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Global monthly sea surface temperature and sea ice reconstruction for historical simulations

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Variability in Sea Surface Temperature (SST) is one of the prime sources of intra-annual variability, and also an important boundary condition for Atmospheric General Circulation Models (AGCMs). In many AGCM simulations, SST and Sea Ice Concentration (SIC) are prescribed. While SSTs are specified according to observations available in recent period of instrumental records (1850 – present), SIC depends on climatological averages with less variability prior to the inception of satellite measurements. This limits our understanding of large-scale climate variations in the past.

In this study, we augment multi-proxy reconstructed annual mean temperature of Neukom et al. (2019) with intra-annual variability from HadISST (v2.0), for 850 years (1000 – 1849). Intra-seasonal variability, such as the phase-locking of El-Nino Southern Oscillation, Indian Ocean Dipole and Tropical Atlantic SST indices to annual-cycle, are utilized. The intra-annual component of HadISST and SST indices estimated from the multi-proxy reconstructed annual mean, are used to develop grid-based multivariate linear regression models using the Frisch-Waugh-Lovell theorem, in a monthly stratified approach. Furthermore, we introduce a scaling technique to ensure homogeneous mean and variance, similar to that of the target. SST observations obtained from ship measurements by ICOADS before 1850, will be integrated in an off-line data assimilation approach.

Similarly, we reconstruct SIC via analogue resampling of HadISST SIC (1941 – 2000), for both hemispheres. We pool our analogues in four seasons, comprising of 3 months each, such that for each month within a season, there are 180 possible analogues. The best analogues are selected based on correlation coefficients between reconstructed SST and its target.