

WORLD METEOROLOGICAL ORGANIZATION

**COMMISSION FOR INSTRUMENTS AND
METHODS OF OBSERVATION**
OPAG-UPPER-AIR

Distr.: RESTRICTED

JOINT MEETING

CIMO/OPAG-UPPER-AIR/
/ET-UASI-1/IOC-1/Doc. 7.4(1)

**CIMO EXPERT TEAM ON
UPPER-AIR SYSTEMS INTERCOMPARISONS**
First Session

(08.II.2004)

AND

**INTERNATIONAL ORGANIZING COMMITTEE (IOC) ON
UPPER-AIR SYSTEMS INTERCOMPARISONS**
First Session

ITEM: 7.4

Original: ENGLISH ONLY

GENEVA (SWITZERLAND), 17-20 MARCH 2004

PROCESSING AND ANALYSIS METHODOLOGY AND PUBLICATION OF RESULTS

**Recent Development of
WRSKOMP Radiosonde Comparison Software**

(Submitted by S. Kurnosenko, USA)

Summary and purpose of document

This document provides information on the recent improvements made to WRSKOMP-Radiosonde Intercomparison Software, which has been regularly used in radiosonde comparisons since 1990.

Action proposed

The meeting is invited to note and comment on the information contained in the report and take actions on the issues raised in the report, as appropriate.

Recent Development of WRSKOMP Radiosonde Comparison Software

The Radiosonde Comparison Software (RSKOMP) has been regularly used in radiosonde comparisons since 1990. It implements the well-established comparison methodology and provides multiple important features that make RSKOMP a powerful and complete tool for radiosonde data analysis. RSKOMP satisfies all basic needs of the radiosonde comparison data collection and processing, requires the simplest available operational environment (any of WINDOWS 98/2000/XP) and does not depend on any third-party applications – such as database engines, statistical or graphic packages. There are many data sets worldwide created and analyzed with RSKOMP software. The software has been developed and verified in close contact with leading radiosonde research centers and companies such as UK Met Office, Swiss Meteo Service, NASA, Vaisala OY, and Russian Central Aerological Observatory.

RSKOMP defines several formal concepts such as DATA SOURCES, DATA UNITS, VARIABLES and others that naturally reflect the complex structure of the highly heterogeneous data volume usually obtained from radiosonde intercomparisons. Statistical and visual comparison tools provided by RSKOMP allow to study and compare the performance of different DATA SOURCES over the certain subset of DATA UNITS, while implementing solutions to a huge amount of technical problems such as uniform data presentation, classification, clusterization, quality control, data correction etc. that always occur in radiosonde comparison practice.

Readers interested in more details are welcome to contact the author and request the complete information / documentation.

Recent Development

During 2003-2004 WRSKOMP software for WIN32 platform has been significantly upgraded. This document explains some of improvements that were specially designed to meet modern practical requirements and should be important for the detailed analysis of multiple-sonde intercomparison experiments.

The new features described below are:

1. New data format standard.
2. Metadata management.
3. Virtual variables .

1. New data format standard (SN2).

WRSKOMP software since its origination uses an internal data storage standard, so-called SND format. This standard was designed in 1994 but gradually became insufficient to hold the increasing amount and variety of radiosounding data: for example, the SND limitation of 8000 measurements may be exceeded in 2-hours long flight with sub-second data resolution. It is also more and more common for radiosonde researchers to report, along with standard meteorological information, multiple technical “housekeeping” parameters what often breaks the limit of 20 measured variables allowed by SND format. To ensure compliance with these modern practical requirements, the new standard SN2 has been recently designed and implemented. The following table provides a quick comparison between SND format and new standard SN2.

Parameter	SND format (1994 – 2004)	SN2 format (2004)
Max. data sources	8	16, potentially 128.
Max. flights	300	Standard 300, configurable from 100 to 4000.
Max. variables	20 per data source and 20 combined	Configurable; standard 64 for each data source, 128 combined.
Max. measurements	8000	Configurable, standard 16K, potentially 64K.
Data precision	Strict requirements	Flexible (see below)
Compression rate	0.1-0.25	0.1-0.25

All the fixed limitations of the old format have been made configurable for the new version. This allows to expand applicability of WRSKOMP software and optimize usage of the system resources. The new standard has built-in version control and increased modularity, so that further upgrades of this format will not require significant changes in software.

One of the inconveniences of the old format standard was a strict requirement that data precision must remain the same for a given data column in all imported ASCII files. This requirement was not always enforced by all users and sometimes caused problems. The new standard removes this requirement. Although precision is still important, it is analyzed automatically and independently for each flight so that user does not have to think about this issue.

High efficiency of data compression was an important advantage of SND format in 1990s but evidently is not as important today. Compression efficiency of SN2 standard remains at the same level as for SND and the new format has an option to abandon compression.

New format has a built-in capability of storing double-precision data. It is not yet opened to user but will be activated in future versions if single precision will ever become insufficient.

It is planned that WRSKOMP will support both SND and SN2 standards for a certain transition period. If the users will recognize SN2 as a reliable and worthy replacement, support of SND format could be discontinued but users who keep old data sets will be provided with adequate conversion tools.

2. Metadata management.

Metadata management is the new feature that adds an essential convenience to WRSKOMP functionality. It allows to store and use lot extra descriptive information normally available from soundings. This information did not fit previous WRSKOMP data model. Recently the problem of metadata management has been carefully formalized and appropriate interfaces have been developed and added to WRSKOMP software.

Simplest way to enter metadata information would be to provide it in ASCII files in the form of header preceding the usual (measurements) data table. This method is implemented in WRSKOMP.

If users plan to use metadata systematically, some minimal changes to their existing data preparation software may be required; if not, no changes needed.

By definition, metadata is some scalar (i.e. single value per flight) parameter with it's unique free-form name, usually related to parameter's physical / technical meaning. There are several predefined names. User has a freedom to introduce new parameters. Parameter values are

supplied and stored in the text form, however, they can be interpreted as numbers, text or date/time.

Examples of the metadata that existed in WRSKOMP before are height and time offsets. Other possible examples include date, time, total ozone content, clouds type, technical information and so on.

Metadata information can be added to database either automatically during data import process or manually.

3. Virtual variables.

Virtual, or Alias variables is a conceptual enhancement of the normal logic used by WRSKOMP to match meteorological variables. Normal mode of operation for both visual and statistical analysis is to match same variable reported by different data sources (sondes). However, users often need more sophisticated selection, such as comparison of different versions of the same parameter measured by the same sonde.

Formally virtual variable may be defined as a set of associations "Data_Source_Name – Variable_Name". This set is distinguished with it's own unique name which is appended to the existing list of variables and is treated by both visual and statistical modules of WRSKOMP in the same way as regular variables. This definition remains a permanent part of the system until it is changed or discarded.

The following example explains the usage of virtual variables:
Suppose we have a Sonde_A that reports 3 versions of temperature: Temperature, Corrected_Temperature and Alternative_Temperature. We also have Sonde_B which reports only Temperature.

Suppose user wants to study difference between all above parameters. The way to do that is to define a virtual variable, for example General_Temperature in the following way:

General_Temperature:

```
Sonde_A    Temperature;
Sonde_A    Corrected_Temperature;
Sonde_A    Alternative_Temperature;
Sonde_B    Temperature.
```

After this definition is added to the list of variables, user selects variable name "General_Temperature" and all the above associations are automatically loaded. In fact, virtual variables provide the logically consistent substitute for the previously existing WRSKOMP feature called "Random selection".

WRSKOMP provides intuitive user interface to define virtual variables.