

# Glowing plants: how to use solar-induced chlorophyll fluorescence to infer carbon and water fluxes?

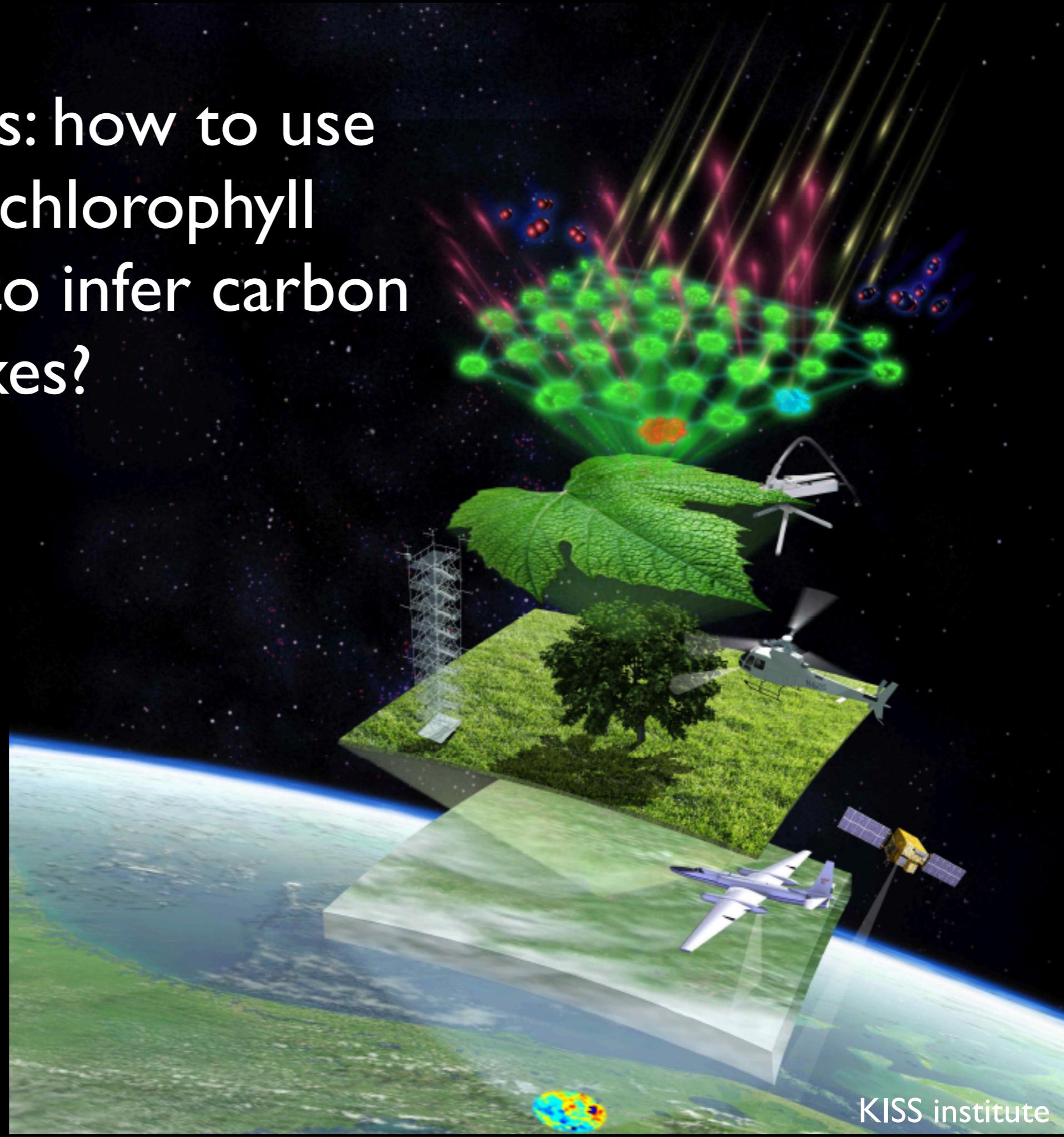
Xi Yang

University of Virginia



NASA IDS  
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KISS institute

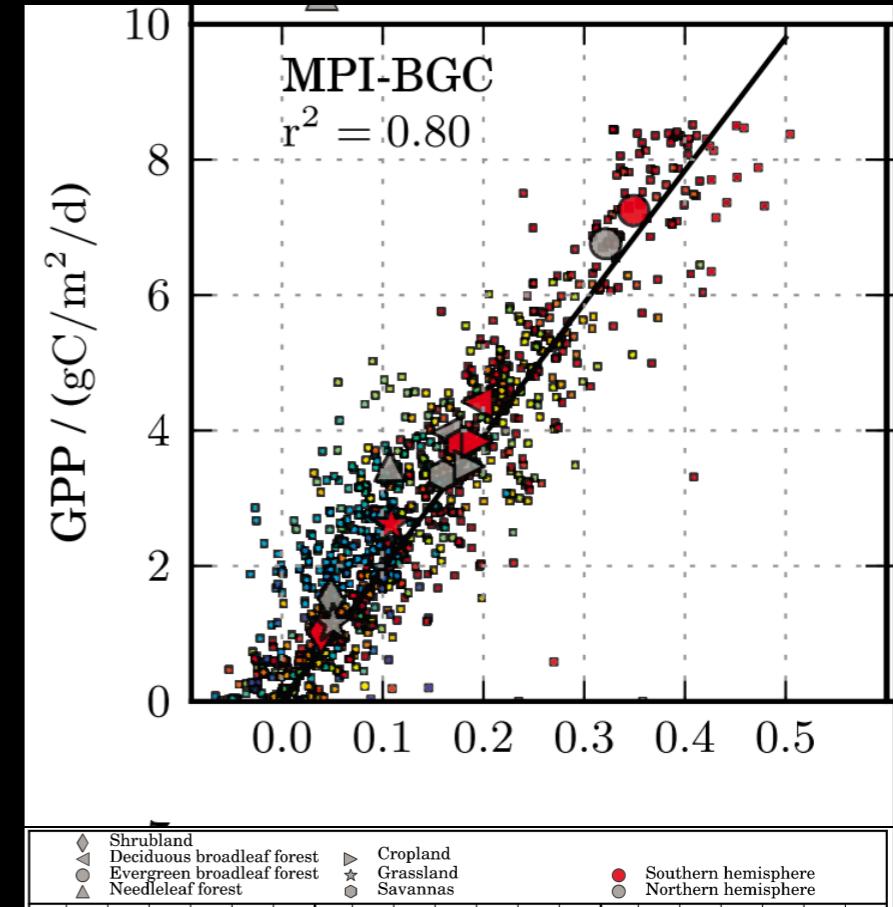
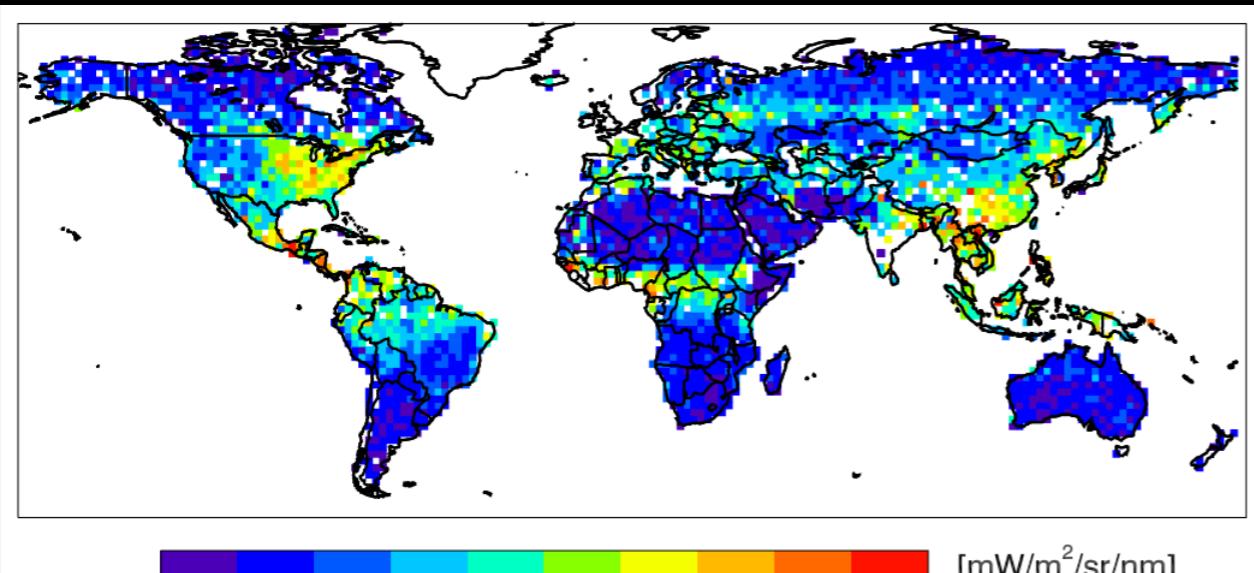
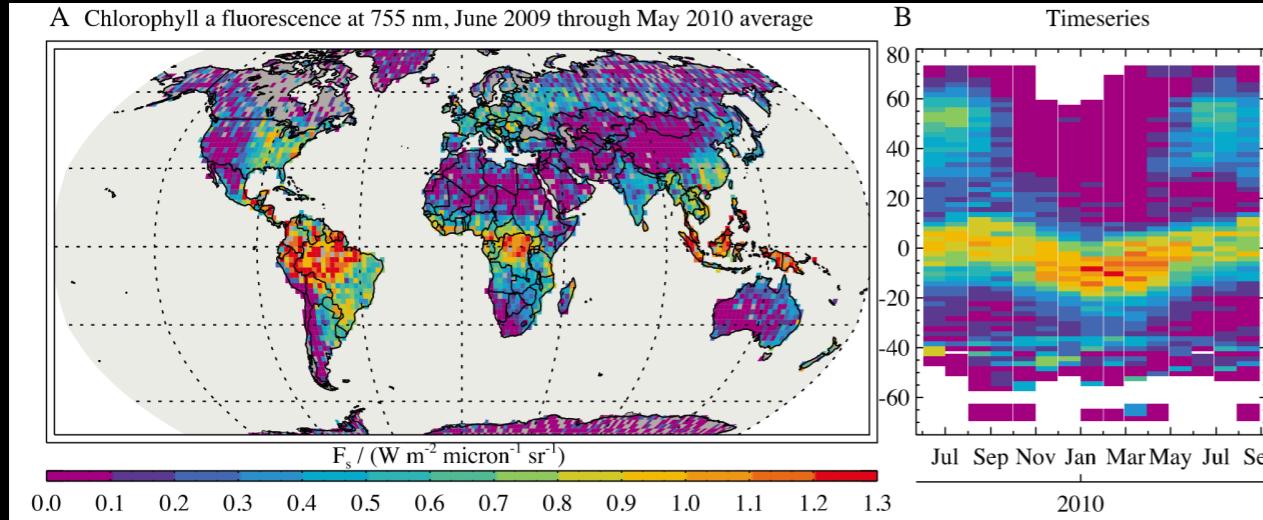
# Glowing plants

SCIAMACHY

OCO-2  
TROPOMI  
GOSAT  
GOSAT-2  
TanSat

OCO-3  
GEOCarb  
FLEX

# SIF as a proxy for GPP

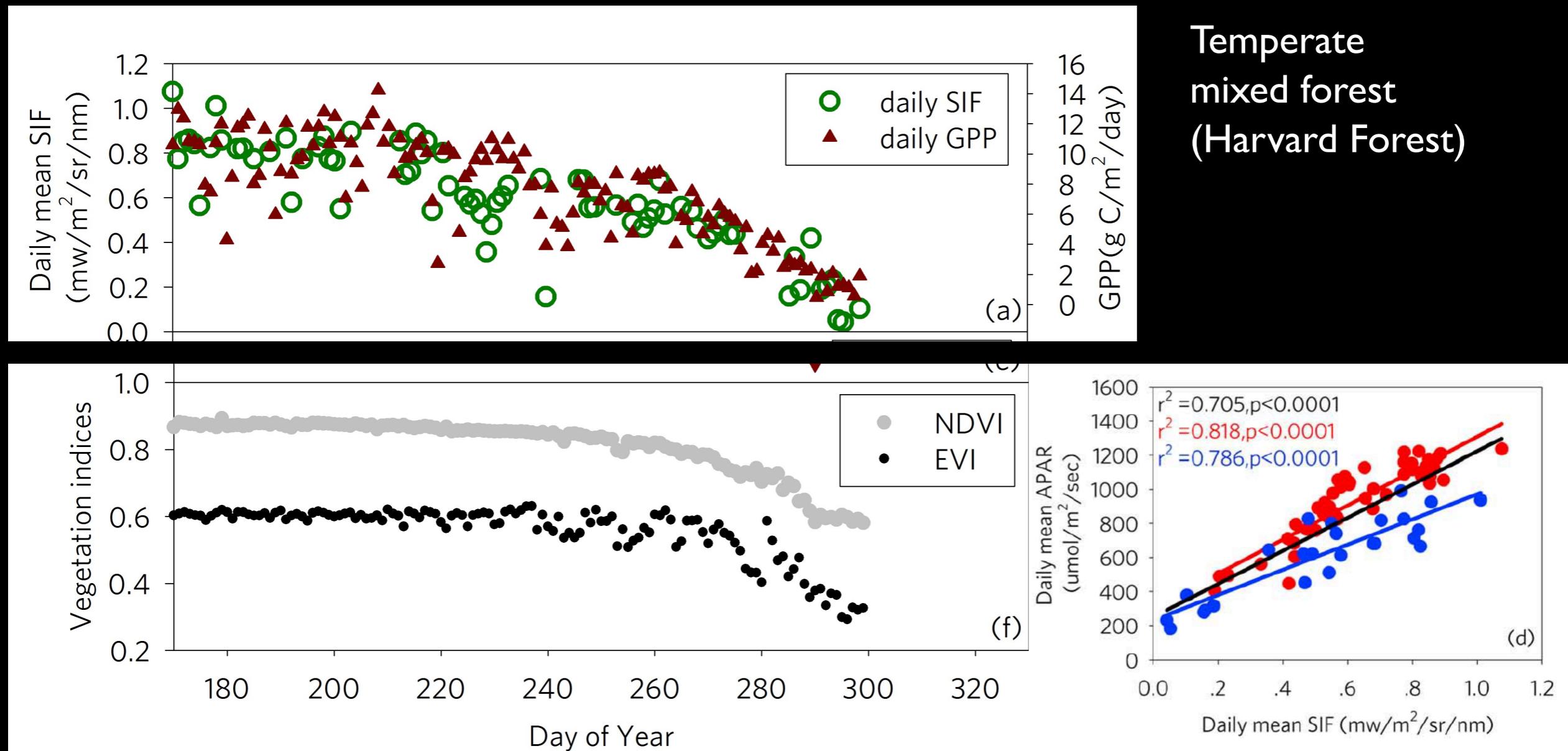


SIF is linearly correlated with GPP at the global scale

First global SIF retrievals from GOSAT

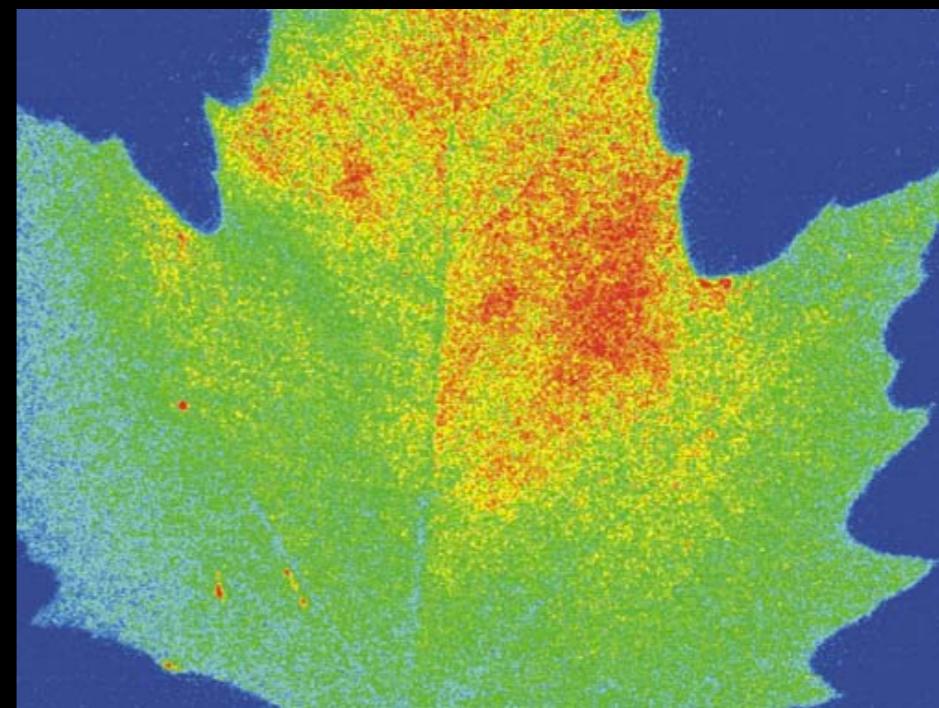
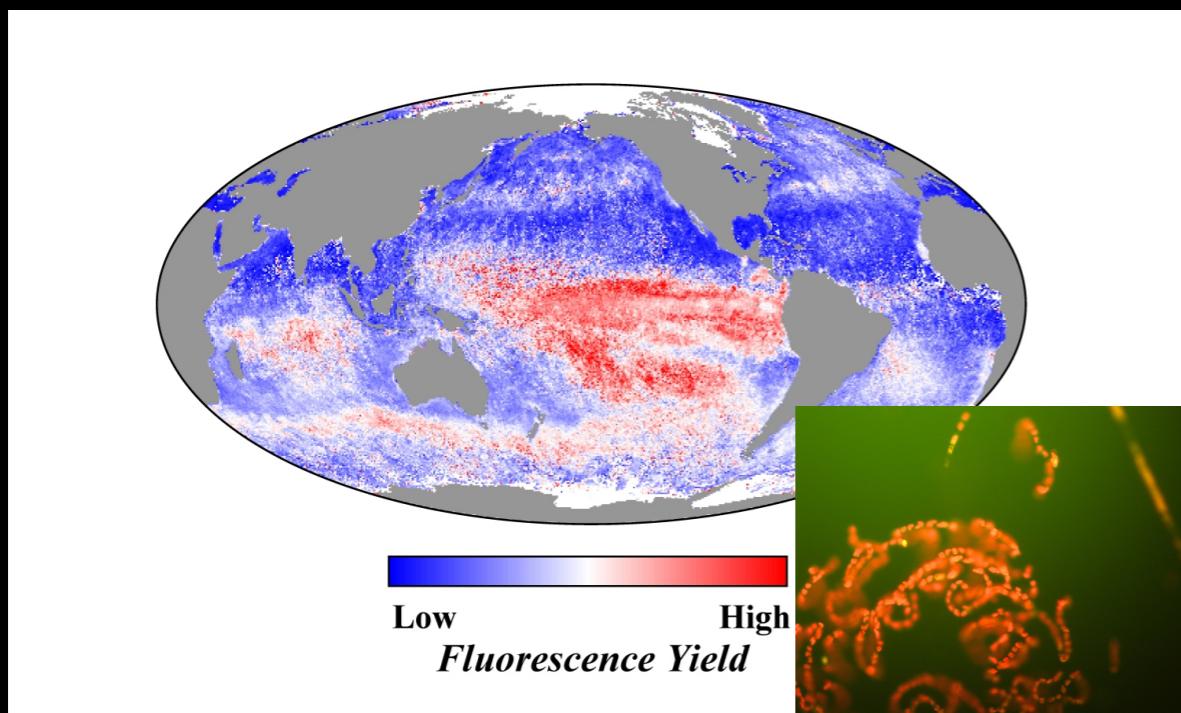
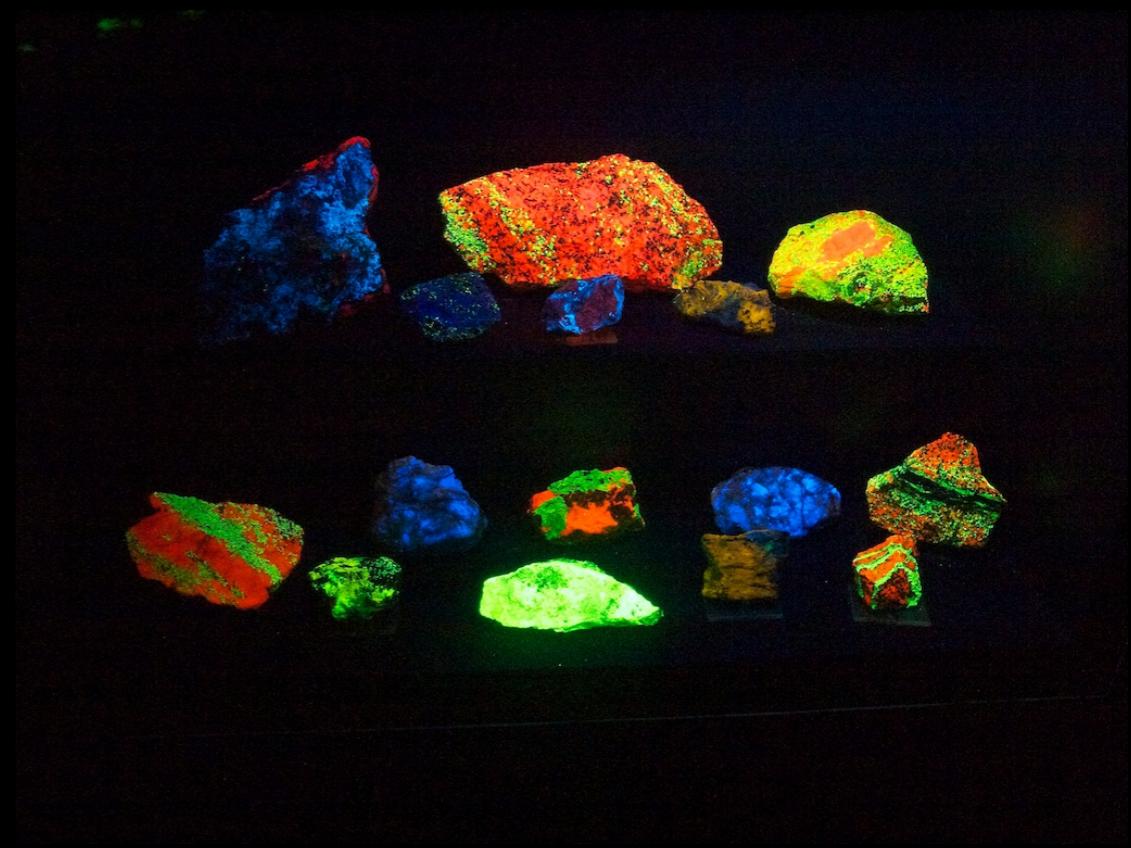
Frankenberg et al., 2011; Joiner et al., 2015

# SIF captures the seasonal variations of GPP



Yang et al., 2015

# Fluorescence in nature

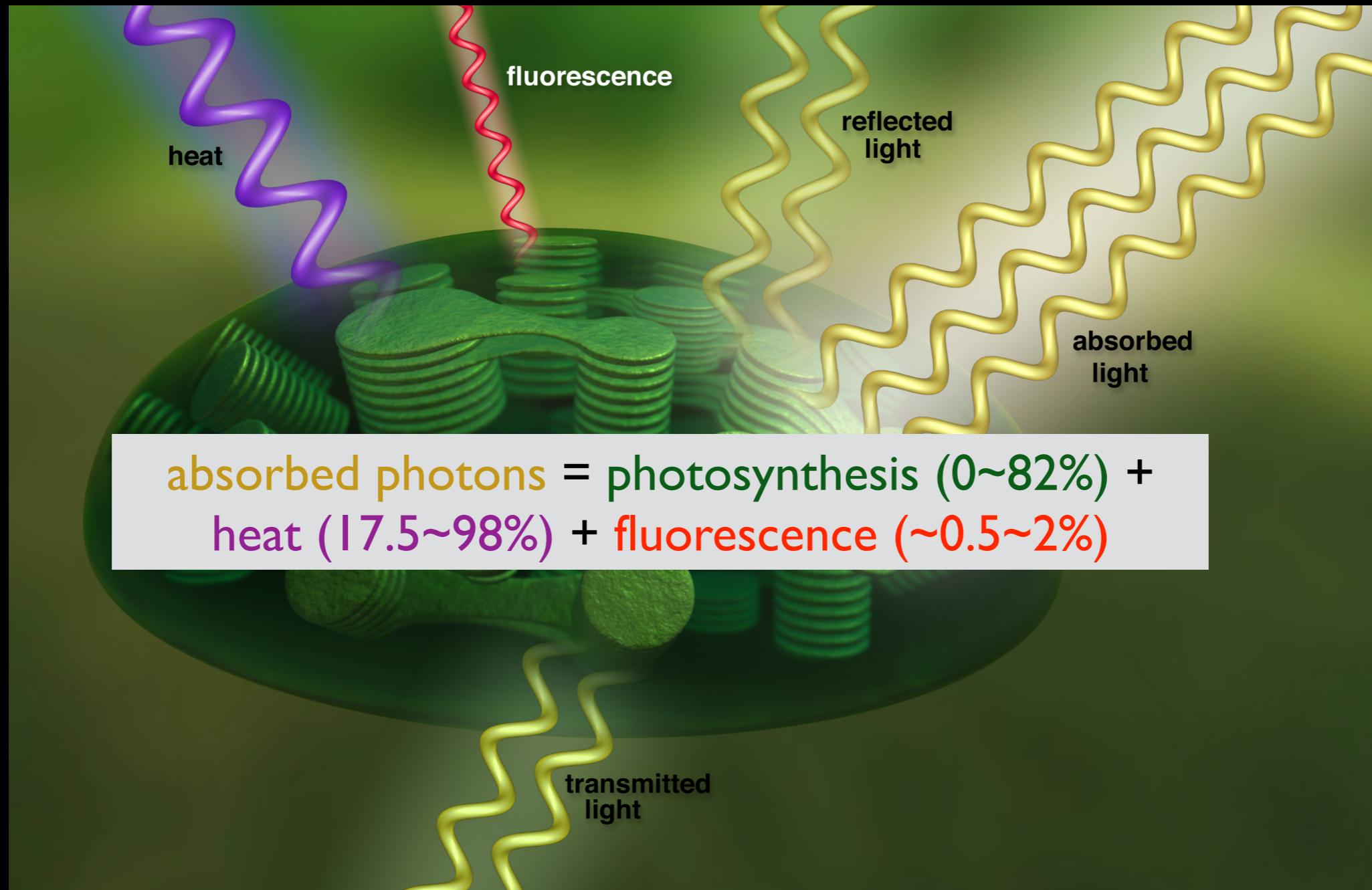


Source: Matt Reinbold; Wikipedia; NASA

Have you seen SIF before?

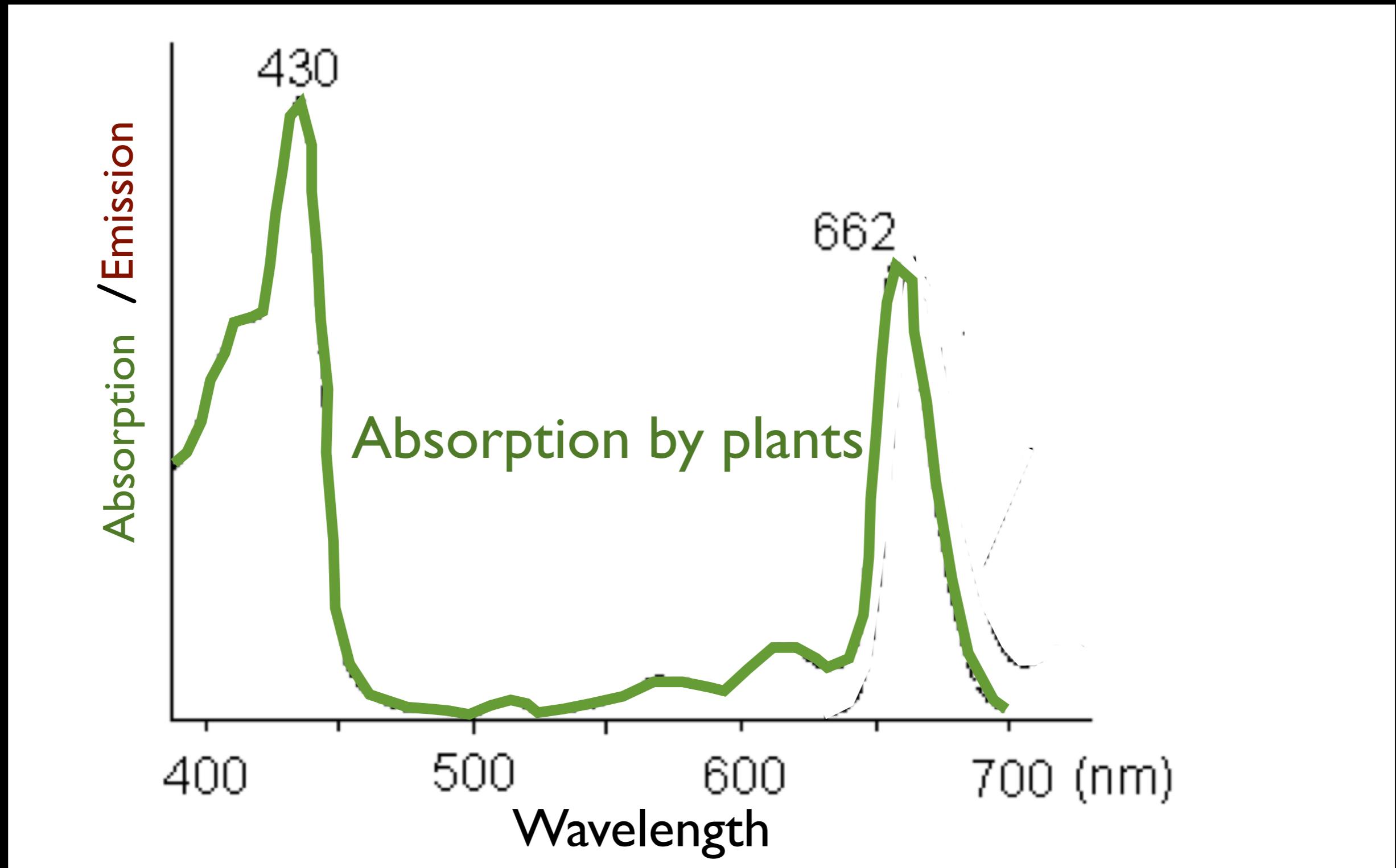
Hands-on experience with spectrometer and Jupyter  
Notebook

# Solar-induced chlorophyll fluorescence (SIF)

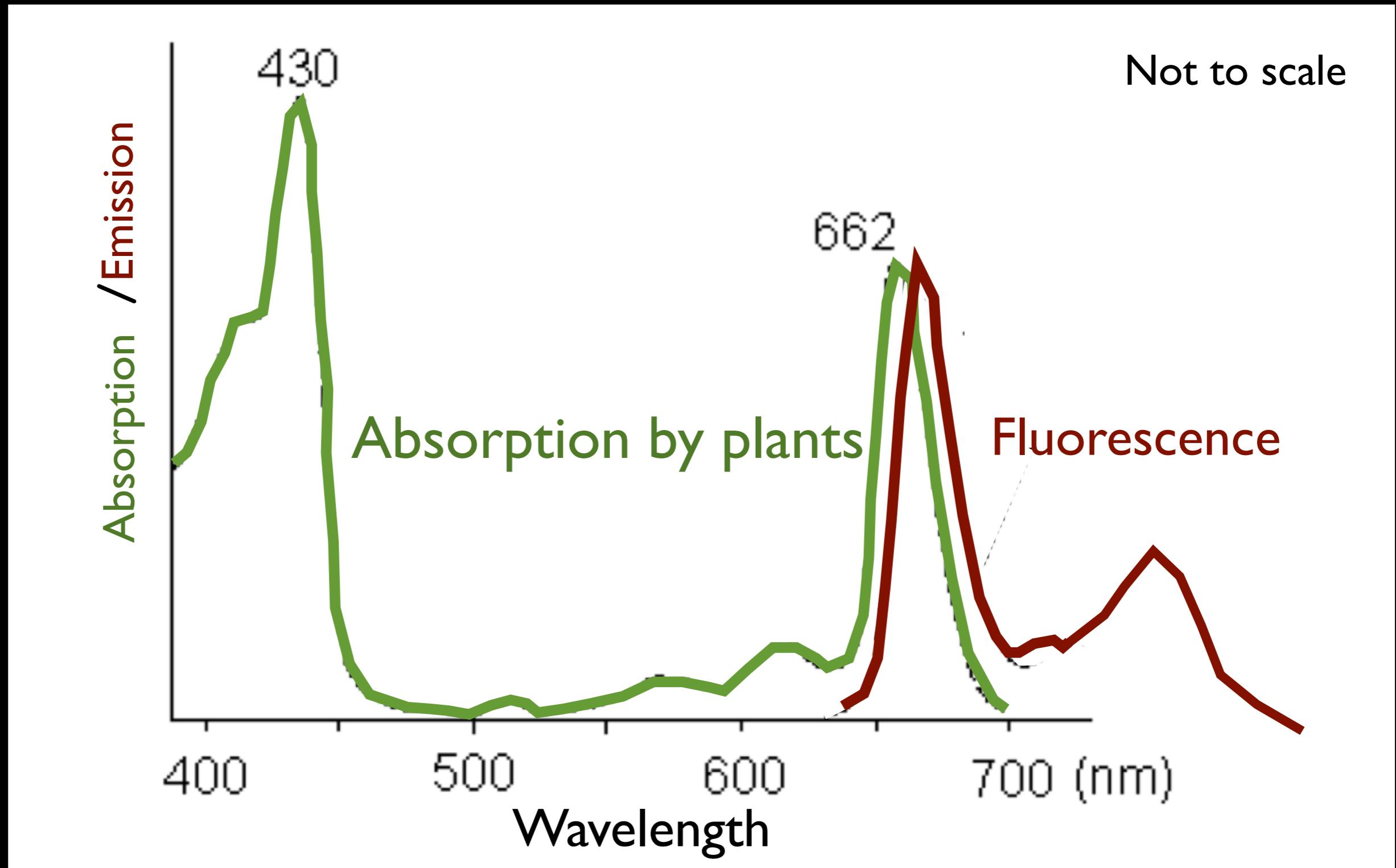


Credit: NASA

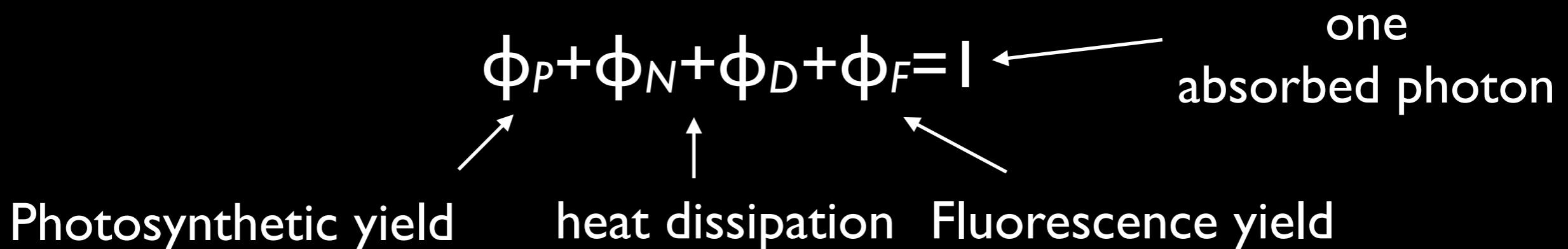
# Chlorophyll absorb mainly blue and red photons



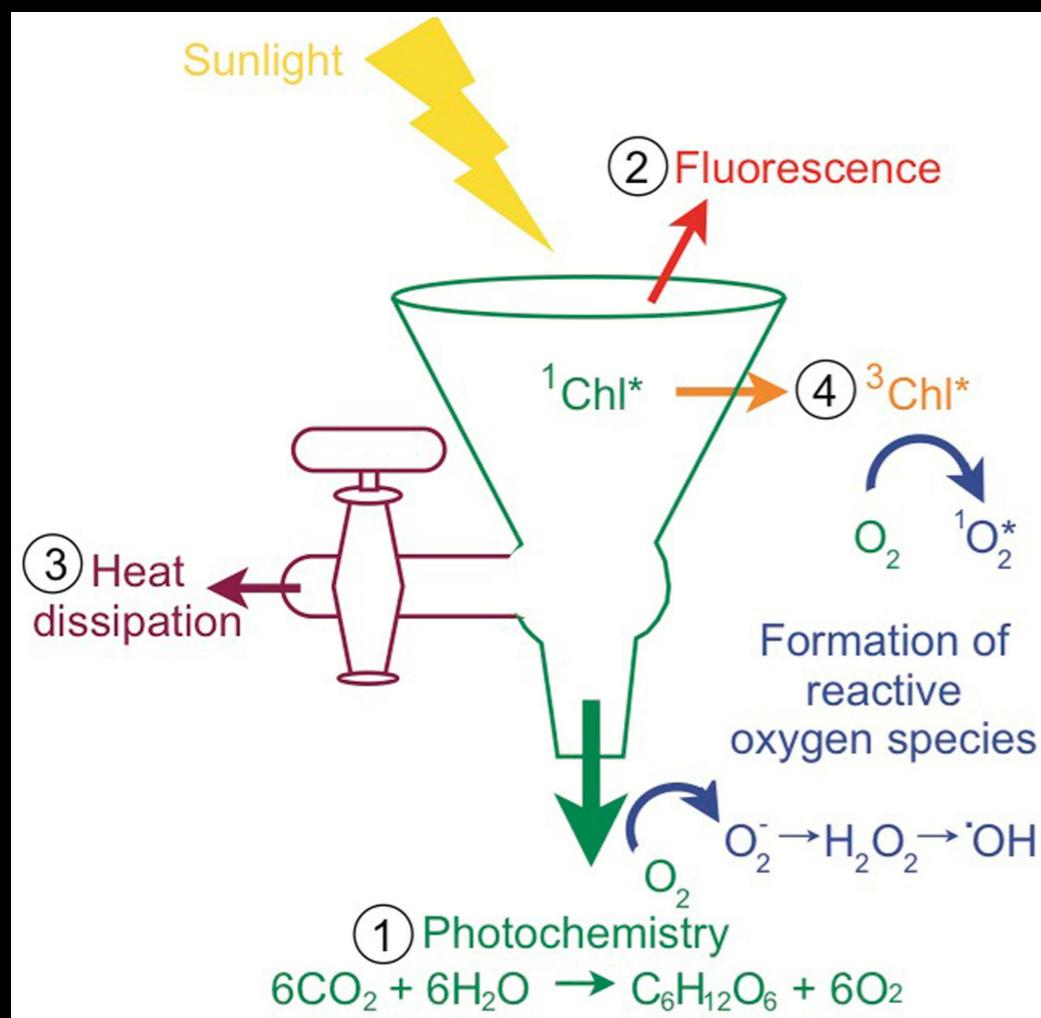
# SIF is emitted in a longer wavelength



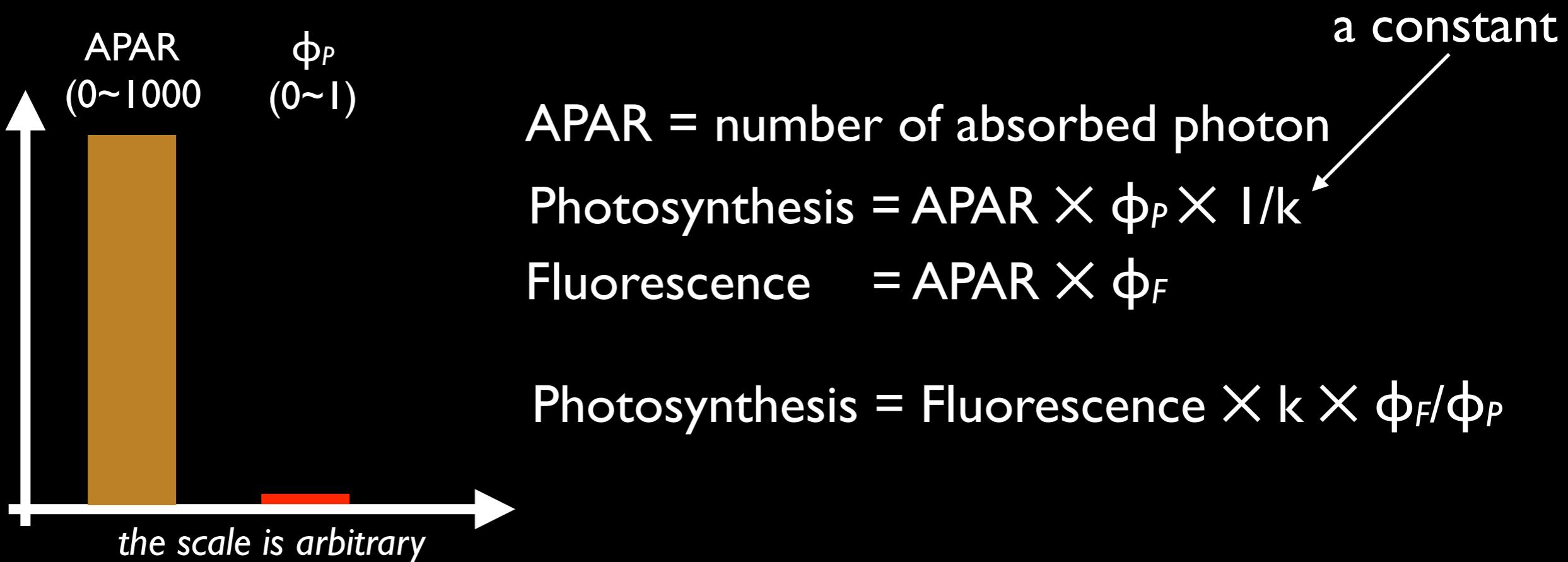
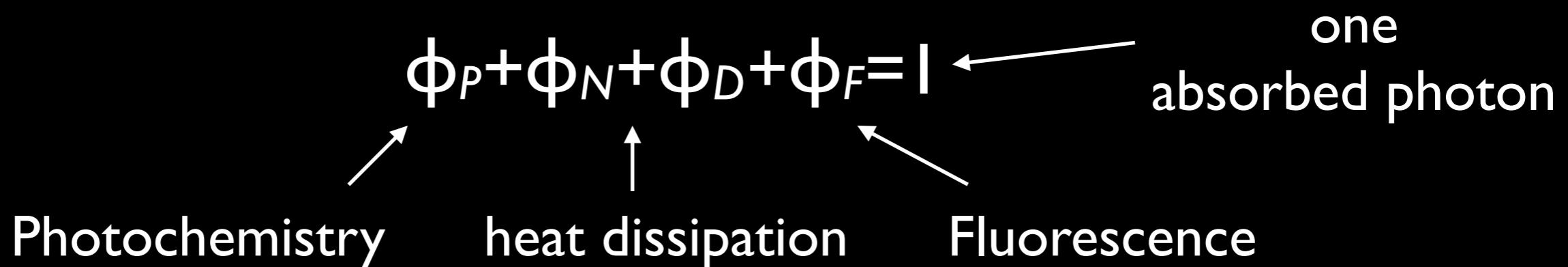
# What is the mechanism that link GPP with SIF?



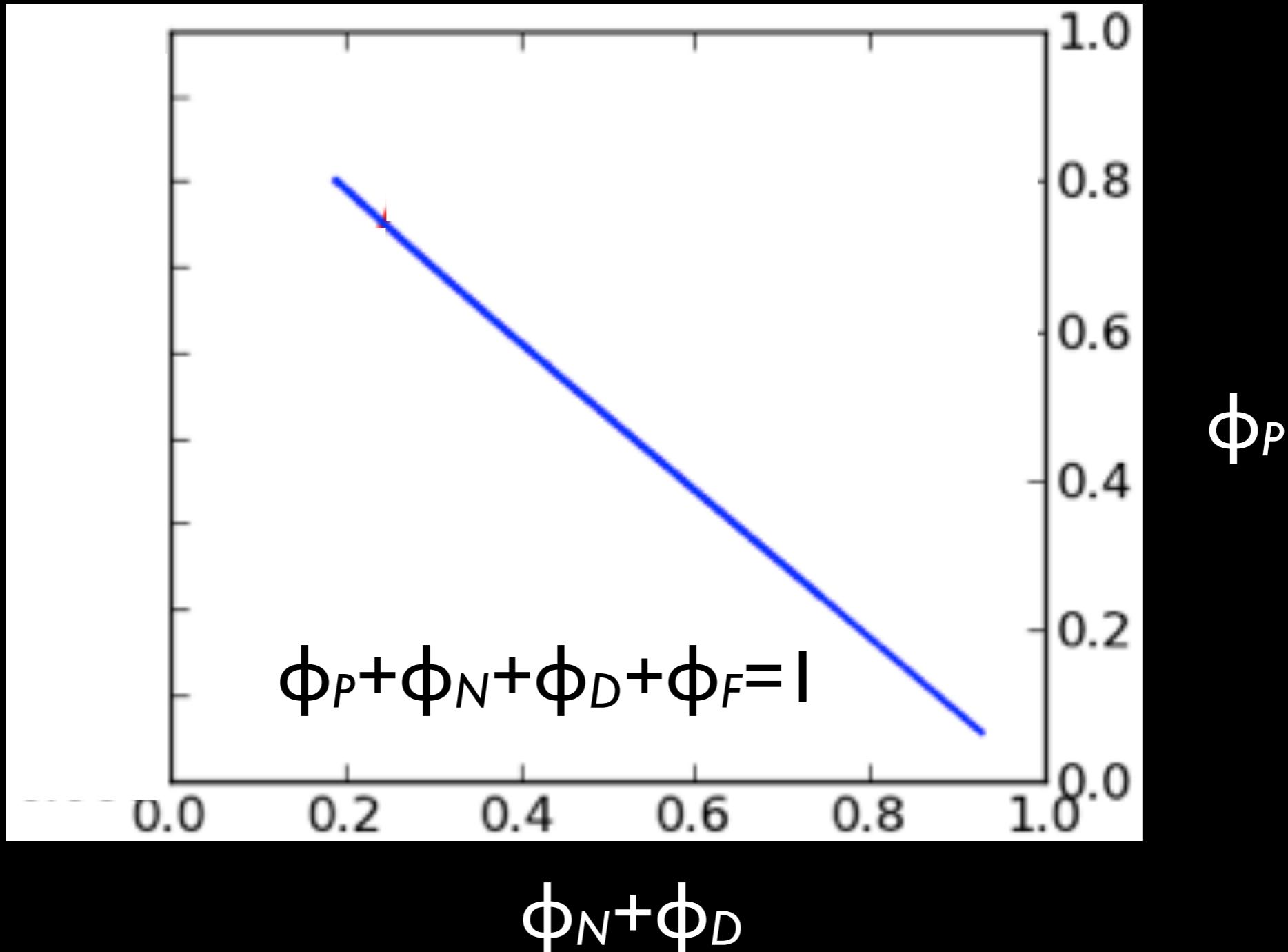
APAR = number of absorbed photon  
Photosynthesis = APAR  $\times \phi_P \times I/k$   
Fluorescence = APAR  $\times \phi_F$



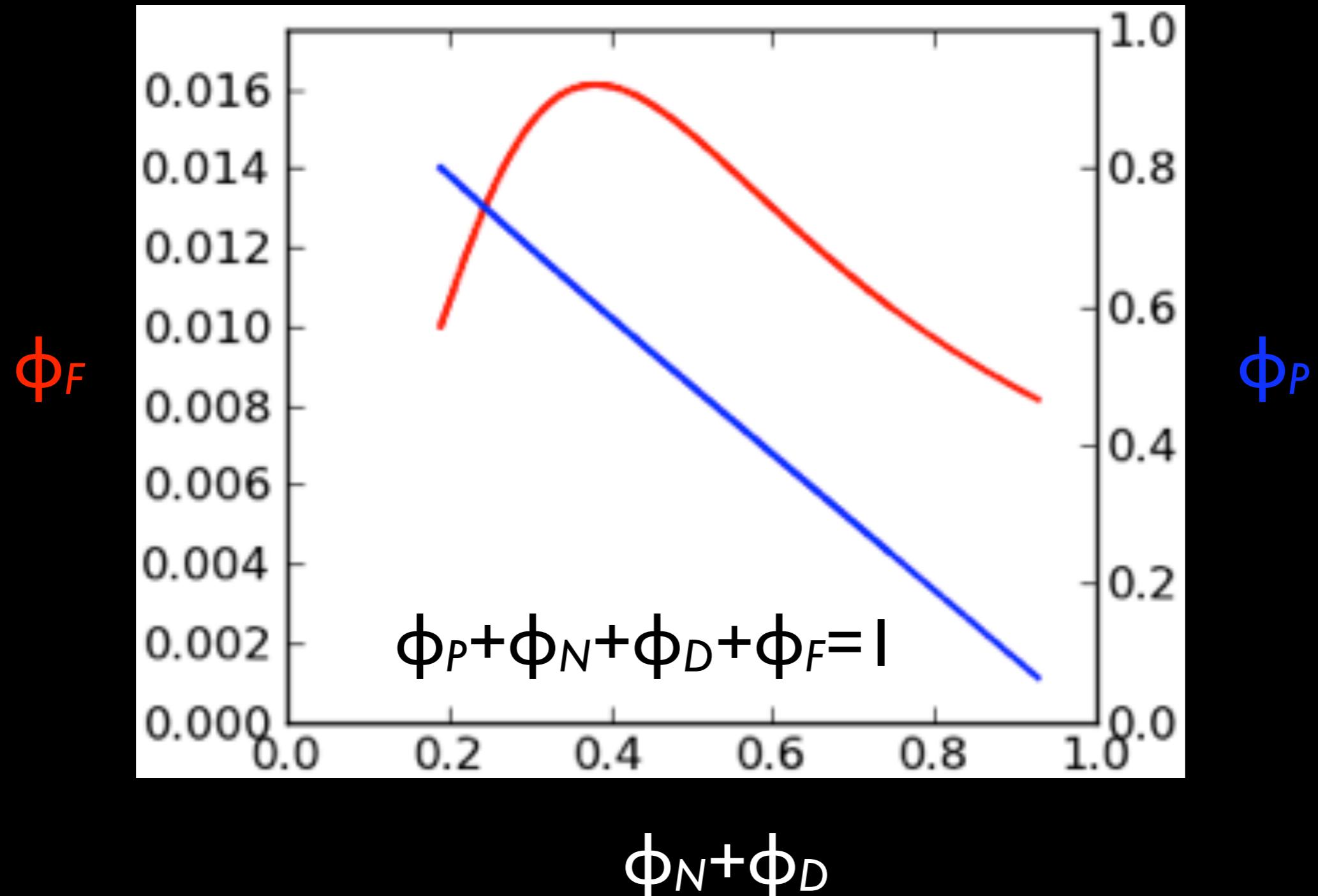
# The mechanism that links photosynthesis to fluorescence



# Heat dissipation is the dominant control on photosynthesis



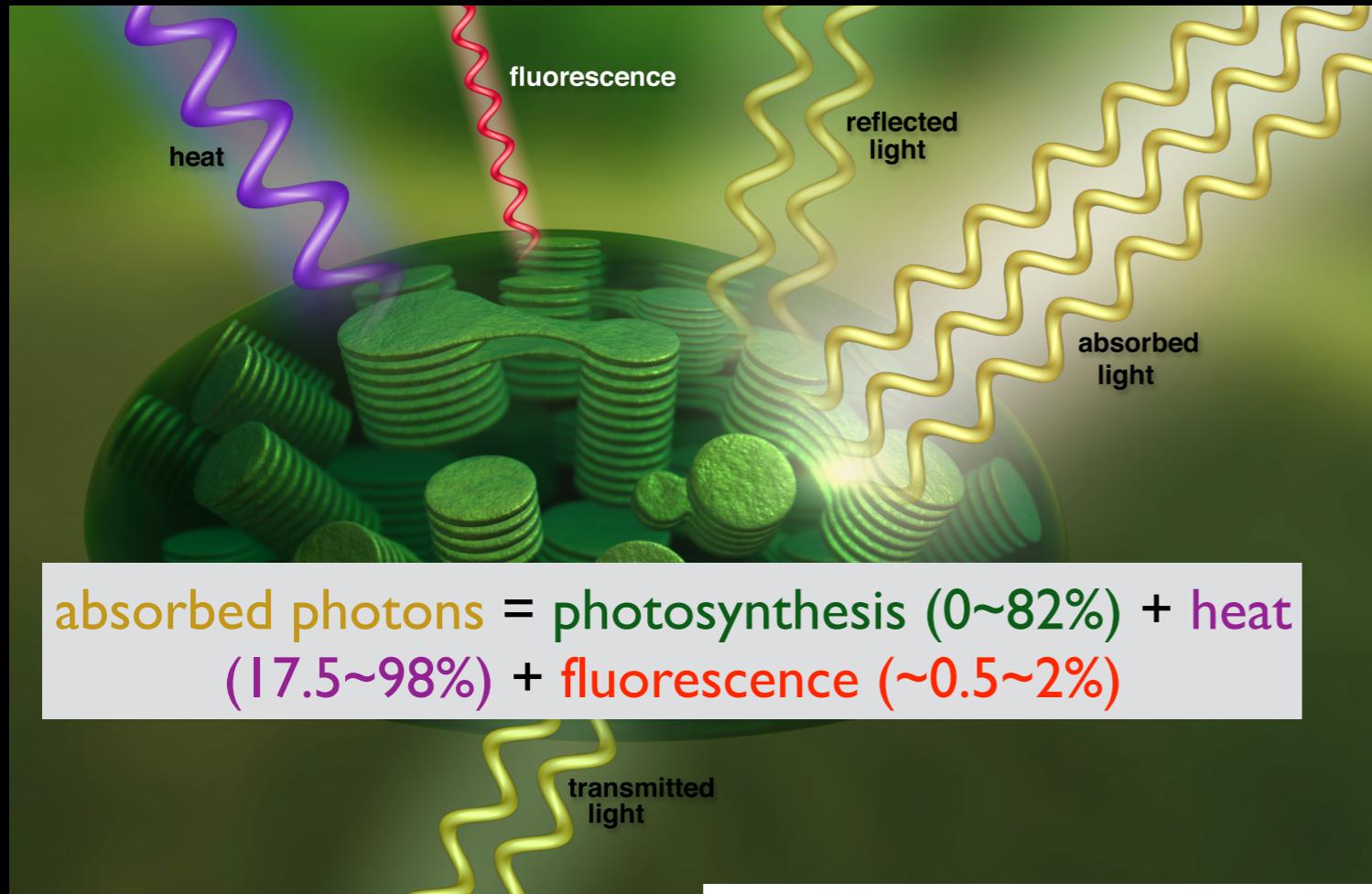
Fluorescence yield is positively correlated to photosynthesis yield most of the time



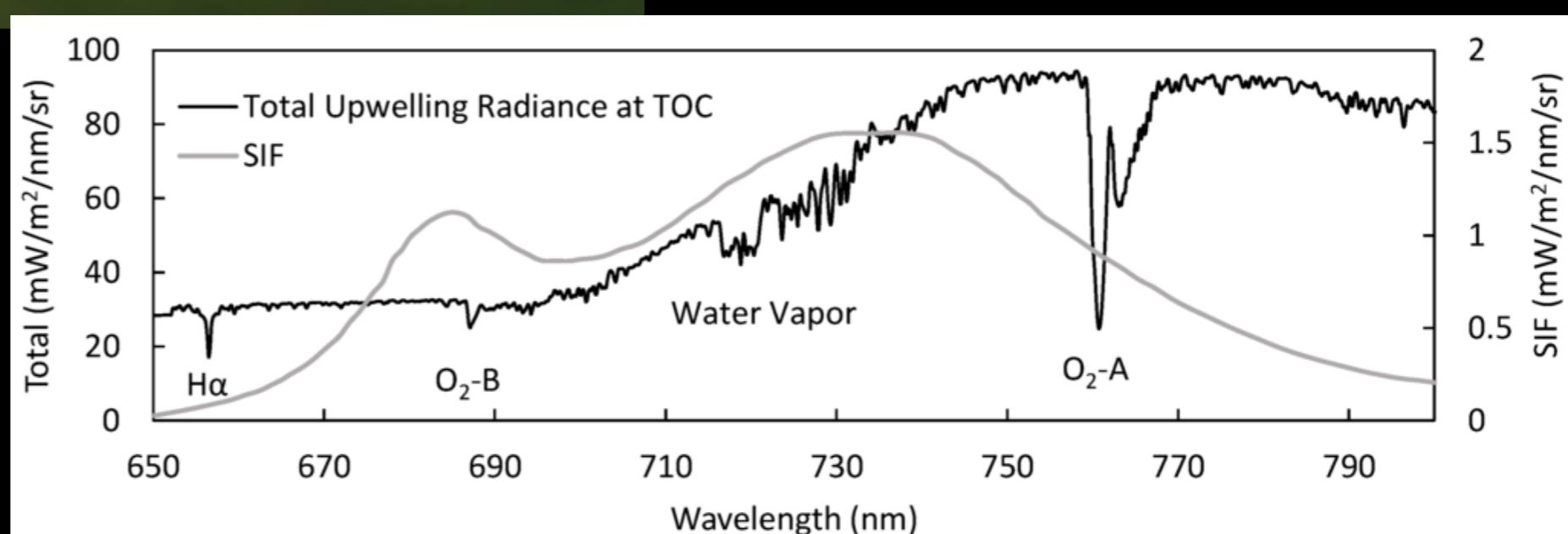
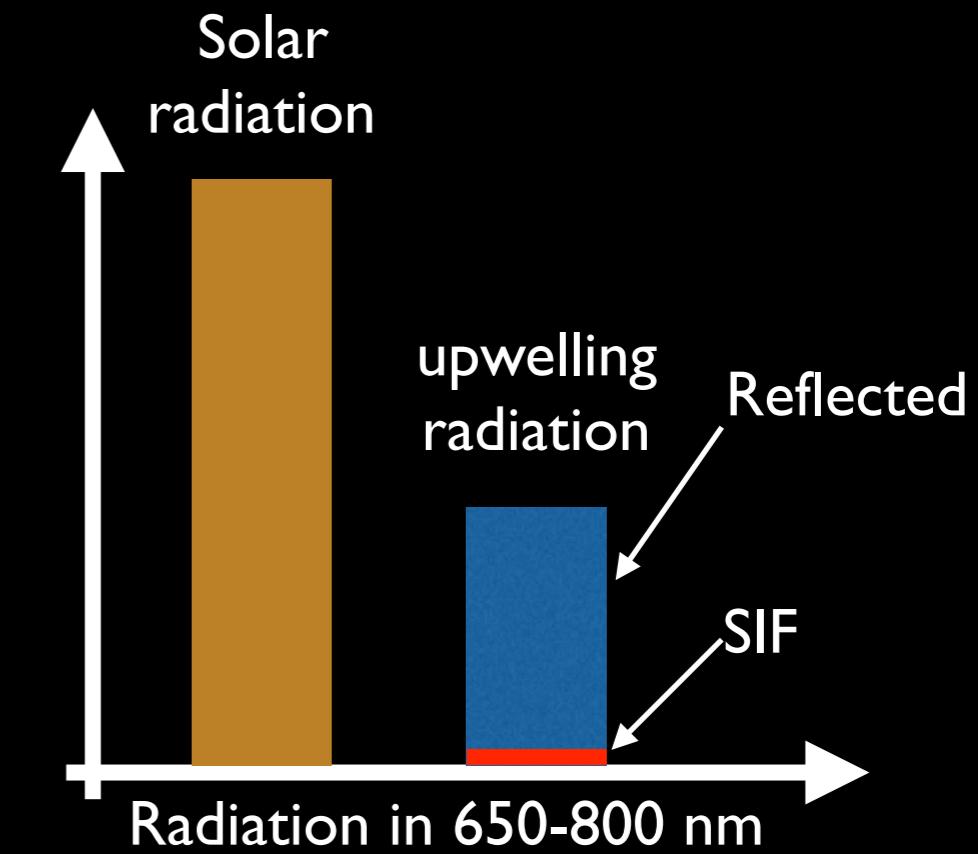
# Let's measure SIF outside!

Hands-on experience with spectrometer and Jupyter  
Notebook

# Solar-induced chlorophyll fluorescence (SIF) is a small fraction of reflected light

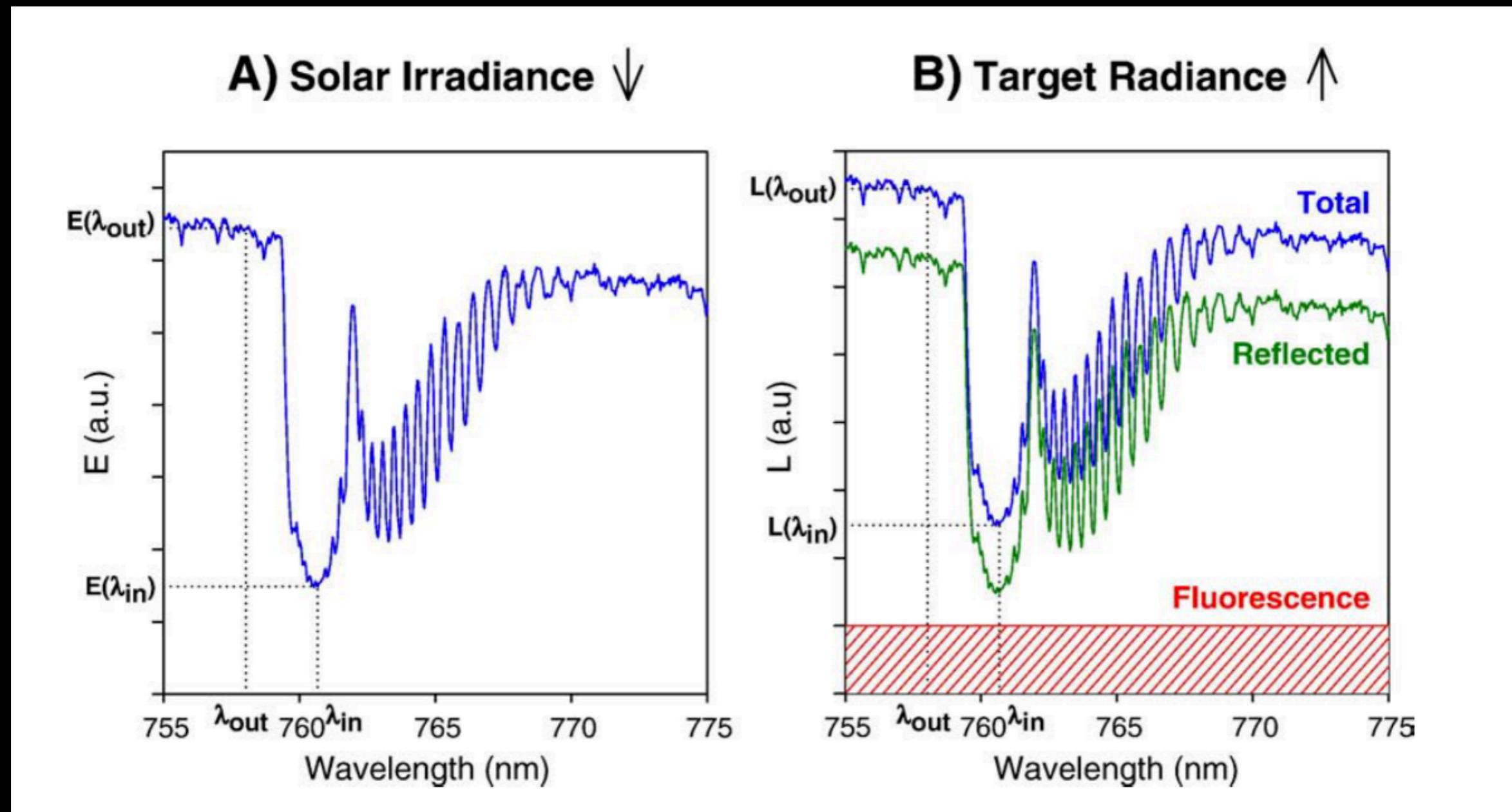


Credit: NASA



Liu et al., 2014

# The basis of SIF retrieval is the “in-filling” of absorption features in solar spectra



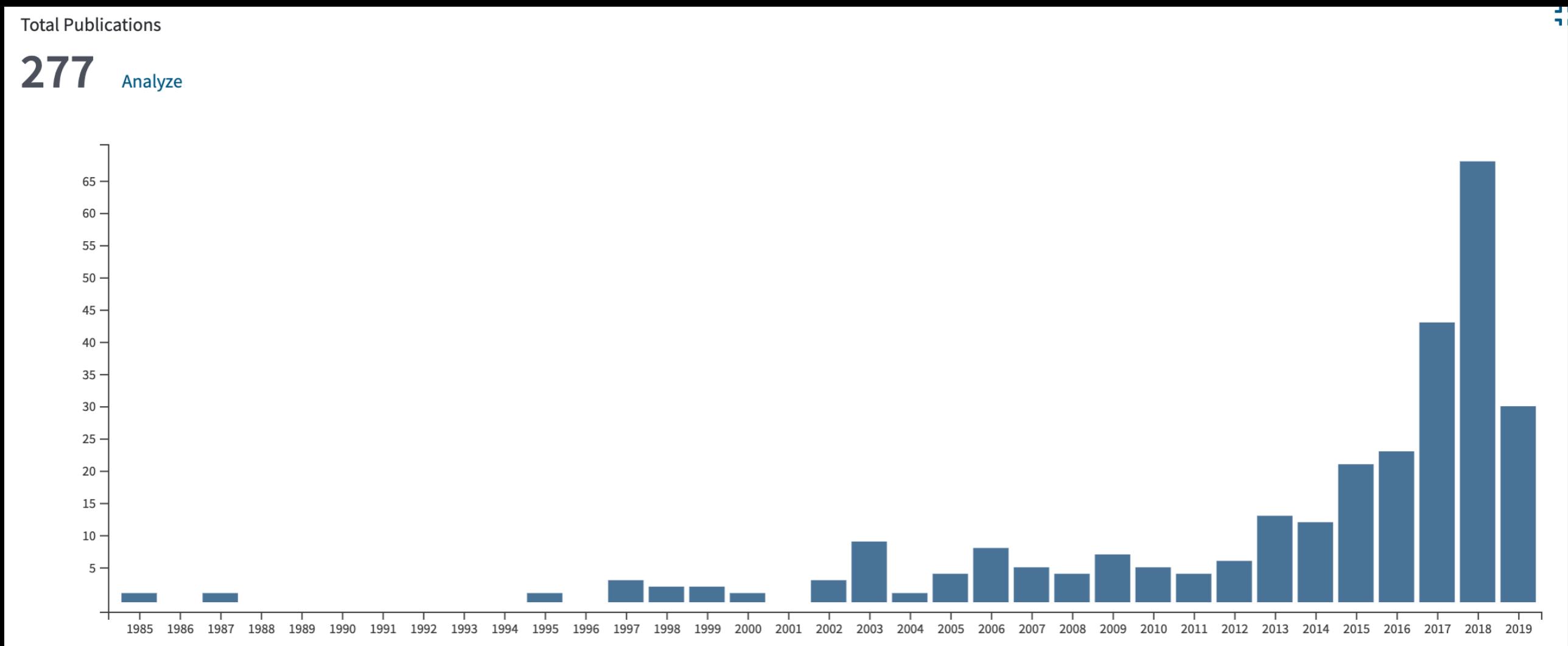
There are many other methods to retrieve SIF, and they share the same idea. (FLD, SFM or SVD)

Meroni et al., 2009

Let's calculate SIF using the spectra you collected

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Notebook

# A booming topic



Web of Science: (topic) solar-induced fluorescence

I want to use satellite SIF data

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