

Hydrologic Similarity Analysis by Unsupervised Classification of watershed's soft data Received from the SWAT Model.

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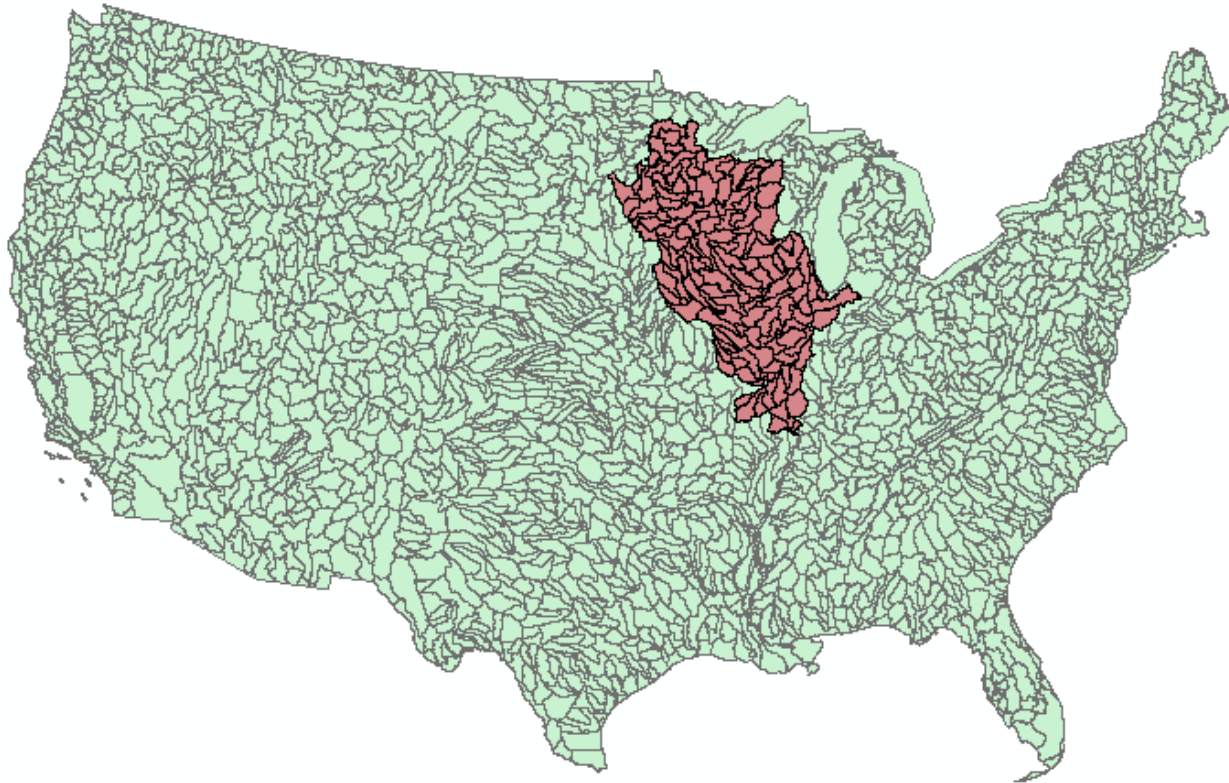
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Use of Grouping hydrologically similar Watersheds

- * Predictions on ungaged basins
- * Calibration of large watersheds
 - * In both the cases few watersheds are calibrated and the parameters are to be transferred to a **hydrologically similar** watershed.

Study-Area

Upper- Mississippi watershed



Area: 2,981,076 km²

Discharge:

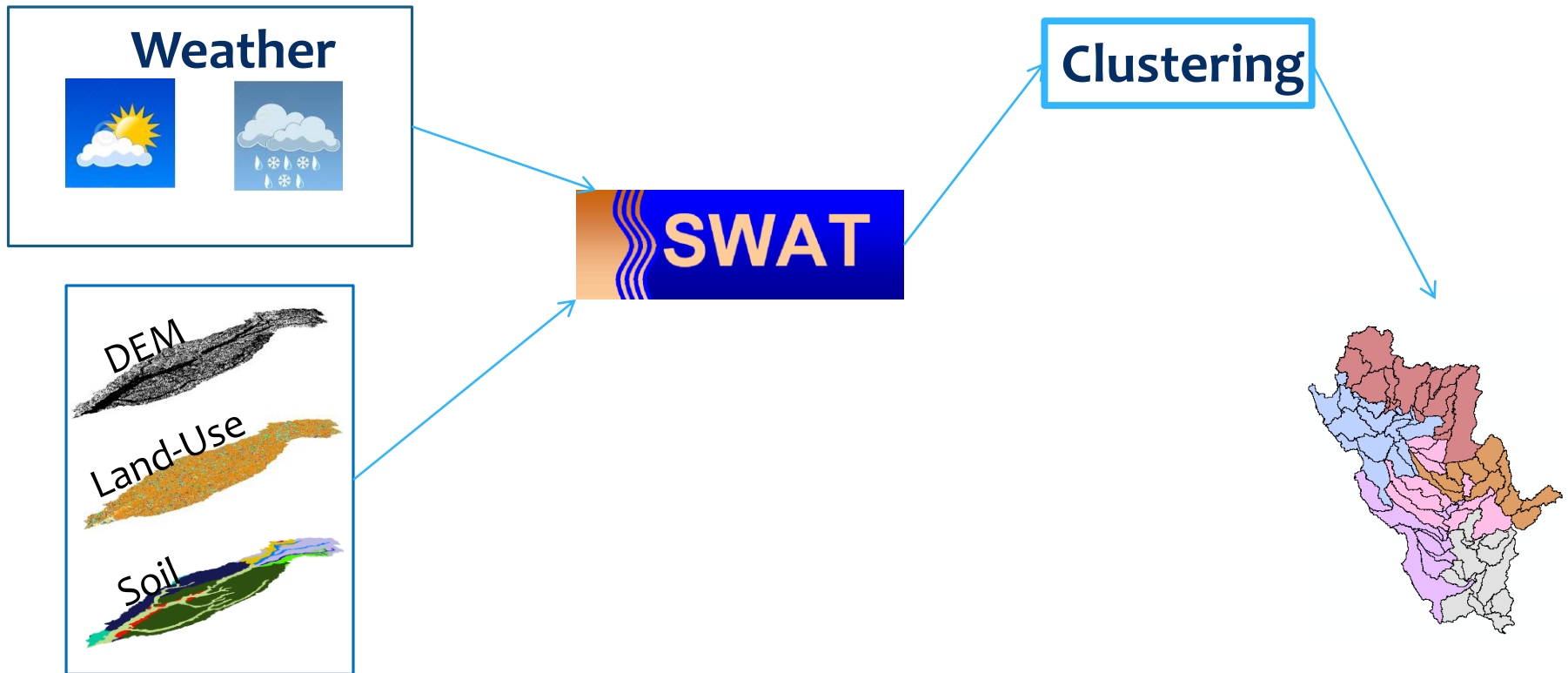
Avg: 593,000 CFS

Max: 3,065,000 CFS

Min: 159,000 CFS

Approach

- * Fuzzy c means clustering of the SWAT model's uncalibrated output.



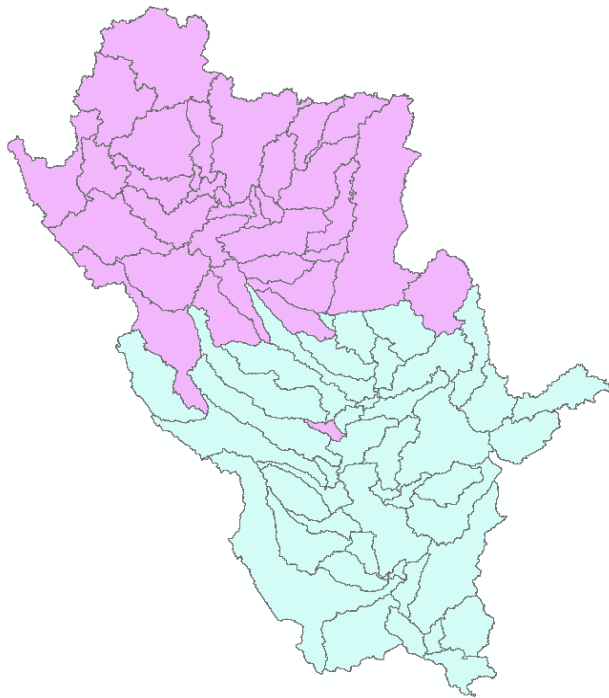
Variables used for Fuzzy c means clustering

- * 8- Variables
 - * Mean and Standard deviation of
 - * Precipitation
 - * Surface Runoff
 - * GW Contribution
 - * Evapotranspiration

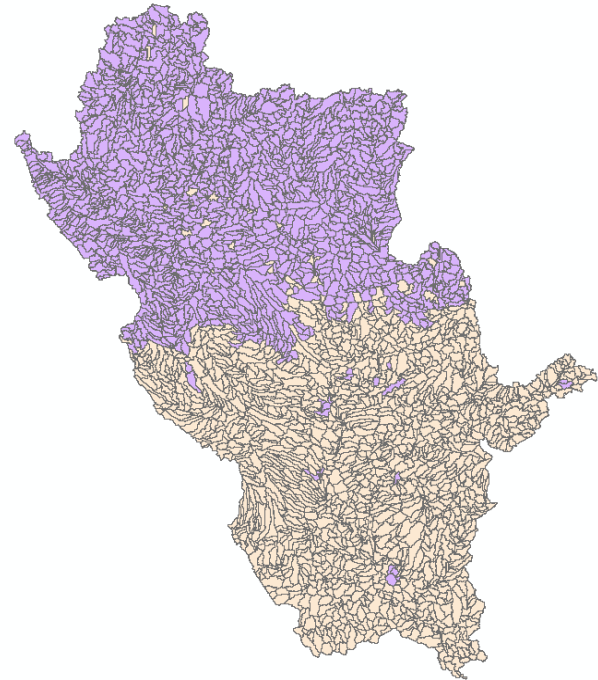
These variables were taken for the initial analysis of the clustering technique to check the effect of the size of the sub-basins, scaling of the variable values and the effect of precipitation variable in the clustering analysis.

Effect of the Size of the sub-basins on the clustering

Mean and Standard deviation of
values for all years

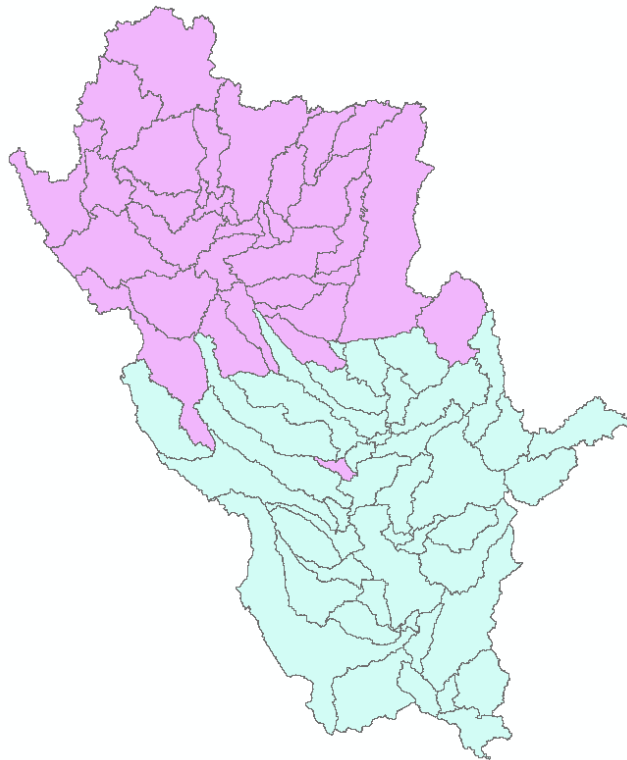


Mean and Standard deviation of
values for all years

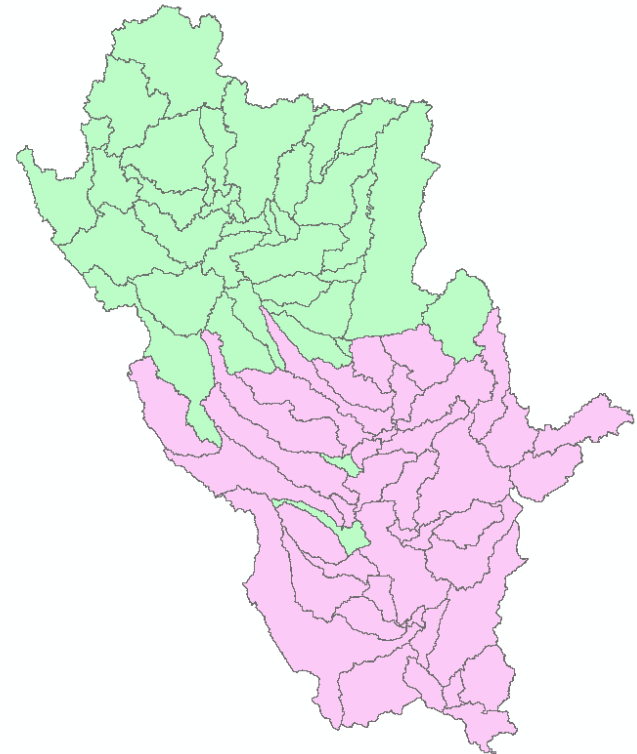


Effect of rescaling of the variables on the clustering

Variables used without rescaling

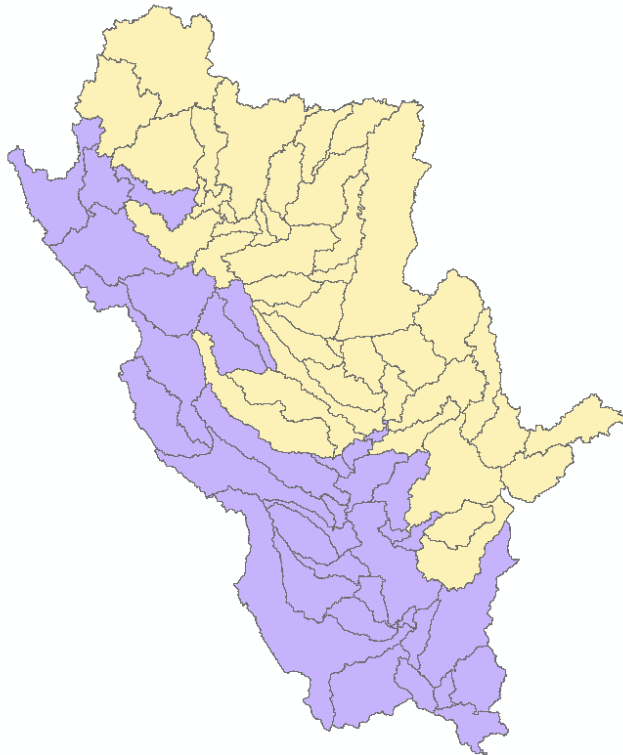


Variables were rescaled from 1-100 for clustering

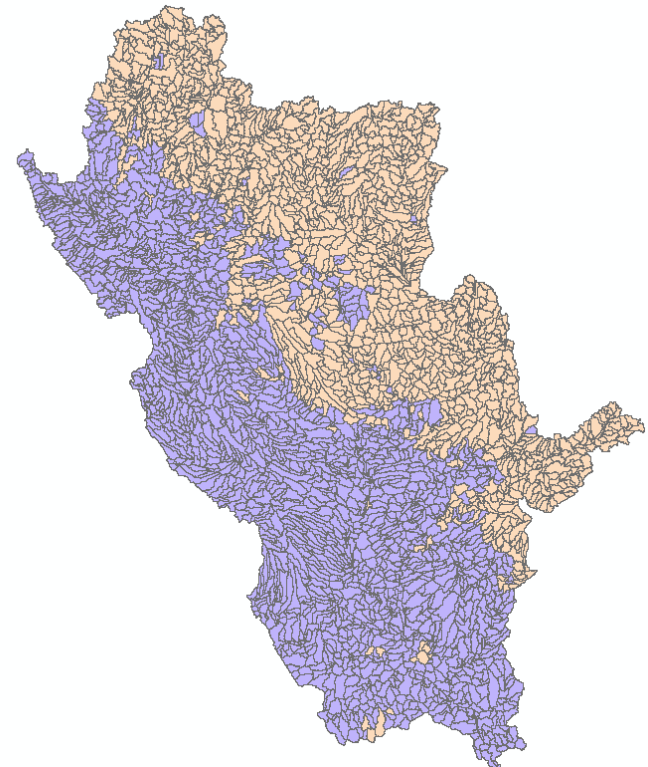


Effect of precipitation as a variable in clustering

Rescaled mean values of variables divided by pcp



Rescaled mean values of variables divided by pcp



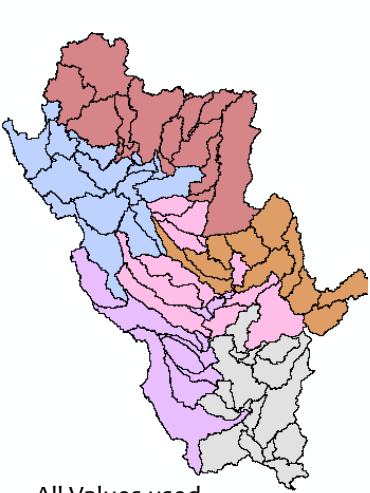


sensitivity of variables used for
clustering

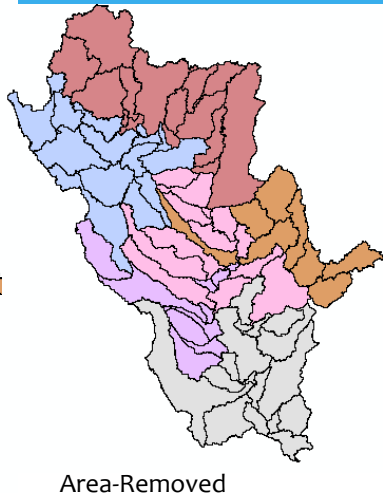
Variables used for sensitivity testing

- * Area of the watershed
- * Precipitation
- * Snow melt
- * Potential Evapotranspiration
- * Evapotranspiration
- * Soil Water
- * Percolation
- * Surface Discharge
- * Ground Water Contribution

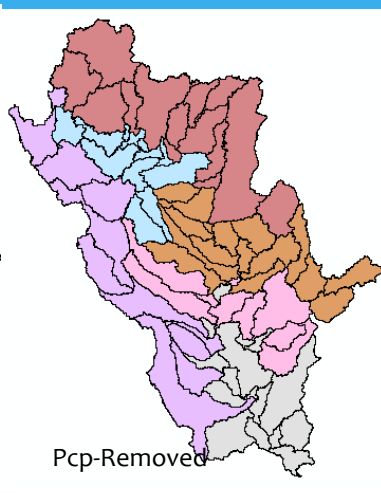
Sensitivity of Variables used- Identified by removing one variable at a time from classification



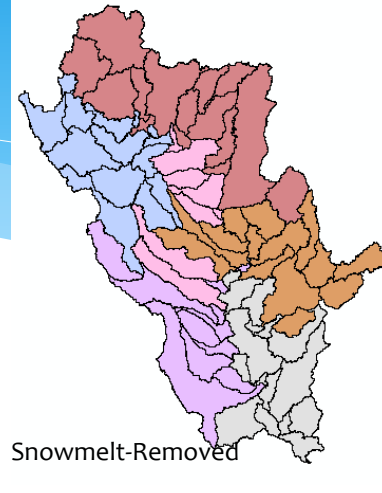
All Values used



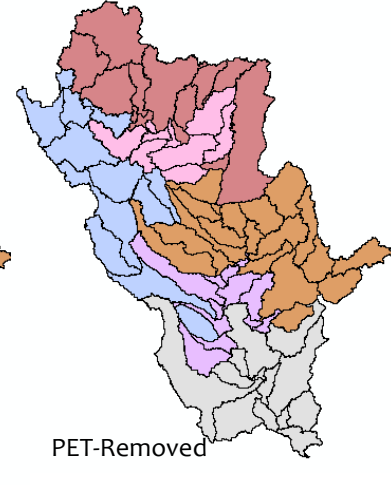
Area-Removed



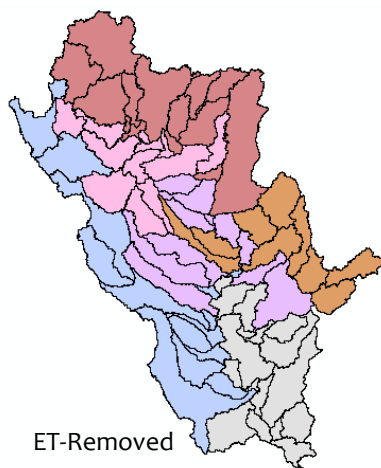
Pcp-Removed



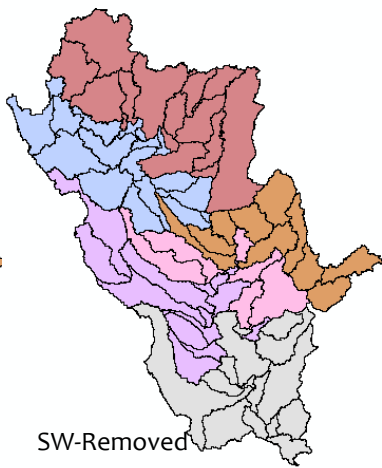
Snowmelt-Removed



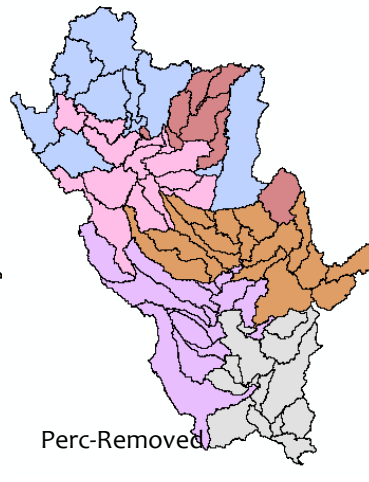
PET-Removed



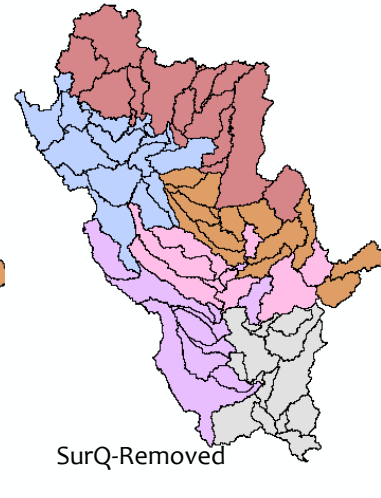
ET-Removed



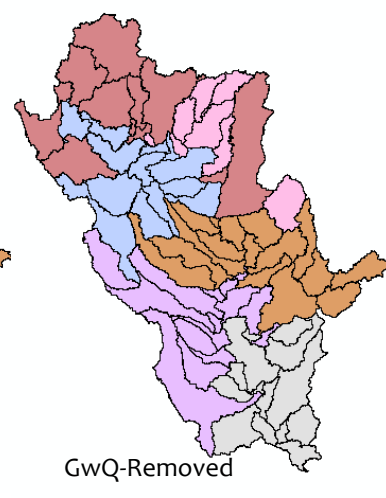
SW-Removed



Perc-Removed



SurQ-Removed

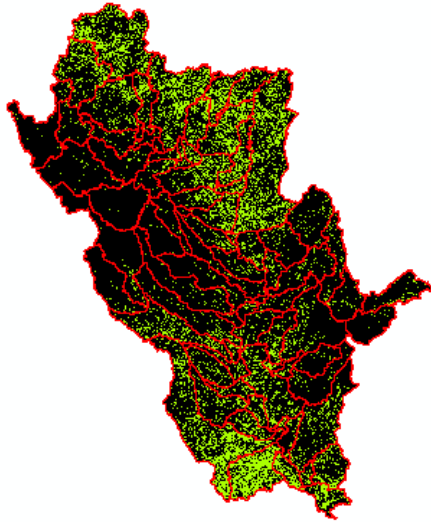


GwQ-Removed

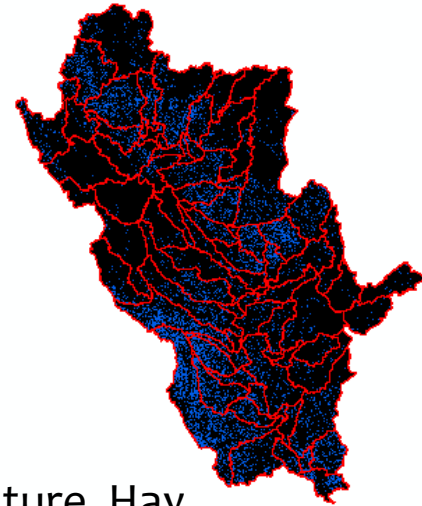


Validation of the methodology

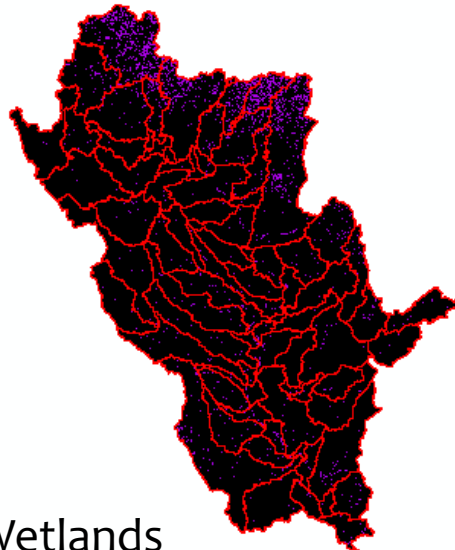
Major land uses found in the upper Mississippi river basin



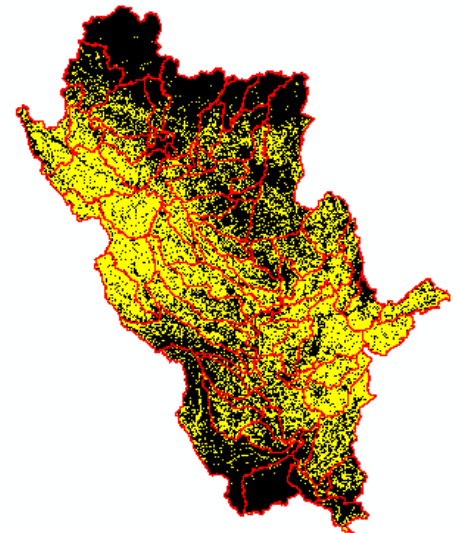
Deciduous Forest



Pasture Hay

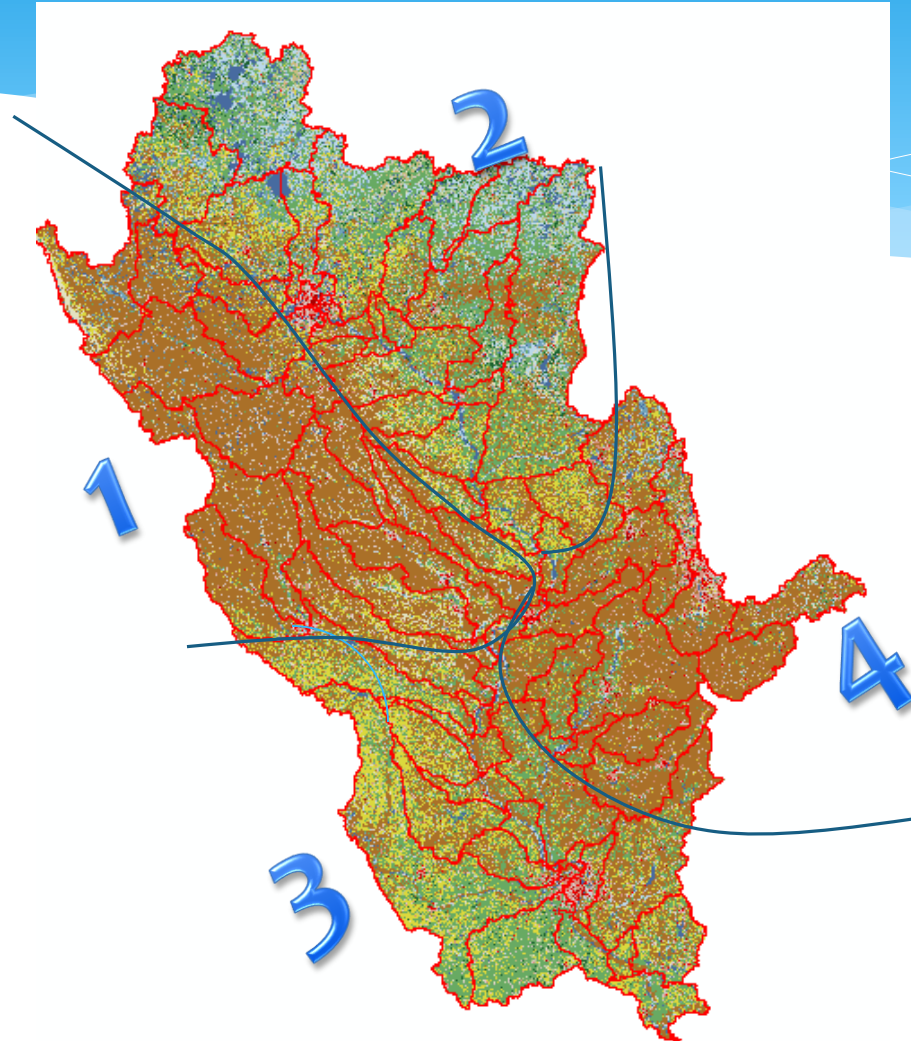


Woddy Wetlands



Cultivated crops

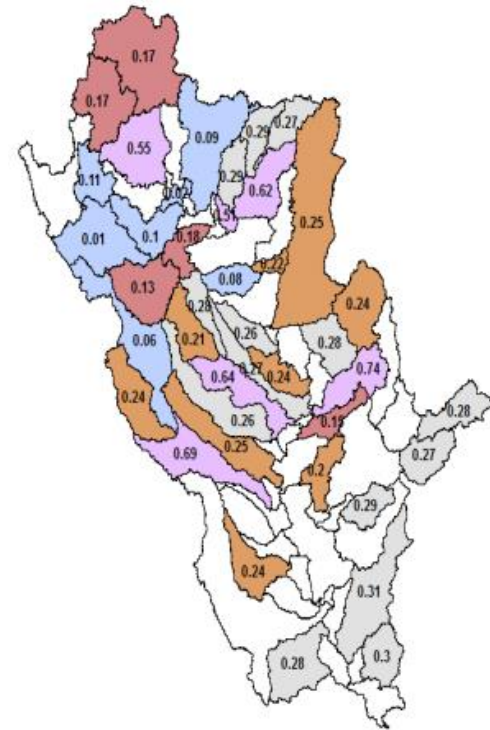
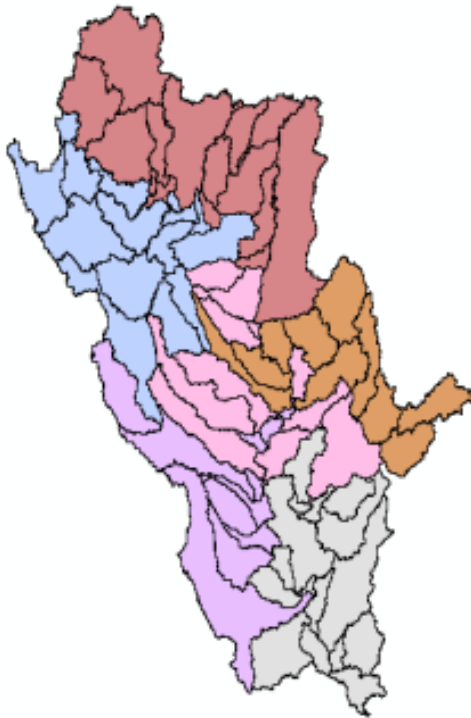
If the Mississippi river should be divided based on the land use-
It should be looking something similar to this



Comparison of clustering with the classification based on the rainfall-runoff ratio

Fuzzy-C- means clustered

Runoff/Rainfall ratio of the sub-basins



Future improvements planned for improving the methodology.

- * The subgroups within the sub-basin at the hru level will be considered.
- * The flow data will be considered only for the high flow seasons for the clustering.
- * The lag between the rainfall and the runoff will be considered for the clustering analysis.
- * The percentage split of the rainfall into various water budget components can be considered for the clustering.



Thank-You