

# Why does carbon and water coupling matter for management of water resources?

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# Why does carbon and water coupling matter for management of water resources?

1. Need to improve predictions of future runoff and groundwater recharge in a changing world:

- Carbon and water coupling determine the use of water by vegetation
- Vegetation exerts a strong control on runoff and groundwater recharge water resources.
- 2. Vegetation can be a direct user of groundwater.
- 3. Changes to crop water use will change demand for irrigation water.

4. Government regulation of forest interception of water resources and other land use changes.

5. Improved projections of the impacts of climate change on rainfall and evapotranspiration.

### **Global shortfall of water resources**



Source: Water 2030 Global Water Supply and Demand model; agricultural production based on IFPRI IMPACT- WATER base case

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### Water scarcity in Australia

#### (1) Water resources are fully or over committed



### (2) Water availability is likely to decline





### (3) Demand for water is increasing





### We no longer live in a stationary world











# Water resources are highly variable over time





# Non-stationarity evident in calibrated hydrological models



"Current"

"Future"

- Calibration: 1989-1994; Prediction: 2000-2006
- A good calibration, but poor prediction of Millennium drought .



## **Changed runoff in SW Western Australia**



Petrone, Hughes, Van Niel, Silberstein 2010 Geophysical Research Letters

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### It's the tails not the means that matter





### Climate change, floods and droughts in the Murray-Darling Basin





## Surface water resources generated from a small proportion of the landscape





## Murray-Darling Basin: a highly managed system





# Catchments of dams are largely covered in native forest; agricultural lands are largely irrelevant for water supply.



## CO<sub>2</sub>, plant physiology and catchment runoff



# Effects of elevated CO<sub>2</sub> on catchment water balance



### Canopy scale: FACE experiments



Catchment scale: more water yield?



### **Context matters for CO<sub>2</sub> effects**



Net eCO<sub>2</sub> effects on water balance predicted by WAVES

- LAI will increase due to eCO<sub>2</sub>, waterlimited > energy -limited;
- **ET** will decrease in energy-limited region due to  $eCO_2$ , however, it will increase in water-limited region because greater enhancement of LAI offset the water saving effects of  $eCO_2$  and transpired more water;
- Runoff in the energy-limited environment will likely increase due to eCO<sub>2</sub>, but it will decrease in the water-limited region due to increase of greater increase of LAI.



### Not just CO2 but disease and fire





### **Groundwater resources**

- Vegetation is a direct user of water resources as well as modulating supply of water
- Groundwater is more importan in drier regions
- Need to separately identify recharge of groundwater from surface runoff generation

### (f) Baseline Annual Average Recharge





## Forest water interception now included in water reform







## New plantations have little impact on water uses (30,000 ha new plantation)



October 2005

Prepared by the Manumbidgee Calictenent Management Authority, from digitised field data held in the Geographical information System

### **GCM prediction of rainfall**





## Why does carbon and water coupling matter for management of water resources?

1. To improve predictions of future runoff and groundwater recharge in a changing world.

2. To improve understanding of direct use of groundwater by vegetation.

3. To improve understanding of crop water demand for irrigation water under a changing climate.

4. To support government regulation of forest interception of water resources and other land use changes.

5. To improve projections of the impacts of climate change on rainfall and evapotranspiration.





## Thank you

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