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Methane at Ascension Island, southern tropical Atlantic Ocean: continuous ground measurement and vertical profiling above the Trade-Wind Inversion

David Lowry (1), Rebecca Brownlow (1), Rebecca Fisher (1), Euan Nisbet (1), Mathias Lanoisellé (1), James France (2), Rick Thomas (3), Rob Mackenzie (3), Tom Richardson (4), Colin Greatwood (4), Jim Freer (4), Michelle Cain (5), Nicola Warwick (5), and John Pyle (5)

(1) Royal Holloway, University of London, Egham, UK (d.lowry@es.rhul.ac.uk), (2) University of East Anglia, Norwich, UK (J.France@uea.ac.uk), (3) University of Birmingham, Birmingham, UK (R.Thomas@bham.ac.uk), (4) University of Bristol, Bristol, UK (Jim.Freer@bristol.ac.uk), (5) University of Cambridge, Cambridge, UK (John.Pyle@atm.ch.cam.ac.uk)

Methane mixing ratios have been rising rapidly worldwide since 2007. At Ascension Island (8^oS in the equatorial Atlantic), a sustained rise has occurred. Prior to 2010, growth was comparable to other regions, but in 2010-11, during a strong *la Nina* event, the increase was 10ppb year-on-year. Reduced growth followed in 2011-12, but in 2012-13 strong growth resumed and continues. This rise has been accompanied by a shift to lighter $\delta^{13}C_{CH4}$ values in 2010-11 in the equatorial tropics. The most likely cause of this shift is emissions from isotopically 'light' biological sources in the equatorial and savanna tropics.

Ascension Island is in the Trade Wind belt of the tropical Atlantic, perfectly located to measure the South Atlantic marine boundary layer. The SE Trade Winds are almost invariant, derived from the deep South Atlantic and with little contact with Africa. However, above the Trade Wind Inversion (TWI) at about 1200-2000m asl, the air masses are very different, coming dominantly from tropical Africa and occasionally S. America. Depending on season, air above the TWI is sourced from the African southern savanna grasslands or the equatorial wetlands of Congo and Uganda, with inputs of air also from southern tropical S. America (Brazil, Paraguay, Bolivia). African methane sources are a major contributor to the global methane budget, but although local campaign studies have been made, African emissions are not well studied in bulk.

In September 2014, an octocopter was used to retrieve air samples from heights up to 2700m asl on Ascension (see Thomas, R. et al, this volume). This allowed sampling through the marine boundary layer, across the TWI cloud layer, and into the mid-troposphere. Samples were collected in part-filled 5L Tedlar bags, which were analysed for CH_4 concentration using Royal Holloway's Picarro 1301 CRDS system at the Met Office, Ascension. This has high precision and accuracy, with a 6-gas calibration suite. Bags were then analysed in the UK for $\delta^{13}C_{CH4}$. The marine boundary layer at the surface has CH_4 mixing ratios below 1800ppb. In the mixing layer of the TWI, values increase, and above 2000m, methane is above 1820ppb. Back trajectory analysis shows that these inputs are from African savanna and wetland emissions. After vertical mixing events the difference across the TWI reduces to less than 10ppb.

The experiment has demonstrated the feasibility of UAV work to observe methane at Ascension. In effect, Ascension becomes a 'virtual mountain observatory' – measurements here can both use the Trade Winds to monitor the wide South Atlantic and Southern Ocean, and also the air above the TWI to assess inputs from tropical Africa and S. America. Comparison of continuous ground measurements, vertical UAV profiles and data from the Ascension TCCON site, potentially allows observation of a complete atmospheric profile.

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