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Sonde Adjust Value-Added Product Technical Report

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1.0 Introduction

The Sonde Adjust (SONDEADJUST) value-added product (VAP) creates a file that includes all fields from original Atmospheric Radiation Measurement Climate Research Facility (ARM Facility) radiosonde files and contains several value-added fields that provide adjustments related to well-known humidity issues. Miloshevich et al. (2009, 2006, 2004, 2001), Wang et al. (2002), Turner et al. (2003), and Vomel et al. (2007) all detail the most significant problems with the humidity sensors that are found on Vaisala-supplied radiosondes. As the literature clearly shows, the sensors have a dry-bias and a time-lag that prevent accurate humidity measurements from being realized. Xie et al. (2010) details the role of diurnal variation on the dry bias of the RS-92 radiosondes. Algorithmic solutions are also presented within these papers—most notably in Wang et al. (2002), Miloshevich et al. (2004 and 2009), and Vomel et al. (2007). Sonde Adjust improves upon the corrections found in the discontinued `sgpsondecorr1miloC1.c1` PI product by including corrections for all classes (RS-80, RS-90, and RS-92) of ARM radiosondes. In addition to the humidity corrections, the Sonde Adjust VAP includes a relative humidity (RH) profile scaled by the precipitable water vapor as detected by the microwave radiometer (MWR).

Following the same format as `sgpsondecorr1miloC1.c1`, output fields include intermediate fields (smoothed RH and dry-biased corrected RH) used to produce the final corrected ambient RH. A final field—an MWR-scaled RH profile using the newly calculated ambient RH—is also included. All classes of Vaisala radiosondes used by the ARM Facility (RS-80, RS-90, and RS-92) have been corrected using the algorithms specifically designed for each. This VAP can be run for all ARM fixed and mobile facility sites. Radiosondes used in ARM field campaigns can also be corrected.

Miloshevich et al. (2009) summarizes all previous work on the relative humidity corrections of Vaisala-supplied radiosondes and contains details of all algorithms used to produce this VAP.

Figure 1 shows the corrected RH profile for Vaisala RS-92 radiosondes launched at the Southern Great Plains (SGP) Central Facility on May 12, 2003. The red profiles represent the uncorrected data, and the blue profiles represent the final corrected profiles. The MWR-scaled corrected profiles are not included.

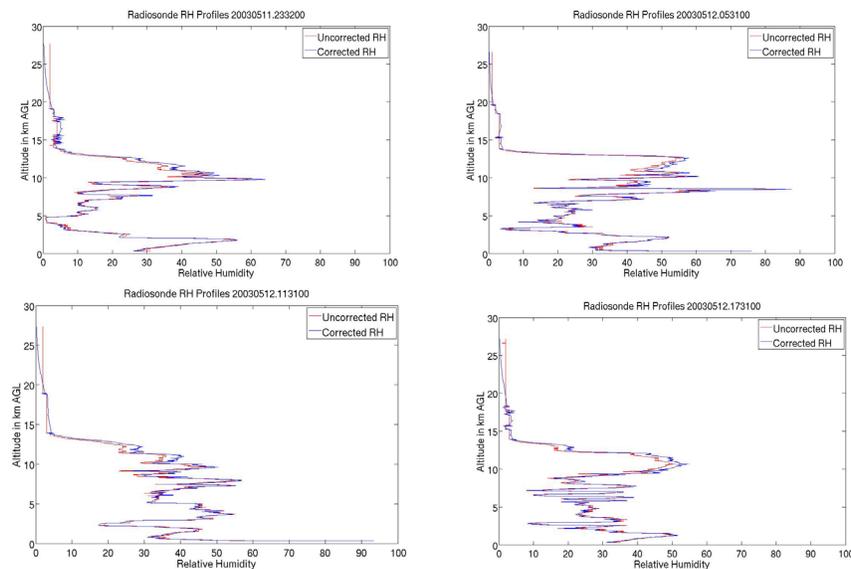


Figure 1. The original (red) and corrected (blue) relative humidity profile for Vaisala RS-92 radiosondes launched at the SGP Central Facility on May 12, 2003.

2.0 General Description

SONDEADJUST produces data that correct documented biases in radiosonde humidity measurements. Previous efforts towards applying some of these corrections are available via the discontinued PI product `sgpsondecorr1miloC1`. Unique fields contained within this datastream include smoothed original relative humidity, dry bias corrected relative humidity, and final corrected relative humidity. The smoothed RH field refines the relative humidity from integers—the resolution of the instrument—to fractions of a percent. This profile is then used to calculate the dry bias corrected field. The final correction fixes the time-lag problem and uses the dry-bias field as input into the algorithm. In addition to dry bias, solar heating is another correction that is encompassed in the final corrected RH field.

Output from SONDEADJUST differs from the previous RH-corrected datastreams in important ways. First, all three types of ARM radiosondes—Vaisala RS-80, RS-90, and RS-92—are corrected using dedicated procedures and/or parameters. Second, the output variables include all of those found in the original radiosonde file:

- dry bulb temperature
- dewpoint temperature
- wind speed
- wind direction
- eastward wind component
- northward wind component
- wind status (a Vaisala-produced field used in conjunction with the Loran system)
- ascent rate
- original relative humidity.

Additional humidity fields are smoothed relative humidity, dry biased corrected relative humidity, final ambient relative humidity, and scaled adjusted relative humidity. Third, quality control (QC) flags of the fields from the original radiosonde datastream are brought into the SONDEADJUST output file. Additional QC variables are created for the new fields.

3.0 Algorithm Outline and Description

1. Load all applicable datastreams (see Table 1).
2. Load radiosonde attributes.
 - a. Ground control pressure
 - b. Ground control temperature
 - c. Ground control relative humidity
 - d. Radiosonde serial number

3. Determine whether sonde launch is day or night.
4. Perform humidity corrections.
 - a. Smooth original RH data.
 - b. Correct smoothed RH for time lag.
 - c. Complete adjustment of RH to true ambient RH.
 - d. Correct ambient RH for diurnal differences.
 - e. Scale final RH by precipitable water vapor.
5. Complete Quality Control.
6. Output datastream.

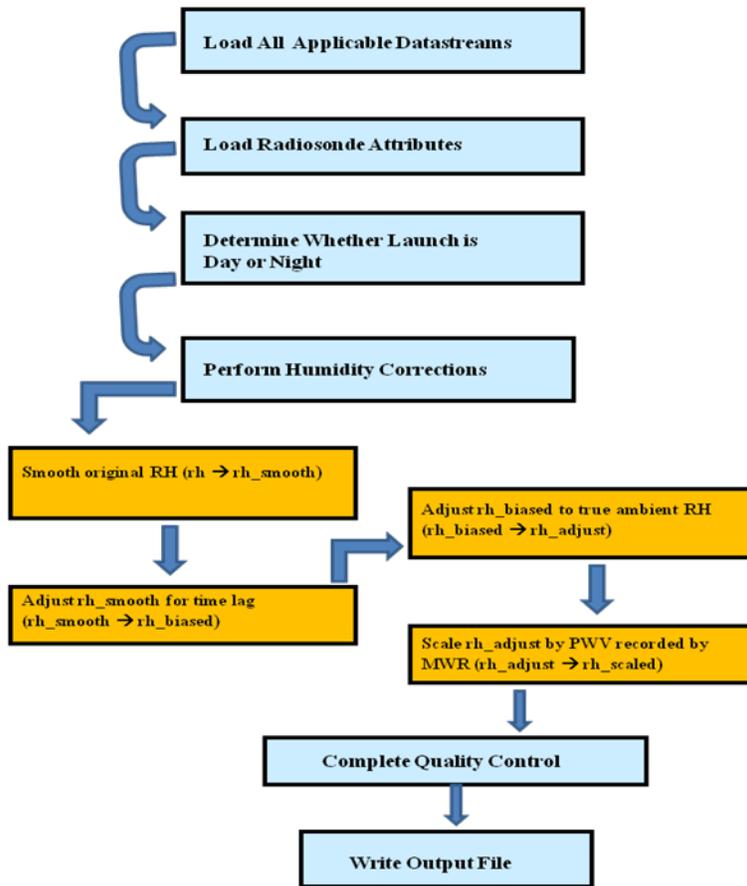


Figure 2. SONDEADJUST flow chart.

4.0 Data

The files that are used as input are listed in Table 1. Table 2 presents a summary of Vaisala radiosonde types used at each location.

Table 1. Input files used by SONDEADJUST.

Location	Radiosonde	Surface	Microwave Radiometer
Southern Great Plains (SGP)	sgpsondewnpnC1.b1	sgp1smosE13, sgpmetE13	sgpmwrret1liljclouC1.c1
North Slope of Alaska (NSA)	nsasondewnpnC1.b1	nsametwr4hC1, nsametC1	sgpmwrret1liljclouC1.c1
Manus Island (MAN)	twpsondewnpnC1.b1	twpsmet60sC1	twpmwrret1liljclouC1.c1
Nauru (NAU)	twpsondewnpnC2.b1	twpsmet60sC2	twpmwrret1liljclouC2.c1
Darwin (DAR)	twpsondewnpnC3.b1	twpsmet60sC3	twpmwrret1liljclouC3.c1
Point Reyes, California (PYE)	pyesondewnpnM1.b1	pyesmet60sM1	pyemwrret1liljclouM1.c1
Niamey, Niger (NIM)	nimsondewnpnM1.b1	nimmetM1	nimmwrret1liljclouM1.c1
Black Forest, Germany (FKB)	fkbsondewnpnM1.b1	fkmetM1	fkbmwrret1liljclouM1.c1
Shouxian, China (HFE)	hfesondewnpnM1.b1	hfemetM1	
Graciosa Island, Azores (GRW)	grwsondewnpnM1.b1	grwmetM1	

Table 2. ARM radiosondes used at each location by date.

Location	Vaisala RS-80	Vaisala RS-90	Vaisala RS-92
SGP	1992–4/30/2001	5/1/2001–2/8/2005	2/9/2005–Present
NSA	1997–4/24/2002	4/25/2002–12/31/2004	1/1/2005–Present
MAN	1996–5/31/2002	6/1/2002–3/31/2005	4/1/2005–Present
NAU	1998–5/31/2002	6/1/2001–3/31/2005	4/1/2005–Present
DAR	2002–6/17/2006		6/18/2006–Present
All Mobile Facilities			2005–Present

4.1 Value-Added Output

The value of this VAP is that adjustments are made for known problems with the RH values recorded by the ARM radiosonde sensors. This VAP can be applied to all types of Vaisala-produced radiosondes that have been used or are currently in use by the ARM Facility. Vaisala RS-80 and RS-90 radiosondes are no longer in use but historical data have been processed to correct the humidity values; Vaisala RS-92 radiosondes are the current instrument of choice used by the ARM Facility and are also processed through SONDEADJUST.

Derived fields are:

1. rh_smooth (RH smoothed from the coarse resolution of the original sounding in order to better capture the physical surroundings)

2. rh_biased (RH that is adjusted to eliminate the dry bias as reported in the literature)
3. rh_adjust (RH that has been corrected for the sensor time lag and for solar warming).

Each of these fields is calculated using the previous field. That is, rh_smooth is calculated using the original relative humidity, rh_biased is calculated using rh_smooth, and rh_adjust is calculated using rh_bias. Smoothing the original RH profile follows the Derivative-Based Smoothing Algorithm found in Appendix B of Miloshevich et al. (2004). The dry-bias correction algorithm is found in Wang et al. (2002) where each component of the error is detailed. Fixes are performed for chemical contamination error, temperature dependence error, basic calibration error, sensor-arm-heating error, and ground-check error. Miloshevich et al. (2004) and Miloshevich et al. (2009) describe algorithms to correct for time-lag error for the RS-80 and RS-90 radiosondes and the RS-92 radiosonde, respectively. These procedures are implemented in this VAP.

Another value derived from this VAP is the scaled RH field. The profile of the RH is scaled by the precipitable water vapor (PWV) as defined in the MWR Retrievals VAP (mwrret1liljclouC1 datastream). Scaled values are calculated by integrating the adjusted ambient RH (rh_adjust), determining a scale factor based on the PWV, and then applying that scale factor to each value of the humidity profile. This scaled-RH field is an improvement to the same field that is contained in the Liebe Scaled Sonde (LSSONDE) VAP, because this is a scaled profile of the corrected sounding. It is therefore the plan that the Sonde Adjust VAP will replace the LSSONDE VAP.

If the MWR data are unavailable, the scaled profile contains only data missing (-9999) entries. This is also the case when the PWV from the MWR is less than 0.8.

4.2 Data Quality Assessment Included

Quality assessments for the variables that are copied from the radiosonde files (barometric pressure, dry bulb temperature, dewpoint temperature, wind speed, wind direction, relative humidity, eastward wind component, northward wind component, and ascent rate) all have the same quality control values, as do the original radiosonde files. The value-added fields (rh_smooth, rh_biased, rh_adjust, and rh_scaled) have newly derived quality control variables. These new quality control variables are requirements from the Data Quality office. At present, they are copied from the RH QC field from the original radiosonde data. As the data are moved from the Evaluation area of the ARM Data Archive to the general area, more detailed information will be assigned to all of the new QC fields.

4.3 Output Products

SONDEADJUST generates only one datastream per radiosonde type version per site. Using the standard VAP naming conventions, we have the following filenames:

- sgpsondeadjustC1.c1 – Southern Great Plains
- nsasondeadjustC1.c1 – North Slope of Alaska
- twpsondeadjustC1.c1 – Tropical Western Pacific (TWP) Manus, Papua New Guinea
- twpsondeadjustC2.c1 – TWP Nauru

- twpsondeadjustC3.c1 – TWP Darwin, Australia
- pyesondeadjustM1.c1 – AMF Pt. Reyes, California
- nimsondeadjustM1.c1 – AMF Niamey, Niger
- fkbsondeadjustM1.c1 – AMF Black Forest, Germany
- hfesondeadjustM1.c1 – AMF Shouxian, China
- grwsondeadjustM1.c1 – AMF Graciosa Island, Azores
- cjcsondeadjustS01.c1 – Intensive Operational Period Cerro Toco, Chajnantor, Chile

4.4 Sample Header File

```
netcdf sgpsondeadjustC1.c1.20060301.232900 {
dimensions:
    time = UNLIMITED ; // (2730 currently)
variables:
    int base_time ;
        base_time:string = "1-Mar-2006,23:29:00 GMT" ;
        base_time:long_name = "Base time in Epoch" ;
        base_time:units = "seconds since 1970-1-1 0:00:00 0:00" ;
    double time_offset(time) ;
        time_offset:long_name = "Time offset from base_time" ;
        time_offset:units = "seconds since 2006-03-01 23:29:00 0:00" ;
    double time(time) ;
        time:long_name = "Time offset from midnight" ;
        time:units = "seconds since 2006-03-01 00:00:00 0:00" ;
    int qc_time(time) ;
        qc_time:long_name = "Quality check results on field: Time offset from midnight" ;
        qc_time:units = "unitless" ;
        qc_time:description = "This field contains bit packed values which should be interpreted
as listed. No bits set (zero) represents good data." ;
        qc_time:bit_1_description = "Delta time between current and previous samples is zero." ;
        qc_time:bit_1_assessment = "Bad" ;
        qc_time:bit_2_description = "Delta time between current and previous samples is less
than the delta_t_lower_limit field attribute." ;
        qc_time:bit_2_assessment = "Bad" ;
        qc_time:bit_3_description = "Delta time between current and previous samples is greater
than the delta_t_upper_limit field attribute." ;
        qc_time:bit_3_assessment = "Bad" ;
        qc_time:delta_t_lower_limit = 20. ;
        qc_time:delta_t_upper_limit = 20. ;
        qc_time:prior_sample_flag = 1 ;
        qc_time:comment = "If the '\prior_sample_flag\' is set the first sample time from a new
raw file will be compared against the time just previous to it in the stored data. If it is not set the qc_time
value for the first sample will be set to 0." ;
    float pres(time) ;
        pres:long_name = "Barometric pressure" ;
        pres:units = "hPa" ;
```

```
pres:valid_min = 0.f;
pres:valid_max = 1100.f;
pres:missing_value = -9999.f;
int qc_pres(time);
qc_pres:long_name = "Quality check results on field: Barometric pressure";
qc_pres:units = "unitless";
qc_pres:description = "This field contains bit packed values which should be interpreted
as listed. No bits set (zero) represents good data.";
qc_pres:bit_1_description = "Value is less than the valid_min.";
qc_pres:bit_1_assessment = "Indeterminate";
qc_pres:bit_2_description = "Value is greater than the valid_max.";
qc_pres:bit_2_assessment = "Indeterminate";
qc_pres:bit_3_description = "Data value not available in input file, data value set to -
9999 in output file.";
qc_pres:bit_3_assessment = "Bad";
float tdry(time);
tdry:long_name = "Dry bulb temperature";
tdry:units = "C";
tdry:valid_min = -80.f;
tdry:valid_max = 50.f;
tdry:missing_value = -9999.f;
int qc_tdry(time);
qc_tdry:long_name = "Quality check results on field: Dry bulb temperature";
qc_tdry:units = "unitless";
qc_tdry:description = "This field contains bit packed values which should be interpreted
as listed. No bits set (zero) represents good data.";
qc_tdry:bit_1_description = "Value is less than the valid_min.";
qc_tdry:bit_1_assessment = "Indeterminate";
qc_tdry:bit_2_description = "Value is greater than the valid_max.";
qc_tdry:bit_2_assessment = "Indeterminate";
qc_tdry:bit_3_description = "Data value not available in input file, data value set to -9999
in output file.";
qc_tdry:bit_3_assessment = "Bad";
float dp(time);
dp:long_name = "Dewpoint temperature";
dp:units = "C";
dp:valid_min = -110.f;
dp:valid_max = 50.f;
dp:missing_value = -9999.f;
int qc_dp(time);
qc_dp:long_name = "Quality check results on field: Dewpoint temperature";
qc_dp:units = "unitless";
qc_dp:description = "This field contains bit packed values which should be interpreted as
listed. No bits set (zero) represents good data.";
qc_dp:bit_1_description = "Value is less than the valid_min.";
qc_dp:bit_1_assessment = "Indeterminate";
qc_dp:bit_2_description = "Value is greater than the valid_max.";
qc_dp:bit_2_assessment = "Indeterminate";
qc_dp:bit_3_description = "Data value not available in input file, data value set to -9999
in output file.";
qc_dp:bit_3_assessment = "Bad";
```

```

float wspd(time) ;
    wspd:long_name = "Wind speed" ;
    wspd:units = "m/s" ;
    wspd:valid_min = 0.f ;
    wspd:valid_max = 100.f ;
    wspd:missing_value = -9999.f ;
int qc_wspd(time) ;
    qc_wspd:long_name = "Quality check results on field: Wind speed" ;
    qc_wspd:units = "unitless" ;
    qc_wspd:description = "This field contains bit packed values which should be interpreted
as listed. No bits set (zero) represents good data." ;
    qc_wspd:bit_1_description = "Value is less than the valid_min." ;
    qc_wspd:bit_1_assessment = "Indeterminate" ;
    qc_wspd:bit_2_description = "Value is greater than the valid_max." ;
    qc_wspd:bit_2_assessment = "Indeterminate" ;
    qc_wspd:bit_3_description = "Data value not available in input file, data value set to -
9999 in output file." ;
    qc_wspd:bit_3_assessment = "Bad" ;
float deg(time) ;
    deg:long_name = "Wind direction" ;
    deg:units = "deg" ;
    deg:valid_min = 0.f ;
    deg:valid_max = 360.f ;
    deg:missing_value = -9999.f ;
int qc_deg(time) ;
    qc_deg:long_name = "Quality check results on field: Wind direction" ;
    qc_deg:units = "unitless" ;
    qc_deg:description = "This field contains bit packed values which should be interpreted
as listed. No bits set (zero) represents good data." ;
    qc_deg:bit_1_description = "Value is less than the valid_min." ;
    qc_deg:bit_1_assessment = "Indeterminate" ;
    qc_deg:bit_2_description = "Value is greater than the valid_max." ;
    qc_deg:bit_2_assessment = "Indeterminate" ;
    qc_deg:bit_3_description = "Data value not available in input file, data value set to -9999
in output file." ;
    qc_deg:bit_3_assessment = "Bad" ;
float rh(time) ;
    rh:long_name = "Relative humidity" ;
    rh:units = "%" ;
    rh:valid_min = 0.f ;
    rh:valid_max = 105.f ;
    rh:missing_value = -9999.f ;
int qc_rh(time) ;
    qc_rh:long_name = "Quality check results on field: Relative humidity" ;
    qc_rh:units = "unitless" ;
    qc_rh:description = "This field contains bit packed values which should be interpreted as
listed. No bits set (zero) represents good data." ;
    qc_rh:bit_1_description = "Value is less than the valid_min." ;
    qc_rh:bit_1_assessment = "Indeterminate" ;
    qc_rh:bit_2_description = "Value is greater than the valid_max." ;
    qc_rh:bit_2_assessment = "Indeterminate" ;

```

```

    qc_rh:bit_3_description = "Data value not available in input file, data value set to -9999
in output file." ;
    qc_rh:bit_3_assessment = "Bad" ;
float u_wind(time) ;
    u_wind:long_name = "Eastward wind component" ;
    u_wind:units = "m/s" ;
    u_wind:calc = "-1 * sin( deg ) * wspd" ;
    u_wind:valid_min = -75.f ;
    u_wind:valid_max = 75.f ;
    u_wind:missing_value = -9999.f ;
int qc_u_wind(time) ;
    qc_u_wind:long_name = "Quality check results on field: Eastward wind component" ;
    qc_u_wind:units = "unitless" ;
    qc_u_wind:description = "This field contains bit packed values which should be
interpreted as listed. No bits set (zero) represents good data." ;
    qc_u_wind:bit_1_description = "Value is less than the valid_min." ;
    qc_u_wind:bit_1_assessment = "Indeterminate" ;
    qc_u_wind:bit_2_description = "Value is greater than the valid_max." ;
    qc_u_wind:bit_2_assessment = "Indeterminate" ;
    qc_u_wind:bit_3_description = "Data value not available in input file, data value set to -
9999 in output file." ;
    qc_u_wind:bit_3_assessment = "Bad" ;
float v_wind(time) ;
    v_wind:long_name = "Northward wind component" ;
    v_wind:units = "m/s" ;
    v_wind:calc = "-1 * cos( deg ) * wspd" ;
    v_wind:valid_min = -75.f ;
    v_wind:valid_max = 75.f ;
    v_wind:missing_value = -9999.f ;
int qc_v_wind(time) ;
    qc_v_wind:long_name = "Quality check results on field: Northward wind component" ;
    qc_v_wind:units = "unitless" ;
    qc_v_wind:description = "This field contains bit packed values which should be
interpreted as listed. No bits set (zero) represents good data." ;
    qc_v_wind:bit_1_description = "Value is less than the valid_min." ;
    qc_v_wind:bit_1_assessment = "Indeterminate" ;
    qc_v_wind:bit_2_description = "Value is greater than the valid_max." ;
    qc_v_wind:bit_2_assessment = "Indeterminate" ;
    qc_v_wind:bit_3_description = "Data value not available in input file, data value set to -
9999 in output file." ;
    qc_v_wind:bit_3_assessment = "Bad" ;
float wstat(time) ;
    wstat:long_name = "Wind status" ;
    wstat:units = "unitless" ;
    wstat:missing_value = -9999.f ;
float asc(time) ;
    asc:long_name = "Ascent rate" ;
    asc:units = "m/s" ;
    asc:valid_min = -10.f ;
    asc:valid_max = 20.f ;
    asc:missing_value = -9999.f ;

```

```

int qc_asc(time) ;
    qc_asc:long_name = "Quality check results on field: Ascent rate" ;
    qc_asc:units = "unitless" ;
    qc_asc:description = "This field contains bit packed values which should be interpreted
as listed. No bits set (zero) represents good data." ;
    qc_asc:bit_1_description = "Value is less than the valid_min." ;
    qc_asc:bit_1_assessment = "Indeterminate" ;
    qc_asc:bit_2_description = "Value is greater than the valid_max." ;
    qc_asc:bit_2_assessment = "Indeterminate" ;
    qc_asc:bit_3_description = "Data value not available in input file, data value set to -9999
in output file." ;
    qc_asc:bit_3_assessment = "Bad" ;
float rh_smooth(time) ;
    rh_smooth:long_name = "Relative humidity smooth" ;
    rh_smooth:units = "%" ;
    rh_smooth:valid_min = 0.f ;
    rh_smooth:valid_max = 100.f ;
    rh_smooth:missing_value = -9999.f ;
    rh_smooth:note = "Intermediate RH profile created by smoothing original RH sonde
profile to eliminate stairstep-like function" ;
int qc_rh_smooth(time) ;
    qc_rh_smooth:long_name = "Quality check results on field: Relative humidity smooth" ;
    qc_rh_smooth:units = "unitless" ;
    qc_rh_smooth:description = "This field contains bit packed values which should be
interpreted as listed. No bits set (zero) represents good data." ;
    qc_rh_smooth:bit_1_description = "Value is less than the valid_min." ;
    qc_rh_smooth:bit_1_assessment = "Indeterminate" ;
    qc_rh_smooth:bit_2_description = "Value is greater than the valid_max." ;
    qc_rh_smooth:bit_2_assessment = "Indeterminate" ;
    qc_rh_smooth:bit_3_description = "Data value not available in input file, data value set
to -9999 in output file." ;
    qc_rh_smooth:bit_3_assessment = "Bad" ;
float rh_biased(time) ;
    rh_biased:long_name = "Relative humidity dry bias" ;
    rh_biased:units = "%" ;
    rh_biased:valid_min = 0.f ;
    rh_biased:valid_max = 100.f ;
    rh_biased:missing_value = -9999.f ;
    rh_biased:note1 = "Eliminates the dry bias as described in Wang 2002" ;
    rh_biased:note2 = "This only applies to RS-80 sondes" ;
int qc_rh_biased(time) ;
    qc_rh_biased:long_name = "Quality check results on field: Relative humidity dry bias" ;
    qc_rh_biased:units = "unitless" ;
    qc_rh_biased:description = "This field contains bit packed values which should be
interpreted as listed. No bits set (zero) represents good data." ;
    qc_rh_biased:bit_1_description = "Value is less than the valid_min." ;
    qc_rh_biased:bit_1_assessment = "Indeterminate" ;
    qc_rh_biased:bit_2_description = "Value is greater than the valid_max." ;
    qc_rh_biased:bit_2_assessment = "Indeterminate" ;
    qc_rh_biased:bit_3_description = "Data value not available in input file, data value set to
-9999 in output file." ;

```

```

    qc_rh_biased:bit_3_assessment = "Bad" ;
float rh_adjust(time) ;
    rh_adjust:long_name = "Relative humidity ambient" ;
    rh_adjust:units = "%" ;
    rh_adjust:valid_min = 0.f ;
    rh_adjust:valid_max = 100.f ;
    rh_adjust:missing_value = -9999.f ;
    rh_adjust:note = "corrects for sensor time-lag (RS-80 sondes) and the solar warming (RS-
90, RS-92 sondes) as described in Miloshevich (2004,2009)" ;
int qc_rh_adjust(time) ;
    qc_rh_adjust:long_name = "Quality check results on field: Relative humidity ambient" ;
    qc_rh_adjust:units = "unitless" ;
    qc_rh_adjust:description = "This field contains bit packed values which should be
interpreted as listed. No bits set (zero) represents good data." ;
    qc_rh_adjust:bit_1_description = "Value is less than the valid_min." ;
    qc_rh_adjust:bit_1_assessment = "Indeterminate" ;
    qc_rh_adjust:bit_2_description = "Value is greater than the valid_max." ;
    qc_rh_adjust:bit_2_assessment = "Indeterminate" ;
    qc_rh_adjust:bit_3_description = "Data value not available in input file, data value set to
-9999 in output file." ;
    qc_rh_adjust:bit_3_assessment = "Bad" ;
float rh_scaled(time) ;
    rh_scaled:long_name = "Relative humidity scaled by mwr" ;
    rh_scaled:units = "%" ;
    rh_scaled:valid_min = 0.f ;
    rh_scaled:valid_max = 100.f ;
    rh_scaled:missing_value = -9999.f ;
    rh_scaled:note = "when there is no mwr or when pwv < 0.8, values are -9999" ;
int qc_rh_scaled(time) ;
    qc_rh_scaled:long_name = "Quality check results on field: Relative humidity scaled by
mwr" ;
    qc_rh_scaled:units = "unitless" ;
    qc_rh_scaled:description = "This field contains bit packed values which should be
interpreted as listed. No bits set (zero) represents good data." ;
    qc_rh_scaled:bit_1_description = "Value is less than the valid_min." ;
    qc_rh_scaled:bit_1_assessment = "Indeterminate" ;
    qc_rh_scaled:bit_2_description = "Value is greater than the valid_max." ;
    qc_rh_scaled:bit_2_assessment = "Indeterminate" ;
    qc_rh_scaled:bit_3_description = "Data value not available in input file, data value set to
-9999 in output file." ;
    qc_rh_scaled:bit_3_assessment = "Bad" ;
    qc_rh_scaled:bit_4_description = "The value of the pwv from the mwr file used to scale
the rh falls below the threshold of 0.8 required to perform scaling." ;
    qc_rh_scaled:bit_4_assessment = "Bad" ;
float lat(time) ;
    lat:long_name = "north latitude" ;
    lat:units = "degrees" ;
    lat:valid_min = -90.f ;
    lat:valid_max = 90.f ;
float lon(time) ;
    lon:long_name = "east longitude" ;

```

```

lon:units = "degrees" ;
lon:valid_min = -180.f ;
lon:valid_max = 180.f ;
float alt(time) ;
alt:long_name = "Altitude above mean sea level" ;
alt:units = "m" ;

// global attributes:
:process_version = "$State: Exp $" ;
:command_line = "/home/troyan/dev/vap/bin/sonde_adjust -d 20060229 -f sgpC1 -a 0" ;
:site_id = "sgp" ;
:facility_id = "C1: Lamont, Oklahoma" ;
:Reference1 = "Wang et.al. 2002. \"Corrections of Humidity Measurement Errors from
the Vaisala RS80-Radiosonde -- Application to TOGA COARE Data.\" Journal of Atmospheric and
Oceanic Technology" ;
:Reference2 = "Miloshevich et.al. 2004. \"Development and Validation of a Time-Lag
Correction for Vaisala Radiosonde Humidity Measurement.\" Journal of Atmospheric and Oceanic
Technology" ;
:Reference3 = "Miloshevich et.al. 2009. \"Accuracy Assessment and Correction of
Vaisala RS92 Radiosonde Water Vapor Measurements.\" Journal of Geophysical Research--
Atmospheres" ;
:qc_standards_version = "1.0" ;
:Sonde_Serial_Number = "B0450705" ;
:input_datastreams_description = "A string consisting of the datastream(s), datastream
version(s), and datastream date (range)." ;
:input_datastreams_num = 10 ;
:input_datastreams = "sgpsondewnpnC1.b1 : 5.120000 : 20060301.000000-
20060301.232900 ;\n",
"sgpmwrrret1liljclouC1.c1 : 2.100000 : 20060301.140840-20060302.000018 ;\n",
"sgp1smosE13.b1 : 7.800000 : 20060228.234500-20060302.000000 ;" ;
:zeb_platform = "sgpsondeadjustC1.c1" ;
:history = "created by user troyan on machine engineering at 9-Sep-2011,20:52:36, using
$State: zebra-zeplib-4.23-0.el5 $" ;
}

```

4.5 VAP Status and Version History

This is the initial production release.

4.6 Time Periods Processed

- SGP.C1 (Lamont, Oklahoma): 1996–2009
- NSA.C1 (Barrow, Alaska): 2002–2008
- TWP.C1 (Manus, Papua New Guinea): 2000–2008
- TWP.C2 (Nauru): April–July 1999; 2001–2008
- TWP.C3 (Darwin, Australia): 2002–2008

- PYE.M1 (Pt. Reyes, California): April–September 2005
- NIM.M1 (Niamey, Niger): January 2006–January 2007
- FKB.M1 (Black Forest, Germany): April–December 2007
- HFE.M1 (Shouxian, China): May–December 2008
- GRW.M1 (Graciosa Island, Azores): May 2009–March 2010
- CJC.S01 (Cerro Toco, Chajnantor, Chile): August–September 2009

4.7 Version Information

Initial Production Release

4.8 Plans for Future Modifications

No plans for additional modifications at this time.

4.9 Data Access

The data policy of the U.S. Global Change Research Program requires a commitment to "the establishment, maintenance, validation, description, accessibility, and distribution of high-quality, long-term data sets". Further, it calls for "full and open sharing" of data sets for all global change researchers. ARM fully supports the spirit and intent of this policy by providing "free and open" access via the ARM Data Archive. The Data Quality Office buttresses this effort in documenting and communicating data quality issues.

4.10 Registering at the ARM Data Archive

The ARM Data Archive supports the ARM Climate Research Facility by storing and distributing the large quantities of data produced. There is no charge for access to the ARM Data Archive. However, in the interests of communicating data quality concerns to users of ARM data and in order to fulfill obligations as a National User Facility, ARM requires users to register prior to having access via the ARM Data Archive. If you are not a registered ARM Data Archive User, please first proceed to the automatic [online registration form](#) before continuing with the instructions below on ordering data.

4.11 Routine Data Request

ARM data can be ordered from the ARM Data Archive via web browser through the ARM Data Archive User Interface. Simply follow the directions on the page to enter your user name or create a new user account. This page also features links to information about the ARM Data Archive.

5.0 References

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6.0 Contacts

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