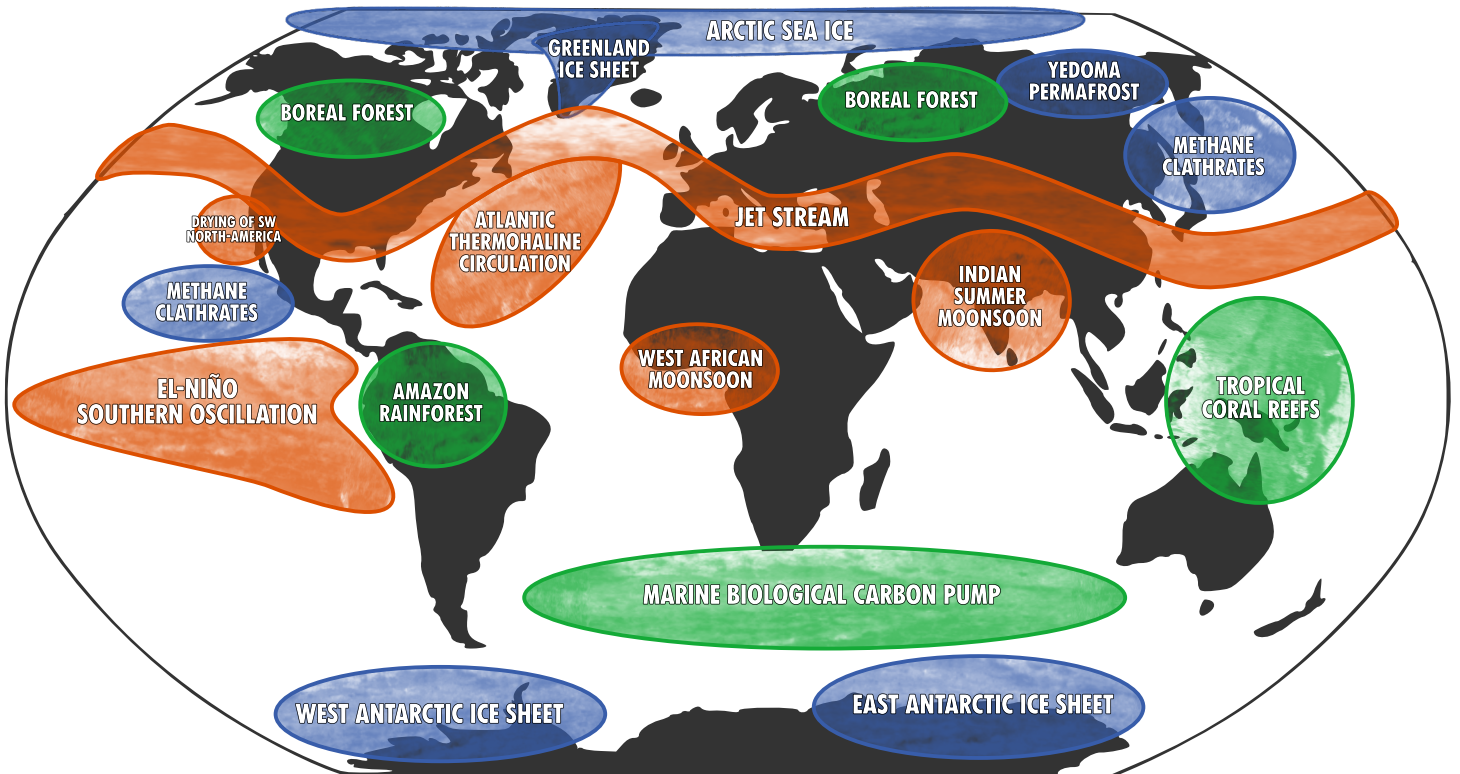


EARTH TIPPING ELEMENTS



CRYOSPHERE ENTITIES

MELTING OF THE ARCTIC SEA ICE

The Arctic will soon be ice-free in Summer. This contributes to an amplification of the regional warming in northern regions.

LOSS OF THE GREENLAND ICE SHEET

The complete collapse of the Greenland ice sheet would cause a sea-level rise of up to seven meters over a timescale of hundreds to thousands of years. It is also responsible of a weakening of Atlantic currents.

COLLAPSE OF THE WEST ANTARCTIC ICE SHEET

If the ice sheet were to break up, sea level would rise by about three meters in the course of several centuries. Scientific evidence indicates that such a process – whether with or without human input – has already been initiated.

PARTIAL COLLAPSE IN EAST ANTARCTICA

Recent research indicates that the melting of a relatively small “cork” in East Antarctica could trigger a self-sustained discharge of the entire basin, similar to the process in the West Antarctic region.

MELTING OF THE YEDOMA PERMAFROST

Thawing permafrost soils in the Siberian and North American Arctic release huge amounts of carbon dioxide and methane. If the surface layer is degraded, deeper soil layers get exposed to thawing and decomposition – a process called thermokarst formation. Such self-reinforcing degradation processes would be irreversible at time scales of a few centuries.

METHANE EMISSIONS FROM THE OCEAN / CLATHRATES

Methane hydrates are solid compounds of methane trapped in frozen water which are stored in sediments of the Arctic sea floor, especially in East Siberia. As water gets warmer, methane bubble out of the sea floor.

CIRCULATION PATTERNS

SLOWDOWN OF THE ATLANTIC THERMOHALINE CIRCULATION

The Gulf Stream is weakening due to the fresh water input from Greenland’s melting ice causing severe impacts on marine ecosystems, cooling of the north Atlantic region, and enhancing sea-level rise, especially at the US-Atlantic coast.

STRENGTHENING OF THE EL-NIÑO PHENOMENON

During El Niño, circulation patterns of the Pacific are disrupted. Its impacts, such as persistent droughts in Australia and South-East Asia or enhanced rainfall on the west coast of South America, span the entire globe.

SLOWDOWN OR STAGNATION OF PLANETARY WAVES OF THE JET STREAM

The air mass movement due to the Jet Stream is slowing down. This can cause prolonged extreme weather conditions such as cold periods and heat waves, floods or droughts.

DESTABILIZATION OF THE INDIAN MONSOON

Climate change is causing a swing between weaker and stronger monsoon events in South Asia which would result in alternating severe droughts and extreme flooding over the region.

SHIFT OF THE WEST AFRICAN MONSOON WITH IMPACTS ON THE SAHARA

A shift of the West African monsoon system could bring increased rainfall or increased dry spells to the population of West Africa, according to whether the rainfall belt shifts southwards to the Gulf of Guinea or northwards into the Sahel zone.

DRYING OUT OF THE SOUTH-WESTERN UNITED STATES

The northward expansion of the subtropical dry zone is causing drought in South-West North America. The process shows great similarities to a monsoon system, with a tipping point which, once exceeded, could abruptly expose the southwestern part of North America to even more severe dryness.

ECOSYSTEMS COMPONENTS

TRANSFORMATION OF THE AMAZON RAINFOREST

Global warming, with declining regional precipitation, in combination with deforestation and forest fire could push the rainforest to a critical threshold. A collapse of the Amazon would have fundamental impacts on global climate, since around 25% of the global atmosphere-biosphere carbon-exchange takes place here and it is one of the most important terrestrial carbon sinks. The loss of biodiversity would also be catastrophic.

RETREAT OF THE NORTHERN BOREAL FORESTS

Climate change critically increases the stress on boreal forests. Once a critical threshold has been crossed, forests can be transformed back to scrub or grassland ecosystems. A loss of these forests would not only mean a destruction of habitats for animals and plants, but also massive release of carbon dioxide, which in turn contributes to accelerated global warming.

DESTRUCTION OF CORAL REEFS

A 2°C global warming will lead to the death of most coral reefs through warmer and more acidic waters. Once a coral system has collapsed, it takes several thousand years for the reef to regrow. Coral reefs are diversity hotspots of world importance who are also a major source of nutrients for the whole marine ecosystem.

WEAKENING OF THE MARINE CARBON PUMP / PLANKTON DYING

The world’s oceans absorb large amounts of carbon – around 40% of all anthropogenic CO₂ emissions are extracted from the atmosphere by the oceans. Much of this is used by algae for growth, and the carbon sinks with them to the ocean floor after they die. The function of this so-called marine biological carbon pump could be impeded by the warming and acidification of sea water as well as by the more frequently occurring oxygen depletion.