Cloud on the Horizon: Scientific Computing and Environmental Regulation

Tom Purucker (purucker.tom@epa.gov)

Cloud computing is a disruptive technology that combines efficiency gains in IT with research and development agility advantages. The well-documented time and cost efficiencies are driving adoption of cloud computing applications in both business and government enterprise systems. Of considerable interest to scientific and regulatory applications is the ability to deploy computational tools in an agile manner that can scale rapidly and in ways that current scientific desktop applications cannot. This interest is due to the central importance of computational modeling in the environmental regulatory process. Although environmental regulations are codified in law, the effectiveness of the environmental protection often comes down to the specifics of how the models are selected and parameterized.

The registration of pesticides relies on risk assessments that are supported by mathematical models to predict environmental exposures and effects. These models estimate pesticide concentrations in different media and, ultimately, their effects on humans and non-target ecological species. The suite of models EPA uses has been in development since the 1980s and include a range of algorithmic complexity and technical implementation -- from Fortran executables to Microsoft Excel spreadsheets. Our group has updated these models to create a consistent application programming interface (API) accessible via a web service implementation. Hosted in the cloud, the API combines relevant spatial information, chemical and pesticide use properties, ecological exposure parameters, and effects data in a decision support "dashboard." The system is a platform-as-a-service implementation available through a front-end user interface that allows anyone access to the models and data with a web browser.

An important implication of migrating the underlying science and data to the cloud is the ability to leverage its efficiencies to add additional components as the science challenges change. Scientists with original ideas, models, data, and tools no longer must secure significant resources for hardware and application programmers to ensure that "translational" research can be used in regulatory decision support structures. Combined with appropriate statistical methods, this can lead to better data and model selection decisions and more robust, defensible regulatory frameworks over time. Therefore, cloud-enabled web applications that encompass the science algorithms and data used in specific Agency workflows can increase decision-making transparency and efficiently transfer science improvements to the regulatory process -- all while functioning as "Science-as-a-Service" to provide needed assessment tools for environmental regulation.

Tom Purucker graduated from the University of Tennessee with a Ph.D. in Ecology and Evolutionary Biology in 2006. He was then hired by ORD's Ecosystem Research Division in Athens, GA as a post-doc and transitioned to a permanent research ecologist position in 2009. He received the PECASE award in 2012 "for exceptional innovation and initiative in creating modeling applications that enable decision-makers and scientists to conduct chemical risk assessments in a number of areas important to implementation of EPA's regulatory responsibilities to protect human health and the environment."