



The marine geoid and its importance to ocean current monitoring

Dagny I. Lysaker

Meeting in the Nordic Working group on geoid determination, Helsinki 10.-11. March 2010



A more precise geoid model has improved height determination using GNSS over land

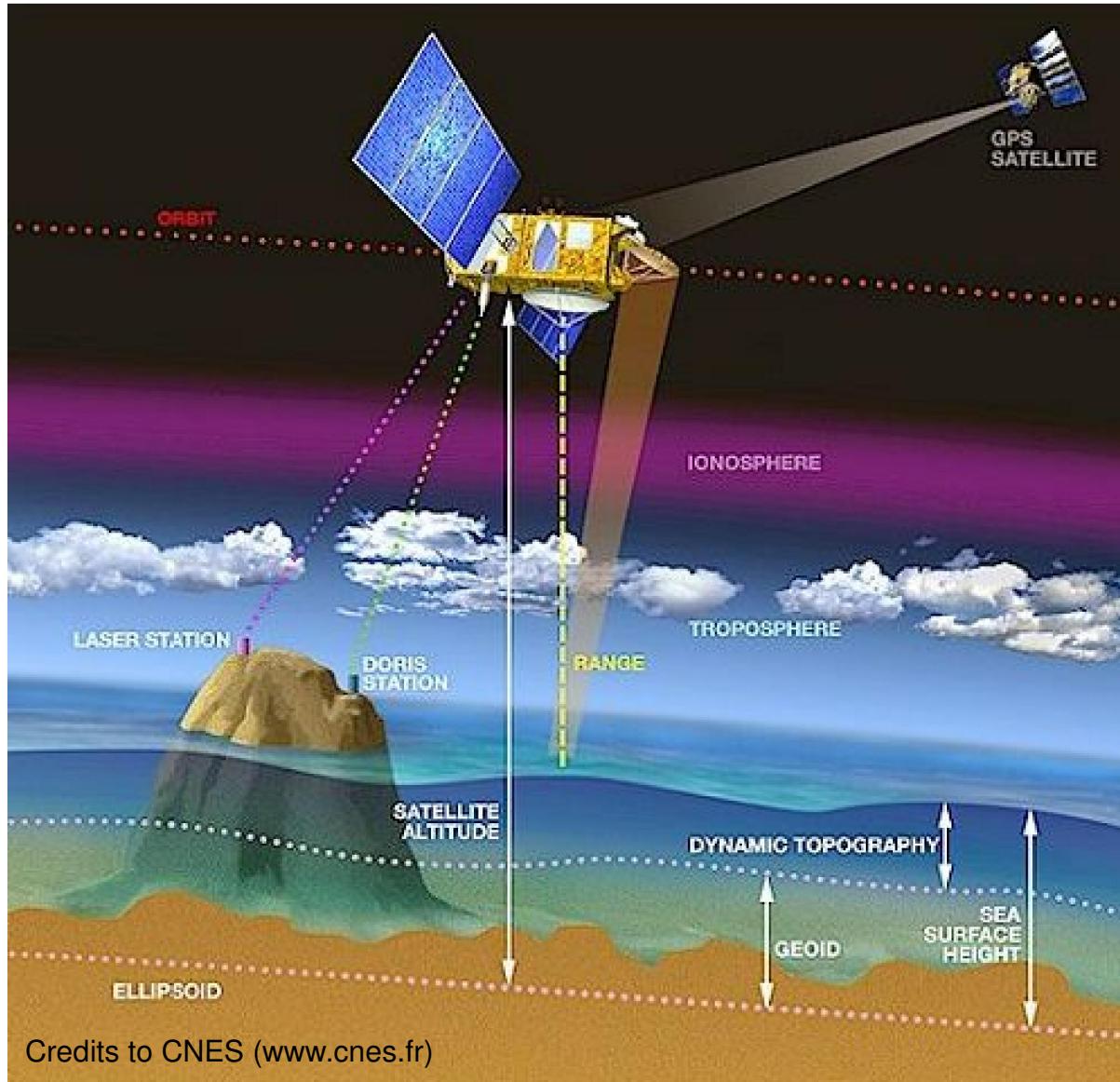
GNSS – levelling \approx geoid = HREF

---->

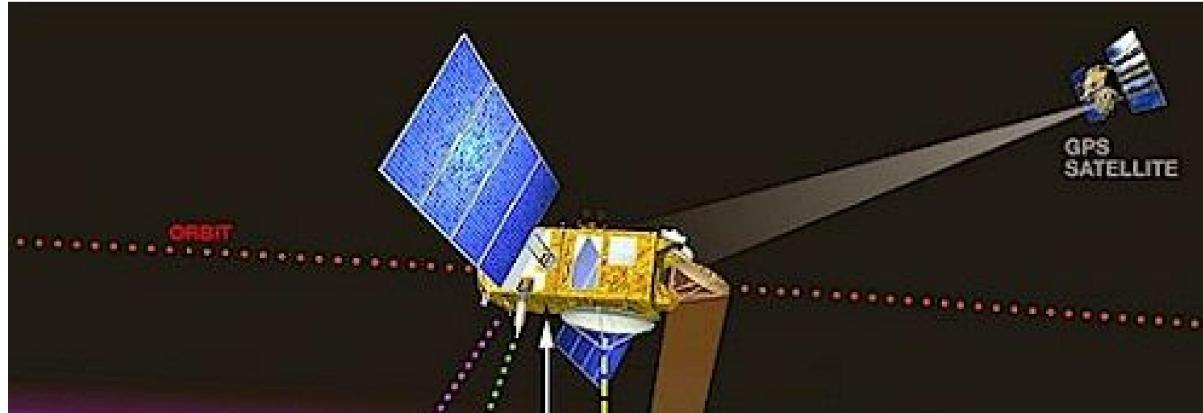
GNSS – HREF = height value



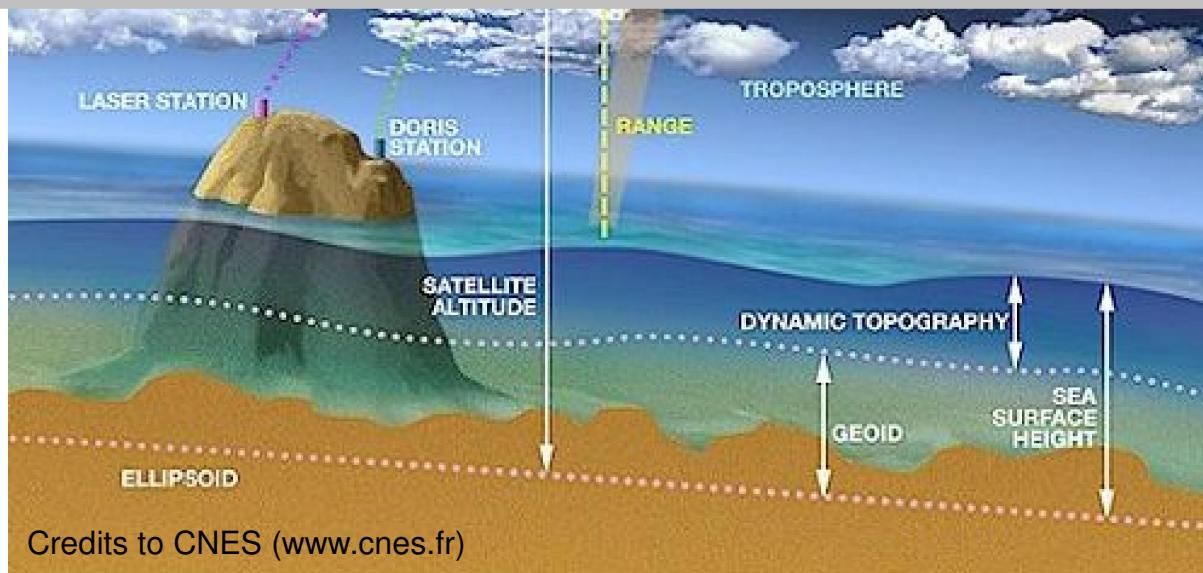
A more precise marine geoid will improve the modelling of ocean currents



A more precise marine geoid will improve the modelling of ocean currents



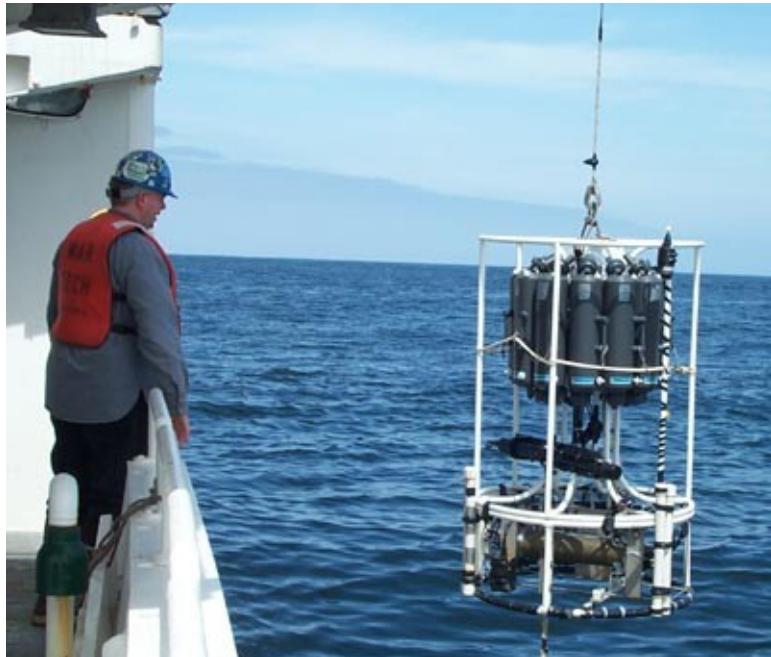
$$MDT = MSSH - N$$



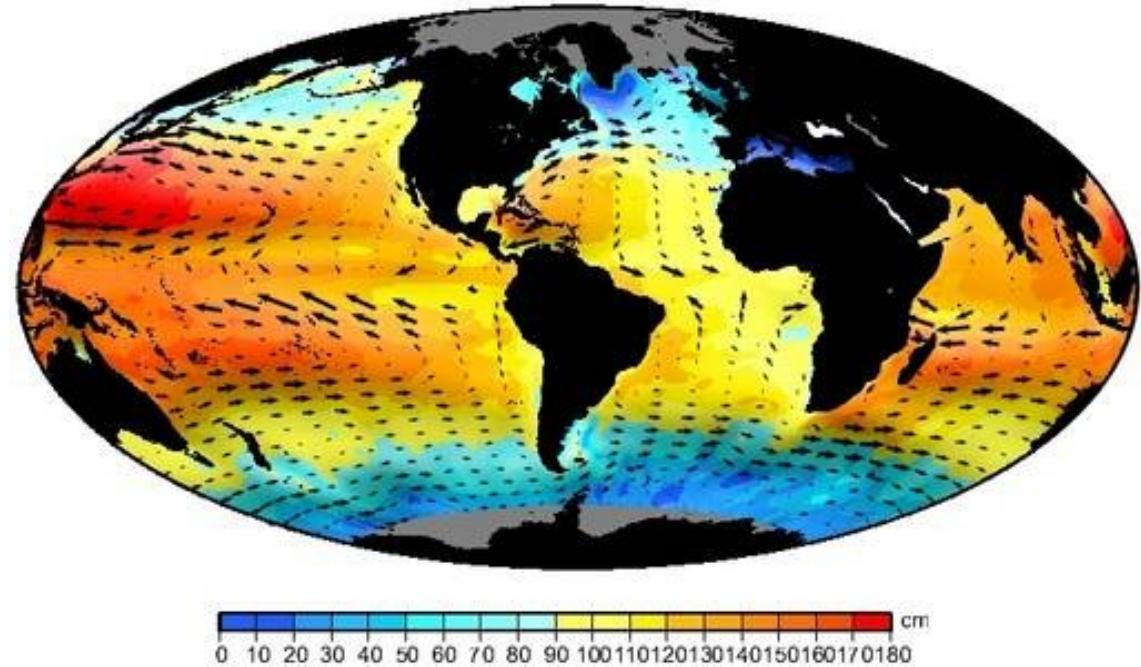
Credits to CNES (www.cnes.fr)



Oceanographers determine MDT from measurements of temperature and salinity and by hydrodynamic modelling



Credits to: www.oceanographers.ru



Credits to: www.aviso.oceanobs.com



Surface currents may be obtained from the slope of the MDT

Ocean currents originate from pressure gradients in the ocean

When the pressure gradient is balanced by the Coriolis effect



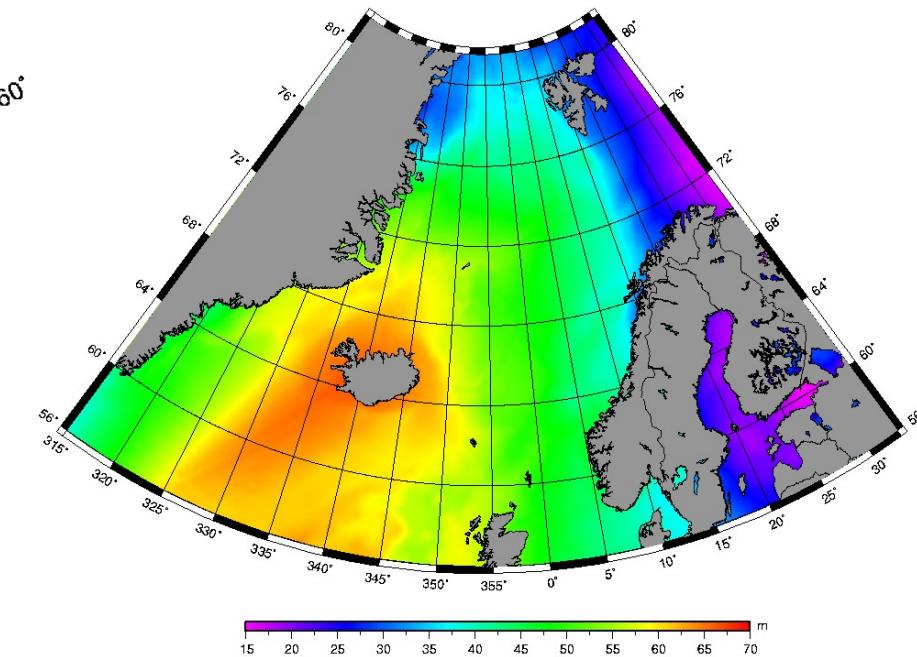
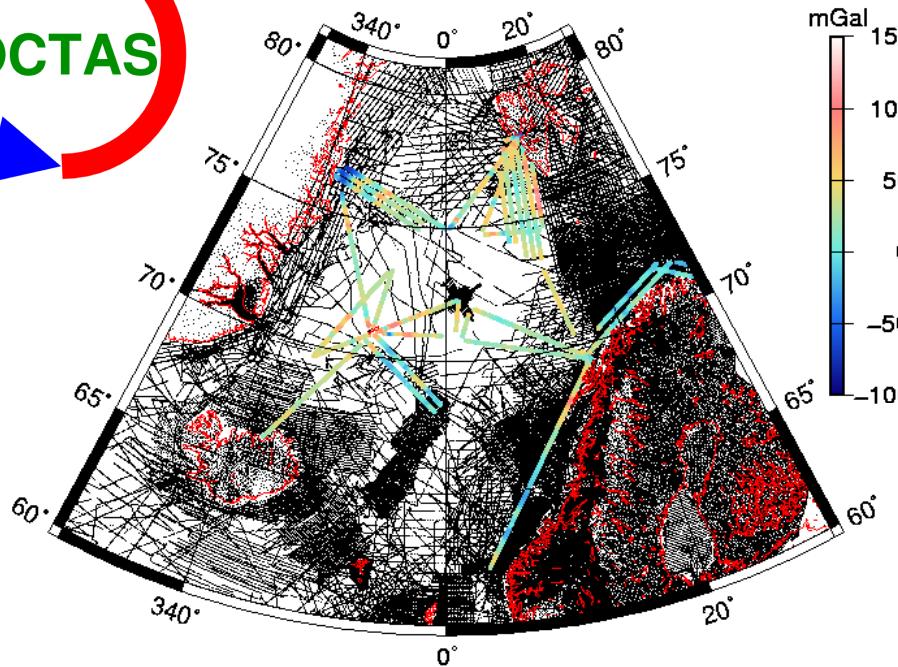
Geostrophic balance

$$u = \frac{-g}{f R} \frac{\partial \zeta}{\partial \phi}, \quad v = \frac{g}{f R \cos \phi} \frac{\partial \zeta}{\partial \lambda}$$

$$(f = 2 \Omega \sin \phi)$$

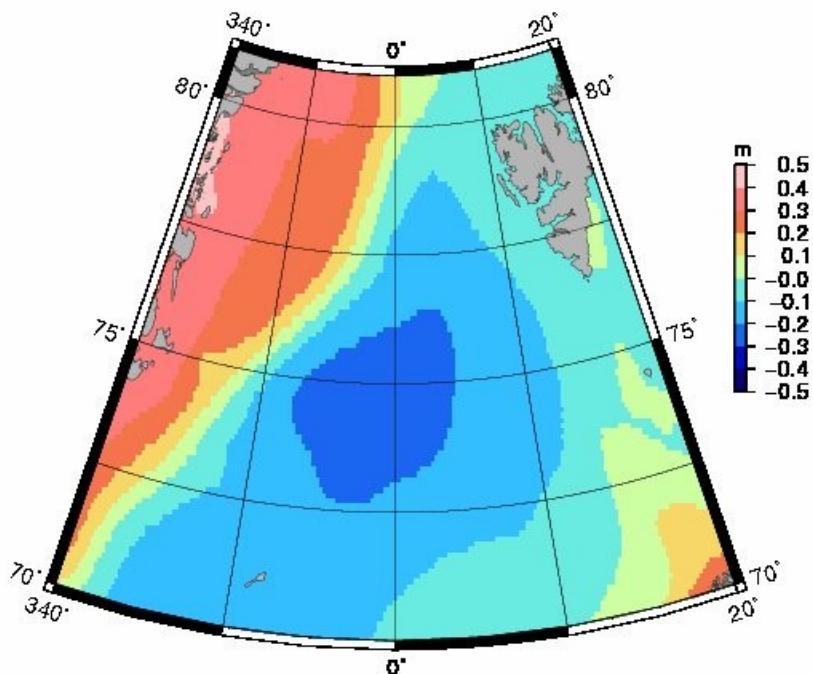


OCTAS - Ocean Circulation and Transport between the North Atlantic and the Arctic Sea

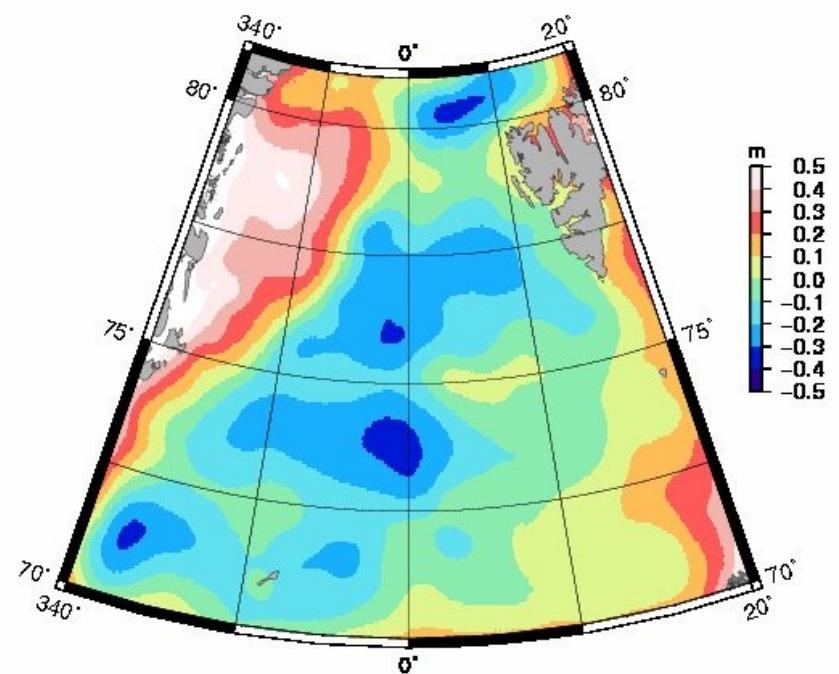


The geodetic model show more details than the oceanographic model

Oceanographic model

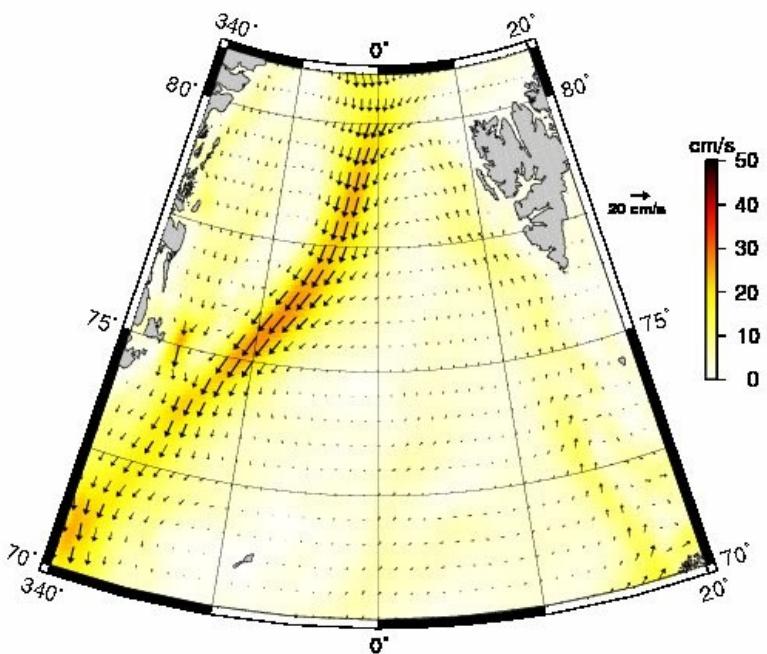


Geodetic model

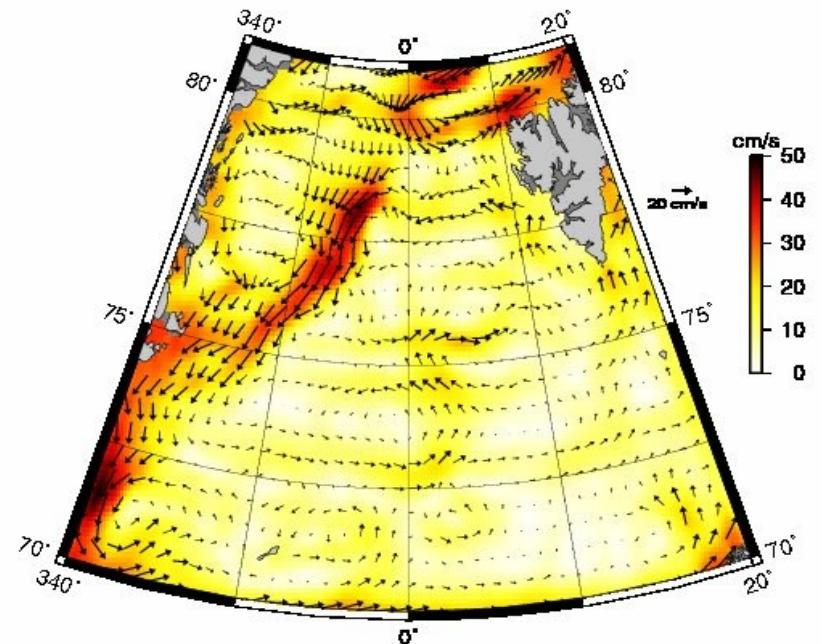


The geodetic model show smaller currents than the oceanographic model

Oceanographic model (OCCAM)

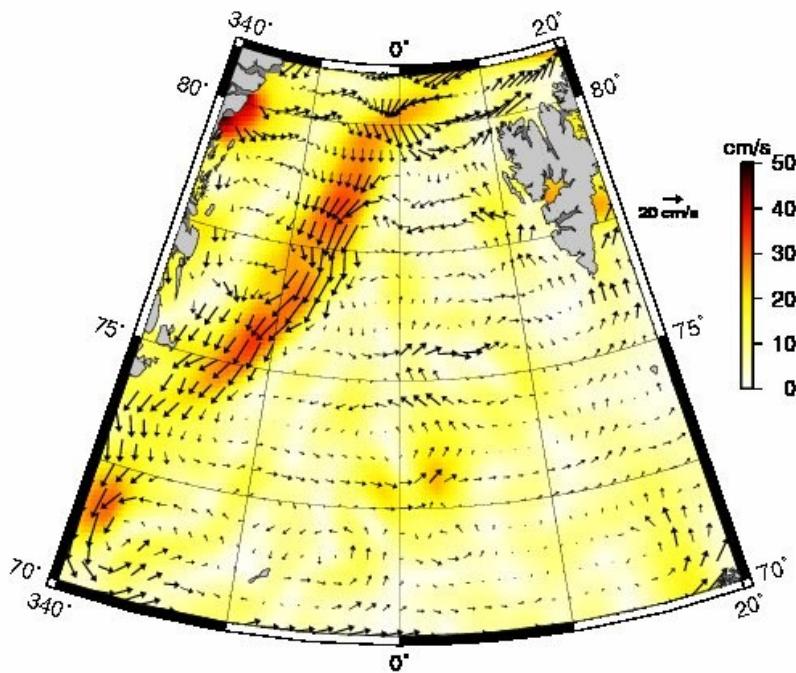


Geodetic collocation model

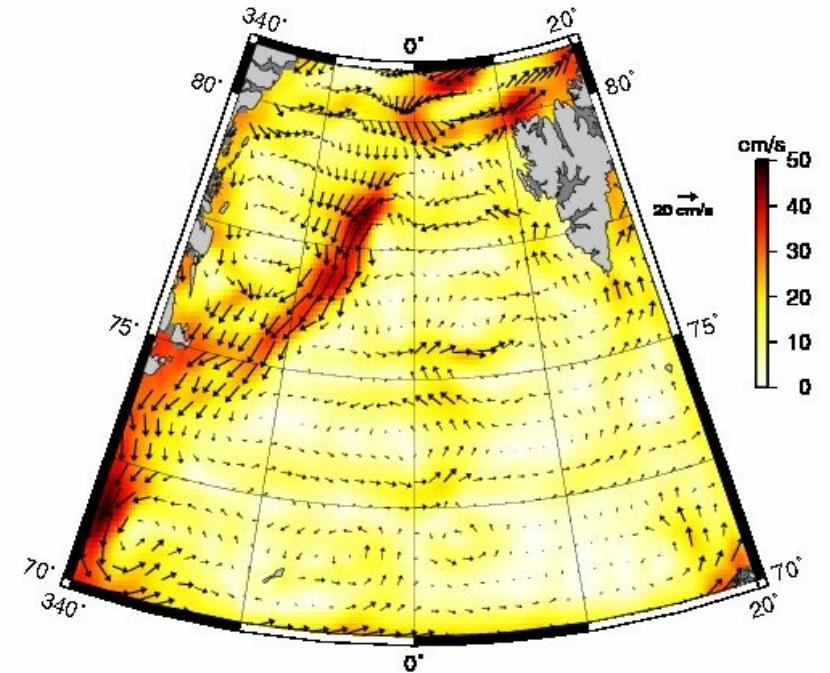


The collocation solution has more pronounced currents than direct subtraction

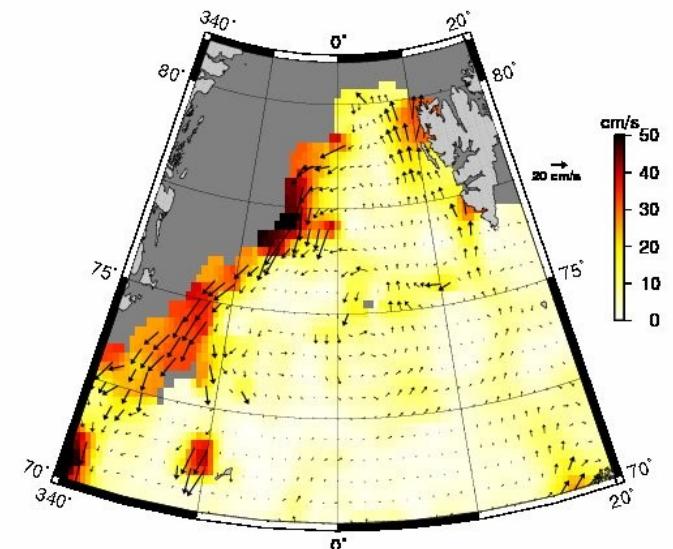
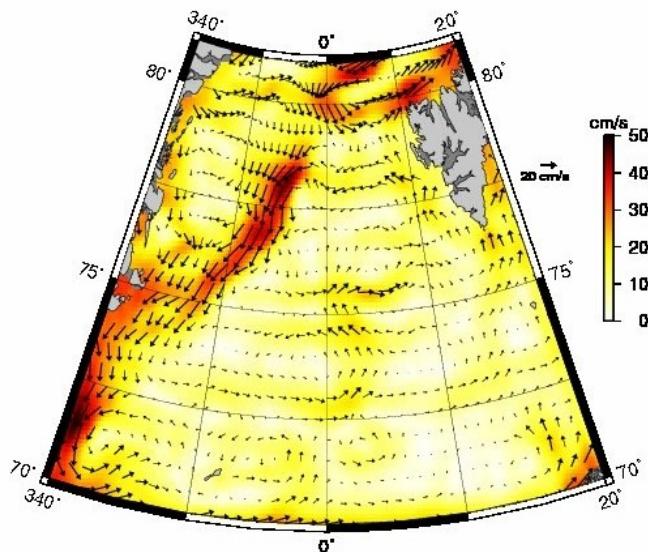
Geodetic direct subtraction model
(MSSH-N)



Geodetic collocation model
(MSSH- S(Δg))

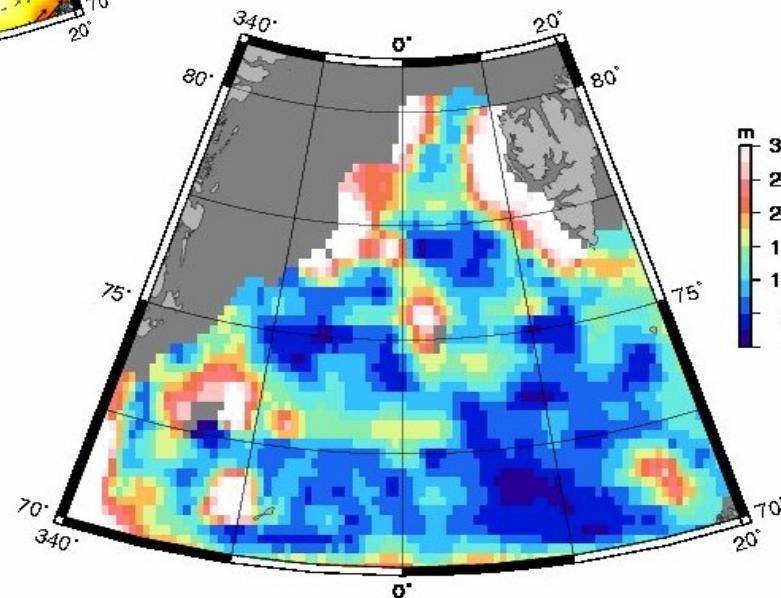


The geodetic model agrees with drifter data

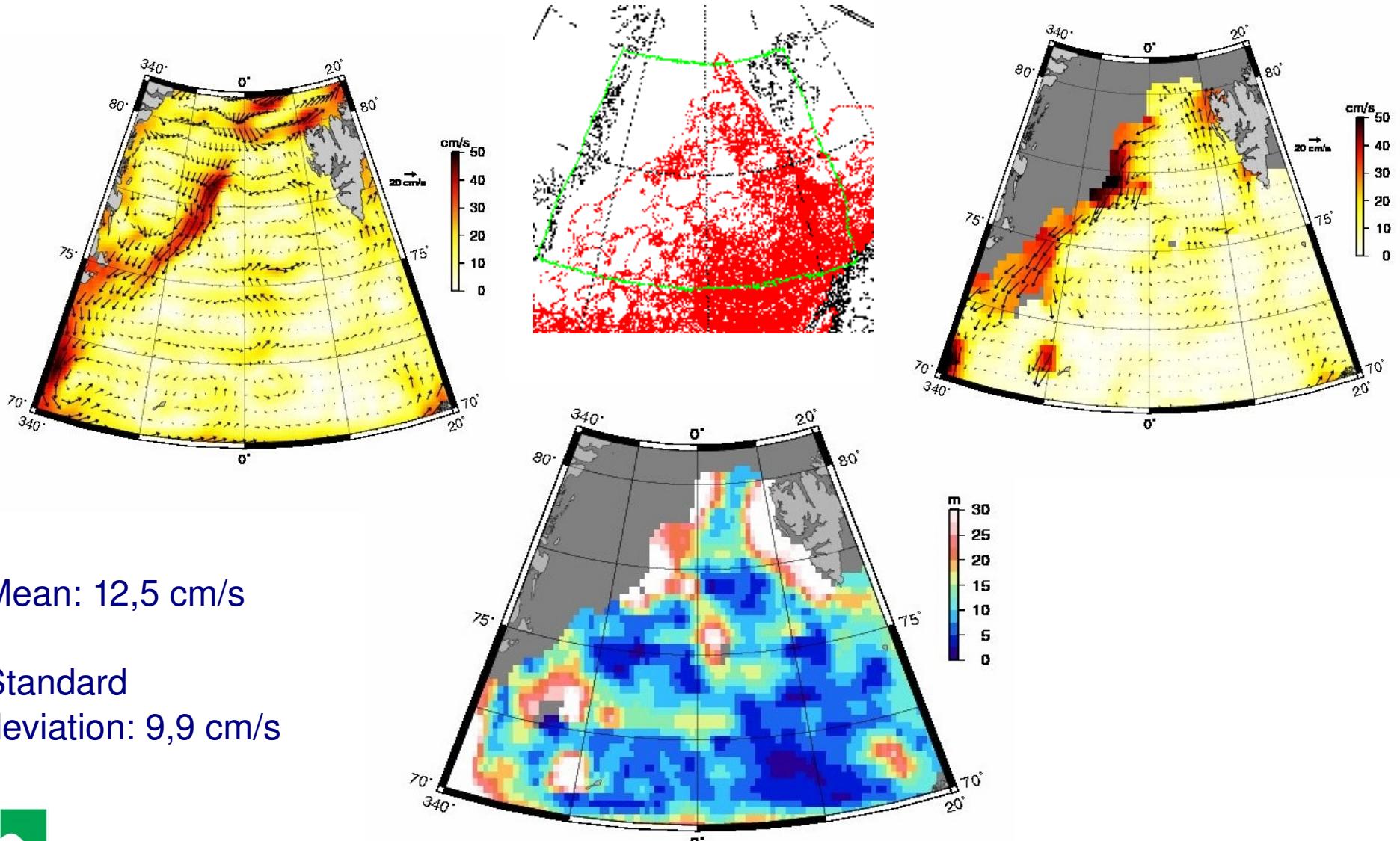


Mean: 12,5 cm/s

Standard deviation: 9,9 cm/s



The geodetic model agrees with drifter data



Mean: 12,5 cm/s

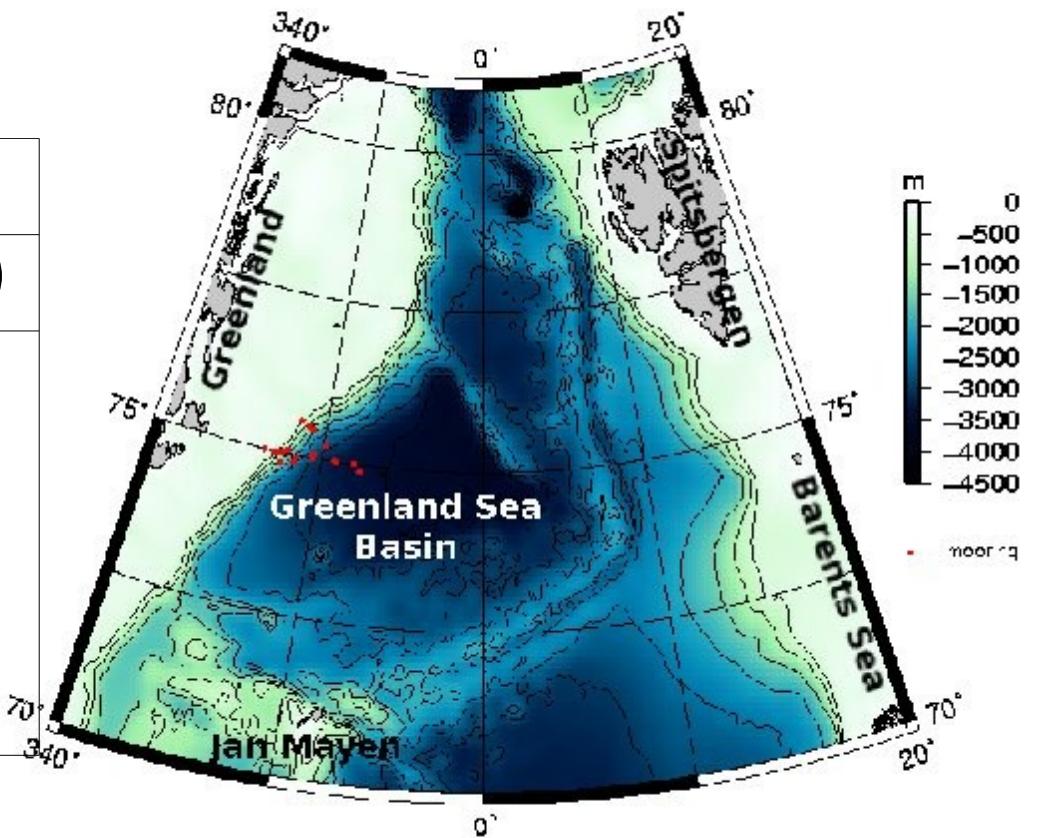
Standard deviation: 9,9 cm/s



Drifter data have the same fit to mooring data as our models



Model subtracted	Mean (cm/s)	Std (cm/s)
MDT_LSC	8.6	5.3
SMDT	10.1	5.2
OCCAM	7.3	4.4
drifter	7.9	6.7



Summary

Ocean currents may be determined from altimetry and gravity

MDT is an important climate parameter

MSSH at high latitude needs improvements

The marine geoid needs improvements



QUESTIONS?

Ocean currents may be determined from altimetry and gravity

MDT is an important climate parameter

MSSH at high latitude needs improvements

The marine geoid needs improvements

