

Bioaerosols in ECHAM5-HAM

ANA SESARTIC¹, ULRIKE LOHMANN¹,
AND TRUDE STORELVMO²

¹ETH Zurich, Institute for Atmospheric and Climate Science,
Zurich, Switzerland (ana.sesartic@env.ethz.ch,
ulrike.lohmann@env.ethz.ch)

²Department of Geology and Geophysics, Yale University,
210 Whitney Ave., USA-06520-8109 New Haven (CT)

Interest in primary biological aerosol particles (bioaerosols) like bacteria and fungal spores is mainly related to their health effects, impacts on agriculture, ice nucleation and cloud droplet activation, as well as atmospheric chemistry [1].

In our study we investigated the impact of bacteria and fungal spores acting as ice nuclei on clouds and precipitation on a global scale. Bacteria [2] and fungal spores [3] as a new aerosol species were introduced into the global climate model ECHAM5-HAM using observational data compiled by [4] for fungal spores and [5] for bacteria.

The addition of bioaerosols into ECHAM lead to only minor changes in cloud formation and precipitation on a global level, however, changes in the liquid water path and ice water path as well as stratiform precipitation in the model were observed in the boreal regions where tundra and forests act as sources bacteria and fungal spores.

This goes hand in hand with a decreased ICNC and increased effective radius of ice crystals. An increase in stratiform precipitation and snowfall can be observed in the model results for those regions as well.

Although bacteria and fungal spores contribute to heterogeneous freezing, their impact in the model was reduced by their low numbers compared to other heterogeneous ice nuclei like mineral dust.

To the best of our knowledge, the influence of bioaerosols on the global climate appears to be small. However, there are still several uncertainties constraining bioaerosol modelling, for example their exact emissions (especially over remote regions and the oceans), the impact of coating and ageing on the bacterial IN-ability, etc. Standardised long-term observations with world-wide coverage of ecosystems, as well as further laboratory data, are therefore necessary for a more precise model evaluation.

[1] Morris *et al.* (2011) *Biogeosciences* **8**, 17-25. [2] Sesartic *et al.* (2012) *Atmos. Chem. Phys.* **12**, 8645-8661. [3] Sesartic *et al.* (2013) *Environ. Res. Lett.* **8**, 014029. [4] Sesartic & Dallafior (2011) *Biogeosciences* **8**, 1181-1192. [5] Burrows *et al.* (2009) *Atmos. Chem. Phys.* **9**, 9281-9297.

N₂O and δ¹⁵N-N₂O data in ice cores: atmospheric versus in situ signal

BARBARA SETH, JOCHEN SCHMITT,
MICHAEL BOCK AND HUBERTUS FISCHER

Climate and Environmental Physics & Oeschger Centre for
Climate Change Research, University of Bern,
Switzerland, (*correspondence: seth@climate.unibe.ch)

N₂O is an important greenhouse gas which has several sources in both terrestrial and marine ecosystems. N₂O mixing ratios and stable isotopes measured from air entrapped in ice cores allow to identify different processes driving changes in these sources. We present a new δ¹⁵N-N₂O record covering the past 15'000 years and discuss possible explanations for the long-term decrease during the Early Holocene.

However, comparative analyses of different ice cores show offsets in the mixing ratios suggesting that elevated mixing ratios are due to in situ production, especially in glacial ice with higher impurity content.

However, the pathways leading to in situ production of N₂O in ice cores are not yet identified. Sowers [1] observes N₂O isotope anomalies in Vostok ice core samples and supposes that microorganisms might use ammonium (NH₄⁺) in ice to produce N₂O. EPICA Dome C (EDC) ice samples suspect to in situ production show fairly heavy δ¹⁵N-N₂O values as well, however, the isotope signature of N₂O produced from ammonium is expected to be rather light. Thus, it is unlikely that in situ produced N₂O in the EDC ice core can be related to NH₄⁺ oxidation.

Alternatively, we propose that in situ N₂O in the EDC ice is produced from nitrate (NO₃⁻). Low accumulation sites like EDC show extremely enriched δ¹⁵N-NO₃⁻ values due to intense post-depositional loss processes [2], while sites with higher accumulation have lighter δ¹⁵N-NO₃ values [3] and we found a lighter δ¹⁵N-N₂O in situ signature for those samples. More knowledge about in situ N₂O could help to verify hidden in situ production or identify ice cores and time intervals suitable to derive the atmospheric history for both mixing ratios and isotopic signature of N₂O.

[1] Sowers (2001), *JGR* **106**, 31903-31914. [2] Blunier *et al.* (2005), *GRL* **32**, L13501. [3] Hastings *et al.* (2005), *GBC* **19**, GB4024.