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Preliminary results from a modeling trail combining SNOWPACK and HIGHTSI models

(This is a ongoing study and results have not been published)

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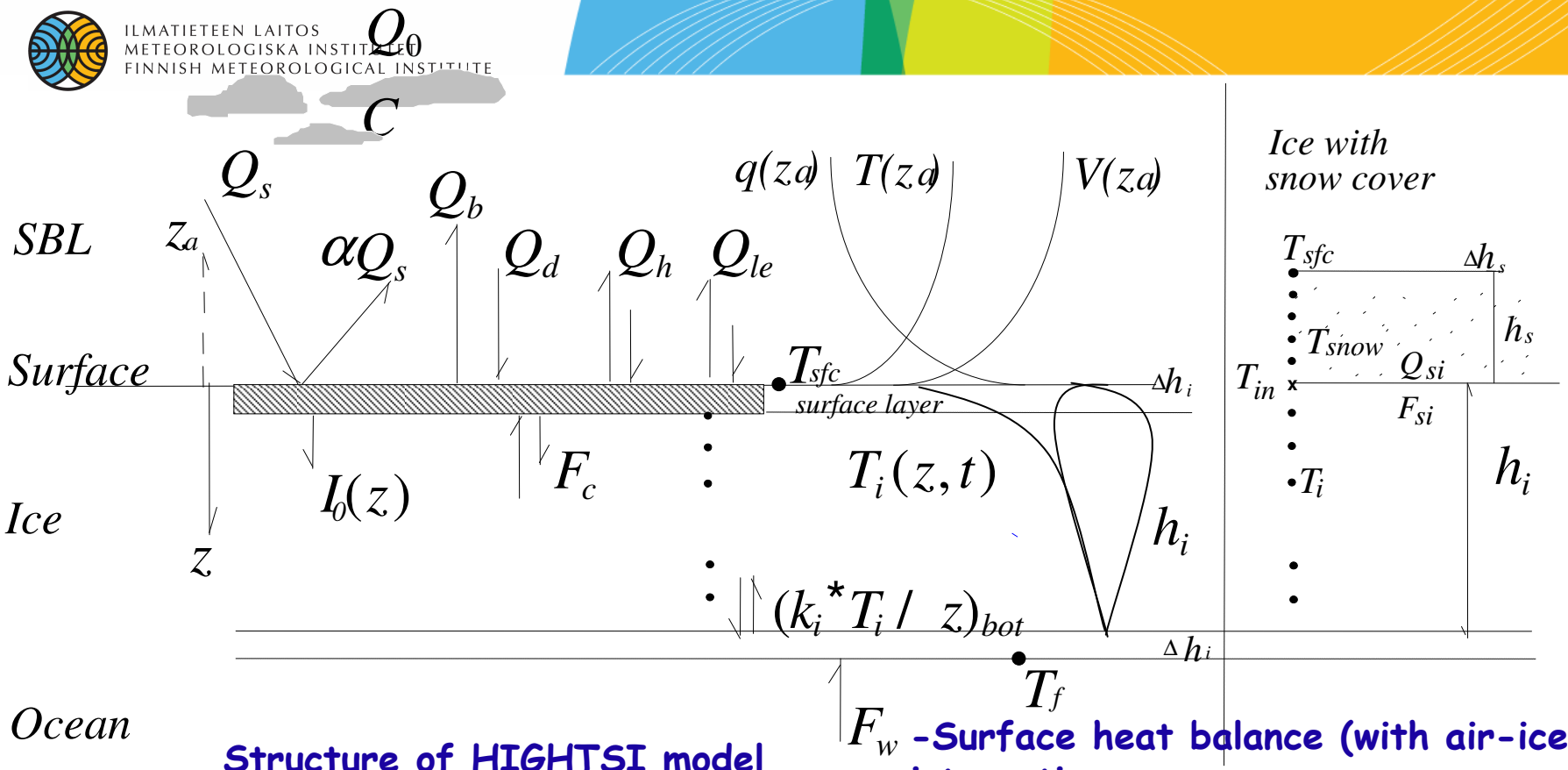
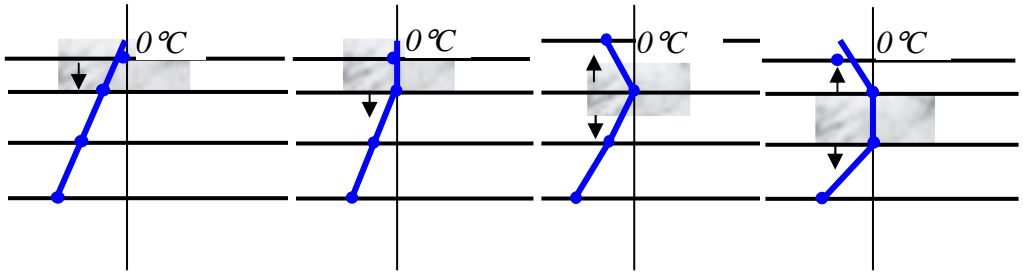
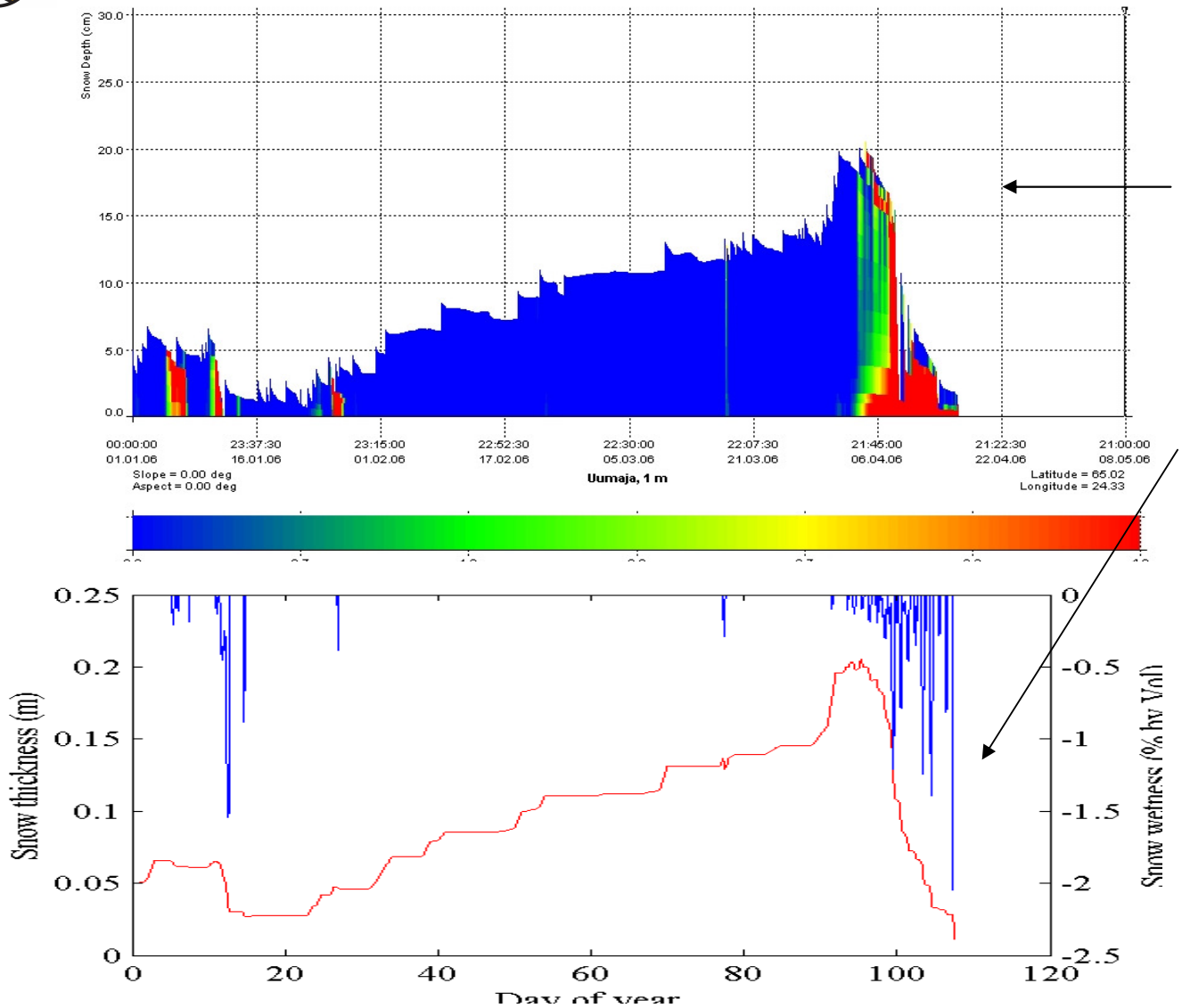
- Motivation: Intercomparsion of modeled snow water content(SWC) from diffetent models (hybrid model run); SWC responses to remote sensing radar signal and very critical for SAR applications The major snow parameters of interest from the point of sea ice SAR mapping: snow wetness, snow water equivalent and snow grain size.
- HIGHTSI : 1-D high-resolution thermodynamic snow/sea ice model developed at FIMR; Forcing: (ECMWF/HIRLAM; in situ measurement). The HIGHTSI is used for snow and sea ice processes studies; it is in operational use in Finnish Ice Service; it is combined with remote sensing applications
- SNOWPACK: *The operational model of the Swiss avalanche warning service; detailed snow processes model; better* performance with prescribed snow thickness; Forcing: ECMWF(provide weather condition), HIGHTSI (provide boundary heat fluxes and snow thickness)



Structure of HIGHTSI model



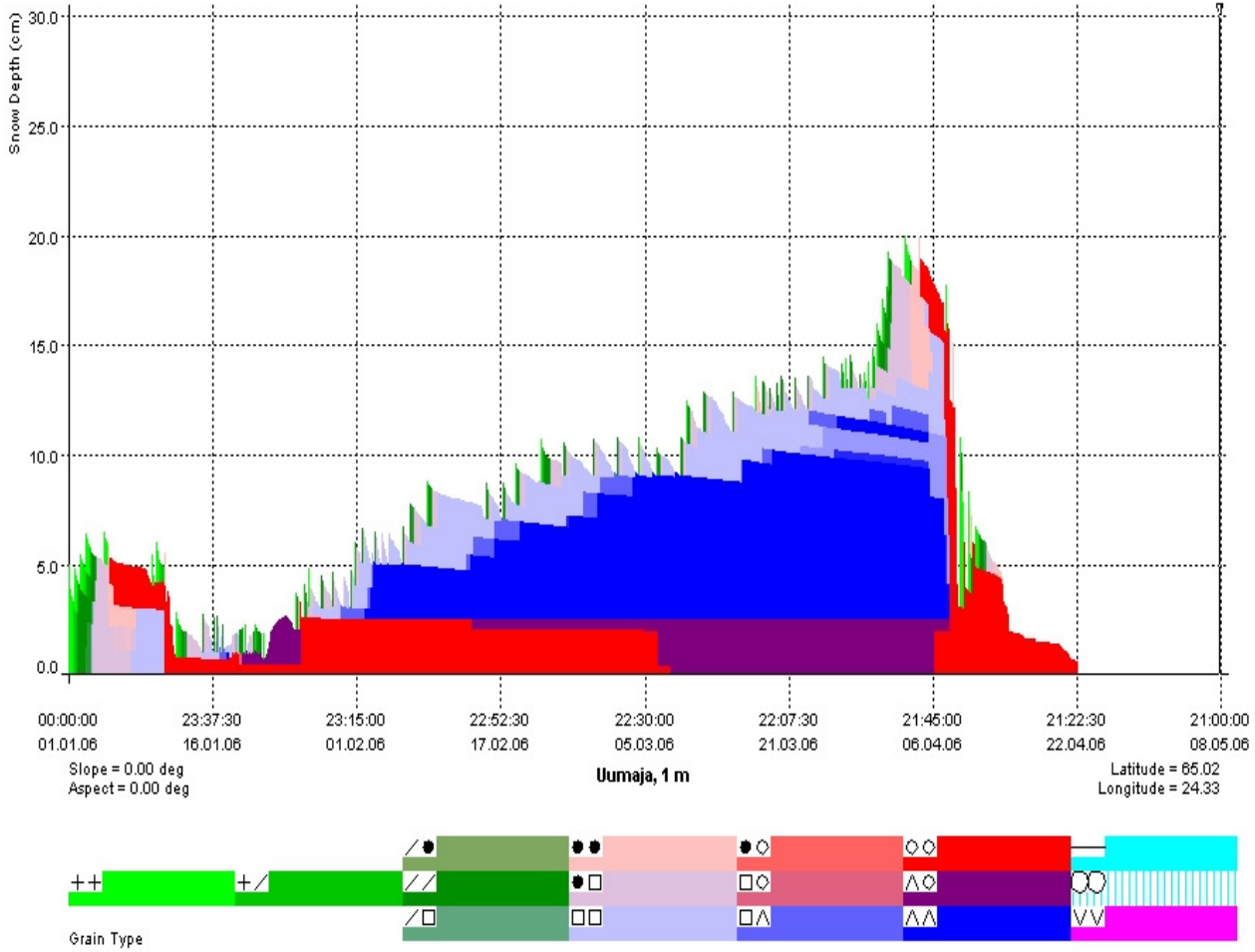
- Surface heat balance (with air-ice interaction
- Penetrating solar radiation in snow/ice
- Sub-surface melting
- Snow to ice transformation (snow-ice and superimposed ice formation)
- Heat and mass balance at ice-ocean interface



Modeled SWC result from SNOWPACK model. Prescribed heat flux through ice provided by HIGHTSI.

result from HIGHTSI model(simple parameterization)

We need to validate results with in situ measurement, however, measurements are made in-directly and also need to be improved.



Modeled snow grain size from SNOWPACK (hybrid model run)

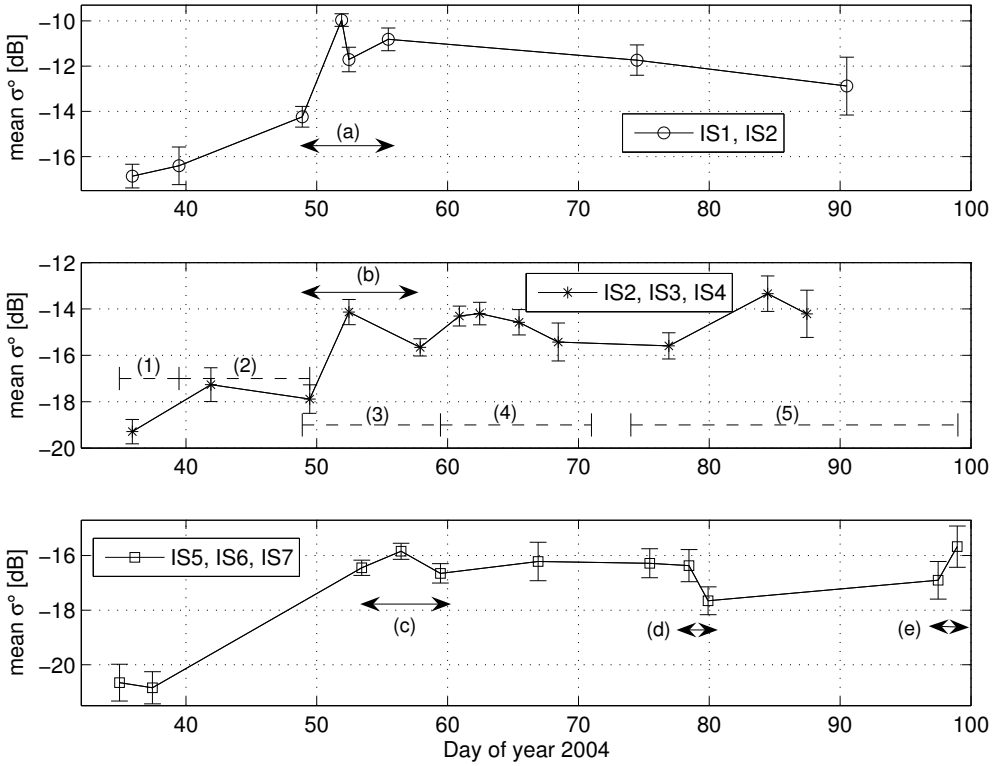
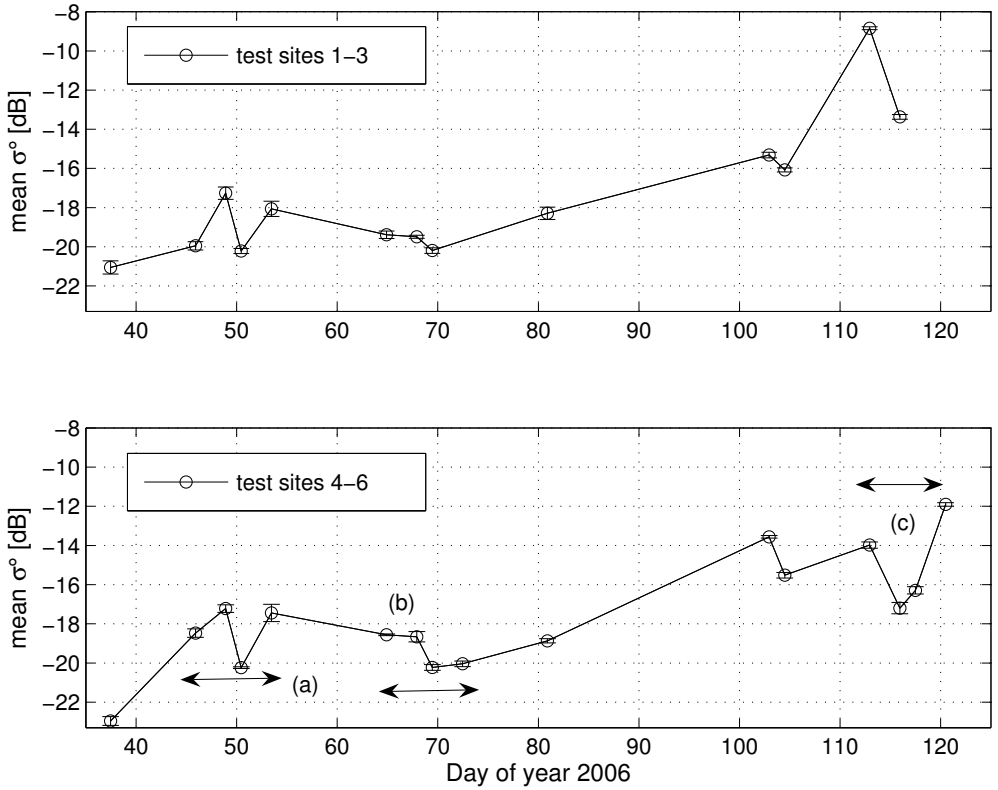


Fig. 2. Average ENVISAT IMP and WSM SAR σ◦ time series for land-fastlevel ice near Hailuoto Island. The time series were obtained using σ◦ data forseven test sites (see Fig. 1). The three different time series are denoted withthe IMP swath types used in their construction (see Table II). Vertical errorbarsindicate ±1 standard-deviation variation of σ◦. Numbers (1)–(5) indicatethe five different main phases in the time series and letters (a)–(e) are the partsselected for detailed qualitative analysis (see Section III-B and C).(Mäkynen et al, 2007)



Average HH-polarized sigma0 time series for land-fast level ice near Hailuoto Island using ENVISAT APP images (2006). The changes of sigma0 are highly linked with the changes of SWC (under investigation).

Related snow modelling work and associated remote sensing applications

This study (on going)

Cheng, B., A. Riihelä1, K. Andersson and T. Manninen. Validation of the surface albedo product over snow covered field during melting season (on going study)

Cheng, B., A. Riihelä and K. Andersson, 2009. Parameterized and satellite (AVHRR) surface albedo on modeled snow and sea ice mass balance in the Baltic Sea. Boreal Environment Research Journal, in revision.

Cheng, B., T. Vihma, Z. Zhang, Z. Li and H. Wu. 2008. Snow and sea ice thermodynamics in the Arctic: Model validation and sensitivity study against SHEBA data, Chinese Journal of Polar Science, 19(2), 108-122.

Cheng, B., Z. Zhang, T. Vihma, M. Johansson, L. Bian, Z. Li, and H. Wu, 2008, Model experiments on snow and ice thermodynamics in the Arctic Ocean with CHINARE 2003 data, J. Geophys. Res., 113, C09020, doi:10.1029/2007JC004654.

Mäkynen, M., B. Cheng, M. Similä, T. Vihma, and M. Hallikainen, 2007. Comparisons between SAR backscattering coefficient and results of a thermodynamic snow/ice model for the Baltic Sea land-fast sea ice. IEEE Trans. Geosci. Remote Sens., 45(5), 1131–1141

Cheng, B., T. Vihma, R. Pirazzini and M. Granskog, 2006. Modeling of superimposed ice formation during spring snowmelt period in the Baltic Sea. Ann. Glaciol., 44, 139-146.