1. Introduction

- The first ever methane vertical profiles retrieved by NOMAD [1] and ACS on the ExoMars Trace Gas Orbiter mission will require interpretation to identify the sources and sinks related to methane on Mars (is it created by life or not?)

- This study [2] tracks the vertical evolution of methane from three different emission scenarios, using a Global Circulation Model (GCM)

2. Model and simulations setup

- Methane plumes are tracked in 3-D space and time using the UK version of the LMD GCM, which includes a UK-only spectral dynamical core [3] and semi-Lagrangian advection scheme [4]

3. Evolution of methane over source location

- For clues to the origin and source of methane plumes we determine timescales on which the three emission scenarios can be distinguished from one another

- To discriminate between a sustained or instantaneous surface emission (at methane release rates constrained by previous observations and modelling studies), requires at least 10 sols of tracking the emission

- To determine if the initial methane source was from destabilisation of metastable methane clathrates (i.e. atmospheric), a methane release must be observed within 5 to 10 sols of the initial emission

4. Vertical evolution of methane away from source location

- In case of nearby observations in time not located directly over the source emission, we also investigate vertical profile of methane away from initial source location

- Stronger high altitude meridional winds result in an initially atmospheric methane source being spread further in latitude after one sol

- It would be difficult to know if the original methane source was released at the surface after 5 sols (away from the source location) since there is a lack of methane below 5 km at the source longitude in all three different scenarios

5. Impact of thermal data assimilation

- Alterations to local wind patterns and deviations in the evolution of a modelled methane plume are seen when combining thermal profiles with the GCM

- To backtrack and localise the source of methane, which will give clues to its origin, it is critical to provide the most accurate wind field to transport methane in the martian atmosphere

6. Summary

- Tracking of a methane plume is vital for determining unknown sources/sinks of methane

- Identifying destabilisation of methane clathrates as the source of methane requires observing the plume within the first 5 to 10 sols of emission

- Assimilation of thermal data is critical for correct backtracking of a methane source to its origin

References