The Mission

Earth Observing System Goals:

Develop the modeling and observational capabilities to predict and/or monitor atmospheric, terrestrial and oceanic processes that are either causing global change or resulting from global change

EOS SAR Goals:

To provide important geophysical products to the EOS data set to improve our understanding of the state and functioning of the Earth system

EOS SAR Strategy:

Define the instrument requirements based on required input to geophysical algorithms

Provide the processing capability and algorithms to generate such products on the required spatial (global) and temporal (3-5 days) scales

Provide the spaceborne instrumentation with international partnerships
  • initially with Germany
  • currently exploring broader international partnerships
Geophysical Properties

Ecology:
Vegetation type
Water status
Biomass
Seasonal state
Fire extent

Hydrology:
Soil moisture
Snow moisture and extent
Inundation extent
Glacier zonation

Oceanography:
Sea ice type and motion
Wavelength and direction
Currents and eddies

Geology:
Landform distribution
Surface roughness
Subsurface structure and drainage
Progress in 1992

ERS-1 Polar Ice Results
- ERS-1/2 -> RADARSAT provide excellent data for polar ice community
- Polarimetric capabilities still required for thin ice type

Waring's SAR Vegetation Working Group (Ecological Applications)
- Current understanding of vegetation products from SAR
- Value in ecosystem models
- Freeze/thaw
- Biomass (<150 tons/ha)
- Inundation extent
- Water status

Engman's Hydrology Working Group and ISLSCP Workshop
- Soil moisture in root zone is the requirement
- Surface moisture measured by SAR may be related to soil moisture
- Algorithm independent of surface roughness developed (Ulaby)
- Shorter wavelength improves snow discrimination (Rott)

References
## Operational Geophysical Products from SAR

<table>
<thead>
<tr>
<th>Product</th>
<th>Band Reqmt's</th>
<th>Temporal Reqmt's</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current ASF for ERS-1:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea ice motion</td>
<td>C-VV or C-HH</td>
<td>3-days</td>
</tr>
<tr>
<td>Sea ice type</td>
<td>C-VV or C-HH</td>
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</tr>
<tr>
<td>Ocean wavelength and direction</td>
<td>C-VV or C-HH</td>
<td>weekly</td>
</tr>
<tr>
<td><strong>JERS-1:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landform distribution</td>
<td>L-HH</td>
<td>once</td>
</tr>
<tr>
<td>Deforestation extent</td>
<td>L-HH</td>
<td>yearly</td>
</tr>
<tr>
<td><strong>ASF Upgrade for RADARSAT/ERS-2:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glacier zonation</td>
<td>C-VV or C-HH</td>
<td>yearly</td>
</tr>
<tr>
<td>Freeze-thaw state</td>
<td>C-VV</td>
<td>&lt; weekly</td>
</tr>
<tr>
<td>Fire extent</td>
<td>C-VV or C-HH</td>
<td>monthly</td>
</tr>
<tr>
<td>Inundation extent (tundra)</td>
<td>C-VV or C-HH</td>
<td>weekly</td>
</tr>
<tr>
<td><strong>SIR-C/X-SAR Free Flyer:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation type</td>
<td>L-quad, C-quad, X-VV</td>
<td>winter and summer</td>
</tr>
<tr>
<td>Regrowth biomass</td>
<td>L-quad</td>
<td>yearly</td>
</tr>
<tr>
<td>Surface roughness</td>
<td>L-quad, C-quad, X-VV</td>
<td>yearly</td>
</tr>
<tr>
<td>Subsurface structure/drainage</td>
<td>L-HH, high angle</td>
<td>once</td>
</tr>
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<td><strong>EOS SAR:</strong></td>
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<td>Soil moisture (and roughness)</td>
<td>L-quad</td>
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<td>Snow moisture and extent</td>
<td>L-quad, C-quad, X</td>
<td>weekly, day-time</td>
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<tr>
<td>Vegetation water potential/moisture</td>
<td>L-quad, C-quad, X</td>
<td>diurnal</td>
</tr>
<tr>
<td>Thin ice type</td>
<td>L-quad</td>
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<tr>
<td>Inundation extent (forests)</td>
<td>L-HH</td>
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</table>
EOS SAR Mission Strategy: MultiSAR

Previous Strategy:

EOS SAR for all geophysical products:
- L- and C-band from US.
- X-band from Germany
- Single platform
- Mission start with EOS SAR launch

Potential International MultiSAR Strategy:

Obtain "baseline" global classification with SIR-C/X-SAR Free Flyer
- Geology products
- Vegetation type
- Regrowth biomass
Continue products started with ERS-1/2, JERS and RADARSAT
- Ice and ocean
- Glaciers.
- Freeze/thaw, fire extent, inundation (tundra)
Design multiple spacecraft/SAR international mission series
- "hydrologic" properties
- change in "classification" properties
Split Concept for Global Data Products

- **SIR-C/X-SAR Free Flyer**
  - **Begin Long-Term Properties**:
    - Geometry
    - High resolution
    - Multiple channels
    - Limited temporal coverage

- **EOS SAR**

- **MultiSAR**
  - **Begin Temporally Varying Properties**:
    - Dielectrics
    - Frequent temporal coverage
    - Select channels
    - Low resolution

  - **Continue Long-Term Properties**
Outstanding MultiSAR Requirements

- Outstanding relative to current international program and SIR-C/X-SAR Free Flyer

Data Products:

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New Requirements:

- Frequency/polarization: L-quad, C-quad, X
- Resolution: 250 - 500 m (L, C), 30 m (X)
- Swath width: 500 km (including quad)
- Calibration: <1dB relative lifetime
- Repeat coverage: 3-5 days
- Equator crossing time: 1:30 p.m., 1:30 a.m.; dawn, dusk
- Duty cycle: 20-50%
Potential Synergism of International MultiSAR Mission

- diurnal coverage
- increased mapping
Evolution of Geophysical Products Through Long-Term International Program

ERS-1/2, RADARSAT, JERS-1

SIR-C/X-SAR Free Flyer

MultiSAR

Sea Ice Type/Motion
Currents, Eddies, Internal Waves
Glacier Zonation
Freeze/Thaw State
Fire Extent
Inundation Extent (Tundra)
Landform Distribution
Deforestation Extent

Vegetation Type
Regrowth Biomass
Surface Roughness
Subsurface Structure/Drainage
Ocean Wavelength/Direction

Soil/Vegetation Moisture
Snow Moisture/Extent
Water Potential
Thin Ice Type
Inundation Extent (Forests)

Energy Flux → Carbon Flux → Water Flux
Conclusions

- Current international capabilities provide some temporally varying data products
- Multifrequency and multipolarization required for many products
- SIR-C/X-SAR Free Flyer provides initial look at long-term geophysical products
- Additional EOS SAR task is to add temporally varying water-related properties
  - must also continue long-term products
- International MultiSAR approach provides opportunity to optimize temporal multifrequency/pol. coverage of the globe
Next Steps

International agreement on science requirements

Series of discipline-oriented workshops and field campaigns

Mission scenario options for study

International approach to operational data product generation