

REVIEWER COMMENTS

The manuscript “*Dynamic Mode Decomposition of Extreme Events*” presents a novel variation of Dynamic Mode Decomposition (DMD) by introducing a penalisation term aimed at improving the reconstruction of extreme events. The topic is timely and important, especially in the context of climate extremes, where improved diagnostics and predictive capacity are highly valuable. The manuscript is generally well-structured, but there are several issues regarding mathematical consistency, figure presentation, and the interpretation of results that need to be addressed before publication. Below, I provide general comments.

General Comments

1. Clarity and Consistency of Formulas

Some equations contain inconsistencies errors. Errors in notation can confuse readers and undermine the technical accuracy of the paper.

Line 125: The expression $\phi_j \mathbb{C}^n$ is incorrect, should be $\phi_j \in \mathbb{C}^n$.

Equation (13): The use of Σ is inconsistent with the subsequent notation $\tilde{\Sigma}$. Please unify.

Equation (19): If the first equal sign's rhs is defined as the "square of the F-norm", then the second equal sign's rhs should not write the square root—this is mathematically inconsistent.

2. Methodology

In equation (20), the global residual is measured by the Frobenius norm, while the residual on the extreme set is measured by an L1 norm, and the two terms are added directly. Since the global term involves all data points while the extreme term involves only a few, their scales may not be balanced. I suggest the authors clarify whether a sensitivity analysis has been conducted, or consider introducing a weighting factor before the extreme term to ensure robustness across different datasets.

3. Figures and Visual Presentation

Many figures lack boundaries, latitude/longitude, clear labels, and standardized color bars, and many captions are vague, which hinders interpretation.

Fig. 9 shows multiple red circles, but Fig. 11 does not specify which is displayed.

4. Results and Discussion

The case study explanations of the 2003 and 2010 heatwaves are too superficial, lacking sufficient discussion of underlying physical mechanisms. Please link the extracted modes to known circulation patterns.

The method is promising, but the comparison with existing Sparse DMD or related approaches is underdeveloped. The manuscript should highlight differences and advantages of “Extreme DMD” over Sparse DMD.

Minor Issues

Minor typographical and formatting errors remain. A thorough proofreading is recommended. Furthermore, please ensure consistency in formatting and consider adding more recent Koopman/DMD climate applications.

Summary and Recommendation

Overall, the manuscript introduces an interesting and potentially valuable approach for studying climate extremes. However, issues in formula consistency, figure quality, and insufficient physical interpretation limit its current impact. I recommend **major revision** before it can be considered for publication.