ICYESS2013-24-3
Interdisciplinary Conference of Young Earth System Scientists
Hamburg, Germany, 22 – 25 September 2013

Down load or up load? Climate change, net primary productivity and bush fire fuel load

H. Clarke (1,2,3), J. Evans (1), and A. Pitman (3)

(1) Climate Change Research Centre, University of New South Wales, Sydney, Australia (h.clarke@student.unsw.edu.au), (2) Climate and Atmospheric Science Branch, NSW Office of Environment and Heritage, Parramatta, Australia, (3) ARC Centre of Excellence for Climate System Science, University of New South Wales, Sydney, Australia

Research
Wildfires can seriously affect not just people and property, but biodiversity, ecosystem health and the earth's carbon budget. Will present day patterns of wildfire across the globe change as our climate changes, and if so, how? So far most research has focused on how a changing climate will alter weather conditions that favour the outbreak and spread of fire. But weather is not the only factor in the outbreak of fire: there must be sufficient vegetation (i.e. fuel), the fuel must be dry enough to burn and there must be an ignition source e.g. lightning or arson.

Here we develop alternative model parameterisations of the link between wildfire fuel load and net primary productivity (NPP) over Australia. NPP is a measure of the rate of movement of carbon from the atmosphere into green plants; it is the difference between the carbon dioxide taken in during photosynthesis minus how much is released during respiration. The link between fuel load and NPP is to be expected as several seasons of high NPP followed by dry conditions and vegetation die-back would tend to increase the accumulated biomass that on drying provides fuel load. We use Community Atmosphere Biosphere Land Exchange (CABLE), a land surface model which calculates carbon, water and heat exchanges between the land surface and the atmosphere. The model parameterisations are evaluated against field-based and remotely sensed observations of fuel load.

The next step of the project is to use the parameterisation(s) in CABLE coupled with the regional climate model Weather Research and Forecasting (WRF) to project changes of fuel load into the future. Will changes in fuel load be large enough to change the statistics of fire risk, compared to natural variability or changes in fire weather?

Uncertainty
Uncertainty over actual fuel load values makes modelling fuel load difficult. Model evaluation requires careful combination of data from field work, remote sensing and physical models.

The interplay between rising carbon dioxide levels and vegetation growth is a key source of uncertainty in projections of wildfire risk under climate change. Will the fertilisation effects of increased atmospheric carbon dioxide on plant growth be reinforced by, or counteract changes due to new climate conditions? How different will responses be among grasses and trees, two very different kinds of wildfire fuel? Will the changes in fuel load be of a magnitude comparable to those caused by natural variability or different weather conditions? And how will the answers to these questions vary in time and space?

One way that modellers love to deal with uncertainty is by running ensembles of simulations. The creation of two or three or nine or 27 or indeed hundreds of parallel worlds, all with subtly different conditions, allows researchers to separate the most central factors in various phenomena from those that are less important; to find out just how sensitive a process is to a range of underlying factors. Indeed, decision makers now are less likely to ask what the future climate will look like, than to ask about a range of plausible climate futures, perhaps each with their own level of confidence or probability.