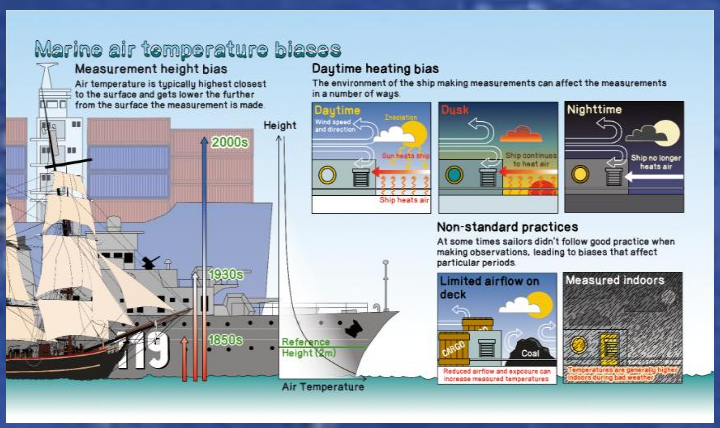
Quantifying Bias and Uncertainties in Historical Land-Ocean Temperature Records

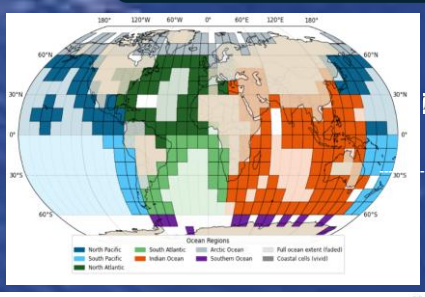
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University of York, University of East Anglia, UK Meteorological Agency.

Introduction



Having a reconstructed MAT record from the 18th century could help us better understand the pre-industrial climate conditions and provide more evidence on how much or less of anthropogenic fingerprints is seen in historical and modern climate conditions. This is crucial for the Paris Agreement.
Additionally, extending temperature records further into the 18th century could help us explain the role of volcanic eruptions in global climate in the 19th century.

Methods

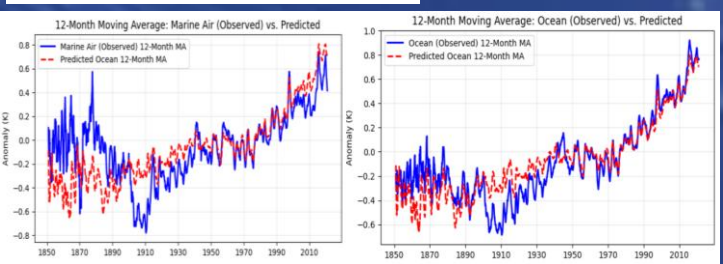


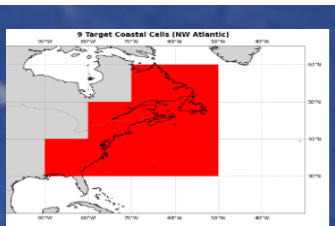
$$To = e_1 \otimes f \quad \text{---------- (1)}$$

$$Ts = \frac{1}{A} e_2 \otimes f \quad \text{---------- (2)}$$

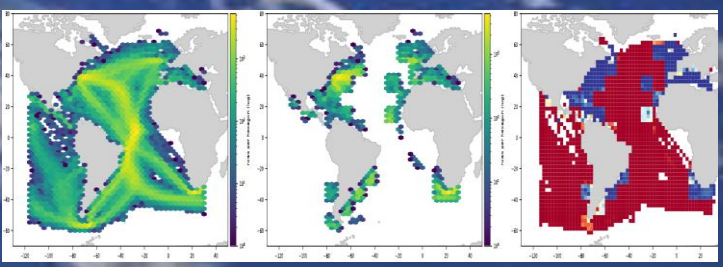
$$T_o = Ae_1 \otimes (e_2^{-1} \otimes f) = A(e_1 \otimes e_2^{-1}) \otimes f \quad \text{----- (3)}$$

A hybrid LAT-SST prediction model was developed using coastal and island cells from the both temperature datasets.





A decadal spatiotemporal global map of the AR(1) significance difference between the coastal cells in the SST and MAT led to the identification of some persistent signals.



T1	SST – MAT		
T2	MAT – Pred		
T3	SST – Pred		

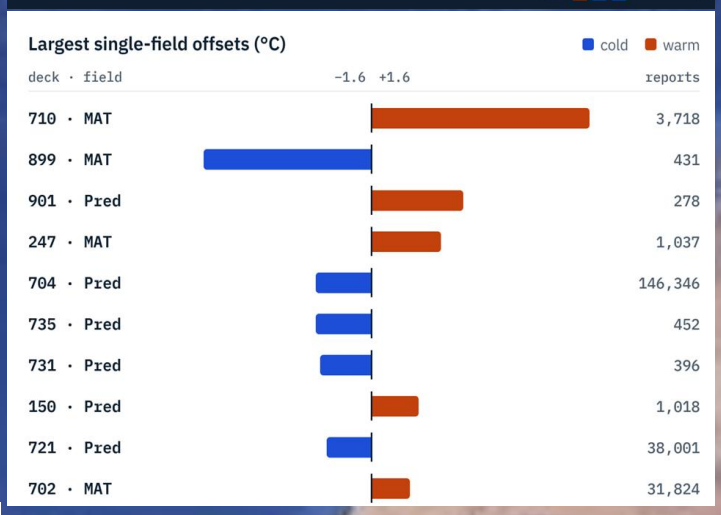
T3 = T1 + T2

	T1 SST–MAT	T2 MAT–Pred	T3 SST–Pred
MAT	–	+	
SST	+		+
Pred		–	–

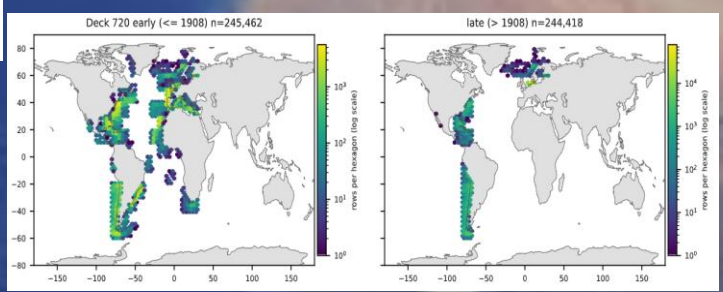
Historical ships report comes in groups called decks. Each deck may carry its own instrument or measuring technique habits. For each deck, a regression on a single deck indicator controls for latitude, longitude, season, wind, cloud, dew point, air temperature and SST.
A regression coefficient counts as large when it is significant and at least 30% of the larger of the other two. The two large coefficients and their signs name the target field.

Preliminary Results









Further Directions

- Assign each ship/platform ID to subsets to restrict bias in similar decks. Only ~ 63% of my dataset currently have IDs. My next step is to find a way to fill in ID for ships without one.
- Create a regional class for the decks/ships. Just as an era change can reveal a change in bias in compound deck/SID, so could a region?
- Apply the more rigorous bootstrap method for uncertainty quantifications.

References

1. Chan, D., Gebbie, G. and Huybers, P. (2023). Global and Regional Discrepancies between Early-Twentieth-Century Coastal Air and Sea Surface Temperature Detected by a Coupled Energy-Balance Analysis. Journal of Climate, 36(7), pp.2205–2220. doi:https://doi.org/10.1175/jcli-d-22-0569.1.
2. Kennedy, John; Kent, Elizabeth; Becker, Amani (2025). Illustration of some sources of bias in observations of marine air temperature. figshare. Figure. https://doi.org/10.6084/m9.figshare.28046009.v2