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Item 6.3

LUAMI campaign summary

(Submitted by Lead Center)

Summary and Purpose of Document

This document gives an overview summary on the "Lindenberg Upper-Air Method Intercomparison" (LUAMI), which took place at the GRUAN Lead Center in Lindenberg, Germany, from 4 to 22 Nov 2008.

Agenda item 6.3: The LUAMI test campaign

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by **F. Immler, GRUAN lead centre, DWD Lindenberg, Germany**

The Lindenberg upper-air method intercomparison (LUAMI) was dedigned to improve our understanding of remote sensing and in situ methods of measureing the basic atmosperic variables (with a focus on humidity) and to test the suitiability of verious optinos for their deployment in operational network including the GCOS Reference Upper-Air Network (GRUAN). During the observational phase (4.11. – 22.11.2008) in-situ and remote sensing instruments were applied as intense as possible to provide a dataset with large redundancy. In order to identify systematic bias and other issues with each instrument results are compared to each other. The campaign was divided into three parts that are briefly described in the following.

1.1. Ground-based Remote sensing (coordinated by Dr. D. Engelbart , DWD)

One major focus of the campaign was the comparison between ground based remote observations and in situ techniques. The RAO routinely operates a number of instruments that are listed in the following table 1. All of this instruments were fully operational during LUAMI and provided data. These data is currently evaluated and will be transferred to the LUAMI database soon. Additionally instrument from partners were installed at Lindenberg and its vicinity.

1.2. Air-borne part observations (coordinated by: Dr. H. Vömel, DWD and Dr. Ch. Kiemle, DLR-IPA, Oberpfaffenhofen)

The DLR- FALCON equipped with a water vapor DIAL system took part in LUAMI with two flights on the 17.Oct 2008m and the 18.10. 2008. On both occasions it passed the sites Payerne, Zugspitze, Cabauw and Lindenberg. At RAO a Radiosonde Compound was launched at 17. Oct at about 19:00 LT which carried a CFH, RS-92FN and GRAW DFM-06 The Falcon followed the flight track of this balloon for a while to allow for optimal conditions for a comparison. First results show a very good agreement between the results of the water vapor DIAL and the CFH.

1.3. In-situ soundings (coordinated by Dr. F. Immler , DWD)

The basic concept of this part of LUAMI followed the guidelines for radiosonde inter-comparisons from CIMO. Radiosondes from different manufactures (see table 1) as well as reference instruments (see table 2) were attached to a rig and launched with one balloon. 4.5 kilogram payload could be launched that way simultaneously. For larger loads

Table 1: Ground based remote sensing equipment for LUAMI

MWP	Microwave-profiler	RAO Lindenberg
MWR	2-channel-microwave-radiometer	RAO Lindenberg
RLI	Water-vapor Raman-Lidar RAMSES	RAO Lindenberg
CLR	36 Ghz Cloud radar	RAO Lindenberg
CEI	4 ceilometers (different types)	RAO Lindenberg
WPR	2 wind profiler-/RASS-systems	RAO Lindenberg
EIS	EISAR FT-Infrared spectrometer	RAO Lindenberg
GPS	GPS-receiving system	RAO Lindenberg
OP	Optical near-infrared system Sun- and starphotometer)	RAO Lindenberg
Instruments form partners		
LEO	PBL Doppler-Wind Lidar	Leosphere, France
LEO	PBL Aerosol-Lidar	Leosphere, France
MTK	HALO cloud radar (ground-based)	METEK, Germany

Table 2: Radiosondes and sensors flown during LUAMI

Abbreviation	*Type / method*	*weight /g*	*Organisation / Company, Country*	*number*
		Commercial radiosondes		
RS-92 SGP	PTU - GPS	280	Vaisala Oyj, Finland	76
DFM-06	PTU - GPS	90	GRAW Radiosondes GmbH, Germany	24
BAT-4G	PTU - GPS	200	InterMet Systems, South Africa	25
SRS-C34	PTU - GPS	620	Meteolabor, Switzerland	29
		Reference- and Research radiosonde sensors		
RS-90 FN	FN Reference	380	RAO, Lindenberg, DWD, Germany	7
RS-92 FN	method			9
SW	Frostpoint mirror	550	Meteolabor AG Wetzikon, Switzerland	21
FLASH	Lyman-Alpha-Hygrometer	980	RAO / CAO Moscow, Russia	4
CFH	Frost-point mirror	990	RAO, Lindenberg, DWD, Germany, University Colorado, Boulder/USA	6
APS	Polymer sensor	600	Vaisala, Finland	12
COBALD	Backscatter sonde	500	ETH Zürich	7

two rigs were prepared and launched with a short time delay of a few minutes. During the intensive period (4.11. - 22.11.2008) 24 single rig launches and 3 double rig launches were carried out. Table 1 shows the number of each type of sondes flown in during LUAMI. The meta data for each launch like weather conditions, equipment (balloon type, payload, etc) was protocoled.

The radiosonde data were collected as soon as possible after the launch by the GRUAN lead centre and made available to all participants using a ftp server. However, access was given only to the teams that have submitted their own data. A common data format (.ldf) was developed by the lead centre and all radiosonde data has been transformed to that format in order to facilitate data access for the participants.

A evaluation tool has been developed in the IDL language that is also available to all participants on the ftp server.

A1. Data protocol

All data of the campaign will be stored in a local data archive for the campaign. This database is accessible to all participants by ftp using the local WLAN and/or the Ethernet connection.

- Accepted data format is any table in ASCII containing at least time, pressure, altitude, temperature, relative humidity, wind direction and speed (for PTU –GPS radiosondes). Other formats are acceptable with the assent of the coordinator.
- Reference data obtained from the routine observational program of the RAO will be supplied to all participants in real time using the same ftp access. All participant therefore need to sign the 'Declaration of Obligation' stating that they will use this data only for scientific purposes (which includes the improvement of commercial radiosondes)
- LUAMI data shall not be disseminated to third parties without the assent the instrument PI and the coordinators of the intercomparison.
- The radiosonde intercomparison will be a blind intercomparison. It means that the participants will not have access to the data of others until all participant of a single balloon launch have uploaded their data. Data visible to all participants can no longer be changed by the instrument PIs.
- Intercomparisons will be made using software that is developed at the RAO. This software is written in IDL . The source is open and available to all participants.