

Parameterization of Lakes in Numerical Weather Prediction and Climate Modelling

Introduction

The lower boundary of the atmosphere is made up of land and water surfaces. For accurate atmospheric prediction in meteorological models, both on human scales and large scales, correct representation of the properties of these surfaces is important.

The lake surface has particular challenges for meteorological modelling. At typical model resolution, many lakes are on the sub-grid scale. Thus they are represented as part of the land surface, although with very different behaviour from other land-surface types such as vegetation or cityscape. For example, the lake surface has a much smaller diurnal temperature range, its fluxes of sensible and latent heat into the atmosphere may be differently partitioned, and lake freezing and melting can dramatically influence the weather and change the surface behaviour for one part of the year.

Workshops

To help meet these challenges, meteorologists with an interest in lake modelling have come together at three international workshops in the last five years:

- 2008 Zelenogorsk, Russia, <http://netfam.fmi.fi/Lake08>
- 2010 Norrköping, Sweden, <http://netfam.fmi.fi/Lake10>
- 2012 Helsinki, Finland, <http://muscaten.ut.ee/Lake12>

At these workshops, they have shared ideas on lake measurement (both in-situ and remotely), lake modelling, the effects of lakes on meteorology and climate, physical lake geography e.g. bathymetry, and lake ecology e.g. algal blooms, etc.

Journal special issues

Work presented at the first two workshops has already been published in two special journal issues. These are both open-access, and are useful starting points to get an overview of current met. lake research:

- Boreal Environment Research 2010, Volume 15 (2)
<http://www.borenv.net/>
- Tellus 2012, Volume 64 (Thematic cluster on lakes)
<http://www.tellusa.net/index.php/tellusa/issue/view/1377>

The FLake model

The FLake lake model has been adopted for the parametrization of lake properties by a number of meteorological centres. This is a one-dimensional model with a similarity representation of the lake temperature profile. It has the capability to represent lake freezing and break-up, and snow accumulation on the ice.

FLake was developed at the Deutscher Wetterdienst and elsewhere. It has its own website <http://lakemodel.net>, with links to download the model, a detailed model description and FLake publications, as well as the capability to run the model online.

Users of FLake are encouraged to register through the website, to receive FLake news and updates, and to publicise any FLake-related publications to all users.

Global lake-depth database

Lake models like FLake require parametric data as part of their initialisation. The most important physical datum is a representative lake depth. Other useful information includes the lake fetch (horizontal lengthscale) and the lake turbidity or opacity. These data are not yet well-characterised for every lake, and completeness of data can vary greatly from one world region to another.

A global lake-depth database has been developed in conjunction with FLake, to facilitate the use of FLake over the regional or global domains of met. models. This combines data from various sources into a single database, and is packaged together with software to map these data onto any required model grid.

The database is currently at version 2, and can be accessed through the FLake website <http://lakemodel.net>.

LakeMIP

The presentation of various lake models at the first workshop in 2008 produced an initiative to compare these models using common forcing and validation data. This is the lake-model intercomparison project, or LakeMIP. LakeMIP has its own website <http://www.unige.ch/climate/lakemip/> and has reported back on its activities, and acquired additional lake data for comparison, at the subsequent workshops.

Conclusion

This document aims to provide a brief summary of lake interest and resources within the meteorological community, focused through a series of lake workshops in recent years. Much more information is available through the various online resources and journal special issues. Hopefully it will help those with common interests to make contact, in order to share information and ideas.

Authored by Gabriel Rooney gabriel.rooney@metoffice.gov.uk
on behalf of the Lake workshop organisers and delegates, 9 October 2012.



*Group photo,
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