Referee Report

Manuscript no.: acp-2019-221

Title: Photochemical modeling of molecular and atomic oxygen based on multiple *in situ* emissions measured during the Energy Transfer in the Oxygen Nightglow rocket campaign.

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In this paper the authors present a new airglow model (MAC, Multiple Airglow Chemistry model) that includes electronically excited states of molecular and atomic oxygen (six of O_2 and two of O) and their ground states. The model is based on the measurements and findings of the ETON sounding rocket campaign conducted from South Uist, Scotland in March 1982 and extends this with later efforts by several authors to model the photochemistry of the MLT (Mesosphere/Lower Thermosphere) region, and updated reaction rates. Unfortunately, the *in situ* measurements of the atmospheric neutral temperature during the ETON campaign were not successful. Instead, the temperature (and neutral density) were taken from the NRLMSISE-00 model in the current study. A sensitivity study was conducted by the authors to investigate the influence of changes in temperature and neutral density in the retrieval of the different excited and ground states of molecular and atomic oxygen.

General comments

The paper presents an extensive model to explain the excitation mechanisms responsible for the observed airglow emissions from the MLT region of the Earth's atmosphere. It is a nice review of the current knowledge of airglow photochemistry, and it constrain the precursors responsible for the Atmospheric band, Infrared Atmospheric band and the Oxygen Green Line emissions. It is an important contribution to the scientific community.

The authors have done a good job in revising the manuscript in accordance with the Referee Comments in the interactive discussion. The structure and language have been substantially improved and the manuscript is much easier to read

Specific comments

A few very minor (technical) suggestions:

On page 27 line 3 it is written "…are not known *a-priori*. Instead…". Write "*a priori"* here to be consistent.

On page 37 line 10: "…the Stern-Volmer method Lakowicz (2006)." Put Lakowicz inside the parenthesis, i.e. "…the Stern-Volmer method (Lakowicz, 2006)."

On page 43 line 15: "…complementary processes proposing the MAC model." Change "proposing" to "proposed".