IMAGING RADAR STUDIES OF POLAR ICE

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Topics

• Scientific Overview
• Radar Data Opportunities
• Sea Ice Investigations
• Ice Sheet Investigations
• Conclusions

Scientific Overview

Sea Ice Scientific Objectives:

• To estimate globally the surface brine generation, heat flux, and fresh water advection (as ice).

• To monitor phasing of seasonal melt and freeze events and accurately estimate melt and growth rates.

• To develop improved treatment of momentum transfer and ice mechanics in coupled air-sea-ice models.

Key Radar Observations: Ice Type and Velocity
STUDY PHILOSOPHY, UNDERSTANDING THE ROLE OF SEA ICE IN CLIMATE

Satellite Sensors
- Passive Microwave
- Imaging Radar
- IR Imaging
- Visible Imaging
- Atmospheric Sounding
- Stations and Buoys
- Global Models

In-situ Sensors
Forecasts and Analyses

Input Data Sources

Processors

Output Fields

Climate Change Analysis

Processors Running Geophysical Algorithms

State Variables
Fluxes
Trends

Global Climate Simulations

Climate Prediction
SATellite DATA SETS FOR SEA ICE OBSERVATIONS

PASSIVE MICROWAVE IMAGING RADIOMETERS
- NIMBUS-5 ESMR
- SEASAT
- NIMBUS 6
- NIMBUS-7 SMMR
- DMSP-SSM/I
- MOS MSR
- EOS
- ENVST

SYNTHETIC APERTURE RADARS
- SEASAT
- ERS-1,2 AMI
- JERS-1
- RADARSAT
- EOS
- ENVST

RADAR ALTIMETERS
- GEOS 3
- SEASAT
- ERS-1,2 ALT
- GEOSAT
- TOPEX/POSEIDON
- EOS
- ENVST

RADAR SCATTEROMETERS
- SEASAT
- ERS-1,2 AMI
- ADEOS-NSCAT
- ENVST

FINE RESOLUTION VISIBLE TO THERMAL INFRARED
- LANDSAT 1-X
- SPOT
- MOS MESSR
- JERS-1
- EOS
- ENVST

MODERATE RESOLUTION VISIBLE TO INFRARED
- NOAA 1-5
- ESSA 1-9
- NOAA POLAR ORBITERS
- NIMBUS 1-4
- DMSP-OLS
- EOS
- ENVST

OCEAN COLOR
- NIMBUS-7 CZCS
- SEAWIFS
- ADEOS-OCTS
- EOS


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Statistics of Ice Deformation

Average over SAR Scenes

Vorticity (per day)

Mean: -0.006
Std dev: 0.015

Divergence (per day)

Mean: -0.002
Std dev: 0.022

Shear (per day)

Mean: 0.011
Std dev: 0.014

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SEASONAL CHANGE IN ERS-1 BACKSCATTER

DAYS 227-248
(15 AUG-04 SEP) 1991
MULTIYEAR ICE BEAUFORT SEA
Radar Opportunities

- Systems Now Deployed in Space: ERS-1, JERS-1
- Ground Station SAR Processors, Geophysical Processors International Collaboration--Could Improve
- Systems Approved for the Near Term, Far Term RADARSAT (Coverage)
- Proposed Systems for the Far Term
- Airborne Systems, Polarimetric Data
- In-Situ and Laboratory Scatterometers
- Historical Data

In Summary: Data Opportunities are Excellent, Will Funded Research Opportunities Keep Up?

Scientific Overview

Ice Sheet Scientific Objectives

- To Map and Classify the Ice Sheets According to Dominant Processes in the Mass budget
- To Monitor the Calving Ice Flux From Greenland and Antarctica

Key Radar Observations: Surface Conditions, Ice Velocity
RADAR INVESTIGATIONS OF GREENLAND
ICE SHEET ZONATION

1. WET SNOW
2. ICE LENSES
3. SATURATED FIRM
4. SURFACE LAKES

ICE
ROCK