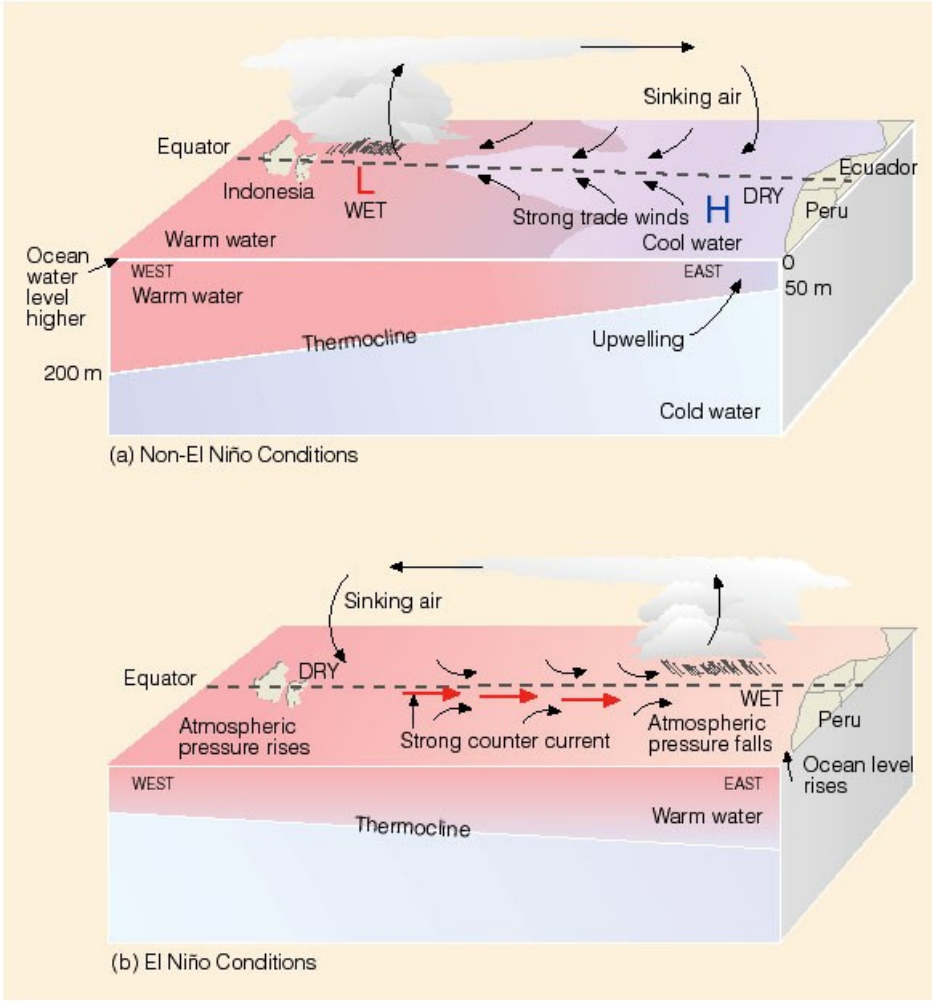
Ocean vector winds are important for ocean-atmosphere interaction and modes of climate variability. Similarly winds play an important role in spatial patterns of climate change. Maintaining a long, consistent, well-calibrated wind dataset is critical for climate change research.

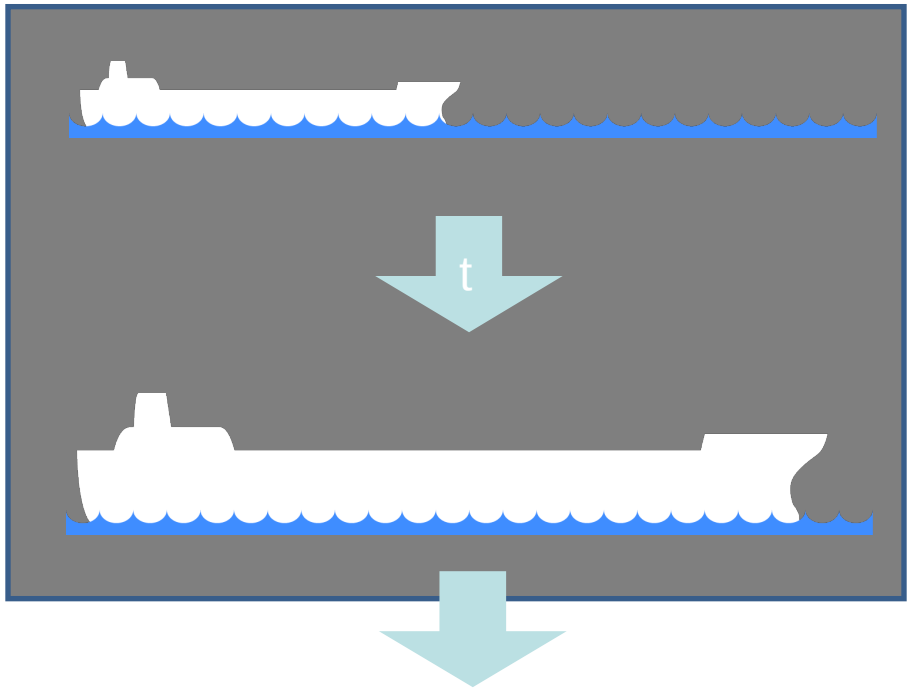


Surface wind trend based on ship obs.

Increased ship size & anemometer height

BEAUFORT FORCE 8
WIND SPEED: 34-40 KNOTS

SEA: WAVE HEIGHT 5.5-7.5M (18-25FT), MODERATELY HIGH WAVES OF GREATER LENGTH, EDGES OF CREST BEGIN TO BREAK INTO THE SPINDRIFT, FOAM BLOWN IN WELL MARKED STREAKS ALONG WIND DIRECTION.



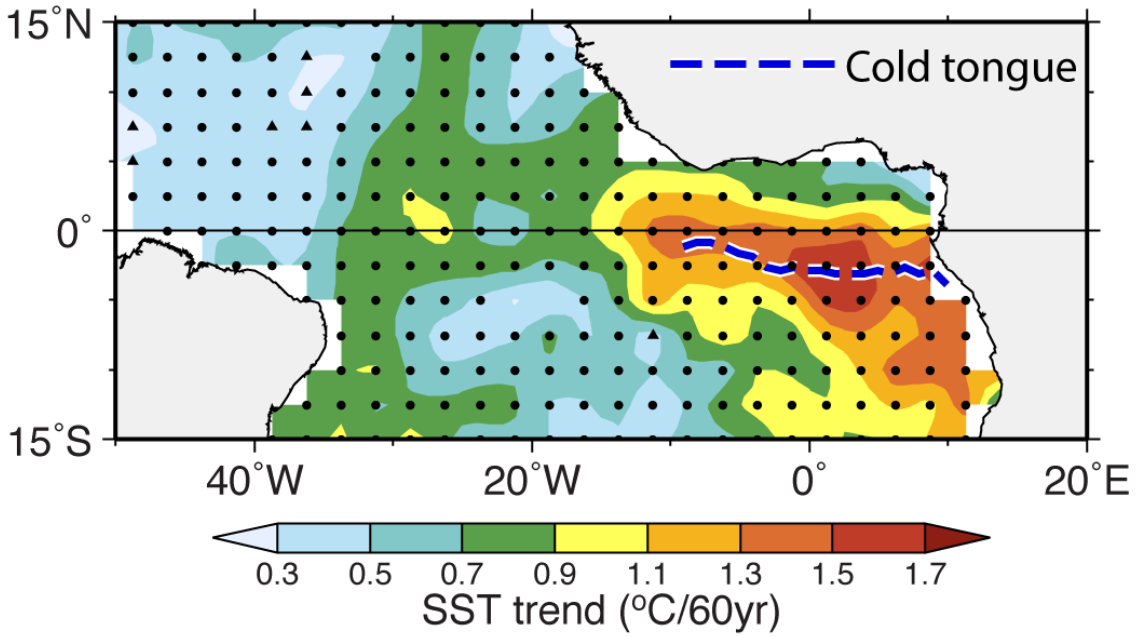
Spurious increase in measured wind

Visual observations of wind wave height → correct wind biases

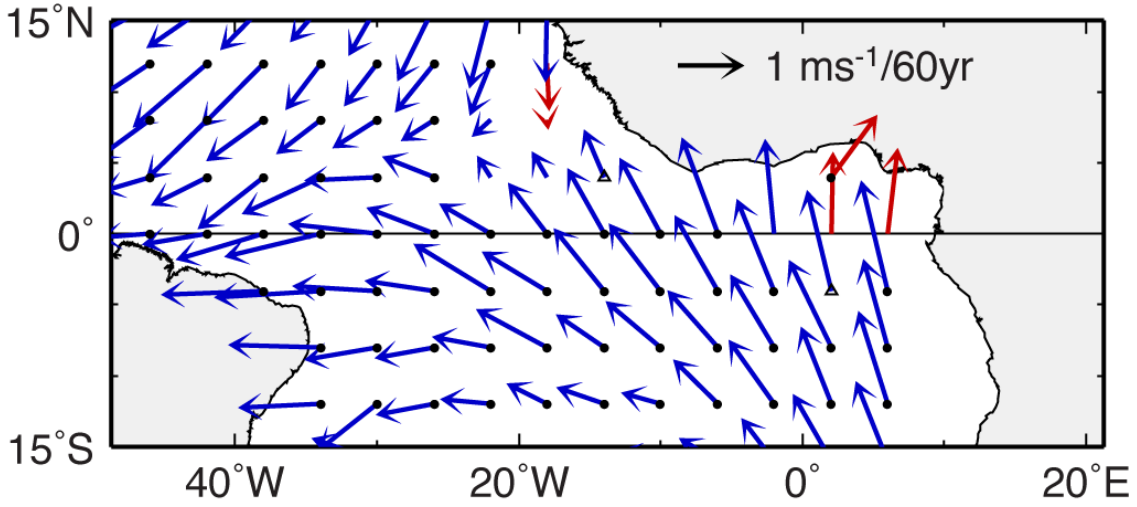
Tokinaga, H., and S.-P. Xie, 2011: Wave and Anemometer-based Sea-surface Wind (WASWind) for climate change analysis. *J. Climate*, 24, 267-285.

Trend for 1950 - 2009

SST
(°C/60yr)

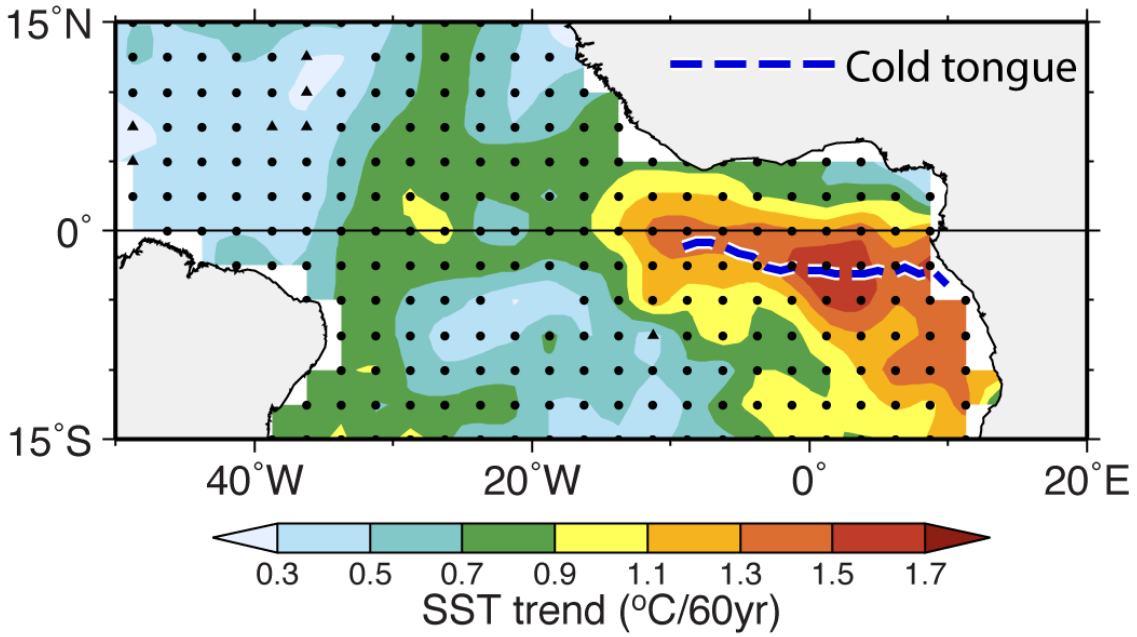


Uncorrected
ICOADS wind
(ms^{-1}/60yr)

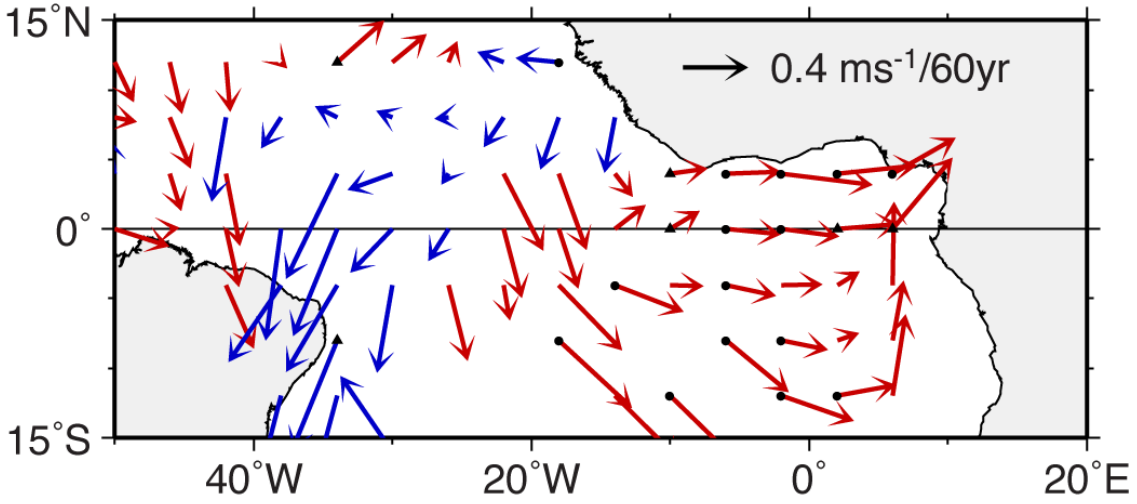


Trend for 1950 - 2009

SST
(°C/60yr)



WASWind
(ms^{-1}/60yr)



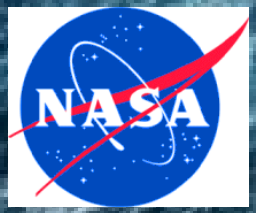
Tokinaga, H., and S.-P. Xie, 2011: Weakening of the equatorial Atlantic cold tongue over the past six decades. *Nature Geosci*., 4, 222-226

Interannual variability of high-wind occurrence over ocean

Shang-Ping Xie[1]

X. Cheng[2,1], T. Sampe[3], H. Tokinaga[1] & Y. Du[2]

1 IPRC, University of Hawaii
2 South China Sea Institute of Oceanology, China
3 Aizu University, Japan



Data & Methods

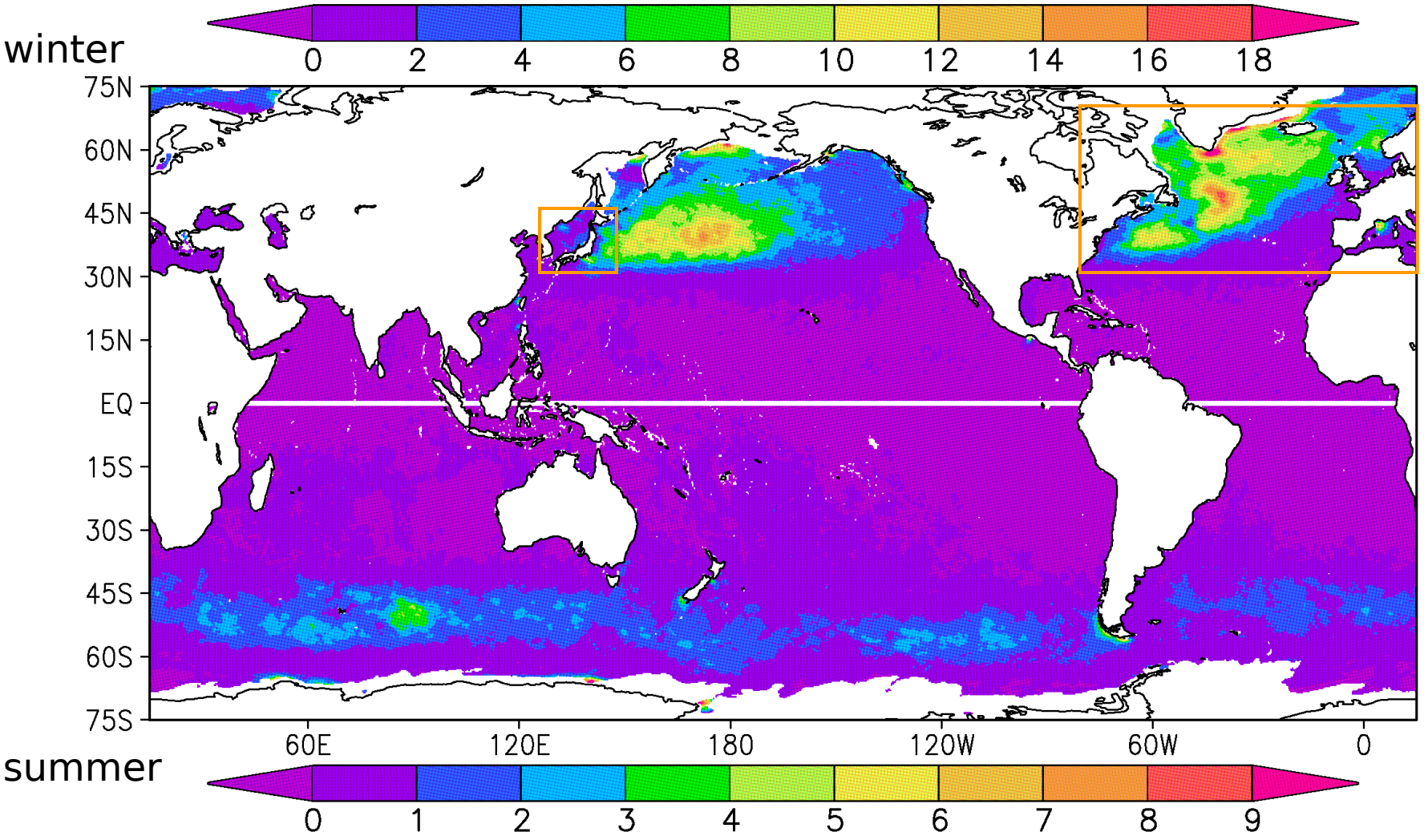
- QuikSCAT wind velocity on 0.25^{o} grid (Sept 1999 - Nov 2009)
- SSM/I wind speed on 0.25^{o} grid (1988-2009)
- Map high-wind (**>20 m/s**) frequency (HWF)

Sampe, T., and S.-P. Xie, 2007: Mapping high sea winds from space: A global climatology. *Bull. Amer. Meteor. Soc*., 88, 1965-1978.

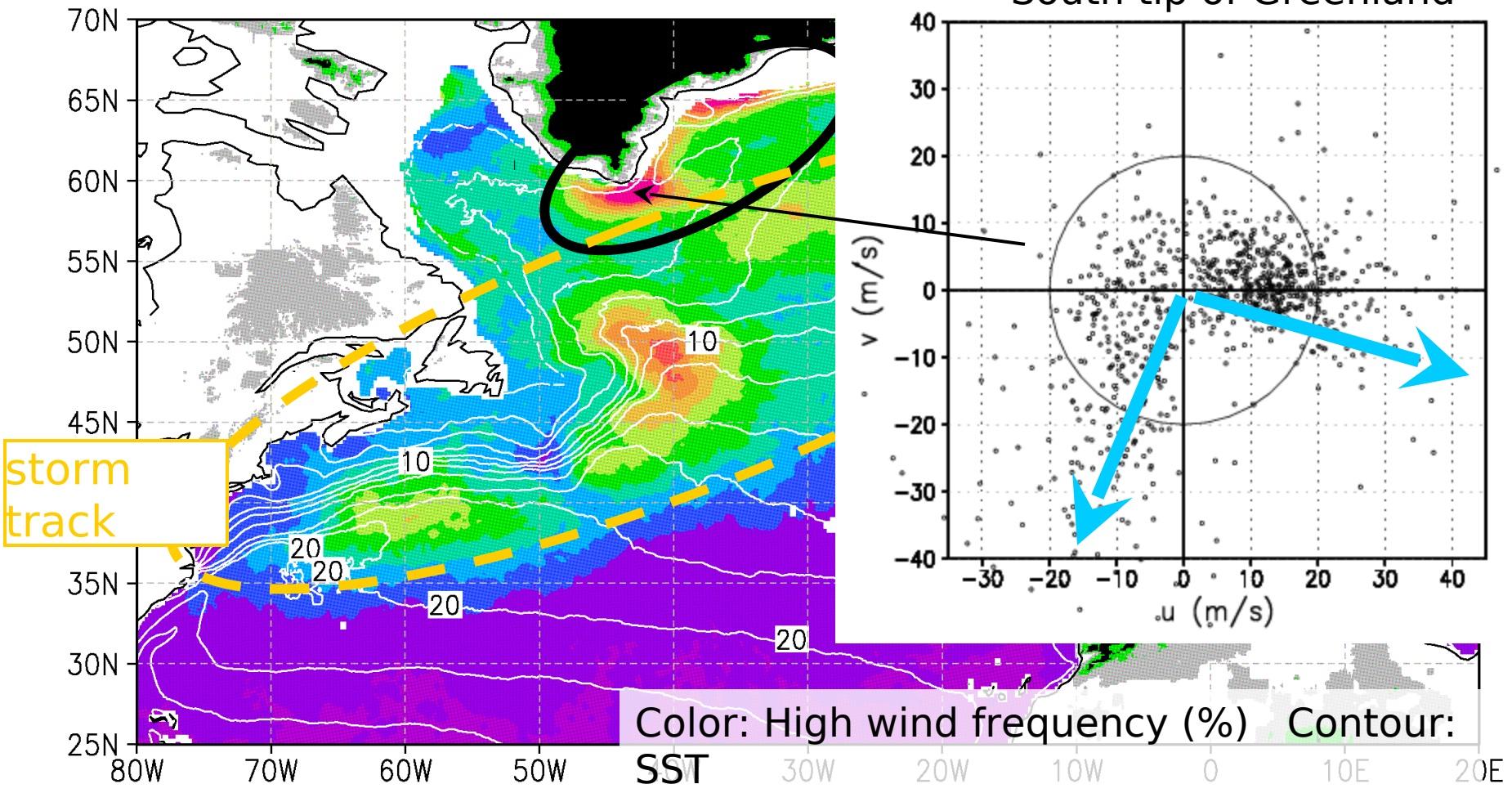
Cheng, X., S.-P. Xie, H. Tokinaga, and Y. Du, 2011: Interannual variability of high-wind occurrence over the North Atlantic. *J. Climate*, revised.

Dec-Jan-Feb high-wind frequency (%)

- frequent in wintertime midlatitudes (storm track region)

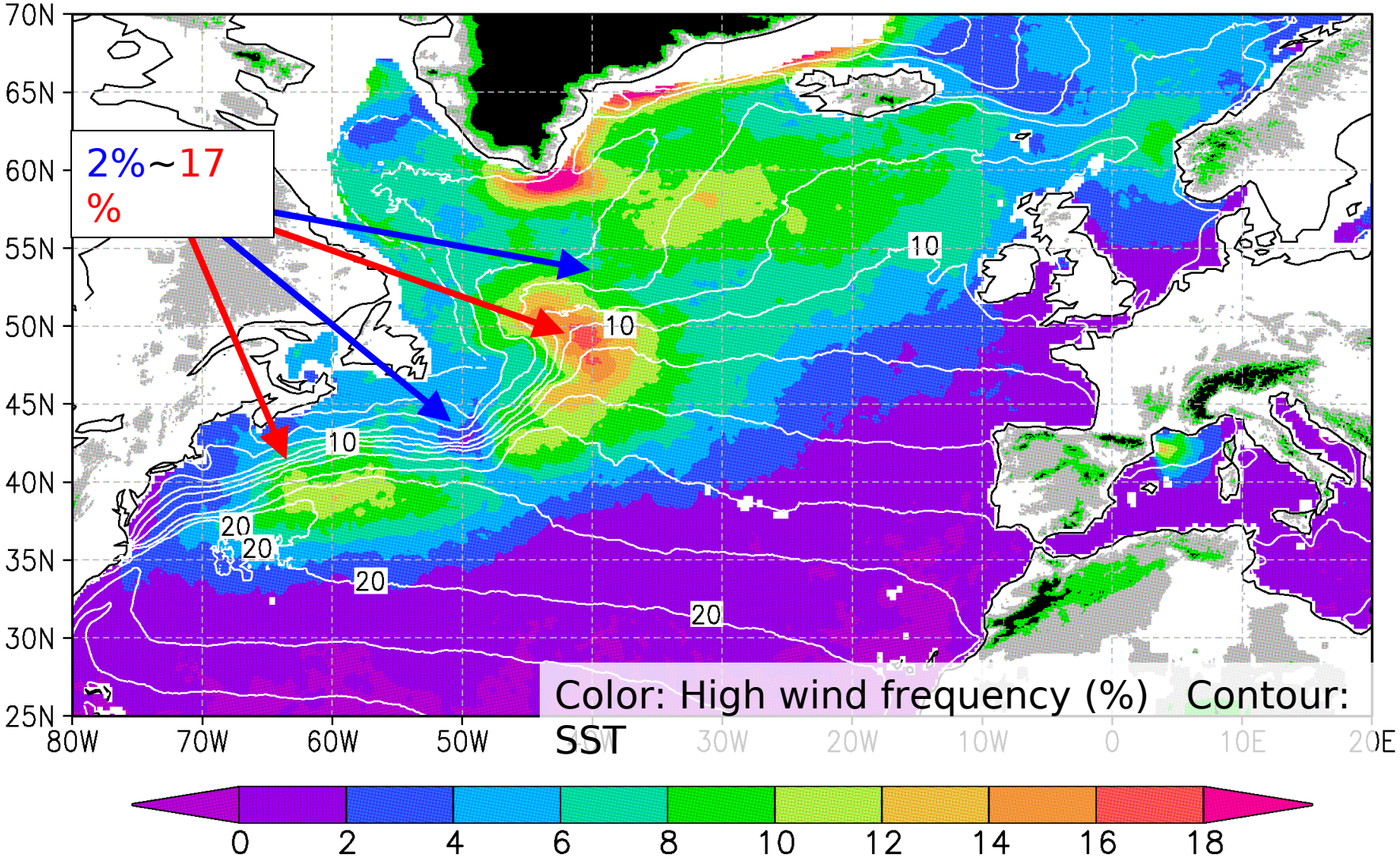


North Atlantic



- Orography (Greenland, Norway, France-“mistral”)
- SST frontal effects (more frequent over warmer waters)

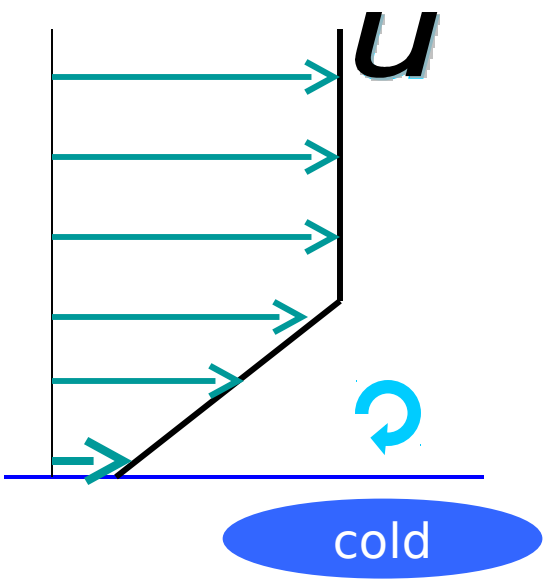
North Atlantic

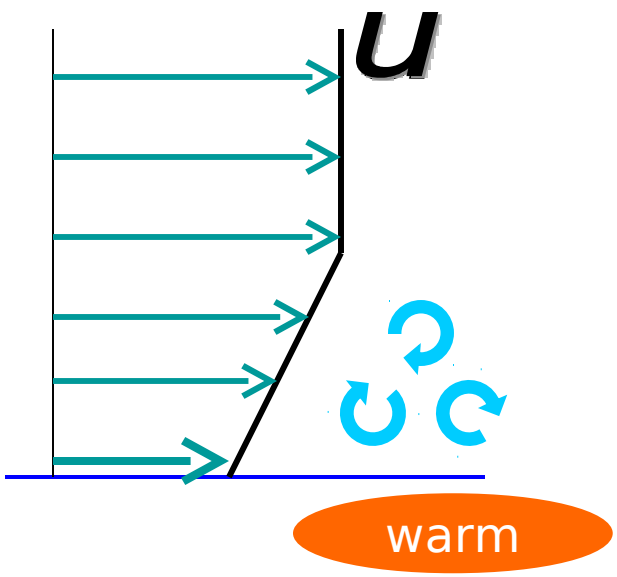


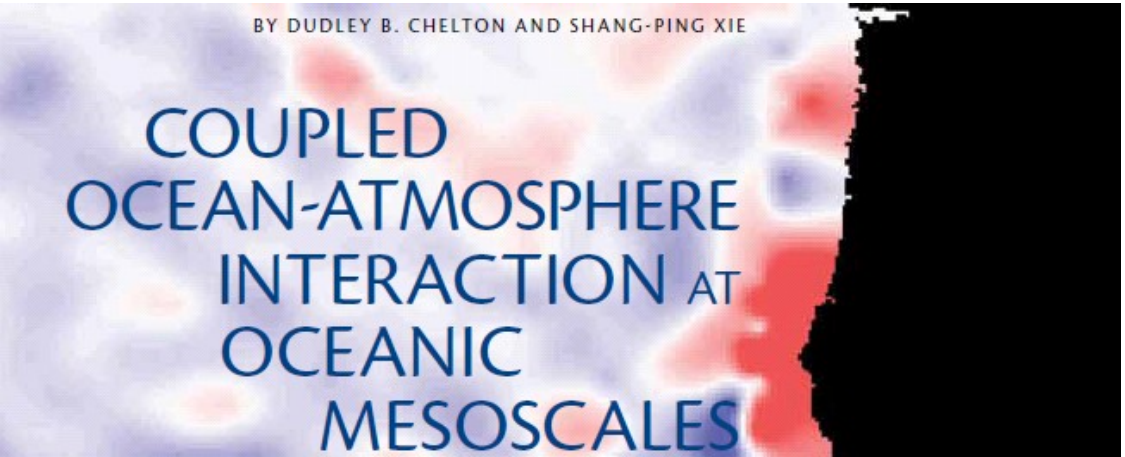
- Orography (Greenland, Norway, France-“mistral”)
- SST frontal effects (more frequent over warmer waters)

Momentum-mixing mechanism

- low static stability over warm waters → enhanced mixing → increased surface wind

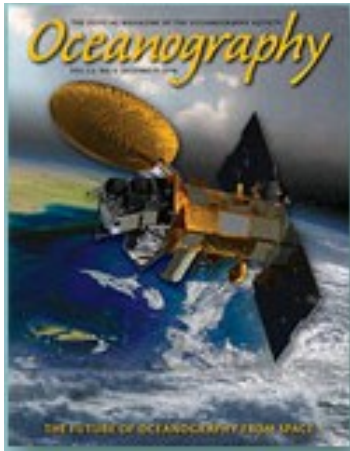






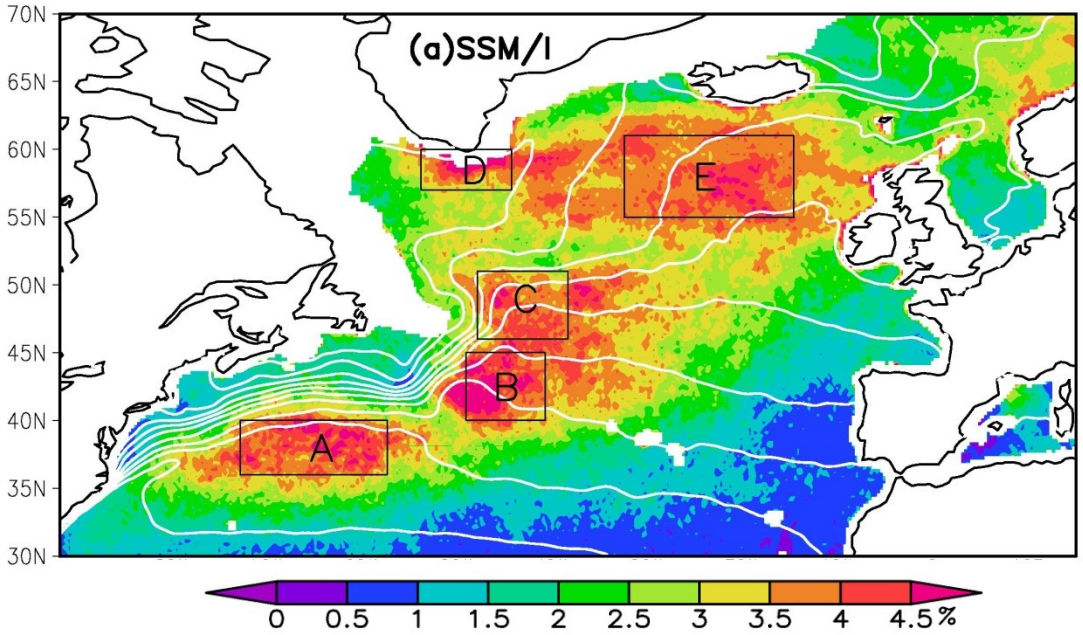
December 2010
Special Issue on

the Future of Oceanography from Space



Interannual variability

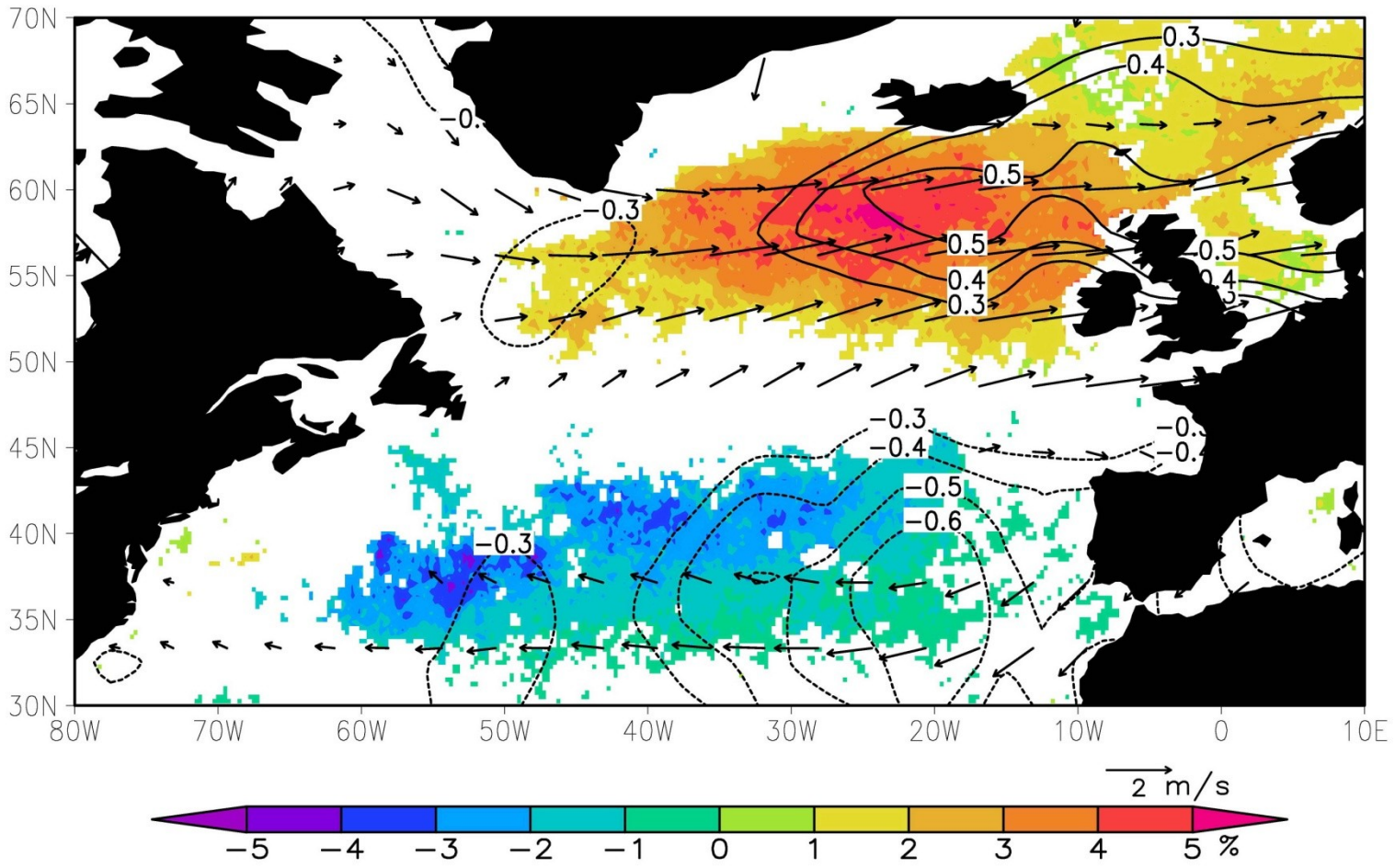
in high-wind frequency (HWF) DJF 1988-2009



High variance

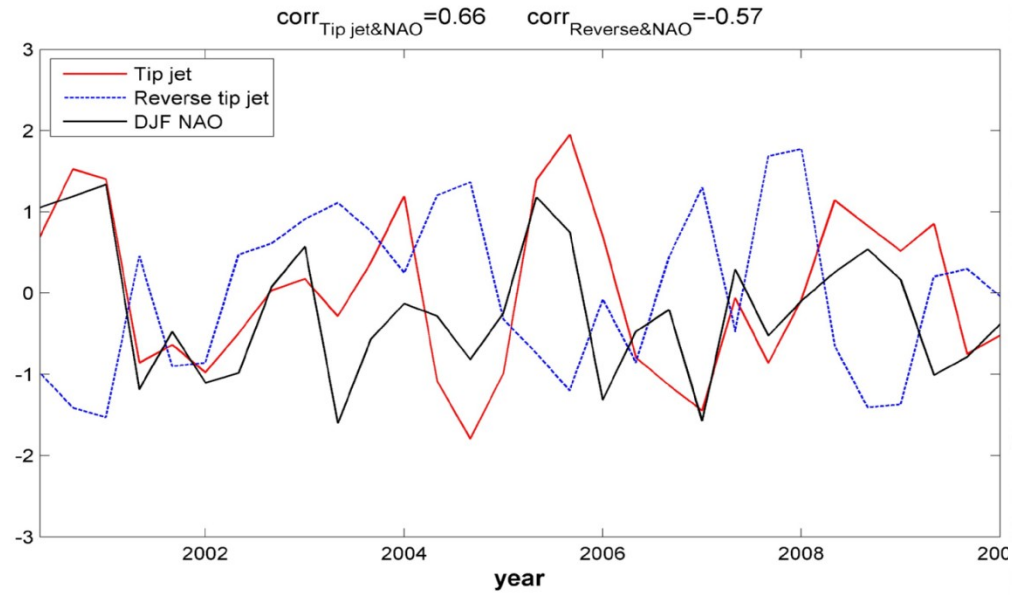
- A, B & C: Gulf Stream front
- D: Cape Farewell
- E: Open ocean band

North Atlantic Oscillation (NAO) effect

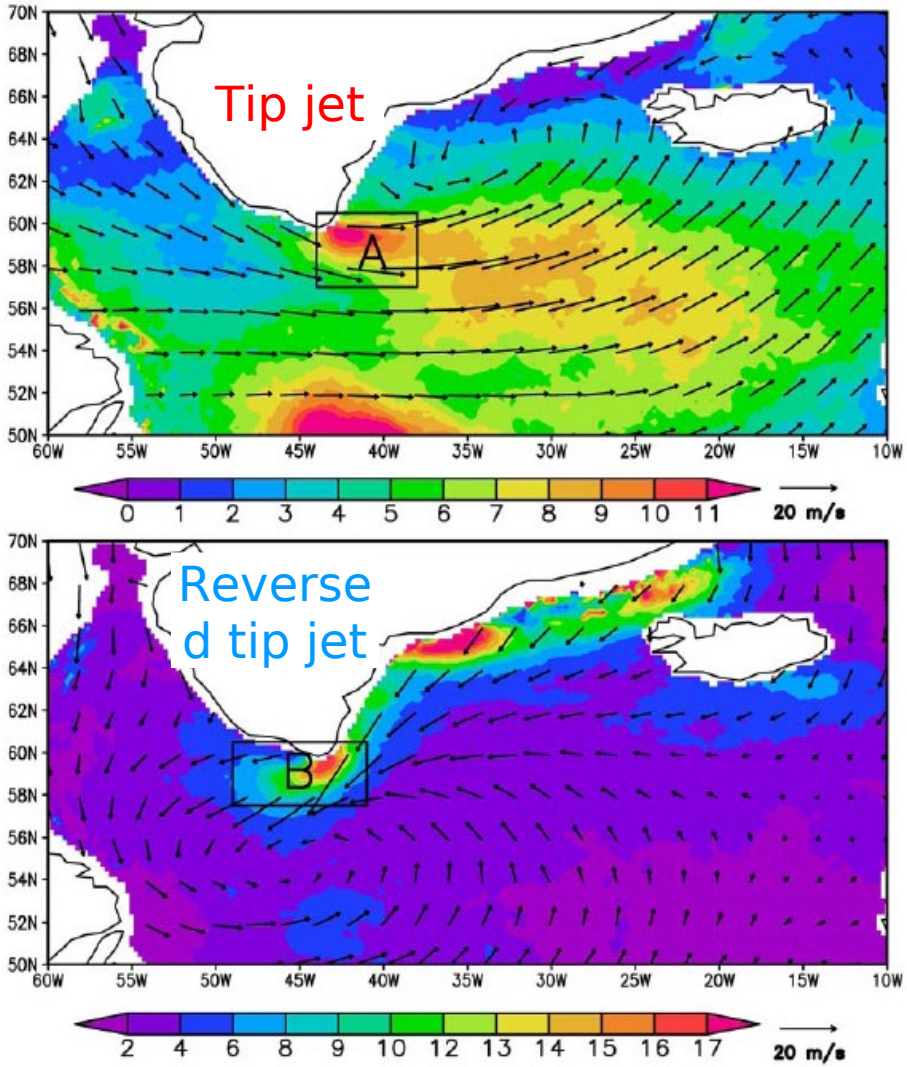


DJF high wind frequency anomaly (color) and wind anomaly (vector) regressed upon the NAO Index, superimposed on correlation between storm-track intensity and NAO index (black contours).

Interannual variations off Cape Farewell

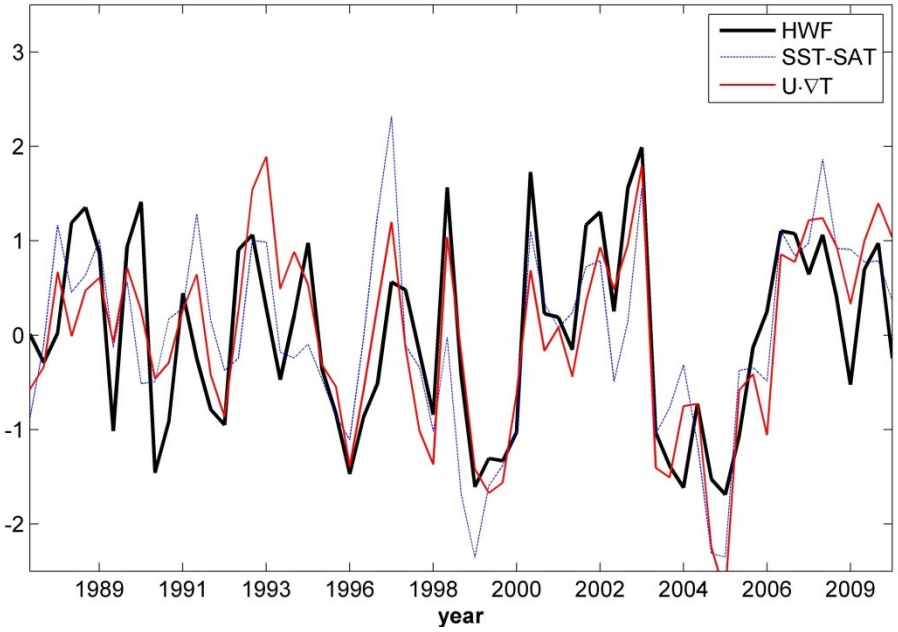


Westerly & easterly HWF; NAO

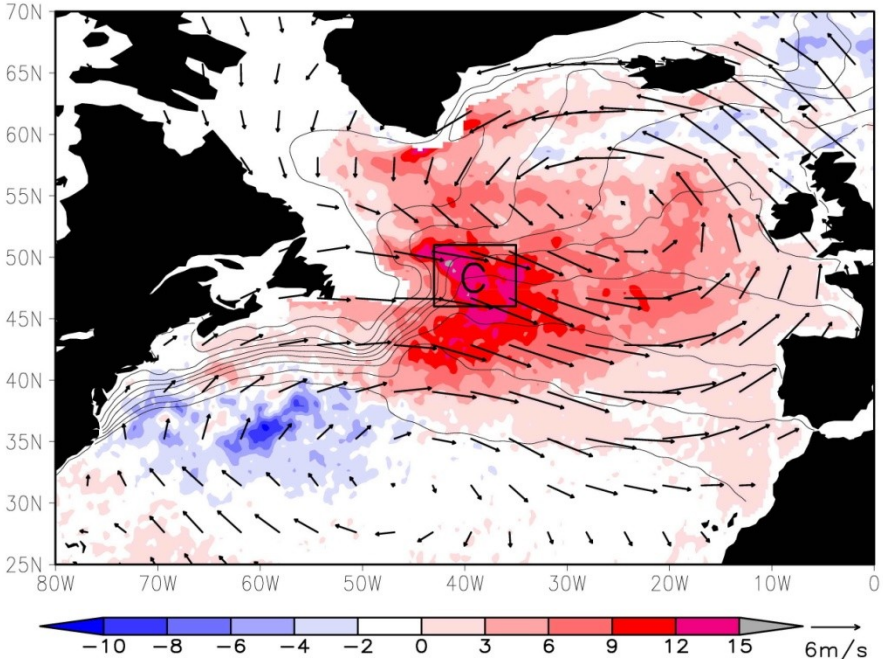


Winter high-wind occurrence (%) associated with (a) westerly and (b) easterly wind

SST front effect

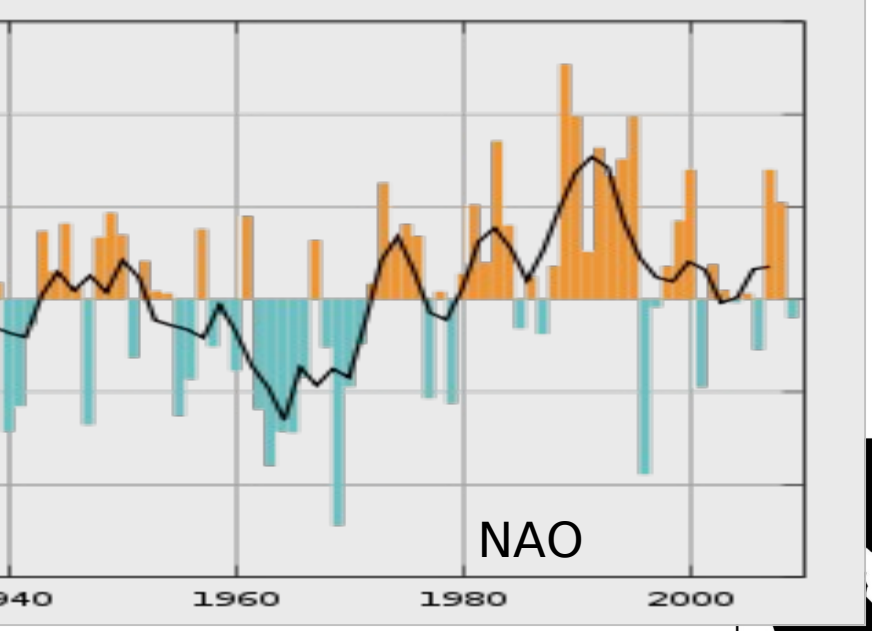


DJF HWF, SST-SAT, and cross-frontal advection

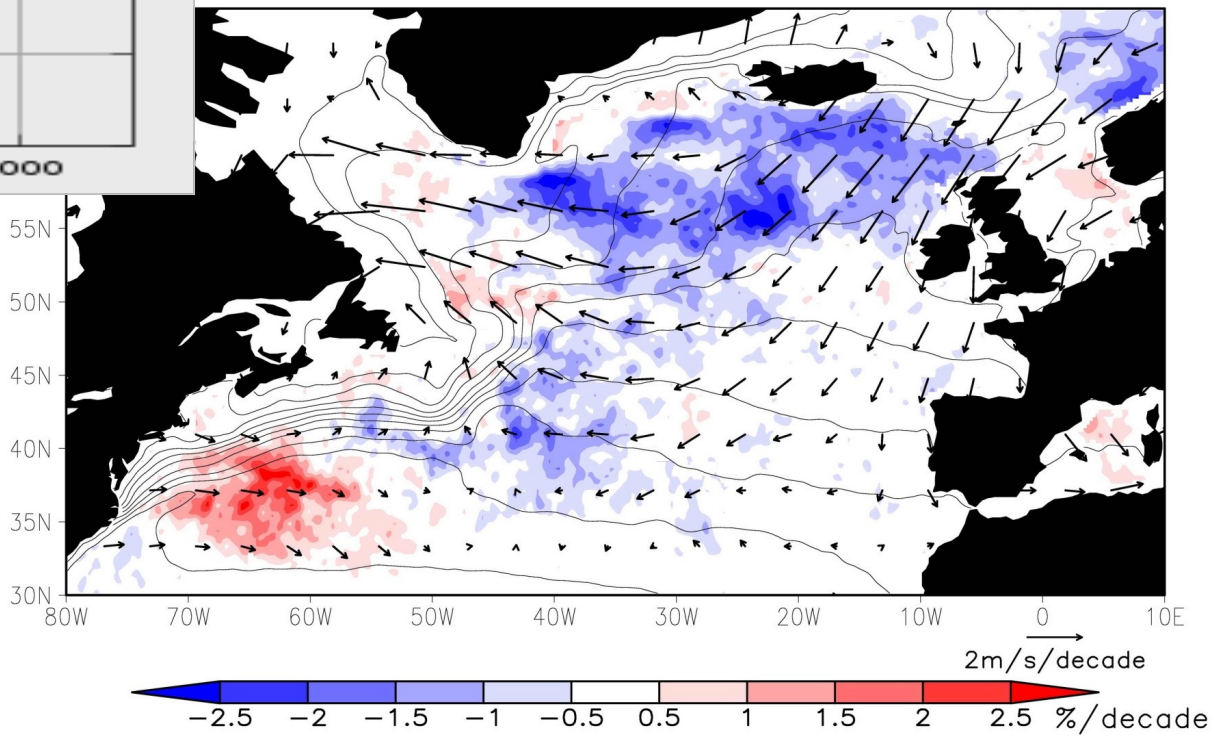


HWF and 10-m wind b/w positive and negative phases of cross-front advection

Correlation with the Eastern Atlantic pattern = 0.64



HWF trend



Local trend of high-wind frequency (color) and 10-m wind (vector) over 1988-2009, superimposed on climatological seasonal means of AVHRR SST.

Factors for high-wind occurrence

Climatology

- Storm tracks
- Sea surface temperature fronts
- Coastal orography

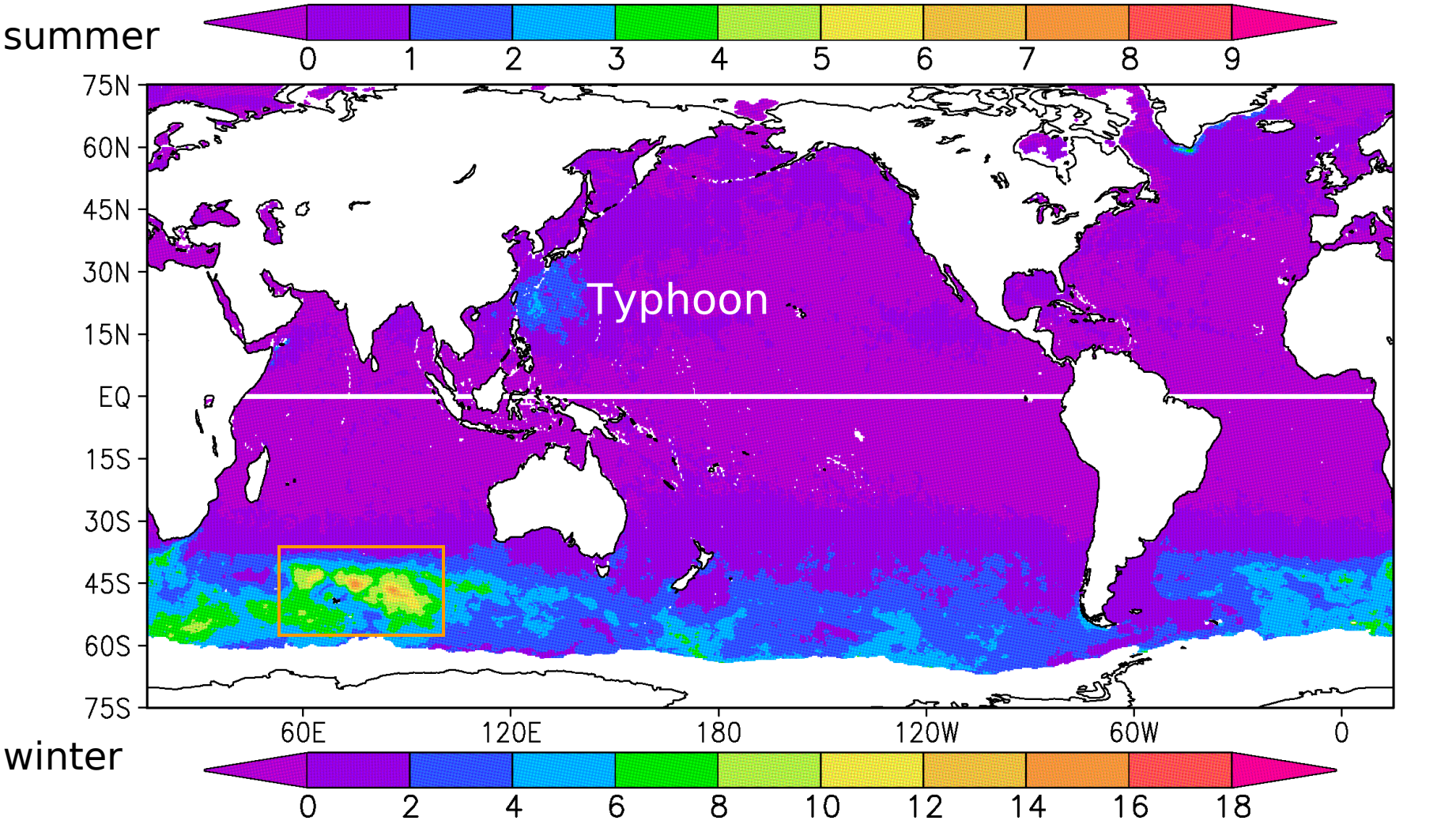
Interannual variability

- North Atlantic Oscillation
- East Atlantic pattern
- SST fronts and orography

Rough Sea by Claude Oscar Monet 188

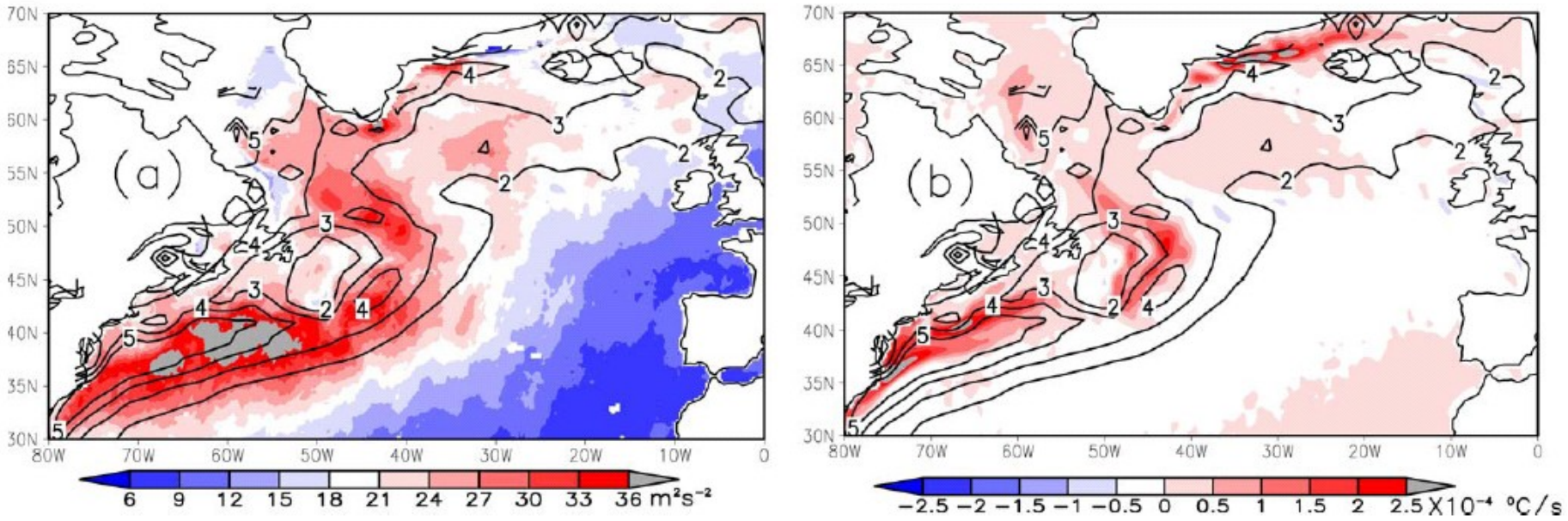
Jun-Jul-Aug

- Tropical cyclones do not emerge in climatology

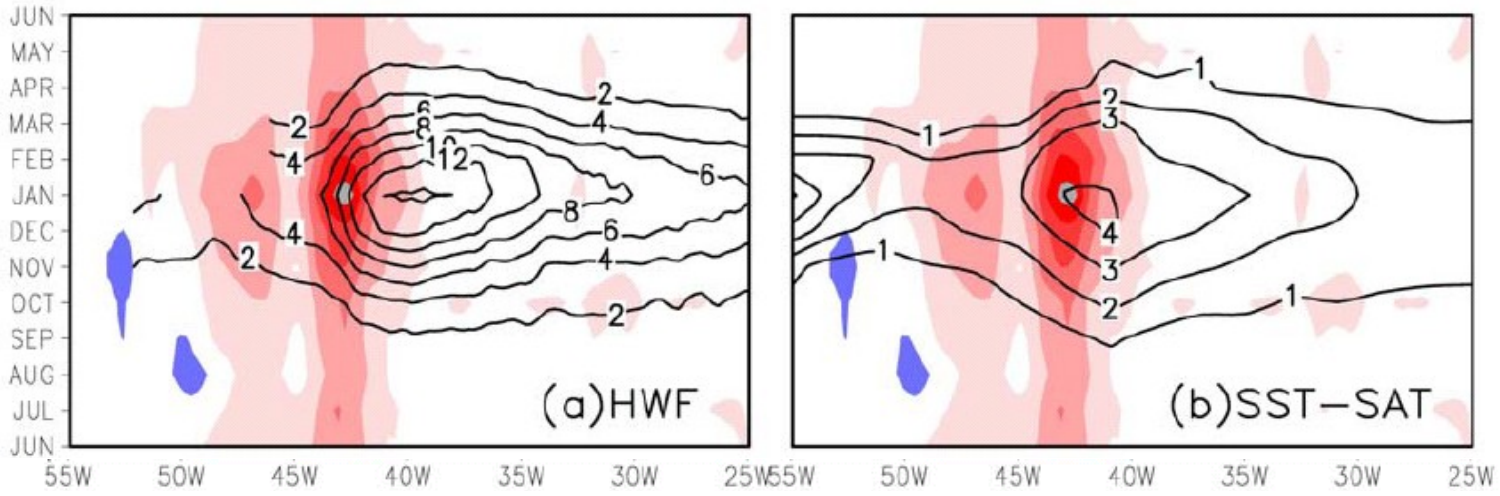


Enhanced eddy-kinetic energy ← Increased instability ← Cross-frontal advection

(black contours)

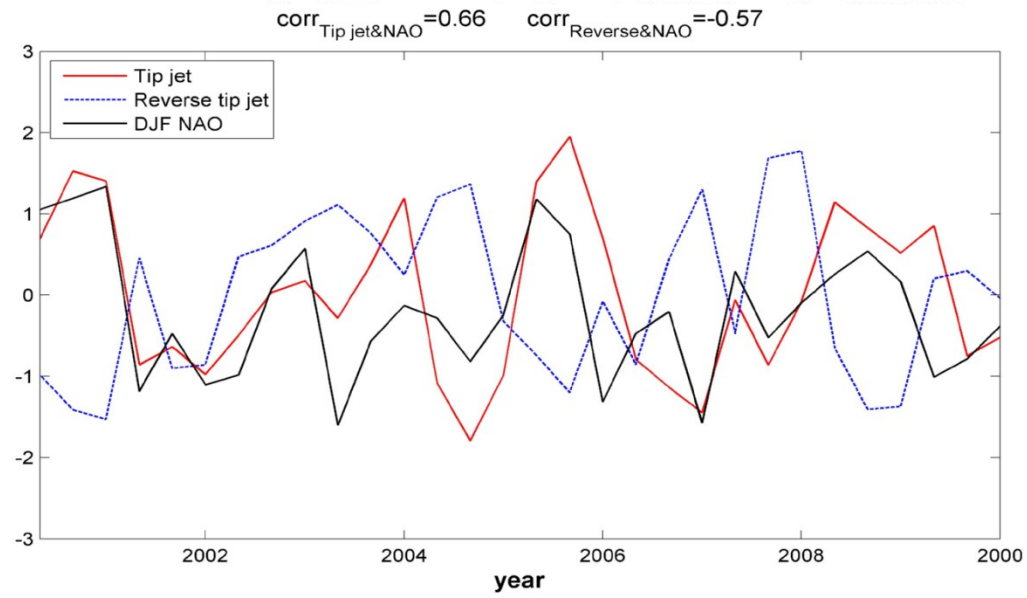


Winter climatology

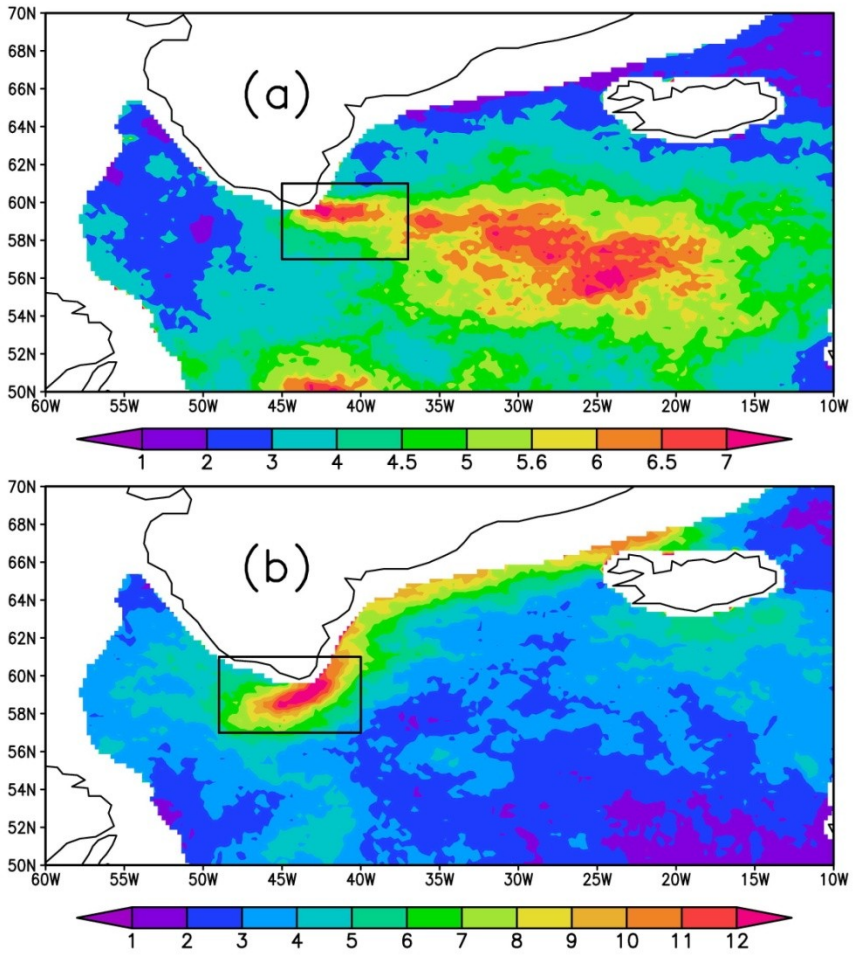


Interannual variations off Cape Farewell

Tip jet



Westerly & easterly HWF; NAO



Interannual standard deviation of winter HWF (unit: %) associated with (a) westerly and (b) easterly wind