Data Set Documentation/Readme Outline:

Title: NCAR-RAL Surface Hydrometeorological Observation Network

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1.0 Data Set Overview:

- Abstract: The RELAMPAGO field campaign had the overarching goal of studying the convective initiation and upscale growth mechanisms of deep electrified thunderstorms in the lee of the Andes Mountains in central South America. The data set in the NCAR-RAL Surface Hydrometeorological Observation Network was designed to provide spatially distributed measurements of near surface meteorological and soil moisture conditions along a longitudinal and elevational gradient extending across central Argentina. The network was deployed from May 2018 through April of 2019 and therefore captures one full annual cycle of hydrometeorological conditions. Principal hydrometeorological variables measured included temperature, humidity, incoming solar radiation, soil moisture and soil temperature, wind speed and direction and precipitation. The network was designed to be low-cost and low-power for relatively long-term, unattended operation. The network was serviced periodically to ensure proper operation and to download recorded data. A few technical and instrument issues were encountered which resulted in some sensor outages. The network was serviced immediately prior to the conducting of the official RELAMPAGO Intensive Observing Period (IOP) during Nov-Dec of 2018. As such, data during the IOP period are most reliable and then some attrition of sensors follows into the austral autumn during March and April of 2019. Most variables were recorded with a 15 minute averaging interval reported on the 00, 15, 30 and 45 minute periods. Precipitation data was recorded as individual tips and was post-processed to several equal time intervals including 5-, 15-, and 60-minutes as well as daily values. Raw tip data can be obtained upon request. Data were subjected to extensive post-processing and quality control following instrument extraction in May of 2019. All data are provided in netcdf format as described in this README file below.
- 1 May 2018 – 1 May 2019
- Physical location (including lat/lon/elev) of the measurement or platform
    - Alpa Corral: -32.65937, -64.74621, 985m
    - Villa Ascasubi: -32.1619, -63.88619, 324m
    - Carcarana: -32.83985, -61.13819, 59m

- o Chacay: -32.89465, -64.86946, 888m
- o Cruz Alta: -32.99385, -61.81926, 78m
- o Gaboto: -32.44441, -60.80927, 19m
- o Inriville: -32.94404, -62.23731, 107m
- o La Cruz: -32.29759, -64.46818, 568m
- o San Marcos Sud: -32.67416, -62.4945, 114m
- o Quillinzo: -32.24213, -64.5131, 546m
- o Villa Maria: -32.38027, -63.26291, 208m
- o Yacanto: -32.11833, -64.72353, 1017m
- o Tortugas: -32.74822, -61.82211, 76m
- o Insolente: -32.17571, -64.80932, 1156m
- o Andino: -32.66537, -60.87044, 37m
- Data collecting organization: NCAR Research Applications Laboratory
- RELAMPAGO Project Website: https://www.eol.ucar.edu/field_projects/relampago

2.0 Instrument Description:

The sensors used in the NCAR-RAL Surface Hydrometeorological Observation Network were selected based on criteria of accuracy, reliability, low power consumption, data collection platform compatibility and cost constraint. The sensors come from a variety of manufacturers. The main hydrometeological parameters measured were temperature, humidity, barometric pressure, wind speed and direction, incoming solar radiation, soil moisture and soil temperature. Deployment of sensors at each site varied somewhat due to site characteristics such as wind fetch, solar obstruction, and soil conditions. The sensor vendors and basic specifications were as follows:

Temperature, humidity and barometric pressure: Decagon/METER VP-4/ ATMOS14 (Humidity resolution 0.1% RH, Humidity accuracy see sensor specification, Temperature resolution 0.1 deg C, Temperature accuracy see sensor specification, Barometric pressure accuracy 0.4kPa)

Incoming Solar Radiation: Decagon/METER PYR (Resolution 1 W/m^2, Accuracy =/- 5%)

Wind speed and direction: Decagon/METER Atmos 22 Ultrasonic Anemometer (Wind speed resolution 0.01 m/s, Wind speed accuracy +/-3%, Wind direction resolution 1 deg, Wind direction accuracy +/- 1%)

Precipitation: Hydrologic Services TB3/TB4 siphoning tipping bucket rain gauge (Accuracy +/-2% up to 250mm/hr)

Soil temperature: Decagon/METER 5TE (Resolution 0.1 deg C, Accuracy +/- 1%)

Soil moisture: Decagon/METER 5TE (Resolution 0.008 m^3/m^3, Accuracy +/- 0.03 m^3/m^3)

3.0 Data Collection and Processing:

Sensor data was collected in the field using a Decagon/METER EM60 datalogger using SDI-12 communication protocols with the sensors. Data (not including precipitation data) was output from the logger as 15min average values at 00, 15, 30 and 45min intervals. Precipitation data were collected as tip 'events' when the rain gauge tipping bucket tipped. Tip times were recorded on an Onset Computer Corporation HOBO Event Logger. Precipitation data were then time aggregated to 5, 15 and 60min interval rate values as well as to daily values. Upon receipt of data at NCAR, data were stored into a replicating database and quality control algorithms were applied. All variables were subject to relevant gross error value checks. Manuel inspection of site specific data and variables was performed and common variable-cross site comparisons were also made to assess reasonableness. Problem data or absent when encountered were flagged and tagged with no data values (=-9999.9) to ensure continuous data records. All data were output from the NCAR databased into a self-describing netcdf dataset that conforms to netcdf4 data standards and, where relevant, cf-compliance. Sensors were all field tested prior to deployment in RELAMPAGO. All TB3 rain gauges were subjected to bucket volume tip calibration and verification prior to deployment.

4.0 Data Format:

- Data from the NCAR-RAL Surface Hydrometeorological Observation Network are provided in a single cf-compliant netcdf data file with multiple site and time dimensions.
- An example netcdf file header and set of variable names are provided at the end of this README file.
- The units of the data are as follows:
    - Temperature: degrees Celsius
    - Humidity: Relative humidity (%), vapor pressure (kPa)
    - Barometric pressure (kPa)
    - Wind speed (m/s)
    - Wind direction (degrees from North)
    - Incoming solar radiation (Watts/meter^2)
    - Precipitation (mm or mm/hr)
    - Soil Temperature (degrees Celsius)
    - Soil Moisture (m^3/m^3)
- The data are currently provided as version 1.0 of the data.
- Missing data or values that were deemed as implausible upon quality control review all have values of -9999.9.

5.0 Data Remarks:

- The data are provided as reliable observations of the hydrometeorological conditions to the best of the investigators knowledge and as site conditions permitted. Data gaps due sensor and/or logger failures do exist within the data and details of the reasons for missing data in the final datasets can be obtained by the PI through the contact information above.

- Any software capable of reading cf-compliant netcdf data should be able to read these datafiles (e.g. R, python, Matlab, IDV, ArcGIS, ncl, etc)

6.0 References:

No references for this dataset are yet available as of this writing:

Website for Decagon/METER sensors: https://www.metergroup.com

Website for Hydrologic Services TB3 and TB4 rain gauges: https://www.hydrologicalusa.com