

Can the CLM simulate the effect of crop cultivation on accumulated soil C?

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Motivation 1: Schlesinger (1991)

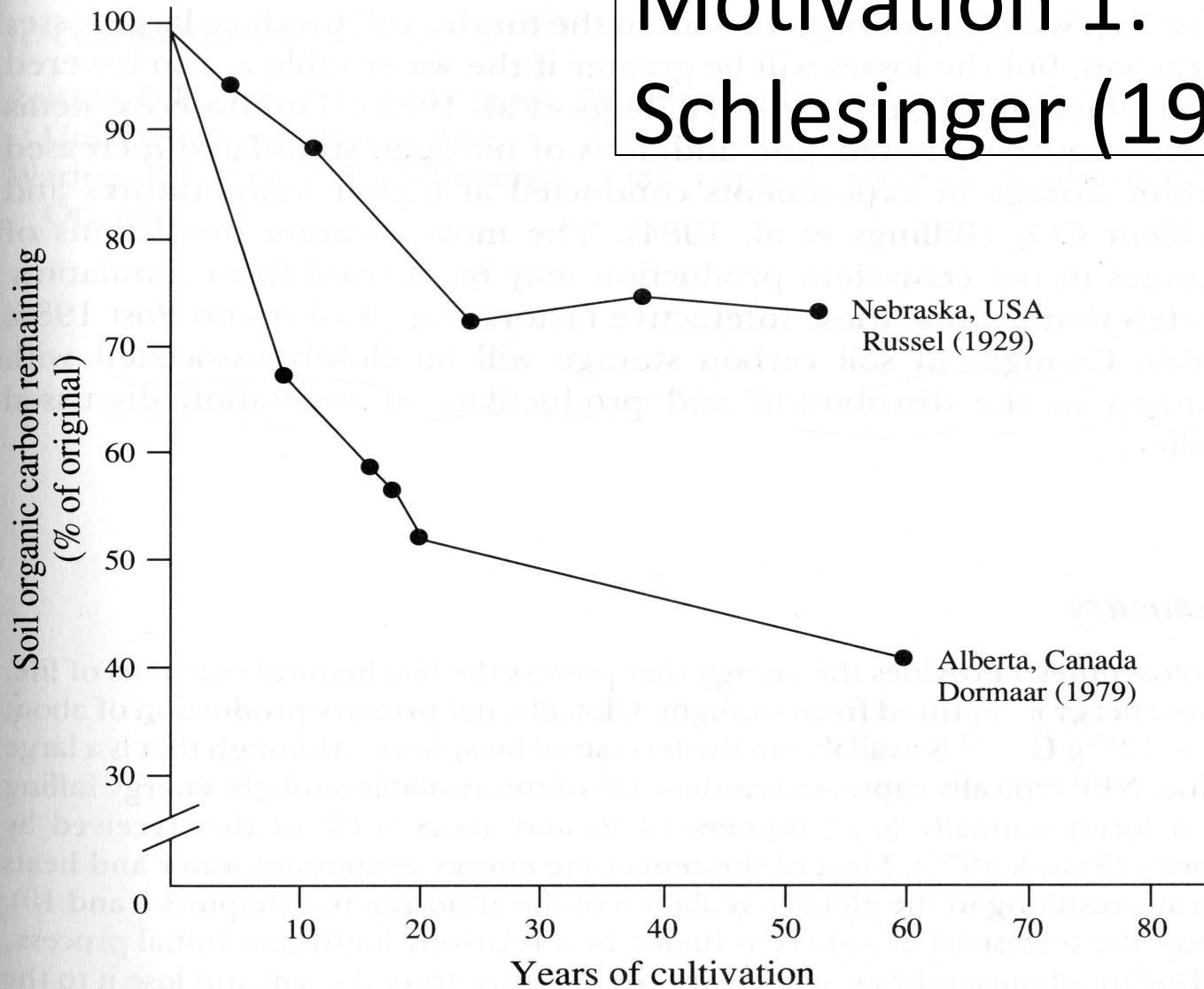
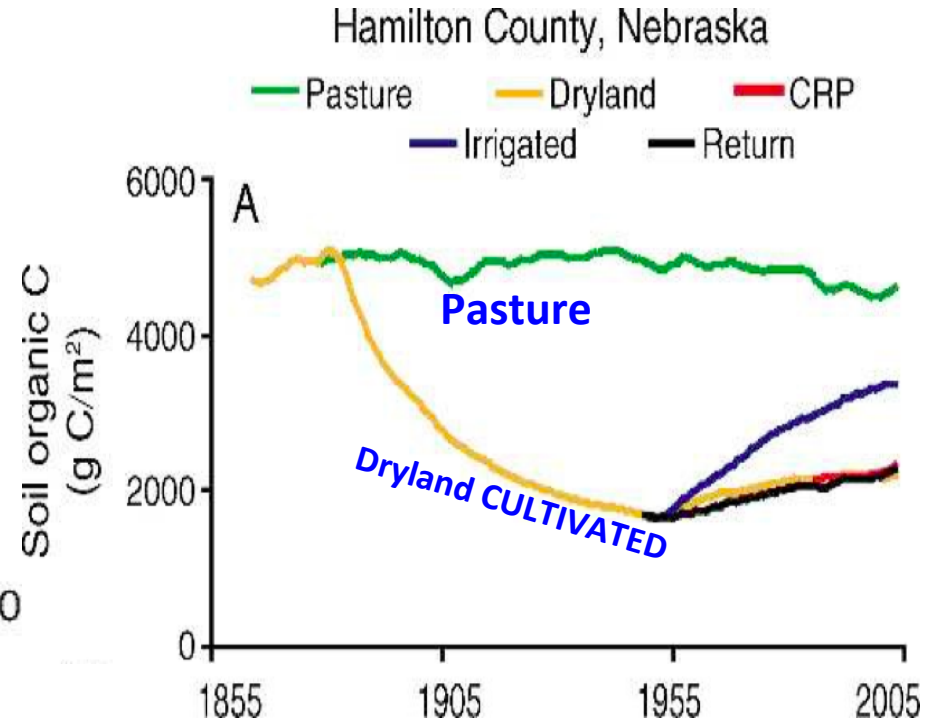
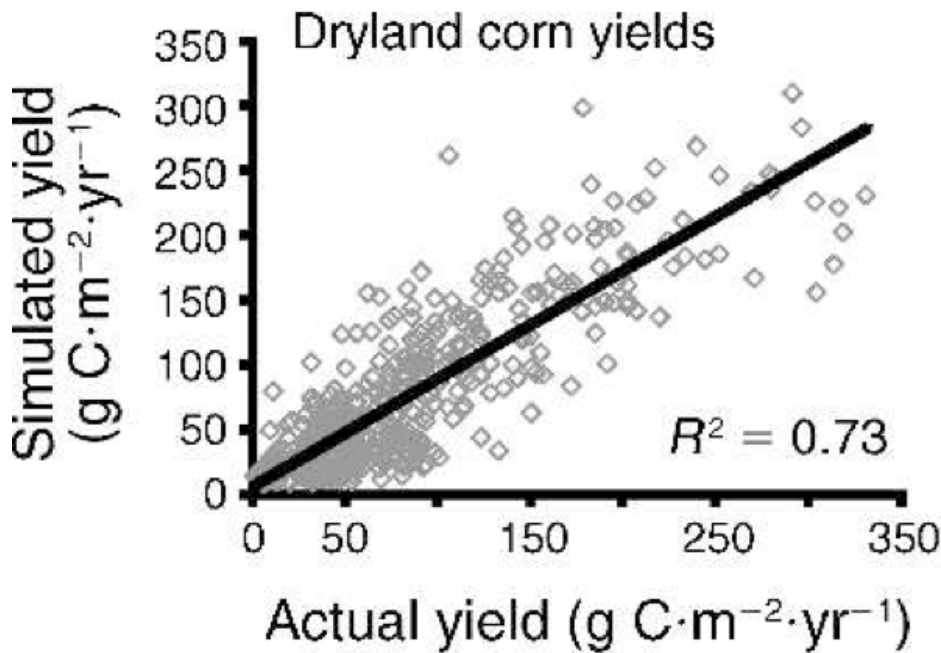


Figure 5.18 Decline in soil organic matter following conversion of native soil to agriculture for two grassland soils.

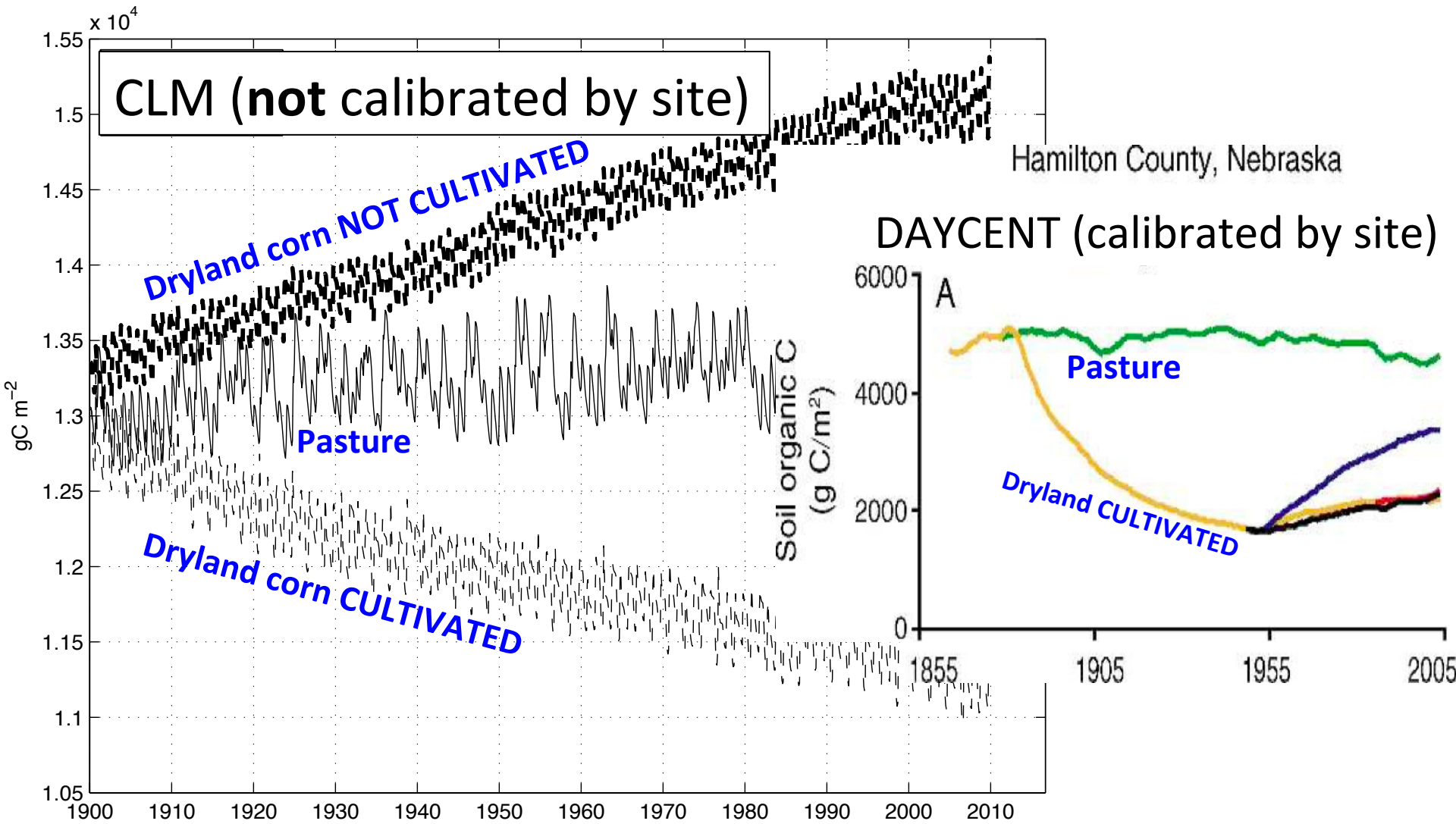
Motivation 2: Hartman et al. (2011)

- DAYCENT calibrated by site
- Simulated vs. observed yield at 21 sites:



Agricultural lands in the Great Plains contributed 1.73 Pg CO₂-C equivalents 1860-2003

TOTAL SOIL CARBON, Hamilton NE



Effect of cultivation on soil C decomposition (NOT in default CLM-CNcrop)

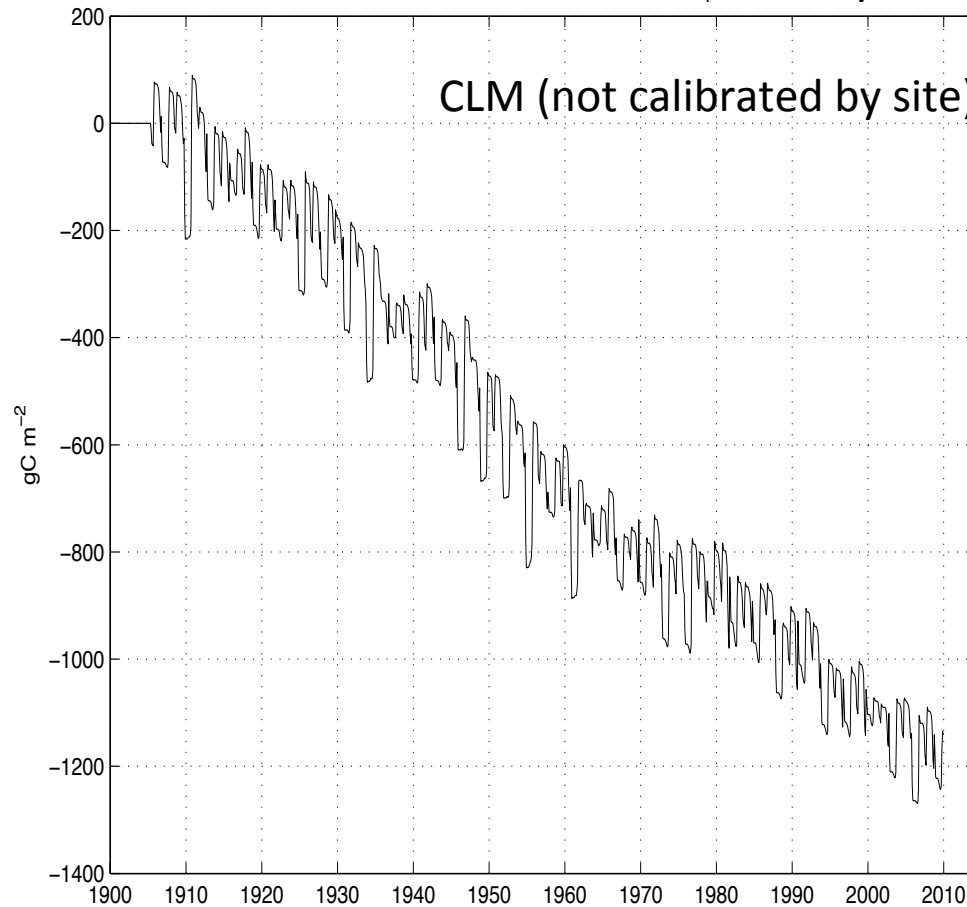
YYYY	DDD	<u>SOIL1</u>	<u>SOIL2,3</u>	<u>LITTER</u>	FARM ACTIVITY
1917	159	1.24	4.44	1.74	multiple tandem
1917	189	1.24	4.44	1.74	multiple tandem
1917	220	1.24	4.44	1.74	multiple tandem
1918	111	1.24	4.44	1.74	multiple tandem
1918	118	8.00	8.00	3.50	moldboard plow
1919	136	8.00	8.00	3.50	moldboard plow
1919	141	1.04	3.04	1.24	cultivatr&plantr
1919	197	1.04	3.04	1.24	cultivatr&plantr

[...]

Δ Total Soil C simulated @ dryland corn site Cultivated minus Not

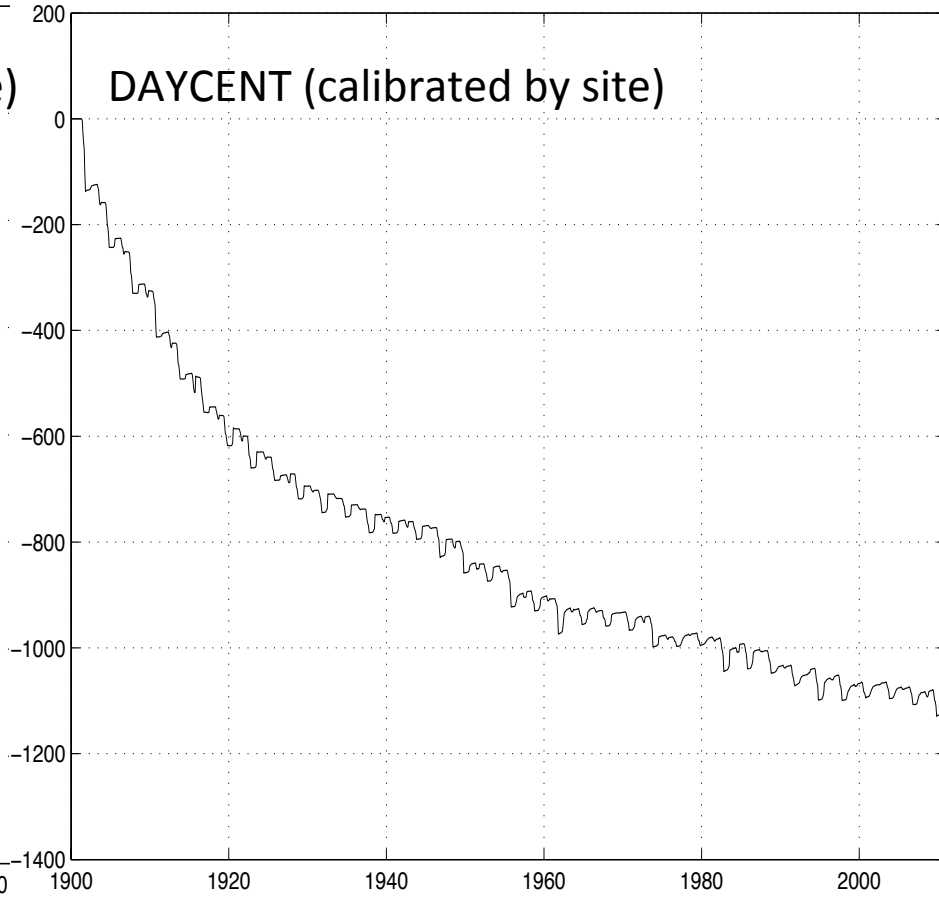
TOTSOILC Cultivated minus Not Cultivated Crop: **Cherry NE**

CLM (not calibrated by site)



TOTSOILC DAYCENT Cultivated minus Not Cultivated Crop: **Cherry NE**

DAYCENT (calibrated by site)



simulations use transient CO₂, N deposition, and CRU-NCEP wx

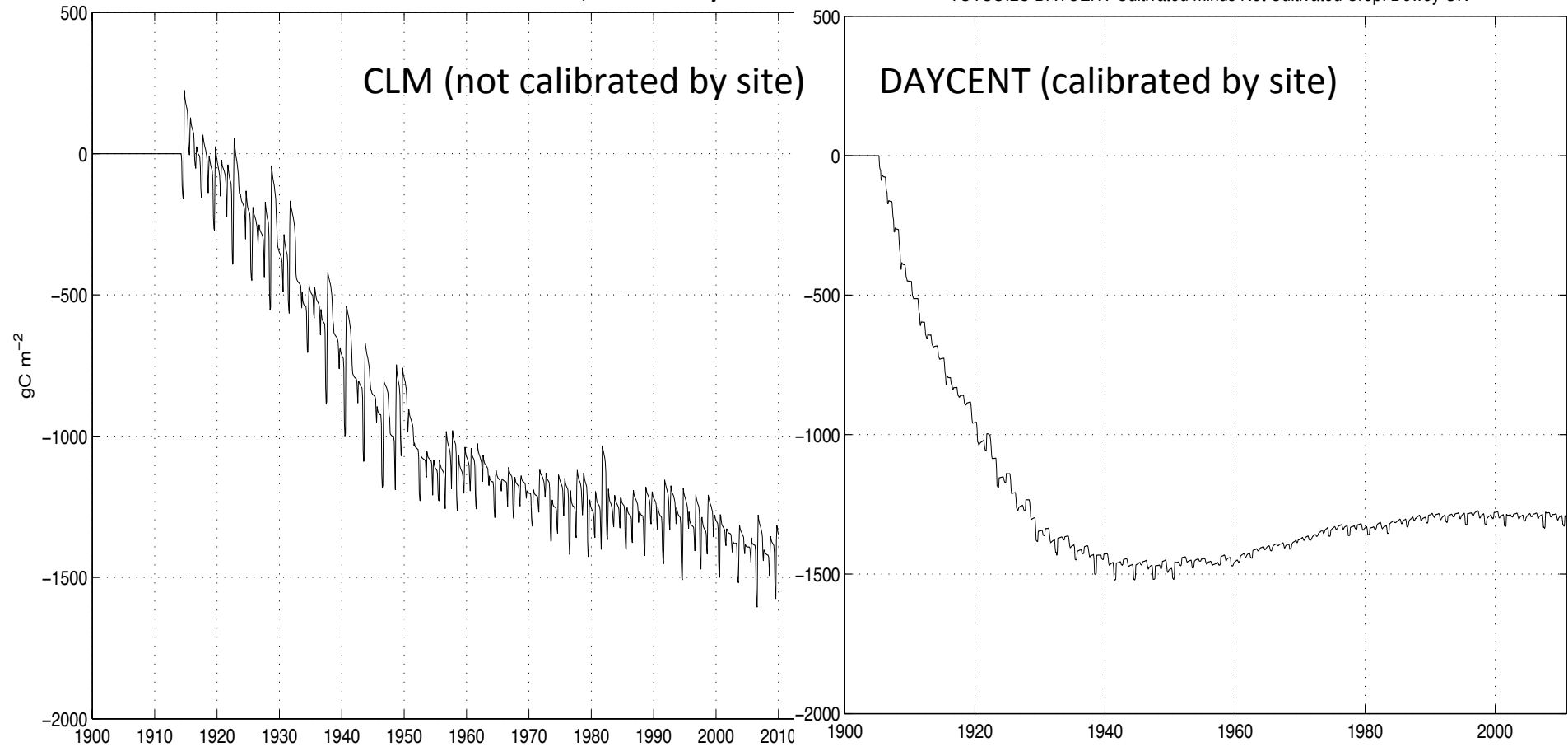
Δ Total Soil C simulated @ dryland corn site Cultivated minus Not

TOTSOILC Cultivated minus Not Cultivated Crop: Dewey OK

TOTSOILC DAYCENT Cultivated minus Not Cultivated Crop: Dewey OK

CLM (not calibrated by site)

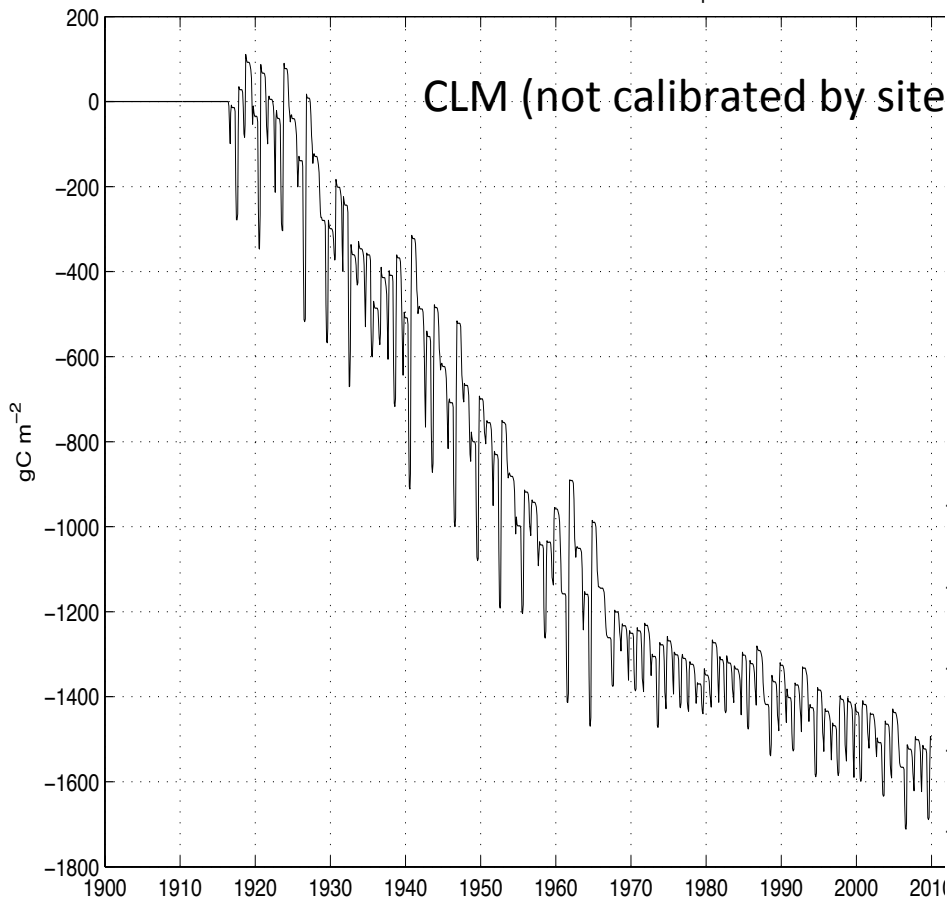
DAYCENT (calibrated by site)



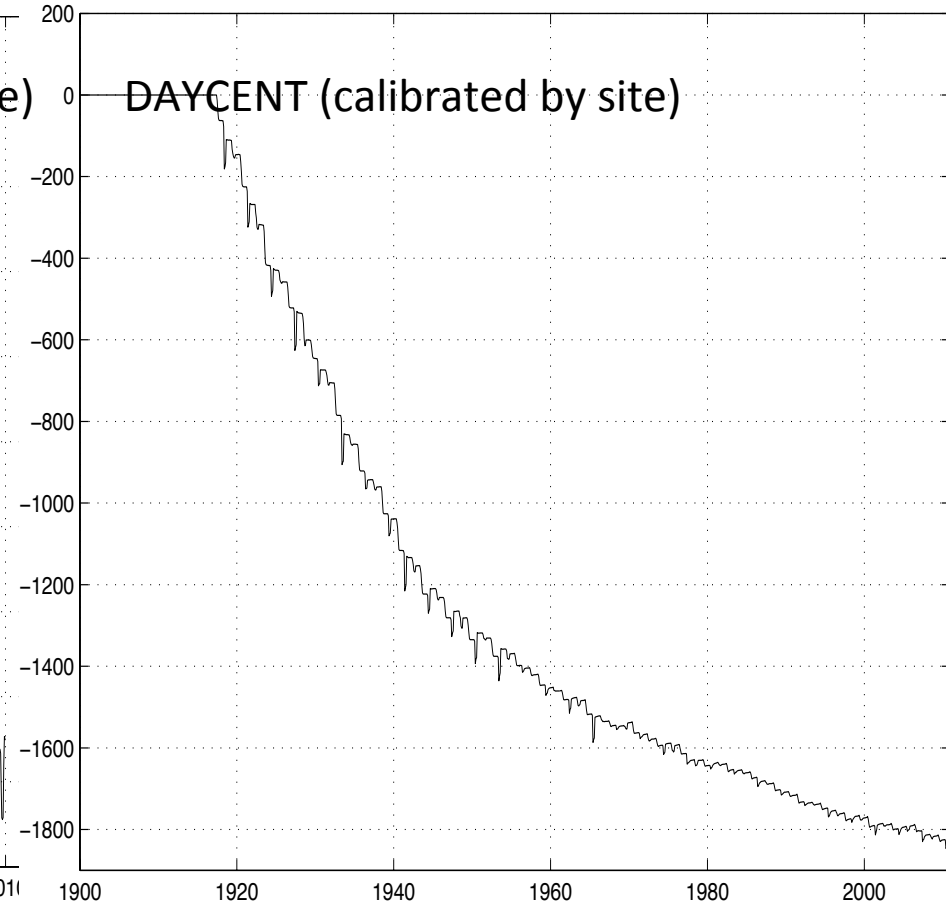
simulations use transient CO₂, N deposition, and CRU-NCEP wx

Δ Total Soil C simulated @ dryland corn site Cultivated minus Not

TOTSOILC Cultivated minus Not Cultivated Crop: Dunn ND



TOTSOILC DAYCENT Cultivated minus Not Cultivated Crop: Dunn ND

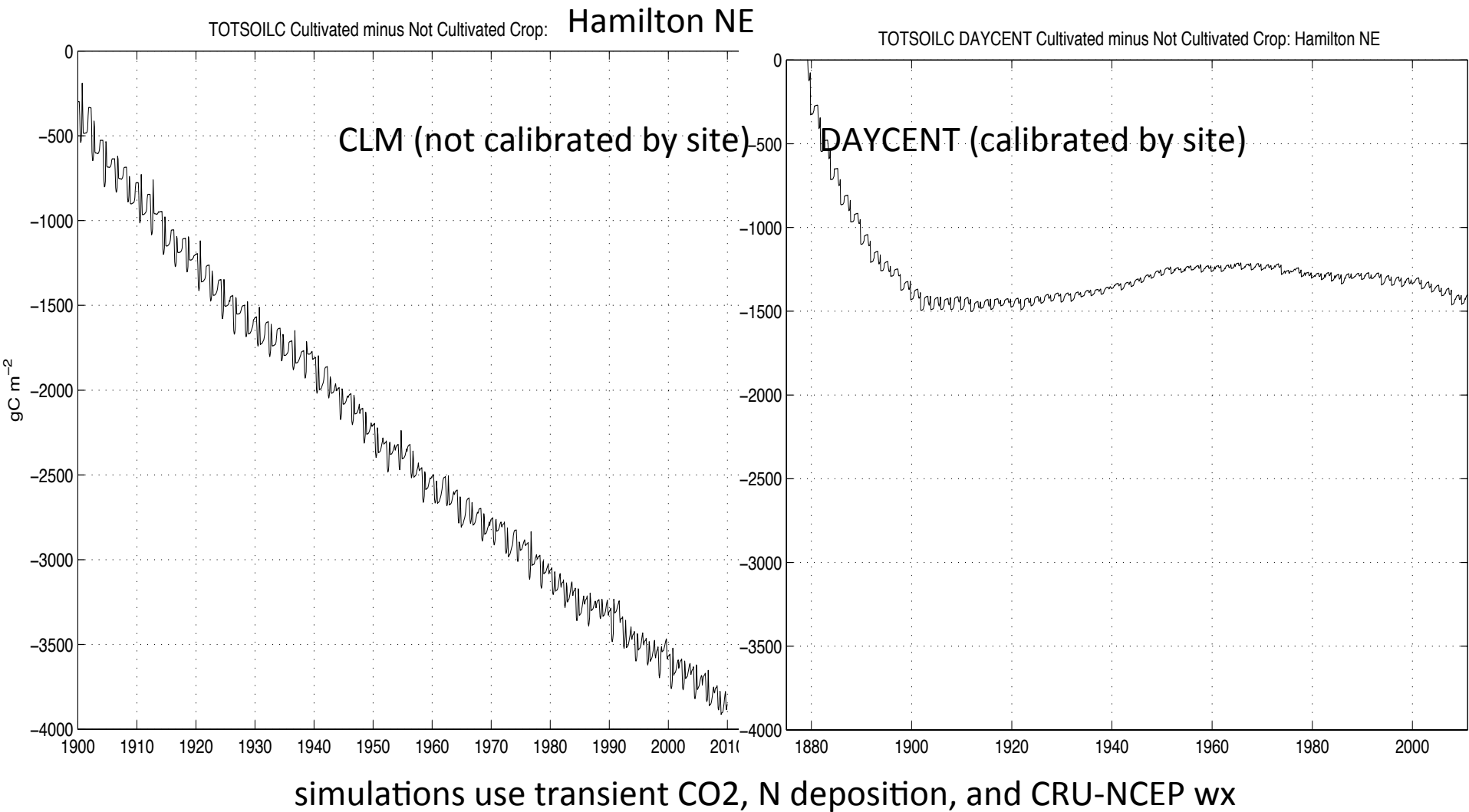


simulations use transient CO₂, N deposition, and CRU-NCEP wx

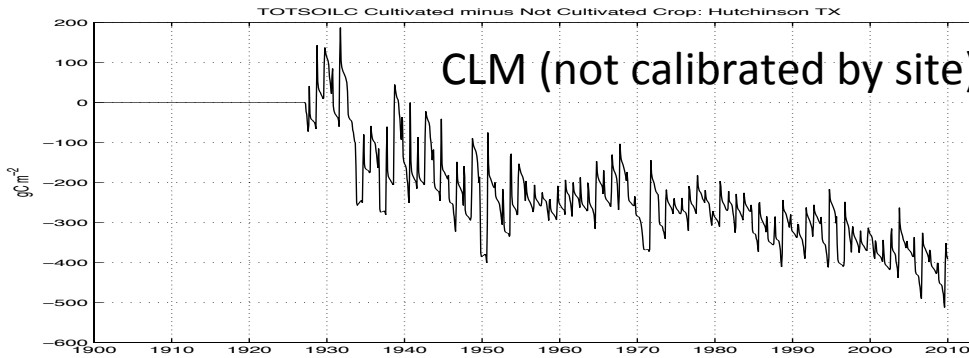
Summary & Conclusions

- Lawrence et al. (2012): LU emissions underestimated; LU term=removal of C by replac. unmanaged veg
- Here: direct effect of cultivation on soil C decomp
- CLM responds with reduced soil C ✓
- BGC models in assessments of the GCP and IPCC do not, yet, include this
- Next: global implementation to quantify globally

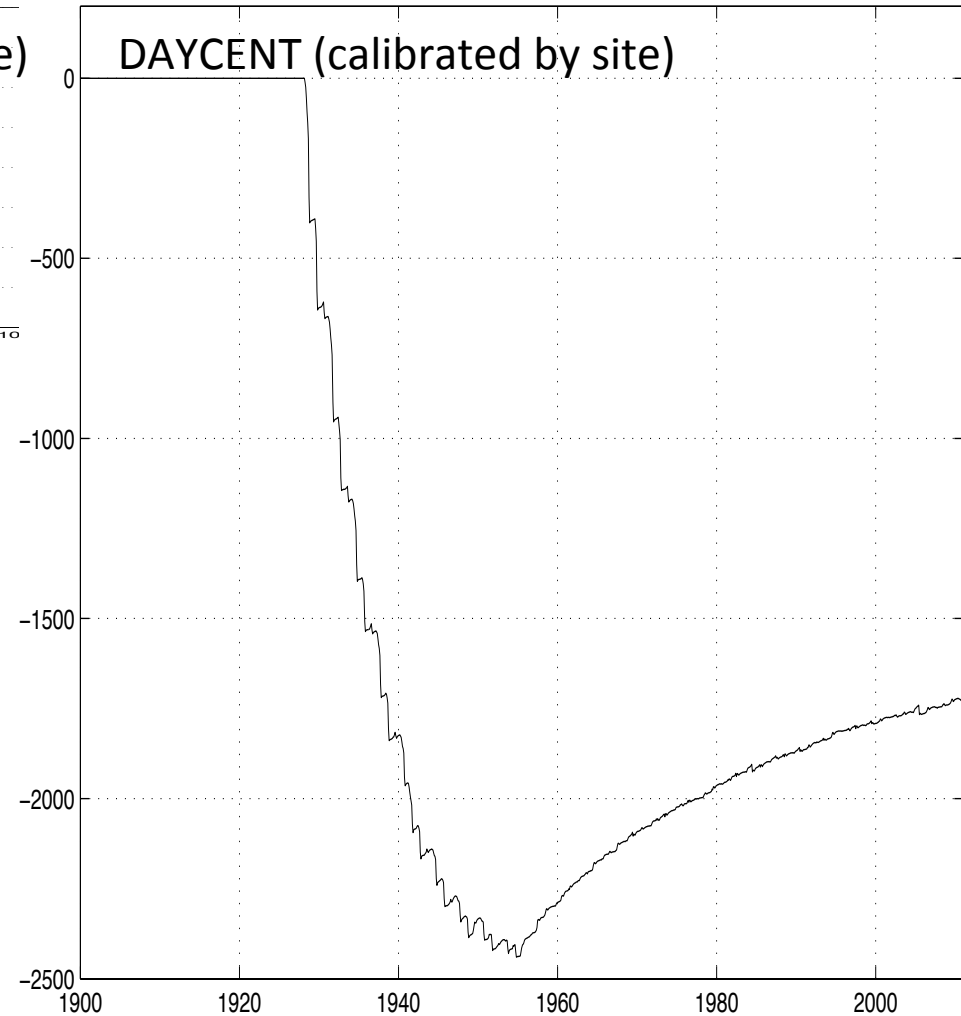
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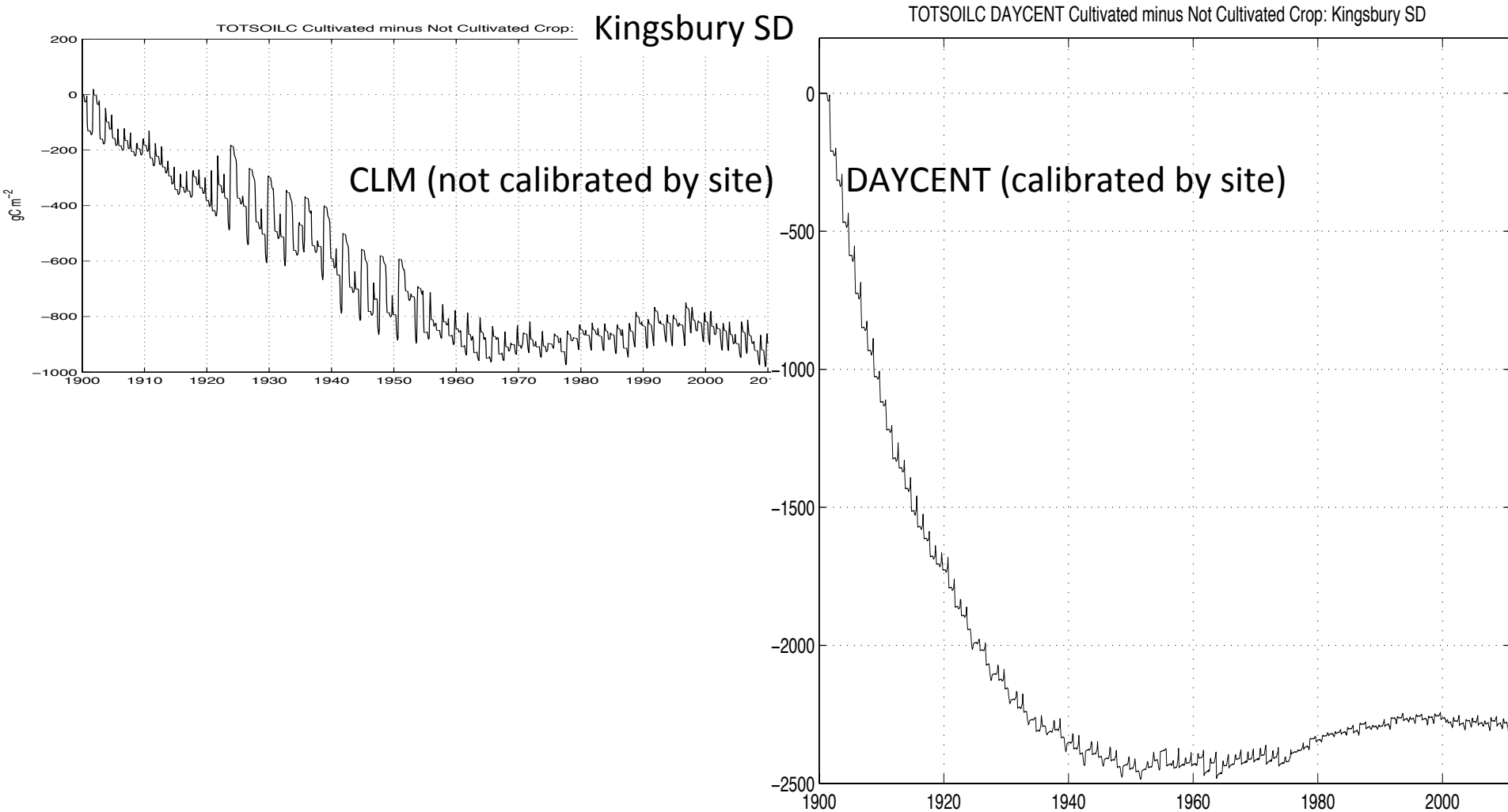


Hutchinson TX



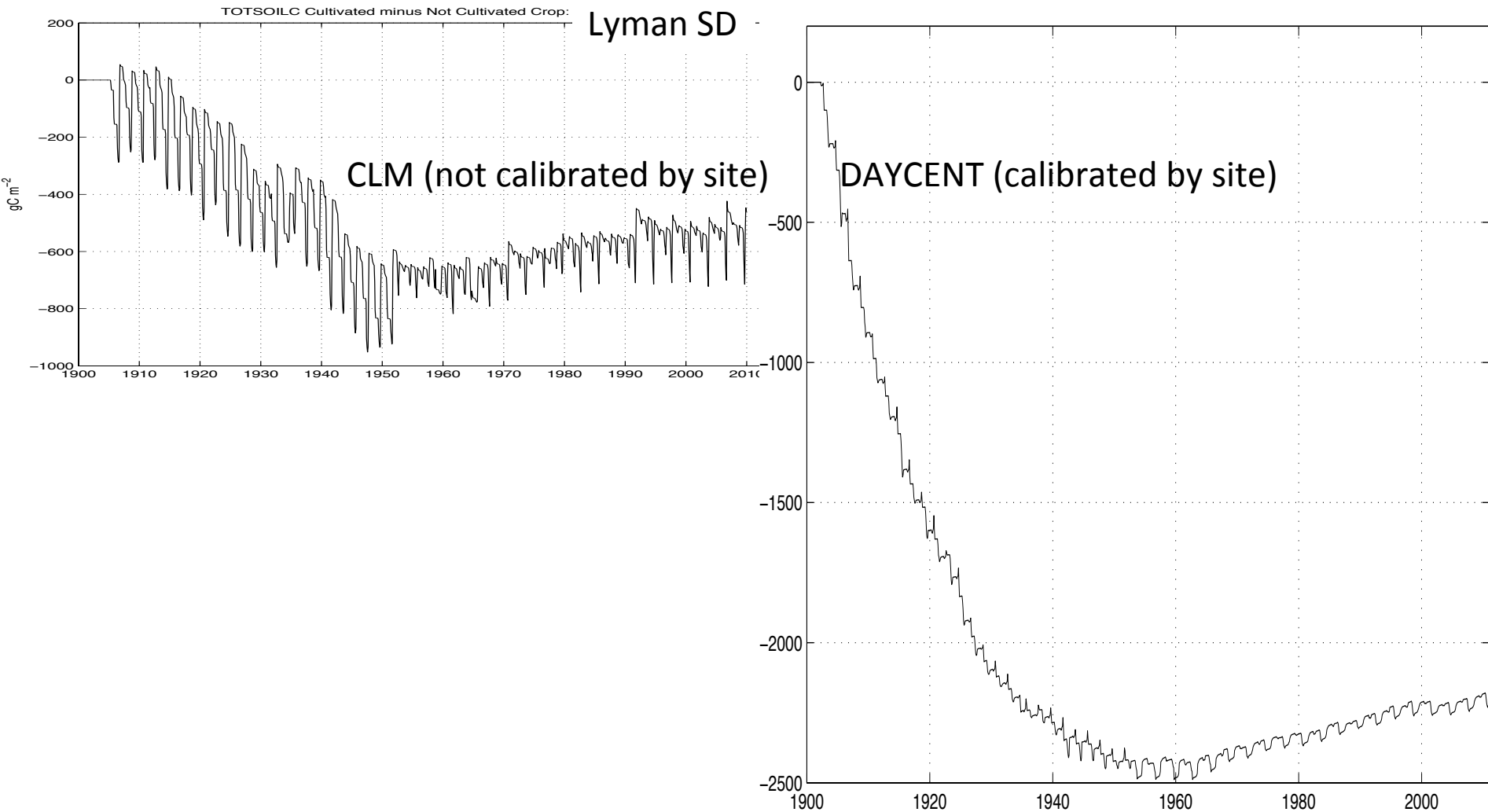
simulations use transient CO₂, N deposition, and CRU-NCEP wx

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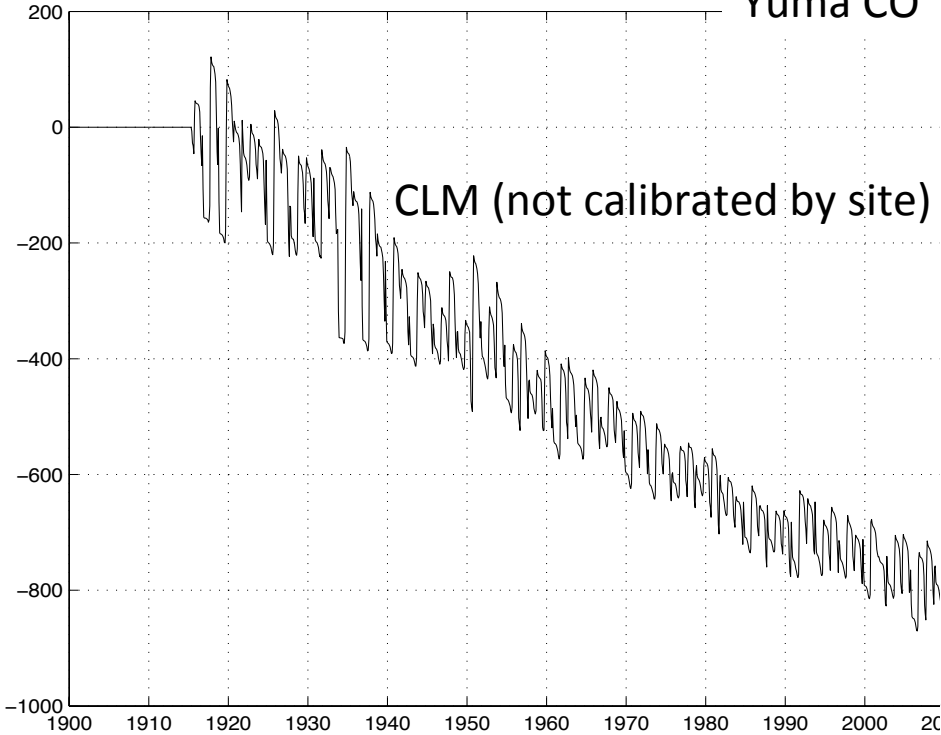
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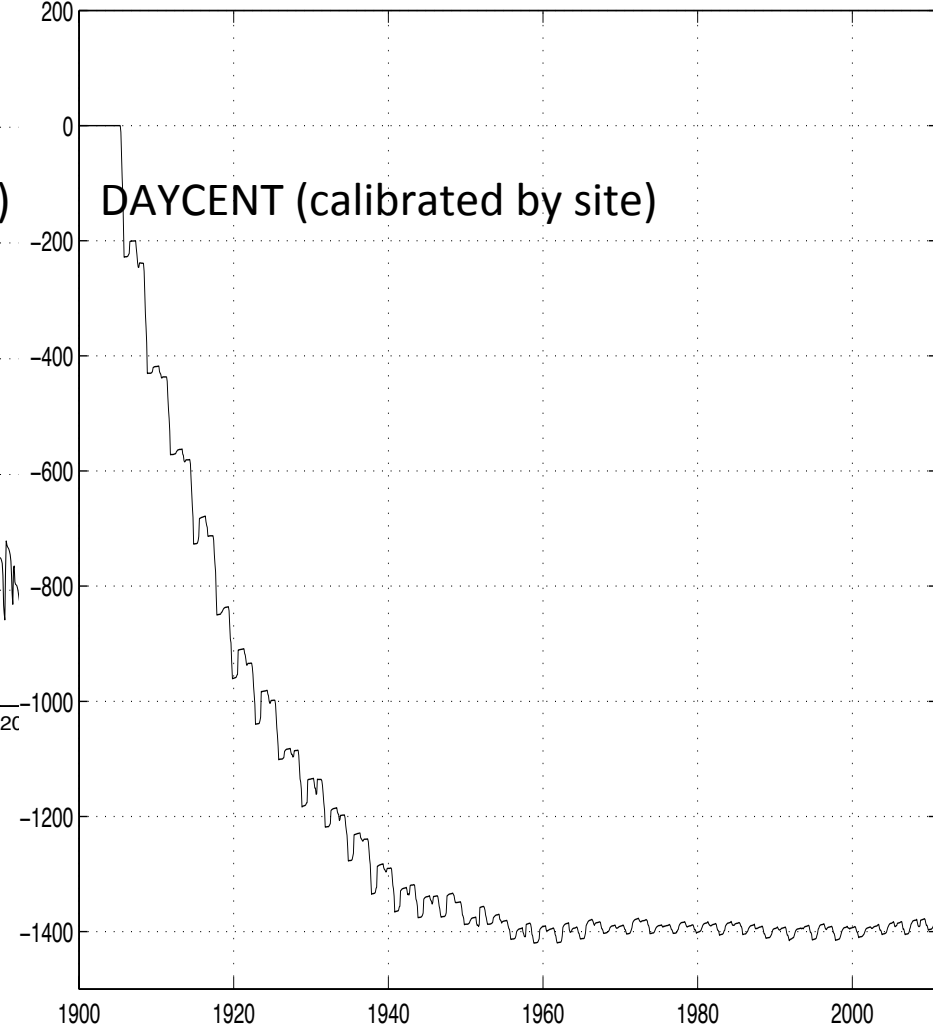
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Δ Total Soil C simulated @ dryland corn site Cultivated minus Not

TOTSOILC Cultivated minus Not Cultivated Crop: Yuma CO



TOTSOILC DAYCENT Cultivated minus Not Cultivated Crop: Yuma CO



simulations use transient CO₂, N deposition, and CRU-NCEP wx