

FY15 NM WRI Research Progress Report Form

January – March 2015

1. **Project Title:** New Mexico statewide water assessment: Comparison of operational precipitation and evapotranspiration products for statewide water assessment.
2. **Investigators (names, university/agency):** Jan M.H. Hendrickx, New Mexico Tech and Thomas Schmugge, New Mexico State University. **Other Researchers:** Dan Cadol, New Mexico Tech.
3. **Brief description of project, research objectives, and impacts on New Mexico (provide performance measures and outcomes):** The economic vitality of New Mexico depends on its water availability, but no one knows exactly where, when, and how much water is available in the state. Precipitation and evapotranspiration are the major components of a water balance equation. We have identified five precipitation and three evapotranspiration products, currently available over New Mexico. The research objectives for this project are:
 1. We will compare and contrast the each of these products spatially and statistically.
 2. We will validate the products against reliable measurements: precipitation products against precipitation gauges and experimental ranges and evapotranspiration against METRIC model ET maps.
 3. We will validate two chosen products for assessment of reference ET to be used to fill in null values in existing ET products.
 4. We will produce statewide precipitation and evapotranspiration products for New Mexico with a quality assessment and a plan for how to improve these products at the proper spatial and temporal scales.
4. **Brief description of methodology:** Each research objective will be completed per phase:
 - Phase 1: Obtain and compile all data and base literature for each product model. Display all data across each year available for the entire state. Produce tabular itemizations for basic statistical analysis for the entire state, for each year, for each model. Produce comparison graphs, histograms, and spatial displays for each model.
 - Phase 2: Obtain and compile all data and base literature for each validation model or dataset. Produce correlation scatter plots that compare each validation product with each precipitation and evapotranspiration product. Establish one or two precipitation and evapotranspiration products to focus on as key products and require less model manipulation for further verification.
 - Phase 3: Validate two existing methods for assessment of the reference ET for the New Mexico environment. One is a remote sensing method, the other consists of calculating the reference ET from NLDAS (North American Land Data Assimilation Systems) data following the standard method of the American Society of Civil Engineers. The reference ET is needed for calculation of the reference ETr fraction (ETrF) that is needed to fill the missing data in the existing ET products. The ETrF is a steady variable that allows reliable interpolation of ET values where missing data occur.

- Phase 4: Compile all precipitation and evapotranspiration data into a geodatabase and set of map documents at a spatial and temporal scale that will allow them to be combined with other water balance component data. Provide all pertinent metadata.

5. Brief description of results to date and work remaining: Phase one resulted in spatial maps, graphs, quantitative statistics, and histograms for each of the eight models, for whole years, for the entire state. Phase two has produced correlation maps and graphs for the Jornada Experimental Range against a covering subset from the TRMM and PRISM models.

We have obtained additional higher elevation rain gauge data for comparison with the precipitation estimates. The comparison of all the precipitation models (PRISM, CHIRPS, AHPS, TRMM and PERSIANN) with the Jornada rain gauges has been completed and the agreement is very good for PRISM and satisfactory for the others with the exception of PERSIANN which substantially overestimated the precipitation.

We have completed the analysis of yearly totals for the 5 models for the years 2000 - 2013. These totals have been compared with the yearly totals for the 30+ rain gauges at the Jornada Experimental Range. The PRISM model gave the best agreement for the average over the entire range, however when compared with yearly totals for the individual gauges, it was clear that PRISM and the other models do NOT account for the small scale variations of rain fall. This analysis will continue for the monthly totals.

Considering all results of the precipitation analyses it was decided to use PRISM daily precipitation values as input for the Statewide Water Assessment. This daily product has been acquired by the NMWRRI and is now available for all investigators in NM; its spatial resolution is 800×800 m.

For ET we have acquired data for 8 flux stations in the state, mostly in Rio Grande valley. Six of them are AmeriFlux stations operated by Dr. Litvak of UNM. The comparison of the yearly ET totals did not yield very good agreement, we will continue this analysis with the monthly totals to see if the remotely sensed estimates correctly track the month to month variations of ET observed on the ground. For this comparison Dr. Senay's group at the EROS Data Center provided us with monthly data for the SSEB model for the period 2000 to 2013. We already had monthly data for the ALEXI model. The comparison of the monthly data showed rather good agreement for the 2 grass/shrubland stations in the Sevilleta LTER site but poor agreement for the 2 higher altitude forested stations in the Valles Caldera. The latter results probably cause the higher statewide values for the two models compared with annual precipitation. ALEXI was particularly bad with higher readings especially in the winter months

For the period 2000 to 2013 we have prepared maps with the ratio of annual SSEB ET over annual PRISM P. A high ratio of about 6 is found in irrigated areas (as expected) and over some mountain ranges (not expected); a ratio of around 1 is found in some desert areas (as expected) but several desert areas have a ratio considerably higher indicating an ET over-prediction by SSEB; ratios of less than 1 are found in some mountain areas, due to runoff and groundwater recharge in these areas.

Another check on the quality of the ET products is the calculation of the reference ET fraction, i.e. the ratio of the annual ET over annual reference ET. The annual reference ET

files have been georeferenced and made available to all investigators through nmepscor-owncloud.unm.edu/.

A prototype soil water balance model has been implemented at NMT that uses as input the daily PRISM precipitation data and NOAA reference ET data. This model will not only be used to predict ET but also for evaluation of ground water recharge in NM.

- 6. Student participation - List all students participating in the project, their classification level (undergraduate, master, Ph.D., post doc) and their field of study (degree major):**
Steve Walker, Master of Applied Geography; Ian Hewitt, Master of Water Science and Management; Reid Brown, Master of Hydrology.
- 7. Provide special recognition awards or notable achievements as a result of the research. Include publications in progress (all published work supported wholly or in part of NM WRI must bear an acknowledgment of support):**
 - In March Jan Hendrickx has started a manuscript to better understand the physics and statistics of different ET algorithms. Co-authors are investigators in Arizona, Idaho and South-Dakota. More co-authors will be added from the NM statewide water assessment team.
- 8. Include references as needed (limit to one additional page):**
- 9. Provide a few sentences on progress toward uploading data to a common/standardized platform, if applicable:** A server that will become a central repository for data collected for the statewide water assessment for New Mexico is in operation at nmepscor-owncloud.unm.edu/. We are further developing the online structure that will allow data to be uploaded, downloaded, and displayed to other researchers and the public through maps, graphs, and tables.
- 10. Provide two PP slides that provide summary information on your project appropriate for viewing by state legislators:**