Environmental Flows and Levels:

Determining Impact Thresholds and Allowable Change

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Water Management District

Flow and Level Standards

Hydrological	7Q10, Tennant method, etc.
Hydraulic rating	Q relationship with channel characteristics
Habitat simulation	PHABSIM, SEFA, EFDC for thermal habitat, etc.
Ecosystem	Integrates natural regime with ecological targets; lentic and lotic

Challenges with Determining Standards

Criteria

- Relevant
- Sensitive to change / withdrawal

Thresholds

- Allowable change
  - Protective
  - Scientifically defensible

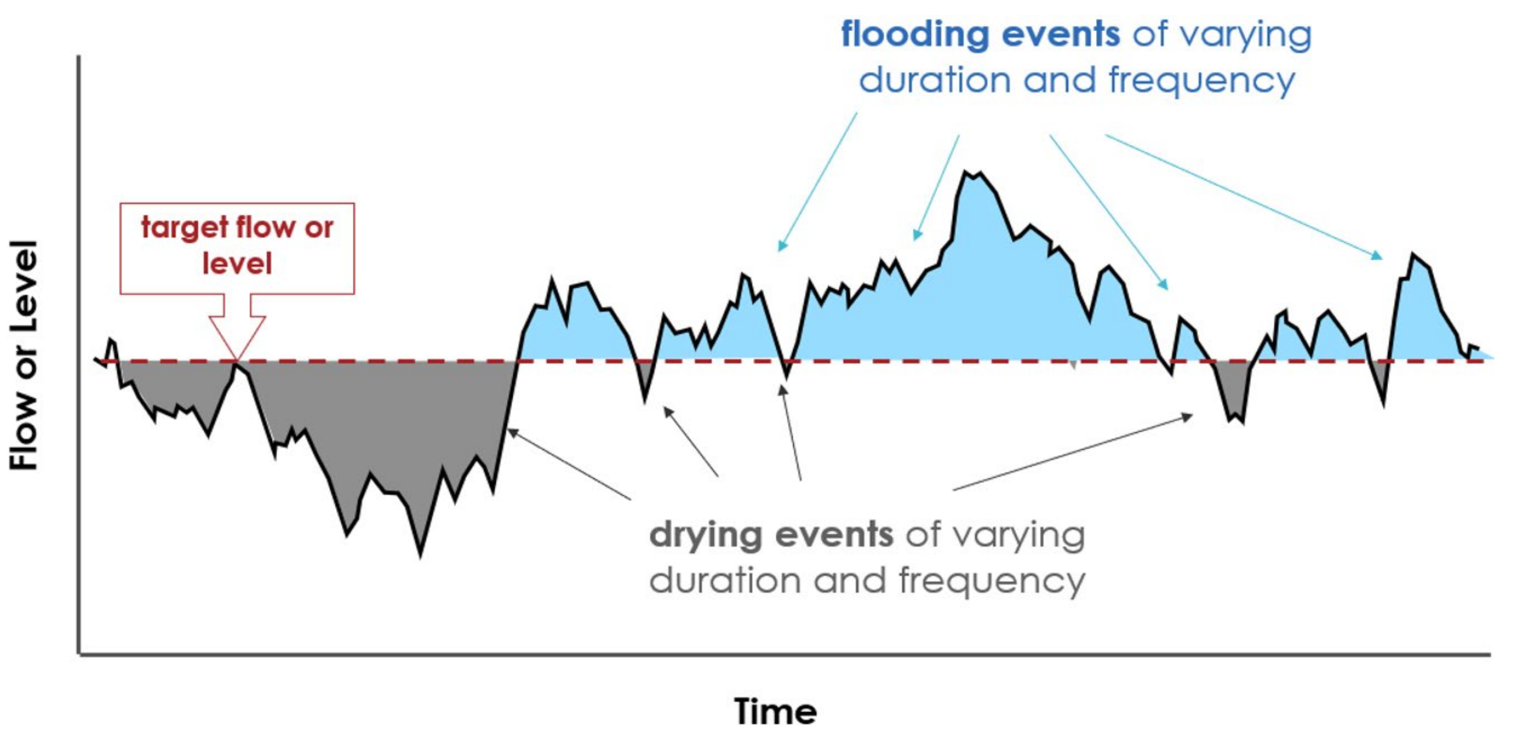
Maintaining Ecologically Relevant Events

Event approach:

allowable change to ecologically critical hydrological events.

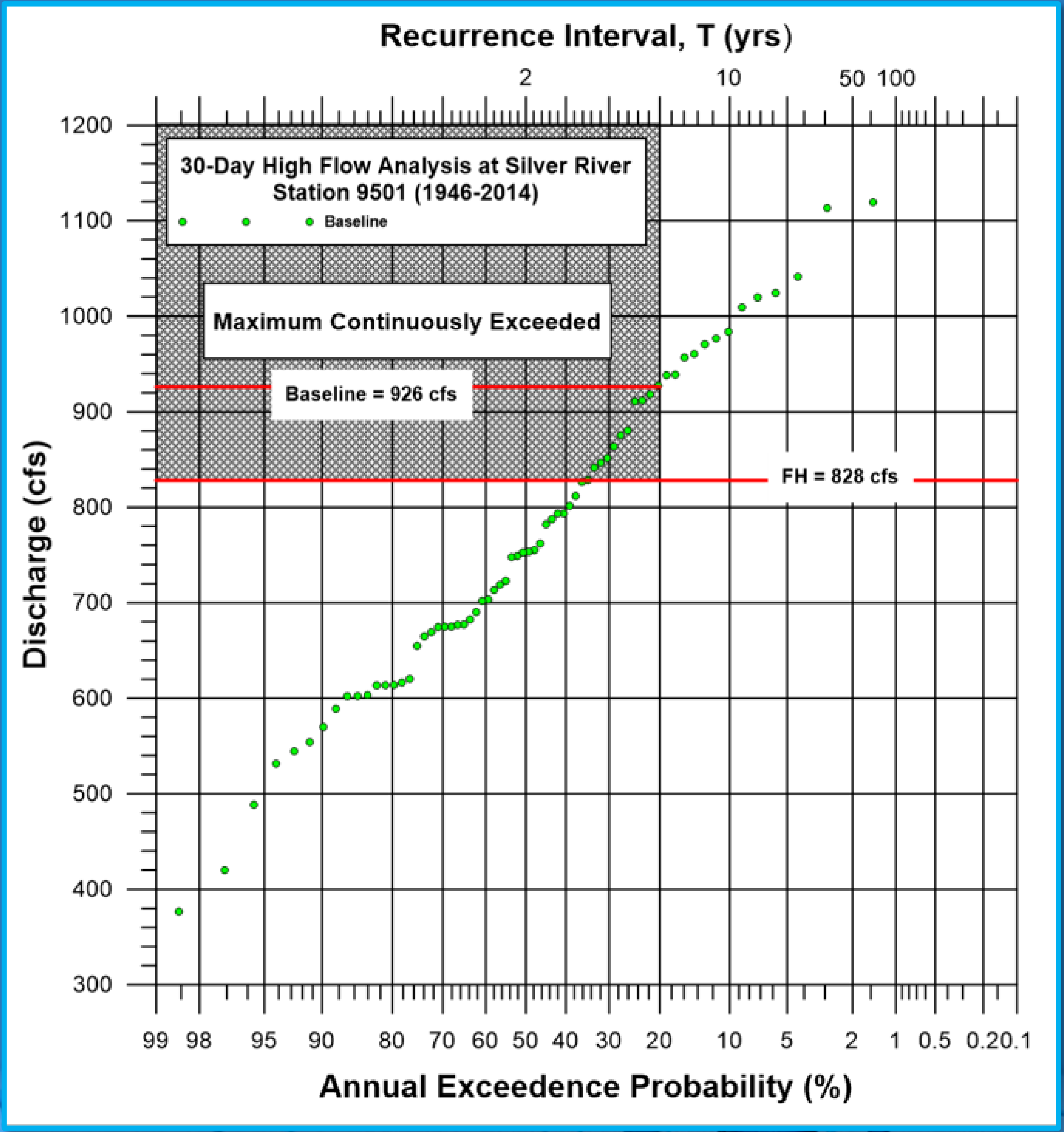
Components: magnitude, duration and frequency

Examples
• Migratory fish passage • Organic soil maintenance • Wetland location / composition



Event-based Approach:

- **Impact threshold:** Minimum flooding frequency (number of flooding events per century), or maximum drying frequency.
- **Assessment:** compare minimum freq. to current
- **Challenge:** what is the minimum frequency?
  – Allowable change from pre-withdrawal?



Hydrological Signatures for Ecological Events

Main question:

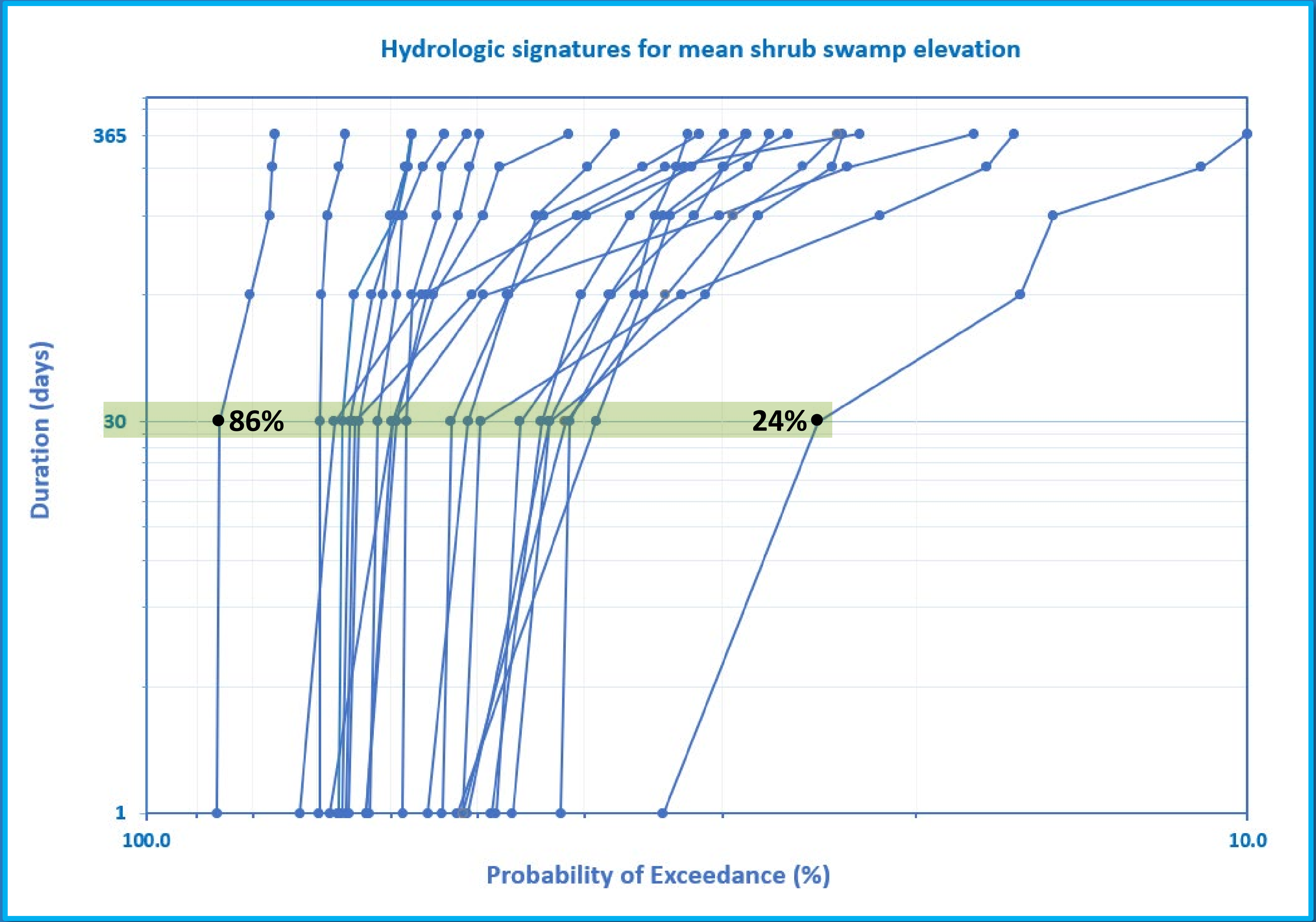
- Recommended frequency (impact threshold) for new site, ensuring safety margin

Challenges:

- High variability in frequency among sites within a region
- Determining the cause of high frequency range

Goal:

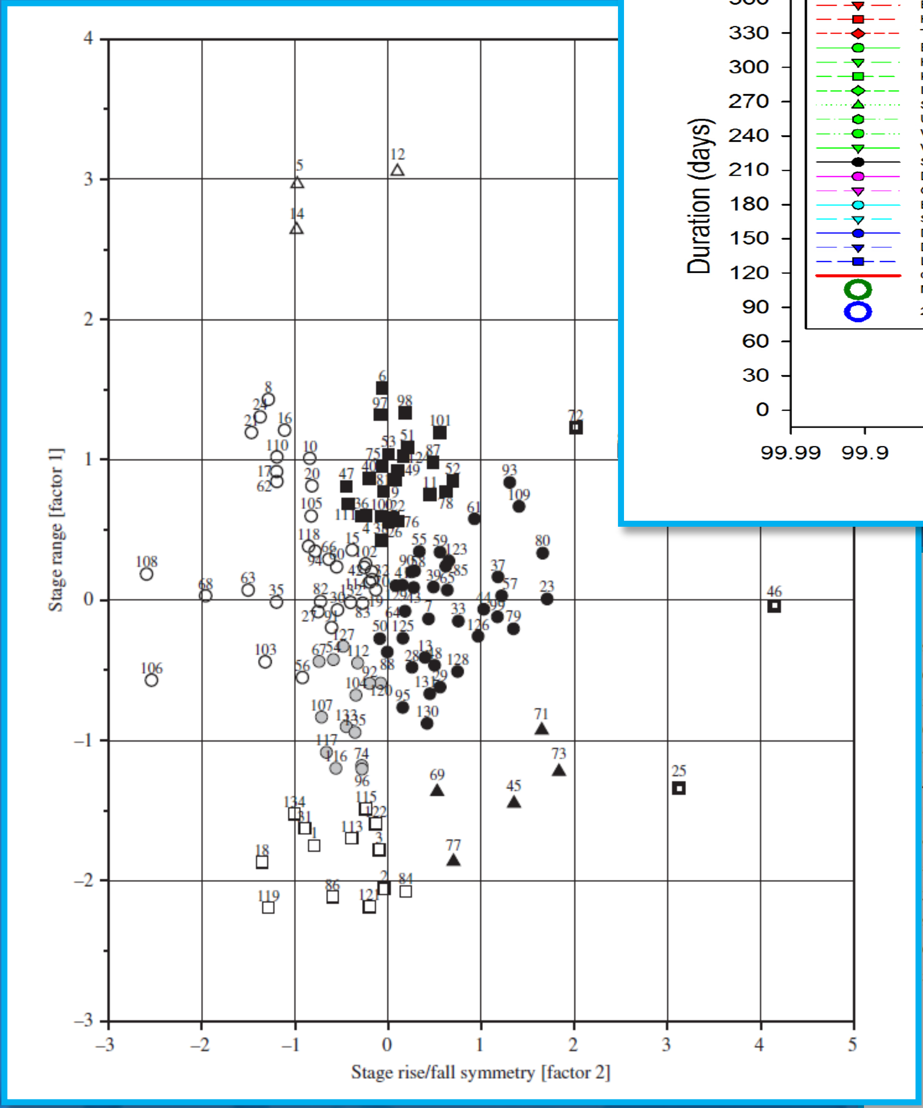
- Classify lakes into meaningful groups, with reduced frequency range

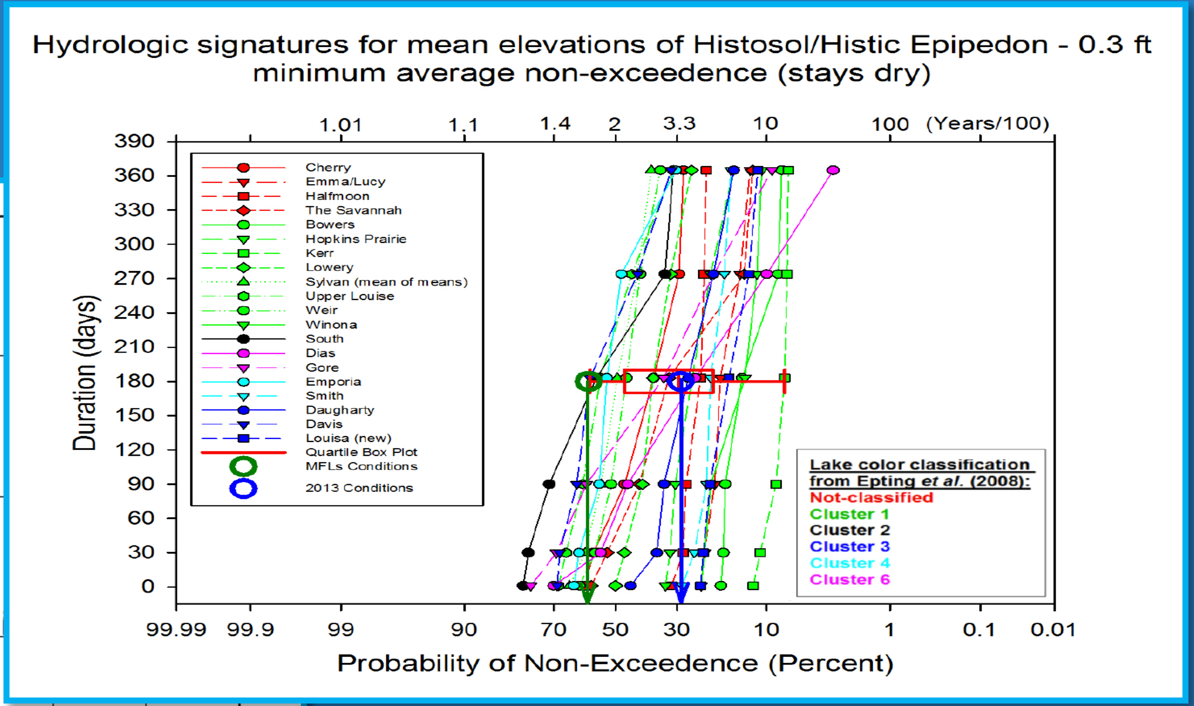


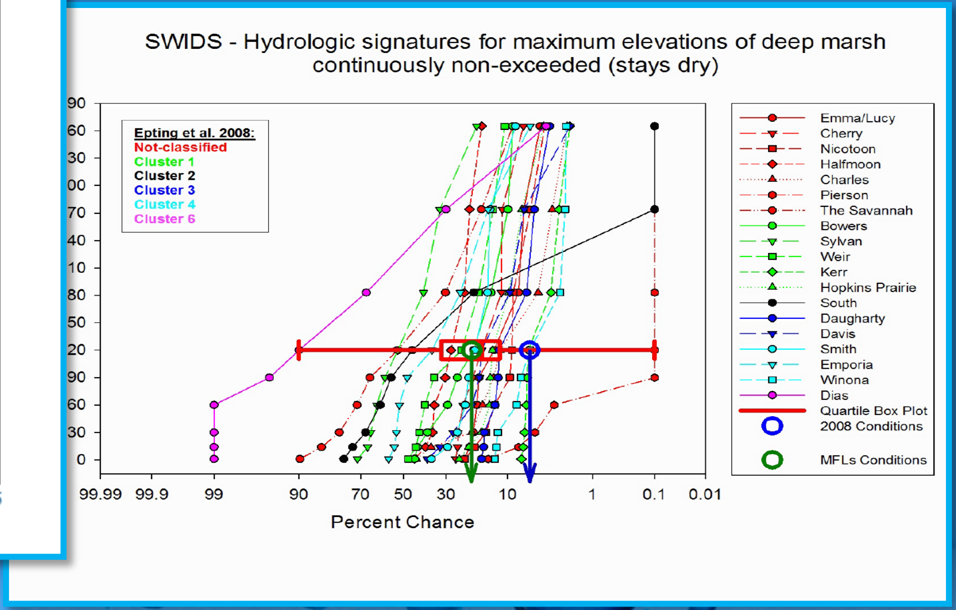
Water Body Classification

Previous efforts:

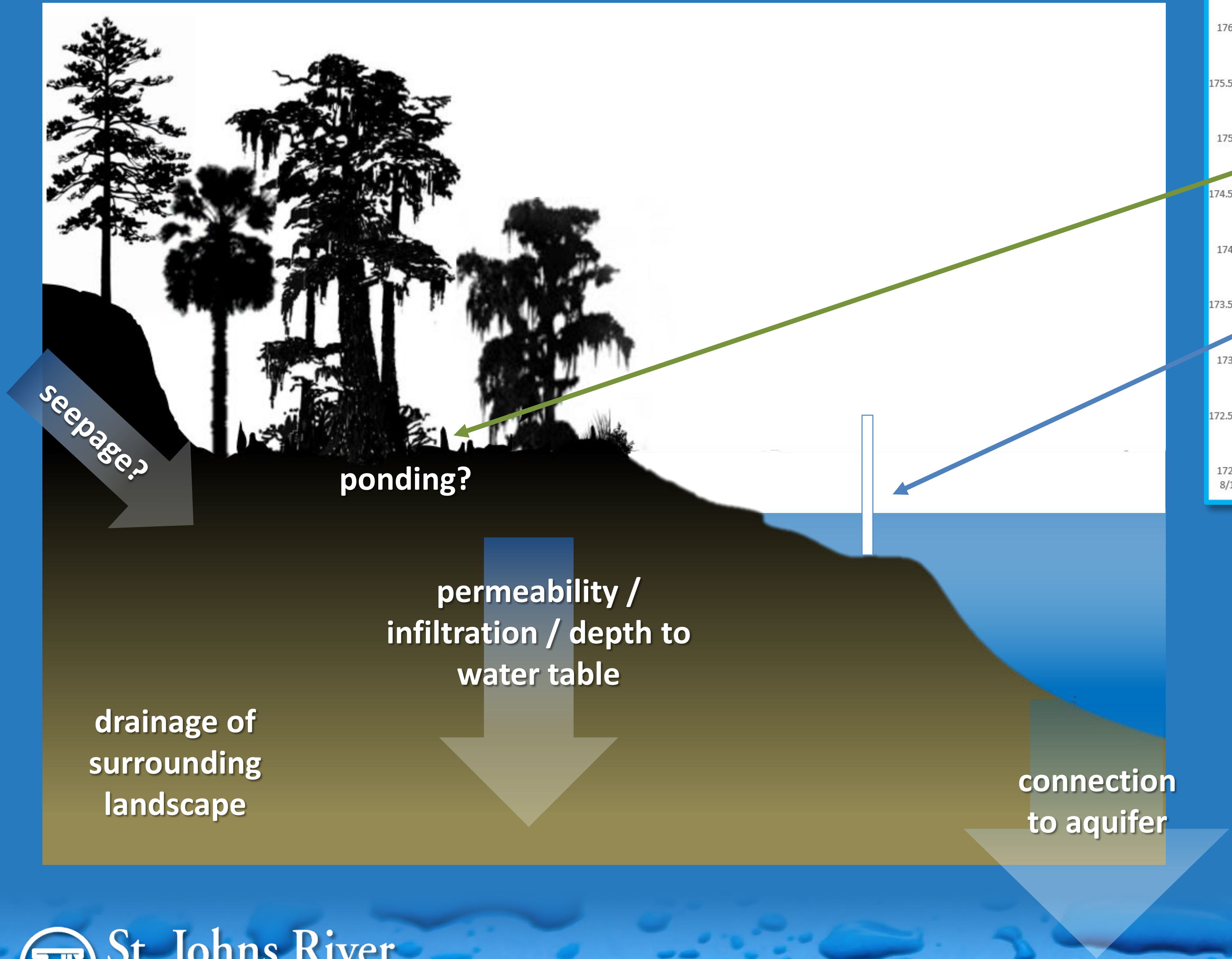
- PCA: hydrological data
  - range
  - symmetry
- Explained 88% of variance between sites
- Somewhat distinct groups
- **However, still have high range of event frequencies**

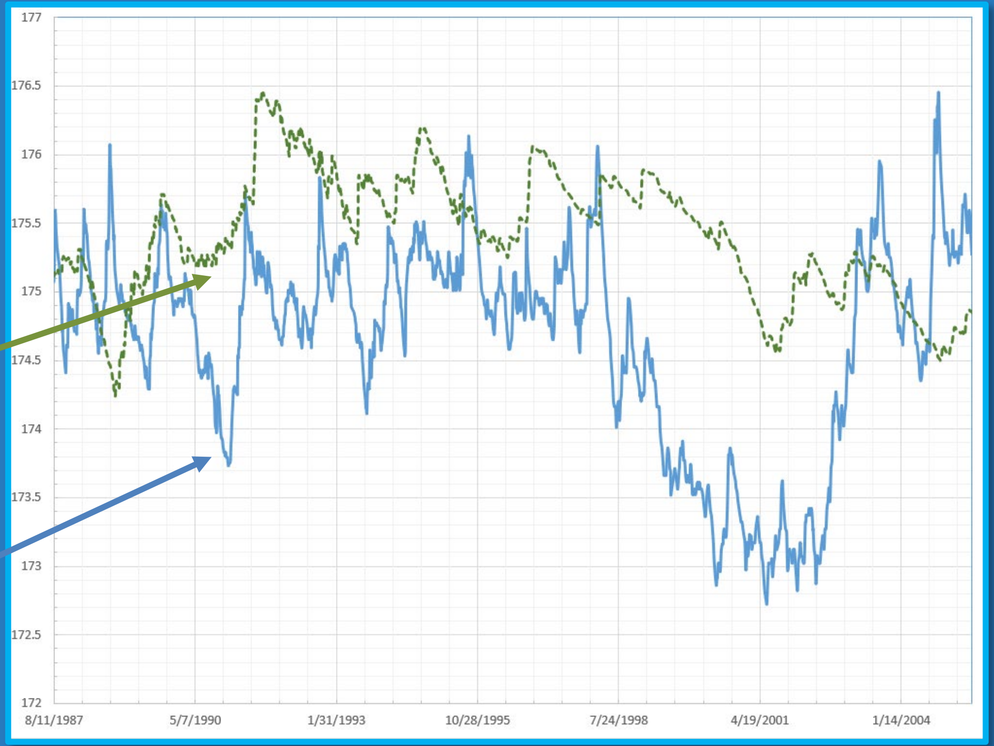






Why the high range in event frequencies?

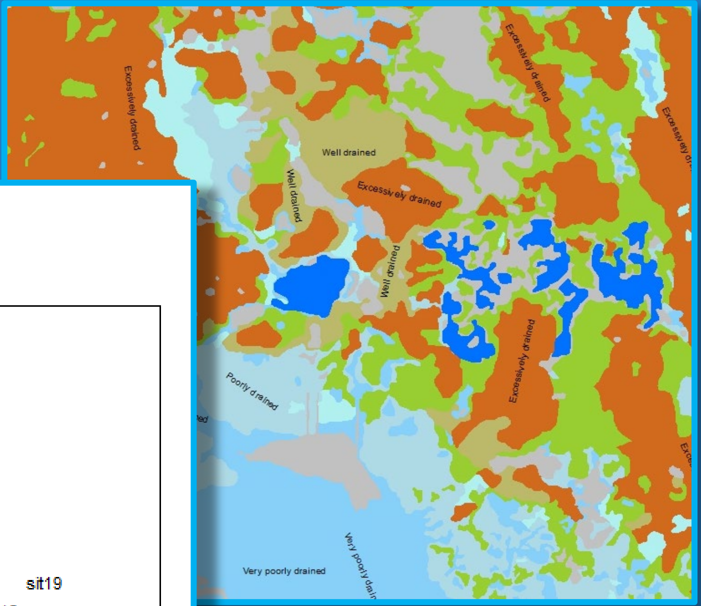


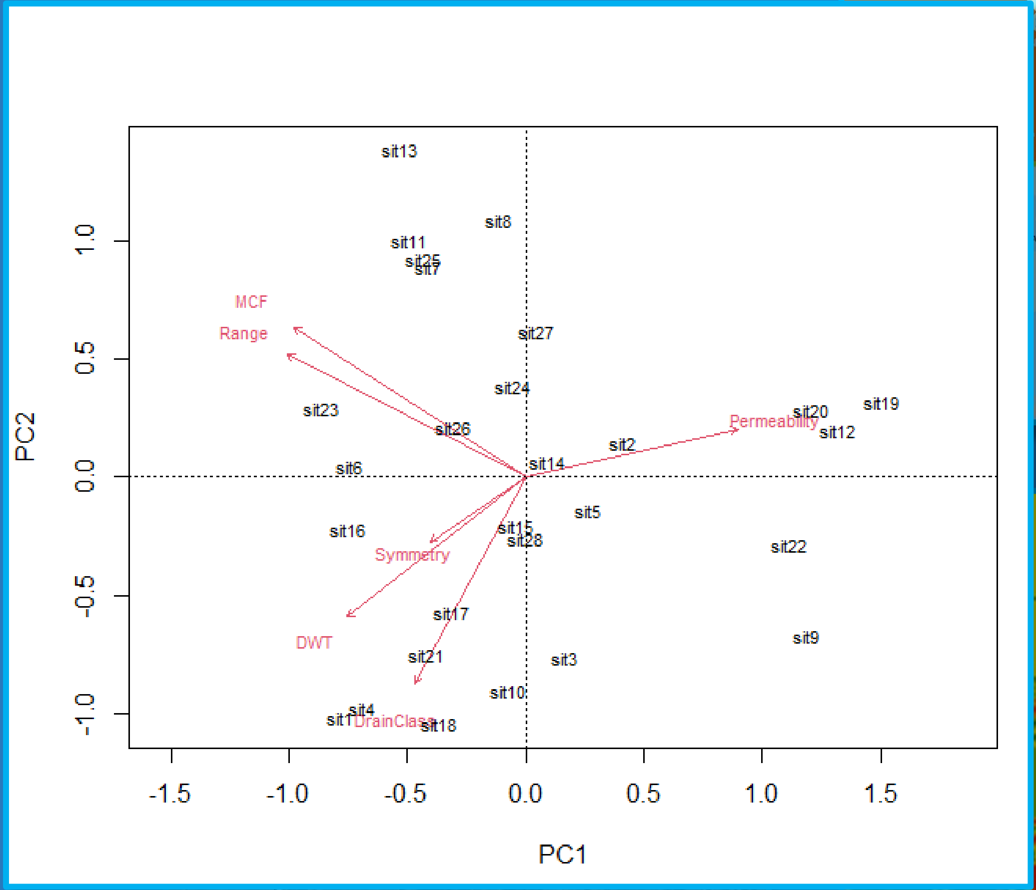


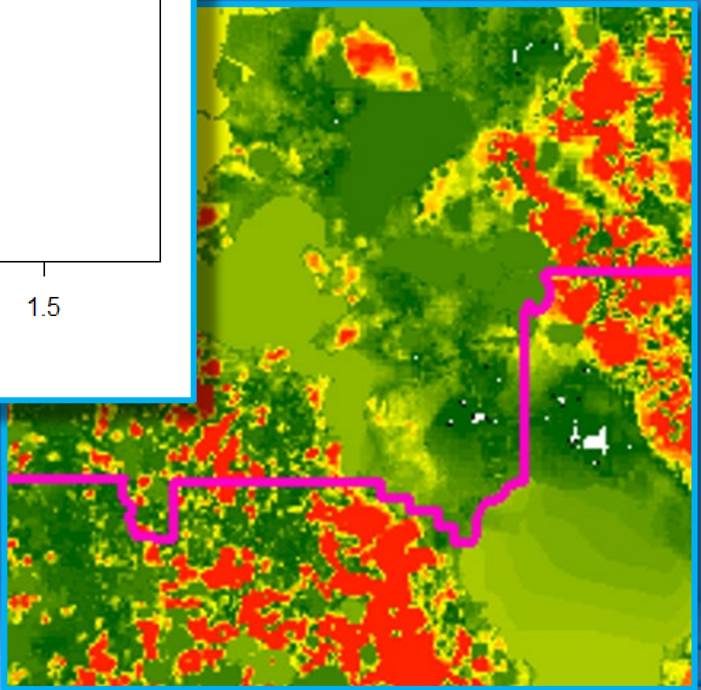
Different combinations of landscape factors = different correspondence between water body and adjacent wetland

Determining most relevant factors

- PCA
- Exploratory: 15 variables
  - Connection to the UFA
  - Soil permeability
  - Depth to water table
  - Drainage class
  - Water level range and symmetry
- First 2 axes explain 65%
- First 3 axes explain ~90%







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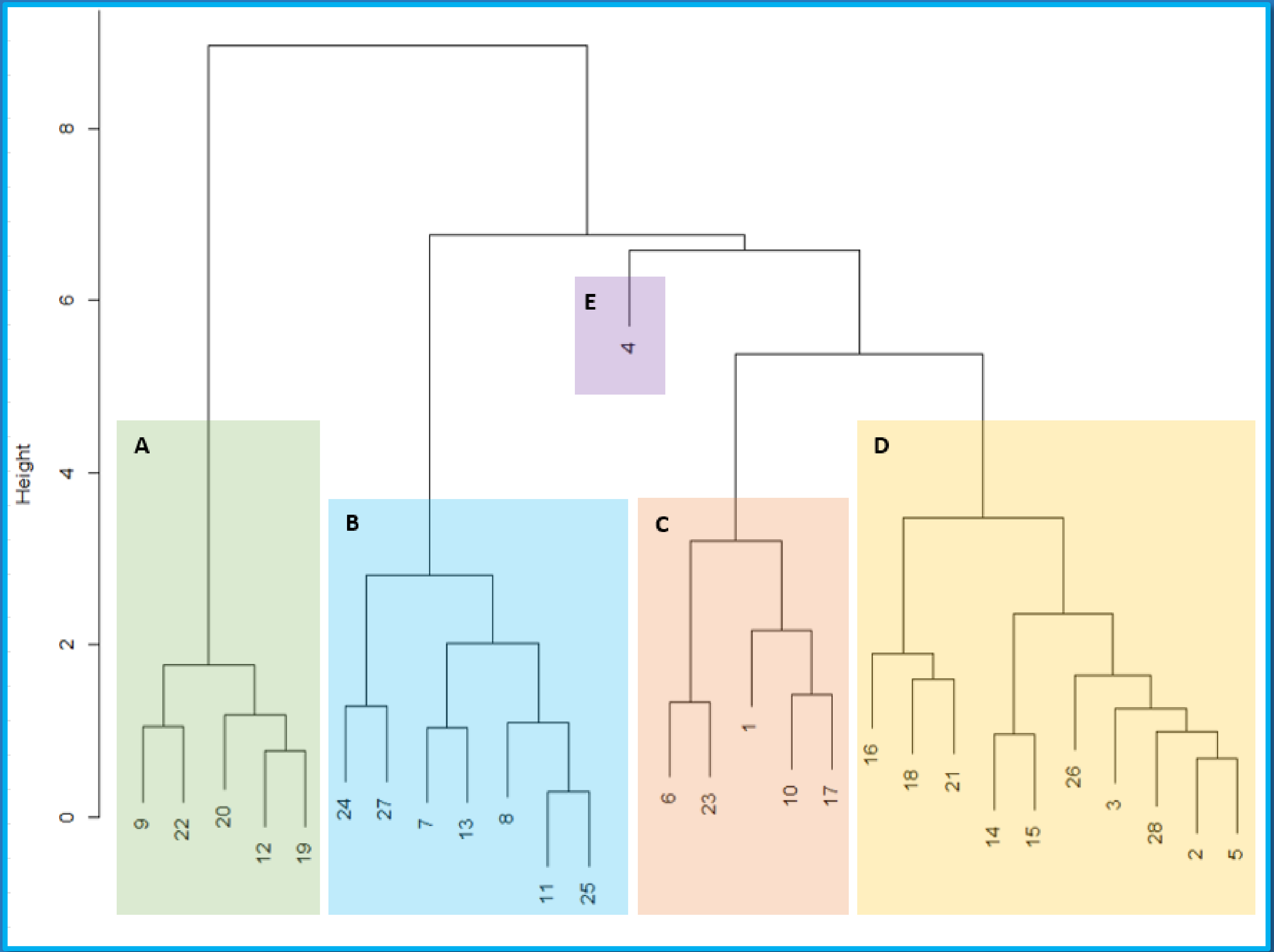
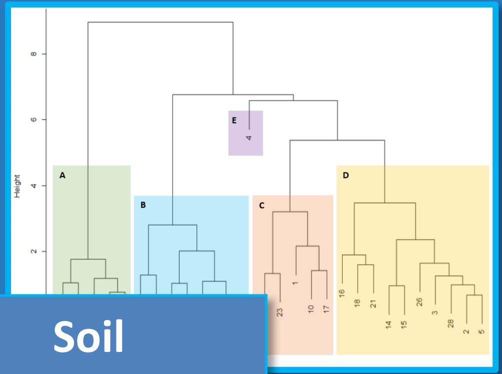
Grouping Sites

- Variables identified using PCA
  - Maximum cumulative fluctuation
  - Soil permeability
  - Depth to water table
  - Water level range
  - Water level symmetry (kurtosis)

Cluster analysis (Ward's method)



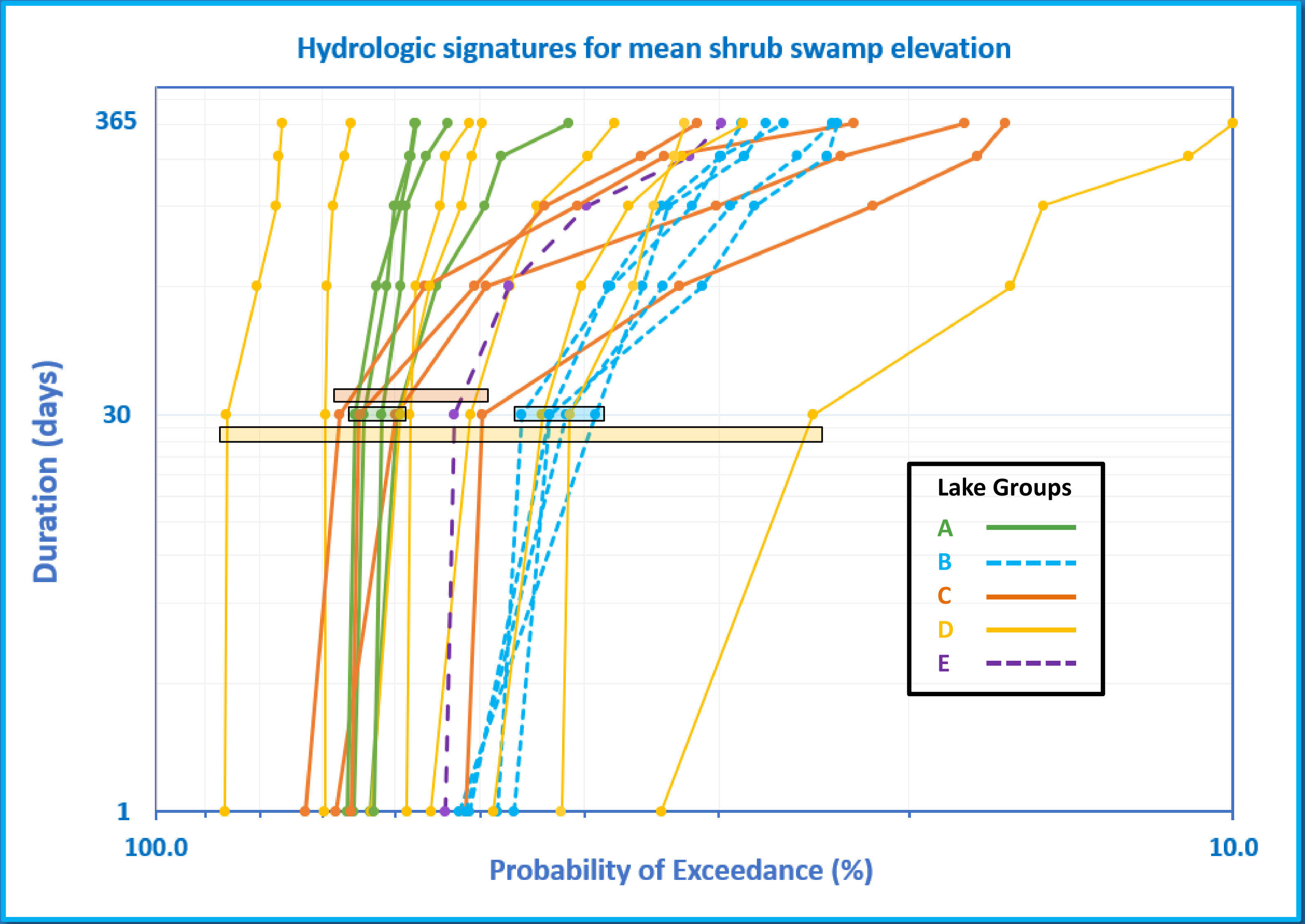
Adding **landscape variables** resulted in distinct groups



Group	WL Range	Drainage	Aquifer Connection	Depth to Water Table	Soil Permeability
A	**low**	**low**	**low**	**low**	**low**
B	mod-high	**low**	mod-high	moderate	moderate
C	mod-high	moderate	mod-high	**very high**	moderate
D	mod-high	**high**	mod-high	moderate	**high**
E	**low**	moderate	high	very high	high

Hydrologic signatures by lake group

- Three groups with much smaller frequency range
- One group with same large frequency range
- One outlier
- **Allowable change:** mean + SE more reasonable when range is smaller



Summary:

- Basing allowable change to lake and river hydrology on frequency of ecological events is useful concept;
- Need better understanding of how correspondence between wetland and waterbody hydrology varies among sites;
- Landscape variables beneficial for lake classification;
- Resulted in lake groups that better explained variability in hydrologic signatures for wetland metrics
- Allowable change: using mean + SE more reasonable with smaller frequency range

Next Steps / ways to improve:

- Fieldwork: modify goal / procedures
- Monitor hydrology in wetlands
- Finer resolution landscape data
- More sites in emerging groups
- Reference sites for emerging lake groups


Questions?