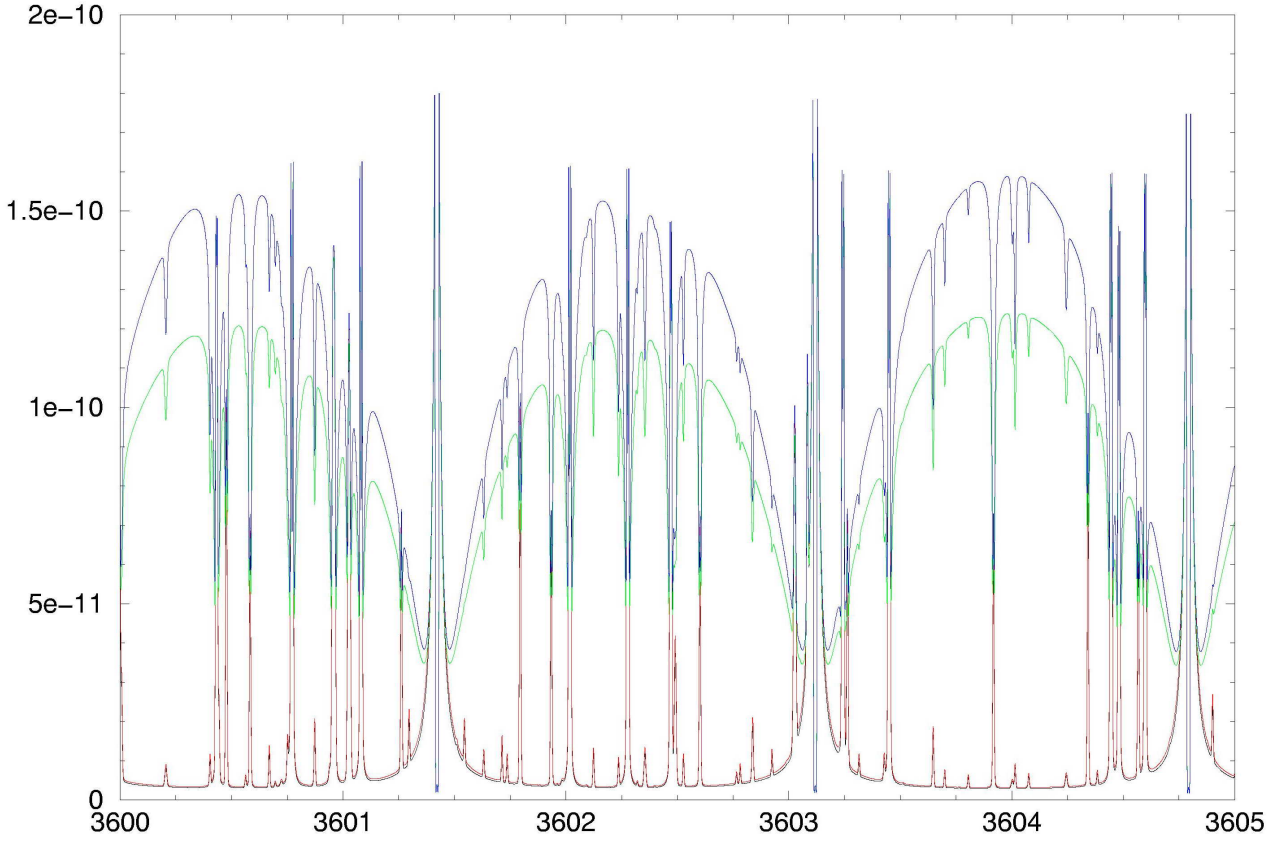
Solar Single Scattering in MIRART



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Content

- **Motivation**
- **New Aspects / Enhancements**
  - aerosol-loaded atmosphere
  - geometry
  - solar source term
- **Examples**

Motivation

- **MIRART:**

  Line-by-Line-Code

  pure gaseous atmosphere (NO absorbing or scattering aerosols considered)

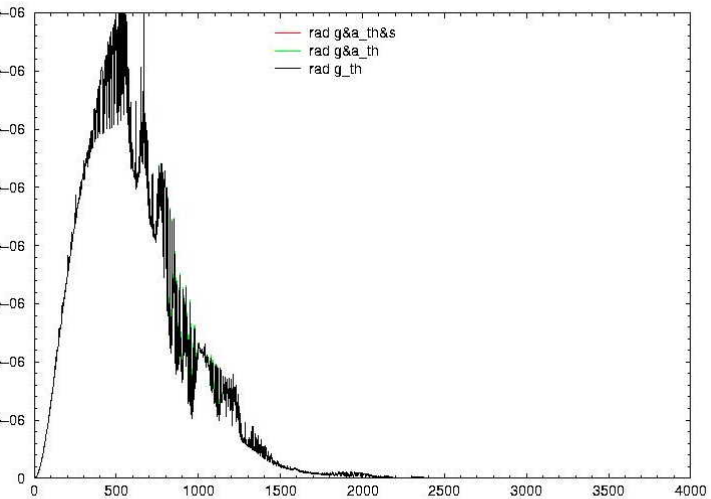
  Planck source term

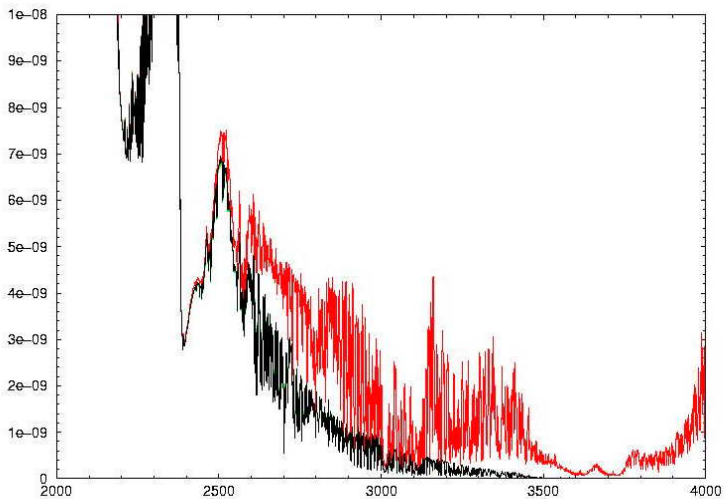
- **Implementation of solar single scattering**

  retrieval in case of fire, smoke, volcanic ash

  basis for new RT-code

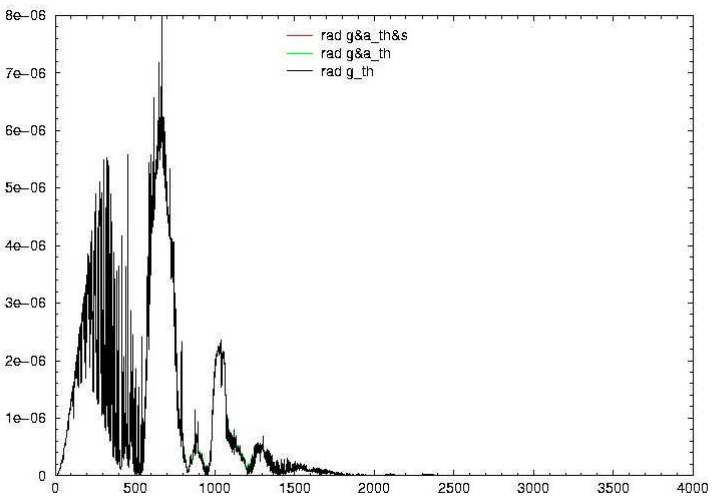
- **Example: Modtran calculations - Radiance**

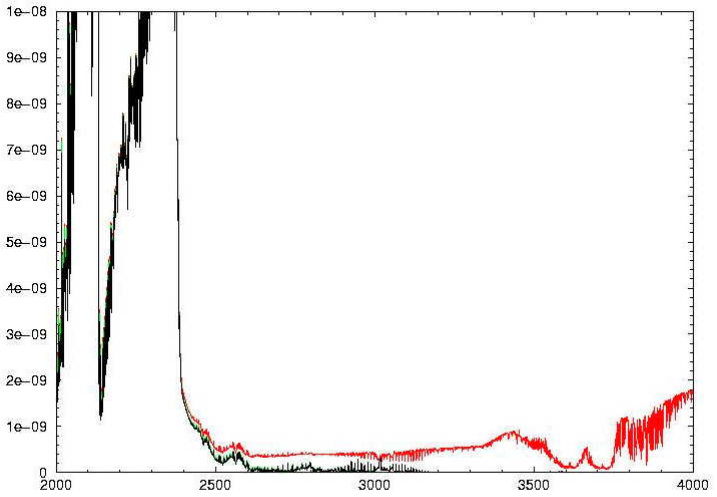




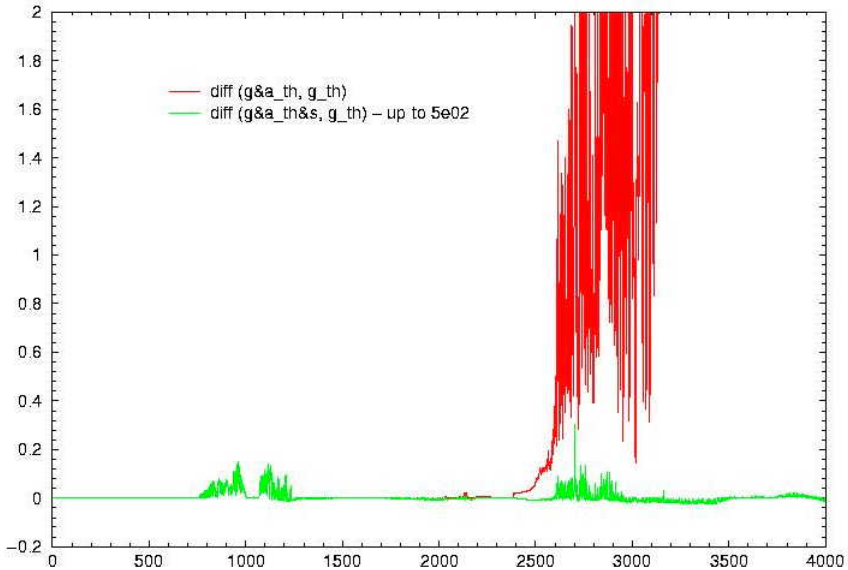
Tangent height = 5 km

Tangent height = 15 km

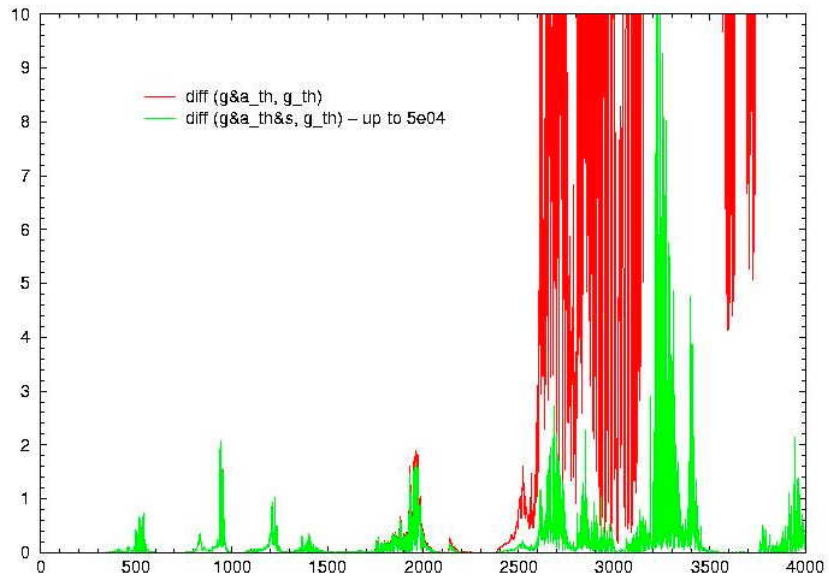




- **Example: Modtran calculations – relative Differences of Radiance**



Tangent height
= 5 km



Tangent height
= 15 km

Enhancement: Aerosols

- **properties (taken from OPAC database)**

  absorbing (abs.coeff. α_A)

  emitting (abs.coeff. α_A), isotropic

  scattering (scatt.coeff β_A), angledependent (phasefunction P)

➔ MIRART_G

$$T = e^{\int a_G ds}$$

$$I = \int a_G B ds$$

MIRART_G&A

$$T = e^{\int (a_G + a_A + b_A) ds}$$

$$I = \int (a_G + a_A) B ds$$

- **Optical Properties of Aerosols and Clouds (OPAC)**

  by Hess/Koepke/Schult/Almeida

  the database: mie-calculated property-base of different aerosol components and clouds, given for $\lambda = 0.25..40\mu m$

  the software package: properties of any mixture of basic components, proposed „typical“ mixtures and height profiles

  actually in MIRART: precalculated files for aerosol-loaded atmospheres

Enhancement: Geometry

- **sun geometry**

  transmission of sunlight ➔ sun zenith angle / tangent heigth at each point of observer path

  scattering angle (const.)

  ➔ to calculate from sun zenith and azimuth angle (at certain point) via spherical trigonometrie

Enhancement: Solar Source Term

- **solar source term**

  modtran sun spectra F_{sun} (res. $1cm^{-1}$)

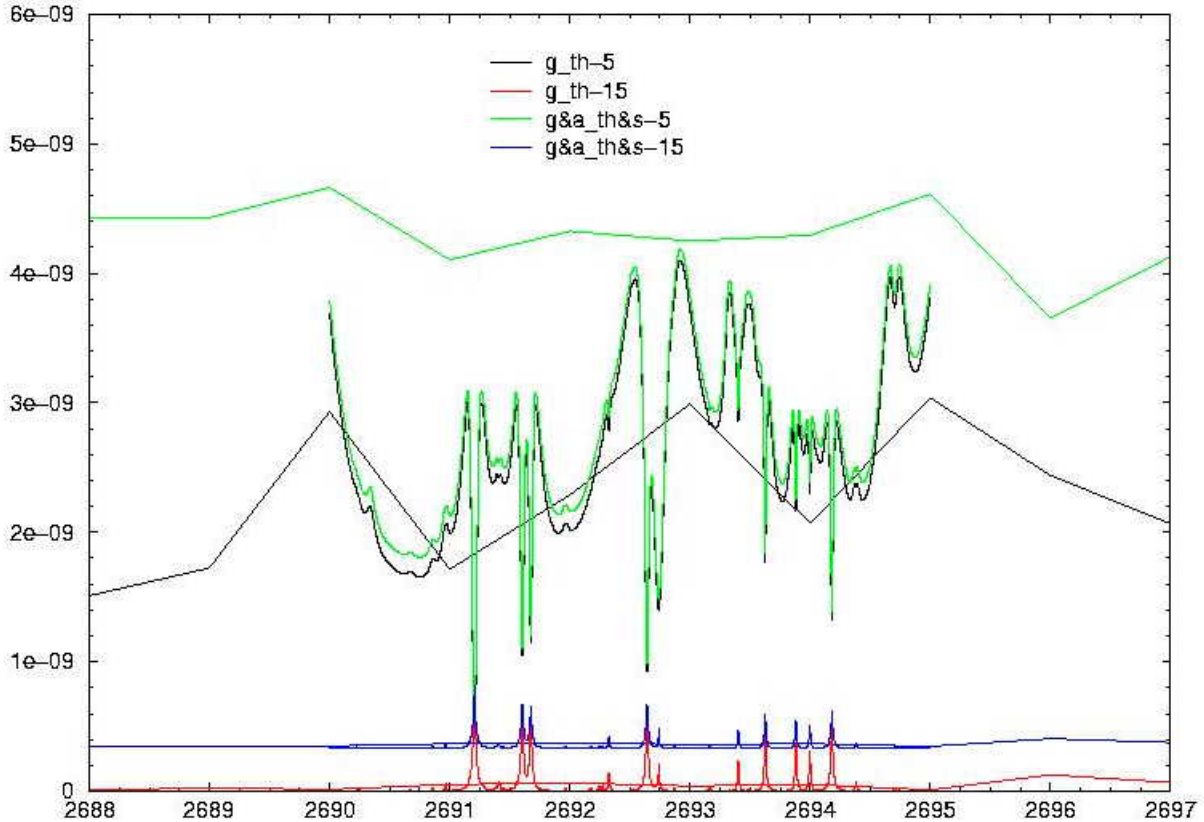
  extincted solar source at scattering point

  aerosol scattering properties

➔ MIRART_P MIRART_P&SS

$$I = \int a \cdot B ds \qquad I = \int \left(a \cdot B + b \cdot P \cdot pF_{sun} \cdot T_{sun} \right) ds$$

Examples: at window



Examples: at narrow lines