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Literature analysis of the potential conduits of satellite river temperature monitoring

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Satellite monitoring of river temperature has so far been scientifically focused but there are a variety of industrial outlets which could make use of this additional information

1. Regulatory

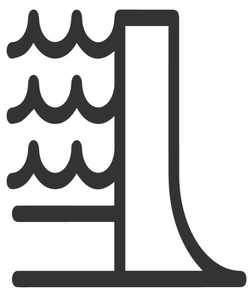
Remote sensing river temperature may provide the evidence needed to set regulatory thresholds and monitor compliance.[1]

2. Nuclear

Power plants suffer efficiency losses from warmer input cooling water.[2] This has had decision making implications on coastal plants [2] but has not been linked to satellite sensed river temperature increases from nuclear plant cooling effluent [3].

3. Hypolimnetic cooling from dams

Dams cool rivers[4] and remove seasonal trends[5] which needs to be balanced against regulations[6]. Expensive retrofits provide flexibility for water extraction[7] but implementation is often based on simple site specific models.[8]

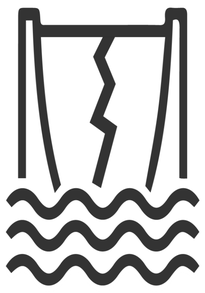


4. Drinking water

Withdrawing cold water from dams reduces dissolved O_2 which is required in drinking water and therefore dam profit structures.[9] Current models focus on reservoir temperature rather than river temperature.[9] Ground water extraction has a lesser impact but also increases stream temperature through reduction of discharge and should be accounted to meet regulations.[10]

5. Thermal displacement

Concrete dams rely on safety curves based on reservoir and river temperature. However, since this information is often lacking, common practise has been to use season as a proxy.[11]



6. Algal blooms

Temperature plays a significant role in riverine Cyanobacteria[12] which risks drinking water quality.[13] However, over-extracting hypolimnetic water from reservoirs will degrade the thermocline, causing upwelling of nutrients and resulting algal blooms.[7] Current models designed to manage this balance do not take up or downstream river temperature into account.[7]

1. Piégay, H., et al. (2020). "Remotely sensed rivers in the Anthropocene: State of the art and prospects." Earth Surface Processes and Landforms **45**(1): 157-188.
2. Durmayaz, A. and O. S. Sogut (2006). "Influence of cooling water temperature on the efficiency of a pressurized-water reactor nuclear-power plant." International Journal of Energy Research **30**(10): 799-810.
3. Wawrzyniak, V., et al. (2012). "Longitudinal and temporal thermal patterns of the French Rhône River using Landsat ETM+ thermal infrared images." Aquatic sciences **74**(3): 405-414.
4. Daniels, M. E. and E. M. Danner (2020). "The Drivers of River Temperatures Below a Large Dam." Water Resources Research **56**(5): e2019WR026751.
5. XIONG, Y. J., YIN, J., ZHAO, S. H., QIU, G. Y. & LIU, Z. 2020. How the three Gorges Dam affects the hydrological cycle in the mid-lower Yangtze River: a perspective based on decadal water temperature changes. *Environmental Research Letters,* 15**,** 014002.
6. EPA, U. S. E. P. A. 2020. Temperature Water Quality Standards for the Columbia, Lower Columbiaand Lower Snake Rivers.
7. RHEINHEIMER, D. E., NULL, S. E. & LUND, J. R. 2015. Optimizing selective withdrawal from reservoirs to manage downstream temperatures with climate warming. *Journal of Water Resources Planning and Management,* 141**,** 04014063.
8. WRIGHT, S. A., ANDERSON, C. R. & VOICHICK, N. 2009. A simplified water temperature model for the Colorado River below Glen Canyon Dam. *River Research and Applications,* 25**,** 675-686.
9. WEBER, M., RINKE, K., HIPSEY, M. & BOEHRER, B. 2017. Optimizing withdrawal from drinking water reservoirs to reduce downstream temperature pollution and reservoir hypoxia. *Journal of environmental management,* 197**,** 96-105.
10. RISLEY, J. C., CONSTANTZ, J., ESSAID, H. & ROUNDS, S. 2010. Effects of upstream dams versus groundwater pumping on stream temperature under varying climate conditions. *Water Resources Research,* 46.
11. TATIN, M., BRIFFAUT, M., DUFOUR, F., SIMON, A. & FABRE, J.-P. 2018. Statistical modelling of thermal displacements for concrete dams: Influence of water temperature profile and dam thickness profile. *Engineering Structures,* 165**,** 63-75.
12. CHA, Y., CHO, K. H., LEE, H., KANG, T. & KIM, J. H. 2017. The relative importance of water temperature and residence time in predicting cyanobacteria abundance in regulated rivers. *Water research,* 124**,** 11-19.
13. SRINIVASAN, R. & SORIAL, G. A. 2011. Treatment of taste and odor causing compounds 2-methyl isoborneol and geosmin in drinking water: A critical review. *Journal of Environmental Sciences,* 23**,** 1-13.

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