

**Draft plan for application of aerosol and chemistry models to the AMMA IOPs  
(WP4.1.3: Modelling the interactions between aerosols/chemistry and the atmosphere)**

*Peter van Velthoven and WP4.1.3 partners – 16 November 2007*

The objective of the model intercomparison is to evaluate the model uncertainties for the AMMA region.

It is proposed to produce output from the chemistry and aerosol models for at least the golden days, but preferably July-August 2006 or from January 2006 if feasible.

High resolution models will likely only simulate selected golden days, global models can provide the whole of 2006.

**Golden days are:**

- For upper tropospheric studies are: 7, 11, 15 and 23 August 2006.
- 13 August 2006: elevated biomass burning emissions (e.g. CO) from Namibia over the Gulf of Guinea (presented by Idir Bouarar)
- For the middle and lower troposphere there are many other interesting days, depending on the specific scientific issue.
- For dust 15-30 January 2006 and 4-9 March 2006
- For Cotonou ozonesoundings: 14 August 2006 (very high ozone concentrations at 2-5 km altitude)
- ....

If possible, provide the daily meridional cross section not only for 2006 but also for 2000 and 2003.

**Emissions**

- Use the best emissions you have globally/regionally for the simulated year.
  - Fossil fuel and biofuel (combustion) emissions: global emissions for 2003 provided by Cathy Liouse on the password protected webpage <http://www.aero.obs-mip.fr:8001/> Username and password have been mailed to you on 23 August 2007.  
Emissions at higher resolution for Africa are also expected to be available in 1 or 2 years.
  - Global and African biomass burning emissions based on L3JRC 2003,2006 are prepared by LA.– expected end of October.  
For 2000 and 2003 emissions from the same source should be used (but different years) – use what you like for the moment. If you start simulations after GBA 2003-2006 has been finished by LA use this.  
Use GBA 2000 to prepare your emission preprocessing. Cathy Liousse has prepared these at 0.5x0.5 degree, monthly resolution. They are available at the above mentioned website <http://www.aero.obs-mip.fr:8001/>  
Use injection heights as described in GBA2000.
  - Dust emissions might be provided by Beatrice Marticorena (LISA).  
For dust emissions there is also a file with soil properties in high resolution (B. Marticorena) e.g. used by Karlsruhe. **Peter to contact Beatrice**
  - Soil NOx emissions: use Yienger and Levy, included in GEIA.  
Use LA emissions in a sensitivity study by only a few models.
  - Also for isoprene the emissions from GEIA can be used.

- Additional tracers (AT and ST) to facilitate interpretation of the simulations for the AMMA period and to diagnose convective transport for comparison to AMMAMIP climate/meteorological models.
  - 5 convective transport tracers with a lifetime of 20 days.
    - For summer the regions are
      - AT1: Sahara (20-30 N), 20W-40E, over land
      - AT2: Sahel (10-20N), 20W-40E, over land
      - AT3: Guinea (0-10N), 20W-40E, over land
      - AT4: South Africa (40S-0N), 20W-40E, over land
      - AT5: South Atlantic (40S-0N), 20W-40E, over ocean
    - For winter (all year) we have decided to use the same regions!**
    - Set (volume) mixing ratio for all AT tracers to 100 between the surface and 850hPa at every time step.
    - Initialize everywhere else to zero mixing ratio at the beginning of the run.
    - The regions have been defined according to meteorological regime.
  - One stratosphere tracer (ST) will be added in the global models
    - We propose to set its (volume) mixing ratio to 100 in all layers above the tropopause at every time step. Initialize the ST tracer to 0 below the tropopause only at the beginning of the run. Apply a lifetime of 20 days below the tropopause to the ST-tracer as for the other artificial tracers.
    - The tropopause is preferably the thermal tropopause, or if you prefer the PV tropopause the 3.5 PVU surface if it is under 90 hPa (so 90 hPa in the tropics).

## Output

- A **3-hourly** meridional vertical cross section (first for 2000, 2003, later 2006).
  - between 20 S and 40 N (or shorter if your model has a more limited latitudinal domain)
  - representative of (averaged over) 2W-6E (covering the aircraft flights)
  - mixing ratios for AT, ST, CO, isoprene, HCOH, O<sub>3</sub>, NO<sub>x</sub> (NO+NO<sub>2</sub>), HNO<sub>3</sub>, PAN, H<sub>2</sub>O<sub>2</sub>, and OH, all aerosol concentrations & optical depths

This corresponds to the “cross”-output of the AMMA MIP for dynamical models, see <http://amma-mip.lmd.jussieu.fr/>

This can be provided on pressure or model levels. In case of model levels please also provide the pressure variable.
- A monthly mean 6-hourly horizontal map at the surface/lowest model level  
For 2006 6 hourly output surface maps (not monthly averaged).

Store in netcdf file and provide to AMMAMIP (LMD). **KNMI will soon provide test files.**

## Additional output for 2006:

- Chemical constituents at the locations of the aircraft (time resolution: every whole minute) for point-to-point comparisons.
  - Files with aircraft location (longitude (degr E), latitude (degr N), pressure (hPa) and time (hours & minutes UT) are already available for the DLR Falcon and the French ATR and Falcon aircraft, **the Geophysicae** and the British BAE aircraft at [http://www.knmi.nl/samenw/campaign\\_support/AMMA/TRACKDATA/index.html](http://www.knmi.nl/samenw/campaign_support/AMMA/TRACKDATA/index.html)
  - It is planned that these files are complemented with T (K), U-wind (m/s), V-wind (m/s), water vapour mixing ratio (ppmv) or RH (%), so that the representativity of the model simulated meteorological fields can be assessed.

Requested model output at these points: date+UT (minutes), T(K), U, V, RH, H<sub>2</sub>O, O<sub>3</sub>, NO<sub>2</sub>, NO, HNO<sub>3</sub>, OH, CO, AT, ST, isoprene, ...

Add the output as extra columns to the aircraft location files.

- Daily tropospheric columns 2D-field of NO<sub>2</sub>, and HCHO at the local overpass time of Sciamachy (10h00 LT) and OMI (13h30 LT) – output netcdf
- Monthly mean tropospheric columns 2D-field of O<sub>3</sub> to compare to OMI-MLS product. There are several such products – the best is likely the one produced by Mark Schoeberl. **He will be contacted by KNMI.**
- AT and CO output fields at 700, 850, 500, 350 hPa (at 10h30 LT) for comparison with MOPITT- output netcdf
- Daily aerosol optical depth to compare to MODIS instruments on the TERRA (overpass time 10h30 LT) and AQUA (overpass time 13h30 LT) satellite – output netcdf
- Ozone, CO, AT and ST profiles at Windhoek (about 17.5 E, 22.5 S) for comparison to MOZAIC Air Namibia flights. Store twice daily profiles at about 18h20 UT and at about 6h15 UT. Please also include pressure (hPa) in the output. Put all profiles for a month in 1 file (ascii or netcdf).
- Ozone, AT and ST profiles at Cotonou (6.21 N, 2.23 E), Nairobi (1.27 S, 36.8 E) and Malindi (2.99 S, 40.19 E). All 3 stations are also part of the SHADOZ network:  
<http://croc.gsfc.nasa.gov/shadoz/>

**Please include also pressure (hPa) in the model output!**

- For Malindi there is presently only 1 sounding available ( 20060104 9h52 UT).
- The date list for Nairobi is available as:  
[http://www.knmi.nl/samenw/campaign\\_support/AMMA/WP413/nairobi.txt](http://www.knmi.nl/samenw/campaign_support/AMMA/WP413/nairobi.txt)
- The date list for Cotonou is available as:  
[http://www.knmi.nl/samenw/campaign\\_support/AMMA/WP413/cotonou.txt](http://www.knmi.nl/samenw/campaign_support/AMMA/WP413/cotonou.txt)  
Background information about the Cotonou soundings was provided by Valerie Thouret, see  
[http://www.knmi.nl/samenw/campaign\\_support/AMMA/WP413/INSTRUMENT-RSO3\\_COTONOU.pdf](http://www.knmi.nl/samenw/campaign_support/AMMA/WP413/INSTRUMENT-RSO3_COTONOU.pdf)
- Gas concentrations and wet deposition output at 9 IDAF sites:
  - Banizoumbou (13.05N,2.06E in Niger)
  - Katibougou (10.86N, -7.58E in Mali)
  - Lamto (6.21N, -5.03E in Ivory Coast)
  - Djougou (9.66 N, 1.91E in Benin)
  - Zoétélé (3.16N,11.96E in Cameroon)
  - Louis Trachardt (-23N, 29.81E in South Africa)
  - Amersfoort (-27.13N, 29.81E in South Africa)
  - Cape Point (-34.36N, 18.83E in South Africa)
  - Kruger National Park (-25N, 31.6E in South Africa)

Output: monthly mean

Atmospheric gas concentrations at the surface:

- SO<sub>2</sub>, NO<sub>2</sub>, HNO<sub>3</sub>, NH<sub>3</sub>, O<sub>3</sub> (µg/m<sup>3</sup>)
- OC, BC (µg/m<sup>3</sup>)

Wet deposition/ rain water analysis (equivalent µg /liter), whatever you can provide from the following list:

- Ions: Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>=</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>,Ca<sup>2+</sup>, CH<sub>3</sub>COO<sup>-</sup>, C<sub>2</sub>H<sub>5</sub>COO<sup>-</sup>, HCOO<sup>-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, Tcarbonates
- Ph

A table with detailed information per station was provided by Fabien Solmon. See [http://www.knmi.nl/samenw/campaign\\_support/AMMA/WP413/IDAFsite.pdf](http://www.knmi.nl/samenw/campaign_support/AMMA/WP413/IDAFsite.pdf)

- At Nangatchori (9.647 N, 1.741 E, 415 m) : daily (12 UT) surface concentrations of NO<sub>x</sub>, O<sub>3</sub>, CO, BC, and OC (µg/m<sup>3</sup>).  
For aerosol models nephelometer data and GRIMM aerosol size data are also available at Nangatchori. See datelist of observations (excel) provided by Cathy Liousse: [http://www.knmi.nl/samenw/campaign\\_support/AMMA/WP413/EOP-chemNangatchori.xls](http://www.knmi.nl/samenw/campaign_support/AMMA/WP413/EOP-chemNangatchori.xls)
- Aerosol optical depth at 12h UT at AERONET sites
  - Agoufou (15.34N, 1.48W) in Mali
  - Capo Verde (16.73N, 22.93W)
  - Banizoumbou (13.54N,2.66E) in Niger
  - Dahkla (23.71N,15.95W) in Morocco
  - Dakar (14.39N,16.96W) in Senegal
  - Djougou (9.66 N, 1.91E) in Benin
  - IER-Cinzana (13.28N,5.93W) in Mali
  - Illorin (8.32N, 4.34E) in Nigeria
  - Ouagadougou (12.20N, 1.40W ) in Burkina Faso
  - For 2006 Lamto has to be added (6.21N, 5.03W) in Ivory Coast

Central Africa station?

For 2000/2003 a reduction of the number of sites is possible.

- 2006: aerosol extinction and SSA profiles at 12h? at the lidar location at Banizoumbou (13.54N, 2.66E) and Djougou (9.66 N, 1.91E?). **(Cathy informs about Djougou & Peter will ask Beatrice about lidar transect)**  
**Investigate what optical properties are used to make this calculation in the models.**
- 3-hourly chemical boundary conditions for regional models from 1 global model (ORISAM-TM4 – Bruno Guillaume) for selected periods in 2006.

**Output for 2000 to be provided end of October 2007, for 2003/2006 in January 2008. Peter will try to set up an ftp-server for additional output.**

The preferred output format is netcdf. Time series and profile data may also be provided in ascii. Please stick to CF convention as much as possible. See examples at [http://wiki.esipfed.org/index.php/CF\\_Standard\\_Names\\_-\\_Accepted\\_names\\_for\\_TF\\_HTAP](http://wiki.esipfed.org/index.php/CF_Standard_Names_-_Accepted_names_for_TF_HTAP)

KNMI (Peter van Velthoven) and Un. Reading (John Methven) will provide backward trajectories from the aircraft locations based on ECMWF, possibly including convective cloud encounters derived from MSG. See [http://www.knmi.nl/samenw/campaign\\_support/AMMA/TRAJ/index.html](http://www.knmi.nl/samenw/campaign_support/AMMA/TRAJ/index.html)

#### Involved European models and contacts

Model	Domain	Type	Contacts	Mail
TM4/5	global	Chemistry	Peter van Velthoven, Jason Williams, KNMI	<a href="mailto:velthove@knmi.nl">velthove@knmi.nl</a> <a href="mailto:williams@knmi.nl">williams@knmi.nl</a>
Meso-NH	Regional	Chemistry Aerosols	Céline Mari, Claire Delon, Marielle Saunois, Veronique	<a href="mailto:marc@aero.obs-mip.fr">marc@aero.obs-mip.fr</a> <a href="mailto:delc@aero.obs-mip.fr">delc@aero.obs-mip.fr</a>

			Pont, LA Pierre Tulet, CNRM	<a href="mailto:saum@aero.ob-mip.fr">saum@aero.ob-mip.fr</a> <a href="mailto:ponv@aero.ob-msip.fr">ponv@aero.ob-msip.fr</a> <a href="mailto:Pierre.Tulet@meteo.fr">Pierre.Tulet@meteo.fr</a>
RegCM	Regional	Chemistry, aerosols	Cathy Lioussé, Fabien Solmon, LA	<a href="mailto:Catherine.Lioussé@aero.obs-mip.fr">Catherine.Lioussé@aero.obs-mip.fr</a> <a href="mailto:soif@aero.obs-mip.fr">soif@aero.obs-mip.fr</a>
TM4-ORISAM	Global	Aerosol	Cathy Lioussé, Bruno Guillaume, LA	<a href="mailto:Catherine.Lioussé@aero.obs-mip.fr">Catherine.Lioussé@aero.obs-mip.fr</a> <a href="mailto:guib@aero.obs-mip.fr">guib@aero.obs-mip.fr</a>
Mocage	Global	Chemistry	Jean-Luc Attié, Brice Barret, LA Béatrice Josse, CNRM	<a href="mailto:attjl@aero.obs-mip.fr">attjl@aero.obs-mip.fr</a> <a href="mailto:Beatrice.Josse@meteo.fr">Beatrice.Josse@meteo.fr</a> <a href="mailto:barp@aero.obsip.fr">barp@aero.obsip.fr</a>
LM-ART	Regional	Chemistry Aerosols	Bernhard Vogel, Karlsruhe	<a href="mailto:Bernhard.vogel@imk.fzk.de">Bernhard.vogel@imk.fzk.de</a>
BOLAM	Regional	Chemistry ?	Federico Fierli ?, CNR ISAC	<a href="mailto:f.fierli@isac.cnr.it">f.fierli@isac.cnr.it</a>
LMDZ-INCA		Chemistry, aerosols	Kathy Law, Idir Bouarar, Mai Pham IPSL	<a href="mailto:kathy.law@aero.jussieu.fr">kathy.law@aero.jussieu.fr</a> <a href="mailto:mai.pham@aero.jussieu.fr">mai.pham@aero.jussieu.fr</a> <a href="mailto:idir.bouarar@aero.jussieu.fr">idir.bouarar@aero.jussieu.fr</a>
Chimere	Regional	Aerosols, chemistry	Schmechtig?, Marticorena?, LISA	<a href="mailto:schmechtig@lisa.univ-paris12.fr">schmechtig@lisa.univ-paris12.fr</a> <a href="mailto:marticorena@lisa.univ-paris12.fr">marticorena@lisa.univ-paris12.fr</a>
pTOMCAT	Global	Chemistry	Xin Yang, Un. Cambridge	<a href="mailto:Xin.Yang@atm.ch.cam.ac.uk">Xin.Yang@atm.ch.cam.ac.uk</a>
			Clermont-Ferrand?	
Contact AMMA-MIP			Frederic Hourdin	<a href="mailto:Frederic.Hourdin@lmd.jussieu.fr">Frederic.Hourdin@lmd.jussieu.fr</a>

## Subjects for joint analysis

### Gas phase chemistry

- Lightning NO<sub>x</sub> (Brice/Celine, Peter, Idir, Xin)
- Impact of soil NO<sub>x</sub> emissions (Marielle, Idir, Xin, Peter)
- Biomass burning (NO<sub>x</sub>, CO) (LA, KNMI, UCAM)

Gives us a very picture of the NO<sub>x</sub> budget

- Isoprene and associated ozone formation (UCAM, KNMI, SA, LA)

### Aerosols + gases

- Wet deposition. together with IDAF (aerosols + gases) – most groups  
Note: already work done by Dentener for 2000.
- Heterogeneous chemistry (chemistry with/without) – IPSL (Mai Pham, Michael Schulz?), LA – EDI, Un. Karlsruhe
- Photolysis rate + optical depth changes due to aerosols (LA, Karlsruhe, IPSL, LISA, CNRM)

## **Aerosols**

- Dust: LISA (Chimere), Karlsruhe, IPSL, CNRM, LA  
Perhaps also study scavenging by dust?  
Focus: march 2006 dust storm
- Mixed aerosol incl. Biomass burning aerosols, SOP0 episode analysis 19-21 January  
(Karlsruhe, LA + any other models)

## **Aerosol-climate coupling?**

Is done by Un. Karlsruhe – otherwise left to other WPs

## **Tracer experiments - analysis**

**KNMI**+all groups