



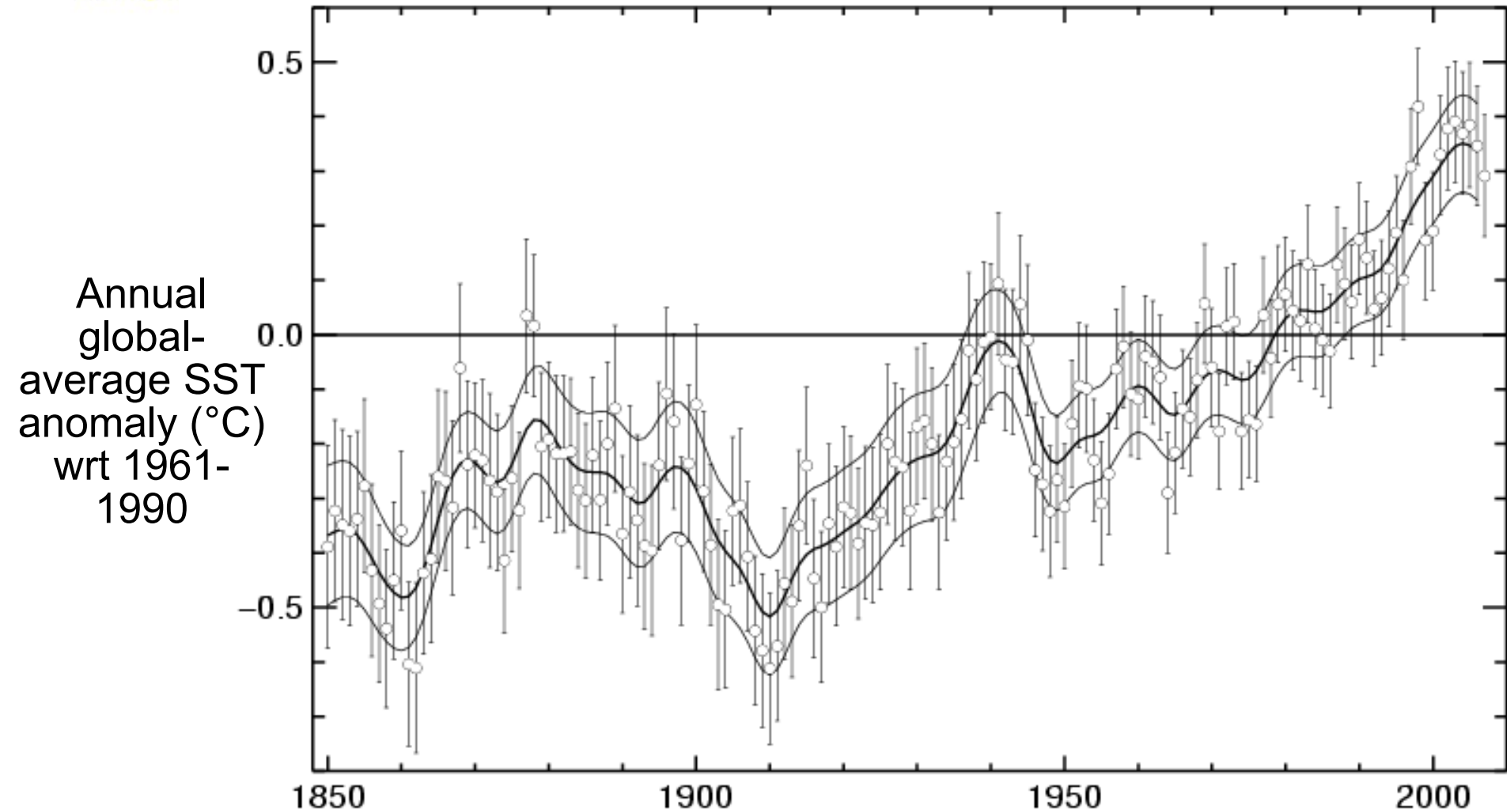
Met Office
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A bias corrected SST analysis from 1900 to the present

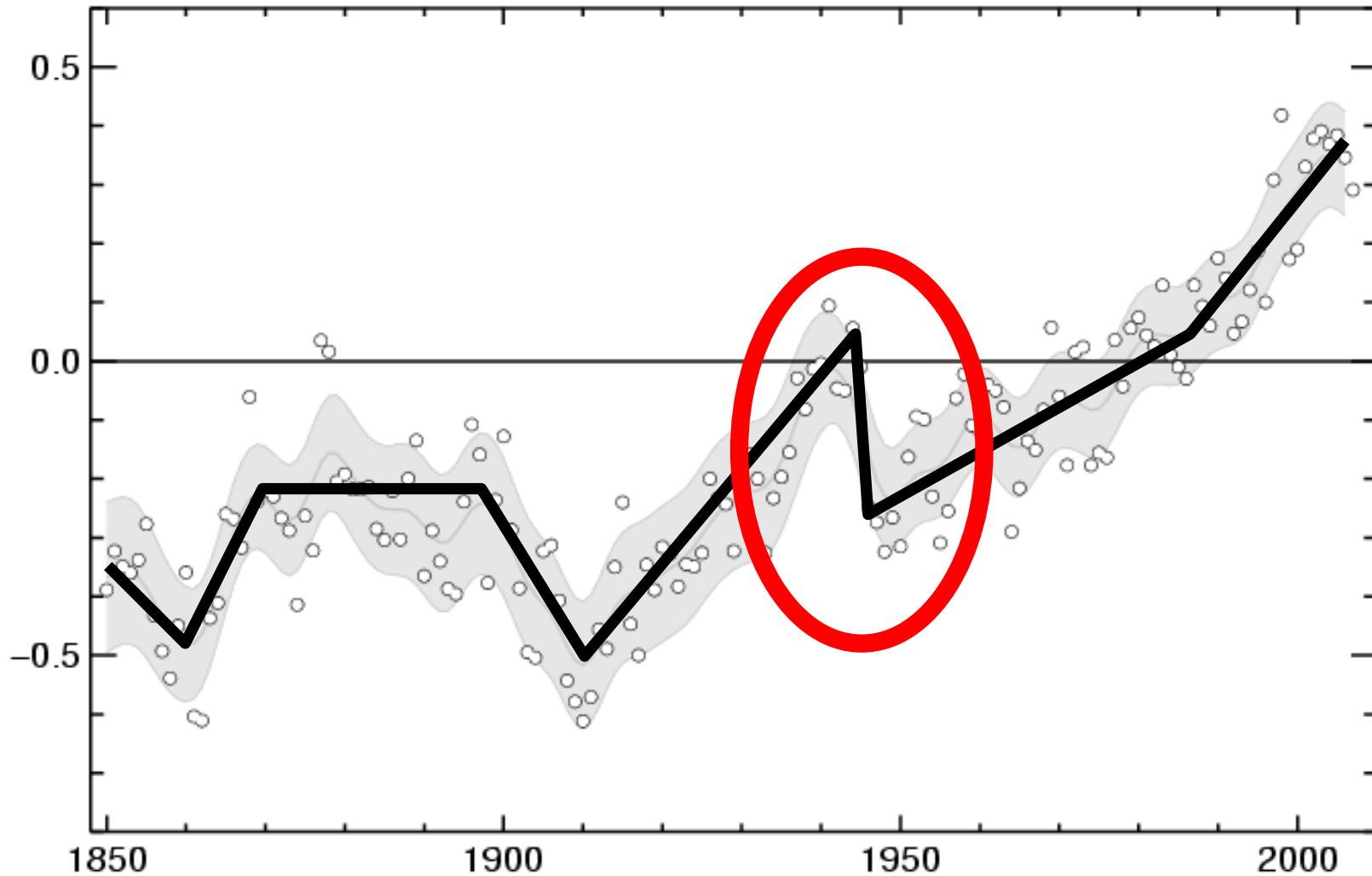
John Kennedy, Nick Rayner and David Parker

CLIMAR3 May 2008 Gdynia, Poland

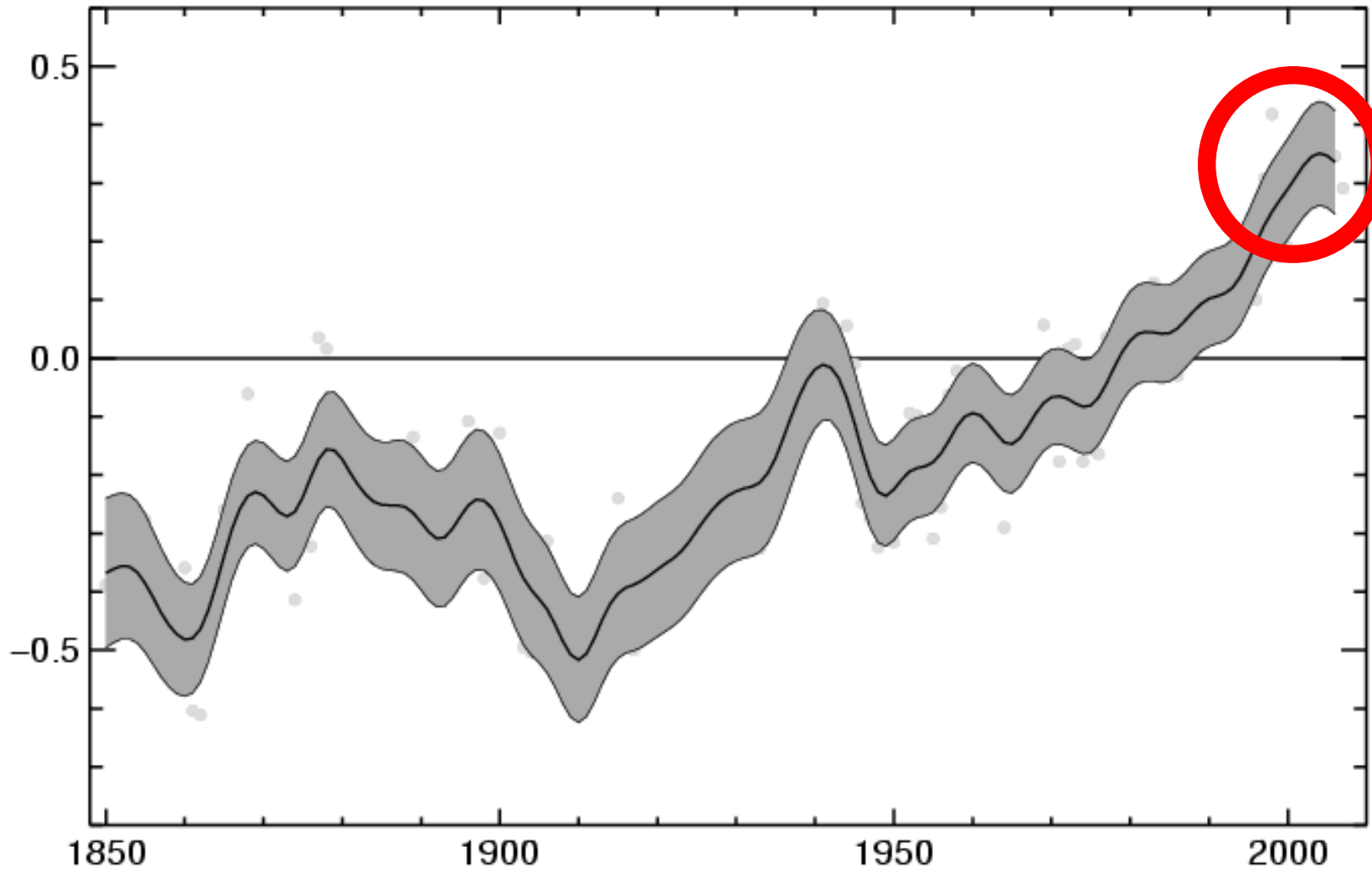
Global-average sea-surface temperature 1850-2008



Large drop in 1945/1946

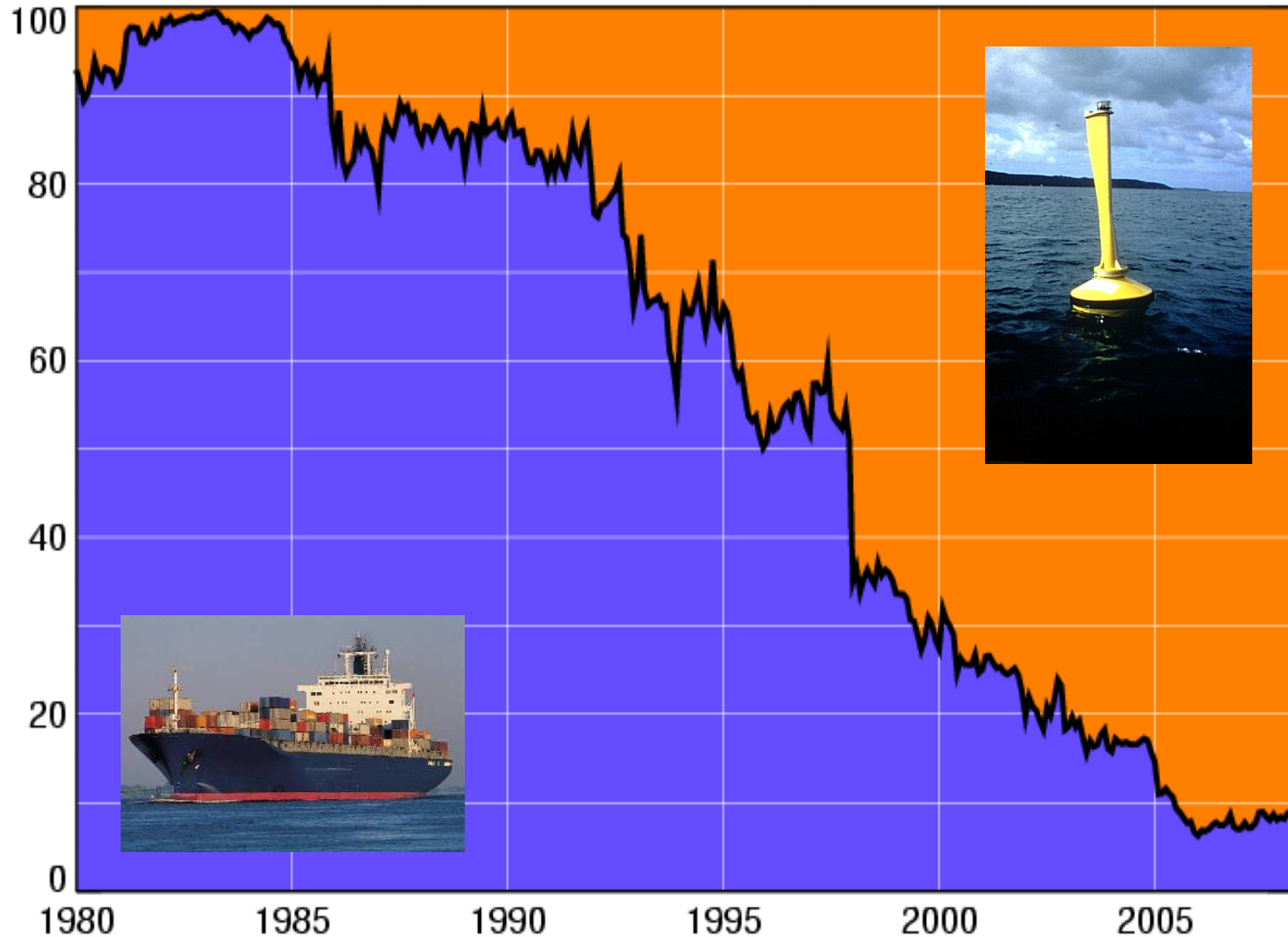


Slow down in recent warming



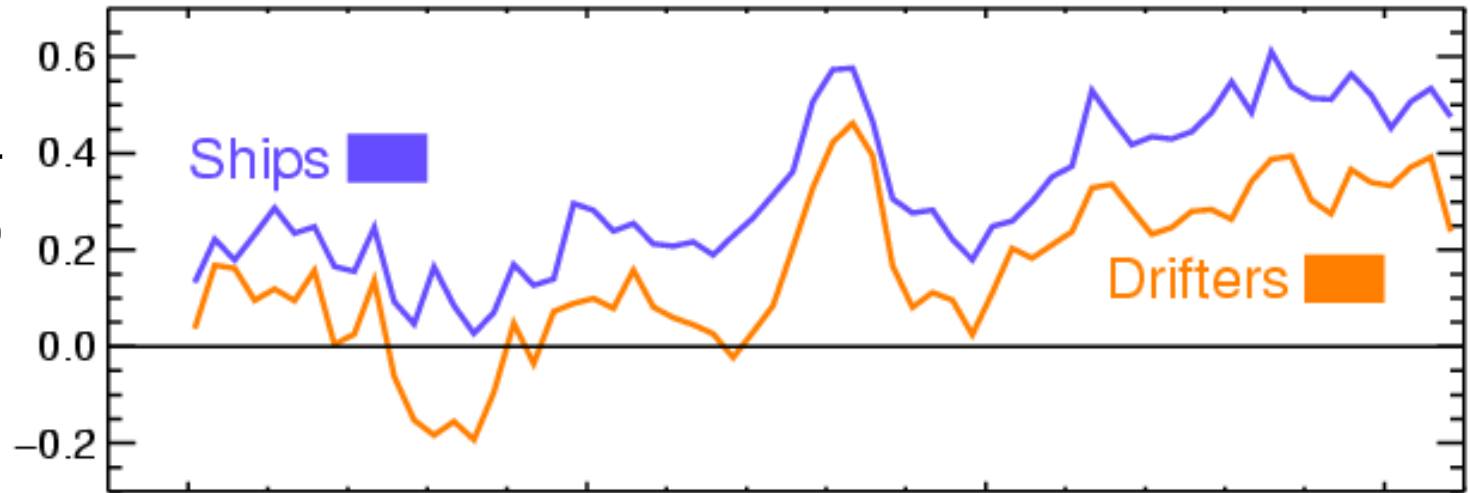
Huge change in observing network in past 25 years

Percentage of observations coming from
DRIFTERS
and
SHIPS

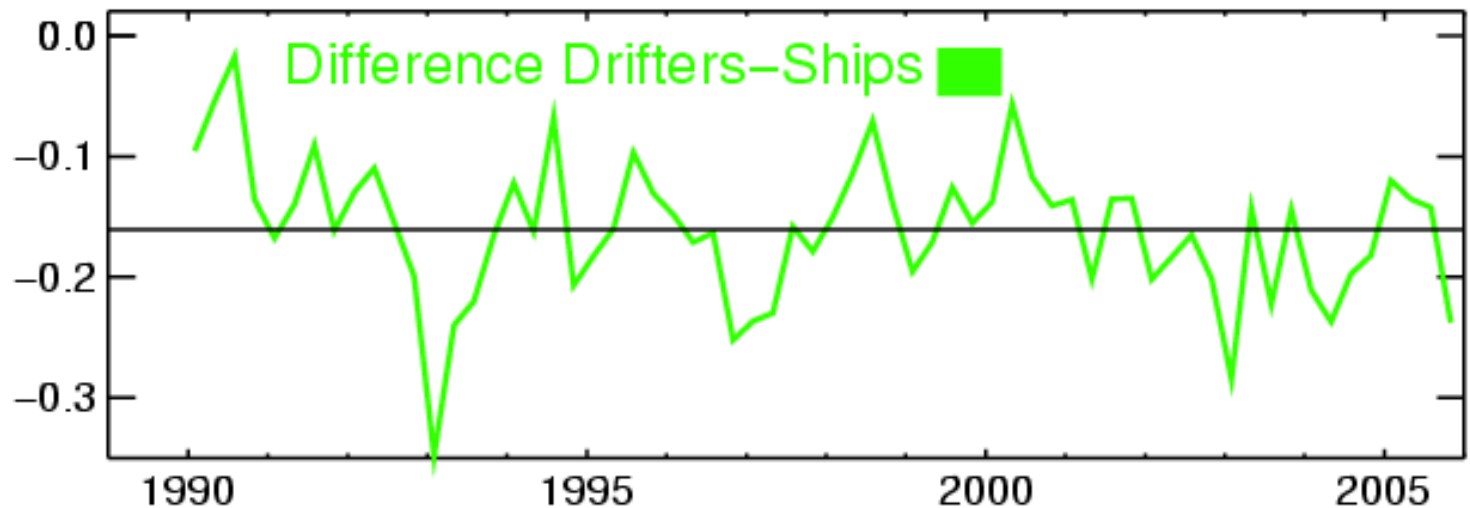


Drifters biased cold $\sim 0.16^\circ\text{C}$ relative to Ships

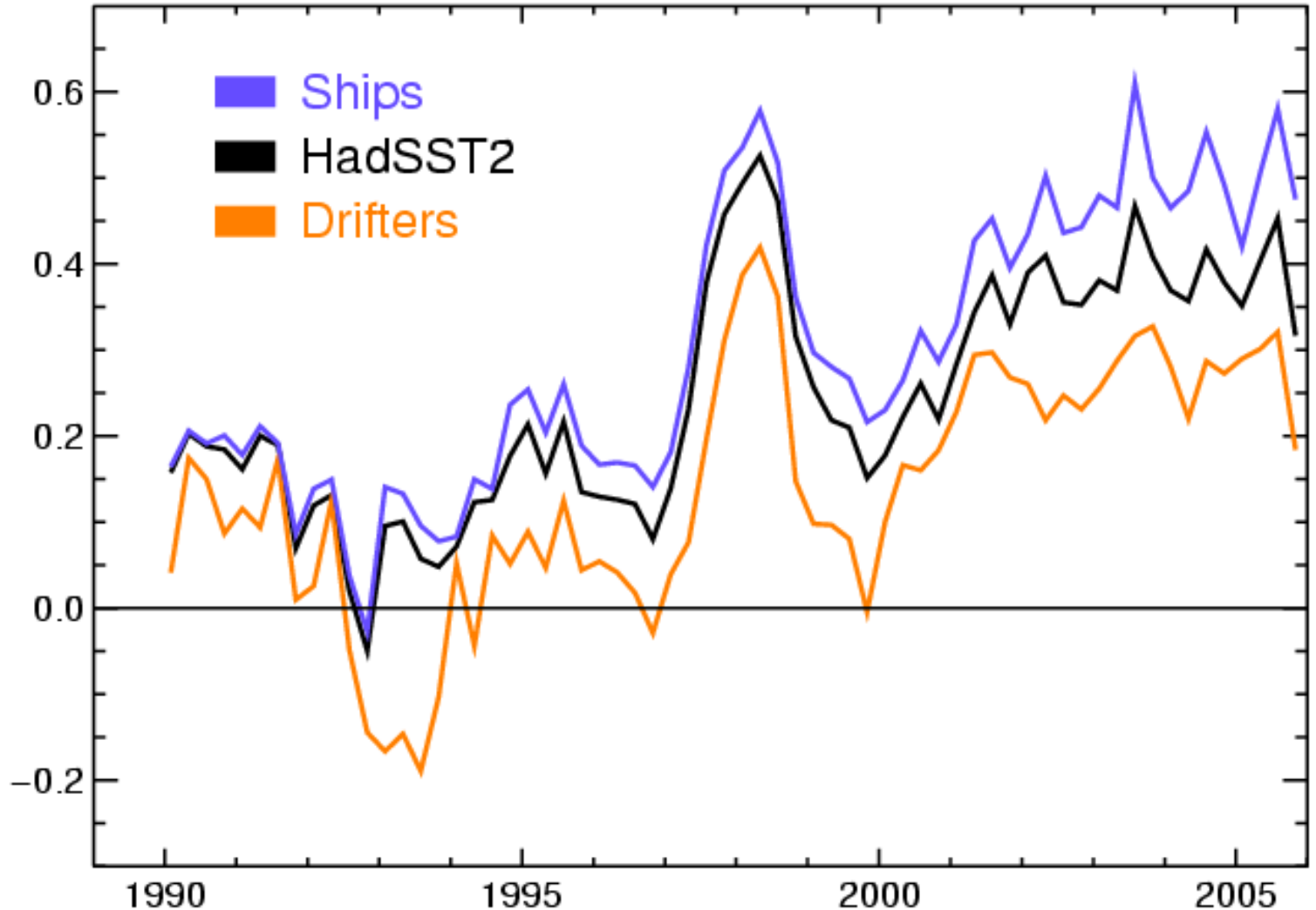
Global-
average SST
anomaly ($^\circ\text{C}$)
wrt 1961-
1990



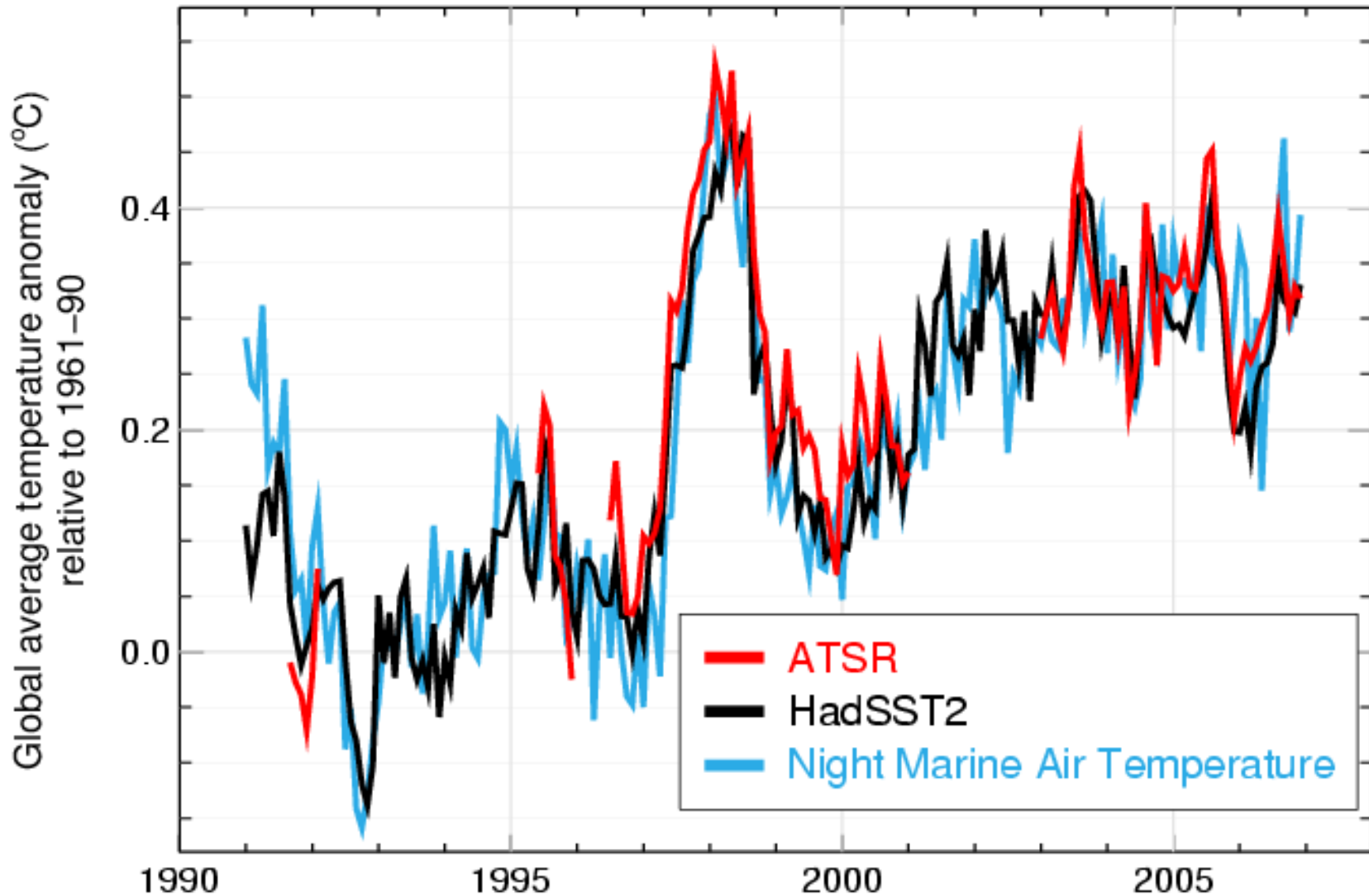
Global-
average SST
difference
($^\circ\text{C}$)



Drifters cause significant cooling in global average SST



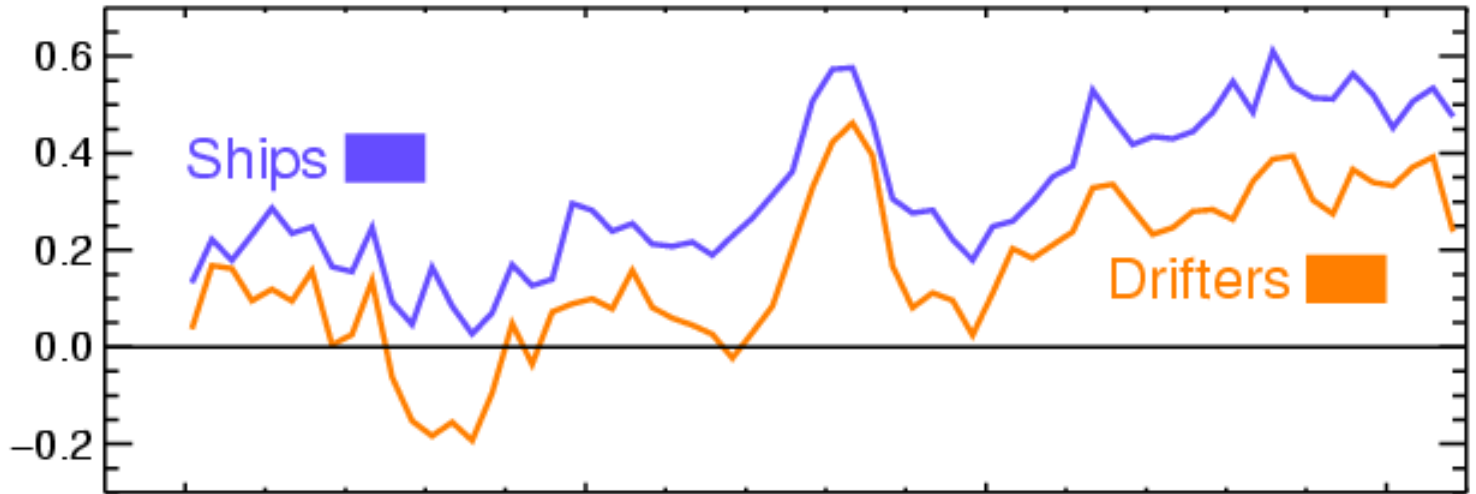
Puzzle: independent estimates agree with HadSST2



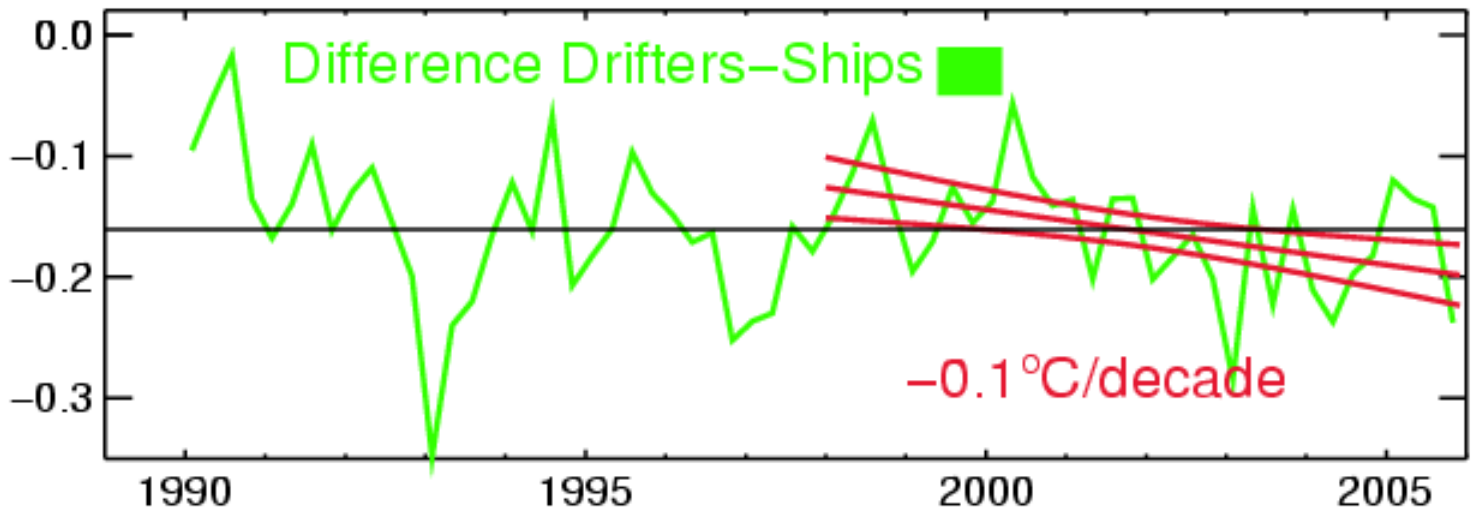


Ships warming faster than Drifters

Global-average SST anomaly ($^{\circ}\text{C}$) wrt 1961-1990



Global-average SST difference ($^{\circ}\text{C}$)





Ship measurement methods

1. Buckets

- Insulated/uninsulated
- Cool bias

2. Engine Room Intakes

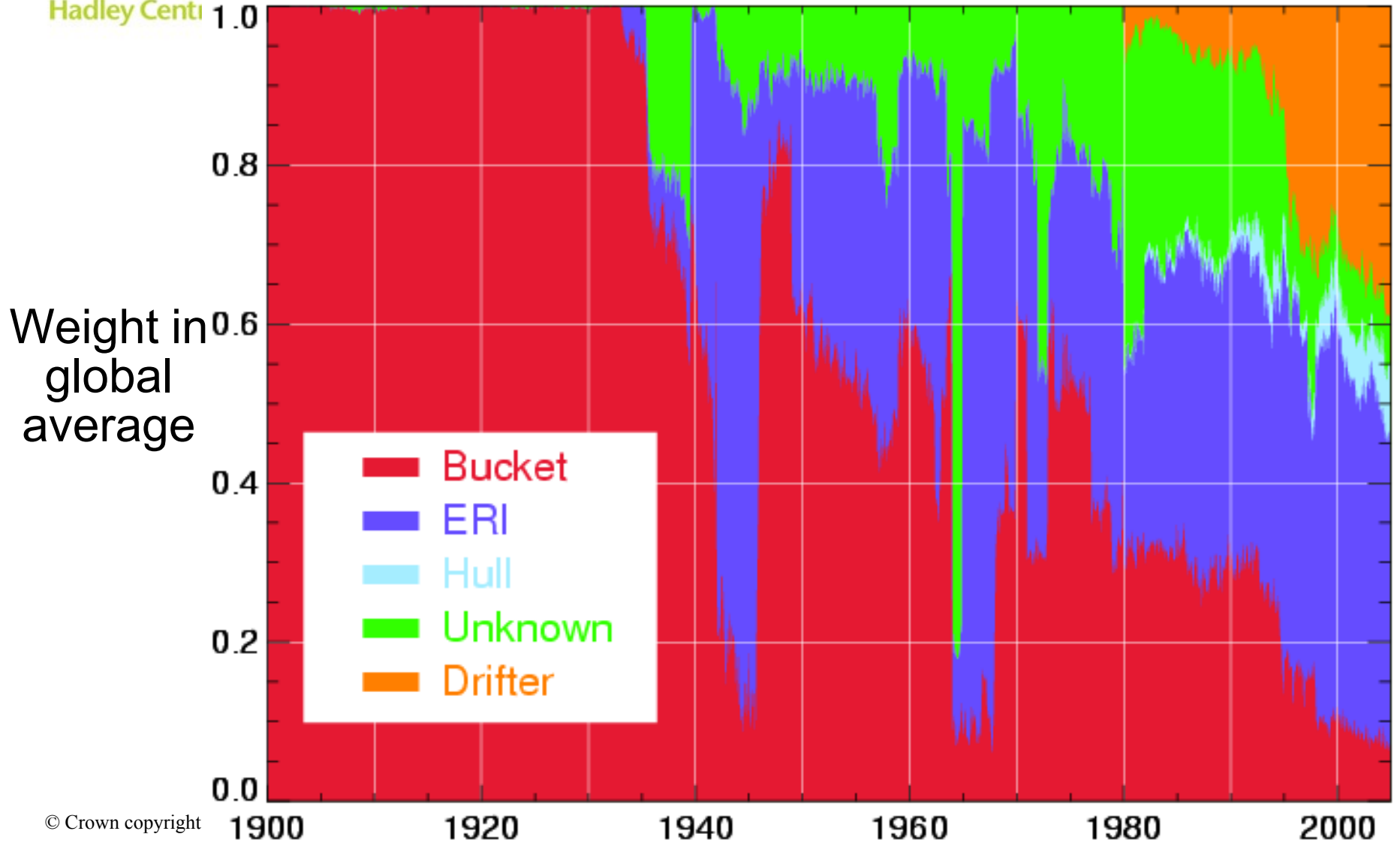
- Warm bias

3. Hull Sensors

History of measurement methods

- If there is a measurement method in ICOADS, use it
 - e.g. observation is 1.0 bucket
- If there is a measurement method in WMO Pub 47, use it
- Identify the Ship's country from Country ID in ICOADS or from the Deck number.
- If there is country information use that to infer the measurement method based on WMO Pub 47.
 - e.g. If country ID indicates ship is Japanese and WMO Pub 47 says that ships in the fleet were 70% ERI and 30% bucket then observation is 0.7 ERI and 0.3 bucket.

Time series of measurement methods

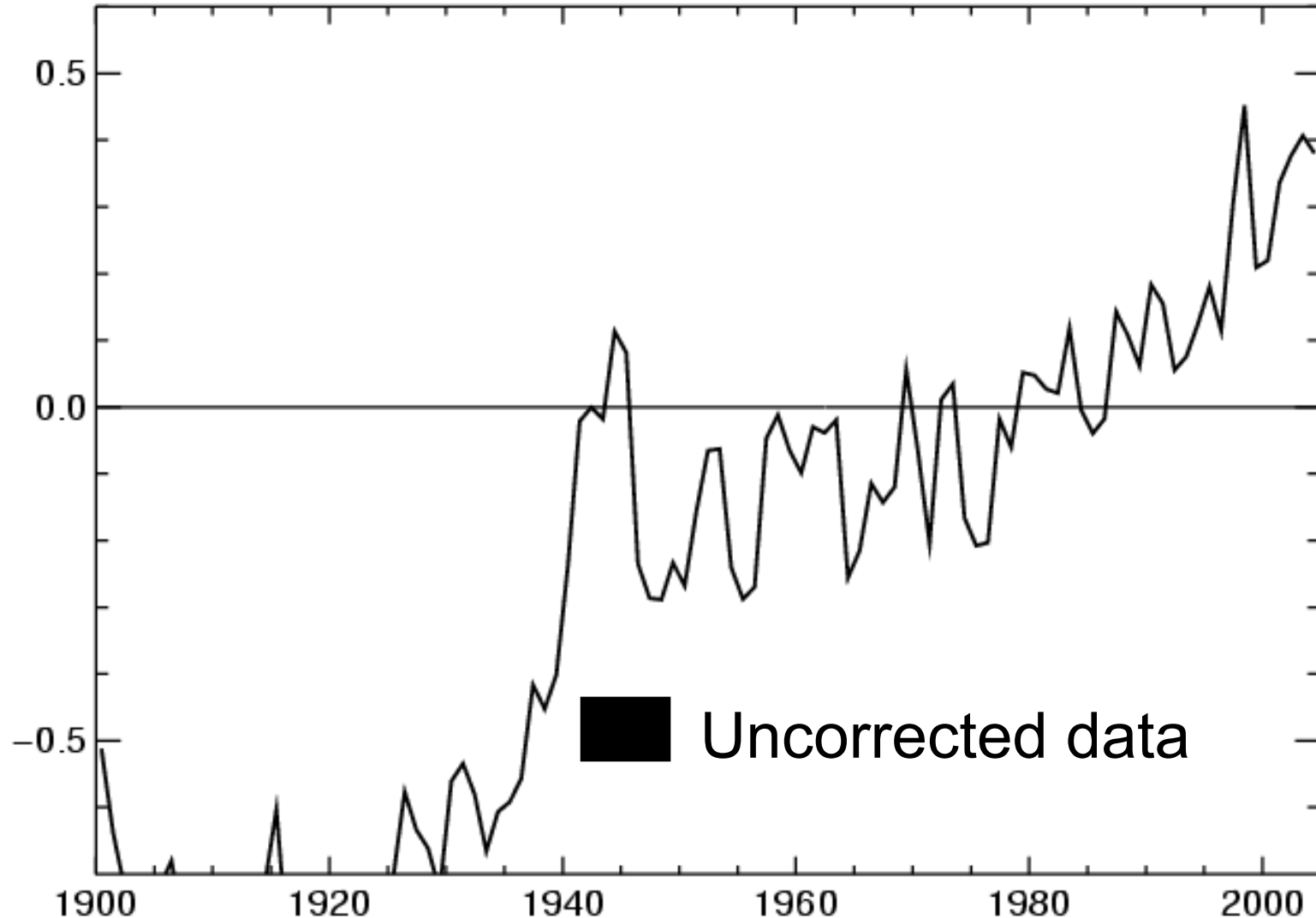


Some assumptions about the biases

- Assume buckets are all uninsulated till 1950 and all insulated by 1960, interpolating linearly between these
 - True for UK data based on Marine Observers Handbooks
 - May be untrue for other countries
- Use Folland and Parker 95 correction fields for insulated and uninsulated buckets
- Assume Engine Room Intake bias is +0.2K throughout
- Drifters are biased cold by 0.17K relative to ships in the modern period.

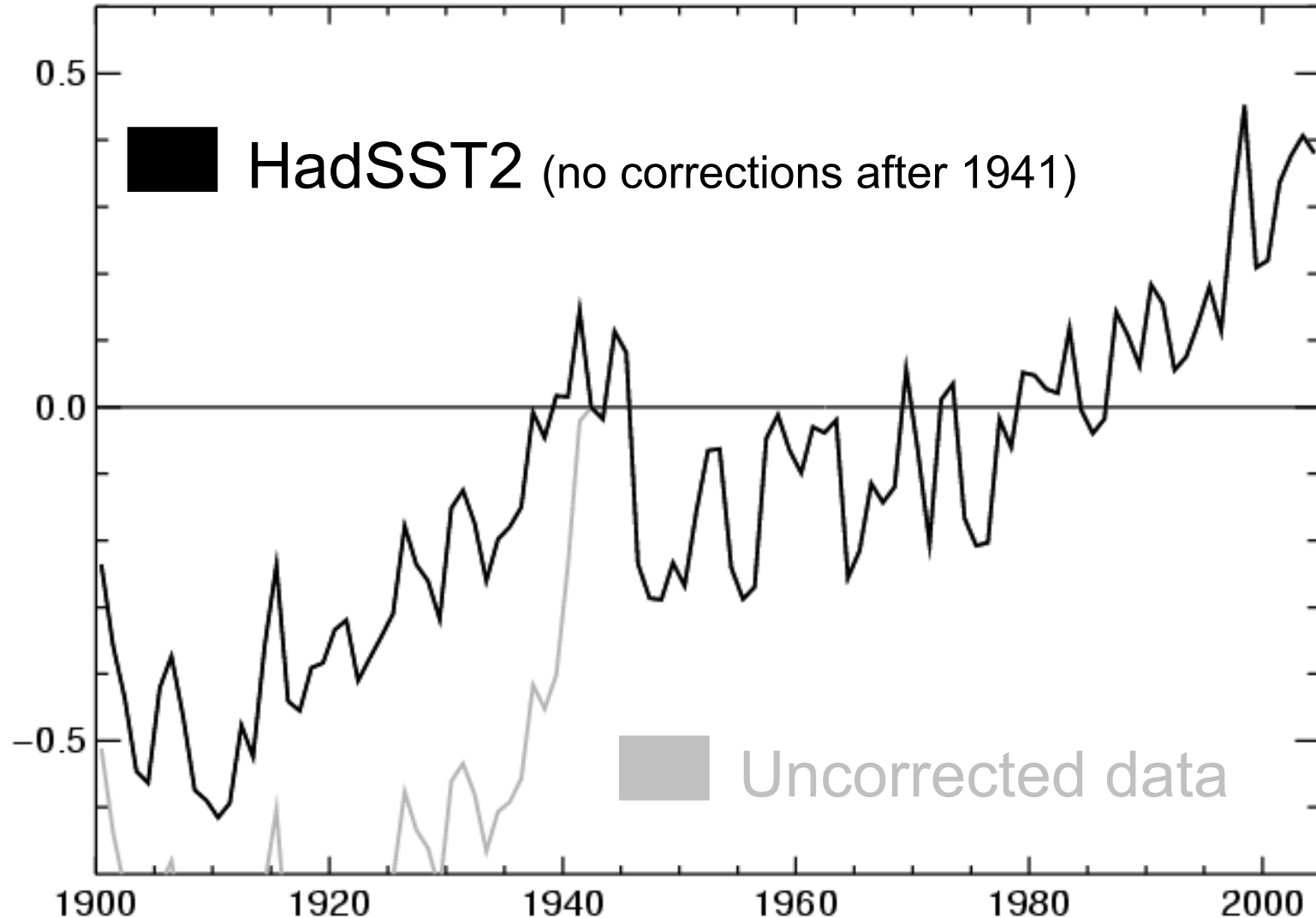
What does the corrected series look like?

Global-
average SST
anomaly ($^{\circ}\text{C}$)
wrt 1961-
1990

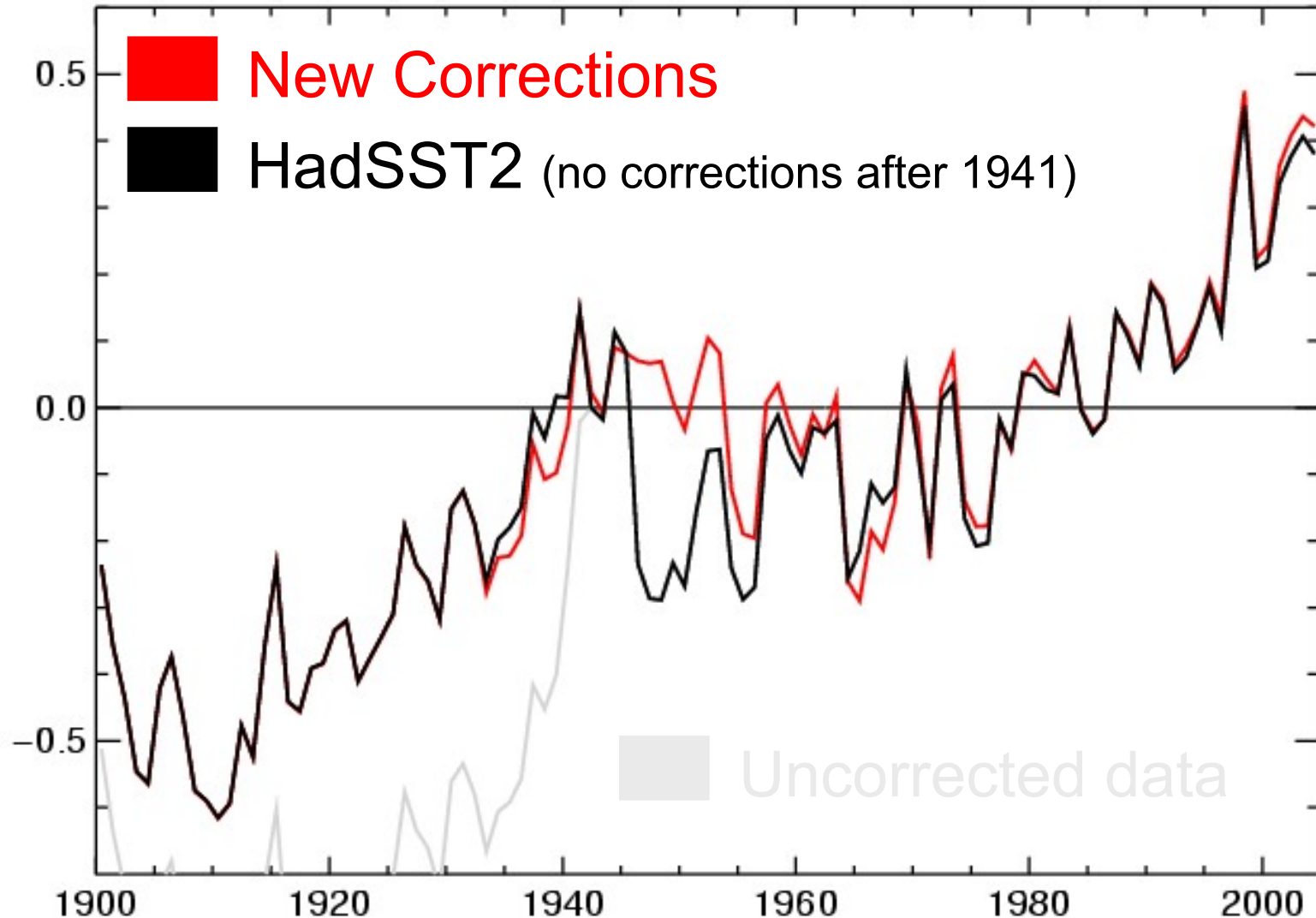


What does the corrected series look like?

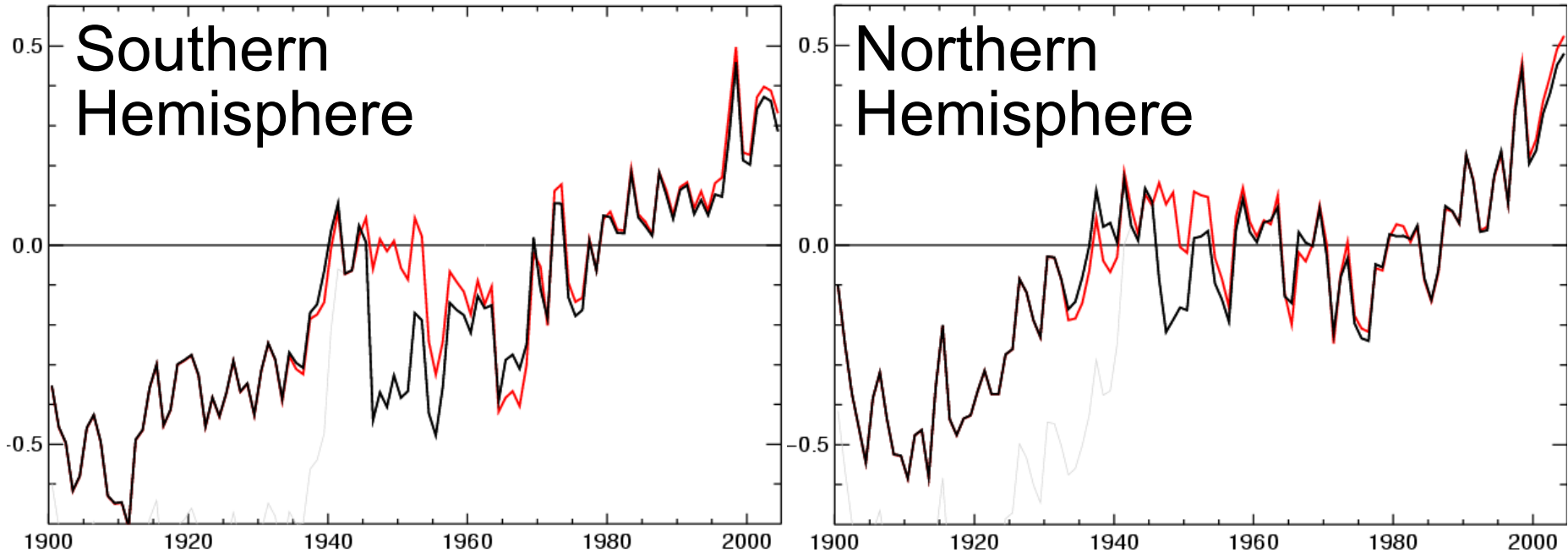
Global-
average SST
anomaly ($^{\circ}\text{C}$)
wrt 1961-
1990



What does the corrected series look like?



Corrections 'work' for other regions



- Corrections larger in Southern Hemisphere $\sim 0.45^{\circ}\text{C}$
- Smaller corrections in Northern Hemisphere.
- The same method can be applied at any scale, even grid box by grid box

How wrong could the corrections be?

- Engine Room Intake bias not constant in time, or space
 - e.g. Kent and Taylor 2006
 - Unclear what happened during the war
- Time history of bucket change from uninsulated to insulated is uncertain
 - Evidence for UK, but not other countries.
 - Timing is important for 1945-1965 period
- Assignment of measurement method is uncertain
 - An observation can't be 0.3 bucket + 0.6 ERI + 0.1 Hull contact
- Validate corrections using new version of ICOADS



Summary

- Generated Time history of measurement methods and bias corrections
- Increase of drifting buoy numbers may offset recent warming slightly...
- ...but effect is likely being countered by increasing warm bias in ship data.
- Drop in late-1945 due to shift from ERI measurements to bucket measurements.
- New data will be used to validate corrections



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Questions and answers