Spatiotemporal variability of ammonia through syntheses of in-situ-, ground-based, and remote sensing measurements

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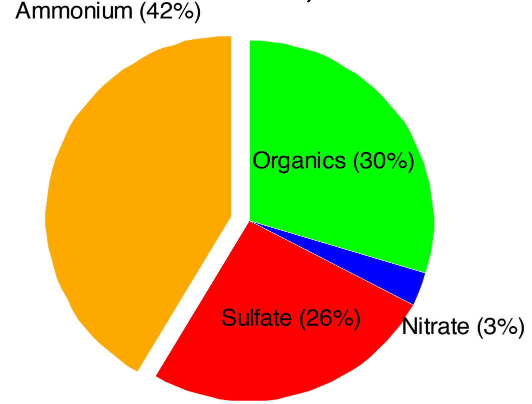
Why NH_3?

- human health: key precursor for PM2.5
  $36 B USD annual health costs from food export
  (Paulot and Jacob, 2014)
- ecological: nitrogen deposition, eutrophication
- expansive PM2.5 blooms in Europe
  upon fertilization of fields *(Fortems-Cheiney, 2016)*

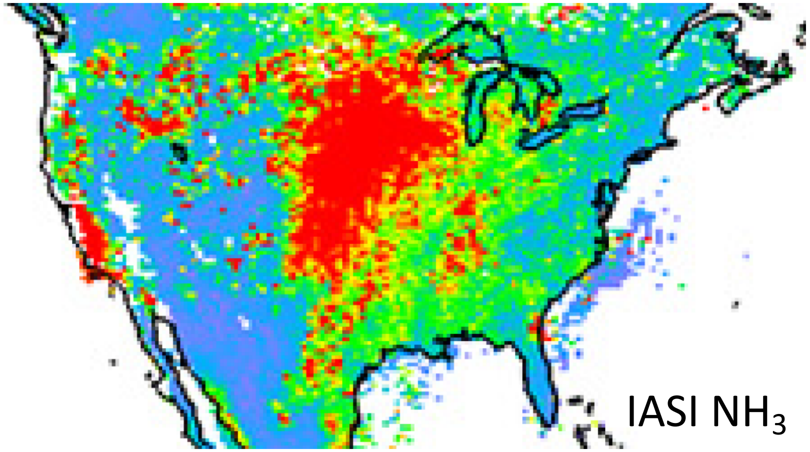
PM2.5 composition
Houston, USA



Molecular composition
(assuming M_{OM} = 100 g/mol)
Jimenez et al., 2009

Challenges

- NH_3 incredibly difficult to measure,
  limited datasets
- new advances in satellite data
  (IASI, CrIS, AIRS) but largely unvalidated
- agricultural emissions poorly constrained
- urban emissions underestimated but co-located
  with NO_x sources, so disproportionately important for PM2.5 *(Sun, 2016)*



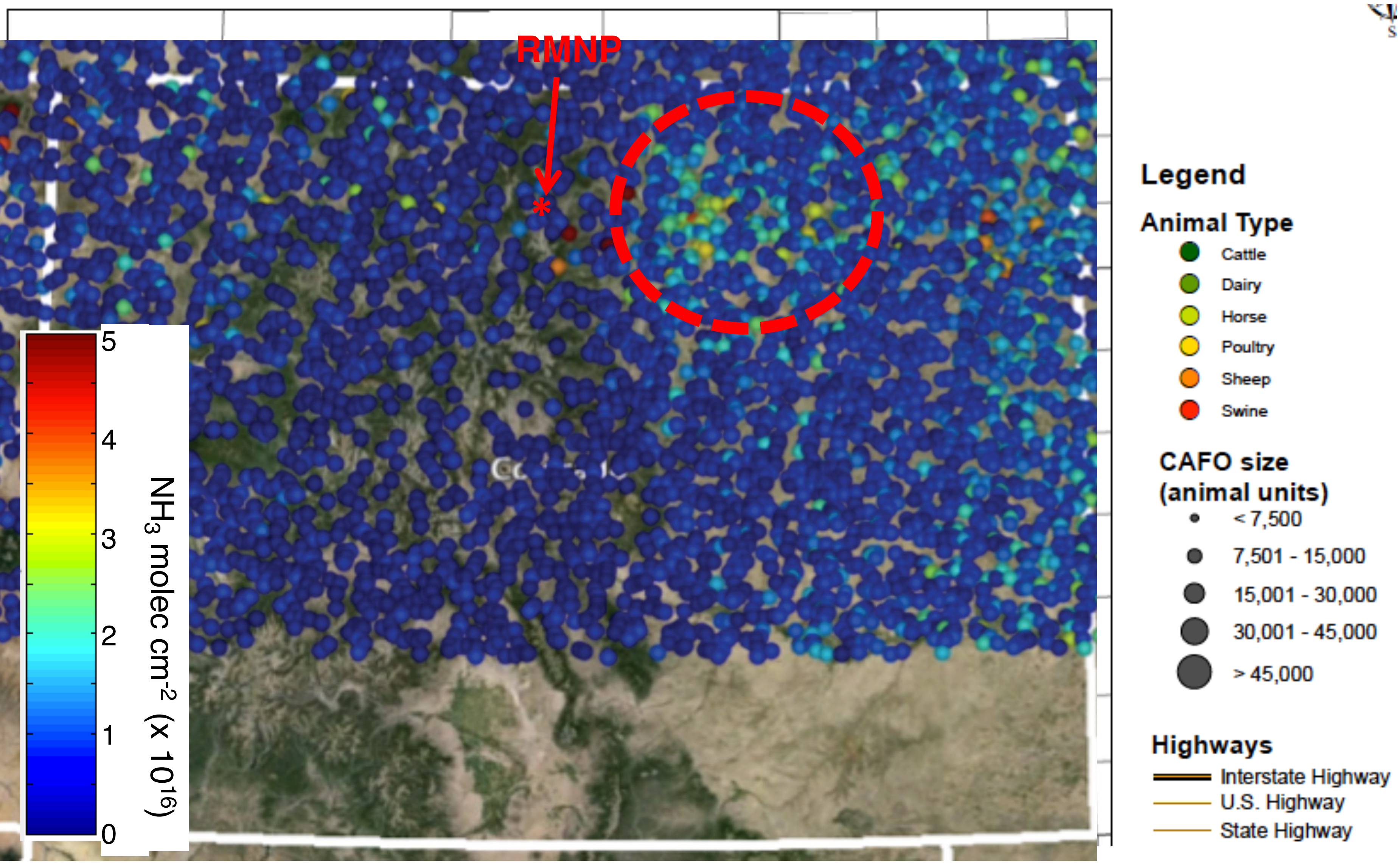
IASI NH_3

van Damme et al., 2015

Agricultural sources of NH_3 in Colorado

Large and many feedlots in NE Colorado, east of mountains

IASI NH_3 MetOp/A columns for July 14-Aug. 1, 2014 (*Whitburn et al., JGR-A, 2016*)



San Joaquin Valley: NH_3 and PM2.5

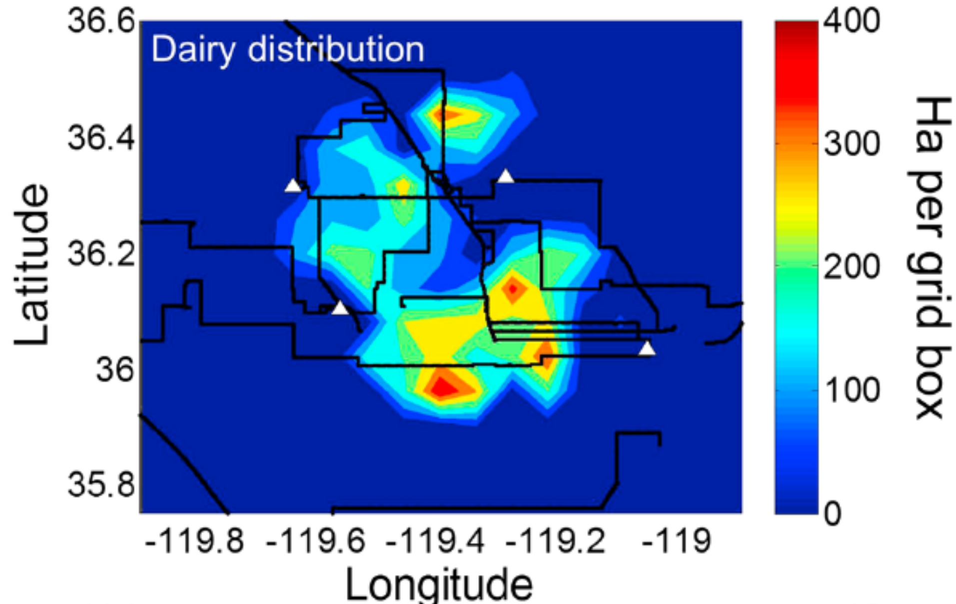
- high concentrations of CAFOs emit copious amounts of NH_3, large PM2.5 problem

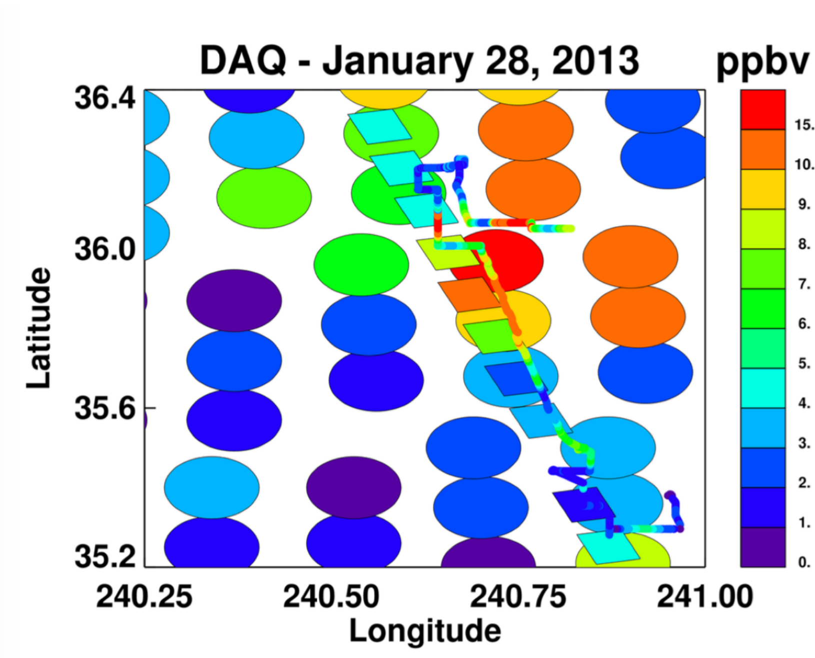
- CrIS, TES NH_3 capture spatial variability of surface measurements

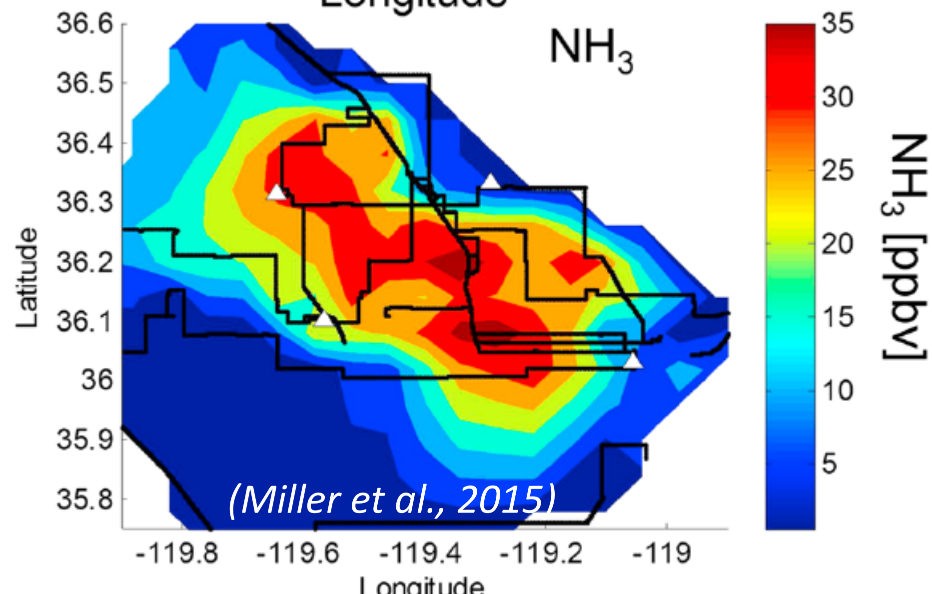
(Sun et al., 2015; Shephard and Cady-Pereira, 2015)

- NH_3 in boundary layer, tracer for agricultural emissions

(a)

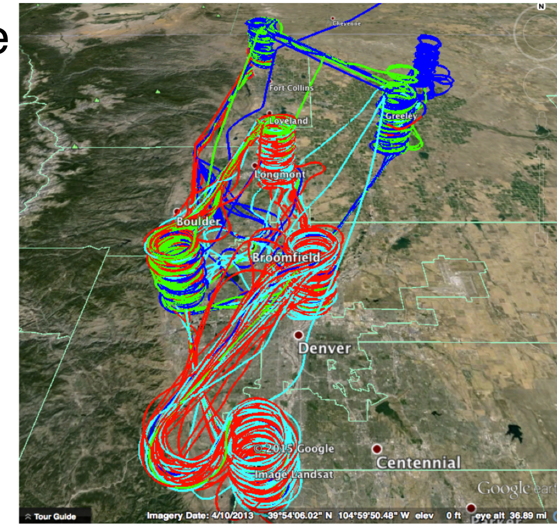






(Miller et al., 2015)

How to integrate NH_3 into air quality



- Quantify accuracy of IASI, CrIS NH_3 at the single pixel scale
  - -DISCOVER-AQ Colorado/California field experiments
  - -optimal integration of IASI, CrIS (0945, 1340 local)

- Identify PM events related to large NH_3 emissions
  - e.g. -fertilizer application linked to PM2.5 outbreaks
  - -transport of NH_3-laden airmasses over cities
  - -climatologies of NH_3 bursts in agricultural regions (spatiotemporal variability)

- Synthesize satellite NH_3 with other measurements (e.g. AOD)

-NH_3 as tracer of agriculture emissions and boundary layer tracer

<u>Impact</u>

voluntary farm management practices to reduce local emissions/deposition (CDPHE)

Date: / Platform:	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1	8/2	8/3	8/4	8/5	8/6	8/7	8/8	8/9	8/10	8/11	8/12
NASA WP-3B (PTRMS,A.Wisthaler/Innsbruck)																														
NSF C-130 (TDL, J. Nowak/Aerodyne)																														
Princeton mobile (Open-path QCL, M. Zondlo)																														
Aerodyne mobile (TDL, C. Floerchinger)																														
Univ. Colo. mobile (FTIR, R. Volkamer)																														
NOAA CSD mobile (Picarro, A. Neuman)																														
NOAA BAO tower (Picarro, J. Murphy/Toronto)																														