



High-resolution stochastic downscaling of climate models: simulating wind advection, cloud cover and precipitation

Nadav Peleg, Simone Fatichi, and Paolo Burlando

Institute of Environmental Engineering, ETH Zurich, Zurich, Switzerland (nadav.peleg@sccer-soe.ethz.ch)

A new stochastic approach to generate wind advection, cloud cover and precipitation fields is presented with the aim of formulating a space-time weather generator characterized by fields with high spatial and temporal resolution (e.g., 1 km x 1 km and 5 min). Its use is suitable for stochastic downscaling of climate scenarios in the context of hydrological, ecological and geomorphological applications. The approach is based on concepts from the Advanced WEather GENERator (AWE-GEN) presented by Fatichi et al. (2011, *Adv. Water Resour.*), the Space-Time Realizations of Areal Precipitation model (STREAP) introduced by Paschalis et al. (2013, *Water Resour. Res.*), and the High-Resolution Synoptically conditioned Weather Generator (HiReS-WG) presented by Peleg and Morin (2014, *Water Resour. Res.*).

Advection fields are generated on the basis of the 500 hPa u and v wind direction variables derived from global or regional climate models. The advection velocity and direction are parameterized using Kappa and von Mises distributions respectively. A random Gaussian fields is generated using a fast Fourier transform to preserve the spatial correlation of advection. The cloud cover area, total precipitation area and mean advection of the field are coupled using a multi-autoregressive model.

The approach is relatively parsimonious in terms of computational demand and, in the context of climate change, allows generating many stochastic realizations of current and projected climate in a fast and efficient way. A preliminary test of the approach is presented with reference to a case study in a complex orography terrain in the Swiss Alps.