Distribution of LMD final data gathered onboard the long-duration balloons during the CONCORDIASI experiment

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This document describes the format of **final data** files produced by LMD during the CONCORDIASI campaign.

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In the event that the dataset addressed in this document is used in publication or presentation, please acknowledge (besides the Concordiasi generic sentences) Laboratoire de météorologie dynamique for providing the quality-controlled meteorological TSEN dataset.

People not involved in the CONCORDIASI project but willing to make any use of this dataset are asked to contact the above address beforehand.

The up-to-date version of this document can be found in:
ftp://ftp.lmd.polytechnique.fr/hertzog/balloon/Concordiasi/doc/

Contents

1 TSEN meteorological observations

1.1 General description

Each long-duration balloon launched during CONCORDIASI [Rabier et al.(2010)] has been equipped with a meteorological payload called TSEN[1] developped at LMD. TSEN makes in-situ measurements of atmospheric pressure and temperature every 30 s during the whole flight. During the campaign however, issues onboard the scientific gondola have leaded to some gaps in the TSEN dataset. The pressure is measured with an accuracy of 10 Pa and a precision of 0.1 Pa. The temperature is measured via two thermistors located 5 m below the last gondola in the flight train. The precision of temperature observations are respectively ~ 0.25 K during day and ~ 0.1 K during night.
The time and location along the balloon trajectory is provided by the CNES ISBA gondola. This dataset has been merged on ground with the TSEN dataset to associate a GPS time and position to the meteorological observations. During this process, the 1-minute ISBA measurements have been interpolated on the TSEN 30-second time frame provided the TSEN observations does not take place during a data gap longer than 15 min in the ISBA dataset.
Some ISBA data gaps longer than 15 min were actually observed during the campaign. In such cases, the time of the observations is ensured by the TSEN real-time clock, but the localizations of the observations are lost.

1.2 Wind computation

At each TSEN observation time t_n, the horizontal velocities of the wind are computed by finite differences[2] between the balloon positions at time t_{n+1} and t_{n-1}. This computation is not done when the GPS position is lacking either at t_{n+1} or at t_{n-1}.

1.3 Temperature corrections

During day time, the thermistors used to measure air temperatures are heated by the sun. Consequently, daytime temperature measurements are warmer than the real air temperature. An empirical correction has been used to correct from this effect [Hertzog et al.(2004)]. The corrected temperature T_c is deduced from the raw measurement T through:

$$T_c = T - \alpha(\mathrm{SZA}) \tag{1}$$

[1] see the acronym list at the end of the document
[2] assuming that the balloon is a perfect tracer of the wind

where

$$\alpha(\mathrm{SZA}) = \begin{cases} A \exp\left(\dfrac{\mathrm{SZA} - 94.5}{B}\right) & \text{if SZA} < 94.5 \text{ (day)} \\ 0 & \text{if SZA} \geq 94.5 \text{ (night)} \end{cases} \tag{2}$$

in which the solar zenith angle (SZA) is expressed in degrees. A and B coefficients have been determined for each thermistor. Typical values are:

$$\begin{aligned} A &\sim 1.5 - 2\,\mathrm{K} \\ B &\sim 5 - 10^{\mathrm{o}} \end{aligned} \tag{3}$$

1.4 Data distribution

Two different datasets are produced. The first one is public and contains scientific data. The corresponding files (one per balloon) are named `tsxxVyyNzz.v[version]`, where `xxVyyNzz` is the flight code given during the campaign and `[version]` has to be replaced by one available data version (for instance, the file suffix for the first available version is `v1105`). This dataset is available at least here. (Note that it replaces the dataset generated during the campaign.)
The second dataset contains technological (housekeeping) information besides the scientific one and its access is restricted. The corresponding files are named `tstxxVyyNzz.v[version]` with the same convention than for the scientific dataset. This dataset is available here. People willing to use this dataset are asked to contact Philippe Cocquerez (CNES).
Note also that both datasets are accessible through the LMD long-duration web page.

1.5 File format

The produced files are coded in ascii and are column oriented. The meaning of each column is detailed hereunder for each dataset. In case of lacking data, the field is replaced by an unphysical value. In particular, lack of GPS positions is associated with negative altitudes.

1.5.1 Public dataset

The columns respectively represent:

1. decimal day (convention 1.0 = January 1st, current year, 00 UTC)
2. year

3. month
4. day of month
5. hour (UT)
6. minute
7. second
8. longitude (decimal degree, positive east of the Greenwich meridian)
9. latitude (decimal degree, positive in the Northern Hemisphere)
10. altitude (m)
11. pressure (Pa)
12. air temperature, first sensor (K)
13. air temperature, second sensor (K)
14. solar zenith angle (°)
15. zonal velocity of the wind (m/s)
16. meridional velocity of the wind (m/s)
17. corrected air temperature, first sensor (K)
18. corrected air temperature, second sensor (K)
19. GPS receiver mode (0: 0D, 1: 2D, 2: 3D)
20. ISBA air temperature, first sensor (K)
21. ISBA air temperature, second sensor (K)
22. zonal velocity provided directly by the GPS receiver (m/s)
23. meridional velocity provided directly by the GPS receiver (m/s)
24. TSEN error code (for information only, all observations have beeen checked)

1.5.2 Restricted-access dataset

The columns respectively represent:

1. decimal day (convention 1.0 = January 1st, current year, 00 UTC)
2. year
3. month
4. day of month
5. hour (UT)
6. minute
7. second
8. longitude (decimal degree, positive east of the Greenwich meridian)
9. latitude (decimal degree, positive in the Northern Hemisphere)
10. altitude (m)
11. pressure (Pa)
12. air temperature, first sensor (K)
13. air temperature, second sensor (K)
14. solar zenith angle (°)
15. zonal velocity of the wind (m/s)
16. meridional velocity of the wind (m/s)
17. corrected air temperature, first sensor (K)
18. corrected air temperature, second sensor (K)
19. GPS receiver mode (0: 0D, 1: 2D, 2: 3D)
20. ISBA pressure (hPa)
21. ISBA air temperature, first sensor (K)
22. ISBA air temperature, second sensor (K)
23. zonal velocity provided directly by the GPS receiver (m/s)

24. meridional velocity provided directly by the GPS receiver (m/s)
25. internal temperature of TSEN instrument (°C)
26. voltage of TSEN power circuit (V)
27. helium superpressure inside the balloon (hPa)
28. helium temperature inside the balloon (°C)
29. internal temperature of ISBA payload (°C)
30. voltage of ISBA power circuit (V)
31. voltage of ISBA heating circuit (V)
32. error code (for information only, all observations have beeen checked)

2 Acronyms

CNES Centre National d'Études Spatiales, the French space agency

GPS Global Positioning System

ISBA The CNES gondola that controls the balloon flight and provides the communication with the ground station

LMD Laboratoire de météorologie dynamique

MÉTÉO-FRANCE the French meteorological service

TSEN Thermodynmical sensor, the LMD meteorological payload

References

[Hertzog et al.(2004)Hertzog, Basdevant, Vial, and Mechoso] Hertzog, A., C. Basdevant, F. Vial, and C. R. Mechoso, 2004: The accuracy of stratospheric analyses in the northern hemisphere inferred from long-duration balloon flights. *Q. J. R. Meteorol. Soc.*, **130**, 607–626. 1.3

[Rabier et al.(2010)] Rabier, F., et al., 2010: The Concordiasi project in Antarctica. *Bull. Am. Meteorol. Soc.*, **91**, 69–86, doi:10.1175/2009bams2764.1. 1.1