Interannual variation in CO_2 and CH_4 fluxes from a rice paddy in the Sacramento-San Joaquin Delta, California

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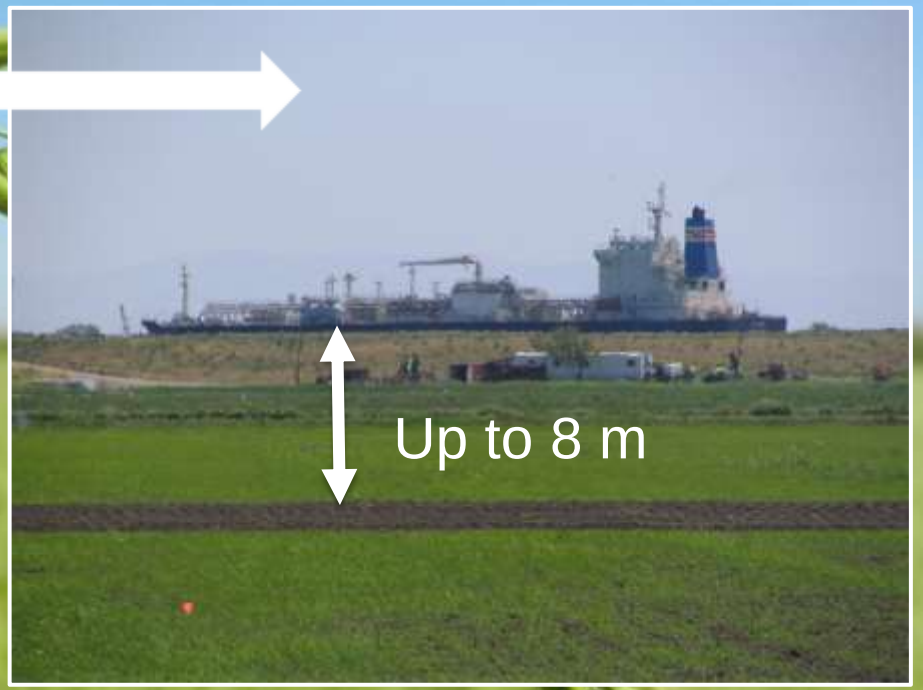
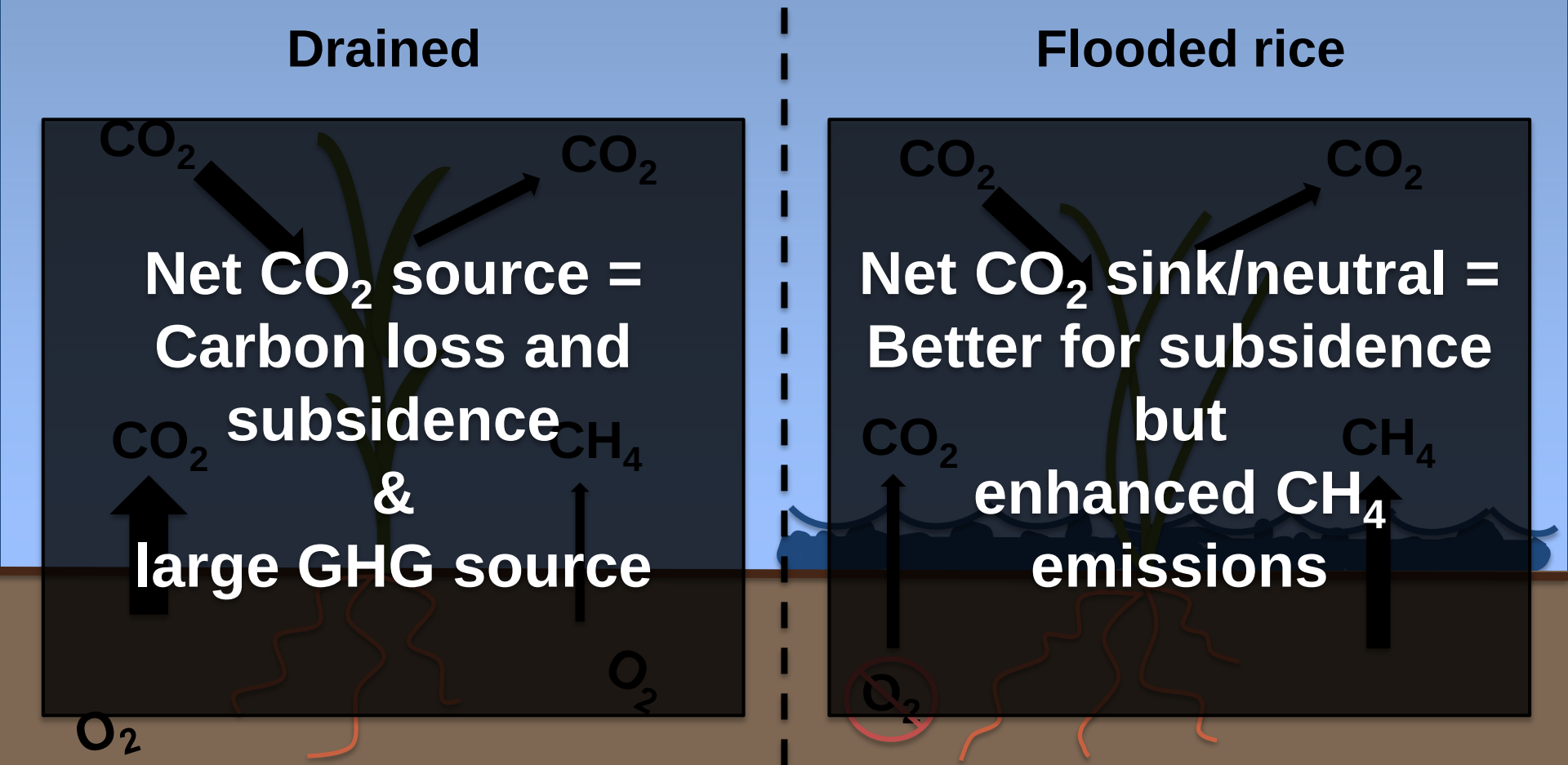
Carbon loss and subsidence



San Joaquin Delta Land Reclamation Photographs, ca. 1904-1907, Bancroft Library Online Archive of California

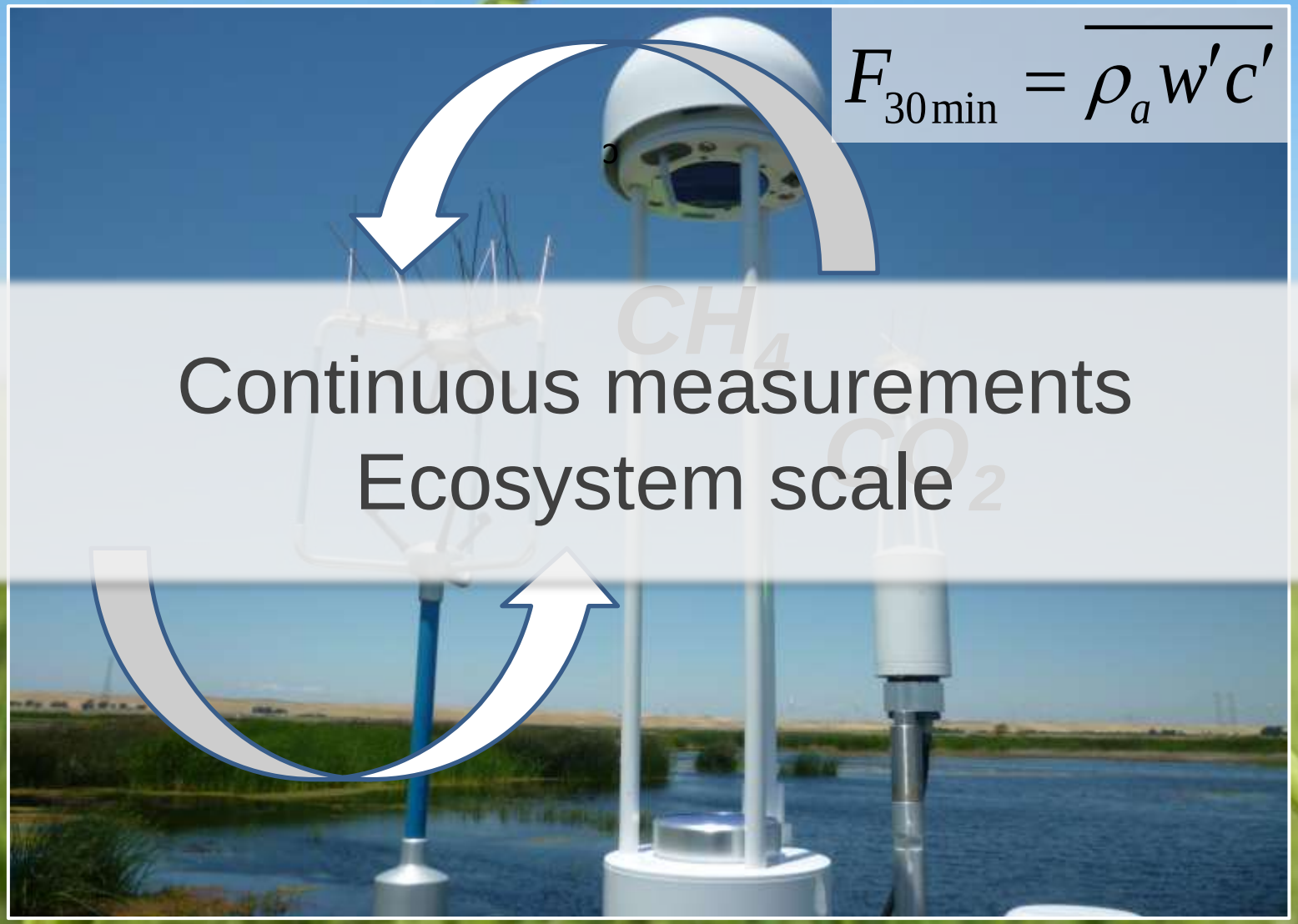
Carbon cycling in drained fields vs. flooded rice



Field site

Public Policy Institute of California, Issue #114, 2007

Eddy covariance method



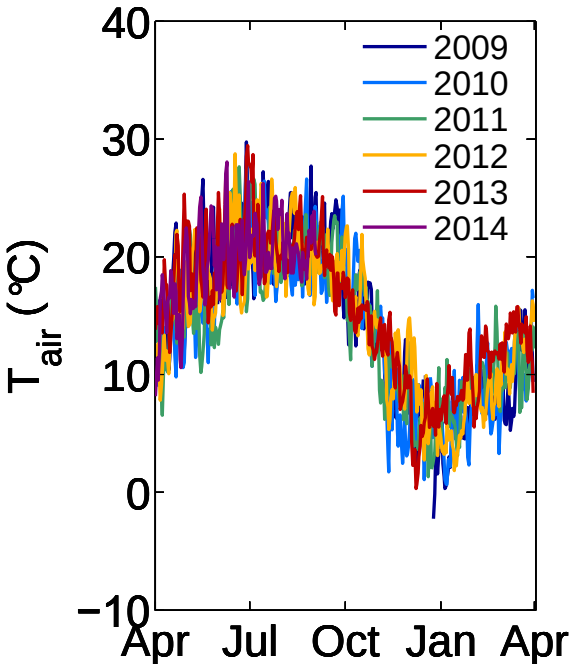
$$F_{30\,\mathrm{min}} = \overline{\rho_a w' c'}$$

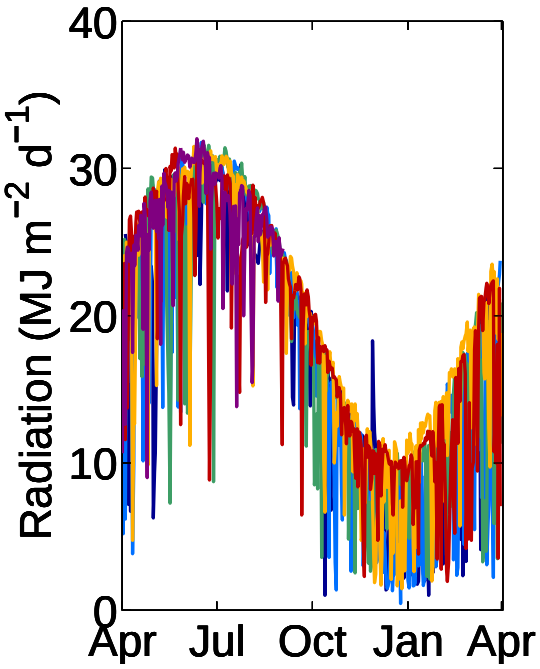
Continuous measurements
Ecosystem scale

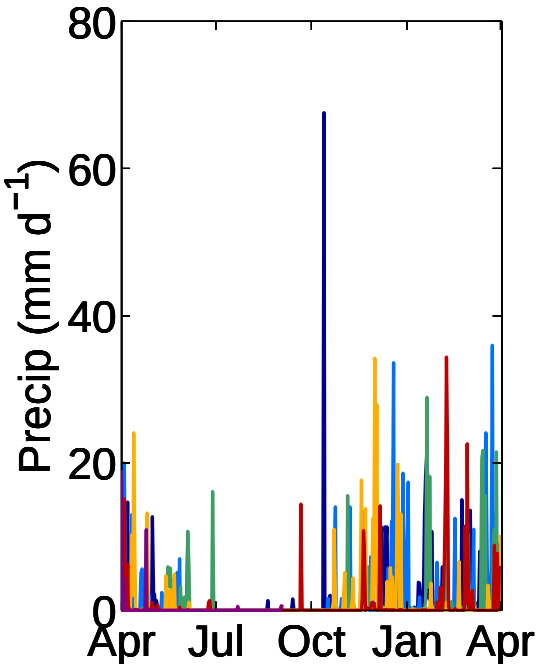
Research questions

1. How do annual sums of CO_2 and CH_4 vary from year to year?
2. How do CO_2 and CH_4 fluxes vary with weather and management?
3. How does rice agriculture compare with other Delta land-use types with respect to GHG budgets and subsidence?

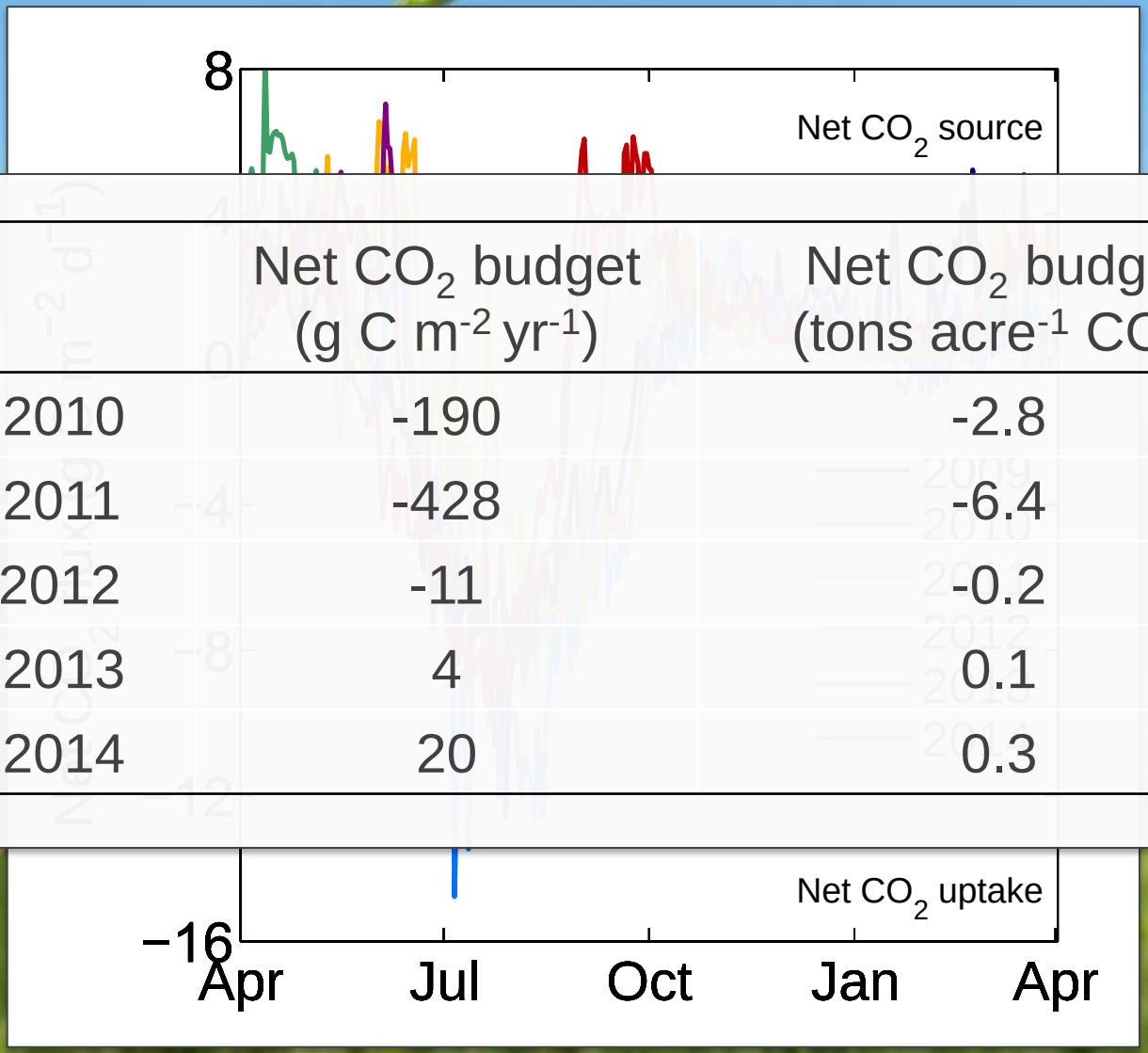
Weather conditions





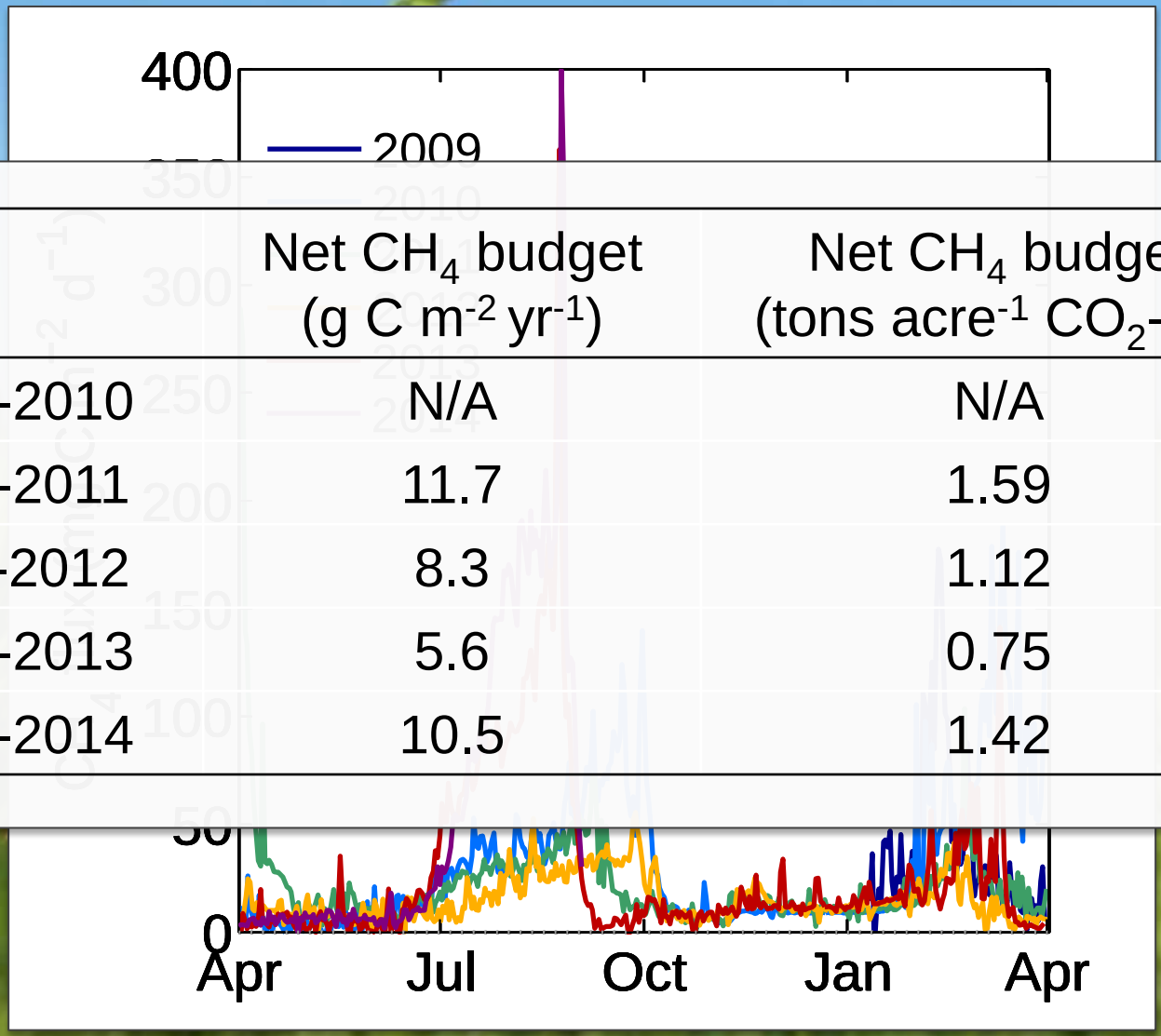


Net CO_2 budgets



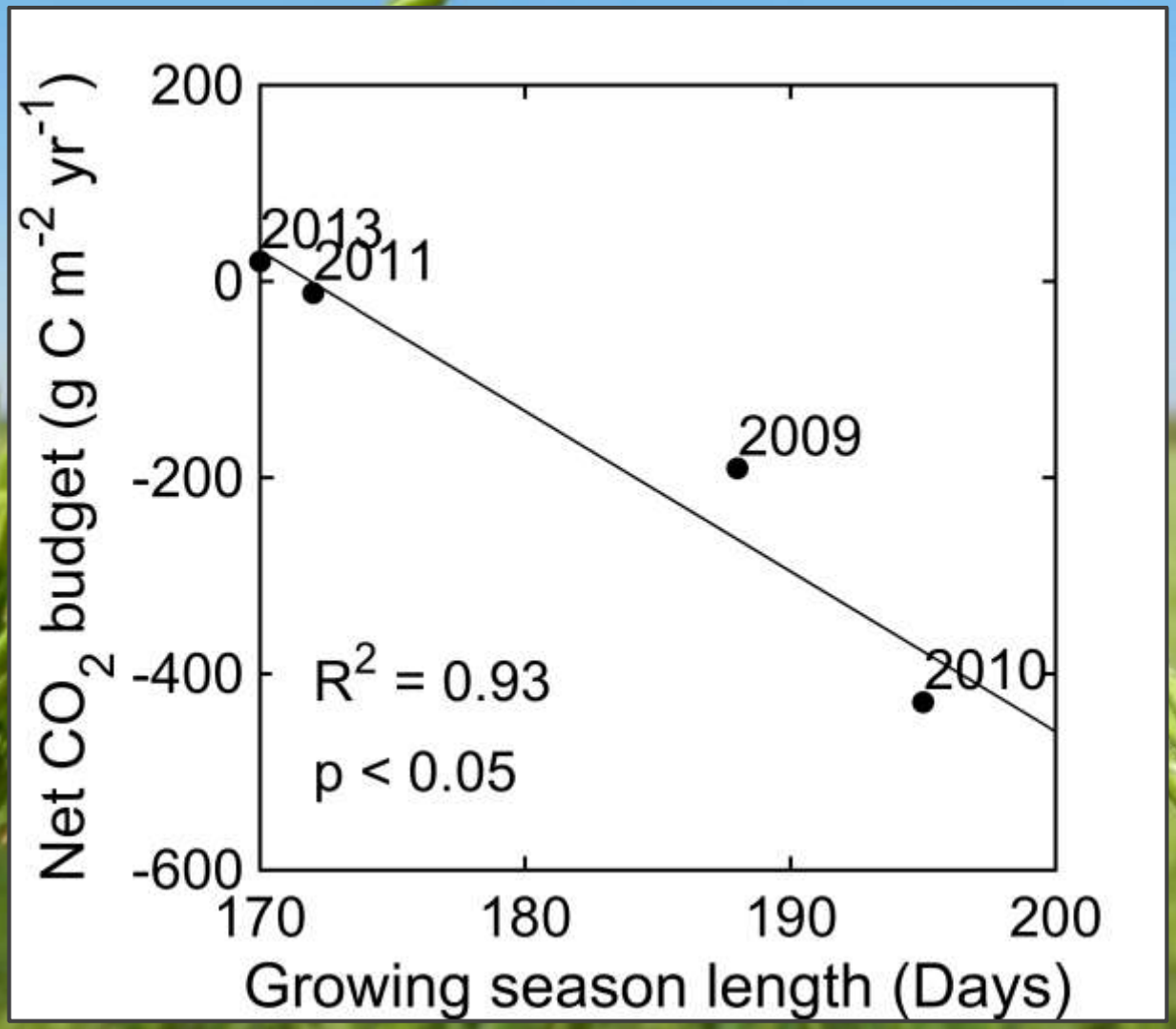
Year	Net CO_2 budget (g C m^{-2} yr^{-1})	Net CO_2 budget (tons $acre^{-1}$ CO_2)
2009-2010	-190	-2.8
2010-2011	-428	-6.4
2011-2012	-11	-0.2
2012-2013	4	0.1
2013-2014	20	0.3

Net CH_4 budgets

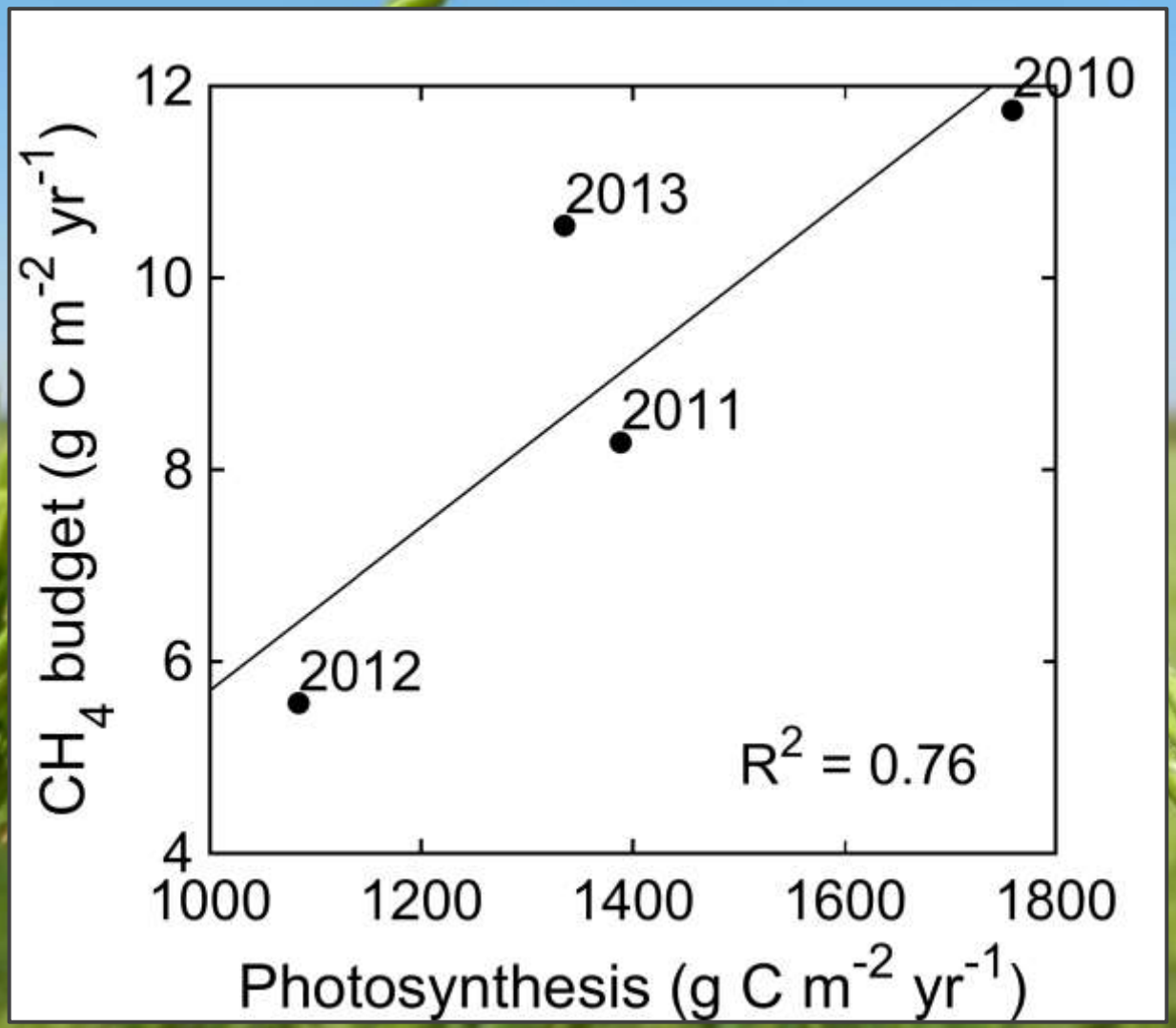


Year	Net CH_4 budget ($g\ C\ m^{-2}\ yr^{-1}$)	Net CH_4 budget (tons $acre^{-1}$ CO_2-eq)
2009-2010	N/A	N/A
2010-2011	11.7	1.59
2011-2012	8.3	1.12
2012-2013	5.6	0.75
2013-2014	10.5	1.42

What's driving interannual variability in CO_2 fluxes?



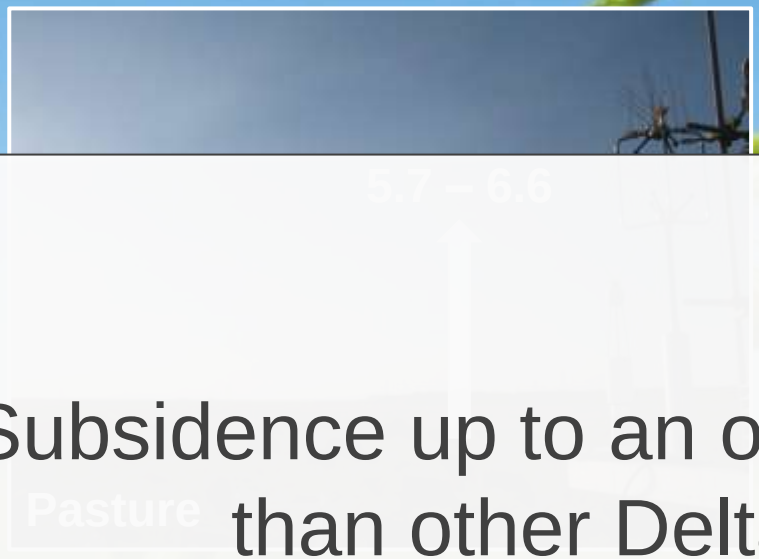
What's driving interannual variability in CH_4 fluxes?

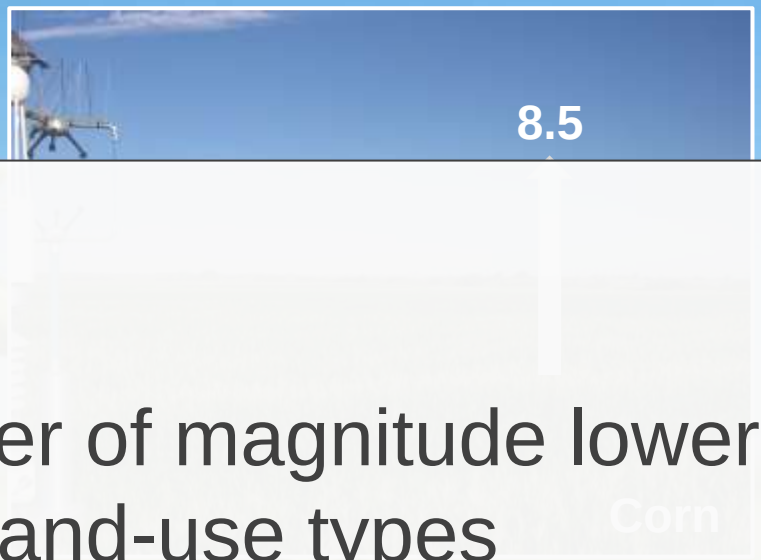


GHG budgets

Year	Net GHG budget (tons acre^{-1} CO_2-eq)	Net GHG budget with harvest (tons acre^{-1} CO_2-eq)
2009-2010	N/A	N/A
2010-2011	-4.77	-2.12
2011-2012	0.94	4.01
2012-2013	0.82	3.12
2013-2014	1.73	6.15

Comparison of GHG budgets





Subsidence up to an order of magnitude lower than other Delta land-use types

Deverel and Rojstaczer (1996) SFEWS; Deverel and Leighton (2010) WRR; Hatala et al. (2012) AEE

Knox et al. (2014) Global Change Biology; Hatala et al. (2012) Agriculture, Ecosystems and Environment

Conclusions

- High interannual variability largely driven by management
- More beneficial from C and GHG standpoint than other Delta land-use types
- Potential to modify management practices to maximize C uptake and minimize CH_4 emissions

Thank you

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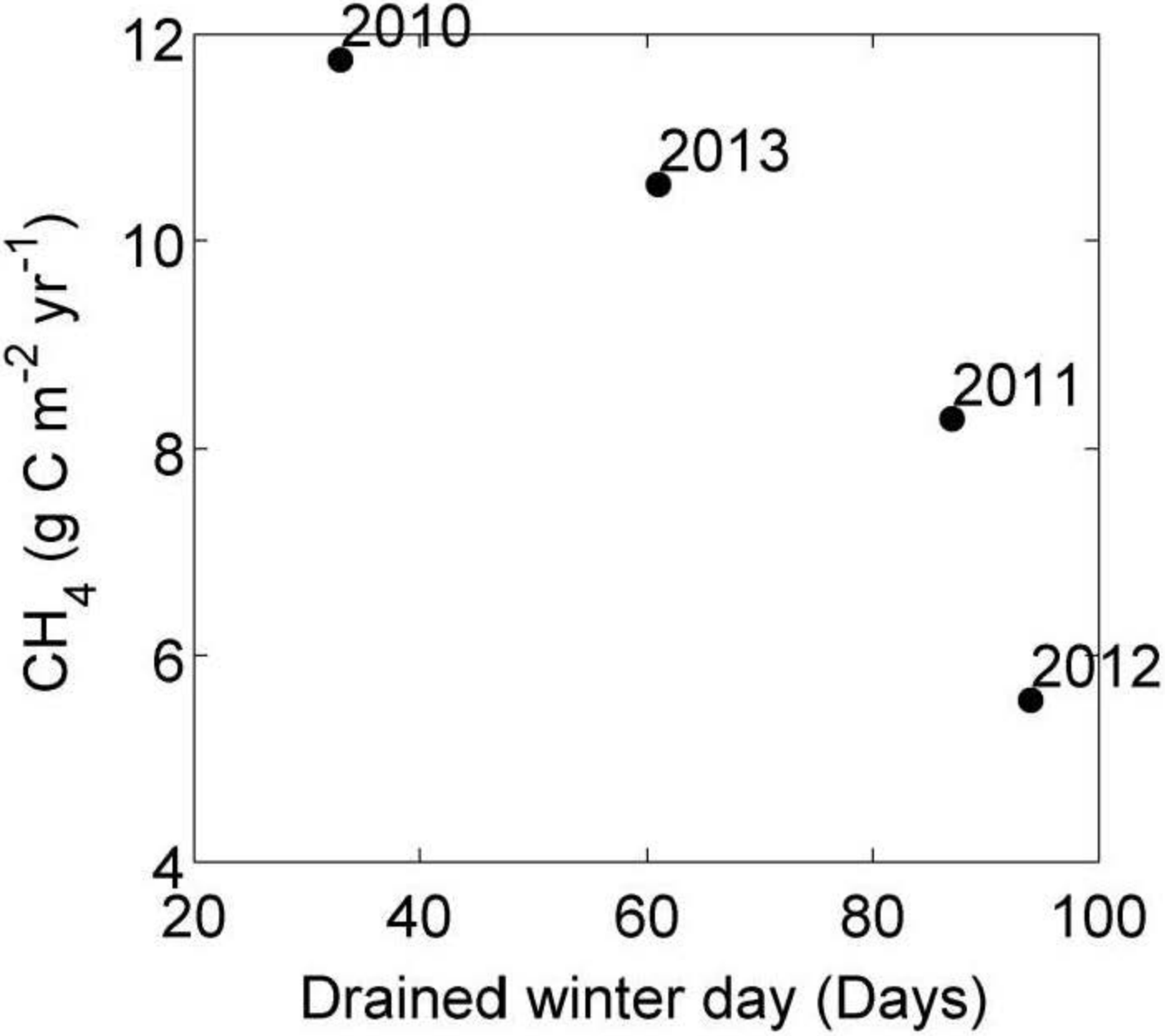
Carbon budgets & subsidence

Year	Net carbon budget including harvest (tons acre^{-1} C)	Rough subsidence estimate (mm)
2009-2010*	-0.17	Soil accretion
2010-2011	-0.97	Soil accretion
2011-2012	0.82	1.4
2012-2013	0.67	1.2
2013-2014	1.33	2.3

*Doesn't include CH_4

vs. > 20 mm for other Delta land-use types

Deverel and Rojstaczer (1996) SFEWS; Deverel and Leighton (2010) WRR


2010
2013
2011
2012
12
10
8
6
4
20
40
60
80
100
CH_4 (g C m^{-2} yr^{-1})
Drained winter day (Days)