

# The LAPS Project: A tutorial, online model to simulate the atmosphere of any terrestrial planet.

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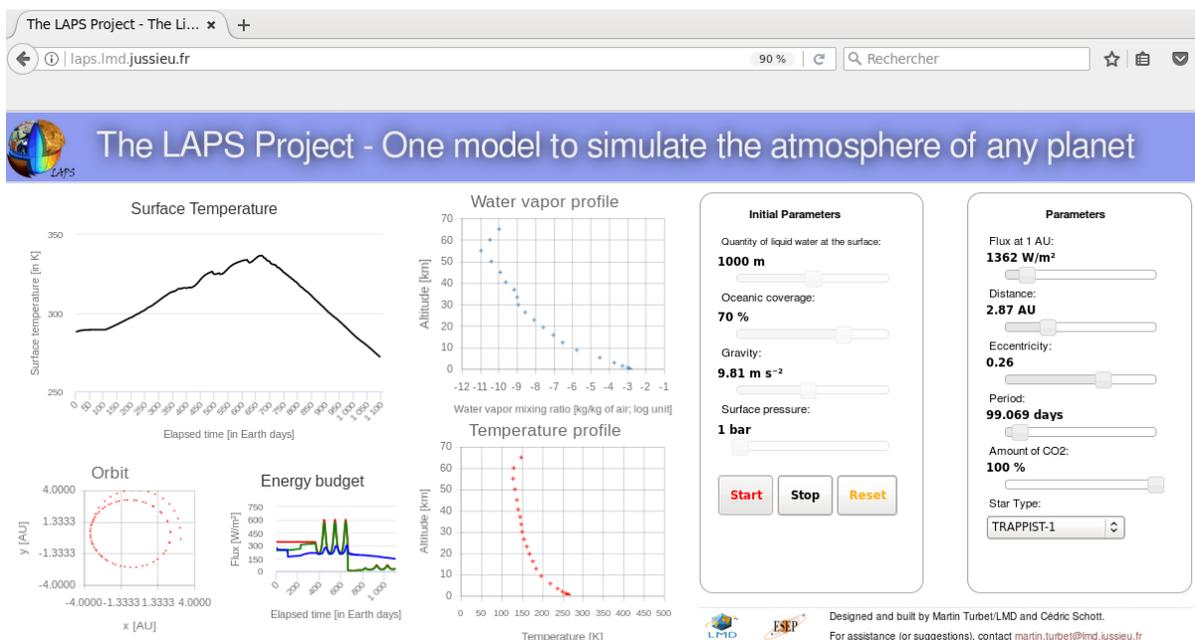
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## The project

The **LAPS** (Live Atmospheres-of-Planets Simulator) is a live 1-D radiative-convective version of the LMD Global Climate Model [1,2,3]. The LAPS provides an accelerated and interactive simulation of the climate of any terrestrial planet and exoplanet. This tool was initially designed for students to explore the boundaries of the «Classical Habitable Zone», defined as the range of orbital distances within which a planet can maintain liquid water on its surface [4].

## Capability of the model

The model faithfully reproduces both the inner edge and the outer edge limits of the Habitable Zone, and their dependencies to the type of star and the gas composition. It can also be used to recover the atmospheres of the Solar System terrestrial planets (Venus, Earth and Mars) and explore how they would evolve when exposed to different external conditions (different star, orbit, ...).



**Figure 1:** Screenshot of the online Graphical User Interface of the LAPS model. It presents the evolution of the surface temperature and the instantaneous vertical profile of temperature and water vapor during a simulation which typically achieve 10 Earth days per CPU seconds.. Throughout the simulations, the star insolation (i.e. the distance from the star), the type of star, the amount of CO<sub>2</sub>, ... can be modified.

The LAPS model provides a "hands on" experiment by showing how the surface and atmospheric temperatures as well as the profile of water vapor evolve through time when the external forcing (insolation, star spectrum, ...) or the planet (gravity, quantity of CO<sub>2</sub>, initial amount of water reservoir, ...) is modified.

## How to use it?

Just click on <http://laps.lmd.jussieu.fr/> !

Note that the tool will be presented on demand and on live during the EPSC-2017 poster session.

## References

[1] Leconte et al. 2013, Increased insolation threshold for runaway greenhouse processes on Earth like planets. *Nature* 504, 268-271.

[2] Charnay et al. 2013, Exploring the faint young sun problem and the possible climates of the archean earth with a 3D GCM. *Journal of Geophysical Research* 118, 414-431.

[3] Turbet et al. 2016, The habitability of Proxima Centauri b. II. Possible climates and observability. *A&A*, 596 (2016) A112.

[4] Kasting et al. 1993, Habitable Zone around Main Sequence Stars. *Icarus* 101, 108-128.