

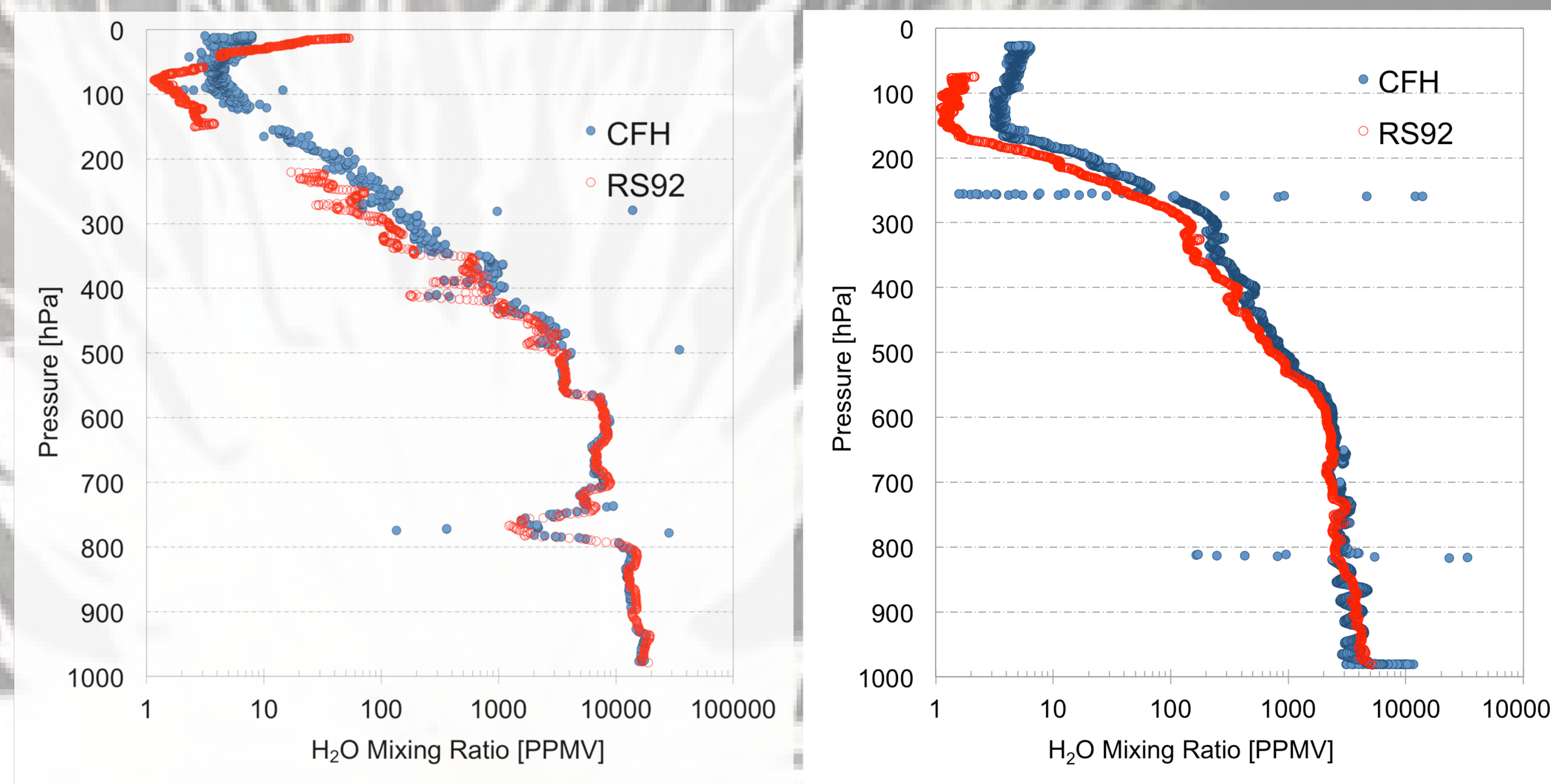
# The Cryogenic Frost point Hygrometer (CFH): Updates, Data Evaluation, and Opportunities

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## Background

ARM Cryogenic Frost Point Hygrometer (CFH) measurements are performed at the ARM Southern Great Planes (SGP) Climate Research Facility in support of the Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN). GRUAN is an international reference-observing network, designed to meet climate requirements and to fill a major void in the current global observing system. Upper air observations within the GRUAN network will provide long-term best-quality climate records. The goal of the ARM CFH measurements is to obtain upper troposphere lower stratosphere best estimate humidity data. The CFH data are used to constrain and validate observations from space based remote sensors, and to provide accurate data for the study of atmospheric processes.



CFH launches from 15 Sept. 2015 (left) and 30 Jan. 2017 (right). Water vapor mixing-ratio profiles from combined CFH and Vaisala RS-92 measurements reveal a typical dry bias observed with radiosondes.



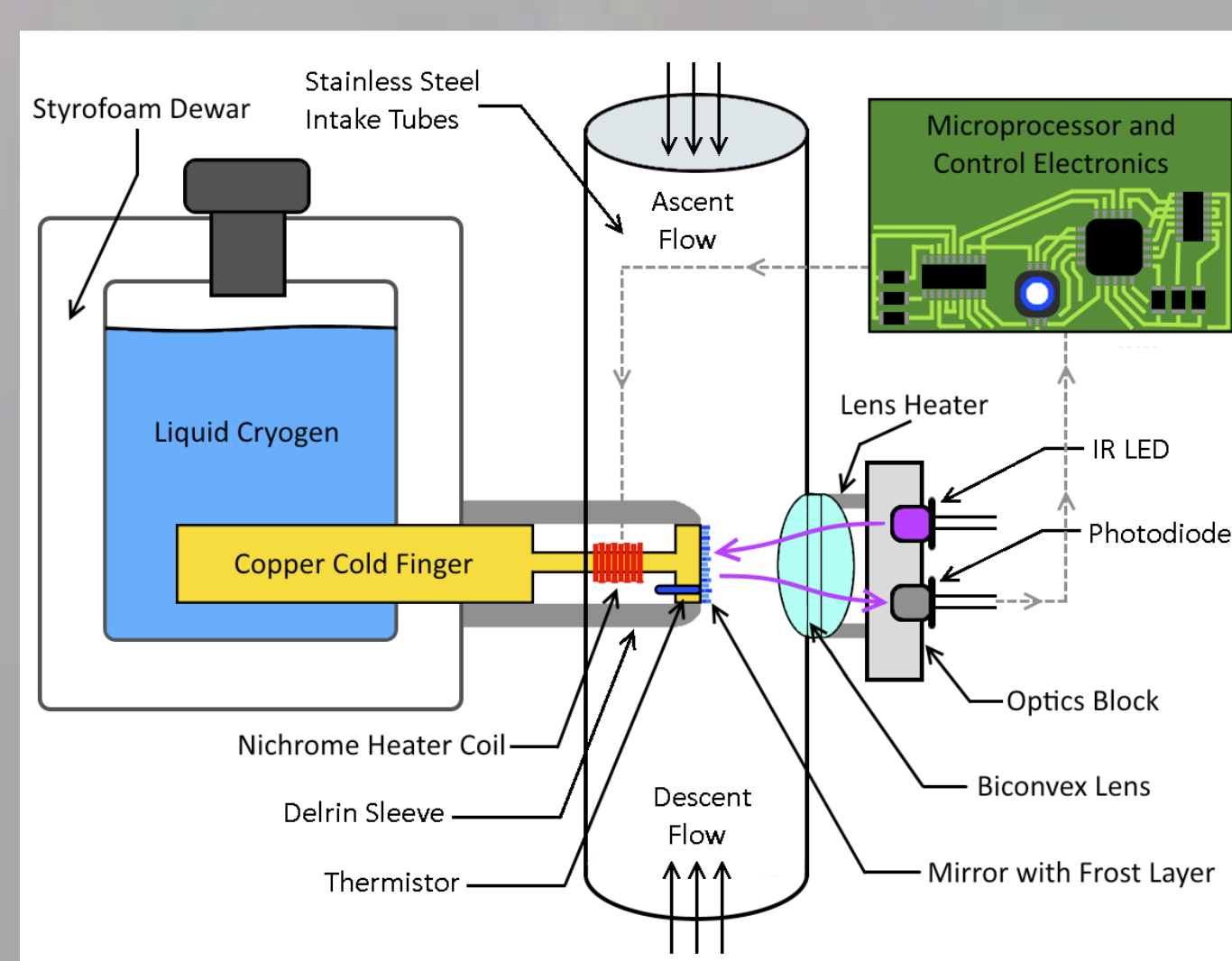
Launch package consisting of the CFH and the RS-92 radiosonde combination.

## Spaceborne H<sub>2</sub>O Profiles

CFH launches have been coordinated with overpasses of the MetOp polar orbiting meteorological satellites to validate Infrared Atmospheric Sounding Interferometer (IASI) data. Analysis provided by Lori Borg.

## Instrument Overview

The CFH accurately measures water vapor at temperatures below -50°C. The instrument has a significantly greater sensitivity to water vapor than standard radiosondes, as it can measure amounts at the parts-per-million level. The lightweight design allows for launching the CFH sonde as a cost effective balloon borne instrument.



*CFH Principle: The instrument measures the temperature of a chilled mirror that is cooled to generate a thin and constant layer of condensate on the mirror. The temperature of the mirror in this condition (of condensation) equals the frost or dew point temperature of the air passing by the mirror.*

## CFH Specifications

Measured Parameters	Ambient frost point
Derived Parameters	Relative humidity, mixing ratio
Technique	Temperature-controlled chilled mirror
Uncertainty	< 4% in tropical lower troposphere
Measurement	< 10% in middle stratosphere
	< 9% in tropopause
Altitude range	0 - 35 km
Weight	< 400 g (without coolant)
Dimensions	~12"Wx12"Dx12"H

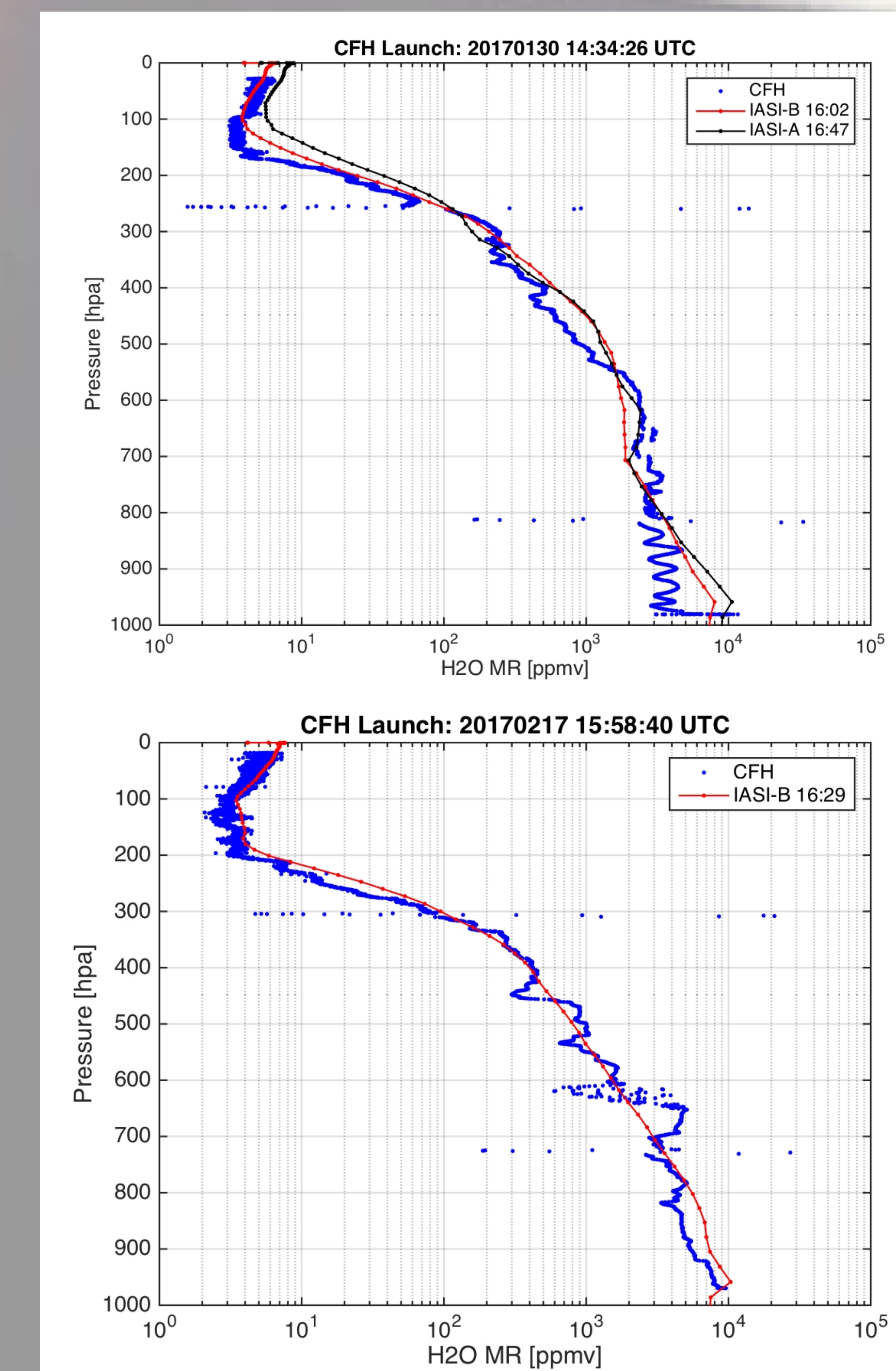
## Acknowledgements

NOAA's National Centers for Environmental Information (NCEI) coordinates the US GRUAN sites. Howard Diamond from NCEI provides the funds for the CFH instruments and accessories used at ARM SGP.



## Deployment History

Seventeen successful CFH launches have been performed at ARM SGP since September 2014.



IASI derived water vapor mixing ratio compared with CFH observational data from 01/30/2017 and 02/17/2017