Towards an operational, fine scale Oslofjord model utilizing the curvilinear option in ROMS

Lars Petter Røed and Nils Melsom Kristensen

Norwegian Meteorological Institute

larspr@met.no

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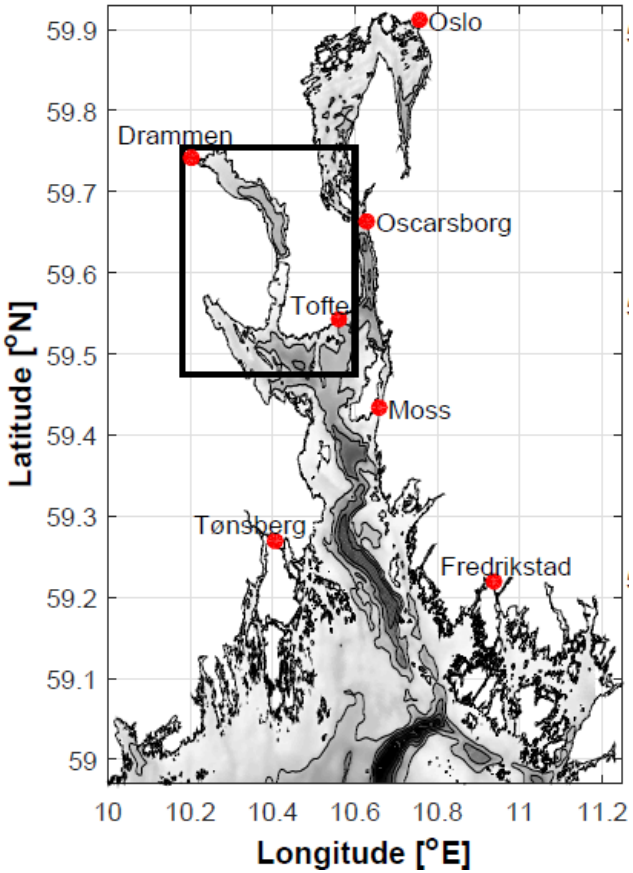
*Lars Petter Røed is also affiliated with Institute of Geoscience, University of Oslo

Overview

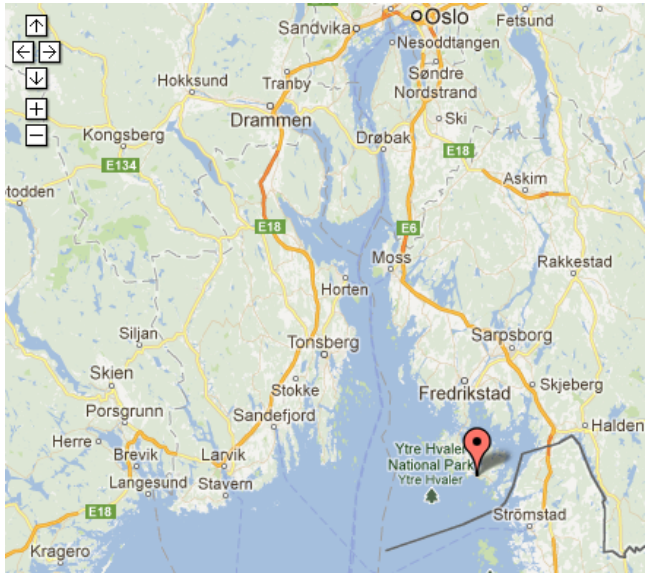
The Oslofjord

1. Located in Southern Norway
2. Not a typical Norwegian fjord
   - Main sill at Drøbak (Oscarsborg)
   - Numerous small islands and narrow sounds
3. Contains Norway's two largest rivers



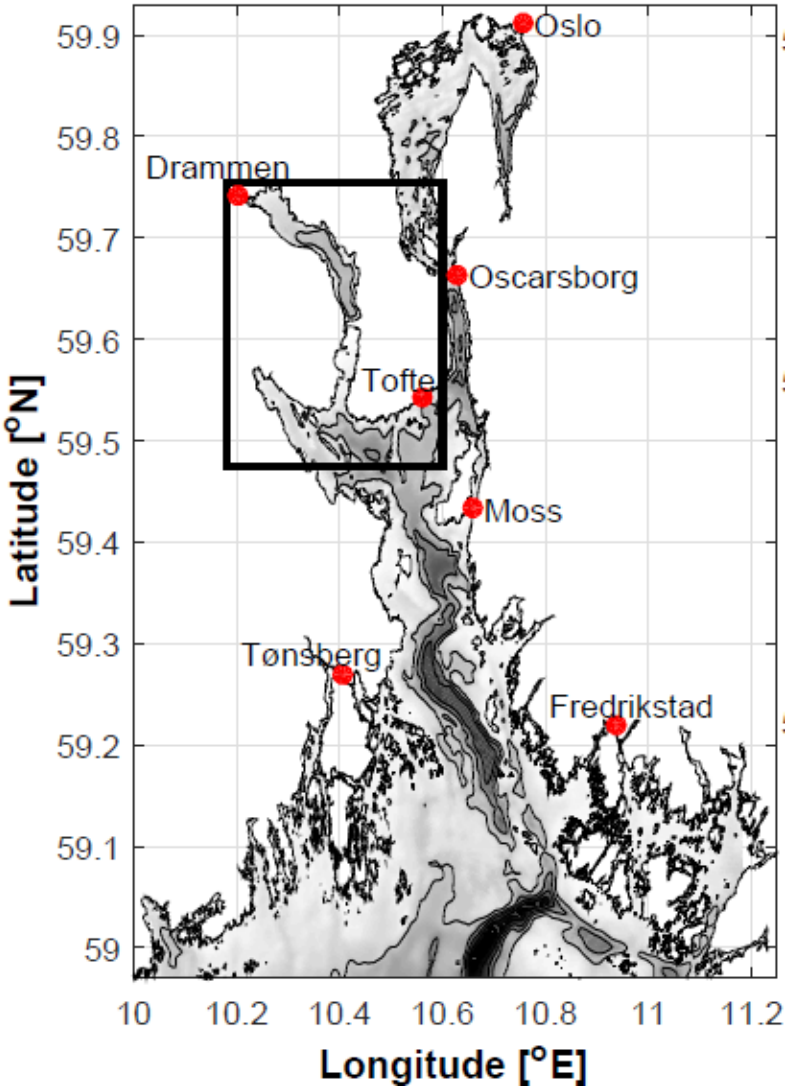
Why a new model?

1. High resolution emergency models are needed in near shore areas in general
2. In particular for the Oslofjord:
   - Heavy ship traffic
   - Most populated area in Norway
   - Highest density of leisure boats
3. Underscored by the "Godafoss" accident February 17, 2011



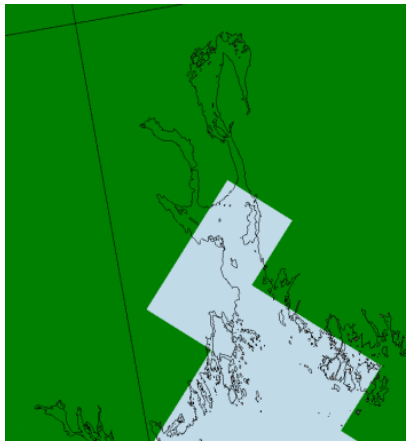
Why a new model?

1. Present operational models too coarse to resolve the small scales associated with narrow sounds, straits and small islands
2. $\Longrightarrow$ Floating or dissolved material is stranding too fast
3. $\Longrightarrow$ Discharges cannot be located at their correct position (e.g. Godafoss)

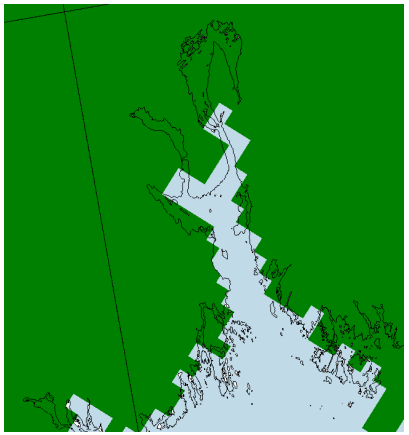


Importance of resolution

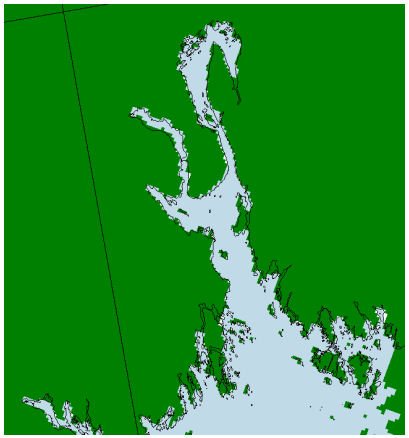
Arctic20km



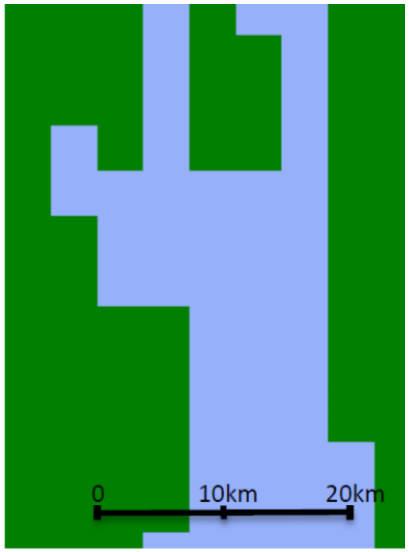
Nordic4km



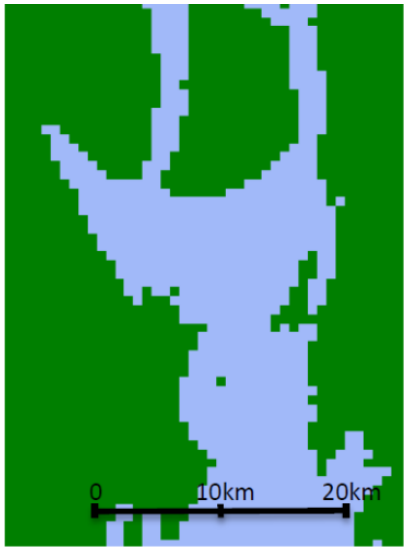
NorKyst-800



Nordic4km



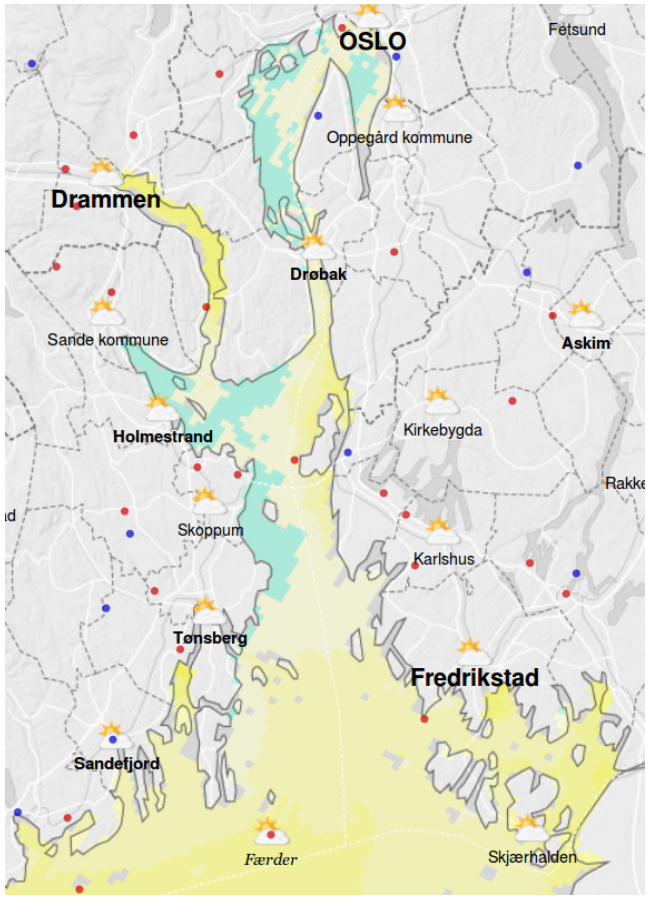
NorKyst-800



100m grid

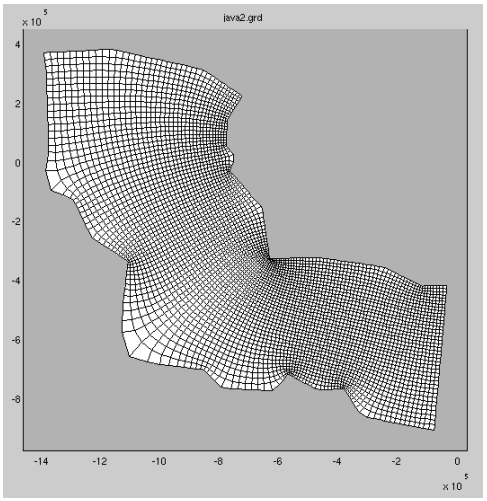
Today's model = NorKyst800

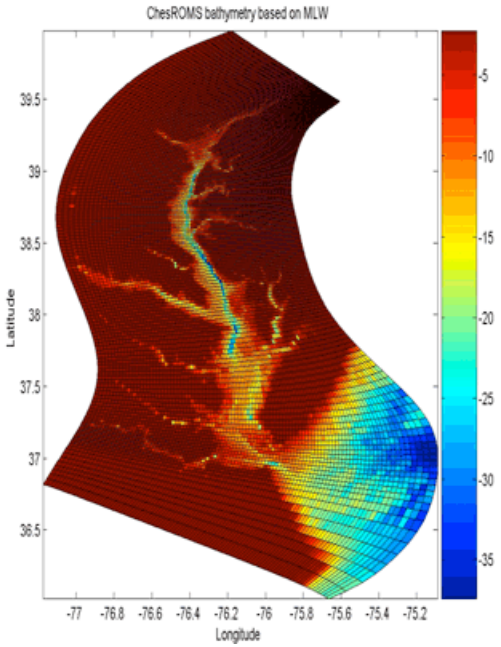
1. Not enough grid resolution
2. Ratio land/wet grid points sub-optimal
3. **Conclusion**: A regular grid model of sufficient resolution too heavy for Norway's (and Sweden's) computers at present
4. **Solution**: Develop a new model based on ROMS' curvilinear option



Creating the curvilinear grid

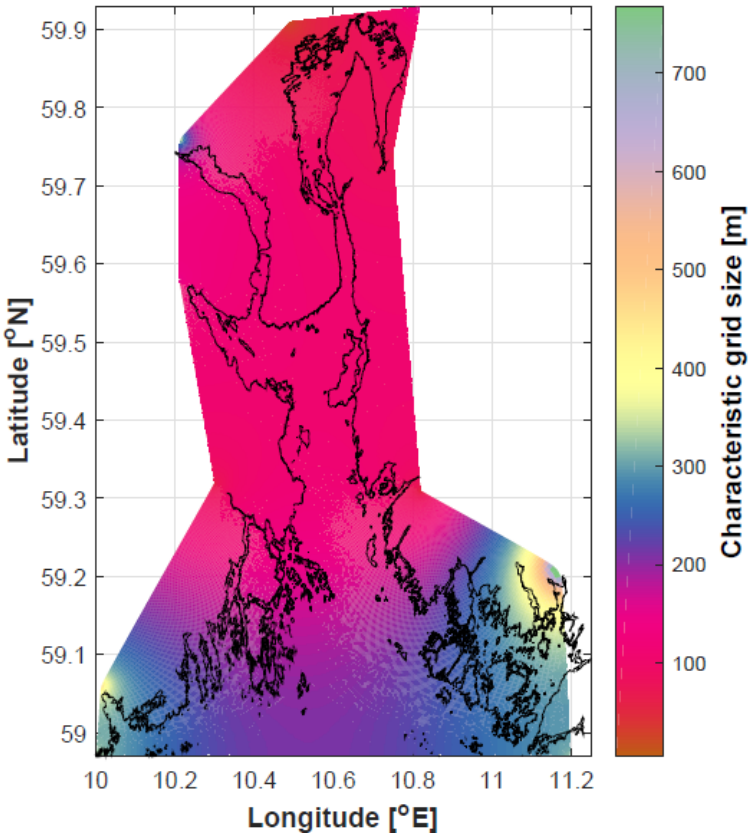
1. ROMS supports curvilinear grids with variable resolution (in addition to rectangular grids)
2. Inspired in parts by models like ChesROMS (Chesapeake Bay) and similar applications





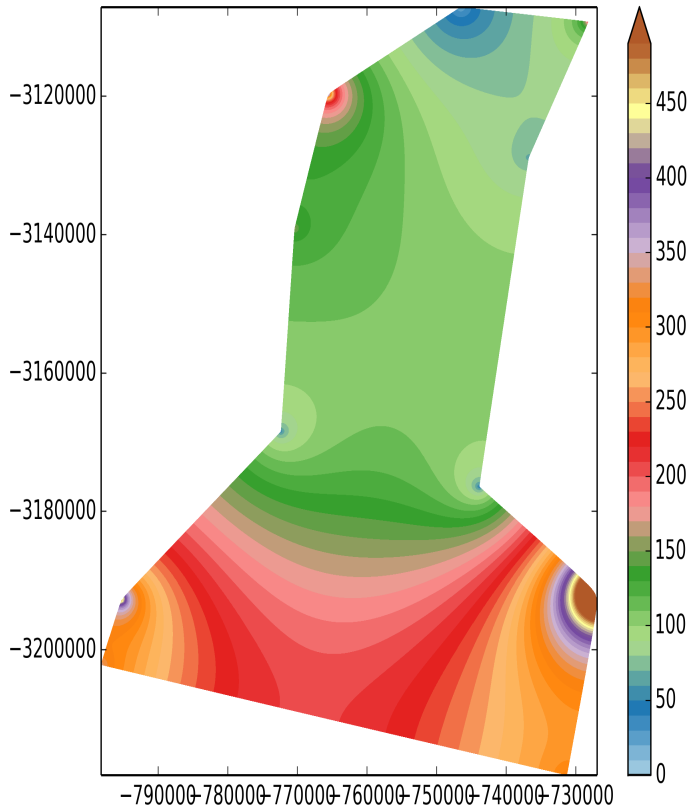
The FjordOs grid

1. FjordOs is generated with the help of the Octant python package
2. MATLAB, Fortran and Python packages are available as well
3. Result is a grid of 300 x 900 grid points with a grid size varying from 40–400 m
4. A computer load similar to a regular grid model of about 300 m grid size



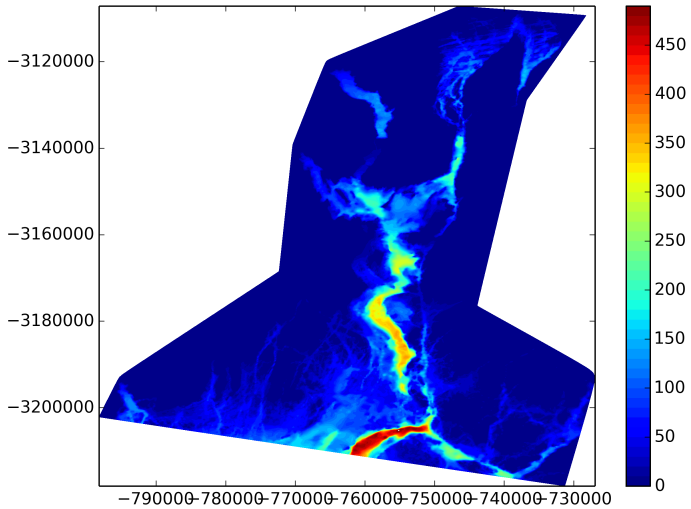
Orthogonality

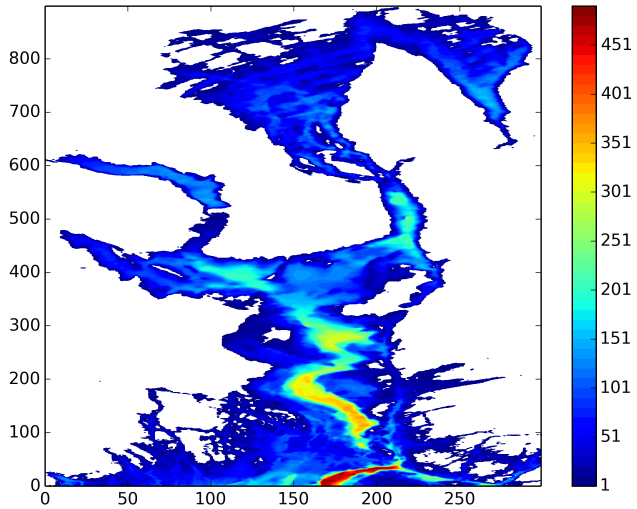
1. Should be around 95% according to ROMS handbook
2. Octant automatically achieves "optimal" orthogonality
3. To reduce orthogonality problems at wet points, corners and nodes are kept on land



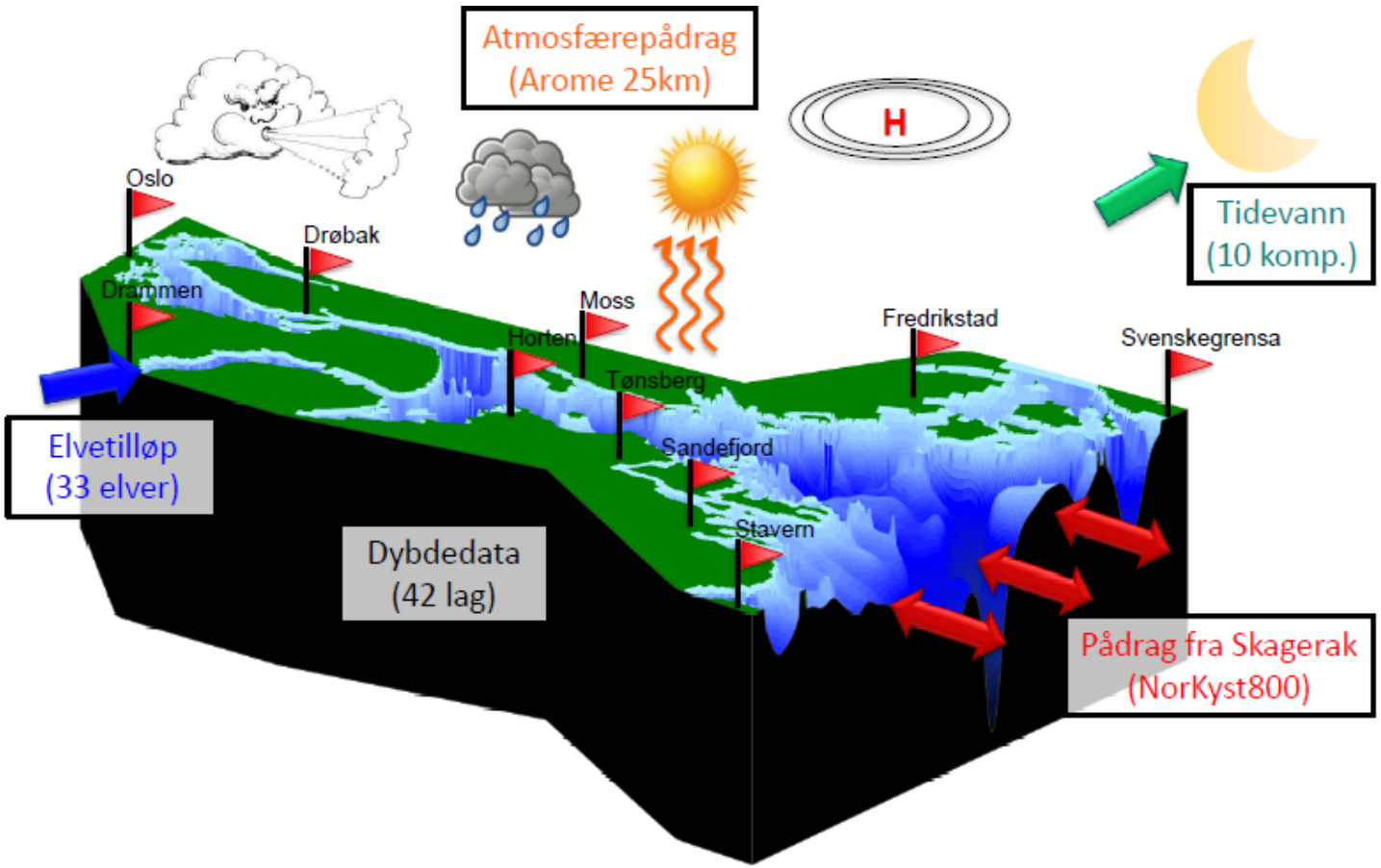
Bathymetry

1. Bathymetry is given as list of depths and x- and y-positions (on UTM grid)
2. Interpolated to the new curvilinear grid using SciPy.interpolate.griddata
3. Manual editing of land mask
4. Manual editing of depth near river outlets
5. Smoothing of topography to reduce PGE

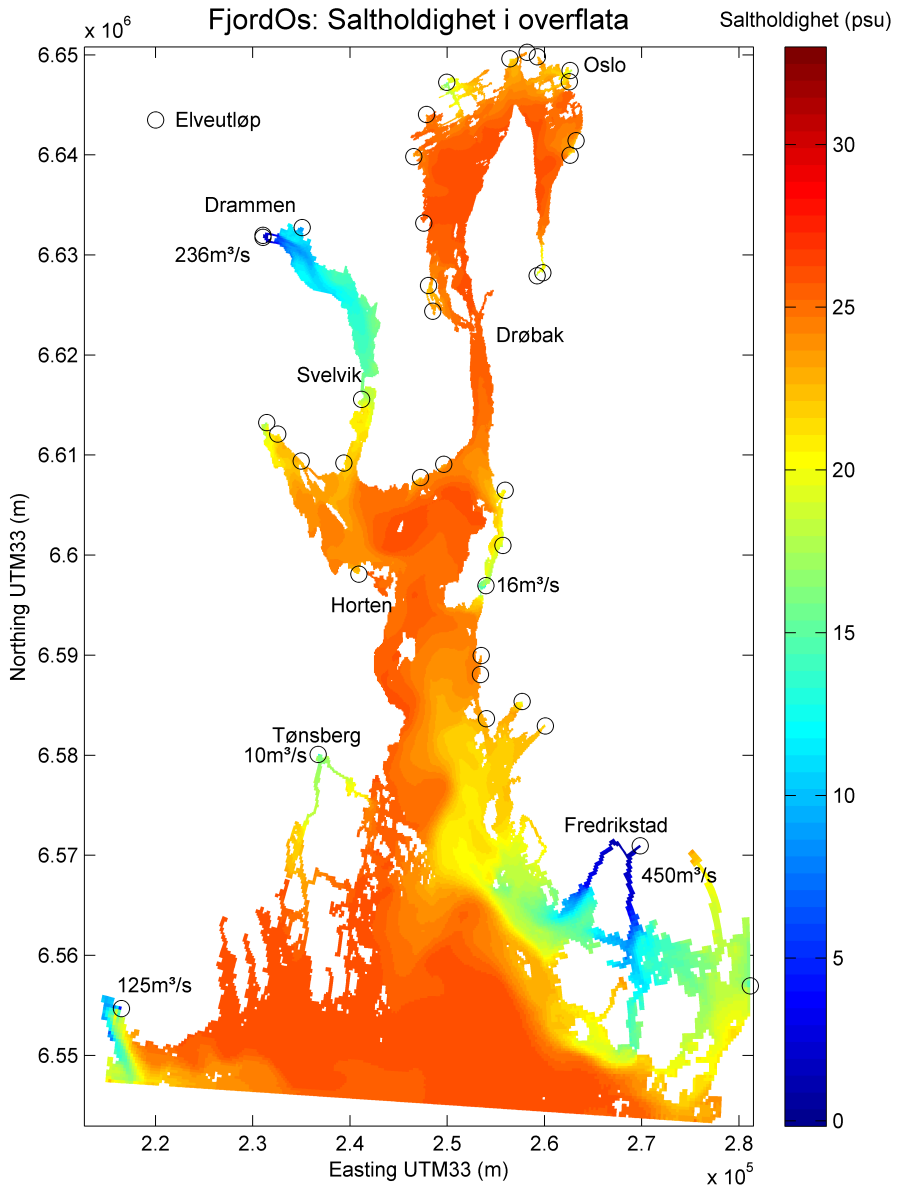




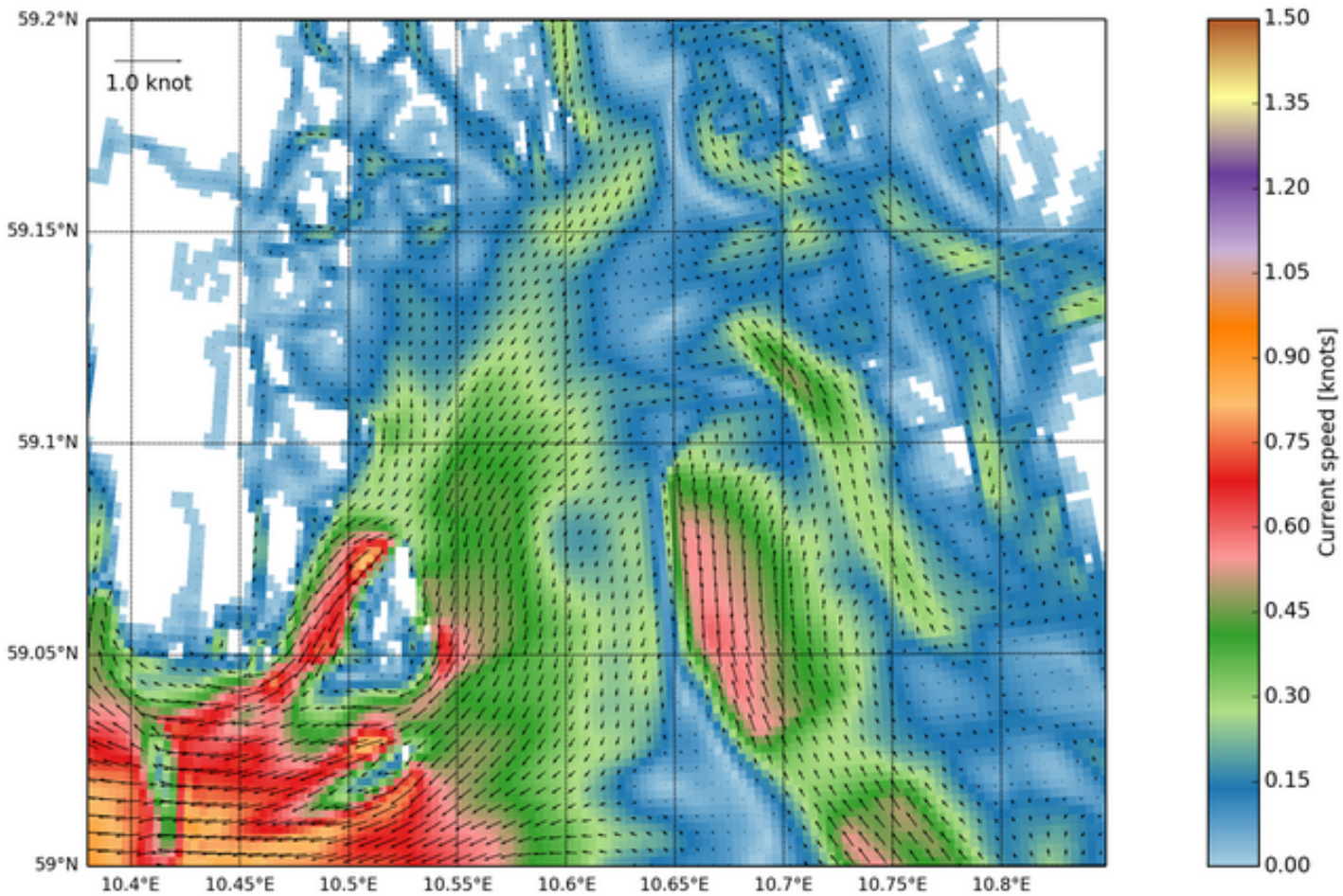
Sketch of the new model



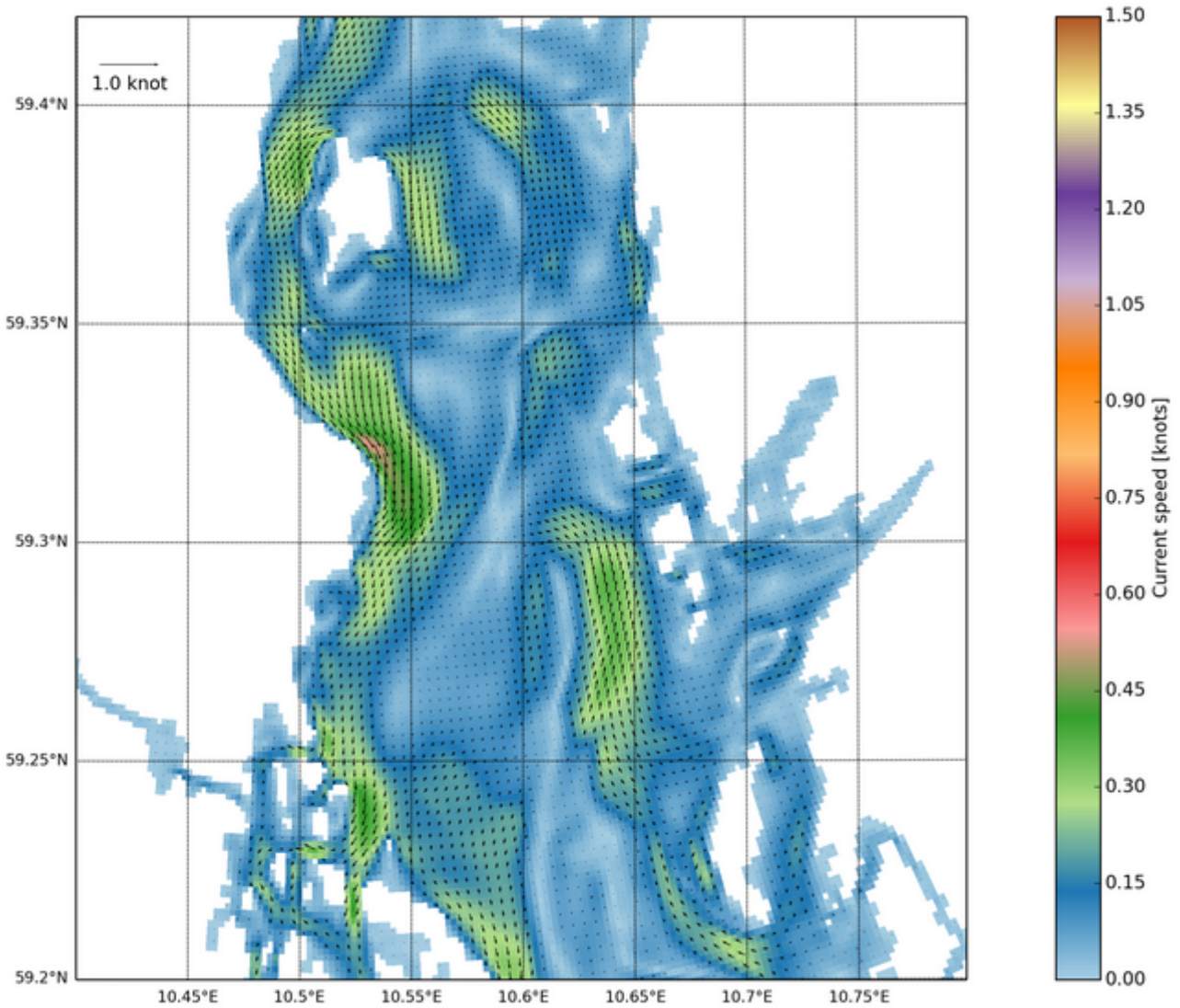
32 rivers included



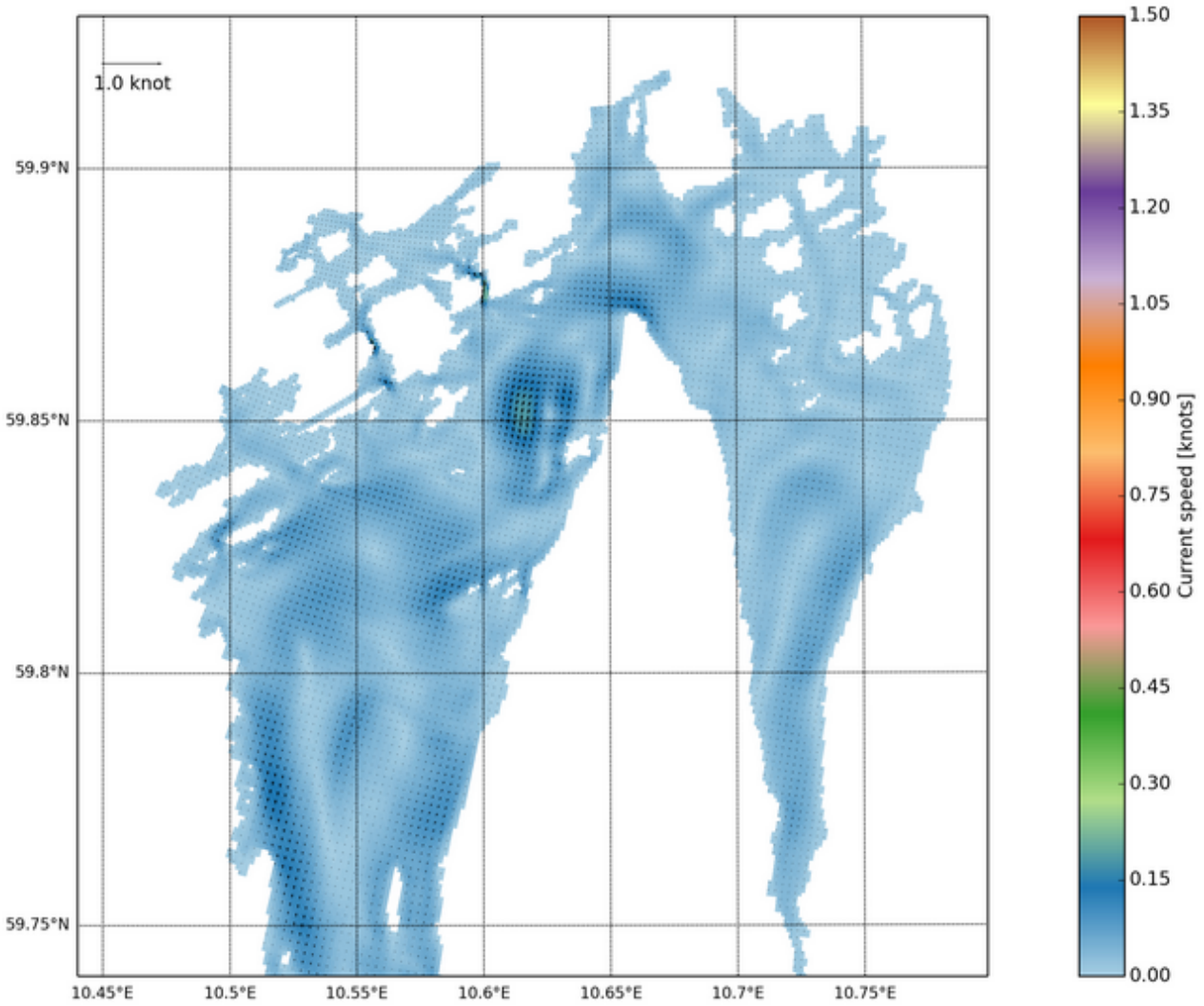
Sample forecast: Bolærne–Tristein



Sample forecast: Bastøy–Bolærne



Sample forecast: Indre Oslofjord



Conclusions

1. Emergency models needed for the Oslofjord
   - Search & Rescue, Oil drift, unwanted discharges (e.g., toxic waste), etc.
   - The Oslofjord area is the highest populated area in Norway
2. Require models of higher resolution than provided by MET Norway's suite of operational models per date
3. For a given computer load use of ROMS' curvilinear option allows much higher resolution than a regular grid
4. Care has to be exercised when choosing the grid (orthogonality requirements)
5. A new Oslofjord model (FjordOs) is developed and runs in pre-operational mode

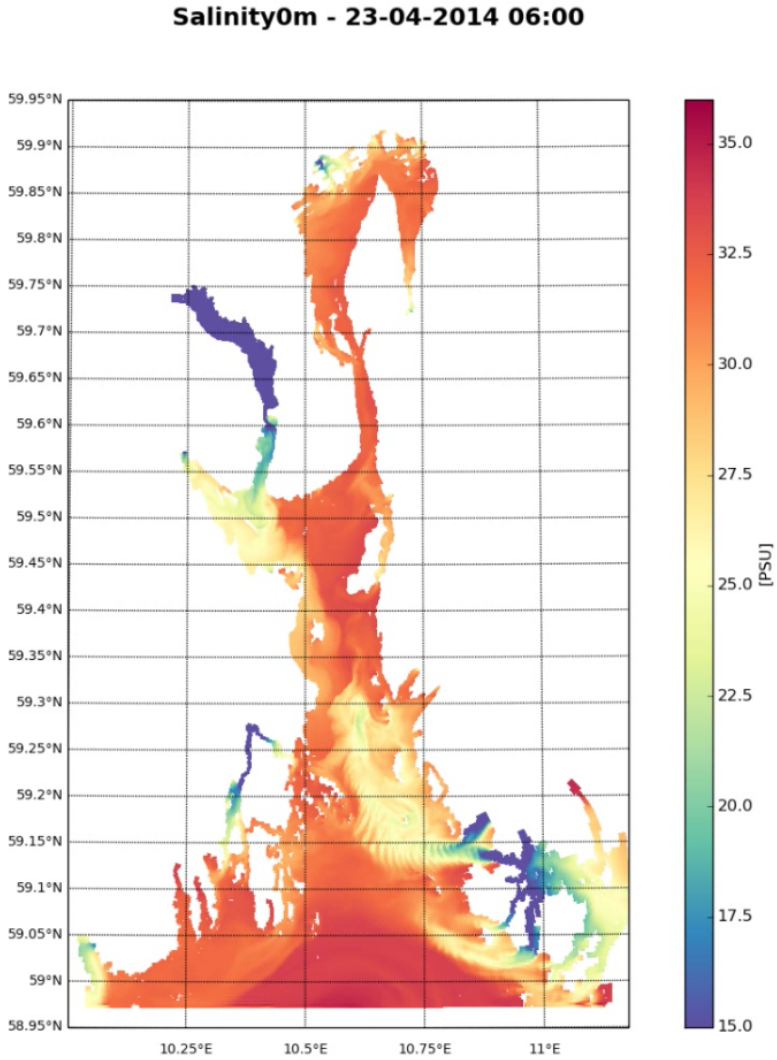
Acknowledgement

The development is part of the FjordOs project

The FjordOs project is a collaboration between MET Norway, Høgskolen i Buskerud og Vestfold and NIVA

The FjordOs project is funded by Oslofjordfondet

Movie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59.3°N
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59.2°N
59.15°N
59.1°N
59.05°N
59°N
58.95°N
10.25°E
10.5°E
10.75°E
11°E
35.0
32.5
30.0
27.5
25.0
22.5
20.0
17.5
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[PSU]

Thank you for your attention