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Tornadoes and Severe Thunderstorms: Physical Understanding and Climate Questions

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Severe thunderstorms (those that produce large hail, high winds and/or tornadoes) are of importance because of the threat to life and property they pose. This talk will review our understanding of the physical processes that lead to them and their distribution in time and space. The basic approach follows that of weather forecasting, focusing on the atmospheric "ingredients" in the environment necessary to produce severe thunderstorms and tornadoes, particularly the thermodynamic state of the atmosphere and the organizing effects of vertical wind shear that leads to the most severe storms. We will look at the challenges of reconciling our limited reporting databases of events and our physical expectations derived from the distribution of those environmental conditions. Consistent (and inconsistent) aspects of the various databases around the world will be discussed with their implications for what we can and cannot say about the basic physical processes. Of particular interest is the record from the United States. Some simple efforts to deal with the spatial and temporal inhomogeneities in the observational record will be developed with the limits that are implied on our ability to detect past changes. Finally, the talk will close with a discussion of the possible effects of anthropogenic global warming on severe thunderstorms, particularly in the United States. Global climate model studies of this problem are very recent, with the first peer-reviewed results appearing in 2007. The limitations of the climate models and possible scenarios for the future will be discussed.