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NCAR/EOL/ISF Dropsonde NetCDF Data Files

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Document Version Control

Version	Date	Author	Change Description
1.0	30 Dec 2019	H. Vömel	Initial Release
2.0	6 June 2024	H. Vömel	Added sea surface skin temperature

1 Conventions

The NetCDF sounding files provided by EOL follow the CF-1.6 metadata convention for climate and forecasting. All variables include a long_name and units attribute, and where applicable a standard_name attribute and a _FillValue attribute.

The standard names for the EOL sounding files use the following convention:

PPP_avaps_RRR_vN_YYYYMMDD_hhmmss.nc

where:

PPP : Project name
avaps : Reference to AVAPS dropsondes
RRR : Dropsonde type
vN : Data set version number
YYYYMMDD_hhmmss: Date and time of launch in universal time (UT)

Example: OTREC_AVAPS_NRD41_v1_20171107_120024.nc.

2 Variables

The sounding files contain profile variables, which are typically at half-second resolution for pressure, temperature, and humidity, and quarter second resolution for horizontal winds; however, a regular spacing of profile data should not be assumed.
The sounding files also contain reference variables, which are scalar values representing reference observations by independent sensors near the launch site. The data files may also contain an estimate of the sea surface skin temperature measured by an infrared thermometer.

2.1 Profile variables

Profile variables are arrays containing the parameters measured by the radiosonde. All fields except time may contain missing values.

Variable	Unit	Missing value	Explanation
time	s		Time since launch
pres	hPa	-999	Air pressure
tdry	°C	-999	Air temperature
dp	°C	-999	Dew point temperature, calculated using Hardy (1998)
rh	%	-999	Relative humidity
u_wind	m/s	-999	Eastward wind component
v_wind	m/s	-999	Northward wind component
w_wind	m/s	-999	Vertical wind component
wspd	m/s	-999	Wind speed
wdir	°	-999	Wind direction
dz	m/s	-999	Sonde fall rate calculated from the change of geopotential height with time. Positive values indicate upward motion.
mr	g/kg	-999	Mixing ratio of mass of water vapor to mass of dry air
vt	°C	-999	Virtual temperature
theta	K	-999	Potential temperature
theta_e	K	-999	Equivalent potential temperature
theta_v	K	-999	Virtual potential temperature
lat	°	-999	North latitude
lon	°	-999	East longitude
alt	m	-999	Geopotential height above MSL*
gpsalt	m	-999	GPS reported altitude above MSL

*) The geopotential height is integrated from the surface upward, if the sonde has transmitted data to the surface. If telemetry has been lost prior to reaching the surface, the geopotential altitude is integrated from the aircraft level downward.

2.2 Reference variables

Reference variables are scalar values, which capture the time of launch as well as reference observations typically coming from a set of independent sensors.

Variable	Unit	Missing value	Explanation
launch_time	s		Time (scalar) given in seconds since the launch time contained in the units attribute of the variable.
reference_time	s	-999	Time of the reference observation (scalar), given in seconds since the launch time contained in the units attribute of the variable.
reference_pres	hPa	-999	Reference pressure (scalar)
reference_tdry	°C	-999	Reference temperature (scalar)
reference_rh	%	-999	Reference relative humidity (scalar)
reference_wspd	m/s	-999	Reference wind speed (scalar)
reference_wdir	°	-999	Reference wind direction (scalar)
reference_lat	°	-999	Reference latitude (scalar)
reference_lon	°	-999	Reference longitude (scalar)
reference_alt	m	-999	Reference altitude above MSL (scalar)
sea_surface_skin_temperature	°C	-999	Sea surface skin temperature measured by an infrared radiometer (scalar) measured at the end of a dropsonde profile closest to the surface.

Most reference observations are provided by the data system of the aircraft on which AVAPS is installed. The user should refer to the aircraft specific documents for the exact source of these observations.

The time of the reference observation is expected to be when the system detected the launch of the dropsonde. For NRD41 and NRD94 dropsondes, this is the moment when the sondes were released. For RD41 and RD94 dropsondes, this may up to a several seconds after release.

The launch time indicated in the reference variables and metadata may differ from the launch time indicated in the file name. In this case, the metadata fields and reference variables contain the correct value. The original time stamp in the file name is maintained to provide traceability to the raw data files.

2.3 Sea surface skin temperature variables

Sea surface skin temperature variables are scalar values, which capture the estimate of the sea surface skin temperature, the corresponding air temperature and relative humidity, as well as the time and location of these observations.

Variable	Unit	Missing value	Explanation
surface_time	s		Time (scalar) given in seconds since the launch time contained in the units attribute of the variable.
surface_lat	°	-999	Latitude of the surface observation (scalar)
surface_lon	°	-999	Longitude of the surface observation (scalar)
surface_pressure	hPa	-999	Surface pressure estimate (0 m height, scalar)
surface_tdry	°C	-999	Surface dry air temperature (scalar)
surface_rh	%	-999	Surface relative humidity (scalar)
sea_surface_skin_temperature	°C	-999	Sea surface skin temperature measured by an infrared radiometer (scalar) measured at the end of a dropsonde profile closest to the surface.

The sea_surface_skin_temperature has been measured by an infrared thermometer on dropsondes that have been equipped with one. The reported skin temperature is the last reported value before the sonde reaches the surface and is the best available approximation for the infrared skin temperature at the landing location. For the quality of these observations please see the respective dropsonde data report.

3 Metadata

Metadata are stored as global attributes in NetCDF sounding files. They are taken from the original sounding system files and generated by the Atmospheric Soundings Processing Environment (ASPEN), which created these files. For details regarding ASPEN, please refer to the ASPEN documentation at https://ncar.github.io/aspendocs/.

3.1 File information

Conventions	:	Version of the CF convention used in this file
featureType	:	="trajectory" indicates a sounding profile
AspenVersion	:	ASPEN version, which generated this file
ConfigSetName	:	Name of the ASPEN configuration set
RepoBranch	:	Revision control information for the ASPEN software, which generated this file
RepoId	:	Revision control information
RepoLastChangedDate	:	Revision control information
RepoRevision	:	Revision control information
ProcessingTime	:	Date and time, when the QC output file has been generated

3.2 Campaign specific information

Project	:	Acronym of the research project during which these data were created
Flight	:	Sequential research flight number of the research campaign
PlatformId	:	Tail number of the research aircraft
Research organization	:	Research organization responsible for these data
PlatformType	:	Aircraft type, e.g. NCAR G-V, or NOAA P-3
Agency	:	Research institution responsible for these measurements

3.3 Sounding specific information

SondeId	:	Dropsonde serial number
ChuteArea	:	Dropsonde parachute cross-sectional area in cm^2
DragCoef	:	The coefficient of drag for the dropsonde payload used in fall rate computations, dimensionless
DropSondeMass	:	Mass of the dropsonde in g
DropsondeHitSfc	:	Flag indicating, whether the dropsonde transmitted data to the surface. In this case, the geopotential height is integrated upward from the surface.
SoundingDescription	:	Metadata summary from the raw data file
ObsNum	:	Sequential observation number assigned by the observer during a research flight. The default value is 99, indicating that no observation number has been assigned.

3.4 Final smoothing parameters

PresSmoothWL : Period over which final pressure data have been smoothed. If this field is set to 0, then no final smoothing has been performed.

RHSmoothWL : Period over which final relative humidity data have been smoothed. If this field is set to 0, then no final smoothing has been performed.

TdrySmoothWL : Period over which final temperature data have been smoothed. If this field is set to 0, then no final smoothing has been performed.

WindSmoothWL : Period over which final wind components data have been smoothed. If this field is set to 0, then no final smoothing has been performed.

3.5 Quality control filter parameters

QCDisclaimer : Disclaimer information about the quality control procedures.

DoQC : Flag indicating, whether ASPEN performed its regular quality control, or whether the data were just reformatted.

DiscardBadCrcData : If true, then telemetry frames with CRC errors were discarded.

PresDisableOutlierCheck : Flag indicating, whether pressure outliers were not removed

RHDisableOutlierCheck : Flag indicating, whether relative humidity outliers were not removed

TdryDisableOutlierCheck : Flag indicating, whether temperature outliers were not removed

WindDisableOutlierCheck : Flag indicating, whether wind components outliers were not removed

PresMonoCheck : Flag indicating that the sondes must have a monotonic pressure increase, i.e. data during upward motion were removed

RHchoice : For older xRD93 and xRD94 dropsondes, this field indicates, which of the two humidity sensors was used to generate the final relative humidity data (0=AVAPS selected, 1=RH1, 2=RH2)

SfcAltitude : Altitude of the surface for soundings over land

SfcAltUnknown : Flag indicating that the surface altitude is not known. If this flag is set, then the upward calculation of the geopotential height is skipped

UseTheoryVentRate : Use the theoretical fall rate in calculations rather than the measured fall rate, in particular in the dynamic wind correction and ventilation correction

WindDisableQCFilter : Flag indicating, whether winds have not been quality controlled

PresEquilTime : Equilibration time used in processing to remove contributions from the aircraft cabin pressure to the measured air pressure

RHEquilTime : Equilibration time used in processing to remove contributions from the relative humidity prior to launch to the measured air relative humidity

TDryEquilTime	:	Equilibration time used in processing to remove contributions from the prelaunch temperature to the measured air temperature
WindEquilTime	:	Equilibration time used in processing to remove contributions from the aircraft speed to the measured wind
WindErrorHigh	:	Threshold for reported wind speed accuracies above 10 km
WindErrorLow	:	Threshold for reported wind speed accuracies below 10 km
WindSats	:	Minimum number of GPS satellites required in wind calculations
TdryDynCorWL	:	Time used in the correction of slower temperature sensor response
WindDynCorWL	:	Time used in the correction of the sonde inertia in response to changing winds
RHOffset	:	Constant offset correction for relative humidity sensor (Obsolete feature)
TdryOffset	:	Constant offset correction for the temperature sensor (Obsolete feature)
PresOffset	:	Constant offset for the pressure sensor based on comparison measurements inside the aircraft prior to launch
RHThreshold	:	Flag indicating, whether the final data have been limited to a range of 0% < RH <= 100%. Without thresholding, relative humidity values in the range 100% < RH <120% will be reported. Values outside this range will be flagged as bad values
BlendLength	:	The blending interval for the last points of dropsonde pressure and winds. A second bspline filter is calculated with a higher frequency wavelength, and the results from this are blended back into the primary filter results, over this time. The width of this filter is also set to BlendLength.
AltInterpSpan	:	Maximum time gaps over which geopotential altitude calculations are interpolated
GPSAltBuddySlope	:	Maximum rate of change between neighboring GPS altitude data points. Data points changing faster are flagged as outliers and removed
GPSAltQCDev	:	Maximum allowed number of GPS altitude standard deviations within a period
GPSAltQCWL	:	Period for GPS altitude outlier filter
GPSPosBuddySlope	:	Maximum rate of change between neighboring GPS position data points. Data points changing faster are flagged as outliers.
GPSPosQCDev	:	Maximum allowed number of GPS position standard deviations within a period
GPSPosQCWL	:	Period for GPS position outlier filter
PosInterpSpan	:	Maximum time span, in seconds, over which the position integration from winds data will be interpolated. (Obsolete feature)
PresBuddySlope	:	Maximum rate of change between neighboring pressure data points. Data points changing faster are flagged as outliers

PresOutlier	:	Threshold for number of deviations from the linear fit, over which a point will be flagged and discarded
PresQCDev	:	Threshold for maximum deviation from the smoothed series, above which values will be flagged and removed
PresQCWL	:	Period for pressure outlier filter
RHOutlier	:	Flag indicating, whether a relative humidity outlier check was performed
RHBuddySlope	:	Maximum rate of change between neighboring relative humidity data points. Data points changing faster are flagged as outliers.
RHQCDev	:	Maximum allowed number of relative humidity standard deviations within a period
RHQCWL	:	Period for relative humidity outlier filter
TdryBuddySlope	:	Maximum rate of change between neighboring temperature data points. Data points changing faster are flagged as outliers
TdryOutlier	:	Flag indicating, whether a temperature outlier check was performed
TdryQCDev	:	Maximum allowed number of temperature standard deviations within a period
TdryQCWL	:	Period for temperature outlier filter
WindBuddySlope	:	Maximum rate of change between neighboring wind components data points. Data points changing faster are flagged as outliers.
WindOutlier	:	Flag indicating, whether a wind outlier check was performed
WindQCDev	:	Maximum allowed number of wind components standard deviations within a period
WindQCWL	:	Period for wind components outlier filter
WindVVdelta	:	Maximum difference between GPS measured vertical fall speed and that calculated from pressure, temperature, and humidity
WindVVPresWL	:	Period for GPS altitude outlier filter

4 References

Bob Hardy, ITS-90 formulations for vapor pressure, frostpoint temperature, dewpoint temperature, and enhancement factors in the range –100 to +100 C, Proceedings of the Third International Symposium on Humidity & Moisture, London, England, April 1998.