[Coupling metrics to diagnose land-atmosphere interactions]

Betts Relationships

- References:
  - Betts, A. K., 2004: Understanding hydrometeorology using global models. *Bull. Amer. Meteor. Soc.*, **85**, 1673-1688, doi: 10.1175/BAMS-85-11-1673.
  - …and many references therein.

- Principle:
  - Scatter diagrams or correlations between time mean (longer than diurnal cycle, and filtering out synoptic variability, e.g., pentad mean) quantities describing land surface states, surface fluxes, near surface meteorology, surface radiation and cloud properties can be used to infer a number of relationships between land and atmosphere. Among them are:
    - Soil moisture and sensible heat flux
    - Sensible heat flux and PBL depth (really is LCL not actual PBL height, yes?)
    - Analog of this for diurnal scales is the EF vs. PBLH analysis of Santanello et al. (2009, 2011).
    - Net longwave radiation and diurnal temperature range
    - Interplay between surface and cloud radiative forcing on near-surface atmosphere.

- Data needs:
  - Long time series of surface fluxes, near surface meteorology, soil moisture and surface radiation components – well suited to model output.

- Observational data sources:
  - Just about the only observational data set long enough and complete enough is all categories is the ARM-CART data over the southern Great Plains. Other observational data sets are either missing components that have to be inferred by other means or left out or are too short to give statistically confident results.

- Caveats:
  - With few exceptions, understanding comes from considering a combination of relationships, and not just a single scatter diagram. Correct interpretations often require consideration of multiple factors. This means many of the Betts-style diagnoses are not easily suited to automated calculation.

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