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TIME SERIES ANALYSIS OF WETLAND DYNAMICS THROUGH SPECTRAL MIXTURE ANALYSIS OF LANDSAT SATELLITE IMAGERY

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ABSTRACT:

Wetlands are dynamic systems that have complex hydrological regimes, which are not well understood as it is time consuming and expensive to monitor landscape level wetland dynamics using current field methods. The consequences of this data limitation have prevented assessment of regional trends over time, including shifts in the relative coverage of different wetland types and changes in wetland function critical to understanding the full picture of wetland dynamics beyond "no net loss". These consequences are now becoming increasingly severe, particularly in semi-arid and arid regions, since it is unknown how climate changes will alter the hydrological dynamics of wetlands and small ponds. This research addresses this need by combining aerial imagery with multitemporal Landsat imagery to map and capture wetland dynamics at a finer scale than previously attained, which can be used both to study historical changes in wetland function and composition and to forecast future changes.

To understand wetland dynamics at both intra- and inter-annual scales we used over 200 dates of Landsat satellite imagery to reconstruct the hydrograph of each wetland within our study area in the Columbia Plateau ecoregion for 30 years (1981 – 2011). First, we used object-based image analysis (OBIA) to delineate wetlands using 2006 and 2011 aerial photography. Next, we used spectral mixture analysis (SMA) to detect percent water for each pixel within each Landsat scene. Finally, we used the delineated wetland polygons derived from the OBIA method to extract the associated SMA pixel values to determine the percent inundation of each wetland for each date of imagery. Results were validated by manually delineating the water surface area for 100 wetlands using high resolution aerial imagery and comparing it to the results from the corresponding date of satellite imagery. Given the extreme shortage of data on wetland dynamics, this research provides a critical historical dataset to support retrospective analyses of wetland change, and to calibrate and test climate-hydrologic models.

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