# Links between Dissolved Organic Carbon export and terrestrial primary productivity: implications for controls on the latter

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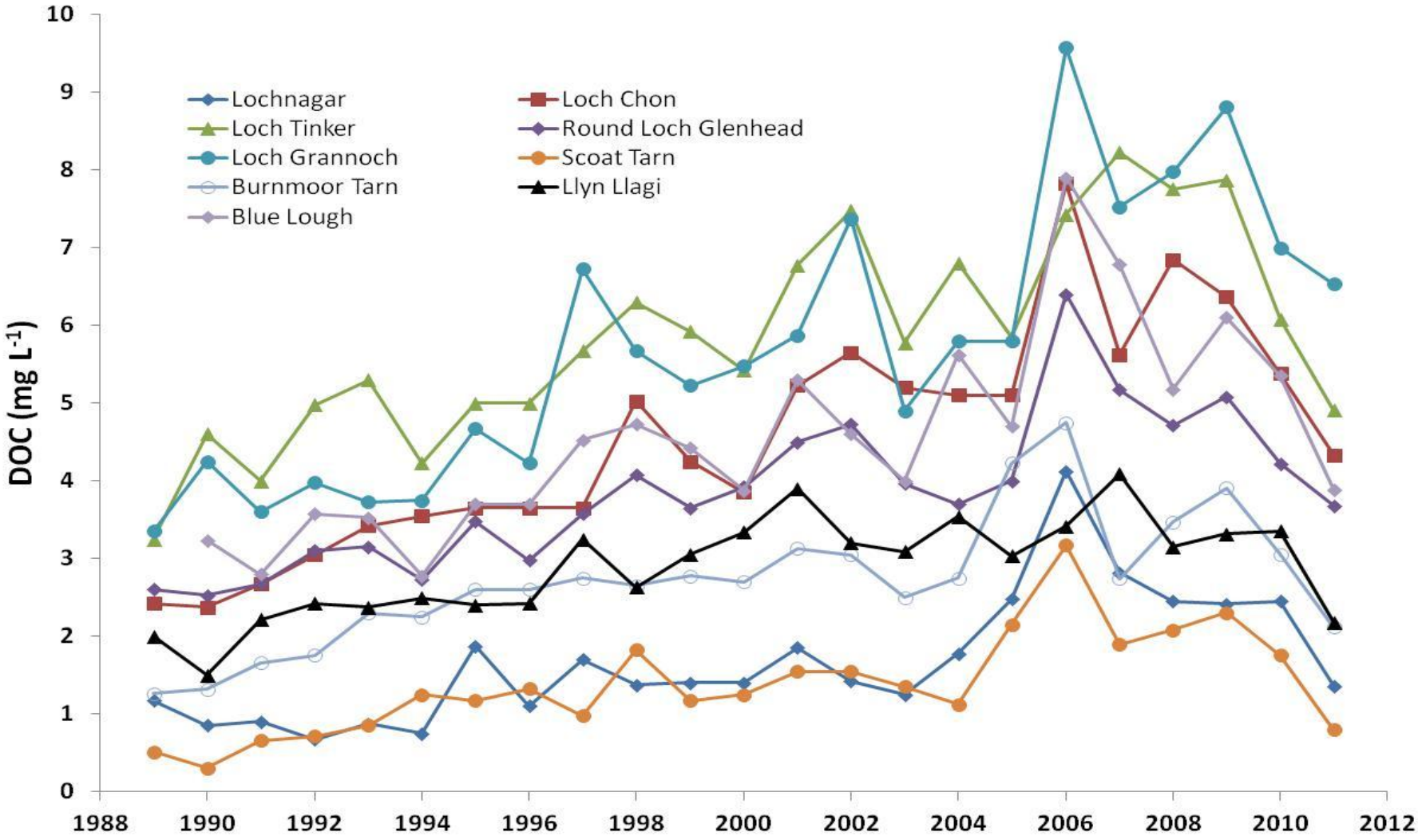
# UK upland DOC concentrations: increasing over past 3 decades

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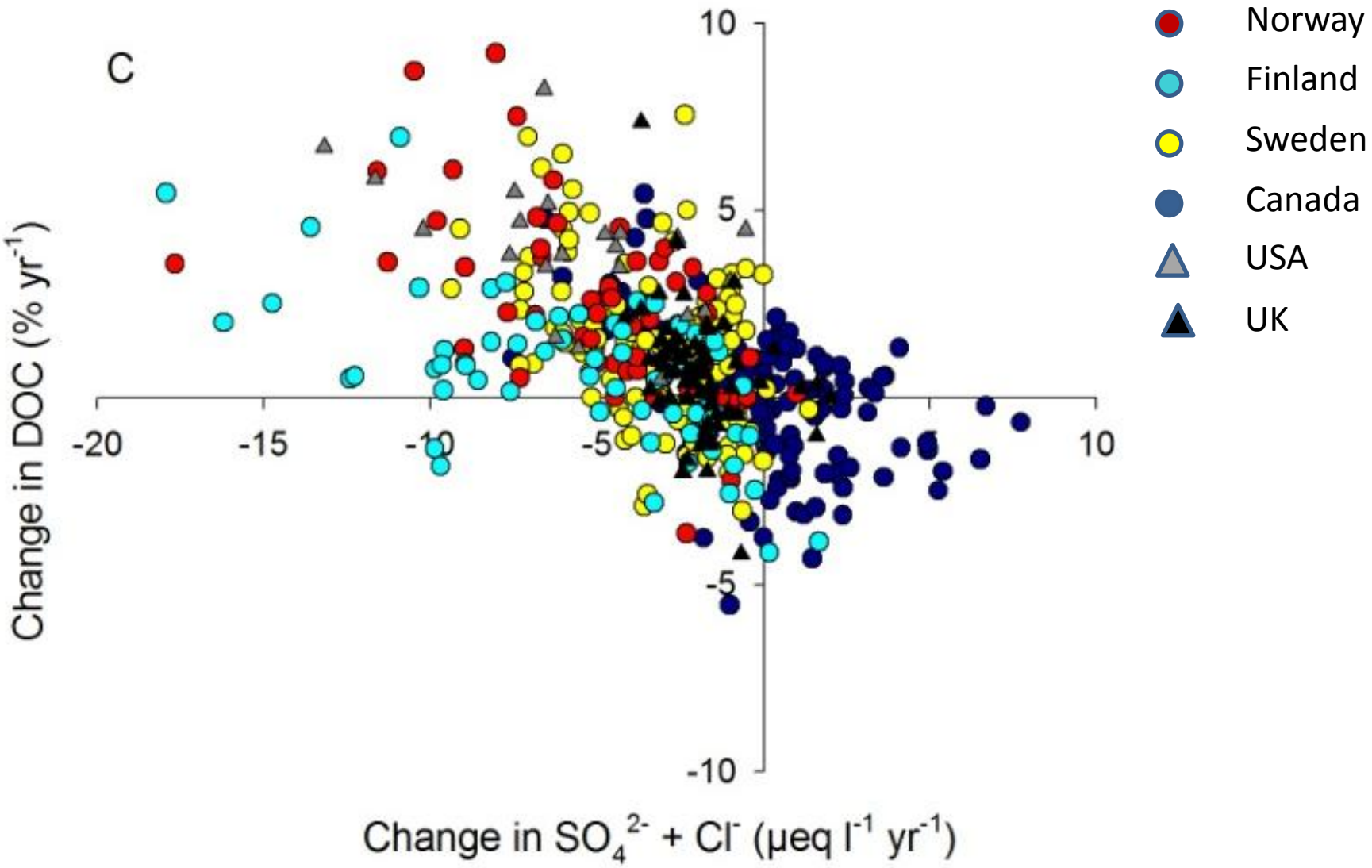
Data source: UK Upland Waters Monitoring Network

# Rate of change in DOC ∞ rate of change in acid deposition




Monteith et al., Nature 2007

# $^{14}C$ measurements suggest DOC draining UK uplands is predominantly modern

e.g.

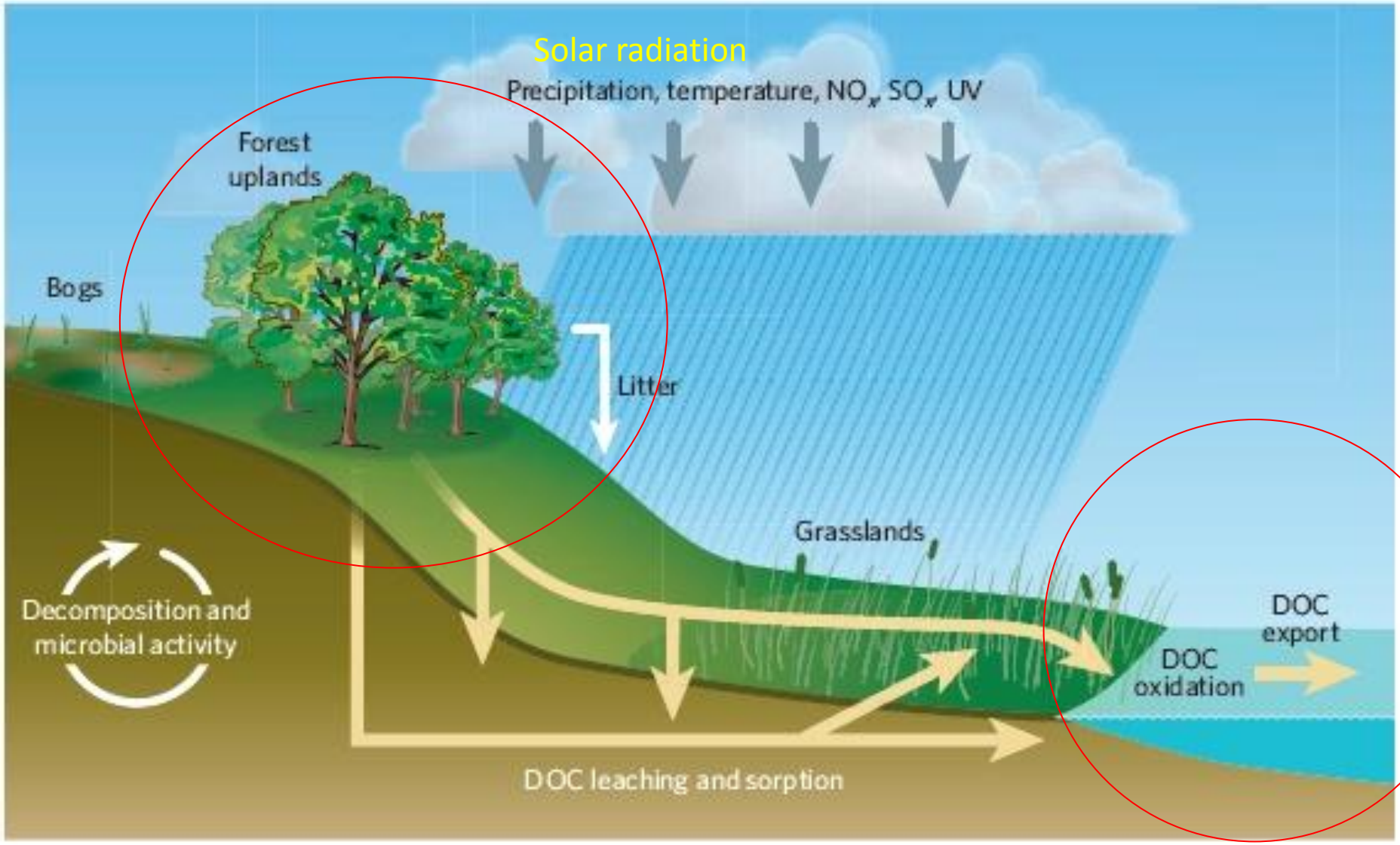
- “DOC exported from C-rich landscapes appears younger than the soil C itself, much of it comprising C assimilated post-1950s.”

  Evans et al. Geophys Res Lett 34, 2007.

- “peat-derived DOM is 5 years old on average, with most of it very recently formed.”

  Tipping et al. Biogeochemistry 100, 2010.

# so could DOC be used as an indicator of primary productivity both in time and space?

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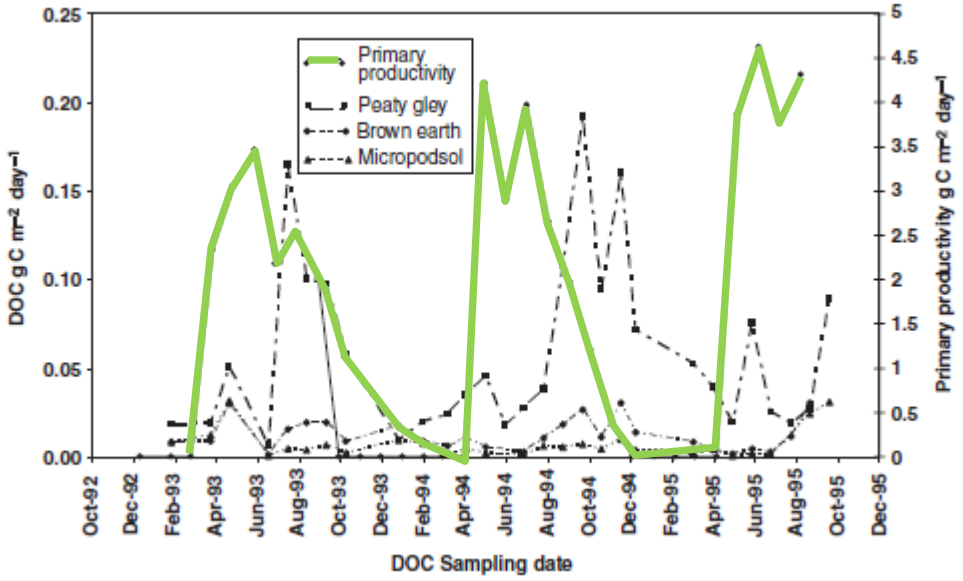
From Roulet & Moore, 2006. Nature

# DOC production at Moor House linked to productivity

- Harrison et al., GCB, 2008: - DOC release from Moor House soils manipulation experiments.

- DOC release strongly dependent on current and two-month lagged solar radiation




NPP estimate: constant light use efficiency of 0.48 gC $MJ^{-1}$ when mean monthly temp >6°C

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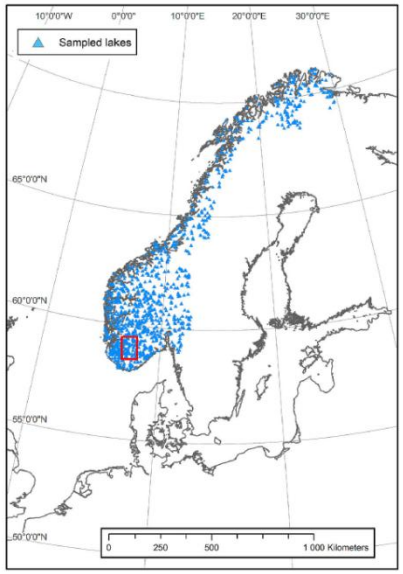
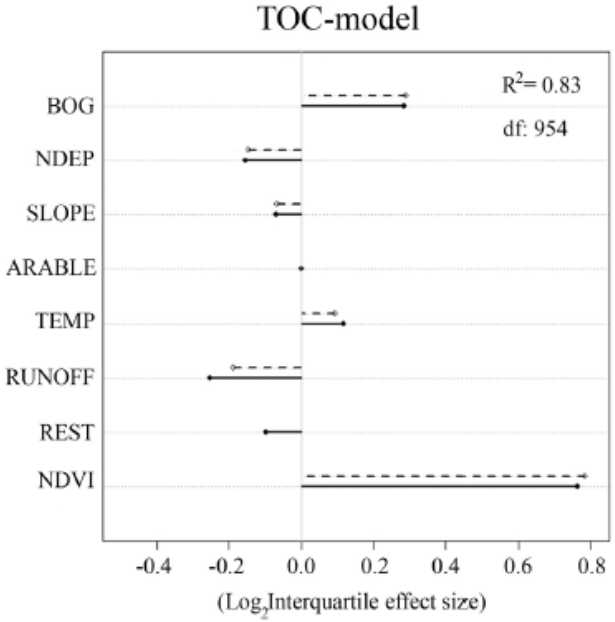
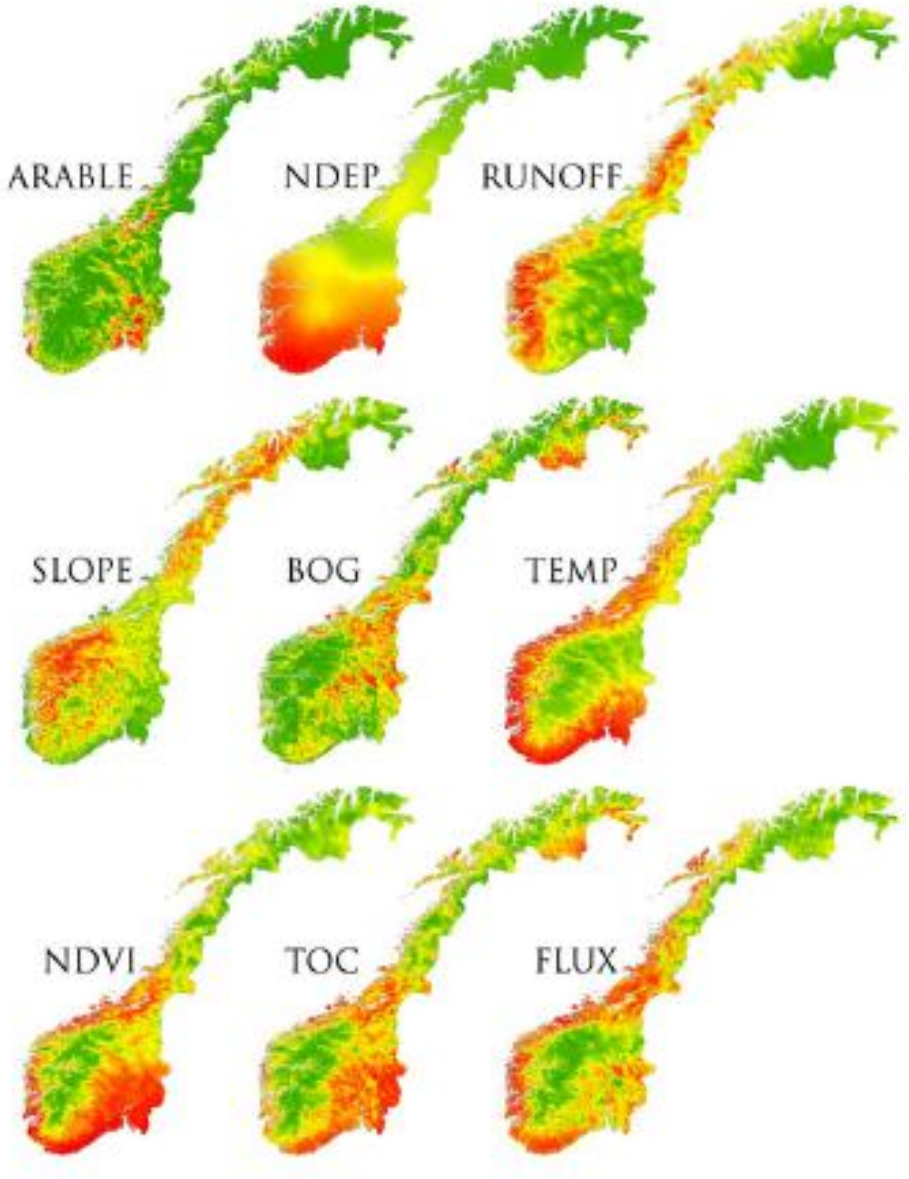
# NDVI: “by far the strongest predictor of Norwegian DOC concentrations & fluxes” (attributed to vegetation density)

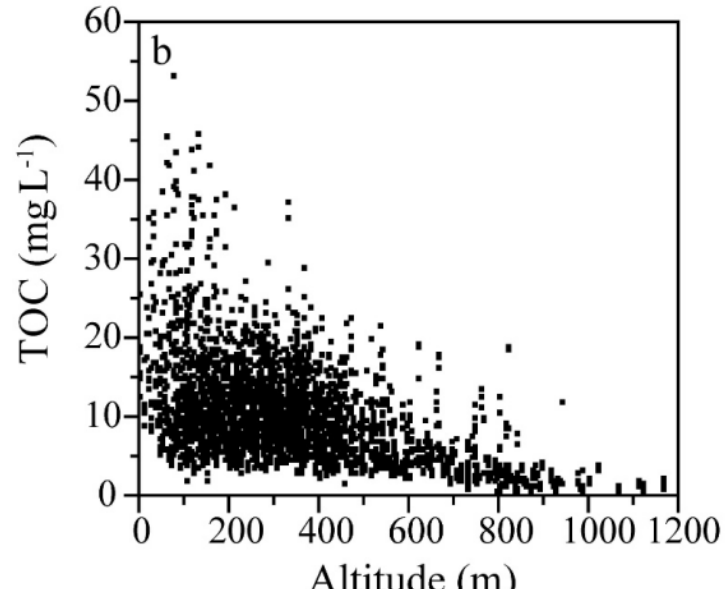


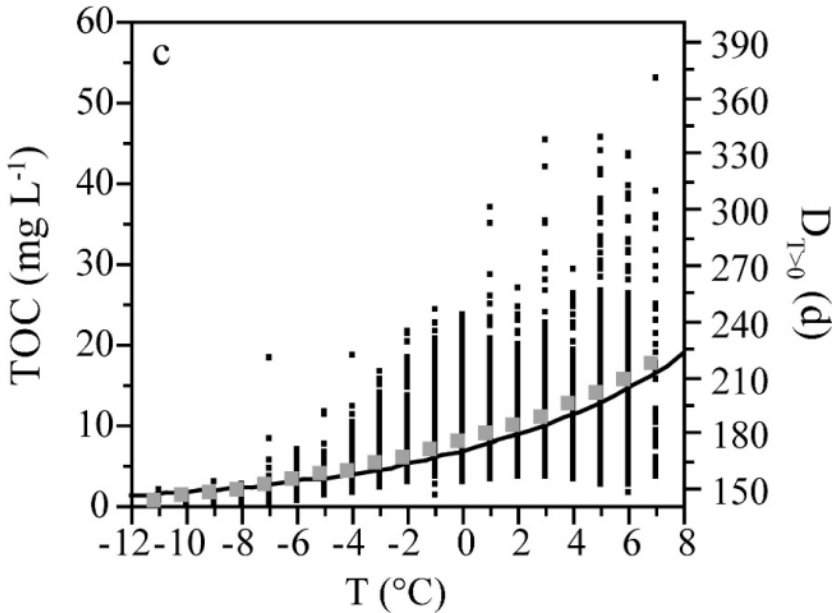




Larsen et al. 2011. Global Biogeochemical Cycles

# “DOC best explained by the number of days when air temperatures exceeded 0° C, i.e., the duration of the main growing and runoff season”

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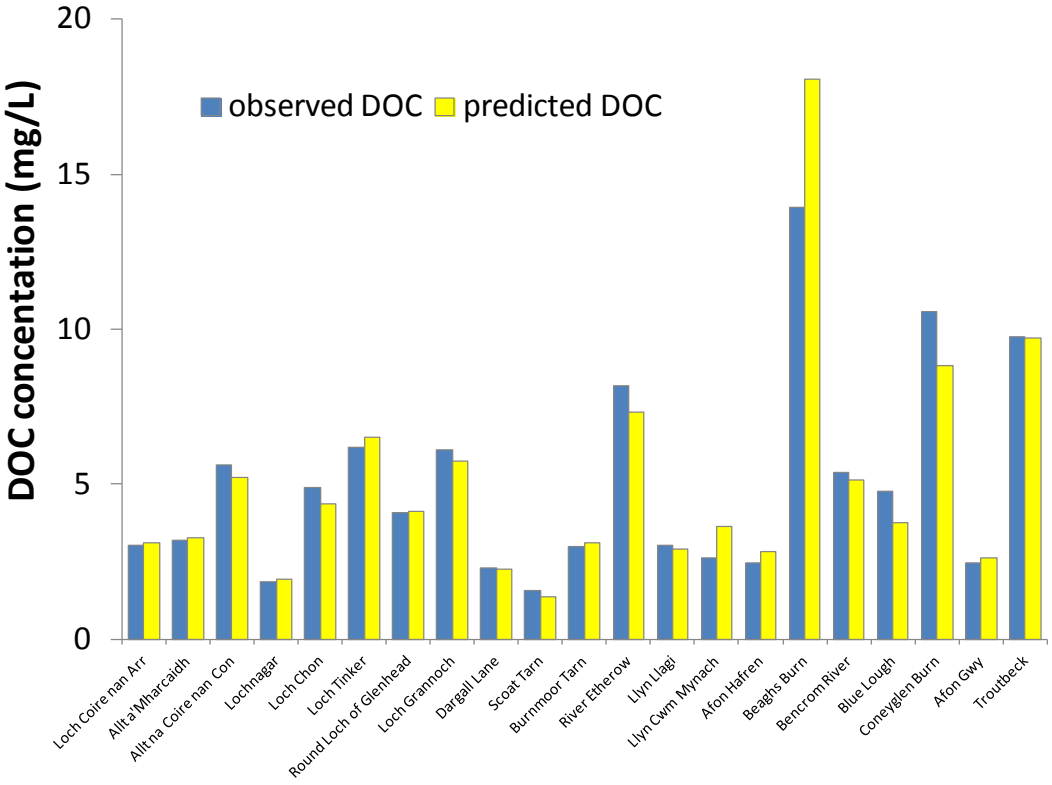
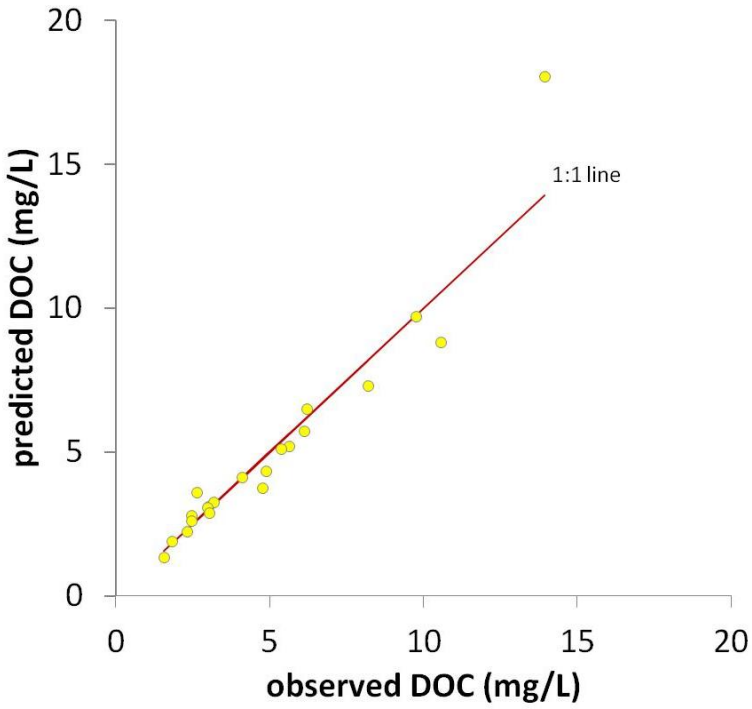
Wehenmeyer & Karlsson, 2009. Limnology & Oceanography

# simple linear model for long term mean concentrations

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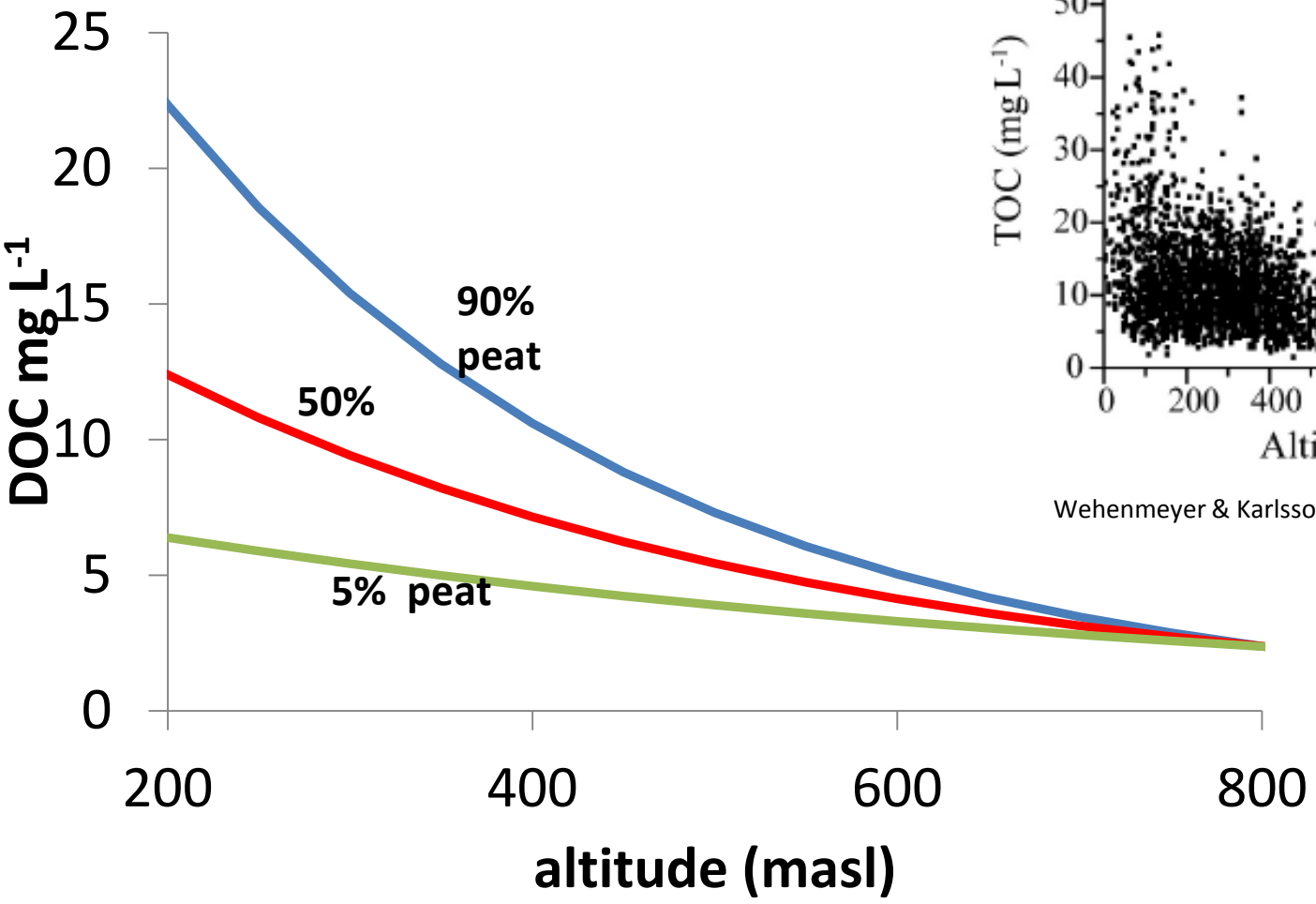
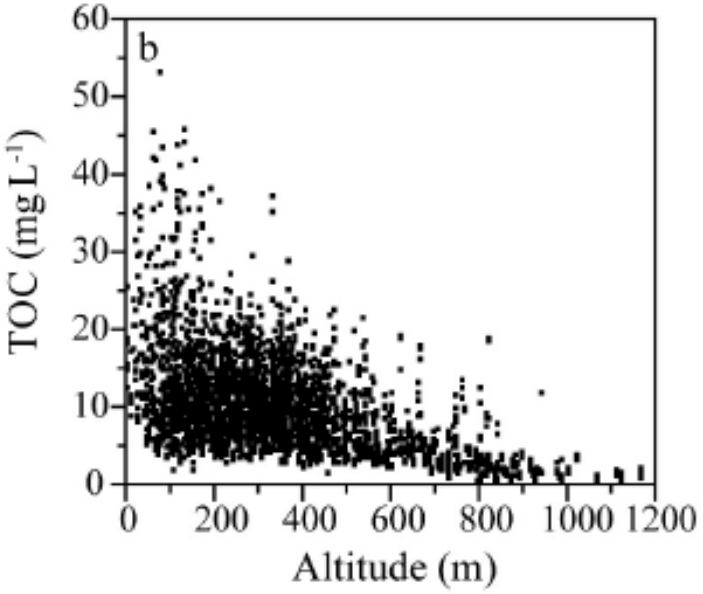
# “altitude” major determinant in UK statistical model




Wehenmeyer & Karlsson, 2009. Limnology & Oceanography

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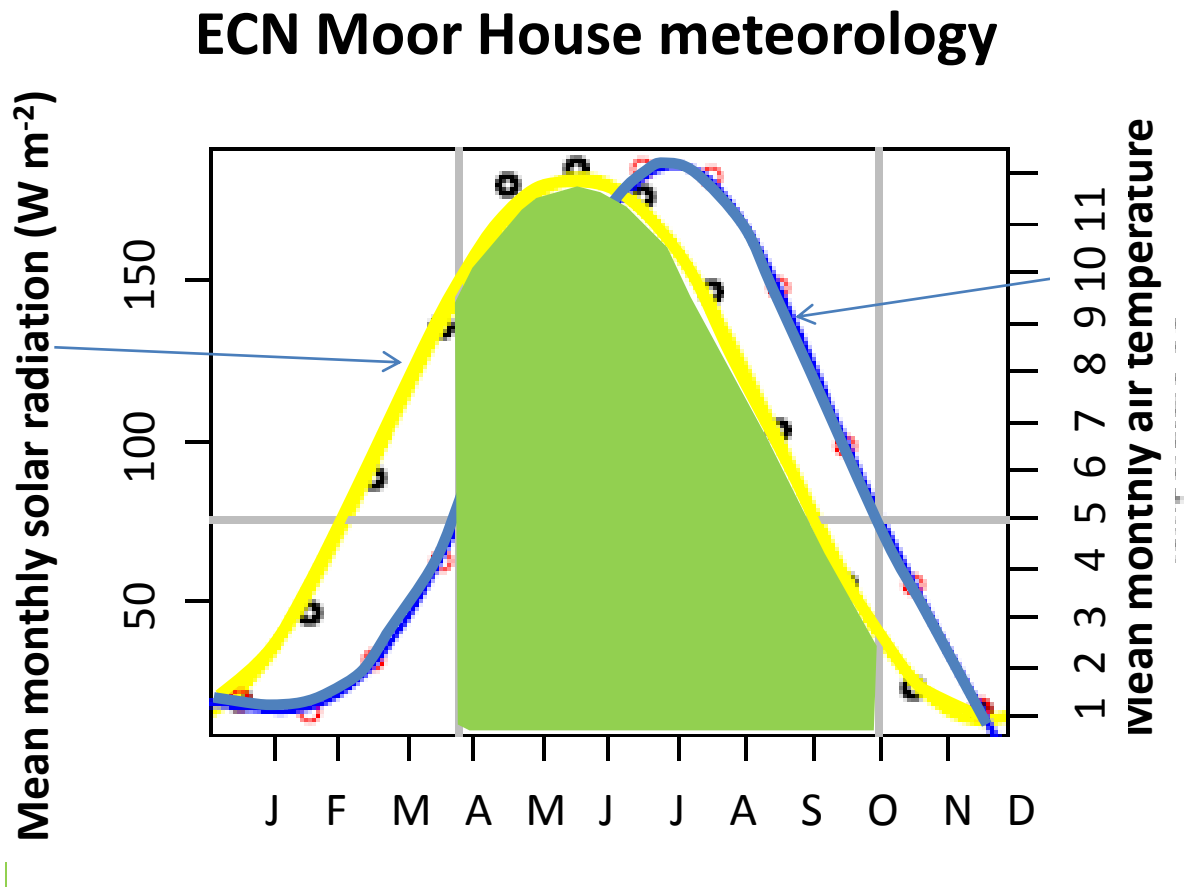
# Effect of altitude on energy capture during growing season

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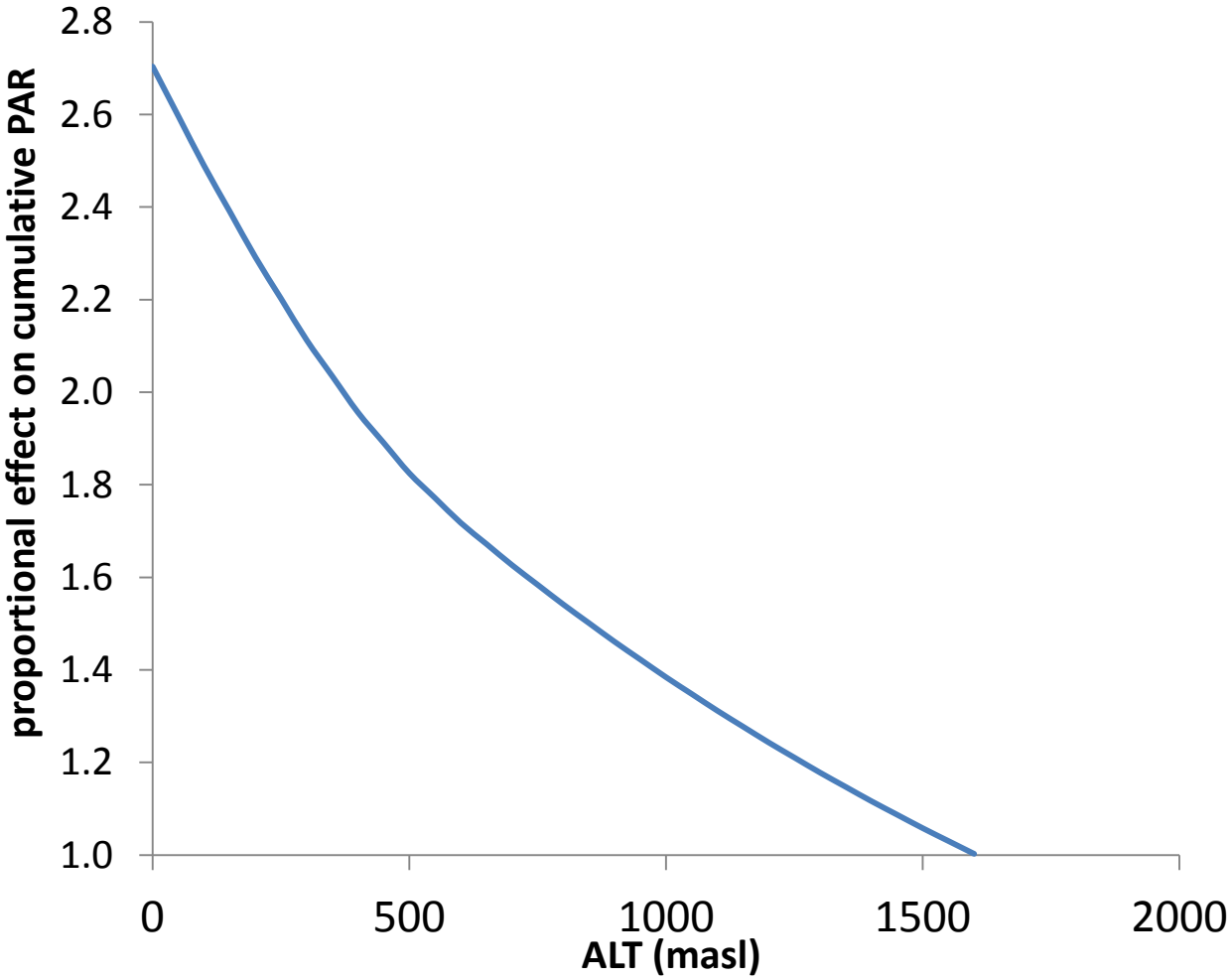
# ECN sites used to predict effect of altitude on cumulative growing season PAR

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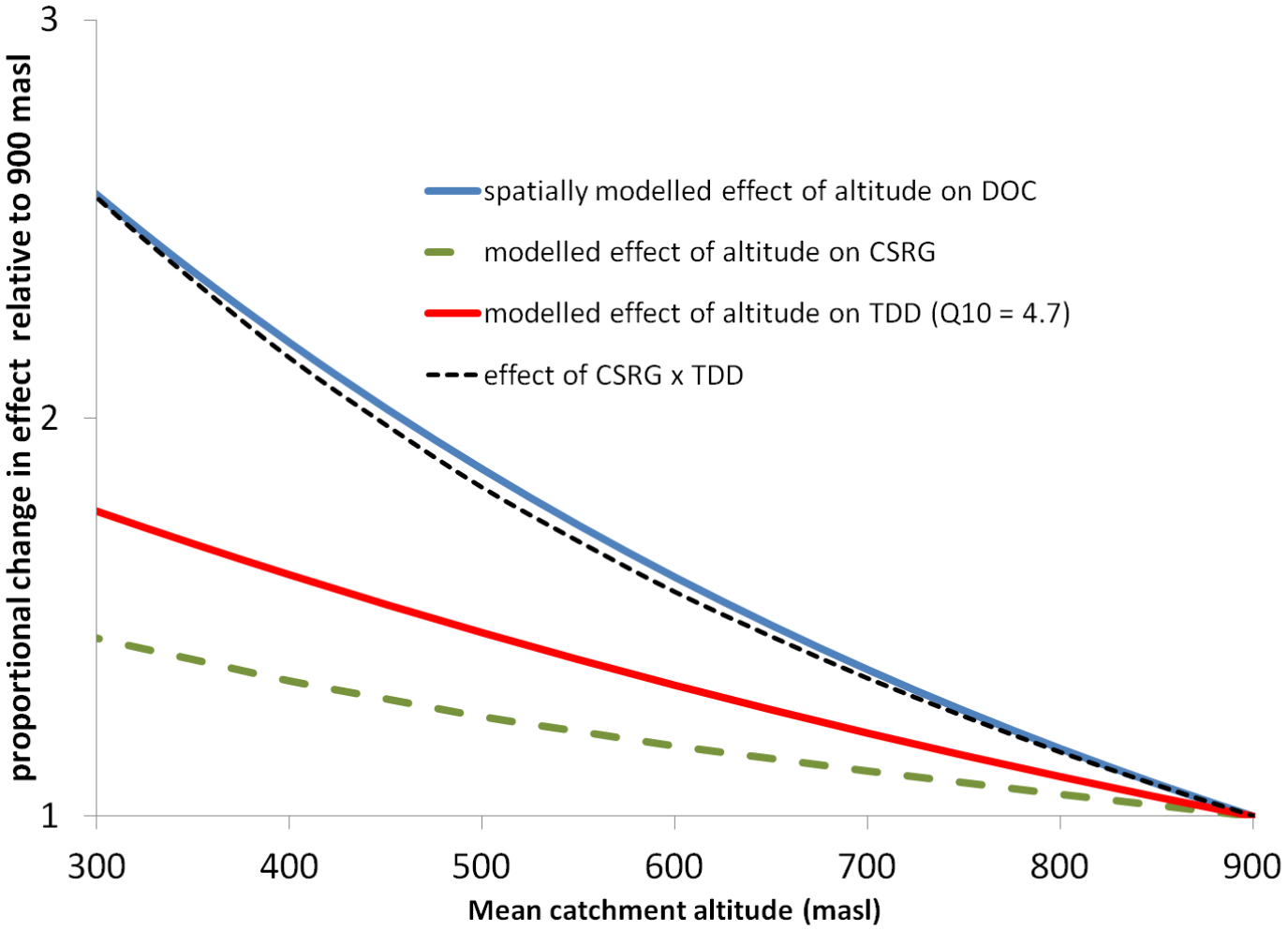
# Response of DOC concentration to altitude explained by combined effects of altitude on cumulative PAR and temperature dependent decomposition (Q10 = 4.7)

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# Key points:

- DOC concentrations draining upland landscapes appears to be highly predictable
- Reasonable grounds to suspect influence of altitude on DOC export is partly due to effect on NPP – in turn linked to cumulative growing season PAR
- Energetics approach to modelling NPP makes strong mechanistic sense
- Role of water and nutrients as potentially limiting factors can then be described with respect to effect on **light use efficiency**
- Has light use efficiency in the uplands (e.g. Moor House) changed since first estimates made in 1970s?