Daily Rain-on-Snow Data Record Time Series Derived from AMSR-E and AMSR2, Version 1 (WY2003 – WY2016)

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I. Introduction

The Version 1 AMSR-E/2 Rain-on-Snow Data Record (ROS) was generated from daily brightness temperatures (T_b) at vertically and horizontally polarized 36.5 GHz and 18.7 GHz from the Advanced Microwave Scanning Radiometer for EOS and Advanced Microwave Scanning Radiometer 2 (AMSR-E/2) across Alaska, USA for water years (WY) 2003 to 2016. The AMSR-E/2 orbital swath T_b data were spatially re-sampled to a 6-km resolution on a polar EASE-Grid (version 2) format using an inverse distance squared weighting method (Brodzick et al. 2012, Du et al. 2017). To ensure cross-sensor consistency, the gridded AMSR-2 T_b data were empirically calibrated against the same AMSRE frequencies using a Double-Differencing method and similar overlapping observations from the FY3B MWRI sensor record (Du et al. 2014).

ROS events and associated snow wetness, induced by atmospheric conditions, were detected using a spectral Gradient Ratio to exploit the 19 and 37 GHz dielectric properties in response to rain-on-snow events and enhanced liquid water content (LWC) within the surface snowpack (Grenfell and Putkonen 2008). The Gradient Ratio is applied to vertical and horizontal polarizations, respectively. The proceedings Gradient Ratios are then ratioed together using a Gradient Ratio Polarization (GRP) (Dolant et al. 2016, Langlois et al. 2017). A threshold value is then applied to the GRP to detect ROS. The threshold is set to < 1 for elevations below 900 m and < -5 for elevations above 900 m.

The satellite derived data record allows for the identification of ROS events at a relatively fine spatial resolution and high temporal resolution. Data are provided at daily acquisitions, allowing for the identification of single ROS events; and monthly annual aggregations from November through March.

Data Citation

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II. Data Format

The daily data are stored in one file as GeoTiffs for each year from WY2003 to WY2016. Files are 2d arrays stored as a sixteen-signed integer (Int16) with 290 rows and 424 columns. The GeoTiffs are projected to the North Pole LAEA Alaska (EPSG:3572), with latitude of center at 90 and longitude of center at -150. The data format and projections are the same for the monthly and annual aggregations.

Table 1. Description of data values.

Value	Description
0	no rain-on-snow identified
1	rain-on-snow, identified snow wetness
-9999	masked values outside of the AK domain

III. File naming convention

Daily
AMSR_ROS_DAILY_A_6km_{date}_v{x}.tif

AMSR represents AMSR-E or AMSR2 observations.
ROS represents rain-on-snow and associated snow wetness.
A represents equatorial crossing of the images used to detect rain-on-snow.
6km is the spatial resolution.
Date (format yyyy/ddd) is the date of ROS occurrence.
v is for data version
x is the data version number

Aggregations
AMSR_ROS_SUM_A_6km_{month/months}_WY{year}_v{x}.tif

AMSR represents AMSR-E or AMSR2 observations.
ROS_SUM represents summation of rain-on-snow events during the defined period.
A represents equatorial crossing of the images used to detect rain-on-snow.
6km is the spatial resolution.
month (format mm) is the month at which the summations occur. Annual summation is defined as ‘NDJFM’.
WY indicates that summations occur in water years. For example, November 2015 – October 2016 = WY2016.
year (format yyyy) is the year the data represent
v is for data version
x is the data version number

IV. Ancillary code

A Python code ‘ROS_Data_Reader_Plotter.py’ is provided to read the ROS data set and extract simple information including; projection, rows/columns, and geotransform. The script requires installations of GDAL, numpy, and matplotlib. The script also allows for quick visualization of the data by plotting the ROS data GeoTiffs as an array. The user is only required to change the 'inputfile' string to the file and associated directory.

V. Accuracy

The ROS data set were validated using a two-tiered validation. The first tier returned accuracies ranging between 75-100% at Fairbanks, AK. The second tier returned a relative accuracy of 86%, using 53 climate stations across Alaska. For the aggregated SUMS, the user should be aware of overestimated pixels, which are typically located in regions of inundated tundra and during periods of intermittent snow. If using the aggregated values, it is suggested to set overestimated pixels to NaN at the user's discretion.

The ROS dataset returned favorable correspondence to climate anomalies, including minimum temperature, maximum temperature and precipitation. These correspondences suggest that the detection of ROS and associated snow wetness, increase during periods of warm temperature and precipitation.

References

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