

## Coupling metrics to diagnose land-atmosphere interactions

### Drawdown Interval Coupling

- References:
  - Levine, P. A., J. T. Randerson, S. C. Swenson, and D. M. Lawrence, 2016: Evaluating the strength of the land–atmosphere moisture feedback in Earth system models using satellite observations. *Hydrol. Earth Syst. Sci.*, **20**, 4837–4856, doi:10.5194/hess-20-4837-2016.
- Principle:
  - The local seasonal cycle of land water (total terrestrial water storage from GRACE in Levine et al. 2016) is calculated and the months of maximum and minimum climatological water storage are defined as the start and end of the drydown interval.
  - Metrics of land-forced climate variability are calculated as the interannual correlation between the water storage anomaly at the start of the drydown interval and surface atmospheric variables averaged over the drydown interval.
  - Metrics of atmosphere-forced land variability are calculated as the interannual correlation between surface atmospheric variables averaged over the drydown interval and the water storage anomaly at the end of the drydown interval.
- Data needs:
  - Multi-year data are necessary, covering enough years to provide reasonable significance of correlations. Monthly mean data are adequate time resolution.
  - The crux is a measure of water storage, which can be from observations or model output. Depending on the depth and size of the measured reservoir, interpretation of feedbacks may vary.
  - Any atmospheric states or fluxes can be paired with water storage for the correlations.
- Observational data sources:
  - Water storage measurements can be in situ or from remote sensing, representing surface soil moisture, soil column moisture or total terrestrial water storage.
- Caveats:
  - As with other metrics based on correlation, causality is not assured. External factors may contribute to the estimated correlation.
  - Likewise, because other factors can contribute to the correlation, the metric does not completely isolate the land-atmosphere coupling strength.
  - Co-located terms in the correlation result in a local coupling metric. If the two terms are not collocated or are representative of different scales (areas), non-local interpretation may be possible.