Storm attribute diagnostics for forecasting and climate applications

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Severe thunderstorms represent a major hazard in many regions of the world, including Australia. However, they remain challenging to forecast due to their small size and the highly nonlinear processes that govern their initiation and subsequent evolution. Traditionally, prediction of these storms relied solely on so-called ingredients-based forecasting, where environmental diagnostics are used to identify conditions favourable for deep convection and associated hazards such as large hail or damaging winds. While this approach remains extremely valuable (particularly in the medium range), the advent of convection-permitting NWP models has allowed for a more direct assessment of severe thunderstorm potential. To this end, the latest version of the Bureau's ACCESS City models output a range of "storm attributes": diagnostics that quantify various aspects of explicitly simulated convection. Over the last few years, these diagnostics have become a key source of guidance for the National Thunderstorm and Severe Weather Outlook produced each day by the Thunderstorm and Heavy Rainfall team. Of particular value are post-processed hourly maximum fields from the ACCESS City Ensemble models, which provide probabilistic information on storm placement, timing, and intensity. In addition to these operational applications, storm attributes are also being produced as part of the Australian Climate Service's new convective-scale regional reanalysis (BARRA-C2) and convective-scale regional climate projections (BARPA-C). Together, these datasets will provide new insight into historical and future severe thunderstorm hazards in Australia. This presentation will introduce the various storm attribute diagnostics and highlight their applications in operational forecasting and climate research.