Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05613, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05613
EGU General Assembly 2008

Temporal Variability of Soil Moisture in Reanalysis Datasets

G.Wang, A. J. Han Dolman

Hydrology and Geo-environment Department, VU University Amsterdam, the Netherlands.

(Email: gwang@falw.vu.nl)

We study the temporal variability of layered soil moisture in ERA40 and NCEP reanalysis data with a fractal method, detrended fluctuation analysis (DFA). The DFA exponent is considered as a measurement of serial correlation. As in the former studies within a Markovian framework for e-folding time, a redder spectrum and longer memory for deeper layer, and memory scale dependence on latitude were found. Beyond the e-folding time, layered soil moisture at each location features a similar long range correlation that obeys a power law dependence. In very dry and very wet, as well as high latitude regions, soil moisture features nonstationarity, which hampers the long-term prediction by traditional statistics.

Soil integrates precipitation within the e-folding time, while long range correlation suggests that soil moisture experiences some quiet modes at very low frequencies. This is confirmed by an analysis of 45-yr soil moisture observation in Ukraine that contains modes at frequency ranges of 2.1 years, 4.5 years, 7.8 years and 18-20 years. As the major driving variable of the hydrological cycle, precipitation, is spectrally white, the strong long-range correlation of soil moisture is possibly a major source of memory in the hydrological cycle over land.

Variation of soil moisture volatility, defined as the absolute value of the time series increments, is also studied. We find that a broad distribution of soil moisture series exhibit a white spectrum in volatility when the DFA exponents are below 0.8. This suggests that the soil moisture processes in these datasets on these timescales are essentially linear. To check the linearity found in volatility analysis, the surrogate test is

also employed to some series selected from wet to dry regions. After shuffling in the surrogate test, the series become spectrally white, revealing again a consistent linearity in the soil moisture processes. This justifies the potential of linear modeling of soil moisture process, such as the widely-used first order Markov model and therefore the deduced e-folding time model. Since the land-atmosphere feedback is expected to be nonlinear, the detailed physics of the observed linearity in the soil moisture reanalysis data needs to be clarified further.