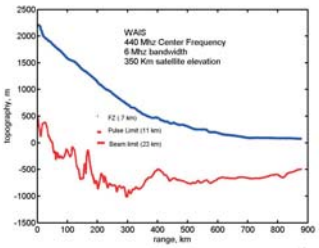
Global Ice Sheet Mapping Orbiter

A NASA Instrument Incubator Project

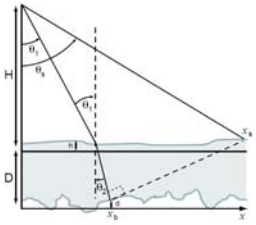
K. Jezek, S. Gogineni, A. Freeman, J. Curlander, X. Wu, C. Allen, P. Kanagaratnam, J. Sonntag, and W. Krabill

Science Team: R. Forster, M. Fahnestock, D. MacAyeal, S. Tulazek, G. Casassa, L. Ulander

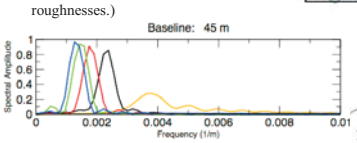


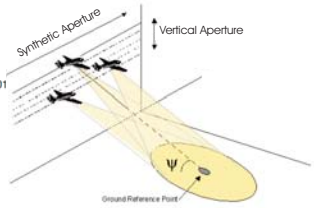
GISMO Concept

Surface clutter is a primary obstacle to spaceborne sounding of icy bodies. Conventional techniques for overcoming clutter are not compatible with science objectives and at best provide ice thickness profiles.



Radar interferometry may overcome these obstacles. Differences in path length and incidence angle (left), result in spectral separation of the interferometric signal from the surface and base of the ice (lower). (Orange is basal return. Other colors are surface return with different roughnesses.)





Alternative approach is radar tomography

GISMO Science Goals:

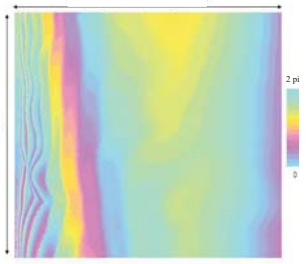
- Determine total global ice sheet volume;
- Determine basal boundary conditions from radar reflectivity;
- Understand the phenomenology of radar sounding of ice for applications to planetary studies. A JPL, 70 by 30 km Galileo image of icy Europa is show below (right), illustrating the moons complex and very rough surface. A 70 x 30 km Radarsat image of Crary Ice Rise is shown on the left.

Instrument Description

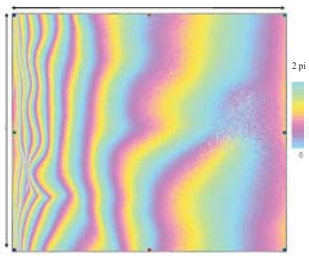
- P-band and VHF interferometric radar (45 m baseline)
- Quad polarization for ionosphere correction
- 1 km spatial resolution
- 10 m height accuracy
- 50 km image swaths, which enable complete polar coverage in two weeks
- Mission lifetime: 3 months
- 600 km polar orbit

Simulated Interferogram - North Central Greenland

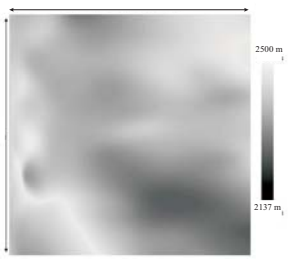
Surface and Basal Signals



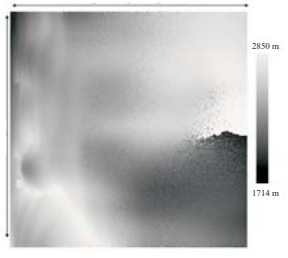
Band Pass Filtered Interferogram



Original Ice Thickness



Derived Ice Thickness
(expected performance reduction past 50 km)

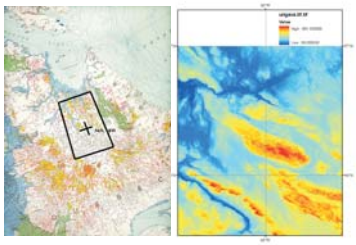


Images are 130 km vertical (azimuth) and 11.9 km Slant range (70 km ground range)

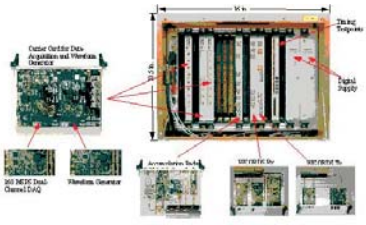
Next Steps

- Model topography of recently deglaciated terrain

Terrain near Ungava Bay was deglaciated roughly 6000 yr b.p. SRTM DEM data is shown on the left. DEM data will be used to improve model simulations and to test system performance over a variety of terrain types.



- Aircraft test flights over Greenland and Antarctica



Photographs of the various sub-systems developed for PRISM, including a dual-channel digitizer with 12-bit A/D converters, waveform generator and transmitter and receiver sub-sections. The carrier card is housed in a module that plugs into a compact PCI chassis. The A/D converter has an input bandwidth of 500 MHz and it can be used in under sampling mode up to 500 MHz. There will be six identical receivers and digital carrier cards for capturing signals from the six GISMO antenna elements.

- Possble collaboration with ESA CARISMA project