7.3 An inter-comparison of RWIS data with AWOS and ASOS data in the state of Iowa

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1. INTRODUCTION

State departments of transportation throughout the country are installing roadway networks to monitor conditions for travelers and the transportation industry. While their main purpose is to monitor road conditions for current weather hazards and inform maintenance crews of potentially dangerous conditions, significant meteorological data is gathered from these stations. In most cases this data is not saved or shared with other organizations. As part of developing the Iowa Environmental Mesonet (IEM) (Todey et al. 2002), data from the Iowa Department of Transportation (IaDOT) Roadway Weather Information System (RWIS) network is being integrated with data from other stations to create a detailed temporal and spatial database of meteorological data in Iowa.

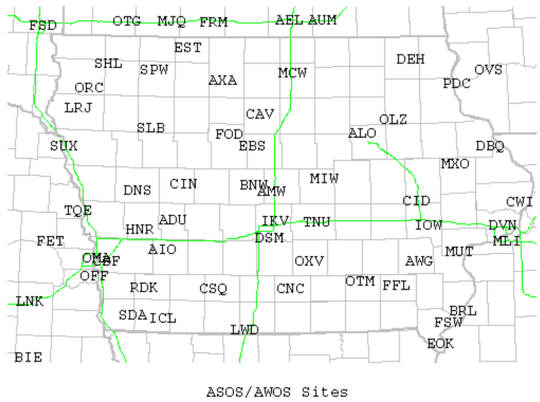

Fig. 1. ASOS/AWOS locations in and near Iowa.

2. NETWORK DESCRIPTIONS

Iowa is one of the most densely monitored states in regard to governmentally-sponsored atmospheric data collection platforms. Three main automated systems exist in Iowa, which are coordinated by the National Weather Service (NWS), Federal Aviation Administration (FAA) and the IaDOT. Located at commercial and local airports are the NWS Automated Surface Observing System (ASOS) (Fig. 1) and the IaDOT/FAA Automated Weather Observing System (AWOS) (Fig. 1). The IaDOT also maintains the RWIS network (Fig. 2), located along major highways and interchanges throughout the state.

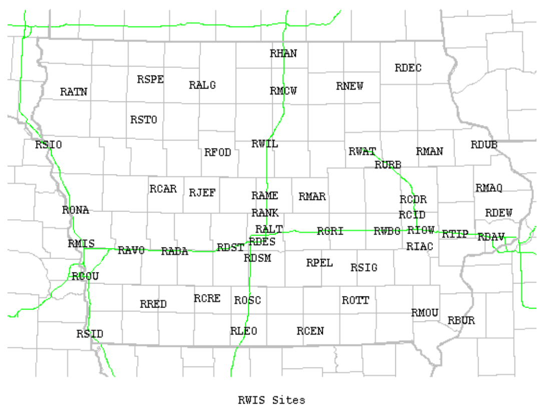

Fig. 2. RWIS locations in Iowa.

2.1 *Station Siting*

While the ASOS sites are located mostly at major airports, the AWOS sites are located at smaller airports. Because of the basic needs of an airport, the ASOS/AWOS sites are located on a flat surrounding topography. The sites may have other surrounding geographic features that lead to data differences. Audubon, IA for example is located in a relatively deep valley, which leads to colder minimum temperature observations compared to nearby stations.

The RWIS sites are more variable in their placement since their need is to monitor major highways wherever they are. Some stations are sited well for comparison, others are not ideally sited. A few stations are located on bridges above rivers, placing them in a significantly different microclimate, leading to different moisture contents and different night-time temperatures. Other stations are located on bridges at interchanges placing sensors at higher elevations above the surface than standard meteorological conditions.

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2.2 *Station Instrumentation*

Data gathered from the ASOS/AWOS network include, temperature, dew point, station pressure, wind speed and direction, and sky cover below 3871 m (12,000 ft). The ASOS stations include precipitation amount and current weather. A few AWOS sites include these, also; soon all AWOS sites will include these. RWIS sites include all of the above except pressure, sky condition, and current weather. Their precipitation sensors are a yes/no sensor, instead of an amount. The RWIS sites also include a pavement and sub-pavement temperature.

The RWIS sensors are placed at the standard collection heights (2 m for temperature as an example). But because of their relative placement to the nearby surface, the effective relative height compared to the ground surface may be questionable.

2.3 *Data Quantity*

Data for the ASOS/AWOS networks is disseminated via the University Center for Atmospheric Research's (UCAR) Unidata Internet Data Distribution System (IDD). Despite the similar distribution system, the ASOS/AWOS data are not consistent in their delivery. The AWOS sites report data every 20 minutes (:15, :35, and :55 after each hour), while the ASOS report one hourly observation. As the FAA takes over reporting responsibilities of ASOS sites, 20 minute data collection will begin occurring there, also. The RWIS data is gathered and disseminated through IaDOT platforms, which are not built for regular data collection. The stations are queried every 15 minutes.

The ASOS system seems to respond quickly to missing data, while the AWOS system does not. The RWIS data collection system is based on a different collection system designed for IaDOT use and is somewhat less stable for meteorological data collection. Problems in timing of data collection and transfer of data between systems still exist. These problems have lead to some data voids when collection has been halted. Current data collection methods have produced only 80% of the possible data for the RWIS data. The collection rate for AWOS is somewhat better at 88%. The ASOS data are extremely consistent at 98% of possible data. Creating a more consistent data collection strategy is necessary for meteorological use of the RWIS system.

3. DATA COMPARISON

Discrepancies exist among observing networks based on siting considerations, type of instrumentation, and maintenance guidelines. Several methods are under way to assess differences in the ASOS, AWOS and RWIS networks to determine any network biases. While the ASOS/AWOS networks are similar siting and instrumentation, their data indicate some that other differences may exist that do not allow grouping the data. In contrast the siting of instruments along a roadway, which is not necessarily meteorologically sound, has produced better than expected data.

3.1 *Network comparison*

Comparisons of the whole networks have uncovered interesting differences in temperatures. The whole network comparisons have been based on the assumption that the stations are distributed evenly. If the ASOS/AWOS data are grouped as a single network, the location of the centroid of this network is within a few kilometers of the centroid of the RWIS network. If the AWOS/ASOS networks are considered separately, the difference in the location of the AWOS and ASOS centroids is about 65 km with the AWOS centroid located farther west and slightly south of the ASOS centroid.

Network temperature means usually indicate the AWOS network having the highest network mean with the ASOS having the lowest mean temperature (Fig 3). This finding is consistent with the western bias of the AWOS sites compared to the ASOS. The mean temperature of the RWIS network usually is between the ASOS and AWOS mean.

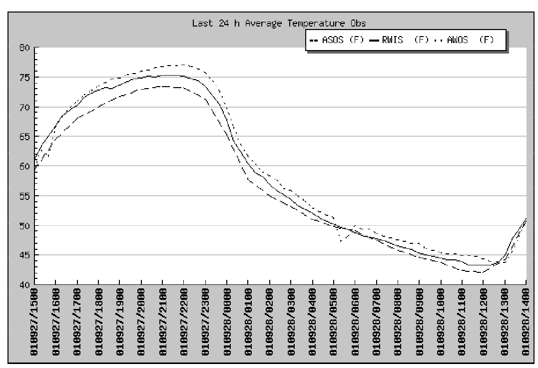

Fig. 3 Mean hourly temperatures of the three networks for a sample 24-hour period.

If grouped together, the ASOS/AWOS network temperature has a larger standard deviation. If handled separately, the ASOS network usually has the lowest network standard deviation with the AWOS and RWIS somewhat higher (Fig. 4).

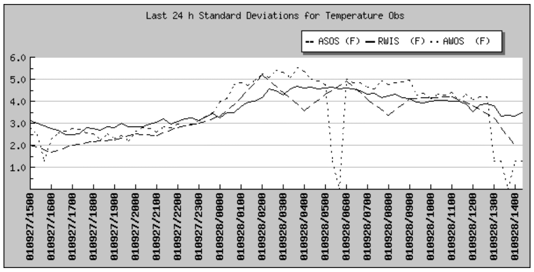

Fig. 4 Hourly network standard deviation of temperatures for a sample 24-hour period.

These results vary based on uniformity of synoptic conditions across the state. These trends have been consistent over many different situations during the warm season comparison. But they do present issues for consideration among the networks.

3.2 *Station comparison*

Another comparison method has linked AWOS or ASOS stations with a nearby RWIS station to determine the relative comparison of stations in a local climate. Some interesting details have appeared. Preliminary results show a distinct diurnal trend in dew points. The ASOS/AWOS stations report lower dew points at night while reporting higher dew points during the day than their RWIS counterparts (Fig. 5). The diurnal temperature trend is not as distinct and is still being studied. These are preliminary results for a warm season period only. Data are still being gathered for a cold season comparison. But the data do point to a station difference in siting or measurement.

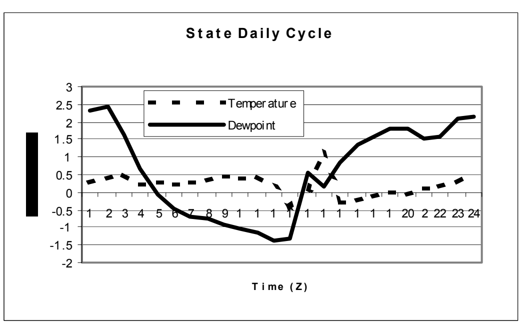

Fig. 5 Hourly difference of temperature (solid line) and dew point (dashed line) of AWOS or ASOS stations from a nearby RWIS station. Differences are a composite of 18 station comparisons.

The moisture content in ASOS/AWOS observations has been questioned by National Weather Service forecasters on several occasions (Jungbluth, 2000).

4. APPLICATIONS

Numerous applications are available for the combination of data and associated database. Other applications are continually being developed. Despite their non-standard nature, they provide another data point to fill in voids in the state. The National Weather Service offices in Iowa are being fed the 20-minute RWIS data for ingestion and analysis into local data analysis software. The NWS has been able to more accurately determine such small-scale features as convergence boundaries to improve forecasts based on additional RWIS data provided by the IaDOT and IEM.

5. CONCLUSIONS

The combination of data from the ASOS/AWOS and RWIS networks greatly improves the resolution and analysis capabilities of many meteorological values across the state of Iowa. This has proven useful to the NWS and is helping resolve other subtle differences across the state.

Data comparison must continue to determine relative biases in the networks and find any systematic differences that can be remedied. Changing station siting will likely not be possible. But subtle instrumentation changes may be possible if systemic differences are proven.

Cross use and sharing of data such as these can only enhance the usefulness of the separate networks. Displaying a broader usefulness for individual network data will lend support to defend resources spent on developing and maintaining such systems.

6. REFERENCES

Jungbluth, K. A., DMX-NWA 2000: Personnal communication.

Todey, D.P., D.E. Herzmann, and G.S. Takle, 2002. The Iowa Environmental Mesonet – combining networks into a single network. *Preprints 6th Symposium on Integrated Observing Systems*, Orlando, FL, Amer. Meteor. Soc.