Atmospheric Radiative Transfer Database for Earth and Climate Observation(ARTDECO)

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Introduction

ARTDECO is a numerical tool that gathers models and data for the 1D simulation of Earth atmosphere radiances (total and polarized) and fluxes as observed with passive sensors in the UV to thermal IR range. It is designed to be flexible and easy to use.

Users can either access a library for the scene definition (atmosphere profile, k-distribution coefficients for gas absorption, surface, aerosol and cloud description, filter transmission, etc) or use their own description through ASCII input files. Then, they can choose among available models to compute radiative quantities. Technical parameters for these models are also accessible through ASCII files. ARTDECO can also be used only to compute new particle optical properties.

It is developed and maintained at the **Laboratoire d'Optique Atmosphérique** and is funded by the **TOSCA program of the French space agency (CNES)**. ARTDECO is intended to be publicly available in the near future through **ICARE** thematic center.

The ARTDECO radiative transfer

A) Library

Atmosphere definition:
- AFGL & McClatchey profiles
- K-distribution coefficients for gas absorption from Dubuisson (H_2O, CO_2, O_3, O_2, N_2O, CO, CH_4, N_2, NO_2, SO_2, λ = 0.4 - 40 µm, res=10 cm^{-1}) and from Kato (λ = 0.24 – 4.6 µm, low res)
- Continuum gas absorption

Solar spectra:
- Kurucz high resolution spectrum

Surface:
- Lambertian spectral albedo for various surfaces

Particle optical properties:
- refractive index for liquid and ice water and for aerosol material (OPAC database, λ= 0.25 – 40 µm)
- Microphysical properties definition for water clouds (Stephens, OPAC), for aerosols (OPAC) and for Cirrus (Baum et al., POLDER/PARASOL model)

B) Models

Particle optical properties:
- Henyey-Greenstein(H-G) approximation
- MIE spherical particles
Ray tracing for hexagonal (pristine(PHM), rough (RHM) or with inclusions(, IHM) monocrystal particles
- Dubovik model for spheroid aerosols

Truncation of phase matrix:
- δ–Potter, δ-M or δ–fit methods

Surface BRDF/BPDF:
- Cox & Munk ocean surface BRDF/BPDF
- "Ross – Li" & "Rahman–Pinty–Verstraete" with hot-spot land surface BRDF
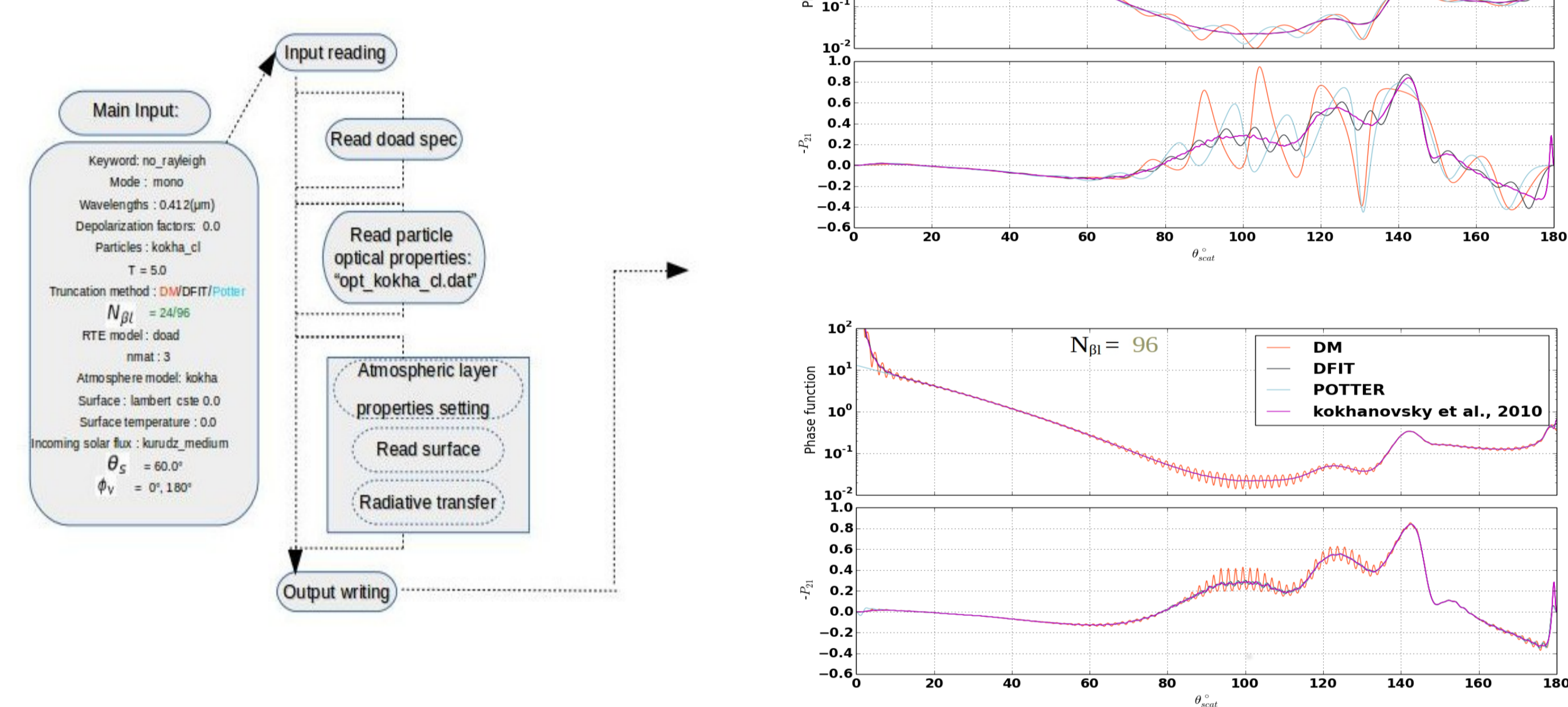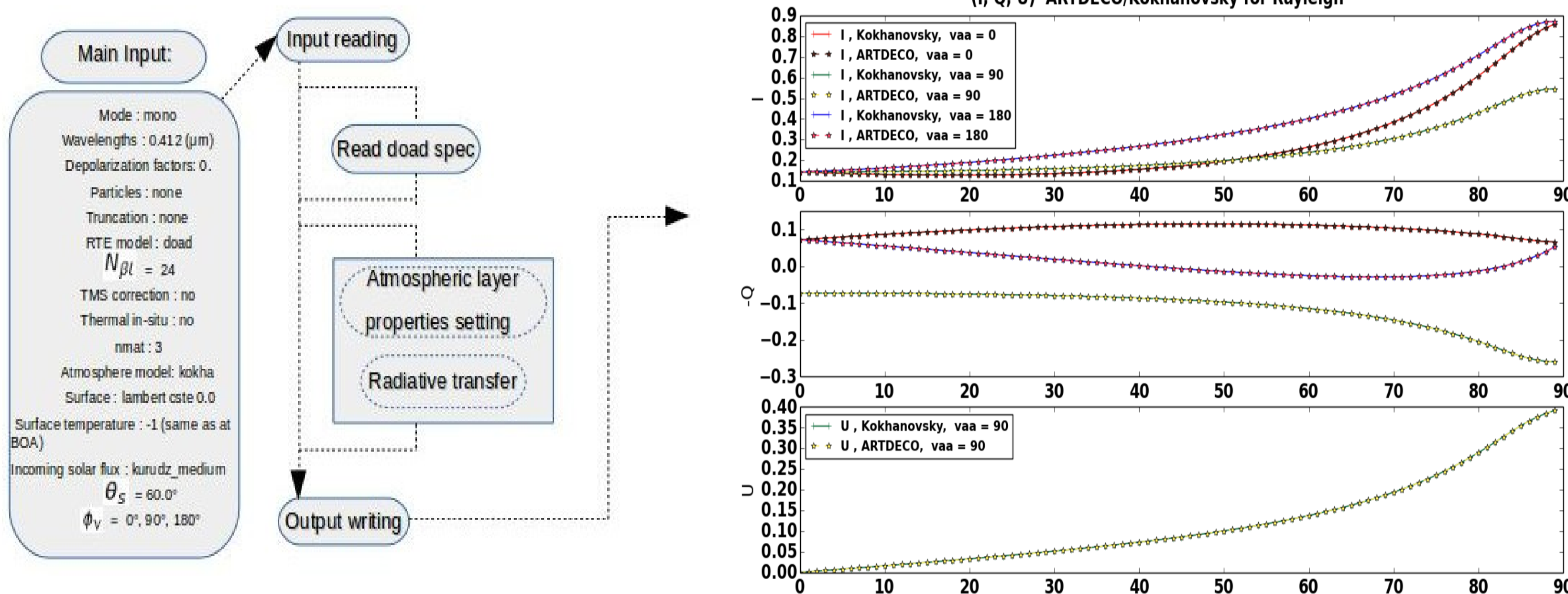- "Maignan & Bréon" land surface BPDF

Radiative transfer (1D):
- DISORT 2.0 discrete ordinate (I, thermal)
- adding-doubling (IQUV, de Haan et al., 1987)
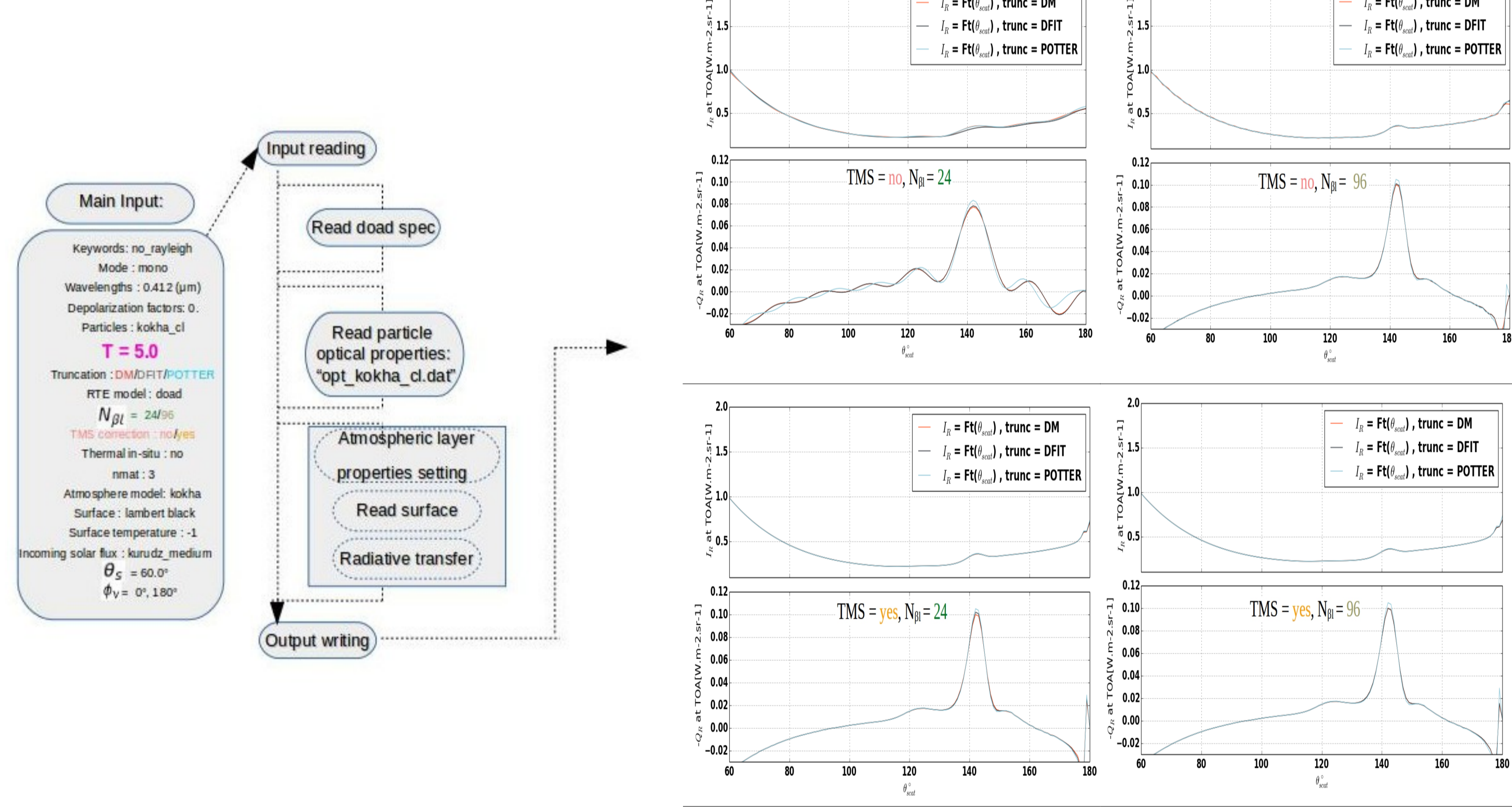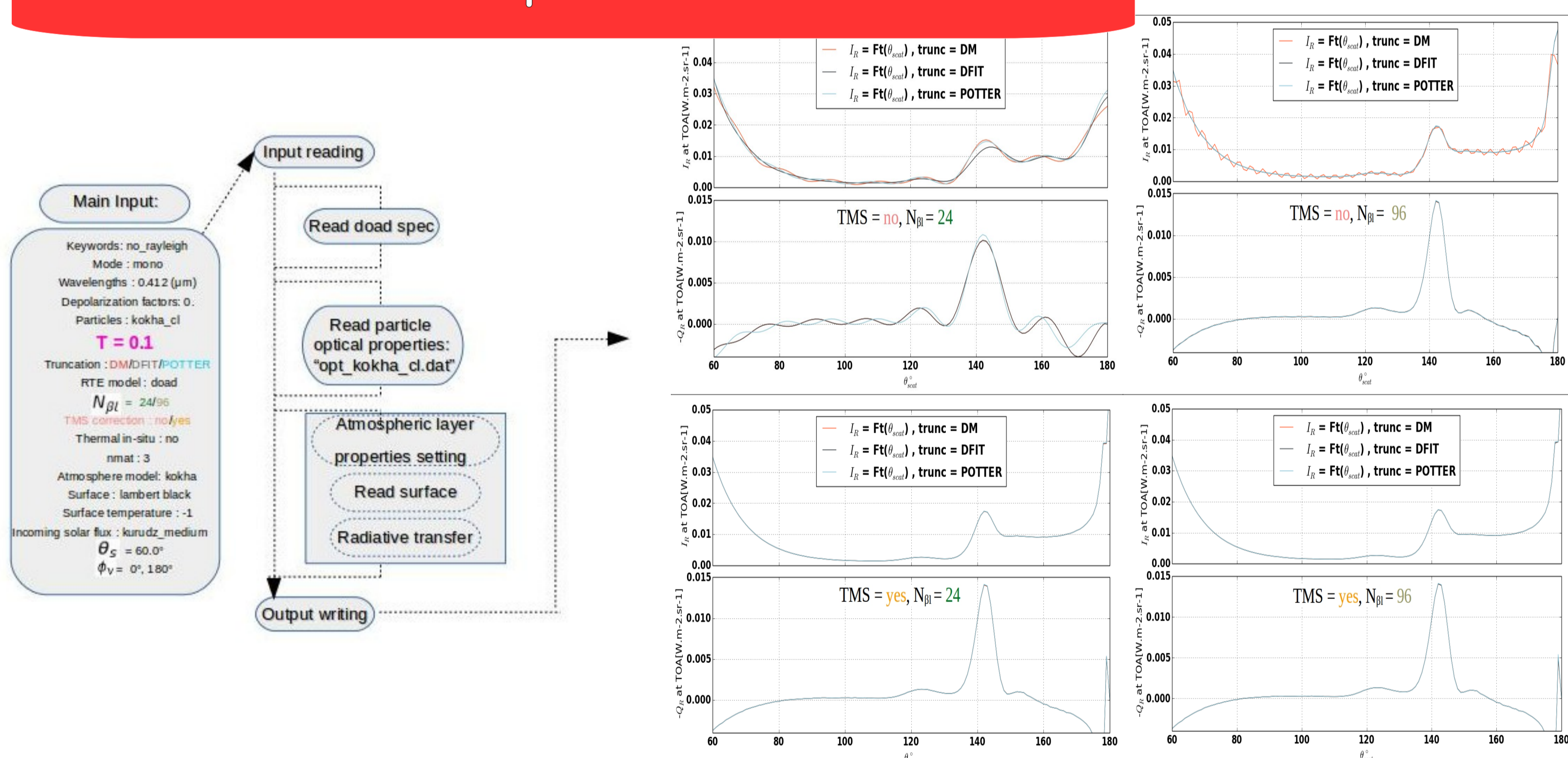- Monte-Carlo (IQUV)
- Single scattering approx. (IQUV)

Intensity correction for first order scattering (TMS)
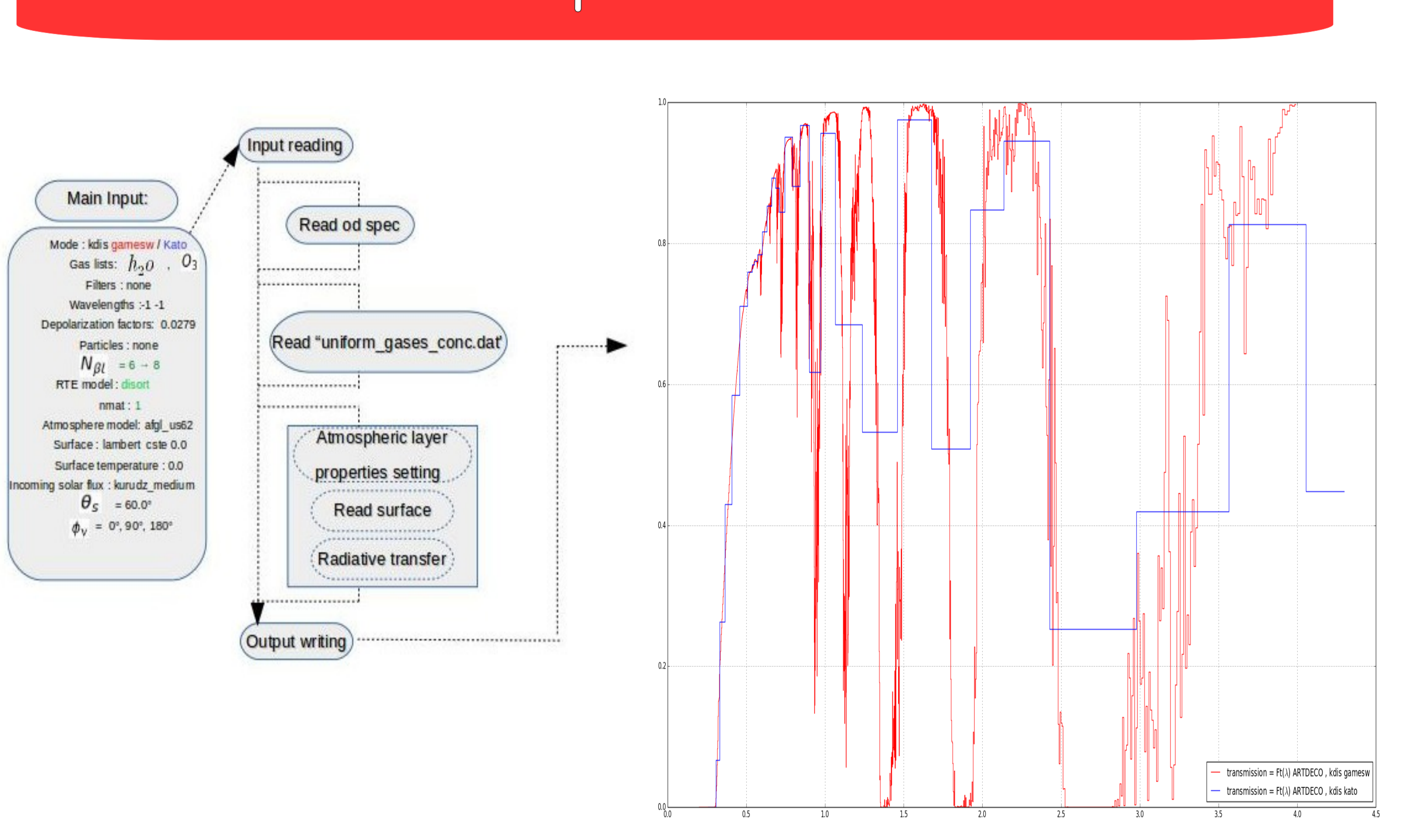- Nakajima & Tanaka (1988)

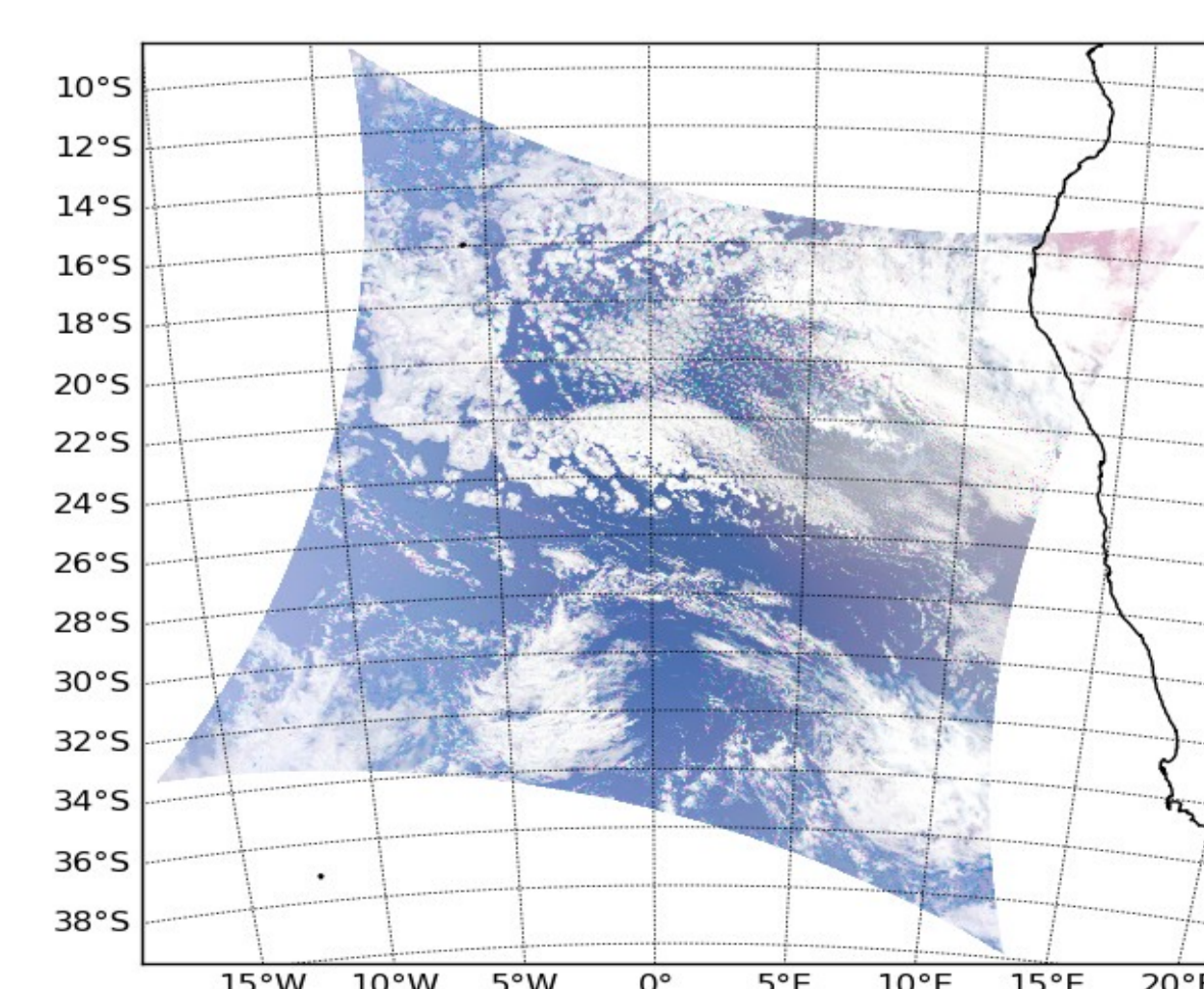## Comparaison of ARTDECO and KOKHANOVSKY et al., JQRST,2010

ARTDECO example use : Radiances

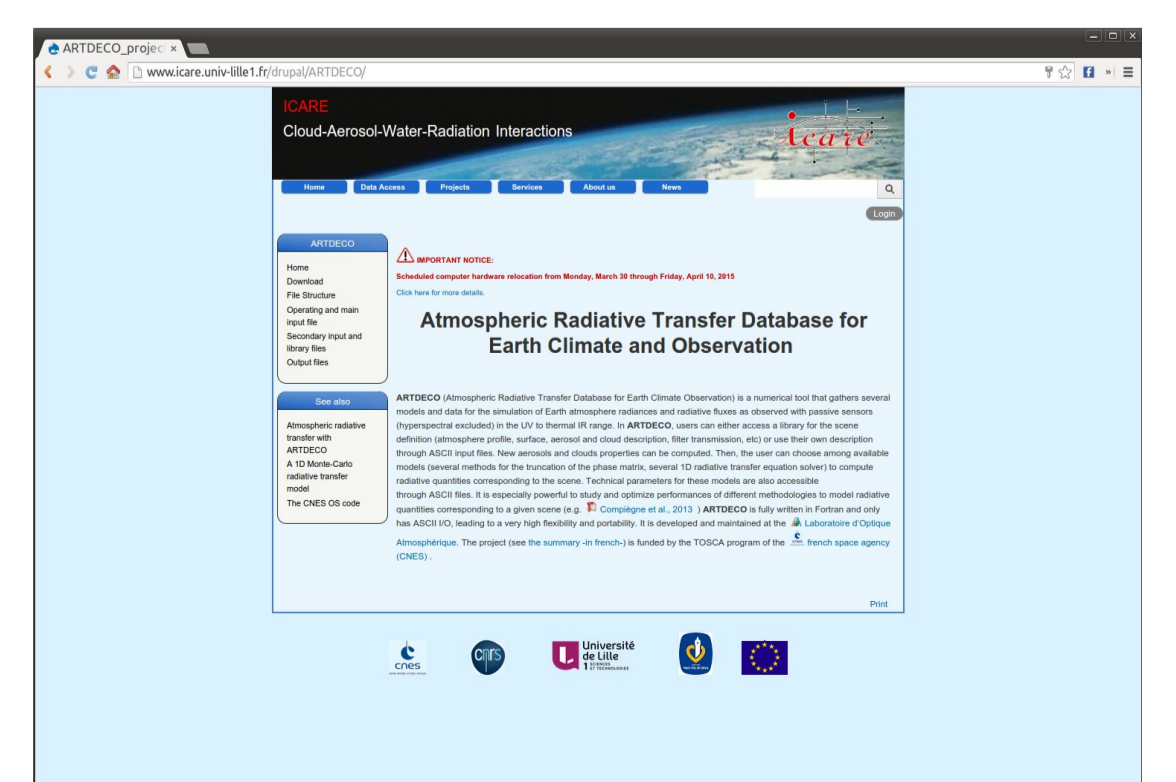## ARTDECO example use : Transmission

Use of ARTDECO in "3MI"

Simulation of the measured signal by the future sensor **3MI** (Multi-viewing,Multi-channel,Multi-polarizaion Imaging) realized from **"ARTDECO"**.

In progress...

- Further validation of "**ARTDECO**".

- "**ARTDECO**" will be available to the community through **ICARE** thematic Pole.

Reference

Kokhanovsky, A. A., et al., 2010: Benchmark results in vector atmospheric radiative transfer, JQSRT, 111, 1931-1946.

M. Compiègne, L. C-Labonnote, and P. Dubuisson : The phase matrix truncation impact on polarized radiance, AIP Conference Proceedings;May2013, Vol. 1531 Issue 1, p95