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VISUALIZING AIR POLLUTION

AMMONIA EMISSIONS IN WISCONSIN

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Most of us rarely think about air pollution in our day-to-day lives because it is often invisible. However, recent advances in satellite imagery provide a way to "see" this pollution that can impact our lives.

One air pollutant that satellites can detect is ammonia. Ammonia is a concerning air pollutant because atmospheric ammonia transforms into fine particulate matter, which is the largest environmental risk factor for negative public health outcomes. Exposure to fine particulate matter can lead to premature death, various respiratory and cardiovascular ailments, and is associated with cancer and nervous system damage.

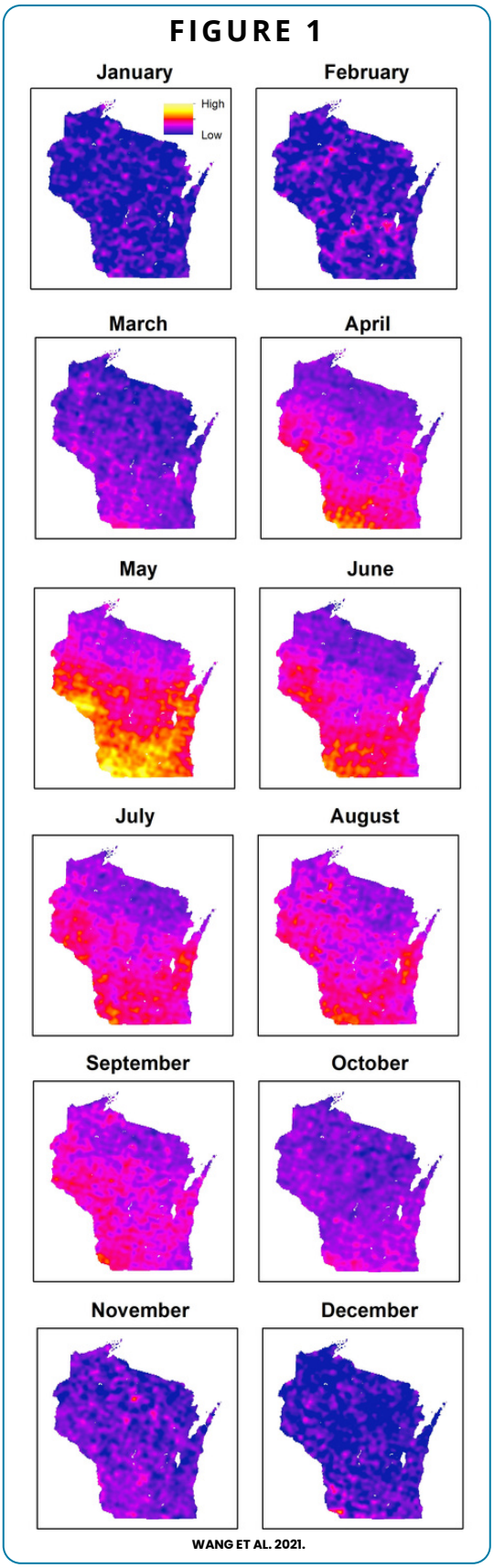
In Wisconsin, over 20% of fine particulate matter comes from agricultural ammonia emissions. Nationwide, agricultural activities account for nearly 90% of ammonia emissions. Ammonia is released from livestock manure and through the use of nitrogen fertilizers. Nearly one quarter of nitrogen applied as fertilizer is lost to the atmosphere as ammonia.

Figure 1 uses satellite imaging data compiled by Wang et al. 2021 **(1)** to show monthly atmospheric ammonia concentrations in Wisconsin. Elevated ammonia emissions are clearly seen in agricultural regions of the state from April to September. Emissions peak around May, coinciding with fertilizer application season.

FIGURE 1

Monthly ammonia concentrations in the air as measured by satellite data. Dark purple indicates low concentrations and warmer colors indicate higher concentrations, with bright yellow indicating the highest concentrations. All data are from Wang et al. 2021.

(1) WANG ET AL. 2021. MONTHLY PATTERNS OF AMMONIA OVER THE CONTIGUOUS UNITED STATES AT 2-KM RESOLUTION. GEOPHYSICAL RESEARCH LETTERS 48: E2020GL090579



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As summer progresses, ammonia hotspots shift towards the northeast part of the state, often occurring near higher densities of large livestock operations **(Figure 2)**. This suggests that release of ammonia from livestock manure facilitated by warm temperatures becomes a more significant source than fertilizer application in the middle of summer.

Practices that improve manure and fertilizer management are often discussed in the context of improving water quality. Manure and fertilizer are also recognized as important contributors to climate change through emissions of methane and nitrous oxide, respectively, which are potent greenhouse gases. As these satellite data help us to visualize, improving manure and fertilizer management can also have important benefits from an air quality perspective.

Practices that can reduce ammonia emissions include: optimizing nitrogen content of animal feed, covering manure storage areas, using low emission spreading practices such as incorporating fertilizer and manure into the soil quickly and spreading on calm, cooler days, and avoiding excess fertilizer and manure application by applying at agronomic rates.

FIGURE 2

Hotspots of ammonia concentrations in Wisconsin in May and July. Red areas indicate top 10% of ammonia concentrations in the state (data source: Wang et al. 2021). Green circles indicate locations of concentrated animal feeding operations (data source: Wisconsin DNR)

FIGURE 2