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Development of a Regional Ocean Prediction System for the Southeast Asian Seas

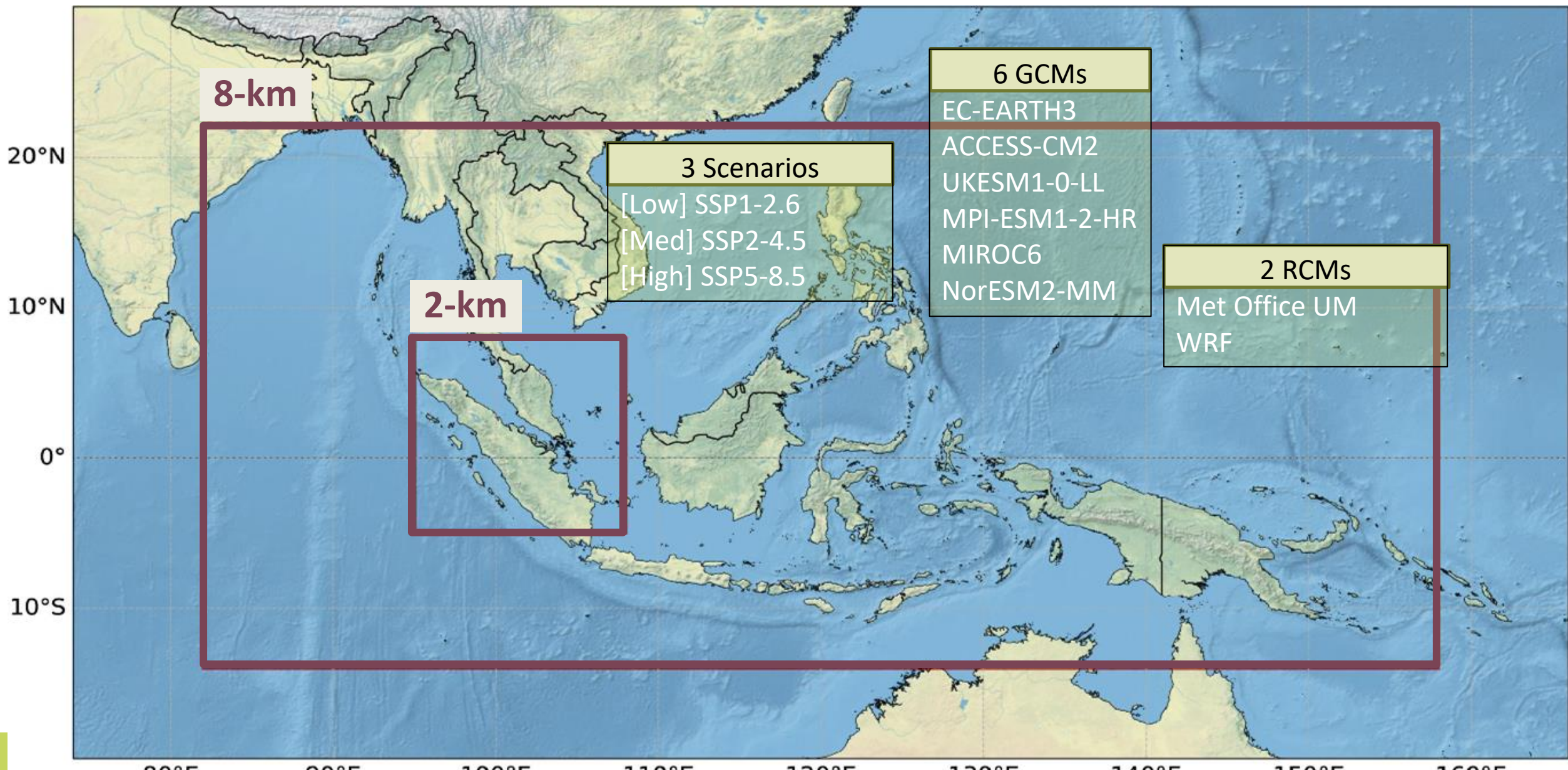
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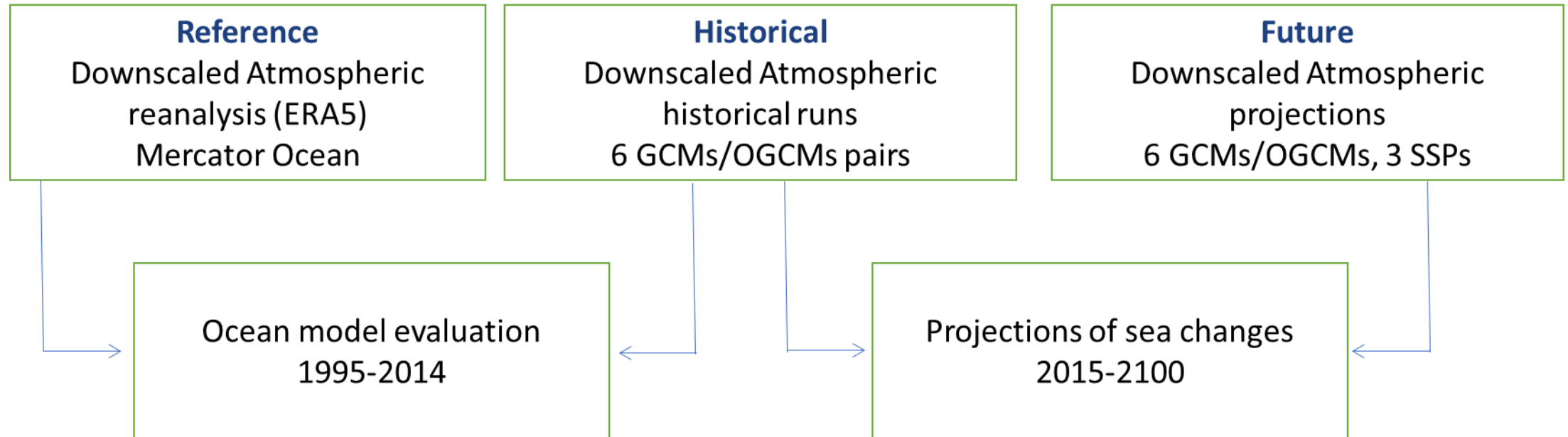
Background of the Ocean Model development

- Following the completion of **Singapore's Third National Climate Change Study (V3)** we further developed a regional ocean model for local marine projections of Southeast Asia (SEA) on timescales of near-term to end-of-century climate change.
- This talk: investigate performance of the model for climate variability and change; show its initial application in ocean dynamic downscaling.

V3 atmospheric downscaling provides local and regional climate change projections



Ocean Dynamical Downscaling

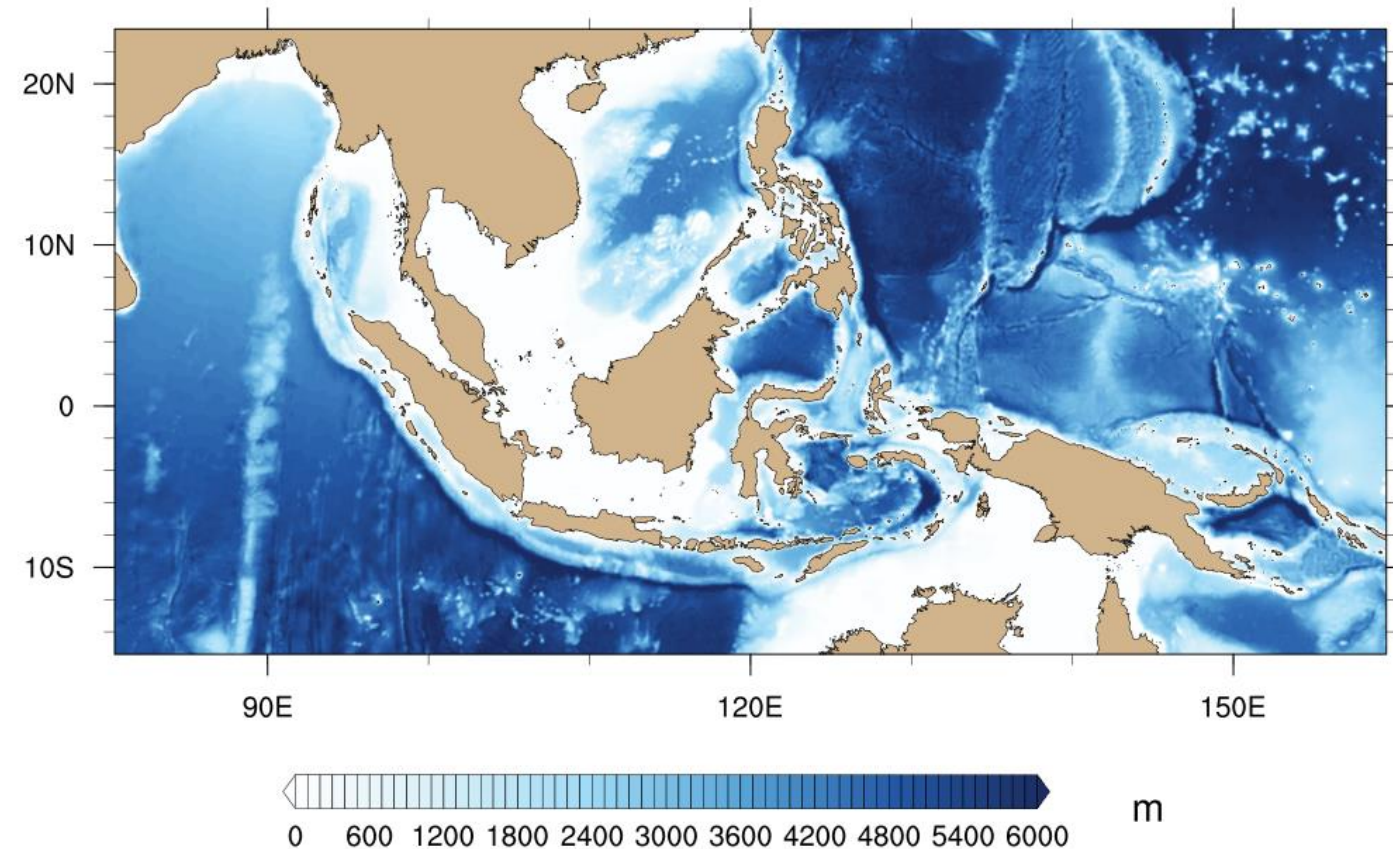


NEMO model: domain and bathymetry

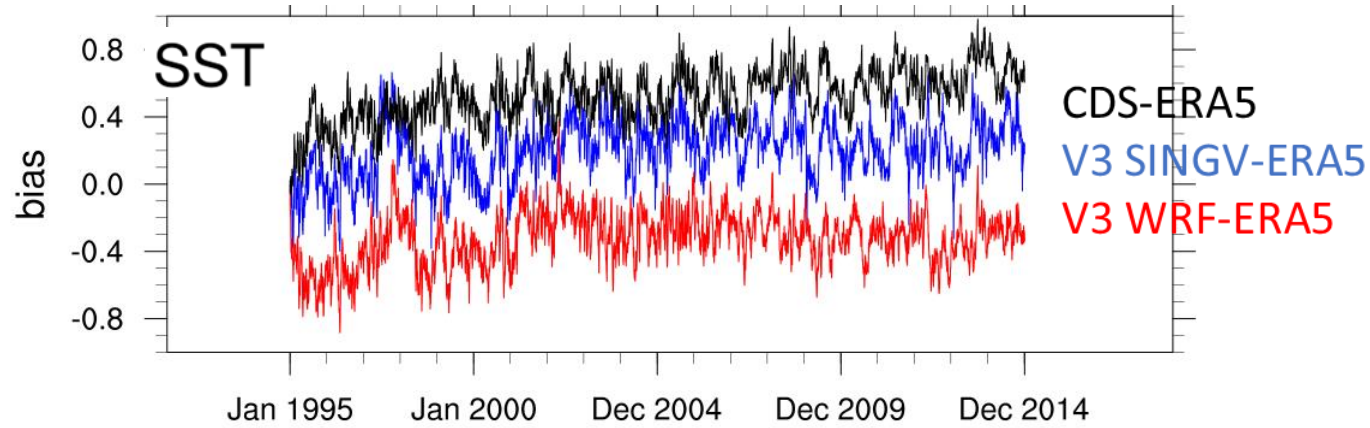
- Nucleus for European Modelling of the Ocean (NEMO)
- The horizontal resolution: 1/12 degree (approximately 9 km)
- Terrain-following s-coordinate 51 levels in the vertical
- Global model of ocean tides TPXO9

Initial/Boundary conditions:

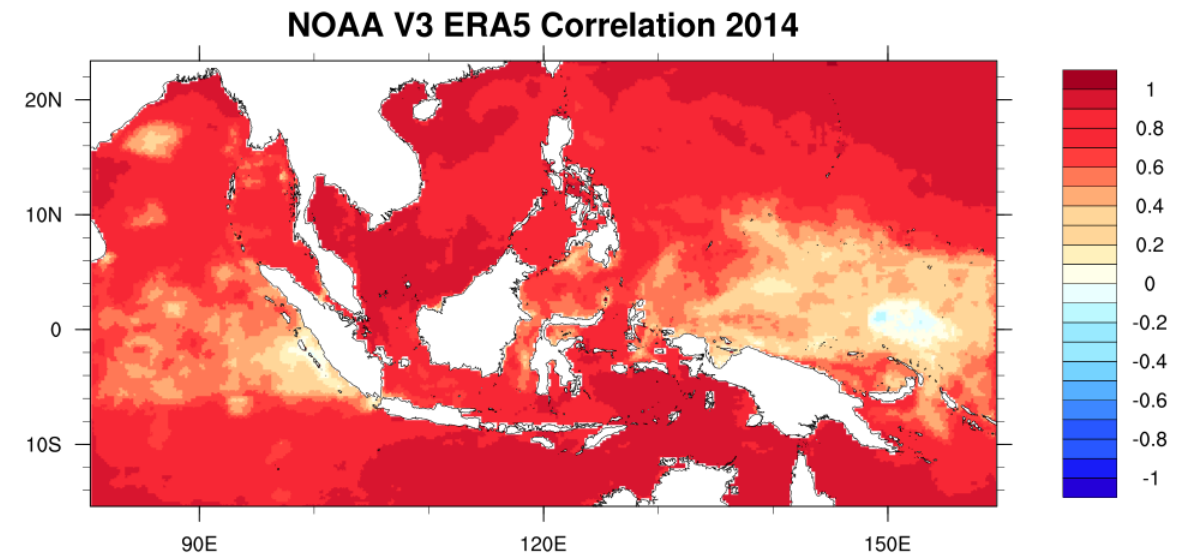
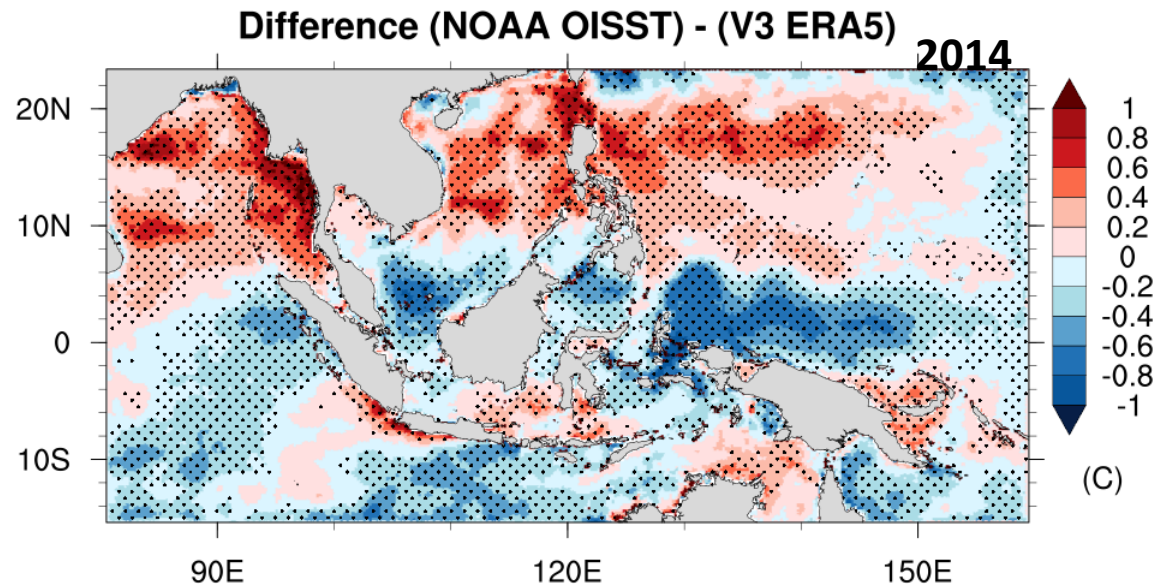
- GLORYS12V1 (1/12°, 50 levels)
- CDS-ERA5 1/4°
- SINGV-ERA5 8-km
- WRF-ERA5 8-km
- 1995-2014



Validation of the Model

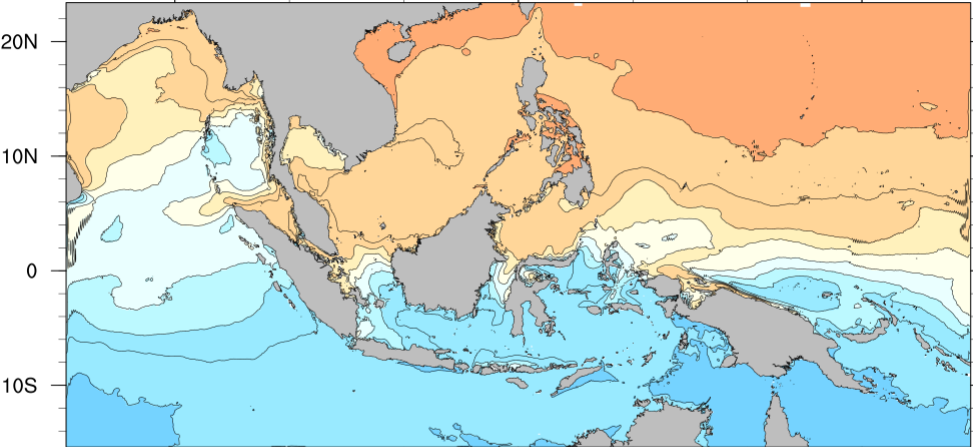


- Model bias is less than 1°C
- SINGV-forcing gives smallest biases
- WRF-forced simulation is too cold
- Model skill for daily SST is generally high

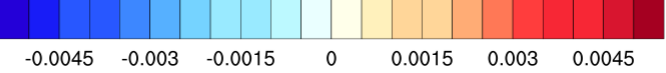
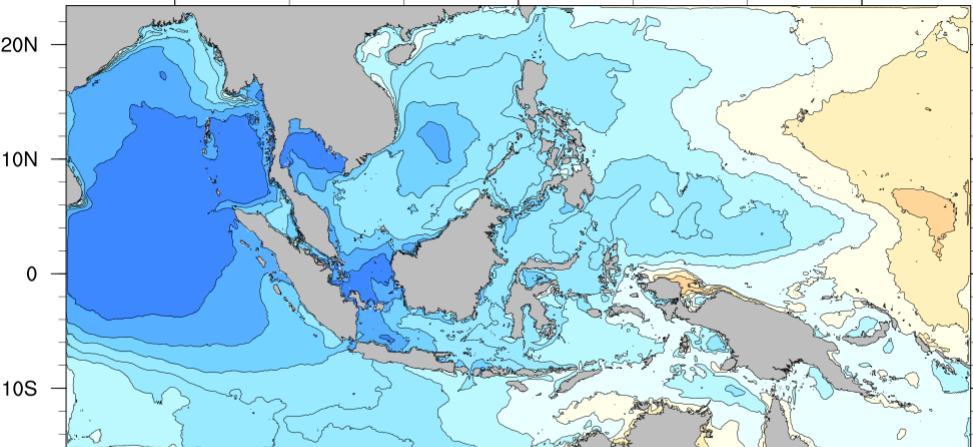


Interannual variability

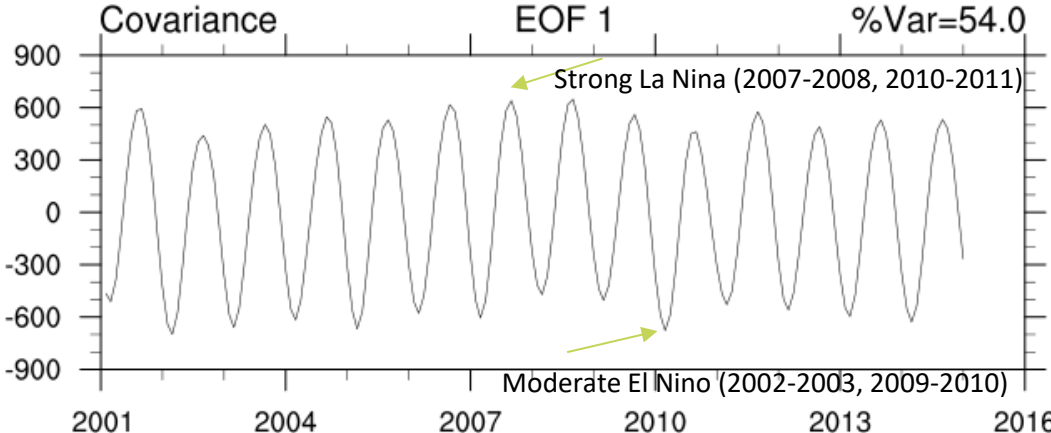
EOF1 %Var=54.0



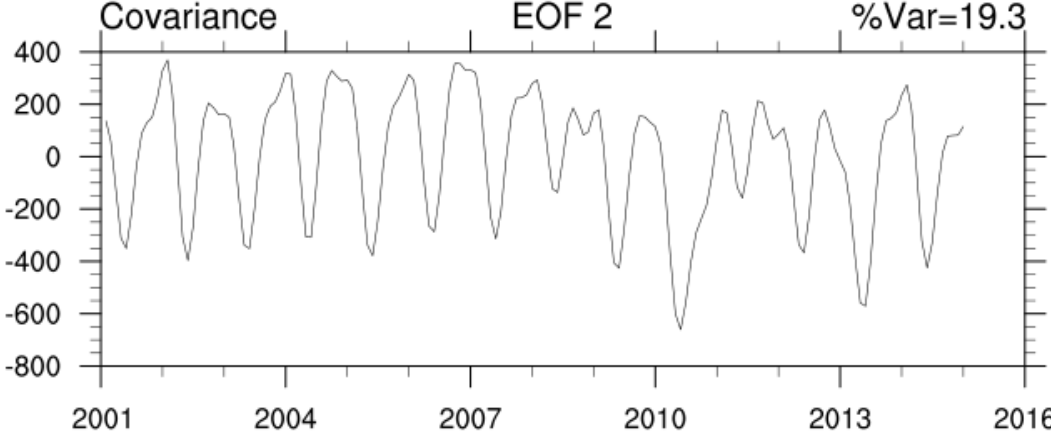
EOF2 %Var=19.3



- The second EOF mode shows ENSO modulation
- Will there be a change in the dominant modes of SST in the future?



Seasonal cycle mode

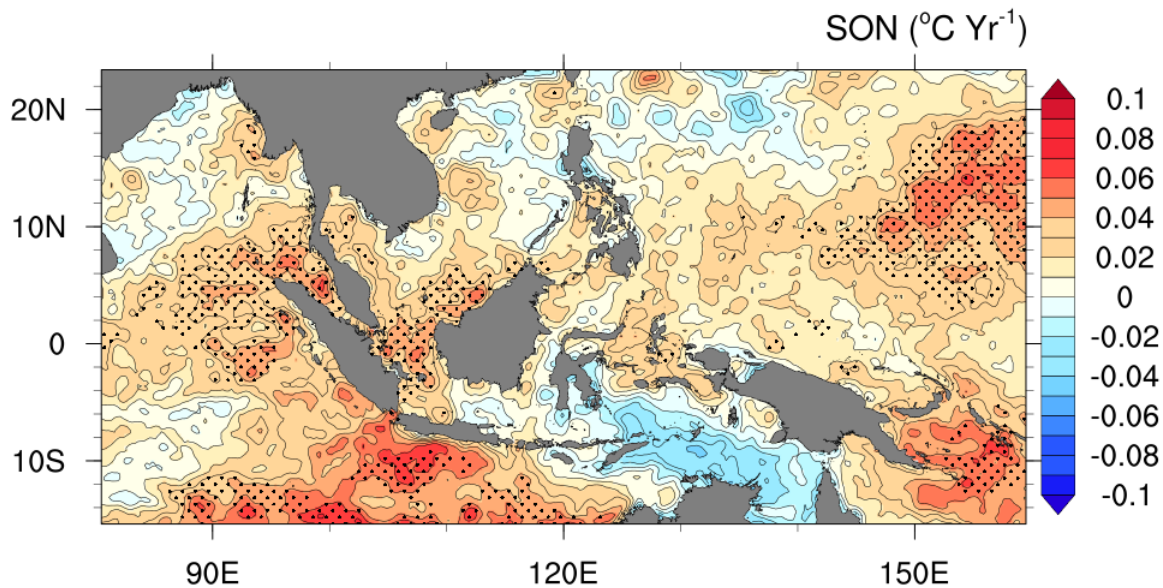


ENSO influence

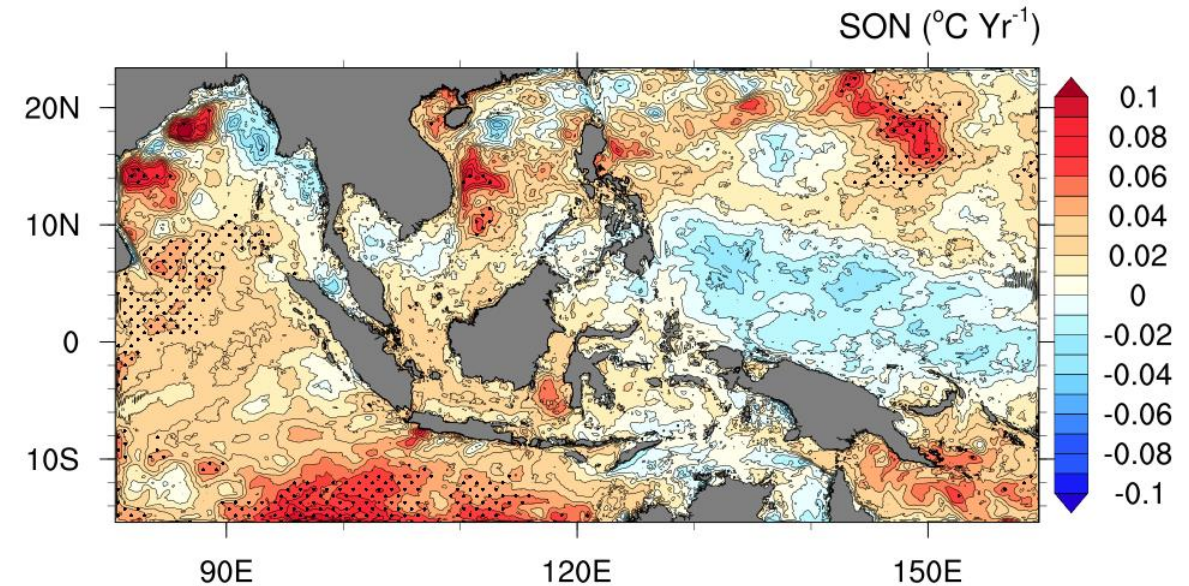
Decadal SST Trends

- The model reproduced the observed spatial distribution of trends for SST
- The observed warming in Indian Ocean is captured by the model
- Trends in small-scale eddies (Tropical cyclone tracks) are present in observation and model
- Equatorial Pacific trends, less well captured: may be due to atmospheric forcing

NOAA OISST SON Linear trend (2001-2014)



V3 ERA5 SON Linear trend (2001-2014)

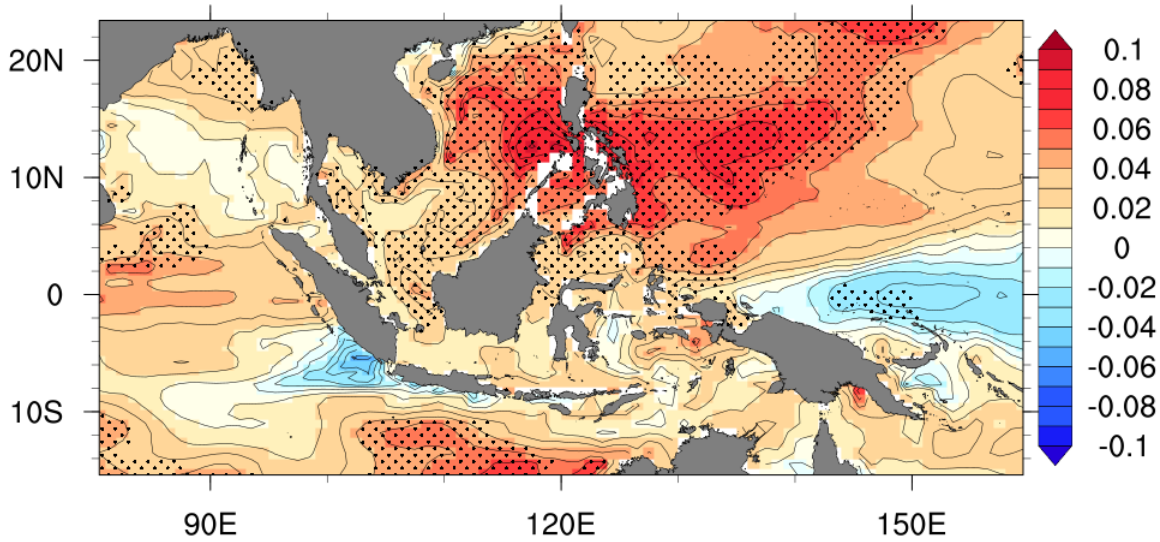


Projected Trends

- The impact of the dynamical downscaling with high-resolution V3 atmospheric forcing

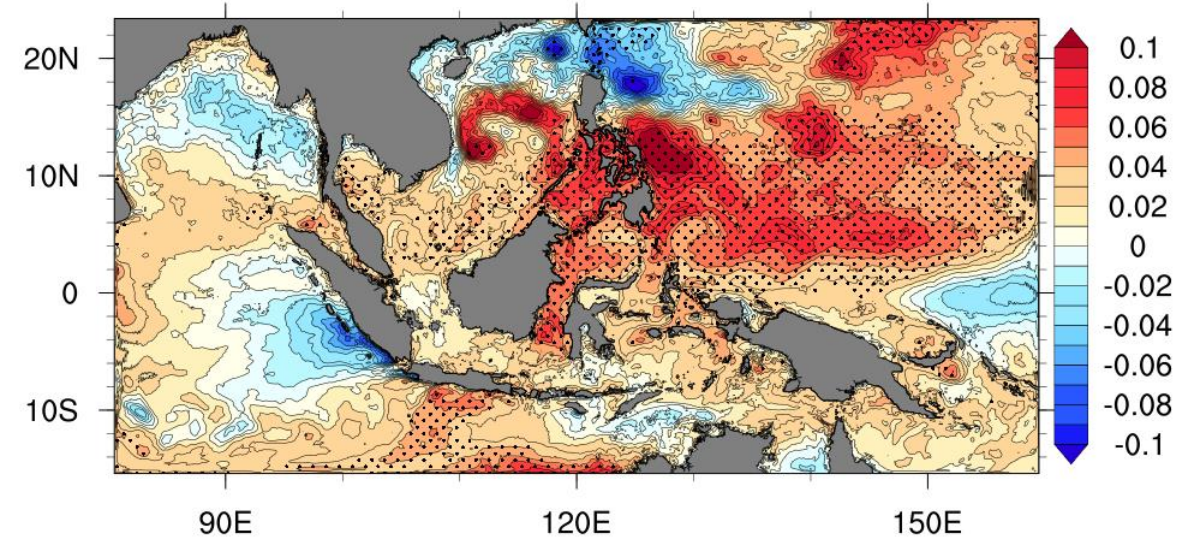
EC-EARTH SSP126 SON Linear trend (2015-2030)

SON ($^{\circ}\text{C Yr}^{-1}$)



EC-EARTH SSP126 SON Linear trend (2015-2030)

SON ($^{\circ}\text{C Yr}^{-1}$)



Summary

- A new high-resolution NEMO ocean model has been developed for dynamical downscaling applications over SEA.
- The model has been validated and is capable of correctly reproducing observed spatial distributions, interannual variability and trends for SST.
- The impact of the dynamical downscaling with high resolution of V3 atmospheric forcing has been examined and found to be able to resolve small-scale ocean dynamics.
- Future model applications include forecasting fine-scale ocean currents and for understanding the underlying physical processes in this region.



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THANK YOU