

Building Federal-Tribal Partnerships through Monitoring Air Quality & Atmospheric Deposition



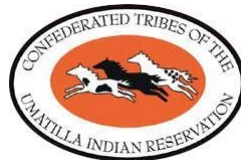
Kickapoo Nation students learning about CASTNET monitoring at KIC003

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Acknowledgements

- **Tribal Partners/Site Operators** – Alabama-Coushatta Tribe of Texas; Cherokee Nation; Confederated Tribes of the Umatilla Indian Reservation; Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas; Nez Perce Tribe; Red Lake Band of Chippewa Indians, Minnesota; Santee Sioux Nation, Nebraska
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- **National Atmospheric Deposition Program** – David Gay, Richard Tanabe
- **U.S. EPA, Office of Air and Radiation** - Greg Beachley, Pat Childers, Rick Haeuber, Julia Hathaway, Kevin Hollerbach, Jason Lynch, Tim Sharac



wood.



Outline

- Tribal air quality priorities
- CASTNET and NADP overview
- CASTNET monitoring on tribal lands
- Partnership benefits
- Critical loads
- Near-term plans



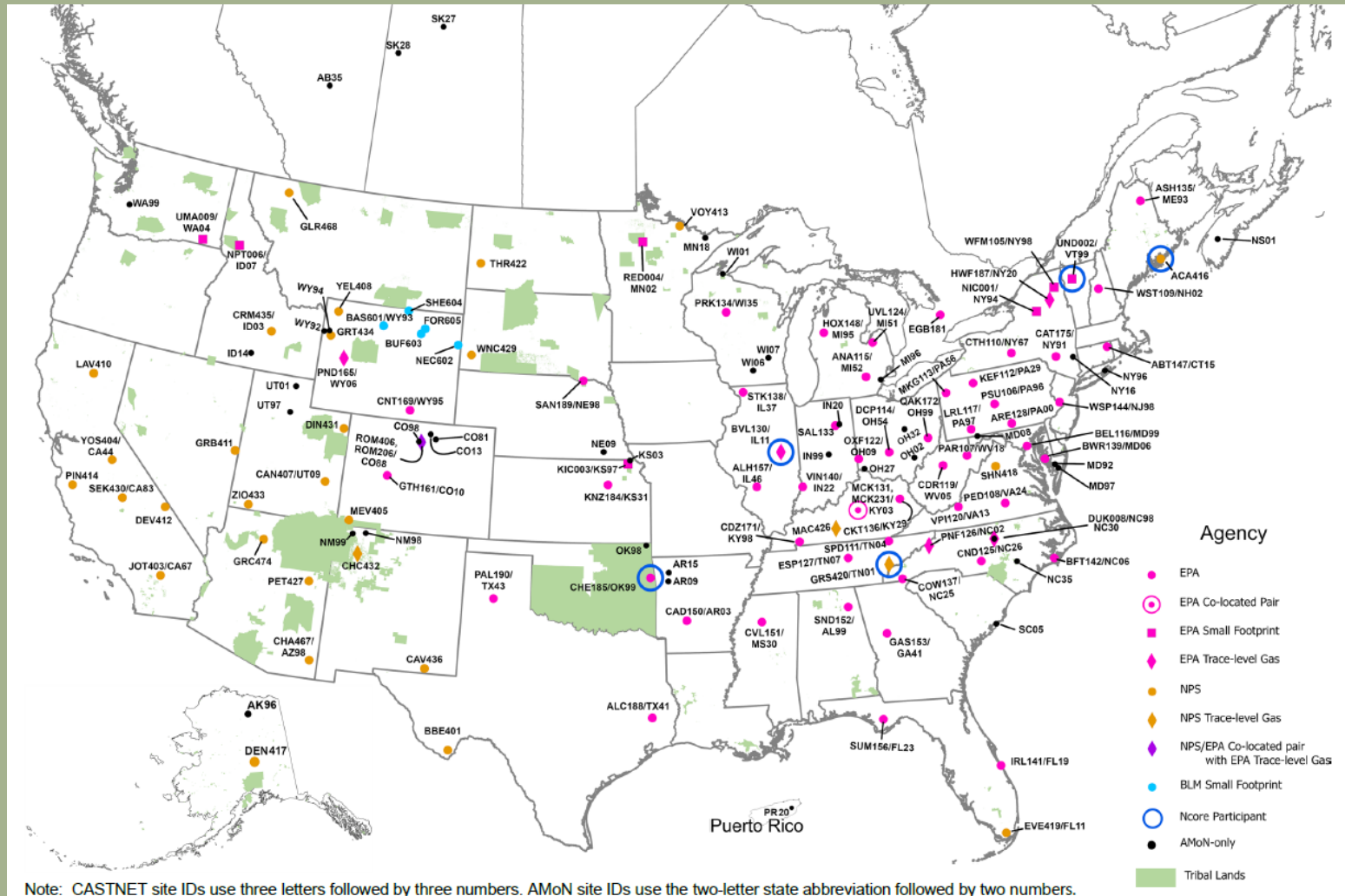
Tribal air quality priorities 2022

NTAA Baseline Needs Assessment (BNA)

- ***Wildfire smoke is an emerging concern, but long-standing air quality issues continue to impact Tribes, including but not limited to road dust, diesel emissions, woodsmoke, and air toxics***
 - Road dust most pervasive air quality issue (80% of Tribes responding to the BNA)
 - Particulate matter (PM) from wildfire smoke is a priority concern (62% of Tribes reporting that wildfire smoke has impacted their community)
 - Other PM sources: diesel emissions reported by 63% of Tribes and residential wood-burning (54%)
 - Air toxics, such as mercury
- ***82% of Tribes responding to the BNA view addressing GHG that impact climate change a high or medium priority***
 - Atmospheric warming associated with climate change has the potential to increase ground-level ozone in many regions, which may present challenges for compliance with the ozone standards in the future

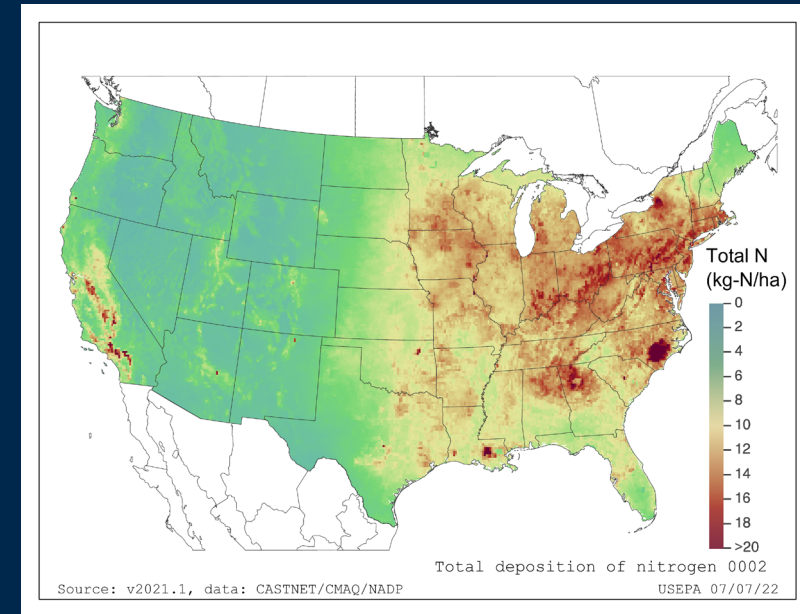
Clean Air Status & Trends Network (CASTNET) Overview

- 100 monitoring sites sponsored by EPA, NPS, BLM-WY
- Ambient concentrations and estimates of dry deposition
- Sites in rural, regionally representative locations away from emissions sources
- Most sites co-located with NADP/NTN sites to provide wet deposition data. CASTNET reports dry and total deposition (wet + dry) fluxes
- Ambient data, quality assurance data and documentation posted routinely to EPA's public website

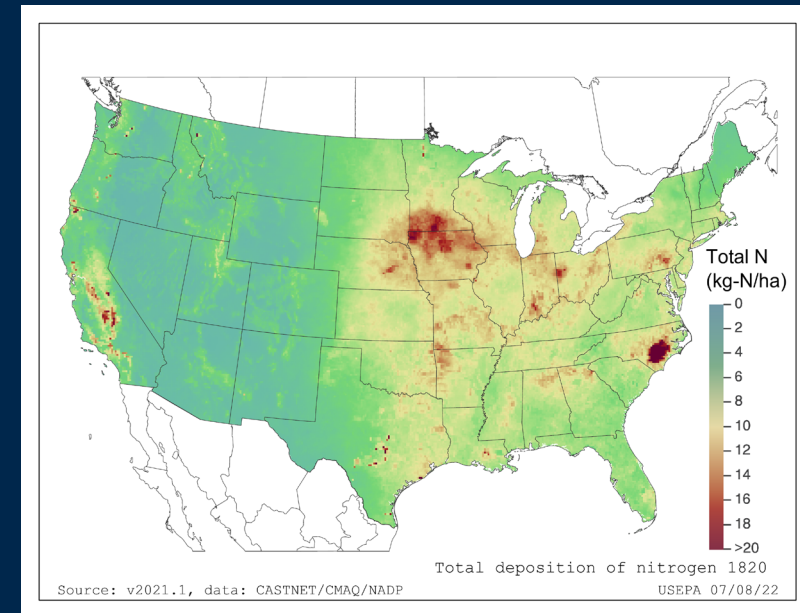


CASTNET measurements

- Each site measures weekly concentrations of SO_2 , SO_4^{2-} , NO_3^- , NH_4^+ , HNO_3 , Cl^- and base cations
 - 3-stage filter pack located on a 10-m tower
 - Filterpacks are prepared, shipped and analyzed at a central laboratory
- Most sites measure hourly O_3 . Ozone data are compared to the NAAQS (70 ppb)
- 8 sites measure trace-gas hourly concentrations
- Only U.S. network providing dry and total deposition (wet + dry) data
- Dry deposition is estimated by $F = \text{CASTNET concentrations} * \text{CMAQ deposition velocities}$

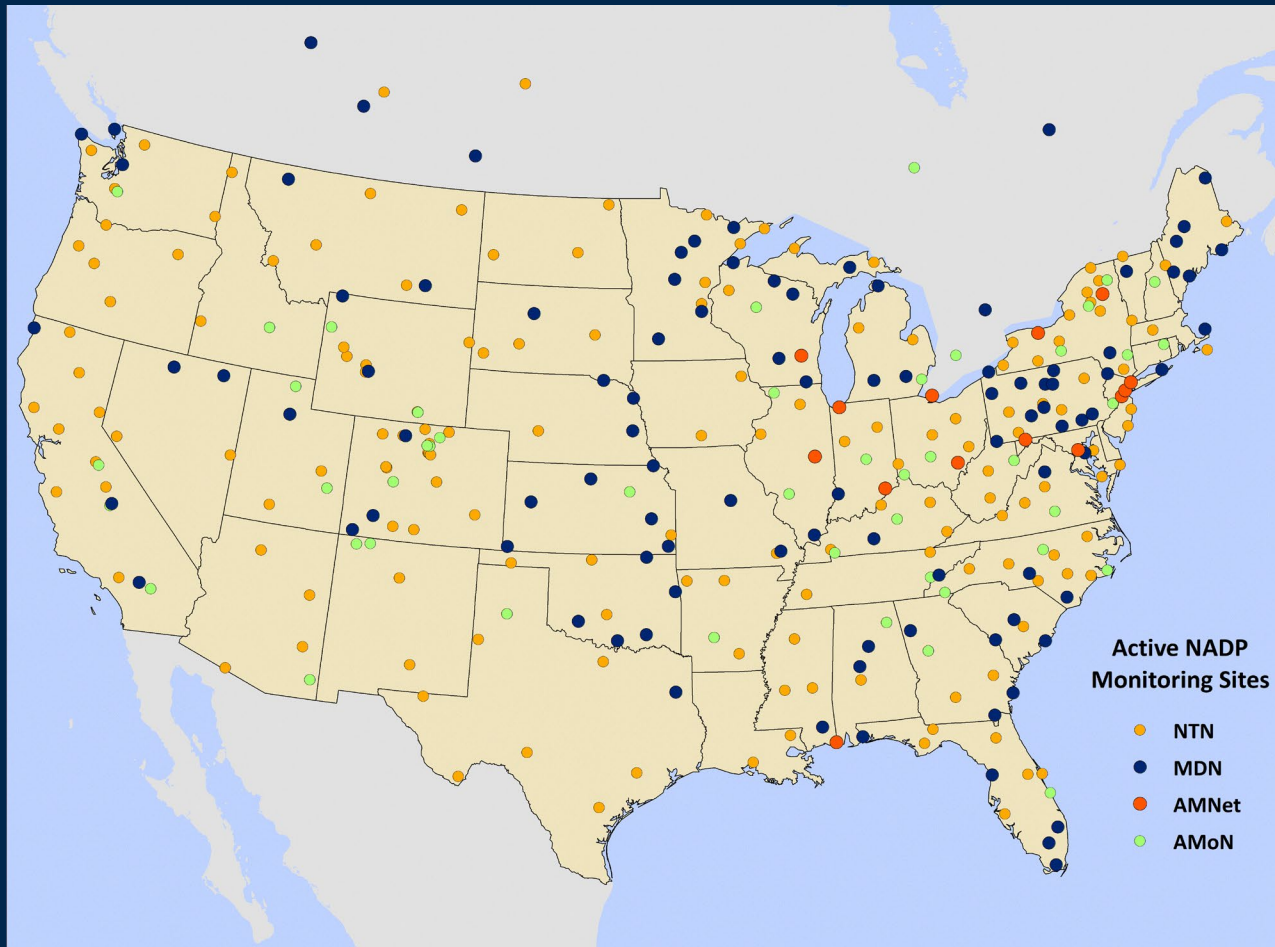


Total Nitrogen Deposition, 2000-2002



Total Nitrogen Deposition, 2018-2020

National Atmospheric Deposition Program (NADP) active sites in 2020

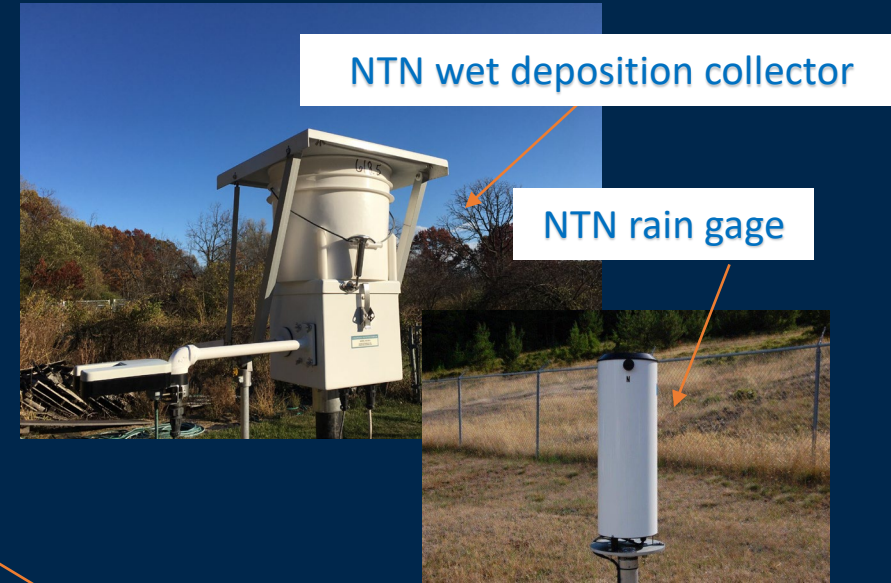


Network	Measurements	Parameters	Period	No. of sites
NTN	12,805	H ⁺ as pH, Ca ²⁺ , Mg ²⁺ , Na ⁺ , K ⁺ , SO ₄ ²⁻ , NO ₃ ⁻ , Cl ⁻ , NH ₄ ⁺ in precip.	weekly	260
MDN	4,121	Total Hg in precip.	weekly	80
AMNET	37,765	GOM, GEM, PBM in atmos.	Hourly/ 2-hourly	10
AMON	3,756	NH ₃ in atmos.	Two week	115

Note: The NADP approved the Mercury Litterfall Network in 2021 (not shown).

National Atmospheric Deposition Program

- Long-term precipitation monitoring network (National Trends Network)
 - Co-located at nearly every CASTNET site
 - Sampling began in 1978
- Ammonia Monitoring Network (AMoN)
 - Passive samplers require no electricity
 - 2-week samples
 - Sampling began in 2007
- Mercury Deposition Network (MDN)
- Atmospheric Mercury Network (AMNet)
- Mercury Litterfall Network (MLN)



AMoN ammonia sampler



MDN wet deposition collector

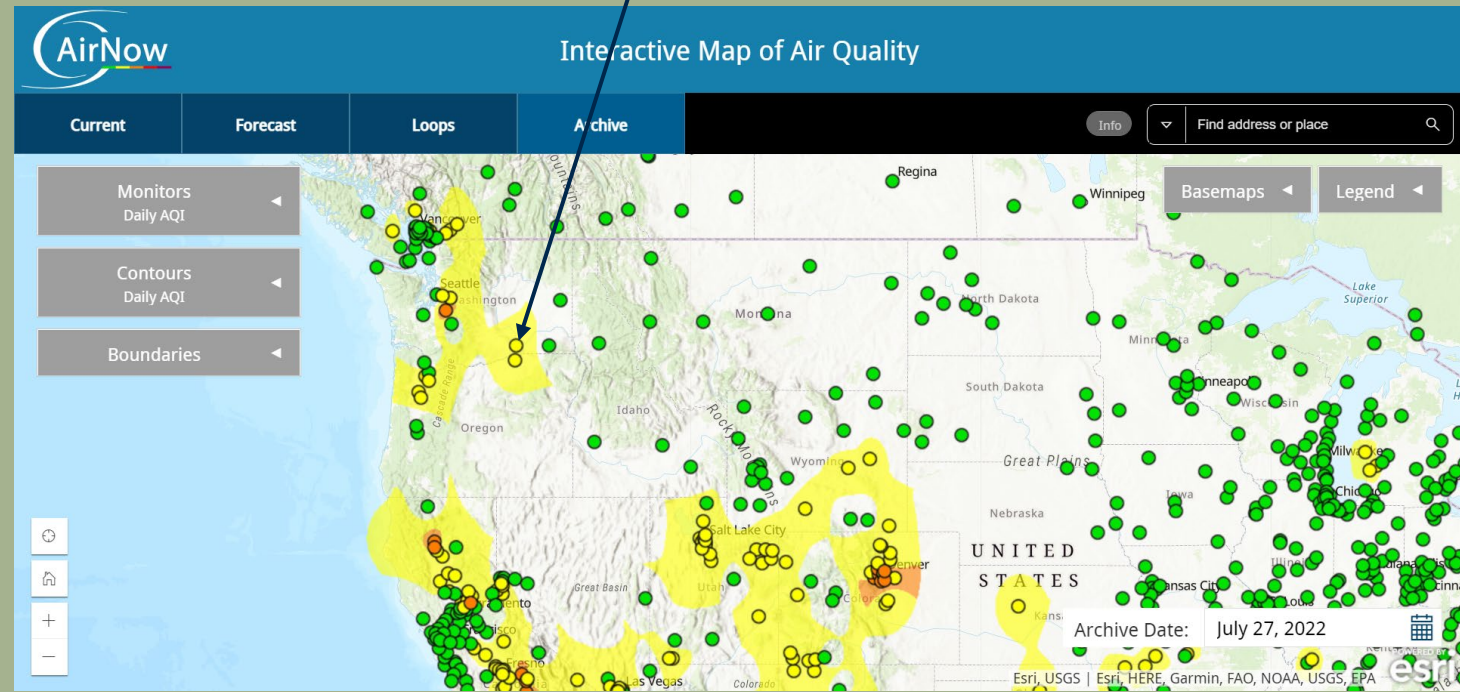
AMNet atmospheric mercury speciation system



Rural monitoring networks

- Real-time data allows public to make decisions about daily activities based on their health risks
- Fills spatial gaps in primarily urban/population-based networks (e.g., SLAMS, Ncore)
- Long-term records to detect trends
- Consistent measurements that are comparable from year to year
- Comprehensive QA
- Regionally representative

Umatilla ozone concentration is below the NAAQS on July 27th but nearby AQI is moderate



CASTNET ozone data are reported to AirNow in near real-time. AirNow provides maps showing current monitors and the calculated Air Quality Index (AQI) using contours

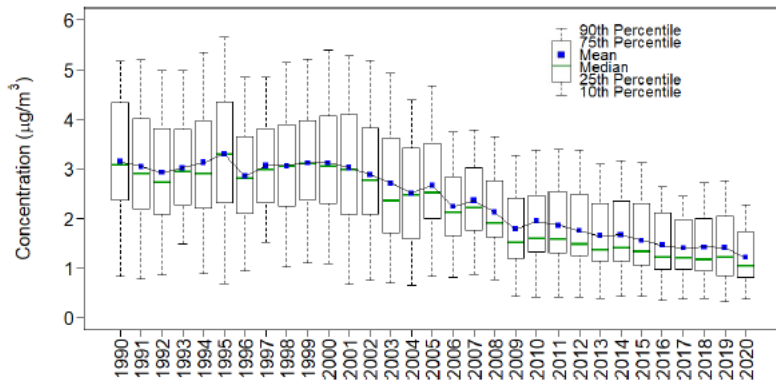
Location matters

Rural locations provide representative data



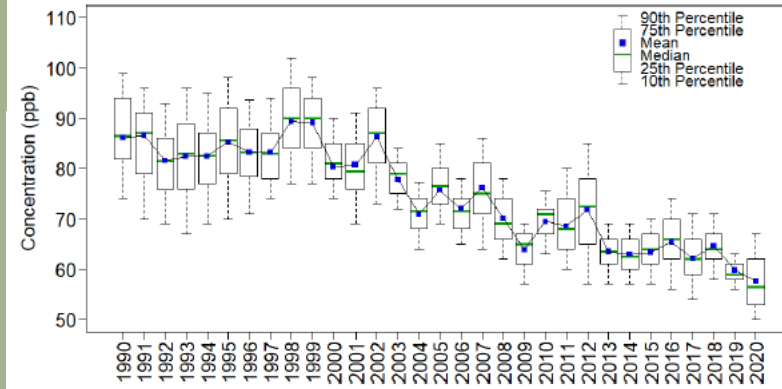
- Unaffected by local sources
- Minimized variability
- Specific siting criteria

CASTNET regional air quality trends



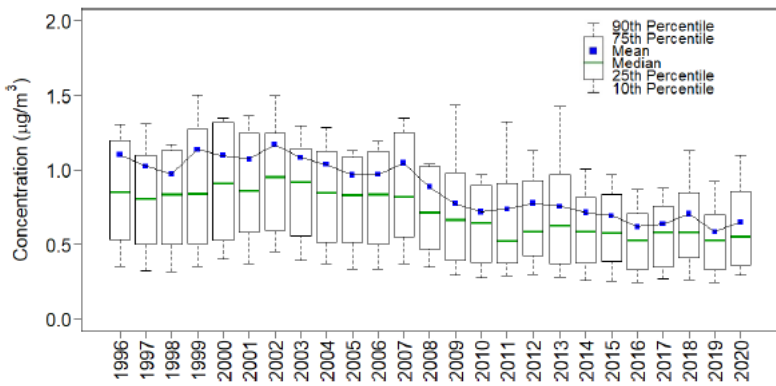
Eastern Reference Sites

Annual mean total NO₃ concentrations (1990-2020)



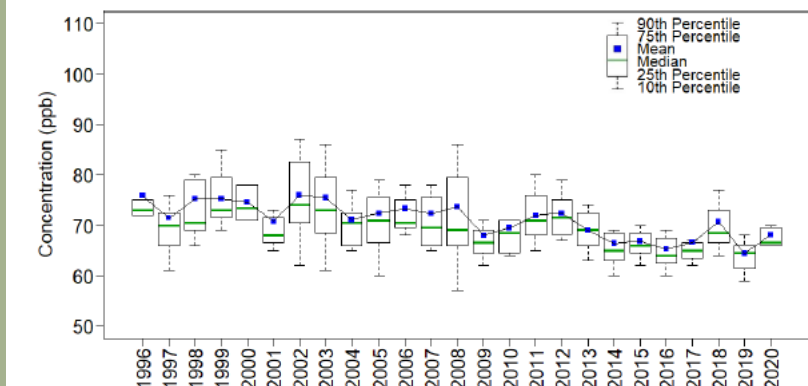
Eastern Reference Sites

Trends in fourth highest DM8A O₃ concentrations (1990-2020)



Western Reference Sites

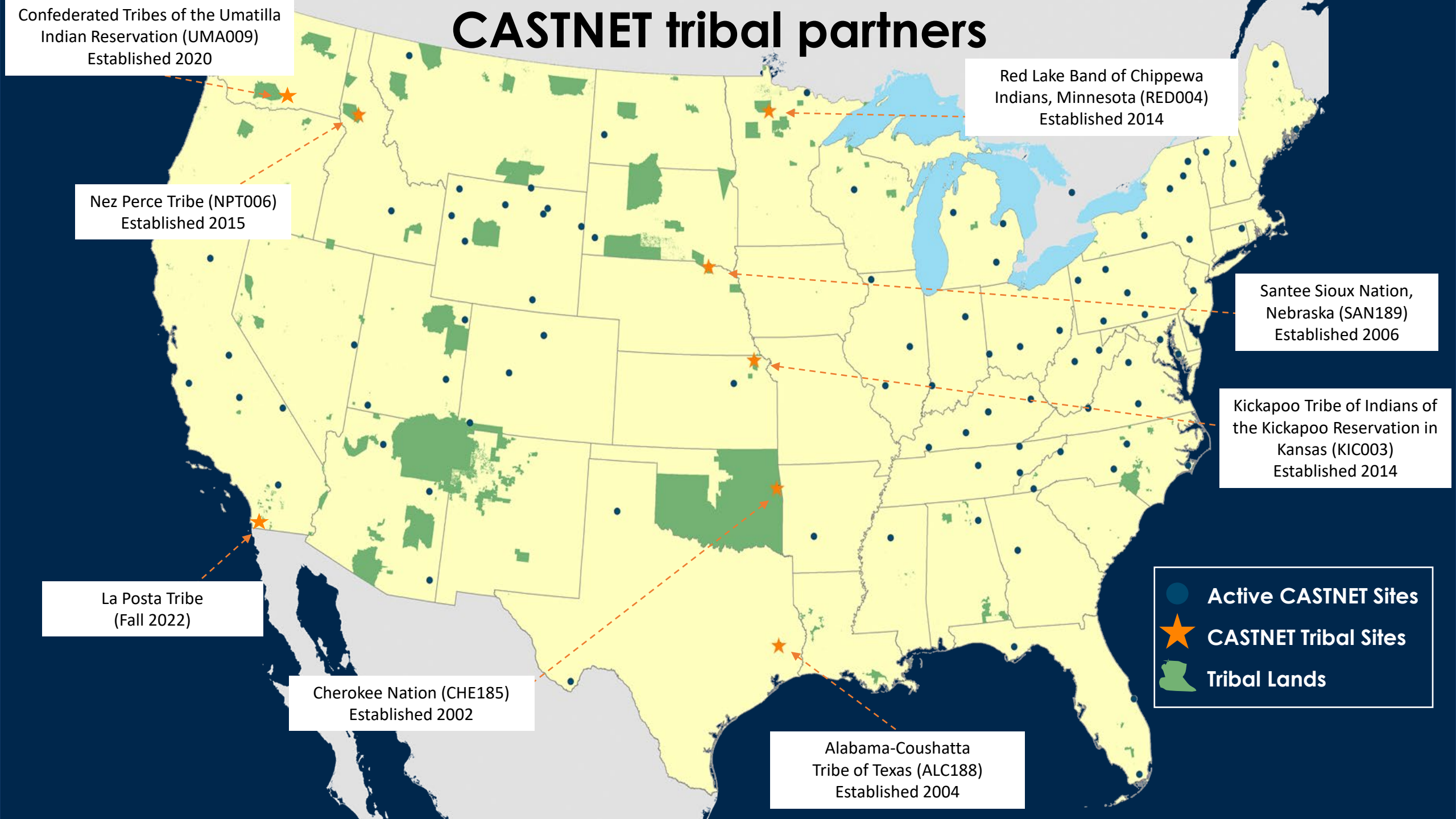
Annual mean total NO₃ concentrations (1996-2020)



Western Reference Sites

Trends in fourth highest DM8A O₃ concentrations (1996-2020)

CASTNET tribal partners



Confederated Tribes of the Umatilla
Indian Reservation (UMA009)
Established 2020

Nez Perce Tribe (NPT006)
Established 2015

La Posta Tribe
(Fall 2022)

Cherokee Nation (CHE185)
Established 2002

Alabama-Coushatta
Tribe of Texas (ALC188)
Established 2004

Red Lake Band of Chippewa
Indians, Minnesota (RED004)
Established 2014

Santee Sioux Nation,
Nebraska (SAN189)
Established 2006

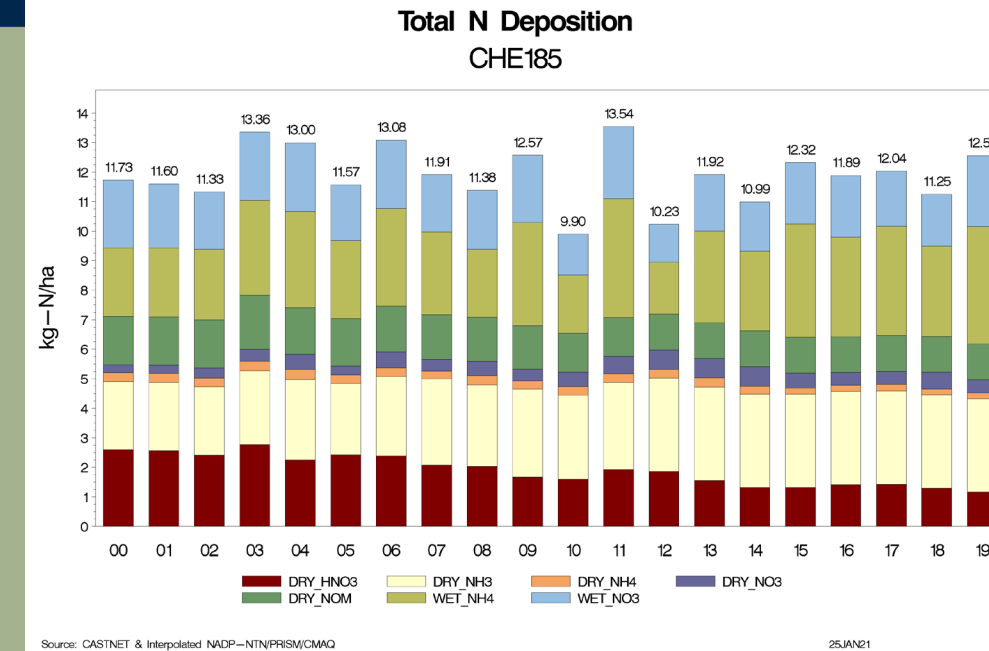
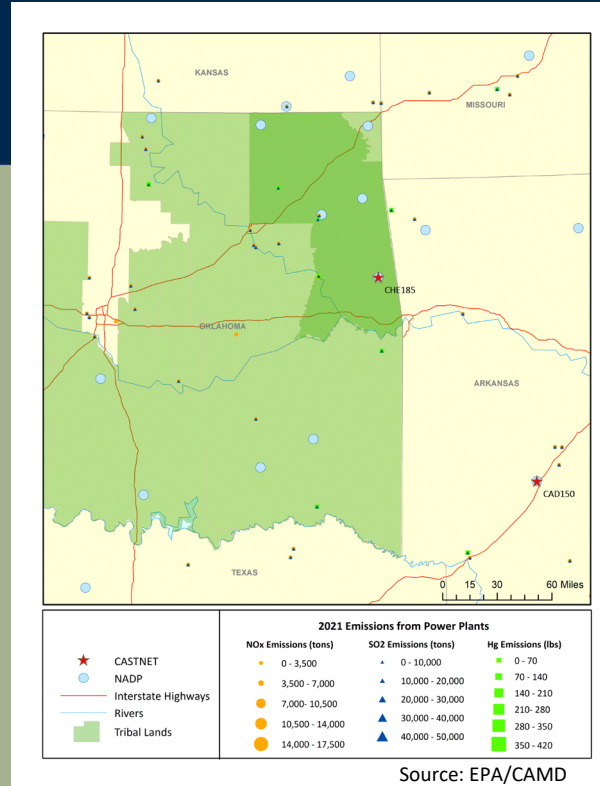
Kickapoo Tribe of Indians of
the Kickapoo Reservation in
Kansas (KIC003)
Established 2014

- Active CASTNET Sites
- ★ CASTNET Tribal Sites
- ▭ Tribal Lands



Cherokee Nation

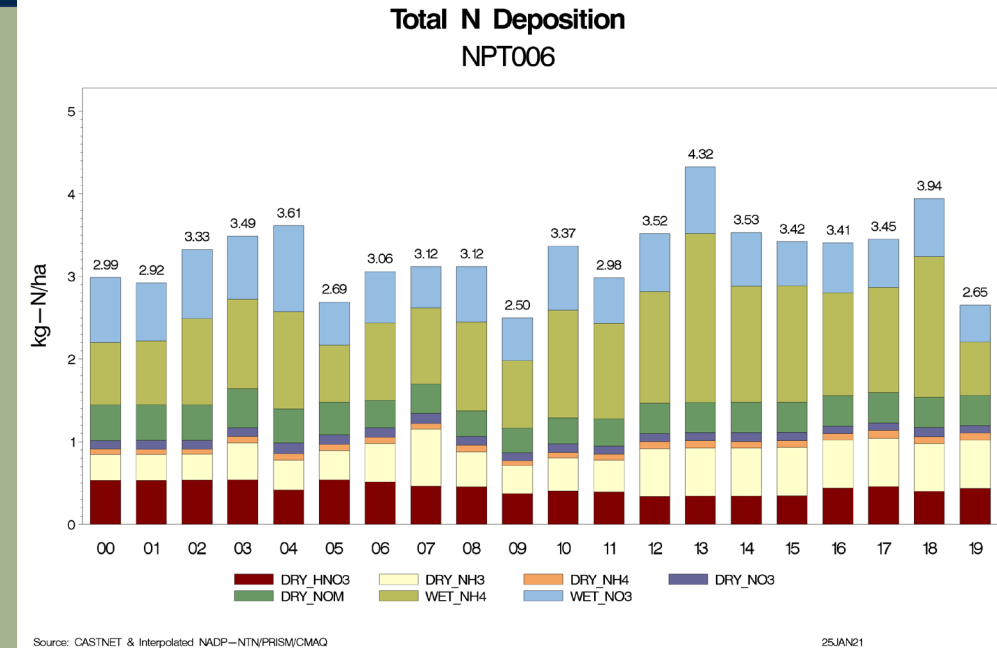
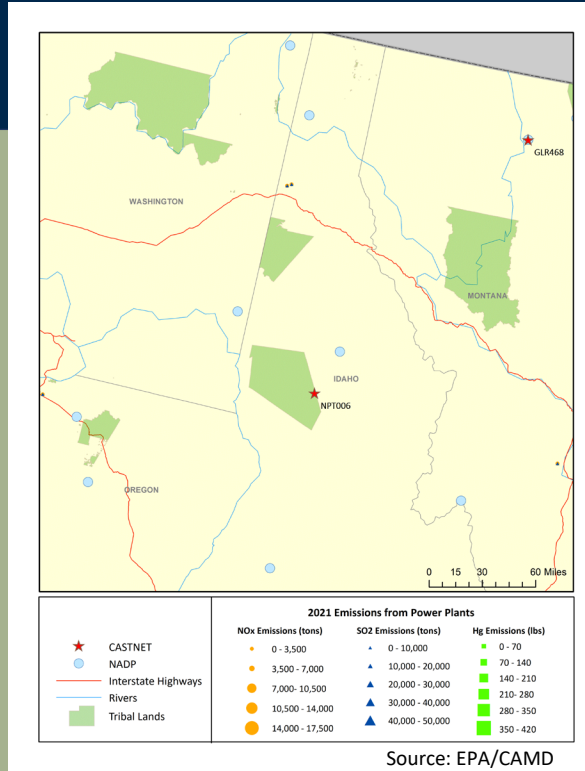
- CASTNET site began in 2002; Stilwell, OK
- Co-located with NCore, NADP (AMoN, MDN)
- CASTNET operates filter pack and meteorological measurements
- Cherokee Nation collects ozone, PM and trace gas measurements
- Site located at a tribal middle school. Students visit site and access data





Nez Perce Tribe

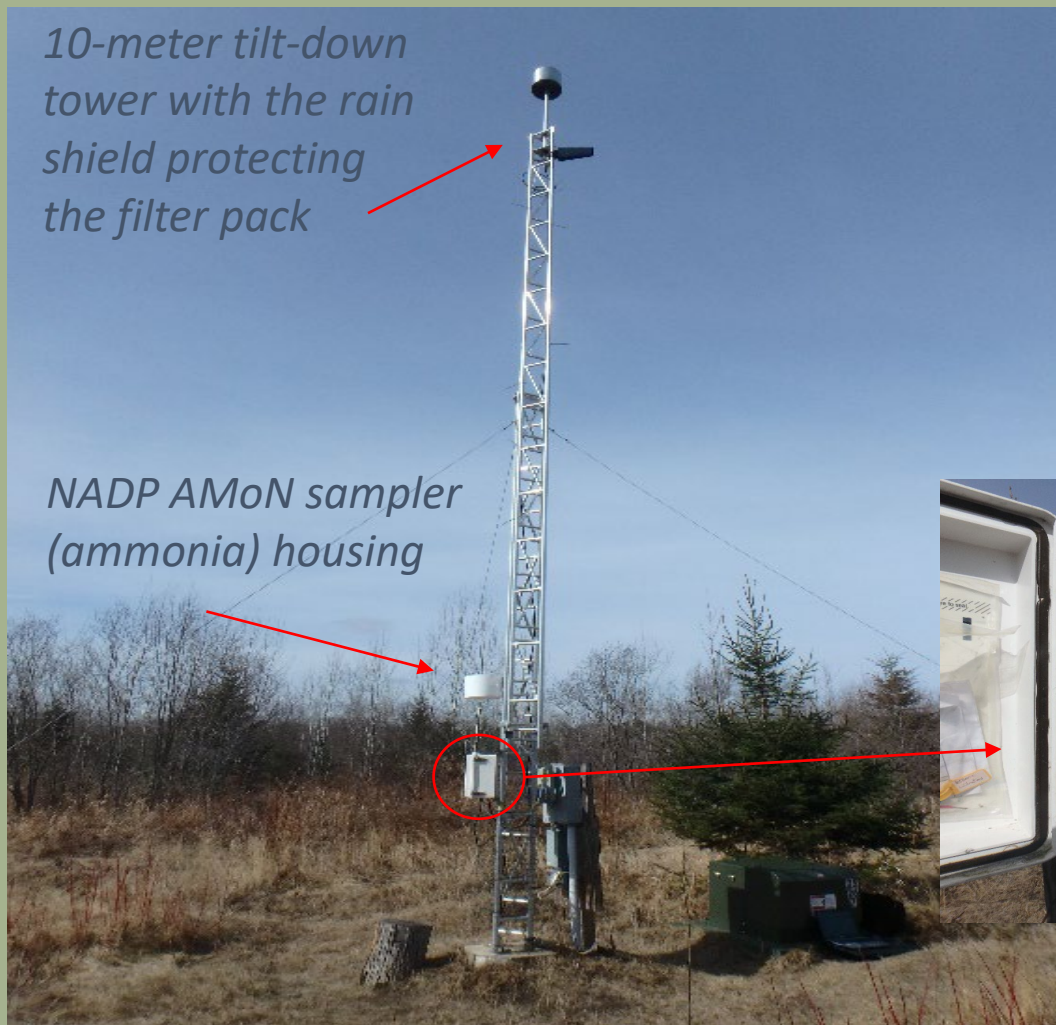
- Located in Idaho
- Small-footprint site established in December 2015
- Designed a temperature controlled shelter for ozone analyzer at a small footprint site
- Established in partnership with the Tribe, EPA Region 10, and OAR



Small-footprint site

- 10-meter tower for the CASTNET filter pack, a temperature probe, and a small enclosure on the tower to house the data logger, mass flow controller, and pump
- Cost-effective to install and maintain

*Red Lake Nation CASTNET Site
(RED004) – Filter pack only*



Enclosure holding the mass flow controller and data logger



Mutual benefits for tribal partners and CASTNET

- Many benefits participating in CASTNET
 - Robust measurements and access to high quality data
 - “Apples to Apples” comparisons with other network sites
 - Scientific and technical training and equipment troubleshooting
 - EPA provided training to Cherokee in 2002
 - Cherokee, in turn, has trained many tribal partners
 - CASTNET/NADP quarterly calls
 - Research opportunities, particularly when CASTNET hosts ITEP interns
 - Reduced burdens associated with owning and operating monitoring equipment, establishing quality management plans, and developing IT infrastructure to flag and validate data
 - Part of a long-term data collection effort that has been featured in thousands of research articles
- Tribes provide in-kind support for operations and land use
- Current sites fill network gaps in the central and western US

Download Data

What type of report would you like to download?

Measurement (Raw Data)

Filter pack data are reported for the time interval that the filter was exposed. Continuous measurements of gases (O₃, SO₂, NO, NO_y, and CO) and meteorological parameters are reported as hourly averages. All data are reported in local standard time (i.e. times are not adjusted for daylight savings). Daily zero, span, and precision checks are reported for ozone and trace gases.

Aggregate Concentration Data

Data are measured concentrations for each pollutant averaged over weekly, seasonal, or annual time periods. In addition, users can download ozone 8-hour daily maximum or W126 values.

Aggregate Deposition Data

Data include total deposition estimates calculated by a measurement/model hybrid method (for more details on the methodology see Schwede and Lear, 2014). Annual total deposition fluxes are calculated as the sum of wet and dry deposition using measured data (from NADP/NTN, NADP/AIRMoN, and CASTNET) and modeled results (from CMAQ and PRISM). Historical dry deposition velocities and fluxes as calculated by the Multi-Layer Model (MLM) are also provided, but these results are no longer updated (as of 2017).

Factual Data

Data include site details and parameters used as input to the Multi-Layer Model (MLM). The MLM is used to estimate deposition rates at by parameter for each CASTNET site.

Prepackaged Data

These prepackaged datasets contain the same data as the previous four report types, but as raw csv data files for intensive data analysis.

Cloud Deposition Data

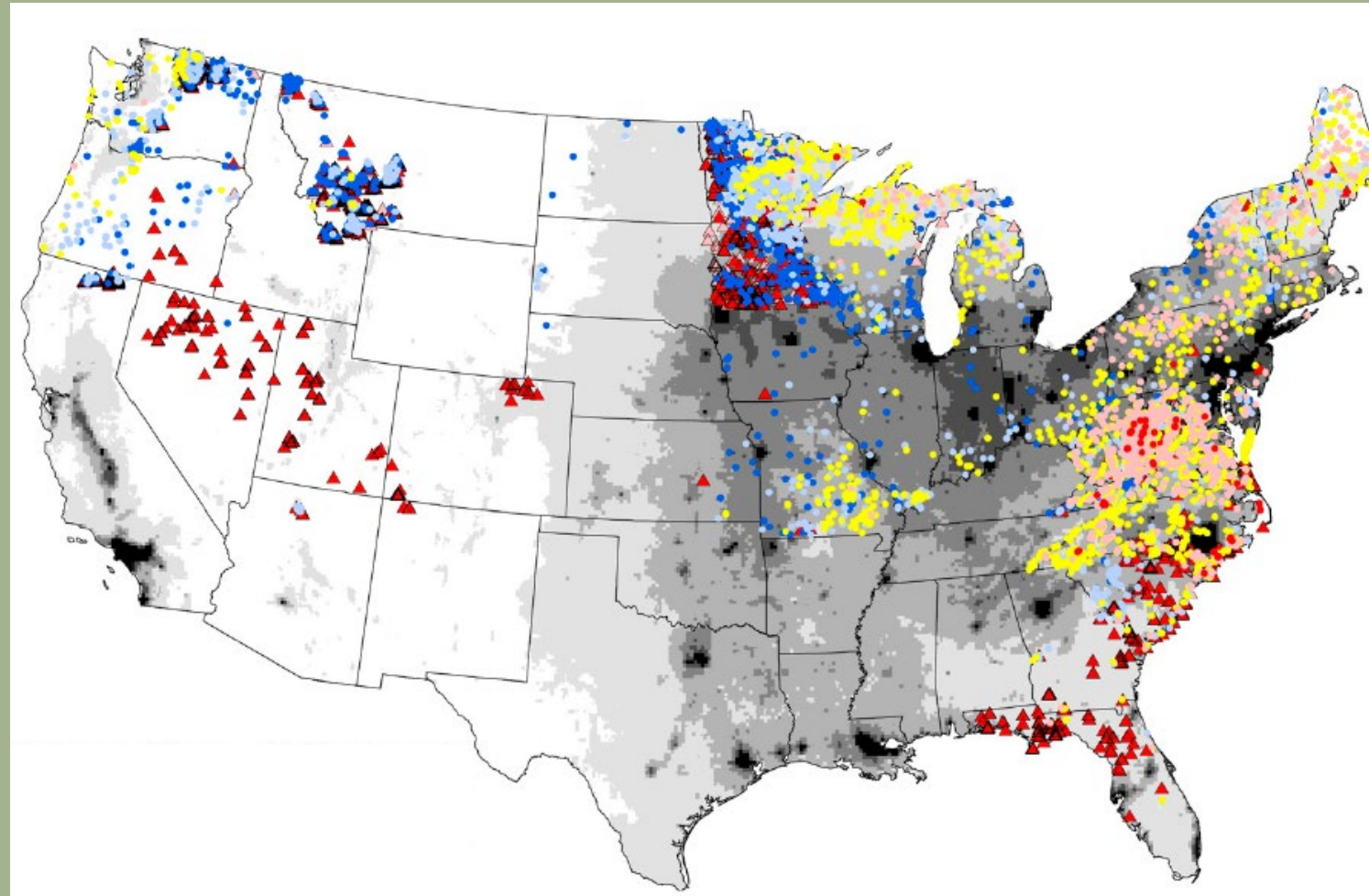
Data are modeled using the CLOUD cloud deposition model during warm weather sampling seasons. Additional information about the cloud deposition monitoring program can be found under the Documents and Reports tab.

Critical loads

- The threshold of deposition below which specified harmful ecological effects do not occur (Porter et al. 2005)
- Potential ecological sensitivity and vulnerability
- It is NOT about protection of human health

Biological receptors



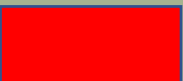
- Aquatic Acidification
(*McDonnell et al. & others*)
- Terrestrial Acidification
(*McNulty et al., Duarte et al., McDonnell & Sullivan, Phelan et al.*)
- Empirical for Nitrogen
(*Pardo et al., Simkin et al.*)
 - Forest
 - Herbaceous Plants and Shrubs
 - Mycorrhizal Fungi
 - Herb Diversity







Analysis

- **Critical Load Exceedance = Deposition – Critical Load**

Acidification

-		Doesn't Exceed
		Could exceed +/- 10%
+		Exceeds

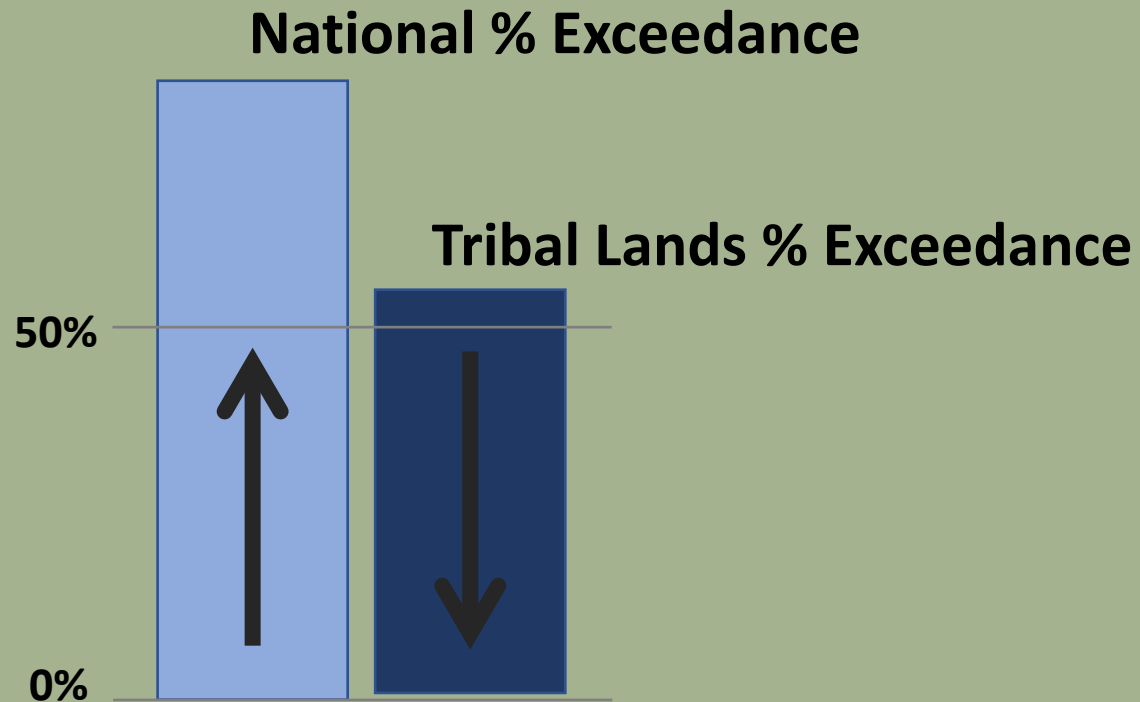
Empirical

		Doesn't Exceed
		Could exceed +/- 0.5 kg/ha
		Exceed min. Critical Load
		Exceed max. Critical Load

- **“Tdep” - Total SN and N Deposition 2000-2002 & 2012-2014**
- **2011 National Land Cover Data**

Analysis (cont.)

National vs. Tribal Lands



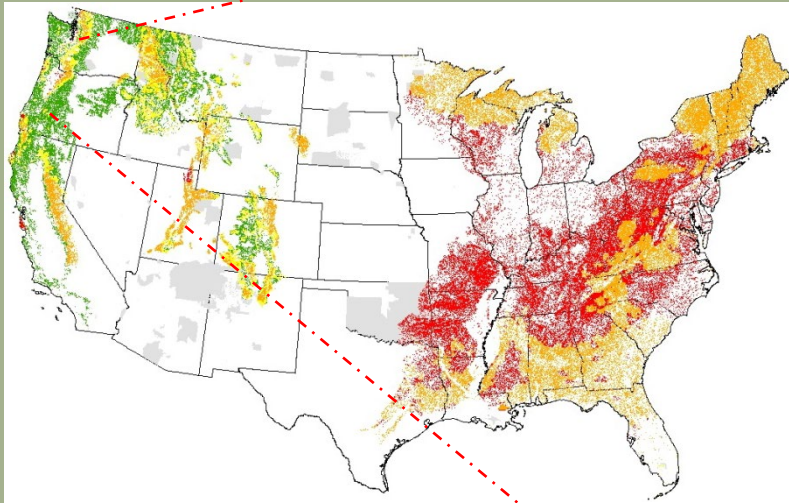
Direction of Change








Increasing from 2000-03 to 2012-14

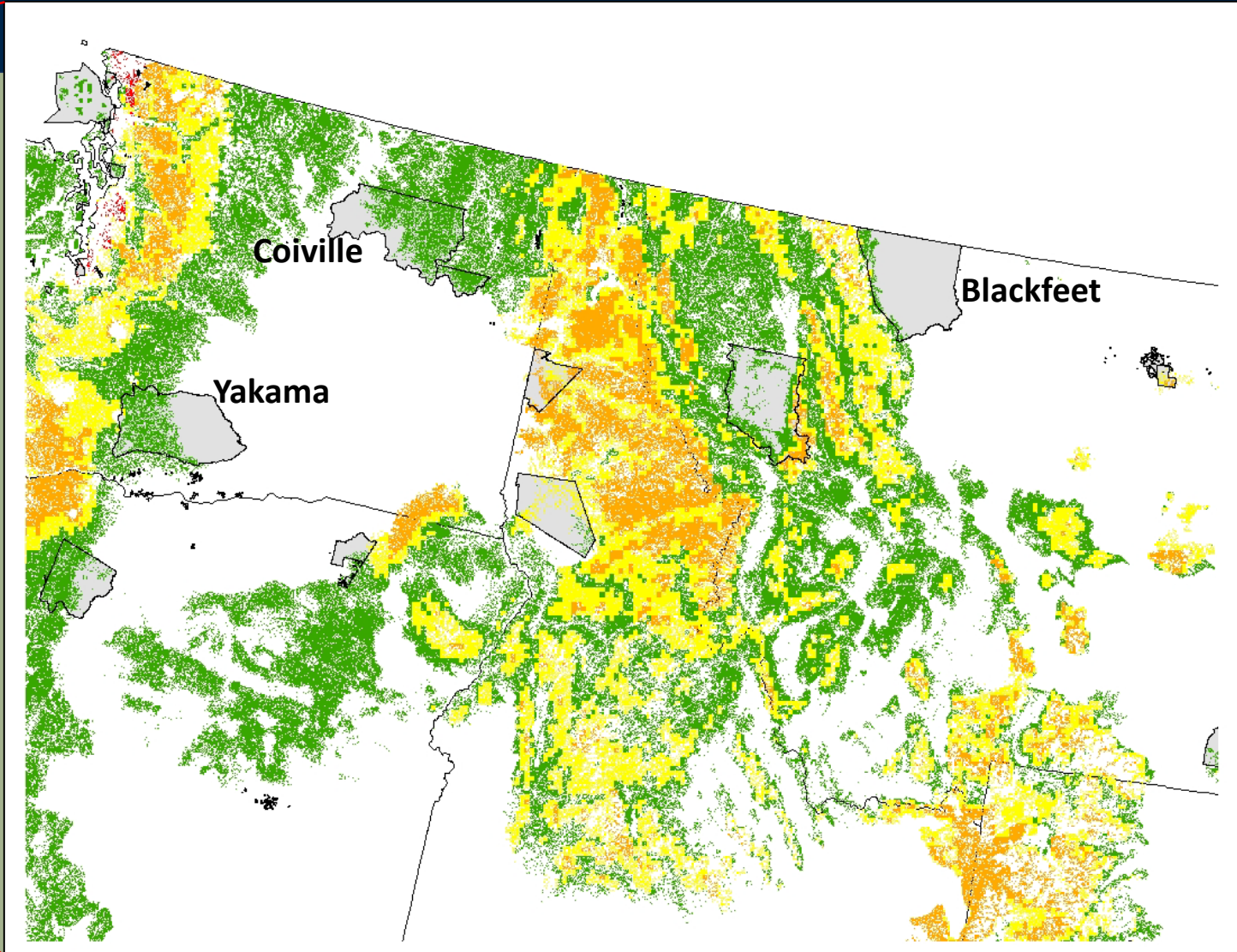
Decreasing from 2000-03 to 2012-14

Empirical - Forests

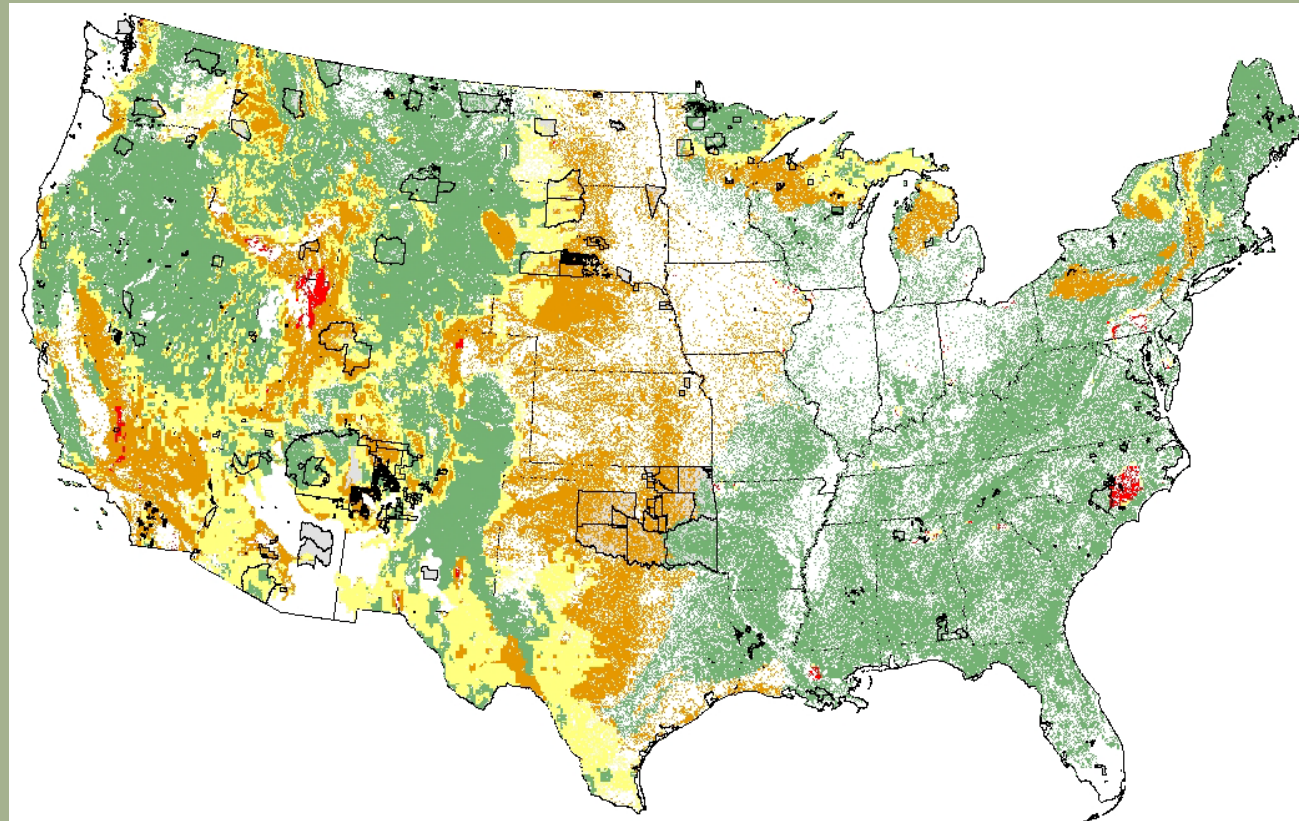


N kg/ha/yr

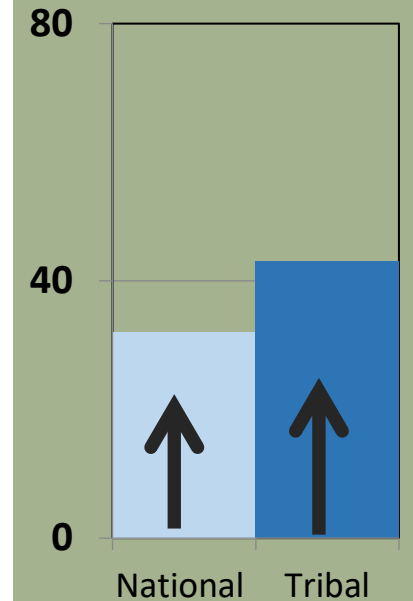
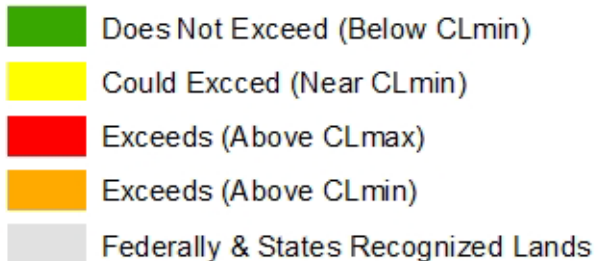
-  Does Not Exceed (Below CLmin)
-  Could Exceed (Near CLmin)
-  Exceeds (Above CLmax)
-  Exceeds (Above CLmin)
-  Federally & States Recognized Lands



Empirical - Herbaceous plants and shrubs



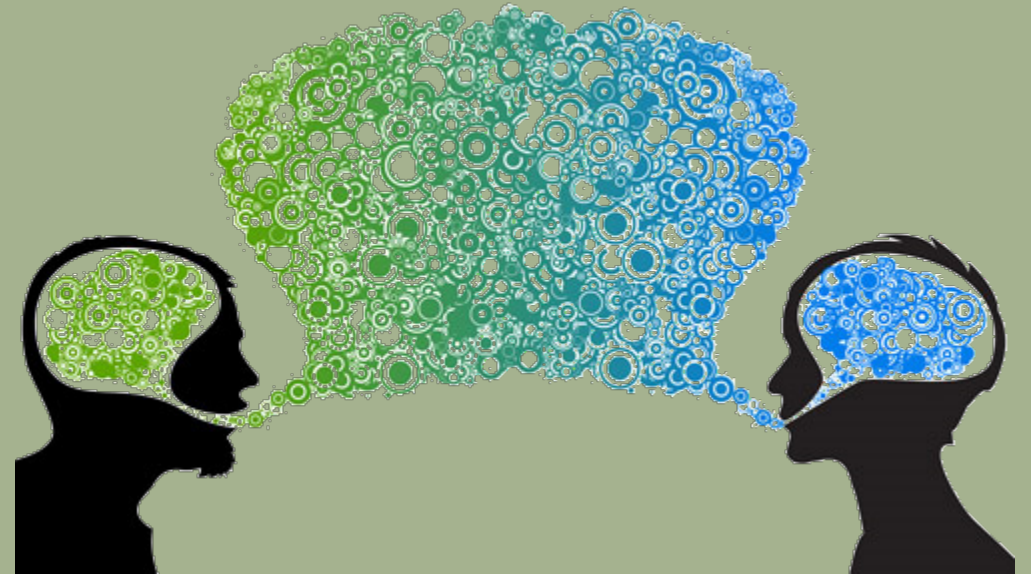
N kg/ha/yr



- **Higher critical load exceedances for Tribal Lands than Nationwide**

In the near future...

- Expand tribal partnerships – more partners, more sites, greater network coverage
- Improve communications
 - What can we do to make sure we are receiving input and feedback from the Tribes?
 - What information is important to Tribes?
 - EPA and NADP are developing training material specifically for existing and new tribal partners
 - Why are the pollutants measured?
 - How can Tribes effectively use the data to communicate with the public/community members?
 - How can we improve our messages about the effects of air pollution on rural communities?
 - Relationship to human health effects (PM formation)
 - Eutrophication of terrestrial and aquatic systems
 - Invasive species, loss of biodiversity
 - Acidification
- Suggestions for CASTNET and/or EPA monitoring programs?





Confederated Tribes of the Umatilla Indian Reservation, WA

For More Information:

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