EGU21-11071, updated on 16 Oct 2021
https://doi.org/10.5194/egusphere-egu21-11071
EGU General Assembly 2021

Using in-situ sensors to quantify spatial variability in nutrient concentrations across the Ganges river basin

Kieran Khamis[1] and the Team SAPTANADI[*]
[1]University of Birmingham, School of Geography, Earth and Environmental Sciences, School of Geography, Earth and Environmental Sciences, Birmingham, UK. (k.khamis@bham.ac.uk)
[*]A full list of authors appears at the end of the abstract

There is increasing interest in monitoring spatial variability in biogeochemical processes using field deployable sensors. Despite this, rigorous assessments of accuracy and optimal sensor configurations remain limited for such applications. We undertook a comprehensive field study, between November and December 2019 (post-monsoon), across diverse monitoring locations on the River Ganges and its tributaries in Northern India. At 81 sites, from the foothills of the Himalayas to the tidal limit at Kolkata, the following suite of routine sensor measurements were taken; dissolved oxygen (DO), electrical conductivity (EC), pH and turbidity. In addition "new" optical parameters were also measured; absorbance (190 – 360 nm) and tryptophan-like fluorescence (TLF). Parallel water samples were collected for laboratory determination of dissolved organic carbon (DOC), nitrogen species (NO_3 and NH_4), phosphorus fractions (SRP, TP, TDP), absorbance and fluorescence excitation emission matrices (EEMs). A series of predictive models for each laboratory derived nutrient parameter were developed based on partial least squares regression, lasso regression, and stepwise regression approaches. The predictive power of the best models (i.e. combination of sensors and model approach) were assessed using 10-fold cross validation. Residual patterns were inspected to help infer the environmental conditions under which in-situ sensors could be used reliably. The highest predictive power was apparent for NO_3, DOC and SRP. This was apparent when considering models based on the routinely measured parameters (R^2_{cv} = 0.45 – 0.6; EC explained most variance) or when new optical parameters were included (R^2_{cv} = 0.6 - 0.8; absorbance <280 nm and TLF explained most variance). No suitable surrogate model could be derived for ammonium (R^2_{cv} = 0.3) or TDP/TP (R^2_{cv} both <0.4). For DOC, changes in DOM composition from upstream – downstream influenced model fit while the nitrate model appeared robust with no spatial pattern in the residuals identified. These findings highlight clear potential for optical sensors to improve our understanding of spatial variability in nutrient concentrations and inform future development of multi-parameter sensing sondes for rapid assessment of nutrient concentration. Further research is required to assess the transferability of field calibrations across seasonal and inter-annual timescales.

Team SAPTANADI: University of the West of England (UK): Darren M Reynolds, Robin MS Thorn, Gillian E Clayton, Eva Perrin, Bethany G Fox; Bose Institute, Kolkata (India): Tapan K Dutta; UKCEH

(UK): Michael J Bowes, Daniel S Read, David J.E. Nicholls, Linda K Armstrong; IIT Roorkee (India): Moushumi Hazra, Himanshu Joshi; University of Manchester (UK): Laura A Richards, David A Polya; Mahavir Cancer Sansthan (India): Ashok Ghosh, Arun Kumar, Rupa Kumari, Aman Gaurav, Siddhu Kumar; National Institute of Hydrology (India): Sumant Kumar, Biswajit Chakravorty; British Geological Survey (UK): Daren Gooddy; University of Birmingham (UK): Stefan Krause, Kieran Khamis, Holly Nel, Uwe Schneidewind, Ben Howard, Danielle Mewes, David Hannah; University of Lincoln (UK): Daniel Magnone