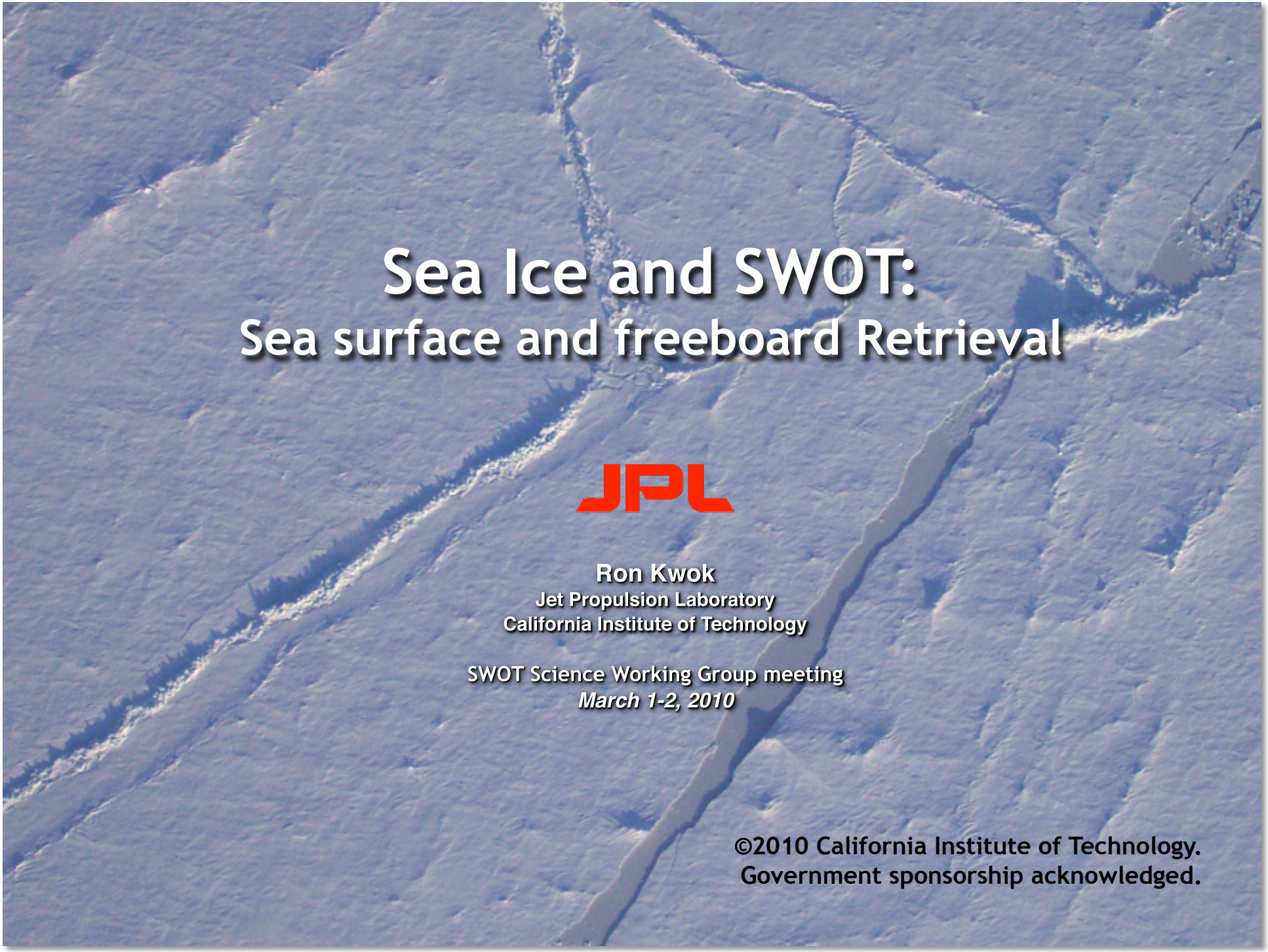
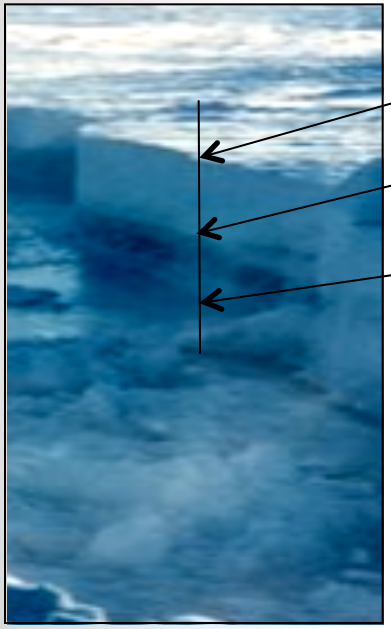


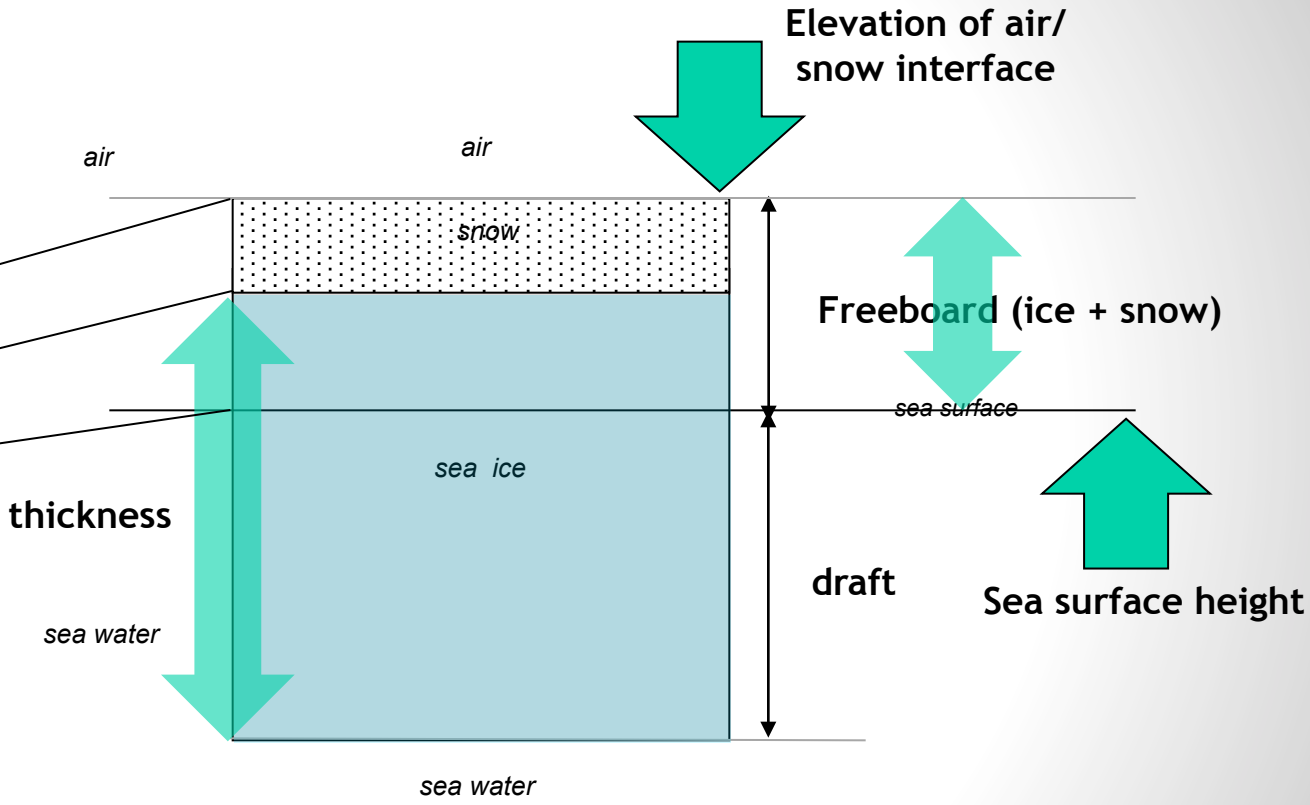
Sea Ice and SWOT:
Sea surface and freeboard Retrieval

Ron Kwok
Jet Propulsion Laboratory
California Institute of Technology

SWOT Science Working Group meeting
March 1-2, 2010

Freeboard, Snow depth, Ice Draft and Thickness



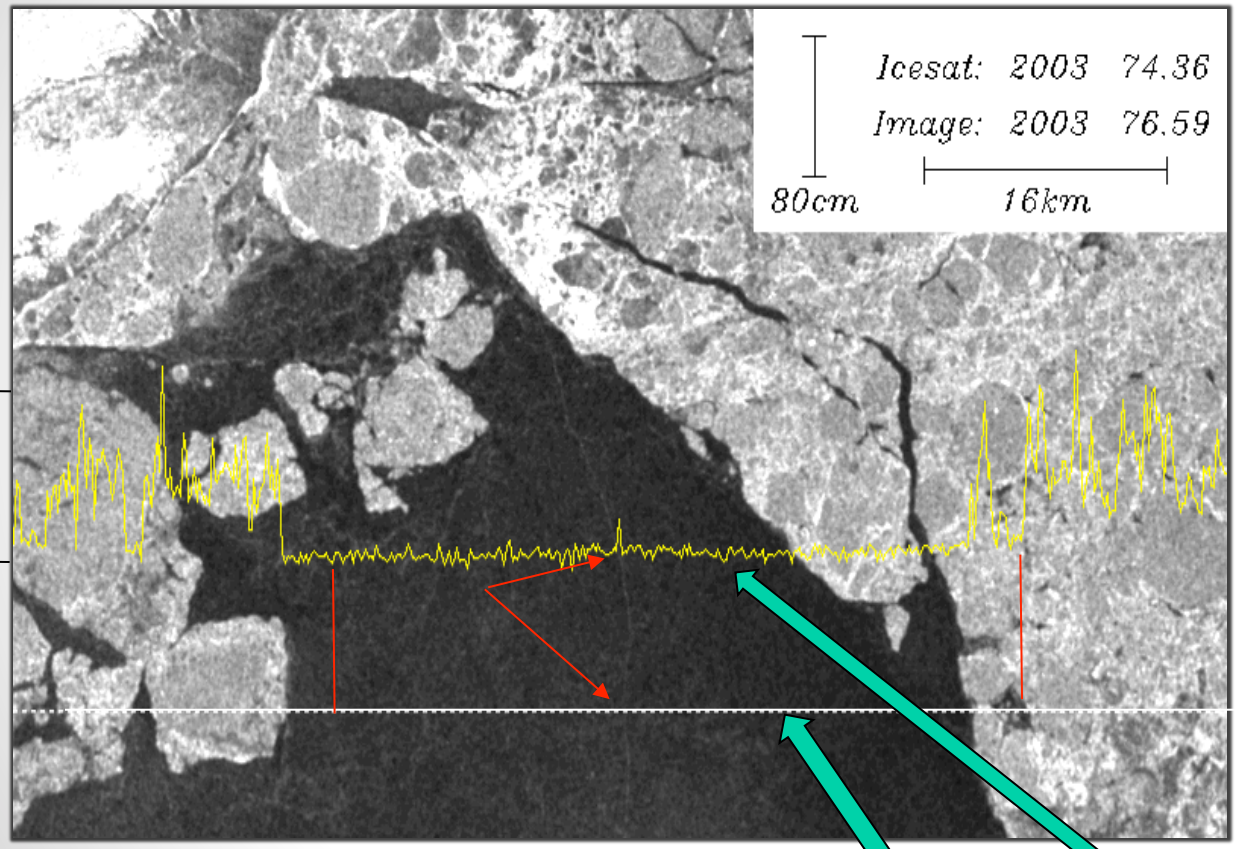


Measurement of freeboard from Space

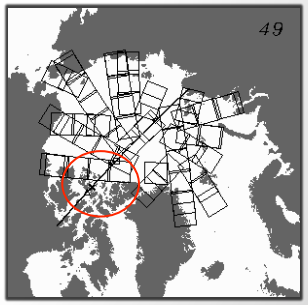
Freeboard

Photo by N. Untersteiner

Pulse-to-pulse precision of the ICESat lidar



- *At 10 km -*
  - *~1.5 - 2 cm*

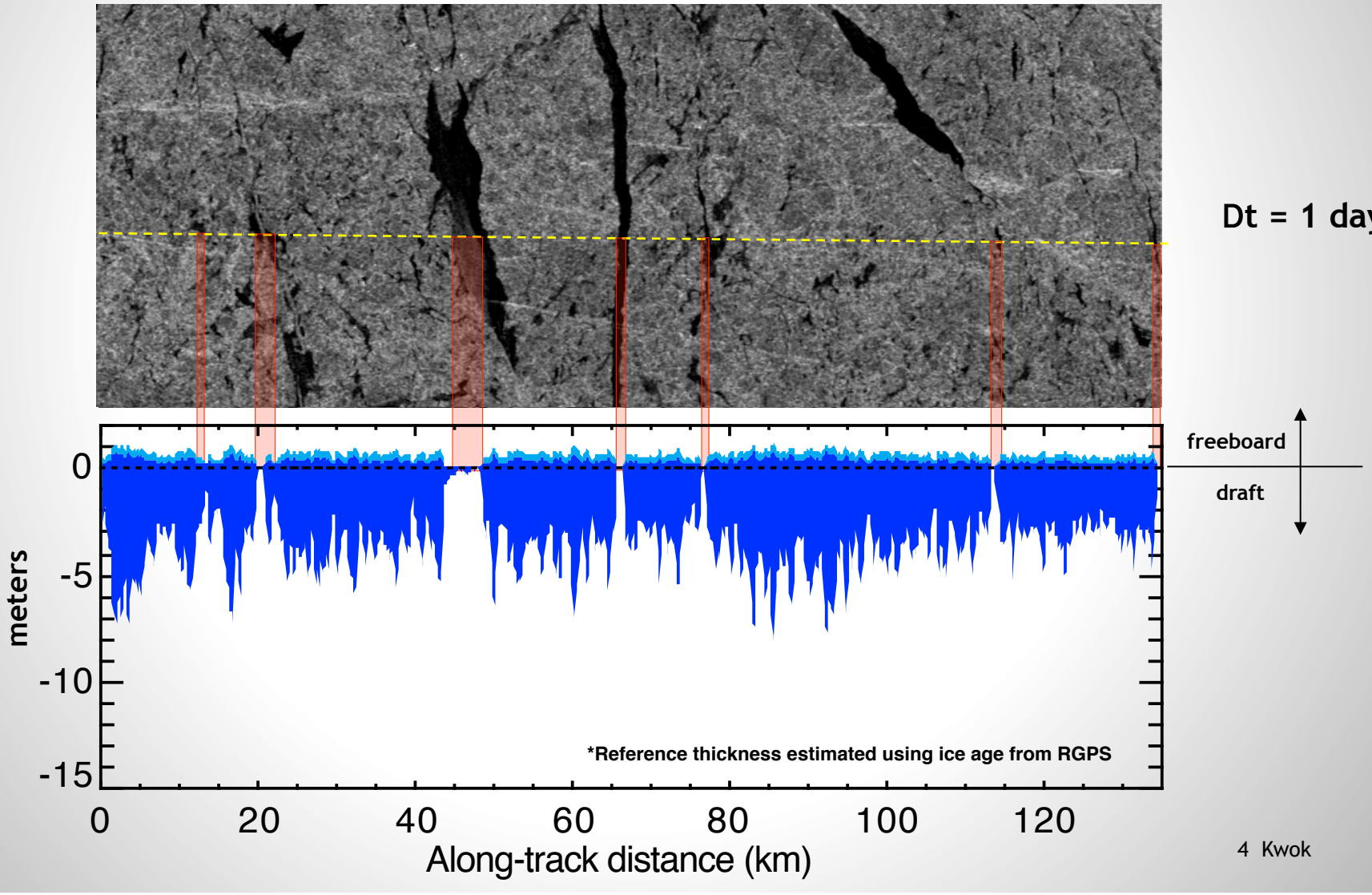


ICESat Elevation Profile (yellow)

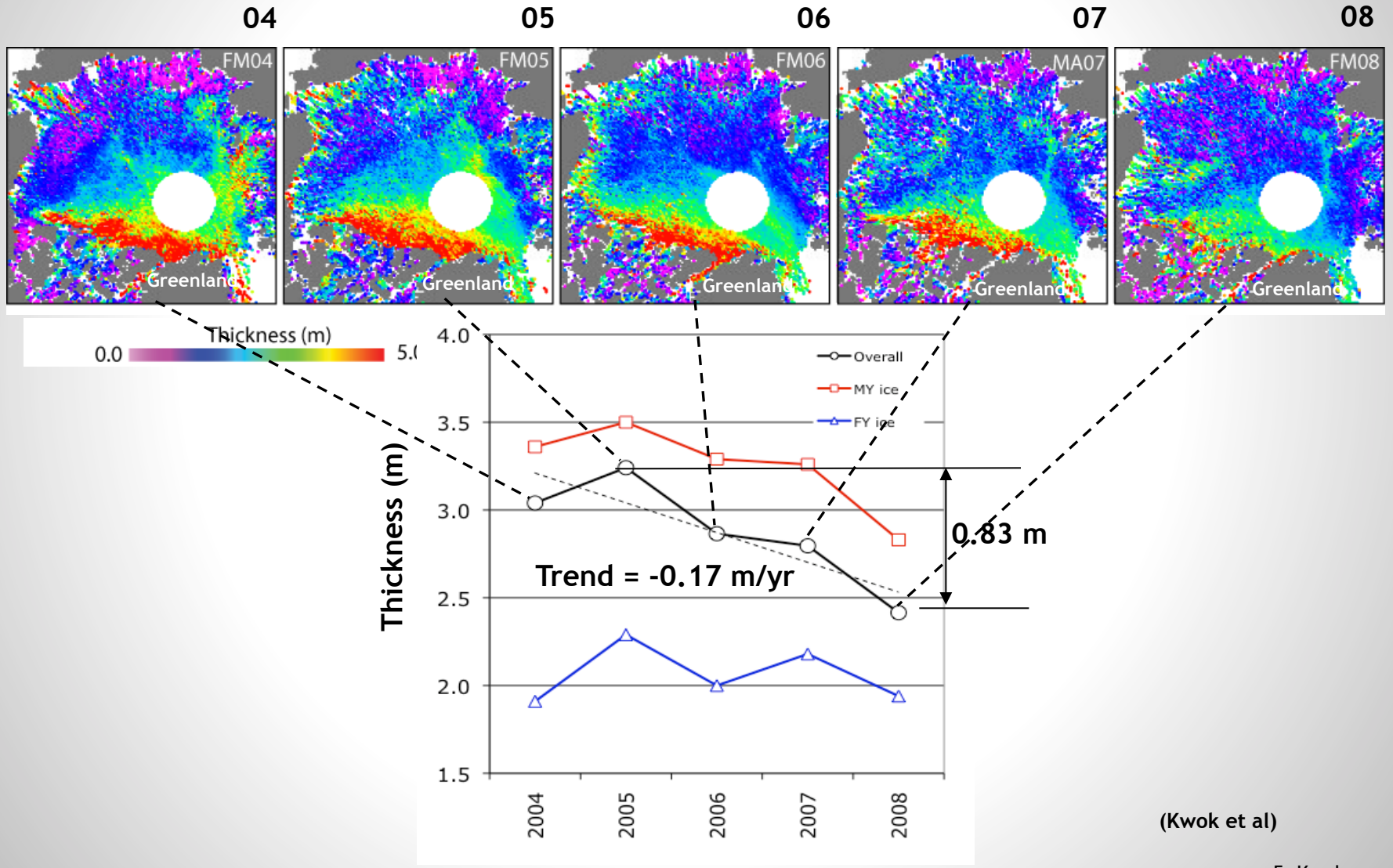
ICESat Track (white)

ICESat (profiling lidar) and RADARSAT (image)

ICESat track on RADARSAT image



Trend in winter sea ice thickness from ICESat



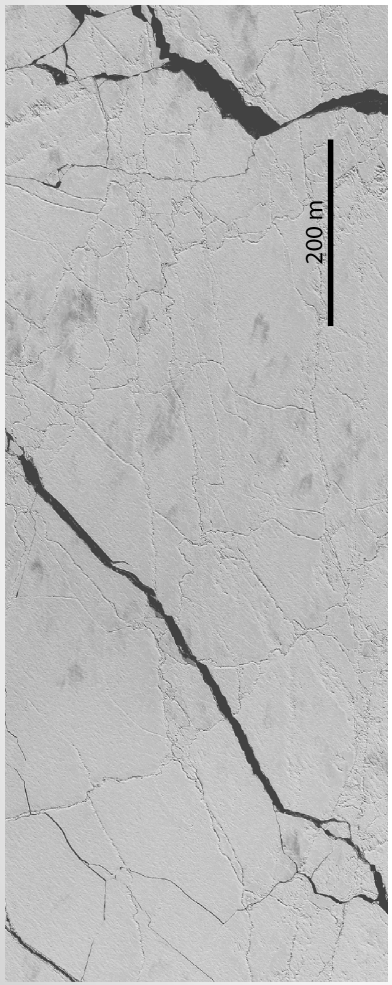
(Kwok et al)

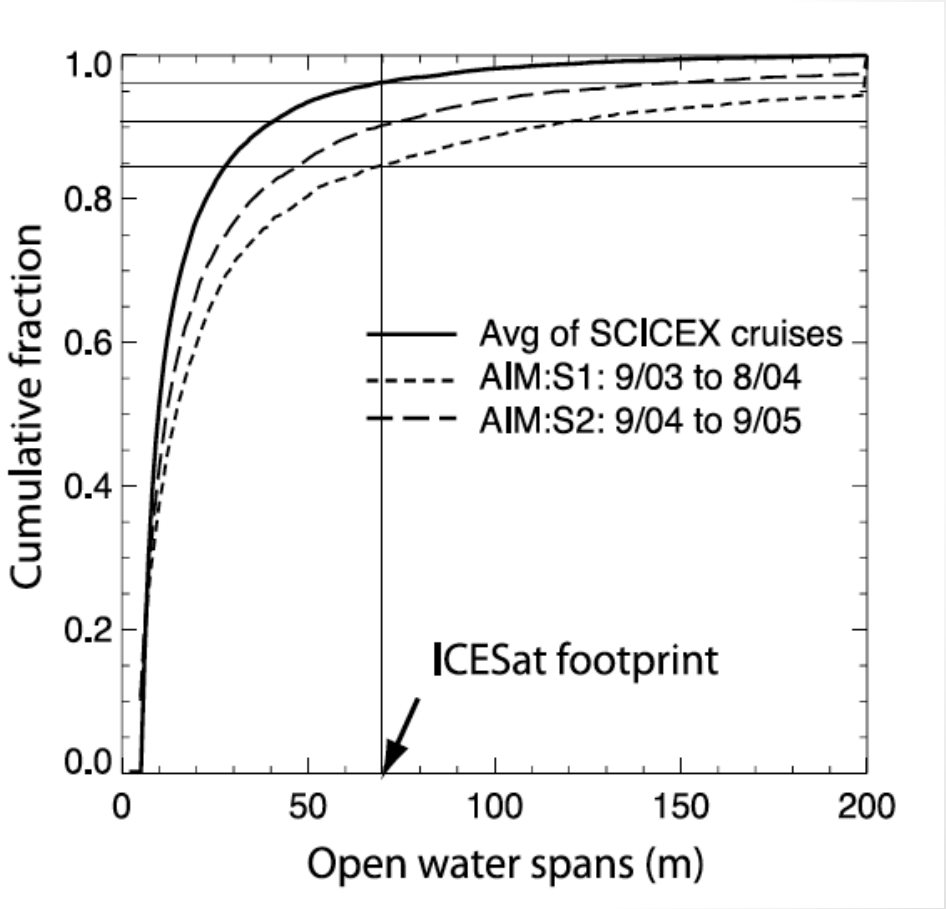
Measurement Considerations

- *Freeboard/Sea surface Retrieval*
  - *Resolution/Precision*
  - *Scattering/Penetration*

- *Coverage*
  - *Spatial*
  - *Temporal*

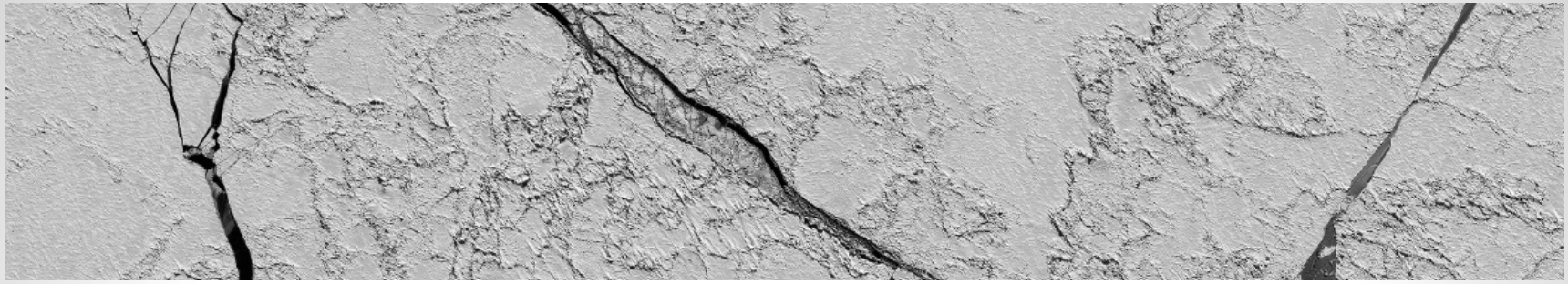
Resolution:
Width of openings in ice cover





Spacing between openings?

SWOT Resolution Considerations



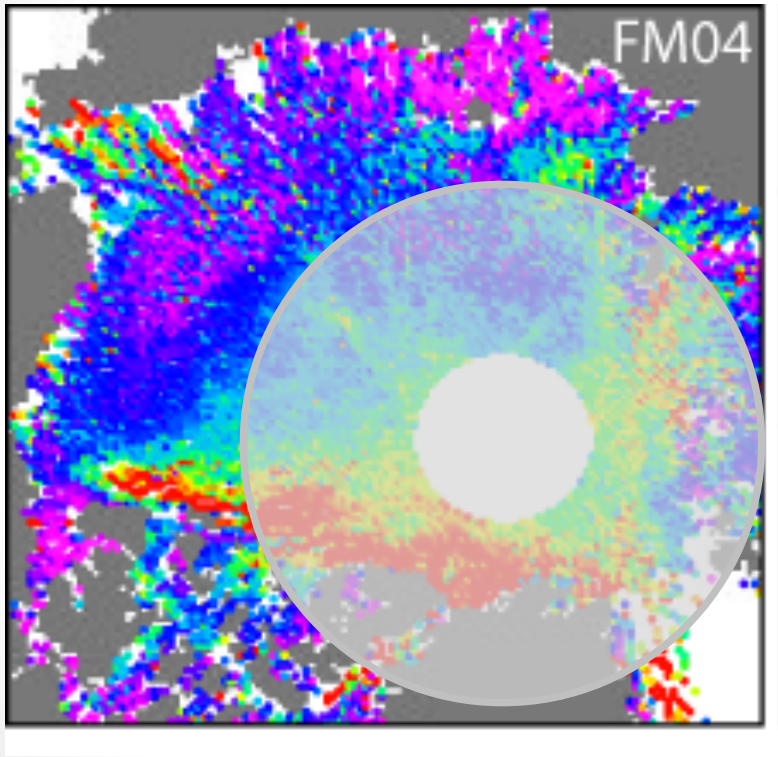
- *Because of geometric characteristics of leads*
  - *Need to construct averages with samples along open water/ thin ice leads to achieve precision of several centimeters*
  - *Require highest resolution data available – not gridded averages*

SWOT Scattering/Penetration Considerations

- *Near-nadir backscatter signatures of snow, ice and open leads require attention*
  - *For discrimination between the sea surface and snow/ice*
  - *Quasi-specular returns*

- *Penetration of K_a-band into snow*
  - *Scattering from air/snow or snow/ice interface*
  - *Where is the mean surface?*

Coverage Requirements



Spatial (Inclination at 78N)
-50% of Arctic Ocean is in the hole
-Covers most of the Antarctic ice cover

Temporal
- Monthly

Unique contributions of SWOT

- *Dense swath sampling*
  - *2-D surface mapping – identification of lead vs ice samples*
  - *Opportunity to perform along lead averaging*

- *Relatively insensitive to atmospheric effects, clouds compared to lidars*
  - *Improved coverage of polar oceans during summer and seasonal transitions*