

I-WATER

Integrated Water, Atmosphere, Ecosystems
Education and Research



Colorado
State
University

Transport of pollutants from
eastern Colorado feedlots
into the Rocky Mountains
via upslope winds

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M.S. Candidate
Advisor: Scott Denning
CMMAP Team Meeting
08-07-2013



Andrew's Tarn



Loch Vale



Sky Pond



Glass Lake



Outline

- Problem
 - Cow feedlots (CAFOs)
 - More concentrated animals → More excrement → More pollutants
 - Concentrated pollutants + East winds → Eutrophication
- Method
 - Choosing a time period from NADP data
 - Modeling mountain meteorology in WRF
 - Verifying synoptic conditions with North American Regional Reanalysis data

Beef Cattle: 2007 Census

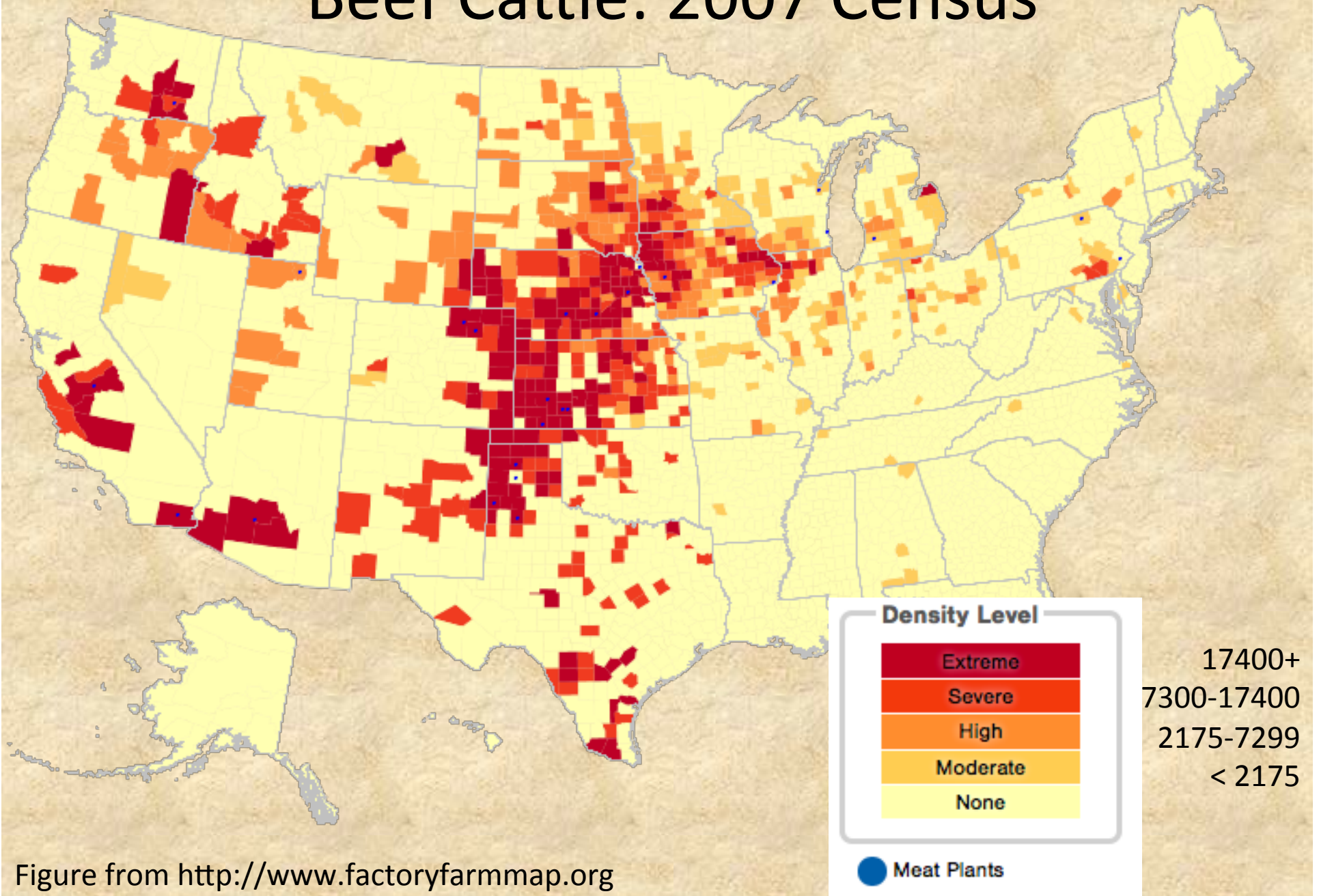


Figure from <http://www.factoryfarmmap.org>



More cows →
More excrement →
More emissions





Cheyenne

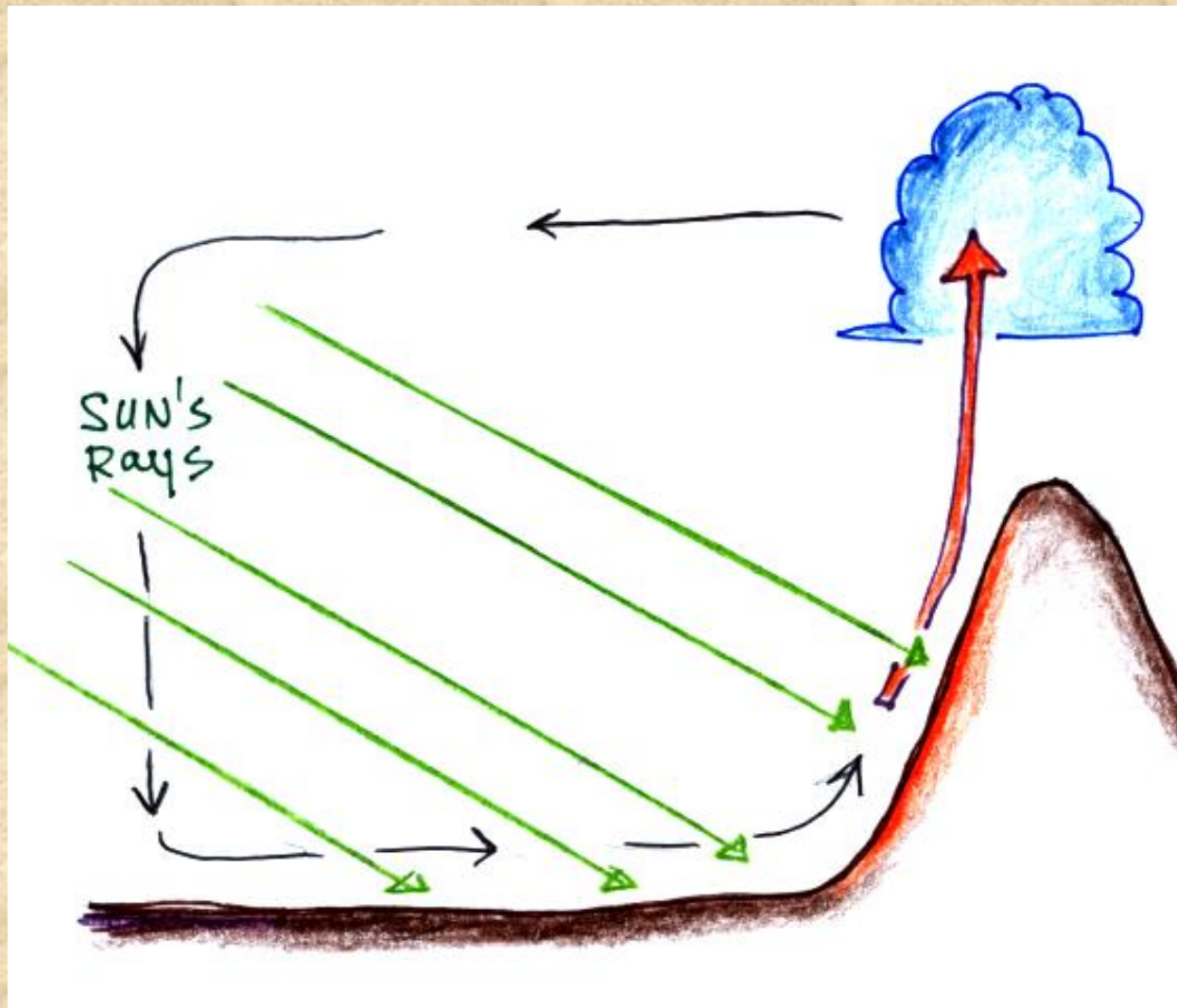
Fort Collins

Greeley

Boulder

Denver

Mountain Circulation during low synoptic forcing



Loch Vale Watershed

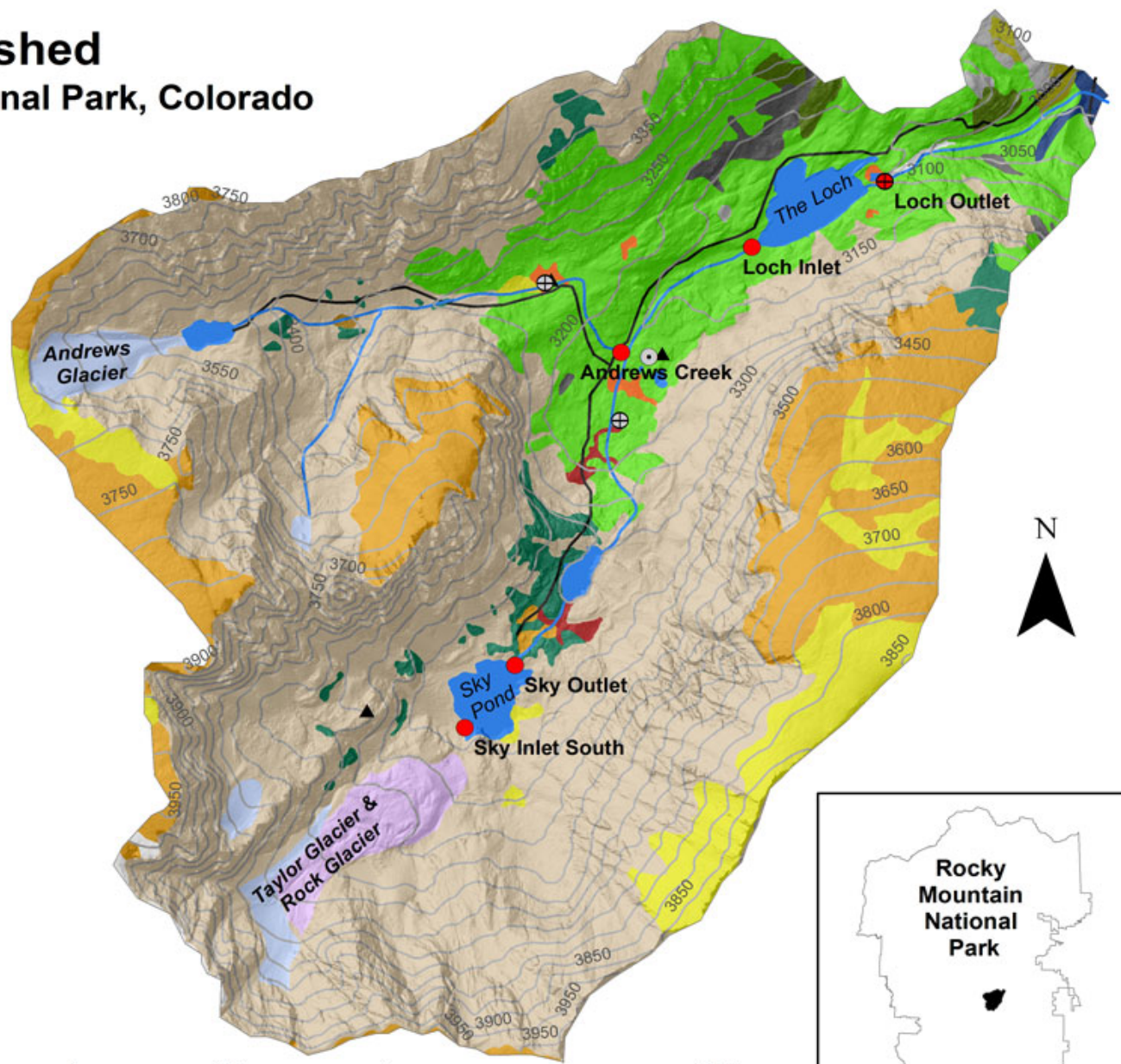
Rocky Mountain National Park, Colorado

Legend

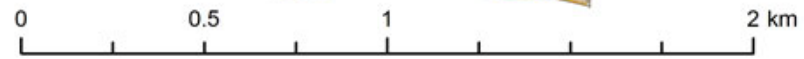
- NADP site
- ⊕ Streamgage
- ⊕ Streamgage & water chemistry
- Water chemistry
- ▲ Weather station
- Streams
- Trails
- Contour (50 meter)

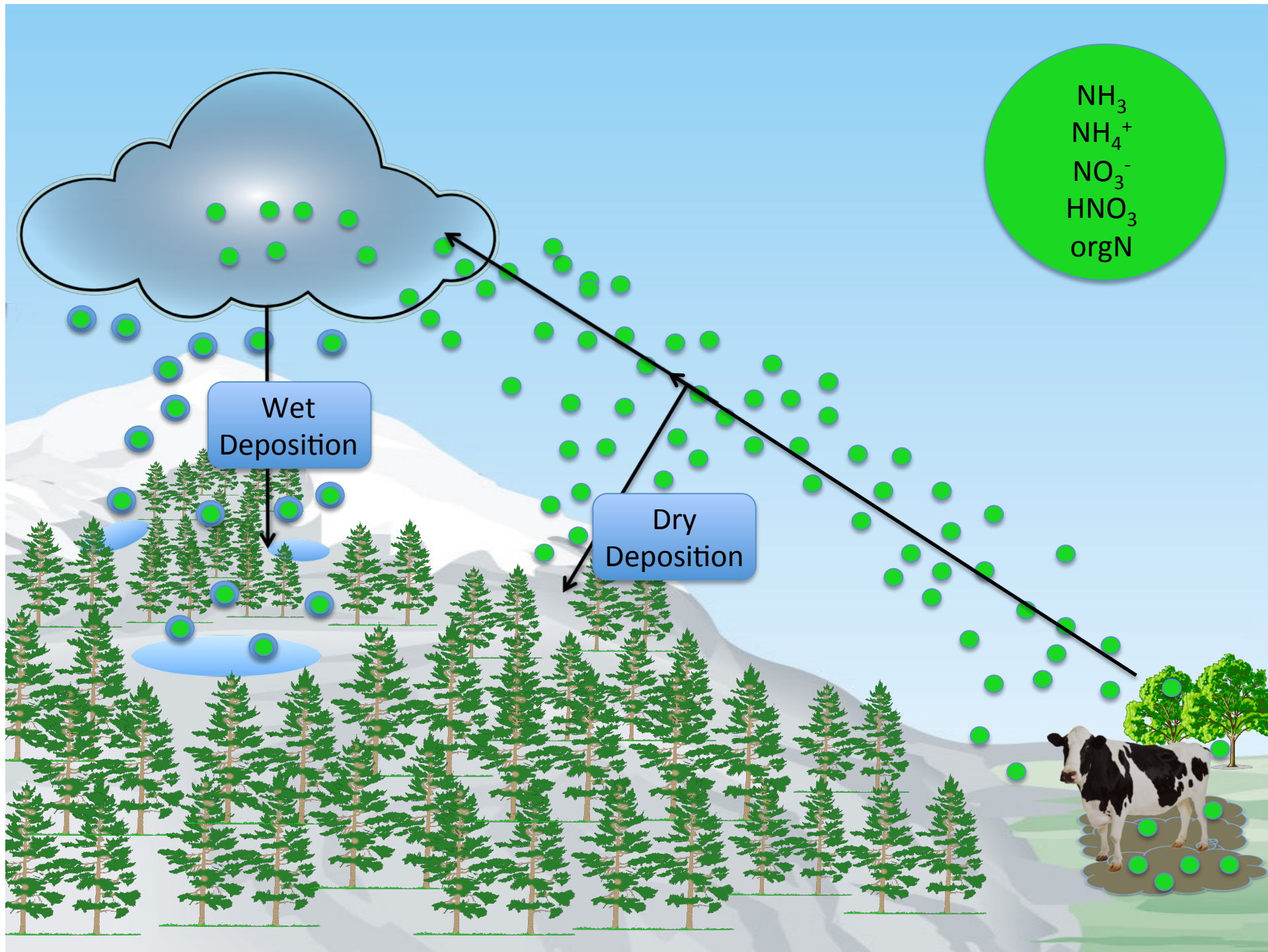
Land Cover

- Wetland
- Fellfield
- Alpine meadow
- Lodgepole pine
- Riparian shrub
- Riparian conifer
- Sub-alpine mixed conifer
- Sub-alpine limber pine
- Krummholz
- Shrub upland alpine
- Cliff face
- Rock
- Talus
- Water
- Glacier
- Rock Glacier

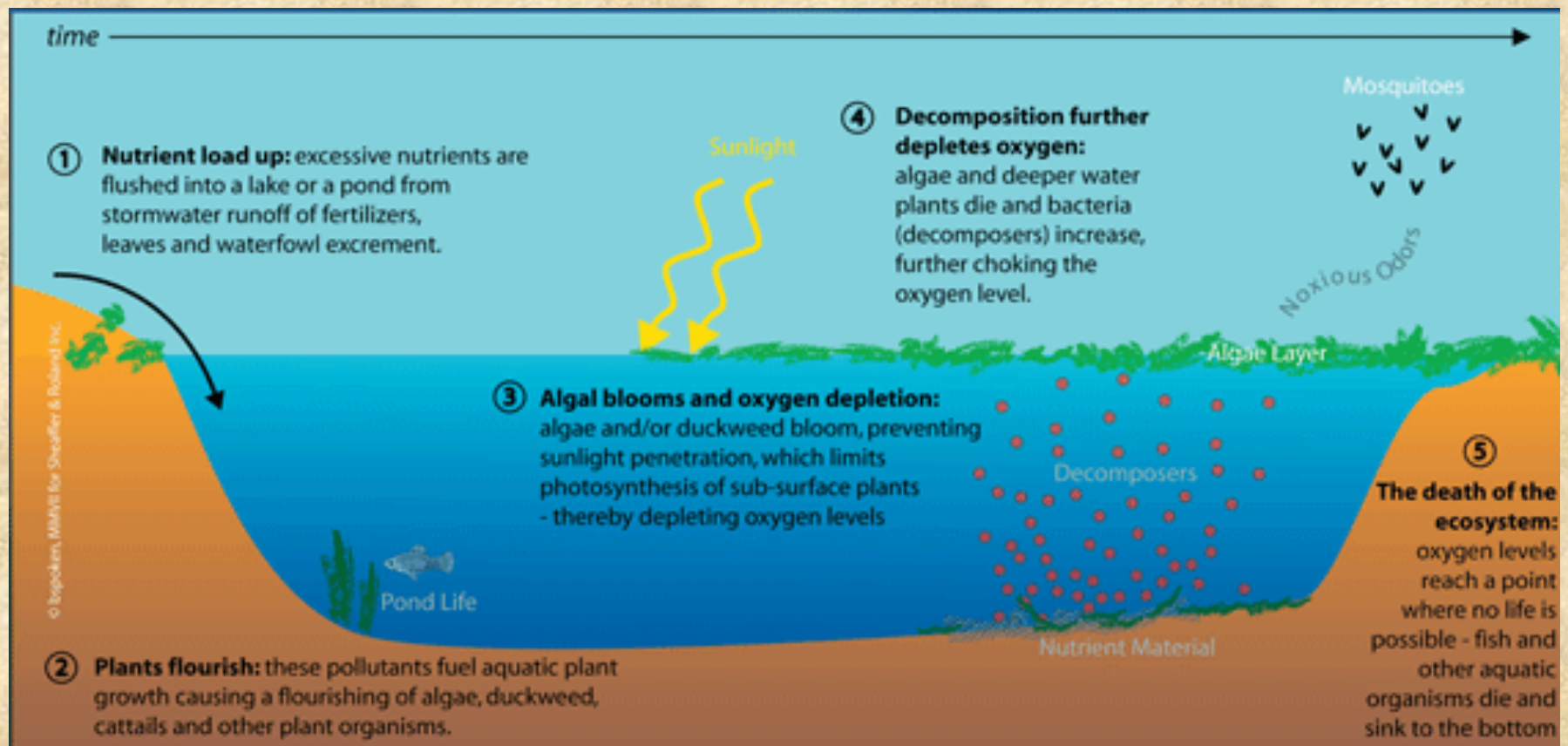


Created by Eric E. Richer
June 20, 2011



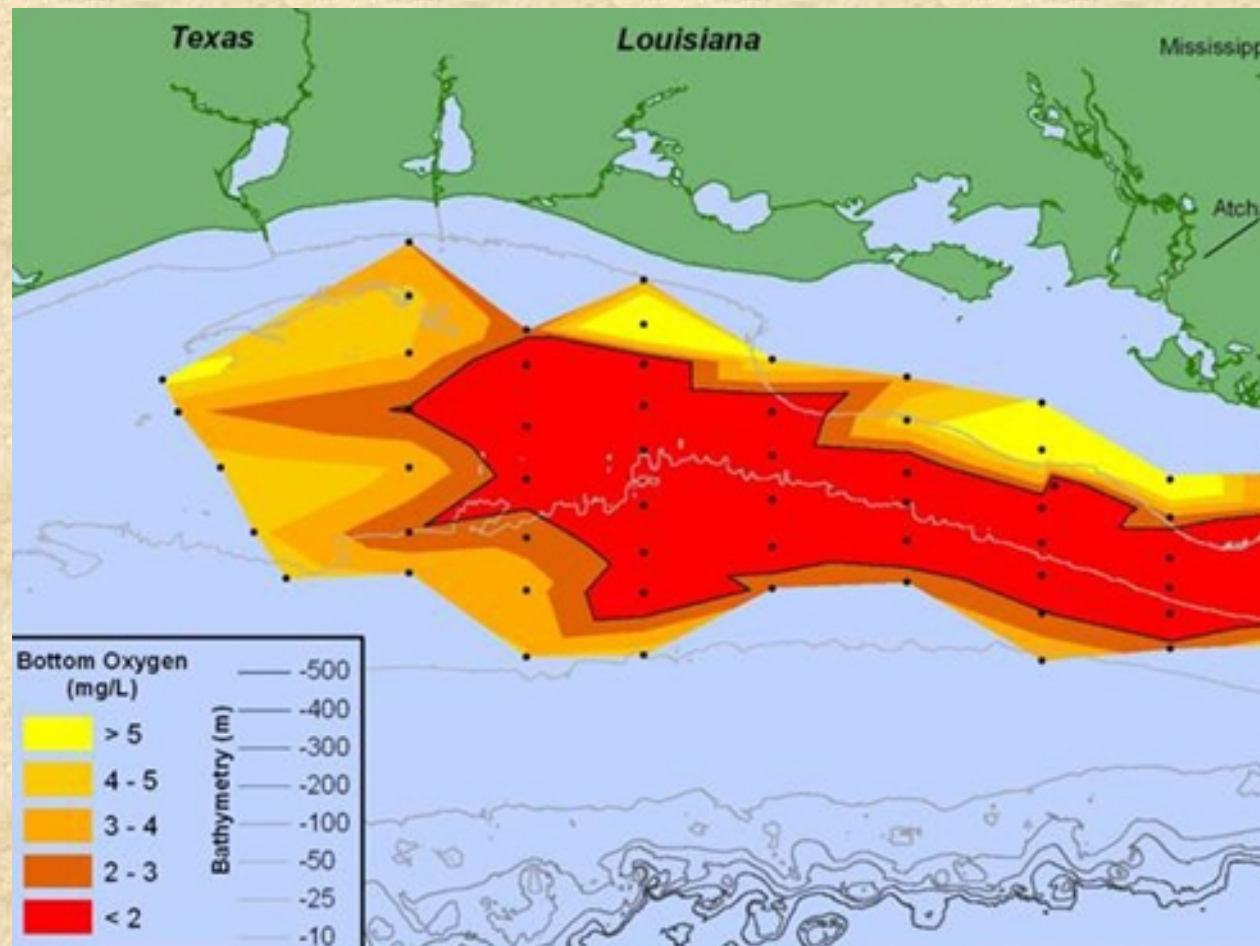


Effects of Nitrogen-loading



Recently in the news...

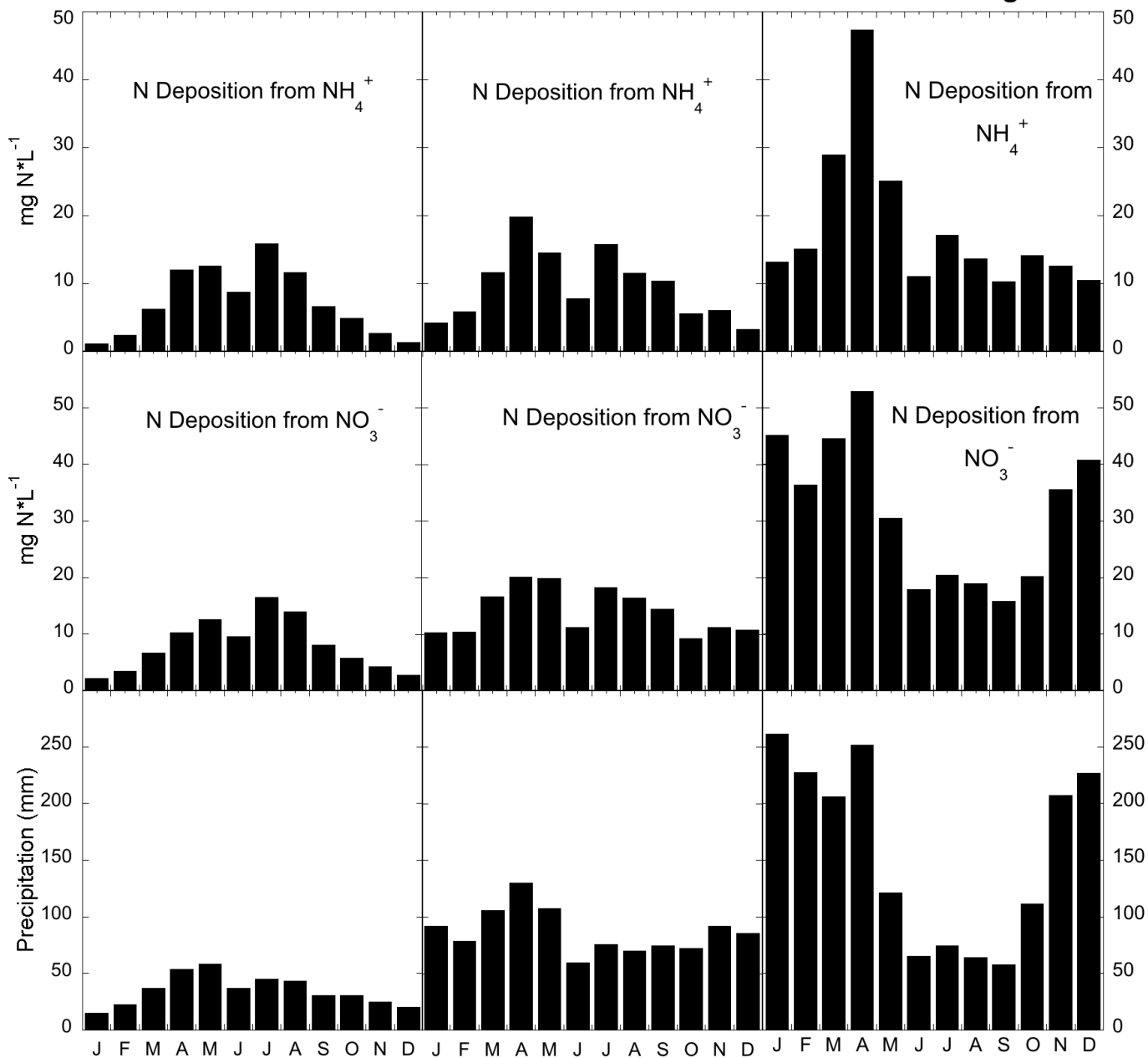
Gulf Coast



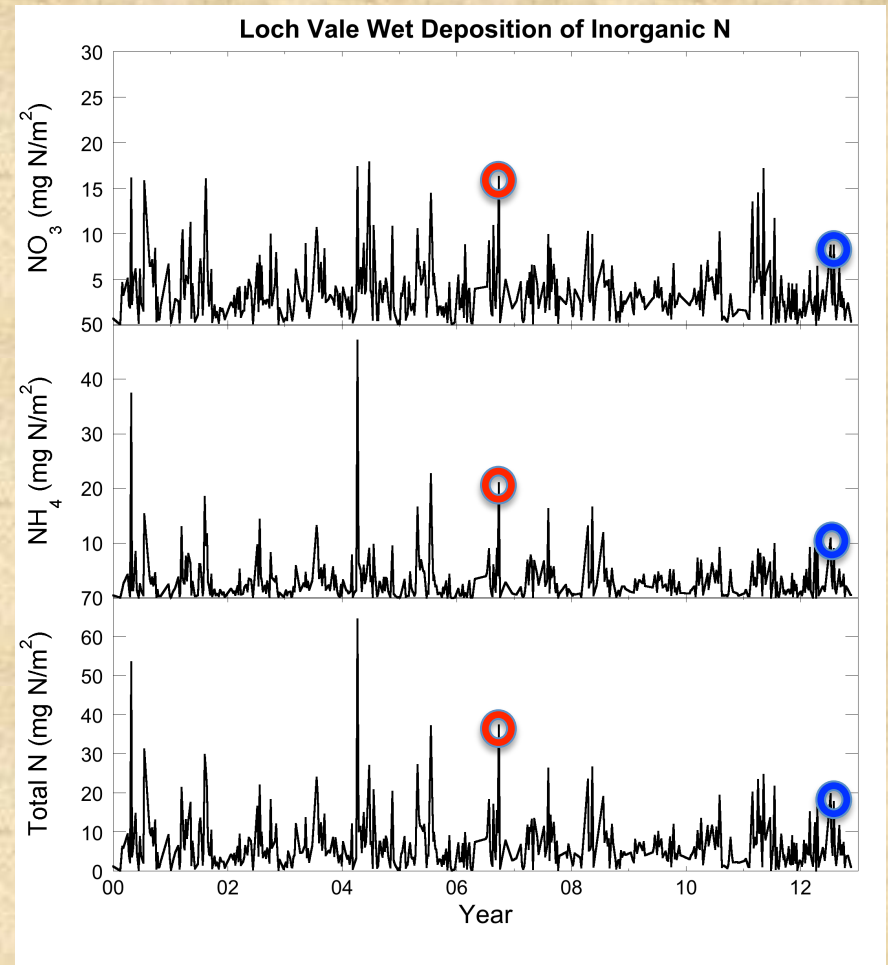
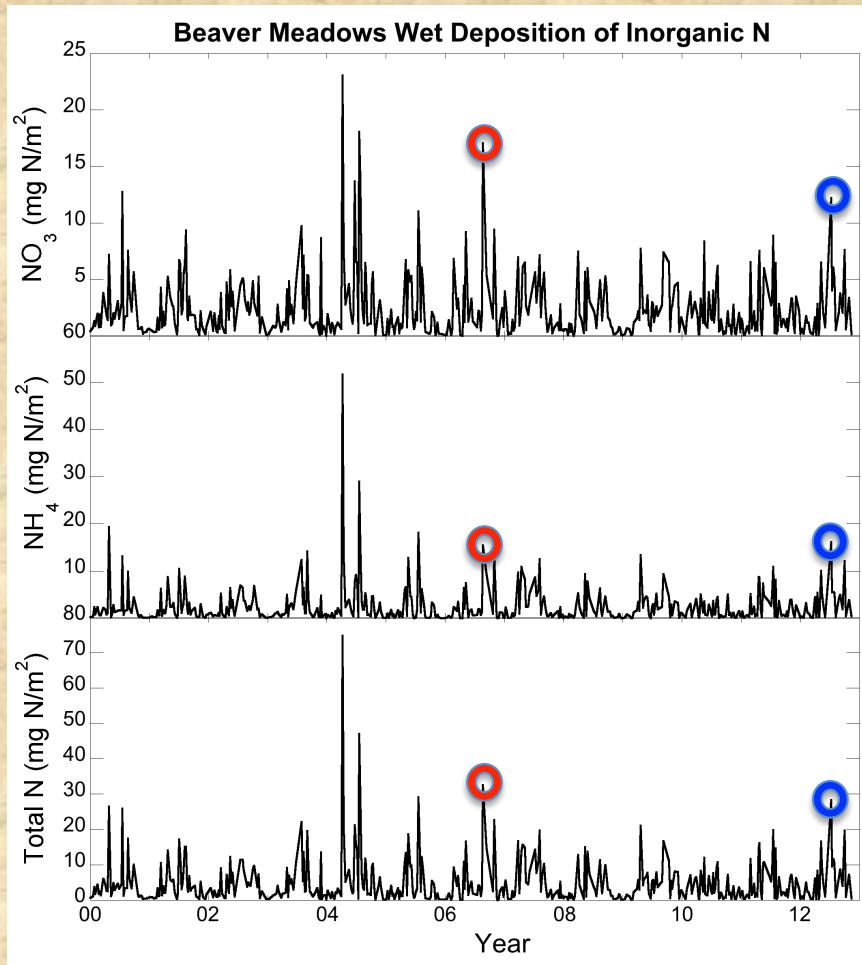
Beaver Meadows

Loch Vale

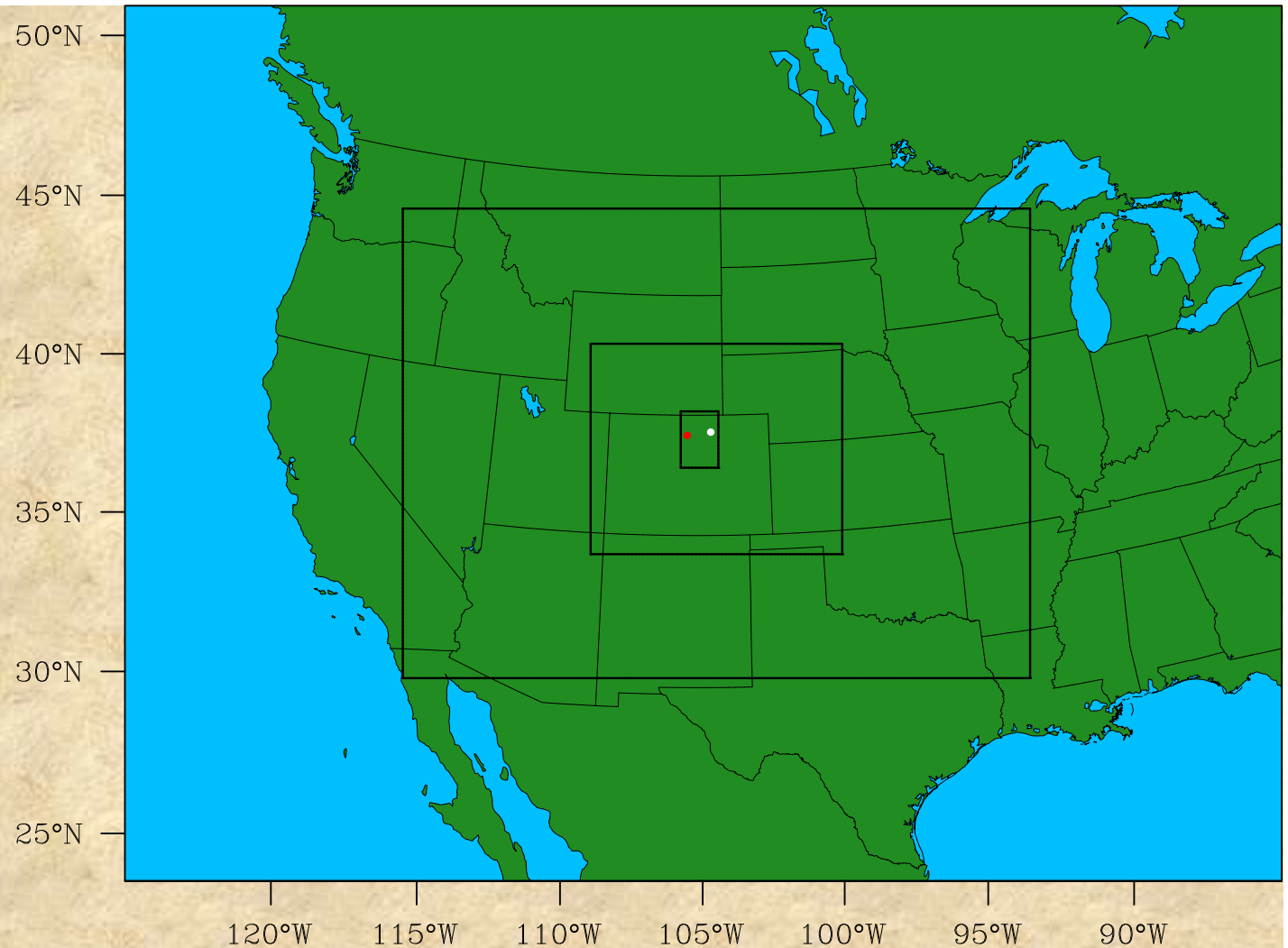
Niwot Ridge



Choosing a Time Period

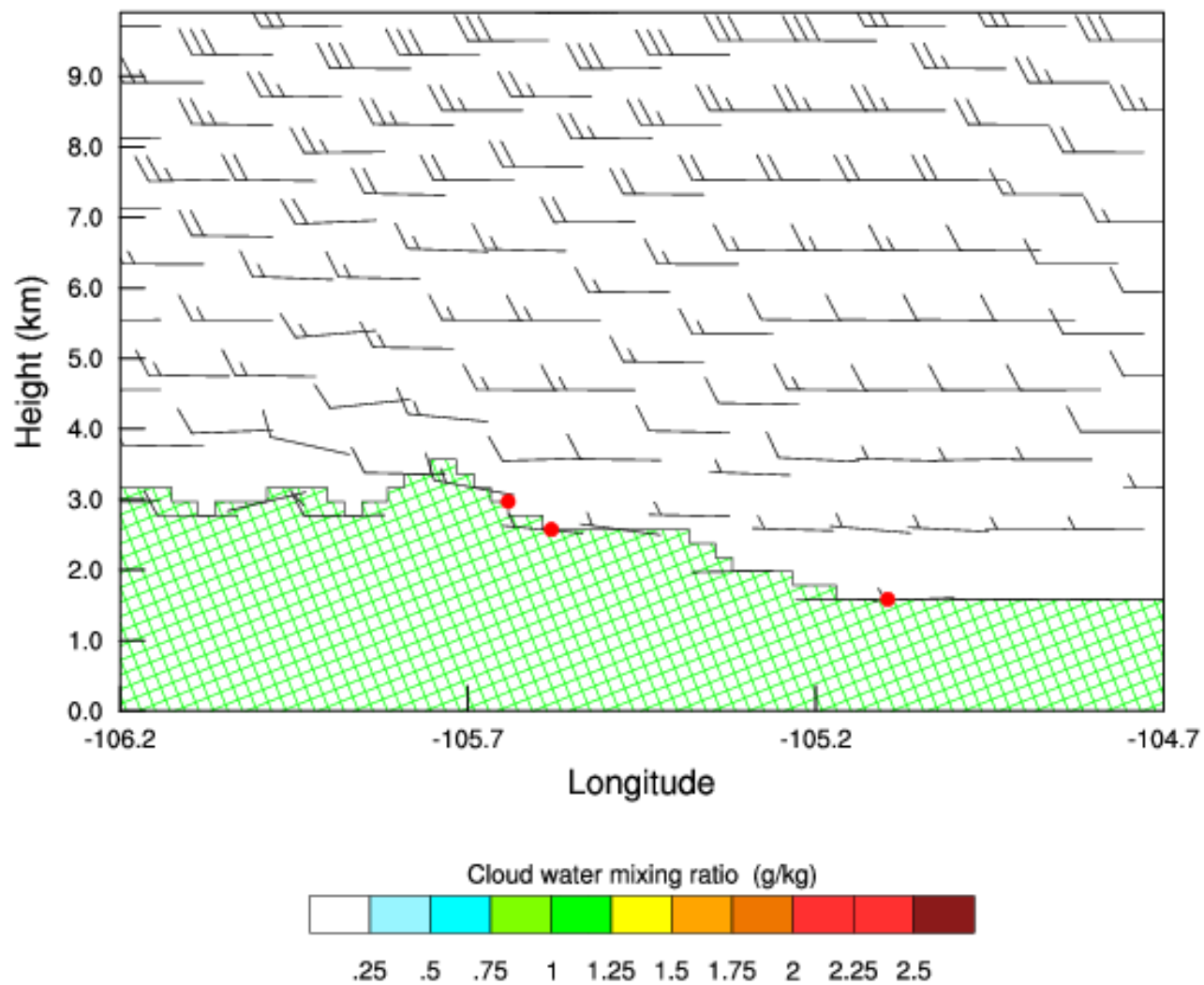


WRF

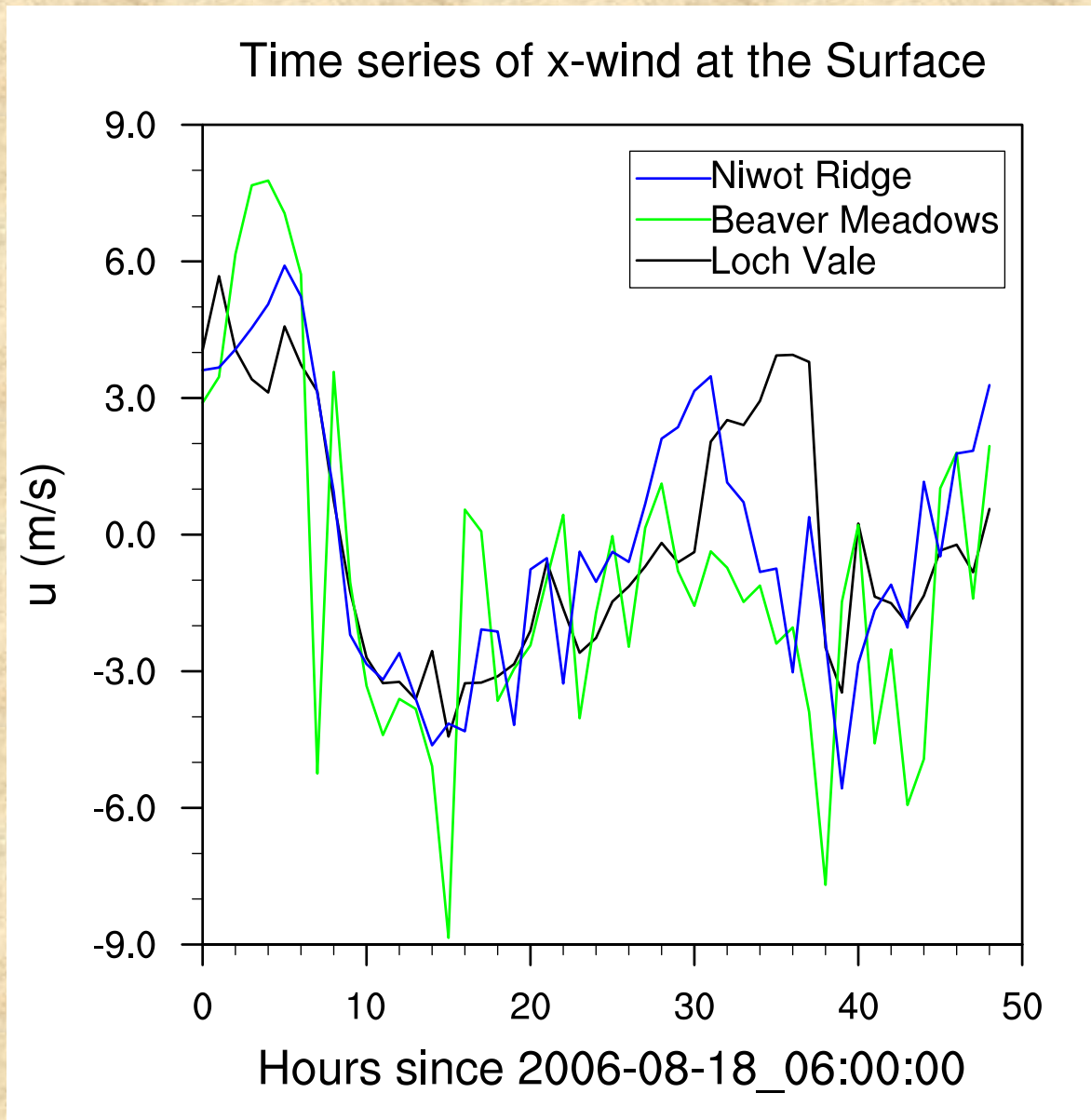


- Initialized with GFS FNL Analysis (1°)
- 4 domains (27 km, 9 km, 3 km, 1 km)
- 50 vertical levels
- Grell 3D cumulus parameterization for domains 1 and 2

RMNP 2006-08-18_06:10:00

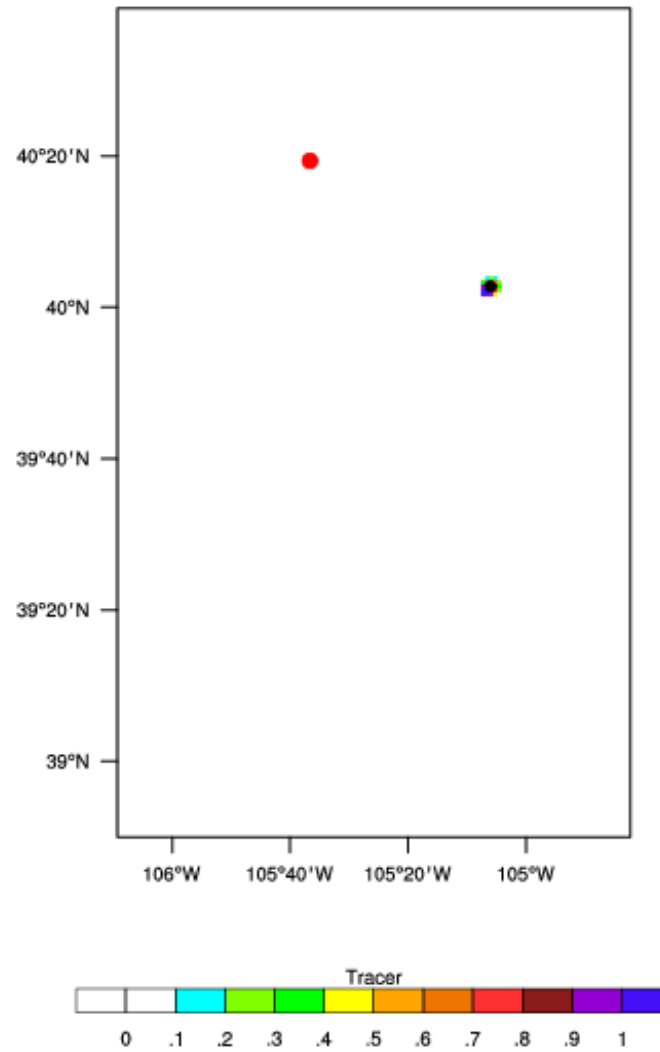


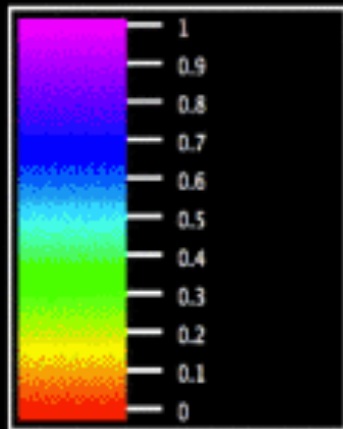
Diurnal Cycle of Winds



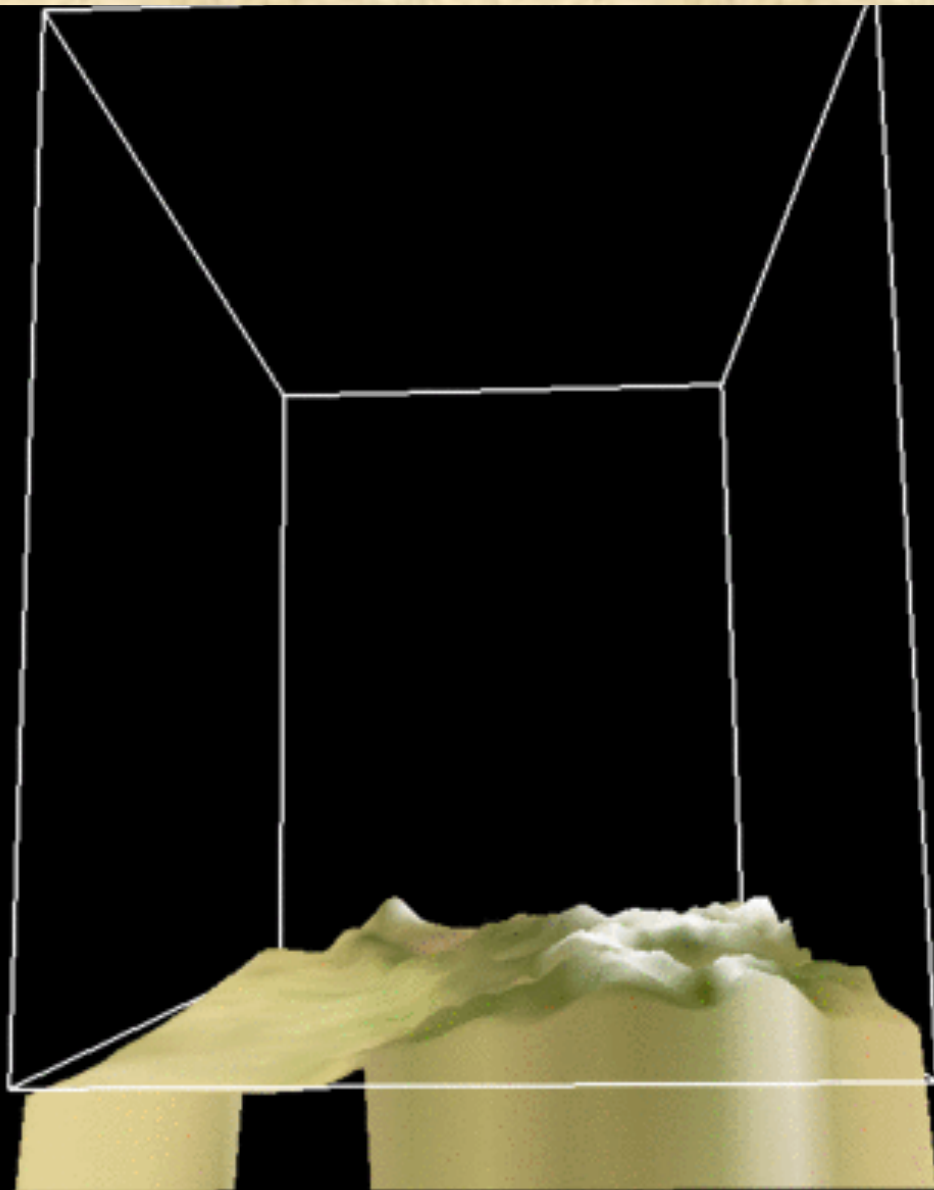
WRF output

Tracer 2006-08-18_06:10:00



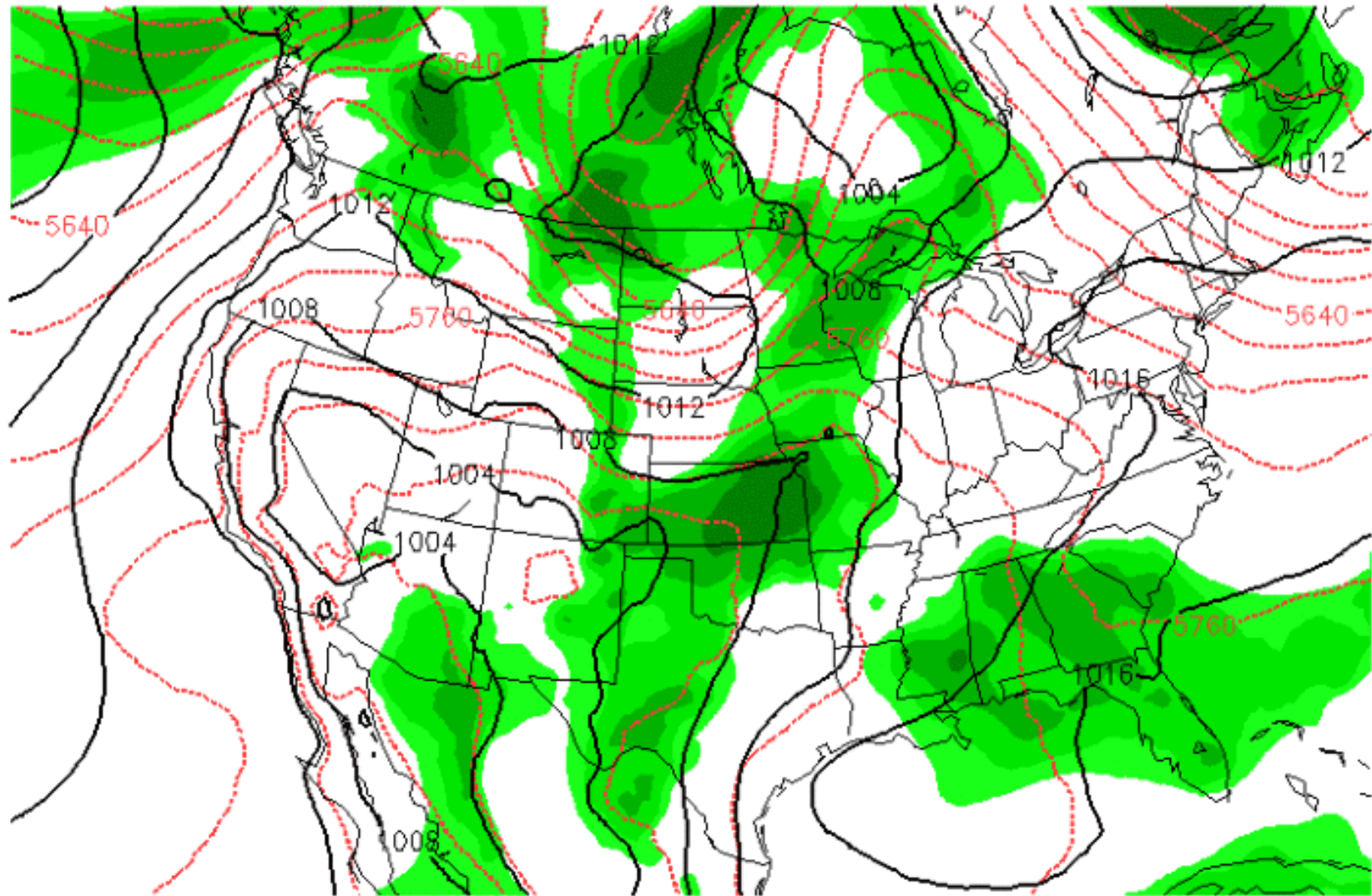


Date/Time: 2006-08-18_06:00:00



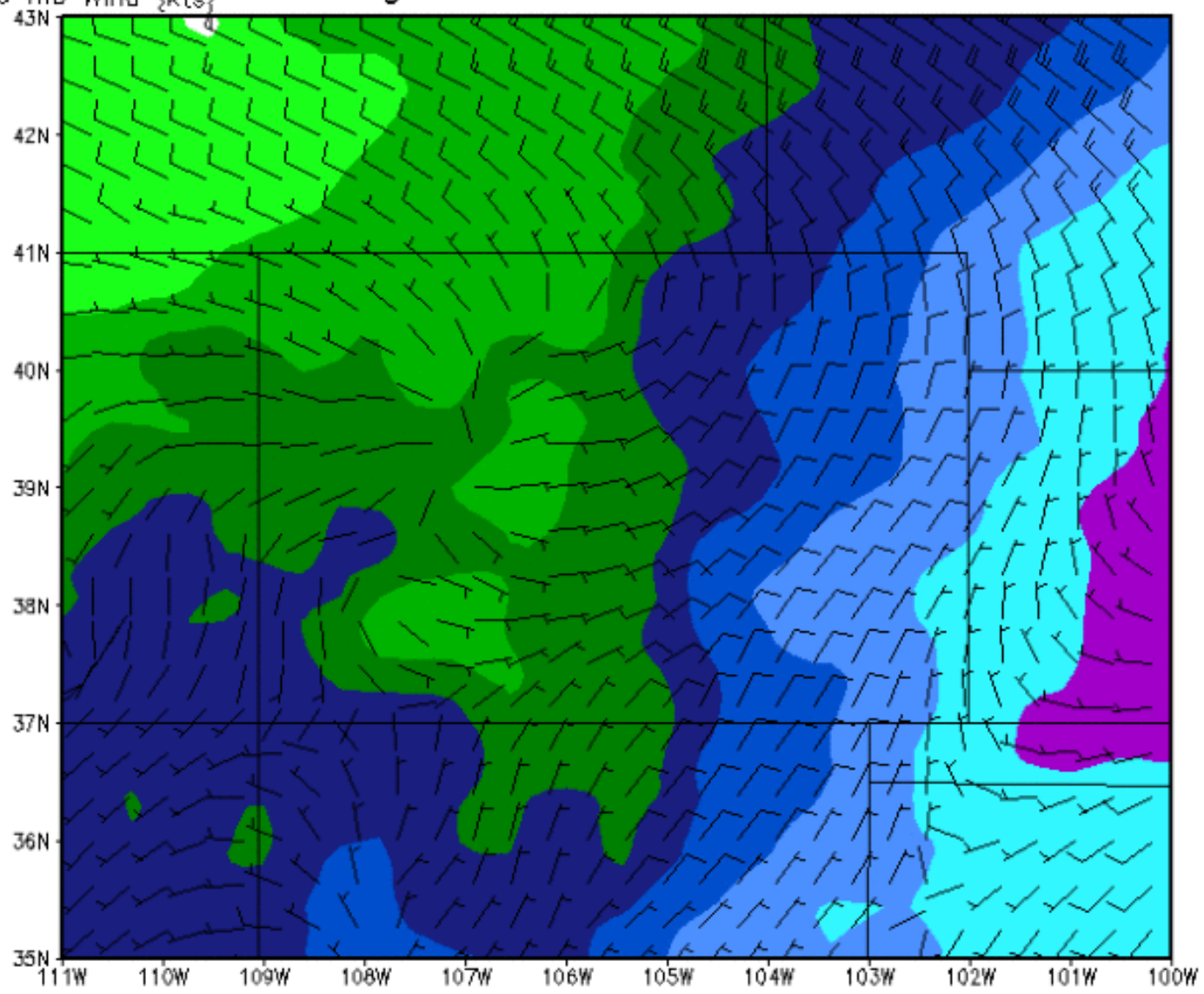
RH {%} (shaded)
☉ {m} (red dashed)
MSLP {hPa} (black)

Aug 13, 2006 6 P.M. MDT



PWC {mm} (shaded)
850-500 mb Wind {kts}

Aug 18 2006 3 P.M MDT



Conclusions

- Looked at N deposition data to choose study period
 - Seasonal cycle in deposition and precipitation
 - Chose two high deposition events
- Simulated time period in WRF
 - Mountain circulation leads to east winds
 - Tracer is advected by winds into the mountains
- Looked at NARR data
 - Synoptic influence has more impact than hypothesized

Acknowledgments

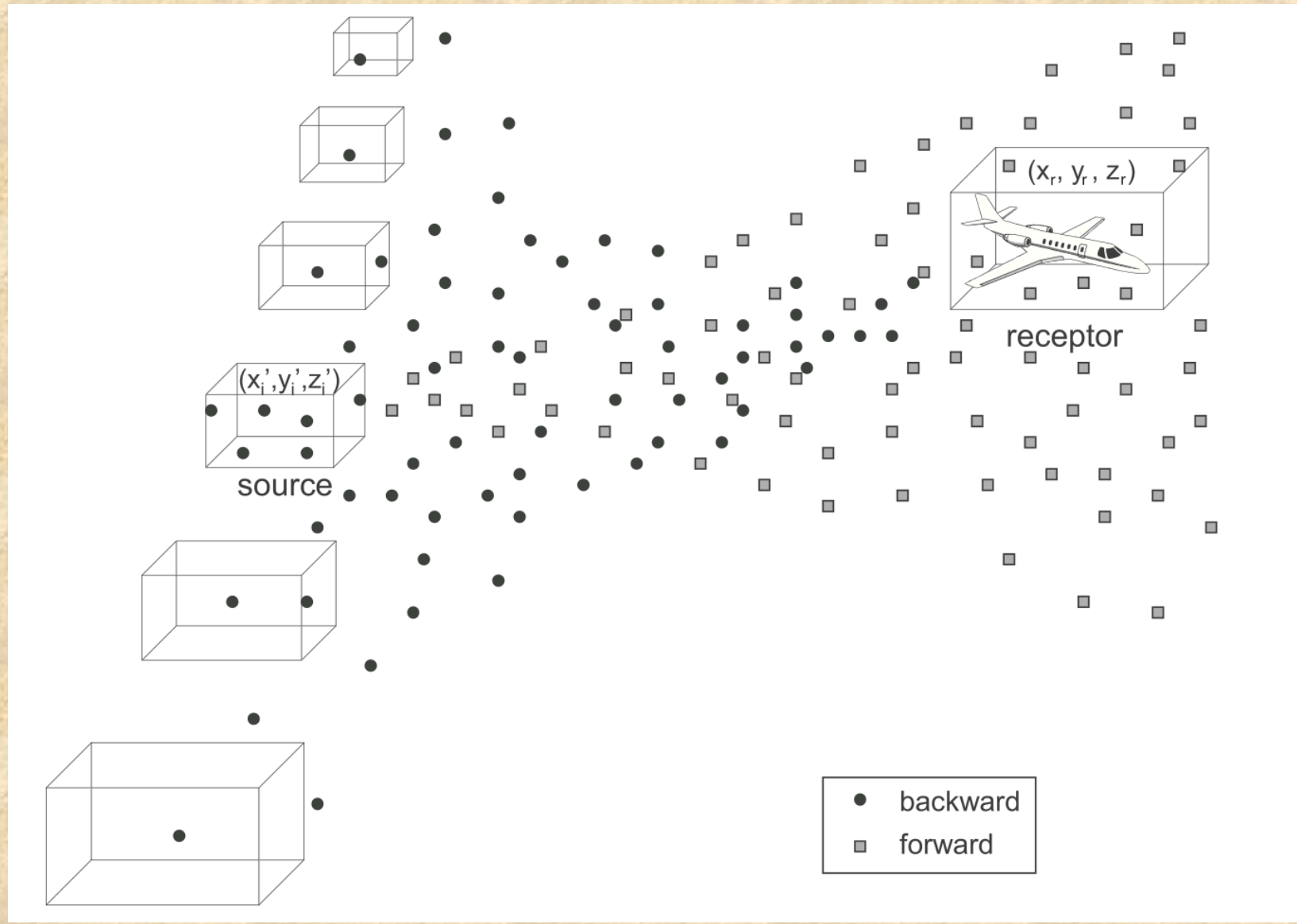
- This material is based upon work supported by the National Science Foundation under Grant No. 0966346.
- Russ Schumacher and Gus Alaka for help with WRF
- I-WATER
- CMMAP
- SOARS
- Title-page feeding: <http://www.nrcs.usda.gov>
- Google Earth
- Animated mountain: <http://dev.prenhall.com>
- Cloud: <http://undertheradarblog.com>
- Deciduous trees: <http://www.finesttreeserviceaz.com>
- Pine trees: <http://www.nmnazkids.com>
- Cow manure 1: <http://www.peta.org>
- Cow manure 2: <http://www.willowcreekfoods.com>
- Sky Pond: <http://resistance.ning.com>
- Glass Pond: <http://bongaloid.deviantart.com>
- Loch Vale: <http://www.summitpost.org>
- Gulf bloom: Louisiana Universities Marine Consortium
- China-man: www.latimes.com
- Eutrophication: <http://onepercentfortheplanet.org/>



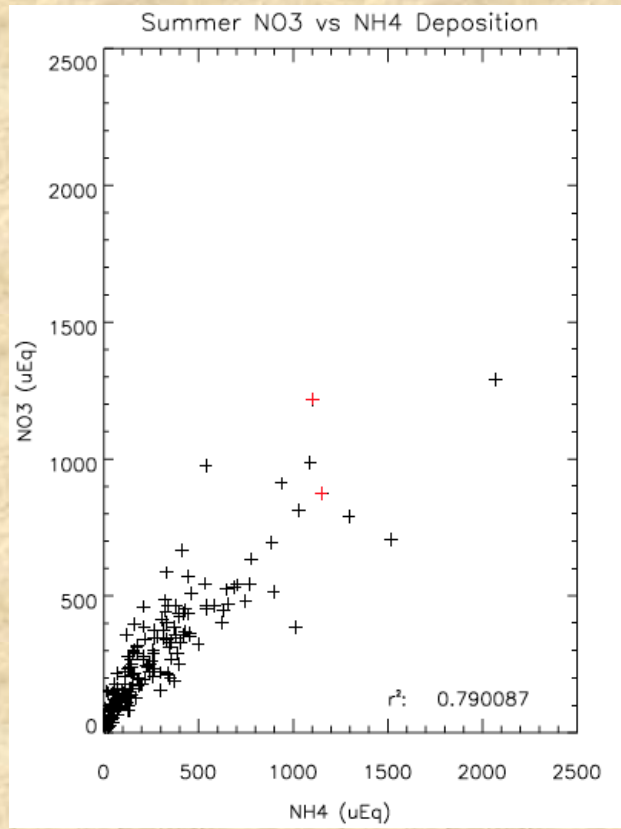
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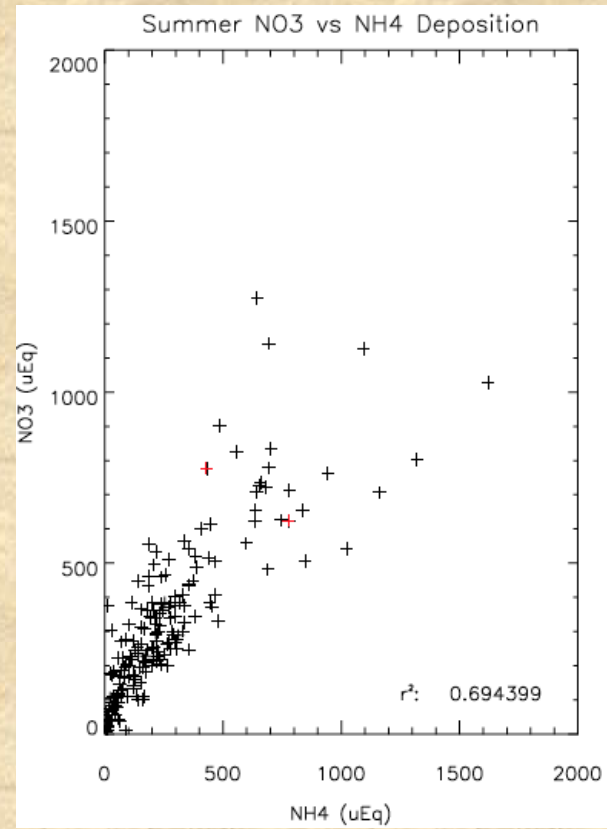
STILT



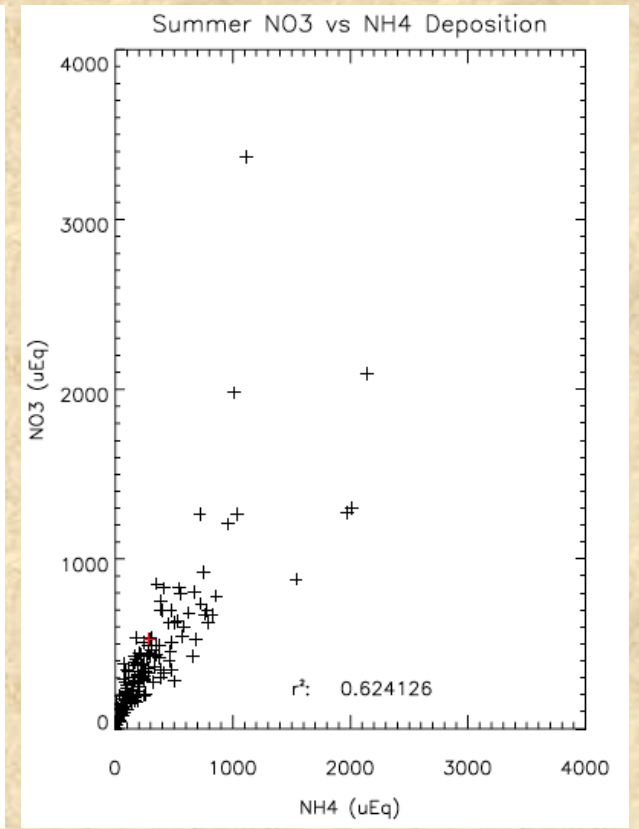
Beaver Meadows



Loch Vale



Niwot Ridge



<http://www.ext.colostate.edu/pubs/crops/00550.html>

