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# Hydrologic Controls on Nutrient and Pesticide Transport through a Small Agricultural Watershed, Morgan Creek, Maryland, USA

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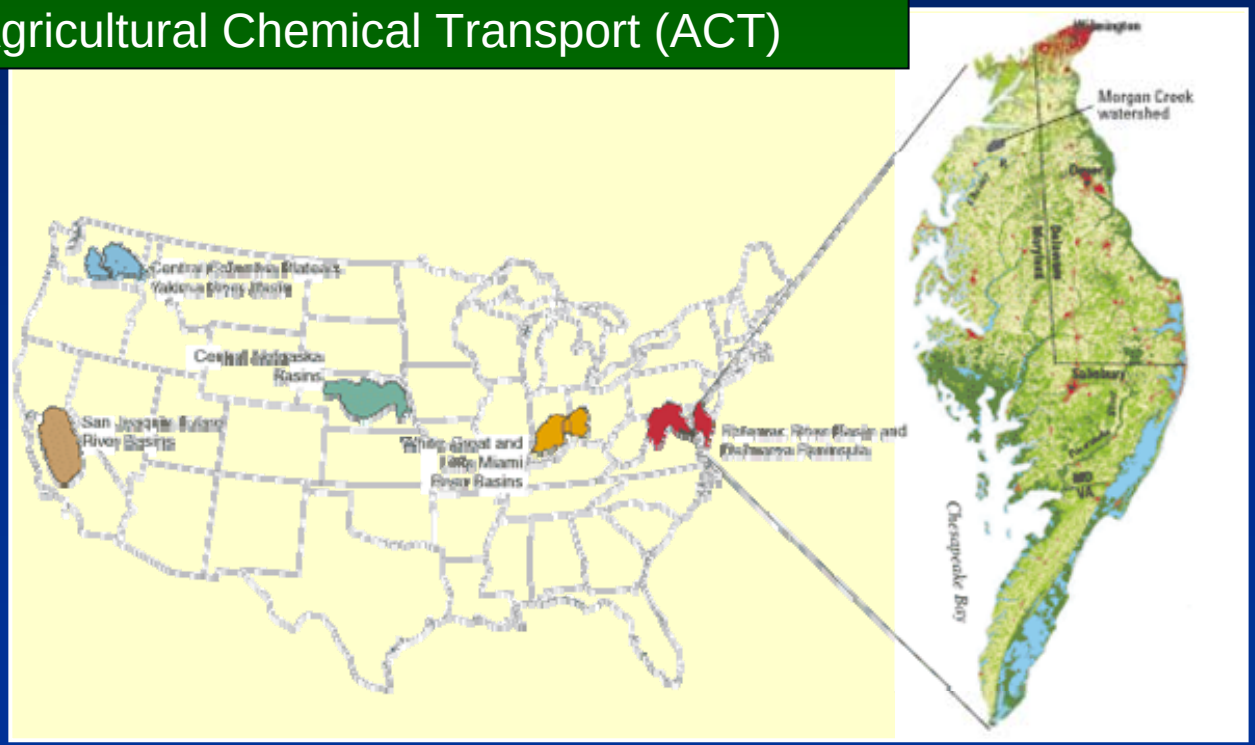
# Morgan Creek watershed is located in the northern part of the Delmarva Peninsula

- ACT is a water-budget approach to sampling nutrients and pesticides
- Define the conceptual hydrology and identify transport pathways
- Sample stream water chemistry, which represents an integration of all source water inputs

• Part of the National Water Quality Assessment (NAWQA) trends network

• Part of the NAWQA topical team study of Agricultural Chemical Transport (ACT)

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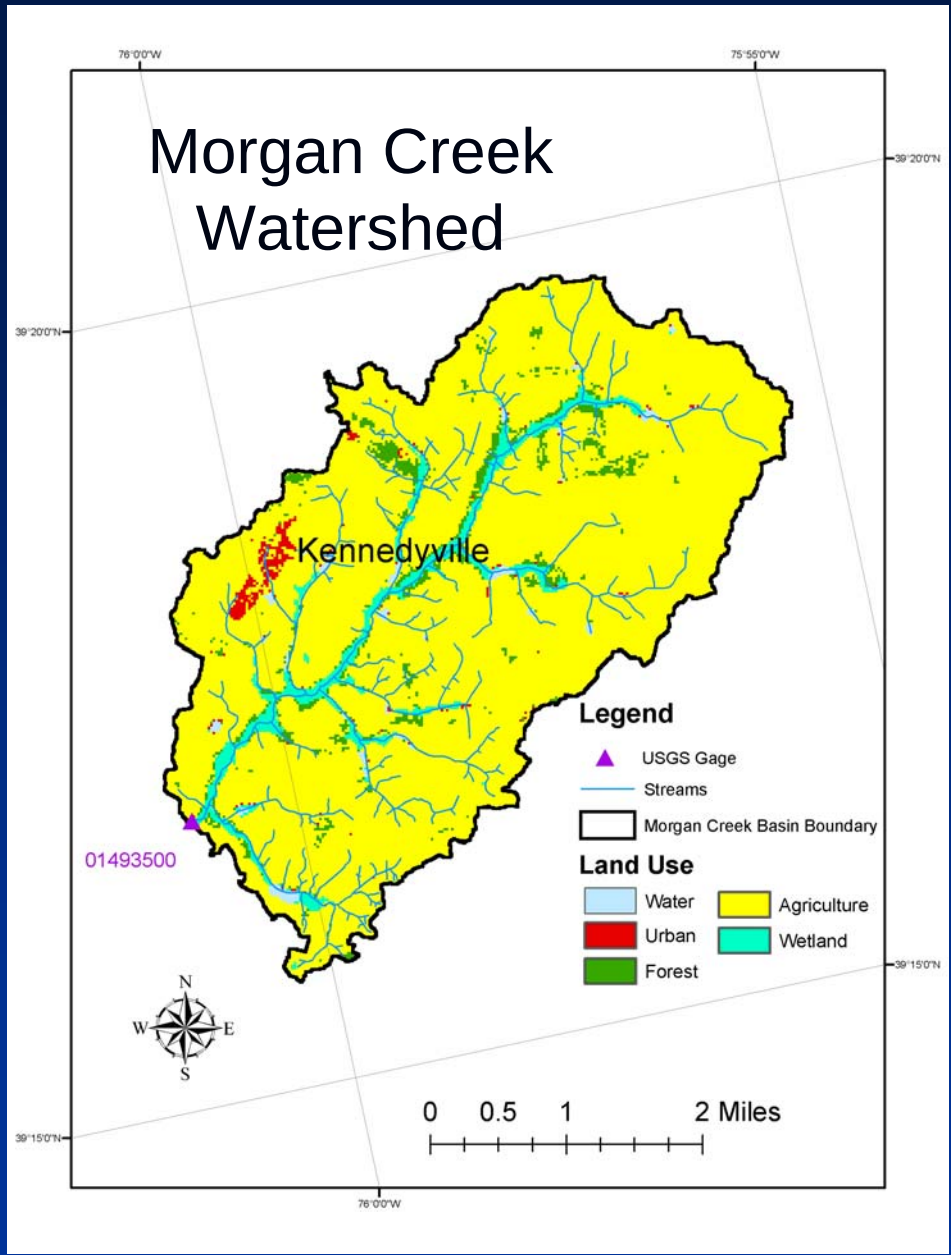
# Physical Setting:

- 31 square kilometer area (12.7 square miles)
- 90% agricultural
- Soils moderately well-drained, porous sandy loams
- Underlying aquifers are marine sand, silt, and clay
- Minimal irrigation with no inter-basin transfer
- Humid sub-tropical climate
- Elevation range is sea level to 25 meters
- Existing stream gage with long-term record

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# Morgan Creek Watershed- Annual Water Budget

**PPT = Precipitation**

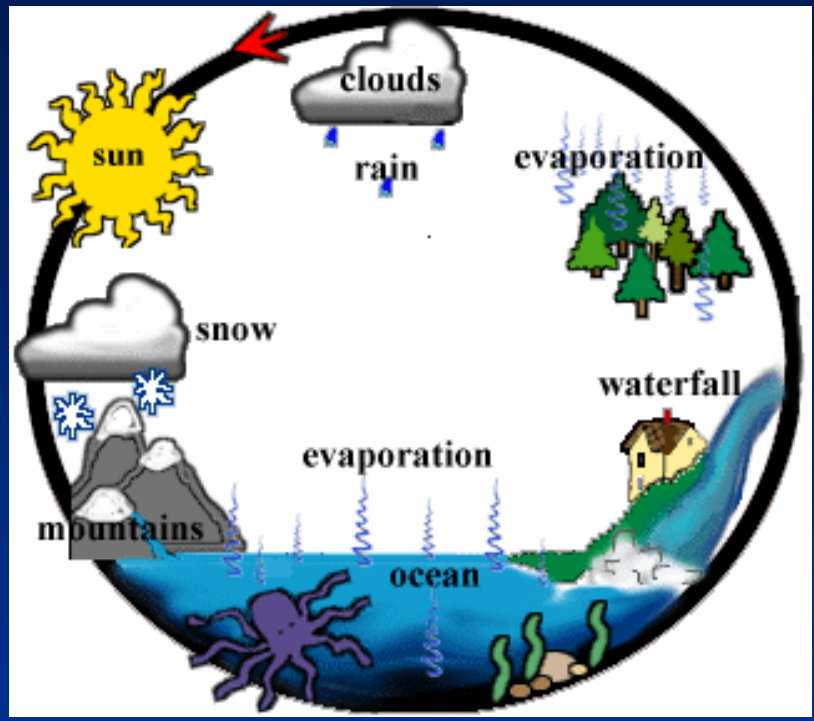
**= 112 cm/yr**

**• 8-10 cm/month, evenly distributed**

**GW= ground-water loss to adjacent basin**

**= 2 cm/yr**

**• Estimated from ground-water model**




**ET = Evapotranspiration**

**= 78 cm/yr**

**• Calculated from budget equation**

**SW = Stream flow**

**= 32 cm/yr**

**• Estimated from long-term stream flow record**

Budget Equation: PPT = ET + GW + SW

112cm = 78cm + 2cm + 32cm

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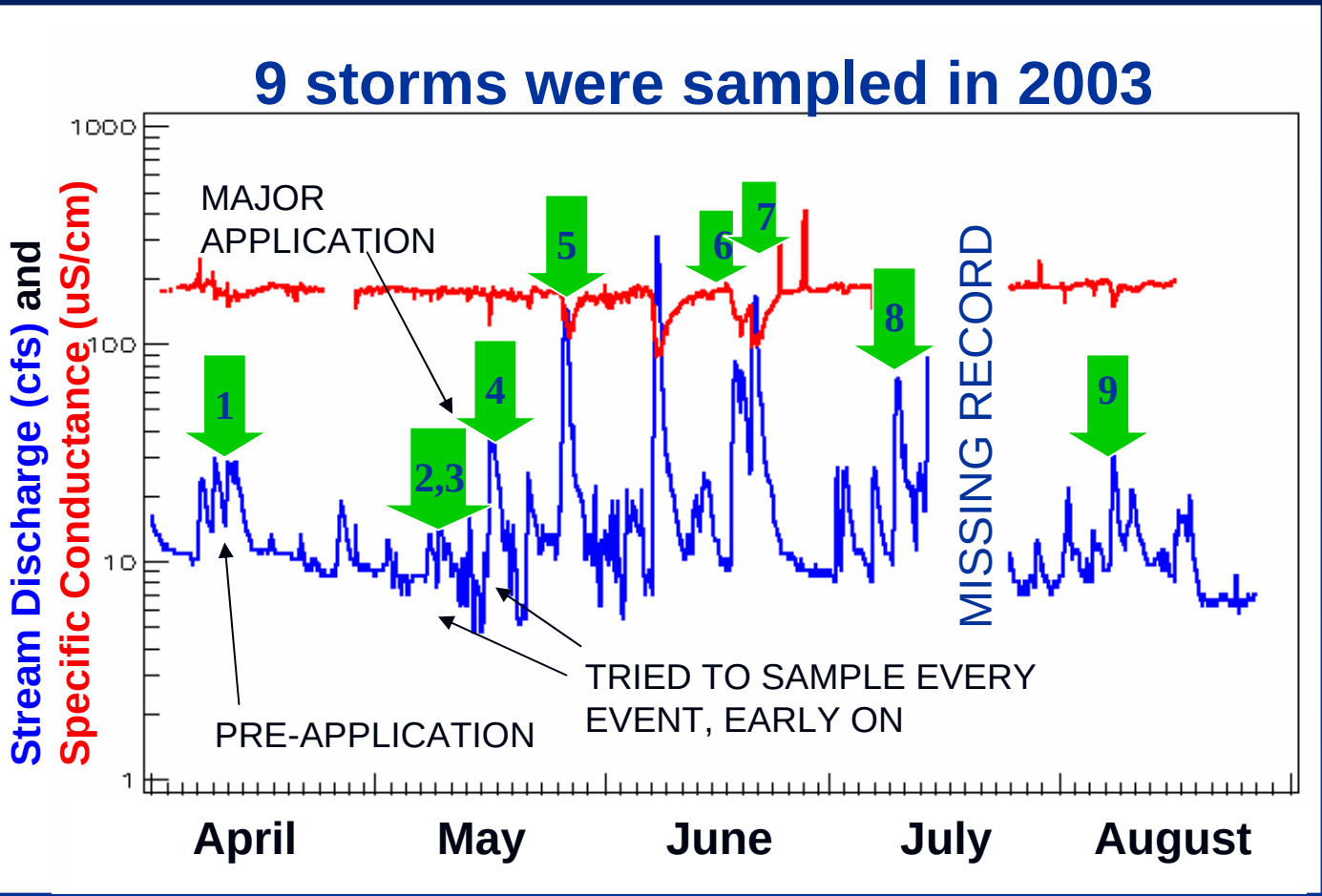
# Sampling Approach

How does the rainfall-runoff process work in the watershed?

How is stream chemistry affected by changes in season or stream flow?




Use a combined approach:

- Fixed interval sampling at regular flows throughout the year (2002-04)
- Targeted storm sampling during growing season (2003, 2004)
- Analyzed for: pesticides, nutrients, sediment, TOC, DOC, major ions

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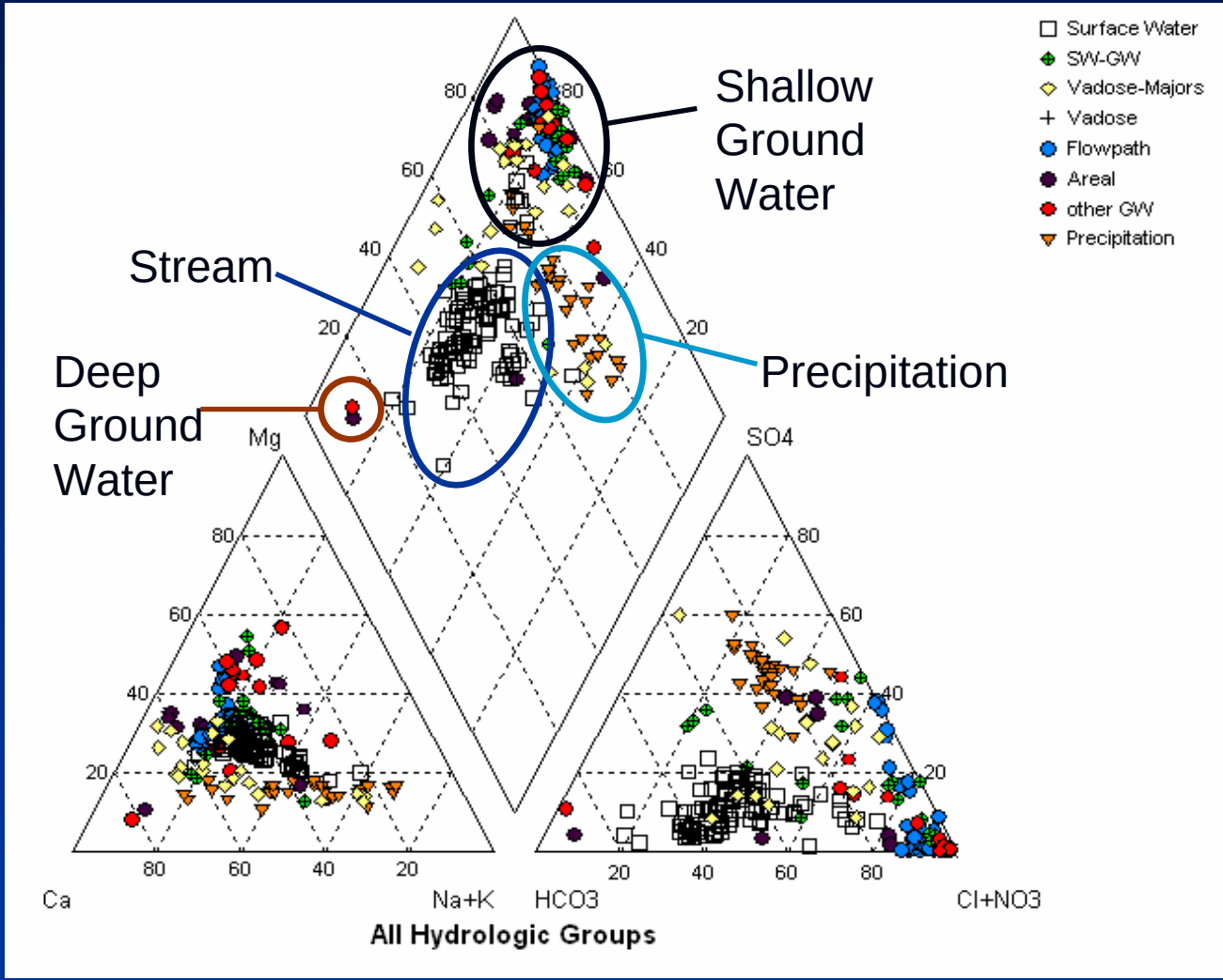
# Contributing Sources of Water




- Stream water is a variable mix of different sources
- Sampled other hydrologic compartments for chemical signatures

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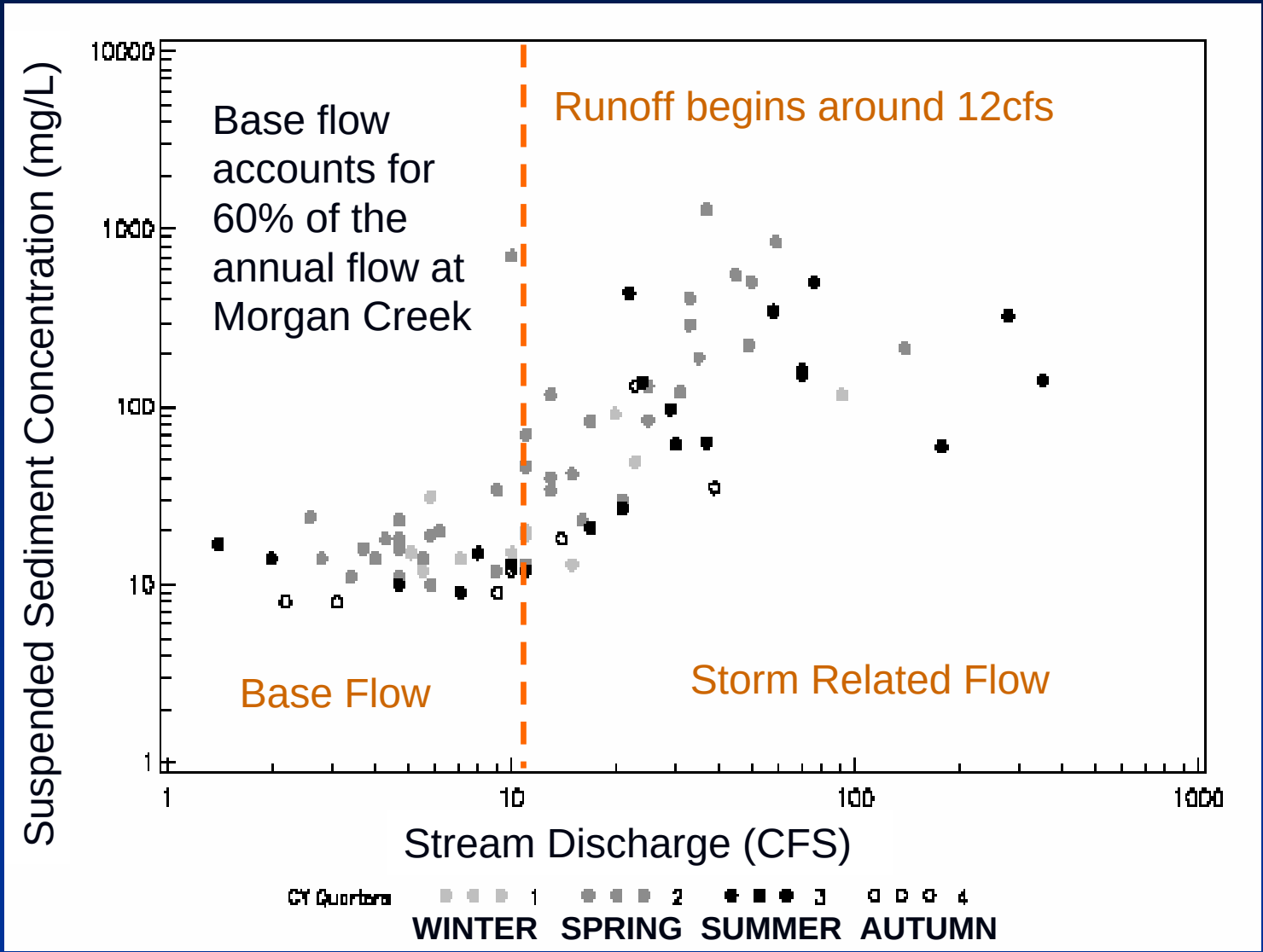
# At what flow does runoff become important?

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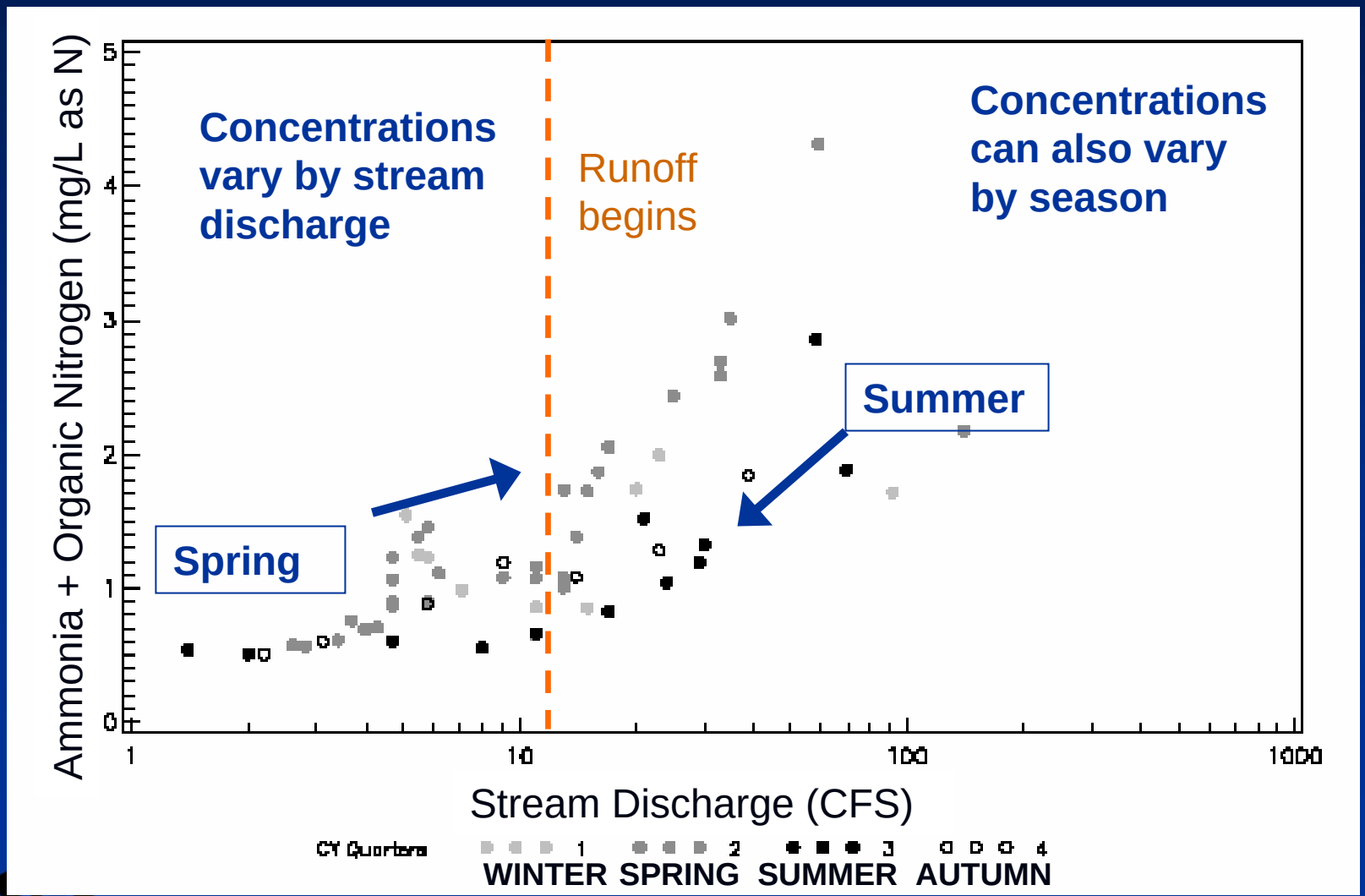
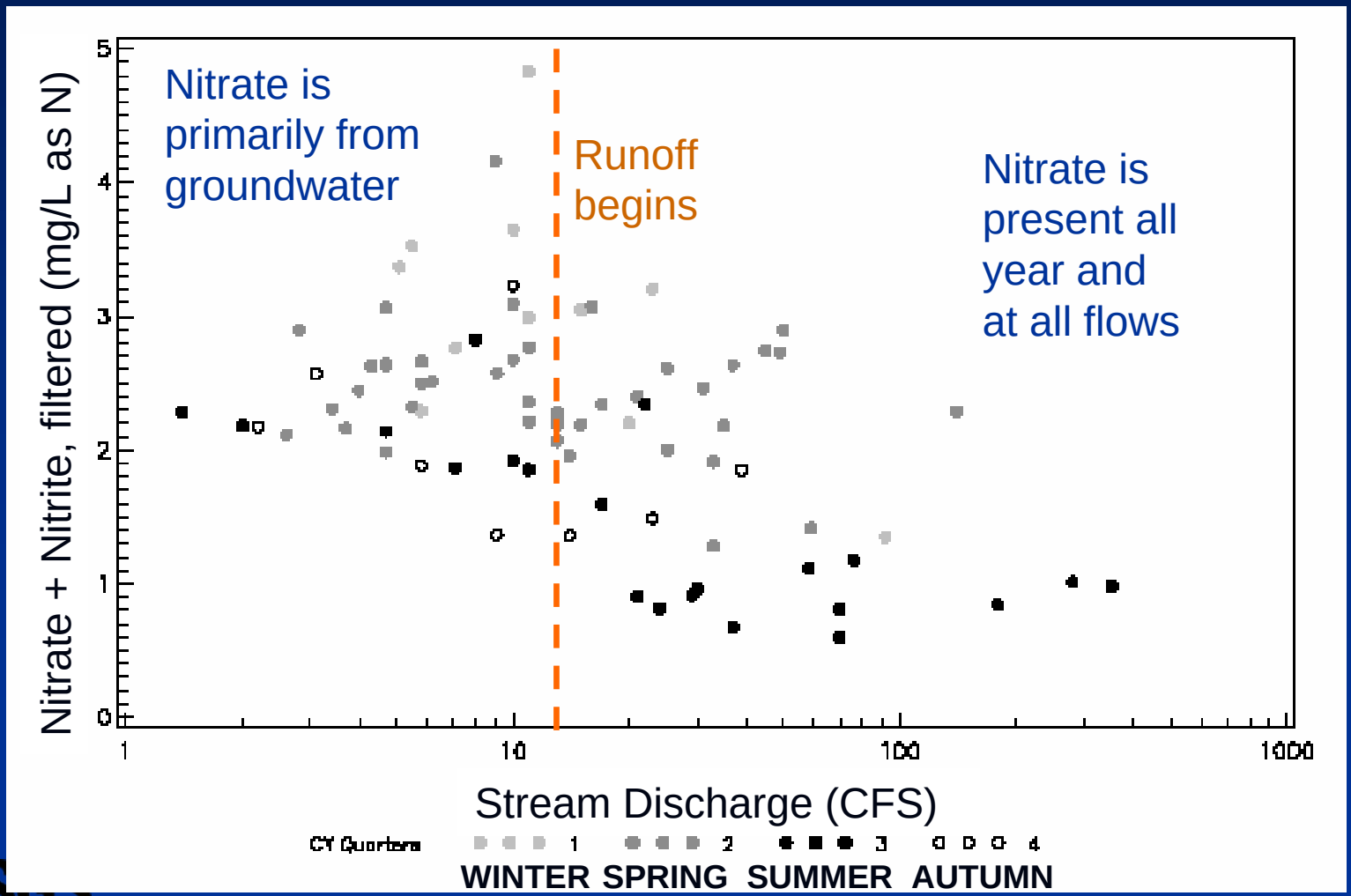
# Less soluble compounds move in runoff

For Morgan Creek, these include: ammonia, organic nitrogen, phosphorus, suspended organic carbon, pesticide parent compounds

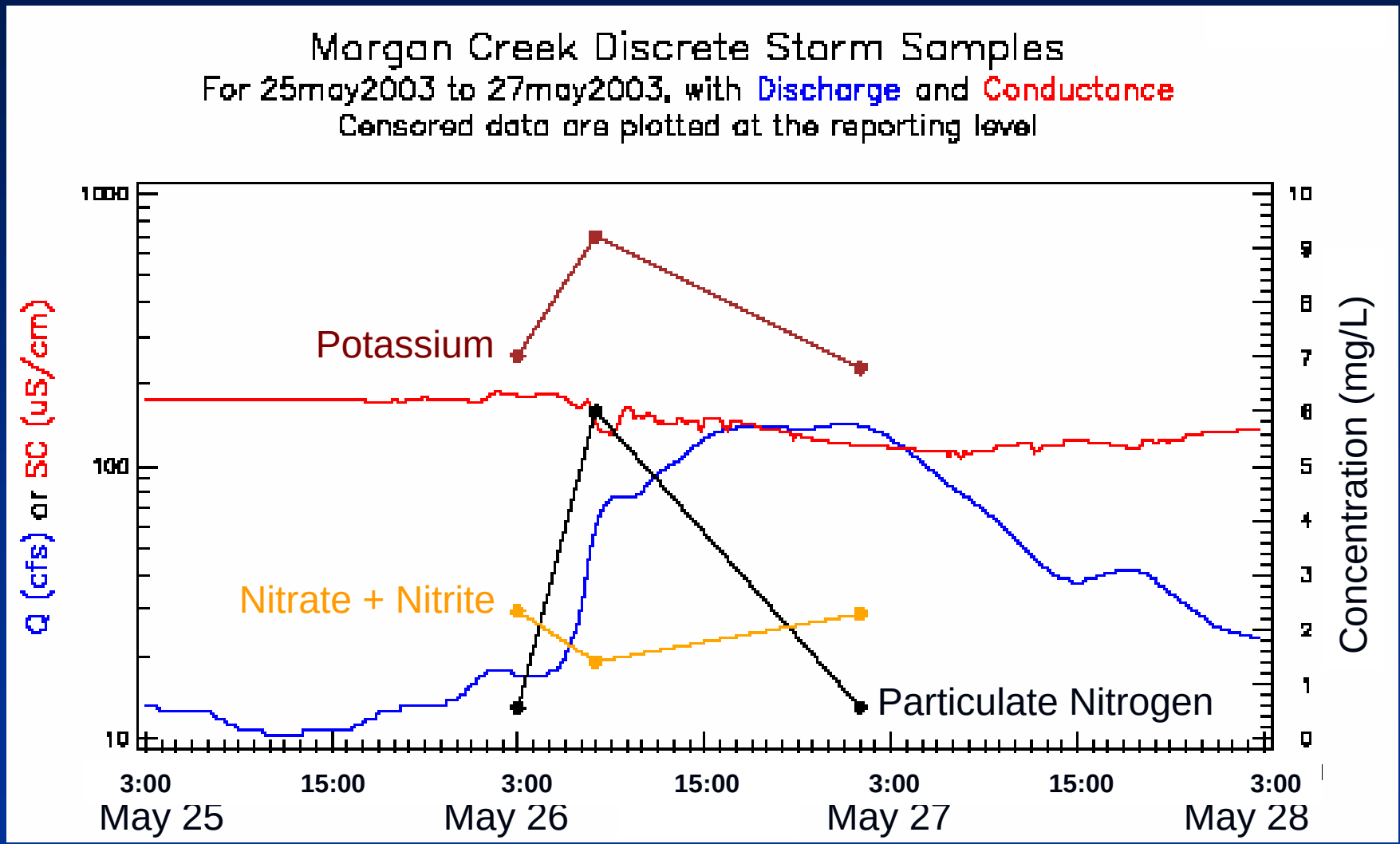


# More soluble compounds move in base flow

For Morgan Creek, these include: nitrate and other major ions, iron, bicarbonate, pesticide degradates



# Dynamic chemistry during storm events

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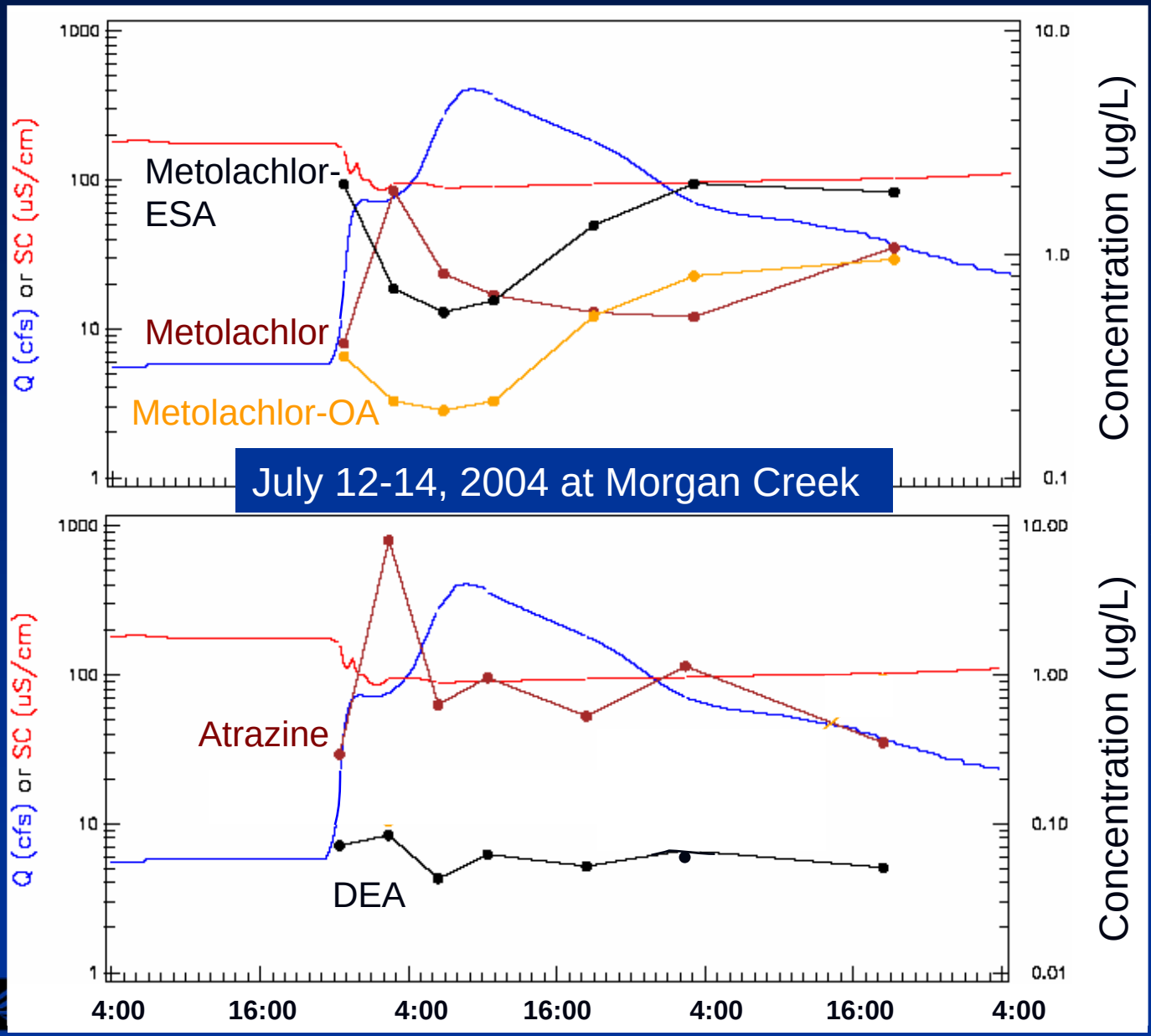
# Variable transport behavior during storm events




- Parent pesticides are transported primarily in runoff
- Metabolites of metolachlor are transported in ground water

*However*

- DEA, a metabolite of atrazine, is transported in runoff similar to its parent compound

# Summary

- Stream chemistry reflects flow-dependent contributions from many source waters
- Insoluble compounds tend to travel in runoff, at stream flows greater than 12 cfs
- Soluble compounds can travel in both runoff and base flow (primarily ground-water discharge)
- Pesticide and nutrient loads are greatest in storms after application, usually in May and June
- Pesticides and their metabolites are present year round in streams and can show contrasting transport behavior

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# Watershed Management Implications

- Develop a conceptual hydrologic understanding to focus monitoring strategies
- Build a robust data set by sampling all seasons at normal flow and during storm events
- Use an iterative process of monitoring to identify hydrologic transport pathways
- Target specific management strategies based on primary transport pathways
- *Remember:* Hydrologic residence times may strongly affect when you begin to see changes!

THE END

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