

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112639	1	1	23	6	This section is missing an appraisal of the Quasi-biennial Oscillation: the most regular internal mode of interannual climate variability. The QBO dominates the tropical stratosphere and has well known links to the high latitudes (e.g. polar vortex and Northern Europe) and tropical troposphere (e.g. Madden-Julian Oscillation). Furthermore, the amplitude of this mode of natural variability has systematically changed over recent decades (Kawatani and Hamilton, 2013) and has shown recent fundamental change via disruptions in 2016 (Newman et al, 2016; Osprey et al, 2016) and in 2020 (Anstey et al, submitted). The fundamental change to this natural mode of variability is likely due to climate change and will pre-occupy the stratospheric research community for years to come. [Scott Osprey, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The modes described in the technical Annex are the ones assessed in details in the main report. The intent of this annex is to support the main assessment and not to provide a comprehensive review of all the modes of variability. For instance, PNA, SASD, etc. are not presented either. We had to make this selection for sake of shortness and focus. The QBO is only mentioned twice throughout the entire report and is therefore defined in the glossary only.
3651	3	1	4	1	I believe you should add reference to the work of M Ghil on this - eg: Ghil, M (2015), \A mathematical theory of climate sensitivity or, How to deal with both anthropogenic forcing and natural variability?" in Climate Change : Multidecadal and Beyond, edited by C. P. Chang, M. Ghil, M. Latif, and J. M. Wallace (World Scientific Publishing Co./Imperial College Press) pp. 31-51 and this: Ghil, M. and Lucarini, V., The Physics of Climate variability and Climate Change, https://arxiv.org/abs/1910.00583 , Rev Modern Physics, in press (2020) [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The last suggested reference has been included in the revised section
7171	3	12	3	12	Suggest deletion of "multiple" , unnecessary [Benjamin Henley, Australia]	Accepted. Word removed
7173	3	20	3	20	Suggest a change of this sentence to: "Since then, the spatial coverage of observations and the measurement of new climatic parameters has improved significantly. These advancements, along with the emergence of new methods for combining different sources of information, have allowed for substantial improvements in our understanding of the characteristic spatial scales of the coherent structures of variability as well as their characteristic temporal expression." [Benjamin Henley, Australia]	Accepted. Thanks for the rewording of these few lines. Changed accordingly
7175	3	22	3	22	Grammatical only: suggest change to "describe" [Benjamin Henley, Australia]	Editorial change accepted.
7177	3	22	3	23	Suggest deletion of "more of less sophisticated", grammatical error and unnecessary. Also suggest deletion of "and interpretation of the variability." [Benjamin Henley, Australia]	Editorial. "of" replaced by "or" and deletion accepted.
7179	3	25	3	36	For both content and grammar, I have made quite a number of edits here, and suggest the paragraph be changed to: "The simplest method to evaluate the temporal evolution of a spatially coherent phenomenon is to take one or more spatial averages of data within a latitude-longitude box. The variables chosen for such analyses include sea surface temperature and sea level pressure, for example. Another classical technique relies on principal component analysis (PCA, also known as empirical orthogonal function, or EOF, analysis) to extract the patterns in the variable with maximum spatial covariance. The method also extracts an associated climate index timeseries, describing the evolution of the spatial pattern in time. Correlation or regression maps between the climate index timeseries and other space-time variables, such as precipitation or temperature, are often calculated to quantify the remote impacts associated with the mode. These remote impacts are referred to as teleconnection patterns. Modes of variability and their teleconnection patterns therefore provide a useful simplified representation of large scale climate variations affecting weather and climate around the world." [Benjamin Henley, Australia]	Accepted. Thanks for the rewording of these few lines. Changed accordingly

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7181	3	38	3	42	For both content and grammar, I have made several edits here, and suggest the paragraph is changed to: "Many modes of variability emerge from internal climate processes and are a critical potential source of climate predictability on subseasonal to decadal timescales. It is essential to understand the physical processes behind their past evolution in order to assess, with confidence, their future changes. External climate forcing may affect their temporal properties (e.g. occurrence, variance, seasonality, persistence) or the spatial properties of the mode and its associated teleconnections." [Benjamin Henley, Australia]	Accepted. Thanks for the rewording of this paragraph. Changed accordingly
7183	3	53	3	54	Suggest a change of "modes" to "mode" and a "the" in "the associated" [Benjamin Henley, Australia]	Accepted. Correction made accordingly
78409	4	21	4	23	Possibly also add Follan et al. 2009 (which is cited later) to this sentence, since this is a key work on NAO during summer? [Hans W Linderholm, Sweden]	Accepted. As all seasons are considered, we have included the suggested reference
78411	6	26	6	26	Because teleconnections between the NAO (SNAO) and climate in East Asia has been shown, it may be relevant to include such information, e.g. "Also, changes in North Atlantic storm track position and transient eddy activity associated with the positive (negative) phase of the NAO during summer, contribute downstream to negative (positive) sea level pressure anomalies in northeastern East Asia, thus affecting regional climate (Linderholm et al. 2011)." Source: Linderholm et al. 2011: Interannual teleconnections between the summer North Atlantic Oscillation and the East Asian summer monsoon. Doi:10.1029/2010JD015235. There are other relevant references as well... [Hans W Linderholm, Sweden]	Accepted. The suggested references and text have been included in the revised section
78413	7	21	7	22	Actually this reconstruction (going back 550 years) is presented in Linderholm et al. 2009: A multicentury perspective on the summer North Atlantic Oscillation (SNAO) and drought in the eastern Atlantic Region. DOI: 10.1002/jqs.1261 [Hans W Linderholm, Sweden]	Noted. The suggested reference was included.
7185	8	20	8	20	Suggest a change from "SAM-fixed latitude" to "SAM fixed–latitude". This does change the meaning, but I think that is what is meant. [Benjamin Henley, Australia]	Accepted. We performed the change as suggested.
32845	8	42	8	43	Arranging the reference with the year [sadegh zeyaeyan, Iran]	Editorial. Copyedit to be completed prior to publication.
79511	8	42	8	43	Arranging the reference with the year(comment by: darvishi.khatooni@gmail.com) [Hanieh Zargarlollahi, Iran]	Editorial. Copyedit to be completed prior to publication.
33175	8	42	8	43	Arranging the reference with the year [Sahar Tajbakhsh Mosalman, Iran]	Editorial. Copyedit to be completed prior to publication.
32847	9	3	9	4	Arranging the reference with the year [sadegh zeyaeyan, Iran]	Editorial. Copyedit to be completed prior to publication.
79513	9	3	9	4	Arranging the reference with the year(comment by: darvishi.khatooni@gmail.com) [Hanieh Zargarlollahi, Iran]	Editorial. Copyedit to be completed prior to publication.
33177	9	3	9	4	Arranging the reference with the year [Sahar Tajbakhsh Mosalman, Iran]	Editorial. Copyedit to be completed prior to publication.
32291	9	17	9	17	Very nice summary of current knowledge on ENSO ! [Eric Brun, France]	Noted. Thanks for the compliment.

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98361	9	21	9	35	Since the paragraph introduces and defines ENSO, citing Walker and Bjerkenes (and other pioneers) might be good. What defines ENSO isn't very clear. A more comprehensive paragraph with specifying about the circulation changes might be necessary. [Feba Francis, India]	Taken into account. The original discovery of the modes is now briefly addressed in the foreword section for ENSO and few other modes. Note though that It is beyond the scope of the annex to provide a comprehensive description for all the modes, because the intent of such an annex is to support the assessments in the main chapters and not to provide a complete review of the modes. On purpose, the text is limited to what is essential for the report.
109743	9	21	10	33	Introduction to the ENSO is incomplete and incomprehensible. It can be improved further. [Vikas Kumar Kushwaha, India]	Noted. Note though that It is beyond the scope of the annex to provide a comprehensive description for all the modes, because the intent of such an annex is to support the assessments in the main chapters and not to provide a complete review of the modes. On purpose, the text is limited to what is essential for the report.
32849	9	40	9	40	Arranging the reference with the year [sadegh zeyaeyan, Iran]	Editorial. Copyedit to be completed prior to publication.
79515	9	40	9	40	Arranging the reference with the year(commrent by: darvishi.khatooni@gmail.com) [Hanieh Zargarlollahi, Iran]	Editorial. Copyedit to be completed prior to publication.
33179	9	40	9	40	Arranging the reference with the year [Sahar Tajbakhsh Mosalman, Iran]	Editorial. Copyedit to be completed prior to publication.
39067	9	55	10	9	The work by Ashok et al., 2007 should perhaps be cited first. Also, the ENSO Modoki is defined in the next paragraph, so perhaps better move it before. [Federico Serva, Italy]	Rejected. It is unclear what the reviewer is referring to here as the Ashok et al 2007 reference already appears first and Modoki events are introduced in this paragraph.
24013	10	6	10	24	Ciasto et al., 2015 'Teleconnections between Tropical Pacific SST Anomalies and Extratropical Southern Hemisphere Climate', worth being discussed in climate modes annex, as it discusses the difference in extra- tropical SH teleconnections associated with tropical CP and EP SST anomalies and their relationship to the SAM. [AMNA JRRAR, Jordan]	Taken into account. Relationships between ENSO and extratropical climate variability are already covered at P11 L14-25. This coverage is not intended to be exhaustive.
14469	10	9			The following comprehensive review paper on ENSO teleconnections is a good reference here to include: Taschetto et al. (2020): Atmospheric teleconnections of ENSO. In "El Niño Southern Oscillation in a Changing Climate", American Geophysical Union, ISBN: 978-1-119-54812-6 [Malte Stuecker, United States of America]	Accepted. Reference added with some minor updates to teleconnections text.
32851	11	16	11	16	Arranging the reference with the year [sadegh zeyaeyan, Iran]	Editorial. Copyedit to be completed prior to publication.
79517	11	16	11	16	Arranging the reference with the year(commrent by: darvishi.khatooni@gmail.com) [Hanieh Zargarlollahi, Iran]	Editorial. Copyedit to be completed prior to publication.
33181	11	16	11	16	Arranging the reference with the year [Sahar Tajbakhsh Mosalman, Iran]	Editorial. Copyedit to be completed prior to publication.

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7187	11	28	11	28	More detail could be given here about the availability of ENSO proxies and reconstructions, including the temporal coverage and the variables reconstructed. Are individual reconstructions discussed in the palaeo chapter? The 400 year reconstruction by Freund et al of CP and EP El Niño events (Freund, M. B., Henley, B. J., Karoly, D. J., McGregor, H. V., Abram, N. J., & Dommenges, D. (2019). Higher frequency of Central Pacific El Niño events in recent decades relative to past centuries. <i>Nature Geoscience</i> , 12(6), 450-455.) (disclosure, I am a co-author, but this would tie in well here with the discussion on page 10 about CP and EP El Niño. A mention of key ENSO proxies (Palmyra, Julia Cole et al) and reconstructions would make sense here, e.g. Li, J., Xie, S. P., Cook, E. R., Morales, M. S., Christie, D. A., Johnson, N. C., ... & Fang, K. (2013). El Niño modulations over the past seven centuries. <i>Nature Climate Change</i> , 3(9), 822-826. [Benjamin Henley, Australia]	Taken into account. This material (including both the references listed here) is currently discussed in Chapter 2 section 2.4.2.
14471	12	9			Relevant reference for the IOD development during ENSO: Stuecker et al. (2017), Revisiting ENSO/Indian Ocean Dipole phase relationships, <i>Geophys. Res. Lett.</i> , 44, doi:10.1002/2016GL072308 [Malte Stuecker, United States of America]	Accepted. Reference added.
98363	12	23	12	27	IOD is the second-lead EOF mode (EOF2) of interannual variability of SST variability in the Indian Ocean from September to November. (Ref: Saji et al., 1999; Yamagata et al., 2003) [Feba Francis, India]	Taken into account. Actually, the EOF analysis of Saji et al (1999 <i>Nature</i>) and Yamagata et al (2003 <i>BAMS</i>) is applied to monthly SST for all seasons in extracting the IOD. Yet, Pillai et al (2019 <i>Theor. Appl. Climatol.</i>) find that the SON EOF1 is unstable in extracting the IOD and therefore we use a different definition of the IOD.

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35315	15	31	18	10	The text gives a nice overview of PDV, and the "Availability of proxy evidence" section contains a good summary of PDO reconstructions for the late Holocene. However, there is a growing body of literature addressing multi-millennial scale shifts in North Pacific coupled ocean-atmosphere circulation, which overwhelmingly indicates that the patterns characteristic of PDV may vary/evolve on millennial timescales (beyond the range captured by climate models). The most common theme that has emerged from the literature is an inferred shift from the middle Holocene, which most studies assert was characterized by dominantly PDO- (weak Aleutian Low) conditions, to the late Holocene, which most studies find was characterized by PDO+ (strong Aleutian Low) conditions, as well as overall increased hydroclimate variability (Anderson et al., 2005, doi:10.1016/j.yqres.2005.03.005; Barron and Anderson, 2011, doi:10.1016/j.quaint.2010.02.026; Jones et al., 2014, doi:10.1016/j.quascirev.2013.12.025; Bailey et al., 2018, doi:10.1016/j.quascirev.2018.06.027; DesChamps et al., 2019, doi:10.1029/2018PA003485; Jones et al., 2019, doi:10.3389/feart.2019.00025; Broadman et al., submitted Dec 2019 to Quaternary Science Reviews). Current knowledge of Holocene PDV was also summarized in a recently submitted review paper (Hernandez et al., submitted Dec 2019 to Earth Science Reviews), and highlighted a shift in the periodicity of PDV at roughly this time. This topic was not addressed in AR5, and several studies have emerged since that strengthen and support claims made by relevant preexisting literature. An addition of this shift, and of possible variations of North Pacific hydroclimate on multi-millennial timescales, would inform the "Definition of the mode" section, and strengthen/expand the "Availability of proxy evidence" section. The number of studies showing a shift in North Pacific ocean-atmosphere circulation from the middle to the late Holocene suggest high confidence that the shift occurred. The agreement among most of these records that the shift was from PDO- to PDO+ conditions suggests medium confidence in the direction of the shift. [Ellie Broadman, United States of America]	Taken into account. This comment is addressed in Chapter 2. This Annex has been revised to mention such proxies, citing Chapter 2 for more details.
14473	16	10	16	11	Reference showing that this is specifically the case for Central Pacific SST anomalies: Stuecker (2018), Revisiting the Pacific Meridional Mode, Scientific Reports, DOI:10.1038/s41598-018-21537-0 [Malte Stuecker, United States of America]	Accepted. Potential feedback between the TPDV and the PMM is included.
98365	17	23	17	31	While mentioning how PDV is similar to ENSO, the authors could also be highlighted how PDV affects ENSO. PDO positive phases enhance an El Nino event and vice-versa. (Ref:- Krishnamurthy and Krishnamurthy., 2014) [Feba Francis, India]	Rejected. Krishnamurthy and Krichnamurthy (2014 Climate Dynamics) found that influence of PDV and ENSO on South Asian summer monsoon are basically additive. Unless there is evidence of non-additivity, describing combined influence from all combinations of modes would make this Annex extremely long.
23523	19	54	19	55	"Box 1.4" does not exist in Chapter 1. [Masaki Satoh, Japan]	Editorial. All the callouts have been double checked prior to publication.

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67575	21	5	21	25	The MJO can also impact the atmospheric composition, such as ozone, carbon monoxide, carbon dioxide, and aerosols (Tian et al., 2007; 2011; Li et al. 2010; Tian and Waliser, 2012). Tian, B., Yung, Y. L., Waliser, D. E., Tyranowski, T., Kuai, L., Fetzer, E. J., & Irion, F. W. (2007), Intraseasonal variations of the tropical total ozone and their connection to the Madden-Julian Oscillation, Geophys. Res. Lett., 34(8), https://doi.org/10.1029/2007gl029451 Li, K. F., Tian, B., Waliser, D. E., & Yung, Y. L. (2010), Tropical mid-tropospheric CO2 variability driven by the Madden-Julian oscillation, Proc. Nat. Acad. Sci. USA, 107(45), 19171-19175, https://doi.org/10.1073/pnas.1008222107 Tian, B., Waliser, D. E., Kahn, R. A., & Wong, S. (2011), Modulation of Atlantic aerosols by the Madden-Julian Oscillation, J. Geophys. Res., 116, 12, https://doi.org/10.1029/2010jd015201 Tian, B., & Waliser, D. E. (2012), Chemical and biological impacts, Ch. 18 in Intraseasonal Variability in the Atmosphere-Ocean Climate System, edited by W. K. M. Lau, and Waliser, D. E., pp. 569-585, Springer Berlin Heidelberg, https://doi.org/10.1007/978-3-642-13914-7_18 [Baijun Tian, United States of America]	Accepted. The suggested references have been included in the revised text
23521	22	14	22	14	"Table 11.4" should be corrected as "Table 11.5" for Regional assessments for Asia. But in Table 11.5, MJO is not referred to. [Masaki Satoh, Japan]	Accepted. Reference to text in the chapters has been corrected according to FGD version
14435	22	24	22	24	Eliminate repeated parenthesis: (dashed)). [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Parenthesis has been removed.
39063	43	6	43	6	Units are not well readable in Fig 1e [Federico Serva, Italy]	Taken into account. Layout corrected
7191	44	2	52	2	Many figures are not colourblind friendly. Green and Red should never appear on the same plot. Use colorbrewer or similar throughout. [Benjamin Henley, Australia]	Taken into account. The colour palettes have been changed to be colour-blinded friendly.
7189	44	4	44	4	Figure AVI.2 I am wondering if the austral summer SAM is the best choice for this figure showing the influence of SAM on rainfall. I know why you chose it, but of most concern to Australian water resources is the storm track shifting to the south, driving lower precipitation in the cool season. It would be nice if this could be mentioned/highlighted in some way. Also, figure c is not colour blind friendly. Please amend colour scale. [Benjamin Henley, Australia]	Taken into account. The intent of the Technical Annex is to support the main assessment across the entire report. Since detection and attribution for SAM are possible for austral summer season only, we chose this specific season for the Technical Annex plot and we decided to stick to this choice for consistency across the modes. That said, we have added in the text that the seasonality of the teleconnection is strong for SAM and we have listed some papers accordingly.
39065	44	4	44	4	In Fig 2d, there is an extra (positive) line over negative values near Australia. [Federico Serva, Italy]	Editorial. Copyedit to be completed prior to publication.
7193	46	2	46	2	Figure AVI.4 Tasmania, most of NZ and Southern South America is cut off. Please amend southern latitude limit of these figures. [Benjamin Henley, Australia]	Taken into account. The southern and northern latitudinal limit have been increased to 45 degrees.
55509	47	5	47	5	Figure AVI.5: "Same as Erreur ! Source du renvoi introuvable". Rewrite? [Maria del Pilar Bueno Rubial, Argentina]	Editorial. Copyedit to be completed prior to publication.
577					In the Atlantic Ocean, there is a subtropical mode of SST variability that influences South America and Africa precipitation: the South Atlantic Subtropical Dipole (SASD). It is not cited in the AR6, and I would recommend to include it, as recently more studies are investigating its behavior during present and past climates. As part of the Atlantic Ocean variability, it may influence Atlantic surface circulation and also features related to the AMOC. References suggestions: Wainer and Venegas (2002, doi:10.1175/1520-0442(2002)015<1408:SAMVIT>2.0.CO;2); Morioka et al. (2011, doi:10.1175/2011JCLI4010.1); Nnamchi et al. (2011, doi:10.1029/2010JD015579); Wainer et al. (2014, doi:10.1038/srep05291); Rodrigues et al. (2015, doi: 10.1175/JCLI-D-14-00483.1); Nnamchi et al. (2017, doi: 10.1002/asl.781), and others. [Luciana Figueiredo Prado, Brazil]	Rejected. The modes described in the technical Annex are the ones assessed in details in the main report. The intent of this annex is to support the main assessment and not to provide a comprehensive review of all the modes of variability. For instance, PNA, QBO, etc. are not presented either. We had to make this selection for sake of shortness and focus. That said, a mention of the SASD mode + a reference (Rodriguez et al.) has been added in the teleconnection section associated with ENSO

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116805					Thanks for this well developed Annex VI (a must read). Some history of science could be added in the foreword, together with a summary of how these modes were addressed in previous IPCC reports. Work is needed to provide a more comprehensive view of paleoclimate evidence, using the latest studies (many of the references, for instance for NAO or AMV, are quite ancient). Finally, based on the systematic approach here, you could also develop a summary table using the regions (land and ocean) of WGI AR6, and report the relative strength of teleconnections with the modes for each region. This could be helpful for discussions of ch 2, 3, 4, 8, 9, 10, 11 and 12 + atlas. I also think that these figures could be called through a link on the atlas to provide background information. [Valerie Masson-Delmotte, France]	Accepted. Thanks for your nice comments. All the suggestions have been taken into account, except for the inclusion of the latest studies regarding the paleo reconstruction of the NAO and the AMV since there are assessed either in Chap2 or Chap3. That said, some references have been added in the Technical Annex to complete the current description. A summary Table following the suggestion has been created but included in the Atlas chapter (Table Atlas.1) and not in the Annex