Modeling of the upper ocean winter (sub)mesoscale variability in the central Arctic Ocean during sthe MOSAiC drift.

3D ocean model to: * analyze scattered in space and time observed data;
* estimate the quasi-steady (sub)mesoscale circulation;
* quantify the horizontal and vertical (sub)mesoscale mass fluxes;

Ivan Kuznetsov[1], Ying-Chih Fang[1], Benjamin Rabe[1], Alexey Androsov[1,2], Mario Hoppmann[1], Volker Mohrholz[3], Sandra Tippenhauer[1], Kirstin Schulz[1], Vera Fofonova[1], Markus A Janout[1], Ilker Fer[4], Till Baumann[4], Timothy P Stanton[5], Hailong Liu[6] and Maria Mallet[1]

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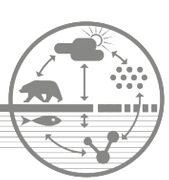
MOSAiC International Arctic Drift Expedition



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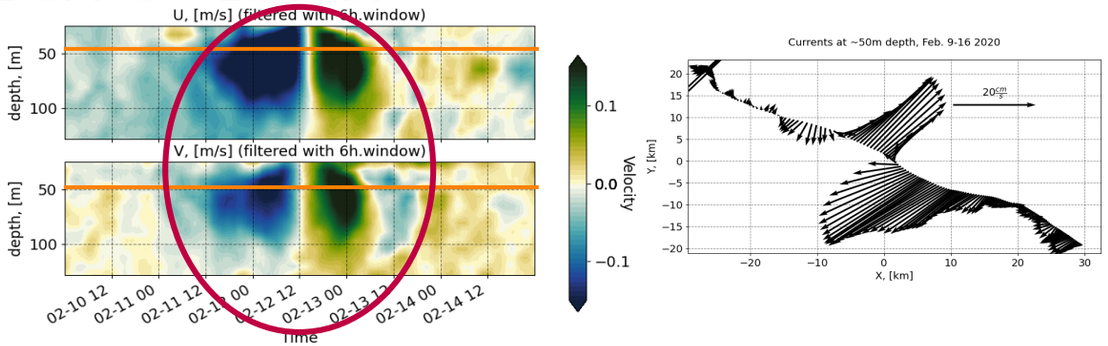
Eddy example (CTD buoys and ADCP data)

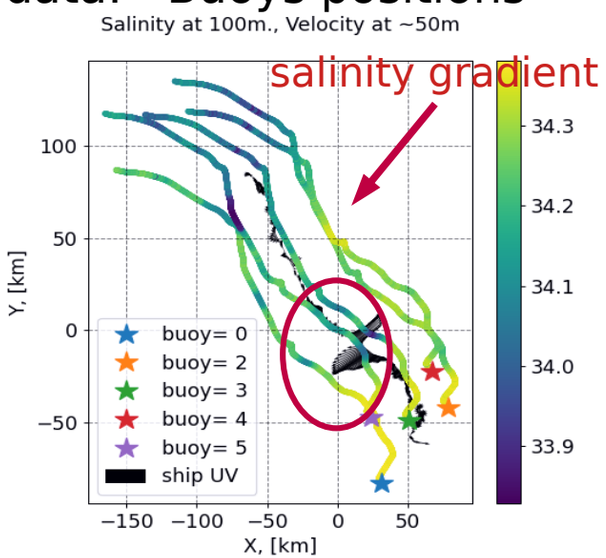
Various (sub)mesoscale eddies have been observed in the central Arctic Ocean by a Distributed Network of buoys

Ship ADCP: 9 – 13 Feb.

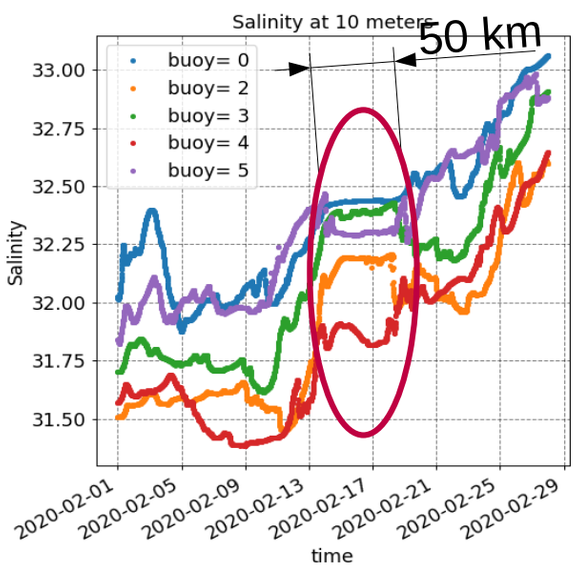


Eddy observation during baroclinic front crossing:
smoothing surface layers, well pronounced horizontal structure on several buoys below halocline

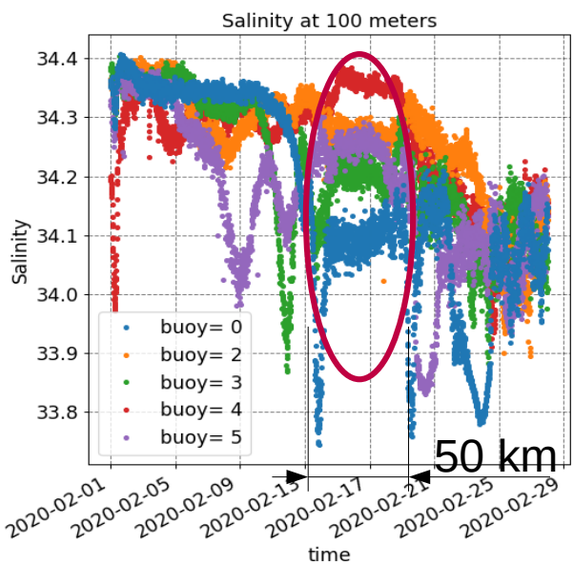
Buoys data: Buoys positions



Surface salinity



Salinity below halocline



Goal: to a better characterization and understanding of (sub)mesoscale dynamics and its role in vertical transport of energy and mass.

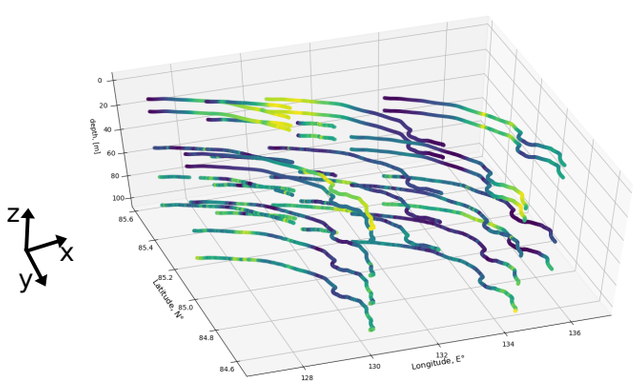
Data and model analysis

FESOM-C - regional model (with open boundary)

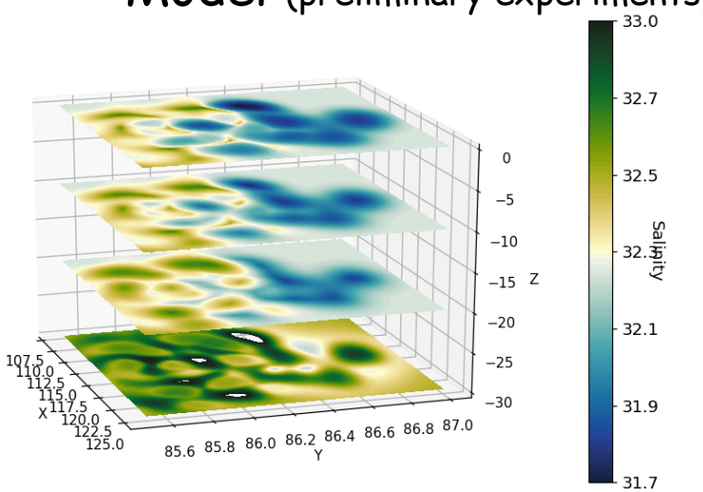
- Time-split scheme (external/internal)
- Cell-vertex finite volume discretization
- Mixed meshes (quads/triangles)
- Vertical sigma coordinates
- schemes of stabilization near OB
- …

- Model setup:
  - 374 000 nodes (around MOSAiC flow +)
    - Horizontal resolution 300 – 1200 m.
  - 340 vertical sigma levels
    - Vertical resolution ~0.5 meters (first 100m.)
- Simplified ice
- b-l turbulence closure, …

Data from 5 buoys



Model (preliminary experiments)

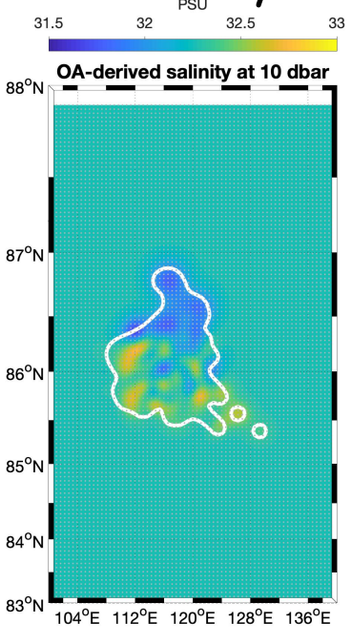


Data and model analysis, first approach:

Interpolated observations data as initial conditions for the model

Buoys data interpolation

Salinity



Errors

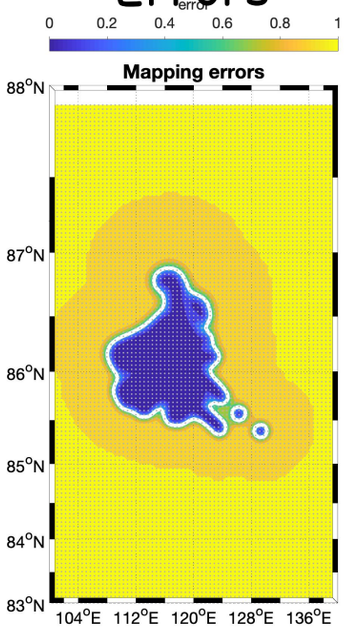
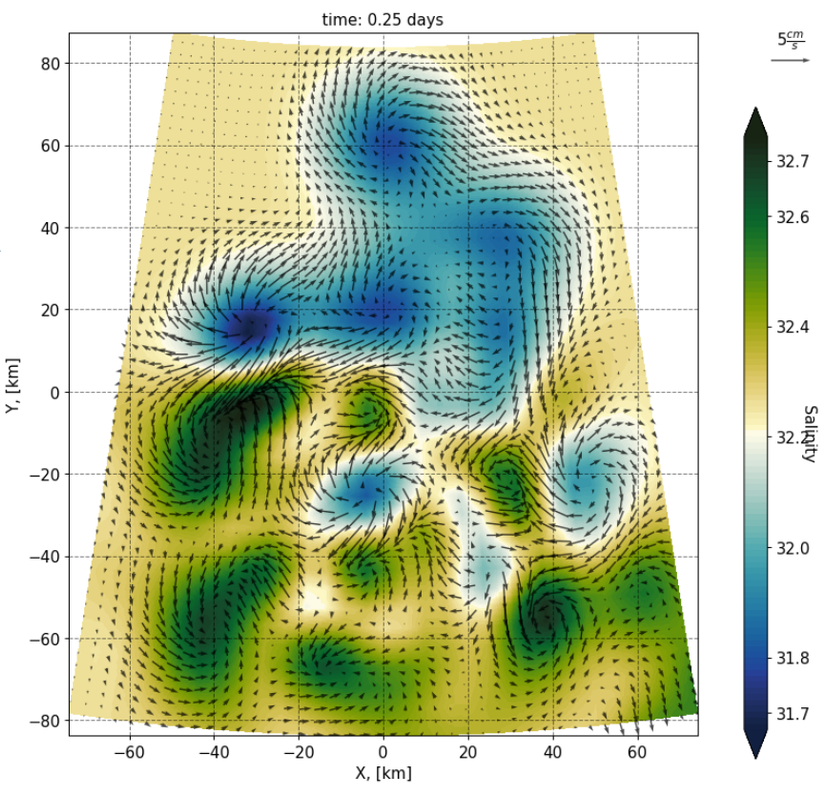


Figure: Ying-Chih Fang

Model in free run after nudging of fields derived from observations

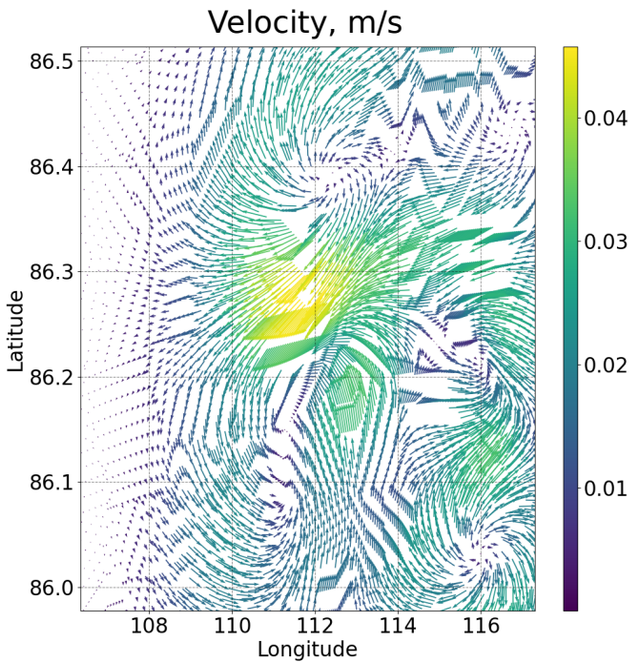


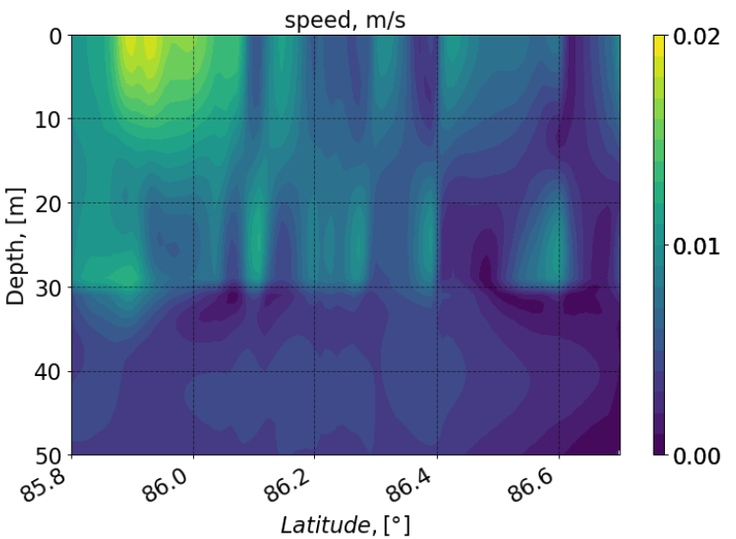
Modeled salinity

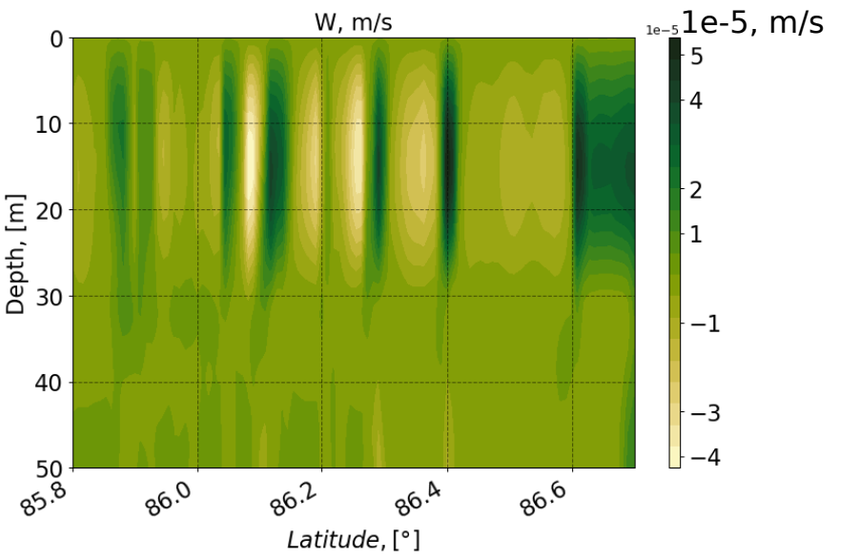
For details: EGU21-3723, Winter upper-ocean thermohaline variability observed from drifting ice platforms in the Amundsen Basin, Arctic Ocean. By Ying-Chih Fang et al.

Data and model analysis, first approach:

Examples of model results after nudging of T/S fields derived from observations



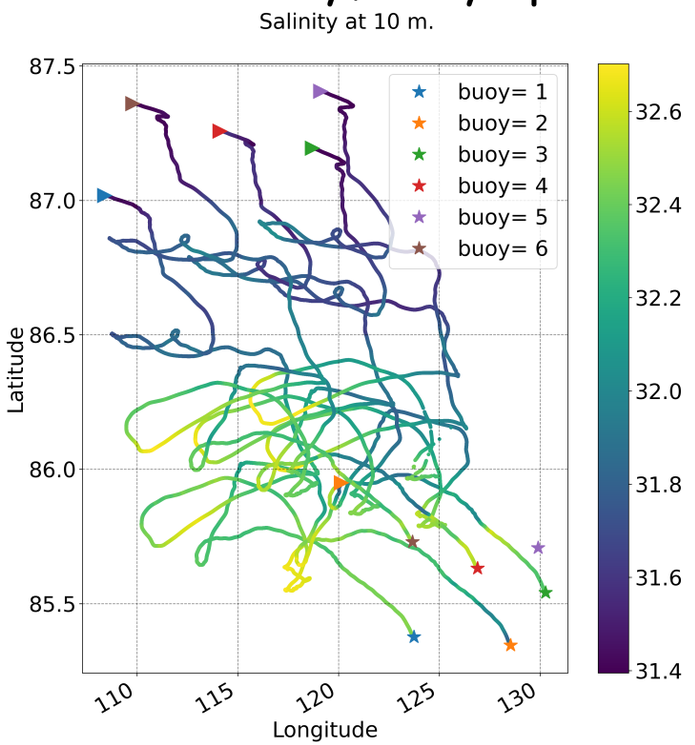




Data and model analysis, second approach:

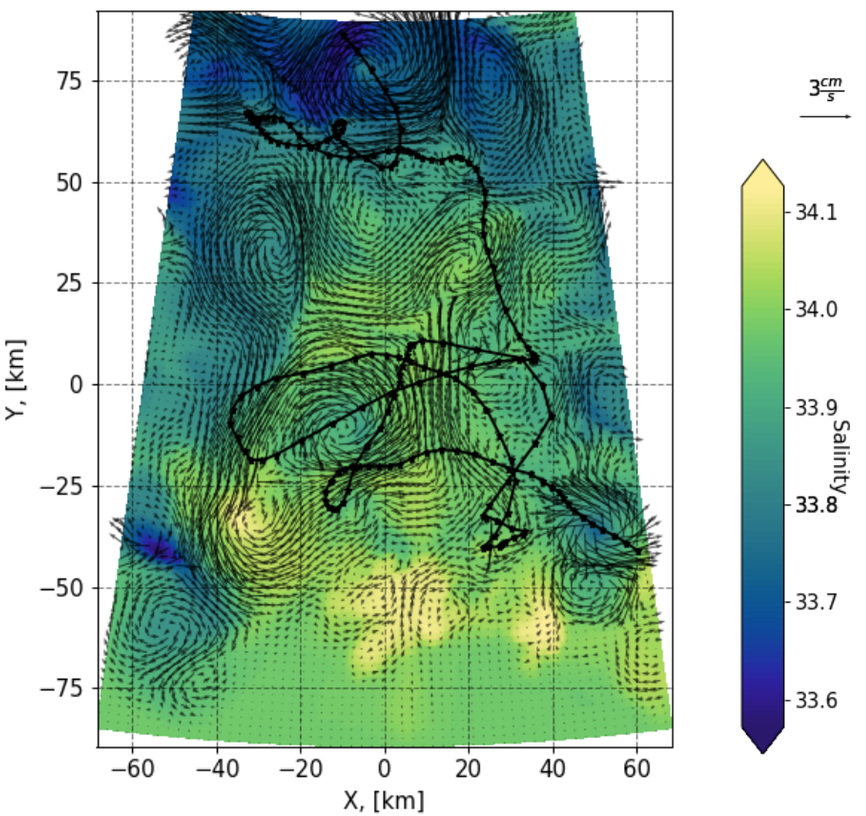
Constant fields as initial conditions and nudging of available observational data

Obs. Salinity, buoys path



Nudging

Simulated U,V,W,T,S,... 3D fields



Data:

+ buoys data
+ ship/CO CTD
+ MSS

Modeled salinity and currents
black line is a ship path

Acknowledgments

MOSAiC OCEAN team

AWI; IOW; U Bremen / Germany

Jacob Allerholt, Ying-Chih Fang, Rainer Graupner, Mario Hoppmann, David Kuhlmey, Ivan Kuznetsov, Maria Mallet, *Benjamin Rabe (coordination),* Julia Regnery, Kirstin Schulz, Sandra Tippenhauer, Myriel Vredenborg ; Volker Mohrholz, Ingo Schuffenhauer ; Christian Mertens, Monika Rhein, Nathalia Sukhikh, Maren Walter

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SIO; OUC; FIO; Shanghai J. T. Univ. / China

Hailun He, Long Lin ; Tao Li, Jialiang Zhu ; Yan He, Bin Kong, Xiaobing Ma ; Hailong Liu

MOSAiC Distributed Network team

Crews of R/V Polarstern and R/V Akademik Fyodorov

AWI cluster Ollie

Everyone that contributed over the last 10+ years to making MOSAiC a reality