Table S1. This table presents information extracted from the United Nations' Intergovernmental Panel on Climate Change's (IPCC) Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) (IPCC, 2019), predominantly Chapter 3 (Meredith et al. 2019), on drivers of change that have a clear connection to Southern Ocean (SO) ecosystem services (ES). The table includes brief statements about future changes in these drivers (circumpolar) and where these statements can be found in the SROCC; the level of confidence in this information (Abram et al. 2019); the biological relevance of this information; and the ES to which it has clear connections.

Key driver of change (climate-related)	**Future changes in driver**	**Biological relevance of changes in driver**	**Connection to which ES**
Sea ice	*Low confidence* in projections, future declines are indicated (SROCC 3.2.1.1).	The annual advance and retreat of sea ice has a dominant role in SO ecosystem dynamics. Changes to sea ice influences: The release of freshwater, ocean stratification, air-sea interactions, light availability, vertical mixing and temperature, all of which are important to ecosystem structure and processes. For example, changes in seasonal sea ice extent and thickness (and ocean stratification - see below) can alter timing, duration and intensity of primary production, with impacts throughout the foodweb, and changes in the amount of light reaching the shallow seabed may result in changes in the composition of benthic communities. The availability (location, extent, etc) of sea ice as a crucial habitat (e.g. for feeding and breeding) for many species, e.g. Antarctic krill, and higher predators such as seals and penguins. The presence of sea ice as a physical barrier, either allowing or restricting the movement and access of species, and fishing and tourism vessels.	Provisioning: Fishery products - Antarctic krill fishery Regulating: Climate regulation - Blue carbon pathway Supporting: Primary production Cultural: Tourism and recreation
Ocean temperature	Projections indicate that observed SO warming trends will continue under RCP4.5 and RCP8.5 scenarios, leading to 1–3°C warming by 2100 mostly in the upper ocean (SROCC 3.2.2.2). Although the direction of model changes appear mostly robust, inter-model spread results in there being *low confidence* in magnitude.	Species vary in their thermal tolerance and temperature has a major role in polar ecological processes, spanning a broad range of influence including primary productivity, growth, metabolism, thermoregulation, life cycles, reproductive success, species assemblages, distribution and range. Effects on location of optimal environmental conditions for growth and recruitment.	Provisioning: Fishery products - Antarctic krill fishery, toothfish and mackerel icefish fisheries, potential future finfish fisheries
Carbon and ocean acidification	The SO will be increasingly affected by CO_2 uptake. It is *very likely* that the SO will experience year-round conditions	Increased CO_2 may cause conditions corrosive for calcium carbonate shell-producing organisms, with associated impacts on marine organisms and ecosystems.	Provisioning: Fishery products - Antarctic krill fishery

	of surface water undersaturation for mineral forms of calcium carbonate by 2100 under RCP8.5; under RCP2.6 the extent of undersaturated waters are reduced markedly (*high confidence*) (SROCC 3.2.1; 3.2.2.3; 3.2.3).		Supporting: Primary production
Mixed layer depth (MLD) and stratification	Projections indicate an increase in stratification and a shallowing of mixed layers; the sign of the trend appears mostly robust across models, though there is *low confidence* in magnitude due to large inter-model spread (SROCC 3.2.2.2).	Stratification is an important factor in determining the rates and distributions of marine primary production.	Supporting: Primary production Nutrient cycling
Retreating glaciers, ice sheets, and ice shelf loss	The Antarctic Ice Sheet (AIS) is projected to lose mass at an increasing rate throughout the 21st century and beyond (*high confidence*) (SROCC, SPM, B.1). There is *limited evidence* and *high agreement* that recent AIS mass losses could be irreversible over decades to millennia (SROCC 3.3.1; Chapter 3 Box 8; 4.2.3.1.2). There is *high confidence* that glaciers in polar regions will lose substantial mass by the end of the century (SROCC Chapter 2 Box 6).	Both polar ice sheets have the potential to release dissolved and sediment-bound nutrients and organic carbon directly to the surface ocean via subglacial and surface meltwater, icebergs, melting of the base of ice shelves, in addition to indirectly stimulating nutrient input via upwelling associated with subglacial meltwater plumes. These nutrient additions, and enhanced iron input from ice shelves, glacial meltwater and icebergs, may influence primary production in some regions. Exposure/creation of new habitat: ice shelf retreat or collapse can lead to new marine habitats and to biological colonisation, which in turn can influence primary productivity, zooplankton and benthic communities. Newly available habitat on coastlines may also provide breeding or haul out sites for land-based predators such as penguins and seals. Glacial retreat, iceberg scour etc may impact the structure and function of benthic communities. These impacts are also relevant to tourism e.g. by facilitating access to new locations and affecting the wildlife present at established tourist sites.	Regulating: Climate regulation - Blue carbon pathway Supporting: Primary production Nutrient cycling Cultural: Tourism and recreation
Ocean circulation	Indications are that, if further increases in the westerly winds are	Although there is limited information on the nature of the impact of future changes in circulation on ecosystem components, the ACC and	Provisioning: Fishery products - Antarctic krill fishery

(horizontal circulation and movement of fronts; overturning circulation and water mass formation)	sustained, then it is *very likely* that the SO eddy field will continue to intensify. It is *likely* that the mean position and strength of the Antarctic Circumpolar Current (ACC) will remain only weakly sensitive to winds. *Low confidence* is ascribed to the CMIP5-based model projections of future Southern Ocean circulation and water mass properties (SROCC Chapter 3 Box 7).	its frontal systems, and subpolar gyres have a dominant role in SO ecosystem dynamics. Wind velocities, strength and position influence circulation, sea ice, MLD and stratification, vertical Ekman pumping and sea surface temperature, nutrient transport, oceanic carbon and oxygen uptake and storage, all have ecological importance. E.g. eddy fields have local impacts on biological productivity, ecosystem structure, and carbon uptake, both directly and via sub-mesoscale processes.	Regulating: Climate regulation - Blue carbon pathway Supporting: Primary production Nutrient cycling

References

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