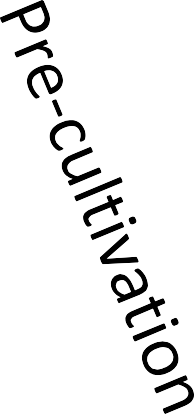


Patterns of soil organic

carbon deficit in the Conterminous US

### Terry Loecke, PhD Skye Wills, PhD 12 Dec 2018



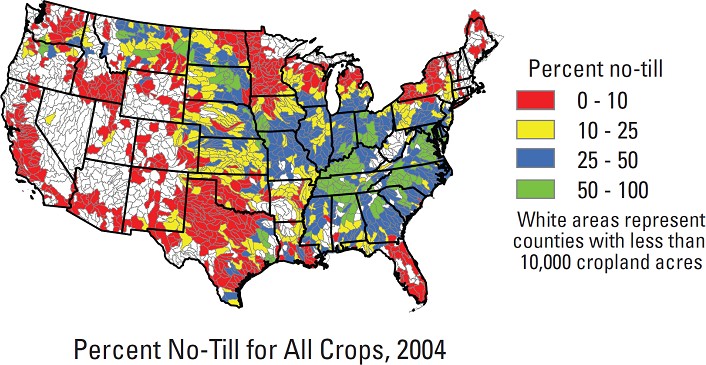
Land use, climate, or management change

Soil organic C (g C g dry soil-1)

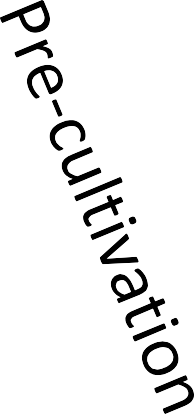
e.g., Paustian et al., 2000

Time (scale system dependent)

heterogeneous



https://water.usgs.gov/nawqa/home\_maps/tillage.html



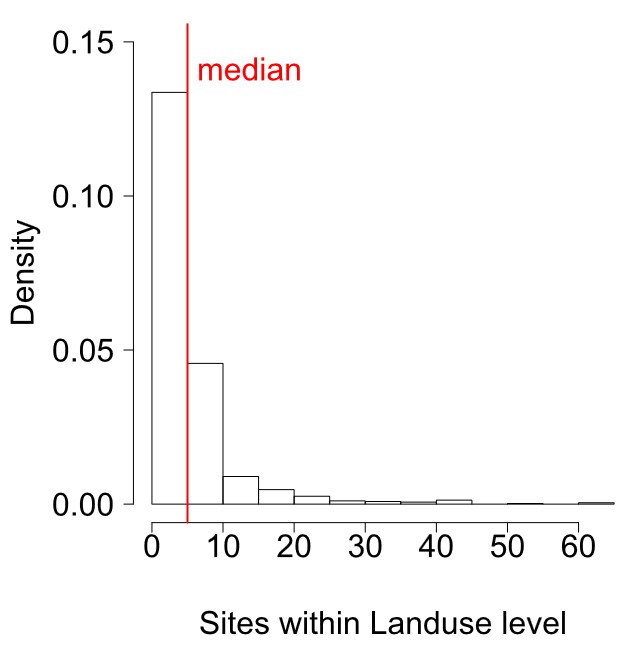
Land use, climate, or management change

Soil organic C (g C g dry soil-1)

Time (scale system dependent)

Assessment (RaCA)

* Provide a traceable probabilistic estimate of CONUS SOC content and stocks at a single point in time .
* Better understanding of land use and landscape level patterns of SOC.

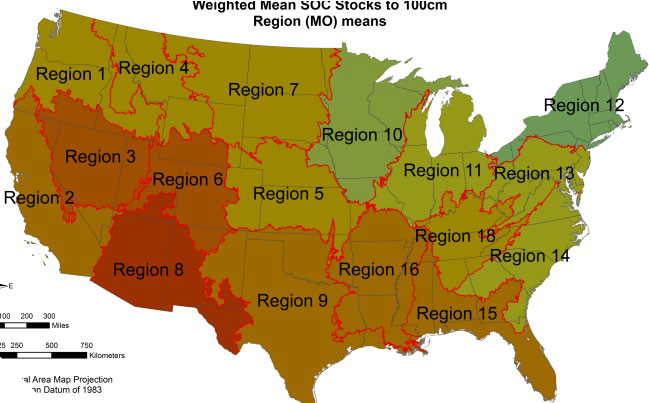
methodology

Stratified random sampling design 17 Regions

8-20 soil groups – Wills et al, 2013

6 Land uses – correspond NRI, NLCD

1 to 61 sites (median = 5) - randomized Five (>1m deep) pedons per site



sectioned by genetic horizon

• 144,833 samples collected

• Field described soil horizons, texture

• Air-dried, sieved, VNIR scans to predict SOC, TN, TS (Wijewardane et al., 2016)

• All O horizon and central pedon samples analyzed for C,N, and S on elemental analyzer (~50k)

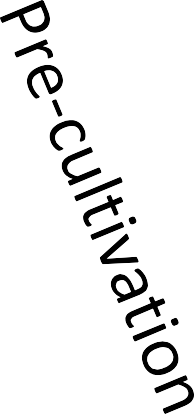
• 32,084 pedons to at least 1 m of depth or rock layer

• 6017 sites

• Bulk density – 0 to 50cm and modeled below (Sequeria et al., 2014)

• > 300 soil scientists

Land use, climate, or management change



Soil organic C (g C g dry soil-1)

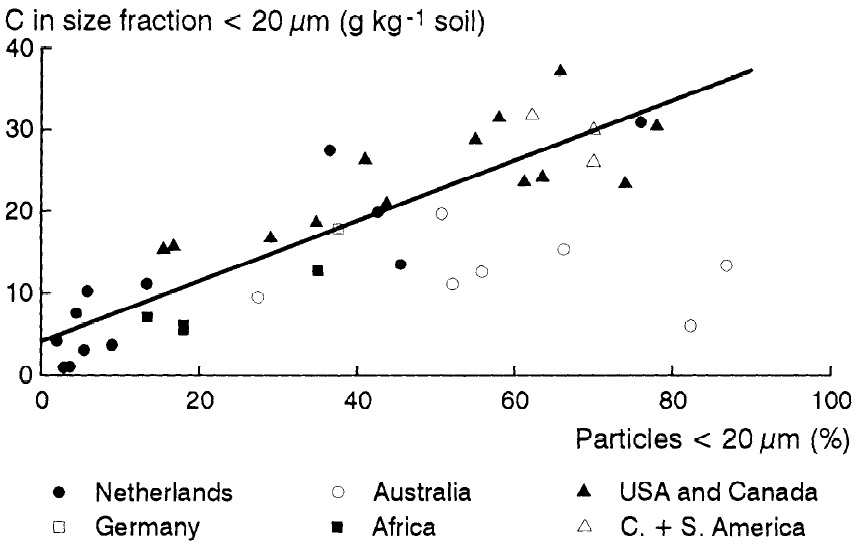
Δ native

Time (scale system dependent)

SOC (g kg-1) = 4.1 + 0.37\*%

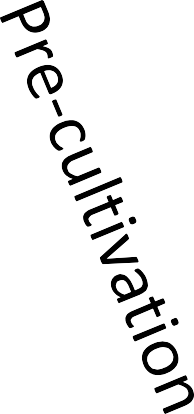
Soil carbon saturation: concept, evidence

and evaluation



J. Hassink, “The capacity of soils to preserve organic C and N by their association with clay and silt particles,” *Plant Soil*, vol. 191, pp. 77–87, 1997.

Land use, climate, or management change



Soil organic C (g C g dry soil-1)

Δ native

(0-100%)

δ MA (>100%)

Mineral Associated SOC

δ MA (0-100%)

Time (scale system dependent)

Δ Native

(0-5 cm)

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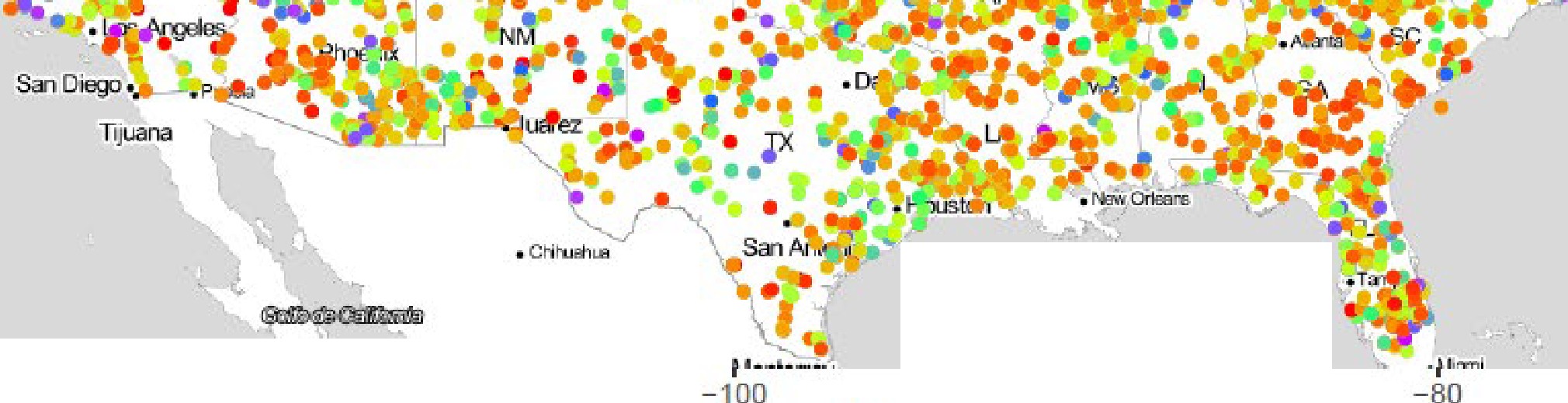
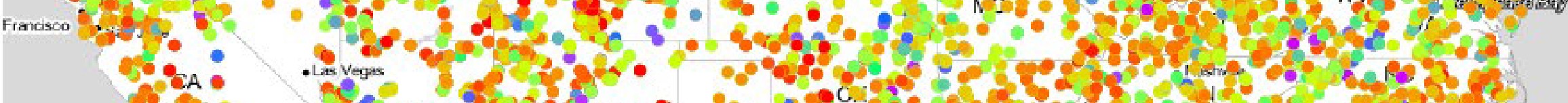
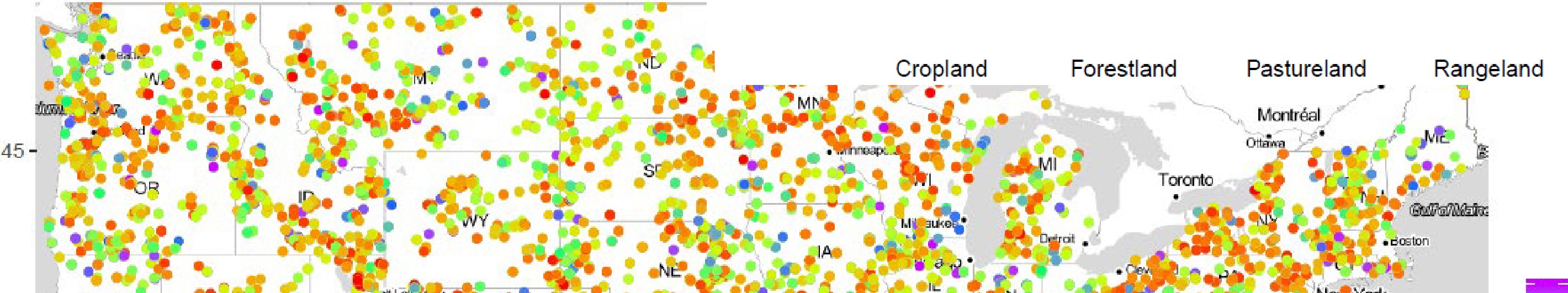
2.5

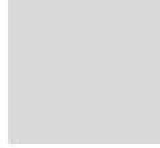
35 -

0

% Saturated

30 -



I

-120

I

- 110

Ion

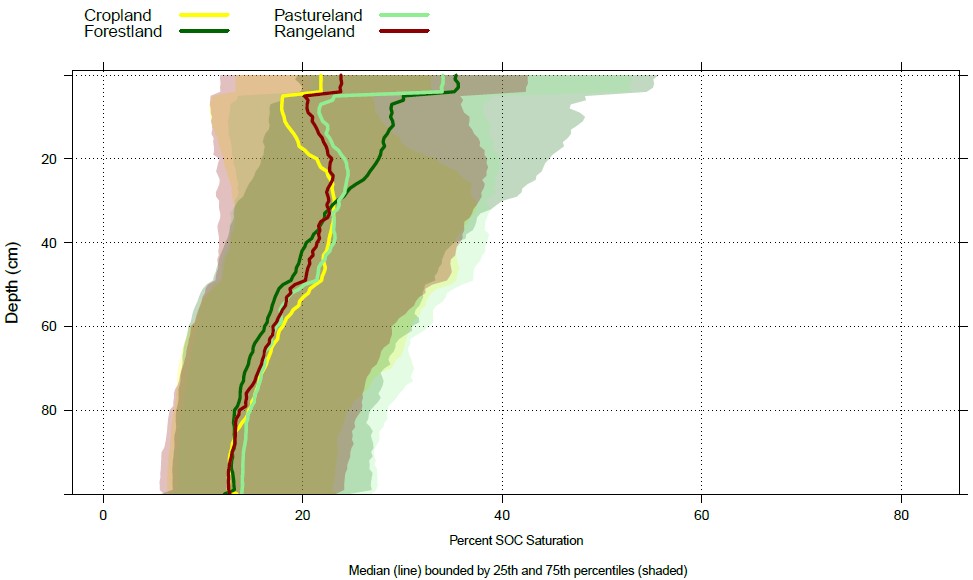
I

-90

I

-70

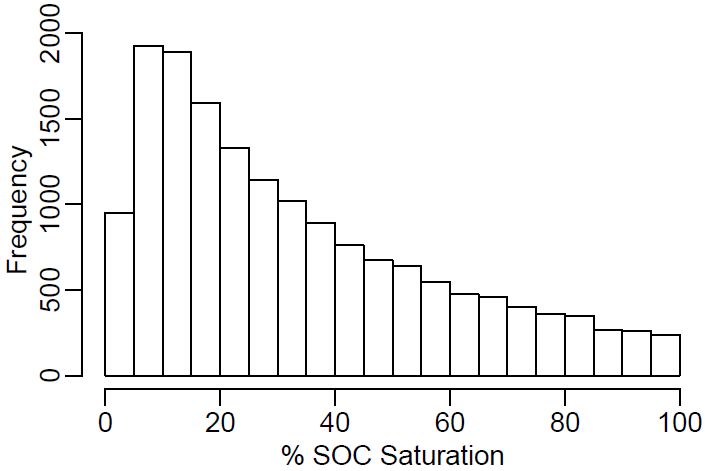
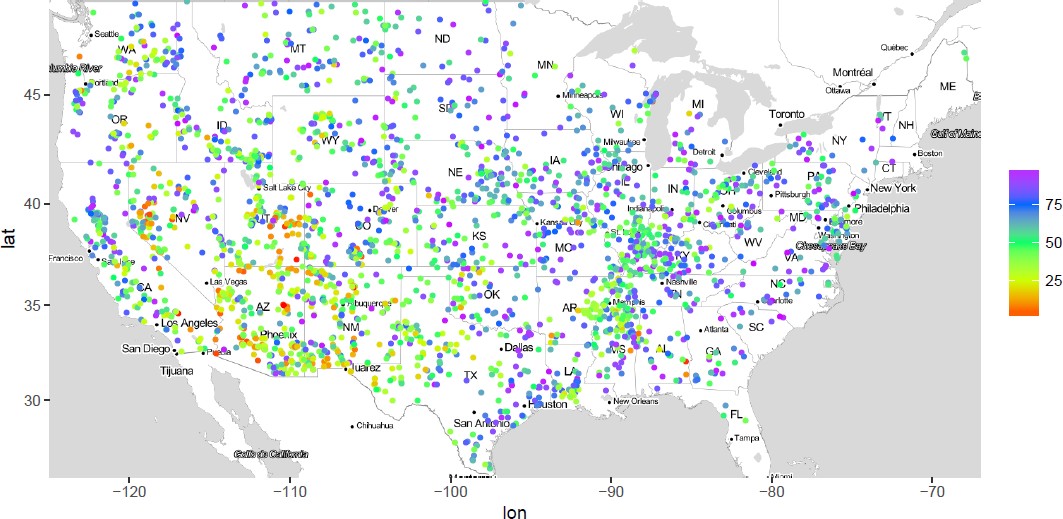
# Δ Native saturation similar among

Land uses at depth

## δ MA SOC

saturation of 0-5 cm

79% have less SOC than mineral associated model



% Saturated

SOC deficit (saturated and unsat)

100

% variance explained

80

60

40

20

0

SOC SOC saturation SOC unsaturated

intersite Land use Soil group Region

variation in the SOC unsaturated

100

% variance explained

80

60

40

20

0

SOC SOC saturation SOC unsaturated

intersite Land use Soil group Region

Sink SOC potential by Land Use

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Depth | LU | km2 | SOC PgC | δ MA (Pg C) | Δnative (Pg C) |
| 5 cm | Cropland | 1235982 | 1.4 | 0.5 | 1.1 |
|  | Forest | 1608849 | 5.6 | 0.4 | 3.9 |
|  | Pasture | 526025 | 1.0 | 0.3 | 0.7 |
|  | Rangeland | 2269444 | 2.1 | 1.1 | 1.7 |
|  |  |  |  |  |  |
| 30 cm | Cropland | 1235982 | 6.6 |  | 5.1 |
|  | Forest | 1608849 | 13.5 |  | 9.4 |
|  | Pasture | 526025 | 3.1 |  | 2.2 |
|  | Rangeland | 2269444 | 7.7 |  | 5.7 |

* RaCA database provides a wide scale snapshot of CONUS SOC to 1m of depth
  + Google it!
* Potential SOC sink in 0-5 cm of CONUS
  + 2.3 to 7.4 PgC
  + ~ 23% to 75% increase over current SOC pool
* Need to develop better generally applicable proxies for lower bounds of SOC sink
* All land uses in CONUS are potential sink!





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#### Patterns in soil organic carbon deficit across the Conterminous US

**Terry Loecke**, University of Kansas, Lawrence, KS, United States and Skye A. Wills, USDA NRCS National Soil Survey Center, Lincoln, NE, United States

#### Abstract Text:

Soil organic carbon (SOC) is integral to ecosystem stability, agricultural productivity, and climate regulation. The capacity of soils to stabilize additional SOC is highly uncertain, yet critical to understanding terrestrial ecosystem feedbacks to rising atmospheric carbon dioxide. Conceptually, the difference between a soil's capacity to sequester SOC (i.e., SOC saturation) and the current stock of SOC is the SOC deficit. To explore patterns in SOC deficit, we are using the newly collected, Rapid soil Carbon Assessment project (RaCA) database. The RaCA database contains more than 6000 pedons from the Conterminous US collected to 1 m of depth or more. Data for these pedons include SOC, soil inorganic C, total soil nitrogen, texture class, VNIR spectrum, and more, all of which are traceable and publically available from the USDA Natural Resources Conservation Service. The general goal of this paper is to test hypotheses about the roles of soil depth, land use and land cover, landscape position, and ecosystem type play in maximizing SOC content. We use existing methods to determine SOC saturation as related to soil texture classes, soil surface area, and statistical approaches. One specific goal is to determine the probability of SOC deficit in sequential soil horizons. For example, we test if SOC saturation is related to the saturation of proximal soil horizons and then explore land use and spatial patterns in the probability that SOC saturation is related to proximity.

Understanding patterns in SOC deficit may be valuable to modelling terrestrial C dynamics in the Anthropocene.

#### Session Selection:

Soil organic carbon: mechanisms of stabilization and change in the Anthropocene

#### Submitter's E-mail Address:

[loeckete@ku.edu](mailto:loeckete@ku.edu)

#### Abstract Title:

Patterns in soil organic carbon deficit across the Conterminous US

#### Requested Presentation Type:

Assigned by Program Committee (oral or Poster)

#### Previously Published?:

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Terry Loecke

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#### Affiliation(s):

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