Discussion Questions

Couplings and Advances

Questions 1 & 2

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Obstacles to scaling from leaf to region:

- We have a sophisticated understanding at small scale. Less at large scale

- Observation datasets:
  - Water – is stream flow data useful? YES in regions where significant discharge occurs. Stream flow is a good integrator of spatially distributed landscape processes. Most locations are ET dominated which, with stream flow, provides strong constraints at the catchment scale.
  - Carbon – flux towers are patch scale. Reasonably well understood at the leaf level (however, laboratory conditions are different to ‘real world’).

- Disturbances – bias introduced into datasets because disturbances are underrepresented

- Leaf, patch and basin are the characteristic scales.
  - Each a ‘tool’ allowing transfer of information up and down scales. Models provide an integrating tool for knowledge of basin scale processes
  - Different scales have different dominant processes that can amplify or dampen other processes at larger or smaller scales. Modelling is a means of understanding the interplay of processes at different scales.

Obstacles to scaling from leaf to region:

- Water limited environment: relatively simple relationship between water availability, growth and canopy development (all else equal)

- Energy limited environment: much more complex…more free variables

- At regional scales interplay between latent and sensible heat flux is sensitive to boundary layer conductance. This sets an upper limit on ET at this scale. Only at very low conductance does stomata begin to exert strong control over ET

- Data Assimilation provides new ways of introducing diverse data sets into constraining carbon and water cycles. However, shifts problem to specifying the covariance matrices of observations and model.

Advances in understanding water-carbon coupling

- In a CO_2 rich world, do we move outside the boundaries of knowledge? Do we adequately reproduce historic trends – but the natural variability obscures these historic trends in the 'real world'. When will the effects of elevated CO2 on ecosystem function become unambiguously evident?

- Current GCMs don't get all the land surface biophysics correct…e.g. diurnal temperature range and collapse of daytime boundary layer at night are not well represented. This means we don't represent well the processes of energy exchange under low wind speed/low incoming radiation conditions.

- Representation of hydrology in GCMs is very poor at this stage. Precipitation has highest errors and these are propagated in hydrology schemes making prediction of river flows under future climates difficult to predict. Runoff response bigger in energy limited environment…etc

- Where would you look for the CO_2 signal on stream flow? Energy limited environments? BUT the signal is obscured by noise. How long will it be before we see and unambiguous signal? Depends on signal:noise ratio…

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• Still a long way from fully understanding FLUXNET data. Non-linearities and storage terms in canopies make it difficult under some conditions. Day time measurements still fail to close the energy budget. Night time respiration is the most difficult component to measure. Large expenditure and huge investment in infrastructure…daily totals…ok

Thank you

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