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Submission to the inquiry into the role of government in assisting Australian farmers to adapt to the impacts of climate change

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The Australian government plays a major role in promoting research into climate change impacts and assessment of adaptation strategies for Australian farmers. For this research to be effective, it needs to produce accurate projections of climate change at spatial scales of relevance to farmers, and include direct and indirect impacts on vegetation and crop production of increasing concentrations of atmospheric CO₂. While changes in temperatures and precipitation are very important when investigating the climate change impacts on vegetation, they are not the only factors that may influence crop production. Many studies have shown that changes in the physical characteristics of the land surface can have an impact on the climate (e.g. N. Zeng & Neelin, 2000; Small & Kurc, 2003; Pitman et al., 2004; R.A. Pielke et al., 1998; Narisma & Pitman, 2003; Hayden, 1998; Dirmeyer & Shukla, 1996; Betts & Ball, 1996; McAlpine et al., 2007). These changes can arise directly from land use activities but may also result from responses of crops to seasonal, inter-annual or longer changes in the atmospheric state. That is, there is a feedback loop between the land and the atmosphere, with each impacting the other. Vegetation (crops, pasture etc) also responds directly to changes in CO₂ (e.g. Farquhar, 1996; Gifford, 1996; Grunzweig & Korner, 2000; Martin, 1993; Narisma et al., 2003) which can change the speed at which crops progress through the various growth stages as well as the total production. Irrigated crops often produce relatively strong coupling between the land and atmosphere and are impacted both by changes in runoff caused by climate change as well as changes in evaporative demand (e.g. Douglas et al., 2009; J.P. Evans & Zaitchik, 2008; Fowler & Helvey, 1974; Ter Maat et al., 2006; Zaitchik et al., 2005). Currently Australia does not have the capacity to produce climate change impact projections that account for these processes. Developing such a capability should be a priority for government backed research in the near future.

In order to achieve this goal an integrated approach to climate and crop modelling needs to be pursued. Such a system would also provide a tool for investigating the likely benefits of adopting different farm strategies such as changing crop types or irrigation techniques as methods for adapting to climate change. This modelling system would consist of

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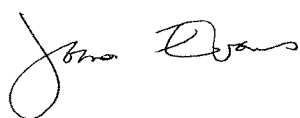
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- A regional climate model with a fully coupled land – atmosphere system. This allows global climate model projections to be dynamically downscaled to spatial scales of relevance to farmers.
- An explicit carbon cycle that allows vegetation to respond directly to atmospheric CO₂.
- An embedded crop/pasture model that allows crop phenology to respond directly to, and feedback on, the changing climate.
- Incorporation of irrigation systems that represent various irrigation techniques such as flood, sprinkler and drip.

Development of the proposed coupled climate-crop modelling system is a critical scientific activity that would enable characterisation of the impacts of climate changes on Australia's agricultural productivity. The scientific and research challenges of such a project are significant. Achieving this goal would position Australia at the forefront of understanding and capacity to respond to the implications of climate changes on our agricultural sector. Ignoring the challenge on the other hand, will severely limit our capacity to adapt to climate changes, and risk the security and sustainability of future agricultural production.

Adding this capacity needs a research team, including meteorology, crop phenology, soil processes and computer modelling. There is no culture in Australian Universities, or within the groups that have launched the Australian Community Climate and Earth System Simulator, that bring together such capacity at research level, or in undergraduate teaching. Thus we are neither teaching or developing the research capacity to capture the impact of climate change on agriculture. More worryingly, we are not developing an understanding of the opportunities for agriculture to affect climate via reductions in emissions. We are therefore failing to explore all possibilities that agriculture offers to offset greenhouse gas emissions. If a research and undergraduate training capacity is to be developed, strategies to engage the University sector are essential.

Yours sincerely,



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