Table 2.A.2 Assessment of uncertainties associated with key statements on Projected Impacts.

Key statement	Geographic region	Time Period or °C for projected Impacts	Consideration of non-climate/CO2 drivers?		Study design		Independent evidence supporting projected change				Level of agreement among studies, models and toher supporting evidence	Confidence level in key statement	SOD sections	References	RESULTS (mostly copy/paste from papers, text only slightly modified)
			Changes in land use incorporated into projected change?	Variance in dispersal abilities incorporated into projected change?	Numbers of studies and/or numbers of different models used to generate projected impacts	Level of agreement among studies and/or model outputs	TYPE = Paleo data: Do climatic changes in deep time of similar type and magnitude as used for	TYPE = Experiments: Do future simulations using manipulative experiments agree with modeled future impacts?	TYPE = Long-term Observations: Are recent trends in the same direction as projected change for target species, community or biome?	*OTHER????*					
Continued climate change under high emissions scenarios could increase future wildfire frequency on one-third to two-thirds of global land by 2100 and decrease fire frequency on one-fifth of global land, with a net global fire frequency increase of ~30% per century												***medium confidence***	{2.4.4.2; 2.5.5.2}		
Increased wildfire, combined with erosion due to deforestation, could degrade water supplies												medium confidence	{2.4.4.2; 2.5.5.2}		
For ecosystems with historically low fire frequencies, particularly tropical rainforests, projected increases of drought under continued climate change increase risks of fire, which could cause biome shifts, e.g., potential conversion of over half the area of Amazon rainforest to grassland.												***medium confidence***	{2.4.4.2; 2.5.5.2}		
Terrestrial ecosystems protect globally critical stocks of carbon and provide an essential service of sequestration of carbon from the atmosphere but are at risk of carbon losses from deforestation and climate change												***high confidence***	{2.4.4.4; 2.5.1}		
Percentages of species projected to suffer extinction vary from zero to 54% with a threshold for extinction of >80% of the species' climate space disappeared. With a threshold for extinction of >50% climatic range lost, under 3.2 °C warming, 49% of insects, 44% of plants, and 26% of vertebrates are projected to be at risk of extinction. At 2°C, this falls to 18% of insects, 16% of plants, and 8% of vertebrates and at 1.5°C, to 6% of insects, 8% of plants, and 4% of vertebrates.	global	Variable (*list ranges*)	yes for some studies *(list or quantify)*	yes for many studies *(list and/or quantify)*	*list common models, quantify how many studies use multiple models*	e.g., low for specific geographic shift or area lost/gained, high for direction of shift, *other???*	how many species being modeled have paleo data?		**Ever-increasing evidence of current impacts of climate change on wild species in turn gives us higher confidence in future projections of biodiversity changes that are based upon known relationships between species and climate.**		Differences in estimates of extinction risk stem from differing assumptions of thresholds for extinction risk, differing geographic regions and taxonomic groups, as well as differing modeling approaches and emissions scenarios	Confidence highly dependent upon statement of range of species' extinctions	{2.5.3.3}		
Climate change induced warming leads to shifts in thermal regime of lakes	global	Representative concentration pathway 8.5				high									
Substantial changes in vegetation structure and ecosystem processes are expected to for already relatively small temperature increases (<2°C above pre-industrial), in particular in cold (boreal, tundra) regions, as well as in dry regions [high confidence]. Land-use chagne will exacerbate projected impacts on ecosystems and will alter ecosystem function and vegetation cover in addition to climate change. Models agree on impacts increasing rapidly with level of global mean temperature change; models also agree that these impacts will be visible the earliest in boreal/tundra regions, as well as in dry areas. Nonetheless there are discrepancies regarding the regional patterns of impacts, not only for climate change but also for land-use change.	Global, tropcial boreal	2100, climate/CO2 as in RCP 2.6, 4.5, 8.5	Yes for some experiments, from LUH/CMIP5	n.a.	Factorial model experiment (HadGEM2-ESM				greening and browning observed in satellite remote sensing studies, and attributed to LUC and climate change/CO2. thier relative impacts vary widely over the globe -- see E:G:; Zhu, Piao et al., 2016 & observed impact section in the chapter.				Projected changes at the biome level	{Davies-Barnard, 2015 #164}	Forest fraction change: global & boreal-- increasing with CC/CO2, most strongly in RCP8.5; tropical -- impacts are small, slight decline in RCP2.6; global/boral/tropical -- decline in response to LUC for 2.6 and 8.5, increase in 4.5.
	Global	2100, climate/CO2 as in RCP 2.6, 4.5, 6.0	Yes, for some experiments, from LUH/CMIP5	n.a.	DGVM (LPJ) with multiple CMIP5 ESM climates, caclulate "gamma metric" which expresses strenght of change in biome shifts and bieogeochemical cycles/ecosystem services									{Ostberg, 2013 #2096;Ostberg, 2018}	For RCP2.6, still >20% of land surface notably impacted by climate change (mostly tundra, boreal regions, but also dry grasslands/deserts). Increasing to >30% (RCP 4.5) and >40% (6.0) of the land surface, and increasingly including now also tropical seasonal forests expanding into tropical forests and into savannas. In a RCP8.5 world, >50% of land sirface affected by climate change alone. LUC substantially enhances the land surface transformation in
	Global	2100, climate/CO2 as in RCP 2.6, 4.5, 6, 8.5	no	n.a.	Seven global vegetation models, driven by ISIMIP climate projections									{Warszawski, 2013 #2414}	At 2oC warming above 1980-2010 levels, 5-19% of land surface at risk of severe change; extend of regions at risk more or less doubles between 2oC and 3oC mean global warming, at 4oC warming ca. 35% of land surface projected to be notably impacted. Vegetation models to some extend disagree on regional patterns of impacts are largest, but agreement that high northern latitudes will be strongly affected.
	Global	2100,	no	n.a.	DGVM LPJ-GUESS & MPI-									{Wårlind, 2014 #2409}	Shifts in vegetation composition in many regions, for
Novel abiotic conditions are expected to also result in no-analogue vegetation composition [medium confidence]	Global	ca. 2050, RCP6.0	no	n.a.	Uses projections of abiotic conditions (R, precip., N deposition) plus human							medium confidence that novel abiotic conditions will also be		{Radeloff, 2015 #2178}	T (and N deposition) largest driver of novelty; large degree of novelty in tropics and subtropics because temperatures reach levels that haven't been seen in the
	Global	2100, SRES B1, A2.	no	n.a.	Vegetation model JeDi, identify distribution of simulated no-analogue vegetation and compare to							medium confidence that novel abiotic conditions will also be seen in novel		{Reu, 2014}	Find no-analogue climate in (sub)tropical regions, mostly of the northern hemisphere and non-analogue vegetation in Finland and western Siberia. Effects stronger in A2.
At least part of what is now humid tropical forest is projected to shift increasingly towards vegetation with traits that correspond to drier and hotter climate [high confidence]	Tropical/Ghana	n.a	no	n.a.	Species functional traits plus vegetation census data (plots) along a rainfall gradient; calculate community-level weighted mean for each trait and plots, CWM is indicator of mean canopy properties. Explore empirical relationship with soil water deficit.								Risk to tropical forest	{Aguirre-Gutiérrez, 2019}	Drier tropical forests increased their deciduous species abundance & generally changed more functionally than forests growing in wetter conditions, suggesting an enhanced ability to adapt ecologically to a drying environment.

	Tropical/Amazon	n.a.	no	n.a.	Calculate exposure as meteorological drought, using the standardized precipitation index (SPI) and the maximum cumulative water deficit (MCWD) from 1981 to 2016 & assess changes in enhanced vegetation index anomalies (AEVI, from MODIS).									Anderson, 2018 #1439;Bartlett, 2019 #1476	Minimum and maximum AEVI indicate that droughts tend to increase the variance of the photosynthetic capacity of Amazonian forests; intensity of negative AEVI increased with time (2005-2016), forest may become more vulnerable to droughts.
	Tropical	Stylised droughts; 400 and 800 ppm CO2	no	n.a.	Empirical model, linking photosynthesis and stomatal conductance and other drought-related traits to soil water content.									{Anderson, 2018 #1439}	Drought impacted competition more than CO2, with elevated CO2 reducing but not reversing drought-induced shifts towards more tolerant strategies --> shifts towards drought adapted vegetation.
	Tropical, global	n.a.	no	n.a.	Reviews, published									{Bonai et al., 2016}	Wide range of responses, seen in e.g. mortality, growth,
	Tropical/Amazon	n.a	no	n.a.	Forest cencus data in									{da Silva, 2018 #1630}	Reduced forest biomass and enhanced post-fire mortality
	Tropical/Central/So	n.a	no	n.a.	Review, published									{Stan, 2019 #2300;}	Climate along a latitudinal gradient indicates drought
	Tropical/Amazon	2050, climate/CO2 as in RCPs2.6, 4.5, 8.5	yes	n.a.	Review, published literature of climate change and land-use chage impacts & simulations with vegetation model CPTEC-PVM2 with nine CMIP5 GCMs									{Nobre, 2016 #2075}	4oC warming or deforestation exceeding 40% of the forest area estimated as tipping point towards "savannisation".
	Tropical/Latin America	2100, climate/CO2 as in RCP2.6 and 8.5	yes, in some experiments	n.a.	Projections with DGVM LPJmL, driven by five ISIMIP climate projections. Land-use change from CLUE, combined with SSPs.									{Boit, 2016 #1521}	Across all scenarios 5–6% of the total area will undergo biome shifts that can be attributed to climate change until 2099, even in the RCP8.5. Changes clearly dominated by land.use change. CO2 fertilisation helps to buffer negative climate change impacts.
	Tropical	2100, climate/CO2 as in SRES A2	no	n.a.	DGVM Moses-Trifid & 22 GCM (from AR4), emulated with pattern-scaler model IMOGEN	Agreement that forest gain biomass, but very large variability in projected tropical forest biomass, depending on which GCM used, despite of only using a single emission scenario								{Huntingford, 2013 #1836}	Agreement that forest gain biomass, but very large variability in projected tropical forest biomass, depending on which GCM used, despite of only using a single emission scenario. Towards end of 21st century peak in biomass-gain and downturn. Only one of all 22 simulations forest projected to loose biomass, and this only in the South American tropics.
	Tropical/Amazon	2100, climate/CO2 as in SRES A1B, RCP 2.6, RCP 8.5	no	n.a.	Trifid + HadCM3									{Boulton, 2017 #1529}	Little change in Amazon forest cover for A1B and RCP 2.6, decline in some of the ensemble runs under RCP 8.5. Impacts get stronger in time periods beyond 2100 ('comitted')
On different continents, and from mesic to dry savannah sub-regions, the relative importance of climate, fire and other factors in shaping savannah vegetation and distribution varies, which makes projections of the change of the biome's extend challenging. Due to the continued strong effect of CO2 on tree to grass ratio in future, models suggest both a loss of savannah extend and conversion into dry forest and an expansion of savannah-type vegetation into arid grasslands.	Savannah	2070, RCP4.5	no	n.a.	Thornley transport resistance statistical distribution model & three versions of aDGVM + MPI ESM-LR								Risk to savannahs	{Moncrieff, 2016 #2042}	2070: DVM project reduced extent of savannah at boundary with forests, while the TTR-SDM projects savannah decrease at boundary with grassland. TTR does not include CO2 impacts.
	Savannah/Africa	2100, SRES A1B	no	n.a.	aDGVM + climate from ECHAM5									{Higgins, 2012 #1804}	(woody) C3 vegetation increases in from dominating less then 5% of study area surface in 2020 to ca. 20% at end of century.
Models of vegetation response to climate project that the observed increases in shrub dominance and in boreal forest encroachment driven by recent warming are to accelerate in coming decades, especially under the higher greenhouse gas emissions scenarios, leading to a shrinking of the area of tundra globally	Tundra	2070, RCP 4.5	no	yes?	SDMs, 116 vascular plants, based on plot observation data -- presumably no CO2 impact on plants								Risk to tundra and boreal forest	{Mod, 2016 #2037}	Abundance of woody plants will expand, decreasing predicted species richness, amplifying species turnover and increasing the local extinction risk for ambient vegetation
	Tundra	2050 & 2070,	no		statistical vegetation model									{Gang, 2017 #1733}	Area of tundra declines in basically all future projections,
	Tundra	2074; 0, 2.5, 5, 8◦C warming compared to 1994	no	n.a.	vegetation model NUCOM-tundra + 16 different climate scenarios; unclear if model accounts for CO2									{van der Kolk, 2016 #2368}	Abrupt permafrost thaw initiating thaw pond formation led to complete domination of graminoids: shrub growth limited by very wet soil conditions and low nutrient supply/graminoids can grow in wide range of soil moistures & access nutrients in deeper soil layers.
Boreal tree species are expected to move northwards (or in mountain regions: upwards) into regions dominated by tundra, unless constrained by edaphic features, and temperate species are projected to grow in regions currently occupied by southern boreal forest. In both biomes, deciduous trees are simulated to increasingly grow in regions currently dominated by conifers.	Boreal	2100,	no	n.a.	DGVM LPJ-GUESS &									{Arneth et al., 2016}	Areas dominated by löarch shift northwards, overall area
	Global/boreal regions (45-80oN)	2100, SRES A1B and climate stabilisation scenario	no	n.a.	HadCM3C									Falloon et al., 2012	Increases in shrub and needleleaf trees at high latitudes
While the future of the global land carbon sink is highly iuncertain, possibly enhanced carbon losses from terrestrial systems further will limit the available carbon budget for global warming staying below 1.5oC [high confidence]	Permafrost region	2300,	no	n.a.	Empirical relationship to								Risk to terrestrial carbon	{Chadburn, 2017 #1577}	Simulations under two future climate scenarios show near-
	Permafrost region	2100, 1.5o and	no	n.a.	Ecosystem model Jules +									{Comyn-Platt, 2018 #1613}	By 2100, the model ensemble estimates a median 138
	Permafrost region	2300, RCP 8.5 &	no	n.a.	Inventory models + CCSM4									{Turetsky, 2020, carbon release through}	Emissions across 2.5 million km2 of abrupt thaw; under
	Permafrost region	2100, climate	no	n.a.	Eight ecosystem models	Large between model								{McGuire, 2018 #2013}	Projected losses of permafrost between 3 - 5 million km2
	N America arctic	2100, RCP8.5	no	n.a.	ecosystem model Ecosys +									{Mekonnen, 2018 #2020}	Between 1982 and 2100 averaged increases in relative
	Peatlands, Amazon	2100,	no	n.a.	Peatland ecosystem model									{Wang, 2018 #2407}	Under warmer (and presumably wetter) conditions over
	Peatlands, northern	2100, RCP/CO2	no	n.a.	ORCHIDEE-peat + IPSL-									{Qiu, 2020, the role of northern}	current carbon this sink will roughly double in the future
	Global	2100, no climate	yes (drainage)	n.a.	Empirical, based on									{Leifeld, 2019, intact and managed}	By 2100, peatland conversion in tropical regions might
	Tropical		yes (peat swamp/oil		Empirical, upscaled									{Cooper, 2020, greenhouse gas emission	Measurements of GHGs emitted during the conversion
	Tropica peatland	none	yes		Review paper									{Page, 2016, peatlands and global}	
	Tropical	2100,	no	n.a.	DGVM Moses-Trifid & 22	Agreement that forest gain								{Huntingford, 2013 #1836}	Agreement that forest gain biomass, but very large
	Global	2100, SRES A2	no	n.a.	Jules,. Adjusted for T-									{Mercado, 2018, large sensitivity in land}	Results suggest that thermal acclimation of
Cascading trophic effects triggered by top predators or the largest herbivores propagate through food webs and reverberate through to the functioning of whole ecosystems, altering notably productivity, carbon and nutrient turnover and net carbon storage [medium confidence]	western North	none	no	n.a.	Data on population								Risk to terrestrial carbon	{Stoner, 2018, climatically driven changes}	Data indicate strong, positive association between plant
	Africa savannah	none	no	n.a.	LPJ-GUESS + grazing									{Pachzelt, 2015, potential impact of}	The grazer–vegetation model predicted substantial
	Africa, lowland primary forest	none	no	n.a.	ecosystem model ED + elephant disturbance									{Berzaghi, 2019, carbon stocks in central Africa}	elephants: reduction of forest stem density --> changes in the competition for light, water and space among trees --> emergence of fewer and larger trees with higher wood density --> increases the long-term equilibrium of aboveground biomass, reduces the forest NPP (trade-off between productivity and wood density). Typical density of 0.5 to 1 animals per km2 --> elephant disturbances increase aboveground biomass by 26–60 t ha−1; Extinction of forest elephants would --> 7% decrease in the aboveground biomass in central African rainforests.