The short and the long of storms: Tracing a storm's life with a trifecta of data

February 27 2013

Deep storm cloud systems typically include three cloud partners: intense centers with strong vertical winds and heavy rain, spread-out areas of lower "flat" clouds that produce light to moderate rain, and a distinctive anvil shaped cloud, not associated with rain but a clear marker of a large storm system. Credit: National Oceanic and Atmospheric Administration and the Department of Commerce

(Phys.org)—The genesis of a thunderstorm determines its duration. Scientists at Pacific Northwest National Laboratory found that the lifetime of large storm systems lasting less than six hours can be traced to the intensity of the storm's initial onset. In storms lasting longer than six hours, they found the storm magnifies when the relative humidity is up to 50 percent higher and, as the storm deepens, has a 40 percent change in the difference between the winds at the top and bottom of the storm. These two conditions feed a continuous growth of the system's rain area which prolongs the storm lifetime.

Every storm is as unique as a fingerprint. Like fingerprints, storms leave clues to their beginnings that scientists are using to paint a complete picture within climate models. The regions of the world encompassing most of the United States, Europe and much of Asia are subject to fast-changing weather systems prompted by air moving in from both the tropics and the poles. Extreme weather such as thunderstorms, hurricanes and cyclones are a yearly occurrence and affect millions of people worldwide. Scientists are working on a better fundamental understanding of the processes that create and fortify strong storm systems. With information gathered from direct observations combined with improved cloud simulations, scientists can help provide the long-term information needed to predict future storms under the influences of climate change.

The research team used observational data from geostationary satellites, ground-based precipitation radars and a regional reanalysis in the United States to analyze deep convective systems in the mid-latitudes. The study implemented an automated satellite tracking algorithm to follow the initiation, maturity and decay of individual storm systems. The team also used a new hybrid classification algorithm that classifies the three parts of the storm system (convective core, stratiform rain and anvil clouds) to combine analysis of satellite and radar data. The team found that factors most important to produce anvil clouds are the size and strength of the convective updraft, stratiform rain area and ambient upper tropospheric wind speed and wind shear. Collocating the reanalysis data with the tracked convective systems, the team used 4,221 tracked convective systems of two warm seasons during May through August, in both 2010 to 2011 to study the desired environment.

By showing the importance of mesoscale organization and ambient environment for deep convective system evolution, their findings provide long-term statistics to compare with models of all scales and evaluate their performance in simulating deep convection.

The authors of the study will focus on understanding the impact of all types of large-scale environmental conditions to convective systems that occur within a typical global climate grid area.

More information: Feng, Z. et al. Life Cycle of Midlatitude Deep Convective Systems in a Lagrangian Framework. *Journal of Geophysical Research-Atmospheres* 117(D23201). DOI:10.1029/2012JD018362

Provided by Pacific Northwest National Laboratory