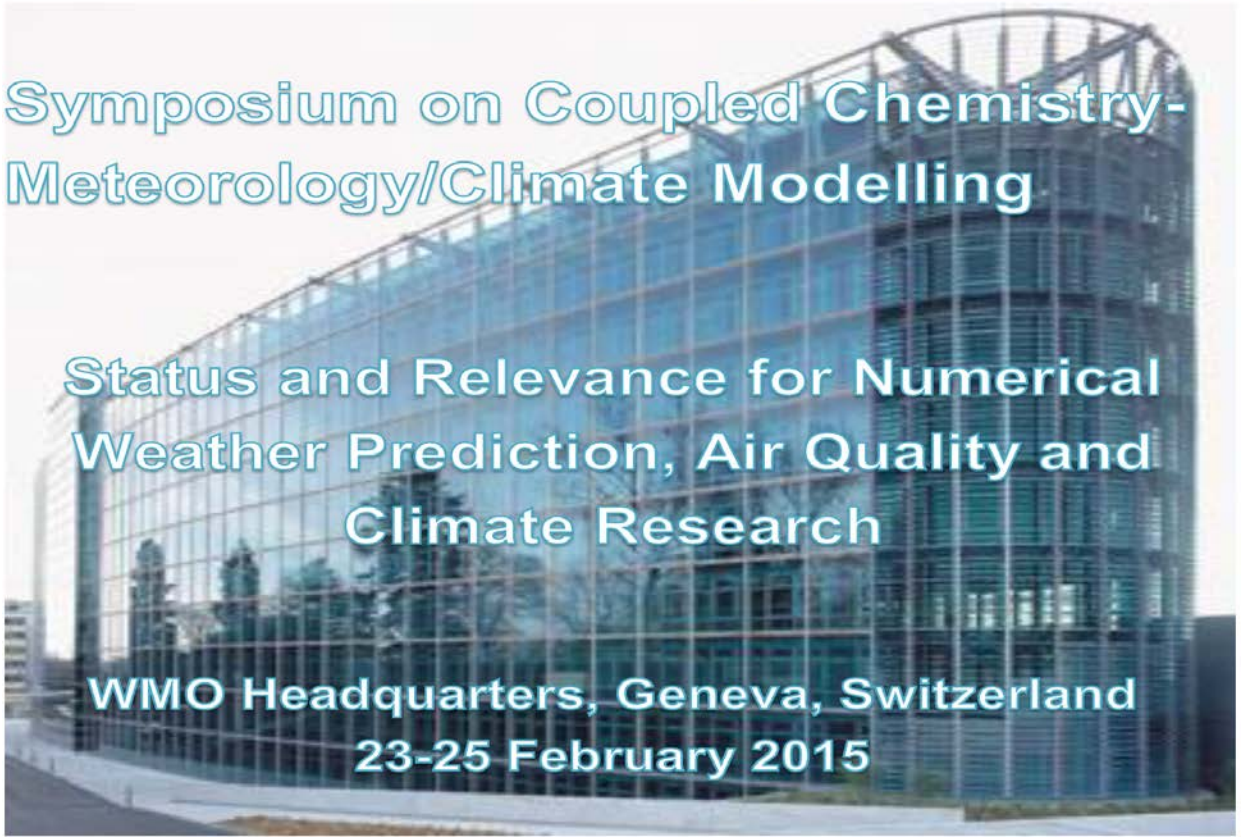

A 10 mn Report

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General Information

- WMO Hq, Geneva.
- 23-25 February 2015.
- 46 talks and 34 posters presentations.
- Seven Sessions:
  1. Coupled chemistry-meteorology systems (CCMMs)
  2. Key processes and interactions
  3. CCMMs for climate studies
  4. CCMMs for air quality and atmospheric composition
  5. CCMMs for NWP and meteorology
  6. Model evaluation
  7. Data assimilation and data requirements.
- Programme/Organizing Committee formed by US,RU,CA,CH,BR,DE,FI,NO,GR,FR,ES and WMO/ECMWF
- Supported by:
  - European Cooperation in Science and Technology (COST) Action ES1004
  - WMO Commission for Atmospheric Sciences (CAS) and World Climate Research Programme (WCRP).

CCMM Symposium Key Topics

*The main focus was on **aerosols and their feedbacks/forcing**, with the following scopes and frameworks:*

- Coupled chemistry-meteorology (weather and climate) modelling (**CCMM**): approaches and requirements;
- Key processes of chemistry-meteorology interactions, their descriptions and numerical representations;
- CCMM for aerosol effects on meteorological processes and **Numerical Weather Prediction** (NWP);
- CCMM for **air quality and atmospheric composition**
- CCMM for regional and global **climate modelling**;
- Model validation and evaluation;
- Data requirements, use of observations and data assimilation.

What can we learn from each of these three communities?

Key scientific questions:

- What are the advantages of integrating meteorological and chemical/aerosol processes in coupled models?
- How important are the two-way feedbacks and chains of feedbacks for meteorology, climate, and air quality simulations?
- What is our current understanding of cloud-aerosol interactions and how well are radiative feedbacks represented in NWP/climate models?
- What is the relative importance of the direct and indirect aerosol effects as well as of gas-aerosol interactions for different applications (e.g., for NWP, air quality, climate)?
- What are the key uncertainties associated with model predictions of feedback effects?
- How to realize chemical data assimilation in integrated models?
- How the simulated feedbacks can be verified with available observations/datasets? What are the requirements for observations from the three modelling communities?

CCMM Relevant Applications:

- Chemical Weather Forecasting (CWF)
- Numerical Weather Prediction (NWP) for precipitation, visibility, thunderstorms, etc.
- Integrated Urban Meteorology, Environment and Climate Services
- Sand and Dust Storm Modelling and Warning Systems
- Wild fire atmospheric pollution and effects
- Volcano ash forecasting, warning and effects
- High Impact Weather and Disaster Risk
- Effects of Short-Lived Climate Forcers
- Earth System Modelling and Projections
- Data assimilation for CWF and NWP
- Weather modification and geo-engineering

Session 5: CCMMs for NWP and meteorology

		WGNE AER/NWP
Evaluating the Impact of Aerosols on NWP.	S. Freitas	X
Impact of mineral dust particles on the forecast of temperature and photovoltaic power	H. Vogel	
Evaluating the impact of aerosols on numerical weather prediction: The use of an aerosol aware convective parameterization	G. Grell	X
Evaluating aerosol impacts on Numerical Weather Prediction in an extreme dust event	S. Rémy	X
Direct radiative effect of mineral dust on meteorology for dust outbreak events over the Mediterranean in summer 2012	O. Jorba	X
Dynamic aerosol in numerical weather forecast: nice to have or necessary?	B. Vogel	
Aerosols in the HARMONIE NWP model - aerosol radiative effects and further perspectives	L. Rontu	
Integrated Meteorology-Aerosol-Chemistry Modelling for NWP Applications: Present Status, Fut. Steps and Challenges	B. Sass	
Development of prognostic aerosol-cloud interactions in a chemistry transport model coupled to a RCM	M. Thomas	
A study showing impacts of aerosols on clouds and precipitation associated with a large winter cyclone	G. Thompson	
Aerosol direct radiative effect during summer 2010 wildfires in Russia simulated with NWP model HARMONIE	V.Toll	

Some outcomes from the meeting

Online coupling for (i) NWP and MetM, (ii) AQ and CWF, (iii) Climate and Earth System modelling

- Relative importance of online integration and level of details necessary for representing different processes and feedbacks can greatly vary for these related communities.
- **NWP** might not depend on detailed chemical processes but considering the cloud and radiative effects of aerosols can be important for fog, visibility and precipitation forecasting, surface T, etc.
- For **climate modelling**, feedbacks from GHGs and aerosols become extremely important. However in some cases (e.g., for long-lived GHGs on global scale), fully online integration of full-scale chemistry is not critically needed. Still too expensive, so models need to be optimized and simplified.
- For **chemical weather forecasting and prediction of atmospheric composition**, the online integration definitely improves AQ and chemical atmospheric composition projections.
- **Main gaps**:
  - Understanding of several processes: aerosol-cloud interactions are poorly represented;
  - data assimilation in online models is still to be developed;
  - model evaluation for online models needs more (process) data and long-term measurements – and a test-bed.

What are the advantages of integrating meteorological and chemical/aerosol processes in coupled models for NWP?

- Advantages for episodes in relation to
  - health effects
  - aviation forecasts (icing, volcanic ash)
  - Radiation & surface temperature
  - Plume rise
- Cloud properties – probably.
- Precipitation - not yet clear.
- Benefits under 'normal' conditions not clear.
- Improving satellite retrieval of CO2 concentrations (and others?)

How important are the two-way feedbacks and chains of feedbacks for NWP?

- strong evidence for the importance of some of the model chains:
  - increased AOD -> lower surface T -> shallower PBL-> increasing primary pollutant concentrations
  - increased AOD -> lower surface T higher T above -> stronger stability-> convection inhibition
- Importance varies strongly with location (indirect effect more important in tropics?) and time (episodes) and with the model applied.
- For weather prediction the 3D real-time aerosol would most probably be important in specific cases of high aerosol concentrations.

Recommendations for future research and actions

- Clear diagnostics for evaluation of cloud – aerosol interactions needed.
- More evaluation of aerosol properties and not PM10 or PM2.5 but also optical properties and number (e.g.).
- More investigation on benefits of using aerosol data in satellite retrievals.

- Merging several initiatives presented in the Symposium is a challenge, but might maximize their outcomes.
- More collaborations between operational centers and research communities to speed up the incorporation of the best science and improve the services for the society.

Future Needs

- Continue intercomparisons both at global and regional scale for AQ, NWP and climate; should consider also intercomparison that are cutting across all 3 fields.
- Need some specifically defined experiment that looks at chemistry-cloud-microphysics at different scales.
- Need for (field experimental) data to evaluate online coupled models.
- Improving the numerical and computational efficiency of the models as the complexity of applications grows (e.g., scales).

Conclusions

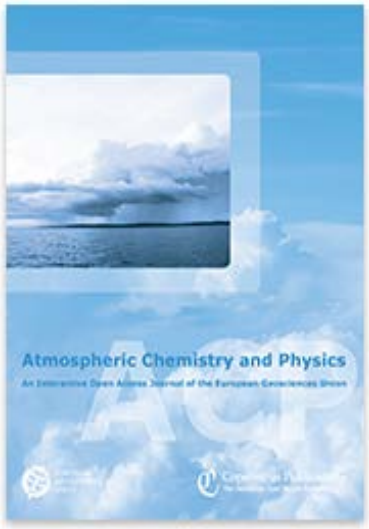
- Online modelling approach is a potential way for future *single-atmosphere* modelling systems with advantages for applications at all time scales of NWP, AQ and climate models.
- Not necessarily one integrated online modelling approach/system is best for all communities.
  - ✓ Parameters of one sphere do not singly depend on processes of that very sphere (e.g. wet deposition depends on aerosol and cloud formation).
  - ✓ We need improved understanding of several processes but also of some parameters.
  - ✓ Data assimilation in online models is still to be developed to avoid over-specification and antagonistic effects.
  - ✓ Model evaluation for online models needs more (process) data and long-term measurements – and a test-bed.

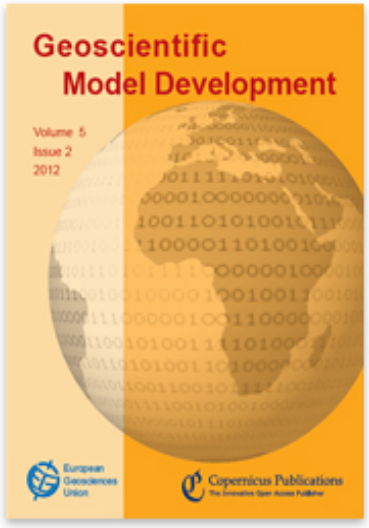
- Thanks for the attention.
- Questions?

- Link for the presentations:

CCMM15-WEBPAGE

CCMM Special Issue of ACP & GDM Journals





Special Issue jointly organized between Atmospheric Chemistry and Physics and Geoscientific Model Development journals :

Coupled chemistry–meteorology modelling: status and relevance for numerical weather prediction, air quality and climate communities.

Open for submissions until August 2015 (can be prolonged)

See: http://www.atmos-chem-phys-discuss.net/special_issue241.html

All participants of the CCMM Symposium and all interested are invited to submit papers!!