Environmental Research Conference:

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How Sensitive is Carbon Uptake in Peatlands and Grasslands to Observed Climate Variation

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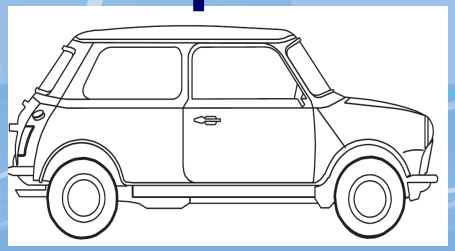
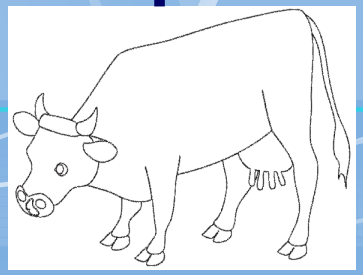
Atmosphere

$+CO_2$

$+CH_4$

$+N_2O$





Transport / Industry

Ruminant Animals

Fertilised Grasslands / Arable

Man Made Emissions of Greenhouse Gases (GHG)

Fluxes from surface to atmosphere are (+)

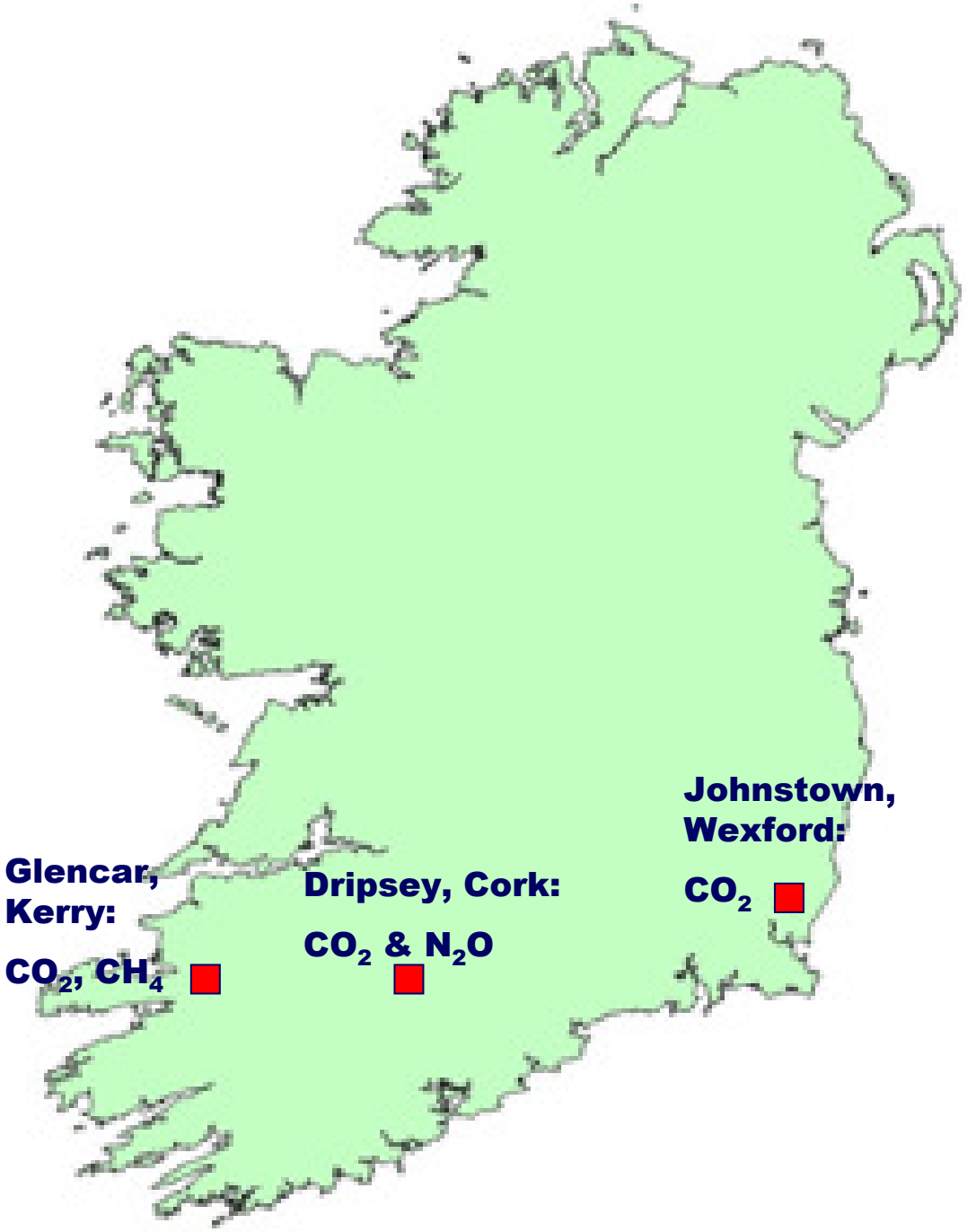
Atmosphere

$-CO_2$ $-CO_2$ $-CO_2$

Peatlands **Grasslands / Arable** **Forestry**

Ecosystems CO_2 Uptake (-)

Flux study sites -UCC



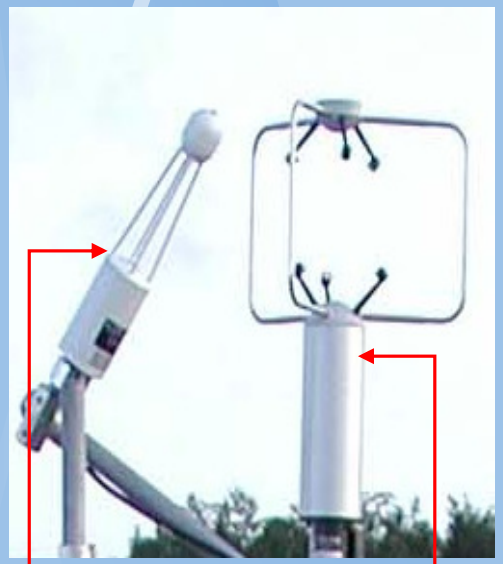
Net Ecosystem Exchange – NEE

Eddy Covariance Method

over a footprint area ~ 1km by 1 km.

$$NEE = P_G - R_E \qquad \text{Tons of Carbon/Ha}$$

$$NEE = F_{CO2} \qquad \textit{Flux of } CO_2$$



LI-7500 Open Path CO_2/H_2O gas analyser

3D-Sonic anemometer

Definition of the CO_2 flux

$$F_c \cong -\overline{w'\,\rho_c'}$$

30 min averaging time

ρ_c' – the density fluctuation of CO_2 [µmol/m^3] @ 10Hz

w' - the vertical wind velocity fluctuation [m/s] @ 10Hz

NEE of Different Ecosystems

(-) uptake: (+) emission

Ecosystem	NEE t C /ha.yr	C sequestered t C /ha.yr
Bogs: UCC – Kerry	**-0.17 to -0.92** **(uptake)**	Subtract CH_4 & DOC
Grasslands UCC –Dripsey UCC -Wexford	**-1.9 to - 2.9** **-0.2 to - 3.9** **(uptake)**	subtract lots…

Blanket Peatland at Glencar, Co. Kerry.

NEE and Total Carbon Budget (Bogs)

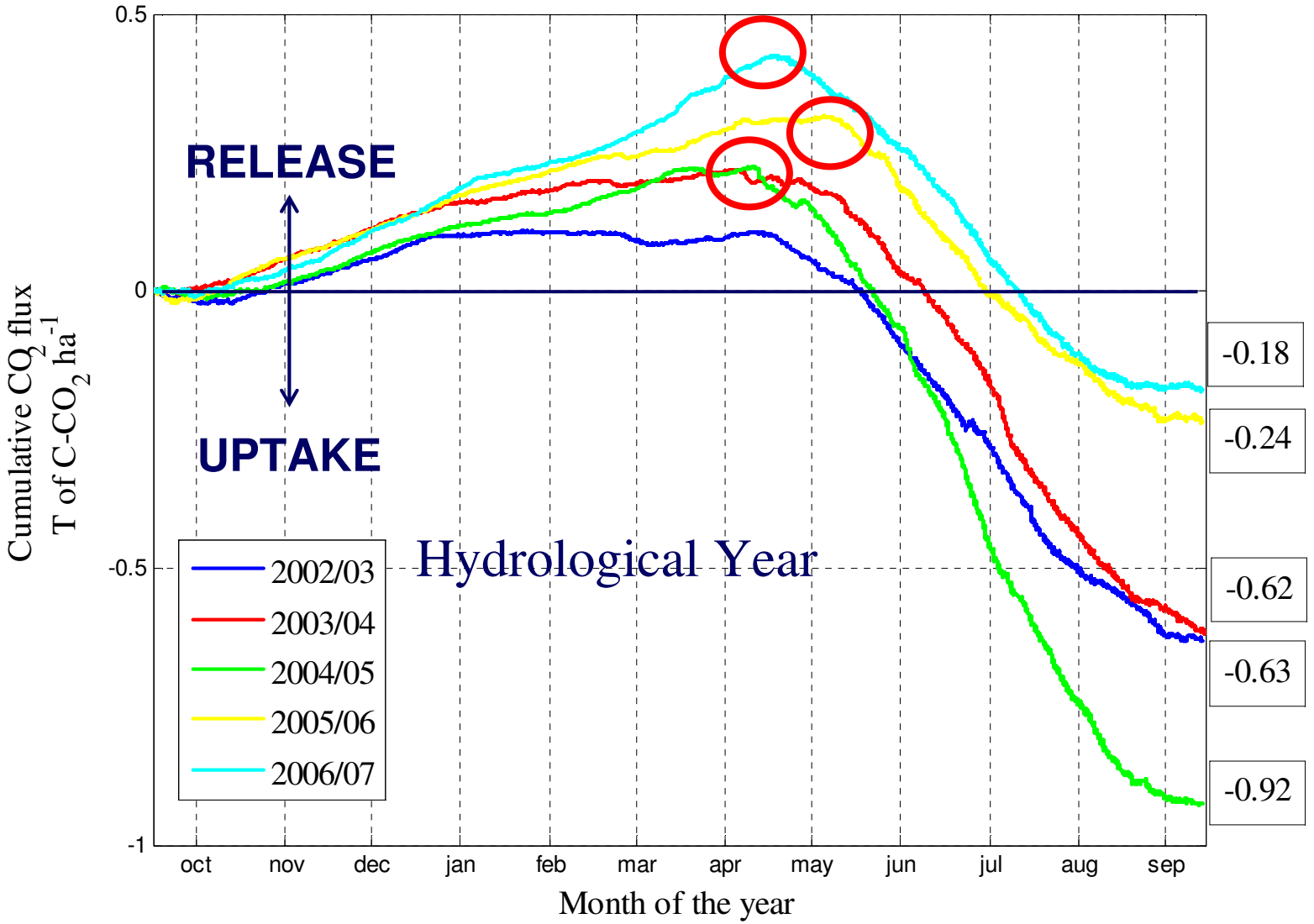
NEE = Net of CO_2 = Photosynthesis - Respiration
= - 0.52 TC/ha.yr (range –0.18 to – 0.92)

Total Carbon Budget (for 2007)
ΔC = C (CO_2) – C (CH_4) – C (DOC)
= - 0.17 (uptake) + 0.05(loss) + 0.14(loss) = + 0.02 TC/ha.yr LOSS

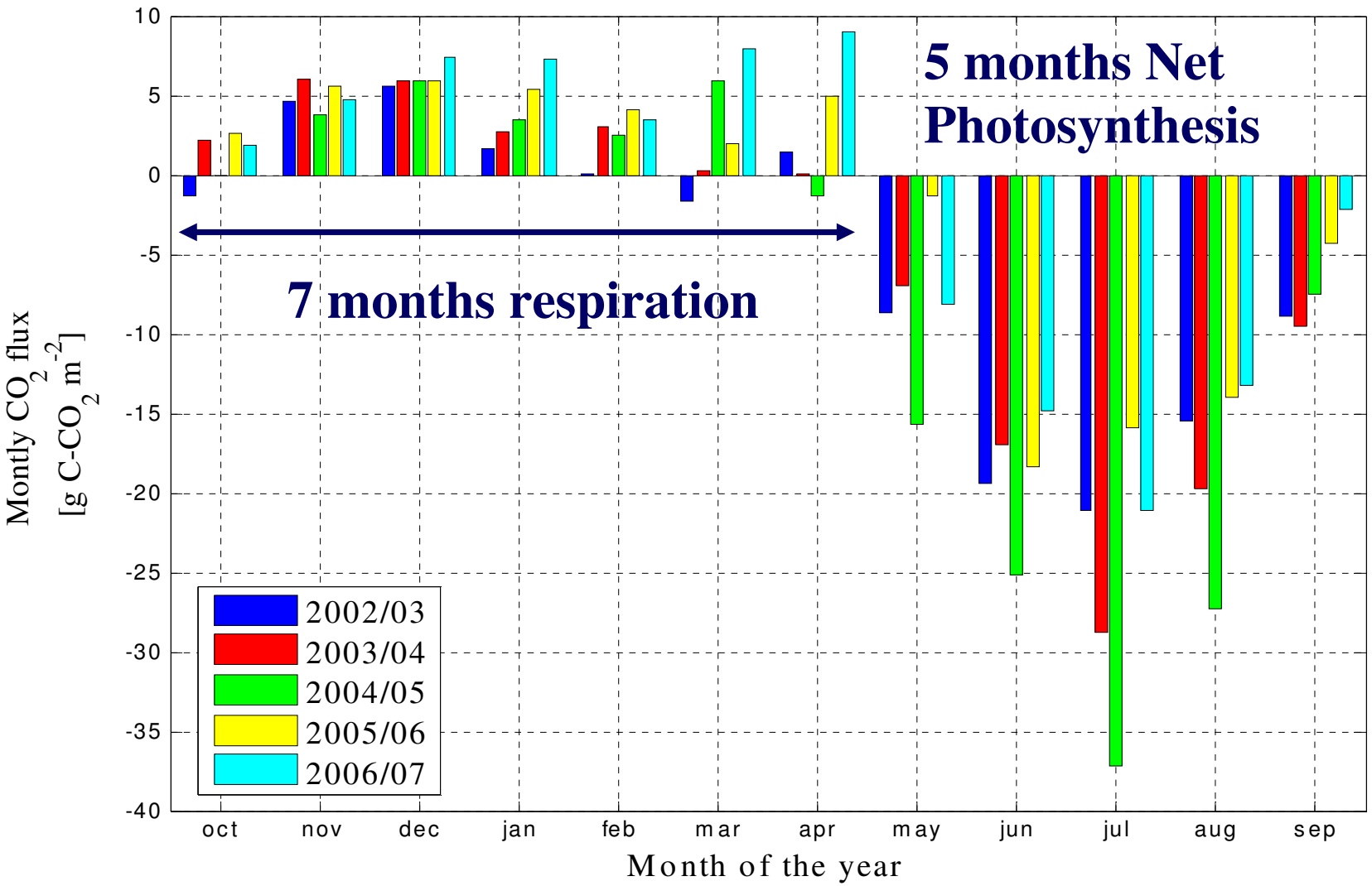
Total Carbon Budget (for 2004)
ΔC = C (CO_2) – C (CH_4) – C (DOC)
= - 0.92 (uptake) + 0.05(loss) + 0.14(loss) = - 0.73 TC/ha. UPTAKE

Carbon sequestered in bog = + 0.02 to – 0.73 TC/ha.yr.

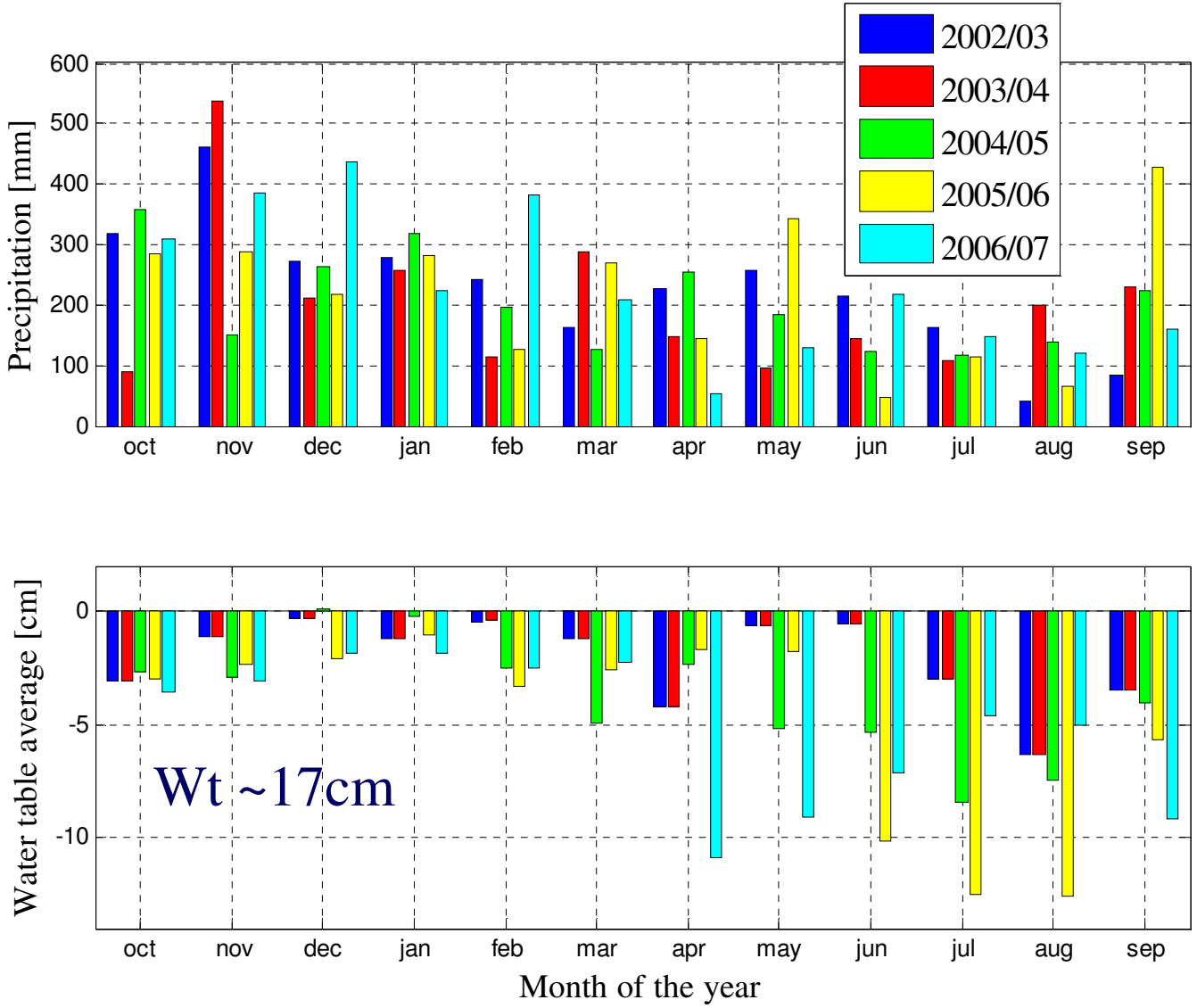
Bog Results: cumulative CO_2 flux



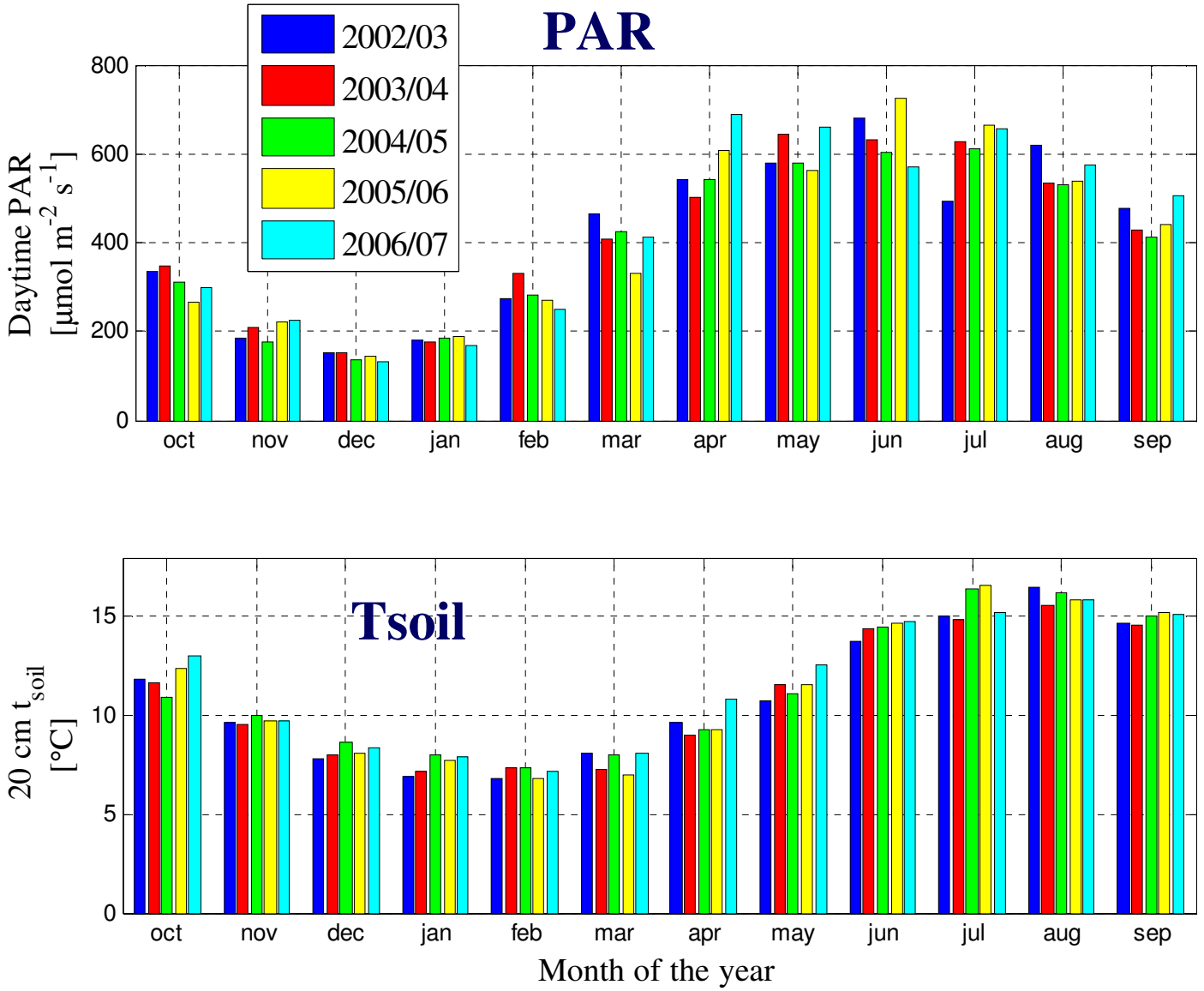
Bog Results: monthly CO_2 flux



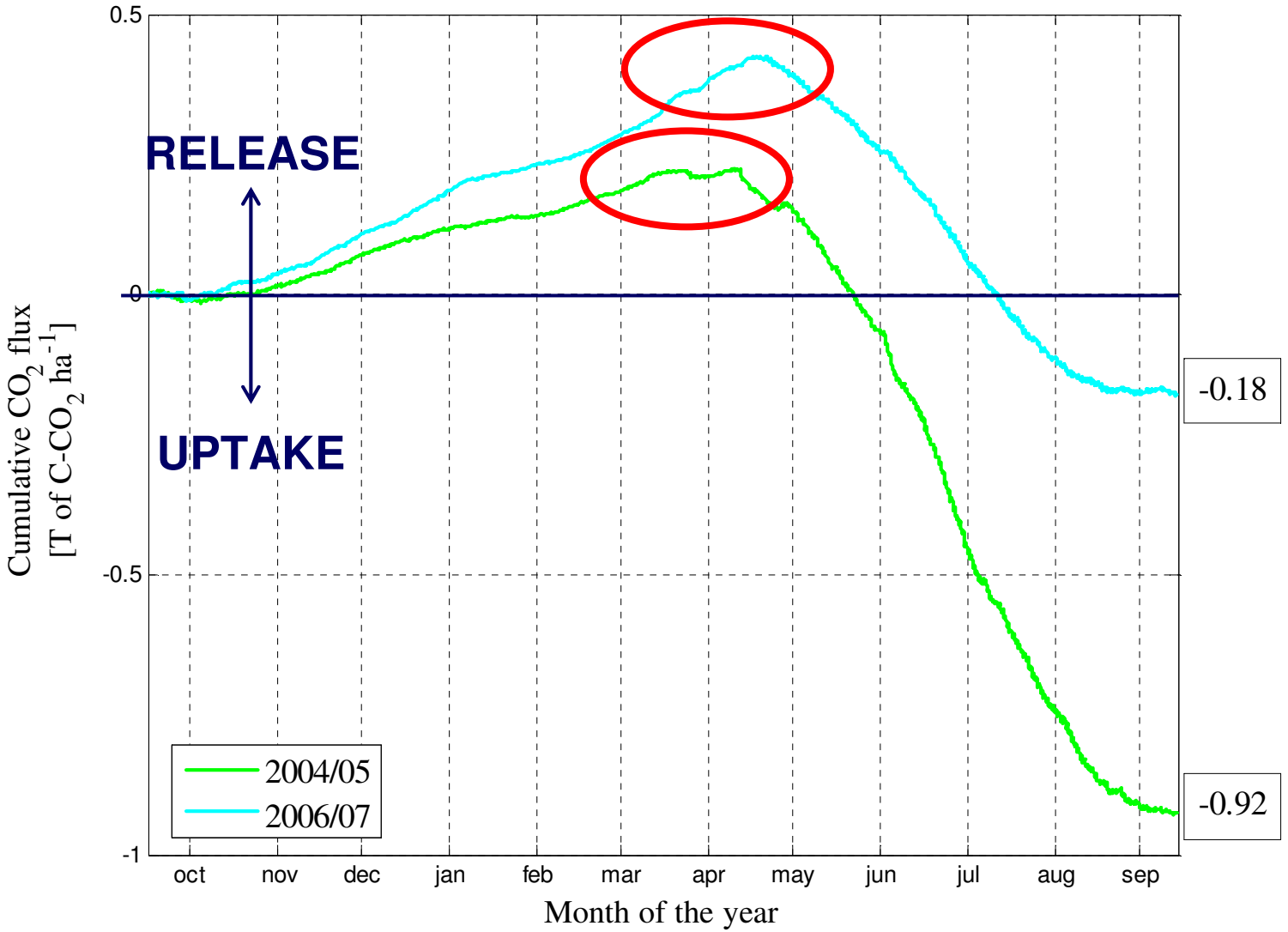
Bog environmental data



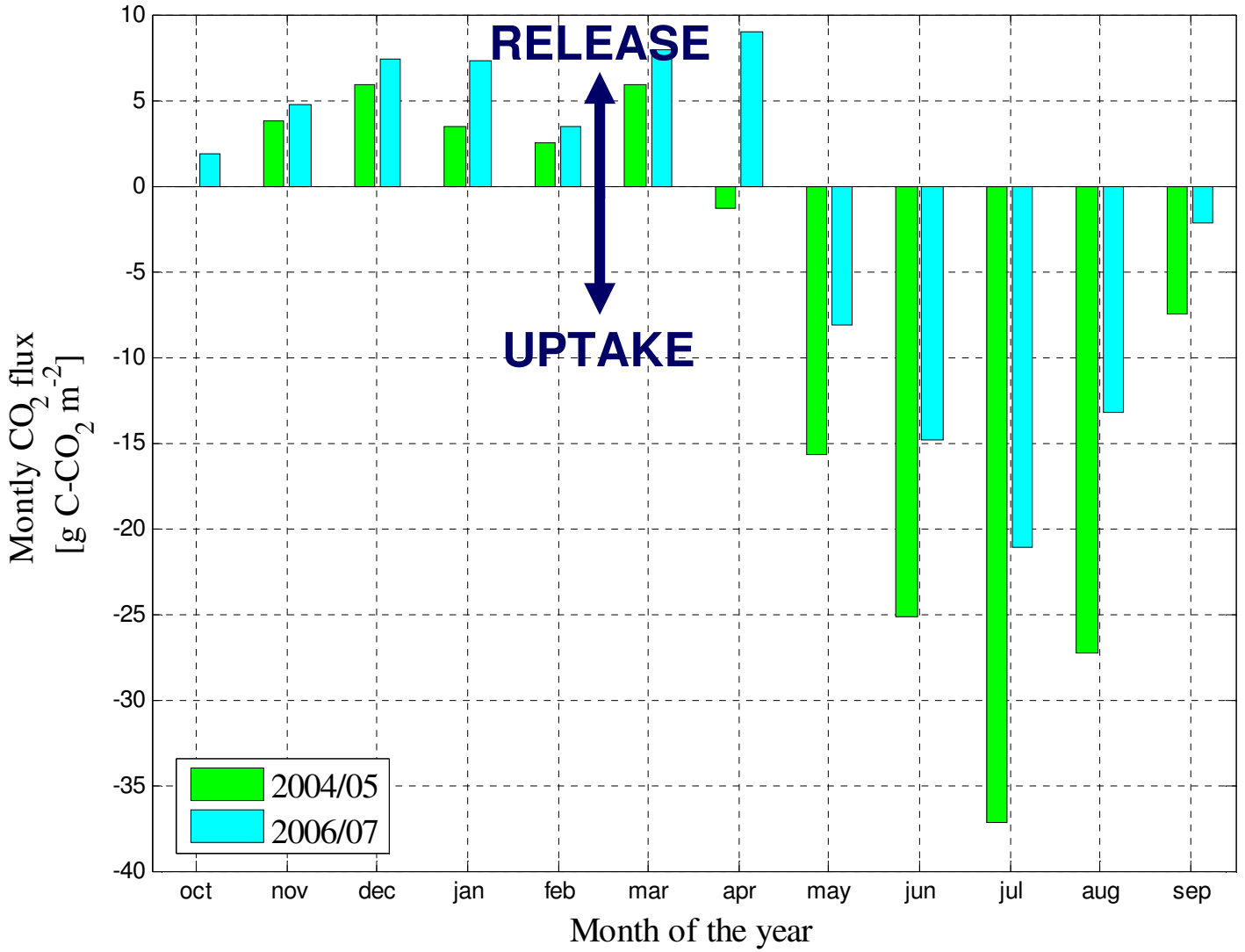
Bog environmental data



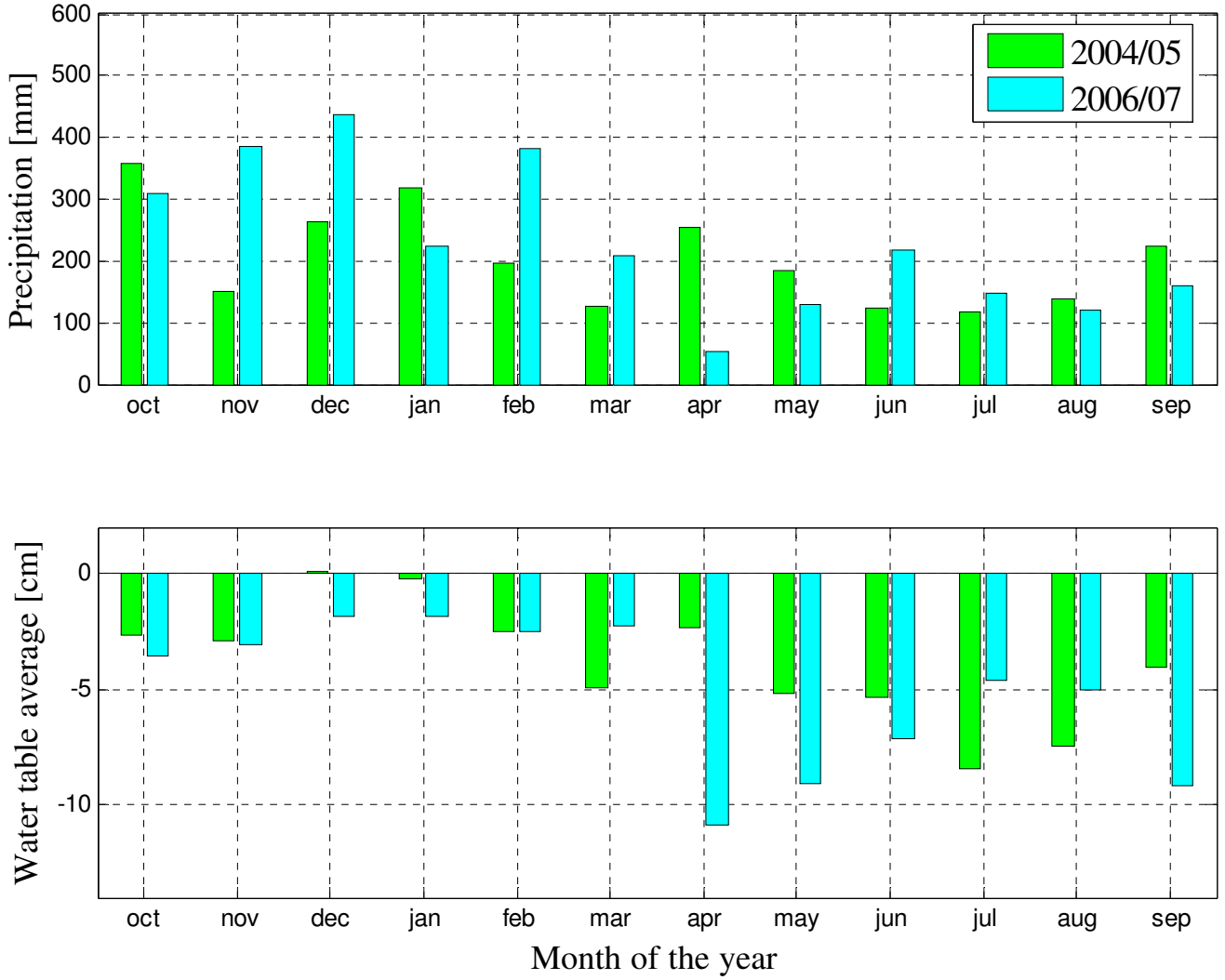
Bog Results: cumulative CO_2 flux



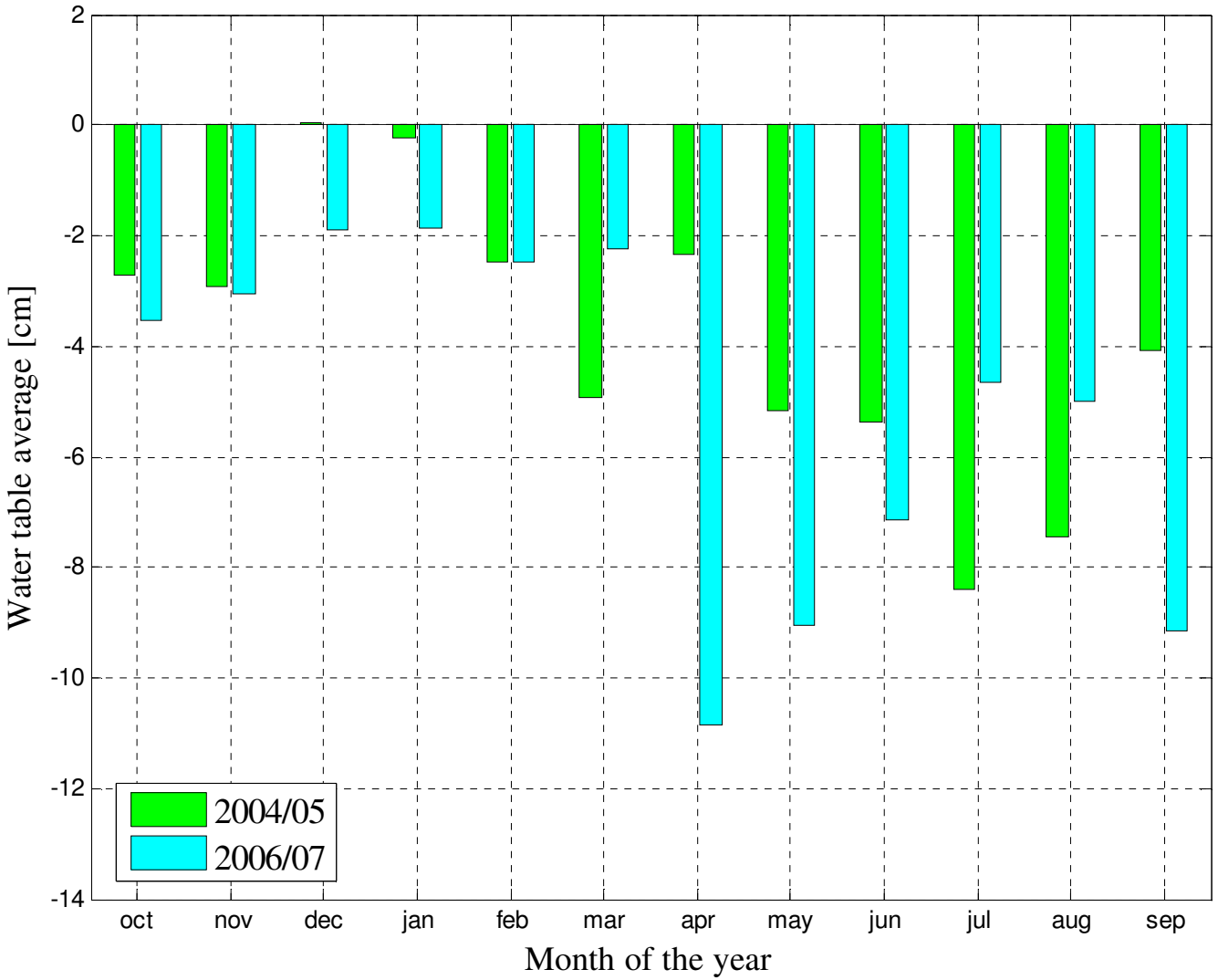
Bog Results: monthly CO_2 flux



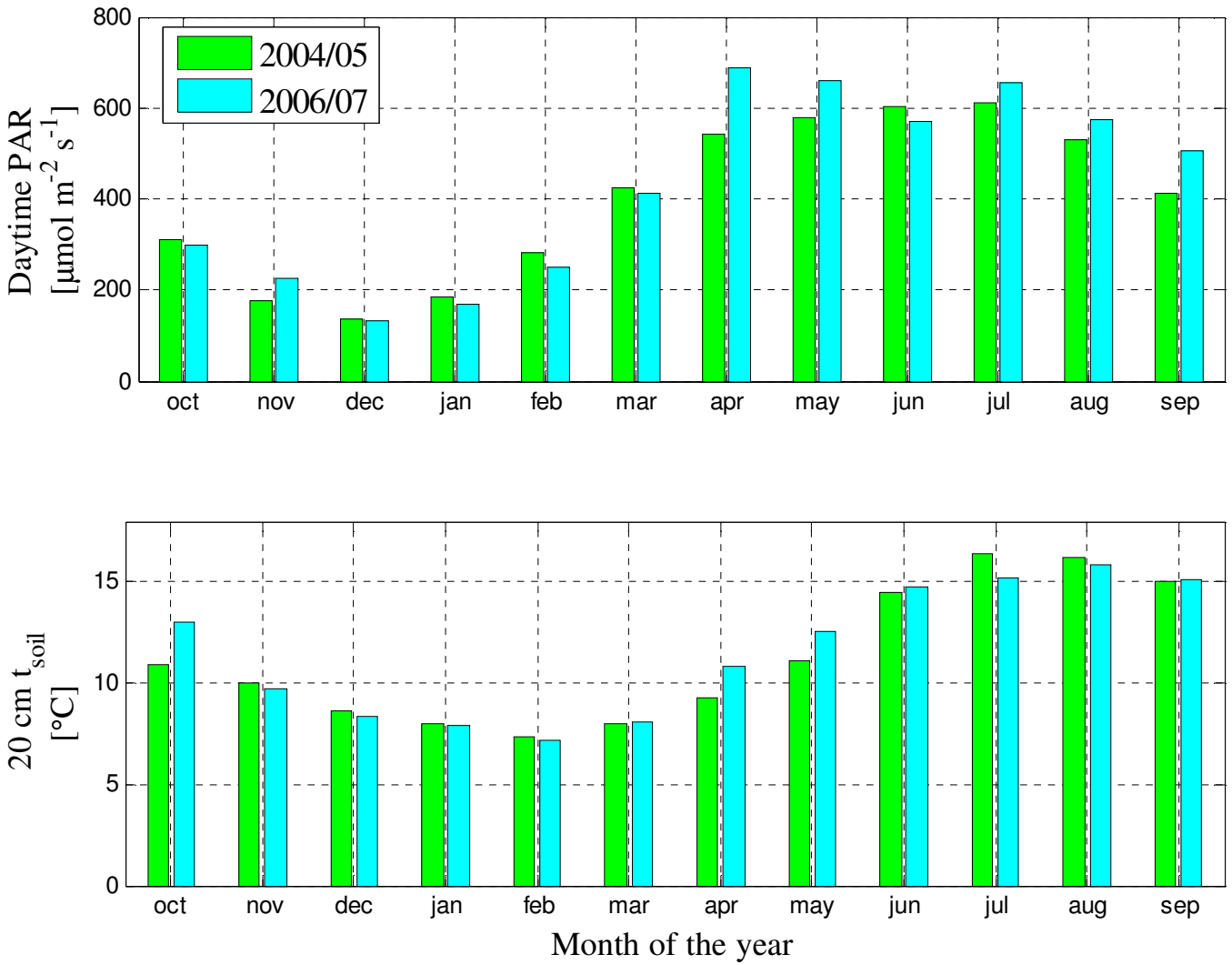
Bog Results: environmental data



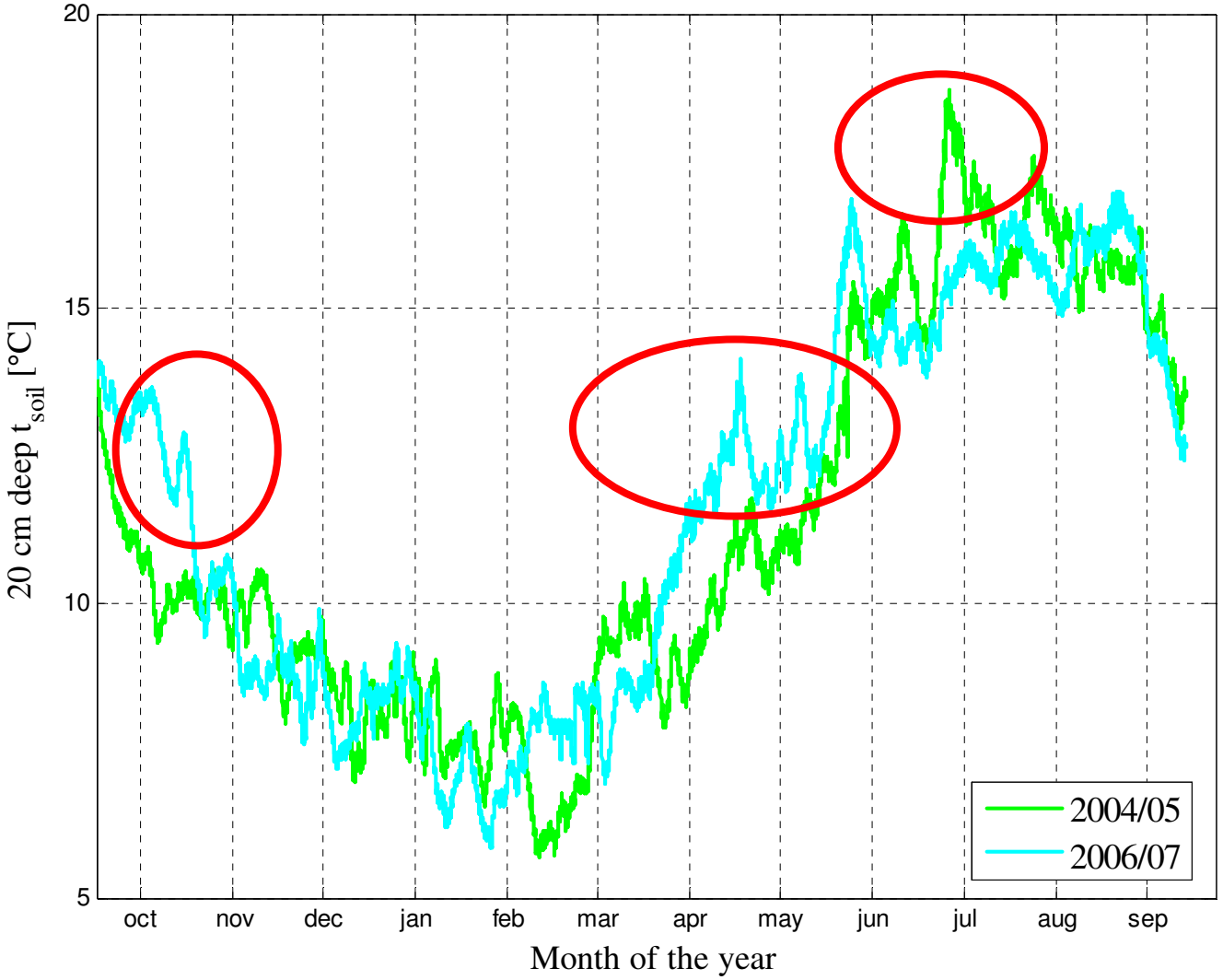
Bog Results: environmental data



Bog Results: environmental data



Bog Results: environmental data



CONCLUSIONS for Glencar Bog -NEE

2004/05…….Highest CO_2 Uptake = - 0.92 TC/ha.

- Low respiration due to “normal” winter/spring temperatures
- High photosynthesis in summer due to frequent but not excess rain with (“normal” water table) accompanied with high soil temperature

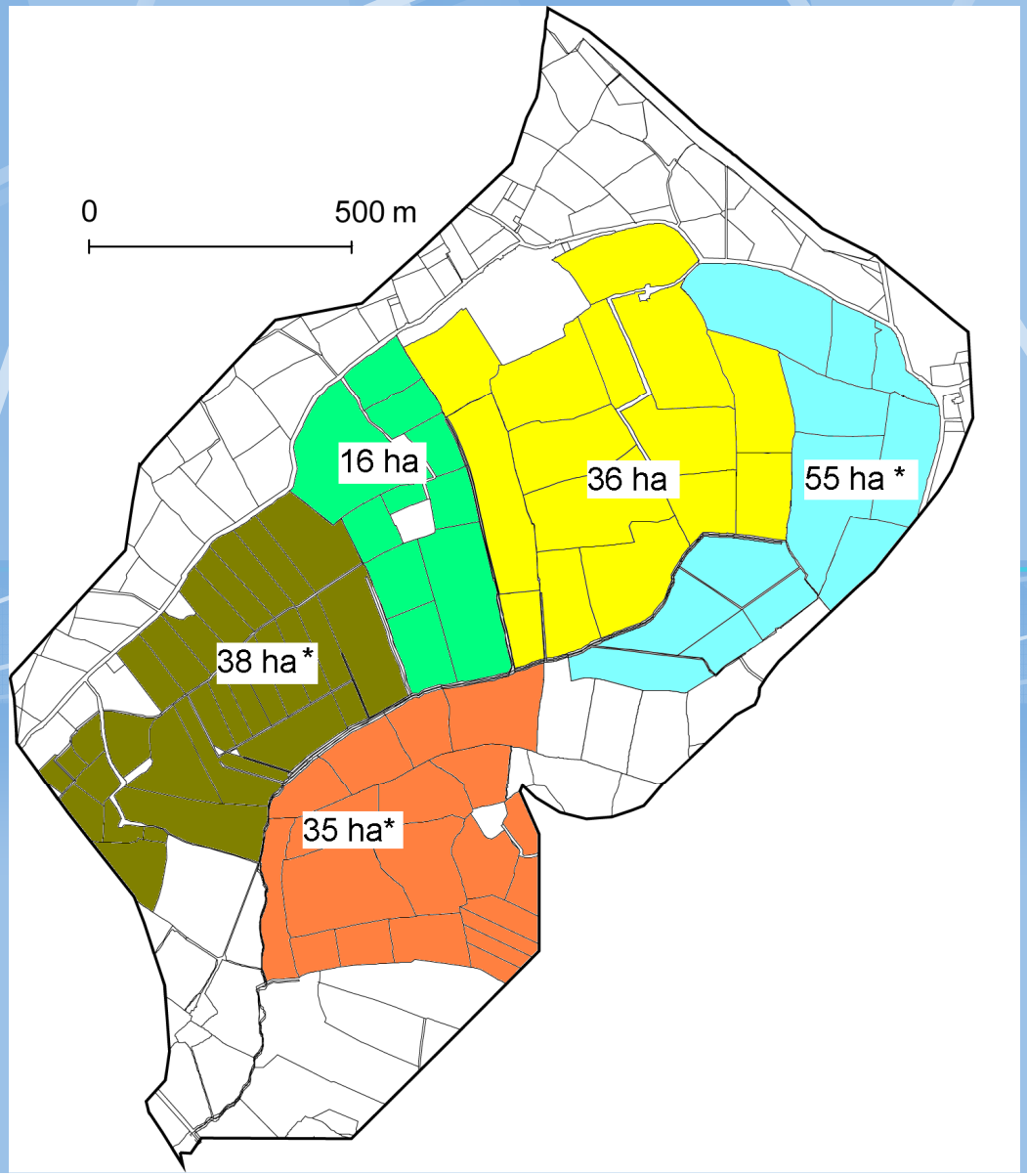
2006/07…….Lowest CO_2 Uptake = - 0.18 TC/ha.

- High Respiration from Spring due to high temperature
- Low photosynthesis in Summer due to excess rain (high water table) and reduced soil temperature (reduced PAR) or drought

- CO_2 Drivers: PAR and Rain and vegetation

Dripsey, Co. Cork - Grassland

Small Farms in Dripsey, Cork.

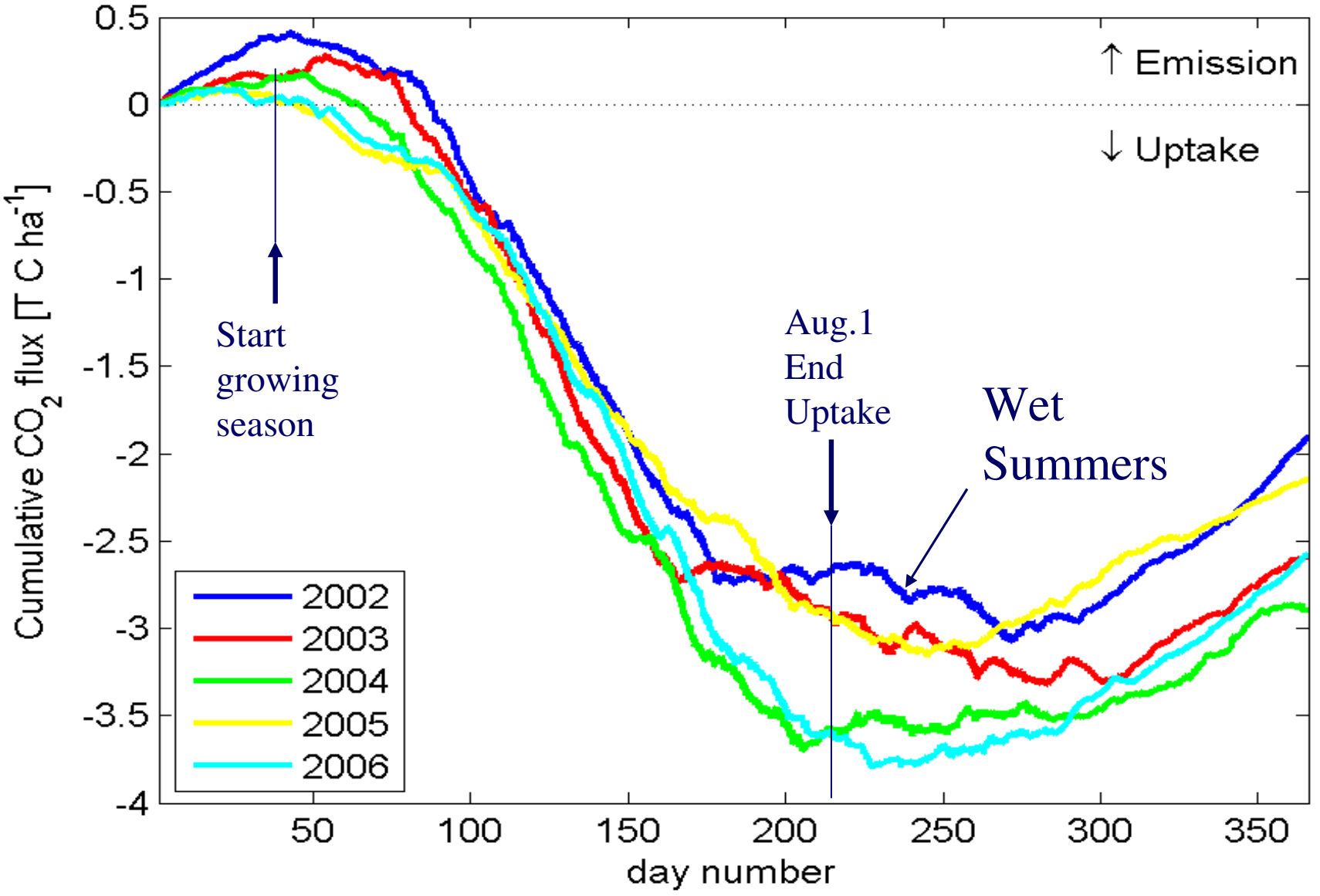


Dripsey Management practices

- ~ 50 ha divided into approx. 50 paddocks.
- Cattle grazing:
  - typically from March to October,
  - density: < 2 LU/ha, with rotations.
- Silage cuts: twice a year.
- Fertiliser + slurry application: < 300 kgN/ha.

in kgN/ha	Chemical fertiliser	Slurry	*Total*
2002	214	91	*305*
2003	204	130	*334*
2004	177	30*	*207*

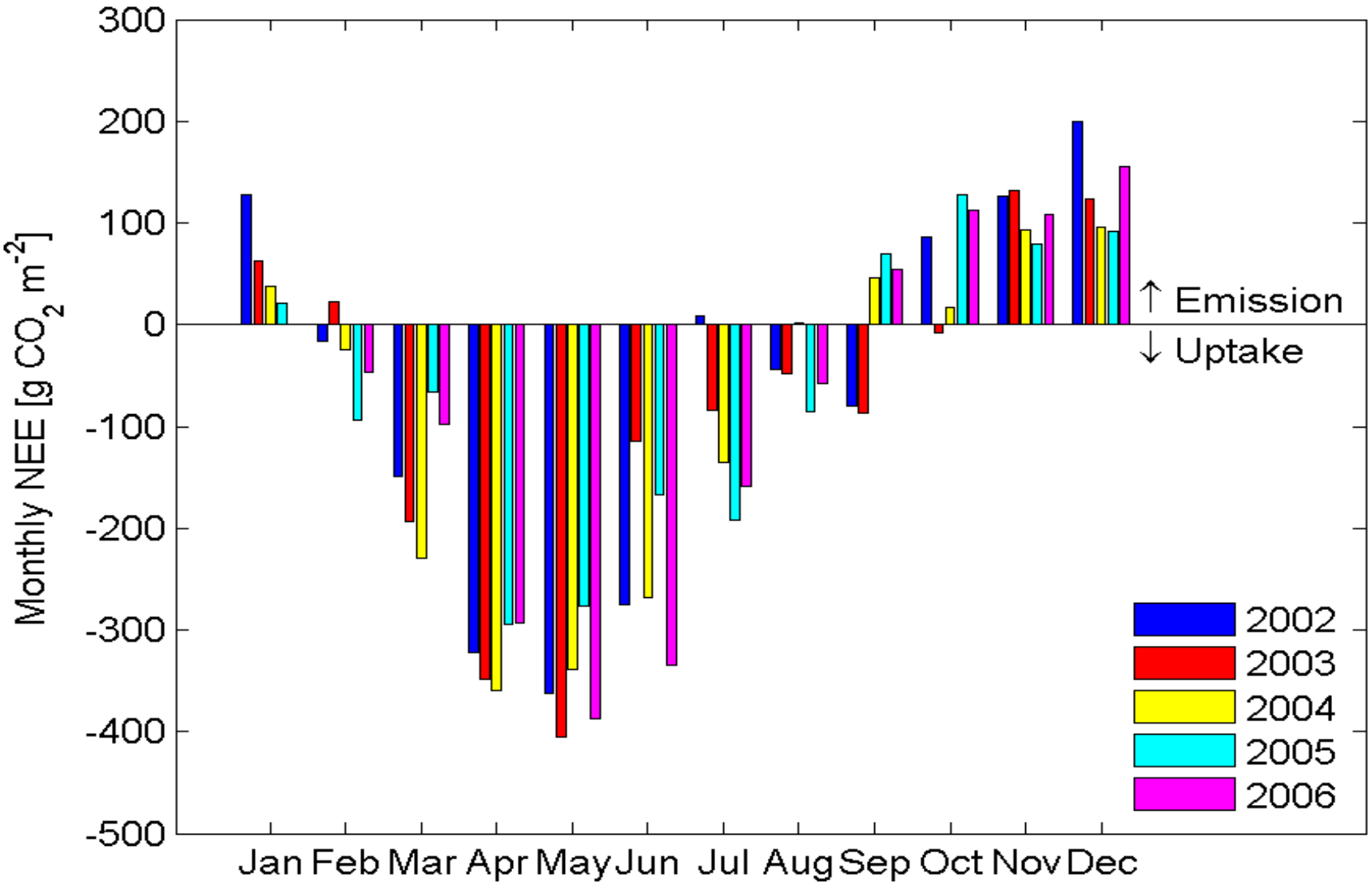
Dripsey - Cumulative NEE in t C /ha



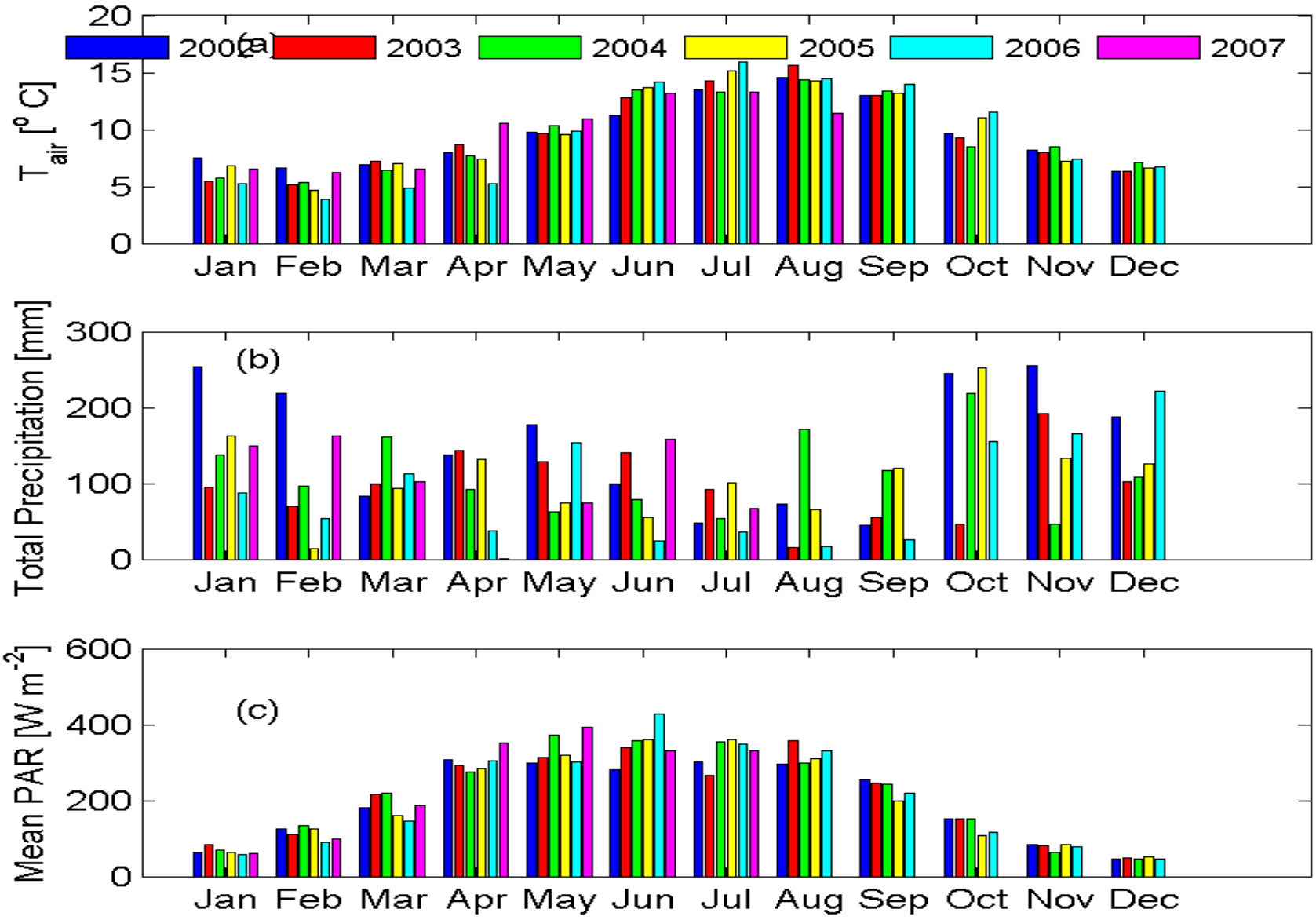
1.9

2.9

Dripsey – Monthly NEE



Dripsey Environmental Parameters



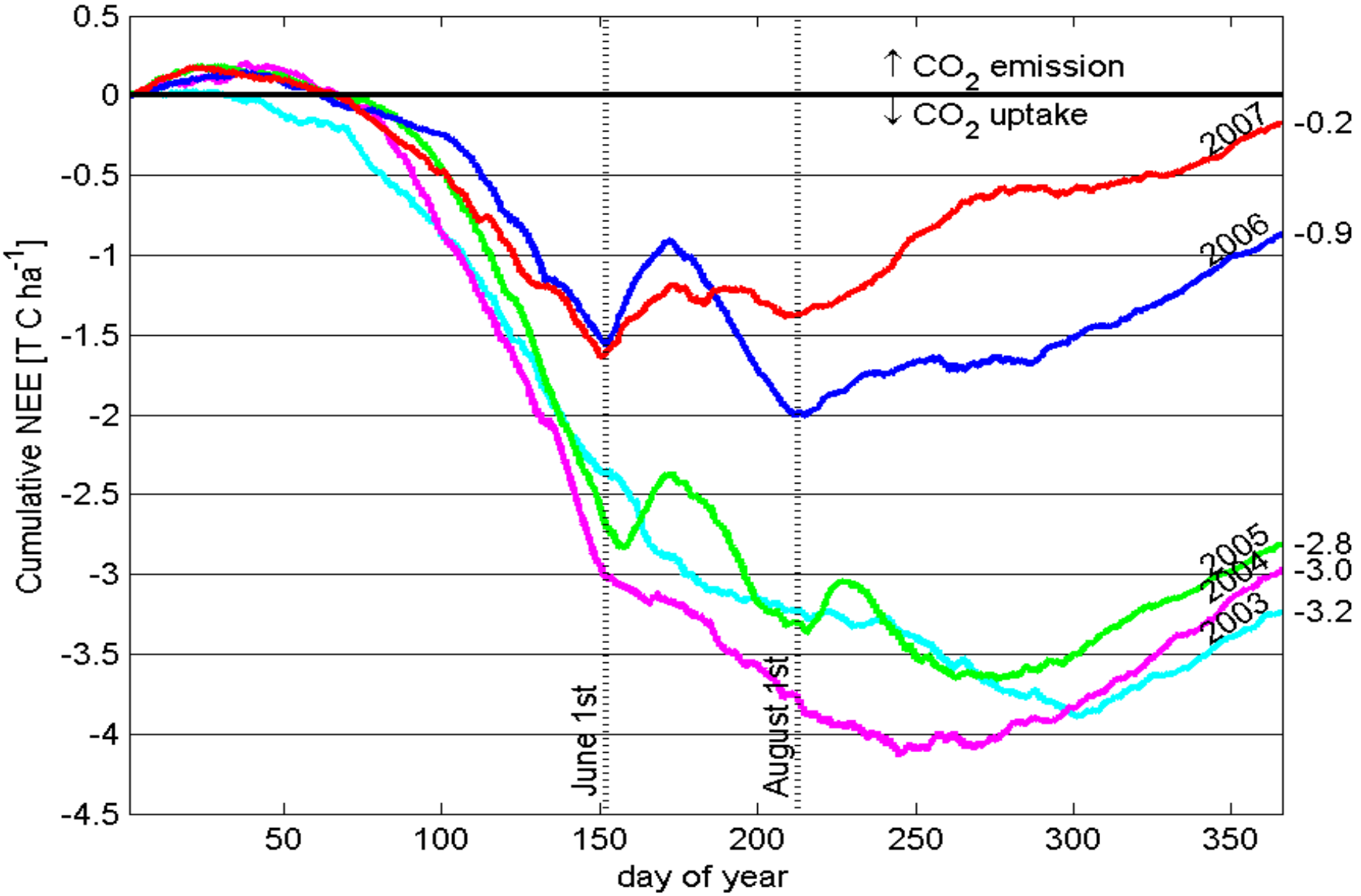
CONCLUSIONS for Dripsey

1. The NEE (CO_2) was -1.9 to -2.9 t C /ha.yr as uptake
2. Resilient to winter Rain
3. Summer rains reduce uptake
4. Based on farm C soil balance, the C sequestered by the soil was ~ -0.5 t C /ha.yr

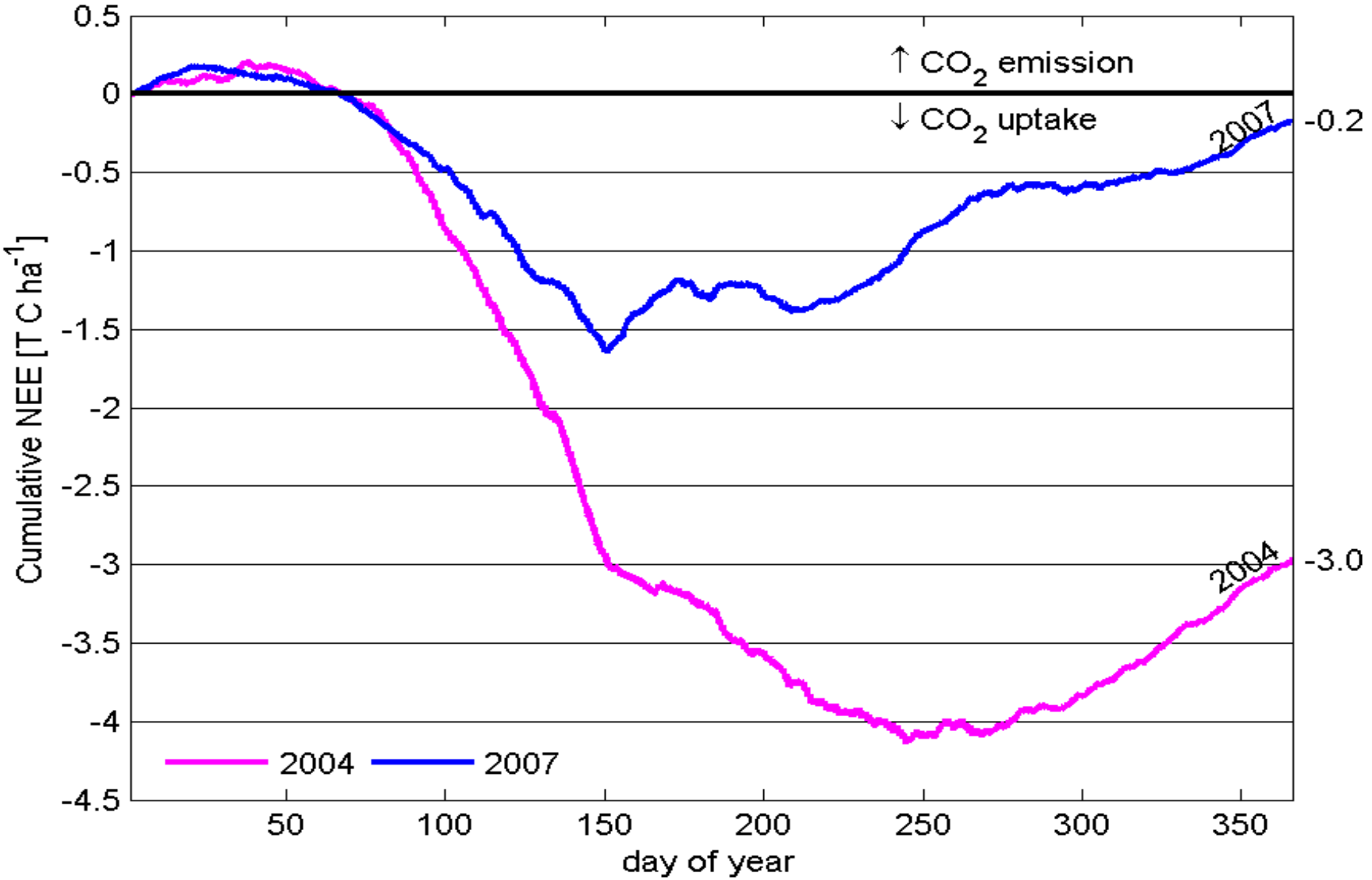
Wexford flux/met data

7th February 2008

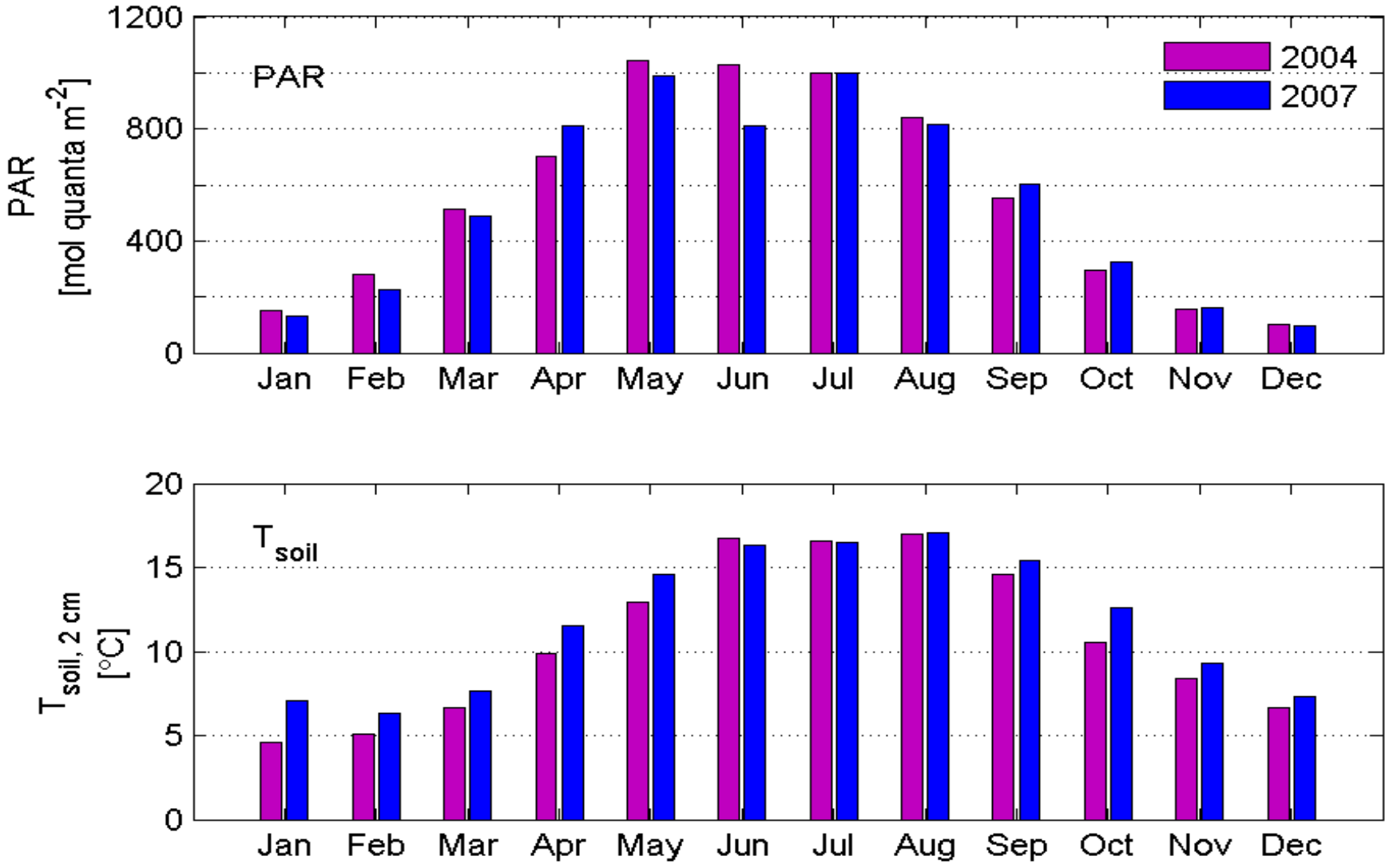
Wexford Grass Fluxes 03 to 07



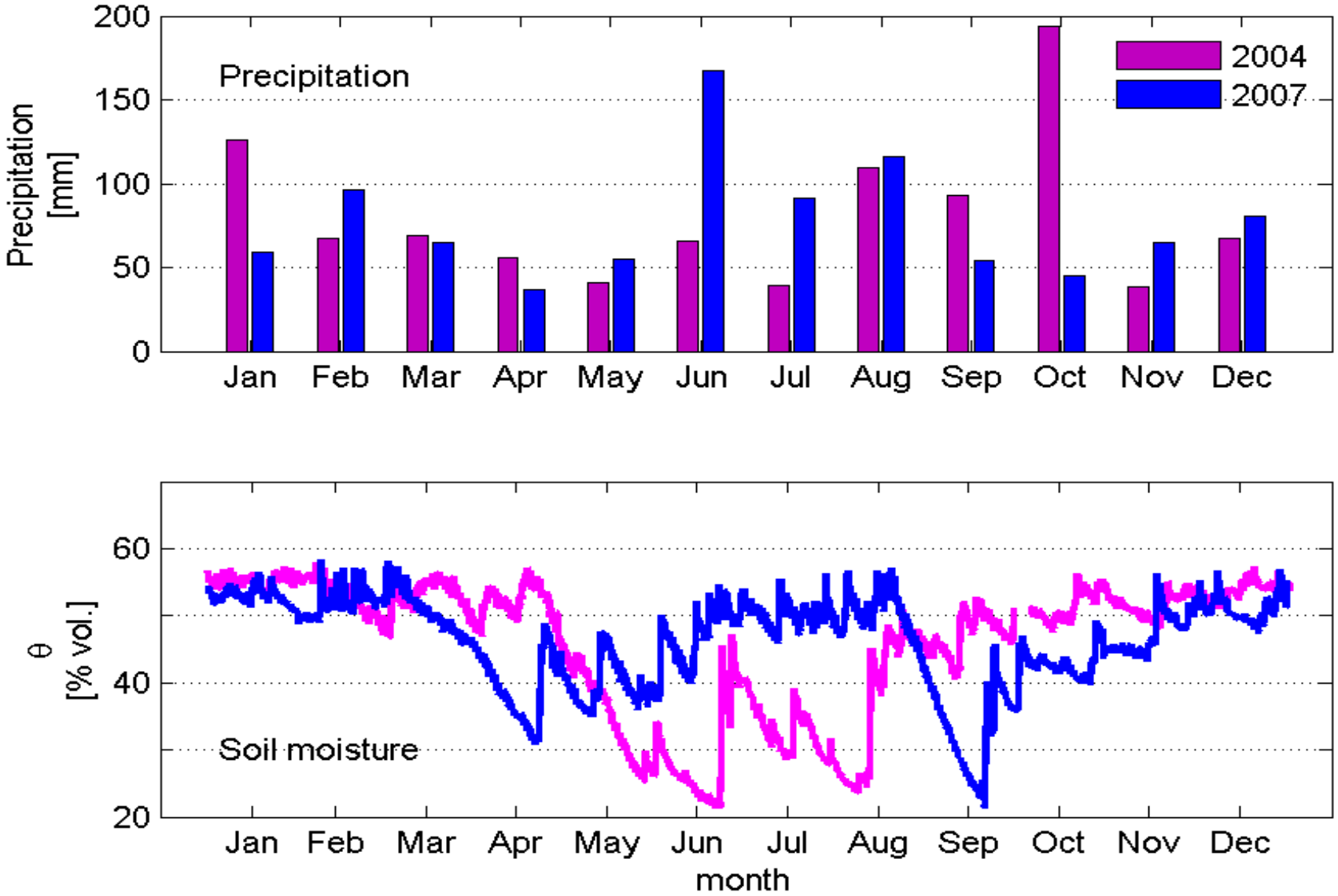
Wexford Grass Fluxes 04 & 07



Wexford met data 2004/2007



Wexford met data 2004/2007



CONCLUSIONS for Wexford

1. The NEE (CO_2) was -0.2 to –3.2 t C /ha.yr as uptake
2. Sensitive to amount and timing of Rain and to PAR changes

Overall Conclusions

BOG:

1. Are sensitive ecosystems and do not do well in extremes of heat or rain

Grasslands:

1. Dripsey (poorly draining soils) are resilient to extremes of winter/spring rain but are poorly productive in wet summers.

2. Wexford (free draining soils) are more sensitive to extremes of rain in Spring and Summer.

Acknowledgements

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All colleagues in the HYDROMET Group at UCC

The END

Thank You

Overall Conclusions

Blanket Bog

- NEE ranges from –0.18 to –0.92 TC/ha.yr
- Total C budget ranges from +0.02 to - 0.73 TC/ha.yr
- Warm winters/spring + cool wet summers increase respiration and so reduce uptake
- Normal winters/spring reduce respiration and moist warm summers increase photosynthesis and so increase uptake

Grasslands

- Wexford NEE ranges from –0.02 to – 3.2 TC/ha.yr
- Dripsey NEE ranges from –1.9 to – 2.9 TC/ha.yr
- Dripsey more resilient to changes in rain and PAR amount
- Wexford sensitive to rain amount and timing and to PAR changes