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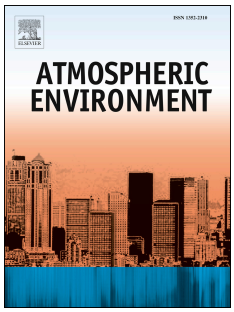

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Determination of chloromethane and dichloromethane in a tropical terrestrial mangrove forest in Brazil by measurements and modelling

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Abstract

Chloromethane (CH_3Cl) and dichloromethane (CH_2Cl_2) are known to have both natural and anthropogenic sources to the atmosphere. From recent studies it is known that tropical and sub tropical plants are primary sources of CH_3Cl in the atmosphere. In order to quantify the biogenic emissions of CH_3Cl and CH_2Cl_2 from mangroves, field measurement were conducted in a tropical mangrove forest on the coast of Brazil. To the best of our knowledge these field measurements were the first of its kind conducted in the tropical mangrove ecosystem of Braganca. A mesoscale atmospheric model, MEsoscale TRAnsport and fluid (Stream) model (METRAS), was used to simulate passive tracers concentrations and to study the dependency of concentrations on type of emission function and meteorology. Model simulated concentrations were normalized using the observed field data. With the help of the mesoscale model results and the observed data the mangrove emissions were estimated at the local scale. By using this bottom-up approach the global emissions of CH_3Cl and CH_2Cl_2 from mangroves were quantified. The emission range obtained with different emission functions and different meteorology are 4-7 Gg yr^{-1} for CH_3Cl and 1-2 Gg yr^{-1} for CH_2Cl_2. Based on the present study the mangroves contribute 0.3 percent of CH_2Cl_2 and 0.2 percent of CH_3Cl in the global emission budget. This study corroborates the study by Manley et al. (2007) which estimated that mangroves produce 0.3 percent of CH_3Cl in the global emission budget. Although they contribute a small percentage in the global budget, their long lifetime enables them to contribute to the destruction of ozone in the stratosphere. From the detailed analyses of the model results it can be concluded that meteorology has a larger influence on the variability of concentrations than the temporal variability of the emission function.

Keywords: chloromethane, dichloromethane, mangrove, emission, METRAS

1. Introduction

Atmospheric halocarbons such as chloromethane (CH_3Cl), bromomethane (CH_3Br) and dichloromethane (CH_2Cl_2) contribute to several atmospheric chemical processes (e.g. stratospheric ozone depletion). These halocarbons originate from both natural and anthropogenic sources such as biomass burning, incineration/industrial processes, oceanic emissions, coastal salt marshes and leaf litter (Khalil and Rasmussen, 1999; Lobert et al., 1999; Yokouchi et al., 2000b; Harper, 1985; Moore et al., 1996; Rhew et al., 2000; Blei et al., 2010; Kolusu et al., 2017). The quantification of halocarbons is uncertain. It is known that the global budgets of CH_3Cl and CH_3Br are imbalanced, i.e. known sinks are much larger than known sources (Butler, 2000; WMO, 2010). Field observations and modelling studies suggest that tropical and subtropical forest plants may be an important source of CH_3Cl (Yokouchi et al., 2000b,a, 2002; Lee-Taylor et al., 1998; Kolusu et al., 2017). Quantification of CH_3Cl and CH_2Cl_2 emissions from mangroves is relevant to the tropospheric ozone, since they contribute to its destruction. However, its major relevance is for climate studies, since CH_3Cl and CH_2Cl_2 have long atmospheric life time i.e. 1 year for CH_3Cl, 0.5 year for CH_2Cl_2 (WMO, 2010). This long life time is sufficient

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