Hydrologic Carbon Fluxes from the Dryland Grain Producing Region of the Inland Pacific Northwest: Measurements and Modeling.

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I. OVERVIEW:

Mitigation strategies to minimize the loss of soil carbon require a fundamental understanding of the dominant hydrologic flow paths which drive runoff generation, soil erosion, and ultimately the quantity and quality of carbon exported from a landscape. The variation in climate across the Inland Pacific Northwest has resulted in unique agroecosystems which, in turn, has affected the long term carbon storage and transport. Understanding the regional and local variability in hydrology as well as the trends in carbon export is an essential first step in the development of carbon budgets and full scale cropping models capable of evaluating precision-based carbon loss mitigation strategies.

II. OBJECTIVES:

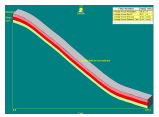
1. Determine the effects conventional and no-till management practices on dissolved organic carbon (DOC), particulate organic carbon (POC) loads.
2. Investigate statistical relationships between DOC, POC, surface runoff, and suspended sediment concentrations (SSC) using historic regional sampling data and high frequency sampling data.
3. Investigate spatial trends in delivered DOC, POC and SSC at 3 scales (~10 ha, ~2000 ha, ~650,000 ha) and temporal trends at the Palouse River near Hooper, WA.
4. Assess the accuracy of the Water Erosion Prediction Project (WEPP) model to predict sediment yield and carbon load from ~10 ha conventional and no-till catchments.

III. METHODS:

Monitoring

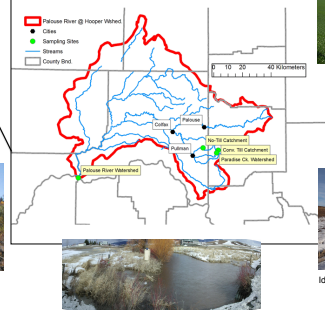
- **15 min surface runoff measurements**
- **Event-based water sampling for TOC, DOC, POC and SSC**
- **Incorporating recent data with historic data for the Palouse River at Hooper.**

Modeling



- **The Watershed Erosion Prediction Project (WEPP) was used to predict runoff and sediment yield**
- **POC loads simulated using POC/SSC relationships**

IV. STUDY SITES:



Cook Farm (CAF NT) 11 Ha no-till site

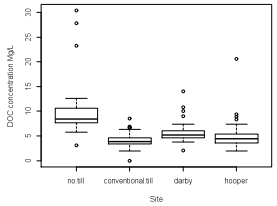
Palouse River at Hooper, WA 650,000 Ha site.

Paradise Creek (Darby) ~2000 Ha site

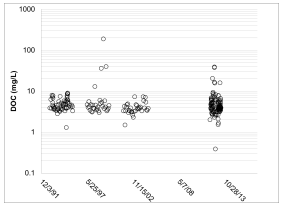
Idaho 14 Ha conventional till site

V. MONITORING:

DOC Concentrations Across Spatial Scales

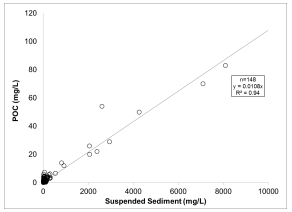


DOC Concentrations at the outlet of the Palouse Basin at Hooper , WA

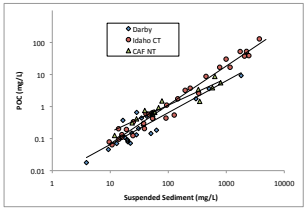


- Dissolved Organic Carbon measurements ranged from **2 – 8 mg/L** and **3-12 mg/L** for the conventional till and no till sites, respectively.
- Statistically significant differences in DOC concentrations exist between the no-till site and all other sampling sites as well as between the conventional tillage and Paradise Creek sites.
- Slight increases in DOC concentrations are seen at the outlet of the Palouse Basin at Hooper, WA.

POC and SSC Relationships for the outlet of the Palouse Basin at Hooper, WA

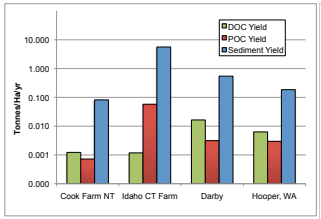


POC and SSC Relationships for Darby, Cook Farm and the Idaho Conventional till site

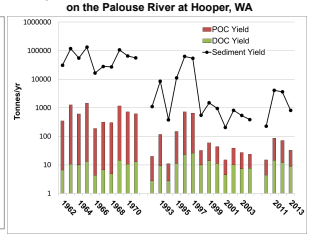


- Good relationships between POC and SSC were found for each of the study sites, Darby R^2=0.84, Idaho CT R^2=0.96, CAF NT R^2=0.91.

Sediment, DOC and POC Loads from all Monitoring Sites



Temporal Trends in Sediment, DOC, and POC Loads on the Palouse River at Hooper, WA

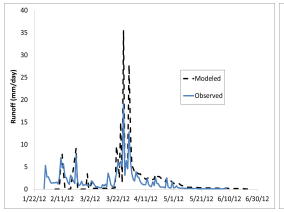


- A significant decrease in sediment and total carbon loads since the 1960s on the Palouse River at Hooper, WA.
- Over the last 50 years the Palouse river has transitioned from a system where total carbon was delivered primarily as POC to a system where total carbon is delivered primarily as DOC.
- This transition is attributed to increased adoption of conservation tillage practices in the region over this time period.

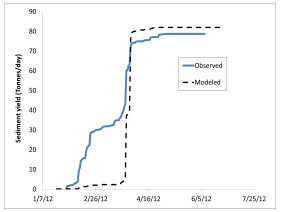
VI. MODELING:

The Watershed Erosion Prediction Project (WEPP) model simulates detachment, transport, and deposition within a hillslope. The model was assessed using continuous runoff and event based suspended sediment concentration (SSC).

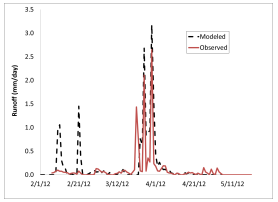
Daily Runoff Observed and Modeled for the Conventional Till Site



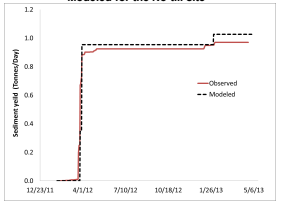
Cumulative Sediment Yield Observed and modeled for the Conventional till site



Daily Runoff Observed and Modeled for the No-Till Site



Cumulative Sediment Yield Observed and Modeled for the No-till site



- WEPP simulated **0.009±0.001** and **1.1±0.02** tonnes of POC from the no-till and conventional till sites respectively.

VII. SUMMARY:

- DOC concentrations from the no-till catchment were two times larger than from the conventional till site suggesting DOC will increases as more no-till practices are adopted in the region.
- SSC and POC concentrations were highly correlated.
- 63% of the total carbon loss from the no-till catchment was delivered as DOC.
- DOC concentrations at the basin scale are similar to those from the conventional tillage site and seem to remain relatively stable over time.
- Observed data indicate a 95% decrease in sediment and an 82% reduction in carbon load at Hooper, WA since the 1960s .
- During the 1960s only 12% of the total carbon load was delivered as DOC; currently 83% of the total carbon delivered from the basin is transported as DOC
- This assessment suggests that the WEPP model can provide the fine-scale resolution modeling to assess the impacts of management practices on field scale POC and sediment load.

VIII. FUTURE WORK:

- Statistical relationships between POC/SSC/SOC as well as temporal trends in DOC will be utilized in conjunction with WEPP determine changes in total organic carbon loads with future climate projections.
- Extensive regional sampling data will be analyzed to establish linkages between soil organic matter and delivered soil carbon.
- A carbon export component will be incorporated into the existing Hydrologic Characterization Tool (Brooks et al)

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