

# **The impact of lakes on the European climate as simulated by a regional climate model**

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Mironov**

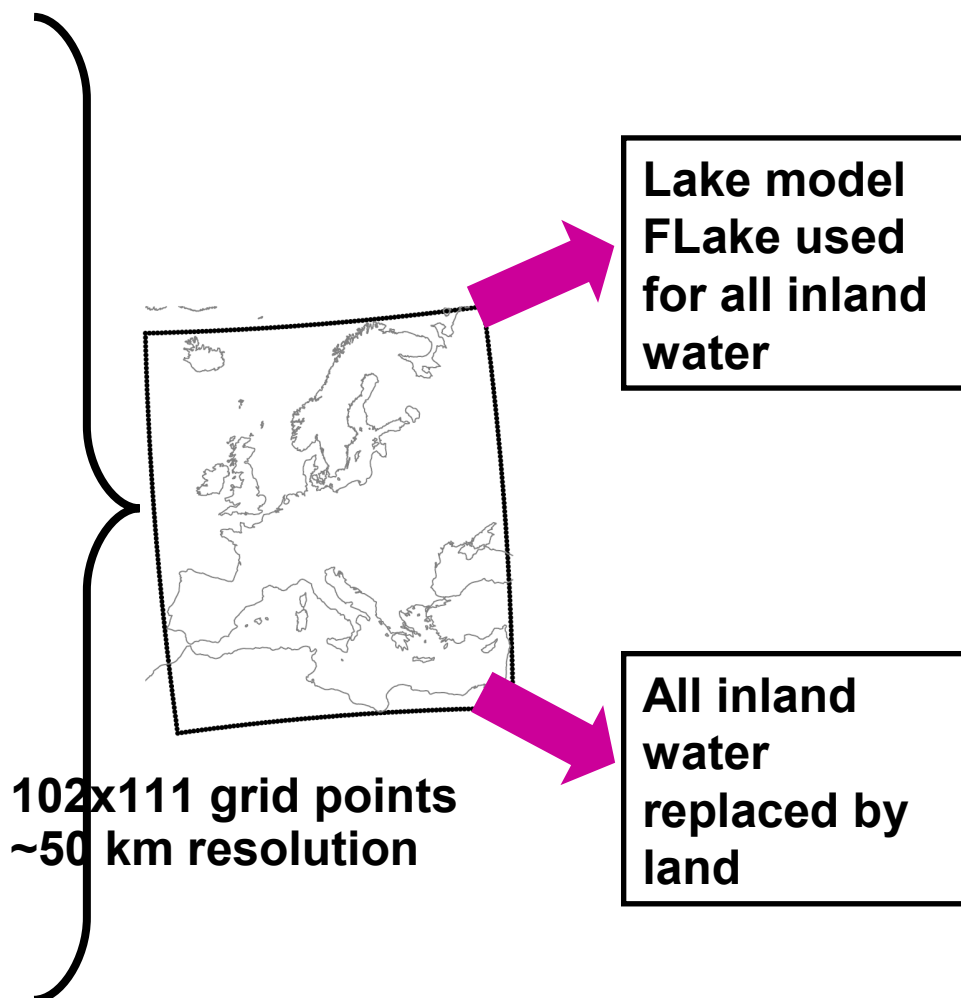
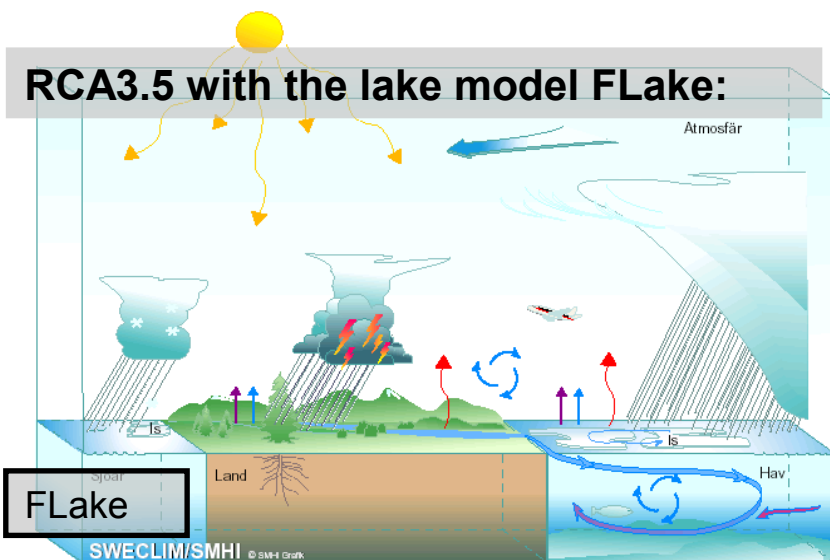
**Boreal Env. Res. 15: 113–129**

# Do we need to account for lakes in climate and NWP modelling?

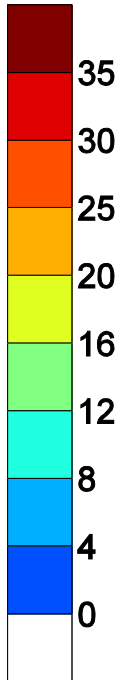
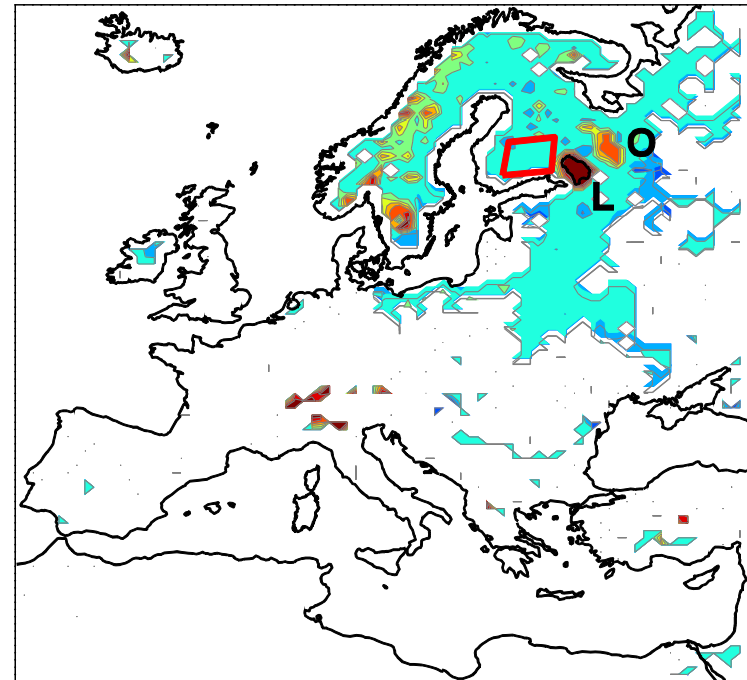
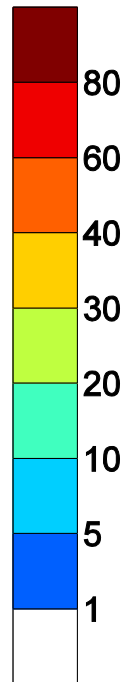
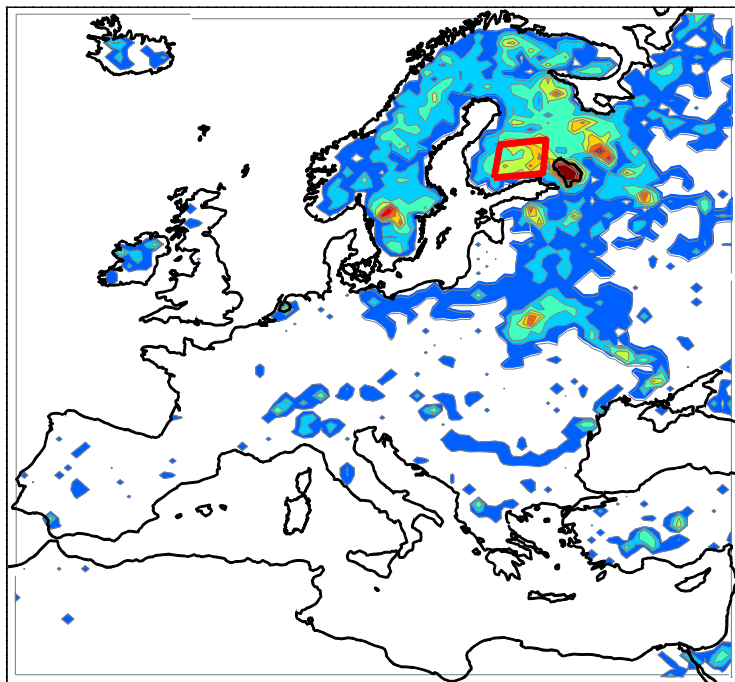
To answer that question two sets of RCM simulations have been done:

- **RCM:**  
the Rossby Centre Regional Climate Model (RCA3.5)
- **Time period:**  
1961-1990
- **Lateral BC and SST:**  
from ERA40 (ECMWF Reanalysis)

RCA3.5 with the lake model FLake:



# Physiographic lake information



Total fraction of lakes (in %) based on ECOCLIMAP physiography.

Depth of lakes (in m) based on data base by Kourzeneva (2010)

RCA uses a tiled/mosaic approach. Each grid square can include fractional coverage of three categories of lakes:

Depth interval (m)	All	Excluding 10 m
0-4 (shallow)	1.4	3.9
4-8 (medium)	7.8	21.8
8-40 (deep)	90.8	74.3
25-40 (deep)	5.6	15.6

# Lake influence on 2m-temperature

Europe 1961-1990

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

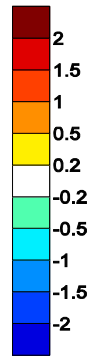
winter

spring

summer

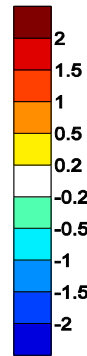
autumn

RCA35\_FLake\_6190 t2mopen\_J - RCA35\_nolake\_6190 t2mopen\_J



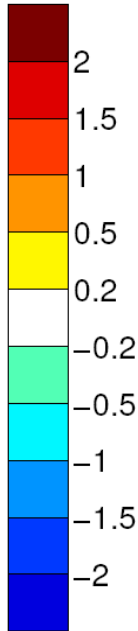
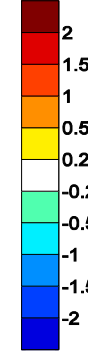
Due to indirect effect of more SW due to less cloudiness

RCA35\_FLake\_6190 t2mopen\_J - RCA35\_nolake\_6190 t2mopen\_J



Due to relatively warm lakes during night time

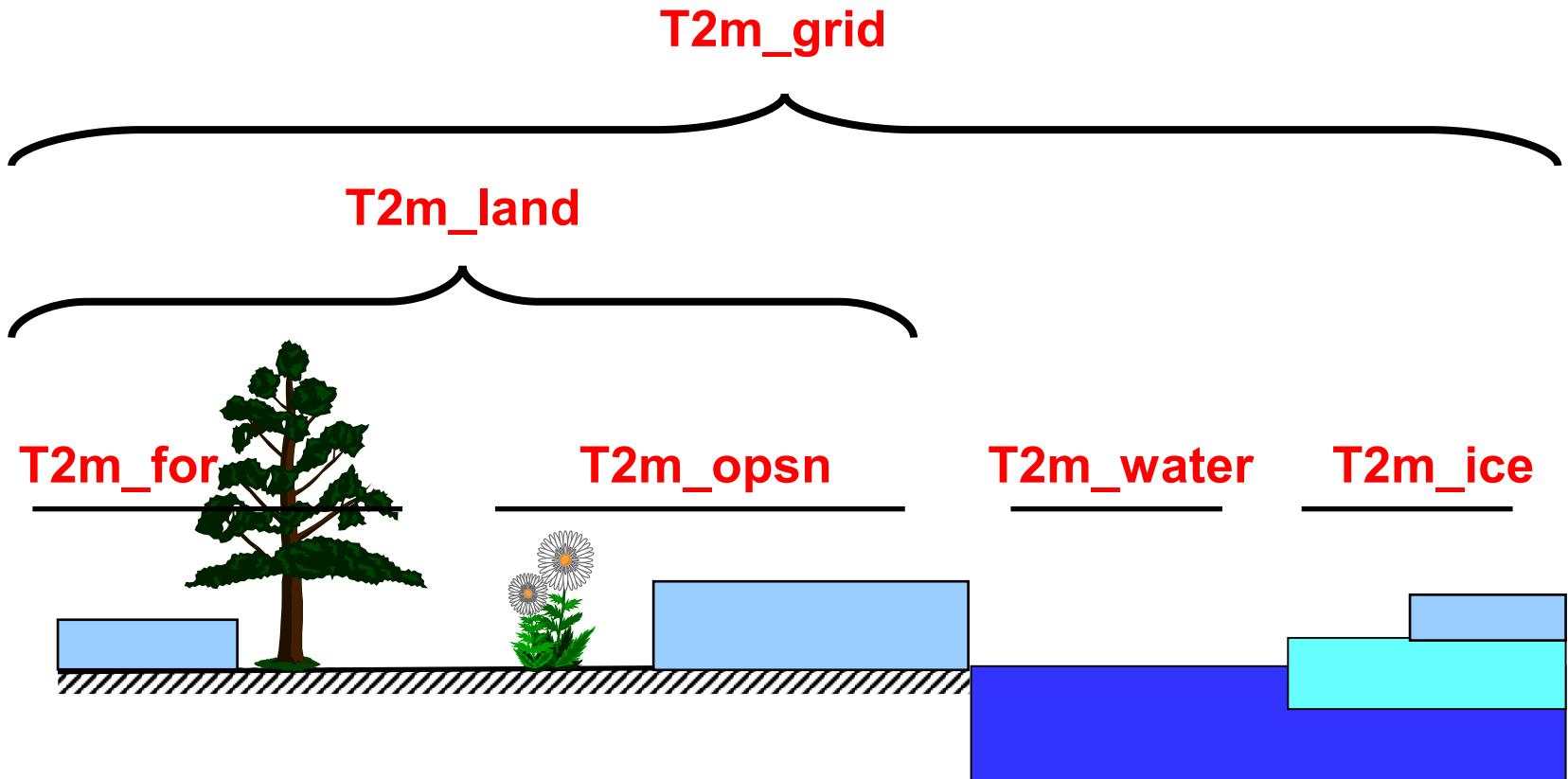
RCA35\_FLake\_6190 t2mopen\_J - RCA35\_nolake\_6190 t2mopen\_J



## Conclusion:

The greatest impact is seen during autumn and winter over southern Finland and western Russia where the warming exceeds 1 K.

# Tiles of 2m-temperature



## **Comment on T2m**

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**T2m\_grid (including lakes) shows a cooling effect of lakes not only during spring time, but also during summer time for the deepest lakes.**

**Bonan (1995) and Krinner (2003) used a lake depth of 50 meters for all lakes present in their GCM domains. This depth is close to the actual mean depth of Lake Ladoga. They conclude that lakes induce a cooling effect on the summer climate.**

**Our results support this conclusion when considering summer grid-box mean T2m over Lake Ladoga, where the fractional area coverage of lake water is large in the RCA domain.**

**However, for the majority of European lakes the mean depth is less than 50 m and the fractional area coverage is quite small. Then, the cooling effect of lakes is less pronounced (if at all), and the warming effect is seen if the T2m over land part of the model grid box is considered.**

# Lake influence on convective precipitation **SMHI**

Europe 1961-1990

Convective precipitation for (lake version) – (no lake version) (%) :

winter

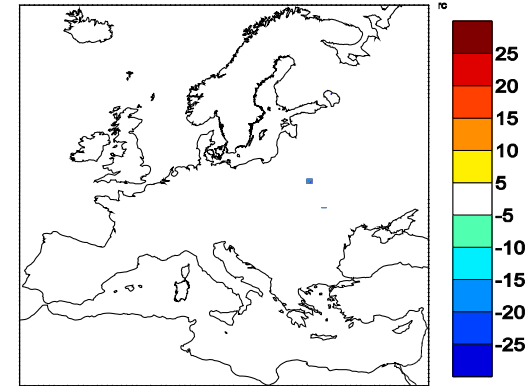
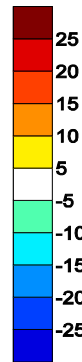
spring

summer

autumn

$(RCA35\_FLake\_6190\ convpro - RCA35\_nolake\_6190\ convpro) / RCA35\_nolake\_6190$  ;  $(RCA35\_FLake\_6190\ convpro - RCA35\_nolake\_6190\ convpro) / RCA35\_nolake\_6190$  ;  $(RCA35\_FLake\_6190\ convpro - RCA35\_nolake\_6190\ convpro) / RCA35\_nolake\_6190$  ;  $(RCA35\_FLake\_6190\ convpro - RCA35\_nolake\_6190\ convpro) / RCA35\_nolake\_6190$

No  
significant  
change



## Conclusion:

Locally, e.g. over southern Finland and over Lake Ladoga, the convective precipitation is enhanced by 20-40% during late summer and early autumn while it is reduced by more than 70% over Lake Ladoga during early summer.

# Lake influence on 2m-temperature

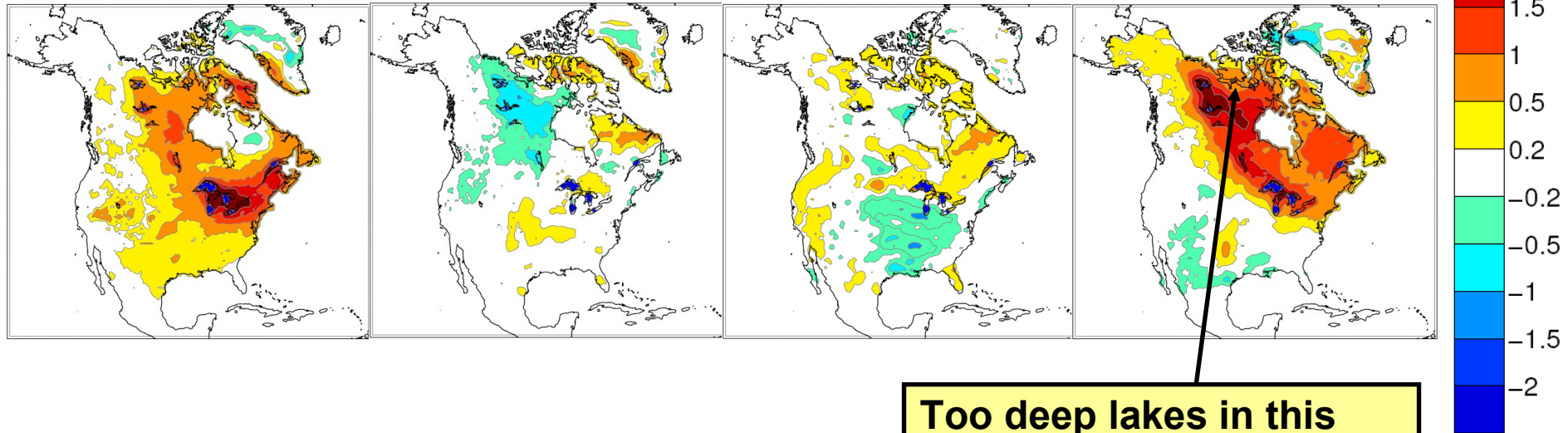
Open land 2m-air-temperature for (lake version) – (no lake version):

winter

spring

summer

autumn



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



An aerial photograph of a lush green landscape. A large, winding river flows through the center of the image. In the lower portion, a town is visible, situated near a large reservoir or dam. The terrain is densely forested with vibrant green trees. The word "THANKS!" is overlaid in large white letters on the left side of the image.

**THANKS!**

**SMHI**