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IDEAL 2017
Radiosonde Data Quality Report

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The radiosonde data for this project were quality controlled and are maintained by the Earth Observing Laboratory at the National Center for Atmospheric Research (NCAR). The National Center for Atmospheric Research is managed by the University Corporation for Atmospheric Research and sponsored by the National Science Foundation.

If this dataset or information or plots from this document are used for publication or presentation purposes, please provide appropriate acknowledgement to NCAR/EOL and NSF and refer to the citation listed below. Please feel free to contact the authors for further information.

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IDEAL home page: https://www.eol.ucar.edu/field_projects/ideal

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Dataset Version Control

Version	Date	Author	Change Description
2.0	30 Nov 2018	H. Vömel	Initial data release, with minor format change

1 Table of Contents

2 Dataset Overview

The Instabilities, Dynamics, and Energetics accompanying Atmospheric Layering (IDEAL) field campaign was conducted at Dugway Proving Grounds, Utah, between 23 October and 15 November 2017. The goal of the project was to combine ground-based in situ observations with modeling efforts to examine 'sheet-and-layer' structures in the lower troposphere under stably stratified conditions. The Earth Observing Laboratory of the National Center for Atmospheric Research (NCAR/EOL) deployed one Integrated Sounding System (ISS) located at 40.121220°N, 113.128677°W. The ISS included a Vaisala MW41 radiosonde sounding system, a 915 MHz wind profiler, and a surface meteorological station. This document describes the quality of the data obtained from the Vaisala RS41 radiosonde launches.

Soundings were typically launched hourly in roughly hourly intervals between 03:00 and 07:00 local time on most days of the campaign period. On the last three days of the campaign, the sounding frequency was increased to every 30 min during the same early morning hours. This schedule provided between five and nine soundings during days of operation.

Figure 1 shows the flight tracks of the ascending part of all soundings. Due to the close spacing of the launches, most soundings were terminated prior to balloon burst. The end-points of most trajectories do not reflect the actual burst points.

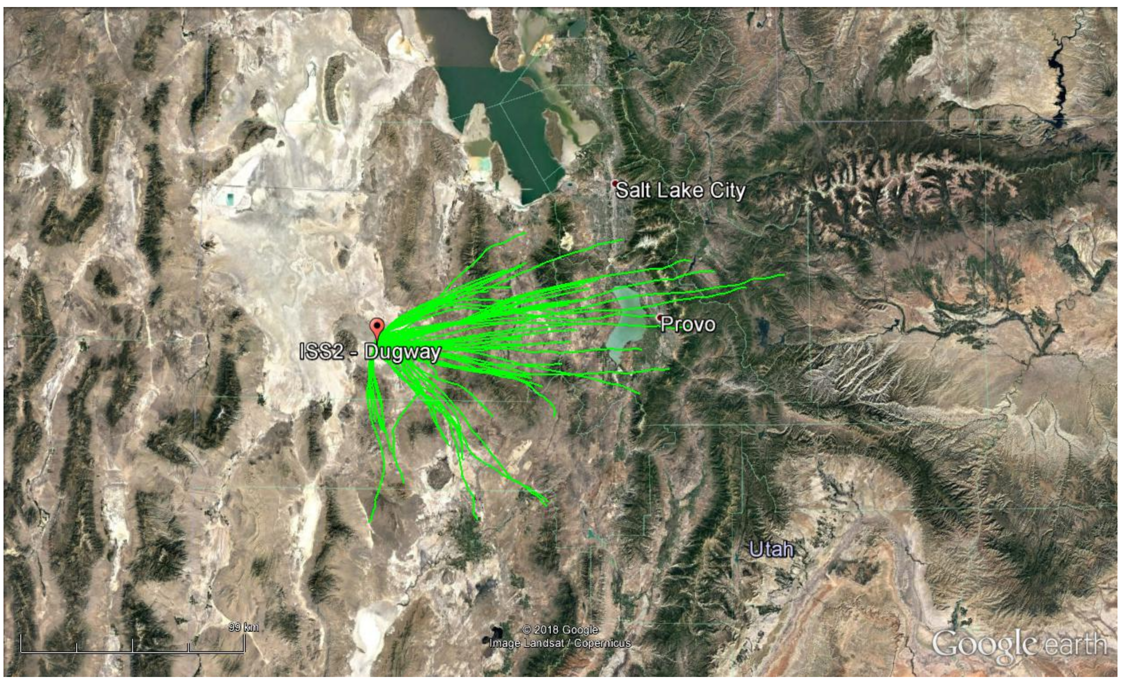

Figure 1: Location of the ISF site at Dugway Proving Grounds, Utah, during IDEAL and flight tracks of all ascending radiosonde profiles.

3 Radiosonde sounding system

This campaign used Vaisala RS41-SGP radiosondes, which were received and processed by the Vaisala MW41 sounding system using software version 2.5.0. The radiosondes used by NCAR/EOL include a pressure sensor, which provides a better altitude and pressure determination in the boundary layer and is more suitable for unstable conditions in convective environments. The sounding system was configured to meet the needs of NCAR for high-resolution data and complete metadata description. All sondes were launched using 100 g balloons supplied by Scientific Sales.

The MWX raw data files from the sounding system were saved along with the ASCII output files, which contained the initially processed profiles.

The sounding system automatically ingests surface reference observations (

Table 1), which are provided by a set of reference sensors about 20 m from the launch site. These observations are stored in the surface observations metadata fields of the sounding files and used in the quality control procedures of the sounding data.

Table 1: Surface reference observations provided by the ISS meteorological reference sensors

Parameter	Location	Sensor
Pressure	The reference pressure was installed on a mast at 1.8 m near the launch site.	Vaisala PTB210
Temperature, humidity, and wind	The reference sensors for temperature, humidity, wind speed, and wind direction were installed on a mast at 3 m near the launch site. A second set of sensors was installed at 10 m on the same mast, but was not used here.	Lufft WS700

4 Quality control procedures

4.1 Standard quality control

The Vaisala system performs a sequence of standard quality control procedures and corrections for all radiosonde data:

- Applies a ground check correction for pressure using the pressure correction measured during the sonde preparation to compensate for small biases inherent in this type of pressure sensor.
- Performs a coarse outlier check for all measurement parameters
- Automatically detects launch based on change in pressure
- Performs a radiation correction for the temperature measurement using the radiation correction lookup table for the Vaisala RS41 radiosonde
- Corrects for response time lag of the temperature sensor
- Smooths the temperature profile
- Corrects for response time lag of the humidity sensor
- Filters out the balloon pendulum effect in the calculation of winds
- Calculates geopotential altitude based on the measured pressure profile

4.2 Custom quality control

In addition to the standard Vaisala procedures, all metadata are verified, and all measured parameters including reference measurements are checked for consistency and for any previously unidentified issue. The radiosonde measurements before launch are compared against the reference measurements and the causes for early termination are investigated. In the IDEAL dataset no additional issues were detected, which needed to be addressed.

Due to a malfunction of the receiving system, the raw data of one sounding (IDEAL_ISS2_RS41_20171024_090238) were lost. However, the initially processed profile was saved. No issues were detected with this profile and raw data were not required for additional processing.

The final quality controlled data are provided in NetCDF format following the CF-1.6 metadata convention for climate and forecasting. For a detailed description of the data format, refer to Vömel et al., 2018, https://doi.org/10.5065/D65X27SR.

5 Sounding metrics

Radiosondes during IDEAL were launched in the early morning hours between 03:00 and 07:00 local time, mostly in one hour or thirty minute intervals. Ninety-three soundings were launched during the campaign without any failure of balloon or radiosonde. Since the balloon ascent time is typically around one hour, most soundings were terminated before balloon burst to be able to conduct the next. The last sounding of each day was allowed to rise to balloon burst.

The vast majority of the soundings was launched in calm to light wind conditions.

Until 28 October, balloons were filled with nominally 23 ft^3 of helium. After that, the amount of helium was reduced to 20 ft^3. The distribution of ceiling heights is shown in Figure 2. The unusual distribution is a result of the need to terminate soundings early.

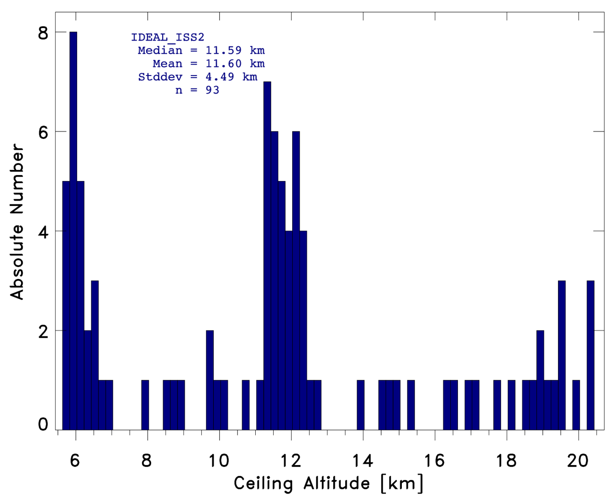

Figure 2: Distribution of ceiling heights for all radiosondes during IDEAL.

For balloons, which were allowed to burst, data were received up to a distance of 180 km. The distribution of balloon distance at the end of data recording and at 1 km above ground is shown in Figure 3. The median distance at which a sounding was terminated was 60 km and the smallest distance was 10 km. At 1 km above ground, all balloons were less than 3 km away from the launch site; and the majority was less than 1.5 km from the launch site.

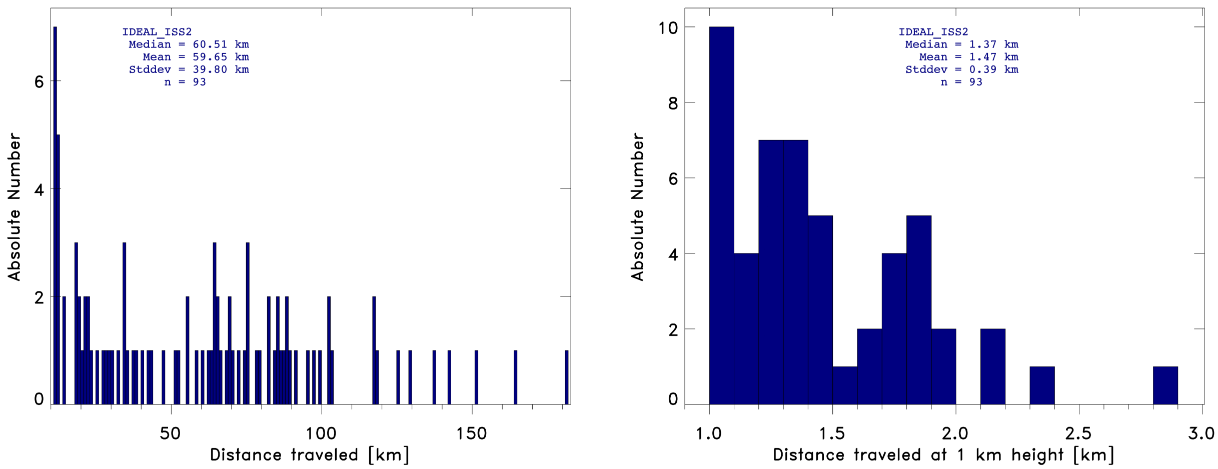

Figure 3: Distribution of balloon distance at end of data recording (left panel) and at 1 km above ground (right panel).

The median rise rate over the entire profile varied between 3.2 m/s and 4.6 m/s with a mean value of 3.7 m/s. A distribution of the rise rates for all soundings is shown in Figure 4. The slightly faster

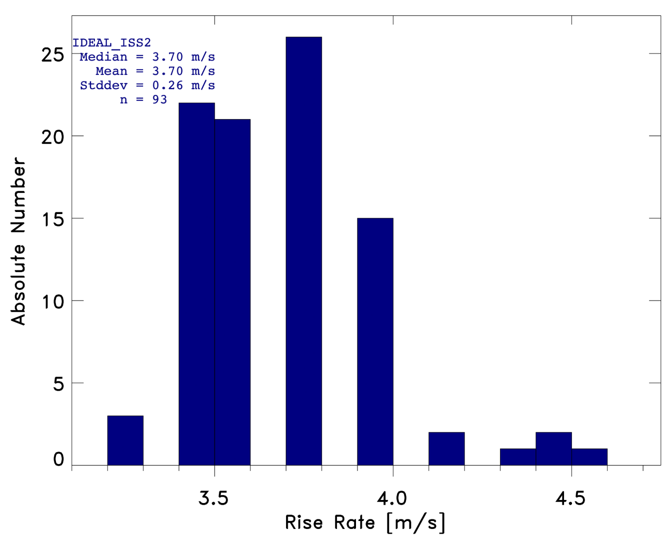

Figure 4: Distribution of rise rates for all radiosondes launched during IDEAL.

balloons were launched during the beginning of the campaign, when slightly more helium was used to inflate the balloons.

The sequence of all balloon rise rates (Figure 5) shows that this type of balloon rises faster in the lowest 1 km with an average rise rate of about 5.4 m/s. Therefore, the vertical resolution of measurements in the lowest km of the profile is about 5 m and about 4 m above that.

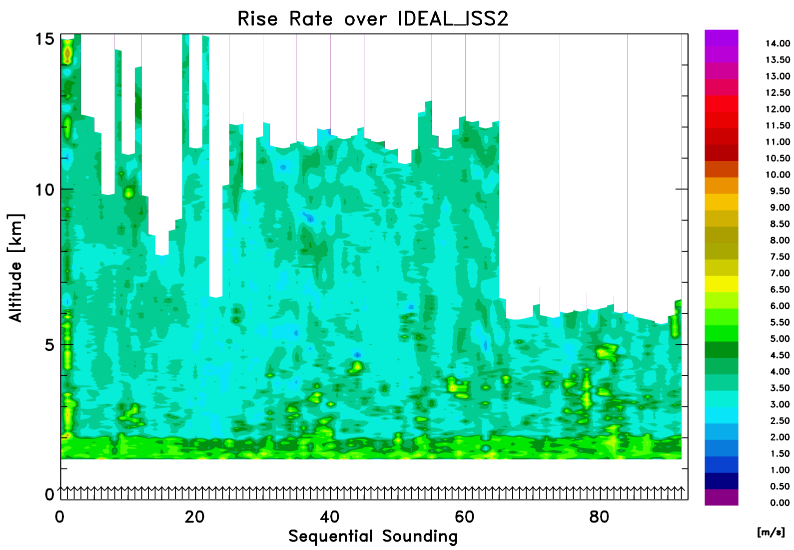

Figure 5: Sequence of rise rate profiles for all radiosondes launched at IDEAL. Each launch is indicated by a small arrow at the bottom of the diagram.

Air temperature and relative humidity measurements from all radiosondes are shown in Figure 6. Due to the close timing of the soundings during days of operation and unequal spacing of observation days, the contours are shown in sequence of soundings, rather than absolute time. The sudden jumps in humidity most clearly show the transition between the different days of operation. The lower ceiling altitude of around 6 km for soundings starting with sounding 67 on 13 November is due to the 30 min spacing between soundings. No sounding was launched in rain and the majority of observations days were clear, which is reflected in the generally low relative humidity. Soundings 42 through 51 launched on 6 and 7 November showed high relative humidity below 4 km and operators noted altocumulus in the vicinity. This layer is capped by very dry air with relative humidity values as low as 1.5% or mixing ratios of 0.03 g/kg.

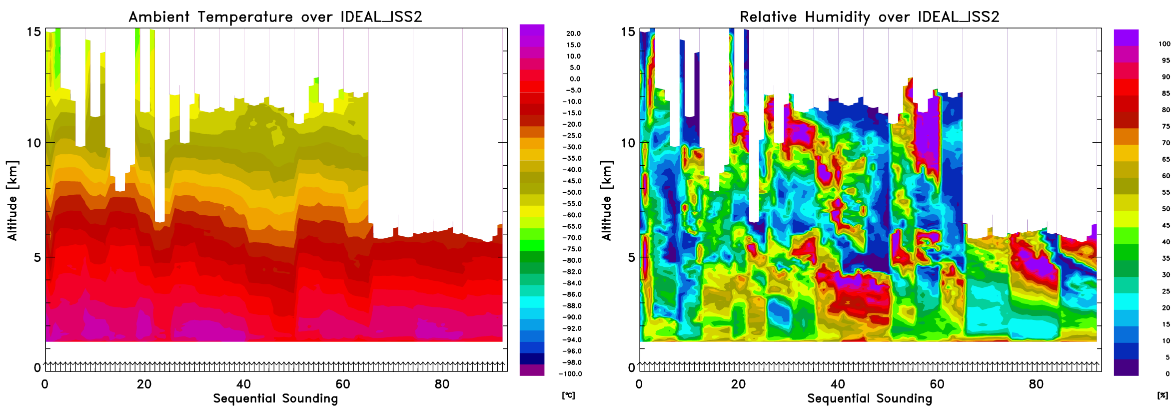

Figure 6: Sequence of temperature profiles (left) and relative humidity profiles (right) from all radiosondes launched during IDEAL. Each launch is indicated by a small arrow at the bottom of the diagram.

The zonal and meridional wind speed measurements at both sites are shown in **Error! Reference ource not found.**. The proximity of the jet stream is indicated by high wind speeds in the upper troposphere reaching up to 70 m/s. Winds near the surface were generally light.

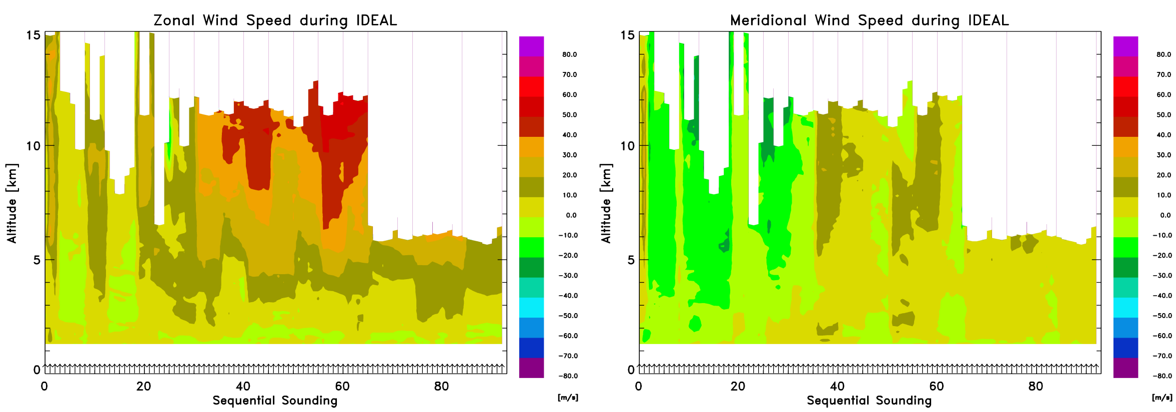

Figure 7: Sequence of zonal (left) and meridional wind speed (right) profiles from all radiosondes launched during IDEAL. Each launch is indicated by a small arrow at the bottom of the diagram.

6 References

Vömel, H., G. Granger, and I. Suhr, 2018, NCAR/EOL/ISF Radiosonde NetCDF Data Files, UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.5065/D65X27SR.