



Transport of Agricultural Chemicals:

Estimating Lag Times in Different Hydrologic Environments

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Objectives

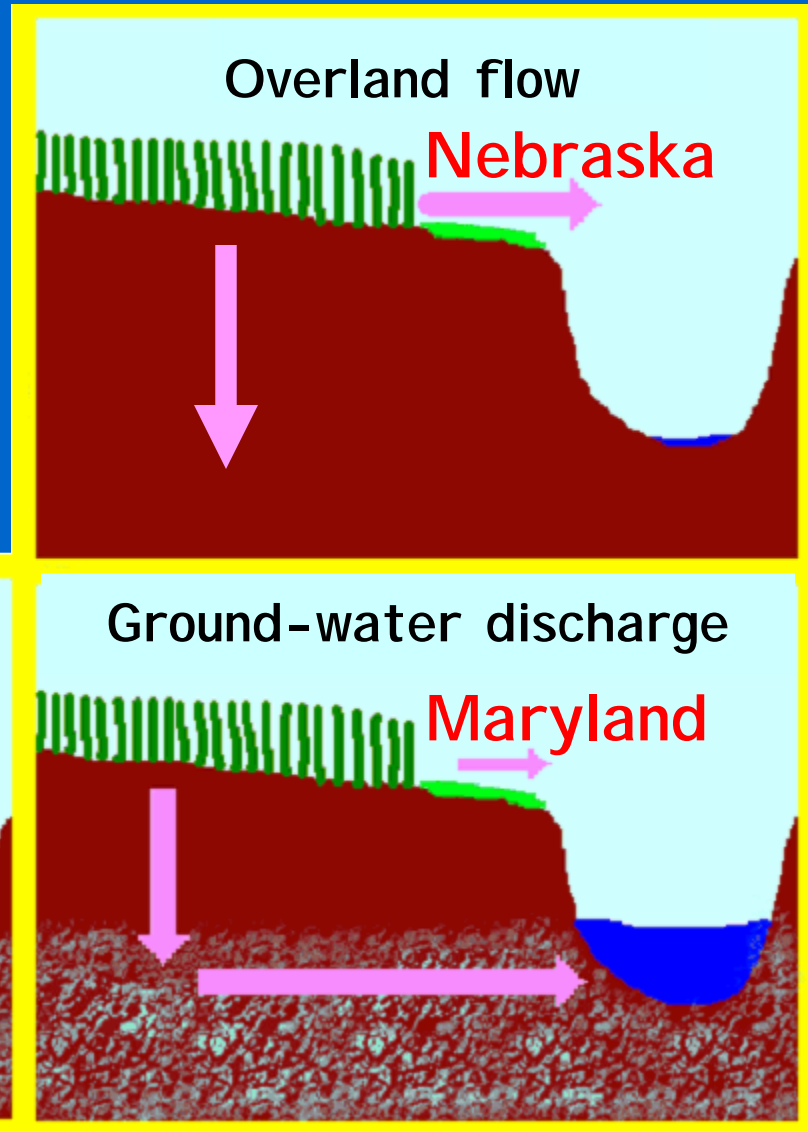
- Quantify lag time at three USGS study areas (National Water-Quality Assessment Program)

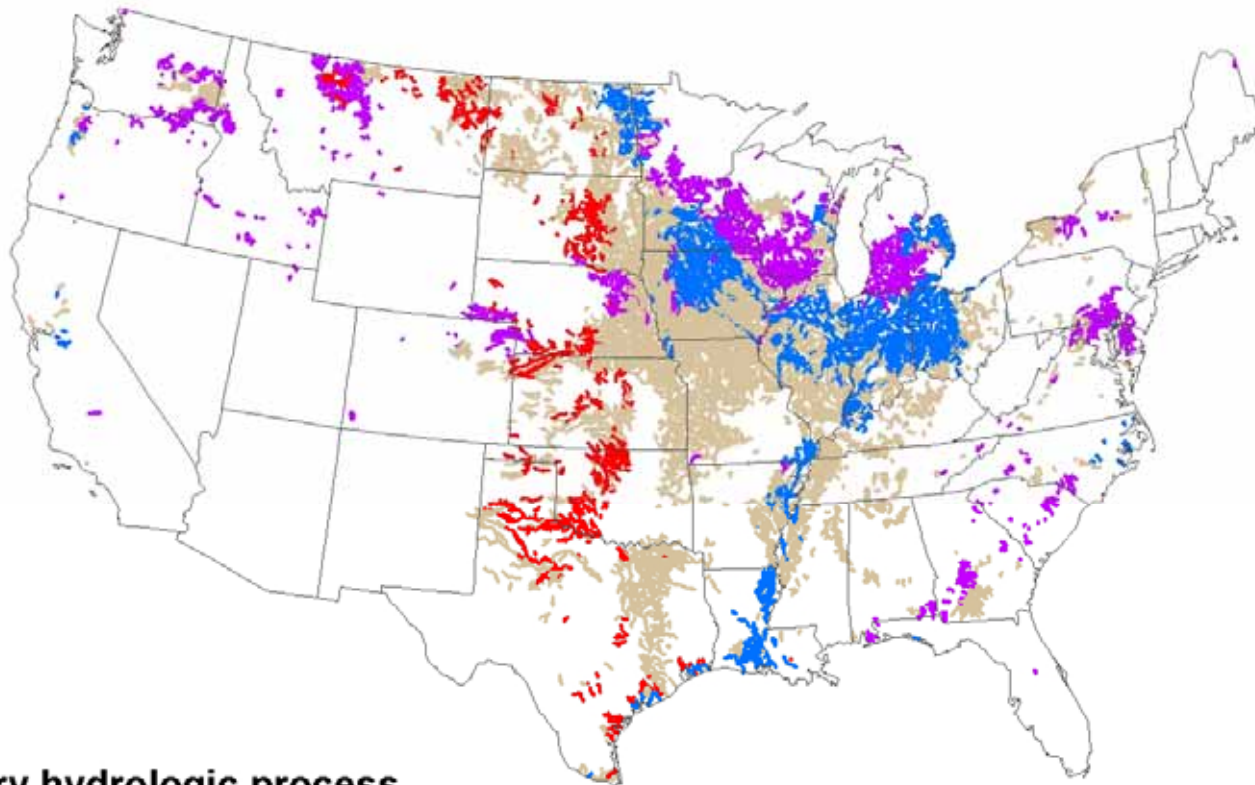
Lag time is the travel time of water and chemicals from the land surface to the stream

- Show implications of hydrology for agricultural chemical management

Study areas

Transport and lag time vary in different hydrologic systems





Primary hydrologic process

- Artificial subsurface drainage
- Overland flow
- Ground-water discharge
- No dominant flow process

Overland-flow-dominated streamflow

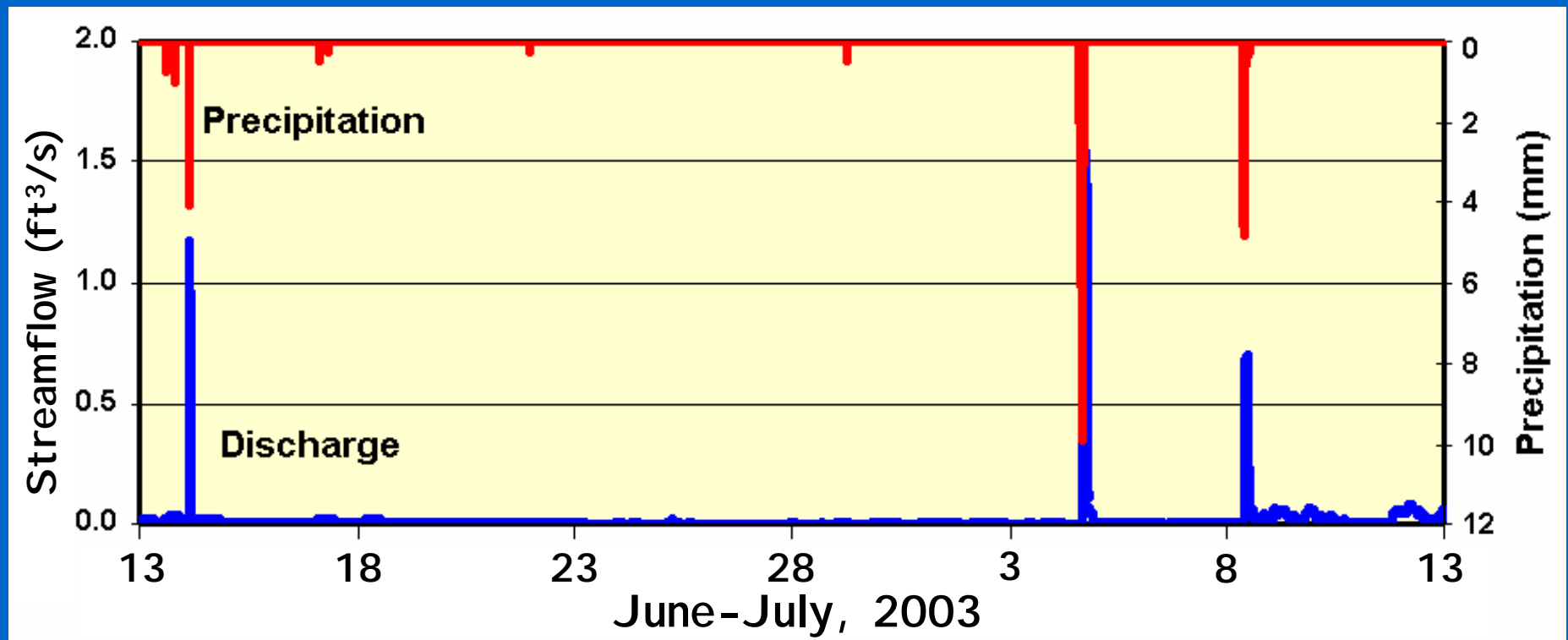
Nebraska site



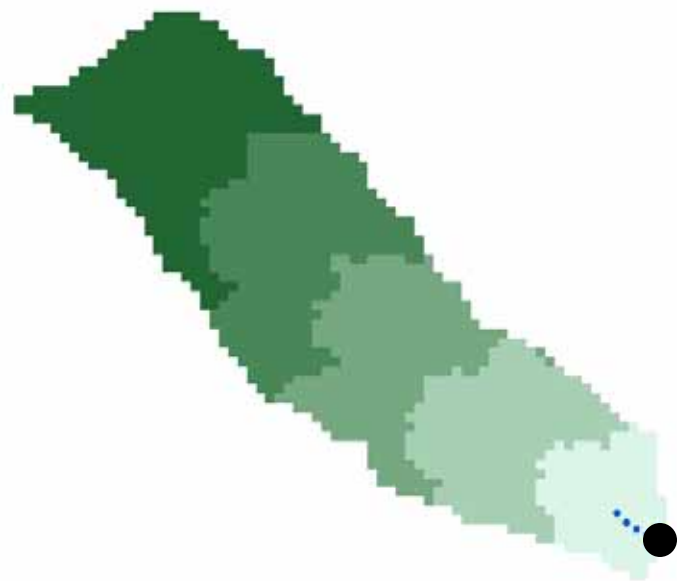
Basin area = 1.5 km²

Overland-flow-dominated streamflow

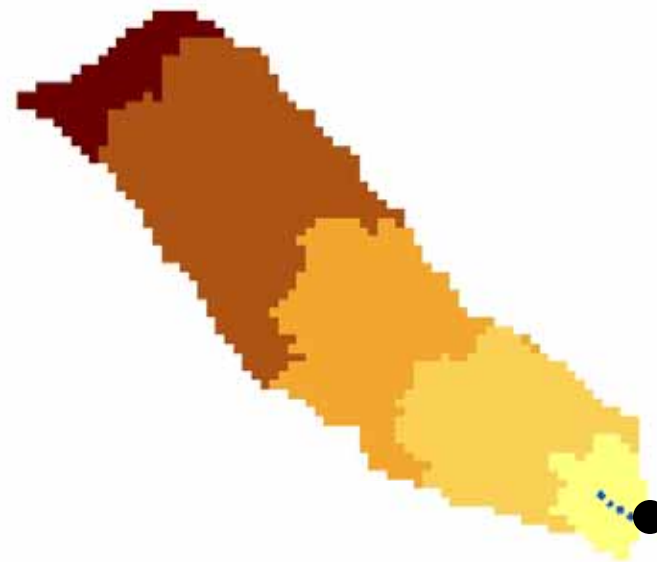
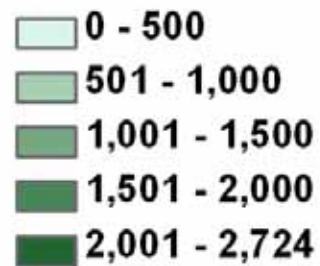
Nebraska site



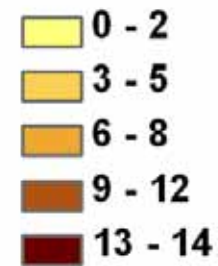
Typical flow event lasts 1-2 hours.



Distance to streamgage (meters)

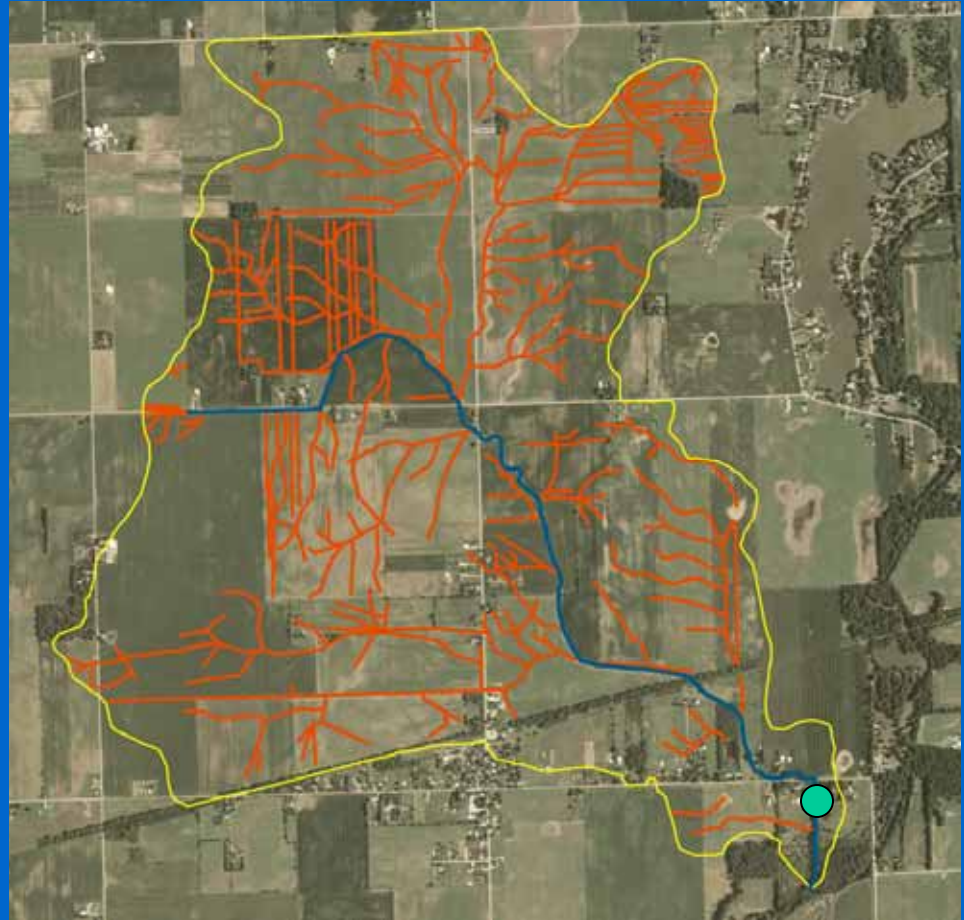


Overland flow travel time (hours)



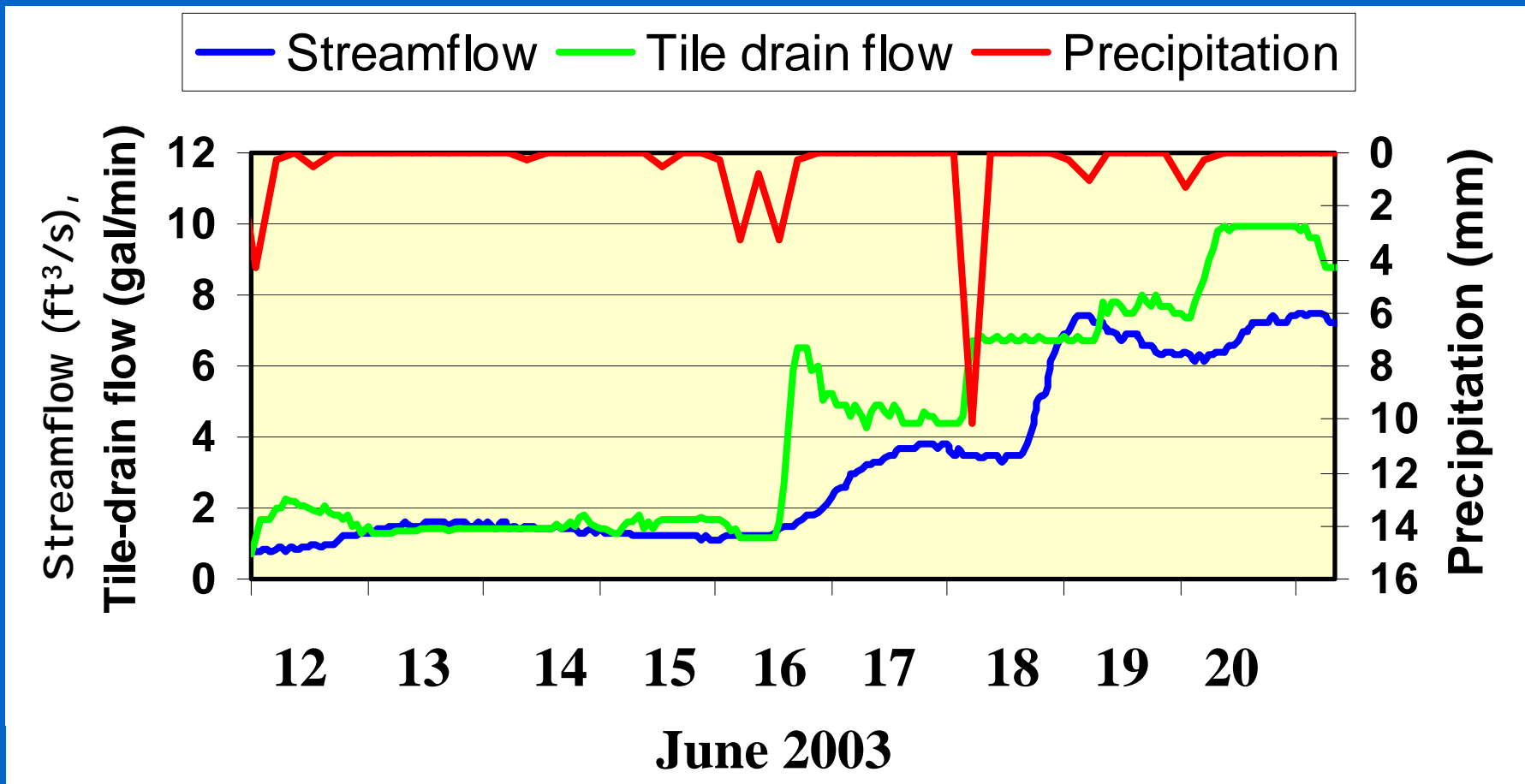
- Assume overland flow velocity is 200 m/hr
- Typical flow event lasts 1-2 hours
- About 10% of the watershed has a travel time < 2 hours

Tile-drain-dominated streamflow



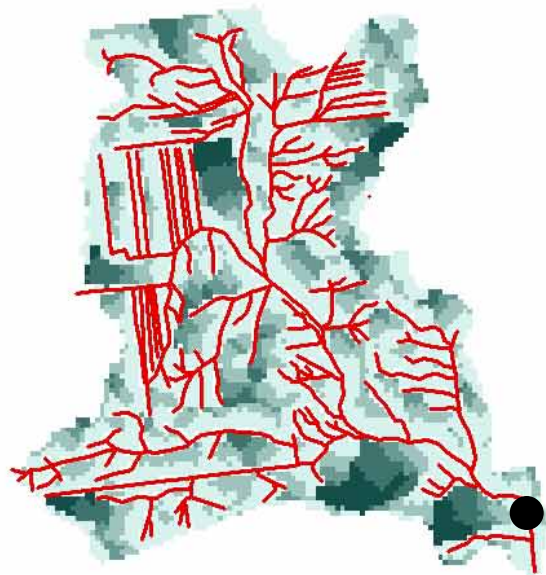
Basin area = 7 km²

Indiana site

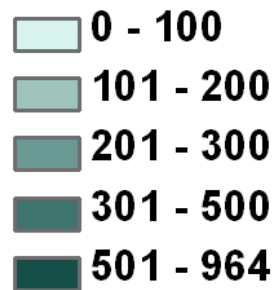


Typical flow event lasts 24-48 hours.

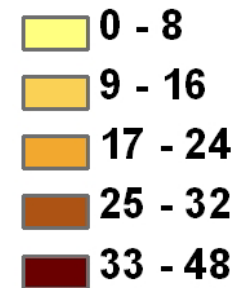
Indiana site



Distance to tile drain (m)



Travel time to tile drain (hours)



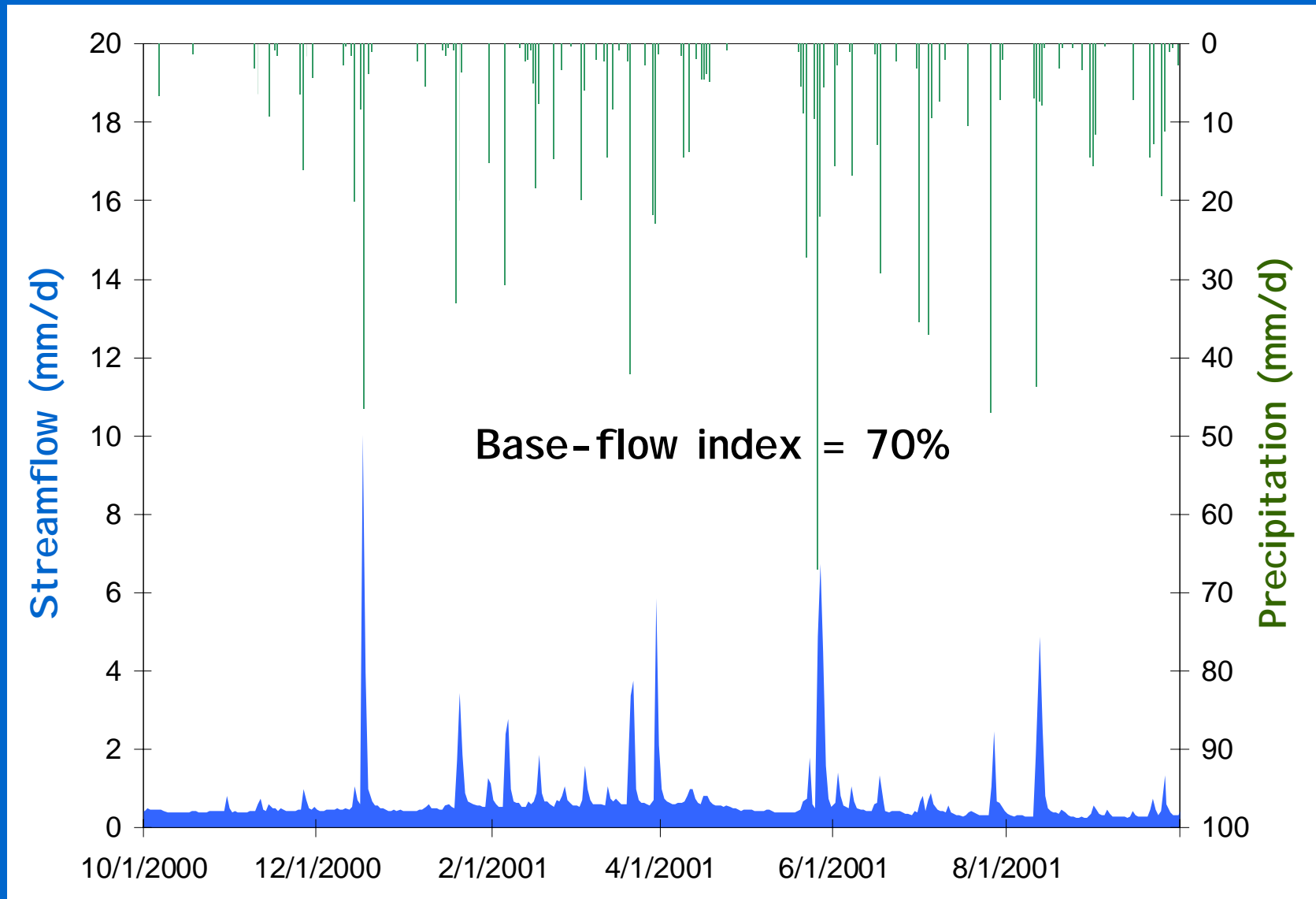
- Assume rapid subsurface flow velocity is 20 m/hr
- Typical flow event lasts 24-48 hours
- The entire watershed has a travel time < 48 hours

Maryland site: Ground-water discharge dominated streamflow



Basin area = 29 km²

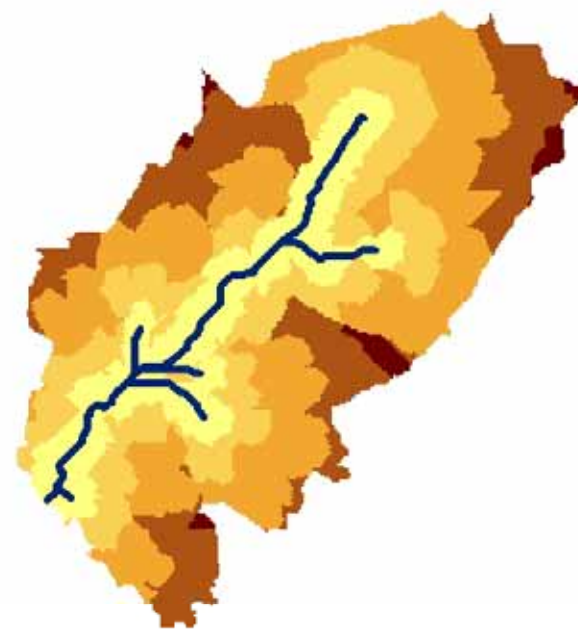
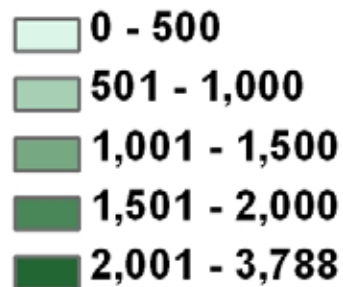
Ground-water discharge dominated streamflow



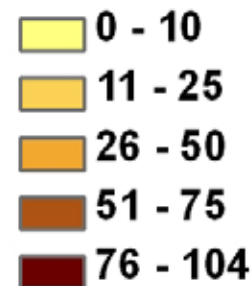
Ground-water discharge to stream is continuous.



Distance to stream (m)



Travel time to stream (years)



- Assume ground-water flow velocity is 0.1 m/day
- Ground-water discharge to stream is continuous.
- The entire watershed is a source of streamflow.

Hydrologic differences

	Nebraska:	Indiana:	Maryland:
	Overland flow	Tile drains	Ground water
• Lag time	Hours	Hours	Decades
• Degradation potential	Low	Low	High
• Fraction of basin contributing to streamflow	Small	Large	Large
• Age of streamflow	Young	Young	Old

Agricultural Chemical Management Implications

Nebraska:

Indiana:

Maryland:

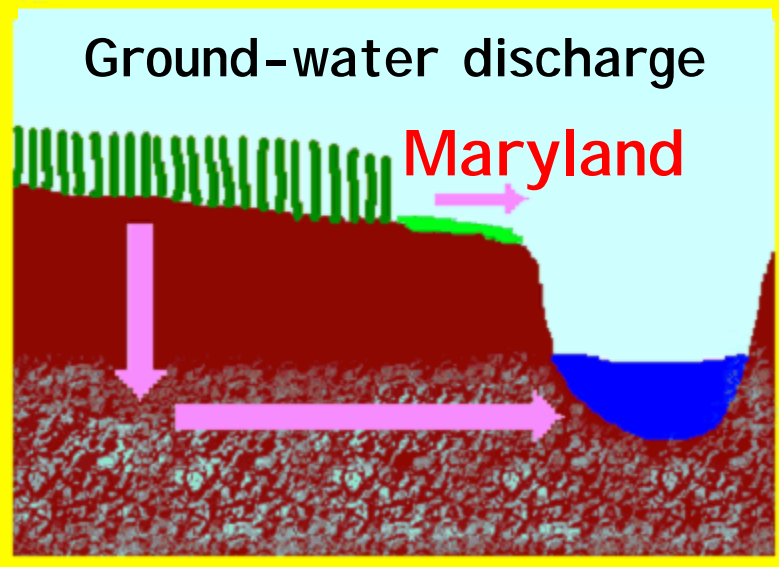
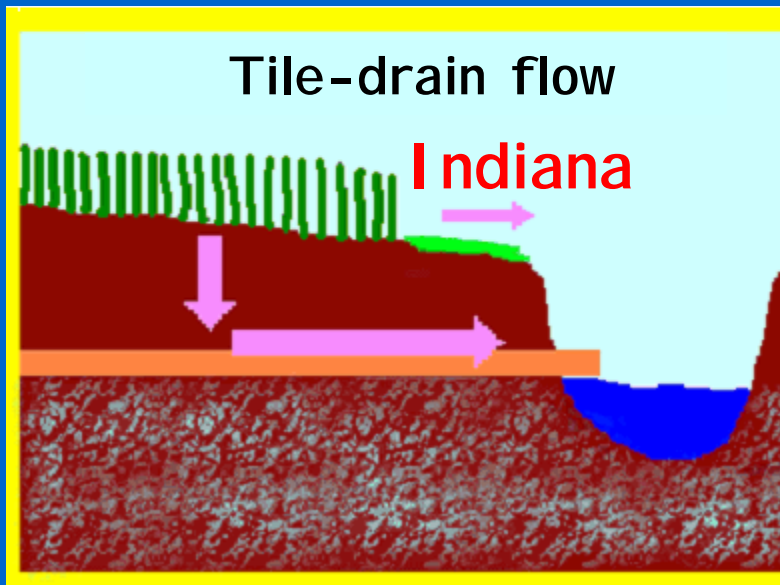
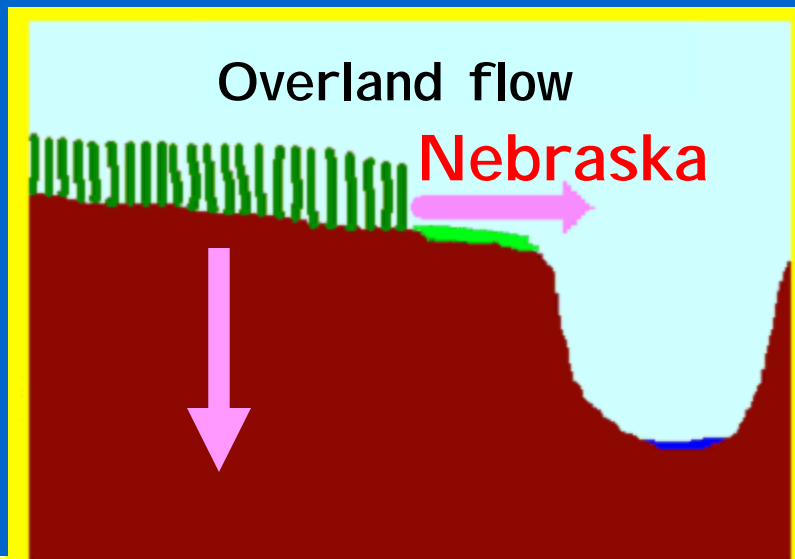
Overland flow

Tile drains

Ground water

- | | | | |
|--|-------|-------|------|
| • Response to changes in chemical applications | Quick | Quick | Slow |
| • Minimum tillage effective? | Yes | No | No |
| • Buffer zones near stream effective? | Yes | No | No |

Bottom line:
Hydrology matters
for managing
agricultural
chemicals



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