Distributed Temperature Sensing and Remotely Piloted Aircraft's: A new way to understand frost events in the Western Australian Wheatbelt

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Abstract:

Spring radiation frost occur during the reproductive stage of winter cereal growth and cost grain growers millions of dollars in lost yield. Frost events in 2005 caused the Western Australian grain industry an estimated 90 million dollars in damage (Knell 2007) and annual average costs across the Australian Wheatbelt are around $300m. Despite higher average winter minimum temperatures due to climate change, less cloud and increased frequency of still conditions and wheat phenological change has increased frost frequency and the challenge for famers (Barlow et al. 2015). This study proposes using two emerging technologies, Distributed Temperature Sensing using fibre optics (DTS) and Remotely Piloted Aircraft's (RPA's) to evaluate techniques that will provide farmers with a better understanding of frost dynamics at the paddock scale and new tools to conduct post-event damage assessment and support better decision making.

Radiation frosts develop under stable atmospheric conditions on cool nights with the presence of a temperature inversion (Snyder et al. 2005). The microclimate of a stable nocturnal boundary layer that occurs at the paddock scale within these events is poorly understood (Thomas et al. 2012) . In a stable boundary layer, turbulence can be more important for diffusion and dispersion of energy than the mean wind speed (Thomas et al. 2012). Small scale turbulence can be undetected by observations from sensor networks in traditional studies. The stable conditions requires sufficiently dense temporal and spatial measurement.

DTS has been presented as a new tool to understand stable atmospheric conditions and the spatio-temporal organisation of frost events (Thomas et al. 2012; Zeeman et al. 2015). DTS allows dense spatial and temporal measurements at resolutions of 2.6s and 0.25m (Zeeman et al. 2015), to study submeso-scale turbulences by tracing the thermal signature of the structures. Increased understanding of the spatio-temporal organisation of frost events will lead to better inputs for modelling, forecasting and management of events at the paddock scale.

Farmers also require a better tools to assess crop damage immediately after frost events. High-resolution thermal imagery can be flown by RPA's and has been widely applied to assess crop stress (Jones et al. 2009). It is prosed to test whether this technology can detect sterility in winter cereal grains caused by frost. The emergence of economic RPA thermal imaging platforms that allow growers or regional groups to fly post-event imagery using classification methods developed in this project may allow farmers new tools to make more informed harvest management decisions to increase profits due to the ability to differentiate frost and non-frost affected portions of the paddock immediately following severe frost events.

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