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Empirical Downscaling of Windfields for Hydrodynamic Modeling of Lakes

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Aiming for the fine spatial and temporal discretization required for hydrodynamic modeling of lakes, wind vectors from General Circulation Models (GCMs) are downscaled stochastically. Instead of dynamic downscaling methods, empirical ones are used here because they are more likely to reproduce the variability and the frequency of extreme values existent in natural winds. Generally GCMs are good predictors of large scale features. Their output is interpreted as the driving force for a process that results in the observed measurements on surface. Using circulation patterns it is possible to discern periods during which such a strong driving force is expected, from those where large scale conditions are not likely to have a higher influence than local phenomena. With the help of dynamical downscaling methods, intermediately discretized wind fields can be generated and compared to the measured data. This overall procedure leads to statistical transfer functions that link the GCM output to observations and can therefore be used to downscale the output of GCMs run for climate scenarios to get input for hydrodynamic modeling of lakes under changing climatic conditions.
Determining the statistical relationships carries with it the necessity of homogenized datasets. There are however significant differences between the results of the NCEP/NCAR and the ERA-40 re-analysis model concerning the wind components in 850hPa height as well as discontinuities within the ERA-40 time series. Whereas the latter ones can be attributed to changes towards a higher abundance of vertically distinguishing measurements from 1979 on, the former are related to different variances. The different variances in the wind components lead to very different mean kinetic wind energies. It is shown that the problem of differing distributions can be overcome by using quantile transformations.