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Anisotropic character of low-order turbulent flow descriptions with the proper orthogonal decomposition NICHOLAS HAMILTON, Portland State University, MURAT TUTKUN, Institute for Energy Technology, RAL BAYON CAL, Portland State University — Proper orthogonal decomposition (POD) is applied to data from distinct sets to characterize the error arising in the description of turbulence. Wind turbine wake experiment data and direct numerical simulation data from a fully developed channel flow are used to illustrate dependence of the anisotropy tensor invariants on the modes used in low-order descriptions. Reduced order flow descriptions via truncated POD bases greatly exaggerate turbulence anisotropy and can lead to a loss of three-dimensionality in extreme cases. Simple corrections to the low-order descriptions significantly reduces the errors. Similar gains are seen in the anisotropy tensor invariants. Corrections of this form reintroduces three-dimensionality to severely truncated POD bases. A threshold for truncating the POD basis based on the equivalent anisotropy factor for each measurement set requires many more modes than a threshold based on energy. The mode requirement to reach the anisotropy threshold after correction is reduced by an order of magnitude for all example data sets, ensuring that economical low-dimensional models in terms of modes included account for the isotropic quality of the turbulence field.

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