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.

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

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
- Stripping artefacts affect several channels
- Channels 4 and 13 exhibit an ascending vs. descending bias
- These reasons cause significantly larger std(O-B) than seen for AMSU-A or 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

5. Assimilation trials with MWHS-2
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

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
- 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, stripping, 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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