

UNIV. OF VALENCIA



MAGELLIUM

HARMONIZATION OF ATMOSPHERIC LOOK-UP TABLES USING THE ALG TOOLBOX

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HARMONIZATION OF ATMOSPHERIC LUT

INTRODUCTION

Context

The development of satellite data processing chains is a costly process that involves important resources to achieve the required mission objectives. However, many developments share some commonalities, at least conceptually, that invite for harmonization.

Atmospheric radiative transfer models

Software tools that simulate the scattering and absorption of electromagnetic radiation through the atmosphere. Widely applied in satellite simulation and [atmospheric correction](#).

In this presentation...

We propose a set of guidelines to harmonize atmospheric look-up tables, and present the ALG toolbox to the hyperspectral community.

GENERAL IDEAS FOR HARMONIZATION

1

Look-up table files format

Avoid ad-hoc solutions through standardization of data format (e.g. netcdf) and interfaces. Facilitates:

- algorithm updates and evolutions;
- documentation of data processing chain and reuse;
- comparison between algorithms.

2

Input & output definition

Consistent definition of input variables (e.g. aerosol properties, angles, units...) and spectral outputs (transmittances & reflectances).

Facilitates understanding of various algorithms and their comparison.

3

Automate LUT generation

RTMs are complex tools and each new development implies specific, but similar, scripts. Reusing existing tools will ease work-load to focus on core scientific algorithmic developments.

4

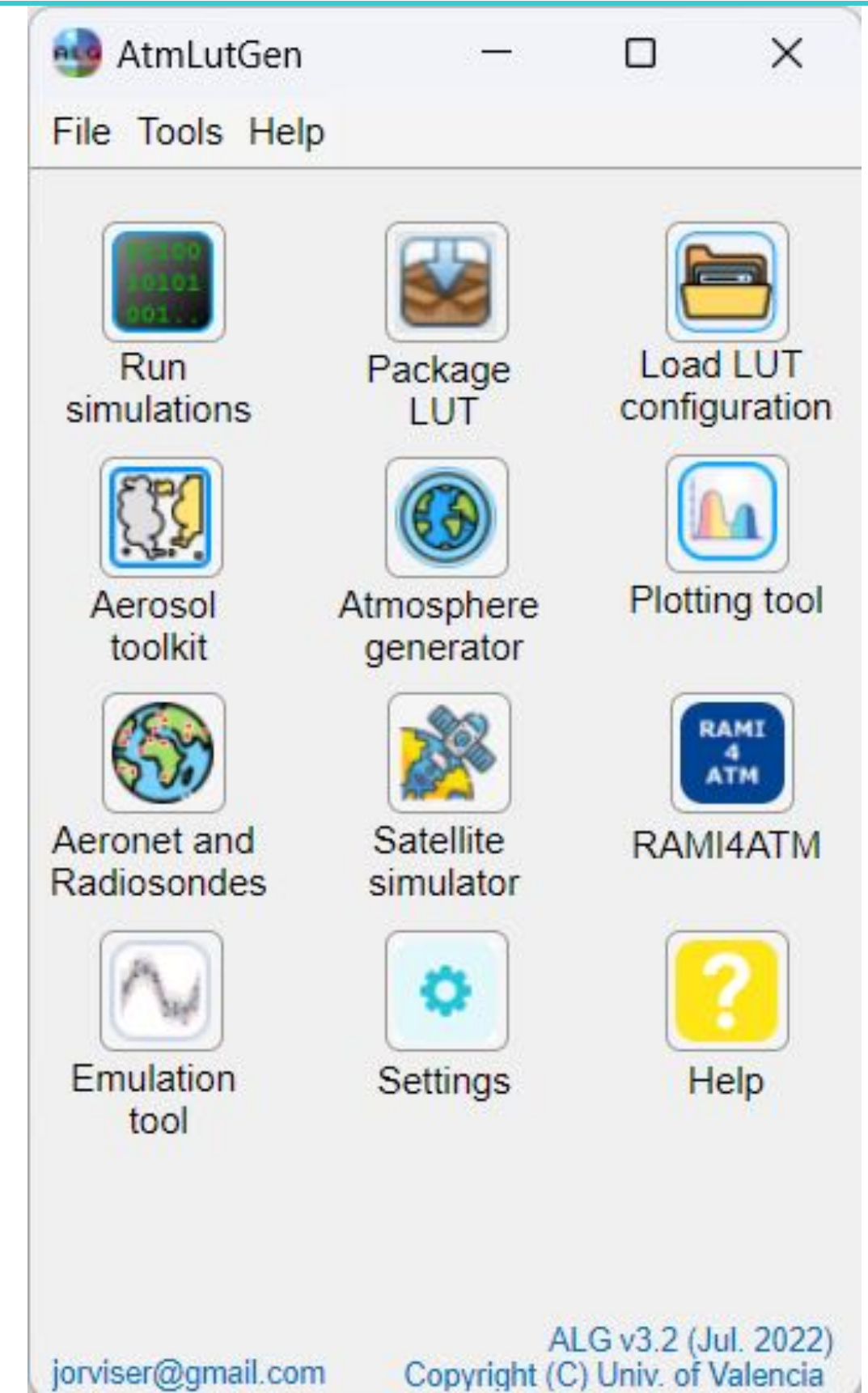
Keep flexible design

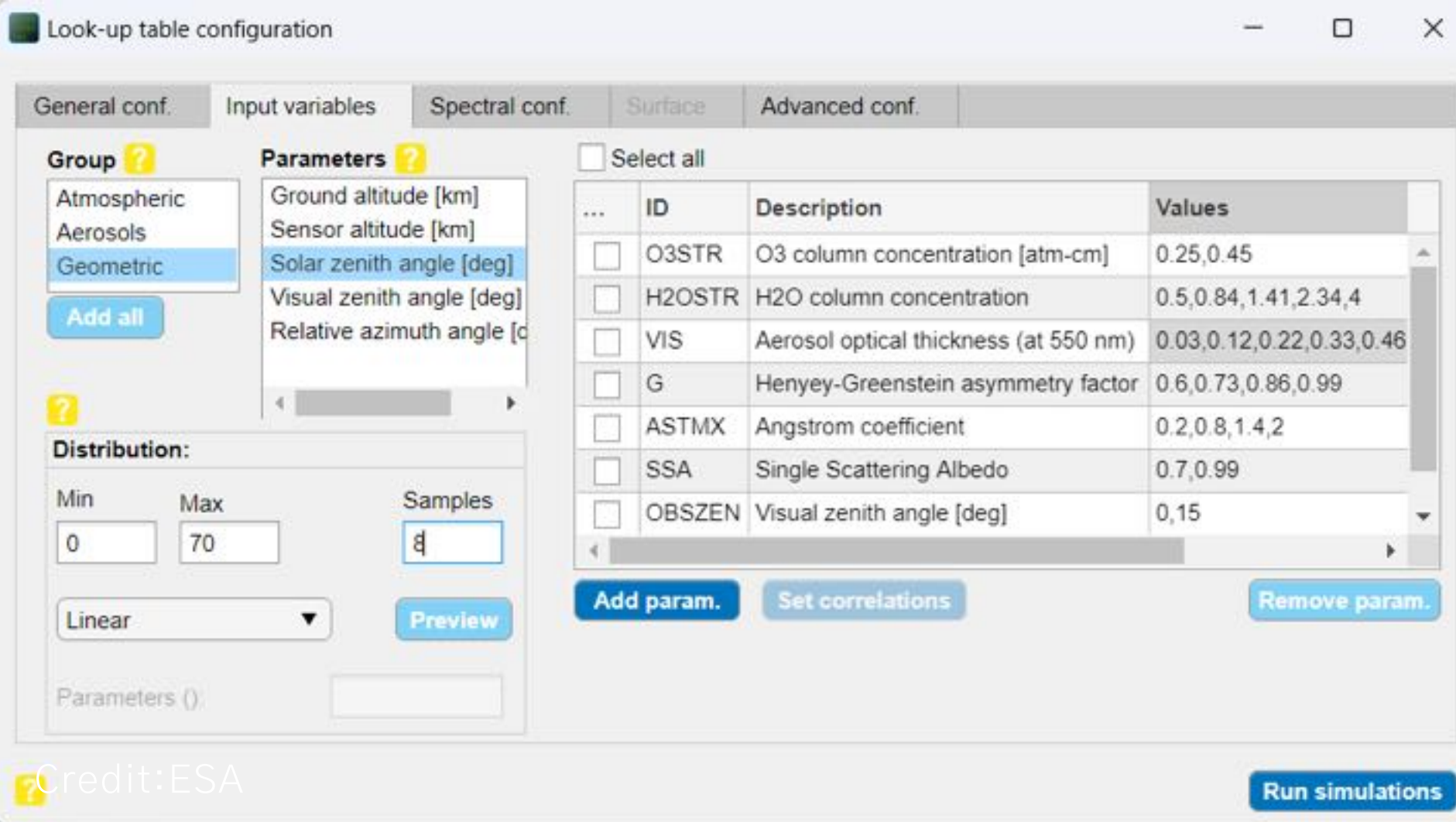
Although standardized, LUT design can still be flexible (input variables, grid points, spectral configuration) to cover specific needs from mission and algorithms.

WHAT IS ALG?

ATMOSPHERIC LOOK-UP TABLE GENERATOR (ALG)

ALG is a software tool that facilitates generating large databases for a variety of atmospheric Radiative Transfer Models (RTM). ALG allows consistent and intuitive user interaction to enable configuration and execution of model simulations, storing RTM data for any spectral configuration in the optical domain.





LUT CONFIGURATION

Same interface for all RTM · Consistent inputs & outputs definition · Flexible spectral configuration · Automate RTM execution, processing and LUT formatting

STANDARD FORMAT

Hierarchical data files (hdf5) containing consistent information (wavelengths, transmittances/reflectances, irradiance, input variables, units...)

Tools (Matlab, Python) are provided for easy integration in data processing code

```
>> h5disp('../LUTs_folder/emuTrain.h5')
HDF5 emuTrain.h5
Group '/'
Attributes:
  'RTMname': 'MODTRAN6'
  'opmode': 'Transfer Functions'
  'inputmode': 'Latin hypercube'
  'sensor': ''
  'lut_package_date': '10-May-2022'
  'outnames': 'Lp0,Edir0,Edif0,S,tdir,tdif'
Dataset 'I0'
Size: 1066x1
MaxSize: 1066x1
```

COMPATIBLE ATMOSPHERIC RTM

MODTRAN

www.modtran.spectral.com

Based on the DISORT solver and a modelization of gas absorptions by the k-correlation method.

Spectral range and resolution: UV to TIR at 0.1 cm⁻¹

6SV

salsa.umd.edu/6spage.html

Based on the SOS solver with polarization and decoupled scattering and absorption.

Spectral range and resolution: VIS to SWIR at 2.5 nm

libRadtran

<http://libradtran.org>

Collection of functions and programs for calculation of solar and thermal radiation in the Earth's atmosphere.

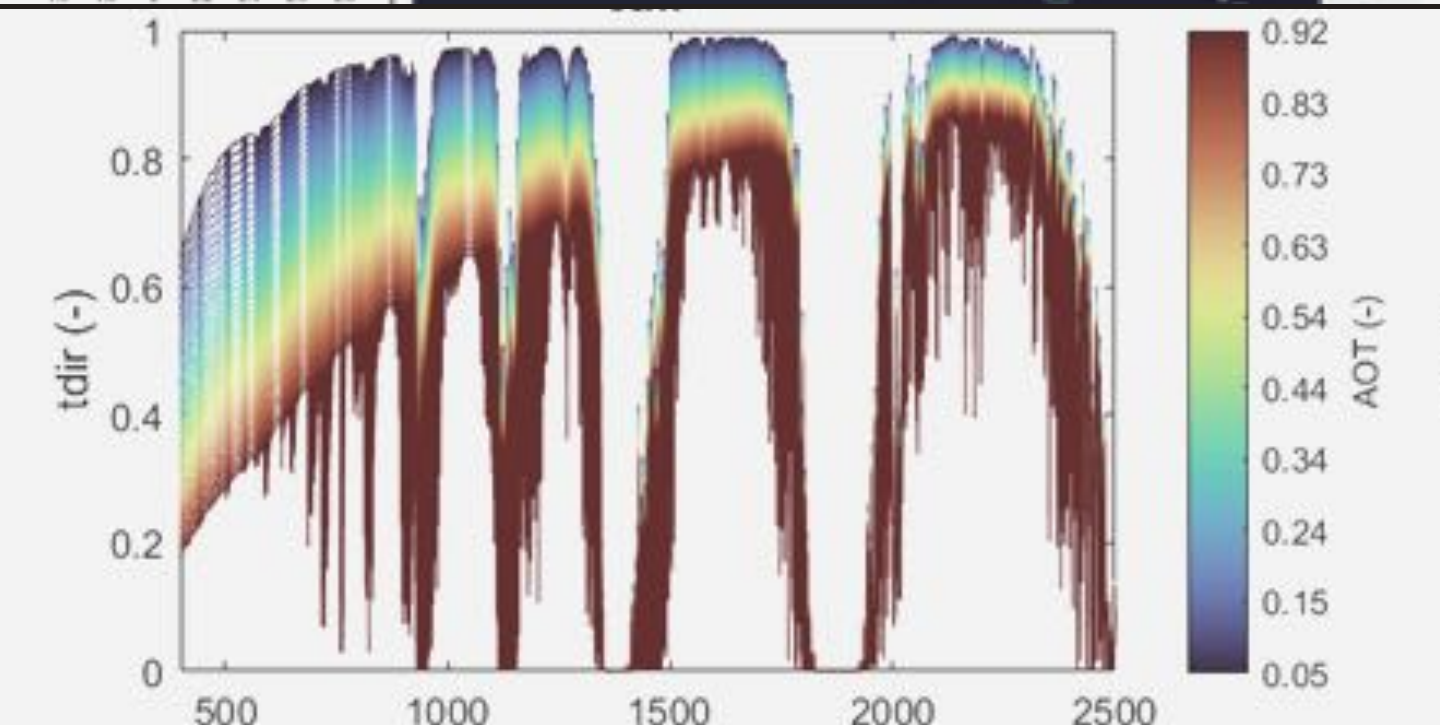
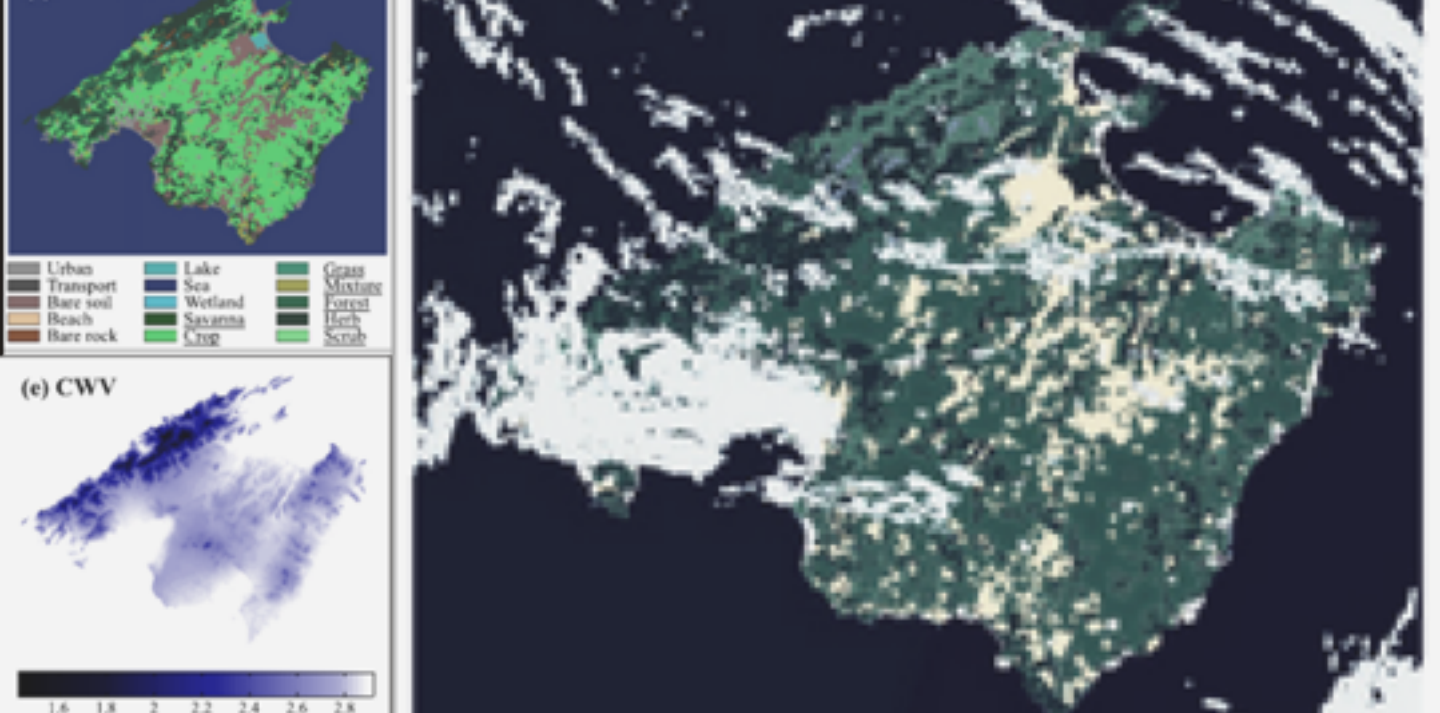
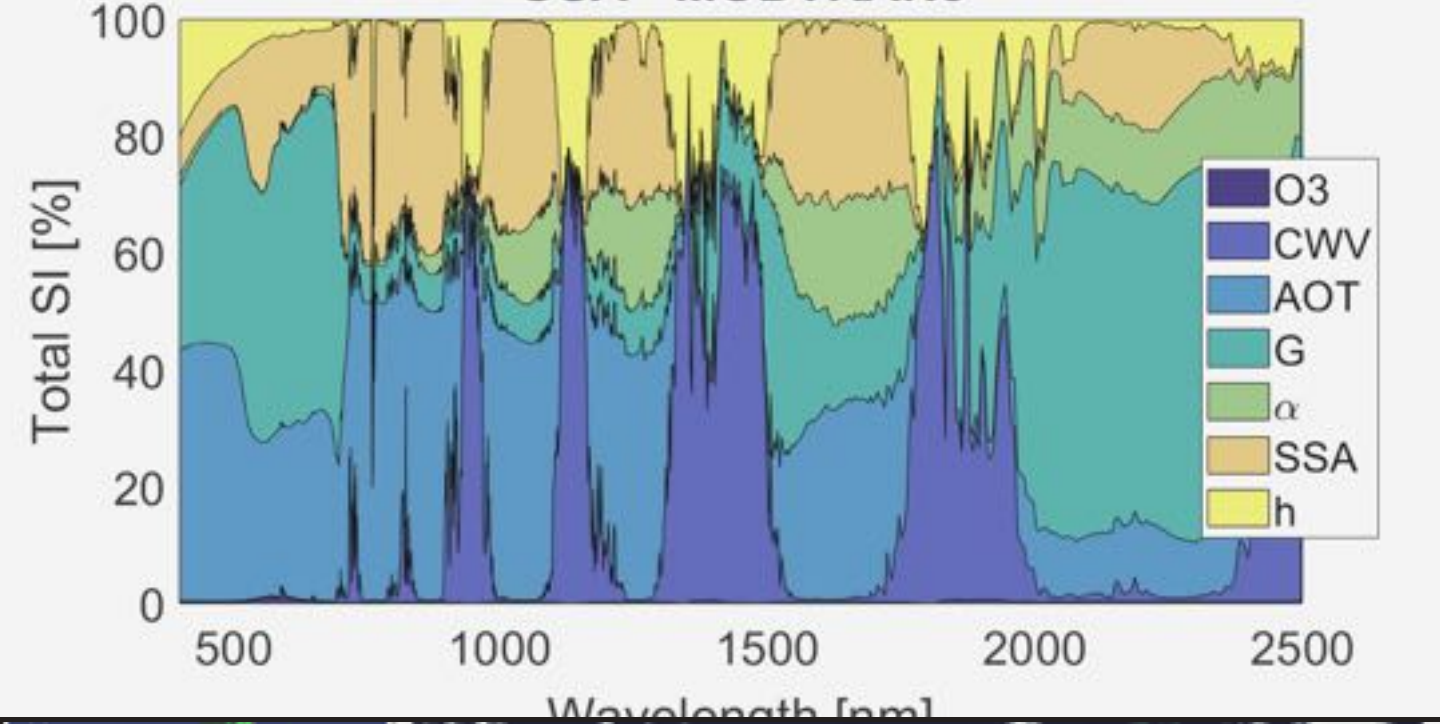
libRadtran is freely available under the GNU General Public License.

Others

ARTDECO (LOA)
SBDART(Univ. California)

[and more in the pipeline...](#)

PYDOME (DLR)
SCIATRAN (IUP Bremen)
SMART-G (HYGEOS)
...



A few use cases

MORE THAN 6 YEARS USING ALG

- Sensitivity analysis and LUT design
- Comparison of atmospheric RTMs (RAMI4ATM)
- Synthetic scene generation (ESA's FLEX E2E simulator, ESA GS00S project)
- Atmospheric correction (FLEX Level-2, ACIX-III)
- Training datasets for designing and testing emulators

WANNA KNOW MORE?

Software

- www.artmtoolbox.com ([download](#))
- SENSECO COST Action tutorial: www.youtube.com/watch?v=8WRrrAXbVQU
- Results to be published as part of RAMI4ATM

Contact us

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References

J. Vicent et al.: Comparative analysis of atmospheric radiative transfer models using the Atmospheric Look-up table Generator (ALG) toolbox (version 2.0), *Geosci. Model Dev.*, 13, 1945–1957, <https://doi.org/10.5194/gmd-13-1945-2020>, 2020.