NASA TCSP 2005

The Aerosonde System

The Aerosonde is a small Unmanned Aerial Vehicle (UAV) with a 3m wingspan and a full weight of about 15kg. The first UAV to fly across the Atlantic, the Aerosonde can fly for up to 30hr and for long distances (up to 3000km)

The Aerosonde system offers two modes of operation: field deployments and global operations. Specialized crews can be deployed to the field to operate aircraft locally under the direction of a Principal Investigator. In this mode, the team works with the PI during a field program to provide all Aerosonde operations, including regulatory approvals and support services. In addition, Aerosonde has established a global aircraft operation mode, with a central command facility and aircraft operating from a distributed set of launch-recovery sites. This mode was successfully tested during operational trials for the Australian Bureau of Meteorology in early 1998. It became fully operational during missions for the Korean METRI in October 2001. Since then, Aerosonde has been deployed to numerous locations in the Arctic, Tropics, and regions between for ecological/biological and meteorological studies.

With a payload plus fuel capacity of 5kg, a number of instruments have been developed for the Aerosonde. These include several cloud physics instruments, CO, SO2, and ozone sensors, digital cameras, streaming video capability, radiometers, and pyrometers.

For more information about the Aerosonde platform, visit http://www.aerosonde.com .

The Aerosonde team for the TCSP 2005 mission consisted of Brenda Mulac (Team Leader and Mission Scientist), Ryan Vu (Pilot), Dave Smith (Technician), Nick Logan (Ground control), Dave Easmunt (NASA Mission Manager), Fabian Garcia (Interpretor), and Jason Roadman (Observer).

Aerosonde Data Release Notes – TCSP July 2005, Costa Rica

The purpose of this document is to provide information on the data obtained and provided by the Aerosonde UAV from the NASA TCSP project. Any questions regarding the data should be directed to Brenda Mulac, Mission Scientist for Aerosonde North America (b.mulac@aerosonde.com; 757-854-4620).

TCSP Flight Summary

Eight Aerosonde flights totaling 75hr were flown off the coast of Costa Rica during the NASA Tropical Cloud Systems Processes Experiment (TCSP) in July 2005. The individual flights are summarized in the table below. Take off and landing times are in UTC.

Flight	Date	Aircraft	Take Off	Landing	Comments
1	July 5	126	2103	2219	Shake down flight over airfield – no data
2	July 7	126	1319	2110	Soundings off coast - daytime
3	July 10	126	1255	2048	Soundings to 1524m along track – daytime
4	July 11	129	1340	2137	Soundings to 1524m along track – daytime
5	July 13	126	1300	2029	Soundings to 500m along track – daytime
6	July 14	129	1320	2149	Soundings to 1524m along track – daytime
7	July 18-19	129	2115	1336	Overnight flight; soundings to 2600m along track
8	July 21-22	126	2040	1300	Overnight flight; soundings to 2600m along track

Measurements of air temperature, pressure, and relative humidity were made on each flight using two Vaisalla RS902 sondes located under the wings of the aircraft. A Heiltronics KT11.k6 infrared pyrometer was used to measure sea surface temperatures (SST). Information on the accuracy and resolution of these instruments is in the table below.

Measurement	Resolution	Accuracy/Uncertainty
Air temperature	0.1C	0.5C
Pressure	0.1hPa	1.5hPa
Relative humidity	1%	5%
KT-11 (SST)	2C	1C

Prior to each flight, a calibration of the sondes was performed against a reference pressure, temperature, and humidity. This information is entered into the groundbase system and used to correct the sonde output automatically. The calibration information for each flight can be found in the appendix.

Data File Format

Five data files have been created for each portion of flight, a PTU file (*.ptu), a wind file (*.wnd), an Aerosonde file (*.as), a GPS file (*.GPS), and a metdump file (M*.txt). File names are of the form XmmddaaY.*, where X is a single letter indicating phase of flight (L=local, E=enroute

(TDMA), R=returning, I=iridium), “mm” and “dd” are two digit numbers indicating respectively the month and day that the flight launch took place; “aa” is a two digit number identifying the aircraft that performed the flight; and “Y” is a letter used to differentiate files when an aircraft has made multiple flights on a single day (“A” for first flight of the day, “B” for second flight of the day, etc..). The naming convention of metdump files is the same as for other files, except “M” is used at the beginning of the file name in lieu of the flight phase designator. A brief description of each file type and its contents is given below.

PTU File: PTU files are comma delimited text files containing pressure (hPa), temperature (C), and relative humidity (%) data from each of the two Vaisala RS902 sensors carried onboard the Aerosonde. The first line of each file contains header information defining the contents of each column of data. Note that UTC time is given in seconds and in hours.

WND File: WND files are comma delimited text files containing the wind data from each flight. The first line of each file contains header information defining the contents of each column of data. Wind measurements are given in ms^{-1}.

AS and GPS Files: The AS and GPS files are also comma delimited text files. The AS file contains the KT-11 SST measurements and pressure altitude. The GPS file contains latitude, longitude, and GPS altitude for the flight. Note that the time stamps for these two files are **not** synchronized.

Metdump File: Metdump files are comma delimited text files and contain data downloaded from the Aerosonde’s onboard meteorological computer after flight. Header information in the first line defines data in each column. The pyrometer data is provided as a raw count in the last column of this file.

Data Quality Control

The data in each of these files has been carefully reviewed and provided in raw form; no corrections have been made. All data that is erroneous or concluded to be bad has been given the value 9999. Sensor failures/problems occur periodically during flights; times, dates, and type of failure/problem the occurred during this experiment are outlined below.

Flight Date	Failure Time	Problem Type
July 10	1746	Left sonde humidity sensor failed
July 11	2112	Right sonde humidity sensor fouled
July 14	Shortly after take off	Unexplained drift in sensor, resulting in 0.7% difference between sondes by end of flight
July 18-19	0858 July 19	Left sonde humidity sensor fouled by heavy rain

Time Stamps and Conversion

The time stamp used in the I* files is Iridium time. The time in Iridium land is always 1200 Jan 6, 1980, which corresponds to 0000 UTC. The sample time stamp is thus the time elapsed since 0000UTC Jan 6, 1980. To convert to UTC time, simply divide the Iridium time by 86400 (the number of seconds in 1 day) and take the remainder. This remainder is the UTC time (in seconds) on the day in question.

The time stamp on the Metdump files is just the time in UTC seconds of the day in flight. Conversion to hours is done simply by dividing the time stamp by 3600.

In all cases, a column was added with UTC in hours for convenience; the time in seconds is provided for those who wish to do their own conversions or prefer to use seconds in their analysis.

Appendix

Sonde Calibrations

Units: Pressure – hPa; Temperature – C; Humidity - %

Flight and Variable	Reference	Left Sonde	Right Sonde
Flight #1			
Pressure	NA	NA	NA
Temperature	NA	NA	NA
Humidity	NA	NA	NA
Flight #2			
Pressure	1008.53	1007.60	1006.98
Temperature	28.8	29.20	29.87
Humidity	0	0.35	0.70
Flight #3			
Pressure			
Temperature			
Humidity			
Flight #4	1007.65	1006.91	1006.75
Pressure	29.6	30.04	30.22
Temperature	0	0.52	0.48
Humidty			
Flight #5			
Pressure	1008.81	1008.10	1008.23
Temperature	32.3	32.51	32.2
Humidity	0	0.68	0.56
Flight #6			
Pressure	1011.23	1010.42	1010.28
Temperature	29.0	29.34	29.20
Humidity	0	0.68	0.65
Flight #7			
Pressure	1007.5	1006.79	1006.73
Temperature	26.0	26.41	26.46
Humidity	0	0.19	0.22
Flight #8			
Pressure	1009.35	1008.59	1008.33
Temperature	28.9	29.27	29.01
Humidity	0	0.40	0.55