U.S. Department of Energy (DOE)
Atmospheric Radiation Measurement (ARM) Climate Research Facility

# ARM Update & Changes

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Represented Contributors:
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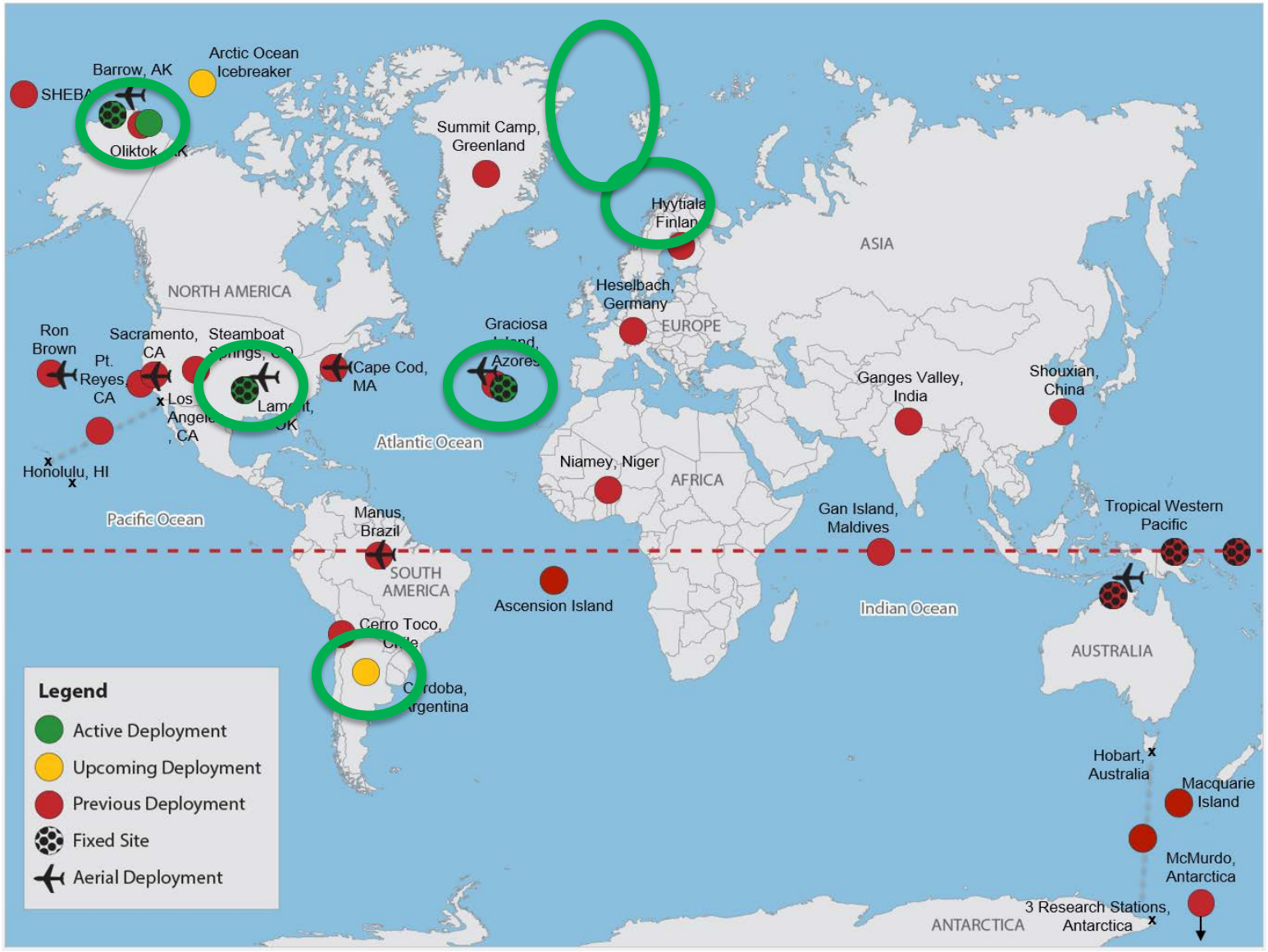
University of Alaska Fairbanks: Martin Stuefer, Telayna Gordon
University of Wisconsin-Madison: Lori Borg
NOAA National Centers for Environmental Information (NCEI): Howard Diamond

# ARM Site & Campaign Locations (1992 – Present)

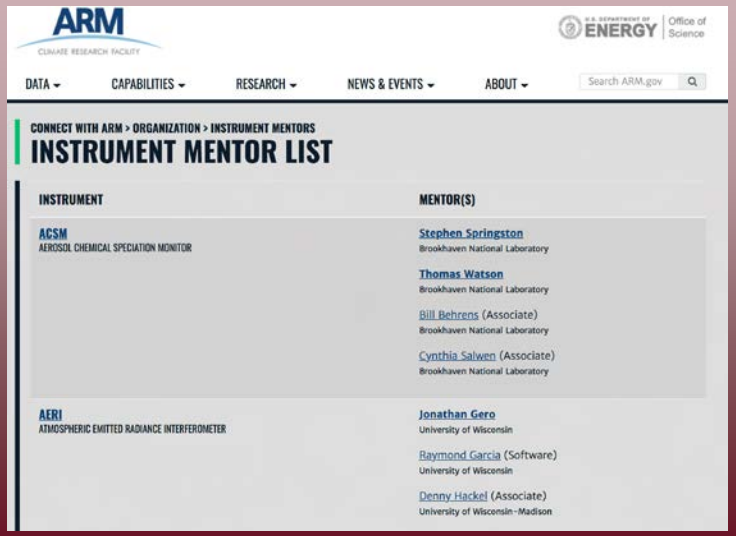


# Working With the ARM User Facility

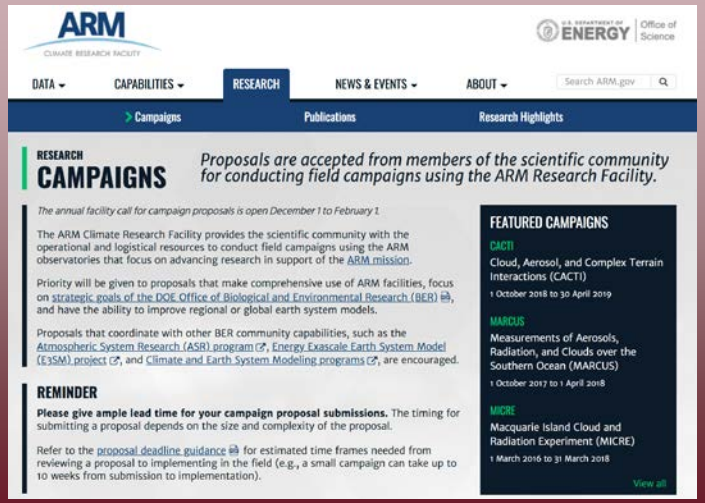
- Types of Funding Activities:
  - Approved Field Campaign
  - Engineering Development
- Justification Measures
  - ARM Mission
  - Scientific Contribution
    - Users
    - Publication Impact

## Download Data From the Archive


## Collaborate with Instrument Mentors




## Propose a Field Campaign



# ARM Radiosonde Operations Upgrades

- May 2017: Expansion of NSA Autosonde deck
  - Improve manual launch operations
  - Support conversion to hydrogen lifting gas
  - Cooperative Agreement w/ National Weather Service
    - Two additional launches per day (1100 & 2300 UTC)
- RS41 Launch Start Dates
  - SGP C1:  13 Nov 2017
  - SGP S01:  14 Jan 2018
  - NSA C1 (Autosonde):  18 Oct 2017
  - NSA S01:  27 Feb 2018
  - ENA S01:  12 Apr 2018 (RIVAL approval yesterday)
  - AMF1: CACTI (Oct 2018)
  - AMF2: MOSAIC (Sep 2019)
- Mass Flow Controllers
  - OLI: 2015/2016
  - SGP: Sep 2017
  - ENA: Coming Soon

# SGP Radiosonde GRUAN Specific Criteria & Gaps

- ✓ ARM submitted SGP GRUAN site certification proposal 06 Mar 2017
- ✓ GRUAN review comments received: 11 Apr 2018
- ❑ Responses to reviewer comments: In progress

- ❑ Resolve ARM/GRUAN User Metrics

- ✓ Dedicated surface observations for radiosonde system:
  - Vaisala MAWS systems are operational and integrated at SGP, OLI, ENA, NSA

- ✓ Balloon Fill Regulation:
  - Mass Flow Controllers in use at SGP, OLI, NSA (autosonde), ENA imminent

- ❑ Standard Humidity Chamber (SHC) at SGP: Funding not proposed
  - Needs champion with scientific justification
  - Informal quote received but order dependent upon 10 quantity purchase

- ❑ Burst Heights 10 mbar (ARM typical 15-20 mbar): Funding not proposed
  - Needs champion with scientific justification

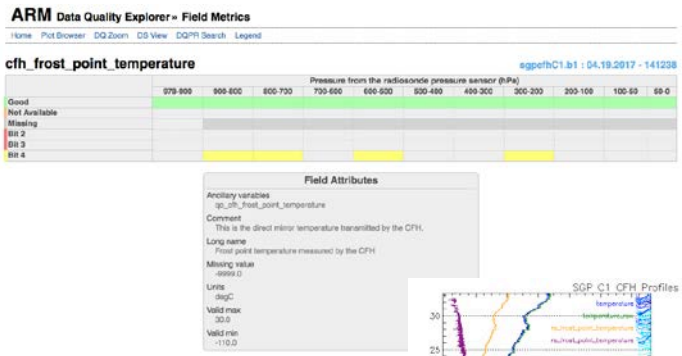
- ✓ Participation in GRUAN Activities: RIVAL outcome of ICM-8 (Borg, et al.)

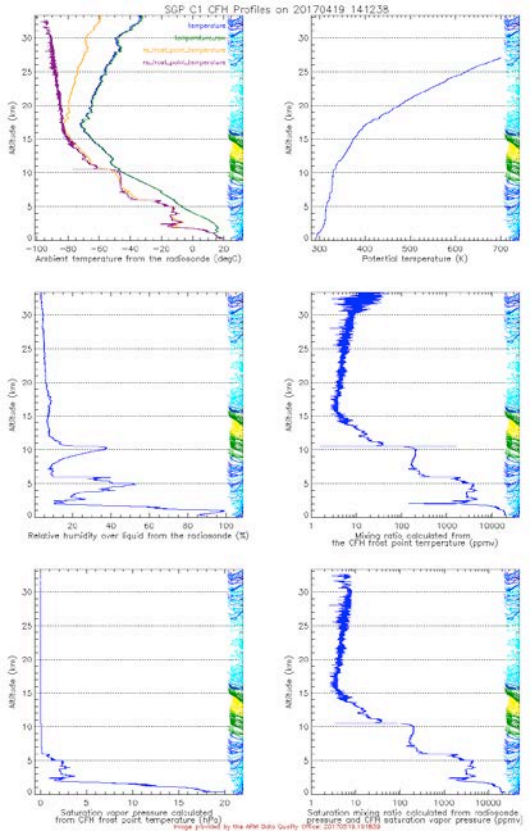
# ARM Balloon-Borne Cryogenic Frost-Point Hygrometer (CFH) Measurements – Humidity (1/mo)

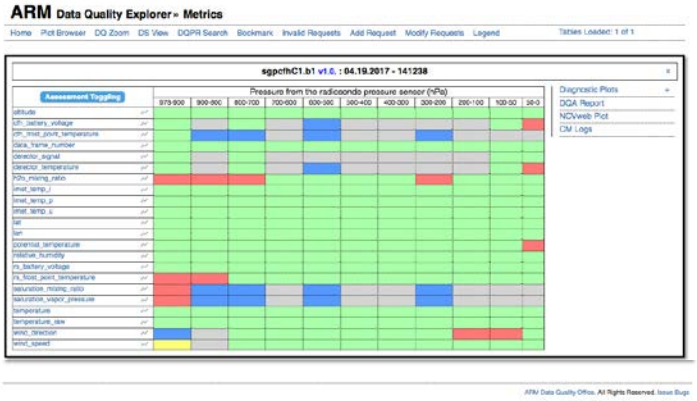
- NOAA provides CFH launch hardware (**Howard Diamond**)
- ARM provides mentorship oversight (**Martin Stuefer, Telayna Gordon**)
- ARM provides operational effort support
- GRUAN Lead Center provided launch procedures & software

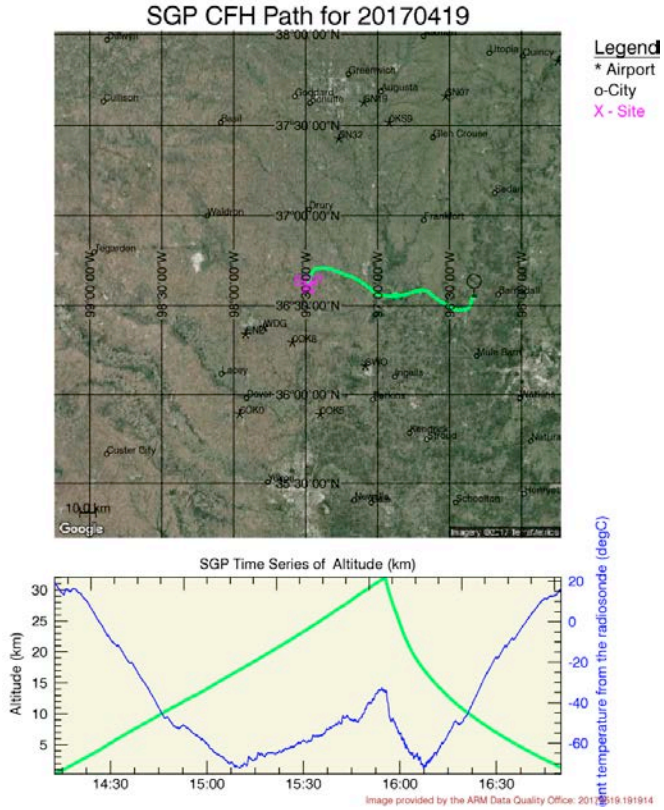
- Launch package updates:
  - Cryogenic Frostpoint Hygrometer from JH Acquisition LLC
  - (EnSci is in the process of becoming JH Acquisition LLC)
  - InterMet IMet1 RSB
  - Vaisala RS92 radiosonde, ground check with Vaisala GC25 prior to each launch
  - Vaisala RS41 radiosondes added to CFH launch package in support of RIVAL: 12 Apr 2018
  - CFH launches have been coordinated with overpasses of the MetOp polar orbiting meteorological satellites
  - ENSCI purchase price for CFH now ~$3,000 (one-time use concerns)

# ARM Data Plots & Quality Checks

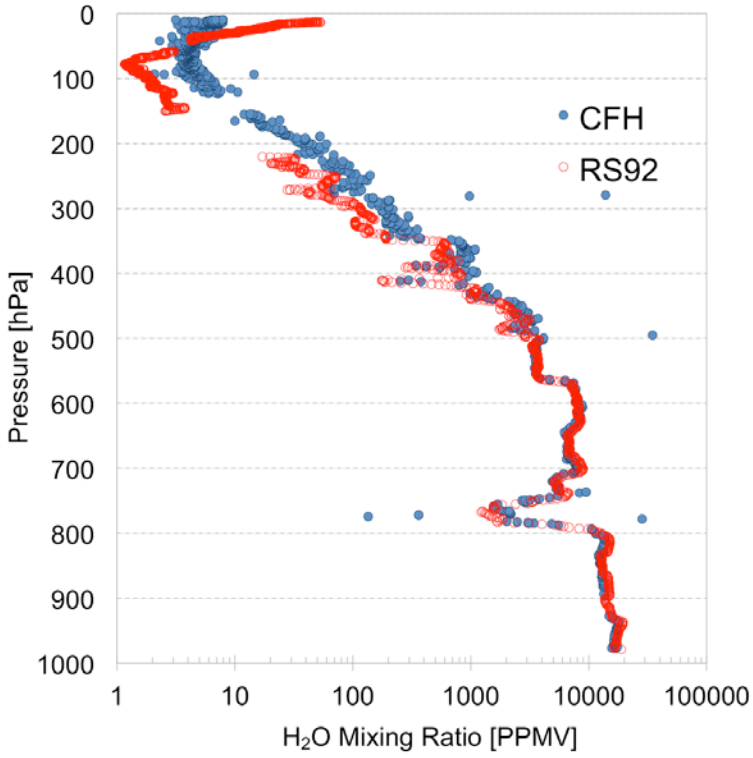


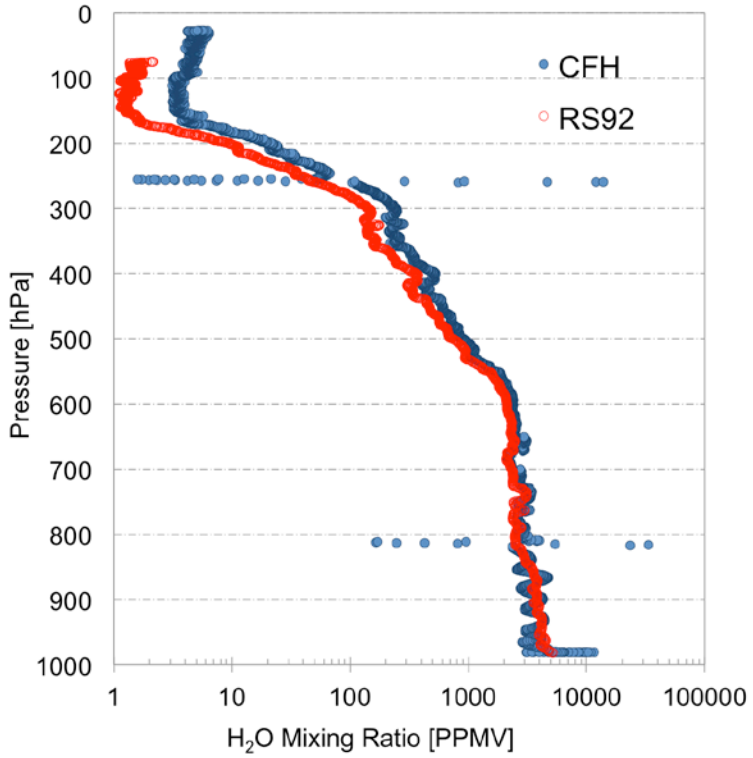



# Profiles



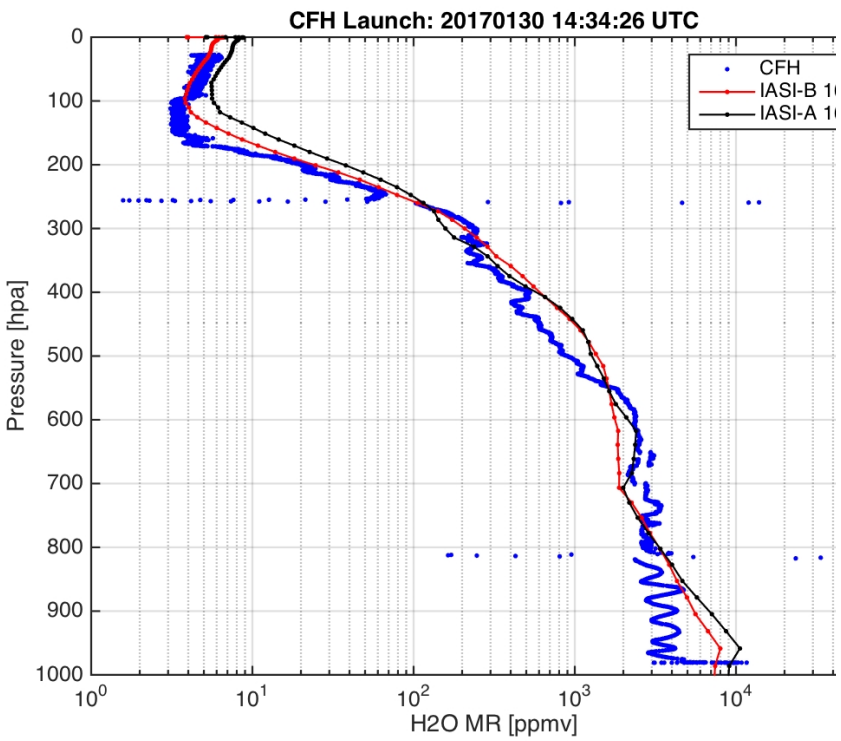

2015-09-15: CFH (blue) versus RS92 (red)



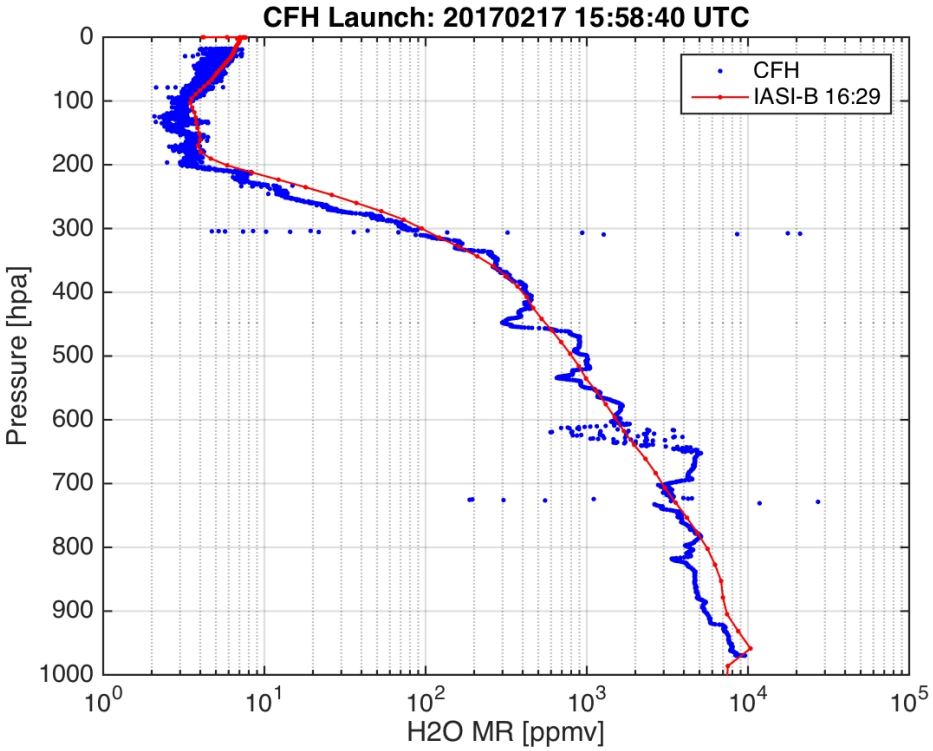

2017-01-30: CFH (blue) versus RS92 (red)

- ✓ Water vapor mixing-ratio profiles from combined instrument measurements reveal a typical dry bias for RS-92 radiosondes.
- ✓ Burst altitudes often exceed 10 hPa
- ✓ Launch times in the late mornings due to METOP overpass coordination

# Spaceborne $H_2O$ Profiles



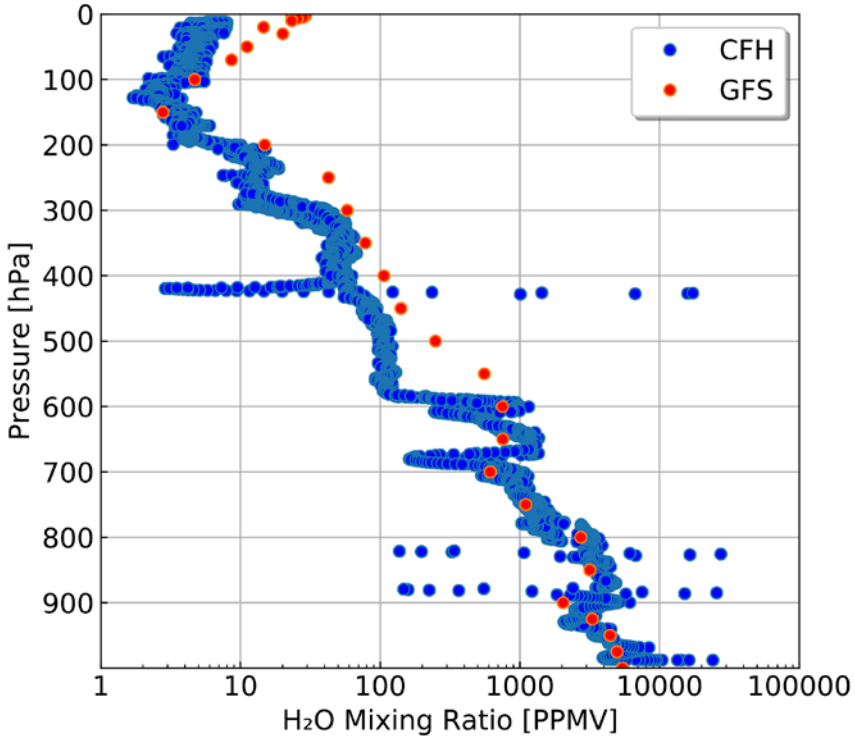

*01/30/2017*




*02/17/2017*

- IASI derived water vapor mixing ratio compared with CFH observational data
- CFH launches have been partly coordinated with overpasses of MetOp polar orbiting meteorological satellites.
- Analysis provided by Lori Borg.

# CFH observations to improve numerical weather models




*03/02/2018*

⇒ *Example CFH launch from March 2, 2018. The water mixing ratio as derived from the CFH as well as from the Global Forecast System (GFS) model (red dots) is shown. Algorithms to remove the radiosonde dry bias are often too 'radical' in operational numerical weather models.*

⇒ *Improvements of the algorithms in progress for NOAA's High Resolution Rapid Refresh model.*

# SGP CFH Tasks

- ✓ ARM Data Ingest
- ❑ GRUAN RS launch client issues
  - Martin working with Michael Sommer
- ❑ Data processing
- ❑ Refine launch procedures for ARM operators
- ❑ Refurbish old CFH instruments
- ❑ Transition from iMet to RS41 on CFH launch package
- ❑ GRUAN certification
  - Upon successful completion of the SGP certification process for radiosondes, ARM intends to prepare a certification request for the SGP CFH

# CFH - Additional Acknowledgements


- Michael Sommer - GRUAN Lead Center
- Ruud Dirksen – GRUAN Lead Center

- ARM SGP Operations
  - Chris Martin
  - Matthew Gibson
  - James Martin
  - John Schatz
  - Nicki Hickmon
  - Mike Ritsche
  - Jody Martin
  - George Sawyer

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