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COSMICS – Clear Sky and Cirrus

ISMAR workshop, Paris, September 2015

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Introduction

- Focus on B893 (Clear sky) and B895 (Cirrus)
- Already discussed instrument performance and looked at high-altitude zenith views from B893
- Comparison with clear sky simulations – what can we learn about instrument characteristics throughout full operating range?
- Polarisation validation (instrument and model setup)
- Is there a discernible signal from cirrus?

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ARTS configuration – B893

- ARTS MetMM sensor descriptions/polarisation for zenith and nadir views
  - Consider O_2, H_2O, N_2, O_3
- Use two atmospheric profiles derived from aircraft measurements during ascent and descent (p, T, q (WVSS2), O_3)
  - Profiles "topped up" using NWP model above aircraft ceiling
  - Vertical resolution reduced to speed up simulations
  - Simulated brightness temperatures interpolated to aircraft altitude
- FASTEM surface
  - "Reasonable" range of values assumed for temperature and wind-speed based on various aircraft measurements
- Compare with Patrick's simulations using ERA-Interim data

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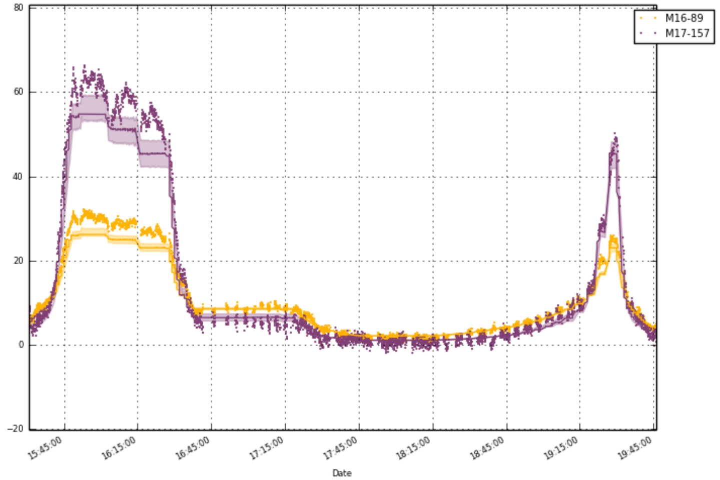
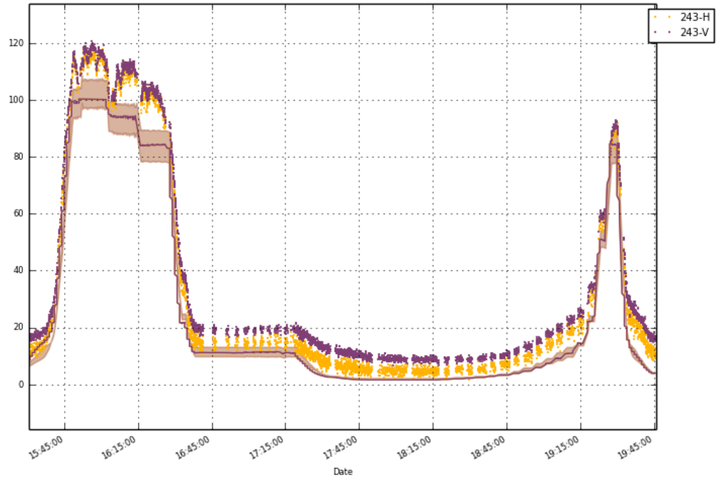
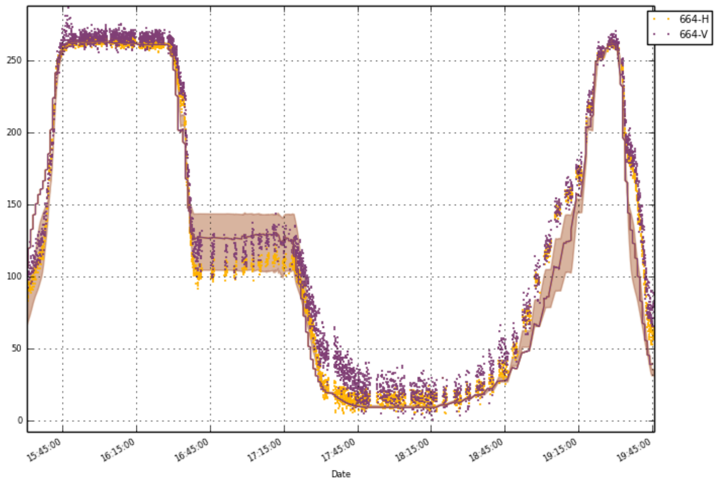
B893 – zenith “window” channels







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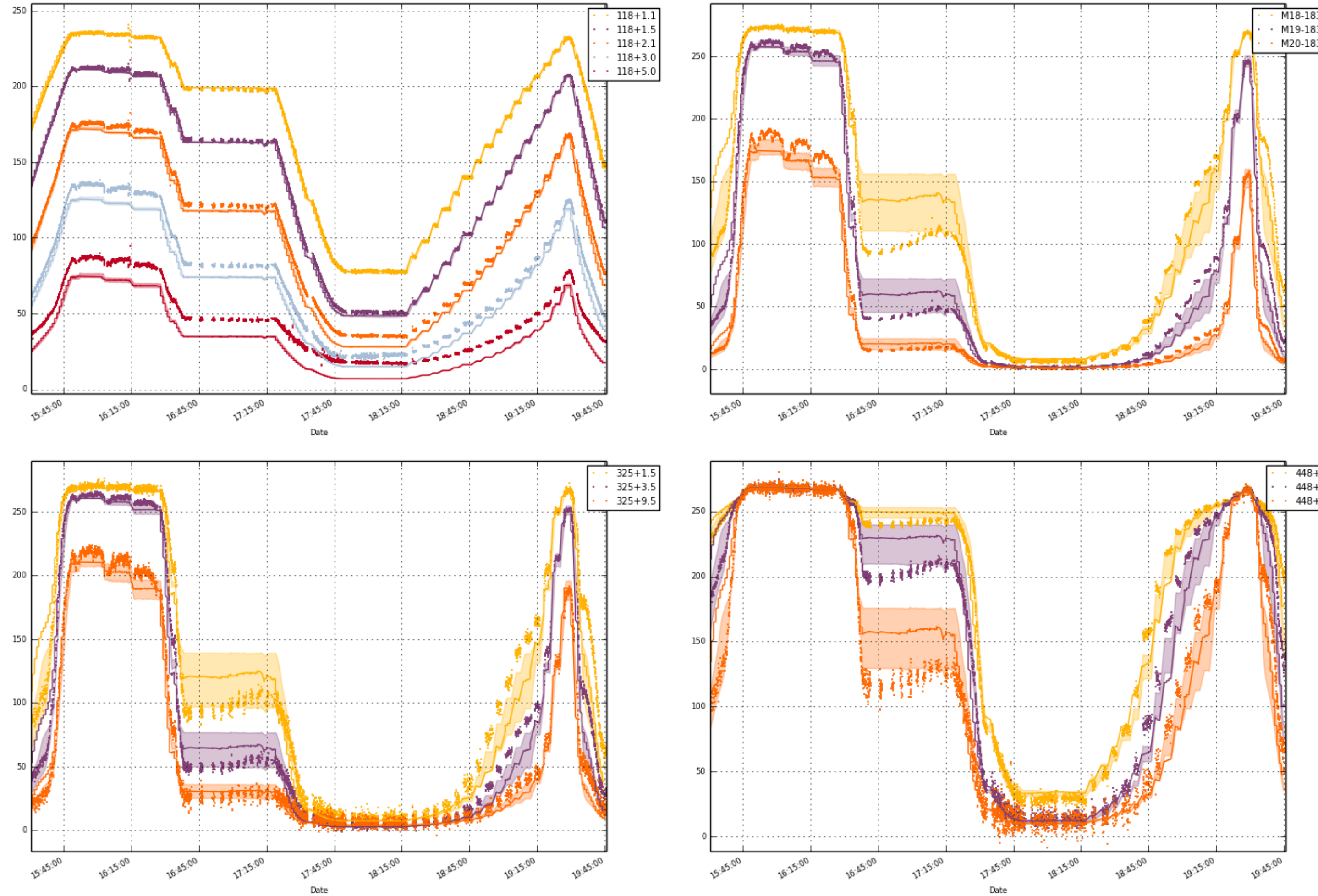
B893 – zenith O_2 and H_2O channels



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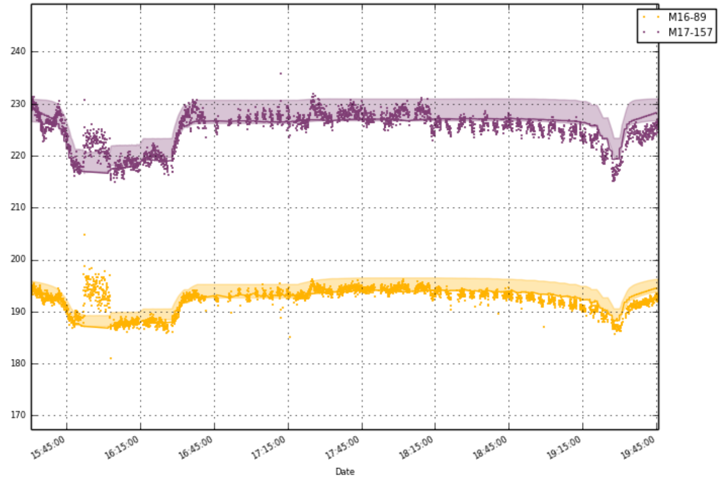
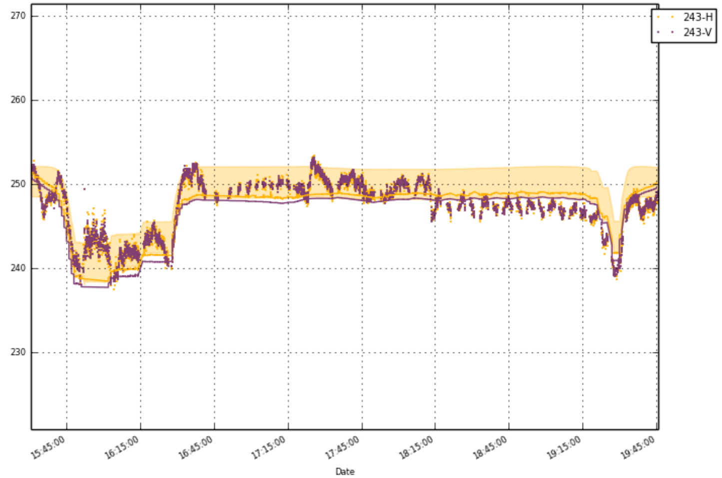
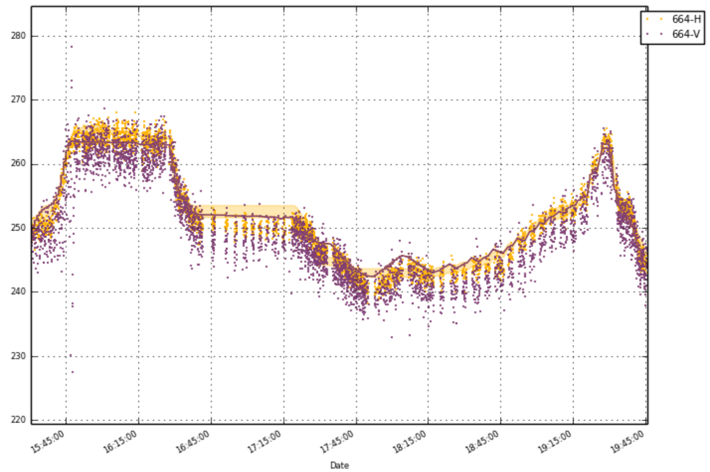
B893 – nadir "window" channels







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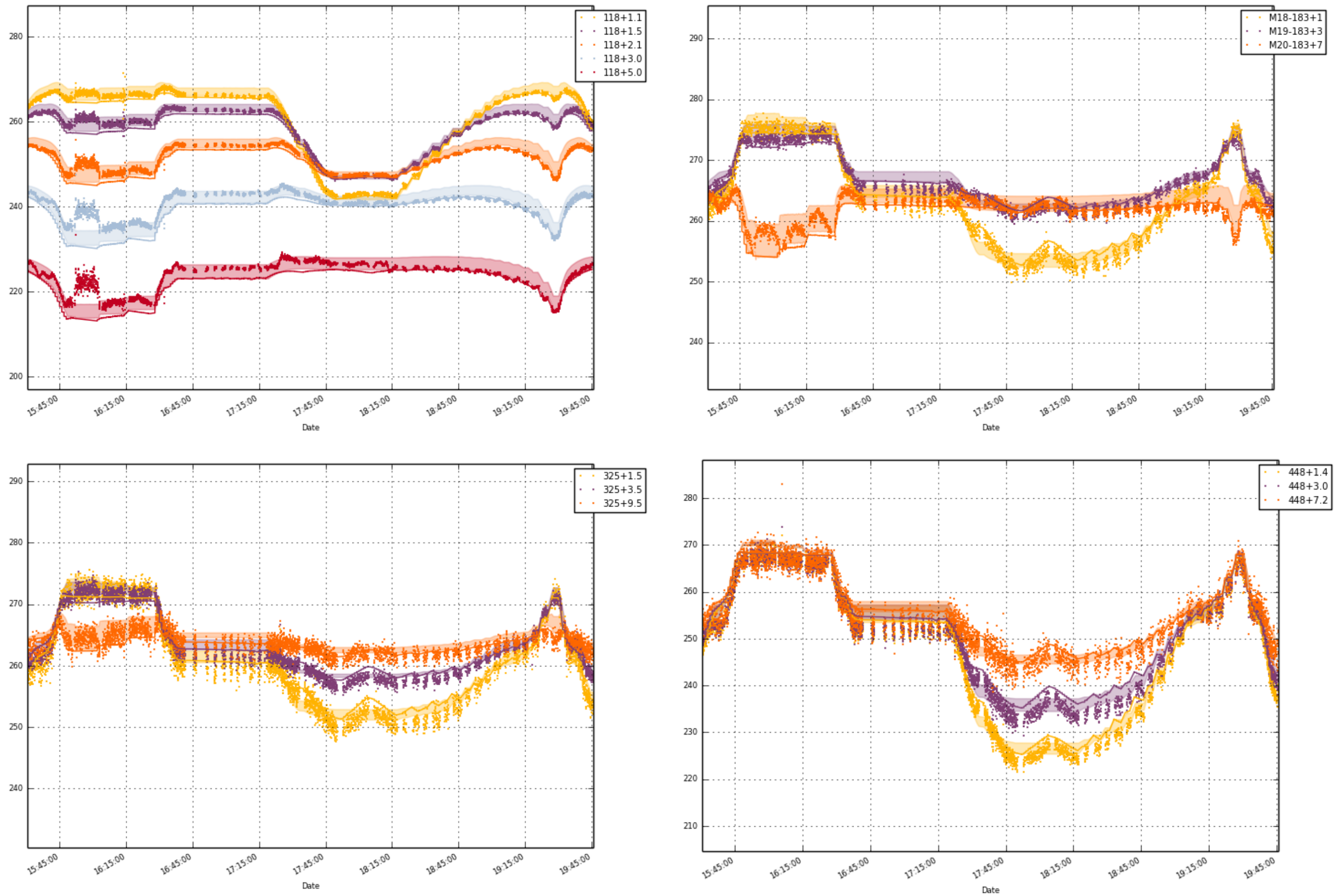
B893 – nadir O_2 and H_2O channels



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Polarisation validation

$$T_{b,up} = R(\theta)T_{b,down}(\theta) + (1 - R(\theta))T_{b,surf}$$

- Upwelling brightness temperatures near surface vary with scan angle:
  - *Approximately* specular surface, and downwelling brightness temperature increases with zenith angle
  - Surface reflectivity varies with viewing angle
  - Surface reflectivity varies with polarisation
  - Detected polarisation rotates with scan angle
- Need big difference between Tb,down and Tb,surf to get good sensitivity to surface reflection – can only look at MARSS and lower-frequency ISMAR channels
- Compare simulated upwelling brightness temperatures (at 1000ft) to measurements

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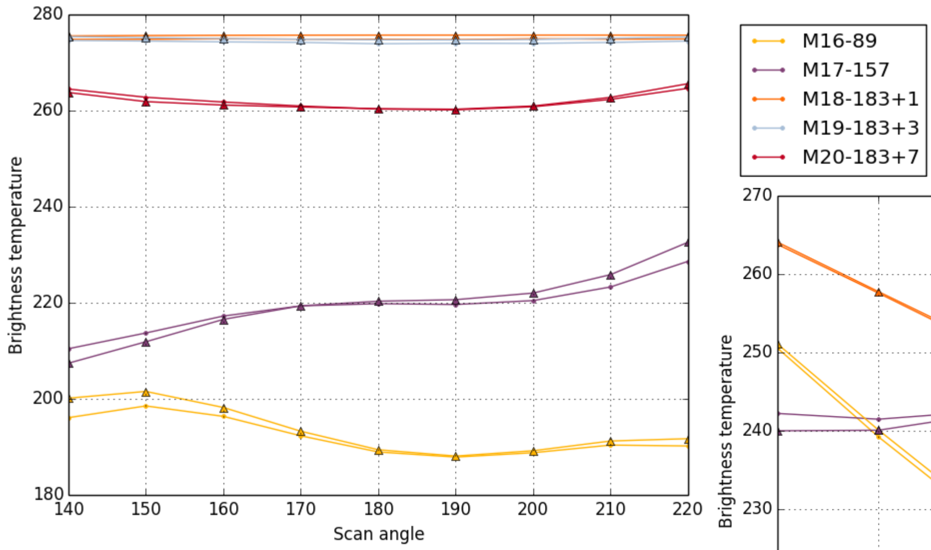
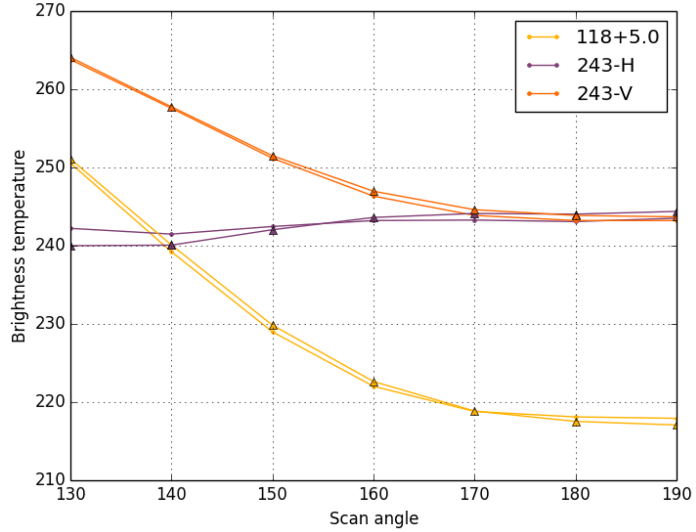
Polarisation





- Good agreement between measurements and simulations
- Suggests instrument polarisations are correct, and correctly modelled

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Cloud signal

- Look for difference between clear-sky simulation and measured values
- Want to use dropsonde data for simulation (co-incident with radiative measurements, full aircraft vertical profiles not always available)
- Need good agreement between measurements and clear sky simulation in no-cloud case for this to work!

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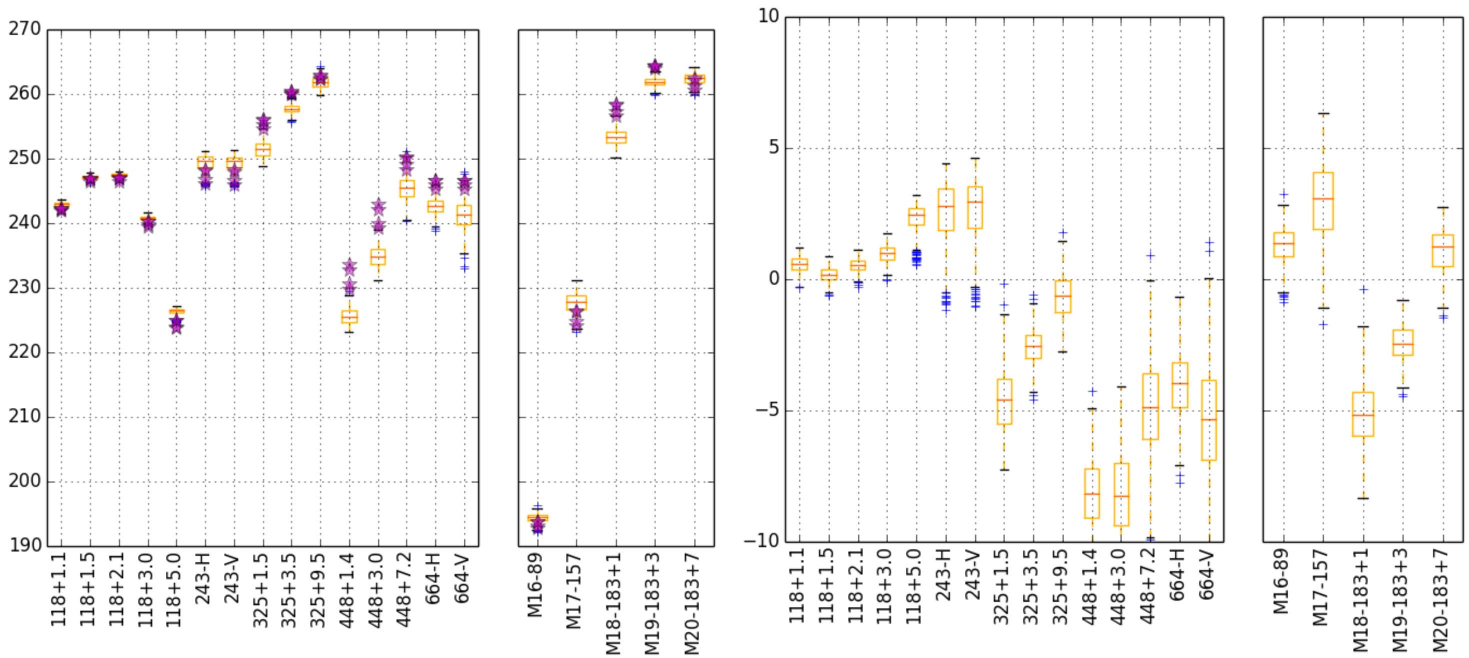
B893 high altitude nadir



- Quite large biases between clear sky measurements and simulations using sondes – similar magnitude to signals expected from Ci

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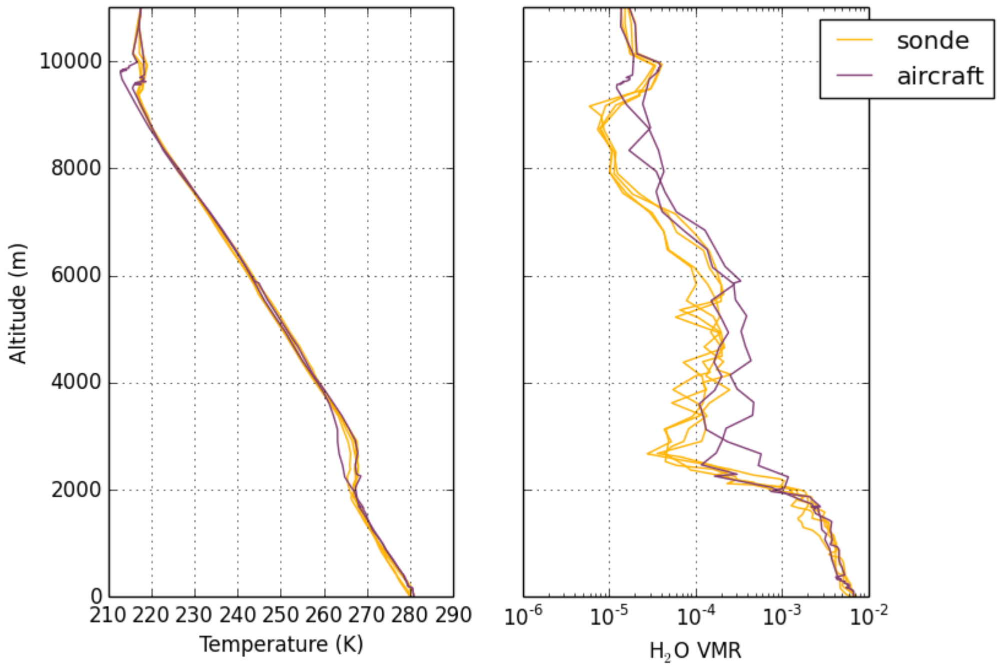
Profiles



- Sondes are generally dry compared to aircraft profiles
- Need better indication of profile below aircraft at time of measurement
- Use MARSS + sonde to retrieve run-mean H_2O profile (assumes no scattering at 183GHz)

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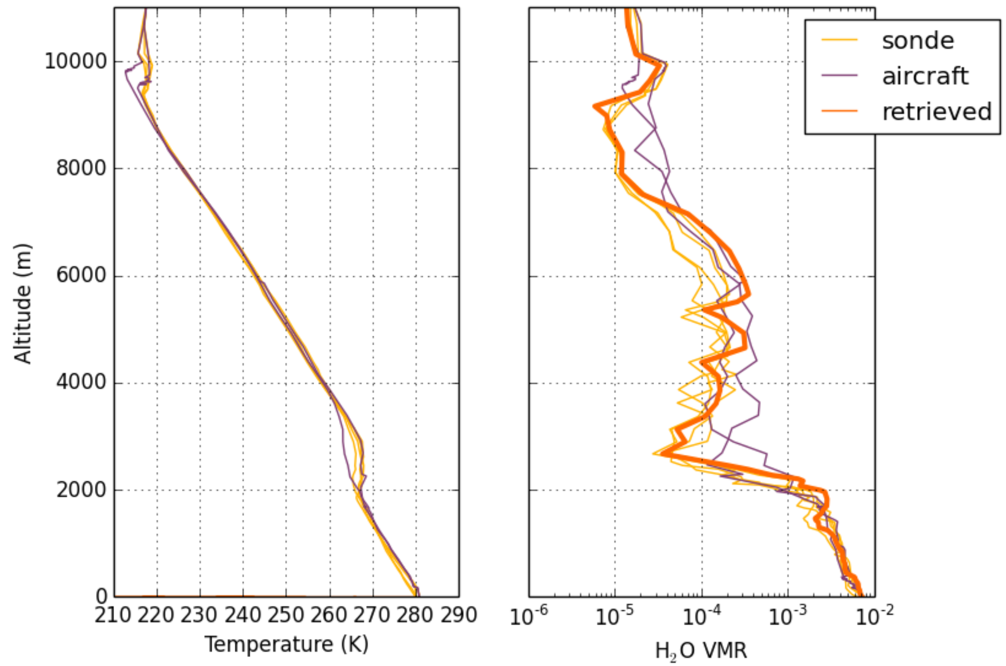
Profiles



- Retrieval leads to moister profile
- MARSS had poor sensitivity above 8000m in this case

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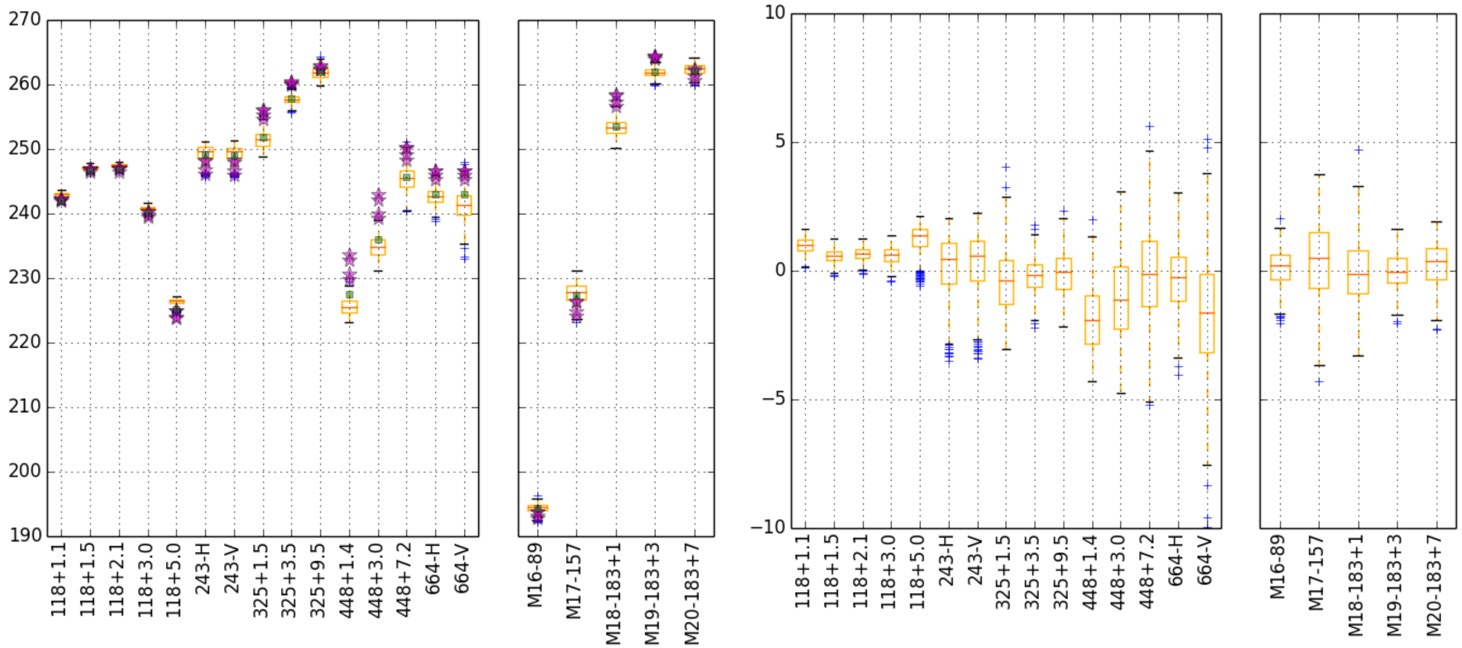
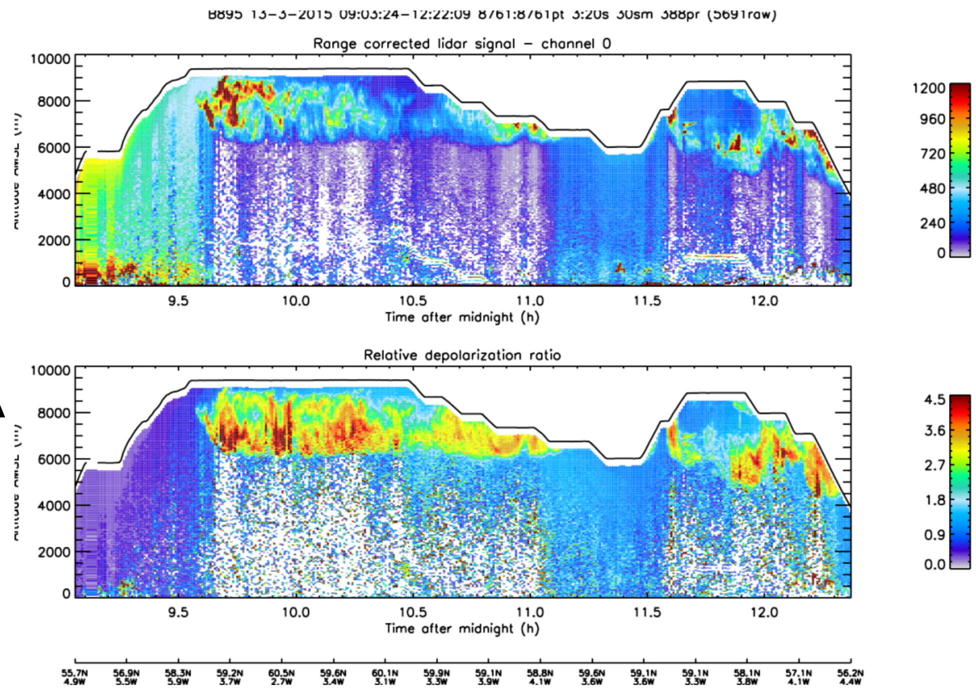
B893 high altitude nadir



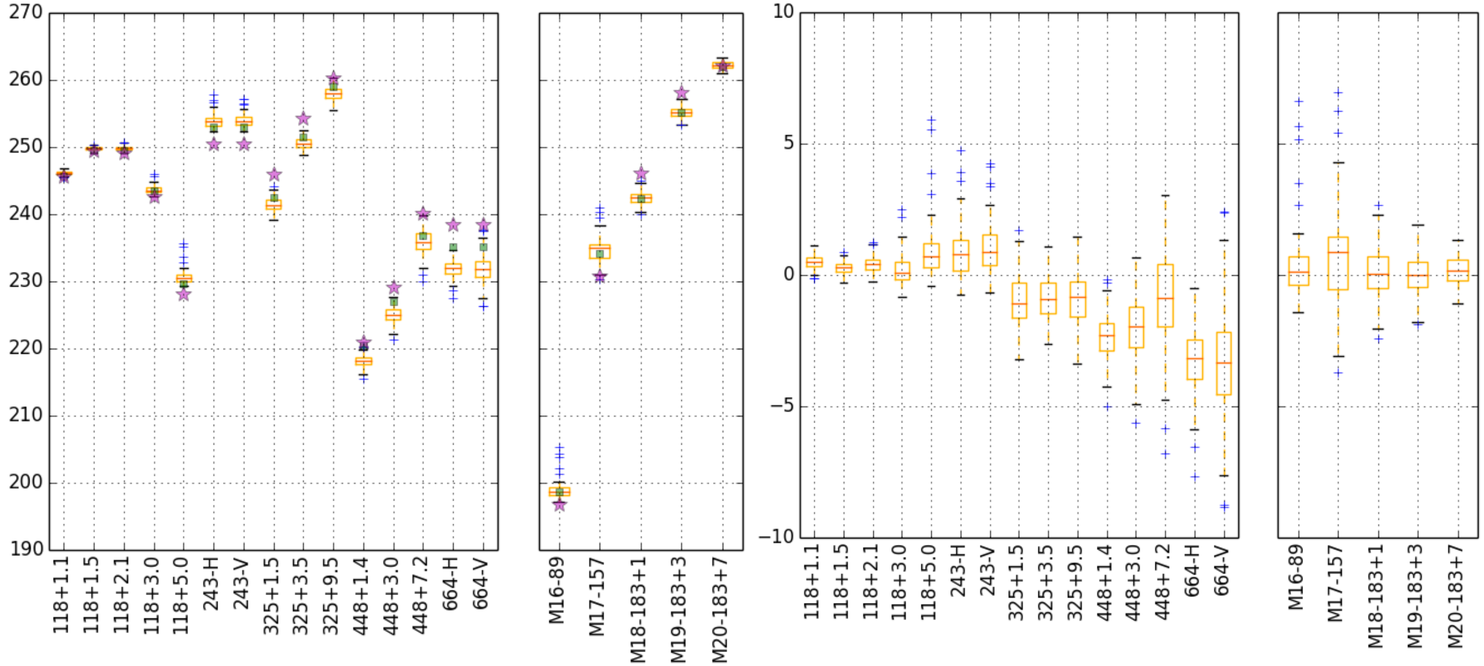
- Much better match to simulations in most ISMAR channels
- Differences within O(1K) for most channels

Application to Ci – B895

- Above-cloud run
- Sonde data as background profile
- SST from OSTIA analysis
- (Salinity from FOAM model)
- Surface wind speed from sonde



B895 above cloud nadir



- Differences of several Kelvin compared to clear sky simulation using MARSS retrieval for water vapour profile
- Difference increases with frequency
- In-situ measurements suggest IWP between 8 and 20g/m^2

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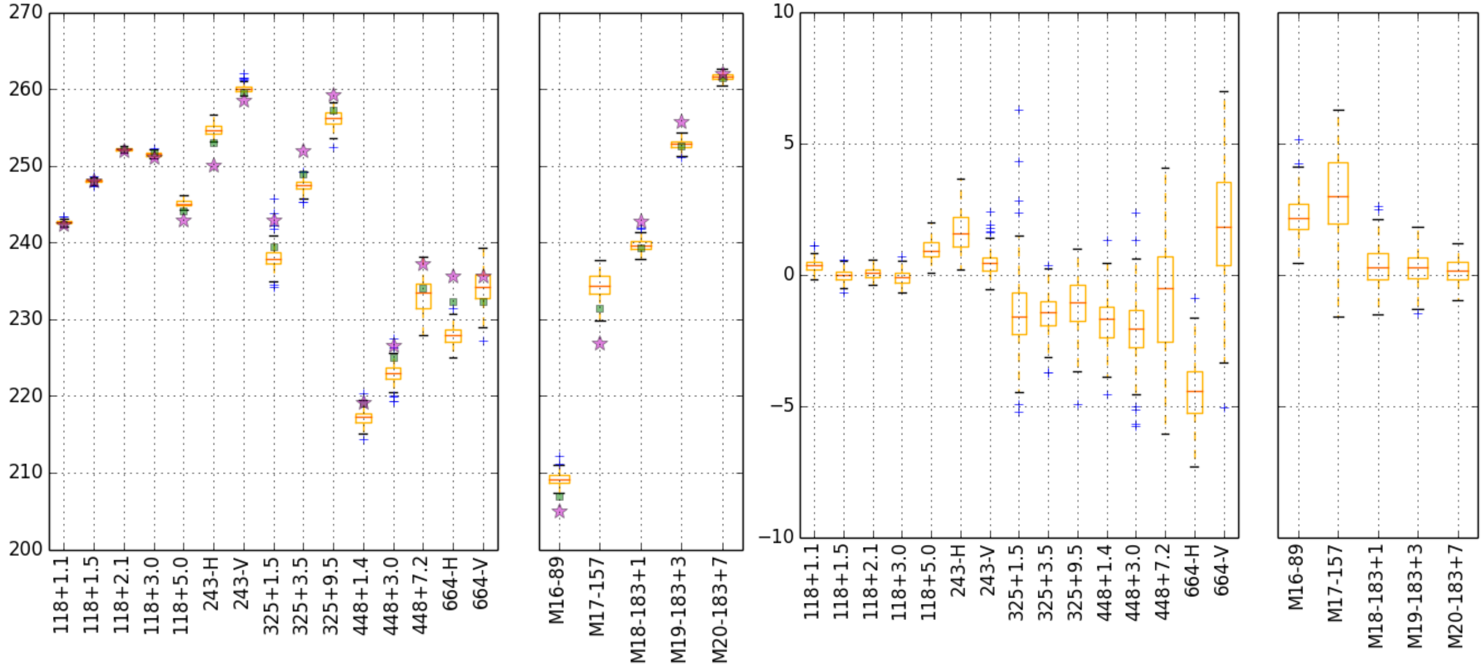
B895 above cloud forward view



- Forward view should increase path length through cloud
- Similar results to nadir views
- Polarisation signal at 664GHz?

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Questions?