North West European Shelf
Operational Oceanographic System

NOOS annual report 2015

Member report – MET Norway

News in red!   October 2015

Country	Norway
Institution	Meteorologisk institutt/Norwegian Meteorological Institute (MET Norway)

Observations
Status and new initiatives
	Status:
	
	• MET Norway operates the Norwegian national network of synoptic weather observations, both on land and on offshore installations in the North and Norwegian Seas.
	• Limited *in situ* ocean observations are collected in real-time at offshore sites in the North and Norwegian Seas and archived at MET Norway.
	   1. Waves: NRT datafeeds from 4 North Sea platforms (Sleipner A, Oseberg A, Heimdal, Gullfaks C, Troll A) to the NOOS data exchange have been implemented*. Ekofisk NRT data are not freely available.
	   2. Water level: Ekofisk (NRT data not freely available)
	   3. Temperature (near-surface): Heimdal (bundled with wave data)
	• Hosts EUMETSAT OSI-SAF high latitude centre. Provides satellite sea ice, SST and radiative flux observations. http://osisaf.met.no
	• Provides NRT river data for all major Norwegian rivers to NOOS repository*. Also included in the data provision are HBV model data for Swedish rivers from SMHI.
	
	New Initiatives:
	• MET Norway is in the process of acquiring three medium-range CODAR SeaSonde HF radars from ENI, which will converted to long-range and deployed at the entrance to the Barents Sea in 2016. Three old SeaSondes from Fedje have been donated to MET and two will be refurbished. One will be deployed on Torungen island close to Arendal in December 2015. The position of the second radar is yet to be decided.

Modelling **Status and new initiatives**	*Status:* Operational physical: • *Regional – North Atlantic and Arctic Oceans*: TOPAZ (with NERSC, IMR); HYCOM coupled ocean-ice code; ~12 km curvilnear grid; climatological OBC; weekly analysis with daily updated 10-day forecast, 12 depths; assimilation of SST, altimeter SLA, T/S profiles, ice concentration and ice drift using EnKF. One-way coupled ecosystem model NORWECOM, no specific data assimilation. CMEMS Arctic MFC product. Figure 1. • *Regional – North Atlantic and Arctic Oceans*: Arctic.20KM; ROMS coupled ocean-ice code; 20 km polar-stereographic grid; nested in FOAM global; daily updated 10-day forecast; assimilation of ice concentration. Free output: daily means, 17 depths; hourly, 2 depths (0,3). • *Regional – Nordic Seas*: Nordic.4KM; ROMS coupled ocean-ice code; 4 km polar-stereographic grid; OBC from Arctic.20KM; 8 tidal constituents; twice daily updated 5-day forecast; assimilation of SST. Free output: daily mean, 17 depths; hourly, 2 depths (0,3). • *Coastal – Norwegian coast*: NorKyst.800M: ROMS coupled ocean-ice code; 800 m

	polar-stereographic grid; OBC from Nordic.4KM; daily updated 66-hour forecast; no assimilation. Free output: daily mean, 17 depths; hourly, 10 depths. • See Figure 2. Operational wave: • Regional – Northern hemisphere: WAM code; 50 km rotated geographic grid; daily updated 66-hr forecasts. To be retired. • Regional – Nordic Seas: WAM code; 10 km polar-stereographic grid; twice daily updated 66-hr forecasts. To be retired. • Regional – Norwegian coastal waters: WAM code; 4 km polar-stereographic grid; twice daily updated 66-hr forecasts. To be retired. • Regional – North & Nordic Seas: MyWave WAM code; 4 km polar-stereographic grid; daily updated 66-hr forecasts. In operational validation phase. • ECMWF global used elsewhere; 0.25°; twice daily updated 10 day forecast. • Coastal – Mid-Norway: Trondheimsleia SWAN; 500m polar-stereographic grid; daily updated 24 hr forecast. • Coastal – West-Norway: Karmøy SWAN; 200m polar-stereographic grid; daily updated 24 hr forecast. • Coastal – North-Norway: Sørøya SWAN; 100m polar-stereographic grid; daily updated 24 hr forecast. • See Figure 3. Emergency response: • *Oil spill fate:* OSCAR and OD3D codes operational; real-time forcing data (wind, wave, currents, temperature, salinity) from MET Norway. • *Drifting objects (search and rescue):* LEEWAY code; real-time forcing data (wind, currents) from MET Norway. • *Ship drift:* SHIP code; real-time forcing data (wave, currents) from MET Norway. Pre-operational, experimental and other: • 50-year (1959-2008) hindcast of ROMS on extended Nordic.4KM grid completed (SVIM project). Available by ftp. • ROMS.eps: Ensemble waterlevel forecasting. ROMS on large subdomain of Nordic.4KM. Forcing by ECMWF EPS (11 members). Pre-operational. See Figure 2. • Implementation of 4DVar for ROMS: satellite SST and ice concentration, in situ profile data, **HF Radar**. Ongoing internal project with PhD student. • Participating in national Center of Excellence program on radioactivity impacts on the environment; development of models for transport of radioactivity in the ocean. ***New initiatives:*** • E-HYPE hindcast river data implemented in ROMS and run in multidecade hindcast production; E-HYPE real-time forecast data ready for implementation in ROMS for operational forecasting. Delayed due to manpower. • Implement Arctic WAM using MyWave WAM code as wave component of CMEMS ARC MFC. Cover Arctic Ocean and Nordic Seas to ~50°N on 8 km grid. Target for operations: 2016 (2017 for CMEMS release). Figure 4 • Replace operational Arctic.20KM and Nordic.4KM with Arctic.4KM. Target for Operations: 2017. • Nordic.4KM.EPS . Target for Operational Suite: 2016. • Deterministic run with 4DVar on ROMS.eps domain. Target for Test Suite: mid 2016. • OpenDrift code nearing completion; framework for drift of substances and objects. Basis for upgraded OD3D (oil spill fate), Leeway (objects, SAR) and ship drift services. Operational mid-2016. Figure 5 • Reinstate basic ecosystem forecasting (collab. IMR). Offline coupling of NORWECOM to ROMS. Postponed.
Dissemination Status and new	***Status:*** • Some MET Norway operational ocean products available for viewing and download

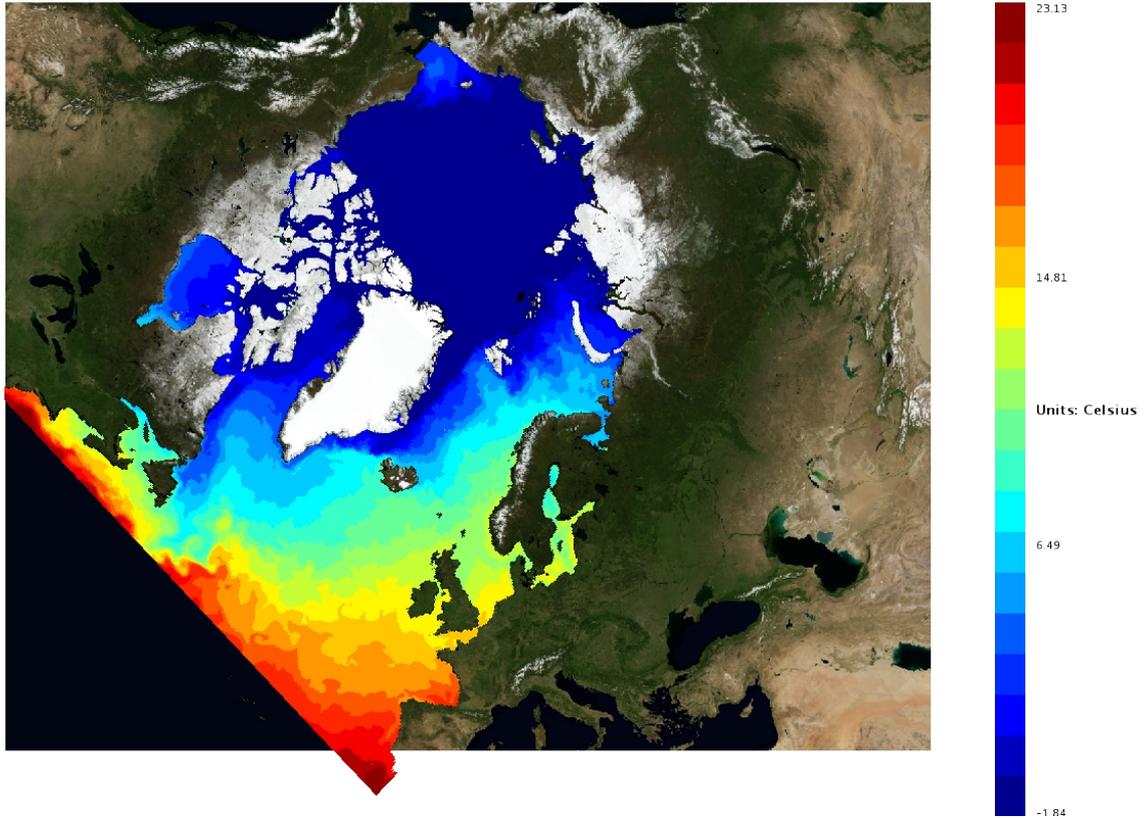| initiatives	(grib) at http://www.yr.no/hav_og_kyst/.
	• Core forecast products freely available by OpeNDAP and WMS at http://thredds.met.no/thredds/fou-hi/fou-hi.html. Currently contains data from NorKyst.800M coastal ocean model, Nordic.4KM regional ocean mode, Arctic.20KM basin ocean model, WAM.10KM* wave model and HIRLAM.10KM* atmospheric model.
	• MET Norway operates Dissemination Units for 2 CMEMS production centers. Products available for viewing (WMS) and download (SUBSETTER, DirectGetFile and MFTP) via http://marine.copernicus.eu.
	• ARC MFC - TOPAZ4 physical and biogeochemical forecasts and reanalyses;
	• OSI TAC - satellite sea ice products (also from DMI, FMI, DTU, NERSC, BAS).
	• Routine validation of CMEMS ARC MFC forecast products are published at http://myocean.met.no/ARC-MFC/V2Validation/index.html.
	• Online validation of ROMS Arctic20, Nordic4 and NorKyst800 at https://projects.met.no/ocmod/validation/index.html.
	New initiatives
	• Common portal for dissemination of all freely available ocean and sea ice products from MET Norway. Uses catalogue, OpeNDAP, http and WMS services for discovery, viewing and download. Implementation started with http://normap.met.no/metamod/.
Relevant national projects	Norwegian Research Council: **OilWave** (improved surface fluxes from wave models) Norwegian Research Council: **NORMAP** (national archive of satellite data) Norwegian Research Council: **ModOIE** (develop & validate Arctic 4km, 17 year hindcast) Norwegian Navy: **GEOMETOC** (development of services for naval applications) Foreign Min.: **BarentsWatch** (national portal for the "greater" Barents Sea. Opened 30 May 2012 at http://www.barentswatch.no)
Relevant International projects	NOAA: **Deep-C:** Development of community oil spill fate code. EU FP7: **PREPARE** (subcontractor to build a simple interface to online ocean forcing data)
Additional information	B. Hackett is member of JCOMM ETMSS (Expert Team on Maritime Safety Services).

Figure 1: CMEMS Arctic MFC product coverage. Data produced by TOPAZ4 assimilation system, run in forecast/analysis mode at MET Norway and in reanalysis mode at NERSC.
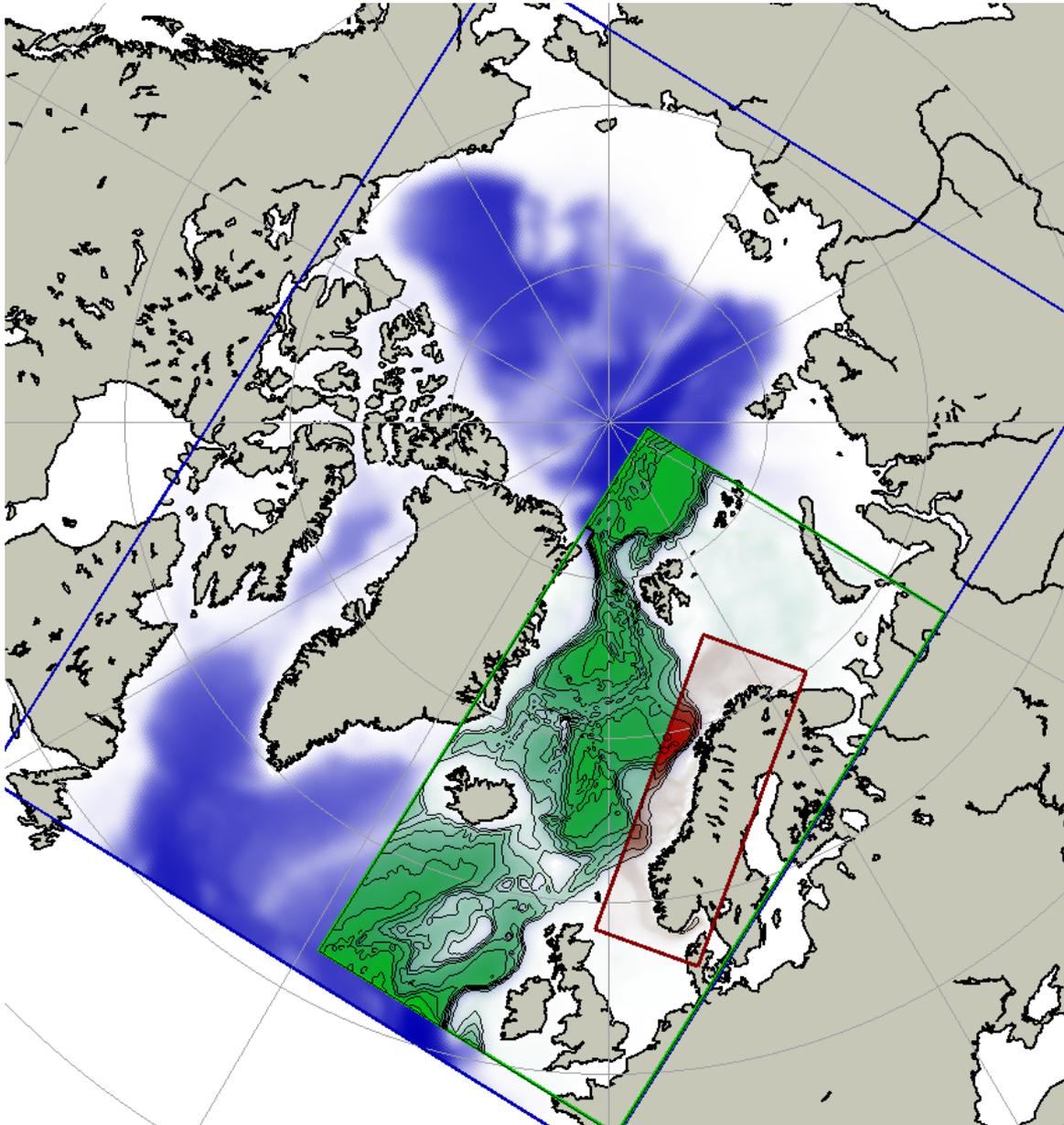
Figure 2: Nested operational hydrodynamical model system at MET Norway. Grid spacings: outer domain 20 km; intermediate domain 4 km; inner domain 800m. Outer model gets open boundary conditions from UK Met Office global FOAM.
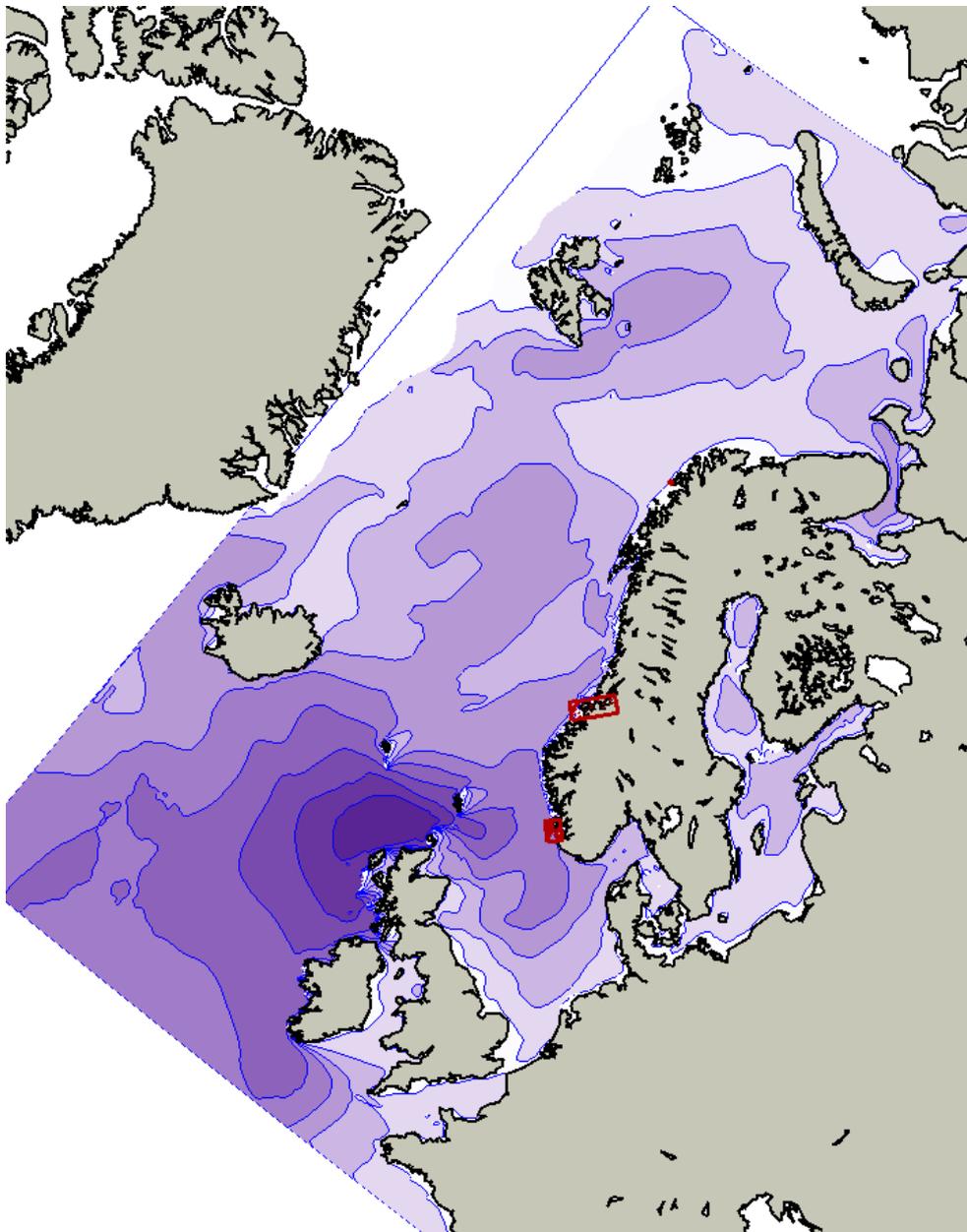
Figure 3: Operational wave model system at MET Norway. Colored field is WAM 4 km (MyWave version). The 3 small red boxes are domains of coastal SWAN models. ECMWF global WAM 0.25° used elsewhere.
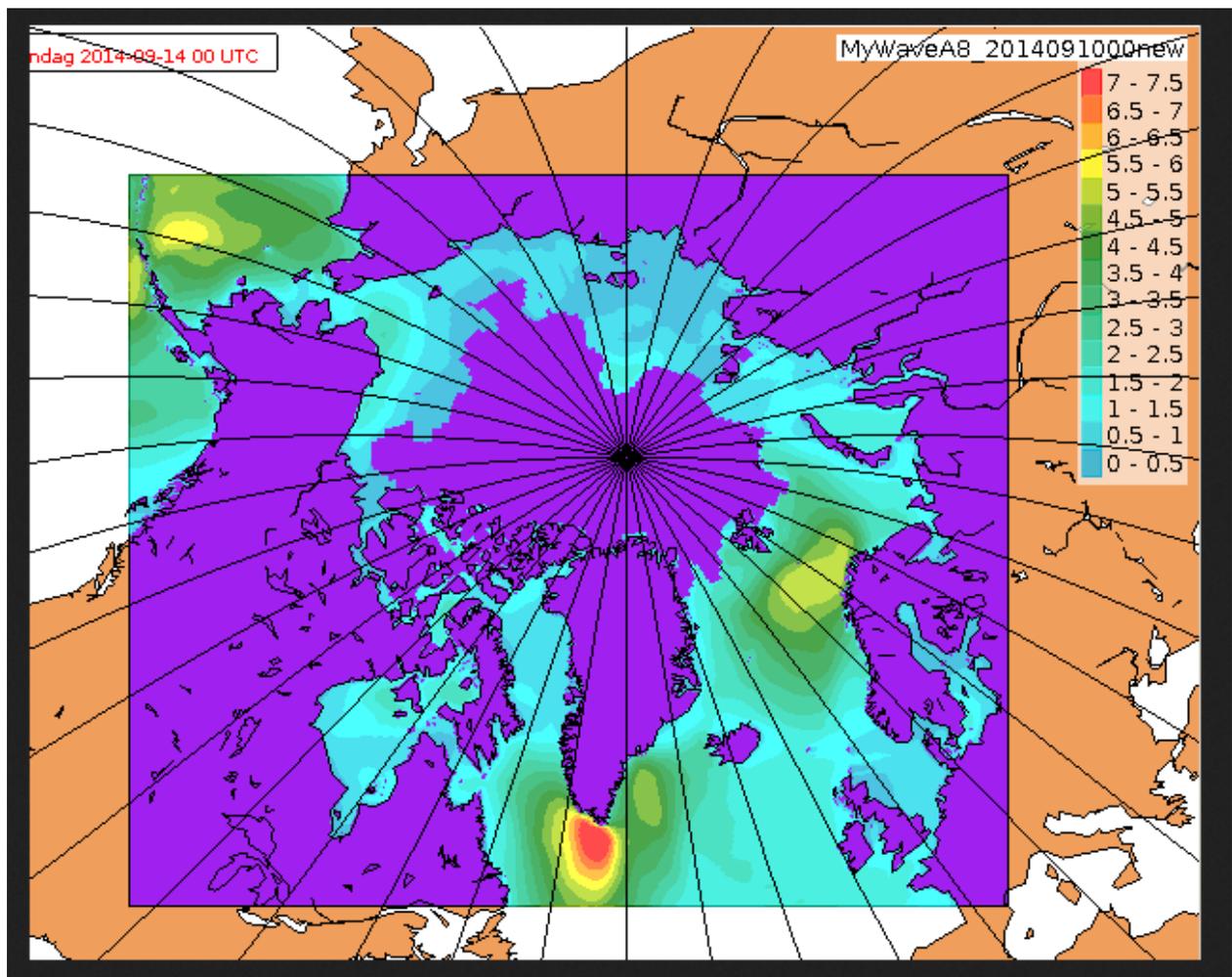
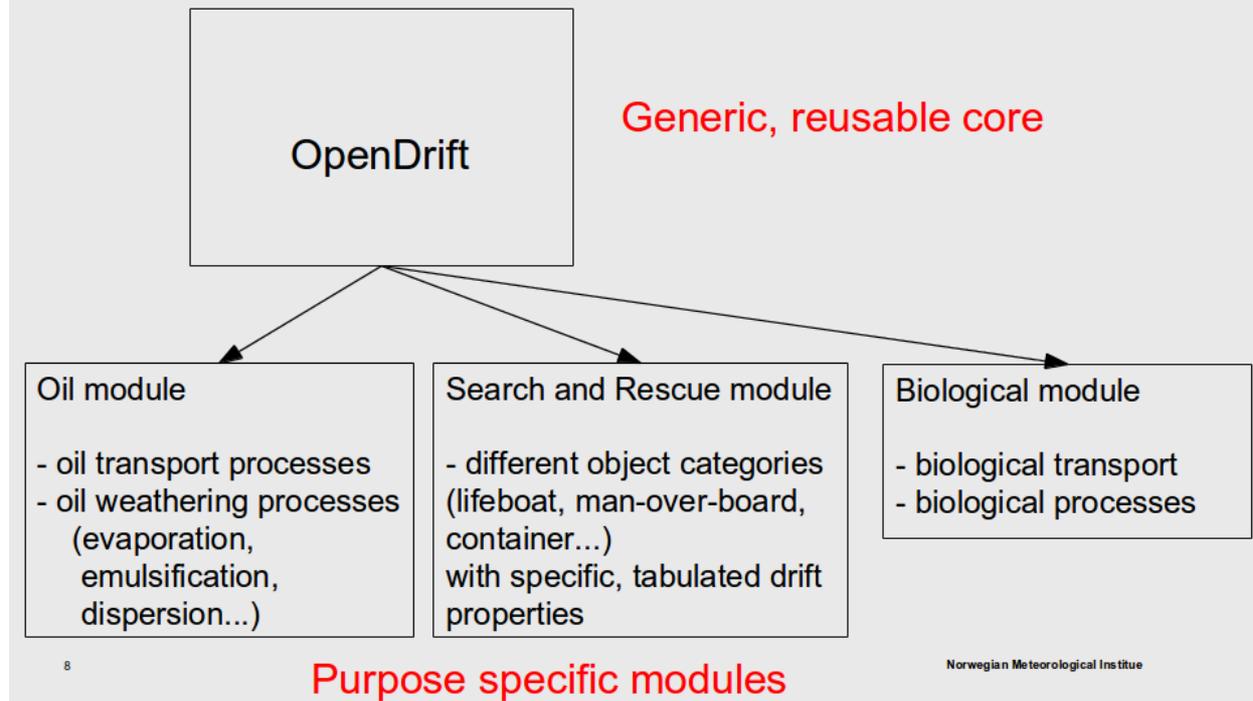*Figure 4: CMEMS Arctic WAM domain (draft). Operational product from CMEMS from April 2017*
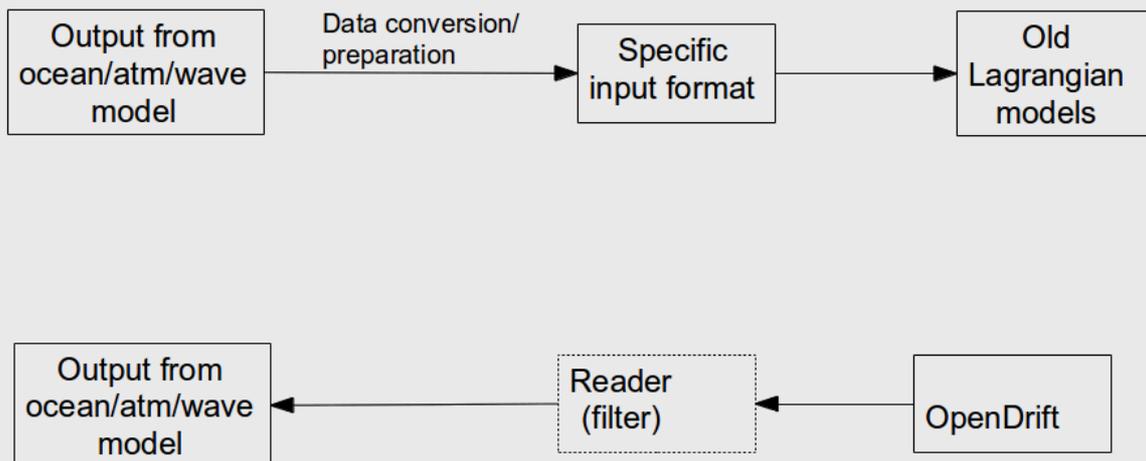
Figure 5: OpenDrift framework to provide geophysical forcing data to emergency drift modeling services.

Avoid preprocessing of input data

Readers may request remote data

- NetCDF C/F through Thredds data server (OPeNDAP protocol)
- Almost as fast as from local files(!)
- Convenient not having to download large amount to local computer, when only a small part is needed
    - especially the case for third party users (e.g. oil companies)

Example of free, online sources of winds, waves and currents:

http://thredds.met.no/thredds/dodsC/sea/norkyst800m/1h/aggregate_be
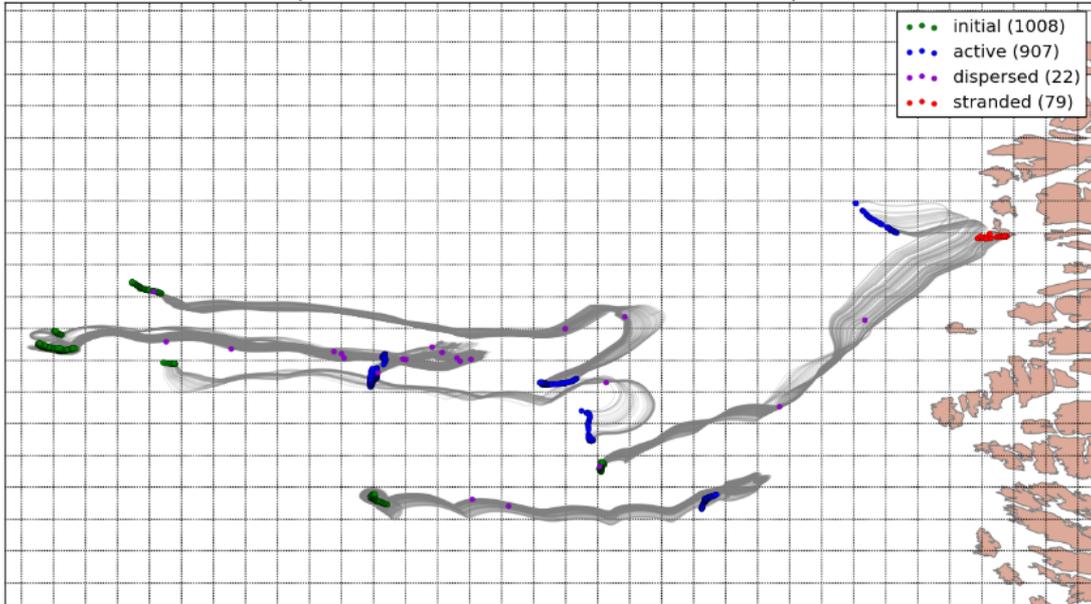http://thredds.met.no/thredds/dodsC/arome25/arome_metcoop_default2_5km_latest.nc
http://tds0.ifremer.fr/thredds/dodsC/CLS-L4-CUREUL_HS-ALT_SUM-V01.0_FULL_TIME_SERIE
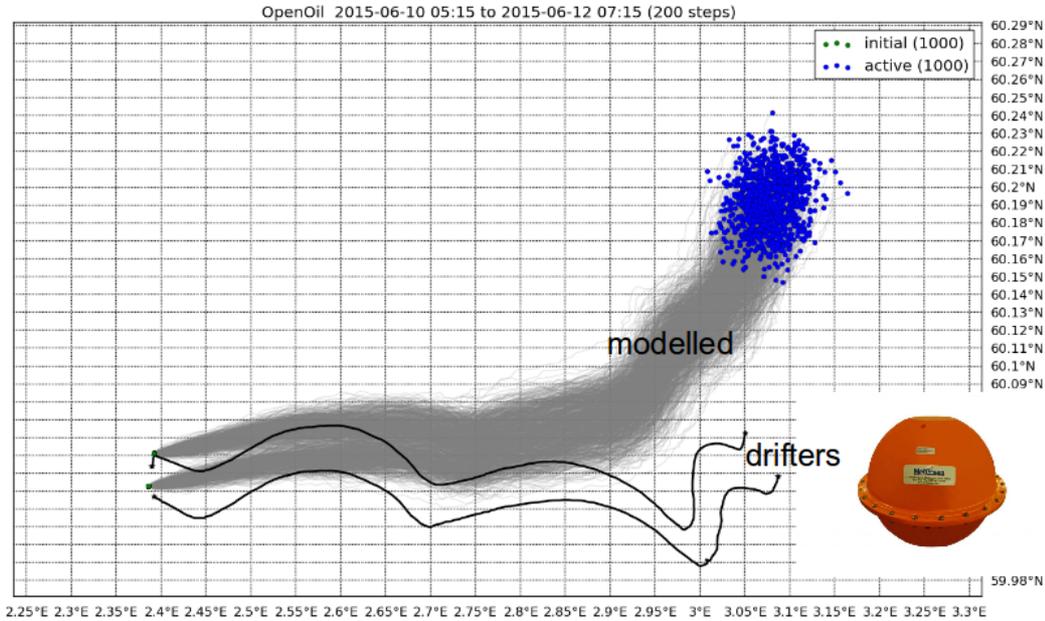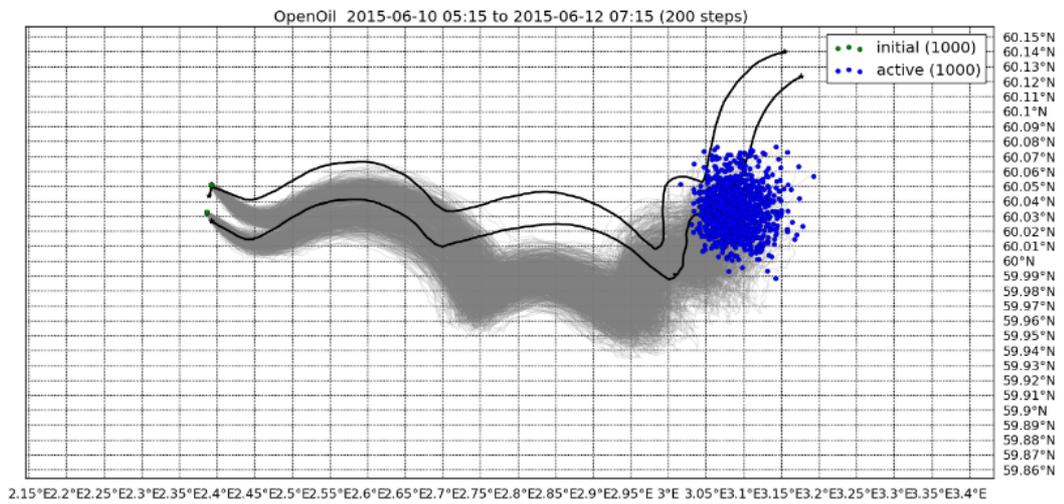http://tds.hycom.org/thredds/dodsC/GLBu0.08/expt_19.1/2010/3hrly
http://www.ncdc.noaa.gov/thredds/dodsC/oceanwinds6hr

Initialisation from satellite images

OpenOil 2015-06-08 17:14 to 2015-06-13 22:14 (250 steps)

Legend:
- initial (1008)
- active (907)
- dispersed (22)
- stranded (79)

Modelled with wind drift only

OpenOil 2015-06-10 05:15 to 2015-06-12 07:15 (200 steps)

Modelled with currents and wind drift

OpenOil 2015-06-10 05:15 to 2015-06-12 07:15 (200 steps)

Using NorKyst800 and Arome
50 hour simulation