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Ensemble Kalman smoothing of algal bloom events

Tuomo Kauranne (1,2), Martin Gunia (1,2), Kari Kallio (3), Olli Malve (3), Juhani Kettunen (3), Marko Laine (4), and Heikki Haario (1)

(1) Lappeenranta University of Technology, Lappeenranta School of Engineering Science, Lappeenranta, Finland (tuomo.kauranne@lut.fi), (2) Arbonaut Ltd., Joensuu, Finland (tuomo.kauranne@arbonaut.com), (3) Finnish Environment Centre SYKE, Helsinki, Finland, (4) Finnish Meteorological Institute, Helsinki, Finland

Algal blooms of inland and coastal waters are frequent events that should be broadcast to the general public as a warning. This is rarely done because there are few real-time monitoring systems that allow them to be detected and mapped in real time. The Finnish Environment Centre SYKE aims to build such an operational system in collaboration with Arbonaut Ltd. and Lappeenranta University of Technology. Such a system was developed and implemented in an off-line mode in 2018. It features access to many different kinds of data sources, such as satellite imagery, Chlorophyll-a and turbidity measurements by ships, by automatic water monitoring stations and by manual water sampling. All these data sources and a simple surface advection model are brought together into a data assimilation system that uses different versions of Ensemble Kalman filtering to create a coherent and continuous map of the presence of algal blooms in any inland or coastal waters in and around Finland. The system provides automatic uncertainty quantification for its estimates and allows the relevance of different data sources to be studied by omitting them selectively. The data assimilation environment also provides diagnostics in the form of point-wise time series of data, estimates and their uncertainty. The core algorithms of the environment will be provided as an Open Source library.