Bathing water in mountain lakes

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CLIM-RUN

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Target groups

➢**Tourism institutions**
➢ **Professional organisations and federations**
➢ **Outdoor activity operators and professionals**

Relevance to the Case-Study Requirements

Savoie's lakes (for example, Bourget Lake) support many different water sports, including water skiing, sailing, wakeboarding and swimming. Water temperatures and their projected future changes affect these activities and the lake ecosystem. This information is therefore particularly relevant to tourism actors, providing them with data to help anticipate potential increasing tourist numbers (as other areas are potentially becoming less attractive from a climate point of view) and to develop activities in conjunction with future projections.

The Approach

Four lakes have been targetted in Savoie: Annecy, Aiguebelette, Leman and Bourget. Observations of the temperature of the lake have been collected by different research institutes: Inra Thonon, CALB, SILA and CIPEL at different depths for the last 30 years for three of the lake of interest (fig.1, left). In order to simulate future changes in the lake temperatures, a lake model is used and is first validated against observations (FLAKE, Mironov, D.V., 2008). The model is validated off-line using different forcings from reanalysis, reconstructions and climate simulation over the past period (fig.1 right). The temperatures are generally well represented by the model, although they show a warm bias in winter compared with observations.
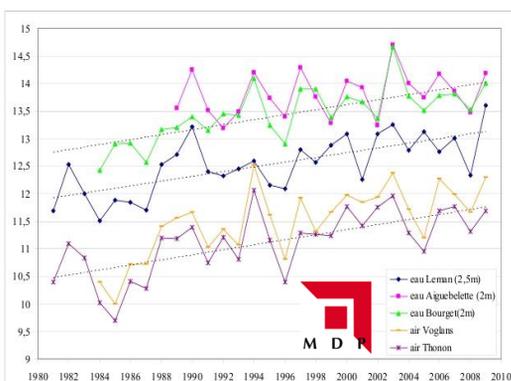

Fig.1, right: The model is validated off-line using different forcings from reanalysis (purple line), reconstructions (blue line) and climate simulation (green line) over the past period. Observations from INRA are shown by the red dots.

Fig.1, left: Evolution of the mean temperature in three diffrent Alpine lakes at 2m depth from collected measurements by INRA. The purple and yellow lines show the air temperature at Voglans and Thonon (data from Météo-France). (Figure realised by C. Chaix, MDP)
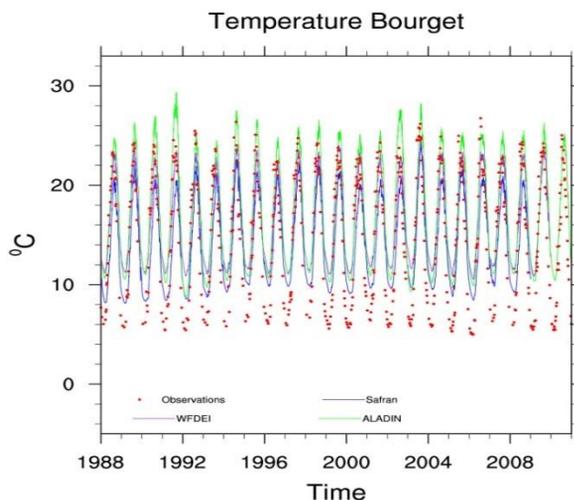
Mironov, D. V., 2008: Parameterization of lakes in numerical weather prediction. Description of a lake model. COSMO Technical Report, No. 11, Deutscher Wetterdienst, Offenbach am Main, Germany, 41 pp.

The observed data are provided by: Base de données SOERE-INRA de Thonon-les-Bains, Données CISALB/CIPEL/SILA-INRA and MDP73, Observatoire du climat (www.MDP73.fr)

The Product

For the future projections, the surface forcings come from 12 km resolution simulations carried out with the Aladin-Climat model at the CNRM or with a fully-coupled lake model from ICTP. Two greenhouse gas emissions scenarios are considered - RCP4.5 and RCP8.5 from 2006 to 2050 - and an historical simulation from 1950 to 2005. Projections of water temperature for the four different lakes are shown in the figures below. In all four lakes, the surface water temperatures show an increase between 2°C and 4°C compared to the reference period 1971-2000.
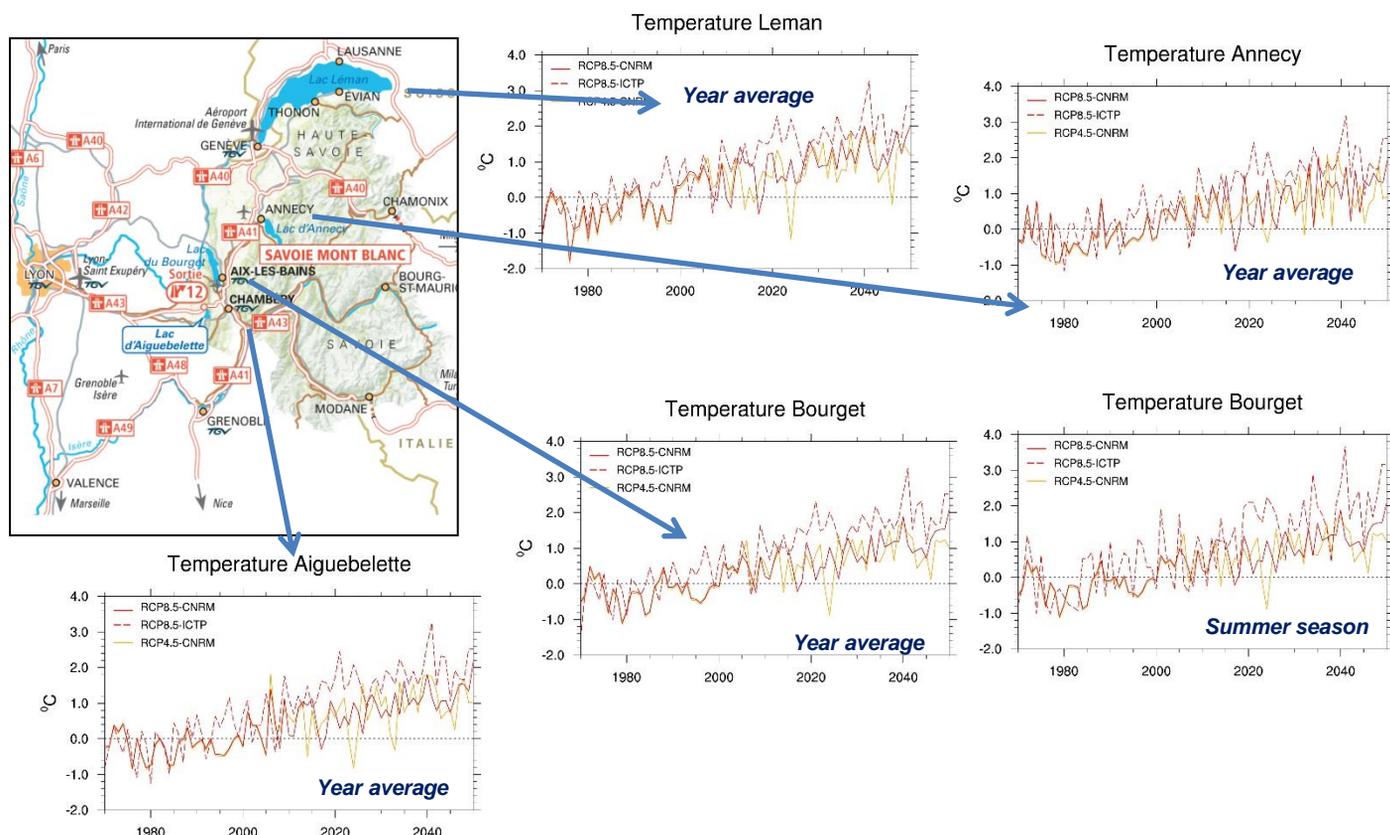
Making the Product Usable

This product presents the first available projections of lake temperatures in an Alpine region. The next generation of regional climate models will be coupled with a lake model thus providing more extensive information including a better representation of model uncertainty.

This product will be disseminated to stakeholders, in particular through the Savoyard Climate Change Observatory. The running of impact models is also encouraged to better understand the impacts of such projections on water quantity and quality and their consequences for outdoor activities.

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