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Predicting pyroconvection: a challenge for fire management as well as fire research

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Heat, moisture and aerosol release from fires can sometimes lead to the formation of convective clouds known as pyrocumulus, or pyrocumulonimbus (pyroCb) for the more intense systems. Dangerous fire behavior can be associated with pyroCbs due to near-surface wind variability, as well as strong updrafts that increase the risk of spot-fires. However, despite the risks associated with pyroconvection, current operational weather models do not account for fire-atmosphere interactions. We present an example for an extreme fire event in southeast Australia, known as Black Saturday, for which models did not indicate a high chance of thunderstorm activity, but we show that the influence of the fires on the atmosphere led to a number of deep thunderstorm complexes. Hundreds of pyrogenic lightning strikes occurred, with a new fire ignited by the lightning about 100 km ahead of the main fire front. New methods using observations (including radar, lightning and satellite data) as well as synoptic-scale model analysis are presented, demonstrating considerable potential for enhanced guidance for predicting pyroconvection. A number of other Australian fire events are examined using a mobile X-band radar from the Bushfire Convective Plume Experiment field campaign. These observations of pyroconvection at short range help us infill the lacking knowledge on the storm-scale processes with the resolution that can be achieved with a mobile platform. It is intended our findings will have benefits for fire response capabilities, based on improved preparedness and short-range prediction of the potential for dangerous fire conditions associated with pyroconvection including nowcasting and model forecasts