Water Budget

- **Input - Output = Change in Storage**
- Also called water balance
- Quantifies water cycle stores and fluxes for a specific place and time
  - Often for a year or season
  - Often for a watershed
What is a watershed?

• An area that drains into a stream, lake, or ocean
• Bounded by topographic divides
• Multiple scales
  – Breakneck Creek → Cuyahoga River → Lake Erie → Great Lakes/St. Lawrence
• Same as a catchment and a drainage basin

Very simple water budget for a very simple watershed

• Inputs - Outputs = Change in Storage
• P – E - T - R = ΔS
• What is ΔS?
  – Soil moisture
  – Groundwater
  – Surface water in streams lakes and ponds
  – Ice and snow at the surface
  – Temporary depression storage
  – Intercepted water on plant surfaces

Image source: http://techalive.mtu.edu/meec/module01/whatiswatershed.htm
Example Water Budget Question:

What is the long-term average evapotranspiration for the Tinker’s Creek watershed?

Watershed area $= 217.3 \text{ km}^2 = 2.173 \times 10^8 \text{ m}^2$

$P - \text{ET} - R = \Delta S$

$P - R - \Delta S = \text{ET}$
Tinkers Creek Water Balance

Input: Precipitation
- ~40 in. = ~1.016 m/yr

Tinkers Creek Water Balance
Output = Runoff
Tinkers Creek Water Balance

Observed mean discharge at Bedford for 1964-2011 is 139 ft³/s or 3.93 m³/s

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\text{Discharge (per second) } \times \text{ seconds (per year)} = 3.93 \, \text{m}^3/\text{s} \times 3.16 \times 10^7 \, \text{s/yr} \\
= 1.24 \times 10^8 \, \text{m}^3/\text{yr}
\]

\[
\text{Discharge (per year) } / \text{ Watershed Area} = \text{ Runoff} \\
1.24 \times 10^8 \, \text{m}^3/\text{yr} / 2.173 \times 10^8 \, \text{m}^2 = 0.571 \, \text{m/yr}
\]

Tinkers Creek Water Balance

• Assume no change in storage?
• Input = Output
• Precipitation = Runoff + ET
• Precipitation - Runoff = ET

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1.016 - 0.571 = 0.445 \, \text{m/yr} = \text{ET}
\]
Tinkers Creek Water Balance

• We estimated ET = 44.5 cm/yr.
• Is that reasonable?

If it’s not reasonable, what might explain it?