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Simulation of Ozone and Oxygen Airglow on Mars

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Abstract

We present new results of the GEM-Mars General Circulation Model with interactive atmospheric chemistry [1], comparing the simulation of the vertically integrated column of ozone (O_3) to observations from the MARs Color Imager (MARCI) [2] on Mars Reconnaissance Orbiter (MRO). We also compare the vertically integrated oxygen dayglow emission ($O_2(a^1\Delta_g)$) at 1.27 μm with measurements taken with the Mars Express SPICAM instrument [3]. The seasonal cycles of total column O_3 and dayglow emission are generally reproduced except for a few differences, highlighting possible processes that are not well represented in the model.

This abstract complements that of Daerden et al. (this session) where results for carbon monoxide and hydrogen peroxide are presented. Also related, we refer to the abstract on the use of the GEM-Mars ozone gradients at the terminator in the retrieval of ozone from SPICAM (Piccialli et al., this session).

1. Introduction

Ozone in the Mars atmosphere is closely related to the abundance of water vapour as one of its main destruction mechanisms is through reactions with the products of H_2O photo-dissociation (H, OH, HO_2 = HO_x). One of the main features of the seasonal cycle of O_3 is the enhancement in the polar winter regions where there is a lack of photolysis and of HO_x species.

Closely related to ozone is the 1.27 μm $O_2(a^1\Delta_g)$ dayglow emission. $O_2(a^1\Delta_g)$ is produced by the photolysis of ozone as well as the three-body reaction of $2O(^3P)$ and CO_2. It can then be quenched by CO_2 or produce an emission at 1.27 μm. Observations of these two quantities provide important constraints for the global model simulations of atmospheric chemistry.

2. Simulations

Several modifications have been implemented relating to GEM-Mars chemistry, including an update to the cross-sections for CO_2 and H_2O around 190 nm. In addition, the on-line calculation of photolysis rates has been improved to take into account the true line-of-sight of the sun.

Based on the suggestion by [2], the rate for the quenching reaction for $O_2(a^1\Delta_g)$ has been reduced to a value of 0.25×10^{-20} $cm^3 s^{-1}$ from that given in [4].

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