



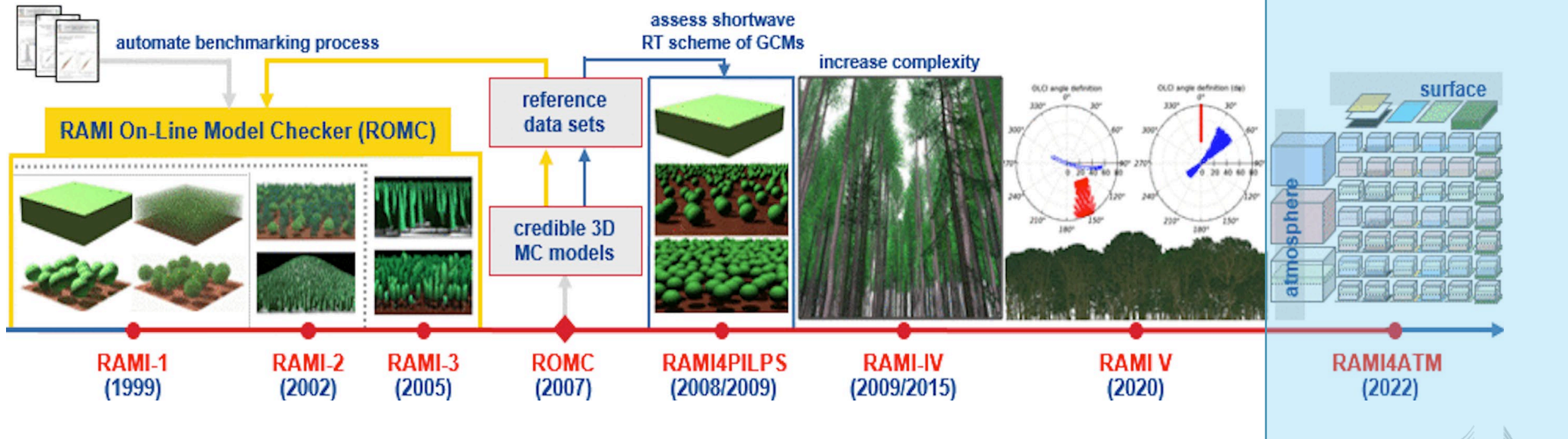
The Radiation Transfer Model Intercomparison for Atmosphere: RAMI4ATM Initiative

LPS 2022, 23 May 2022

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1: EC JRC, 2: Rayference

Radiation Transfer Model Intercomparison exercise

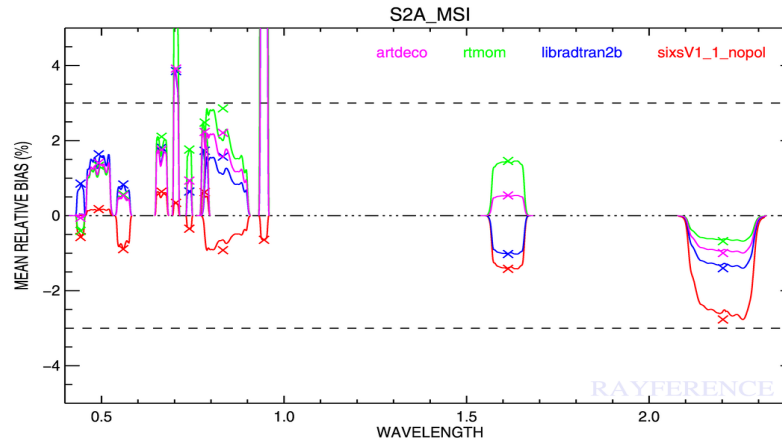
- 3D Radiative Transfer model independent assessment
- 20+ years activities (five phases, ROMC and RAMI4PILS)
- Blind concept
- Increased complexity of scenarios and experiments
- Oriented to vegetated surfaces
- Oriented to satellite and in situ observations



Background

Many radiative transfer models have been developed and are widely used in Earth Observation:

- **Calibration**

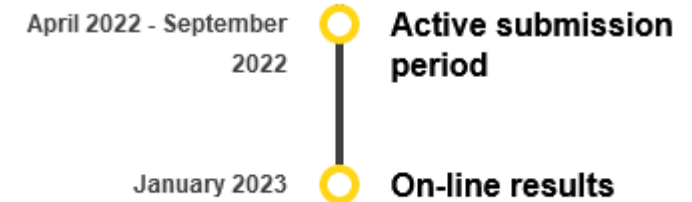


- **Atmospheric correction or sensitivity analyses**

- The uncertainties of these models have **not** been clearly assessed in **realistic usage conditions** when supporting typical Earth Observation applications by remote sensing scientists.



RAMI4ATM is a **new** initiative dedicated to the benchmarking of **coupled surface-atmosphere** radiative transfer models. **It is primarily oriented to RTM users.**



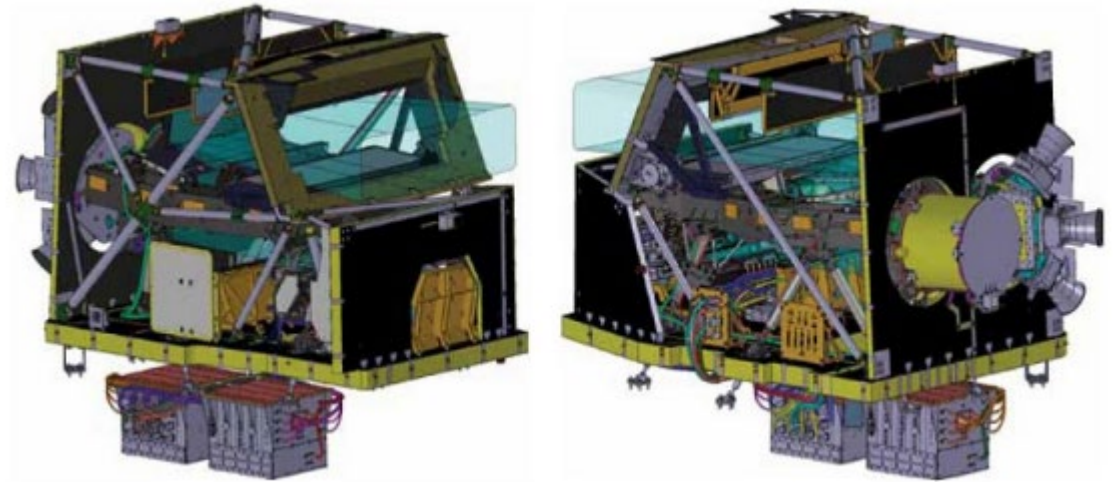
<https://rami-benchmark.jrc.ec.europa.eu/>



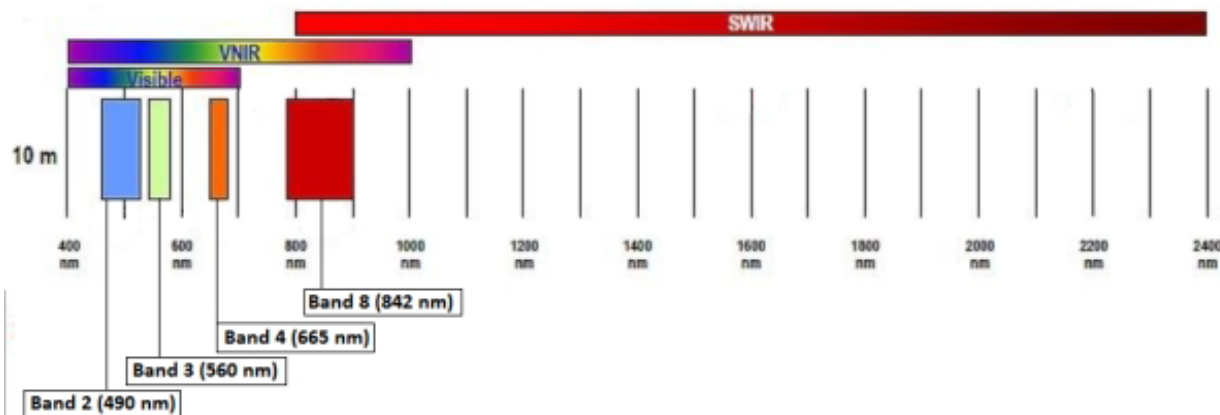
Sentinel-2



	Band	Centre	Width
Blue	MSI 2	492,4nm	66nm
Green	MSI 3	559,8nm	36nm
Red	MSI 4	664.6nm	31nm
NIR	MSI 8a	864,7nm	21nm
1,6µm	MSI 11	1613nm	91nm
2,1µm	MSI 12	2202nm	175nm

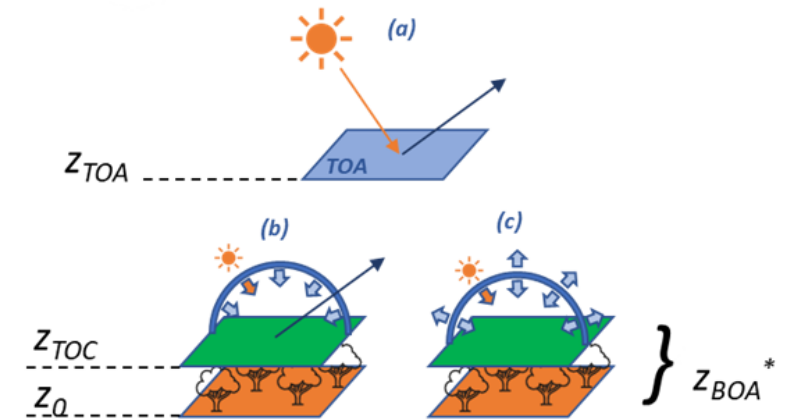


MultiSpectral Instrument (Airbus Defence and Space) source: sentinels.copernicus.eu

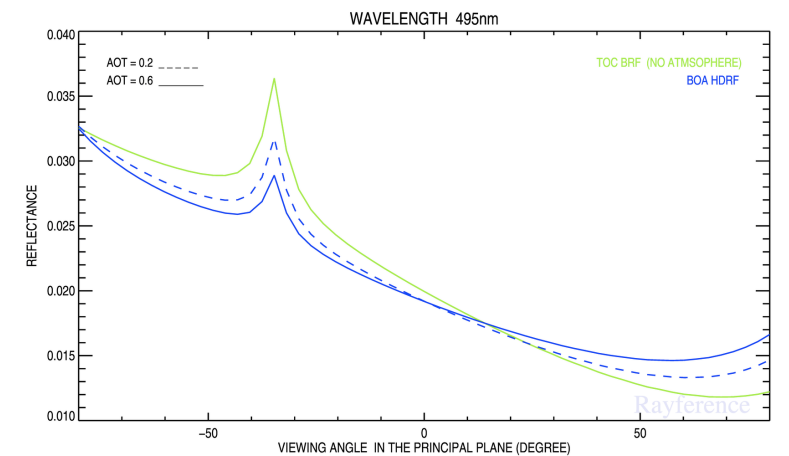


Measurements

<meas> Identifier tag	Link to Format file description	Level of the measurement
bhr	Bi-Hemispherical Reflectance	BOA
hdrfpp	Hemispherical Directional Reflectance Factor in the principal plane	BOA
hdrfop	Hemispherical Directional Reflectance Factor in the orthogonal plane	BOA
brfpp	Bi-directional Reflectance Factor in the principal plane	TOA
brfop	Bi-directional Reflectance Factor in the orthogonal Plane	TOA



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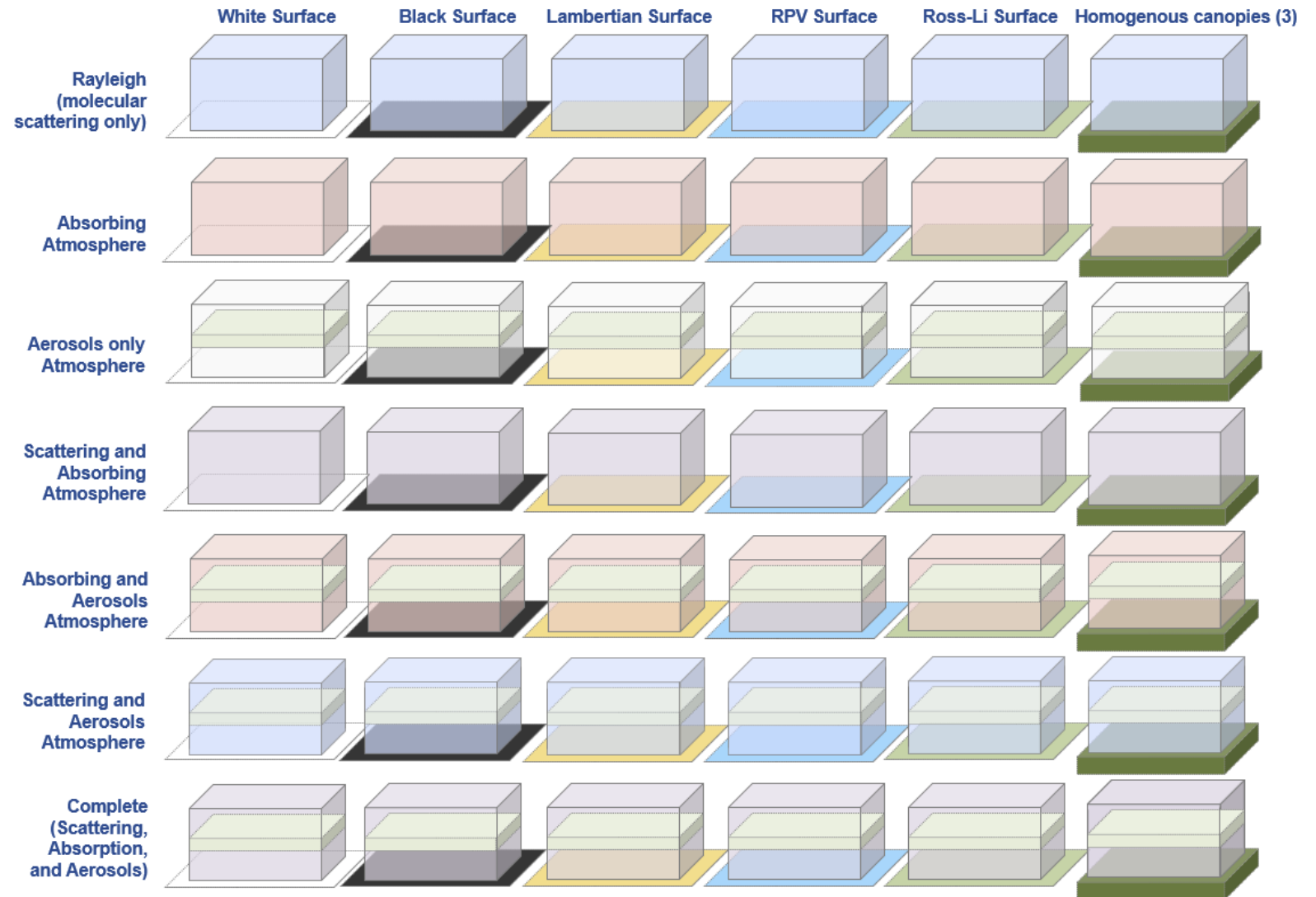


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Scenarios

7 Atmospheres families

Surfaces: 5 parametric + 3 abstract canopies



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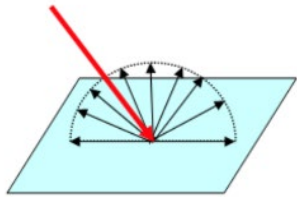


Surfaces

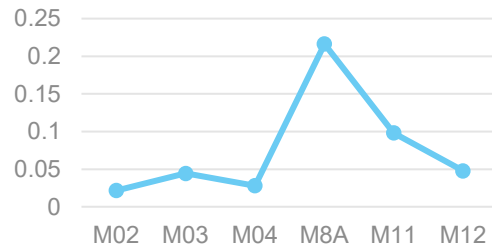


Purist corner $R = 0.0$

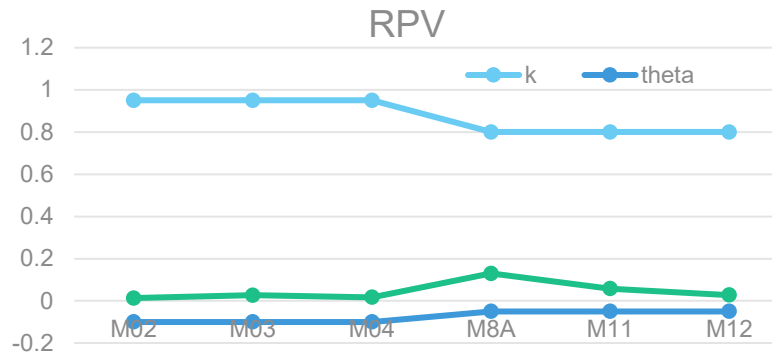
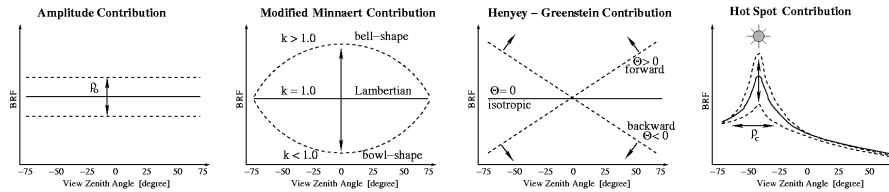
$R = 1.0$



reflectance



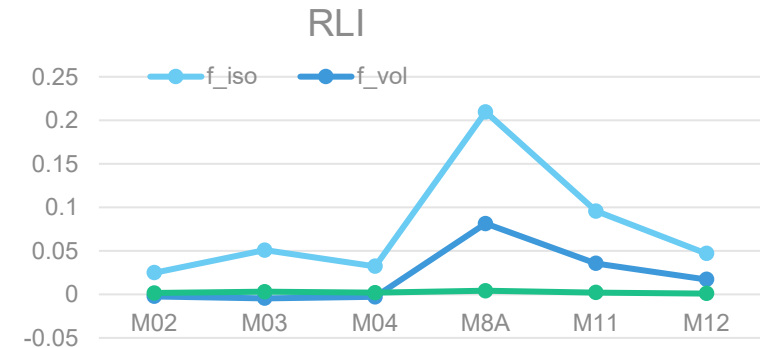
RPV model with 3 parameters: ρ_0, k, θ



$$\rho(z_0, \mu_i, \mu_r, d\phi; \rho_0, \Theta, k, \rho_c) = \rho_0 \cdot M(k) \cdot F_{HG}(\Theta) \cdot H(\rho_c)$$

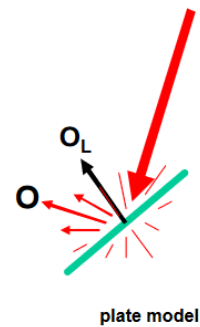
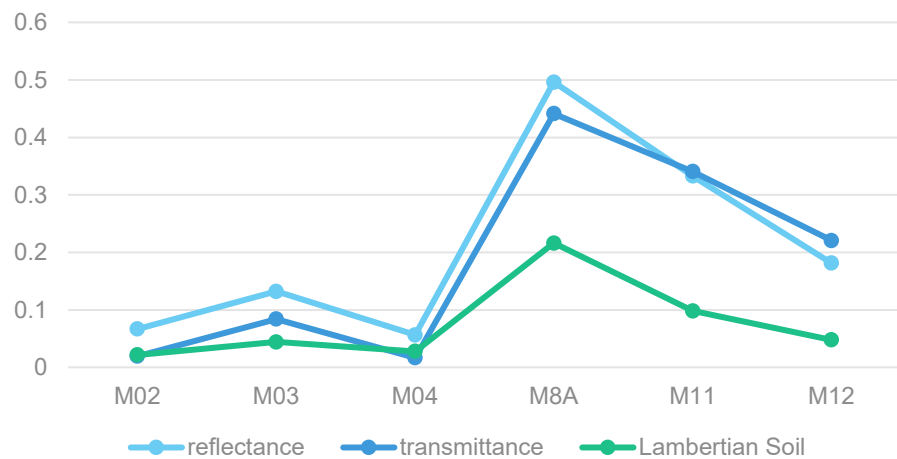
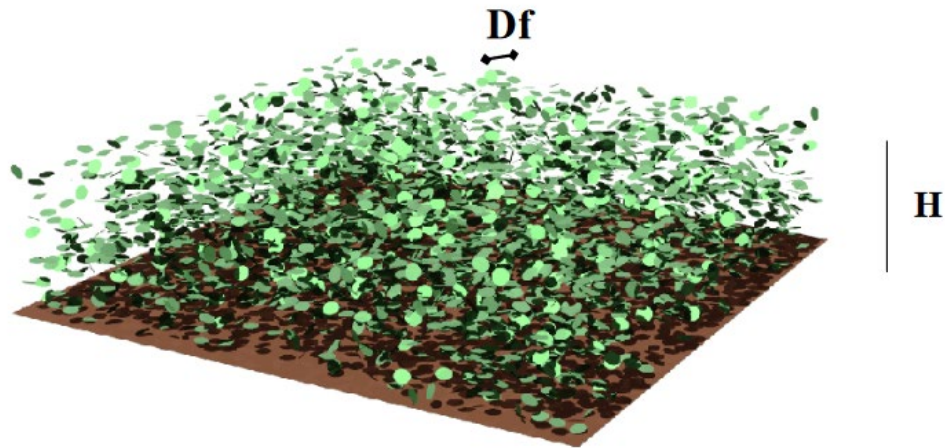
$$= \rho_0 \frac{(\mu_i \mu_r)^{k-1}}{(\mu_i + \mu_r)^{1-k}} \frac{1 - \Theta^2}{(1 + \Theta^2 + 2\Theta \cos g)^{1.5}} \left(1 + \frac{1 - \rho_c}{1 + G} \right)$$

Ross thick and Li sparse kernels combinations: $f_{iso}, f_{vol}, f_{geo}$



$$\rho(\theta_i, \theta_r, d\phi) = f_{iso} K_{iso} + f_{vol} K_{vol} + f_{geo} K_{geo}$$

Surfaces



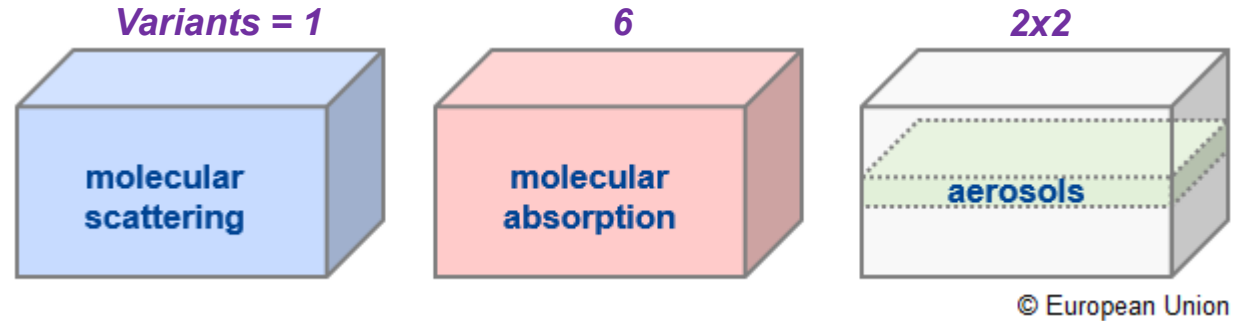
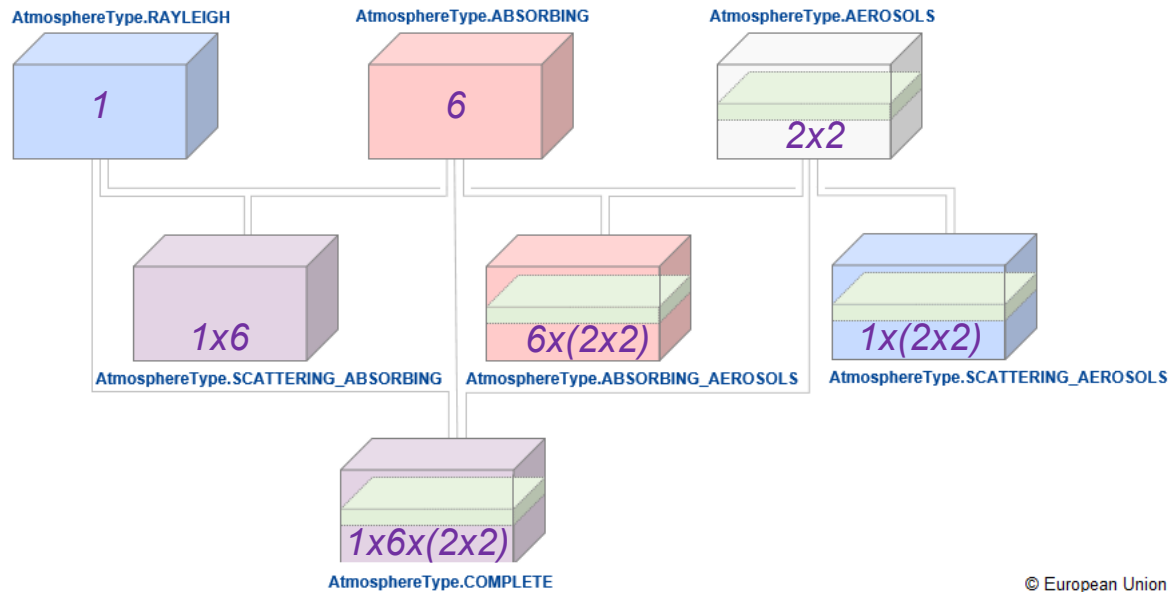
3 homogeneous abstract canopies

Scene dimension	25 x 25 x 2.1 m
Leaf center (Xmin, Ymin, Zmin)	-12.500, -12.500, 0.100 m
Leaf center (Xmax, Ymax, Zmax)	-12.500, -12.500, 2.100 m
Scatterer Radius	0.05 m
Leaf area index	3 m ² /m ²
Height of canopy	2 m
Number of leaves	238732
Planophile LAD (HOM25_LAM)	$\mu=2.531 \nu=1.096$
Erectophile LAD (HOM35_LAM)	$\mu=1.096 \nu=2.531$
Uniform LAD (HOM45_LAM)	$\mu=1.0 \nu=1.0$

Common properties

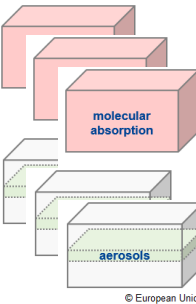
Atmospheres

Three main elements are combined to create **seven** atmosphere families as shown in the diagram below



As the three main elements are further characterized by specific properties such as:

- 6 different combinations of the columnar concentrations of **water vapor** and **ozone**
- **Continental** and **Oceanic** aerosol models
- AOD550 low (0.2) and high (0.6)

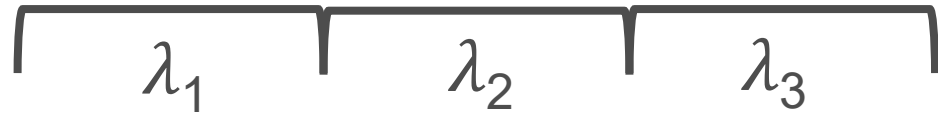


A total of **69 atm. variants** are defined in **RAMI4ATM**.

Some of them are used only

Participation

RTM users versus expert mode



Radiative transfer equation (RTE) is strictly valid only for monochromatic intervals.

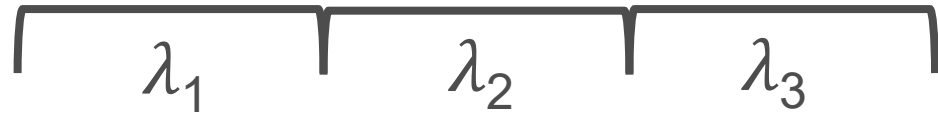
For practical reasons, RTE is solved in spectral intervals when simulating satellite bands.

One homogeneous atmospheric layer

Participation

RTM users versus expert mode

One spectral band



Molecular absorption (lines)
Molecular scattering (Rayleigh)
Scattering/absorption by aerosols

Advanced coupled surface-atmosphere RTMs combine all the radiative processes in each atmospheric layer and in each spectral interval for the **users**.

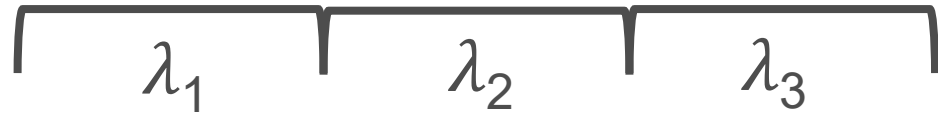
RAMI4ATM primarily targets these users.

One homogeneous atmospheric layer

Participation

RTM users versus expert mode

One spectral band



Molecular absorption (lines)
Molecular scattering (Rayleigh)
Scattering/absorption by aerosols

One homogeneous atmospheric layer

RTM developers can participate. Single scattering albedo and phase function of each layer and spectral interval is however not provided. Provided information is:

- Aerosol micro-physical properties
- Aerosol vertical concentration
- Molecular concentration

Participation

<https://rami-benchmark.jrc.ec.europa.eu/>

EU Login



Log in English

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RAMI Homepage

RAdiation transfer Model Intercomparison

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The new RAMI V

The new RAMI4ATM

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News and events

April 2022 **RAMI4ATM**

[Launch of the RAMI4ATM phase](#)

October 2020 **RAMI V**

[Launch of the 5th RAMI phase](#)

2009/2015 **RAMI IV**

2008/2009 **RAMI4PILPS**

This is the official site of the RAdiation transfer Model Intercomparison (**RAMI**) initiative. RAMI proposes a mechanism to benchmark models designed to simulate the transfer of radiation at or near the Earth's terrestrial surface, i.e., in plant canopies and over soil surfaces.

As an open-access, on-going activity, RAMI operates in successive phases each one aiming at re-assessing the capability, performance and agreement of the latest generation of radiation transfer (**RT**) models. This in turn, will lead to model enhancements and further developments that benefit the RT modelling community.

RAMI-V maintains the abstract and actual scene definition of [RAMI-IV](#) phase. Additionally, two actual scenes, defined through a semi-parametric (Savanna) and an



Participation



Logged in English



Logged in English

Search

About the European Commission > RAMI > Phase: RAMI4ATM

The new RAMI4ATM

2022 - on going

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Description

Scenario Combinations

Experiments

Output Filename and Formats

JSON file to setup RAMI4ATM experiments

RAMI On-line Format Checker

RAMI On-line Model Submission

References

Download

Acknowledgments



Compared to previous RAMI benchmarks, the major difference radiative effects occurring between the surface and the simulated Sentinel-2A/MSI spectral bands has been chosen for that it support the simulation of radiative processes at the surface coupling between the two.

Over the past decades, many radiative transfer models have been used for Observation for e.g., vicarious calibration, lookup table generation and analyses. Many of these models have been extensively tested in ideal conditions but so far, no long-term systematic comparisons have been made when they are used to simulate typical Earth Observation applications by remote sensing sensors. The uncertainties of these models have not been clearly assessed. This new phase is oriented toward the support of calibration and validation of radiative transfer models for the simulation of satellite observations in the visible, near and shortwave infrared spectral

About the European Commission > RAMI > Phase RAMI4ATM: RAMI On-line Model Submission (ROMS)

RAMI On-line Model Submission (ROMS)

RAMI4ATM phase

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This table is showing the last 100 successfully submitted testcases. To visit the entire table, [click here](#). You are advised to check the **logfile** each time you submit new data, especially for new archives: this file informs you of any problems with results submission.

All form fields identified by * are required.

Model

New model

Allowed chars: [a-z, 0-9, -]
(min: 3, max: 20 chars)

eradiate

Additional information

Description* (min: 3, max: 500 chars)

Copernicus Community model

Reference* (min: 3, max: 500 chars)

Add reference if exists ...

Note

Developer or user

Register a Model

Submission files

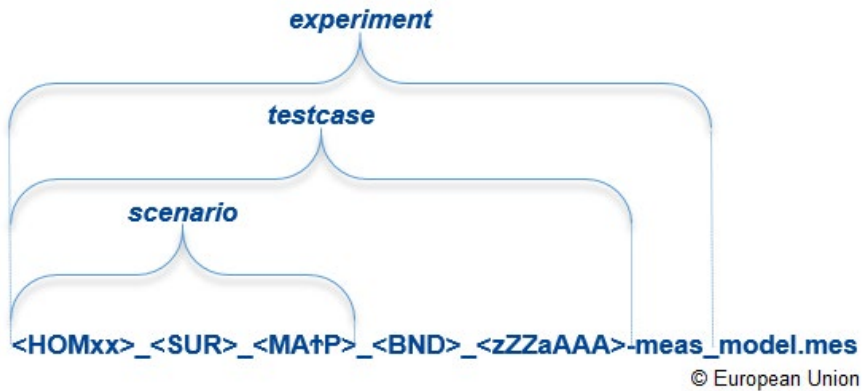
The maximum size of an uploaded file is 2Mb.
Allowed extensions are: mes, zip, tgz, tar, bz2.

DROP HERE

BROWSE



Practical Information



RAMI On-Line Format Checker (ROFC)
RAMI4ATM phase

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Check your format

RAMI On-line Model Submission (ROMS)
RAMI4ATM phase

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As a new feature, **RAMI4ATM** offers participants the possibility to test compliance of **Output Filename and Formats** of their model-generated result files with the **RAMI On-Line Format Checker (ROFC)**, prior to submission.

You are strongly encouraged to perform an on-line format check to verify that your results have produced correctly named and formatted result files.

Using the upload form, please upload an **ascii .mes** file by clicking on **Browse** button or directly using the **drag and drop** functionality to the box (left hand side).

RAMI On-line Model Submission (ROMS)
RAMI4ATM phase

Home Past phases The new RAMI V The new RAMI4ATM Scenario Measurements Guidance How to participate

6/16/2025 10:00 AM
sixsnad model updated correctly

Last 100 submitted testcases for model sixsnad

Log and Legend

This table is showing the last 100 successfully submitted testcases. To visit the entire table, [click here](#). You are advised to check the **logfile** each time you submit new data, especially for new archives: this file informs you of submission.

See your results

Upload your results

All form fields identified by * are required.

Model

New model
Allow 63 chars. (a-z, 0-9, -)
(min 3, max 20 chars)

sixsnad

sixsnad

Additional information

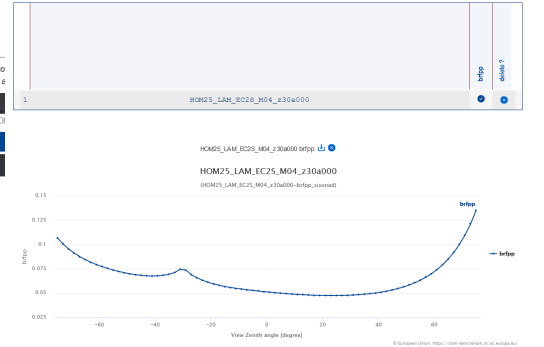
Description* (min. 3, max. 500 chars)
RT coupled model used for ESA

Reference* (min. 3, max. 500 chars)
none

Note
test

Submission files
The maximum size is 5 MB
Allowed extensions: .mes

Update Model results



About the European Commission > RAMI > Phase: RAMI4ATM, Download for RAMI4ATM

Download for RAMI4ATM
RAMI4ATM phase

• Experiment list and setting section

RAMI4ATM experiments description JSON file
English (603 KB - zip file) [Download](#)

A JSON file with all experiments available for RAMI4ATM phase.

RAMI4ATM experiments names
English (152 KB - ASCII file) [Download](#)

An ascii file with the list of all experiments available for RAMI4ATM phase.

• Jupyter Notebook section (example)

Jupyter Notebook file for testcases
English (238 KB - ipynb file) [Download](#)

An example of Jupyter Notebook used to illustrate how RAMI4ATM participants may load the ****user mode**** parameters for each scenario, perform their simulations and save their results.

• Surface section

RAMI4ATM lambertian spectral parameters
English (104 bytes - csv file) [Download](#)

An ascii file with spectral reflectances parameters of the Lambertian models.

RAMI4ATM RPV spectral parameters
English (173 bytes - csv file) [Download](#)

An ascii file with spectral parameters of the RPV model.

RAMI4ATM Ross-Li spectral parameters
English (223 bytes - csv file) [Download](#)

An ascii file with spectral parameters of the Ross-Li model.

Thank you



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