**Abstract for the 27th Annual Conference of The International Environmentrics Society joint with GRASPA 2017 on Climate and Environment**

Bergamo, Italy, 24-26th July 2017

(Abstract submission deadline: 30th March, extended to 14th April 2017)

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**Title: Bayesian estimation of global Glacio-Isostatic Adjustment for sea level rise re-evaluation**

Glacio-Isostatic Adjustment (GIA) makes a crucial contribution to sea level rise evaluation. In general, estimates of the GIA process have been obtained by simulating from physical models with assumptions about the Earth structure or ice loading history. These models often lead to significant regional discrepancies from the observations due to the incomplete information of in lower mantle viscosity and ice loading histories, and the 3-D structure of the Earth. In this study, we propose a data-driven approach to provide GIA estimate that is consistent with the full suite of observations and processes when integrated into a Bayesian hierarchical model (BHM) framework for mass exchange within a complete land-ocean-solid Earth system.

Based on a previous study over Antarctica, we use the vertical land motion from a global network of permanent GPS stations over the epoch 2005-2015 as observations in estimating the latent GIA process. GIA is considered to be a time-invariant Gaussian process on the sphere with Matern covariance function. Following a full Bayesian approach and the principle of stable inference, we use the GIA estimate derived from the ICE-6G (VM5a) model as the prior mean and the parameters in the covariance functions are updated by slice samplers within Gibb’s steps. A single update of the GIA estimate at a desired one degree resolution over the entire globe requires inverting a dense covariance matrix with size about seventy thousands squared. To achieve feasible computational budget, we use a sparse matrix representation induced by a Gaussian Markov random field (GMRF) approximation and then by using the colouring theorem on the GMRF vertices, we manage a parallel updating of the GIA process.