Tracking Variations of Catchment Storage with Stable Water Isotopes

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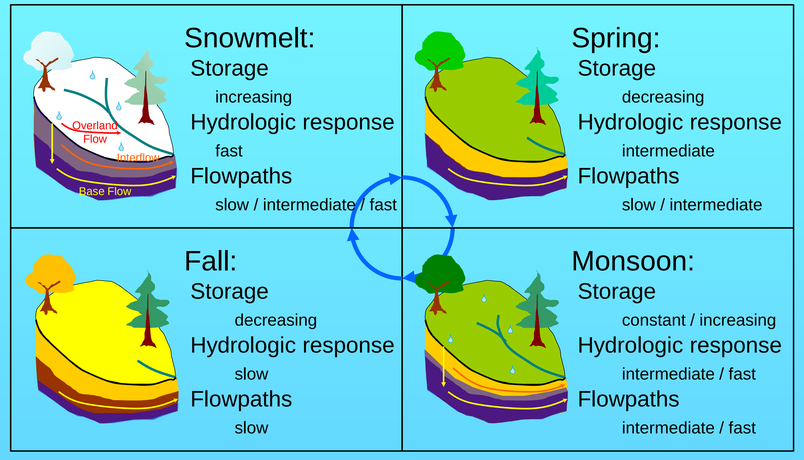
Question / Problem

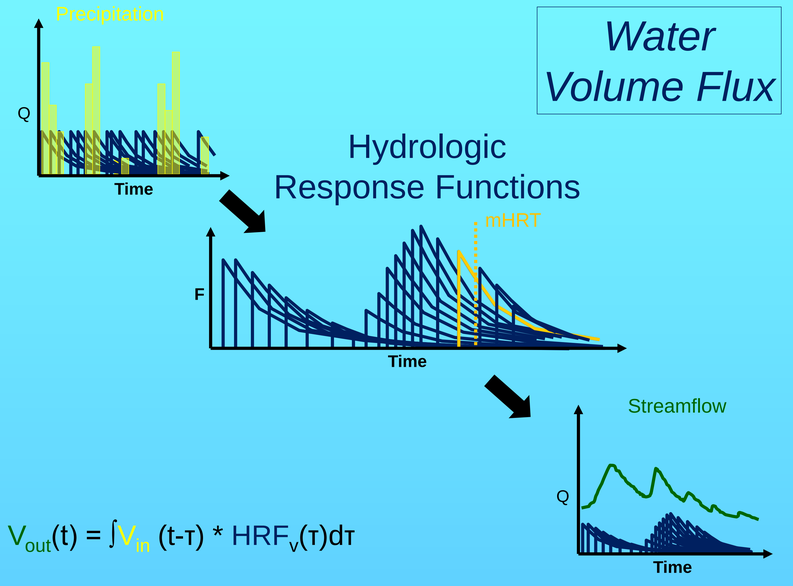
- What total amount of water is stored in a catchment? How does the amount of stored water vary over time?
- It is extremely difficult to monitor water storage variations for entire catchments



- Important!
- It controls hydrologic catchment response to a great extent
- It also controls mixing processes and water chemistry in the catchment

Hydrologic Response Function

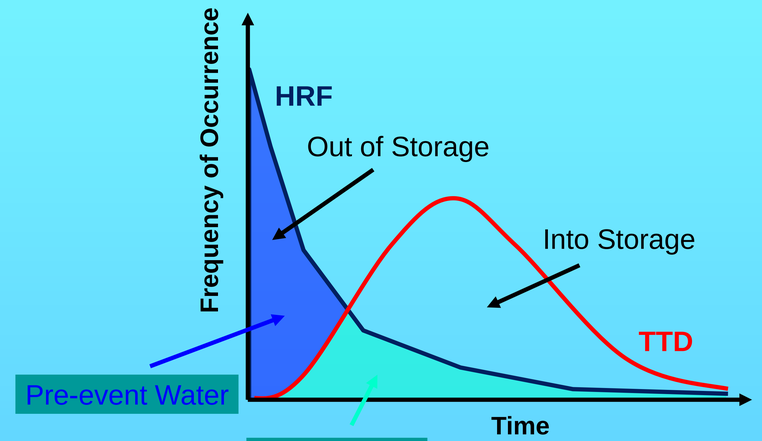
- How fast do we observe outflow after a precipitation event?
  - HYDROLOGIC RESPONSE TIME



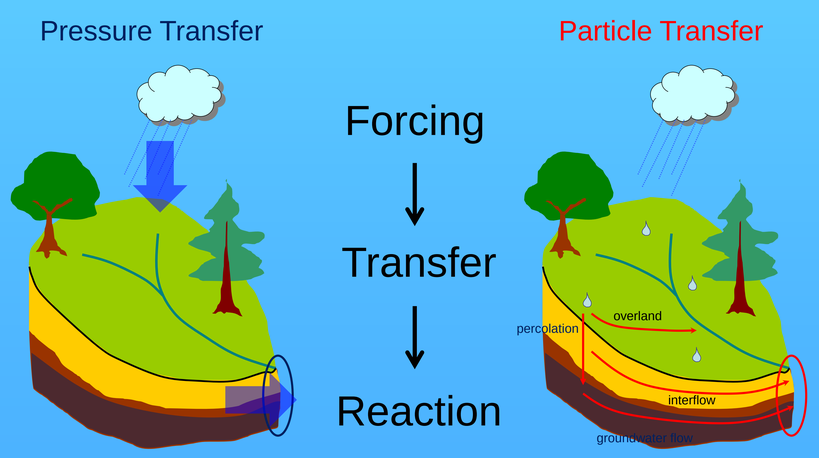
$$V_{out}(t) = \int V_{in}(t-\tau) * HRF_v(\tau)d\tau$$

Comparison

- Comparing hydrologic response function (HRF) and transit time distribution (TTD) gives insight into storage variations
  - Event water vs. pre-event water
  - Outflow from storage vs. inflow into storage

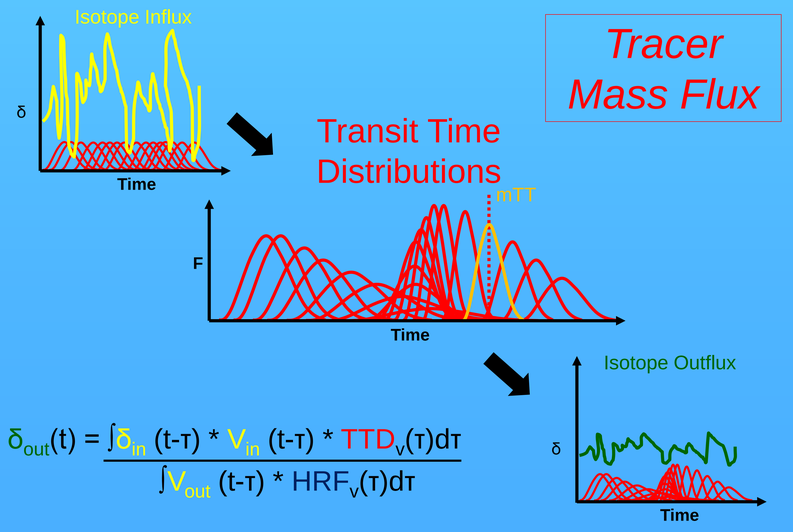


Hydrologic Forcing & Catchment Reaction



Transit Time Distribution

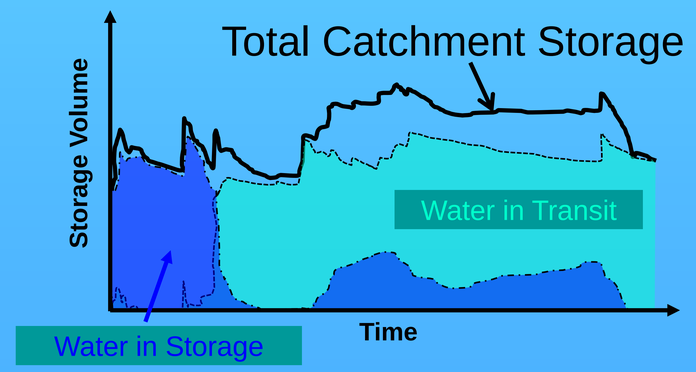
- How much time does the water spend inside the catchment?
  - TRANSIT TIME



$$\delta_{out}(t) = \frac{\int \delta_{in}(t-\tau) * V_{in}(t-\tau) * TTD_v(\tau)d\tau}{\int V_{out}(t-\tau) * HRF_v(\tau)d\tau}$$

Storage Tracking

- Tracking HRF and TTD in time reveals storage behavior:



Conclusion

- Combined approach using water volume and isotope chemistry:
  - Yields information on both total water storage and water storage variations
  - Can be used to infer future catchment reactions

Acknowledgements

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