ECMWF update

WGSIP 22

Stephanie Johnson representing the Earth System Predictability Section

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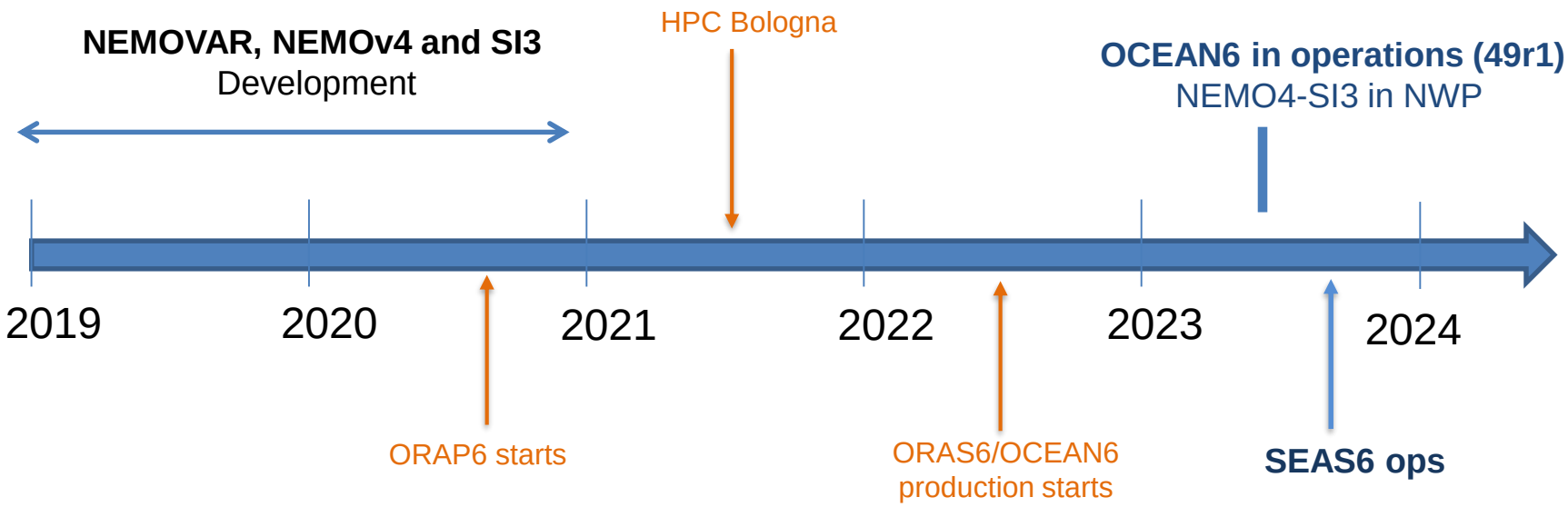
ECMWF

Upgrades coming to operational systems: timeline



Extended range

L137 and single precision expected in 2021 (Cy47r2)

Change in real-time configuration expected in 2022 (Cy48r1)

Long range

SEAS5 will remain operational until OCEAN6 is ready in 2023

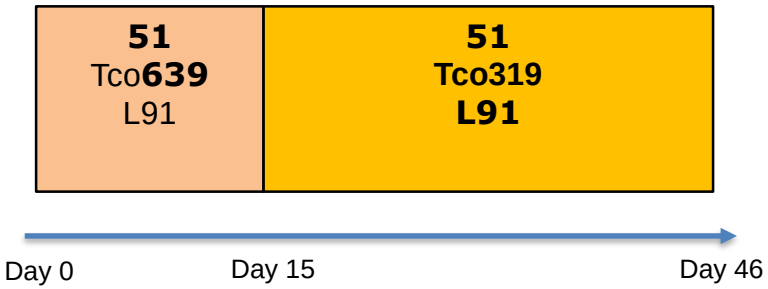
SEAS6 will include Nemo4/SIC, ERA5/OCEAN6 initialization for reforecasts, L137 and single precision

Thanks to M.A. Balmaseda

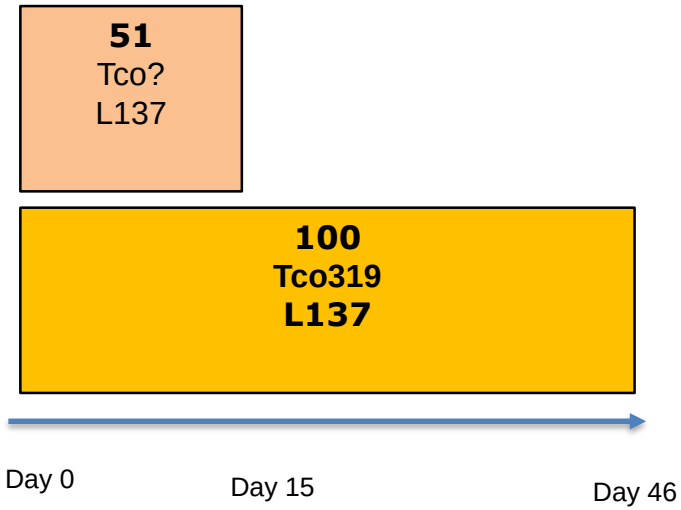
ECMWF

Upgrades coming to operational systems: extended range

Current configuration



Next configuration

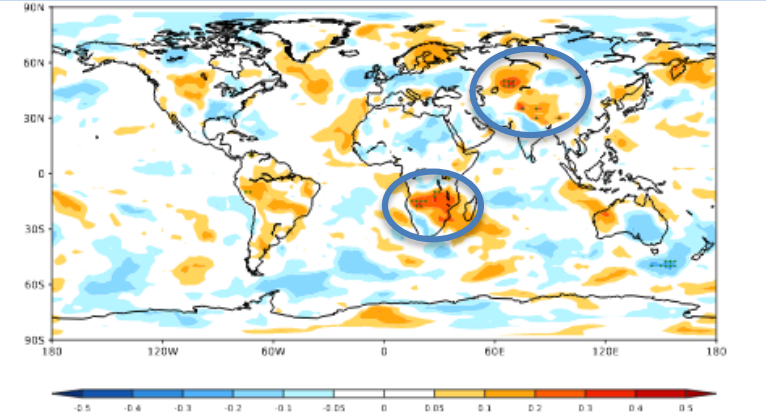


- **Increasing ensemble size:** Positive impact on ensemble forecast performance. Better representation of the tail of the ensemble distribution which should lead to improved extreme event products.
- **No increase of horizontal resolution**: No statistically significant positive impact beyond week 1, including on sources of extended-range predictability such as the MJO. Metis experiment (Tco1279 runs) also show lack of improvement after week 1.
- **Starting from day 0**: more flexibility for re-forecast configuration, no resolution jump at day 15 and possibility of **dual resolution medium-range ensemble (150 members) at 00Z.**

Thanks to F. Vitart

Upgrades coming to operational systems: long range (SEAS6)

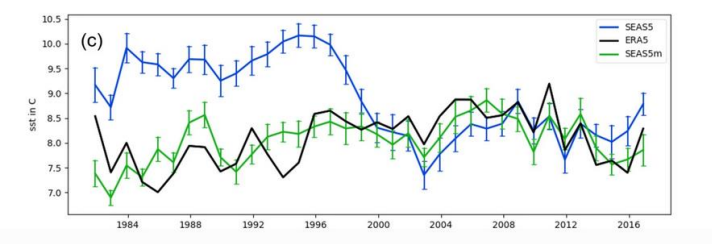
ERA5 Initialization



JJA Change in 2mT CRPSS

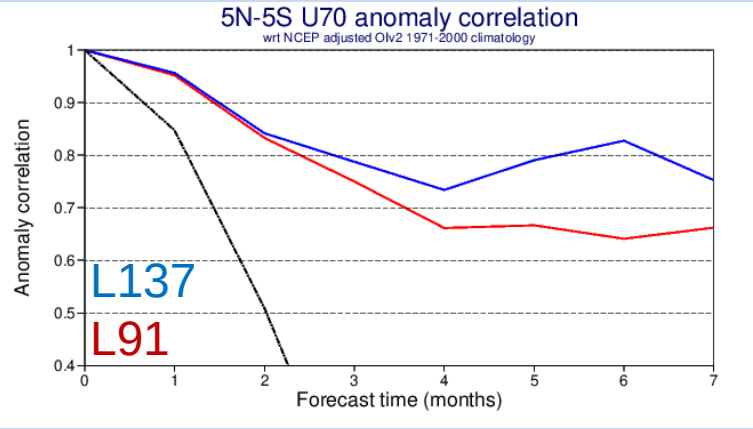
Local improvements in 2m T skill due to ERA5 initialization.

OCEAN6 - Nemo4/SI3



Including multicategory sea ice and fix to decadal variability in North Atlantic (Tietsche et al. 2020).

Improved stratosphere



Many model developments including increasing vertical resolution to 137 levels give improvements in stratosphere temperature biases and QBO.

- H2020 Confess (collaboration with Meteo-France, VUA, BSC) to contribute:
  - Time-varying land cover/use and improved tropospheric aerosols (ready for 49r1 and SEAS6)
  - Improved time evolution of volcanic aerosols and investigate parameterization of real-time eruptions (implemented if ready)
  - Prognostic vegetation and fire ignition (unlikely to be ready for SEAS6)

Research on earth system predictability

Initialization and Modelling

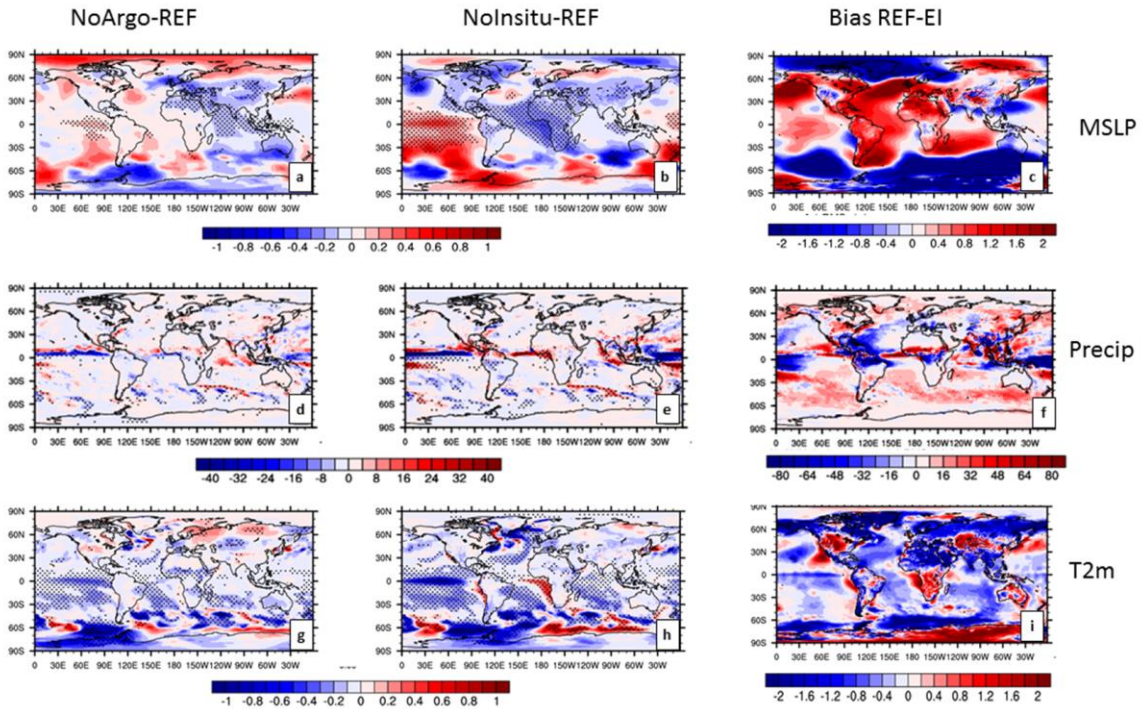
- Ocean/Sea-Ice modelling
  - Nemo4/SIC3 development
  - Ocean analysis data denial experiments
  - Experiments assimilating new variables such as level 3 SIC
- Impact and evolution of biases across timescales
  - Impact of mid-latitude SST fronts and biases
  - Eastern Indian Ocean biases
  - Stratosphere
- Time evolution of stratospheric ozone

Predictability

- Teleconnections: sources and pathways
  - Tropical to extratropical
  - Polar to midlatitude
  - Stratosphere to midlatitude
- Attribution of subseasonal/seasonal anomalies
  - Case study of DJF 2019/2020
- Predictability out to two years
  - Cross basin interactions
- Interaction across timescales
  - Daily weather statistics in the sub-seasonal and seasonal forecast systems
  - Decadal modulations of seasonal forecast skill

Impact of ocean observations on S2S

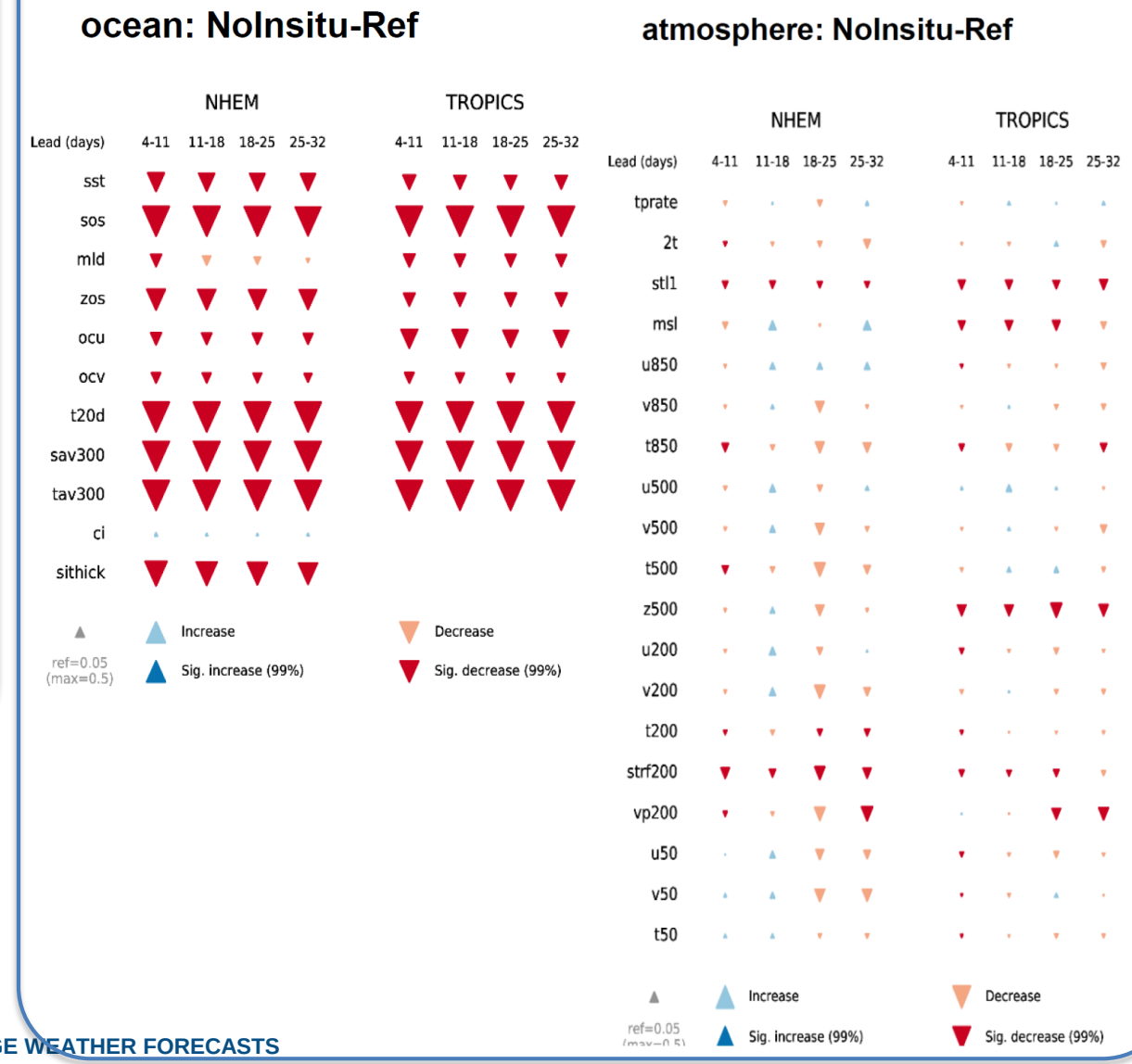
Seasonal Forecasts



Difference in JJA from seasonal forecasts initialized in May (2005-2015)

Ocean observations affect the forecast atmospheric circulation, via fast mixed layer processes, and slower equatorial dynamical processes.

Extended Range Forecasts

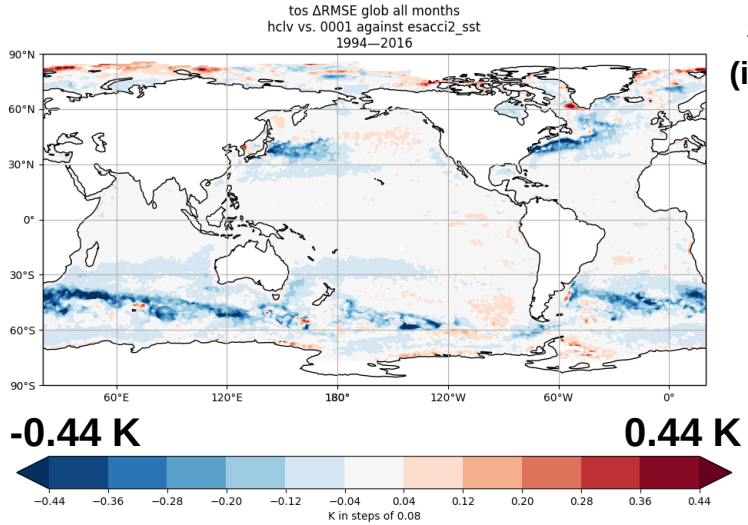


M.A. Balmaseda, M. Mayer, B. Balen-Sarojini

Hybrid ocean initial conditions for predictability research

- **Aim:** to quantify the relative importance of (i) initial condition errors/uncertainties and (ii) model formulation for the evolution of SST biases and forecast skill. Particularly interested in Gulf Stream separation (Roberts et al. 2020).
- **Approach:** Create “hybrid analysis” ocean initial conditions suitable for coupled IFS experiments (ORCA1 and ORCA025) from 4 different CMEMS ocean reanalysis products including reanalysis at higher resolution than ORAS5.
- **Hybrid initialization method**: run NEMO ocean model with ECMWF surface forcing and a strong constraint towards evolving 3D state of another ocean reanalysis.
- **Result**: Preliminary analysis indicates that modified initial conditions derived from a higher resolution analysis can improve SST forecasts, but the impact depends on location/season. Evaluation of atmospheric impact is ongoing.

ORCA025 NEMO constrained by 1/12th degree Glorys12 reanalysis vs ORAS5 (ΔRMSE)



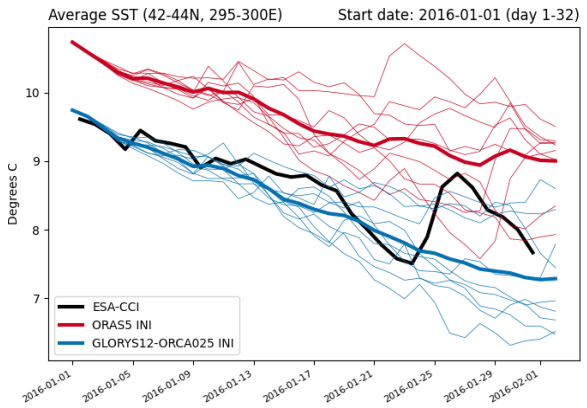
SST vs ESA CCI (initial conditions)

BLUE = hybrid performs better than ORAS5

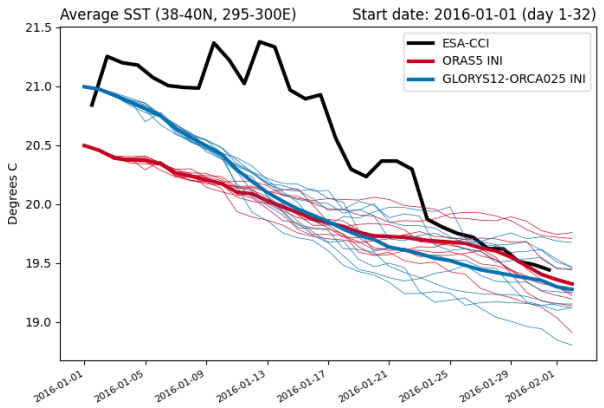
Plot from NVER

SST Forecasts

box North of Gulf Stream



box South of Gulf Stream



OBS HYBRID INI ORAS5 INI

C. Roberts

SEAS5-20C: Biennial (24-month long) hindcasts for the 20th Century with SEAS5

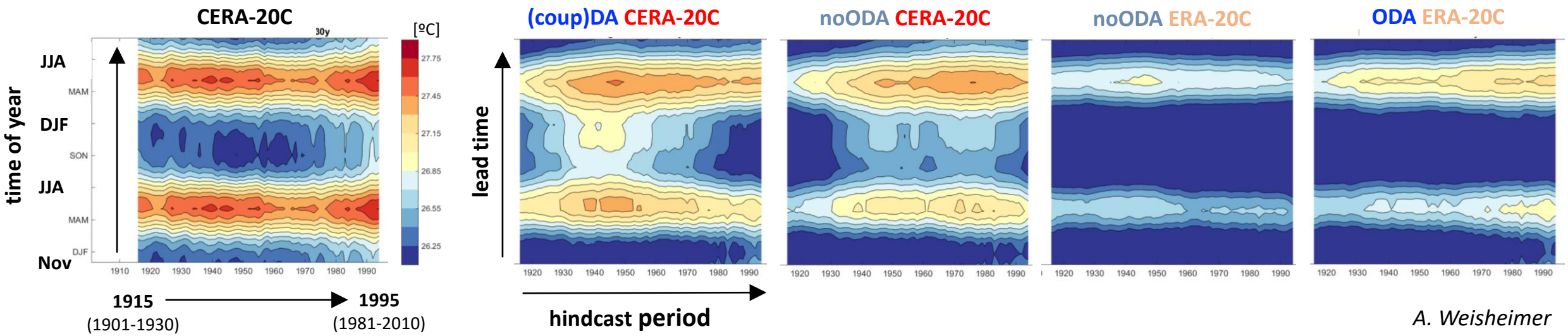
Motivation

- Can we predict ENSO beyond one year? Has the model climate converged after 2 years?
- How flow-dependent is the predictability of ENSO on seasonal to multi-annual timescales in the presence of multi-decadal climate variability?

Experiments

- Coupled hindcasts initialised from coupled 20th Century reanalysis CERA-20C from 1901 to 2010
- SEAS5 low-res model resolution: T_{co}199L91 (ca. 50km) with ORCA1Z42 (1 degree)
- 24-month forecasts with 10 ensemble members
- Additional experiments to test sensitivity to ocean initial conditions (impact of data assimilation and atmospheric forcing)

Nino3.4 SSTs (mean state) 1st Nov start dates



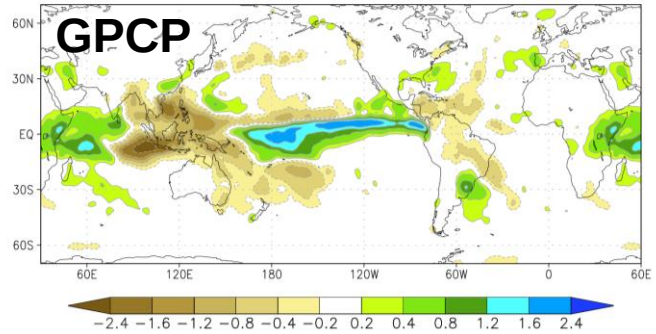
A. Weisheimer

Teleconnections from Indo-pacific warm pool to the extra-tropics

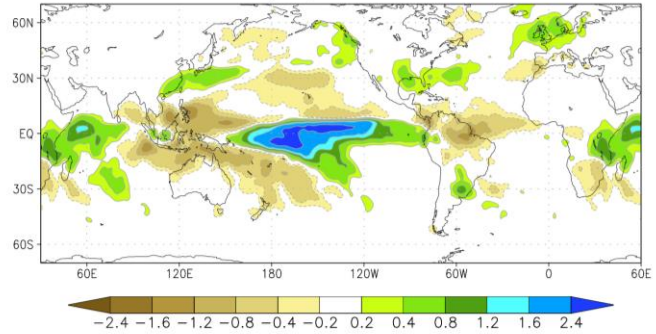
Influence of Autumn SSTs on winter predictability

Covariance with IOD

Rainfall Oct-Nov



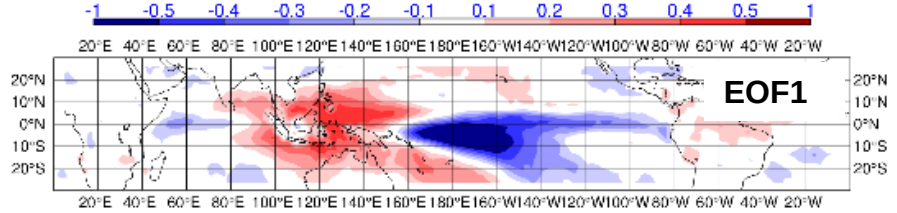
Rainfall Dec-Jan

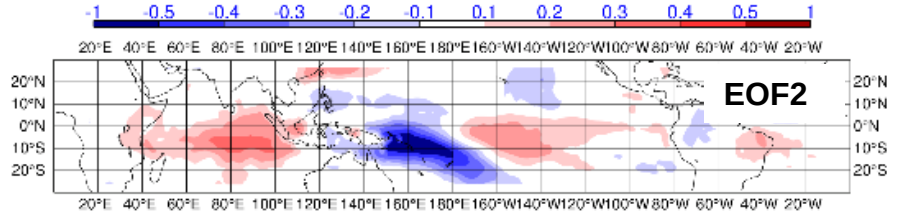


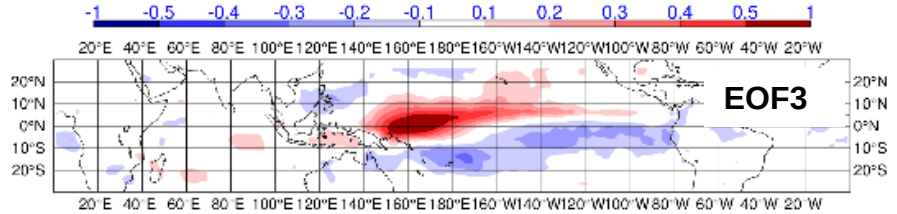
Precipitation anomalies from ON tend to persist into DJ. Work motivated by errors in teleconnections in the IFS (e.g. Molteni et al. 2015, Molteni et al. 2020).

F. Molteni

Interaction of subseasonal and seasonal teleconnections on the seasonal time-scale







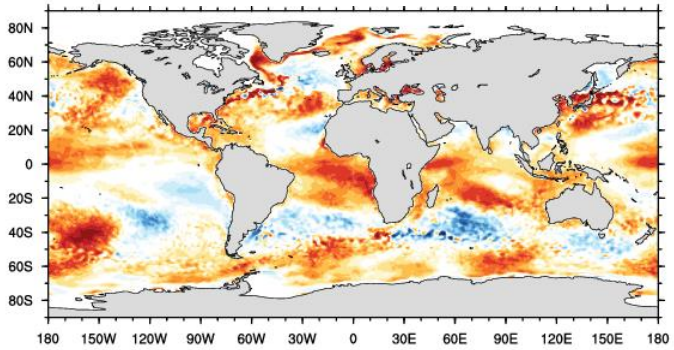
Using EOFs of JFM CMAP pentad tropical rainfall to understand the contribution of ENSO and MJO variability to seasonal-mean extra-tropical teleconnections.

S. Johnson and L. Ferranti

Attribution experiments DJF 2019/2020

SEAS5-ObsSST experiments forced by ERA5 SST with SST anomaly removed (i.e. SST replaced with ERA5 climatology) in the different tropical ocean basins.

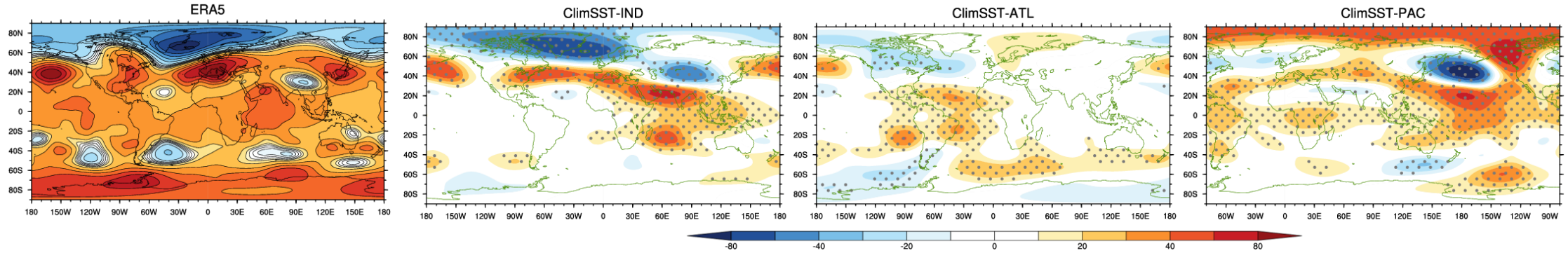
ERA5 SST Anomaly 2019/20



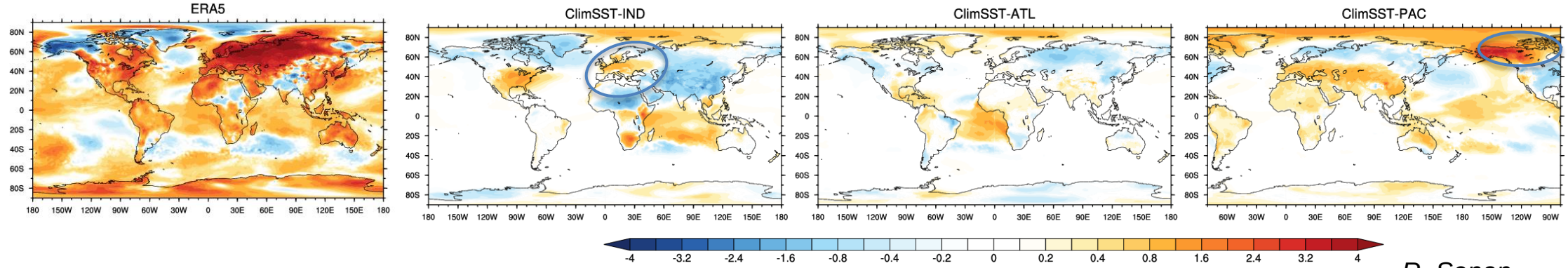
Observed Anomaly

Impact of imposing SST anomaly (SEAS5-ObsSST minus ClimSST-Exp)

Z200



2m T



R. Senan

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