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REGIONAL DATA STREAM PLAN: ALASKA DEPT OF TRANSPORTATION, ROAD WEATHER INFORMATION SYSTEM (RWIS), AUGUST 2016 (DATA STREAM PLAN BEING UPDATED 02/2017)

1. DATA AND INFORMATION TYPES

A. Provide a contextual description of the data stream.

The Road Weather Information System (RWIS) is a network of meteorological and pavement sensors located along the highway system. RWIS stations are located in strategic locations to provide accurate real-time road weather information and critical observations for forecasts. This and other weather information helps Alaska Department of Transportation & Public Facilities (ADOT&PF) improve timeliness of maintenance actions (e.g., snowplowing; deposit anti-icing/de-icing chemicals on the highways). AOOS served data from RWIS directly, which now makes up the historical sensor data for this data stream.

MADIS ingests data from NOAA data sources and non-NOAA providers, decodes the data then encodes all of the observational data into a common format with uniform observational units and time stamps. Quality checks are conducted and the integrated data sets are stored along with a series of flags indicating the results of the various QC checks. MADIS provides several methods for users to access the data to meet their needs. Users can request data from July of 2001, which is when MADIS was first available to the public, to the present.

To provide these services, MADIS leverages partnerships with international agencies; federal, state, and local agencies (e.g., states' Departments of Transportation); universities; volunteer networks; and the private sector (e.g., airlines, railroads) to integrate and quality check observations from their stations with those of NOAA.

MADIS runs operationally at the NWS National Centers for Environmental Prediction (NCEP) Central Operations (NCO) as part of the Integrated Dissemination Project (IDP). All MADIS data are being added to NOAA's data archive that is run by the National Environmental Satellite, Data, and Information Service (NESDIS) National Climatic Data Center (NCDC). Research and development efforts are being provided by NOAA's Office of Oceanic and Atmospheric Research (OAR) Earth System Research Laboratory (ESRL) Global Systems Division (GSD).

AOOS will access data from the MADIS system starting in 2017.

Website URL: Historical Sensor Catalog: Source: Alaska Department of Transportation
http://portal.aoos.org/#module-metadata/0cbe63ce-87aa-11e3-acbf-00219bfe5678/467dd946-87aa-11e3-9eb2-00219bfe5678

Website URL: Real-time Sensor Catalog: Source (starting February 2017): MADIS

http://portal.aoos.org/#module-metadata/5da59d98-59ad-11e1-a1da-0019b9dae22b/8c5dd704-59ad-11e1-bb67-0019b9dae22b

B. How many station locations are there for this data stream?

40

C. What are the specific parameters of the data.

The parameters of this data stream include: date, time, cameras and three categories of environmental sensors:: atmospheric, surface/sub-surface, and water level/snow depth.

Deployed sensors may include: air temperature, relative humidity, wind speed and direction, precipitation occurrence, precipitation type, precipitation intensity, precipitation accumulation, visibility, visibility situation, station atmospheric pressure, snow depth, water level, solar radiation, pavement temperature, pavement grip (friction), pavement contaminant depth, and soil temperature (single sensor and multi-sensor probe).

Refer to the About RWIS page link for more details:
https://www.google.com/url?q=http://www.roadweather.alaska.gov/iways/roadweather/forms/About.html&sa=D&ust=1473815268471000&usg=AFQjCNE7bRGiBGbkHnanpwLDfcrvH43q8Q

D. Provide information about the sampling platform or instrumentation.

Alaska's RWIS stations may include some or all the following:

1. pavement sensors in travel lanes to measure surface and subsurface (17" below the surface) temperatures
2. atmospheric sensors adjacent to the roadway to measure: air temperature, dew point temperature, relative humidity, wind speed and direction, precipitation occurrence, precipitation accumulation, atmospheric station pressure, snow depth, or stream water level
3. closed circuit cameras that take images of the roadway for snow and ice control as well as for traveler information. ADOT&PF also provides images of mountains and passes to supplement the Federal Aviation Administration web camera program

2. Data Pathway

A. Is a data sharing agreement required?

Yes. The information that is provided on this web site is a property of the Alaska Department of Transportation & Public Facilities (ADOT&PF). It is not to be sold, or used in any process for resale as a value-added product, or otherwise distributed for profit in any form without expressed written consent of the ADOT&PF. The ADOT&PF assumes no responsibility for any loss due to any computer or software generated problems associated with these files. It is the sole responsibility of the user to keep all files current with those on the web site. ADOT&PF will provide no technical support. ADOT&PF provides the foregoing information as a public service. This information is published automatically and

its accuracy or timeliness cannot be guaranteed. The observation screens are not automatically refreshed; users of these data should use the refresh or reload capability of their web browsers to get the most recent observations. This information depends on internet availability, communication networks, and computer equipment which are beyond the control of the ADOT&PF. The weather links to other sites are provided as a service to the traveling public and do not represent ADOT&PF.

B. In which format(s) are data received by AOOS?

Historical data were retrieved in CSV file format from the originator's website AKDOT. In the future, AOOS will work on accessing these data from the MADIS system which provides full QC and archival procedures.

C. How can the information be accessed?

The data are available through the AOOS data portal, where it can be downloaded or explored through interactive visualizations. Specifically, data are available from two unique access points:

- File downloads (CSV)
- ERDDAP

D. What file formats will be used for sharing data, if different from original?

Data are shared as CSV and through ERDDAP. Data are also available for exploration in the AOOS portals via interactive, graphical visualizations.

E. Describe how the data are ingested (e.g. the flow of data from source to AOOS data portals) and any transformations or modifications made to share data in the AOOS data portal.

Data are downloaded from the source to the AOOS storage. Custom Java, Scala, and Python scripts are used to convert data formats suitable for internal and external interoperability services. Data are made available in the AOOS portals through the access points and via graphic displays generated through internal JSON-format data requests from these services.

Graphic displays include a mapping service, customized interactive visualizations, and time-series plots of the unit values wherein each parameter is graphed independently. Back-end scripts handle the conversion of visualized data from CF standards to other, non-CF units that may be requested by the user. Data files may be downloaded by the user from the AOOS data portal. A user request for a CSV file request pulls the data from the server cache. A user request for ERDDAP pulls data from the ERDDAP service using the same cache. For this data, no CF-standard names or units exist, therefore custom names of abundance_of_{scientific_name} were used. Refer to Appendix I for CF standards.

Summary statistics generated within the interactive graphical displays may be requested by the user. Summary statistics may include minimum, maximum and mean values. Seasonal statistics, available on time series longer than 3 years, include mean, and 10th and 90th percentiles. Note: the number of points visually available to interactive users from the

source data are limited when necessary using temporal binning, such as daily, weekly, monthly, seasonally and yearly.

F. What metadata or contextual information is provided with the data?
The Road Weather Information System (RWIS) provides overview information and a glossary describing each sensor measurement. Data are shared in the AOOS portals with descriptive narratives describing the data and linking back to the originator's site.

G. Are there ethical restrictions to data sharing?
No

a. **If so, how will these be resolved?**
N/A

H. Who holds intellectual property rights (IPR) to the data?
Alaska Department of Transportation & Public Facilities

I. Describe any effect of IPR on data access.
None

3. Data Source and Quality Control

A. Indicate the data source type (i.e. Federal, Non-Federal, University, State Agency, Local Municipality, Military Establishment (branch), private industry, NGO, non-Profit, Citizen Science, Private individual)
State Agency

Going forward, AOOS will work on accessing these data directly from the NWS MADIS program, as described below. This will eliminate the need for QARTOD application and archival processes beyond AOOS data server activities.

a. If Federal data source, were changes applied to the data?
MADIS ingests data from NOAA data sources and non-NOAA providers, decodes the data then encodes all of the observational data into a common format with uniform observational units and time stamps. Quality checks are conducted and the integrated data sets are stored along with a series of flags indicating the results of the various QC checks. MADIS provides several methods for users to access the data to meet their needs. Users can request data from July of 2001, which is when MADIS was first available to the public, to the present.

b. If Yes, describe any changes to the data that require documentation?
N/A

B. Indicate the data reporting type (e.g. real-time, historical).
Real-time, Historical

C. If real-time, list the QARTOD procedures that are currently applied.

Historical Data through January 2017:

There are five required QARTOD tests for weather parameters Wind Speed,Wind Direction and Wind Gusts, of which three are implemented by the AOOS Data System -- the syntax, gross range and time gap tests (see 3G). A version of the Timing Gap Test, which with QARTOD is intended to ensure ingestion of minimum hourly time series, is performed by AOOS. The AOOS version of the timing gap test changes the station color to a grey shade ("shade-flags") on the real-time sensor map display after 4 hours of missed data reports, and removes the station from the map (though not the archive) after a week of missed reports. Data remain available in the Historical Sensors catalogue.

QARTOD requires two additional tests to the three implemented by AOOS on the weather data -- a location test and climatology test. Three additional tests are required for water (stream) level data that may be included in any of the AKDOT data stream -- gross range tests, location and climatology tests.

The gross-range test for water level will be implemented within 12 months of certification (Target June 2017). Currently, the AKDOT station data served by AOOS are not reporting water level data.

Given that the AKDOT Weather stations land-based and fixed position, and are not at risk of "breaking" mooring, the location test is considered unwarranted for this data stream. However, the Location Test will be implemented by June 2017 for stations that produce GPS output in the reported data. Currently, the AKDOT weather stations do not transmit a GPS value with their real-time data.

The Climatology Test is more rigorous, and currently, the AOOS Data System does not have the historical data in place to perform meaningful climatology tests on non-federal sourced weather assets. It is a test that may be considered after there are 7+ years of data in the AOOS archive.

February 2017 - *: Source will be Federal, and MADIS will be implementing stringent QC procedures on all real-time data.

D. If real-time, list the QARTOD procedures that are planned for implementation.

Ongoing real-time data will be considered Federal, and will be QC'd under MADIS.

E. What is the status of the reported data? (e.g. raw, some QC, incomplete, delayed mode processed but not QC'd)

Historical: Some QC as delivered from RWIS, and some basic QARTOD QC by AOOS

F. Describe the data control procedures that were applied by the originator.

Historical: Raw binary data are converted by the instruments to engineering units using internally stored calibration and conversion algorithms. These data are from a

non-federal real-time data feed and are assumed to have no additional QC for errors prior to data ingestion by AOOS beyond the simple data conversion. The following processes are provided on the originator's website regarding data processing and parameter data binning and formats. (http://www.roadweather.alaska.gov/iways/roadweather/forms/Glossary.html)

Starting in 2017, AOOS will be accessing data from MADIS, which implements rigorous QC procedures, as described below:

Wind Direction
The direction from which the wind is blowing, reported in true north. The wind sensor is located approximately 10 meters (30 feet) above the ground. The remote processing unit (RPU) picks the last wind direction from the 1 second (for the ESS-ESP RPU operating system or 3 second (for the Linux LX-RPU operating system) wind sampling period. The reported wind direction is the mode of these wind directions over the previous two minutes. Calculated in quadrants.

Wind Direction of Maximum Speed
The wind direction at the time of reported maximum wind speed over the last 10 minutes, as taken from the wind speed/direction array (see Wind Speed Maximum). Calculated in quadrants.

Wind Speed
The average wind speed over a pre-determined time interval, as sampled from the wind sensor is located approximately 10 meters (30 feet) above the ground. The remote processing unit (RPU) averages speeds over 1 second (for the ESS-ESP RPU operating system) or 3 second (for the Linux LX-RPU operating system) wind sampling period. The reported wind speed is the mean of these averages over the previous 2 minutes. Reported in km/hr.

Wind Speed Maximum
The maximum wind speed over the last ten minutes. The RPUs maintain wind speed/direction array of 10 one-minute cells. If the current wind speed is greater than the value in the most recent one-minute array, then the current wind speed and the associated wind direction replaces those values in that cell. When the current minute has expired, the 10 one-minute cell contents shift, and the oldest wind speed/direction values are dropped. The reported maximum wind speed is the highest wind speed from the 10 one-minute cells. Reported in km/hr.

Station Atmospheric Pressure
The force per unit area exerted by the atmosphere, reported in millibars. The pressure is for RWIS site and has not been corrected for altitude or temperature. It should not be used for aviation purposes.

Precipitation Occurrence
The precipitation occurrence reported value will depend on the type of sensor installed: either infrared or forward scatter technology.

Infrared - precipitation is detected with dual beam infrared (IR) sensors over a 150 mm distance. The sensor can detect droplets as small as 0.010" (0.10 mm) to large hail stones. The sampling timeframe is a sliding one minute window. Valid sensor output is

YES or NO. Other reported values are OTHER (indicates IR beam degradation from interference such as a dirty lens or rime ice) and UNKNOWN (other possible atmospheric particulants, e.g., dust, drizzle, etc.).
Forward Scatter - a capacitive device, combined with a forward scatter and temperature sensors, estimates the liquid water content of precipitation. The output follows WMO Table 4680 primary weather types.

Precipitation Rate

The rate of precipitation, as measured with a capacitive device. The sensor combines this information with forward scatter and temperature measures to provide a precipitation rate per hour. For frozen precipitation, the output is a liquid water equivalent (LWE).

Relative Humidity

A measure of the amount of moisture present in the atmosphere, expressed as a percentage. The RH is ratio of the existing vapor pressure to the saturation vapor pressure with respect to water at the current temperature.

Precipitation Accumulation

The liquid water equivalent (LWE) for frozen, freezing, and liquid precipitation in one of six time periods immediately preceding the observation time:

- 10 minute
- 1 hour
- 3 hour
- 6 hour
- 12 hour
- 24 hour

Precipitation Intensity

The intensity of the precipitation as determined by the precipitation rate. The sensor estimates the water content of precipitation with a capacitive device and combines this information with forward scatter and temperature measures to provide a precipitation intensity according to the WMO and NWS code tables:

- None
- Slight
- Light
- Moderate
- Heavy

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a. **Provide a link to any documented procedures.**
   http://www.roadweather.alaska.gov/iways/roadweather/forms/About.html

MADIS: https://madis.noaa.gov/

G. Describe the data control procedures that were applied by AOOS.

AOOS currently applies three standard QC procedures to real-time and historical observation data before it is stored in the AOOS Data System. These tests include the following:

1. *Syntax Test:* Each regional data source uses unique syntax to transfer data. Some (e.g., Canada Water Office) have standardized data storage protocols and provide files whereas others (e.g., Alyeska Weather stations) are merely html web pages that are scraped for data. Therefore, each regional source requires a custom syntax test, which merely checks for parity errors by testing if data can be extracted from the downloaded or scraped data. If no data can be extracted, the test fails, and no data are accessed, served or stored for that record.
2. *Gross Range Test:* This test checks data values against minimum and maximum values defined for each parameter. In addition to parameters outlined in QARTOD manuals, AOOS includes gross range tests for parameters not covered by QARTOD (see Appendix H for the list and minimum and maximum values). Parameters in this data stream with gross range checks include Air temperature (-130 and 130 deg F); barometric pressure (355 and 1085 mbar); wind speed and gust speed (0 and 253 mph); wind direction and gust direction (0 and 360 degrees); relative humidity (0 and 100%); precipitation amount (0 min only); snow depth (0-500 inches). Values outside of the prescribed parameter ranges are rejected and replaced with missing value flags in data storage connected to access points and the graphic displays.
3. *Time-Gap Check:* AOOS implements a *"time-gap check"* that informs observational assets (e.g., weather stations) displayed on its "Real-Time Sensor Map". If no data are received from an existing observational station for four hours, the icon on the map changes from a scaled color to a small grey-shade dot. If no data are received from an existing observational station for one week, the asset is automatically removed from the map, although assets are still made available on a historical sensor map.

AOOS QC syntax and gross range tests qualify as legitimate QC checks for many data stream parameters described by US IOOS Quality Assurance of Real-Time Oceanographic Data (QARTOD) protocols. The AOOS version of the "*time-gap check"* does not flag data or gaps in the underlying AOOS data storage, thus may not completely satisfy the "time-gap test" proposed by QARTOD.

a. Provide a link to any documented procedures.

AOOS Data Assembly Center and Data Management Plan (2016).

H. List the procedures taken for data that could not be QC'd as directed.

N/A

4. Stewardship and Preservation Policies

A. Who is responsible for long-term data archiving?

Data are aggregated for visualization and exploration with other layers in the AOOS data portal. AOOS stores the real-time and historical data on the AOOS data servers. AOOS also facilitates archival of data to NCEI. However, these data are already being archived by MADIS, and have been since AOOS has been serving the data.

The ADOT&PF openly shares RWIS data with **the National Weather Service**, **the Federal Aviation Administration**, the University of Alaska, and Elmendorf Air Force Base.

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B. Which long-term data storage facility will be used for preservation?

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https://madis.noaa.gov/

C. Describe any transformation necessary for data preservation.

N/A

D. List the metadata or other documentation that will be archived with the data.

N/A