POLYTEC

SEEING THINGS DIFFERENTLY

JONSMOD 2014:

NUMERICAL MODELING OF SEA BOTTOM TEMPERATURES IN THE NORTH SEA.

Torleif Lothe and Rachel Furner

May 2014

NUMERICAL MODELING OF SEA BOTTOM TEMPERATURES IN THE NORTH SEA.

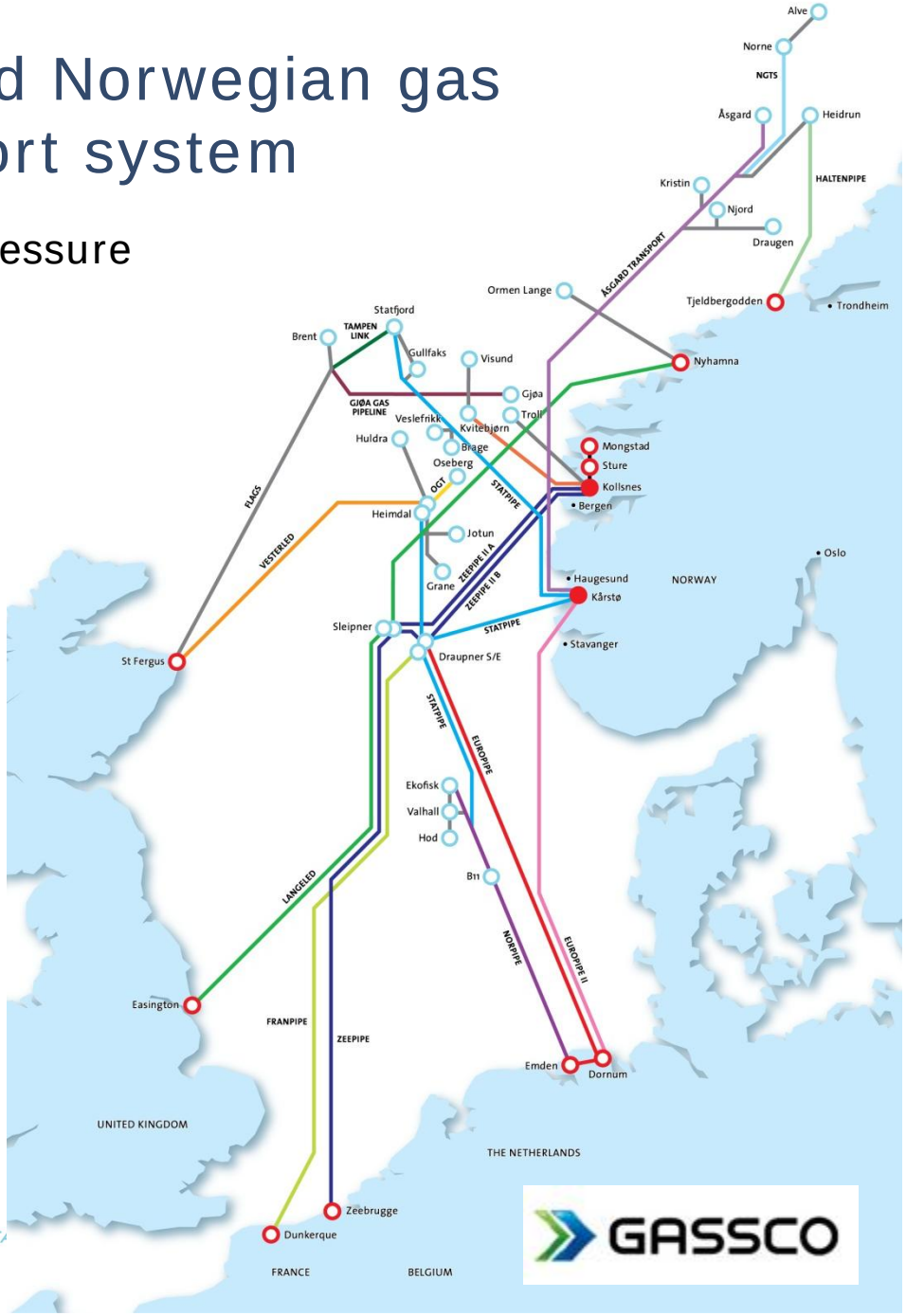
TORLEIF LOTHE (POLYTEC/UNIVERSITY OF BERGEN)
RACHEL FURNER (MET OFFICE, UK)

Outline :

- Motivation : Subsea Gas Transport
- Method, Statistical areas
- Observation Data, kobheg data, rov data
- Climatology
- Analysis
- Some results

The integrated Norwegian gas transport system

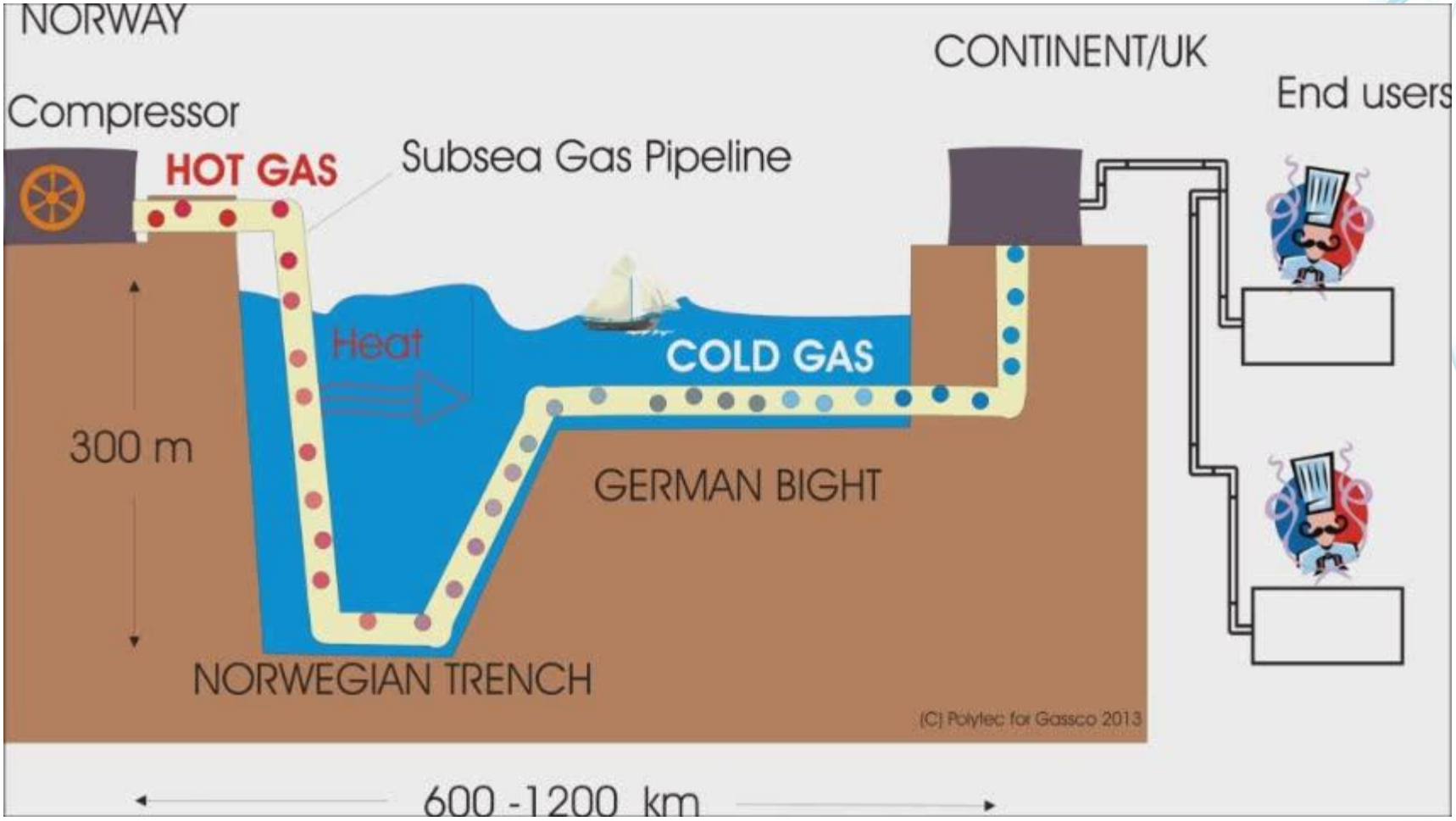
- 7 975 km of large-diameter, high-pressure pipelines
- 20 % of European gas consumption
- Large processing facilities in Norway
- Receiving terminals in four European countries
- Connected to major downstream gas transmission systems in Europe and the UK



POLYTEC

ENERGY TRANSPORT

GASSCO


NORWAY
CONTINENT/UK
End users
Compressor
HOT GAS
Subsea Gas Pipeline
Heat
COLD GAS
300 m
GERMAN BIGHT
NORWEGIAN TRENCH
(C) Polytec for Gassco 2013
600 -1200 km

Timeline-Ocean Models in Subsea Gas Transport

- 2003: Climatology (World Ocean Atlas, modified).
- 2003: First sketches of an integrated ocean model in PMS are made by T. Lothe and W. Postvoll.
- 2003: Feasability study (M. Mathiesen, Polytec): Modeling of Sea Bottom Temperaure
- 2004-2005 :Implementation of Shelf Seas Model (POLCOMS, Met Office)
- 2005-> Several quality studies made by Polytec in collaboration with Met Office
- 2006: Presented at the Pipeline Simulation Interest Group
- 2013->POLCOMS model -> AMM7 (NEMO Core)

Pipeline Simulation Interest Group 2006 (Hendriks, Postvoll, Mathiesen, Spiers & Siddorn)

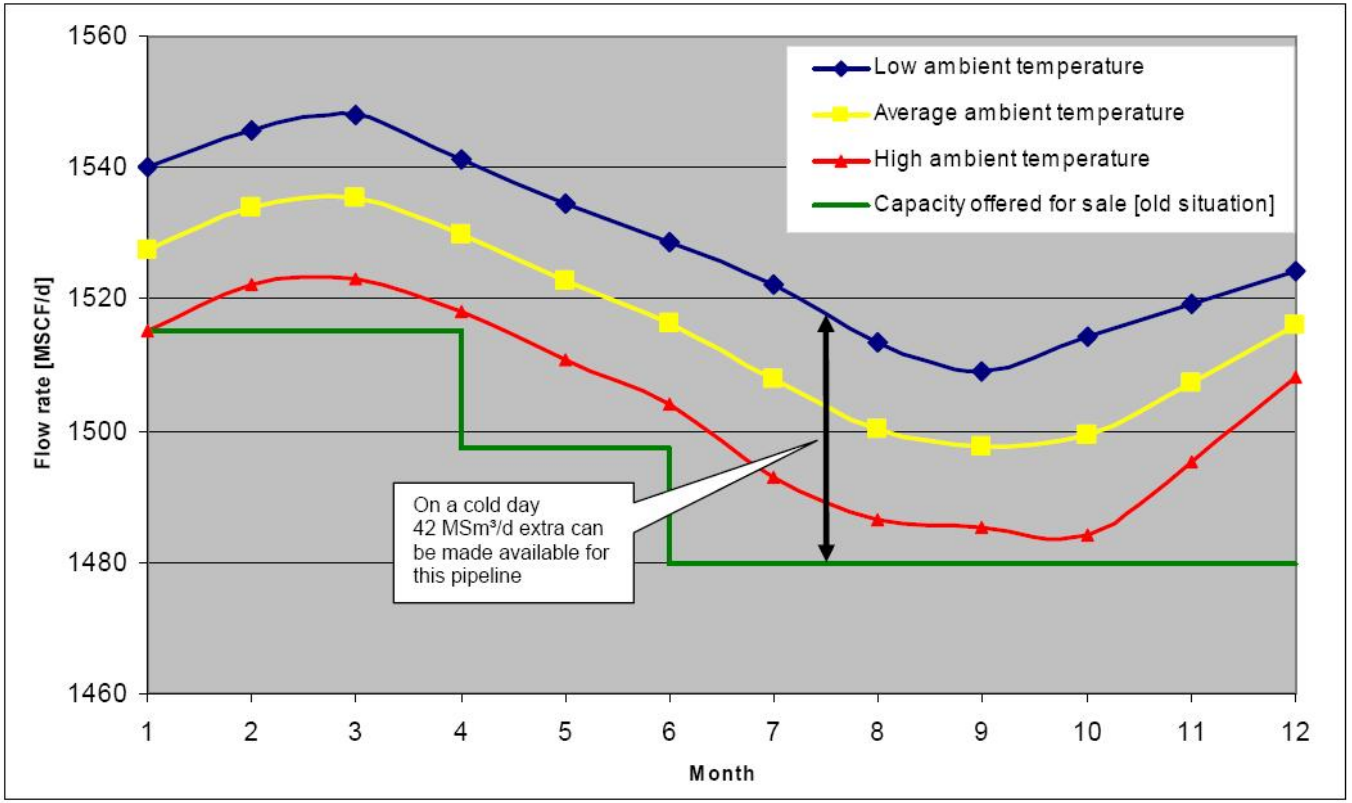
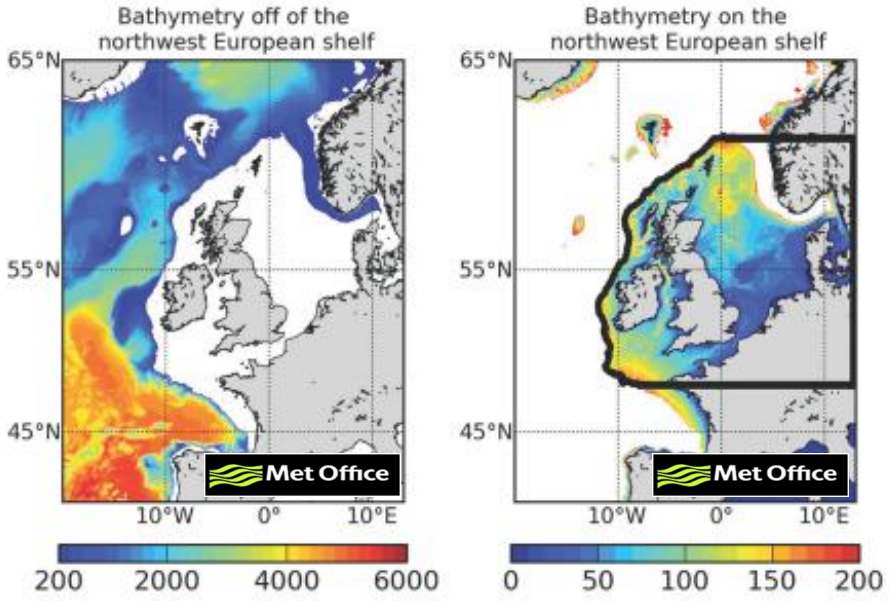


Figure 1 – Example hydraulic capacities for a pipeline.

THE AMM7 MODEL AT MET OFFICE (NEMO BASED)



- Atlantic Margin Model, 7 km resolution
- 40-60 °N, 20 °W-13 °E
- Stretched S-coordinate 32 levels.
- NOOS Bathymetry
- Arakawa C
- -> O'Dea et al 2012

O'DEA ET AL

R1 –RUN (NON ASSIMILATIVE)

METHOD

Develop statistical areas

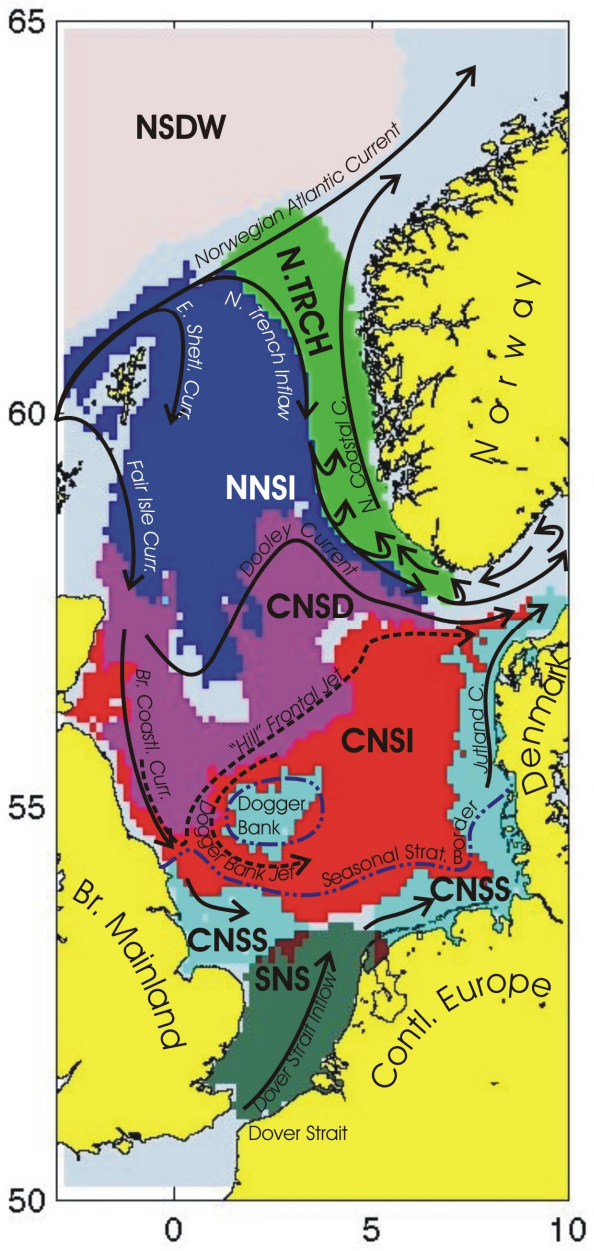
Compare AMM7 to

- Climatology (WOA and Janssen)
- ROV and moored measurements

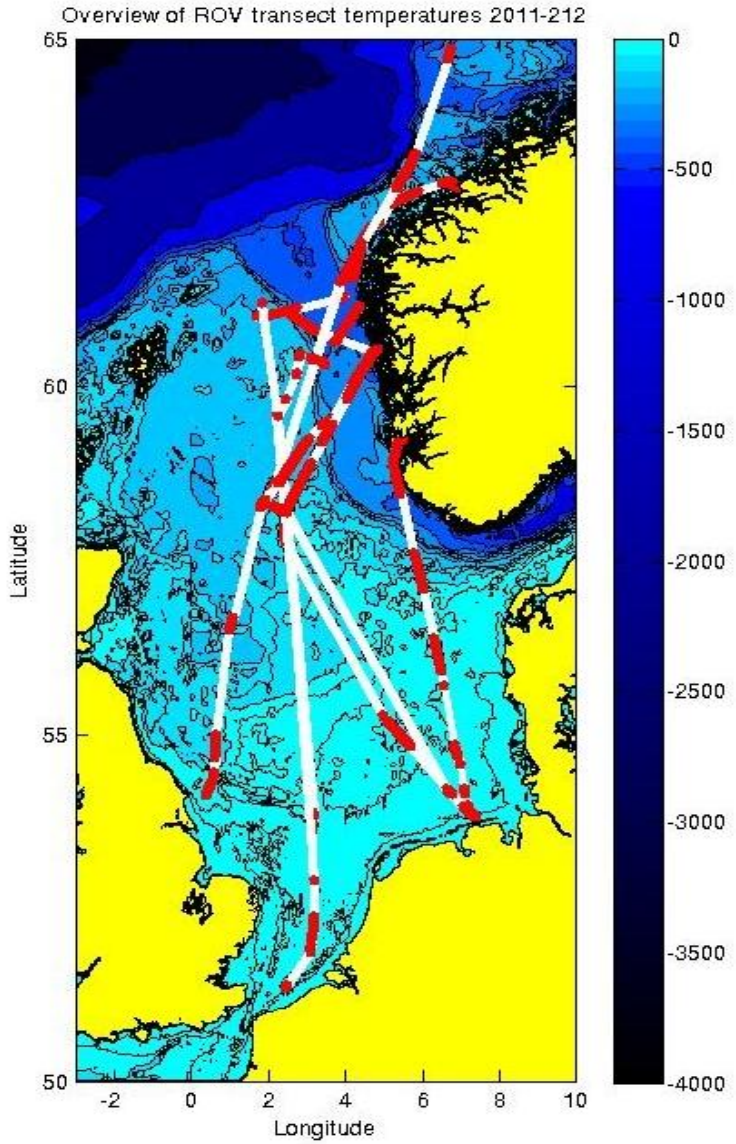
Test for sensitivity of

- SST assimilaition
- GLS Parameters
- Lateral diffusion scheme

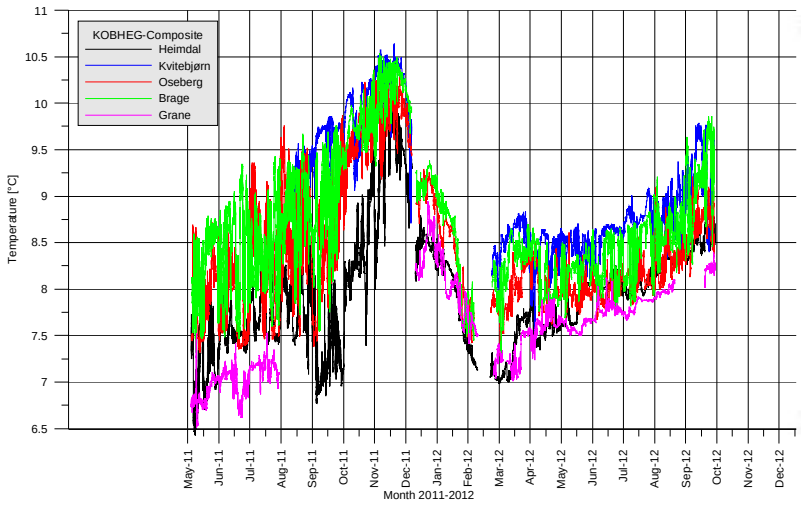
Statistical areas

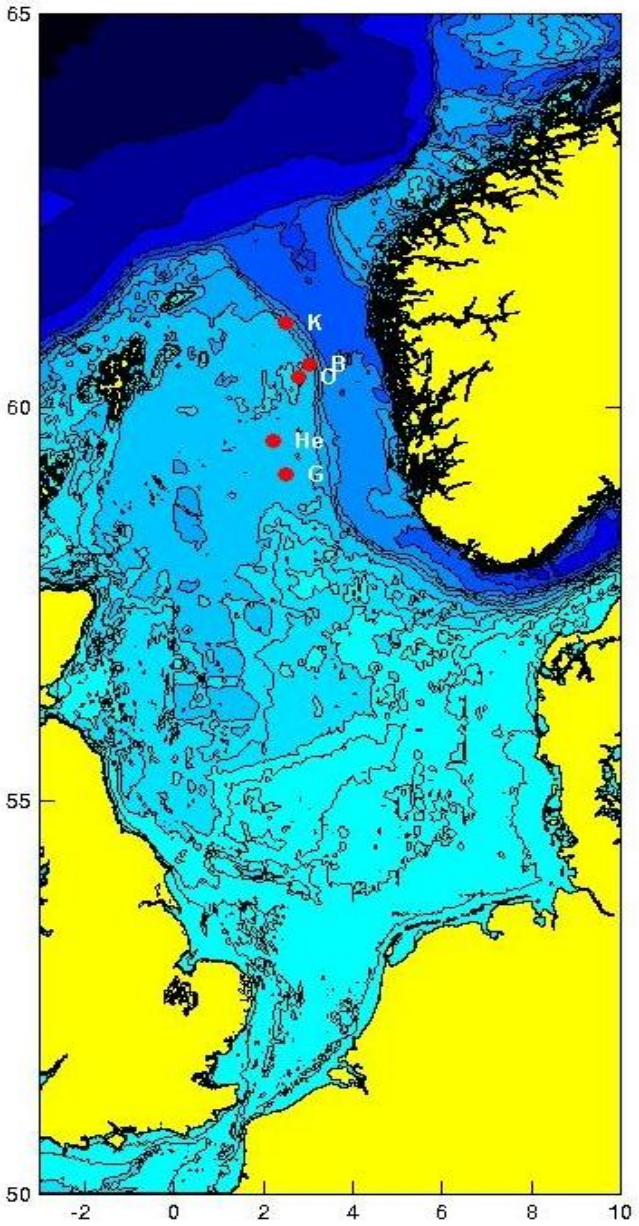


ROV DATA

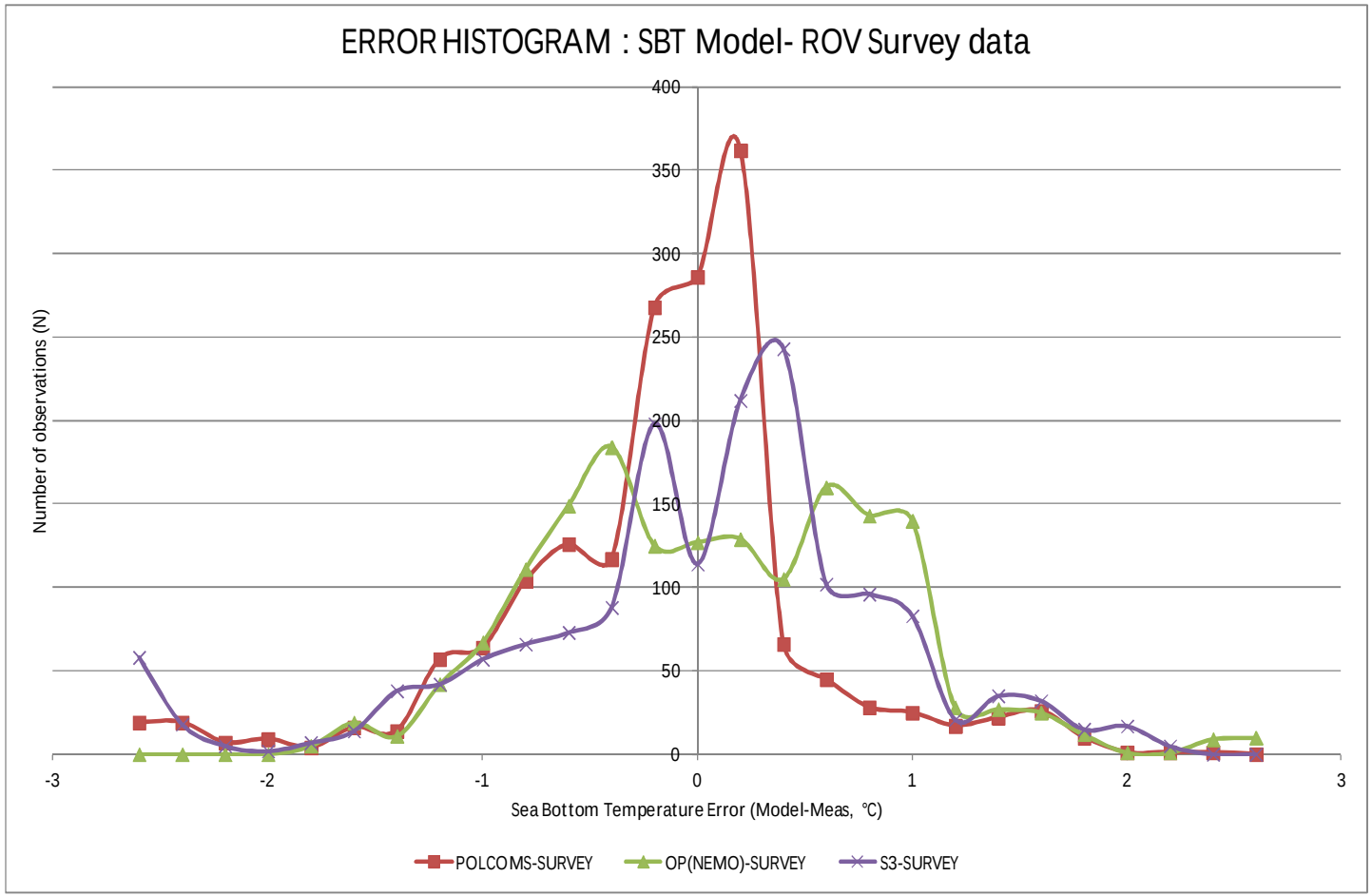

Overview of ROV transect temperatures 2011-212
Latitude
Longitude
65
60
55
50
-2
0
2
4
6
8
10
0
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000

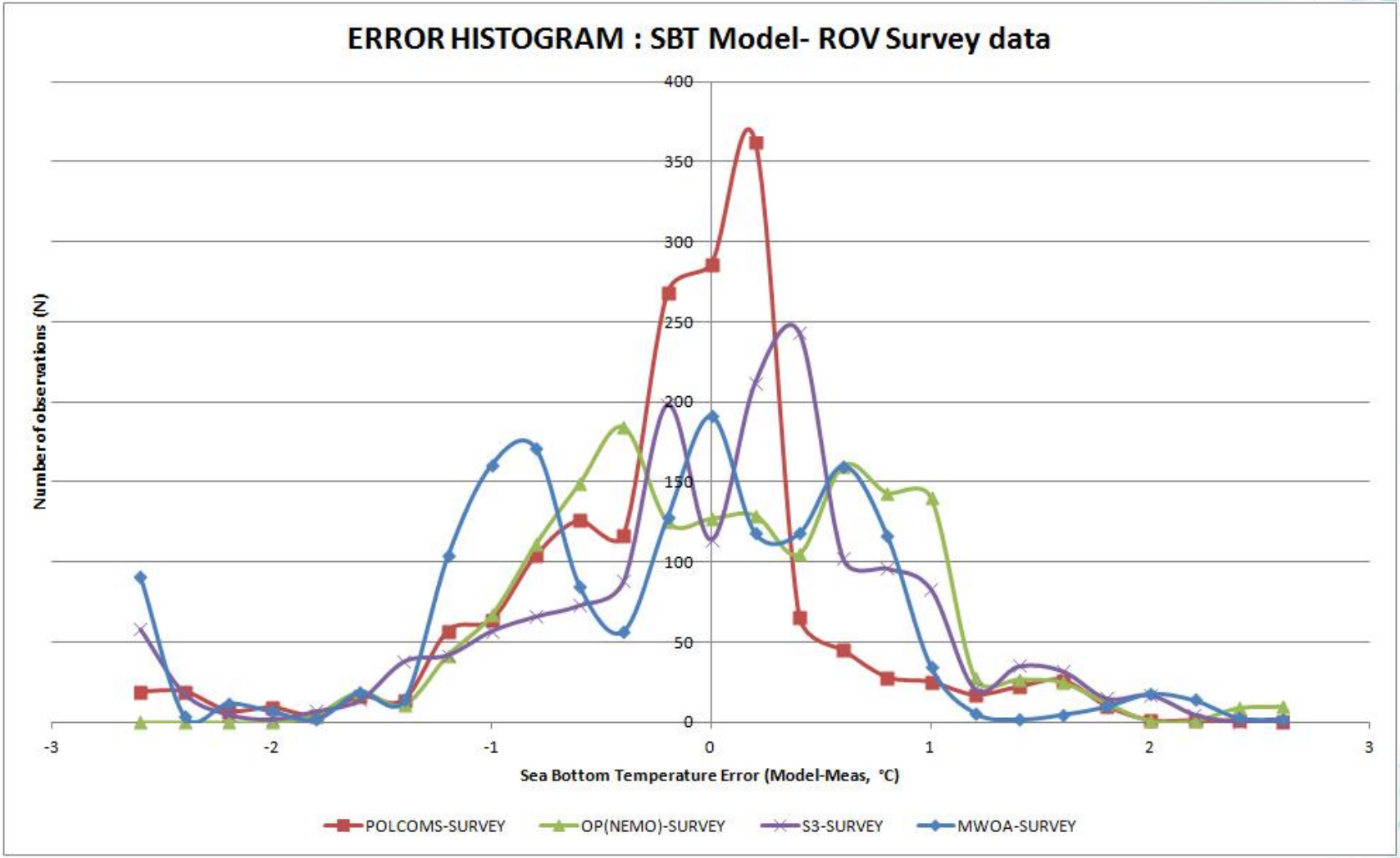
KOBHEG DATA (MOORINGS)



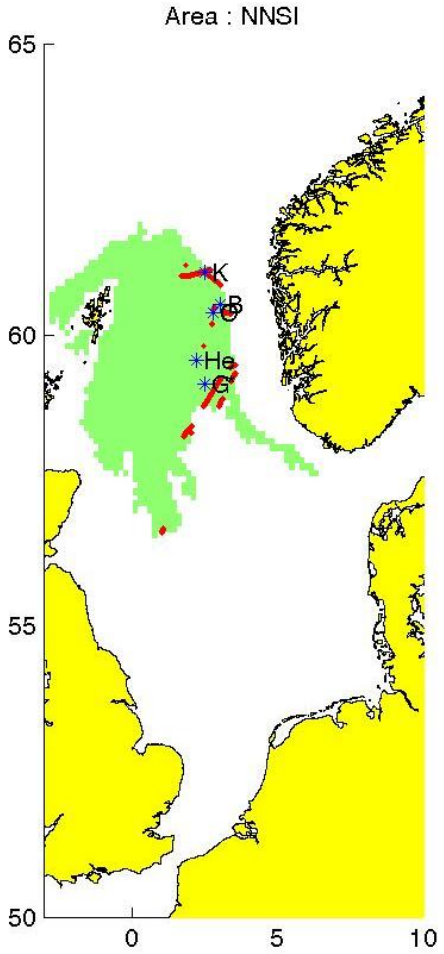


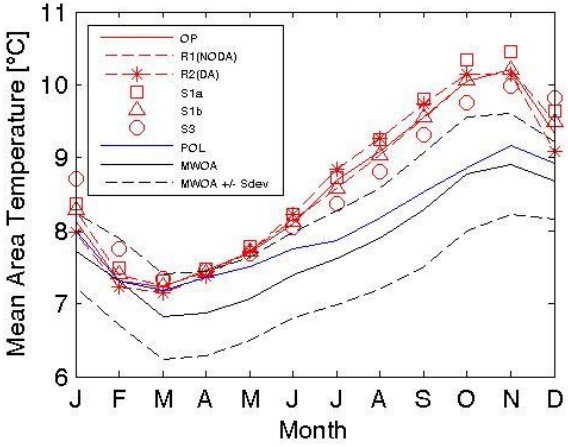
RESULTS – ERROR HISTOGRAM

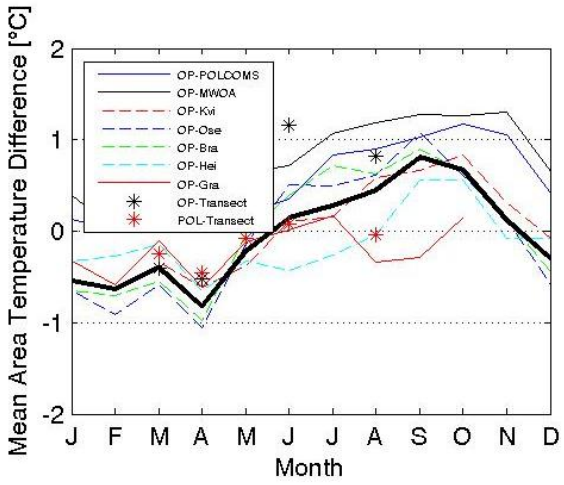



ERROR HISTOGRAM : SBT Model- ROV Survey data
Number of observations (N)
400
350
300
250
200
150
100
50
0
-3
-2
-1
0
1
2
3
Sea Bottom Temperature Error (Model-Meas, °C)
POLCOMS-SURVEY
OP(NEMO)-SURVEY
S3-SURVEY
MWOA-SURVEY

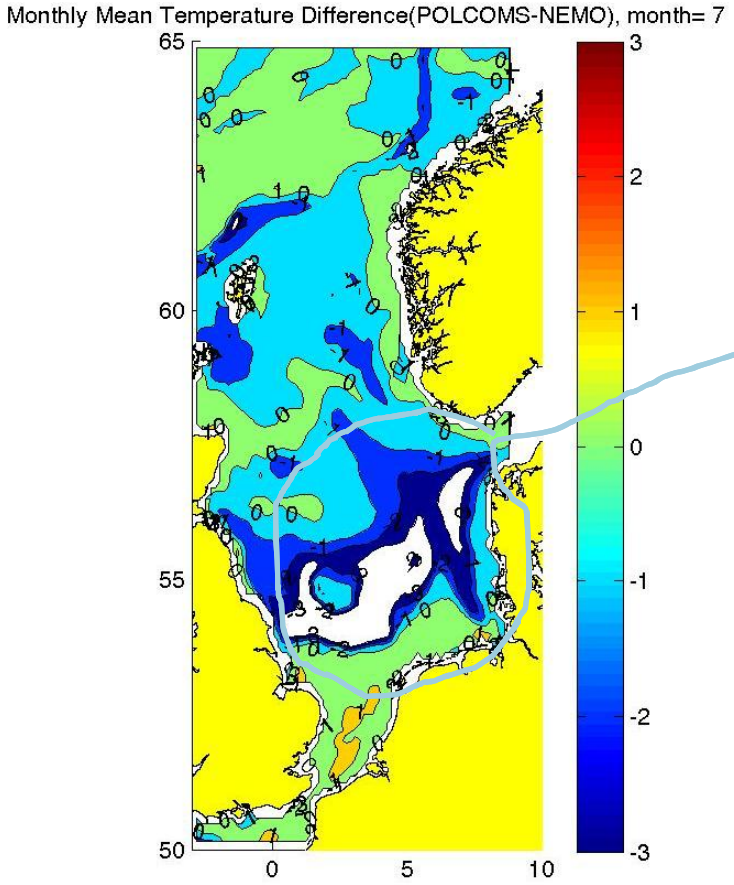
RESULTS – KOBHEG-DATA







RESULTS - CNSI



Cold, dense pool
of winter water trapped
below seasonal stratification

SUMMARY

AMM7 operational bottom temperatures is used in gas transport industry

Very good results during winther months

AMM7/NEMO seems to understratify during summer in CNSI thus overestimating bottom temperature.

AMM7 underestimates Norwegian Trench Inflow temperature in the winter and overestimates it in the summer.

SST assimilation is very active, due to understratification?