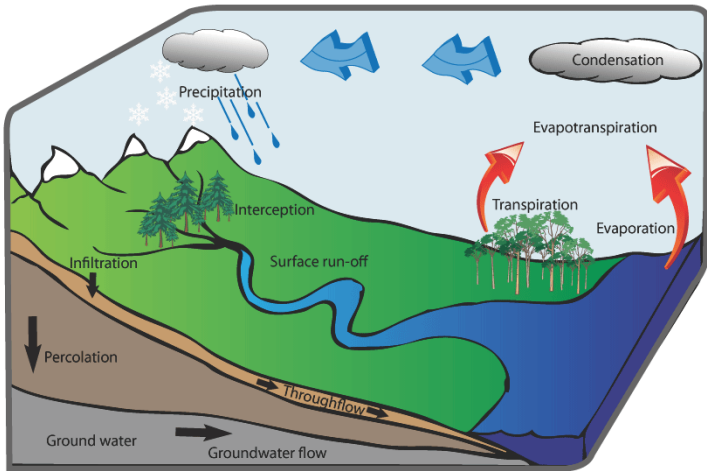
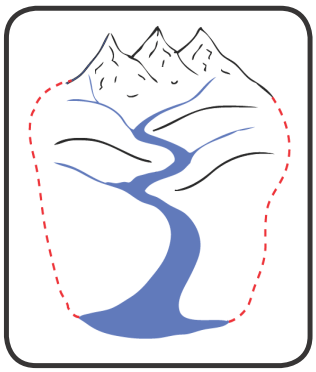
The Hydrological Cycle

Key Terms

* **Evaporation:** water from lakes & oceans turning into vapour
* **Transpiration:** water vapour given off by plants/trees.
* **Evapotranspiration**: the sum of evaporation & transpiration
* **Condensation:** water vapour cooling & turning into water droplets.
* **Precipitation**: water falling back to earth (snow, hail, rain, sleet).
* **Interception:** trees etc stop some rain reaching the ground.
* **Throughfall:** water dropping from leaves.
* **Stemflow:** water running down plant stems/tree trunks.
* **Surface run-off:** water flowing through streams & rivers.
* **Infiltration:** water soaking into the surface soils.
* **Through-flow**: water flowing downhill through the soil
* **Percolation:** water seeping through rock & deeper soils.
* **Groundwater:** water deep in saturated rocks underground.
* **Groundwater flow**:(baseflow) slowly moving to river channel or the sea.





The Drainage Basin

A drainage basin is the total area drained by a river & its tributaries.

* **Source:** the start of a river
* **Tributary:** a smaller river that runs into a larger one
* **Confluence**: the meeting point of two rivers/tributaries
* **Mouth**: the end of the river where it flows into the sea
* **Watershed**: Also known as drainage divide, it is the line defining the boundary of a river drainage basin.

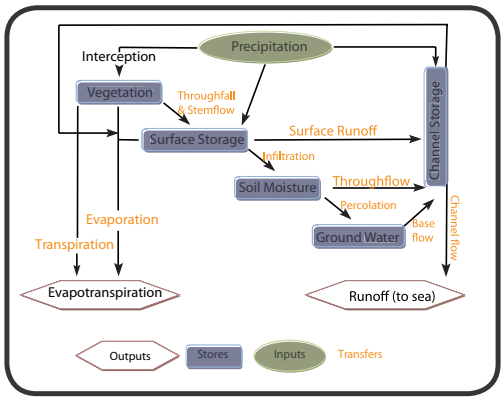
Changing Balance of Water Storage

Reduction in ice storage

* Global warming is melting mountain glaciers and Arctic/Antarctic ice sheets.

Impacts

* Increased amounts of surface runoff (higher levels of meltwater) leading to increased flood risk.
* Rising sea levels due to additional water.
* Possible lower infiltration rates due to increased surface runoff.
* Impact on groundwater levels if infiltration is reduced.



Maximum Sustainable Yield

The maximum level of extraction of water that can be maintained indefinitely for a given area.
This concept relates to a balance between the inputs and outputs of the water system. If we increase water use for irrigation then there will be an increase in the amount of water lost through evapotranspiration. Similarly - rising populations are increasing water consumption and then sending the waste water quickly to the seas where it is lost to the system.

Discharge

* This is the volume of water that passes a certain point over a certain period of time. It is usually measued in ***cumecs*** (cubic meters per second).
* Discharge tends to increase as the river travels downstream due to tributaries joining but also increased velocity (less friction)

Peak Discharge

This is the time at which the river is flowing at its fullest after the peak rainfall.

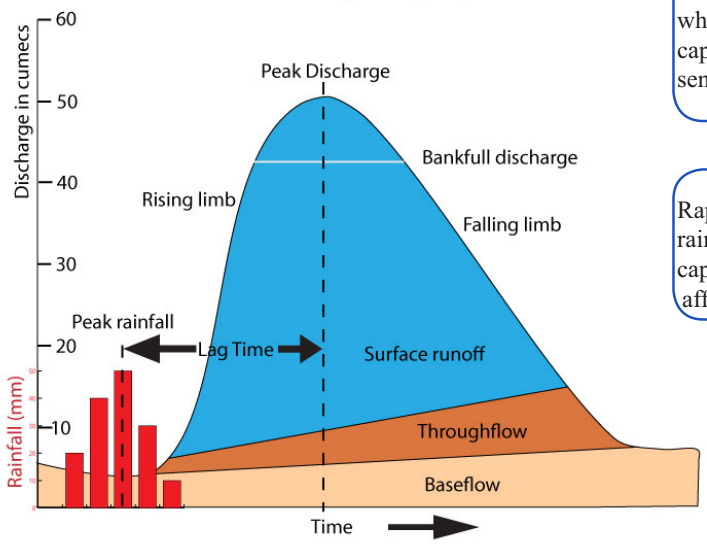
Lag Time

The time between peak rainfall and peak discharge. It is significant since it represents how quickly the water from the rain reached the river

Peak Rainfall

Represents the time at which there was the heaviest rainfall during the storm.

Storm Hydrograph



Bankfull Discharge

This represents the point at which the river is flowing at capacity. Above this line represents flooding.

Surface Runoff

Rapid increases in this as heavy rainfall exceeds infiltration capacity. Various factors will affect this rate. (see below)

Throughflow.

This is lower and slower than surface runoff due to the time taken to infiltrate and pass through the soil.

Rising Limb

Linked to lag tme - a steep rising limb (quick increase in discharge levels in a river) - flash flood risk.

Falling Limb

This shows how quickly the discharge returns to pre-storm levels.

Base Flow

Changes in base flow are small and more gradual. It takes more time to infiltrate and percolate to base flow.

Factors Affecting Flood Hydrographs

* **Infiltration rates**: impermeable soils and surfaces (urban areas) reduce the amount of water that can soak in. This increases the amount of surface runoff & will cause a steeper rising limb.
* **Drainage density**: a higher density of streams and tributaries speeds up the rate at which the rainfall enters the main channel - steeper rising limb.
* **Vegetation cover**: areas with vegetation are likely to have higher interception rates which reduces the amount of water reaching the river channel & slows down the speed at which it reaches the channel.
* **Urban areas**: these not only increase the amount of runoff, they deliberately increase the speed at which it reaches the river.

Flooding - Case Study: Bangladesh 1998

Natural Causes

* Most of Bangladesh has been formed by the deposition of alluvial soils over millions of years by the rivers running through it.
* Due to the nature of its formation as a floodplain it is very flat, low lying and naturally prone to flooding.
* It has 3 major rivers (Ganges, Brahmaputra & Meghna) converging and at times of peak flow the confluences are likely to experience flooding.
* Continued deposition of material by the rivers slowing reduces their capacity and increases the flood risk.
* This geographical region experiences the monsoon rainy season from May to September with high levels of rain falling in the 3 main river basins that flow through Bangladesh.

Human Causes

* Deforestation in the Himalayas has reduced interception rates, increased surface runoff and led to higher peak discharge levels.
* Deforestation is leading to increased soil erosion in mounatin areas which is increasing silting of the river channel downstream.
* Increasing levels of population in Bangladesh & India are causing urban expansions and larger impermeable areas.
* Lack of available finance is leading to lack of investment in flood defenses (maintenance & new defences).

Consequences

* Almost $1 billion of damage. Extensive damage to rice plantations and huge loss of livestock - impact on food supply & price.
* 4750 people killed.
* Drinking water supplies contaminated which lead to spread of cholera & dysentry.
* 7 million homes destroyed and almost 25 million people made homeless.