

# Impacts of Combined FY-3D MWTS and MWHS Data Stream on Typhoon Forecasts

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## ABSTRACT

FY-3D satellite was launched with microwave temperature sounder (MWTS) and microwave humidity sounder (MWHS) on board. Typically, two data streams from both instruments are assimilated in numerical weather prediction models. Unlike ATMS and AMSU, MWTS does not two low frequencies at 23.8 and 31.4 GHz and thus it is difficult for those users who are accustomed with the quality control (QC) of ATMS data in NWP models. In this study, we presented a combined microwave sounding data sets (CMWS) generated from MWTS and MWHS with a total of 30 channels. Two synthetic channels at 23.8 GHz and 31.4 GHz are also produced through a machine learning training against ATMS data. In addition, MWTS and MWHS are also matched to the same field of field size similar to ATMS temperature sounding channels. It is shown that the cloud liquid water (CLW) retrieved from CMWS data has a similar quality to ATMS one and can be used for quality control, a key procedure in satellite data assimilation. After removing the scan-angle dependent bias, CMWS is now successfully assimilated in the typhoon prediction model and produced a forecast impact comparable to ATMS. The CMWS data is now also being used as a proxy data for the upcoming FY-3E MWTS and MWHS data that have the same number channels of CMWS.

## BACKGROUND

Several challenges need to be addressed when to assimilate FY3D MWTS/MWHS observation into numerical forecast. They are:

- Two channels at frequency of 23.8 and 31.4 GHz are missing. It leads to the absence of the retrieved cloud liquid water (CLW) and total perceptible water (TPW) in quality control procedure.
- Unlike ATMS, FY3D MWTS/MWHS are two separate units. It is not convenient to use the temperature and humidity observations coherently.
- There exists significant scan-angle dependent bias.

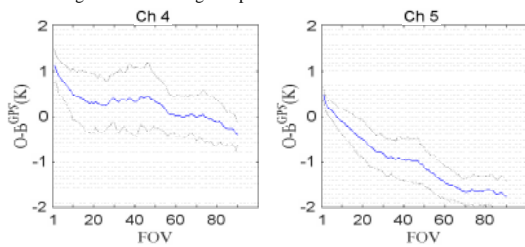


Fig 1. The difference of brightness temperature between simulation and observation varying with the scan angle for FY3D MWTS channels 4 and 5.

## METHODOLOGY

A CMWS data set is generated and assimilated in the numerical weather prediction.

- ✓ The cloud liquid water and total perceptible water retrieved from two synthetic channels at 23.8 and 31.4 GHz are used in quality control.
- ✓ Like ATMS, the temperature and humidity is assimilated in one data stream.
- ✓ The scan-angle dependent bias is deliberately removed.

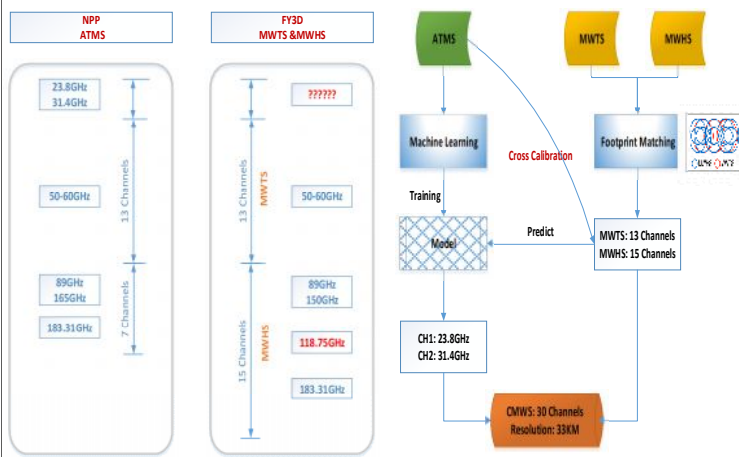


Fig 2. The flow process to generate a combined microwave sounding data sets (CMWS).

## ASSIMILATION OF FY3D CMWS DATA

### 1. Retrieved CLW utilized in quality control

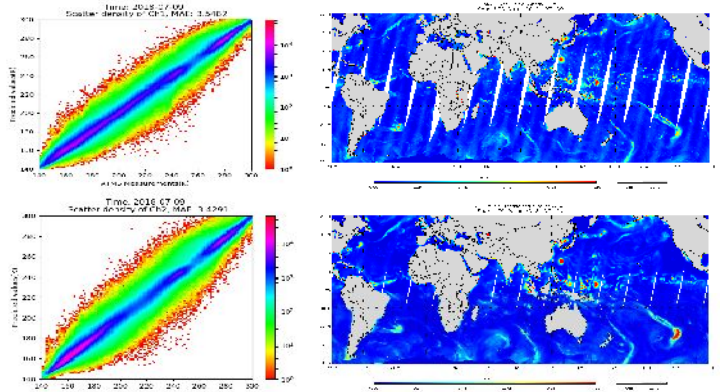


Fig 3. The scatter density of the reconstructed channels and ATMS measurements (top: Ch1; bottom: Ch2).

Fig 4. Comparison of retrieved CLW between FY-3D reconstructed observation (top) and ATMS (bottom) on July 9, 2018.

### 2. Impact of bias correction on data usage

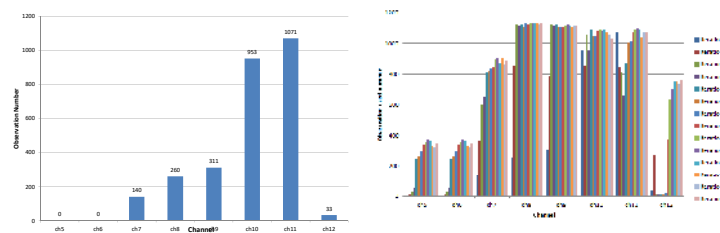


Fig 5. The MWTS data number assimilated. (Left: without BC; Right: with BC cycle tuning)

### 3. Impact of combined FY3D microwave data on typhoon forecasts

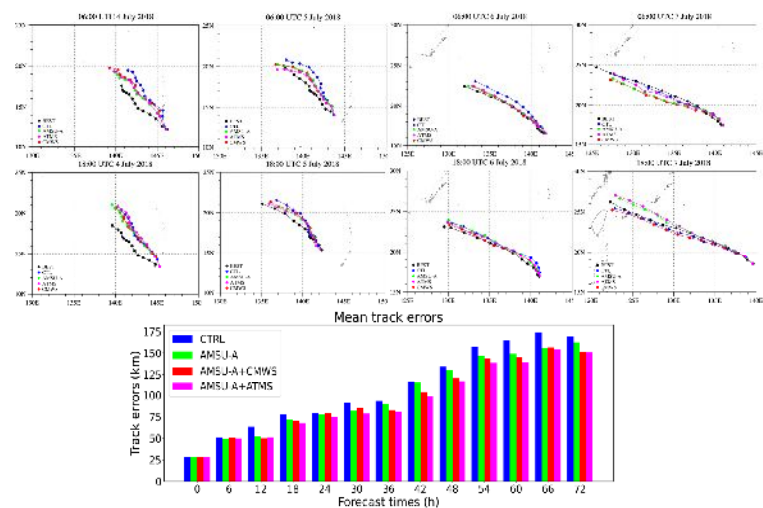


Fig 6. Comparison and statistics of the impact of satellite data assimilation on typhoon forecasts

## CONCLUSIONS

- 1) A 30 channels combined microwave sounding data sets (CMWS) with two synthetic channels at 23.8 and 31.4 GHz is generated from FY3D MWTS and MWHS.
- 2) CMWS is successfully assimilated in the typhoon prediction model and produced a forecast impact comparable to ATMS.
- 3) The CMWS data is now also being used as a proxy data for the upcoming FY-3E microwave data.

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