Understanding and reducing seasonal prediction errors of the ECMWF system in the tropical Indian Ocean

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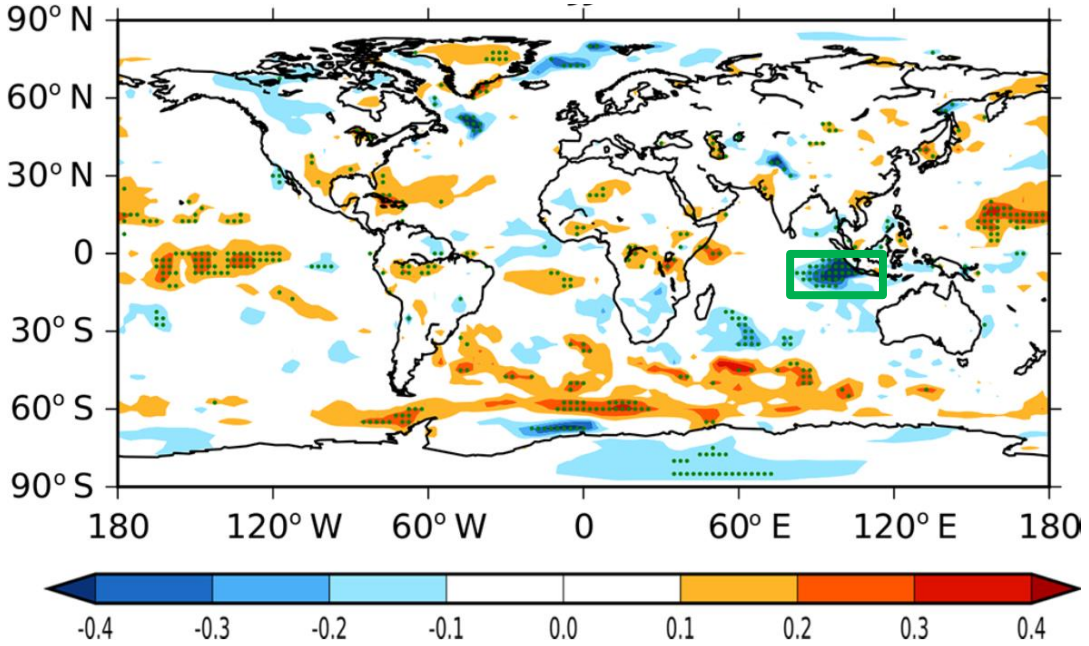
Motivation

- SST prediction skill in Eastern equatorial Indian Ocean (EEIO) highly relevant for global forecasts through teleconnections
- Recent skill reduction in EEIO motivated assessment of forecast errors
- Region of strong ocean-atmosphere coupling
  → look at relationships between SST and atmospheric quantities in coupled and uncoupled mode
  → look at subsurface errors
  → inter-model comparison

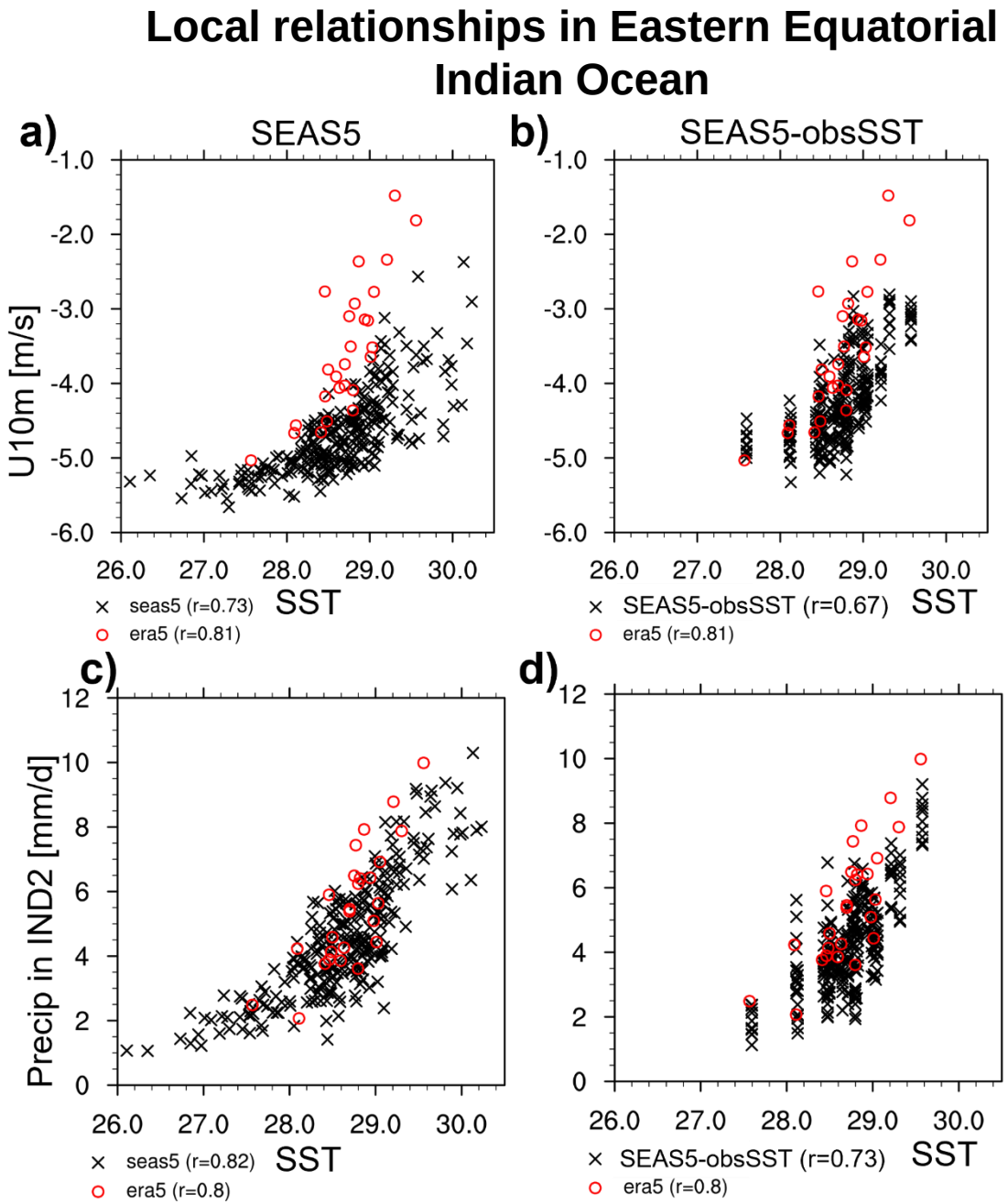
Difference in SST forecast skill in JJA between SEAS5 and SEAS4



From Johnson et al. (2019)

Wind-SST relationships

- Easterlies too strong for a given SST
- Too weak response of winds to a warm SST perturbation
- Local precipitation response to SSTs only slightly underestimated
- Wind response in uncoupled mode only modestly improved



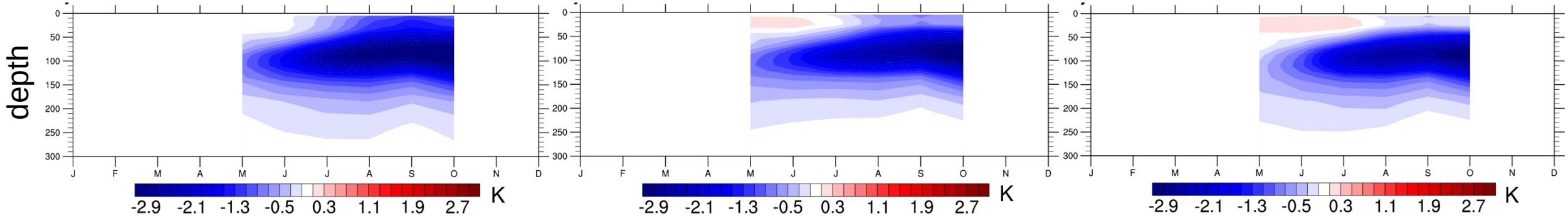
Subsurface temperature biases in EEIO

May start dates 1993-2016
(reference data: Hadley EN4)

Operational SEAS5

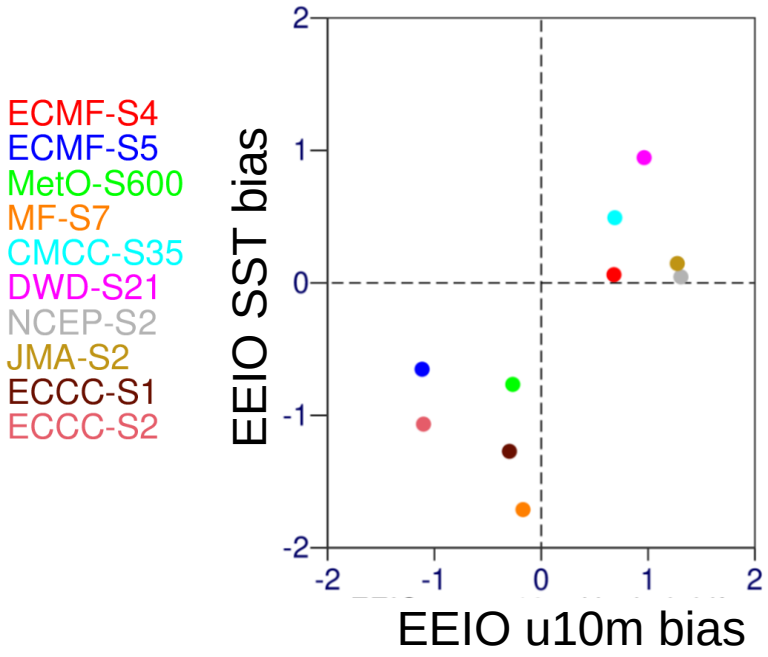
Low-resolution SEAS5

Low-resolution SEAS5 init. from previous ocean reanalysis



- Cold thermocline bias from lead month 1, which subsequently strengthens with lead time
- Dependent on resolution and model version how strongly it impacts the surface

Wind-SST error relationships in C3S systems



- Clear relationship between u10m wind drift and SST drift across different C3S systems
- Eastern equatorial Indian Ocean is a region with strong coupling that needs a well-balanced model and initial conditions

Further reading:

M. Mayer, Balmaseda, M., Johnson, S., et al. 2022: Outcomes from UGROW-IO: Forecast errors in the Eastern Indian Ocean across lead times ECMWF Technical Memorandum 898

Johnson, S. J., et al..: SEAS5: the new ECMWF seasonal forecast system, Geosci. Model Dev., 12, 1087–1117, https://doi.org/10.5194/gmd-12-1087-2019, 2019.

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