Generalized EF-SM Coupling Relationship

- References:
  - Haghighi, E., D. J. Short Gianotti, R. Akbar, G. D. Salvucci, and D. Entekhabi, 2018: Soil and atmospheric controls on the land surface energy balance: A generalized framework for distinguishing moisture-limited and energy-limited evaporation regimes. *Water Resour. Res.*, **54**, 1831–1851, doi: 10.1002/2017WR021729.
- Principle:
  - The classic dependency relationship of EF on soil moisture, by which energy vs. moisture controlled regimes (and thus active land-atmosphere coupling) are defined, contains a great deal of scatter. Haghighi et al. (2018) propose a theoretical framework under which the scatter is attributed to variations in meteorological conditions and soil properties. Both the critical soil moisture that denotes the boundary between regimes, and actual EF(SM) response, are defined in terms of wind speed, temperature, humidity, radiation, etc., as a set of non-dimensional ratios of resistances and other terms that can be estimated from observed data.
  - The critical soil moisture value, as a definition of the transition point between coupled and uncoupled land-atmosphere states, is the key coupling metric and can be determined as a highly dynamic function of conditions.
- Data needs:
  - Daytime values of standard meteorological observations plus net radiation, along with soil moisture and surface heat fluxes (sensible, latent and ground; to tune soil parameters).
  - Readily available from weather and climate models.
- Observational data sources:
  - Method developed using semi-arid FLUXNET sites; require data like that in the typical suite of complete flux tower observations.
  - Could potentially use a blend of observations and model data, or in situ and remotely sensed data.
- Caveats:
  - The derivation is predicated on unstable atmospheric conditions, well suited to daytime conditions in the tropics, subtropics and summertime mid- and high-latitudes.
  - The derivation contains many parameters and a large number of assumptions that are well-documented in Haghighi et al. (2018) and references therein. Take note that these assumptions are appropriate for any particular application.