

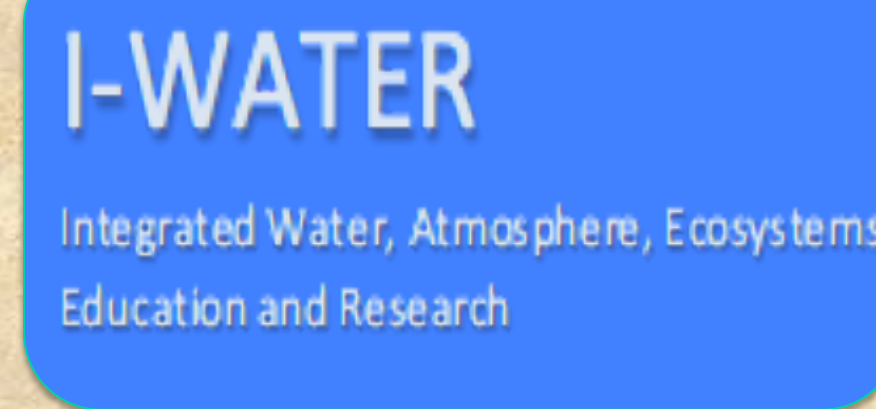
# Transport of pollutants from cow feedlots in eastern Colorado into Rocky Mountain alpine lakes

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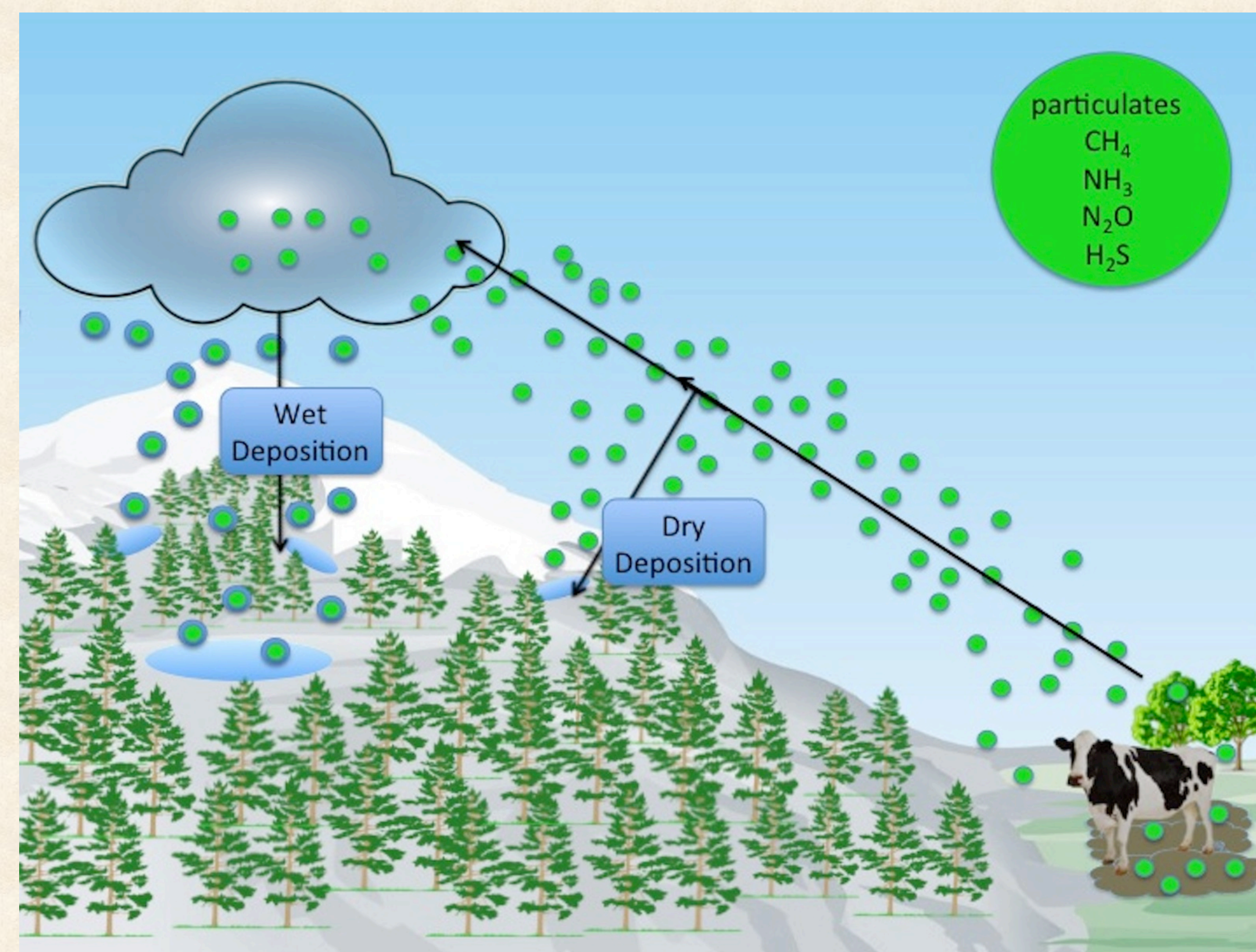
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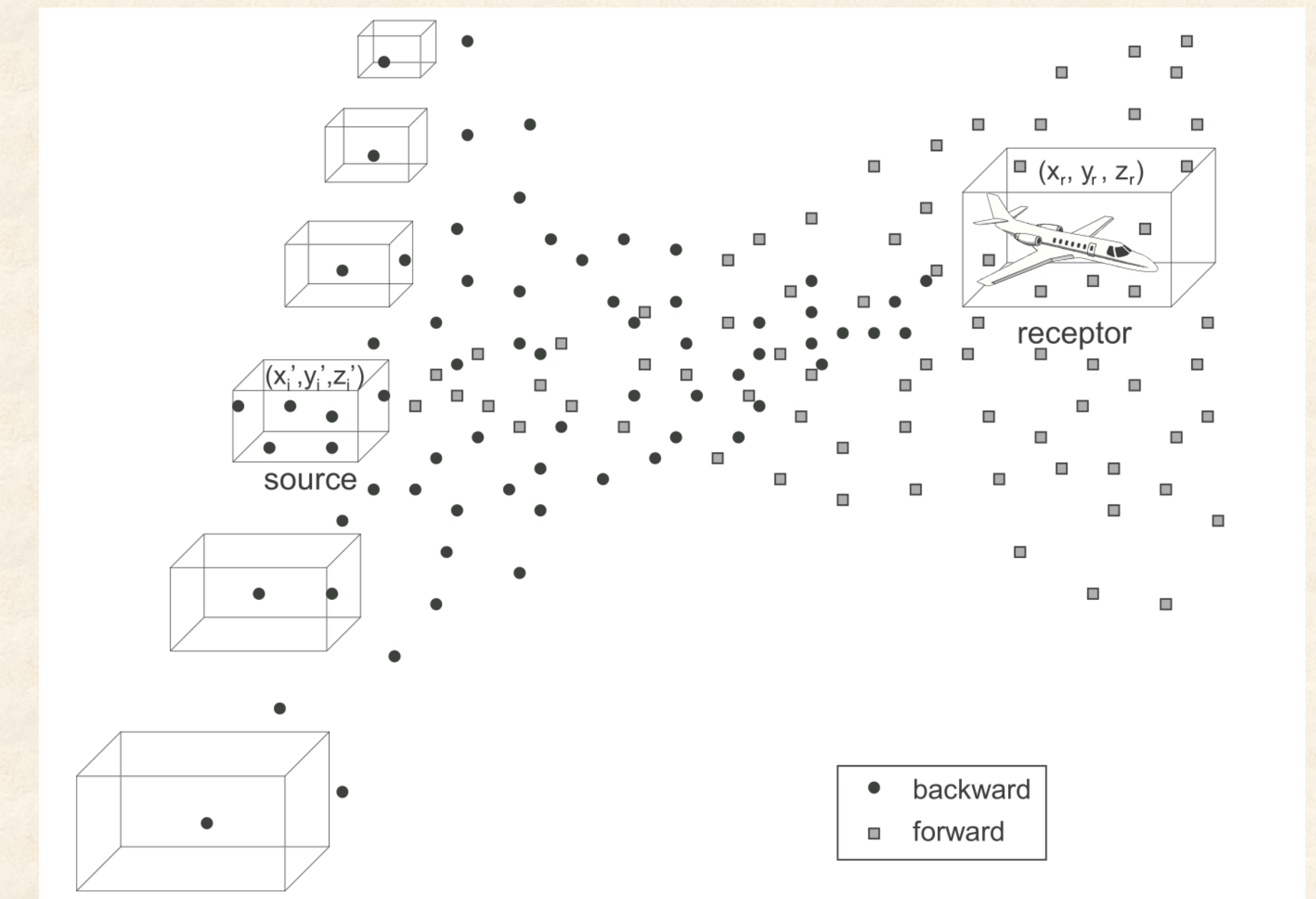
## Abstract

Concentrated Animal Feeding Operations (CAFOs), also called factory farms, are known for raising tens of millions head of livestock including cows (beef and dairy), swine, and poultry. With as many as 250 head of cattle per acre, a United States Department of Agriculture's (USDA) Agricultural Research Service (ARS) report showed beef cattle from CAFOs in the United States produce as much as 24.1 million tons of manure annually. Gases released from cow manure include methane ( $\text{CH}_4$ ), nitrous oxide ( $\text{N}_2\text{O}$ ), hydrogen sulfide ( $\text{H}_2\text{S}$ ), and ammonia ( $\text{NH}_3$ ). During boreal summers Colorado experiences fewer synoptic weather systems, allowing the diurnal cycle to exert greater control of meteorological events along the mountain-plains interface. Anabatic, or upslope winds induced by the diurnal cycle, contribute largely to the transport of gases and particulates from feedlots in eastern Colorado into the Rocky Mountains, presenting a potential harm to natural alpine ecosystems. This study focuses on locating the source of transport of gases from feedlots along the eastern Front Range of Colorado into alpine lakes of the Rocky Mountains. Source regions are approximated using backward time simulation of a Lagrangian transport model.



## Problem

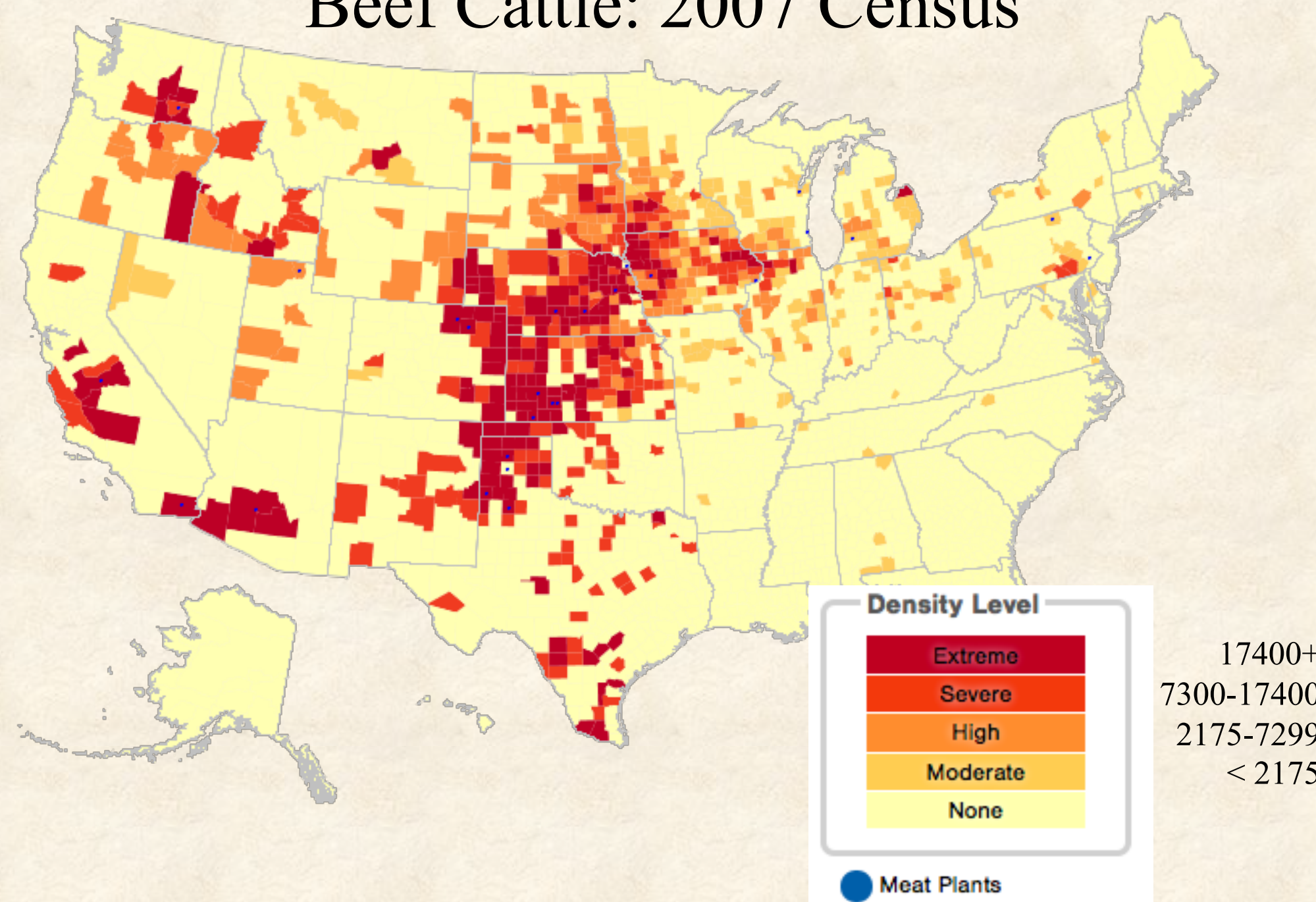
During upslope events, pollutants from feedlots along the Front Range of the Rocky Mountains in eastern Colorado are transported into alpine lakes of the Rocky Mountains. Upslope events for this study are being assumed to be anabatic winds caused by the diurnal cycle of the atmosphere along the Front Range.



## STILT

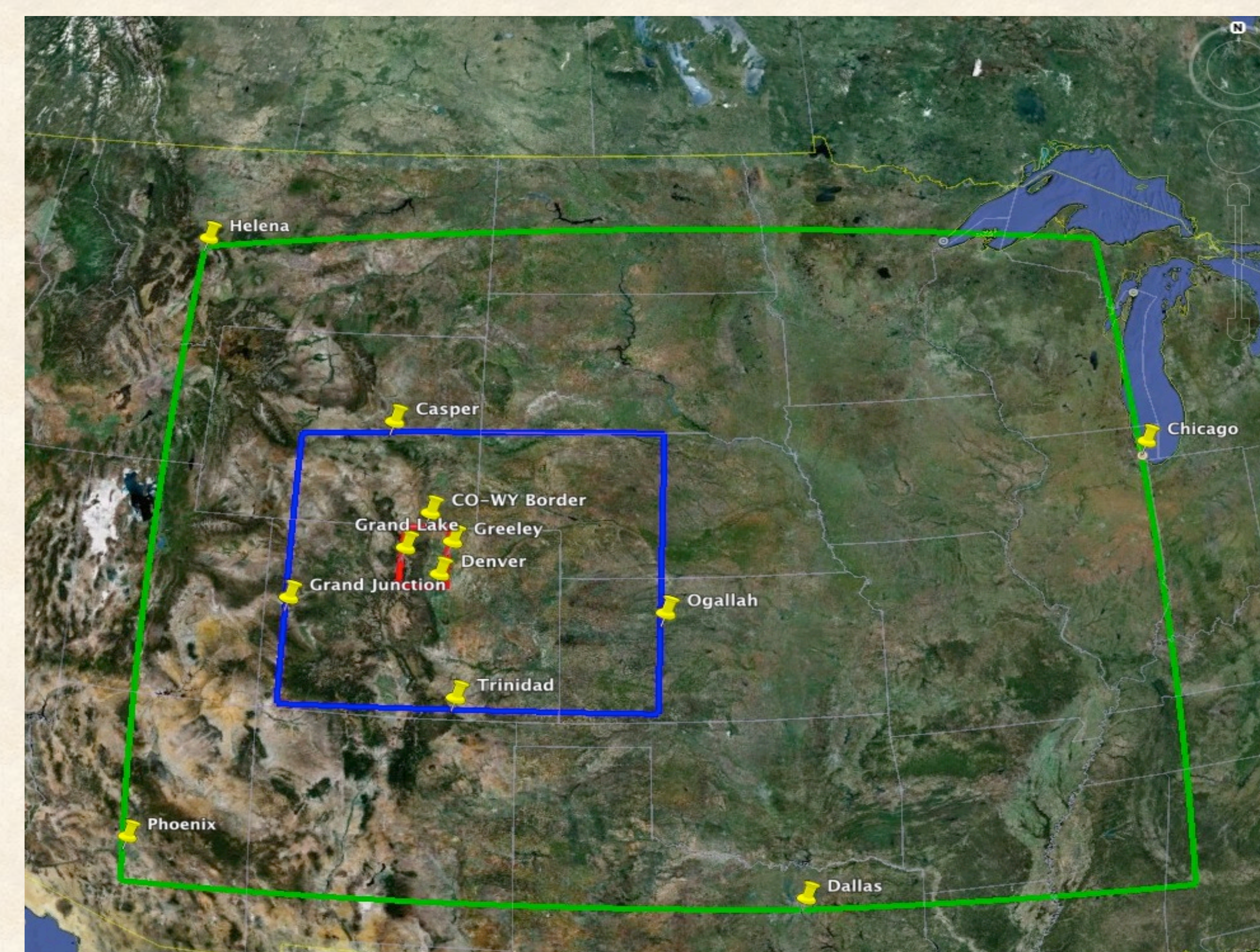
Variables from WRF-ARW, such as u-wind, v-wind, w-wind, detrainment, entrainment, and convective precipitation were used as inputs for the STILT model (Lin et al., 2003). The STILT model used the data from WRF-ARW and ran backward simulations of the transport of pollutants from eastern Colorado into alpine lakes. From a backward simulation, the STILT model gave probabilities for sources of pollutants. Sources with higher probabilities were georeferenced using ArcGIS.

Beef Cattle: 2007 Census



## CAFOs

CAFOs include dairy and beef cattle, poultry (layers and boilers), and swine. This study is concerned with pollutants from cow feedlots in feedlots along the Front Range of Rocky Mountains in eastern Colorado.



## WRF

For the three domains, we ran WRF-ARW (version 3.4) at 20 km, 4 km, and 800 m resolution. Output variables from WRF were then used as inputs to the Lagrangian transport model.

## Future Work

Applications for this project will be to mitigate transport from high-source CAFOs towards alpine lakes. A possibility is to create a warning system that determines when CAFO ranchers should bulldoze manure piles.

## Acknowledgements

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