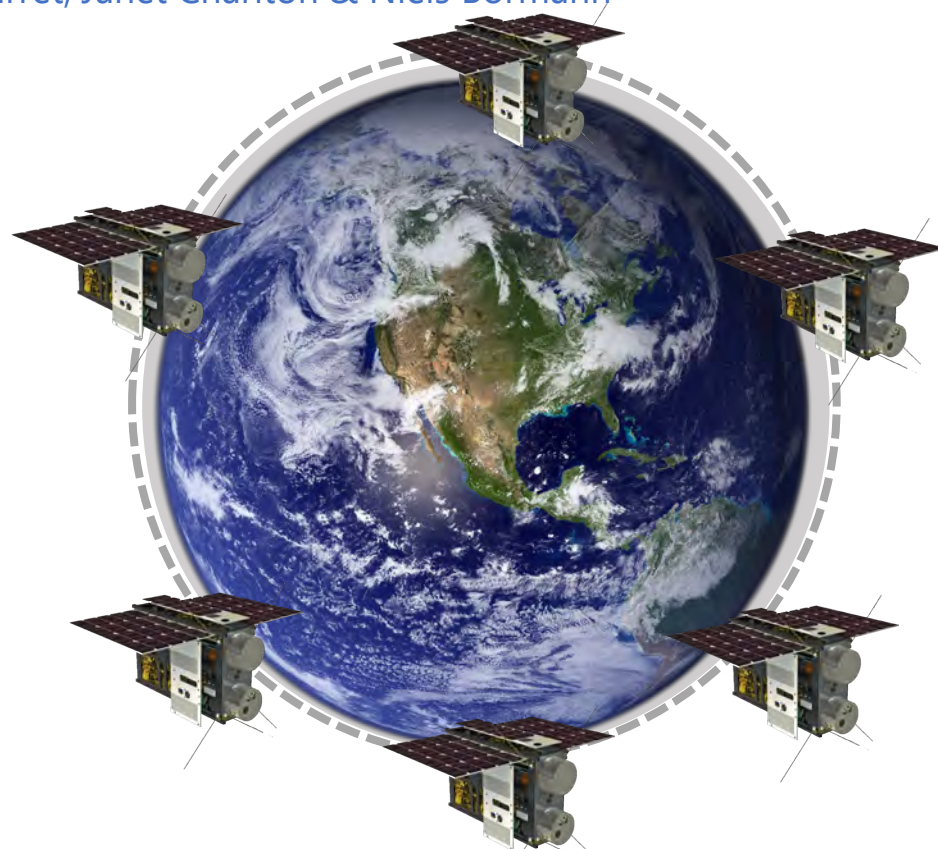


Hyperspectral Microwave Sounder Constellation of Nano Satellites for Climate Change and Mitigation

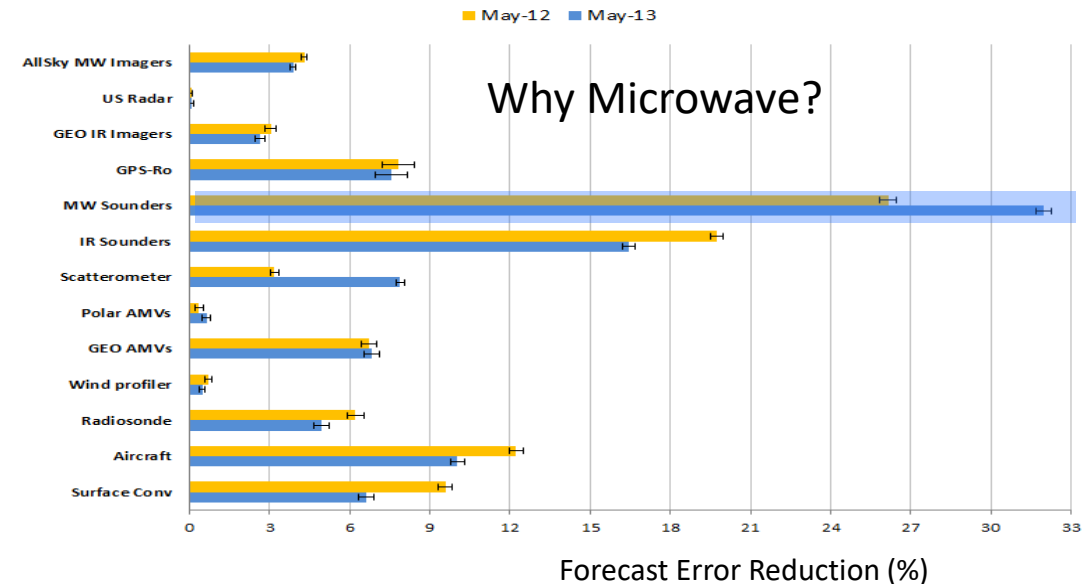
Manju Henry, Jacob Cunnison, Kai Parow Souchon, Ian Rule, Brian Ellison, Daniel Gerber, Rob King, Dave Tiddeman, Stuart Fox, Steve Parkes, Martin Dunstan, Mark Jarret, Janet Charlton & Niels Bormann



*New Innovation
New Space*

- ✦ Background
- ✦ Motivation
- ✦ Technology Readiness
- ✦ HYMS Airborne Demonstrator
- ✦ HYMS In-Orbit Demonstrator
- ✦ HYMS Future Outlook
- ✦ HYMS Mission Benefits
- ✦ HYMS CONCAM-Impact

- **Global** observations of temperature and humidity are needed under all-weather conditions to drive weather forecast models.
- **Microwave** observations are needed to provide cloud penetration.
- Most weather events happen in the order of hours.
- Severe weather events are a critical exception, usually cloud shrouded; key observables vary within **~15 km and ~30 minutes**

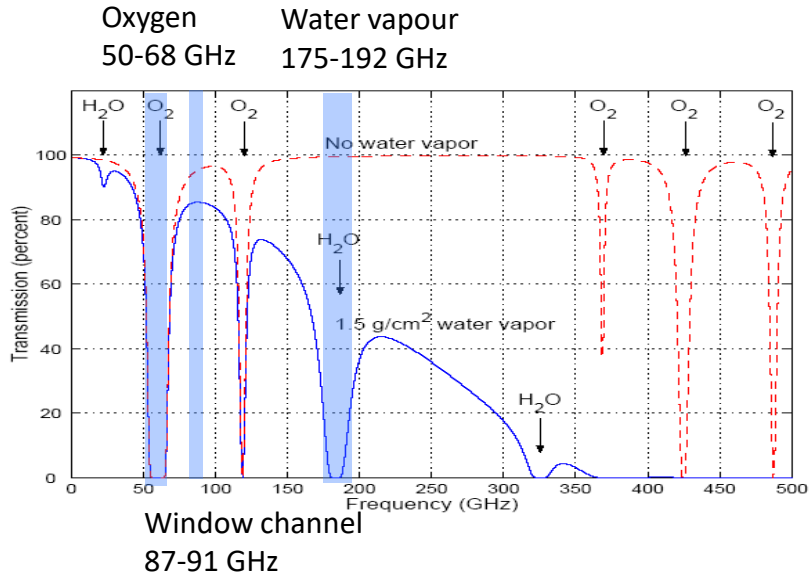


NOAA20 satellite view of Europe showing a cloud cover over a period of 140 days.

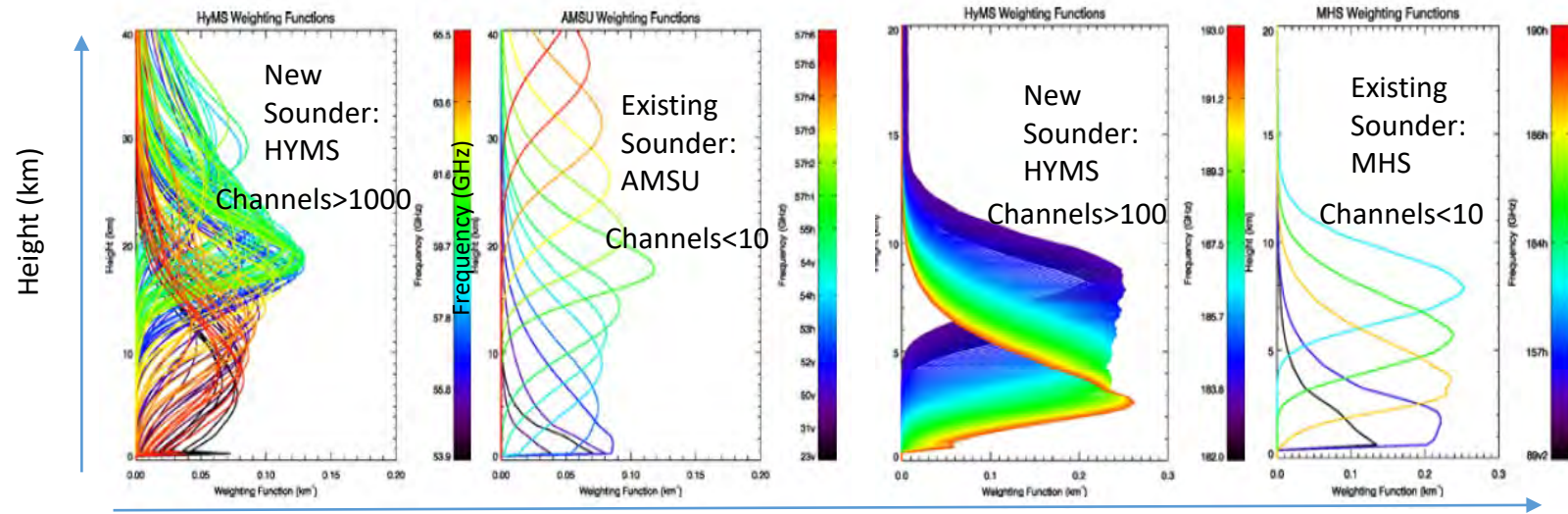
The early sounders were seen in infrared. It has a major limitation, it can't see through clouds.

HYMS: Motivation

Hyperspectral sounding enables ultra-fine resolution temperature and water vapour profile retrievals



Oxygen (temperature) and water vapour (precipitation) sensing is a key element for weather forecasting.



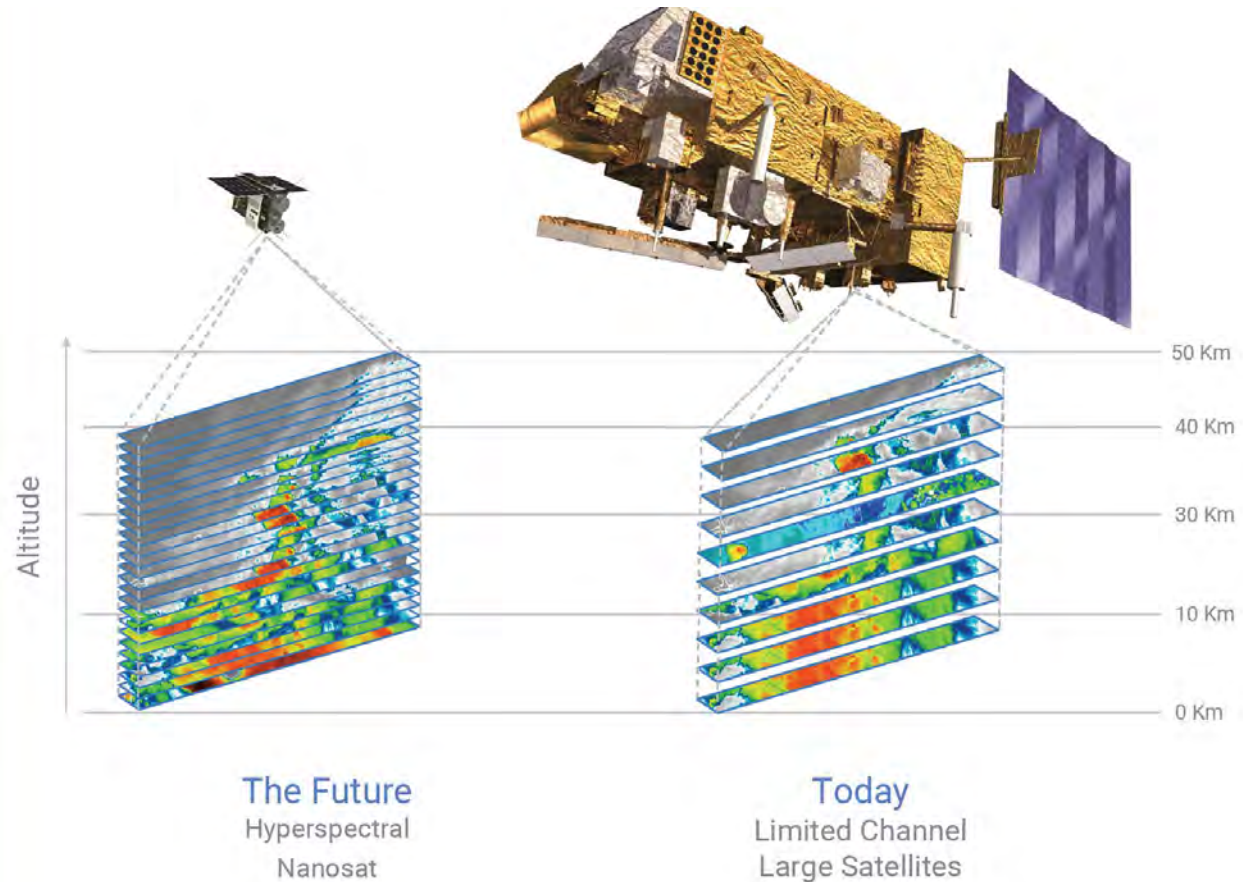
Weighting Functions

HYMS uses 100s of detection channels

First-time demonstration of the benefits of increased vertical resolution microwave sounding

Enables accurate weather forecasting

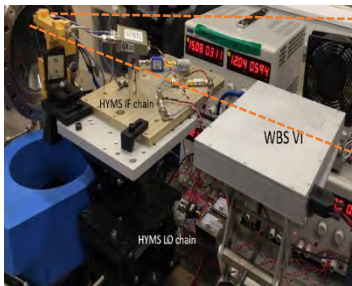
HYMS: Accurate Timely Weather Forecasts



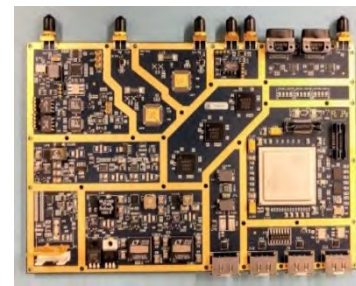
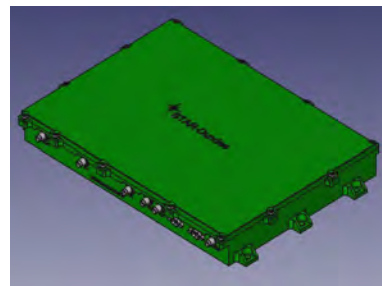
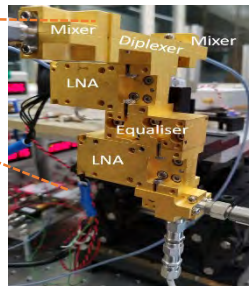
Nanosatellite constellation of HYMS

HYMS: Technology Readiness

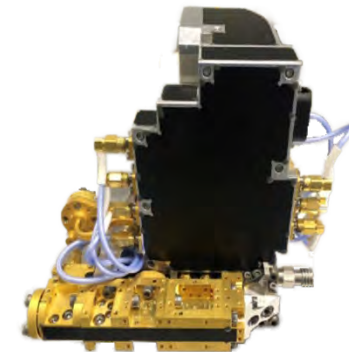
- Ultra-low noise receivers operating at 54 GHz and 183 GHz were developed and demonstrated, leveraged on our MetOp SG receiver work ongoing at RAL Space.
- Radiometer system noise temperature <200K is achieved across the oxygen band (50 GHz-68 GHz). This is state-of-the-art performance for a room temperature atmospheric sounder of this type. Also, a system noise temperature <670K is achieved for the water vapour band (175-192 GHz)
- Wide-band ultra-high-resolution spectrometer (WBS-V1, 9.6 GHz BW, 1 MHz resolution) is also demonstrated. This new version gives a factor of improvement of 40 compared to the baseline (WBS-V)
- HYMS radiometers are miniaturised for nanosatellite accommodation without compromising performances



60 GHz Hyperspectral Lab Prototype System



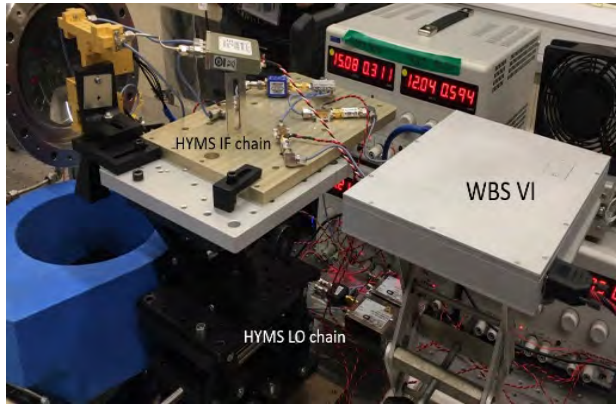
Ultra-Wideband High-Resolution Spectrometer
Instantaneous BW:9.6 GHz, spectral resolution 1 MHz



Not to scale

An example of MetOp SG Receiver and the miniature radiometer developed at RAL Space (patent filed). Volume is reduced by a factor of 50.

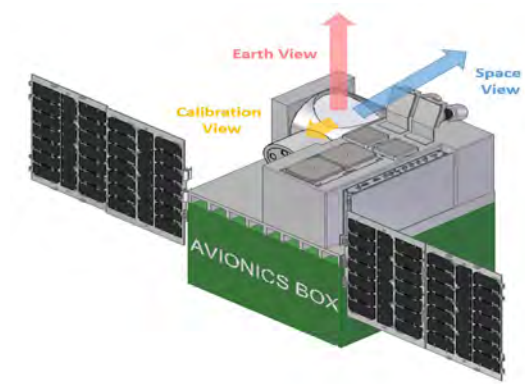
HYMS Technology Development Roadmap



HYMS Lab Demonstrator (2016-2018)



SERMON Airborne Demonstrator (2019-2021)



HYMS Nano Satellite Payload (2020-2023)

PI: RAL Space, STFC

Collaborators: UK Met Office, ECMWF, STAR Dundee, JCR Systems, GMV

Funding Support: CEOI & UKSA