



Radiative transfer improvements in the Venus PCM

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Radiative transfer in the Venus PCM



Source: https://psg.gsfc.nasa.gov/helpmodel.php

Radiative transfer in the Venus PCM

The radiative transfer model based on the Net Exchange Rate formalism, where the infrared radiative budget of a given atmospheric layer i, ζ i, is computed as the sum of the radiative net exchanges $\Psi(i,j,\lambda)$ between this layer and all other atmospheric layers j, including the boundaries, i.e., the surface and space:

$$\zeta_i = \sum_{\lambda} \sum_{j} \psi(i, j, \lambda)$$

The individual net exchange rates are computed with

$$\psi(i, j, \lambda) = (B(T_i, \lambda) - B(T_j, \lambda)\xi(i, j, \lambda)$$

Infrared (IR) part in the model



Tools

kspectrum

Kspectrum computes the synthetic absorption spectrum for a gas mixture in arbitrary thermodynamic conditions (pressure, temperature and molar composition) from public spectroscopic databases

exo-k

offer the possibility to easily convert radiative data to and from many different formats.



The influence of resolution and new data



The influence of new data

Different database

The total K comparison using the latest data and the former

The influence of new data

The same resolution(1.0e-2 cm⁻¹) and CO2 truncation distance(200 cm⁻¹)

Updated data:Red Former data:Blue

All spectrum under 1bar and 350K with different database(updated to 2020)

The influence of resolution only

Comparison between Lower resolution(1e-2) and higher resolution(5e-4) for the total K

The influence of resolution only

Comparison between Lower resolution(1e-2 cm⁻¹) and higher resolution(5e-4 cm⁻¹) for the CO2

Important windows for energy exchange

The influence of Truncation distance

The impact of CO2 truncation distance (same resolution) Red for 1500 cm⁻¹ and blue for 200 cm⁻¹

CO2 spectrum under 100bar and 700K with new CO2 line and former(different CO2 truncation) CO2 spectrum under 100bar and 700K with new CO2 line and former(different CO2 truncation)

The influence of Truncation distance

The impact of CO2 truncation distance (same resolution) Red for 1500 cm^{-1} and blue for 200 cm^{-1}

The influence of Truncation distance

The impact of SO2 truncation distance (same resolution) Red for 100 cm⁻¹ and blue for 25 cm⁻¹

SO2 spectrum under 100bar and 700K (different truncation)

Conclusion

1. The latest spectrum database has been used to produce the high resolution continuum spectral data.

2.The impact of using different resolution maybe important for some species in the characteristic spectral region. An appropriate resolution need to be found to save the most important details and reduce the calculation time cost.

3. The influence of truncation distance has been discussed, especially CO2 3-7um windows.