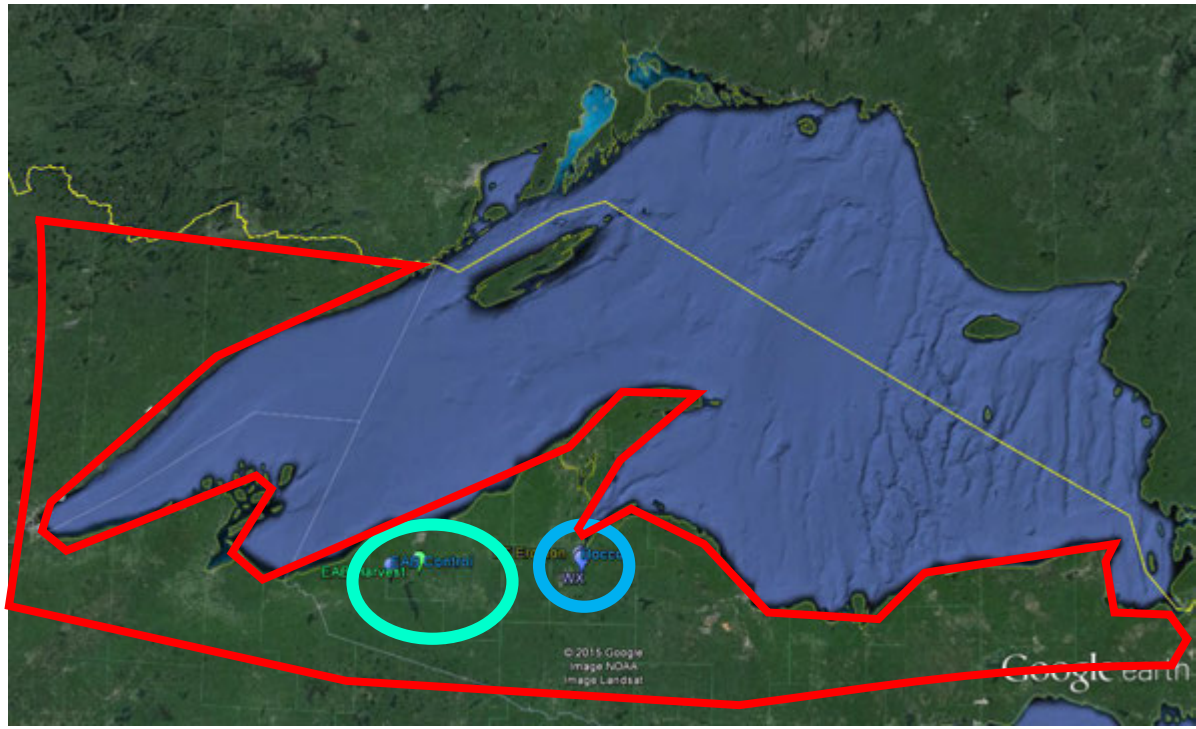
Applied watershed hydrology in the Superior Basin

- **Simulated effects of emerald ash borer**
- **Upland hydrology**
- **Impacts from forest management activities**
- **Climate effects on inland lake physical properties**



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Simulated effects of emerald ash borer 2011-present

- Three treatments:
  - Control, Girdled, Ash-cut
  - Simulate stages of infestation
- Replicated small watersheds (~0.5-3 ac): hydrologic, nitrogen, and carbon responses
- Paired watersheds: hydrologic, nitrogen, and carbon responses
- 3 separate planting sites
- GLRI funded through US Forest Service

Team: Nick Bolton, Matt VanGrinsven, Josh Davis, Joe Shannon, Tom Pypker (TRU), Randy Kolka (USFS), Stephen Sebestyan (USFS)

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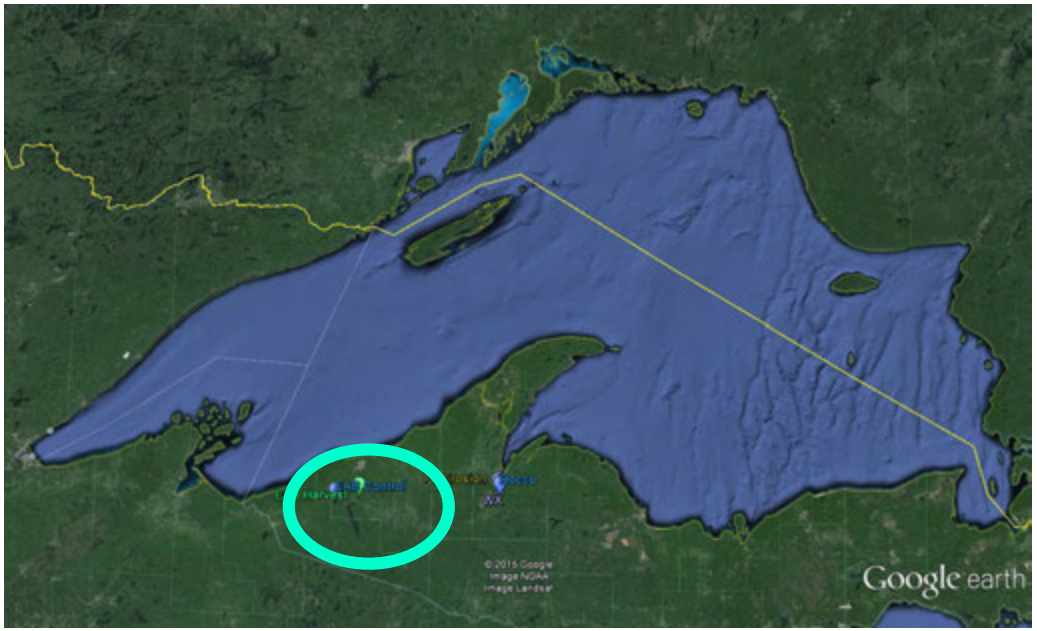
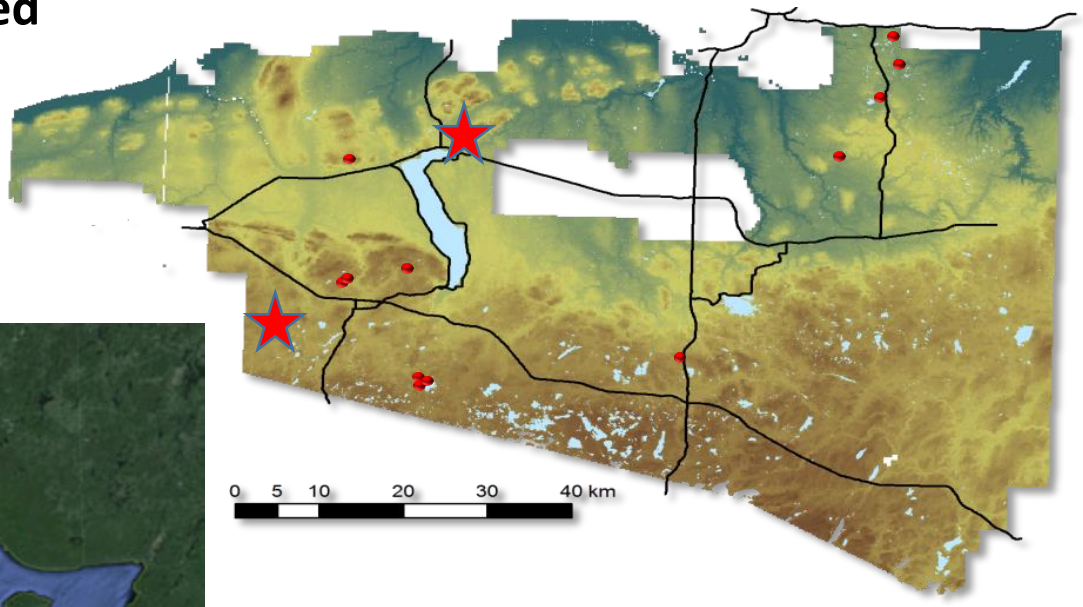
Simulated effects of emerald ash borer Sites

- **Black ash (Fraxinus nigra) dominated wetlands**
- **Woody peat histosols**
- **Annual precip. ~900 mm**





Paired watershed

Replicated site or planting site

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Simulated effects of emerald ash borer Measurements

Replicated sites:

- **Pre- treatment: 2012**
- **Post-treatment: 2013-2014**
  - **Some through 2017+**
- **Precipitation (gross and throughfall)**
- **Water table depth**
- **Sapflux (transpiration) (exc. ash-cut)**
- **Soil CO_2 and CH_4 emissions**
- **Stem CO_2 and CH_4 emissions (controls only)**
- **N fluxes via litter, stemflow, and throughfall**
- **Source water analysis: Isotopic analysis of throughfall, snow, soil water, groundwater**
- **Air and soil temperature**

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Simulated effects of emerald ash borer Measurements

Paired watersheds: stream water, carbon, and nitrogen fluxes

- **Pre-treatment 2013-2014**
- **Post-treatment 2015-2017+**
- **Precipitation (gross and throughfall)**
- **Water table depth**
- **Discharge**
- **Surface and pore water**
  - **DOC and DOM**
  - **TDN, Nitrate and ammonium**

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Upland hydrology on Ford Forest 2013-present

- **Research-grade weather station**
- **Stream flow monitoring in 1st and 2nd order streams (intermittent)**

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Upland hydrology on Ford Forest Weather station

Aug 2014-present

- **Precipitation**
- **Incoming and outgoing shortwave and longwave radiation; PAR**
- **Wind speed and direction (10 ft)**
- **Air temp., humidity, pressure**
- **Soil temp. and moisture**
- **Remote camera: local conditions, phenology**
- **Expanding infrastructure in 2015**
  - **Snow depth**
  - **120 ft tower on local high point (Burton/NSF)**
    - **High elevation weather**
    - **Power, fiber optic, telemetry**

Team: GLRC, Andy Burton, Evan Kane, Amy Marcarelli, Robert Froese

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Upland hydrology on Ford Forest Stream Measurements

- **1st and 2nd order stream**
- **Intermittent measurements, 2014-present**
  - **Stream flow**
  - **Bedload and suspended sediment**
  - **Snow depth and SWE**
- **Expansions in 2015**
  - **Continuous streaflow and turbidity**
  - **Bedload and suspended sediment**
  - **Snow measurements**

Team: Wes Ellenwood, Kaitlin Reinl, Ali Dahlbacka, Ashlee Baker, Iskender Demirtaş

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Impacts from forest management activities Ford Forest, 2013-present

- **Sediment production from forest activities**
  - **Control, skid trail, forest road**
- **9 sediment fences**
- **Throughfall & ground cover**

Team: Jarrod Nelson, Wes Ellenwood, Kaitlin Reinl, Ali Dahlbacka, Ashlee Baker, Iskender Demirtaş

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Impacts from forest management activities Ford Forest, 2015-2016

Snow roads have potential to reduce impacts of forest access on soil water resources

- **Test impacts of snow roads on soils:**
  - **Bulk density, temperature, moisture, infiltration**
  - **Traffic passability**
  - **Snow melt rate**
  - **Vegetation cover**

Team: Liz Ernst, Evan Kane, Russ Alger, Deb Dumroese (USFS), Jim Schmierer

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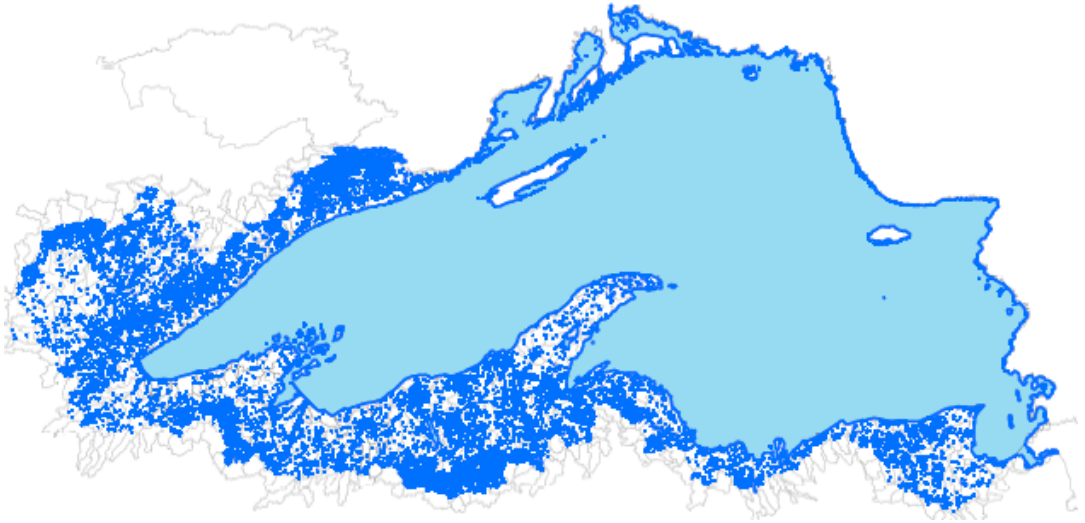
Climate effects on inland lake physical properties

- **Modeling impact of climate change on inland lake temperature profiles**
- **Will assess inland lakes in the Superior Basin**



Team: Kaitlin Reinl, Noel Urban