## ARCTIC OCEAN PHYSICS ANALYSIS AND FORECAST

**PRODUCT IDENTIFIER**

ARCTIC_ANALYSIS_FORECAST_PHYS_002_001_a

**GEOGRAPHICAL COVERAGE**

Areas:
- arctic-ocean

**VARIABLES**

- sea_water_potential_temperature (T)
- sea_water_potential_temperature_at_sea_floor (bottomT)
- sea_water_salinity (S)
- sea_surface_height_above_geoid (SSH)
- sea_water_x_velocity (3DUV)
- sea_water_y_velocity (3DUV)
- ocean_mixed_layer_thickness_defined_by_sigma_theta (MLD)
- sea_ice_area_fraction (SIC)
- sea_ice_thickness (SIT)
- sea_ice_x_velocity (SIUV)
- sea_ice_y_velocity (SIUV)
- surface_snow_thickness (SNOW)
- age_of_sea_ice (SIAGE)
- sea_ice_albedo (SIALB)
- sea_surface_elevation ()

**OBSERVATION/MODELS**

numerical-model

**PRODUCT TYPE**

near-real-time
forecast

**PROCESSING LEVEL**

L4

**DATA ASSIMILATION**

In-Situ TS Profiles
- Sea Level
- SST
- Sea Ice Concentration and/or Thickness

**SPATIAL RESOLUTION**

12.5km x 12.5km

**VERTICAL COVERAGE (m)**

from -3000 to 0 (12 levels)

**COORDINATE REFERENCE SYSTEM**

NSIDC Sea Ice Polar Stereographic North (EPSG 3411)

**FEATURE TYPE**

Grid

**TEMPORAL COVERAGE**

from 2011-10-19 to Present

**TEMPORAL RESOLUTION**

hourly-instantaneous
daily-mean
| **UPDATE FREQUENCY** | daily  
  (Forecast: following day at 00:30 UTC; Analysis: Mondays at 14:00 UTC) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRODUCTION UNIT</strong></td>
<td>ARC-METNO-OSLO-NO</td>
</tr>
<tr>
<td><strong>ORIGINAL FILE FORMAT</strong></td>
<td>NetCDF-3</td>
</tr>
</tbody>
</table>
ARCTIC OCEAN PHYSICS ANALYSIS AND FORECAST

Short description:
The operational TOPAZ4 Arctic Ocean system uses the HYCOM model and a 100-member EnKF assimilation scheme. It is run daily to provide 10 days of forecast (average of 10 members) of the 3D physical ocean, including sea ice; data assimilation is performed weekly to provide 7 days of analysis (ensemble average).

Detailed description:
Operational Ocean General Circulation Models describe routinely the 4D evolution of the physical ocean and sea ice variables, such as temperature, salinity, currents, sea level height, sea ice thickness and concentration. The TOPAZ system has provided analyses and forecasts for the Atlantic and Arctic Basins since 2003, assimilating available satellite and in situ observations. TOPAZ has provided the Arctic physics analysis and forecast component of the product suite for MyOcean (2009-2015) and for CMEMS since May 2015.

Processing information:
The current version of the TOPAZ system - TOPAZ4 - uses the latest version of the Hybrid Coordinate Ocean Model (HYCOM) developed at University of Miami (Bleck 2002). HYCOM is coupled to a sea ice model; ice thermodynamics are described in Drange and Simonsen (1996) and the elastic-viscous-plastic rheology in Hunke and Dukowicz (1997). The model's native grid covers the Arctic and North Atlantic Oceans, is obtained by conformal mapping and has fairly homogeneous horizontal spacing (between 11 and 16 km). 28 hybrid layers are used in the vertical (z-isopycnal). TOPAZ4 uses the Ensemble Kalman filter (EnKF; Sakov and Oke 2008) to assimilate remotely sensed sea level anomalies, sea surface temperature, sea ice concentration, sea ice thickness and Lagrangian sea ice velocities (the latter two in winter only), as well as temperature and salinity profiles from Argo floats. All assimilation data are acquired from the CMEMS Thematic Assembly Centres: Sea Level TAC, Sea Surface Temperature TAC, Ocean and Sea Ice TAC and In Situ TAC. The output consists of daily mean fields interpolated onto standard grids in NetCDF CF format. Surface fields are provided at hourly frequency. Variables include 3D currents (U, V), temperature and salinity, as well as 2D fields of sea ice parameters, sea surface height, mixed layer depth and more. Data assimilation, including the 100-member ensemble production, is performed weekly on Mondays to produce a week-long analysis (ensemble average) and initialize a 10-day forecast. A new 10-day forecast is produced daily using the previous day's forecast and the most up-to-date prognostic forcing fields. From April 15 2014 onwards, the daily updated forecast fields are the mean of a 10-member ensemble, which is based on 10 of the ensemble members from the most recent analysis.

Resolution:
For output products: 12.5 km at the North Pole (equivalent to 1/8 deg in mid-latitudes)

Quality/accuracy/calibration information:
The quality of the data products and the production chain is monitored in accordance with CMEMS guidelines and metrics. Accuracy is monitored and assessed weekly by human expertise as an internal process; visual checks, metrics computation and assimilation diagnosis are employed. Production and data quality are assessed and reported on a quarterly basis as a comprehensive CMEMS process; Service Management Reports, Quarterly Performance Reports.

Suitability, Expected type of users / uses:
7 main uses are targeted:

1. Lateral boundary conditions for regional or coastal forecasting models.
2. Analyses and forecasts of 3D currents and sea ice for the offshore oil and gas industry.
3. Initialization of climate forecast (decadal, seasonal)
4. Coupled forecasting of ocean biogeochemistry (primary production) and surface waves.
5. Evaluation of the ocean observation network and recommendations.
6. Ocean analyses for environmental agencies' regular assessments.
7. Engage and educate the public at large.

REFERENCES