Performance of FLake in HARMONIE

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• FLake in HARMONIE
• FLake performance, impact and verification

• 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

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
  Apr.-May 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:

<table>
<thead>
<tr>
<th>Lake</th>
<th>Ice Cover Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vänern</td>
<td>from Nov.-Dec. to Apr., not every year</td>
</tr>
<tr>
<td>Vättern</td>
<td>from Nov.-Dec. to Apr., not every year</td>
</tr>
<tr>
<td>Ladoga</td>
<td>from Jan., 21 to Jan., 29</td>
</tr>
<tr>
<td>Peipsi</td>
<td>from Jan., 3 to Apr., 5</td>
</tr>
</tbody>
</table>

Challenge for FLake to reproduce!
FLake performance: autumn

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

Situation improves gradually, ~ in one month
On impact of lakes...

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

From standard verification, it is difficult to make conclusions
Verification: FLake vs WATFLUX

Lists of lake stations for different regions: totally, 122

- 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

We may see improvements and degradations for different lake regions.
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.