Soil CO_2 and CH_4 Emissions and Carbon Budgeting in Dry Floodplain Wetlands

Jackie Batson[1], Gregory B. Noe[1], Cliff R. Hupp[1], Ken W. Krauss[2], Nancy B. Rybicki[1], and Edward R. Schenk[1]

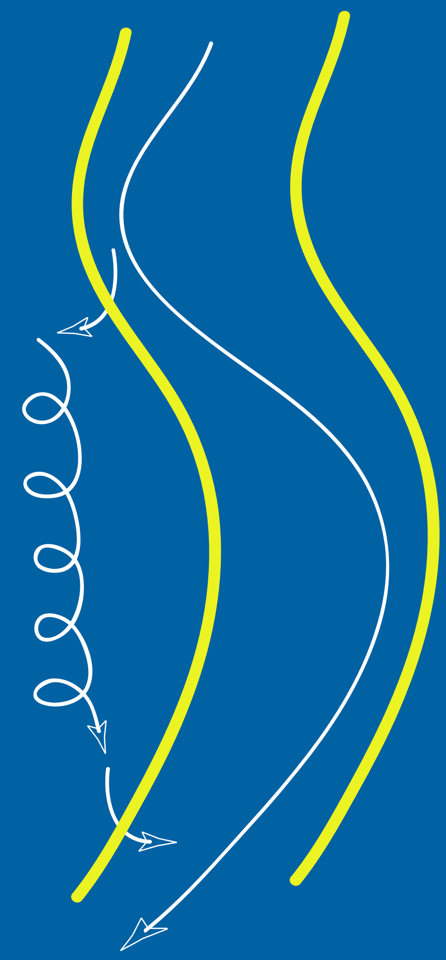
[1]National Research Program, Reston, VA, USA
[2]National Wetlands Research Center, Lafayette, LA, USA

U.S. Department of the Interior
U.S. Geological Survey

River floodplains

Understand river-floodplain carbon cycling to:

- assess the controls on greenhouse gas emissions
- determine the potential for floodplain carbon sequestration.



Four dimensions of river corridors influence floodplain ecosystem processes through river-floodplain ***hydrologic connectivity***

This heterogeneity is critical to the prediction and scaling of floodplain effects on carbon cycling

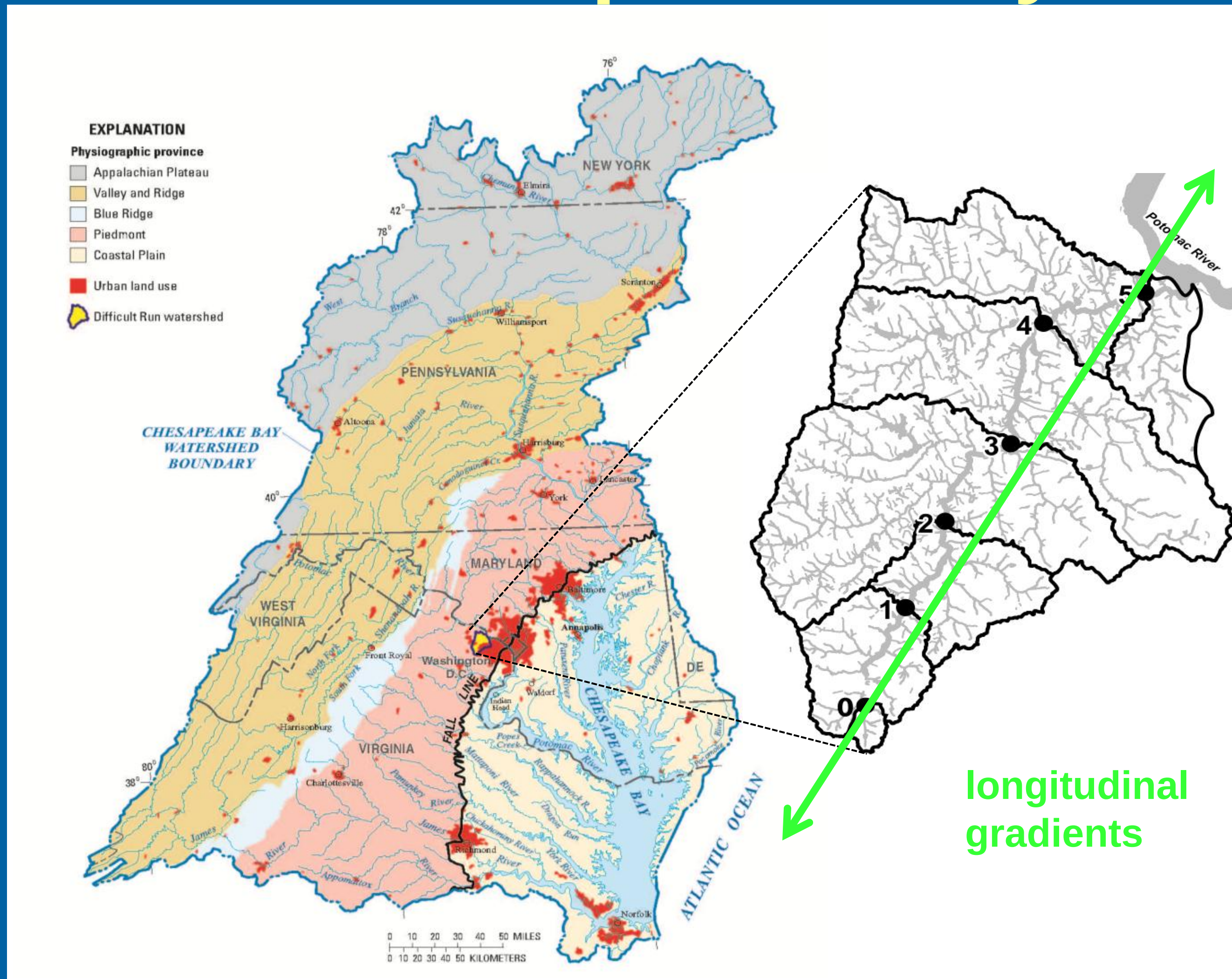
Goals of this study:

- quantify carbon fluxes through soil CO_2 and CH_4 emissions
- determine the controls on soil aerobic and anaerobic respiration
- develop an urban floodplain carbon budget along lateral and longitudinal gradients of hydrologic connectivity
- compare CO_2 flux results using an infrared gas analyzer and gas chromatograph

Noe. 2012. *Treatise of Geomorphology.* Modified from NRC 2002.

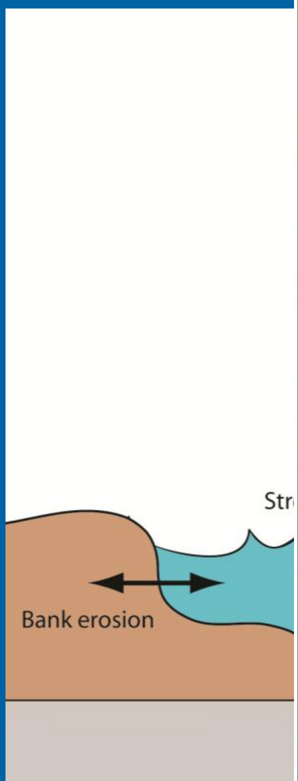
USGS

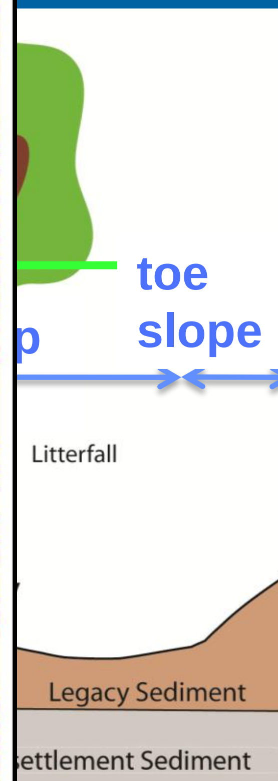
Difficult Run floodplain study

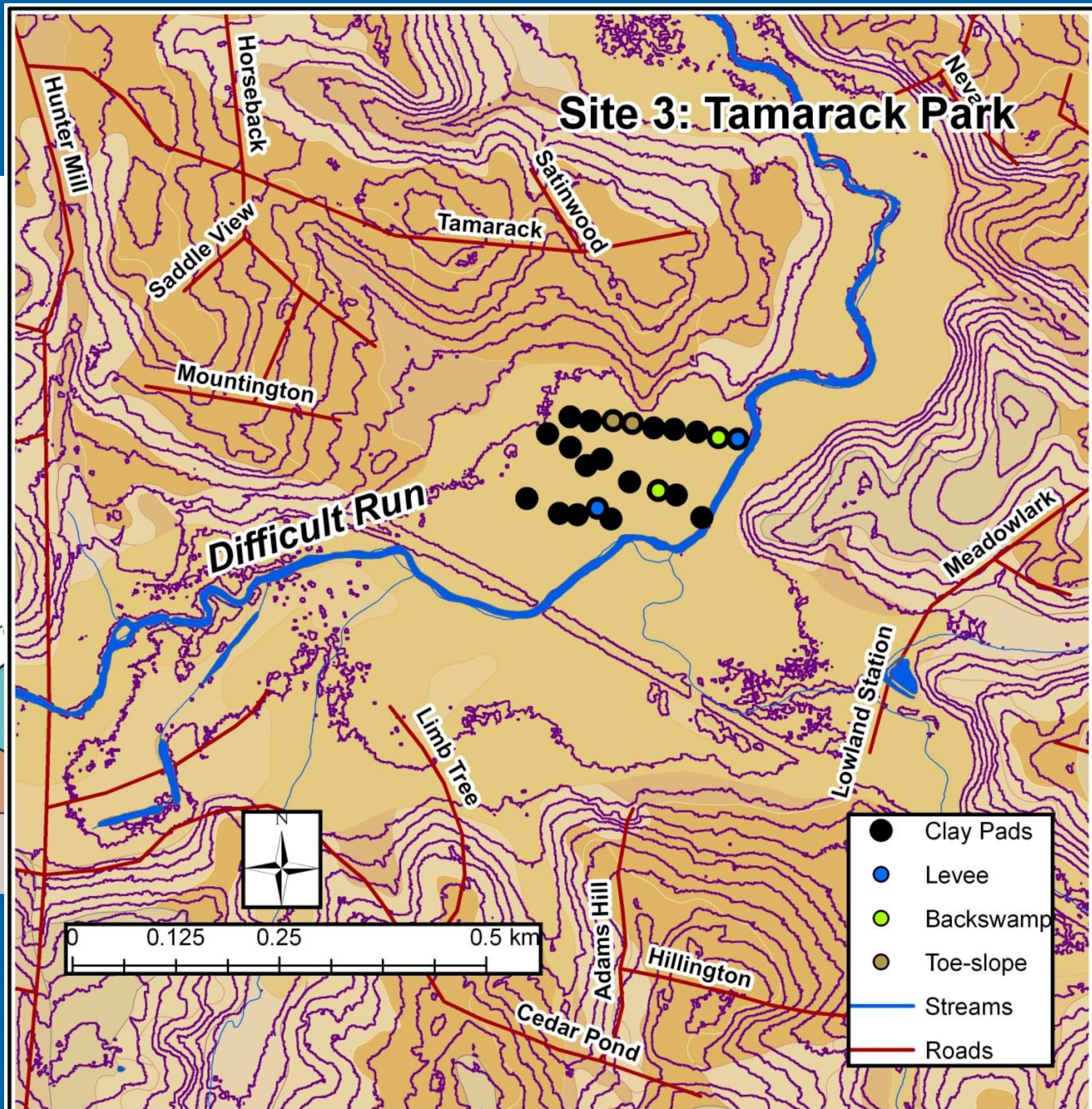


USGS

Difficult Run floodplain study







USGS

CO_2 and CH_4 (and N_2O) flux measurements

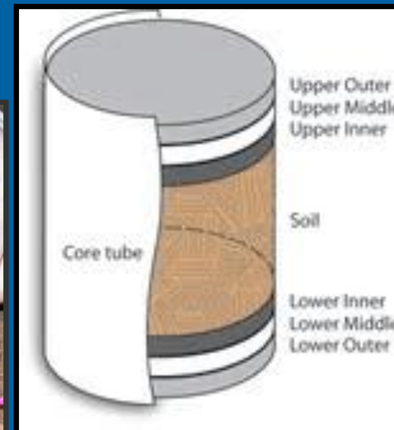
- **Soil CO_2 fluxes measured every three weeks for one year on a LI-COR 8100 infrared gas analyzer (IRGA)**

- **Gas samples extracted quarterly from chamber incubations and analyzed for CO_2, CH_4, and N_2O on a gas chromatograph**

USGS

Other ecosystem process measurements

Litterfall



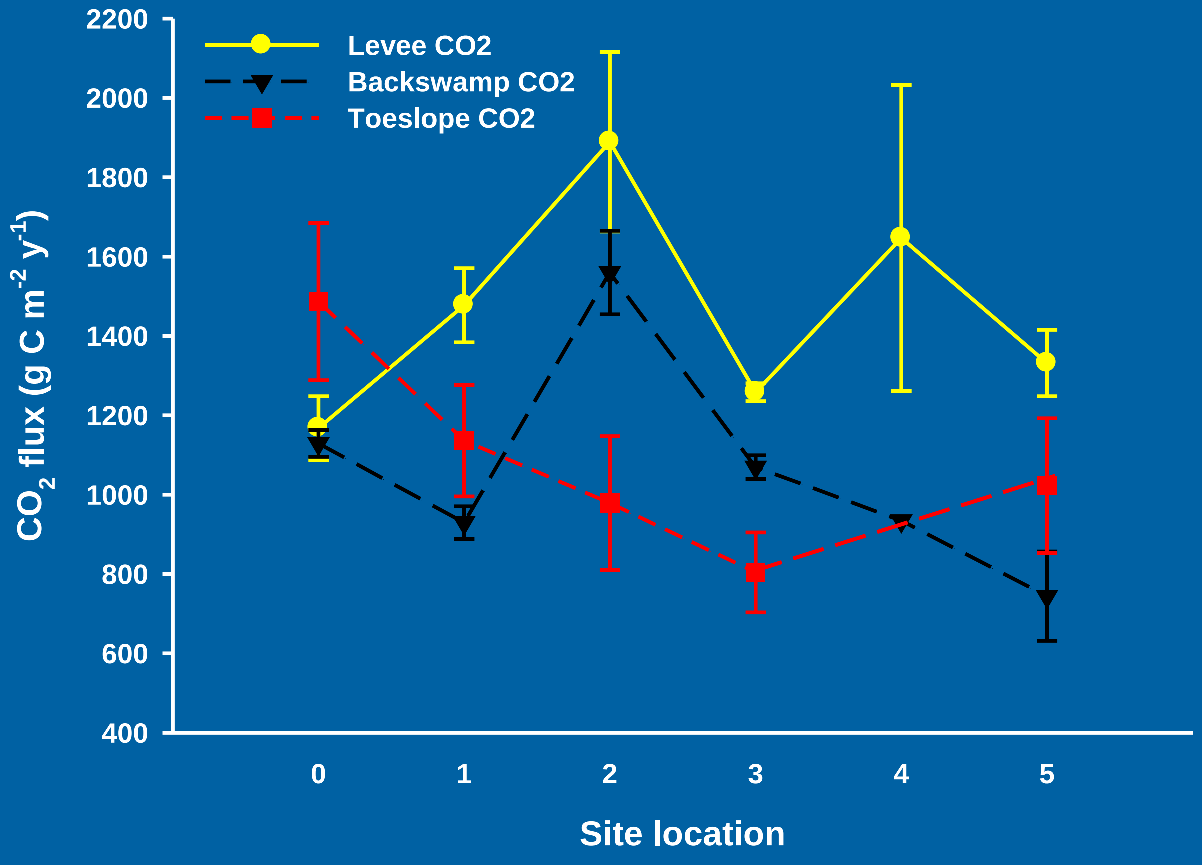
Mineralization

Sedimentation

Hydroperiod

Bank erosion

CO_2 flux: lateral and longitudinal gradients



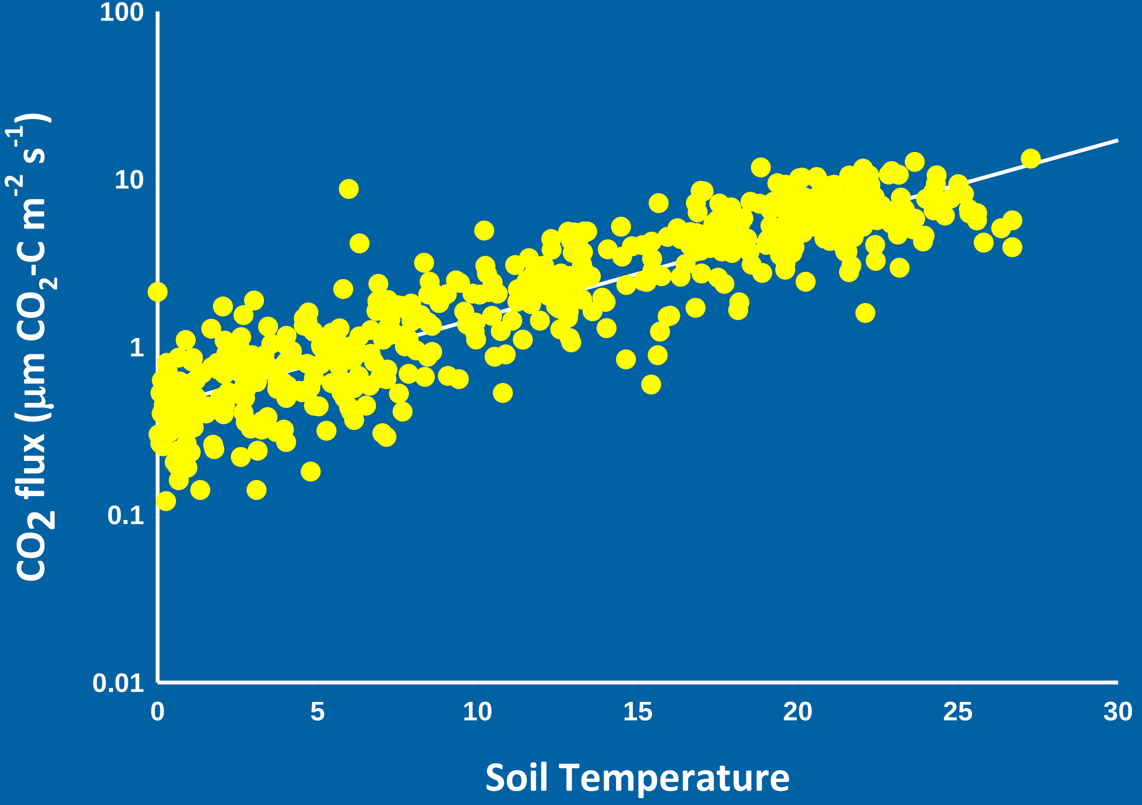
Longitudinal	CO_2 flux (g C m^{-2} yr^{-1})
0	1316
1	1234
2	1491
3	1084
4	1587*
5	1076

Lateral	CO_2 flux (g C m^{-2} yr^{-1})
Levee	1518
Backswamp	1115
Toeslope	1116

**no toe slope*

USGS

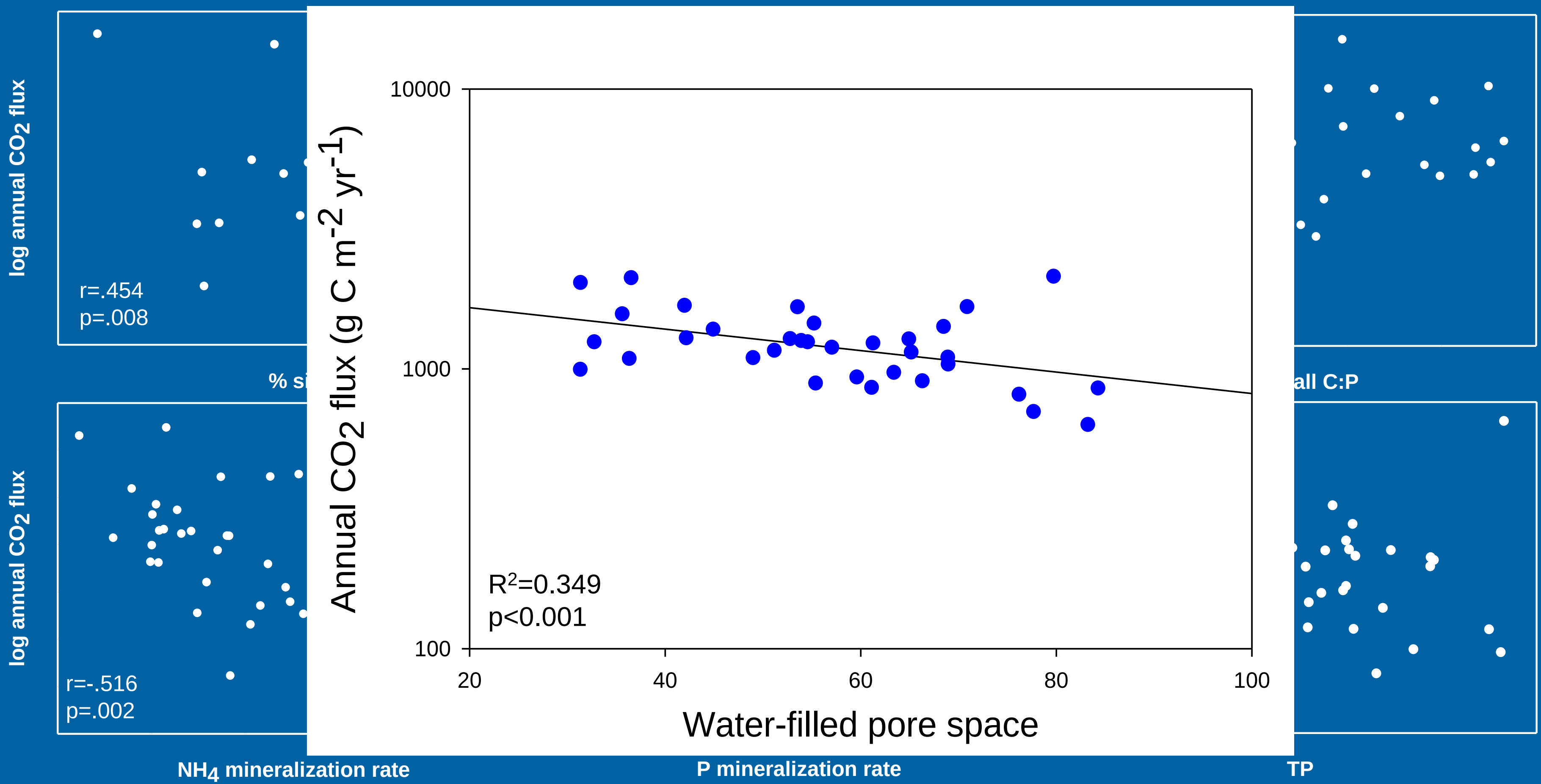
Intra-annual CO_2 flux controlled by temperature



Factor	p
Time	<0.0001
Longitudinal position	0.0161
Lateral position	0.0003
Lateral*time	0.0002
Longitudinal*time	<0.0001
Lateral*longitudinal	0.0155
Lateral*longitudinal*time	<0.0001

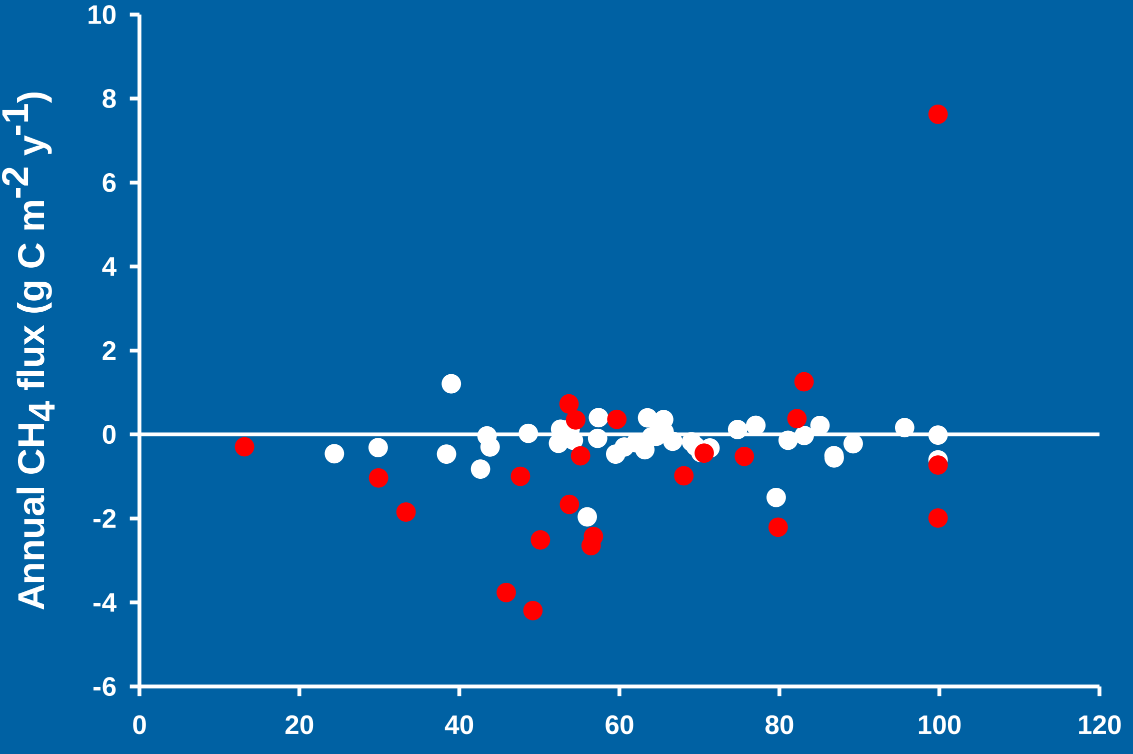
USGS

Annual CO_2 flux correlations



Annual CO_2 flux controlled by hydrology

CH_4 flux

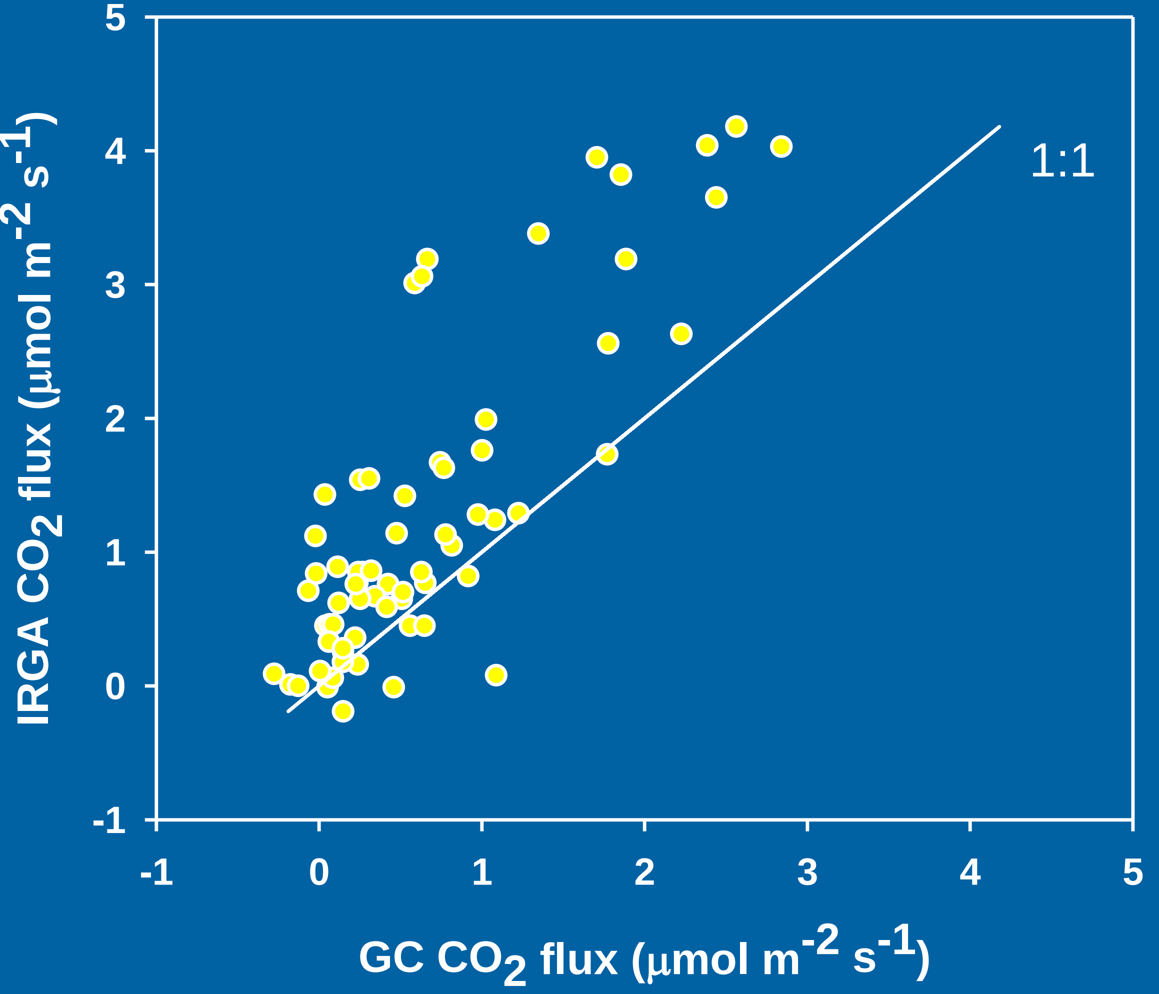


Water-filled pore space

Red dots indicate fluxes that differ significantly (α=0.1) from zero.

USGS

IRGA vs. GC



Method	Mean	SE
IRGA, 3.5 m	1.27	0.13
GC, 20 m	0.64	0.08

$p<0.001$

Method	Mean	SE
IRGA, 3.5 m	1.27	0.13
IRGA, 20 m	1.18	0.13

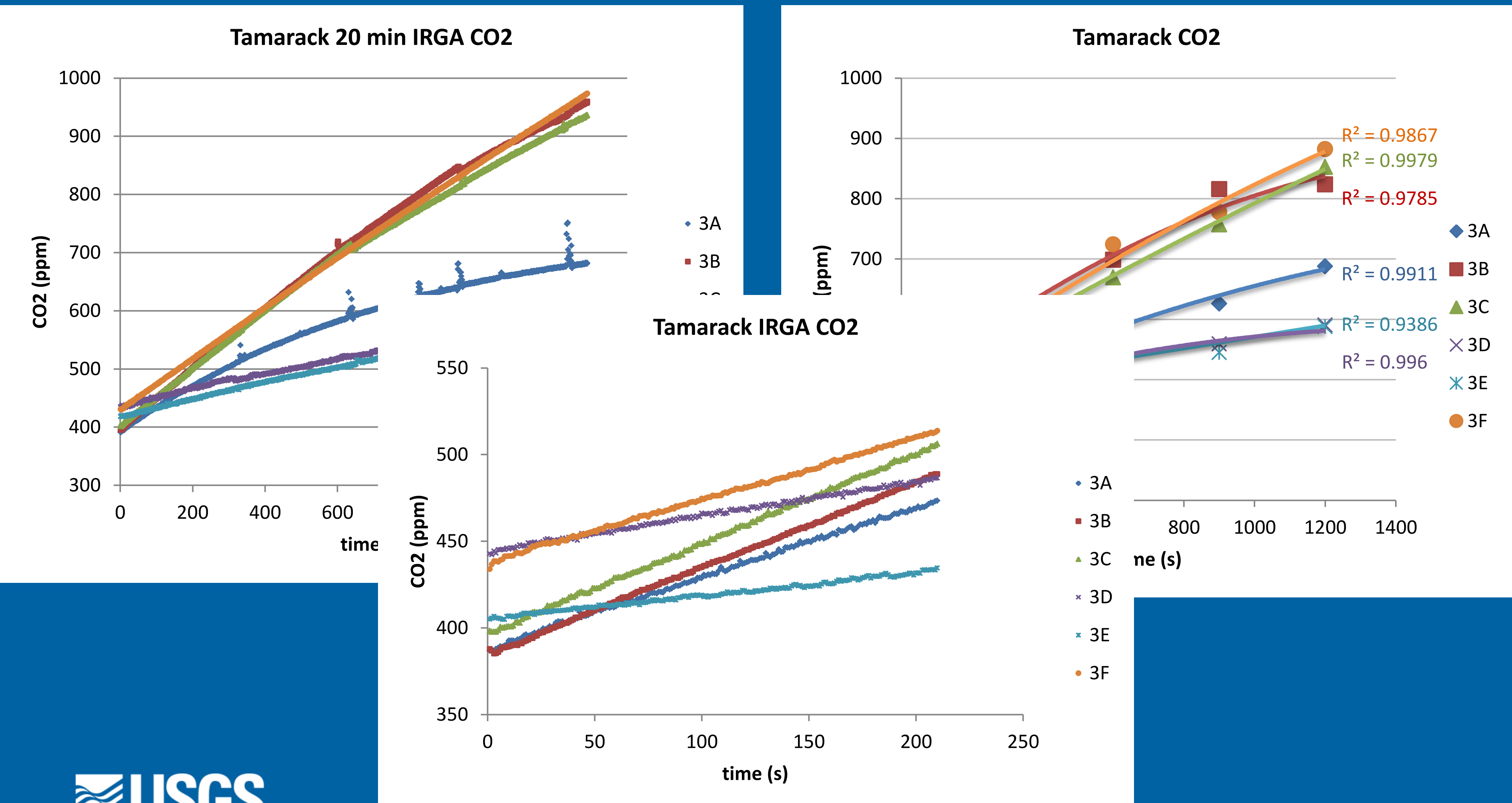
$p=0.087$

Method	Mean	SE
IRGA, 20 m	1.18	0.13
GC, 20 m	.64	0.08

$p<0.001$

USGS

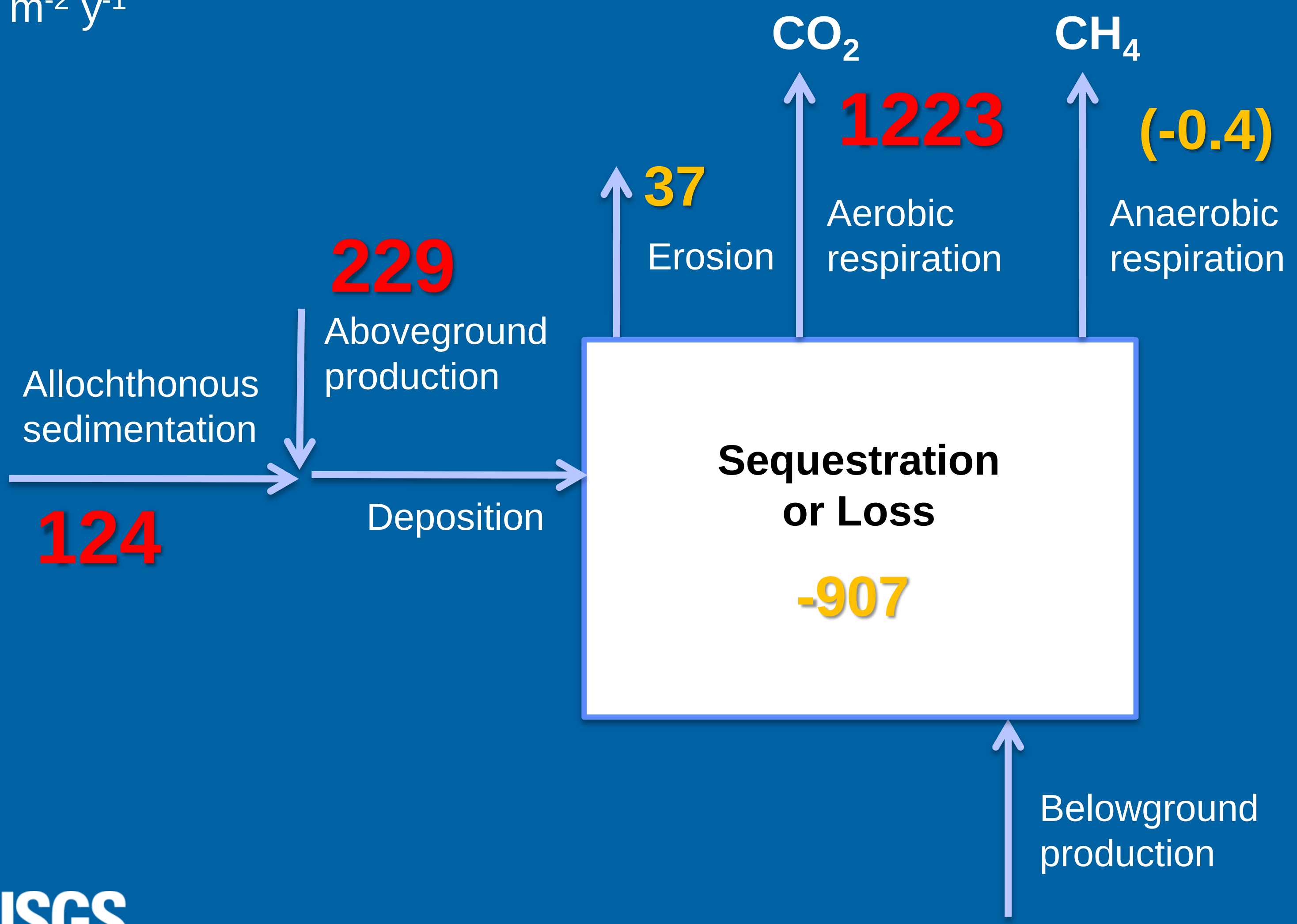
IRGA vs. GC



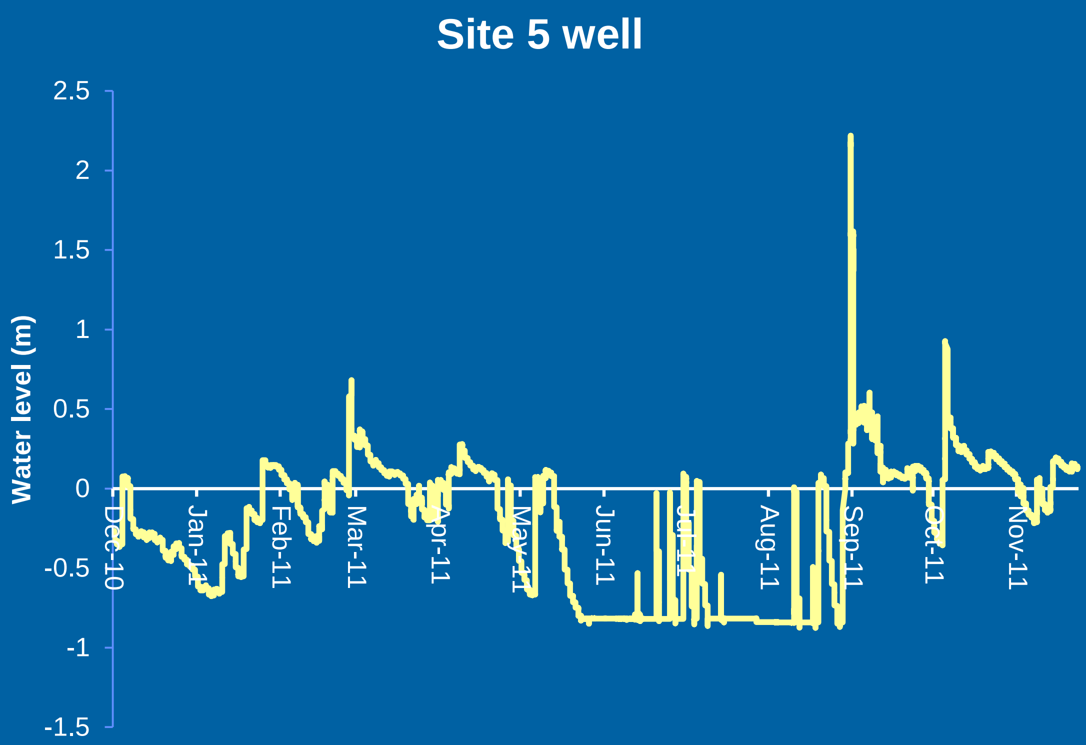
USGS

Difficult Run C budget

g C m^{-2} y^{-1}



Oxidizing system



Among all sites:
Average water level= **-0.84 m**
Average hydroperiod = **7.61%** of days with surface water present

Summary

- C losses through respiration exceeded C inputs
- Annual aerobic respiration was largely controlled by hydrology
- CO_2 fluxes were higher when measured with an infrared gas analyzer versus samples collected and analyzed on a GC

USGS

Thank you!