Welcome to the

IOMASA Progress Meeting 1

at DMI, April 24-25, 2003!

IOMASA – Integrated Observing and Modeling of the Arctic Sea ice and Atmosphere

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Historic Background

- IUP: Remote sensing of sea ice and polar atmosphere
- Cooperations with DTU in EU projects
  - PELICON (1993-96): Long-term variability of Antactic sea ice
  - SEA LION (1998-2000): Sea ice in the Antarctic Linked with Ocean – Atmosphere Forcing
- Cooperation with DMI and met.no in EUMETSAT SAF OSI: Synergy of scatterometer and SSM/I
- Initiative of DMI to continue cooperation -> IOMASA

Role of UAG

- contribute to the evaluation of IOMASA product performances and of their impact
- link with other projects
- disseminate information on IOMASA

in the fields of

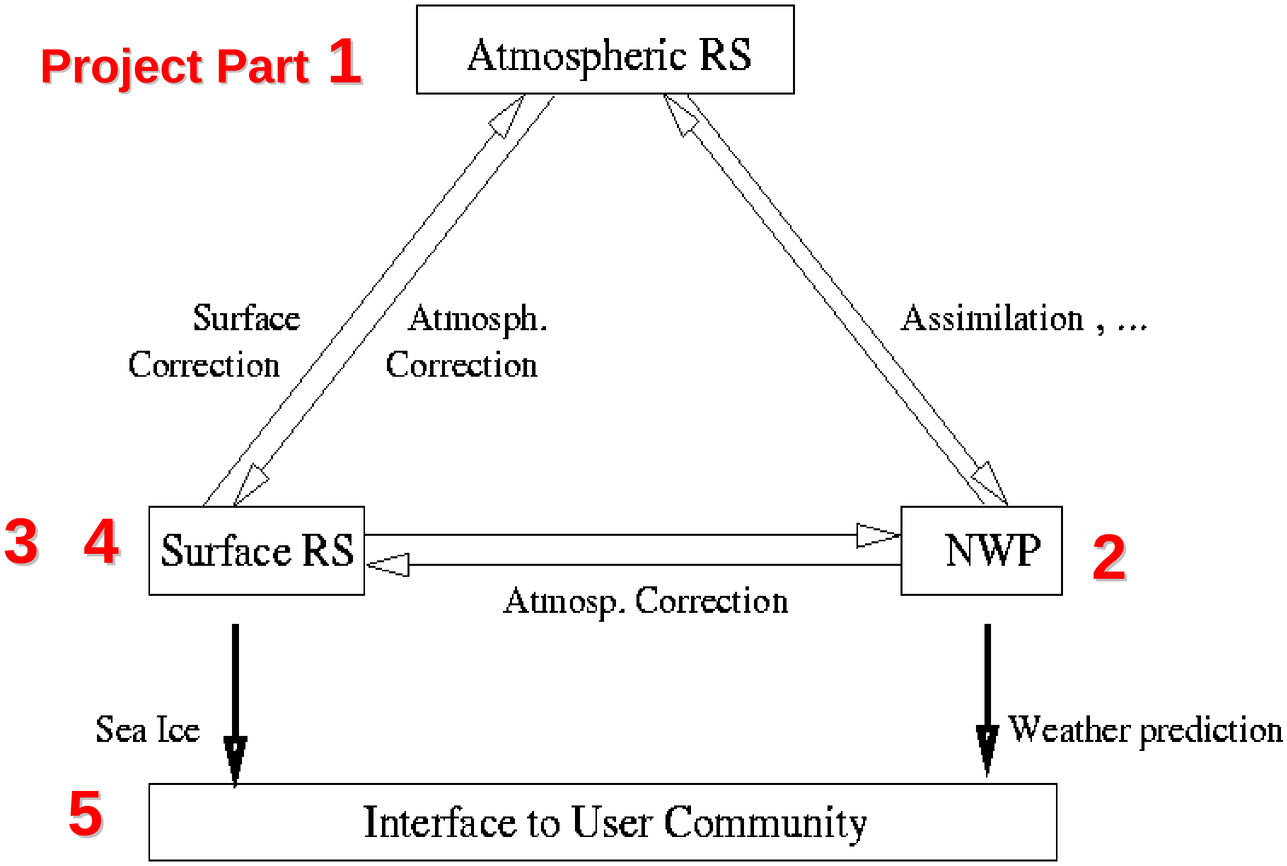
- weather forecast
- ice charts
- heat flux estimation

- pave the way for IOMASA results to operational applications

UAG members

S. English	Met. Office	
C. Fortelius	FMI	
K. Hansen	DMI	Sea Ice charting
M. Rummukainen	SMHI	
S. Sandven	NERSC	Sea ice & ocean modeling
H. Tangen	met.no	Sea ice charting

Innovation of IOMASA



4 Project Phases

1. Preparatory Phase:

   Provide data, day 0 algorithms, data sets; literature studies

2. Development Phase:

   Algorithms for retrieval and assimilation

3. Production experiment:

   Produce on 2-year historic data

4. Validation and real time experiment:

   Demonstrate operational use and data distribution

Project Phases and Schedule

Table 1: IOMASA Project Planning and Time Table

Project Month	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35
Project Phase	I			II											III		IV	
Meeting	⇓		⇓							⇓				⇓		⇓		⇓
Management	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Part 1: Remote sensing of atmospheric parameters (Partner 1)																		
1.1: Data and day 0 algorithms	■	■	■															
1.2: Atmospheric algorithms				■	■	■	■	■	■	■	■	■	■	■				
1.3: Produce retrieved fields															■	■		
1.4: Validation																	■	■
Part 2: Improving numerical weather prediction models (Partners 4,5)																		
2.1: Prepare NWP activities	■	■	■															
2.2: Improve Arctic high-resolution NWP				■	■	■	■	■	■	■	■	■	■	■				
2.3: Prepare real time assimilation															■	■		
2.4: NWP Production and validation																	■	■
Part 3: Empirical model for emissisivity and backscatter of sea ice (Partner 2)																		
3.1: Prepare sea ice modeling	■	■	■															
3.2: Sea ice foreward models				■	■	■	■	■	■	■								
3.3: Influence of snow											■	■	■	■	■	■		
3.4: Validate sea ice foreward models																	■	■
Part 4: Sea ice concentration retrieval (Partner 3)																		
4.1: Prepare sea ice retrieval	■	■	■															
4.3: Sea ice retrieval algorithm				■	■	■	■	■	■	■	■	■	■	■				
4.3: Produce sea ice fields															■	■		
4.4: Validate sea ice algorithm																	■	■
Part 5: Real time processing and user interface (Partner 2)																		
5.1: Define interfaces and formats	■	■	■															
5.2: —																		
5.3: Setup of production and interface															■			
5.4: Validate production and interface																	■	■

IOMASA Project Parts

- Part 1: Atmospheric Remote Sensing : UB
- Part 2: Numerical Weather Prediction Models: met.no, SMHI
- Part 3: Empirical Model for emissivity and backscatter of sea ice: DTU-DCRS
- Part 4: Sea ice concentration retrieval: DMI
- Part 5: Real time processing and user interface: DTU-DCRS

Remote Sensing of Polar Regions at IUP

- Sea Ice
  - Individual weather correction (PELICON)
  - ice concentration: improved resolution (SEA LION, ARTIST)
  - high resolved ice edge (IED)

- Polar Atmosphere
  - improved Temperature profiles (SSM/T, ASMU-A)
  - Total Water Vapor from humidity sounders SSM/T2 and AMSU-B
  - Liquid Water Path over sea ice (SSM/I)

Part 1 (UB): Atmospheric Remote Sensing

Overall Goal: Establish Communication with Users

Three Segments of Part 1:

- Total water vapor
- Cloud Signature
- Estimate surface emissivity at temperature sounder frequencies

The three segments of Part 1

1. **Transfer Total water vapor procedure to**
   – AMSU-B frequencies
   – Arctic conditions
   – using a set of Arctic R/S and low TWV values over open water
2. **Transfer Cloud Signature procedure to**
   - Arctic atmospheric conditions,
   - Arctic sea ice emissivity (literature and ice types from Part 3)
   - AMSR(-E)
3. **Estimate surface emissivity at AMSU-A frequencies and incidence angles**
   - needed to improve temperature profiles in NWPs
   - use ice concentrations from SSM/I,
   - use surface temperatures from AVHRR, cloud free
   - R/S for atmospheric data

Transparencies

Results for Phase 1 of Part 1

1. Provide data of investigation period
   – AMSU-A data
   – SSM/I data
   – AMSU-B data
2. Radiosonde data
3. Day 0 algorithms
4. IOMASA Web Site
5. Sea ice emissivity at AMSU-A frequencies and incidence angles
6. Sea ice literature

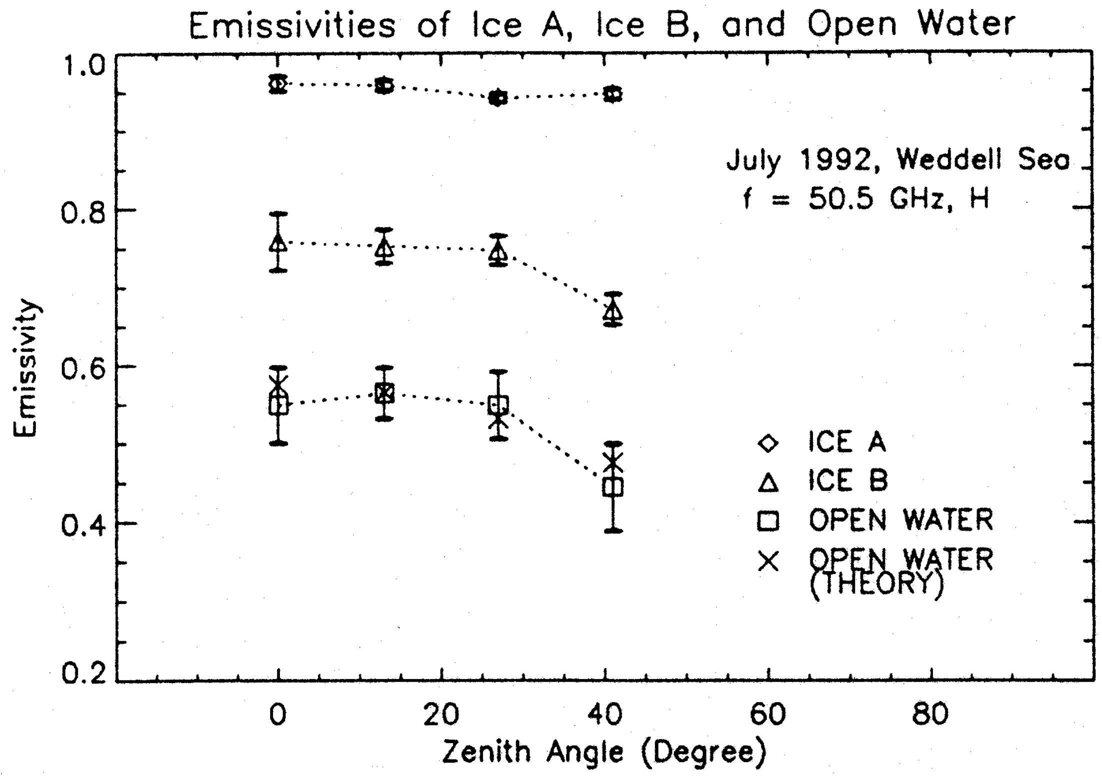
4. Sea ice emissivity at T-sounding frequencies

- Temperature sounders scan cross track
- incidence angle varies:
  - SSM/T1:   4 scan positions, 0....42°
  - AMSU-A: 30 scan positions, 0....48°
- adopt procedure of Miao et al., 1997:

- Determine
  - surface type distribution from SSM/I within AMSU-A footprint
  - atmospheric influence from coincident R/S profiles
  - surface temperature from IR sensor
  - Solve linear equations systems, one for each scan position
  - Broaden data base: Estimate error if ‚mean‘ profiles are used

4. Sea ice emissivity at T-sounding frequencies (cont‘d)

- Results of Miao 97 in Weddell Sea:

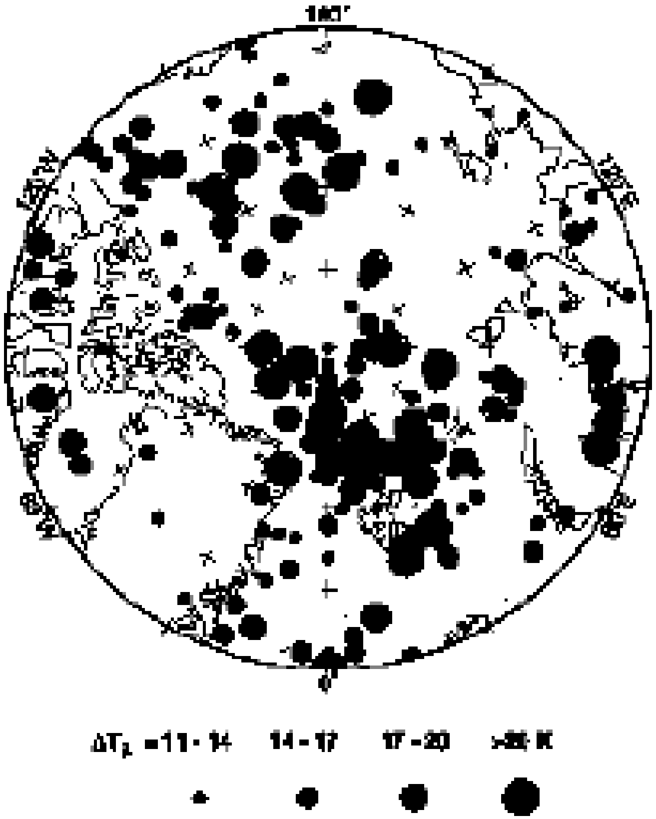


5. Sea Ice Literature

- 5.1 Liu & Curry 2003: ‚Hot Spots‘ at 85 GHz in Arctic
- 5.2 Voss et al. 2003: Ice type discrimination with SSM/I & QuikScat
- 5.3 Josberger & Mognard, 1999: Snow thickness over land

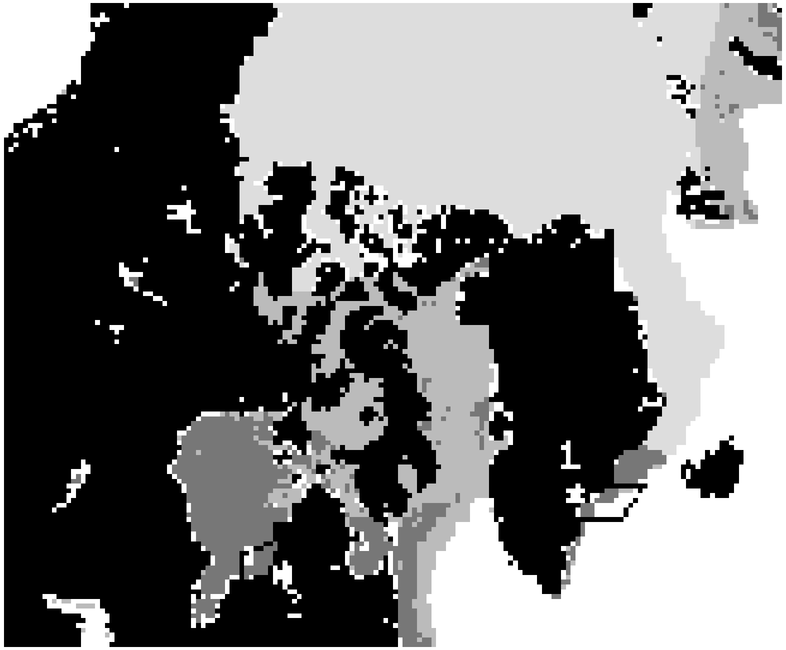
5.1 Liu & Curry 2003: Arctic ‚Hot Spots' at 37 and 85 GHz

- Anomalies up to 30K (15K) at 85 GHz (37 GHz)
- Most important factors contributing
  - CLW ~ 10K
  - Ts ~ 10K
  - Open Leads ~ 2K (?)



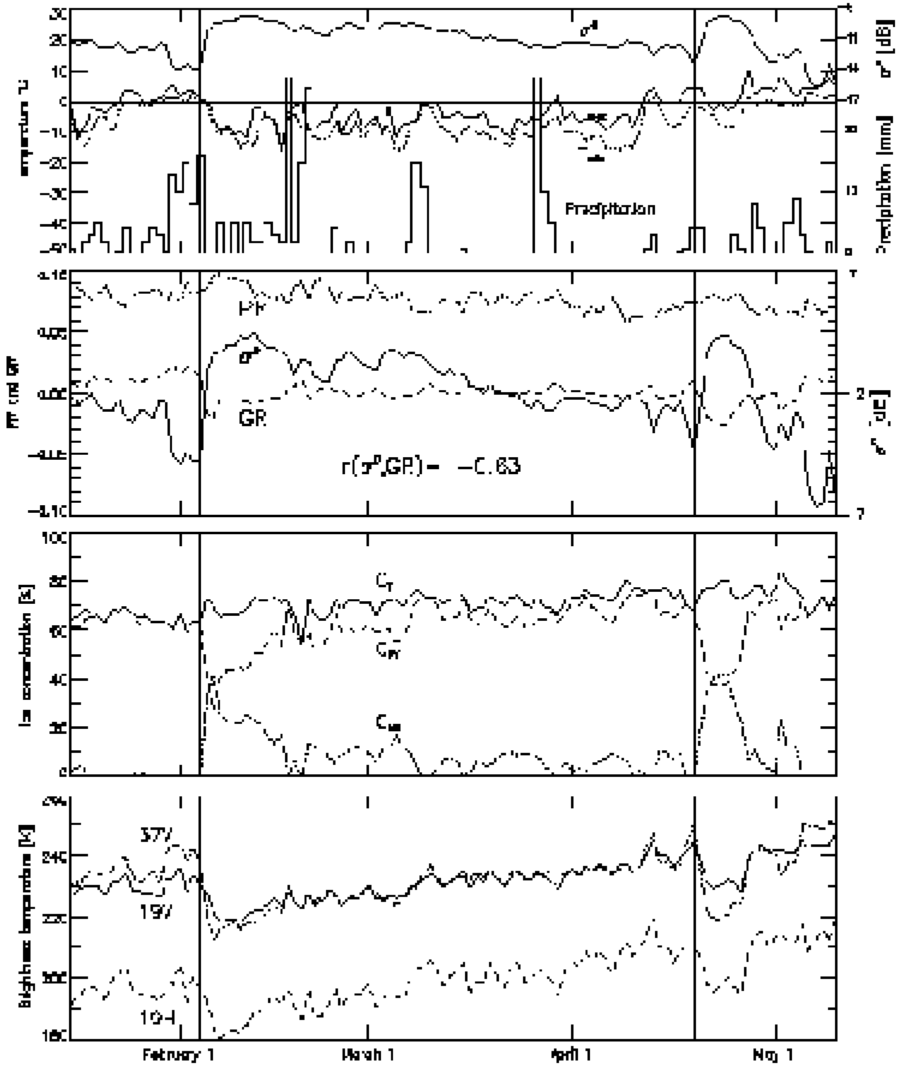
5.2: Voss et al. 2003: Ice types from SSM/I & QuikScat

- NTA: MY ice concentration increases in summer
- one contribution: transitional melting / wet precipitation



- results from test region 1 (Tasiilaq):

5.2: Voss et al. 2003 (cnt'd)



5.3 Snow depth and snow metamorphism

Josberger and Mognard, 1999, snow depth over land:

- define Temperature Gradient Index

$$TGI = \frac{1}{C}\int \frac{T_{ground} - T_{air}}{D(t)} dt$$

D(t) snow depth

- estimate *TGI* from

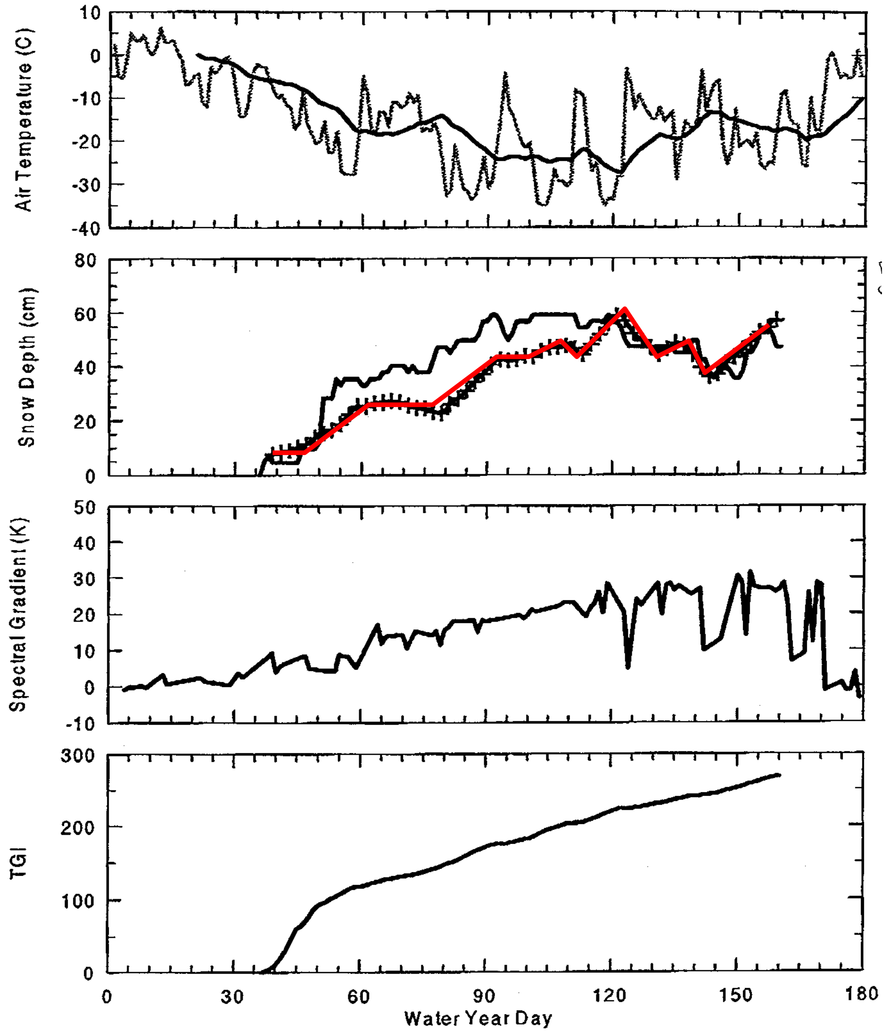
$$\Delta T_b = T_{b19H} - T_{b37H} = \alpha TGI + \beta$$

- invert for snow depth

$$D(t) = -\alpha T_{air} / \left[C \frac{d}{dt}(\Delta T_b) \right]$$

5.3 Snow depth and snow metamorphism (cont‘d)

- Results



- daily mininum
- 21 day average

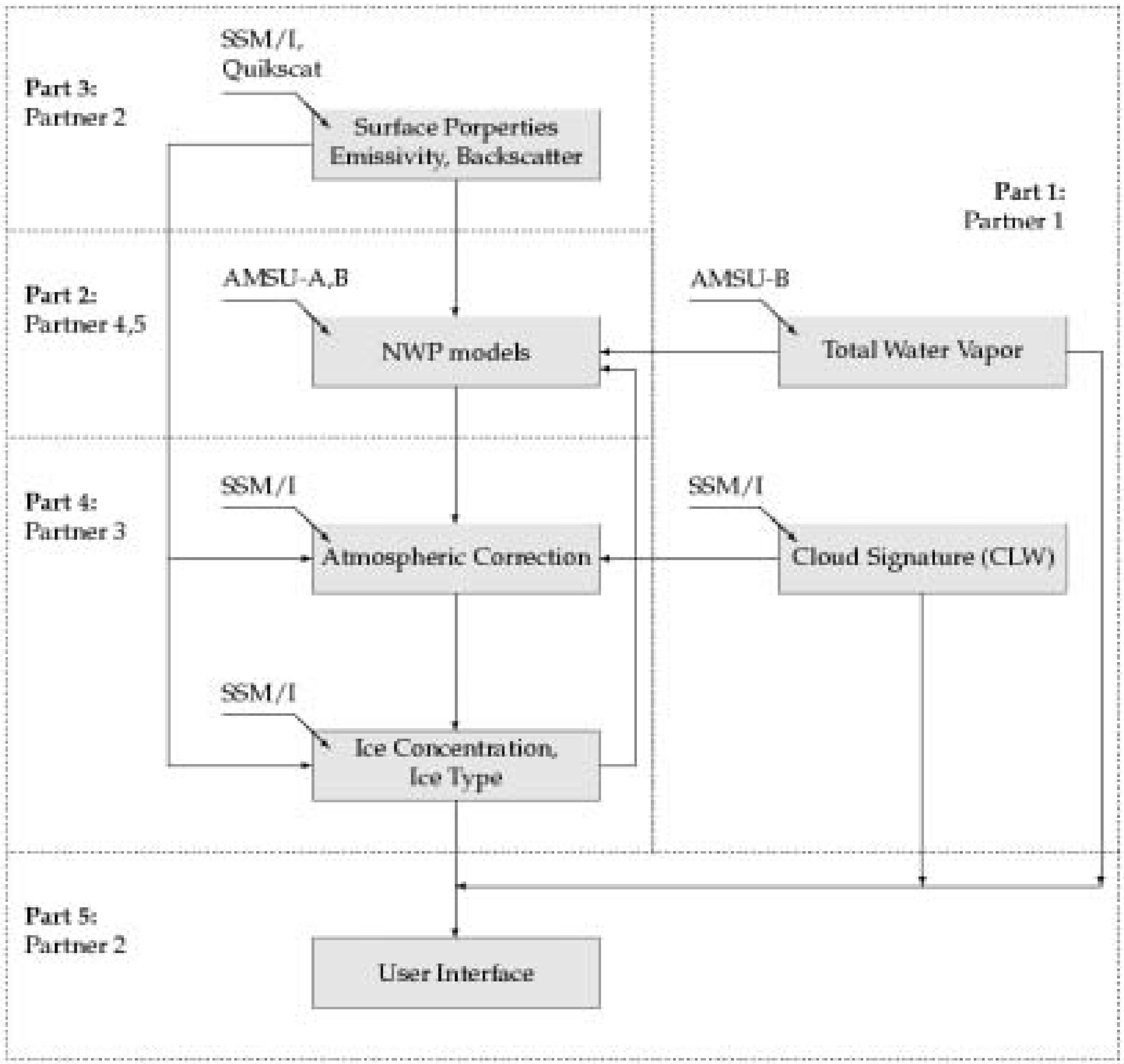
--: in situ

+: SSM/I

Anticipated IOMASA outcomes - Products

End

Project logic



Total Water Vapor procedure

Role of water vapor in climate system

1. Hydrological Cycle: Source of cloud and precipitation
2. Climate change: the major greenhouse gas
3. Redistribution of energy: source of heat after condensation, vertical and horizontal transport on various scales

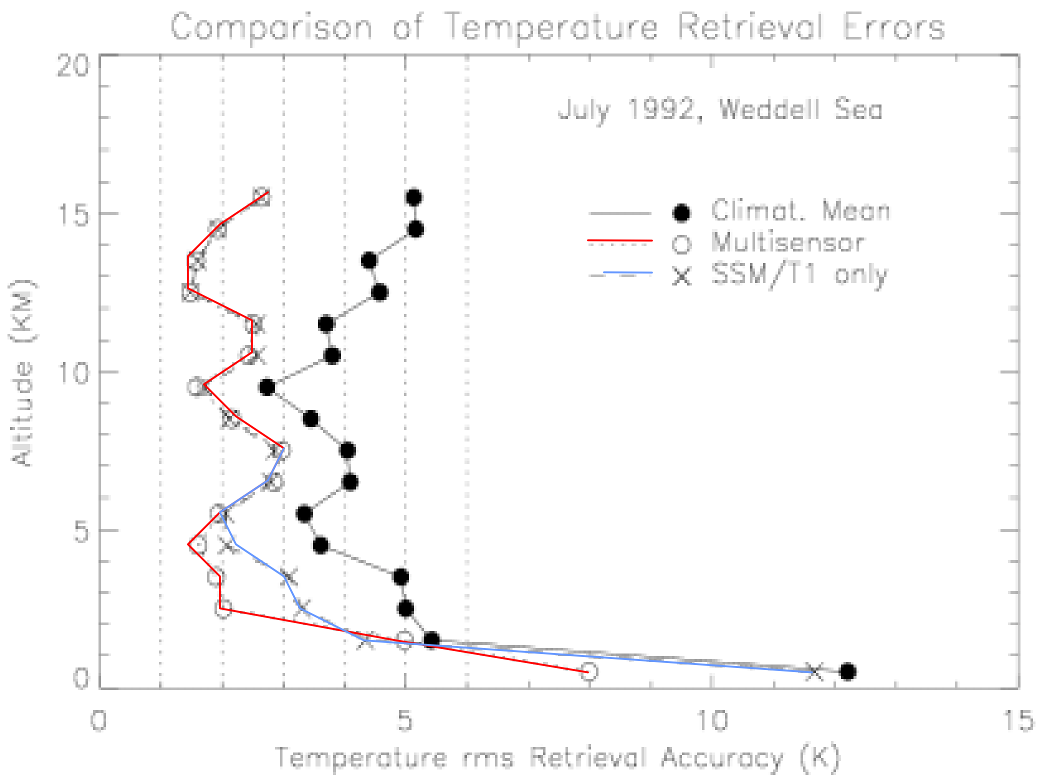
Problems for remote sensing in Polar Regions

1. surface ice high and variable microwave emissivity
2. Water vapor and cloud liquid water content low

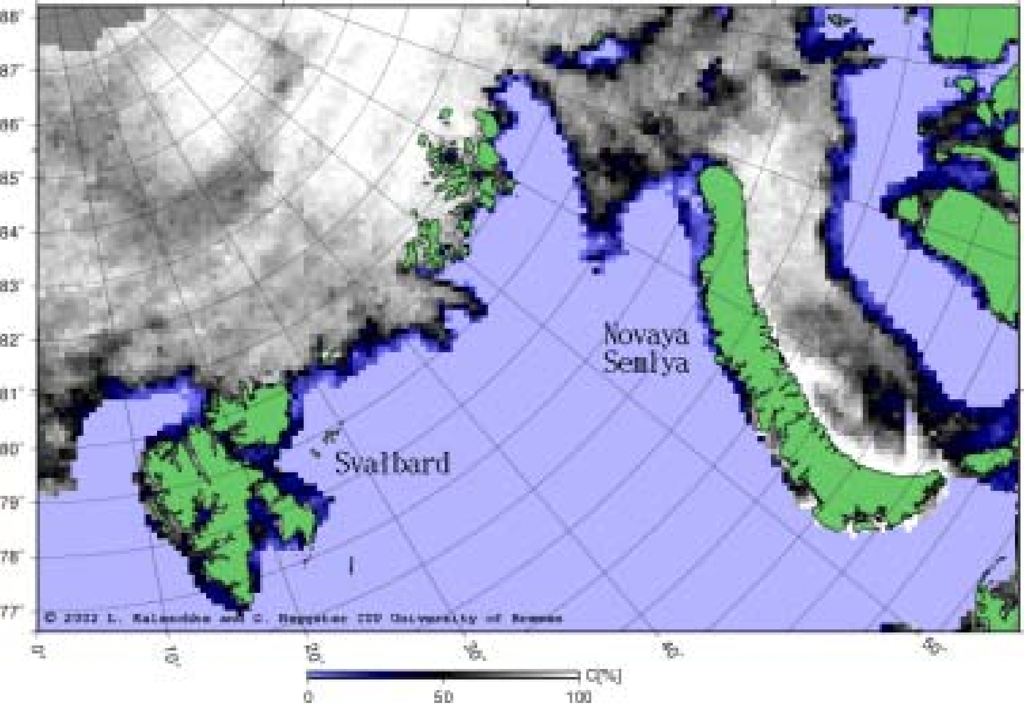
- uses humidity sounder SSM/T2 near 183 GHz, similar to AMSU-B

Temperature profiles over sea ice

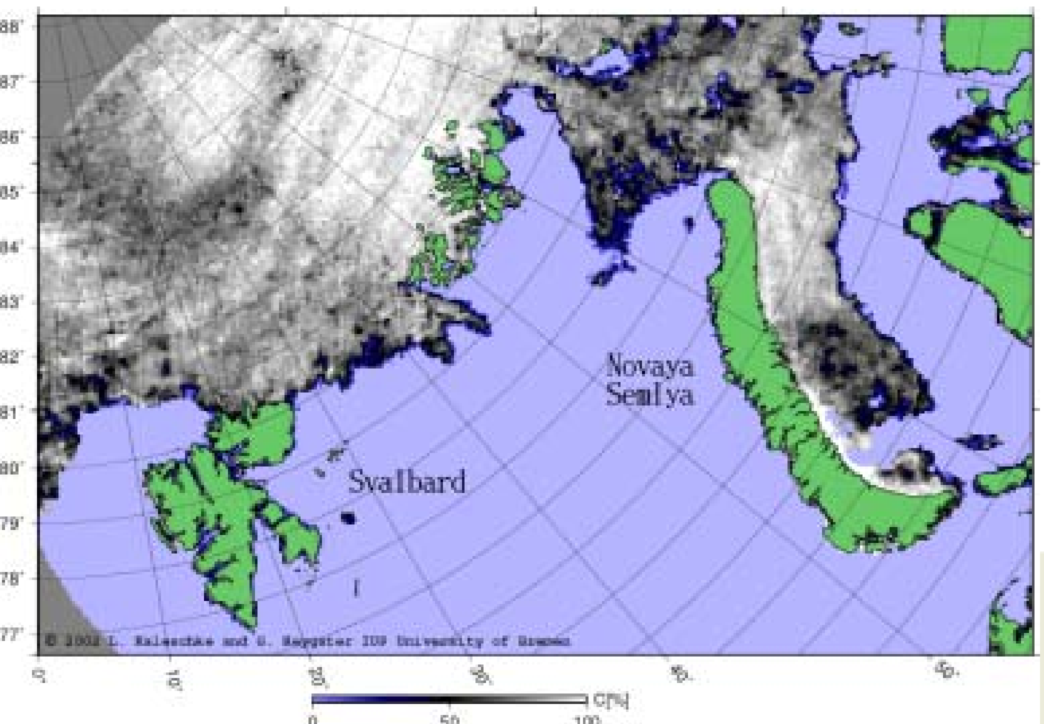
- from microwave temperature sounder SSM/T1, SSM/I (sea ice) and OLS (surface temp.)
- improved by knowledge about sea ice emissivity and concentration



AMSR-E Sea Ice



- SSM/I ASI



- AMSR ASI