Determining the Effects of Land Use Change and Forest Management on Stream flows in the Verde River Watershed

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Background & Methods

Problem

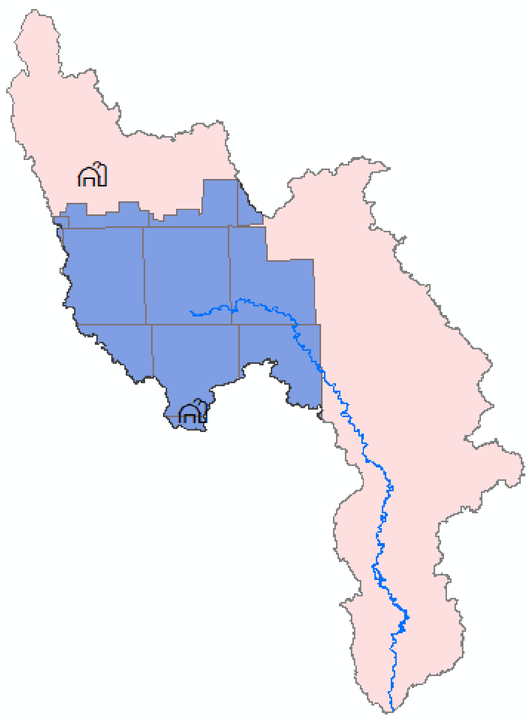
- Streamflow regime changes in the Verde River include decreased peak streamflows in spring and summer
- Due to changes in Forest Management (fire suppression) there is a need to model water lost to evapotranspiration along riparian buffers
- An increase in forest density along the streambank could lead to an increase in evapotranspiration losses. Increases in temperature can also lead to increased ET losses
- Different vegetation types/trees will have different amounts of ET losses

Fig. 1 Example of Riparian vegetation on the Verde

Approach

- Land use classification entails using a geospatial software to *classify* pixels of remotely-sensed images into its corresponding land use.
- The two types of classification are *supervised* and *unsupervised.* These methods look for pixels with similar characteristics to group them
- Using ERDAS Imagine software to classify land-use, specifically focusing on forest changes
- By classifying multiple portions of the Verde River across many years (coinciding with forest management changes) the forest density changes can be determined with respect to spatial and temporal extents
- This will be compared with streamflow changes

Anticipated Results



- Spatial extent of USDA photomosaic aerial images from 1940 depicted to the left, along with locations of known concentrated animal feeding operations (CAFOs)
- Changing Ag practices that made it such that cows could not graze along the riparian vegetation may also have an effect on evapotranspiration, due to increased vegetation
- Historical spatial extent of grazing and barns largely unknown – spatial analysis of farm locations and animal count with respect to the riparian buffer may provide insight into animal practices over time

- Riparian vegetation along the Verde:
  - Cottonwood trees
  - Willow trees
    - Cottonwood and willow trees rely on groundwater
  - Cattails
  - Horsetail plants

Fig. 2 Cattle along Verde River, circa 2015 (photo credit: Ellen Jo Roberts)

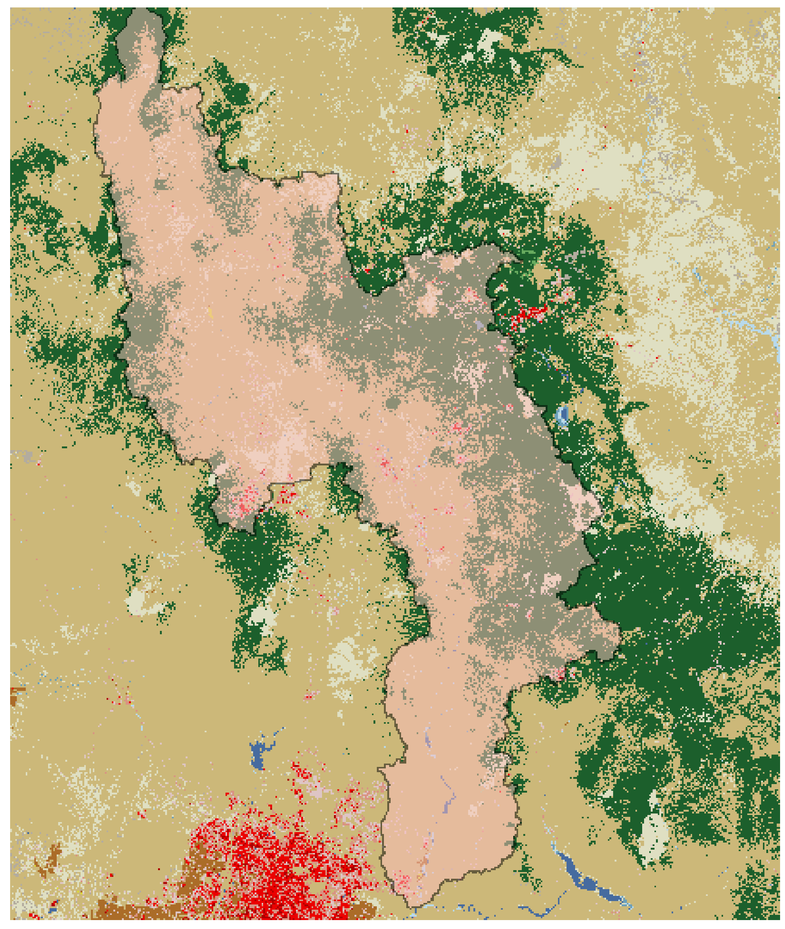


Fig. 3 Example of land use classification done by the Multi-Resolution Land Characteristics (MRLC) consortium. The National Land Cover Data Base classified land-cover in the US beginning in some areas of the US in 2001, however forest management practices changed in the 90s. This necessitates classifying historical aerial images prior to the first iteration of NLCD. At 30 m spatial resolution, it is too coarse to capture riparian buffer vegetation necessary to estimate ET. It may also not capture variations in tree species influencing streamflow.

Conclusions & Next Steps

- Classifying forest density with disregard to tree/vegetation type does not quantitively determine amount of evapotranspiration losses.
- Evapotranspiration can be measured through remote sensing techniques — such as determining the enhanced vegetation index. The EVI is a measure of greenness in an area. ET can then be calculated from the EVI.
- The reduced deep percolation to groundwater can be calculated as the amount of precipitation less the water lost to ET in the riparian buffer.

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