

WGSIP Prediction Capabilities Project: Ocean prediction

Bill Merryfield, Johanna Baehr, Hong-Li Ren WGSIP 23 November 16, 2021 (online)





Objectives

- Systematically evaluate prediction capabilities for ocean variables other than SST across time scales and for multiple climate prediction systems
- Assess **performance of individual prediction systems** in relation to their initialization, resolution, etc.
- Assess multi-model performance gains
- Assess properties and suitability of different **verification datasets**, utility of multi-product verification
- Assess **sources of predictability** and ability of models to represent them
- Facilitate useful **real-time forecasting** of ocean properties having societal impacts



Initial focus #1: Sea surface height (SSH)

cfsr

as5ge

Progress so far:

- *Evaluated & compared global mean and regional SSH from 6 ٠ verification datasets (5 reanalyses and 1 altimetry-based) \rightarrow
- *Evaluated correlation & RMSE skill vs verification dataset for 5 CHFP models
- Compared skill for single vs multi-product verification datasets
- SSH skill evaluation for BCC CSM1.1m (next slide) ٠

Next steps:

- Extend analysis to new Canadian + any other available ٠ models
- Finish and submit paper focusing on dependence of multi-٠ model SSH skills on verification datasets & combinations thereof

*Reported in WGSIP 22



GEIDAIDS

GELOA

AVIGEIOA

Evaluations of seasonal prediction for sea level in BCC_CSM1.1m

provided by H.-L. Ren*





8.0

0.6 0.4

0.2

-0.2 -0.4 -0.6

-0.8

Items	Detail		
Prediction model	BCC-CSM1.1m in Beijing Climate Center, CMA		
Data period	1993-2013 (hindcast), 2014-2018 (forecast)		
Oceanic model	MOM_L40, 1/3°(tropical)~1°(high-latitude) horizontal;		
Initialization	Ocean temperature initialized towards NCEP-GODAS		
Output	Sea surface height (SSH) forecast for 0-12 months		
Verification data	data Altimetry data from AVISO; ¼ degree, 1993-2018, monthly		
Others	Remove linear trend; climatology during 1993-2010		

TCC averaged in tropical ocean (20°S-20°N)



- ✓ Model prediction skills are higher in tropical ocean
- ✓ Sea level (SSH) in **boreal winter is more** predictable than summer
- ✓ Prediction skills decrease more slowly with lead increasing as compared to persistence forecast
- $\checkmark\,$ SSH initialization is needed to improve forecast

Initial focus #2: Mixed-layer depth (MLD)

Progress so far:

 Initial evaluations and comparisons of MLD from 7 data products:





Dataset	Туре	Period	MLD defined by
EN3v2a	obs-only	1993-2011	0.03/0.125 kg/m3
ARMOR3D	obs-only	1993-2010	0.03/0.125 kg/m3
GECCO2	reanalysis	1948-2011	0.03/0.125 kg/m3
ORAS4	reanalysis	1958-2011	0.03/0.125 kg/m3
ORAS5	reanalysis	1979-2018	0.01 kg/m3
GODAS	reanalysis	1980-2021	0.8 C
CFSR	reanalysis	1979-2010	0.25 kg/m3

Next steps:

- Assess skill of available CHFP models based on these verification datasets & combinations thereof
- Seek collaborators for scoping paper on MLD prediction, possibly including S2S early results and DCPP

Anomaly correlations 1993-2010

Community engagement (1)



Physical Sciences Laboratory

NOAA-NASA RISE Seasonal Prediction

(Experimental local and regional sea level forecasts)





Current directions and challenges

- · Bias correction for systems having different hindcast periods
- · Whether/how to account for trends
- Operationalizing \leftrightarrow securing real time SSH predictions from NMME and other systems

 \rightarrow engaged with RISE investigators in Dec 2020 to share approaches and results, ongoing participation in RISE mtgs



Community engagement (2)

2021 United Nations Decade of Ocean Science for Sustainable Development

- UN Decade has invited formation of Communities of Practice loosely organized, voluntary networks that "allow partners who are working on similar themes...to communicate, collaborate and work together*" to optimize collective impact in achieving the Decade vision.
- Mercator is proposing to host a Decade Collaborative Centre on Ocean Prediction (DCC-OP) that will serve "as a communication and collaboration hub for ocean prediction" and "engage with relevant Communities of Practice, who can 'plug in' to Centre activities**"
- The WGSIP and S2S ocean prediction projects are aiming to set up a Subseasonal to Seasonal Ocean Prediction (S2DOP) Community of Practice, and have begun discussions with the Decade office and Mercator

** <u>https://www.mercator-ocean.fr/en/news/ocean-decade-</u> <u>collaborative-centre-ocean-prediction/</u>

^{*} Creating "Communities of Practice" in the Ocean Decade, UNESCO, June 2021 https://drive.google.com/file/d/1PNSyP9t4MVhxI7g_rzEx33TGtn3k7Dr3/view_



Community engagement (2)

2021 United Nations Decade of Ocean Science for Sustainable Development

Rationale and objectives of the S2DOP Community of Practice:

- Global hindcast datasets for numerous ocean variables besides SST are or soon will be available from S2S, C3S, NMME...
- Little exploited so far despite relatively high predictability of ocean
- Aims include
 - promoting evaluations of the potential utility of these predictions
 - stimulating their uptake for practical decision making
 - facilitating information exchange to stimulate advances, avoid duplications of effort
- Envisaged initial activities include
 - webinars
 - communication through mailing list
 - possibly online symposium(s), community article for BAMS or such

Additional S2S ocean variables (daily values)

Depth of 20°C isotherm

Mean salinity in the upper 300 metres

Mean potential temperature in the upper 300 metres

Mixed-layer thickness defined by σ_{θ} 0.01 kg/m3

U component of surface current

V component of surface current

Sea-surface height

Sea-surface salinity

Sea-ice thickness

Similar variable sets (monthly values) proposed by C3S and NMME

Many decadal hindcast ocean variables (monthly/ annual values) from CMIP5/6