

A decadal climatology of atmospheric state at Southern Great Plains

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Motivation

- General Circulation Models (GCMs) have difficulty representing clouds, and determining the source of the errors is challenging.
- Because GCMs do not predict specific weather events, model output cannot be directly compared to observations. Rather, long term averages of model and observational data are usually compared. This obscures the source of any errors that may exist.
- Compositing model and observational data by atmospheric state is an alternative method of making comparisons. In this case, when errors are found, the physical conditions which caused the errors are better known.

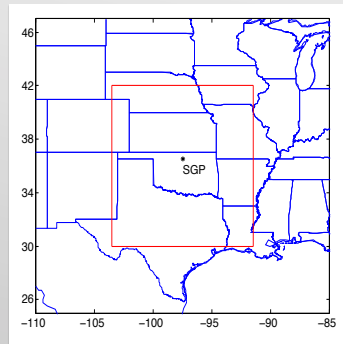
Methods

- 13 years of ECMWF reanalysis fields (T, U, V, RH, surf. pressure) comprise our input data. We use a competitive neural network to define an initial set of states.
- An issue common to many clustering studies is the proper selection of the number of clusters. We use an iterative technique (Marchand et al., 2006 & 2009) to determine the optimal number of states and millimeter cloud radar data from the ARM site as an independent test of the statistical significance of the states.

Examples of state meteorology

The following states frequently occur in sequence, demonstrating the algorithm's ability to discern different stages of a passing front.

Region of interest

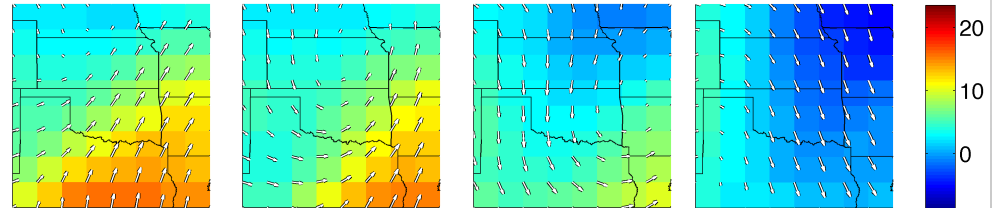


- Reanalysis is sampled on a 9x9 horizontal grid within the red box, at 7 vertical levels.

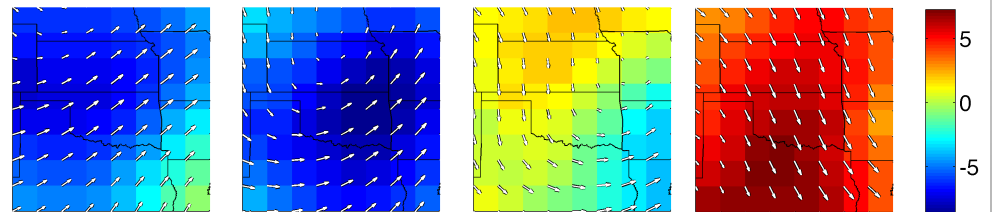
- Vertically pointed millimeter radar at the ARM program Southern Great Plains site marked by the star.

State 12 – warm sector / arriving cold front **State 18** – front has passed, cooling the region **State 14** – pressure building, northerly flow **State 6** – high pressure, clear and cold

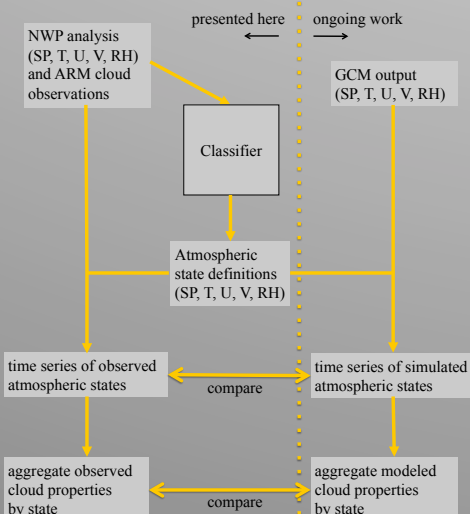
875 mb dew point (°C) & winds



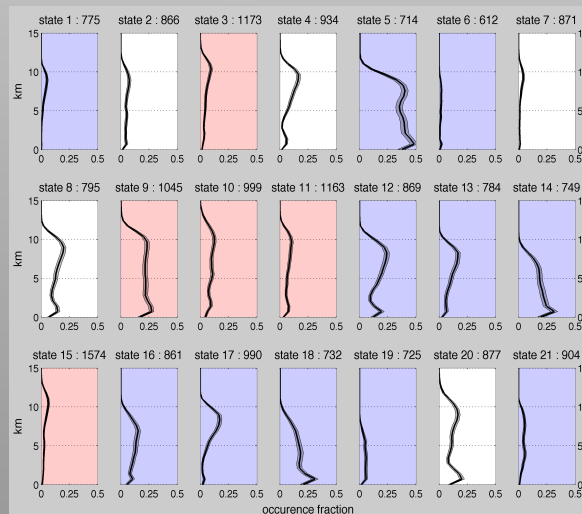
Surface pressure anomaly (mb) & 750 mb winds



Conceptual flow chart



Composite cloud profiles for each state



- Cloud occurrence for the 21 atmospheric states, as observed by the vertically-pointed millimeter radar at the SGP site in Lamont, OK.

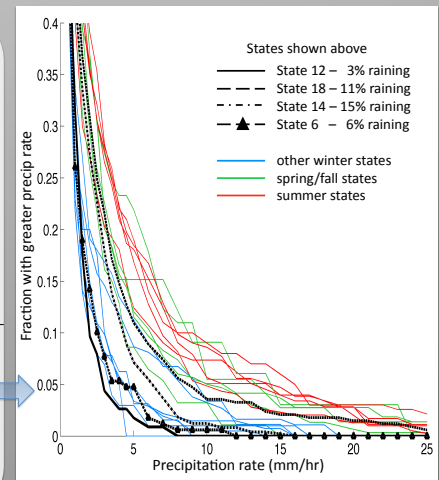
- Red shading marks states which occur in **summertime**. Blue shading marks states which occur in **wintertime**. Unshaded states occur primarily in shoulder seasons.

- Greater variability in winter than summer leads to more wintertime states.

- Precipitation data from the ABRFC 4km gridded precipitation dataset.

- Each curve represents only those times when it is raining – ranging from 1 – 15% of the observations, depending on state.

Precipitation intensity



Questions? Email sevens@atmos.uw.edu