Always follow the Water

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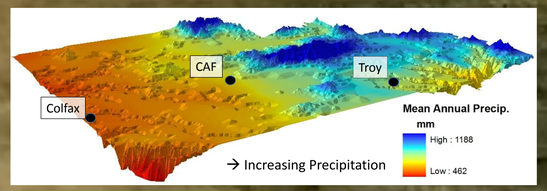
Hydrologic Research in the Annual Cropping Region

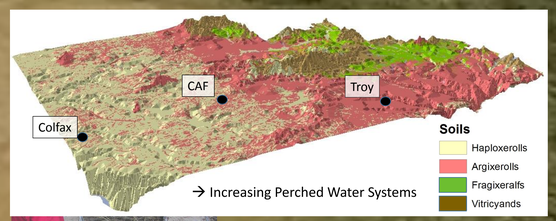
The storage of seasonal rainfall in healthy soils is essential for cereal production in the Annual Cropping AEC. Over winter precipitation is typically large enough to fill the soil profile each year and therefore summer fallow is not practiced in this region.

The challenges in water management in the high precipitation zone can often be managing excess water in the spring, minimizing spring nitrogen losses through runoff and deep drainage, and developing appropriate prescribed fertilizer rates which optimize profit.

Over the last five years we have been monitoring soil water and nitrogen storage and transport from and within 5 field catchments distributed across a large climate gradient in the region. This work was funded USDA funding through the ***Site-specific Climate Friendly Farming (SCF) Project***, the ***Regional Approaches to Climate Change (REACCH) Project***, as well as funding through the USDA-ARS ***Long Term Agroecological Research (LTAR)*** monitoring network.

Regional Variability in Soils and Climate





Soils in the eastern region contain extensive hydrologically restrictive Argillic Soil Horizons

Cook Agronomy Farm Hydrologic Monitoring (Tier I)

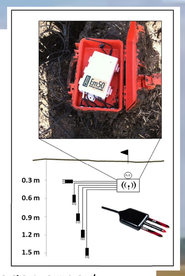
42 Soil Moisture Monitoring Points (Gasch, 2016)

- ECH20 and 5TE Sensors Decagon Devices Inc. Pullman, WA
- Hourly soil moisture temperature, EC monitored every 1 ft down to 5 ft since 2007
- Data Loggers buried 4-6 inches below soil surface in water proof pelican boxes
- Wireless download to a receiver unit
- Data publicly available (Gasch et al. 2016)

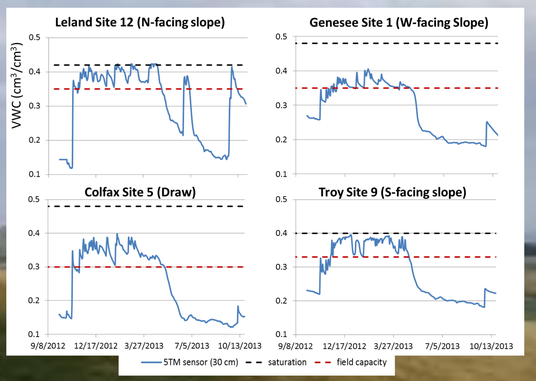
Subsurface water flux through artificial drainage lines (Kelley et al. 2016)

- Flow and concentration monitoring since 2001
- 15 kg/ha (13 lb/ac) N lost through artificial drain each year. (15% of the applied rate)
- 1/3rd reduction in fertilizer rates since 2010 did not result in decreased declines in nitrogen export
- Evidence of significant preferential flow of surface water through the subsurface.

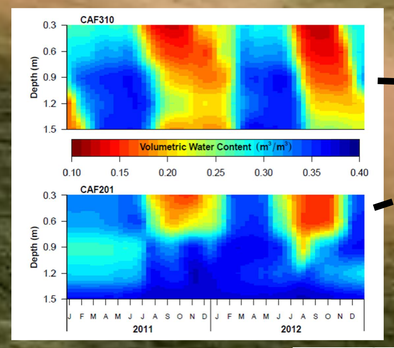
Surface Runoff with Parshall Flume, deep leaching with passive capillary drain gauge

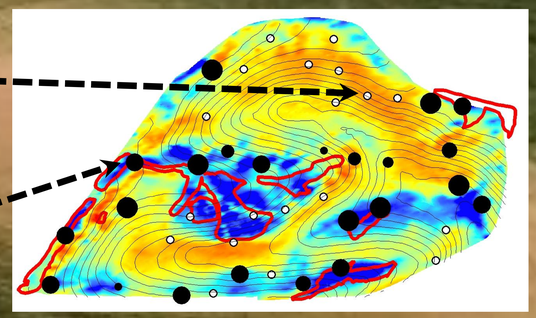


Soil profiles are completely saturated multiple times leading to surface runoff in Leland and Troy whereas soil moisture in Colfax and Genesee remains near field capacity most of winter



Soil water content varies substantially across the CAF. Sensors indicate 40% of the watershed has high soil moisture conditions ranging from 1 to 180 days per year.





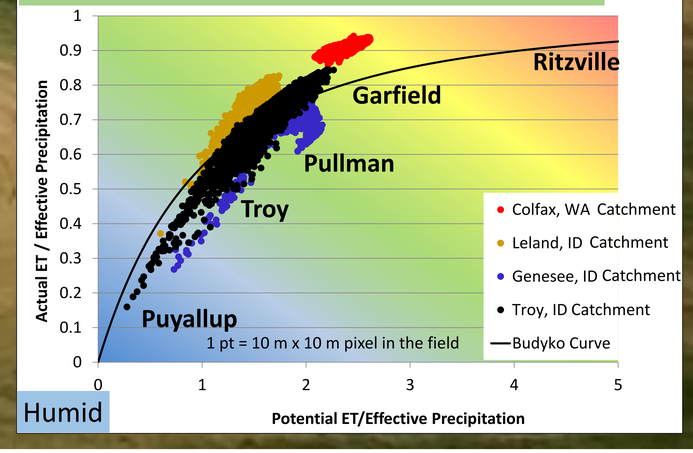
Large variability in the total water balance across the annual cropping region

Location	Precip. (inches)	Runoff (inches)	Percolation (inches)	Drainage (inches)	ET (inches)	Total excess water (inches)	Water Storage Capacity (inches)	Water Use Efficiency
Colfax	16.5	0.0	1.5	0.0	15.0	1.5	9.4	91%
CAF**	18.2	0.1	----	4.4	13.8	4.5	6.3	76%
Genesee	19.8	0.1	5.4	1.1	14.1	5.7	8	71%
Troy	21.7	4.3	2.5	0.0	14.4	7.3	5.6	66%
Leland	22.8	1.9	4.4	0.0	16.6	6.2	6.6	73%

Budyko Curve Analysis

Using simulated ET and effective precipitation (precip. + lateral redistribution), each Tier II field site was broken down into unique agroecosystems following a modified Budyko Approach (Budyko, 1974) for 2012-2014 years

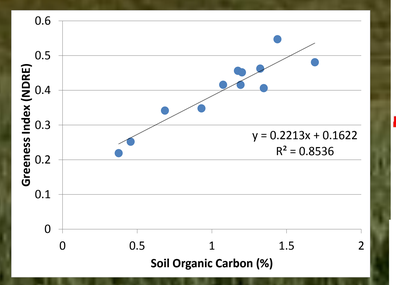
The redistribution of water at the Troy catchment creates an environment similar to that found in the western coastal climates



Tier II SCF Field Sites

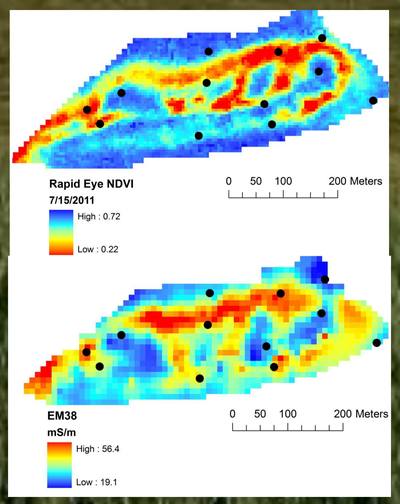
Colfax

Crop response in the western drier region is closely linked to variability soil properties (e.g. soil organic carbon)



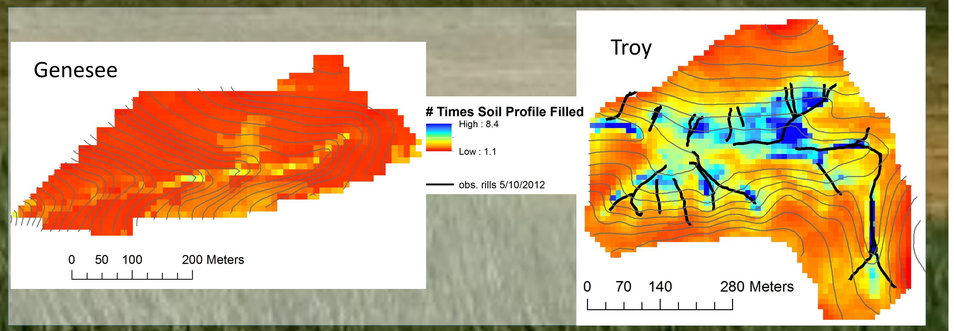
Genesee

Soil EC measurements closely correlate to crop response in Genesee



Troy

- High over-winter runoff and leaching losses in the eastern edge of the region.
- Lateral downslope redistribution of water leads to prolonged periods of saturation
- In some convergent regions there is enough water to fill the soil profile multiple times (up to 8 times per year)



Leland

Summary of Hydrologic Variability across the Region

- Large regional variability in excess water
- The redistribution of water at the field scale effectively creates unique agroecosystems ranging from humid to arid

Management Implications:

- Over winter loss and redistribution of water and nitrogen occurs across the high precipitation zone.
- To minimize over-winter nitrogen loss consider decreased fall application of fertilizer and/or potentially using nitrogen release inhibitors
- Tile lines installed in wet regions of the field to facilitate drainage can result in 10-30% losses in nitrogen.
- Modelling studies suggest redistribution of nitrogen to toe slope positions occurs (Zhang *et al.*, 2011) and perhaps should be accounted for in developing variable rate prescription fertilizer maps.

"Site-specific Climate-friendly Farming (SCF)" (award #2011-67003-30341) and *"Regional Approaches to Climate Change (REACCH)"* (award #2011-68002-30191) are funded through the USDA-National Institute for Food and Agriculture.