

Assessment of the FY-3D microwave instruments at ECMWF

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1. Introduction

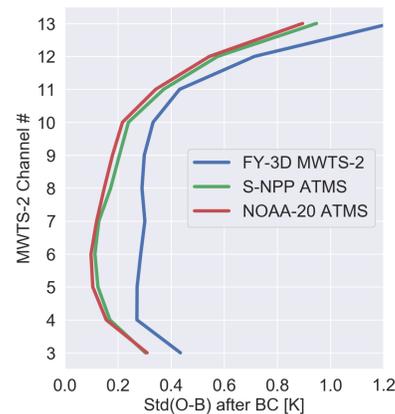
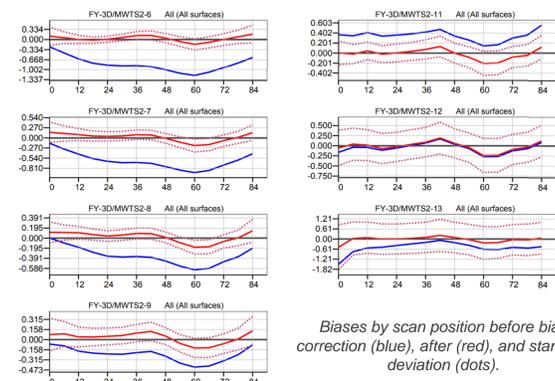
The ECMWF forecast model is used to evaluate the microwave instruments on board the latest polar-orbiting meteorological satellite in the Chinese FY series, launched in 2017. FY-3D has three microwave instruments:

- MWHS-2: humidity sounder with additional 118GHz temperature sounding channels
- MWTS-2: temperature sounder similar to AMSU-A
- MWRI: microwave imager with channels from 10-89GHz

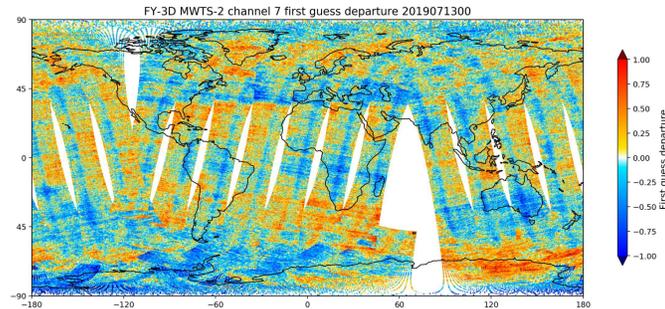
ECMWF has had an FY-3D data stream since July, with operational monitoring beginning on October 14th.

3. MicroWave Temperature Sounder 2 (MWTS-2)

- Scan position biases for MWTS-2 are not resolved well by bias correction predictors in the ECMWF system
- Striping artefacts affect several channels
- Channels 4 and 13 exhibit an ascending vs. descending bias of order 1K
- These reasons cause significantly larger std(O-B) than seen for AMSU-A or ATMS

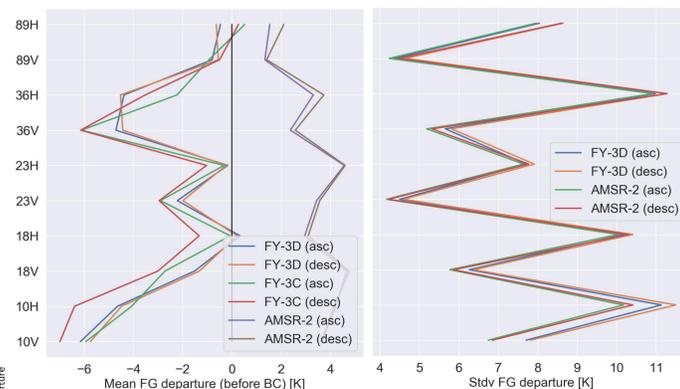
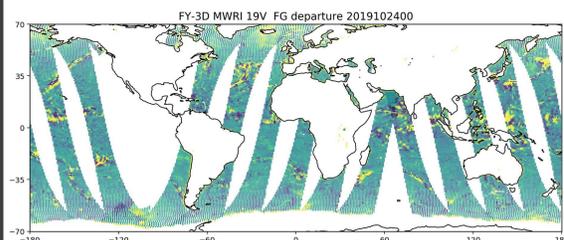


3x3 averaging is applied to MWTS-2 data analysed, as with ATMS



4. MicroWave Radiation Imager (MWRI)

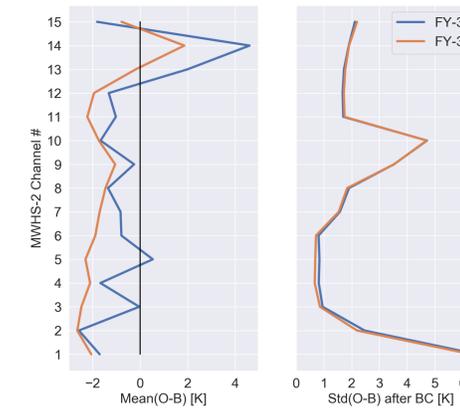
- Compared to FY-3C MWRI, FY-3D displays much lower ascending vs. descending bias
- Strong negative biases at 10GHz and 36GHz before bias correction, like on FY-3C
- From initial assessment in operations, std(O-B) for FY-3D is comparable to AMSR2



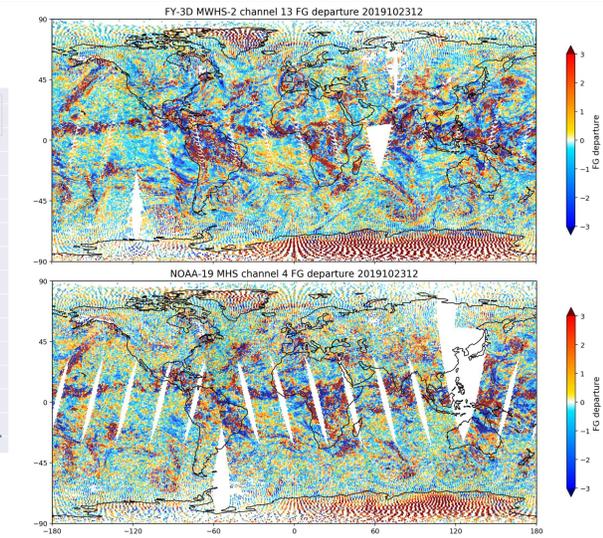
Data for assessment against AMSR2 from operational CY46R1 short range forecasts, screening out land, sea ice, and clouds. Data span Oct. 16 to Oct 23

2. MicroWave Humidity Sounder 2 (MWHS-2)

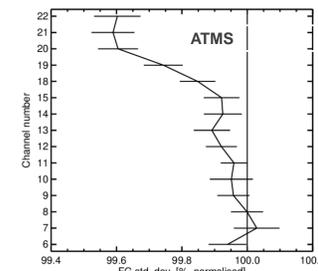
- MWHS-2 on FY-3D behaves similarly to FY-3C with slightly larger biases at 118GHz channels before correction
- Behaviour for humidity channels is also similar to equivalent MHS channels
- Due to this assessment and previous successful assimilation of FY-3C MWHS-2, assimilation trials were begun



Data screened for land, sea ice, and cloud, spanning two weeks in July.



5. Assimilation trials with MWHS-2



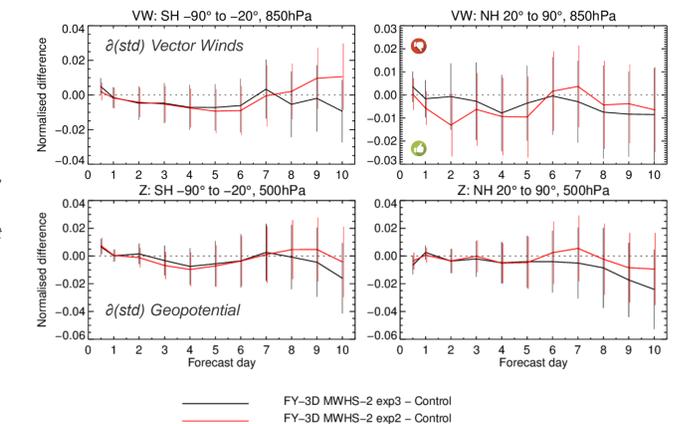
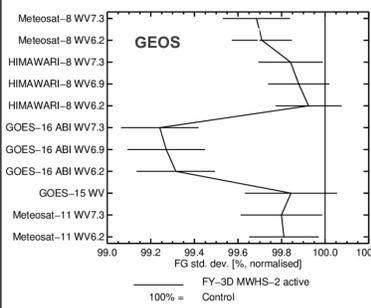
MWHS-2 is treated in the "all-sky" stream.

183GHz channels are assimilated over most surfaces, except some high orography and high latitudes.

Channels 2-6 are assimilated over all surfaces except sea ice, and ch. 7 is used over ocean only.

Exp2 = MWHS-2 active + FY-3C 13/14

Exp3 = Exp2 + ch 2-6 over sea ice



Neutral or slightly positive impacts from MWHS-2 assimilation

- Small but significant reductions of FG departures are seen for other microwave sensors and IR humidity channels
- Different channel configurations are being tested, including reintroduction of FY-3C channels 13 & 14, and use of 118GHz channels over sea ice
- Assimilation of even more 183GHz channels still shows benefit, in addition to the 30+ already assimilated at ECMWF
- Figures are from 3-month assimilation trials in different configurations

Summary

- FY-3D microwave instruments are now operationally monitored at ECMWF
- MWHS-2 performs quite similarly to FY-3C; initial assimilation experiments demonstrate neutral forecast impact so far but improved fits for humidity observations, so this is a prime candidate for operational assimilation before the end of the year
- MWTS-2 exhibits higher std(O-B) than AMSU-A and ATMS due to cross-scan biases, striping, and some orbital biases
- MWRI shows promising preliminary results, with no strong ascending vs. descending bias like its predecessor on FY-3C; it will thus be subject of assimilation experiments to judge potential operational use in the future

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