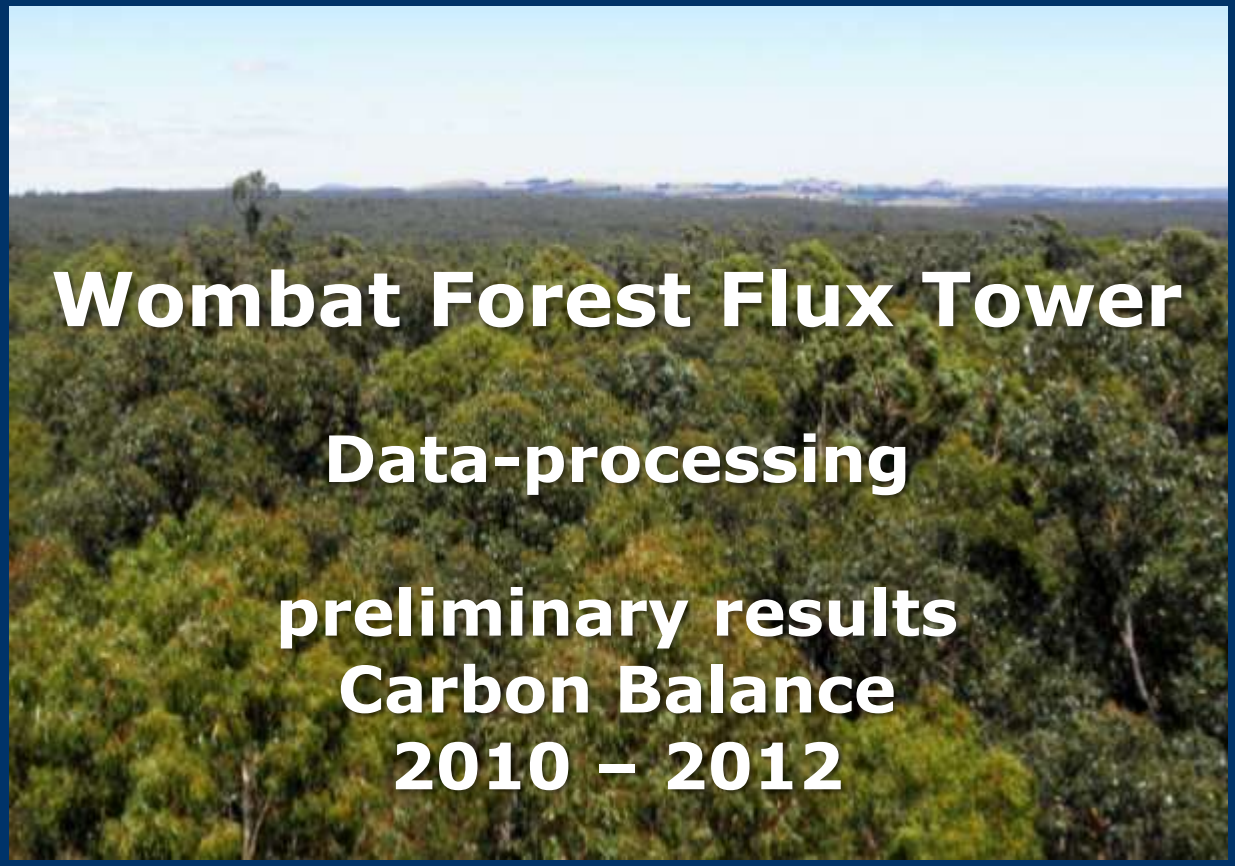


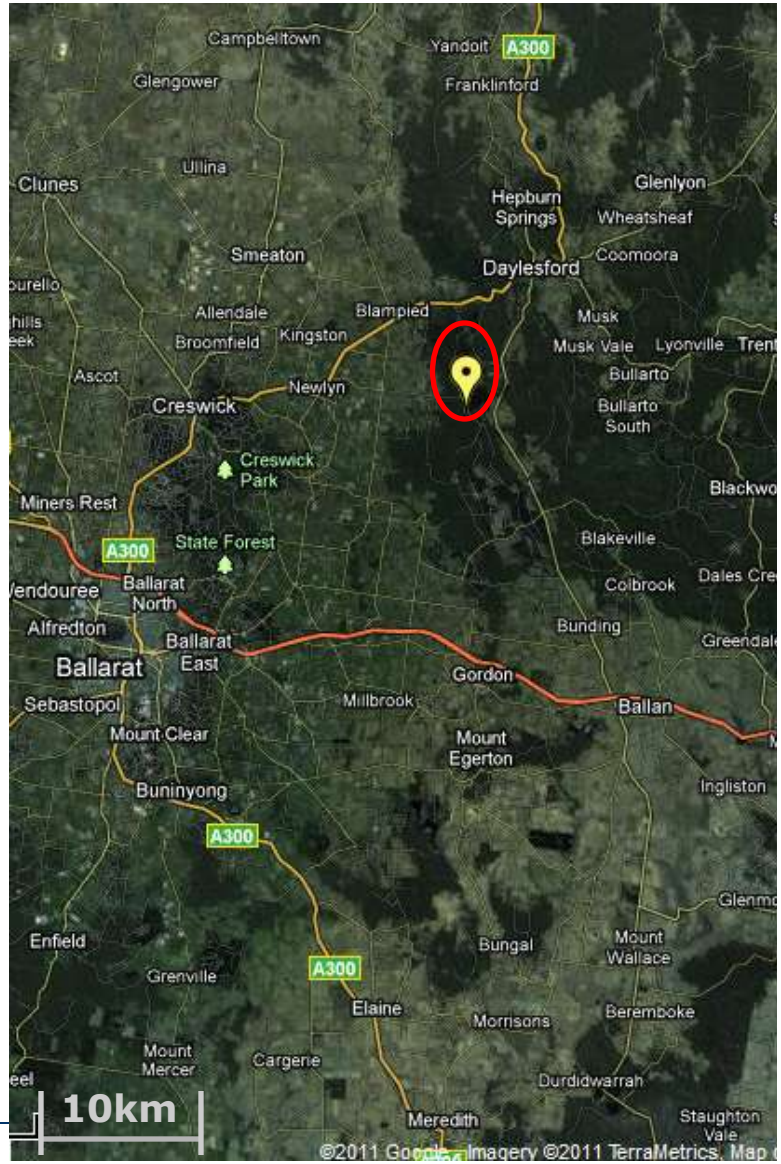
Wombat Forest Flux Tower

Data-processing

preliminary results
Carbon Balance
2010 – 2012

Nina Hinko-Najera, Stefan K. Arndt, Jason Beringer,
Stephen J. Livesley, Benedikt Fest, Ian McHugh, Peter Isaac,
Darren Hocking, Julio Najera

Wombat Forest

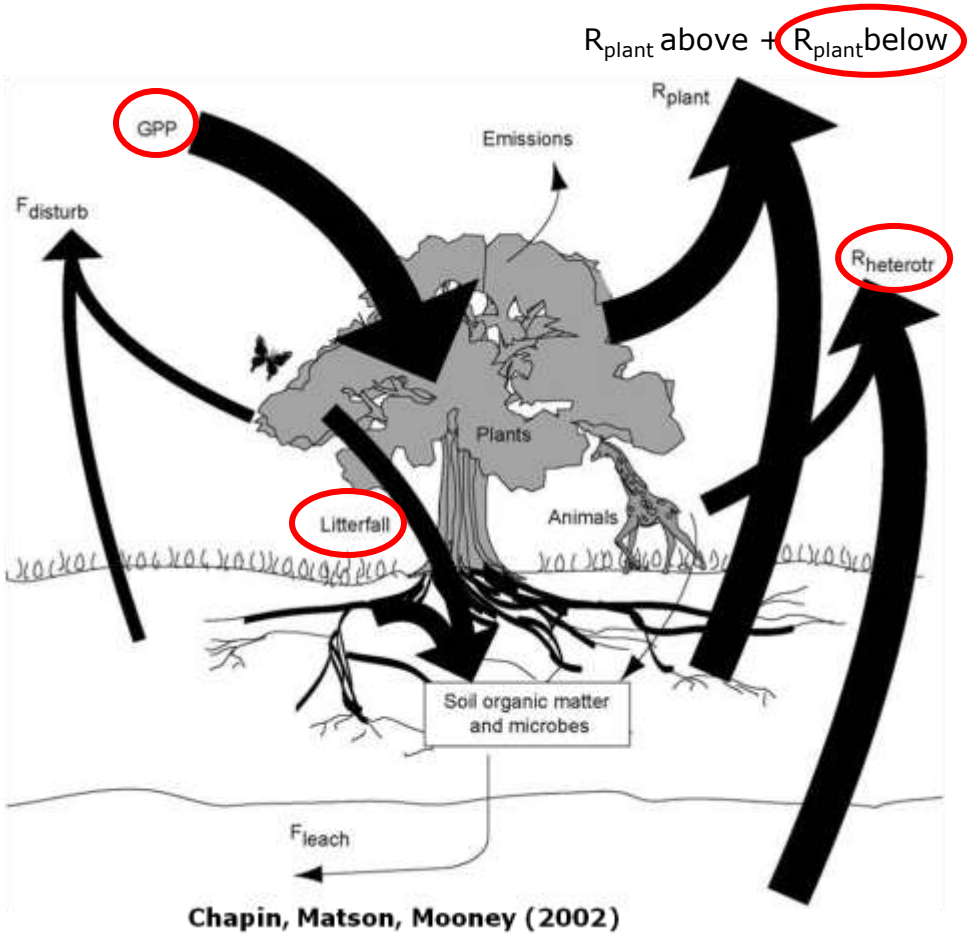


- cool temperate dry sclerophyll forest
- *E. obliqua* (messmate stringybark), *E. rubida* (candlebark gum), *E. radiata* (narrow-leafed peppermint)
- climate: cool temperate to Mediterranean (warm & dry summers, cold & wet winters)
- yellow podzolic soil, silty clays overlying clays (from Ordovician marine sediments)

- **35 m tall EC- tower**
- **automated soil GHG chambers –FTIR system**
- operating since late January 2010

Research Focus

- Carbon balance of a dry temperate sclerophyll forest & its strength as carbon sink/source
- Quantification of NEE, RE, GPP
- Quantification and contribution of soil CO_2 emissions to overall RE
- Quantification of soil non-CO_2 GHG exchange processes
- seasonal, inter-daily, inter-annual variations
- database for carbon- and land surface models



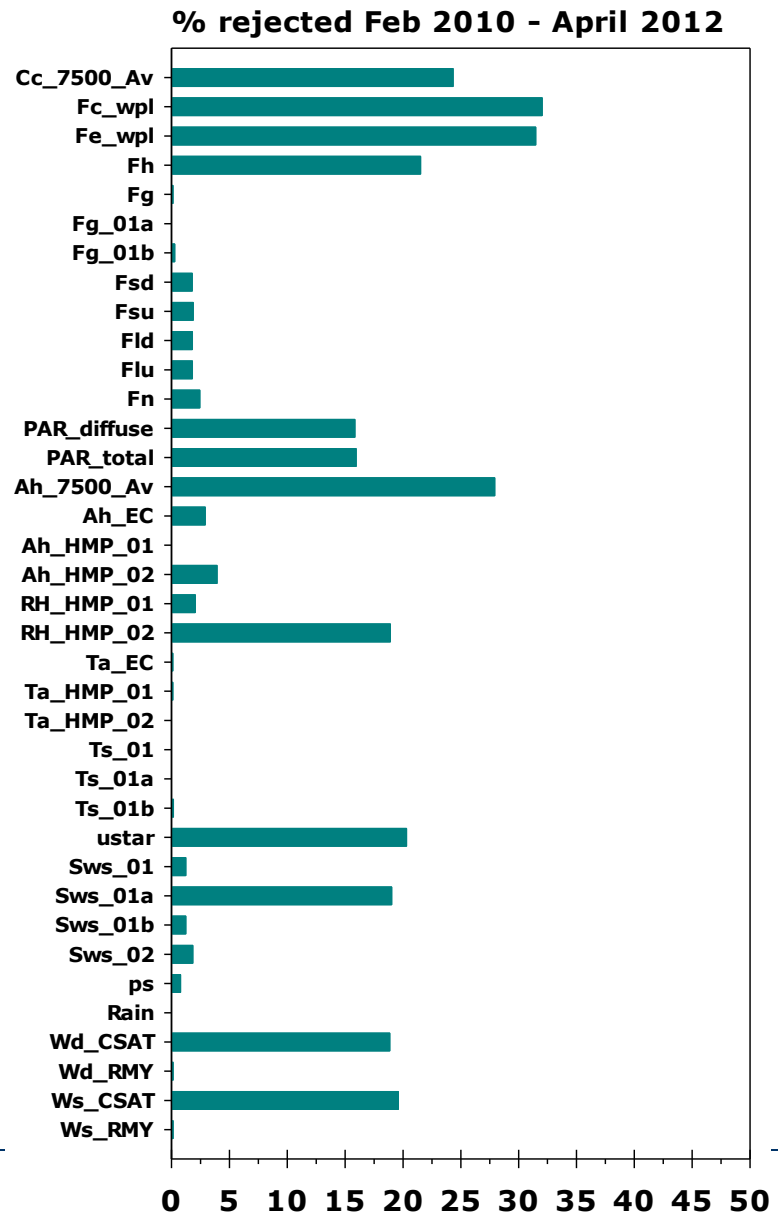
EC-Data Control & Processing

- instantaneous check of data – Real Time Monitoring Control (Jason Beringer):
  http://www.arts.monash.edu.au/ges/research/climate/wombat/index.php

- Data collection: Daily download via Maxon modem (Monash University)

- Quality Control on half-hourly data with Python 2.7.1. (EPD v7.0.2)
  current scripts: **OzFluxQCv1.5.1.** (**Peter Isaac** and **James Cleverly**)
  - L1 – raw data (half hourly data for radiation, fluxes, met-data, extra sensors)
  - L2 – range checks, diurnal checks, exclusions days/hours, diagnostics CSAT & Li-7500
  - L3 – linear corrections for Ah, covariances of Ah and Cc,
    correction for 2D coordinate rotation,
    calculation of fluxes from covariances (Fc_wpl, Fe_wpl), calculation of Fn,
    merge series (Tair, Ah, Fd, Tsoil, SWC), WPL-correction,
    range checks of calculated fluxes

Data loss

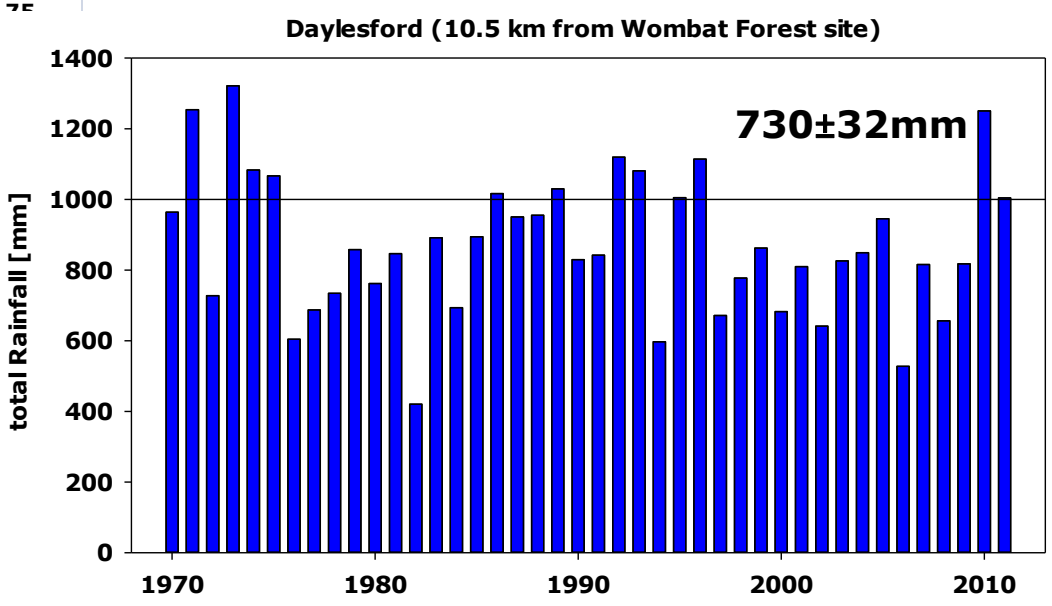


% used

69
62
62
72
93
93
99
92
92
92
92
91
78
78
66
91
86
90
91

Start/End	Year	datapoints	power	
20-Jan	2010	16608	2394	**14.4%**
	2011	17520	189	**1.1%**
1-May	2012	5808	0	--
	Total	39936	2583	
			6.5%	

- power issues in 2010
- longest gaps: June 2010 – 16 days
  November 2010 – 17 days
- high rainfall in 2010 (1129 mm) and 2011 (1076 mm)



EC-Data Gapfilling

- small gapfilling (up to 3 half hourly means) with linear interpolation

Gapfilling of meteorological data

- half-hourly meteorological data from nearest BoM station (Ballarat Aerodrome , 28km SW) & Wombat Forest FESA sites (Kevin Tolhurst, Markus Löw)
  ⟹ Tair, RH (Ah, VPD), atmospheric pressure, precipitation, WS, WD

- Radiation (Fsd, Fsu, Fld, Fln) gapfilled by **Ian McHugh**: model to proportional distribute daily incoming global radiation data from BoM (Ballarat/Daylesford) over a day in half-hourly steps

- soil moisture (SWC) and soil temperature (Tsoil) from CABLE-output by **Vanessa Haverd**

Gapfilling of fluxes – with ANN (Jason Beringer, Statistica10)

- trained model
- non-linear regressions, 5 models

Flux	input variables
Fg	Fn, Tsoil, SWC
Fh	Tair, Ah, WS, Fa, SWC
Fe	Tair, Ah, WS, Fa, VPD, SWC
Fc	Fsd, Tair, VPD, Ah, WS, Tsoil, SWC

EC-Data Partitioning

Partitioning with the NN (Jason Beringer)

- night-time Fc fluxes filtered for u* (0.4ms^{-1})
- input variables for RE (over night & day-time data): Tsoil, SWC
- during day-time GPP = Fc -RE

Online EC-gapfilling and flux partitioning tool from M. Reichstein

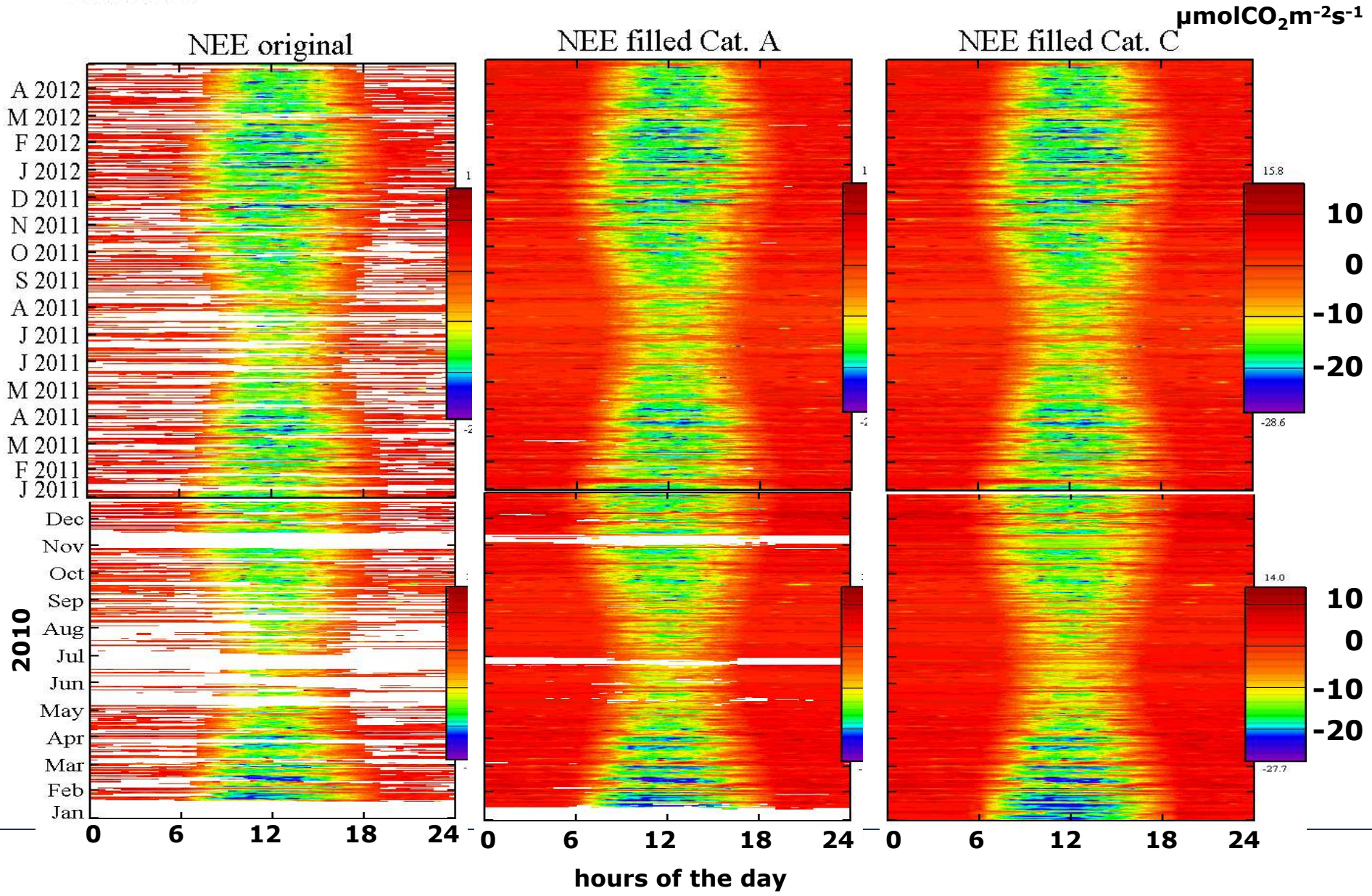
(Max Planck Institute for Biogeochemistry http://www.bgc-jena.mpg.de/~MDIwork/eddyproc/)

- Method based on night-time NEE (= RE), its extrapolation to day-time and its short-term temperature sensitivity (10 days, ΔTair > 5°C)
  (Reichstein *et al.* 2005)
- temperature sensitivity:

$$RE = R_{ref} * e^{E0\ (1/Tref-T0-1/T-T0)}$$ (Lloyd & Taylor 1994)

- ustar-filtering applied (assumes correction for storage): 6 temperature classes – split into 20 ustar classes – determination of ustar treshold for each temperature class – was finally set to 0.4 ms^{-1}

Net Ecosystem Exchange



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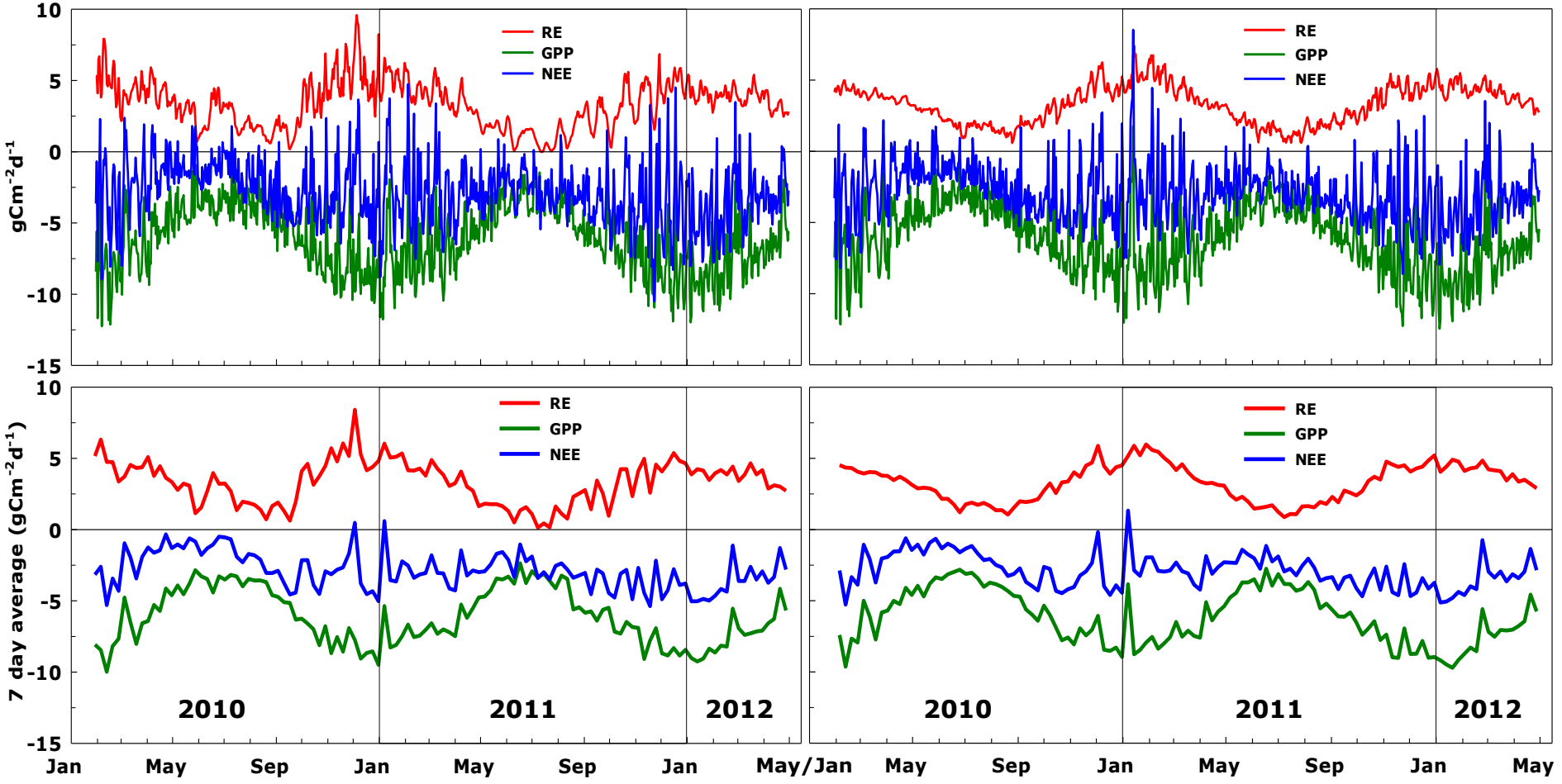
Wombat Forest: Carbon Balance

Reichstein- Online tool

Jason – NN



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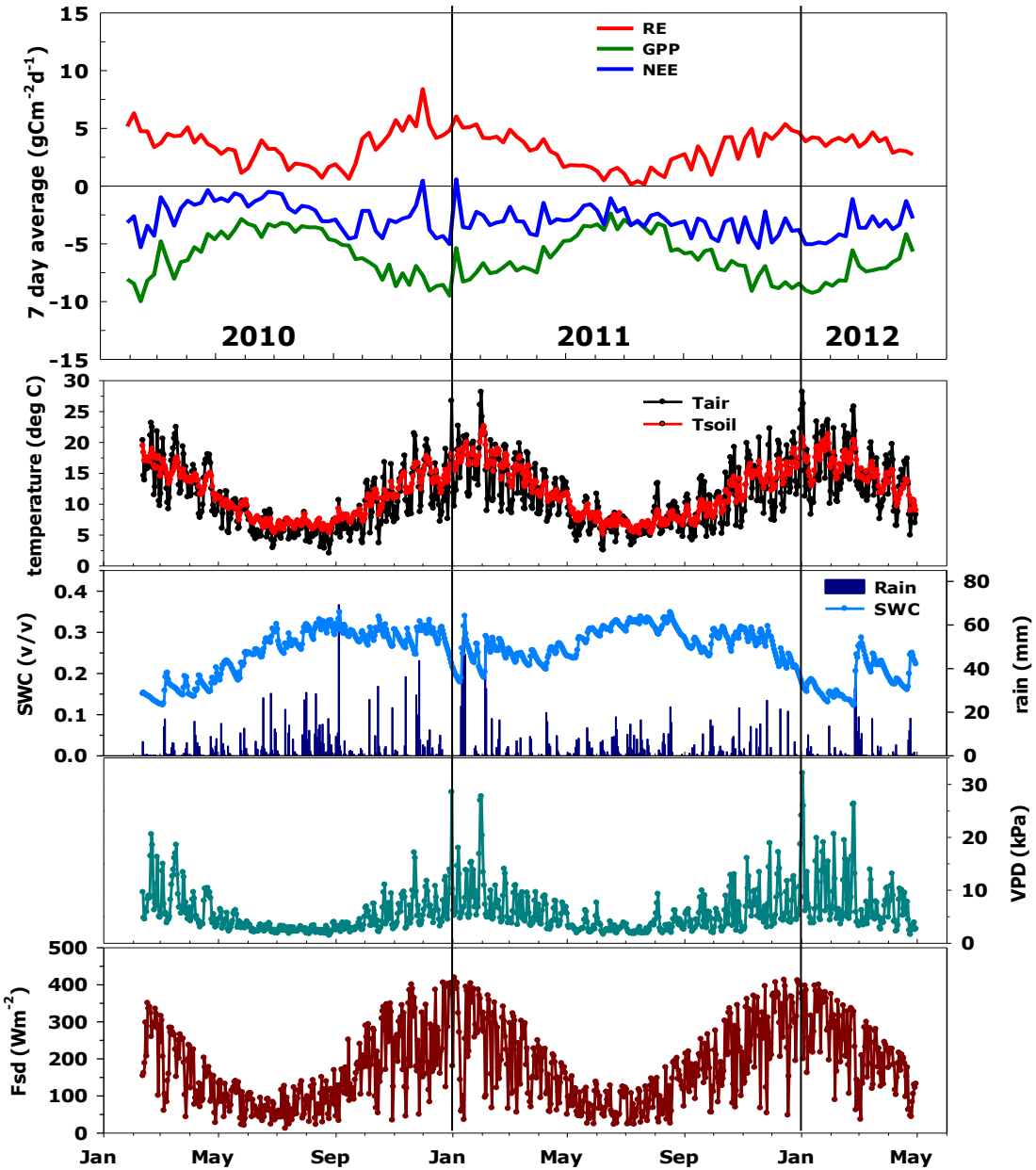
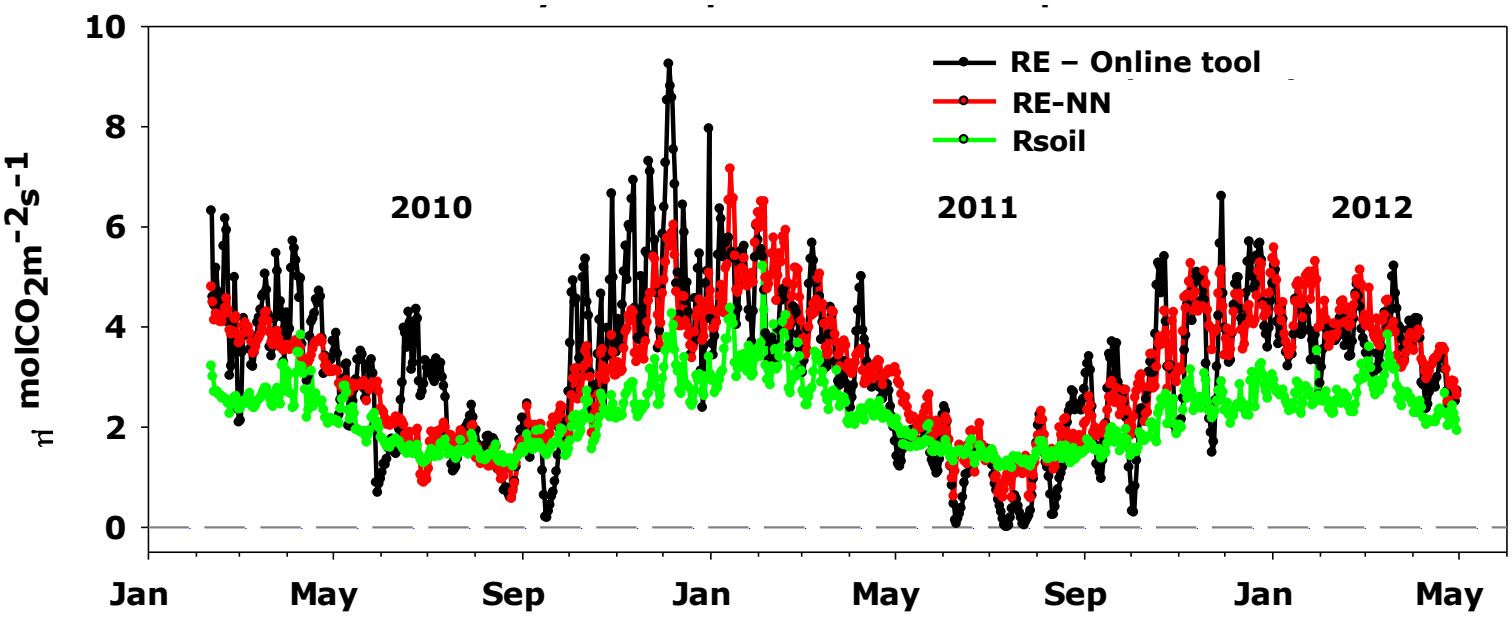
environmental drivers

daily averages



Ecosystem & soil respiration

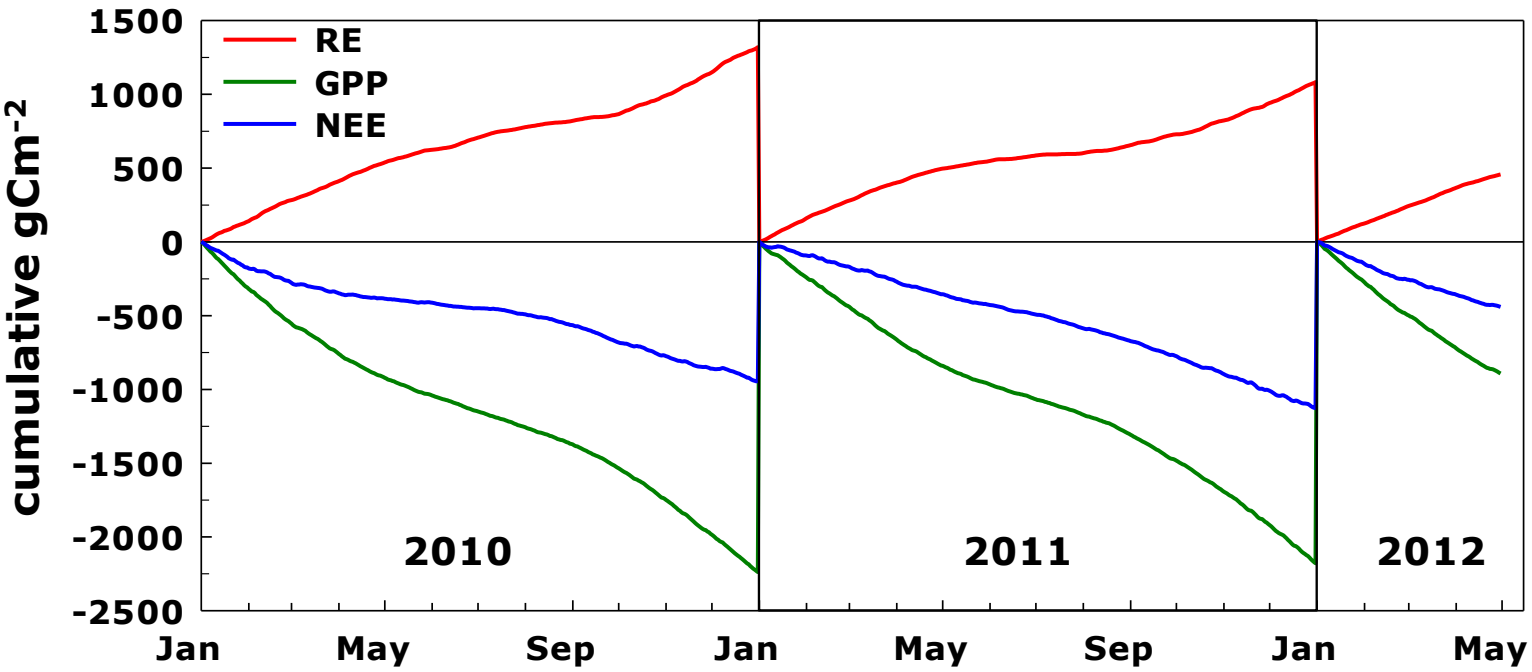
daily averages



Rsoil from FTIR soil chamber measurements

(gaps are filled with modified Lloyd & Taylor model which describes dependence on soil temperature and soil moisture, R2 = 0.78, Reichstein et al. 2003)

Wombat Forest: Carbon Balance



	tC ha^{-1}yr^{-1}	
RE	**13.2**	(5.4)
GPP	**- 22.6**	(- 9.3)
NEE	**- 9.4**	(- 3.9)

	tC ha^{-1}yr^{-1}	
RE	**10.8**	(5.0)
GPP	**- 22.1**	(- 8.5)
NEE	**- 11.3**	(- 3.5)

	tC ha^{-1}
RE	**4.6**
GPP	**- 9.0**
NEE	**- 4.4**

Partitioning with Online-tool

early comparison with other sites in SE-Australia

wet sclerophyll forest

(old growth *E. regnans* forest)

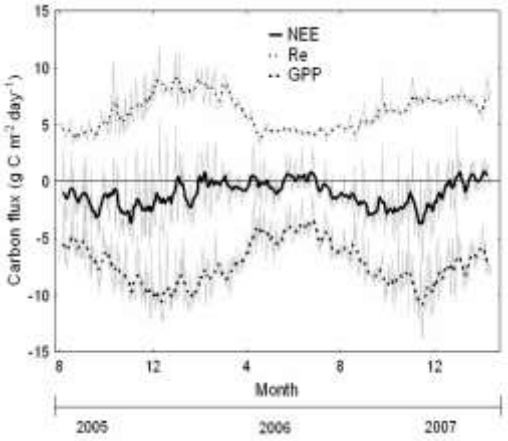
Wallaby Creek (Musa Kilinc, PhD Thesis, 2009)

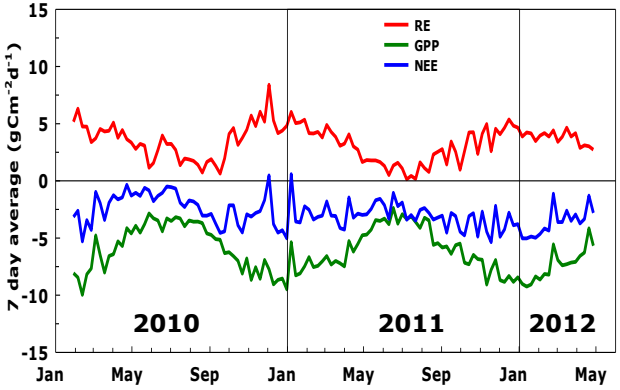
for 2006 with summer drought:

NEE -3.77 tC ha^{-1}yr^{-1}

RE 22.38 tC ha^{-1}yr^{-1}

GPP - 26.15 tC ha^{-1}yr^{-1}





wet sclerophyll forest

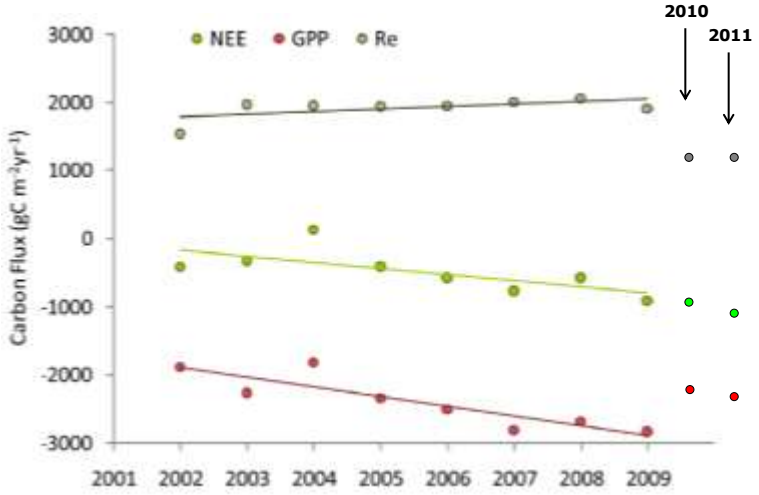
(*E.delegatensis*)

Tumbarumba (van Gorsel Ozflux meeting 2011, Keith et al. 2012)

for 2009: **NEE - 9.33 tC ha^{-1}yr^{-1}**

RE ~ 20 tC ha^{-1}yr^{-1}

GPP ~ - 28 tC ha^{-1}yr^{-1}



to sum up and future work

- Wombat Forest: continuous net carbon sink: **~ 10 tC $ha^{-1}yr^{-1}$ (?)**
- measurements during extraordinary wet years (>1000 mm) – optimal conditions
- **underestimation of RE:**
  - → different partitioning approach (light response curve)
  - → clarify issues of drainage
  - → storage correction – profile system since February 2012 (Ian McHugh, 6 heights)
- detailed analyses of environmental drivers for NEE, RE and GPP in the Wombat Forest
- predicted climate changes in SE-Australia (warmer, less rainfall) – importance of measurements during drier periods
- disturbance: prescribed burning planned Spring 2012 or Autumn 2013
- complementary measurements: aboveground biomass – micro dendrometers, vegetation dynamics – ground based LIDAR

Thank you

for your attention!

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