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SIGNAL ANALYSIS OF GLOBAL AND HEMISPHERIC MEAN TEMPERATURE VARIATIONS BY MEANS OF AN ENERGY BALANCE MODEL

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An energy balance model (EBM) is presented which is calibrated with respect to satellite data, general circulation model calculations and palaeoclimatic reconstructions. A particular analytic solution of this model can be used as a recursive filter for time series analysis. This solution is applied to two natural and two anthropogenic forcing mechanisms which are expressed in terms of heating rate anomaly time series: volcanism, solar activity, greenhouse gases, and tropospheric sulfate aerosols. Thus modelled global and hemispheric mean temperature variations since 1866 are obtained.

In addition, it is shown that the observed (ENSO-corrected) global mean temperature time series can be explained by the external forcing mentioned above and a white noise forcing. In this way it is also possible to separate different signals and to compare them.

As a result global anthropogenic climate change can be detected at a significance level of 99 % without considering spatial patterns but including natural forcing in a multforced model as it is usually not done. Furthermore, the related model forecasts of anthropogenic signals with respect to different forcing scenarios are in close agreement with the results of other approaches. Finally, the climate response delay time with respect to anthropogenic forcing is calculated and a statistical-observational verification using a multiple regression model (MRM) is also carried out.