Geophysical Research Abstracts
Vol. 12, EGU2010-9775, 2010
EGU General Assembly 2010


# Model-based estimation of changes in air temperature seasonality

Susana Barbosa and Ricardo Trigo
University of Lisbon, IDL, Lisboa, Portugal (sabarbosa@fc.ul.pt)

Seasonality is a ubiquitous feature in climate time series. Climate change is expected to involve not only changes in the mean of climate parameters but also changes in the characteristics of the corresponding seasonal cycle. Therefore the identification and quantification of changes in seasonality is a highly relevant topic in climate analysis, particularly in a global warming context. However, the analysis of seasonality is far from a trivial task. A key challenge is the discrimination between long-term changes in the mean and long-term changes in the seasonal pattern itself, which requires the use of appropriate statistical approaches in order to be able to distinguish between overall trends in the mean and trends in the seasons. Model based approaches are particularly suitable for the analysis of seasonality, enabling to assess uncertainties in the amplitude and phase of seasonal patterns within a well defined statistical framework. This work addresses the changes in the seasonality of air temperature over the 20th century. The analysed data are global air temperature values close to surface (2m above ground) and mid-troposphere (500 hPa geopotential height) from the recently developed 20th century reanalysis. This new 3-D Reanalysis dataset is available since 1891, considerably extending all other Reanalyses currently in use (e.g. NCAR, ECWMF), and was obtained with the Ensemble Filter (Compo et al., 2006) by assimilation of pressure observations into a state-of-the-art atmospheric general circulation model that includes the radiative effects of historical time-varying CO2 concentrations, volcanic aerosol emissions and solar output variations. A modeling approach based on autoregression (Barbosa et al, 2008; Barbosa, 2009) is applied within a Bayesian framework for the estimation of a time varying seasonal pattern and further quantification of changes in the amplitude and phase of air temperature over the 20th century.

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