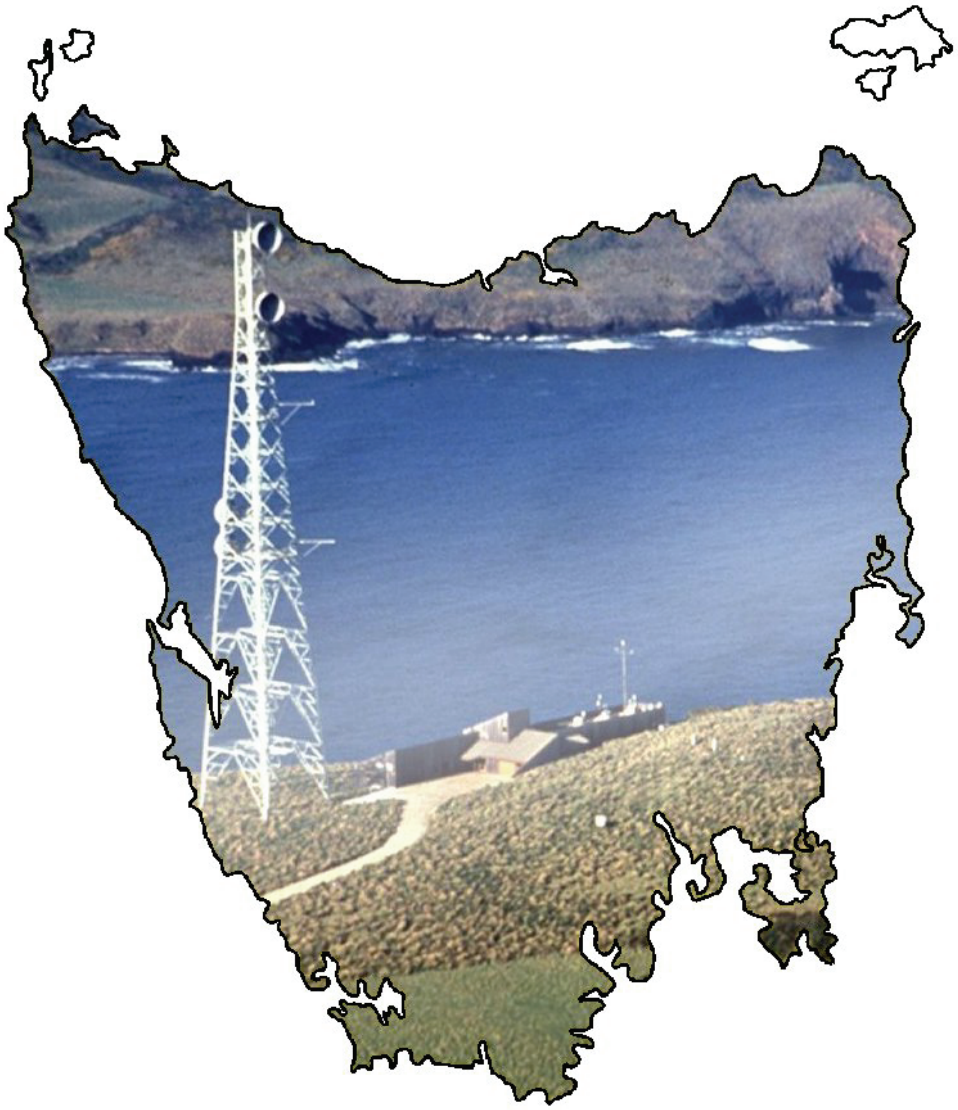
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Cape Grim Baseline Air Pollution Station
Annual Science Meeting 2007

ABSTRACTS



Edited by
Paul Krummel, Nada Derek & Jill Cainey

CENTRE FOR AUSTRALIAN WEATHER AND CLIMATE RESEARCH
CSIRO MARINE AND ATMOSPHERIC RESEARCH
ASPENDALE, VICTORIA
6 - 7 DECEMBER 2007

Cape Grim Baseline Air Pollution Station
Annual Science Meeting 2007

Centre for Australian Weather and Climate Research
CSIRO Marine and Atmospheric Research
Aspendale, Victoria

6 – 7 December 2007

Thursday, 6th December		
Chair		
09:00	Convenors	General information on arrangements etc.
09:05	Greg Ayers?	Welcome and opening of meeting
09:15	Stephen Wilson	Hydroxyl radical concentration estimates at Cape Grim
09:40	Paul Steele	Recent changes in the growth of atmospheric methane
09:55	Wayne Kirstine	A global environmental model for ethanol
10:20	Rob Gillett	Oxalic acid and oxalate in the atmosphere
10:45	**Morning Tea**	**Provided**
11:10	Ian Galbally	The Cape Grim Reactive Gases Program
12:00	Samuel Oltmans	Background tropospheric ozone on the west coast of the United States
12:25	Matt Tully	Interannual variability in southern hemisphere ozone
12:50	Peter Vohralik	Aircraft impact on ozone: the role of plume processes
13:15	**Lunch**	**Own Arrangements**
Chair		
Wlodek	Zoë Loh	Cavity ringdown spectroscopy of atmospheric trace gases
14:25	Paul Steele	Calibration of CO_2 measurements, an evolving challenge
14:50	Marcel van der Schoot	LoFlo continuous CO_2 analysers - calibration and observation network performance in new Australian regional GHG network
15:15	Rachel Law	No evidence for a saturating Southern Ocean carbon sink due to recent climate change
15:40	**Afternoon Tea**	**Provided**
16:05	Andrew Bowie	The importance of iron for sub-Antarctic zone ecosystems: an atmospheric source from Australia?
16:30	Colin Allison	Calibration of carbon dioxide stable isotope measurements in CSIRO's GASLAB
16:55	Andrew Smith	Update on the atmospheric and soil gas $^{14}CO_2$ program at ANSTO
17:20	Wlodek Zahorowski	Radon-222 in characterisation of turbulent transport and exchange in the lower atmosphere
17:45	**Close of Papers**	
17:50	**Poster, Wine and Cheese Evening**	CSIRO Marine and Atmospheric Research Canteen
19:30	**Meeting Dinner**	**Gold Fish – 1/93 Wells Road, Chelsea Heights**

Cape Grim Baseline Air Pollution Station
Annual Science Meeting 2007

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CSIRO Marine and Atmospheric Research
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Friday, 7th December		
Chair		
09:00	Convenors / Hosts	
09:05	Tal Katz-Freiman	Urban and rural biomass burning in Southern Africa
09:30	John Gras	Postfrontal nanoparticle enhancement
09:55	Melita Keywood	Organic composition of aerosol at Cape Grim
10:20	Jill Cainey	Particle formation – is there a role for plankton and seaweed?
10:45	**Morning Tea**	**Provided**
11:10	Michael Grose	An analysis of baseline methyl halide and small particle measurements from Cape Grim, investigating evidence of coastal sources
11:35	Pater Franz	Trace gas research at NIWA Wellington – current status and new tools
12:00	David Etheridge	A new multi purpose atmospheric monitoring station in southwest Victoria - the Otway Project.
12:25	Steven Siems	An autopsy on a proposal to the atmospheric radiation measurement program for the deployment of the ARM mobile facility (AMF)
12:45	**Lunch**	**Own Arrangements –** Breakout meeting on ARM mobile facility - Siems
Chair		
13:45	Paul Krummel	Analysis of the Cape Grim air archive on the CSIRO Aspendale Medusa instrument
14:10	Cathy Trudinger	Global PFC emissions from measurements on the Cape Grim air archive and Antarctic firn air
14:35	Paul Fraser	PFC emissions from Australian aluminium production
15:00	Colin Allison	Emissions of non-CO_2 greenhouse gases and ozone depleting chemicals from the Rye landfill site
15:25	**Afternoon Tea**	**Provided**
15:50	Additional meeting for interested parties	Tropical Baseline Station - Forgan
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HYDROXYL RADICAL CONCENTRATION ESTIMATES AT CAPE GRIM

S. Wilson*

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Abstract

Measurements of global and diffuse UV-B irradiance, spectrally resolved, have been made for several years at Cape Grim [Wilson, 2006]. These measurements have been calibrated using co-located sunphotometers using methods that have been developed at Cape Grim [Wilson and Forgan, 1995].

The measurements can then be used to derive estimates of the photolytic production of the excited oxygen atom (O ^{1}D) from ozone (J O ^{1}D) [Wilson, 2004]. These estimates compare well with those made by more direct measures of the photolysis rate as part of SOAPEX-2.

The OH concentration under baseline conditions can be determined through a relationship between J O (^{1}D), [O_3], [H_2O] and OH [Creasey *et al.*, 2003] (See figure 1), or a simple photochemical steady state estimate justified by the detailed measurements and analysis arising from SOAPEX-2 [Sommariva *et al.*, 2004]. Such estimates will be compared with the modelled estimates of the OH concentration for Cape Grim.

Reference

Creasey, D. J., G. E. Evans, D. E. Heard, and J. D. Lee, Measurements of OH and HO_2 concentrations in the Southern Ocean marine boundary layer, *J. Geophys. Res.*, *108*(D15), 4475, doi:10.1029/2002JD003206, 2003.

Sommariva, R., A. L. Haggerstone, L. J. Carpenter, N. Carslaw, D. J. Creasey, D. E. Heard, J. D. Lee, A. C. Lewis, M. J. Pilling, and J. Zádor, OH and HO_2 chemistry in clean marine air during SOAPEX-2, *Atmos. Chem. and Phys.*, *4*, 839-856, 2004.

Wilson, S. R., O (^{1}D) photolysis estimates for Cape Grim, in *Cape Grim Baseline Air Pollution Station Annual Science Meeting 2004* [abstracts], 14-15 October 2004, Aspendale, Victoria, edited by J. Cainey and N. Derek, CSIRO Atmospheric Research, Aspendale, Victoria, 8, 2004.

Wilson, S. R., The Cape Grim Scanning UV Spectrometer, in *Baseline Atmospheric Program (Australia) 2003-2004*, edited by J. M. Cainey, N. Derek and P. B. Krummel, Australian Bureau of Meteorology and CSIRO Marine and Atmospheric Research, Melbourne, Australia, 9-16, 2006.

Wilson, S. R., and B. W. Forgan, *In Situ* Calibration Technique for UV Spectral Radiometers, *Appl. Opt.*, *34*(24), 5475-5484, 1995.

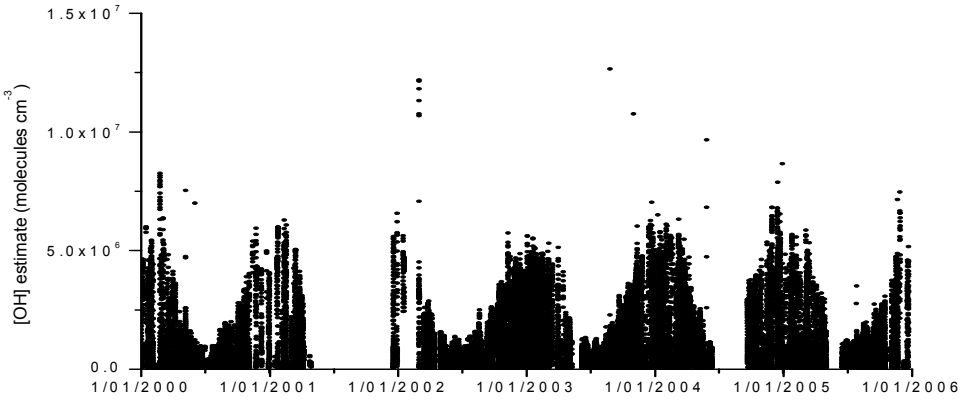


Figure 1. Estimates of [OH] at Cape Grim for 2000 – 2005 based on measurements of O (^{1}D) photolysis rate.

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RECENT CHANGES IN THE GROWTH RATE OF ATMOSPHERIC METHANE

P. Steele[1*], P. Krummel[1], P. Fraser[1], R. Langenfelds[1], R. Weiss[2], P. Salameh[2], C. Harth[2] and L. Porter[3†]

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Abstract

For the 8-year period 1999-2006 inclusive, annually averaged values of the baseline mixing ratio of atmospheric methane (CH_4) at Cape Grim remained remarkably stable, with a mean value of 1729.01 nanomoles per mole (nmol mol^{-1}) of dry air, and a standard deviation of only 0.80 nmol mol^{-1}. The highest value was 1730.39 nmol mol^{-1} in 2003, and the lowest was 1727.97 nmol mol^{-1} in 2006. These values are based on the AGAGE (Advanced Global Atmospheric Gases Experiment) *in situ* measurements of methane which have been made at Cape Grim since 1993.

This hiatus in the growth rate of atmospheric methane appears to be coming to an end. The seasonal maximum CH_4 in September 2007 rose to about 8 nmol mol^{-1} higher than those in any of the previous 8 years. A preliminary analysis of the data will be presented, and comparisons with CH_4 data from flask samples will be made.

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A GLOBAL ENVIRONMENTAL MODEL FOR ETHANOL

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Abstract

A global environmental model of ethanol is presented that provides quantitative estimates of the global sources of ethanol, modelled loss processes and a balanced budget for ethanol in the global environment. This model is presented at a time when ethanol is increasingly used as a petrol additive or extender, and when atmospheric concentrations are known to be enhanced in regions where ethanol is utilised as a fuel. The total annual global production of ethanol is estimated as 67 Tg y^{-1}, of which 92% comes from the fermentation pathway in plants. The removal by hydroxyl radical oxidation in the atmosphere accounts for 80% of the removal. In the continental boundary layer, the concentrations of ethanol are predicted as 1.1 nmol mol^{-1} in the Northern and Southern Hemispheres. These concentrations are 20 – 40 times higher than those in the free atmosphere. Due to the paucity of ethanol measurements in the Southern Hemisphere, the predictions of this model provide important and topical estimates of the ethanol mixing ratios in the continental boundary layer and the free atmosphere of the Southern Hemisphere.

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OXALIC ACID AND OXALATE IN THE ATMOSPHERE

R. Gillett*, I. Galbally, G. Ayers, P. Selleck, J. Powell, M. Meyer, M. Keywood and R. Fedele

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Abstract

Oxalic acid gas and particulate concentrations have been measured at a number of locations from remote areas such as the Burrup Peninsula, WA to rural in the Hunter Valley in NSW and an site urban in Melbourne, all in Australia, and Petaling Jaya, near Kuala Lumpur, Malaysia.

The concentrations of oxalic acid gas at the remote and rural sites range from about 700 ng m^{-3} to 4000 ng m^{-3} and have a very strong annual cycle, with high concentrations during the summer periods. At the urban site in Petaling Jaya concentrations of oxalic acid gas are higher than at the remote sites, ranging from about 8000 ng m^{-3} to 30,000 ng m^{-3} and up to about 60,000 ng m^{-3} during episodic events, and they do not display a distinct annual cycle.

Oxalate particulate concentrations were measured concurrently with oxalic acid gas concentrations at some sites and the data show that at least 85% of the total is in the gas phase, which is consistent with the high vapour pressure of oxalic acid at ambient temperatures. The data presented here show a widespread occurrence of oxalic acid gas in the atmosphere. The seasonal variation in concentrations at remote sites exhibit a summer maximum and a winter minimum, suggesting that either plants or photochemistry may be the dominant source of oxalic acid in remote and rural continental atmospheres. The only previously clearly defined source of oxalic acid is motor vehicle exhaust.

The data from Petaling Jaya show that concentrations of particulate oxalate and oxalic acid were high during periods of intense forest fires in Asia indicating that biomass burning is probably a significant source of oxalic acid gas concentrations observed in the atmosphere. The mass of oxalic acid emitted from biomass burning worldwide is calculated to be 28 Tg y^{-1} ± 20 Tg y^{-1}, including 2.8 Tg y^{-1} ± 2 Tg y^{-1} particulate phase oxalic acid.

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THE CAPE GRIM REACTIVE GASES PROGRAM

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Abstract

A review will presented of the Cape Grim Reactive Gases Program since its inception in 1976 as the Surface Ozone and Nitrogen Oxides Measurements and its subsequent evolution through the O_3, NO_x and VOCs Program to its current form.

The review will cover:

- The program goals (past and present)
- The instrumentation including its in-house development (past, present, future)
- The ongoing monitoring of surface O_3
- The campaigns, NO_x, VOCs, ACE1, SOAPEX.
- The discoveries and achievements
- The documentation

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BACKGROUND TROPOSPHERIC OZONE ON THE WEST COAST OF THE UNITED STATES

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Abstract

Rapidly increasing economic development in eastern and southern Asia with the accompanying emission of pollutants into the atmosphere has raised the awareness of the potential for long range transport of pollutants across the Pacific to North America. In particular ozone formed from precursor emissions in Asia has been suggested as a contributor to enhanced background ozone levels entering the U.S. with possible impacts on the ability to meet ambient air quality standards. The NOAA Earth System Research Laboratory, Global Monitoring Division (ESRL/GMD) operates an air sampling observatory at Trinidad Head, California on the Pacific coast of the U.S. at 41°N latitude. Continuous measurements of surface ozone and aerosols are made along with weekly flask sampling. This is also an AGAGE site with a large suite of species measured on a continuous basis. In addition to the 5+ years of ground-based measurements, there is now a 10-year record of weekly ozone profile measurements from ozonesondes. The dominant air flow to this site is from off the Pacific Ocean with minimal influence from air that has passed over North America, and as such represents 'background' air entering the continent.

Spring is the season of strongest transport across the Pacific and also the season with the highest observed ozone amounts at Trinidad Head with hourly average ozone mixing ratios exceeding 50 ppbv. While ozone near the surface declines too much lower amounts during the summer, ozone in the troposphere above the boundary layer (altitudes > 1 km) remains relatively high with the minimum occurring during the winter. Although the springtime flow to Trinidad Head is dominated by air coming from the west or northwest, occasional events with flow from the northern hemisphere subtropics bring air with much lower ozone levels to the observing site. The spring, especially in the free troposphere, is regularly punctuated with air that likely had a relatively recent stratospheric origin. In most cases air that reaches the west coast of the U.S. near the surface has spent one to two weeks over the Pacific and likely represents a mixture of sources. The relatively short 5-year record of surface ozone shows a consistent year-to-year pattern with no longer term change. The longer 10-year ozonesonde record also does not indicate that there has been a significant change in tropospheric ozone over this period.

Reference

Oltmans, S. et al., Background ozone levels of air entering the west coast of the U.S. and possible longer-term changes in background ozone levels, *Atmos. Environ.*, in preparation, 2007.

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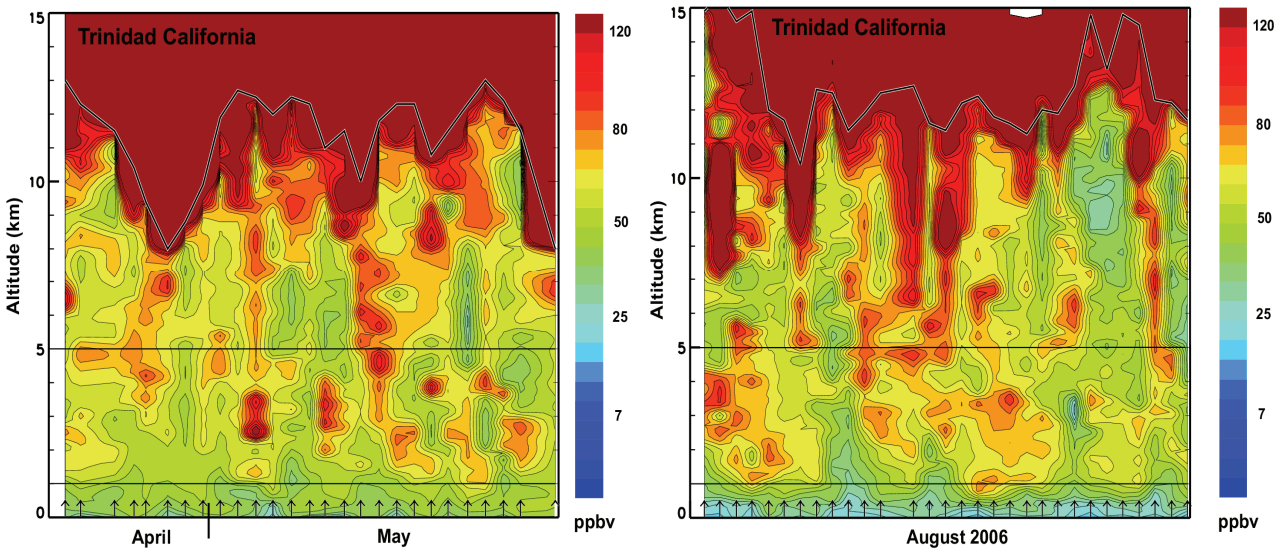


Figure 1. Cross-section of daily ozone mixing ratio profiles for two periods (April-May 2002 and August 2006) with daily ozonesonde measurements.

INTERANNUAL VARIABILITY IN SOUTHERN HEMISPHERE OZONE

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Abstract

Ozone climatologies are presented for a number of locations in the Australian region, making use of both total ozone and ozone profile data, as measured by the Bureau of Meteorology's Dobson and ozonesonde networks. For mid-latitude sites (Melbourne and Macquarie Island), interannual variability is found to be dominated by the Quasi-Biennial Oscillation (QBO), particularly in the winter and spring months when the Brewer-Dobson circulation is strongest.

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AIRCRAFT IMPACT ON OZONE:THE ROLE OF PLUME PROCESSES

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[2]*Boeing Company, Seattle, Washington, USA*

Abstract

A Gaussian plume model was used to investigate the chemistry in expanding aircraft plumes for a wide range of conditions, including the plume expansion rate, the composition of the background atmosphere, and the total time of the plume integration. The conversion of NO_x in the plume to more stable nitrogen compounds is sensitive to the amounts of O_3 and HO_x in the background air, and is therefore a strong function of altitude, latitude, season and other factors affecting the composition. This dependence of plume processing on latitude, altitude and season has been studied in order to generate parameterizations for use in global models.

Two different parameterizations which have been used in previous investigations to couple plume processes to global models are compared in the present work. One of these earlier studies reported reductions of 20-35% in aircraft-induced NO_x at cruise altitude and 10-12% smaller column ozone changes at northern mid latitudes when plume effects were incorporated. Our results suggest that plume processing has only a small effect on the calculated aircraft impact on ozone at subsonic cruise altitudes. Both plume parameterizations gave small changes in ozone perturbations, suggesting that the differences between previous modelling studies are not primarily due to the different parameterizations used in those studies.

Reference

Vohralik, P. F., L. K. Randeniya, I. C. Plumb and S. L. Baughcum, The effect of plume processes on aircraft impact, *J. Geophys. Res. - Atmospheres*, accepted, to appear.

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CAVITY RINGDOWN SPECTROSCOPY OF ATMOSPHERIC TRACE GASES

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Abstract

Laser absorption spectroscopy techniques are commonly used for determining concentration in many disciplines, but have not generally been applied to the measurement of atmospheric trace gases due to the rigorous sensitivity and precision demands of that task. Emerging variants of a technique known as cavity ringdown spectroscopy offer the required precision for atmospheric trace gas measurements and field deployable instrumentation is becoming commercially available. In these instruments, the optical cell is formed by a pair of highly reflective mirrors, resulting in effective path lengths of up to several kilometres, providing excellent sensitivity for species present at trace amounts.

Unlike conventional absorption spectroscopic techniques, in which the magnitude of absorption is measured, cavity ringdown spectroscopy measures the rate of absorption to determine concentration. After injection of light into the cavity, the signal intensity is monitored as a function of time. When the cavity is empty, the output light intensity decays at a rate related to the reflectivity of the mirrors as a small fraction of the light is transmitted through the mirrors with every pass. The 'cavity ringdown' time, τ, is the time taken for the cavity output intensity to drop to 1/e of its initial value. A decay profile associated with the empty cavity scenario is depicted in Figure 1, curve a. When an absorber is present in the cell, the characteristic ringdown time is modified as shown in Figure 1, curve b, such that $\tau_a > \tau_b$.

This talk will outline the theory behind cavity ringdown spectroscopy and discuss how it will be used at the Otway site for obtaining continuous measurements of $^{12}CH_4$ and $\delta^{13}CO_2$.

Reference

Paul, J. B., L. Lapson, and J. G. Anderson, Ultrasensitive absorption spectroscopy with a high-finesse optical cavity and off-axis alignment, *Applied Optics*, Vol. 40, No. 27, 4904-4910, 2001.

Baer, D. S., J. B. Paul, M. Gupta, and A. O'Keefe, Sensitive absorption measurements in the near-infrared region using off-axis integrated-cavity-output spectroscopy, *Applied Physics B*, Vol. 75, 261-265, 2002.

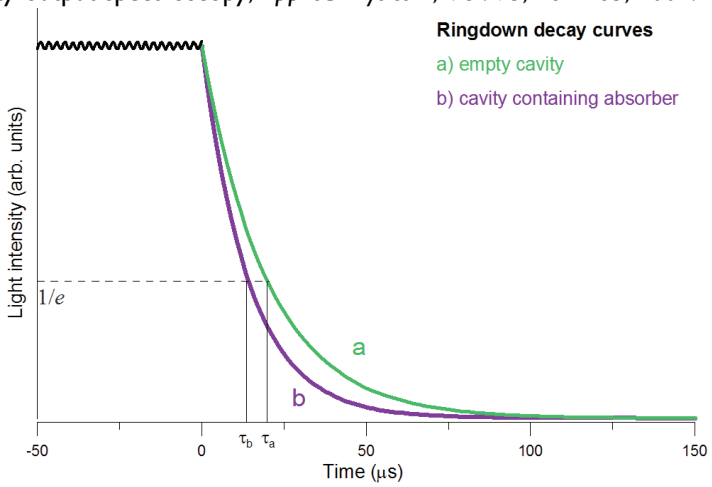


Figure 1. Ringdown decay curves. In trace a) the optical cell is empty and the decay curve can be used to determine mirror loss. In trace b) an absorber is present in the cell, modifying the decay profile.

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CALIBRATION OF CO_2 MEASUREMENTS, AN EVOLVING CHALLENGE

P. Steele[1*], R. Langenfelds[1], P. Krummel[1], M. van der Schoot[1], and L. Porter[2†]

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Abstract

Continuous measurements of atmospheric CO_2 were begun by Charles David Keeling at the Mauna Loa Observatory (MLO), Hawaii in March 1958, almost 50 years ago, pioneering the use of infrared analysers for this purpose (Keeling, 1978). The MLO CO_2 record since that time has become one of the most recognised time series of a geophysical measurement in existence. Keeling also established the so-called manometric measurement technique for CO_2, which continues to form the basis for the calibration of CO_2 measurements.

A brief overview will be presented of the basis for calibration of CO_2 measurements, as well as the challenges and opportunities ahead, as new measurement techniques are emerging.

Reference

Keeling, C.D., The influence of Mauna Loa Observatory on the development of atmospheric CO_2 research, *in: Mauna Loa Observatory, a 20th Anniversary Report*, edited by John Miller, U.S. Department of Commerce/NOAA, Boulder, Colorado, USA, September 1978, pp. 36-54.

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LoFlo continuous CO_2 analysers - calibration and observation network performance in new Australian regional GHG network

M. V. van der Schoot*, L. P. Steele, D. A. Spencer, P. B. Krummel, and R. J. Francey

Centre for Australian Weather and Climate Research/CSIRO Marine and Atmospheric Research, Aspendale, Victoria

Abstract

Results are presented from a series of calibration experiments which have been conducted to investigate the propagation of CO_2 mole fraction mixing ratios in dry CO_2-in-air standards. A primary, CSIRO GASLAB (Global Atmospheric Sampling LABoratory) calibration suite, consisting of seven standards, each of which has been calibrated by the WMO CCL (NOAA ESRL CCGG), has been used to propagate the CO_2 calibration scale to other LoFlo calibration suites using a high precision LoFlo CO_2 analyser ('LoFlo 2B'). The results of these experiments will be described in detail.

Preliminary data will be presented from continuous atmospheric LoFlo CO_2 measurements sites initiating the new Australian Regional Greenhouse gas Observational Network (ARGON) which includes Cape Grim Baseline Air Pollution Station and a recently installed (March 2005) LoFlo CO_2 analyser system at the remote Macquarie Island (54.48°S, 158.97°E) in the Southern Ocean.

These results demonstrate the very high precision achievable (using LoFlo technology) to: measure CO_2-in-air gas standards and atmospheric CO_2, and importantly in propagating and maintaining a central calibration scale network wide. This should allow the successful resolution of small atmospheric CO_2 spatial gradients across the Southern Ocean and the inference of CO_2 fluxes in this region.

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NO EVIDENCE FOR A SATURATING SOUTHERN OCEAN CARBON SINK DUE TO RECENT CLIMATE CHANGE

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Abstract

Le Quéré *et al.* [2007] used inversions of atmospheric CO_2 and ocean model simulations to estimate southern ocean carbon uptake and concluded that the southern ocean carbon sink was not increasing as rapidly as would be expected due to increasing CO_2 in the atmosphere. In fact they found a small positive trend in southern ocean carbon uptake between 1981 and 2004 (i.e. a decreasing carbon sink) and they attributed this to changes in wind forcing over this period. We have also estimated southern ocean carbon uptake using inversions of atmospheric CO_2 and ocean model simulations and our results do not support their conclusions. We used simulated carbon fluxes and atmospheric CO_2 concentrations to test our inversion methodology and found that the interannual variability and trend in southern ocean carbon uptake can be reliably retrieved using only the small number of observing sites active since the early 1980s. We also found in our test inversion that the estimated trend is relatively insensitive to the network of observing sites used. In contrast, when the inversion is performed with real observed atmospheric CO_2 we find a large sensitivity to the network choice. Networks including Amsterdam Island (AMS) and Ascension Island (ASC) data give the positive trend in southern ocean carbon uptake found by Le Quéré *et al.* (2007) (who included these sites in their inversions) while networks without these sites give the negative trend in southern ocean carbon uptake expected from increasing atmospheric CO_2. Examination of the AMS and ASC CO_2 records suggest measurement or sampling error in the ASC record in the early 1980s and in the AMS record in recent years. During these periods the AMS and ASC records can differ by 0.2-0.5 ppm from other nearby sites and these differences are sufficient to explain the change in carbon sink trend.

The CSIRO ocean carbon model [Matear & Lenton, 2007] has been run from 1948 to 2002 using firstly, observed winds and heat and freshwater fluxes from 1948-2002 and secondly, constant 1948 forcing. In both cases an increasing southern ocean carbon sink is found, consistent with the inversion without AMS and ASC. In the first simulation we find two compensating processes occurring: the observed wind forcing reduces the southern ocean carbon sink, as was found by Le Quéré *et al.* [2007] but the observed heat and freshwater flux forcing increases the carbon sink. The combination of our inversion results and the ocean model simulations lead us to the conclusion that the evidence for a saturating southern ocean climate sink due to recent climate change is not robust.

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THE IMPORTANCE OF IRON FOR SUB-ANTARCTIC ZONE ECOSYSTEMS: AN ATMOSPHERIC SOURCE FROM AUSTRALIA?

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Abstract

The SAZ-SENSE expedition took place in mid-austral summer 2007 in the Australian sector of the Southern Ocean south of Tasmania, with an overall goal of understanding the controls on Sub-Antarctic Zone (SAZ) productivity and carbon cycling, and assessing their sensitivity to climate change. Three process stations (SAZ-West, Polar Frontal Zone and SAZ-East) were identified to take advantage of naturally-occurring, persistent, zonal variations in Southern Ocean biogeochemical processes, primary production and biomass.

This paper focuses on the role of iron, predominantly a limiting micronutrient in the high-nutrient low-chlorophyll Southern Ocean, and its function in structuring the lower phytoplankton productivity waters west and south of Tasmania, compared with higher productivity waters to the east. We report detailed dissolved and particulate iron distributions (which were obtained using a new autonomous trace metal sampling rosette), together with atmospheric fluxes measured during the expedition. The exported iron flux to deeper waters, and its relationship to carbon and major nutrients, was obtained using free-floating sediment traps. Other trace elements were used to fingerprint the source of the iron to the SAZ, in an attempt to differentiate between atmospheric (dust) inputs from the Australian continent and the intrusion of sub-tropical waters from the north (which may be enriched with iron from resuspended shelf sediments). We conclude by assembling a preliminary iron budget for the SAZ region, and investigate its sensitivity to past and future global change.

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CALIBRATION OF CARBON DIOXIDE STABLE ISOTOPE MEASUREMENTS IN CSIRO's GASLAB

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Abstract

We have recently published a detailed description of the CSIRO2005 calibration procedures used at CSIRO Marine & Atmospheric Research GASLAB for stable isotope measurements of atmospheric carbon dioxide [Allison and Francey, 2007]. The Cape Grim *in situ* and flask programs, with relatively independent calibration strategies, provide a unique opportunity to assess the procedures, while 'guest' programs provide indirect scale comparisons (via the Cape Grim records) with other laboratories. A major improvement is the individual uncertainty assignment to CO_2 stable isotope measurements made in GASLAB from 1978 through to the present. All measurements continue to be expressed on the internationally recognized VPDB scale, but the uncertainty assigned to individual measurements includes the sample analytical uncertainties plus assignment uncertainties for all standards used in scale propagation. A significantly lower uncertainty in temporal or spatial gradients based on CSIRO GASLAB measurements is achieved if the uncertainties are expressed relative to the internal CSIRO2005 scales; a fixed uncertainty due to the link to VPDB can be included for comparison with results from other laboratories. Combination and/or selection using the two Cape Grim programs provides 'best estimate' values and uncertainties of $\delta^{13}C$ and $\delta^{18}O$ in baseline atmospheric CO_2 over 25+ years. The impact of recommendations made at recent WMO/IAEA CO_2 Experts Meetings [e.g. WMO, 2006] to modify both the ion correction procedure and assigned values of the VPDB calibration material used in the CSIRO GASLAB procedure will be examined.

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UPDATE ON THE ATMOSPHERIC AND SOIL GAS $^{14}CO_2$ PROGRAM AT ANSTO

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Abstract

We report on developments in the ANSTO atmospheric and soil gas $^{14}CO_2$ program since the 2006 Cape Grim Baseline Air Pollution Station Annual Science Meeting. This period has seen a refinement of the apparatus used to cryogenically separate the CO_2 from the air stream. Now that the method has been improved, effort is underway to automate the process as much as possible. This will have the dual purpose of improving the reproducibility of the extractions, in terms of flow rates and trapping pressures, and also of permitting the extractions to be undertaken by laboratory technicians, rather than by scientists.

$^{14}CO_2$ measurements have been completed on a set of six replicate 0.5L GASLAB glass flasks, a set of six 5 L glass flasks sampled at South Pole and a set of six soil gas samples from the Otway Basin geosequestration project in Western Victoria. The latter samples were provided in gas storage bags that performed much better than those used in the initial pilot study. Additionally, we have devised a design for 1.5 L dual-ported glass flasks, which optimise the sample size for ^{14}C AMS on graphite derived from air CO_2. 20 of these flasks have been manufactured and are currently undergoing testing.

ANSTO and CSIRO are participating in the first international $^{14}CO_2$ atmospheric inter-comparison experiment, organised by NOAA/CMDL & INSTAAR (Colorado). This involves two rounds, filling flasks from two parent cylinders of air for distribution to the participating laboratories. CO_2 extractions from the first round have been completed and the samples have been converted to graphite. Flasks from the second round will be despatched by the end of the year. This represents an ideal opportunity to benchmark our performance.

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RADON-222 IN CHARACTERISATION OF TURBULENT TRANSPORT AND EXCHANGE IN THE LOWER ATMOSPHERE

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Abstract

Radon-222 is a naturally occurring radioactive tracer of air mass transport on local to regional scales. Our group has a long history of deploying radon systems in international collaborative field campaigns and long-term monitoring programs including the World Meteorological Organisation's Global Watch Program, CarboEurope and the North American Carbon Program. Over the last three years we have initiated a new program of research, using radon-222 to advance our understanding of physical processes involved in turbulent transport and exchange in the lower atmosphere.

The experimental approach adopted involves characterisation of turbulence and mixing conditions in the lower atmosphere using meteorological towers and aircraft: (1) Continuous measurements of radon-222 gradients are conducted at two meteorological towers on seasonal and inter-annual timescales. Near-surface gradients (2-50m) are recorded on a 50m tower at Lucas Heights, New South Wales, and boundary layer gradients (20-200m) are recorded on a 213m tower at the Cabauw Experimental Site for Atmospheric Research in the Netherlands. (2) Radon-222 vertical profiles up to 4,000 m above ground level are measured in different seasonal and synoptic conditions using samplers mounted on light aircraft. We present experimental details and discuss selected results.

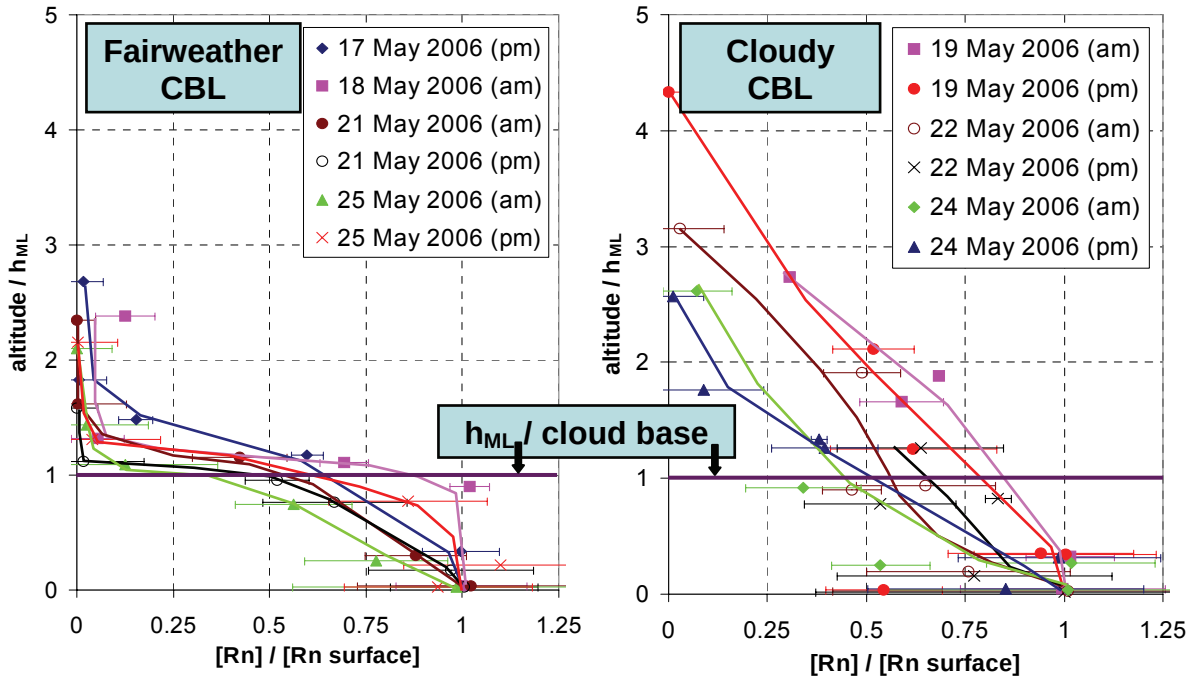


Figure 1: Vertical profiles of radon-222 concentrations in convective atmospheric boundary layers over rural inland New South Wales under cloudless (left) and cloudy (right) conditions. Radon displays a strong gradient within the (sub-cloud) mixed layer despite significant turbulent mixing.

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ATMOSPHERIC O_2/N_2 CHANGES, 1993–2002: IMPLICATIONS FOR THE PARTITIONING OF FOSSIL FUEL CO_2 SEQUESTRATION

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Abstract

Improvements made to an established mass spectrometric method for measuring changes in atmospheric O_2/N_2 are described. With the improvements in sample handling and analysis, sample throughput and analytical precision have both increased. Aliquots from duplicate flasks are repeatedly measured over a period of 2 weeks, with an overall standard error in each flask of 3-4 per meg, corresponding to 0.6-0.8 ppm O_2 in air. Records of changes in O_2/N_2 from six global sampling stations (Barrow, American Samoa, Cape Grim, Amsterdam Island, Macquarie Island, and Syowa Station) are presented. Combined with measurements of CO_2 from the same sample flasks, land and ocean carbon uptake were calculated from the three sampling stations with the longest records (Barrow, Samoa, and Cape Grim). From 1994-2002, We find the average CO_2 uptake by the ocean and the land biosphere was 1.7 ± 0.5 and 1.0 ± 0.6 GtC yr^{-1} respectively; these numbers include a correction of 0.3 Gt C yr^{-1} due to secular outgassing of ocean O_2. Interannual variability calculated from these data shows a strong land carbon source associated with the 1997-1998 El Niño event, supporting many previous studies indicating that high atmospheric growth rates observed during most El Niño events reflect diminished land uptake. Calculations of interannual variability in land and ocean uptake are probably confounded by non-zero annual air sea fluxes of O_2. The origin of these fluxes is not yet understood.

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A NEED FOR INTERCALIBRATION OF ATMOSPHERIC AND OCEANIC MEASUREMENTS OF SHORT-LIVED HALOCARBONS

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Abstract

Understanding global and regional distributions and fluxes of short-lived halocarbons has become increasingly important. These gases have been implicated as significant sources of reactive halogens, in both the marine boundary layer and in the lower stratosphere. Several laboratories have produced data sets on short-lived halocarbons, but, because of a lack of intercalibration experiments, measurement and quality control guidelines, it is not possible to determine whether differences in data sets are real or due to measurement issues.

We seek to establish a coordinated, international calibration program and measurement guidelines for short-lived halocarbons. This program could expand on existing bilateral arrangements such as those between NOAA and AGAGE and expand on intercalibration programs, such as IHALICE, to include the ocean community and to encompass ranges of concentrations encountered by both atmospheric and oceanic communities. It is envisaged that a WMO working group could be established to oversee these activities.

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SEASONAL AND INTER-ANNUAL VARIABILITY IN AIR MASS FETCH BASED ON 3-YEARS OF OBSERVATIONS AT SADO ISLAND, JAPAN

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Abstract

Sado Island (38.25°N, 138.4°E) was the northernmost of three Southeast Asian sites at which we deployed radon detectors as part of the Asian Aerosol Characterisation Experiment (ACE-Asia). A 3-year record (2002-2004) of continuous hourly atmospheric radon concentrations at this site has now been prepared and, in conjunction with back trajectory analyses, has been used to investigate seasonal and inter-annual variability in radon-derived fetch regions. Since radon and many atmospheric pollutants have mainly terrestrial origins, fetch regions corresponding to extremes of terrestrial influence (indicated by high and low radon concentrations) are interpreted here as a measure of pollution events of terrestrial origin. The central western coast of Japan is subjected to varying degrees of pollution year round. Our analysis of air masses arriving at Sado Island that have experienced the greatest terrestrial influence indicates that the source regions for dominant pollution events changes markedly throughout the year, but the pattern is relatively consistent inter-annually. In the coldest months (November-March), when the winter monsoon flow is strongest, high radon air masses originate from north-eastern China and Mongolia. In the transitional periods between the winter and summer monsoons (mid spring and autumn) high radon air masses originate from the Korean Peninsula and Eastern China. Throughout summer the high radon air masses originate from central and southern Japan. The main contrasting factors between these pollution fetch regions are (a) a very low population density throughout the winter fetch region compared to the other two regions, and (b) a higher degree of industrialization (with low emissions control) over the transitional period fetch regions. The most severe pollution events occur when the anthropogenic emissions from the transitional fetch regions are supplemented by natural dust storms sweeping through from central Asia.

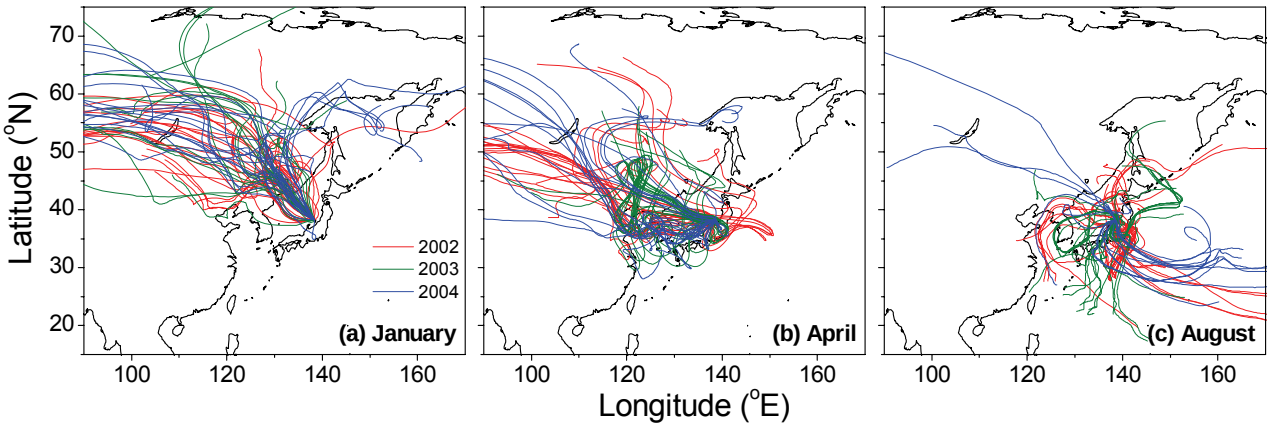


Figure 1. 7-day back trajectories from Sado Island corresponding to high radon events in months representative of (a) winter, (b) spring and (c) summer for 2002, 2003 and 2004.

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HALOCARBON AND OTHER ATMOSPHERIC TRACE SPECIES TRENDS IN THE TROPOSPHERE

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Abstract

Tropospheric trends of nitrous oxide, halocarbons, and other climate gases are shown from NOAA baseline station and cooperative stations including the Bureau of Meteorology (BoM) station at Cape Grim, Tasmania.

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OZONE IN THE LOWER TROPOSPHERE AT HIGH SOUTHERN LATITUDES

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Abstract

Understanding and characterising the variability of ozone in the lower atmosphere is a key aspect of regional and global climate assessment. Tropospheric ozone influences climate by absorbing outgoing longwave terrestrial radiation, thereby acting as a greenhouse gas, and by affecting the lifetimes and hence concentrations of other important greenhouse gases such as methane and chlorofluorocarbons. The bulk of tropospheric ozone is produced photochemically from precursors, most notably nitrogen oxides, carbon monoxide, methane and non-methane hydrocarbons, all of which have variable biogenic and anthropogenic sources. Heterogenous and oxidation reactions produce ozone sinks.

In this paper, we discuss tropospheric ozone variability at high southern latitudes through comparison of meteorological analyses with ozonesonde measurements obtained between 2003 and 2006 from Davis (69°S) and Macquarie Island (54°S), and surface ozone measurements during the Sea Ice Physics and Ecosystem eXperiment (SIPEX) of September-October 2007 from within the Antarctic pack-ice (~65°S) and between Antarctica and Tasmania.

The Davis and Macquarie Island ozonesonde measurements show a dominant annual cycle in near-surface ozone, with peak-to-peak amplitudes of approximately 20 parts per billion by volume (ppbv) and 10 ppbv respectively, on a background of 25 ppbv. The annual peak at the two sites occurs in early spring and is dictated by competition between meridional transport and photochemical loss [Klekociuk & Tully, 2007]. In the upper troposphere above Davis, distinct episodes of down-welling from the stratosphere associated with the passage of cut-off lows and the dissipation of the stratospheric ozone hole were observed.

At Davis, ozone losses of up to 15 ppbv were observed episodically within the boundary layer during winter and spring. All of these events were accompanied by strong surface temperature inversions. Two of the strongest depletion events were associated with long and slow fetches over the sea-ice region, for which heterogeneous reactions are implicated. The remainder of the events appear to have been associated with long katabatic flows over the Antarctic plateau, for which we speculate that ozone was removed to the snow pack before reaching the station. In contrast to Davis, the near-surface ozone at Macquarie Island exhibited very weak vertical gradients which exhibited variability that was likely related to horizontal transport effects.

Slow variations (on timescales of hours to 1-2 days) in surface ozone of up to 5 ppbv were observed in the pack ice during SIPEX, and the origins of these variations are discussed using back trajectory analyses. The SPIEX measurements provided an estimate of -0.2 ppbv for the meridional surface ozone gradient between latitudes of 65°S and 45°S. We discuss the SPIEX measurements in comparison with other surface ozone measurements obtained from Macquarie Island, the Southern Ocean and Cape Grim.

Reference

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GROWTH OF HFC-125 (CHF_2CF_3) DETERMINED FROM *IN SITU* OBSERVATION AT AGAGE AND SOGE OBSERVATORIES

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Abstract

High frequency, *in situ* observation from the Advanced Global Atmospheric Gases Experiment (AGAGE) and System for the Observation of Greenhouse Gases in Europe (SOGE) networks for the period 1998 to 2006 have been used to capture the rapid growth of the HFC-125 (CHF_2CF_3) in the atmosphere. These measurements indicate that the atmospheric accumulation since 1998 has been mid-way between linear growth and exponential growth. The growth rate in 2006 was 0.7 ppt/year (16%/yr) in 2006. The mole fraction in the lower troposphere at the beginning of 2006 is estimated to be 4.0 ppt.

The extensive observations have been combined with a range of modelling techniques to derive global and regional emission estimates in a top down approach, which can be compared to bottom up estimates of emissions based on production and consumption data. This independent verification of emissions is vital in assessing the effectiveness of international treaties such as the Kyoto protocol.

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FIRST YEAR OF RADON-222 GRADIENT OBSERVATIONS AT CABAUW, THE NETHERLANDS

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Abstract

We report on results of the first year of radon gradient observations at Cabauw Experimental Site for Atmospheric Research (CESAR) in the Netherlands (51.971°N, 4.927°E). Two radon-dedicated inlets are mounted on the main meteorological tower at 20 m and 200 m above ground level. The Cabauw site, located 50 km inland on a polder in an agricultural region, has a simple orography with surface elevations changing by a few metres at most within a 20 km radius. These radon gradient observations in the atmospheric boundary layer are part of an effort to characterise turbulent mixing processes throughout the lower atmosphere which also includes continuous measurements of radon gradients in the Atmospheric Surface Layer on a 50 m tower near Sydney, as well as campaign-style measurements of radon profiles up to altitudes of 3000 m above ground level using light aircraft.

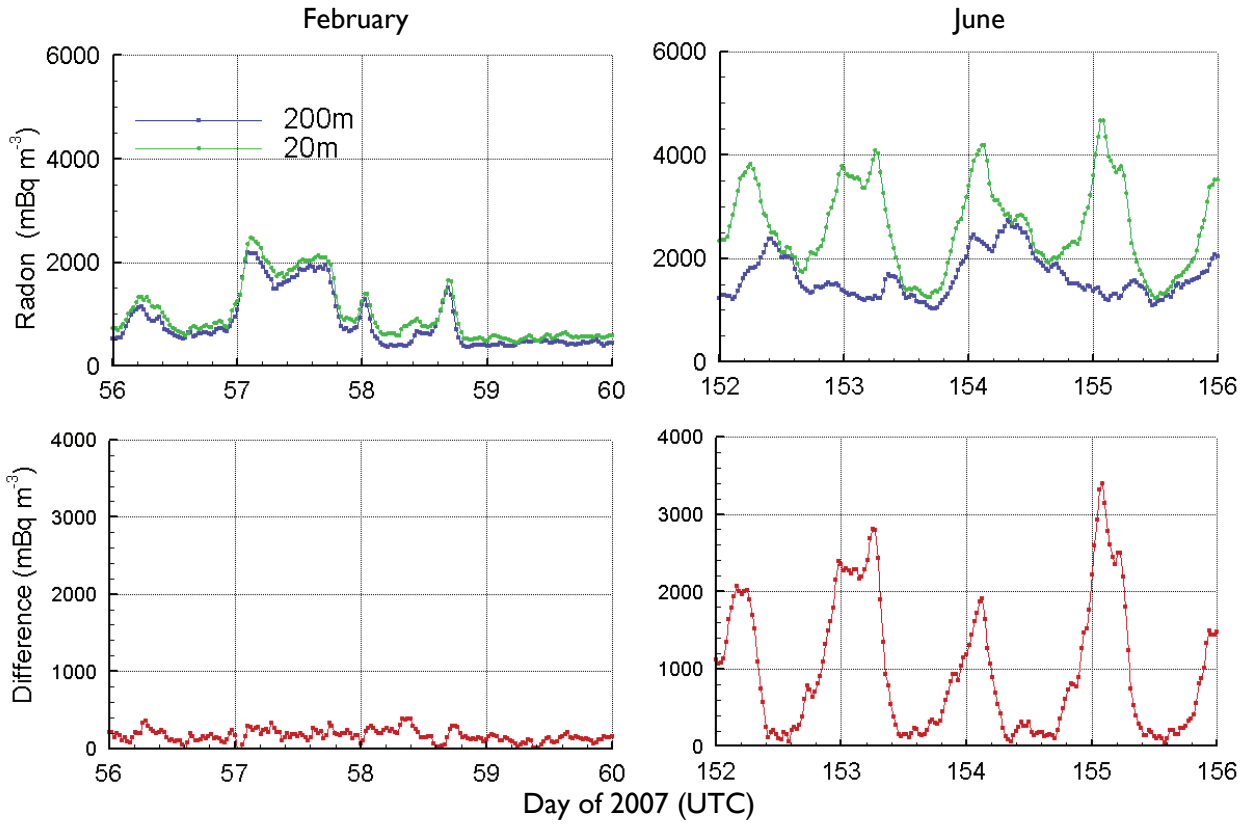


Figure 1. The figure shows sample observations of constituent radon time series (top panel) and the corresponding radon concentration gradients (bottom panels) recorded in four-day periods at Cabauw in Northern Hemisphere winter (February) and late spring (June). The seasonal differences in diurnal variability are typical for the annual set and, together, with other meteorological variables, quantify the degree of mixing in the lowest 200 m of the atmosphere.

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URBAN AND RURAL BIOMASS BURNING IN SOUTHERN AFRICA

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Abstract

An awareness of the nature and extent of aerosol distribution is key to understanding global atmospheric changes and air pollution debates. Spatially and temporally resolved information on the atmospheric burden and radiative properties of aerosols is required to estimate radiative forcing, to validate satellite and aerosol retrievals, to apply to transport and radiation budget studies as well as to incorporate into epidemiological studies.

Extensive anthropogenic burning of vegetation occurs in Africa south of ~20°S – be it on a daily basis for domestic cooking and heating purposes in non-electrified urban and rural settlements, or through intensive seasonal open fire vegetation clearing (August-October). The atmospheric aerosol and trace gas loading resulting from these activities significantly affects not only the source regions but the chemistry and physics of the entire subcontinent, through localised to large-scale transport in the low- to mid-troposphere. Various campaigns over the last decade and a half have attempted to understand and quantify the direct and indirect impacts of biomass burning on the region relative to other natural and man-made emissions. The nature and extent of seasonal aerosol loading and transport over Southern Africa's urban, rural and remote regions will be presented through some of the major projects undertaken in the region.

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POSTFRONTAL NANOPARTICLE ENHANCEMENT

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Abstract

An enhancement of nanoparticle concentrations, in the form of a nucleus mode, is a frequent feature following cold fronts at Cape Grim. We have examined the importance of these events for their potential to add to the CCN-size particle population. The approach taken relies on the quasi-stable nature of the size distribution observed in the Southern Ocean marine boundary layer and a modelled removal rate including aerosol-aerosol and aerosol-cloud droplet coagulation, dry deposition to the ocean surface, and below-cloud wet removal. The results show that these events produce a modest overall contribution to total particle population but have very little impact at sizes representative of climatically important aerosol.

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ORGANIC COMPOSITION OF CLEAN MARINE AEROSOL AT CAPE GRIM

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Abstract

With 70% of the earths surface covered by oceans, aerosols in the marine boundary layer play an important role in climate system, directly by scattering and absorbing radiation and indirectly by acting as cloud condensation nuclei (CCN), thus influencing cloud droplet size distribution, cloud albedo and lifetime. The marine aerosol is dominated by sea-salt aerosol, generated by bursting of bubbles entrained at the ocean surface during white cap production. While most of the sea-salt aerosol mass resides in particles greater than 1 μm, a significant fraction of sea-salt aerosol can also be found in the submicrometer range [Murphy *et al*., 1998], and sea-salt is an important source of cloud condensation nuceli [Keene *et al*., 2007]. The submicrometer marine aerosol however, is dominated by non sea-salt sulfate, which in the unpolluted marine boundary layer is derived from the oxidation of dimethyl sulphide (DMS) emitted by various marine organisms. In addition, Quin *et al*. [2000] showed that a large fraction of the submicrometer aerosol over the marine environment can not be accounted for by just sea-salt and non sea-salt sulfate, so that a significant fraction of the radiatively important submicrometer aerosol over the world's oceans is uncharacterised.

Organic compounds may contribute to this fraction. The presence of organic compounds in marine aerosol has been known for many years [Lodge *et al*., 1960, Blanchard, 1964, Hoffman and Duce, 1964] and Middlebrook *et al*. [1999] estimated that organic aerosol made up 10% of the aerosol mass under clean marine conditions at Cape Grim during the First Aerosol Characterisation Experiment (ACE 1). The species that make up the organic aerosol provide information on the sources of the organic compounds, their production mechanisms and their likely interaction with the climate system. In this presentation the species that make up the organic fraction of PM10 at Cape Grim collected under baseline conditions between August 2002 and October 2003 are described and their potential sources discussed.

Reference

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PARTICLE FORMATION – IS THERE A ROLE FOR PLANKTON AND SEAWEED?

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Abstract

It is now 20 years since the 'CLAW Hypothesis' was published and an extensive amount of research on the role the sulfur cycle might play in providing cloud condensation nuclei (CCN) has been performed. We now have a better understanding of the contribution biogenically derived sulfur has to CCN numbers in the marine boundary layer, but there are still many uncertainties in determining sign of any feedback process.

A brief review of research on the CLAW Hypothesis and the sulfur cycle is discussed and new ideas and their impacts introduced to assess the magnitude of the potential role plankton and seaweed have in providing new particles.

Reference

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AN ANALYSIS OF BASELINE METHYL HALIDE AND SMALL PARTICLE MEASUREMENTS FROM CAPE GRIM, INVESTIGATING EVIDENCE OF COASTAL SOURCES

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Abstract

The record of methyl iodide, methyl bromide and UCN (3-10 nm) from purely marine air at CGBAPS from 2004-2006 is examined to investigate the characteristics of the marine source, particularly emissions from coastal regions. All data were filtered by wind direction 180-280° to include air from the baseline sector and coast to the south, and then strictly filtered by radon concentration to eliminate air with any terrestrial input and examine purely marine air.

A first look at the methyl iodide record from the new 'Medusa' instrument featuring improved accuracy and calibration from the older AGAGE instrument, confirms the seasonal cycle in marine air found by Cox *et al.* [2005], but with a lower minimum winter average and larger seasonal cycle amplitude in 2004-06. This cycle was attributed by Cox *et al.* [2005] to a cycle in the photochemical marine source, but there is some evidence for a biological component to this source. In addition, using this filter technique also reveals an increase in the number of short-term peaks in CH_3I between November and April, with evidence that these peaks represent local coastal emissions from biological sources.

UCN (3-10 nm) in clean marine air in 2004-06 shows a seasonal cycle, with a maximum in October. Particle concentration showed variation over a daily cycle, with high anomalous peaks more frequent in the late afternoon, consistent with photochemical production mechanisms. A few incidents of particle peaks were found following low tide, inferring a source from coastal emissions initiated by exposure of kelp, however these incidents were not numerous and the cause is still ambiguous. Other features in the record are also discussed.

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TRACE GAS RESEARCH AT NIWA WELLINGTON – CURRENT STATUS AND NEW TOOLS

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Abstract

NIWA Wellington operates one of the leading laboratories in trace gas research. We routinely determine concentrations and isotopic compositions of CO_2, CH_4 and CO, the concentration of N_2O, and O_2/N_2 ratios. In this presentation we will show the current status of our laboratory and our clean background air station at Baring Head, as well as data from Arrival Heights and Pacific transect voyages.

Over the last couple of years we have improved our analytical equipment to allow for the isotopic analysis of very small air samples. Applications include a new ice grater and extraction device for concentrating samples from ice cores, and a new small-sample conversion line for analysis of ^{14}CO from melted ice.

As part of this presentation we would also like to show results from the GERRIS model, which has analysed air flow at the Cape Grim baseline station.

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A NEW MULTI PURPOSE ATMOSPHERIC MONITORING STATION IN SOUTHWEST VICTORIA - THE OTWAY PROJECT

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Abstract

An atmospheric monitoring program has been established at Australia's first geological CO_2 storage site - the CO2CRC Otway Project. The project is in a rural and agricultural setting 4 km inland of the Victorian SW coast, where there are natural accumulations of methane and CO_2 in deep geological formations. The atmospheric monitoring strategy consists of measurements of CO_2, CO_2 isotopes, other atmospheric trace gases (including species to be used as tracers), and CO_2 fluxes, combined with modelling of carbon fluxes from vegetation and atmospheric dispersion with the coupled CSIRO Atmosphere Biosphere Land Exchange (CABLE) model and The Air Pollution Model (TAPM). Cape Grim baseline data are used as upwind boundary conditions. The monitoring is designed to optimise the detection and quantification of potential leaks to the atmosphere of CO_2 to be injected into a depleted natural gas reservoir. It has also provided data on the carbon dynamics of the region that can be used to calibrate CABLE. Results from the pre-injection background stage of the project will be presented.

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AN AUTOPSY ON A PROPOSAL TO THE ATMOSPHERIC RADIATION MEASUREMENT PROGRAM FOR THE DEPLOYMENT OF THE ARM MOBILE FACILITY (AMF)

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Abstract

To quote the U.S. Dept. of Energy Atmospheric Radiation Measurement (ARM) program homepage, '*The primary goal of the ARM Program is to improve the treatment of cloud and radiation physics in global climate models in order to improve the climate simulation capabilities of these models.*' The ARM Mobile Facility (AMF) is one of the resources available through this program and has been designed to be deployed internationally for periods of 6 – 10 months. To further quote the ARM website, '*The purpose of the ARM Mobile Facility (AMF) is to collect essential information about the cloudy and clear atmospheres in climatically important regions that are under sampled at present.*' To date the AMF has been deployed at Point Reyes, California (2005), Niamey, Niger (2006) and Germany (2007). It is scheduled to be deployed in China in 2008 and the Azores in 2009. The AMF includes profiling and narrow beam column-integrating instruments (such as a lidar, AERI, microwave radiometers, cloud radar and wind profiler), surface flux, sky condition, surface meteorological instruments and aerosol observing instruments. The recent paper by Miller & Slingo [2007] highlights the use of the AMF during its deployment in the Sahel in 2006.

In June of this past year, a proposal was submitted to the ARM program to deploy the AMF at Cape Grim in 2009. This bid was unsuccessful, although there was some encouragement to make another attempt for 2010. The limited time available for the preparation of this proposal prevented a wider engagement of the CGBAPS community. In this presentation, some of the lessons learned in the proposal process will be highlighted, as well as opening up a discussion on whether a new proposal should be submitted.

Reference

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ANALYSIS OF THE CAPE GRIM AIR ARCHIVE ON THE CSIRO ASPENDALE MEDUSA INSTRUMENT

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Abstract

The Cape Grim Air Archive has proven to be a very valuable resource for determining multi-decadal trends of many atmospheric species since the first archive sample was collected in 1978. In late 2006, a Medusa gas chromatograph-mass spectrometer (GC-MS) system was commissioned at CSIRO Marine and Atmospheric Research in Aspendale. The Medusa instruments were developed for the Advanced Global Atmospheric Gases Experiment (AGAGE) network of baseline atmospheric trace gas measurement stations, including Cape Grim, where Medusa measurements began in January 2004. The Medusa instruments employ a custom-designed cryogenic trace gas trapping and pre-concentration system, along with integrated software for instrument control and operating diagnostics, data processing and management (Miller *et al*., 2007). They are currently configured to measure more than 40 atmospheric trace gas species (including CFCs, HCFCs, HFCs, PFCs, halons, chlorocarbons, bromocarbons, one iodocarbon, SF_6, COS, SO_2F_2, and hydrocarbons) in a 2-litre air sample. Data from all of the Medusa instruments at all sites are reported in common scales, allowing easy data integration and comparisons.

During early 2007, the Aspendale Medusa system was optimised and fully characterised for system blanks and any non-linearities in instrument response, over the range of concentrations expected in the Cape Grim Air Archive. Following this, all Cape Grim Air Archive samples with sufficient volume and pressure for analysis (totalling 64 tanks, spanning 1978 to 2006) were sampled on the system during a two month period. Typically 3-6 measurements were made on each air archive tank. To assess the instrument stability during the two month period, five air archive tanks with high pressure were selected for replicate sets of measurements near the beginning of, in the middle and towards the end of the measurement period. Results for a range of trace gas species will be presented to illustrate the instrument performance, stability of the trace gases in the air archive (as compared with *in situ* data), as well as trace gas histories for some previously un-measured gases. Time permitting, results for some species that exhibit strong seasonal cycles will be shown, with a view to the feasibility of extracting both a trend and seasonal cycle information for these from the Cape Grim Air Archive.

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GLOBAL PFC EMISSIONS FROM MEASUREMENTS ON THE CAPE GRIM AIR ARCHIVE AND ANTARCTIC FIRN AIR

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Abstract

PFCs are very potent and long-lived greenhouse gases, released predominantly during aluminium production and electronic chip manufacture. We present measurements of PFC-14, PFC-116 and PFC-218 in air samples from the Cape Grim Air Archive and from Antarctic firn made on the Cape Grim and Aspendale Medusa instruments. The data are used to derive global emissions of these PFCs, which are then combined with aluminium production data to produce PFC emission factors for the globe. These are compared with aluminium industry estimates of the emission factors.

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PFC EMISSIONS FROM AUSTRALIAN ALUMINIUM PRODUCTION

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Abstract

PFCs (perfluorocarbons: CF_4, C_2F_6) are significant greenhouse gases emitted to the atmosphere during the production of aluminium. PFCs are included in the UNFCC process for estimating national greenhouse gas emissions and are candidates for future emissions regulation and carbon trading. Global and Australian aluminium producers are committed by 2010 to a voluntary 80% reduction in the PFC emission factors (PFCs emitted per unit of aluminium production) that applied in 1990.

PFCs have been measured *in situ* at Cape Grim (since 2004) and at Aspendale (since late-2006) to better than 1% precision using Medusa GC-MS instruments developed by the Scripps Institution for Oceanography and the University of Bristol, employing new, absolute gravimetric PFC standards.

The PFC data from Cape Grim and Aspendale can be used to calculate emissions (and emission factors) for the SE Australian smelters at Pt. Henry, Portland and Bell Bay, using TAPM simulations, and compared to national average emission factors contained in the National Greenhouse Gas Inventory (NGGI).

An alternative method of estimating PFC emissions using stack sampling will be discussed.

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EMISSIONS OF NON-CO_2 GREENHOUSE GASES AND OZONE DEPLETING CHEMICALS FROM THE RYE LANDFILL SITE

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Abstract

Landfills are a potentially significant urban source of greenhouse and ozone depleting gases. Flux chamber experiments commenced in mid-2006 at the Rye landfill site, 60 km south of Melbourne, to estimate the emissions of these gases from a typical site. We have collected samples from a number of locations on the presently active cell at the Rye landfill site and are building up a comprehensive picture of the emissions from this cell.

The emissions are highly variable and, as expected, CH_4 dominates the non-CO_2 greenhouse gas emissions, but many other trace gases are seen escaping from this active cell at the landfill. In contrast, the sealed cells do not show any significant greenhouse gas emissions. We have also analysed samples of the fuel gas from the sealed cells and exhaust gas from the Rye landfill power generating system, suggesting that the landfill gas combustion process is effective in destroying the non-CO_2 greenhouse gases and ozone-depleting chemicals present in landfill gas.

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