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Details around lake model FLake in SURFEX and HARMONIE

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Background

- Lakes affect fluxes in boundary layer and change albedo when freezing
- They may cause local weather events such as 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

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Experience of HIRLAM: Lake Ladoga case

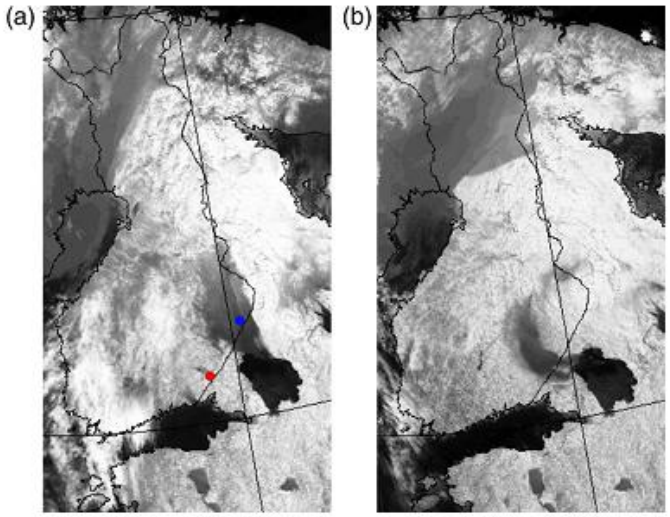

Fig. 3. NOAA AVHRR thermal IR images over Finland and Karelia on 28 January 06 UTC (a) and on 29 January 00 UTC (b) 2012. The low-level cloud cover, shown with dark-grey shades,

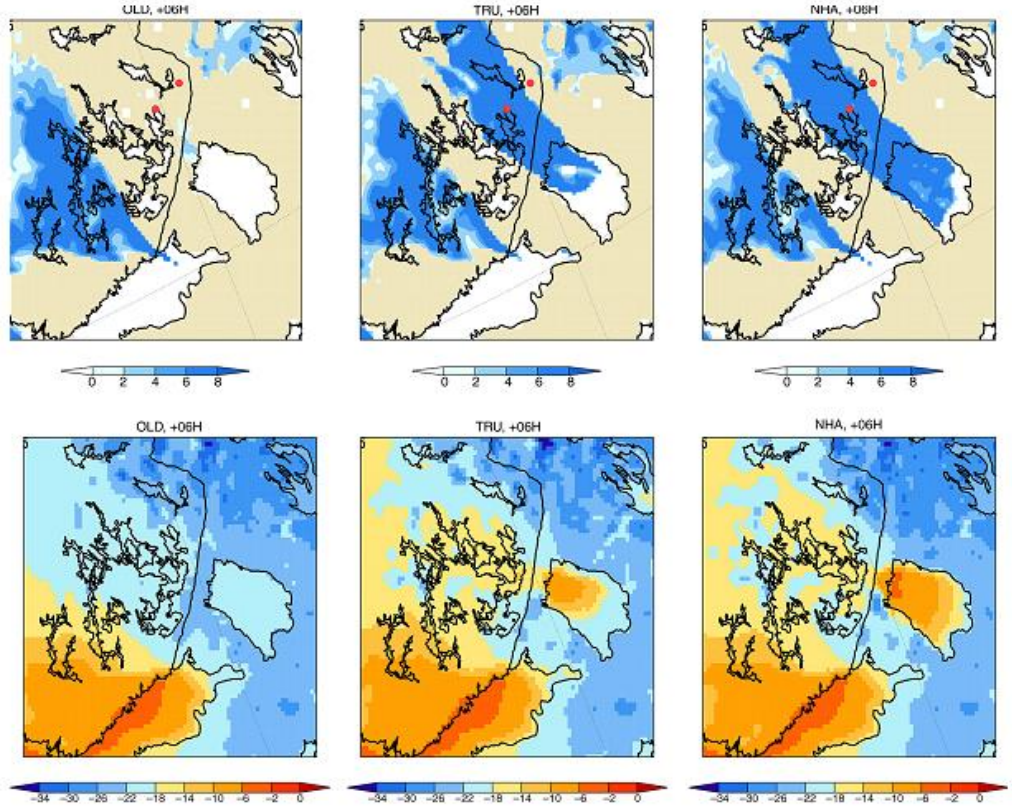

Fig. 6. Six-hour forecasts of instantaneous low-level cloud cover (octas, upper panels) and screen-level temperature (°C, lower panels) from the three experiments OLD (left), TRU (middle), and NHA (right). The analysis time (starting time of the forecasts) is 28 January 00 UTC. The red dots denote the two observation stations, Ilomantsi and Joensuu (see Fig. 5).

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Outlines

Running of FLake in NWP environment of HARMONIE provides additional testing for the whole SURFEX platform. Our experience:

- Consistency between databases
- Aggregation/interpolation problems
- Fresh results from HARMONIE parallel runs
- Announce the new version of Lake Database

Consistency between databases

- ECOCLIMAP: each Cover contains fractions of 4 main surface types: nature, urban, sea and inland water
- Philosophy of SURFEX is to apply a single model to each surface type:
  ISBA (or …) for nature,
  TEB (or …) for urban,
  SEAFLUX (or …) for sea,
  WATFLUX (or FLake) for **inland water bodies**

Partition of Covers into 4 tiles in ECOCLIMAP should be done bearing in mind a possibility to apply a specific model in SURFEX and to provide parameters to it

Inland water bodies are very different

- freshwater and saline lakes, rivers, reservoirs, ponds
- different types of wetlands (mires, bogs, fens, polders)
- closed bays, coastal lagoons and mangroves are sea water or inland water, depending on application
- the Caspian Sea and the Aral Sea are sea water or inland water, depending on the application

Which model describes better the behavior of the cover type in question? Not always FLake!

- For each tile, its fraction together with a set of parameters is provided.
- Some parameters such as LAI are produced by ECOCLEMAP software
- Others, such as sand and clay fractions or the lake depth are taken from external databases
- It is not always possible to provide all the needed parameters with a chosen partition of tiles for Cover
- For Covers such as wetlands, mangroves, etc., the "lake depth" can't be provided by Lake Database. Simple fix (just set it to the default value of 10 m) is not physical

- All "inland water"-related Covers in ECOCLIMAP were examined and two types of situations were distinguished
- 1 type: "wetland"-type or "sea"- type Covers.
  For them, it is better to use ISBA or SEAFLUX instead of FLake.
  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. They appear because of statistical methods which were applied when producing ECOCLIMAP. To harmonize this, not only changes in partition were made, but also the binary map itself was fixed.

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%

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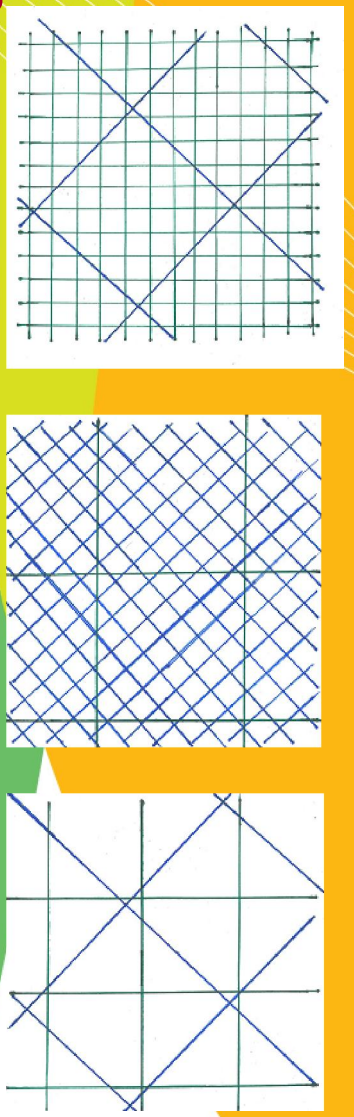
Aggregation/interpolation problems

- Project on a target grid: atmospheric model grid
- Two situations differing in principle:

  A: a resolution of a land-use map is finer than of a target grid: aggregation of data is needed

  B: a resolution of a land-use map is coarser than of a target grid: interpolation of data is needed; NB! interpolation methods are important because fields of parameters may be not smooth or discontinuous, such as the depth of lakes
- Plus an intermediate situation may happen
  C: when resolutions are approximately the same



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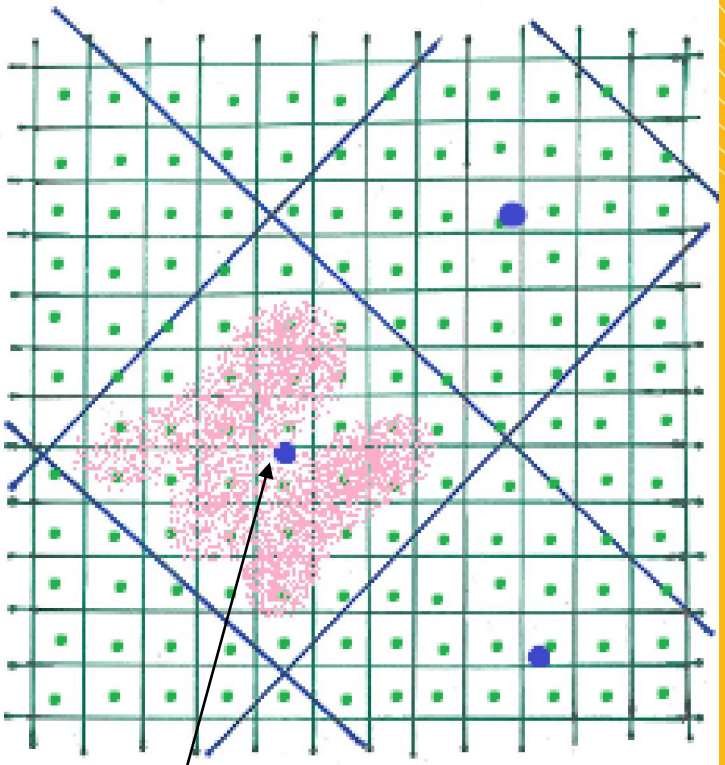
Related coding aspects in SURFEX : two-steps treatment of data

Step1, attempt to aggregate.
Inside each grid-cell of the target grid, try to find all the grid-cells of the initial grid.

- If they were found, aggregation is performed, and the target grid-cell gets an aggregated value.

Note that each grid cell in both grids is defined by its center!

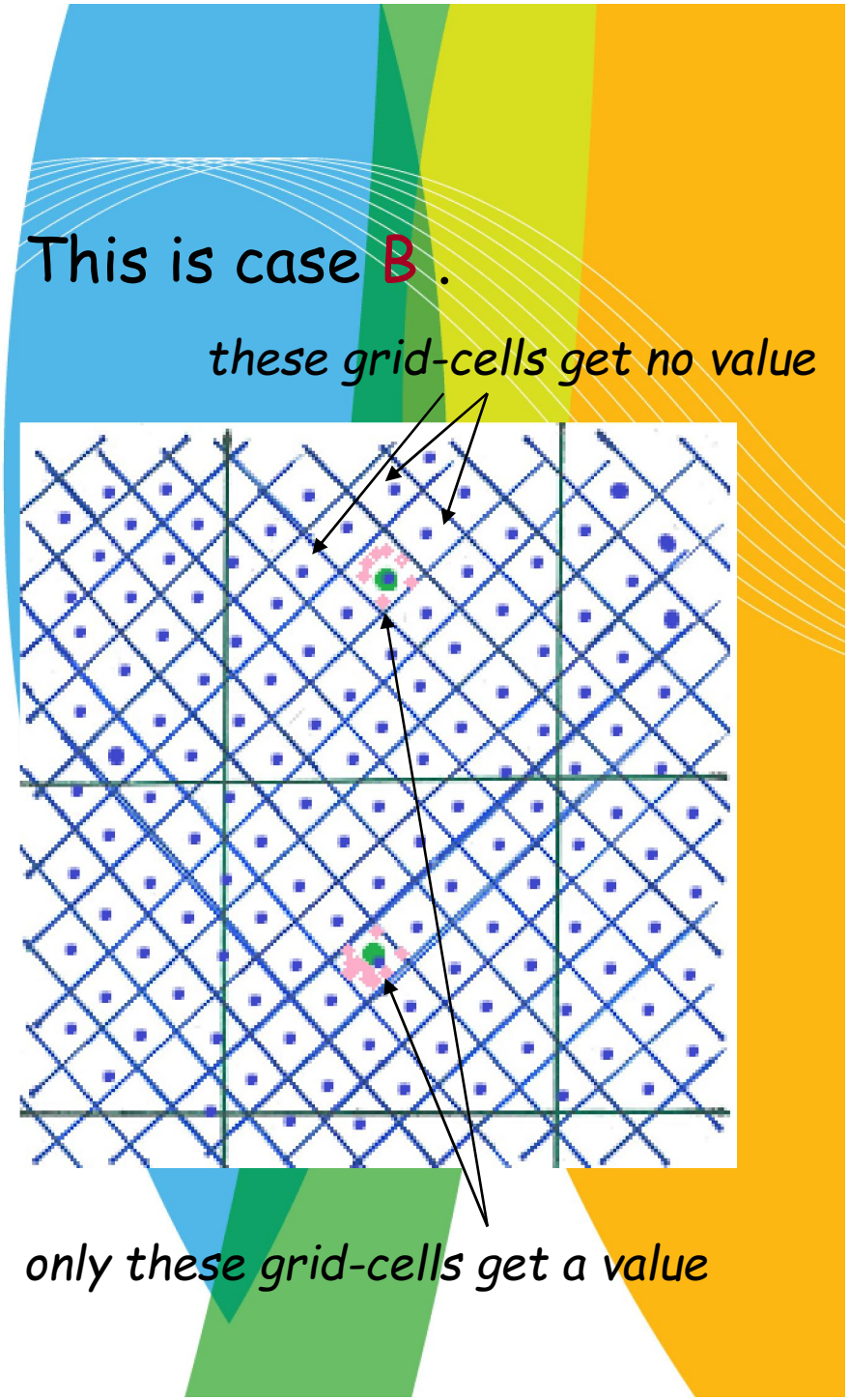
This is Case A .



Step1, attempt to aggregate. Inside each grid-cell of the target grid, try to find all the grid-cells of the initial grid.

- If they were not found (for most of points), aggregation is impossible, the target grid-cell gets no value and interpolation will be needed.

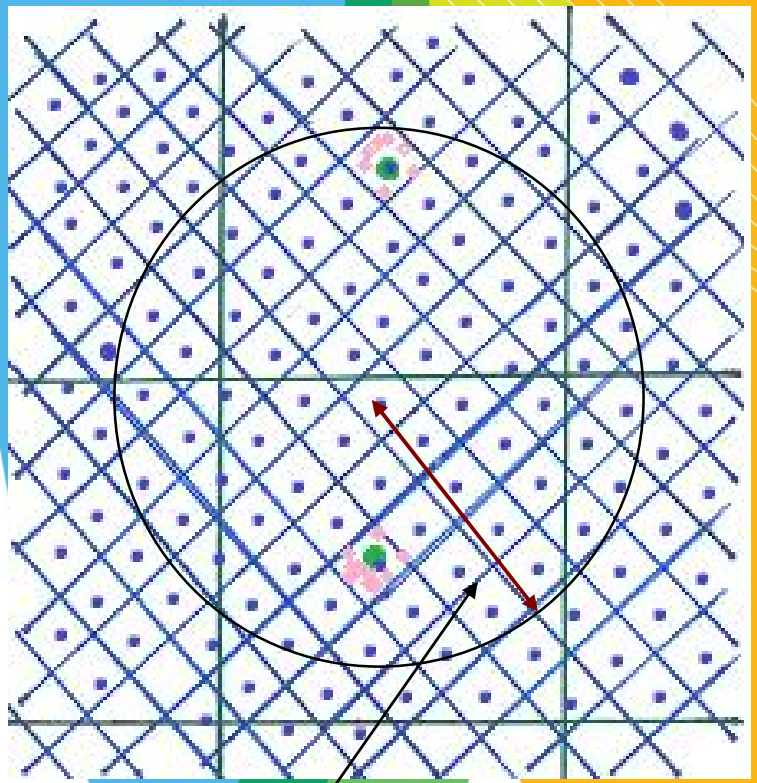
Note that each grid cell in both grids is defined by its center!



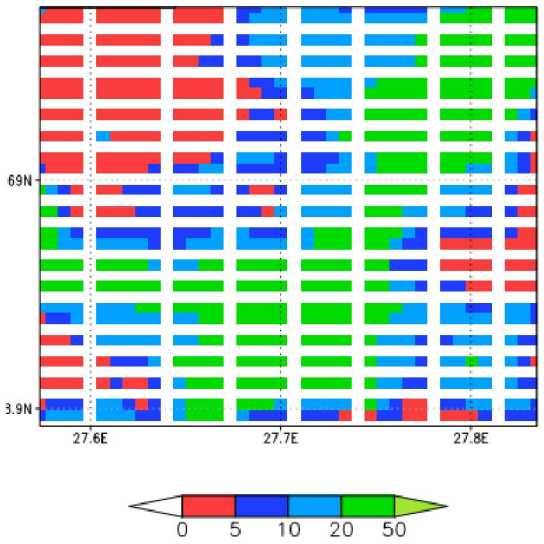
Step 2: if needed, interpolation on the target grid, for no-value grid-cells. Usually, spline interpolation is applied.

- Ambition behind this technique is to make a universal code for different situations A, B and C , not analyzing explicitly how resolutions of the initial field and the target grid relate to each other.
- Price for this elegancy: existence of a tuning parameter NHALO which defines a radius (in a grid-cell space) to seek for data for interpolation.

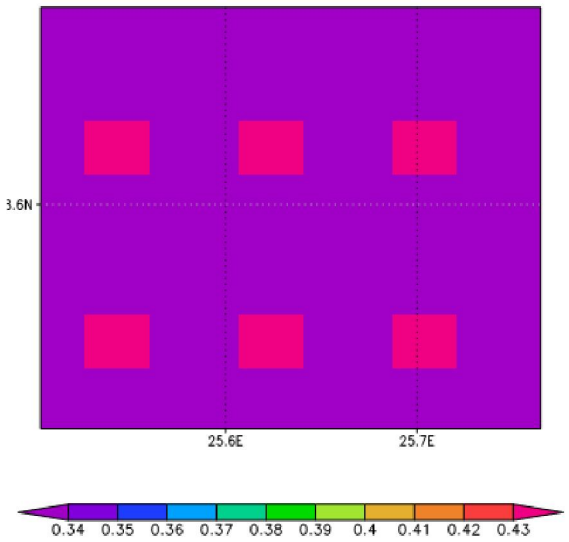
This is case B .



- What happens if NHALO is too small?
- Something like this, depending on a resolution:



Water depth, m



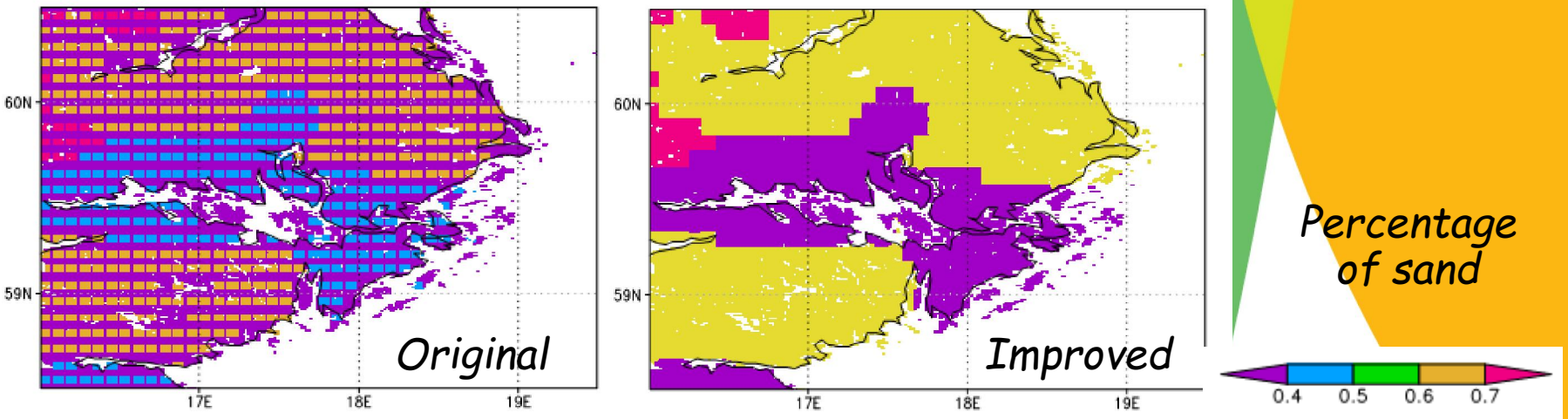
Percentage of sand

Crash!

- Tuning process may be a headache
- Discontinuous fields can't be treated like this
- Artificial smoothing with splines often should be avoided

How to improve?

- Best solution: to distinguish between situations A,B and C explicitly, use only interpolation methods which are applicable for the parameter in question.
  But this needs lot of re-coding.
- Intermediate solution: instead of using NHALO, apply the nearest neighbor interpolation method, seeking close points within the whole field.
  This was implemented, (although memory-consuming). Applicable for all fields.



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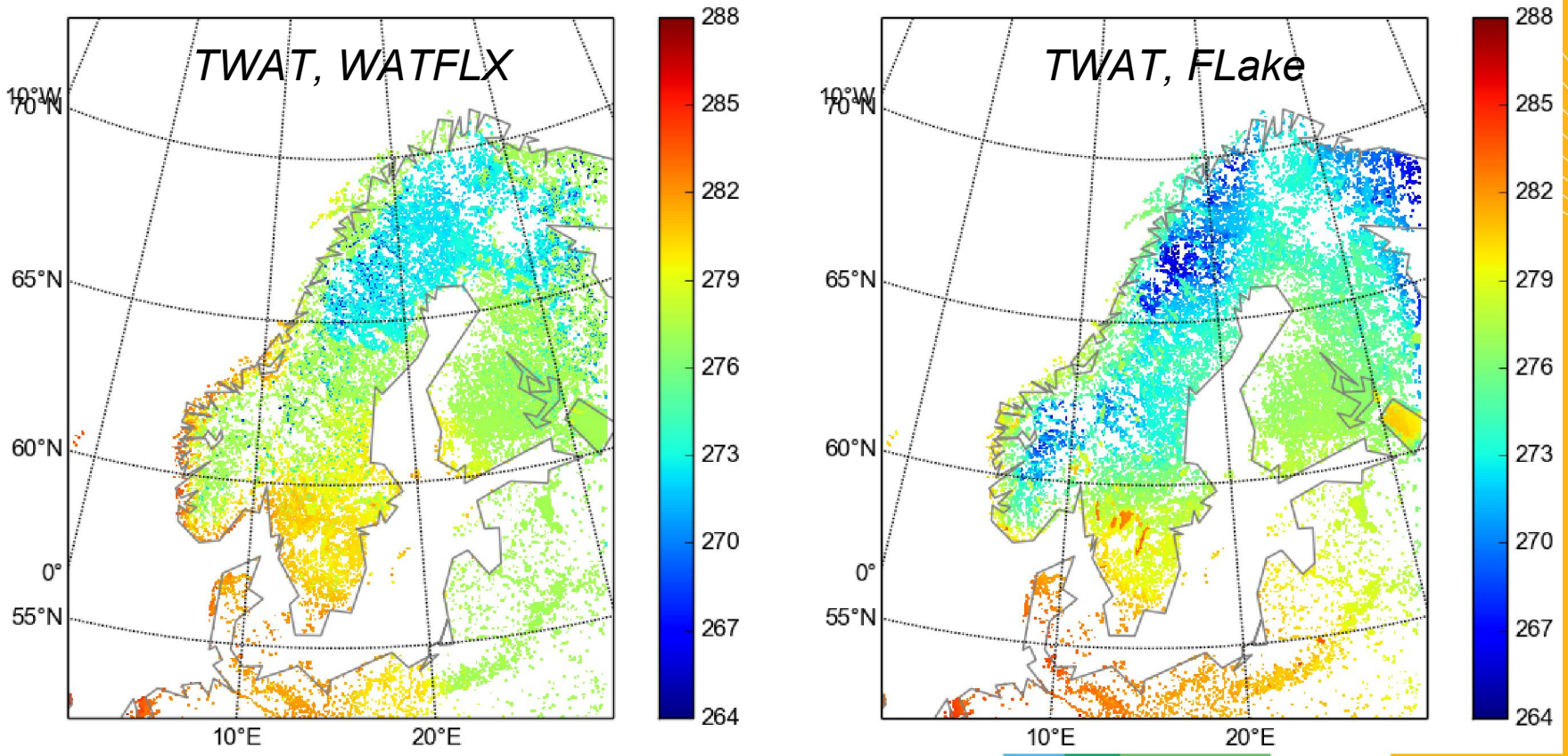
Fresh results with FLake in HARMONIE



00h 15 Nov. 2015 +00

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News about Lake Database

- V3 contains more data
- contains new estimates of the depth of unstudied lakes from their geological origin for Northern Hemisphere outside boreal zone and for Southern Hemisphere
- contains bathymetry for large lakes in Finland
- bug for large rivers is removed
- bug in the Antarctic is removed

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Thank you for your attention.

Questions?