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CyanoTRACKER: A cloud-based integrated multi-platform architecture for global observation of cyanobacterial harmful algal blooms

Deepak Mishra

University of Georgia, Department of Geography, Athens, GA, United States of America (dmishra@uga.edu)

Over the past decade, the global proliferation of cyanobacterial harmful algal blooms (CyanoHABs) have presented a major risk to the public and wildlife, and ecosystem and economic services provided by inland water resources. As a consequence, water resources, environmental, and healthcare agencies are in need of early information about the development of these blooms to mitigate or minimize their impact. Results from various components of a novel multi-cloud cyber-infrastructure for initial detection and continuous monitoring of spatio-temporal growth of CyanoHABs is highlighted in this study. The novelty of this CyanoTRACKER framework is the integration of community reports, remote sensing data and digital image analytics to differentiate between regular algal blooms and CyanoHABs. Individual components of CyanoTRACKER include a reporting website, mobile application (App), remotely deployable solar powered enabled automated hyperspectral sensor (CyanoSense), and a cloud-based satellite data processing and integration tool. All components of CyanoTRACKER provided important data related to CyanoHABs assessments for regional and global waterbodies. Reports and data received via social cloud including the mobile App, Twitter, Facebook, and CyanoTRACKER website, helped in identifying the geographic locations of CyanoHABs infested waterbodies. A significant increase (124.92%) in tweet numbers related to CyanoHABs was observed between 2011 (total relevant tweets = 2925) and 2015 (total relevant tweets = 6579) that reflected an increasing trend of the harmful phenomena across the globe as well as increased awareness about CyanoHABs among Twitter users. The CyanoHABs infested geographic locations extracted via social cloud were utilized for the deployment of CyanoSense at smaller waterbodies and analysis of satellite data for larger waterbodies. CyanoSense was able to differentiate between ordinary algae and CyanoHABs through the use of their characteristic absorption feature at 620nm. The results and products from this infrastructure can be rapidly disseminated via CyanoTRACKER website, social media, and direct communication with appropriate management agencies for issuing warnings and alerting lake managers, stakeholders and ordinary citizens to the imminent dangers posed by these environmentally harmful phenomena.