# U.S. Experiences with Gypsum as a Soil Amendment

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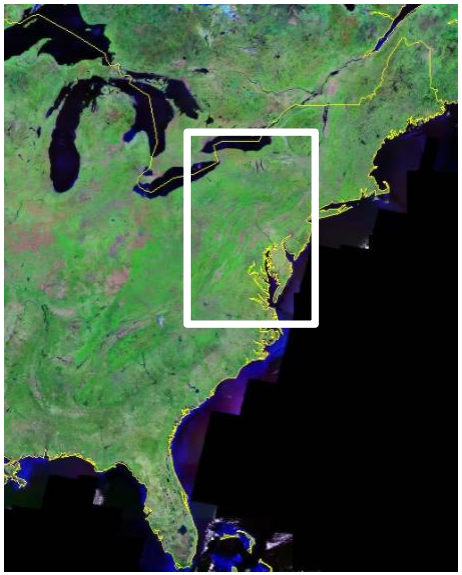
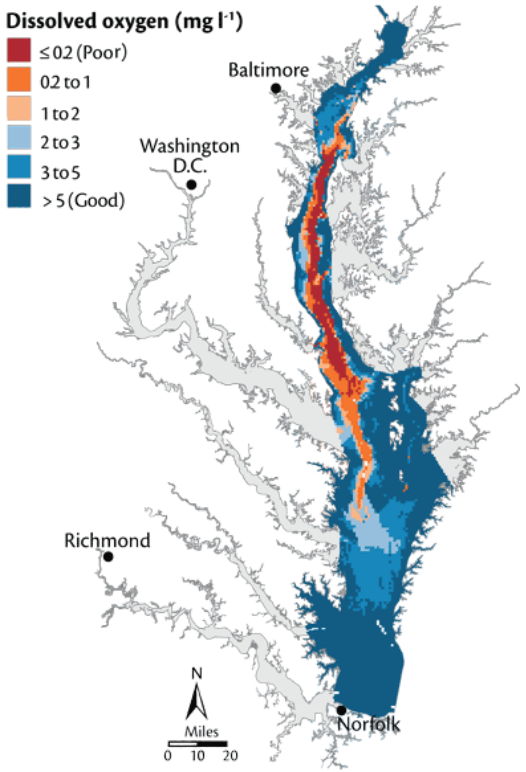
University Park, Pennsylvania USA

WEBINAR ON GYPSUM AND RESEARCH

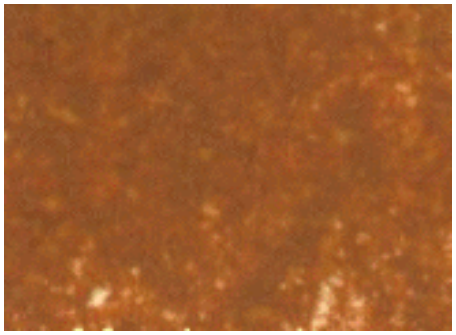
November 16, 2021

# Research area: Chesapeake Bay watershed



# Phosphorus-sorbing products



Acid mine drainage treatment residuals (Fe & Al oxides)

Drinking water treatment residuals (alum)

Bauxite mining and production waste (red mud)

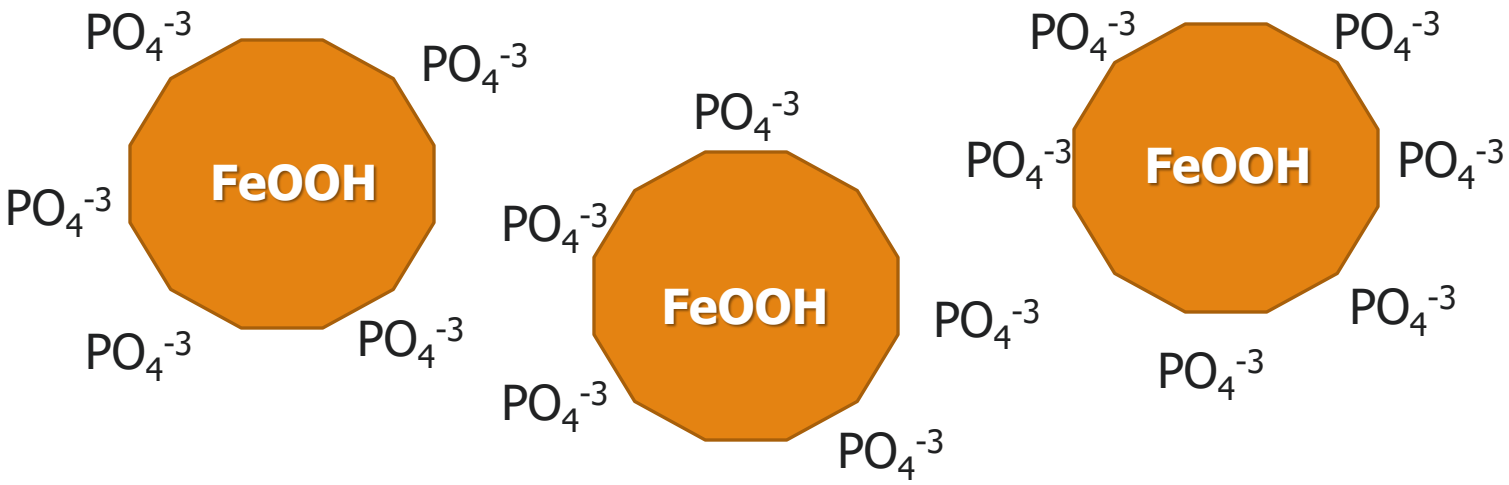
Fly ash

Paper mill waste

Steel slag waste

**Gypsum (calcium sulfate)**

# Sorption: Adsorption and precipitation




$$CaSO_4 \cdot 2H_2O \rightleftharpoons Ca^{+2} + SO4^{-2}$$

$$Ca^{+2} + PO_4^{-3} \rightleftharpoons CaHPO_4\downarrow \quad CaHPO_4(H_2O)\downarrow \quad CaHPO_4(H_2O)_2\downarrow$$

# Gypsum (calcium sulfate dihydrate)


Knocknacran gypsum mine - UK

Natural impurities

Geographically limited

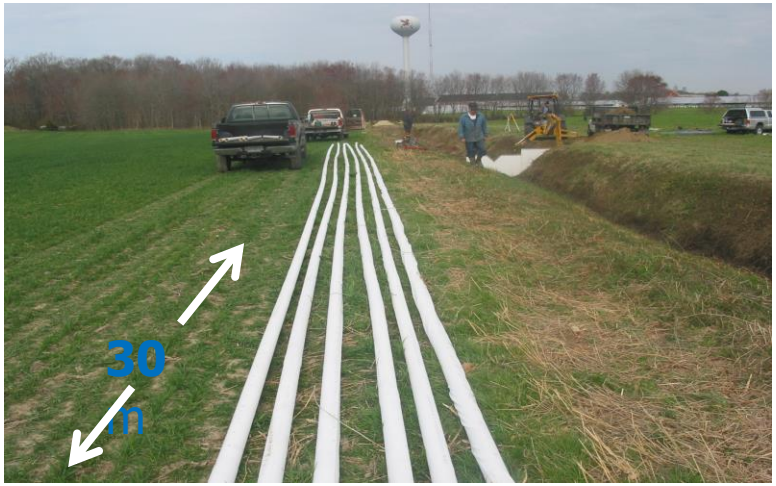

Branden Shores Power – Baltimore, MD USA

Low levels of impurities

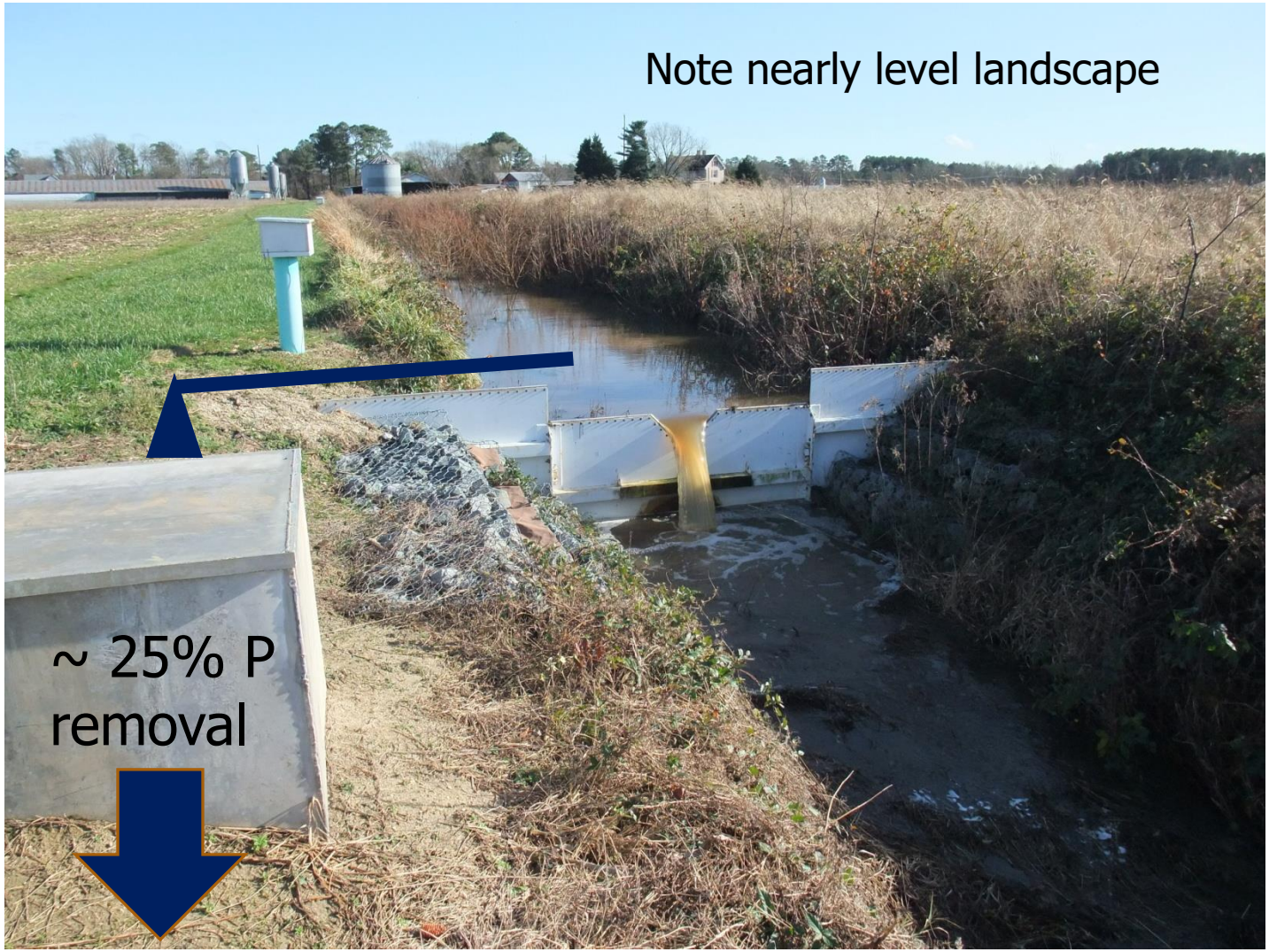
Widely available in U.S.

# FGD gypsum ditch filter






# Phosphorus removal by filtration



# Gypsum “curtain” for nearly level soils

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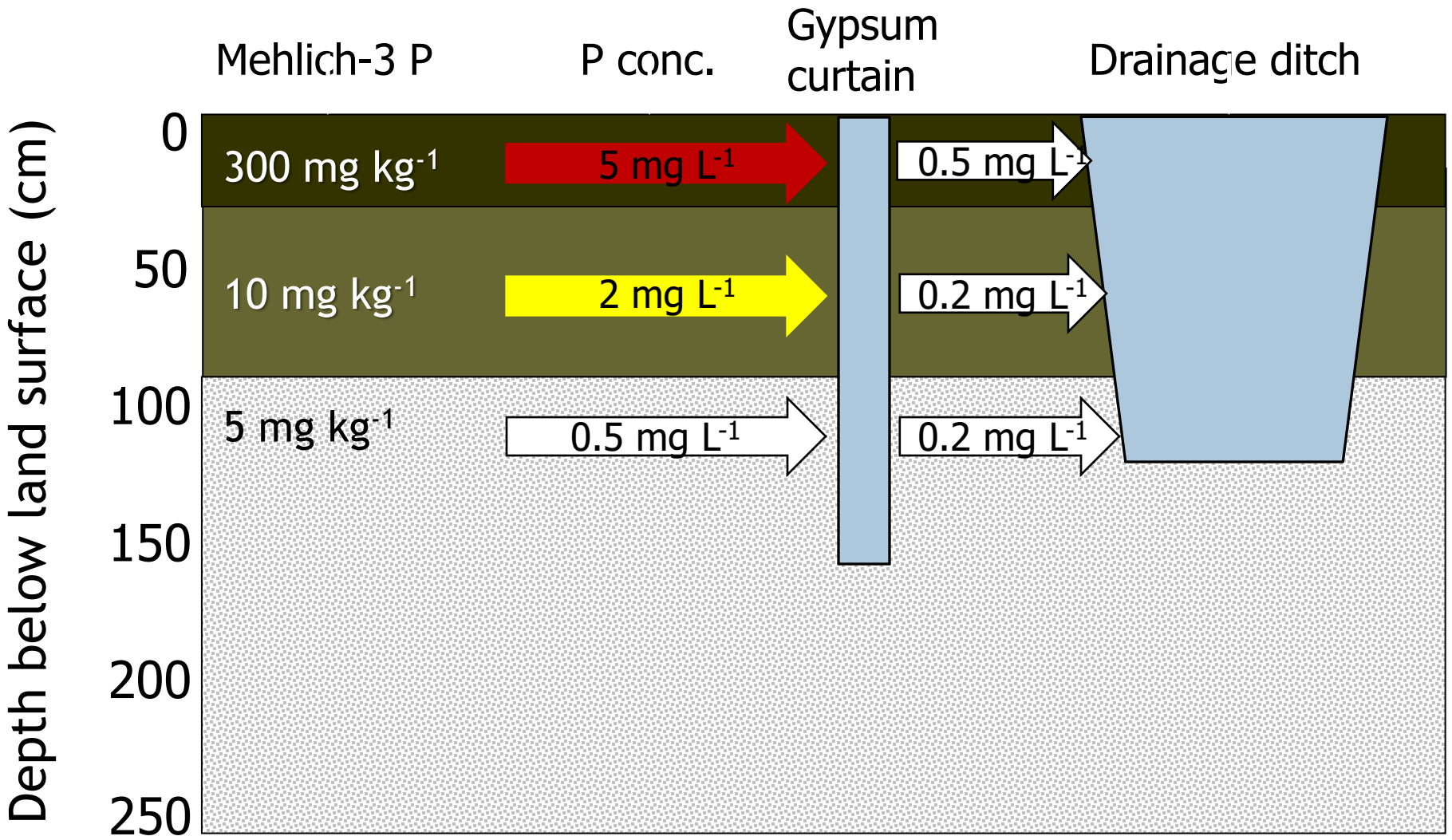


# Best strategy: Surface application

Conservation Practice Standard (Code 333):
Amending Soil Properties with Gypsiferous Products

# To remediate sodic soils, use the conservation practice Salinity and Sodic Soil Management (Code 610)

Photo courtesy of Mike Singer

# Purpose: Reduce dissolved phosphorus concentrations in surface runoff and subsurface drainage

## Additional Criteria:

General Use on High P Soils – Apply 2 tons/acre broadcast on the soil surface when soil test phosphorus (STP) is greater than two times the "maximum optimum level" for crop production, or when the P Index rating for the field is ***HIGH*** or ***VERY HIGH***.

# Purpose: Improve soil physical/chemical properties…


Photo courtesy of Darrell Norton

# Purpose: Improve soil physical/chemical properties… to increase infiltration and reduce soil erosion and particulate P loss


Photo courtesy of Darrell Norton

# Purpose: Mitigate subsoil Al toxicity

## Additional Criteria:

When exchangeable aluminum below a 12-inch soil depth is greater than 1.0 meq/100 mg soil, apply gypsum at a rate recommended by the Land Grant University or ARS.

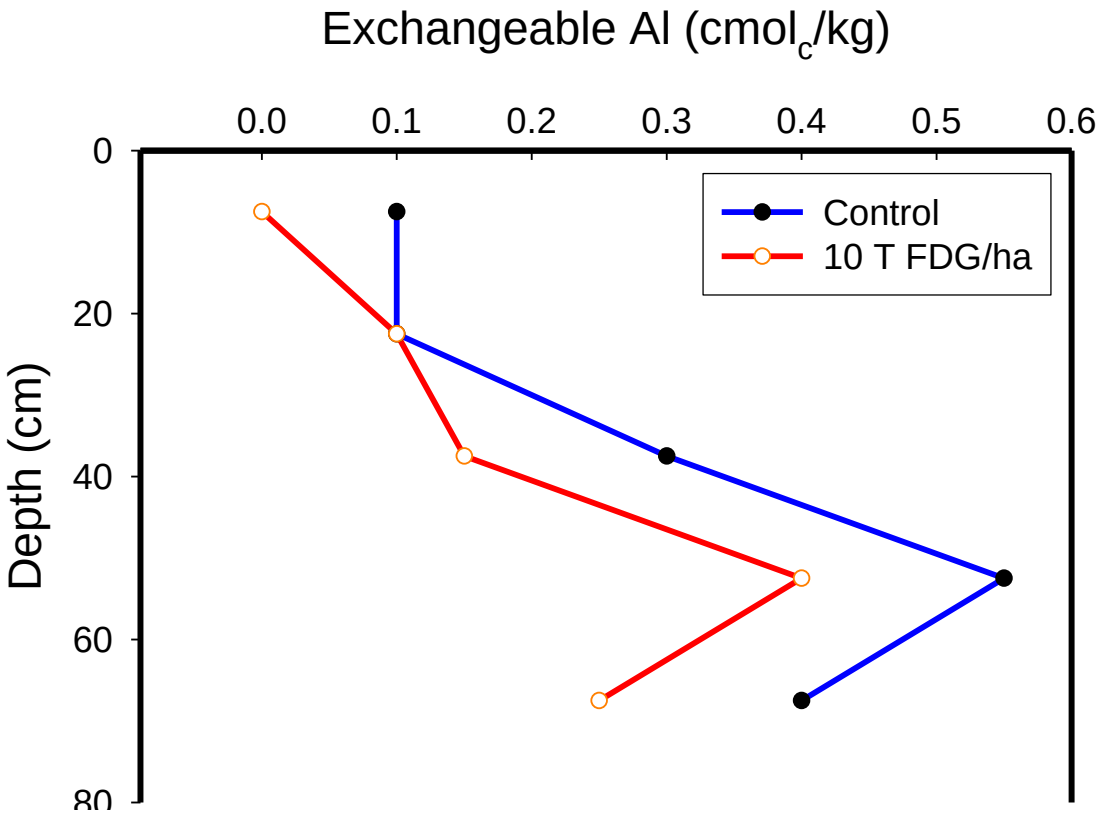



Figure courtesy of Malcolm Sumner

# Purpose: Reduce the potential for pathogen transport

## Additional Criteria:

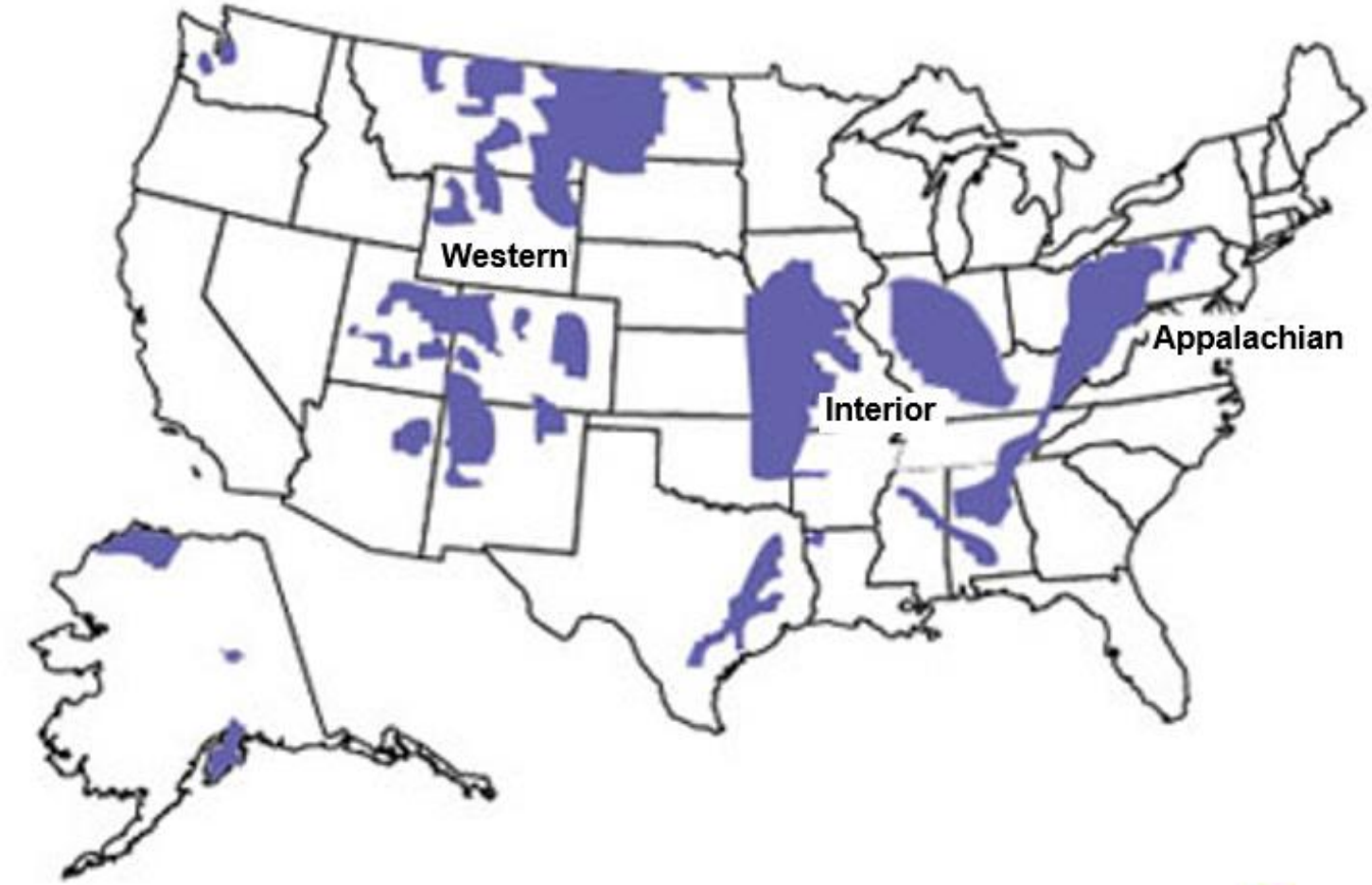
Apply 2.0 tons of gypsum within 5 days after manure or biosolid application, or prior to the next runoff event after manure application, whichever occurs first.

Photo courtesy of Michael Jenkins

# Target ranges for base saturation of cations

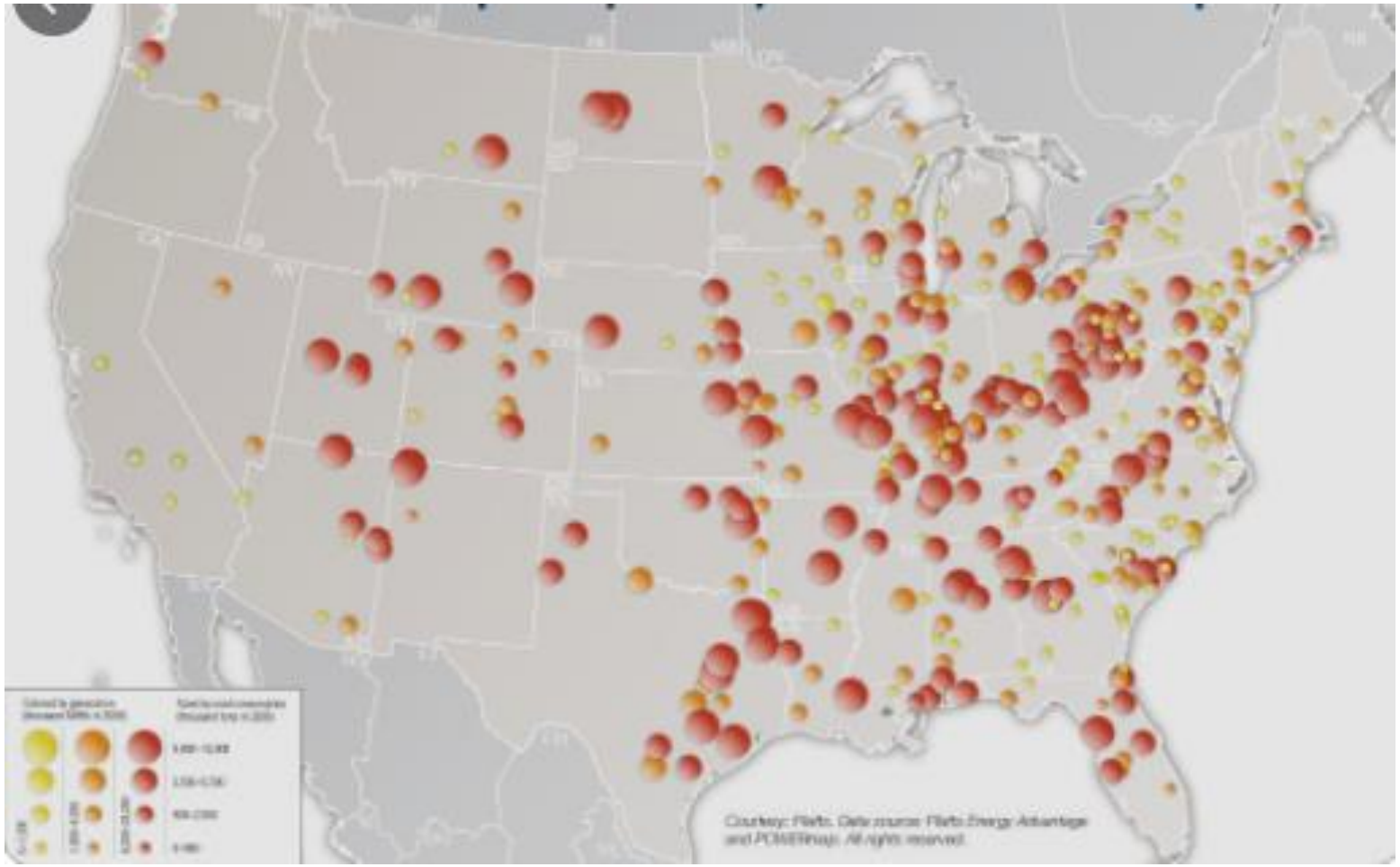
| Base Saturation | Balanced |
|---|---|
| Calcium | 70–80% |
| Magnesium | 10–13% |
| Potassium | 2–5% |
| Hydrogen | 1–10% |

# U.S. Coal resource regions

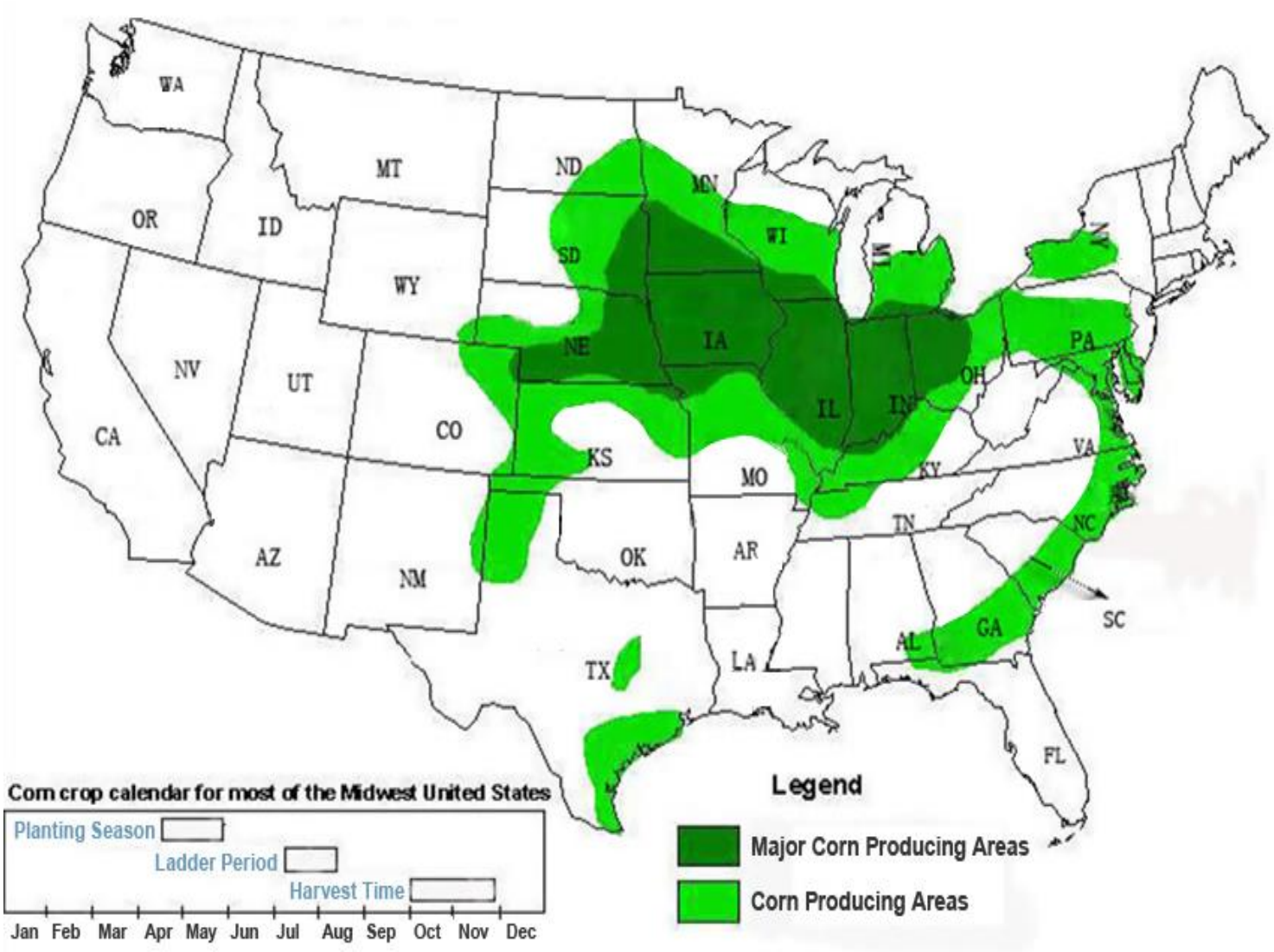



Source: U.S. Energy Information Administration, *U.S. Coal Reserves*

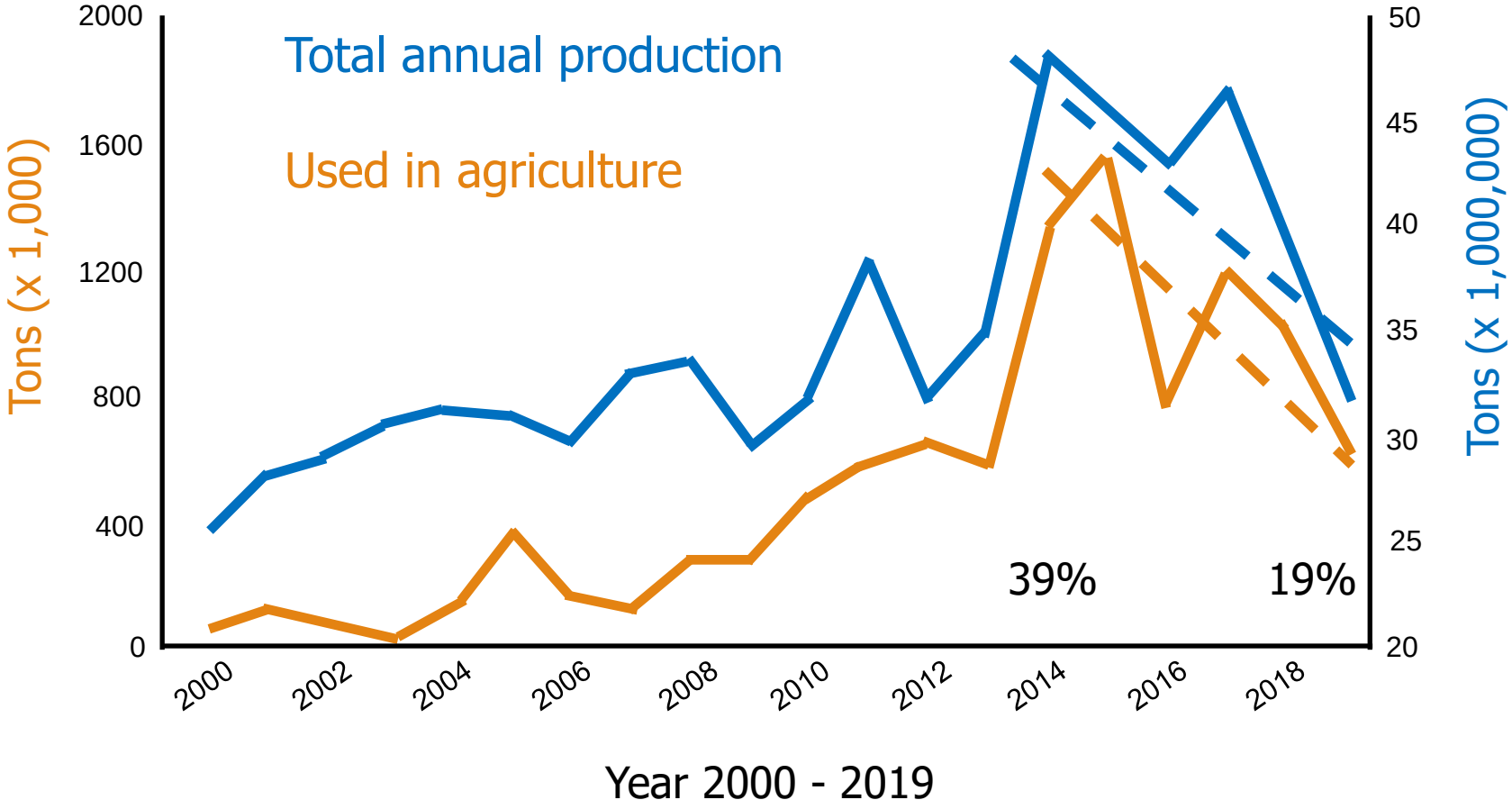
# U.S. Coal-fired power plants



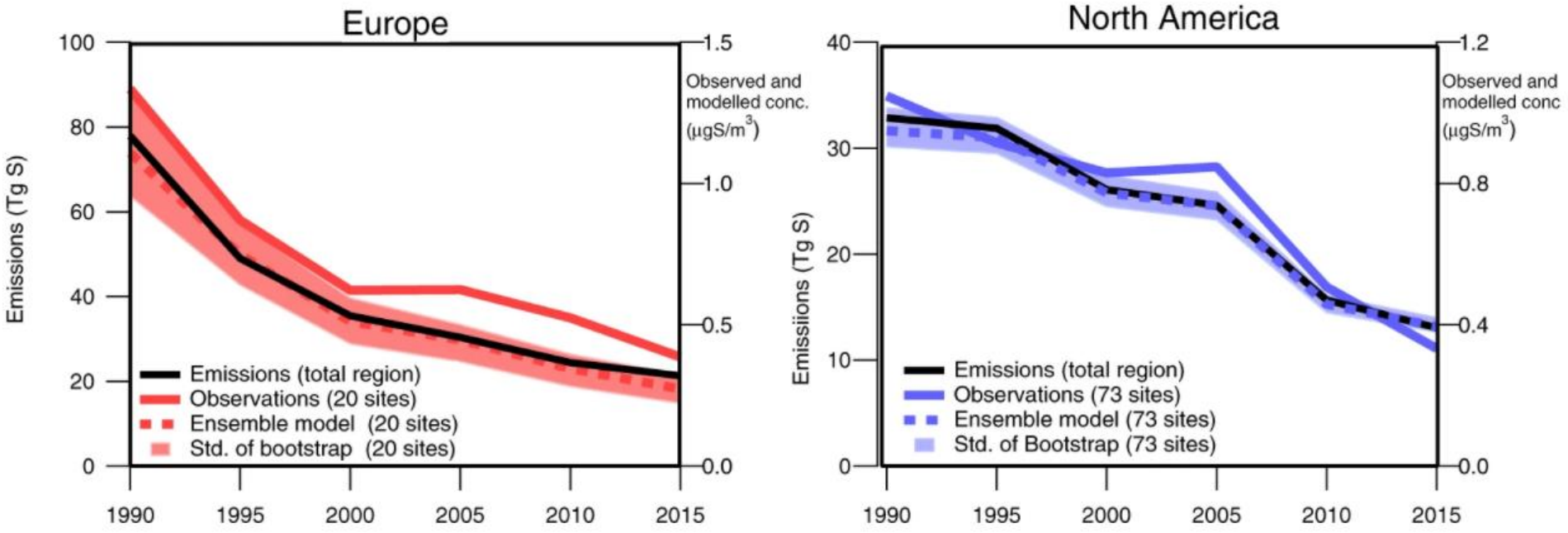
# U.S. Corn-growing region



# Trend in flue gas desulfurization (FGD) gypsum use



# Global and regional trends of atmospheric sulfur




Aas, W., Mortier, A., Bowersox, V. *et al.* Global and regional trends of atmospheric sulfur. *Sci Rep* **9,** 953 (2019). https://doi.org/10.1038/s41598-018-37304-0

# Final Thoughts

"The use of bulk / powder gypsum in agriculture seems to have declined due to limited access as coal fired utilities shut down.

We are seeing an increase of use of pelletized gypsum where it's used as a nutrient source. There are several pellet plants around the country and  others being built near a gypsum mine.

Gypsoil purchased rights and has begun harvesting a gypsum monofill with 1.4 millions tons of FGD gypsum that came from a local power plant for use in agriculture.  This has become a popular trend with cement and wallboard companies too - everyone is in desperate need of gypsum as it is in such short supply."

Trevor Schuuman, Beneficial Reuse Management LLC.

Thank you!

Questions?