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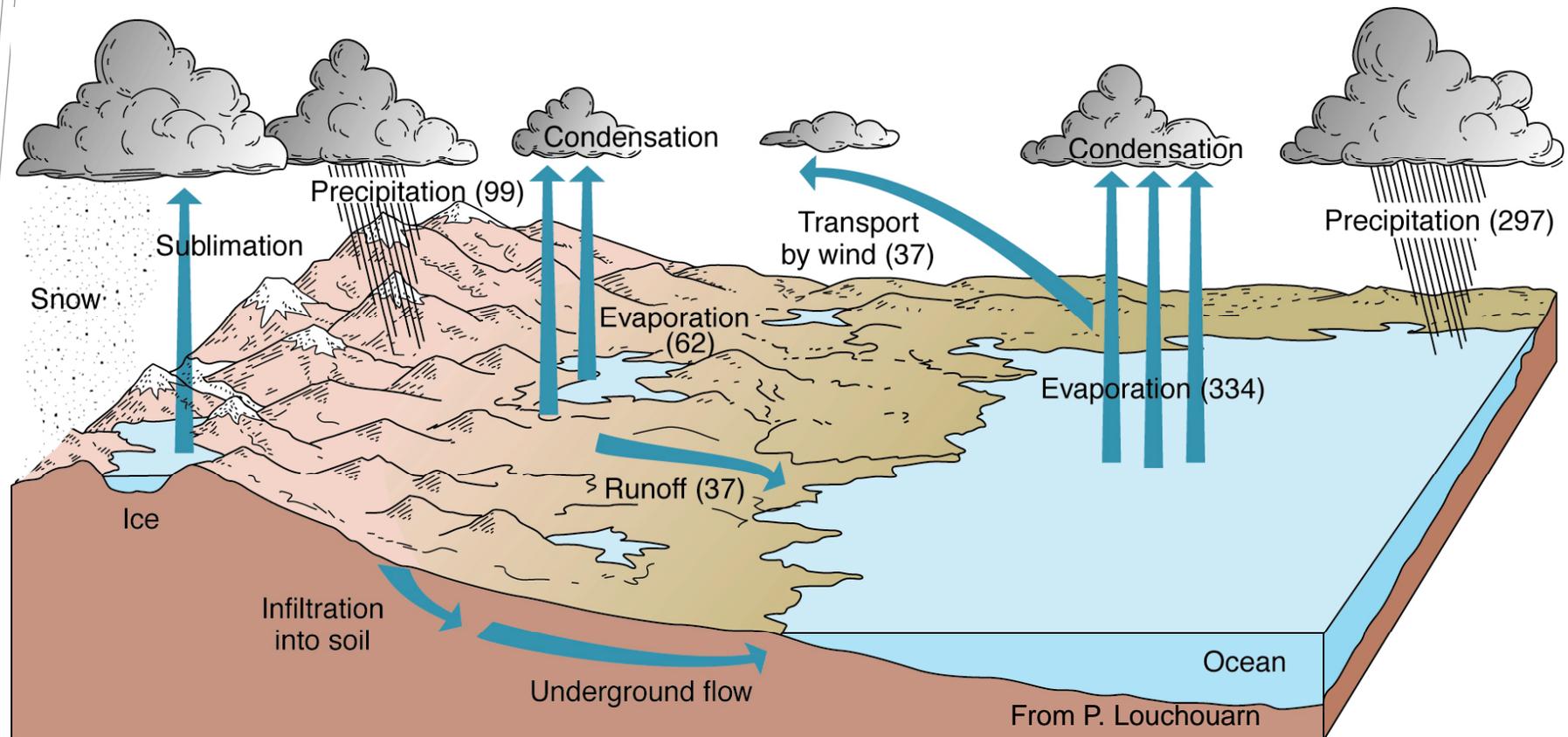
What can a flux station do for you?

Richard Silberstein
CSIRO Land and Water
June 13th, 2011

OZ *Flux*

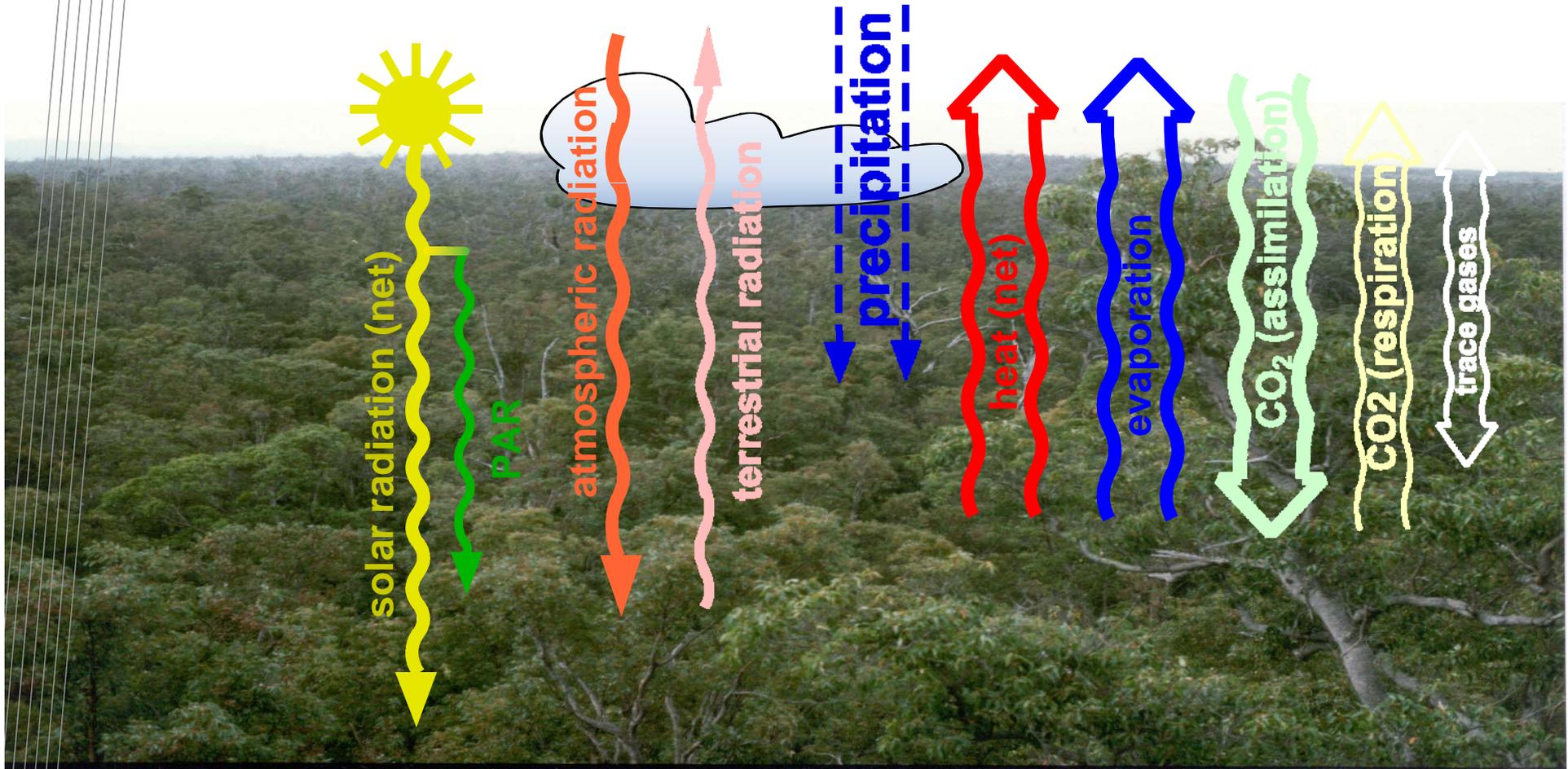


- We are confronted with many environmental and hydrological issues



- That require us to understand the changes in storage and transfers of energy and material, primarily water and carbon

If we are to manage our environment properly we need to understand it, for this we need to measure the water, carbon and other balances



Graphics adapted from Ray Leuning

How do we measure state variables and fluxes, in ecological systems responding to change ...

The critical fluxes of water and carbon, and other trace elements in:

- Vegetation responding to a disturbance, such as fire, logging or disease?
- A bushland regenerating?
- A catchment responding to changes in vegetation or climate?
- An ecological community responding to stress?

How do we measure state variables and fluxes, in ecological systems responding to change ...

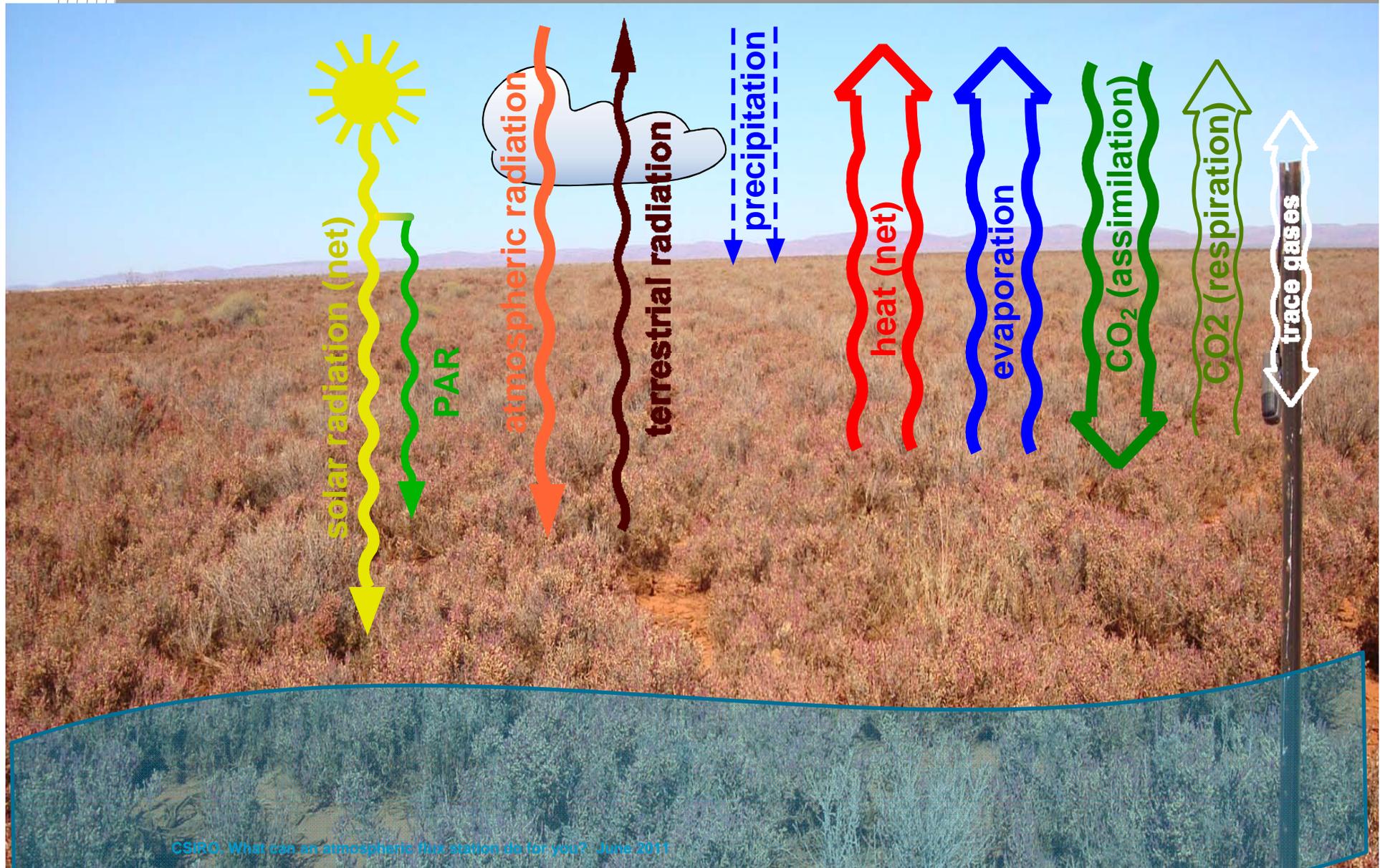
The critical fluxes of water and carbon, and other trace elements



Say we want to compare the water and carbon balance of two patches of bush

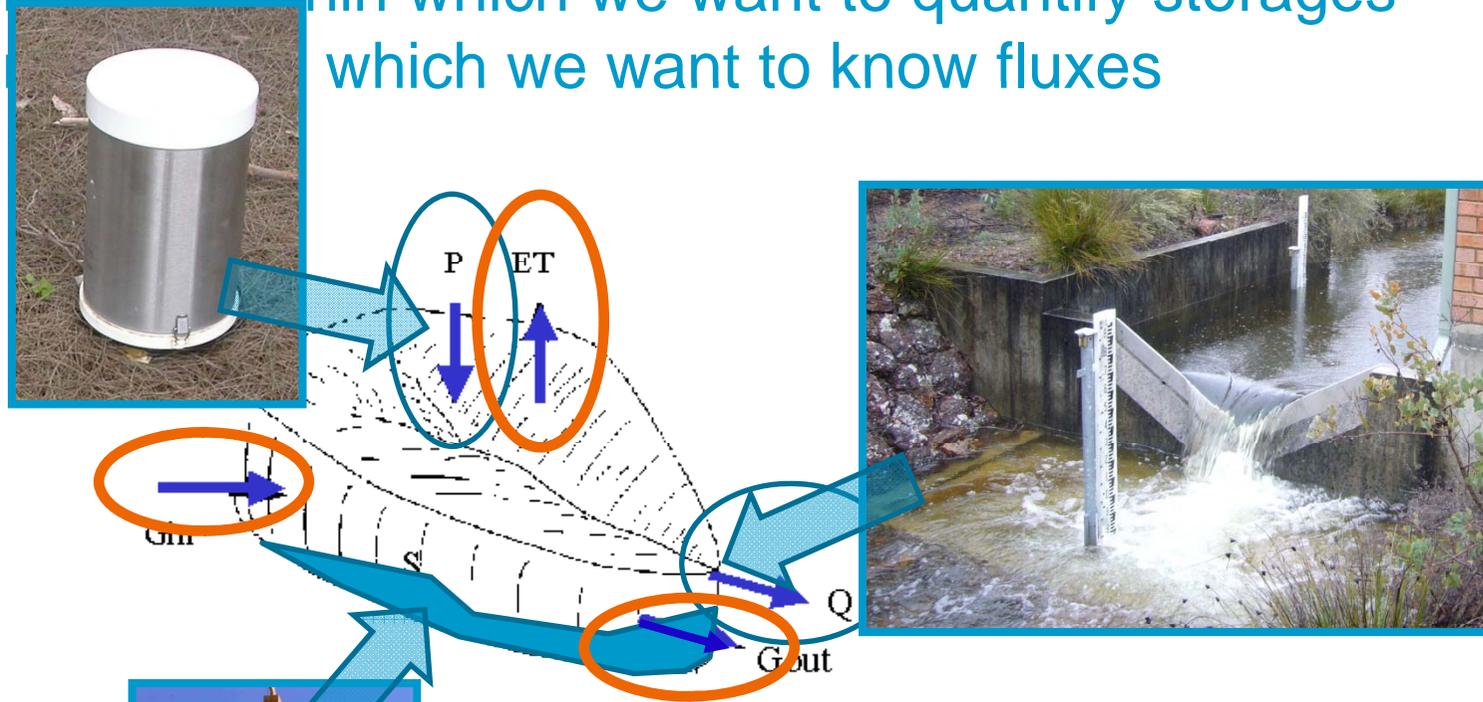


Or determine impact of change in groundwater regime on an ecosystem



Consider a catchment or recharge area as a 'Control Volume'

an entity within which we want to quantify storages
and fluxes

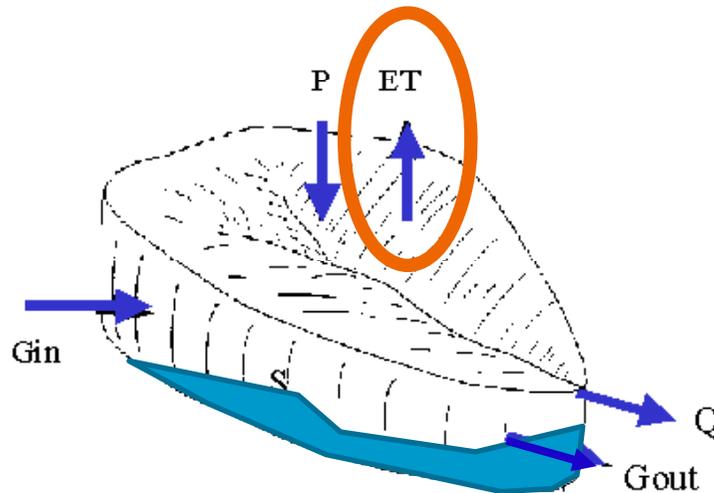


We want to quantify what goes in,
what comes out, and
how much is stored

Some of these are easier, others are harder

Consider a catchment or recharge area as a 'Control Volume'

Evaporation is the 2nd biggest flux
How do we quantify it?

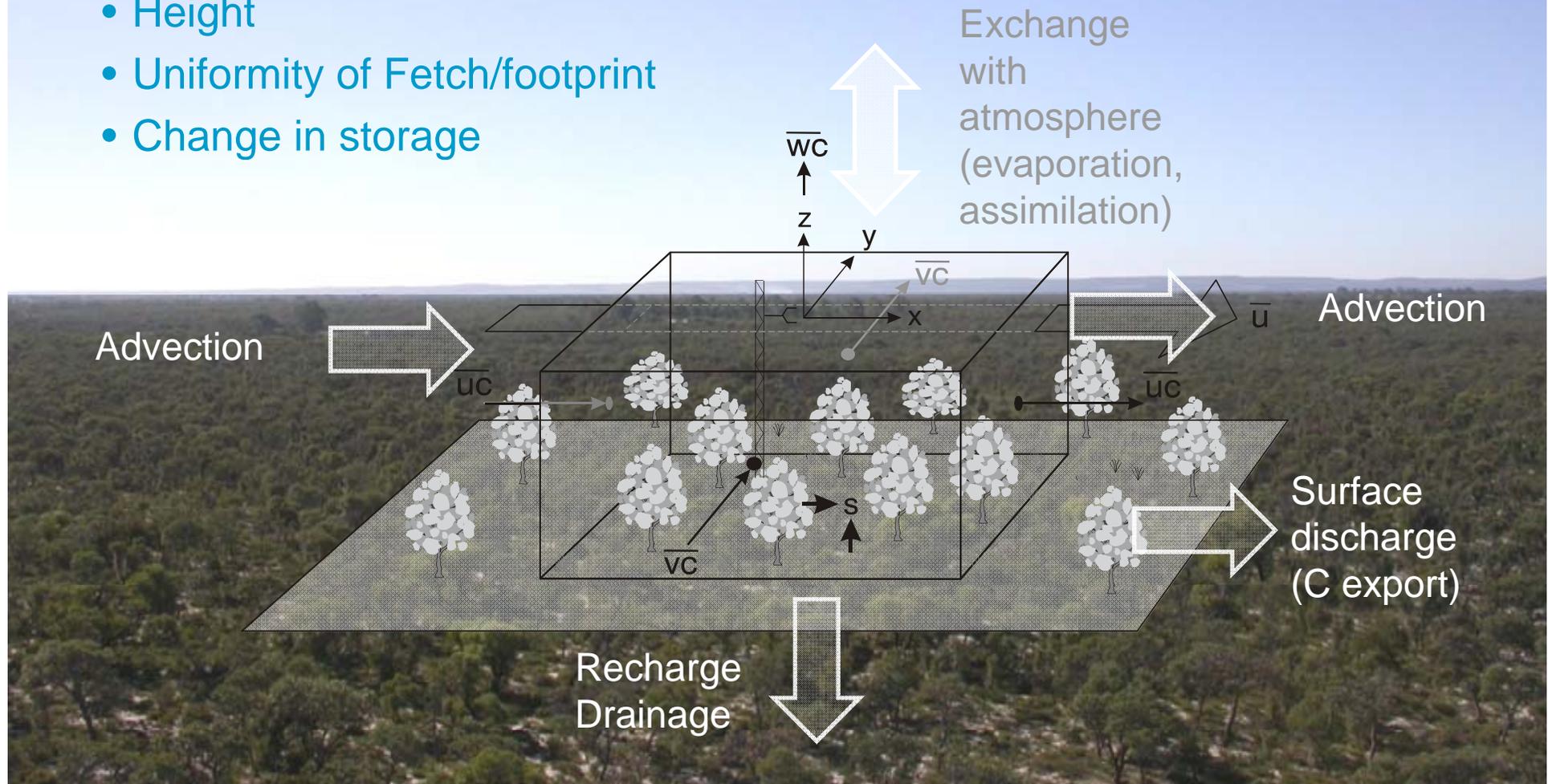


An eddy covariance flux station gives us
a 'stream gauge' for evaporation
and for carbon dioxide and other 'trace' gases

Consider our 'control volume' of atmosphere interacting with the surface in sub-surface

Important considerations:

- Height
- Uniformity of Fetch/footprint
- Change in storage



With suitable instruments we can close the energy, water and carbon balances, & monitor other gases

Net radiation

Average wind

Solar radiation

Digital camera

Plus:

soil moisture,
soil temperature,
groundwater level
soil evaporation
sap flow
soil and water
salinity

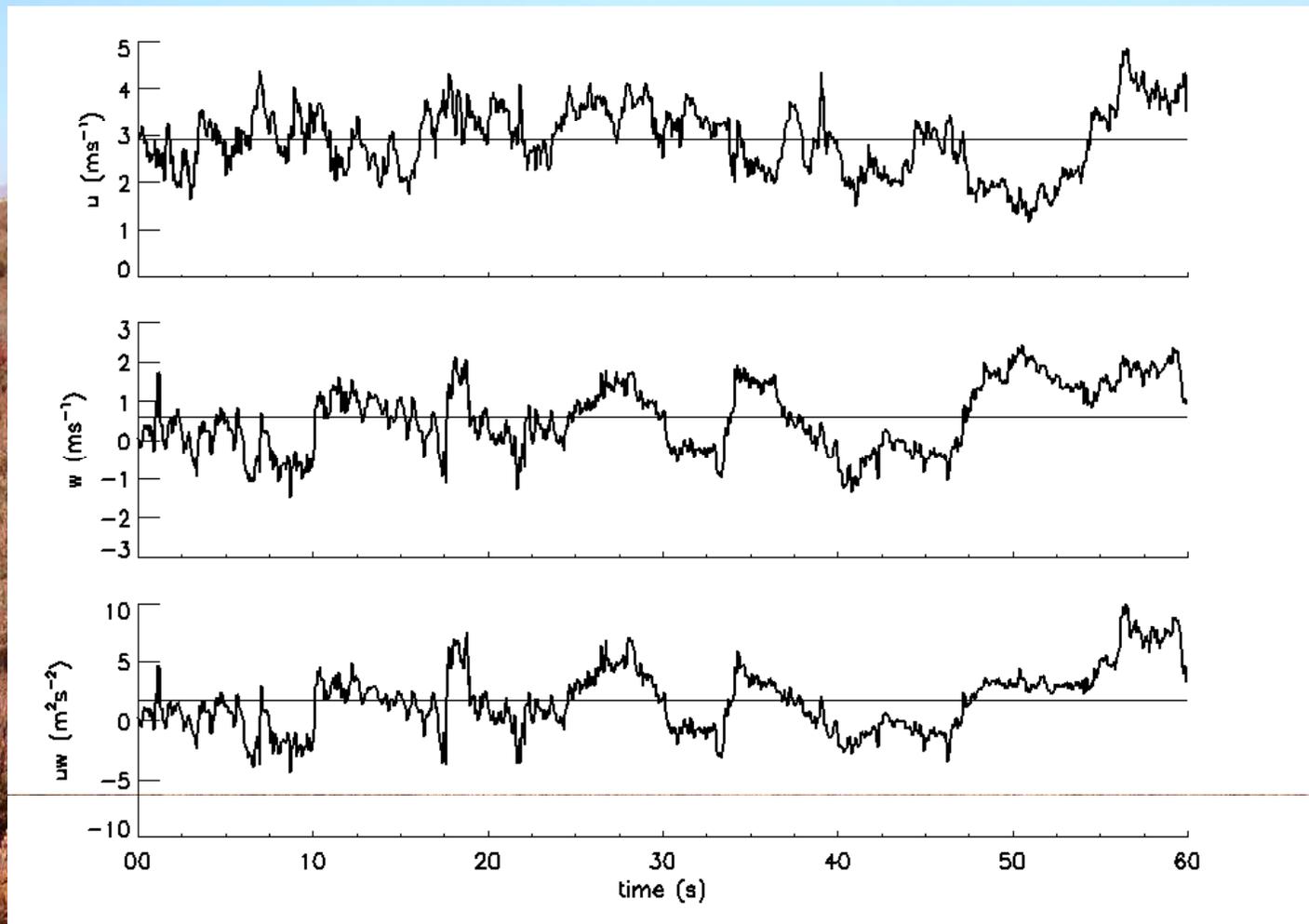


Humidity

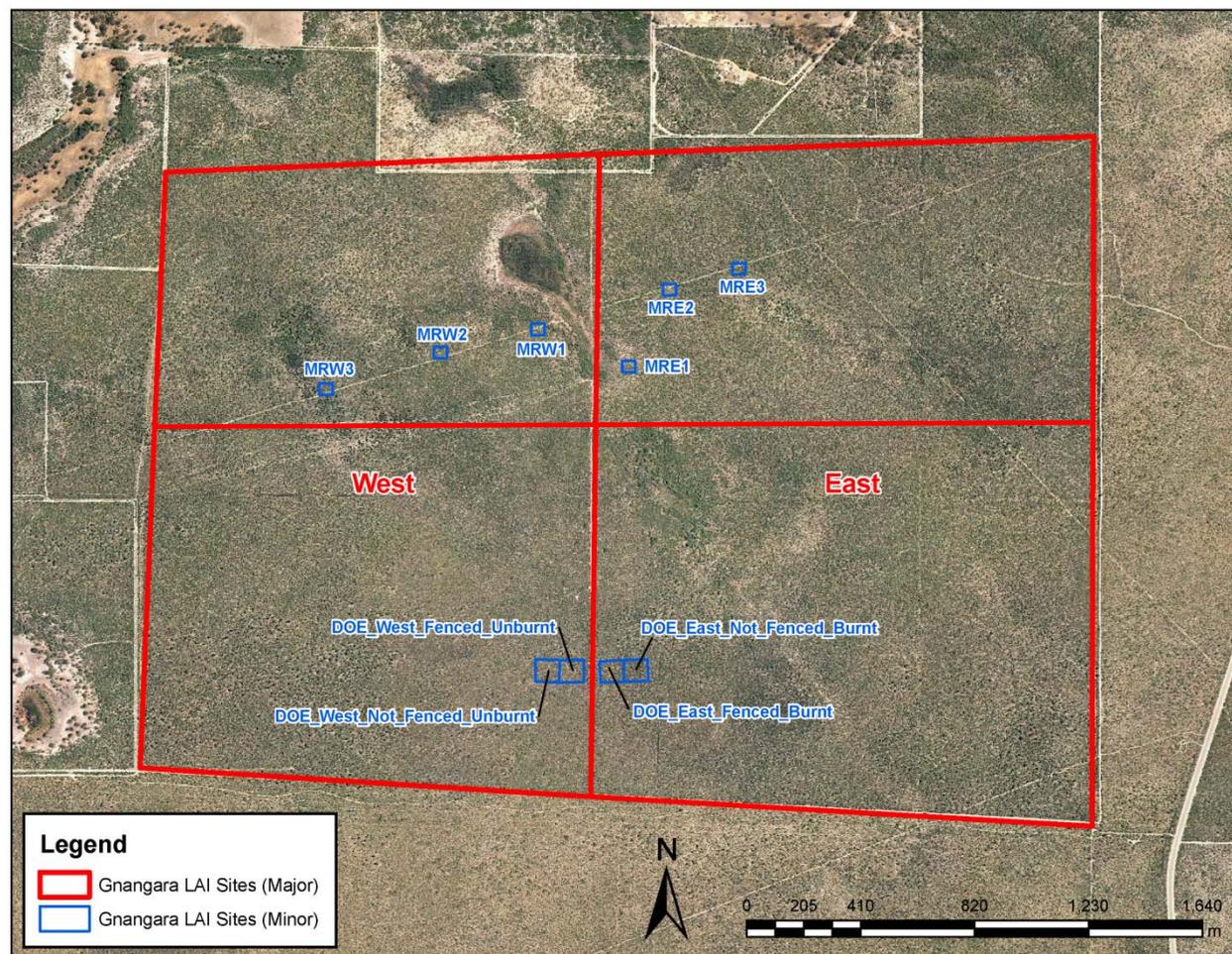
Temperature
and wind
fluctuations

We combine the high frequency measurements to give us Atmosphere - biosphere exchange:

=>The water and carbon balance

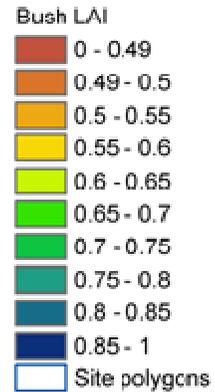


Say we compare two patches of bush
– one subject to an impact, one not



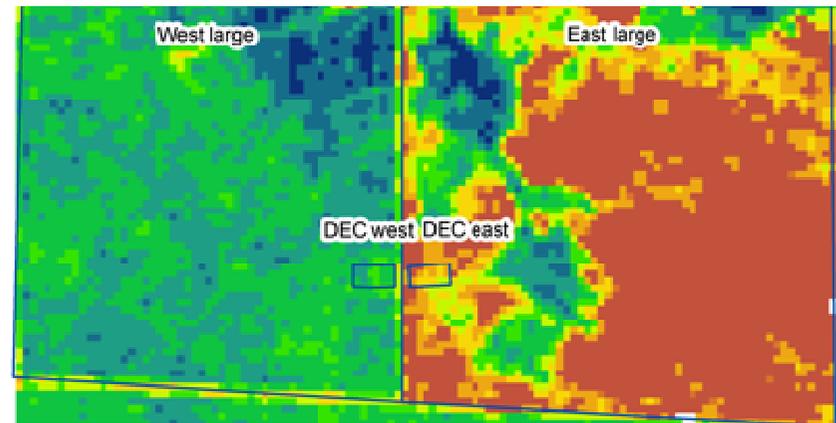
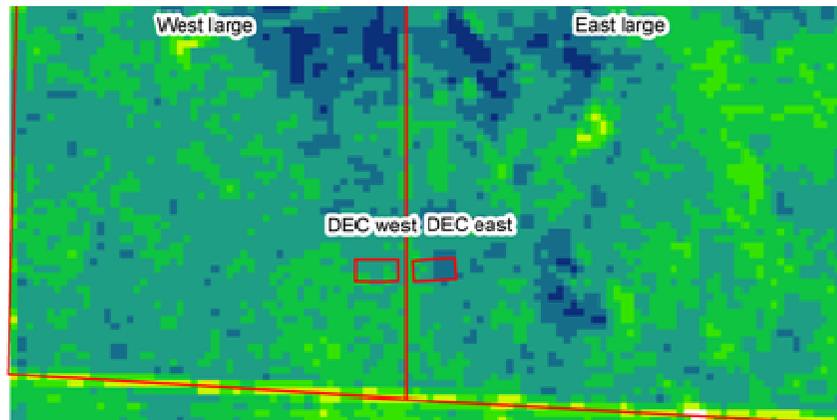
Say we compare two patches of bush – one burned, one not

Leaf Area Index

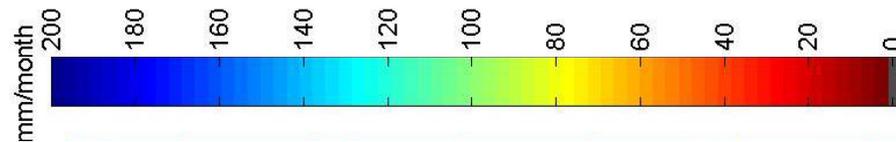
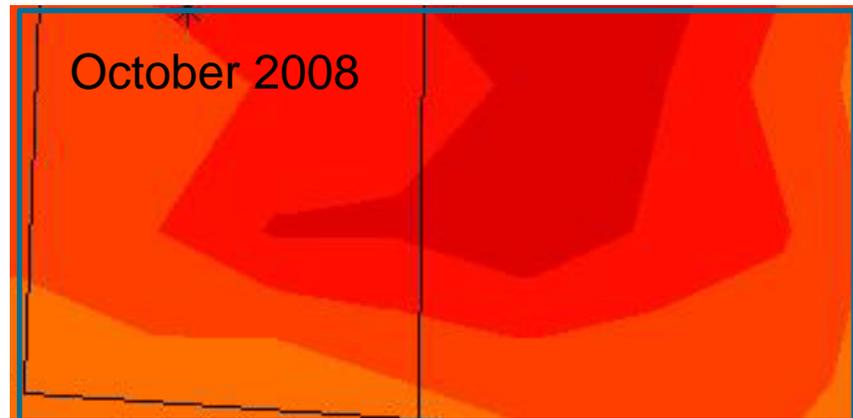
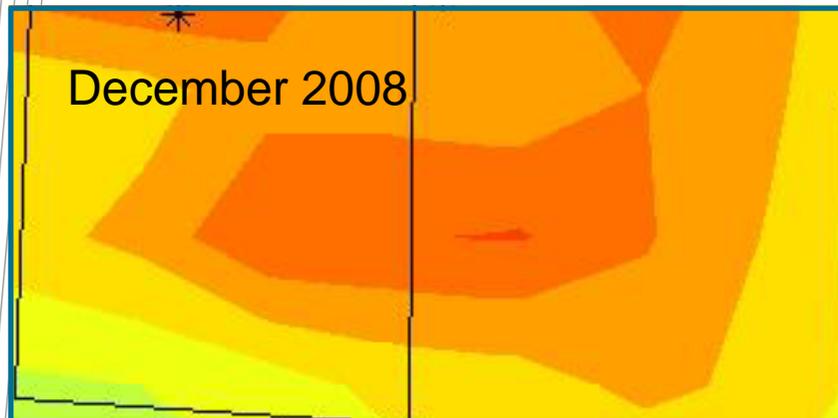
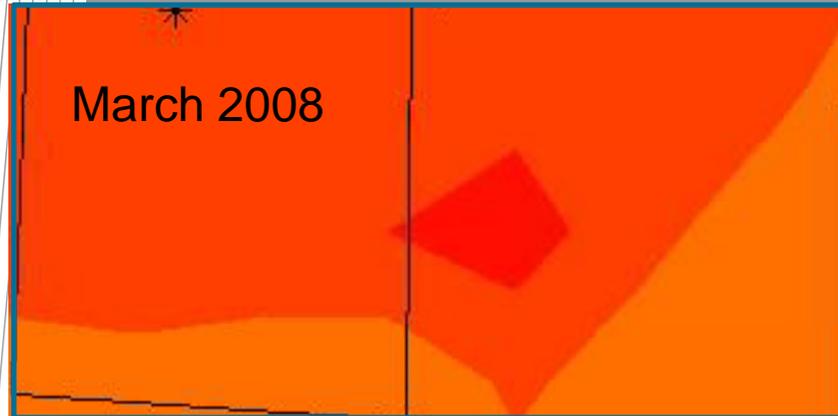


Feb. 2008 – before the fire

Feb. 2009 – after the fire

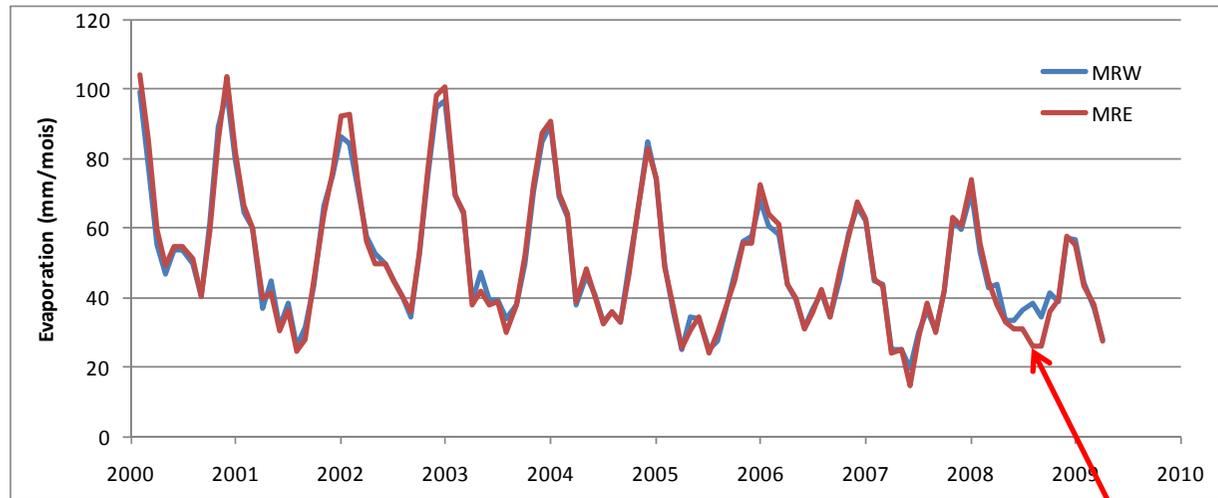


Remote sensing of evaporation by satellite



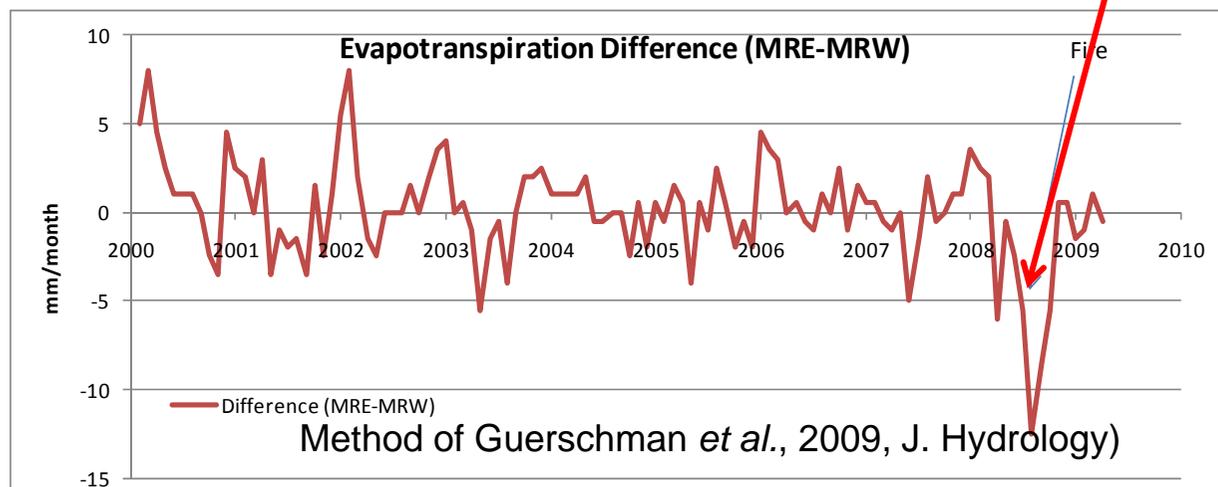
Method of Guerschman et al., 2009, J. Hydrology

Remote sensing of evaporation by satellite

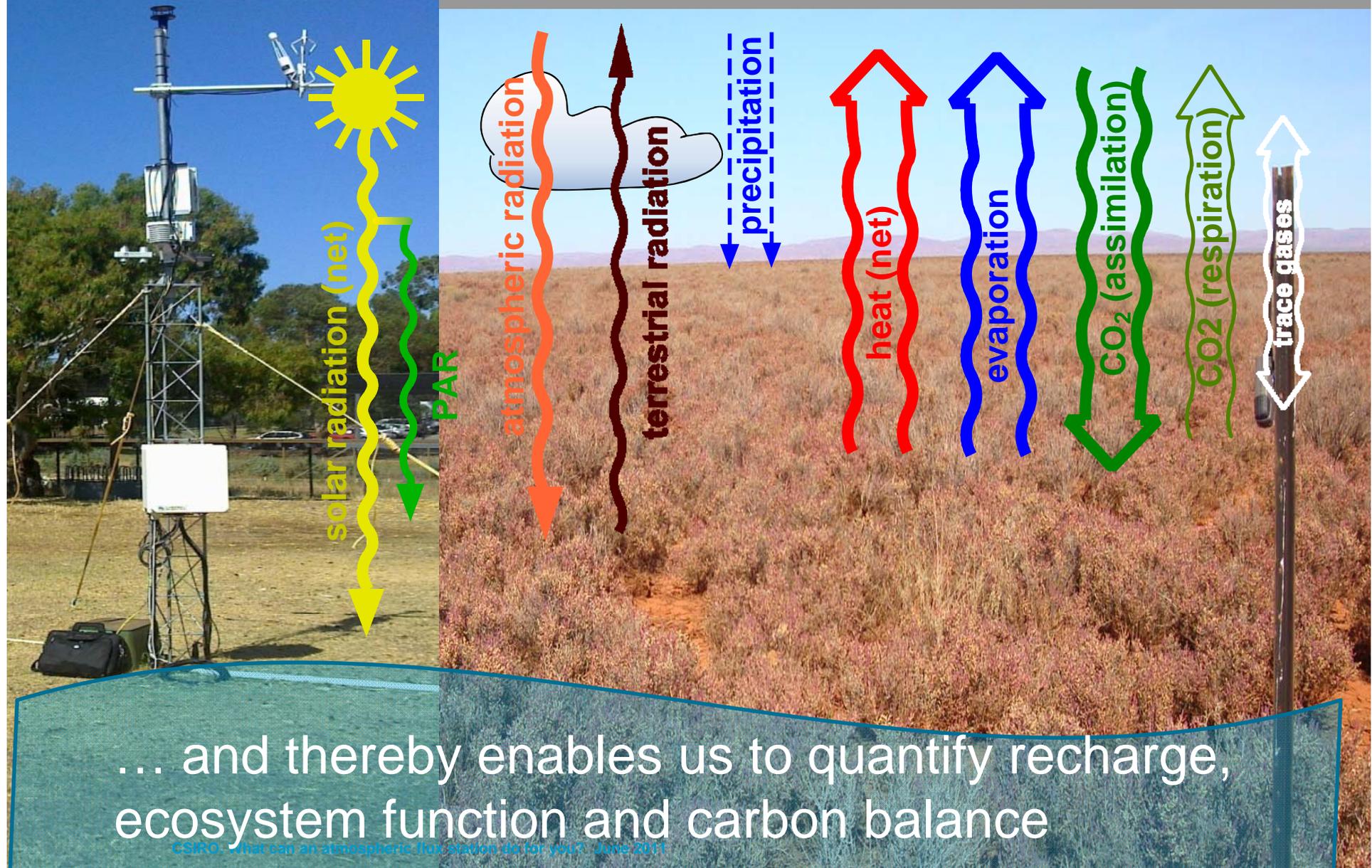


It looks good,
but we need ground truth to confirm and calibrate

The fire



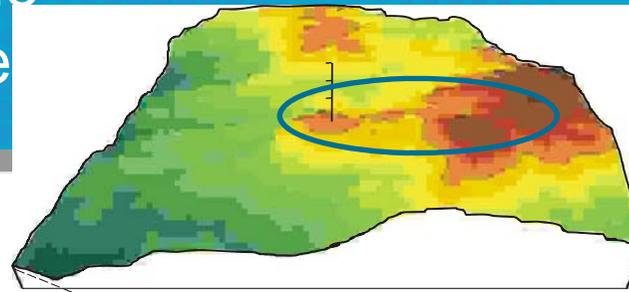
An eddy flux system is the best method we have to measure evaporation and CO₂ fluxes in the 'wild'



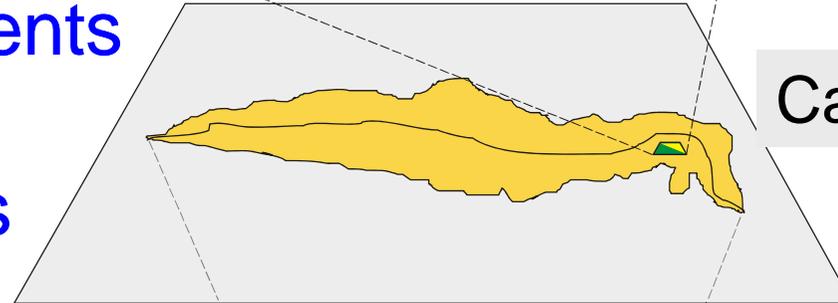
... and thereby enables us to quantify recharge, ecosystem function and carbon balance

A flux station helps scale up to regional and large scales

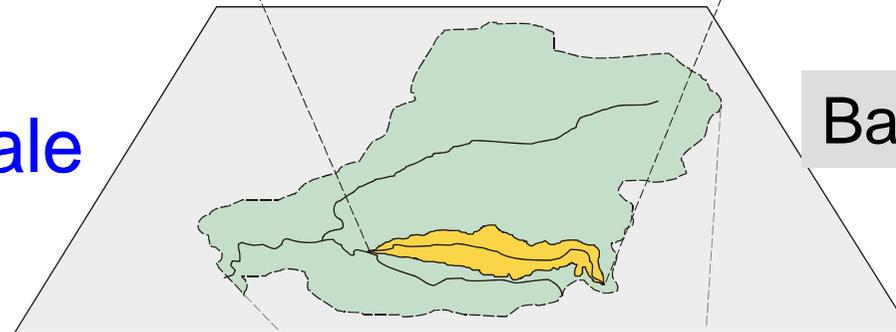
Eddy flux measurements help close water (and carbon) budgets and extend point measurements to ecosystem patch scale



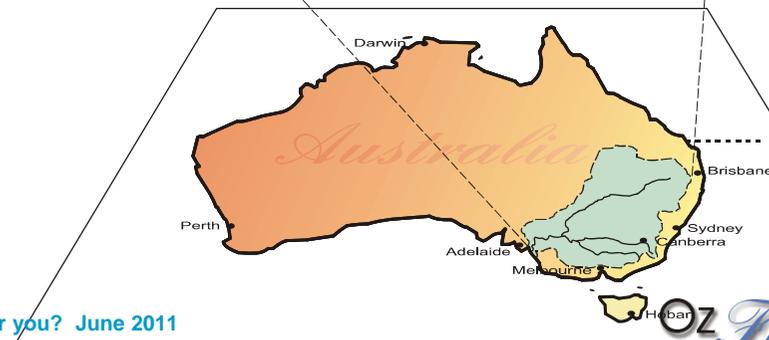
Patch



Catchment



Basin



Continent

Eddy covariance helps close the water and carbon balances

We monitor :

- Incoming and outgoing energy
- Rainfall, evaporation and CO₂ fluxes
- Moisture storage
- Vegetation condition
- These complement ecophysiology measurements
- And help calibration of satellite images

So, what can an eddy flux station do for you?

- Close catchment water balance
- Determine recharge, subtracting ET from rainfall
- Determine whether an ecosystem is in growth or decline => quantifying carbon uptake or release
- Link ecosystem function to water balance
- Place point scale physiology and flux measurements in a large scale context
- Provide 'ground truth' for remote sensing ET models



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Thank you

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