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Process-Based Model Evaluation using Functional Relationships

Introduction:
- Global ESMs have large disagreements in simulations of hydro-climatic processes
- Single-variable evaluation of model vs observations is necessary but not sufficient for global model validations.
- Model disagreements are not always due to different climate forcing, but also involves uncertainties in hydrological simulations.

Definition:
Using known or observation-based hydro-climatic relationships between different variables for model evaluation.

Functional relationship examples:
- Co-variations patterns between key variables in the observational data
- Known regular hydrological relationships such as Budyko (partitioning of P into ET and R) or the change in empirical relationship of P-Q in Australian catchments before and after Millennium drought.
- Potential applications of machine learning for pattern recognition and comparison

Gnann et al., 2023
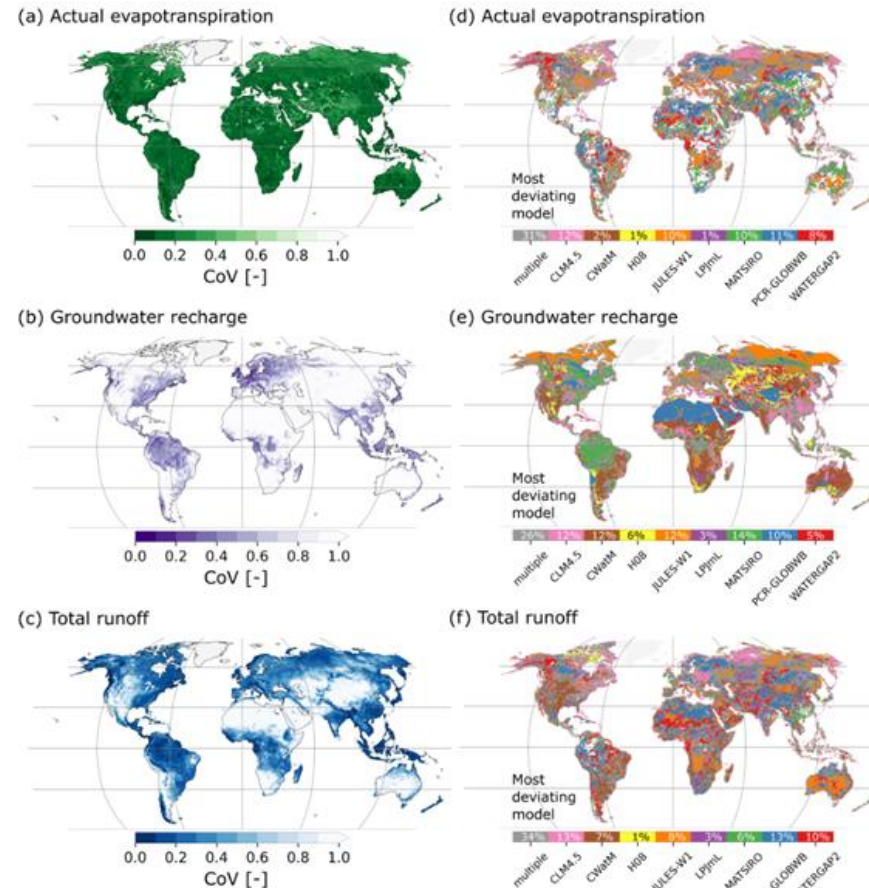
Advantages:
- Provides deeper insight on model uncertainties in process understanding and simulation.
- Identifying systematic errors in system behavior simulations.
- Guiding model developers on where to invest for fundamental model enhancements.

Ghajarnia et al., 2021