STRATOSPHERIC MODELING AND CHEMICAL DATA ASSIMILATION AT BIRA-IASB

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1. THE BIRA-IASB STRATOSPHERIC MODEL

The chemical transport model (CTM) developed at BIRA-IASB describes the evolution of 57 chemical species relevant to the stratosphere. The species are transported by wind fields computed operationally at the European Center for Medium-range Weather Forecasts (ECMWF), and react through 140 gas-phase reactions, 10 heterogeneous reactions and 50 photolysis reactions. An important aspect of the model is a detailed microphysical module which describes the formation and evolution of polar stratospheric cloud (PSC) particles. PSC's play a key role in the process of ozone destruction in the polar regions ("ozone hole").

2. CHEMICAL DATA ASSIMILATION

The BIRA-IASB stratospheric model is incorporated in the chemical data assimilation system BASCOE (*Belgian Assimilation System for Chemical Observations of Envisat*), which is also developed at BIRA-IASB. While dynamical approaches to data-assimilation have been incorporated in meteorological centers since a decade now, BASCOE is the first assimilation system of chemical species observations which takes all chemical couplings into account. BASCOE uses the modern 4D-VAR technique, which calculates the set of initial conditions minimizing the difference between the observations and the model state within a given timeframe. In the period when the instrument MIPAS on Envisat provided near-real time data (2002-2004), BASCOE ran as an operational chemical data assimilation system and provided daily analyses and 10-day forecasts of stratospheric chemistry. BASCOE can also be used to re-analyze past satellite data.

3. RECENT AND ONGOING WORK

3.1. Polar chemistry: study of the 2002 Antarctic ozone hole.

The Antarctic ozone hole is a very specific stratospheric phenomenon which happens every year in September and October. With BIRA-IASB's model the relevant polar chemistry can be studied in detail throughout the polar winter and spring. Comparisons have been made between the model's results and data from several satellite instruments (GOME, MIPAS, POAM III) and from groundstations. A method has been derived to make a direct comparison between the model and the GOME observations of slant column densities of the important species OClO and BrO.

3.2. Polar stratospheric clouds

The formation and evolution of PSC's is very sensitive to the temperature and the concentrations of water vapor and nitric acid in the lower stratosphere. All three quantities are

poorly known: polar stratospheric temperatures are known with limited accuracy during the local winter and spring, and the retrieval of water vapor and nitric acid concentrations from satellite data is very hard in the vicinity of PSC's. To obtain an idea of the model's performance regarding PSC's, a direct comparison is made between the calculated model optical extinction and satellite observations of aerosol and PSC extinction, currently from the instrument POAM III onboard SPOT-4.

REFERENCES

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