





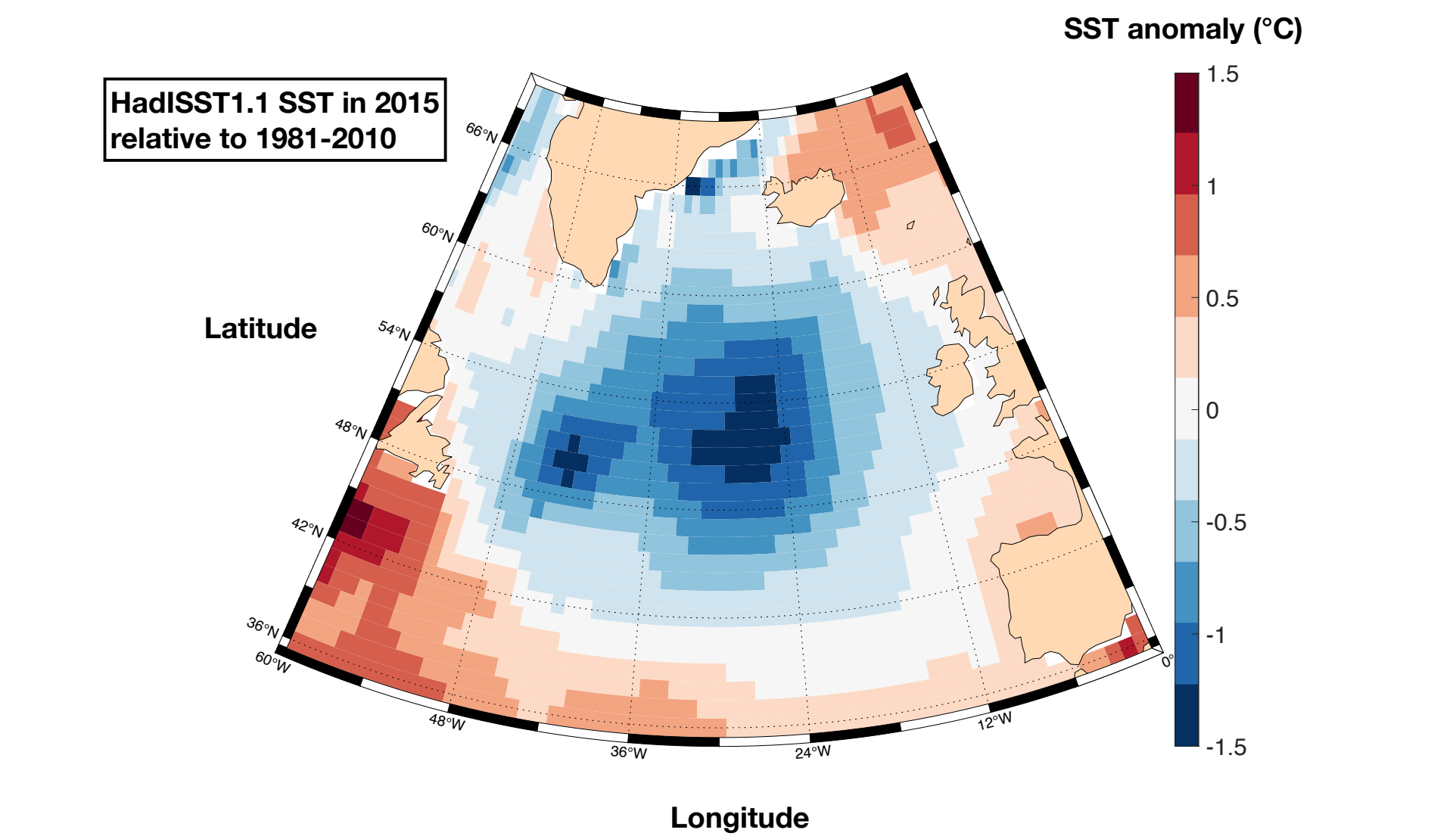
# Local and remote causes of the recent North Atlantic cold anomaly: an adjoint sensitivity study



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**BACKGROUND:** North Atlantic cold anomalies are associated with large-scale circulation changes and European heat waves. What creates and sustains these interannual cold anomalies? Here we examine a particular cold anomaly from 2014-2015.



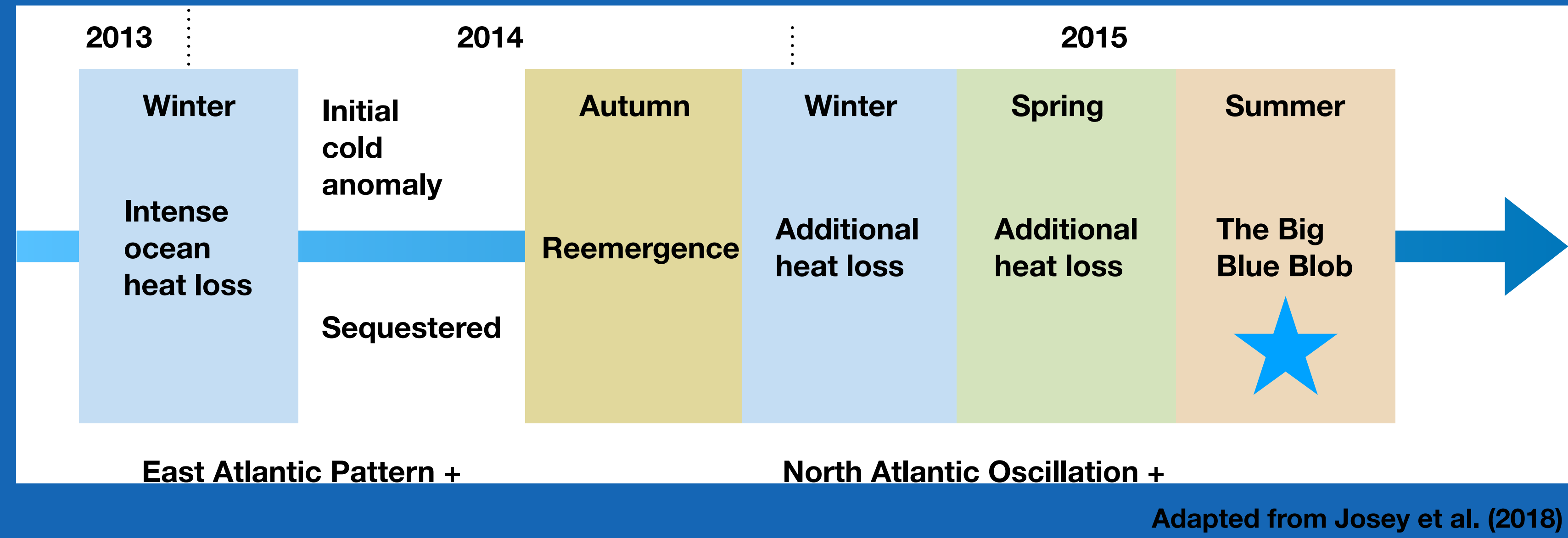
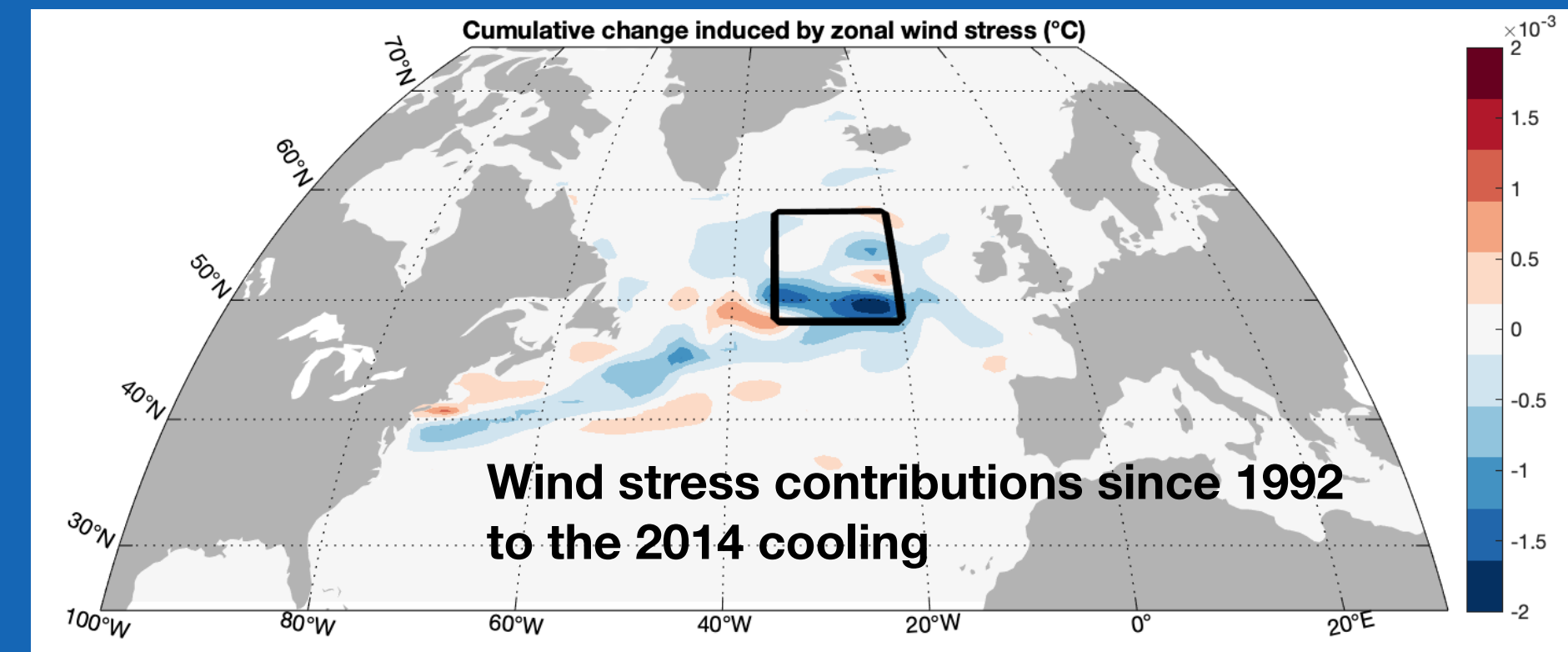
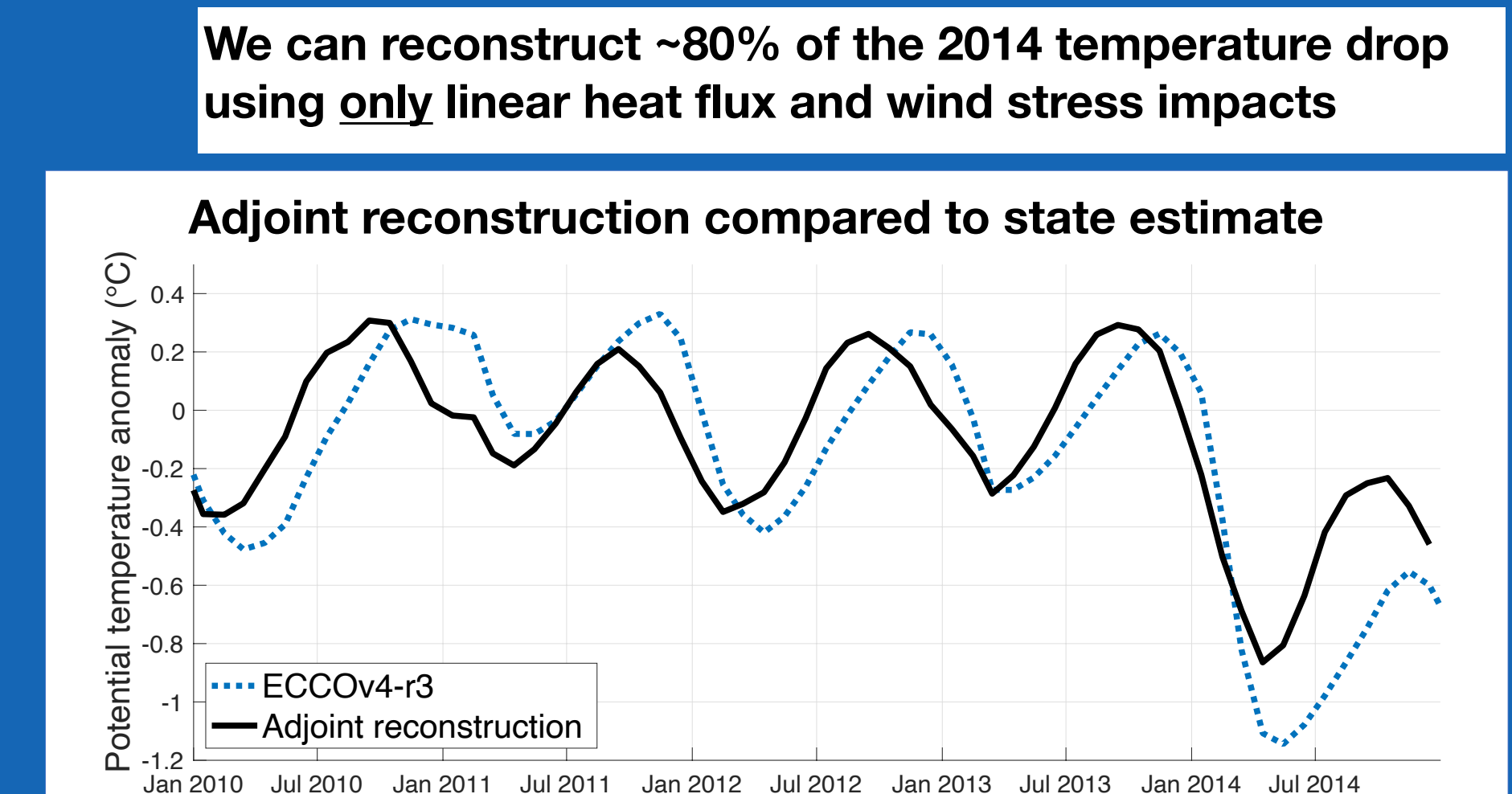
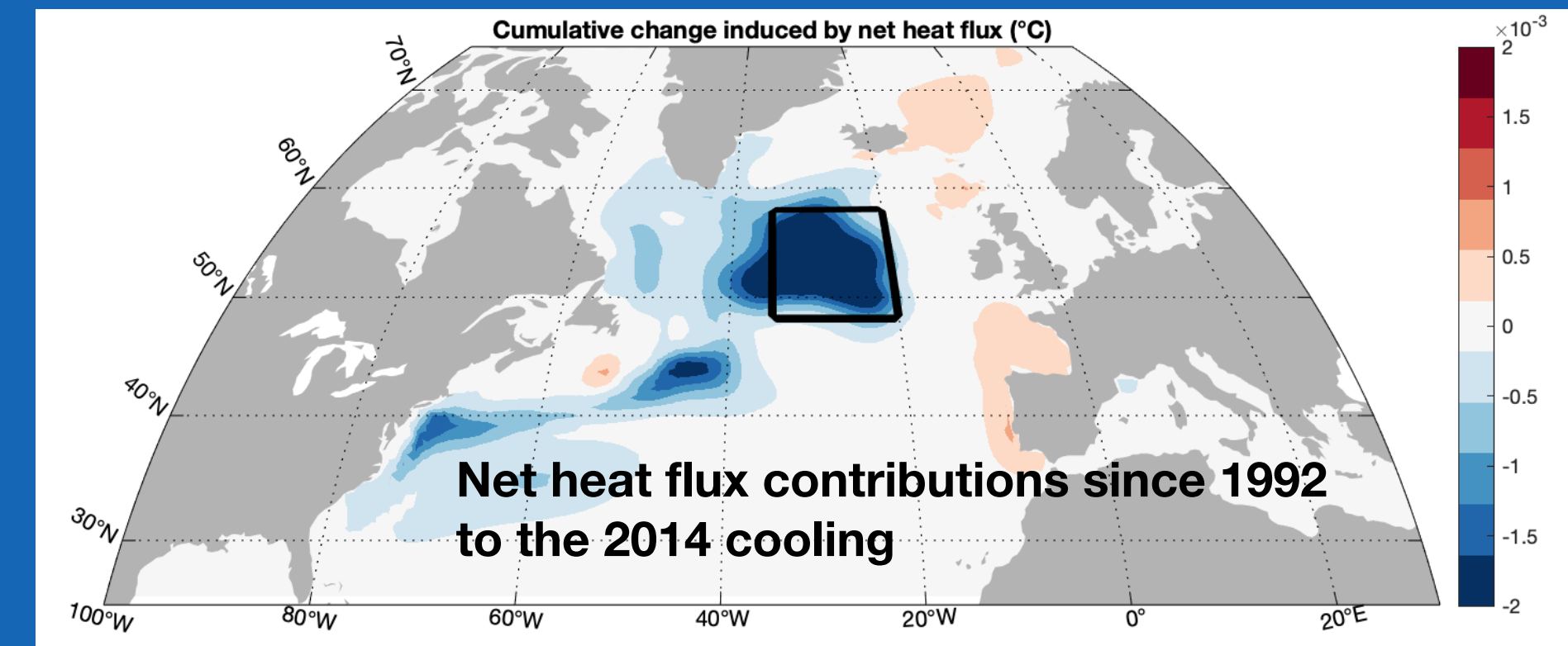
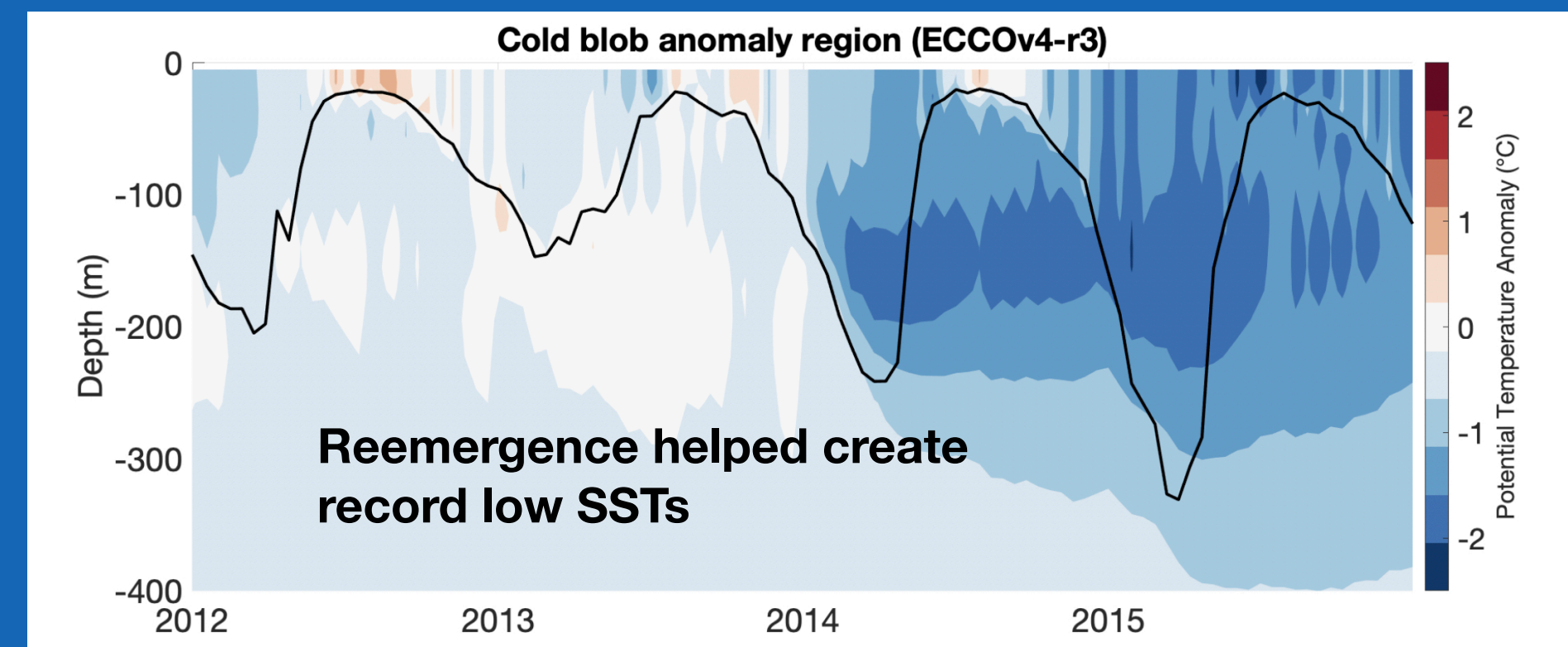
## MODEL AND METHODS

- Model: the ECCOV4-r3 state estimate
- Calculated heat budget in control volume (white box above, top 500m)
- Performed adjoint reconstruction of temperature

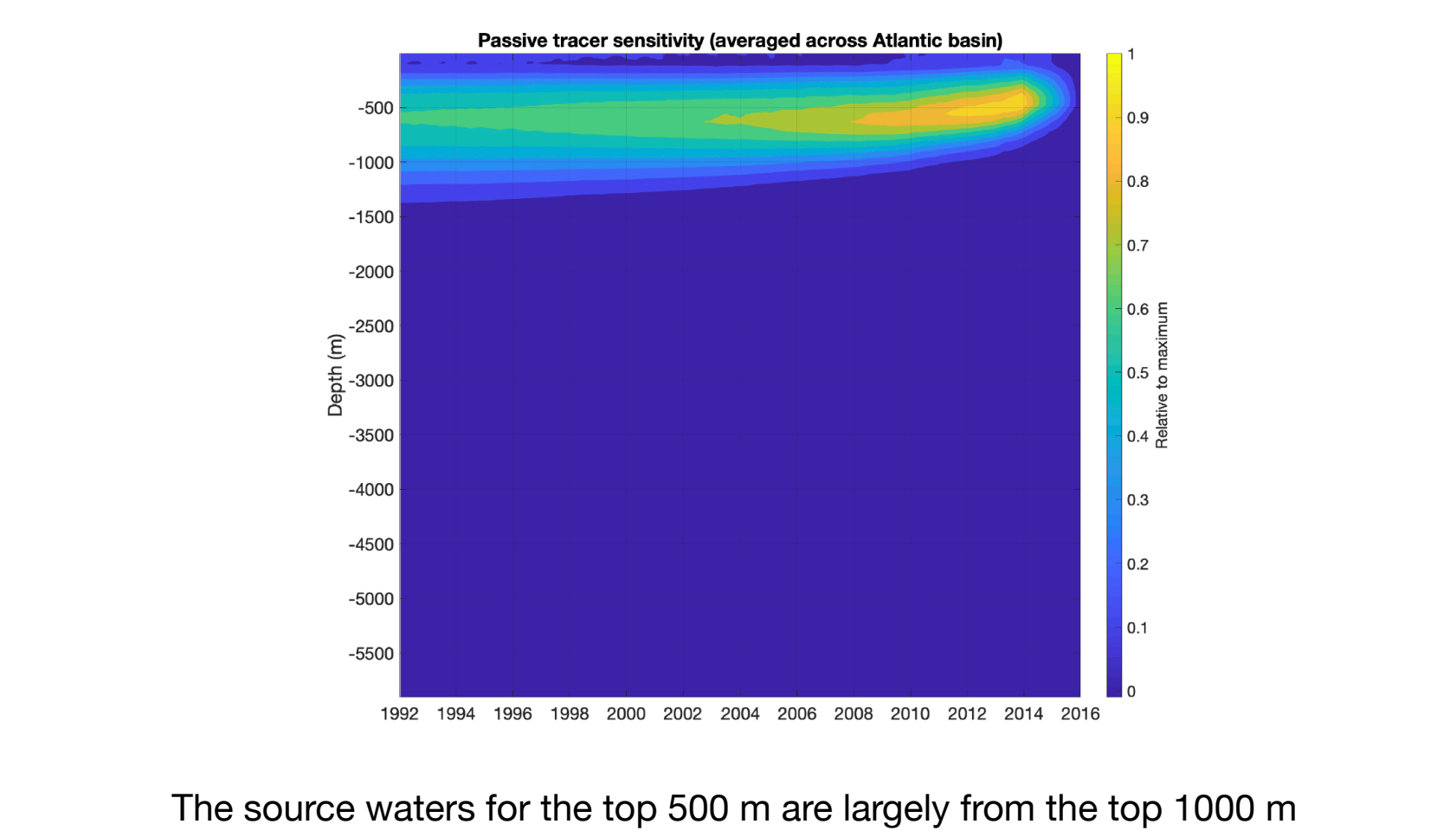
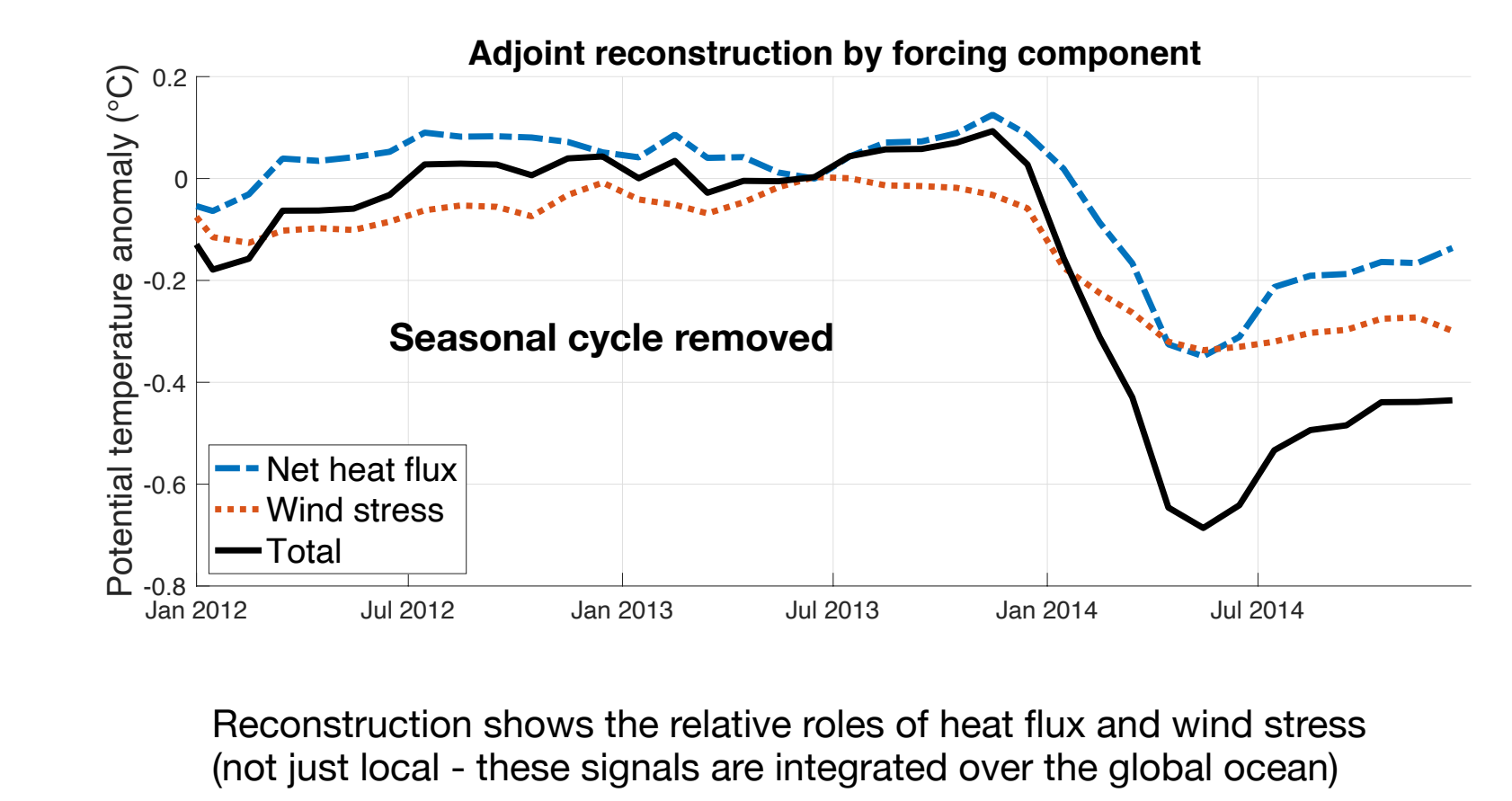
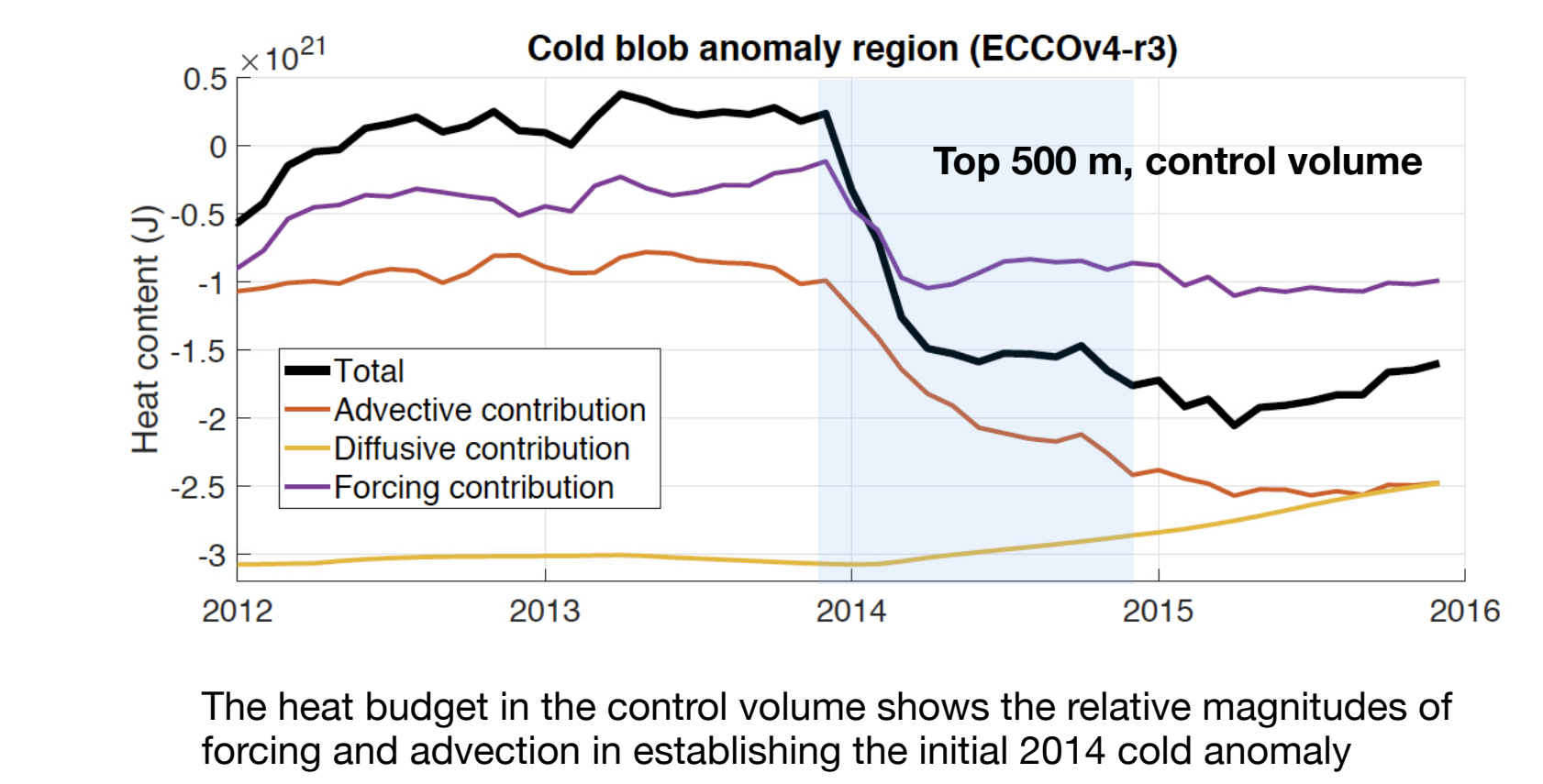
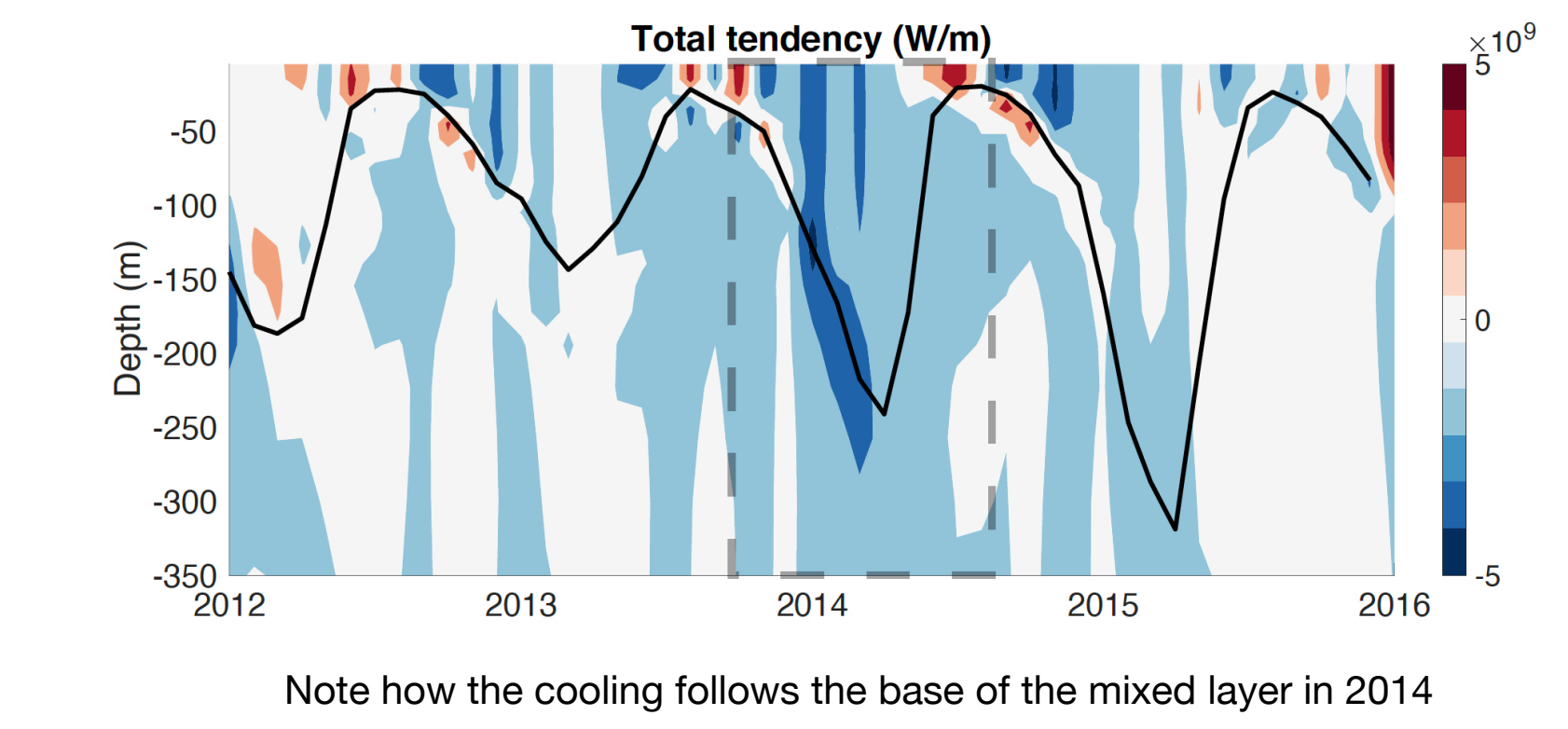
## RESULTS

- Reemergence signature:
  - intense ocean heat loss in winter 2013-2014 created especially cold subpolar mode water that became isolated from the atmosphere when the mixed layer shoaled in spring
  - another round of intense heat loss in winter 2014-2015 brought this cold anomaly back up to the surface, contributing to record low SSTs in 2015
- Adjoint reconstruction:
  - we can reconstruct ~80% of the 2014 interior cold anomaly (top 500 m) using *only* heat flux and wind stress. (Note that this reconstruction only includes linear changes induced by the forcing)

# Record low sea surface temperatures in the North Atlantic caused by successive winters with extreme heat loss






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