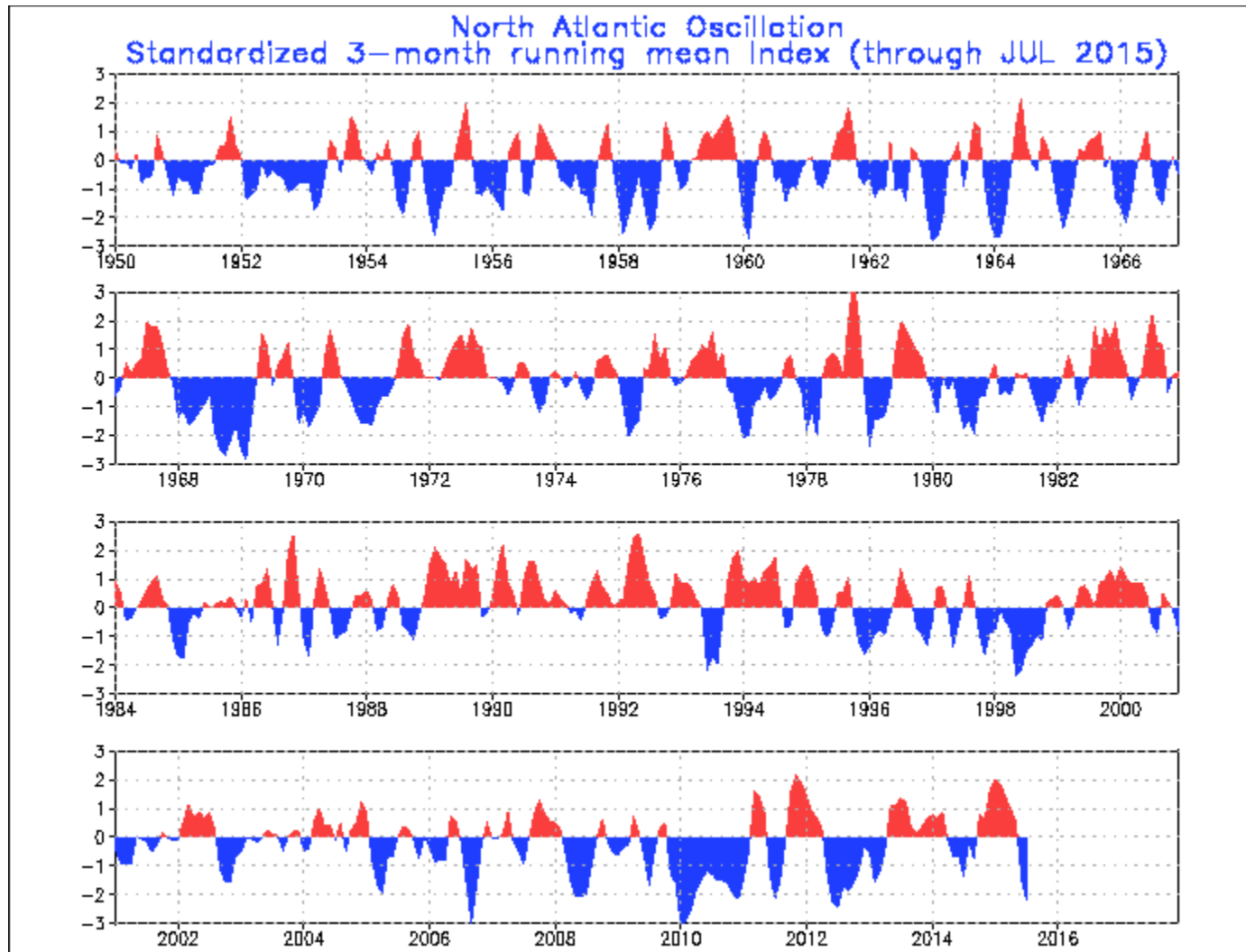
- Absolute maximum of wind storm activity (relative anomaly greater 200%) in DJF 2013/14 and concurrent absolute minimum of surface temperature over central North America in ERA Interim Reanalysis (1979-2014).
- Fewer than normal cyclones over NE-Pacific, anomalously high sea surface temperatures in N-Pacific, negative PNA values and high convective activity (low OLR values) over the Western Pacific Warm Pool in DJF 2013/14
- Conditions in and over the Pacific show
  - significant correlations to surface temperatures over central North America
  - weak and not significant correlations to wind storm frequency over North Atlantic and UK



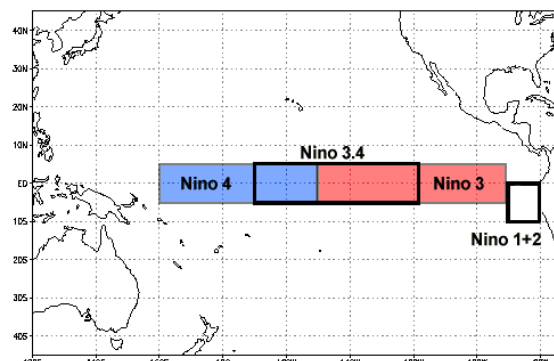
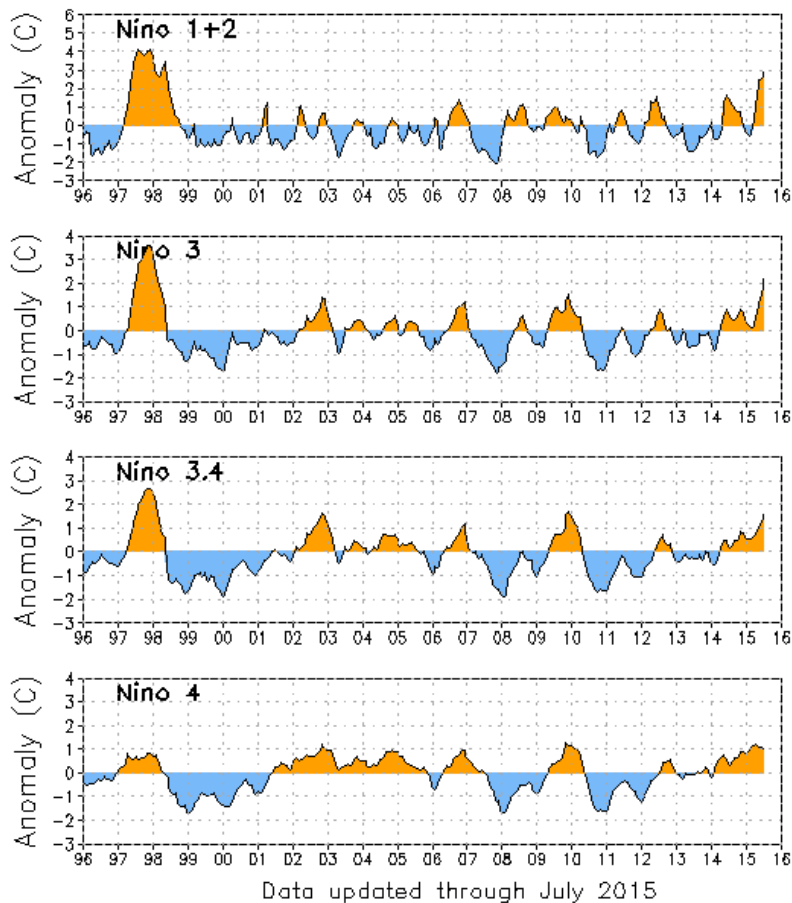
Low surface temperatures over North America and **upstream conditions** over the North and tropical Pacific **favoured** the positive wind storm anomaly over the North Atlantic and the UK in the winter season 2013/14

**BUT:** conditions in the Pacific and its induced anomalies over the North American continent are generally not sufficient to explain such an extraordinary high winter windstorm frequency

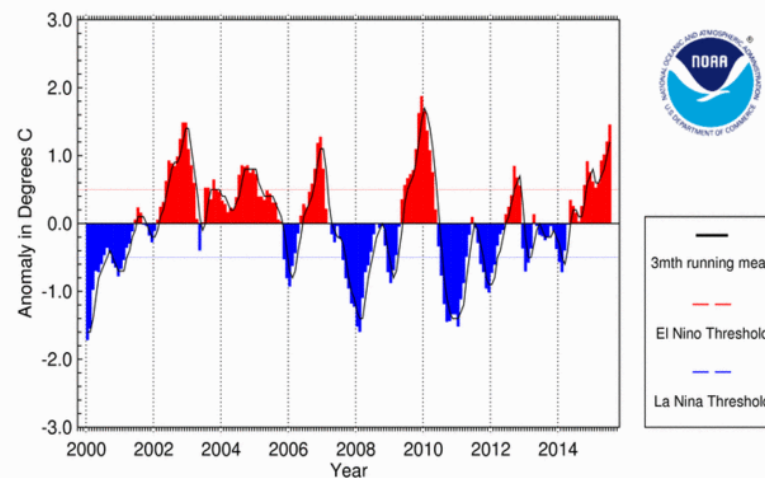
→ additional (independent) drivers such as **warm Western Atlantic** sea surface temperatures (**SSTs**) were necessary







SST Anomaly in Niño 3.4 Region (5N-5S, 120-170W)



National Climatic Data Center / NESDIS / NOAA