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Long-term forecasting of flow and water temperature for cooling systems: case study of the Rhone River, France

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Abstract Electricity production from nuclear power plants needs water intake for cooling systems. Due to climate change, an electricity producer such as EDF (Electricity de France), could be impacted by an increase of the air temperature, which may cause a problem to fulfilling legal environmental limits and/or safety limits. This will have direct consequences on electricity production capacity. Thus EDF is interested in the future evolution of water temperature and discharge for the rivers where its industrial sites are located. This paper presents a case study of the cross-boarder Rhone basin at Viviers (73 000 km^2, France). Long-term forecasting of the thermal and hydrological regimes of this river was established, starting from the modelled system and forced by observed climatic variables. The hydrological model coupled with a thermal model was calibrated and controlled with the historical data. The data set includes meteorological variables, discharge, and water temperature data from the last 35 years. The watershed is influenced by Lake Leman in the upstream part of the basin, and by the presence of several tributaries characterized by various hydrological regimes (from glacier-fed to rain-fed). Rhone River runoff is also influenced by glaciers in the headwaters and by reservoir management for hydroelectricity. All these characteristics have to be taken into account when extrapolating this model to other climate conditions. The selected future scenarios were run using results of six coupled regional models (RCM-GCM) by the European project ENSEMBLE.

Key words water temperature; rivers; air temperature; runoff; climate change; cooling sources; Rhone River, France