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Greenhouse gases in the South Atlantic Ocean: recent trends and anomalies from continuous island and shipboard measurements

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In-situ observation of tropical and southern Atlantic greenhouse gases is still limited. Continuous high-precision greenhouse gas measurement by CRDS in the South Atlantic started in 2010 on Ascension Is. (8˚S) and near Stanley on East Falkland Is. (52˚S), and in 2012 on the British Antarctic Survey ship RRS James Clark Ross, which sails annually from the UK to Antarctica and back. Both the Ascension and Falklands records show sustained inter-annual growth in both CO_2 and CH_4. NOAA data from a small number of stations indicate that Southern Tropical Methane has been increasing since 2007 but that growth is now slowing. This is confirmed by our new data. Strong CH_4 growth of 11 ppb was observed on Ascension between July 2010 and July 2011 (winter to winter), of 7 ppb/yr from Jan 2011 to Jan 2012 (summer-to-summer) and decreased further to 4 ppb from July 2011 to July 2012. This compares with a fairly constant growth of 4-5 ppb/yr for the Falklands site.

Isotopic evidence for the causes of the 2010-11 southern hemisphere sub-tropical methane anomaly is inconclusive. A slight depletion in ^{13}C on Ascension during the period of growth might indicate that wetland emissions are the dominant cause of the anomaly, fitting with much higher than average sub-tropical rainfall during recent years, but a much longer data set is required to isolate the anomaly from the long-term trend.

On 23 April 2011, Ascension experienced a 20-year event when the ITCZ moved far south of its normal position. In very clean marine air, in the space of 3 minutes the methane jumped from a normal autumn southern hemisphere level of 1763 ppb to 1795 ppb, closer to the concentrations of northern hemisphere spring, settling near to 1800 ppb for six hours, after which it rapidly fell back to 1760 ppb. Simultaneously CO_2 rose from 389 to about 392 ppm, then to 396 ppm before falling back to 388 ppm. During this period there was very heavy rainfall, with nearly 300 mm on the slopes of Green Mountain and more than 200 mm in surrounding desert areas. The 35 ppb magnitude of this methane switch compares with a magnitude of 55 ppb (1825 to 1770 ppb) observed by continuous measurement on-board the James Clark Ross when crossing the ITCZ from 8˚N to 8˚S in October 2010. In this event, high altitude Northern hemisphere air was moving SE over NW moving trade winds until the storm brought high level air to ground level. The observations highlight the usefulness of continuous measurement at such a site and demonstrate that the meteorological boundary between the hemispheres can on occasion be very sharp.