

# **A new combined mean dynamic topography model – DTUUH19MDT.**

Per Knudsen & Ole Andersen, DTU Space

Nikolai Maximenko & Jan Hafner, U Hawaii

## Contents:

---

Early 2018 we completed the ESA supported OGMOC project improving:

- Satellite-only combined geoid (CSR, U Texas)
- Combined geoid model (TU Munich)
- Respective MDTs (DTU and UH)  
(Ref. Gruber, et al.)

Early this year we had the opportunity to update:

1. The geodetic MDT using a new MSS
2. The combined MDT by improving the inversion integrating the geodetic MDT with drifter velocities.

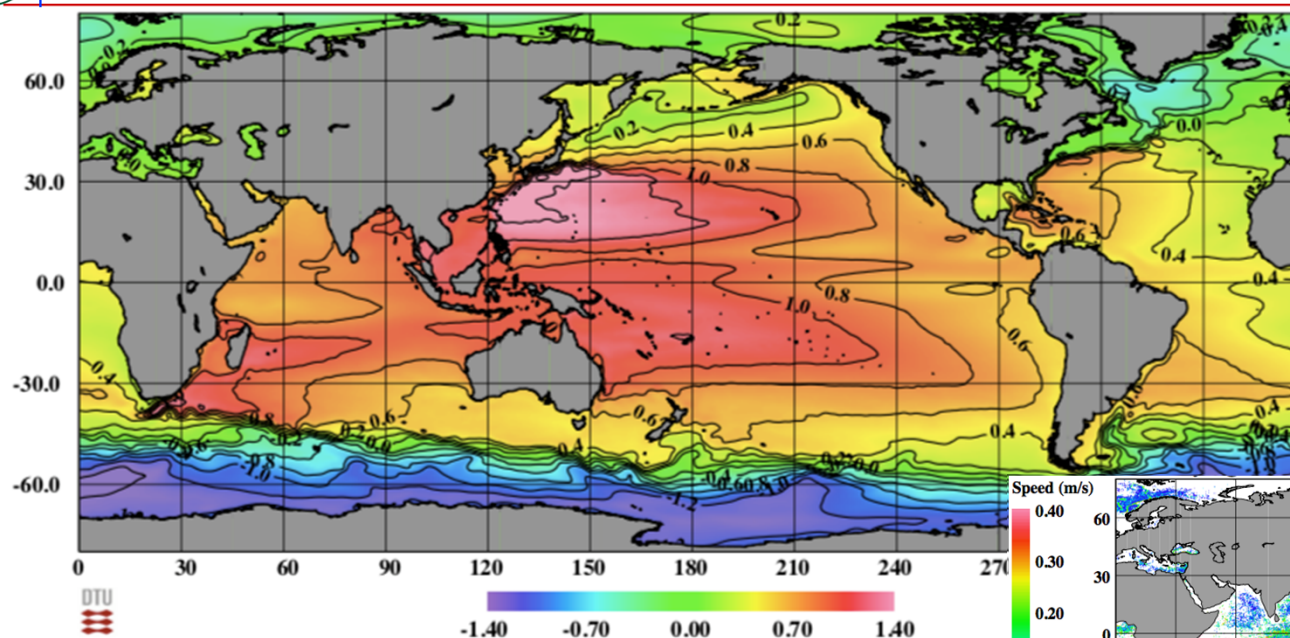
# The geodetic DTU19MDT

Update models:

	Mean Sea Surface	Geoid
DTU13MDT	DTU13MSS	EIGEN-6C3stat
DTU15MDT	DTU15MSS	GOCO05S-EIGEN-6C4 hybrid
DTU16MDT	DTU15MSS	GOCO05C-EIGEN-6C4 hybrid
DTU17MDT	DTU15MSS	OGMOC hybrid
DTU19MDT	DTU18MSS	OGMOC hybrid

- New Mean Sea Surface DTU18MSS (mainly retracked Cryosat-2 and Polar fixes)
- Geoid models complete to d/o 2160.

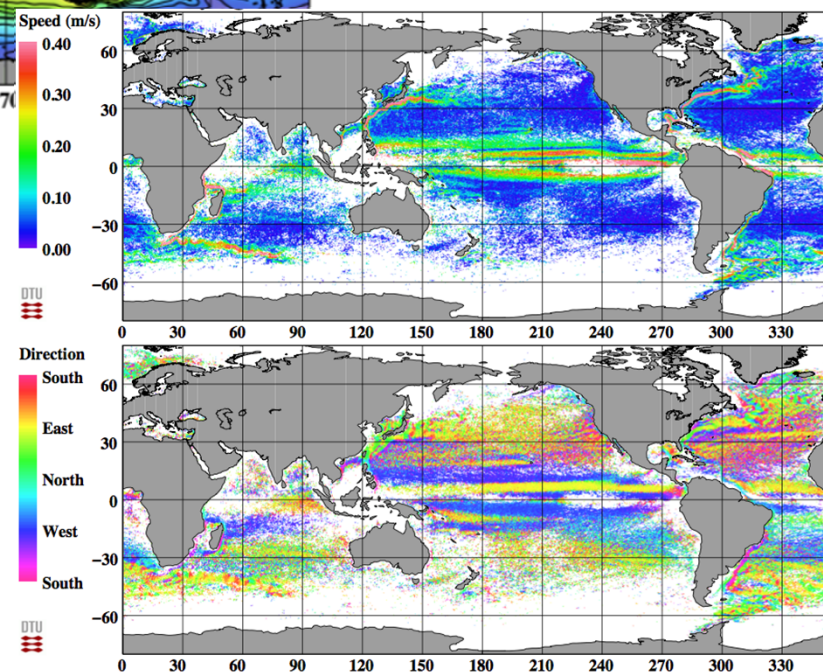
# DTU19MDT



Comparison with drifter means

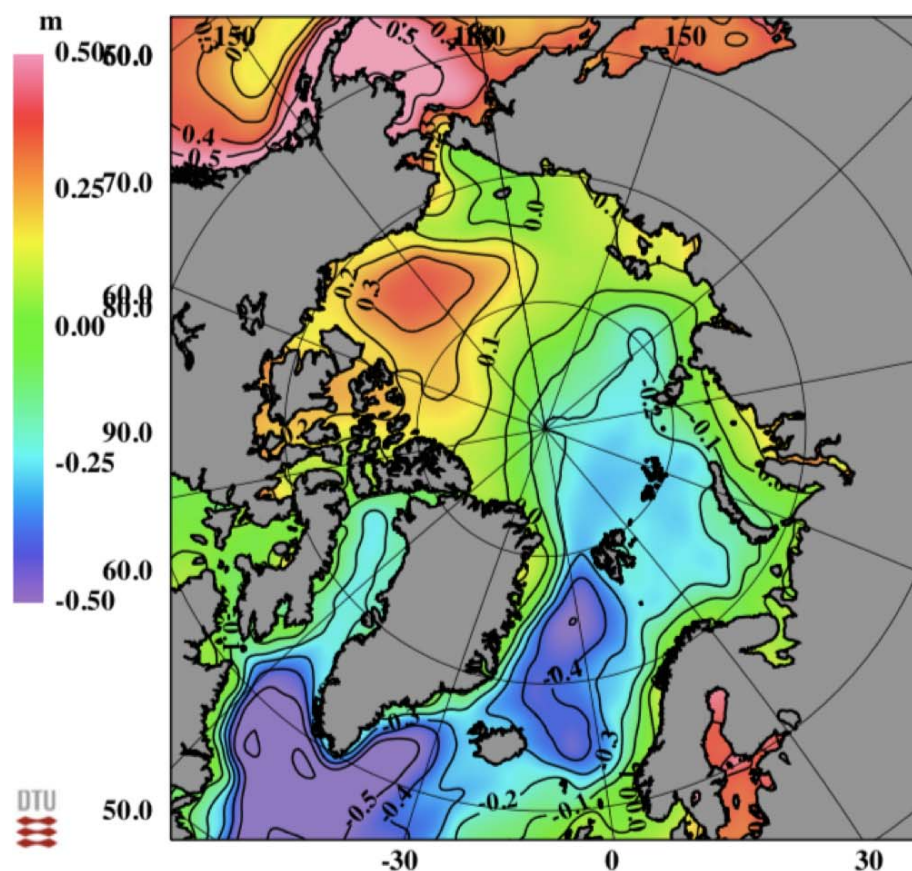
- Stats: [cm/s]

Lat 10-30#		Lat 30-50#	
u	v	u	v
4.8	5.5	4.7	4.6

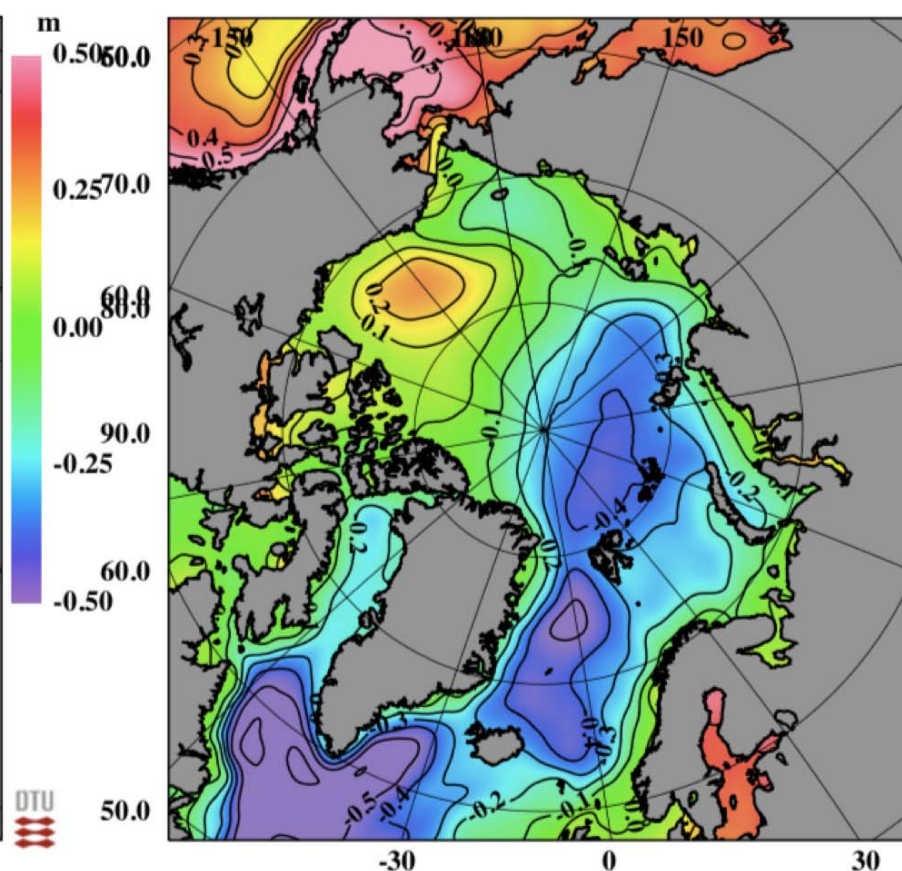


# DTU19MDT – Arctic region

DTU17MDT:



DTU19MDT:



# The combination model DTUUH19MDT:

---

Build on DTU19MDT - a purely geodetic MDT.

Derive mean drifter velocities:

- Processing of drifter velocities (Ekman + Aviso GCA (20y)),

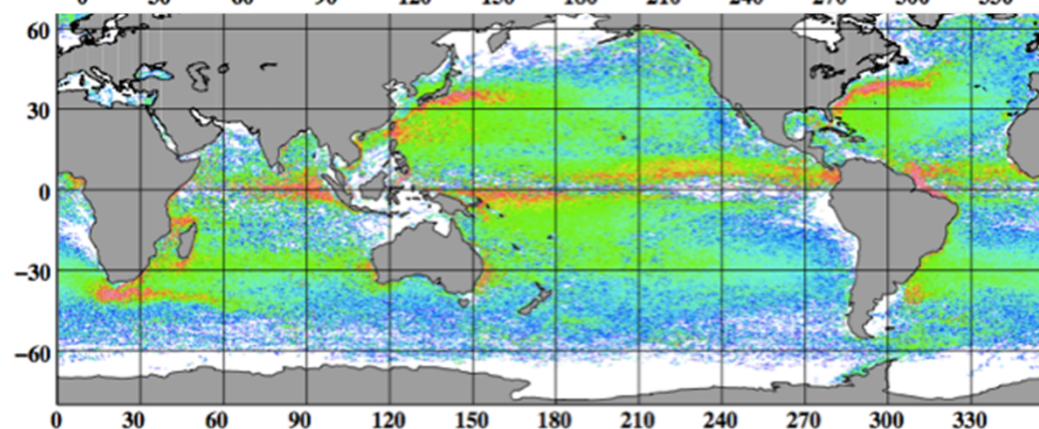
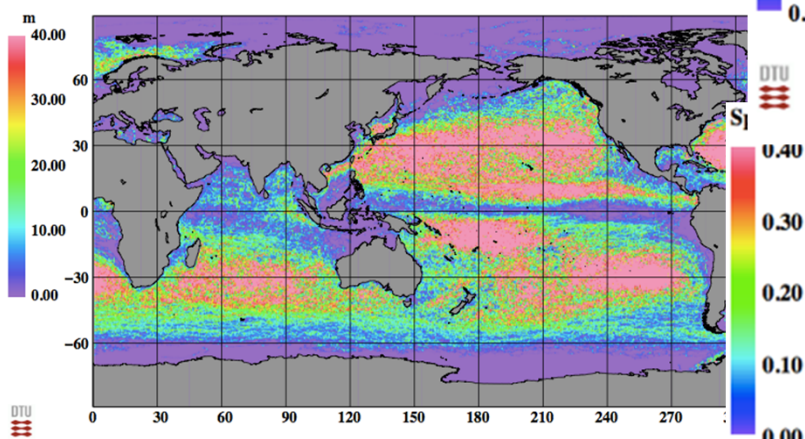
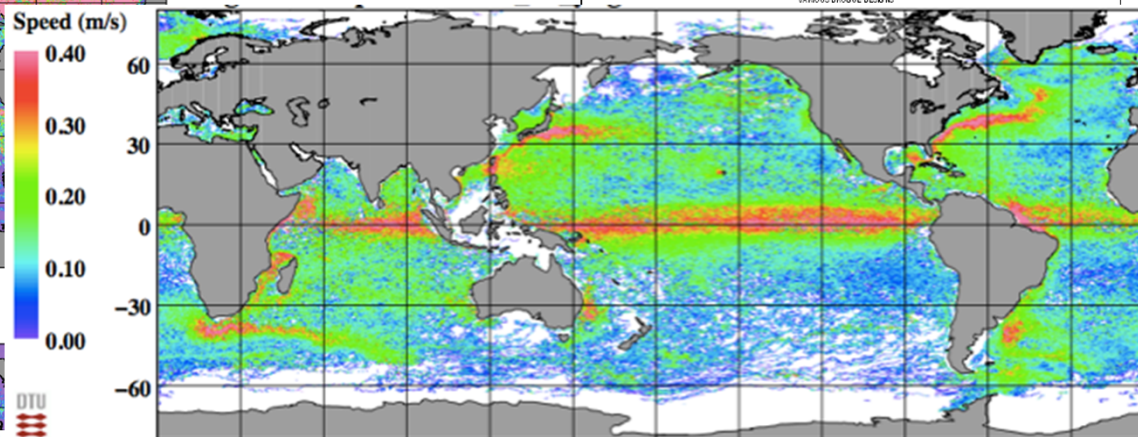
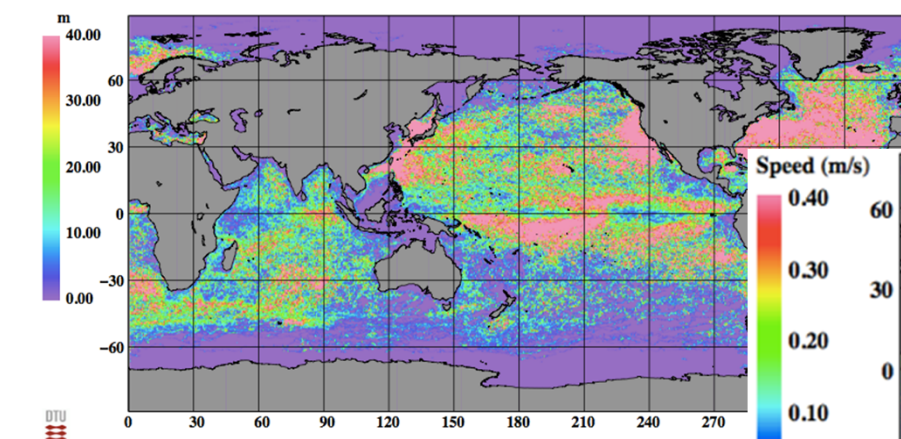
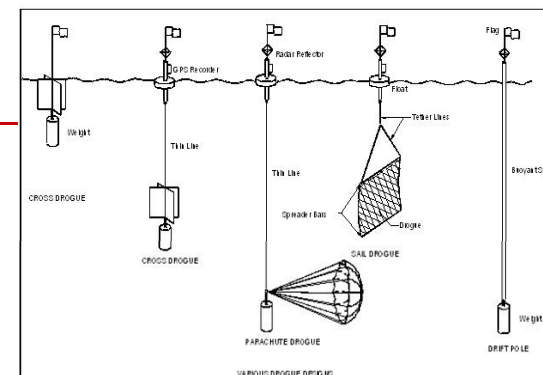
Comparisons and error assessment (MDT and mean velocities),

Improve the integration through inversion:

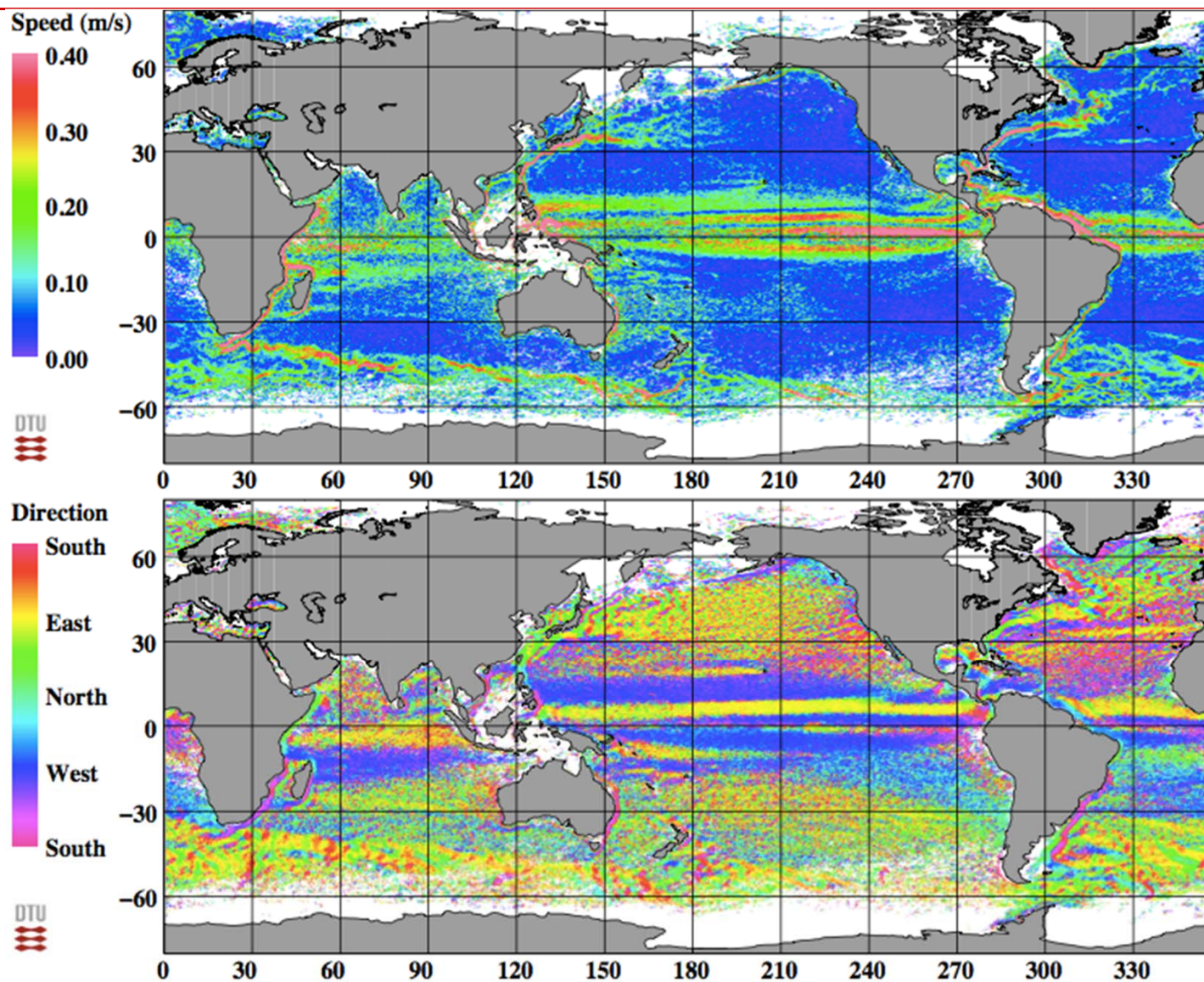
- Higher resolution,
- Consider MDT error covariances,
- Add constraints wrt smoothing, coast lines..

# Processing of drifters

Drogued and un-drogued drifters.



# Merged set of mean drifter velocities



# Inversion

Model: MDT heights at nodes of a regular 1/8 by 1/4 deg grid.

Minimizing the cost function:

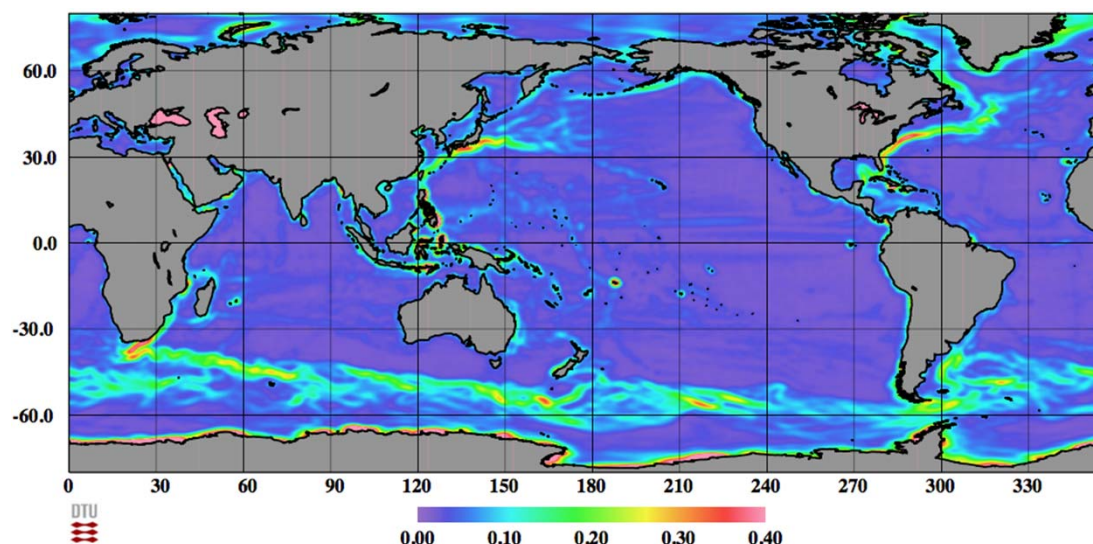
$$F = \sum (MDT - MDT_{geodetic})^2 + C_{gradient} \cdot \sum (\nabla MDT - \nabla MDT_{oceanographic})^2 + C_{smoothness} \cdot \sum (\Delta MDT)^2$$

Considering errors:

- Mean drifter velocities:  $e \sim 1/\sqrt{n}$
- MDT error:

Experimenting with:

- Weights
- Smoothness
- MDT error covariances



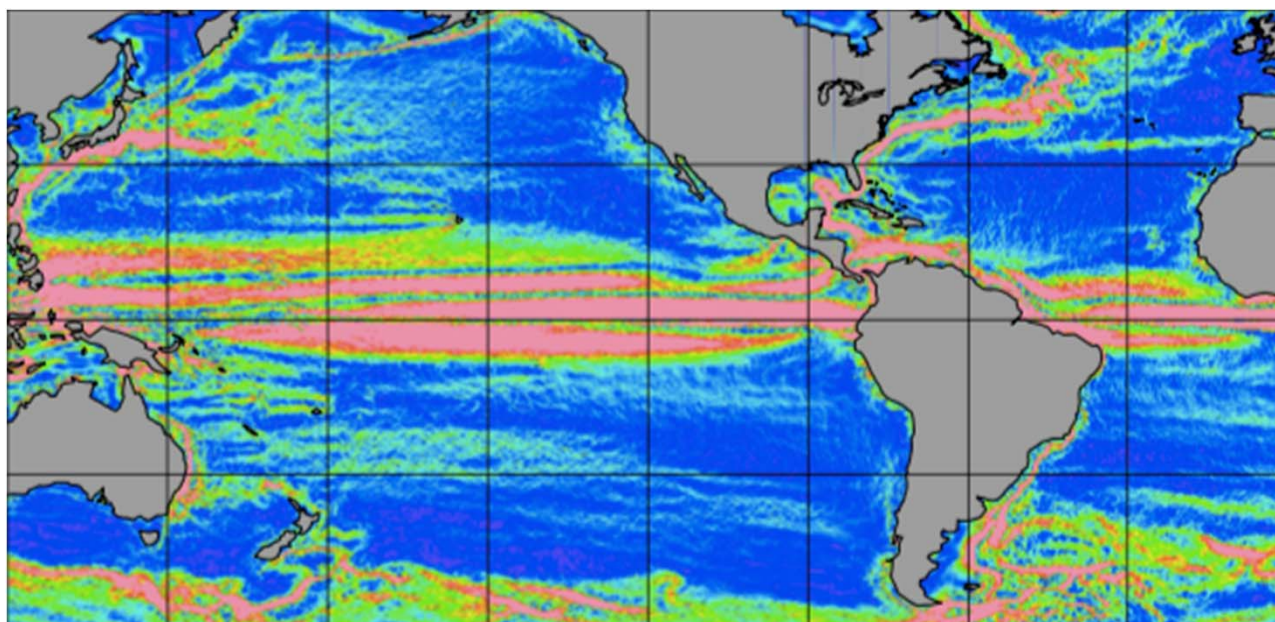
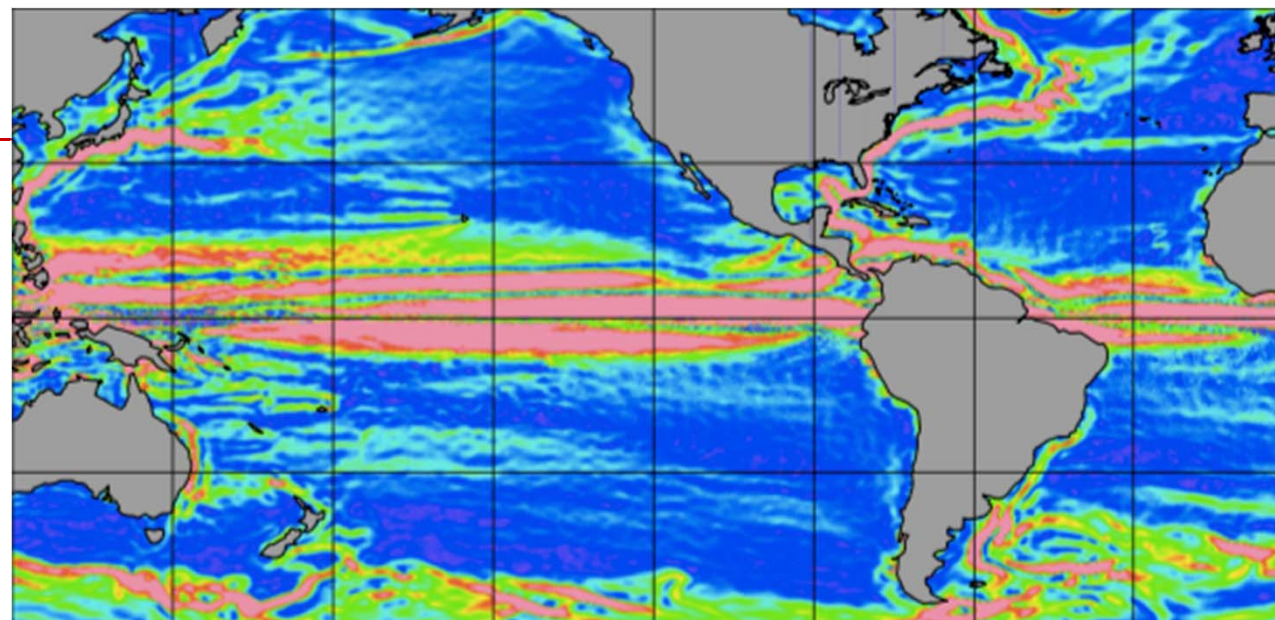
# Results

DTU19MDT >

Speed (m/s)



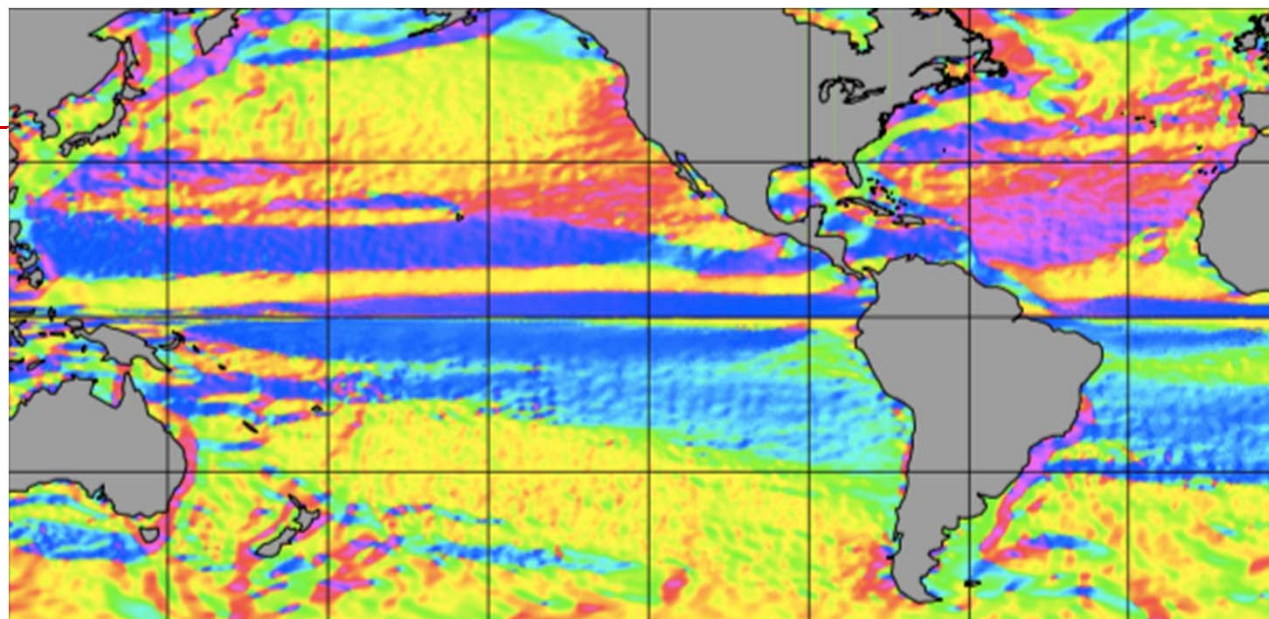
DTU19MDT >



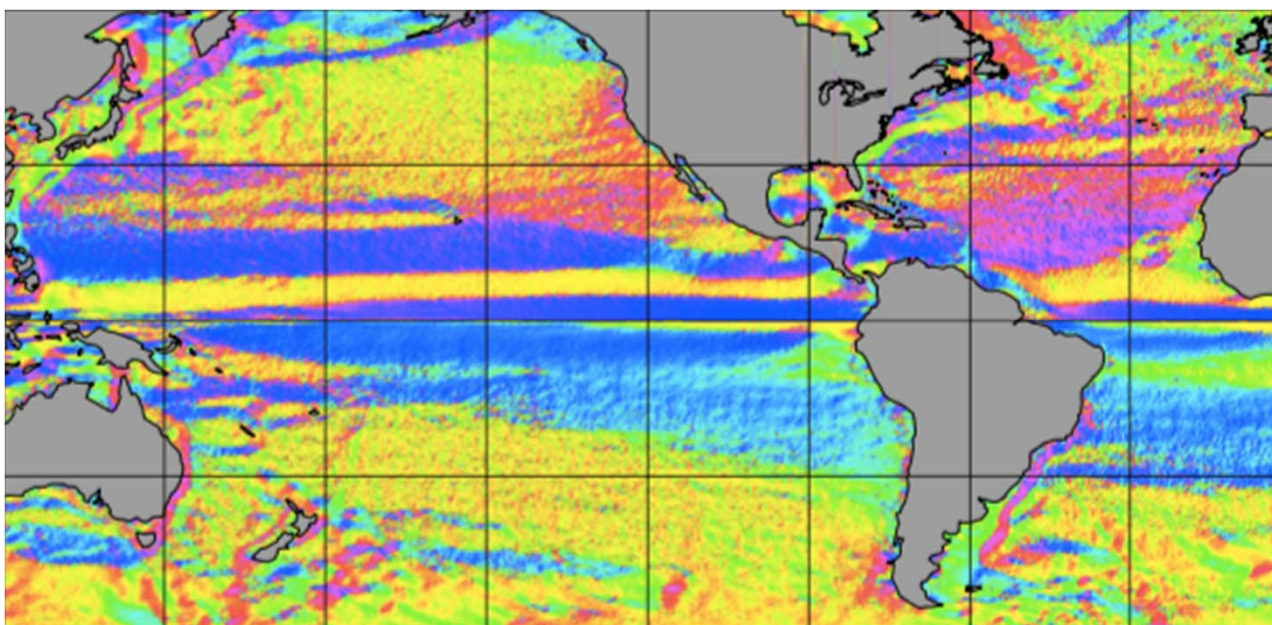
# Results

DTU19MDT >

Direction

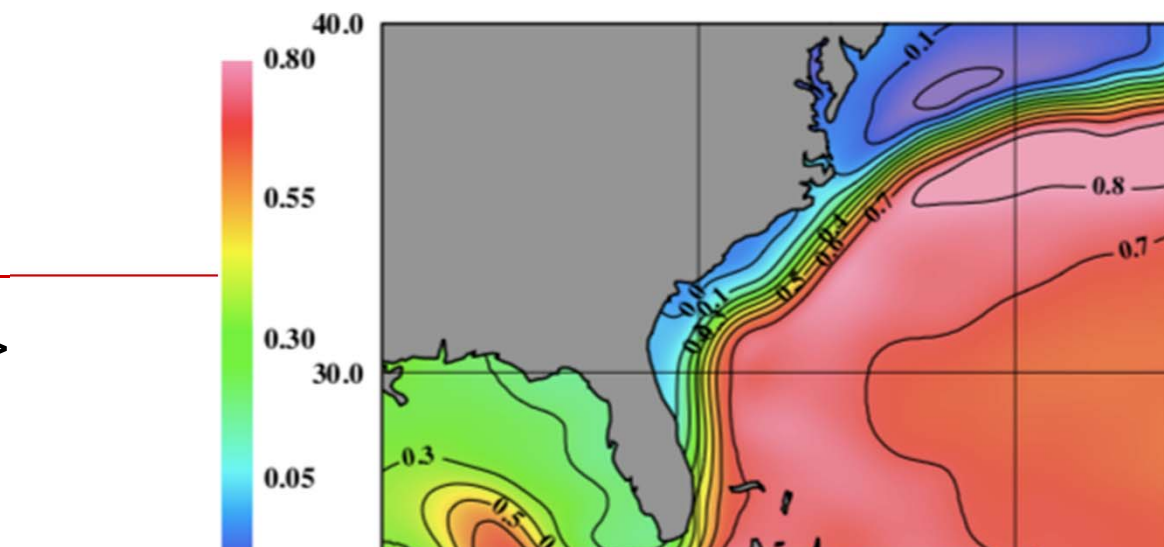


DTU19MDT >

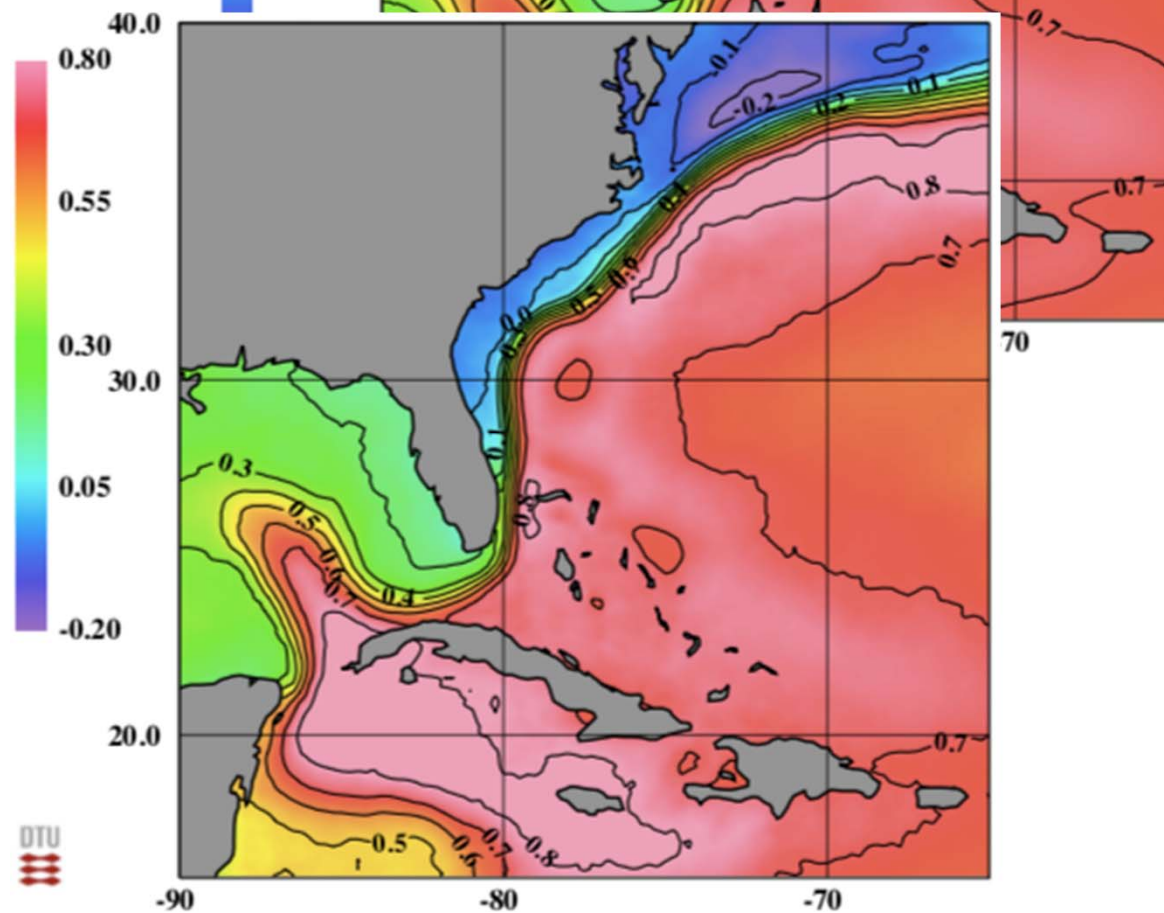


# Results

DTU19MDT >

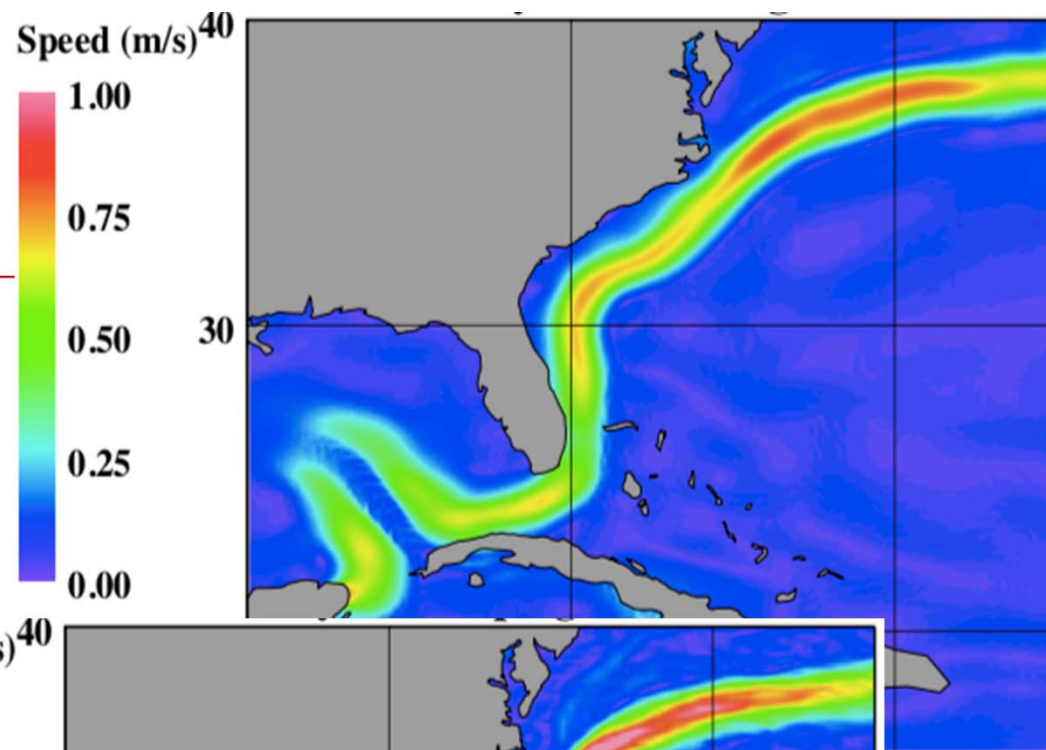


DTUUH19MDT >

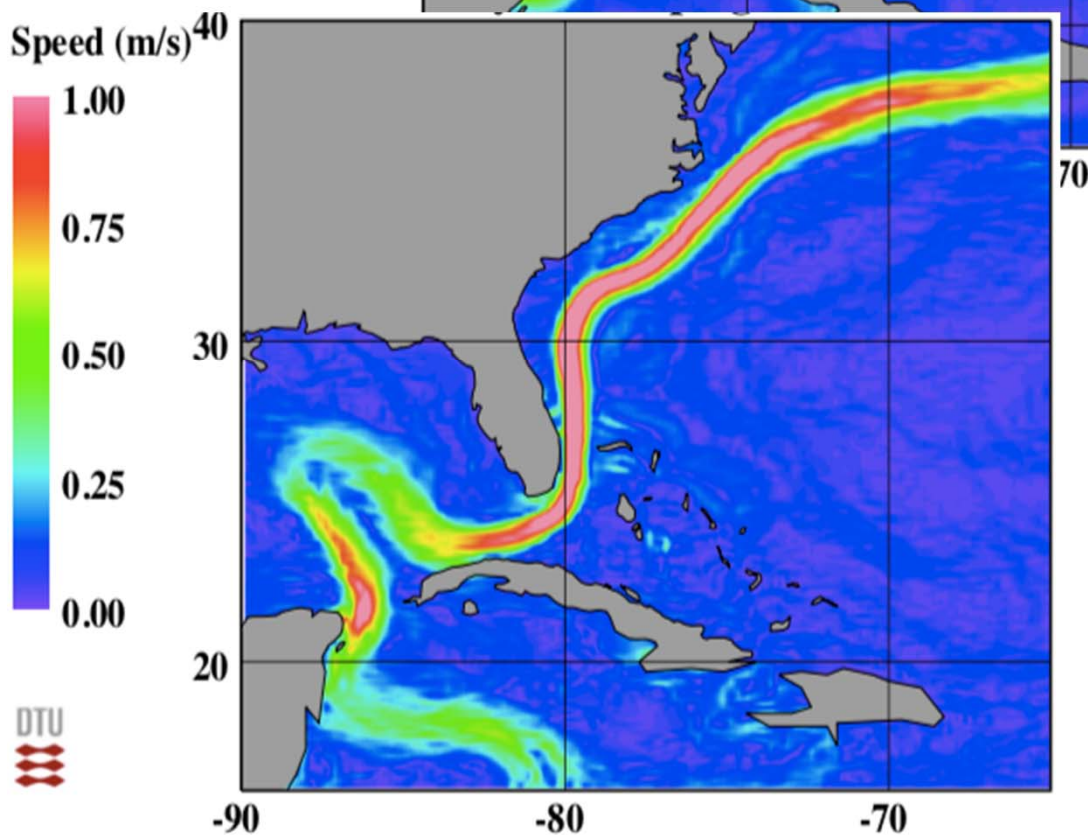


# Results

DTU19MDT >

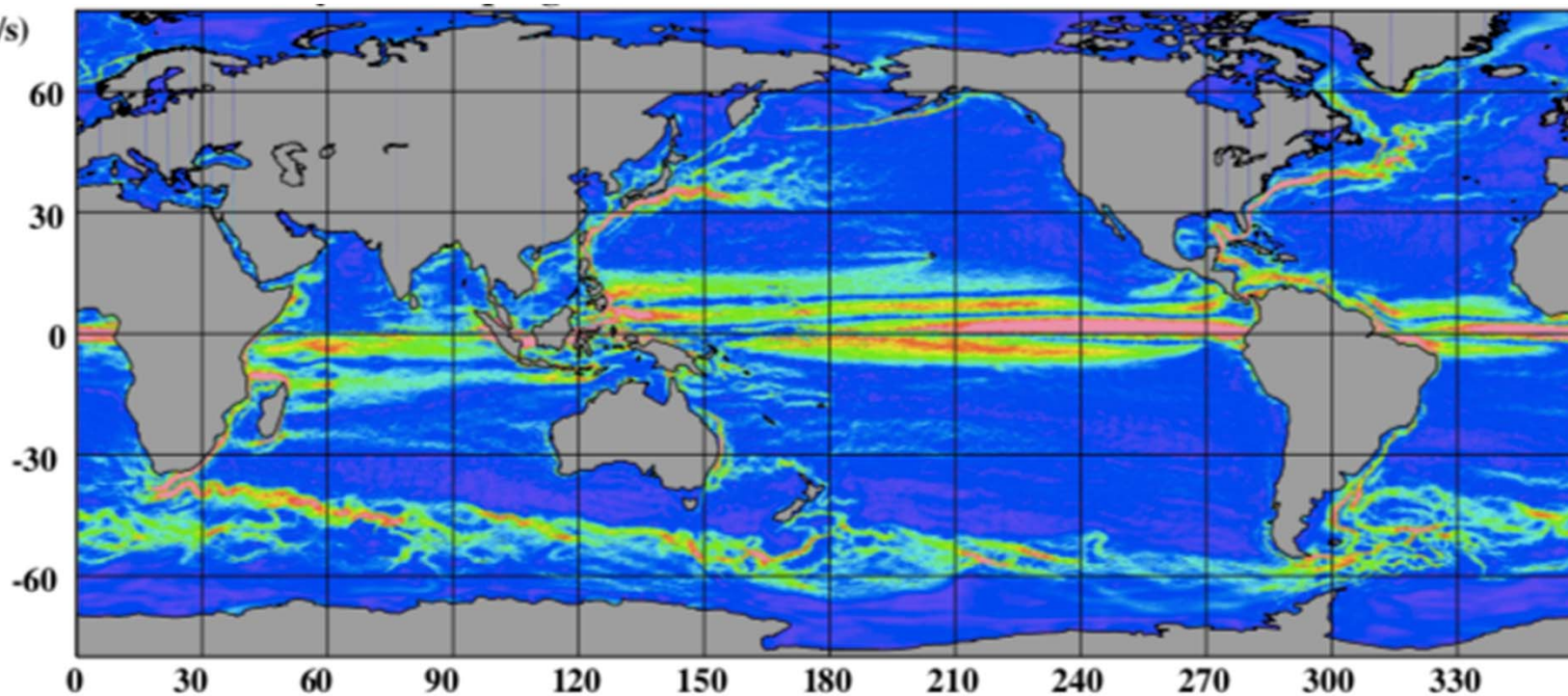
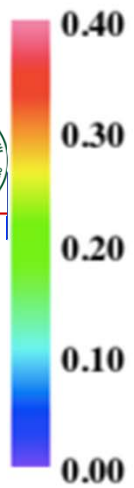


DTUUH19MDT >

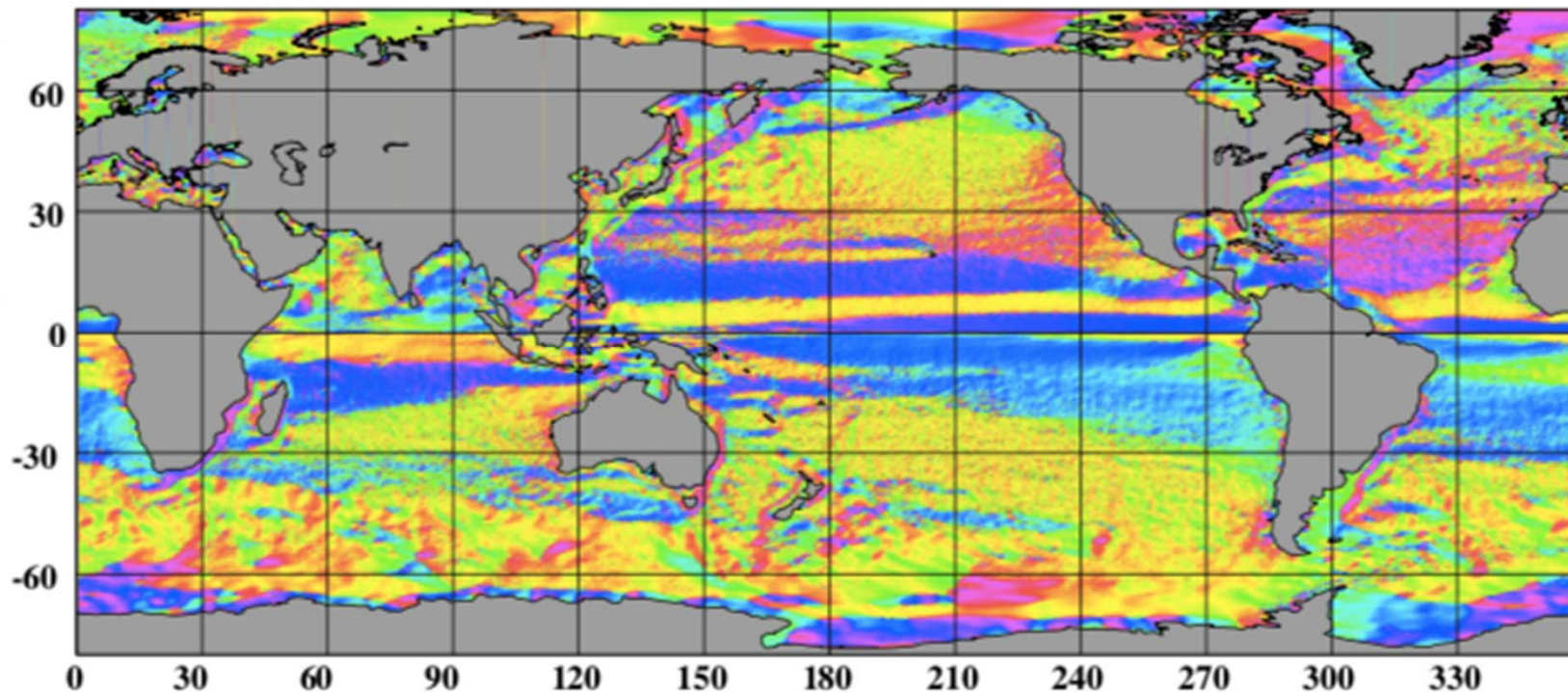
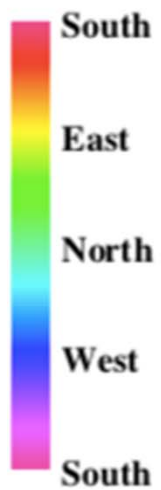




Speed (m/s)



Direction



# Summary

---

The geodetic model:

- DTU19MDT has been derived

The combined model:

- A preliminary version DTUUH19MDT has been derived.
- Still need to:
  - Assess errors,
  - Experiment with weights and regularization/smoothing,
  - Converge toward the final model.