https://doi.org/10.5194/acp-2020-655
Preprint. Discussion started: 1 September 2020

Atmospheric Chemistry and Physics Discussions

Cloud-scale modelling of the impact of deep convection on the fate of oceanic bromoform in the troposphere: a case study over the west coast of Borneo

Paul. D. Hamer[1,2], Virginie Marécal[2], Ryan Hossaini[3], Michel Pirre[4,*], Gisèle Krysztofiak[4], Franziska Ziska[5], Andreas Engel[6], Stephan Sala[6], Timo Keber[6], Harald Bönisch[6], Elliot Atlas[7], Kirsten Krüger[8], Martyn Chipperfield[9], Valery Catoire[4], Azizan A. Samah[10,11], Marecel Dorf[12], Phang Siew Moi[11], Hans Schlager[13], Klaus Pfeilsticker[14]

[1]Norwegian Institute for Air Research (NILU), Kjeller, Norway
[2]Centre National de Recherches Météorologiques, Université de Toulouse, Météo-France, CNRS, Toulouse, France
[3]Lancaster Environment Centre, Lancaster University, Lancaster, LA1 4YQ, UK
[4]Laboratoire de Physique et Chimie de l'Environnement et de l'Espace, CNRS and University of Orléans, UMR7328, Orléans, France
[5]GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany
[6]Institute for Atmospheric and Environmental Sciences, University of Frankfurt, Altenhöferallee 1, 60438 Frankfurt, Germany
[7]University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149
[8]Department of Geosciences, University of Oslo, Postboks 1022, Blindern, 0315 OSLO
[9]The Institute for Climate & Atmospheric, Science, School of Earth and Environment, University of Leeds, Leeds, UK
[10]National Antarctic Research Centre, University of Malaya, Kuala Lumpur 50603, Malaysia
[11]Institute of Ocean & Earth Sciences, University of Malaya, 50603 Kuala Lumpur, Malaysia
[12]Max Planck Institute for Chemistry, Department of Atmospheric Chemistry, Mainz, Germany
[13]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Atmosphärische Spurenstoffe, Münchner Straße 20, 82234 Oberpfaffenhofen-Wessling, Germany
[14]Institute of Environmental Physics, Ruprecht-Karls-Universität Heidelberg, Im Neuenheimer Feld 229, D-69120 Heidelberg, Germany
[*]Retired

Correspondence to: Paul D. Hamer (paul.hamer@nilu.no)

Abstract. Coastal oceans emit bromoform ($CHBr_3$) that can be transported rapidly to the upper troposphere by deep convection. In the troposphere, the spatial and vertical distribution of $CHBr_3$ and its product gases (PGs) depend on emissions, chemical processing, transport by large scale flow, convection, and associated washout. This paper presents a modelling study on the fate of $CHBr_3$ and its PGs in the troposphere. A case study at cloud scale was conducted along the west coast of Borneo, when several deep convective systems triggered in the afternoon and early evening of November 19th 2011. These systems were sampled by the Falcon aircraft during the field campaign of the SHIVA project. We analyse these systems using a simulation with the cloud-resolving meteorological model C-CATT-BRAMS at 2 × 2 km resolution that describes transport, photochemistry, and washout of $CHBr_3$. We find that simulated $CHBr_3$ mixing ratios and the observed values in the boundary layer and the outflow of the convective systems agree. However, the model underestimates the background $CHBr_3$ mixing ratios in the upper troposphere, which suggests a missing source. An analysis of the simulated chemical speciation of bromine within and around each simulated convective system during the mature convective stage reveals that >85% of the bromine