Using a Remotely Piloted Vehicle to Investigate the Southern Tropical Methane Anomaly

R. M. Thomas [1], A. R. MacKenzie [1], J. Freer[2], T. Richardson [2], and E. Nisbet[3]

1:University of Birmingham, Birmingham, UK 2:University of Bristol, Bristol, UK,
3:Royal Holloway, University of London, Egham, UK

Please e-mail questions to Rick Thomas : R.thomas@bham.ac.uk

A major deployment of a substantial Remotely Piloted Vehicle (RPV) is planned for 2014 to aid investigation of anomalous methane sources in the tropics. The size of vehicle and altitudes involved mark a first for UK RPV operations

Southern Methane Anomaly Project Background

Tropical methane sources account for nearly two-fifths of the global budget (200Tg/yr), and are the main contributor to annual variability in the atmospheric methane growth rate (Bousquet 2006). In 2010, arguably the largest recent excursion in the global methane record occurred in the tropics. This Southern Tropical Methane growth anomaly continued through 2012. Such anomalies are a direct "fingerprints" of short-term biogeochemical feedbacks onto climate and, as such, are a key science target for the Southern methane anomaly project (SMA); an integrated programme of observations, field campaigns and modeling studies to be undertaken in 2014 to investigate these anomalies in their wider Southern Tropical setting (Figure 1).

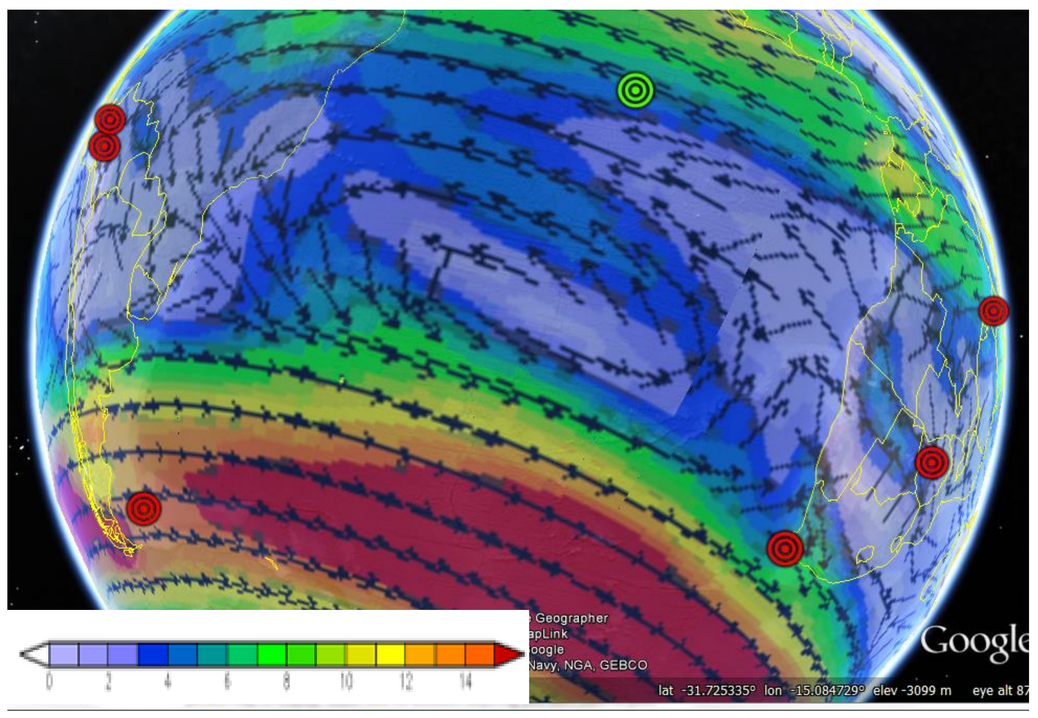

Figure 1: Ascension Island (Green) and other SMA measurement sites (Red) around the Southern Atlantic. Wind vectors (courtesy of NOAA/CIRES) are shown at 700mb level for Jan-Mar 2000-2010. Colour scale is in m/s.

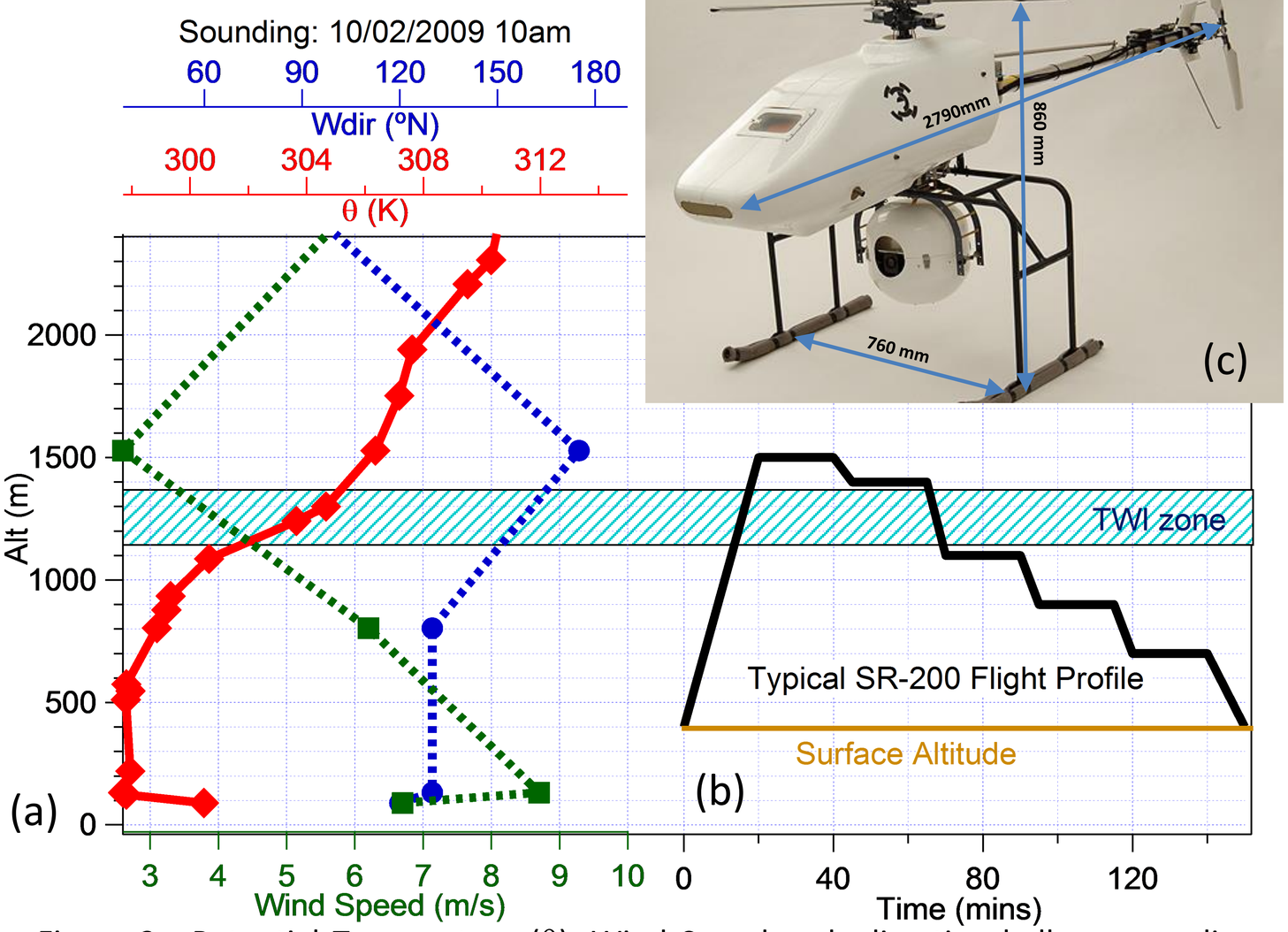

Figure 2: Potential Temperature (θ), Wind Speed and direction balloon sounding from February 2009 compared with typical planned flight profile for Ascension Island RPV campaign. SR-200 RPV system is shown in (c).

RPV Sampling on Ascension Island

The SR 200 RPV (Fig. 2c) has a 121cc 9hp Gasoline 2-stroke Engine, a 3m diameter rotor, a dry weight of 25 kg, a maximum additional payload capacity of 22.7 kg, and a maximum flight duration of 5 hours. It is capable of sampling up to a maximum altitude of 1500m (Rotomotion, 2011). The RPV will be equipped with a gas grab-sampling system developed at the University of Birmingham and deployed on Ascension Island in the South Atlantic Ocean in early 2014 for two field periods of 14 days with up to four daily ascents.

Ascension near-ground air comes almost invariantly from the far south in the SE Trades, and above the Trade Wind Inversion (TWI), comes from either tropical Africa or tropical South America (e.g. Figure 1). Thus Ascension is perfectly situated to measure methane in the Trade Winds from a massive swath of the deep south Southern Hemisphere.

Gas Grab Sampler

The grab-sampler payload consists of 7 sampling vessels (Tedlar bags), a valve switching system, a DC pump, and sampling inlet (Fig. 3). The inlet projects forwards and includes a chemical drier. A low cost, lightweight ARM processor controls the pump, multiport valve, polls the autopilot for positional data, and records sampling parameters. The system can either automatically sample predefined volumes of air at designated altitudes, or be manually operated via surface telemetry. A typical 2hr sortie would comprise ascent to above the trade wind inversion, with subsequent pauses for grab-sampling at several levels on the way down (Fig. 2b).

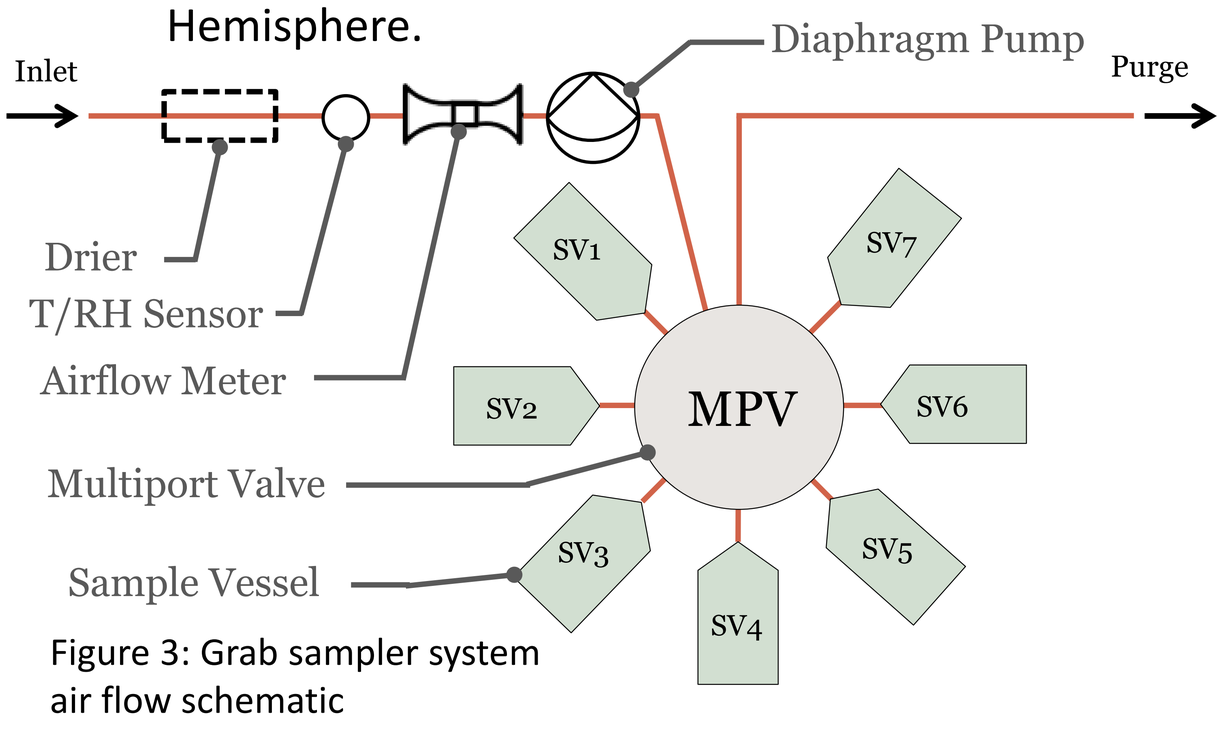

Figure 3: Grab sampler system air flow schematic

References: 1) Bousquet, P. et al. (2006) Contribution of anthropogenic and natural sources to atmospheric methane variability. *Nature* **443**, 439-443; 2) Rotomotion, 2011, SR200 Helicopter UAV Specs, accessed 17th April 2013, http://www.rotomotion.com/

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