VALIDATION OF MARS GENERAL CIRCULATION MODELS USING SPECTRALLY RESOLVED DATA FROM PFS

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We propose to test the general circulation models (GCMs) developed for the Mars atmosphere using data obtained by the **Planetary Fourier Spectrometer** (**PFS**) on board the **Mars Express Mission**. The method suggested is based on the evaluation of radiance covariances and has been developed with in mind similar test for the Earth. Results obtained by this method are presented that show how the natural variability of the Earth climate system as measured by IRIS spectrometer on board the Nimbus and IMG on board the ADEOS satellite taking as reference the variability observed in the ECMWF and NCEP data. The physics on which Martian GCM are based is the same of the Earth GCM so that the assessment we propose may have important implications for the Earth.

At the present time the only tool available to predict future climate for the Earth are the General Circulation Models (GCM). The assessment of the performance of such models is mainly based on the comparison with the climate data that refer to the present epoch. This procedure however presents several problems in parts related to the paucity of the data but mainly because they were not taken for such particular use in the first place. Data available results from averages of meteorological variables that are measured with a complete different strategy in mind.

On possible approach to test climate models is to take into account the way in which a forcing propagates through the climate system. If one climate variable is perturbed (forced), and we wish to predict the response of another variable, we must understand the co-variances of all variables involved in the chain between forcing and response. Leith (1975) showed that the statistics governing this process are the time-lag covariances between climate variables. Consequently, one criterion for a model to have good predictive capability is to have accurate time-lag covariances between relevant variables. Time-lag covariances are a robust feature of climate statistics, simple to calculate and to handle using the technique of empirical orthogonal functions (EOFs). The test procedure is simply to compare EOFs (often the first two or three suffice) for different time lags. Information on the system can be obtained from any length of record, although for complete tests long data records will be required.

In this paper we outline a strategy to test the GCM models for Mars based on the time-lag covariance technique and using the radiances measured by the Planetary Fourier Spectrometer. These models (Forget et al., 1999; Richardson and Wilson, 2002) are based on the same physical principle and numerical techniques employed for the Earth GCM The analysis could be carried out following the method outlined above using EOF analysis. In principle these should be simpler models than the corresponding developed for the Earth. In particular the absence of the oceans and of thick clouds could facilitate the comparison. A complication is the presence of dust in the atmosphere also in quiescent conditions (i. e absence of dust storms). Preliminary studies could be performed using IRIS data taken during one the Mariner mission compared with GCM simulation. This preliminary study is directed to develop strategies for the observations during the Mars Express mission.

The strong perturbation that develops during global dust storms could however be used as a sensitivity test for the model considering that the IR radiation emitted from the planet change Most of the analysis that will be summarized here are a continuation of a preliminary study carried out for the Small Missions Call by Italian Space Agency.

considerably. The major uncertainty in this case may be related to the optical properties of the dust and its distribution.

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