Reply to Comment by Vicente-Serrano on "Mediterranean drying by a positive North Atlantic Oscillation trend over the last 65 years is an extreme outlier in the CMIP6 multimodel ensemble" by Seager et al.

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We appreciate the work that Vicente-Serrano and colleagues have done to both confirm most of the findings of our recent paper "Mediterranean drying by a positive North Atlantic Oscillation trend over the last 65 years is an extreme outlier in the CMIP6 multimodel ensemble" and place its results in a valuable longer-term context. We agree with the points made in their Comment.

The primary objective of our study was not a study of precipitation trends per se. Its' main goal was an analysis of the physical mechanisms, over the past decades of strong greenhouse gas radiative forcing, for dynamically-induced winter drying of the Mediterranean region and its linkage to the North Atlantic Oscillation (NAO). The work used analysis of the moisture budget and atmospheric circulation in the ERA5 Reanalyses (Hersbach et al. 2020) which, at the time of study initiation, dictated a start date of 1959. Vicente-Serrano and colleagues correctly point out that this means that, by chance, our start date was within a period that was unusually wet for the 20th century and that had a notably negative NAO. Nonetheless, our paper pointed out that the trend we analyzed occurred within significant multidecadal variability, referencing Vicente-Serrano et al. (2025), and that the trend in century long precipitation records is smaller and often not statistically significant. The new results presented here by Vicente-Serrano and colleagues emphasize that point. The strong drying trend is of great interest from a climate dynamics and impacts perspective and it is gratifying to see in the Comment that the

consistency across the products we used (CRU, E-OBS, and ERA5) also extends to the new data compilation of Vicente-Serrano et al. (2025).

In our paper we showed that the observed, and clearly related (via moisture budget decomposition), trends in Mediterranean precipitation and the NAO were at the very limit of CMIP6 simulations for the same 1959-2023 period. Vicente-Serrano and colleagues have extended our analysis to show that it is also very unusual when assessed against trends in model simulations for any time period and also within pre-industrial control simulations. Their findings are a valuable update to, but consistent with, earlier ones from our group using CMIP3 (Kelley et al. 2012), which their Comment references.

Vicente-Serrano and colleagues also examine paleoclimate reconstructions of the NAO and show that the trend over recent decades may not be unprecedented over the last millennium. Here is not the place to debate validity of particular paleoclimate reconstructions, but once more we agree. We referenced the E.R. Cook et al. (2019), B.I. Cook et al. (2016) and Scholz et al. (2022) reconstructions in our paper to make the same point.

Vicente-Serrano and colleagues' Comment adds to our knowledge of Mediterranean precipitation change to date. In our paper, we made clear that model projections of future drying of the region needed to be treated with caution given that 1) models and observations mechanistically disagree on why the region has dried since the late 1950s, 2) it is not clear whether the precipitation and NAO trends arise from natural variability, forcing or some mix thereof. The work of Vicente-Serrano and colleagues emphasizes these same points and uses considerable evidence to make clear that the recent drying is contained within a longer term record of strong multidecadal variability which, while rare, can be reproduced by models. Consequently, we agree with Vicente-Serrano and colleagues that the NAO trend over recent decades cannot unambiguously be attributed to anthropogenic forcing and that natural multidecadal variability is also a viable explanation, points that were made in our paper.

Finally, we are all in agreement that more research is needed to understand the contributions of natural multidecadal variability and forced change to the drying of the Mediterranean region over recent decades, whether models can reproduce that with the right mechanisms, and what

this all means for the future. All regions across the Mediterranean are vulnerable to climate change and need our community to provide reliable assessment of what the future will be. The work of Vicente-Serrano and colleagues greatly helps us understand the decadal and longer-term variability in the region and rightly cautions about drawing inferences from short records. Our study adds to that work by diagnosing the dynamical mechanisms responsible for the winter drying over past decades. This improved understanding of variability and mechanisms will help our community advance the important task of determining how precipitation will evolve across the Mediterranean in the coming decades.

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Data and Software Availability Statement. No data or software were used in preparing this reply to a Comment.