In Situ Observations During the Arctic AMSRIce03 and AMSRIce06 Validation Campaigns

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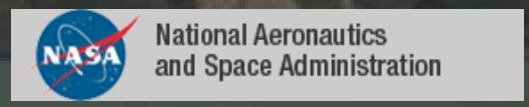
Ft. Hays State



Goals of the surface measurements component of AMSRIce03 and AMSRIce06:

1. Provide data to support efforts to understand physical relationships, in addition to supporting validation comparisons
2. Minimize the constraints posed by sea ice and polar conditions
3. Support scaling-up from surface observations to aircraft and satellite data

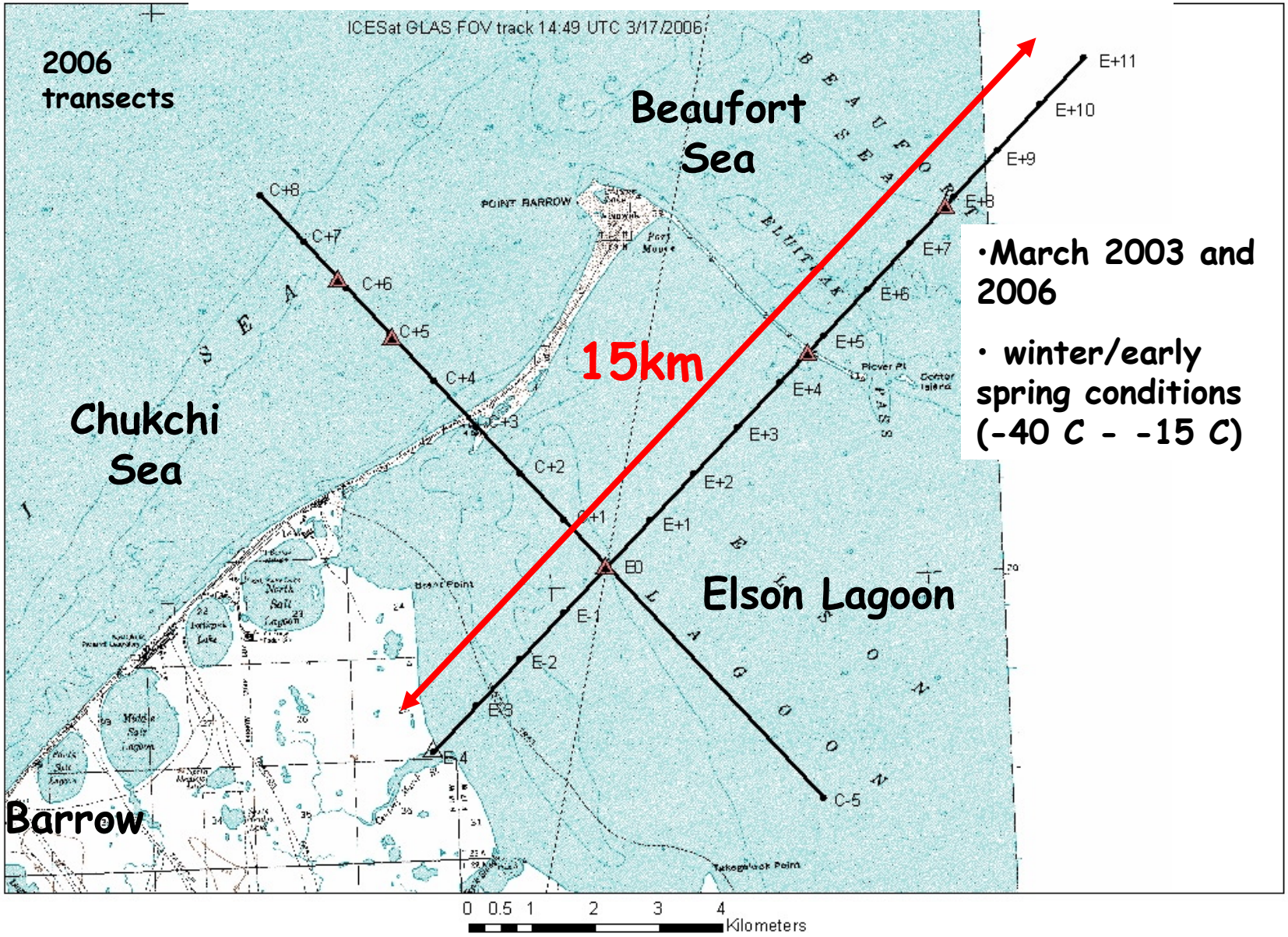
"Sources of algorithm error/uncertainty":

- effects of snow properties (structure, density) on brightness temperatures (Tbs)
- effects of ice properties (type, roughness, salinity, structure) on Tbs
- relationships between macro-scale ice roughness and snow accumulation and properties
- temperature variation within the snow/ice column
- effects of surface-type mixtures within sensor field of view

Sampling Strategy:

- surface (~ meter spacing over transects totaling ~22 km distance)
- low-level aircraft for aerial photos, laser height profiling, SAR imaging
- low/mid-altitude observations from P3
- satellite imagery (SAR, MODIS,
- AMSR-E)
- GIS and database to coordinate and integrate data

AMSRIce03 and '06 study area

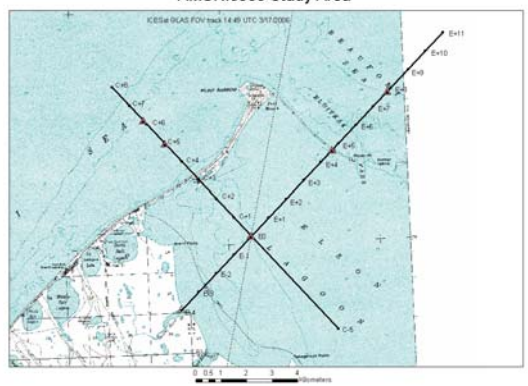


- March 2003 and 2006
- winter/early spring conditions (-40 C - -15 C)

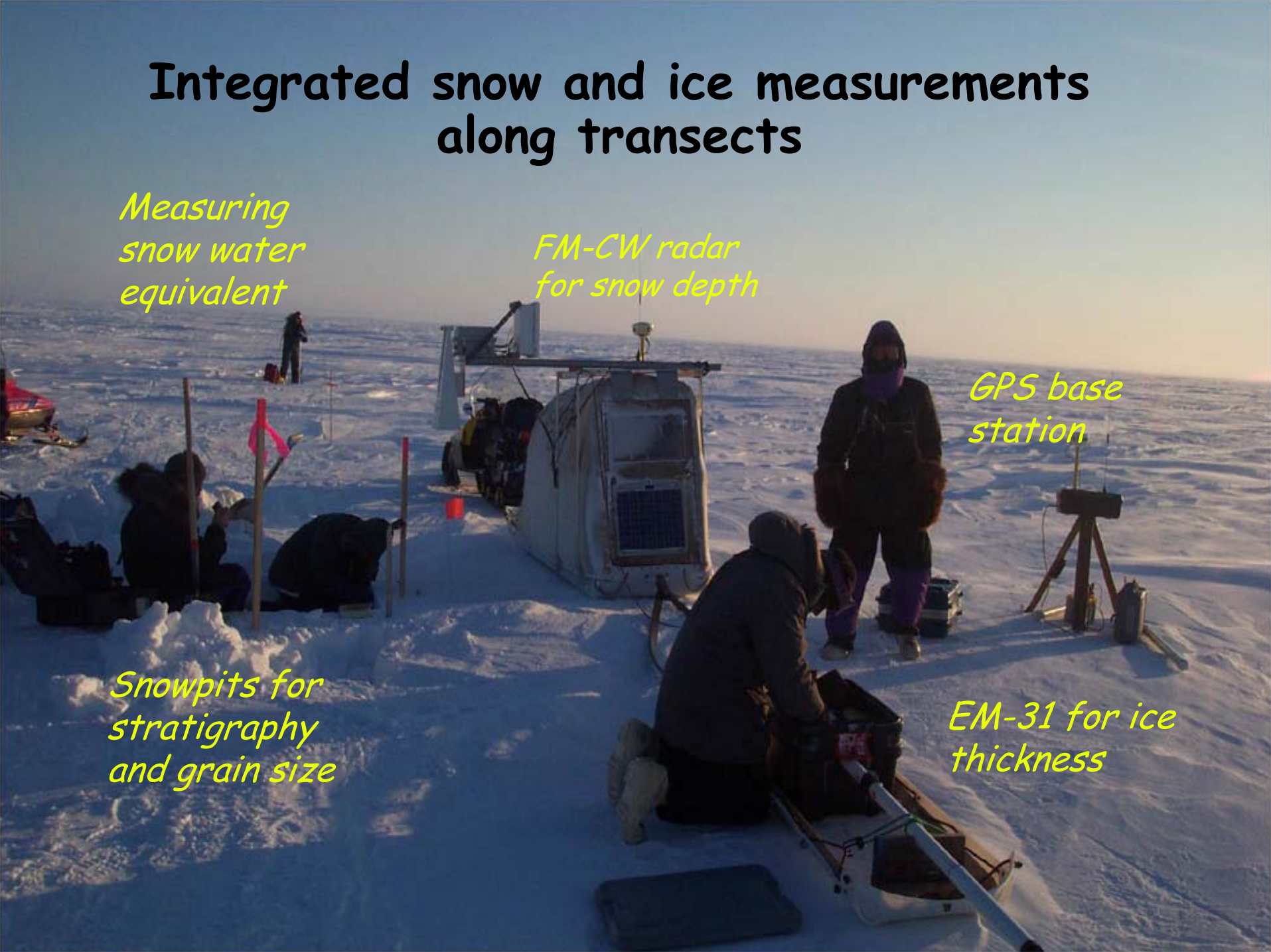
March
2003

N

AMSRIce06 Study Area

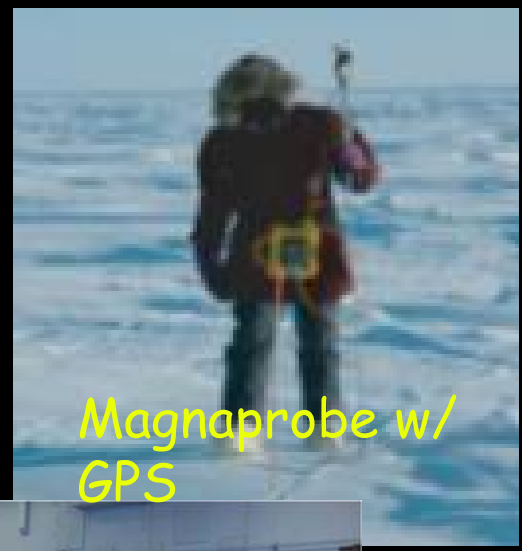


Integrated snow and ice measurements along transects



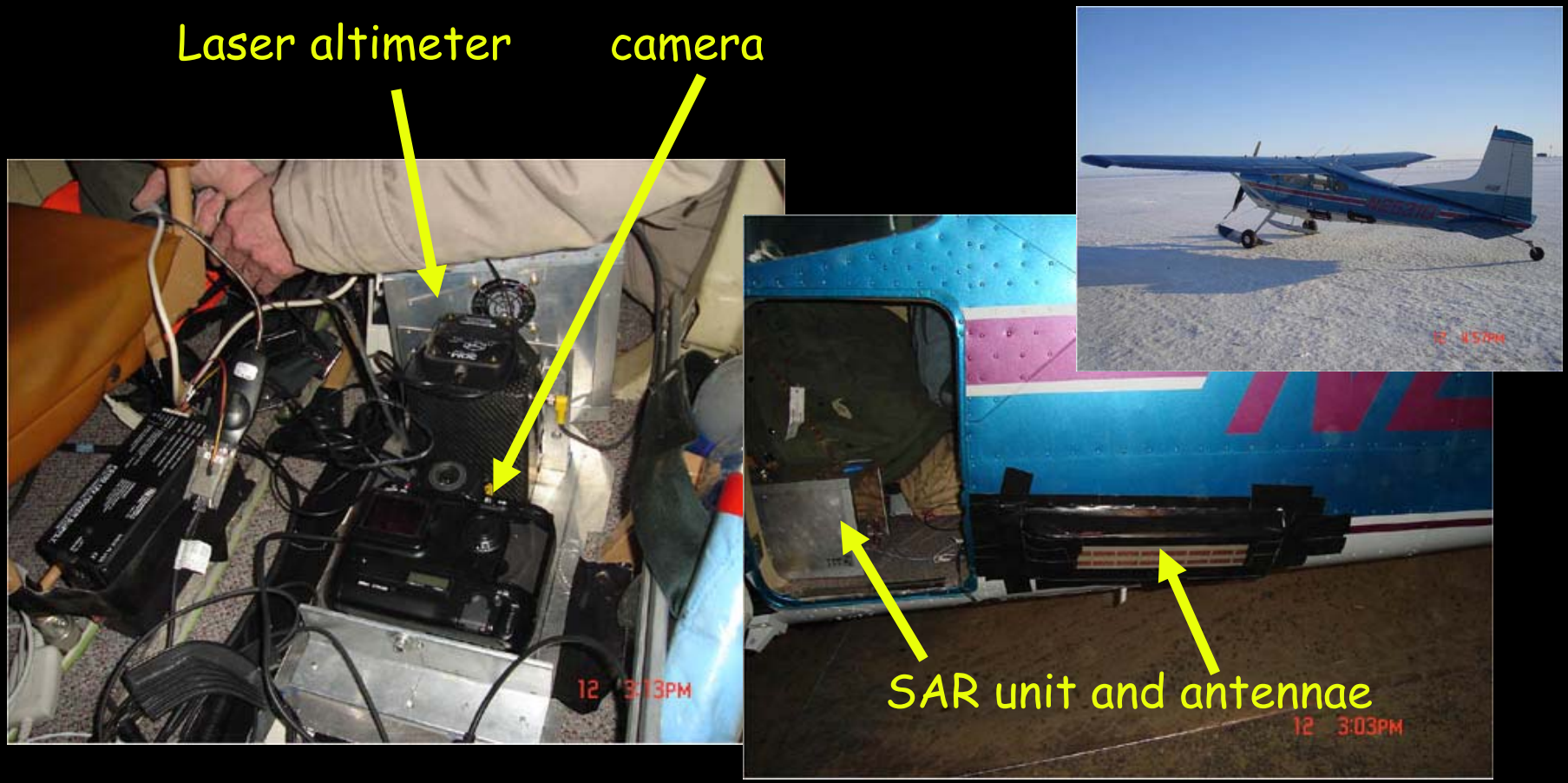
New FM-CW radar combined with a kinematically-corrected GPS system and integrated with the EM-31 in order to collect a coordinated set of ice thickness and snow depth measurements. Approximately 300,000 radar snow depths were obtained with about 10,000 ice thicknesses, and with ~15,000 snow depths obtained by hand.


Radar in operation on Elson Lagoon; rear sled holds the EM-31


Magnaprobe w/ GPS

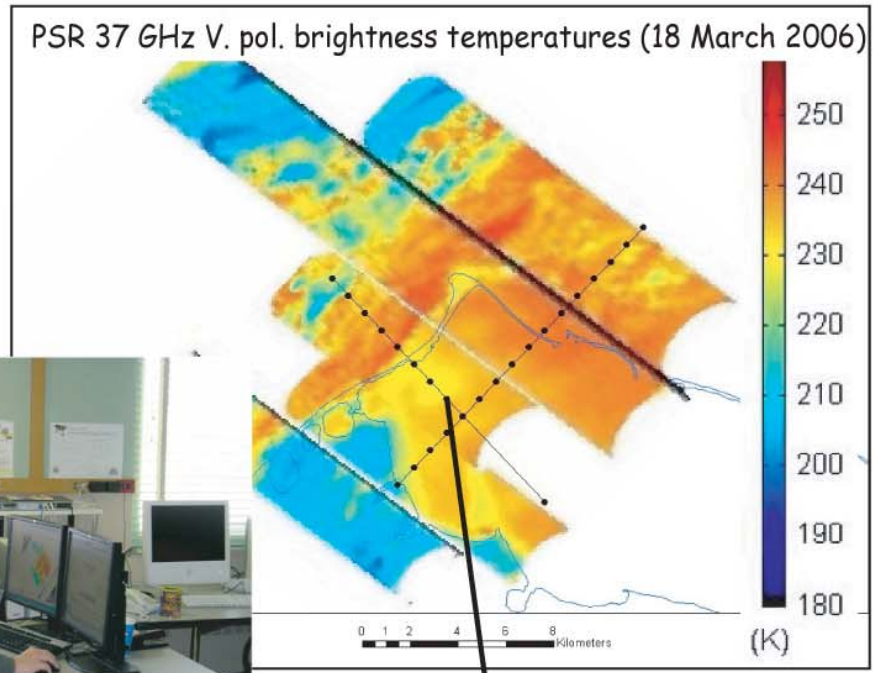

Heat sled for computers and operator

Laser altimetry and MicroSAR system onboard the Cessna 172. The laser provides sub-meter spacing of height measurements at ~ 2 cm. accuracy. SAR imagery is sub-meter resolution.

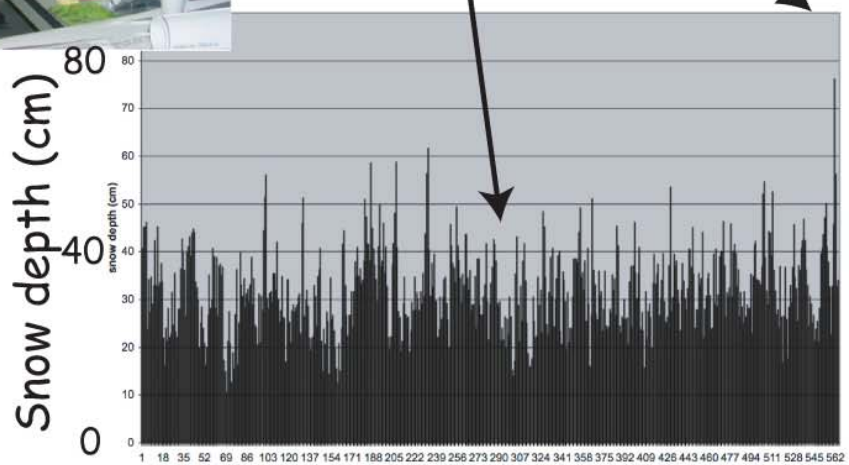


Aerosonde UAVs (2003) – imagery and skin temps.

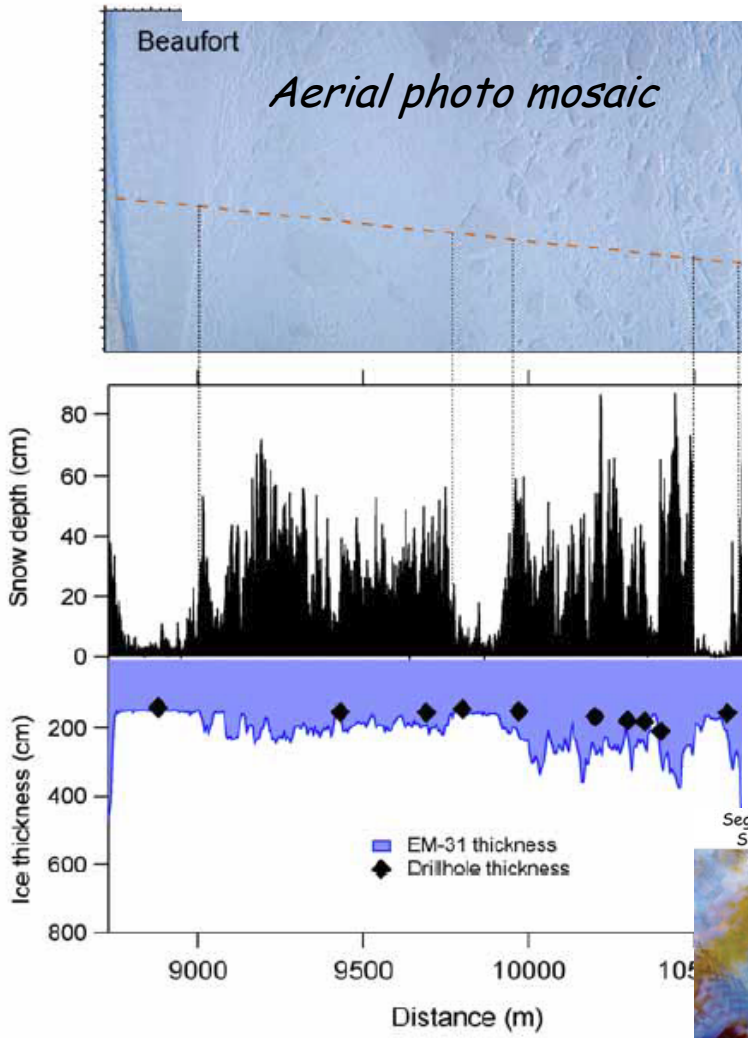
Coordination of Aircraft and Surface Observations

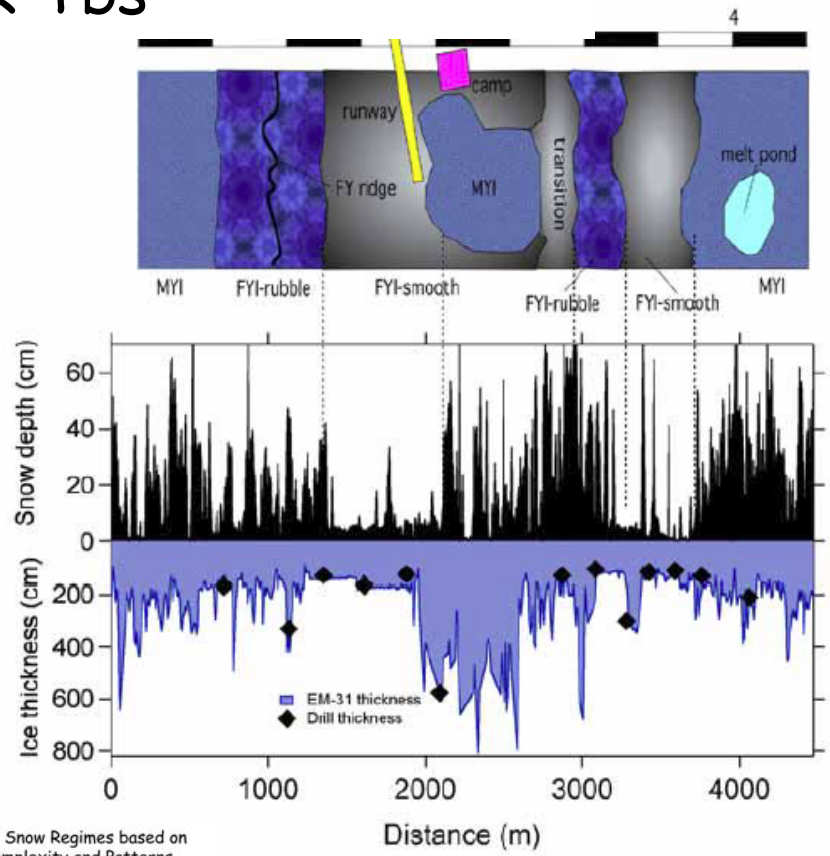


Chukchi E0 to C2.0

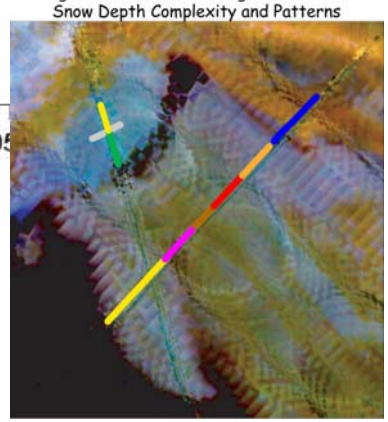


Snow and ice thickness vs. ice conditions and PSR Tbs



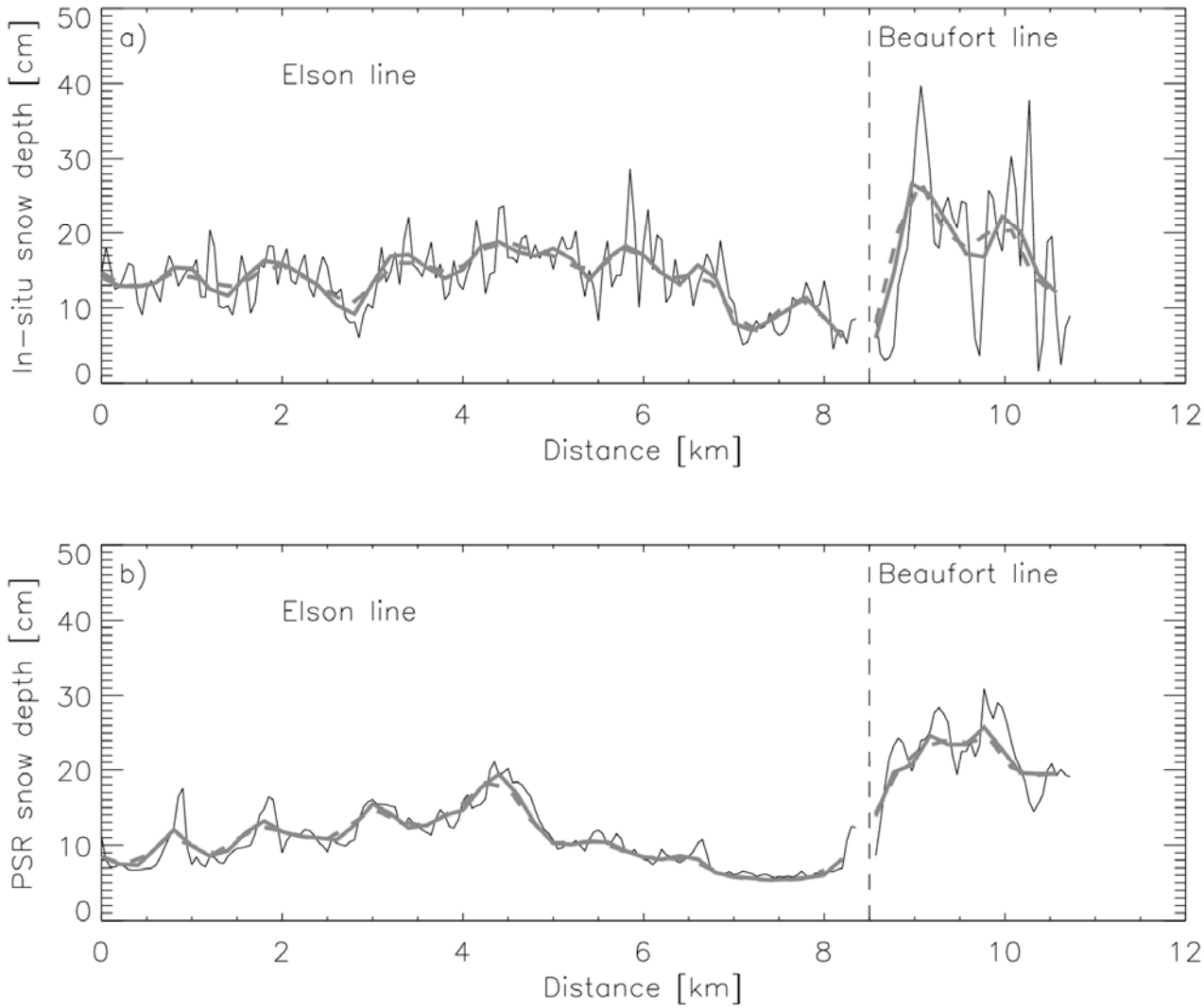


Segmentation of Snow Regimes based on Snow Depth Complexity and Patterns



PSR channel composite

Observed vs. microwave (PSR)-derived snow depth



Simulated and Observed TB Variability in Relation to Observed Snowdepth

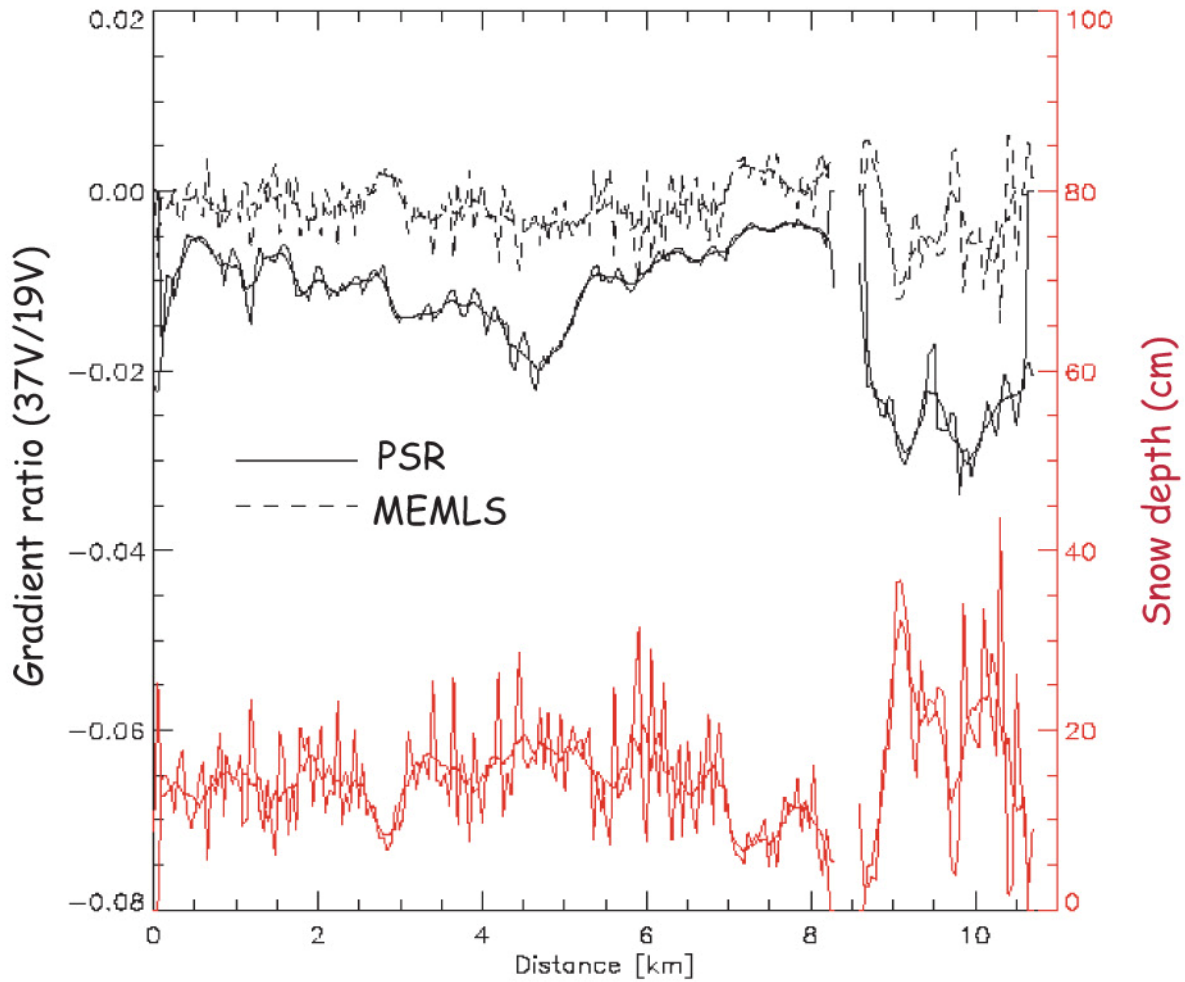
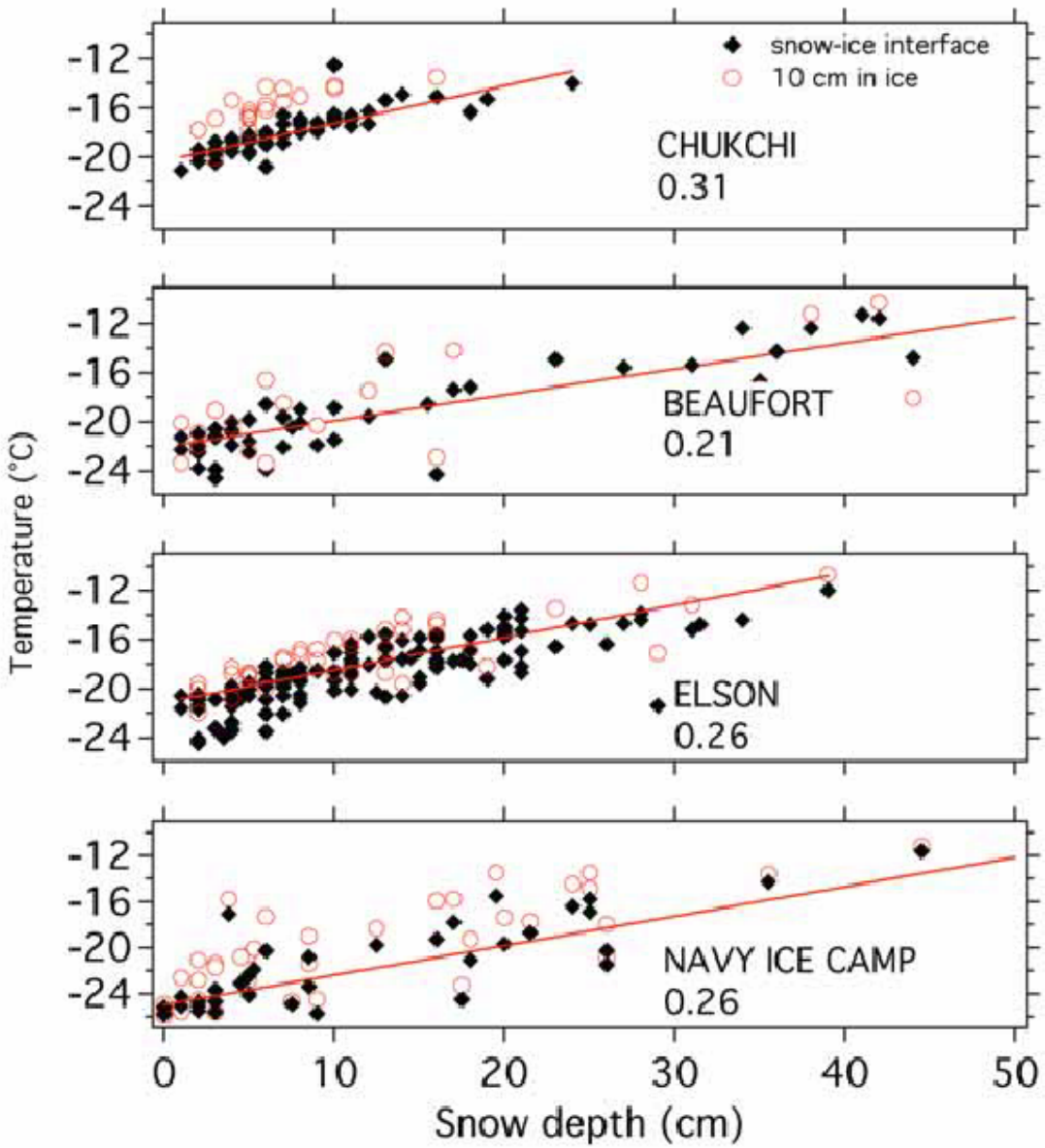


Figure 7: The spectral gradient ratio for 37/19 GHz for PSR-A and MEMLS data. The snow depth for the Elson and Beaufort lines is shown on the right axis. The thick lines represent the 200 meter running mean



Relationships between ice temperature, snow/ice interface temperature and snow depth

Effects of roughness on microwave-derived snow depth and ice concentration

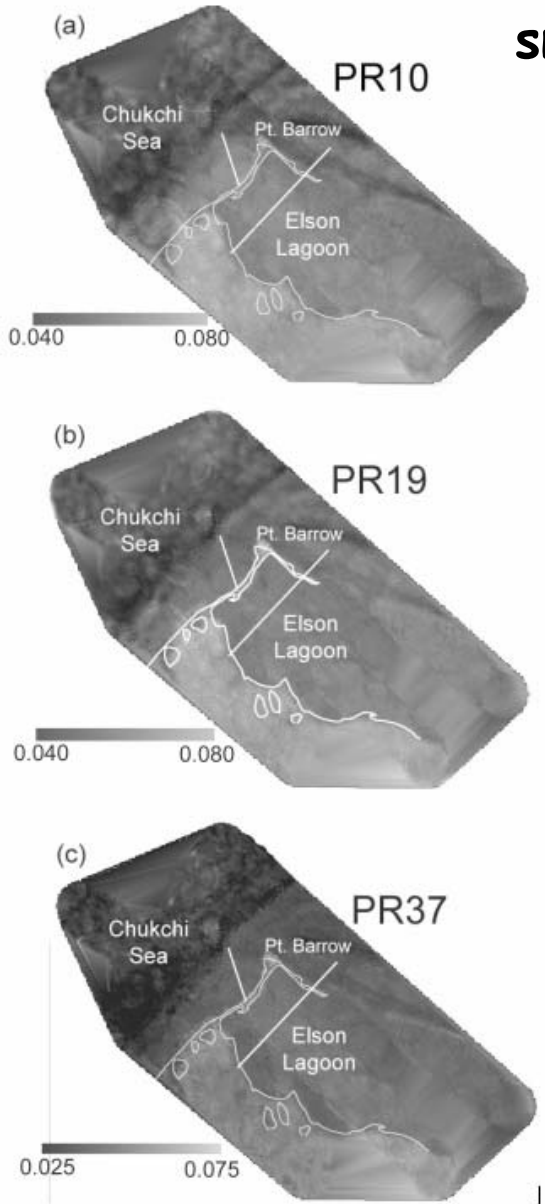
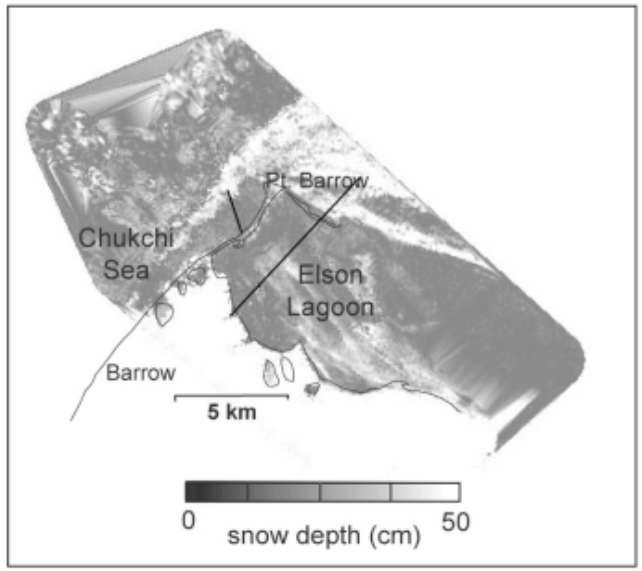
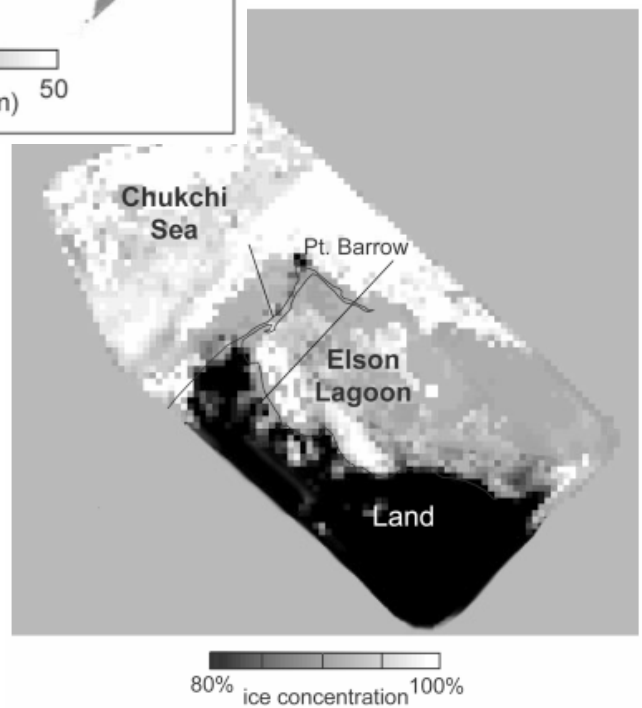
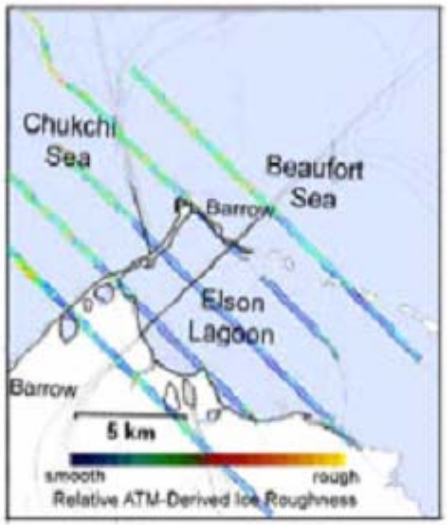


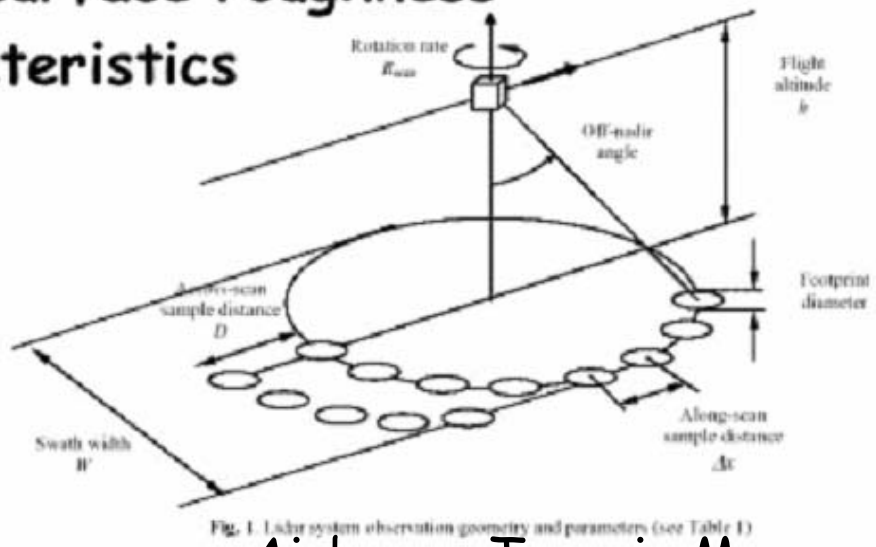
Figure 9. Comparison of PR_{10} (a), PR_{19} (b), and PR_{37} (c). Lowest PR regions vary with frequency and appear to correspond to different ice roughness conditions.





Laser-derived surface roughness characteristics





Airborne Terrain Mapper scan configuration

	Low Altitude		High Altitude	
	σ_b (cm)	l_b (m)	σ_b (cm)	l_b (m)
Young ice	**4-7**	**0.8-2**	**No data**	
Level FY	**5-7**	**4-6**	**7-9**	**5-7**
Deformed FY	**15-35**	**4-6**	**20-40**	**5-7**
Multiyear	**No data**		**10-30**	**5-8**

Ice roughness characteristics based on P3 ATM laser height profiles (root mean square height σ_b and correlation length l_b)

- **AMSRIce06 field team members (17 total):**

Person	Assignment	AMSR-Ice03 participant?
Matthew Sturm	Co-PI, Field leader	Yes
Jim Maslanik	Co-PI, snow depth & remote sensing	Yes
Jon Holmgren	FM-CW radar for snow depth	Yes
HP Marshall	FM-CW radar for snow depth	No
Don Perovich	Ice cores, ice thickness, EM-31	Yes
Julienne Stroeve	Snow depth & remote sensing	Yes
Ken Tape	Snow pits, NIR grain size	Yes
Tom Douglas	Snow water equivalent	Yes
John Heinrichs	GIS and remote sensing	Yes
Tom George	Pilot, aerial photography	Yes
Chuck Fowler	Instrumentation (SAR, laser)	No
Thorsten Markus	Field assistant	Yes
Rick Rachow	Field assistant	No
Carl Kippi	Ice/bear safety	No
Perry	Ice/bear safety	No
Keith Williams	Ice/bear safety	No
Alice Brower	Ice/bear safety	No

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- **IEEE TGARS "AMSRIce03" special issue**

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