

# Refining Pyrethroid Aquatic Exposure Assessments by Incorporating Measured Landscape and Environmental Variability using Probabilistic Approaches. II – Characterizing Nationwide Landscape Vulnerability for Several Pyrethroid Crops

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## Introduction

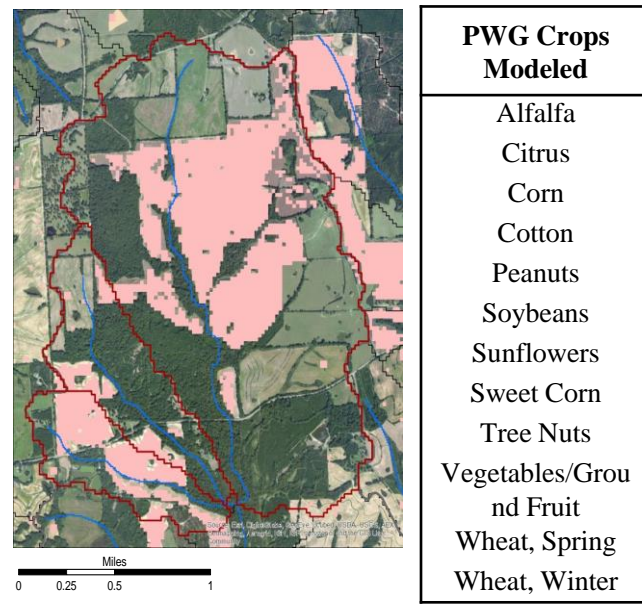
The Pyrethroid Working Group (PWG) is conducting a probabilistic refinement of aquatic exposure estimates for agricultural pyrethroid uses. Landscape variability, as it affects the potential for pyrethroid runoff and drift loads to enter receiving water bodies, was identified for quantification in this analysis. In a national assessment, for every NHD+ catchment containing the crop of interest (Col), potential vulnerability was estimated using the percent of Col in the 200m proximity zone around the NHD+ stream reaches to reflect potential drift loading. Erosion/runoff loading potential of each NHD+ catchment was ranked using the crop area-weighted 30-year median PRZM model output for all Col cropped soils in the catchment with local weather stations. These two parameters were plotted for each catchment in each of 10 or 11 bins using a 2-D matrix to characterize the distribution of nationwide landscape vulnerabilities. Each matrix of 110 combinations for soil / weather / PCA / proximity was modeled using PRZM/VFSMOD/AGRO-2014 and RegDisp/AgDRIFT to calculate 30 years of annual maxima EECs. Results were weighted by the actual occurrence in the national distribution, resulting in a distribution of 3330 EECs suitable for probabilistic analyses.

This method accounts for the distribution of drift and R/E vulnerabilities of all the NHD+ catchments cropped to the Col, which can then be represented by a simplified modeling process which avoids conducting individual exposure assessments for each catchment.

## Materials and Methods

The following were used as the primary datasets to characterize and model potential pyrethroid transport into surface water:

- National Hydrography Dataset Plus (NHDPlus ver. 2)
- USDA NASS Cropland Data Layer for the years 2008-2012 grouped into 12 classes
- USDA NASS 2012 Census of Agriculture
- NRCS Soil Survey Geographic (SSURGO) database.
- Solar and Meteorological Surface Observational Network (SAMSON) weather stations
- National Resource Inventory (NRI) database

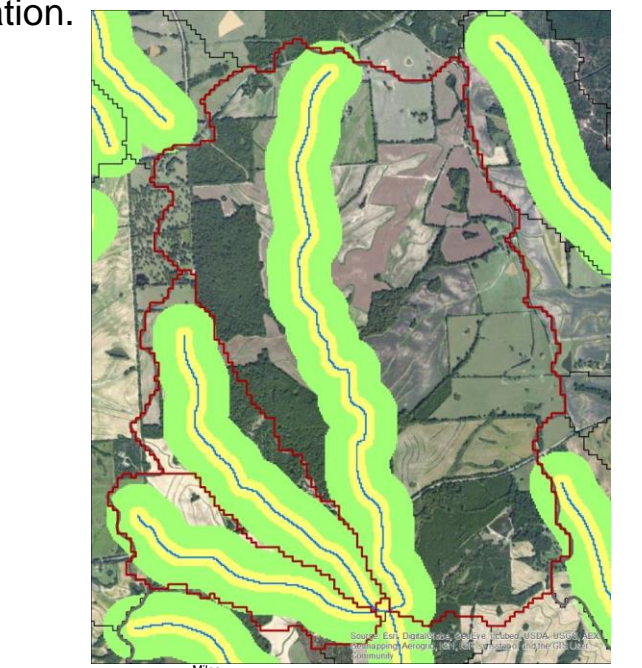


PWG Crops Modeled
Alfalfa
Citrus
Corn
Cotton
Peanuts
Soybeans
Sunflowers
Sweet Corn
Tree Nuts
Vegetables/Ground Fruit
Wheat, Spring
Wheat, Winter

Catchments were characterized to produce the following metrics for each of the 2.6 million NHD+ catchments across the US: Surface water density (ponds, streams, ditches), cropping density (12 classes), cropping proximity (5 zones), crop / soil intersection, slope/LS factor, and local weather station.

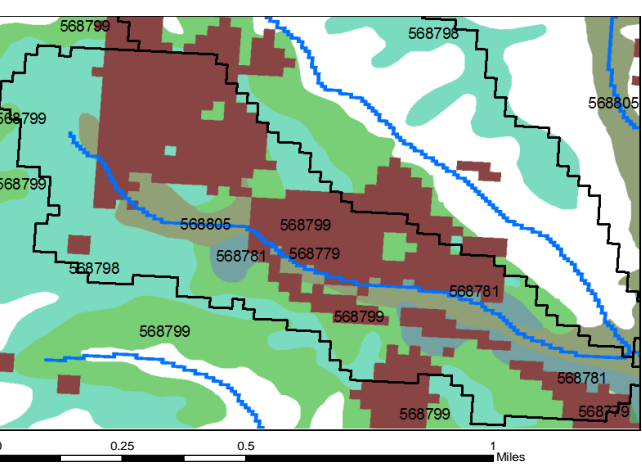
## Spray Drift Deposition

- Buffers of 10-50 (ground app) or 50-200m (aerial app) generated around flowing water (see right)
- Overlay with crop layer and determine PCA in zone
- Calculate drift mass using application rate, drift fraction based on buffer distance (using AgDrift® or RegDisp), surface water area, number of apps, and PCA of drift zone

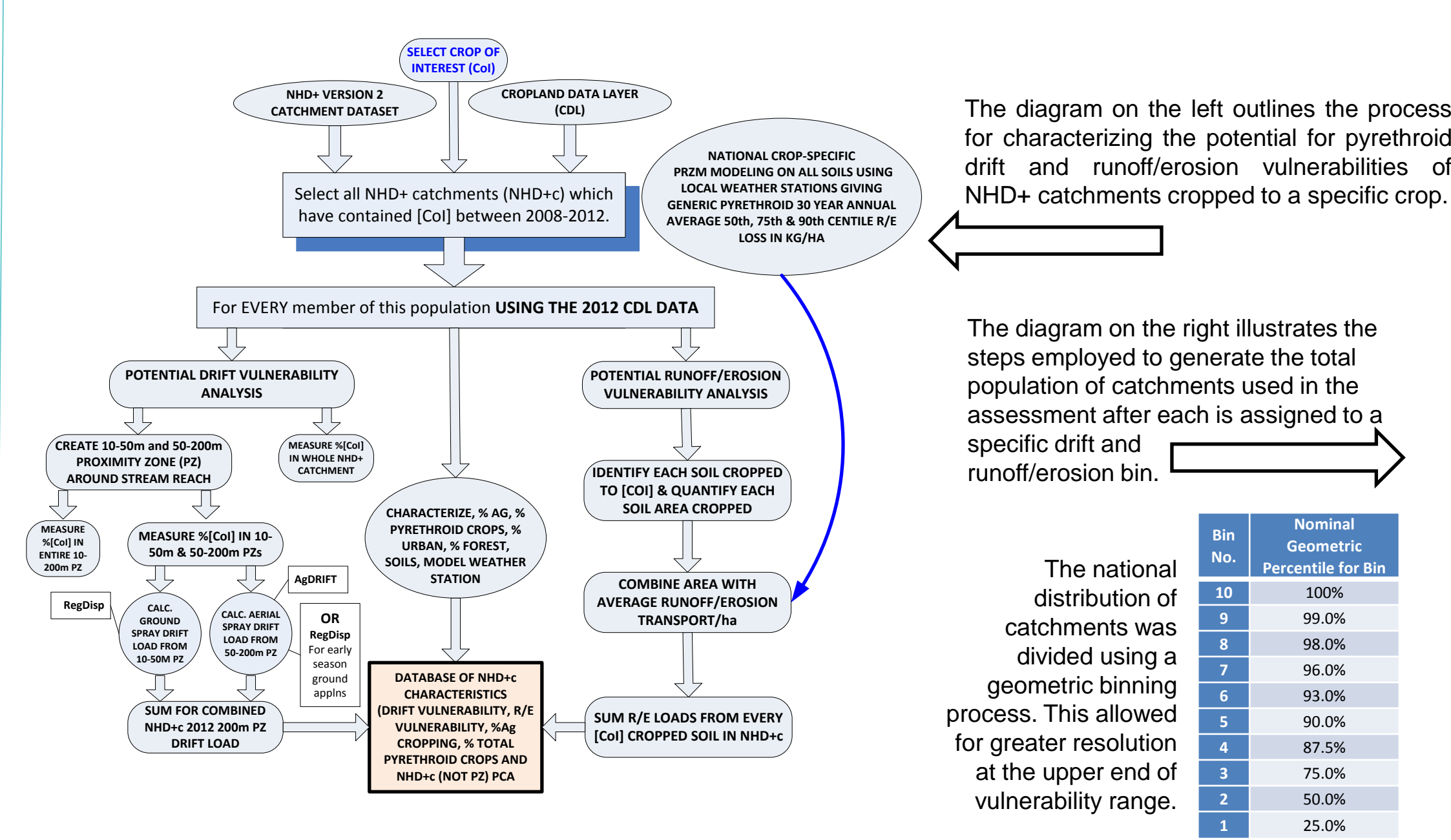


## Runoff/Erosion Mass

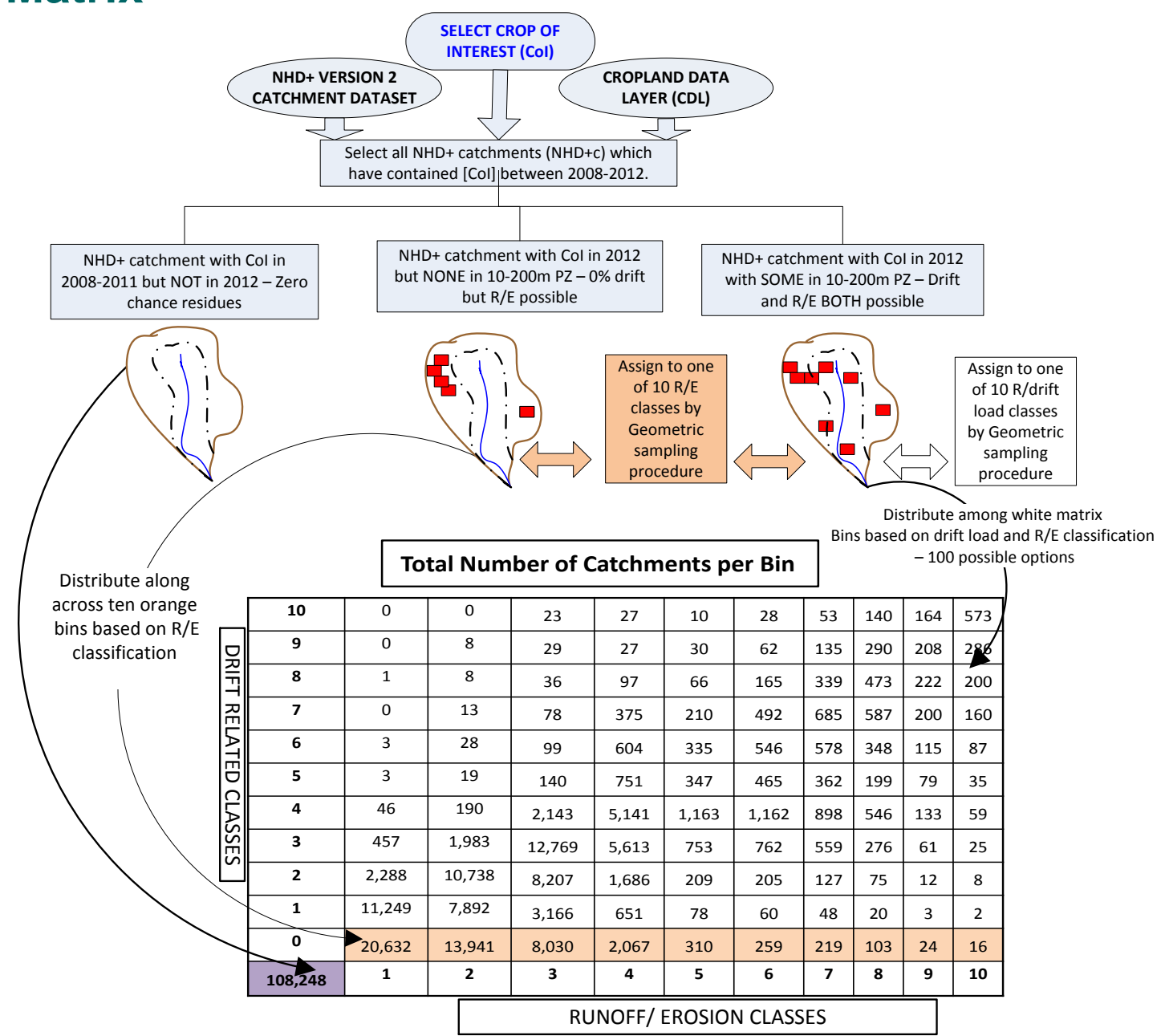
- Model R/E chemical flux for all ~375,000 unique soil / weather combinations in US using PRZM (kg/ha, 30 year average annual maxima)
- Overlay soils & catchments with each of 12 crop groups
- R/E mass generated by the PRZM chemical flux for each soil/weather, multiplied by the area of crop in catchment
- Catchment total sum of R/E mass from all soils with crop present in the catchment



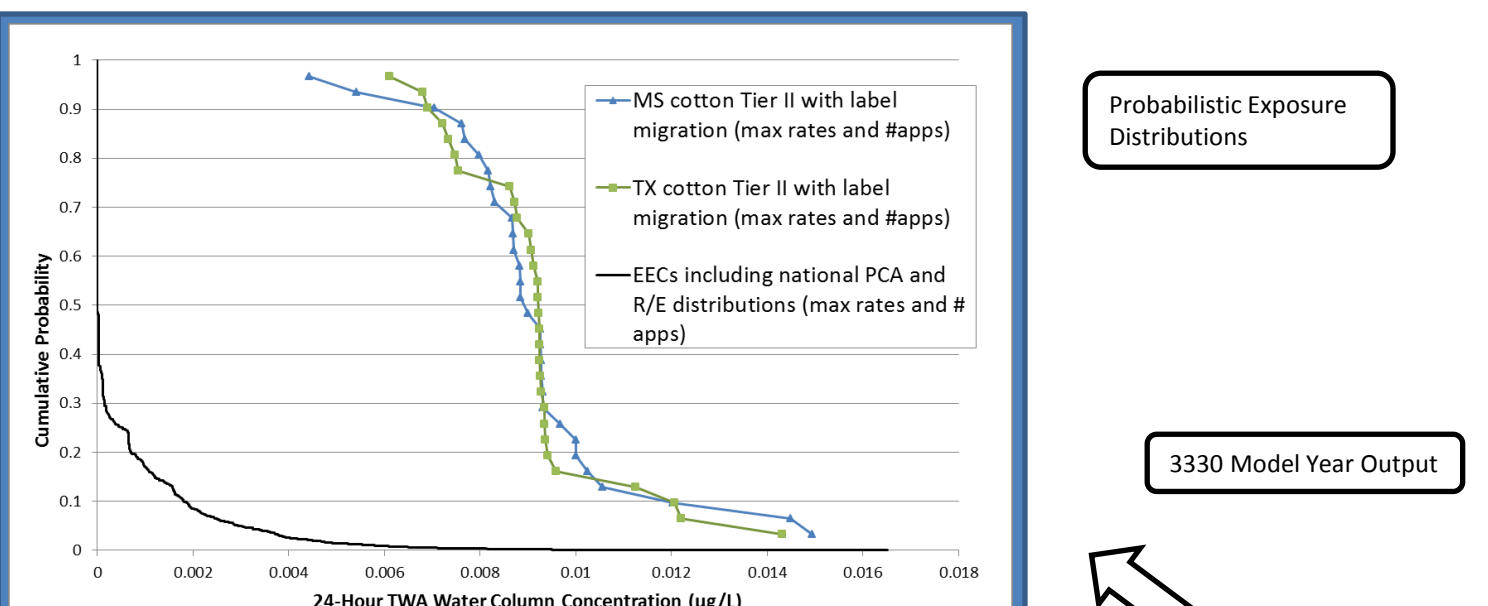
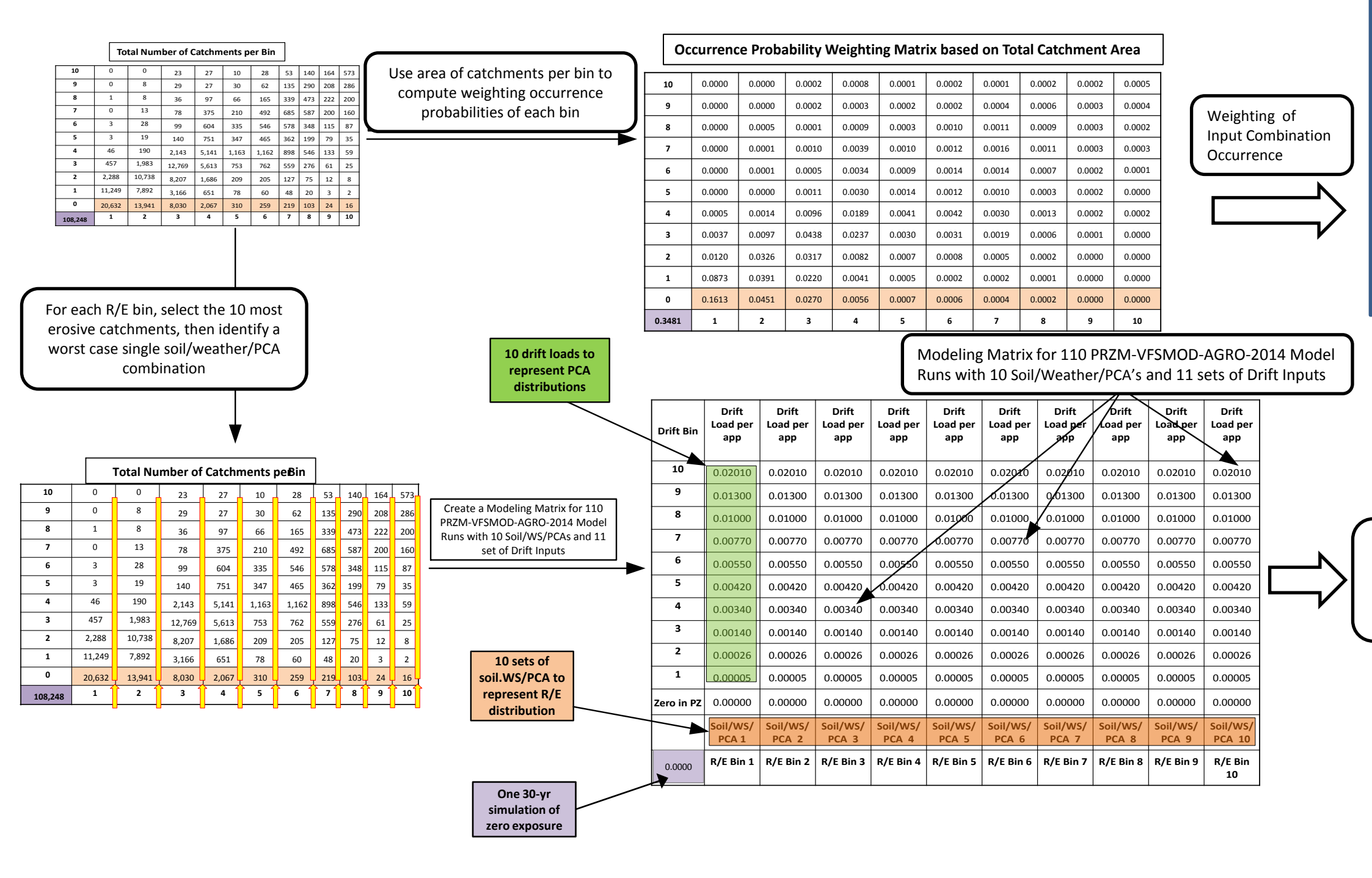
## Landscape Characterization and Selection of NHD+ Catchments for Vulnerability Matrix



Bin No.	Nominal Geometric Percentile for Bin
10	100%
9	99.0%
8	98.0%
7	96.0%
6	93.0%
5	90.0%
4	87.5%
3	75.0%
2	50.0%
1	25.0%



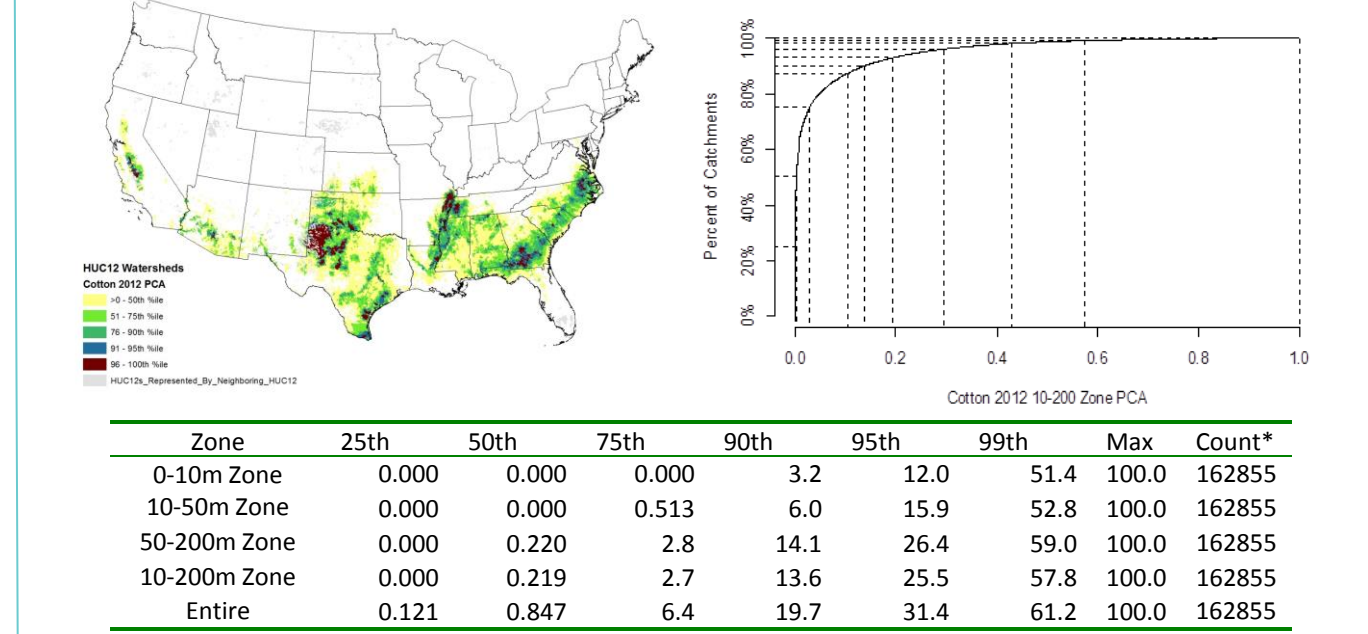
## Selection of Crop Specific Modeling Inputs Applied to National Weighting Matrix of Soil / Weather / Crop / Proximity



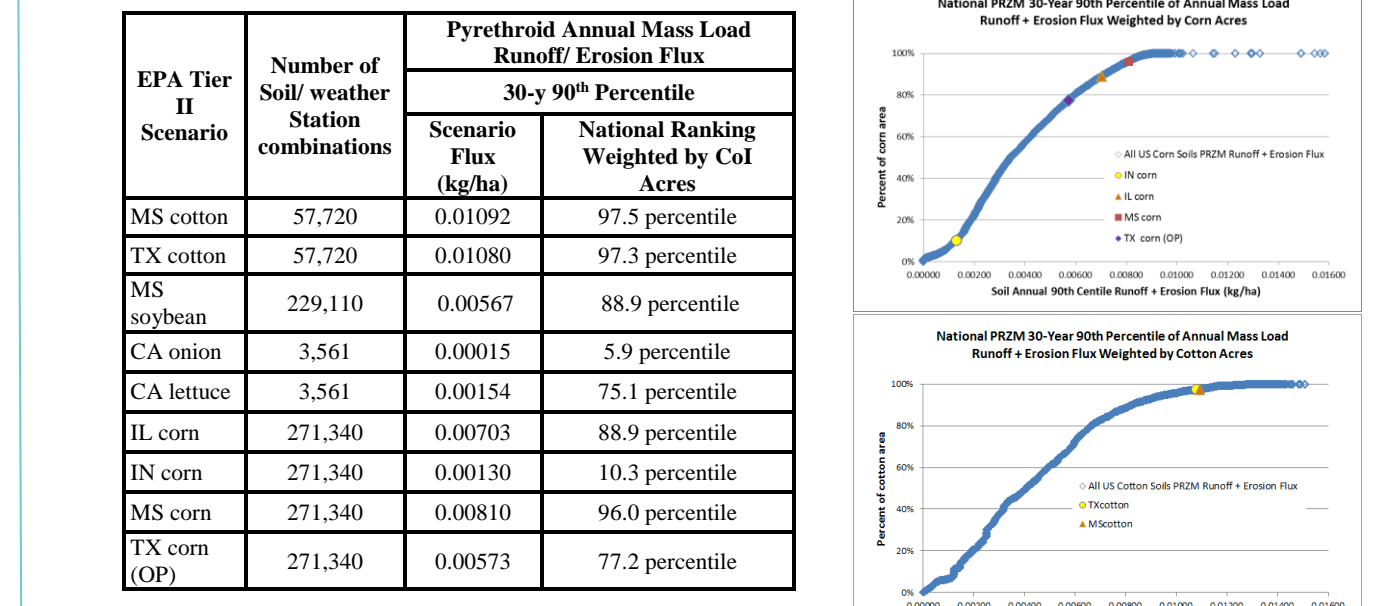
## Results and Discussion

### Crop-specific PCA national distributions

The figures below present the national characterization of 162,855 catchments containing cotton in 2012, with entire catchment PCA (map at HUC12 level) and several proximity zone PCAs reported.

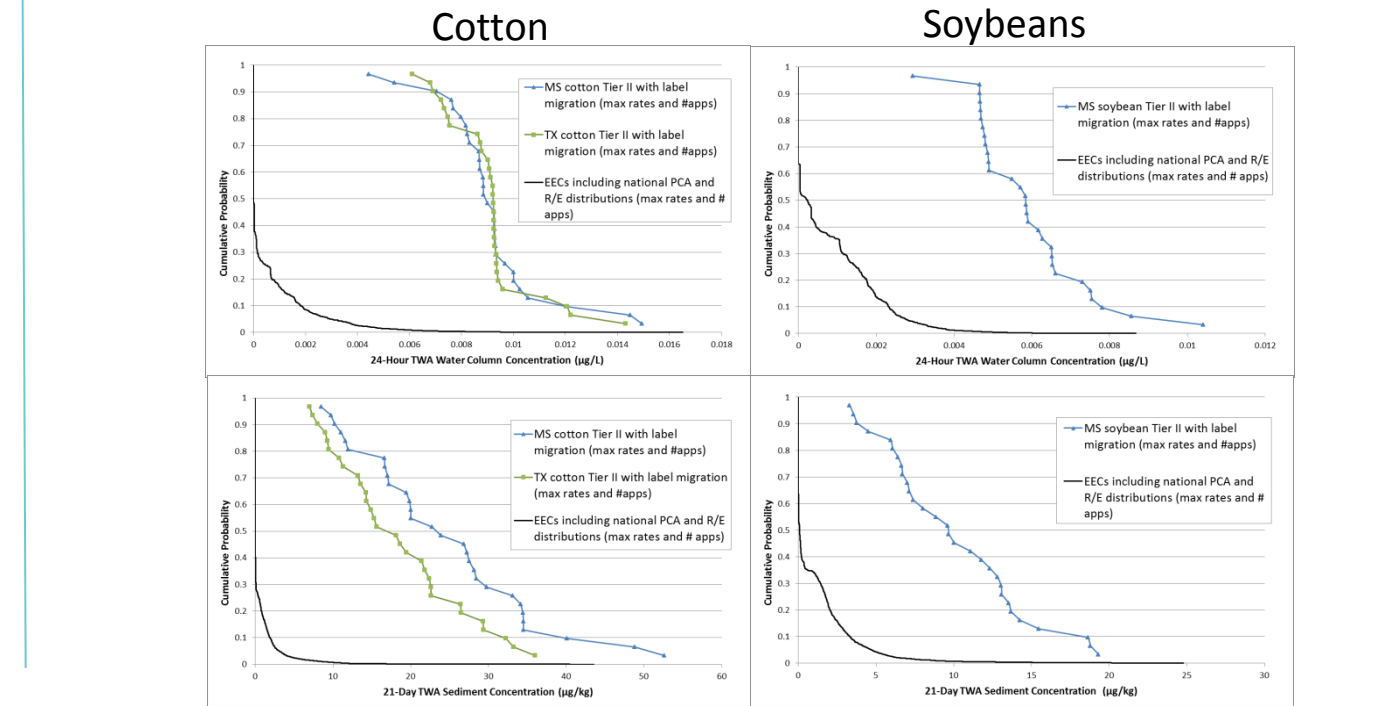


### Crop-specific national distributions of runoff/erosion potential put USEPA Tier II PRZM scenarios into context



### Combined effect of landscape factors on EEC distributions

The charts below present the final probabilistic distributions of 24-hour TWA water column and 21-day TWA sediment EECs for cotton (left) and soybeans (right) based on 110 modeling scenarios and national weightings of occurrence for each crop (3330 pond years). Also plotted in each chart are the 30 annual maxima of relevant US EPA scenarios for that crop.



## Acknowledgement

The Pyrethroid Working Group (PWG) is a US task force whose members include eight primary pyrethroid registrants (AMVAC Chemical Corporation, BASF Corporation, Bayer CropScience LP, Cheminova A/S, DuPont Crop Protection, FMC Corporation, Syngenta Crop Protection, LLC, Valent U.S.A. Corporation).