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DOE/SC-ARM/TR-151

Station-based Surface Data Value-Added Product

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ARM
CLIMATE RESEARCH FACILITY

DISCLAIMER

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Version 1.0

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Acronyms and Abbreviations

2D	2-Dimensional
ARM	Atmospheric Radiation Measurement
ARMBE	Atmospheric Radiation Measurement Best Estimate
ARMBE2DGRID	ARMBE 2D gridded surface data
ARMBE2DSTNS	ARMBE station-based surface dataset
BAEBBR	Best-Estimate Fluxes from EBBR Measurements and Bulk Aerodynamics Calculations
EBBR	Energy Balance Bowen Ratio Station
ECOR	Eddy Correlation Flux Measurement System
KAM	Kansas mesonet station
MET	ARM-standard Meteorological Instrumentation at surface
MWR	Microwave Radiometer
OK	Oklahoma
QC	Quality Control
QCRAD	Data Quality Assessment for ARM Radiation Data
SGP	Southern Great Plains
SWATS	Soil Water and Temperature System

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1.0 Introduction

This report describes the Atmospheric Radiation Measurement (ARM) Best Estimate (ARMBE) station-based surface data (ARMBESTNS) value-added product. It is a twin data product of the ARMBE 2-Dimensional gridded (ARMBE2DGRID) data set. Unlike the ARMBE2DGRID data set, ARMBESTNS data are reported at the original site locations and show the original information (except for the interpolation over time). Therefore, the users have the flexibility to process the data with the approach more suitable for their applications. This document provides information about the input data, quality control (QC) method, and output format of this data set. As much of the information is identical to that of the ARMBE2DGRID data, this document will emphasize more on the different aspects of these two data sets.

2.0 Input Data

The input data (see Table 1) are from various datastreams, and include surface atmospheric state variables (p, u, v, T, and q), surface fluxes (radiation and eddy fluxes, and precipitation), liquid water path, precipitable water vapor, and soil measurements (soil temperature and moisture).

Table 1. Input Datastreams and Variables included in ARMBE2DGRID

Variable Name	Input Datastream
Surf. u, v, T, q, precipitation	• ARM-standard meteorological instrumentation at the surface (MET) • Oklahoma mesonet • Kansas State University mesonet
Surf. pressure	• MET • Oklahoma mesonet
Surf. radiative fluxes	• Data Quality Assessment for ARM Radiation Data (QCRAD)
Liquid water path precipitable water vapor	• Microwave radiometer (MWR)
Surf. heat fluxes	• Best-Estimate Fluxes from EBBR Measurements and Bulk Aerodynamics Calculations (BAEBBR) • Eddy Correlation Flux Measurement System (ECOR)
Soil moisture Soil temperature	• Soil Water and Temperature System (SWATS) • EBBR

3.0 Algorithm and Methodology

Data are interpolated and reported on 1-hour intervals.

3.1 Flowchart

Figure 1 shows the flowchart for creating the ARMBESTNS data. The steps are straightforward, except for the QC. Details about the QC are given in the following section.

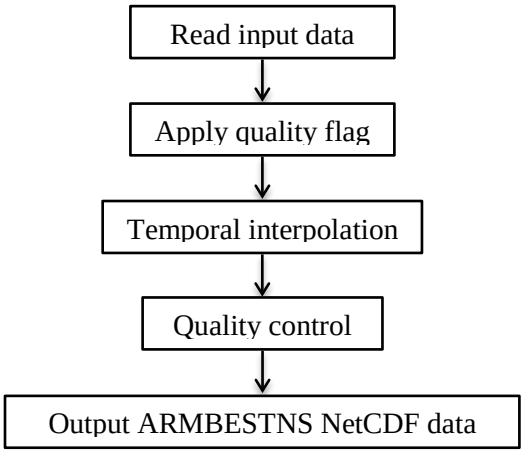

Figure 1. Procedures for Creating ARMBE2DGRID Data Procedures

3.2 Quality Control Methods

The following stringent QC procedures (Zhang et al. 2001a, b) are applied to improve the data quality over the raw sources.

- Data range check on maximum and minimum values.
- Outlier check using standard deviation. If data values depart from the mean value by more than four times the standard deviation, the data are rejected.
- Temporal variability check using the moving window method. This method is applied with a sliding block of seven deviation scores. After each test, six deviation scores remain, and a new deviation score is added to the block. The Grubbs method is used to determine if the new score contributes an inordinate amount to the variance of the block, so that it should be considered an outlier.
- QC flags of EBBR and SWATS.

4.0 Output Data

The full list of the output variables is given by the NetCDF header file (see Appendix A).

5.0 Example Plots

Example plots shown in Figure 1 through Figure 6 provide a “quicklook” at the data.

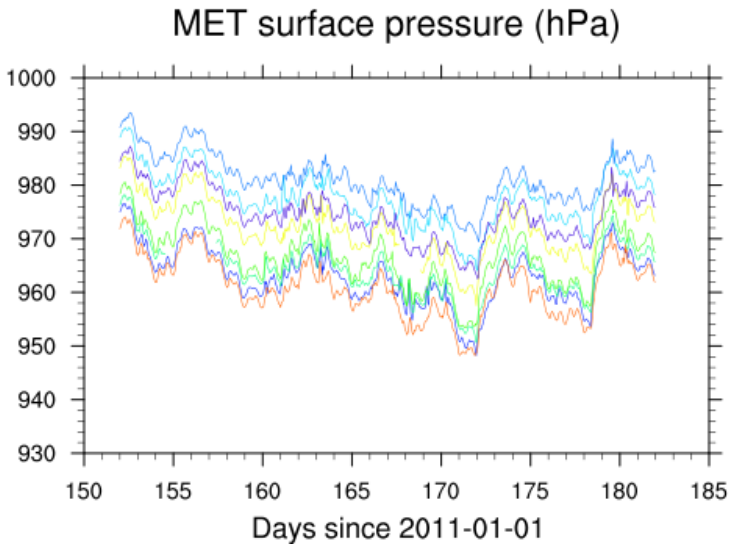

Figure 2. Time Series of MET Surface Pressure (expressed as hPa) for June 2011. Different sites are color coded.

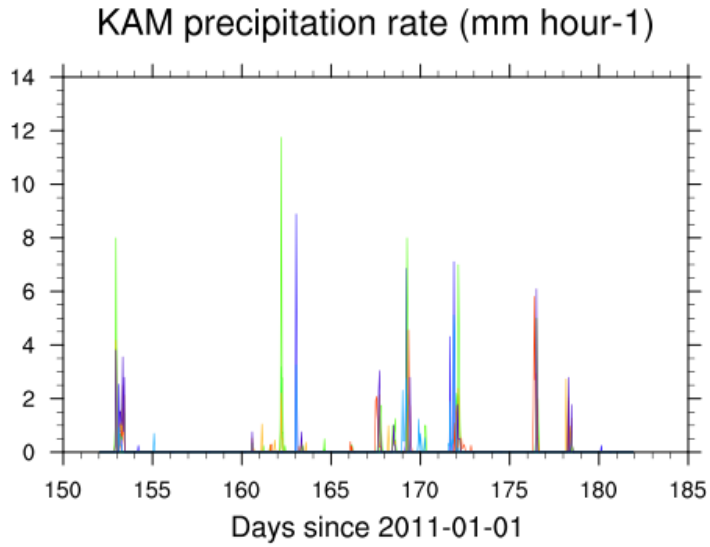

Figure 3. Same as Figure 2 but for Kansas Mesonet Station (KAM) Surface Precipitation Rate (expressed as mm/hour)

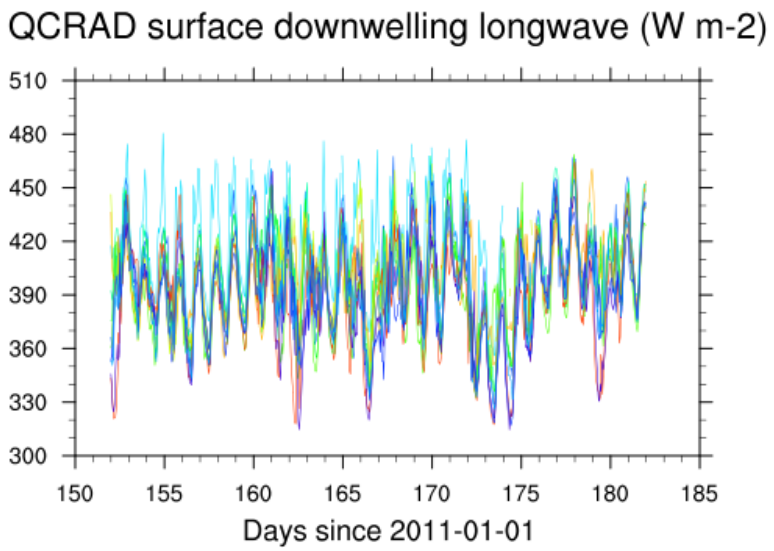

Figure 4. Same as Figure 2 but for QCRAD Surface Downward Longwave Radiation (expressed as W/m^2)

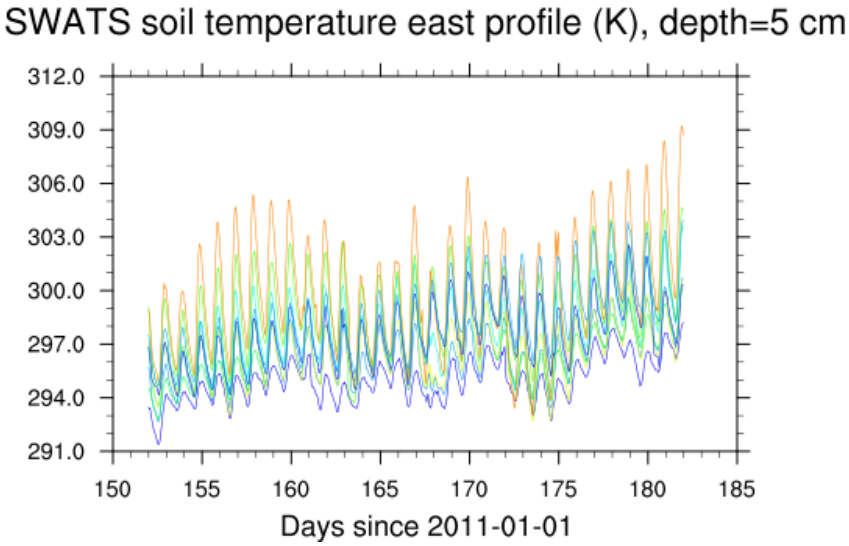

Figure 5. Same as Figure 2 but for SWATS Soil Temperature (expressed as K) East Profile at 5 cm

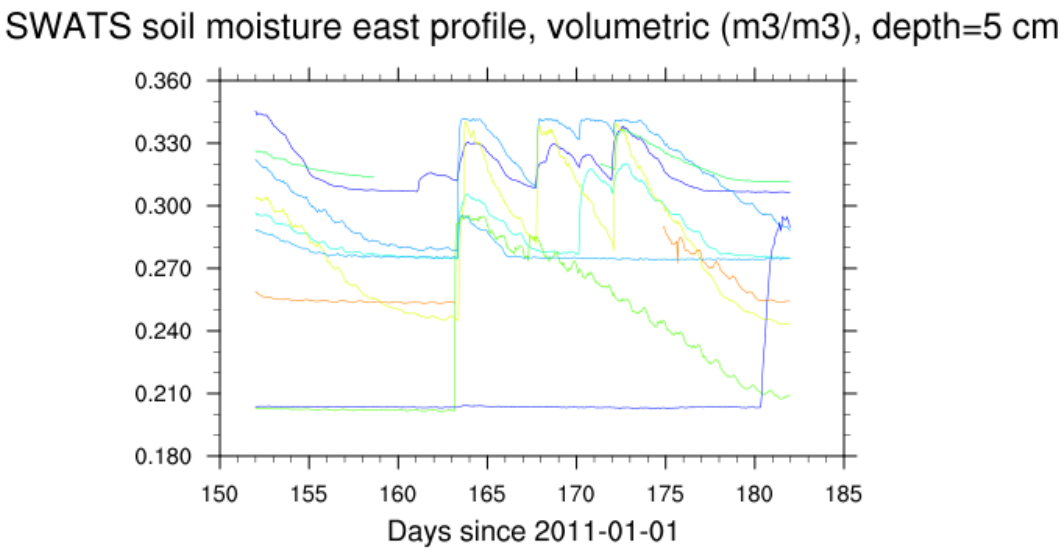

Figure 6. Same as Figure 2, but for SWATS Soil Moisture (expressed as m^3/m^3, volumetric) East Profile at 5 cm

6.0 References

Zhang, MH, JL Lin, RT Cederwall, JJ Yio, and SC Xie. 2001(a). "Objective analysis of ARM IOP data: Method and sensitivity." *Monthly Weather Review* 129:295-311.
doi: http://dx.doi.org/10.1175/1520-0493(2001)129<0295:OAOAID>2.0.CO;2

Zhang, M, S Xie, RT Cederwall, and JJ Yio. 2001(b). Description of the ARM Operational Objective Analysis System, DOE/SC-ARM/TR-005, U.S. Department of Energy, Office of Biological and Environmental Research, Washington, D.C.
Available at http://www.arm.gov/publications/tech_reports/arm-tr-005.pdf.

Appendix A

Output Data

Appendix A

Output Data

```
netcdf sgparmbestnsX1.c1.20110601.000000 {
dimensions:
    time = UNLIMITED ; // (720 currently)
    depth = 4 ;
    bound = 2 ;
    str_len = 5 ;
    stn_met = 9 ;
    stn_mwr = 1 ;
    stn_baebbr = 8 ;
    stn_kam = 13 ;
    stn_okm = 127 ;
    stn_ecor = 5 ;
    stn_qcrad = 13 ;
    stn_ebbr = 8 ;
    stn_swats = 11 ;
variables:
    int base_time ;
        base_time:string = "2011-6-1 0:00:00 0:00, UTC" ;
        base_time:long_name = "Base time in Epoch" ;
        base_time:units = "seconds since 1970-1-1 00:00:00 0:00" ;
        base_time:ancillary_variables = "time_offset" ;
    double time_offset(time) ;
        time_offset:long_name = "Time offset from base_time" ;
        time_offset:units = "seconds since 2011-6-1 0:00:00 0:00" ;
        time_offset:ancillary_variables = "base_time" ;
        time_offset:bounds = "time_bounds" ;
    double time(time) ;
        time:long_name = "Time offset from midnight" ;
        time:units = "seconds since 2011-6-1 0:00:00 0:00" ;
        time:bounds = "time_bounds" ;
        time:calendar = "gregorian" ;
        time:standard_name = "time" ;
    double time_bounds(time, bound) ;
        time_bounds:long_name = "Time cell bounds" ;
        time_bounds:units = "seconds since 2011-6-1 0:00:00 0:00" ;
        time_bounds:bound_offsets = -1800.f, 1800.f ;
    double time_frac(time) ;
        time_frac:long_name = "Calendar day fraction of the year " ;
        time_frac:units = "days since 2010-12-31" ;
        time_frac:calendar = "gregorian" ;
    short depth(depth) ;
        depth:long_name = "Sensor depth below surface" ;
        depth:units = "cm" ;
        depth:positive = "down" ;
    float z_a ;
```

```
        z_a:long_name = "Height above ground level, coordinate a" ;
        z_a:units = "m" ;
        z_a:positive = "up" ;
    float z_b ;
        z_b:long_name = "Height above ground level, coordinate b" ;
        z_b:units = "m" ;
        z_b:positive = "up" ;
    float z_c ;
        z_c:long_name = "Depth below ground level, coordinate c" ;
        z_c:units = "cm" ;
        z_c:positive = "down" ;
    float z_d ;
        z_d:long_name = "Integration of top layer below ground level, coordinate d" ;
        z_d:units = "cm" ;
        z_d:positive = "down" ;
    char stn_met(stn_met, str_len) ;
        stn_met:long_name = "MET facility id" ;
        stn_met:units = "unitless" ;
    float lat_met(stn_met) ;
        lat_met:long_name = "MET north latitude" ;
        lat_met:units = "degree_north" ;
        lat_met:standard_name = "latitude" ;
        lat_met:valid_min = -90.f ;
        lat_met:valid_max = 90.f ;
    float lon_met(stn_met) ;
        lon_met:long_name = "MET east longitude" ;
        lon_met:units = "degree_east" ;
        lon_met:standard_name = "longitude" ;
        lon_met:valid_min = -180.f ;
        lon_met:valid_max = 180.f ;
    float alt_met(stn_met) ;
        alt_met:long_name = "MET altitude above mean sea level" ;
        alt_met:units = "m" ;
        alt_met:standard_name = "altitude" ;
    float u_wind_met(time, stn_met) ;
        u_wind_met:long_name = "MET u wind component" ;
        u_wind_met:units = "m s-1" ;
        u_wind_met:standard_name = "eastward_wind" ;
        u_wind_met:coordinates = "z_a" ;
        u_wind_met:missing_value = -9999.f ;
        u_wind_met:_FillValue = -9999.f ;
    float v_wind_met(time, stn_met) ;
        v_wind_met:long_name = "MET v wind component" ;
        v_wind_met:units = "m s-1" ;
        v_wind_met:standard_name = "northward_wind" ;
        v_wind_met:coordinates = "z_a" ;
        v_wind_met:missing_value = -9999.f ;
        v_wind_met:_FillValue = -9999.f ;
    float temp_met(time, stn_met) ;
        temp_met:long_name = "MET air temperature" ;
        temp_met:units = "K" ;
```

temp_met:standard_name = "air_temperature" ;
temp_met:coordinates = "z_b" ;
temp_met:missing_value = -9999.f ;
temp_met:_FillValue = -9999.f ;
float rh_met(time, stn_met) ;
rh_met:long_name = "MET relative humidity" ;
rh_met:units = "%" ;
rh_met:standard_name = "relative_humidity" ;
rh_met:coordinates = "z_b" ;
rh_met:missing_value = -9999.f ;
rh_met:_FillValue = -9999.f ;
float pressure_met(time, stn_met) ;
pressure_met:long_name = "MET surface pressure" ;
pressure_met:units = "hPa" ;
pressure_met:standard_name = "surface_air_pressure" ;
pressure_met:missing_value = -9999.f ;
pressure_met:_FillValue = -9999.f ;
float precip_rate_met(time, stn_met) ;
precip_rate_met:long_name = "MET precipitation rate" ;
precip_rate_met:units = "mm hour-1" ;
precip_rate_met:standard_name = "lwe_precipitation_rate" ;
precip_rate_met:missing_value = -9999.f ;
precip_rate_met:_FillValue = -9999.f ;
char stn_mwr(stn_mwr, str_len) ;
stn_mwr:long_name = "MWR facility id" ;
stn_mwr:units = "unitless" ;
float lat_mwr(stn_mwr) ;
lat_mwr:long_name = "MWR north latitude" ;
lat_mwr:units = "degree_north" ;
lat_mwr:standard_name = "latitude" ;
lat_mwr:valid_min = -90.f ;
lat_mwr:valid_max = 90.f ;
float lon_mwr(stn_mwr) ;
lon_mwr:long_name = "MWR longitude" ;
lon_mwr:units = "degree_east" ;
lon_mwr:standard_name = "longitude" ;
lon_mwr:valid_min = -180.f ;
lon_mwr:valid_max = 180.f ;
float alt_mwr(stn_mwr) ;
alt_mwr:long_name = "MWR altitude above mean sea level" ;
alt_mwr:units = "m" ;
alt_mwr:standard_name = "altitude" ;
float pwv_mwr(time, stn_mwr) ;
pwv_mwr:long_name = "MWR column precipitable water vapor" ;
pwv_mwr:units = "cm" ;
pwv_mwr:missing_value = -9999.f ;
pwv_mwr:_FillValue = -9999.f ;
float lwp_mwr(time, stn_mwr) ;
lwp_mwr:long_name = "MWR cloud liquid water path" ;
lwp_mwr:units = "cm" ;
lwp_mwr:missing_value = -9999.f ;

```
        lwp_mwr:_FillValue = -9999.f ;
    char stn_baebbr(stn_baebbr, str_len) ;
        stn_baebbr:long_name = "BAEBBR facility id" ;
        stn_baebbr:units = "unitless" ;
    float lat_baebbr(stn_baebbr) ;
        lat_baebbr:long_name = "BAEBBR north latitude" ;
        lat_baebbr:units = "degree_north" ;
        lat_baebbr:standard_name = "latitude" ;
        lat_baebbr:valid_min = -90.f ;
        lat_baebbr:valid_max = 90.f ;
    float lon_baebbr(stn_baebbr) ;
        lon_baebbr:long_name = "BAEBBR east longitude" ;
        lon_baebbr:units = "degree_east" ;
        lon_baebbr:standard_name = "longitude" ;
        lon_baebbr:valid_min = -180.f ;
        lon_baebbr:valid_max = 180.f ;
    float alt_baebbr(stn_baebbr) ;
        alt_baebbr:long_name = "BAEBBR altitude above mean sea level" ;
        alt_baebbr:units = "m" ;
        alt_baebbr:standard_name = "altitude" ;
    float latent_heat_flux_baebbr(time, stn_baebbr) ;
        latent_heat_flux_baebbr:long_name = "BAEBBR surface latent heat flux" ;
        latent_heat_flux_baebbr:units = "W m-2" ;
        latent_heat_flux_baebbr:standard_name = "surface_upward_latent_heat_flux" ;
        latent_heat_flux_baebbr:missing_value = -9999.f ;
        latent_heat_flux_baebbr:_FillValue = -9999.f ;
    float sensible_heat_flux_baebbr(time, stn_baebbr) ;
        sensible_heat_flux_baebbr:long_name = "BAEBBR surface sensible heat flux" ;
        sensible_heat_flux_baebbr:units = "W m-2" ;
        sensible_heat_flux_baebbr:standard_name = "surface_upward_sensible_heat_flux" ;
        sensible_heat_flux_baebbr:missing_value = -9999.f ;
        sensible_heat_flux_baebbr:_FillValue = -9999.f ;
    char stn_kam(stn_kam, str_len) ;
        stn_kam:long_name = "Kansas Mesonet facility id" ;
        stn_kam:units = "unitless" ;
    float lat_kam(stn_kam) ;
        lat_kam:long_name = "KAM north latitude" ;
        lat_kam:units = "degree_north" ;
        lat_kam:standard_name = "latitude" ;
        lat_kam:valid_min = -90.f ;
        lat_kam:valid_max = 90.f ;
    float lon_kam(stn_kam) ;
        lon_kam:long_name = "KAM longitude" ;
        lon_kam:units = "degree_east" ;
        lon_kam:standard_name = "longitude" ;
        lon_kam:valid_min = -180.f ;
        lon_kam:valid_max = 180.f ;
    float alt_kam(stn_kam) ;
        alt_kam:long_name = "KAM altitude above mean sea level" ;
        alt_kam:units = "m" ;
        alt_kam:standard_name = "altitude" ;
```

```
float precip_rate_kam(time, stn_kam) ;
    precip_rate_kam:long_name = "KAM precipitation rate" ;
    precip_rate_kam:units = "mm hour-1" ;
    precip_rate_kam:standard_name = "lwe_precipitation_rate" ;
    precip_rate_kam:missing_value = -9999.f ;
    precip_rate_kam:_FillValue = -9999.f ;
float rh_kam(time, stn_kam) ;
    rh_kam:long_name = "KAM relative humidity" ;
    rh_kam:units = "%" ;
    rh_kam:standard_name = "relative_humidity" ;
    rh_kam:coordinates = "z_b" ;
    rh_kam:missing_value = -9999.f ;
    rh_kam:_FillValue = -9999.f ;
float temp_kam(time, stn_kam) ;
    temp_kam:long_name = "KAM air temperature" ;
    temp_kam:units = "K" ;
    temp_kam:standard_name = "air_temperature" ;
    temp_kam:coordinates = "z_b" ;
    temp_kam:missing_value = -9999.f ;
    temp_kam:_FillValue = -9999.f ;
float u_wind_kam(time, stn_kam) ;
    u_wind_kam:long_name = "KAM u wind component" ;
    u_wind_kam:units = "m s-1" ;
    u_wind_kam:standard_name = "eastward_wind" ;
    u_wind_kam:coordinates = "z_a" ;
    u_wind_kam:missing_value = -9999.f ;
    u_wind_kam:_FillValue = -9999.f ;
float v_wind_kam(time, stn_kam) ;
    v_wind_kam:long_name = "KAM v wind component" ;
    v_wind_kam:units = "m s-1" ;
    v_wind_kam:standard_name = "northward_wind" ;
    v_wind_kam:coordinates = "z_a" ;
    v_wind_kam:missing_value = -9999.f ;
    v_wind_kam:_FillValue = -9999.f ;
char stn_okm(stn_okm, str_len) ;
    stn_okm:long_name = "Oklahoma Mesonet facility id" ;
    stn_okm:units = "unitless" ;
float lat_okm(stn_okm) ;
    lat_okm:long_name = "OKM north latitude" ;
    lat_okm:units = "degree_north" ;
    lat_okm:standard_name = "latitude" ;
    lat_okm:valid_min = -90.f ;
    lat_okm:valid_max = 90.f ;
float lon_okm(stn_okm) ;
    lon_okm:long_name = "OKM longitude" ;
    lon_okm:units = "degree_east" ;
    lon_okm:standard_name = "longitude" ;
    lon_okm:valid_min = -180.f ;
    lon_okm:valid_max = 180.f ;
float alt_okm(stn_okm) ;
    alt_okm:long_name = "OKM altitude above mean sea level" ;
```

```
        alt_okm:units = "m" ;
        alt_okm:standard_name = "altitude" ;
    float precip_rate_okm(time, stn_okm) ;
        precip_rate_okm:long_name = "OKM precipitation rate" ;
        precip_rate_okm:units = "mm hour-1" ;
        precip_rate_okm:standard_name = "lwe_precipitation_rate" ;
        precip_rate_okm:missing_value = -9999.f ;
        precip_rate_okm:_FillValue = -9999.f ;
    float pressure_okm(time, stn_okm) ;
        pressure_okm:long_name = "OKM surface pressure" ;
        pressure_okm:units = "hPa" ;
        pressure_okm:standard_name = "surface_air_pressure" ;
        pressure_okm:missing_value = -9999.f ;
        pressure_okm:_FillValue = -9999.f ;
    float rh_okm(time, stn_okm) ;
        rh_okm:long_name = "OKM relative humidity" ;
        rh_okm:units = "%" ;
        rh_okm:standard_name = "relative_humidity" ;
        rh_okm:coordinates = "z_b" ;
        rh_okm:missing_value = -9999.f ;
        rh_okm:_FillValue = -9999.f ;
    float temp_okm(time, stn_okm) ;
        temp_okm:long_name = "OKM air temperature" ;
        temp_okm:units = "K" ;
        temp_okm:standard_name = "air_temperature" ;
        temp_okm:coordinates = "z_b" ;
        temp_okm:missing_value = -9999.f ;
        temp_okm:_FillValue = -9999.f ;
    float u_wind_okm(time, stn_okm) ;
        u_wind_okm:long_name = "OKM u wind component" ;
        u_wind_okm:units = "m s-1" ;
        u_wind_okm:standard_name = "eastward_wind" ;
        u_wind_okm:coordinates = "z_a" ;
        u_wind_okm:missing_value = -9999.f ;
        u_wind_okm:_FillValue = -9999.f ;
    float v_wind_okm(time, stn_okm) ;
        v_wind_okm:long_name = "OKM v wind component" ;
        v_wind_okm:units = "m s-1" ;
        v_wind_okm:standard_name = "northward_wind" ;
        v_wind_okm:coordinates = "z_a" ;
        v_wind_okm:missing_value = -9999.f ;
        v_wind_okm:_FillValue = -9999.f ;
    char stn_ecor(stn_ecor, str_len) ;
        stn_ecor:long_name = "ECOR facility id" ;
        stn_ecor:units = "unitless" ;
    float lat_ecor(stn_ecor) ;
        lat_ecor:long_name = "ECOR north latitude" ;
        lat_ecor:units = "degree_north" ;
        lat_ecor:standard_name = "latitude" ;
        lat_ecor:valid_min = -90.f ;
        lat_ecor:valid_max = 90.f ;
```

float lon_ecor(stn_ecor) ;
lon_ecor:long_name = "ECOR east longitude" ;
lon_ecor:units = "degree_east" ;
lon_ecor:standard_name = "longitude" ;
lon_ecor:valid_min = -180.f ;
lon_ecor:valid_max = 180.f ;
float alt_ecor(stn_ecor) ;
alt_ecor:long_name = "ECOR altitude above mean sea level" ;
alt_ecor:units = "m" ;
alt_ecor:standard_name = "altitude" ;
float latent_heat_flux_ecor(time, stn_ecor) ;
latent_heat_flux_ecor:long_name = "ECOR surface latent heat flux" ;
latent_heat_flux_ecor:units = "W m-2" ;
latent_heat_flux_ecor:standard_name = "surface_upward_latent_heat_flux" ;
latent_heat_flux_ecor:missing_value = -9999.f ;
latent_heat_flux_ecor:_FillValue = -9999.f ;
float sensible_heat_flux_ecor(time, stn_ecor) ;
sensible_heat_flux_ecor:long_name = "ECOR surface sensible heat flux" ;
sensible_heat_flux_ecor:units = "W m-2" ;
sensible_heat_flux_ecor:standard_name = "surface_upward_sensible_heat_flux" ;
sensible_heat_flux_ecor:missing_value = -9999.f ;
sensible_heat_flux_ecor:_FillValue = -9999.f ;
char stn_qcrad(stn_qcrad, str_len) ;
stn_qcrad:long_name = "QCRAD facility id" ;
stn_qcrad:units = "unitless" ;
float lat_qcrad(stn_qcrad) ;
lat_qcrad:long_name = "QCRAD north latitude" ;
lat_qcrad:units = "degree_north" ;
lat_qcrad:standard_name = "latitude" ;
lat_qcrad:valid_min = -90.f ;
lat_qcrad:valid_max = 90.f ;
float lon_qcrad(stn_qcrad) ;
lon_qcrad:long_name = "QCRAD east longitude" ;
lon_qcrad:units = "degree_east" ;
lon_qcrad:standard_name = "longitude" ;
lon_qcrad:valid_min = -180.f ;
lon_qcrad:valid_max = 180.f ;
float alt_qcrad(stn_qcrad) ;
alt_qcrad:long_name = "QCRAD altitude above mean sea level" ;
alt_qcrad:units = "m" ;
alt_qcrad:standard_name = "altitude" ;
float longwave_up_qcrad(time, stn_qcrad) ;
longwave_up_qcrad:long_name = "QCRAD surface upwelling longwave" ;
longwave_up_qcrad:units = "W m-2" ;
longwave_up_qcrad:standard_name = "surface_upwelling_longwave_flux_in_air" ;
longwave_up_qcrad:missing_value = -9999.f ;
longwave_up_qcrad:_FillValue = -9999.f ;
float shortwave_up_qcrad(time, stn_qcrad) ;
shortwave_up_qcrad:long_name = "QCRAD surface upwelling shortwave" ;
shortwave_up_qcrad:units = "W m-2" ;
shortwave_up_qcrad:standard_name = "surface_upwelling_shortwave_flux_in_air" ;

shortwave_up_qcrad:missing_value = -9999.f ;
shortwave_up_qcrad:_FillValue = -9999.f ;
float longwave_down_qcrad(time, stn_qcrad) ;
longwave_down_qcrad:long_name = "QCRAD surface downwelling longwave" ;
longwave_down_qcrad:units = "W m-2" ;
longwave_down_qcrad:standard_name = "surface_downwelling_longwave_flux_in_air" ;
longwave_down_qcrad:missing_value = -9999.f ;
longwave_down_qcrad:_FillValue = -9999.f ;
float shortwave_down_qcrad(time, stn_qcrad) ;
shortwave_down_qcrad:long_name = "QCRAD surface downwelling shortwave" ;
shortwave_down_qcrad:units = "W m-2" ;
shortwave_down_qcrad:standard_name = "surface_downwelling_shortwave_flux_in_air" ;
shortwave_down_qcrad:missing_value = -9999.f ;
shortwave_down_qcrad:_FillValue = -9999.f ;
char stn_ebbr(stn_ebbr, str_len) ;
stn_ebbr:long_name = "EBBR facility id" ;
stn_ebbr:units = "unitless" ;
float lat_ebbr(stn_ebbr) ;
lat_ebbr:long_name = "EBBR north latitude" ;
lat_ebbr:units = "degree_north" ;
lat_ebbr:standard_name = "latitude" ;
lat_ebbr:valid_min = -90.f ;
lat_ebbr:valid_max = 90.f ;
float lon_ebbr(stn_ebbr) ;
lon_ebbr:long_name = "EBBR east longitude" ;
lon_ebbr:units = "degree_east" ;
lon_ebbr:standard_name = "longitude" ;
lon_ebbr:valid_min = -180.f ;
lon_ebbr:valid_max = 180.f ;
float alt_ebbr(stn_ebbr) ;
alt_ebbr:long_name = "EBBR altitude above mean sea level" ;
alt_ebbr:units = "m" ;
alt_ebbr:standard_name = "altitude" ;
float soil_temp_ebbr(time, stn_ebbr) ;
soil_temp_ebbr:long_name = "EBBR mean soil temperature over the 5 sensors" ;
soil_temp_ebbr:units = "K" ;
soil_temp_ebbr:standard_name = "soil_temperature" ;
soil_temp_ebbr:coordinates = "z_d" ;
soil_temp_ebbr:missing_value = -9999.f ;
soil_temp_ebbr:_FillValue = -9999.f ;
float soil_moisture_ebbr(time, stn_ebbr) ;
soil_moisture_ebbr:long_name = "EBBR mean soil moisture over the 5 sensors, volumetric" ;
soil_moisture_ebbr:units = "m3/m3" ;
soil_moisture_ebbr:coordinates = "z_c" ;
soil_moisture_ebbr:missing_value = -9999.f ;
soil_moisture_ebbr:_FillValue = -9999.f ;
char stn_swats(stn_swats, str_len) ;
stn_swats:long_name = "SWATS facility id" ;
stn_swats:units = "unitless" ;
float lat_swats(stn_swats) ;
lat_swats:long_name = "SWATS north latitude" ;

```
        lat_swats:units = "degree_north" ;
        lat_swats:standard_name = "latitude" ;
        lat_swats:valid_min = -90.f ;
        lat_swats:valid_max = 90.f ;
    float lon_swats(stn_swats) ;
        lon_swats:long_name = "SWATS east longitude" ;
        lon_swats:units = "degree_east" ;
        lon_swats:standard_name = "longitude" ;
        lon_swats:valid_min = -180.f ;
        lon_swats:valid_max = 180.f ;
    float alt_swats(stn_swats) ;
        alt_swats:long_name = "SWATS altitude above mean sea level" ;
        alt_swats:units = "m" ;
        alt_swats:standard_name = "altitude" ;
    float soil_temp_west_swats(time, depth, stn_swats) ;
        soil_temp_west_swats:long_name = "SWATS soil temperature west profile" ;
        soil_temp_west_swats:units = "K" ;
        soil_temp_west_swats:standard_name = "soil_temperature" ;
        soil_temp_west_swats:missing_value = -9999.f ;
        soil_temp_west_swats:_FillValue = -9999.f ;
    float soil_temp_east_swats(time, depth, stn_swats) ;
        soil_temp_east_swats:long_name = "SWATS soil temperature east profile" ;
        soil_temp_east_swats:units = "K" ;
        soil_temp_east_swats:standard_name = "soil_temperature" ;
        soil_temp_east_swats:missing_value = -9999.f ;
        soil_temp_east_swats:_FillValue = -9999.f ;
    float soil_moisture_west_swats(time, depth, stn_swats) ;
        soil_moisture_west_swats:long_name = "SWATS soil moisture west profile, volumetric" ;
        soil_moisture_west_swats:units = "m3/m3" ;
        soil_moisture_west_swats:missing_value = -9999.f ;
        soil_moisture_west_swats:_FillValue = -9999.f ;
    float soil_moisture_east_swats(time, depth, stn_swats) ;
        soil_moisture_east_swats:long_name = "SWATS soil moisture east profile, volumetric" ;
        soil_moisture_east_swats:units = "m3/m3" ;
        soil_moisture_east_swats:missing_value = -9999.f ;
        soil_moisture_east_swats:_FillValue = -9999.f ;

// global attributes:
        :Conventions = "CF-1.7" ;
        :command_line = "nc_2d_stn, iop=1106" ;
        :site_id = "sgp" ;
        :facility_id = "X1" ;
        :process_version = "vap-armbestns-1.0" ;
        :location_description = "Southern Great Plains (SGP)" ;
        :title = "Atmospheric Research Measurement Best Estimate (ARMBE) Station-based Product,
ARMBESTNS" ;
        :description = "ARMBESTNS 1-hourly averaged product" ;
        :platform_id = "armbestns" ;
        :data_level = "c1" ;
        :datastream = "sgparmbestnsX1.c1" ;
        :dod_version = "armbestns-c1-v1.0" ;
```

```
        :averaging_interval = "1 hour" ;
        :date_created = "Wed Apr 22 17:59:53 2015" ;
        :doi = "DOI:10.5439/1178332" ;
        :history = "created by user tang30 on machine arm.llnl.gov at Wed Apr 22 17:59:53 2015" ;
}
```

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