Feedback parameter $\lambda$

- References:

- Principle:
  - The influence of a slowly-varying variable $X$ at time $t$ on a faster atmospheric variable $Y$ at future time $t+dt$ can be estimated with a feedback parameter:
    $$\lambda = \frac{\text{cov}[X(t-\tau),Y(t)]}{\text{cov}[X(t-\tau),X(t)]}$$
    where $\tau$ is a time scale > $dt$. The denominator is proportional to the lagged autocorrelation of $X$, or its memory.

- Data needs:
  - Time series of the two variables - well suited to large model output data sets. The larger the sample, the more robust and stable the results.

- Observational data sources:
  - Well suited to observational time series, but sensitive to sample size (see below).

- Caveats:
  - With finite data sets there will be sensitivity to the choice of $\tau$.
  - As with all correlation-based metrics, causal relationships are not guaranteed. This is not a process-level metric.
  - Likewise, the metric isolates only linear relationships. Nonlinear or categorical (threshold) relationships may not be well captured.