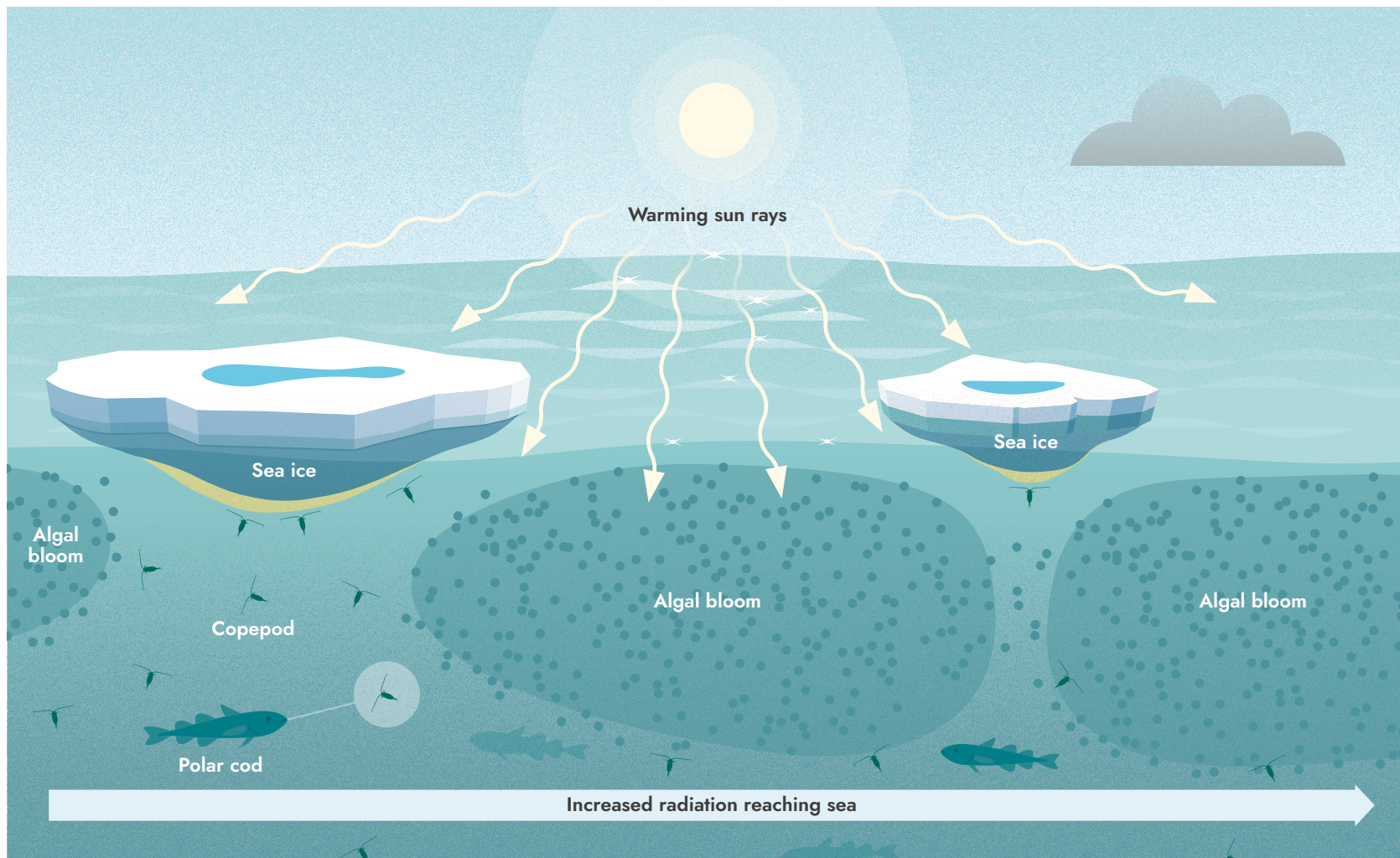
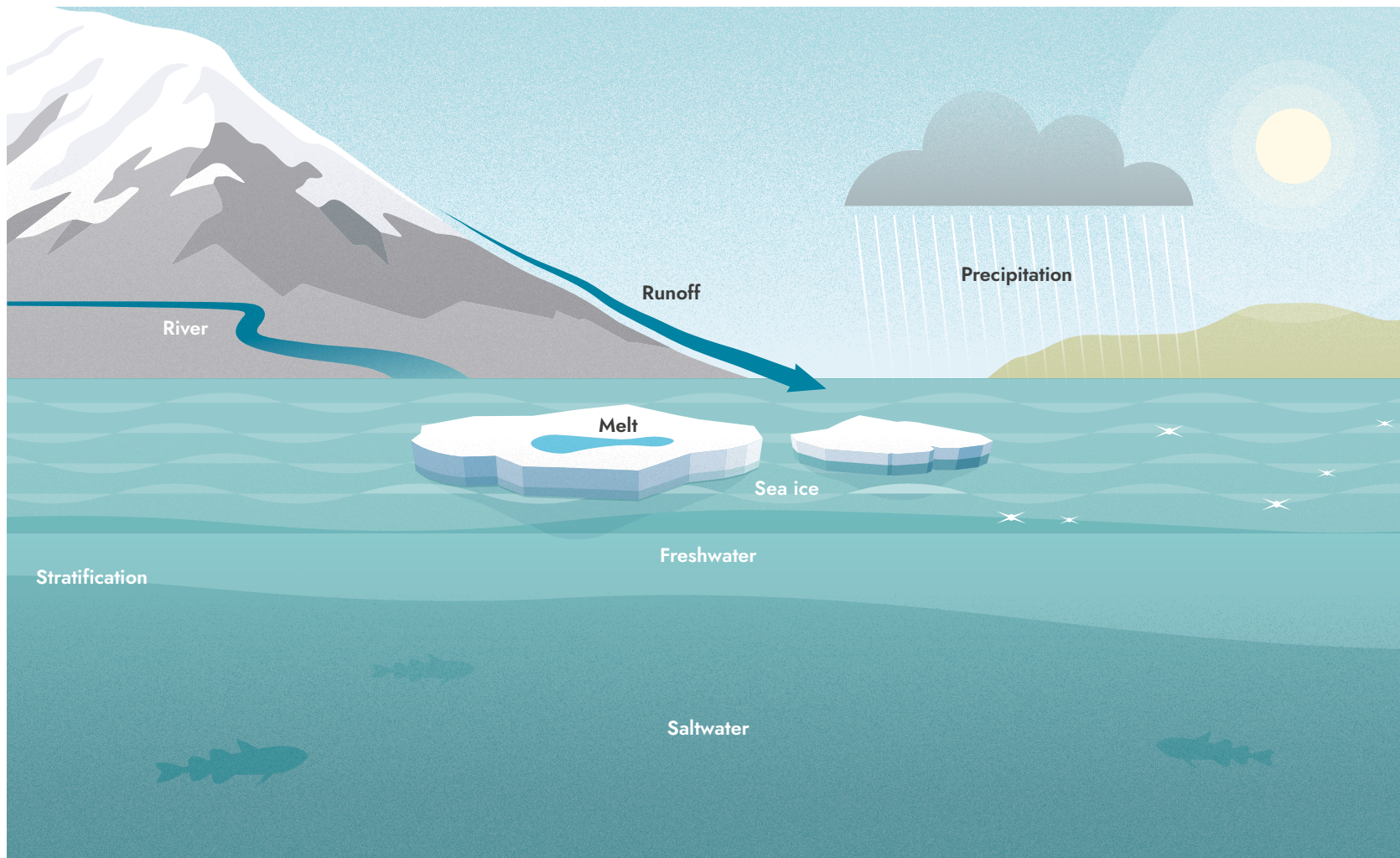




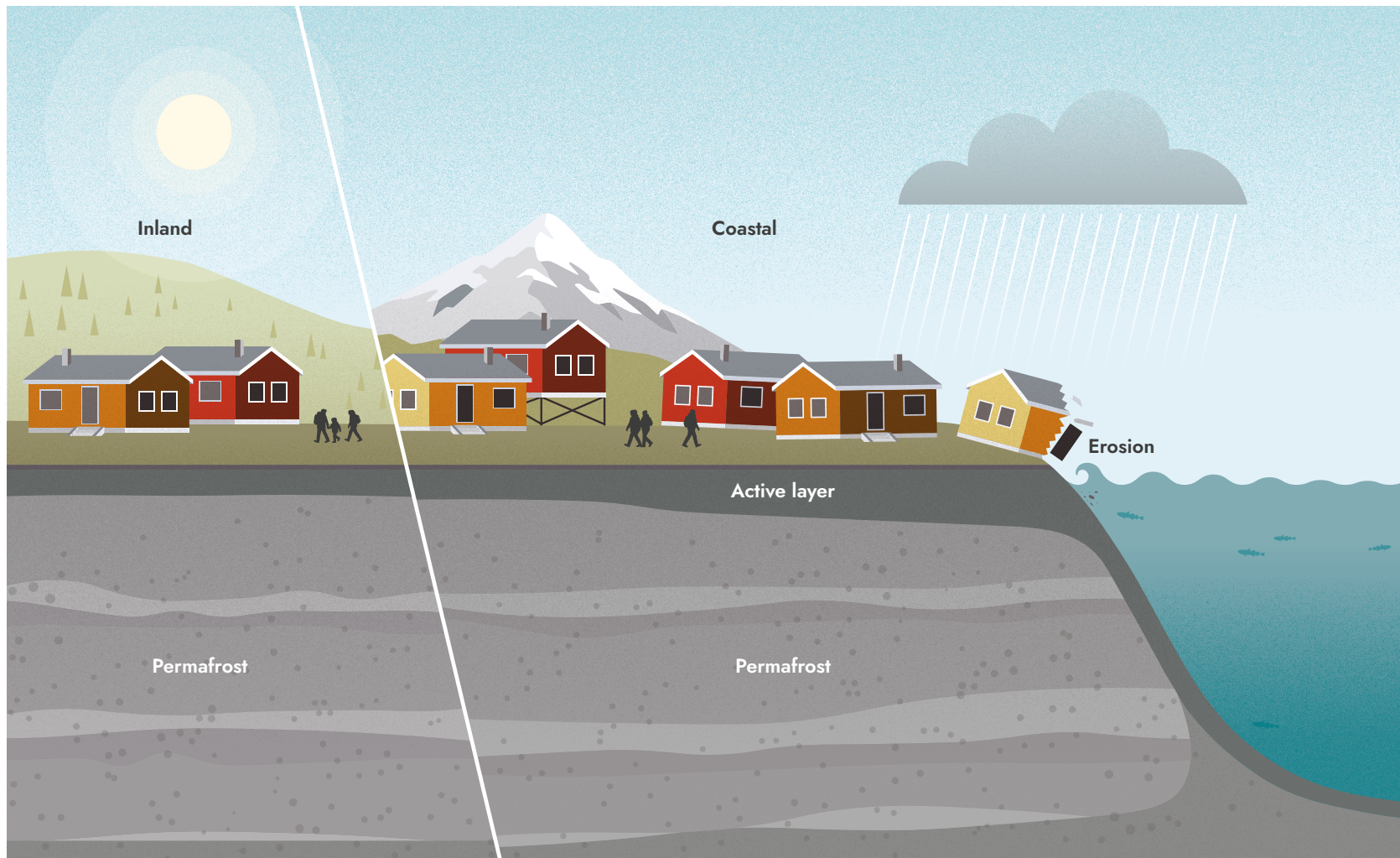
INCREASED PRIMARY PRODUCTION

Melting sea ice increases the area and prolongs the period of favorable light conditions for planktonic and benthic algal growth. Increased production is sustained by larger input of nutrients



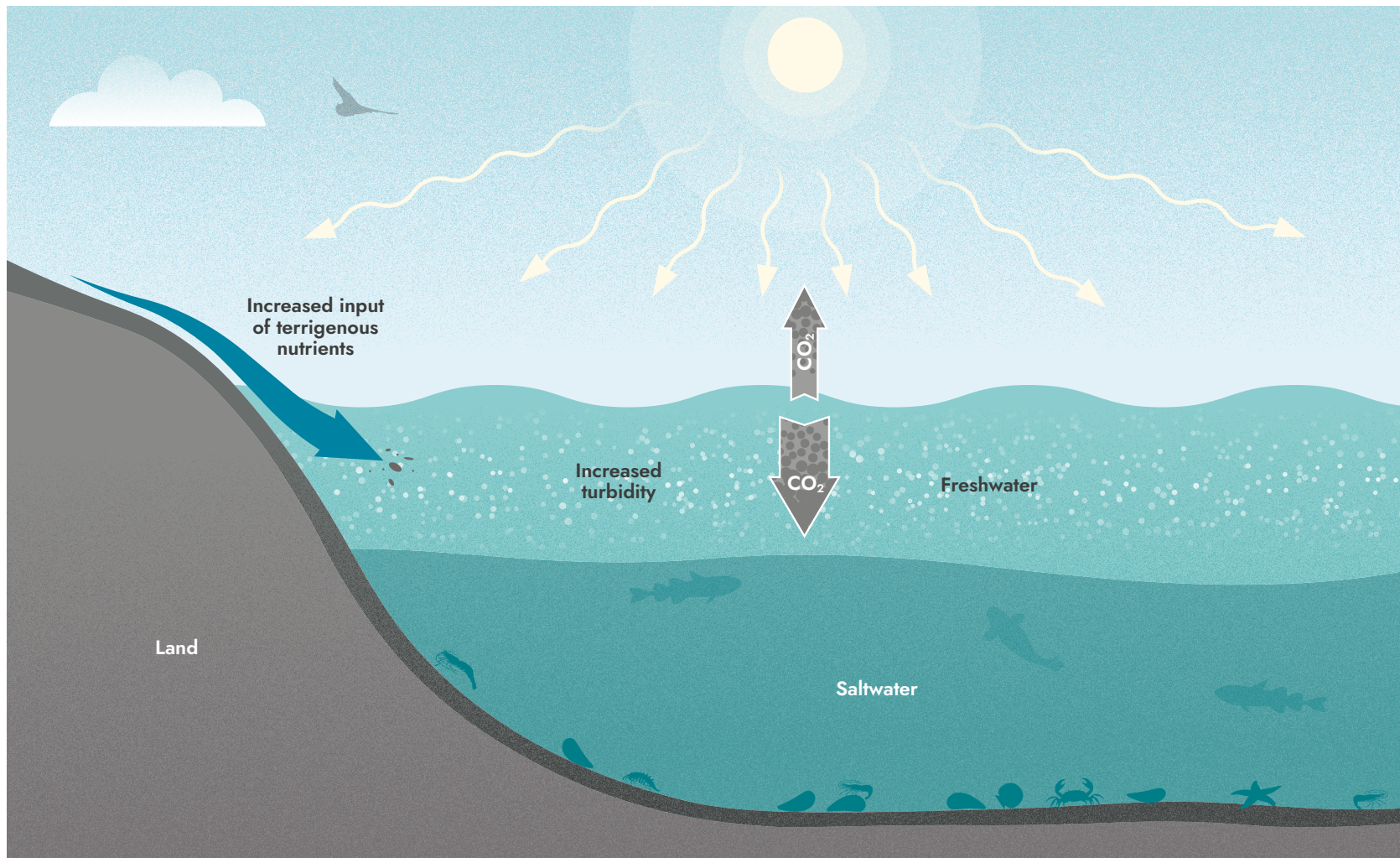
SEAWATER FRESHENING

Increased supply of freshwater from melting ice and precipitation stratify the Arctic water masses and reduce the mixing of nutrients and oxygen in the water column



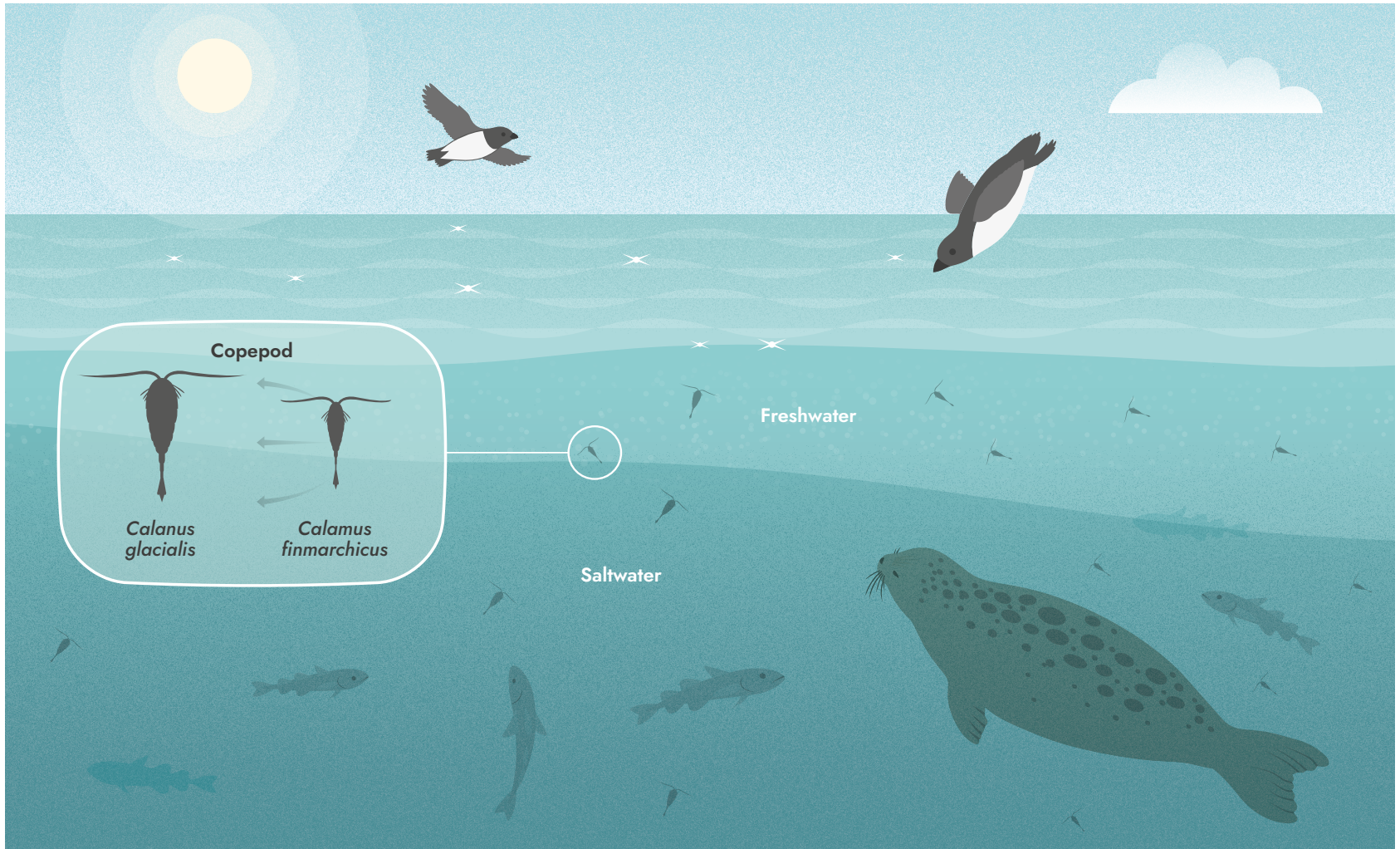
COASTAL EROSION AND RIVERINE INPUT

Melting coastal permafrost and increased wave action from an ice-free ocean erode the Arctic coasts. Increased precipitation and melting of permafrost increase the riverine discharge of freshwater and terrigenous materials. About one-third of the Arctic ocean primary production is currently sustained by the input of nutrients from coastal erosion and rivers



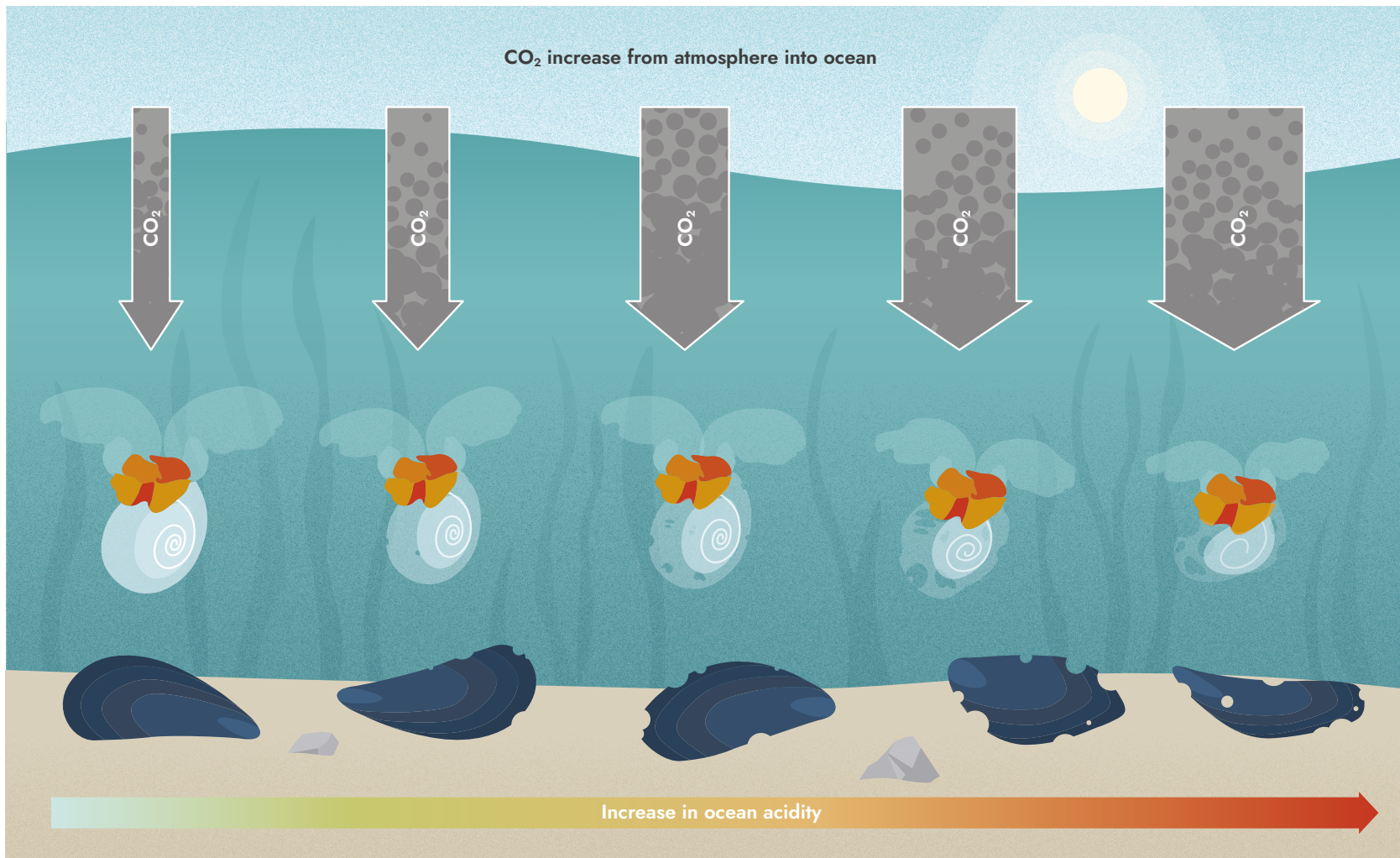
INCREASED RESPIRATION AND DEOXYGENATION

Increased input of terrigenous nutrients, warming and freshening of surface waters increase microbial respiration and remineralization of carbon and nitrogen. The result is deoxygenation, increased turbidity, reduced carbon sequestration and storage, reduced export of organic matter to bottom-dwelling organisms and less production available for higher trophic levels



SHIFT IN THE PLANKTON COMMUNITY

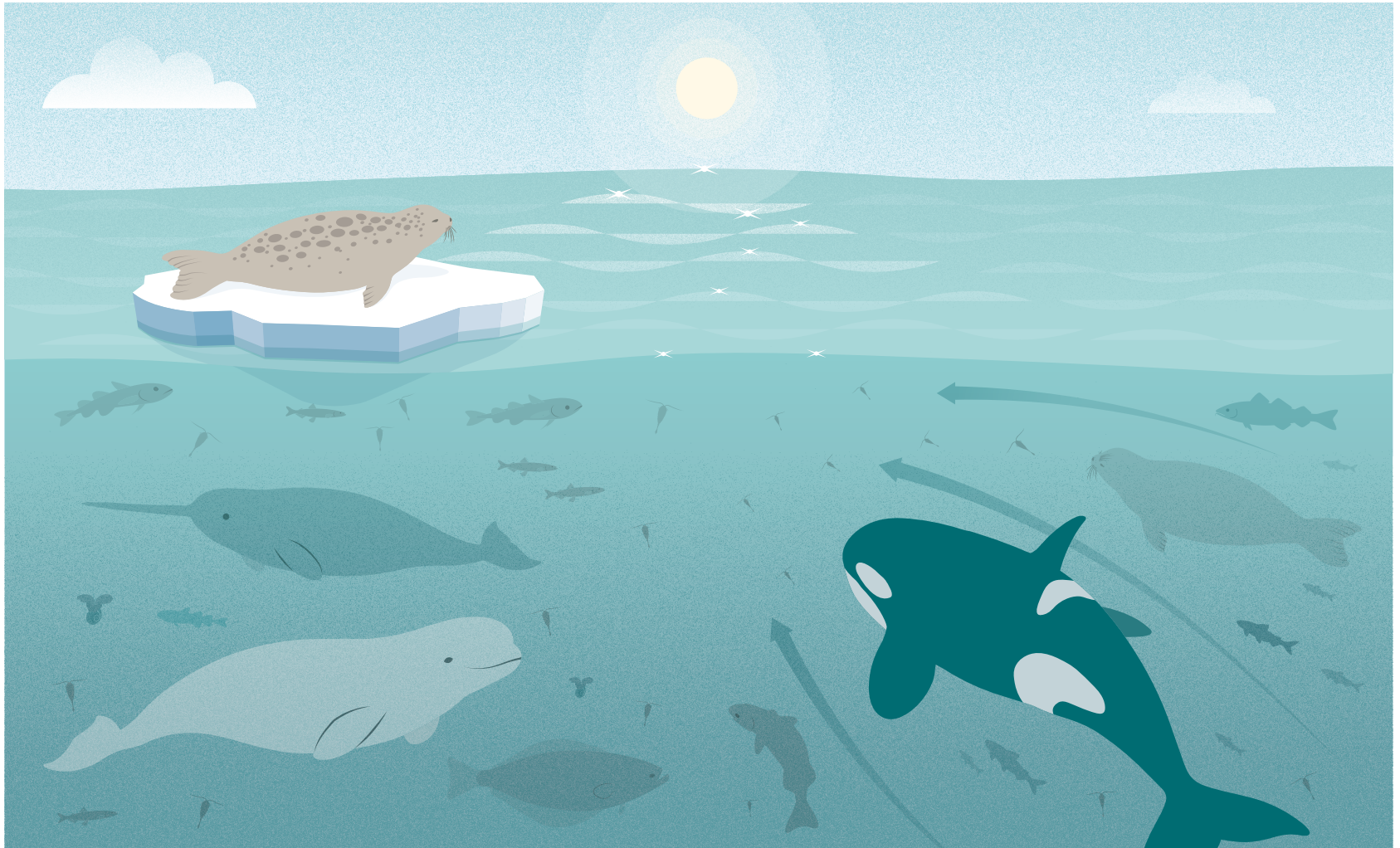
Warmer and more stratified waters drive a shift in the Arctic plankton community to smaller and less nutritious species, reducing the efficiency of trophic transfer to fish, seabirds and mammals



OCEAN ACIDIFICATION

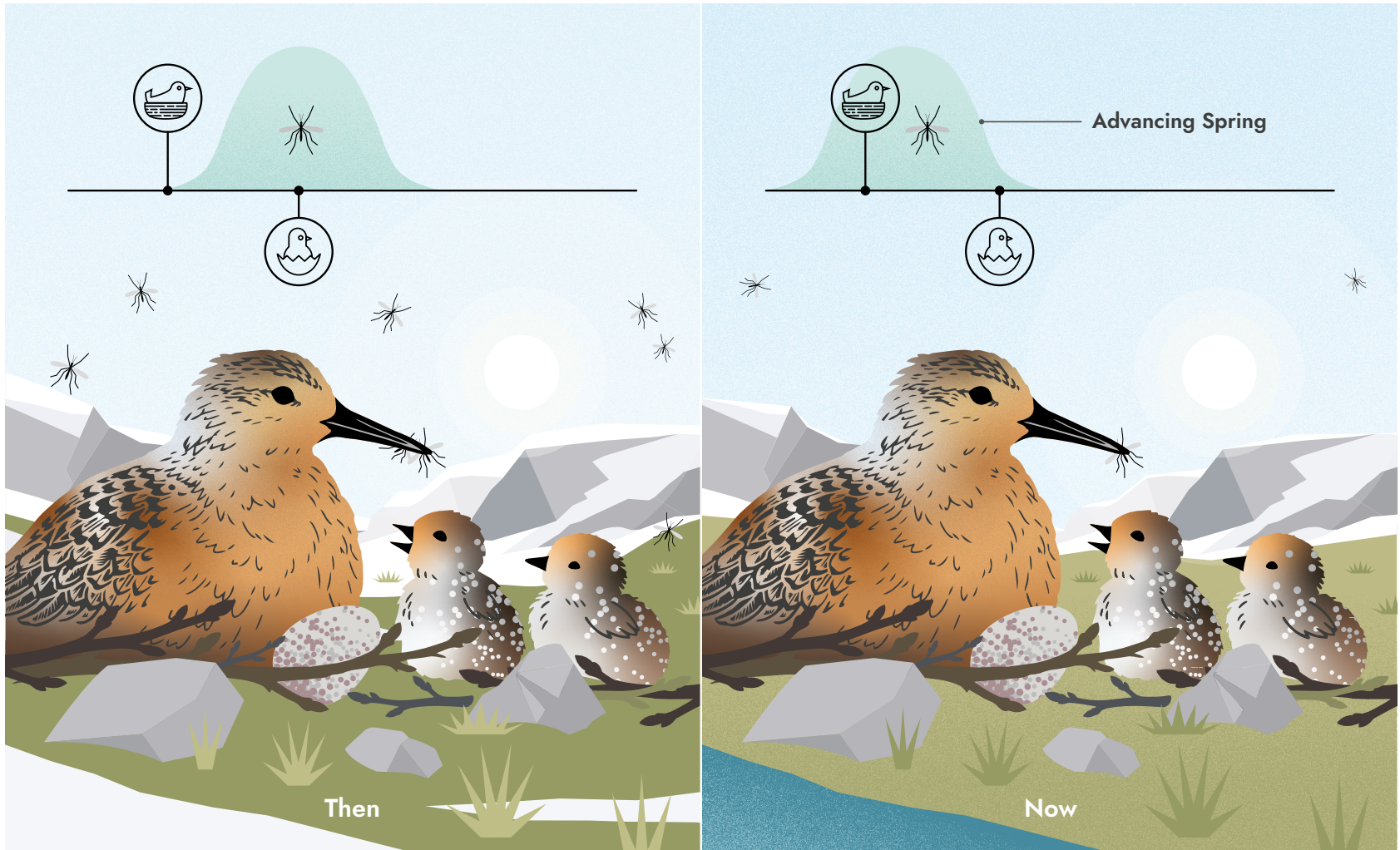
Low water temperature and seawater freshening make the Arctic especially vulnerable to ocean acidification.

On a basin scale, the Arctic ocean is projected to become undersaturated with respect to aragonite within this century with large potential consequences for calcifying organisms and the marine ecosystem



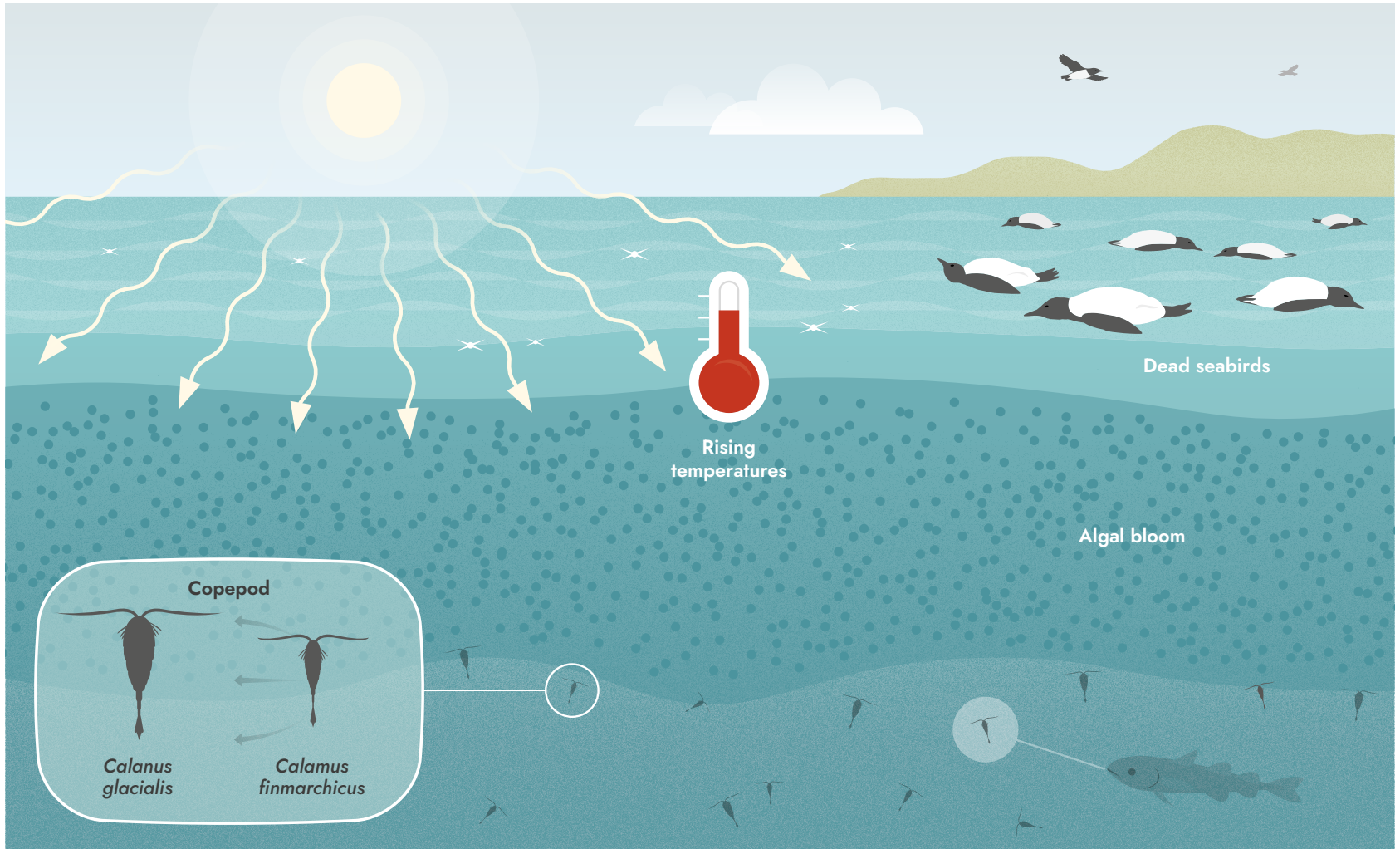
BOREALIZATION

Northward expansion of boreal and sub-Arctic species is replacing Arctic and ice-associated species and thereby altering ecosystem function and dynamics



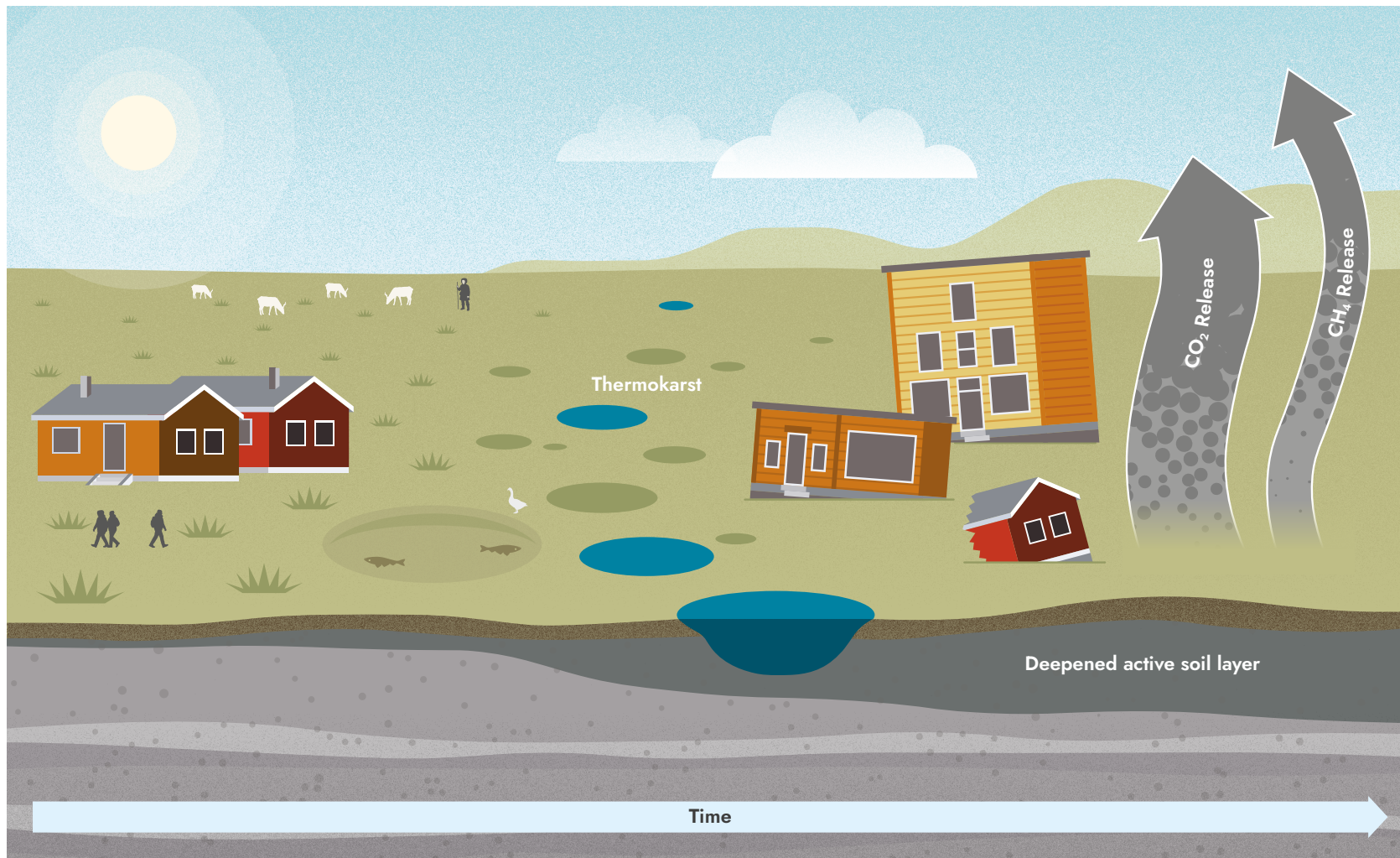
MIGRATORY SPECIES AND FOOD-WEB MISMATCH

Many mammals, birds and fish migrate from the south to the Arctic to reproduce and/or feed. Rapid climate change can disrupt the synchrony between interacting species, leading to phenological mismatches in timing or spatial mismatches in distribution. These disruptions can disturb food webs, potentially resulting in population booms due to predator relief, and/or population collapse due to starvation



CLIMATIC EXTREMES

Marine heatwaves increase in frequency and intensity with pervasive effects on the marine ecosystem, triggering harmful algae blooms, replacement of important functional groups, and reduced growth and mass mortality of susceptible species



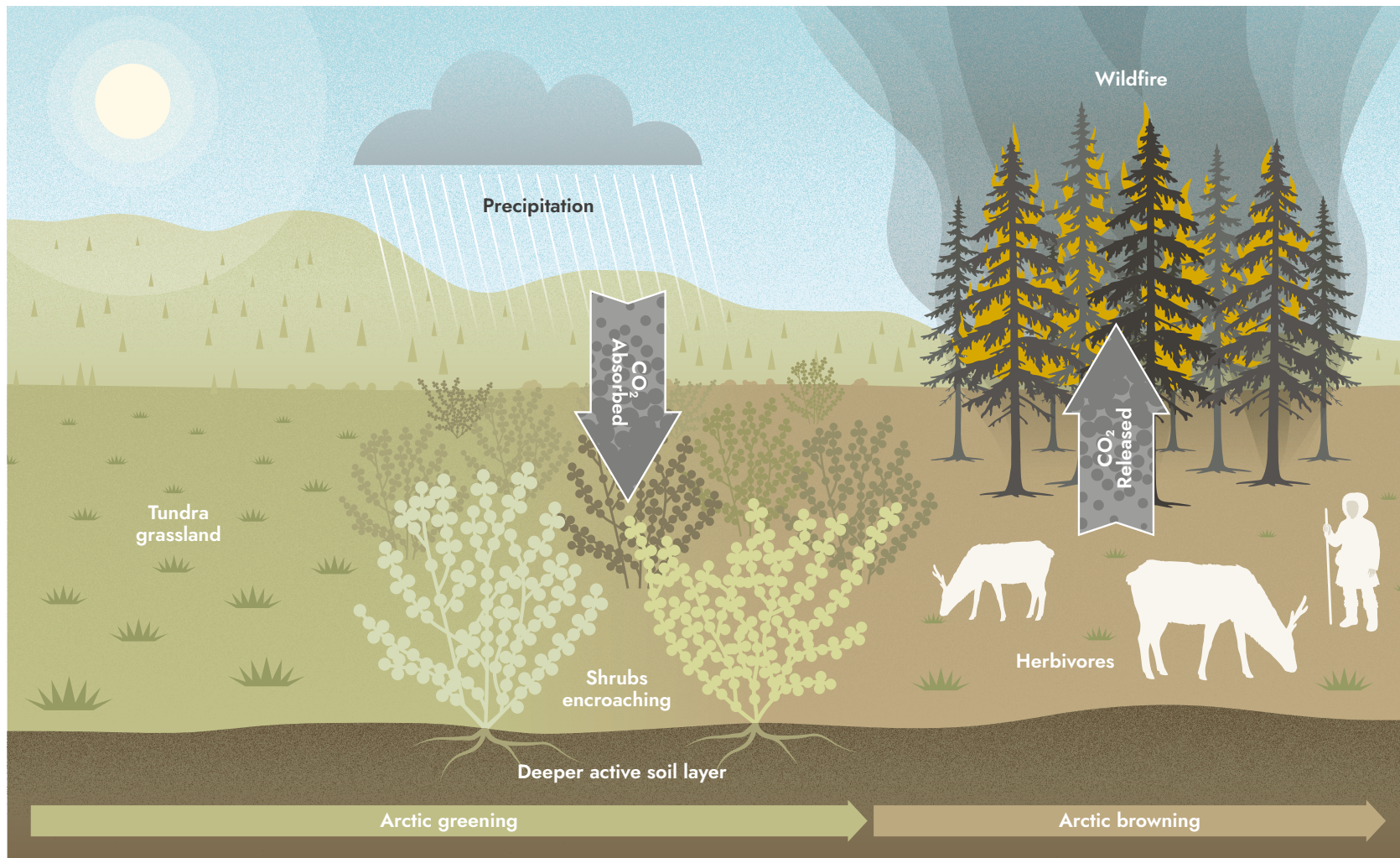
PERMAFROST THAWING

Permafrost thawing leads to widespread landscape changes, such as ground subsidence, thermokarst development, the formation or draining of wetlands and lakes, and the deepening of the active soil layer. Abrupt thaws occur when local subsidence and changed hydrology expose deeper layers to thaw. As the ice-rich permafrost melts, previously frozen organic carbon is exposed to microbial activity, resulting in the release of CO₂ and methane into the atmosphere



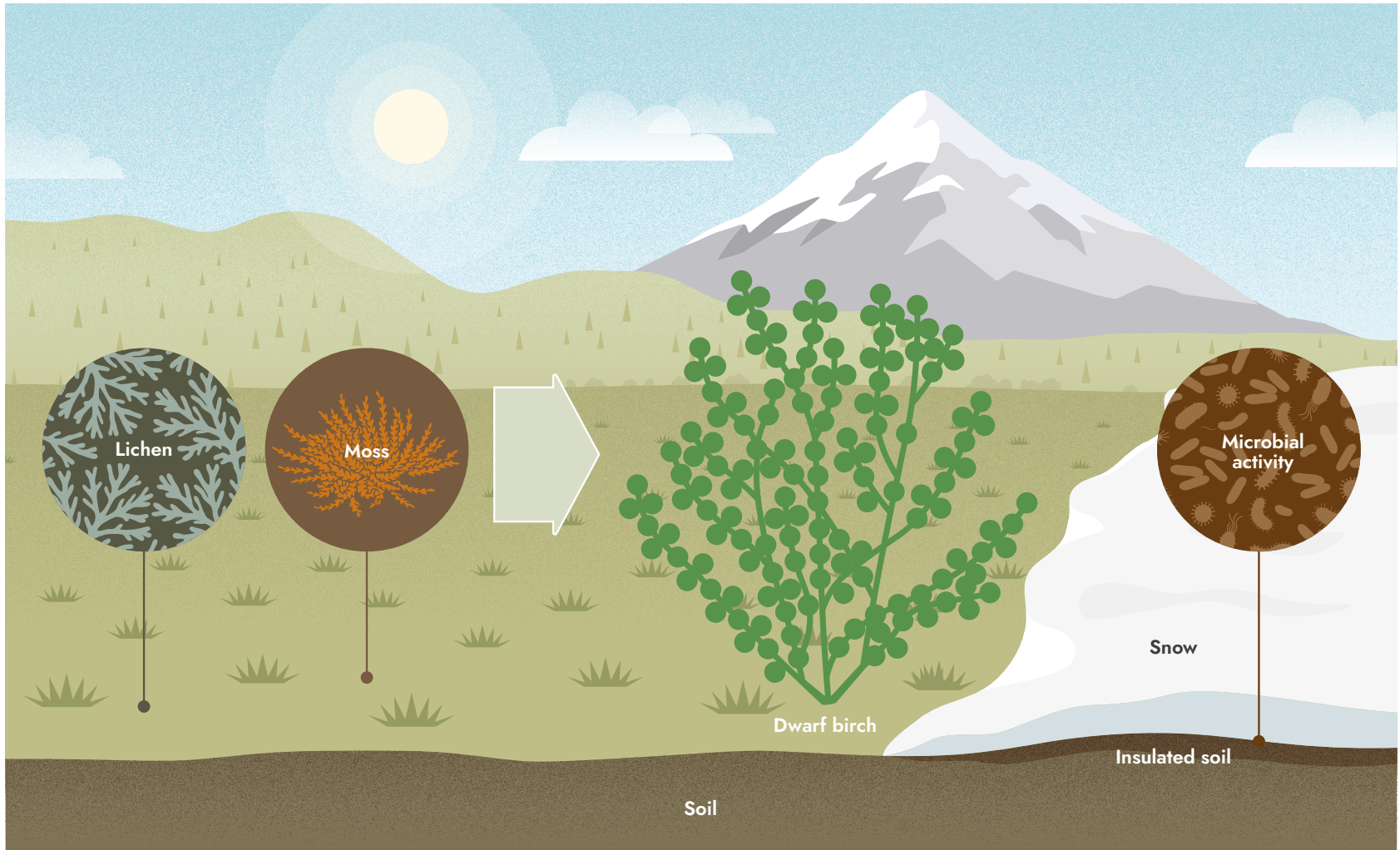
CHANGES IN HYDROLOGY

Accelerating evaporation, precipitation, ice melting and freshwater runoff intensify and alter the Arctic water cycle, leading to more extreme hydrological events such as floods and droughts, as well as fundamental changes in river regimes, groundwater recharge, and the distribution of lakes and wetlands in Arctic landscapes



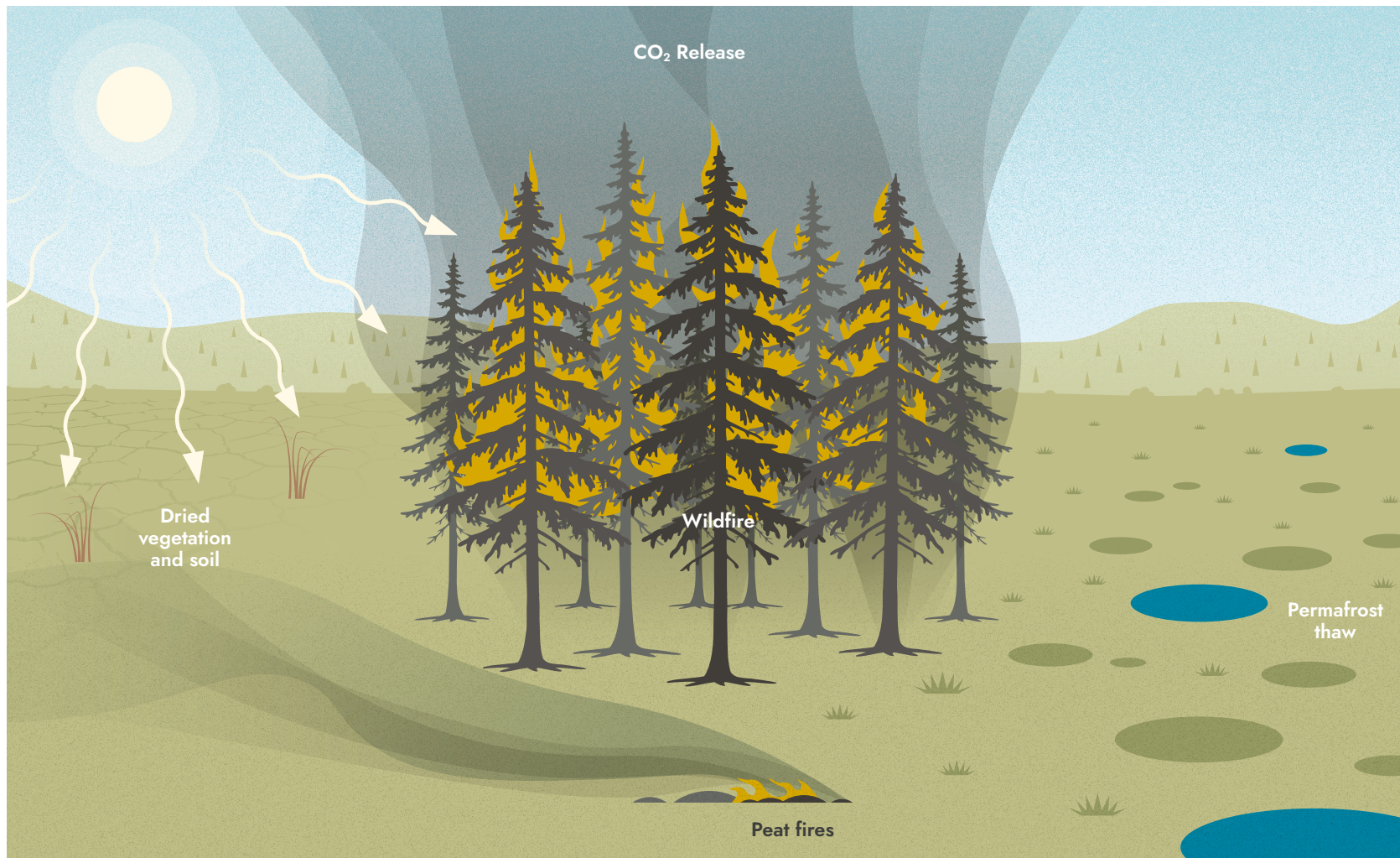
ARCTIC GREENING

Warmer summer temperatures, an extended growing season, and a deeper active soil layer enhance plant growth, leading to increased carbon sequestration and storage in plant tissues. Disturbances such as climate extremes, increased herbivory, wildfires and altered hydrology intermittently disrupt the overall greening trend, resulting in areas of browning



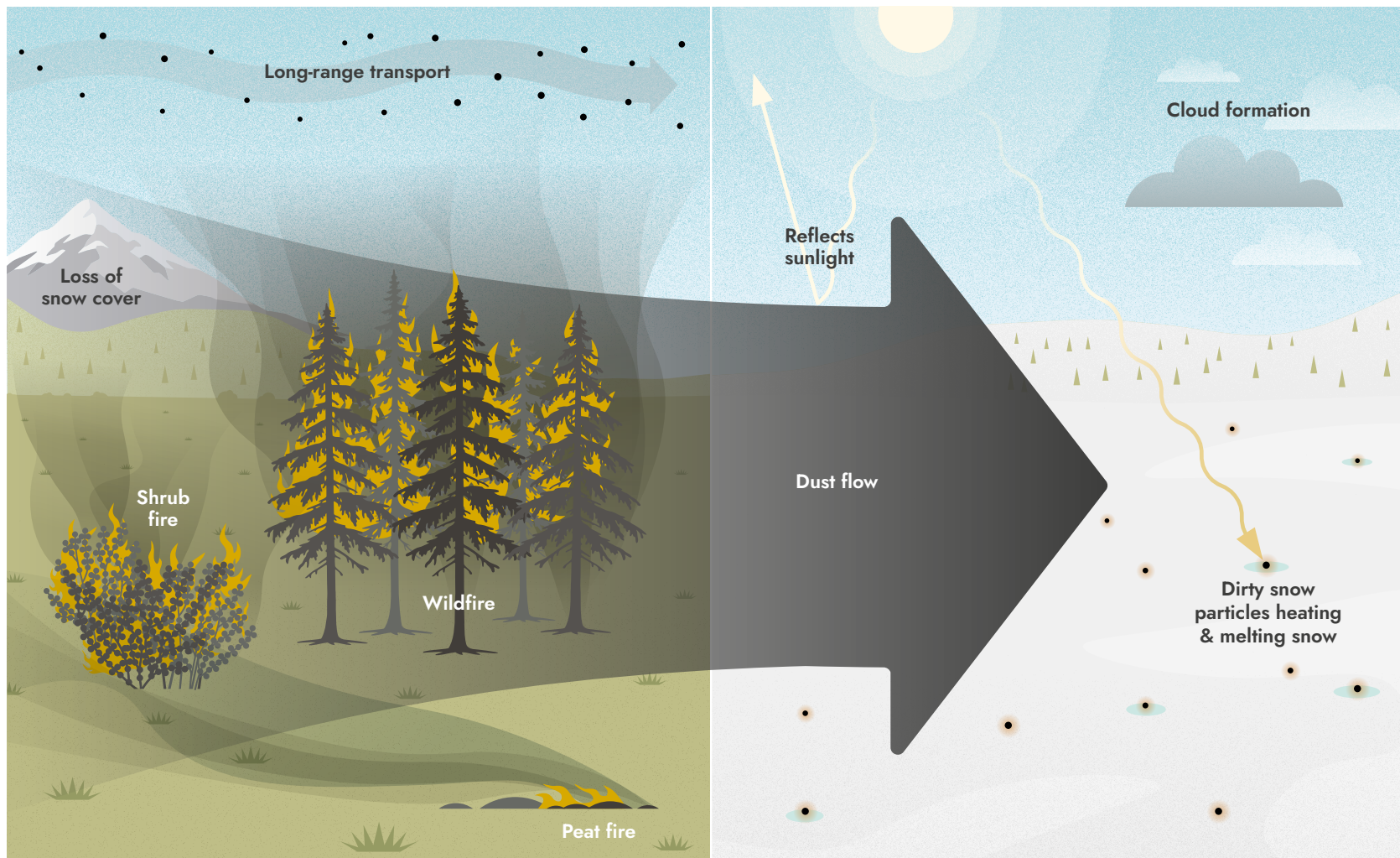
SHRUB EXPANSION

Arctic greening is associated with a “shrubification” of the tundra, where tall deciduous shrubs expand and replace lichen and moss dominated vegetation. The shift in vegetation cover feeds back to the climate system by enhancing carbon sequestration through plant growth, reducing surface albedo, increasing snow accumulation and soil insulation, and stimulating microbial activity and decomposition



WILDFIRES

Rising temperatures causes longer fire seasons, more ignition from lightning and drier vegetation and soil. Combined with more fire fuels from woody plants and dried peat, the frequency, intensity, and extent of Arctic wildfires are accelerating. Crucially, as permafrost thaws, large areas of carbon-rich soils and peatlands dry out, making them susceptible to prolonged burning. This process releases significant amounts of CO₂ and aerosols into the atmosphere and accelerates permafrost thawing, creating a feedback loop that intensifies the environmental changes. A new fire regime with increased frequency and intensity of wildfires have large implications for biodiversity and ecosystem resilience



DUST IN THE ARCTIC

Wildfires, loss of snow cover, glacier retreat, permafrost thaw, and rising drought intensity all contribute to increased dust and aerosol production in the Arctic. These particles can be transported over long distances, engaging in complex interactions with both climate and ecosystems, including radiative forcing (positive and negative), cloud formation, albedo and fertilization of aquatic ecosystems