

Implementation and Validating of the Regional Ocean Model System (ROMS) for the Sunda Strait connecting the Java Sea to the Indian Ocean

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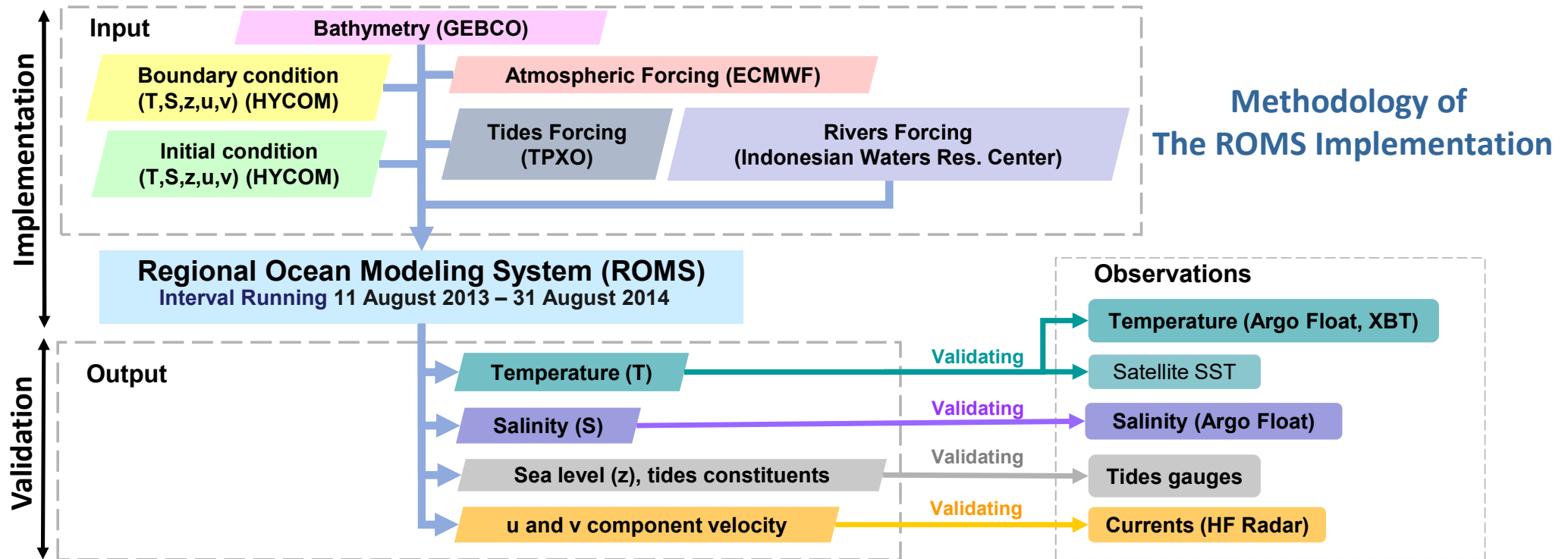
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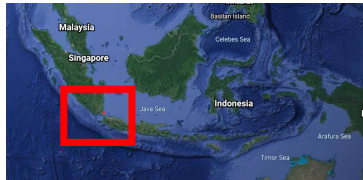
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Motivation → ROMS can capture the ocean characteristics of the complex sea area such as shallow waters, continental shelf, and deep ocean.

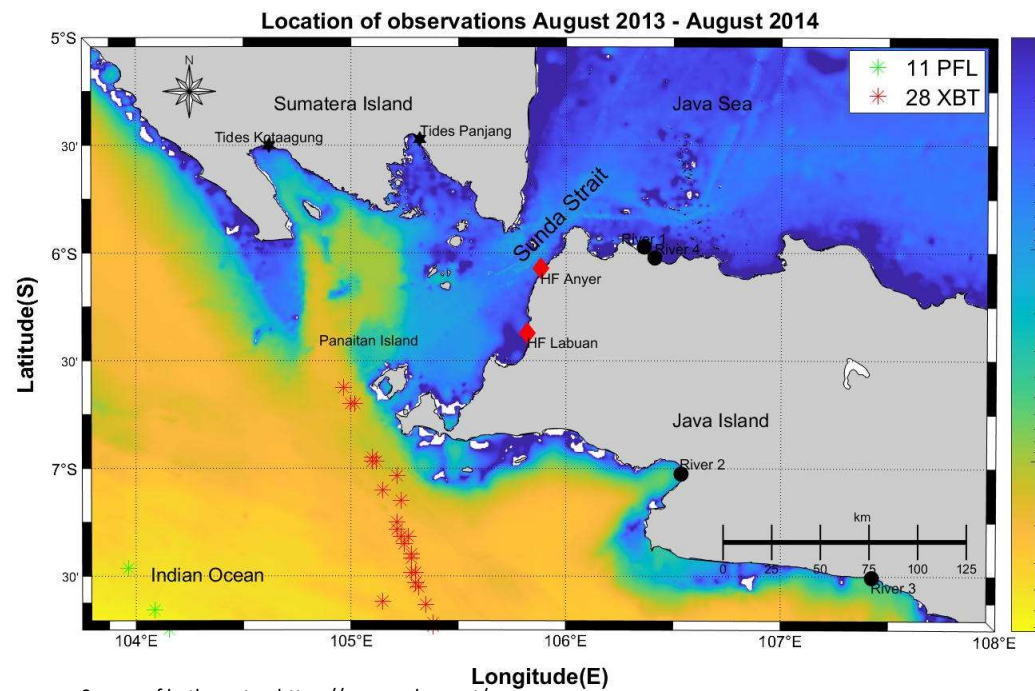
Objective → aims to obtain a better ocean model representing surface currents for the Sunda Strait and the surrounding area, which is a combination between shallow area, continental shelf, and the deep ocean, and hopefully can merge the model with HF Radar currents in the future.



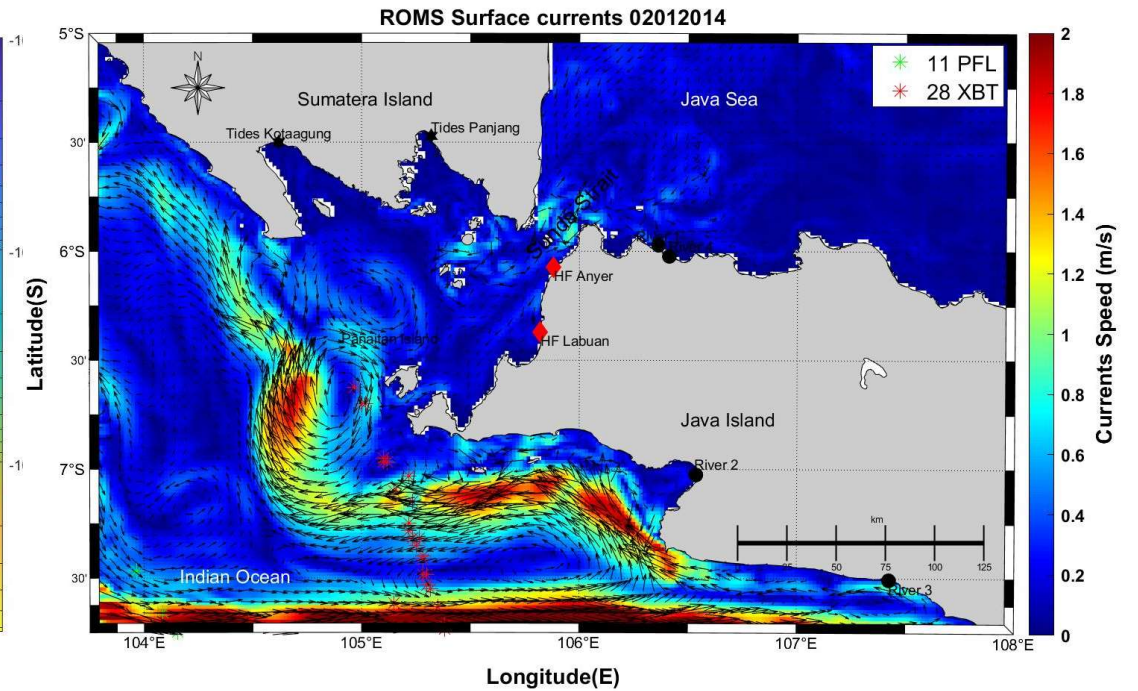


Source : <https://earth.google.com/>

Research domain



Source of bathymetry : <https://www.gebco.net/>



Implementation steps

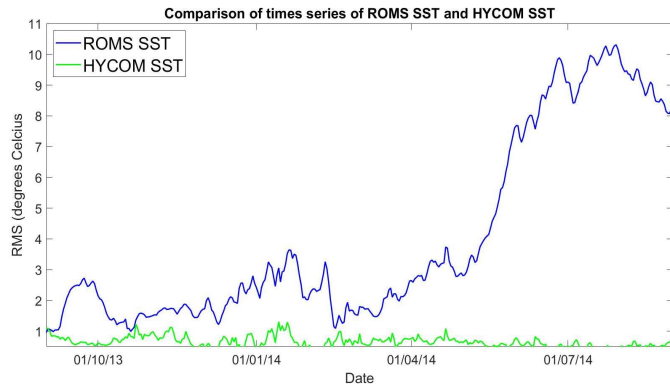
1. Configuring research domain and interval data for simulation
2. Preparing input files such as bathymetry, initial condition, boundary condition, atmospheric forcing, rivers forcing and tides forcing
3. Configuring parameters in ROMS and working environment for simulation
4. Defining some functions for executing ROMS parameters

Some treatments for troubleshooting

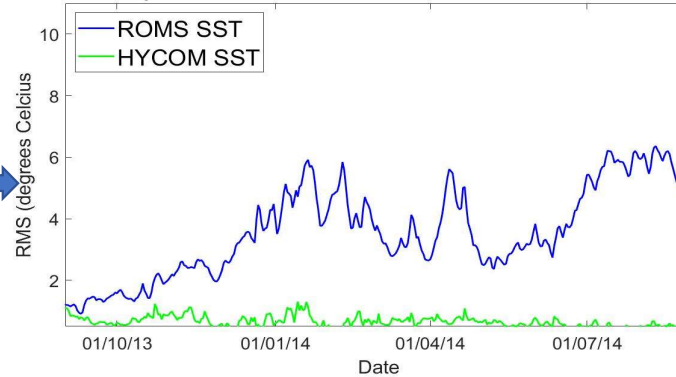
1. Applied different scheme of turbulence mixing layer
2. Activated a correction to the heat flux by deactivating bulkflux
3. Applied a bigger domain of atmospheric forcing (ECMWF)
4. Applied a reduced bounding box domain
5. Checked the vertical currents at the boundaries to analyze the cold surface water comes from deeper layers.
6. Applied nudging near the boundary towards a climatology
7. Compared interpolated boundary values to HYCOM
8. Plotted boundary condition in vertical cross section
9. Applied the initial condition from the last simulation which has a good RMS.

Historical Implementation

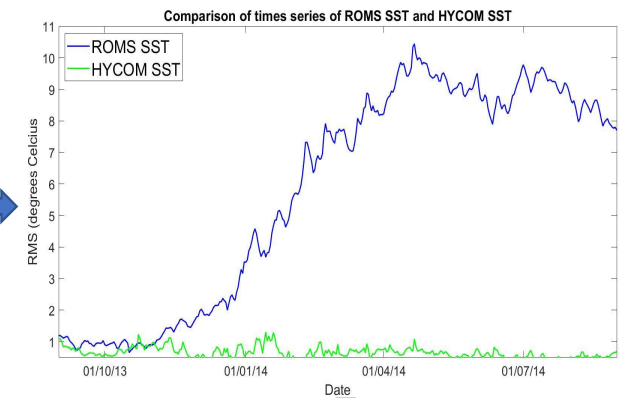
MY, without Heat Flux correction, nudging



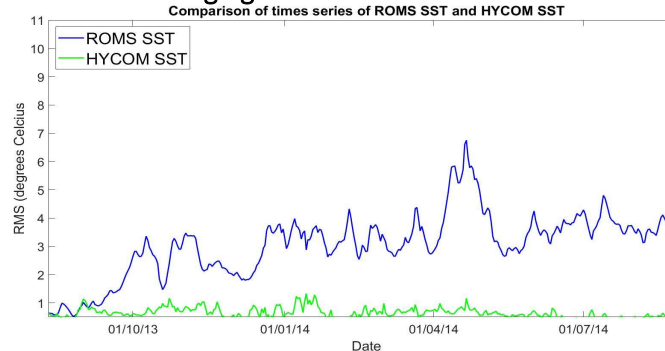
MY, with heat flux correction
Comparison of times series of ROMS SST and HYCOM SST



GLS, with heat flux correction

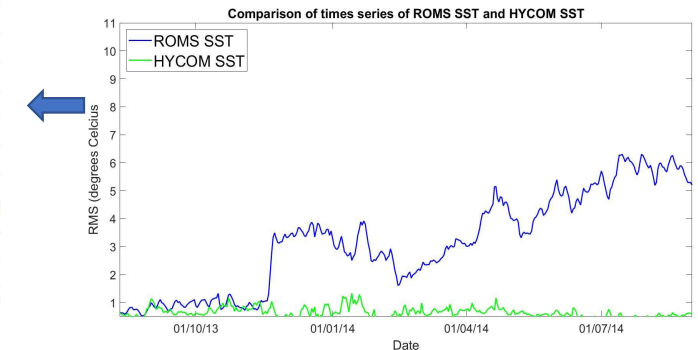


MY, with heat flux correction, reduced domain,
modified nudging

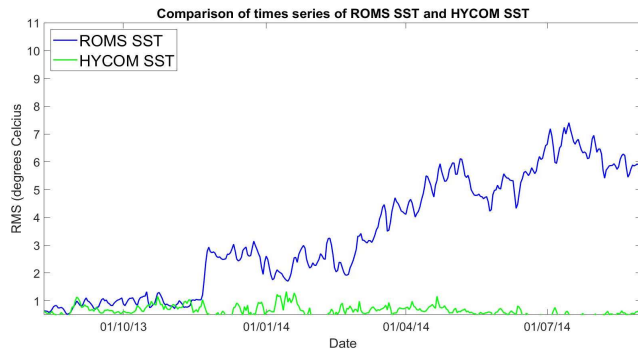


Source of ROMS : <https://www.myroms.org/>

MY, with heat flux correction, reduced domain

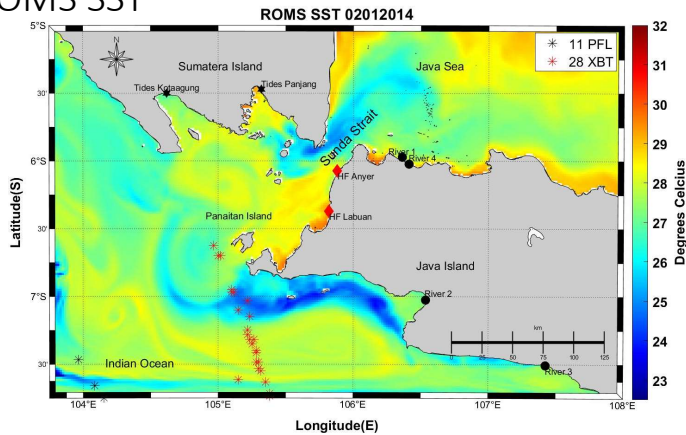


MY, with heat flux correction, reduced domain,
modified nudging, Initial condition from previous
simulation

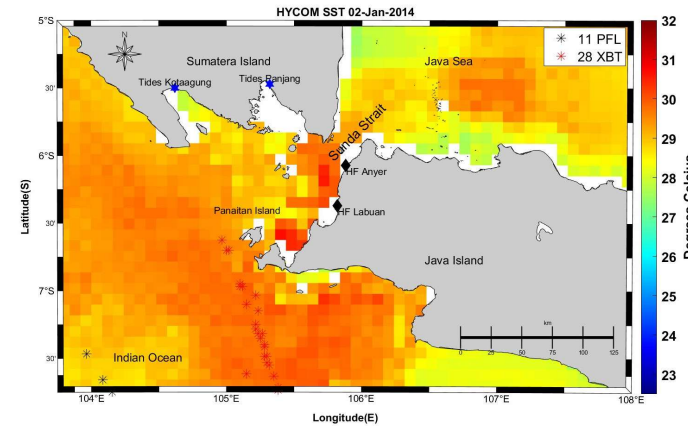


Validation

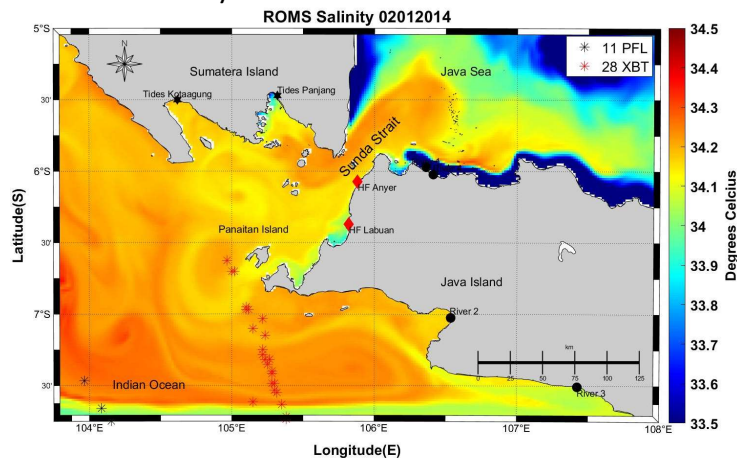
ROMS SST



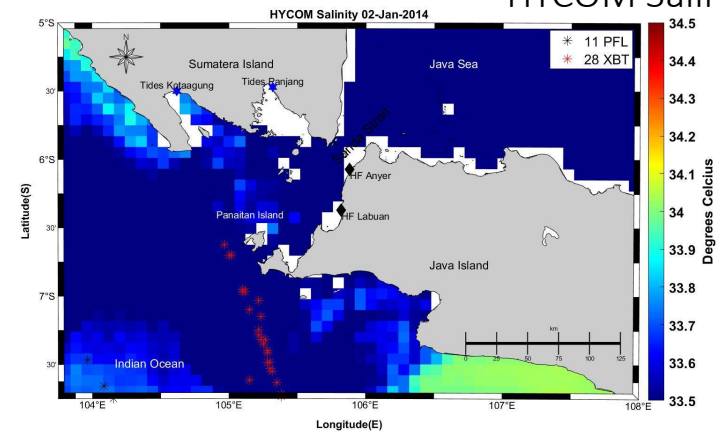
HYCOM SST



ROMS Salinity



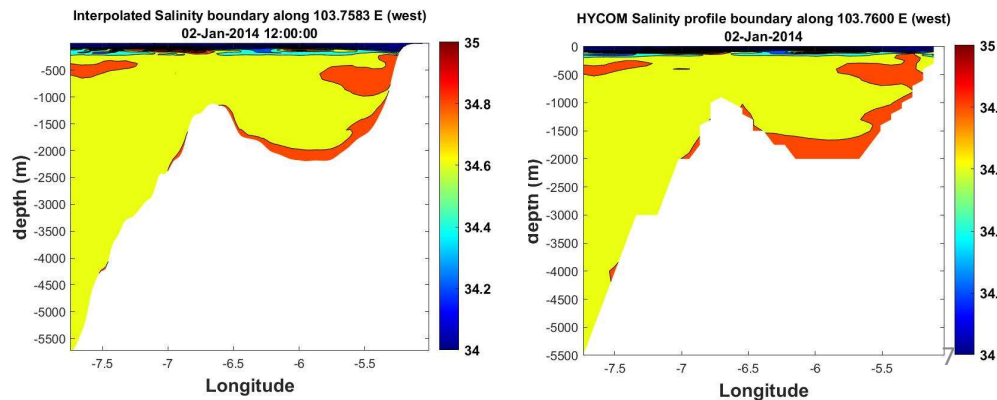
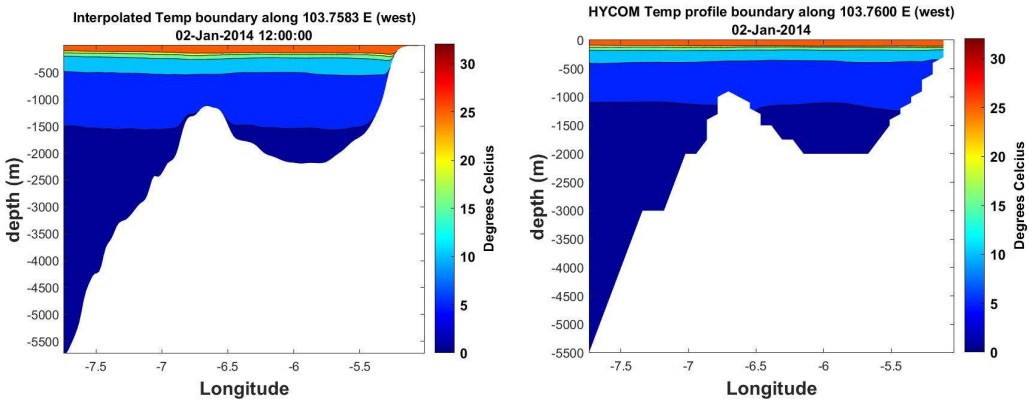
HYCOM Salinity



Source of HYCOM : <https://www.hycom.org/>

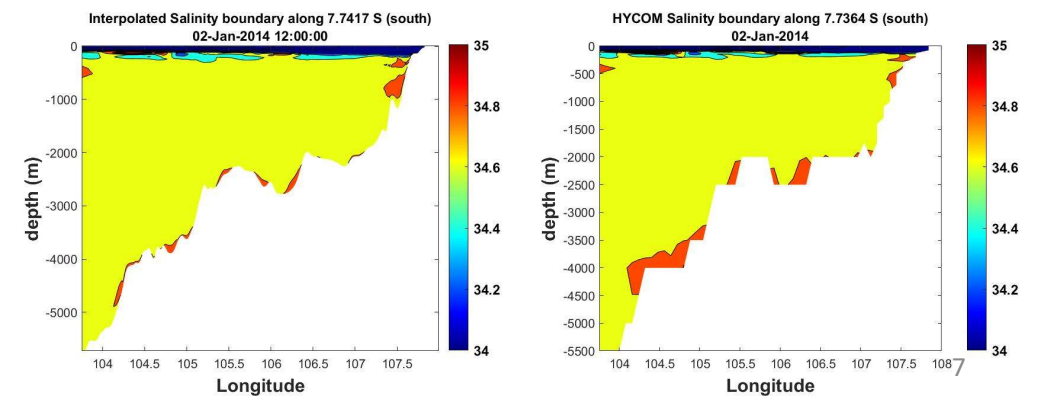
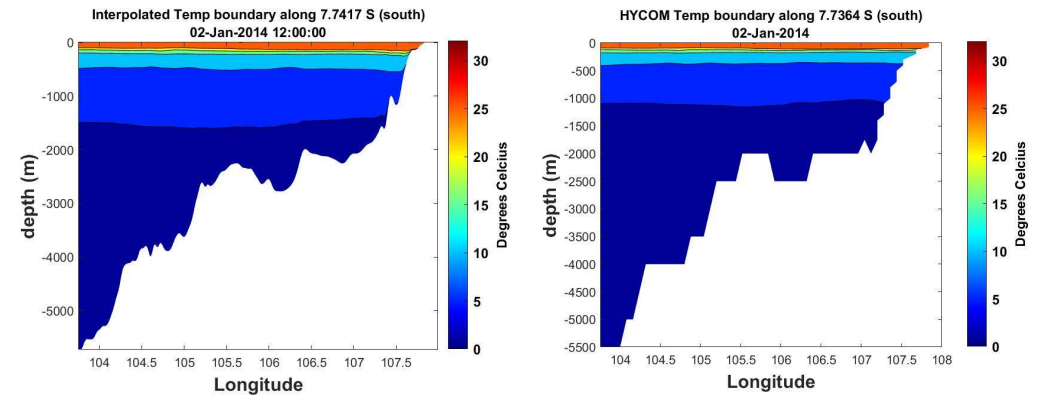
ROMS Spatial Resolution : 0.0167 degree
HYCOM Spatial Resolution : 0.0793 degree (y-axis), 0.08 degree (x-axis)

West boundary



Source of HYCOM : <https://www.hycom.org/>

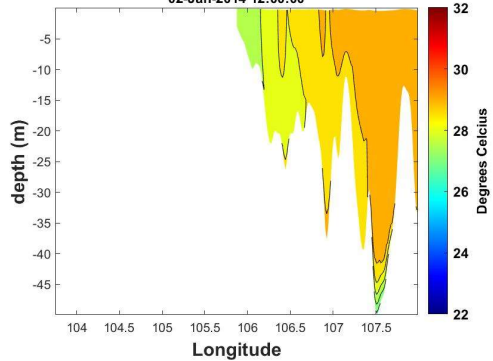
South boundary



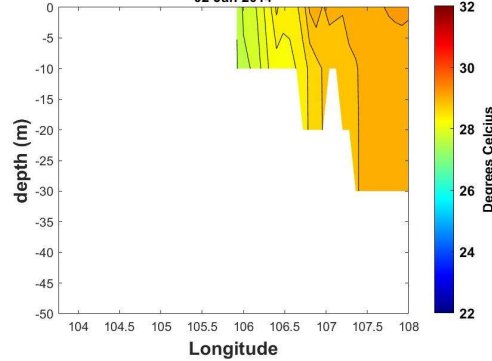
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North boundary

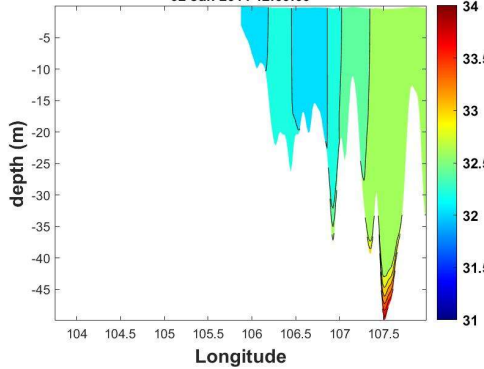
Interpolated Temp profile boundary along 5.0083 S (north)
02-Jan-2014 12:00:00



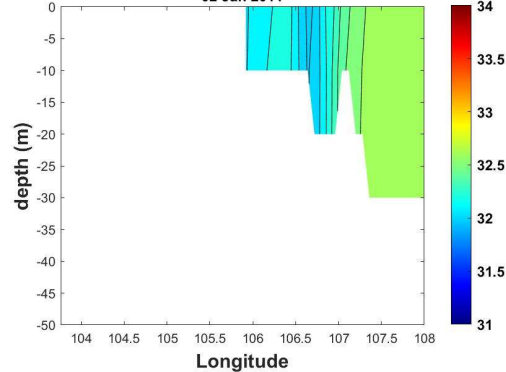
HYCOM Temp profile boundary along 5.0083 S (north)
02-Jan-2014



Interpolated Salinity boundary along 5.0083 S (north)
02-Jan-2014 12:00:00



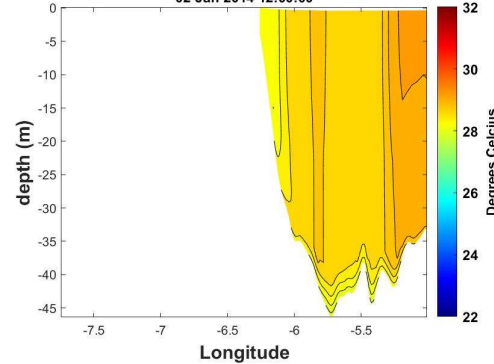
HYCOM Salinity profile boundary along 5.0083 S (north)
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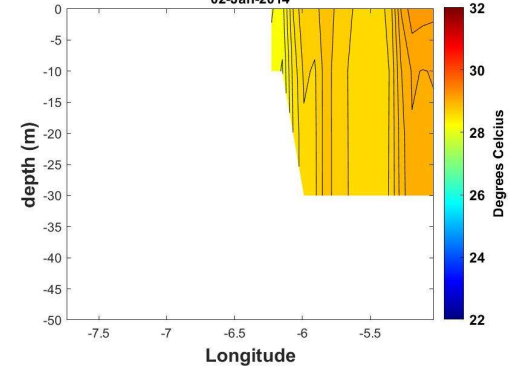
Source of HYCOM : <https://www.hycom.org/>

East boundary

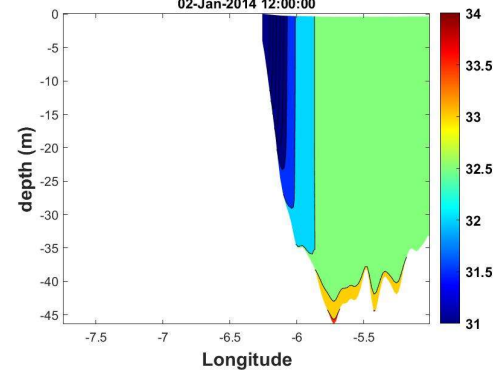
Interpolated Temp profile boundary along 107.9917E (east)
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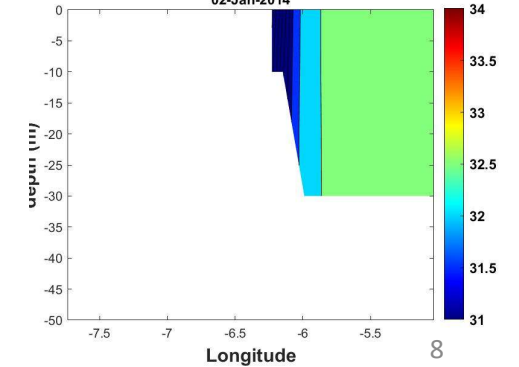
HYCOM Temp boundary along 108 E (east)
02-Jan-2014



Interpolated Salinity boundary along 107.9917E (east)
02-Jan-2014 12:00:00

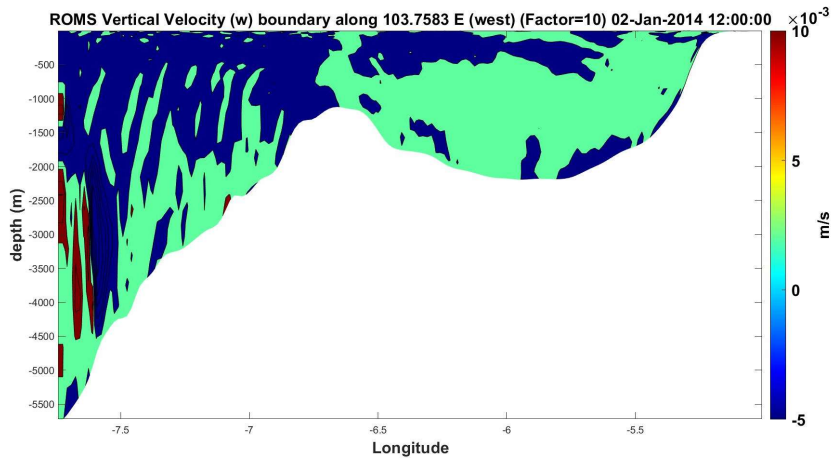


HYCOM Salinity boundary along 108 E (east)
02-Jan-2014

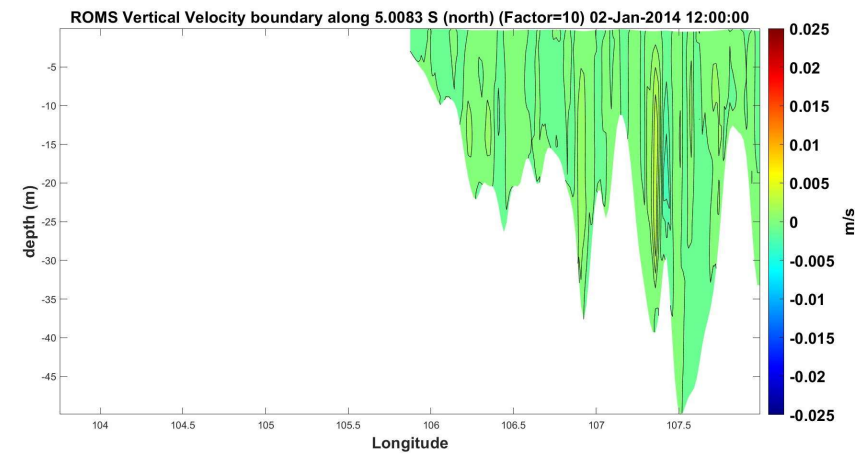


ROMS Vertical Velocity boundary

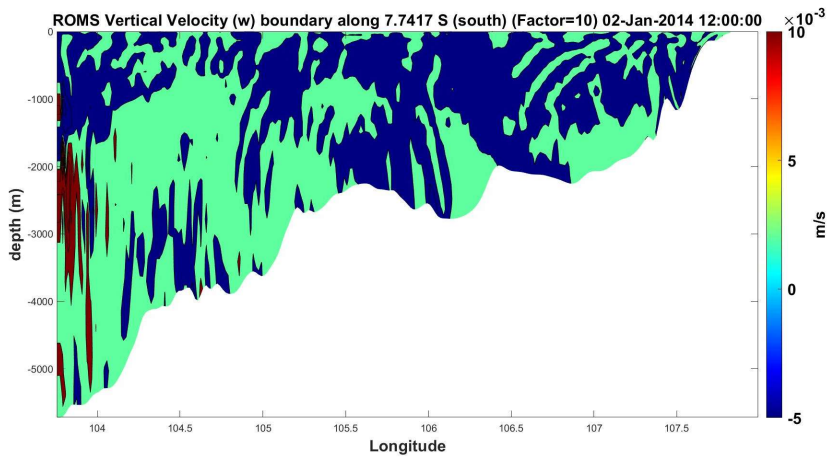
West



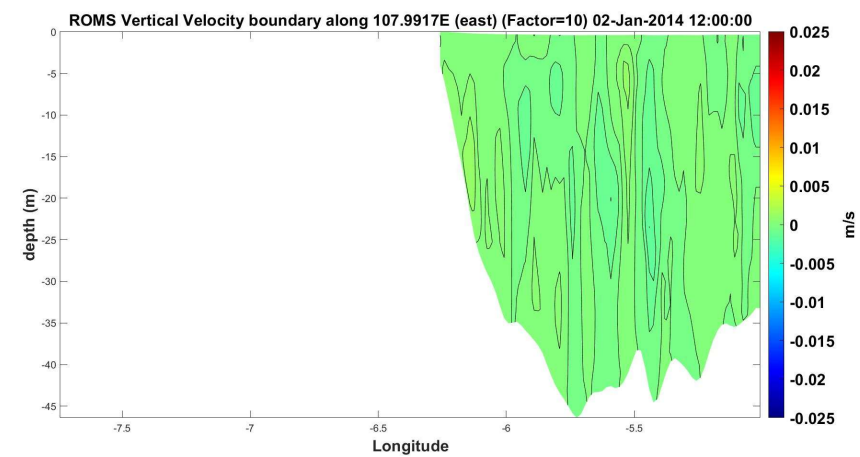
North



South

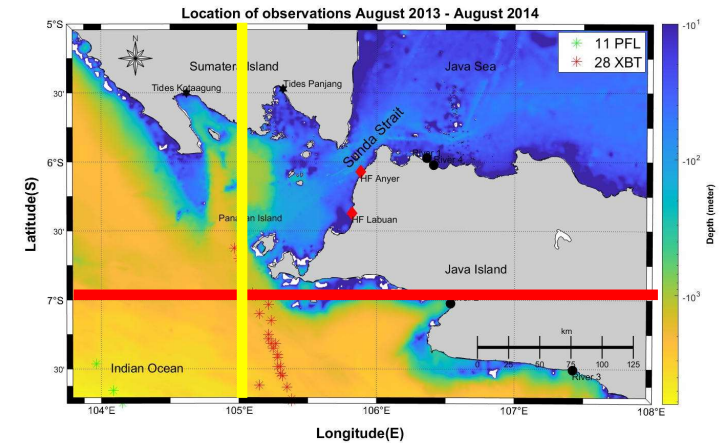
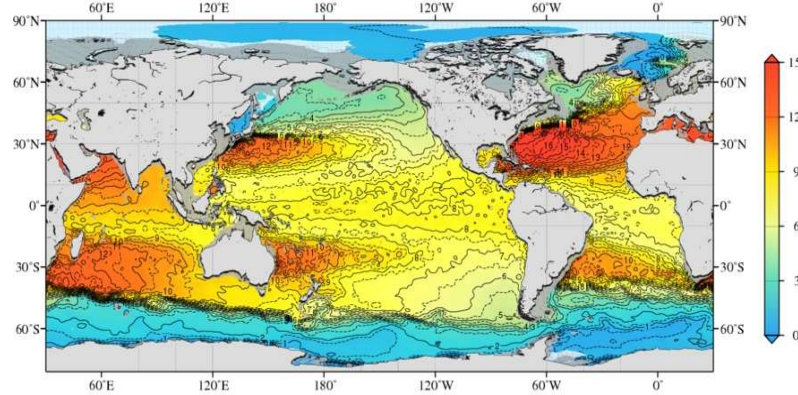


East

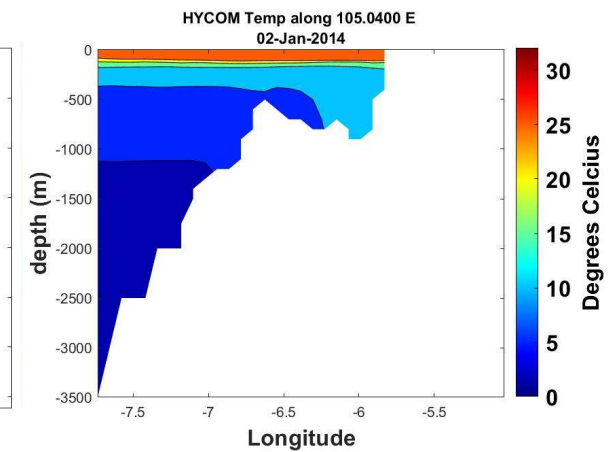
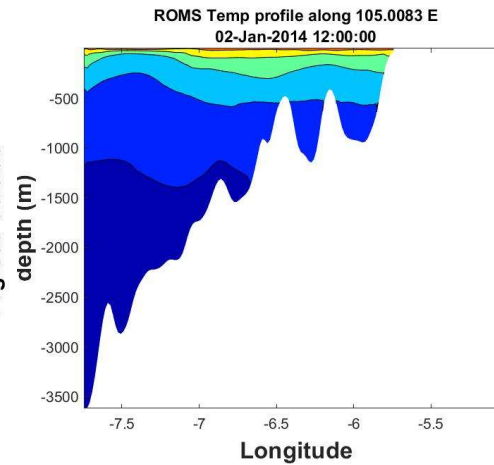
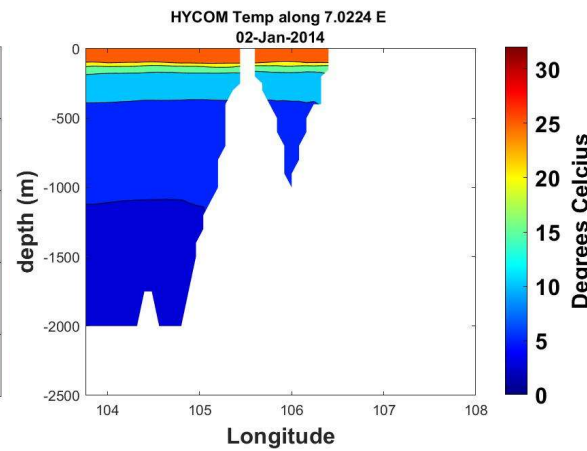
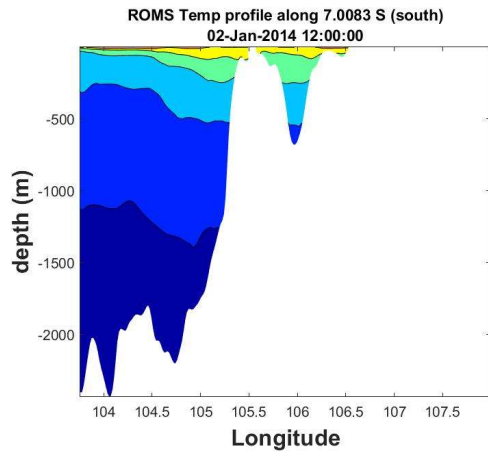


World Ocean Atlas Climatology
Decadal average: 1955 - 2017
Contour Interval=0.5

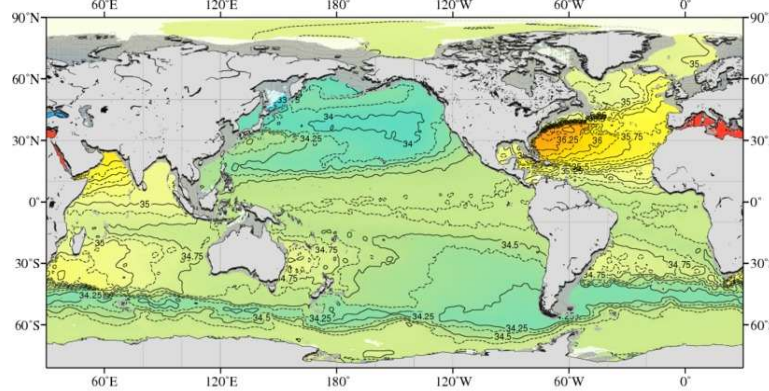
Temperature



January temperature [°C] at 500 m. depth (quarter-degree grid)
Source : NOAA National Centers for Environmental Information
(<https://www.ncei.noaa.gov/>)

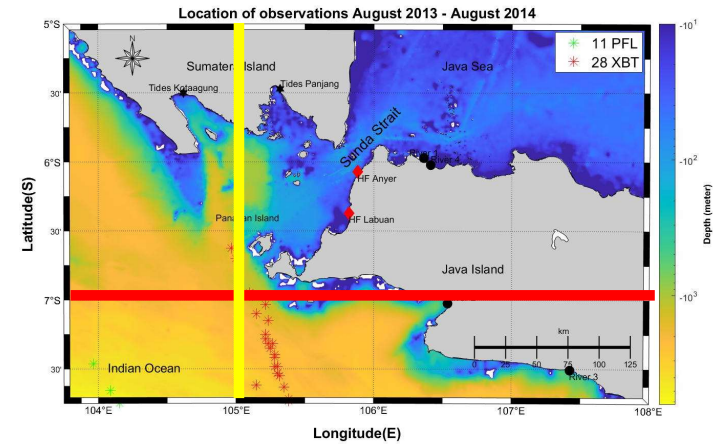


World Ocean Atlas Climatology
Decadal average: 1955 - 2017
Contour Interval=0.125

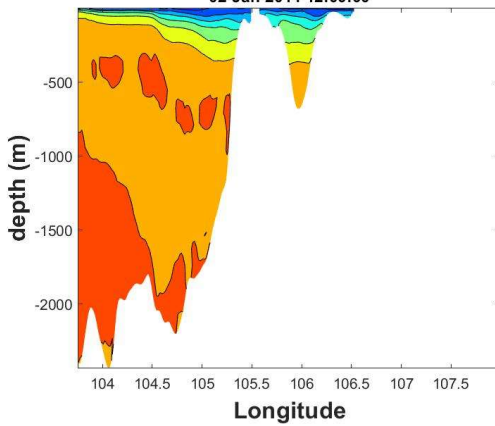


Salinity

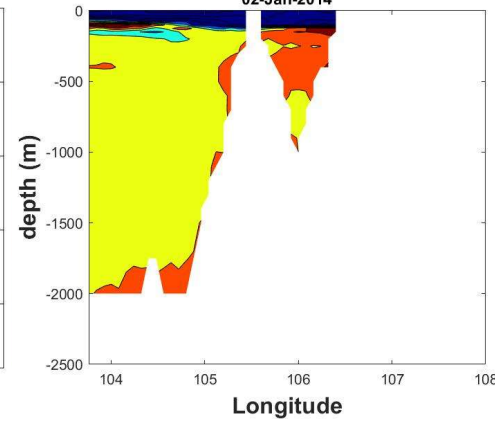
January salinity at 500 m. depth (quarter-degree grid)
Source : NOAA National Centers for Environmental Information
(<https://www.ncei.noaa.gov/>)



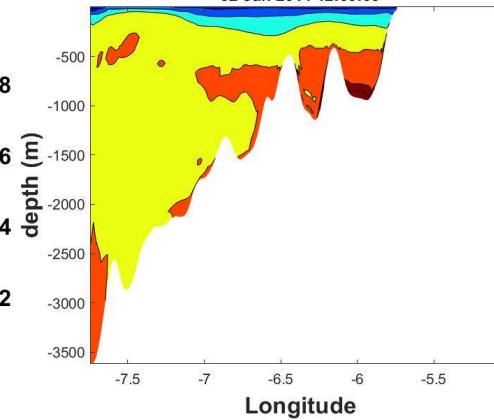
ROMS Salinity profile along 7.0083 S (south)
02-Jan-2014 12:00:00



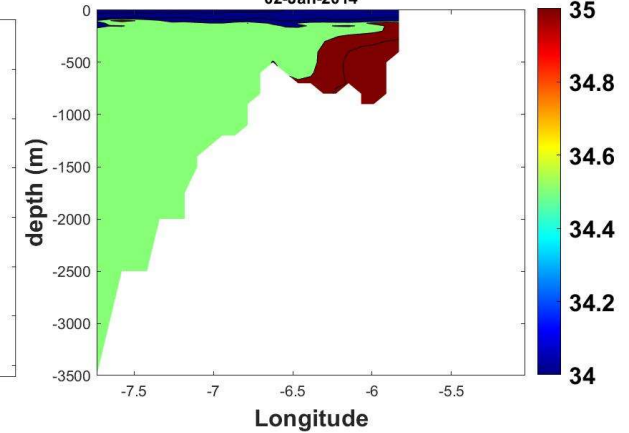
HYCOM Salinity along 7.0224 E
02-Jan-2014



ROMS Salinity profile along 105.0083 E
02-Jan-2014 12:00:00

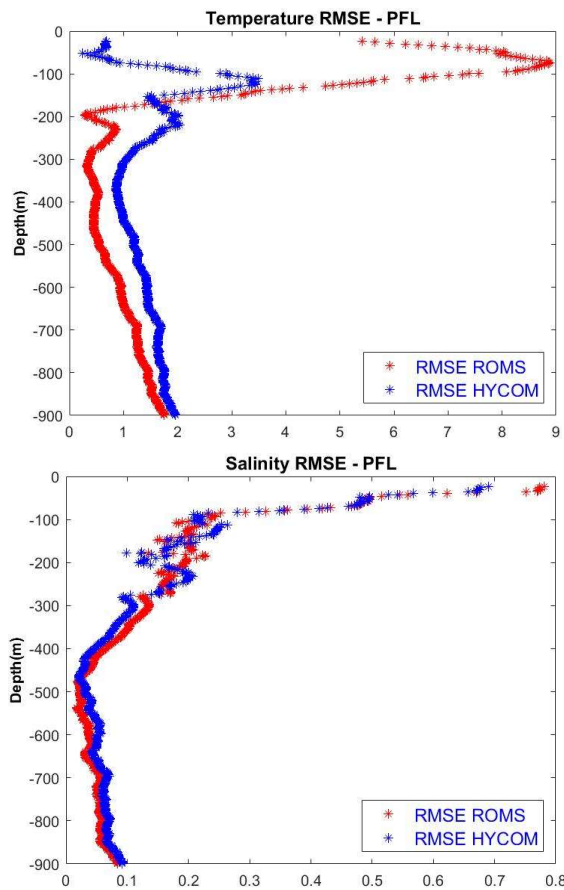


HYCOM Salinity along 105.0400 E
02-Jan-2014

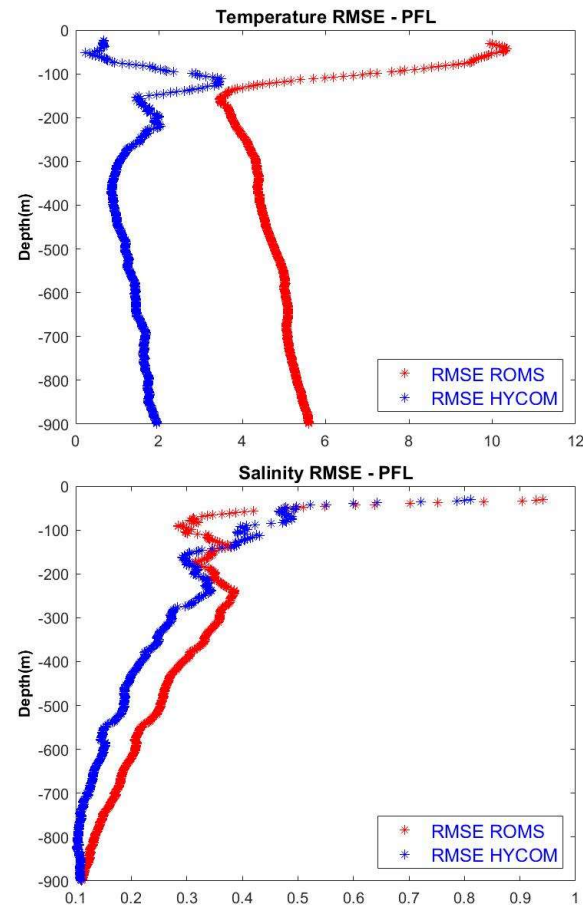


11 August – 31 December 2013

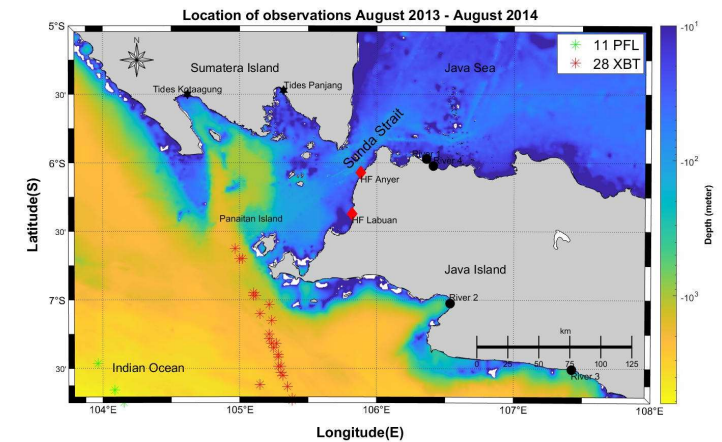
11 August 2013 – 31 August 2014



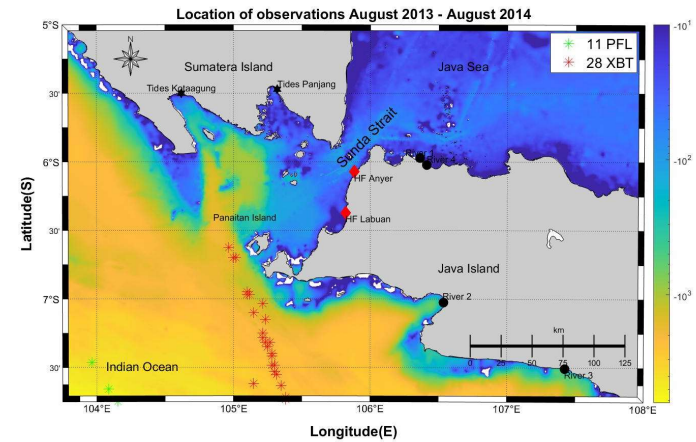
Source of Argo Float: <http://wod.iode.org/>



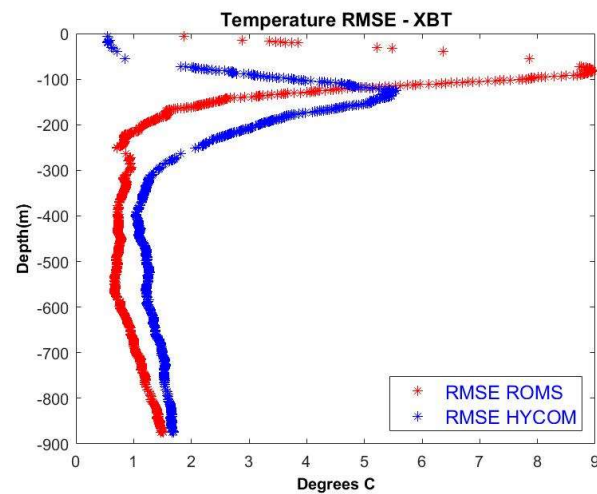
Temp, Salinity ROMS and HYCOM vs Argo float



Temp ROMS and HYCOM vs XBT

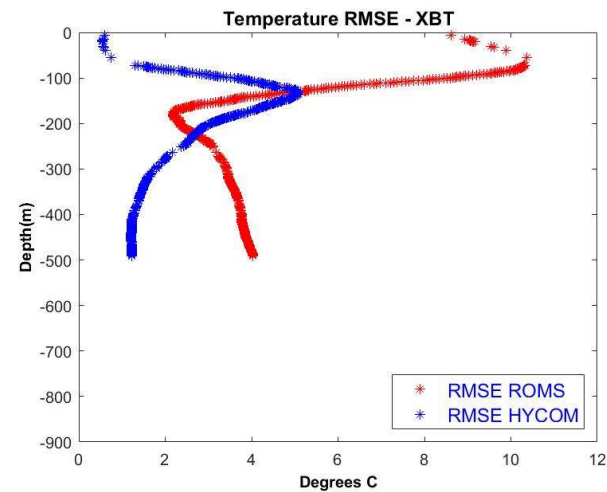


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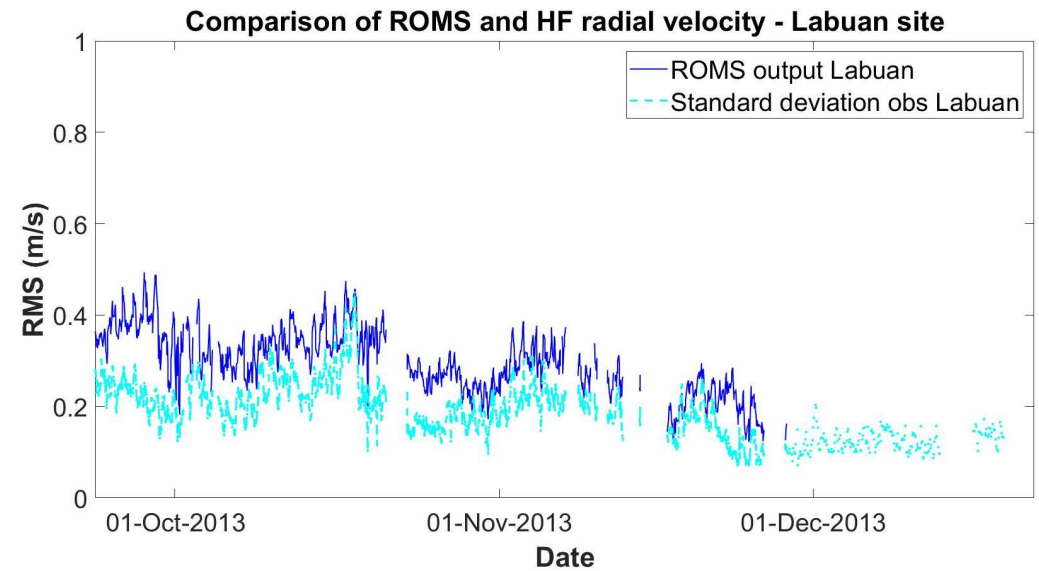
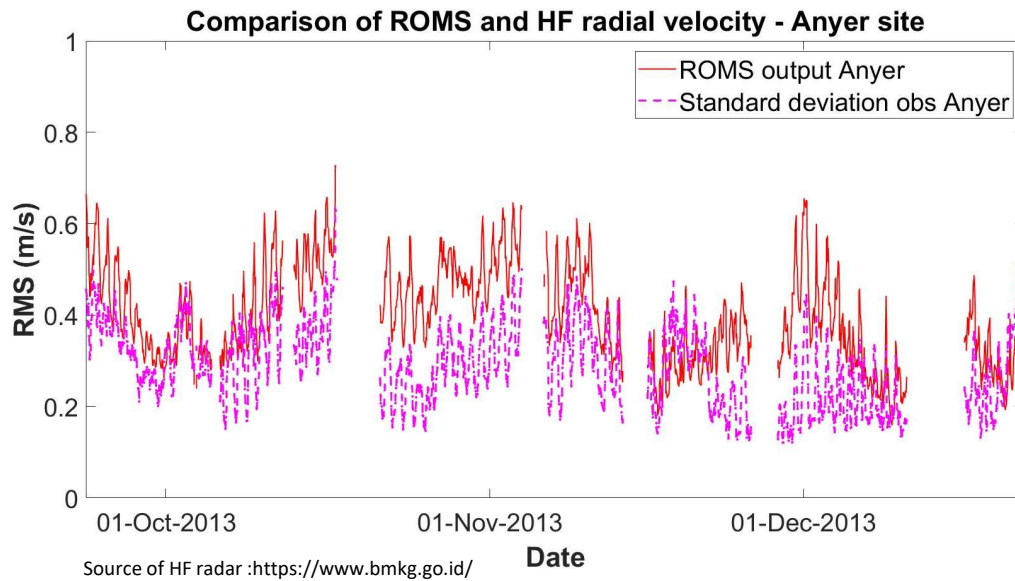


Source of XBT :<http://wod.iode.org/>

11 August 2013 – 31 August 2014

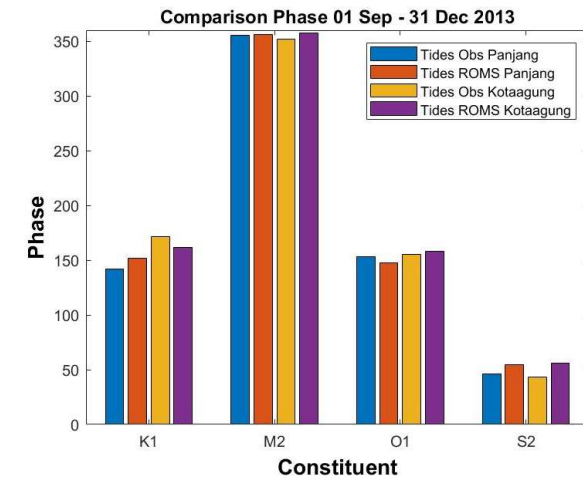
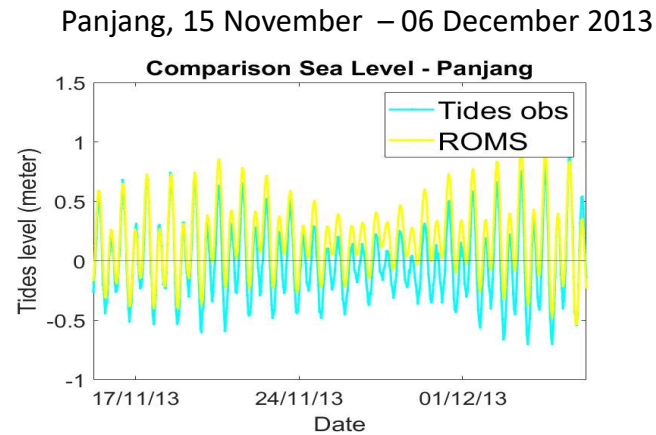
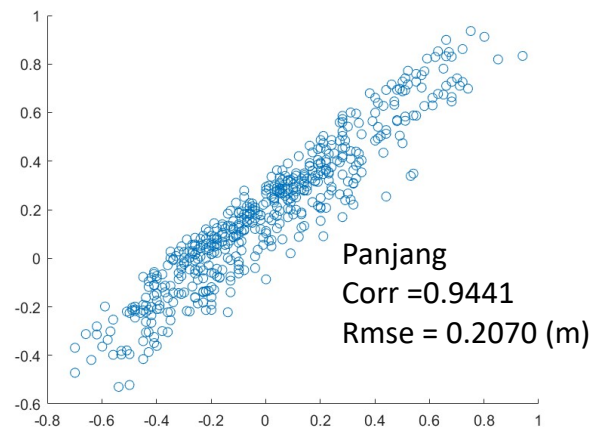
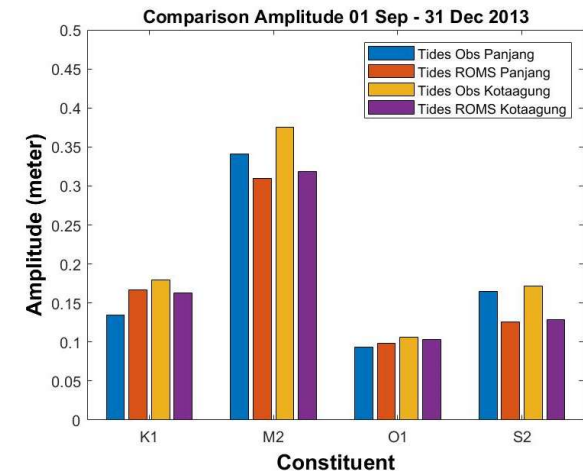
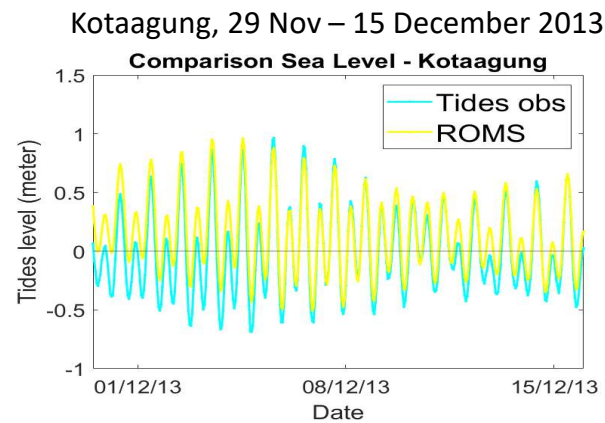
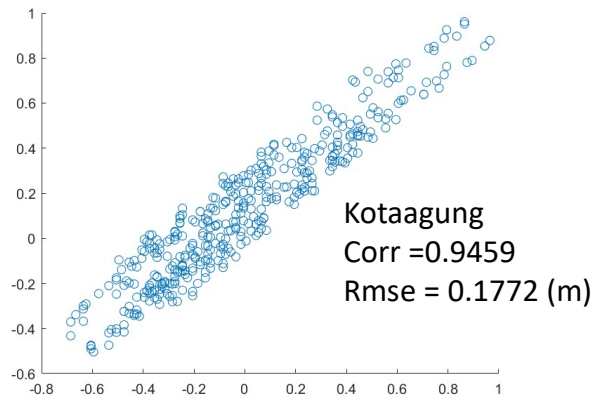


Comparison ROMS and HF radial velocity



- Note: ROMS output without tides

Comparison ROMS Sea level and Tides obs



Source tides observations : <https://www.big.go.id/>

Conclusion

- RMS of SST and the time series can be used as an initial indicator to assess the ROMS outputs.
- Validation result shows that the further simulations are needed to improve by considering
 - The modified topography steep coefficient
 - The modified nudging value
 - Simulation of a three-month or four-month interval and using the initial condition from the previous simulation

Acknowledgement

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HF Radar data was provided by the Agency for Meteorology, Climatology, and Geophysics of the Republic of Indonesia (BMKG)

Rivers data were provided by the Indonesian Waters Resource Center (<https://www.pusair-pu.go.id/>)

Funding for the development of HYCOM has been provided by the National Ocean Partnership Program and the Office of Naval Research. Data assimilative products using HYCOM are funded by the U.S. Navy. Computer time was made available by the DoD High Performance Computing Modernization Program. The output is publicly available at <https://hycom.org>

Computational resources have been provided by the Consortium des Équipements de Calcul Intensif (CÉCI), funded by the Fonds de la Recherche Scientifique de Belgique (F.R.S.-FNRS) under Grant No. 2.5020.11 and by the Walloon Region

Satellite SST data were provided by JPL under support by NASA MEaSUREs program

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