ILMATIETEEN LAITOS
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Performance of FLake in HARMONIE

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Joint 28th ALADIN Workshop and HIRLAM ASM
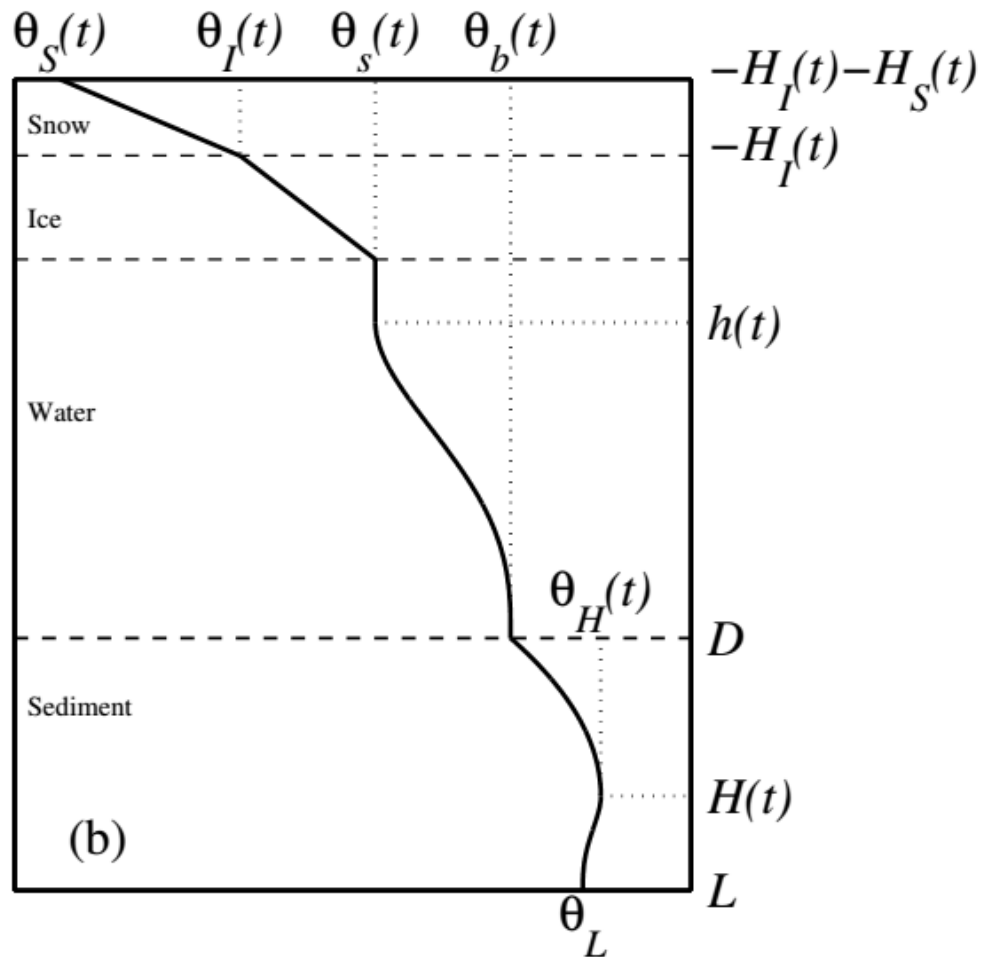### Toulouse, April 16-20, 2018

Outlines

- FLake in HARMONIE

- FLake performance, impact and verification

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- Parameterization of lakes runs operationally in HIRLAM model for many years, but until recently, not in HARMONIE …

- As in HIRLAM model, parameterization of lakes in HARMONIE is based on FLake (via land surface modeling platform SURFEX)

FLake in HARMONIE

(b)

Lake model FLake:

- Self-similarity concept

- Parametric representation of temperature profile in water, ice, snow on ice and in bottom sediments

- Temperature profile in water: the mixed layer and thermocline

- Solar radiation flux: exponential approximation of the decay law

FLake in HARMONIE

- **Lake fraction**: land-use map ECOCLIMAP
  Tiling!

- **Lake depth**: GLBDv3

- **Initialization of FLake**: Lake climatology, v.1

Problems to solve:

- Consistency problem: in ECOCLIMAP, different types of wetlands and coastal lagoons contained "lake water" => fixes both in Cover tables and in the bitmap

- Aggregation/interpolation problem in SURFEX: corrected.
  Use the nearest neighbor method for interpolation of lake parameters

FLake performance

HARMONIE experiments:

- Cy h40.1, SURFEXv7.3
- MetCoOpB domain, 2.5 km res
- 2 runs: Nov.2015- Jan.2016
        Apr.-May 2016   Winter 2015-2016
- 3h forecasts for DA cycling
- 48-h forecasts start at 00 and 12 UTC

FLake performance

Winter 2015-2016 was unusually warm in the region!
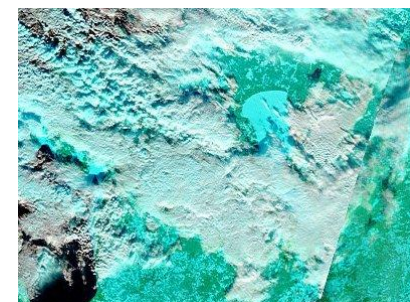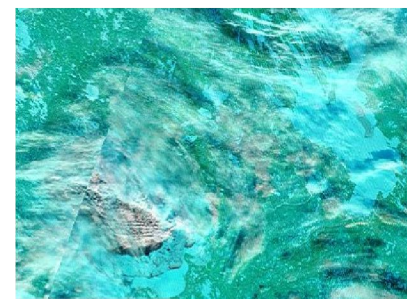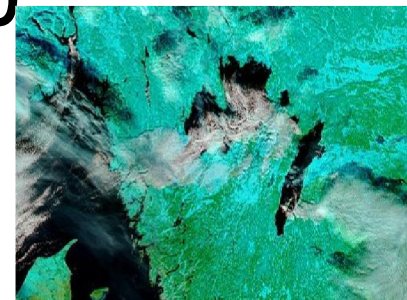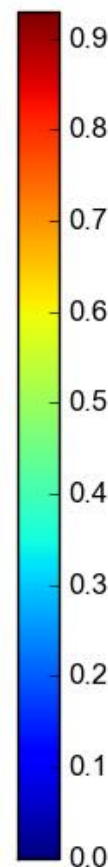
Ice cover periods:

	from MODIS, winter 2015-2016	climatology
Vännern	no ice cover	from Nov.-Dec. to Apr., not every year
Vättern	no ice cover	from Nov.-Dec. to Apr., not every year
Ladoga	from Jan., 21 to Jan., 29	from Dec.-Feb. to beg. of May
Peipsi	from Jan., 3 to Apr., 5	from Nov.-Dec. to Apr.-May

Challenge for FLake to reproduce!
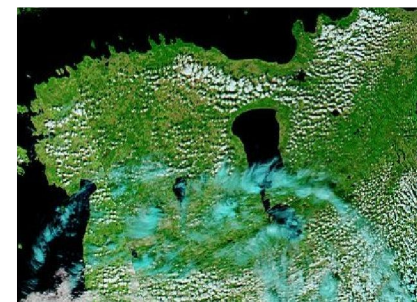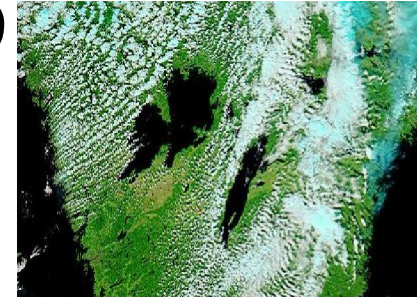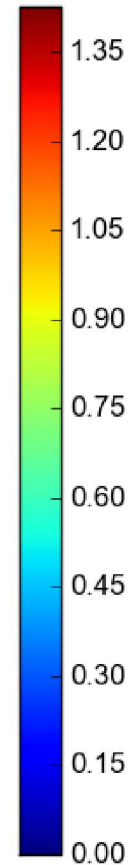
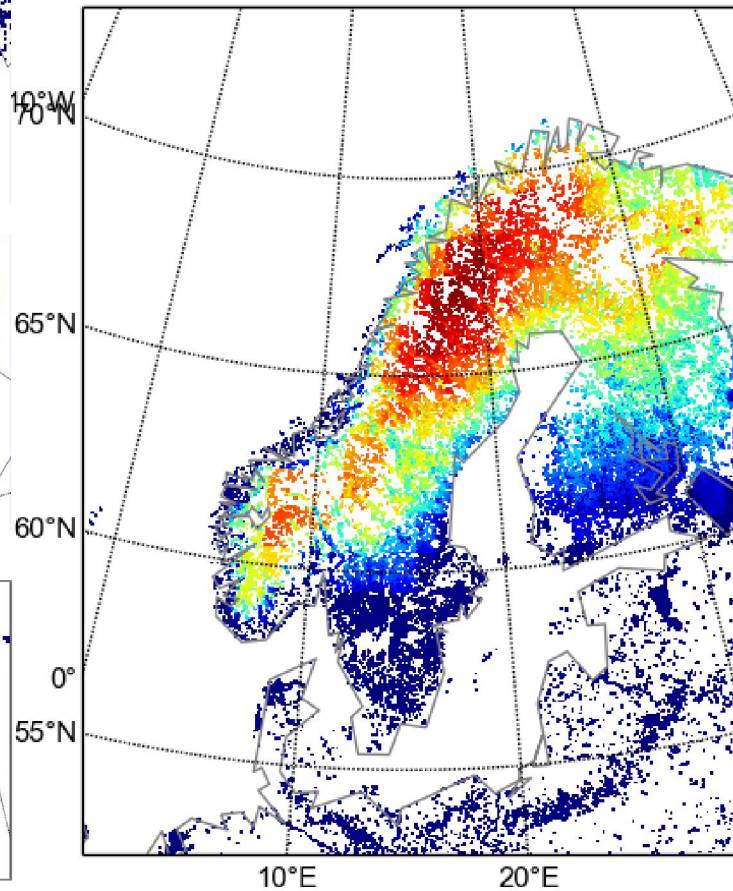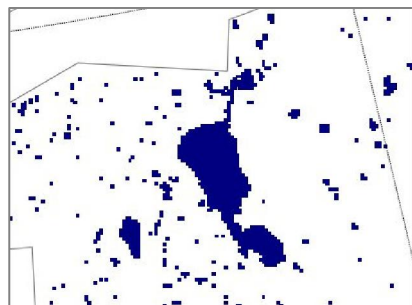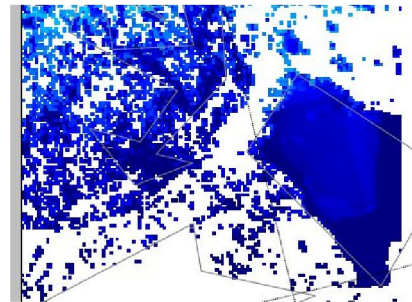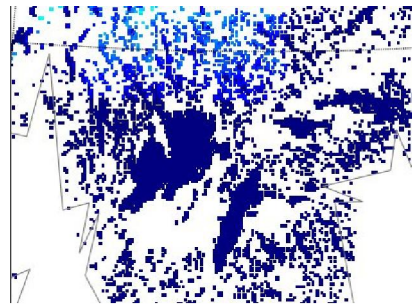# FLake performance: autumn

H ice, m, 15.01.2016.00+00
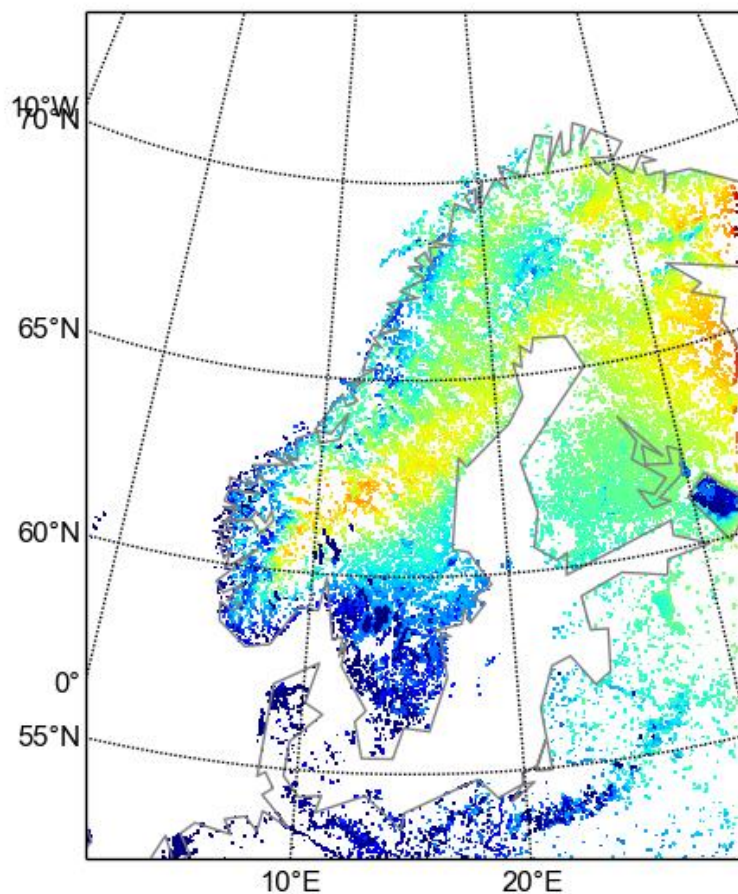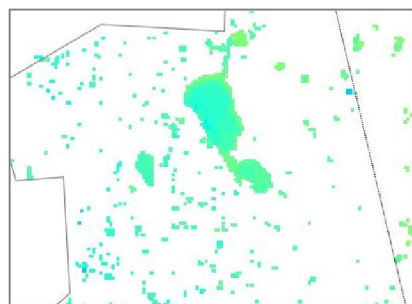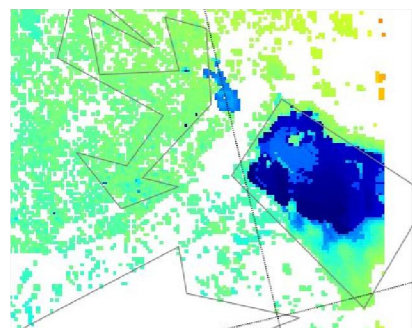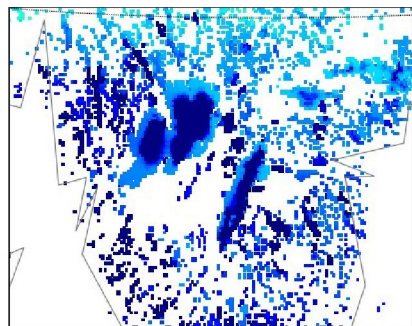
FLake performs good!

FLake performance: spring

H ice, m, 01.05.2016.00+00

Too much ice in FLake due to starting from climatology
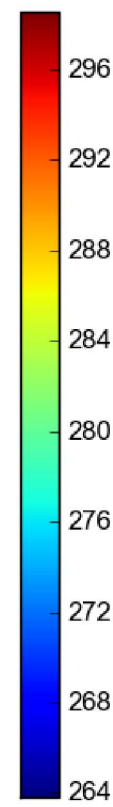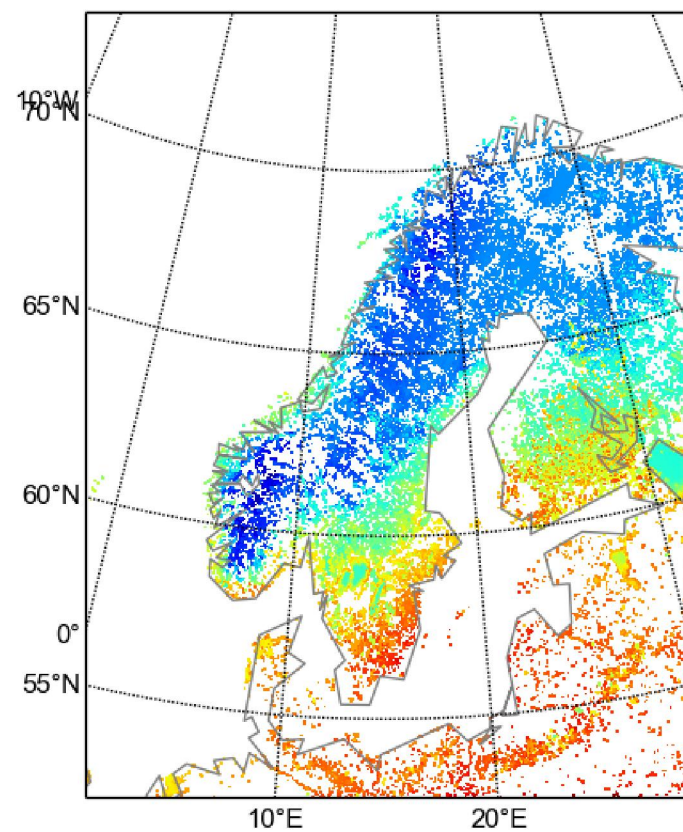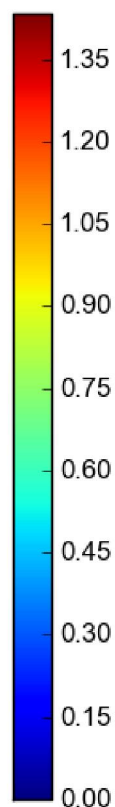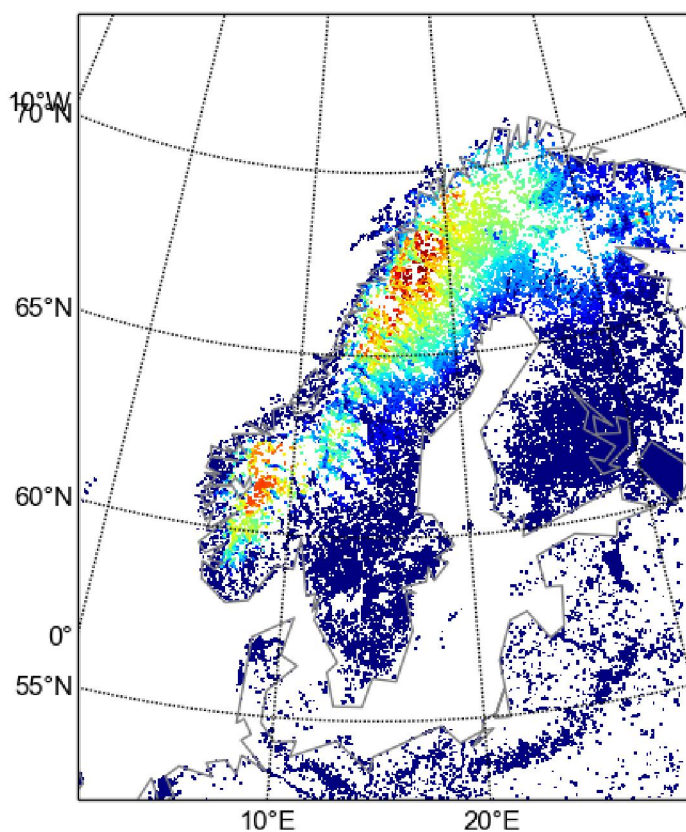
FLake performance: spring

H ice, m   15.05.2016.00+00   Ts, lake, K

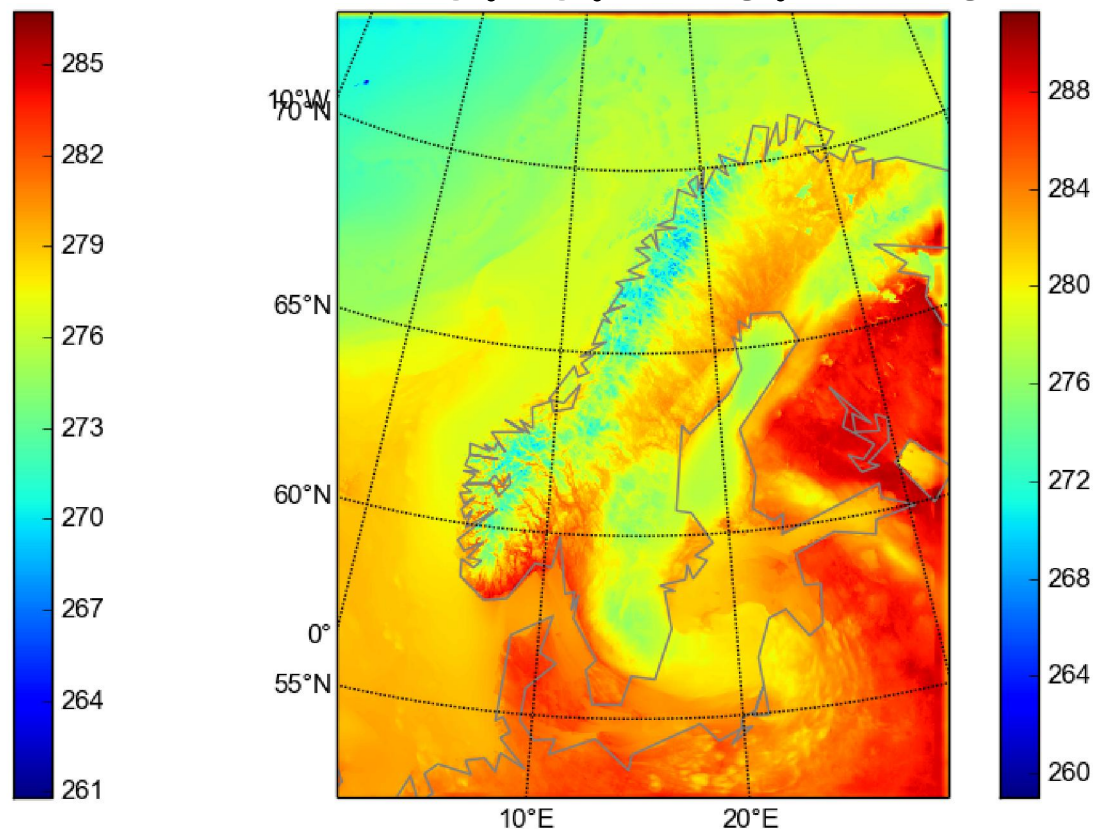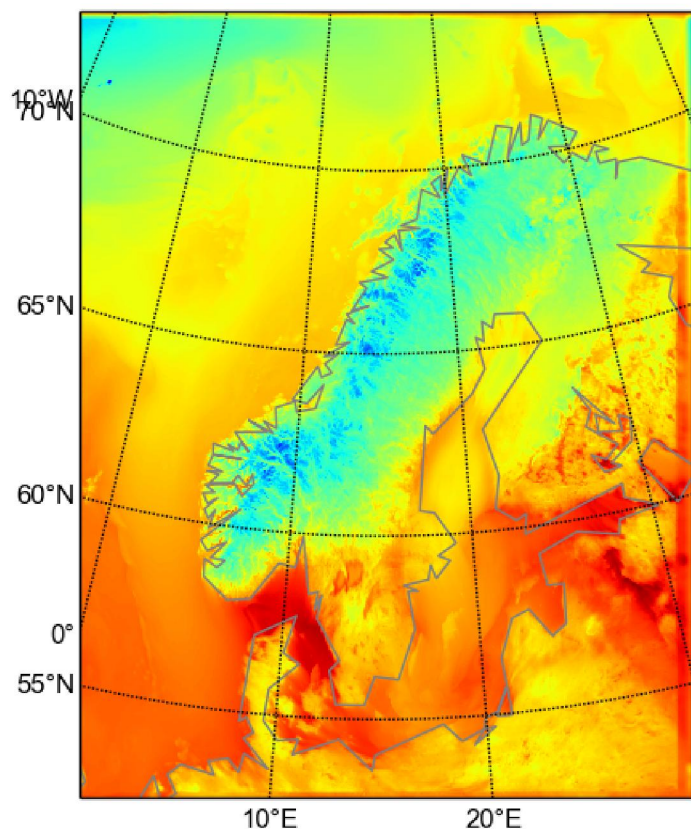Situation improves gradually, ~ in one month

On impact of lakes …

T lowest model, K

15.05.2016.00+24

15.05.2016.00+36

**Atmospheric model often "sees" large and medium lakes;
Lakes might affect large scale atmospheric motions**

Verification: FLake vs WATFLUX

WATFLUX:

- Ts lake is constant during the forecast

- In MetCoOp setup, Ts lake is initialized each forecast cycle from the interpolated SST and the deep soil temperature

WATFLUX is affected by T2m observations via the analysis procedure (due to using of the deep soil temperature).

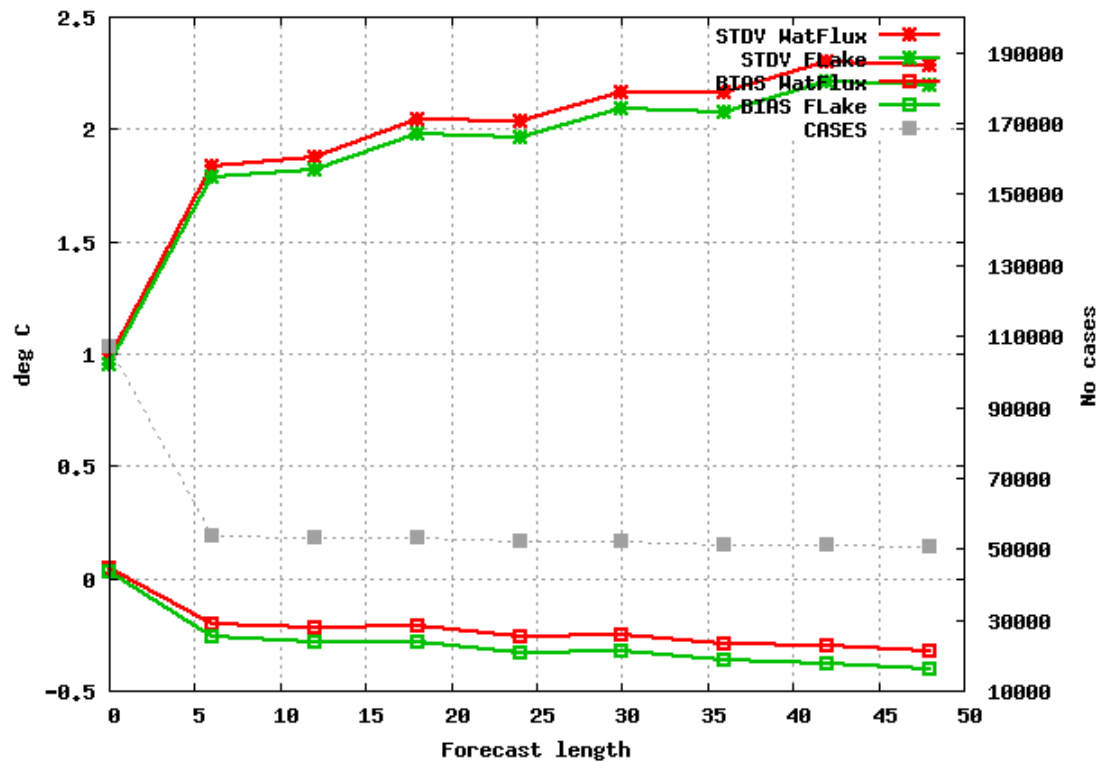FLake runs freely!

Not easy to beat WATFLUX!

Verification: FLake vs WATFLUX

T 2m bias and ESTD, K, December, 2015

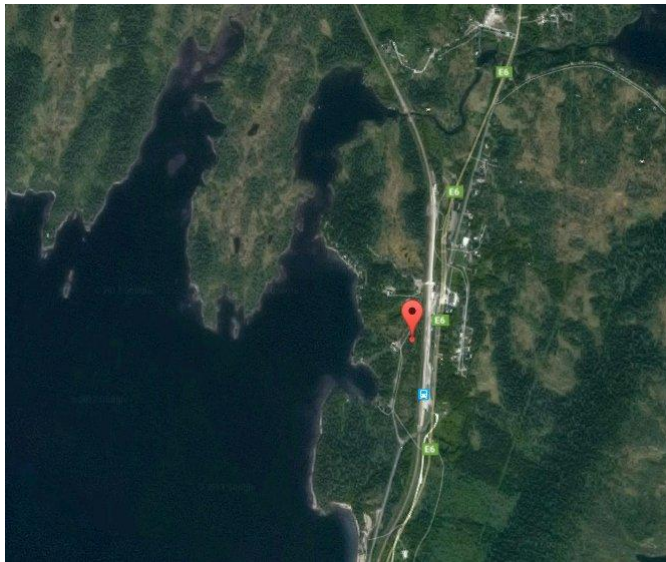WATFLX   FLAKE

From standard verification,

it is difficult to make conclusions

Verification: FLake vs WATFLUX

Lists of lake stations for different regions: totally, 122

We may see improvements and degradations for different lake regions

- Norway lowland   NL   – 12 stations
- Norway mountains   NM   – 9 stations
- Sweden lowland   SL   – 12 stations
- Sweden mountains   SM   – 14 stations
- Finland North   FN   – 12 stations
- Finland South   FS   – 39 stations
- Baltic region   BR   – 7 stations
- Russia North   RN   – 4 stations
- Russia Arctic   RA   – 4 stations
- Russia Center   RC   – 1 station
- Lake Vänern   VN   – 2 stations
- Lake Vättern   VT   – 2 stations
- Lake Ladoga   LA   – 3 stations
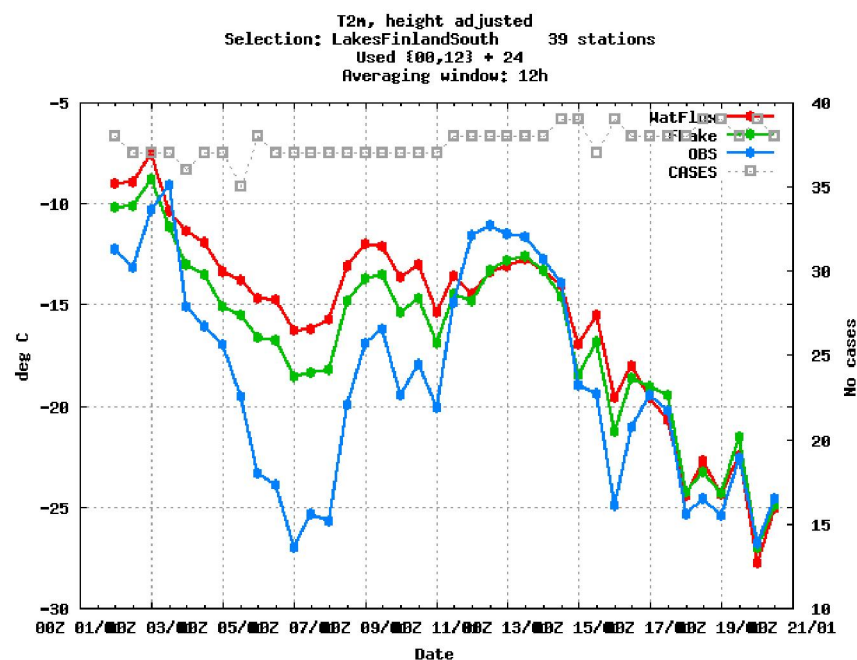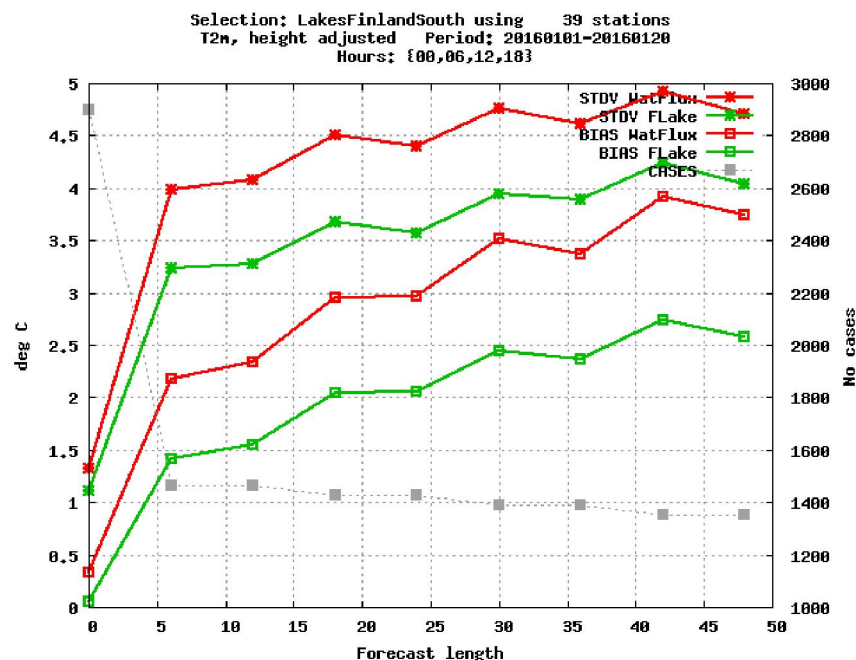- Lake Peipsi   PE   – 1 station

Verification: FLake vs WATFLUX

January, 2016, Finland South, WATFLX vs FLAKE

T 2m bias and ESTD, K

T 2m, K, timeserie

Improvement of T2m scores.

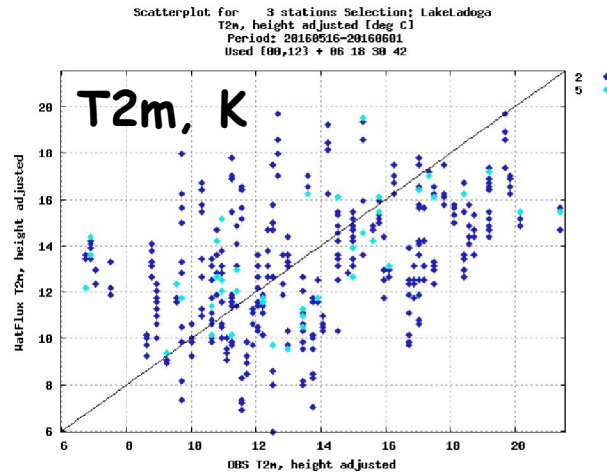**FLake contributes to the solution of the "stable boundary layer" problem?**
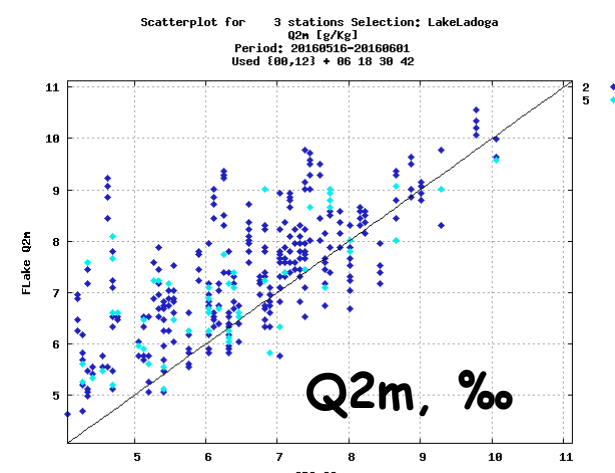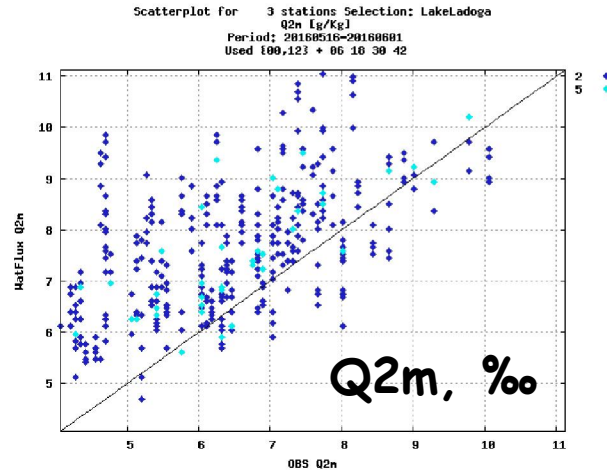
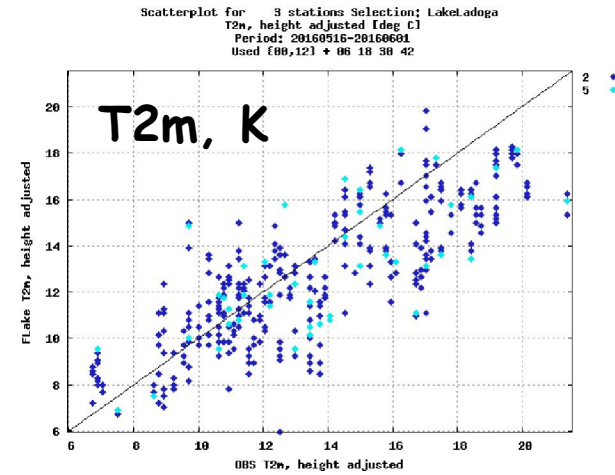# Verification: FLake vs WATFLUX
May 15- June, 1,2016, Ladoga
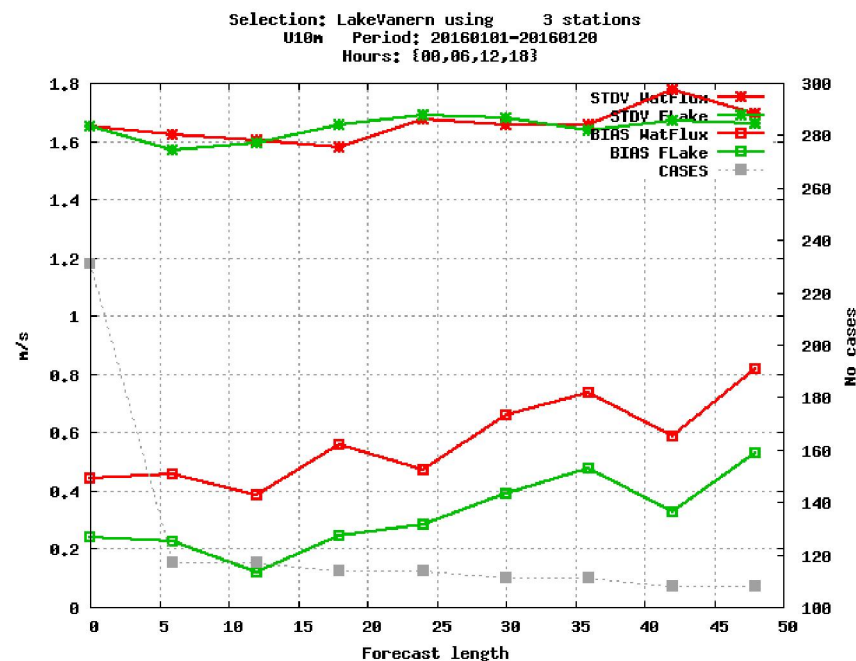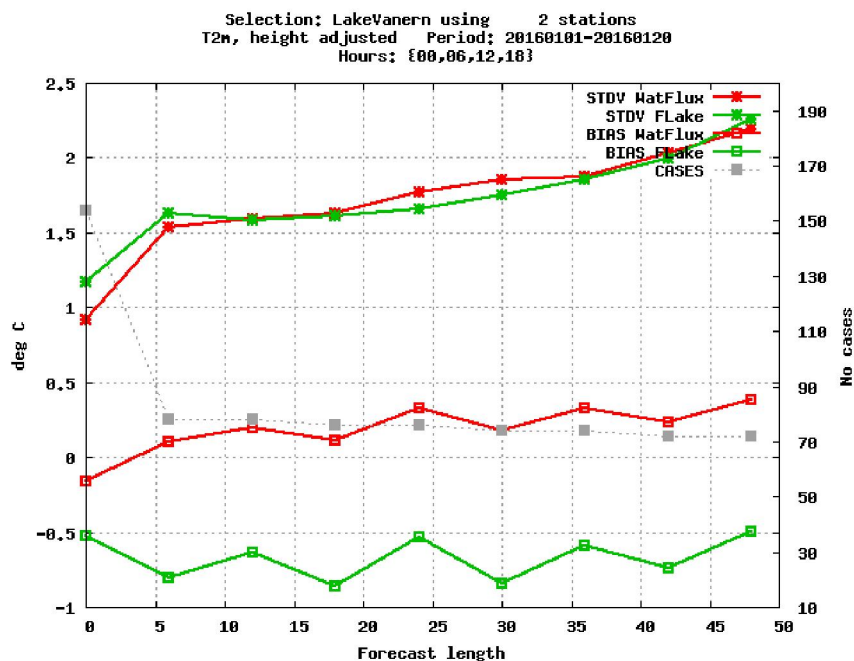

Improvement of T2m and Q2m scores.

Verification: FLake vs WATFLUX

January, 2016, Vänern, WATFLX vs FLAKE

T 2m bias and ESTD, K

U 10m bias and ESTD, m/s

Deterioration of T2m scores

Improvement of U10m scores

Main conclusions and findings

- Starting from the climatology in unusually warm situation, FLake performs better in autumn than in spring.
  Too cold spring state in FLake improves in ~ 1.5 months.

- Atmospheric model often "sees" large and medium lakes; Lakes might affect large scale atmospheric motions.

- For verification, lists of "lake stations" are useful.

- Verification scores are very different for different variables (T2m, Q2m and U10) and regions, there are examples of improvement and deterioration.

- It is possible to make a general conclusion that parameterization of lakes (based on FLake) allows to improve HARMONIE forecasts.

Thank you for your attention!

And many thanks to
Laura Rontu and Carl Fortelius
for useful scripts and visualization
tools