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Session 5

Site Report: Lauder, New Zealand

(Submitted by Paul Johnston)

Summary and Purpose of Document

This document contains an overview of the measurement programme at the Lauder site with respect to GRUAN requirements, and addresses the questions to be discussed in this session.

Lauder Report to GRUAN ICM-3 Meeting
Queenstown, 28 February-4 March 2011

Introduction

Our goal is to align relevant Lauder NDACC measurements with GRUAN requirements so we can maximise our contribution to the GRUAN's goals. Unfortunately, Lauder is currently not nationally funded for GRUAN operations, but it does receive support from NOAA to make frost point hygrometer (FPH) flights and to help move Lauder towards this alignment. In the following we show the position of Lauder is this regard. The requirements sections in italics are from the WMO GCOS and WG-ARO documents.

Radiosonde Measurements

GCOS-121 Radiosonde Site Requirements:

- *1 x weekly production radiosonde with the best technology currently available at the site.*
- *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 other sensors, from the surface to ~ 32 km on a weekly schedule. This programme started in 1986, in collaboration with NOAA, to establish a long term archive of ozone profiles at southern mid-latitudes. This work is a component of New Zealand's NDACC commitment.

Two measurement configurations are used:

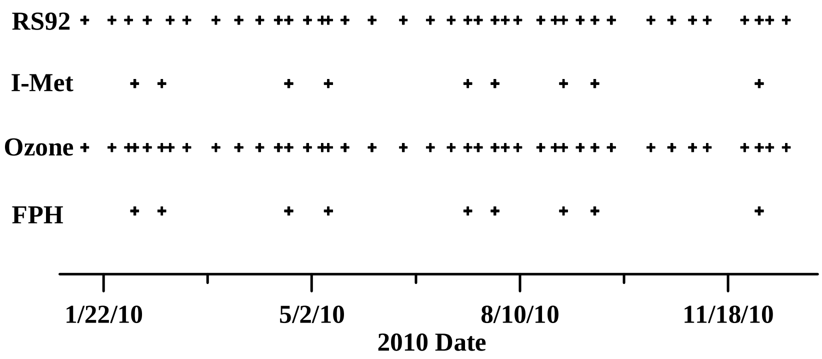
1. An RS92-SGP with an EN-SCI Z1 model ECC Ozone sensor and GPS receiver.
2. An I-met 1 RSB radiosonde with an EN-SCI Z1 model ECC Ozone sensor and GPS receiver, plus a "Micro Controlled Digital Frost Point Hygrometer" (under a NOAA contract). For most of the 2010 calendar year an RS92-SGP radiosonde was also added to this configuration to improve the consistency of the weekly radiosonde measurements (GRUAN "best technology currently available").

Note: During the 2010 calendar year we were unable to meet the weekly schedule for radiosonde flights and the monthly schedule for FPH flights. Factors were:

- Staff overload: as national funding decreases in real terms, it was not possible for the two part-time (70% + 20%) operators to achieve this figure.
- Weather limits: extensive periods of unsuitable conditions.
- Limited availability of FPH components over part of the year.

We have now allocated time for a third part-time support operator which will reduce the occurrence of no operators being available during weeks when some are away. Furthermore, in discussion with NOAA we have established an improved FPH parts stock reporting system. The reduction by NOAA to 1 FPH per month in 4th quarter 2010 will also be more realistic schedule for us to meet. We were also successful in obtaining special NIWA funding to augment the Lauder ozone programme for the current financial year. At this time we do not know if this will be available in our July 2011 – June 2012 financial year.

Table of radiosonde (RS92 and IMet), Ozonesonde and FPH flights during the 2010 calendar year.



Radiosonde Calibrations and Processing

- 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).
- Ozone EEC**:** WMO standard operating procedure, with 0.5% buffer soln, 3 mils of cathode soln.

Data availability

These data are available through the NDACC and WOUDC archives.

Guidelines used

NDACC and WMO guidelines are used for radiosonde and ozone measurements.

Data dissemination practice

Currently NDACC, but alternative quicker release of data will be possible.

Ground-Based Instrumentation and Observing Practices (GCOS-121):

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 (but we plan to apply for NIWA capital to obtain a suitable – defined by GRUAN - GPS system within the coming financial year).

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 stratospheric O_3 and H_2O emission measurement instruments).
- *multi-channel infrared radiometer (e.g. FTIR*):
  Bruker HR direct sun viewing 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 4 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. The appendix tabulates the GRUAN status of Lauder with respect to GCOS-121 specifications.

Lauder Resource Status:
Adding a GRUAN station, at an estimated NZ$1 million/year for a 2 radiosonde flights a day operation together with the other priority 1 & 2 measurements is beyond our current resources at Lauder. 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 increased resource support unlikely for now. However, together with the WMO Permanent Representative of New Zealand, we will continue to explore every opportunity.

Maybe working with the NZ Meteorological Service's GUAN Station in Invercargill, 180 km away, could provide an adequate twice daily radiosonde protocol?

With continuing support from NOAA we expect to maintain our weekly best-available radiosonde programme, and monthly water vapour measurements.

The existing levels of NDACC trace specie, column and in-situ carbon, and radiation measurements are expected to be reviewed and some may be reduced due to the current economic situation.

Possible Future Developments:
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: Lauder status with respect to GCOS-121 specifications

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:** • **An RS92-SGP with EN-SCI Z1 model ECC Ozone sensor and GPS.** • **An RS92-SGP plus an I-Met 1 RSB 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/sRMS**	**?**

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**