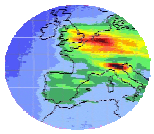
ACCENT
ATMOSPHERIC COMPOSITION CHANGE
THE EUROPEAN NETWORK OF EXCELLENCE

Troposat-2



Report on the

Workshop on Radiative Transfer Modelling, Heidelberg, June 9-11, 2005

Thomas Wagner, IUP Heidelberg

1. Scope of the RTM Workshop

The Heidelberg RTM workshop focused on the comparison of the results of current RTM for DOAS observations of scattered radiation. The main focus was the modelling of various MAXDOAS geometries. Accurate modelling of MAXDOAS observations is important for satellite observations because of two main reasons: first, from the radiative transfer modelling of the rather complex MAXDOAS geometries, important and detailed conclusions on the quality of the different models can be drawn. These conclusions can be directly applied to the various satellite viewing geometries. Second, accurate atmospheric trace gas products are very important for the validation of satellite measurements, especially for tropospheric trace gases.
The workshop had three major aims:
1) to compare existing RTM codes for selected (MAXDOAS) case studies
2) to investigate the aerosol influence on MAXDOAS observations
3) to discuss most necessary future developments for satellite (3-D-) RTM applications
To make the workshop most effective, detailed modelling exercises were sent out to all participants prior to the workshop. People who can not join the workshop were encouraged to participate in the model intercomparison by sending their model results.

2. Agenda

Below the workshop agenda is shown:

Thursday, 9. June 2005 *(Neuer Hörsaal, Physikalisches Institut, Philosophenweg 12)*

13:00 Welcome
13:10 Individual presentations of the participating models (each 20 min)
-Hilke Oetjen (Bremen)
-Hitoshi Irie (Japan)
-Oleg Postylyakov (Moskow)
-Michel van Roozendael (Brussels)
-Greg Bodeker (New Zealand)
-Johannes Keller (Switzerland)
-Klaus-Peter Heue & Tim Deutschmann (Heidelberg)
15:30 Coffea Break
16:00 Talks on specific aspects (30 min)
- Summary from Brussels QUILT-RTM workshop (Michel van Roozendael)

- Information content of MAXDOAS for aerosol retrieval (Udo Friess)
- Aerosol scattering properties as derived from Mie-theory Modelling (Suniti Sanghavi)

17:30 Discussion on the settings for the MAXDOAS RTM intercomparison

Friday, 10. June 2005 (Seminar room 2403, Kirchhoff-Institut, Im Neuenheimer Feld 227)

11:15 Start of RT modelling intercomparison
13:00 Lunch Break
14:00 RT modelling intercomparison
16:00 Discussion of first results

20:00 Dinner

Saturday, 11. June 2005 (Seminar room 2403, Kirchhoff-Institut, Im Neuenheimer Feld 227)

9:00 Overview talks on '3D-challenges' for satellite retrievals in the UV/vis/NIR
- Influence of intra-pixel heterogeneities on satellite observations (Thomas Wagner)

10:00 Discussion, Summary, Future steps (publication of results?)
12:00 End of workshop

3. Participating models

At the Heidelberg workshop the following models were introduced by the developers or their representatives:

Model name	**Responsible person**	**Institution**	**Abbreviation in this exercise**
SCIATRAN	Hilke Oetjen	IUP Bremen	BR
MCC++	Oleg Postylyakov	Institute of Atmospheric Physics, Moscow	RU
MCARaTS	Hitoshi Irie	Frontier Research Center for Global Change, Yokohama	JP
DISORT package	Michel van Roozendael	IASB, Brussels	BL
Modtran 4	Johannes Keller	Paul Scherrer Institute, Villigen	SW
Nimo	Greg Bodecker	NIWA, Lauder	NZ
TRACY-1/2	Klaus-Peter Heue, Tim Deutschmann	IUP Heidelberg	H1/ H2

In addition, results from the following models (without representation) at the workshop will also be included in the comparison exercise

Model name	Responsible person	Institution	Abbreviation in this exercise
	Chris McLinden	Meteorological Service of Canada Toronto	CA
PROMSAR	Elisa Palazzi	National Research Council, Institute of Atmospheric Science and Climate, Bologna	IT
DAK	Ping Wang	KNMI, Utrecht	NL

The abbreviations indicated in the last column should be used throughout this intercomparison (also for the names of the data files).

4. First Results

Many of the proposed exercises will be finalised after the workshop. In particular, also the exercises have been updated and completed (see below). Nevertheless, first comparison results have been already achieved during the workshop.

Box-AMFs for different altitudes for a zenith-looking instrument in a pure Rayleigh atmosphere

At the workshop it was decided to start with a very simple viewing geometry in order to discriminate potential fundamental errors. The results of this first comparison are shown in Fig. 1. This scenario was added as new exercise 0 (see below).

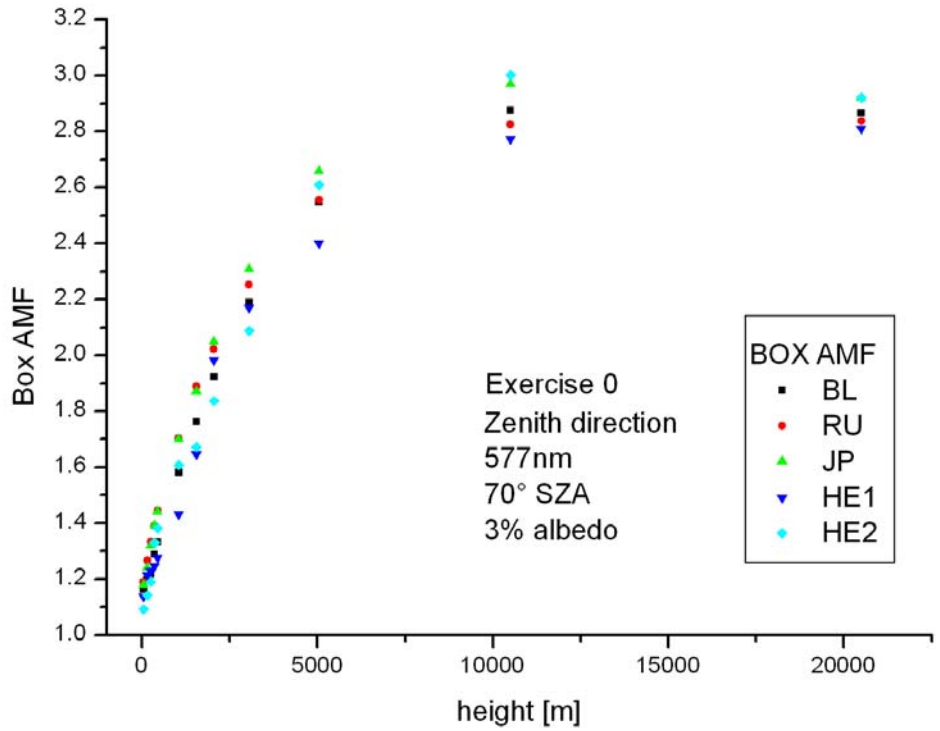
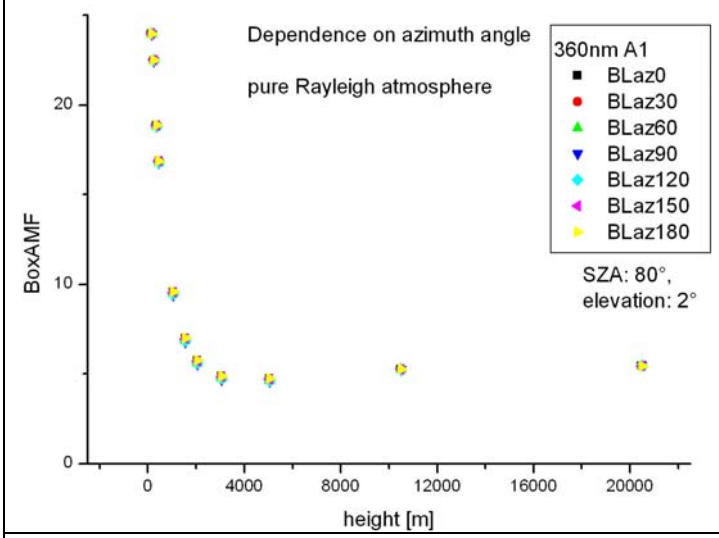
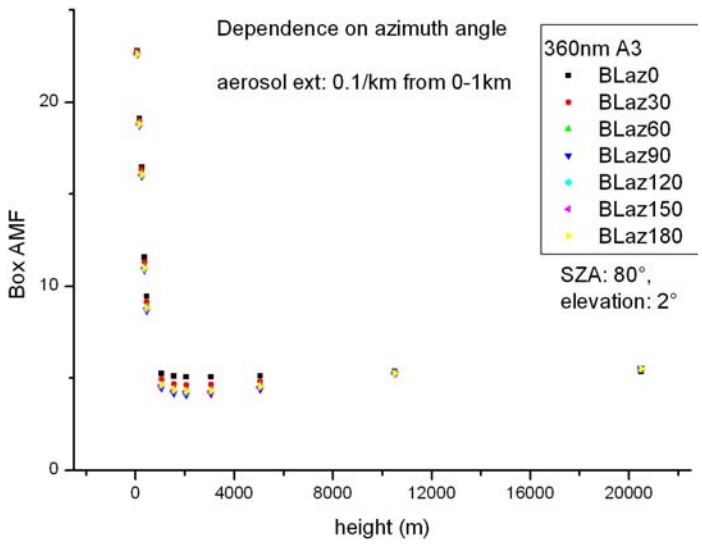
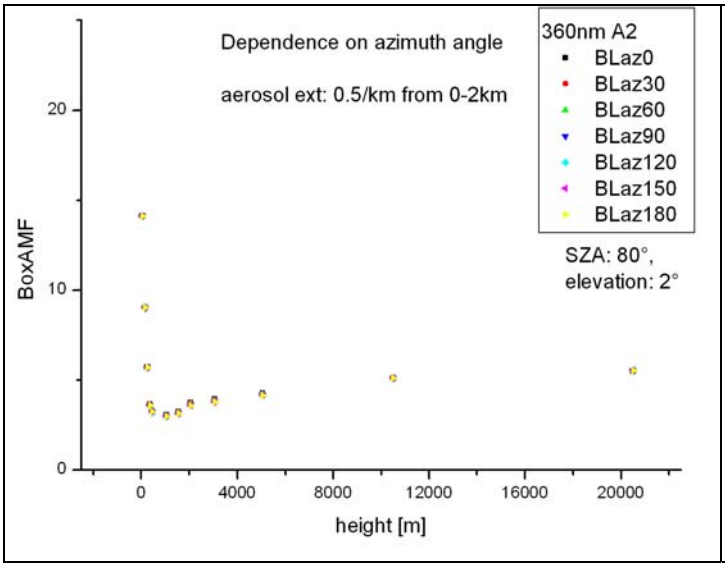


Fig. 1 Box-AMF as a function of altitude for a zenith viewing instrument in a pure Rayleigh atmosphere (SZA: 70°).

Larger azimuth effect for weaker aerosol extinction

Hitoshi Irie suggested to change exercise 2. He discovered that for the selected aerosol scenario (strong extinction) no pronounced azimuth effect occurred. In contrast, for a much weaker aerosol extinction the Box-AMFs depend much stronger on the relative azimuth angle (see Fig. 2). It was decided to extend exercise 2 by the aerosol case A3 (aerosol extinction: 0.1/km for a layer from 0 to 1km altitude). (see below).

	**Pure Rayleigh atmosphere:** **Almost no azimuth dependence**
	**Weak aerosol extinction:** **substantial azimuth dependence**



Strong aerosol extinction:

Almost no azimuth dependence

Fig. 2 Azimuth effect for different aerosol extinction: for a weak aerosol extinction (case A3) the dependence of the Box-AMF on relative azimuth angle is strongest.

Influence of the field of view (FOV)

Especially for low elevation angles (e.g. 1°) the magnitude of the FOV becomes important. It was therefore decided to reduce the FOV from 1° to (almost) zero (smaller than 0.1°) (see below). The influence of the FOV might explain e.g. the differences for low elevation angle between the Heidelberg and the Canadian model (see Fig. 3).

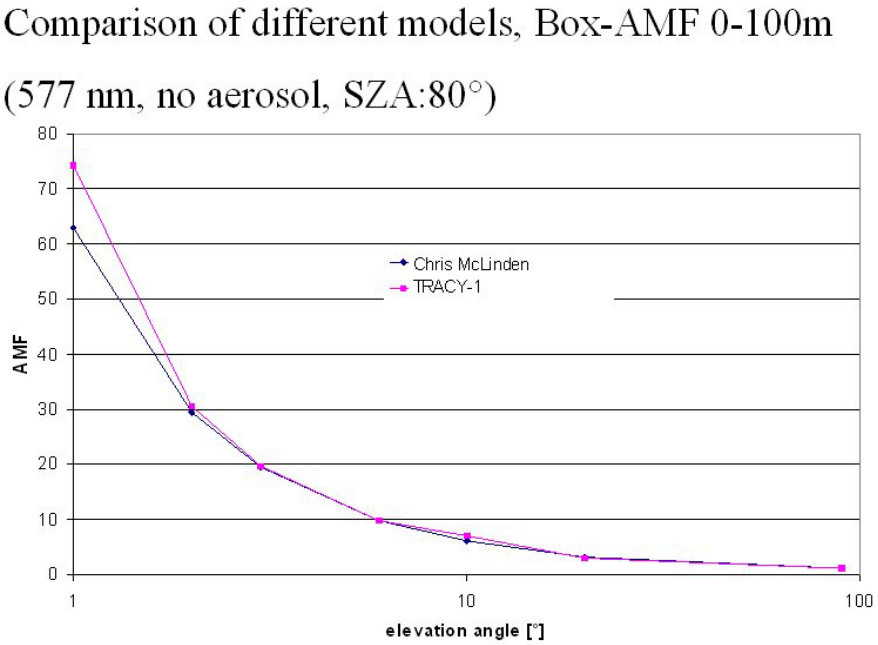


Fig. 3 Comparison of Box-AMF (0-100m altitude) as a function of the elevation angle (logarithmic scale!) for the Heidelberg and the Canadian model. The differences for the lowest elevation angle might be caused by a different field of view of both models.

5. Updates of the exercises and general settings

All updates are included in the new parameter overview at the end of this document.
Compared to the previous version the following changes were made:

a) It was agreed to limit the field of view to a value of almost zero (<0.1°)
b) For the selected wavelengths the following values of the O_3 cross sections should be used (from SCIA O_3 cross sections for 273K):

Wavelength [nm]	310	360	440	477	577
O_3 cross section [cm²]	9.59e-20	6.19e-23	1.36e-22	5.60e-22	4.87e-21

c) The temperature profile should be interpolated linearly; the logarithm of the pressure should be interpolated linearly

d) Also for the altitudes between 500 and 1000m Box-AMFs should be calculated

e) A new exercise 0 was included: Rayleigh atmosphere, zenith looking instrument, SZA: 70°, ground albedo: 3%, all wavelengths.

f) For exercise 2 also case A3 (aerosol extinction: 0.1/km from 0-1km altitude) is included.

g) Please provide also the vertical optical depth (VOD) with respect to Rayleigh- and aerosol-extinction.

6. Next steps

-Additional information from the participating groups: A short description of the different models (half page) is requested. This description should contain in particular information on the vertical discretisation used for the exercises.

-Completion of the exercises: Complete results of the exercises should be sent until mid of July.

-Web page: A web page for the RTM workshop will be set up containing the model results, the descriptions of the models, and the findings of the comparison

-Publication: It is planned to present the results of the RTM exercise in a scientific publication. The choice of the journal and the specific focus of the paper will depend on the outcome of the comparison exercises and accompanying discussions.