European Commission

Climate Change

BACCHUS

At a glance

Title: Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding

Instrument: FP7 collaborative project

Total Cost: € 11,463,091

EC Contribution: € 8,746,587

Duration: 48 months

Start Date: 1 Dez 2013

Consortium: 20 partners from 12 countries

Project Coordinator: ETH Zürich (CH)

Project Web Site:

Key Words: Aerosol-cloud-interactions, climate feedbacks, biosphere, VOCs, climate-change, Arctic, Amazon, ice nucleation, field studies, satellite studies, long-term observations, process & earth system models

The challenge

Clouds are a very important, yet not well understood feedback factor in climate change and they contribute to the radiative forcing (RF) through aerosol-cloud interactions (ACI). The uncertainty caused by this crucial detail of the climate system is larger than the uncertainty related to the forcing of other agents. Also, feedbacks between the terrestrial and marine biosphere and the atmosphere involving ACI are thought to play an important role in regulating climate change but their relevance remains poorly quantified.

Project Objectives

BACCHUS will quantify key processes and feedbacks controlling ACI, by combining advanced measurements of cloud and aerosol properties with state-of-the-art numerical modelling. The analysis of contrasting environments will be the guiding strategy for BACCHUS. We will investigate the importance of biogenic versus anthropogenic emissions for ACI in regions that are key regulators of Earth's climate (Amazonian rain forest) or are regarded as tipping elements in the climate system (Arctic).

Capturing the key aerosol-cloud interactions and feedbacks involving natural and anthropogenic aerosols in the present climate will reduce the uncertainty about the impact of biogenic and anthropogenic emissions on clouds and climate in future climate projections.

Methodology

BACCHUS will generate a unique database linking long-term observations and field campaign data of aerosol, cloud condensation and ice nuclei and cloud microphysical properties; this will enable a better quantification of the natural aerosol concentrations and the anthropogenic aerosol effect. BACCHUS will advance the understanding

of biosphere aerosol-cloud-climate feedbacks that occur via emission and transformation of biogenic volatile organic compounds, primary biological aerosols, secondary organic aerosols and dust. Integration of new fundamental understanding gained in BACCHUS in Earth Systems Models allows reducing the uncertainty in future climate projections.

In detail BACCHUS will carry out the following work:

- Collect and harmonize aerosol, cloud condensation nuclei (CCN), ice nuclei (IN) and cloud microphysical properties datasets (WP1);
- Perform process studies of the role of both organic and inorganic aerosol in CCN/IN and derive from them parameterizations for use in Earth System Models (ESMs) (WP2)
- Study the key processes controlling cloud systems in contrasting environments and the role of aerosols vs. dynamics for different cloud systems (WP3)
- Explore aerosol and cloud related feedback processes in the climate system using ESMs and conduct future climate scenarios (WP4)
- The optimisation of impact of the acquired knowledge will be ensured by a dedicated work package on knowledge transfer and dissemination (WP5)

Expected Impact

By providing a more accurate estimate of background aerosol concentrations representative of pre-industrial times, BACCHUS will provide an improved quantification of the aerosol RF (including ACI) since then. Such information is necessary to assess the extent to which the aerosol RF has offset the greenhouse gas RF until now and how it will evolve in future. Clear information on the aerosol RF will help European and international policymakers in formulating cost-benefit policies aiming at both reducing air pollutant emissions (resulting in an amelioration of air quality) and mitigating climate change.

In addition, to avoid dangerous anthropogenic interference with the climate system, the United Nations Framework Convention on Climate Change has adopted to limit global warming below 2ºC (2 degree target). Allowable emissions to stay below the 2ºC target depend heavily on Earth's climate sensitivity as uncertainties in climate sensitivity translate into uncertainties in the emissions allowed to stay within a 2ºC warming target. One source of uncertainty is a poor understanding of the aerosol RF. By advancing our understanding of this forcing, BACCHUS enables the development of more reliable estimates of the allowable emissions for a given stabilization target.

Degradation of air quality (and in particular increasing aerosol and aerosol precursor emissions) severely impacts human health, as well as ecosystem services. BACCHUS will contribute to a better understanding of the processes driving the aerosol distribution by quantifying natural vs. anthropogenic emissions. A better understanding of biosphere-aerosol-cloud-climate interactions will allow to better inform the policy regulations and thus to ensure a better protection of humans and ecosystems' health.

BACCHUS will be particularly closely allied with the current and on-going review of the European Commission's Thematic Strategy on Air Pollution and Air Quality regulation, which was formulated in 2005 and is currently being reviewed and updated - as part of a broader review of EU Air policy - through stakeholder expert groups and public consultation.

Project Partners	
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Max Planck Institute for Meteorology and the Max Planck Institute for Chemistry, DE	Groupe d'étude de l'Atmosphère Météorologique (CNRS), FR
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