Demonstration of the new InterMet radiosondes system installed at the Tanzania Meterological Agency, Dar-es-Salaam

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1. Introduction

An IMS 1600 upper air sounding system was installed by the manufacturer in Dar-es-Salaam, Tanzania in August 2004. The upper air station is located at Dar-es-Salaam airport. The IMS 1500 radiotheodolite, see Fig.2, was installed on the top of an observatory building, as advised by WMO representatives (see Fig.1), with the ground station computers located in the upper floor of the building.

Fig.1 View of observing station at Dar-es-Salaam Airport from the balloon shed.

A contract was placed with the UK Met Office to provide a demonstration test of this system, with reports to be generated for the US donors supporting the regeneration of radiosonde stations within the GCOS network. The test took place from 18 to 30 October 2004, with a lot of help from Carl Bower of NOAA and from a wide range of staff from the Tanzania Meteorological Agency.

2. Structure of demonstration test

Plans for the test had to be revised daily, once it was realised that the Tanzanian staff needed more instruction in operational radiosonde procedures than had been provided by the Intermet engineers responsible for the installation. Thus, the competed demonstration test consisted of:-

- 14 individual Vaisala RS92 flights, used to train TMA staff in procedures.

(These flights were processed by DigiCora III software using equipment brought to Tanzania by the UK team. Measurements were usually performed by TMA staff. The radiosonde were ground checked as recommended by the manufacturer, so the humidity sensors should have been regenerated from contamination before launch.)

- individual Sippican MKII training flights.
- nighttime simultaneous comparisons between Sippican and Vaisala,
- 5 daytime simultaneous comparisons between Sippican and Vaisala ,
- nighttime simultaneous comparisons between MODEM and Vaisala
- 2 daytime simultaneous comparisons between MODEM and Vaisala.

The limited number of simultaneous flights were sufficient to identify areas where more work was needed on the system. It was found that the IMS system was not really ready for a larger scale quantitative test.

Fig.2 shows a Sippican radiosonde prepared for launch, with the chip thermistor deployed facing upwards and the wire support bent to hold the thermistor well above the top of the radiosonde. Earlier radiosonde testing in 2004 at Camborne, UK had shown that this mode of sensor deployment gave reproducible results with the Sippican MkII.

Fig.2 Sippican MKII Radiosonde and Intermet IMS 1500 radiotheodolite.

The radiosondes in the twin flights were suspended under each end of a length of plastic water pipe. See Fig.3. Launching a twin flight is shown in Fig.4. The night time measurements were usually launched as the sun was setting, so the end of the flights was in the dark.

Fig.3 Preparing to launch a Sippican / Vaisala RS92 twin flight, Dar-es-Salaam.

The balloons used for the testing were a mixture of Pawan and Totex 350g balloons with burst heights typically between 19 and 23 km respectively. Six Totex 1200g balloons lifted radiosondes to heights above 30 km. The 1200g balloons were a little large for the balloon shed. However, the hydrogen generator was easily able to supply sufficient gas for this type of balloon. The large balloons performed best in the nighttime flights.
Working arrangements for balloon filling were improved during the trial with the installation of an automatic balloon filler and a table on which balloons were prepared, see Fig.5.

Results of the test

The IMS 1600 system clearly needed more testing than had occurred before it was deployed in Tanzania. A lot of the system outputs were inconsistent within the various modules of the software.

Temperature corrections applied to radiosonde measurements were not made with the correct local time. The origin of corrections applied was not well documented and there appeared to be a significant lack of cooperation between the radiosonde supplier and the IMS software engineers. Operational measurements should be made uncorrected until reliable correction schemes can be implemented.

Fig. 4 Launch of twin flight at Dar-es-Salaam

Fig.5 Use of automatic balloon filler during the test.

A computational error for the pressure derived from geometric heights by IMS prevented operational use of the MODEM GPS radiosondes. e.g. the 100 hPa geopotential height was in error by more than 2 km.

The tracking of the radiotheodolite appeared good and able to meet user requirements for wind in the tropics, but the algorithms used for generating winds were not computing values at the resolution needed [or indicated by the software settings], i.e. 1 minute near the ground and 1 to 4 minutes in the stratosphere, see the results from the twin flight comparison in Fig.6.

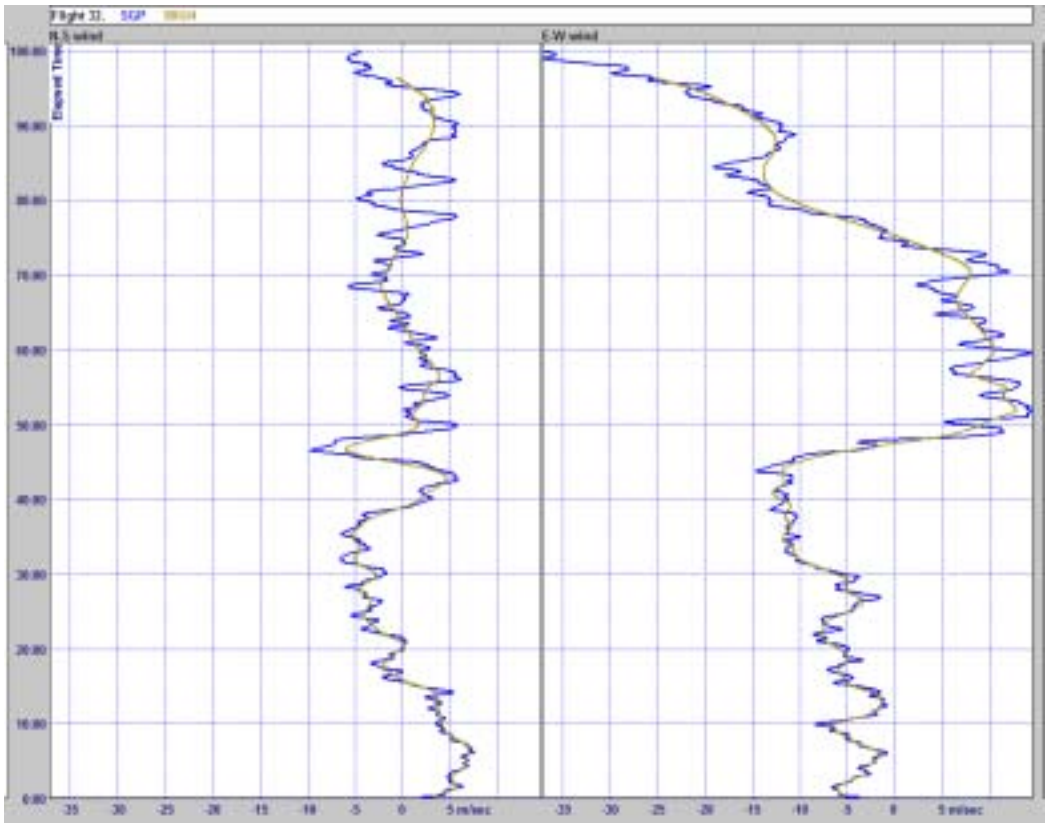

Fig.6 Simultaneous measurements of wind from Vaisala (SGP) and IMS (MKII4) from flight 32 on 28.10.04

Mounting the radiotheodolite on the roof in Dar-es-Salaam hinders the automatic tracking of the radiosonde at launch. Launch routines would probably be easier if the radiotheodolite were mounted on the ground. Then, the person who launched the balloon could be responsible for checking that it was tracking on the main beam.

General conclusions

1. Further action is required to provide a more reliable method of communicating data from Dar-es-Salaam onto the GTS. Message generations needs to be made more reliable, see Fig.7 where a considerable manual effort was required to generate the TEMP message in a suitable format.

2. Re-establishing radiosonde measurements in a location such as Dar-es-Salaam where radiosonde ascents had not been made for more than 10 years requires a concerted training effort with staff present from both the manufacturer and from a National Meteorological Service with the necessary experience in radiosonde operations.

3. It would be beneficial if a suitable expert was sent to Tanzania to complete the training started during the demonstration test and to implement improved message communications. This should be considered once IMS are ready to upgrade the system software.

4. The hydrogen generator installation worked well and is clearly capable of supporting the use of 800 or 1000g balloons on a regular basis. It is recommended that suitable funding be provided for the use of the larger balloons at Dar-es-Salaam in the long term.

5. Met Office staff were grateful for the help and enthusiasm of the staff from the Tanzania Meteorological Agency, who made the test successful.

Fig.7 Working together to generate a satisfactory TEMP message.