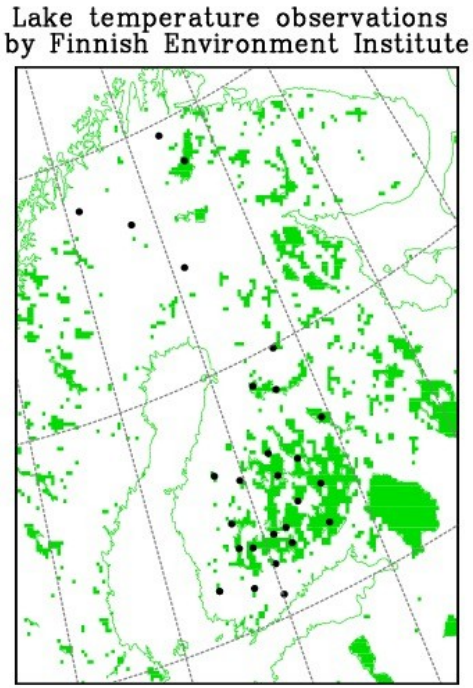
Laura Rontu, Ekaterina Kurzeneva, Kalle Eerola

Experimenting with FLake in HIRLAM



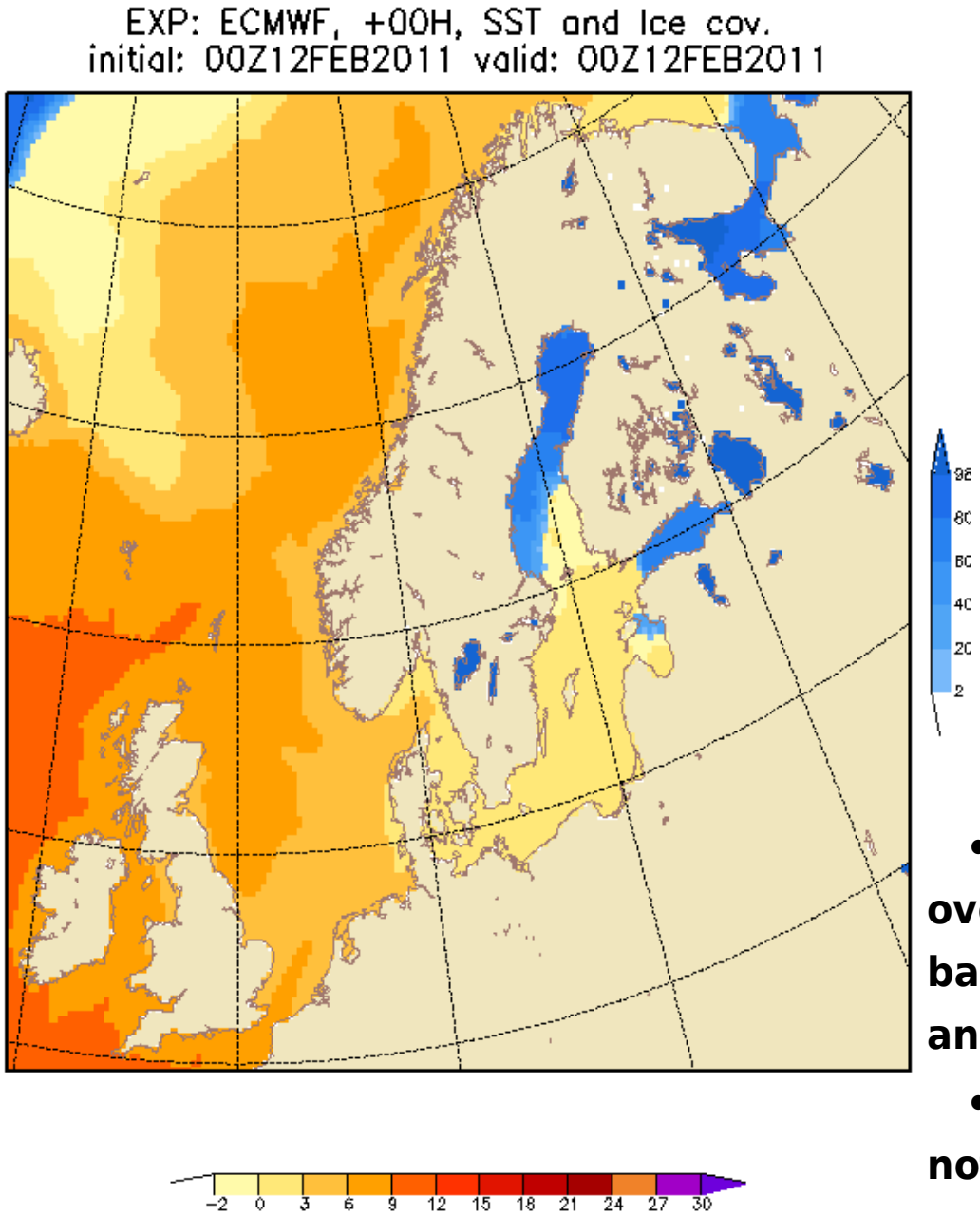
Outline:

About observations

Peaceful coexistence

Testing HIRLAM 7.4

Surface data assimilation
working days Helsinki 9-11.3.2011



ECMWF analysis

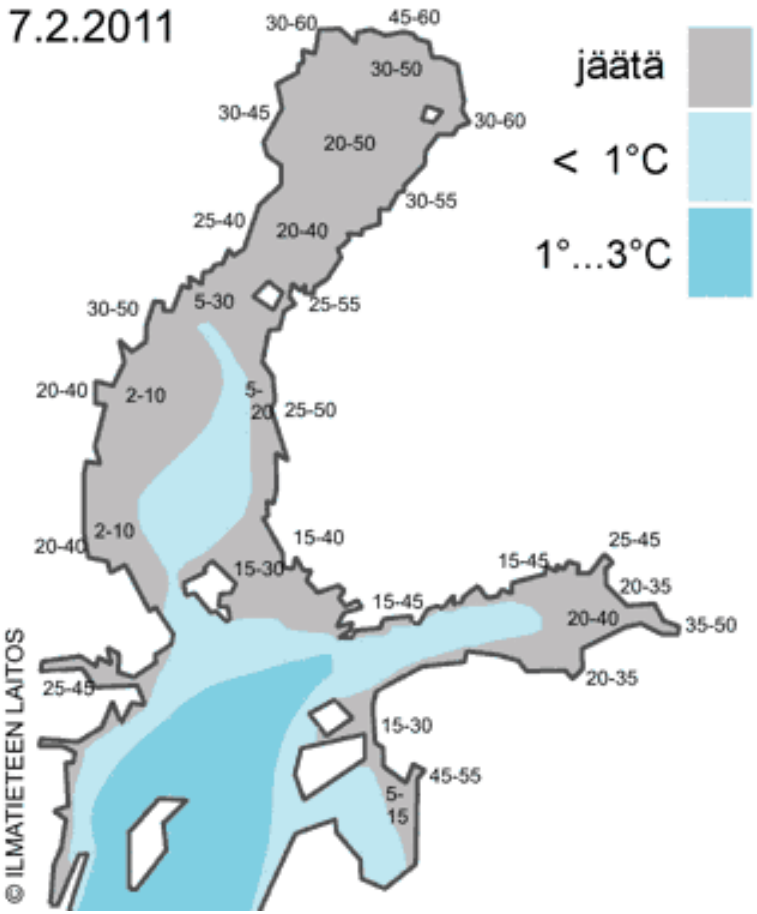
Observed LST only over the North American Great Lakes

Elsewhere, climatological data derived from time-lagged near-surface observations

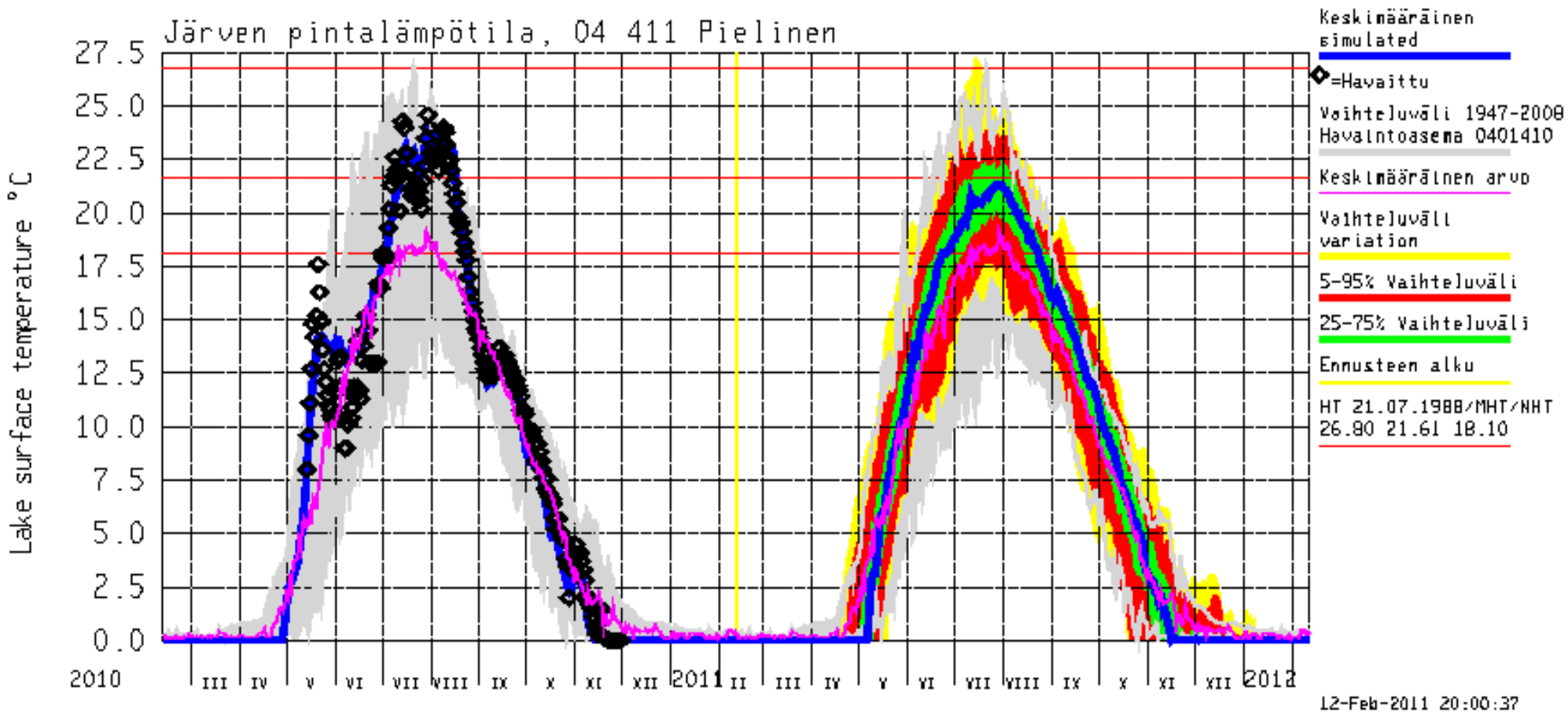
- **Climatological pseudo-observations over the Finnish and some neighbouring lakes, based on the long-term climatology of freezing and breakup dates of the lakes.**
- **Ocean climate extrapolated for backup whe nothing else is available**

Over the Baltic Sea and the Swedish lakes Vänern and Vettern, temperature observations based on the operational ice map by the Finnish Meteorological Institute

+ Vänern & Vettern

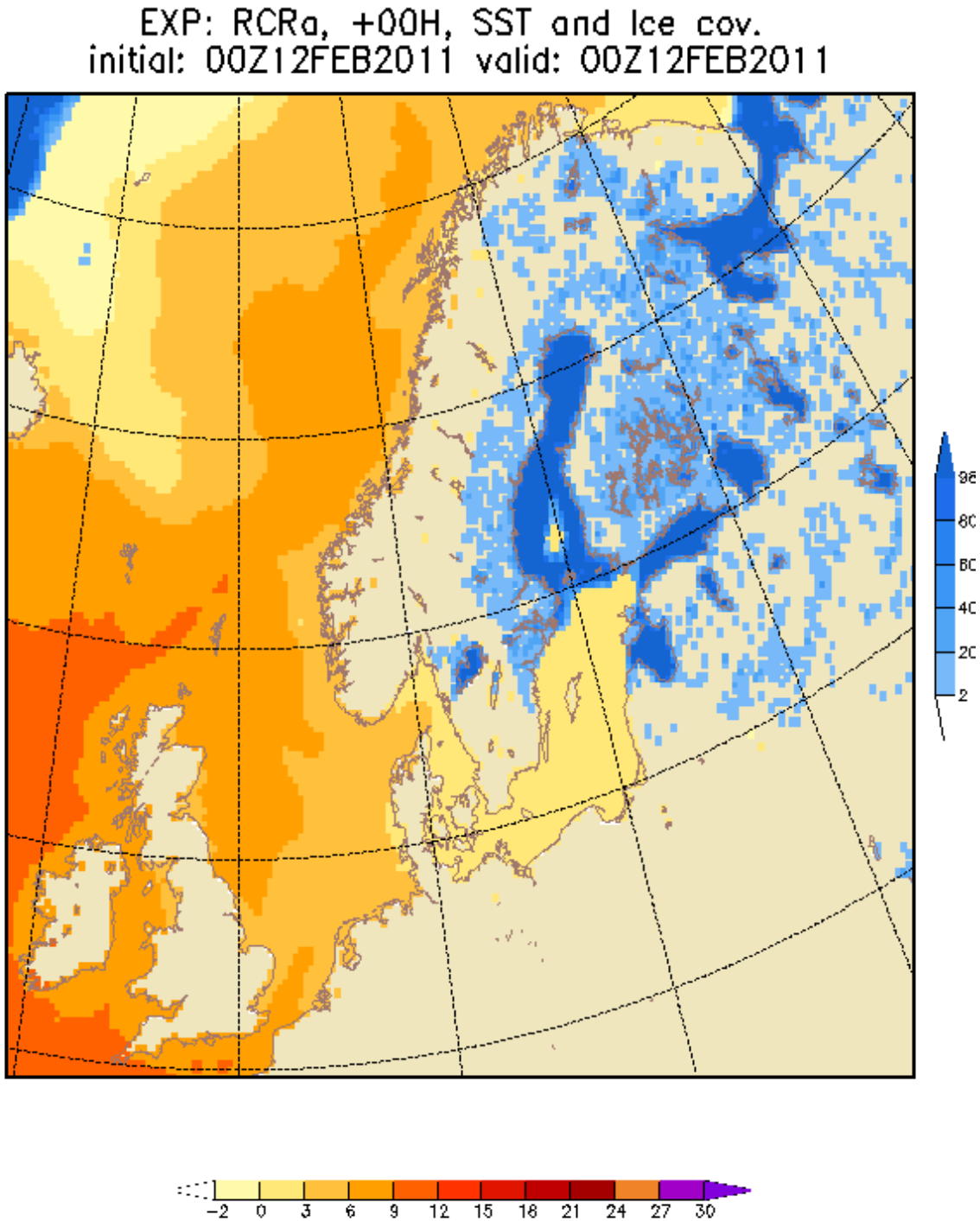


http://www.itameriportaali.fi/en/itamerinyt/en_GB/jaatilanne/



Lake surface temperature observations over 27 lakes in Finland, backed up by the Finnish Enviroment Institute (SYKE) lake model

http://wwwi2.ymparisto.fi/i2/kooste/jarvilampo_p.html



Result of combination:

HIRLAM RCR analysis

Note the Swedish-Norwegian problem!

The next version: HIRLAM 7.4

- will contain all of the previous observations
+ prognostic FLake parametrizations

- possibly more observations:

satellite-based temperatures/ice cover over Lake Ladoga (Onega ...)

North Hydrology satellite data for testing!

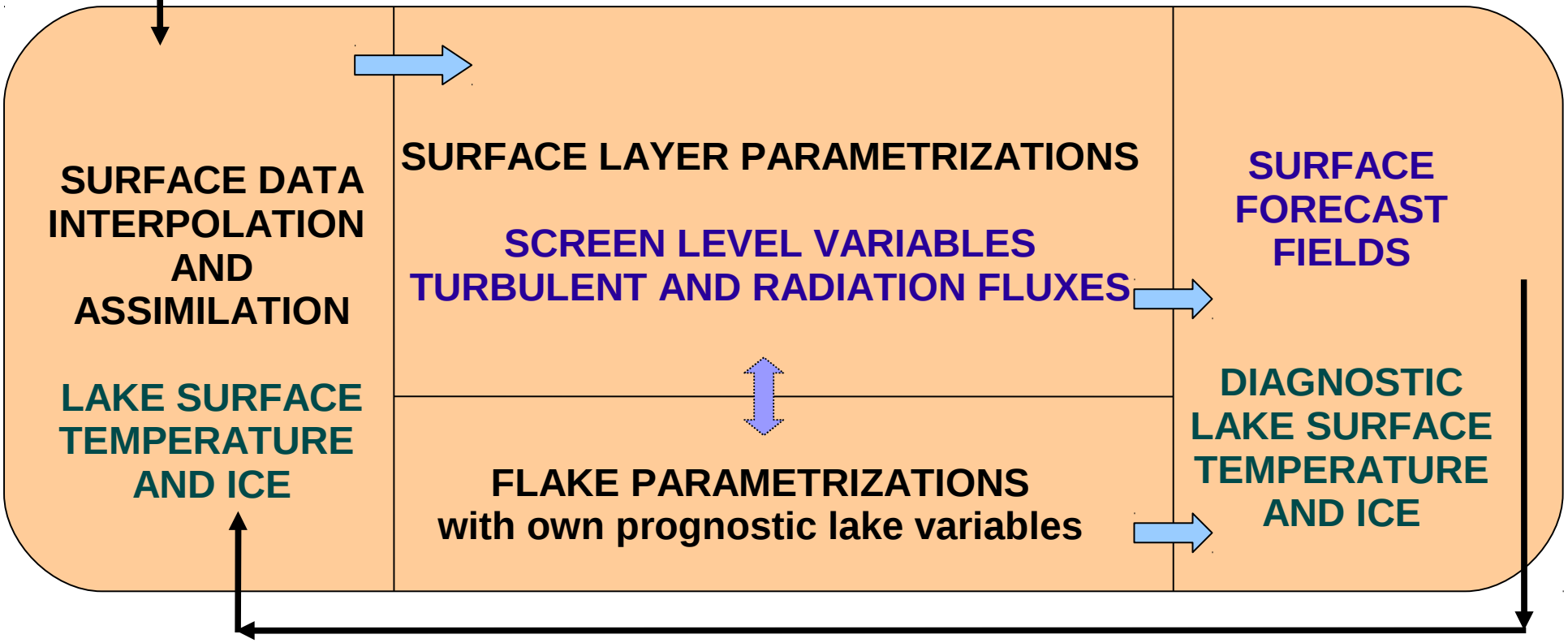
Future development in data assimilation related to sea, lakes, snow and ice: towards integration of forecast and analysis in the HARMONIE framework

PEACEFUL COEXISTENCE OF SURFACE DATA ASSIMILATION AND FLAKE

INPUT (OBSERVATIONS)

- ECMWF analysis = climate!
- Finlake climate data
- Baltic sea observations
- Local lake observations

- **FLake provides background for the LST analysis**
- **FLake prognostic lake variables are not influenced by the data assimilation**
- **During the forecast, the HIRLAM surface layer parametrizations see the assimilated SST and ice/water fraction and evolving lowest model level variables**
- **FLake parametrizations know the evolving atmospheric fluxes at each time step**



Sea and lake surface variables in HIRLAM	Sea			Lake		
	Water sfc	Ice	Snow on ice	Water sfc	Ice	Snow on ice
Temperature	assimilated	predicted by I	not included	assimilated predicted by F	predicted by I, F	not included (predicted by F)
Fraction	diagnosed	diagnosed	(diagnosed)	diagnosed	diagnosed	(diagnosed)
Thickness	-	not included	(diagnosed)	-	predicted by F	(diagnosed, predicted by F)

Testing HIRLAM 7.4 with FLake

Question of cold start: **where to take initial state of the**
Flake prognostic in-lake variables?

Answer: **from the global lake climatology data base by Katya et al., derived by applying climatological atmospheric forcing to stand-alone FLake**

But
… the cold start spring values are wrong here in the North:
use them and your ice will never melt!

Only start experiments in autum with well mixed lakes

Why is the cold start data wrong (ongoing work in RSHU)? > **find the reason and correct**

Testing HIRLAM 7.4 with FLake

Munchausen mode results

- analysis and forecast largely separated

- small technical issues still to check over lakes where no
  observations are available
  (relaxation to climatology, relation between sea and lake
  variables, flag temperature of frozen lakes ..)
- started: activate snow-on-lake-ice parametrizations

Testing of forcing mode

- more integrated surface data assimilation + FLake

- technical issues – check definitions and connections
  between variables in the HIRLAM code

  Forcing mode does not work yet
  – perhaps it is even not so necessary

Preliminary comparisons between

HIRLAM 7.3 as such v.s.

HIRLAM 7.4 with

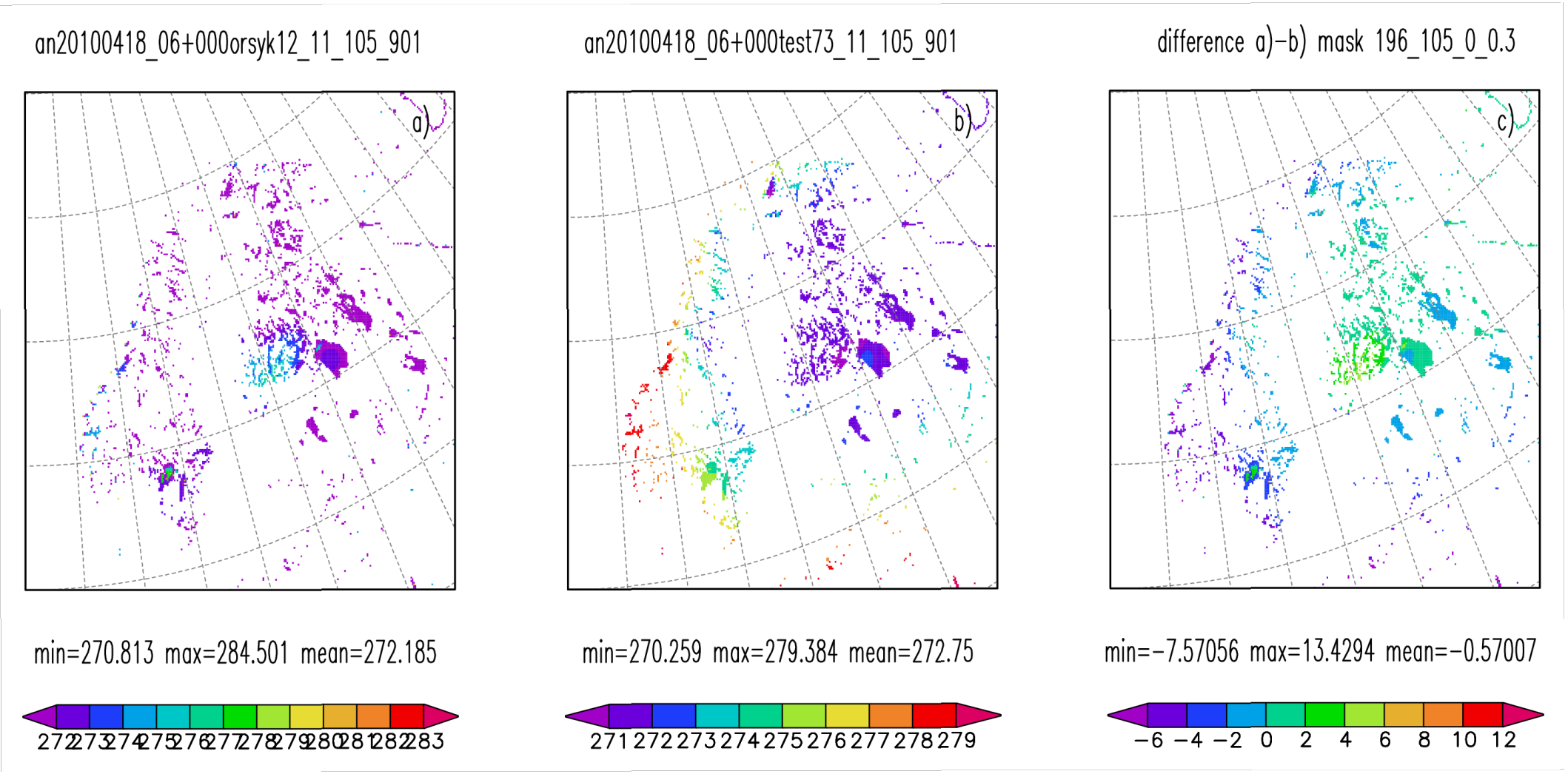
- SYKE and Baltic Sea observations (Swedish lakes only 2011)

- FLake Munchausen with minor modifications, including snow, from November 2009 to 31.5.2010

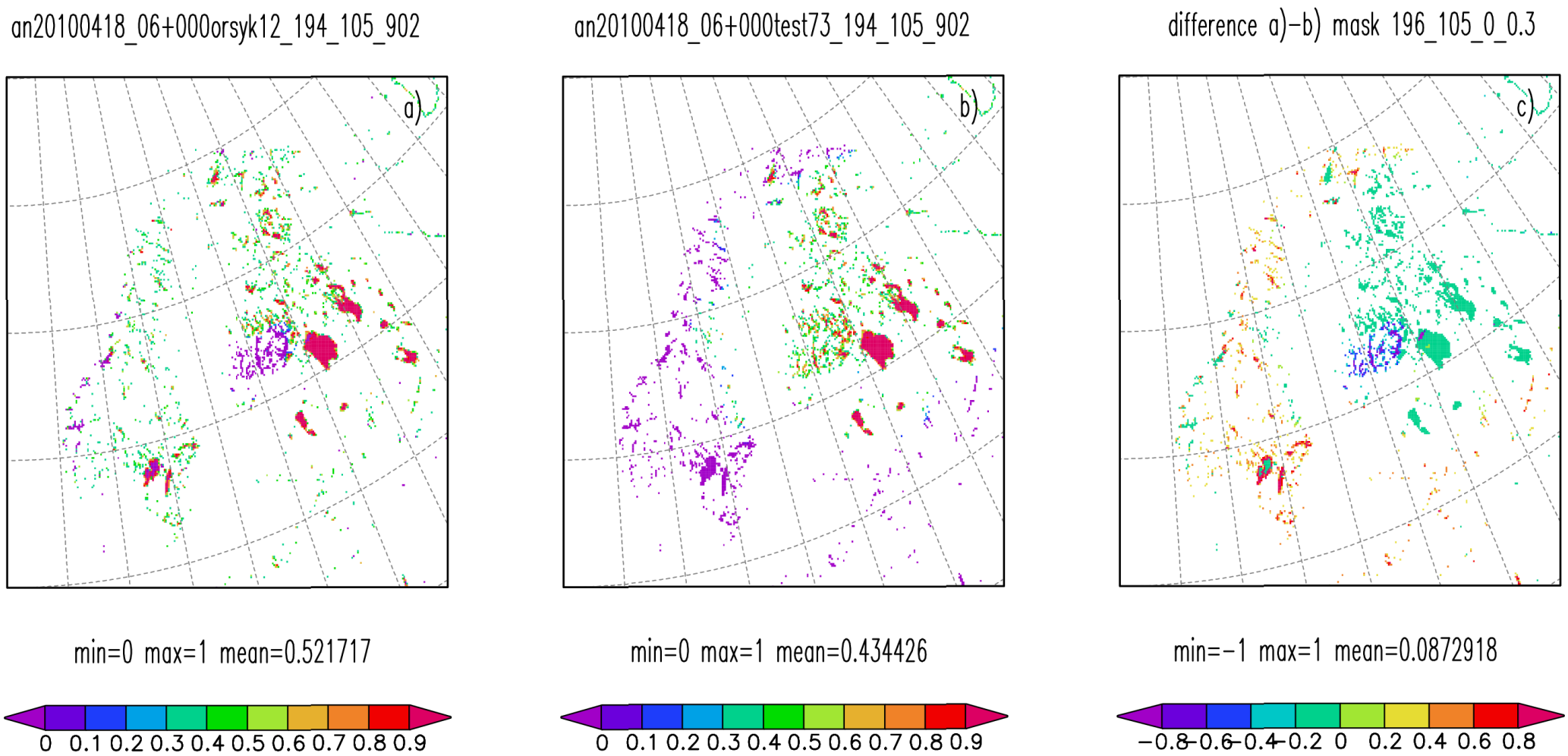
- FLake Munchausen as in 7.4
from November 2010 to 28.2.2011 (some problems here)

Snapshots on LST, fraction of ice, snow on ice
Time-series of analysed LST (Kalle's tool for obsa-files!)

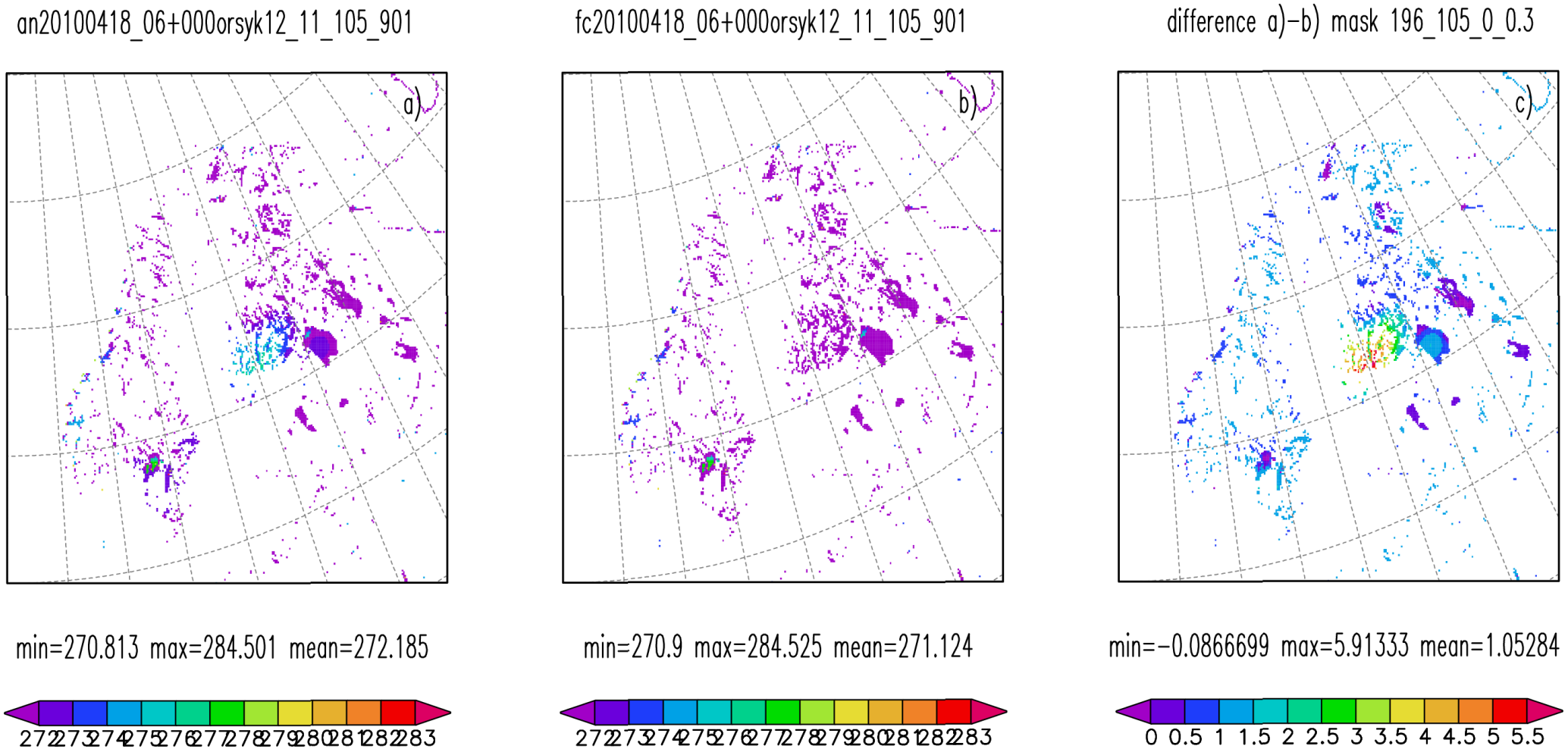
Lake surface temperature



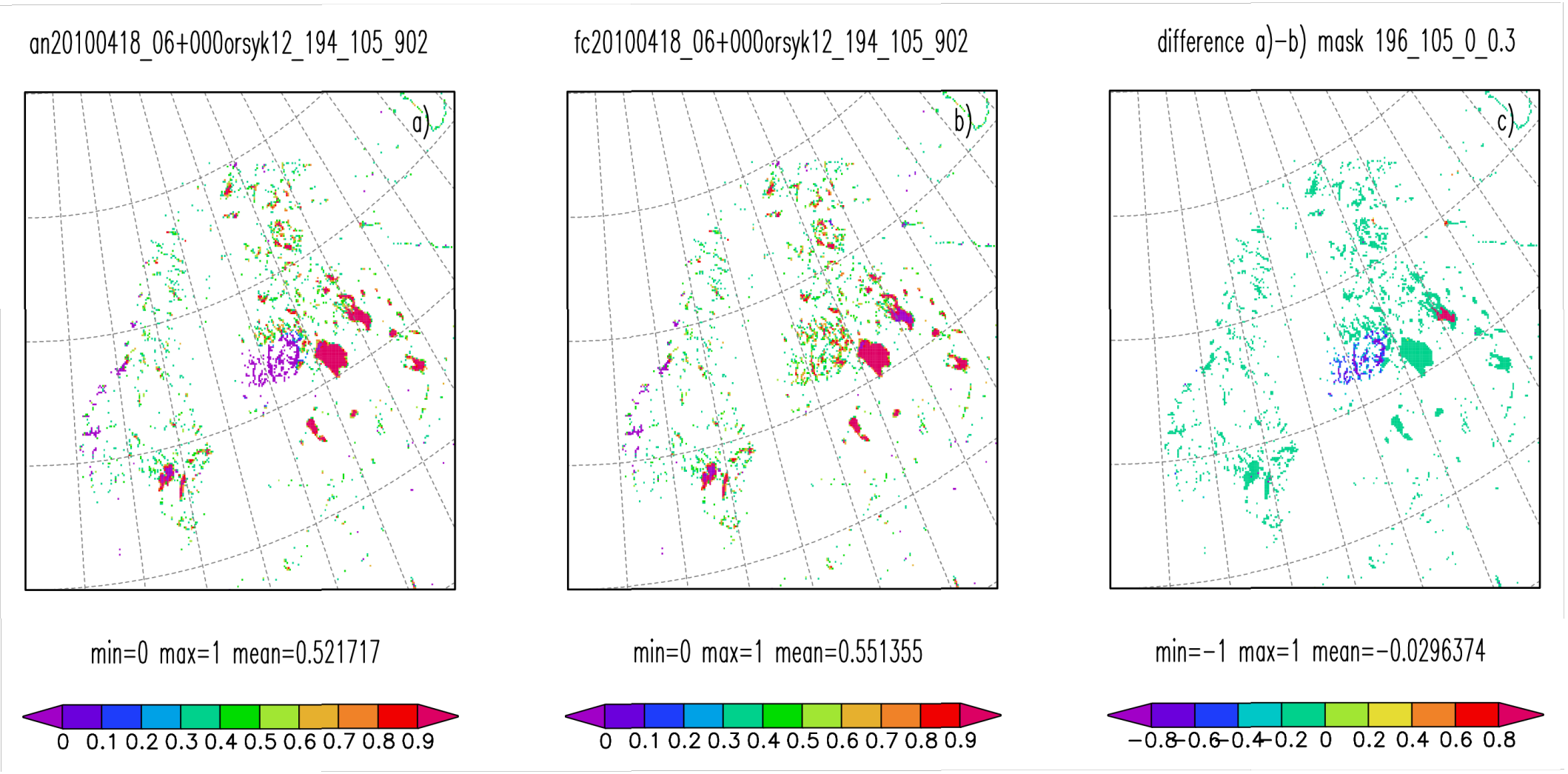
Fraction of ice



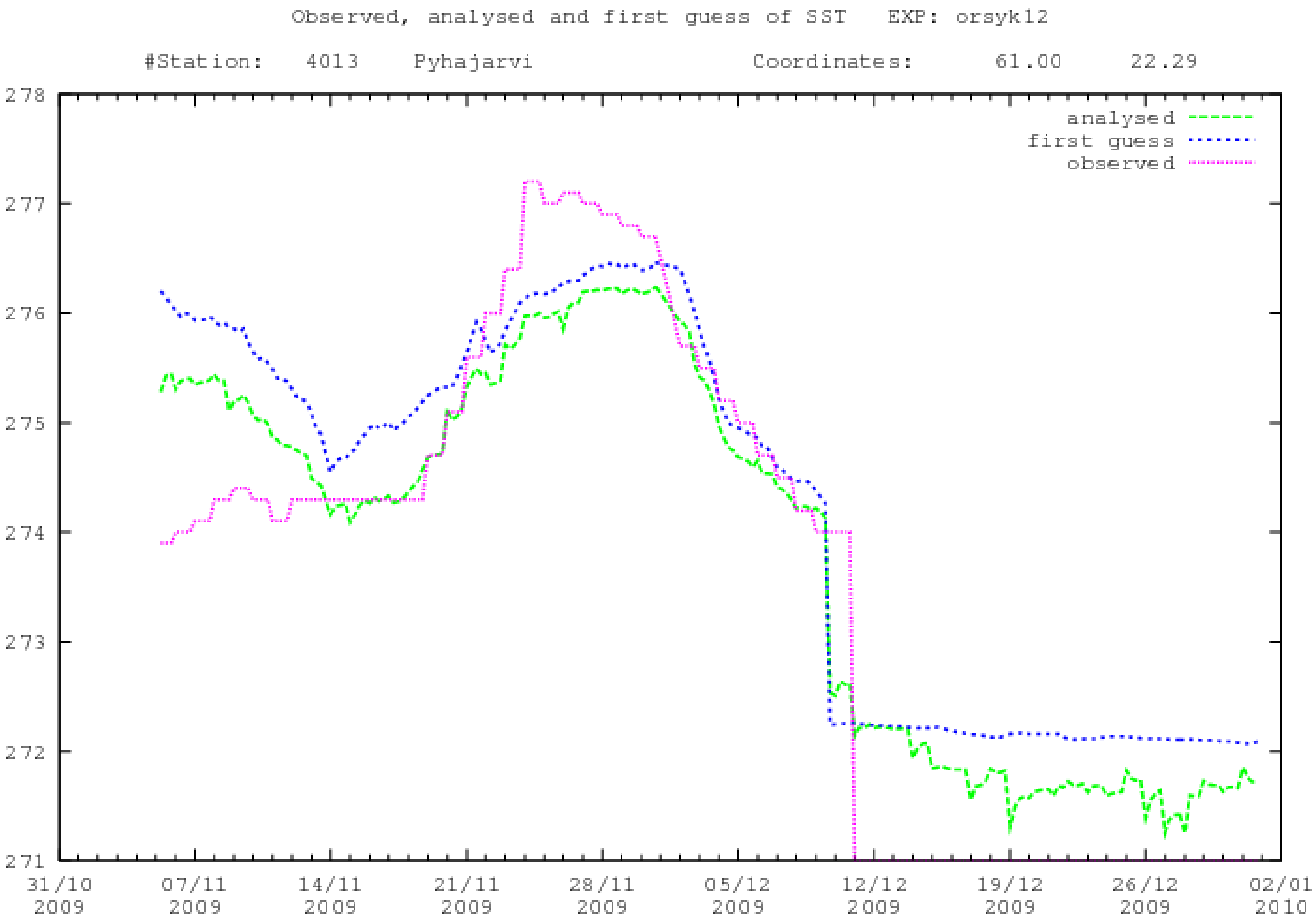
Analysis – first guess by FLake: temperature

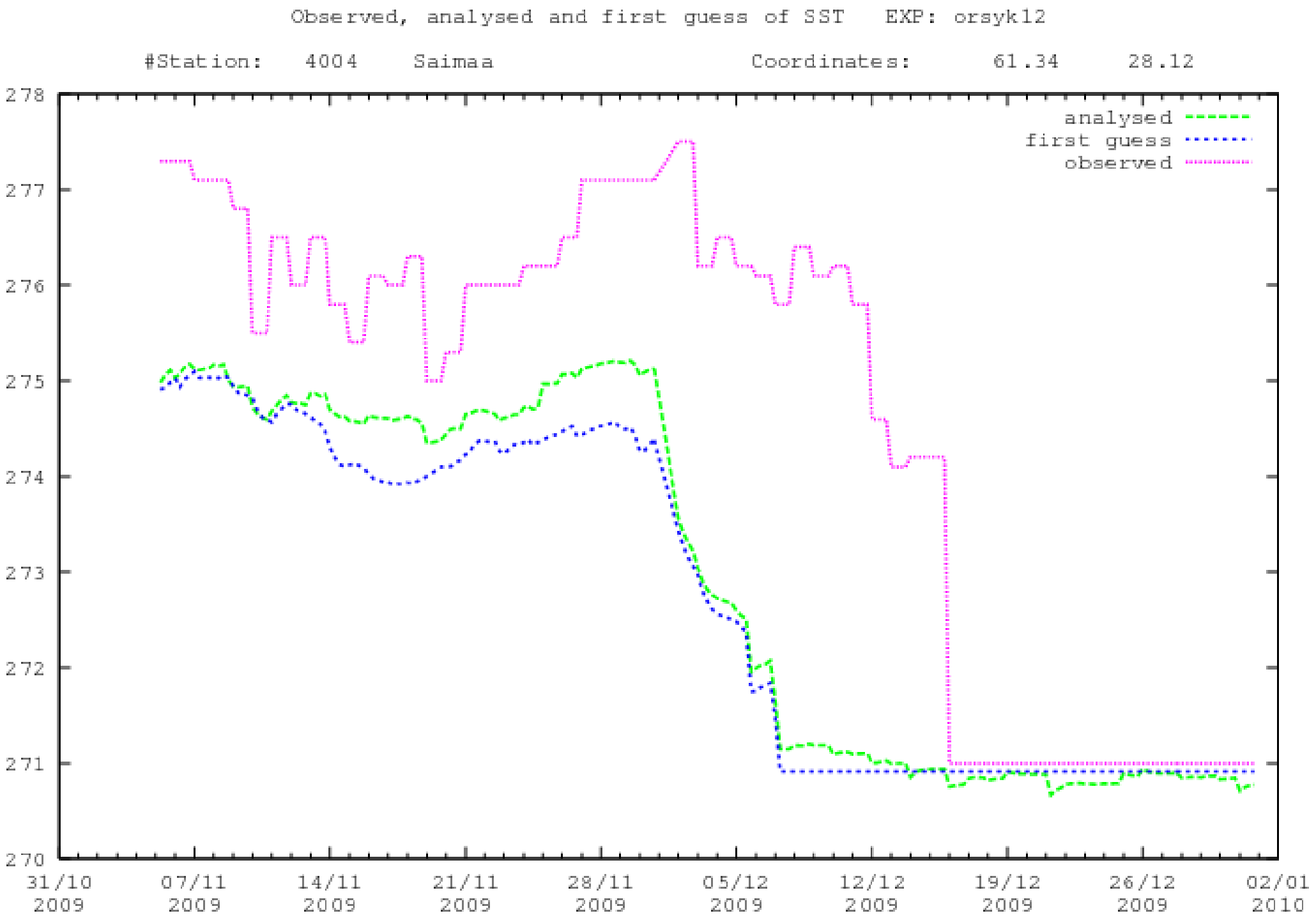


Analysis – first guess by FLake: fraction of ice



2010.00	4.00	18.00	4.00	-2.20	63.27	29.61	Pielinen	- frozen lake flag set
			4.00	-2.20	62.76	27.78	Kallavesi	- frozen lake flag set
			4.00	4.54	62.11	28.39	Haukivesi	- SYKE statistical fit
			4.00	4.19	61.34	28.12	Saimaa	- SYKE statistical fit
			4.00	-2.20	62.86	24.79	Paajarvi1	- frozen lake flag set
			4.00	-2.20	63.11	26.53	Nilakka	- frozen lake flag set
			4.00	-2.20	62.63	26.60	Konnevesi	- frozen lake flag set
			4.00	5.34	61.63	26.14	Jaasjarvi	- SYKE statistical fit
			4.00	5.28	61.61	25.48	Paijanne	- SYKE statistical fit
			4.00	5.18	61.30	26.17	Ala-Rievel	- SYKE statistical fit
			4.00	5.05	62.00	27.08	Kyyvesi	- SYKE statistical fit
			4.00	4.78	60.44	25.05	Tuusulanja	- SYKE statistical fit
			4.00	5.24	61.00	22.29	Pyhajarvi	- SYKE statistical fit
			4.00	4.92	61.54	24.37	Langelmave	- SYKE statistical fit
			4.00	4.15	61.06	25.13	Paajarvi2	- SYKE statistical fit
			4.00	5.32	62.14	23.76	Vaskivesi-	- SYKE statistical fit
			4.00	5.39	60.79	23.86	Kuivajarvi	- SYKE statistical fit
			4.00	4.91	61.63	23.75	Nasijarvi	- SYKE statistical fit
			4.00	1.83	63.15	23.67	Lappajarvi	- SYKE statistical fit
			4.00	-2.20	64.95	28.65	Pesiojarvi	- frozen lake flag set
			4.00	-2.20	64.18	28.02	Rehja-Nuas	- frozen lake flag set
			4.00	-2.20	64.45	26.97	Oulujarvi	- frozen lake flag set
			4.00	-2.20	68.38	23.60	Ounasjarvi	- frozen lake flag set
			4.00	-2.20	67.17	25.71	Unari	- frozen lake flag set
			4.00	-2.20	69.01	20.82	Kilpisjarv	- frozen lake flag set
			4.00	-2.20	69.75	27.01	Kevojarvi	- frozen lake flag set
			4.00	-2.20	69.08	27.92	Inarijarvi	- frozen lake flag set


Observed, analysed and first guess of SST EXP: orsyk12
#Station: 4013 Pyhajarvi Coordinates: 61.00 22.29
analysed
first guess
observed
278
277
276
275
274
273
272
271
31/10 2009
07/11 2009
14/11 2009
21/11 2009
28/11 2009
05/12 2009
12/12 2009
19/12 2009
26/12 2009
02/01 2010


Observed, analysed and first guess of SST EXP: orsyk12
#Station: 4004 Saimaa
Coordinates: 61.34 28.12
analysed
first guess
observed
278
277
276
275
274
273
272
271
270
31/10 2009
07/11 2009
14/11 2009
21/11 2009
28/11 2009
05/12 2009
12/12 2009
19/12 2009
26/12 2009
02/01 2010

OPEN QUESTIONS OF INTERPOLATION AND DATA ASSIMILATION

Observations and model

- Role of observations and the prognostic lake parametrizations
- Availability and combination of different observations and ”observations"
- Specific questions of handling ECMWF (climatological) input
- Perspectives of usage of the North Hydrology observations

Interpolation methods

- Successive corrections or optimum interpolation?
- Interpolation between different lakes, lakes and sea?
- Relation between the ice cover and surface temperature analysis
- Quality control of observations: first guess/neighbours
- The role of model background (first guess) and climatic information

Towards lake data assimilation

- From diagnostics and horizontal interpolation towards assimilation