Geophysical Research Abstracts
Vol. 16, EGU2014-11069, 2014
EGU General Assembly 2014

Parameter and uncertainty estimation for mechanistic, spatially explicit epidemiological models

Flavio Finger (1), Bettina Schaefli (1), Enrico Bertuzzo (1), Lorenzo Mari (1,2), Andrea Rinaldo (1,3)

(1) Institute of Environmental Engineering, École Polytechnique Fédérale de Lausanne (EPFL), Switzerland, (2) Dipartimento di Elettronica e Informazione, Politecnico di Milano, Italy, (3) Dipartimento di Ingegneria Civile, Edile ed Ambientale, Università di Padova, Italy

Epidemiological models can be a crucially important tool for decision-making during disease outbreaks. The range of possible applications spans from real-time forecasting and allocation of health-care resources to testing alternative intervention mechanisms such as vaccines, antibiotics or the improvement of sanitary conditions. Our spatially explicit, mechanistic models for cholera epidemics have been successfully applied to several epidemics including, the one that struck Haiti in late 2010 and is still ongoing.
Calibration and parameter estimation of such models represents a major challenge because of properties unusual in traditional geoscientific domains such as hydrology. Firstly, the epidemiological data available might be subject to high uncertainties due to error-prone diagnosis as well as manual (and possibly incomplete) data collection. Secondly, long-term time-series of epidemiological data are often unavailable. Finally, the spatially explicit character of the models requires the comparison of several time-series of model outputs with their real-world counterparts, which calls for an appropriate weighting scheme.
It follows that the usual assumption of a homoscedastic Gaussian error distribution, used in combination with classical calibration techniques based on Markov chain Monte Carlo algorithms, is likely to be violated, whereas the construction of an appropriate formal likelihood function seems close to impossible. Alternative calibration methods, which allow for accurate estimation of total model uncertainty, particularly regarding the envisaged use of the models for decision-making, are thus needed. Here we present the most recent developments regarding methods for parameter and uncertainty estimation to be used with our mechanistic, spatially explicit models for cholera epidemics, based on informal measures of goodness of fit.