Global climate models (GCMs) have problems in simulating some high-impact events, including underestimating heavy rainfall events. Reliable simulation of high-impact events in climate models requires not only higher resolution but also adequate treatment of physical processes. We show that a dynamical regional climate model (RCM) gives better simulations of selected high impact events than GCMs. We assess the ability of a fine-scale (0.1 degree) dynamical stretched-grid RCM, CCAM, to simulate three kinds of high-impact events over Tasmania, Australia. First, we examine cutoff low synoptic events that bring heavy rainfalls to Tasmania with the automated synoptic detection software package Synview. This is the first time this method has been applied to a fine-scale RCM. Second, we investigated synoptic drivers of extreme fire conditions using an established phase-space method. Third, we assessed the atmospheric environment suitable for storms (cool season tornadoes, dry lightning and thunderstorms) using established indices. The RCMs more accurately simulated the incidence of cutoff lows than GCMs (30% underestimation, rather than 45%). Biases in the wider context of cutoff lows were reduced compared to GCMs, such as atmospheric blocking and the split jet structure. The RCM showed an improved ability to simulate the atmospheric environment associated with extreme fire weather conditions for Tasmania, cool-season tornadoes, dry lightning and thunderstorms. Some traditional problems remain. The RCM still significantly underestimate the historical incidence of cutoff lows and their influence on total annual rainfalls. The improved simulation of high-impact events by the RCM lends greater confidence to projected trends in these features.