

OIB sea ice products status, evaluation, and updates

Product status

Campaign	Status	Comments
2009 Arctic	Done	
2010 Arctic	Done	
2011 Arctic	Done	
2012 Arctic	Done	
2013 Arctic	Ongoing	All data sets in, currently processing DMS data (2/9 flights done)
2009 Antarctic	Done	
2010 Antarctic	Ongoing	DMS processing done, in final quality checking stage (2/3 done)
2011-2013 Antarctic	Pending	Will begin after Arctic 2013

2009 Antarctic

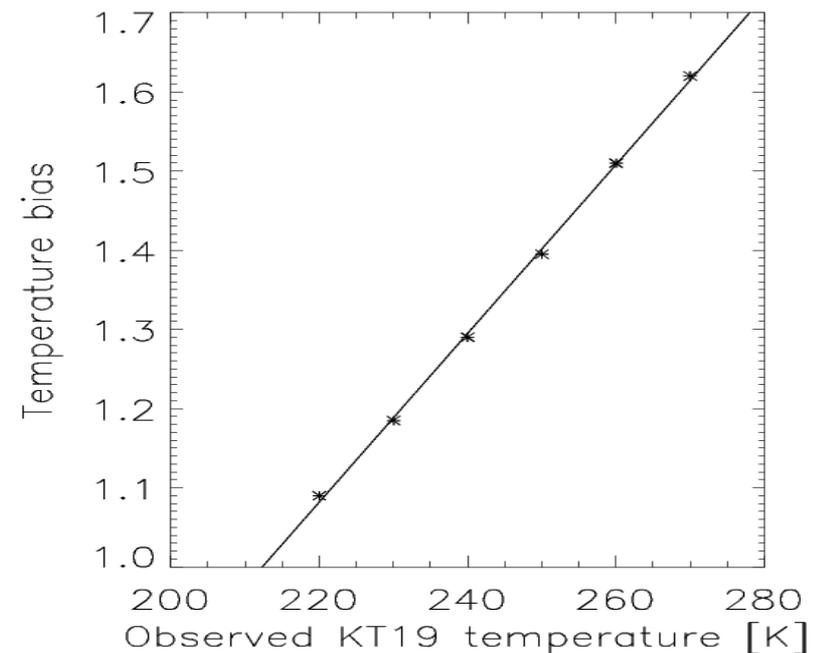
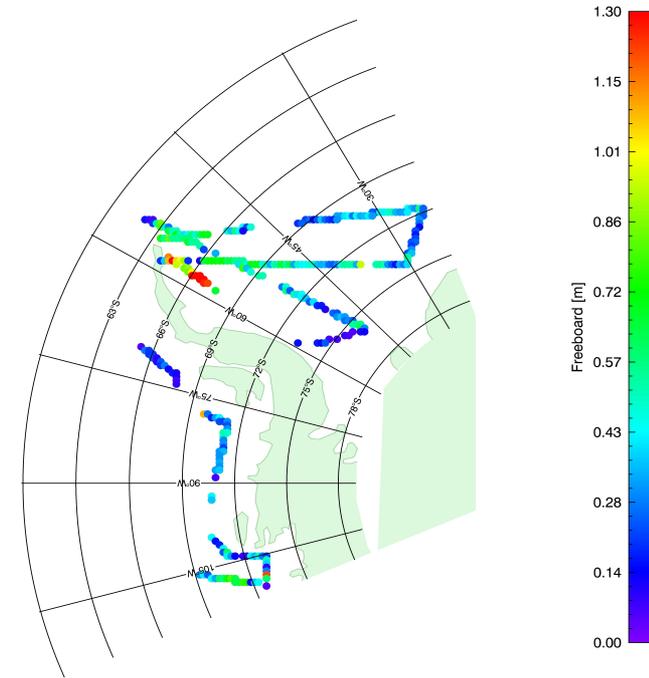
Data processed to freeboard only

Correction to KT19 surface temperature, emissivity set at 1, corrected to 0.97 by numerically integrating Planck's law over the KT19 range of observed wavelengths

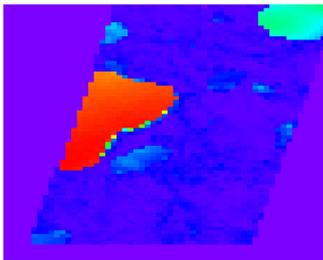
$$I_1 = \int_{\lambda_1}^{\lambda_2} \frac{\epsilon_1 2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda k_b T_1}} - 1} d\lambda$$

$$I_2 = \int_{\lambda_1}^{\lambda_2} \frac{\epsilon_2 2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda k_b T_2}} - 1} d\lambda$$

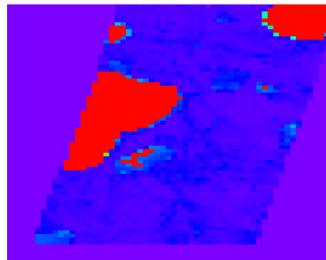
$$T_2 - T_1 = T_1 * 0.01066 - 1.263$$



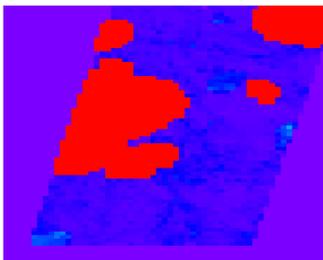
grid elev max



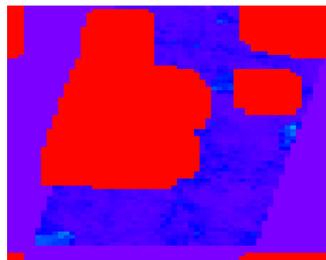
filtered for 2.50000 m high icebergs



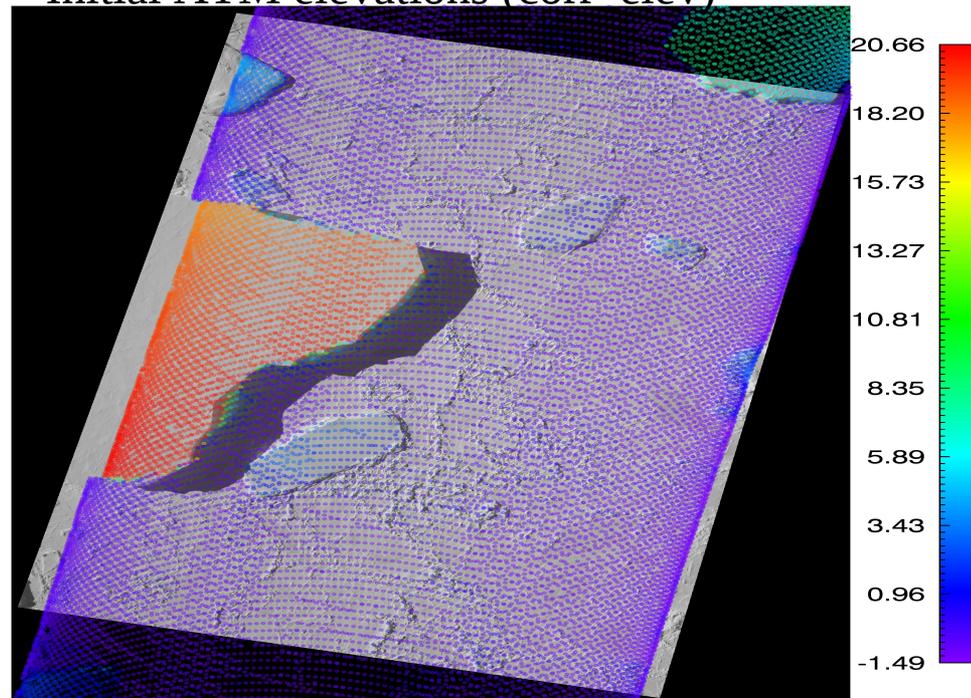
grown regions



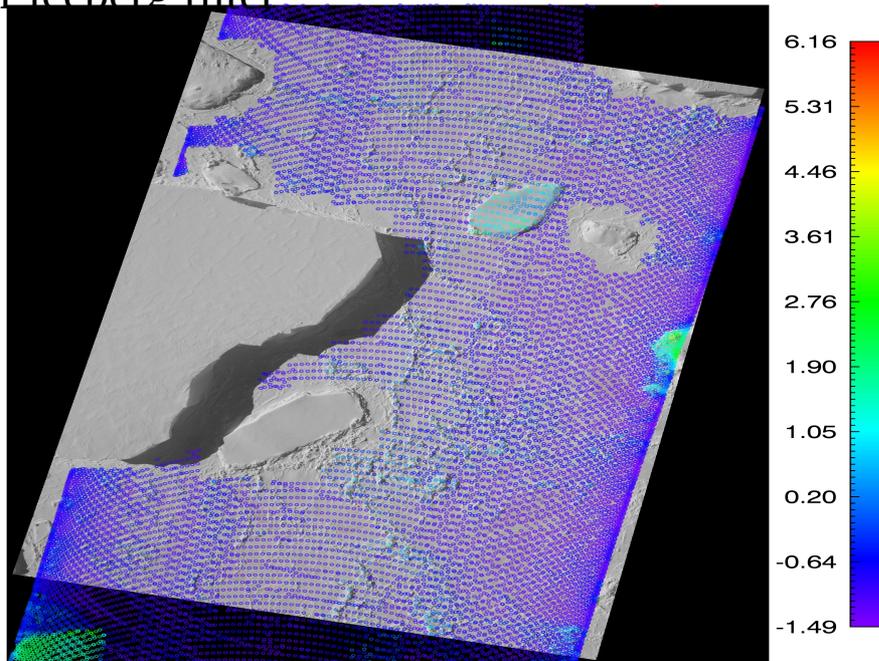
shadow regions



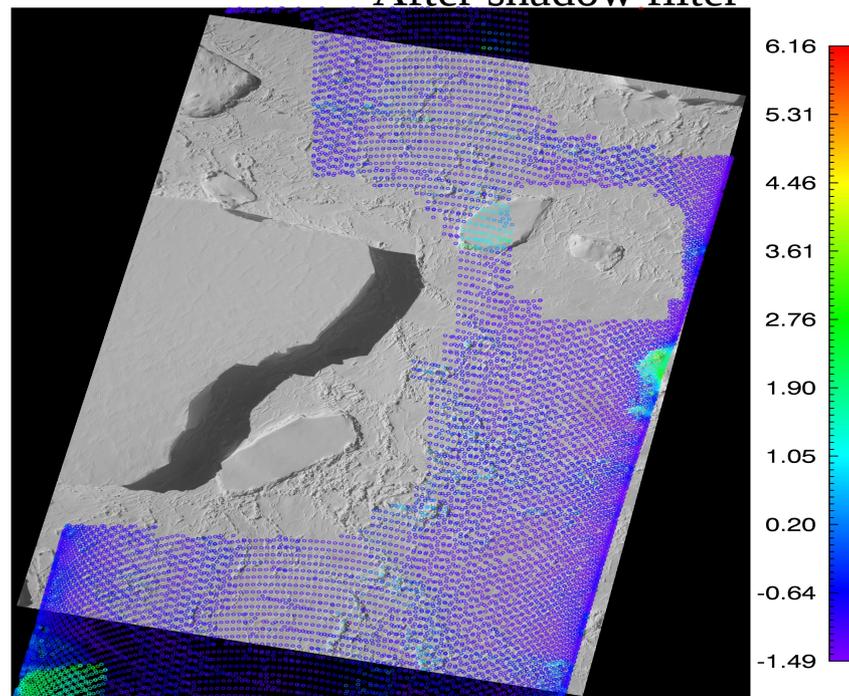
Initial ATM elevations (corr elev)



After iceberg filter



After shadow filter



Sea ice products improvements and version 2 processing

V2 processing would be fast (a few weeks for entire data set) since the DMS lead processing step does not need to be repeated. Some steps now being implemented in new data, but need to be applied to previous data. V2 processing to fix errors in past processing and reduce overall uncertainty.

Dynamic atmospheric correction from the Mog2D-G high resolution barotropic model has replaced the static inverse barometer for 2012-present Arctic and all Antarctic data sets

Quantification of uncertainties from in-situ validation experiments: current snow radar uncertainty is set at 5.7 cm. In-situ data Webster et al., in prep found an RMSE of 5.8 cm which shows the current estimate in the products is reasonable. Can be updated as new information becomes available.

Need consistent ice type: OSI-SAF data for 2012-present Arctic data, previously AMSR-E data used 2009-2011

Need to correct spatial averaging error which is present in all previous data sets, this was caused by an error in the code which averages the data to 40 m length scale.

Scan angle bias correction in ATM data (work by Donghui Yi).

Version 2 processing: reducing geoid errors

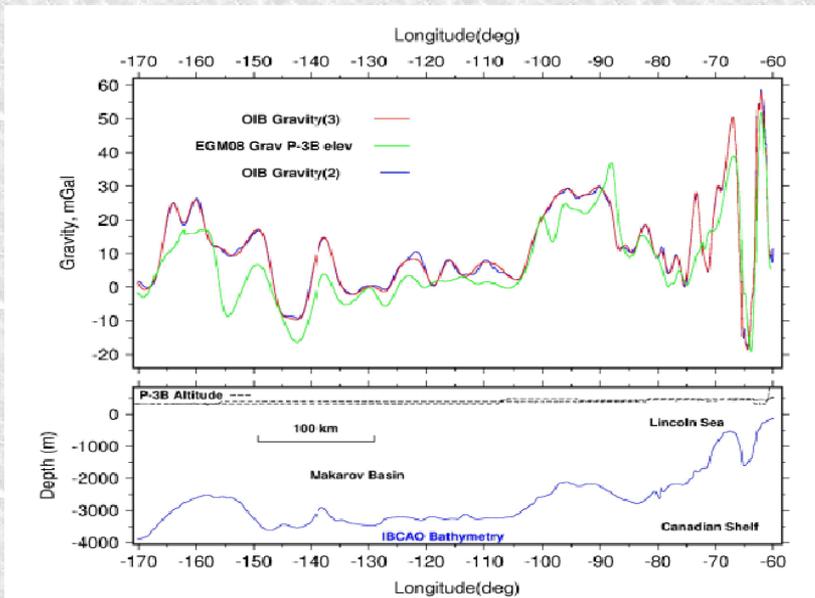
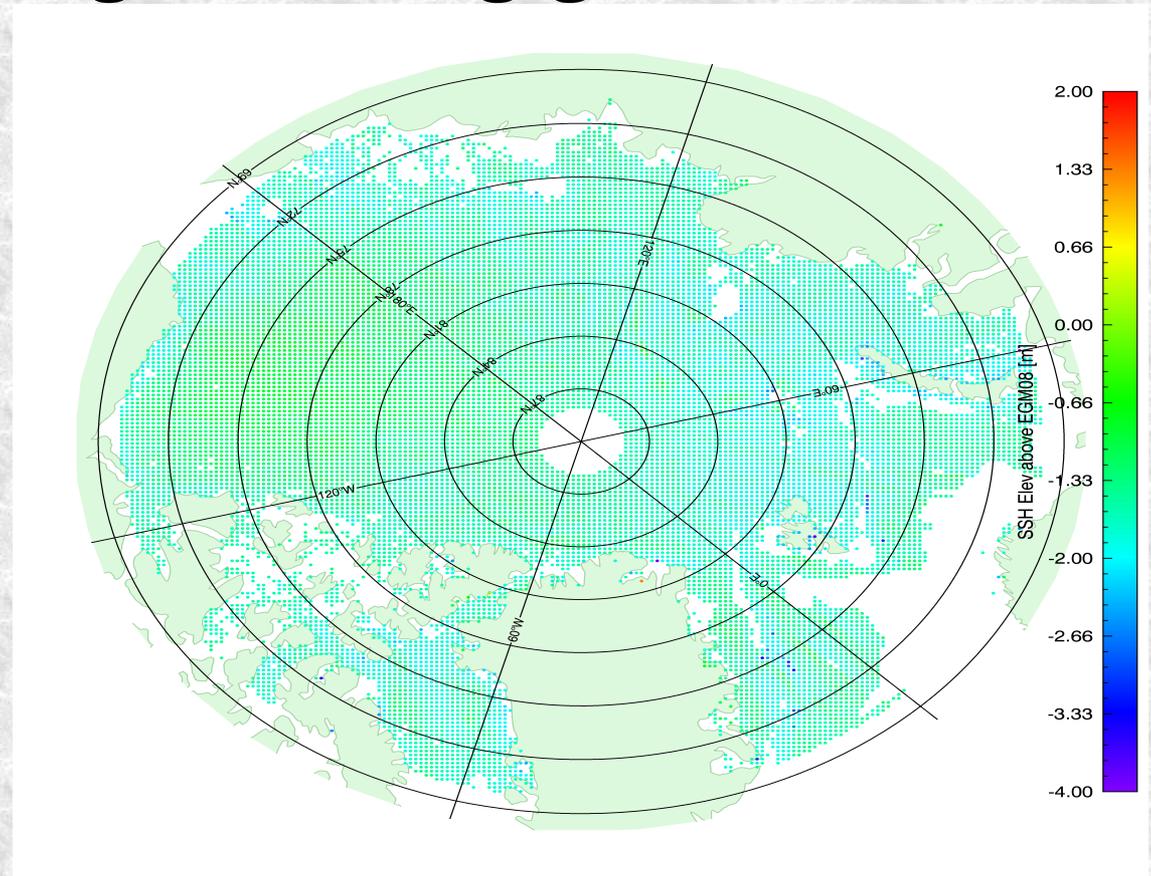


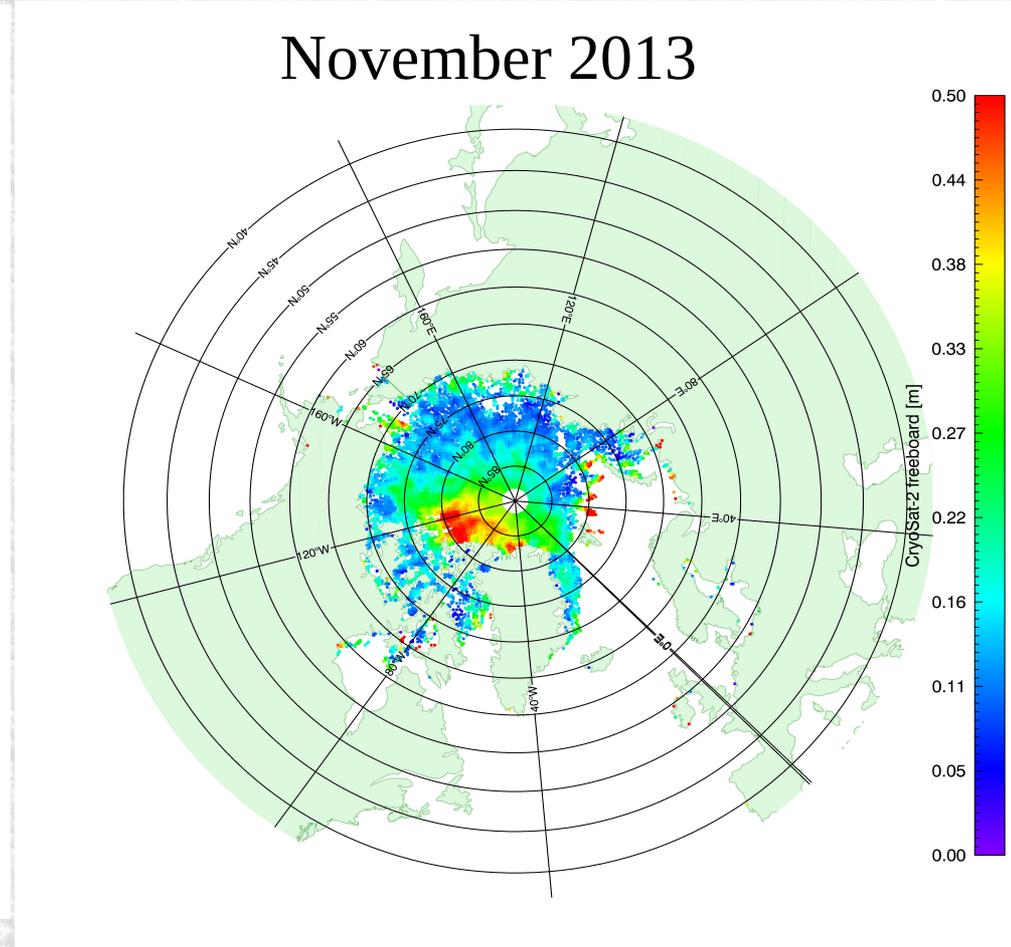
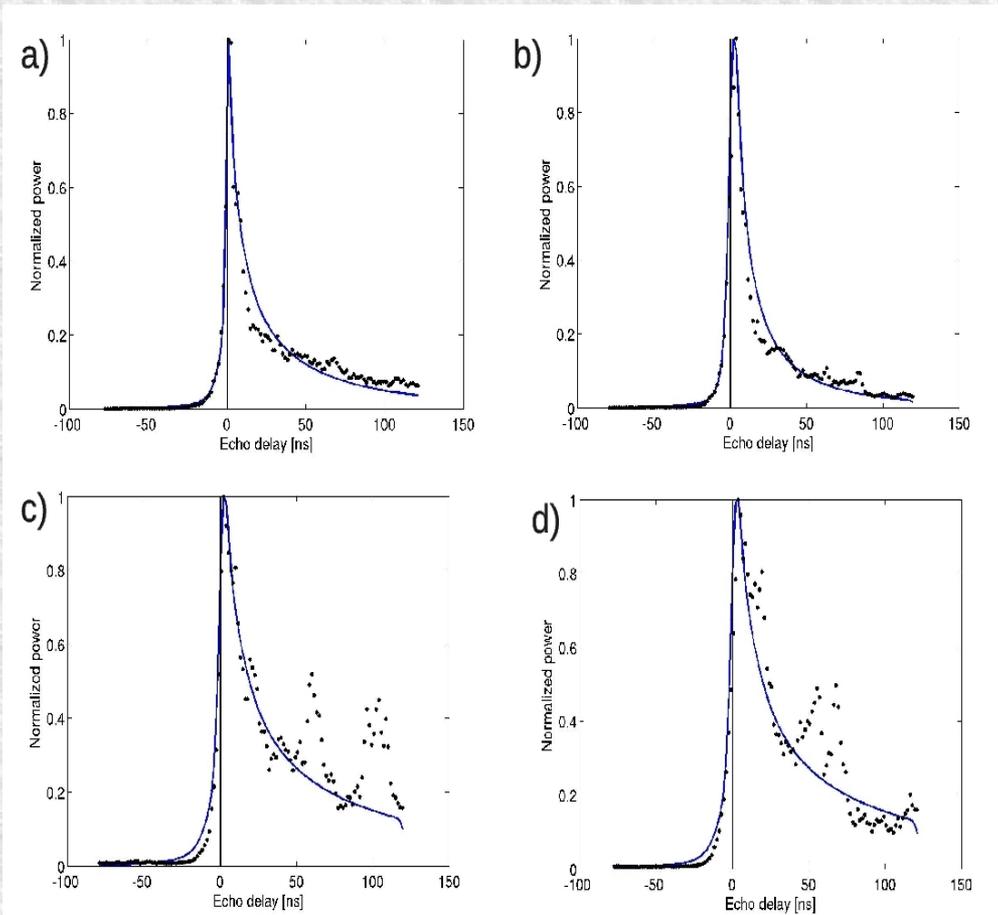
Figure from McAdoo et al., 2013.



CryoSat-2 mean sea surface elevation for March 2013.

Catalyst for V2 processing will be the availability of at least one years worth of sea surface height observations from CryoSat-2 (possibly available for 2013 Arctic). Data will be used to construct a mean sea surface height to replace the use of EGM08. A simple quality test will be used to determine viability of the data: does the new data set reduce the variance of the SSH data along a flight line?

Quick look data



New waveform fitting elevation retrieval method to be used, full write-up in The Cryosphere Discussions (<http://www.the-cryosphere-discuss.net/8/721/2014/>). Compared to 2013 quick look data: 7.8 cm freeboard RMSE and 1.2 cm mean difference.

New for 2014: CryoSat-2 estimates of sea ice freeboard and thickness to be provided in addition to OIB quick look data to expand spatial coverage.

Quick-look product evaluation

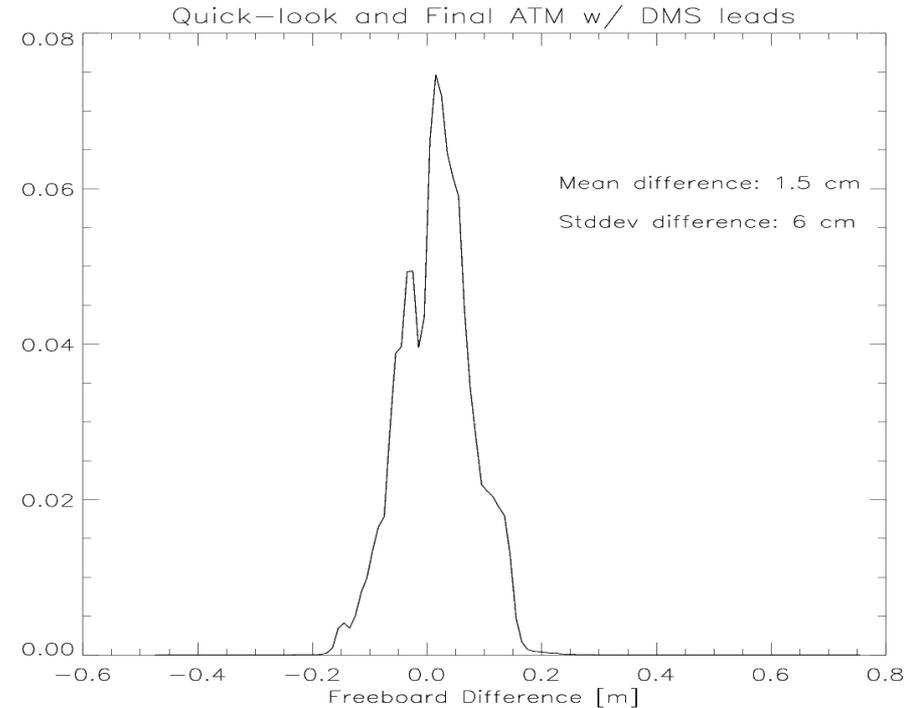
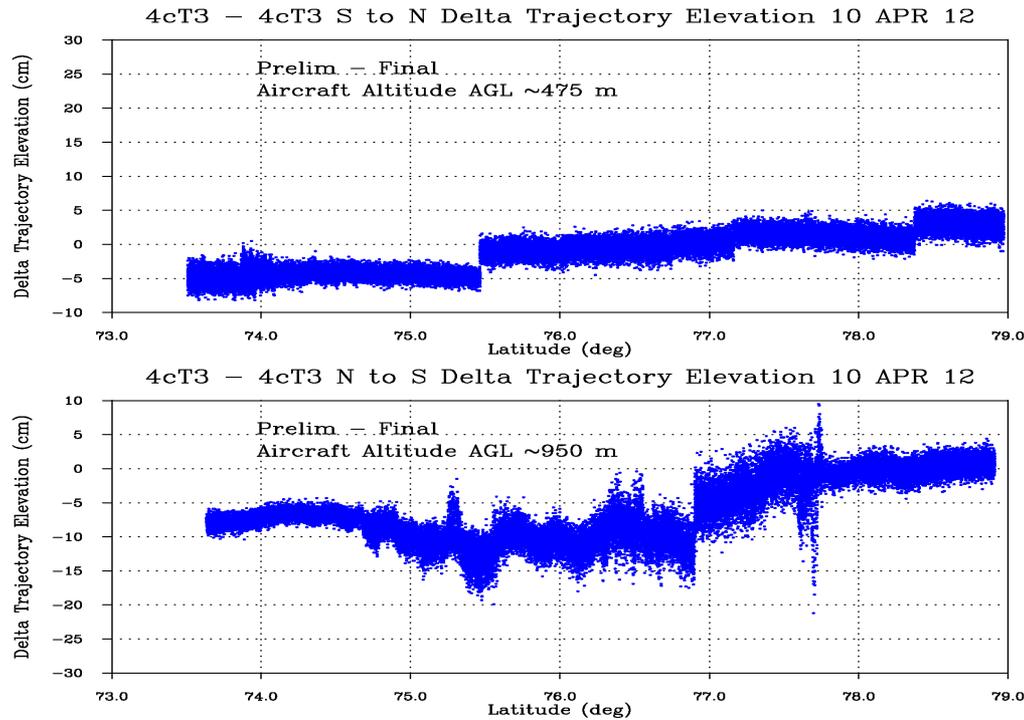
Lessons learned in 2012 and applied to improve 2013 quick look data processing.

Comparison of the two years not 'apples to apples', but the component error sources for the quick look data are the same regardless of year:

1. Freeboard errors due to quick look ATM processing.
2. Snow depth errors due to differences in snow radar data.
3. Lead identification and SSH errors.

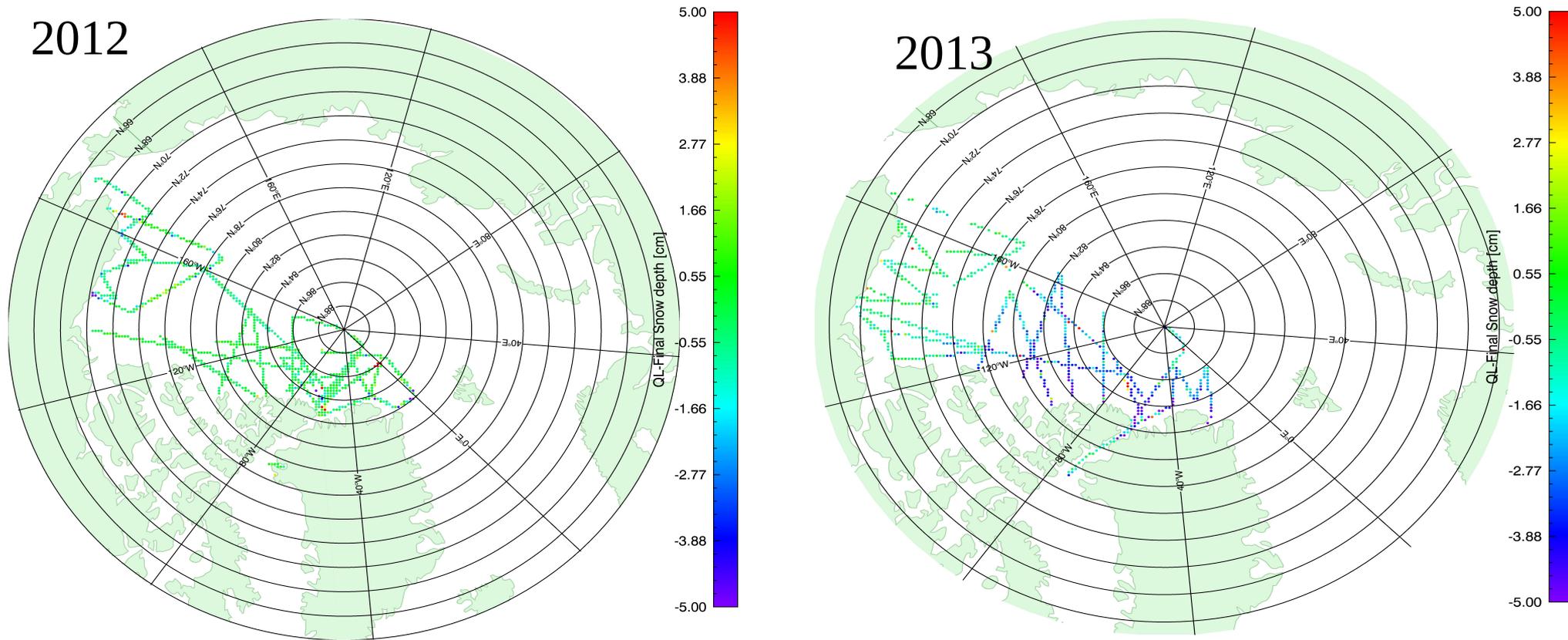
Error sources 1 and 2 are inherent to the data, but appear small. Most significant error source for 2012 quick look data is error source 3 (presented at January 2013 science team meeting). New processing implemented for 2013 data looks to have mitigated the issue.

Errors due to quick look ATM elevation processing



Detailed report by Bob Swift from the ATM team describing errors due to trajectory data for the 2012 data. Overall, the quick look ATM processing added an additional 6-7 cm uncertainty and 1.5 cm bias to the retrieved freeboard.

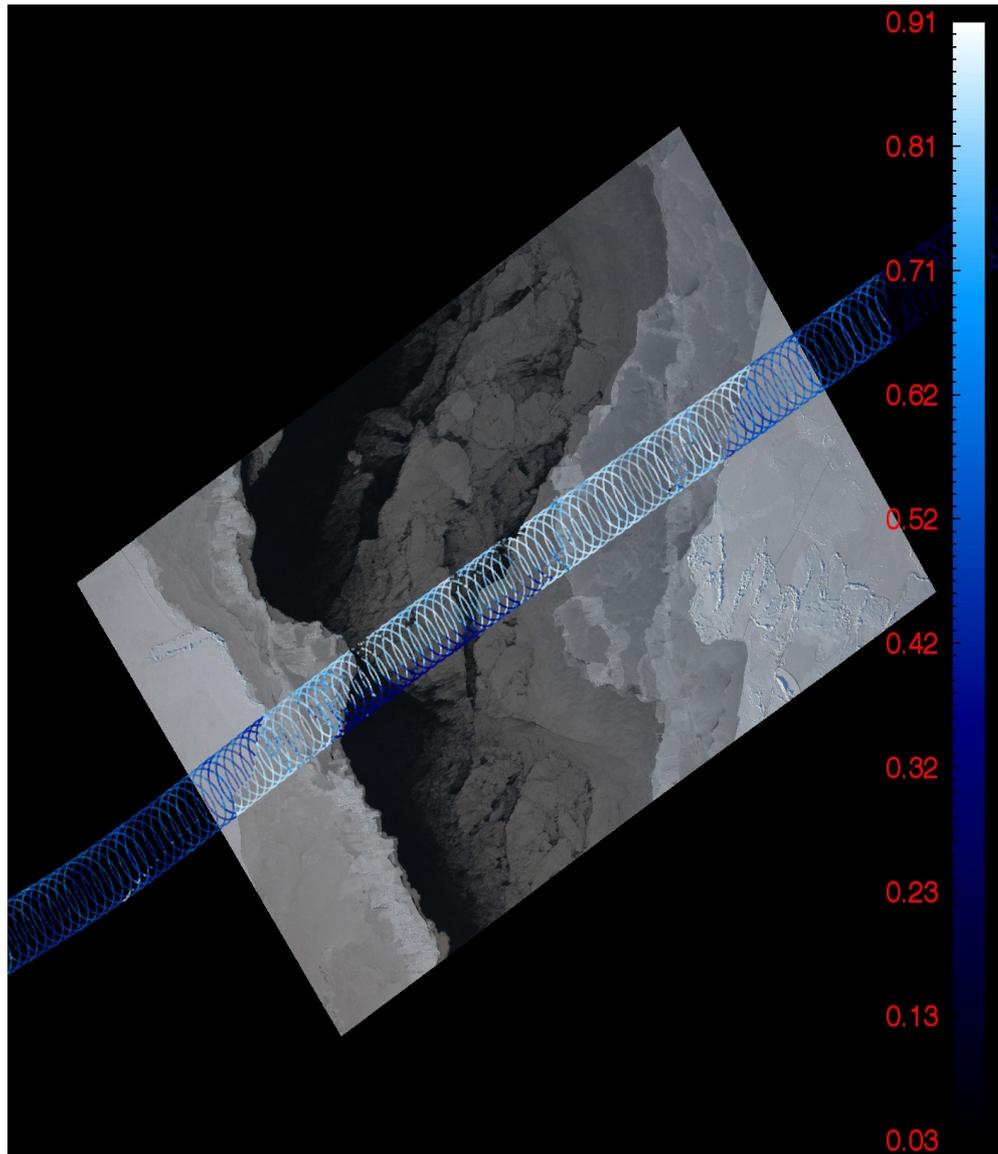
Errors due to snow radar input files



Negligible differences in 2012, 0.05 cm mean difference in snow radar output and 2 cm std. In 2013, 1.6 cm mean difference and 2.4 cm std. Same code used for 2012 and 2013 data, so differences in snow depth come from radar data files.

2013 quick look data lead identification

Lead Probability



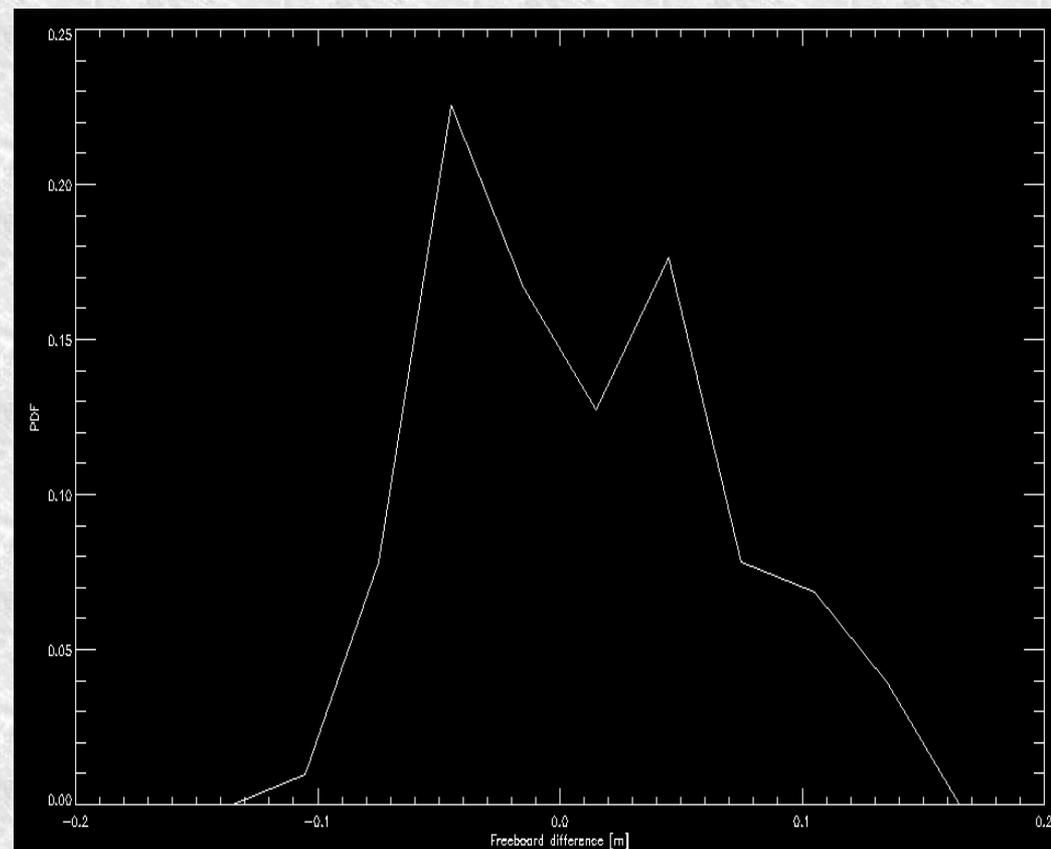
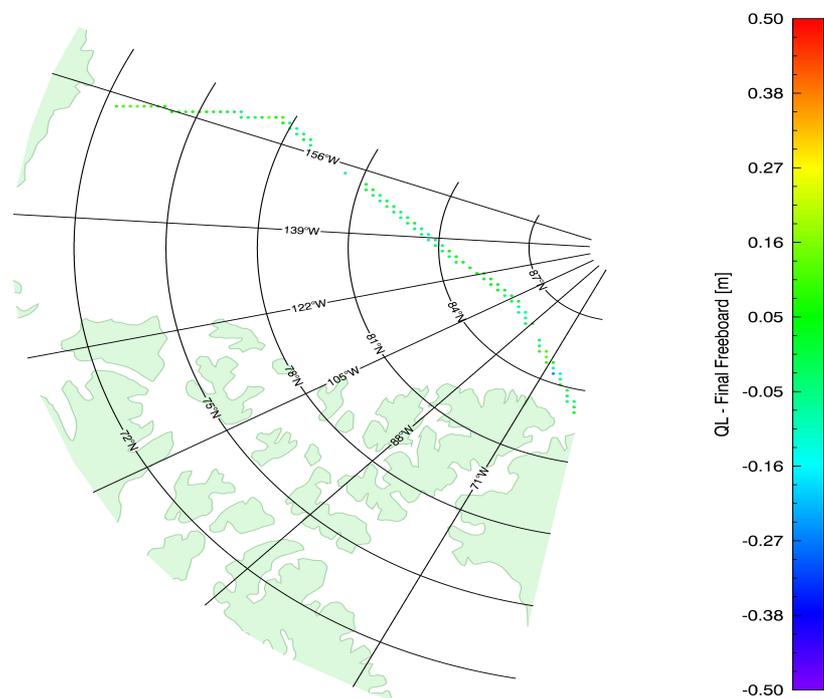
New automated lead detection algorithm to reduce SSH biases found in 2012 data.

Bayesian probability that each ATM measurement is over a lead calculated from combined surface temperature, reflectivity, and surface roughness.

Cross-checking with DMS images was done to visually verify points were actually over leads.

Automated approach does not identify all leads, but finds enough to provide good sea surface height estimation

Quick look vs final for 3-21-2013



Freeboard difference: $0.2 \text{ cm} \pm 6.9 \text{ cm}$

Ice thickness difference: $6.6 \text{ cm} \pm 67 \text{ cm}$

More leads found in final data (as expected) which led to slightly lower (1 cm)

uncertainties. New quick look processing appears to have reduced overall bias in the data, but increased uncertainty due to inherent errors in quick look data sources.