

MnROAD Weather Stations

General Description

To record the weather conditions at the MnROAD facility, several on-site weather stations have been utilized since 1990. Missing data is often supplemented with a nearby weather station located at the Buffalo Minnesota regional airport.

Equipment Types

Much of the recent weather data comes from two weather stations containing the following equipment:

NW weather station

Campbell Scientific CR1000 Datalogger with the following sensors:
 Temperature/Relative Humidity - Vaisala probe Model HMP45AC
 Wind Monitor - RM Young Model 05103
 Ambient Pressure - Campbell Scientific CS106 (Vaisla PTB110)
 Precipitation - Tipping bucket - Met One Instruments 380/385
 Radiometer - Kipp & Zonen NR Lite 2

SE weather station

Campbell Scientific CR1000 Datalogger with the following sensors:
 Temp/Rh - Vaisala probe Model HMP45C
 Wind Monitor - RM Young Model 05103
 Ambient Pressure – Campbell Scientific CS106 (Vaisla PTB110)
 Tipping Bucket Met One 380/385
 Radiometer - Kipp & Zonen NRLite 2

Note: Specific information on the equipment for the past weather stations can be found if necessary.

Weather Stations Used

The following weather stations have been used at MNROAD

Weather Station	Start Date	End Date
AWS	September 26, 1990	February 17, 1997
CRREL	October 30, 1990	April 18, 1997
NW	March 21, 1997	Current
SE (WIM building)	April 30, 1998	Current



Weather Stations Database Table

In the past MnROAD had different tables for each of the weather stations related to MnROAD.

Past Historical Weather Tables:

WEATHER_AWS (15 minutes)	WEATHER_CRREL (15 minutes)	NW_WEATHER (15 minutes)	WEATHER_SE (15 minutes)	WEATHER_BUFFALO* (Daily Summary)
DAY HOUR QHR AIR_TEMP ATMOS_PRES PRECIP_SE REL_HUMIDITY SOLAR_RAD_IN WIND_DIRECTION WIND_GUST WIND_SPEED GUST_DIRECTION SOLAR_RAD_OUT	DAY HOUR QHR AIR_TEMP ATMOS_PRES PRECIP_NW REL_HUMIDITY SHORTWAVE_RAD_IN WIND_DIRECTION WIND_GUST WIND_SPEED LONGWAVE_RAD_OUT SNOW_DEPTH	DAY HOUR QHR AIR_TEMP ATMOS_PRES PRECIP_NW REL_HUMIDITY SHORTWAVE_RAD_IN WIND_DIRECTION WIND_GUST WIND_SPEED	DAY HOUR QHR AIR_TEMP PRECIP_TOTAL REL_HUMIDITY WIND_DIRECTION WIND_SPEED	DAY HIGHTEMP_F LOWTEMP_F PRECIP_IN

*Buffalo, Minnesota - Weather station number 211107 - Lat: 45.19782 Lon: 93.89255 <http://climate.umn.edu/HIDradius/radius.asp>

Current Weather Tables:

The data from the historical weather stations were combined into the following table in the MNROAD database in 2013 and currently only storing the NW and SE weather station data since 1998 again collecting data every 15 minutes.

WEATHER_MNROAD_RAW

Field Name	Description
LOCATION	Weather Station data source
DAY	Date
HOUR	Hour of the day (0-23)
QHR	Quarter Hour (0,1,2,3)
AIR_TEMP_DEG_C	Air temp (Celsius)
ATMOS_PRES_MBARS	Atmospheric Pressure (millibars)
PRECIP_100TH_INCH	Heated Rain Gauge Precipitation (100th inch)
REL_HUMIDITY_PCT	Relative Humidity (Percent)
NET_RADIATION_W_PER_M_SQUARED	Net Radiation (Watts/Square Meter)
NET_SHORTWAVE_W_PER_M_SQUARED	Net Shortwave Radiation (Watts/Square Meter)
NET_LONGWAVE_W_PER_M_SQUARED	Net Longwave Radiation (Watts/Square Meter)
WIND_DEGREES_FROM_NORTH	Wind Direction (Degrees from North)
AVG_WIND_SPEED_M_PER_SEC	Wind Average Speed (Meter/Second)
MAX_WIND_GUST_M_PER_SEC	Wind Mas Gust (Meter/Second)
GUST_DEGREES_FROM_NORTH	Wind Gust Direction (Degrees from North)



The data then is summarized after the raw data was reviewed and placed into the following table that uses the most reliable data from that time period or uses an average to determine the value. Currently the NW and SE weather stations are being used.

WEATHER_MNROAD_COMPOSITE

Field Name	Description
DAY	Date
HOUR	Hour of the day (0-23)
QHR	Quarter Hour (0,1,2,3)
AIR_TEMP_DEG_C	Air temp (Celsius)
ATMOS_PRES_MBARS	Atmospheric Pressure (millibars)
PRECIP_100TH_INCH	Heated Rain Gauge Precipitation (100th inch)
REL_HUMIDITY_PCT	Relative Humidity (Percent)
NET_RADIATION_W_PER_M_SQUARED	Net Radiation (Watts/Square Meter)
NET_SHORTWAVE_W_PER_M_SQUARED	Net Shortwave Radiation (Watts/Square Meter)
NET_LONGWAVE_W_PER_M_SQUARED	Net Longwave Radiation (Watts/Square Meter)
WIND_DEGREES_FROM_NORTH	Wind Direction (Degrees from North)
AVG_WIND_SPEED_M_PER_SEC	Wind Average Speed (Meter/Second)
MAX_WIND_GUST_M_PER_SEC	Wind Mas Gust (Meter/Second)
GUST_DEGREES_FROM_NORTH	Wind Gust Direction (Degrees from North)

Note the solar radiation sensors were replaced on 19-NOV-13 at 1500 hours. The new sensors only collect the net solar radiation and do not collect the short and longwave radiation.

Because some of the data over the years has been affected by damaged sensors within the MnROAD weather stations, extreme data outliers have been corrected to better correlate with 30-year historical data from the Buffalo, MN weather station (QWIKCAST.COM). The following examples relate to precipitation and solar radiation data:

PRECIP data has been manipulated at times using the following equation:

$$\frac{PRECIP\ OUTLIER}{100\ or\ 1000} \times 2.54 = adjusted\ value$$

Please note that the denominators were used according to which value (100 or 1000) provided a value closest to the Buffalo averages. If there was no data in the WEATHER_COMPOSITE table for some of the months, the monthly average taken from the Buffalo summary was inserted.

Solar radiation data has been manipulated in the following way:

SOLAR_RAD_IN data and SOLAR_RAD_OUT data from 10/1994 – 4/1997 were both off by factors of ten. The SOLAR_RAD_IN data during this period was divided by ten and the SOLAR_RAD_OUT data was divided by 100 to be comparable to the rest of the WEATHER_COMPOSITE data.



For more information:

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MnROAD is a state of the art cold weather pavement and transportation testing facility located in Minnesota