A CLOUD-BASED FRAMEWORK TO CHARACTERIZE WINTER WATER LEVEL DRAWDOWN OF LAKES IN THE NORTHEAST UNITED STATES USING SATELLITE REMOTE SENSING

Winter water level drawdown (WD) is an artificial lake management strategy to protect shoreline infrastructure from ice damage, control nuisance macrophytes, and maintain recreational values. Based on in-situ data from 18 Massachusetts lakes, the timing, magnitude, and duration of WDs varied among years and lakes, resulting in variable impacts on lake ecosystems. Characterizing WDs and evaluating associated impacts in wide geographic regions is not feasible using field data alone because of spatio-temporal limitations of in-situ monitoring stations. We used satellite data (Sentinel-1 synthetic aperture radar) from 2014-2021 to develop a Google Earth Engine (GEE)-based framework that used an automated land-water thresholding algorithm to create binary maps of lake surface area (SA). The satellite-derived SA was combined with digital elevation models to derive water level (WL). We used in-situ water level data for validating the temporal trend observed in satellite-derived SA and WL for multiple lakes within the northeast United States (MA, ME, CT, VT, NH). Both satellite-derived SA and WL showed consistent trend with in-situ water level for medium-to-large lakes (lake size > 1 km2). Within-lake spatial variability of SA maps were found consistent with the shallow depth regions. Although the current model can capture the timing and duration of WDs, still further work is required to quantify the WD magnitude. Overall, the cloud-based tool developed in this study is user-friendly, easy to share with stakeholders, and can have significant broader impact in characterizing water level fluctuations not only in managed lakes but also in natural lakes in wide geographic regions. The data and results from this study will be utilized in understanding State-wide management strategies and potential negative impacts of WDs on lake ecosystems under future climate change scenario.

ABHISHEK KUMAR, POSTDOCTORAL RESEARCH ASSOCIATE | UNIVERSITY OF MASSACHUSETTS - AMHERST

Abhishek has recently finished his Ph.D. (May-2021) at the University of Georgia (UGA) in the Department of Geography. His dissertation was focused on developing remote sensing models for Cyanobacterial Harmful Algal Blooms (CyanoHABs) monitoring in inland lakes and coastal waters using multiple earth-observing satellite sensors. Over the last five years at UGA, he was involved in several NASA and NSF projects that have utilized multi-platform remote sensing data toward aquatic, environmental, and natural resource management issues. His role in these projects was to develop remote sensing models, analyze data, and extract useful information from earth-observing satellite sensors. He also maintains the CyanoTRACKER social media platforms (https://twitter.com/cyanotracker) (https://www.facebook.com/cyanotracker) for this NSF funded project, which is helpful to disseminate the timely information regarding CyanoHABs to the public.

Abhishek started his postdoc position at the University of Massachusetts (UMass) Amherst in June-2021. He has joined Climate Adaptation Science Center (CASC) funded project focused on winter lake drawdown in northeast and midwest United State, led by Dr. Allison Roy in the Department of Environmental Conservation at the UMass Amherst. His role in this project is to work directly with state and federal partners to compile existing hydrology and cyanobacteria data, process and analyze remote sensing data, draft annual reports, lead quarterly meetings with partners, conduct cross-region webinars and regional workshops to share models and solicit feedback. His primary research interests are applications of remote sensing and geospatial science in water resources, mangroves/forests, and climate change studies.

AKUMAR1@UMASS.EDU

Co-Authors:

ALLISON ROY | U.S. GEOLOGICAL SURVEY, MASSACHUSETTS COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT, DEPARTMENT OF ENVIRONMENTAL CONSERVATION, UNIVERSITY OF MASSACHUSETTS - AMHERST

KONSTANTINOS ANDREADIS | DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING, UNIVERSITY OF MASSACHUSETTS - AMHERST

CAITLYN BUTLER | DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING, UNIVERSITY OF MASSACHUSETTS - AMHERST

XINCHEN HE | DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING, UNIVERSITY OF MASSACHUSETTS - AMHERST