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Primary and secondary organics in the tropical Amazonian rainforest aerosols: chiral analysis of 2-methyltetraols

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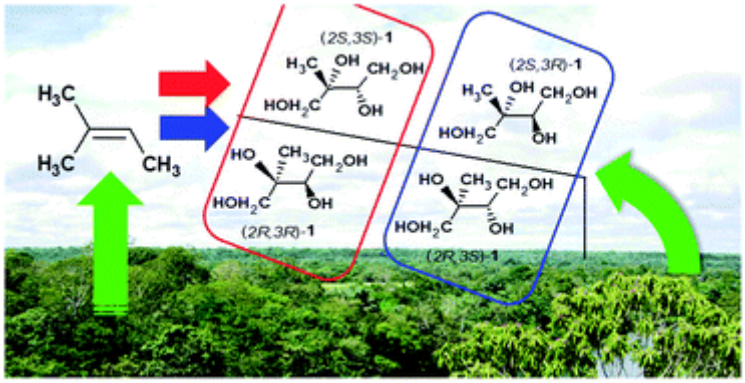
Abstract

This work presents the application of a new method to facilitate the distinction between biologically produced (primary) and atmospherically produced (secondary) organic compounds in ambient aerosols based on their chirality. The compounds chosen for this analysis were the stereomers of 2-methyltetraols, (2*R*,3*S*)- and (2*S*,3*R*)-methylerythritol, (L- and D-form, respectively), and (2*S*,3*S*)- and (2*R*,3*R*)-methylthreitol (L- and D-form), shown previously to display some enantiomeric excesses in atmospheric aerosols, thus to have at least a partial biological origin. In this work PM_{10} aerosol fractions were collected in a remote tropical rainforest environment near Manaus, Brazil, between June 2008 and June 2009 and analysed. Both 2-methylerythritol and 2-methylthreitol displayed a net excess of one enantiomer (either the L- or the D-form) in 60 to 72% of these samples. These net enantiomeric excesses corresponded to compounds entirely biological but accounted for only about 5% of the total 2-methyltetrol mass in all the samples. Further analysis showed that, in addition, a large mass of the racemic fractions (equal mixtures of D- and L-forms) was also biological. Estimating the contribution of secondary reactions from the isomeric ratios measured in the samples (=ratios 2-methylthreitol over 2-methylerythritol), the mass fraction of secondary methyltetrols in these samples was estimated to a maximum of 31% and their primary fraction to a minimum of 69%. Such large primary fractions could have been expected in PM_{10} aerosols, largely influenced by biological emissions, and would now need

to be investigated in finer aerosols. This work demonstrates the effectiveness of chiral and isomeric analyses as the first direct tool to assess the primary and secondary fractions of organic aerosols.



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