Flood myth

"Great Flood" redirects here. For other uses, see Great Flood (disambiguation).

"The Deluge", frontispiece to Gustave Doré's illustrated edition of the Bible. Based on the story of Noah's Ark, this shows humans and a tiger doomed by the flood futilely attempting to save their children and cubs.

A **flood myth** or **deluge myth** is a narrative in which a great flood, usually sent by a deity or deities, destroys civilization, often in an act of divine retribution. Parallels are often drawn between the flood waters of these myths and the primeval waters found in certain creation myths, as the flood waters are described as a measure for the cleansing of humanity, in preparation for rebirth. Most flood myths also contain a culture hero, who strives to ensure this rebirth.[1]

The flood myth motif is widespread among many cultures as seen in the Mesopotamian flood stories, the Hindu religious books from India called Puranas, Deucalion in Greek mythology, the Genesis flood narrative, and in the lore of the K'iche' and Maya peoples in Mesoamerica, the Lac Courte Oreilles Ojibwa tribe of Native Americans in North America, the Muisca people, and Cañari Confederation, in South America.

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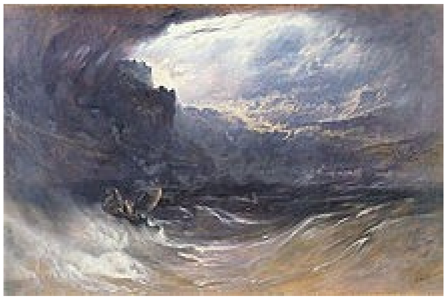
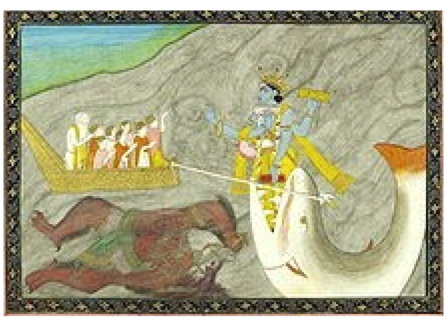


"The Deluge", by John Martin, 1834. Oil on canvas. Yale University

The Mesopotamian flood stories concern the epics of Ziusudra, Gilgamesh, and Atrahasis. In the Sumerian King List, it relies on the flood motif to divide its history into preflood and postflood periods. The preflood kings had enormous lifespans, whereas postflood lifespans were much reduced. The Sumerian flood myth found in the *Deluge tablet* was the epic of Ziusudra, who heard the Divine Counsel to destroy humanity, in which he constructed a vessel that delivered him from great waters.[2] In the Atrahasis version, the flood is a river flood.[3]

Assyriologist George Smith translated the Babylonian account of the Great Flood in the 19th century. Further discoveries produced several versions of the Mesopotamian flood myth, with the account closest to that in Genesis 6–9 found in a 700 BCE Babylonian copy of the *Epic of Gilgamesh*. In this work, the hero, Gilgamesh, meets the immortal man Utnapishtim, and the latter describes how the god Ea instructed him to build a huge vessel in anticipation of a deity-created flood that would destroy the world. The vessel would save Utnapishtim, his family, his friends, and the animals.[4]



Matsya-avatara of Lord Vishnu pulls Manu's boat after having defeated the demon.

In Hindu mythology, texts such as the Satapatha Brahmana mention the puranic story of a great flood,[5] wherein the Matsya Avatar of Vishnu warns the first man, Manu, of the impending flood, and also advises him to build a giant boat.[6][7][8]

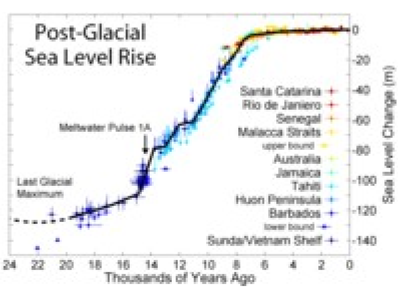
In the Genesis flood narrative, of the Hebrew Bible, Yahweh decides to flood the earth because of the depth of the sinful state of mankind. Righteous Noah is given instructions to build an ark. When the ark is completed, Noah, his family, and representatives of all the animals of the earth are called upon to enter the ark. When the destructive flood begins, all life outside of the ark perishes. After the waters recede, all those aboard the ark disembark and have God's promise that He will never judge the earth with a flood again. He gives the rainbow as the sign of this promise.[9]

In Plato's *Timaeus*, Timaeus says that because the Bronze race of Humans had been making wars constantly Zeus was angered and decided to punish humanity by a flood. Prometheus the Titan knew of this and told the secret to Deucalion, advising him to build an ark in order to be saved. After 9 nights and days the water started receding and the ark was landed at Mount Parnassus.[10]

The tale of Tiddalik the Frog is a legend from Australian Aboriginal mythology. In the telling of the myth, Tiddalik awoke one morning with an unquenchable thirst, and began to drink until all the fresh water was greedily consumed. Creatures and plant life everywhere began to die due to lack of moisture. Other animals conspired against Tiddalik, and devised a plan for him to release all of the water he had consumed. This was successfully coordinated by a wise old Wombat, when Nabunum the eel made Tiddalik laugh when he tied himself in comical shapes. As Tiddalik laughed, the water rushed out of him to replenish the lakes, swamps and rivers. The legend of Tiddalik is not only an important story of the Dreamtime, but has been the subject of popular modern children's books. In some Aboriginal cultures, Tiddalik is known as "Molok".

Claims of historicity

See also: Outburst flood



Earth's sea level rose dramatically in the millennia after the Last Glacial Maximum

Nanabozho in Ojibwe flood story from an illustration by R.C. Armour, in his book *North American Indian Fairy Tales, Folklore and Legends*, (1905).

This flood could have resulted from a rise in sea level after the Ice Age. Another hypothesis is that a meteor or comet crashed into the Indian Ocean around 3000–2800 BC, created the 30-kilometre (19 mi) undersea Burckle Crater, and generated a giant tsunami that flooded coastal lands.[11]

In ancient Mesopotamia, the Sumerian kinglist reads "After kingship came down from heaven .... the kingship was taken to Shuruppak. In Shuruppak, Ubara-Tutu became king; he ruled for 5 sars and 1 ner. In 5 cities 8 kings; they ruled for 241200 years. Then the flood swept over." Excavations in Iraq have revealed evidence of localized flooding at Shuruppak (modern Tell Fara, Iraq) and various other Sumerian cities. A layer of riverine sediments, radiocarbon dated to about 2900 BC, interrupts the continuity of settlement, extending as far north as the city of Kish, which took over hegemony after the flood. Polychrome pottery from the Jemdet Nasr period (3000-2900 BC) was discovered immediately below the Shuruppak flood stratum. Other sites, such as Ur, Kish, Uruk, Lagash, and Ninevah, all present evidence of flooding. However, this evidence comes from different times periods.[12] Geologically, the Shuruppak flood coincides with the 5.9 kiloyear event at the end of the Older Peron. It would seem to have been a localised event caused through the damming of the Kurun through the spread of dunes, flooding into the Tigris, and simultaneous heavy rainfall in the Nineveh region, spilling across into the Euphrates. In Israel, there is no such evidence of a widespread flood.[13] Given the similarities in the Mesopotamian flood story and the Biblical account, it would seem that they have a common origin in the memories of the Shuruppak account.[14]

The geography of the Mesopotamian area was considerably changed by the filling of the Persian Gulf after sea waters rose following the last ice age. Global sea levels were about 120m lower around 18,000 BP and rose until 8,000 BP when they reached current levels, which are now an average 40m above the floor of the Gulf, which was a huge (800 km (500 mi) x 200 km (120 mi)) low-lying and fertile region in Mesopotamia, in which human habitation is thought to have been strong around the Gulf Oasis for 100,000 years. A sudden increase in settlements above the present water level is recorded at around 7,500 BP.[15][16]

Adrienne Mayor promoted the hypothesis that global flood stories were inspired by ancient observations of seashells and fish fossils in inland and mountain areas. The ancient Greeks, Egyptians, and Romans all documented the discovery of such remains in these locations; the Greeks hypothesized that Earth had been covered by water on several occasions, citing the seashells and fish fossils found on mountain tops as evidence of this history.[17]

Speculation regarding the Deucalion myth has also been introduced, whereby a large tsunami in the Mediterranean Sea, caused by the Thera eruption (with an approximate geological date of 1630–1600 BC), is the myth's historical basis. Although the tsunami hit the South Aegean Sea and Crete, it did not affect cities in the mainland of Greece, such as Mycenae, Athens, and Thebes, which continued to prosper, indicating that it had a local rather than a regionwide effect.[18]

It has been postulated that the deluge myth in North America may be based on a sudden rise in sea levels caused by the rapid draining of prehistoric Lake Agassiz at the end of the last Ice Age, about 8,400 years ago.[19]

One of the latest, and quite controversial, hypotheses of long term flooding is the Black Sea deluge hypothesis, which argues for a catastrophic deluge about 5600 BC from the Mediterranean Sea into the Black Sea. This has been the subject of considerable discussion.[20][21]

See also

The Great Flood, by anonymous painter, The vom Rath bequest, Rijksmuseum Amsterdam

- List of flood myths
- Ancient Greek flood myths
- Antediluvian
- Atlantis
- Aztlán
- Black Sea deluge hypothesis
- Bochica
- Cantre'r Gwaelod
- Finnish flood myth
- Gilgamesh flood myth
- Great Flood of China
- Immanuel Velikovsky
- Lemuria
- Mesoamerican flood myths
- Monomyth
- Viracocha
- Ys

References

1.

^ Leeming, David (2004). "Flood | The Oxford Companion to World Mythology". Oxfordreference.com. Retrieved 17 September 2010.
^ ^ Bandstra 2009, p. 61, 62.

^ ^ Atrahasis, lines 7–9, by Lambert and Millard

¬ʌ ¬ʌ Pritchard, James B. (ed.), *Ancient Near Eastern Texts Relating to the Old Testament* (Princeton, N.J.: Princeton University Press, 1955, 1969). 1950 1st edition at Google Books. p.44: "...a flood [will sweep] over the cult-centers; to destroy the seed of mankind; is the decision, the word of the assembly [of the gods]."

¬ʌ ¬ʌ The great flood – Hindu style (Satapatha Brahmana).

¬ʌ ¬ʌ Matsya *Britannica.com*

¬ʌ ¬ʌ Klostermaier, Klaus K. (2007). *A Survey of Hinduism*. SUNY Press. p. 97. ISBN 0-7914-7082-2.

¬ʌ ¬ʌ Sehgal, Sunil (1999). *Encyclopaedia of Hinduism: T-Z, Volume 5*. Sarup & Sons. p. 401. ISBN 81-7625-064-3.

¬ʌ ¬ʌ Cotter, David W. (2003). *Genesis*. Collegeville (Minn.): Liturgical press. p. 49. ISBN 0814650406.

¬ʌ ¬ʌ Plato's Timaeus. Greek text: http://www.24grammata.com/wp-content/uploads/2011/01/Platon-Timaios.pdf

¬ʌ ¬ʌ Carney, Scott (November 7, 2007). "Did a comet cause the great flood?". Discover Magazine. Retrieved 17 September 2010.

¬ʌ ¬ʌ Bandstra 2009, p. 61: (Parrot, 1955)

¬ʌ ¬ʌ Bandstra 2009, p. 62.

¬ʌ ¬ʌ Hendel, Ronald S.(1987), "Of Demigods and the Deluge: towards an interpretation of Genesis 6:1-4" (Journal of Biblical Literature, Vol 186 No 1)

¬ʌ ¬ʌ *Lost Civilization Under Persian Gulf?*, Science Daily, Dec 8, 2010

¬ʌ ¬ʌ Rose, Jeffrey I. (December 2010), "New Light on Human Prehistory in the Arabo-Persian Gulf Oasis", *Current Anthropology*, Vol. 51, No. 6: 849–883, retrieved 2012-02-22

¬ʌ ¬ʌ Mayor, Adrienne (2011). *The First Fossil Hunters: Paleontology in Greek and Roman Times: with a new introduction by the author*. Princeton: Princeton University Press. ISBN 0691058636.

¬ʌ ¬ʌ Castleden, Rodney (2001) "Atlantis Destroyed" (Routledge).

¬ʌ ¬ʌ Early days among the Cheyanne & Arapahoe Indians by John H. Seger, page 135 ISBN 0-8061-1533-5

¬ʌ ¬ʌ "'Noah's Flood' Not Rooted in Reality, After All?" *National Geographic News*, February 6, 2009.

1. ¬ʌ Sarah Hoyle (November 18, 2007). "Noah's flood kick-started European farming". University of Exeter. Retrieved 17 September 2010.

Bibliography

- Bandstra, Barry L. (2009). *Reading the Old Testament : an introduction to the Hebrew Bible* (4th ed. ed.). Belmont, CA: Wadsworth/ Cengage Learning. pp. 59–62. ISBN 0495391050.
- Bailey, Lloyd R. *Noah, the Person and the Story*, University of South Carolina Press, 1989. ISBN 0-87249-637-6
- Best, Robert M. *Noah's Ark and the Ziusudra Epic, Sumerian Origins of the Flood Myth*, 1999, ISBN 0-9667840-1-4.
- Dundes, Alan (ed.) *The Flood Myth*, University of California Press, Berkeley, 1988. ISBN 0-520-05973-5 / 0520059735
- Faulkes, Anthony (trans.) *Edda* (Snorri Sturluson). Everyman's Library, 1987. ISBN 0-460-87616-3.
- Greenway, John (ed.), *The Primitive Reader*, Folkways, 1965.
- Grey, G. *Polynesian Mythology*. Whitcombe and Tombs, Christchurch, 1956.
- Lambert, W. G. and Millard, A. R., *Atrahasis: The Babylonian Story of the Flood*, Eisenbrauns, 1999. ISBN 1-57506-039-6.
- Masse, W. B. "The Archaeology and Anthropology of Quaternary Period Cosmic Impact", in Bobrowsky, P., and Rickman, H. (eds.) *Comet/Asteroid Impacts and Human Society: An Interdisciplinary Approach* Berlin, Springer Press, 2007. p. 25–70.
- Reed, A. W. *Treasury of Maori Folklore* A.H. & A.W. Reed, Wellington, 1963.
- Reedy, Anaru (trans.), *Nga Korero a Pita Kapiti: The Teachings of Pita Ka*

as suspended matter or bed load.

Riverine

River or rambla flows may rise to floods levels at different rates, from a few minutes to several weeks, depending on the type of river or rambla and the source of the increased flow.

Slow rising floods most commonly occur in large rivers with large catchment areas. The increase in flow may be the result of sustained rainfall, rapid snow melt, monsoons, or tropical cyclones. Localized flooding may be caused or exacerbated by drainage obstructions such as landslides, ice, or debris.

Rapid flooding events, including flash floods, more often occur on smaller rivers, rivers with steep valleys, rivers that flow for much of their length over impermeable terrain or ramblas. The cause may be localized convective precipitation (intense thunderstorms) or sudden release from an upstream impoundment created behind a dam, landslide, or glacier.

Dam-building beavers can flood low-lying urban and rural areas, occasionally causing some damage.

Estuarine and coastal

Flooding in estuaries is commonly caused by a combination of sea tidal surges caused by winds and low barometric pressure, and they may be exacerbated by high upstream river flow.

Coastal areas may be flooded by storm events at sea, resulting in waves over-topping defenses or in severe cases by tsunami or tropical cyclones. A storm surge, from either a tropical cyclone or an extratropical cyclone, falls within this category.

Urban flooding

Urban flooding is the inundation of land or property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers. Although sometimes triggered by events such as flash flooding or snowmelt, urban flooding is a condition, characterized by its repetitive and systemic impacts on communities, that can happen regardless of whether or not affected communities are located within formally designated floodplains or near any body of water.[4] There are several ways in which stormwater enters properties: backup through sewer pipes, toilets and sinks into buildings; seepage through building walls and floors; the accumulation of water on property and in public rights-of-way; and the overflow from water bodies such as rivers and lakes.

The flood flow in urbanized areas constitutes a hazard to both the population and infrastructure. Some recent catastrophes include the inundations of Nîmes (France) in 1998 and Vaison-la-Romaine (France) in 1992, the flooding of New Orleans (USA) in 2005, and the flooding in Rockhampton, Bundaberg, Brisbane during the 2010–2011 summer in Queensland (Australia). Flood flows in urban environments have been studied relatively recently despite many centuries of flood events.[5] Some researchers have mentioned the storage effect in urban areas. Several studies have looked into the flow patterns and redistribution in streets during storm events and the implication on flood modelling.[6] Some recent research has considered the criteria for safe evacuation of individuals in flooded areas.[7] However, some recent field measurements during the 2010–2011 Queensland floods showed that any criterion solely based upon the flow velocity, water depth or specific momentum cannot account for the hazards caused by velocity and water depth fluctuations.[5] These considerations ignore further the risks associated with large debris entrained by the flow motion.[7]

Catastrophic

Catastrophic flooding is usually associated with major infrastructure failures such as the collapse of a dam, but they may also be caused by damage sustained in an earthquake or volcanic eruption. See outburst flood.

Effects

Primary effects

The primary effects of flooding include loss of life, damage to buildings and other structures, including bridges, sewerage systems, roadways, and canals.

Floods also frequently damage power transmission and sometimes power generation, which then has knock-on effects caused by the loss of power. This includes loss of drinking water treatment and water supply, which may result in loss of drinking water or severe water contamination. It may also cause the loss of sewage disposal facilities. Lack of clean water combined with human sewage in the flood waters raises the risk of waterborne diseases, which can include typhoid, giardia, cryptosporidium, cholera and many other diseases depending upon the location of the flood.

Damage to roads and transport infrastructure may make it difficult to mobilize aid to those affected or to provide emergency health treatment.

Flood waters typically inundate farm land, making the land unworkable and preventing crops from being planted or harvested, which can lead to shortages of food both for humans and farm animals. Entire harvests for a country can be lost in extreme flood circumstances. Some tree species may not survive prolonged flooding of their root systems [8]

Secondary and long-term effects

Economic hardship due to a temporary decline in tourism, rebuilding costs, or food shortages leading to price increases is a common after-effect of severe flooding. The impact on those affected may cause psychological damage to those affected, in particular where deaths, serious injuries and loss of property occur.

Urban flooding can lead to chronically wet houses, which are linked to an increase in respiratory problems and other illnesses.[9] Urban flooding also has significant economic implications for affected neighborhoods. In the United States, industry experts estimate that wet basements can lower property values by 10-25 percent and are cited among the top reasons for not purchasing a home.[10] According to the U.S. Federal Emergency Management Agency (FEMA), almost 40 percent of small businesses never reopen their doors following a flooding disaster.[11]

Flood forecasting

Main articles: Flood forecasting and flood warning

Anticipating floods before they occur allows for precautions to be taken and people to be warned [12] so that they can be prepared in advance for flooding conditions. For example, farmers can remove animals from low-lying areas and utility services can put in place emergency provisions to re-route services if needed. Emergency services can also make provisions to have enough resources available ahead of time to respond to emergencies as they occur.

In order to make the most accurate flood forecasts for waterways, it is best to have a long time-series of historical data that relates stream flows to measured past rainfall events.[13] Coupling this historical information with real-time knowledge about volumetric capacity in catchment areas, such as spare capacity in reservoirs, ground-water levels, and the degree of saturation of area aquifers is also needed in order to make the most accurate flood forecasts.

Radar estimates of rainfall and general weather forecasting techniques are also important components of good flood forecasting. In areas where good quality data is available, the intensity and height of a flood can be predicted with fairly good accuracy and plenty of lead time. The output of a flood forecast is typically a maximum expected water level and the likely time of its arrival at key locations along a waterway,[14] and it also may allow for the computation of the likely statistical return period of a flood. In many developed countries, urban areas at risk of flooding are protected against a 100-year flood - that is a flood that has a probability of around 63% of occurring in any 100 year period of time.

According to the U.S. National Weather Service (NWS) Northeast River Forecast Center (RFC) in Taunton, Massachusetts, a general rule-of-thumb for flood forecasting in urban areas is that it takes at least 1 inch (25 mm) of rainfall in around an hour's time in order to start significant ponding of water on impermeable surfaces. Many NWS RFCs routinely issue Flash Flood Guidance and Headwater Guidance, which indicate the general amount of rainfall that would need to fall in a short period of time in order to cause flash flooding or flooding on larger water basins.[15]

Control

Main article: Flood control

In many countries around the world, waterways prone to floods are often carefully managed. Defenses such as detention basins, levees,[16] bunds, reservoirs, and weirs are used to prevent waterways from overflowing their banks. When these defenses fail, emergency measures such as sandbags or portable inflatable tubes are often used to try and stem flooding. Coastal flooding has been addressed in portions of Europe and the Americas with coastal defenses, such as sea walls, beach nourishment, and barrier islands.

In the riparian zone near rivers and streams, erosion control measures can be taken to try and slow down or reverse the natural forces that cause many waterways to meander over long periods of time. Flood controls, such as dams, can be built and maintained over time to try and reduce the occurrence and severity of floods as well. In the USA, the U.S. Army Corps of Engineers maintains a network of such flood control dams.

In areas prone to urban flooding, one solution is the repair and expansion of man-made sewer systems and stormwater infrastructure. Another strategy is to reduce impervious surfaces in streets, parking lots and buildings through natural drainage channels, porous paving, and wetlands (collectively known as green infrastructure or sustainable urban drainage systems [SUDS]). Areas identified as flood-prone can be converted into parks and playgrounds that can tolerate occasional flooding. Ordinances can be adopted to require developers to retain stormwater on site and require buildings to be elevated, protected by floodwalls and levees, or designed to withstand temporary inundation. Property owners can also invest in solutions themselves, such as re-landscaping their property to take the flow of water away from their building and installing rain barrels, sump pumps, and check valves.

Benefits

Floods (in particular more frequent or smaller floods) can also bring many benefits, such as recharging ground water, making soil more fertile and increasing nutrients in some soils. Flood waters provide much needed water resources in arid and semi-arid regions where precipitation can be very unevenly distributed throughout the year and kills pests in the farming land. Freshwater floods particularly play an important role in maintaining ecosystems in river corridors and are a key factor in maintaining floodplain biodiversity.[17] Flooding can spread nutrients to lakes and rivers, which can lead to increased biomass and improved fisheries for a few years.

For some fish species, an inundated floodplain may form a highly suitable location for spawning with few predators and enhanced levels of nutrients or food.[18] Fish, such as the weather fish, make use of floods in order to reach new habitats. Bird populations may also profit from the boost in food production caused by flooding.[19]

Periodic flooding was essential to the well-being of ancient communities along the Tigris-Euphrates Rivers, the Nile River, the Indus River, the Ganges and the Yellow River among others. The viability of hydropower, a renewable source of energy, is also higher in flood prone regions.

Computer modelling

While flood computer modelling is a fairly recent practice, attempts to understand and manage the mechanisms at work in floodplains have been made for at least six millennia.[20] Recent developments in computational flood modelling have enabled engineers to step away from the tried and tested "hold or break" approach and its tendency to promote overly engineered structures. Various computational flood models have been developed in recent years; either 1D models (flood levels measured in the channel) or 2D models (variable flood depths measured across the extent of a floodplain). HEC-RAS,[21] the Hydraulic Engineering Centre model, is currently among the most popular computer models, if only because it is available free of charge. Other models such as TUFLOW[22] combine 1D and 2D components to derive flood depths across both river channels and the entire floodplain. To date, the focus of computer modelling has primarily been on mapping tidal and fluvial flood events, but the 2007 flood events in the UK have shifted the emphasis there onto the impact of surface water flooding.[23]

In the United States, an integrated approach to real-time hydrologic computer modelling utilizes observed data from the U.S. Geological Survey (USGS),[24] various cooperative observing networks,[25] various automated weather sensors, the NOAA National Operational Hydrologic

Remote Sensing Center (NOHRSC),[26] various hydroelectric companies, etc. combined with quantitative precipitation forecasts (QPF) of expected rainfall and/or snow melt to generate daily or as-needed hydrologic forecasts.[27] The NWS also cooperates with Environment Canada on hydrologic forecasts that affect both the USA and Canada, like in the area of the Saint Lawrence Seaway.

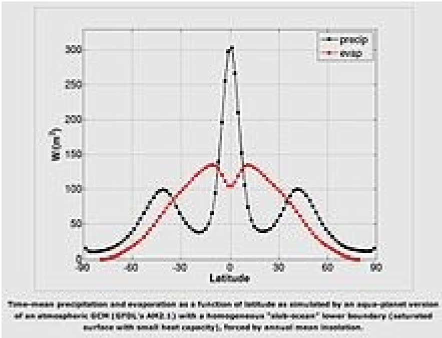
Deadliest floods

Main article: List of deadliest floods

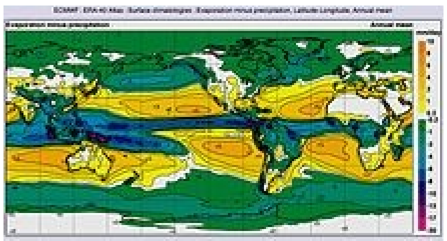
Below is a list of the deadliest floods worldwide, showing events with death tolls at or above 100,000 individuals.

Death toll	Event	Location	Date
2,500,000–3,700,000[28]	1931 China floods	China	1931
900,000–2,000,000	1887 Yellow River (Huang He) flood	China	1887
500,000–700,000	1938 Yellow River (Huang He) flood	China	1938
231,000	Banqiao Dam failure, result of Typhoon Nina. Approximately 86,000 people died from flooding and another 145,000 died during subsequent disease.	China	1975
230,000	Indian Ocean tsunami	Indonesia	2004
145,000	1935 Yangtze river flood	China	1935
100,000+	St. Felix's Flood, storm surge	Netherlands	1530
100,000	Hanoi and Red River Delta flood	North Vietnam	1971
100,000	1911 Yangtze river flood	China	1911

In myth and religion



Time-mean precipitation and evaporation as a function of latitude as simulated by an aqua-planet version of an atmospheric GCM (GFDL's AM2.1) with a homogeneous "slab-ocean" lower boundary (saturated surface with small heat capacity), forced by annual mean insolation.



Global map of Annual mean Evaporation minus precipitation by Latitude-Longitude

The water cycle describes the processes that drive the movement of water throughout the hydrosphere. However, much more water is "in storage" for long periods of time than is actually moving through the cycle. The storehouses for the vast majority of all water on Earth are the oceans. It is estimated that of the 332,500,000 mi^3 (1,386,000,000 km^3) of the world's water supply, about 321,000,000 mi^3 (1,338,000,000 km^3) is stored in oceans, or about 97%. It is also estimated that the oceans supply about 90% of the evaporated water that goes into the water cycle.[12]

During colder climatic periods more ice caps and glaciers form, and enough of the global water supply accumulates as ice to lessen the amounts in other parts of the water cycle. The reverse is true during warm periods. During the last ice age glaciers covered almost one-third of Earth's land mass, with the result being that the oceans were about 400 ft (122 m) lower than today. During the last global "warm spell," about 125,000 years ago, the seas were about 18 ft (5.5 m) higher than they are now. About three million years ago the oceans could have been up to 165 ft (50 m) higher.[12]

The scientific consensus expressed in the 2007 Intergovernmental Panel on Climate Change (IPCC) Summary for Policymakers[13] is for the water cycle to continue to intensify throughout the 21st century, though this does not mean that precipitation will increase in all regions. In subtropical land areas — places that are already relatively dry — precipitation is projected to decrease during the 21st century, increasing the probability of drought. The drying is projected to be strongest near the poleward margins of the subtropics (for example, the Mediterranean Basin, South Africa, southern Australia, and the Southwestern United States). Annual precipitation amounts are expected to increase in near-equatorial regions that tend to be wet in the present climate, and also at high latitudes. These large-scale patterns are present in nearly all of the climate model simulations conducted at several international research centers as part of the 4th Assessment of the IPCC. There is now ample evidence that increased hydrologic variability and change in climate has and will continue to have a profound impact on the water sector through the hydrologic cycle, water availability, water demand, and water allocation at the global, regional, basin, and local levels.[14] Research published in 2012 in *Science* based on surface ocean salinity over the period 1950 to 2000 confirm this projection of an intensified global water cycle with salty areas becoming more saline and fresher areas becoming more fresh over the period:[15]

Fundamental thermodynamics and climate models suggest that dry regions will become drier and wet regions will become wetter in response to warming. Efforts to detect this long-term response in sparse surface observations of rainfall and evaporation remain ambiguous. We show that ocean salinity patterns express an identifiable fingerprint of an intensifying water cycle. Our 50-year observed global surface salinity changes, combined with changes from global climate models, present robust evidence of an intensified global water cycle at a rate of 8 ± 5% per degree of surface warming. This rate is double the response projected by current-generation climate models and suggests that a substantial (16 to 24%) intensification of the global water cycle will occur in a future 2° to 3° warmer world.[16]

An instrument carried by the SAC-D satellite launched in June, 2011 measures global sea surface salinity but data collection began only in June, 2011.[15][17]

Glacial retreat is also an example of a changing water cycle, where the supply of water to glaciers from precipitation cannot keep up with the loss of water from melting and sublimation. Glacial retreat since 1850 has been extensive.[18]

Human activities that alter the water cycle include:

- agriculture
- industry
- alteration of the chemical composition of the atmosphere
- construction of dams
- deforestation and afforestation
- removal of groundwater from wells
- water abstraction from rivers
- urbanization

Effects on climate

The water cycle is powered from solar energy. 86% of the global evaporation occurs from the oceans, reducing their temperature by evaporative cooling.[19] Without the cooling, the effect of evaporation on the greenhouse effect would lead to a much higher surface temperature of 67 °C (153 °F), and a warmer planet.[citation needed]

Aquifer drawdown or overdrafting and the pumping of fossil water increases the total amount of water in the hydrosphere, and has been postulated to be a contributor to sea-level rise.[20]

Effects on biogeochemical cycling

While the water cycle is itself a biogeochemical cycle,[21] flow of water over and beneath the Earth is a key component of the cycling of other biogeochemicals. Runoff is responsible for almost all of the transport of eroded sediment and phosphorus[22] from land to waterbodies. The salinity of the oceans is derived from erosion and transport of dissolved salts from the land. Cultural eutrophication of lakes is primarily due to phosphorus, applied in excess to agricultural fields in fertilizers, and then transported overland and down rivers. Both runoff and groundwater flow play significant roles in transporting nitrogen from the land to waterbodies.[23] The dead zone at the outlet of the Mississippi River is a consequence of nitrates from fertilizer being carried off agricultural fields and funnelled down the river system to the Gulf of Mexico. Runoff also plays a part in the carbon cycle, again through the transport of eroded rock and soil.[24]

Slow loss over geologic time

Main article: Atmospheric escape

The hydrodynamic wind within the upper portion of a planet's atmosphere allows light chemical elements such as Hydrogen to move up to the exobase, the lower limit of the exosphere, where the gases can then reach escape velocity, entering outer space without impacting other particles of gas. This type of gas loss from a planet into space is known as planetary wind.[25] Planets with hot lower atmospheres could result in humid upper atmospheres that accelerate the loss of hydrogen.[26]

History of hydrologic cycle theory

Floating land mass

In ancient times, it was thought that the land mass floated on a body of water, and that most of the water in rivers has its origin under the earth. Examples of this belief can be found in the works of Homer (circa 800 BCE).

Precipitation and percolation

By roughly 500 BCE, Greek scholars were speculating that much of the water in rivers can be attributed to rain. The origin of rain was also known by then. These scholars maintained the belief, however, that water rising up through the earth contributed a great deal to rivers. Examples of this thinking included Anaximander (570 BCE) (who also speculated about the evolution of land animals from fish[27]) and Xenophanes of Colophon (530 BCE).[28] Chinese scholars such as Chi Ni Tzu (320 BC) and Lu Shih Ch'un Ch'iu (239 BCE) had similar thoughts.[29] The idea that the water cycle is a closed cycle can be found in the works of Anaxagoras of Clazomenae (460 BCE) and Diogenes of Apollonia (460 BCE). Both Plato (390 BCE) and Aristotle (350 BCE) speculated about percolation as part of the water cycle.

Precipitation alone

Up to the time of the Renaissance, it was thought that precipitation alone was insufficient to feed rivers, for a complete water cycle, and that underground water pushing upwards from the oceans were the main contributors to river water. Bartholomew of England held this view (1240 CE), as did Leonardo da Vinci (1500 CE) and Athanasius Kircher (1644 CE).

The first published thinker to assert that rainfall alone was sufficient for the maintenance of rivers was Bernard Palissy (1580 CE), who is often credited as the "discoverer" of the modern theory of the water cycle. Palissy's theories were not tested scientifically until 1674, in a study commonly attributed to Pierre Perrault. Even so, these beliefs were not accepted in mainstream science until early nineteenth century.[30]

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Waste sorting is the process by which waste is separated into different elements.[1] Waste sorting can occur manually at the household and collected through curbside collection schemes, or automatically separated in materials recovery facilities or mechanical biological treatment systems. Hand sorting was the first method used in the history of waste sorting.[2]

Waste can also be sorted in a civic amenity site.

Waste segregation means dividing waste into dry and wet. **Dry waste** includes wood and related products, metals and glass. **Wet waste**, typically refers to organic waste usually generated by eating establishments and are heavy in weight due to dampness. Waste can also be segregated on basis of biodegradable or non-biodegradable waste.

Landfills are an increasingly pressing problem.[citation needed] Less and less land is available to deposit refuse, but the volume of waste is growing all time. As a result, segregating waste is not just of environmental importance, but of economic concern, too.

Contents

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Methods[edit]

Waste is collected at its source in each area and separated. The way that waste is sorted must reflect local disposal systems. The following categories are common:

- Paper
- Cardboard (including packaging for return to suppliers)
- Glass (clear, tinted – no light bulbs or window panes, which belong with residual waste)
- Plastics
- Scrap metal
- Compost
- Special/hazardous waste
- Residual waste

Organic waste can also be segregated for disposal:

- Leftover food which has had any contact with meat can be collected separately to prevent the spread of bacteria.
  - Meat and bone can be retrieved by bodies responsible for animal waste
  - If other leftovers are sent, for example, to local farmers, they can be sterilised before being fed to the animals
- Peel and scrapings from fruit and vegetables can be composted along with other degradable matter. Other waste can be included for composting, too, such as cut flowers, corks, coffee grindings, rotting fruit, tea bags, egg- and nutshells, paper towels etc.

Chip pan oil (fryer oil), used fats, vegetable oil and the content of fat filters can be collected by companies able to re-use them. Local authority waste departments can provide relevant addresses. This can be achieved by providing recycling bins.

By country[edit]

In Germany, regulations exist that provide mandatory quotas for the waste sorting of packaging waste and recyclable materials such as glass bottles.[3]