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Earth System Dynamics
Discussions

Interactive comment on "Eurasian autumn snow impact on winter North Atlantic Oscillation depends on cryospheric variability" *by* Martin Wegmann et al.

Anonymous Referee #2

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REVIEW

Manuscript: ESD-2019-68

Title: Eurasian autumn snow impact on winter North Atlantic Oscillation depends on cryospheric variability.

Authors: Martin Wegmann, Marco Rohrer, María Santolaria-Otín and Gerrit Lohmann.

General Comments

This study presents and discusses statistical relations (diagnostics based on correlations and linear regressions) between Eurasian snow cover in autumn and wintertime

atmospheric circulation anomalies, claiming a causal link (forcing and response relationship) the strength of which varies in different historical epochs. The authors make valid references to recent and past literature on this broad topic and show original and valuable results. The Reviewer would recommend this study for publication after some minor points are addressed (minor revision). In particular : (i) the authors should account for serial correlation in the timeseries when assessing statistical significance, this is an important point since it can potentially affect (quite strongly) the discussed statistics and the associated conclusions. (ii) the authors should make an effort to be more explicit when referring to dynamical pathways, even if they do not directly assess any of the mentioned dynamical relationships (a weakness of this study). (iii) the authors should explain (otherwise remove) their line of argument on the likely driving role of ENSO in respect to low-frequency (decadal to multi-decadal) variability.

Specific Comments

1. Line 17 Perhaps the mathematical term "non-stationarity" does not convey the right message here. Obviously, predictability due to ESC varies from year to year for two basic reasons: (i) ESC anomaly may be small, thus not providing a strong forcing leading to a predictable signal, (ii) other processes affecting predictability may be more dominant.

2. Line 20 "tendency" also means time derivative. For this reason, avoid this expression, or clarify.

3. Line 23 Delete "slowed"

4. Line 24 "correlation power" is not approved terminology.

5. Line 29 Three times using "power" in the abstract alone.

6. Line 34 "climate mode... over" → climate variability pattern affecting winter climate over

7. Lines 36–37 Here and elsewhere, please put a comma between "et al." and the

publication year and use semicolons to separate different references.

8. Line 38 The NAO is not defined as the strength of the gradient, it rather refers to the variability of this gradient (seesaw). Please rephrase.

9. Line 40 “its configuration” → its variability

10. Line 42 high-priority (with hyphen)

11. Line 59 manifests itself / occurs / is manifested

12. Line 79 a mechanism described by...

13. Line 89 What exactly is meant here? “forming...” how?

14. Line 93 summarized → discussed

15. Line 110 consequences → conclusions

16. Line 111 who point to the prediction power of

17. Line 114 link → chain (?)

18. Line 129 For a detailed description

19. Line 143 “found” → defined (?)

20. Line 148 The NAO centers of action are known to migrate zonally, but not so much meridionally [e.g. Barnston and Livezey (1987)].

21. Line 159 “normalized” → standardized

22. Line 165 “is above” → is higher than

23. Line 182 “the second dimension” → two dimensions (meridional and zonal direction)

24. Line 188 Blocks do not always divert the westerlies (they can also block).

25. Line 190 fulfill the two above-mentioned conditions

26. Lines 213–214 “window” → period (?)

27. Line 217 “any” → each

28. Line 233 This hints toward

29. Line 244 Please check typos (missing spaces)

30. Line 269 increase polar (“heights” is plural).

31. Line 287 “increase” → aid

32. Line 306 anomalies are regressed

33. Line 309 Remove “a” (two occurrences)

34. Line 310 “is able to support” : please rephrase

35. Line 325 “it” : please be more explicit for lucidity, what does “it” refer to?

36. Lines 327–328 “which in turn favors...” : how and why?

37. Line 329 “slightly” : this undervalues the significant differences (4 half periods vs 3 half periods, not just “slightly out of phase”. In this paragraph the authors jump from an NAO reasoning to a direct connection of continental anomalies to the BKS, yet the respective dynamics are not compatible: the NAO links to more/less zonal advection, while Ural blocking links to meridional advection.

38. Lines 338–341 This approach requires a proper evaluation of the effective number of degrees of freedom, which most likely are seriously reduced due to serial correlation (related to the low-frequency nature of the discussed variability but also to the applied filter).

39. Lines 342–353 So the previously-discussed dynamics work in one decade but fail to work in another?

40. Lines 371–373 Please help the reader see whether there is anything new here in respect to the cited studies.

41. Lines 375 “popular” (is this the right word?)

42. Lines 397 low-frequency (with hyphen)

43. Line 412 . . ..pattern via a stratospheric pathway.

44. Line 428 Remove “that” before “seem”. Referring to this paragraph, the reviewer finds the reasoning related to ENSO to be poorly based given that ENSO itself cannot be claimed to be a primary driver of (multi)decadal variability. This is an important point that should be addressed in a revised version of the manuscript.

45. Line 435 strength (not in plural)

46. Lines 433–443 Even two noisy processes after 21-year smoothing will exhibit periods of correlation and anticorrelation (purely an artifact related to limited samples and sub-samples). For robust statistics, the time window / period considered should contain at least a few periods... otherwise any result can be expected.

47. Lines 513 “counterintuitive” → contrasting (?)

FIGURE 2: How is statistical significance assessed? A suitable and rigorous test is required accounting for serial correlation (which tends to decrease the effective number of degrees of freedom). The colorbar (in this and other plots) is not a good choice as it does not allow distinguishing high from moderate values (e.g. 50 and 100 have very similar tones). Please choose a colormap with more colors. Also, add more ticks and labels in the colorbar, including the max and min values covered.

FIGURE 4: The figure caption was found in a different page (unacceptable).

FIGURE 5: The pressure unit is “Pa”, not PA. Also, please define what is meant by “time unit”.

REFERENCES: Why some appear gray and other in black font?

Please also note the supplement to this comment:
https://www.earth-syst-dynam-discuss.net/esd-2019-68/esd-2019-68-RC2-supplement.pdf

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