



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

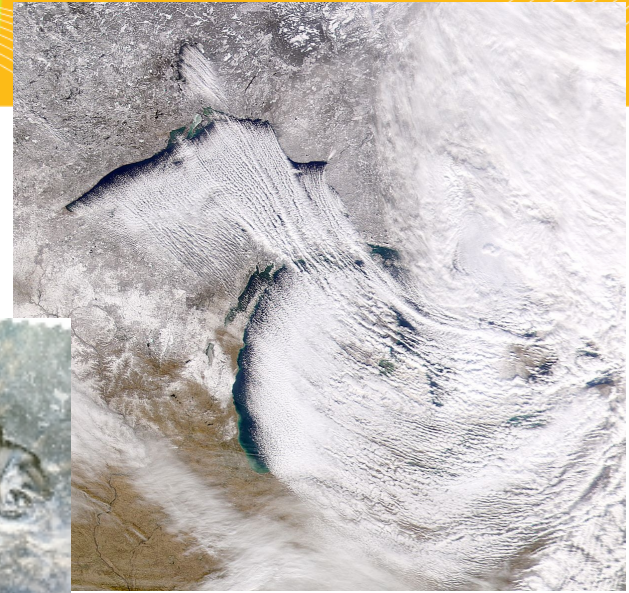
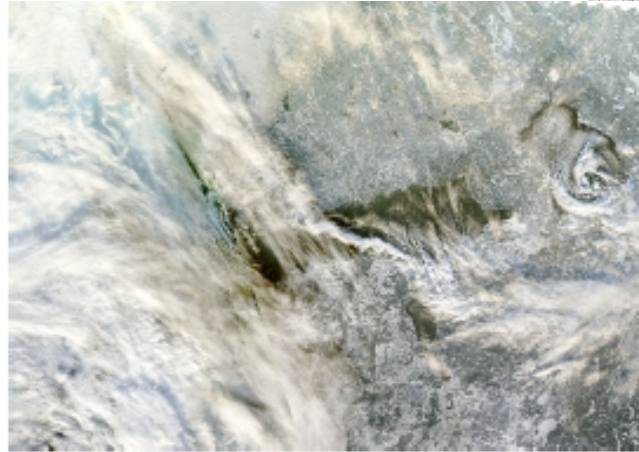
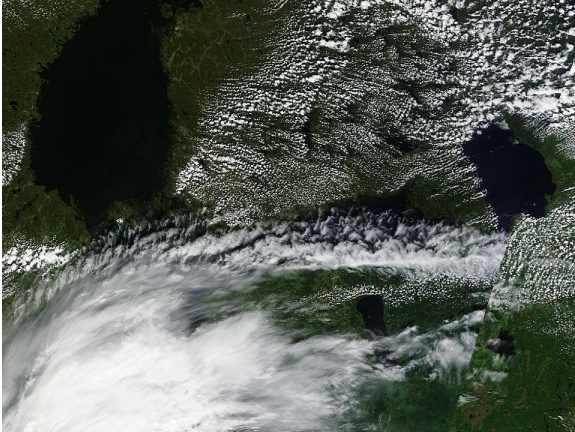
Recent HIRLAM lake-related activities

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Margarita Choulga (RSHU),
Yurii Batrack (RSHU)
and
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15-18 April 2013, Reykjavik



Introduction



MODIS, 2011

- lakes influence regional climate and local weather conditions
- may cover the significant part of the territory: Nordic countries
- lakes affect surface fluxes
- ice covered/ ice free surface - different physics



Introduction

- Parameterisation scheme (model)
FLake in RCA, HIRLAM, SURFEX, HARMONIE
- External parameters (physiography)
Regional lake database =>
Global lake database v.1 =>
Global lake database v.2
- Observations
in-situ, satellite
- Data assimilation methods
in horizontal: OI
in vertical: EKF
- Climatology
Global lake climatology v.1 =>
Global lake climatology v.2



Lake parameterisation: FLake (D. Mironov)

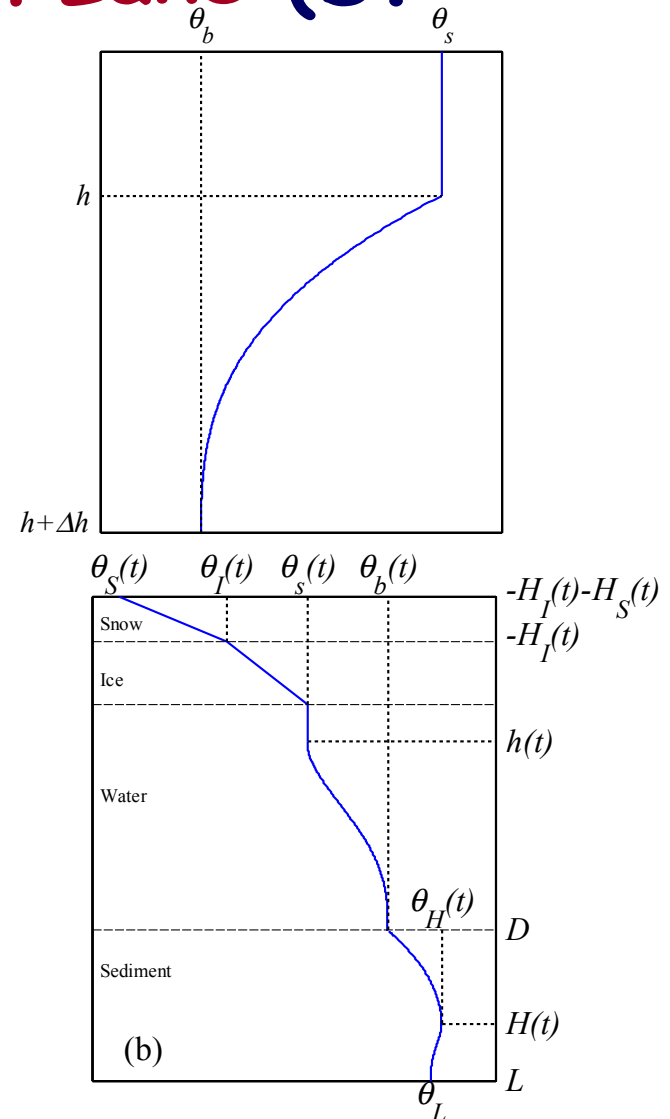
FLake - a bulk lake model 1D (0D)

based on two-layer parametric representation of the temperature profile and self-similarity concept

θ_s - mixed layer temperature,

h - mixed layer depth,

θ_b - bottom temperature





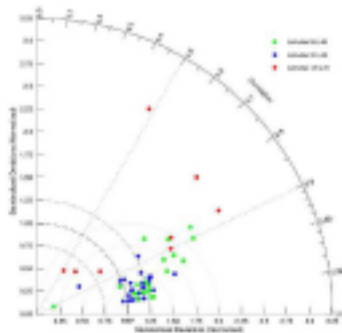
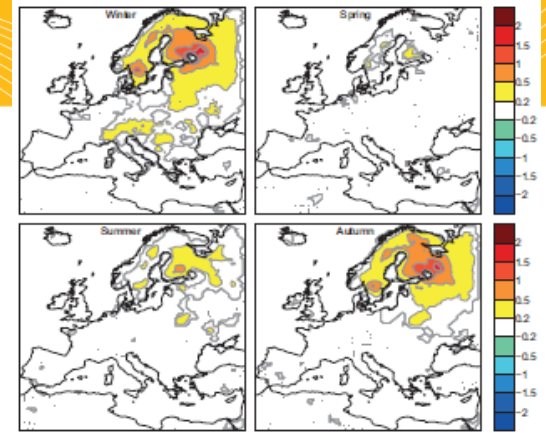
Lake parameterisation: FLake

- main equations: predict characteristics of the temperature profile
- the mixed layer depth is predicted in
 - convection, neutral and stable stratification
- short-wave radiation transfer block
- ice and snow (tested by T. Semmler)
- bottom sediments

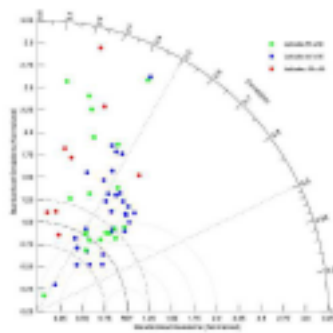


FLake is coupled with ...

- RCA
- HIRLAM
- included into SURFEX
recent tests by A. Boon and P. Le Moigne
global lon-lat grid - to be tested more!
- HARMONIE - to be tested!

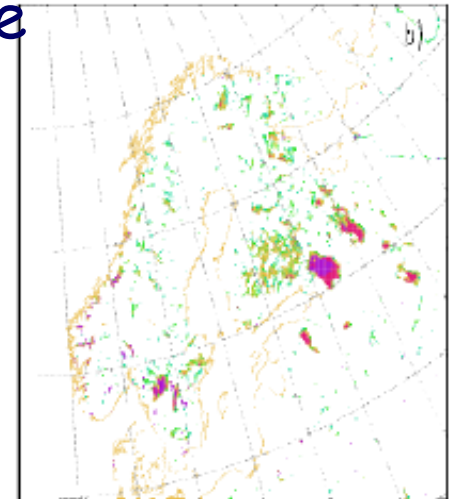


Raw data
SURFEX SSC Meeting, March 28, 2013



Annual cycle removed
Toujours un temps d'avance

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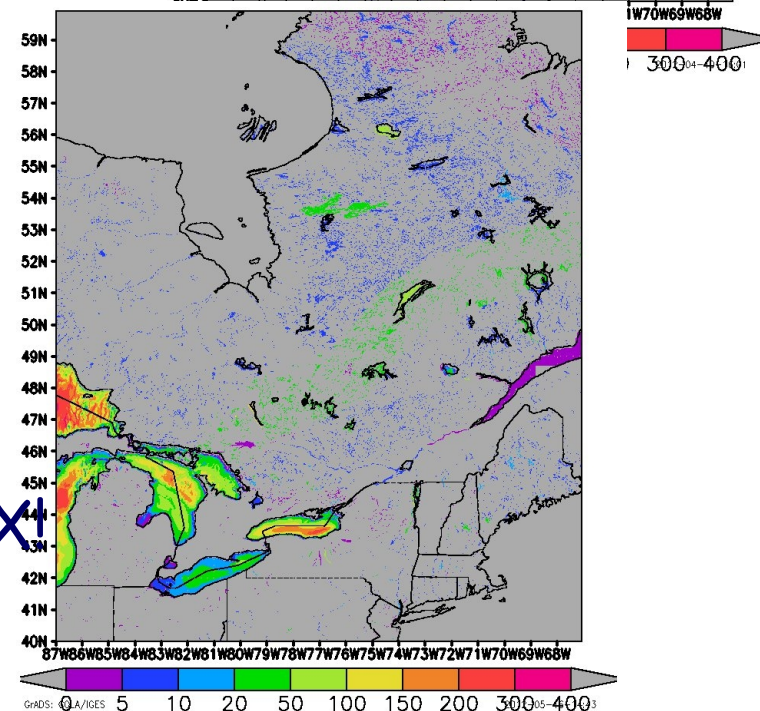
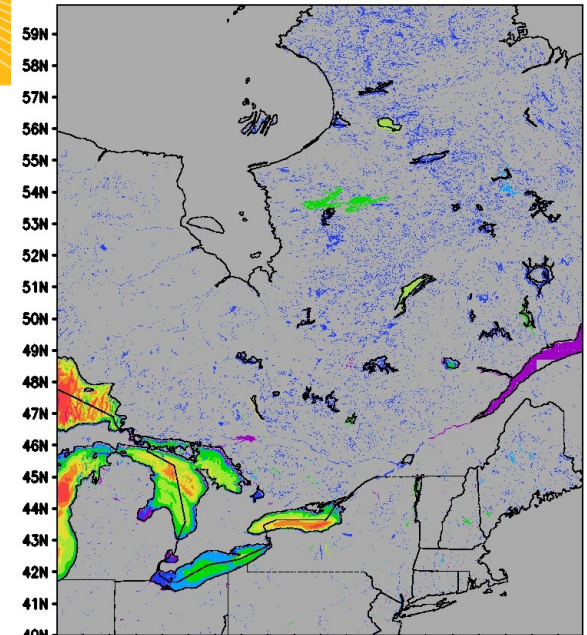
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min=0 max=1 mean=0.518296



External parameters ... physiography

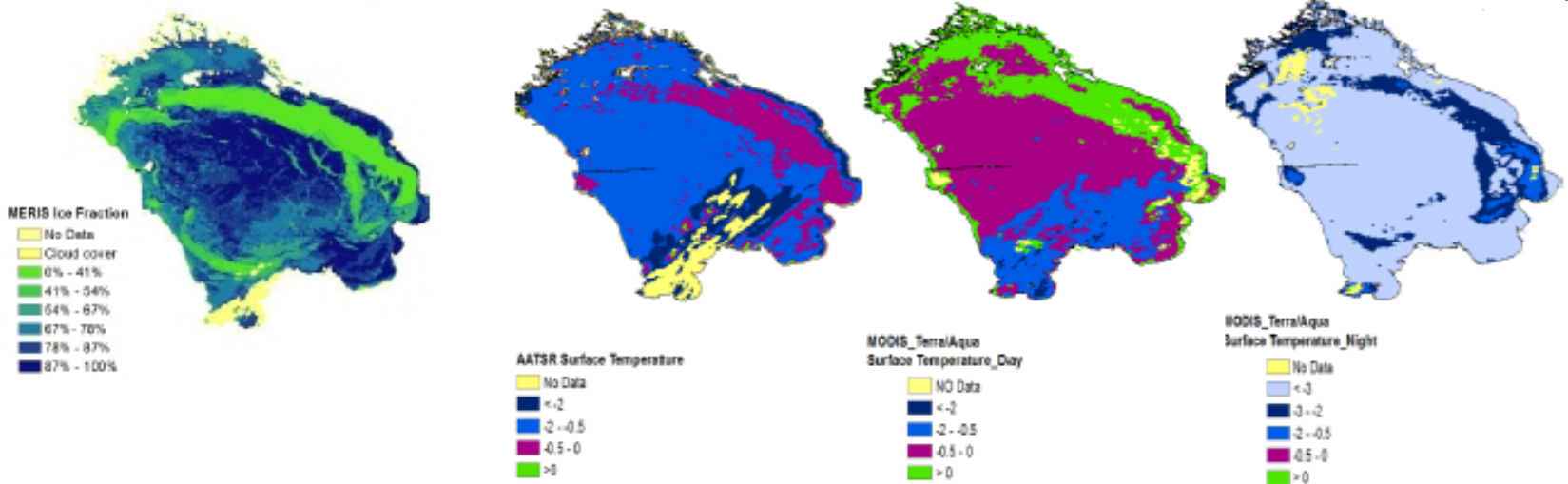
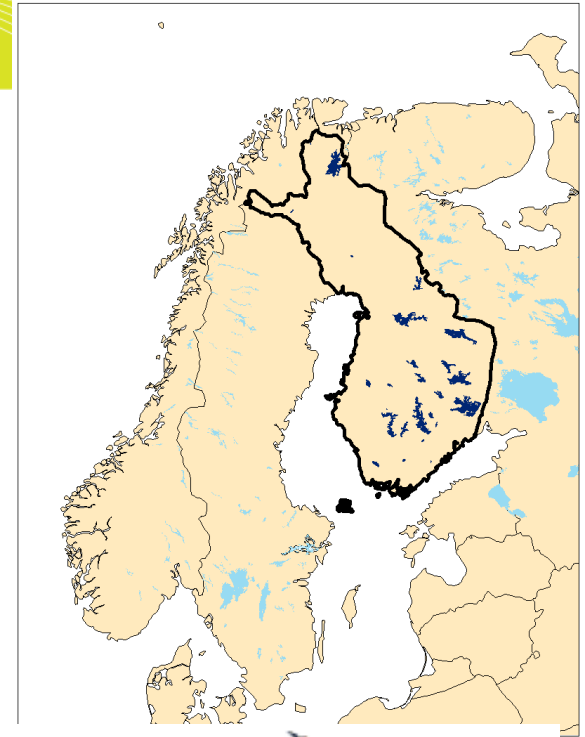
- Regional lake database
- Global lake database v.1
 - ca. 13 000 lakes
 - 30" resolution
- Global lake database v.2 -
 - includes indirect estimates of lake depth from geological origin
 - ... to be continued!
 - ... to be included into SURFEX!





Lake observations ...

- in-situ: SYKE, Finland
- satellite:
see pres. by Homa Keyrollahpour





Data assimilation methods ...

- In horizontal ... plans and ideas:
 - for LS, use OI as for SST, but with the dependency of structure functions on the difference in lake depth and elevation?
 - for remote sensing data: thinning, super-observations by aggregation, lake masks consistency problem
 - fraction of ice - how to assimilate?
 - ... see pres. by Homa Keyrollahpour
 - ... to be continued



Data assimilation methods ...

- In vertical (inside FLake):
 - EKF was developed
 - tested for different kinds of obs:
SYKE, synthetic, cross-validation check

Role of obs: SYKE vs synthetic

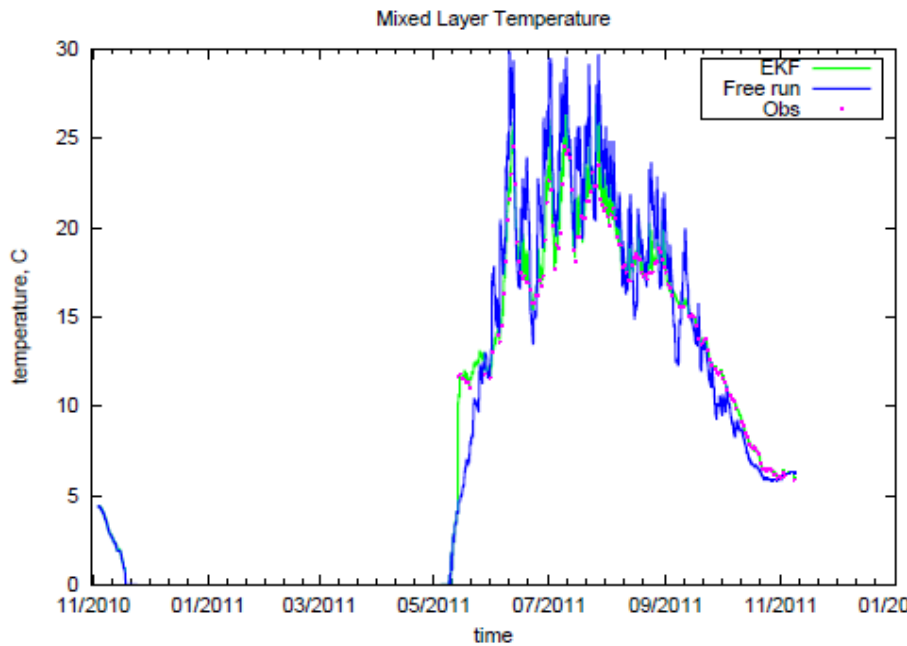
SYKE obs: start ~ a week after ice break-up

Synthetic obs: SYKE + MODIS + SYKE ice break-up dates

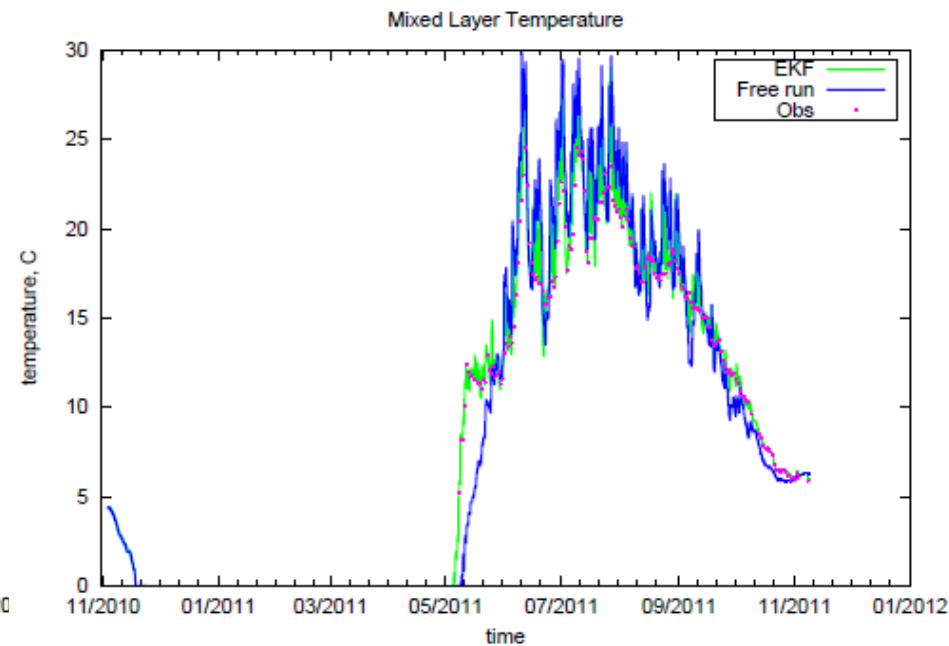


Role of obs: SYKE vs synthetic

Lake Lappa, 7m
LWST



SYKE



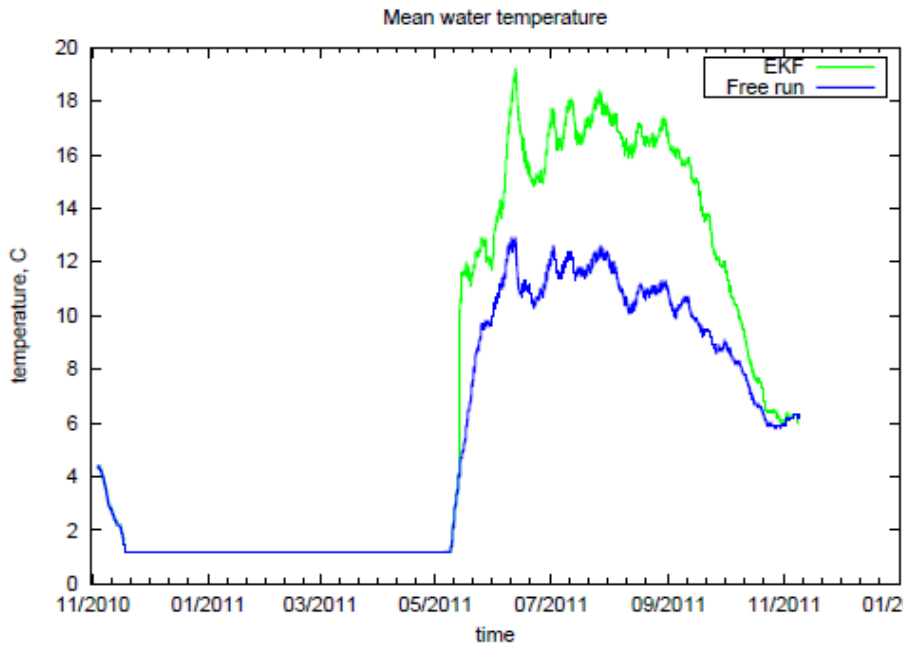
SYNTH



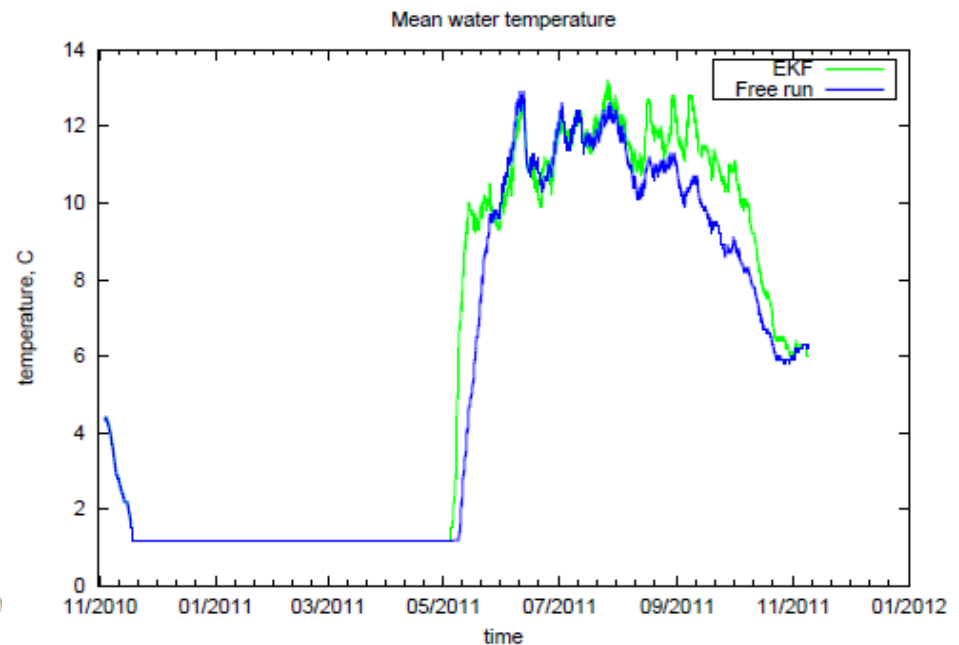
Role of obs: SYKE vs synthetic

Lake Lappa, 7m

Mean water temperature



SYKE



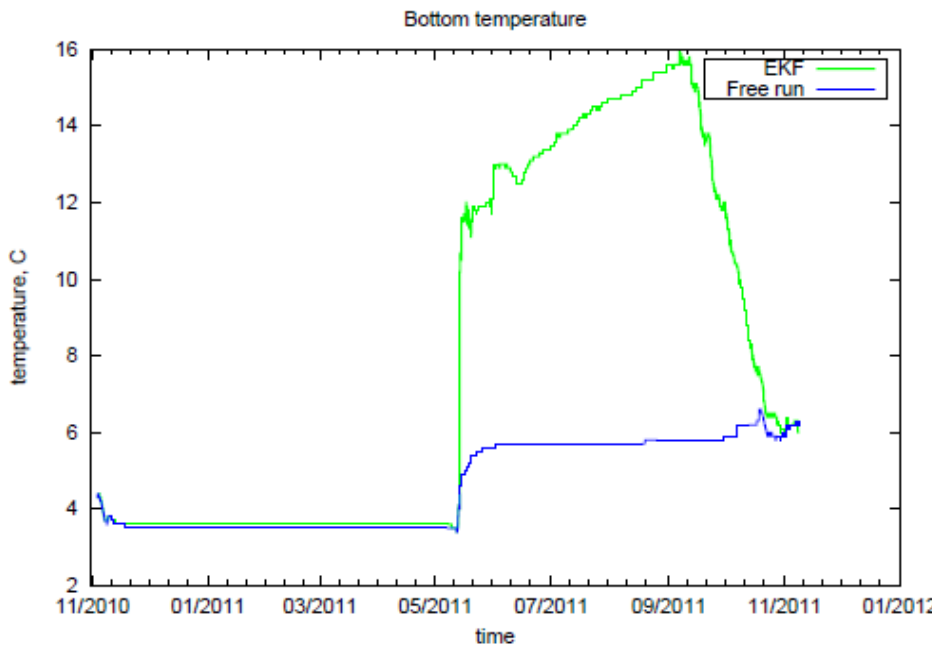
SYNTH



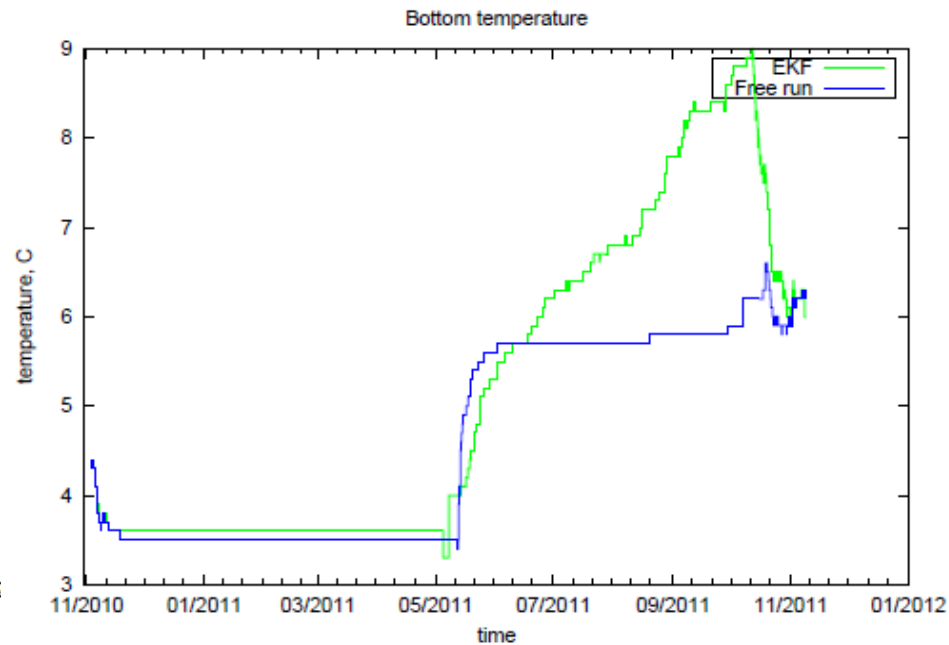
Role of obs: SYKE vs synthetic

Lake Lappa, 7m

Bottom temperature



SYKE



SYNTH



Cross-validation

- Synthetic data. Assimilate every second obs.

Lake	Bias		RMS	
	REF	EKF	REF	EKF
Inari (14 m)	-2.0	-2.0	5.0	1.3
Saimaa (11m)	-1.1	-1.1	3.7	1.7
Tuusula (3m)	0.8	0.8	2.9	1.9
Lappa (7m)	1.2	1.2	2.9	2.0

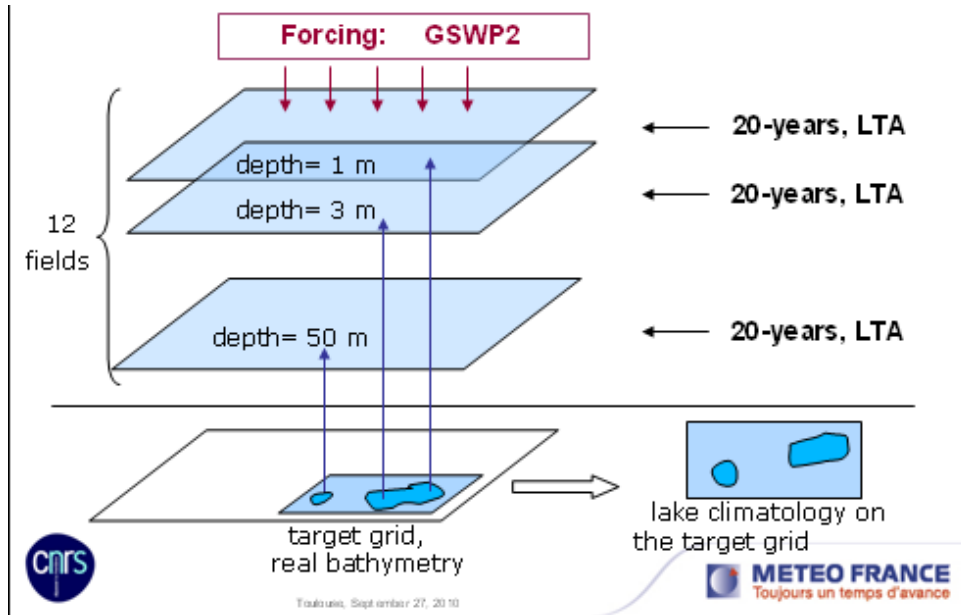
... continue testing

... include into SURFEX and HARMONIE!

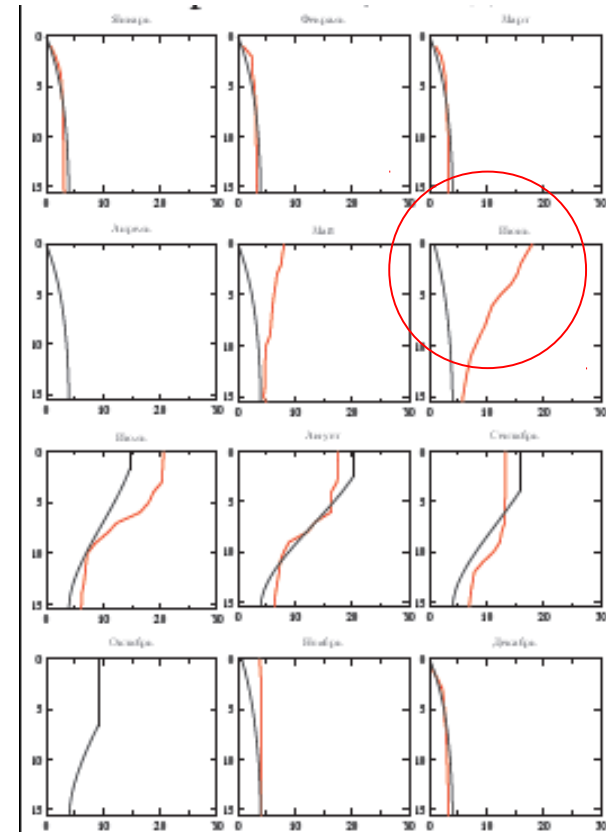


Climatology

- Global lake climatology v.1: serious problems in spring
- Global lake climatology v.2



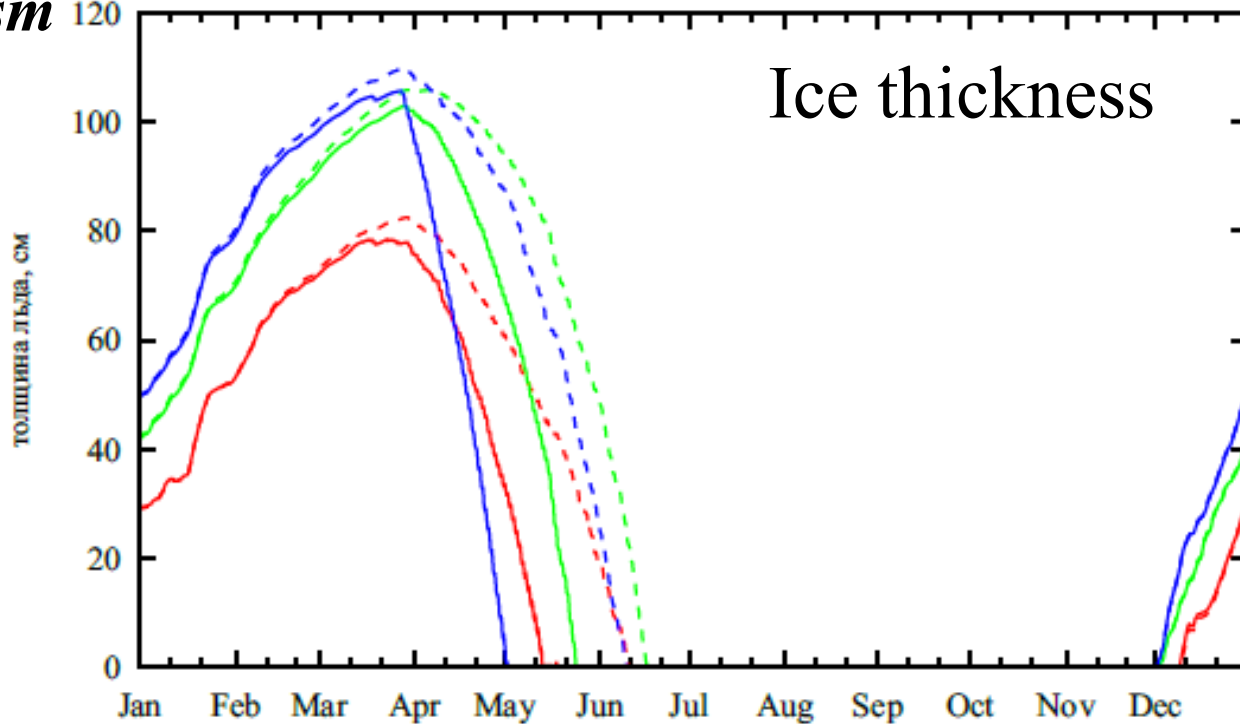
Lake Amisk, Canada





Climatology

h_{ice} , sm



0.6 GDAS
GMFD LSM
NCEP

0.3-0.5 GDAS
GMFD LSM
NCEP

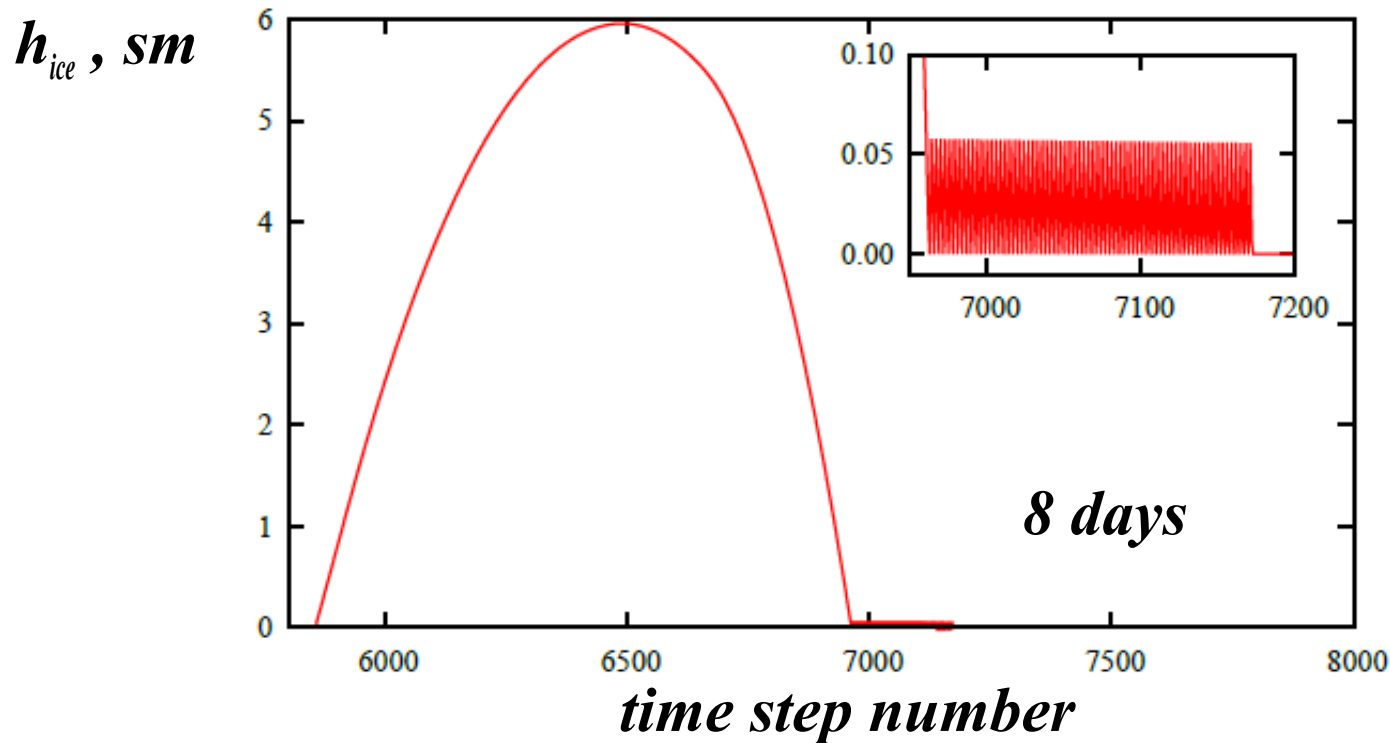
GDAS
GMFD LSM
NCEP

30° LON, 60° LAT, d=10 m



Climatology

Numerical instability in quasi-equilibrium ice model



5° LON, 50° LAT, $d=7$ m, $\Delta t = 1$ hour

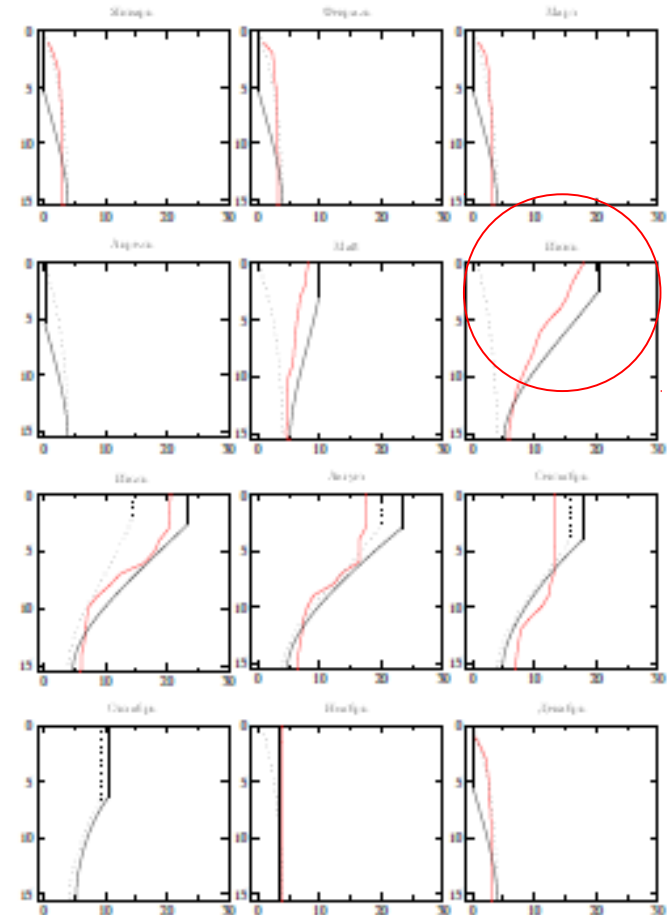


Climatology

- Global lake climatology v.2
 - forcing from NCEP
 - albedo after Mironov-Ritter
 - Euler scheme with $\Delta t=20min$
 - snow on lake ice
 - => reduced errors in spring

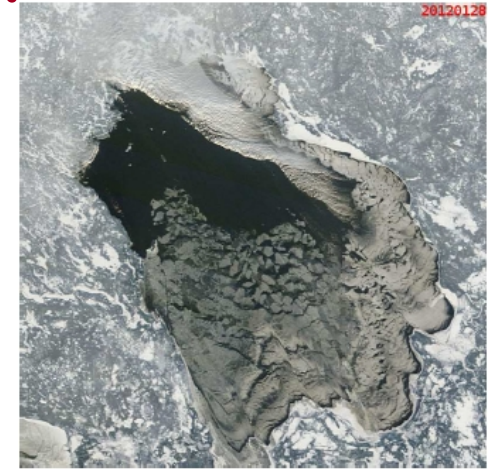
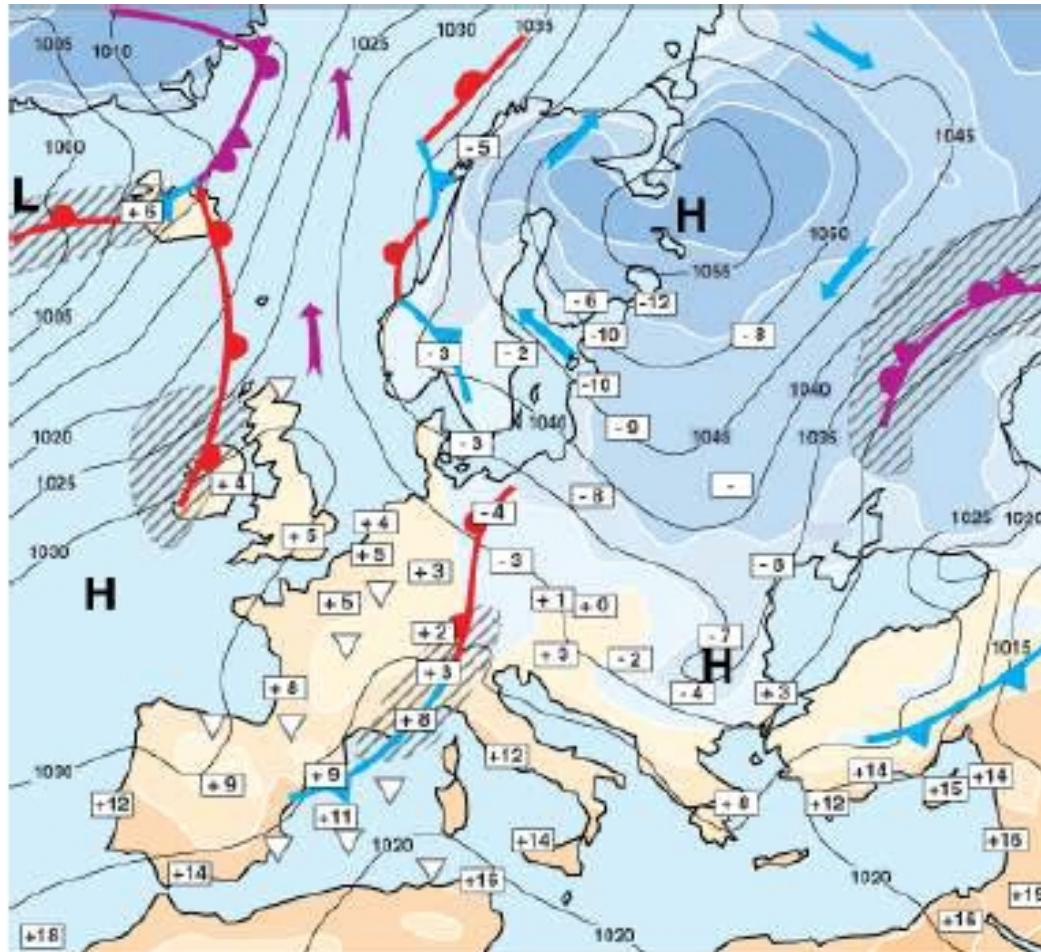
... to implement into HIRLAM,
SURFEX and HARMONIE!

Lake Amisk, Canada



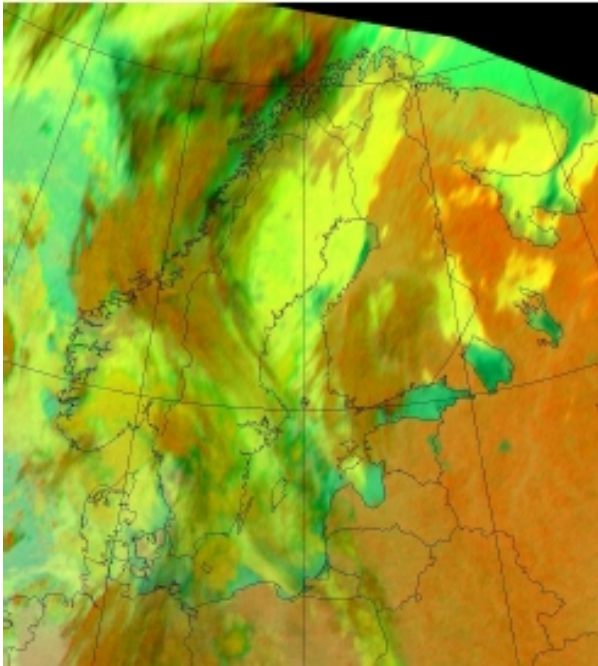


Case study over Lake Ladoga, 28.01.12

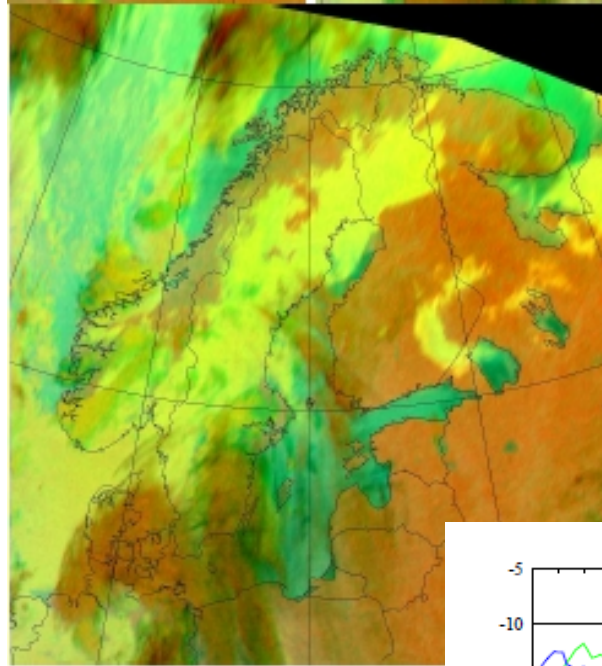




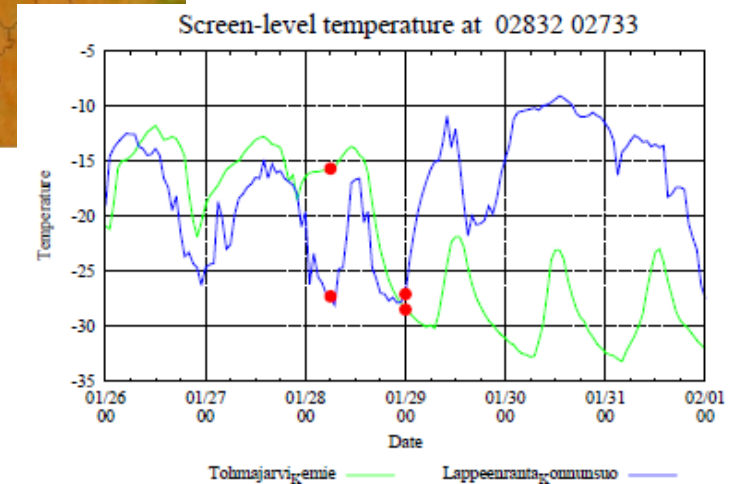
Case study over Lake Ladoga, 28.01.12



06UTC 28.01



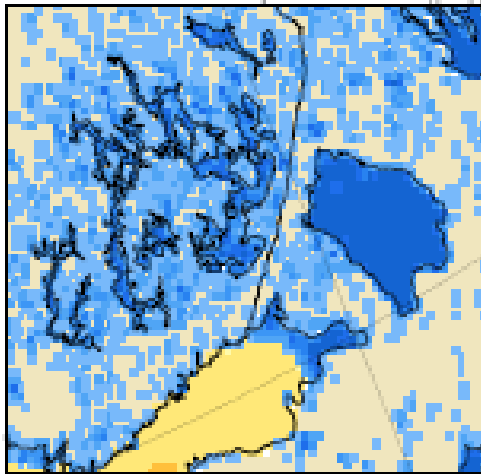
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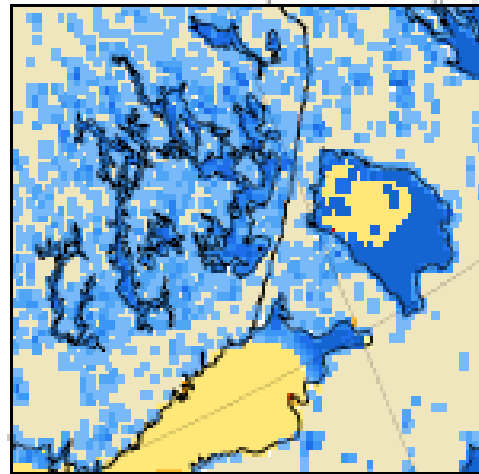


Case study over Lake Ladoga, 28.01.12

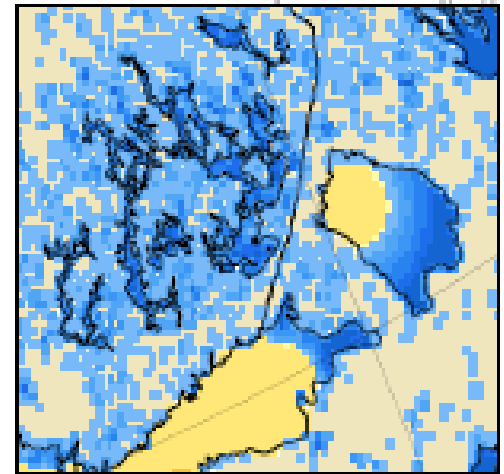
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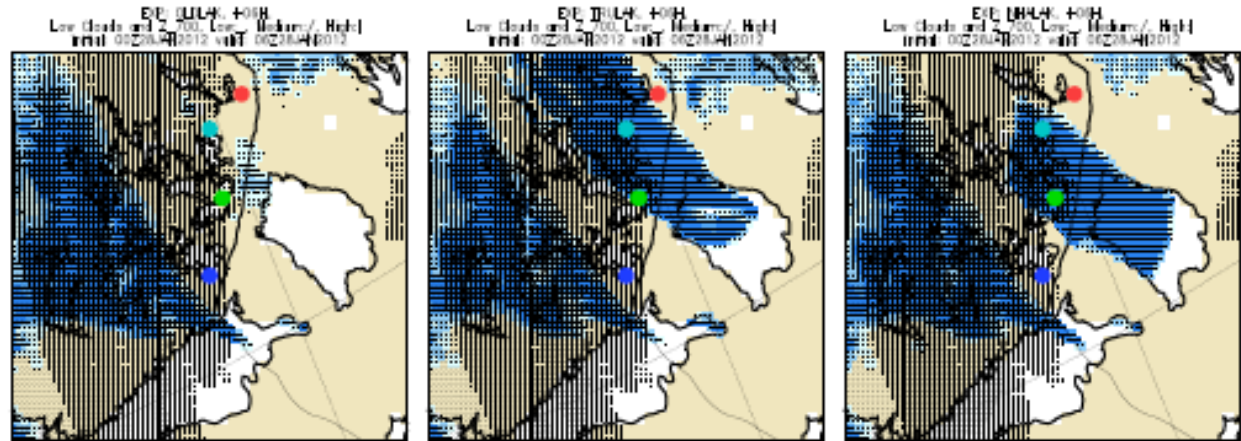


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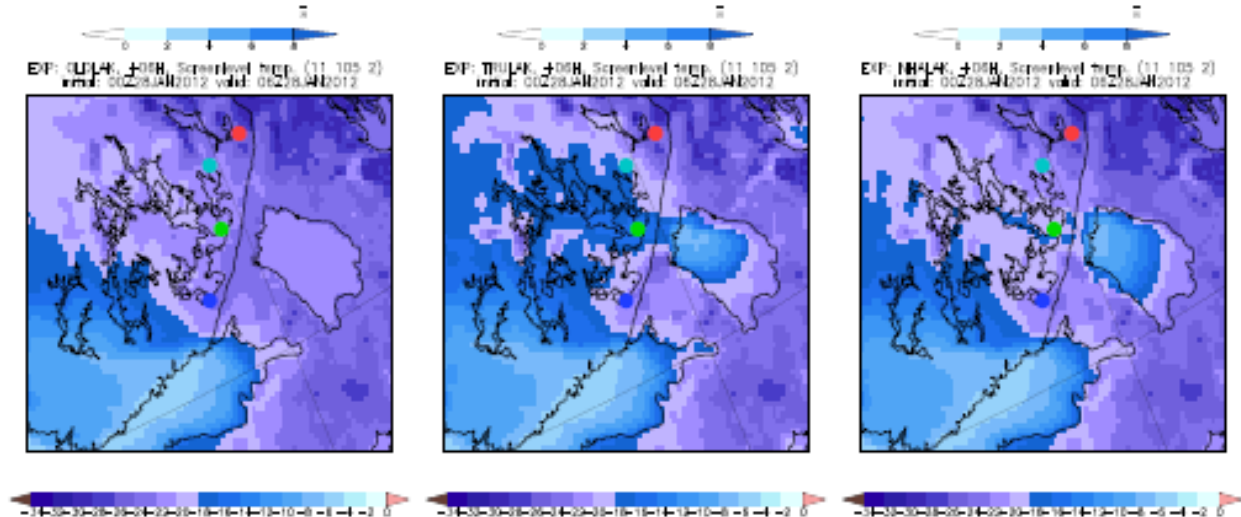




Case study over Lake Ladoga, 28.01.12

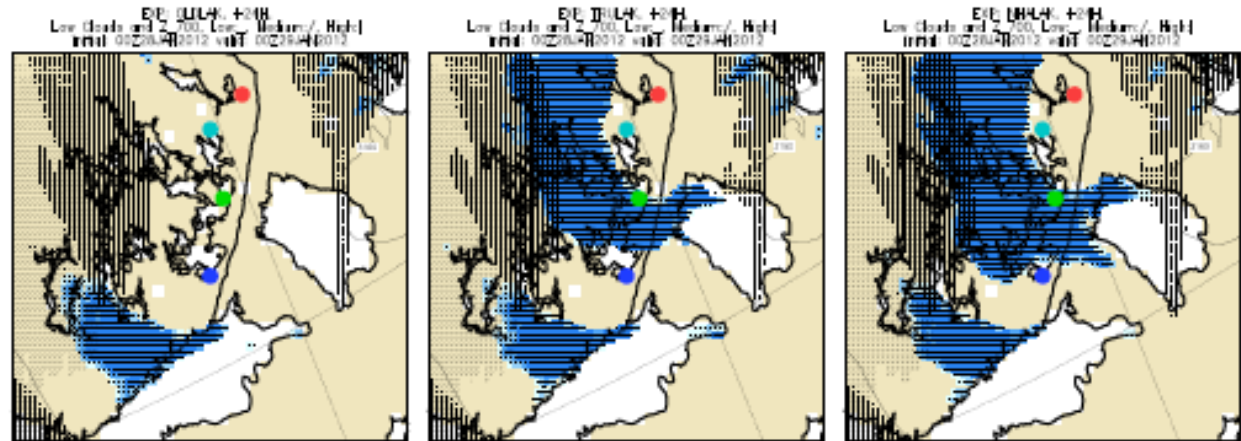


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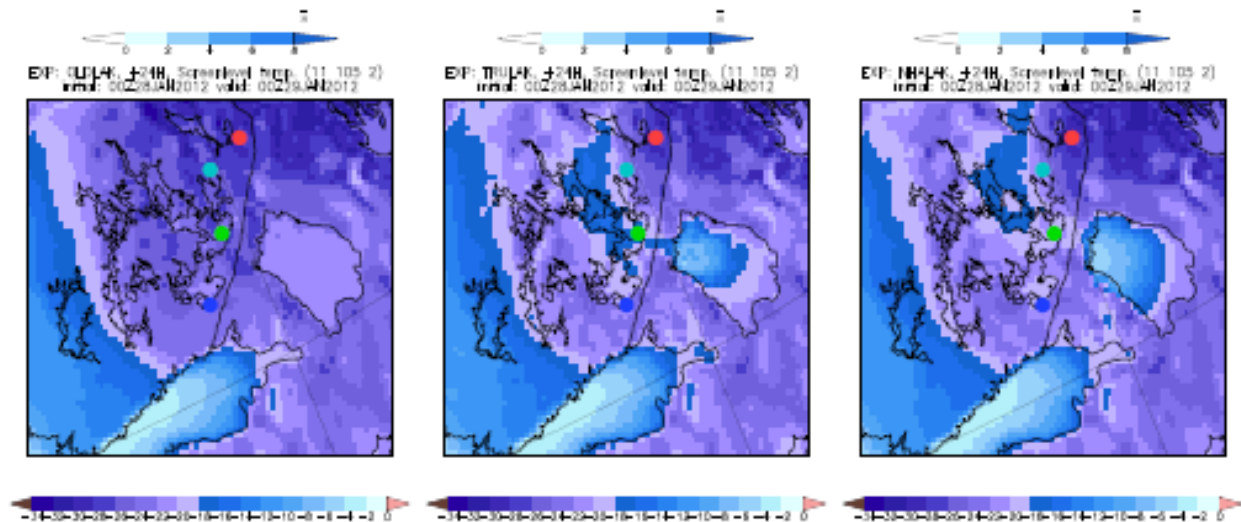




Case study over Lake Ladoga, 28.01.12

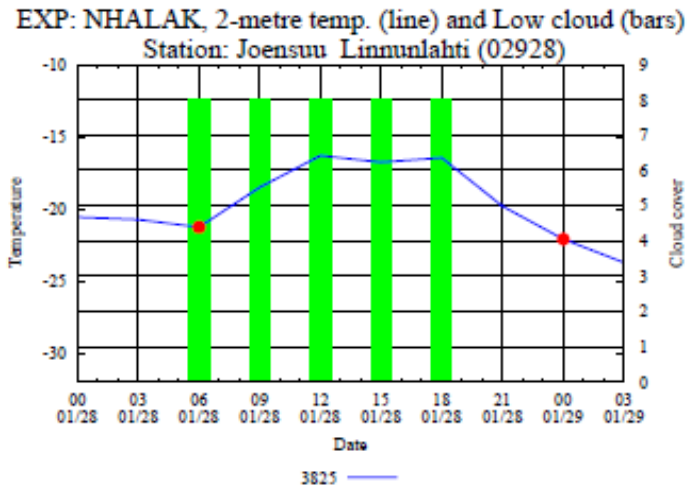
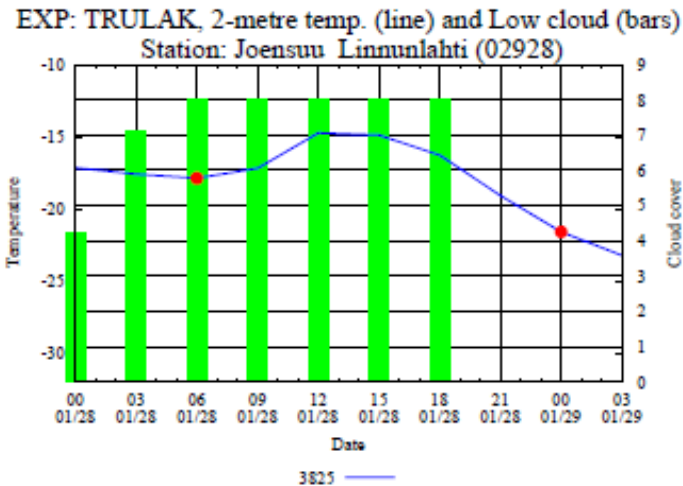
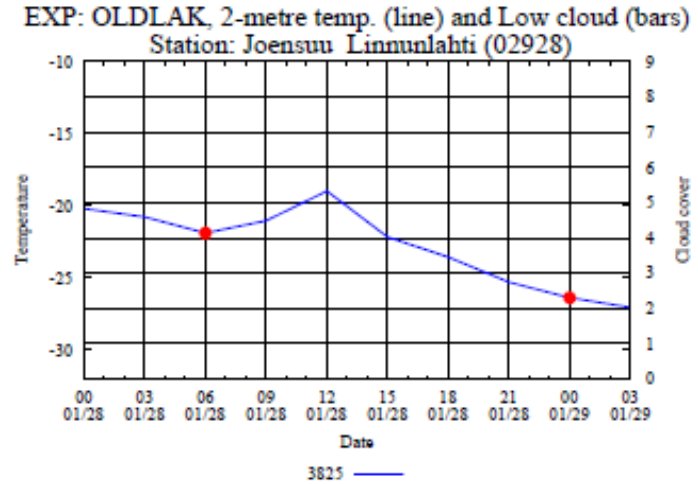
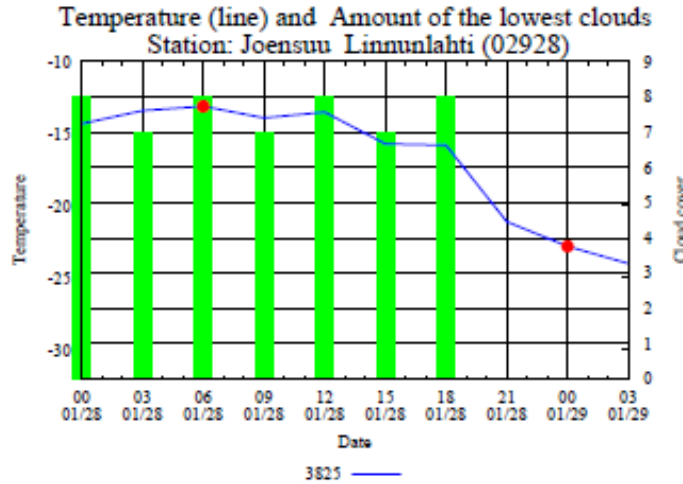


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Case study over Lake Ladoga, 28.01.12



Thank you for attention!

