FY15 NM WRRI Research Progress Report Form

Report Due Date: 1 December 2015

1. Project Title:

New Mexico statewide water assessment: Soil water balance method for statewide evapotranspiration assessment – Year Two

2. Investigators (names, university/agency):

Jan M.H. Hendrickx, New Mexico Tech; Dan Cadol, New Mexico Tech.

3. Brief description of project, research objectives, and impacts on New Mexico (provide performance measures and outcomes):

Project goal is to adapt a proven soil water balance method for the estimation of statewide evapotranspiration for groundwater recharge assessment. Because most groundwater recharge in New Mexico occurs in mountainous regions, this project focuses on how evapotranspiration is affected by topography and quantitative approaches for the calculation of actual evapotranspiration in challenging topographic environments.

The four specific project objectives are:

Objective 1: Develop a procedure for calculation of reference ET (ETr) that includes the effects of slope and aspect of each pixel as well as shadow effects from surrounding pixels.

Objective 2: Further develop our procedure to convert ETr to actual ET using the operational MODIS NDVI product.

Objective 3: Conduct a reality check on our predicted ET values in mountainous areas. Note that a true validation study is not possible for lack of ET measurements in challenging topographic terrains.

Objective 4: Prepare a web accessible fact sheet dealing with statewide evapotranspiration assessment from the soil water balance method.

Stream flow and groundwater recharge are the drivers for water availability in the state. Because precipitation and evapotranspiration are much larger components of the statewide water budget than stream flow and groundwater recharge combined, a small error in precipitation and/or evapotranspiration will lead to a large error in the estimation of water availability [*Gee and Hillel*, 1988; *Hendrickx and Walker*, 1997]. Accurate evapotranspiration data in NM's mountain ranges will greatly improve statewide assessments of the temporal and spatial distributions of groundwater recharge and water availability in New Mexico.

4. Brief description of methodology

In Objective I we adjust the incoming solar radiation on a horizontal pixel to the true incoming solar radiation on any pixel taking into account slope and aspect of the pixel as well as topographic shading. The adjusted incoming solar radiation will be used for calculation of the reference evapotranspiration.

In Objective 2 we will further develop our procedure to convert the ETr to actual ET using the operational MODIS NDVI product by using METRIC ET data in the Sacramento mountains and analyzing how ET depends on tree species.
In Objective 3 we will compare our predicted ET values with limited eddy covariance measurements and literature data.
In Objective 4 we will prepare a fact sheet that explains to the people of New Mexico the spatial and temporal distribution of evapotranspiration in New Mexico and how it affects groundwater recharge.

5. Brief description of results to date and work remaining

A prototype model has been implemented in the Rio Penasco watershed that has a pronounced topography and a range of elevations (Figure 1) that results in global annual clear-sky radiations varying from 1,550 kWh/m^2 on north facing pixels to 2,260 kWh/m^2 on south facing pixels (Figure 2). As a result of the differences in incoming solar radiation, the reference evapotranspiration also varies from as low as 1429 mm/year to as high as 1831 mm/year (Figure 3). Of special interest for our study is the difference between opposing hillslopes. For example, the daily reference evapotranspiration for the north/south slope points shown in Figures 1 and 3 varies from about 0.2-0.4 mm/day in June and July to about 0.4-0.9 in February through April when most of the snow melt occurs (Figure 4).

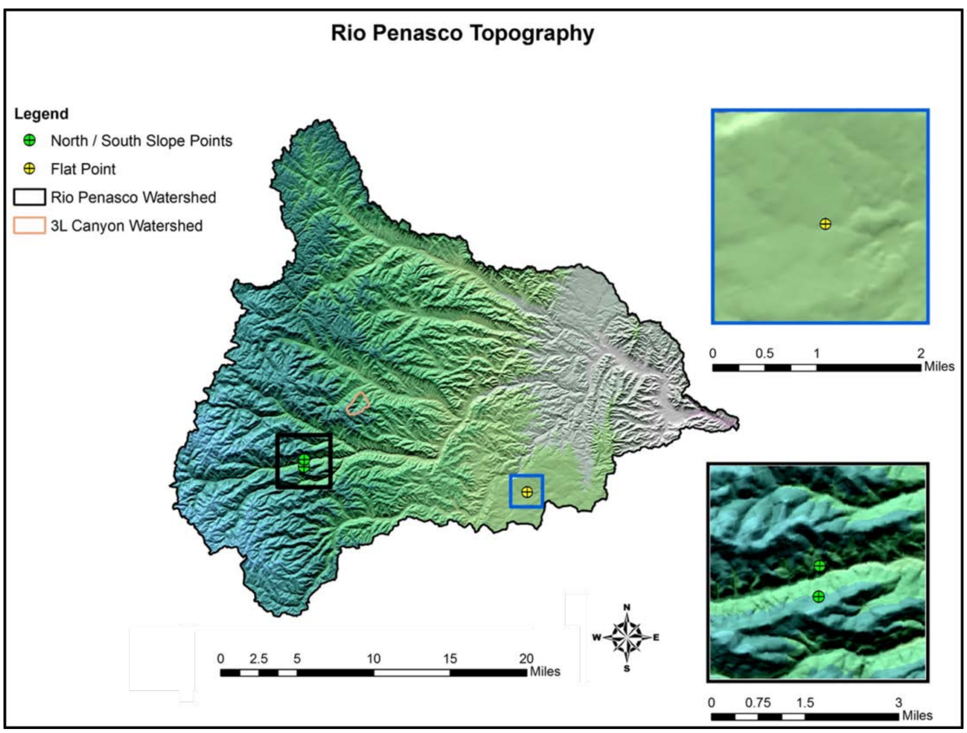

Figure 1. Topography of the Rio Penasco watershed with details of a flat pixel (yellow) and north/south pixels (green). The elevation varies from about 2000 m in the grey areas to about 2900 m in the blue areas.

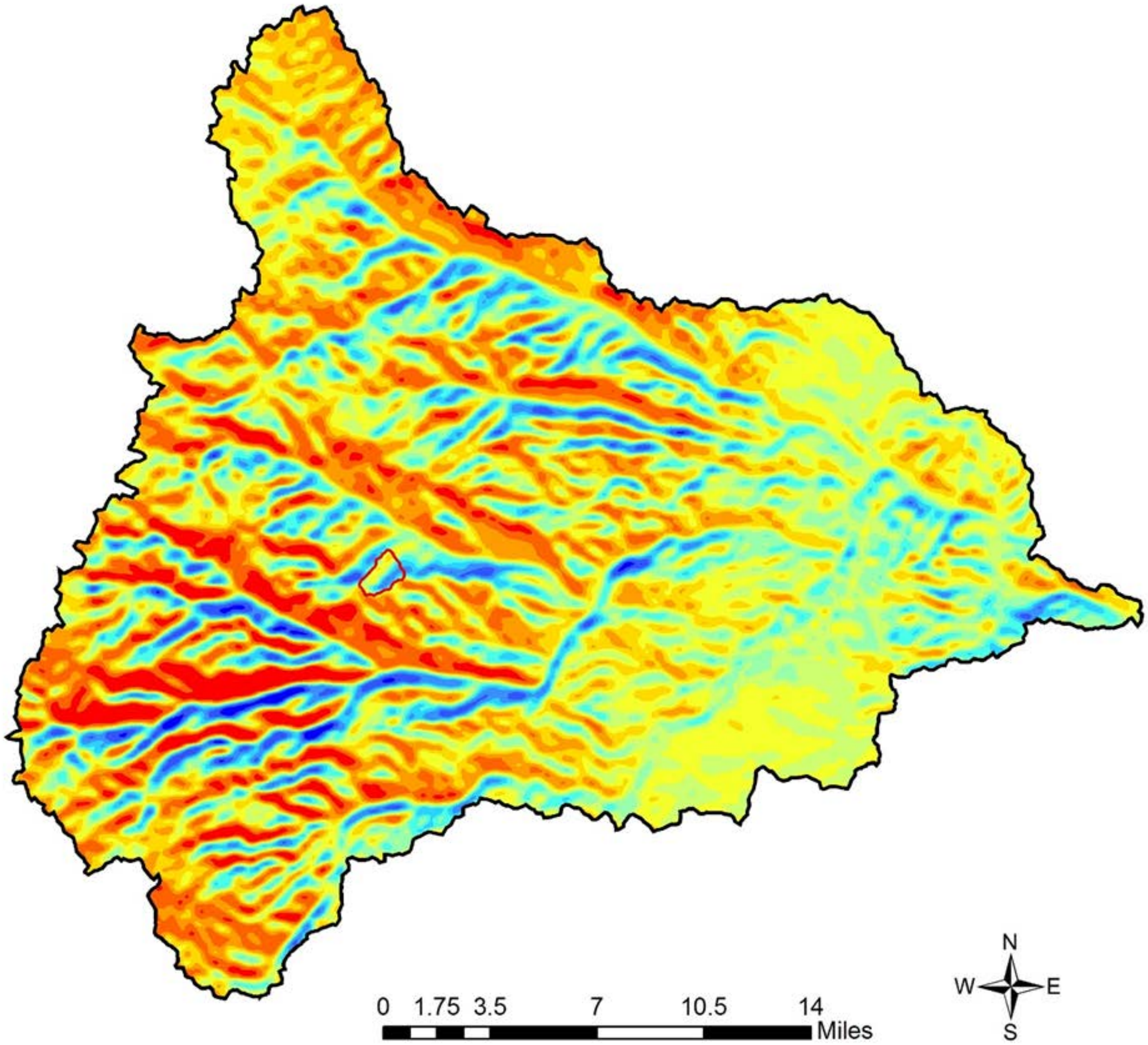

Figure 2. Clear-sky annual global radiation varying from 1,550 kWh/m^2 on north facing slopes to 2,160 kWh/m^2 on south facing slopes.

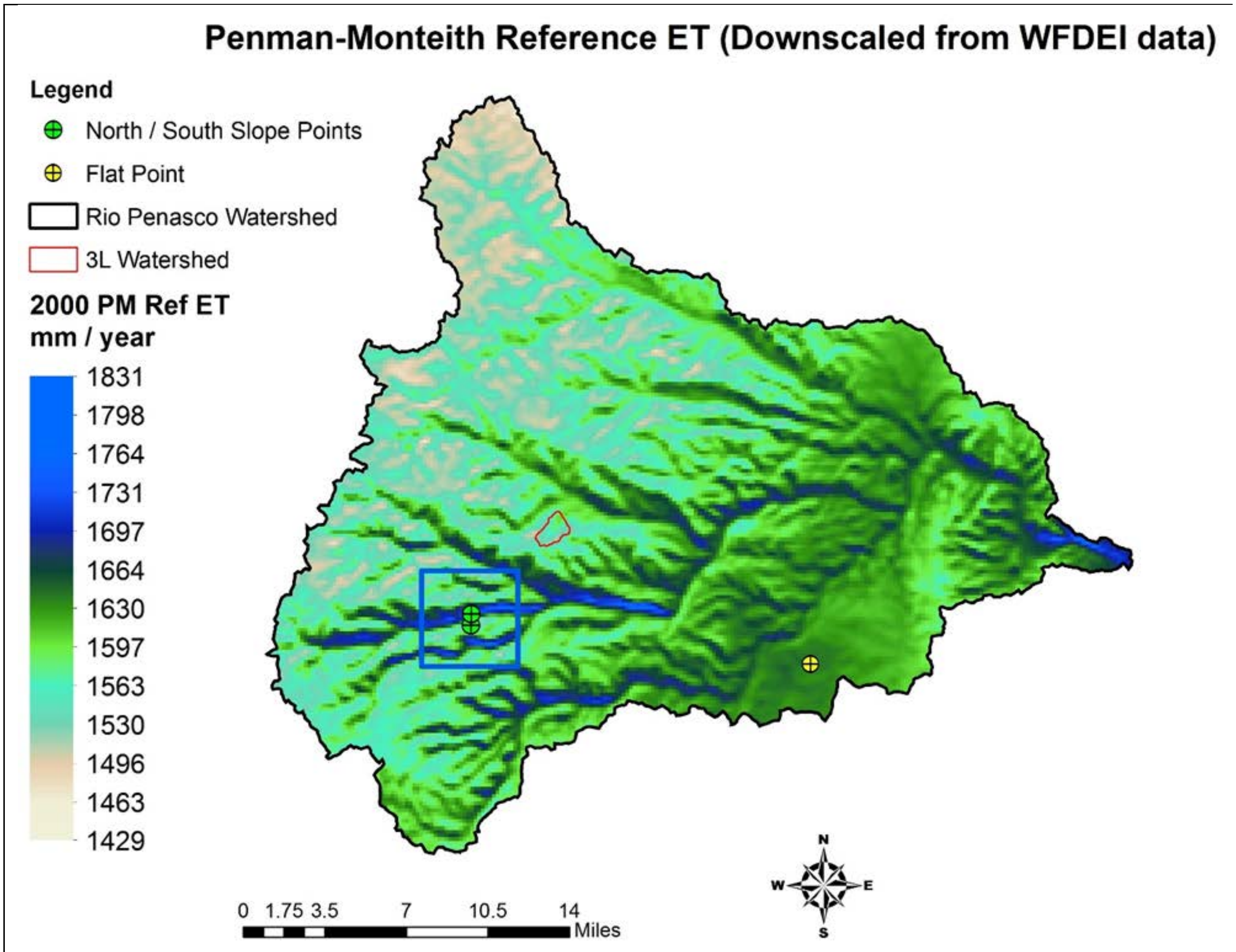

Figure 3. Annual reference evapotranspiration varies from 1429 mm/year on north facing slopes to 1831 mm/year on south facing slopes.

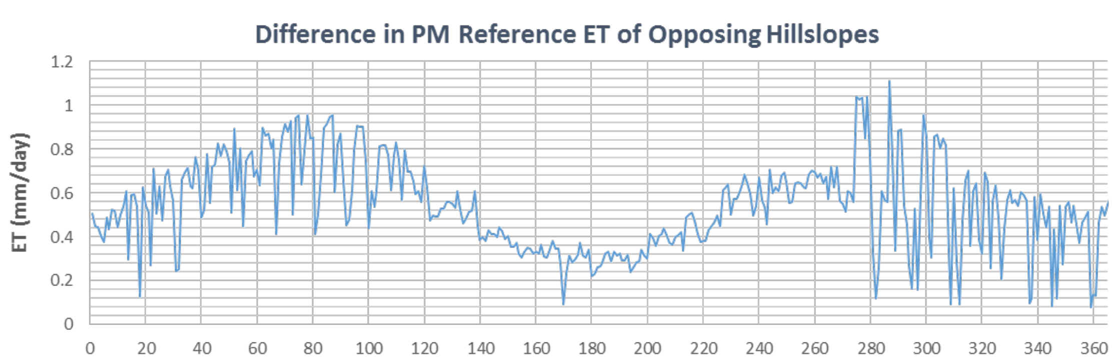

Figure 4. An example of the daily difference in reference ET (mm/day) on the opposing hill slopes shown in Figures 1 and 3.

6. Student participation - List all students participating in the project, their classification level (undergraduate, master’s, Ph.D., post doc) and their field of study (degree major)

Peter Revelle, MS Graduate Hydrology Student

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 WRRI must bear an acknowledgment of support)

N/A

8. Include references as needed (limit to one additional page)

See References.

9. Provide a few sentences on progress toward uploading data to a common/standardized platform, if applicable.

N/A

10. Provide two PP slides that provide summary information on your project appropriate for viewing by state legislators.

Two PP slides will be prepared as soon as we have results.

References

Gee, G. W., and D. Hillel (1988), Groundwater recharge in arid regions: review and critique of estimation methods, *Hydrol. Process.*, *2*, 255-266.

Hendrickx, J. M. H., and G. Walker (1997), Chapter 2 Recharge from precipitation, in *Recharge of phreatic aquifers in (semi)-arid areas*, edited by I. Simmers, pp. 19-114, Balkema, Rotterdam, The Netherlands.