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High-resolution water temperature impact assessment on thermal power plants operations in Europe and riverine ecosystems

Marko Adamovic, Ad de Roo, Berny Bisselink, and Bruna Grizzetti
JRC European Commission; Directorate D - Sustainable Resources, Unit D2 Water and Marine Resources, Ispra, Italy (marko.adamovic@hotmail.com)

Thermal power plants consume large amounts of water for electricity generation, mainly for cooling purposes that is later discharged back to riverine eco-systems. Increase in water temperature of the river systems and oceans is becoming the real environmental challenge to tackle, posed by the accelerated changes in climate change.

In this study, new high-resolution data set of the water temperature projections of the main rivers in Europe due to climate change has been created using the new LISTEMP water resources model. We developed the new model called LISTEMP as a result of online coupling between the LISFLOOD open source hydrological model and newly developed water temperature module that runs on a 5 km grid and solved using a semi-Lagrangian numerical scheme. The results are based on 11 climate models which project current and future climate under two Representative Concentration Pathways (RCPs): RCP4.5 and RCP 8.5 emission scenario. We assess thermal plant's vulnerability to water temperature changes as climate change continues.

We conclude that operations and maintenance of many thermal power plants could be at risk due to the water temperature change since their efficiency and performance depend mostly on a possibility to intake huge quantities of cooling water. Furthermore, we identified the hot spots in Europe where current power plants urge for technological change in order to be more resilient to climate. We also detect spots where plants are returning water at a temperature above the ecologically desirable ranges due to climate change. Knowledge acquired in this study and dataset contribute to multi-scale water-energy-food nexus and Common Fisheries Policy for conserving fish stocks with future climate.