Uncertainty in Estimating Storm Flow and Base Flow Response to Extreme Weather Events in Coastal Forested Watersheds

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Objective:
Predict stream flow in lowland watersheds

Hydrological Cycle

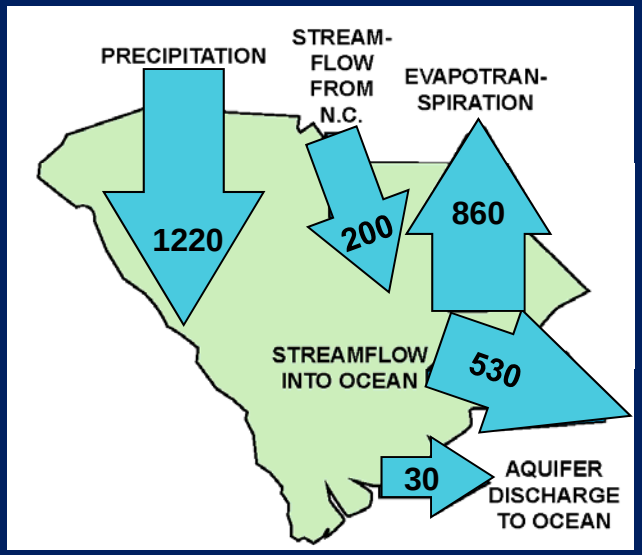
Southeast U.S.

- Water surplus (P > ET)

Lower Coastal Plain

- Low-gradient poorly drained lands
- Saturation-excess Runoff

- *Increased urbanization*
- *Saltwater intrusion*
- *Sea level rise*



SC DNR (2008)

Ecoregions: Carolina Flatwoods,
Sea Islands/Coastal Marshes

After Hurricane Hugo,
22 Sept. 1989

Predictions for Southeast U.S.

- Increased storm intensity, longer-duration droughts

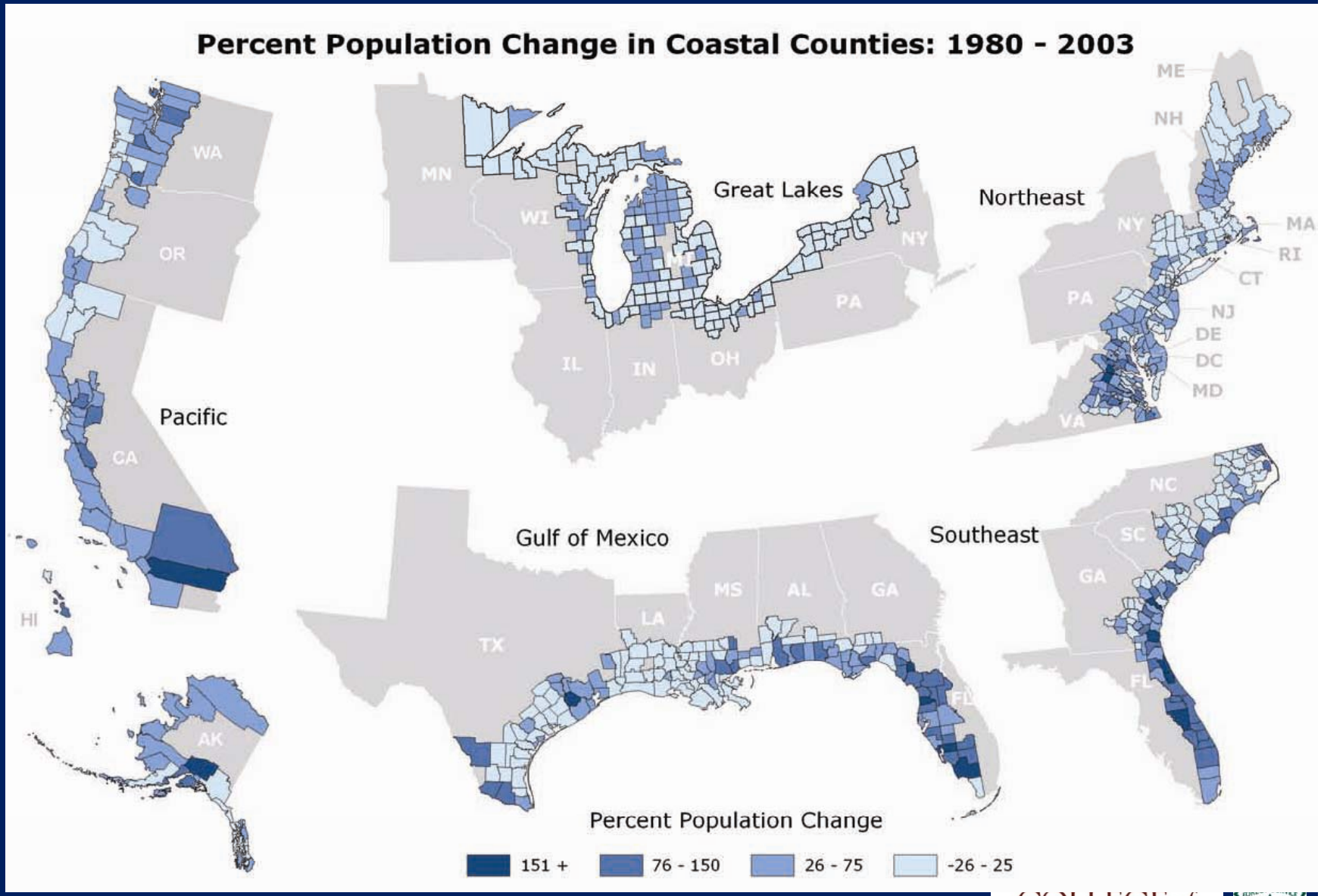
  Hurricanes: 13 major storms since Hugo (1989)

  Droughts: 1998 – 2002, 2006 – 2007; 2011 - ?

Increasing population in coastal regions

- 53% pop. in 17% land area (U.S. Census, 2003)

  800 hectares farmland converted per day (USDA, 2004)



U.S. Census Dept (2003), Allen and Lu (2003)

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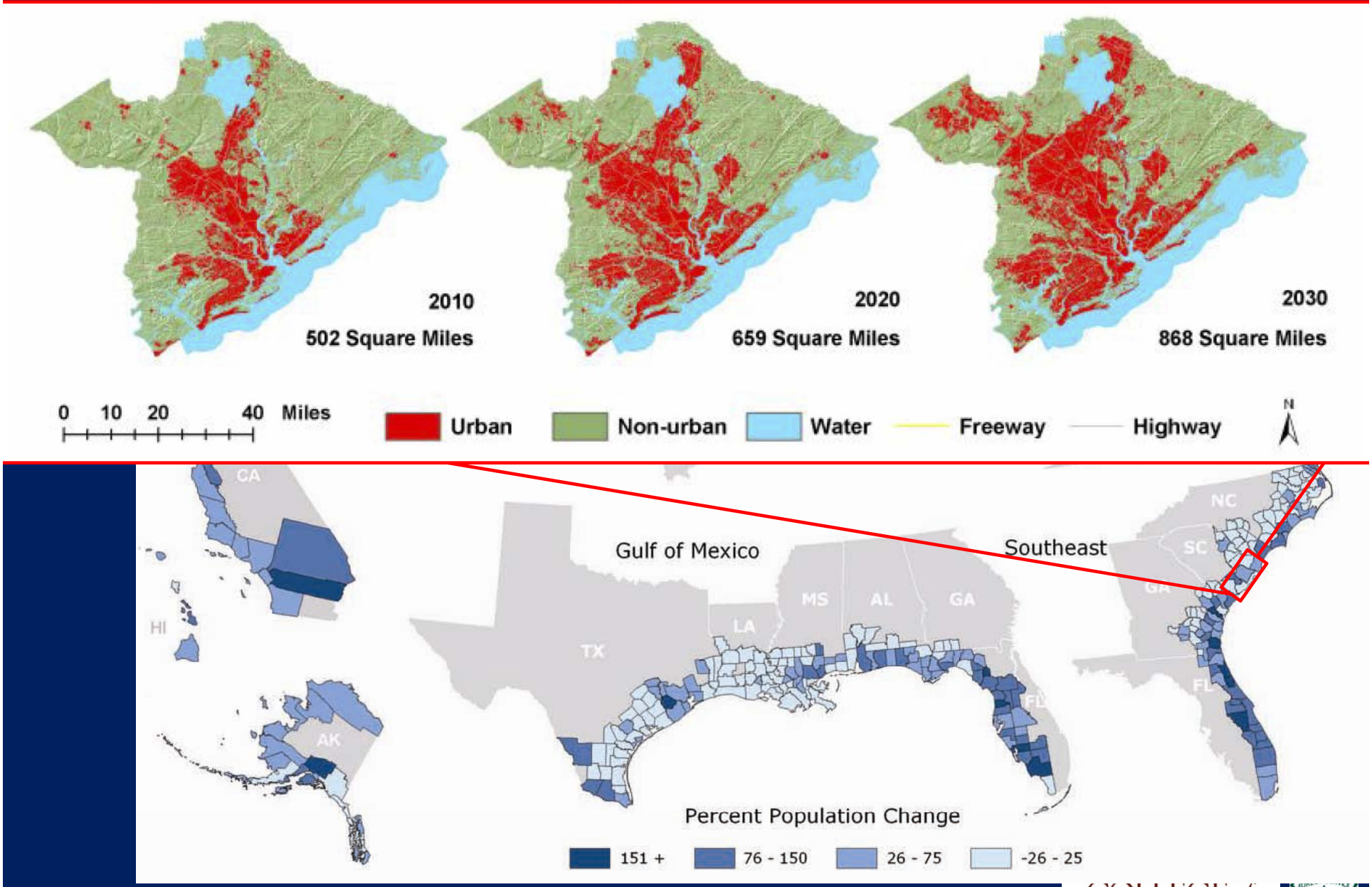

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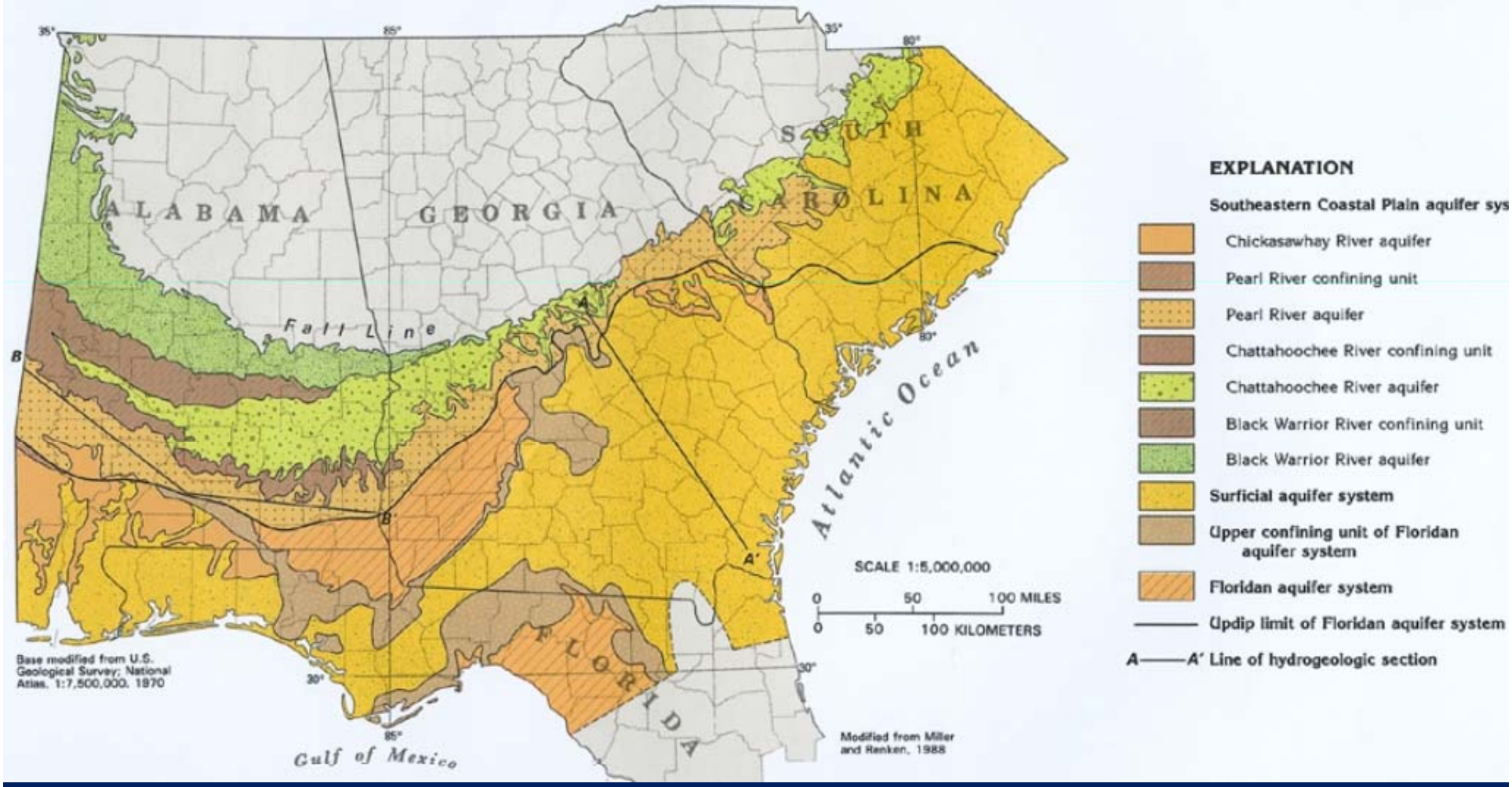
Watershed Characteristics



USGS, 1990; 2001

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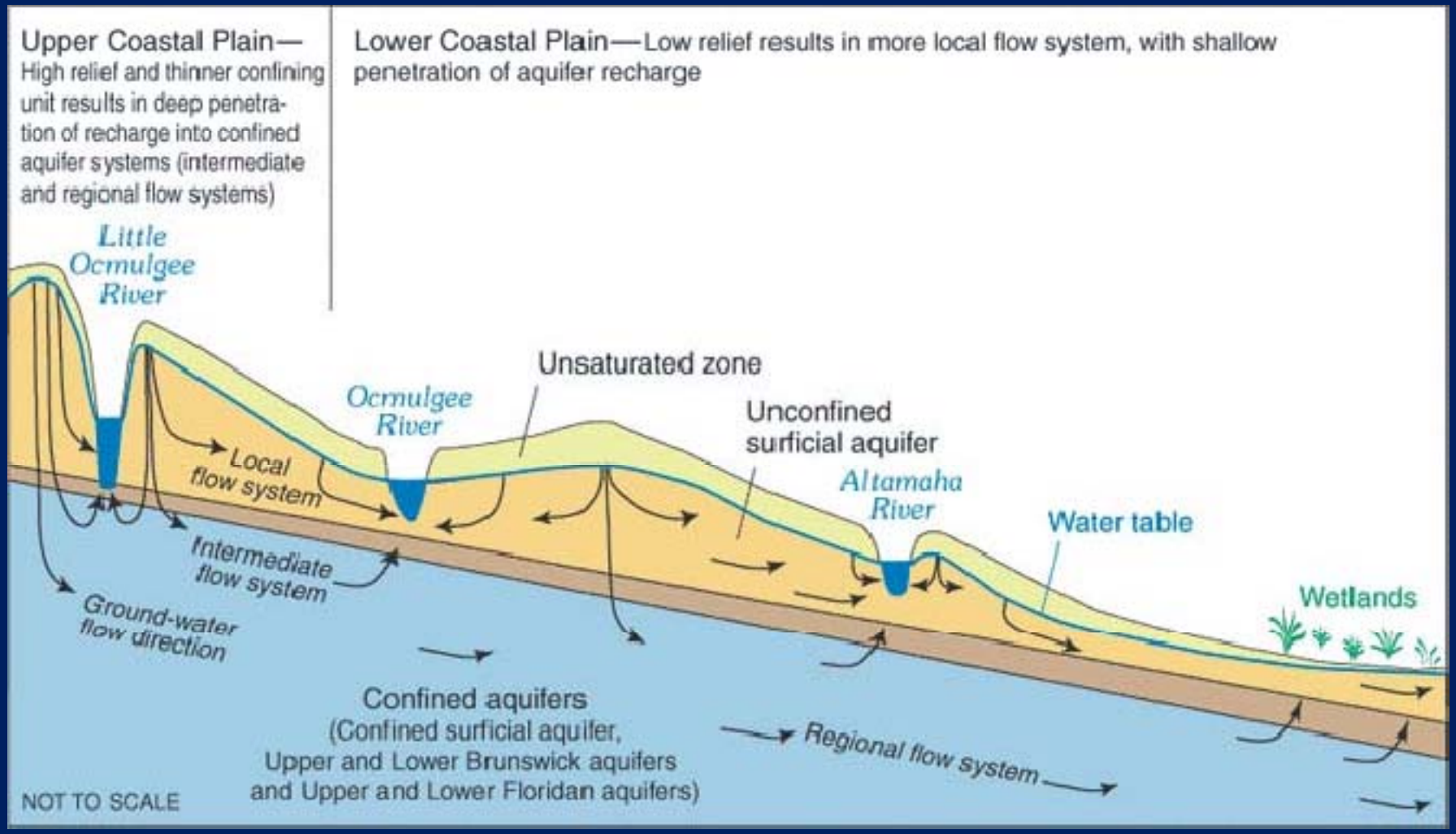
Watershed Characteristics

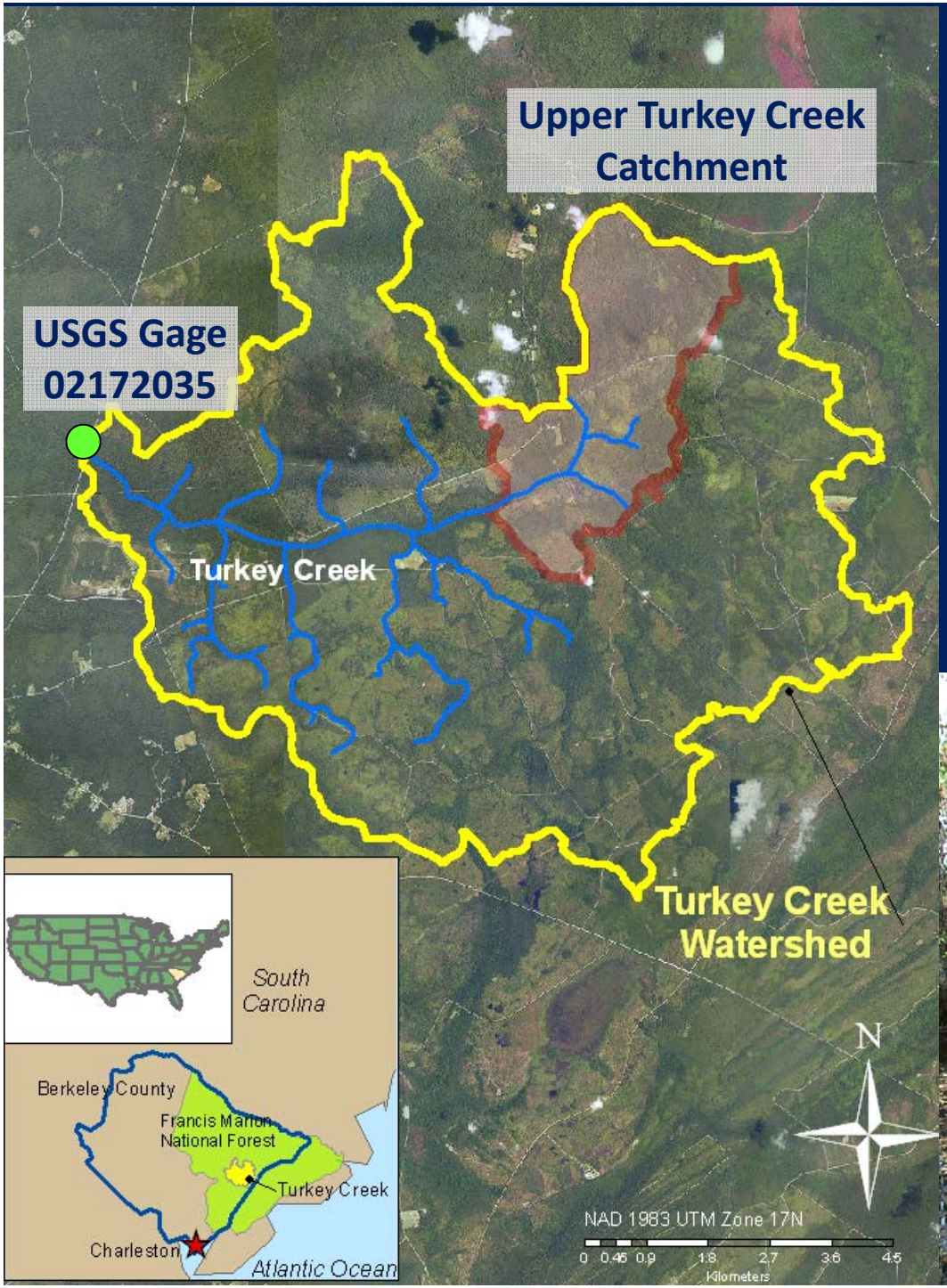


USGS, 1990; 2001

Study Site

Turkey Creek Watershed

Lower Coastal Plain, South Carolina

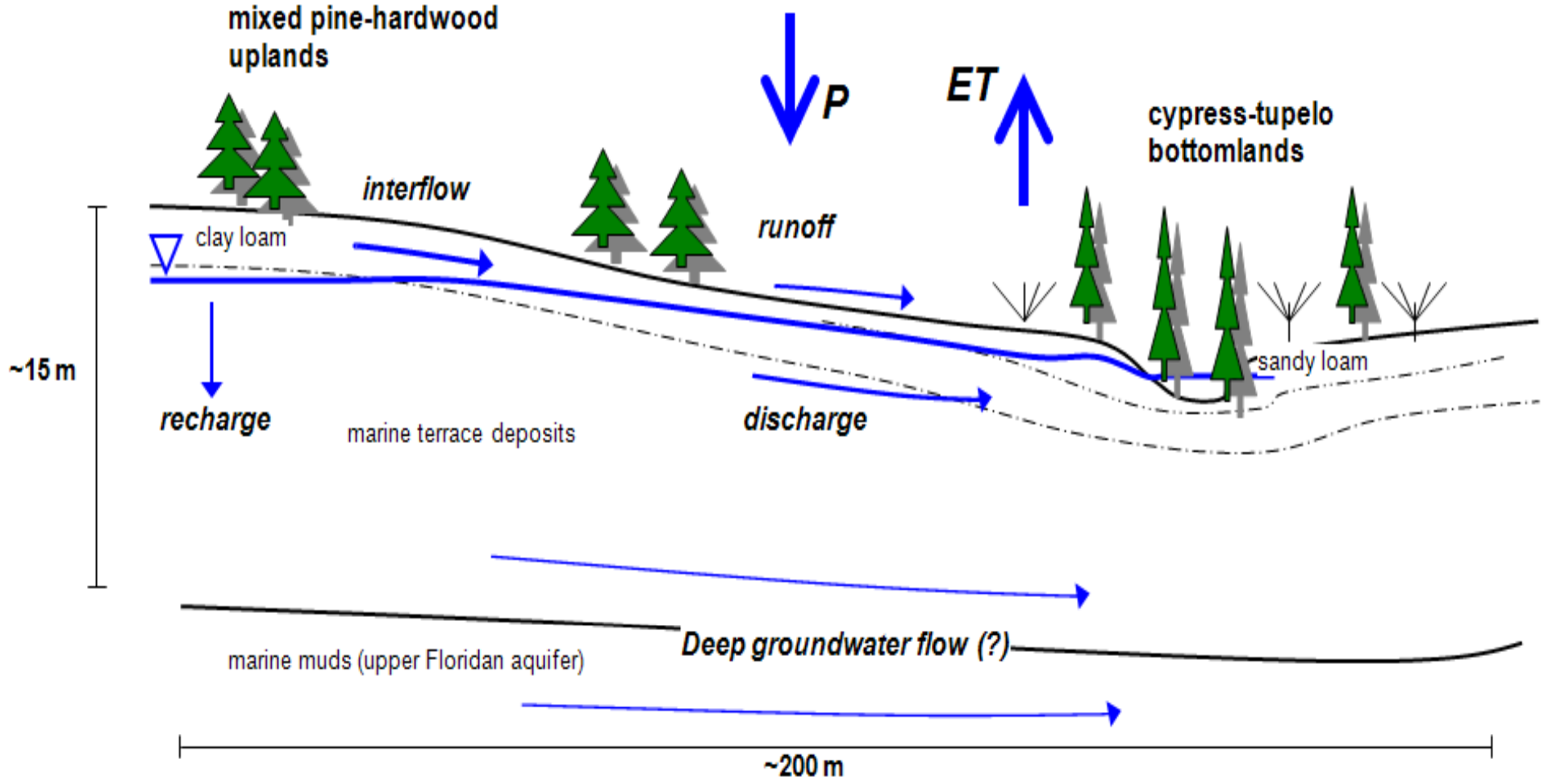


Runoff Mechanisms

Saturation-excess Runoff
("Groundwater flooding")

Stream Flow

- ***Base Flow***
- ***Storm Flow***



Base Flow Separation Methods

- Plot-scale
  - Water-table fluctuation
- Catchment-scale
  - Chemical hydrograph separation (End-member mixing analysis)
- Watershed-scale
  - Linear regression
  - Autofilter method (in Soil Water Assessment Tool)

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Session No. 281
Room M100 HI
Wed., 2:15 pm

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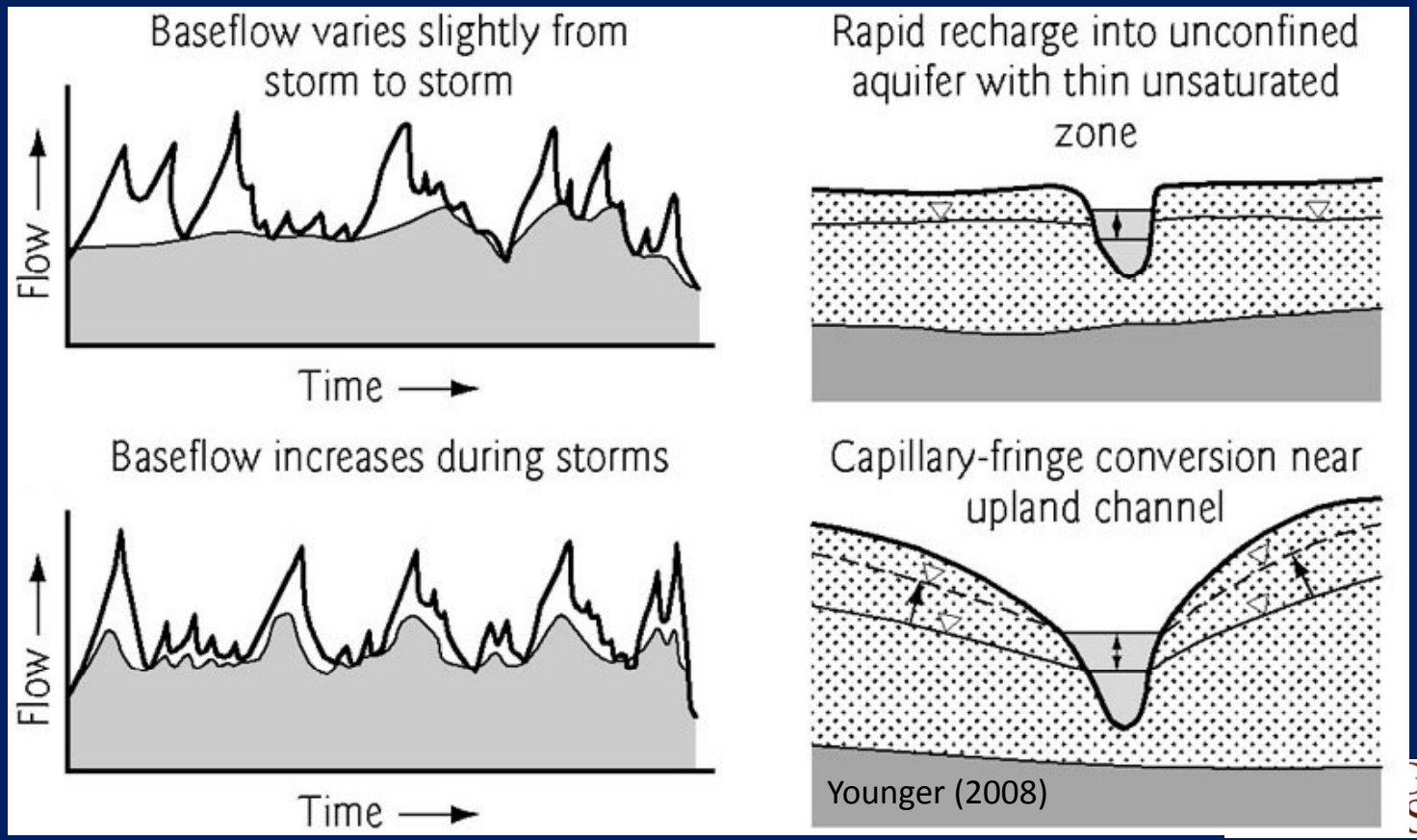
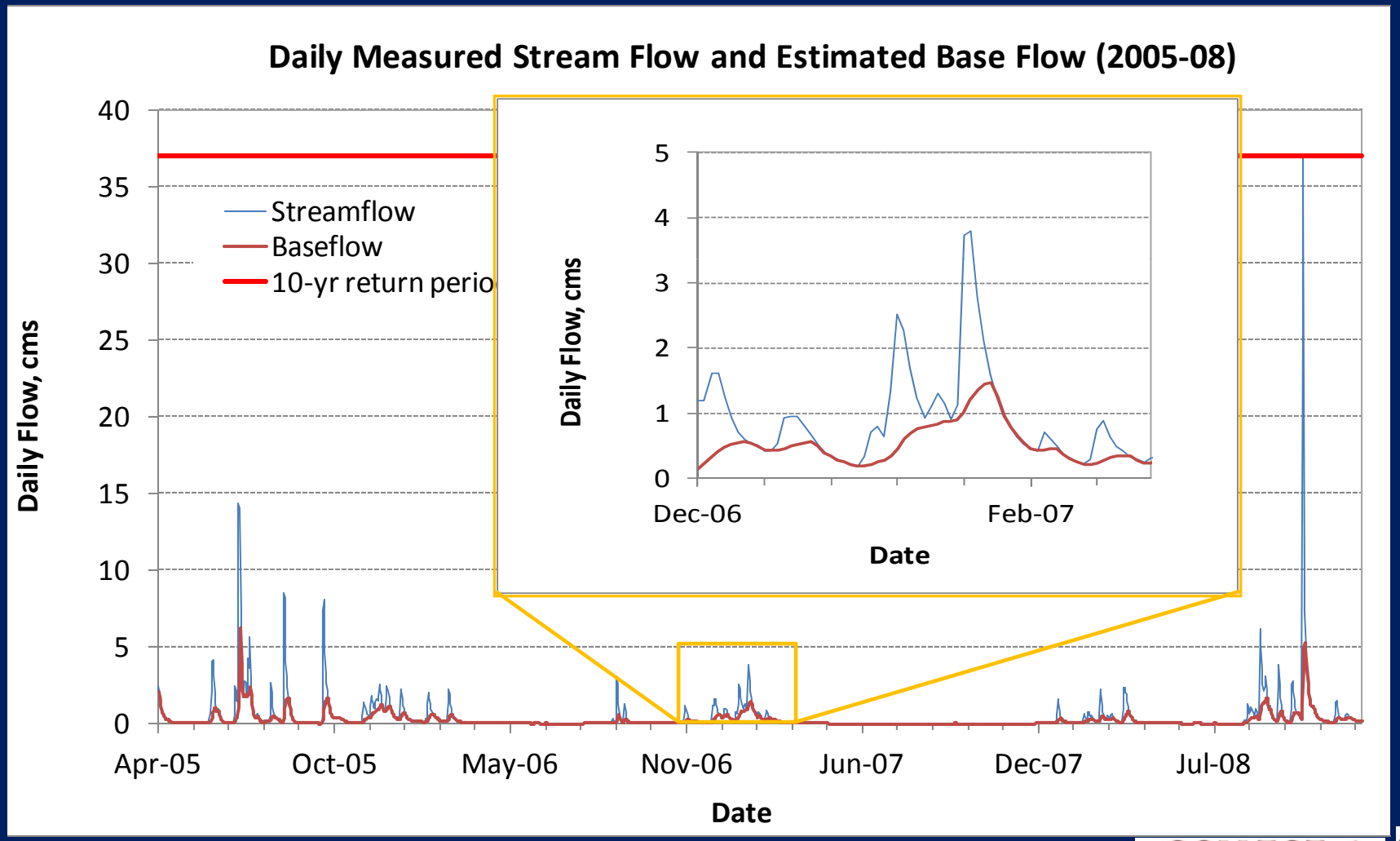
Stream Flow Response to Storms

– Base flow separation:

- Nitrogen and other dissolved loads in ***base flow***
- Sediment and phosphorus loads in ***storm flow***



Stream Flow Behavior: Third-Order Watershed



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Base Flow separation

Base flow / Stream flow estimates

Water-table response (event-based)	58% ± 53%
End-member mixing (event-based)	40% ± 11%
Watershed scale (daily)	46% ± 24%

- Predictable relationship between rain event and stream flow response (including peak flow rate)
- Uncertainty – result depends on method
- Implications for storm water & water quality management, wetland restoration and best management practices

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Example

- Model sensitivity
  - Chemical hydrograph separation sensitive to end-members

Storm response analysis, second-order catchment

End-member median conc. change	Precipitation	Riparian groundwater	Streambed groundwater
No change	61%	18%	21%
10% increase in Cl^-	61	21	18
10% increase in Si	64	15	22
50% increase in Cl^-	61	27	11
50% increase in Si	75	**- 2.7**	21

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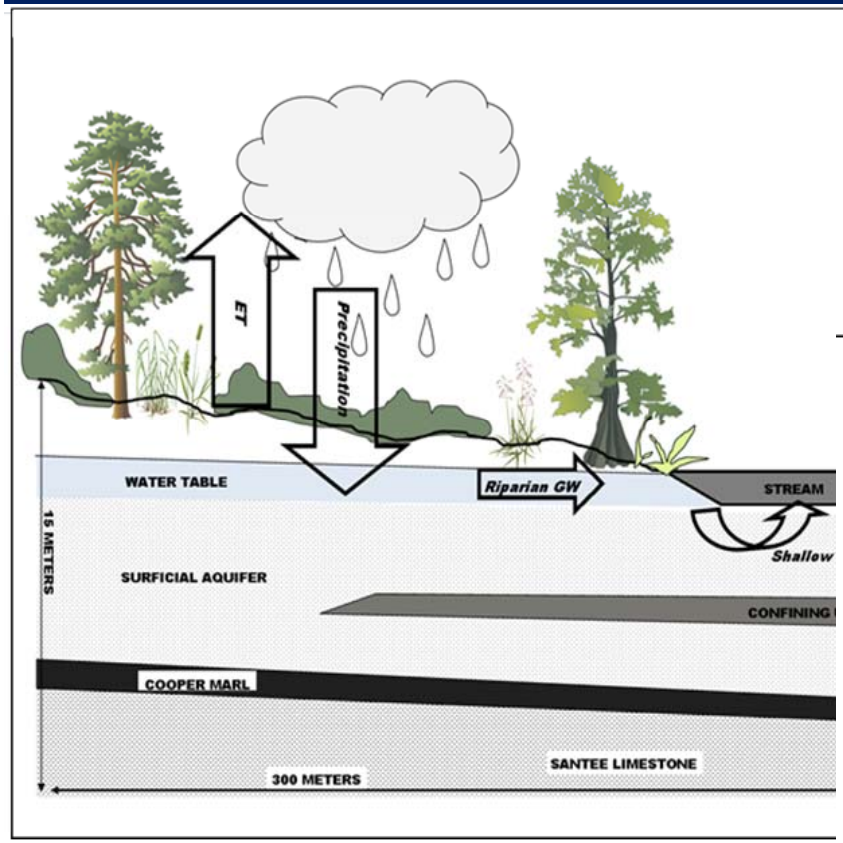
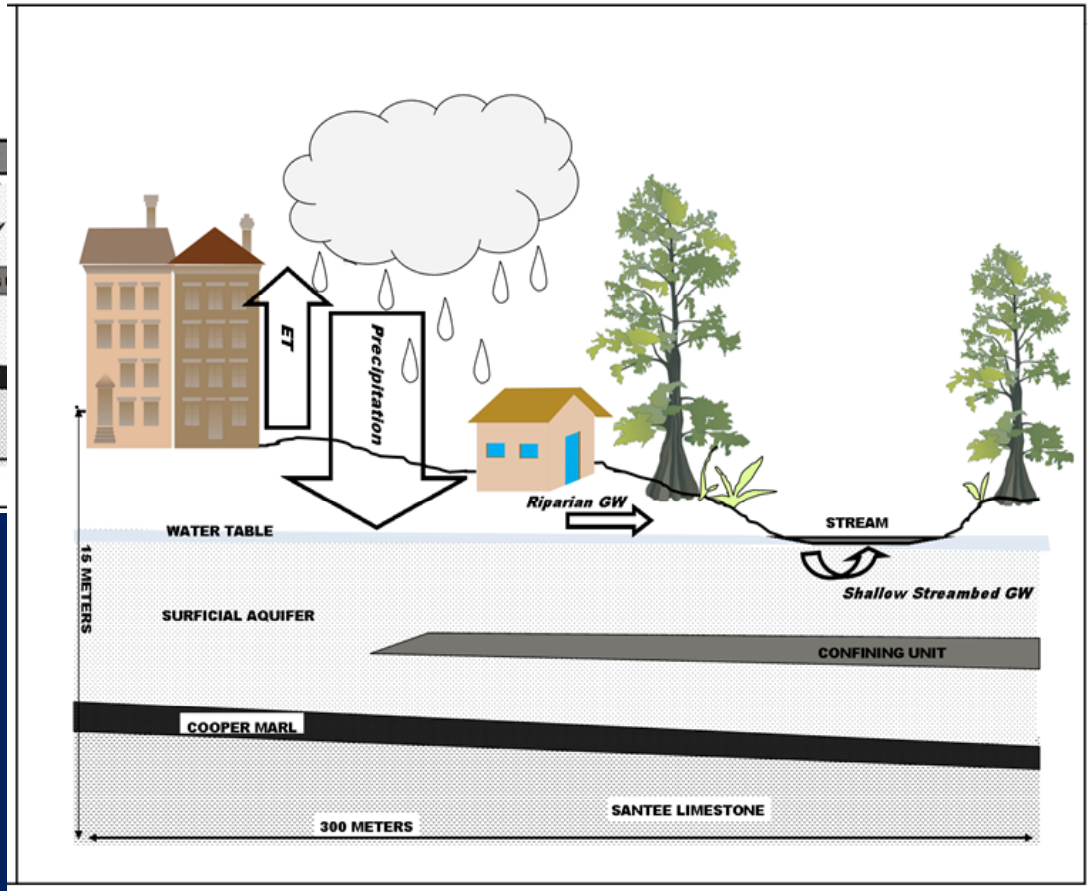
Discussion



Garrett *et al.* (in press)

Decreased base flow:
smaller nitrogen loads (?)



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