Geophysical Research Abstracts
Vol. 19, EGU2017-18388, 2017
EGU General Assembly 2017

Pyro-eco-hydrologic feedbacks and catchment co-evolution in fire-prone forested uplands

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The south east Australian forested uplands are characterized by complex and inter-correlated spatial patterns in standing biomass, soil depth/quality, and fire regimes, even within areas with similar rainfall, geology and catenary position. These system properties have traditionally been investigated independently, however recent research in the areas of post fire hydrology and erosion, and new insights into forest structure, fuel moisture, and flammability, suggest the presence of critical co-evolutionary feedbacks between fire, soils and vegetation that may explain the observed system states. To test this hypothesis we started with a published ecohydrologic model, modifying and extending the algorithms to capture feedbacks between hyrology and fire, and between fire, vegetation and soil production and erosion. The model was parameterized and calibrated with new data from instrumented forested hillslopes across energy and rainfall gradients generated by selecting sites with a range of aspect (energy) and elevation (rainall). The calibrated model was able to reasonably replicate the observed patterns of standing biomass, water balance, fire interval, and soil depth. The catchment co-evolution/feedback modelling approach to understanding patterns of vegetation, soils and fire regimes provides a promising new paradigm for predicting the response of forested se Australian catchments to declining rainfall and increasing temperatures under climate change.