Relative Humidity Tendency

- References:
  - Ek, M. B., and A. A. M. Holtslag, 2004: Influence of soil moisture on boundary layer cloud development. *J. Hydrometeor.*, **5**, 86-99, doi: 10.1175/1525-7541(2004)005%3C0086:IOSMOB%3E2.0.CO;2.
  - Gentine, P., A. A. M. Holtslag, F. D'Andrea and M. Ek, 2013: Surface and atmospheric controls on the onset of moist convection over land. *J. Hydrometeor.*, **14**, 1443-1461, doi: 10.1175/JHM-D-12-0137.1.

- Principle:
  - Rate of change of relative humidity at the top of a growing boundary layer determines time to cloud formation, and depends on properties of the boundary layer itself, the free atmosphere and the surface (namely EF and "non-evaporative terms"). From an initial RH, the tendency can be integrated to determine if/when clouds will form.
  - Critical EF above which the PBL will moisten instead of dry: $EF_C = \frac{1+2w}{1+2w+B_{inv}} < 1$, where $B_{inv} = - c_P G_q / l_V G_q$ is the inverse Bowen ratio at the top of the boundary layer, and ω is an entrainment ratio between PBL top and surface $\cong 0.2$ (is this simply the Priestley-Taylor coefficient $\alpha - 1$?).
  - Increasing specific humidity will not lead to cloud if RH_{PBLH} is not increasing. Dry vs. wet soil advantage regime transitions occur when $dRH_{PBLH}/dET = 0$, but this cannot be solved analytically as RH_{PBLH} is highly non-linear in ET. In Gentine et al. (2013) this is solved numerically.

- Data needs:
  - A full set of surface and profile data are needed including surface fluxes to calculate analytically. There should be a way to approximate the relationships in Fig 5 (and other figures of Gentine et al. 2013) with simple functions of EF and $?_?$, B_{inv}, etc., that best fit the curves.

- Observational data sources:
  - Profiles and fluxes together at the same location(s).

- Caveats:
  - Comes with many built-in assumptions (see references). There is a lack of easy analytical solutions – a full shakedown with model output might uncover problems.

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