Geophysical Research Abstracts
Vol. 15, EGU2013-3380, 2013
EGU General Assembly 2013

Atmospheric Downscaling using Genetic Programming

Tanja Zerenner, Victor Venema, and Clemens Simmer
Bonn, Meteorological Institute, Bonn, Germany (tanja.zerenner@yahoo.de)

Coupling models for the different components of the Soil-Vegetation-Atmosphere-System requires up-and downscaling procedures. Subject of our work is the downscaling scheme used to derive high resolution forcing data for land-surface and subsurface models from coarser atmospheric model output.

The current downscaling scheme [Schomburg et. al. 2010, 2012] combines a bi-quadratic spline interpolation, deterministic rules and autoregressive noise. For the development of the scheme, training and validation data sets have been created by carrying out high-resolution runs of the atmospheric model. The deterministic rules in this scheme are partly based on known physical relations and partly determined by an automated search for linear relationships between the high resolution fields of the atmospheric model output and high resolution data on surface characteristics. Up to now deterministic rules are available for downscaling surface pressure and partially, depending on the prevailing weather conditions, for near surface temperature and radiation.

Aim of our work is to improve those rules and to find deterministic rules for the remaining variables, which require downscaling, e.g. precipitation or near surface specifc humidity. To accomplish that, we broaden the search by allowing for interdependencies between different atmospheric parameters, non-linear relations, non-local and time-lagged relations. To cope with the vast number of possible solutions, we use genetic programming, a method from machine learning, which is based on the principles of natural evolution.

We are currently working with GPLAB, a Genetic Programming toolbox for Matlab. At first we have tested the GP system to retrieve the known physical rule for downscaling surface pressure, i.e. the hydrostatic equation, from our training data. We have found this to be a simple task to the GP system. Furthermore we have improved accuracy and efficiency of the GP solution by implementing constant variation and optimization as genetic operators. Next we have worked on an improvement of the downscaling rule for the two-meter-temperature. We have added an if-function with four input arguments to the function set. Since this has shown to increase bloat we have additionally modified our fitness function by including penalty terms for both the size of the solutions and the number intron nodes, i.e program parts that are never evaluated. Starting from the known downscaling rule for the two-meter temperature, which linearly exploits the orography anomalies allowed or disallowed by a certain temperature gradient, our GP system has been able to find an improvement. The rule produced by the GP clearly shows a better performance concerning the reproduced small-scale variability.