

BENEFITS OF MOUNTAIN OBSERVATORIES FOR COMPOSITION OF THE ATMOSPHERE

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MOTIVATION

- At present, the U.S. operates very few mountain sites for long-term observations of atmospheric composition.
- Not a single mountain site within the continental U.S. has reached the distinction of a World Meteorological Organization Global Atmospheric Watch Global Station.
- For comparison, there are currently six such mountain sites in Europe.

World Metrological Organization (WMO) Global Atmospheric Watch (GAW) Global Stations



MOTIVATION

- Four reports from the U.S. National Academies of Sciences have advocated for long-term measurements at mountain sites.
 - 2001 “**Global Air Quality**” stressed the need and made recommendation to “*establish new capabilities to provide long-term measurements.*”
 - 2010 “**America’s Climate Choices**” recommended that federal government redouble efforts towards *long-term, stable, well-calibrated observations, with mountains as strong indicators of climate change.*
 - 2010, “**Global Sources of Local Pollution**,” stated *continuous aerosol measurements, including those made at mountaintop sites, can distinguish between local and long-range transported pollutants.*
 - 2017 report on Atmospheric Chemistry - key recommendation: “*The National Science Foundation should take the lead in coordinating with other agencies to identify the scientific need for long-term measurements and to establish synergies with existing sites that could provide core support for long-term atmospheric chemistry measurements.*”



ACPM 2010; Swiss Academy of Sciences in Interlaken ACPM 2014: Storm Peak Laboratory, Steamboat Springs, CO

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Overview of the Special Issue “Selected Papers from the 2nd Atmospheric Chemistry and Physics at Mountain Sites Symposium”

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ACPM2017

2017 Symposium on
Atmospheric Chemistry and Physics
at Mountain Sites

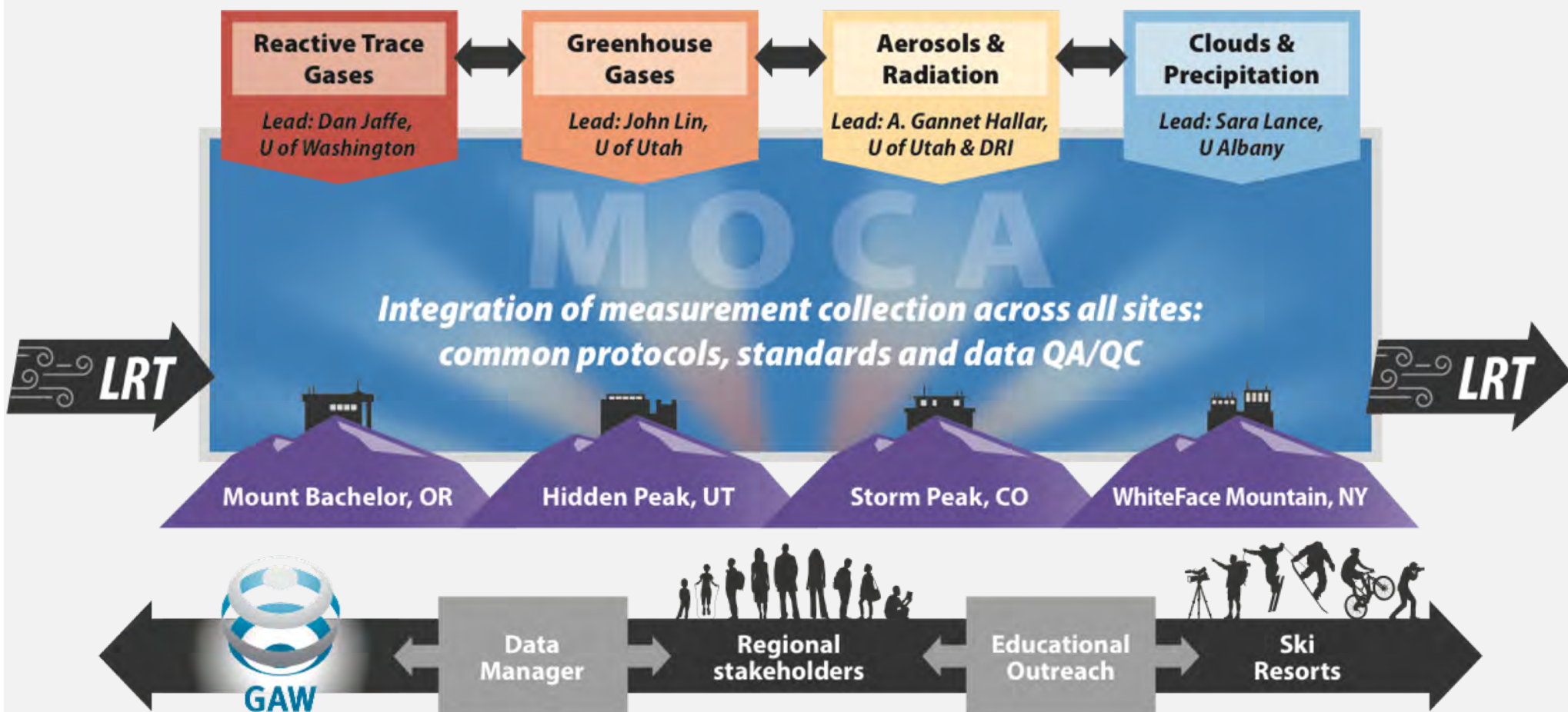
November 6 - 10/ Tokinosumika, Gotemba, Shizuoka, Japan

Mountain Observations for Composition of the Atmosphere (MOCA)

DESIGN PLAN FOR U.S. NETWORK

- Start with existing mt. sites with recognized expertise in distinct research areas.
- Assemble an international recognized science team for each research area.
- Ensure sites are located in separate regions and sample different chemical regimes.
- Ensure that all sites follow protocols established by GAW for data collection, data quality, data format, and data access.
- Convene a strong external advisory board to ensure MOCA meets the scientific needs of community.
- Ensure all sites provide high quality research training and scientific outreach.

PIs, External Advisory Board, and Project Manager



MT. BACHELOR OBSERVATORY (MBO) REACTIVE TRACE GASES



“Sampling the free troposphere since 2004”

- The only high elevation/free trop research site on west coast of U.S. (2.8 km asl)
- Continuous observations of CO, O₃, aerosols and Hg since 2004;
- Frequent detection of Asian pollution and biomass burning plumes;
- Data Validate global models for Hg, O₃ and CO;
- Data collected and used in 10+ PhD theses
- 50+ publications and 30+ collaborators.

Key goal: Identify importance of global sources on US air quality.

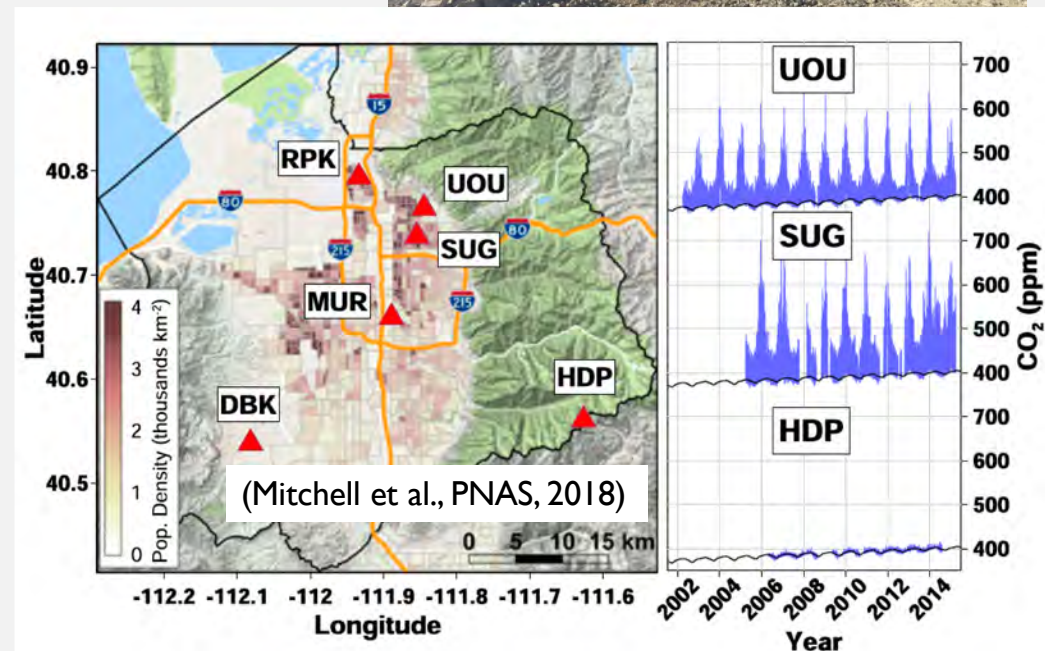


HIDDEN PEAK (HDP) GREENHOUSE GASES

- HDP CO₂ site established by NCAR (PI: B. Stephens) in 2006
- Instruments in ski tram building on Snowbird Ski Resort
- Management of site transitioned to University of Utah in 2016



Vicinity to Salt Lake City urban area has enabled it to serve as regional background site against which **urban emissions and enhancements** can be characterized

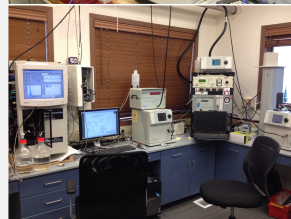


STORM PEAK LABORATORY (SPL) AEROSOL AND RADIATION

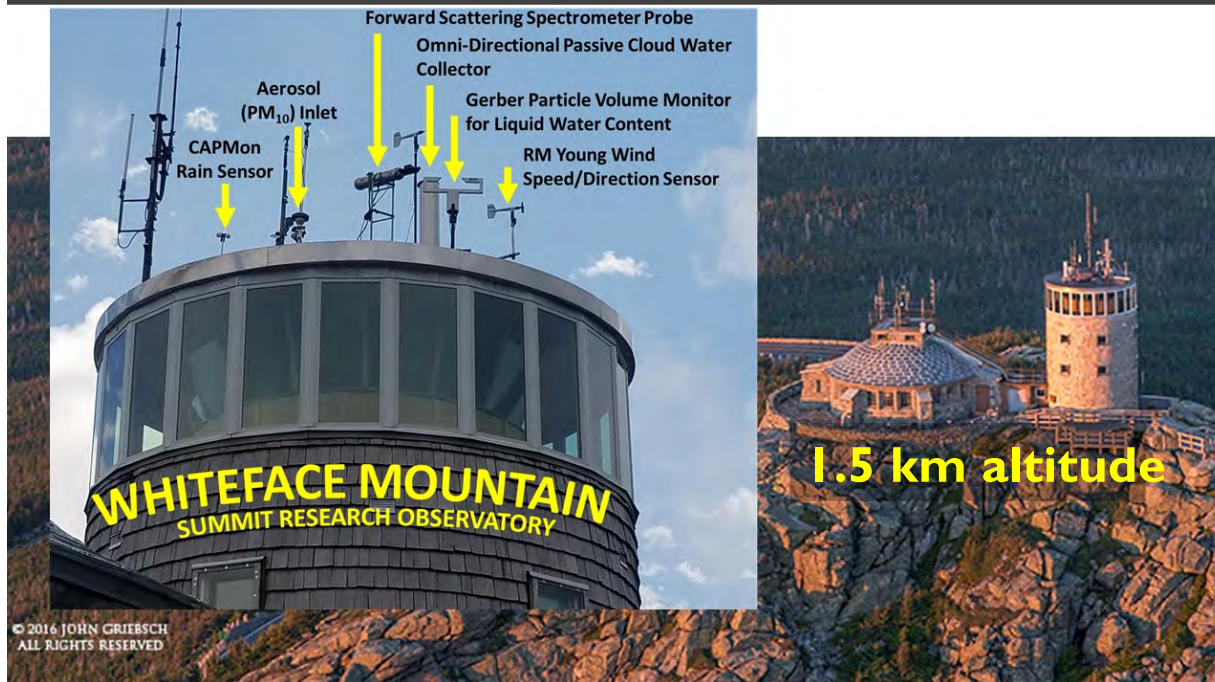
- **Aerosol Concentration**
- **Aerosol Optical Properties**
 - Nephelometer - 3λ
 - CLAP - 3λ
- **Aerosol size distributions**
 - TSI SMPS 10-350 nm
 - TSI nano-SMPS 3-60 nm
 - TSI APS 0.5 – 20 μm
- **DMT CCN Counter**
- **Multi-Filter Shadow-band Radiometer (UV & Visible)**
- **DMT Cloud Probes**
 - SPP-100 forward scattering spectrometer 2–47 μm
 - CIP 25–1550 μm
 - PIP 100–6200 μm
- **CO₂ Measurement - NCAR**
- **O₃, SO₂, CO, NO_x, Water Vapor**
- **Isotope measurements**
- **Cold Room- Cloud Sieves**
- **Meteorological Stations –7 on mt.**
- **Sonic Snow Depth and Liquid Water Equivalent**



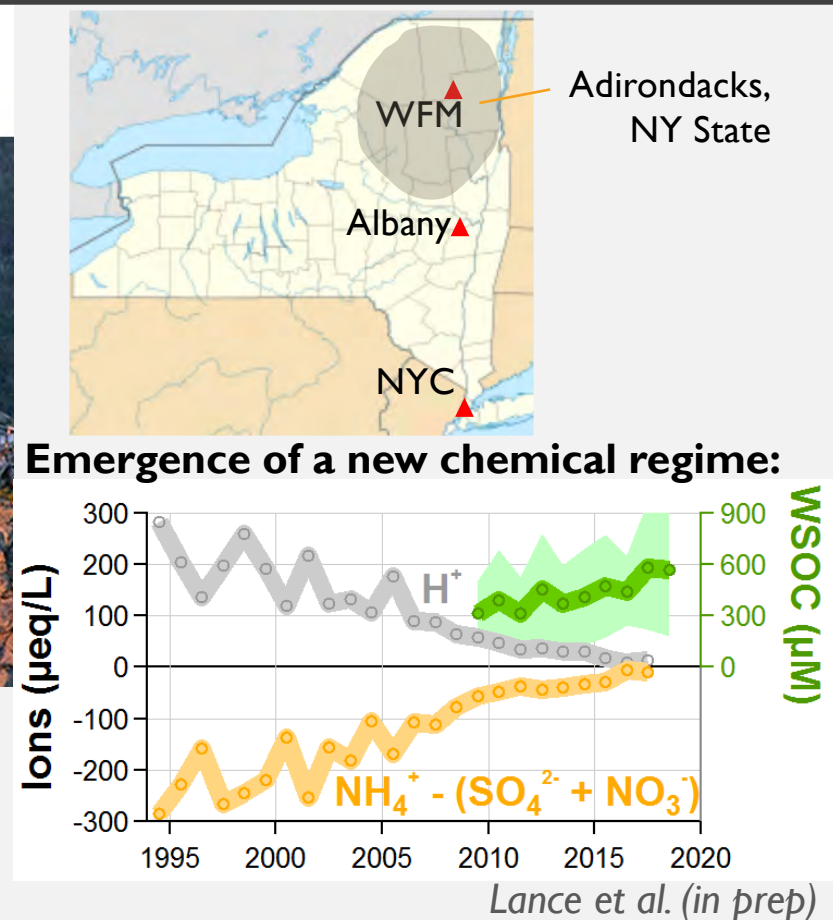
Located on Steamboat Springs Ski Resort
Elevation: 3220 m (10,530 ft)
Pressure: ~ 690 mb
In cloud ~25% of time in winter
Mixed Phase Clouds
9 Person Bunkhouse
Full Kitchen, Running Water
Facility and Guest Instruments
Wet Chemistry Lab
~140 peer reviewed publications



WHITE FACE MOUNTAIN (WFM) CLOUDS AND PRECIPITATION

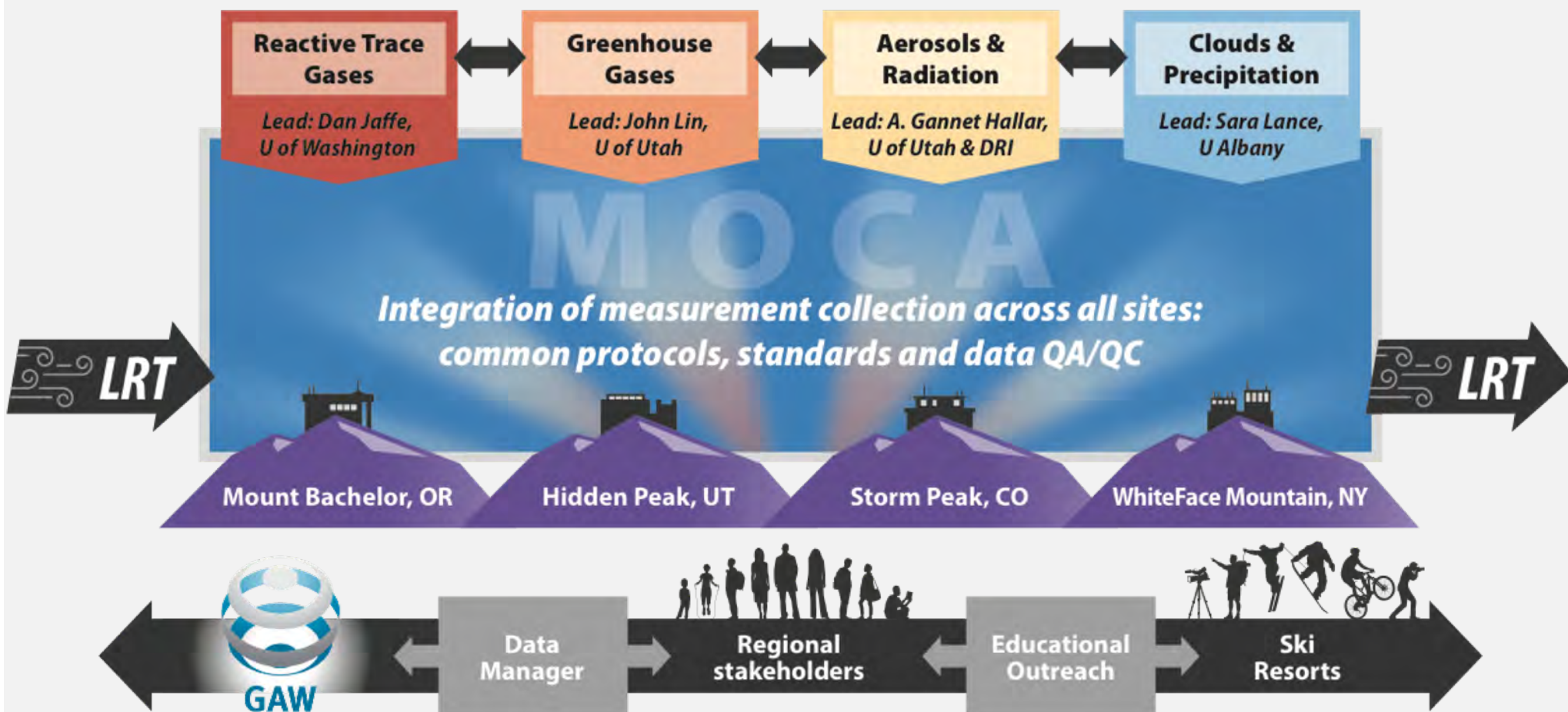


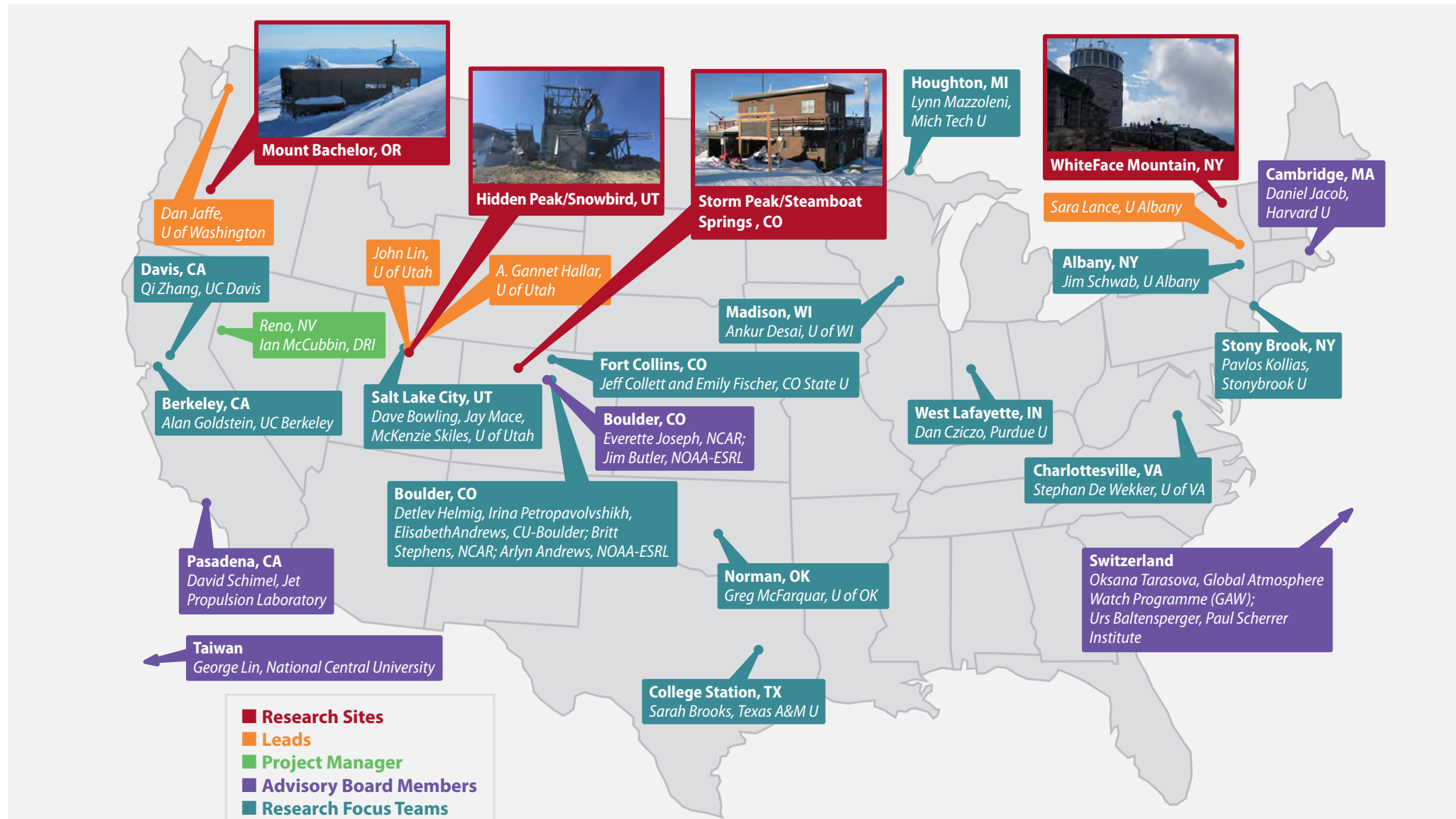
Polluted samples are more basic now due to reduced SO₂ and NO_x emissions and relatively high NH₄. The new chemical regime exhibits increasing water soluble organic carbon (WSOC).



Decades of reactive trace gas (O₃, SO₂, NO_x), aerosol and cloud measurements. -- Brandt et al., Schwab et al. (2016)

PIs, External Advisory Board, and Project Manager





SUMMARY MOCA CONCEPT

- Goal to establish an internationally competitive center of excellence for the study of high-elevation atmospheric processes to understand changes in aerosols, greenhouse gases, reactive gases, and clouds across the U.S.
- Provide critical atmospheric measurements will lay the foundation for integrating a common suite of continuous long-term measurements and transferring knowledge among the centers of excellence.
- Managed as a collaborative effort and supported by a distinguished advisory board, the network will create new synergy by capitalizing on existing expertise at each site to expand the capabilities at all sites.

MOCA WORKSHOP PLANNED FOR SUMMER/FALL 2020

- Details coming soon.
- Will be hosted by SUNY Albany (WFM)
- Please email: gannet.hallar@utah.edu to join us!



Thank you!