



ILMATIETEEN LAITOS
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FLake in HARMONIE

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ALADIN/HIRLAM
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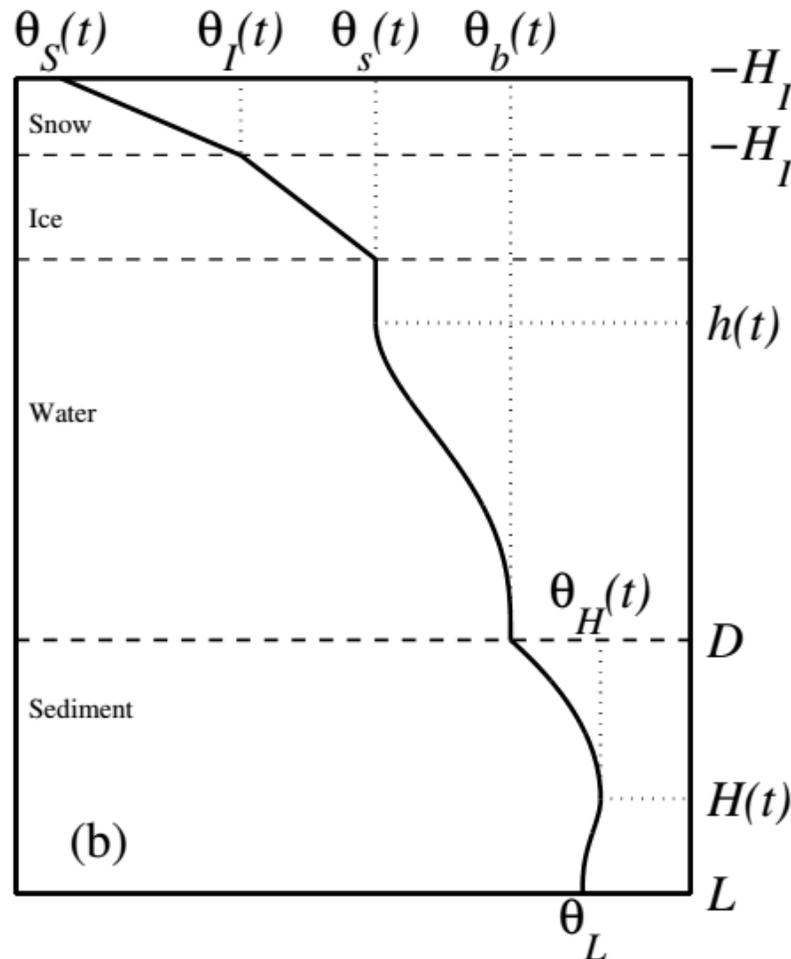
Background

- Lake affects local weather, depending on the region, the season, the synoptic situation, the size and depth of a lake. They may cause thunderstorms, snowstorms and local warmings
- Parameterization of lakes with lake model FLake runs operationally in HIRLAM, but not yet in HARMONIE/SURFEX
- Experience of HIRLAM shows the benefits of using FLake for NWP over territories with large fraction of lakes



Outlines

- Info about FLake
- External parameters: lake depth database, lake climatology
- Consistency within ECOCLIMAP
- Aggregation/interpolation problems
- HARMONIE runs with FLake:
technical aspects,
very fresh results
- Conclusions



Lake model FLake

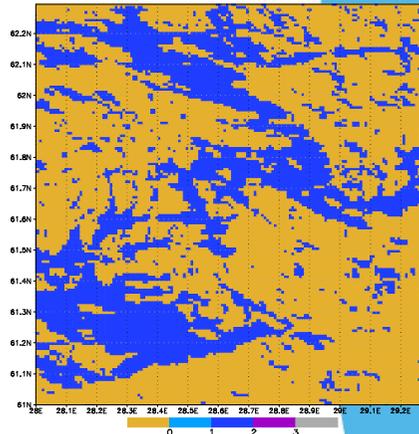
- Self-similarity concept
- Parametric representation of temperature profile in water, ice, snow on ice and in bottom sediments
- Temperature profile in water: the mixed layer and thermocline
- Solar radiation flux: exponential approximation of the decay law
- 11 prognostic variables



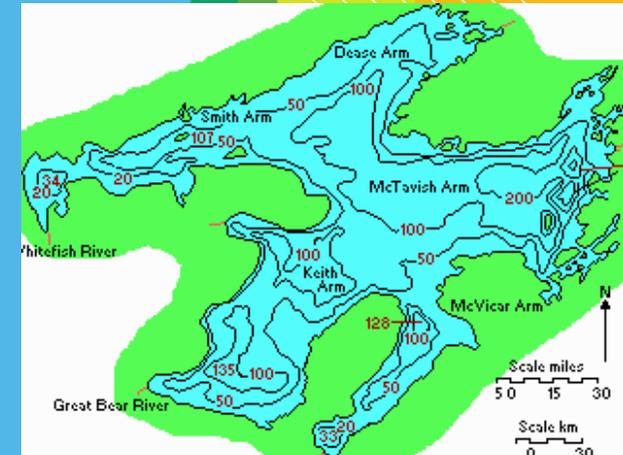
External parameters: lake depth database

Lat, deg	Lon, deg	Mean Depth, m	Max Depth, m	Surface area, km ²	International name	Country
42.2	19.3	5	8.3	372.3	Scutari_(Skadar)	Albania
41	20.8	14.5	286	370	Orind	Albania
41	21	9566	3099	313.6	Dig_Proopa	Albania
40.8	21.05	9999	9999	47.4	Small_Prespa	Albania
47.434	11.717	67.7	133	7.1	Achensee	Austria
47.786	13.969	2.5	6	0.9	Almsee	Austria
47.641	13.785	34.3	52.6	2.1	Altaussee_Sec	Austria
48.25	10.41	2.2	6.8	1.0	Alte_Donau	Austria
47.89	13.55	83.3	170.6	46.2	Attersee	Austria
47.511	9.679	89.3	254	539	Bodensee	Austria
40.592	15.4	14	40	1.5	Ochraastensee	Austria
47.542	15.058	24	38	0.5	Erlaufsee	Austria
46.578	13.924	14.9	29.5	2.2	Faaker_See	Austria
47.806	13.258	35	66.9	2.7	Fuschlsee	Austria
48.601	15.152	14.8	3.2	0.6	Gerhartsteinich	Austria
46.932	10.739	53.8	112	2.6	Gepatsch_Stausee	Austria
47.982	13.065	9.7	14	1.3	Grabensee	Austria
47.636	13.881	41.1	63.8	4.1	Grundlsee	Austria
47.493	10.973	11	22	0.8	Hallertsee	Austria
47.553	13.665	63.1	125.2	8.6	Hallsstaetter_See	Austria
48.82	15.135	1.4	2.5	0.6	Haekelsee_Toch	Austria
47.459	10.772	40.4	50	1.4	Heilwanger_See	Austria
47.76	13.247	9.3	22	0.7	Hintersee	Austria
47.542	12.216	12.8	35	0.6	Hintersteiner_See	Austria
47.924	13.305	14.9	32	3.5	Insee	Austria
46.588	14.102	10.4	15.6	1.4	Keutschacher_See	Austria

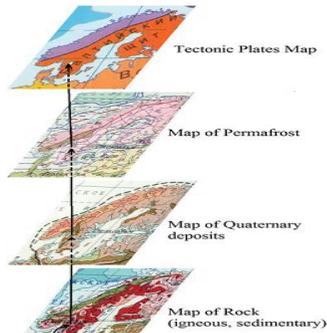
Data on the mean depth for each lake individually, includes 14500 lakes



ECOCLIMAP map
1 km resolution



Bathymetry for 36 large lakes



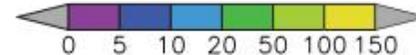
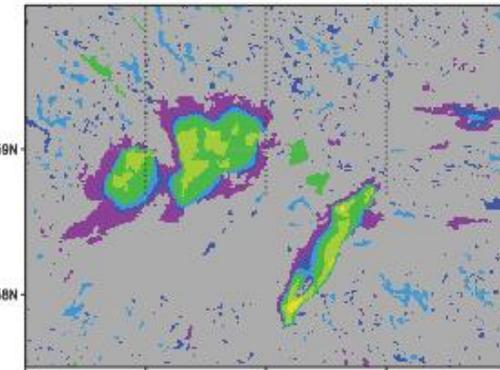
Estimates of depth from geological origin of lakes

Vector form

Data on the lake depth with 1 km resolution

Lat	Lon	Mean depth, m	Max depth, m	Surface area, km ²	Lake name	Country
58.903	13.595	27.8	106.0	5648.0	Vänern	Sweden
58.320	14.360	39.9	128.0	1856.0	Vättern	Sweden

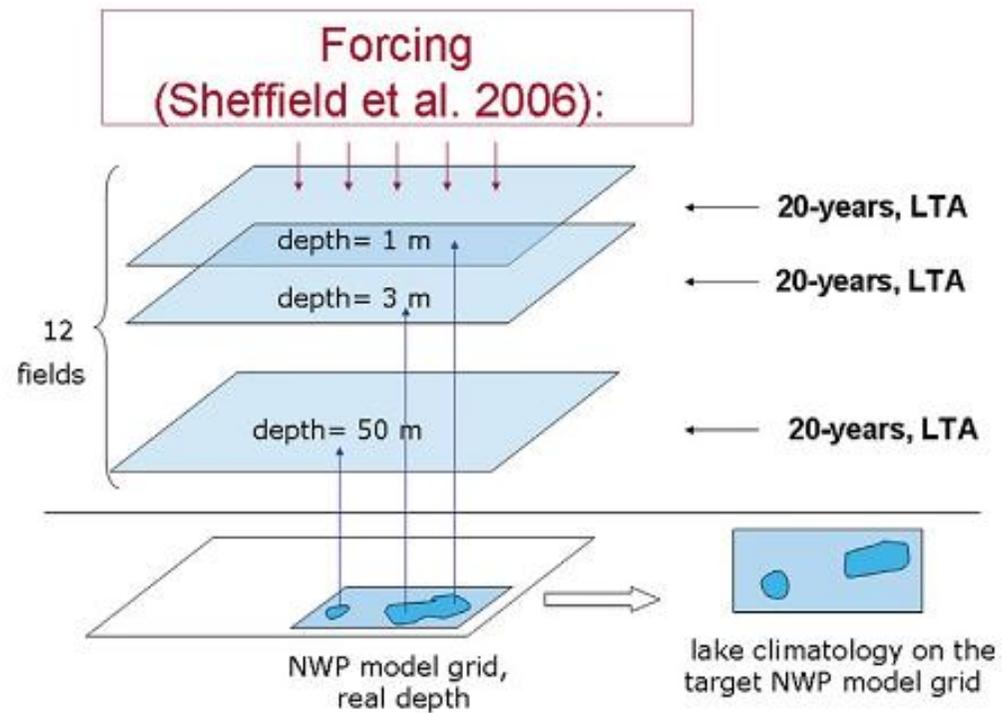
List of lakes (latitude, longitude)





Lake climatology

To initialize FLake at the cold start
Then, FLake runs freely





Consistency between ECOCLIMAP and lake database

- ECOCLIMAP: each Cover contains fractions of 4 main surface types: nature, urban, sea and inland water
- For inland water SURFEX uses WATFLUX or FLake

Inland water bodies are very different: freshwater and saline lakes, rivers, reservoirs, ponds, mires, bogs, fens, polders, closed bays, coastal lagoons and mangroves, the Caspian Sea and the Aral Sea





All "inland water"-related Covers in ECOCLIMAP were examined and two types of situations were distinguished

- 1 type: "wetland"-type Covers - to use ISBA
"sea"- type Covers - to use SEAFLUX

For this, partition between tiles for Cover was changed

Cover		Old partition	New partition	Remarks
124	Warm tropical wetlands	nature – 80% inland water – 20%	nature – 100 %	-
125	Subpolar wetlands	nature – 80% inland water – 20%	nature – 100 %	-
239	Subpolar wetlands	nature – 80% inland water – 20%	nature – 100 %	Exist only in Iceland
249	INLAND WATERS1	inland water – 100%	sea water – 100%	Polders and coastal lagoons



- 2 type: Covers which in different regions refer to very different real landscapes. This happens due to statistical methods which were used when producing ECOCLIMAP. Changes in partition plus fixes of the binary map

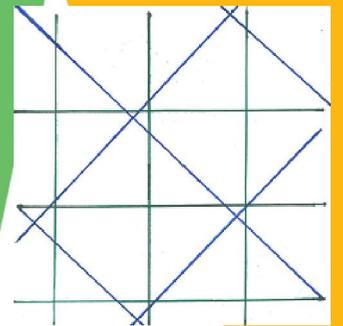
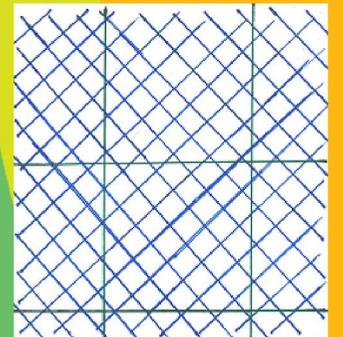
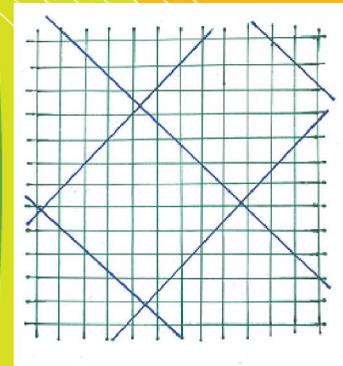
Cover		Old partition	Remarks	New partition
550	UNDEFINED1	nature – 45% inland water – 55%	In Europe: sea water near the coast, coastal lagoons, river estuaries. In Ukraine and Turkey: lakes. In Asia: land.	Several cover fixes in binary map: from 550 to 2 or from 550 to the major cover type in the vicinity. For the rest: nature – 45% sea water – 55%
552	POLAR WETLANDS1	nature – 100%	In Europe: sea water near the coast, coastal lagoons. In Asia: lakes and land.	Cover fixes in binary map: from 552 to 1 or from 552 to 2
553	INLAND WATERS3	nature – 1% inland water – 99%	In Europe: glaciers, sea water near the coast, coastal lagoons, river estuaries. In Asia: lakes, sea water near the coast and land.	Several cover fixes in binary map: from 553 to 2 or from 550 to the major cover type in the vicinity. For the rest: nature – 1% sea water – 99%



Aggregation/interpolation problem

- **A:** a resolution of a land-use map is finer than of a target grid: **aggregation**
- **B:** a resolution of a land-use map is coarser than of a target grid: **interpolation**
- **C:** when resolutions are approximately the same: **interpolation**

Interpolation methods are important!
Fields may be not smooth or discontinuous, e. g. the lake depth.





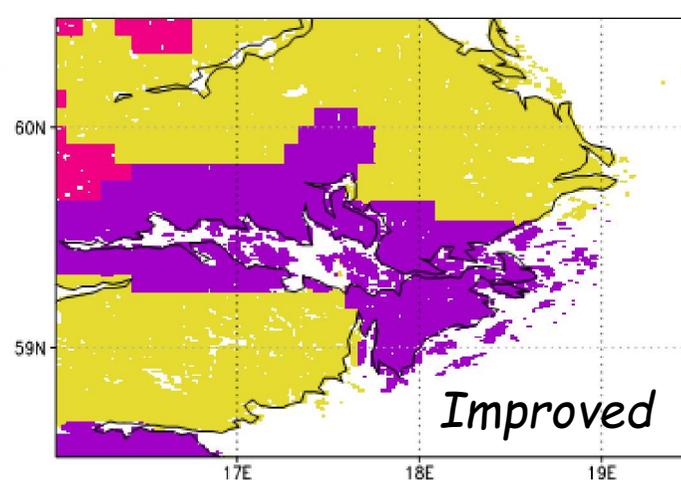
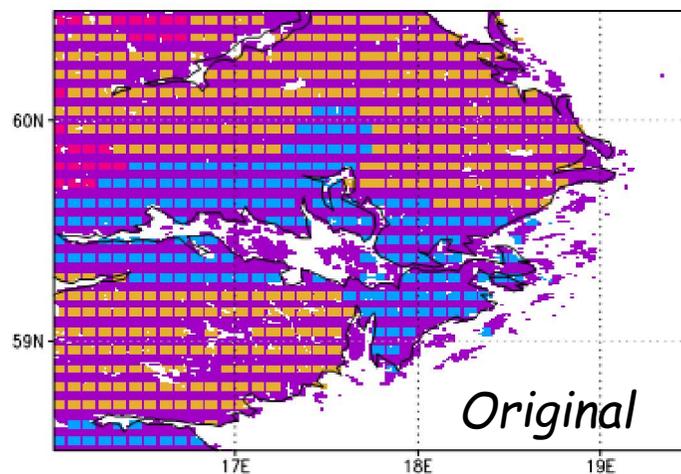
Aggregation/interpolation problem

- SURFEX code: all 3 situations are combined.
- All fields are treated in two steps:
1) aggregation and 2) interpolation.
- The price for this unification is a new tuning parameter **NHALO**: defines a radius (in a grid-cell space) to seek for data for interpolation
- Tuning process may be a headache
- Discontinuous fields can't be treated like this

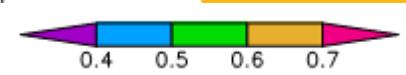


Aggregation/interpolation problem

- Solution: instead of using *NHALO*, apply the nearest neighbor interpolation method, seeking close points within the whole field.
- Implemented (although this solution is intermediate)
- Applicable for all fields.



Percentage
of sand





More modifications of FLake in SURFEX

- Lake Database v3 is used in HARMONIE - important!
- Lake depth threshold: 50 m
- Modifications of snow block after T. Semmler
- Decreasing of albedo of snow and ice during melting period
- Keeping FLake constraints in initialization (prep)
- No data assimilation: FLake runs freely

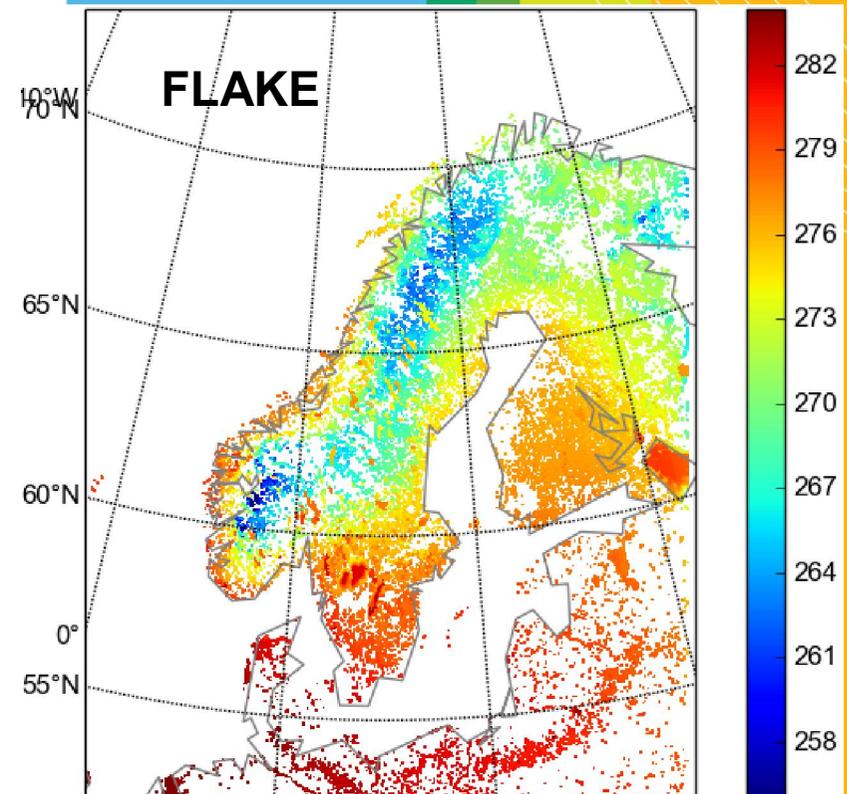
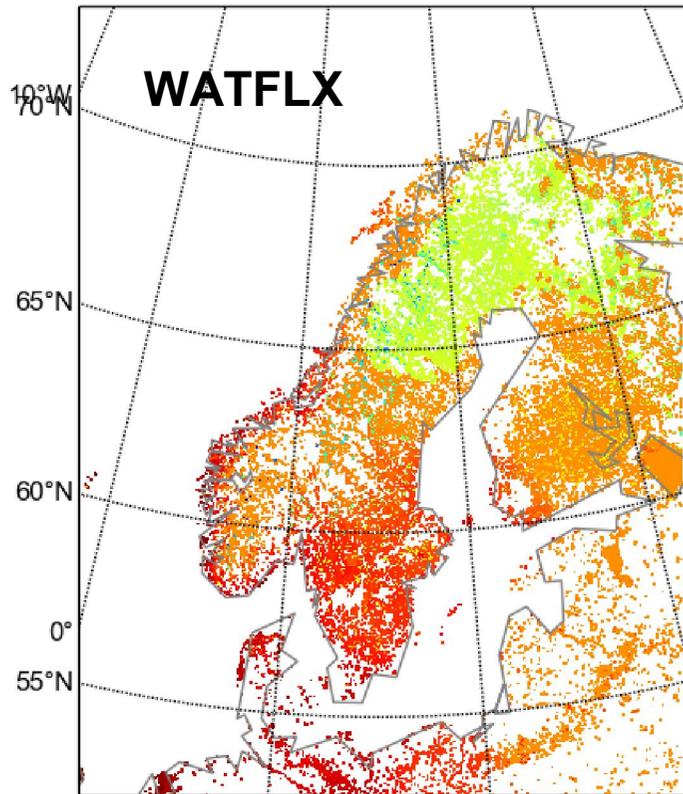


HARMONIE runs with FLake

- Technically, FLake is in HARMONIE cy40h1 (SURFEX7.3).
- Physical tests are ongoing
- **WATFLX** - with WatFlx scheme; the lake surface temperature is taken from different sources
FLAKE - with FLake; all lake parameters evolve.
- Autumn-winter 2015-2016, spring 2016, MetCoOpB domain, 2.5 km res.
- For **WATFLX**:
`LEXTRAP_WATER='.FALSE.'`
`LWATERTG2='.FALSE.'`



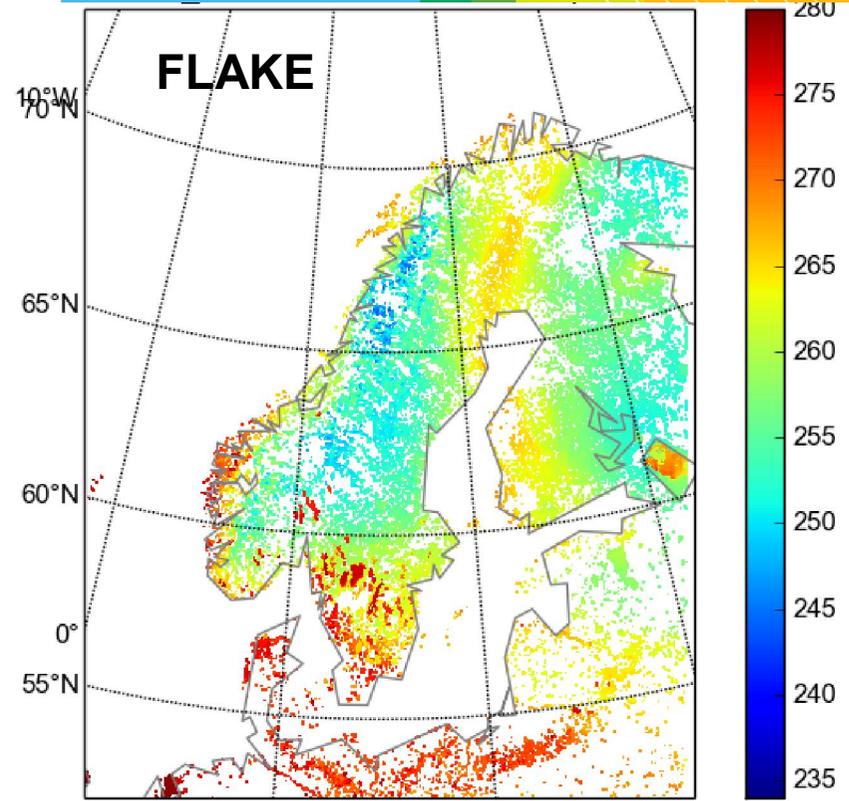
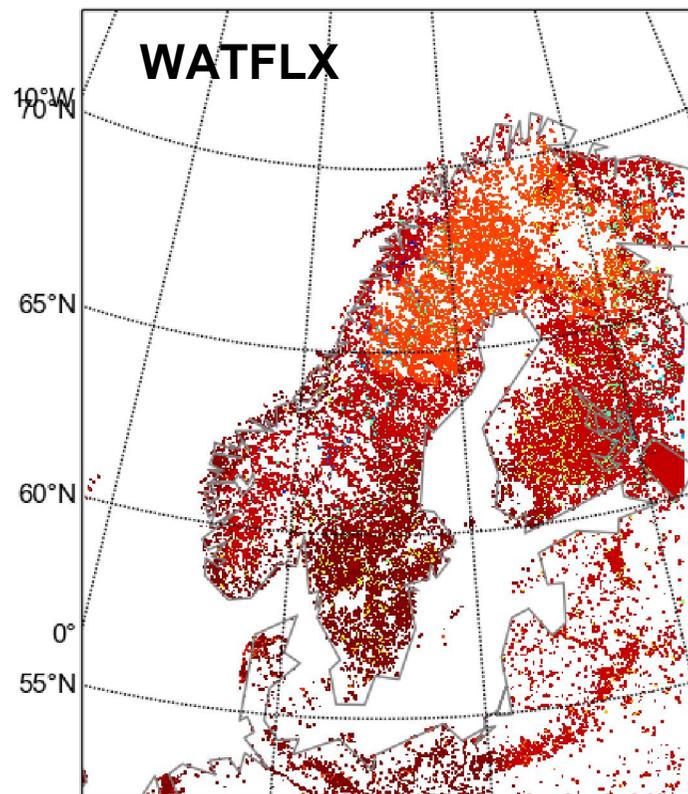
HARMONIE runs with FLake



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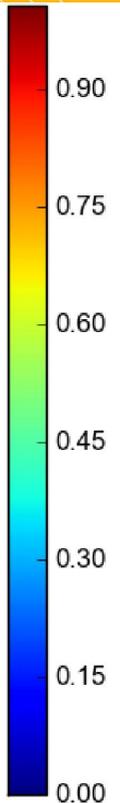
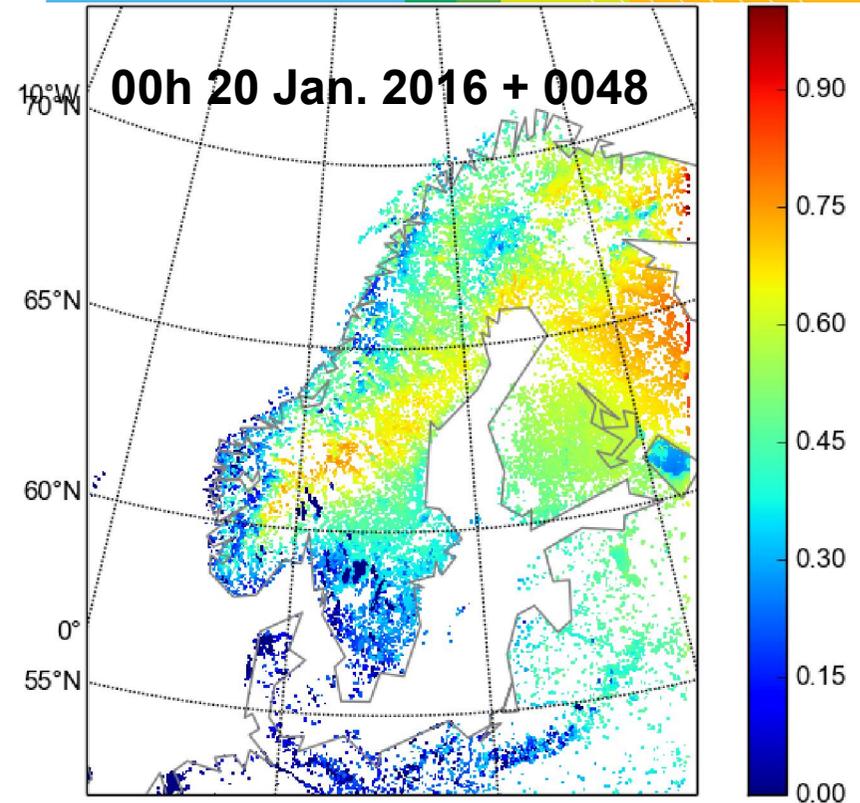
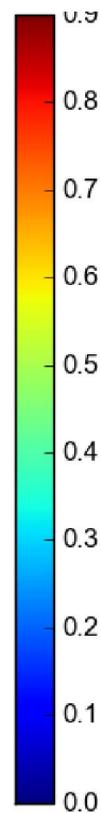
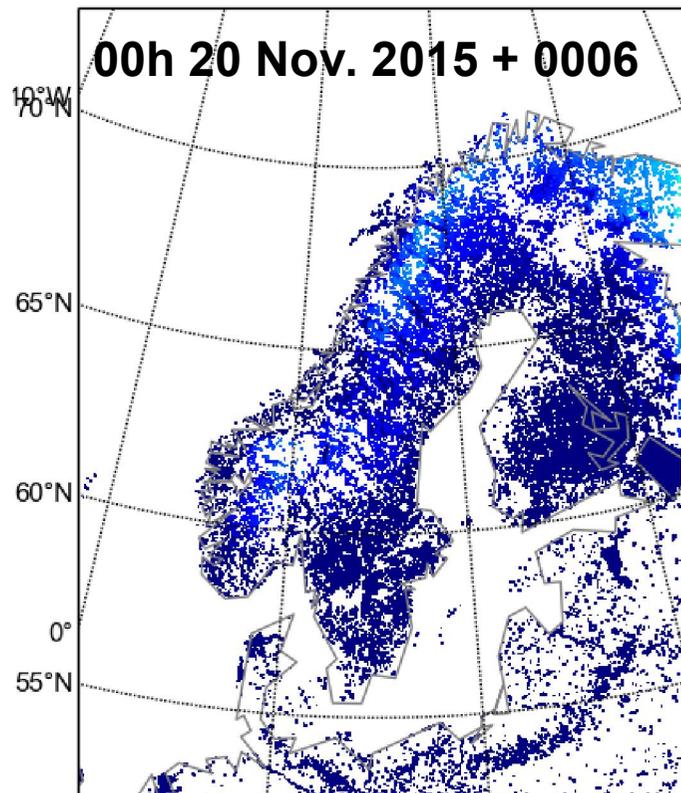
HARMONIE runs with FLake



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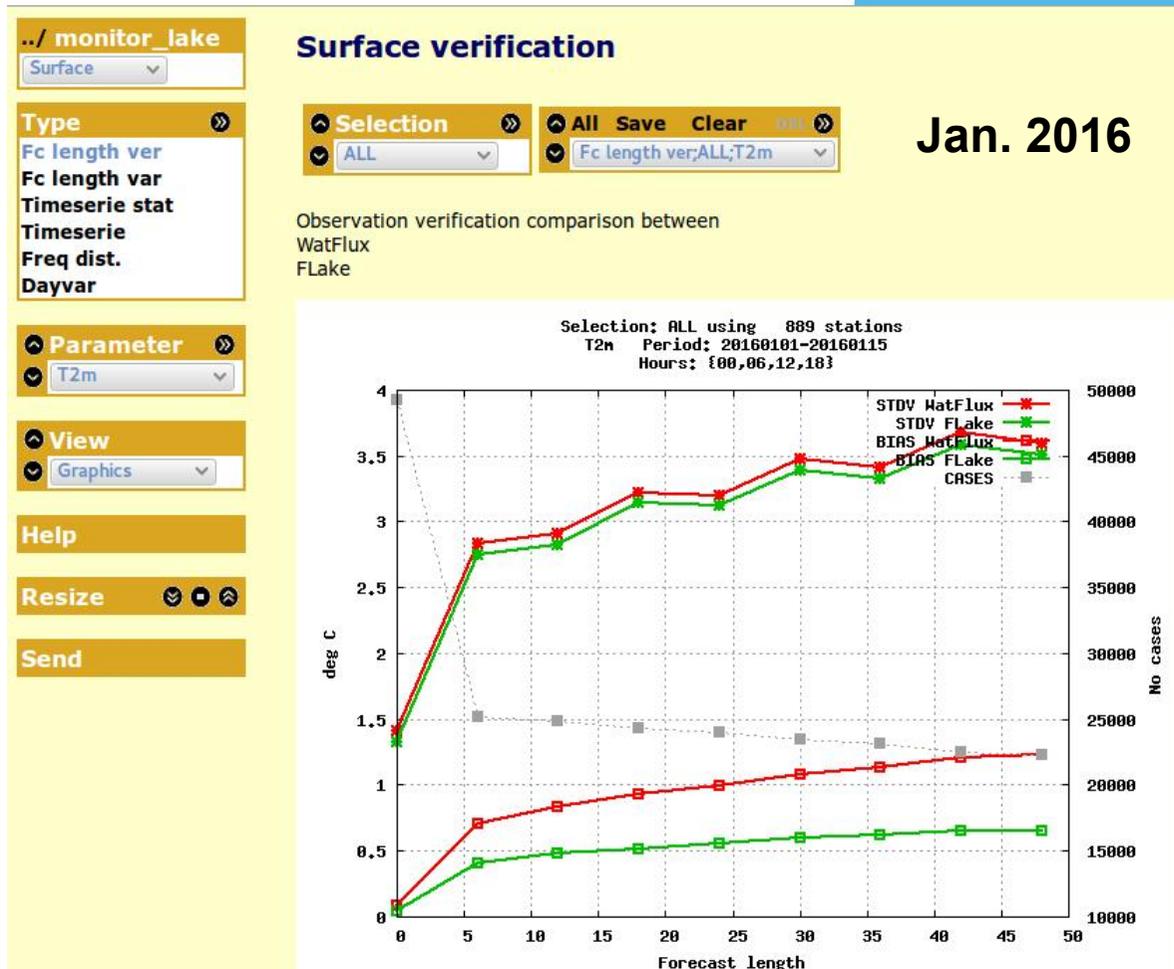
HARMONIE runs with FLake



Hice in FLAKE

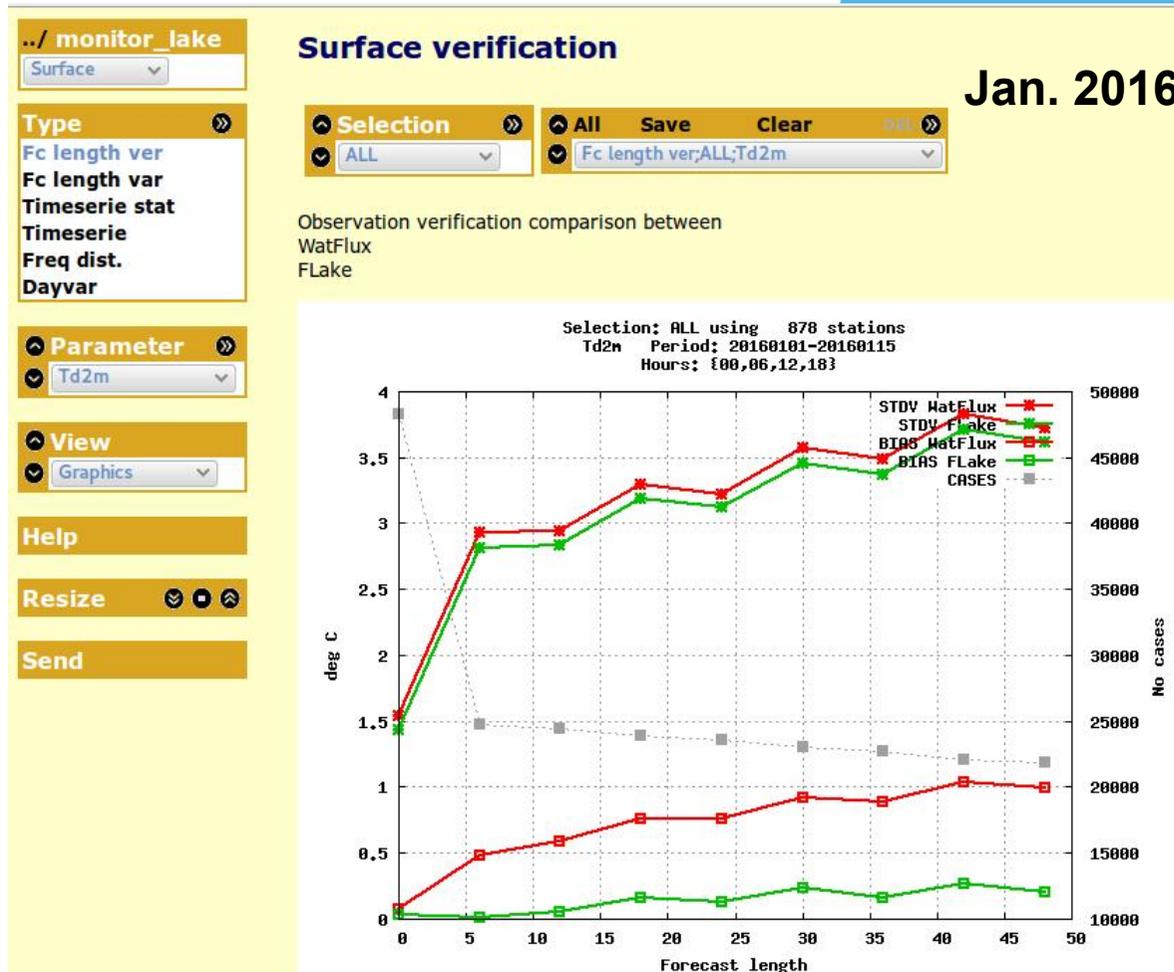


HARMONIE runs with FLake





HARMONIE runs with FLake





Conclusions

- FLake runs in HARMONIE cy40h1. technically
- To make this possible, the following problems were solved:
 - ECOCLIMAPII: corrected bitmap, corrected partition for Covers
 - Aggregation/interpolation: getting rid of *NHALO*, adjustments for lakes
 - Lake database: latest version (v.3)
 - Corrections into snow block after T. Semmler
 - Balances for FLake in prep
- Meteorological testing is ongoing



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Thank you for your attention.

Questions?