HIRLAM in Sodankylä and at Vatnajökull

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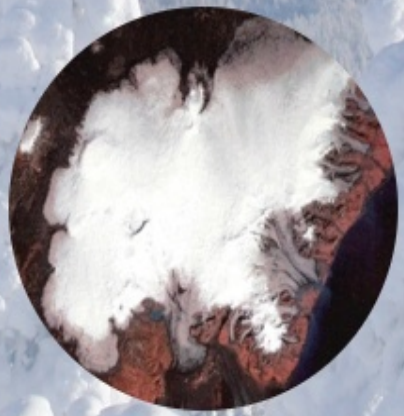

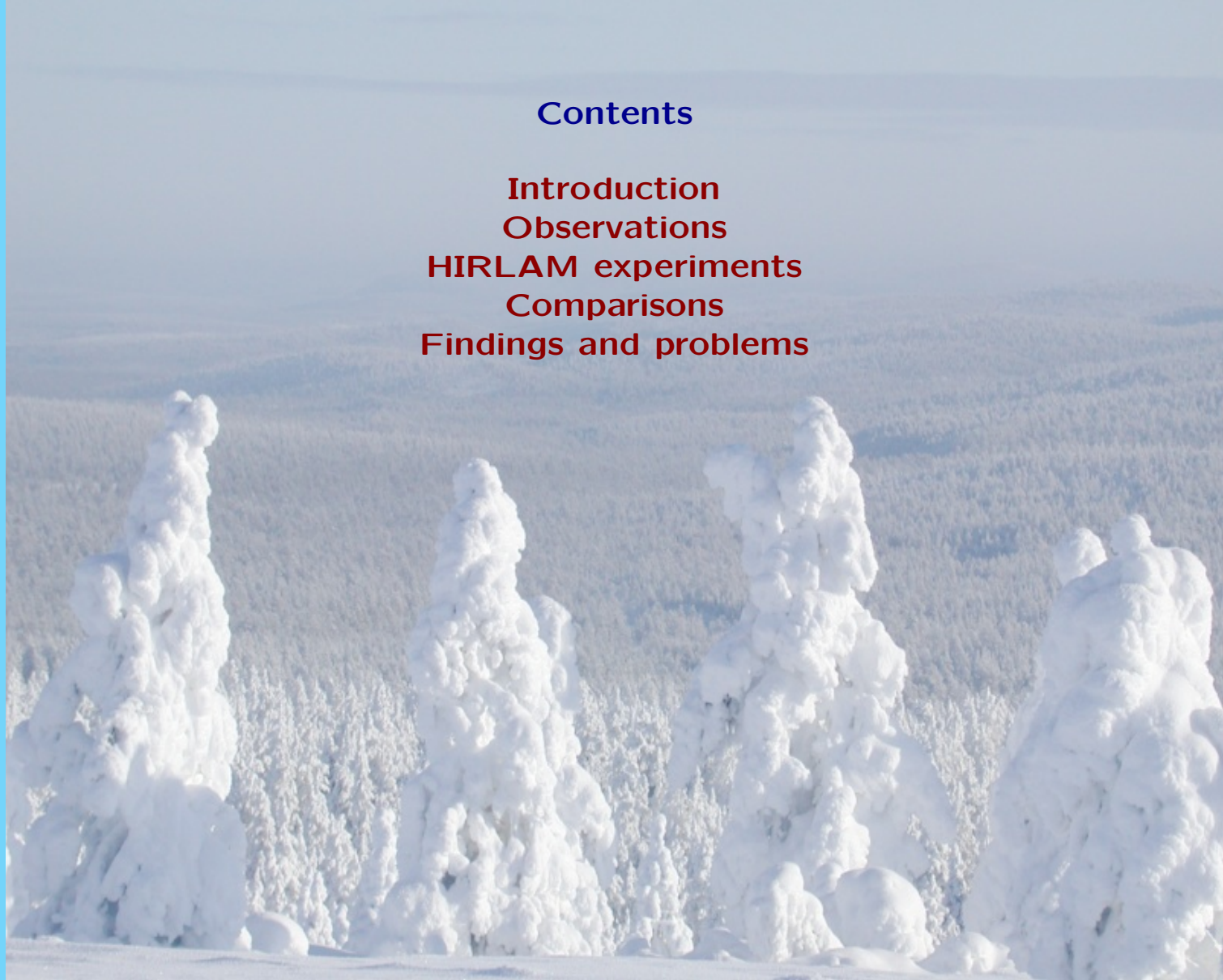

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HIRLAM

- Nordic Temperature Problem
- New developments: “newsnow” surface scheme
- Need for detailed model-observation comparison

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⇒Comparison of simulated and observed surface energy balance in Sodankylä and Vatnajökull (separately)

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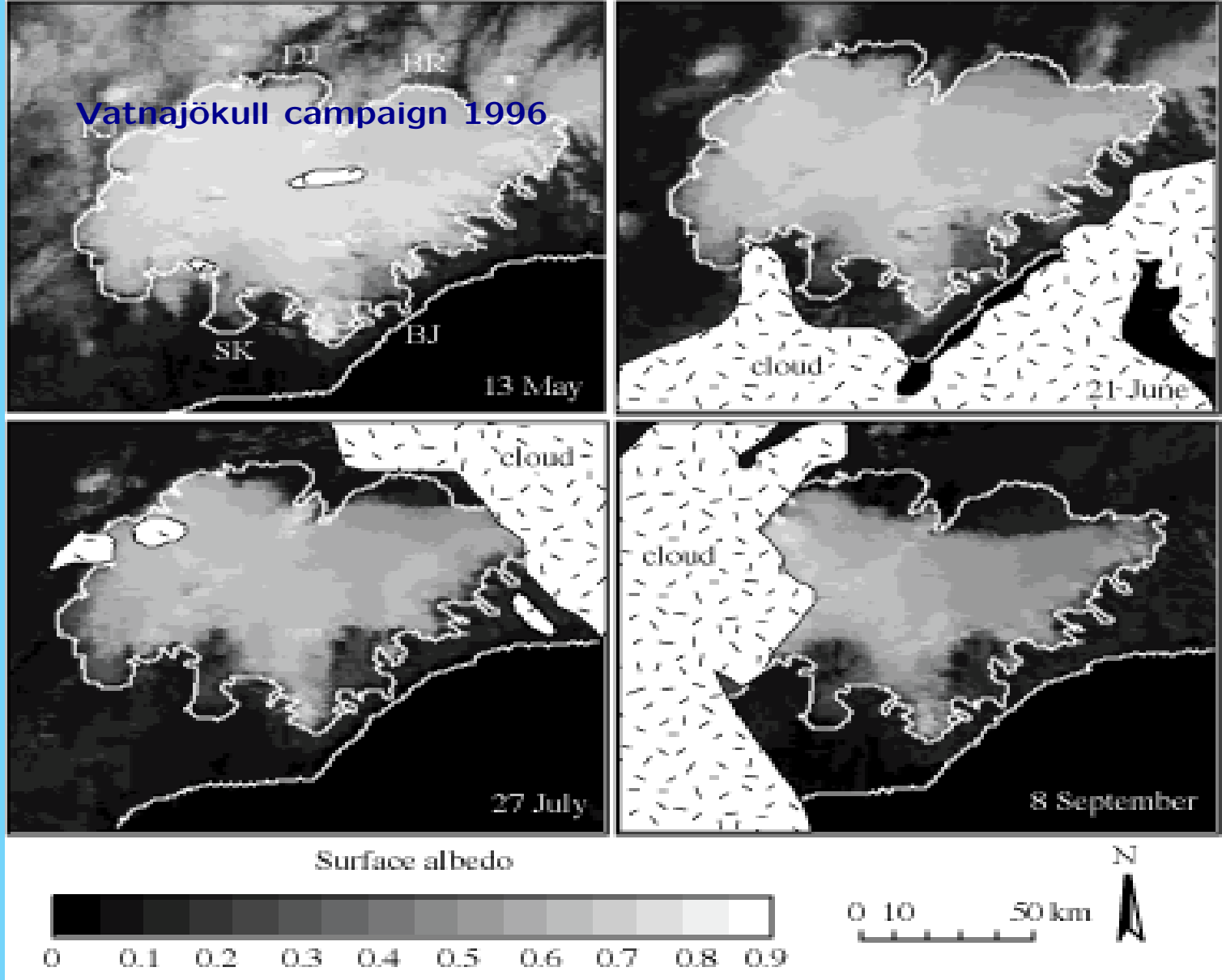
See also NetFAM CBL07 (Toulouse, March 2007)

and ICAM 2007 (Chambery, June 2007)

Sodankylä data

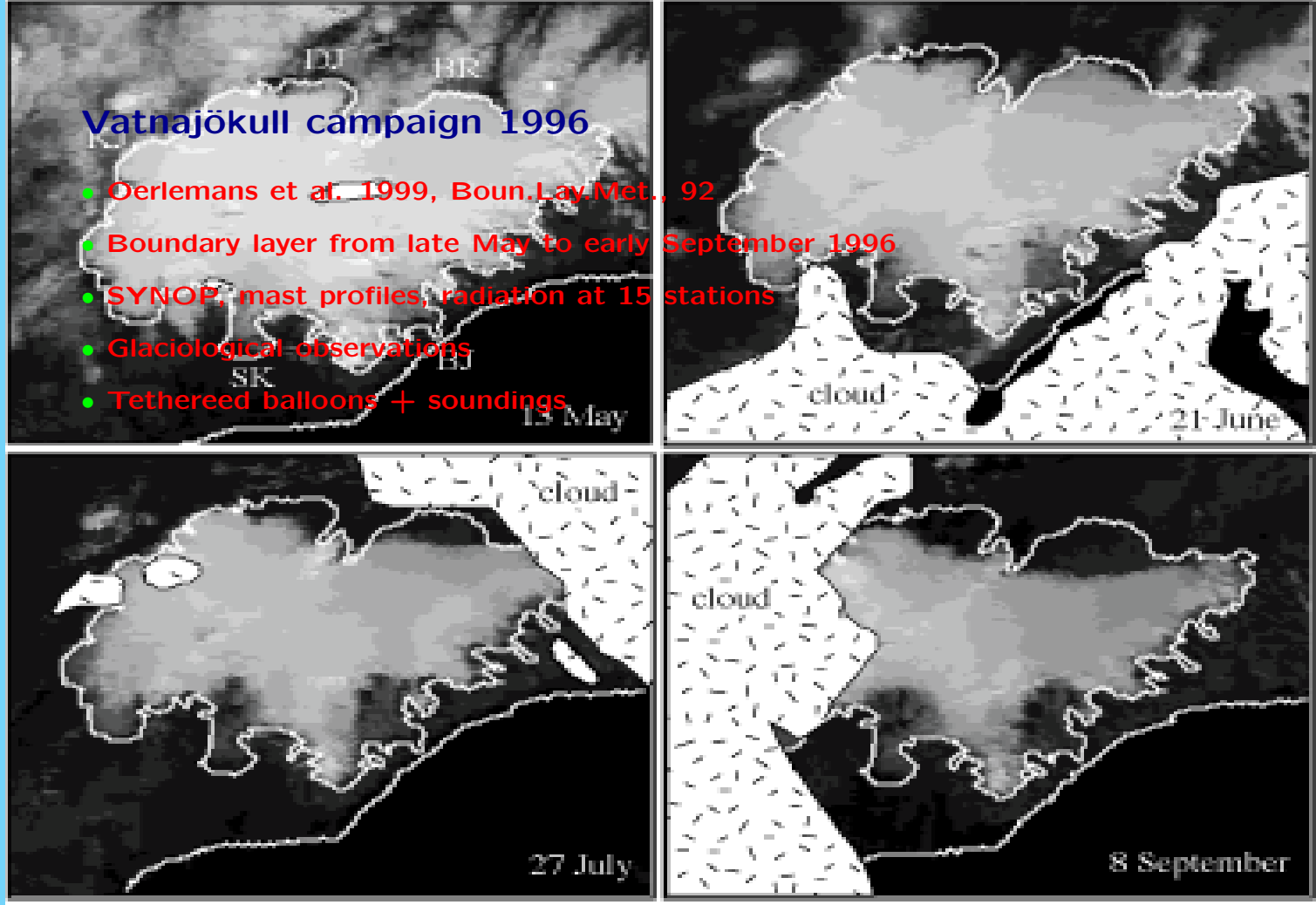
Sodankylä data

- High temporal resolution soundings
- AWS data, including ceilometer
- Radiation measurements
- Profiles from 50m mast
- Turbulent fluxes from mast
- Soil and snow temperatures


Vatnajökull campaign 1996
DJ
BR
SK
BJ
13 May
cloud
21 June
cloud
27 July
cloud
8 September
Surface albedo
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
0 10 50 km
N

Vatnajökull campaign 1996

- Oerlemans et al. 1999, Boun.Lay.Met., 92
- Boundary layer from late May to early September 1996
- SYNOP, mast profiles, radiation at 15 stations
- Glaciological observations
- Tethereed balloons + soundings



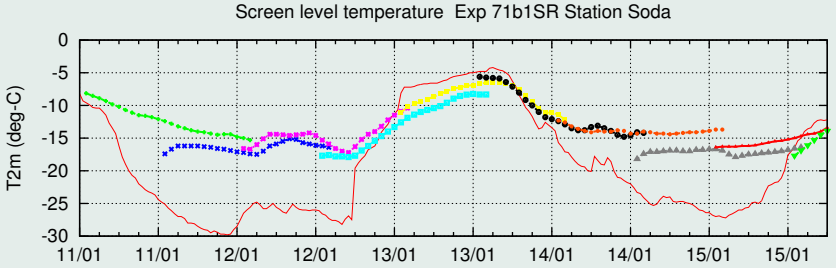
HIRLAM experiments

Table 1: HIRLAM experiment setup

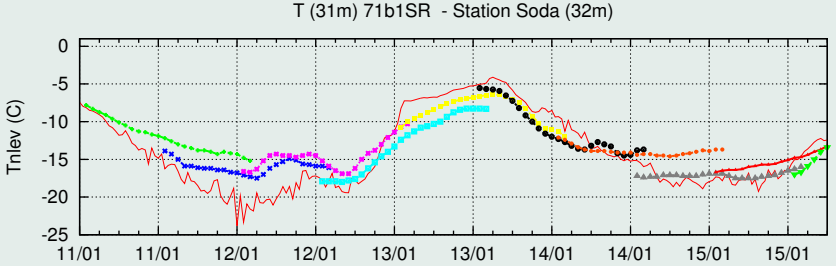
	Sodankylä	**Vatnajökull**
HIRLAM versions	7.1beta1 and "newsnow"	7.1beta2 and "newsnow"
resolution	11km/60L	2.8km/60L
domain	Northern Europe	Iceland
period	January 2007	June 1996
initial analysis	**NOUA**	**NOUA**
boundaries	HIRLAM RCR 22km/40L (an)	HIRLAM beta2 17km/40L (an)
validation	standard + Sodankylä	standard + Vatnajökull
comments	newsnow alpha3 and 7.1	double nesting: ERA40-17km-2.8km

January 2007 Sodankylä: HIRLAM reference

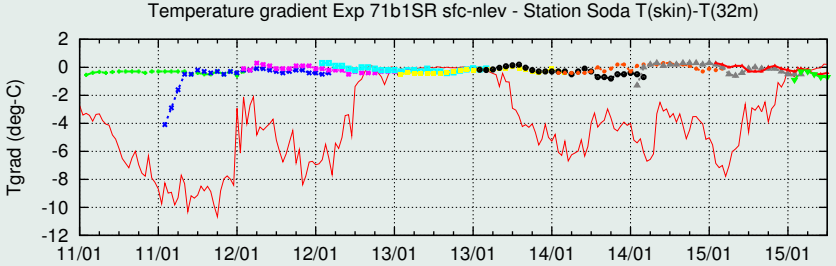
Temperature AWS 2m/Hirlam 2m



Temperature mast 31m/Hirlam 32m

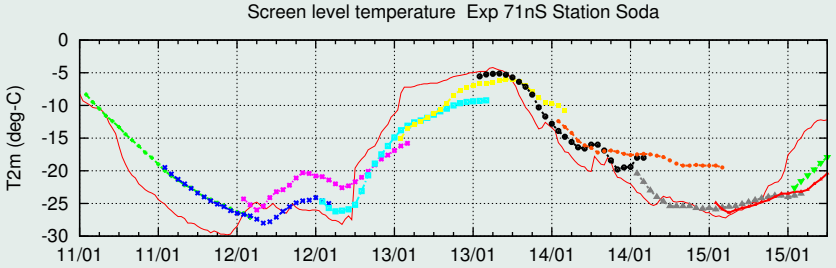


Temperature gradient Ts-Tnlev mast/Hirlam



January 2007 Sodankylä: HIRLAM "newsnow" corrected

Temperature AWS 2m/Hirlam 2m



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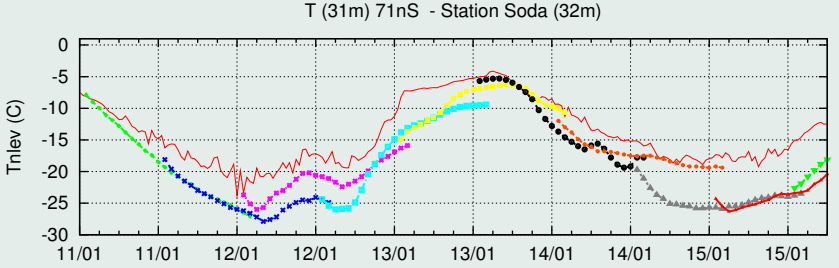

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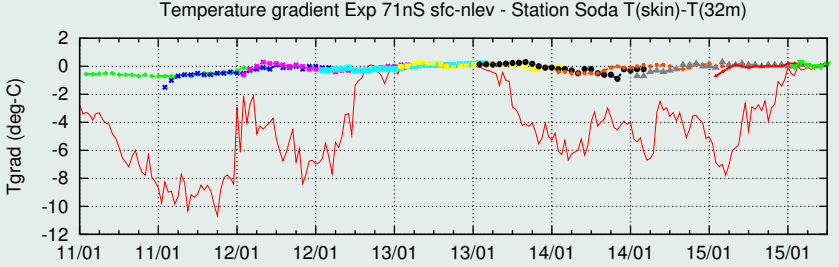
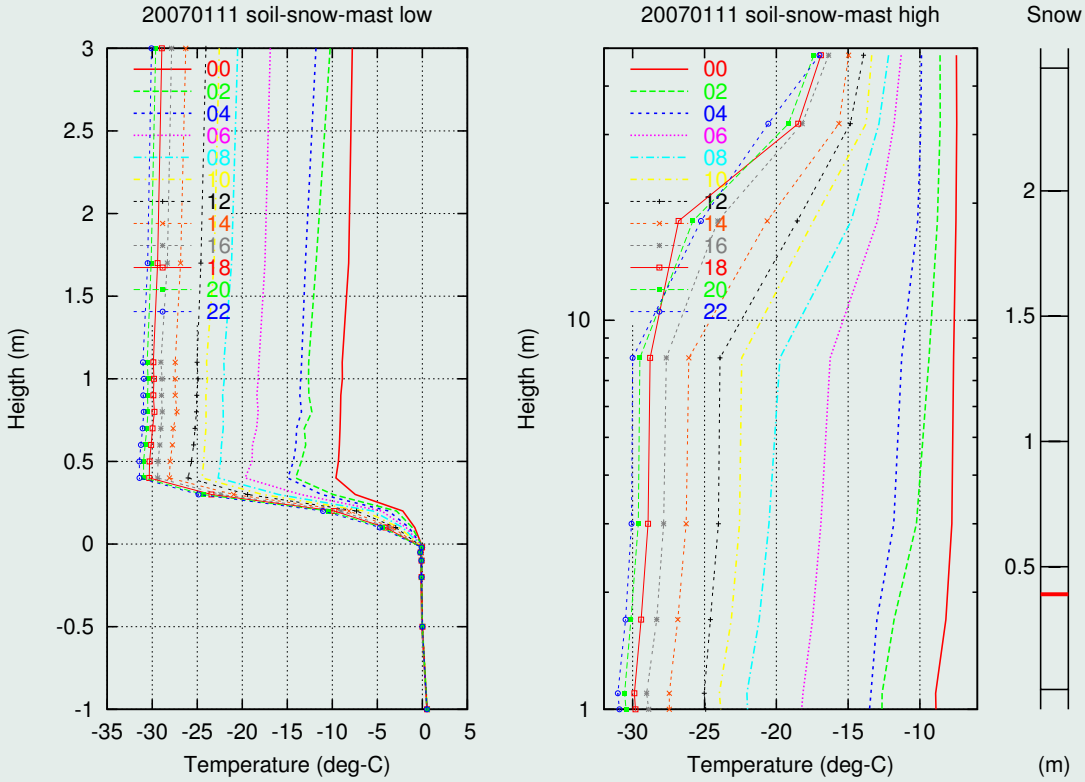
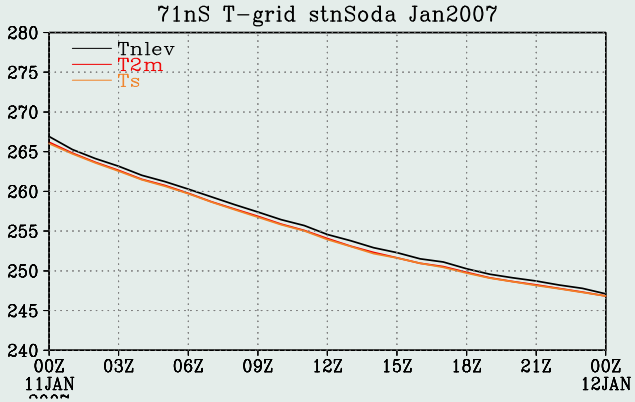
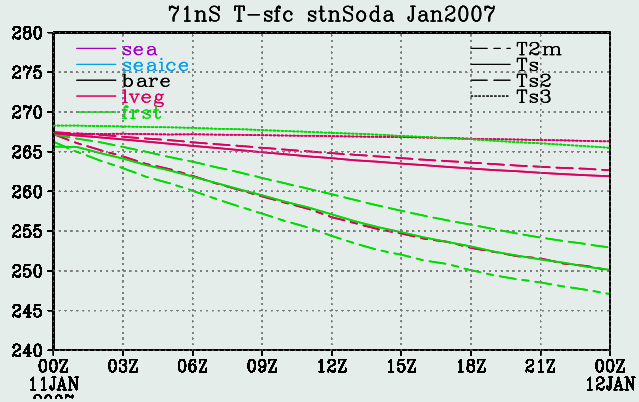


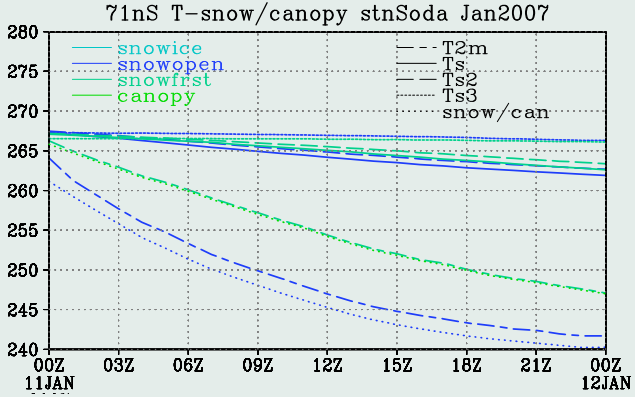
Observed temperatures -1 ... 48 m: soil, snow and mast

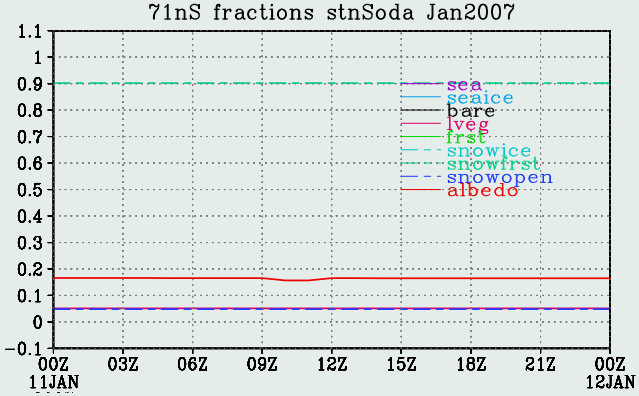


"Newsnow" temperatures

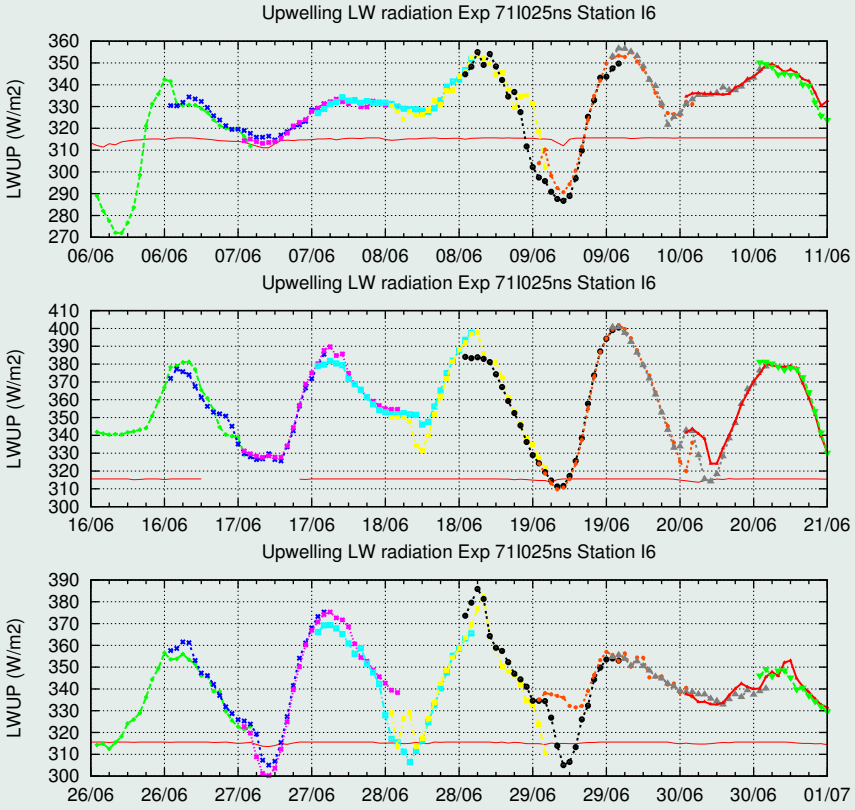




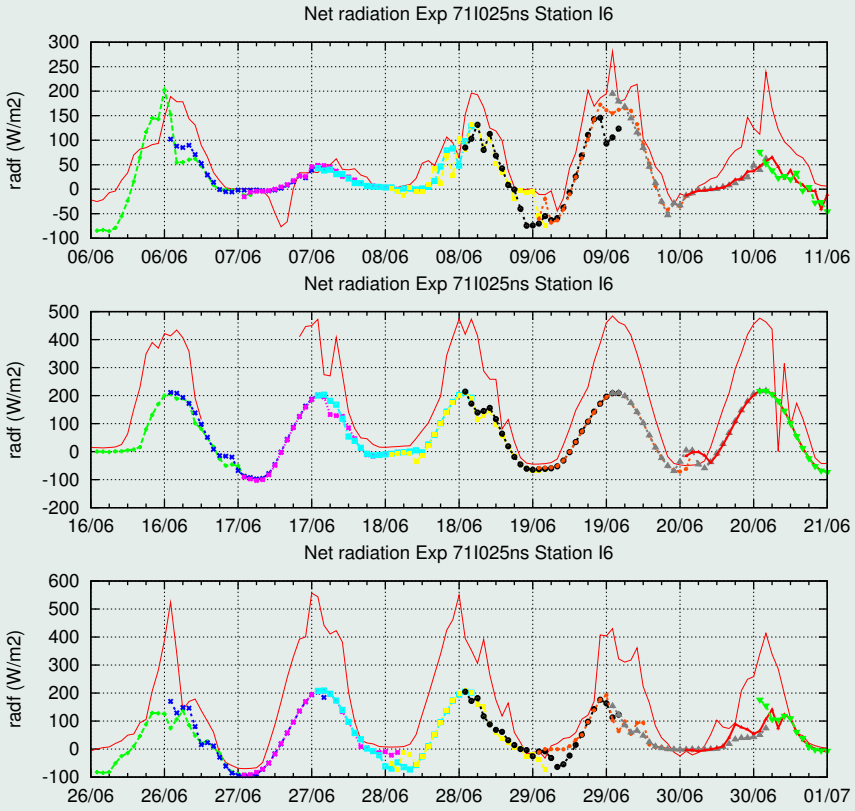




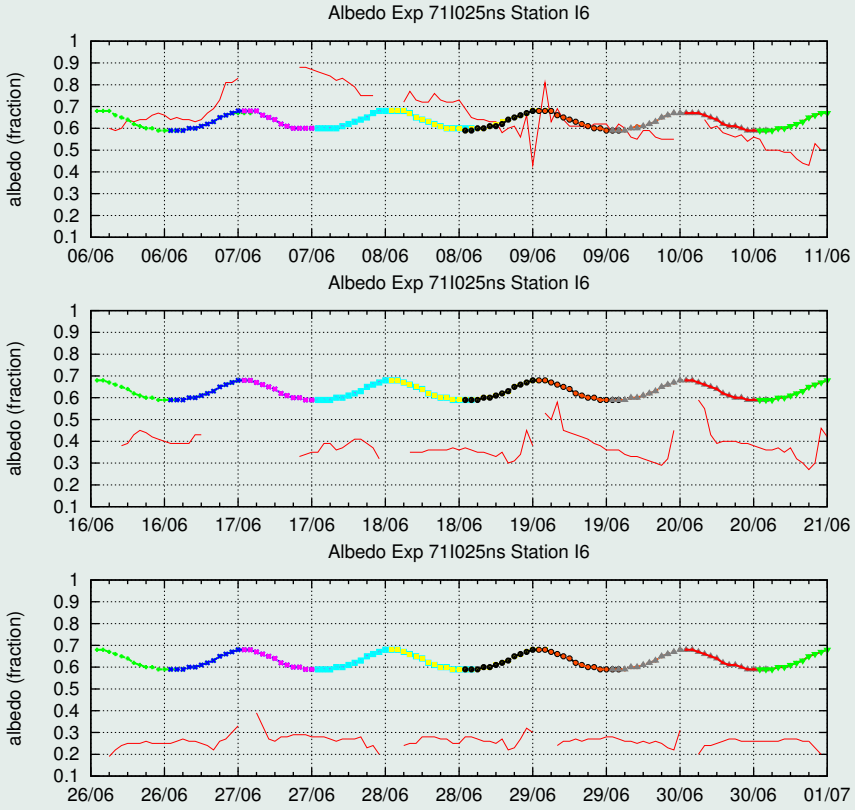
June 1996 Vatnajökull: HIRLAM "newsnow"



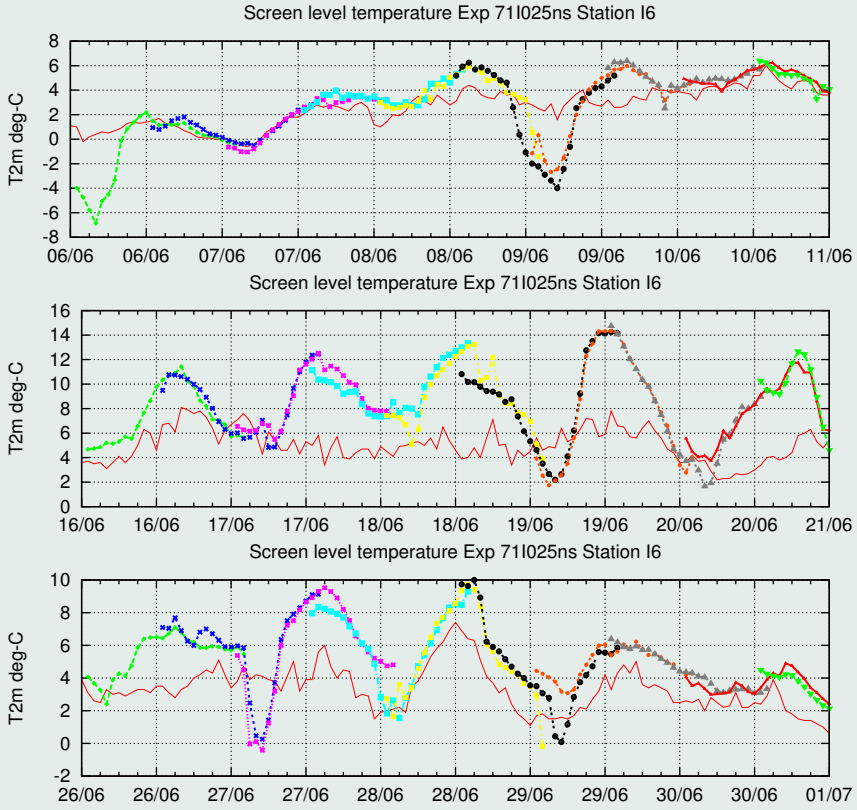
June 1996 Vatnajökull: Net radiation, HIRLAM "newsnow"



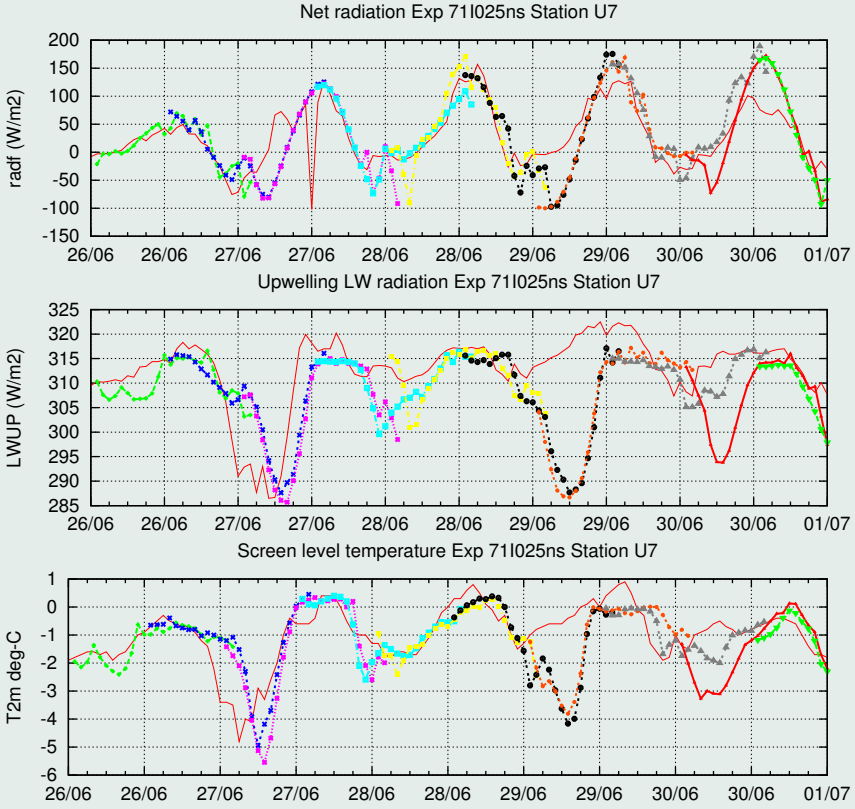
June 1996 Vatnajökull: Albedo, HIRLAM "newsnow"



June 1996 Vatnajökull: T_{2m} HIRLAM "newsnow"



June 1996 at the top of Vatnajökull HIRLAM "newsnow"



June 1996 Vatnajökull: HIRLAM modifications

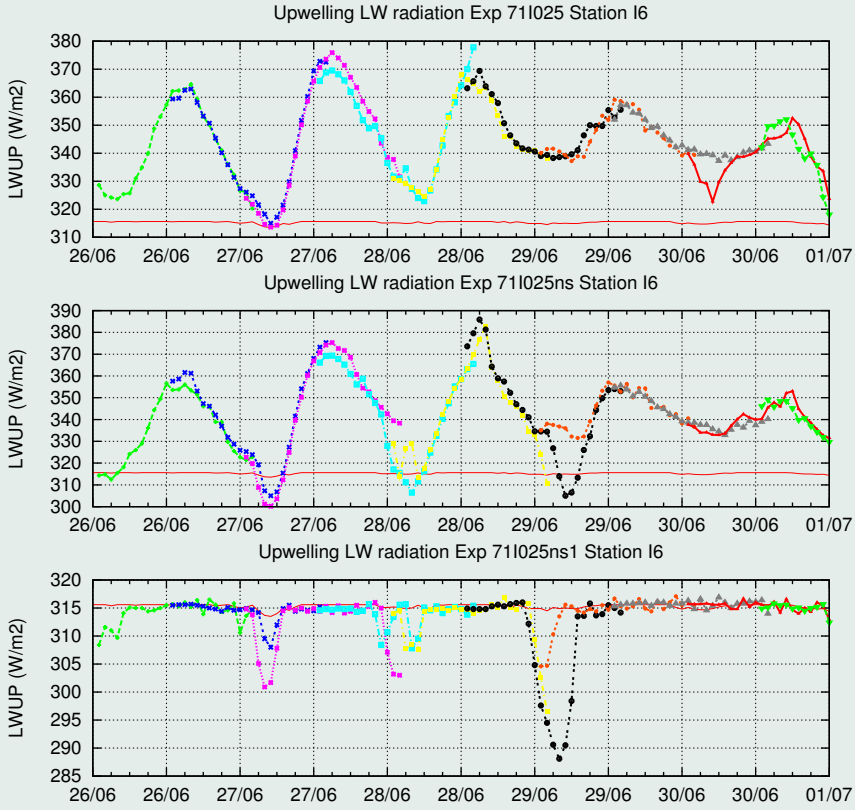


Table 2: Impact of the HIRLAM modifications at different stations

Stn	Elev. (m)	Ice		Snow		T_s quality		
		Nature	HIRLAM	Nature	HIRLAM	reference	newsnow	tuned
I6	715	yes	yes	partly	no	poor	poor	good
U7	1530	yes	yes	yes	yes	fair	good	good
U2	50	no	yes	no	no	fair	fair	poor

Findings and problems

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Sodankylä temperatures

- "Newsnow": open snow temperature cold enough, forest a bit warm
- Still no vertical gradient: nlev too cold - why?
- In nature: isothermal from snow surface to tree tops,
  temperature gradient between 30 and 10m : not easy for model
- HIRLAM forest too dense - relation between open land and trees?

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"Newsnow" Vatnajökull energy balance

- Wrong snowcover and albedo + thermal properties of permanent ice

$\Rightarrow$ Wrong surface energy balance and surface temperature

- But not completely crazy two-metre temperature - because of good T_{nlev}?
  Synoptic scale in general is good: psurf, wind ...
- "Newsnow" improves situation over snow surface (top of ice cap)
- Tuning improves situation over glacier with no snow
- It is very important to know the surface type

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More conclusions

- Sometimes it is good to learn by looking at details ...
- Perspectives of NOUA

By-products:

- Tools for model-observation studies
- Suggestions for improvements of the Sodankylä operational comparison

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To do ...

- Study details of temperature and humidity, find remaining problems
- Turn to the Sodankylä spring problem
- Try higher vertical resolution with lower nlev
- Develop parametrization of stable BL turbulent fluxes
- Study aspects related to (low) clouds
- Improve surface description: climate files, surface analysis
- Over Vatnajökull: study local orographic circulations

Thanks to

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Thank YOU for attention!

P.S. Want to see the Sodankylä spring problem?

(from the operational page http://fminwp.fmi.fi)