

MATISSE :
MODELISATION AVANCEE de la TERRE pour l'IMAGERIE
et la SIMULATION des SCENES et de leur
ENVIRONNEMENT

**« Advanced Earth Modeling For Imaging and Scene
Simulation »**

Version 1.1 : first results

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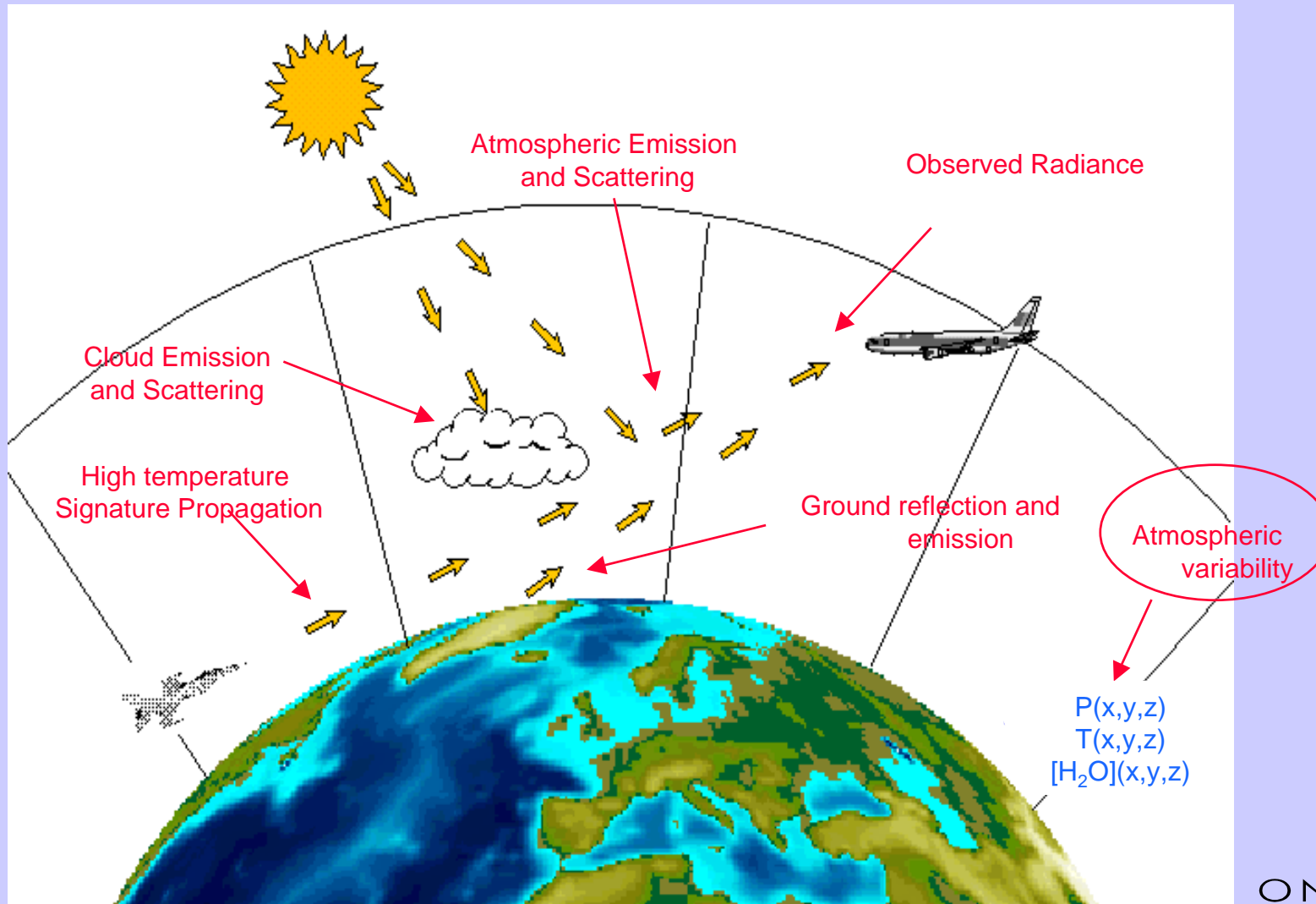
ONERA
Applied and Theoretical Optical Department



PRESENTATION OUTLINE

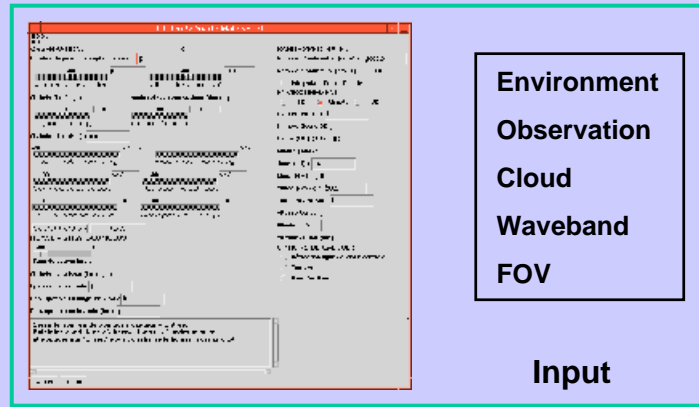
- **1/ Mission**
- **2/ Short description**
- **3/ Validations and comparisons**
- **4/ Results**
- **5/ Conclusion and future works**

Mission of MATISSE : Radiance images



Short description

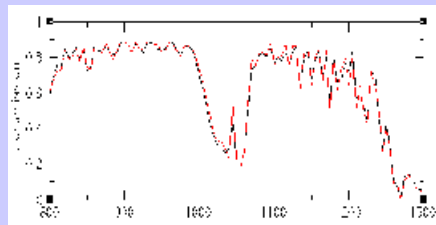
Short description : input / output



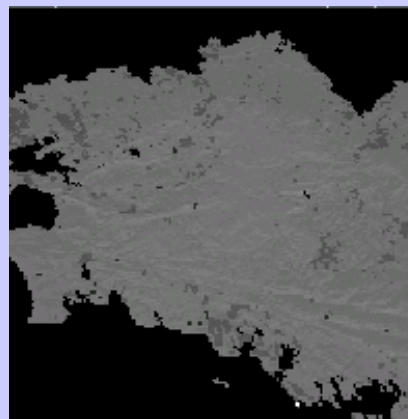
Main program and data

Industrial computer code coupling

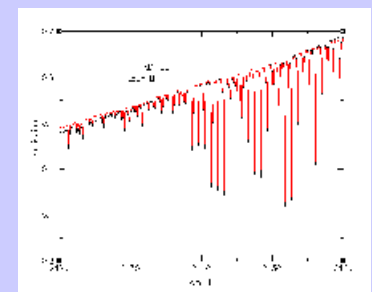
Intermediates outputs
* Spectral transmission and radiance (750 to 3300 cm^{-1} / resolution 5 cm^{-1} / step 5 cm^{-1}) with refraction along a LOS



Output
Integrated or spectral radiance images (750 to 3300 cm^{-1} / resolution 5 cm^{-1} / step 5 cm^{-1})



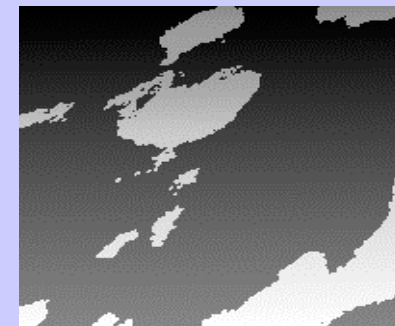
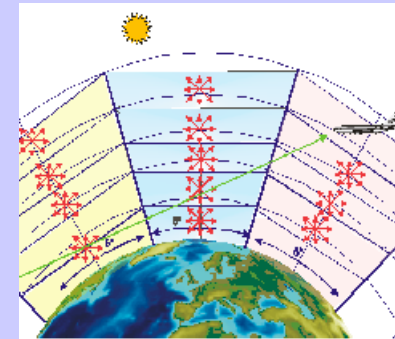
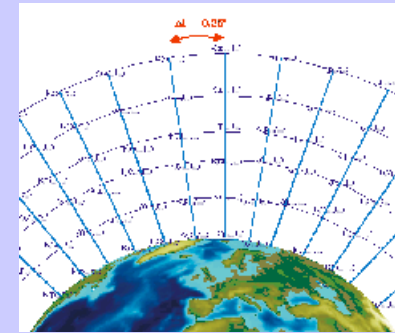
High spectral resolution output
* Monochromatic spectral transmission (750 to 3300 cm^{-1})



Short description : main program

Main program

- * Atmosphere : thermodynamic grid (0.25°x0.25° or 5°x5°)
- * Atmospheric gaseous absorption : Correlated K distribution method / Full 3D geometry
- * Thermal radiance : 3D thermal source function computation / Full 3D geometry
- * Direct scattering (SS) : Full 3D geometry
- * Diffuse radiance (MS) : 1D geometry / source function computation (DOM, Plane //) - IPA (5°x5°) - CK coupling
- * Partial or total Scv coverage radiance : cloud cover generator + cloud BRDF, BTDF and ϵ + shadowing + texture model
- * Earth modelisation : WGS 84
- * Ground temperature computation
- * Soils texture model
- * C and F90
- * Quality management

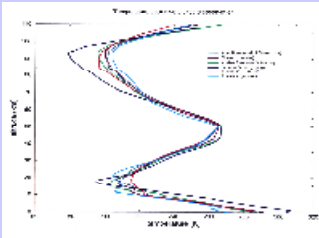


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Short description : data

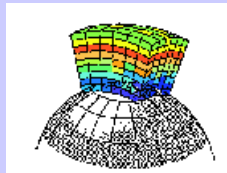
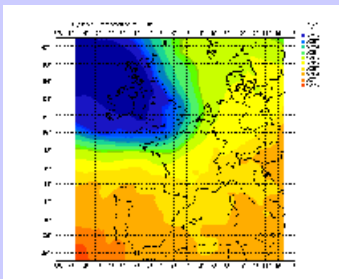
Atmospherics profiles

- * Local measured atmospheric profiles (1800)



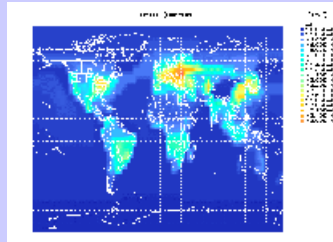
- * Climatologic atmospheric profiles (lat. spatial resolution = 10°)

- * 3D atmospheric profiles scenes (lat / long spatial resolution = 0.25°×0.25°)



Aerosols data

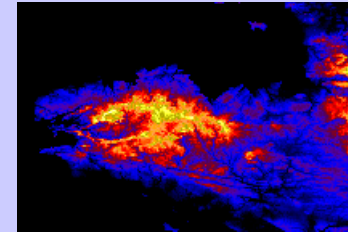
- * GADS Aerosols climatology (lat/long spatial resolution = 5°×5° global coverage)



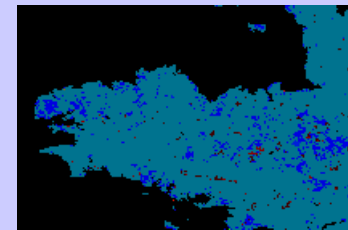
- * Rural, Urban (Modtran)

Soils

- * DTED 30'' (global) and 3'' for Europe



- * TODB (reflectivity, emissivity)



Main program

Cloud parameters data

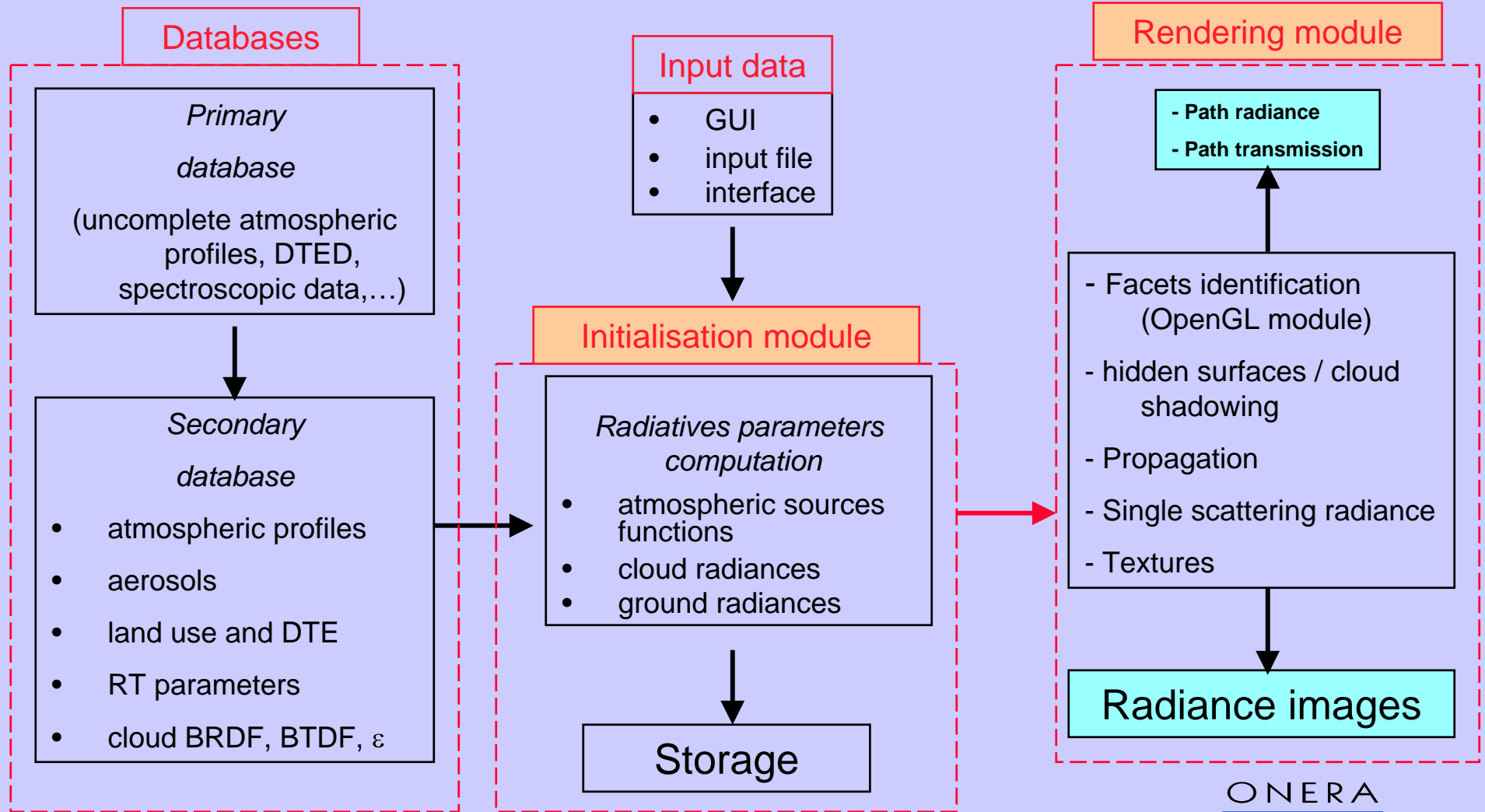
Scu cloud BRDF, BTDF, ϵ

Radiative transfer data

Spectro., CK parameters

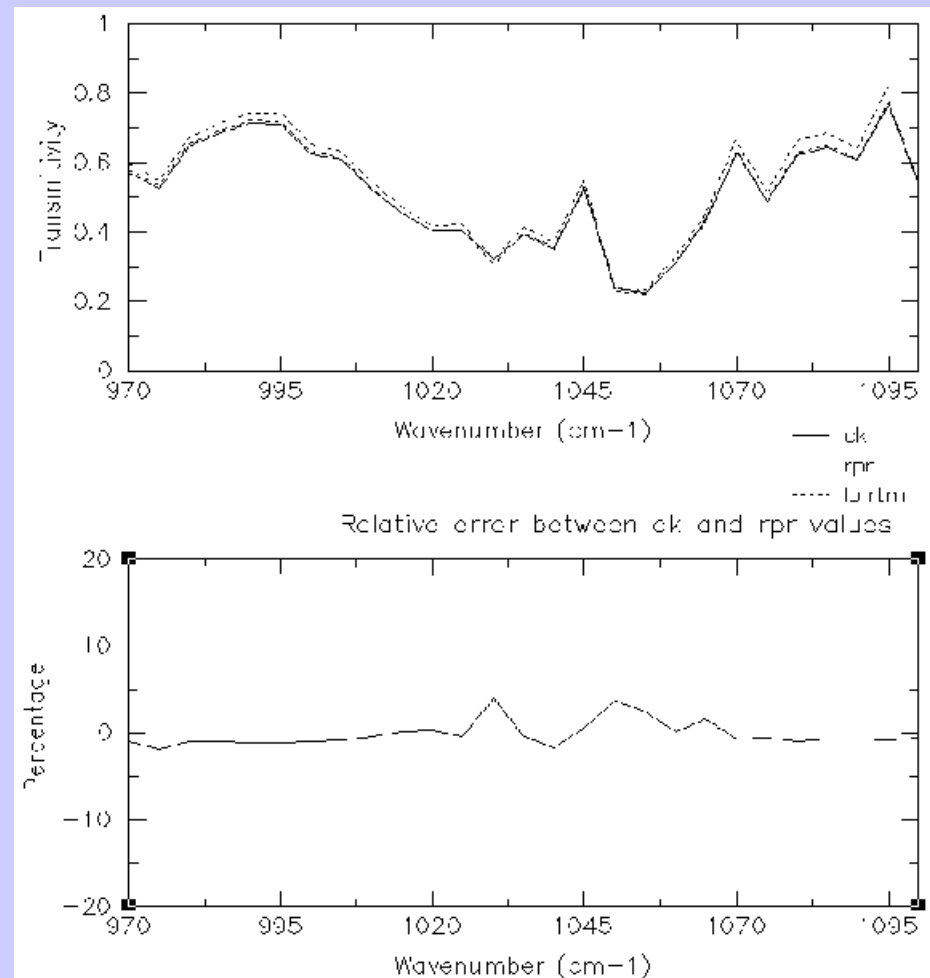
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Short description : Flow chart

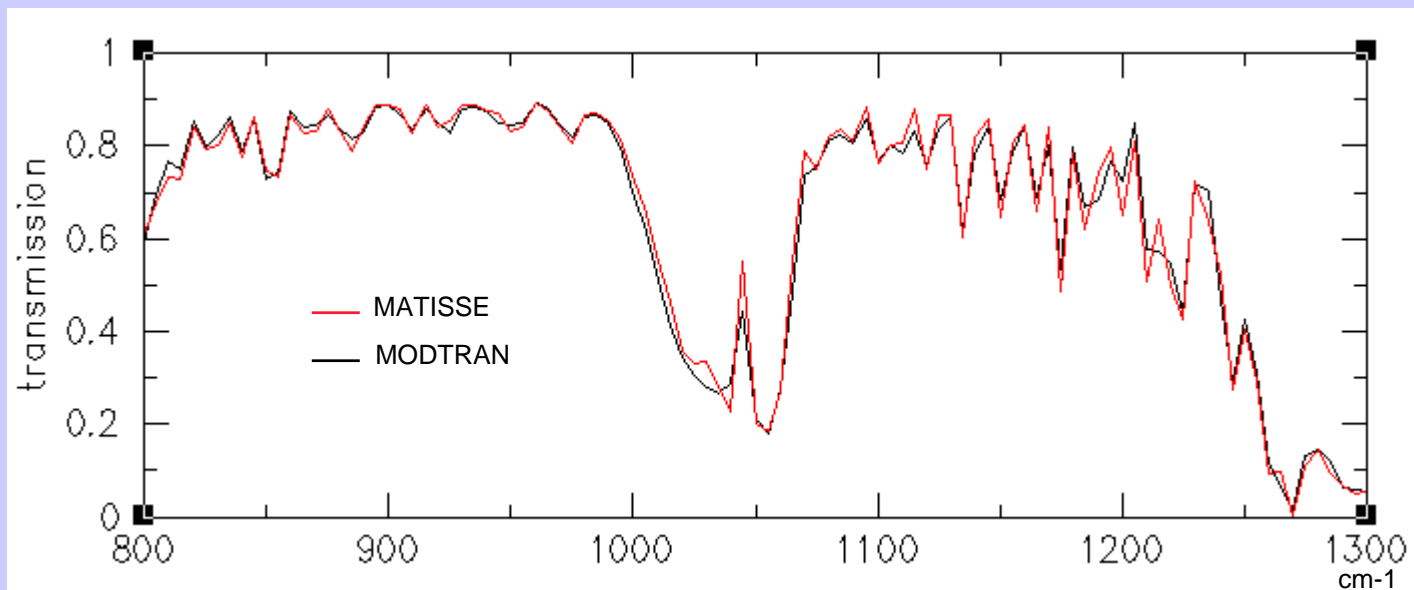


Comparisons / Validations

RPR, LBLRTM and CK transmission comparisons

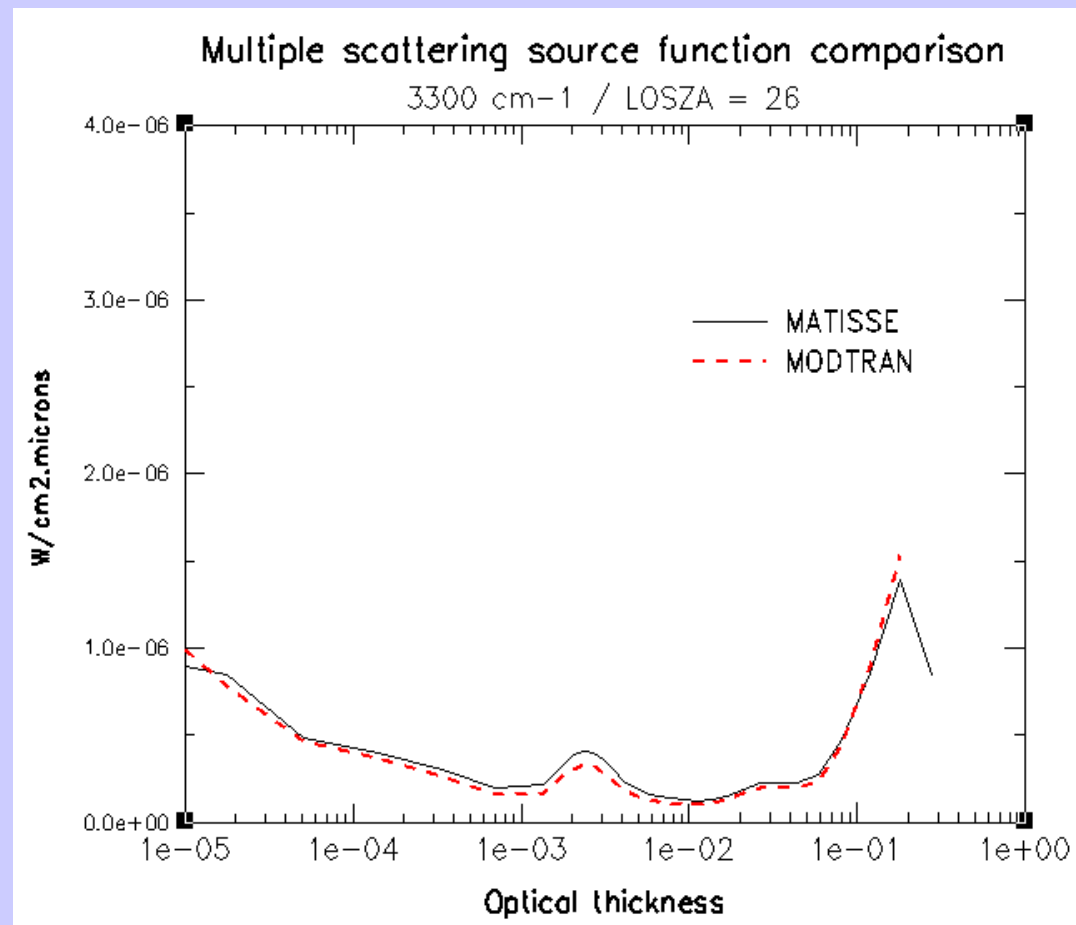


MATISSE / MODTRAN3 Transmission comparisons



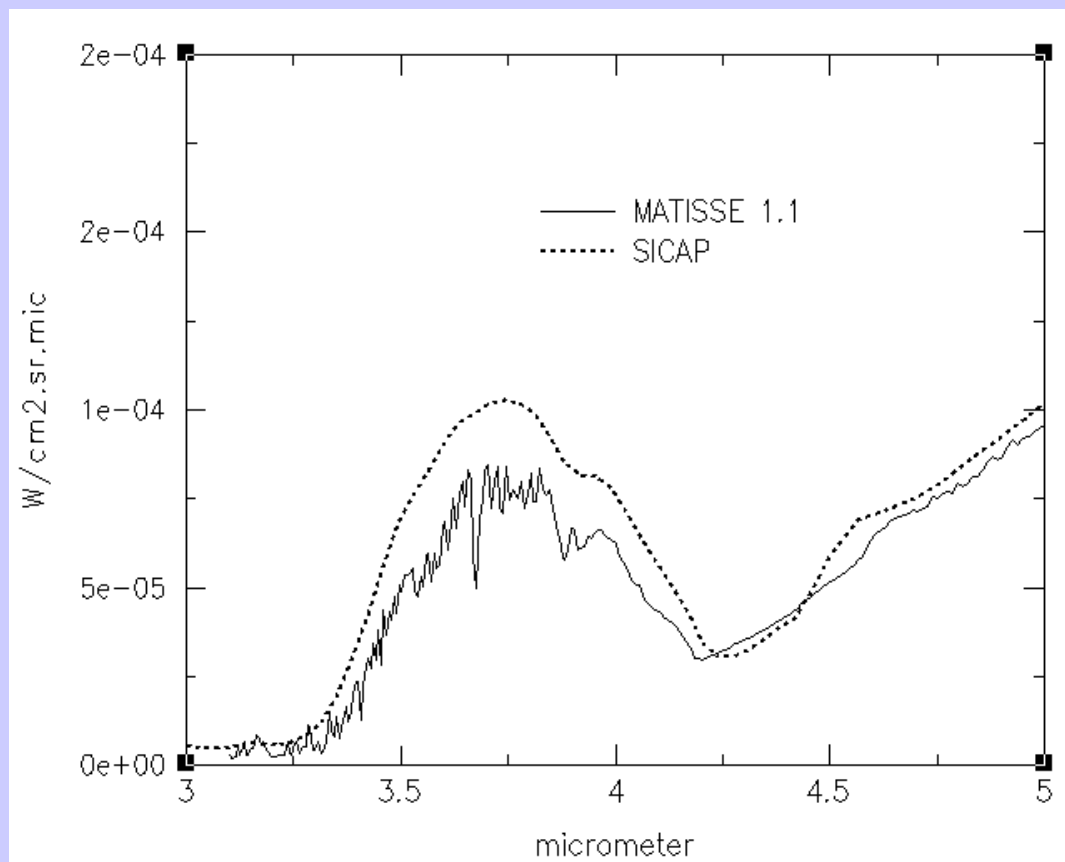
- US Std
- Rural 23 km
- LOSZA = 45°
- Obs. altitude = 0 km

MODTRAN3 / MATISSE 1.1 multiple scattering source function comparison



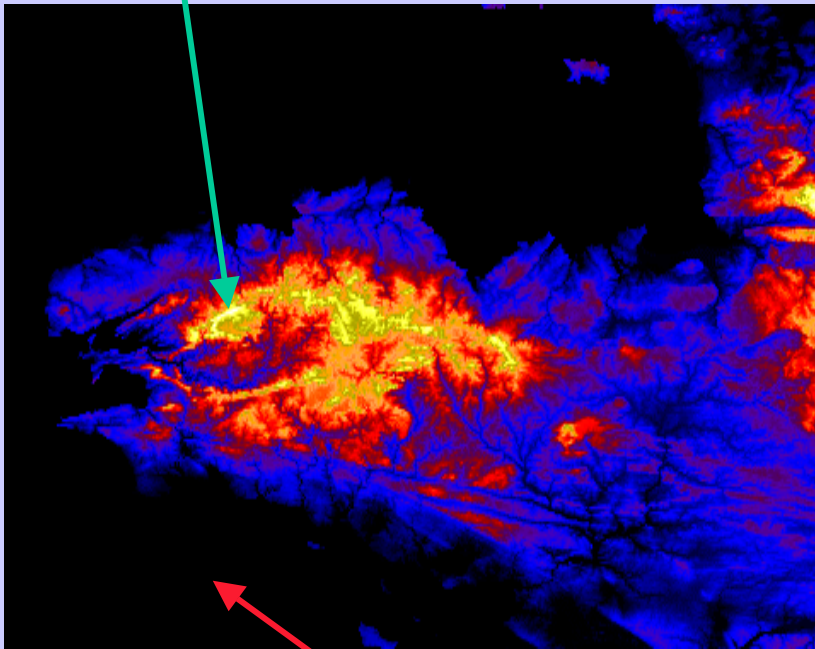
- US Std
- Rural 23 km
- LOSZA = 26°
- SZA = 0°
- 3300 cm⁻¹

Measurement / MATISSE 1.1 cloud radiance comparison (1 column)



DTED / Terrain types validation

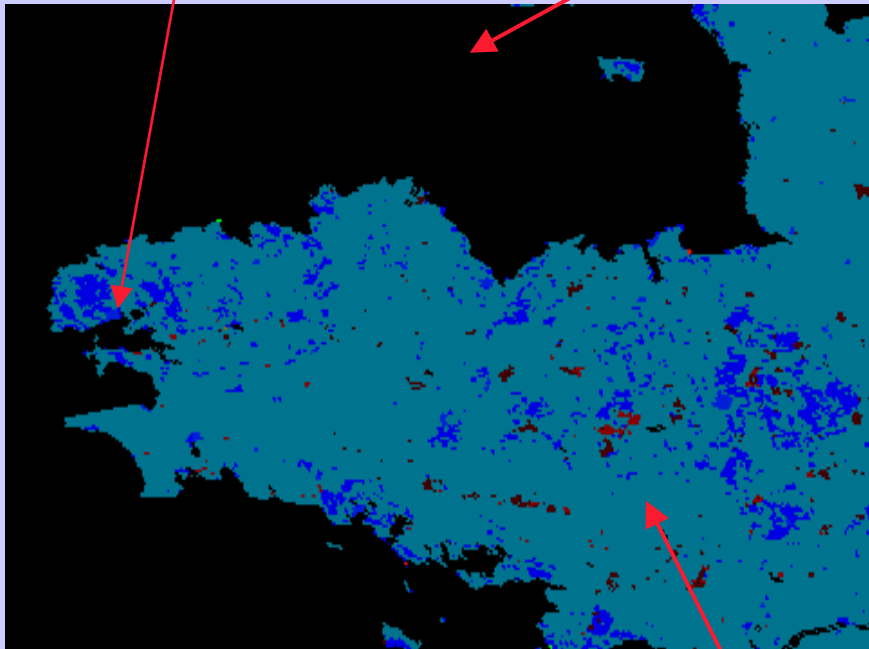
Elevation = 355 m



Elevation = 0 m

13 : urban

17 : water



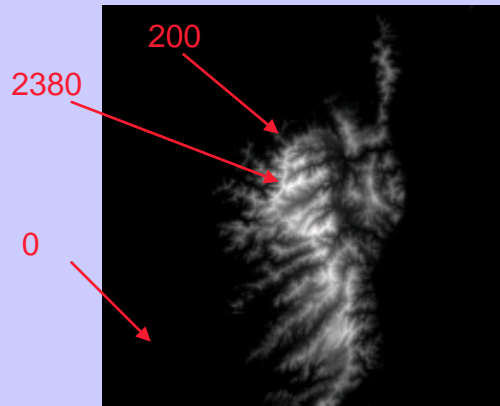
12 : agricultural area

Results

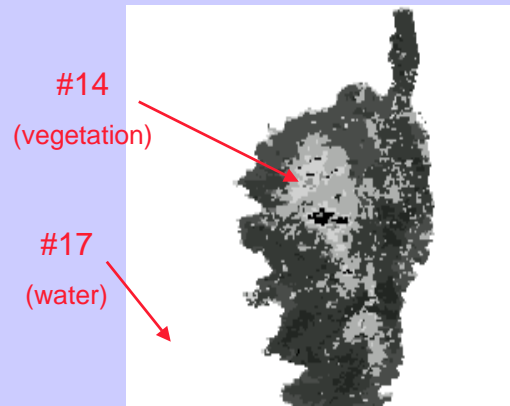
Visualisation outputs

- **Date** : 30/10/02 / 12h TU
- **Obs. alt.** : 90 km / **Obs. Elev.** : -90°
- **FOV** : 80°x80° / **pixel number** : 200x200
- **Wavenumber** : 2700 cm⁻¹

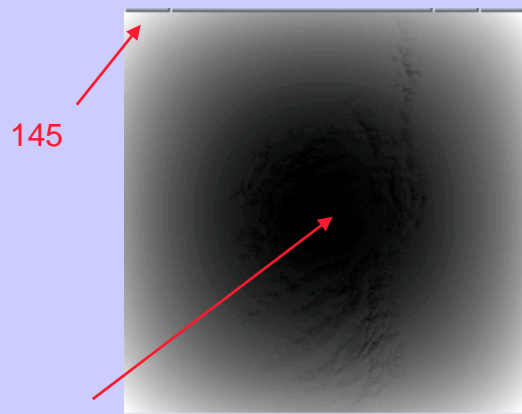
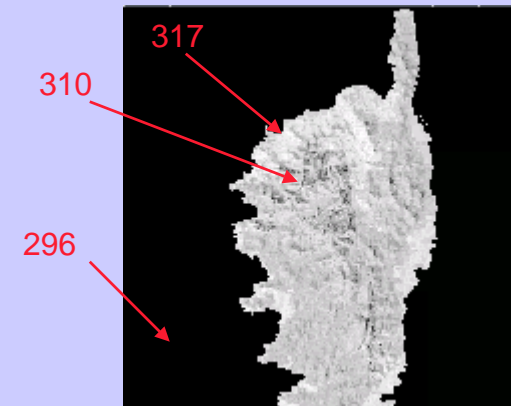
DTE (m)



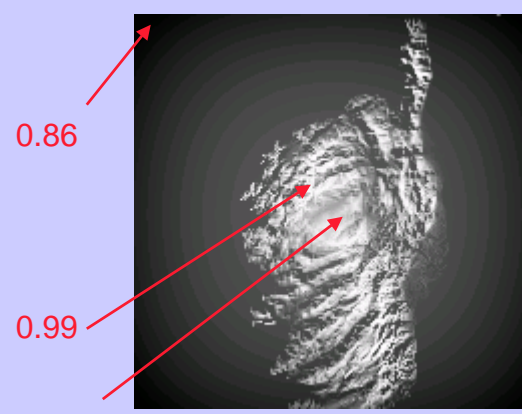
Terrain type



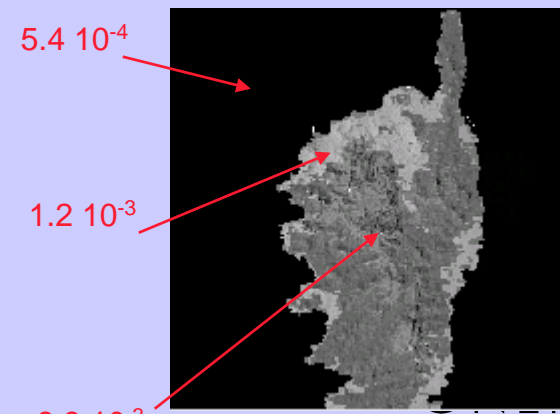
Temperature (K)



Distance (km)



Transmission



Radiance W/m².sr.cm⁻¹

RADIANCE IMAGES



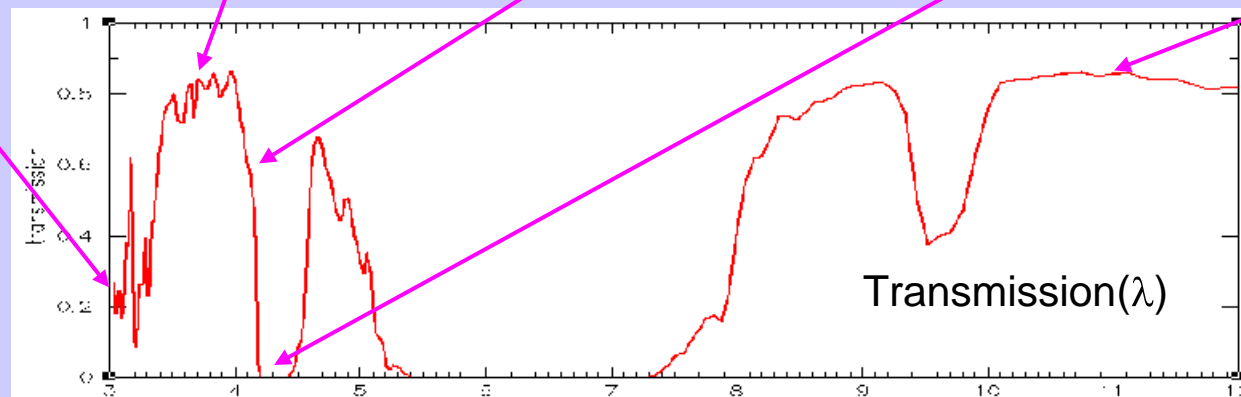
$\lambda = 3 \mu\text{m}$

$\lambda = 3.7 \mu\text{m}$

$\lambda = 4.16 \mu\text{m}$

$\lambda = 4.19 \mu\text{m}$

$\lambda = 11 \mu\text{m}$



- Altitude obs. = 100 km
- Image 200x200
- FOV = 80°x80°
- 13h00 TU

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RADIANCE IMAGES



20% Scu coverage

$\lambda = 3.7 \mu\text{m}$



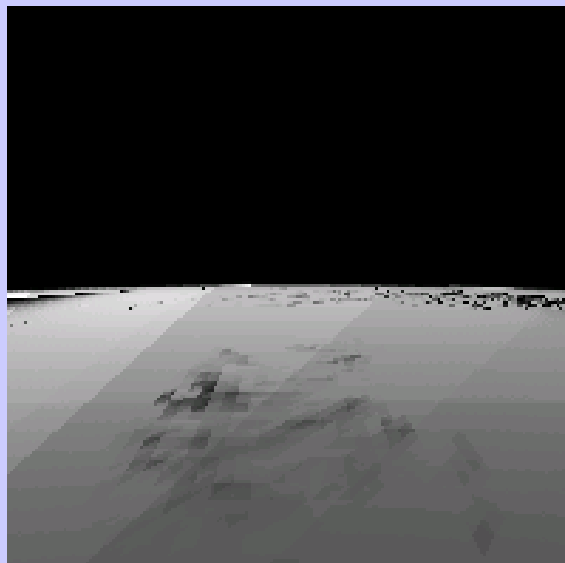
- **Date** : 7/7/02 / 11h30 TU
- **Obs. alt.** : 20 km / **Obs. Elev.** : -20° / **Azim** = 180°
- **FOV** : 20°x20° / **pixel number** : 200x200
- **Wavenumber** : 3.5 μm
- 10 % Scu coverage

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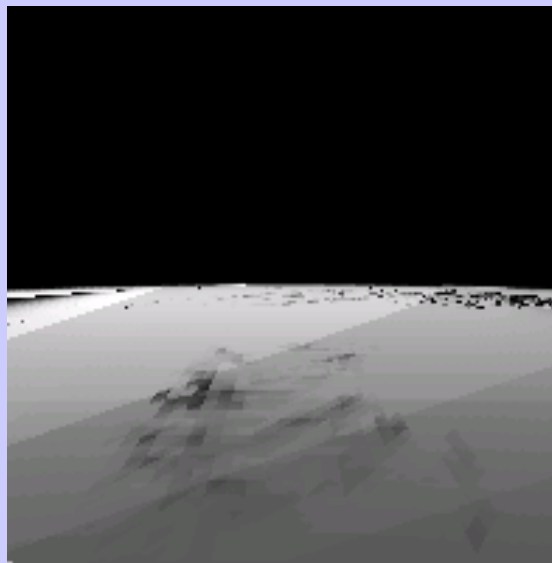
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RADIANCE IMAGES : limb viewing

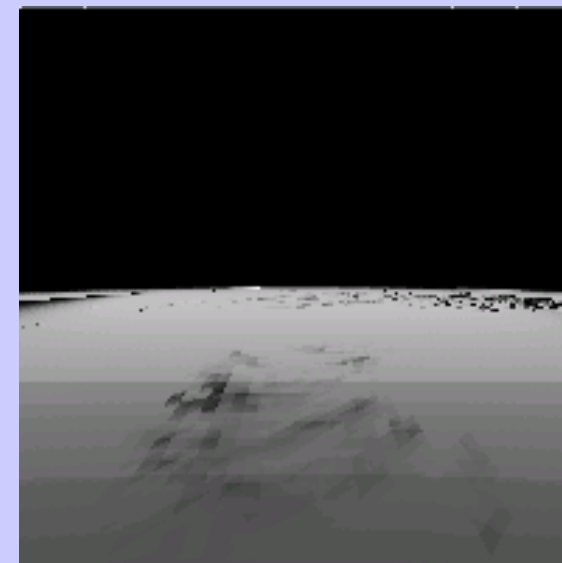
- **Date** : 30/10/02
- **Obs. alt.** : 100 km
- **Obs. Elev.** : -10° / **azim.** : 180°
- **FOV** : $40^\circ \times 40^\circ$ / **pixel number** : 200x200
- **Wavelength** : $3\mu\text{m}$
- **DTE** : 5 mn



07h30



09h30



11h30

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Conclusion and future works

Conclusion

MATISSE : new Background Scene Generator

- Radiance images 750 to 3300 cm^{-1} / resolution 5 cm^{-1} / step 5 cm^{-1})
- Atmospheric spatial variability
- Partial coverage Scu clouds + shadowing
- Ground temperature computation
- Ground and cloud Texture model
- Refraction (along 1 LOS)
- LBL (along 1 LOS)

Release of MATISSE 1.1 : june 2002

Matisse 1.1 is sponsored by the 'Délégation Générale de l'Armement'



Future works

- **Tests and optimisations**
- **Homogeneous cirrus clouds**
- **Local thermal model**
- **Spectral domain extension and resolution modification**
- **Monochromatic spectral thermal emission along one LOS**