CO_2 diffuse processes in soils: impacts of rainfall, snowpack and closed chambers

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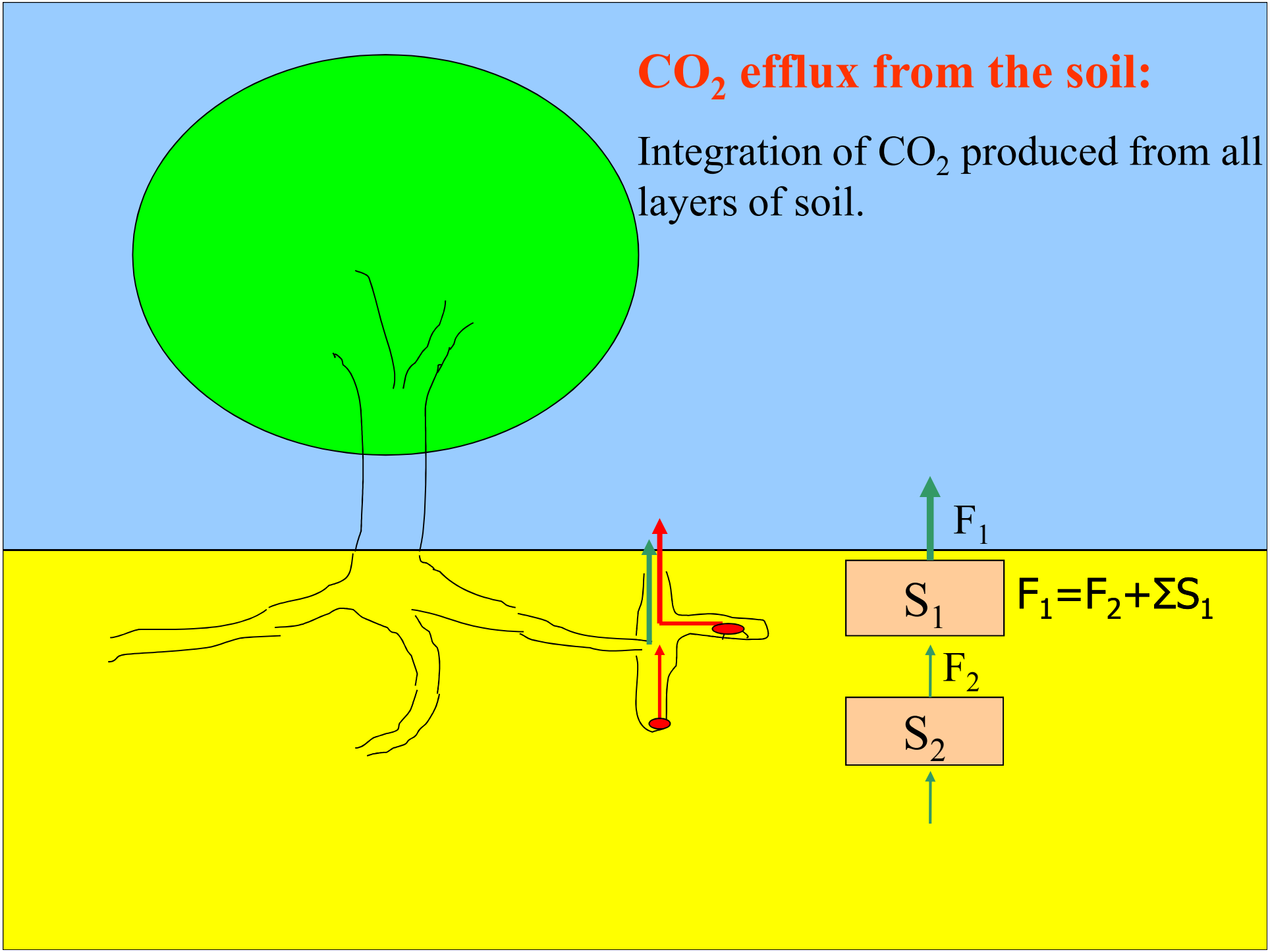
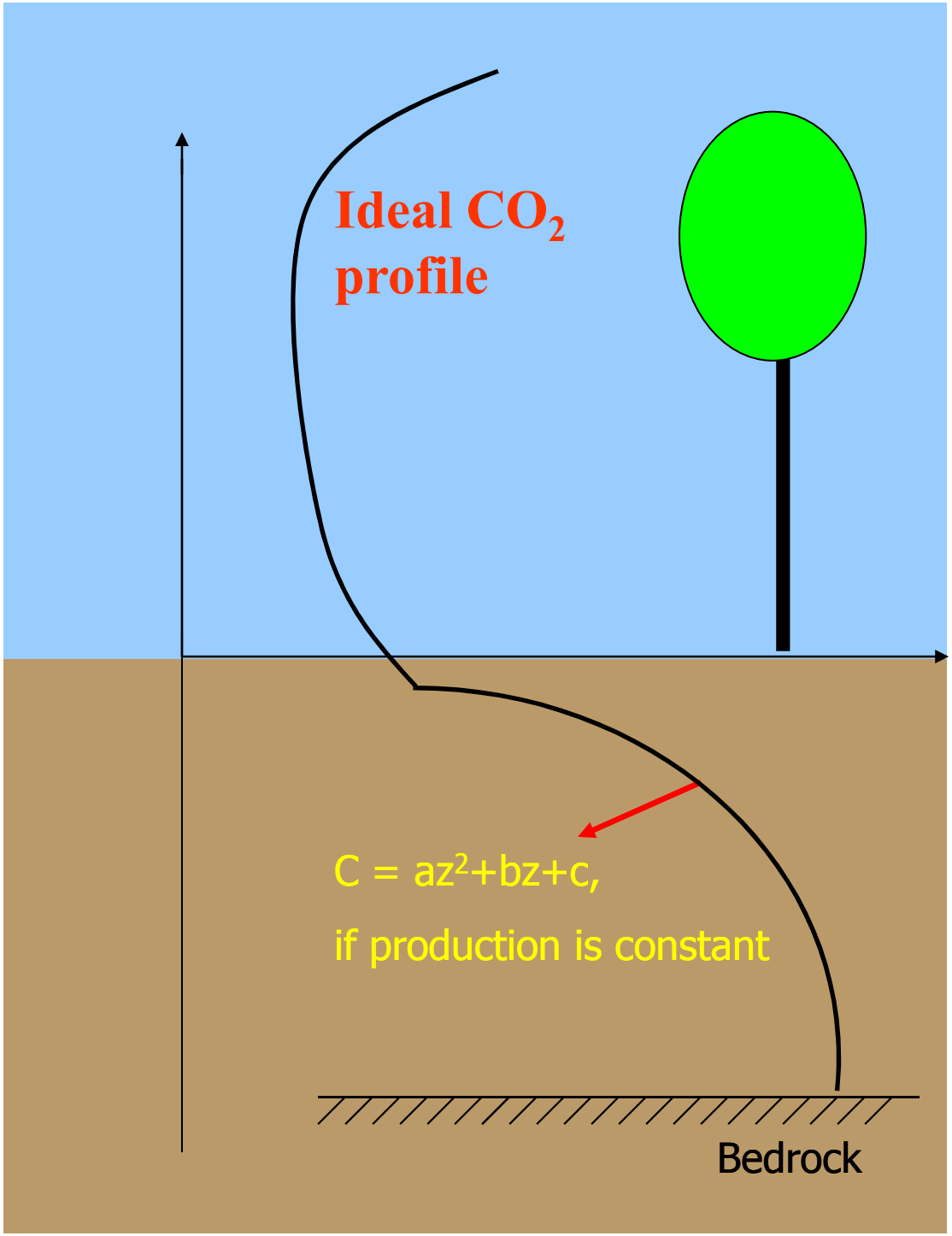
CO_2 efflux from the soil:

Integration of CO_2 produced from all layers of soil.

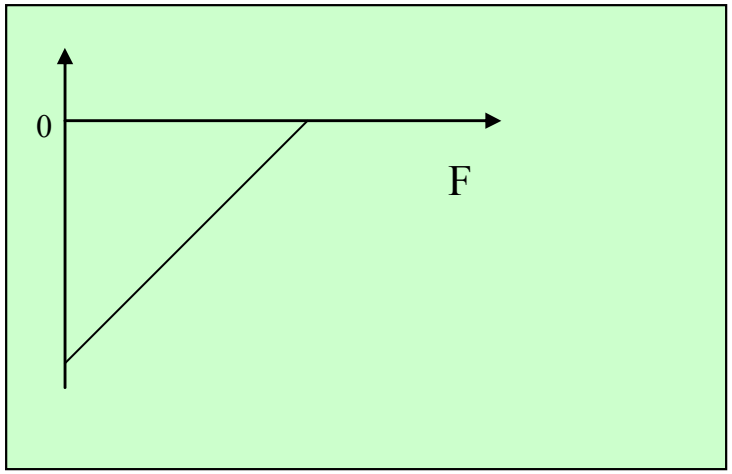


Daytime CO_2 profile

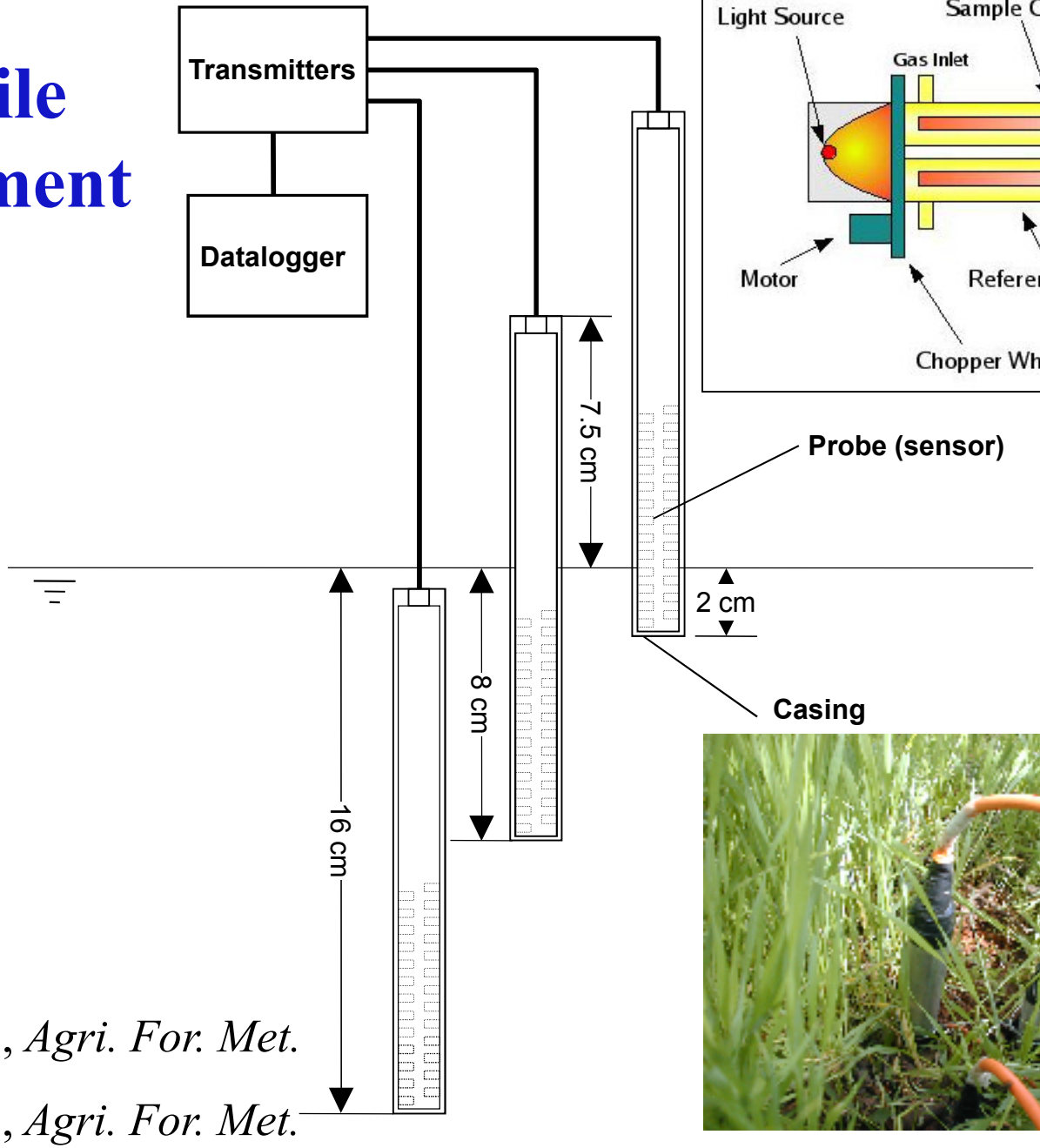


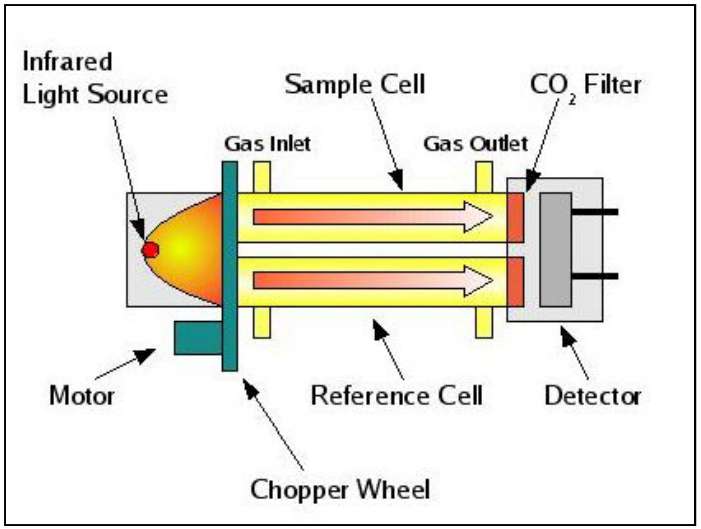
Diffuse process:

$$F = -D_s \frac{\mathrm{d}C}{\mathrm{d}z}$$



CO_2 profile measurement

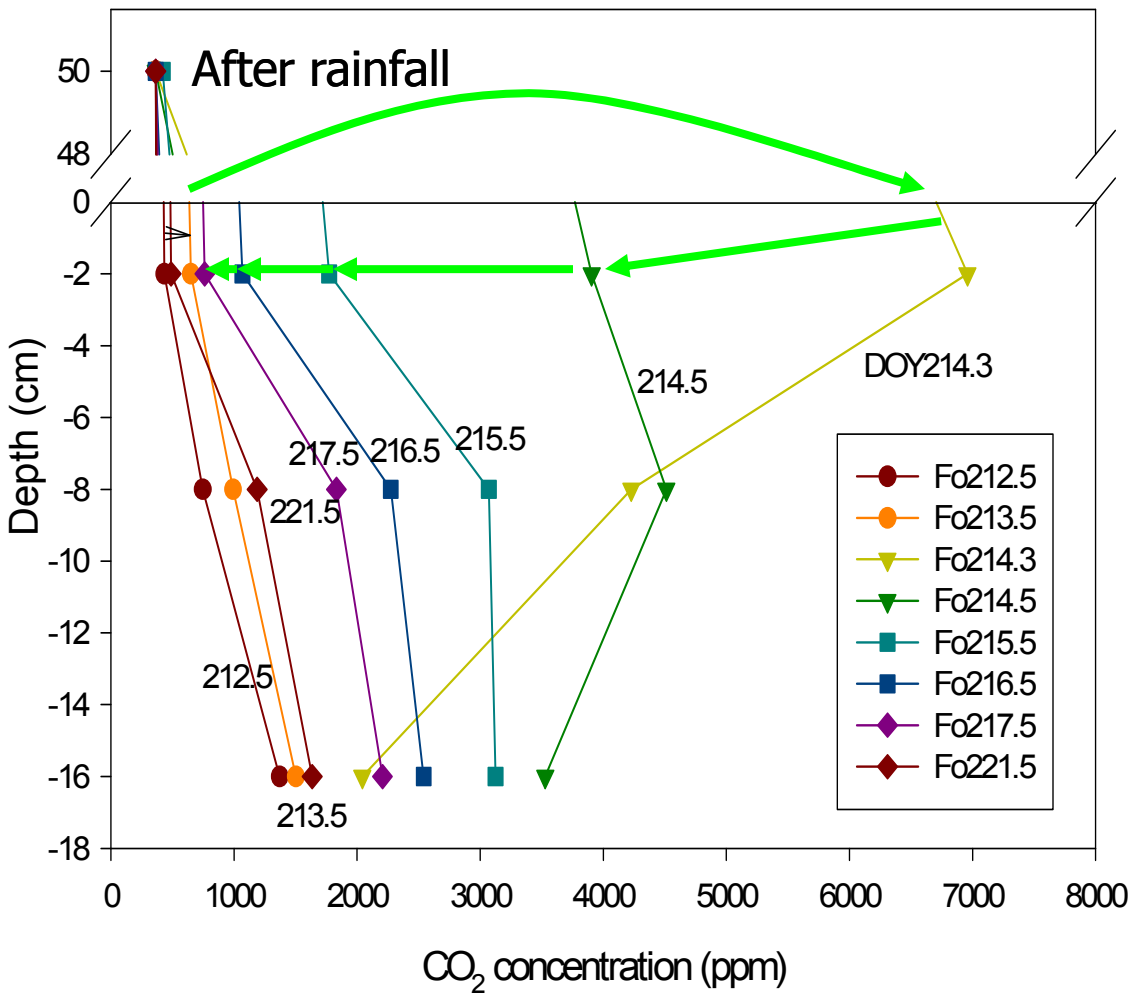


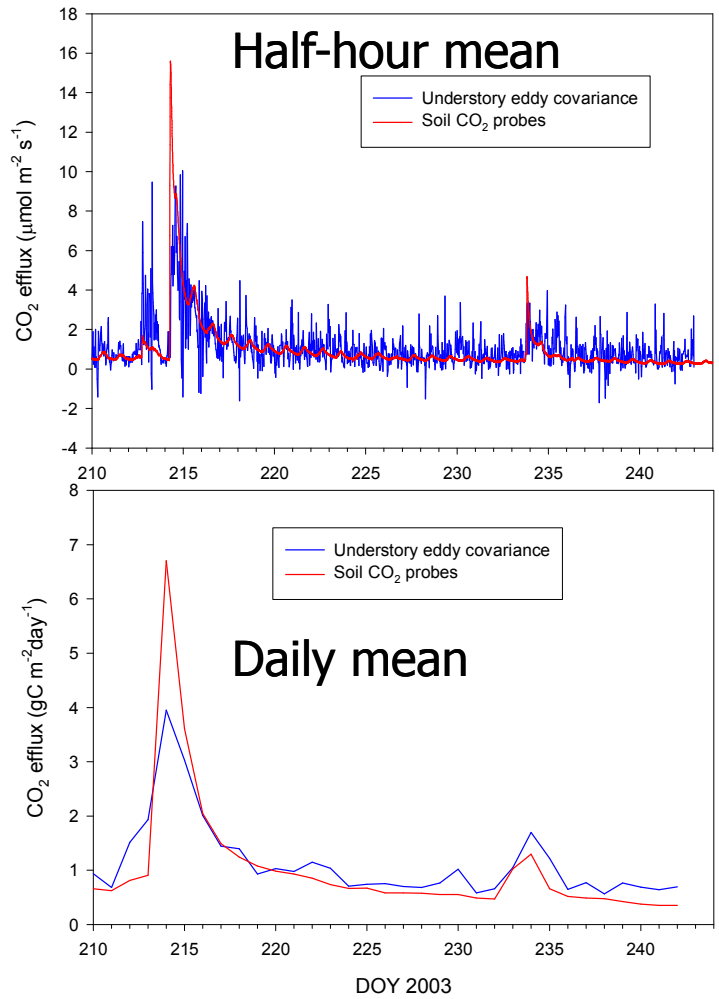


Tang et al. 2003, *Agri. For. Met.*

Tang et al. 2005, *Agri. For. Met.*

CO_2 profile in soils after rainfall in California



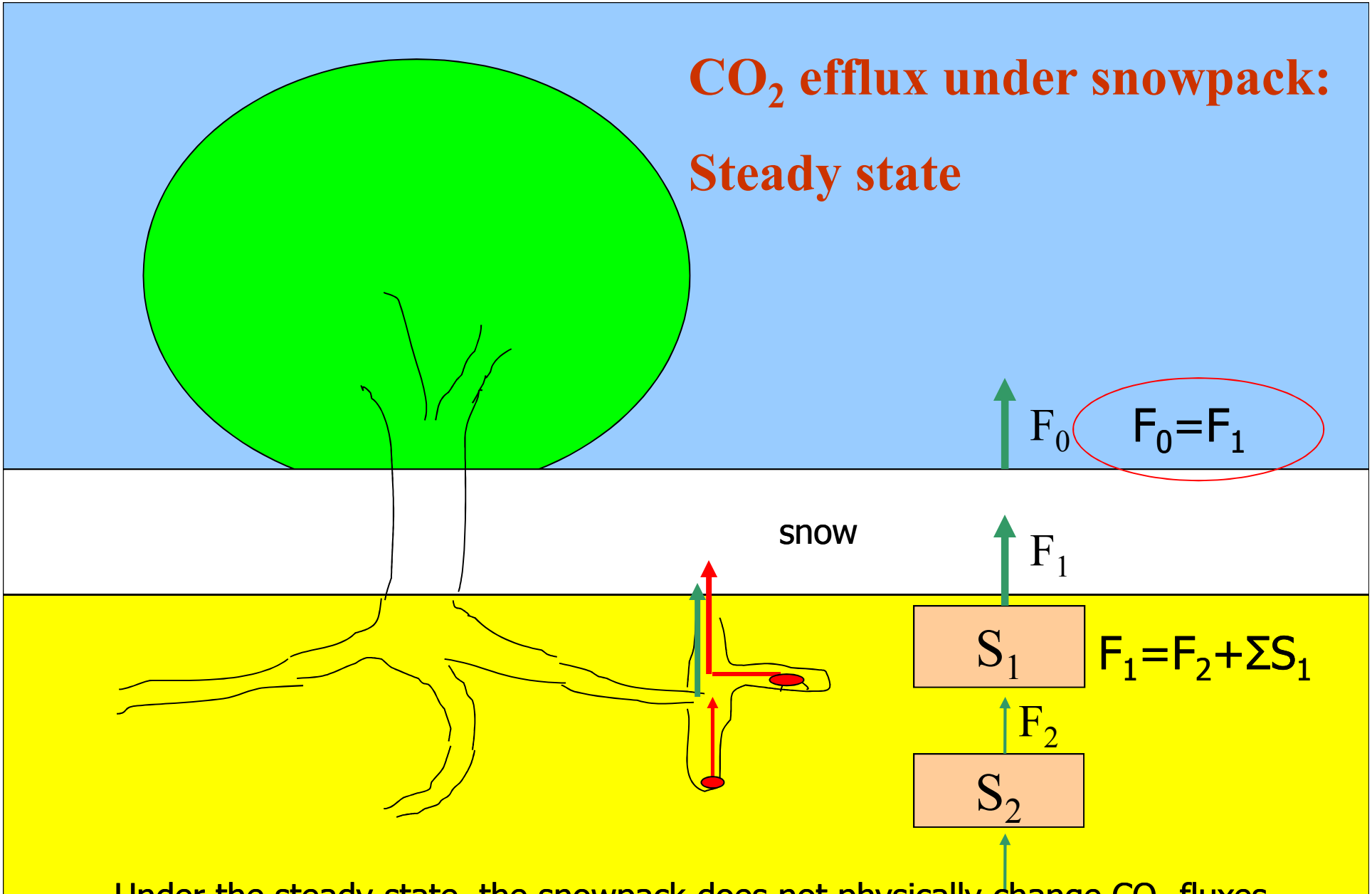


Xu et al. 2004, *Glob. Biogeo. Cycle* Tang et al. 2005, *Agric. For. Meteorol.*

CO_2 profile under snowpack at Harvard Forest

CO_2 efflux under snowpack:

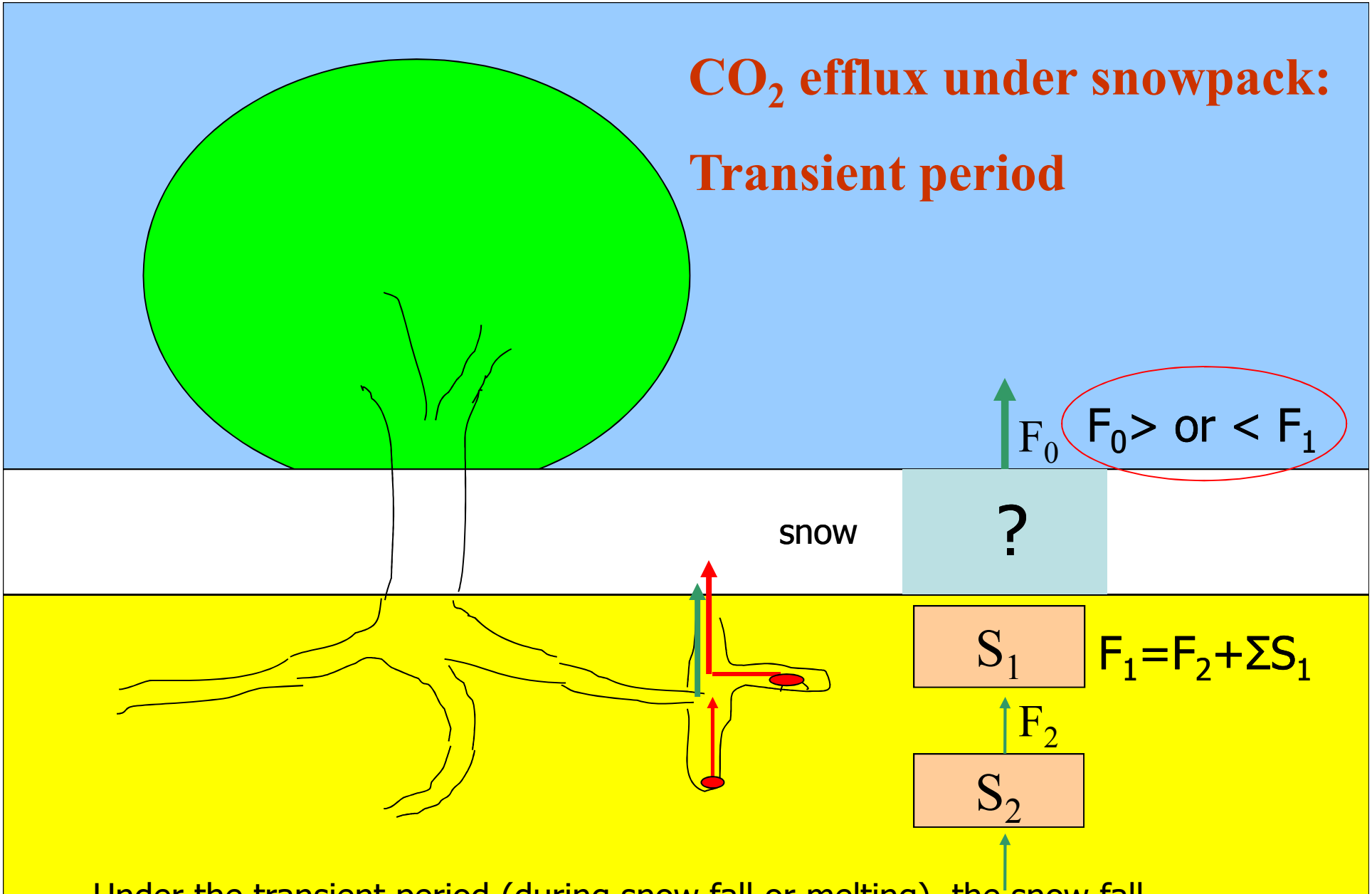
Steady state



Under the steady state, the snowpack does not physically change CO_2 fluxes, but does change the CO_2 concentration gradient and diffusivity.

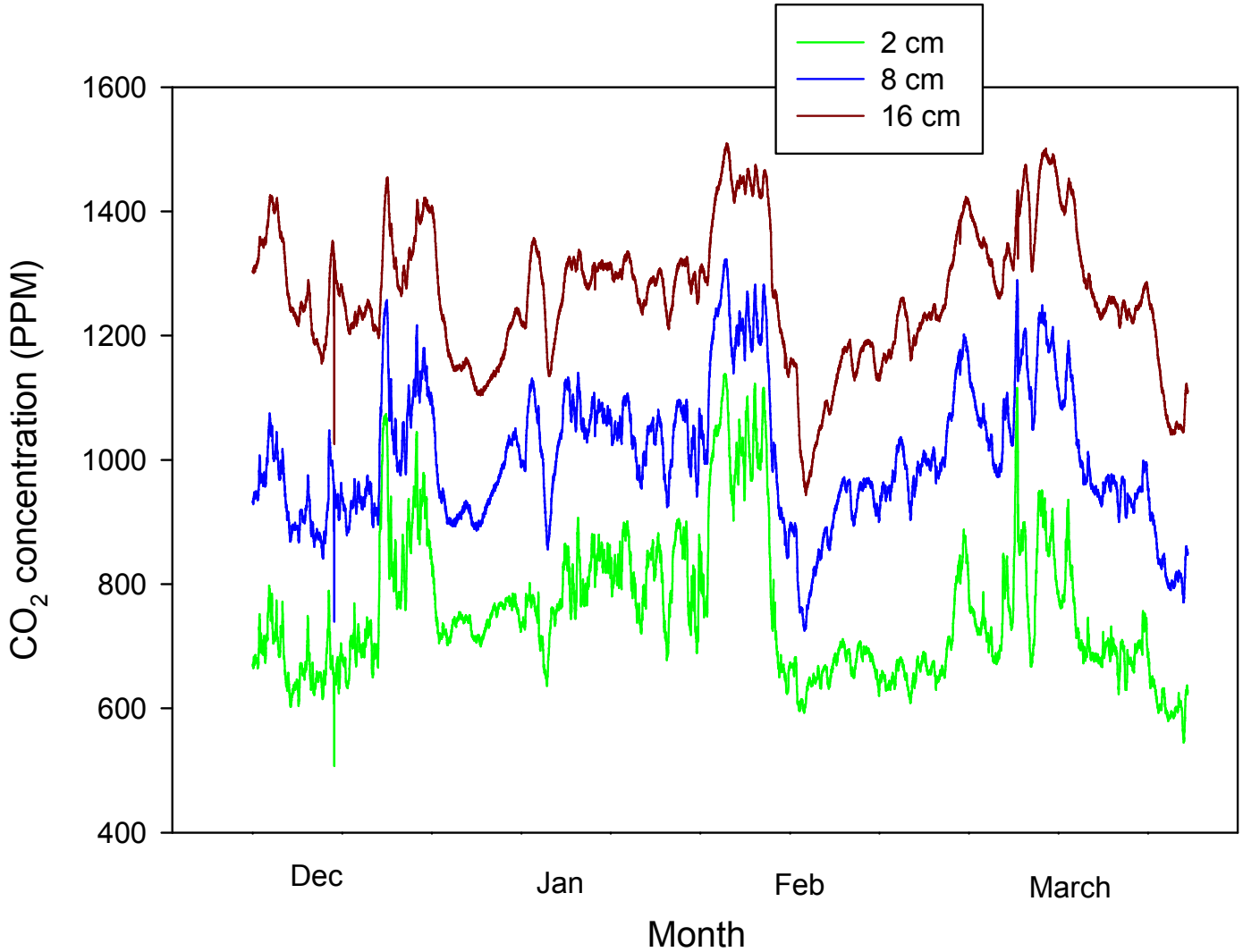
CO_2 efflux under snowpack:

Transient period

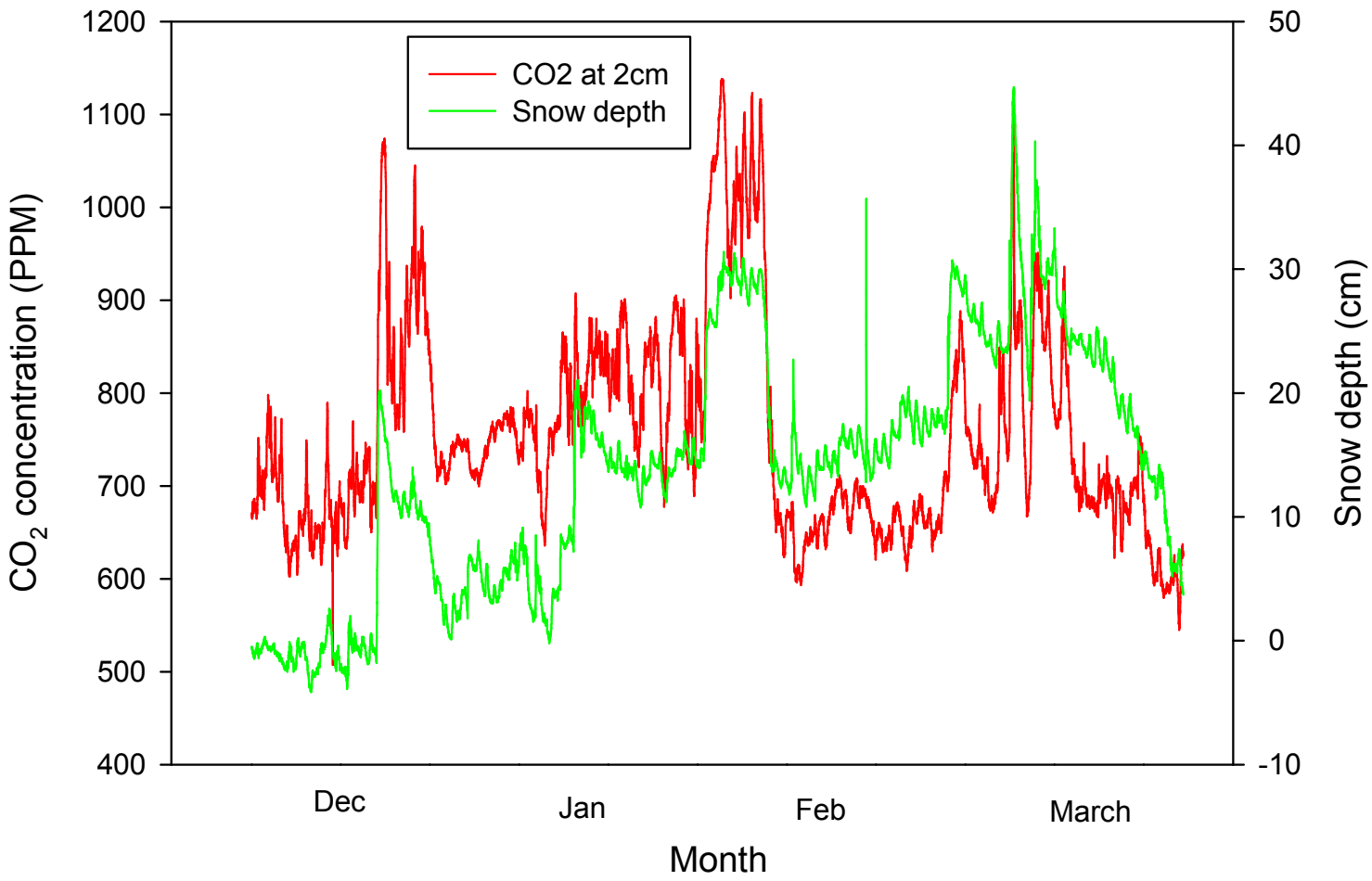


Under the transient period (during snow fall or melting), the snow fall decreases the flux and the melting of snowpack increases the flux.

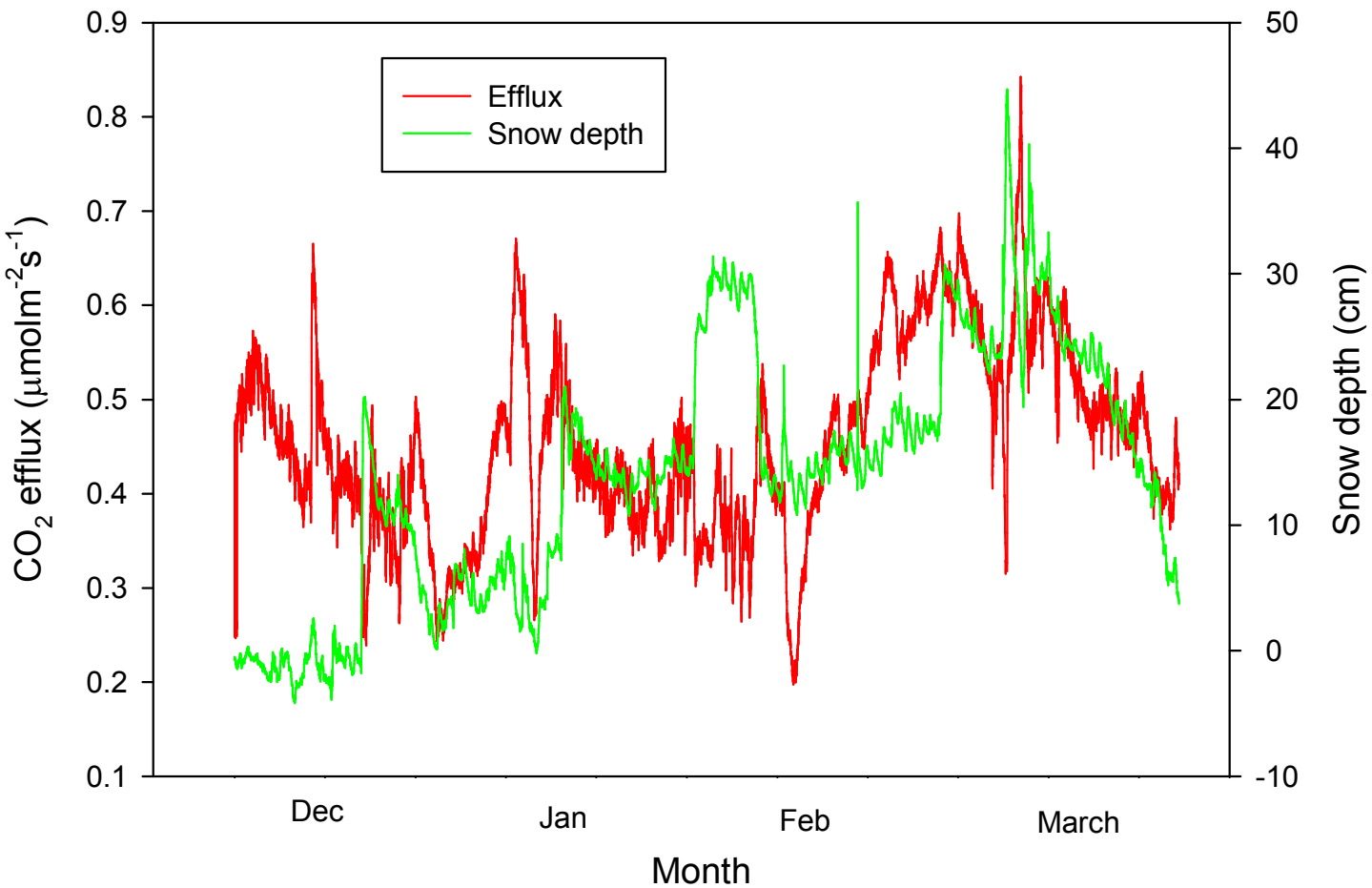
Soil CO_2 profile under snowpack



CO_2 concentration and snow depth

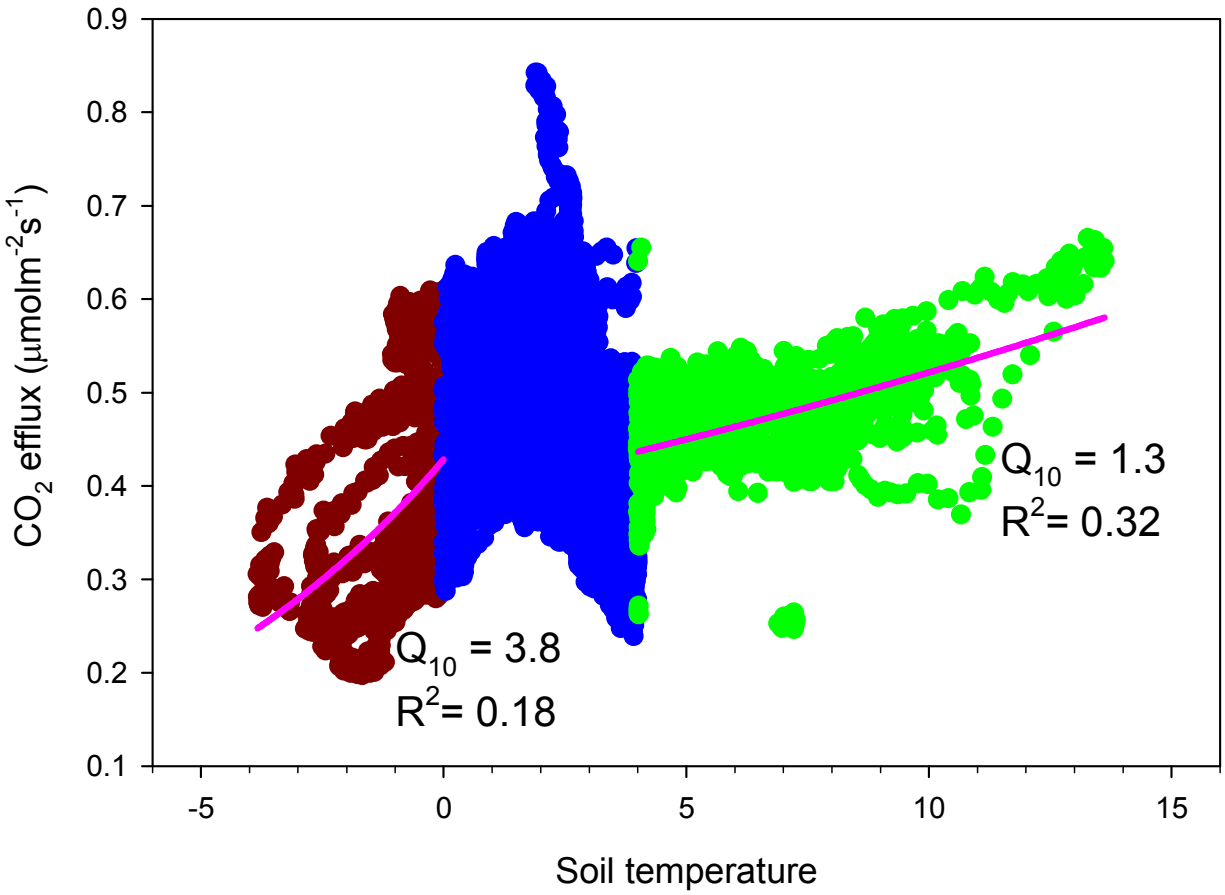


CO_2 efflux and snow depth



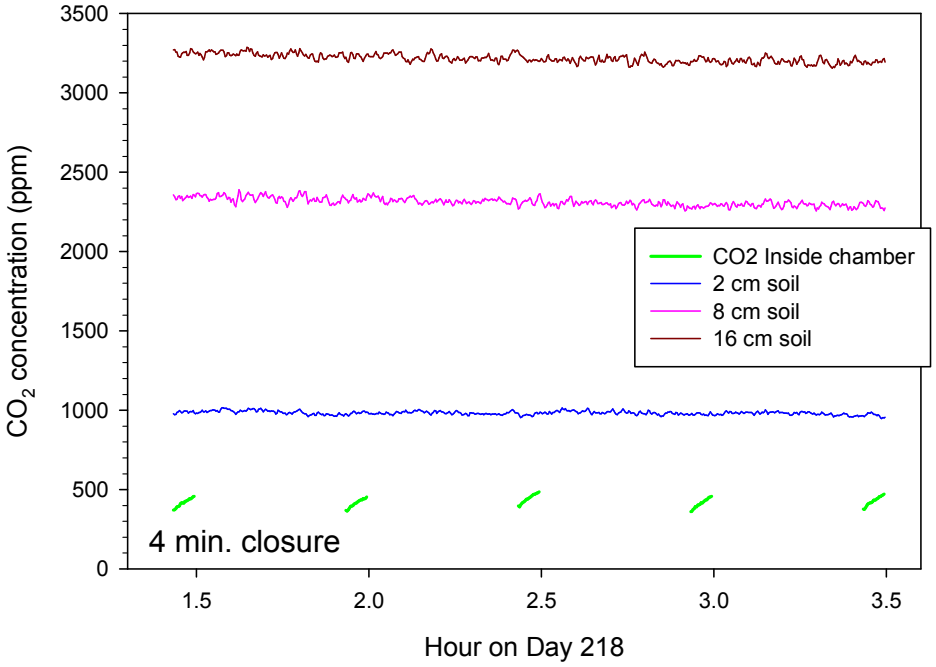
Total CO_2 efflux over the winter (90 days) = 50.6 gC m^{-2}

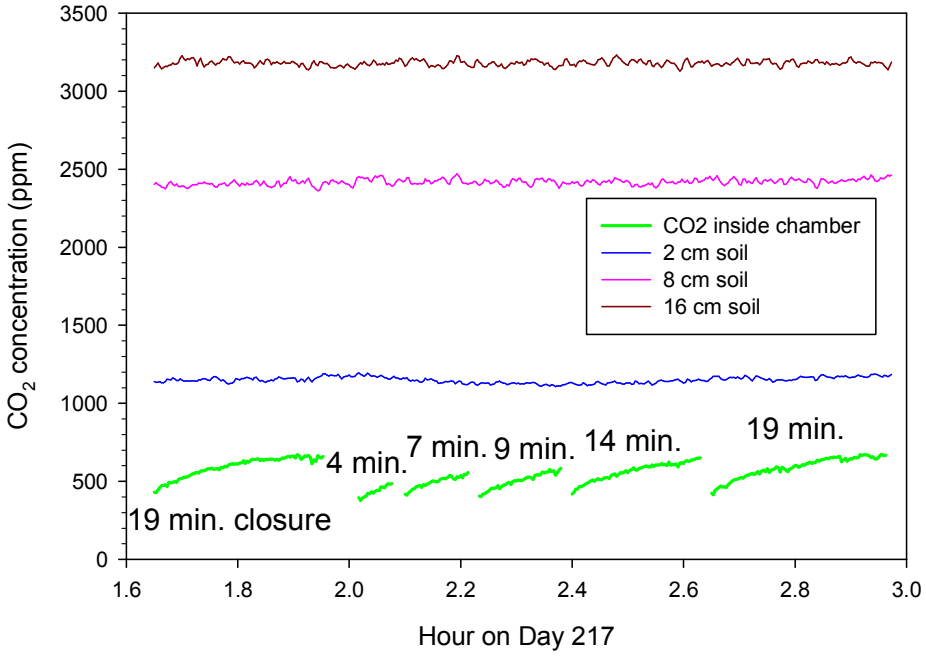
CO_2 efflux vs. temperature



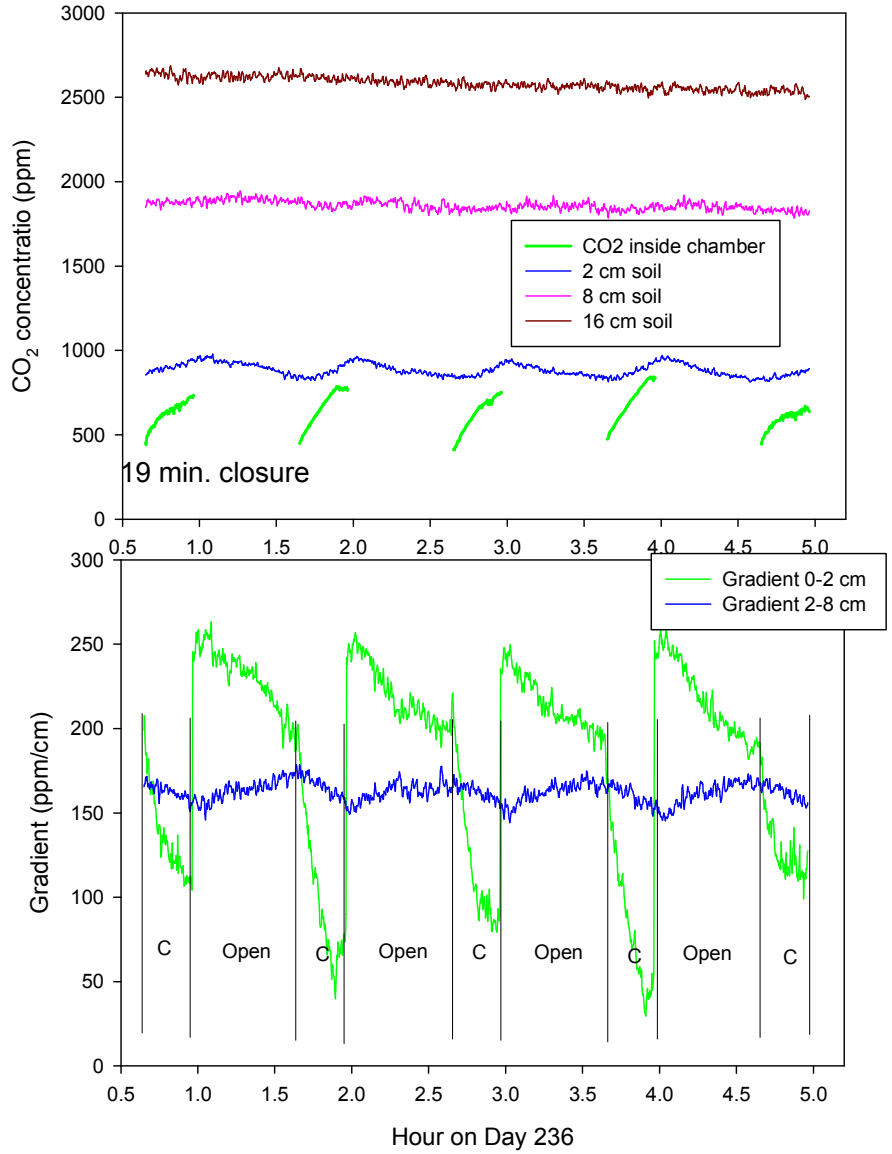
CO_2 profile and automated chambers at Harvard Forest

Soil CO_2 profile and [CO_2] in closed chambers

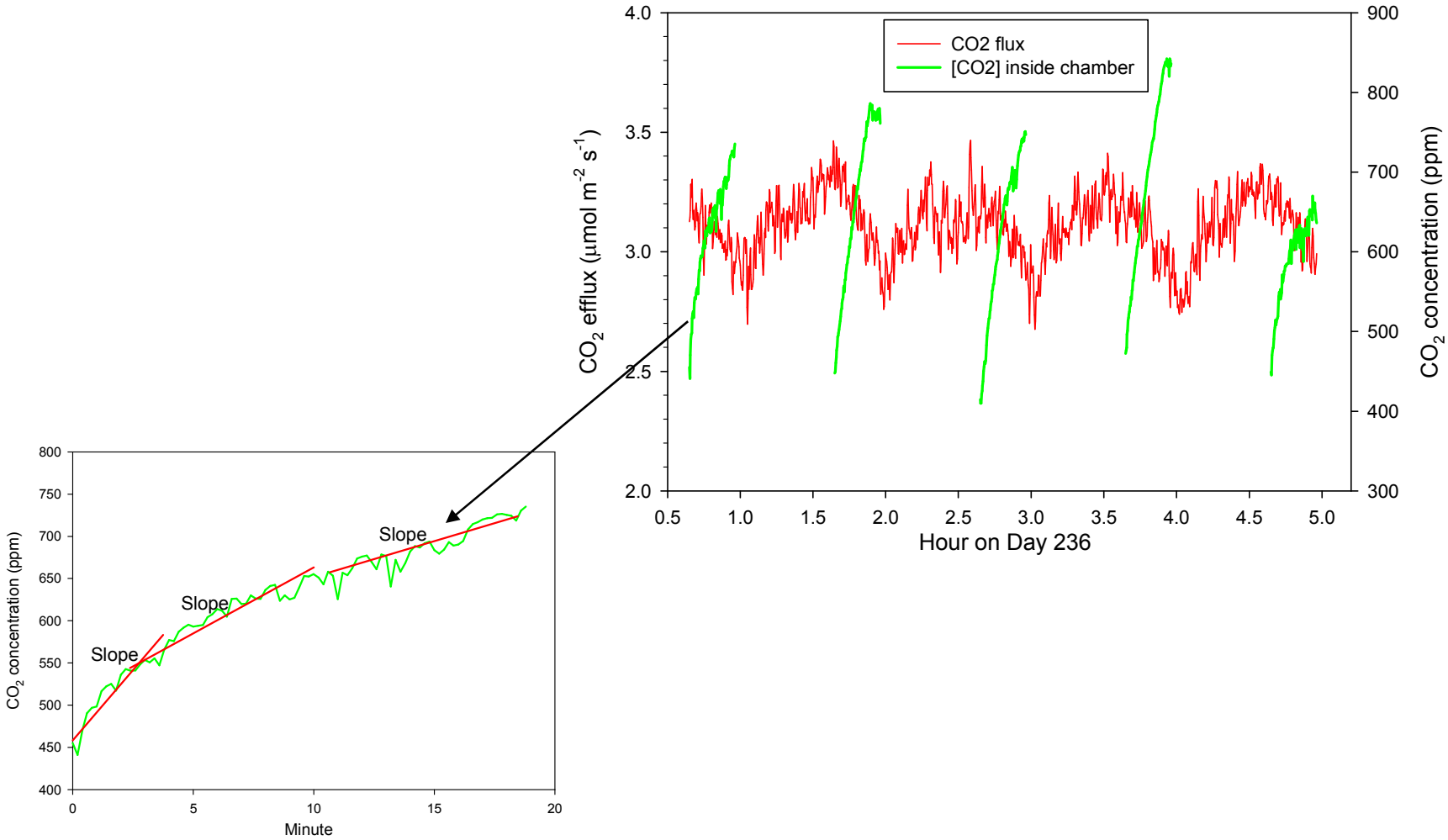




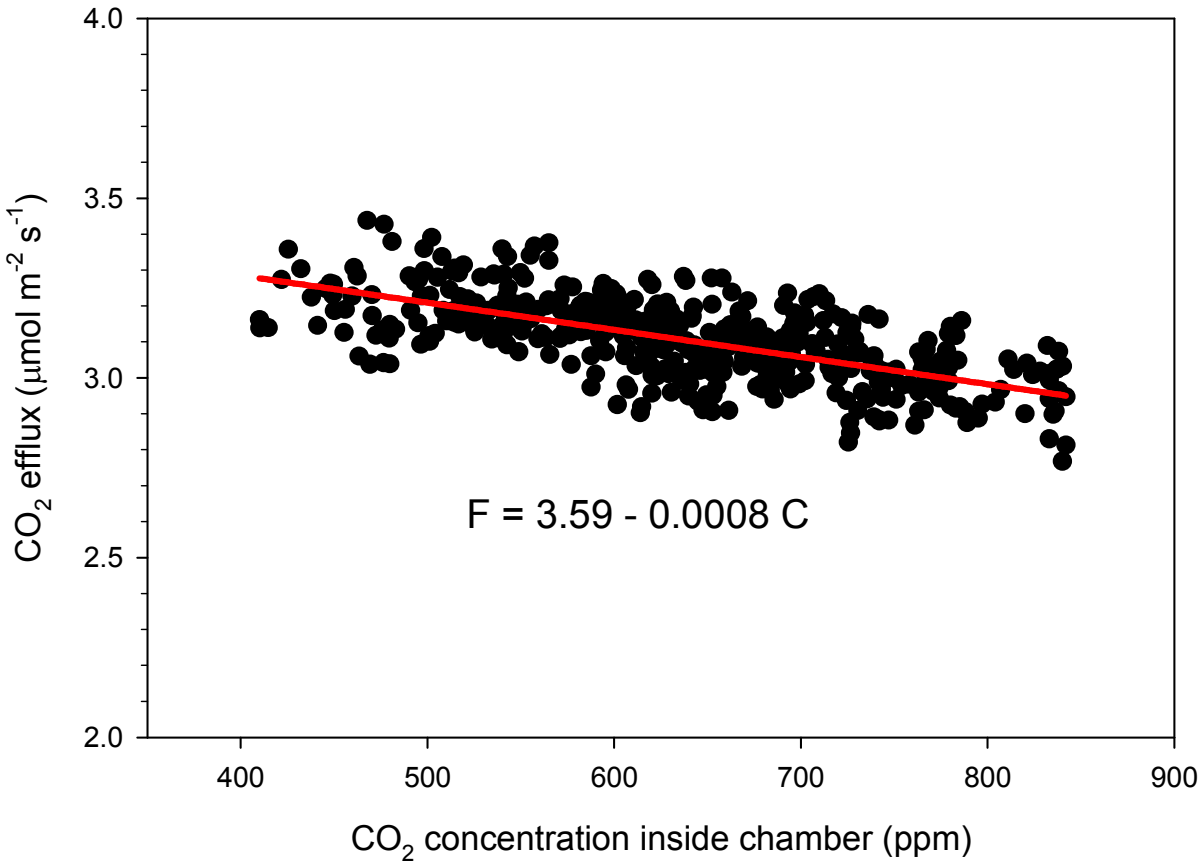
Soil CO_2 profile and [CO_2] in closed chambers



CO_2 efflux and [CO_2] in closed chambers



CO_2 efflux and [CO_2] in closed chambers



For every 100 ppm increase in CO_2 concentration inside the chamber, CO_2 efflux could be decreased by 0.08 µmol m^{-2} s^{-1}.

Conclusions

- The physical impacts of snowpack vary between under the steady state and during the transient period (snow fall or melting).

  Q_{10} is higher in the low temperature range than that in the high temperature range in winter.
- The closed chamber decreases the CO_2 gradient in soil and thus may underestimate CO_2 efflux.

Acknowledgements

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Questions and Comments???