Exploring the Martian atmosphere with Ares
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Exploring the Martian atmosphere with Ares: *A retrieval framework Mars model for ExoMars Trace Gas Orbiter (TGO) NOMAD solar occultation (SO) measurements*

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1. Is there life on Mars?

Since its tentative detection in 2003[1][2], the nature of methane, CH_4, on Mars has caused controversy[3][4][5]. On Mars CH_4 has, at most, a predicted lifetime of 300 years[6], the short lifetime in the Martian atmosphere implies that CH_4 should be uniformly distributed. However, non-uniform distributions have been observed, **Figure 1**[3]. Both non-biological, (e.g. Fischer-Tropsch-type (FTT)[7] water-rock reactions) and biological (methanogenic archaea[8]) sources could explain the detections.

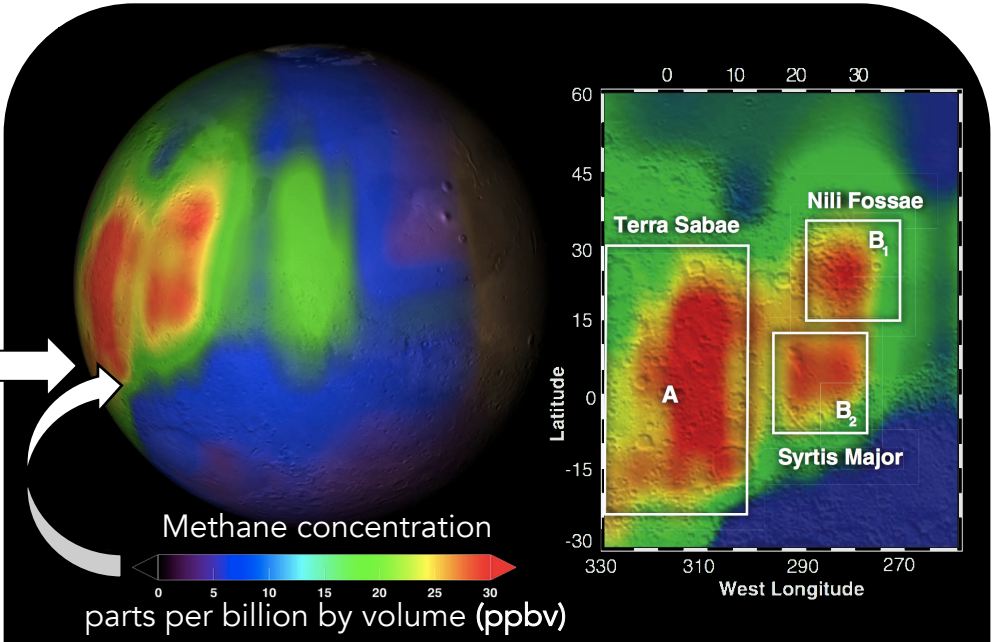

Figure 1: Non-uniform distributions of CH_4, on Mars at Northern mid-summer in 2003 [3].

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2. Ares[9] is an extension of the TauREx3[10] exoplanetary atmospheric retrieval framework for Mars for ESA's TGO NOMAD SO channel. Ares may help unravel the nature of CH_4 on Mars, through its heritage in low signal-to-noise (SNR) observation methods and NOMAD spectra posterior distribution generation, enabling mapping of correlations between Mars atmospheric parameters.

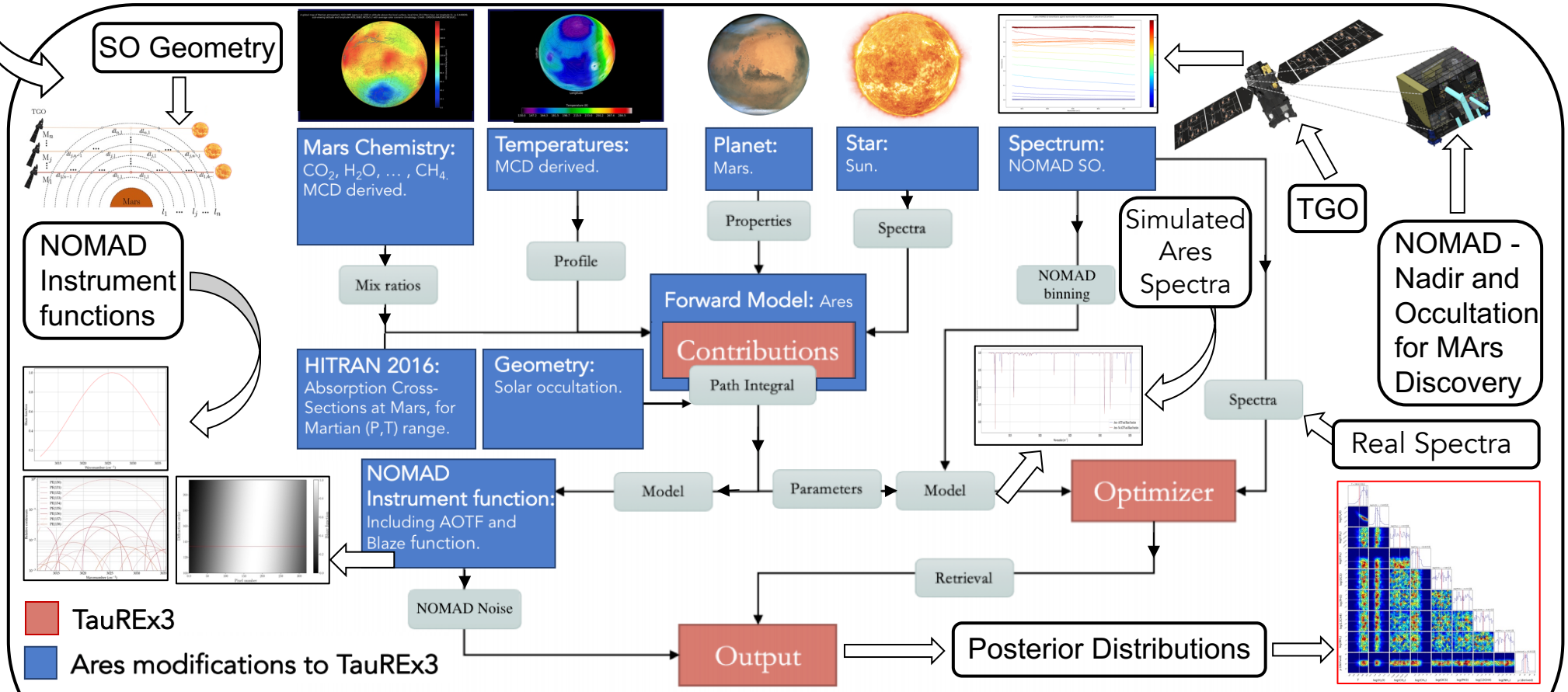

Figure 2. A flow diagram of Ares, modified from Al-Refaie et al. (2019)[11]. Red boxes represent TauREx3 modules. Blue boxes represent Ares modifications to TauREx3.

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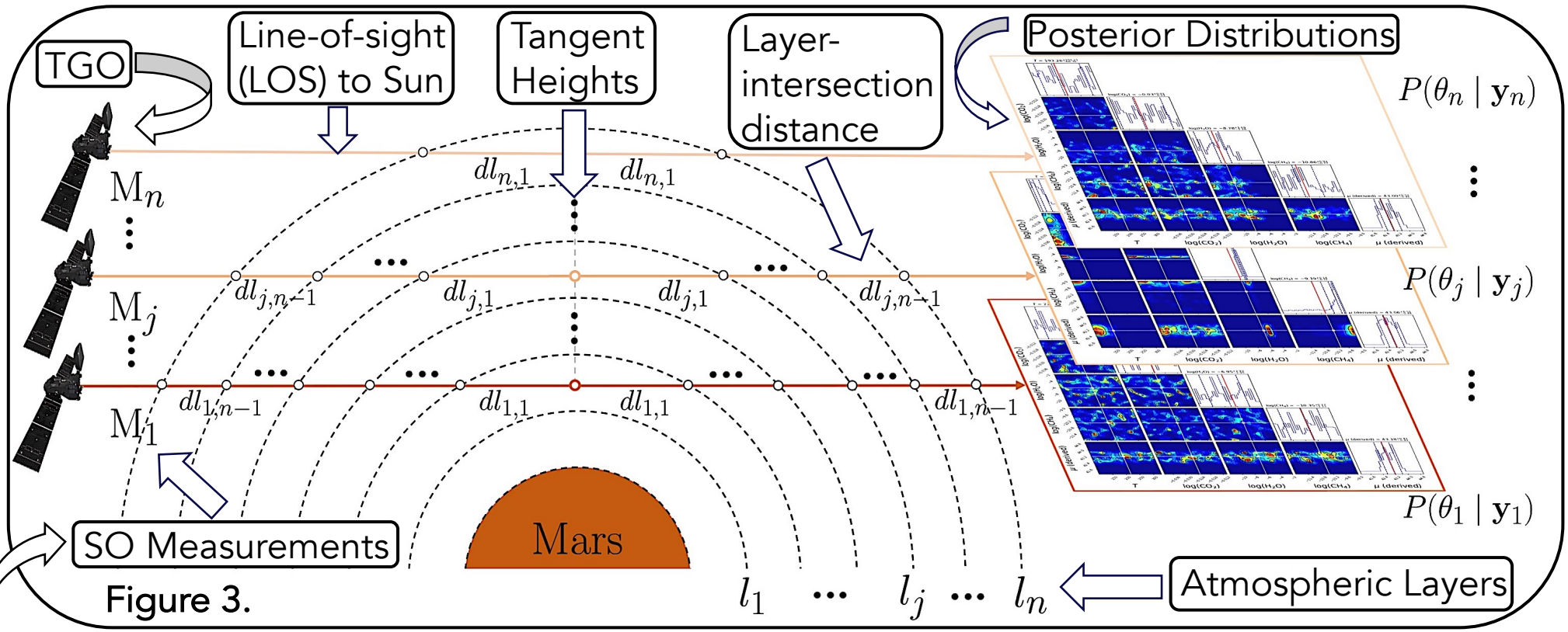

Figure 3.

3. Marginalised and Conditional Posterior Distributions as a function of Tangent Height

In **Figure 3.** (above) a set of Martian atmospheric layers and corresponding Ares a posterior distributions are shown, mapping the correlations between atmospheric parameters. Shown is a layer-by-layer retrieved atmosphere using NOMAD spectra, for diffraction order 134, diffraction order 134 at 3.3μm is used to search for CH_4. Three tangent heights are shown in the lower, middle and upper Martian atmosphere. Retrievals for lower tangent heights are strongly noise dominated while middle atmosphere retrievals produce tighter constraints.

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Summary, Acknowledgements, References and Further Information

4. Summary:

This poster has briefly described Ares, an atmospheric retrieval framework designed for ESA's TGO NOMAD SO channel. Ares will be used for the interpretation of future NOMAD observations, in particular to search for CH_4 and to search for possible signals of derivatives, namely methanol, CH_3OH, and formaldehyde, H_2CO[12].

5. Acknowledgements:

We would like to thank the UK Space Agency for their support of this Aurora Science studentship STFC: 535385.
The development of TauREx has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 Research and Innovation Programme (Grant agreement No. 758892, ExoAI).

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7. Further Information:

For further information I'll be available for questions and discussions via email and social media. For further details on Ares visit arXiv: https://arxiv.org/abs/2007.13458.

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