Comment form for 1st Review Phase of the Deliverable 3c) Fast-track methodological assessment on scenarios and models Chapter 4 'Impacts'

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Sonja C. Jähnig (SJ)
Lionel Hertzog (LH)
Neil Burgess (NB) together with Derek Tittensor, Mike Harfoot, Tim Newbold (WCMC)
Joseph Bigirimana (JB)
Lisa Venier (LV)
Herve Le Bouler (HLB)
Thierry Oberdorff (TO)
Moana Badie (MB)
Wei Zhang (WZ)
Thomas Brooks (TB)
Sonali Ghosh (SG)
Debra Peters (DP)
Karel Mokany (KM)
Andrew Hartley (AH)
Bradley J. Cardinale (BC)

Comments in green not completely addressed in the second draft and need to be revisited when addressing comments from the second review phase.

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1.						Generally, I find that in the whole deliverable aspects related to freswhater are not enough represented, although they provide essential ecosystem services, host an exceptional high proportion of biodiversity (given their coverage) and are under highest threat of all ecosystems.	Sonja C. Jähnig (SJ)	We could not explicitly deal with this request in this revision and we will plan to include freshwater examples in the next revision. **UPDATE:** An effort has been made to add some examples from freshwater systems in the final version of the ms. However, given

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								space constraints, their number is still limited.
2.	4					In Chapter 4 are various sections, which I find relevant to all scenarios/model areas – and which I would prefer to see in the overview part, i.e. 4.1.2, 4.1.3 or 4.5 on uncertainty or complexity	Sonja C. Jähnig (SJ)	Uncertainty issues will be explicitly addressed and coordinated across chapter in later stages of the deliverable.
3.	4					Clearly, freshwater and floodplains aspects are missing, here; I will just mention a few publication from my own group, but in these there are other references that are highly relevant: - Domisch S, Araújo MB, Bonada N, Pauls SU, Jähnig SC, Haase P. 2013. Modelling distribution in European stream macroinvertebrates under future climates. Global Change Biology 19:752–762. - Domisch S, Jähnig SC, Haase P. 2011. Climate-change winners and losers: stream macroinvertebrates of a submontane region in Central Europe. Freshwater Biology 56:2009–2020. - Jähnig SC, Kuemmerlen M, Kiesel J, Domisch S, Cai Q, Schmalz B, Fohrer N. 2012. Modelling of riverine ecosystems by integrating models: conceptual approach, a case study and research agenda. Journal of Biogeography 39:2253–2263. - Kiesel J, Schröder M, Hering D, Schmalz B, Hörmann G, Jähnig SC, Fohrer N. 2015. Development, sensitivity, and univariate application of the macroinvertebrate community model HET. Fundamental and Applied Limnology (Archiv für Hydrobiologie) 186:117–133. - Kuemmerlen M, Schmalz B, Guse B, Cai Q, Fohrer N, Jähnig SC. 2014. Integrating catchment properties in small scale species distribution models of stream macroinvertebrates. Ecological Modelling 277:77-86. - Schmalz B, Kuemmerlen M, Kiesel J, Cai Q, Jähnig SC, Fohrer N. 2014. Impacts of land use changes on hydrological components and macroinvertebrate distributions in the Poyang lake area. Ecohydrology DOI: 10.1002/eco.1569.	Sonja C. Jähnig (SJ)	We could not explicitly deal with this request in this revision and we will plan to include freshwater examples in the next revision. **UPDATE:** Thanks for the list of illustrative examples. An effort has been made to add some examples from freshwater systems in the final version of the ms. However, given space constraints, their number in the final version of the chapter is still limited.
4.	4.3	11	4			Special care should be taken to use similar terms, e.g. how are the different models classified (as outlined in Figure 1.4) – in contrast to Chapter 1 and 3 here the terms phenomenological and mechanistic are used	Sonja C. Jähnig (SJ)	We have revised the use of these terms but a more general harmonisation of terms across chapters is envisaged in later stages of

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								the deliverable development.
5.	4	25	28	26	7	The literature cited is a bit outdated, more recent reviews provide deeper insight into the relation between biodiversity and ecosystem function (eg Hooper 2005 Ecological Monographs, Cardinale 2012 Nature …), concerning microbial richness works by Naeem might also be relevant citation here.	Lionel Hertzog (LH)	The literature on these topics is enormous. We thank the review for the suggestion and the authors will try to balance reference addition in the last version of the chapter.
6.	4	2	6			"outmost"? Is this meant to read "utmost"?	Thomas Brooks (TB)	Ok.
7.	4	2	8			Delete "and ecosystem" – ecosystems are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** We have followed advice from co-chairs and used biodiversity and ecosystems as presented in the IPBES conceptual framework.
8.	4	3	4			Delete "and ecosystem processes" – ecosystem processes are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
9.	4	3	21			"essential" is an overstatement; "important" would be better, here.	Thomas Brooks (TB)	Ok
10.	4	4	20			Change "Ecosystems are" to "Biodiversity is an" – ecosystems are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
11.	4	4	43			Delete "ecosystem functioning and" – ecosystem functioning is part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.

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12.	4	5	23			Change “ecosystems” (specific) to “biodiversity” (general) here	Thomas Brooks (TB)	Section rewritten **UPDATE:** See update 94.
13.	4	5	28	5	29	This two-fold typology of direct drivers does not seem consistent with Chapter 3. Where would invasives and pollution fit in this? Salafsky et al. 2008 Conserv Biol would be a good citation here.	Thomas Brooks (TB)	To be further integrated in later versions of the deliverable after specific discussions with authors from chapter 3. **UPDATE:** Revised for consistency with chapter 3.
14.	4	6	21	6	22	Delete “across ecosystems” and “functioning and”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** Revised.
15.	4	6	24			Delete “ecosystem”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** Revised.
16.	4	26	9	26	15	Here it might also be interesting to mention the effect of keystone predator, ie wolves in the yellowstone affecting erosion rates on riverbanks ie Beschta and Ripple Ecohydrology	Lionel Hertzog (LH)	We have not added this reference due to space constraints.
17.	4	6	25	6	27	Change “ecosystem processes” to “ecological processes” or similar, two places here.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
18.	4	6	31			Delete “ecosystem and” from title.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
19.	4	6	40			Change “ecosystem” to “biodiversity”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.

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20.	4	8	19			"SDM" – does this mean "Structured Decision Making" as per Section 2.2.8 in Chapter 2? Doesn't seem right?	Thomas Brooks (TB)	Decision on final acronyms usage will be made at a later stage with a clearer vision of the whole deliverable in mind. **UPDATE:** SDM is now used to refer to species distribution models only.
21.	4	8	37			Delete "and ecosystem functioning" from title.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
22.	4	9	2			Change "ecosystems" to "biodiversity".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
23.	4	9	9			Delete the bottom row from Table 4.1 – "Landscape" is not a level of ecological organization, but rather of the way in which humanity subdivides and characterises space.	Thomas Brooks (TB)	To be further discussed in a later stage of the chapter development **UPDATE:** "Landscape level" renamed as "ecosystem level" (and "Ecosystem" removed from the previous row).
24.	4	9	11	10	41	This entire section is written almost exclusively about ecosystem level components of biodiversity. It should be expanded and restructured to make clear that the remit of IPBES is to address biodiversity broadly, at genetic and species levels as well as at the ecosystem level. Characterising (and thence modelling) each of these levels of ecological organization is important for different decision contexts regarding biodiversity and ecosystem services, a point which has been made repeatedly elsewhere in the draft assessment.	Thomas Brooks (TB)	The chapter has been rewritten to try to be more inclusive and address biodiversity more broadly.
25.	4	11	2			Delete "and ecosystem functioning" from title.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development.

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								UPDATE: See update 94.
26.	4	11	4			Change "the ecosystem" to "biodiversity".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
27.	4	26	41	26	42	Transition from purely ecological assessment of feedbacks to IAM is rather abrupt, some example of feedbacks between ecosystems and human society might be necessary here to understand why and how models coming from different fields might be integrated.	Lionel Hertzog (LH)	The IAMs issue has been identified and need to be treated together with other chapters of the deliverable (i.e. chapter 6). **UPDATE:** Acknowledged. However this issue was discussed at the author's meeting in Beijing with CLAs from chapter 6 and the section has been slightly modified to deal with this issue.
28.	4	11	4	11	5	"two broad categories" – is this consistent with the categorisation in Chapter 1 and specifically Section 1.2.5.1?	Thomas Brooks (TB)	We have changed the model typology to more closely match those used in chapter 1. Further coordination may necessary in later stages of the deliverable development.
29.	4	17	1	17	8	Also important to note work done to validate projections from application of SARs, e.g., Pimm & Askins 1995 PNAS, Pimm et al. 1996 Science, Brooks et al. 1997 Conserv Biol, Brooks et al. 2002 Conserv Biol.	Thomas Brooks (TB)	To be assessed in later stages of the chapter if space allows. **UPDATE:** Acknowledged but lack of space did not allow the inclusion of this topic in the chapter.
30.	4	23	23	24	17	One major field of biodiversity models which needs to be covered in Chapter 4, and is currently missing, is the threshold approaches used in, for example, Red List assessments of species extinction risk (Mace et	Thomas Brooks (TB)	To be added in a more advanced version of the ms.

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						al. 2008 Conserv Biol) and risk of ecosystem collapse (Keith et al. 2013 PLoS ONE). I think that this would fit best as an additional couple of paragraphs at the end of Section 4.3.4, in the sense that Red List approaches incorporate both comprehensively quantitative criteria (e.g., the "E criterion" for the Red List of Threatened Species) as well as threshold-based criteria describing species population sizes, characteristics, and trajectories, often with respect to direct drivers (e.g., in the subcriteria (c)–(e) under the Red List A criterion; the subcriterion (b) under the Red List B criterion; etc). (Box 6.1 in Chapter 6 gives a good example of why this approach is so important to reflect here.)		**UPDATE:** Acknowledged. But this proposed section not clearly within the scope of the chapter. Such a section cold be interpreted more like an application of biodiversity models in a particular decision context (protected areas)
31.	4	23	23	24	17	Another set of work which should be reflected in Chapter 4, and would likely fit best here in Section 4.3.4, is the identification of sites contributing significantly to the global persistence of biodiversity, or "key biodiversity areas" (Eken et al. 2004 BioScience). This encompasses numerous widely-used approaches such as Important Bird Areas (e.g., Butchart et al. 2012 PLoS ONE) and Alliance for Zero Extinction sites (Ricketts et al. 2005 PNAS). Again, this work can utilise both threshold-based approaches and comprehensively quantitive irreplaceability modelling. A global standard uniting such approaches is currently being finalised by IUCN (see http://www.kbaconsultation.org).	Thomas Brooks (TB)	We think that this addition go beyond the current scope of the chapter as was agreed within the deliverable in that it is not explicitly dealing with direct linkages between drivers of change and biodiversity and how it is modeled. Threshold approached are now presented later on is space allows.
32.	4	28	15			Delete "and ecosystems".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
33.	4	28	17			Delete "and ecosystem functioning".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
34.	4	28	21			Delete "ecosystems and".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.

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35.	4	29	2	29	3	Delete “and ecosystem processes”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
36.	4	29	13			Delete “and ecosystems”	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
37.	4	29	30	32	10	This entire Section 4.5.1 seems to duplicate Section 2.4.2. Are both necessary? Can 4.5.1 be merged into 2.4.2?	Thomas Brooks (TB)	Section rewritten to aim at avoiding potential duplications and improved clarity
38.	4	28	19	28	19	Uncertainty in model predictions might also come from the fact that some ecological process are inherently stochastic	Lionel Hertzog (LH)	Acknowledged. Uncertainty issues should also be better conveyed across chapters.
39.	4	34	23			Delete “and ecosystem” from title.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
40.	4	34	24			Delete “and ecosystem”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
41.	4	34	27			Delete “and ecosystem”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
42.	4	37	15			“is the only option” is a massive overstatement. Replace with something like “can provide powerful support”.	Thomas Brooks (TB)	Deleted
43.	4	37	16			Delete “and ecosystem functioning”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter

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								UPDATE: See update 94.
44.	4	37	16			Change "The best..." to "Good...". There are better examples from biodiversity and ecosystem services directly (as have been discussed throughout the assessment draft) – such as the use of PVA and PHVA to inform management of threatened species.	Thomas Brooks (TB)	Deleted
45.	4	37	21			Delete "or ecosystem functions".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
46.	4	37	24	37	25	Delete "and ecosystem functioning".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
47.	4	37	35			Delete "and ecosystem".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
48.	4	37	37			Delete "and ecosystem functioning".	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
49.	4	32	13	32	44	This might be beyond the scope of this report, but uncertainty in models also arise because basic population-level parameters and their reaction to changes are not known for many species, field or experimental data allowing us to derive such parameter are missing (similar cases for trophic network), because such results would not seem "novel" enough to be published in peer-review science, there is limited incentives for academics to design and conduct such work for whole communities. Maybe such data limitation issue to modelling is discussed elsewhere in the report but I think that it should also be mentioned in this chapter	Lionel Hertzog (LH)	Acknowledged. Uncertainty issues should also be better conveyed across chapters.

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50.	4	38	1			Change “ecosystems” to “biodiversity”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
51.	4	38	4	38	5	Delete “and ecosystem functions”.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter **UPDATE:** See update 94.
52.	4					A general comment: this Chapter 4 (and in fact the assessment overall) is strong on scenarios and modelling for the ecosystem level of biodiversity, gives reasonable attention to the species level, and is very weak on the genetic level. On the latter, models of population genetics used for, e.g., management of threatened species ex situ in zoos, aquaria, and botanical gardens, are almost entirely missing.	Thomas Brooks (TB)	To be discussed in later statges of chapter development **UPDATE:** There is now a section (4.2.1) addressessing the various levels of biological diversity and not just the ecosystem level.
53.	FOUR	14	25	14	30	A small paragraph may be included on Resource Selection Function models (RSF) that may read as .... While SDMs look at species-presence data, Habitat use can be characterized by resource selection functions (RSFs) that are proportional to the probability of an area being used by an animal (Boyce et.al., 1999). These models are popularly known as Resource Function models and have been used extensively for modleling species distribution across landscapes. Reference: Boyce, M.S., McDonals, L.L.(1999). Relating populations to habitats using resource selection functions. Trends in Ecology and Evolution. 14(7) pp268-272	Sonali Ghosh (SG)	To be added in later statges of chapter development if space allows **UPDATE:** Acknowledged. But space constraints did not allow to include such paragraph.
54.	4	36	23	36	30	Do not understand why only SDM are mentioned here, strategies for communicating model complexity apply to all modeling techniques	Lionel Hertzog (LH)	Uncertainty section has been restructured to illustrate this.
55.	4	36	1	36	14	Again here hierarchical modeling structure could be used for other modeling technique than only SDM, do not understand the reason to	Lionel Hertzog	Totally agree. We plan to adapt this text in later stages

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						focus on this type of models here.	(LH)	of the chapter to accommodate a wider range of models. **UPDATE:** Acknowledged and reflected in the final structure of the chapter.
56.		General				In general, this chapter is more logically organised and consistently written than the other chapters; I suggest that the authors of other chapters take a look at it for consideration, e.g. in terms of the balance between explanation, detail, and examples.	Neil Burgess (NB)	Thanks for the comment.
57.		General				Notwithstanding the above, I find the distinction between ‘’process-based’ and ‘mechanistic’ models arbitrary and not useful. For example, Dynamic Energy Budget theory, here listed as a mechanistic model, at its core appears to have assumed functional forms (e.g. Arrhenius, Michaelis-Menten, von Bertalanffy). The Arrhenius expression, used to describe the temperature dependence of physiological processes in DEB, is an approximation for the rate of bimolecular reactions in the gas phase. In DEB (as in MTE) it is used to approximate the temperature dependence of a highly complex series of enzyme catalysed reactions occuring within living cells. It is used as Kooijman describes “The Arrhenius relationship seems to describe the effect of temperature on metabolic rates with acceptable accuracy in the range of relevant temperatures”. DEB therefore has the same assumptions about the goodness of fit of these parameters, functional forms, and so forth that are listed for process based models. It also has the same limitations as explained in page 17 lines 14-18. For example, at some level, a functional form has to be assumed (as specified above for DEB), and the system dynamics will be sensitive to this assumption. It is not clear why DEB and mechanistic models are assumed to have high cognitive capacity, and ability to predict into the future, while process-based models do not. It is not clear how e.g. APECOSM is listed as mechanistic, but Madingley (With which I am familiar) listed as process-based, as both aim to be built from mechanistic principles (the metabolic theory of ecology, rather than dynamic energy budget in Madingley, for example. Madingley is organised around traits, much as APECOSM is, despite being listed as size-structured (i.e. it does not disregard	Neil Burgess (NB)	Reconsideration of the model typology has been extensive in the new version of the chapter. We have followed the suggestion from the reviewer and used a two categories continuum model to illustrate model characteristics.

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						metabolic and physiological differences between organisms, which are contingent upon their traits as well as their size). Note that I am *not* criticizing either DEB or APECOSM, both of which are incredibly well-thought throught models. It is just that they would seem to belong in the same category as the process-based models – or if they don't, this is not clearly enough explained in terms of why they should be separate. I would suggest cutting these three categories down to 2 – primarily correlative, and primarily mechanistic (recognizing that there is a spectrum from correlative to mechanistic) as the authors themselves acknowledge on page 11 lines 10 - 12. As implied above, *all* models have to make a functional form assumption at some level; it is just that mechanistic models try and do this at a much finer level (e.g. individual metabolism or predation events) than correlative models. Note that APECOSM could be critiqued further for lack of mechanism – movement and representation of autotrophs are lacking here.. but I'm not sure that would add to the argument substantively.		
58.		4	7	4	17	There is another reason for developing mechanistic models, in that they can elucidate the underlying data gaps necessary to understand how ecosystems fit together, 6and hence drive data gathering prioritisation.	Neil Burgess (NB)	Acknowledged
59.		6	5	6	9	It would be good to have some references here.	Neil Burgess (NB)	This section has been revised accordingly.
60.		6	13	6	22	This section is difficult to read and a little technical for the less specialized reader.	Neil Burgess (NB)	This section has been revised accordingly.
61.		6	41	6	42	Habitat heterogeneity could also be an explanatory variable. Perhaps it is better to use a different example?	Neil Burgess (NB)	You are right. To be changed in a more advanced version. **UPDATE:** Acknowledged and changed.
62.		8	21	8	23	Also problems associated with extrapolating beyond the bounds observed in the data.	Neil Burgess (NB)	Acknowledged
63.		9	23	10	30	This paragraph feels overlong and overcomplicated; can it be	Neil	This section has been

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						simplified and streamlined?	Burgess (NB)	revised and shortened.
64.		10	40	10	41	Not clear what this means.	Neil Burgess (NB)	Deleted.
65.		11	3	11	8	It would be clearer to represent this as a continuum. At one end, all statistical models make some assumptions about the structure of the process relationships. At the other end, all mechanistic models use some fitting of observed data to generate the functional forms represented. Of course there are many different approaches in between.	Neil Burgess (NB)	Suggestion adopted and continuum adopted as a main guidance to communicate model typology in the chapter.
66.		11	36	11	37	Aren't all models limited by this?	Neil Burgess (NB)	Yes, but we think this effect is more explicit and dangerous in correlative models in which processes are not explicit.
67.		12	1	12	1	Point (2) is true for all models, including (especially) correlative models.	Neil Burgess (NB)	Yes, but we think this effect is more explicit and dangerous in correlative models in which processes are not explicit.
68.		12	4	12	5	Another advantage of process-based or mechanistic models is that they can get around the taxonomic and geographic biases in all available biodiversity datasets.	Neil Burgess (NB)	Good comment, but we think that this depends on the kind of process based model involved and the specific data requirements.
69.		12	25	12	25	What is meant by 'empirically undetermined'? Often these are parameterized from the scientific literature, as are other model types.	Neil Burgess (NB)	Deleted.
70.		13	Section 4.3.11			It might also be worth mentioning models of species response to land use at a local scale. For example, in Newbold et al. (2014, Proc. Roy. Soc. B), we modelled the occurrence and abundance of species in four taxonomic groups in response to land use across the world's tropical and sub-tropical forests.	Neil Burgess (NB)	To be assessed in a later stage of the chapter and then to decide whether it is possible to add given space constraints. **UPDATE:** Acknowledged but lack of space did not allow inclusion of further examples.
71.		15	4.3.1.2			More recently, Foden et al. (2013) conducted a trait-based assessment	Neil	Not added due to space

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						of the risk from climate change for birds, amphibians and corals.	Burgess (NB)	constraints. Thanks for the suggestion.
72.		16	7	16	16	This is useful information on how one might go from predictions about distributions to predictions about whole assemblages, but there are other ways of modelling assemblage composition (for example modelling recorded species richness as a function of land use - not using distribution maps). Other non-SDM approaches include modelling species richness/diversity directly against environmental variables.	Neil Burgess (NB)	This is already included as potential pathway and referred as the assemble first which may include the assemblages of species in descriptive indicators such as species richness that are later modeled as a function of env. Variables.
73.		17	Section 4.3.2			The section on correlative models also needs to start with a paragraph indicating their cognitive capacity, and their limitations, as they suffer from exactly this same set of three points – arbitrary mathematical forms, sensitivity to data, and disconnection of process.	Neil Burgess (NB)	Sections describing model typology have been now completely rewritten
74.		31	41	31	45	Ideally, would it not be better to evaluate models against independent data rather than just conduct sensitivity analyses?	Neil Burgess (NB)	Completely agree. To be added later on when revising broader issues on sensitivity analyses with other chapters. **UPDATE:** Acknowledged.
75.		34	30	34	39	It is not necessarily true that more complex models are less predictive; certainly at the very simplest end of the spectrum, adding in complexity would very likely enhance predictive power. I do agree that unneccesary complexity should not be added, but it is perhaps better for focus on this, and on comparing the results of models against test data (which may be better predicted by either complex or more simple models). Section 4.7.1.3 words this better.	Neil Burgess (NB)	We placed this statement in a decision-making context in which our formulation we think can be substantiated.
76.		36	Section 4.7.1.2 to 4.7.1.4			This seems very SDM based. Can it be made broader?	Neil Burgess (NB)	Effort have been made to make the chapter more general and minimize reference to specific models (and other dealing with broader issues)
77.	4					This transition manuscript on modelling impacts of drivers on biodiversity and ecosystem functioning already report remarkably the ins and outs of the topic. If one of the main objective of this chapter is to identify and vulgarize the already exiting modelling methods of impacts of drivers on biodiversity and ecosystem functioning and their	Joseph Bigirimana (JB)	We will be working at later stages of the draft on producing an additional table listing available models (not

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						eventual complementarities and to alert on their limitations, I think it would be beneficial for some recipients of this work, to have a summary table matching the different contexts to which analysts, policymakers and other decision-makers often face and the most appropriate methods to analyze the available data and better guide their decision.		comprehensively) and provide brief examples of application. **UPDATE:** Decision making context has been treated in more detail in chapter 2. Due to chapter arrangements and space constraints this topic has not been touched in depth in chapter 4.
78.	4	5	12-29			Status and trend of urban population and the ecological footprint of cities are used to support how human become the dominant driver of environmental changes status and trend and the consequent effects on biodiversity and ecosystem functioning. So, I believe that some readers of this work may be well aware by including such information.	Joseph Bigirimana (JB)	Ok. But section rewritten and moved to outputs of models.
79.	4	6	26-29			It would be appropriate to explain how decreasing connectivity can increase biodiversity or at least provide reference(s).	Joseph Bigirimana (JB)	We prefer to leave the wording like this because it is not always clear that decreases in connectivity are associated to losses in biodiversity.
80.	4					Other of my comments are very minor and relates to typing errors and non-uniformities through the central text and the references. For all practical purposes, let me note that the most of these frequent non-uniformities observed in citations and references could be easily solved by using the Endnote program.	Joseph Bigirimana (JB)	A throughout revision has been undertaken to minimize reference problems.
81.	4					Generally I think there is a stong link to be made from this kind of modelling to a Risk Assessment approach. We have started to expore Bow Tie analysis as one possible approach but the genreal idea is that you need to build a conceptual model with expert opinion that links a policy framework, an environmental change (driver), and a risk event. The contructed framework would ultimately provide the conceptual basis for building a data driven model but the risk assessment process helps to put the whole model into a management/policy framework and helps to identify the critical elements and processes that need to be estimated.	Lisa Venier (LV)	The policy context of biodiversity models are not the main object of chapter 4 and this policy context will be mostly dealt with in chapter 2.
82.	4	1	37	2	11	Remove the nunmbering and just itemive the objectives. There are really about 6 objectives here... 'outmost' should be 'utmost'	Lisa Venier	Objectives of the chapter have been completely

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
							(LV)	reformatted.
83.	4	5	22	5	35	This whole paragraph is a bit ambiguous about what you are referring to as direct vs indirect, also some ambiguity about resource extraction vs habitat impacting. For example how would forest harvest be categorized?	Lisa Venier (LV)	This part has been completely deleted and some its content moved elsewhere (inputs sub-section) to enhance the clarity of the chapters message.
84.	4	6	16			What is 'cause-to-cover'?	Lisa Venier (LV)	To be clarified. **UPDATE:** meaning cause-effect relationships.
85.	4	7	1			There seem to be multple classifications of things in this chapter, for exapmle are the Environmental and biotic factors here 'drivers of change?' It would be useful to maintain the same terms for the same things. Also could use a better example here such as spatial distribution of land cover	Lisa Venier (LV)	Structure of the chapter has been changed to be more consistent with the classification used (specially model typologies)
86.	4	7	11	7	20	Some redundancy here	Lisa Venier (LV)	This section has been completely restructured to reduce redundancy
87.	4	8	9	8	16	Again here you use the term 'external variables' and 'drivers' are these the same thing	Lisa Venier (LV)	Drivers are in fact external variables in biodiversity models… but not all external variables in models are drivers.
88.	4	9	17	9	18	You provide examples of SDM's that do not require the transfer of energy to be taken into account…so maybe reword to emphasize importance but not necessity	Lisa Venier (LV)	Ok
89.	4	3	17	4	17	I am not sure if there is enough philisophical and scientific consensus to state that biodiversity has an intrisic values, if yes please cite some litterature	Lionel Hertzog (LH)	We leave this interpretation to the IPBES conceptual framework, but our understanding of this framework is that biodiversity has indeed intrinsic values.
90.	4	13	39	13	40	I think that bioclimatic envelope models are just a subset fo SDM's which can also be based on things like habitat distribuiotn and other environmental factors	Lisa Venier (LV)	We now describe bioclimatic envelope as a subset of SDMs.
91.	4	14	4	14	5	I would think that the omission of habitat distribution would be a consideration here	Lisa Venier	Thanks for the suggestion but we have rewritten this

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
							(LV)	section now to simplify the message.
92.	4	17	10	17	18	Redundancy with p 11 lines 34-37, p 12 lines 1-2	Lisa Venier (LV)	The sections describing model typologies have been completely rewritten to avoid redundancy and enhance clarity.
93.	4	17	25			Would choice of functional response form not be derived from empirical data in the best case?	Lisa Venier (LV)	The sections describing model typologies have been completely rewritten to avoid redundancy and enhance clarity.
94.	4	28	15			Anthropogenic drivers	Lisa Venier (LV)	Section rewritten
95.	4	28	17	28	18	Should take place on best available knowledge	Lisa Venier (LV)	Section rewritten
96.	4	29	27	29	28	This sentence seems unconnected to previous paragraph	Lisa Venier (LV)	Section rewritten
97.	4	31	1			I'm not sure you have demonstrated that models have optimal levels of complexity	Lisa Venier (LV)	Need to be addressed in later stages of the chapter. **UPDATE:**Acknowledged and changed in the final draft of the chapter.
98.	4	31	41	31	45	Yes but also some form of calibration or validation no?	Lisa Venier (LV)	Completely agree. To be added later on when revising broader issues on sensitivity analyses with other chapters. **UPDATE:**Acknowledged and changed in the final draft of the chapter to incorporate evaluation with independent data.
99.	4	32	1	32	10	Seems like a poor connection between ideas in this paragraph	Lisa	Section rewritten

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
							Venier (LV)	
100	4	4	38	4	45	A short discussion here of the issue of finding the right indices to represent this abstract concept that is biodiversity might be interesting, there scaling issue may come back in the discussion	Lionel Hertzog (LH)	This part has been now deleted to simplify the introduction section.
101	4	33	10	33	26	There isn't much information in this box that is specific to SDM's or that hasn't been said elsewhere. I think it could be removed.	Lisa Venier (LV)	Deleted
102	4	11	3	11	12	Daccord avec la visoin d'un continuum machanistic correlative	Herve Le Bouler (HLB)	Ok
103	4	1	1	48	20	All the chapter seems in line with the objectives of Chapter 1 and properly handle the issue of biodiversity modeling. However, the expression and description of the issues, concepts, and methods seems difficult thing to understand for non-specialists. According to the readers covered by the report, it will be necessary to adjust the expression or complete it by inserts and abstracts for policy makers.	Herve Le Bouler (HLB)	The requested changes will be implemented in later stages of chapter and deliverable development.
104	4	1	10	1	11	The authors seem slightly regret having to use "formal representations" of biodiversity and ecosystems. But is it possible to understand and predict anything real or unreal without formal représentations ? among Descartes : NO !	Herve Le Bouler (HLB)	We completely agree with the referee that's why models are so fundamental. This section has been rewritten.
105	4	1	26	1	26	The general plan of the whole chapter is right for me.	Herve Le Bouler (HLB)	Ok
106	4	4	4	4	5	Each model is not suitable to all decision-making context . in some cases the use of an incorrect type of models can lead to maldaptation. Its neccesaary to insist on this ponit. Kearney, M. (2006). Habitat, environment and niche: what are we modelling? Oikos, 115(1), 186–191. doi:10.1111/j.2006.0030-1299.14908.x Araújo, M. B., & Peterson, A. T. (2012). Uses and misuses of bioclimatic envelope modeling. Ecology, 93(7), 1527–1539.	Herve Le Bouler (HLB)	Acknowledged
107	6	6	31	10	41	in this part, I think it is absolutely necessary to develop the niche concetps of Hutchinson Grinnell and Elton Soberón, J. (2007). Grinnellian and Eltonian niches and geographic distributions of species. Ecology Letters, 10(12), 1115–1123. Colwell,	Herve Le Bouler (HLB)	Acknowledged.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						R. K., & Rangel, T. F. (2009). Hutchinson's duality: the once and future niche. Proceedings of the National Academy of Sciences, 106(Supplement 2), 19651–19658. Holt, R. D. (2009). Bringing the Hutchinsonian niche into the 21st century: Ecological and evolutionary perspectives. PNAS, 106, 2.		
108	4	11	3	11	12	I full aggree with this vision of a continuum beween coorelative et mechansitic models	Herve Le Bouler (HLB)	Ok
109	4	11	1	24	17	Becasue it is a new and very dynamic and evolutive science, the typology of écosystème modelling is still complex to establish. One proposed here is apparently complete.Iit would be interesting to supplement it with summary tables	Herve Le Bouler (HLB)	Section rewritten and tables to be added in later stages of chapter development in coordination with other chapters (5,6).
110	4	24	24	25	25	The idea on non linearity and its translation as potential whole system bifurcations are critrical for the future . It would be interesting to discuss the possiblility for models to treat it. Is seems very difficult to predict those shifts . An other apporoch woul be to study the possibily to identify early indicators of shifting.	Herve Le Bouler (HLB)	To be assessed in later stages of the chapter if space allows. **UPDATE:**Acknowledged , space constraints did not allow to further develop this interesting idea.
111	4	7	15	7	20	This seems like a repetition of what was said under item 1 at the end of page 6	Lionel Hertzog (LH)	Section restructured to avoid repetition.
112	4	28	20	34	20	I think that is that a major cause of uncertainty is that biodiversity and ecosystems are not truly possible subject to laws but are simply described by models. They result from the combination of chance and necessity The unpredictable emergent properties are characteristics of living. The human impacts are so fast and intense that are likely to emerge forms of organization of Biodiversity and Ecosystem Approaches never observed and almost unpredictable. Williams, J. W., & Jackson, S. T. (2007). Novel climates, no-analog communities, and ecological surprises. Frontiers in Ecology and the Environment, 5(9), 475–482. doi:10.1890/070037 and (Araújo et al. 2005) in this chapter .	Herve Le Bouler (HLB)	Uncertainty issues will be explicitly addressed and coordinated across chapter in later stages of the deliverable.
113	4	37	30	37	30	Formation of Model inter-comparison group, similar to CMIP is a real urgency Modellers are often isolated between them and had poors relations with fields ecologists end managers of ecoystems.	Herve Le Bouler (HLB)	This has been identified as one of the main recommendations of our

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								chapter to IPBES.
114	4	17	1		10	**Paragraph 4.3.1.3. Community level modelling**. The authors discuss on SAR models in this paragraph. in range size, habitat area or, for freshwater taxa, river flow. However, the lag time between being **"**committed to extinction**"** and actually going extinct may range from decades to many millennia, so future research must focus on quantifying these time lags…" See as an example the work of (Tedesco et al. 2013 *Journal of Applied Ecology* 50, 1105-1115) concerning freshwater systems and showing that reaching riverine fish extinction levels projected by Xenopoulos et al. (2005) for 2080 could take from 1500 to 234 000 years!	Thierry Oberdorff (TO)	Criticism needs to be included but it will be assessed in later stages of the chapter if space allows. **UPDATE:** Acknowledged but setting future research agendas in detail was beyond the scope of the present chapter.
115	4	13	38	15	25	**Paragraph 4.3.1.1 Species level modelling**. Besides evaluating species distribution there are also attempts to incorporate species densities. in the modeling process. These types of models seem promising to me and should be at least mentioned in this chapter. See the recent review made by Ehrlen & Morris 2015 – Ecology Letters 18, 303-314.	Thierry Oberdorff (TO)	To be assessed in later stages of the chapter if space allows. **UPDATE:** Acknowledged. Section restructured (4.3.1.2. on Species- or population-level models) to incorporate such models.
116	4	7	18	7	19	External variables or drivers are also anthropogenic. Especially if drivers are defined from the scenarios (cf fig 1.6 in chapter 1)	Moana Badie (MB)	Section rewritten
117	4	8	36	10	30	The paragraph is too specific to one type of ecosystem. It is an example among others. Paragraph 4.2.1 should be more generic to all types of ecosystems. If it is not possible, or too conceptual, sub-paragraphes should be written for a few types of ecosystems.	Moana Badie (MB)	Section rewritten
118	4	10	37			Should be more detailed.	Moana Badie (MB)	Section rewritten.
119	4	17	17			Disconnection of processes exists only if processes are from very different scale	Moana Badie (MB)	Section deleted and chapter completely rewritten.
120	4	17	25			Example for responses for types I, II, III ?	Moana Badie (MB)	Section deleted and chapter completely rewritten.
121	4	18	0	18	5	This synthesis shouldn't be here	Moana Badie (MB)	Section deleted and chapter completely rewritten.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
122	4	10	38	10	42	Do not understand this paragraph and do not see what additional information except that traits are changing through evolution, it brings	Lionel Hertzog (LH)	The section including models on evolutionary processes has been totally restructured and now included in section 4.3.1.1
123	4		10		35	Age/stage structured models are a type of box model. They should be presented as such	Moana Badie (MB)	Section rewritten
124	4	21	42			Deterministic, static, biogeography and biogeochemistry models are not other approaches. They rely on other typologies. Biogeography and biogeochemistry models can be built from a correlative, process based expert-based or hybrid approach.	Moana Badie (MB)	Section deleted and chapter completely rewritten.
125	4	22	41	23	21	Expert-based systems are very useful where data is missing and also to deal with uncertainties. Difficulties for these approaches are coming from expertise elicitation and validation	Moana Badie (MB)	Acknowledged.
126	4	23	25			They are more often used in the high-level models, and in the integrated approaches. They enable to combine different specialized models, and can include any type of information : from data, from processes, from experts, depending on available data and knowledge, and depending on scale. Development of hybrid models is made easier using graphic modeling tools, such as bayesian networks for instance. Bayesian networks can handle quantitative and accurate knowledge, from learning algorithms or specific models, as well as qualitative knowledge, provided by experts. They are adapted to represent and model complex systems and to manage uncertain and incomplete knowledge (Badie M., Ferraris J., Pascal N. & C. Chaboud, Simulation of MPA scenarios governance by Bayesian network, 11th Pacific science intercongress, Tahiti, 2009)	Moana Badie (MB)	To be assessed in later stages of the chapter if space allows. **UPDATE:** Acknowledged.
127	4	26	16			Feedback must be formalized as an output of the biodiversity model, and as an input for the adjacent models/systems. It can also generate a loop : the feedback can modify one or more drivers. Taking into account feedback requires an integrated approach, or coupled models. Coupling models can be difficult because of the different levels of knowledge, scales, types of models. Expert judgment is often used to do the job, and this judgment should be explicitly formalized.	Moana Badie (MB)	Acknowledged
128	4	28	18			And all human activities	Moana Badie (MB)	Section rewritten

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
129	4	29	17			Is it because of uncertainty or because it is out of the scope of the model ?	Moana Badie (MB)	Section rewritten
130	4	33	27			Uncertainty analysis, sensibility analysis help to uncertainty due to natural variability, observation error and outcome uncertainty. Probabilistic models can help to quantify uncertainty. Graphical models are efficient to reduce uncertainty for inadequate communication between scientists and structural complexity of the system. Structural complexity is also managed with scenarios. Scenarios are used to deal with uncertainty on the evolution of complex systems. The scenario selection methodologies also have to provide a basis for reflexion and traceability of the reasoning.	Moana Badie (MB)	Section rewritten
131	4	36	1			Graphical models which enable to combine quantitative and qualitative knowledge should be mentioned	Moana Badie (MB)	To be assessed in later stages of the chapter if space allows. **UPDATE:** We have not considered graphical models as a type of model in our typology.
132	4	36	16			This is not an operational method. It is a way to compare and validate different approaches. The term "use" instead of "comparison" should be used here.	Moana Badie (MB)	Section restructured and moved to new 4.5.1.
133	4	13	38	15	25	Use only one term for correlative distribution model, either SDM, ENM or other, but using several term for the same modeling technique is rather confusing.	Lionel Hertzog (LH)	Effort has been invested in employing the same terminology to refer to SDMs. However, it should be kept in mind that SDMs or ENM are not always used as synonymous.
134	4	36	21			As mentioned above graphic models enable a better communication between scientists and a better comprehension of the system	Moana Badie (MB)	Ok
135	4	2	13	10	40	It seems some of the materials covered in these sub-sections have already been covered in previous chapters.	Wei Zhang (WZ)	To be revised by all chapters in the second revision

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
136	4	28	14	33	26	The issue of "uncertainty" in models was discussed extensively at several places (e.g., 4.5 in chapter 4 and 2.4 in chapter 2). I wonder if this can be somehow consolidated or coordinated, either as a stand-alone topic/chapter or better-focused if it needs to be discussed in each chapter.	Wei Zhang (WZ)	Uncertainty issues will be explicitely addressed and coordinated across chapter in later stages of the deliverable.
137	4	1	1	1	2	Delete “and ecosystem functioning” from title. Ecosystem functioning is part of biodiversity, as per Chapter 2, and more broadly, the IPBES Conceptual Framework, and the Convention on Biological Diversity definition	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** We have followed advice from co-chairs and used biodiversity and ecosystems as presented in the IPBES conceptual framework.
138	4	1	8			Delete “ecosystems and” – ecosystems are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** We have followed advice from co-chairs and used biodiversity and ecosystems as presented in the IPBES conceptual framework.
139	4	1	10			Change “Ecosystems are” to “Biodiversity is an” – ecosystems are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
140	4	1	16			Delete “and ecosystem processes” – ecosystem processes are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
141	4	1	19			Change “Ecosystems are” to “Biodiversity is” – ecosystems are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								UPDATE: See update 94.
142	4	1	28			Delete "and ecosystem" – ecosystems are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
143	4	1	38			Delete "and ecosystem" – ecosystems are part of biodiversity.	Thomas Brooks (TB)	To be discussed with Co-chairs in later stages of the chapter development. **UPDATE:** See update 94.
144	4					General comment 1. This document seems to be dominated by a rather limited perspective in modeling ... namely, looking at how climate change or related physical and chemical changes in an ecosystem impact populations and communities of organisms. Three things strike me as missing from the document: (1) there seems to be little attention paid to ecosystem ecology and the many modeling approaches used to quantify and predict primary and secondary production, biogeochemical cycles, decomposition, carbon storage, etc. This is unfortunate given that these ecological processes ultimately underlie most ecosystems services. This chapter might benefit from more collaboration with ecosystem ecologists. (2) with exception of a small portion of text on pages 24-25, there is little in this document that focuses on the large body of work produced over the last 2-decades showing that genes, species, and communities of organisms control the physical and chemical environment. There's almost no mention of entire fields like biodiversity-ecosytem functioning, ecological stoichiometry, or ecosystem engineering – all of which have well developed models for predicting how changes in organisms influence ecosystems and the services they provide. This chapter might benefit from more collaboration with select individuals who work in these field. (3) I apologize if I missed it, but I don't remember seeing any text dedicated to evolutionary models, which would be noteworthy given	Bradley J. Cardinale (BC)	We have profoundly changed the chapter structure in coordination with the deliverable Co-chairs to better reflect the general comments made during the external revision. We have tried to more explicitly incorporate changes and models at the ecosystem level (comment 1) and explicitly include a more explicit subchapter on evolutionary models (4.3.1.1, pag 421). Comment 2 is now also explicitly treated in section 4.4 on feedbacks and interactions.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						the chapter talks about the need to model the generation, maintenance, and function of genetic diversity. This chapter might benefit from more collaboration with evolutionary biologists..		
145	4					General comment 2. I felt the document could use a bit more thought about what is meant by 'biodiverity'. I tend to use the term to represent variation in life, whether at the level of genes, populations, species, communities, etc. But this document seems to equate biodiversity to most any structural or functional attribute of a system that involves a living entity. The extremely broad interpretation and use of the term biodiversity throughout the document makes it non-operational in many instances because the authors can't define what they mean by the term, nor put units on a real variable. That poses a problem in a chapter dedicated to modeling, which argues that conceptual and quantitative models are needed to define variables and make sense of mechanistic relationships.	Bradley J. Cardinale (BC)	We have used the IPBES conceptual framework as a reference when interpreting what is meant by Biodiversity.
146	4					General comment 3. There are several characteristics and/or goals of models that didn't seem to be adequately addressed in this chapter. (1) Scaling across space and time. Though the chapter mentions the importance of scaling, it does not not cover the methods nor approaches used to generate models that allow one to scale, or that seek to find scale-free properties. (2) Feedbacks. While the chapter mentions feedbacks, the text focuses on a narrow definition involving only feedback loops. It does not deal with issues like dynamic coupling, such as when predator-prey populations cycle due to their joint responses to changes of the other. This latter form of feedback is essential for understanding temporal feedbacks. (3) Integrating multiple levels of biology. The proposal mentions the need to develop models that span genes, to individuals, to populations and communities. But other than a tiny paragraph in section 4.7.1.2, it doesn't go on to explicitly talk about nested or hierarchical biological models.	Bradley J. Cardinale (BC)	1) Scale is a transversal issue in biodiversity models and has been treated in our chapters in different places. We think that models such as species-area relationships can be included in the categories mentioned by the reviewer. However, if necessary and with more explicit guidance, this section could be further expanded. **UPDATE final version:** The section on feedbacks has not been finally expanded due to strong space constraints in the revision. 2-3) We have now more explicitly described these kind of multiple level

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								integration in our section on hybrid modelling (4.3.1.5, pag 431) and section 4.5 on model complexity (pag. 443). Certainly, the section on model complexity could be further expanded to include dynamic coupling of different biological components more explicitly.
147	4	1		7		The first 7 pages doesn't say much, other than to justify the use of models and explain why they are important. This section could be condensed by 50% or more without loss of content.	Bradley J. Cardinale (BC)	The introductory section has been modified and condensed. The main objective of the introductory section is now to link the chapter with the IPBES working programme and other chapters from the deliverable 3c.
148	4	3	9	3	14	I tend to disagree with the generalized statement that community data is more appropriate when looking at regulatory roles of biodiversity, but population data are more adequate for direct use values. This assumes that biodiversity per se does not contribute to direct use values; yet, there are many examples that run counter to this.	Bradley J. Cardinale (BC)	This section has been deleted (See also response to comment 4). However, the statement has been maintained in section 4.2 (pag. 407) because we think it cannot be derived from our statement that biodiversity per se does not contribute to direct use values.
149	4	4	38	4	38	Biodiversity can sometimes be an abstract concept. At other times, it can be quite specific (e.g. if quantified in terms of species richness)	Karel Mokany (KM)	See also comment 2 on biodiversity and the IPBRS conceptual framework.
150	4	5	4	5	4	This number should be revised. Assuming a pre-industial CO_2 concentration at 1860 of 280ppm, and 2013 CO_2 of 391ppm (Le Quere et al., 2013), CO_2 increase is 40%.	Andrew Hartley (AH)	The section on drivers has been deleted from the introduction (see also comment 4). Drivers are explicitly but more briefly introduced in section 4.2.1.1

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								(pag 410) and more deeply in chapter 3 of the present deliverable.
151	4	5	8	5	9	What does "*evolutions of drivers*" mean?	Karel Mokany (KM)	The section on drivers has been deleted from the introduction (see also comment 7).
152	4	5	27	5	29	Which of these two groups does climate change fit in? These categories don't seem helpful.	Karel Mokany (KM)	The section on drivers has been deleted from the introduction (see also comment 7).
153	4	6	19	6	22	Here, there needs to be acknowledgement of the large range of uncertainty in human induced land use change projections, related to various political and economic conditions in the future.	Andrew Hartley (AH)	The section on drivers has been deleted from the introduction (see also comment 7).
154	4	6	31	10	41	This section seems to be written with a single specific perspective rather than a broader view, which would be more appropriate.	Karel Mokany (KM)	The section has been now completely restructured to better convey the broader perspective suggested by the reviewer.
155	4	7		7		Fig. 4.2 has several problems when being used to summarize the basic characteristics of models, and I would suggest the authors consider an alternative to make their points. (1) the diagram shows only unidirectional causality, assuming all aspects of biology follow from abiotic variables. There is nothing that illustrates much work showing biology can drive physical and chemical variation. (2) the diagram lacks clear paths of causality, which is made worse by (3) the diagram does not differentiate basic stocks from fluxes or, in some cases, even define the variables. As such, Fig. 4.2 does not show any operational model, which makes it problematic as an example of the components of a model.	Bradley J. Cardinale (BC)	We plan to expand this figure to probably include ecosystem services linkage with ecosystem processes more explicitly (to be discussed with chapter 5) and also to better visualise bidirectional causality.
156	4	8	5	8	5	Poor phrasing... "*represent well*"	Karel Mokany (KM)	Phrase deleted when section reformulated.
157	4	8	18	8	20	This doesn't make sense. Why would they be complex approaches if they're taking shortcuts	Karel Mokany (KM)	Complexity has many components better described in the corresponding section of the chapter (4.5). Here we interpreted levels of

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								complexity as the number of processes included in the model.
158	4	8	20	8	22	Poor phrasing in this sentence.	Karel Mokany (KM)	Not changed at present.
159	4	8	31	8	32	This statement depends on what you mean by "predictive capability". There is no a priori reason why more complex models would generate less accurate predictions.	Karel Mokany (KM)	This sentence has been deleted in the new version of the chapter.
160	4	9		9		Table 4.1 doesn't strike me as being well-developed. Several of the entries in the cells are vague (e.g., what is 'genetic process'?), and the table has few entries on any form of ecological functions such as primary and secondary production, or nutrient cycling. This table seems to be focused on population and community ecology (ecosystem processes notably lacking), and where population and community attributes are the dependent variables (the opposite direction of causality ignored0.	Bradley J. Cardinale (BC)	Table to be finalised together with the figures in the next version of the chapter. **UPDATE final version:** the table has now been revised according to comments from the SOD.
161	4	9	9	9	10	Poor english, and no close to the brackets	Karel Mokany (KM)	Changed.
162	4	9	17	20	19	This statement is false. We can model biodiversity dynamics without considering transfer of energy. This is commonly done	Karel Mokany (KM)	The section has been deleted from the current version of the ms
163	4	9	27	9	27	Environmental conditions are as important as environmental variability.	Karel Mokany (KM)	Ok
164	4	9	29	9	31	This text seems relevant only to plants, not for all other species.	Karel Mokany (KM)	Ok
165	4	9	31	10	1	Organic matter from primary production is the basis for most life on earth, not all (e.g. not chemotrophs)	Karel Mokany (KM)	Ok
166	4	10	1	10	2	These factors do not have to be included in models of biodiversity or ecosystem function. Researchers can (and do) apply models that do not consider these factors.	Karel Mokany (KM)	Changed and moved to 4.2.6, pag 420.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
167	4	10	32	10	32	"*Recycling*" does not have to be considered in models. This whole section needs to be edited to expand the currently restricted and prescriptive focus, which appears to be on ecosystem dynamics for plant communities. A much broader perspective is required.	Karel Mokany (KM)	This section has been modified and included in the new section 4.2.6 (pag 419) and expanded to adopt a broader perspective (that can be however expanded even further.) **UPDATE final version:** The section on ecosystem function descriptors has not been finally further expanded due to strong space constraints in the revision.
168	4	10	41	10	41	"*However, this link does not need to be one-to-one*" -> what does this mean?	Karel Mokany (KM)	We have now better contextualised (and moved to pag. 432) this sentence and added a reference (Lurgi et al. 2015)
169	4	11	1	24	16	This section ignores a number of important/distinct approaches for modelling biodiversity dynamics. These include: - Island biogeography models (e.g. Gravel et al. 2011. Ecology Letters 14: 1010-1016) - Neutral models (e.g. Zillio & Condit 2007. Oikos 116: 931-940) - Broader hybrid species-level approaches (Keith et al. 2008. Biology Letters 4:560-563; Engler & Guisan 2009. Diversity &Distributions 15:590-601.) - Eco-evolutionary models (e.g. Rangel et al. 2007. The American Naturalist 170:602-616) - Metacommunity models (e.g. Mokany et al. 2012. Global Change Biology 18: 3149-3159) - TreeMig forest landscape model (Lishke et al. 2006. Ecological Modelling 199:409-420) I found it overly simplistic to suggest there are only two types of models: statistical vs. mechanistic models. This strikes me as a false dichotomy. And I also would not equate statistical models to being correlative and lacking in mechanistic explanation, as this is clearly not true for statistical models derived from experimental manipulations.	Karel Mokany (KM)	We have now explicitly included some of these suggestions in the new version of the chapter (i.e. hybrid species-level approaches and Island Biogeography models (species-area) and eco-evolutionary models (pag 423). Further, we have followed the referee advice and modified our categorisation of statistical vs. mechanistic models in order to better convey the idea of a continuum from purely phenomenological

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						Perhaps there would be more value in describe models that lie across a continuum from purely phenomenological, to mechanistic models, and then give examples of models that lie at different points on the continuum.		(correlative) to mechanistic models (process based) and represent this in the form a new figure (4.5).
170	4	11	28	12	2	This section needs an example up front top clarify what is meant.	Karel Mokany (KM)	We have now restructured this section and introduced a new heading to make clear the point that our objective is to list "Model types of special relevance for IPBES"
171	4	12	18	12	20	This sentence is too vague. If you're going to use these very similar terms (process-based, mechanistic) to mean different things, explain it better or give an example to clarify how a model could be mechanistic but not process-based, etc.	Karel Mokany (KM)	This terms are now better defined and explained in new section 4.2.5 on "The model continuum: from correlative to process-based". See also comment 33.
172	4	12	34	12	35	Greater than what?	Karel Mokany (KM)	This sentence has now been deleted from the current version due to restructuring of the corresponding section.
173	4	12	34	12	35	There is the potential for interpreting the causation of phenomena using correlative models, but also obscuring it, if only distal variables are used as predictors.	Karel Mokany (KM)	See comment 33.
174	4	12	41	12	42	This statement contradicts increasing evidence for the importance of microclimate in influencing biodiversity patterns.	Karel Mokany (KM)	This is partially true, although it is also generally accepted that climate has stronger effects on biodiversity at large spatial scales whether.
175	4	12		12		Section 4.3.1 struck me as being rather narrow in focus. It seems to put all of its attention on a tiny subset of models where attributes of populations and communities are modeled as a function of environmetnal variation (mostly). This section does not touch on the large body of research that has shown how populations and community can influence ecological functions and services (work by Tilman, Loreau, Cardinale, etc.), nor does it touch on recent attempts to join these two perspectives with Structural Equations Models (e.g., work by	Bradley J. Cardinale (BC)	Although this section has been completely rewritten following suggestions by reviewers, it stills needs to be further expanded in the final version of the chapter. **UPDATE final version:**

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						Grace)		This section has been completely rewritten in the final version. We have made an effort to expand the range of approaches covered thought the chapter, but unfortunately not all the suggested by all reviewers have been included.
176	4	13	1	31	1	Change “will” to “may”	Karel Mokany (KM)	Not yet changed **UPDATE final version:** sentence does not appear in the last version.
177	4	13	23	13	24	Most researchers would anticipate the ongoing use of correlative models for biodiversity projections, not just Elith et al.	Karel Mokany (KM)	We have now reworded this sentence to tone down the statement (pag 418).
178	4	13	31	13	36	This example is unimpressive, and it’s unclear why it was used.	Karel Mokany (KM)	The example has now been discarded from the current version.
179	4	14	4	14	13	SDM critique could potentially include other aspects such as scale of input variables, or poor performance for range restricted species. For example, climate change information is often downscaled using a change factor approach that gives a false impression of high spatial resolution (see Wiens and Bachelet, 2009. Cons Letters). Additionally, since SDMs are correlative many of the most vulnerable species (i.e. range restricted or scarce species) have too few records to be considered in the modeling approach. As a consequence, if SDMs are used in isolation, there is a danger that conservation decisions are made based on changes in the most common species (see for example Platts et al. 2014, Div & Dist).	Andrew Hartley (AH)	Not agreed as being priority aspects to be included at this stage. Will be evaluated in the last revision stage. **UPDATE final version:** Fair comments but finally issue not included as not considered a priority and lack of space. However, in fact lack of data has been considered in this chapter and other throught the deliverable as a major concern for modelling from a more general perspective beyond SDMs.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
180	4	14	11	14	13	Another odd example. Perhaps better explain what these examples are intending to illustrate.	Karel Mokany (KM)	We have kept this one.
181	4	14	26	14	26	You should cite Philips et al 2006 here (Ecological Modelling 190: 231-259) , not Peterson.	Karel Mokany (KM)	Corrected.
182	4	14	31	15	25	It is unclear where the case study fits with the text. The case study refers to Ecological Niche Models (ENM) but this is not a model type discussed.	Debra Peters (DP)	To be further clarified but ENM are considered SDM in the terms described in the chapter. **UPDATE final version:** This box has been finally deleted.
183	4	14	35	14	38	Change “preys” to “prey”	Karel Mokany (KM)	Not yet changed.
184	4	15				The section on trait-based approaches is under-developed. There is a long history of work by people like P. Grime, M. Huston and many others that have tried to predict the dominant functional traits in ecosystems as a function of environmental variable. Complimenting this, people like O. Petchey, S. Naeem, and S. Diaz have gone on to show how biological traits then drive ecological function and ecosystem services. Some of these models should be mentioned and developed since biological traits are ultimately key to predicting biodiversity as well as ecosystem services.	Bradley J. Cardinale (BC)	We have expanded this section in section 4.3.1.4.3 (pag 430). But further inclusion of specific models still pending. **UPDATE final version:** This section has been completely rewritten in the final version. We have made an effort to expand the range of approaches covered thought the chapter, but unfortunately not all the suggested by all reviewers have been included.
185	4	15	27	15	34	Reference needs to be made here to the IUCN species vulnerability assessment (Foden et al., 2013, PlosOne). Benefits of the approach are that species experts are engaged in the assessment process, but linkages to environmental drivers of change tends to be more anecdotal.	Andrew Hartley (AH)	Pending. **UPDATE final version:** This section has been completely rewritten in the final version. We have made

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								an effort to expand the range of approaches covered thought the chapter, but unfortunately not all the suggested by all reviewers have been included. In this case, however, we considered assessments as such beyond the scope of the present chapters as they deal with specific context for interpretation of modelled outputs.
186	4	15	30			This section on species traits approaches is very short relative to the other sections; either expand it or combine with another model type or delete it.	Debra Peters (DP)	See comment 48. **UPDATE final version:** Incorporated into the more general section on community level modeling approaches.
187	4	15	36	17	8	In this section (and much of the rest of the document) the references cited are limited, older, and not very diverse in terms of applied modelling approaches.	Karel Mokany (KM)	Checked, but need final revision. **UPDATE final version:** An effort has been generally done to update reference in this section and generally in the whole chapter.
188	4	16	13	16	14	The description of 'Assemble and predict together' is wrong. From Ferrier & Guisan 2006, this is about all species being modelled simultaneously, within a single integrated modelling process. This is not about fitting individual species distribution models.	Karel Mokany (KM)	Ok. Wording needs however, final revision. We have included a new figure 4.7 to further describe the approaches available. **UPDATE final version:** This table is not included in the final version of the chapter.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
189	4	16	15			The reader would benefit from a summary statement at the end of each model type description that states the conditions under which that model would be best used got biodiversity policy.	Debra Peters (DP)	Table 4.2 has been now deleted.
190	4	17		17		- The first metric ("individual species") is not a community metric, as the column title suggests - For the last metric ("compositional dissimilarity") the "derived grid layer" (3rd column) does not just have to be a matrix of pairwise dissimilarities, but can also be layers of transformed environmental variables, that can be used to calculate the predicted dissimilarity of any pair of grid cells (see Ferrier et al. 2007; Diversity & Distributions 13:252-264). Section 4.3.2 By the time I got through this section, I began losing track of the various models and where they fit into this document. I wonder if the chapter might benefit from a Table or Figure that gives an organization of the type of models, when and why they might be used, and what their strengths and weaknesses are.	Bradley J. Cardinale (BC)	Table 4.2 has been now deleted.
191	4	17	1	17	8	Expanded critique of the SAR assumptions is needed here. See for example Lewis, 2006 (Phil Trans B).	Andrew Hartley (AH)	We have expanded the section on SAR including the listing of some limitations on pag 431.
192	4	17	10	17	18	This is one very long sentence – there are numerous examples throughout the chapter of very long sentences that need to be rewritten to be shorter and easier to understand.	Debra Peters (DP)	This paragraph and the whole section on process-based and mechanistic models has been completely rewritten (see comment 33).
193	4	17	13	17	13	What are "process based phenomenological models" ? Explain better, with examples.	Karel Mokany (KM)	Following the advice of some of the comment made, we have decided not to use this category of model (see more on the continuum concept used on comment 33).
194	4	19	15	19	15	This whole box seems overly biased in favour of DGVMs. E.g. in what way are they "the most advanced tool" ?	Karel Mokany (KM)	Pending better wording. **UPDATE final version:** Reworded in the final version.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
195	4	19	23	19	23	DGVMs simulate some ecosystem processes and ignore others.	Karel Mokany (KM)	Ok.
196	4	19	29	19	29	Worth pointing out thst the grids applied in such simulations typically have coarse spatial resolution	Karel Mokany (KM)	Pending better wording. **UPDATE final version:** We have decided to not expand on the level of detail due to space constraints.
197	4	19	30	19	34	Please define acronyms (ESM, AOGCM).	Debra Peters (DP)	Acronyms removed.
198	4	19	34	19	34	It would also be worthwhile highlighting all the factors thst DGVMs ignore or consider in a very simple way.	Karel Mokany (KM)	Pending better des cription of such processes. **UPDATE final version:** added.
199	4	19		23		It would be very useful to provide a table summarizing the model types, their strengths and limitations, and stating when each one would be selected for use.	Debra Peters (DP)	Not easy to come up with such a table which has been under discussion from the first draft of the ms. Pending assessment of possibilities for inclussion in the final version. **UPDATE final version:** we have now included a new table in coordination with the corresponding table included in chapter 5 in the final version and partially including the requested information.
200	4	21	2	21	3	Neutral models are purely mechanistic biodiversity models.	Karel Mokany (KM)	Section rewritten.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
201	4	21	7	21	14	The "*theory based biodiversity model*" referred to here is really just a simple demonstration and discussion of how metapopulation models could be extended and applied to predict changes in the distribution of species. This is not a complete model, and hence there is no spatially-explicit test or demonstration or application of the ideas proposed. This section of text needs to be reworded to acknowledge these facts.	Karel Mokany (KM)	Section rewritten.
202	4	21	16	21	31	DEB theory is currently only applicable to animals. This taxonomic restriction to its application should be noted.	Karel Mokany (KM)	Section rewritten.
203	4	21	28	21	40	There is a lot of focus on work involving Maury here, who happens to be one of the authors of this chapter. What about a broader perspective (e.g. what about the Atlantis marine ecosystem model, and others?)	Karel Mokany (KM)	Section rewritten to avoid this bias. See also comment 33.
204	4	21	42	22	39	This section needs a fair bit of work to make it clearer and provide a much broader perspective. The words "vegetation" and "plants" are used extensively here, and highlights the overly specific focus of the text. The "MAPPS approach is listed under two of the categories (indicating poor classification of approaches). The "biogeography models" have nothing to do with biogeography	Karel Mokany (KM)	Section rewritten.
205	4	22	29			Along with biogeography models, what about meta-population and community models? These are commonly used to predict both the causes as well as ecosystem-level consequences of species and communitys.	Bradley J. Cardinale (BC)	Section rewritten.
206	4	22	42	23	21	Bayesian Belief Networks should be mentioned in this section.	Karel Mokany (KM)	Pending addition. **UPDATE final version:** Acknowledged. Finally not included due to space constraints.
207	4	22	43			Being an 'expert' does not equate to being 'reliable. Supposed experts used to think the world was flat. Section 4.3.3 does not make clear the potentially negative consequences of relying on expert opinion when it is used in lieu of data.	Bradley J. Cardinale (BC)	We have reworded this sentence to tone done the statement on expert reliability.
208	4	23	24	24	16	Specific mention is need here of efforts to combine the SDM and traits-based vulnerabiltiy assessment approaches. See for example Garcia et al. 2014 (J of Biogeog)	Andrew Hartley (AH)	Pending addition. **UPDATE final version:** Acknowledged. Finally not included as this section intends to generally

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								exemplify how model integration may work by combining different modelling approaches not by mentioning of existing examples.
209	4	23	28	23	30	Hybrid modelling approaches are not only restricted to species niche approaches. See for example – Mokany et al. 2012. Global Change Biology 18: 3149-3159.	Karel Mokany (KM)	Pending addition. **UPDATE final version:** Acknowledged and section rewritten to avoid focus on niche based approaches.
210	4	23	32	23	43	Critique of these approaches is fine, but be consistent and critique the other approaches discussed in the chapter (e.g. DGVMs).	Karel Mokany (KM)	Ok.
211	4	24	21	24	21	what is meant by "*both systems*" ?	Karel Mokany (KM)	We refer to the beginning of the sentence human and non-living environments (may need further rewording). **UPDATE final version:** We think the two systems can be well identified. No further rewording done.
212	4	24		26		Feed forwards, thresholds, cross-scale interactions should also be discussed as challenges in addition to feedbacks	Debra Peters (DP)	Pending addition. **UPDATE final version:** Due to space constraints and discussions arisen during the writing of the final draft, the discussion on feedbacks and complexity integration into biodiversity models has been deleted and content moved to respective section on model types (hybrids) and

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								handling complexity.
213	4	25	28	26	1	I think there needs to be more here on the feedbacks between vegetation and the carbon cycle, including implications for the hydrological cycle. CO_2 fertilisation should be discussed in the context of biodiversity and the earth system via increased NPP, greater land carbon sinks mitigating further warming, and how more efficient water use under higher atmospheric CO_2 may mitigate some of the impacts of high global temperatures.	Andrew Hartley (AH)	Pending addition. **UPDATE final version:** see response to comment 79.
214	4	26	3	26	7	Cite more recent work, assessing longer-term effects (e.g. Isbell et al. 2011. Nature 477: 199-202)	Karel Mokany (KM)	Pending addition. **UPDATE final version:** Acknowledged but finally not included.
215	4	26	9	26	14	This is an odd example with no reference	Karel Mokany (KM)	Pending addition of reference. **UPDATE final version:** Example deleted.
216	4	26	17	28	13	This section would be more useful if it was focused more on how biodiversity and ecosystem function are modelled in IAMs. Also, it would be worthwhile citing Harfoot et al (2013) Global Ecology and Biogeography 23: 124–143	Karel Mokany (KM)	Reference added and figure 4.9 now also added making explicit reference to how biodiversity and ecosystem function are included in IAMs.
217	4	26		29		Additional tools include variable time steps, variable spatial layers, and model-data fusion techniques that can reduce uncertainty.	Debra Peters (DP)	Pending addition. **UPDATE final version:** Uncertainty sections rewritten to deal with comments on second order draft.
218	4	28	15	28	15	Add “global change” before “drivers”	Karel Mokany (KM)	Sentence deleted.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
219	4	28	15	29	28	Why is this section on uncertainty only about Integrated Assessment Models? It should be much broader.	Karel Mokany (KM)	Section on uncertainty has been rewritten to better reflect a broader perspective on this issue.
220	4	29	17	29	18	Although other 'difficult' processes such as the nitrogen cycle and biomass harvesting are currently being developed for the next generation of earth system model (CMIP6).	Andrew Hartley (AH)	Agreed.
221	4	30	11	30	12	Varoability doesn't always have to influence precision of parameter estimates, it could just mean variation in predictions due to stochastic factors.	Karel Mokany (KM)	Ok. Agreed.
222	4	32	12	32	44	This box is well written, but haven't we had enough coverage of DGVMs?	Karel Mokany (KM)	We think using specific, well known models as an examples across the chapter can be illustrative of the points made throughout.
223	4	32	29	32	30	In addition, DGVMs that do include fire as a dynamic process are highly uncertain. Since fire dynamics are, generally speaking, dependent on anthropogenic triggers, uncertainties in the location and timing of these triggers result in large differences in the quantities and the location of burnt biomass. Also, while some DGVMs do consider land use change dynamics (in the sense of competition between PFTs, and interaction with the climate), most do not.	Andrew Hartley (AH)	Pending addition of this critic. **UPDATE final version:** uncertainty on many relevant factors acting on biodiversity may in fact be of human related origin (not only fire). So we think it is not necessary to stress these here (i.e. included in direct drivers of environmental change, chapter 3).
224	4	33	19	33	26	Be more specific. E.g. uncertainty in these models could come from differences in realised and fundamental niches; use of presence-only data collected in an ad-hoc and often biased manner.	Karel Mokany (KM)	Pending addition. **UPDATE final version:** Uncertainty sections rewritten to deal with comments on second order draft.

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
225	4	33	37	33	39	I would add an extra point here on the need for better observational datasets that can be used for model benchmarking and evaluation. In parts of the world (e.g. Sub-Saharan Africa, and South America) that are key for both the earth system and biodiversity, there is a strong need for improved data collection networks in order to reduce uncertainties in climate models and downstream biodiversity impacts models. Improved observations for both climate information and the seasonal or inter-annual distributions of species are needed.	Andrew Hartley (AH)	We think a deeper discussion on data needs may be included elsewhere in the deliverable 3c (chapters 6 and 8).
226	4	34	24	34	26	This statement depends on how 'adequate' we need the models to be.	Karel Mokany (KM)	Ok, agreed.
227	4	35	34	35	35	This needs a reference.	Karel Mokany (KM)	References made in the following sentences.
228	4	36	1	36	44	This text is overly specific in referring constantly to SDMs.	Karel Mokany (KM)	Made more general (section 4.5.1, pag 442-443). Some sections have been deleted for being to narrow in the treatment of complexity issues.
229	4	37	15	38	6	A general remark on the conclusions. I understand that the scope of this chapter is to review different biodiversity modelling approaches. However I think consideration should be given to the timescales involved for creating improved models of ecosystems and species that are currently under threat. If many (SDM-based) global modelling studies are to believed, we are approaching an extinction crisis by the middle of the 21st Century, brought on by a combination of anthropogenic land use change, invasive species, and climate change. There will never be the perfect model for all decisions, since natural systems are so complex. The best we can hope and advocate is that models that are currently available are used as best as possible to meet stakeholder needs, and that the results (and associated uncertainties) are communicated clearly and precisely so that effective adaptation decisions can be made.	Andrew Hartley (AH)	The section on general conclusions has been completely rewritten to better reflect deliverable objectives and chapter bases for recommendations to the IPBES working programme.
230	4	37	18	37	20	DGVMs do not predict change in biodiversity.	Karel Mokany (KM)	See comment 96

Nr	Chapter/ Section	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
231	4	37	42	37	43	How is it coordinated so it best informs modelling?	Karel Mokany (KM)	See comment 96