Geophysical Research Abstracts, Vol. 9, 02506, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02506

Coupling meteorological and hydrological models for river discharge forecasting. Part I: A methodological approach

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The present contribution proposes an approach for the preparation of the meteorological input needed by hydrological models to forecast the surface runoff in medium-sized river catchments (50-1000 km^2). Rather than using Limited Area Models to achieve a high-resolution representation of atmospheric processes, we reconstruct precipitation fields at a local scale from the statistical elaboration of forecasts from a General Circulation Model (approx. resolution 20 km), using eigentechniques originally developed for the downscaling of weather scenarios from climate models. Modes of joint spatial variability between the predictand field (precipitation) and other predictor variables (e.g. pressure, temperature, humidity) can be identified by studying their cross-covariance spectrum through Singuar Value Decomposition or Cross Correlation Analysis. The predictor and predictand fields of each particular day can then be approximated as a linear combination of the leading covariance modes, determined from a training set of historic precipitation measurements and weather analyses. The predictive step consists in computing the coefficients of the linear combination of modes for the predictor through SVD or CCA expansion, and using them to estimate those for the predictand. The forecast field is then obtained by combining the known leading spatial modes of the predictand using the estimated time expansion coefficients. With the aim of maximizing the predictive skill of the procedure, the training set can be made homogenous by selecting a subset of similar days through a classification or analogue search procedure. Different approaches developed within synoptic climatology (e.g. Lamb or Teweles-Wobus methods) or borrowed from statistical data analysis (e.g. cluster analysis) can be used to the purpose. The ability of forecasting daily precipitation through the selection of an appropriate training set and the prognostical application of eigentechniques is investigated.