



Visualizing and comparing In-Situ, Model and EO data

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At NERSC, we utilize a large variety of data. For the most part, we can categorize the data in three main categories:

In-Situ Data

We have oceanographical In-Situ data back from 1850 to 2015
E.g. ocean chemistry, ocean physics, rate measurements, plankton and chlorophyll

Numerical Model Data

Ecosystem modelling
Large-scale climate dynamics modelling
Sea ice modelling

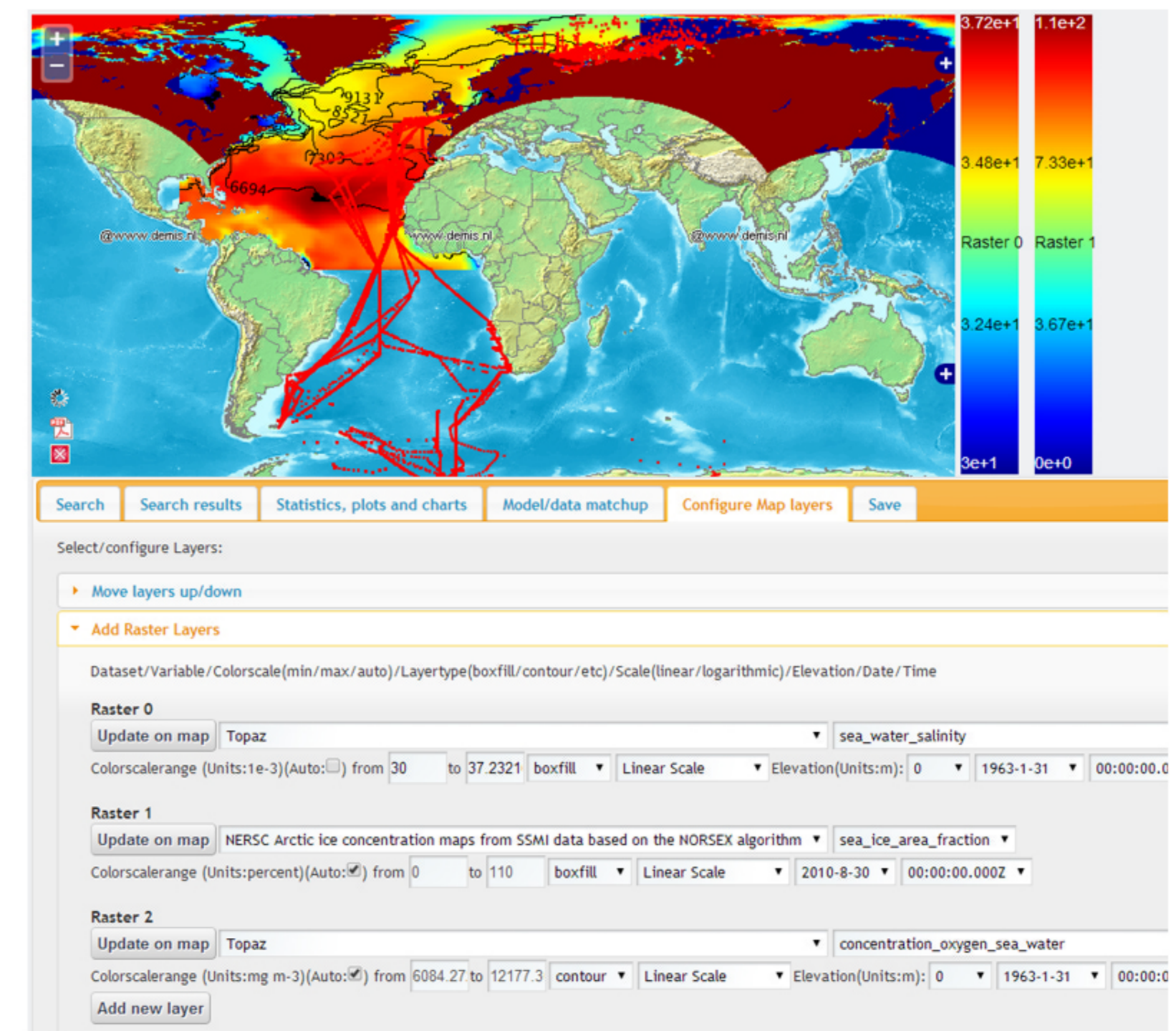
Earth Observation Data

Mostly from satellites
We're computing e.g. ice concentration/drift, wind, currents and temperatures from satellite sensors

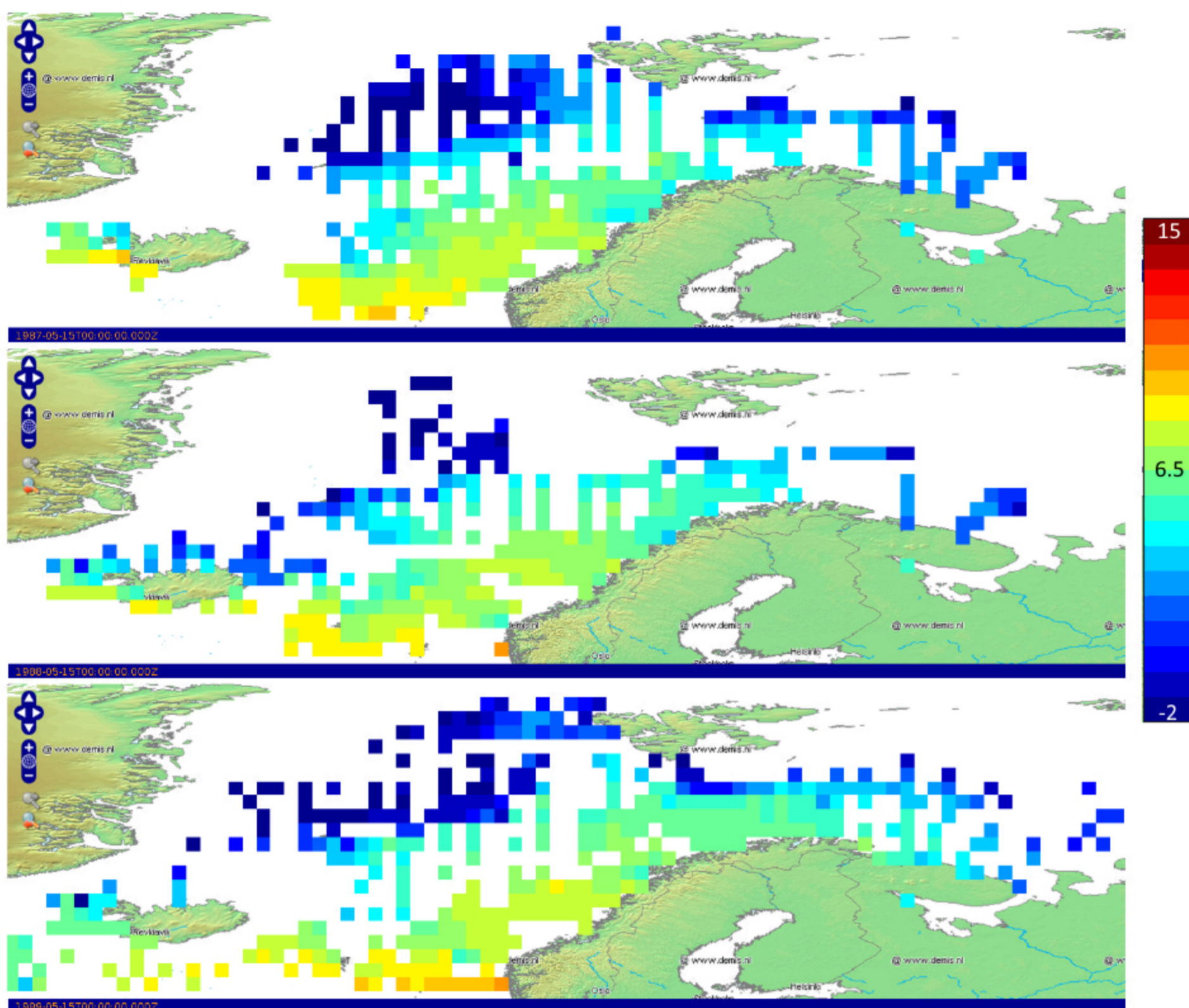
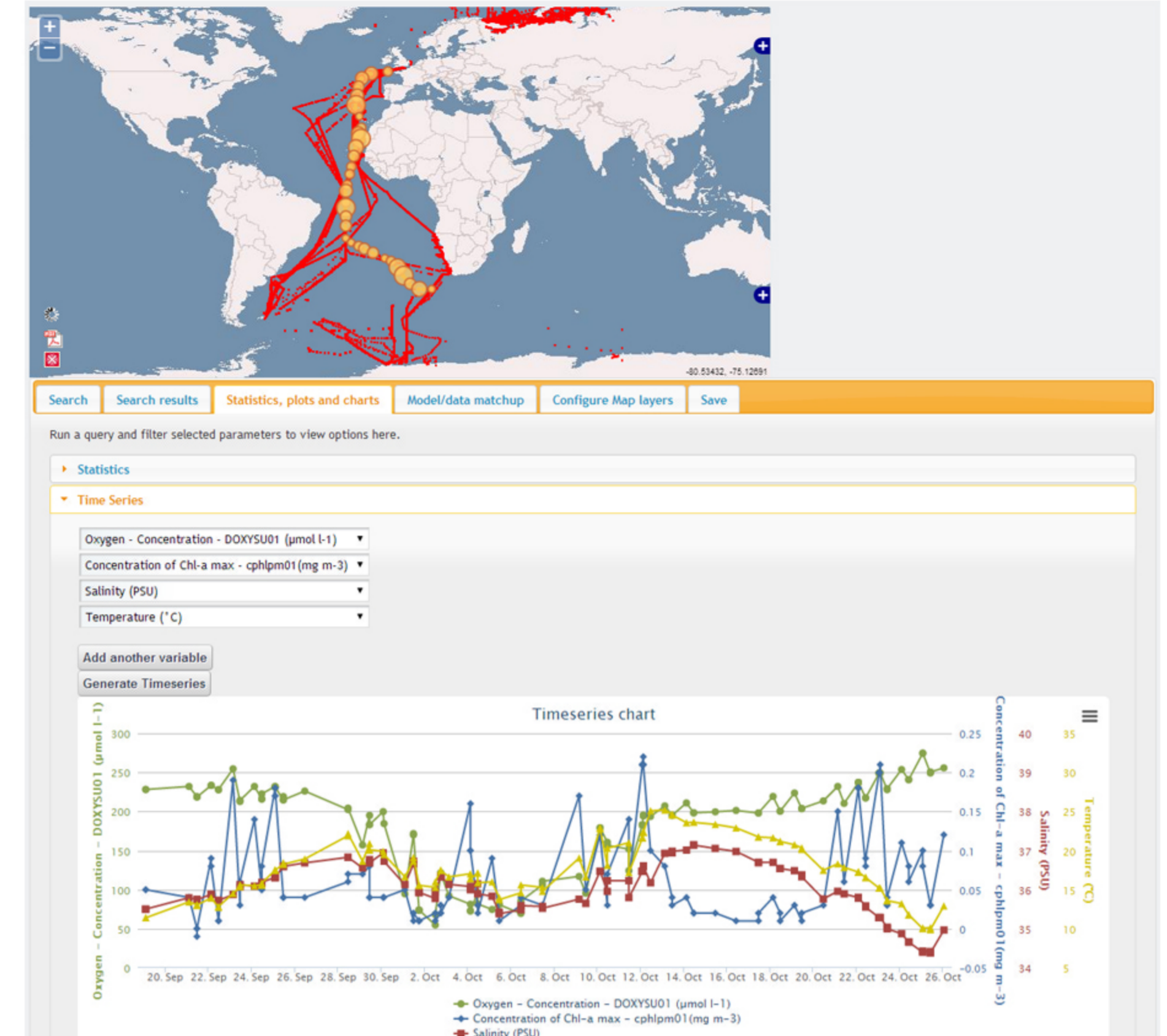
My work, in the three projects GreenSeas, NMDC and NORMAP, has prioritized the availability and searchability of the data. The visualization of this data has consisted of 2D images, maps and charts. The challenge we face, which has not been prioritized, is how to visualize and compare all the various oceanographical data types. In addition, we want to find a method that improves the co-location, both temporal and spatial, of data. The easiness of co-location is essential for scientists to be able to find useful data.

This poster is displaying how the data has been visualized, and it is meant to give the viewer an idea of what the different kinds of data are, to stimulate a discussion on how it would be possible to visualize this in a better way.

Right: The GreenSeas web client can display various types of data, and multiple layers at ones. This screenshot presents oxygen and salinity levels from the Topaz model as well as sea ice concentration computed from satellite images.

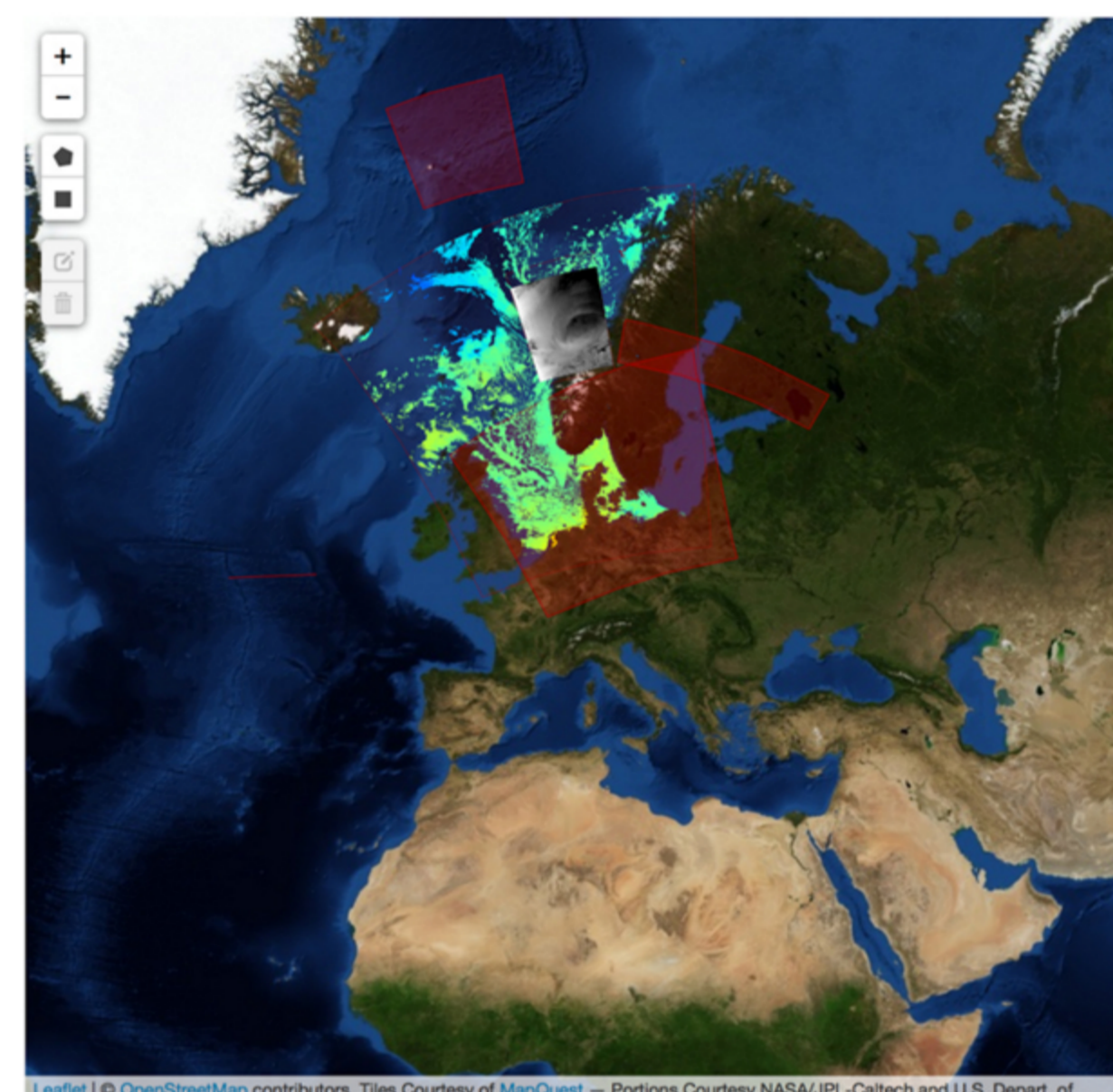


Right: The surface data for four different variables, oxygen, chlorophyll, salinity and temperature, for an AMT cruise visualized in a timeseries chart.



Left: In-Situ temperature data from May 1987, 1988 and 1989 has been interpolated to a 1 degree grid and the resulting dataset could make it easier to co-locate data. The images themselves are taken from a gif which shows an animation of data for the month of May from 1880-2005. These years have been chosen as they are the ones with the highest spatial coverage.

Nansen-cloud data archive

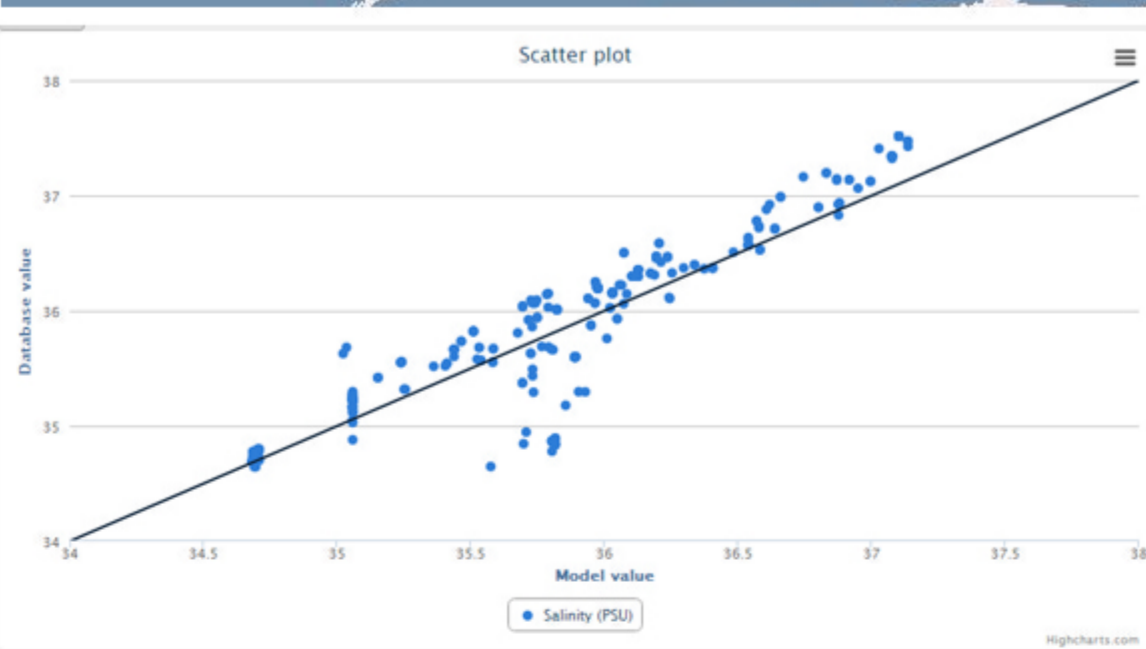
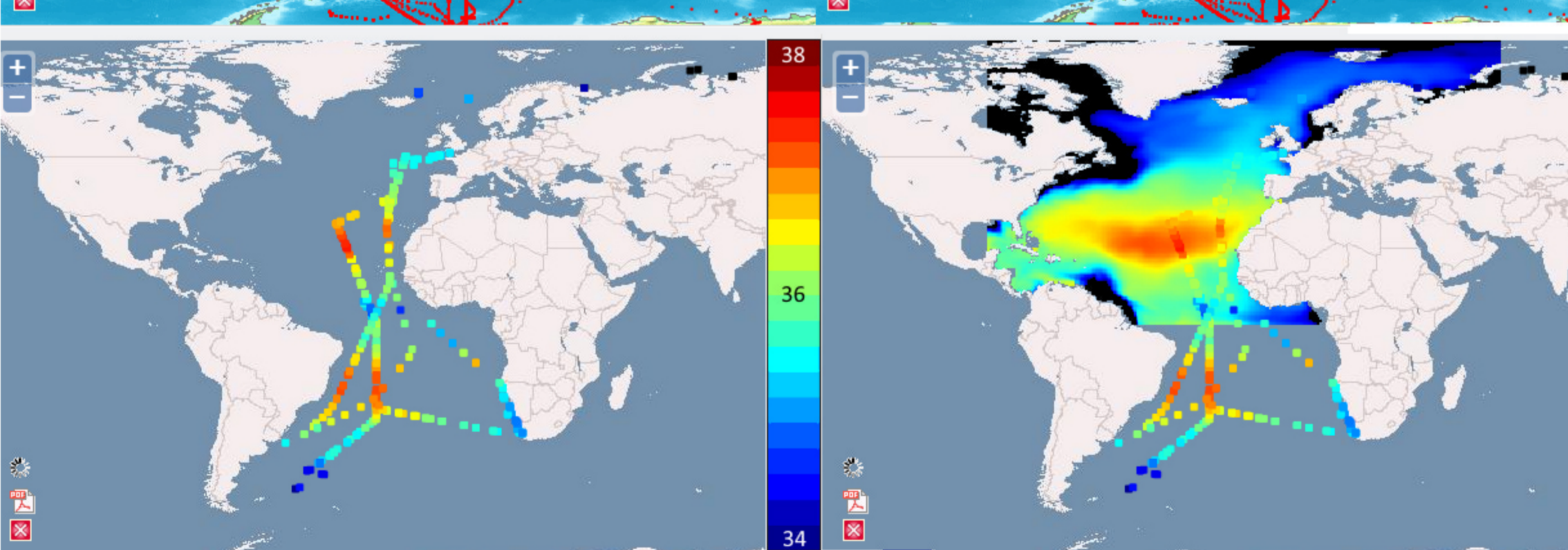
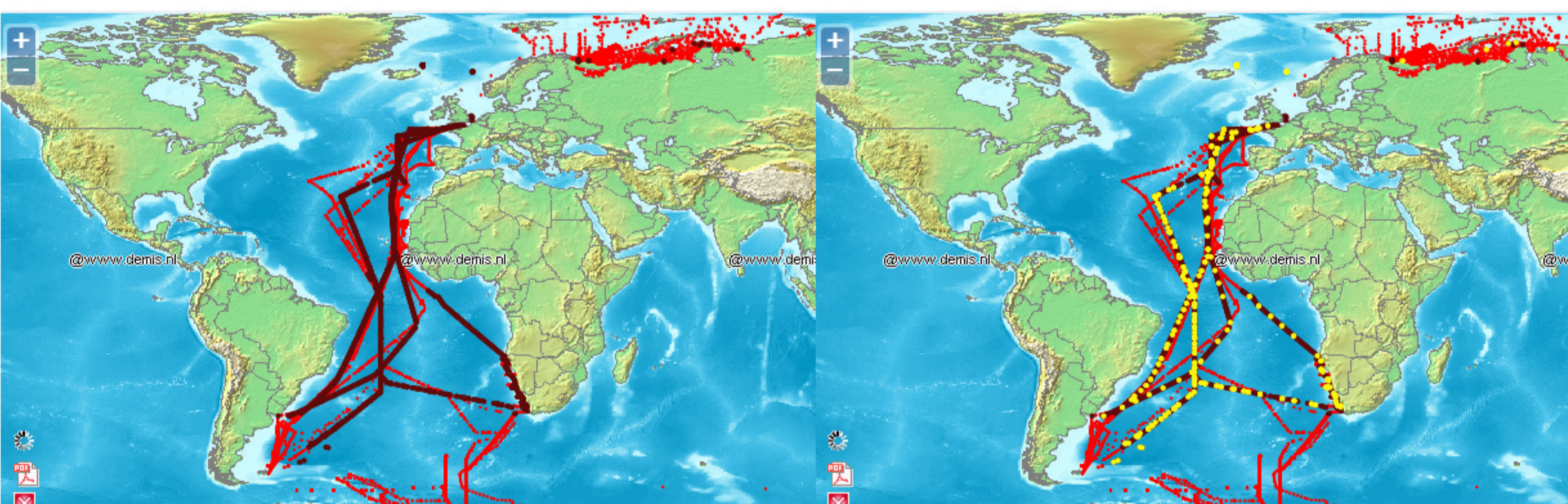


Source	Start time	Products	Show
ENVISAT/ASAR	Nov. 10, 2008, 8:56 p.m.	sigma0_VV	<input type="checkbox"/>
Satellite AIS/AIS	Jan. 1, 2011, 12:31 a.m.		<input type="checkbox"/>
ENVISAT/MERIS	March 3, 2012, 9:38 a.m.		<input type="checkbox"/>
RADARSAT-2/SAR	Oct. 25, 2014, 1:54 p.m.		<input type="checkbox"/>
AQUA/MODIS	May 1, 2015, 11:36 a.m.	SST_chlor_a	<input type="checkbox"/>
AQUA/MODIS	May 2, 2015, 12:20 p.m.	SST_chlor_a	<input type="checkbox"/>
RADARSAT-2/SAR	May 30, 2015, 4:39 p.m.		<input type="checkbox"/>
SENTINEL-1A/SAR/July 2, 2015, 5:29 p.m.		sigma0_HH	<input type="checkbox"/>

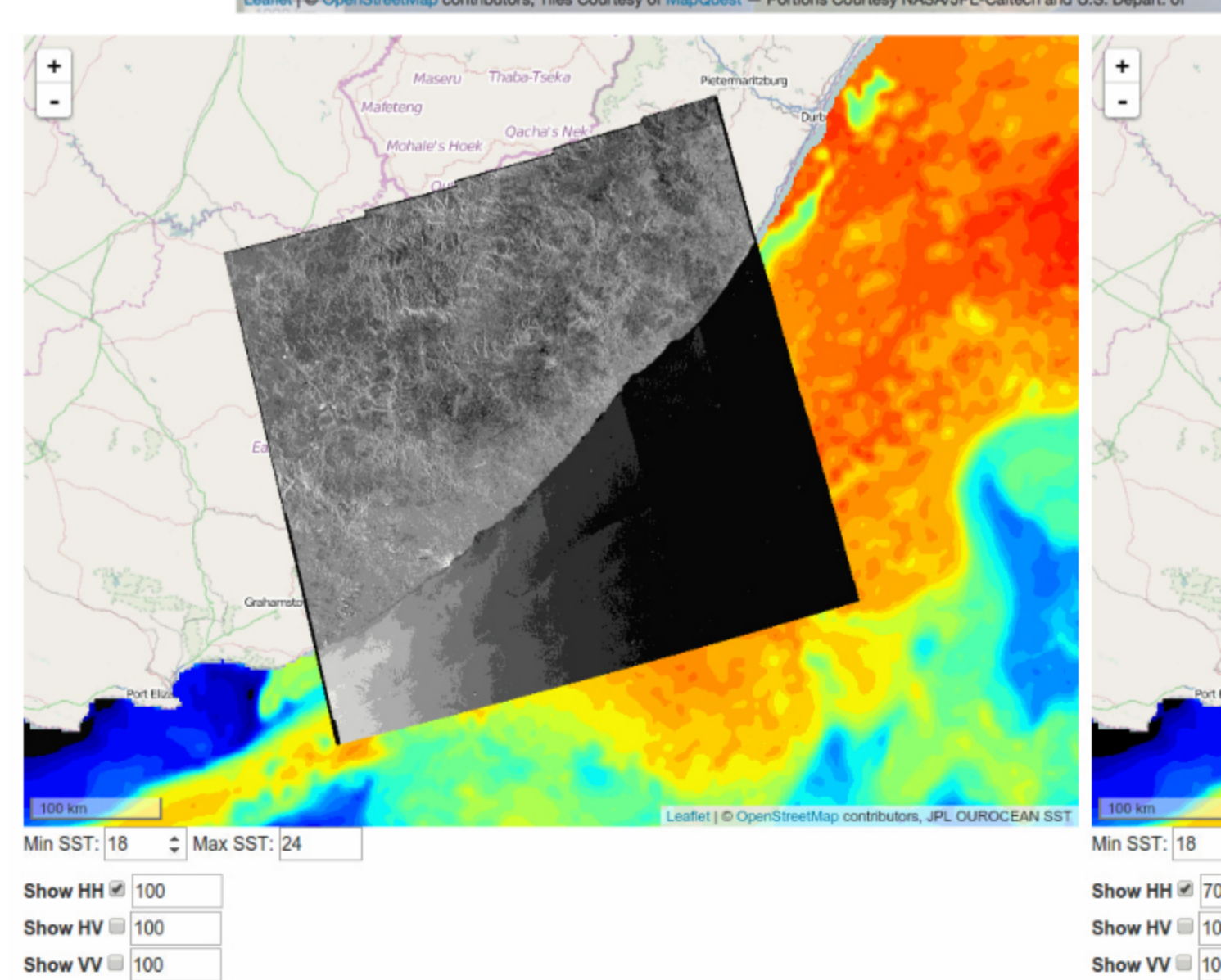
Above/Left: An approach for both visualizing data availability and the data itself, in a web viewer is being tested in the Nansen-Cloud webapplication. Below: Example on how transparency can be used to compare satellite and model data. The two screenshots are from the Nansen-Cloud webapplication.

Below: The number of different parameters is huge. A small selection of parameters from the GreenSeas database is displayed here. This really increases the difficulties on co-locating the data.

- Chemistry
- Light/Chlorophyll
- Plankton
 - Picoplankton
 - Bacteria - HBCCAFTX
 - Bacteria - P700A90Z
 - Bacteria - P701A90Z
 - Bacteria - Pelagic
 - Picoeukaryote
 - Strombidium spp.
 - Bacteria - CBCCAFTX - Abundance (# ml-1)
 - Bacteria - Carbon biomass - HBBAFTX (mg m-3)
 - Bacteria - TBCCA90Z - Abundance (# ml-1)
 - Picoplankton (# ml-1)
 - Prochlorococcus spp. - Carbon biomass - C701A90Z (mg m-3)
 - Synechococcus spp. - Carbon biomass - C700A90Z (mg m-3)
 - Nanoplankton
 - Flagellate [Size: 2-20µm]
 - Nanoplankton 10-15 µm
 - Nanoplankton 15-20 µm
 - Flagellate [Size: 15µm] - Abundance - P400M00R (# ml-1)
 - Flagellate [Size: 2µm] - Abundance - P400M00A (# ml-1)
 - Flagellate [Size: 5µm] - Abundance - P400M00K (# ml-1)
 - Nanoplankton (# ml-1)
 - Nanoplankton - flow cytometry (# ml-1)
 - Open Ocean Diatoms (20-200µm)
 - Microplankton
 - Ciliata
 - Dinophyceae [Size: >20µm Subgroup: heterotrophic]
 - Dinophyceae [Size: >20µm]
 - Microplankton 20-30 µm
 - Microplankton 30-50 µm
 - Microplankton 50-100 µm
 - Mesozooplankton
 - Mesozooplankton
 - Others
 - Tintinnidae
 - Cheanolagellida (ITIS: 43811; WoRMS 25) - Abundance - P400M00F (# ml-1)
 - Silicoflagellida (ITIS: 43789; WoRMS 378496) - Abundance - P400M00E (# ml-1)
- Rate measurements
- Salinity
- Temperature

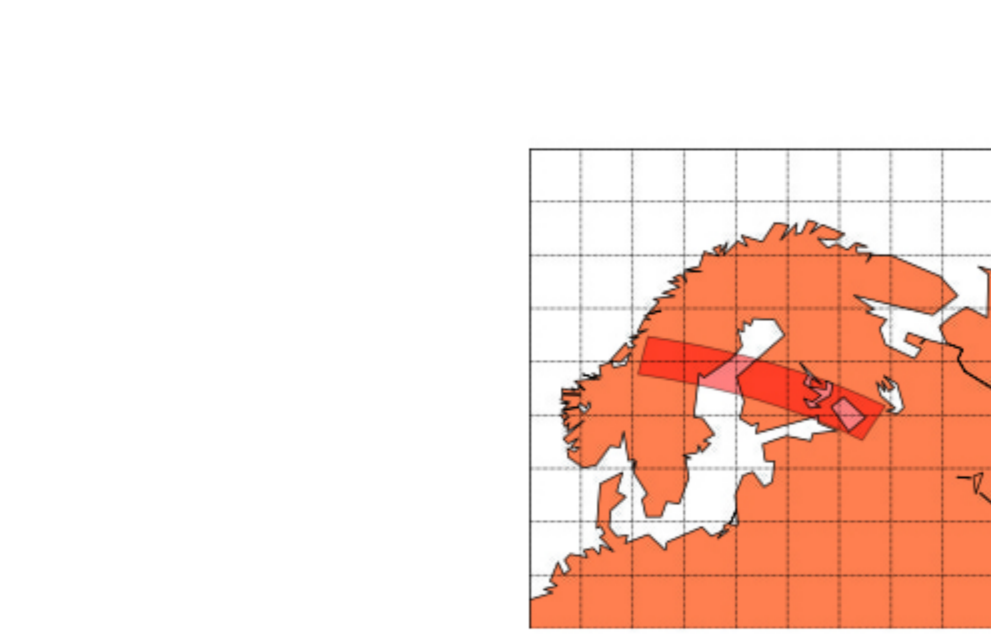
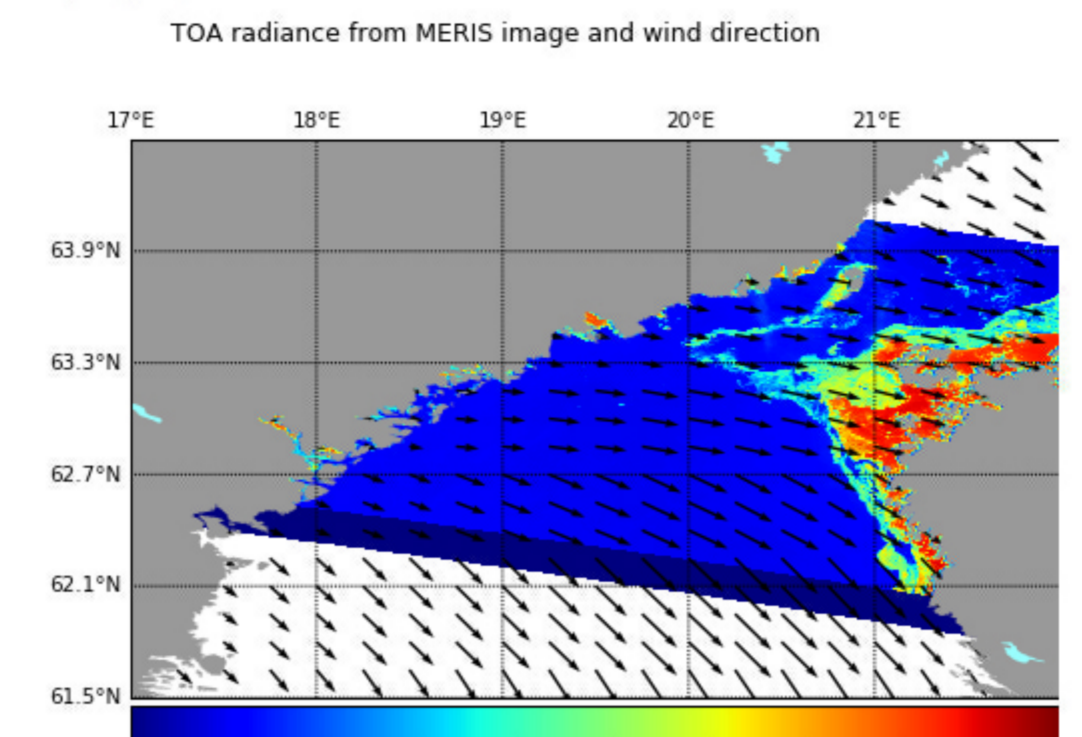


Above: Displays the steps in the process of searching for data in the GreenSeas database, and comparing the In-Situ data with model data. Left: The same comparison as a scatter plot, where the model value has been plotted against the In-Situ value.



```
# Import necessary modules
from nansat import *
import numpy as np
# Open the image
n = Nansat('MERIS-test.N1')
w = Nansat('gfs-test.t00z.master.grbf00')
# Create a domain and reproject the images
d = Domain(4326, '-lle 17 61.5 22 64.5 -ts 1000 1000')
n.reproject(d)
w.reproject(d)
# Get the data arrays
L_560=n['L_560']
u = w['U']
v = w['V']
# Create the canvas, add radiance, wind, colorbar, grid and title
mMap = Nansatmap(n, resolution='E')
mMap.pcolormesh(L_560)
mMap.quiver(u,v,quiverlength=20)
mMap.add_colorbar()
mMap.drawgrid()
plt.suptitle('TOA radiance from MERIS image and wind direction')
# Save the generated map in a png file
mMap.save('201203_L_560.png')
```

The code above generates the image to the right, which is a combination of a NCEP model field from a NCEP model (downloaded from noaa.gov) and the 560 wavelength band from a MERIS sensor on the Envisat satellite



Below: raw sensor output at the 560 wavelength band from the MERIS sensor on the Envisat satellite

Left: Footprint of the same image Right: A section, which has been transformed to the EPSG 4326 projection, of the same image covering the part that covers the Baltic Sea and parts of Finland/Sweden.

