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Managing Water in the West

A (Very) Brief Overview of Streamflow Hydrology:

Natural and Human Processes That Influence Streamflow

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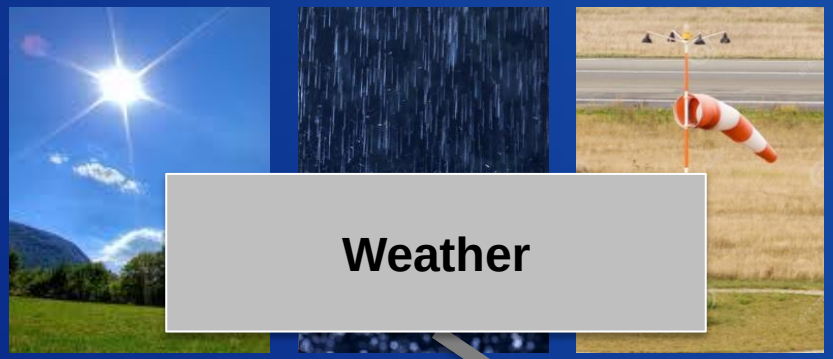
Big Picture: It's Complicated…

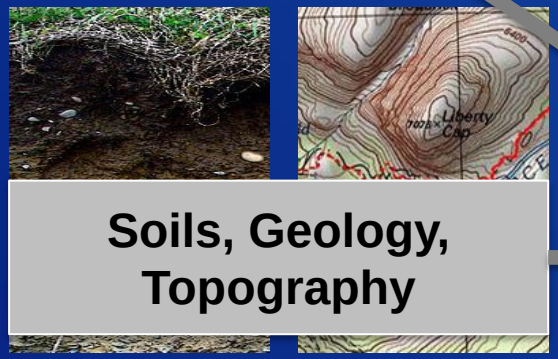
Natural

Human



Weather

Storage, Diversion, Consumptive Use



Soils, Geology, Topography

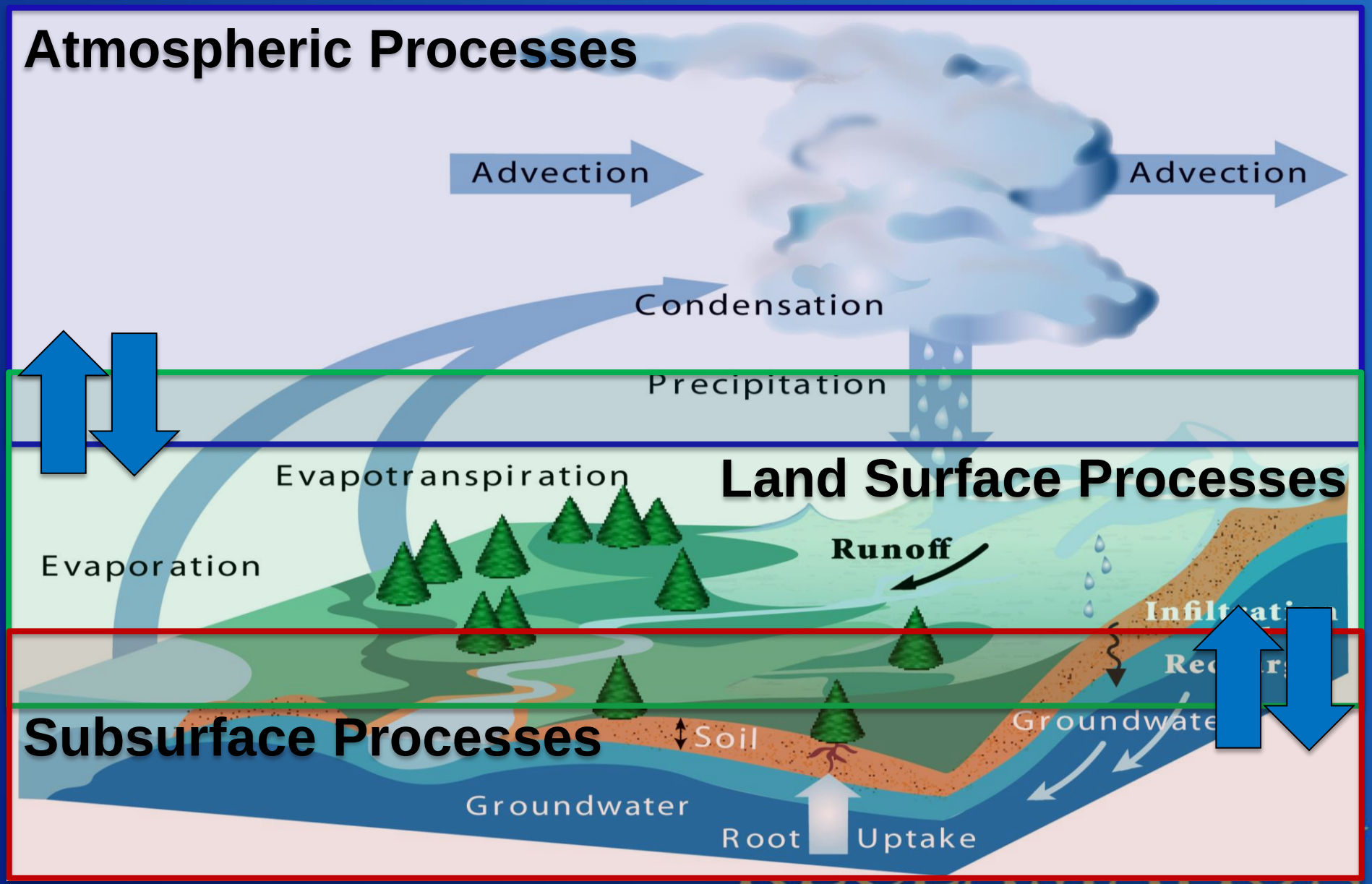
Streamflow

GW Pumping, Land Cover Change

Vegetation

Etc…Etc…Etc…

Hydrologic Cycle

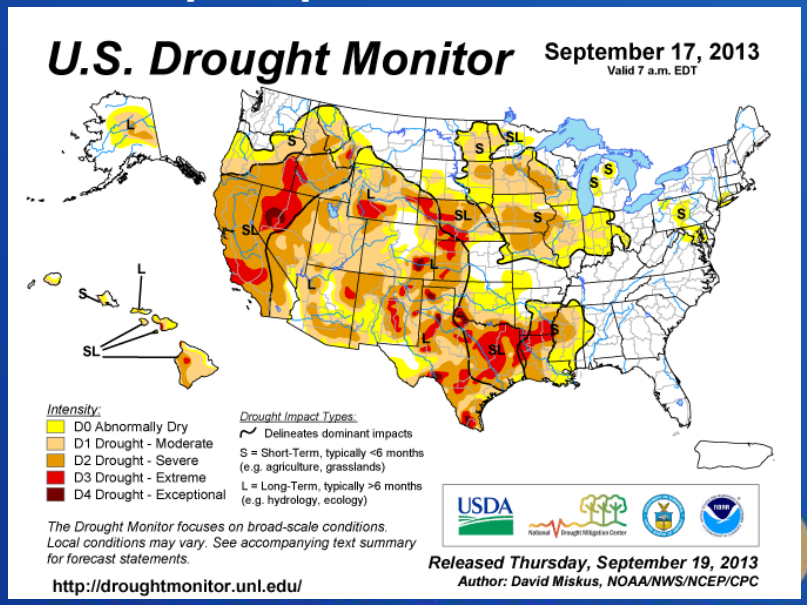


Natural Factors Affecting High/Low Flow

- **Meteorology**
  - Includes precipitation, wind, temperature, solar radiation, etc.
  - Affects water supply and demand
  - Affects streamflow on short and long-term timescales (e.g., floods, water supply)

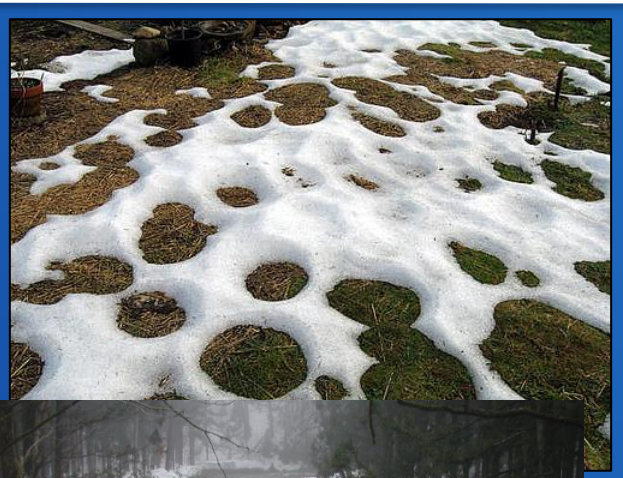
Individual Weather Events

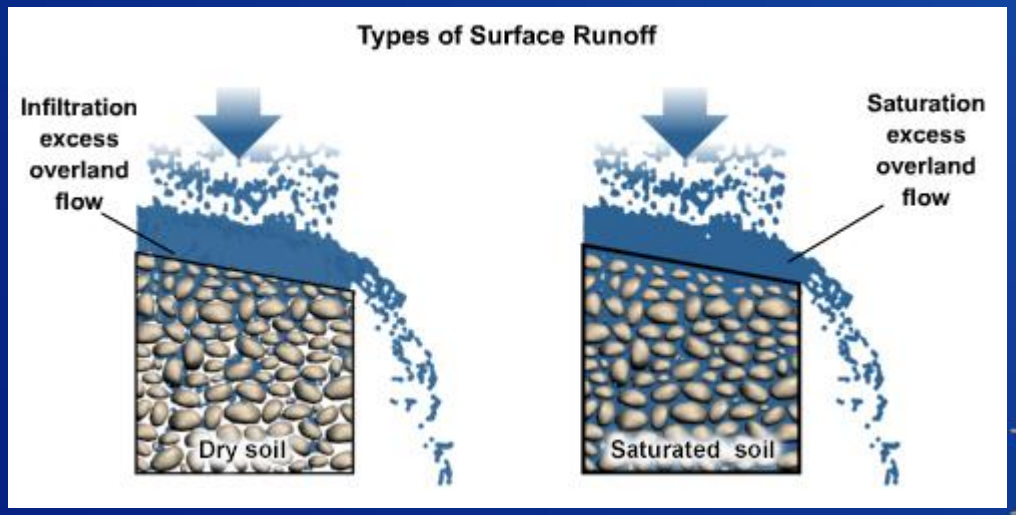
Sustained periods of above or below normal precipitation and/or ET

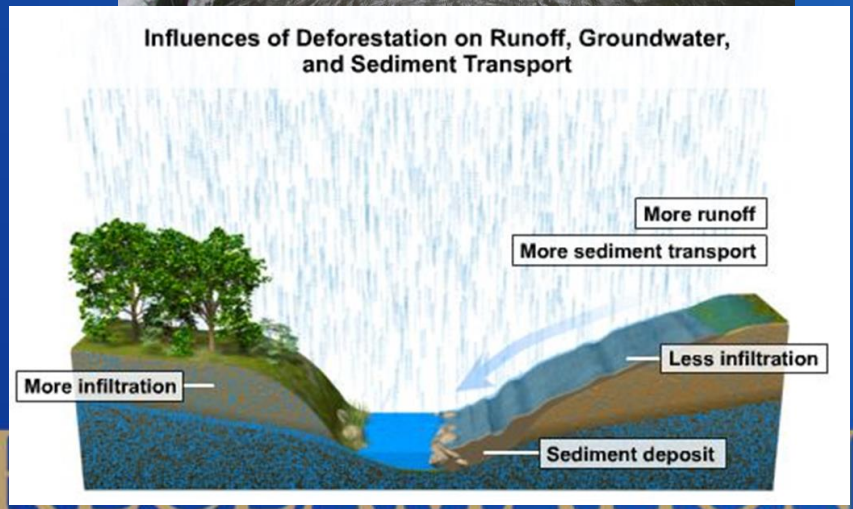


Natural Factors Affecting High/Low Flow

- **Antecedent Conditions**
  - Typically only considered on shorter timescales, since vary widely over longer periods
  - Significant effect on runoff and recharge generation
    - Saturation excess runoff
    - Rain on snow
    - Disturbances (e.g., fire, clearing)







Human Factors Affecting High/Low Flow

- **Land Cover Change**
  - increase in impervious surfaces, drainage/grading of wetlands, and other changes
  - can contribute to high runoff from precipitation events
  - can reduce groundwater recharge and baseflow
  - can result in higher peak flows and lower low flows
- **Consumptive Use**
  - surface water diversions
  - surface water depletions due to groundwater pumping (complex effect, difficult to quantify)
- **Storage**
  - storage typically reduces peak flows, increases low flows
  - can affect total flow in areas with high reservoir evaporation

Tools for Evaluating Streamflow

- **Field Data and Analysis**

- **Common Measurements:**
  - Streamflow
  - Groundwater elevation
  - Meteorological conditions (temperature, wind speed, solar radiation, humidity, etc.)

- **Common Uses:**
  - Water budget estimates
  - Trend analysis
  - Correlation analysis

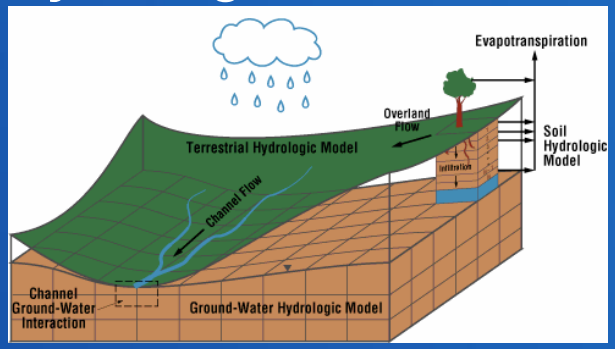
Tools for Evaluating Streamflow

- **Hydrologic Models**

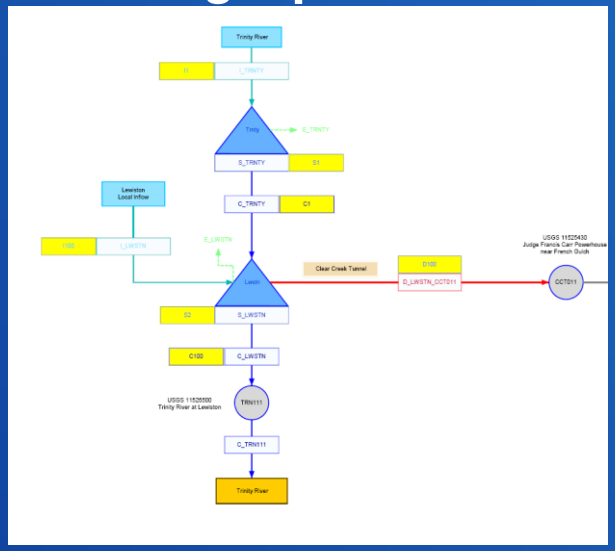
  - **What are Models?**
    - Computer software
    - Mathematical relationships representing physical processes and/or system operations
    - Calculate water balance based on natural and human factors

  - **Role of Models**
    - Isolate effects of individual factors (“numerical experiments”)
    - Evaluate streamflow response to future changes (e.g., urbanization, climate change, etc.)

Hydrologic Models



Planning/Ops Models



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Reclamation Studies in California

- **Current Long-Term Planning Studies in CA**
  - Evaluate water supply and demand under projected future conditions (climate, land use, etc.)
  - Develop and evaluate alternatives to address projected imbalances in supply vs. demand
  - For more information: *http://www.usbr.gov/WaterSMART/bsp/*

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Summary:

- **Streamflow is Complicated…**
  - Many factors, some natural and some human
  - Factors act simultaneously
    …but with different locations and durations
  - Streamflow reflects complex interaction between factors in both space and time

- **Models are Important Tools for Understanding and Simulating Streamflow**
  - Represent relevant processes and interactions
  - Provide a means of isolating effects of individual factors – e.g., effects of groundwater pumping on streamflow
  - Allow us to evaluate complex interactions between factors
  - Models allow us to project future streamflow response to changing conditions

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