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Confronting Earth System Model Trends with Observations: The Good, the Bad, and the Ugly

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Despite the early warnings of the scientific community in general and of the IPCC in particular, we have entered decades in which climate models are no longer black boxes as the consequences of past emissions of greenhouse gases are emerging rapidly in multiple climate records. This unprecedented situation is likely to change our methods and our view of the respective roles of models and observations in understanding recent and predicting future climate change, regardless of the considered emission scenario. Among the key questions raised are the role of observations in model tuning versus projection constraining and the design of future model intercomparison projects. These questions will be illustrated by several recent studies aimed at constraining CMIP6 projections and, hopefully, with a fresh although critical look on the forthcoming CMIP7 project.