

Retrieving photosynthesis from leaf chlorophyll fluorescence and green reflectance

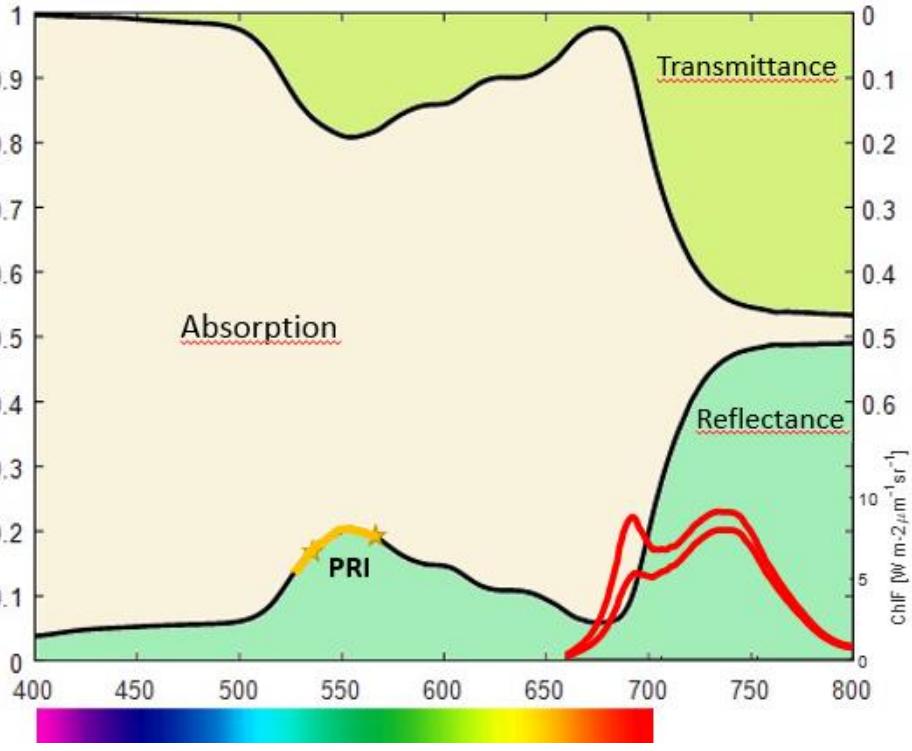
Nastassia Vilfan
Christiaan van der Tol
Wouter Verhoef



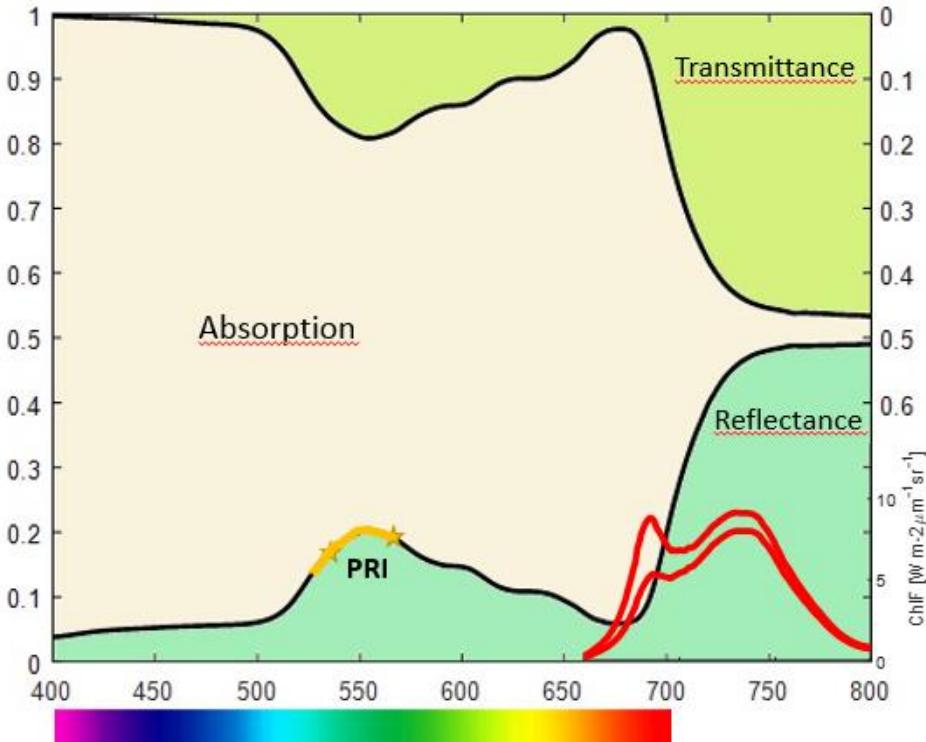
UNIVERSITY OF
TWENTE.



OBJECTIVES

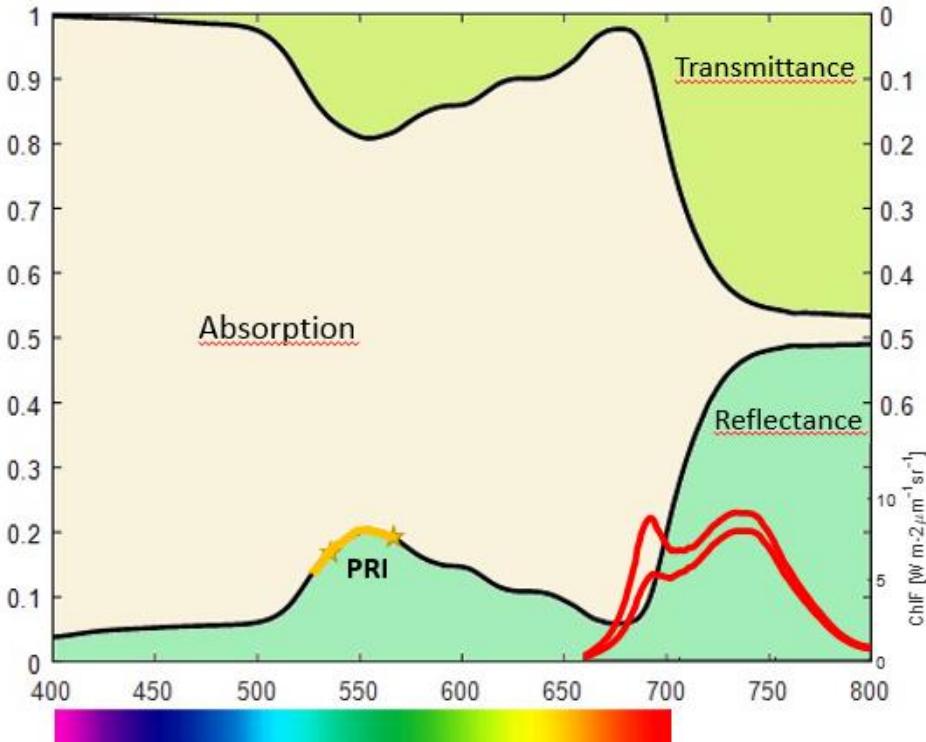


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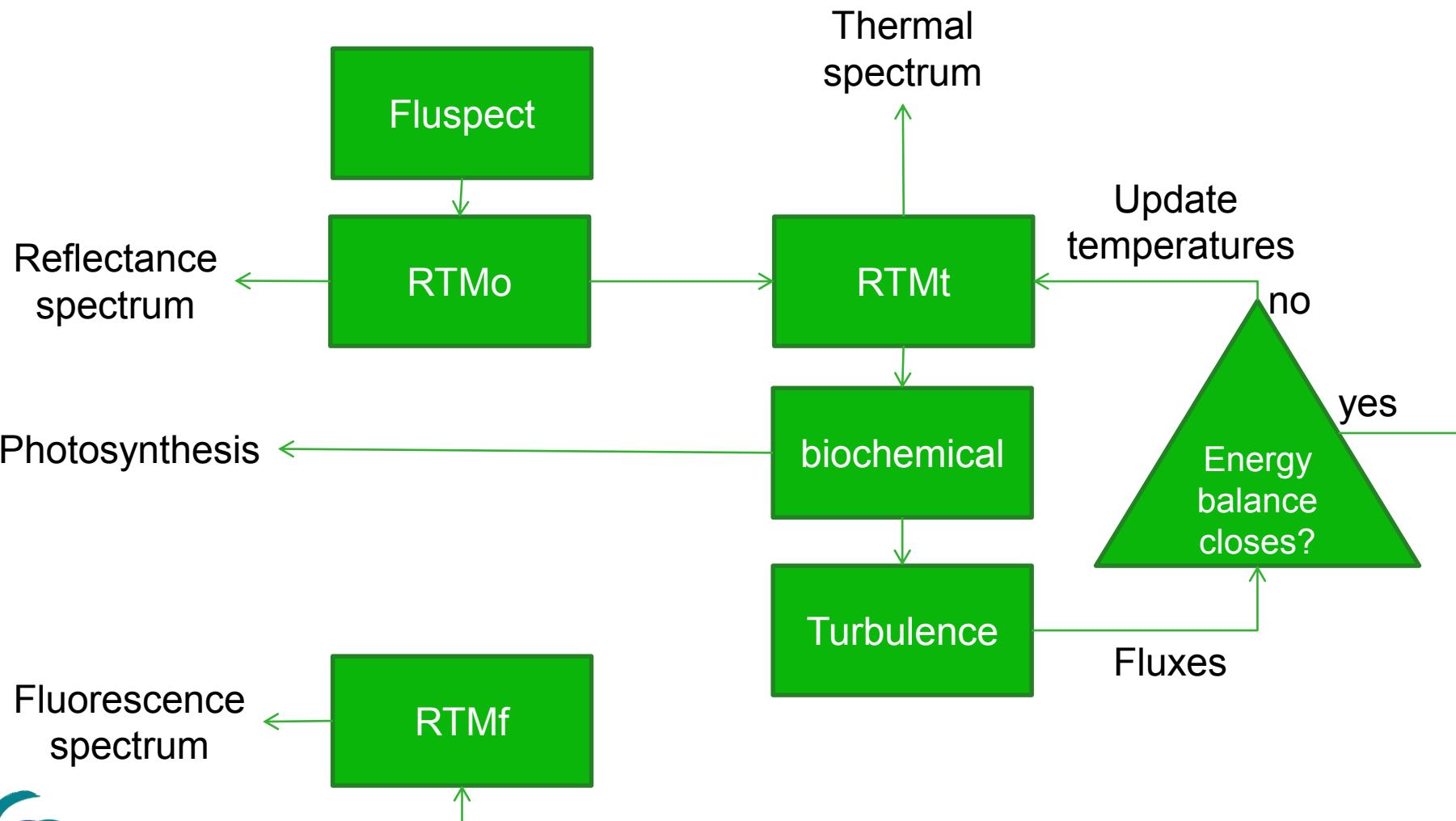
- Could reflectance and chlorophyll fluorescence provide more information about photosynthesis, when used together?

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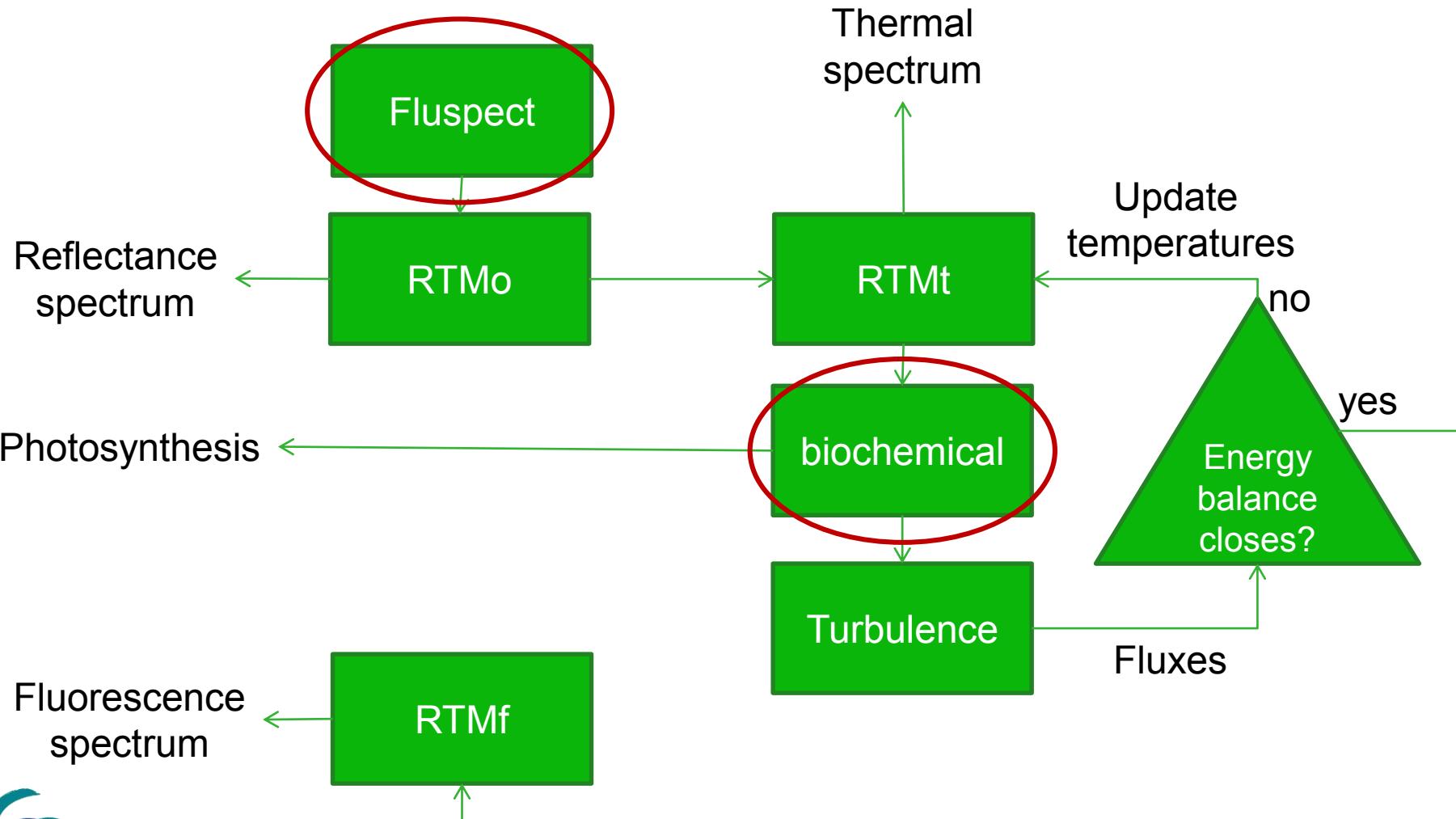


- Could reflectance and chlorophyll fluorescence provide more information about photosynthesis, when used together?
 - RT model coupled to a biochemical model
 - The SCOPE model (Van der Tol et al. (2009))

THE STRUCTURE OF SCOPE



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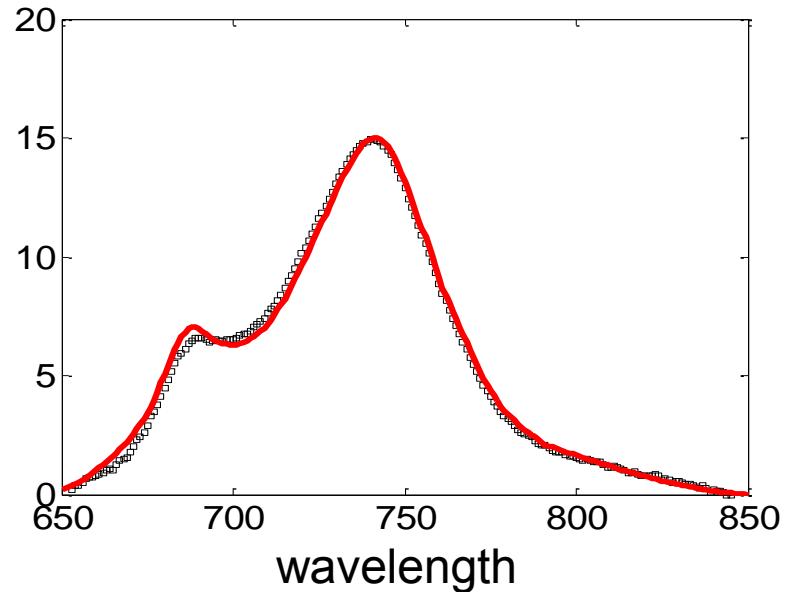


FLUSPECT

Parameter	Symbol
Chlorophyll a+b content	C_{ab}
Total carotenoid content	C_{car}
Anthocyanin content	C_{ant}
Water content	C_w
Dry matter content	C_{dm}
Leaf mesophyll structure parameter	N
Senescence material (brown pigments)	C_s
Fluorescence quantum efficiency for PS-I	η_I
Fluorescence quantum efficiency for PS-II	η_{II}
Xanthophyll cycle EPS parameter	C_x

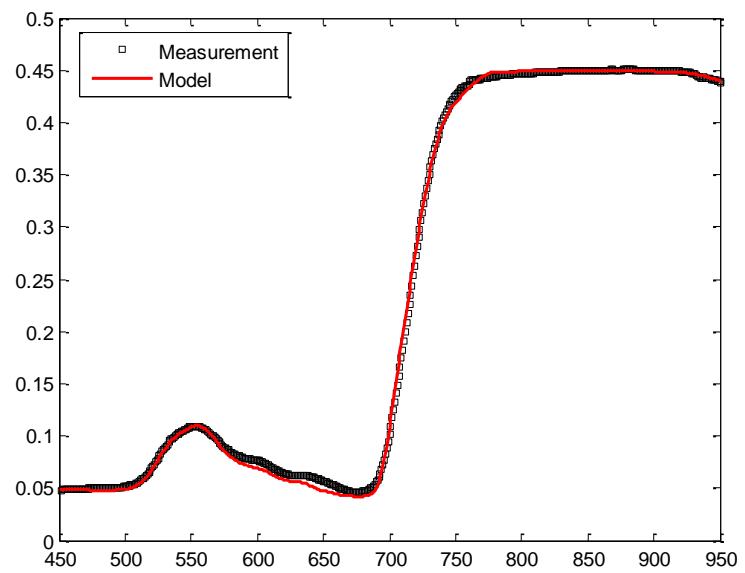
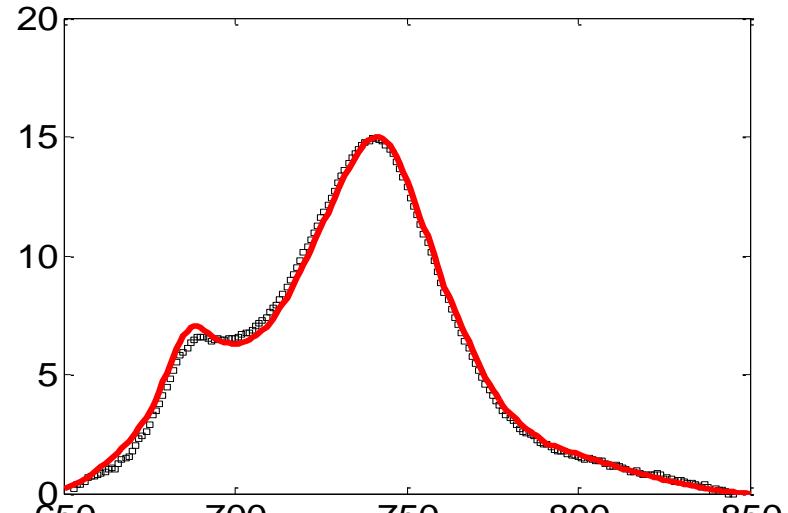
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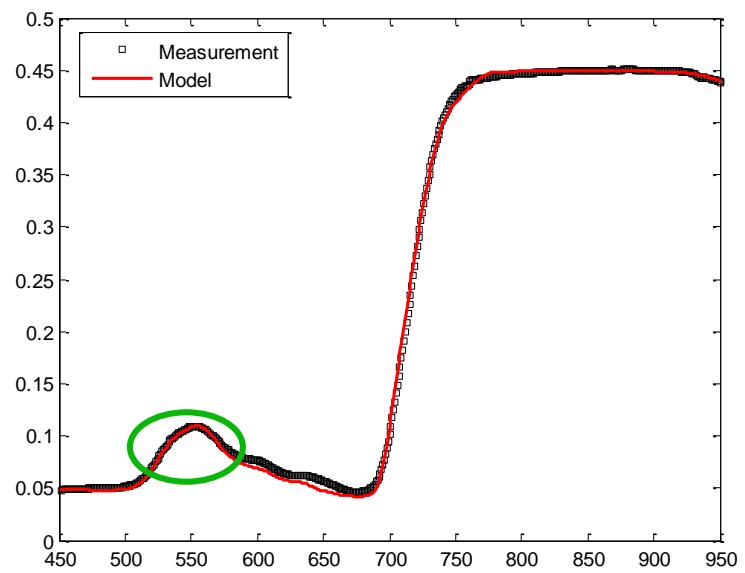
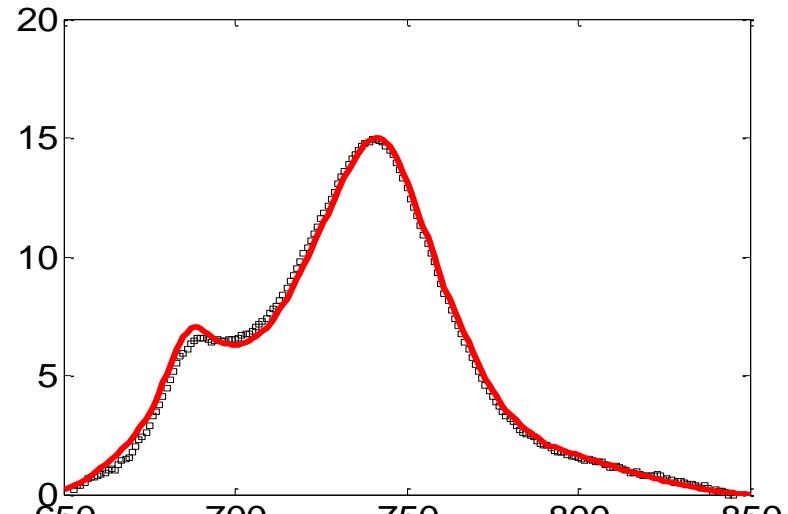
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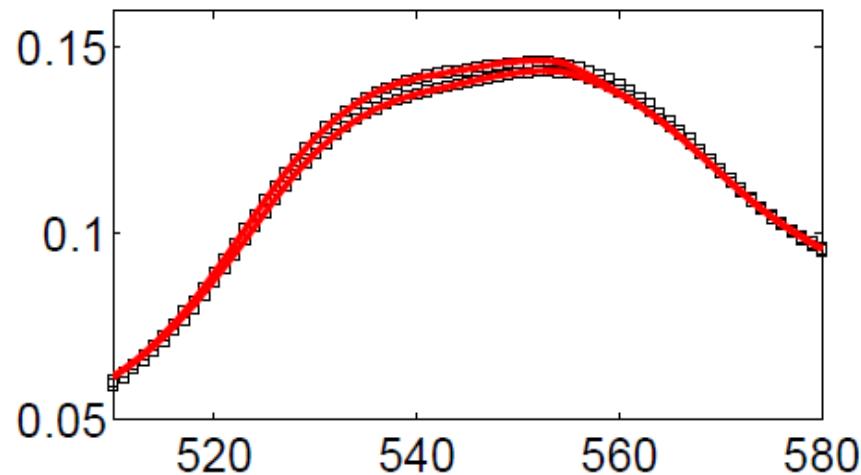
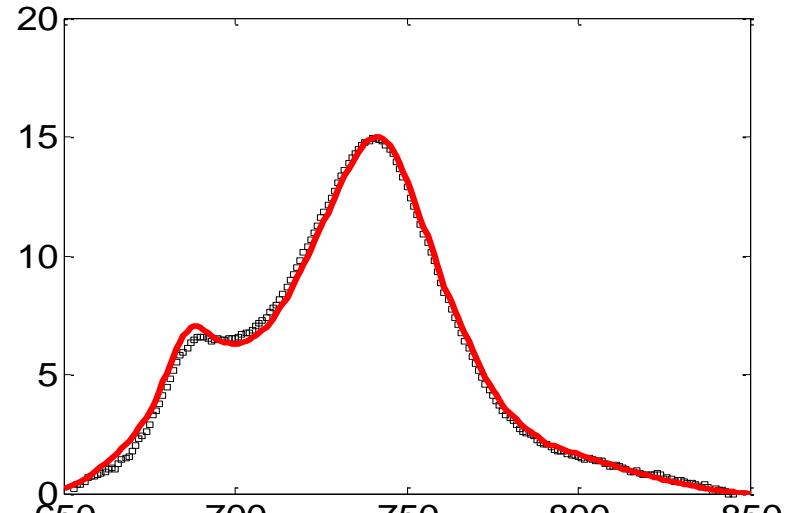
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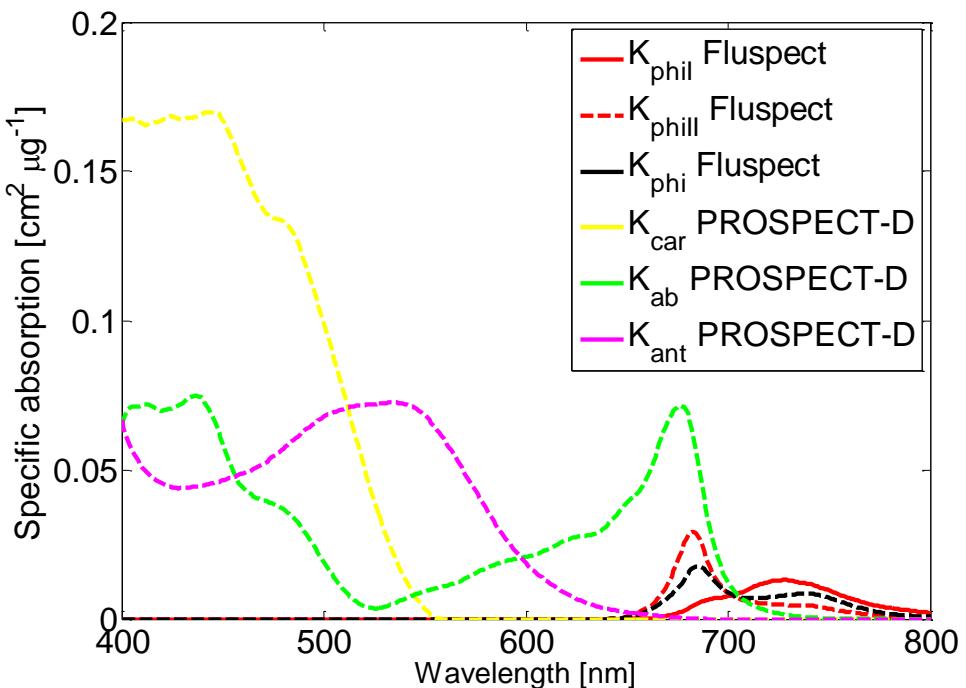
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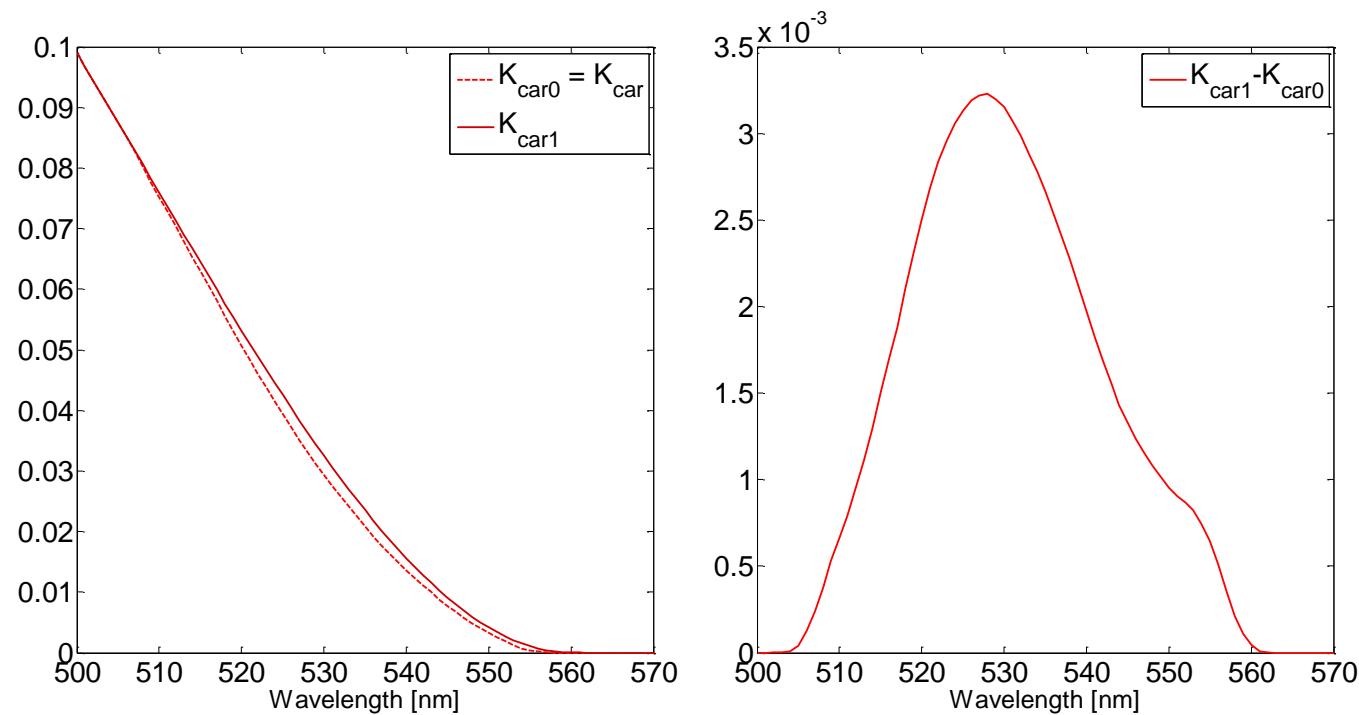
- Vilfan, N., van der Tol, C., Muller, O., Rascher, U., & Verhoef, W. (2016). Fluspect-B: A model for leaf fluorescence, reflectance and transmittance spectra. *Remote Sensing of Environment*, 186, 596–615. <http://doi.org/10.1016/j.rse.2016.09.017>
- Vilfan, N., van der Tol, C., Yang, P., Wyber, R., Malenovský, Z., Robinson, S. A., & Verhoef, W. (2017). A model for leaf dynamic xanthophyll cycle reflectance. *Submitted to Journal of Remote Sensing of Environment*.

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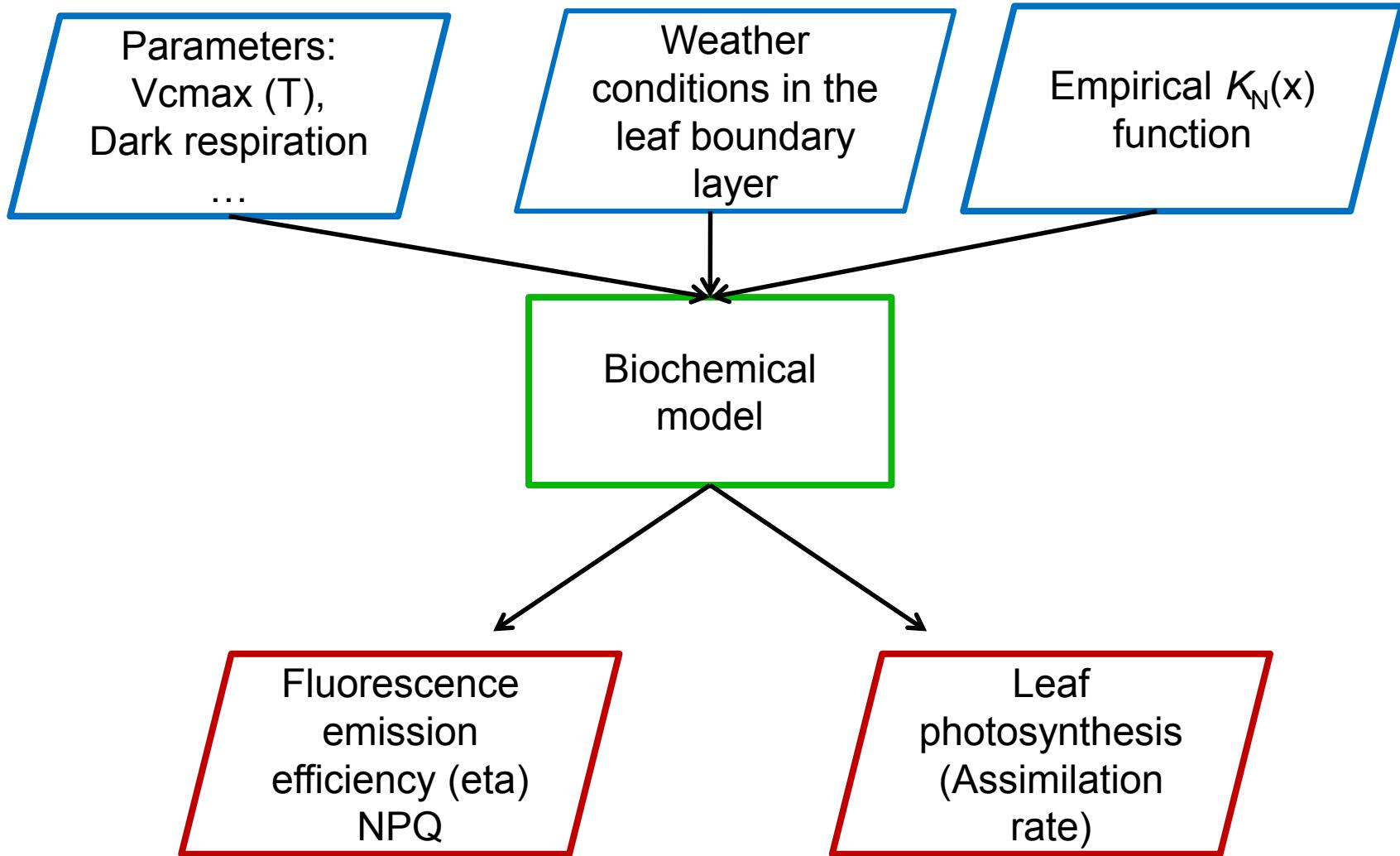
FLUSPECT



Xanthophyll cycle EPS parameter

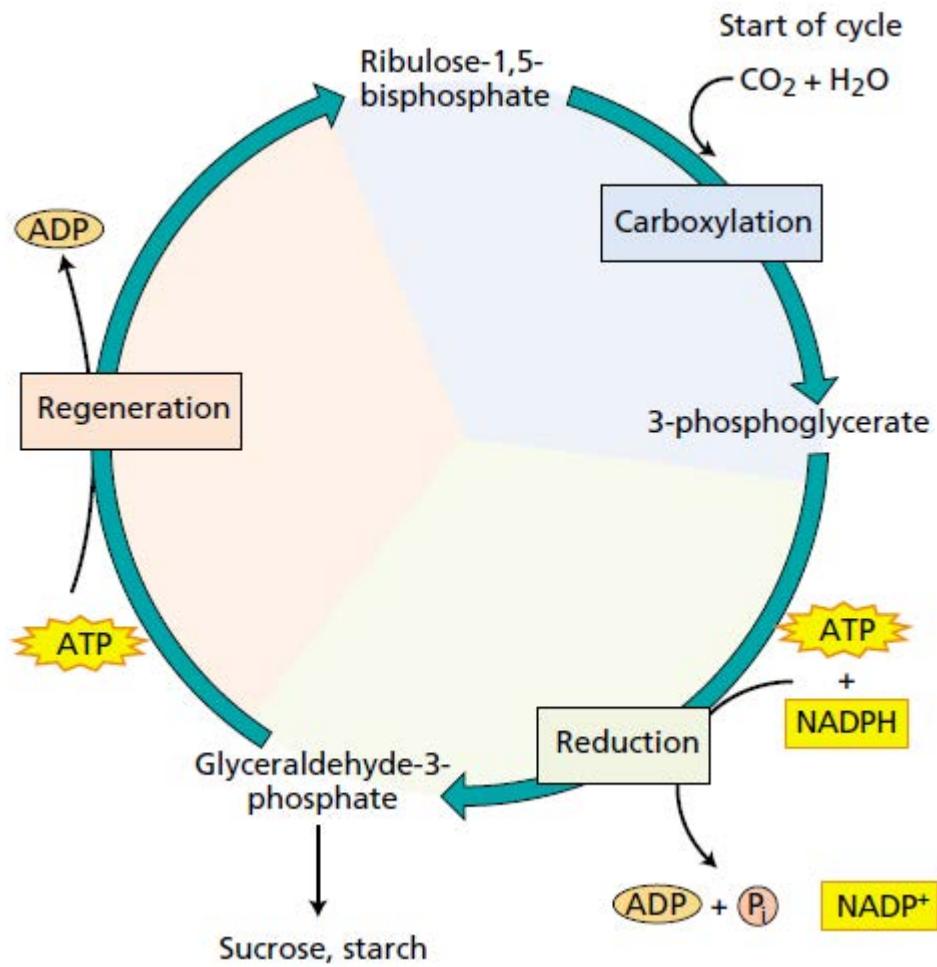
C_x

BIOCHEMICAL MODEL

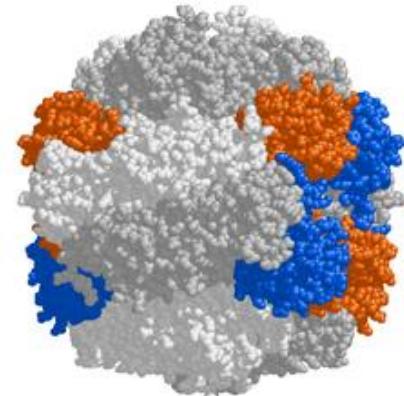
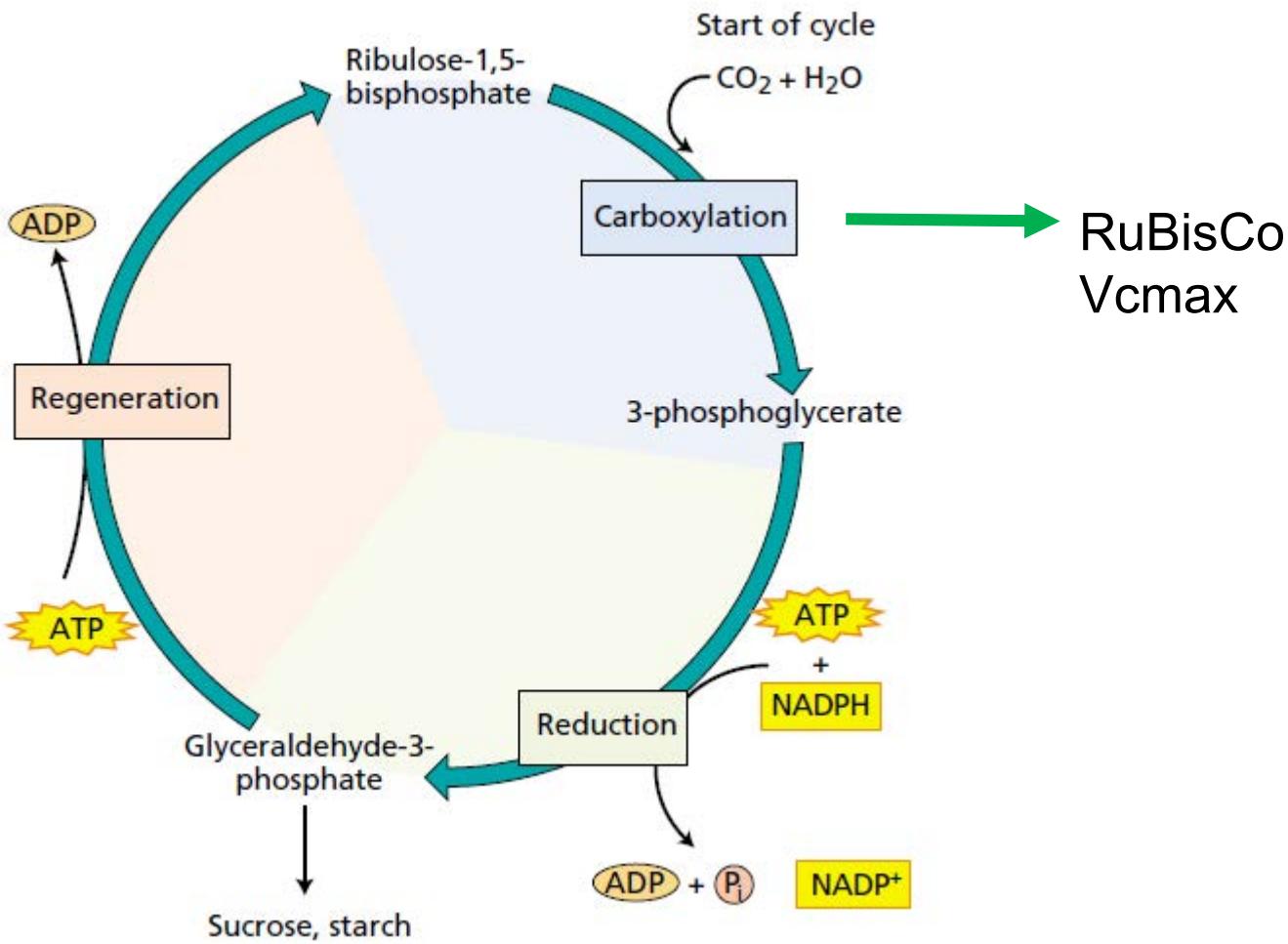


Van Der Tol, C., Berry, J. A., Campbell, P. K. E., & Rascher, U. (2014). Models of fluorescence and photosynthesis for interpreting measurements of solar-induced chlorophyll fluorescence. *Journal of Geophysical Research G: Biogeosciences*, 119(12), 2312–2327. <http://doi.org/10.1002/2014JG002713>

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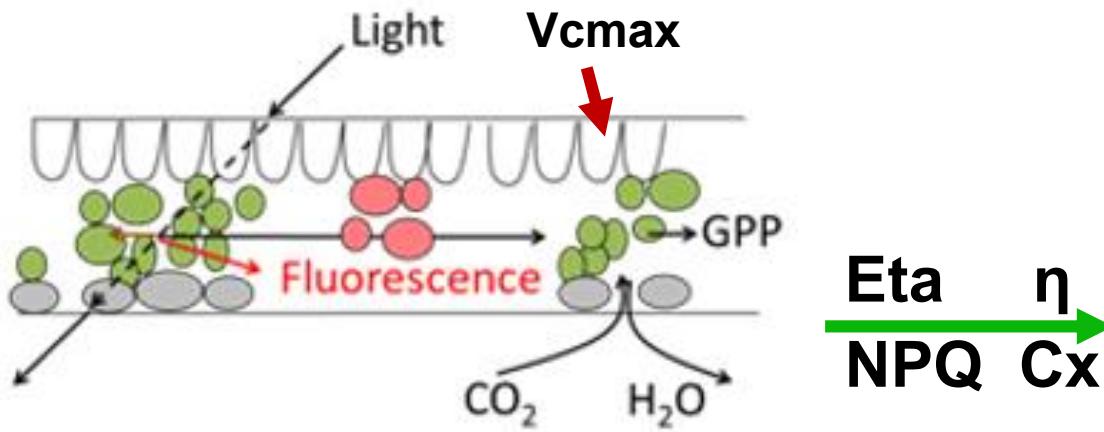
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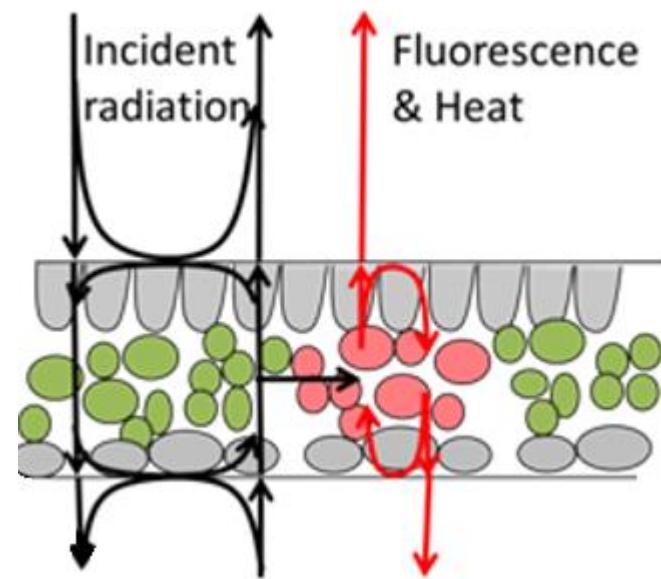
SCOPE

Leaf models

Biochemical



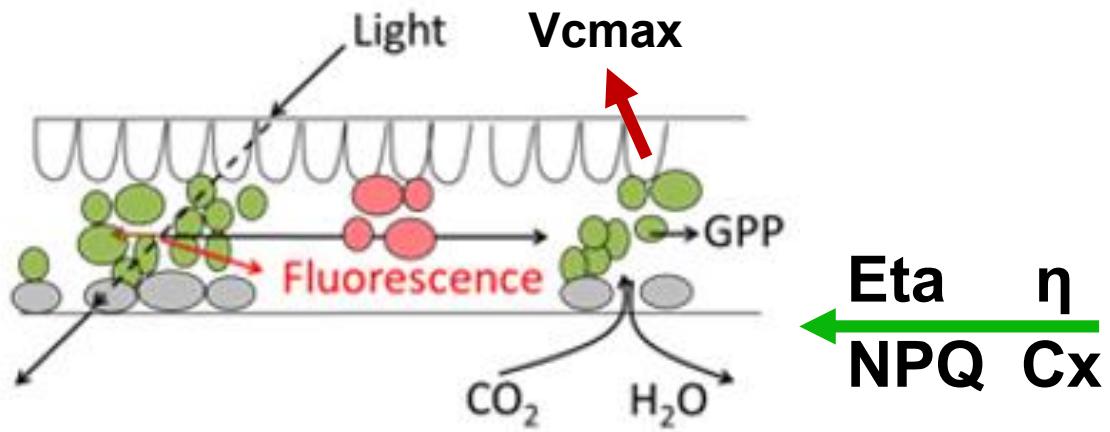
Fluspect



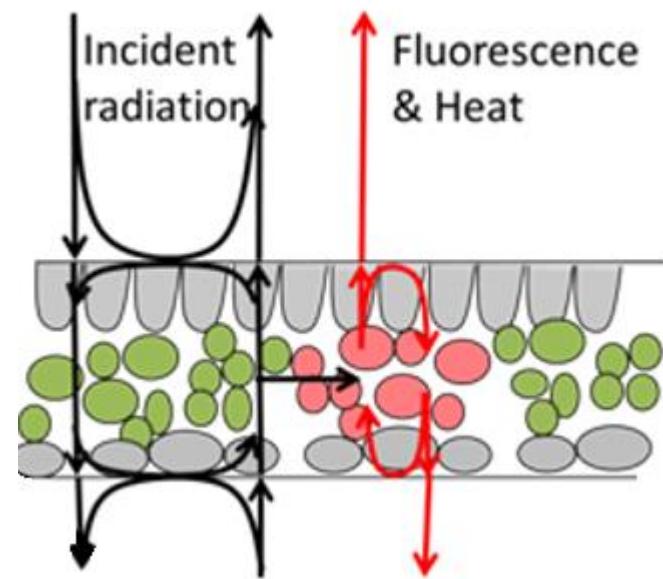
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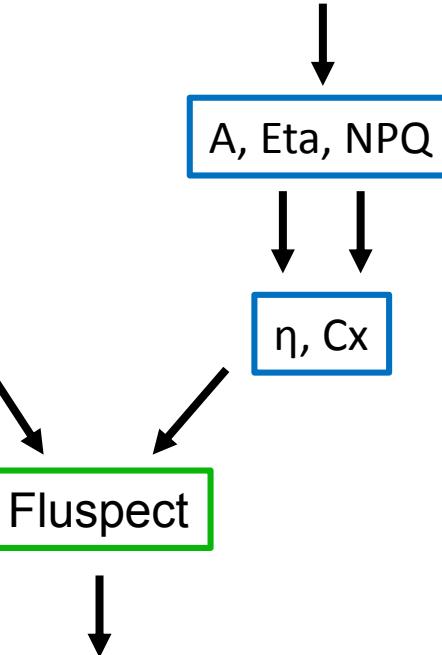


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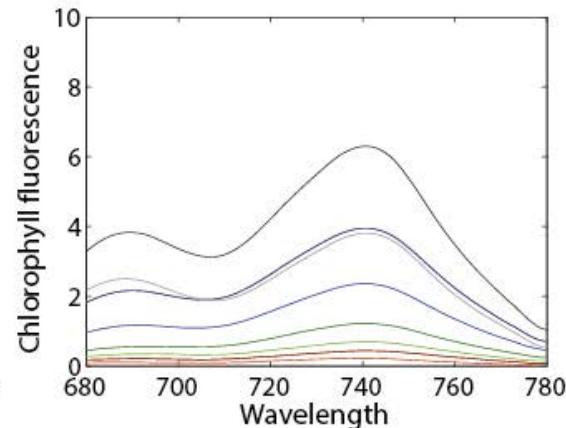
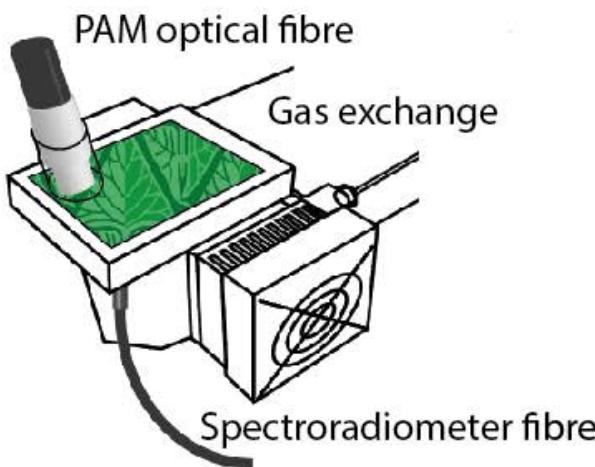
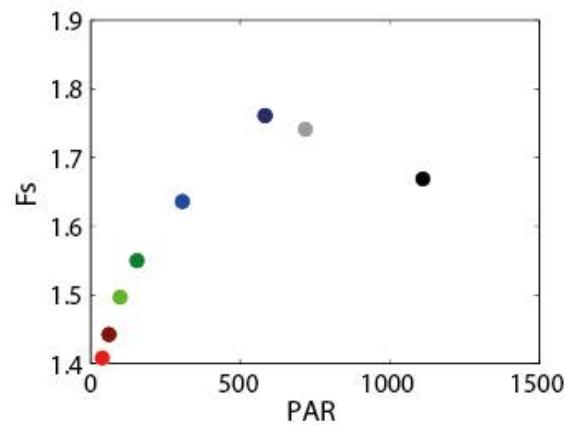
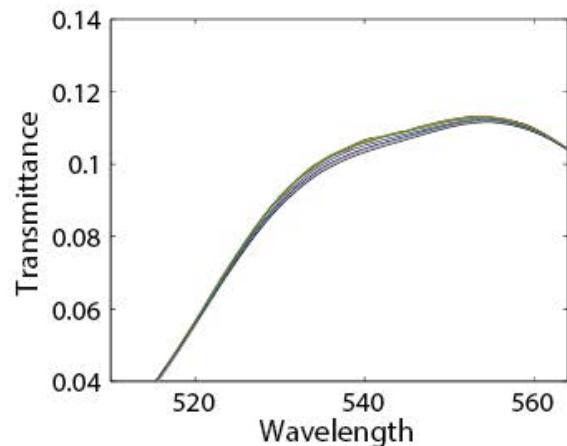
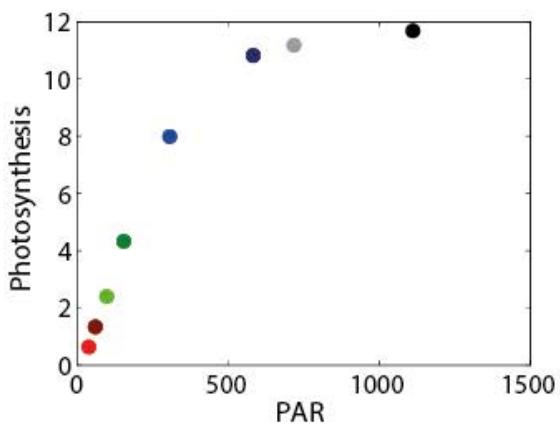
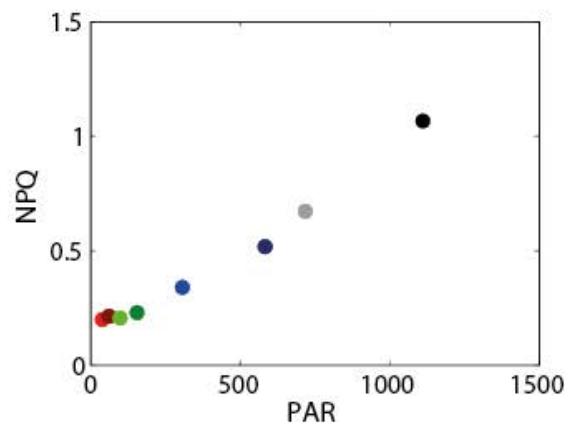
Biochemical model
Standard input: $V_{max} = 70$,
+ PAR, T_{leaf} , CO_2 , H_2O



R 525-545 nm
F 730-750 nm

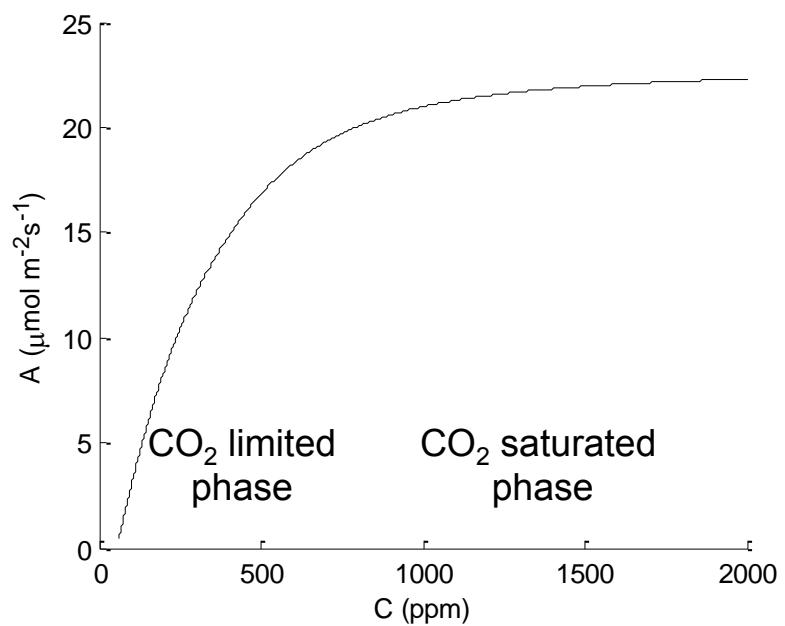
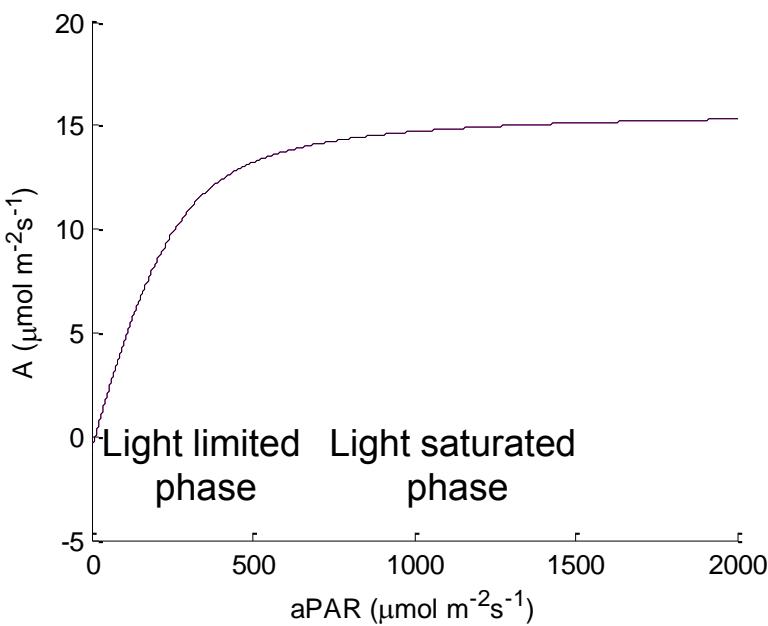
Vcmax optimization

COMBINED SIMULTANEOUS IRGA, PAM AND HYPERSPECTRAL

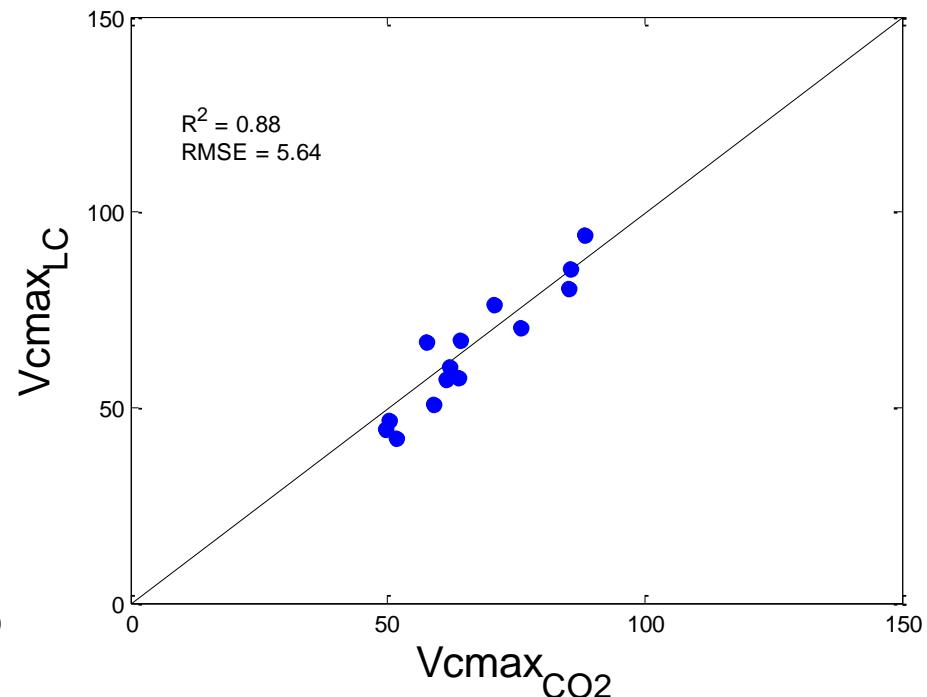
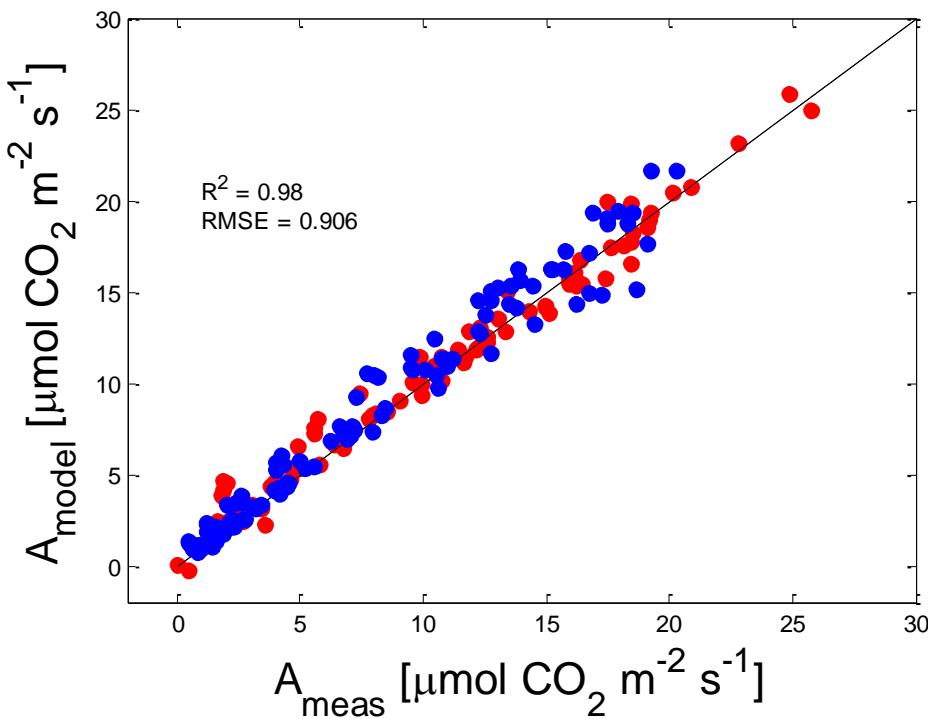


Most important parameters:

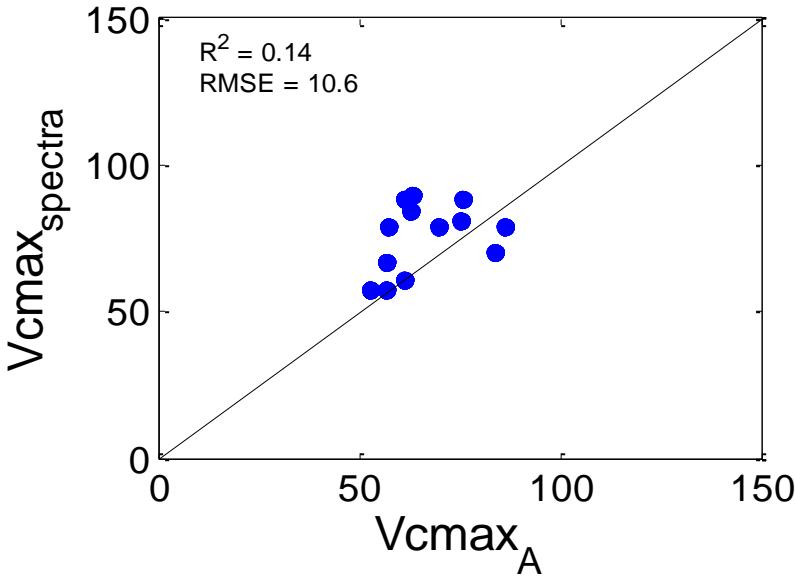
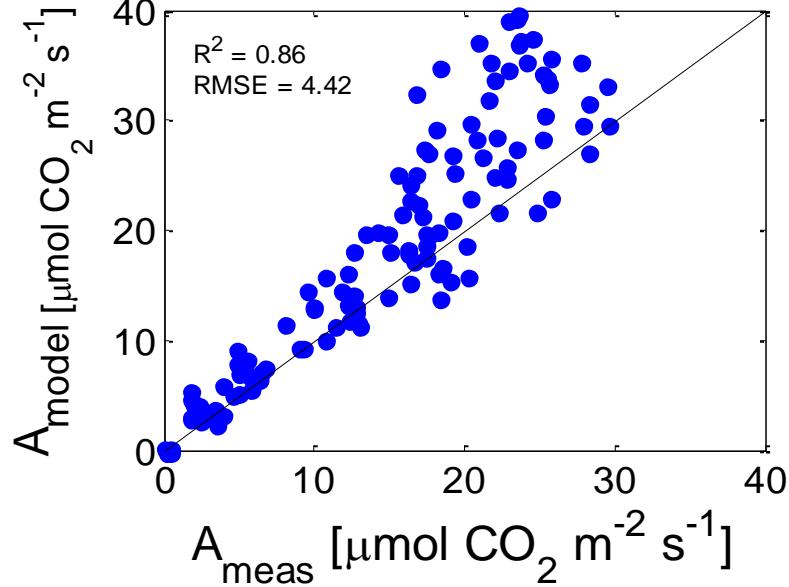
- Initial slope of light response curve
- Curvature of the light response
- Carboxylation capacity: *highly variable*



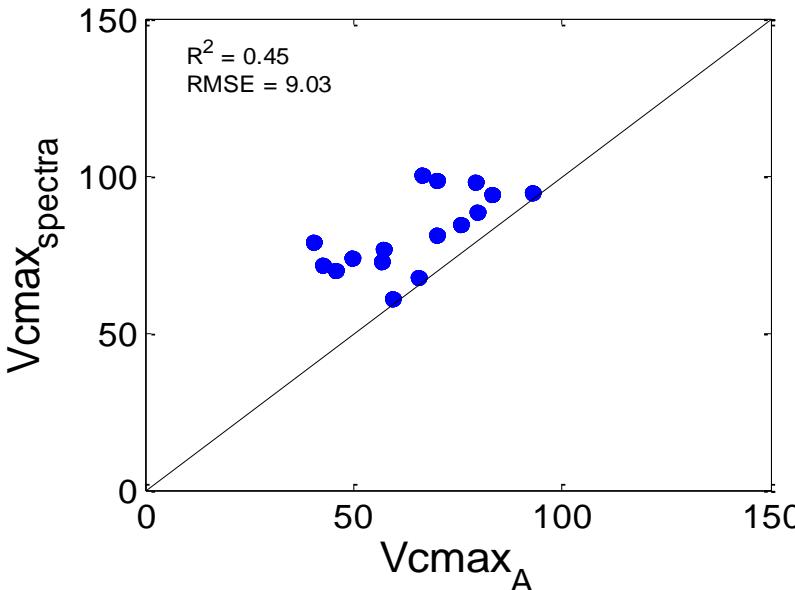
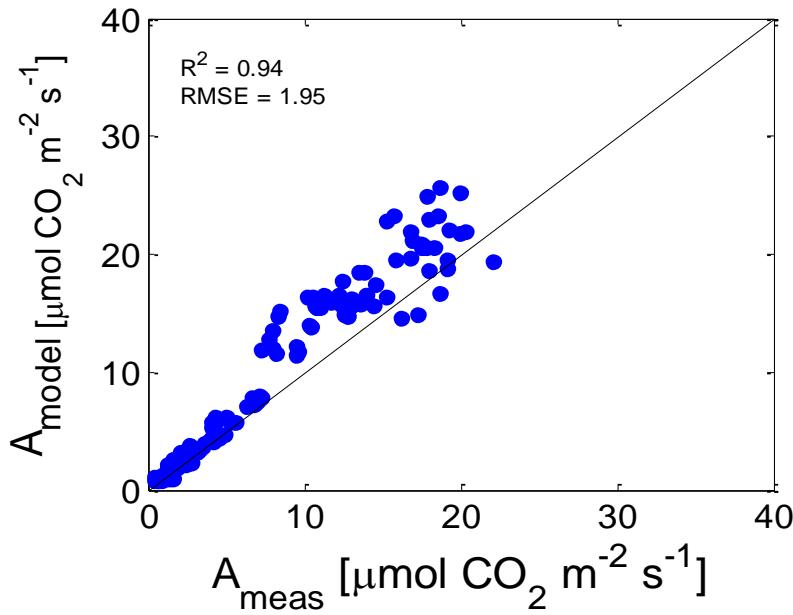
RETRIEVING VCMAX FROM GAS ECHANGE DATA

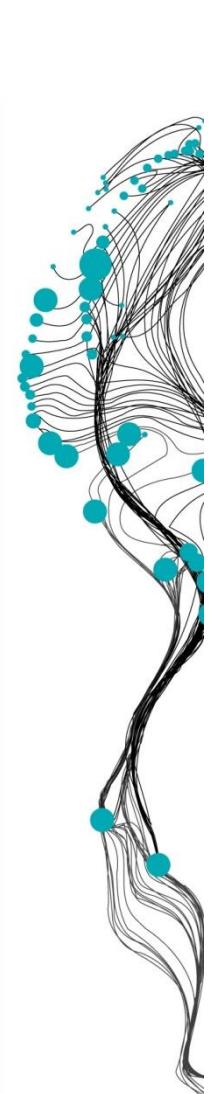


CO₂ curves



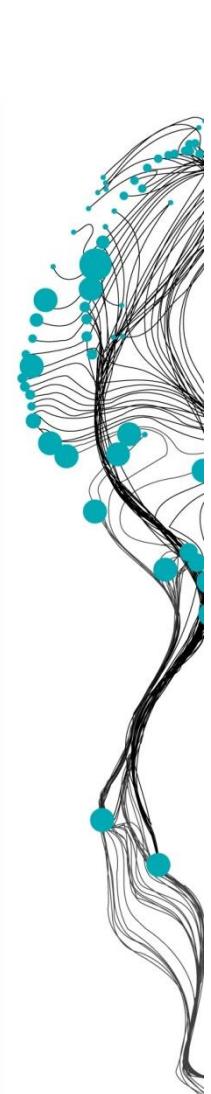
Light curves





CONCLUSIONS

- Coupled RT to biochemical models → new framework for retrieval of photosynthesis
- Relatively simple code, easily adjusted and upgraded
- Canopy...



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Thank you!



Netherlands Organisation
for Scientific Research



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