AFS11-Developed Validated Requirements for 2D-RTMA/URMA

General Requirements (CaRDS 18-028[1]):

Systematically and fundamentally enhance the quality of the NWS mesoscale analysis, i.e., URMA, by improving the representation of spatiotemporally-varying effects of significant terrain variation (over mountains, coastlines, lakes, and islands) using physics-based methods for observation data quality control, modeling, downscaling, and/or data assimilation. The improved mesoscale analysis should reveal significant reduction of the systematic biases over complex terrain and other major areas of terrain variation.

Specific Requirements (CaRDS 20-036[2]):

1. Reduce the biases in key parameters (temperature, wind, precipitation, and wave height) of RTMA/URMA over complex terrain, following the verification and validation procedures detailed in Sections 2 and 3, which are reported by the field and attributed to the lack of observations with sufficiently high quality, in order for the forecasters to properly understand the nature of outstanding weather events, such as cold pools, downslope gusty winds, mountain gap flow, and rain shadow effects in complex terrain. Suggested approaches include:

    a. **Quality Control (QC) processes or algorithms**
        i. Meet the needs of the field and the recommendations of the RTMA SOO Group by allowing the QC processes or algorithms for observation station data to distinguish between the states of the atmospheric flow over complex terrain (e.g., complicated by inhomogeneous, transient, anisotropic characteristics of the flow).
        ii. Make the QC processes and algorithms general enough to be applicable to all NWS Regions and geographic areas, not just over complex terrain.

    b. **Station flagging processes or algorithms**
        i. Apply the requirement 1a to the black/white-listing processes or algorithms for observation station data.
        ii. Allow forecasters to flag specific surface observations anytime for URMA usage (for NBM bias correction), execute the flagging process at least four times a day, and automate the process at the NCO[3].

    c. **Sensor information utilization and station type weighting** (e.g., for Mesonet data)
        i. Implement up-to-date sensor information (hardware types, sensor elevation, etc.).
        ii. Categorize and weight the stations depending on the relative fidelity of data (sensor type, etc.).

    d. **Additional data sources** (e.g., satellites, Mesonet, webcams)

[1] MDC-Validated on 6/17/2019. Suggests general requirements for key algorithms of the system to improve the overall performance of the system.
[2] MDC Validated on 5/10/2021. Suggests specific requirements to improve the quality control of the system
[3] NCEP Central Operations

i. Assimilate available non-ASOS[4]/AWOS[5] (METAR[6]) data, including COOP[7], RAWS[8], CWOP[9], HADS[10], PGE[11], NWLON[12], C-MAN[13], etc., into RTMA/URMA (with special focus on COOP data).
ii. Set up a plan to assimilate other data sources such as satellites and webcams for incorporation into RTMA/URMA.

2. For verifying the requirements proposed in Section 1, meet the following **threshold tolerances[14] of the key model parameters** requested by the field (Temperature, Dew Point Temperature, Wind, QPE/QPF[15], and Wave Height) in all NWS Regions and geographic areas, especially over complex terrain for the following parameters:
    a. Temperature (+/- 3 degrees F)
    b. Dew Point Temperature (+/- 3 degrees F)
    c. Wind (+/- 5 knots or better)
    d. QPE/QPF (+/- 0.1 inches)
    e. Wave Height (+/- 1 foot)

We would like to note that the two groups of requirements (1a/1b and 2; i.e., QC/Station Flagging and Thresholds) have been designed to work in tandem. The thresholds for key model parameters, which were based on the field's survey input, are not proposed to blindly pull analyses toward observations. The threshold values will serve as general guidelines rather than pass or non-pass criteria on individual parameters, and should be imposed only when the reference observation has been validated or quality controlled.

3. In order to respond to the field's needs in view of outstanding weather events, collaborate on verification and validation (V&V) activities, which are used to check if the reported biases are reduced in the current version of the system, with respect to the old system or against the thresholds presented in Section 2.

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[4] Automated Surface Observing System, NWS
[5] Automated Weather Observing System, FAA
[6] METeorological Aerodrome Report (data format)
[7] COoperative Observer Program, NWS
[8] Remote Automatic Weather Stations, owned by wildland fire agencies
[9] Citizen Weather Observer Program
[10] Hydrometeorological Automated Data System, NWS (Office of Dissemination)
[11] Pacific Gas & Electric Co. Weather Stations
[12] National Water Level Observation Network
[13] Coastal-Marine Automated Network, NDBC
[14] These threshold tolerance values for the model input/output (e.g., temperature, wind, wave height) will be cross-checked against existing NOAA observation requirements laid out in the COURL/OURD (Consolidated Observing User Requirement List/Observational User Requirements Document) documents, as applicable, in collaboration with the Office of Observations.
[15] Quantitative Precipitation Estimates/Forecasts