Atmosfere di pianeti di tipo terrestre

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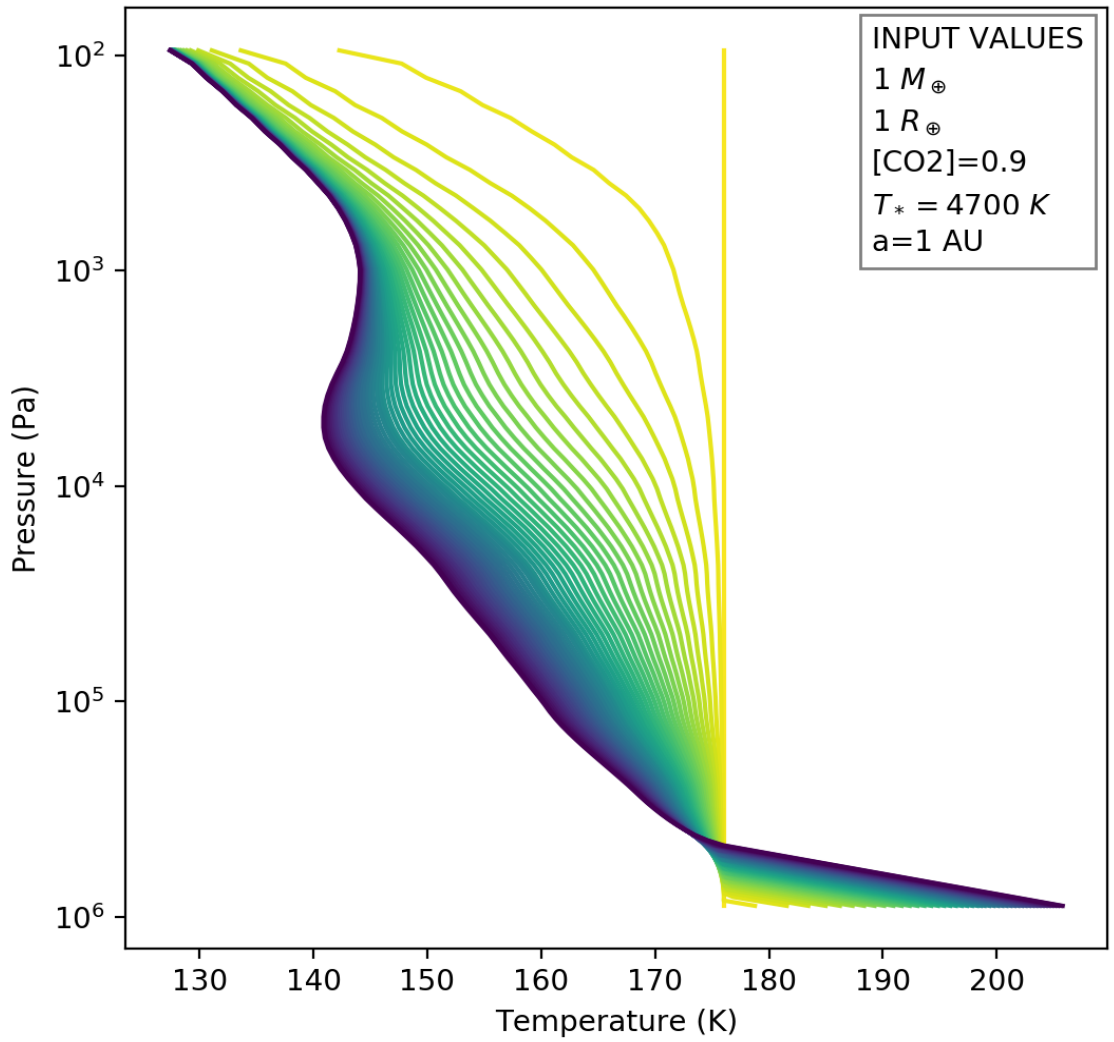
MAGRATHEA

[...] And thus were created the conditions for a staggering new form of specialist industry: custom-made luxury planet building. The home of this industry was the planet Magrathea, where hyperspatial engineers sucked matter through white holes in space to form it into dream planets - gold planets, platinum planets, soft rubber planets with lots of earthquakes - all lovingly made to meet the exacting standards that the Galaxy's richest men naturally came to expect. [...]

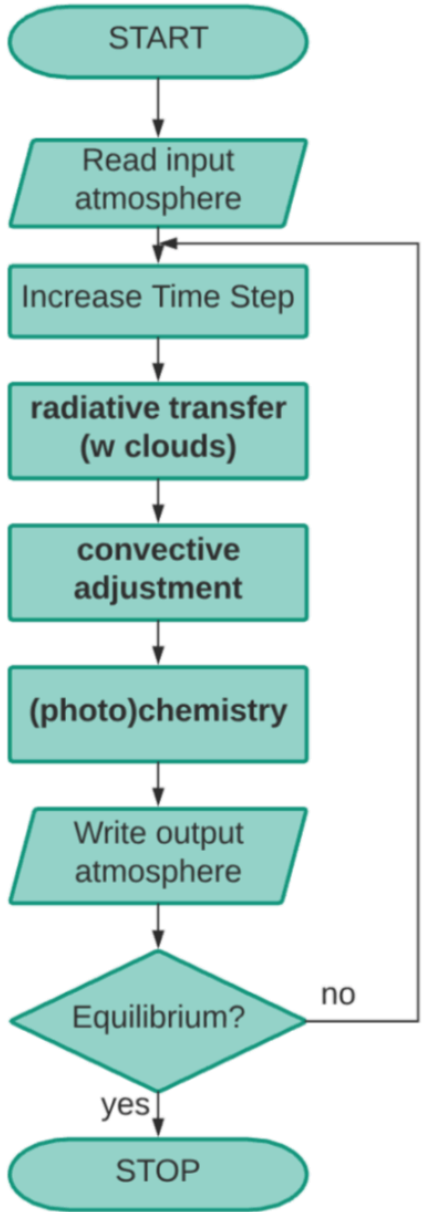
"Magrathea is a myth, a faery story! It's what parents tell their children about at night when they want them to grow up to become economists!"

Douglas Adams – The Hitchhiker's Guide to the Galaxy

Structure



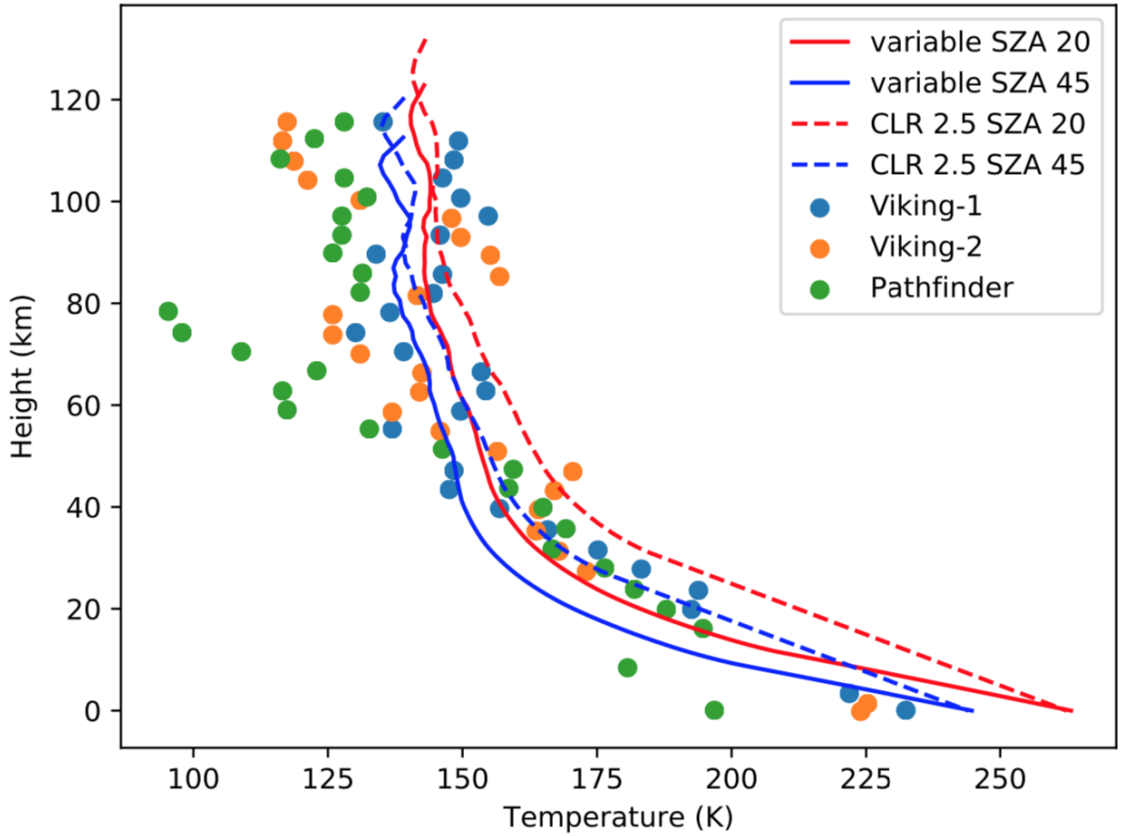
Petralia et al., 2019, in prep.



Alei et al., 2019, in prep.

Mars Validation

Models at various SZA with variable and fixed CLR of a Martian atmosphere (95% CO_2, 5% N_2). Comparison with data acquired from Viking-1, Viking-2, Pathfinder landers.

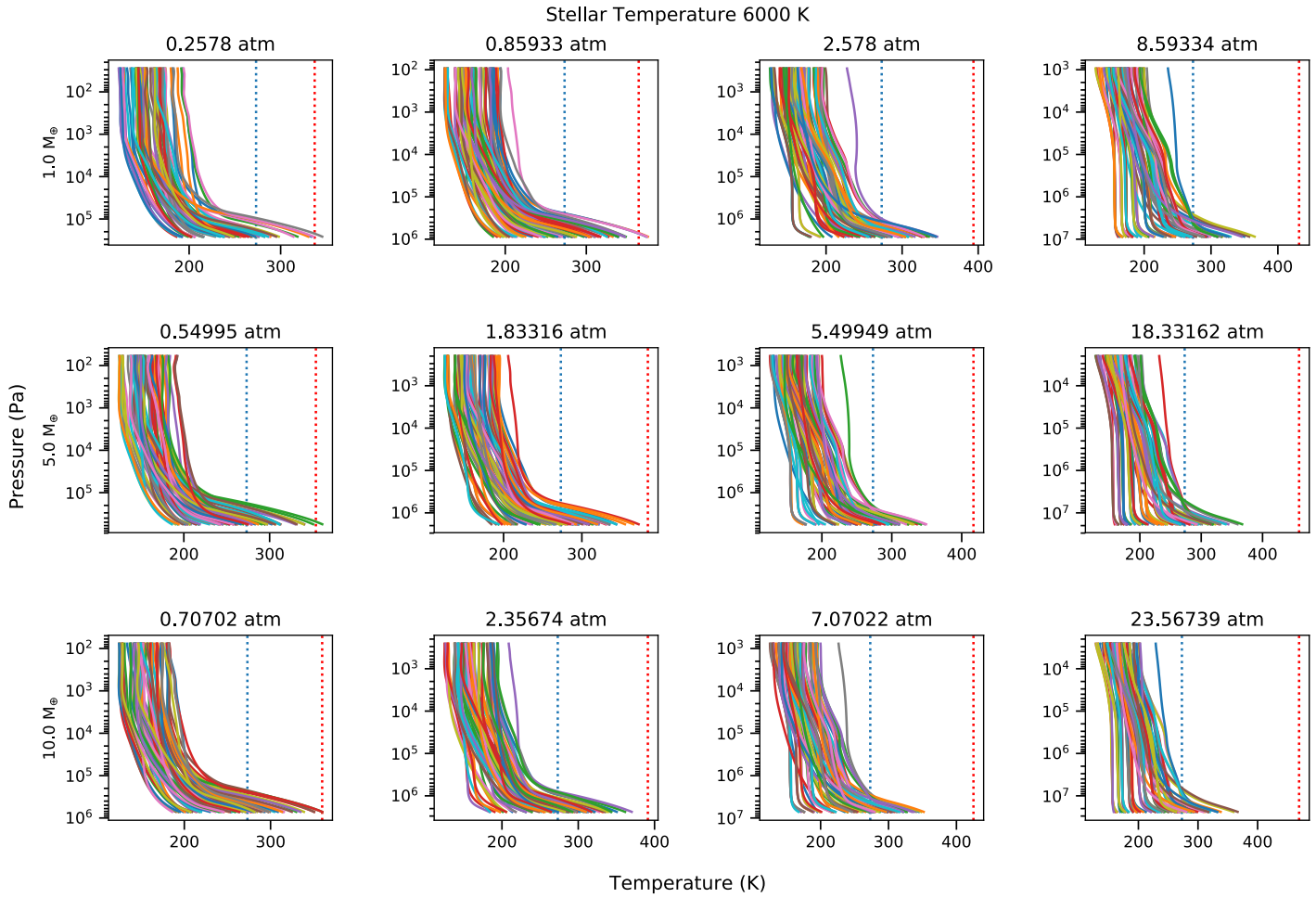


Petralia et al., 2019, in prep.

Alei et al., 2019, in prep.

Sample Results

- More than 30000 models run with CINECA clusters (in a few months' time).
- Many results to be analyzed!
- Developing an analysis method to retrieve information on so many models.



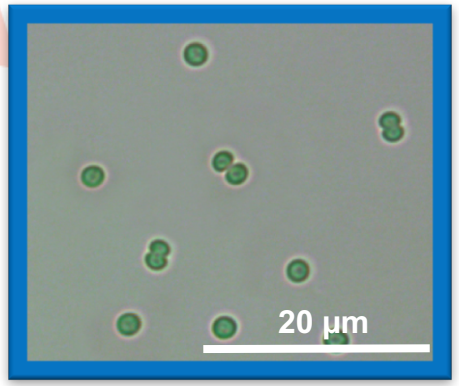
Petralia et al., 2019, in prep.

Alei et al., 2019, in prep.

Atmosphere in a Test-Tube

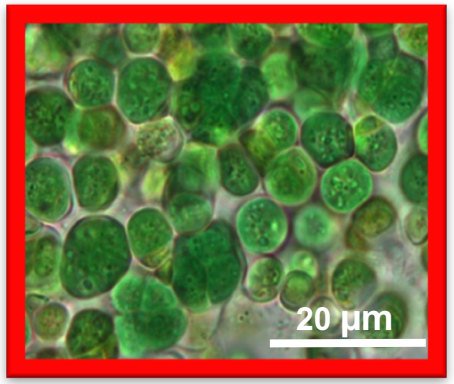
Atmosphere in a Test-Tube

Aim: Provide insights on exoplanet atmospheres modification due to biological intervention, by reproducing in laboratory the conditions of warm Earths/Super Earths and exposing cyanobacteria populations to the new environment.



2 Target species:

- *Synechocystis sp.* PCC 6803
- *Chlorogloeopsis fritschii sp.* PCC 6912



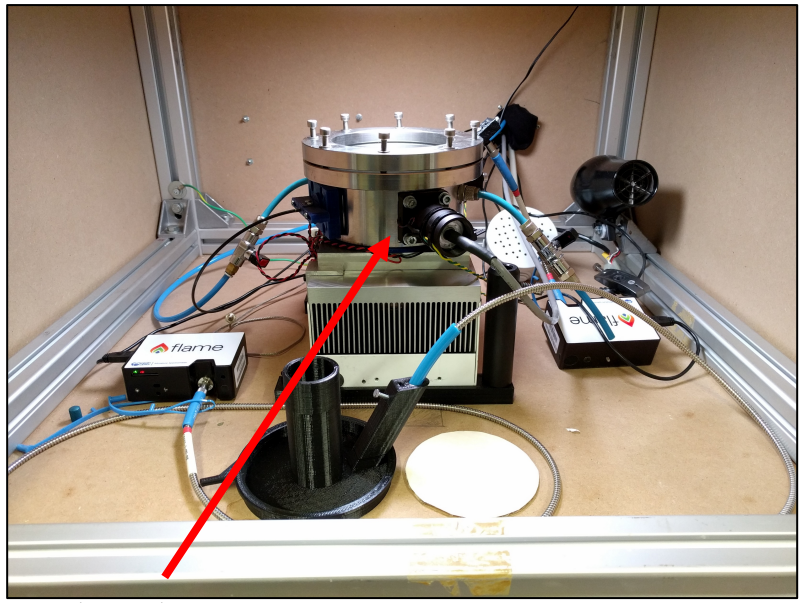
Atmosphere in a Test-Tube

Today

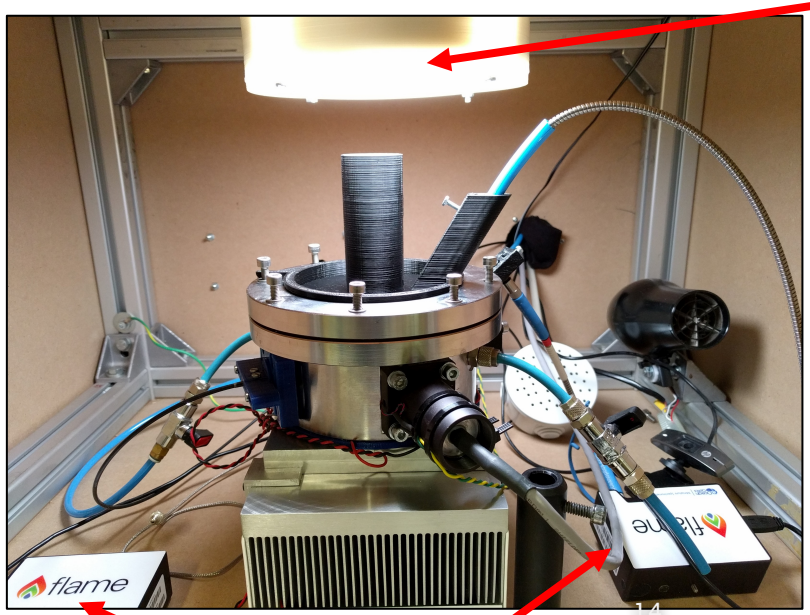
Phase 1
Earth – Sun

Phase 2
Earth – M star

Phase 3
SE – M star



Chamber



Claudi et al., in prep.

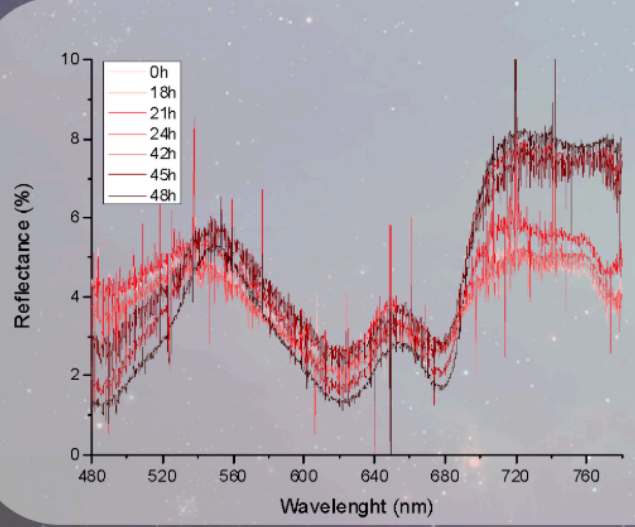
Battistuzzi et al., in prep.

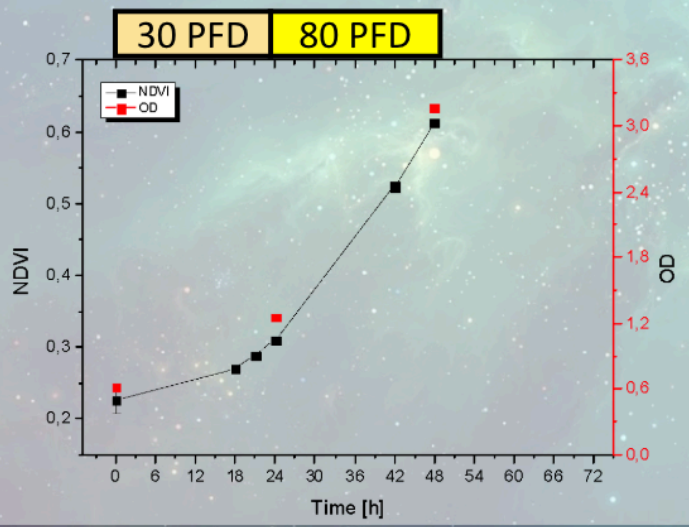
Results

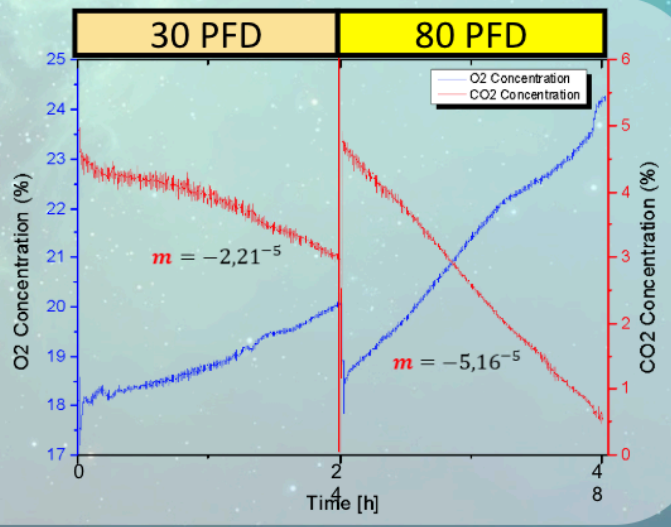
Operational Parameters:

***T** = 30 °C; **P** = 1 atm;*

***Light Spectrum** = Simulated G2 (Solar) Light Spectra; **Atmospheric Composition** = 75 %N_2, 20 %O_2, 5 %CO_2*







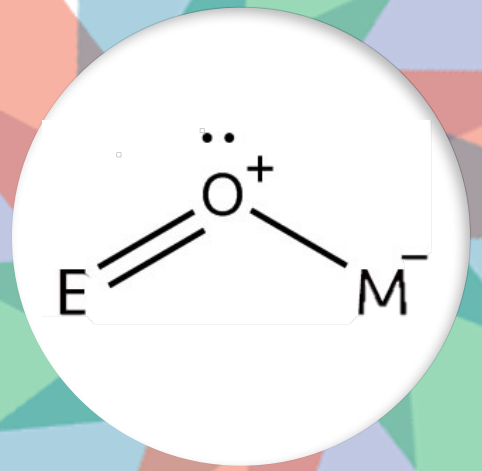
Reflectance Spectra

NDVI/Time vs. OD/Time Charts

% CO_2 Consumption vs. % O_2 Evolution Charts

PFD (Photon Flux Density) = µmol m^{-2} s^{-1}

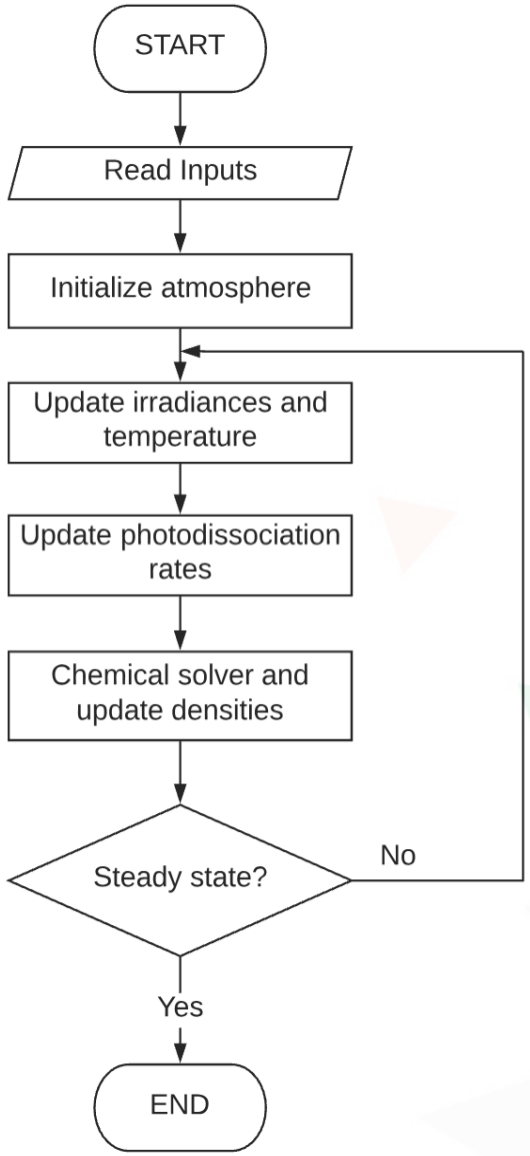
Courtesy of M. Battistuzzi & N. La Rocca (Dep. Biology, UNIPD)



Exoplanet Ozone Model

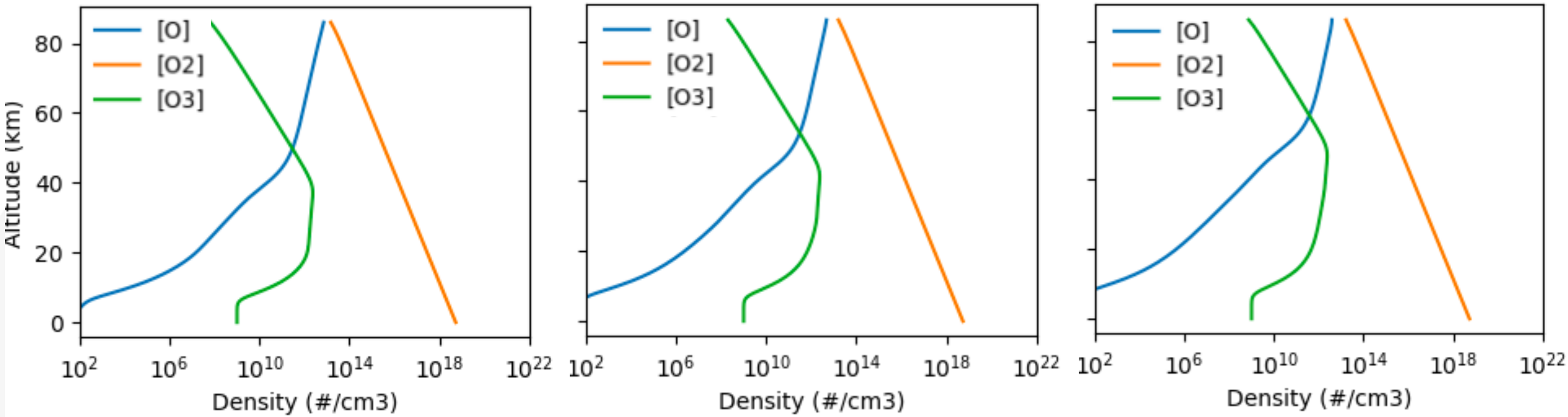
Exoplanet Ozone Model

- 1D photochemical model, accounts for: O, O_2, O_3, NO, NO_2 ,(Cl, Br)
- 150 Altitude layers
- Photodissociation and thermal chemistry
- Irradiance specified as BB or using observations
- Easily extensible
- Key parameters specified at runtime
- Assumptions:
  - Chemistry only (No transport, no diffusion)
  - Cross sections are averaged to irradiance bins
  - First tests have used low resolution irradiances



Results

Tstar = 5778 K, Earthlike atmospheric composition, e=0



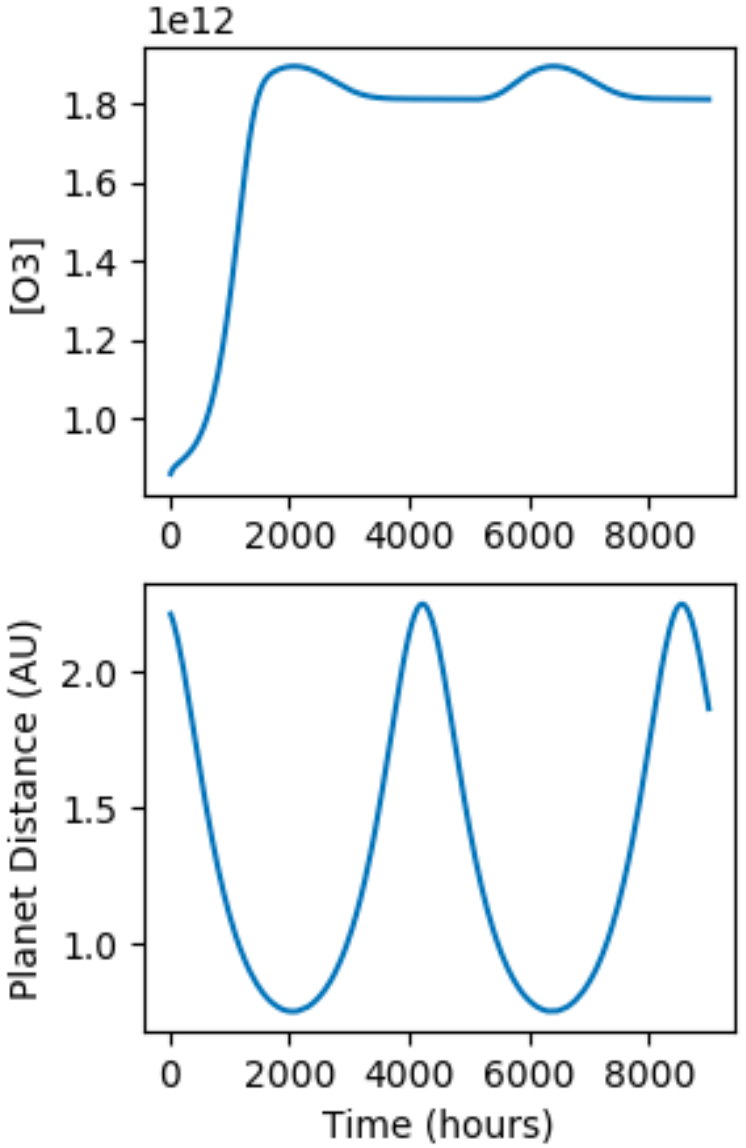
a=0.7 AU T_{eq}=305 K a=1.0 AU T_{eq}=255 K a=1.5 AU T_{eq}=195 K

Results

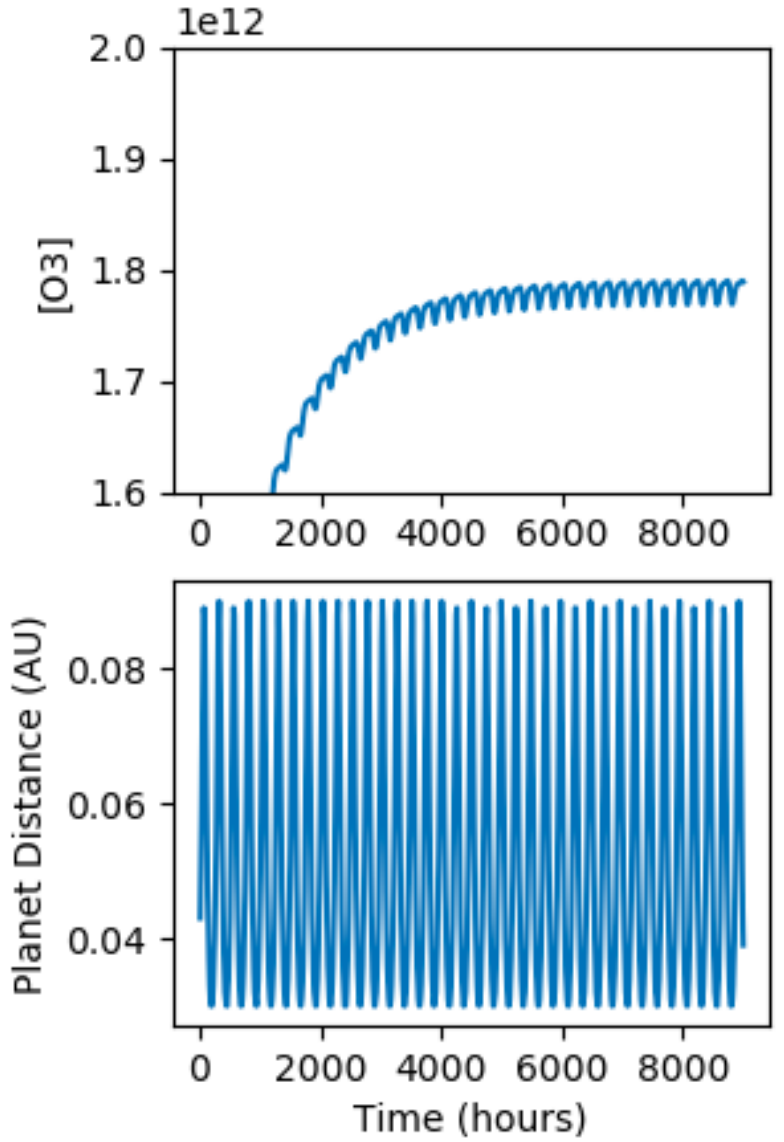
$[O_3]$ at 97 km
Earthlike atmosphere
e=0.5

Time dependent: variable orbital distance

T = 5778 K a = 1.5 AU



T = 3200 K a = 0.06 AU



Stay tuned!