

(1) **HYCOM-CICE** – HYbrid Coordinate Ocean Model (HYCOM) - Community Ice CodE (CICE); Coupled ocean and sea ice system

(2) **DMI** – Danish Meteorological Institute, Copenhagen, Denmark

Till Soya Rasmussen <tar@dmu.dk>

(3) **Available modes for the model runs:** Research, semi-operational and operational

(4) **Components & processes:** Physical ocean and sea ice; ocean includes tracers

(5) **Brief model description**

The ocean and sea-ice model system at the Danish Meteorological Institute, DMI [Madsen et al., 2016] consists of the HYCOM v2.2.98, e.g. [Chassignet et al., 2007] and CICE v4.0 e.g. [Hunke and Dukowicz, 1997; Hunke, 2001] coupled with the Earth System modeling Framework (ESMF) coupler [Collins et al., 2004]. The model is forced with either operational data from ECMWF or ERA – Interim [Dee et al., 2011]. It assimilates sea ice concentration based on OSISAF [Eastwood et al., 2011] and SST from the global DMI_OI Level 4 analysis [Høyer et al., 2014]. The horizontal resolution is approximately 10 km in order to ensure an eddy-permitting ocean model and resolve the coastal shelf waters, while balancing computational resources. The domain covers the Arctic Ocean and the Atlantic Ocean to approximately 20°S, see Figure 1.

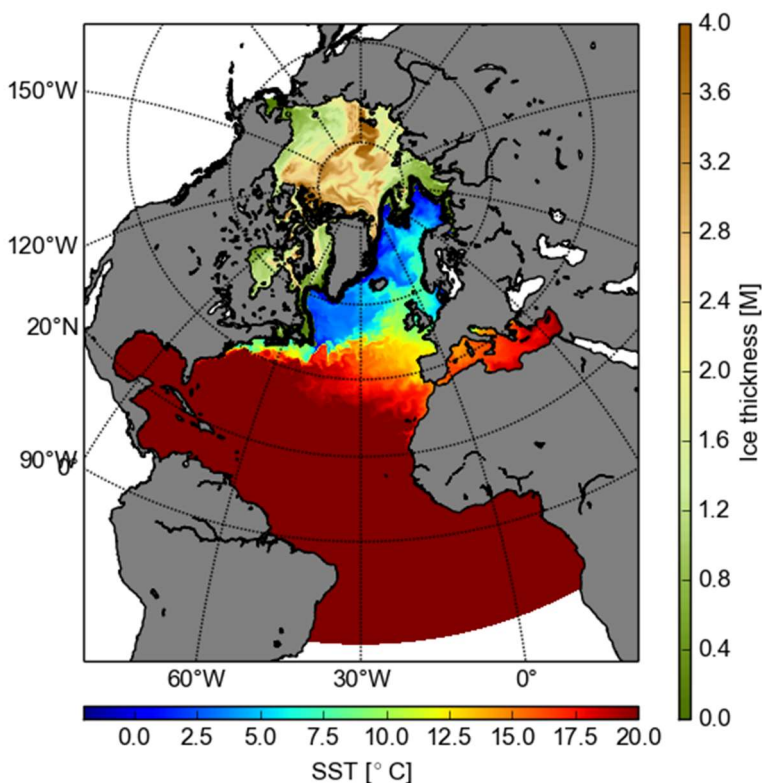


Figure 1 Snapshot of sea surface temperatures (SST) and ice thickness of the DMI coupled ocean and sea ice model. Ice thickness is shown where the ice concentrations is higher than 15%. Vertical colorbar illustrates ice thickness whereas the horizontal colorbar illustrates SST. The black contour around the sea ice edge illustrates the 15% ice concentration. Gray areas are land and white areas are areas that are not covered by the model domain. The model domain extends from 20°S in the Atlantic ocean northwards including the Arctic ocean.

The coupled model system describe the three dimensional flow of the ocean, the horizontal flow of the sea-ice and the thermodynamics of the ocean and the sea-ice. All model setups at DMI include tides and it is possible to do tracer experiments. CICE is a multi-category sea-ice model that in addition to the previous mentioned details describes the redistribution of sea-ice

between the different ice thickness categories. The model system can be setup as nested areas in high resolution, see e.g. [Rasmussen et al., 2011]

References:

- Chassignet, E. P., H. E. Hurlburt, O. M. Smedstad, G. R. Halliwell, P. J. Hogan, A. J. Wallcraft, R. Baraille, and R. Bleck (2007), *The HYCOM (Hybrid Coordinate Ocean Model) data assimilative system*, *Journal of Marine Systems*, 65, 60–83.
- Collins, N., G. Theurich, C. DeLuca, M. Suarez, T. A. V. Balaji, P. Li, W. Yang, and C. Hill (2004), *Design and implementation of components in the earth system modeling framework*, *International Journal of High Performance Computing Applications*, 19(3), doi:doi:10.1177/1094342005056120.
- Dee, D. P., S.M. Uppala, A.J. Simmons, P. Berrisford, P. Poli, S. Kobayashi, U. Andrae, M.A. Balmaseda, G. Balsamo, P. Bauer, P. Bechtold, A.C.M. Beljaars, L. van de Berg, J. Bidlot, N. Bormann, C. Delsol, P. Dragani, M. Fuentes, A.J. Geer, L. Haimberger, S.B. Healy, H. Hersbach, E.V. Holm, L. Isaksen, P. Kaallberg, M. Kohler, M. Matricardi, A.P. McNally, B.M. Monge-Sanz, J.J. Morcrette, B.K. Park, C. Peubey, P. de Rosnay, C. Tavolato, J.N. Thepaut, F. Vitart (2011), *The ERA-Interim reanalysis: configuration and performance of data assimilation system*, *Quart. J. R. Meteorol. Soc.*, 137, 553 – 597.
- Eastwood, S., K. Larsen, T. Lavergne, E. Nielsen, and R. Tonboe (2011), *Global sea ice concentration reprocessing - product user manual. product osi-409*, Tech. rep.
- Hunke, E. C. (2001), *Viscous-plastic sea ice dynamics with the EVP model: linearization issues*, *Computational Physics*, 170, 18–38.
- Hunke, E. C., and J. Dukowicz (1997), *An elastic-viscous plastic model for sea ice dynamics.*, *Journal of Physical Oceanography*, 27, 1849–1867.
- Høyer, J. L., P. L. Borgne, and S. Eastwood (2014), *A bias correction method for arctic satellite sea surface temperature observations*, *Remote Sensing of the Environment*, 146, 201–213.
- Madsen, K. S., T. A. S. Rasmussen, M. H. Ribergaard, and I. M. Ringgaard (2016), *High resolution sea-ice modelling and validation of the arctic*, *PolarForschung*, 85(2), 101–105.
- The Faroe shelf circulation and its potential impact on the primary production*, Rasmussen, Till Andreas Soya, Olsen, Steffen M., Hansen, Bogi, Hátún, Hjálmar, Larsen, Karin M.H., *Continental Shelf Research*, 88 (2014)