

Scaling nighttime turbulence intensity for correcting CO₂ fluxes

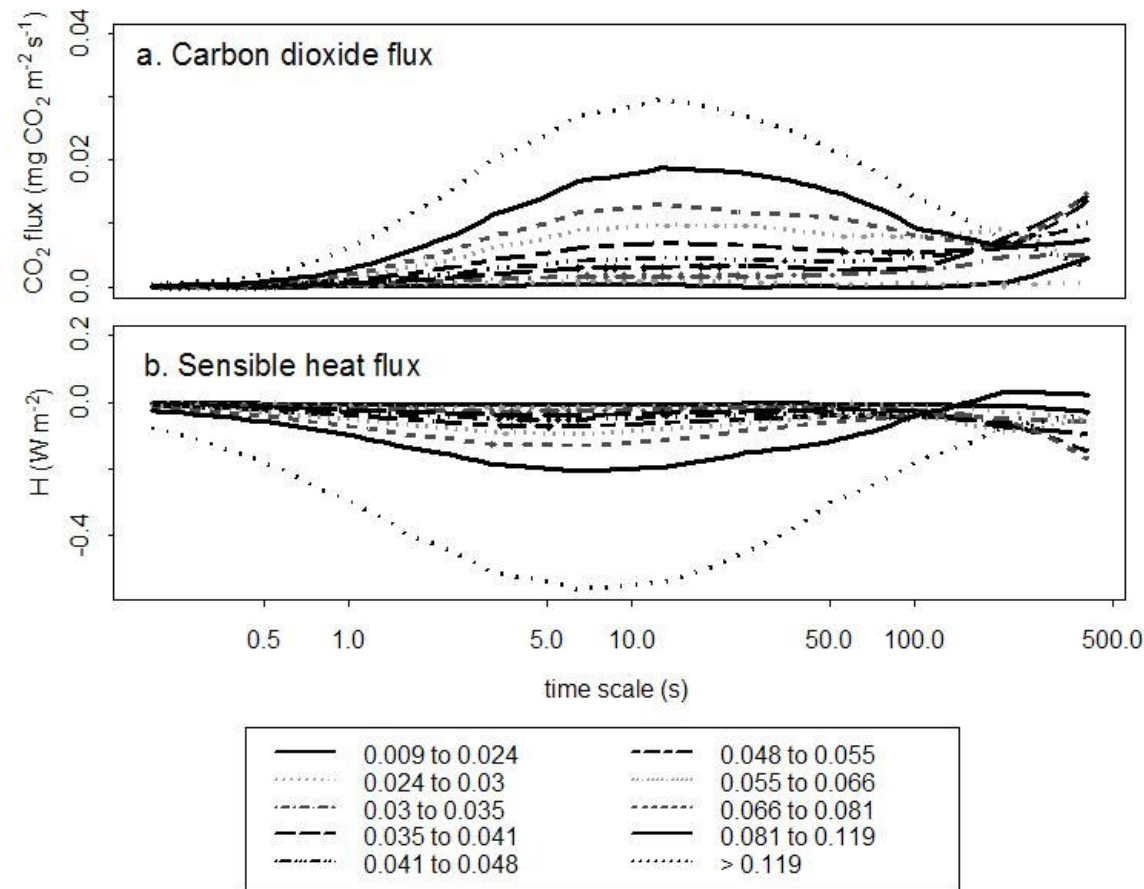
Otávio C. Acevedo, Osvaldo L. L. Moraes, José G. Campos

Universidade Federal de Santa Maria, Santa Maria, RS, Brazil

David R. Fitzjarrald, Ricardo K. Sakai

Atmospheric Sciences Research Center, Albany, NY, USA

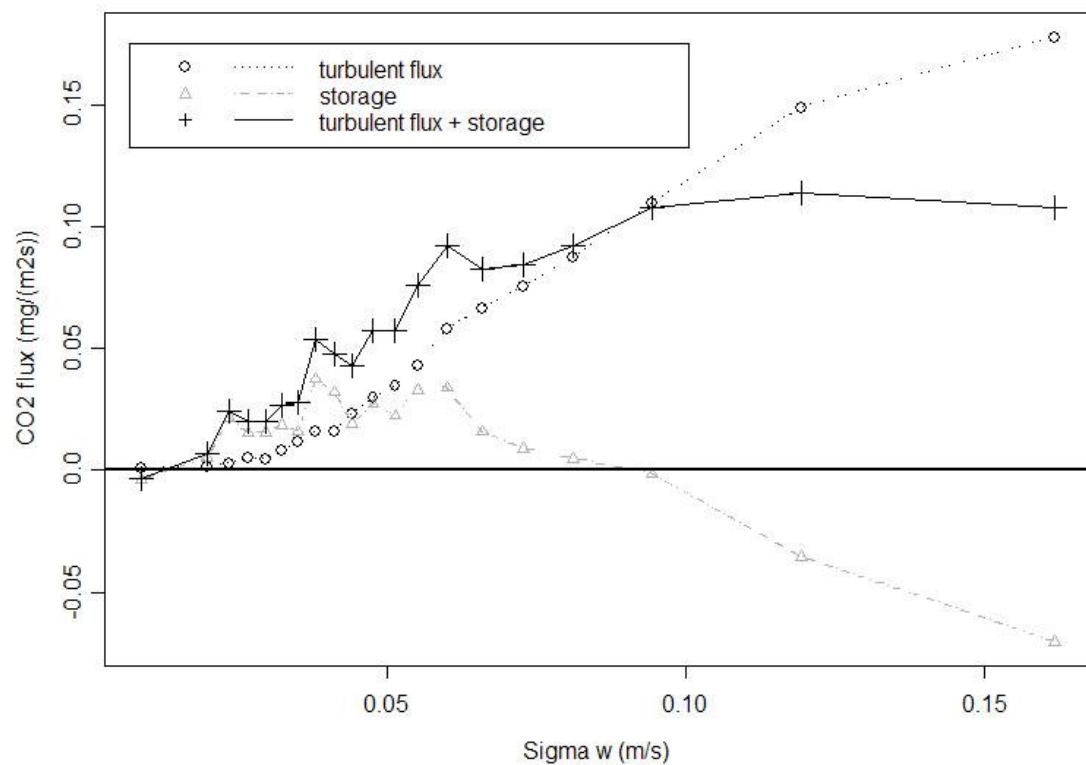
In previous meetings...



Acevedo, O. C., O. L. L. Moraes, D. R. Fitzjarrald, R. K. Sakai, L. Mahrt (2007), Turbulent carbon Exchange in very stable conditions. *Boundary.-Layer Meteorol.*, 125, 49-61.

See also poster by José G. Campos on applying this technique to Manaus flux data.

At this point, we call the attention to a specific detail: the turbulence intensity scale.

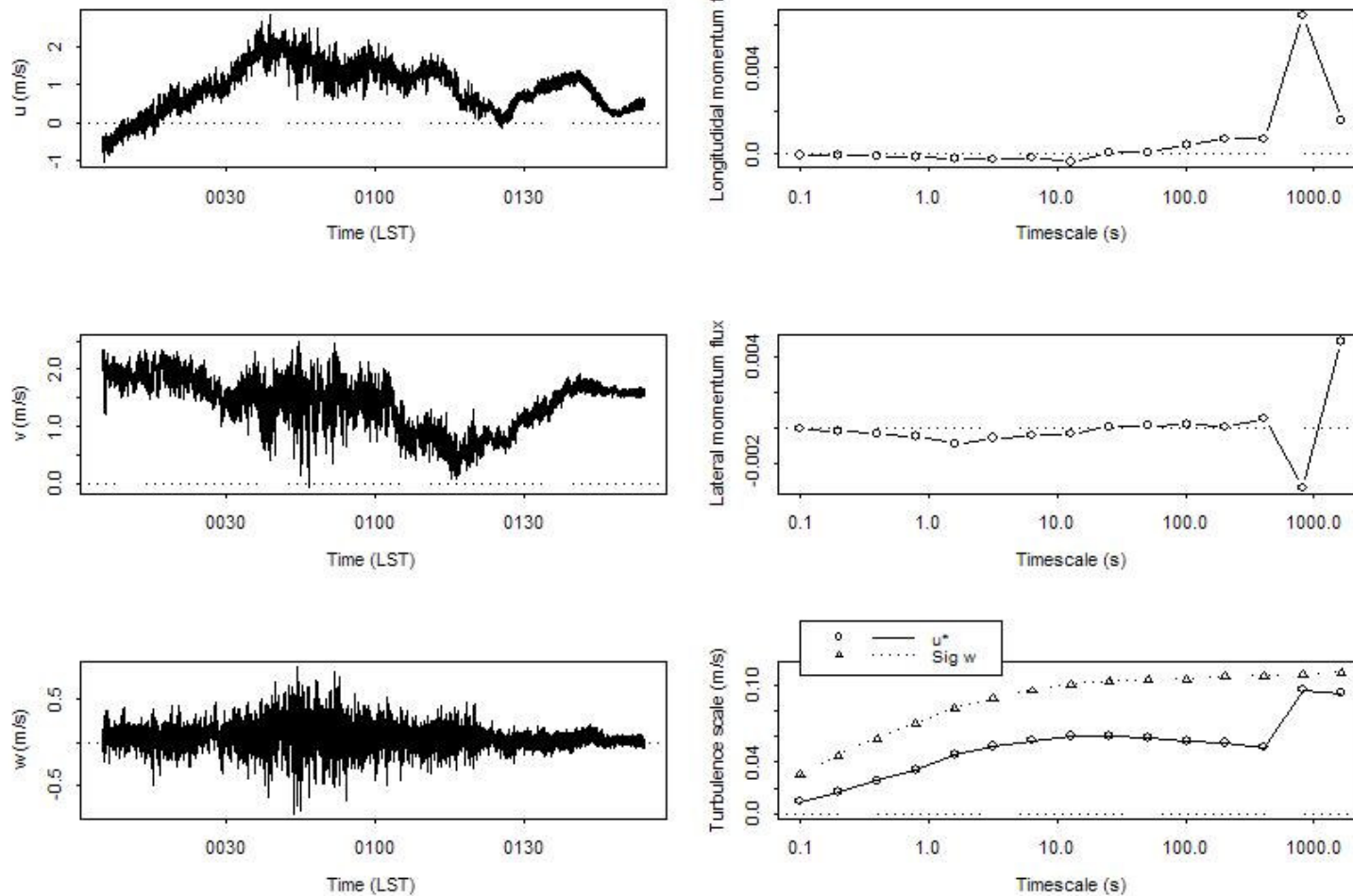


Is it really better to use σ_w instead of u_* ?

Being a flux, u_* is subject to a large scale dependence.

$$u_* = \left(\overline{u' w'}^2 + \overline{v' w'}^2 \right)^{1/4}$$

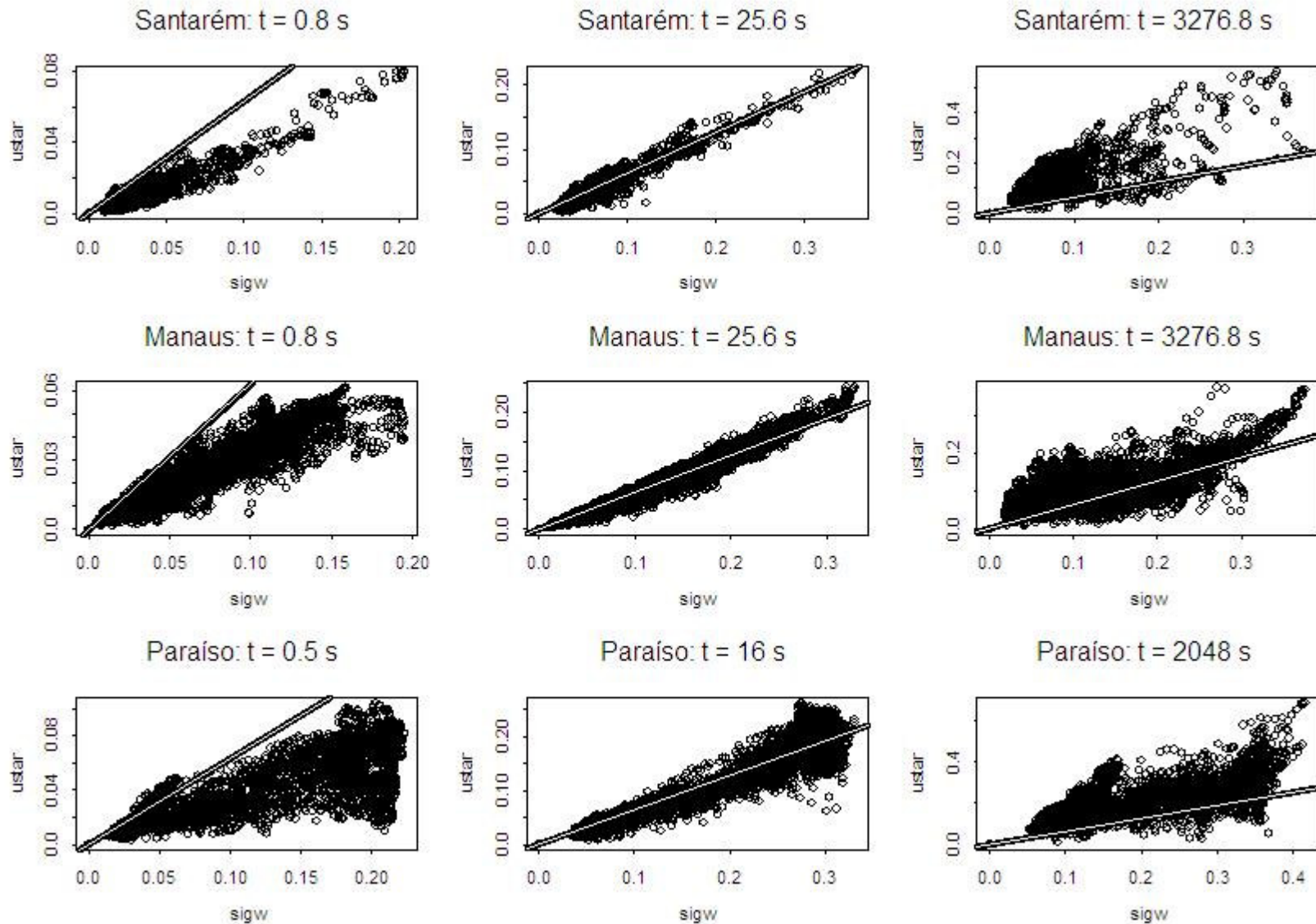
Manaus, 6 March 2006



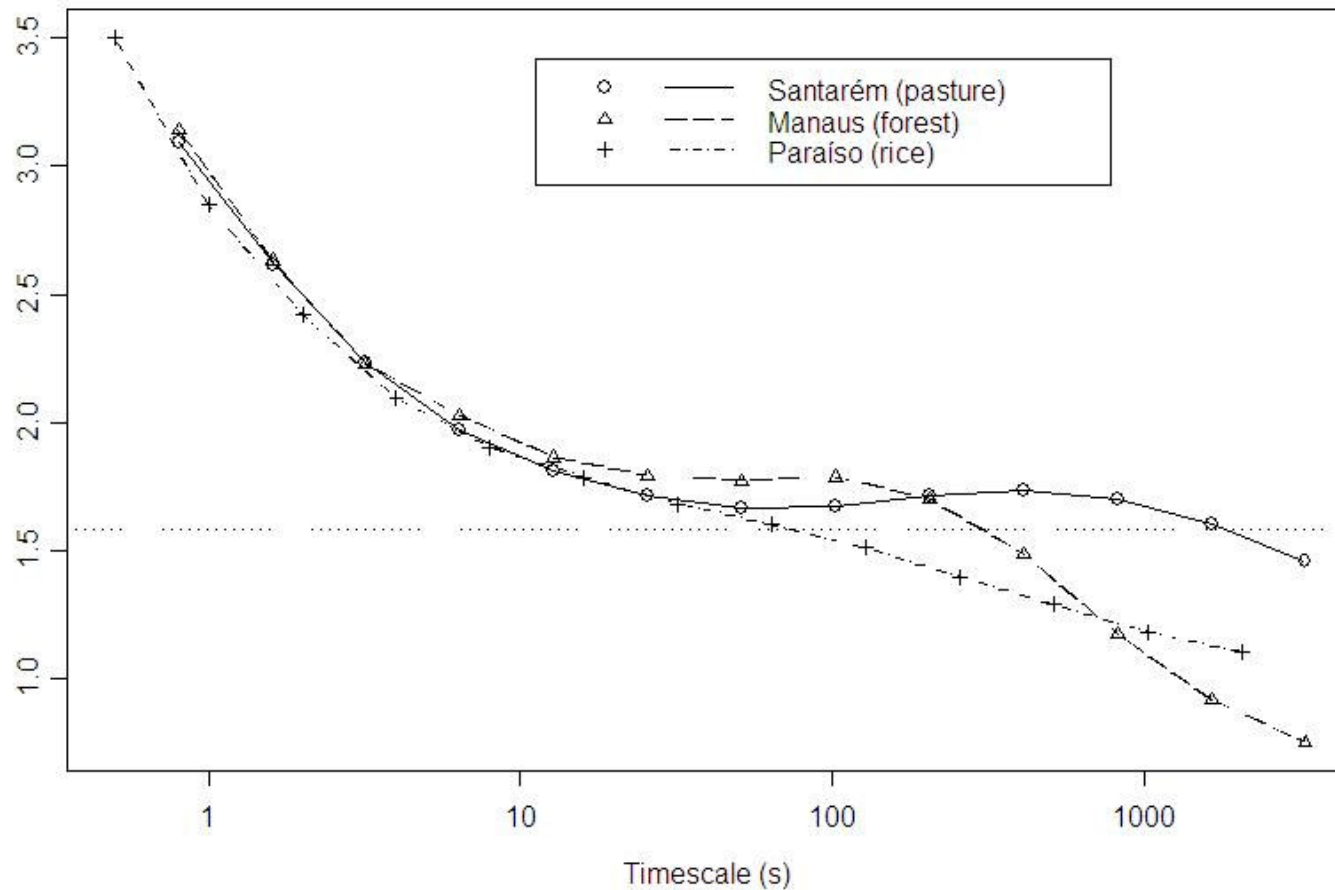
The analysis presented here will use nocturnal data from three completely distinct sites.

- **Santarém, km 77:** Pasture, extremely stable, 61 nights from January to March, 2001;
- **Manaus, k34:** Forest, highly intermittent, 70 nights from January to April 2006;
- **Paraíso do Sul (southern Brazil), CT-Hidro project:** rice, weakly stable, 60 nights from July to November, 2003.

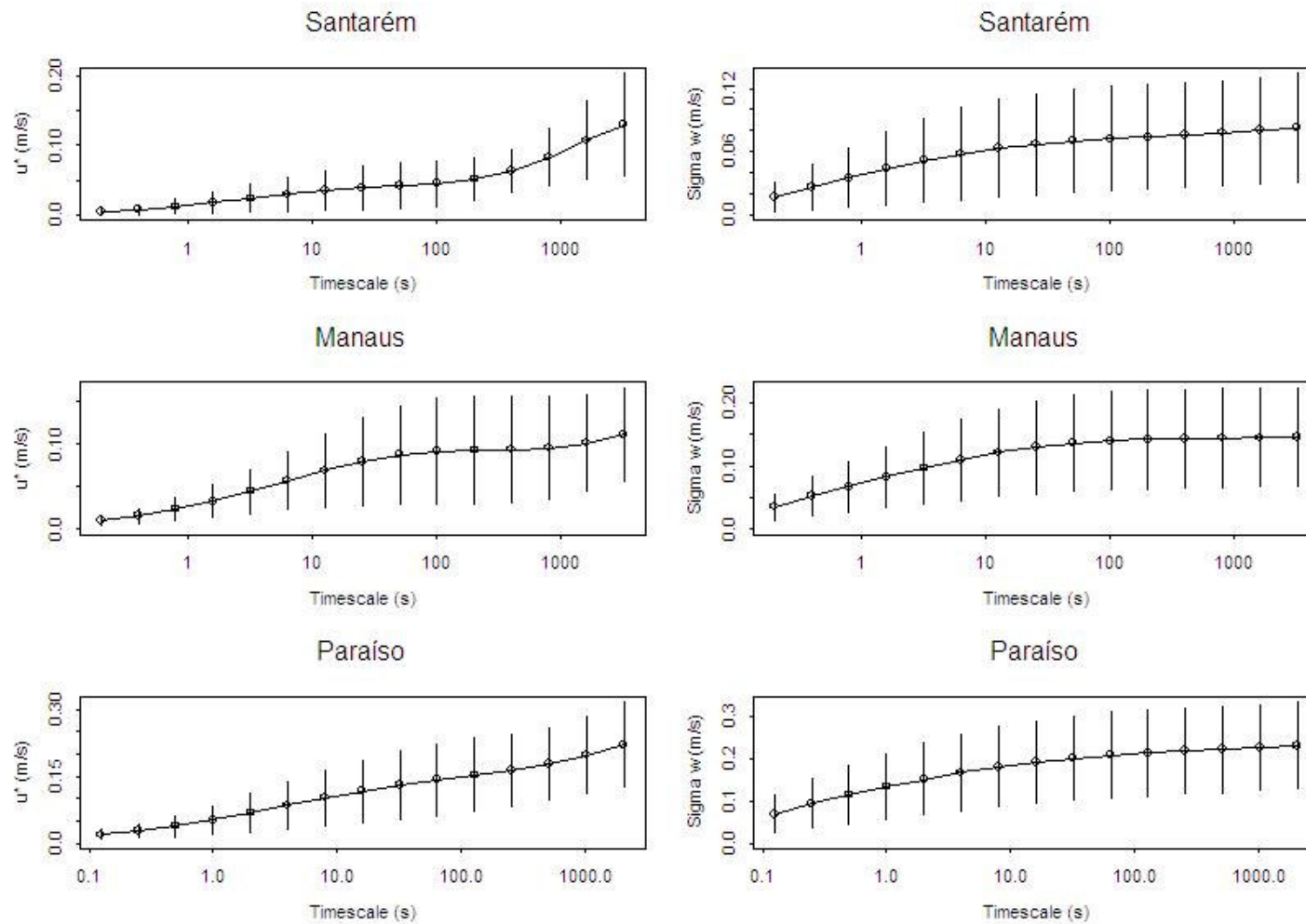
How do the scales relate to each other?



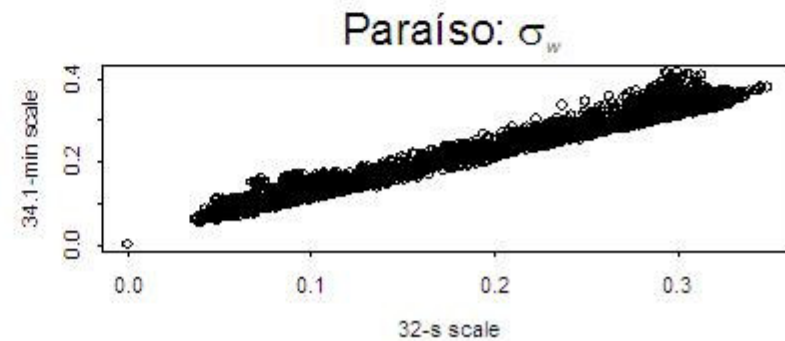
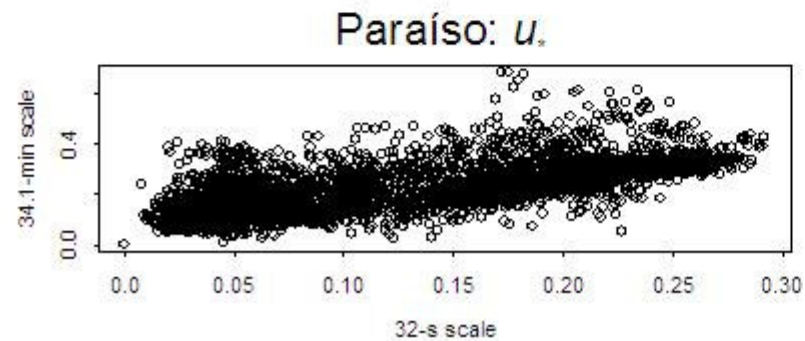
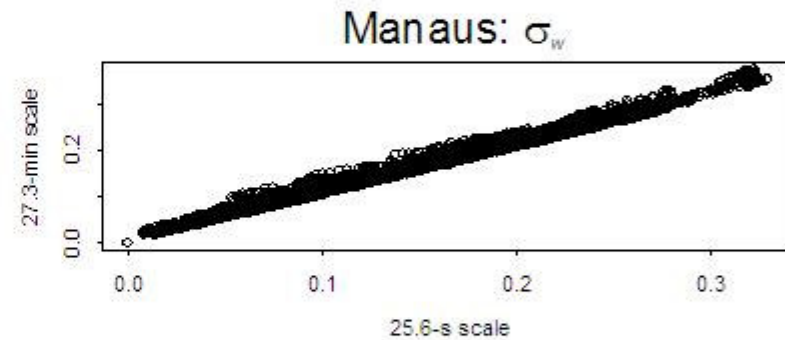
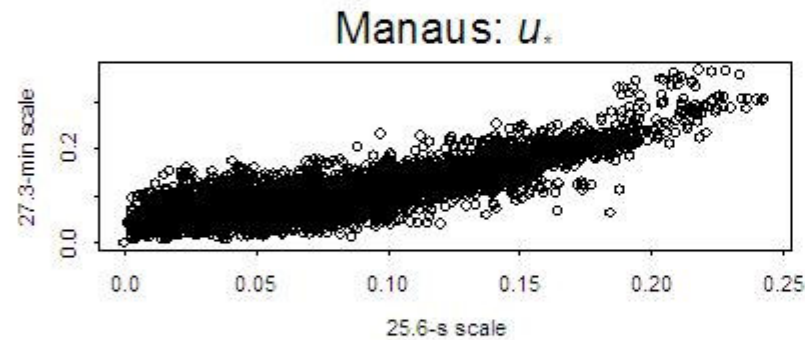
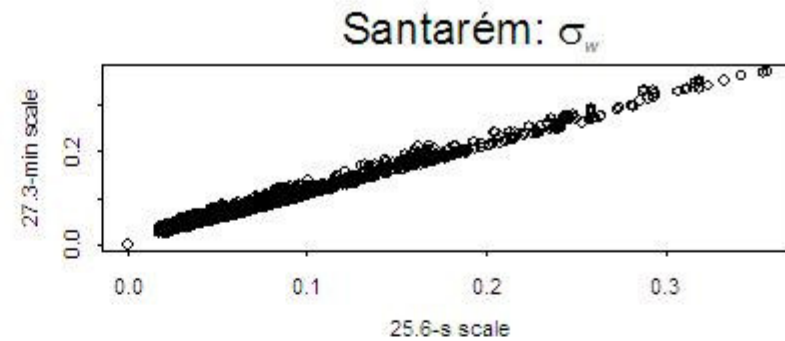
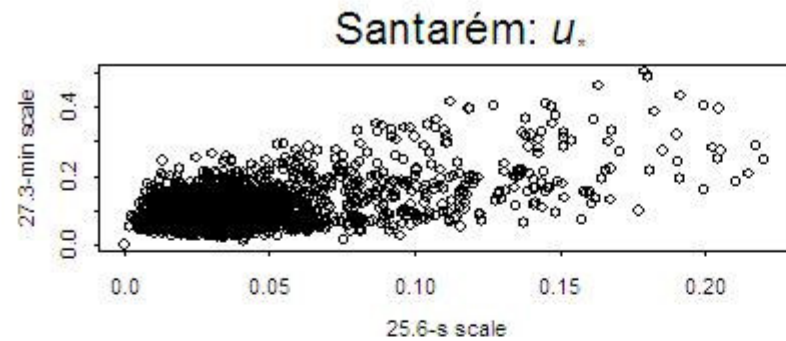
The relationship is universal, and scale-dependent,
within the turbulence range.



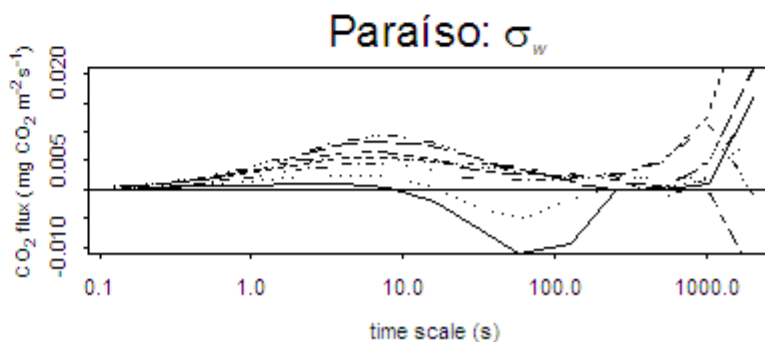
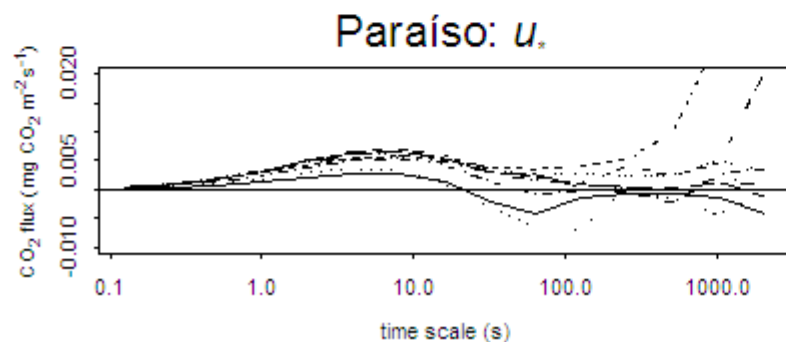
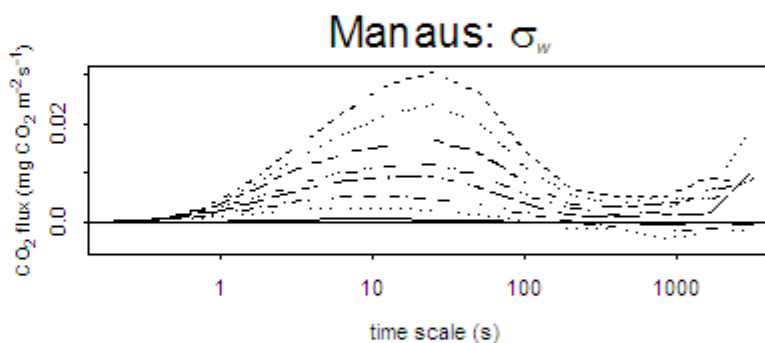
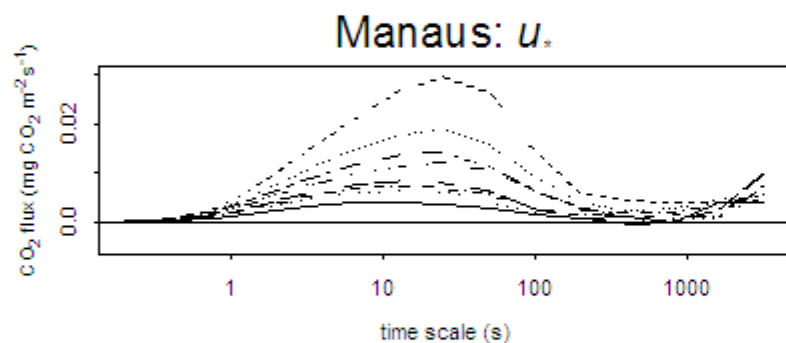
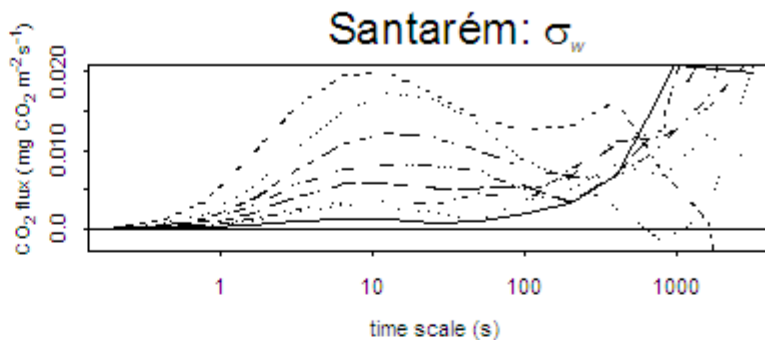
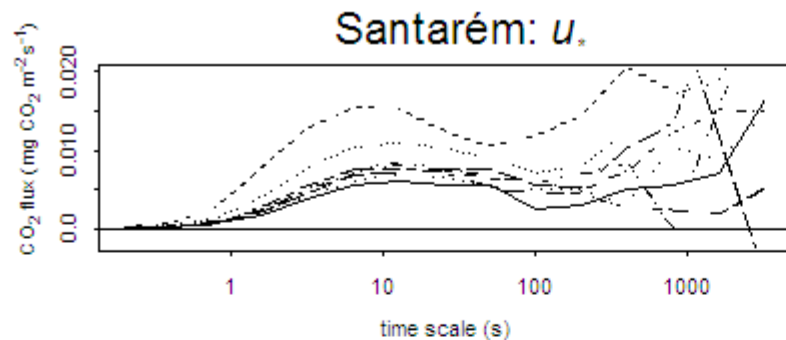
Only σ_w converges to a scale-independent value within the turbulence range.



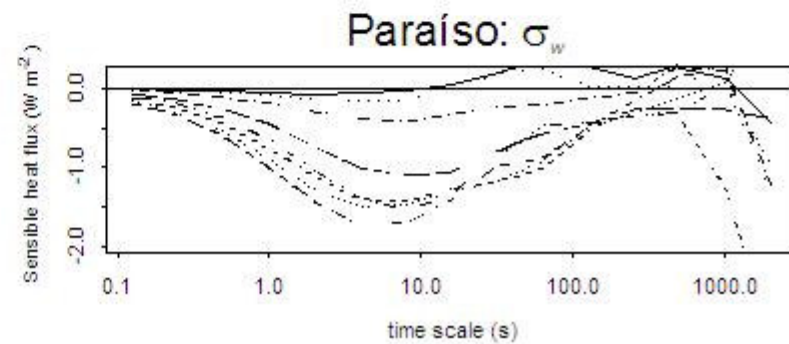
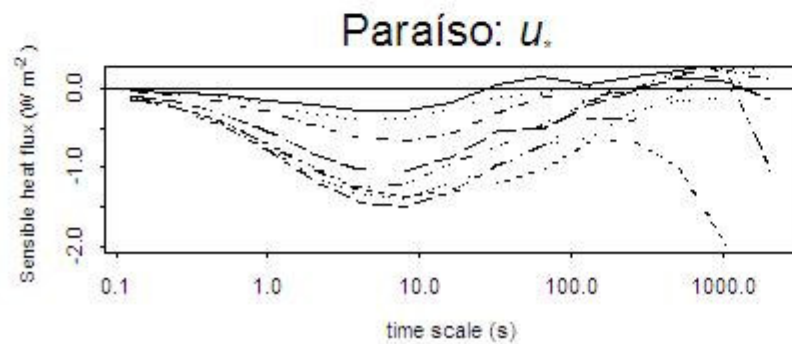
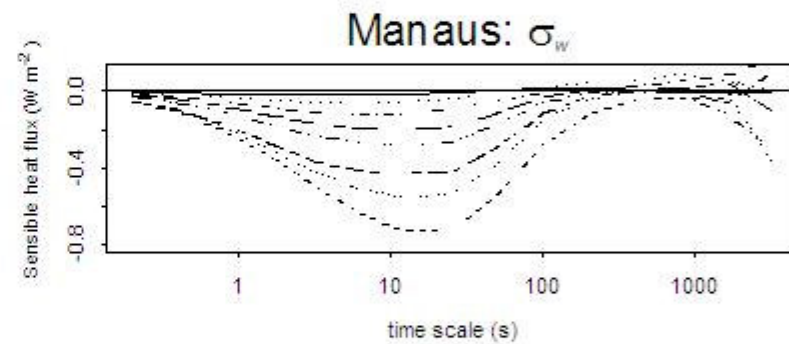
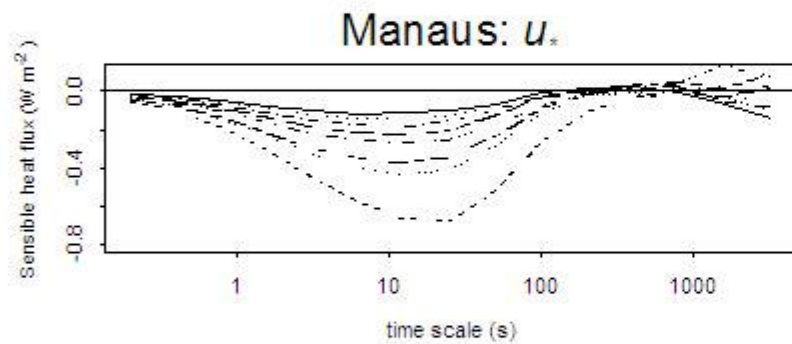
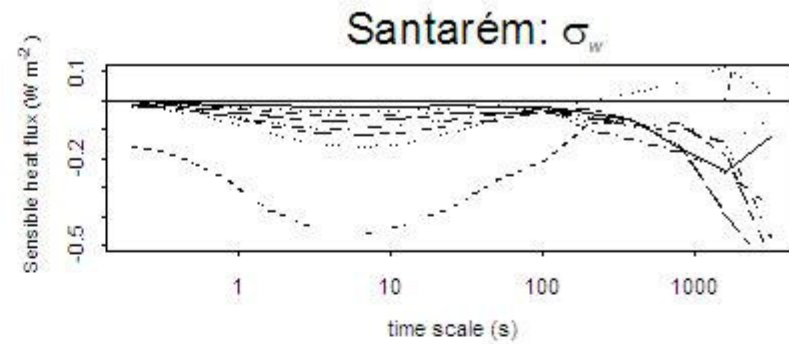
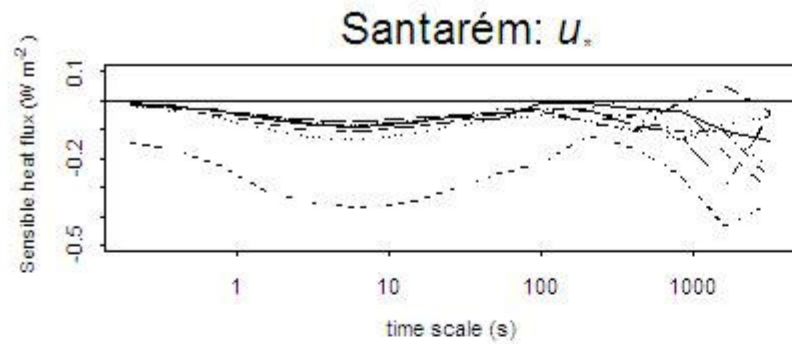
How do they compare at different temporal scales?



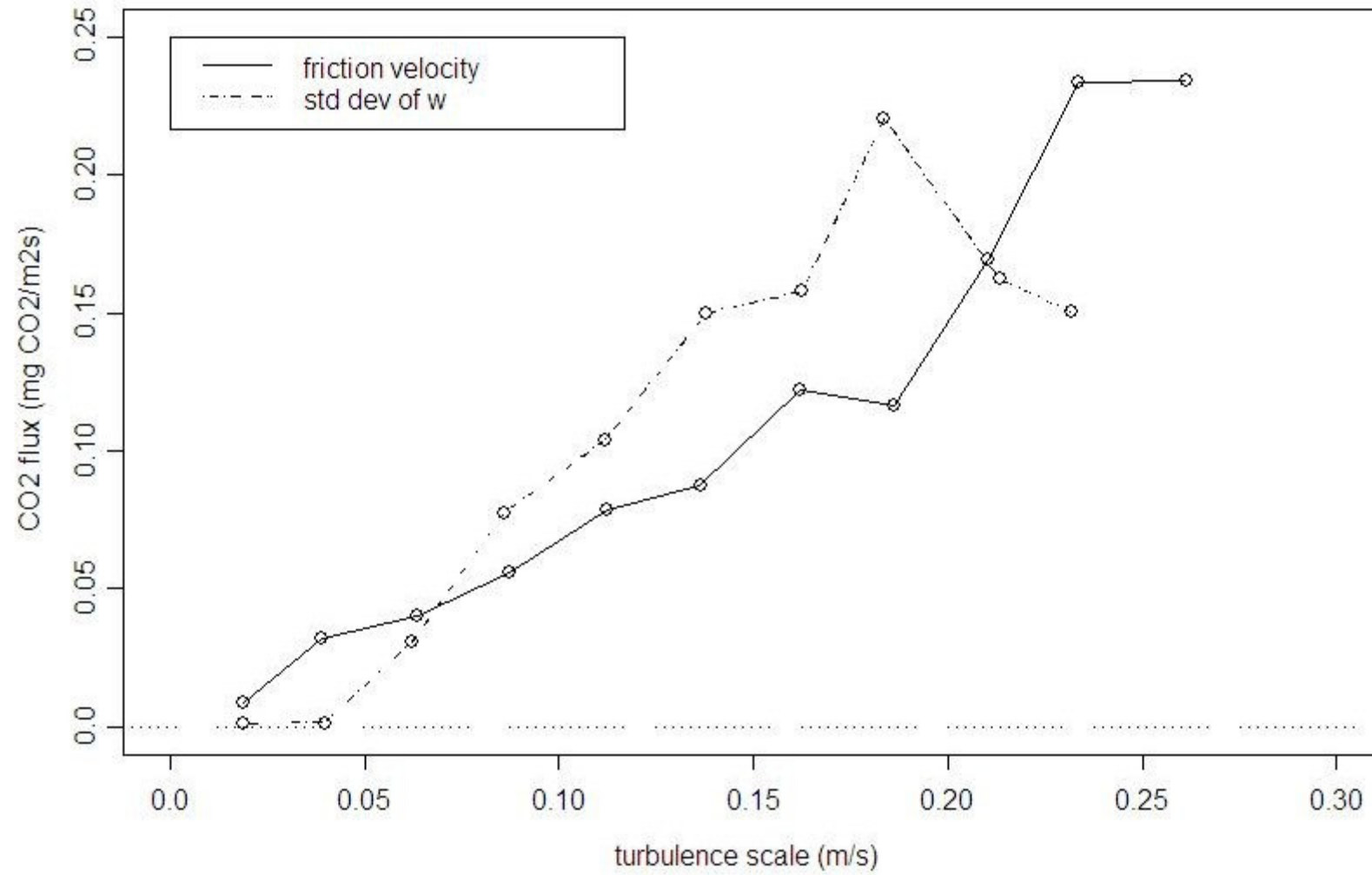
How about scaling Carbon fluxes?



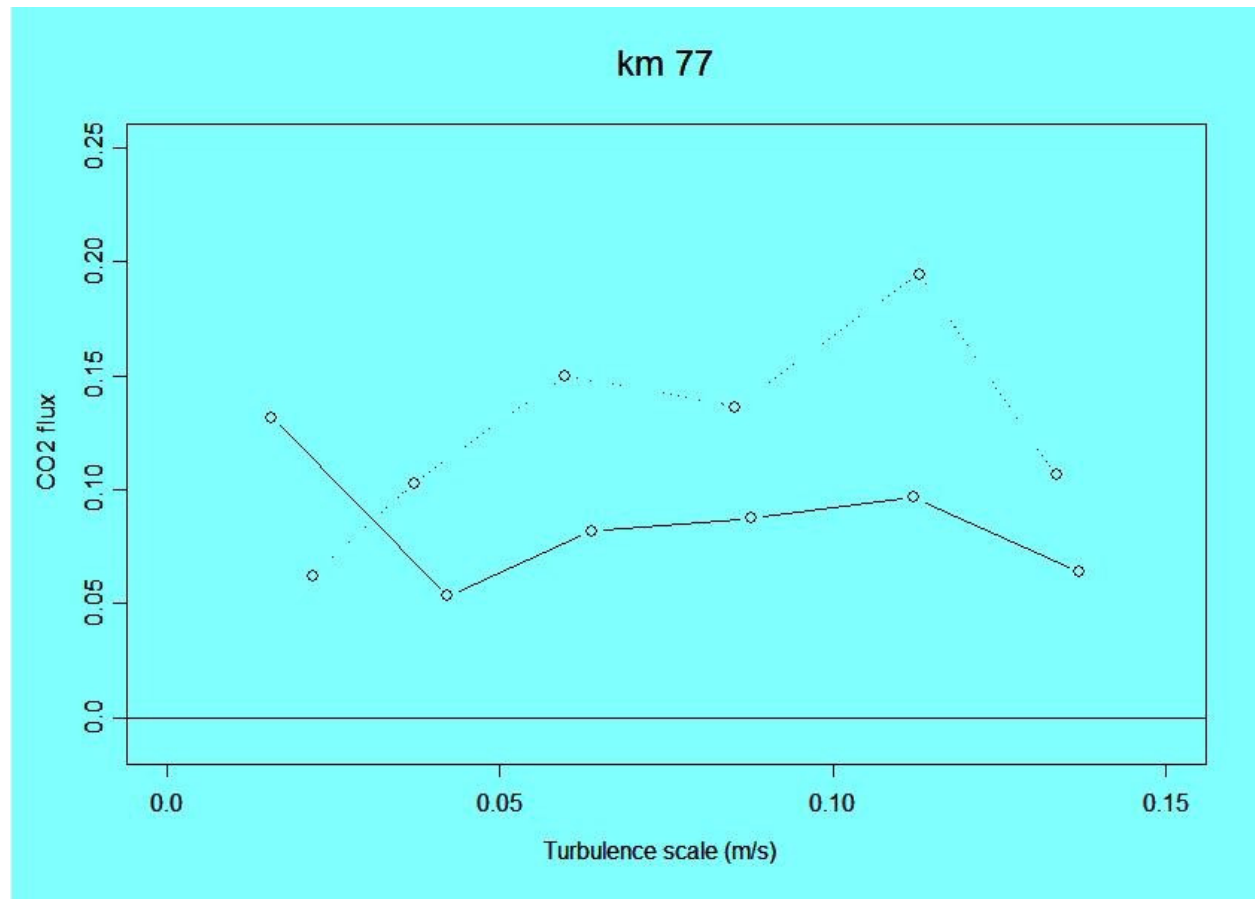
And for sensible heat fluxes?



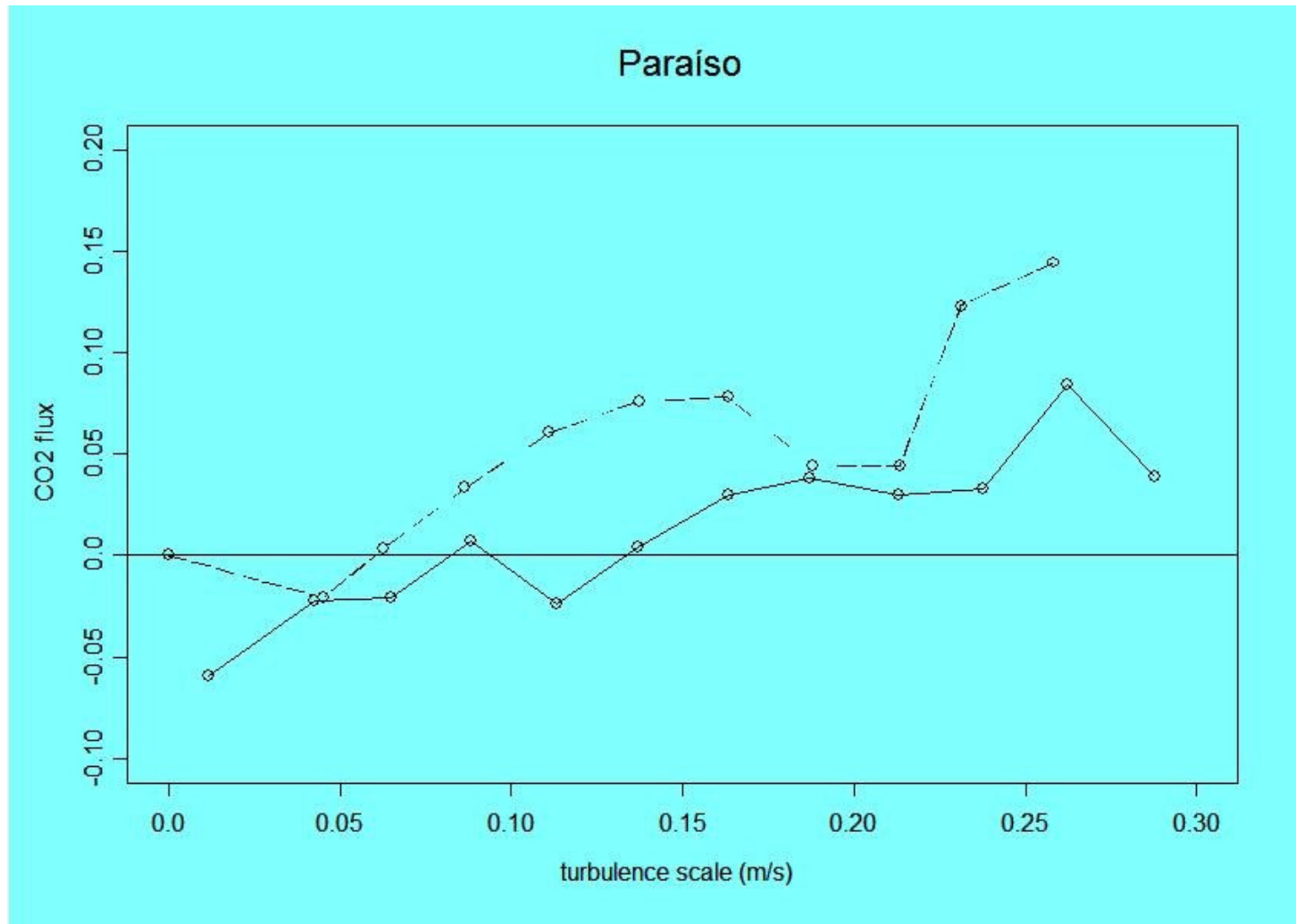
Using u_* tends to smooth the flux dependence on turbulence scale.



In extreme conditions, this dependence is only evident using σ_w



In general, using σ_w leads to a lower filtering threshold and larger fluxes.



Concluding remarks

- Storage needs to be accounted to quantify the impact of the turbulence scale on NEE estimates;
- The role of mesoscale fluxes need to be addressed to identify the temporal scale for flux calculation.