Geophysical Research Abstracts
Vol. 17, EGU2015-10647, 2015
EGU General Assembly 2015

On the Assimilation of Tree-Ring-Width Chronologies

Walter Acevedo (1), Sebastian Reich (2), and Ulrich Cubasch (1)

(1) Freie Universität Berlin, Meteorology, Earth Sciences, Berlin, Germany (walter.acevedo@met.fu-berlin.de), (2) Institut für Mathematik, Universität Potsdam, Potsdam, Germany

Data assimilation (DA) of climate proxy records is currently acknowledged as a promising approach to the paleoclimate reconstruction problem, with the potential to bring physical consistency to reconstructed fields. Previous paleo-DA studies have typically assumed a linear relationship between climate forcing and the resulting proxy data, whereas there exist growing evidence of complex, potentially non-linear, proxy formation processes. Accordingly, it appears natural to simulate the proxy response to climate in a more realistic fashion, by way of proxy-specific forward models. Following this train of thought, we investigate the assimilation of the most traditional climate proxy type, Tree-Ring-Width (TRW) chronologies, using the process-based tree-ring growth forward model Vaganov-Shashkin-Lite (VSL) and ensemble Kalman filter (EnKF) techniques. Used as observation operator, VSL's formulation implies three compounding, challenging features: (i) time averaging, (ii) "switching recording" of 2 variables and (iii) bounded response windows leading to "thresholded response". DA experiments involving VSL-based pseudo-TRW observations are performed first for a chaotic 2-scale dynamical system, used as a cartoon of the atmosphere-land system, and then for an atmospheric general circulation model of intermediate complexity. Our results reveal that VSL's nonlinearities may considerable deteriorate the performance of EnKF for Time-Averaged (TA) estimation, as compared to the utilization of a TA linear observation operator. Moreover, we show that this assimilation skill loss can be considerably reduced by embedding VSL's formulation into fuzzy logic theory, which fosters new interpretations of tree-ring growth limitation processes.