ISMAR

An Introduction to ISMAR and its alternative use as an airborne platform for other instrumentation

Ian Rule, Edinburgh 7th October 2015

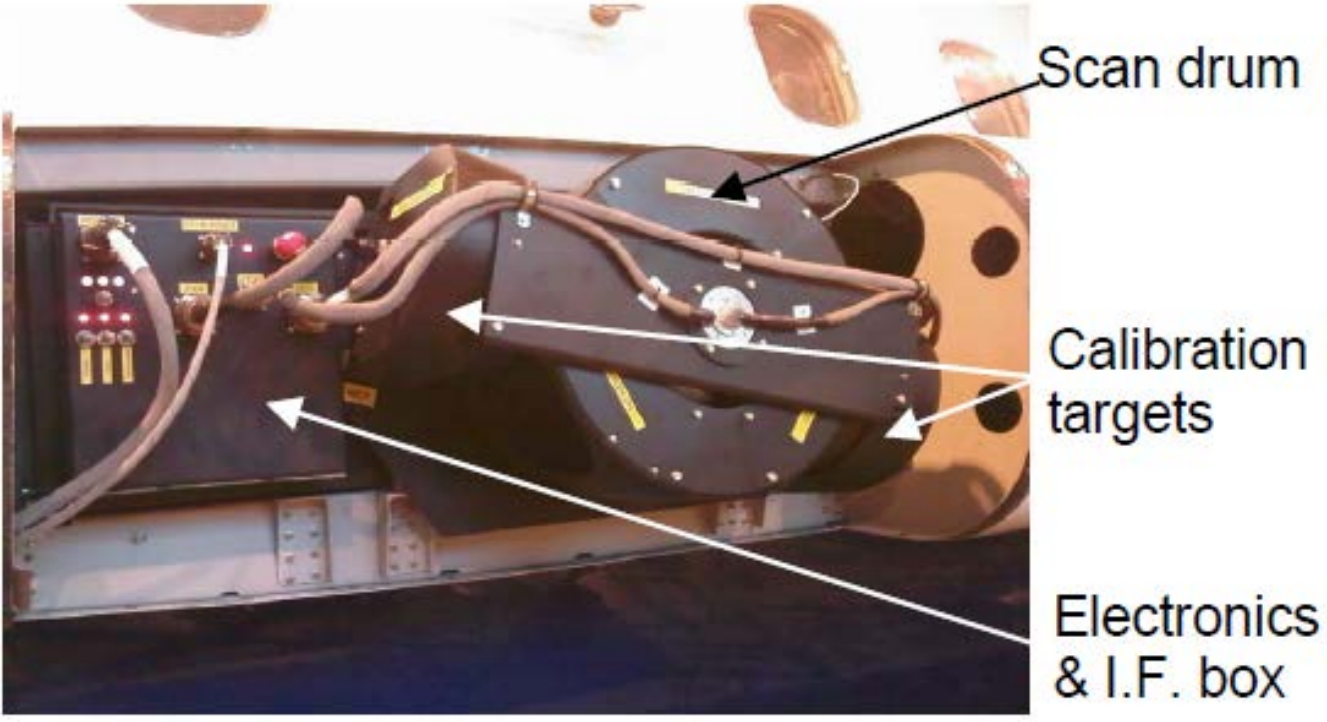
Contents

This short presentation covers the following areas

- Description of ISMAR
- Scientific Applications
- Alternative use as a flight platform for other instrumentation
- Questions

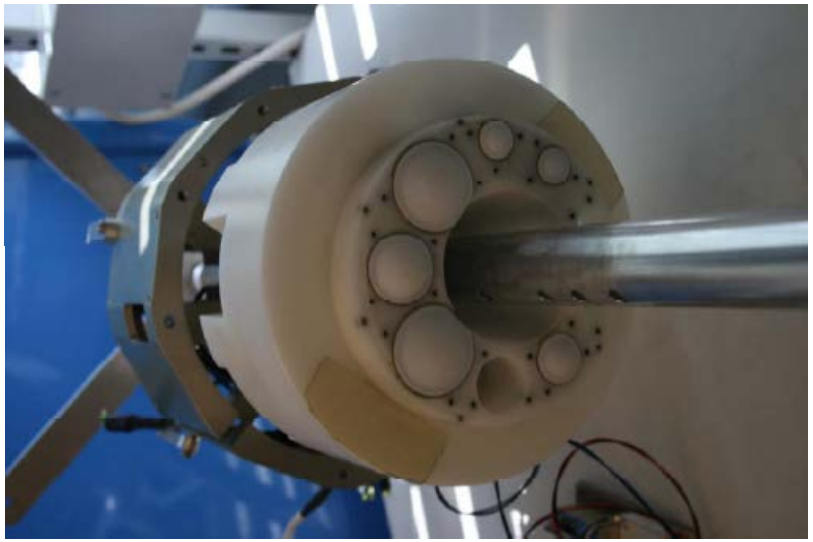
Description of ISMAR

- Scanning multi channel microwave and submillimetre wave radiometer
- International SubMillimetre Airborne Radiometer
- Current receivers fitted – 118GHz, 243GHz, 325GHz, 448GHz and 664GHz



- Scan drum houses a 45º reflecting mirror machined to optical standards and plated with 5µm thick gold
- Mirror is heated to eliminate condensation
- Calibration loads designed and manufactured by RAL – one is heated the other ambient
- Data acquisition unit based on NI CompactRIO
- Separate enclosure for I.F amplifiers etc
- Approx dimensions 1.1m x 0.4m x 0.5m and 90kg

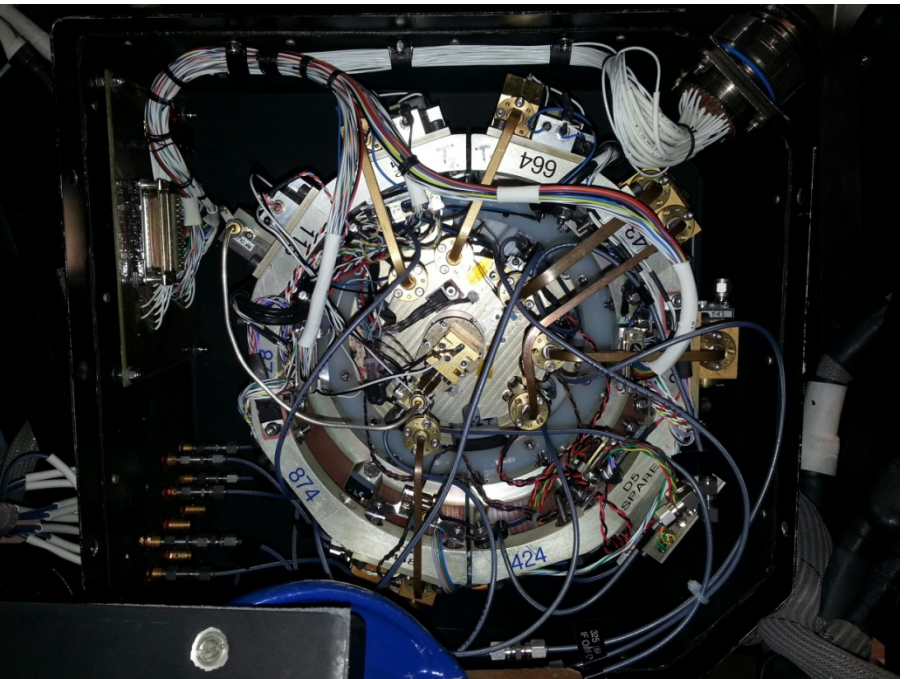
Description of ISMAR

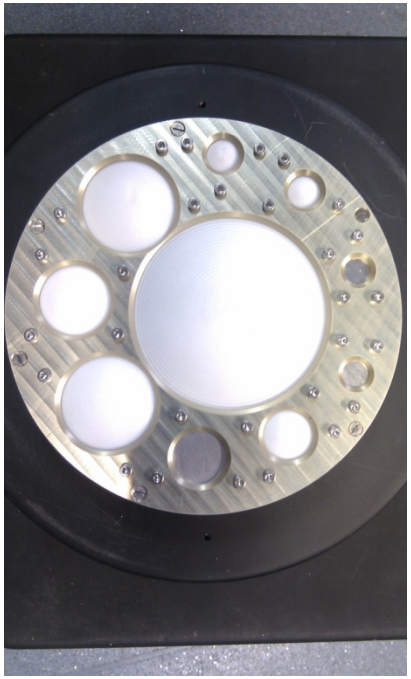


- Receivers are arranged into a ‘Plug’ such that they all have direct vision of the scan mirror

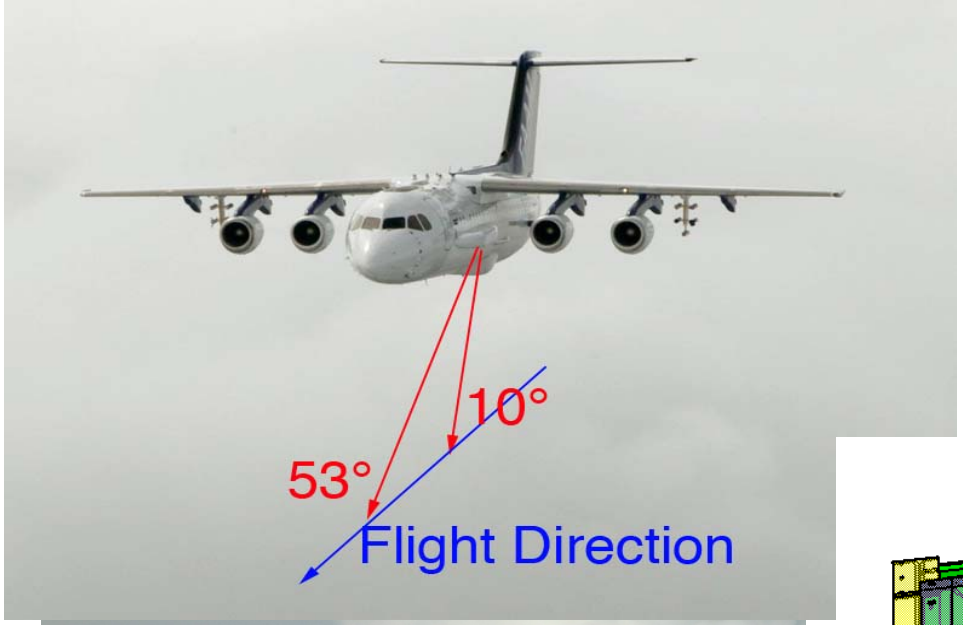
- Local Oscillators and power regulation mount onto the ‘Turret’

- I.F. Signal from mixers sent to I.F amplifiers, filters and video amps in a separate box



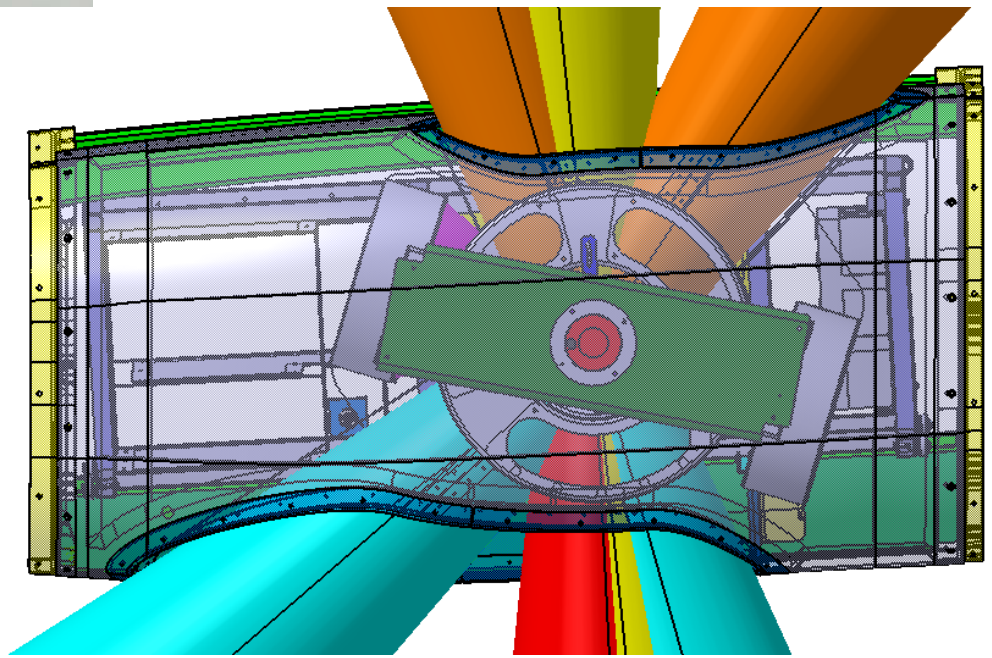


Description of ISMAR - Scanning angles



ISMAR is fitted into the large radiometer blister on the FAAM Bae-146 aircraft – external environment. It has viewing directions along the track of the aircraft:

+53 deg to -10 deg nadir
+10 deg to -40 deg zenith

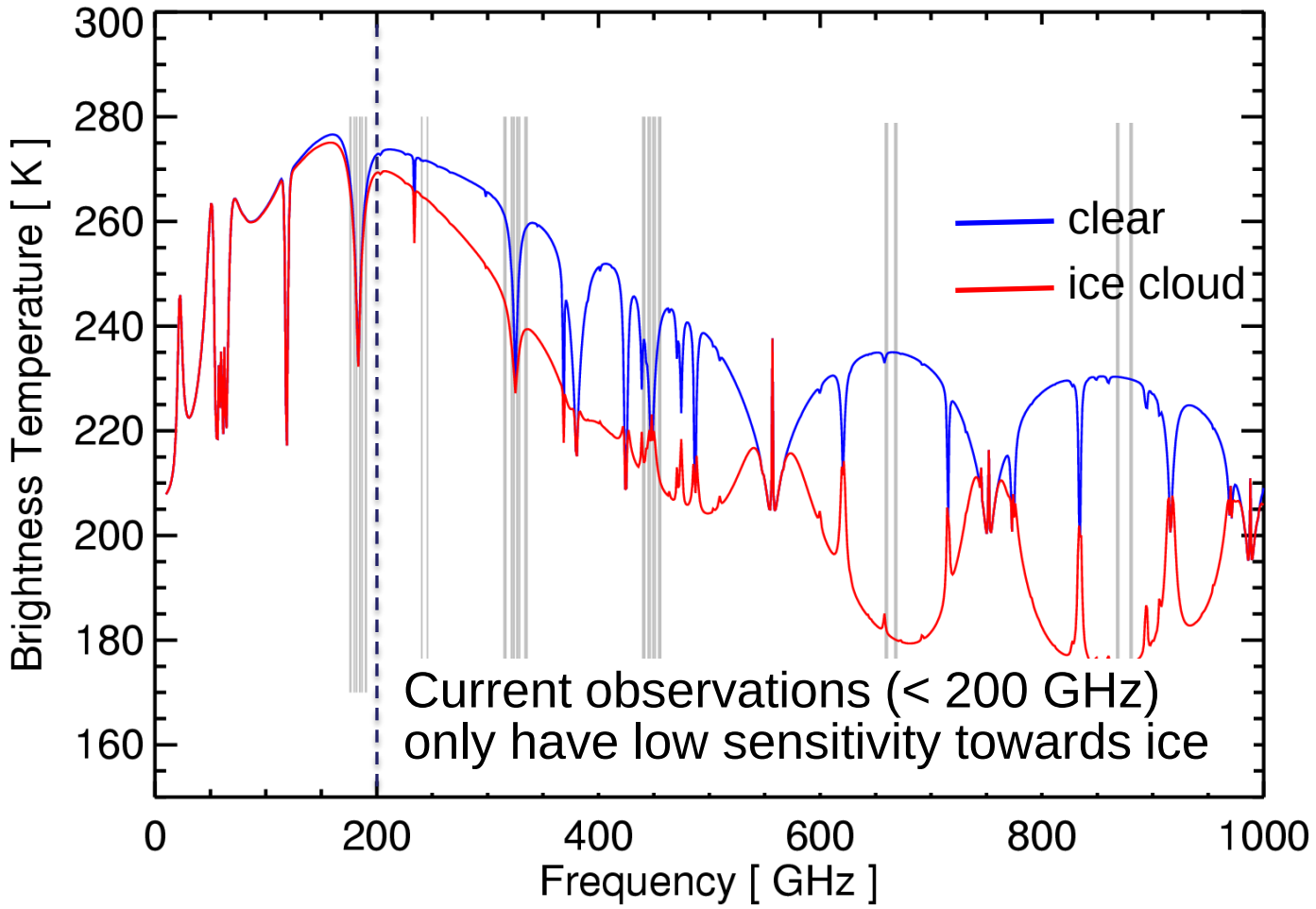


Description of ISMAR - instrument channels

Channels (GHz)		BW (GHz)	Polarisation	Feature	Aircraft/Satellite Instrument
23.8	±0.07	0.127	V&H	Water vapour line	Deimos
50.3	±0.05	0.082	V&H	Oxygen line	Deimos, GOMAS
88.992	±1.1	0.65		Window	MARSS
118.75	**±1.1 ±1.5 ±2.1 ±3.0 ±5.0**	**0.4 0.4 0.8 1 2**	**V**	**Oxygen line**	**ISMAR, GOMAS**
157.05	±2.6	2.6	V	Window	MARSS
183.31	±1 ±3 ±7	0.45 1 2	V	Water vapour profile and snowfall	MARSS, ICI, GOMAS
243.2	**±2.5**	**3**	**V&H**	**Quasi-window, cloud ice retrieval**	**ISMAR, ICI**
325.15	**±1.5 ±3.5 ±9.5**	**1.6 2.4 3.0**	**V**	**Water vapour profile, cloud ice retrieval**	**ISMAR, ICI**
424.7	±1.0 ±1.5 ±4.0	0.4 0.6 1	V	Oxygen line	Awaiting funding, GOMAS
448	**±1.4 ±3.0 ±7.2**	**1.2 2 3**	**V**	**Water vapour profile, cloud ice retrieval**	**ISMAR, ICI**
664	**±4.2**	**5**	**V&H**	**Quasi-window, cloud ice retrieval**	**ISMAR, ICI**
874.4	±6.0	5	V&H	Quasi-window, cloud ice retrieval	Under development

Scientific Applications

- Submillimeter frequencies are very sensitive to ice
- Instrument view from high altitude towards Earth shows large signal difference between clear and ice cloudy scenes



Scientific Applications

- Cirrus properties:
  - Submillimetre frequencies are very sensitive to ice and can provide a direct retrieval of Ice Water Path important in GCMs (General Circulation Models).
- Mixed phase cloud properties:
  - Can use a series of H_2O channels with same weighting functions to differentiate between liquid and ice phases.
- Snow surface emissivity:
  - Can use 243 GHz window channel and extreme wings of H_2O channels to retrieve surface properties.
- Precipitation
  - Precip can be inferred by building a temp/humidity profile of the atmosphere using multiple channels, including ISMAR's 118 and 424 GHz O_2 channels and the 325 and 448 GHz H_2O channels

Scientific Applications

- Satellite demonstrator:
  - Aircraft remote sensing instruments can be used as a psuedo satellite. Currently there are no atmospheric vertical viewing satellites at submillimetre frequencies. Modelling studies and radiative transfer development requires measurements for validation.
- Satellite validation and calibration:
  - The Ice Cloud Imager (ICI) instrument is due to be launched on the MetOp-SG satellite in the next few years. ISMAR can be used for calibration and validation of the satellite.
- Test flying of other receivers or instrumentation
  - The Met Office invites interested parties to discuss their requirements for flying their instrumentation installed into ISMAR

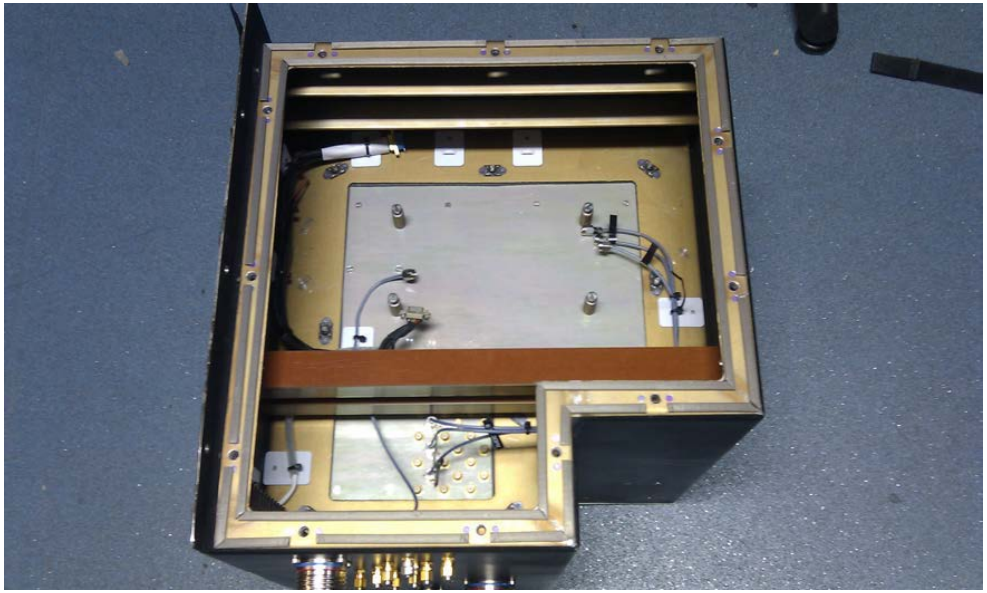
ISMAR – flight platform for other instrumentation

Main Features

- Shielded Front End space available for receivers or other instruments
- Shielded Back End box for other instrumentation or electronics
- Shielded box with data acquisition and computer electronics for instrument control and data logging using a National Instruments CompactRIO running LabVIEW software
- Separate ± 15VDC clean power supply for receivers and sensitive electronics – up to 250W available
- Power provision for heaters in the Front End and Back End areas – up to 400W at 28VDC available
- Provision for temperature monitoring and heater control in Front and Back Ends

Back End space available

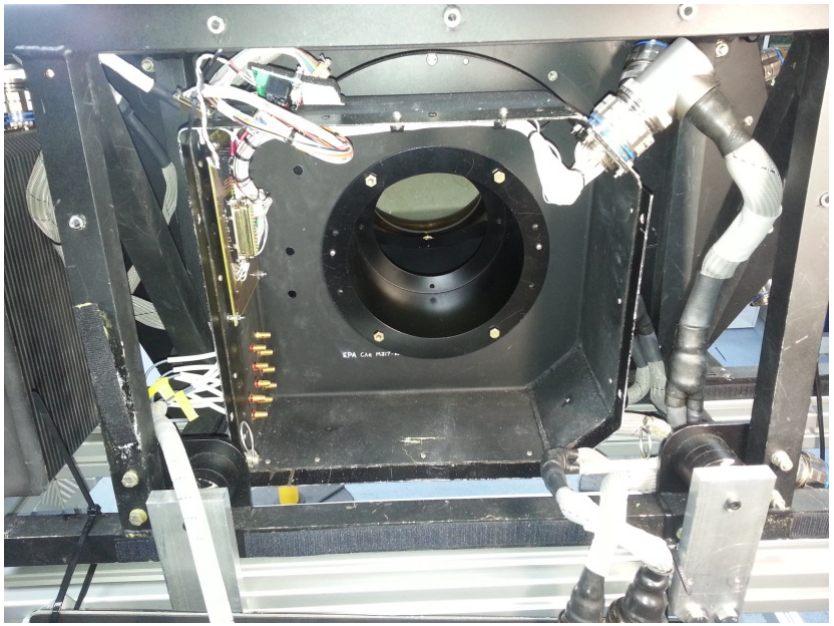
A block of approximately 310mm x 215mm x 115mm in the main electronics box, which is separate from the data acquisition and instrument control electronics. The photo below shows the space which is between the (removable) rails.

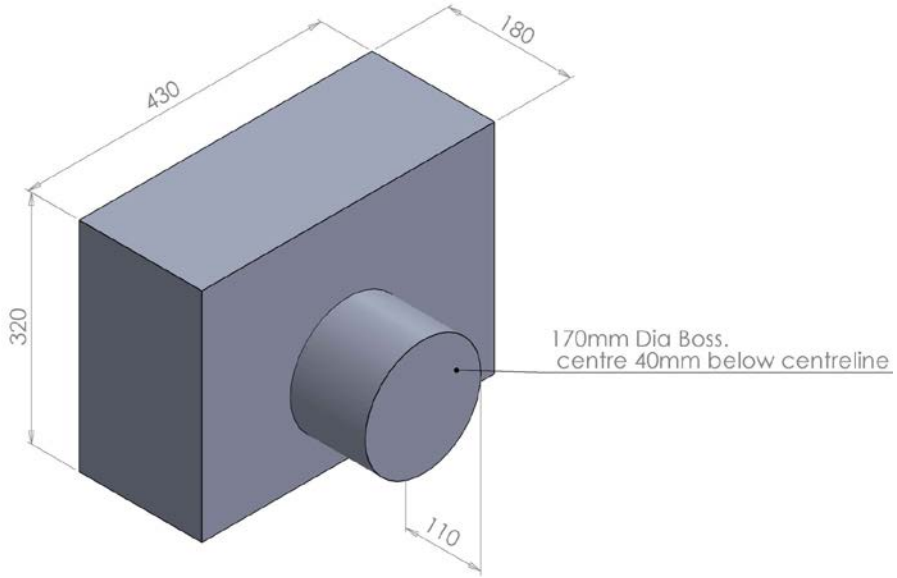


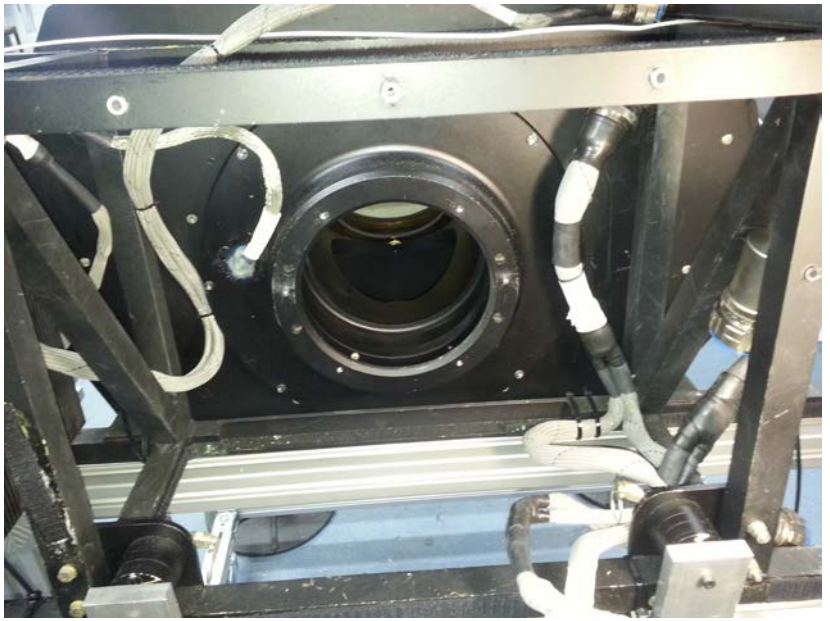
ISMAR – flight platform for other instrumentation

Front End space available

The approximate space available for equipment is shown in the photo and is defined by the model drawing





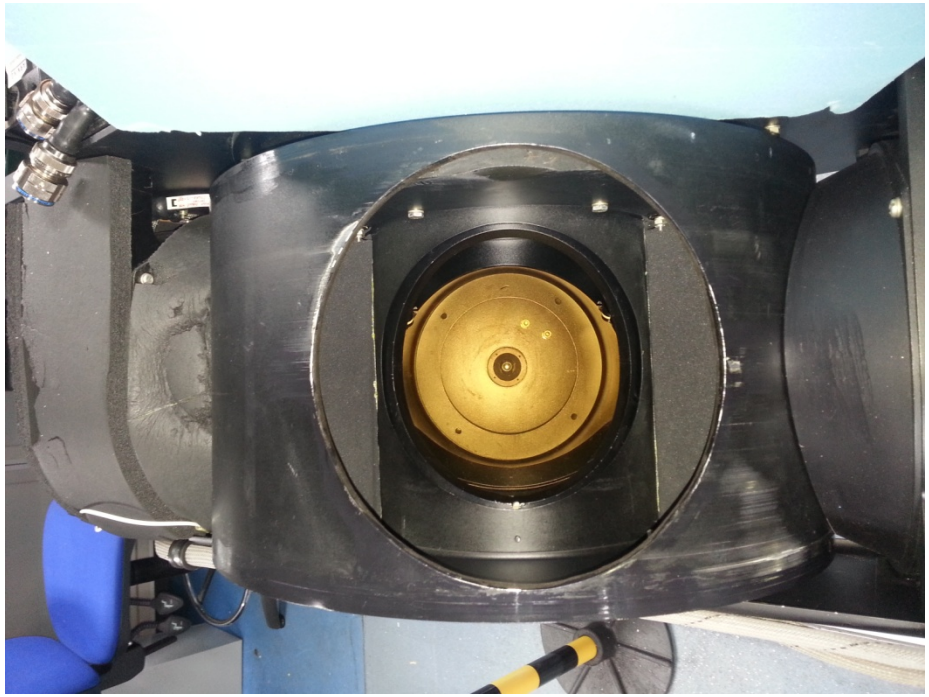


ISMAR – flight platform for other instrumentation

Met Office

Current optional fit

•Small infra-red camera fitted in place of Front End receivers ‘Plug’. Photo’s show a view of camera reflected in scan mirror and the back of the camera in the Front End cover box



Any Questions?