Comments on Summary (avtoreferat) of the thesis submitted for the degree of a Candidate of Science in physics and mathematics by Margarita Choulga "Predstavlenie ozer v modelyah pogody i klimata: vneshnie parametry, ob'ektivnyi analiz temperatury poverhnosti vody i verifikatsiya" for specialisation 25.00.30 - meteorology, climatology, agrometeorology

The thesis by Margarita Choulga is devoted to the influence of lakes on atmosphere. It focuses on the impact of the lake depth to the results of numerical weather prediction (NWP) models. The main outcome of the work is the improved Global Lake Data Base (GLDB, version 3), containing gridded data on the depth of the lakes. These data are necessary for NWP and climate models, which obtain their lower boundary conditions over lakes - the lake surface water temperature (LSWT) and ice cover - by using lake models such as the Freshwater Lake Model (FLake) for the prognostic parametrization of lake thermodynamics. The improvement of GLDB, suggested by the author, consists of using geological information for indirect definition of the mean depth of thousands of medium and small lakes (typically, of the size less than 200 km^2) where the measured depths may not be available. This is a novel approach, which allows to significantly increase the realism of the description of the lake properties in the atmospheric models, applied anywhere on the globe.

For the initialisation, NWP models may also utilize objective analysis of LSWT observations, i.e. interpolation of the irregularly distributed real-time measurements to the NWP model grid. The available observations are based on local instrumental measurements and, increasingly, on satellite data. For the objective analysis, knowledge of the statistical structure of the LSWT distribution is necessary. Autocorrelation functions, applied in the optimal interpolation, allow the optimal usage of the existing LSWT observations, also their extrapolation from one lake to another. The author suggests to take into account, in addition to the usually applied distance between points, also the lake depth differences. For example, LSWT of a deep lake may be more correlated to LSWT of another deep lake than to that of the nearest shallow lake. This is also a novel approach and the autocorrelation functions depending on both variables, which are calculated in this work based on 5-year measurements on 27 Finnish lakes, are ready for testing in NWP models.

Influence of the lake depth, given by the GLDB, on the lake water temperature distribution, predicted by FLake, is demonstrated by the author in two cases. One is a case study in January 2012 in the vicinity of Lake Ladoga, where the High Resolution Limited Area Model (HIRLAM) was applied for weather forecast. It is shown that a realistic estimate of the Lake Ladoga bathymetry was crucial for the correct forecast of cloudiness and screen-level temperature in the Eastern Finland. In this anticyclonic situation, the local weather was determined by the state of ice cover over Lake Ladoga. Another validation was done over the lake Kyyvesi, Central Finland, where different lake depths were tested using stand-alone FLake. The results are shown to depend on depth differently in different thermal states of the lakes, related to the annual cycle. Both the Ladoga and Kyyvesi cases confirm that the model results are indeed sensitive to the variations of the lake depth, and thus the improved knowledge of the values of this characteristic is essential.

The results presented by the author for the defense of the dissertation have been published in an international peer-reviewed journal (concerning GLDB) and in a local publication series (validation study on Lake Kyyvesi). Publication of the results related to statistical structure of LSWT observations (autocorrelation functions), is also desirable based on the dissertation. All results have been presented in several international workshops on lakes in numerical weather prediction. The summary allows to understand the contents of the study, main features of the methods and significance of the results. A few critical remarks to the summary could be made:

- The method of derivation lake depths from geological information is explained in detail in the summary (p.11-12). However, it is difficult to follow the description because some definitions remain unclear. For example, what is meant with the usage of the list of lakes v.s. the usage of lake pixels from the digital map? Does the latter mean GLDB, v1 or something else?

- The indirect estimates of lake depths have been validated against new data from 353 Finnish lakes (p.13). It is shown that the mean absolute and RMS error of the lake depths GLDB v3 is smaller than that of v1. However, no details of the data used for validation are given in comparison to the already available data in GLDB over the area. In the future, this limited-area validation could be complemented with studies over larger/different areas of the globe.

- In the summary, all figures are shown in the black and white, which makes them almost impossible to interpret. The results of the Lake Kyyvesi study, all given in the text, are complicated to follow (p. 17-19). It would have been better to present them in the form of a table or graphics.

These critical comments do not alter the overall positive impression of the study. In my opinion, the author of the dissertation has made an extensive and important work, obtaining results valuable for the international atmospheric and lake modelling communities. Based on the summary, the work without doubt meets the Supreme Attestation Comission (VAK) requirements and the author deserves the degree of the candidate of physico-mathematical sciences in the specialisation 25.00.30.

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