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GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)
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1st GRUAN Implementation-Coordination Meeting (ICM-1)
Norman, Oklahoma, USA
2-4 March 2009

Item 4.5

Site report: New Zealand - Lauder

(Submitted by Paul Johnston)

Summary and Purpose of Document

This document contains an overview of the Lauder measurement program with respect to GRUAN requirements.

Lauder Report to GRUAN ICM-1 Meeting, University of Oklahoma, 2-4 March 2009

1. Lauder Status

Introduction: Lauder is currently not funded for GRUAN operations, so the following outlines measurements being made for the NDACC that also meet GRUAN requirements. See below for more information on our funding status.

1. (a) What is the site status with respect to the requirements outlined in GCOS-121 and GCOS-112 (priority 1 and 2)?

Considering GCOS-121 ***Radiosonde Site Requirements, Interim measure*** (p.5)
Tier 1: *1 x weekly production radiosonde with the best technology currently available at the site;*
Tier 2: *1 x monthly radiosonde capable of capturing moisture signal in the UT/LS and all other priority 1 variables to the best level possible with current technology, launched together with weekly radiosonde;*

Lauder is flying a radiosonde together with an Electro Chemical Cell (ECC) in-situ ozone sensor, from the surface to ~ 32 km weekly. This programme started in 1986, in collaboration with NOAA, to establish a long term archive of ozone profiles at southern mid-latitudes. This work was supported by our funding agency, the Foundation for Research, Science and Technology (FRST), and this support is expected to continue for the next 5 years (when it will be reviewed). This work is a component of New Zealand's NDACC commitment.

Two measurement configurations are used, usually on alternative weeks:
1. An RS92-SGP with an EN-SCI Z1 model ECC Ozone sensor and GPS receiver.
2. An RS80-15H with an EN-SCI Z1 model ECC Ozone sensor and GPS receiver, plus a "Micro Controlled Digital Frost Point Hygrometer" (under a NOAA contract).

Radiosonde Calibrations and Processing:
- RS80-15H and RS92-SGP sondes are pressure tested in a vacuum chamber pre-flight at 10 hPa. and combined with ground pressure measurements to correct pressure sensor offset and slope.
- Marwin ground station processing is available, but not used for ozone profiles. These are processed using modified Viasala ground checks – multiple Temp, Press, and Humidity tests are averaged and applied to flight data after the flight. The flight data are processed using an in-house computer program for higher temporal resolution (1 sec RS92, 1.5 sec RS80).

Ozone EEC:
- WMO standard operating procedure, with 0.5% buffer soln, 3 mils of cathode soln. Propriety software provided originally by NOAA.

Data availability:
These data are available through the NDACC, WOUDC and BSRN archives.

Tier 3: *Regular 00 and 12 LST (as a preference over UTC) launches of a production radiosonde with best technology currently available.*
Such a radiosonde flight programme is currently not supported – see resource situation below.

1. (b) *Which guidelines/manuals do you use when taking measurements, if any?*
NDACC and WMO guidelines are used for radiosonde and ozone measurements.

1. (c) *What is your data dissemination practice?*
Currently NDACC, but alternative quicker release of data may be possible.

Ground-Based Instrumentation and Observing Practices
The minimum set of ground-based instrumentation is to have a ground-based GPS receiver to measure total column water vapour (GPS PW) at each GRUAN site.
Not supported.

The list for additional ground-based instruments (GCOS-112, priority 2) encompasses six instruments:

- *surface radiation instruments*:
  Lauder BSRN station measurements are:
  - Incoming Longwave Radiation- Pyrgeometer (BSRN)
  - Aerosol Optical Depth - 4 Wavelengths (412, 500, 610, 778 nm) (BSRN)
  - Incoming Shortwave Radiation- Diffuse + Direct (BSRN)
  - Cloud Optical Depth - Some Information (UVA Transmission using UV Spectroradiometer)

  The Lauder BSRN station is calibrated by Bureau of Meteorology, Melbourne.
- *microwave radiometer*:
  None at Lauder (other than O_3 and H_2O emission instruments – likely unsuitable).
- *multi-channel infrared radiometer (e.g. FTIR*):
  Bruker HR spectrometer used to measure trace atmospheric specie column amounts with some profile distinction. However, it is not a calibrated radiance measurement.
- *Lidar (e.g. Raman Lidar*:
  Aerosol lidar makes regular NDACC measurements at night – up to 6 times per month.
- *integrated trace gas measurements and sun photometer*:
  Suite of composition measurements, NDACC trace plus greenhouse gases (CO_2, CO, CH_4, N_2O).
- *cloud radar (may also be useful)*:
  None at Lauder.

These data are available through the NDACC, WOUDC and BSRN archives.

2. What do you need from the Lead Centre / working group / secretariat?

If this is not already being pursued, perhaps GRUAN leadership could try and persuade the World Climate Research Program (WCRP) Working Group on Coupled Modelling (WGCM) to actively support the GRUAN goals with the appropriate agencies. Believable models are essential for governments to plan adaption to climate change and GRUAN will contribute data for critical comparisons.

3. Are there any scientific or organizational developments we should be aware of?

Lauder Resource Status:
The invitation letter inviting consideration of establishing NIWA, Lauder, as one of the initial candidate sites, has been sent by WMO to the Permanent Representative of WMO in New Zealand, and discussions have started with NIWA. For a small country of 4.3 million people and a lower GDP per capita than the OECD average (24th of 32 countries), New Zealand already makes a large contribution to global climate and atmospheric chemistry research. For example, the number of authors, contributors and reviewers in the WMO Scientific Assessment of Ozone Depletion 2006 was markedly higher than the US or Germany on a per capita basis. (There were also 16 New Zealanders in IPCC AR4.) Additionally, the NDACC Primary Station at Lauder is a substantial investment for New Zealand.

Adding a GRUAN station, at an estimated NZ$1 million/ year for a Tier 3 (2 radiosonde flights a day) operation together with the other priority 1 & 2 measurements, is a considerable request of our funding agency, the Foundation for Research Science and Technology (FRST). Their existing funding for climate and atmospheric chemistry research in New Zealand is largely invested in long term contracts with NIWA, typically 8 year terms, so changes take time. A year ago we had hoped that a political announcement of new additional funds for Climate Change research might provide an opportunity to start a GRUAN Station, but the final RfP did not include climate measurements. We very strongly embrace the vision and goals of GRUAN, and recognise the urgency of better balancing the hemispheric coverage, but unfortunately the current funding situation in New Zealand makes resource support unlikely for now. However, together with the Permanent Representative of New Zealand with WMO, we will continue to explore every opportunity.

Maybe working with the GUAN Station in Invercargill, 100 km away, could provide an adequate Tier 3 radiosonde protocol. (But, does GRUAN philosophy require that GRUAN stations be distinct from GUAN stations ?)

We expect to continue our weekly radiosonde programme meeting Tier 1 protocol, and if external support for water vapour measurements continues, the Tier 2 protocol, and data from these will be available from NDACC and WOUDC archives. The existing level of NDACC trace specie, column and insitu carbon, and radiation measurements are expected to continue and likewise will be available from the NDACC and other archives.

If researchers from other countries wanted to use the Lauder site for their GRUAN experiments we would endeavour to host them (this may need to be cost neutral to us).

Appendix

Variable	Temperature	Water Vapour	Pressure
Priority (1-4)	1	1	1
Measurement Range	170 – 350 K	0.1 – 90000 ppmv	1 –1100 hPa
Vertical Range	0 – 50 km	0 to ~30 km	0 – 50 km
Vertical Resolution	0.1 km (0 to ~30 km) 0.5 km (above ~30 km)	0.05 km (0 – 5 km) 0.1 km (5 to ~30 km)	0.1 hPa
Precision	0.2 K	2% (troposphere) * 5% (stratosphere)	0.01 hPa
Accuracy	0.1 K (troposphere) 0.2 K (stratosphere)	2% (troposphere) * 2% (stratosphere)	0.1 hPa
Long-Term Stability	0.05 K *	1% (0.3%/decade) *	0.1 hPa
Lauder Status	**Two measurement configurations are used, usually on alternative weeks:** • **An RS92-SGP with EN-SCI Z1 model ECC Ozone sensor and GPS.** • **An RS80-15H with EN-SCI Z1 model ECC Ozone sensor and GPS receiver, plus a "Micro Controlled Digital Frost Point Hygrometer".**		

Variable	Wind Speed	Wind Direction*
Priority (1-4)	2	2
Measurement Range	0 – 300 m/s	0 – 360 degrees
Vertical Range	Surface to stratopause	Surface to stratopause
Vertical Resolution	0.05 km (troposphere) 0.25 km (stratosphere)	0.05 km (troposphere) 0.25 km (stratosphere)
Precision	0.5 m/s (troposphere) 1.0 m/s (stratosphere)	1 degree (troposphere) 5 degrees (stratosphere)
Accuracy	0.5 m/s *	5 degrees
Long-Term Stability	0.1 m/s (troposphere) 0.5 m/s (stratosphere)	1 degree (troposphere) 5 degrees (stratosphere)
Lauder Status	**Accuracy 0.5 m/s RMS**	**?**

Variable	Ozone	Carbon Dioxide	Methane
Priority (1-4)	2	3	2
Measurement Range	0.005 – 20 ppmv	350 – 450 ppmv	200 – 1800 ppbv
Vertical Range	Surface to stratopause	Surface to stratopause	Surface to stratopause
Vertical Resolution	0.5 km (stratosphere) 0.2 km (troposphere)	1 km (stratosphere) 0.5 km (troposphere)	2 km
Accuracy	3% (total column) 5% (stratosphere) 5% (troposphere)	1 % (total column) 3 ppmv (profile)	2 % (total column) 20 ppb (profile)
Long-Term Stability	0.2% (total column) 0.6% (strat) 1% (trop)	1 ppmv	
Lauder Status	**Surface to ~ 32 km** **EN-SCI Z1 sonde** **Electrochemical cell** **Resolution: < 10m** **Accuracy** **0 - 10 km 5%** **10 - 30 km 3%** **30 km - 10 hPa 3%** **> 10 hPa 8%** **(Hassler, et al., 2008)**	**Surface (Licor)** **(0.1 ppm)** **Total Column** **(solar FTIR)** **(precision 0.2% clear sky, accuracy 0.5%)**	**Surface (FTIR cell)** **(0.35ppb)** **Total Column** **(Solar FTIR)** **(precision 0.2% clear sky, accuracy 0.5%)**

B. Hassler, G. E. Bodeker, and M. Dameris. Technical Note: A new global database of trace gases and aerosols from multiple sources of high vertical resolution measurements
Atmos. Chem. Phys., 8, 5403–5421, 2008

Variable	Net Radiation	Incoming Shortwave Radiation	Outgoing Shortwave Radiation
Priority (1-4)	2	2	2
Measurement Range	-300 – 1500 W/m2	0 – 2000 W/m2 *	0 – 1365 W/m2
Lauder Status	No Measurements	BSRN Diffuse + Direct	No Measurements
Variable	Light Scattering	Light Absorption	
Priority (1-4)	2	2	
Lauder Status	No Measurements	No Measurements	
Variable	Incoming Longwave Radiation	Outgoing Longwave Radiation	Radiances
Priority (1-4)	2	2	2
Measurement Range	50 – 700 W/m2	50 – 900 W/m2	Full spectral range 100 – 1700 cm-1 190 K<Tb<330 K
Vertical Range	Surface	Surface	Surface to top of atmosphere.
Precision	N/A	N/A	N/A
Accuracy	1 W/m2 *	1 W/m2 *	0.01%
Long-Term Stability	3 W/m2 *	3 W/m2 *	0.15%
	0.1 W/m2	0.1 W/m2	0.03% per decade
Lauder Status	BSRN Pyrgeometer	No Measurements	Total Sky Imager only
Variable	Aerosol Optical Depth	Total Mass Concentration	Chemical Mass Concentration
Priority (1-4)	2	2	2
Measurement Range	0.005 – 5	0.1 – 100 µg m-3	0.1 – 30 µg m-3
Accuracy	0.005	10%	10%
Long-Term Stability	0.005	10%	10%
Lauder Status	BSRN 4 Wavelength (412, 500, 610, 778nm)	No Measurements	No Measurements

Variable	Cloud Amount/Frequency	Cloud Base Height	Cloud Layer Heights and Thicknesses
Priority (1-4)	2	2	2
Lauder Status	No Measurements	No Measurements	No Measurements
Variable	Cloud Top Height	Cloud Top Pressure	Cloud Top Temp
Priority (1-4)	3	3	3
Lauder Status	No Measurements	No Measurements	No Measurements
Variable	Cloud Particle Size	Cloud Optical Depth	Cloud Liquid Water/Ice
Priority (1-4)	4	4	4
Lauder Status	Aerosol Lidar provides some info	UVA Transmission UV Spectroradiometer	No Measurements