ASSESSMENT OF VARIOUS GEOSPATIAL METHODS FOR IDENTIFYING IRRIGATION ACTIVITY IN THE UPPER CLARK FORK RIVER BASIN OF WESTERN MONTANA

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Irrigation maps are important for water management and hydrologic modeling, especially in the arid western United States. Irrigation classification methods used to generate irrigation maps vary from standard normalized difference vegetation index (*NDVI*) threshold analyses performed on single images to complex time-series analyses done with machine learning algorithms. Methods continue evolving, yet the body of literature lacks a comprehensive assessment of techniques used in the past decade. Additionally, the literature also appears to lack an example of the use of spectral methods to distinguish between different forms of irrigation (e.g., center-pivot and flood irrigation). Finally, recent irrigation-mapping research involved trading spatial for temporal resolution or vice-versa. Generally, researchers trade spatial resolution for temporal resolution, because irrigation mapping requires time-series datasets that are atmospherically and cloud corrected. Therefore, they commonly use 250-m or 500-m MODerate Resolution Imaging Spectroradiometer 16-day *NDVI* composites. Landsat datasets have a higher resolution (30-m), and Landsat Surface Reflectance (SR) products are atmospherically corrected, but SR products are not always available, and they are not cloud corrected, making Landsat-based time-series analysis difficult. However, a recently-released, spatially- and temporally-continuous, climatology-interpolated Landsat *NDVI* composite dataset derived from SR products (Robinson et al. 2017) provides an opportunity to use a high spatial- and temporal-resolution dataset for irrigation classification.

Here, I propose to apply recently tested digital-image analysis methods to the Robinson et al. (2017) *NDVI* dataset at one study area, the Upper Clark Fork River Basin (UCFRB) and then compare accuracies of results and efficiencies of methods at each stage of a two-stage classification process. I will test supervised machine-learning methods, including the nonmetric decision tree and Random Forest model trained by sample *NDVI* profiles and then compare results and workflows of those machine-learning methods with the results and workflows of spectral angle mapping and simple threshold classifiers. The results of the first-stage classification will be one binary irrigated/unirrigated map (Figure 1) from each classification procedure. I will apply the same classification procedures, but with different

Figure 1: A map of delineated irrigated land cover.

training samples, to irrigated land-cover pixels derived from the most accurate first-stage irrigated/unirrigated map to classify irrigation by method (i.e., center-pivot and other-method) (Figure 2). The goals of this study are to determine: (1) if any method is superior to others; (2) if any of the applied spectral methods are suitable for distinguishing different irrigation practices; and (3) if the Robinson et al. (2017) dataset is suited for irrigation classification. I chose the UCFRB of western Montana as the study region, because I am familiar with the region, it is readily accessible for ground truthing, and it is characteristic of semi-arid western US landscapes within which irrigators employ a variety of methods.

Figure 2: A map of center-pivot and other-method land cover.

The results of this study can inform future attempts to classify irrigation by establishing an efficient workflow/methodology that produces accurate results, thus instilling confidence in other researchers that may automate on a regional scale the process determined most accurate and efficient by this study. An accurate, efficient process for classifying irrigation that managers could apply regionally may provide researchers with a tool to annually update irrigation maps for water managers and hydrologists that wish to more confidently track water use and parameterize surface-ground water interaction models, respectively.

REFERENCE

Robinson, Nathaniel P., Allred, Brady W., Jones, Matthew O., Moreno, Alvaro, Kimball, John S., Naugle, David E., Erickson, Tyler A., and Andrew D. Richardson. 2017. "A Dynamic Landsat Derived Normalized Difference Vegetation Index (NDVI) Product for the Conterminous United States." *Remote Sensing* 9, no. 8: 63-877.