

Aerosols in HARMONIE applicable to NWP and climate: A discussion of current ideas.

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***With contributions from participants from
Météo-France , HIRLAM - and ALADIN***

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Motivation(1)

a) Aerosols are natural ingredients of the atmosphere, i.e. represent natural extensions to traditional atmospheric models

b) Climate models should contain aerosol effects , e.g. because of their radiative impact on the atmosphere

c) Results from online models, e.g. WRF-chem and

Motivation (2)

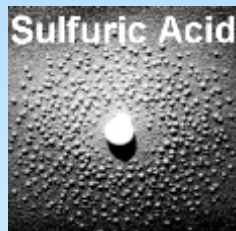
d) Opportunity for synergy between regional climate modelling and NWP: Emerging plans for regional climate modelling based on HARMONIE seem to provide an opportunity for a positive feed-back between NWP and regional climate modelling.

e) Experience in IFS community: Modelling of aerosols in HARMONIE can build on existing experiences at Météo-France (Meso-NH model platform) , from HIRLAM (Enviro-HIRLAM) and from ECMWF (MACC projects)

Aerosol Microphysics in Enviro-HIRLAM

Considered Compounds:

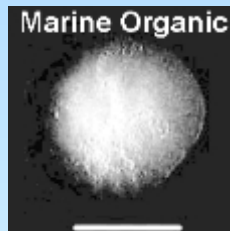
Sulfate



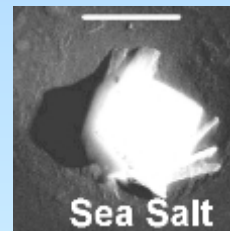
Black Carbon



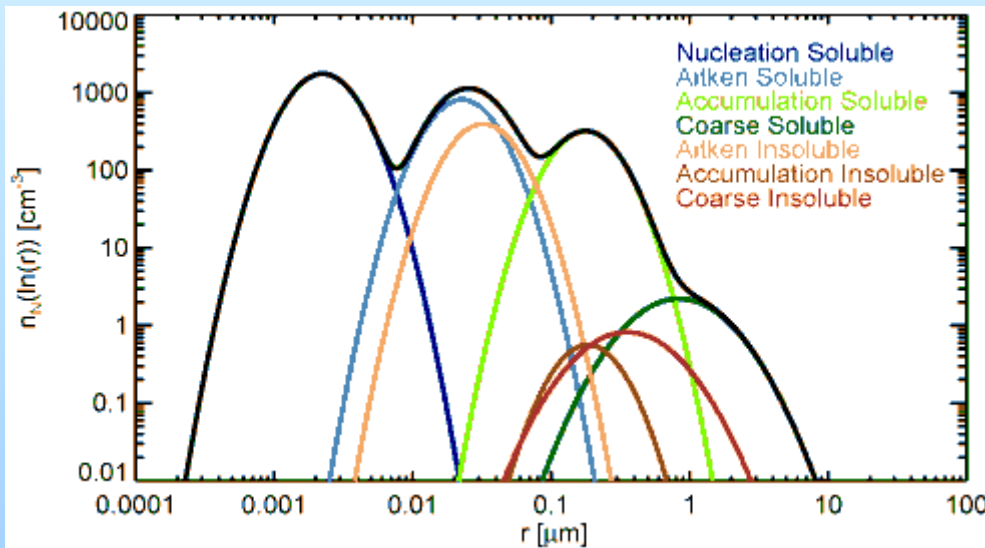
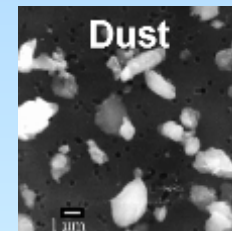
Organic Matter



Sea Salt



Mineral Dust



Sulf: nucl./ait./accu./coars – soluble

BC: ait. – soluble/insoluble,
 accu./coarse – insoluble

OC: ait. – soluble/insoluble,
 accu./coarse – insoluble

SS: accu./coarse – soluble

Dust: accu./coarse – soluble,
 accu./coarse – insoluble

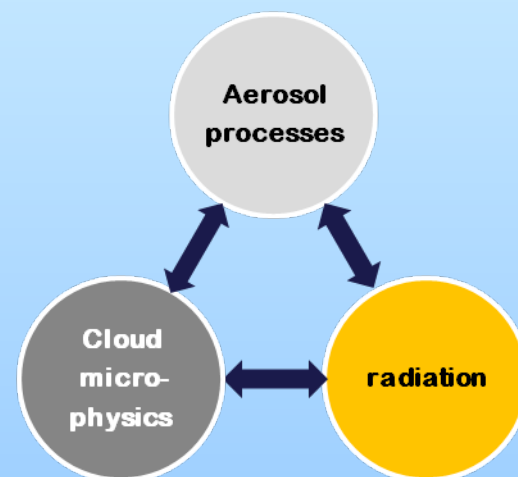
Motivation(2):

Improved aerosol treatment provides a better framework for

- **Prediction of visibility and fog**
- **Time evolution of clouds and rain**



- **Diurnal course of meteorological weather parameters, e.g. as a result of changing radiation fluxes**



Biological effects

Improved aerosol treatment provides a better framework for

- **Modelling of biological effects ,
e.g. forecasts of pollen - About 20 %
of the European population suffers
from allergenic reactions from pollen
and the number is steadily increasing**
- **Air quality prediction and related
possibility to monitor and predict
impact on human health !**



Outcome from status- and planning meeting 30 Sept. 2014 (aerosol-chemistry in AROME, HARMONIE, HIRLAM)

A) Strategic goal: build a common system for research and operations

- An on-line modelling approach is consistent with ECMWF developments for COPERNICUS
- HARMONIE is defined as the common platform
- It is suggested to formalize the collaboration initiative as a part of the Météo-France-HIRLAM-ALADIN future coordination activities.
- It is recommended to obey the agreed way of developing cycles in the IFS community. There is already a practice at Météo-France to make use of Meso-NH developments in Arome evolutions
- The activities should be included into the HIRLAM-ALADIN planning (rolling work plan).

Outcome from status- and planning meeting 30 Sept. 2014 (aerosol-chemistry in AROME, HARMONIE, HIRLAM)

B) Practicalities

- Aerosol/chemistry branch:** It is suggested to build an aerosol/chemical branch for HARMONIE.
- ECMWF' s investment in aerosol data-assimilation should be accounted for** Development of HARMONIE with online aerosols should make use of the ECMWF C-IFS/ MACC aerosol analysis as initial state for higher resolution LAMs , in order to start forecasts from a realistic spatial distribution. Also aerosol information from lateral boundaries should be considered.
- The complexity of aerosol-chemistry:** realize that the chosen model complexity in a given LAM setup should depend on the purpose . Complex gas chemistry may be important for air quality but not for short range NWP → code options needed !
- Results from process studies** (impact studies) carried out with Meso-NH and Enviro-HIRLAM should be utilized to select the most important processes to account for and the proper balance in complexity for a given purpose

Outcome from status- and planning meeting 30 Sept. 2014 (aerosol-chemistry in AROME, HARMONIE, HIRLAM)

C) Activities:

- **Study specific events**, e.g. dust events , forest fires etc. Wet deposition mechanisms are linked with 4D-clouds.
- **Validation and verification tools** : NWP verification tools are already available and are developed for high resolution NWP (e.g. HARP). Use of Aqmeii experience is recommended. Extend verification tool with additional statistical parameters. New chemical parameters should be included. This implies adding extra database with chemical observations.

Surface interactions

- Build a base-line emission database and/or build on SURFEX developments.
- Establish collaborative link between Enviro-Hirlam, Mocage and SURFEX communities to build emission preprocessor for HARMONIE.
- Use and further develop urban model (TEB) as part of SURFEX. Incorporate data from very high resolution land use data-bases.
- Regarding biogenic emissions further discussions are needed with SURFEX community.

Outcome from status- and planning meeting 30 Sept. 2014 (aerosol-chemistry in AROME, HARMONIE, HIRLAM)

D) Challenges

- **Simplified chemistry is needed** for aerosol formation in operational models. Many aerosol types exist in nature, but are not properly reflected in the model systems. Which aerosols should be accounted for in a given scheme ?
- **Ice nucleation appears to be a special challenge** : The role of bacteria and other biogenic aerosols which have properties to serve as ice nucleators at high temperatures need to be better understood
- **Data-assimilation , new observations ?** Data-assimilation of aerosols is a huge challenge, collaboration with ECMWF is desirable. A combination of lidars and satellite information is suggested.
- **Numerical aspects** : Schemes must not be diffusive, also they are required to be positive definite and mass conserving. Improvements have already been made in meso-NH. Enviro-HIRLAM has experience with development of mass conserving scheme. More research is required to obtain a proper scheme.

Suggestions for practical steps towards setups with on-line aerosols in HARMONIE

- APRIL - JUNE 2015:**
- Task of HIRLAM Management Group and CSSI in collaboration with HAC and PAC : should establish a group starting to plan how aerosol setups for HARMONIE can be established. Participants from Meteo-France- HIRLAM- and ALADIN community
 - Possibly establish special project proposal at ECMWF on Enviro-Aerosols in HARMONIE (e.g based on DMI proposal)

JULY - DECEMBER 2015:

- The working group considers existing ideas from planning meeting 30 Sep. 2014.
- IFS code evolution aspects: Do plans for OOPS and scalability put constraints on how to establish the aerosol setup of HARMONIE ?
- The working group should produce recommendations for a new ALADIN - HIRLAM management starting from January 2016.

Thank You !

COST ES1004 EuMetChem: <http://eumetchem.info>

Enviro-HIRLAM: <http://hirlam.org>

Meso-NH: <http://mesonh.aero.obs-mip.fr/mesonh51>