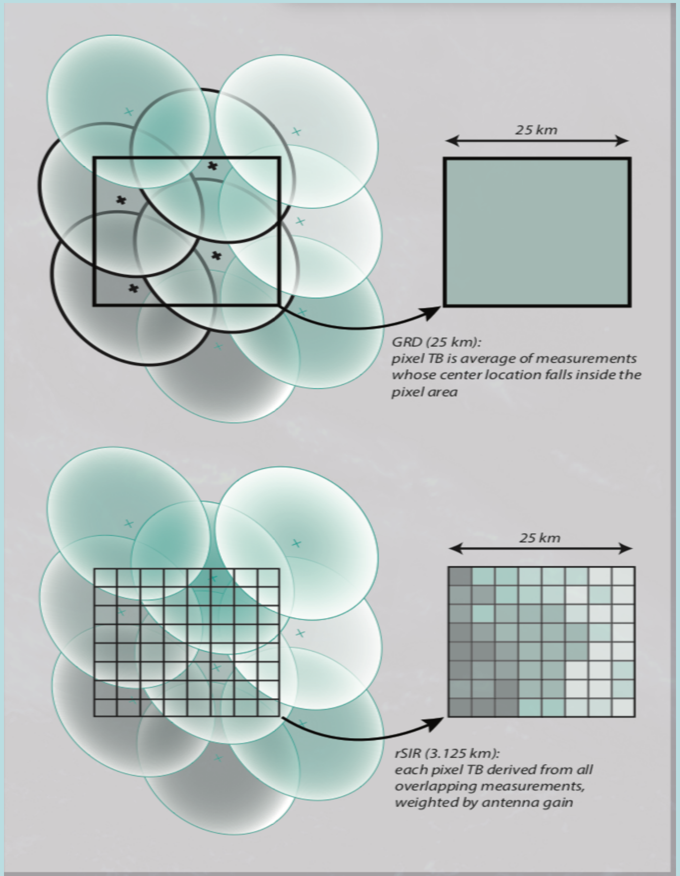
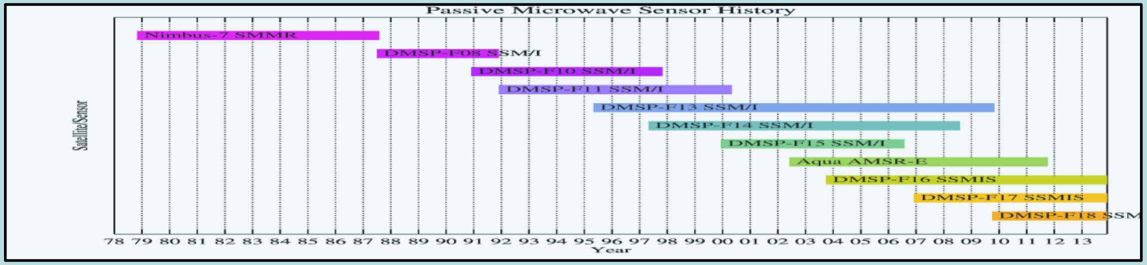
CETB: Calibrated Enhanced-Resolution Brightness Temperatures: NSIDC-0630



Gridding techniques (top) with the lowest noise factors take the average of all measurements whose locations fall inside the gridded pixel area, producing smooth but relatively coarse-resolution output. Compare to image reconstruction for resolution enhancement (bottom), which takes advantage of oversampled information in overlapping brightness temperature footprints to deduce higher-resolution gridded output.



We have produced an improved, enhanced-resolution, gridded passive microwave ESDR for monitoring cryospheric and hydrologic time series

Full record includes SMMR, all SSM/I-SSMIS and AMSR-E

Enhance gridded resolution to as much as ~3 km (channel-specific)

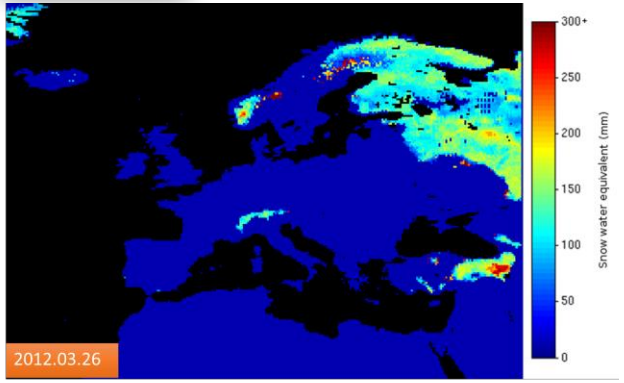
EASE-Grid 2.0

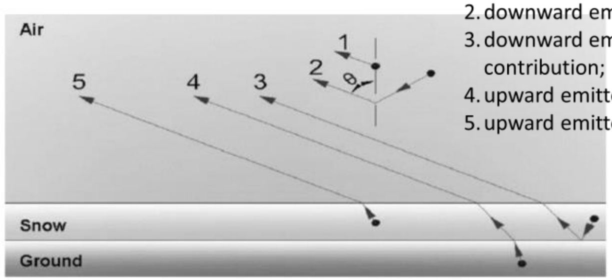
Molly (1)

Investigators:
M. J. Brodzik, NSIDC
D. G. Long, BYU

February 5, 2018

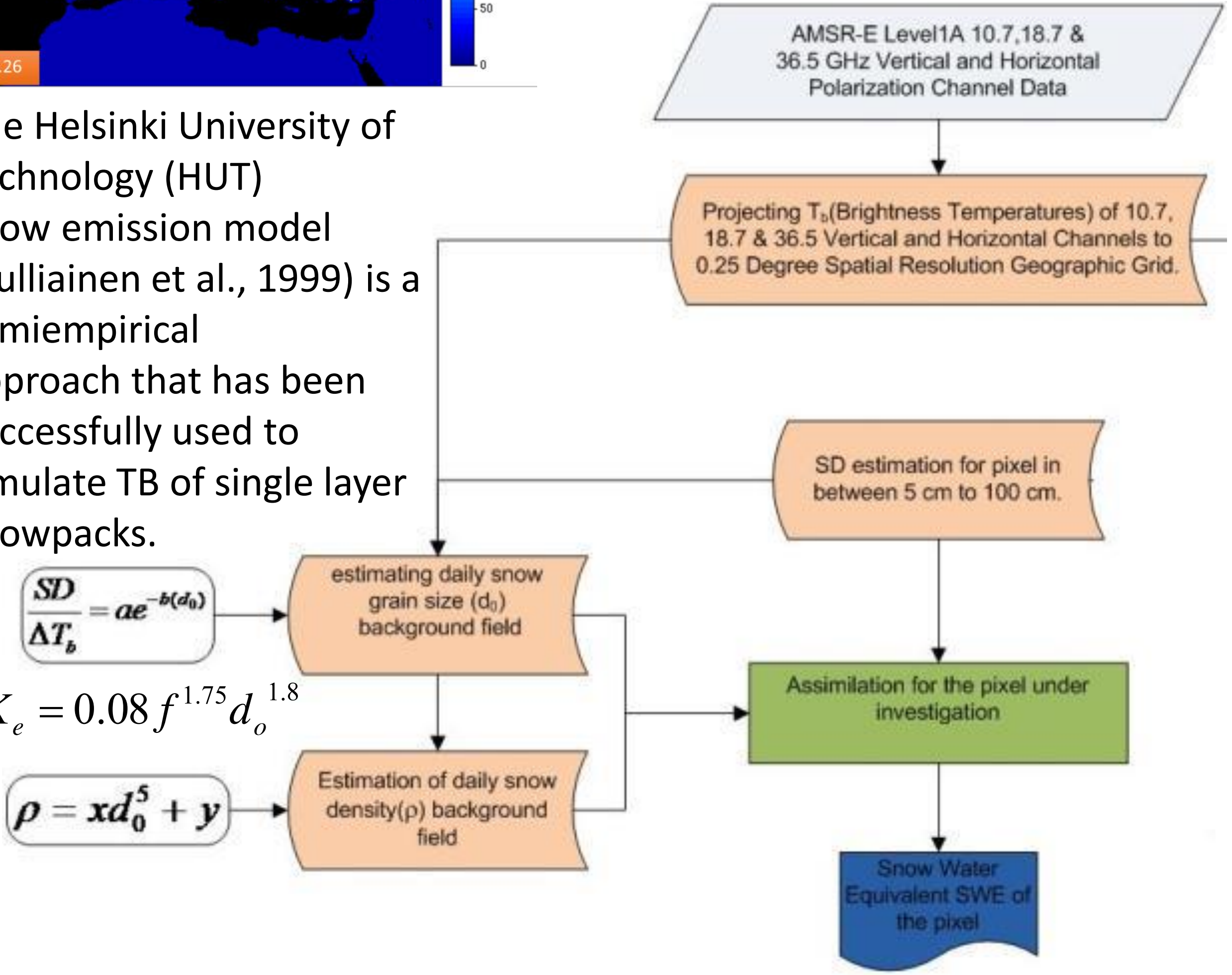
H13-SWE product retreived from SSMI/S since 2012....



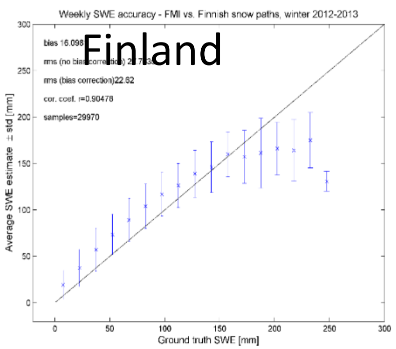


1. upward emitted atmospheric radiation;
2. downward emitted reflected atmospheric radiation;
3. downward emitted reflected snowpack emission contribution;
4. upward emitted soil emission contribution;
5. upward emitted snowpack emission contribution

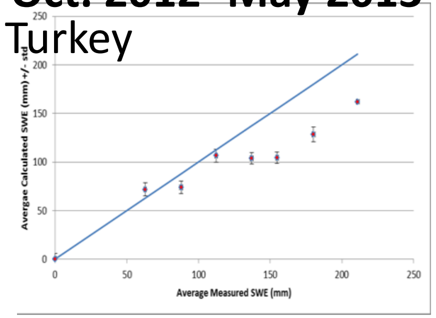
The Helsinki University of Technology (HUT) snow emission model (Pulliainen et al., 1999) is a semiempirical approach that has been successfully used to simulate TB of single layer snowpacks.

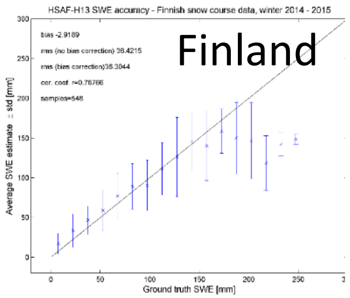


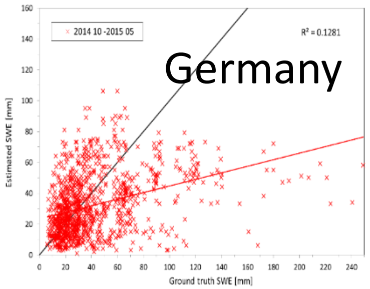
$$K_e = 0.08 f^{1.75} d_o^{1.8}$$



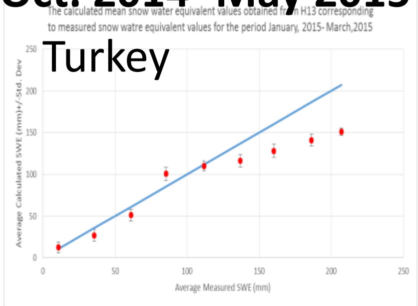
Oct. 2012- May 2013

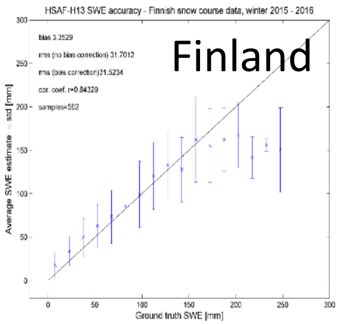


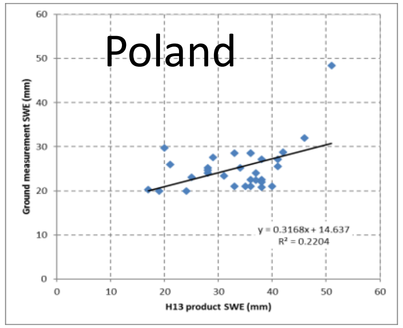




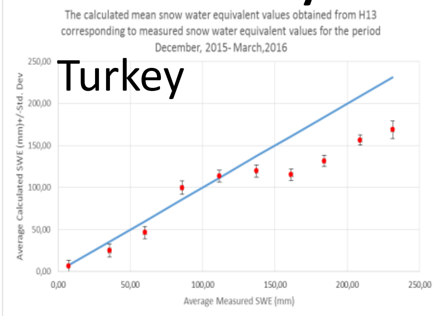
Oct. 2014- May 2015



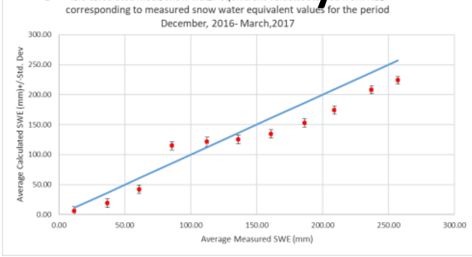




Oct. 2015- May 2016



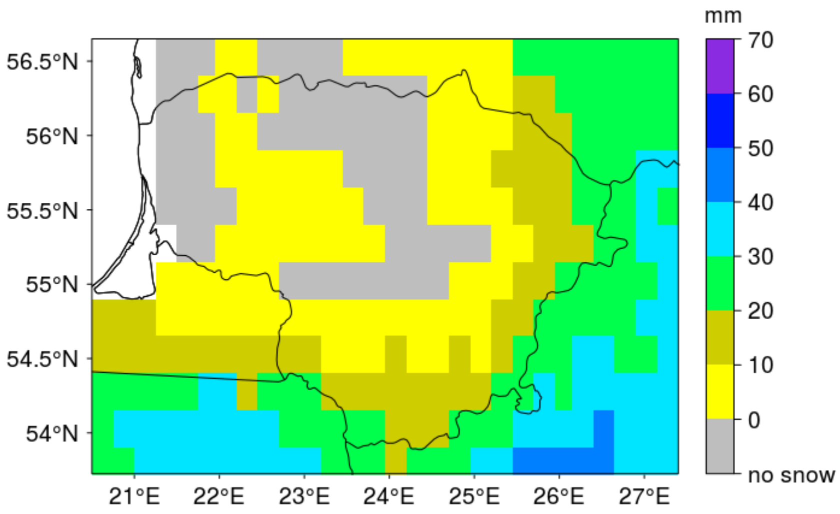
Oct. 2016- May 2017



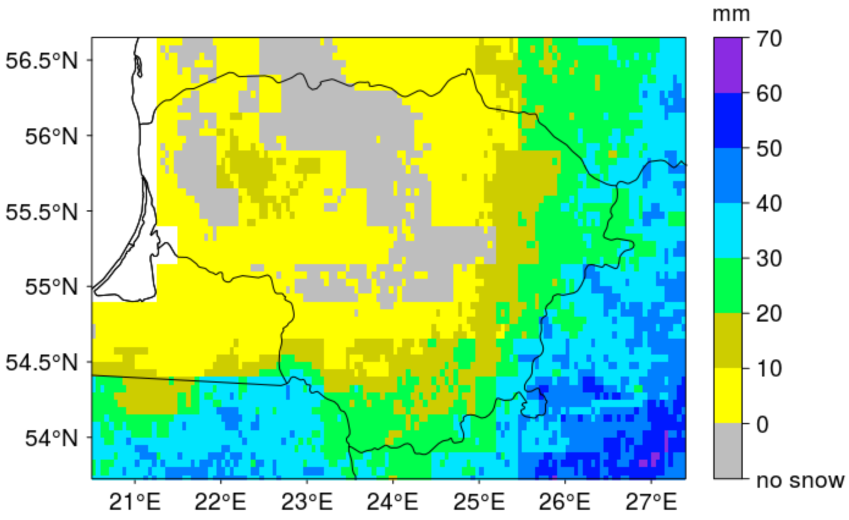
Product requirements				H13
area	threshold	target	optimal	total
flat	40mm	20mm	10mm	40 mm
mountain	45mm	25mm	15mm	45 mm

Zuhal Akyurek
zakyurek@metu.edu.tr
METU

SWE retrievals from AMSR-E microwave radiometer



HSAF SWE product, 0.25°x0.25°, 2017-02-10



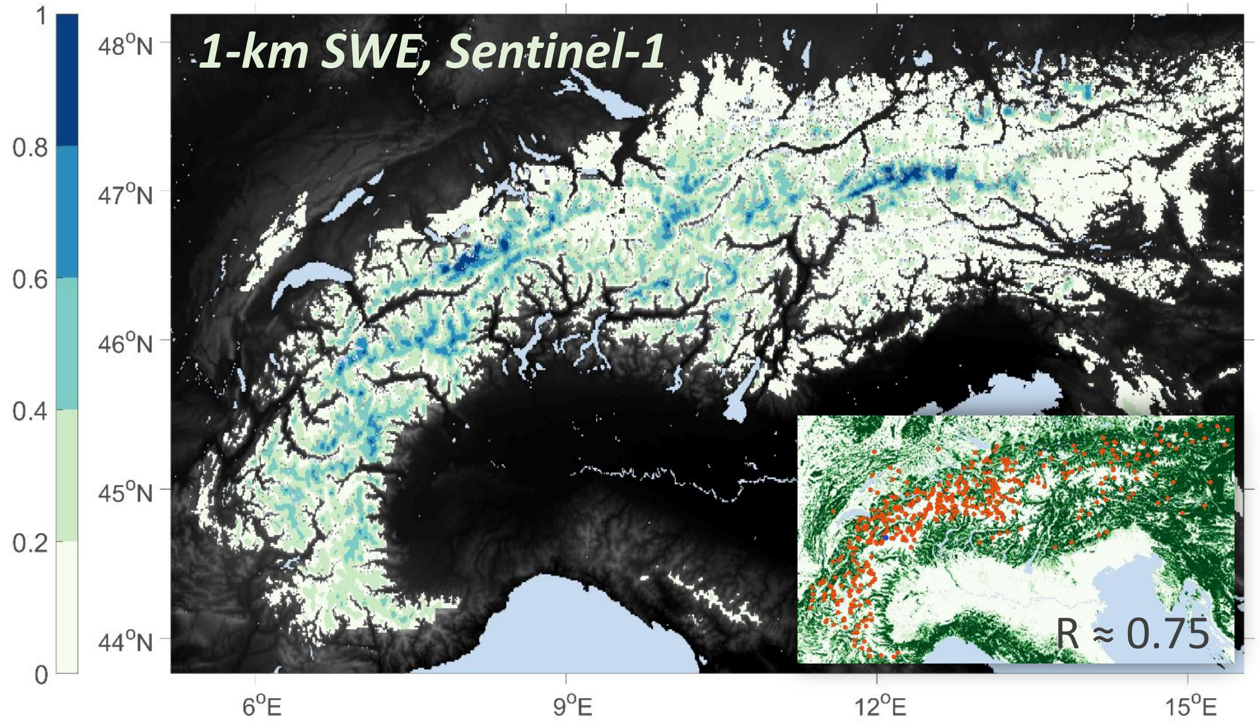
Downscaled SWE product using neural network, 0.05°x0.05°

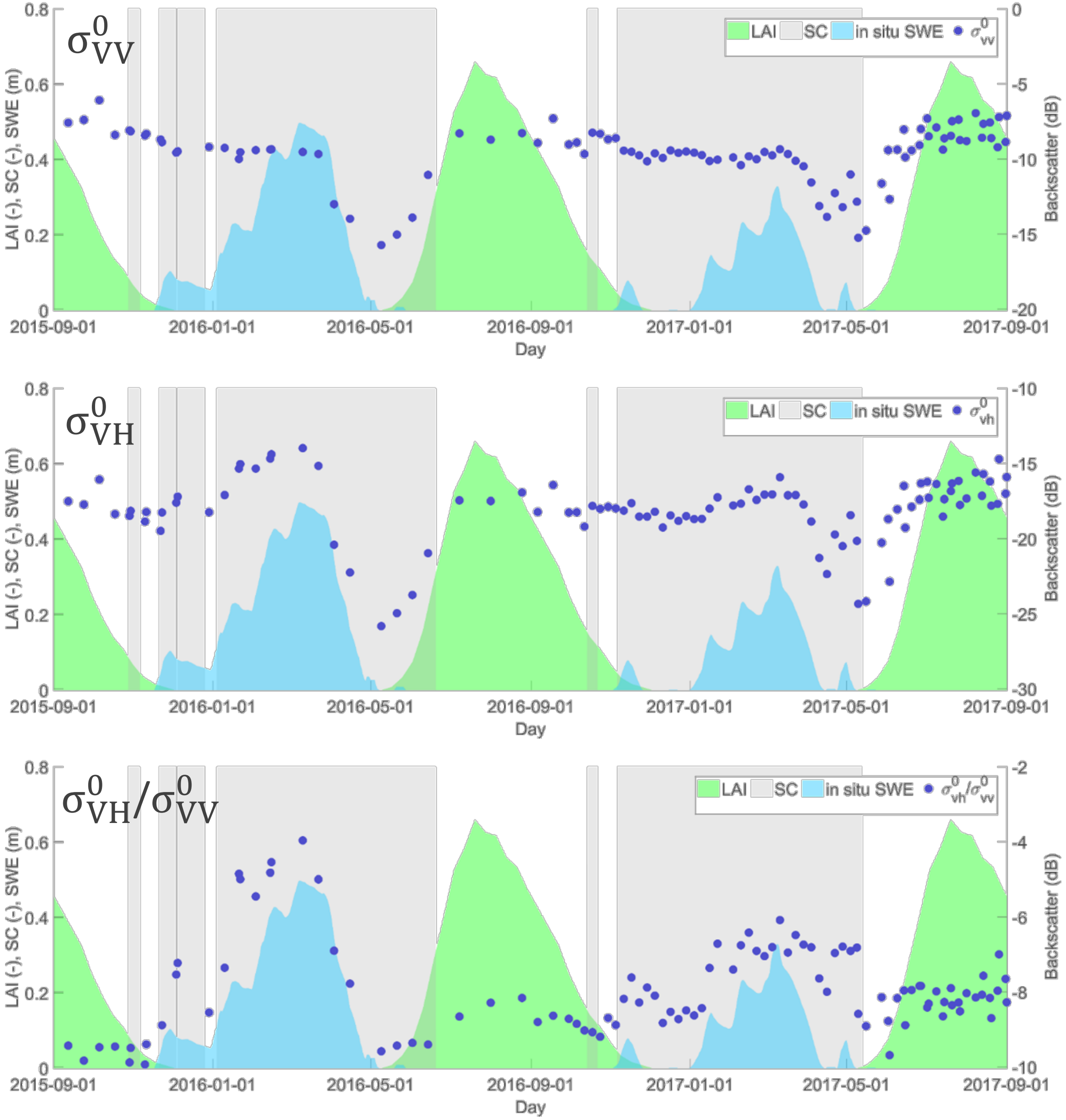
- I am familiar with HUT model.
- I want to know more about SMRT, DMRT, MEMLS models.
- Radiative transfer models vs artificial neural networks.

Justinas Kilpys, Vilnius University, Department of Hydrology and Climatology, e-mail: justinas.kilpys@gf.vu.lt

Snow Water Equivalent Remote Sensing

Hans Lievens, Ghent University





1. Support observed C-band sensitivity to SWE with SMRT
   - Impact of snow grain size, density, stratigraphy
   - Impact of vegetation
2. Compare SWE sensitivities btw active and passive RS, and btw frequencies (from C to Ka bands)
   - Couple SMRT with a Land Surface Model to forward predict and assimilate RS observations

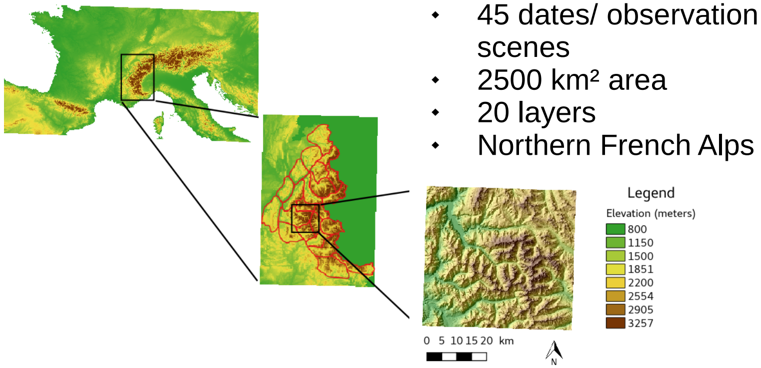
Contributions of SAR observations from Sentinel-1 to study snowpack physical properties in Alpine regions

CNRM UMR 3589

Veyssière Gaëlle, Météo-France Snow Research Center

PhD objective : Assimilation of Sentinel-1 SAR data over the french mountainous areas into the snowpack model Crocus

- Sentinel-1's C-band :
  - Relevant to study the wet snow evolution
  - Snow liquid water content : significant for the avalanche forecast
  - Continuity of Sentinel-1 observations ⇒ opportunity to consider operational assimilation
- To understand and to simulate the impact of snow properties on the microwave signal
- Evaluation of the microwave signal simulations against Sentinel-1's data
- To develop a relevant data assimilation method to assimilate Sentinel-1 data



- 45 dates/ observation scenes
- 2500 km² area
- 20 layers
- Northern French Alps

Remote sensing observations : backscatter signal σ_0

→ Not a direct measure of the snow properties

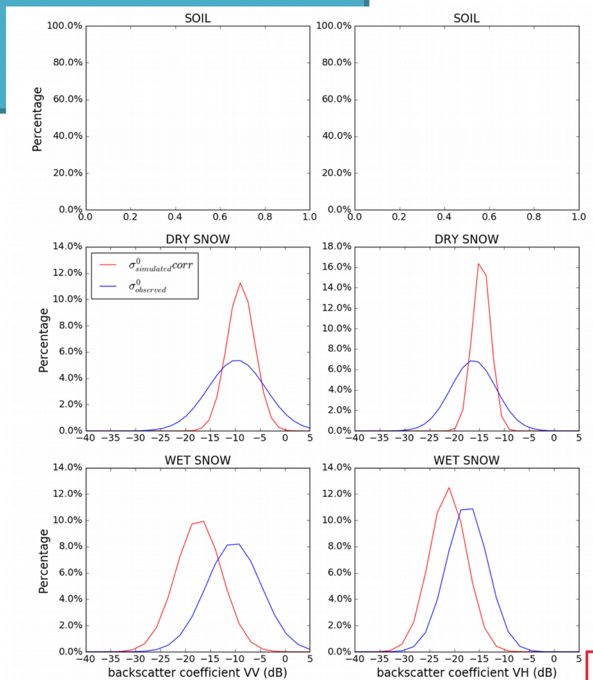
Model area (**layered snowpack/ ISBA-Crocus** Vionnet et al., 2012)

T, snowdepth, grain size, density, SWE, … → Model equivalent to observations ⟷ Observations

Sentinel-1's SAR observations

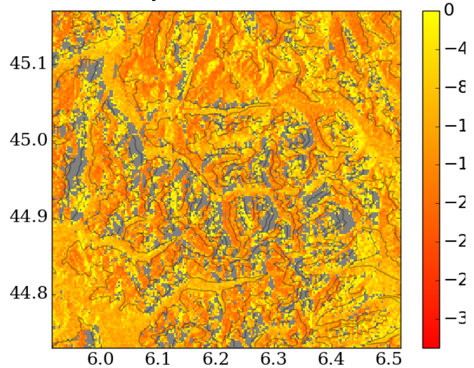
Radiative transfer model : **MEMLS**

(Wiesmann and Mätzler, 1999 ; Proksch et al., 2015)

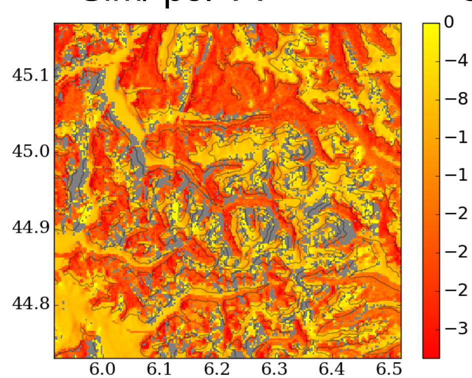


Some results...

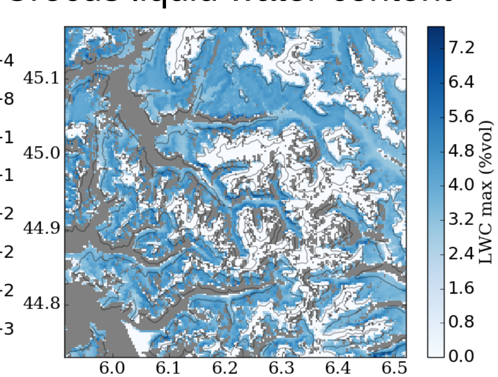
Obs/ pol VV



Sim/ pol VV



Crocus liquid water content



Scientific Question:

How the melt/refreeze cycles in snowpack should be treated in microwave modeling?

How microwave modeling should help:

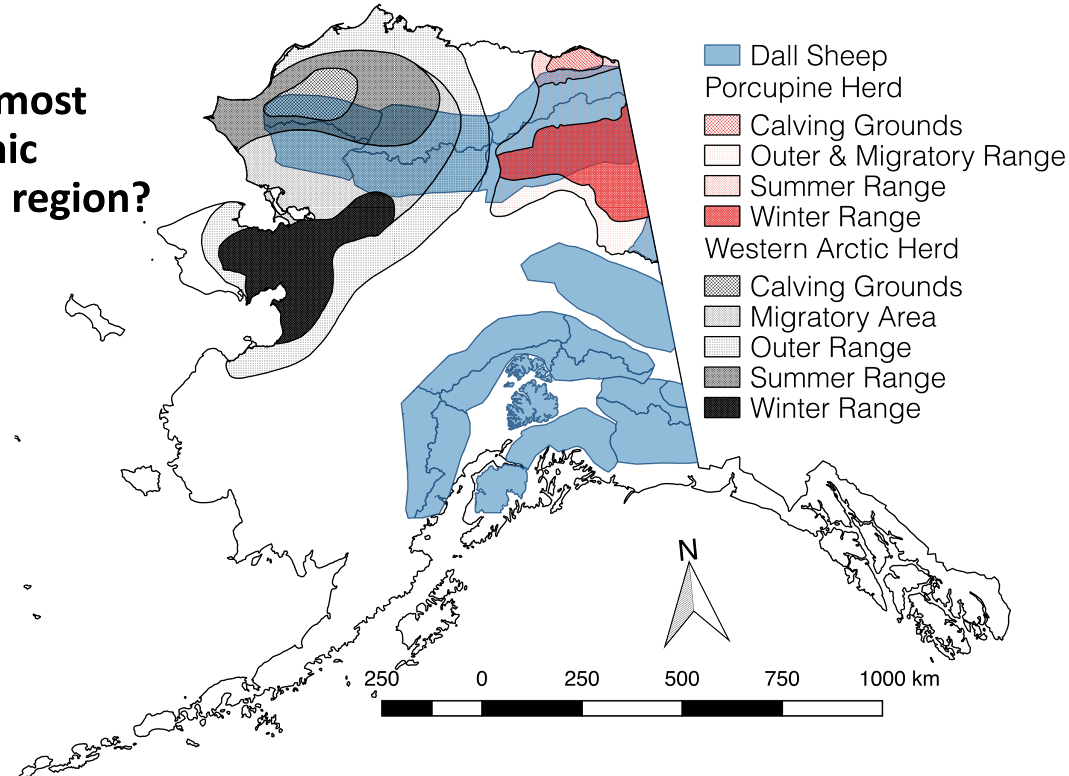
- Microwave modeling may have a component which should describe physical behavior of melt/refreeze cycles in snowpack under various conditions such as
  - amount of snowpack (depth of snowpack)
  - different type of ground (-soil type)
  - forested areas (are melt /freeze cycles same with or without forest)
  - etc.

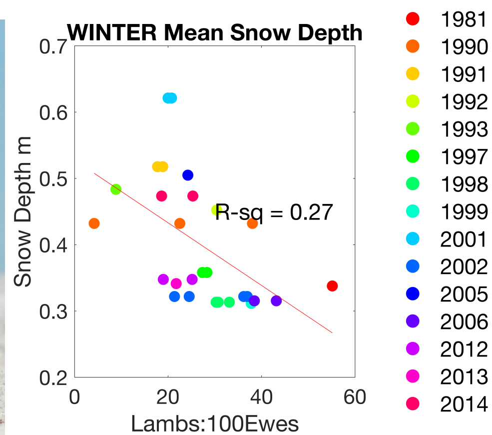
Mapping and Characterizing Arctic Boreal Wildlife-relevant Snow Conditions

Oregon State University

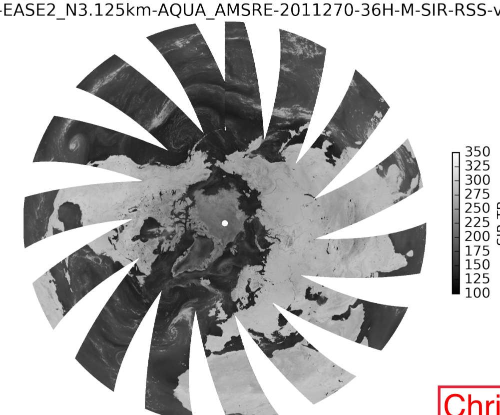
ABoVE ARCTIC - BOREAL VULNERABILITY EXPERIMENT

What combinations of snow metrics are most relevant to understanding success of iconic ungulate populations in the Arctic Boreal region?



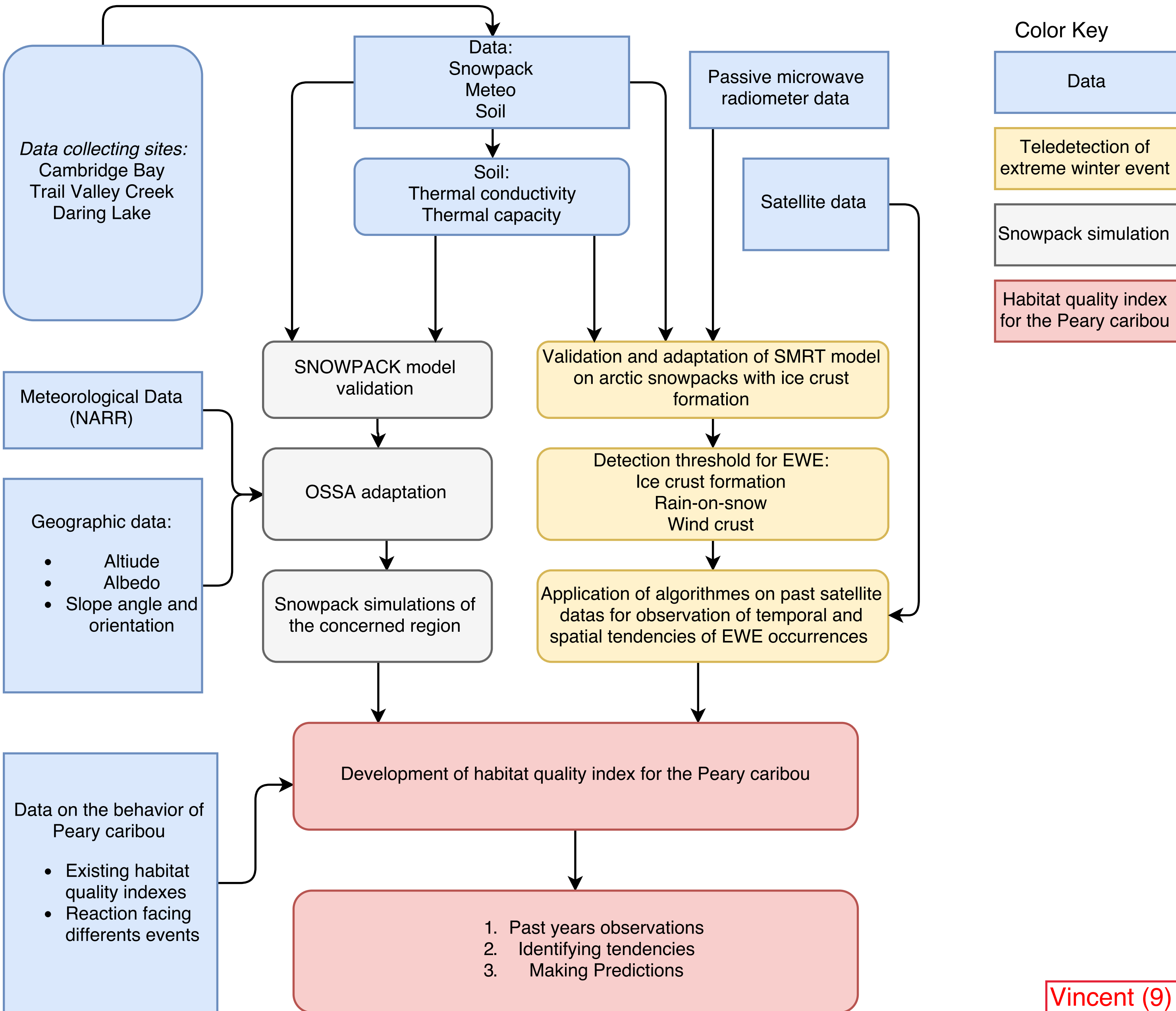


NSIDC-0630-EASE2_N3.125km-AQUA_AMSRE-2011270-36H-M-SIR-RSS-v1.0.nc



Chris (8)

http://nsidc.org/sites/nsidc.org/files/images/data/measures/0630/NSIDC-0630-EASE2_S3_125km-AQUA_AMSRE-2011270-36H-M-SIR_small.png. (2018).

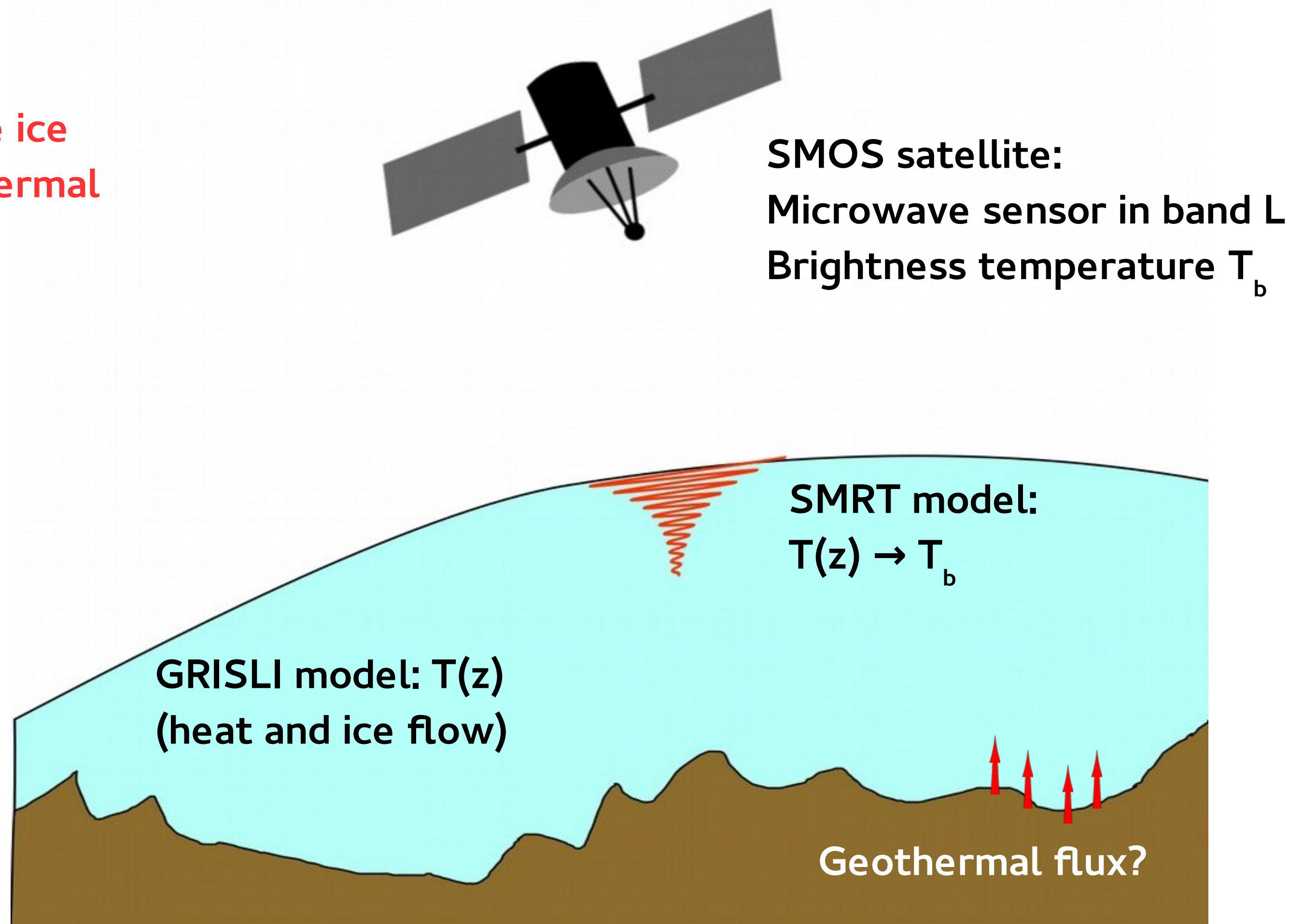

Color Key
Data
Teledetection of extreme winter event
Snowpack simulation
Habitat quality index for the Peary caribou
Data collecting sites: Cambridge Bay Trail Valley Creek Daring Lake
Data: Snowpack Meteo Soil
Passive microwave radiometer data
Soil: Thermal conductivity Thermal capacity
Satellite data
SNOWPACK model validation
Validation and adaptation of SMRT model on arctic snowpacks with ice crust formation
Meteorological Data (NARR)
OSSA adaptation
Detection threshold for EWE: Ice crust formation Rain-on-snow Wind crust
Geographic data: Altiude Albedo Slope angle and orientation
Snowpack simulations of the concerned region
Application of algorithmes on past satellite datas for observation of temporal and spatial tendencies of EWE occurrences
Development of habitat quality index for the Peary caribou
Data on the behavior of Peary caribou
Existing habitat quality indexes
Reaction facing differents events
1. Past years observations
2. Identifying tendencies
3. Making Predictions

Vincent (9)

What is the thermal structure of deep Antarctic ice?

Olivier Passalacqua[1], Ghislain Picard[1], Catherine Ritz[1], Marion Leduc-Leballeur[2]
1 Univ. Grenoble Alpes, CNRS, IRD, IGE, F-38000 Grenoble, France
2 IFAC-CNR, Florence, Italy

Goal: getting constraints on the ice column temperature and geothermal flux from observations of the brightness temperature



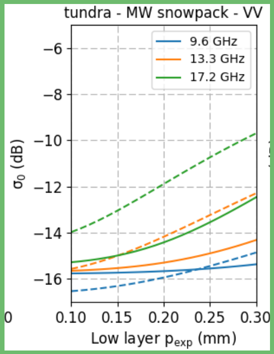
Marion Leduc-Leballeur
IFAC-CNR, Florence, Italia

Key scientific question
Retrieve snow properties from microwave observations
Microwave modeling helps for:

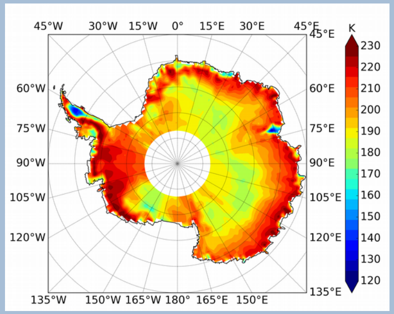
Theoretical analyses in tundra and taïga areas

- ✔ Sensitivity tests to snow grain size, snow density, SWE…
- ✔ Ku and Ka-band
- ✔ Active and Passive

- ✔ SnowConcepts and SCADAS ESA projects
  lead by J. Lemmetyinen, FMI, Finland



Interpretation of satellite observations in Antarctica



- ✔ Ice-sheet temperature, melting detection along the coast
- ✔ Passive radiometers
- ✔ SMOS, AMSR-E…

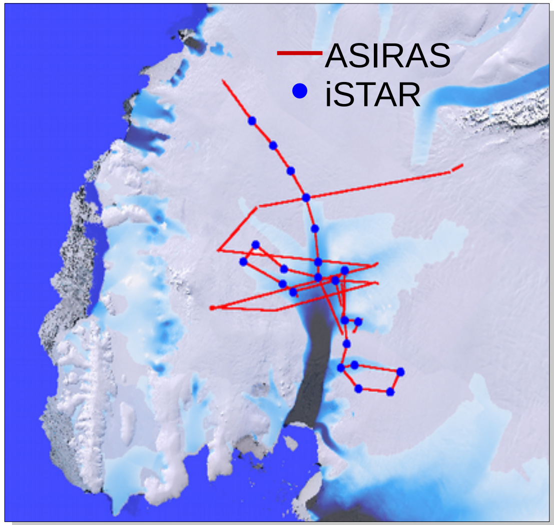
- ✔ CryoSMOS ESA project (leads by G. Macelloni, IFAC-CNR, Italia)
  + collaboration IGE, Grenoble, France

(16)

Stefan Kowalewski,
Veit Helm*, Olaf Eisen*, Liz Morris (SPRI)

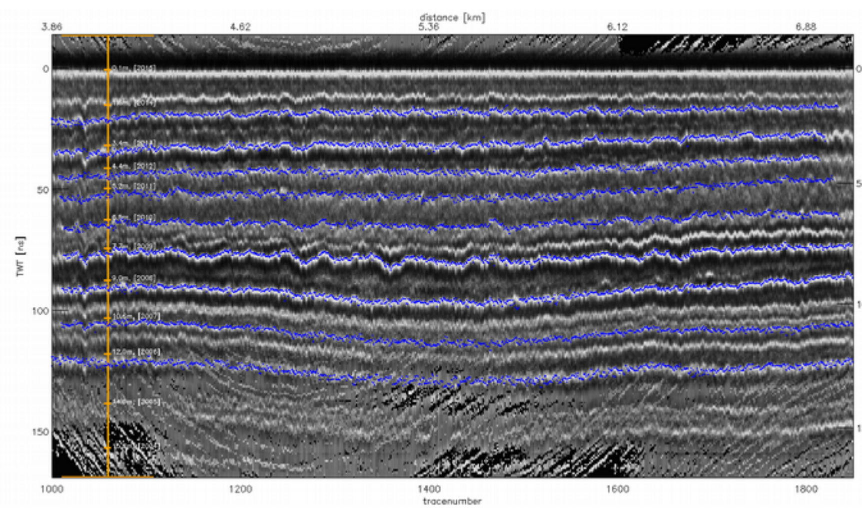
My project background:

- **ASIRAS (A**irborne SAR / **I**nterferometric **R**adar **A**ltimeter **S**ystem)
- operated during the iSTAR campaign (NERC/BAS) at Pine Island (PIG), West Antarctica
- resolving the internal stratigraphy of the upper 15-30 m firn column
  - ➢ calibrating ASIRAS soundings with iSTAR core measurements
  - ➢ studying the tempo-spatial variability of annual snow accumulation

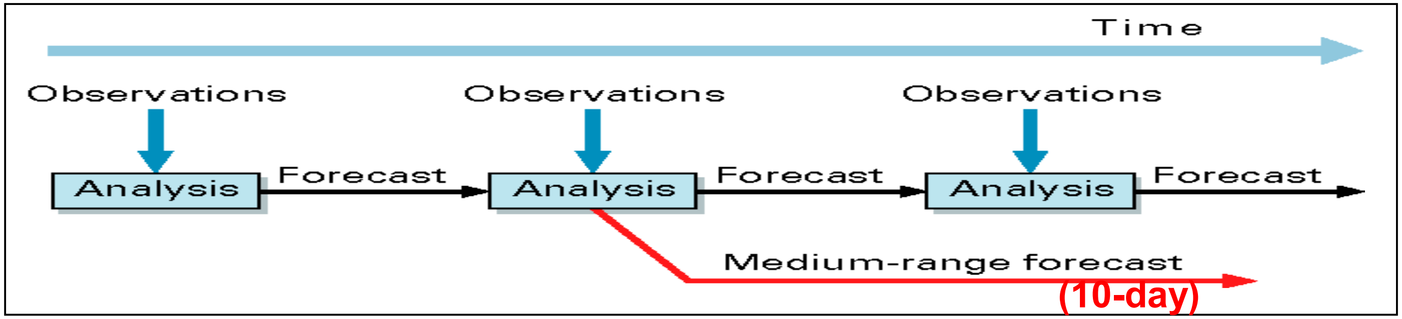


Ongoing challenges:

- **complex stratigraphy** at PIG (interseasonal layering)
- varying response between ASIRAS soundings and co-located iSTAR proxies (i.e. density modulation, photochemical tracers)
  - ➢ simply a statistical problem? (i.e. single point measurement vs. horizontally integrated radar soundings)
  - ➢ varying physical radar response function?
  - ➢ … or both?
    - ➔ potential contribution of modelling the radar return from iSTAR core profiles

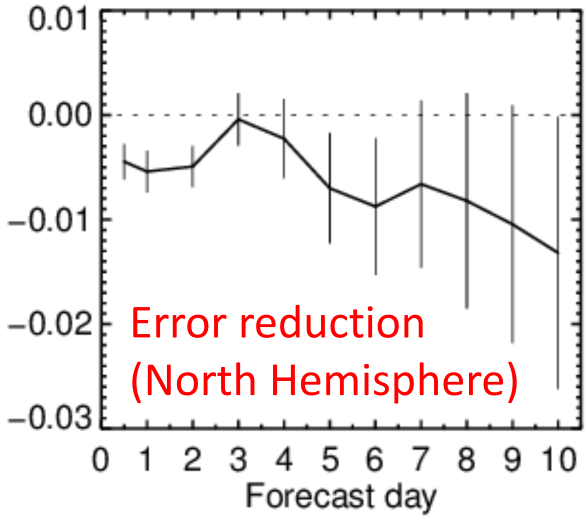


Snow Data Assimilation for Numerical Weather Prediction



- **Forecast Model:** GCM including the H-TESSEL land surface model (coupled)
- **Data Assimilation → initial conditions of the forecast model prognostic variables**
  - **4D-Var for atmosphere and Land Data Assimilation System (LDAS)**

IMS snow cover impact on near surface air temperature forecasts



Objective:

- Use of level 1 satellite data to analyse SWE and snow emissivity for the benefit of 4D-Var and LDAS
- Coupled 4D-Var and LDAS to enhance consistency between land and atmospheric initial conditions

Patricia (10)

…in charge of

- Maintenance of operational programs, and research on surface analysis for data assimilation.
- This includes Snow, Screen Level (T2m, Rh2m), Soil Moisture and Sea Surface Temperature analysis.

Why using SMRT ?

No satellite data presently used in snow analysis except for external data sources (IMS snow mask, afwa snow depth) which are used over data sparse regions in the northern hemisphere.

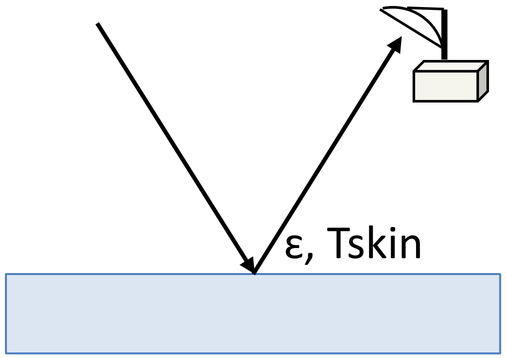
Use of microwave satellite data for snow analysis in future.

- Training required to gain expertise in microwave forwards modelling for use in snow analysis.
- Preparation of snow models to provide physical parameters required for radiative transfer modeling.
- Get overview about existing packages and practical use.

Snow and ice interfaces for NWP satellite atmospheric radiative transfer

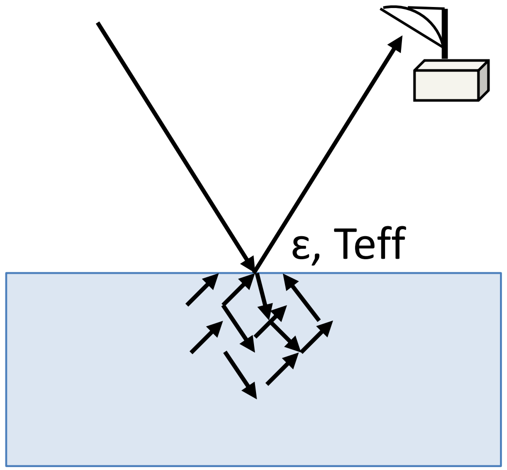
Alan Geer

Now: dynamic emissivity retrieval
- specular reflection assumption

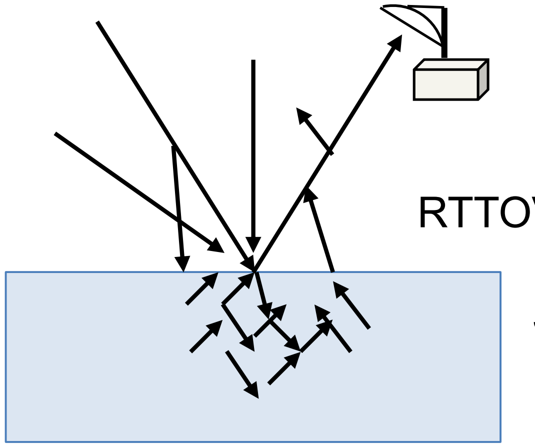


Stage 1: dynamic emissivity retrieval
- lambertian reflection assumption
- PC-constrained frequency dependence
- Inform / constrain with SMRT?

Stage 2: physically modelled simple interface
- Coupling through ε, Teff ?



Stage 3: coupled snow/ice and scattering atmosphere
- Coupling through BRDF?
- Simultaneous scattering solution (e.g. Simultaneous DISORT through atmosphere and snow/ice?)



Constraining the hydrological cycle at northern latitudes using soil moisture and snow observations

Name: Jostein Blyverket

PhD-student at the Norwegian Institute for Air Research and the University of Bergen.

Working on:
Land surface data assimilation at northern latitudes.

Goal for SMRT model use:
Constrain the hydrological cycle at northern latitudes using snow and soil moisture observations.

Norsk institutt for luftforskning
Norwegian Institute for Air Research

Approach:
- SURFEX land surface model, ISBA-DF (soil moisture) and 3-L snow scheme.
- Data assimilation (Ensemble Kalman Filter).
- Community Microwave Emission Model for soil moisture Tb and SMRT for snow properties.

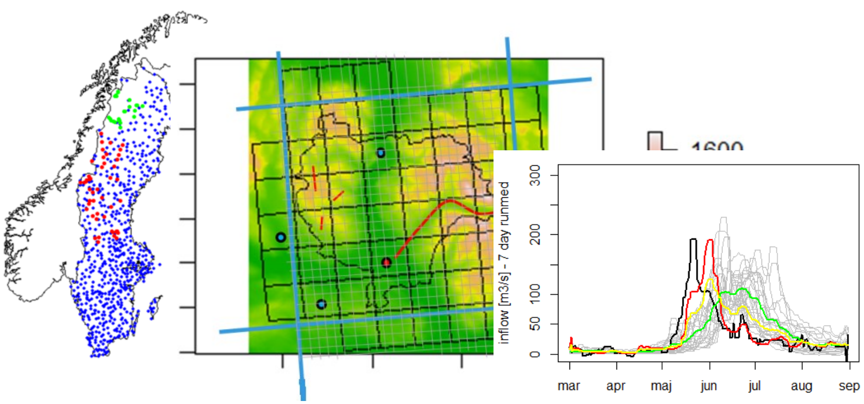
Near term goals:
- Learn about snow microwave modelling.
- Include SMRT for the winter season in the NILU land data assimilation system.

UNIVERSITAS BERGENSIS

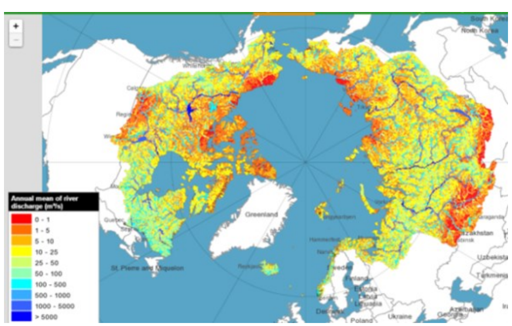
SMRT Training, Col du Lautaret, France, 8-11 Feb 2018
David Gustafsson, Swedish Meteorological and Hydrological Institute
E-mail: david.gustafsson@smhi.se

Snow models for all - with a little help of SMRT?

- Snow water equivalent => runoff volume for hydropower (hydrological models)
- Snow extent, depth and density => land surface heat exchange (nwp, climate models)
- Snow structure => snow conditions for reindeer grazing (dedicated snow models)
- Assimilation of in-situ and satellite based observations of snow, ice, runoff, frost



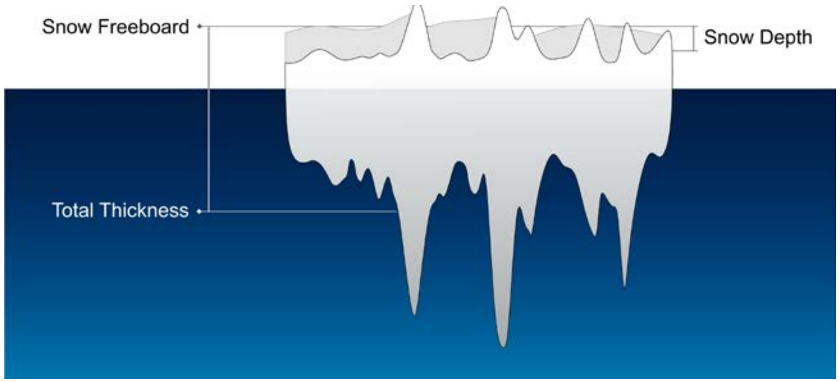
Sweden – hydropower, nwp, reindeers

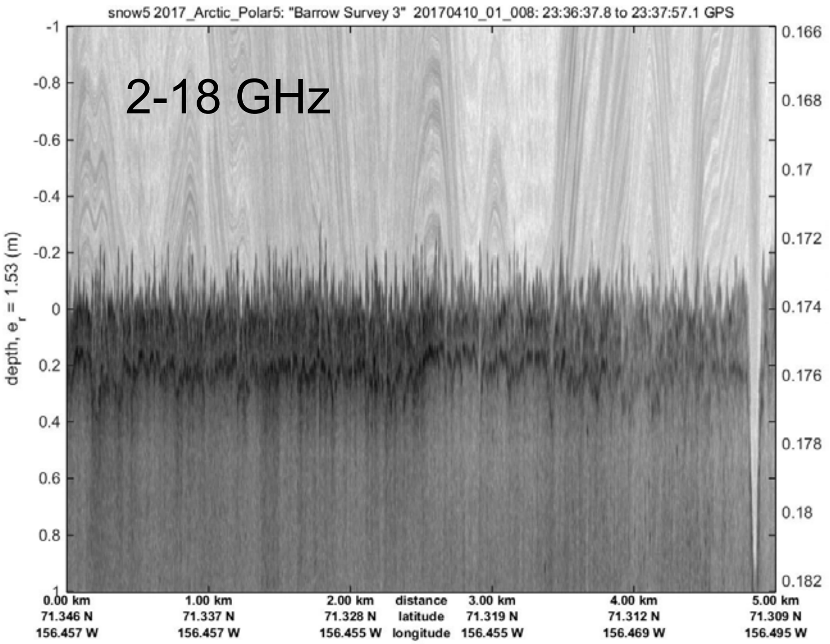


Arctic – climate impacts, hydrological regimes, permafrost, flow to ocean

Lightning talk | Arttu Jutila

- Newcomer PhD student at AWI Sea Ice Physics
  - Preliminary overarching topic: *“Microwave radar remote sensing of snow on sea ice”*
- I’m here to find out if/how the SMRT model could help me to understand snow-microwave interactions in active microwave radar signals
- One of the ultimate goals is to derive snow depth

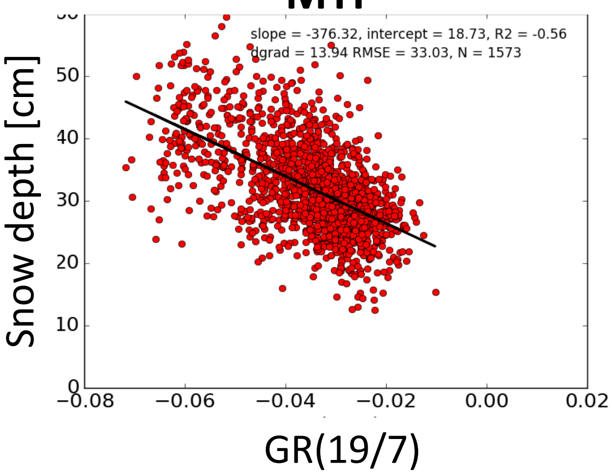




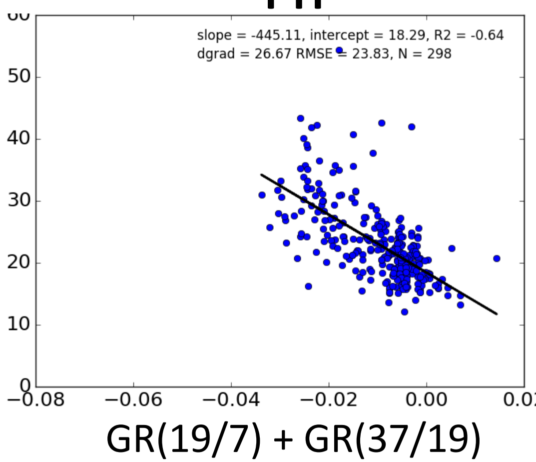
"Snow Depth on Arctic Sea ice from Passive Microwave Radiometers"

- Satellite brightness temperatures vs OIB snow depth

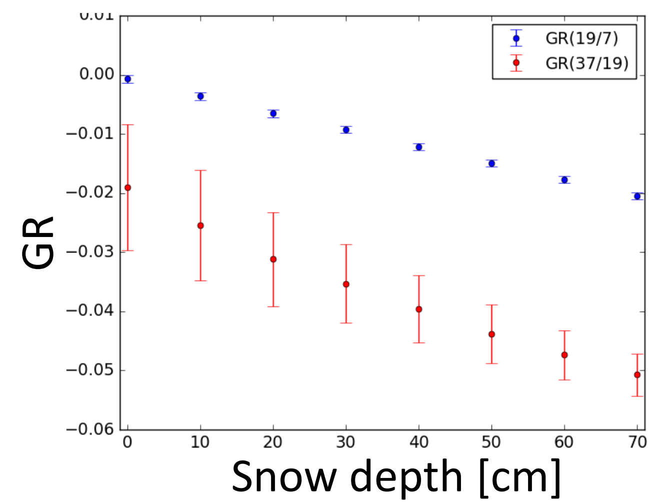
MYI



FYI



- Monte-carlo simulation over MYI using MEMLS-seaice
- Model underestimates influence of the MYI



- New study: use detailed in-situ snow and ice observations (N-ICE2015)

→ How can the detailed measurements be used to improve the snow depth retrieval?

FLUXES ARCTIC AMPLIFICATION (AC)³ CLOUDS SURFACE TRANSPORT

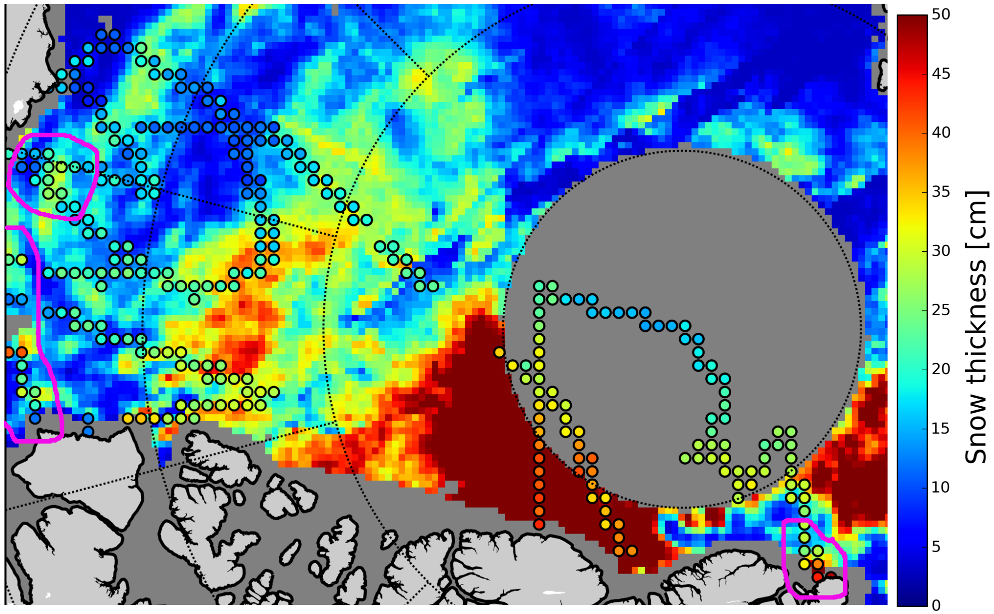
Philip Rostosky, University of Bremen, Germany, prostosky@iup.physik.uni-bremen.de

TRANSREGIO TR 172 | LEIPZIG | BREMEN | KÖLN UNIVERSITÄT LEIPZIG Universität Bremen University of Cologne TROPOS AWI

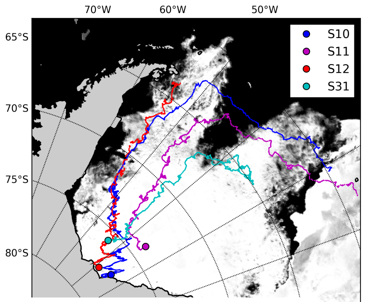
Nina Maaß - *Sea ice remote sensing* group at Institute of Oceanography (University of Hamburg)

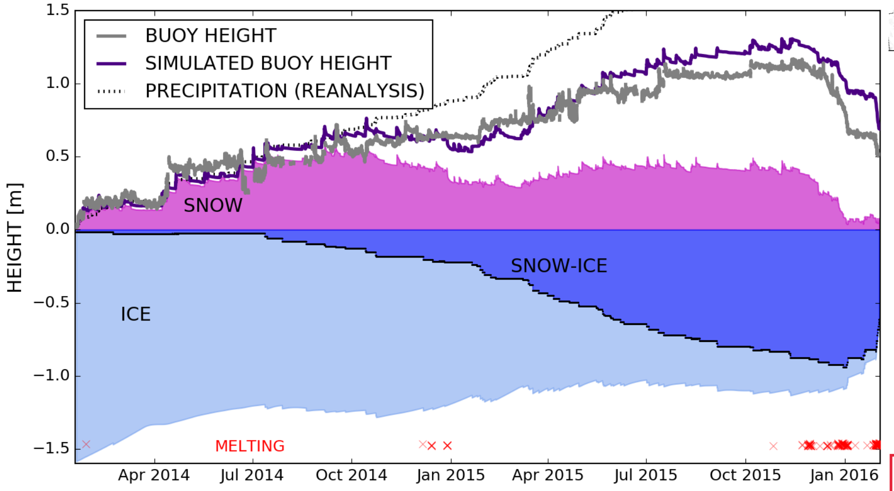
- **What?** Satellite retrieval of ice and **snow thickness** using **SMOS L-band** (1.4GHz) brightness temperatures at horizontal & vertical polarization
- **How?** Radiative transfer model for air – snow (1 layer) – ice (several layers) – water. Scattering neglected for L-band.
  Input: Snow and ice layer thicknesses, temperatures T & permittivities ε (depends on brine volume fraction (calculated from T & salinity S) for ice / density & T for snow); water T & ε (depends on T & S)

Arctic: SMOS map & Icebridge airborne d_snow



Antarctic: TB simulation from SNOWPACK output & in-situ buoy





Ice thickness retrieval and sensitivity analysis

Generate vertical salinity profile

input parameter
($S(z)$, T, ρ, d_i....)

existing multilayer model at 1.4 GHz

- Sensitivity analysis

→ retrieve d in multilayer model

model across broader frequency spectrum

0.5GHz ice thickness & salinity	1.4 GHz snow & thin ice thickness	4GHz ice con-centration, ice & sea surface Temp.

- Expand applied frequency spectrum for permittivity and emissivity
- Sensitivity analysis

→ Simultaneous retrieval of key parameters

evaluation against field measurements

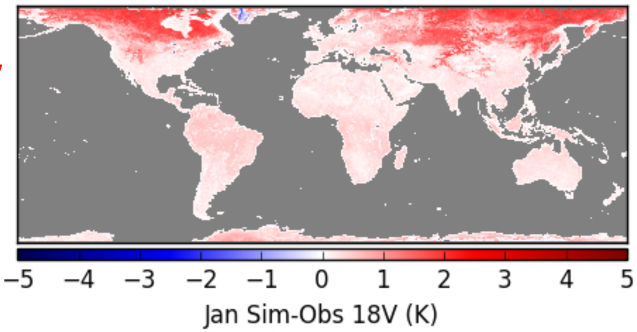
SMRT in support of precip retrievals?

Ludo Brucker

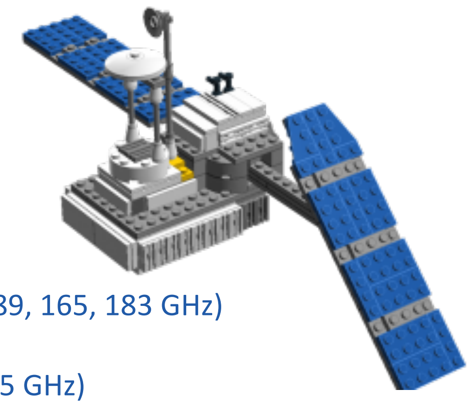
Context & Objective

- To improve satellite retrievals of precipitation (rain- & snowfall)
- Land cover information is required by the algorithm
- To offer details on background emission and backscattering
- Can we do better by considering simultaneous observations of TB and σ°?

Issues over snow

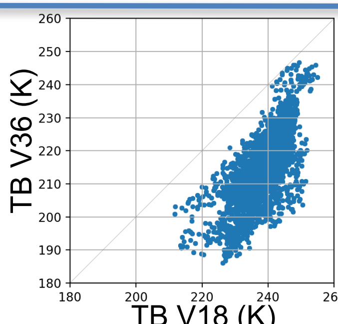


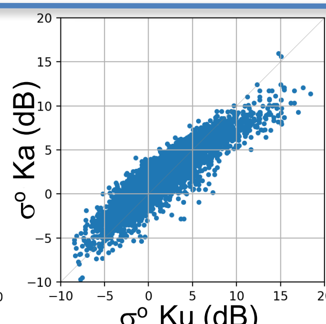
Global Precipitation Measurement (GPM)

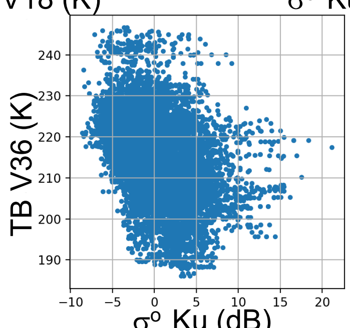


- Since spring 2014
- Microwave Radiometers
  (10, 18, 23, 36, 89, 165, 183 GHz)
- Dual Frequency Radars
  (Ku & Ka, 13.6 & 35.5 GHz)
- Non-Sun-synchronous orbit

Observations







Collocated TB and σ°
from one swath
in March 2017
over NH snow-covered land.

How SMRT could be used right away?

- If we know the TB at several frequencies, do we know σ°?
- Identify realistic ensembles of {TB, σ°} with Monte Carlo simulations
- Help us define better snow classifications designed for the precipitation retrievals