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

In-situ Sensors
- Stations and Buoys

Global Models

Forecasts and Analyses

Input Data Sources

Processors

State Variables

Fluxes

Trends

Global Climate Simulations

Climate Prediction

Output Fields

Climate Change Analysis
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

SYNTHETIC APERTURE RADARS

SEASAT

ERS-1,2 AMI
JERS-1
RADARSAT

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

MODERATE RESOLUTION VISIBLE TO INFRARED

NOAA 1-5
ESSA 1-9
NOAA POLAR ORBITERS
NIMBUS 1-4
DMSP-OLS

ENVST

OCEAN COLOR

NIMBUS-7 CZCS
SEAWIFS
ADEOS-OCTS

EOS
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

- \( \text{div} / |e| \):
  - Mean: -0.086
  - Std dev: 0.409
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