The role of aquatic macrophytes in the carbon dynamics of Amazon floodplains

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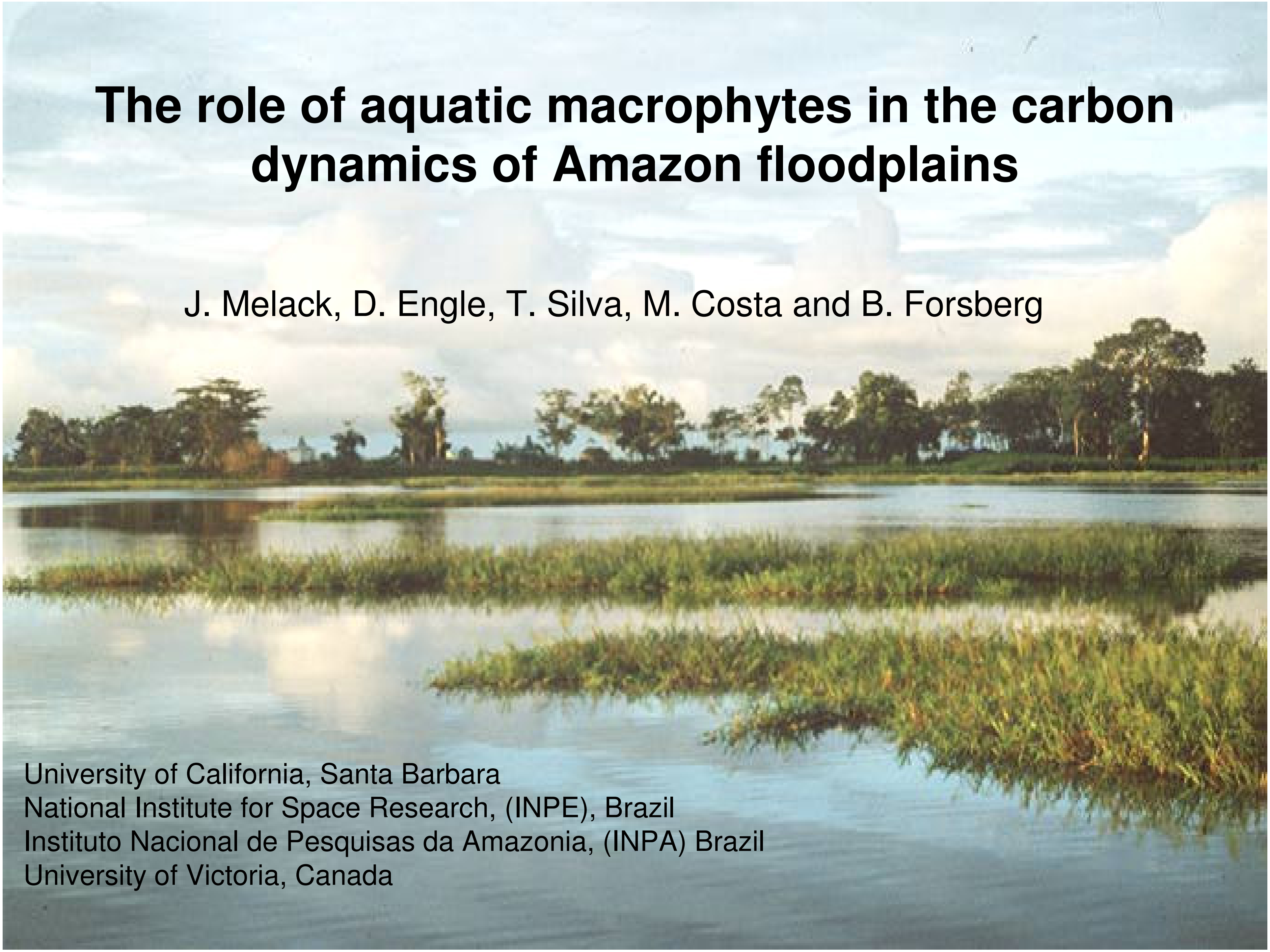


Cabaliana floodplain:

Aquatic macrophyte (floating meadow) vegetation

Upper and lower left: high water

Lower center and right: low water

Aquatic Macrophytes

- A source of carbon dioxide outgassed by rivers and floodplains
- High rates of nutrient uptake and release
- Significant seasonal variations in cover area and productivity
- Associated with the high methane emission rates

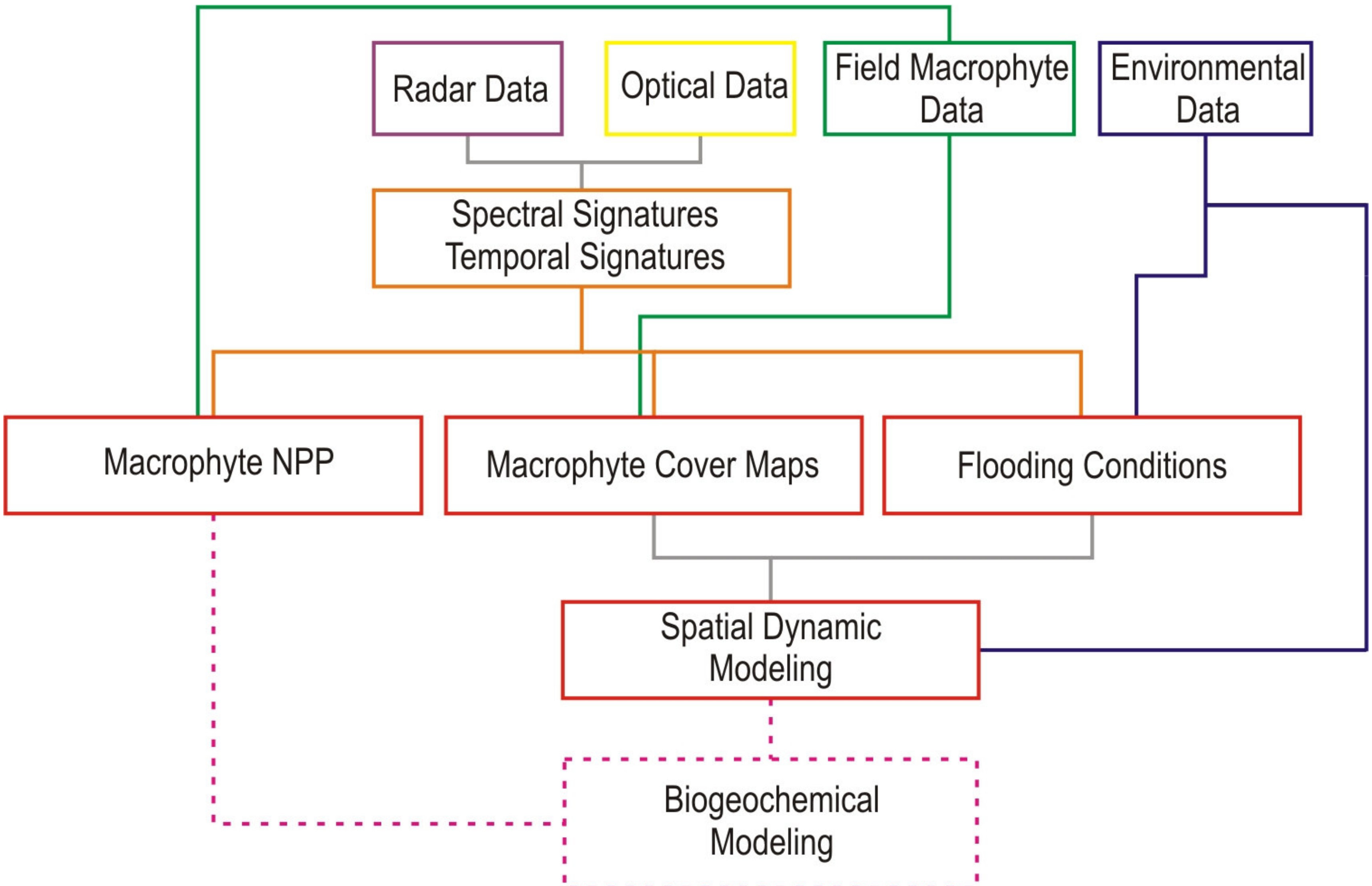
Research Objectives

– Quantify the spatial variation in macrophyte cover over time by using optical and radar imagery

– Quantify the seasonal dynamics of growth and loss from macrophyte communities by the combined use of field and satellite data

– Apply spatial modeling techniques to calculate macrophyte growth and cover from biotic and abiotic environmental parameters

Conceptual Framework

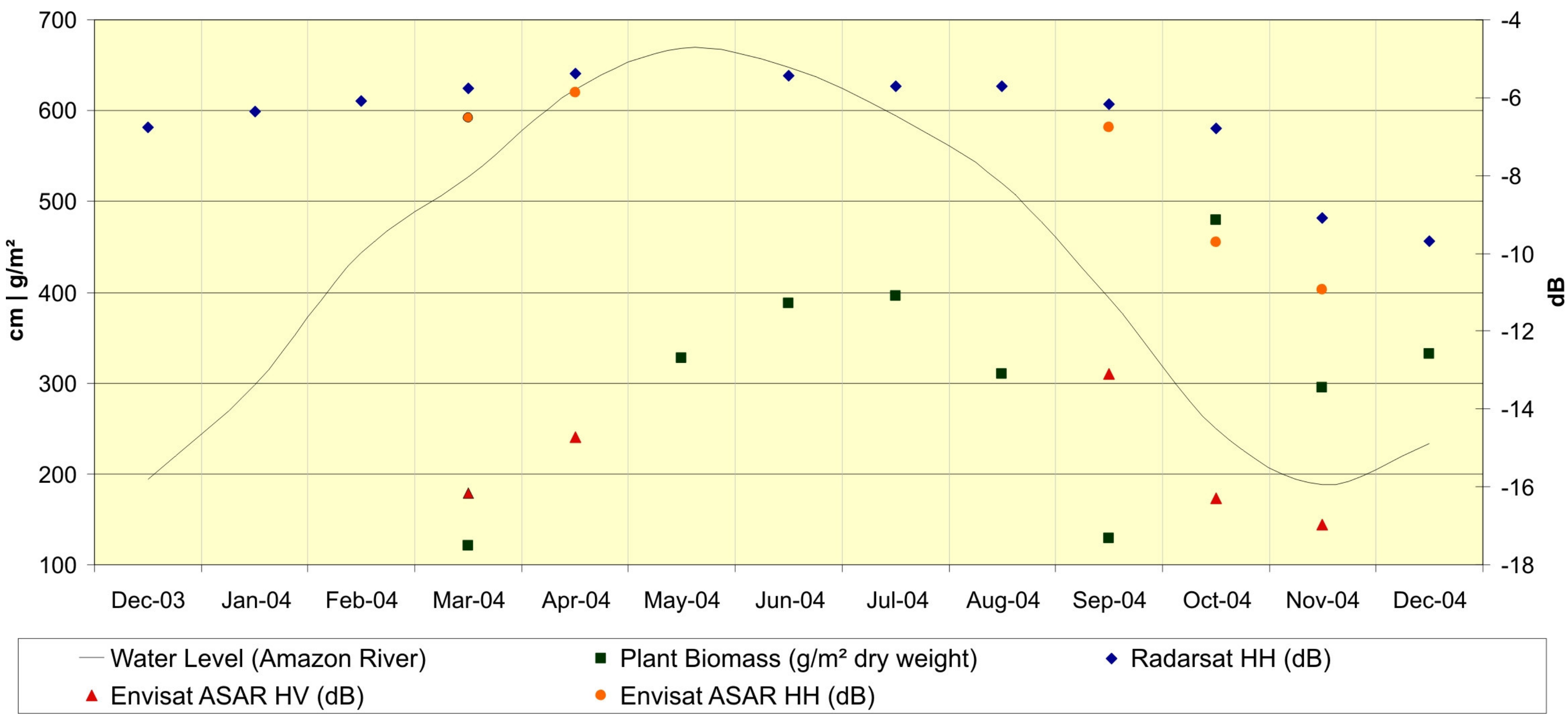


Available Data
(2003 - 2004 season, Santarem area)

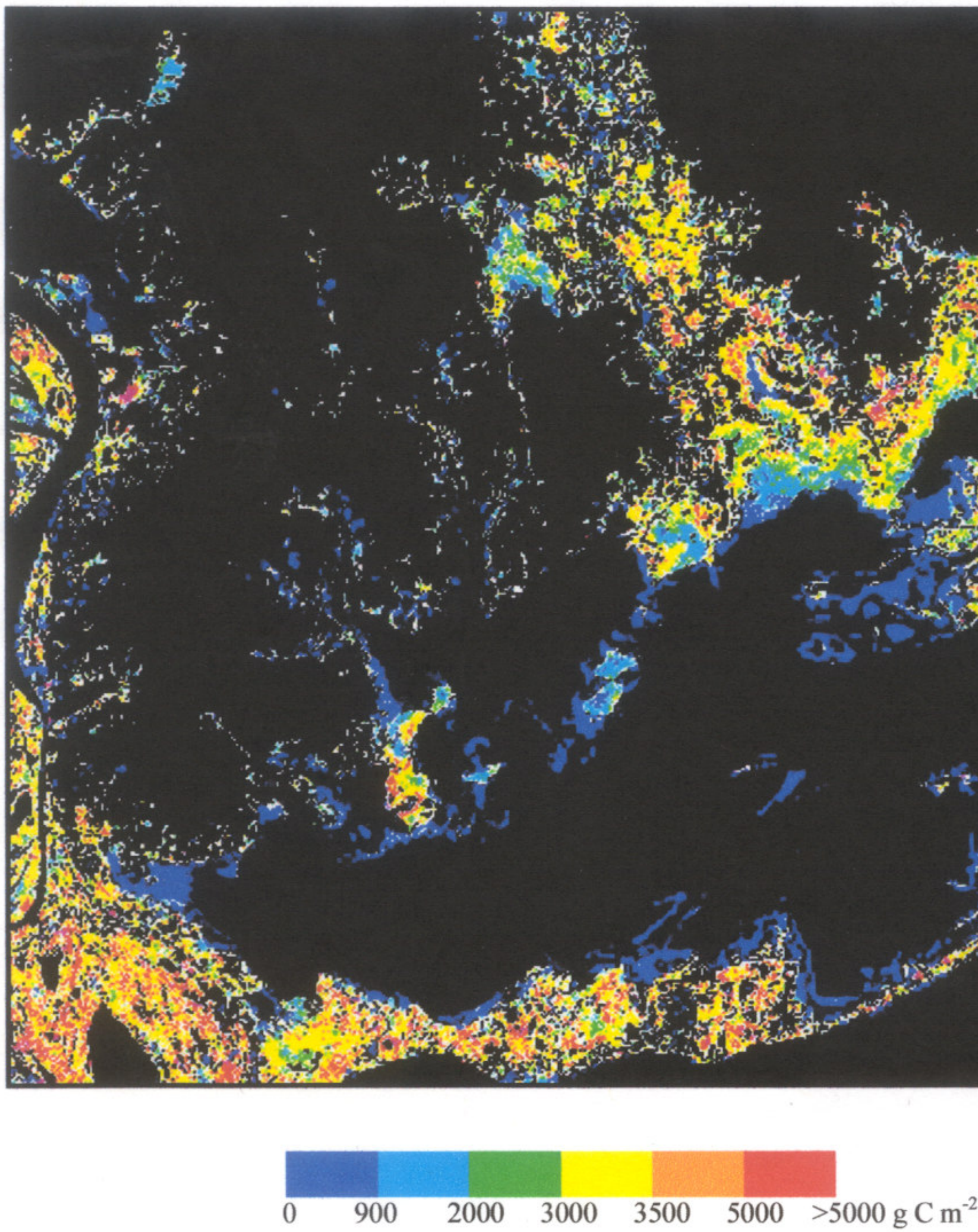
- Landsat TM (7 dates)
- CBERS (6 dates)
- MODIS (MOD-09 1 day reflectance – 1 per month at least)
- Radarsat (every 24 days for the whole seasonal cycle)
- Envisat ASAR (8 dates)
- Monthly macrophyte biomass

Correlation between biomass and radar backscattering

(T. Silva)



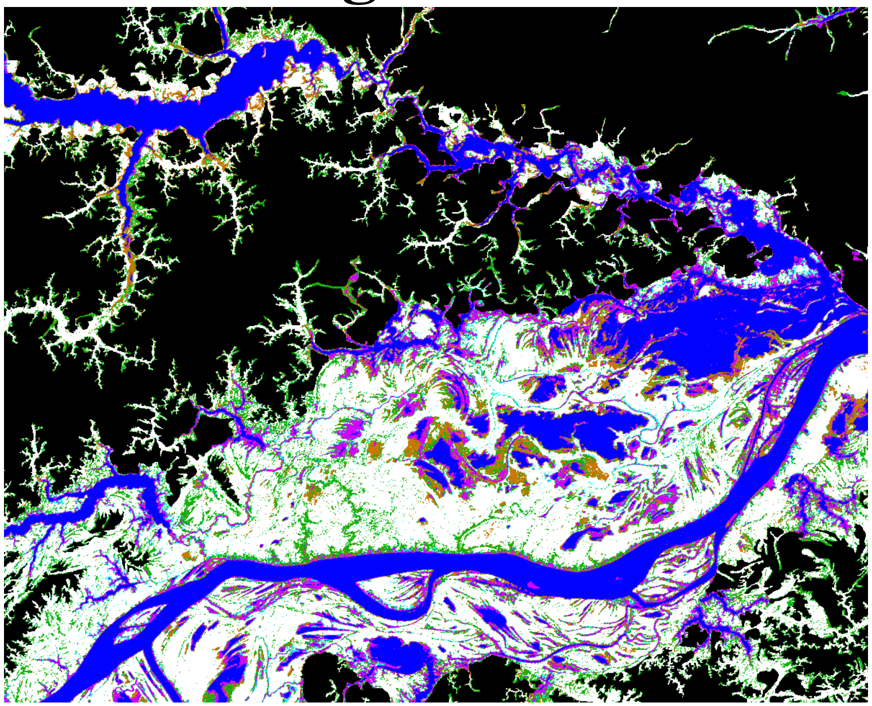
Net Annual Primary Productivity of Floating Macrophytes



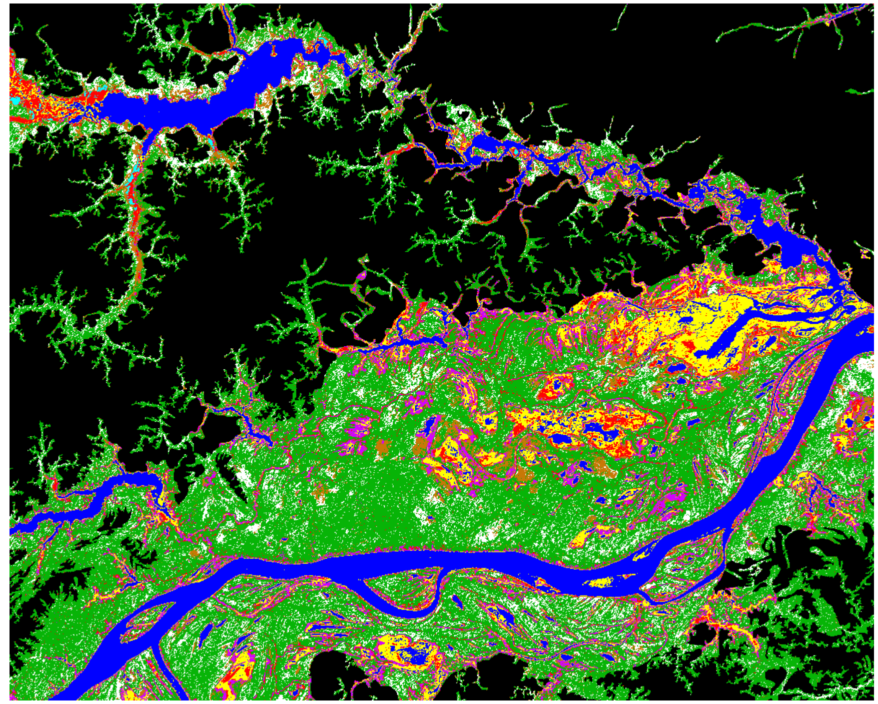
M. Costa 2000, 2005

Cabaliana Floodplain (from JERS)

High Water



Low Water

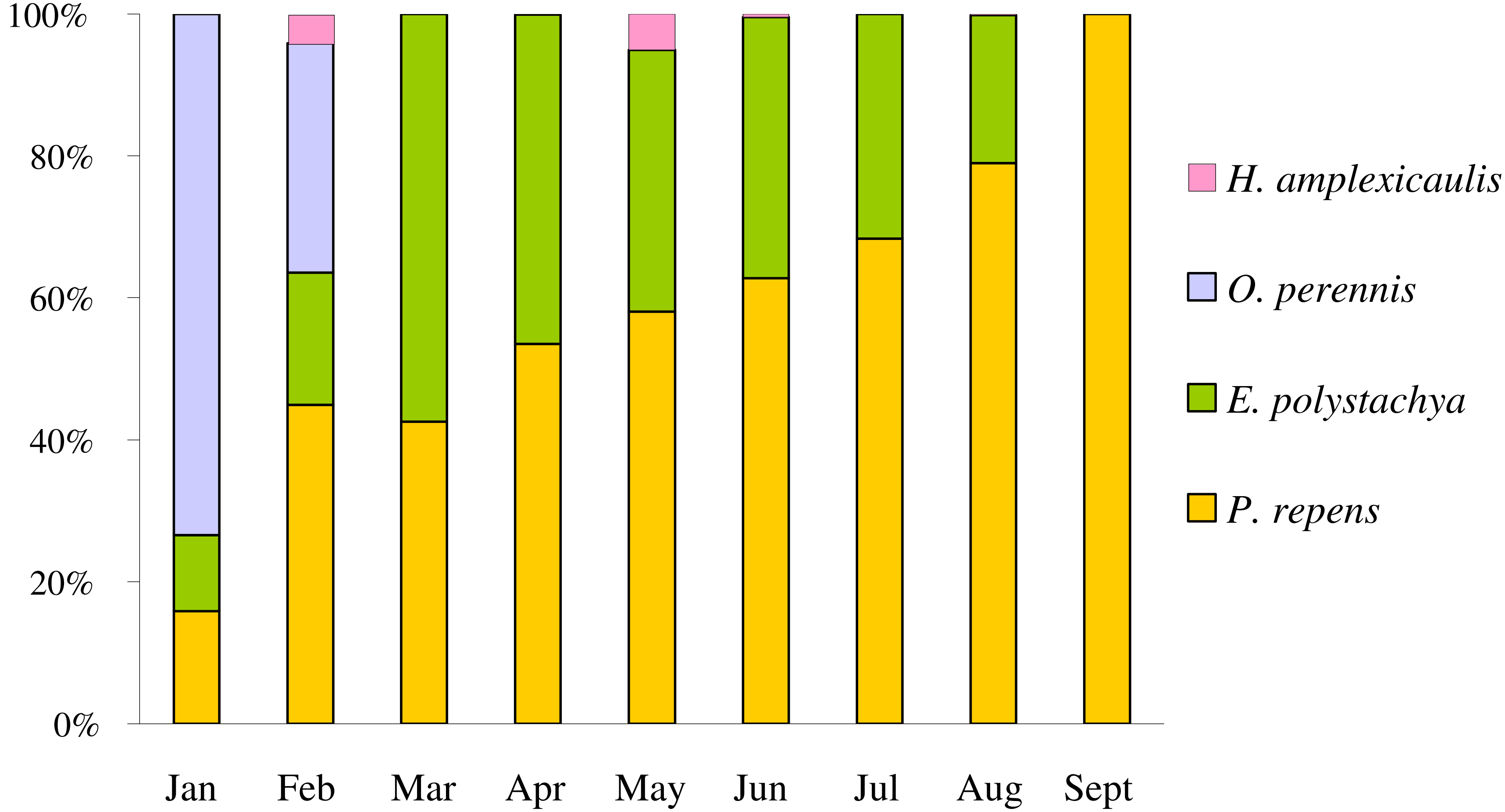


- Water
- Bare or herbaceous, non-flooded
- Herbaceous, flooded
- Shrub, non-flooded
- Shrub, flooded
- Woodland, flooded
- Forest, non-flooded
- Forest, flooded

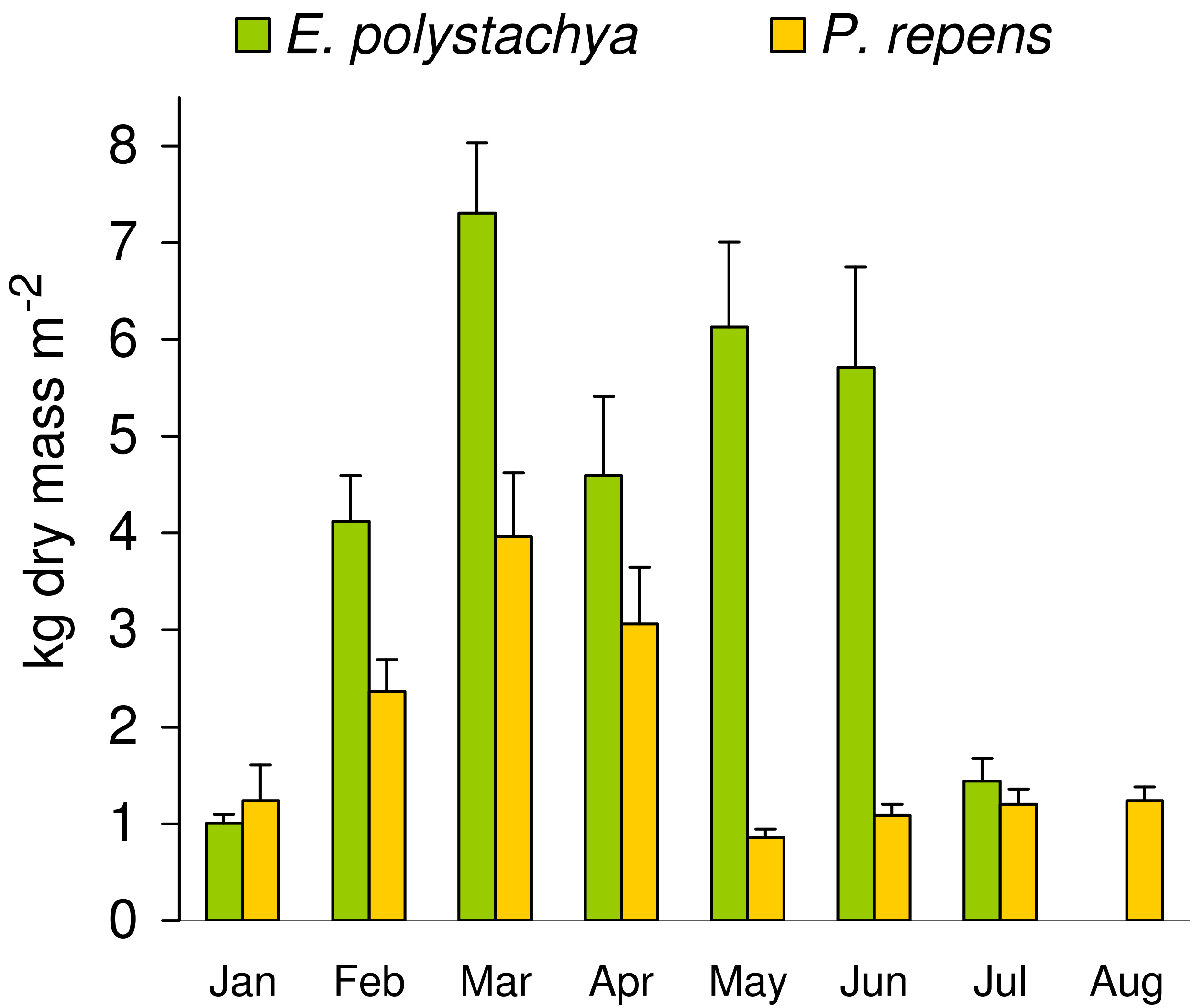

Lake Calado

Species contributions to above-water biomass in floating meadows (Calado)

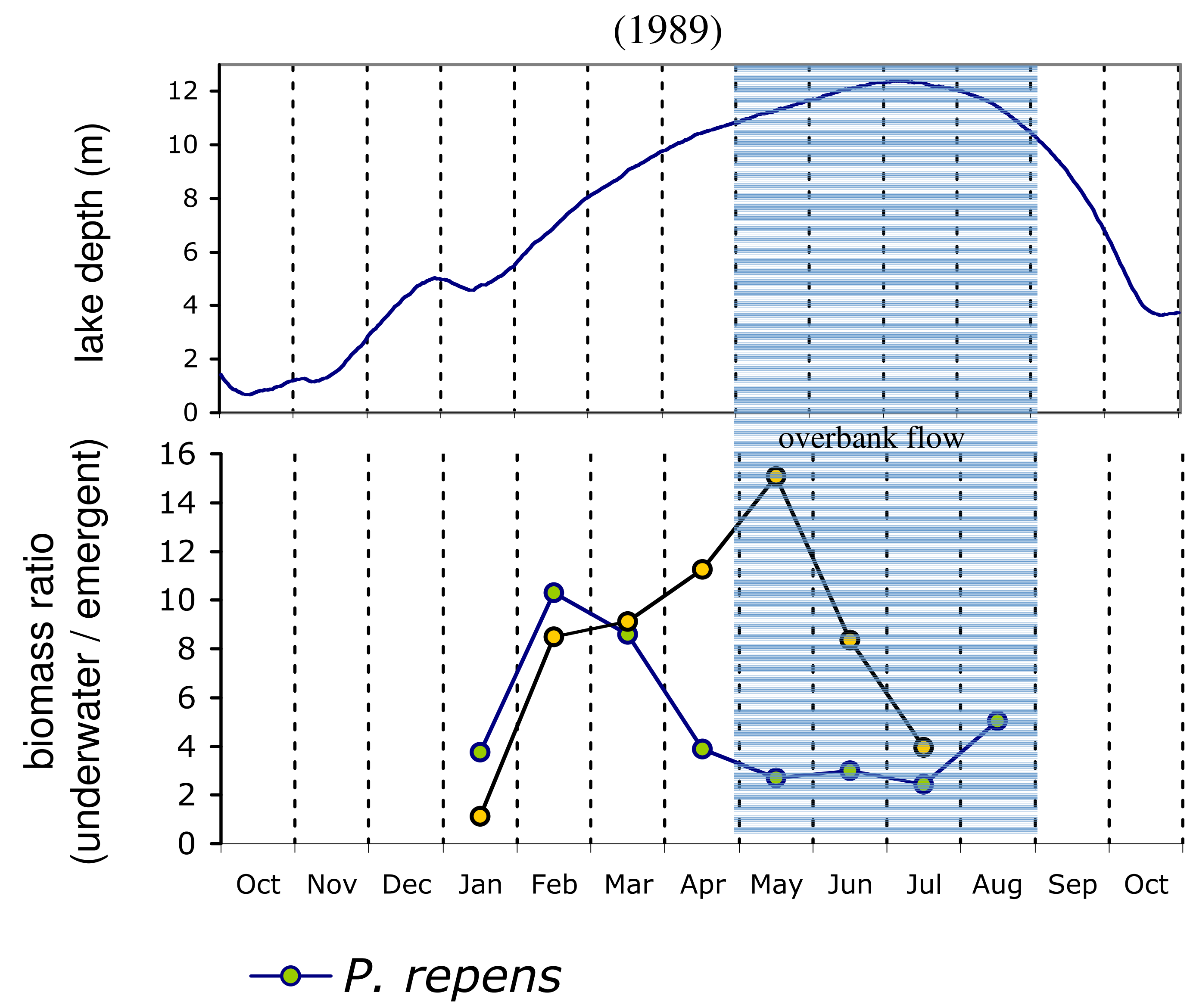
mean percents for 1988-1990



Biomass per unit area
(submerged + emergent)



Biomass ratio (underwater/emergent) *vs* lake depth



Monthly loss rates for aquatic grasses in L. Calado

	Areal extent of grasses (km^2)	Lakewide Biomass Mg dry mass		Percent lost
		Observed	Predicted	
March	0.329	1817	3120	42%
April	0.340	1324	2246	41%
May	0.425	996	2169	54%
June	0.496	1156	1668	31%
July	0.366	479	1869	74%
August	0.396	560	1180	53%
				mean: 49%

Daily rates of NPP by aquatic grasses

Species	NPP g dry mass m^{-2} d^{-1}	Source
New estimates		
E. polystachya and *P. repens*	64 ± 12	present study
P. repens	77 ± 34	
E. polystachya	34 ± 13	
Previous estimates		
E. polystachya	24-30	Piedade et al. (1991)
		Morison et al. (2000)
		Piedade et al. (1994)
P. repens	15-28	Junk & Piedade (1993)
O. perennis	23	Junk & Piedade (1993)
H. amplexicaulis	21	Costa (2005)

Regional extrapolation* of macrophyte NPP and carbon loss using rates from L. Calado

	Total for aquatic phase (Jan.-Sept.)	
	NPP	**Loss of macrophyte-C**
Region	**Tg C**	
Central Amazon Quadrat	197 ± 13	96 ± 7
Mainstem Floodplain	80 ± 6	39 ± 3

Annual CO_2 emissions from rivers and fringing floodplain (Richey et al. 2002)	
Central Amazon Quadrat	210 ± 60
Annual CH_4 emissions from flooded area (Melack et al. 2004)	
Central Amazon Quadrat	6.8 ± 1.3

* Using monthly areal extents for macrophytes derived by Melack et al. (2004)