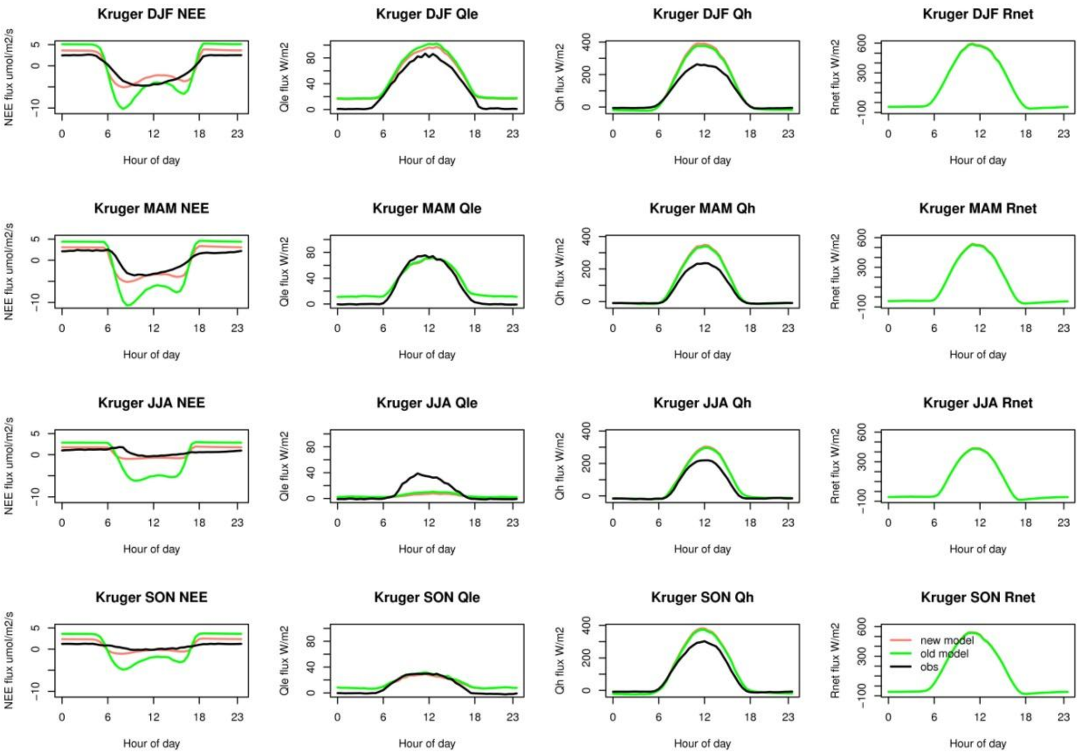
Changes to CABLE for Dry Conditions

An update to constrain photosynthesis flux under restricted availability of soil moisture (reported by Vanessa Haverd).

Offline tests using forcing data from PALS at selected sites revealed that CABLE produced an excessive photosynthesis flux in two arid sites in South Africa: Mopane and Kruger. Both sites are covered with savannah which in CABLE is represented as C4 grass and deciduous broadleaf trees tiles.

To correct this the minimum stomatal conductance was modified with soil water availability factor 'fwsoil' which scaled down the photosynthesis flux.

Example. Kruger.



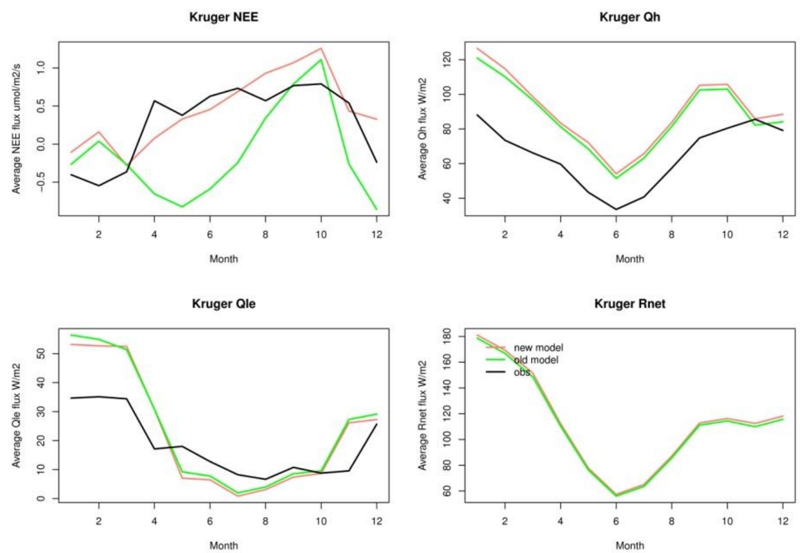
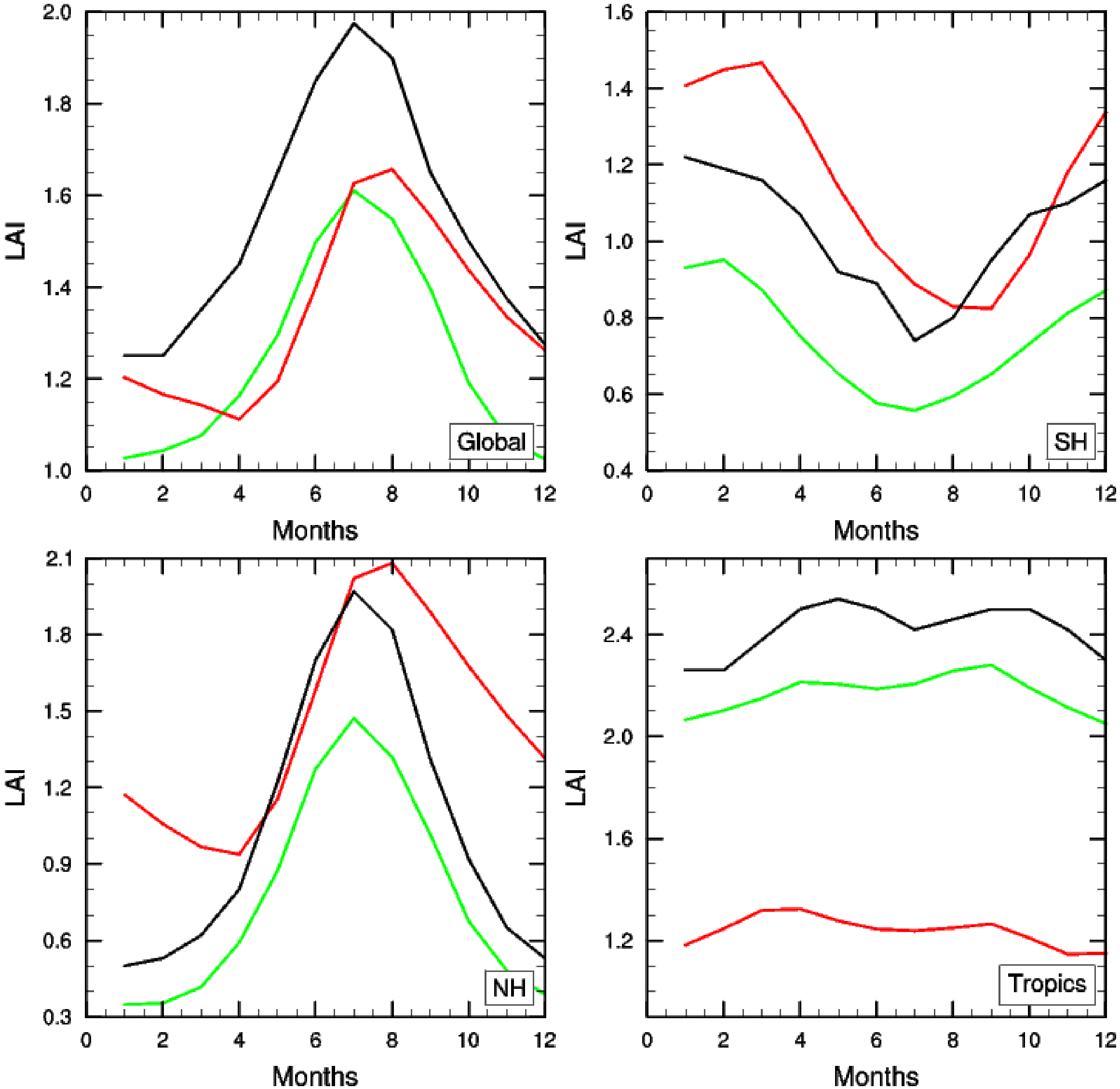


Fig 1 (top). Diurnal cycles of NEE, Qle, Qh and Rnet during DJF, MAM, JJA and SON season at the Kruger station. The new results are in red, old in green and the observations in black.

Fig 2 (bottom). Mean monthly fluxes of NEE, Qle, Qh and Rnet at the Kruger station. The new results are in red, old in green and the observations in black.

L. Stevens, E. Kowalczyk.
Ticket #24

Leaf Area Index



Mean LAI for vegetated areas only (1988-1997)

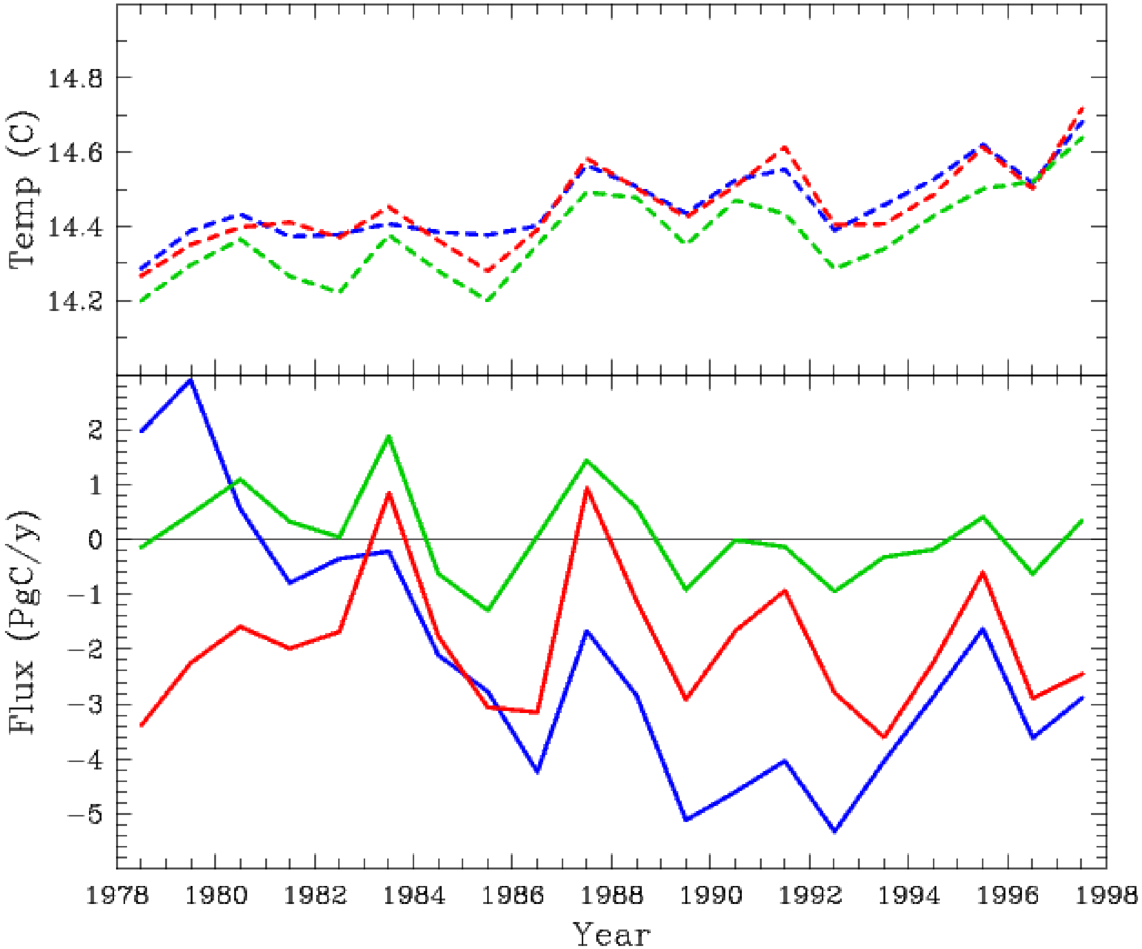
Southern Hemisphere (SH) 20S-90S

Northern Hemisphere (NH) 20N-90N

black – observations (1986-2005)
green – prescribed LAI
red – prognostic LAI

T. Ziehn
Ticket #26

Global carbon fluxes

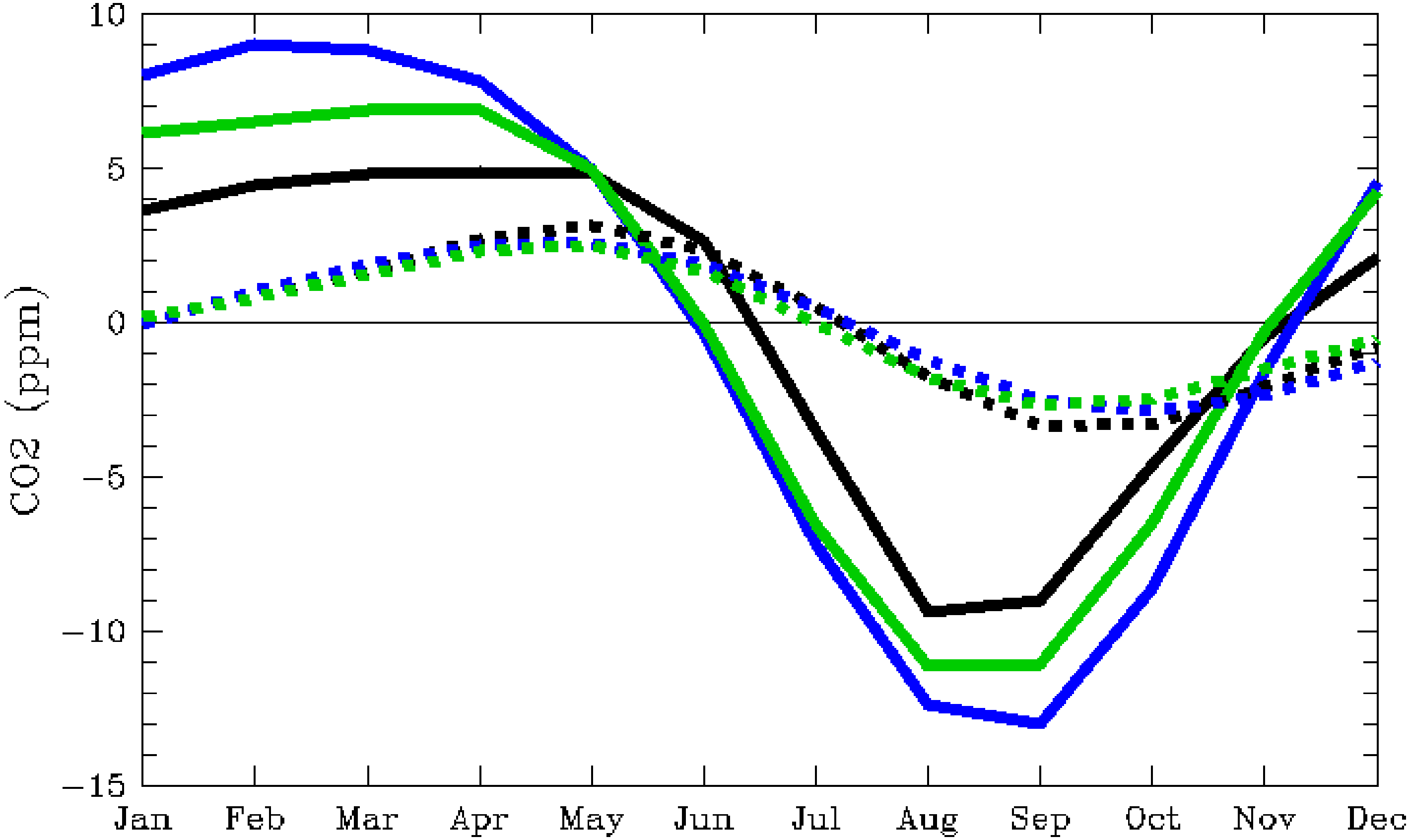


Temperature and Net Ecosystem Exchange for three atmosphere-only ACCESS simulations

green – prescribed LAI
red – prognostic LAI
blue – nutrient limitation

T. Ziehn, L. Stevens
Ticket #28

Atmospheric CO_2 concentrations

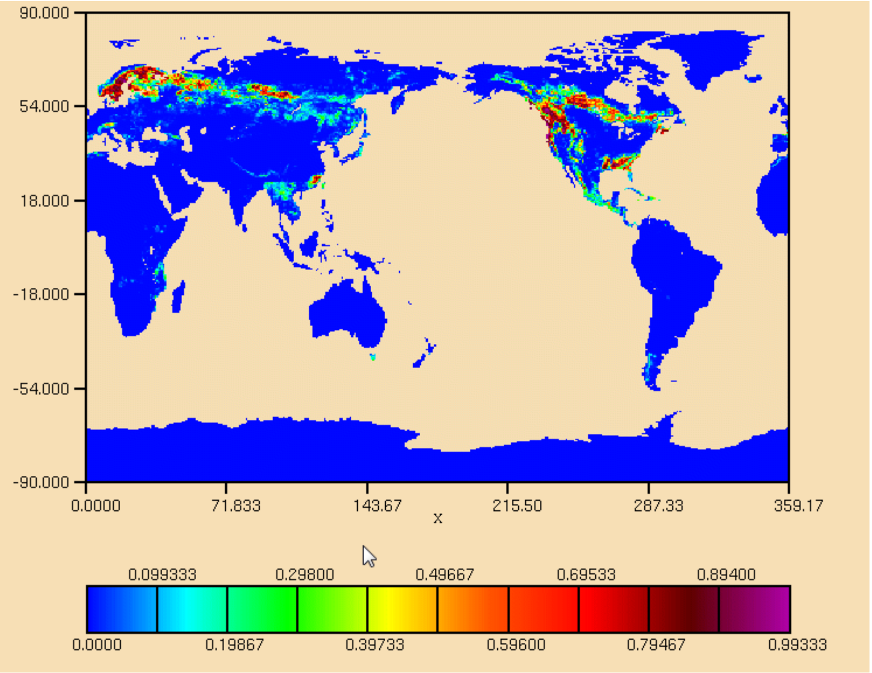


Seasonal cycle of CO_2 concentrations at Mauna Loa (dotted lines) and Alert (solid lines)
Black: observations; Green: prescribed LAI; Blue: nutrient limitation

Towards high-resolution CABLE in ACCESS

Peter Dobrohotoff and Marcus Thatcher

- Motivation: Support RCM with high-resolution global simulations
- N216, N320, N512, N1024 (??)
- Developing tools to create required CABLE ancillary files
- High-resolution vegetation datasets based on GLCC and MODIS data tested at N96
  - Note definition of permanent ice
- Next: Test at N216
- Which other input datasets would be useful for the CABLE community? Recommendations?



N216 Evergreen Needleleaf Forest

7 Aug 2013

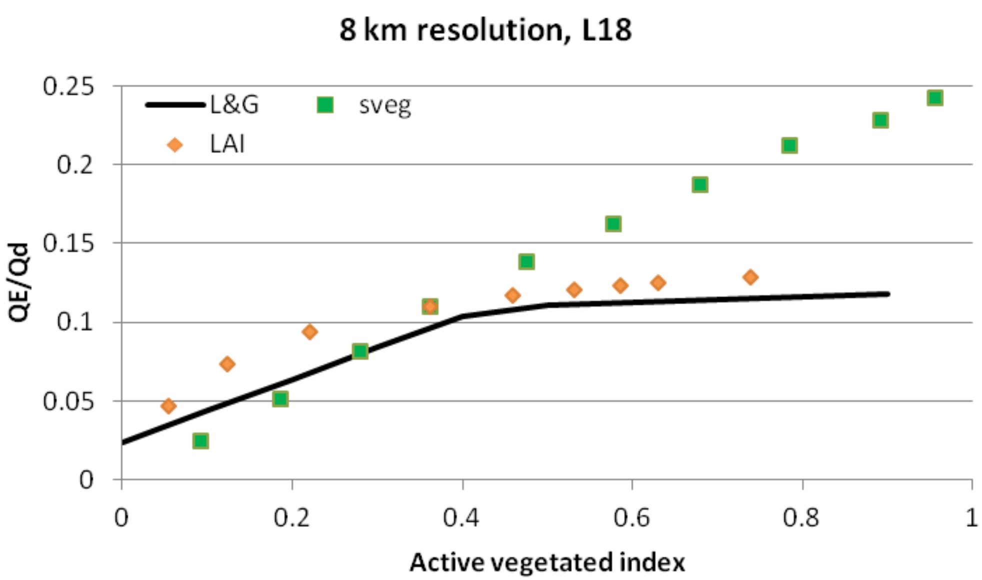
Modeling urban environments

Marcus Thatcher

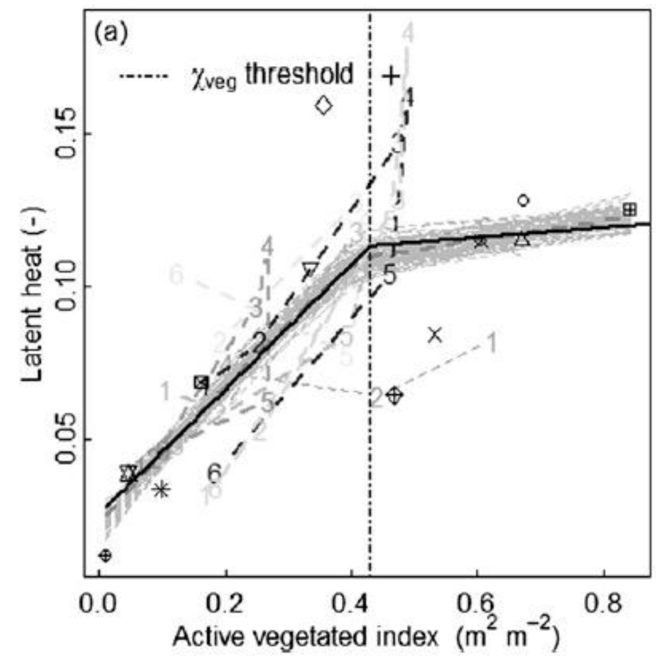
- Using Active Vegetation Fraction (Loridan and Grimmond, 2012) to test urban vegetation scheme. Figure shows the Latent heat flux (QE) divided by the net downwelling radiation (Qd) as a function of the Active Vegetation Index (A_{veg})

$$A_{veg} = LAI_{tree} P_{tree} + LAI_{grass} P_{grass}$$

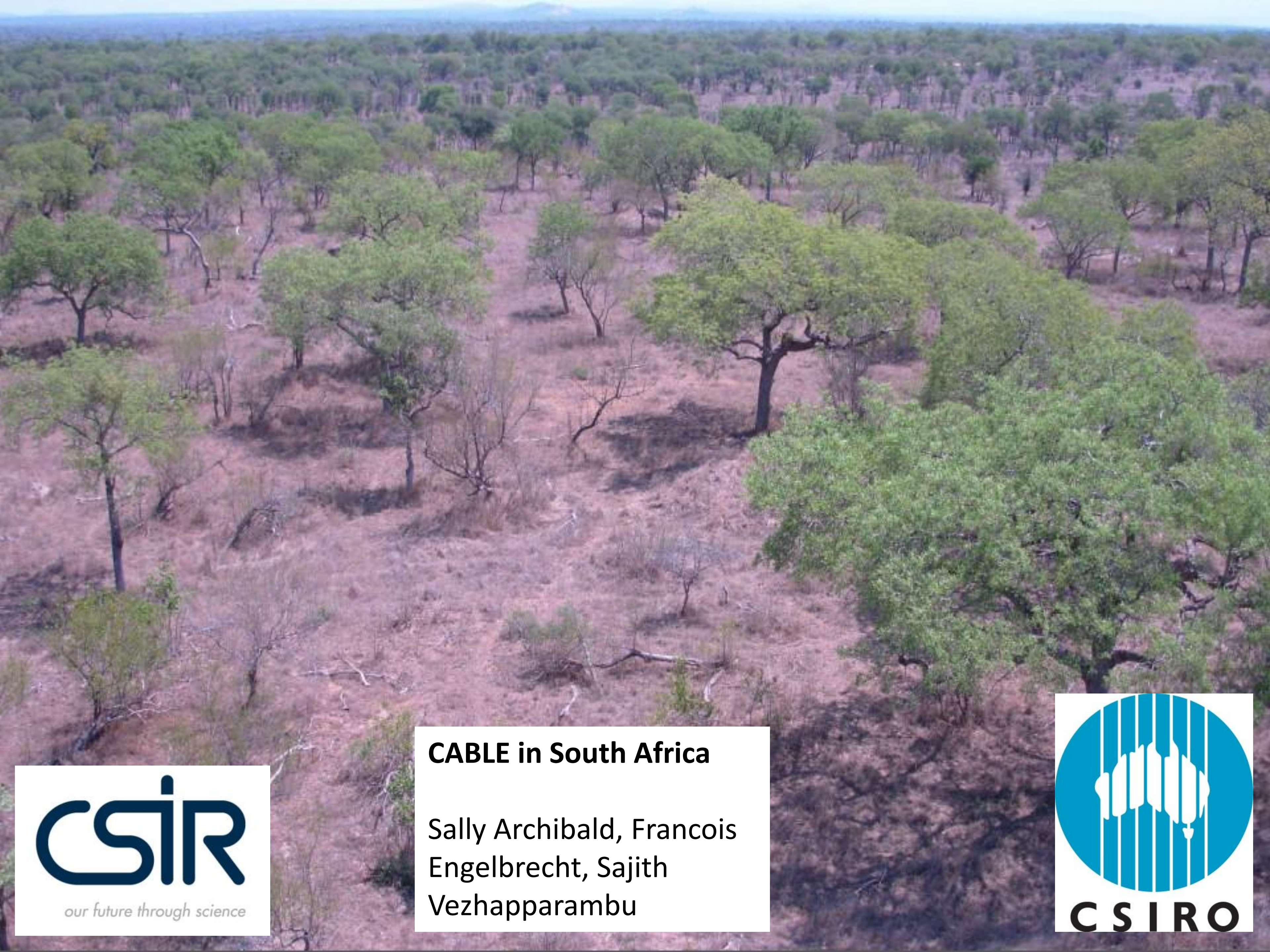
- Where P_{tree} and P_{grass} are the plan areas. Results suggest that vegetation parameters need to be better constrained



Preliminary results for predicting Active Vegetated Index as a function of urban vegetation fraction (sveg) and urban LAI.



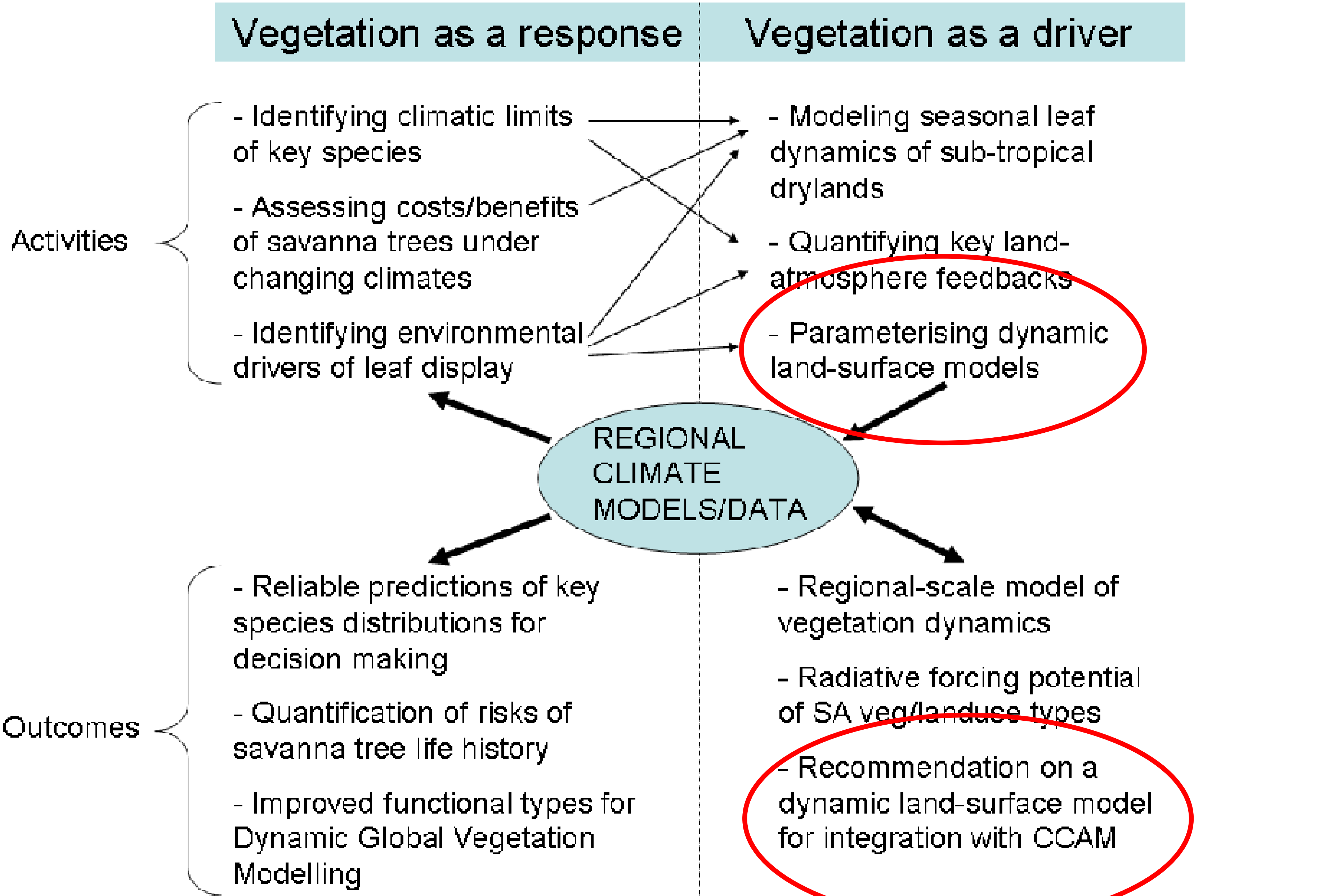
Observed relationship between QE/Qd and Active Vegetated Index from Loridan and Grimmond 2012



CABLE in South Africa

Sally Archibald, Francois Engelbrecht, Sajith Vezhapparambu

CSIR projects focus on the link between climate and the land surface and the limits of our knowledge around these processes

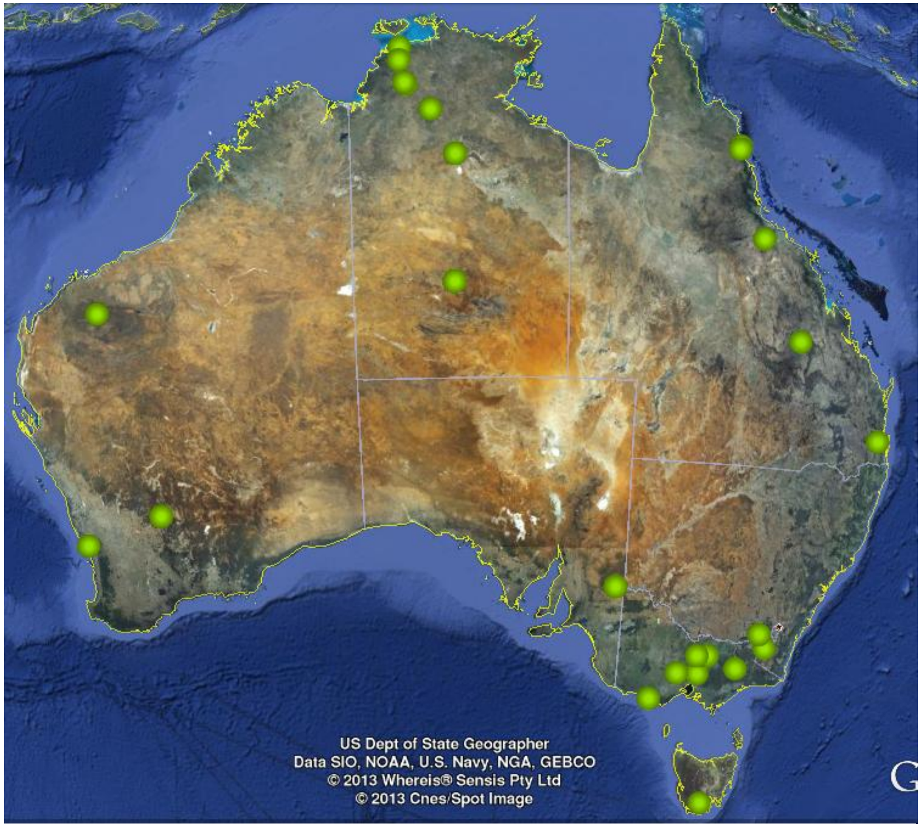


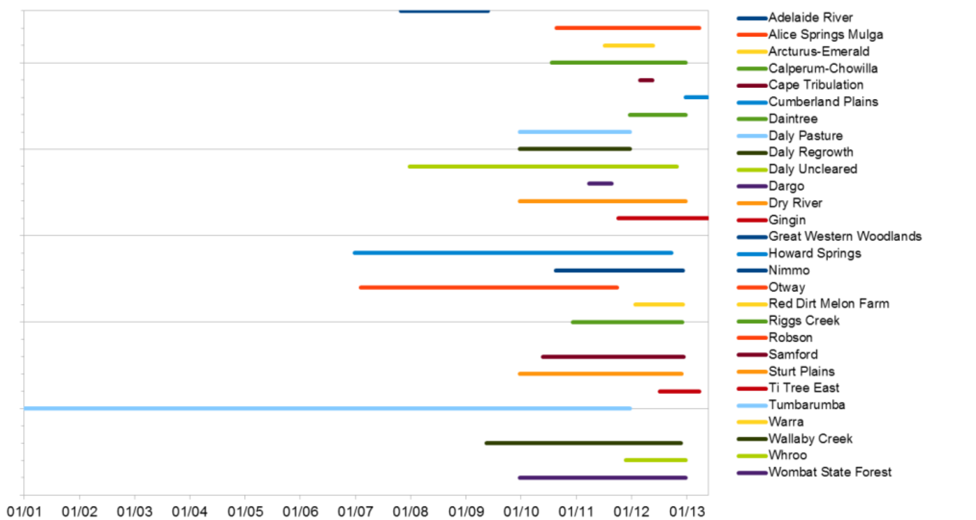
Skukuza flux tower

our future through science

OzFlux

- OzFlux is a TERN facilities.
- 28 sites across Australia.
- 63 site-years of data available on the portal.
- 30 minute observations:
  - 4 radiation components
  - T, RH, WS, WD, precip
  - Soil T and VWC
  - Fluxes of momentum, sensible heat, latent heat and CO2

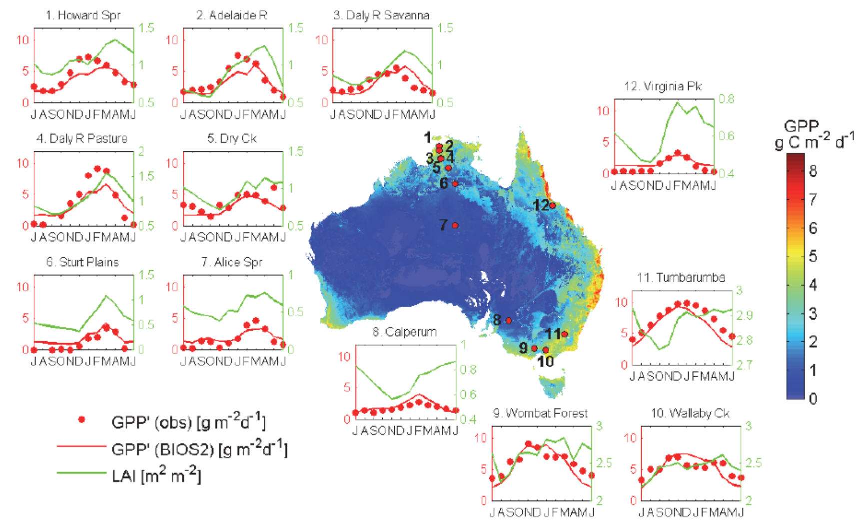


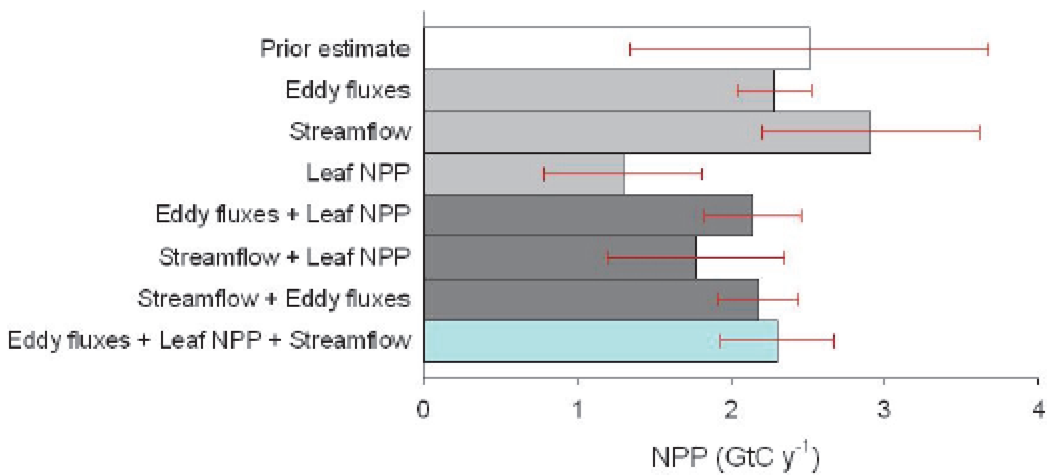


Peter Isaac

CABLE-related Activities I

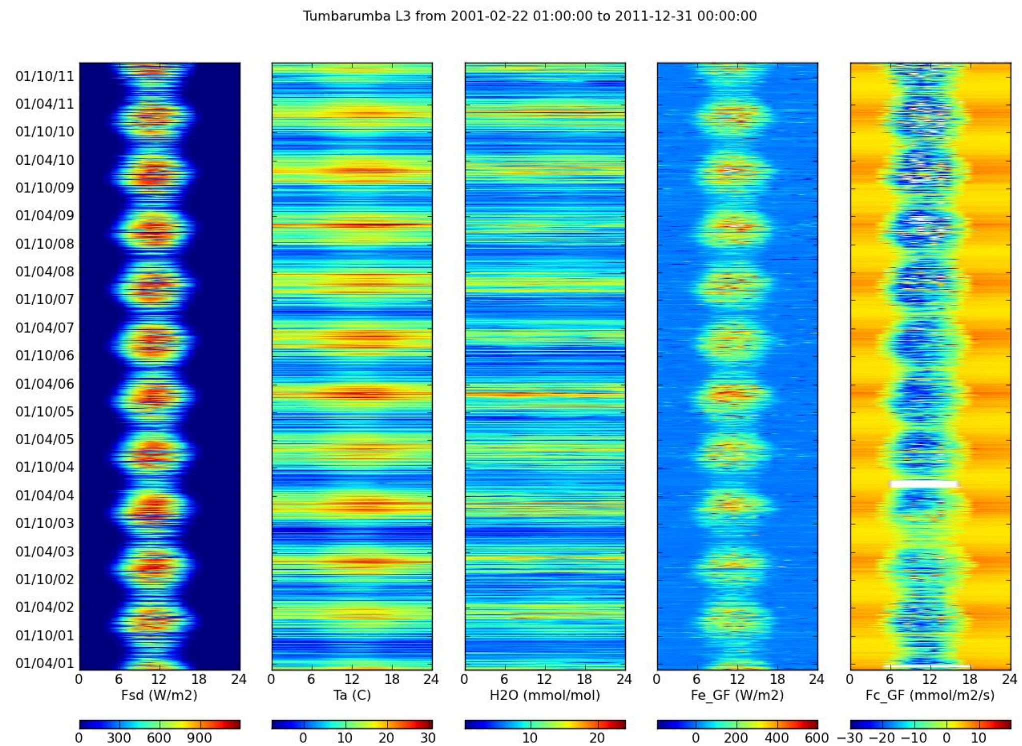
- Haverd et al (2012):
  - Use of data from flux towers to parameterise and validate BIOS2.
  - Flux data provides the strongest constraint.
  - 2/3 NPP from "grassy" vegetation.
  - 2/3 ET from soil evaporation.





CABLE-related Activities II

- Use of CABLE as a gap filling tool for OzFlux data.
- Provision of OzFlux data to eMAST for use in PALS.
- Use of ACCESS data:
  - Psuedo-time series of meteorological data for gap filling
  - Evaluation of ACCESS output
- Submission of data to FluxNet



Ticket 27#
Inclusion of a dynamic soil albedo scheme in CABLEv2.0

Jatin Kala and Kai Lu

(J.Kala@unsw.edu.au, Kai.Lu@unsw.edu.au)

Soil Albedo

- Back-ground soil albedo is prescribed in CABLEv2.0
  - Can be simply parameterized based on soil moisture and color:

$$\alpha_{soil} = \alpha_{sat} + \min\{\alpha_{sat}, \max[0.11(11 - 40\theta_{sm}), \alpha_{dry}]\} \quad (1)$$

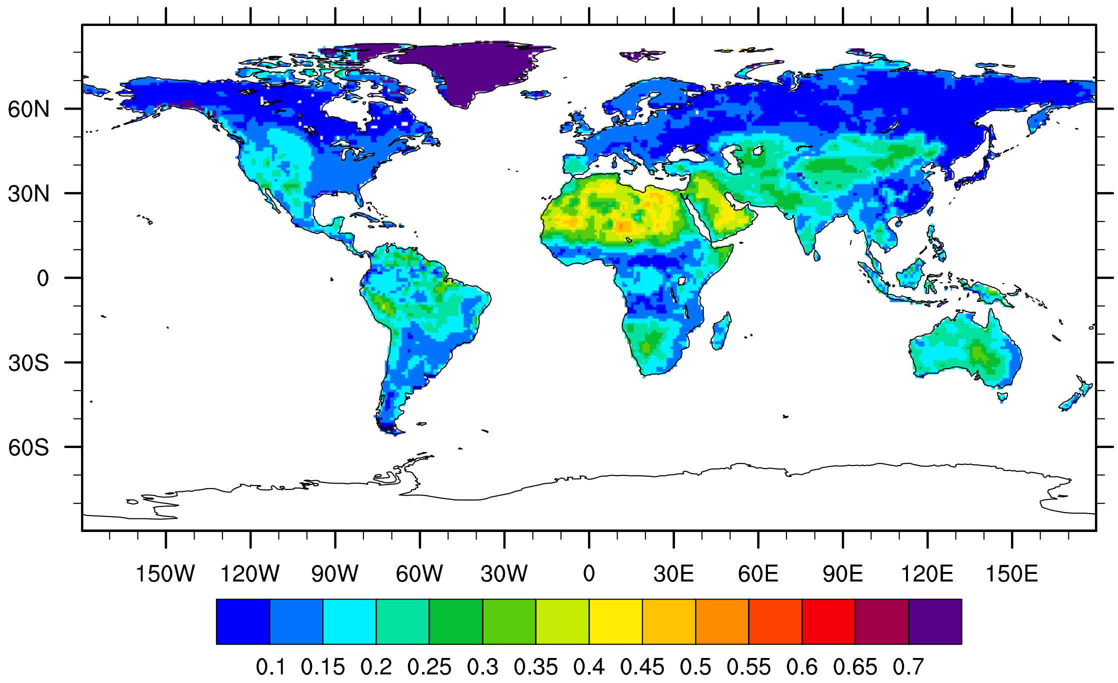
where α_{sat} and α_{dry} are the albedo of a saturated and dry soils respectively, dependant on the soil colour (light to dark), as shown in Table 1, and θ_{sm} is the surface volumetric soil moisture content.

Experiments

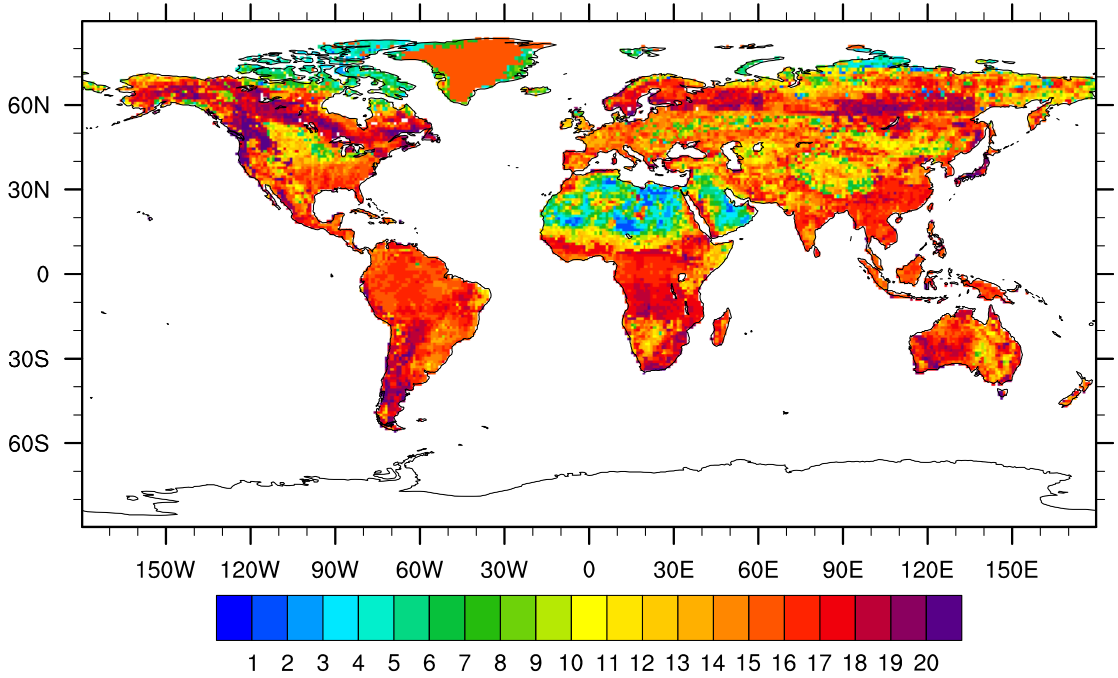
- Control (CNTL) simulation:
  - Global 1 by 1 degree GSWP forced default set-up
- Soil Albedo (SALB) simulation:
  - Same as CNTL except soil albedo parameterized

- Evaluated against MODIS white-sky NIR and VIS albedo from Boston University (Crystal Schaaf's group)

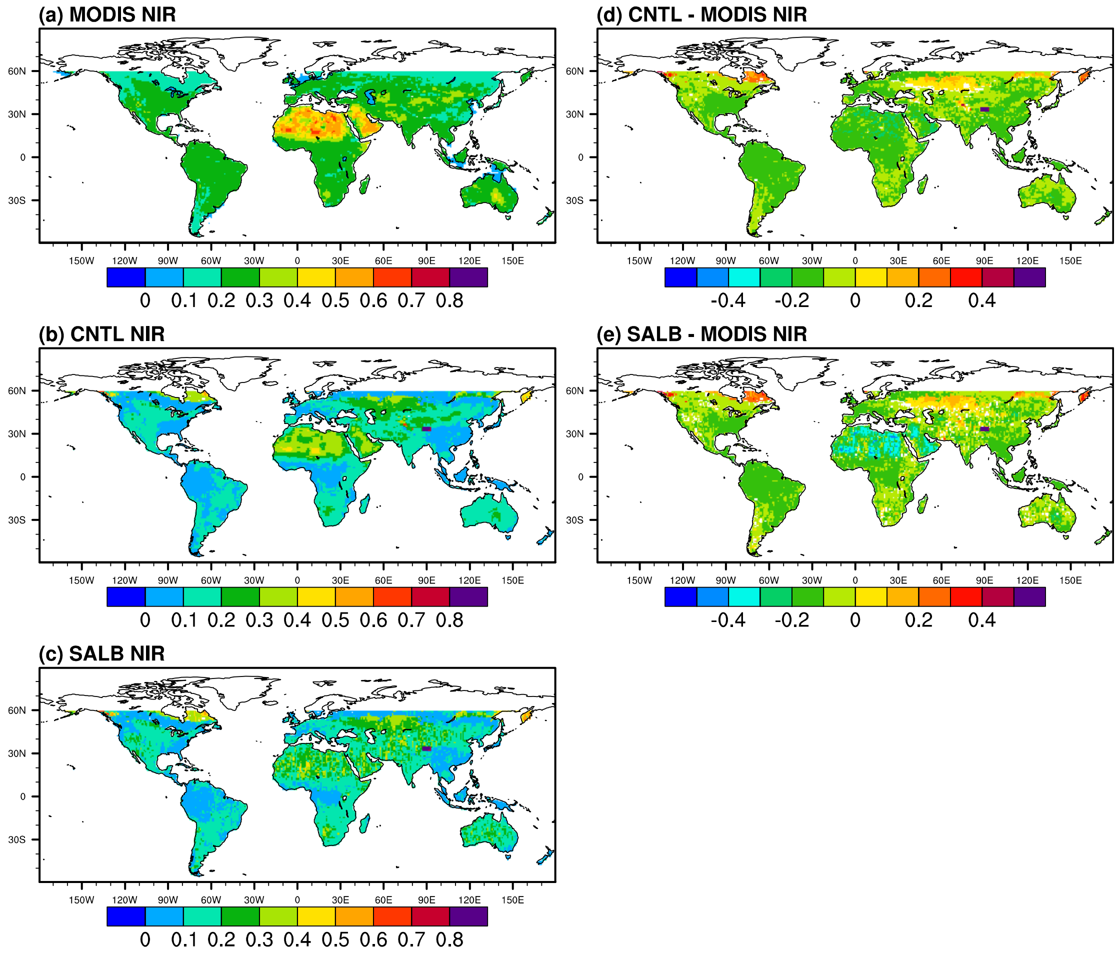
Prescribed Background soil albedo used in CNTL:



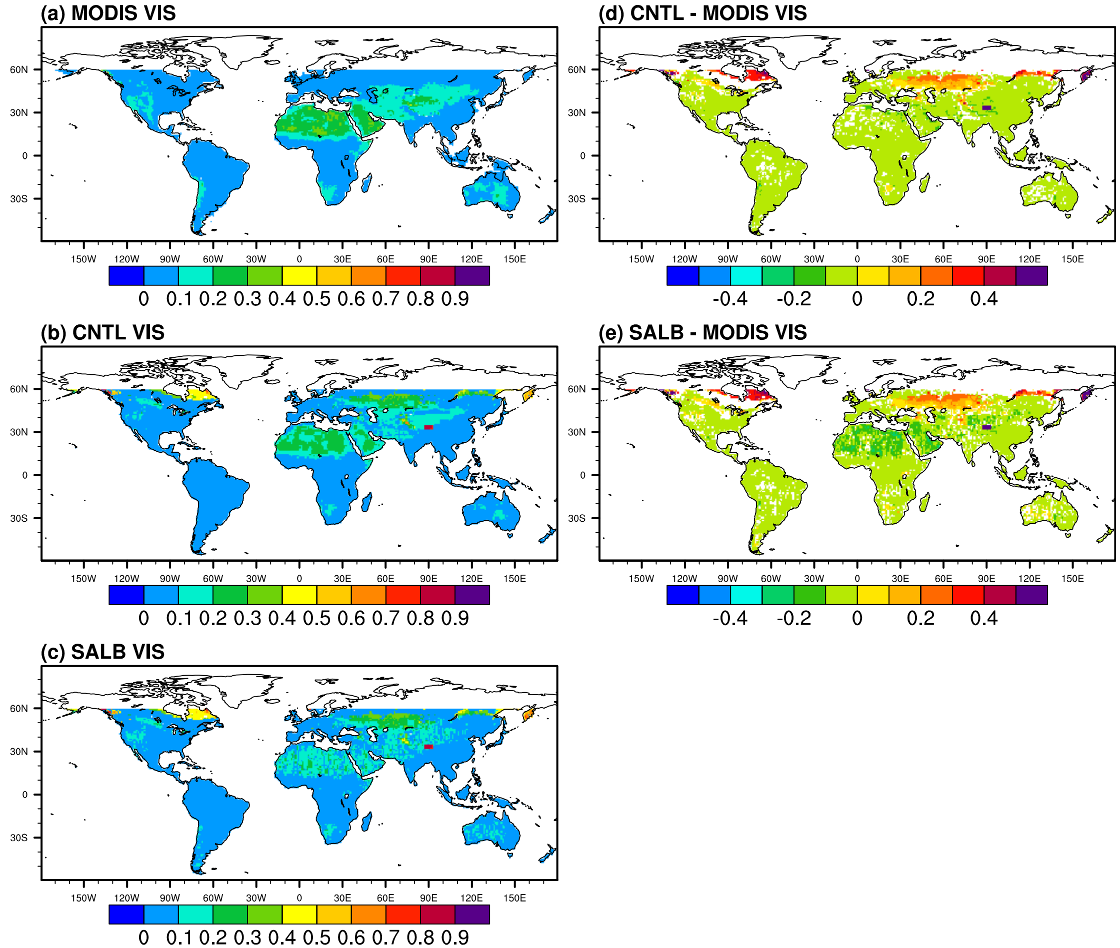
Soil colors use in SALB



Evaluation against MODIS



Evaluation against MODIS

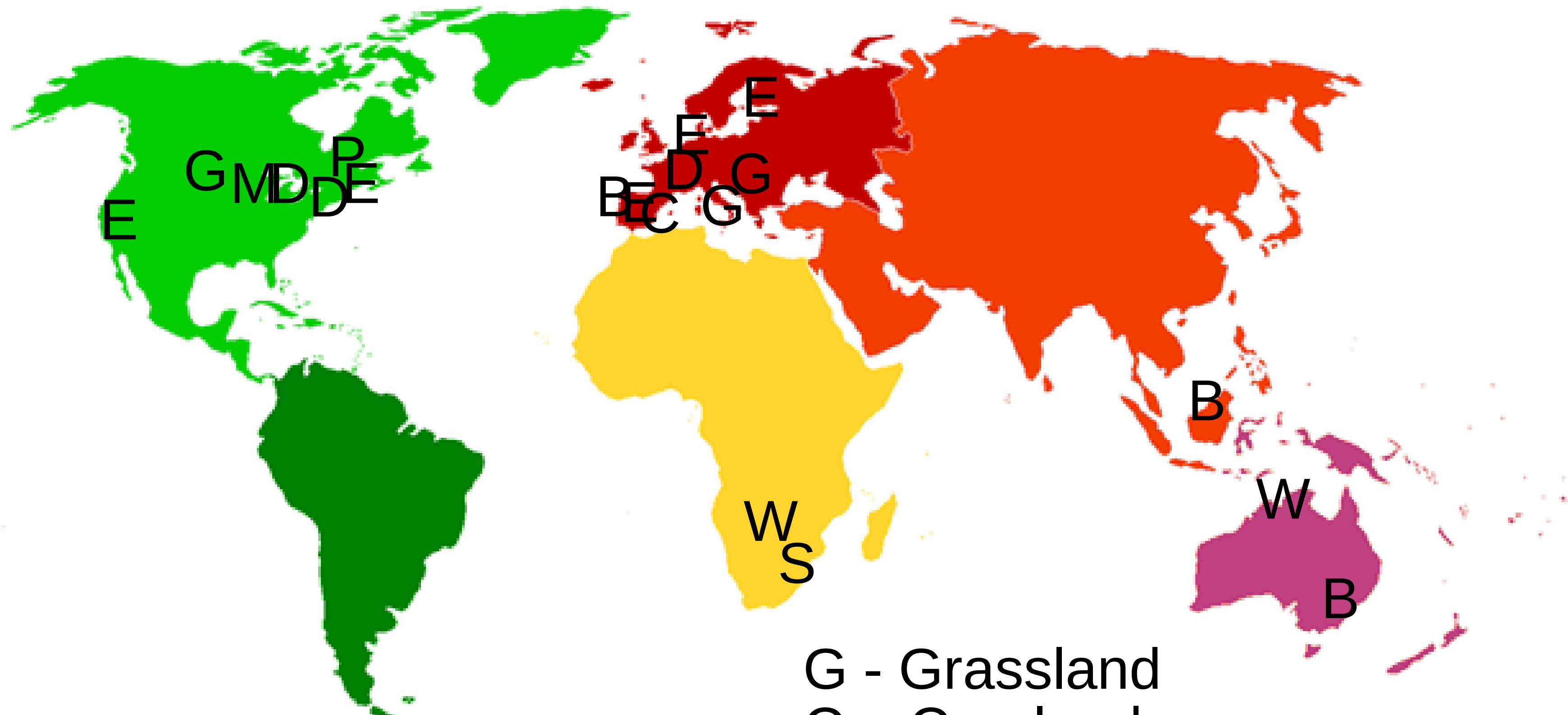


Conclusions

- The parameterization performs Worst than the default
  - Especially in desert regions (Sahara)
  - Perhaps not un-expected – default is derived from remote sensing in the first place
- This is only a first step in developing dynamic soil albedo
- These changes Only apply to CABLEv2.0 MPI version
  - Not serial or ACCESS versions
  - Some additional changes required (e.g., for tiling etc.)
  - Likely remain in CABLEv2.0 offline MPI version for now
  - More details: https://trac.nci.org.au/trac/cable/attachment/ticket/27/CABLEv2_Soil_Albedo_Documentation_v2.pdf

PALS Land sUrface Model Benchmarking Evaluation pRoject (PLUMBER) – the 20 flux tower sites

Gab Abramowitz and Martin Best



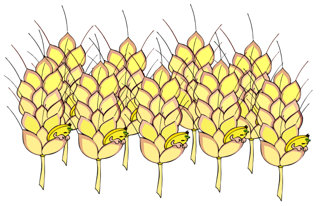
E – Evergreen Needleleaf
B – Evergreen Broadleaf
D – Deciduous Broadleaf
M – Mixed Forest

G - Grassland
C – Cropland
W – Woody Savanna
S – Savanna
P – Permanent Wetlands

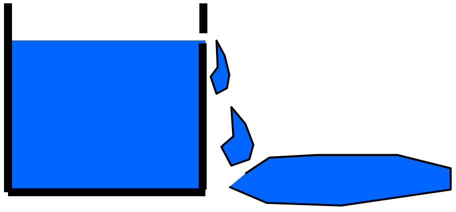
GLASS
Met Office
ARC CENTRE OF EXCELLENCE FOR CLIMATE SYSTEM SCIENCE
TERN

The Benchmarks

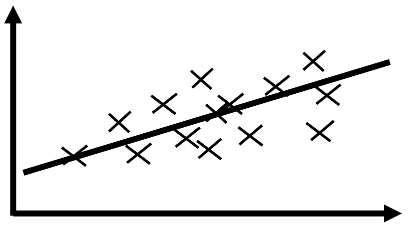
- Penman-Monteith



- Manabe bucket model



- Empirical regressions



The three empirical models

- All 3 are automatically calculated and plotted alongside model and observed data on PALS
- All 3 empirical models are trained with data from sites other than the testing site (i.e. out of sample)
- They are each created for LE, H, NEE:
    - "1lin": linear regression of flux against downward shortwave (SW)
    - "2lin": as above but against SW and surface air temperature (T)
    - "3km27": non-linear regression – 27-node k-means clustering + linear regression against SW, T and relative humidity at each node

All are instantaneous responses to met variables with no knowledge of vegetation type, soil type, soil moisture or temperature, C pools

Fluxes and metrics for normalised rank calculation (next slide)

Sensible heat flux (H)	Latent Heat flux (LE)	Net Radiation (Q*)	Net Ecosystem Exchange (NEE)

Mean Bias Error	MBE	$\left(\sum_{i=1}^{n}(M_i - O_i)\right)/n$
Normalised Mean Error	NME	$\dfrac{\sum_{i=1}^{n}\lvert M_i - O_i\rvert}{\sum_{i=1}^{n}\lvert \overline{O} - O_i\rvert}$
Standard Deviation	sd	$\sqrt{\dfrac{\sum_{i=1}^{n}\left(M_i - \overline{M}\right)^2}{n-1}}$
Correlation coefficient	r	$\dfrac{n\sum_{i=1}^{n}(O_i M_i) - \left(\sum_{i=1}^{n} O_i \sum_{i=1}^{n} M_i\right)}{\sqrt{\left(n\sum_{i=1}^{n} O_i^2 - \left(\sum_{i=1}^{n} O_i\right)^2\right)\left(n\sum_{i=1}^{n} M_i^2 - \left(\sum_{i=1}^{n} M_i\right)^2\right)}}$

Ranks against benchmarks