# Applying a dynamical systems approach to characterize climate for physical interpretation and comparison of models to observations

**D. E. Newman** (1), U. S. Bhatt (1), I. Polyakov (2), R. Sanchez (3), R. Wackerbauer (4)

(1) University of Alaska Fairbanks/Geophysical Institute, USA, (2) University of Alaska Fairbanks/IARC, USA, (3) Oak Ridge National Laboratory/Fusion Energy Division, USA, (4) University of Alaska Fairbanks, USA (ffden@uaf.edu)

Complex geophysical systems such as the climate need many measures to properly characterize their state and dynamics. This is needed both to understand the physical processes in the system and to enable realistic comparison with models. Now that the IPCC fourth assessment is finished, the next step is to use this type of comparison to carefully scrutinize our models and evaluate the key processes that we need to improve for the next generation of climate models.

To this end, we apply a variety of tools from a dynamical systems approach that are designed to probe the "temporal dynamics" inherent in a time series and the PDFs of these series. These methods provide additional information than what can be obtained from our standard set of climate evaluation methods. Hurst's R/S analysis is one such method that is able to detect differences in the ordering of the time series and make the correlations hidden within them apparent. We first construct various time series (indices and local data) in both the real data and models outputs. We will then present results that evaluate these data from a suite of CCSM3 simulations and observations using R/S analysis and a range of other techniques to determine to what extent the model captures the long-term dynamics of the real climate systems. Using these results we will explore the strengths and weaknesses of the models and discuss potential additions to the models which might improve their dynamical fidelity to the

observations. We will also look at the applicability of the standard diffusion model for parameterization in these models.