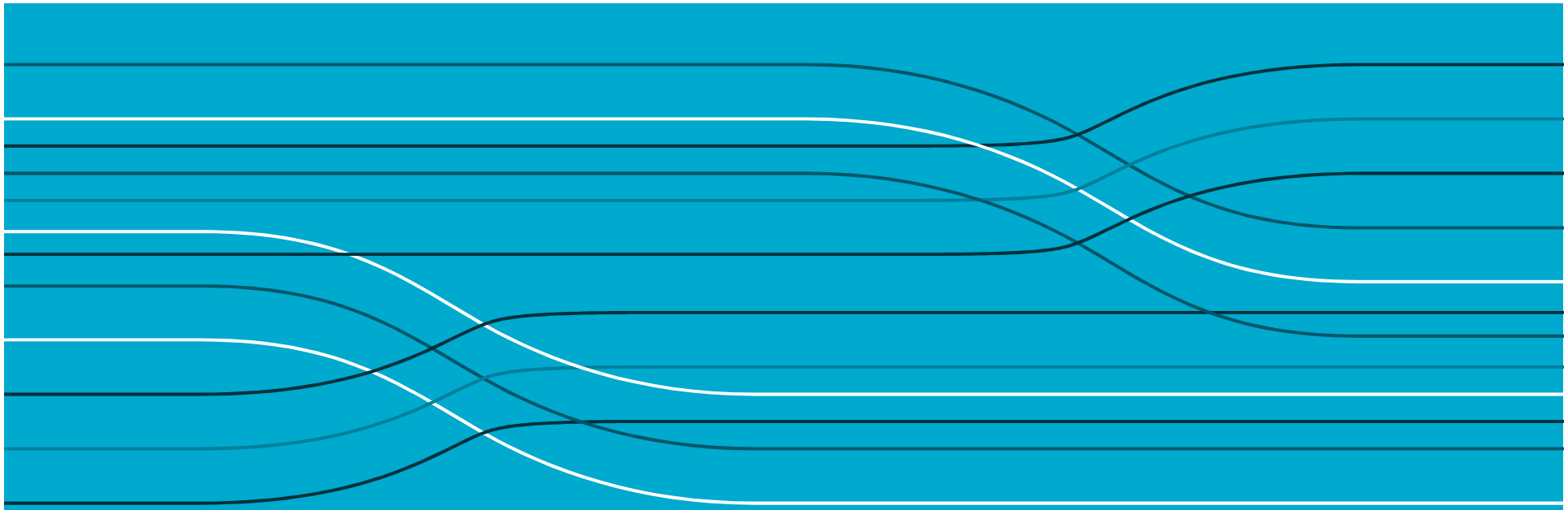

Modelling coupled drought response and root water uptake in the CABLE land surface scheme

Vanessa Haverd and Cathy Trudinger

2 December 2015

OCEANS AND ATMOSPHERES
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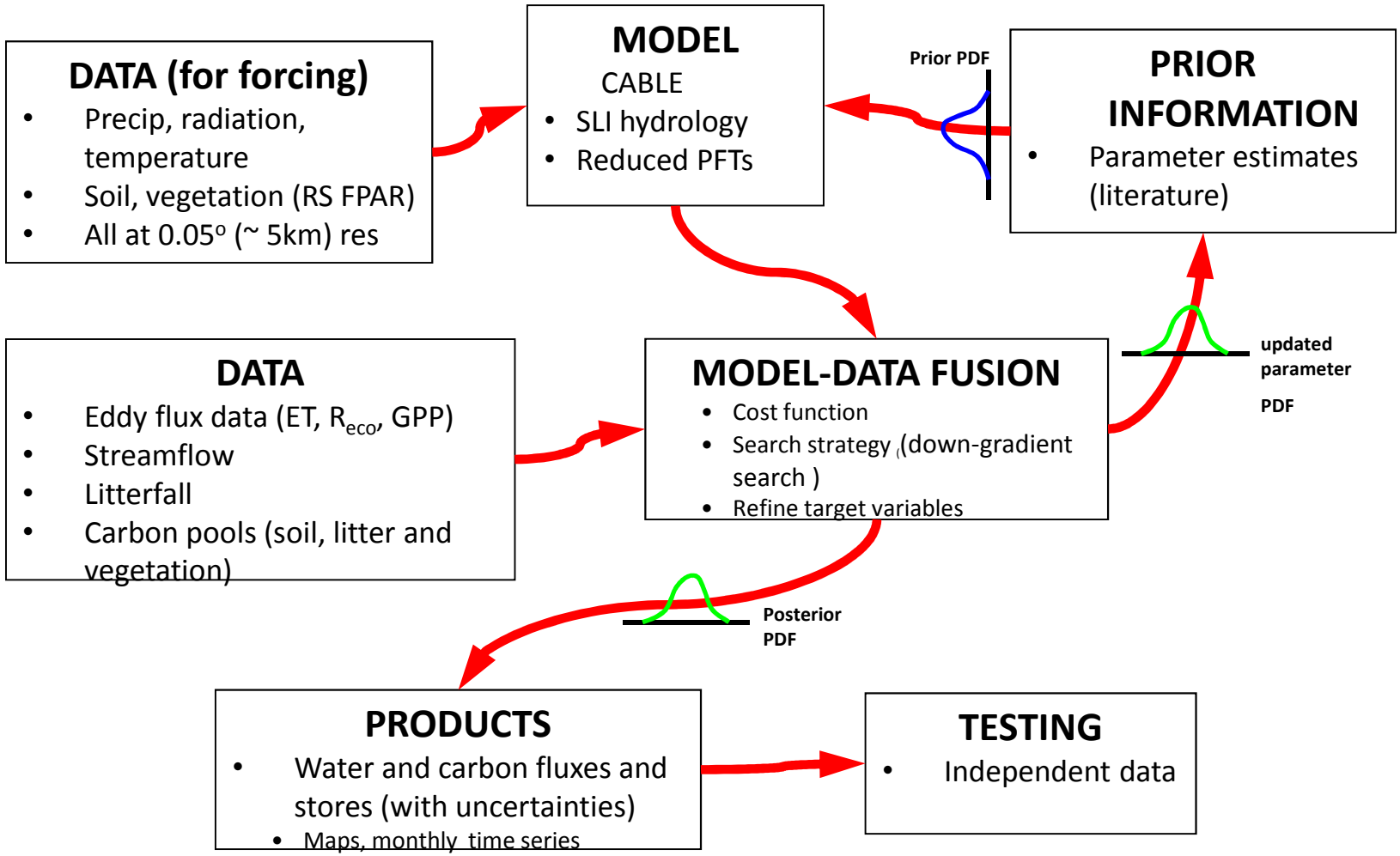
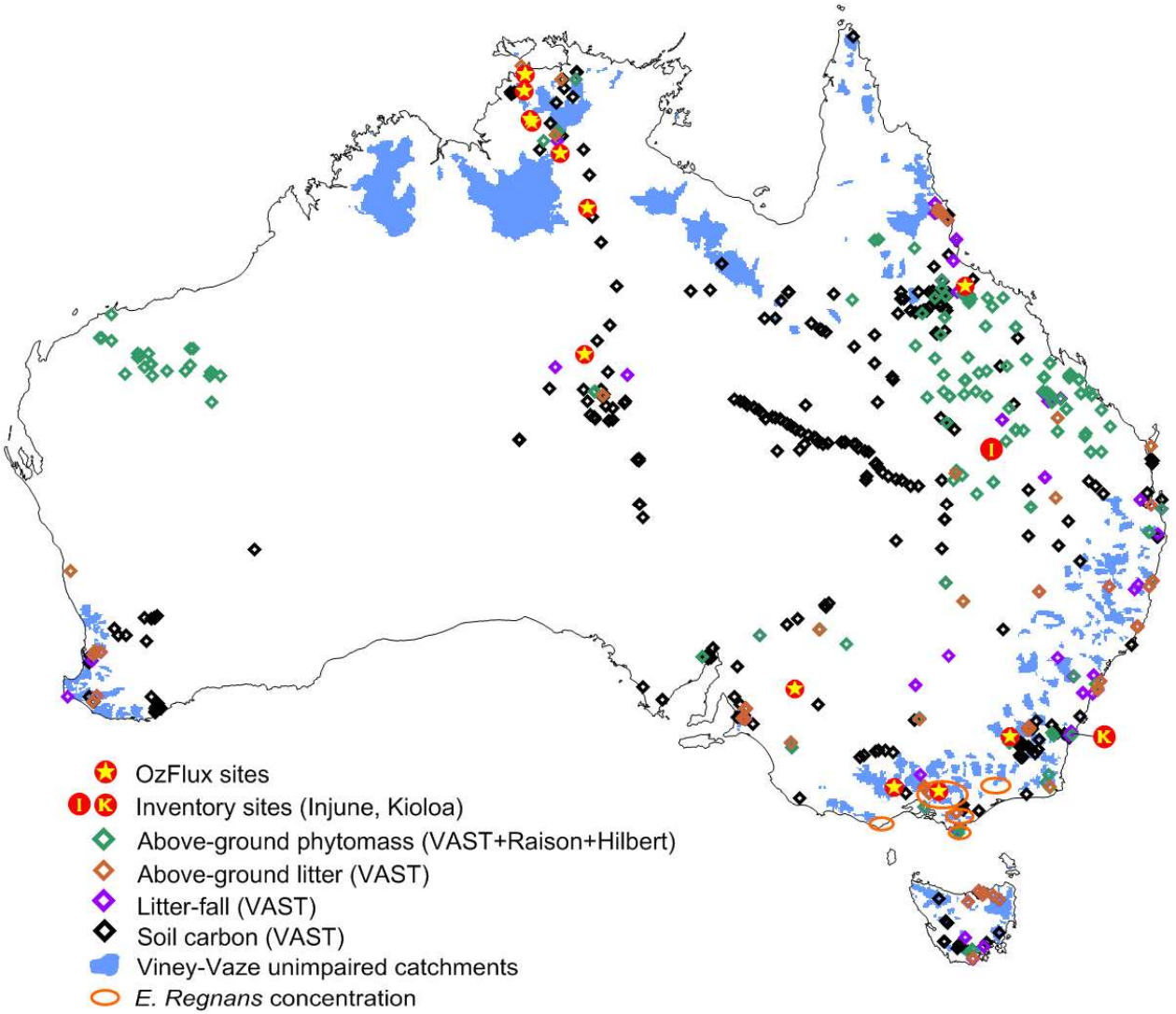
Multiple constraints approach (water and carbon)



Multiple Data Types for CABLE constraint and evaluation



Haverd *et al.*, (2013).

Example parameterisation of root water uptake and drought response (Haverd et al. 2013)

$$r_{ex,j} = \alpha\left(\theta_j\right) g_j q_{trans} \quad (1)$$

$$\alpha_1\left(\theta\right) = \begin{cases} \left(\dfrac{\theta - \theta_w}{\theta_s}\right)^{\gamma/\left(\theta-\theta_w\right)} & ,\left(\theta-\theta_w\right) > 0 \\ 0 & ,\left(\theta-\theta_w\right) \le 0 \end{cases} \quad (2)$$

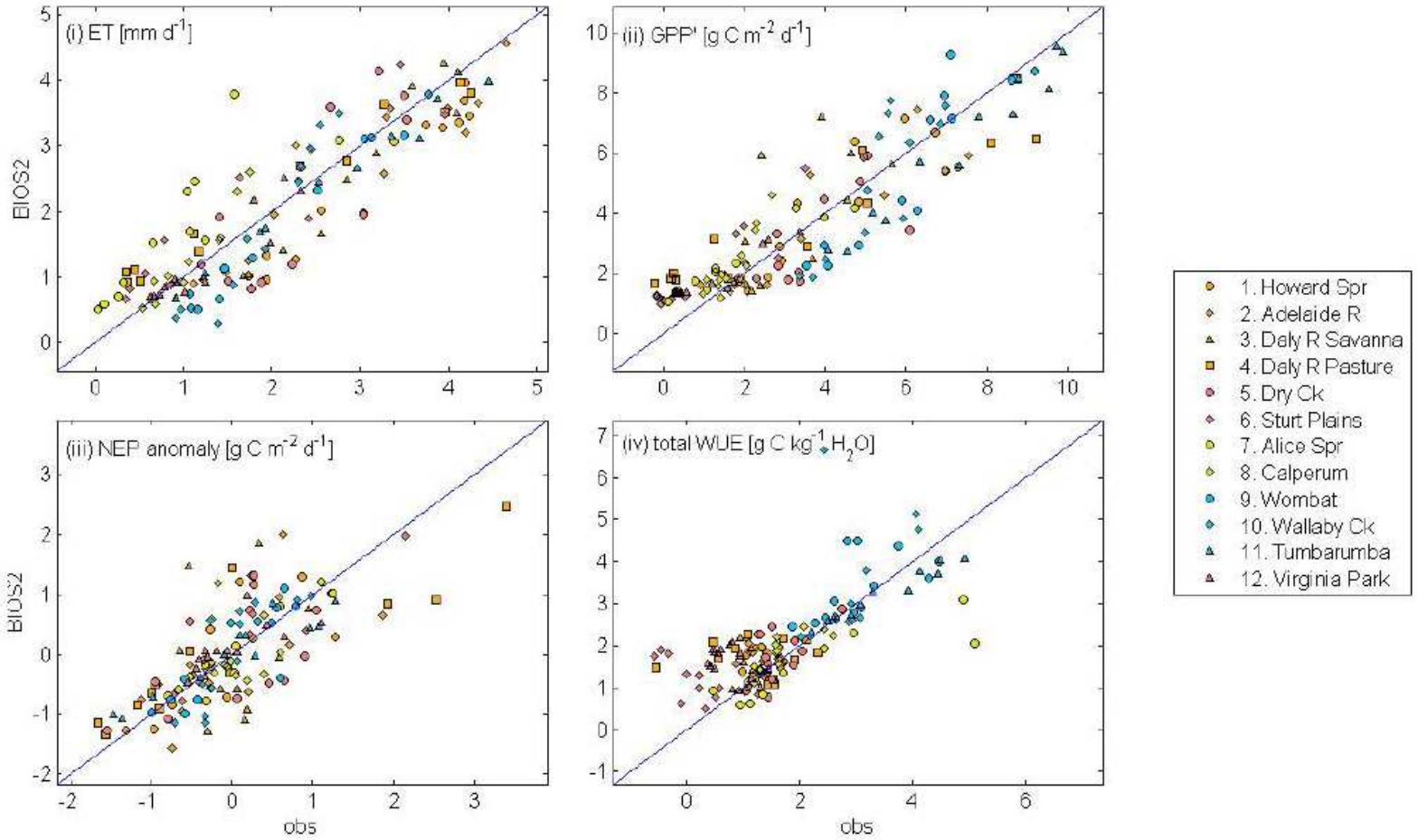
$$\alpha_j = \frac{\alpha_1\left(\theta_j\right)}{\sum_k \alpha_1\left(\theta_k\right) g_k} \quad (3)$$

!

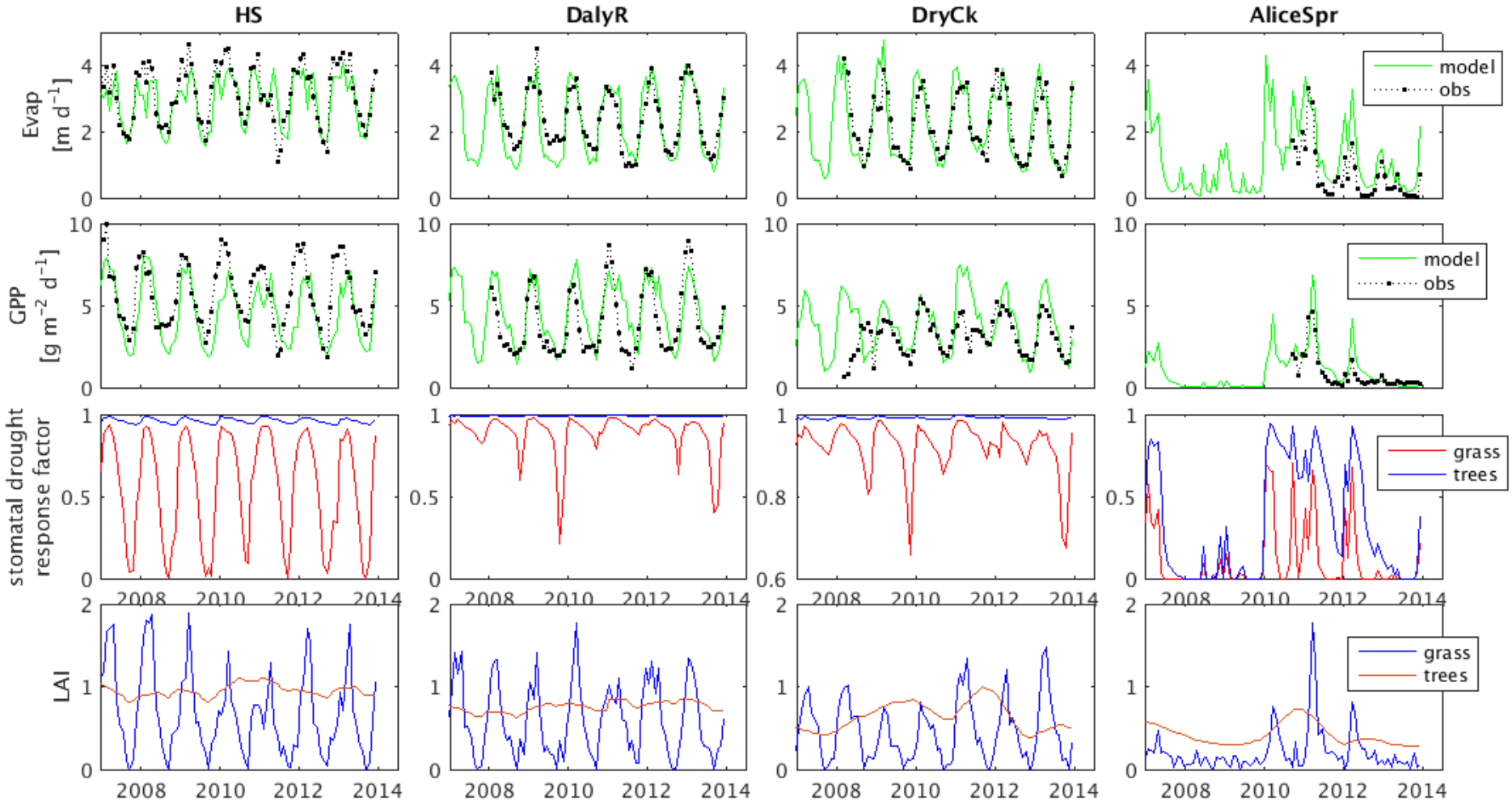
$$f_{w,soil} = \max\left\{\alpha_1\left(\theta_j\right)\delta_j, j = 1,n\right\} \quad (4)$$

1. Root water extraction (rex) proportional to uptake efficiency (α), root density (g), total transpiration (q_{trans})
2. Uptake efficiency: increasing function of soil moisture above wilting point (Lai and Katul 2000)
3. Actual uptake efficiency scaled such that total extraction equals transpiration
4. Drought response depends on soil moisture of wettest accessible layer
   - maximal utilization of available water resources
   - Compensates for assumption of static root profile.

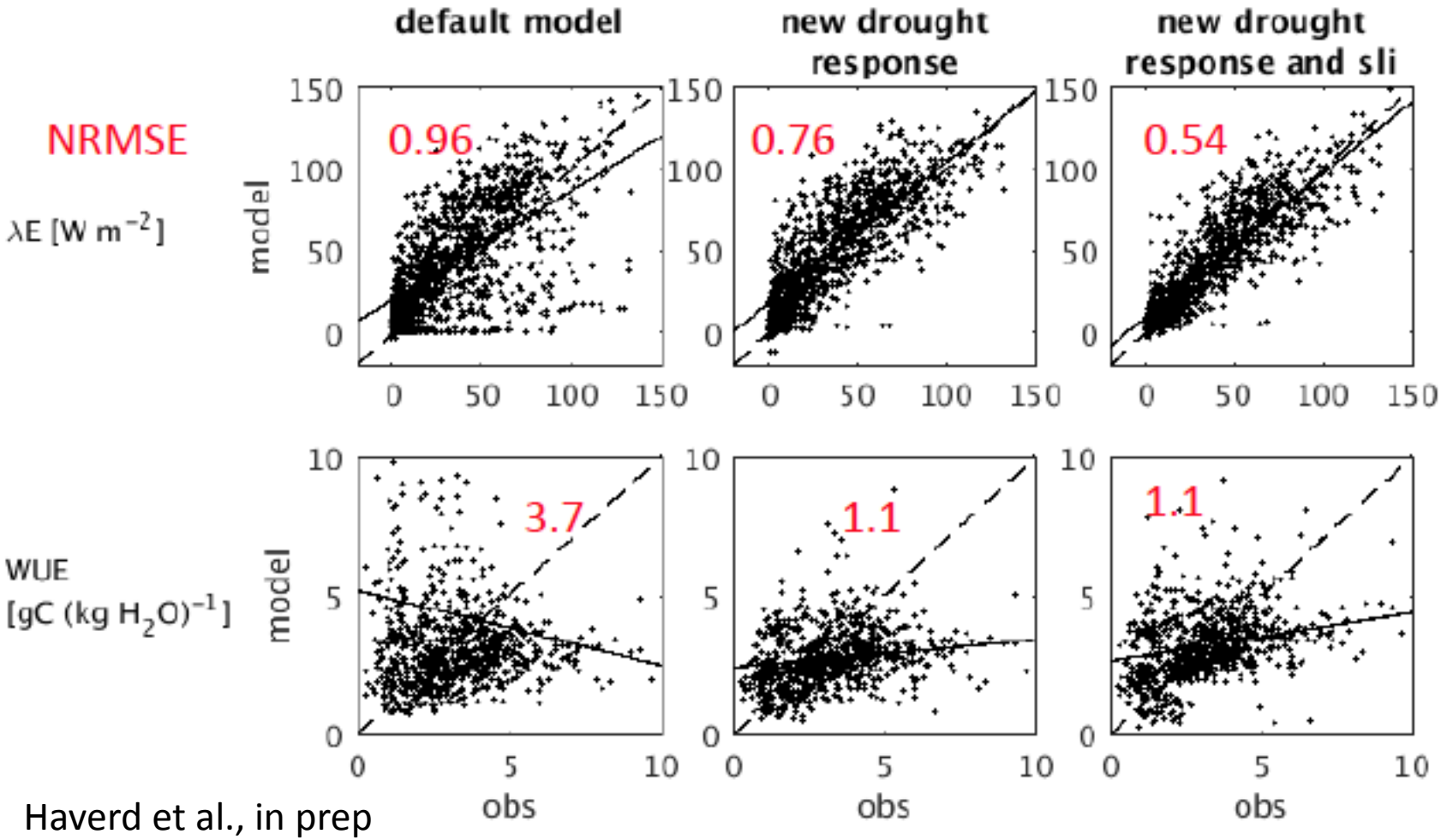
OzFlux Data confirm CABLE (BIOS2) response to seasonal drought: monthly scattergrams



Haverd, V. *et al. Biogeosciences* 10, 2011-2040, (2013)

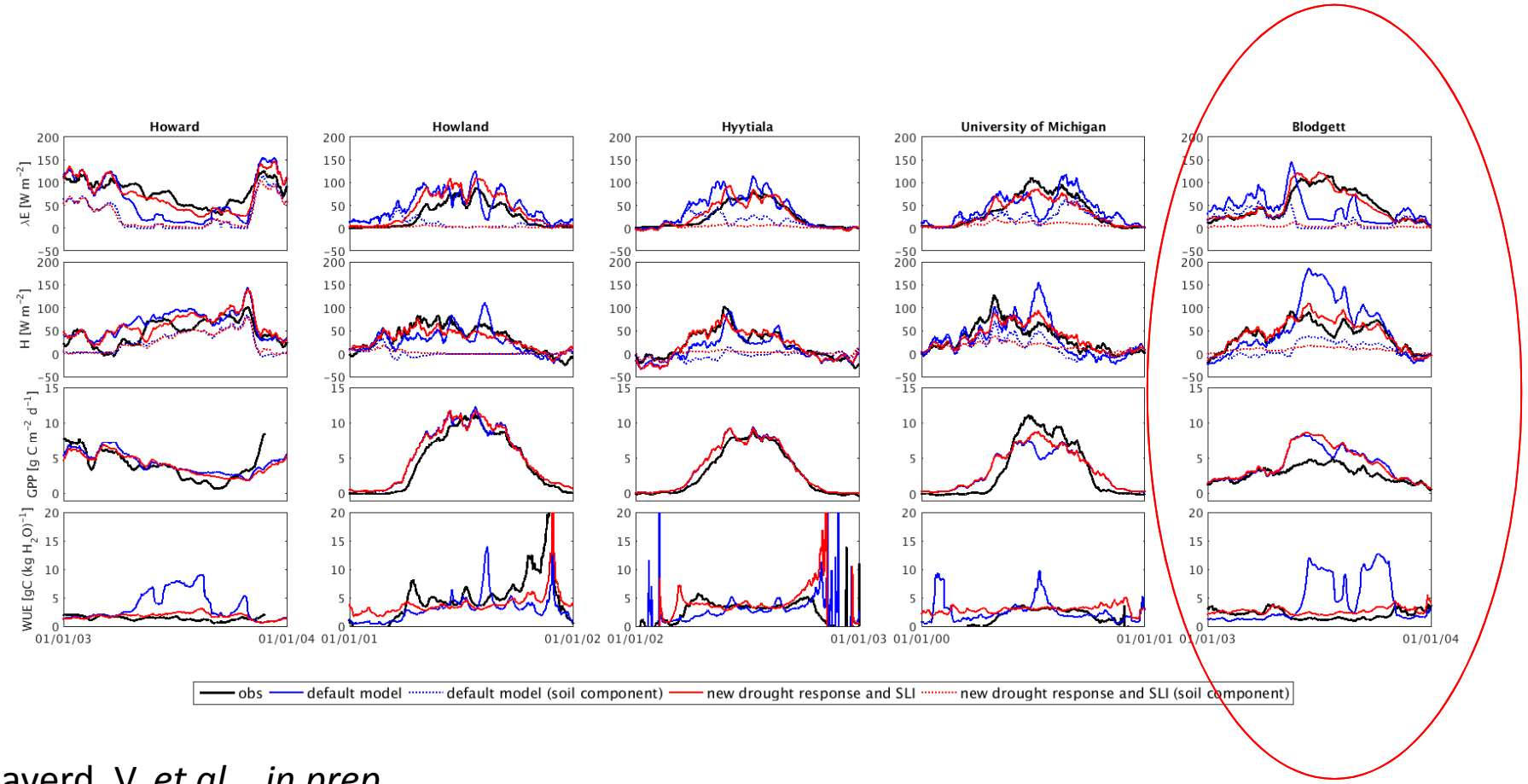

HS
DalyR
DryCk
AliceSpr
Evap [m d^{-1}]
GPP [g m^{-2} d^{-1}]
stomatal drought response factor
LAI
model
obs
grass
trees
2008
2010
2012
2014

Alternate drought response and SLI hydrology improve CABLE ET predictions at global Fluxnet sites



Haverd et al., in prep

Alternate drought response and SLI hydrology improve CABLE ET predictions at global Fluxnet sites: examples



Haverd, V. *et al. , in prep*

Summary

- The only state variable accessible to CABLE drought response is soil moisture (no information on root carbon or root conductance profile)
- A static root profile is assumed
- In the absence of explicit dynamic rooting, a parsimonious parameterisation of deep water access is desirable.
- Our parameterisation compensates for lack of explicit root conductance profile by simulating maximal utilization of available water resources (via stomatal drought response dependence on soil moisture in wettest accessible soil layer).

Thank you

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