TABLE 2

Summary of physical plausibility assessments

Physical processes	How did the physical process evolve in the past?	What would the continuation of recent dynamics under increased global warming mean for the prospect of attaining the Paris Agreement temperature goals (PAtg)?		What are the consequences of failing to attain the Paris Agreement temperature goals, and what would be the consequences for this physical process of exceeding given global warming levels?	In which way is this physical process connected to other physical and social processes?	Is it plausible that drastic or abrupt changes in the basic dynamics of this process are triggered within the 21st century?
		supports the attainment of the PAtg does not affect the attainment of the PAtg moderately inhibits the attainment of the PAtg inhibits the attainment of the PAtg			interconnections between physical processes interconnections between physical and social processes	no plausible drastic or abrupt change plausible drastic or abrupt change uncertain about the plausibility of drastic or abrupt change
6.2.1 Permafrost thaw	Significant permafrost warming was observed over the past 30–50 years. Thickening of the soil active layer and an increase of abrupt permafrost thaw phenomena, such as thermo-erosion and thermokarst, were detected. There is limited evidence of trends in annual CO_2 and CH_4 emissions.	About one year of today's anthropogenic emissions could be released by permafrost thaw between now and 2050. Thus, permafrost thaw moderately inhibits the plausibility of attaining the Paris Agreement temperature goals.		Additional carbon release proportional to the warming is expected. Permafrost carbon is considered a tipping element with the potential for abrupt climate change under continued warming.	We see additional effects on regional and global climate change through changes of the hydrological cycle and land-atmosphere interactions. Permafrost thaw has serious impacts on local ecosystems, wildlife, and human infrastructure and communities, as well as adverse effects on reindeer herding. Permafrost thaw threatens the symbolic representations, material practices, and emotional ties that local communities have developed toward their land.	Due to existing gaps in understanding and modeling of abrupt thaw processes, plant-soil interactions, and disturbances such as fires, we cannot rule out that drastic changes in permafrost carbon storage might occur in the 21st century. Even a worst-case increase of CH_4 emissions from terrestrial permafrost landscapes due to Arctic climate change will be considerably smaller than plausible reductions of global anthropogenic CH_4 emissions by mitigation measures.
6.2.2 Arctic sea-ice decline	A rapid decline as a linear response to changes in the external forcing was observed. No sign of a tipping point is seen.	The loss of Arctic sea ice in the summer has little potential to directly affect the prospects of achieving the Paris Agreement temperature goals, partly because its impact on the temperature of the surrounding permafrost regions is limited.		The ice-free period of the Arctic will become longer, raising prospects of an Arctic Ocean that is ice-free all year round, but it is still unclear at which level of global warming this might occur, because climate models underestimate the sensitivity of the Arctic sea-ice cover to global warming.	There is low confidence that Arctic sea-ice loss plays a substantial role in the modification of weather patterns in other regions of the planet. Sea-ice decline has limited impact on additional thaw of land permafrost. Sea-ice decline is a threat to animals and peoples in the Arctic.	All modeling and observational evidence suggests a largely linear loss of Arctic summer sea ice in response to ongoing warming. Hence, abrupt changes in Arctic sea ice in the 21st century are not plausible.
6.2.3 Polar ice-sheet melt	Substantial ice-mass loss at an accelerating rate was detected. The melting of polar ice sheets is expected to be the dominant source of global-mean sea-level rise over the coming decades.	The melting of polar ice sheets barely has a direct impact on the global-mean temperature.		The polar ice sheets will cross more and more regional tipping points, which will rapidly and strongly increase the long-term committed global mean sea-level rise.	The melting of polar ice sheets impacts the global ocean circulation, with freshwater input from Greenland potentially increasing the heat accumulation in the Southern Ocean, causing additional ice loss. The sea-level rise caused by ice-sheet melt is a key driver for migration and displacement.	It is not only plausible but indeed very likely that the basic process dynamics will change drastically if certain temperature levels are crossed. There is some evidence that regional instabilities have possibly been triggered already. With increasing global warming, more and more of these instabilities will be triggered, causing a sharp rise in committed sea-level rise.
6.2.4 Atlantic Meridional Overturning Circulation (AMOC) instability	Global warming is expected to weaken the AMOC, but measurements so far have been inconclusive regarding whether such weakening has already occurred.	The expected slowdown and even more a potential collapse of the AMOC would lower the prospects of reaching the Paris Agreement temperature goals, because the slowing down AMOC would remove less heat and CO_2 from the atmosphere.		While AMOC weakening over the 21st century is very likely, the rate of weakening is approximately independent of the emissions scenario (high confidence). We therefore conclude here that there is insufficient evidence for assessing plausible consequences for the AMOC, if any, if the goals of the Paris Agreement were not met.	AMOC weakening is expected to respectively increase and stabilize the ice mass loss from the Antarctic and Greenland Ice Sheets. AMOC weakening might cause changes in large-scale precipitation patterns. It is currently not possible to assess what wider societal effect the attention to the weakening might cause.	A relatively sudden collapse of the AMOC for a specific amount of freshwater forcing in the North Atlantic is possible. The IPCC AR6 expresses medium confidence that the declining AMOC will not involve an abrupt collapse within the 21st century.
6.2.5 Amazon Forest dieback	Changes in precipitation, more frequent and intense weather extremes, and prolonged fire seasons were observed. The Amazon Forest undergoes extensive deforestation and forest degradation. The Amazon Forest is losing resilience. The Amazon carbon sink is declining.	Though a decline in carbon sink is observed, models still show uncertainties with respect to tropical carbon pool sensitivity to climate change. Extrapolating from the current trend in Amazonian deforestation until 2050, we predict less than 7 GtC of additional accumulated emissions until 2050. Thus, deforestation of the Amazon Forest can moderately inhibit the plausibility of attaining the Paris Agreement temperature goals.		Weather extremes and a high fire regime will become the new norm in Amazonia, which could shift toward a savanna-like vegetation with devastating impacts on the ecosystems. Regional dieback is plausible. Not only climate change, but also human activities are pushing the Amazon Forest toward tipping points.	Changes in the AMOC, weather extremes, and a warmer North Atlantic could lead to a drier Amazonia in the future. It is not a single factor but the interaction of various economic, institutional, technological, cultural, and environmental factors that is responsible for deforestation. Since the end of the 19th century several Amazonian states started protecting forest and Indigenous areas. If forests are to contribute as natural sinks to achieving carbon neutrality, preserving existing natural forests can make a much greater contribution than afforestation.	Large-scale dieback of the Amazon Forest solely driven by climate change during the 21st century is not plausible. However, the greatest changes are expected to come from deforestation and forest degradation. By assessing current trajectories we conclude that a scenario of forest dieback under combined forcings of deforestation and climate change within the 21st century is plausible, unless policy and regulatory measures, as well as financial incentives, are strengthened.
6.2.6 Regional climate change and variability	Changes in the polar vortex, storm tracks, jet stream, and planetary waves, which can affect the frequency, intensity, duration, seasonality, and spatial extent of weather extremes like cold spells, heat waves, and floods, were observed.	Changes in mean climate and extremes will be either amplified or attenuated by internal variability, which will therefore co-determine the frequency and intensity of extreme events on a regional scale.		More concurrent and multiple changes in climate extremes associated with severe impacts in various sectors (e.g., hemispheric co-occurrence of extremes with severe socioeconomic consequences) are expected.	Changes in regional climate variability and extreme events have socioeconomic relevance and could affect sustainability and security through cascading impacts across sectors. This can lead to either negative or positive changes in social or environmental systems.	The occurrence of regional low-likelihood but potentially high-impact outcomes cannot be ruled out, even if the global warming falls within its very likely range for a given emissions scenario. With higher warming more extreme compound events that were unprecedented in the observational record are expected to occur, potentially leading to dramatic socioeconomic changes.