



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

First experiences of operational HIRLAM with Flake

Kalle Eerola, Laura Rontu, Ekaterina Kurzeneva

Finnish Meteorological Institute



Contents

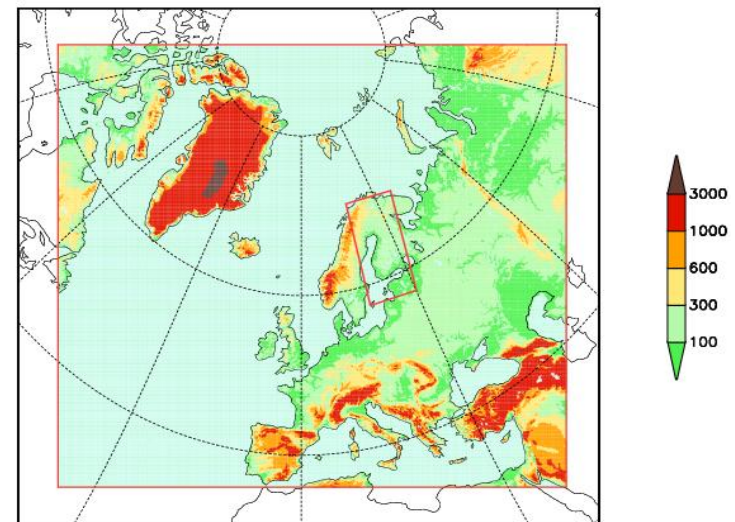
- **Introduction**
- **Flake in HIRLAM**
- **Freezing of LADOGA**
- **Example of the effect of frozen/open Ladoga**
- **Melting of Ladoga**
- **Finnish lakes in summer**
- **Conclusions**



Introduction

- HIRLAM 7.4 implemented operationally in March 2012
- Pre-operational since July 2011
- Main new features:
 - Resolution ~7km, 65 levels in vertical
 - Flake
 - Orographic radiation parametrisation
 - Other minor changes
- Running 4 times/day, up to +54 h
- RCR (Regular runs with the Reference) in the HIRLAM program
- Half a year's experience of operational runs
- More than half a year's experience of parallel runs
 - Hirlam 7.3: No Flake
 - Hirlam 7.4: with Flake

HIRLAM V74 / HARMONIE aro36h14





Flake in HIRLAM (peaceful co-existence)

Flake like in climate simulations:

- Implemented as a physical parametrisation scheme in the forecast model
- Interacts with the forecast model in both directions
- Continues from previous cycle without interruption by the surface analysis

Surface data assimilation

- Parameters: sst (lake surface temp., snow, land soil properties)
- Lake surface temperature:
 - Gets the first guess from FLake
 - Results in an independent analysis, which does not affect FLake or atmospheric model
- Other parameters assimilated normally and affect in the normal way

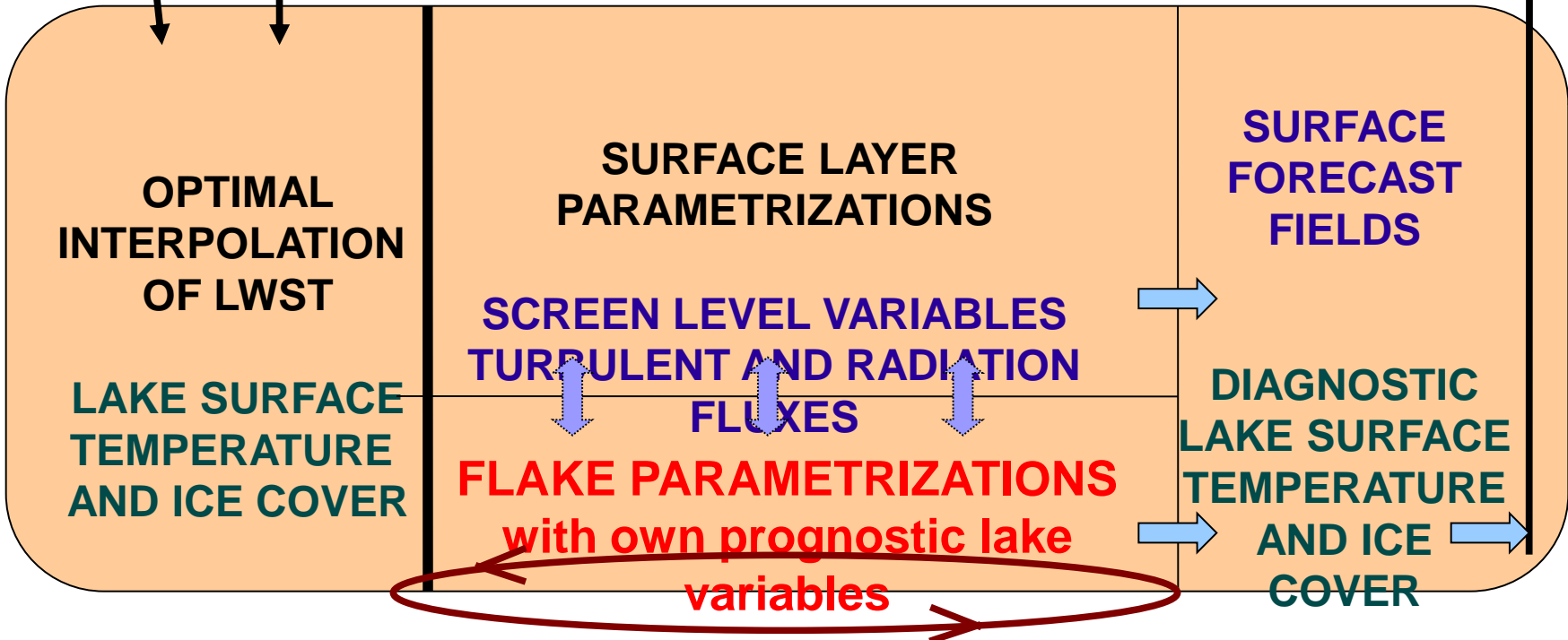


**THIS IS HOW HIRLAM
CURRENTLY WORKS!**

INDEPENDENT LAKE ANALYSIS IN COUPLED NWP + LAKE MODEL

OBSERVATIONS
LWST

BACKGROUND
LWST





Motivation: Are lakes important for weather forecasting

Do the lakes affect the weather?

- Great Lakes
- In Finland, duty forecasters can tell this

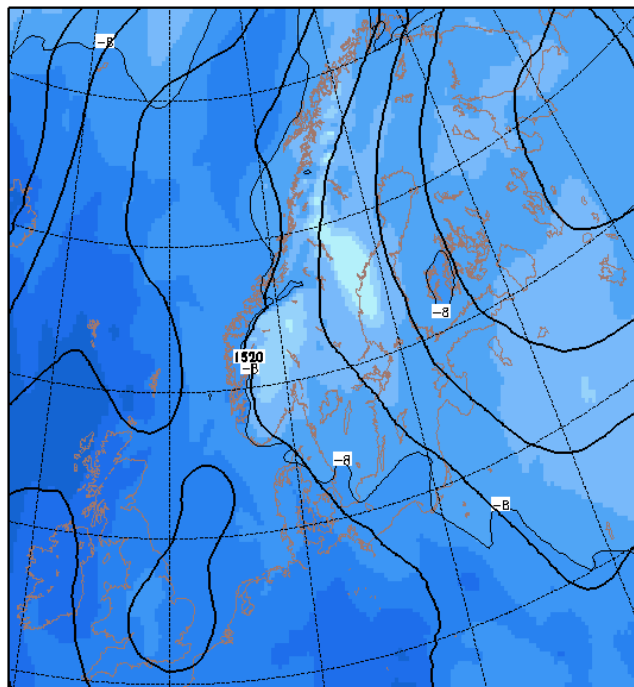
Given the correct lake properties, can the forecast model use this information?

An example last winter (next slides)

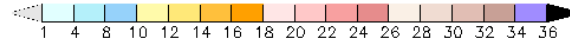
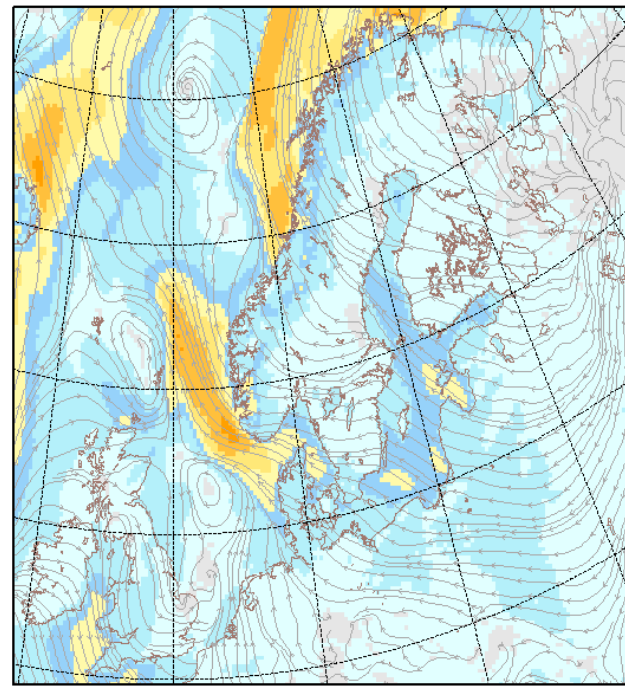
- Lake Ladoga open in January
- Very cold air mass (colder than -10° C at 850 hPa)
- Wind from south-east
- Effect on observed 2m temperature in eastern Finland
- What does HIRLAM do?



EXP: RCRa, +00H,
850 hPa T (shades), Z (contours)
initial: 00Z28JAN2012 valid: 00Z28JAN2012

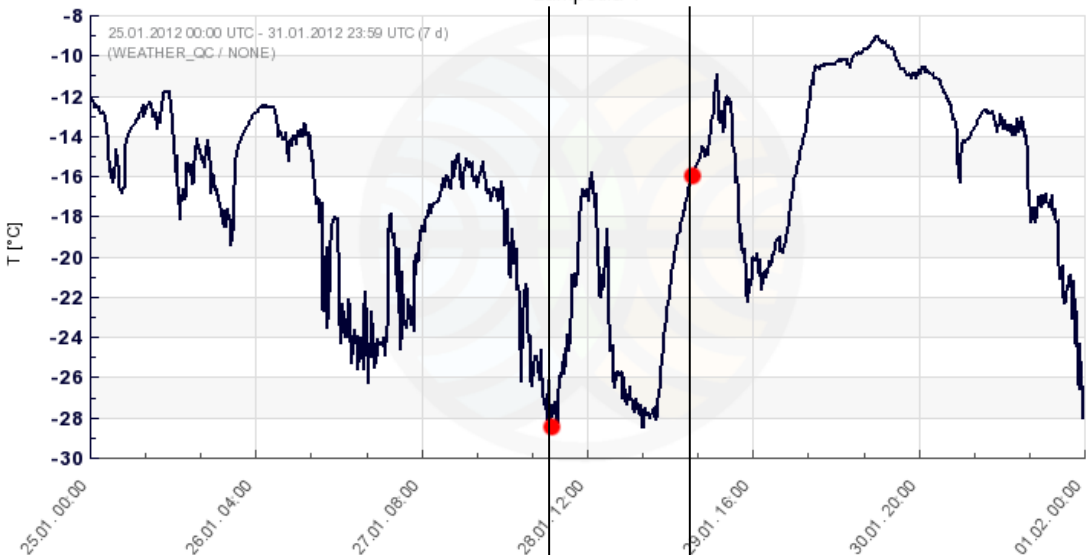


EXP: RCRa
Windspeed (m/s) and streamlines at 10 m
initial: 00Z28JAN2012 valid: 00Z28JAN2012

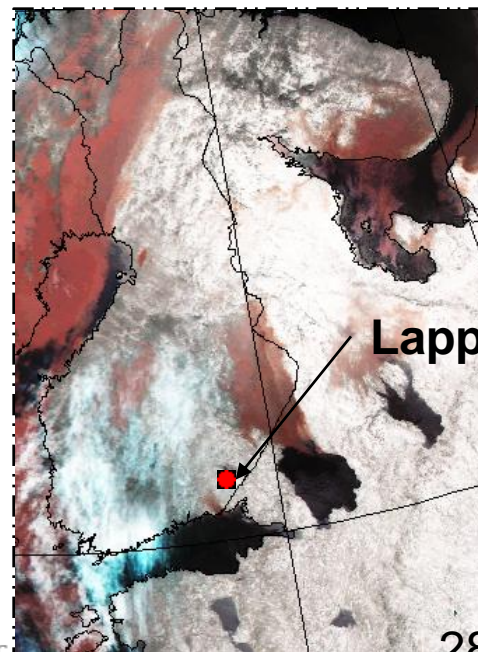


Lappeenranta Konnunsuo (LPNN 1710)

Lämpötila T



14.02.2012 12:50:16 UTC

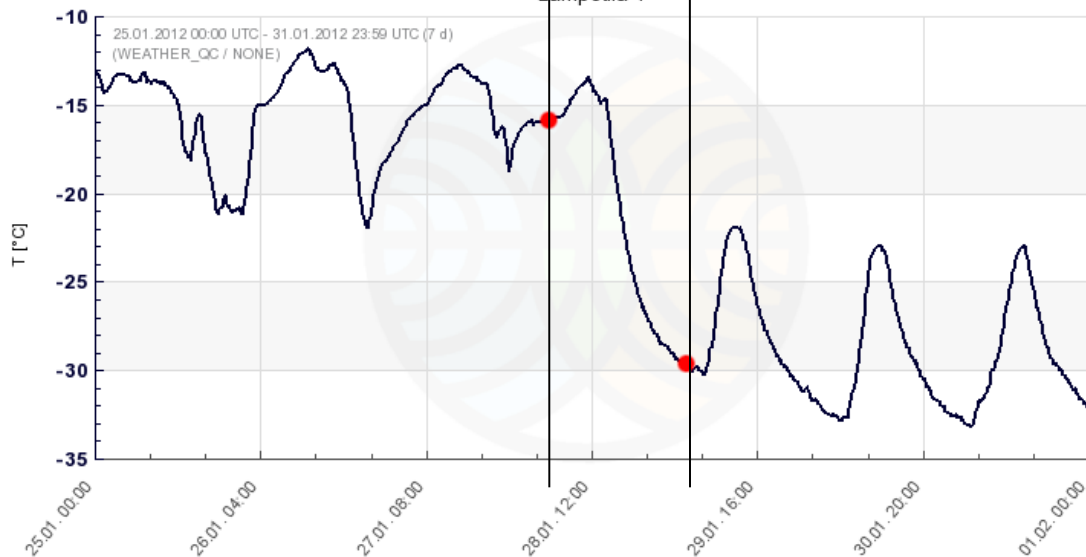


Lappeenranta

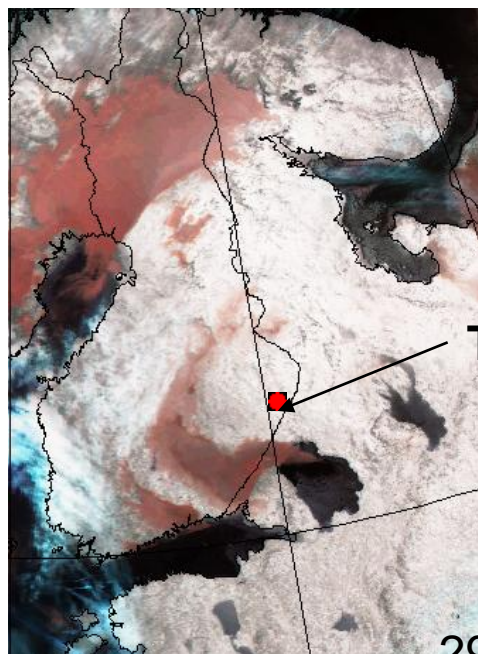
28.01 06UTC

Tohmajärvi Kemie (LPNN 2902)

Lämpötila T



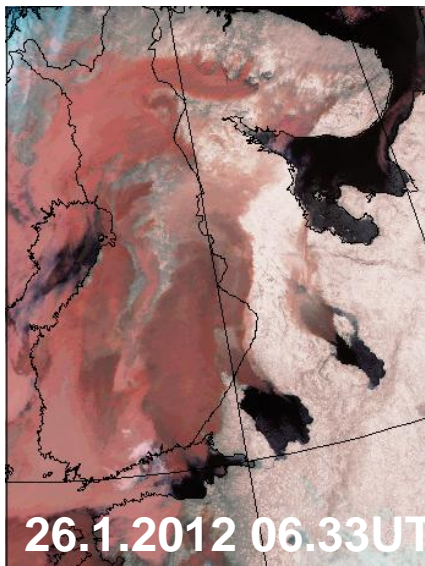
14.02.2012 12:40:23 UTC



Tohmajärvi

29.01 06UTC

NOAA AVHRR

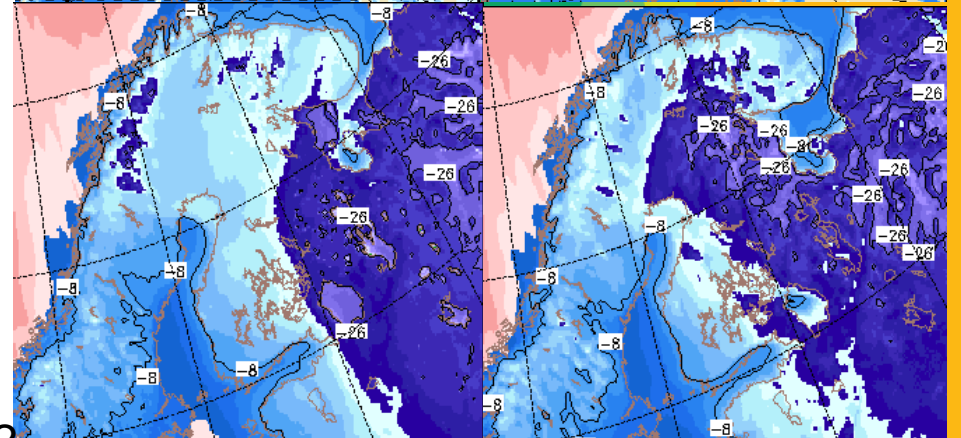
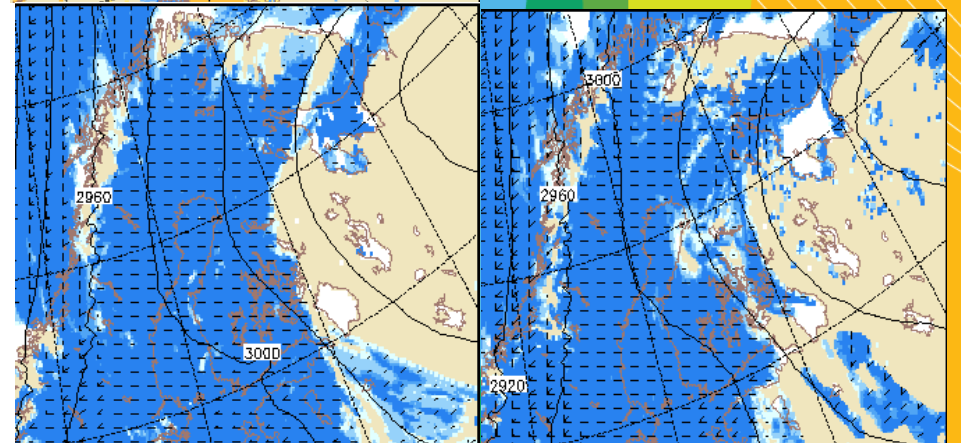
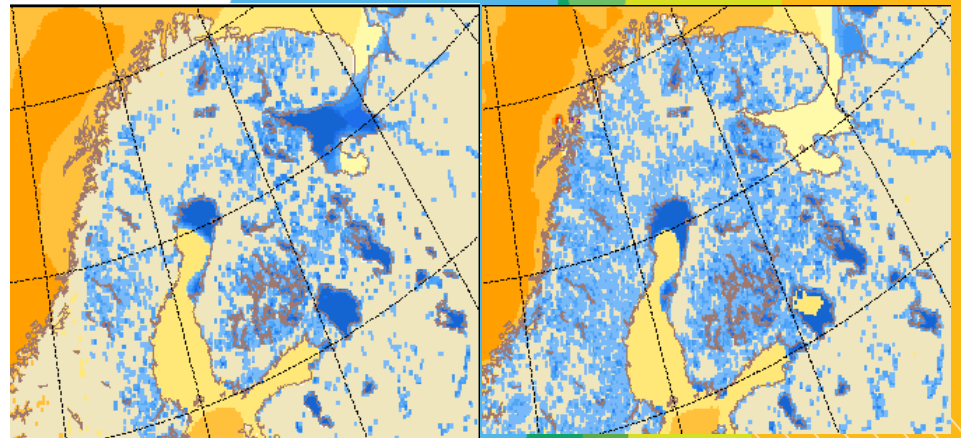


ITUTET
CAL INSTITUTE

26.1.2012 06.33UT



MODIS Aqua 26.1.2012





Comments on previous slides

MBE – old HIRLAM without Flake

- Lake Ladoga is frozen based on ECMWF climatology
- No clouds develop in the anticyclonic area around the Lake Ladoga
- Near-surface temperature is very cold everywhere

V74 – preoperational new HIRLAM with Flake

- The northern part of Lake Ladoga is unfrozen
- Clouds develop realistically in the cold air flow over the lake
- Near-surface temperature is realistic under the cloud



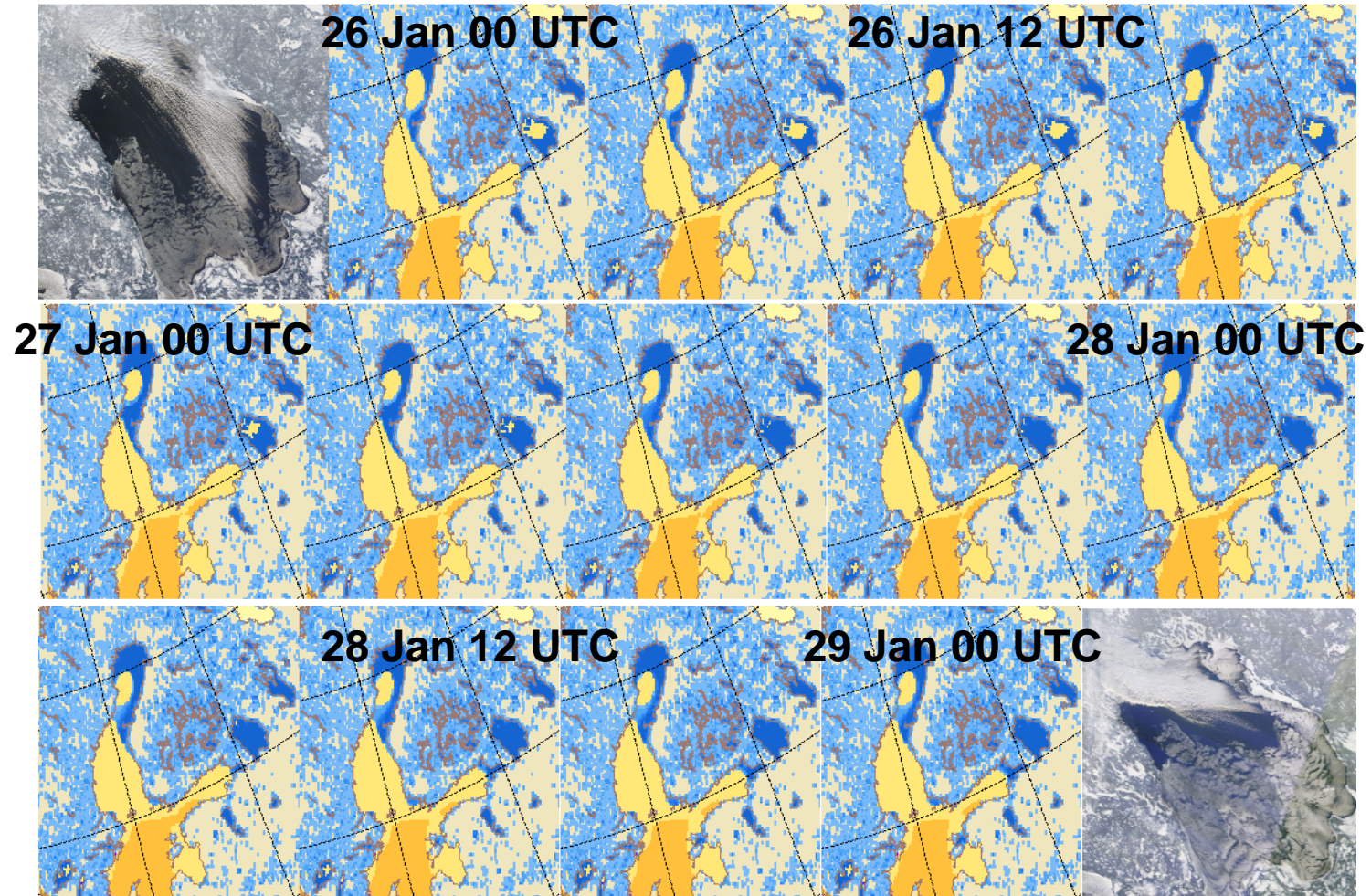
How did Flake got Ladoga frozen last winter?

Lake surface properties with the time interval of 6 hours

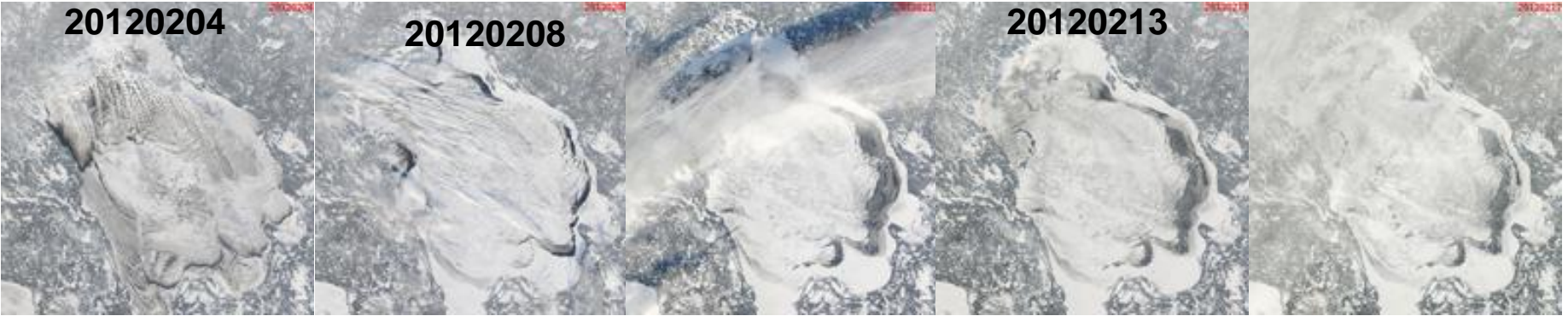
- Blue: frozen
- Yellow: open



Lake Ladoga 26-29 Jan 2012



FREEZING OF LADOGA 16 January - 9 March 2012



TERRA MODIS



Freezing of Lake Ladoga in winter 2011-2012

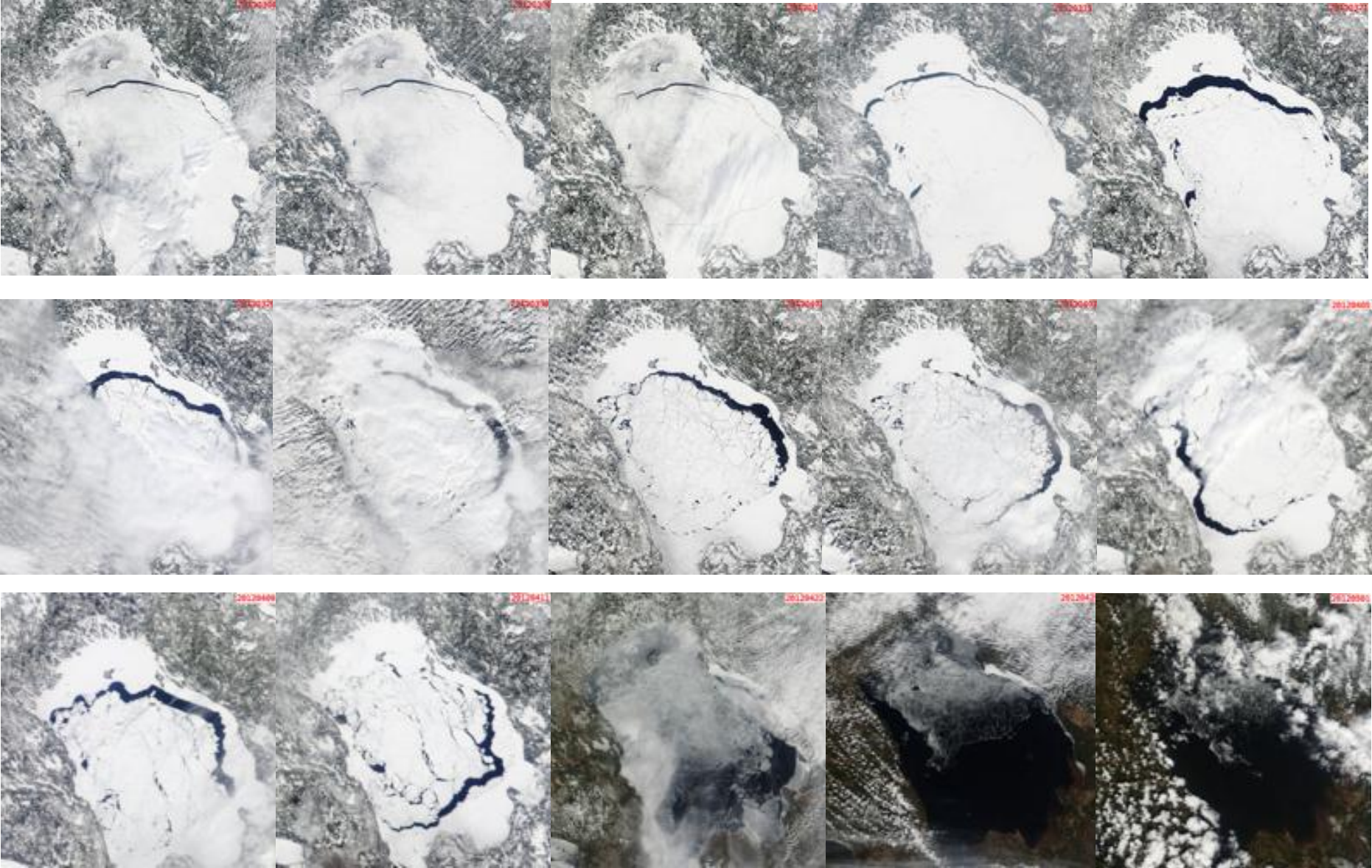
Flake

- The whole lake gets frozen in a few days 26-28 January
- The shallower southern part gets frozen first

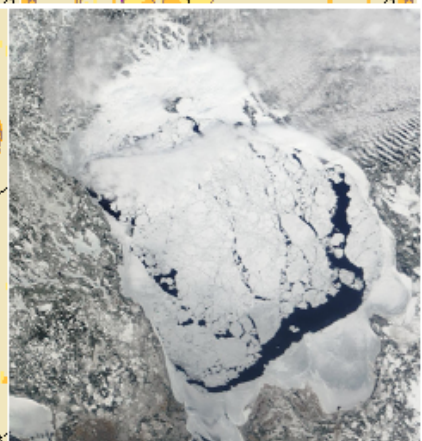
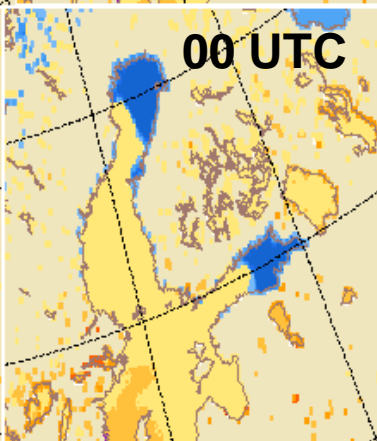
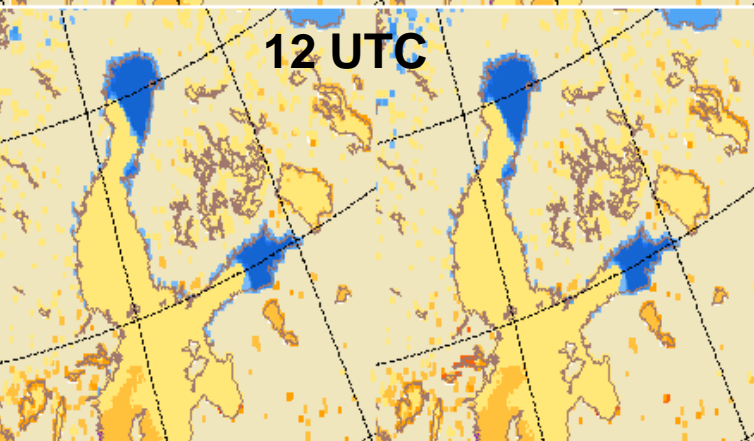
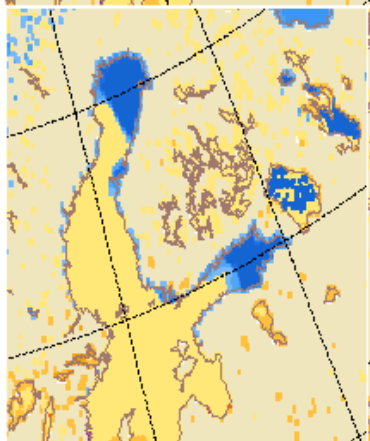
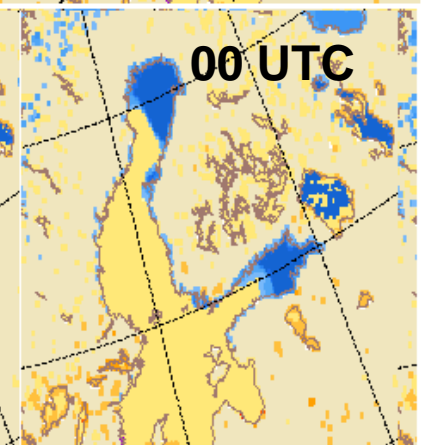
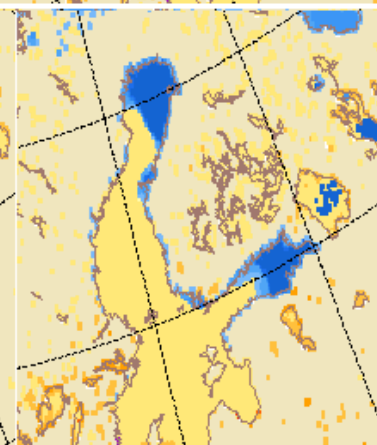
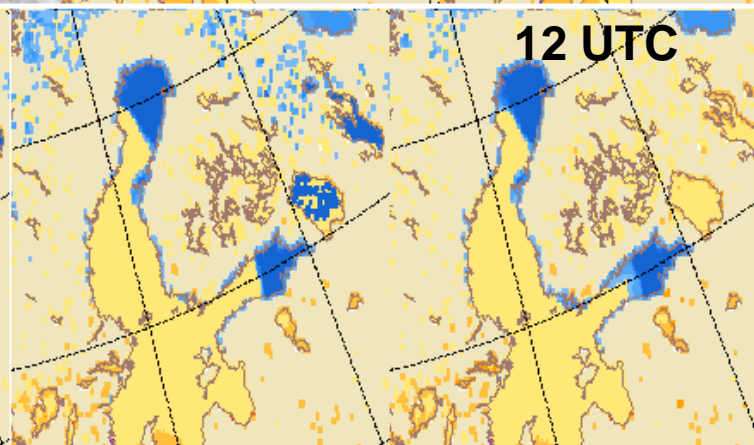
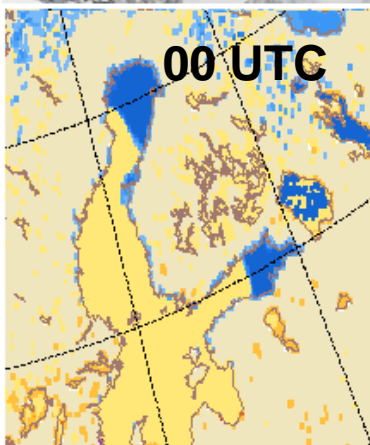
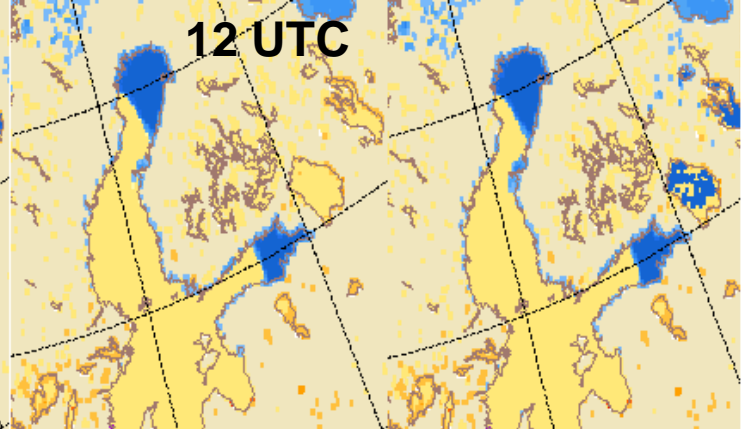
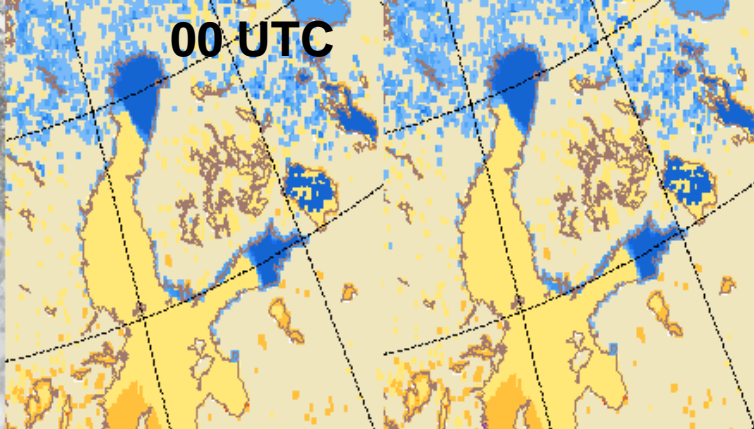
Satellite pictures

- It takes several weeks to get the whole lake frozen
- The southern part gets frozen first in early January
- The whole lake is frozen about 8 February
- A big “railo” can be seen later

MELTING OF LAKE LADOGA 4 March - 1 May 2012



TERRA MODIS





Melting of Ladoga in March-May

Satellite pictures

- In a series of satellite pictures a broad “railo” is seen in March
- Melting takes place mainly in

Flake

- A flip-flop feature is seen:
 - At day-time the lake is melted
 - At night-time it is frozen again
- Starts already mid-March and lasts until stays totally open in 13 April

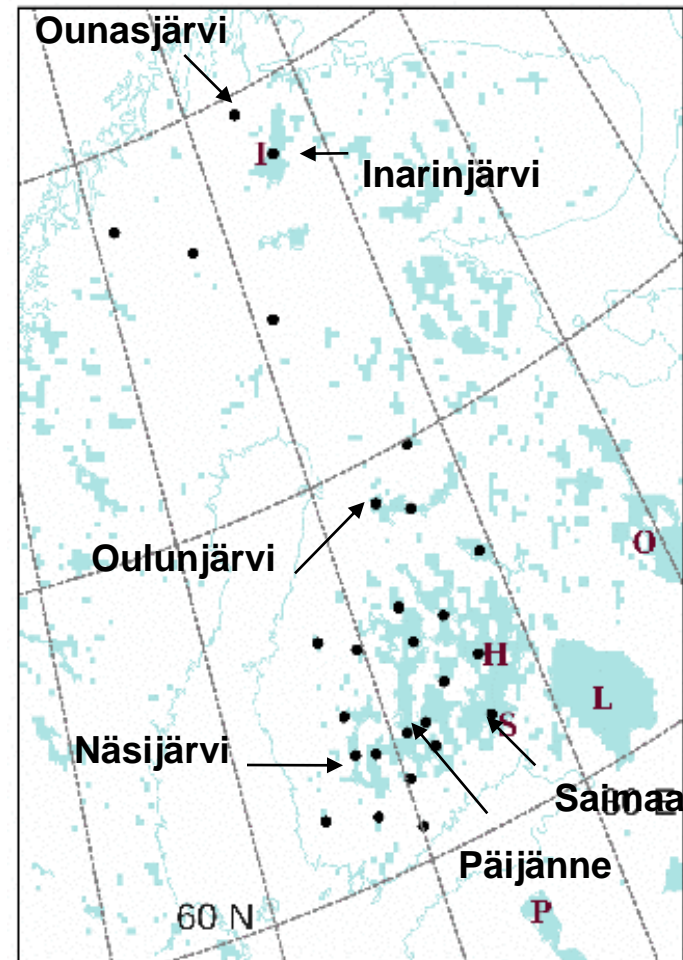


HIRLAM/FLake in summer in Finland

**SYKE = The Finnish Environment
Institute**

We use for comparison

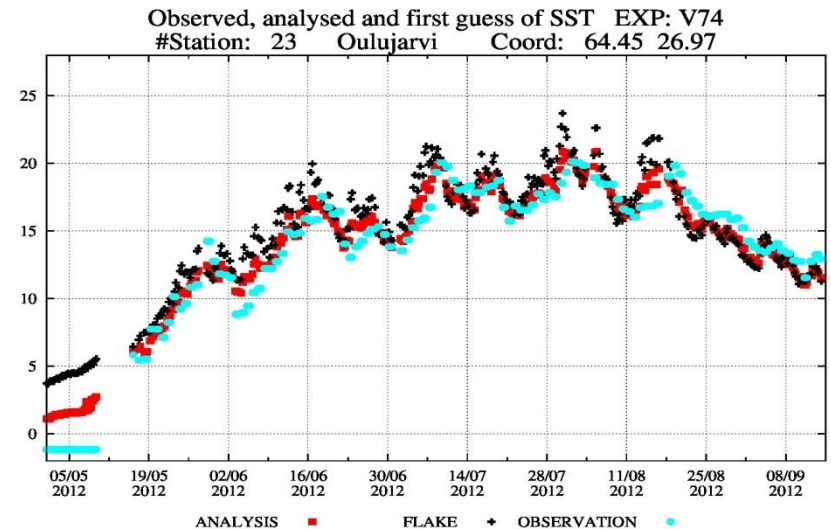
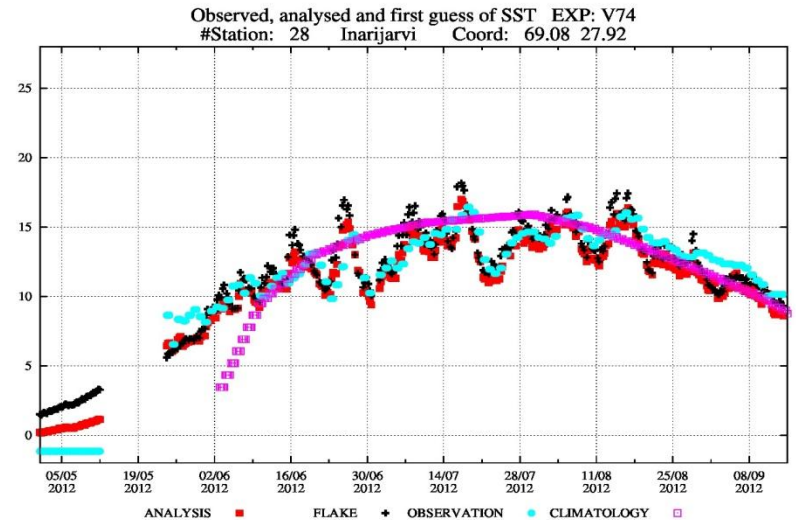
- Optimally interpolated analysis of lake water surface temperature
- First guess from Flake
- SYKE observations





Time-series for the whole summer, good cases

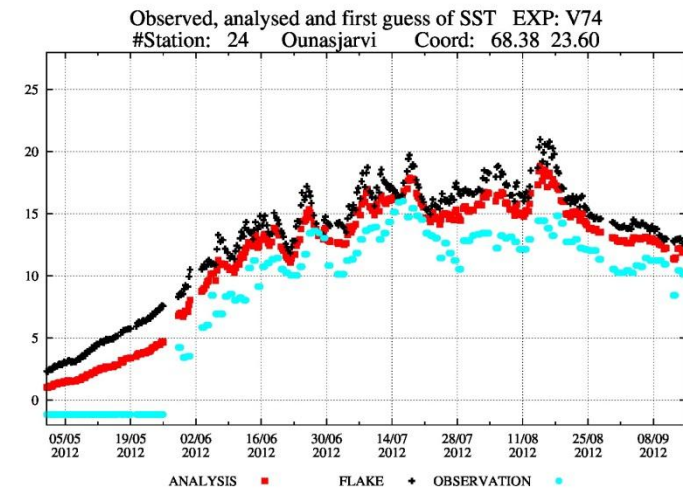
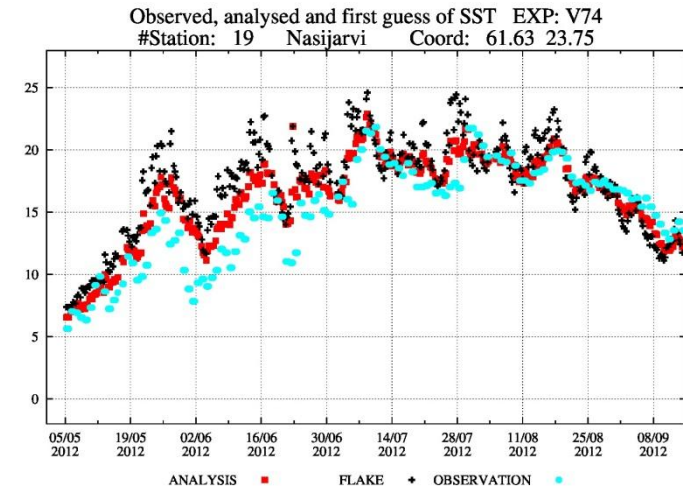
- Remember that Flake runs without data assimilation
- Good correspondence with Flake and observations
- Large lakes
- Flake overshoots the warming
- Flake colder in autumn
- Climatology in spring colder





Time-series for the whole summer, biased

- Flake is too warm
- Flake is sensitive, large variation





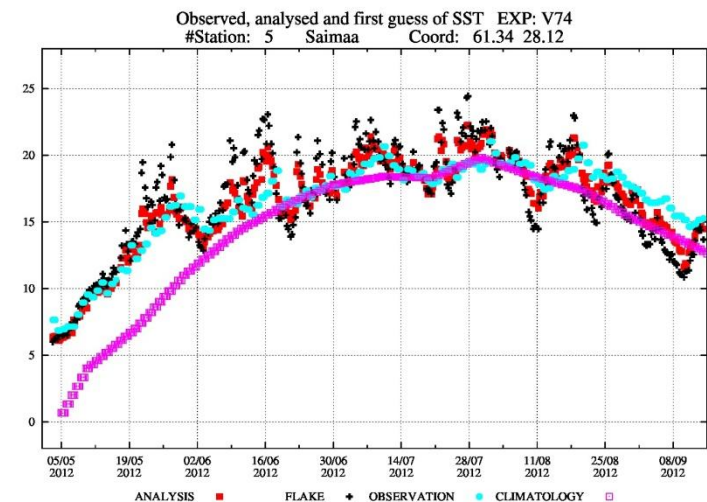
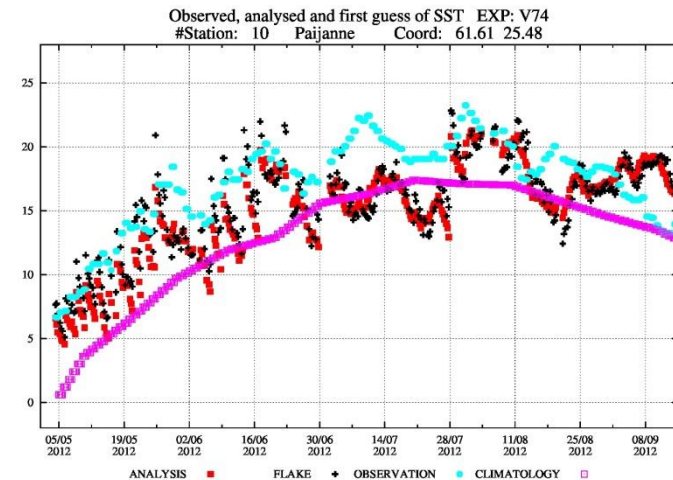
Time-series for the whole summer, more cases

Päijänne

- Flake much colder than observed
- Warmer in autumn
- Where measured?

Saimaa

- Good in spring
- Overestimation and over shooting in summer
- Underestimation in autumn





Summary and outlook

Flake is implemented into HIRLAM forecast model, but no assimilation yet

We have demonstrated that

- Lakes affect the weather
- HIRLAM makes use of the information from underlying surface (lakes)
- Ladoga get frozen in too short a time compared to satellite picture, the details during winter cannot be simulated
- In spring flip/flop feature on Ladoga and Onega
 - Freezes in night, melts in daytime
 - This lasts a month
- In summer reasonable simulation



Summary and outlook...

- ❑ **Flake now runs in a “climate mode”**
- ❑ **The current OI analysis cannot be used by FLake, because it analyses only the lake surface temperature**
- ❑ **EKF a promising approach, Ekaterina's presentation**
- ❑ **More observations needed**
 - ❑ Nationally made observations
 - ❑ Satellite observations, Homa's presentation