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Estimation of the error covariance matrix for IASI radiances and its impact on the assimilation of ozone in a chemistry transport model

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Abstract

Ozone is an important trace gas that plays a key role in the Earth's radiative budget (Gauss et al., 2014). In the chemical processes occurring in the atmosphere, and in climate change studies, it is important to know the distribution of ozone. Ozone is a highly reactive gas and with its negative effects on human and animal health, and on crops and ecosystems, tropospheric ozone is, therefore, a vital component of life on the Earth since it protects the biosphere from harmful UV radiation (Gauss et al., 2014). Satellite data, such as that from the Infrared Atmospheric Sounding Interferometer (IASI) instrument, are used to improve tropospheric Composition and Climate (MACC) project (Hendrick et al., 2012). Ill. is a methodology to estimate the error covariance matrix for IASI radiances and its impact on the assimilation of ozone in a chemistry transport model. The error covariance matrix is important in the data assimilation scheme for system stability and forecasts.

Ozone and water vapour are an essential proportion of an observational network for the assimilation of ozone in a chemistry transport model. Ill. estimates the error covariance matrix for the atmospheric state and uses it to provide appropriate information for total column ozone, tropospheric ozone, and water vapour. The error covariance matrix is based on Stiller-Reeve et al. (2008, Stiller-Reeve et al. (2009, Stiller-Reeve et al. (2010, Stiller-Reeve et al. (2011. The error covariance matrix is calculated for a chemistry transport model, the Tropospheric Chemical Model (TOMCAT) (Chipperfield, 2006). The error covariance matrix is then used in the data assimilation scheme for the assimilation of ozone in the TOMCAT model. The IASI data are assimilated using the Kalman filter (Kalman, 1960) and the Synthesis Approach (Heskes and Cornelissen, 2000). The Kalman filter is a sequential data assimilation scheme that propagates the error covariance matrix. The Synthesis Approach is a variation of the Kalman filter that does not propagate the error covariance matrix. The Synthesis Approach is used because it is computationally less expensive than the Kalman filter. The Synthesis Approach is used in the Tropospheric Ozone Assimilation Model (TOAM) (Dhomse et al., 2011). The TOAM is a chemistry transport model that assimilates ozone from the IASI instrument. The TOAM is used to assimilate IASI data for the year 2007 to 2009. The assimilation of IASI data is compared with ozone sondes and ozone from the Ozone Monitoring Instrument (OMI).

The error covariance matrix is calculated using the standard error covariance matrix with the correlation matrix. The correlation matrix is modelled using a Gaussian function. The error covariance matrix is then multiplied by the standard error covariance matrix to produce the error covariance matrix. The error covariance matrix is then used in the data assimilation scheme. The error covariance matrix is used in the Synthesis Approach and in the Kalman filter. The Synthesis Approach is used because it is computationally less expensive than the Kalman filter. The Synthesis Approach is used in the Tropospheric Ozone Assimilation Model (TOAM) (Dhomse et al., 2011). The TOAM is a chemistry transport model that assimilates ozone from the IASI instrument. The TOAM is used to assimilate IASI data for the year 2007 to 2009. The assimilation of IASI data is compared with ozone sondes and ozone from the Ozone Monitoring Instrument (OMI).

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1 Introduction

Ozone is an important trace gas that plays a key role in the Earth's radiative budget (Gauss et al., 2014). In the chemical processes occurring in the atmosphere, and in climate change studies, it is important to know the distribution of ozone. Ozone is a highly reactive gas and with its negative effects on human and animal health, and on crops and ecosystems, tropospheric ozone is, therefore, a vital component of life on the Earth since it protects the biosphere from harmful UV radiation (Gauss et al., 2014). Satellite data, such as that from the Infrared Atmospheric Sounding Interferometer (IASI) instrument, are used to improve tropospheric Composition and Climate (MACC) project (Hendrick et al., 2012). Ill. is a methodology to estimate the error covariance matrix for IASI radiances and its impact on the assimilation of ozone in a chemistry transport model. The error covariance matrix is important in the data assimilation scheme for system stability and forecasts.

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