

NetFAM



# Report on Lake workshop

Sander Tijm

Slides used from: Peroud, Martynov,  
Rontu, Samuelsson

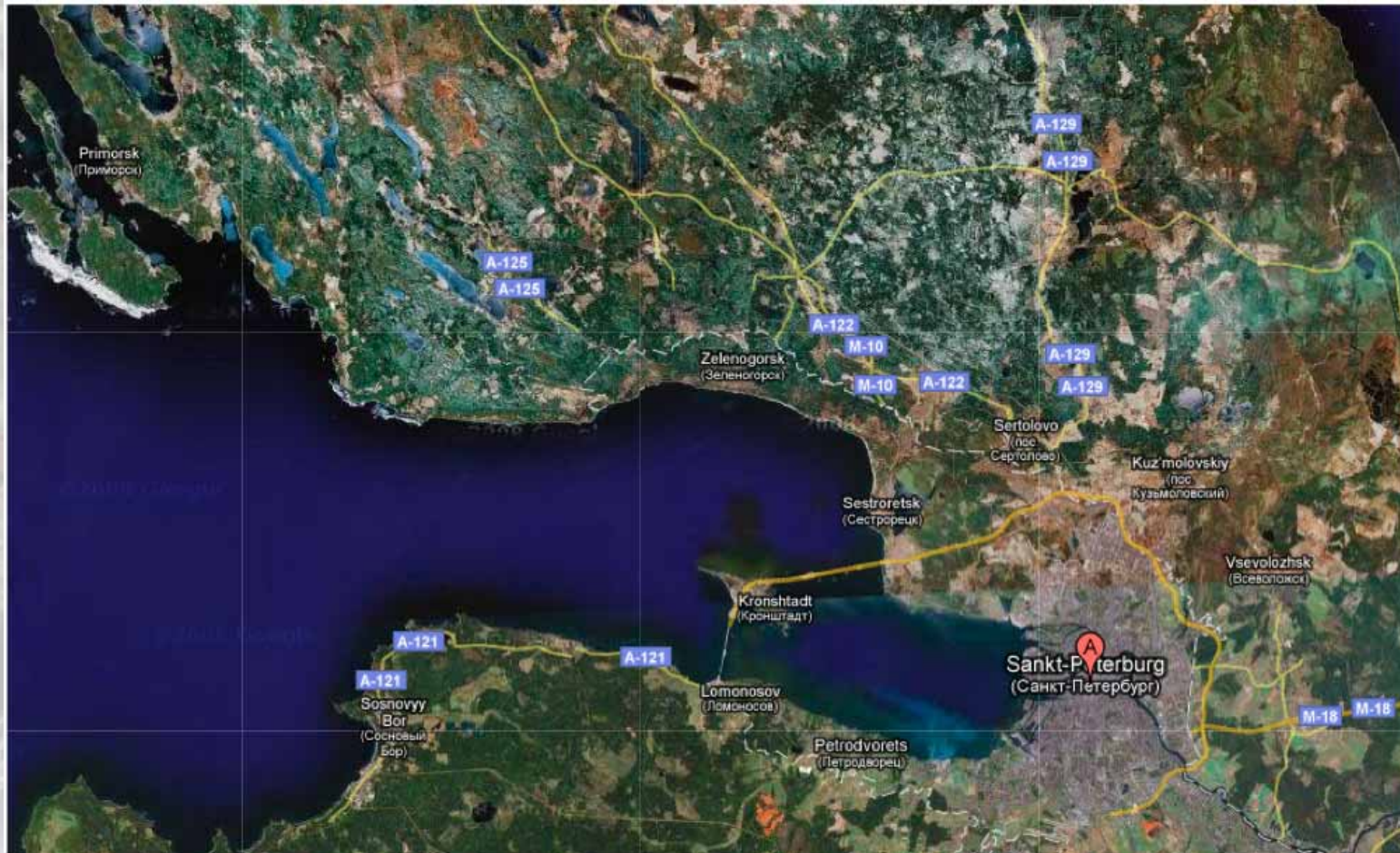


# HirLAM Introduction



- Workshop on lake modelling in Zelenogorsk, 18-20 november 2008







# HirLAM Introduction



- Workshop on lake modelling in Zelenogorsk, 18-20 november 2008
- Subjects: Lake modeling, surface scheme developments, data-assimilation, lake data bases, observations
- Good overview of lake modeling
- Supposed to be first surface expert team meeting.



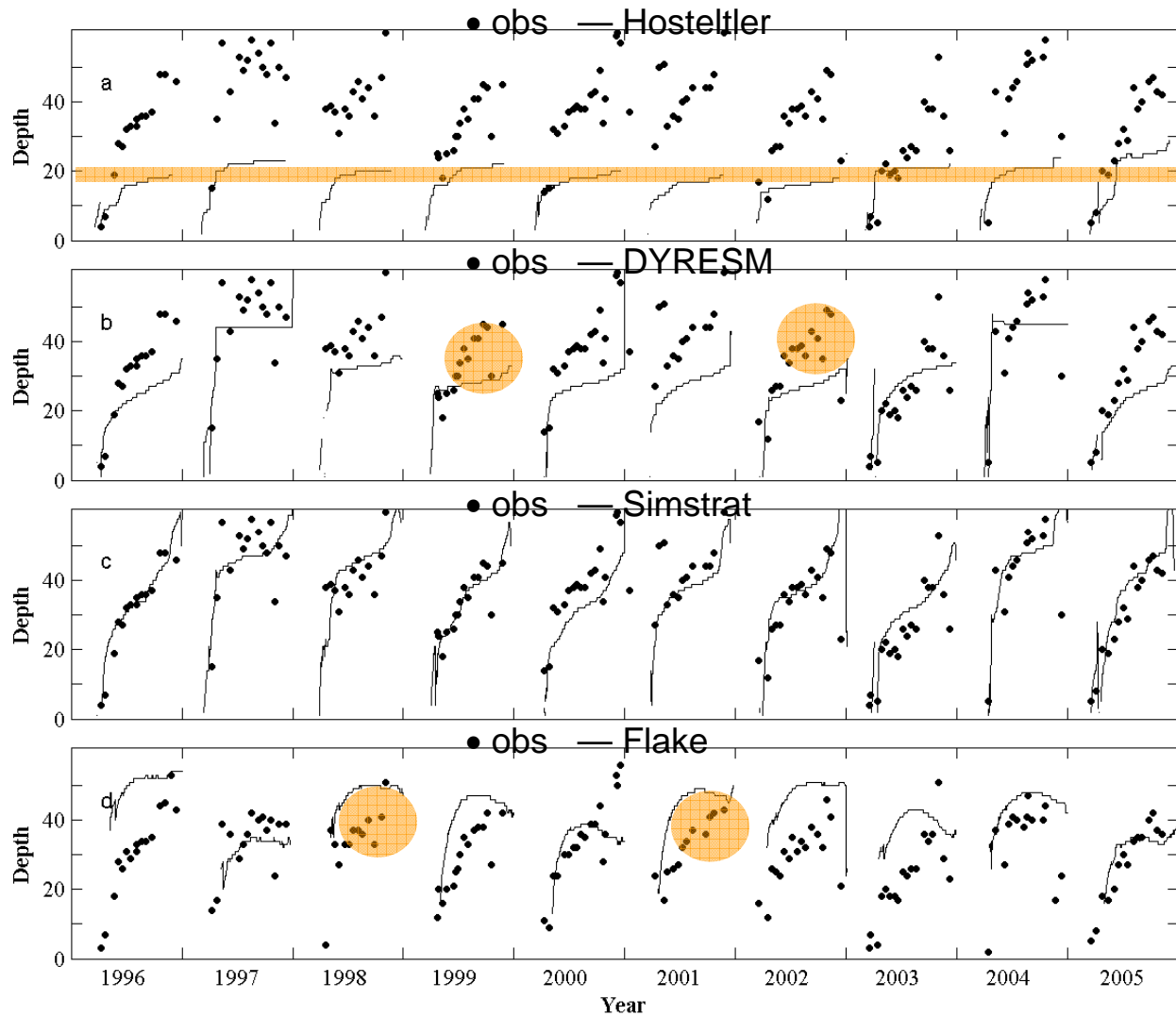
# Different lake models



- Different models around:
  - FLake
  - Hostetler
  - DYRESM
  - Simstrat
  - K- $\epsilon$  model
- Ranging from 2-layer to many-layer 1D models, resolution up to 75 cm!



# Lake Geneva (depth > 300m)



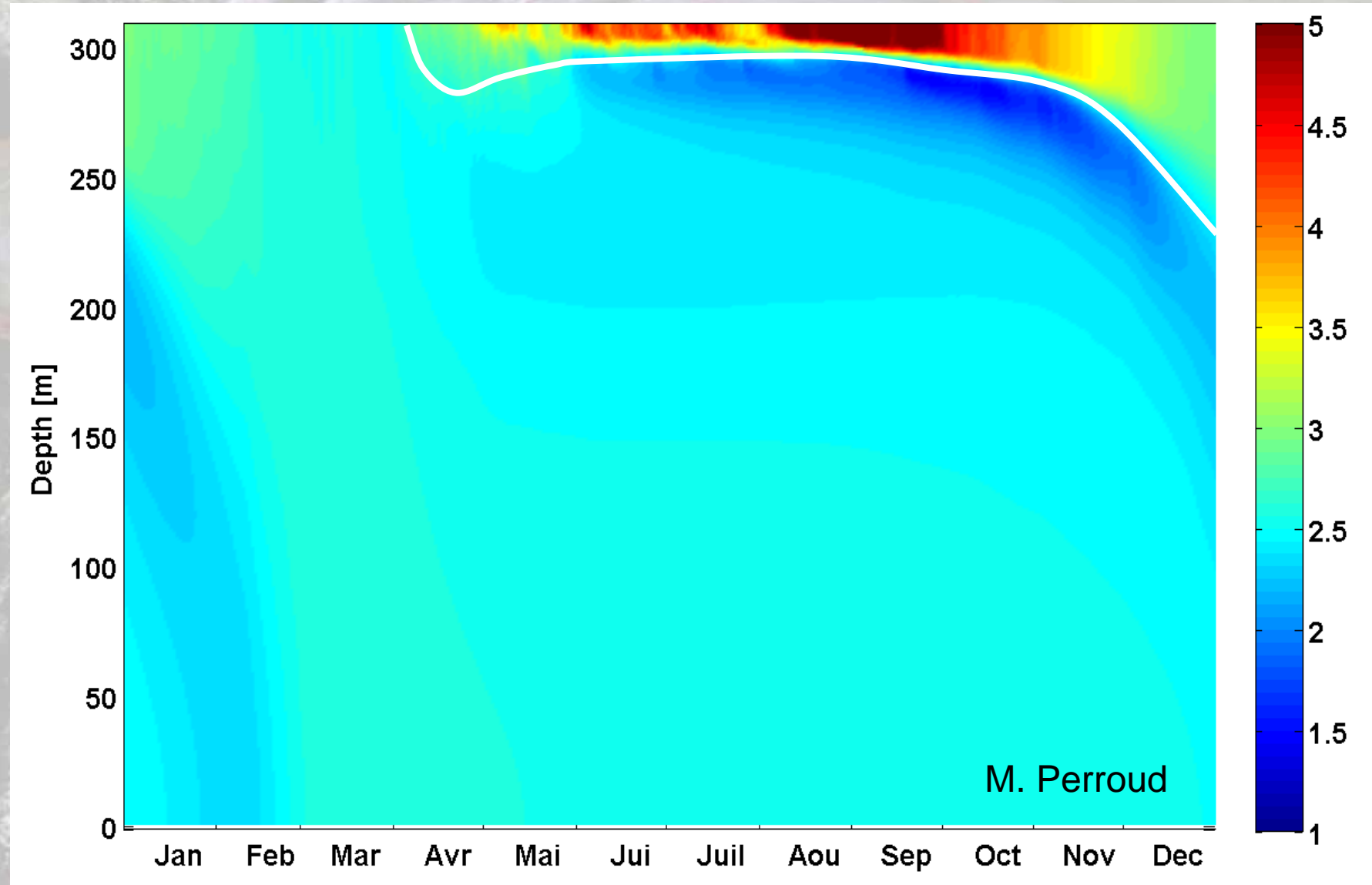
Lower boundary of  
the metalimnion

$$DT_{T100\max} = T_{100\text{m}} - T_D$$

M. Perroud



# Difference between daily means for years 1976-1986 and 2076-2086





## Use of lake models



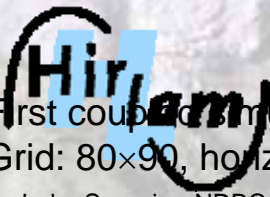
- Different lake models, choice dependent on use
- Flux and LST important, models like FLake can be used
- Temperature profile important, more sophisticated model necessary (use for water quality, algae blooms, fishing)
- Use of FLake for rivers also possible. Use shallow lake, possible because strong mixing



# How to test models



- Testing of models:
  - Results depend on way of coupling
  - Offline: no feedback of lake on meteorology, weather (clouds), near surface profiles (fluxes). Comparison with observations can be tricky
  - Online: more expensive, fluxes better and results can be compared with observations

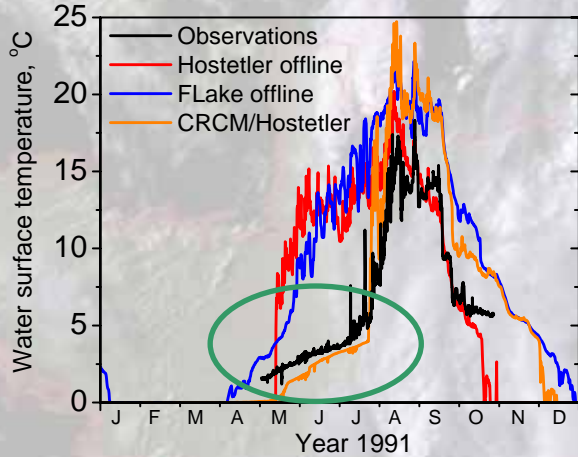


# Coupling with lake models

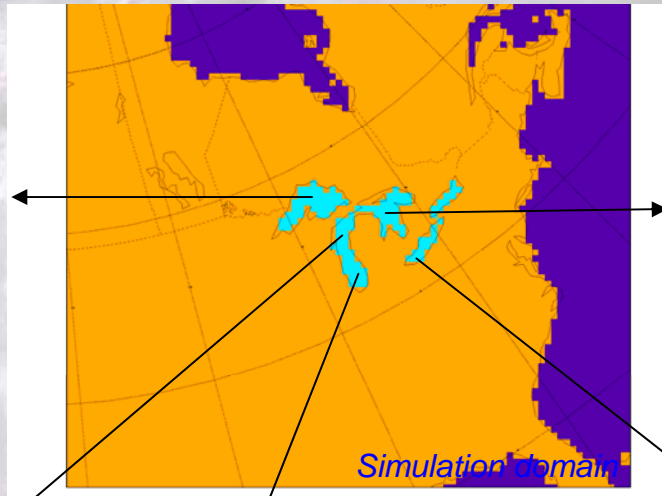
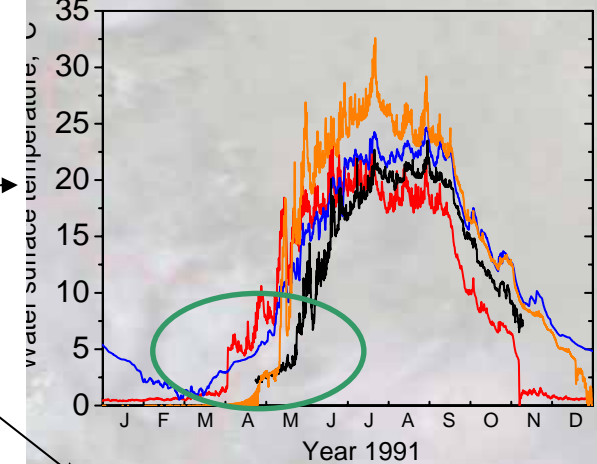


First coupled simulation: year 1991, LAKE=2 (Hostetler), driven at the boundaries by the NCEP/NCAR reanalysis  
Grid: 80x90, horizontal resolution: 45 km. Lakes: only the Great Lakes (other lakes are masked out)

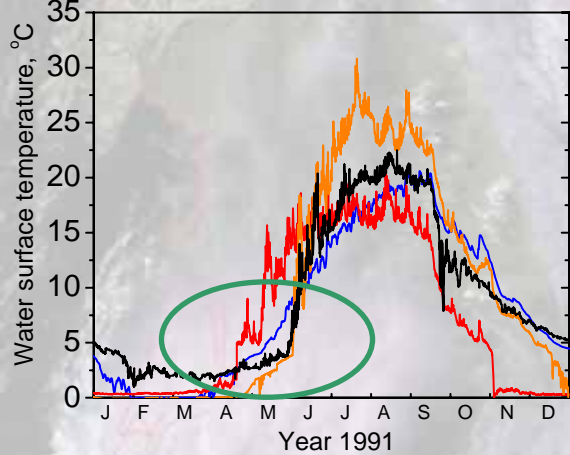
Lake Superior, NDBC buoy 45001, depth: 261.6 m



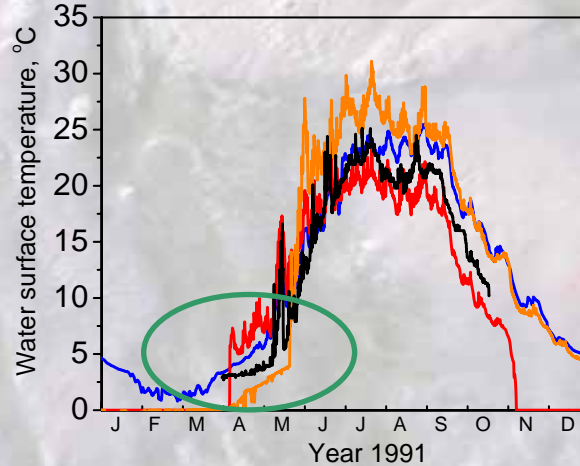
Lake Huron, NDBC buoy 45008, depth: 54.3 m



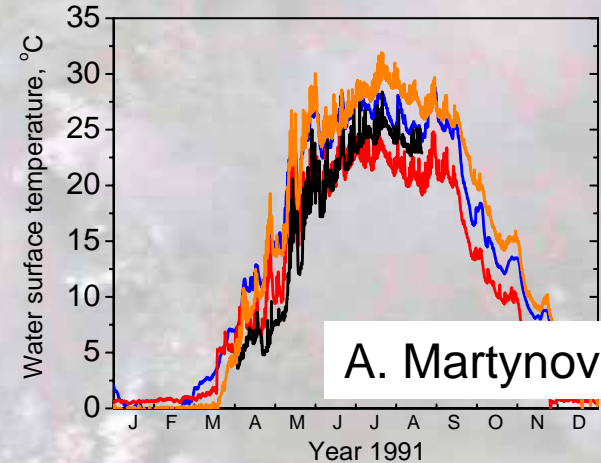
Lake Michigan, NDBC buoy 45002, depth: 181.1 m



Lake Michigan, NDBC buoy 45007, depth: 160 m



Lake Erie, NDBC buoy 45005, depth: 12.6 m



A. Martynov

**This coupled simulation reproduces much better the observed temperature patterns, than offline ones. Long spring water warming from 0°C to 4°C in deep lakes is reproduced in coupled simulations. Why? Too high water temperature in summertime: air/lake interactions need to be adjusted.**



# HirLAM FLake



- FLake is (being) implemented in all European models
- Impact dependent on surface scheme (tiling approach or not)
- Model needs characteristic values for every lake (one effective depth, turbidity, size) from lake database
- At this moment model does not take changing depth into account, important for ice cover



## Optimal parameters FLake



- Lake model results strongly dependent on characteristic values of model
- Values in database may not be optimal for NWP model
- Use variational technique to find best fit of yearly temperature cycle per lake
- Ice cover period second parameter to fit, FLake produces too much ice, snow has to be taken into account



# Underlying data



- Data base important, needs to be extended for all of Europe, rest of world
- FLake website, quick check of impact of changes in parameters
- **FLake Page** <http://lakemodel.net> (also <http://nwpi.krc.karelia.ru/flake>)



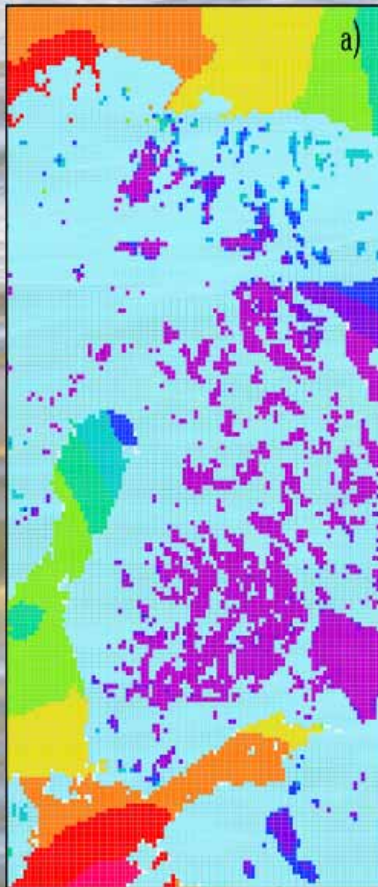
# Application Flake HIRLAM



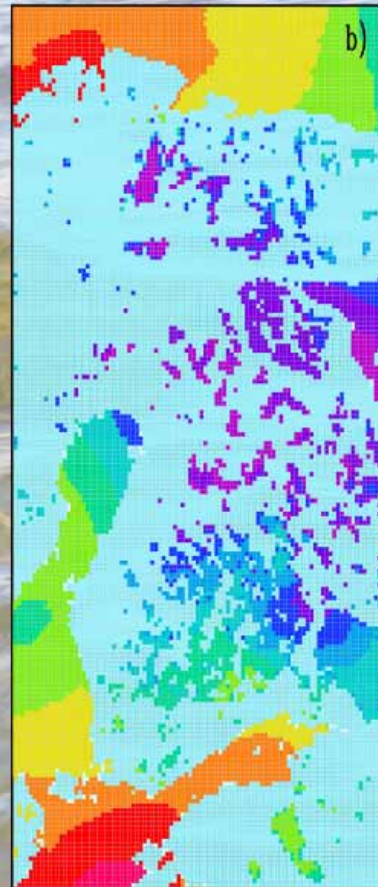
Lake temperatures 10.12.2006

L. Rontu

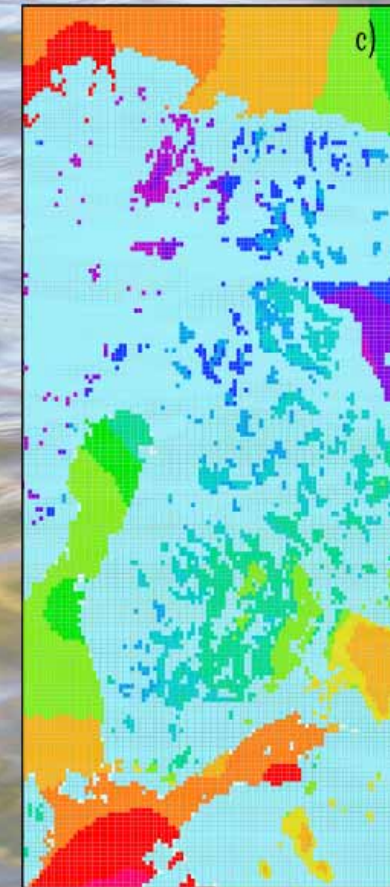
FINLAKE climate 10.12.2006



OBSERVED estimate 10.12.2006

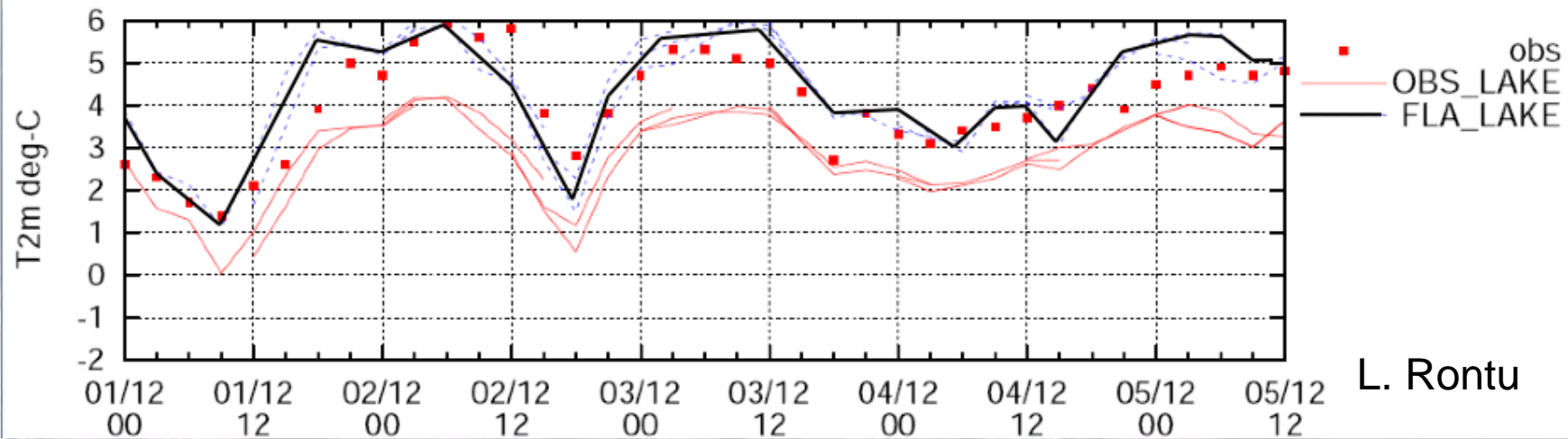
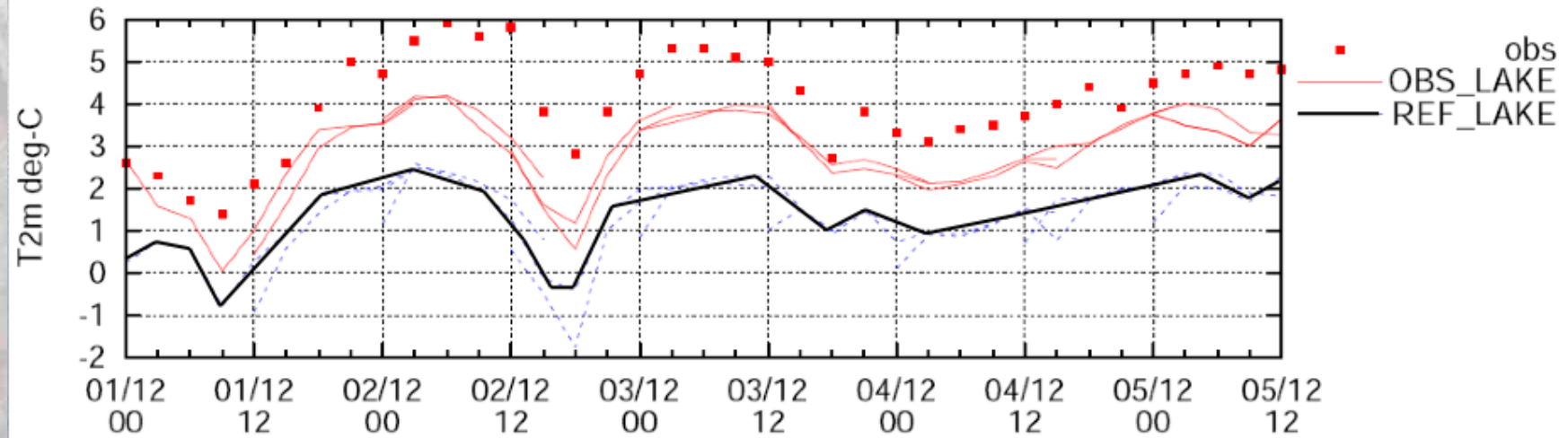


FLAKE simulated 10.12.2006





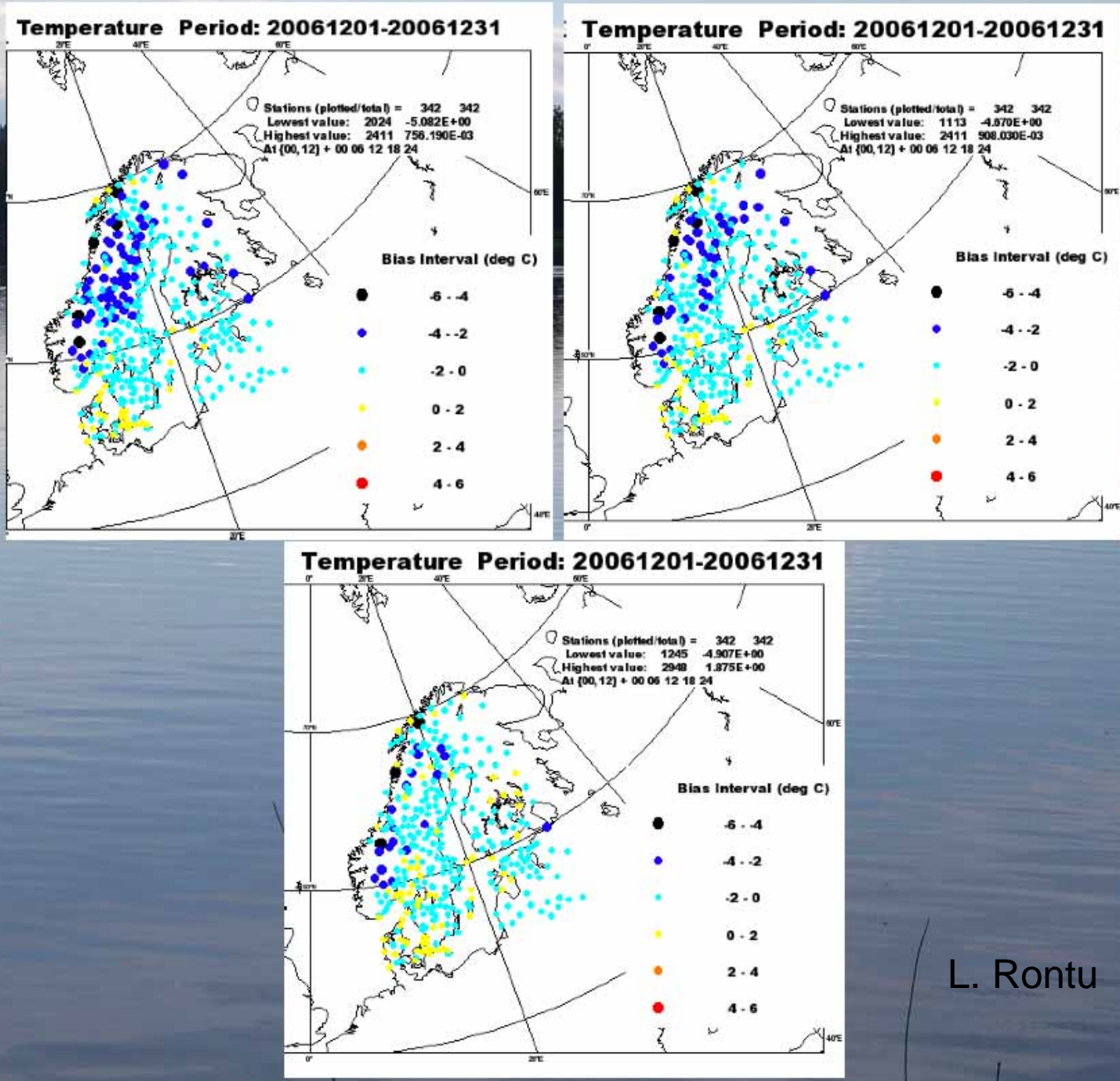
# Lake station T2m



L. Rontu

# Statistical verification in December 2006

Hi



L. Rontu



# Lake influence on 2m-temperature



North America 1985-1989

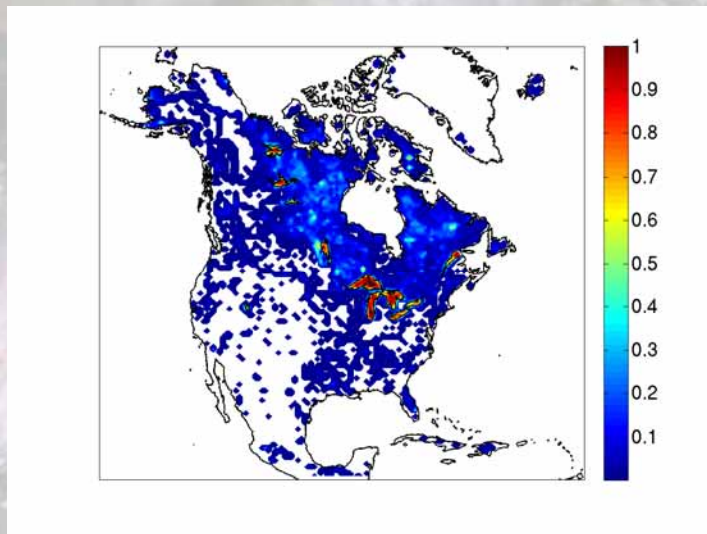
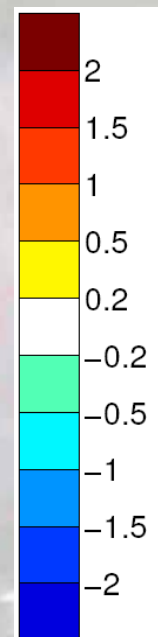
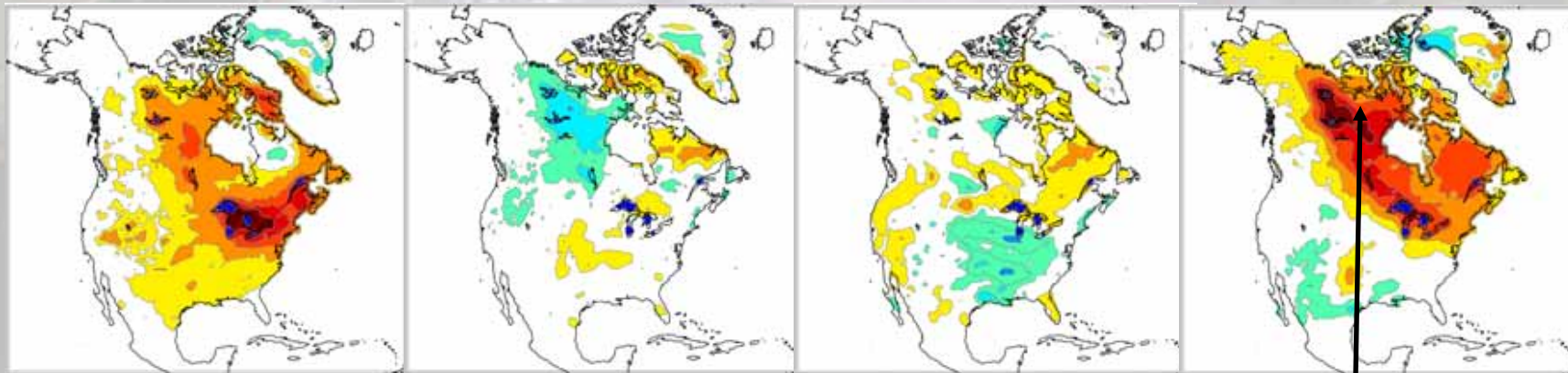
Open land 2m-air-temperature for (lake version) – (no lake version):

winter

spring

summer

autumn



Lake fraction

Too deep lakes in this area can contribute to a warm bias we experience (also the case in Siberia).

Signatur

P. Samuelsson



# Lake influence on precipitation



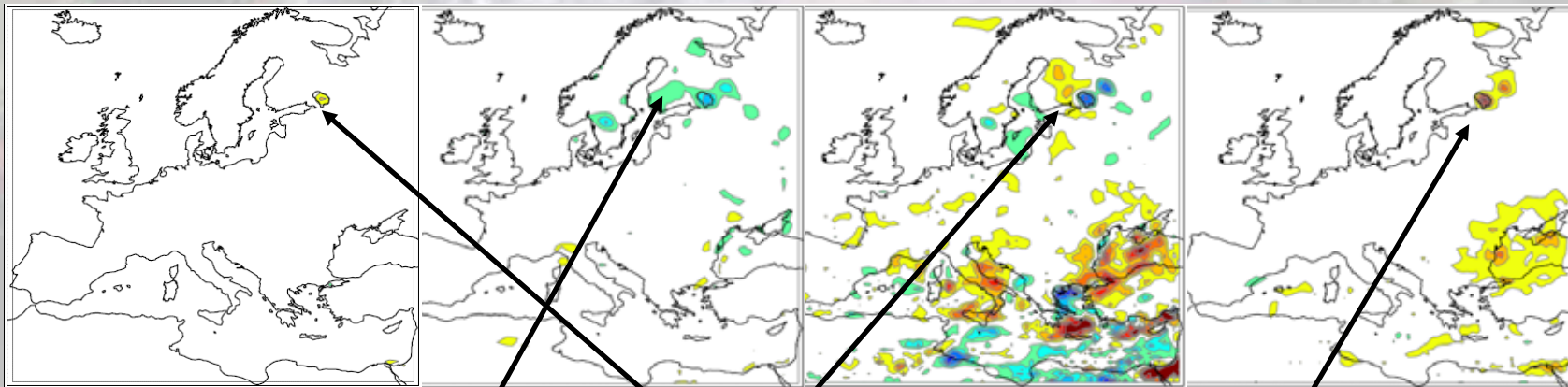
winter

spring

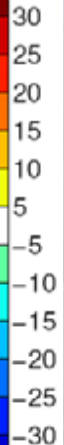
summer

autumn

Total precipitation for ((lake version) – (no lake version))/(no lake):



%



Less prec over lakes in spring

Less prec over big/deep lakes

More prec over big/deep lakes in autumn-winter

More prec over small/shallow lakes

P. Samuelsson



## Remaining issues



- Extension of database, search for funds
- Extension of FLake with snow on ice, for better ice cover period
- Extension to 2D, changing depth for large lakes. T and %ice depend strongly on depth.
- Flow of ice for large lakes
- Intercomparison of lake models (LakeMIP)
- Role of SRNWP in organization of workshop in 2 years time