

Can Sea Ice Freeboard Determination Benefit from a Precise Geoid?

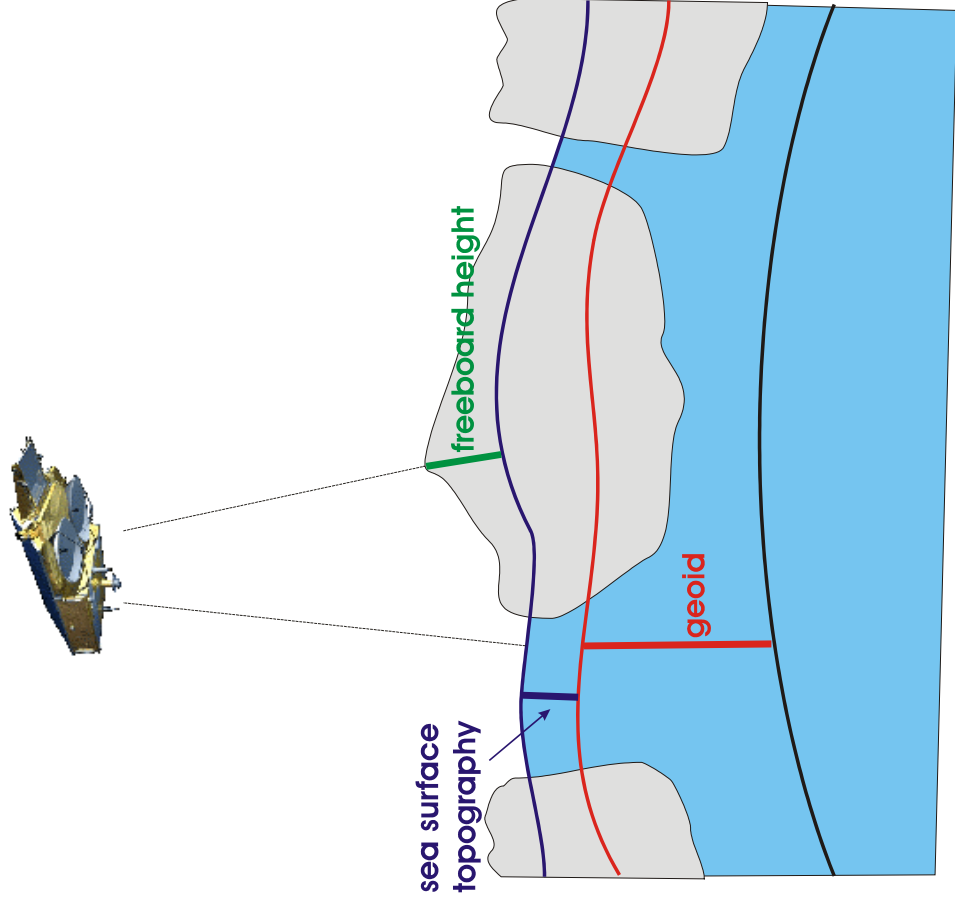
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Freeboard Height and Sea Level



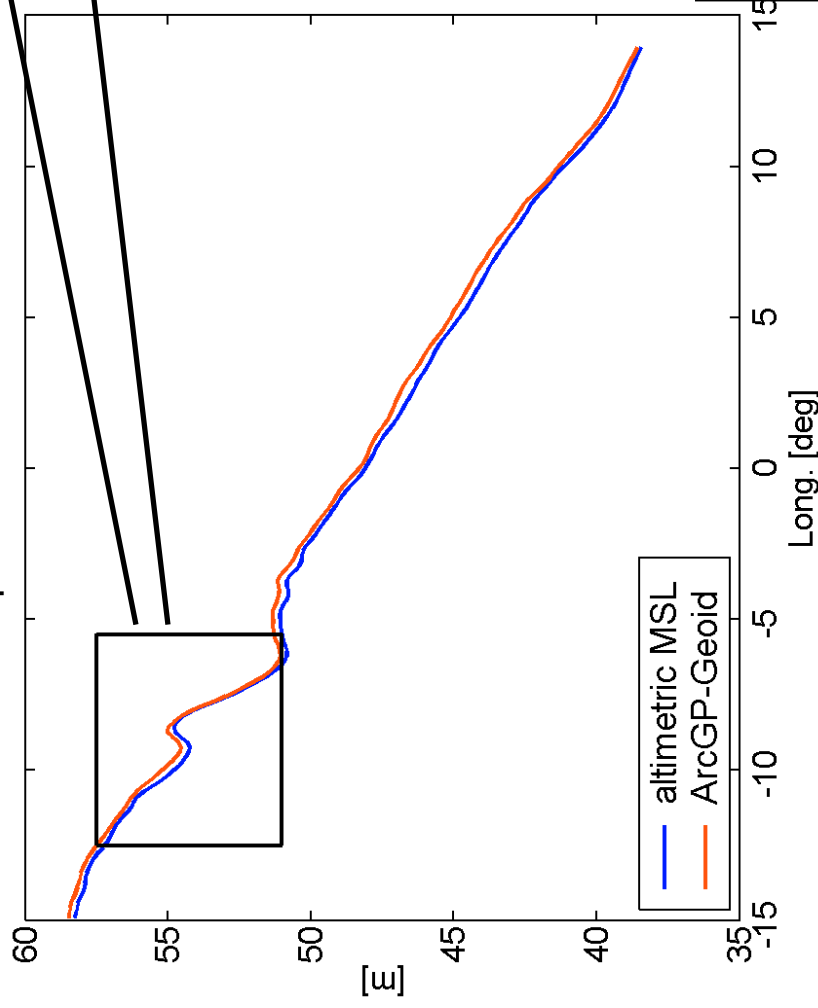
- ↑ Freeboard determination *inside of closed ice surfaces* requires: mean sea level (MSL), time variation
- ↑ Concept of CryoSat: MSL determination for polar areas from the first months of CryoSat altimetry
- ↑ possible alternative for backup, gaps, validation (cf. Jacobsen and Forsberg GRL 2002):
 - geoid from geoid model
 - sea surface topography from ocean model*cm-accuracy needed!*

Interpolation Test

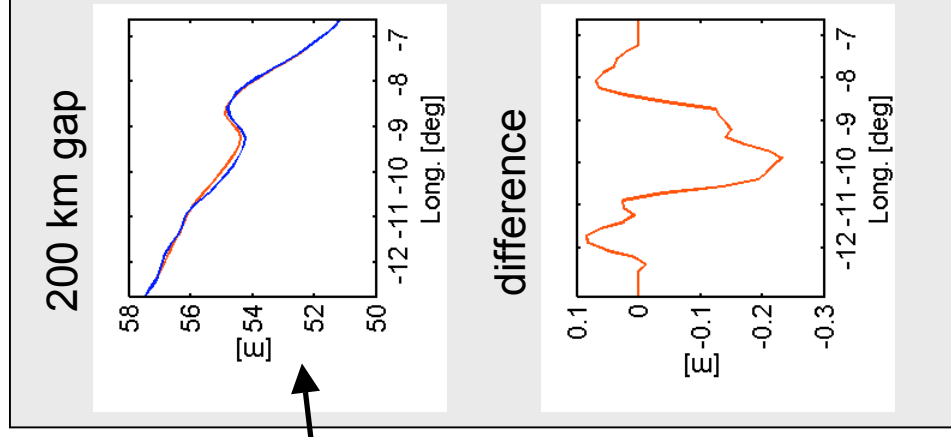
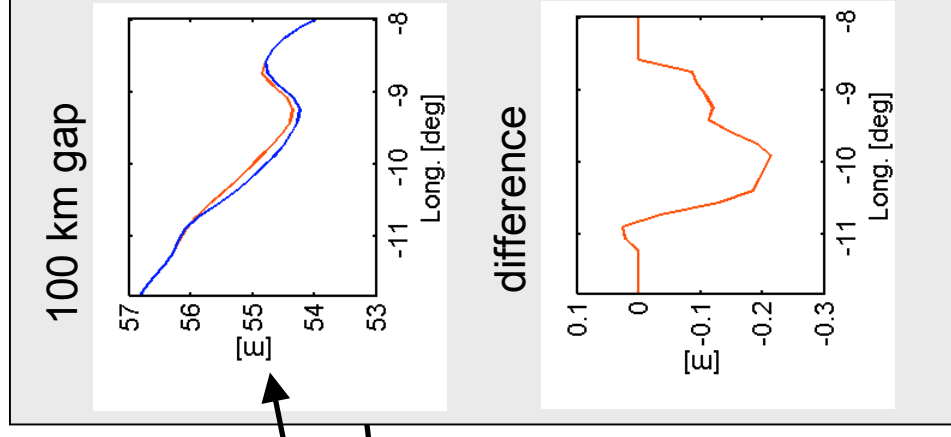
What happens, if we don't know MSL for a gap, and use the geoid for interpolation?

using a state-of-the-art geoid: Arctic Gravity Project geoid ArcGP

North atlantic profile at 70° North



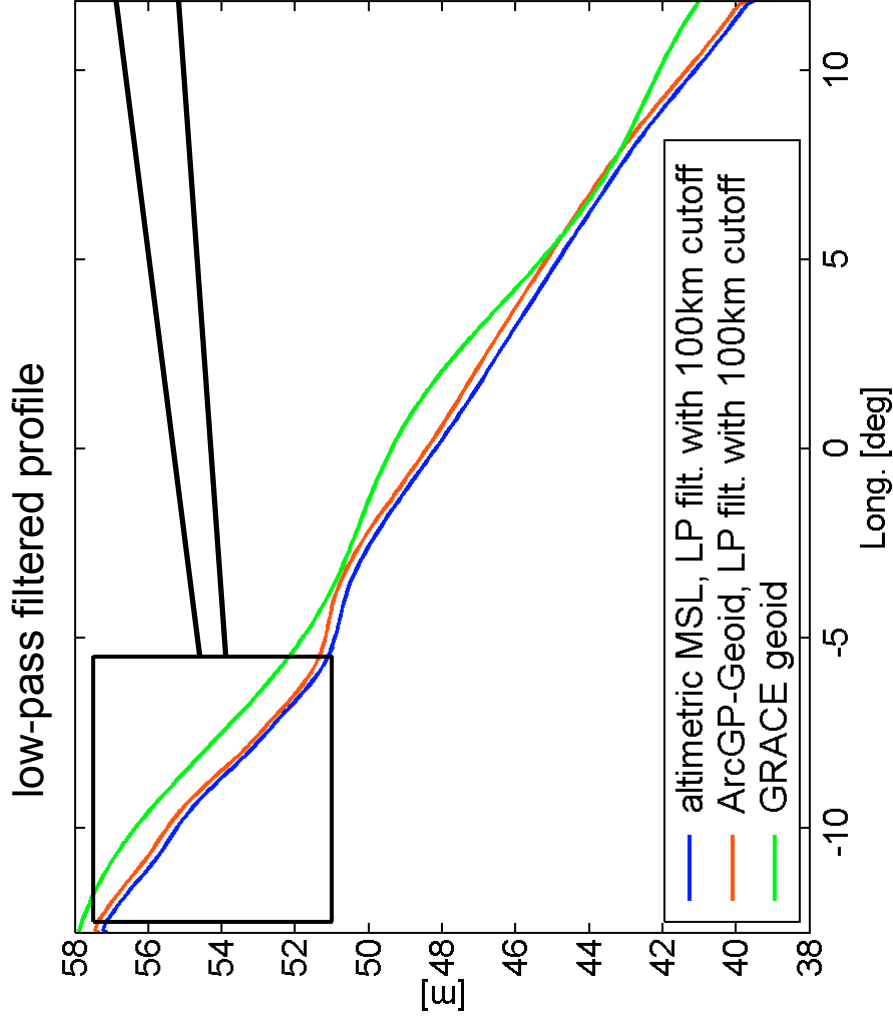
interpolated gaps



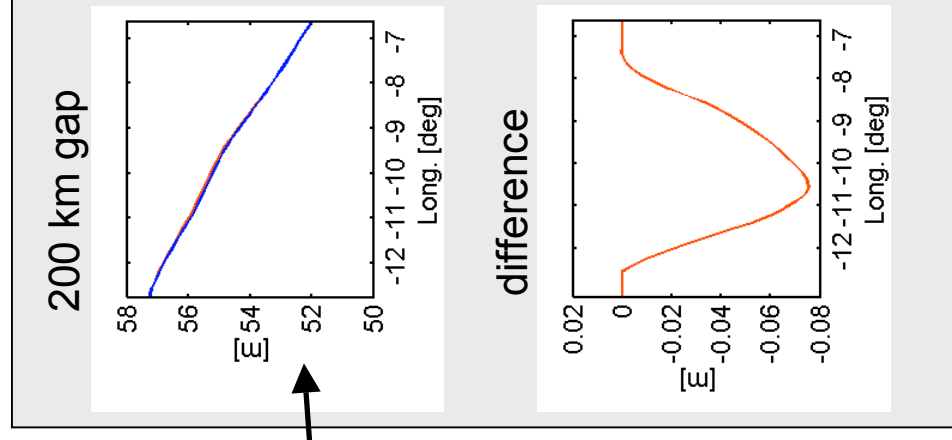
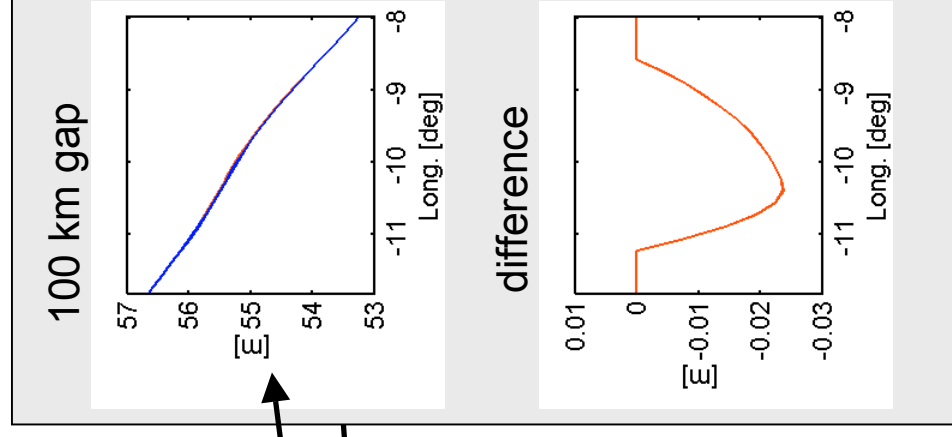
→ interpolation errors due to ArcGP geoid errors much too large for freeboard determination

Test with Filtered Signals

CryoSat needs 100km x 100km mean values
100 km low-pass filtering reduces geoid errors
drastically



interpolated gaps



Maximum interpolation errors for the 70° North MSL profile
(difference original MSL - interpolated MSL):

a) linear interpolation without geoid		
<i>gap size</i> [km]	<i>max. error</i> [m]	
100	1.1	
200	2.0	
500	2.2	

b) interpolation with unfiltered ArcGP geoid		
<i>gap size</i> [km]	<i>max. error</i> [m]	
100	0.25	
200	0.30	
500	0.35	

c) interpolation with 100 km low-pass filtered ArcGP geoid		
<i>gap size</i> [km]	<i>max. error</i> [m]	
100	0.03	
200	0.10	
500	0.12	

d) interpolation with GOCE geoid		
<i>gap size</i> [km]	<i>error standard deviation</i> [m]	
100	0.01-0.02	
200	0.01-0.02	
500	0.01-0.02	

Conclusions

For 100 km low-pass filtered signal an interpolation over MSL gaps can be done:

- in an accuracy around 10 cm or better with a state-of-the-art geoid
- in an accuracy of 1-2 cm with the future GOCE geoid
- the GOCE geoid could help for freeboard height interpolation

Drawback: GOCE geoid not before 2007

- validation, backup, re-analysis, fill for gaps

ArcGP geoid errors, seen in the difference MSL - geoid, without and with filtering

