Water and carbon coupling at regional scales: key issues and a new approach

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A CSIRO Cutting Edge Symposium

Welcome

Sponsors:

- **CSIRO Office of the Chief Executive (OCE)**
- **CSIRO Water for a Healthy Country Flagship**
- **CSIRO Marine and Atmospheric Research (Climate and Atmosphere Theme)**
- **Terrestrial Ecosystem Research Network (TERN)**

Conference Opening

1. Aims of the conference

Helen Cleugh, Deputy Chief, CSIRO Marine and Atmospheric Research

Aim: to identify key issues in developing one of the most advanced modelling systems in the world for studying both water availability and carbon dynamics under current and future climate conditions in Australia

Break-out Sessions: 2 groups, 4 questions

1. While the coupling of water and carbon fluxes at leaf scale is quite well understood, this is much less so at regional scales.

   What are the major obstacles?

2. What are major advances in our understanding of coupled C & W cycles over the last two decades?

   How have FLUXNET measurements contributed to these advances?

3. How will water and carbon budgets, and coupling, change under future climate and higher CO_2 conditions?

   What are the key processes and mechanisms?

4. What is needed to improve our understanding of those key processes and mechanisms?

Conference Opening

1. **Aims of the conference**

   Helen Cleugh, Deputy Chief,

   CSIRO Marine and Atmospheric Research

2. **Climate change science and the role of carbon & water exchanges: A view from the DCCEE**

   Anthony Swirepik, Director, Climate Science,
   Department of Climate Change and Energy Efficiency

Session 1:
Water and carbon coupling: science and policy issues

1. **The economics of leaf-gas exchange in a fluctuating environment and their up-scaling to the canopy-level using turbulent transport theories**

   Gaby Katul (Duke University)

2. **Advancing representation of terrestrial physics to support water-carbon coupling in GFDL's Earth System Models**

   Chris Milly (GFDL)

3. **Three decades of evolution in our understanding of canopy turbulence**

   John Finnigan (CSIRO)

4. **Carbon planting and water policies – real or perceived conflicts?**

   Ian Prosser (CSIRO)

Session 2:
Observed water and carbon fluxes

1. **Linking measured CO_2 exchange by sugarcane crops and biomass production** Tom Denmead (CSIRO)
2. **Savannah patterns of energy and carbon integrated across the landscape.** Jason Beringer (Monash Uni)
3. **Carbon and water fluxes in a tropical lowland rainforest in Far North Queensland.** Mike Liddell (James Cook Uni)
4. **Patterns of carbon and water fluxes of arid zone Mulga in Australia: sources, sinks and their responses to precipitation pulses .** Derek Eamus (UTS)
5. **Responses of carbon and water exchanges of an Eucalyptus forest to prolonged dry and wet periods.** Eva van Gorsel (CSIRO)
6. **A reassessment of rooting depth dynamics and their influence on catchment water fluxes.** Randall Donohue (CSIRO)
7. **Vegetation impact on mean annual catchment evapotranspiration: a global non-paired catchment perspective.** Murray Peel (Melbourne Uni)

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Session 3:
Modelling and synthesis

1. **Thirty years of progress and future prospects in micrometeorology and ecophysiology from leaf to global scales**

   Ray Leuning (CSIRO)

2. **Interpreting 30 years of vegetation dynamics in Budyko's hydroclimatic framework.** Tim McVicar (CSIRO)

3. **Optimal stomatal conductance under rising CO_2.** Belinda Medlyn (Macquarie University)

4. **The hydrological responses of vegetated catchments to elevated CO_2: Results of a simulation study.** Lei Cheng (CSIRO)

Session 3:
Modelling and synthesis (cont.)

5. **An analytical perspective on the coupled carbon climate - human system.** Michael Raupach (CSIRO)
6. **Improving hydrological process simulations using remote sensing vegetation data in bushfire impacted catchments.** Yongqiang Zhang (CSIRO)
7. **Can biomass carbon capture threaten our water resources?** Albert van Dijk (ANU)
8. **Inferring the unobservable: synthesising data and models to diagnose ecosystem processes of water and carbon exchange.**

   Damian Barrett (CSIRO)
9. **Carbon and water observations reduce uncertainty in Australia's terrestrial carbon balance.** Vanessa Haverd (CSIRO)

Session 4:
New directions

1. **A perspective on plant function for carbon cycle and land surface modelling.** Colin Prentice (Macquarie Uni)
2. **Challenges to representing plant adaptation at regional scales.** Roddy Dewar (ANU)
3. **Constraining global GPP using water fluxes: the power of coupling.** Yingping Wang (CSIRO)
4. **Towards defining processes and thresholds of forest mortality: observations from leaf to regional scale.** Tony O'Grady (CSIRO)