

FLEX (Fluorescence Explorer) Mission

European Space Agency

Terrestrial carbon cycle

Large uncertainty in global / regional estimates of carbon balance, in particular GPP (Gross Primary Production)





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FLEX objectives

Quantitative global mapping of <u>actual photosynthetic activity</u> of terrestrial ecosystems, as a function of variable vegetation health status and environmental stress conditions



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FLEX/Sentinel-3 Tandem Mission





longitude (deg)

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Information content in the shape and amplitude of fluorescence emission



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Retrieval concept

0.025

0.020

0.015

0.010

0.005

0

 $<F_{signal}>/<R_{signal}>$



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Xanthophyll cycle Dynamical reflectance changes associated to HO vegetation adaptation to stress conditions violaxanthin low irradiance excess irradiance 0.02zeaxanthin 160 chla chlb 0.01 eflectance changes 140 betacaroter lutein coefficient neoxanthir 120 violaxanthir zeaxanthin antheraxanthi 0.00 100 absorption 80 -0.01 20 -0.02460 480 500 520 540 560 580 600 350 400 450 500 550 600 650 700 wavelength (nm) wavelength (nm)

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FLEX / Sentinel-3 spectral information



FLORIS:

Spectral resolution: 0.3 nm Spectral sampling: 0.1 nm

300 m spatial resolution

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FLORIS instrument

Double slit assembly

LR spectrometer

LR FPA

Calibration unit

Earth Nadir Port



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FLEX products

	LEVEL-2 PRODUCTS	COMMENTS
•	Total fluorescence emission (spectrally integrated value) Peak values (F680 and F740) PSI – PSII contributions	Integrated values at canopy level are the ones required by models. $\varepsilon(F_s) \le 0.2 \text{ mW m}^{-2} \text{sr}^{-1} \text{nm}^{-1}$ for instantaneous observations.at 300 m original spatial resolution.
•	Non-photochemical energy dissipation	Regulated energy dissipation, accounts for the fraction of light absorbed by non- photochemical pigments (carotenoids / chlorophyll ratio and violaxanthin / zeaxanthin ratio, anthocyanin).
•	Fluorescence quantum efficiency	Ratio between energy emitted as fluorescence versus actual chlorophyll specific absorption.
•	Photosynthesis rate	Effective charge separation at PSII, interpreted as actual electron current.
•	Vegetation stress	Defined as "actual photosynthesis / potential photosynthesis"
	LEVEL-3 PRODUCTS	COMMENTS
•	Spatial mosaics	Regional / continental / global maps
•	Temporal composites	Monthy / seasonal / annual composites
•	Activation / deactivation of photosynthetic machinery	Determines length of the growing season
	LEVEL-4 PRODUCTS	COMMENTS
•	Gross Primary Productivity (GPP)	Carbon uptake, derived by data assimilation with usage of external inputs (meteo data, land cover maps)
•	Dynamical vegetation stress	Decoupling between different stresses through dynamical model

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