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# The sensitivity of CMC analysis to the characteristics of different observation data sets

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## Introduction

In an effort to improve the accuracy of the SST analysis and to reduce the volume of data processed at the Canadian Meteorological Centre, a series of sensitivity studies was carried out to evaluate the impact of the characteristics of different observation data sets on the SST analysis.

The first part of this study contains details about the CMC SST analyses and the performance of the systems in 2016.

Following WMO's recommendation to replace the TAC (Traditional Alphanumeric Codes) format with the BURF (Binary Universal Form Representation) format for in situ observations, in June 2016, CMC SST analyses started using buoys data retrieved from GTS in BUFR format. The second part presents the influence of increasing the precision of data assimilated in the SST analysis when using data coded in two decimals versus data coded in one decimal.

The last part examines the degradation of the SST analyses if satellite data is missing for a few days, followed by conclusions and future work.

## 1. Performance of the CMC SST analyses in 2016

CMC produces two L4 analyses every day:

- **The operational 0.2° CMC SST** (assimilates only AVHRR data)
- **The experimental 0.1° CMC SST**

| Data set | Data type | Producer / Source |
|---|---|---|
| NOAA18 AVHRR | L2P | NAVOCEANO / PO.DAAC |
| NOAA19 AVHRR | L2P | NAVOCEANO / PO.DAAC |
| MetOp-A AVHRR | L2P | NAVOCEANO / PO.DAAC |
| MetOp-B AVHRR | L2P | NAVOCEANO / PO.DAAC |
| GCOM-W2 AMSR2 | L3 | REMSS |
| SUOMI-NPP VIIRS | L2P/L3U | NOAA/NESDIS/OSPO / PO.DAAC |
| In situ | TAC / BUFR | GTS |
| Sea-ice concentration | L4 | CMC ice analysis |

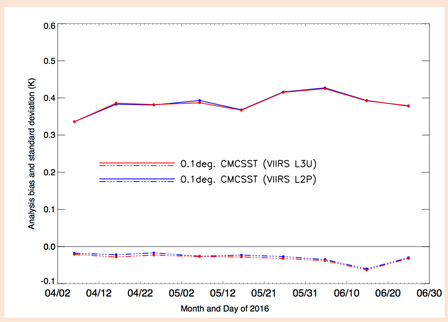


*Figure 1 a) Five day means for the 0.1° experimental analysis using ACSPO VIIRS data in L3U and L2P format*

- The operational and experimental analyses are compared with GMPE product for 2016
- The 0.1º CMC SST performs similarly to the GMPE, with some changes observed in April, July and October (the next few points explain some of these differences)

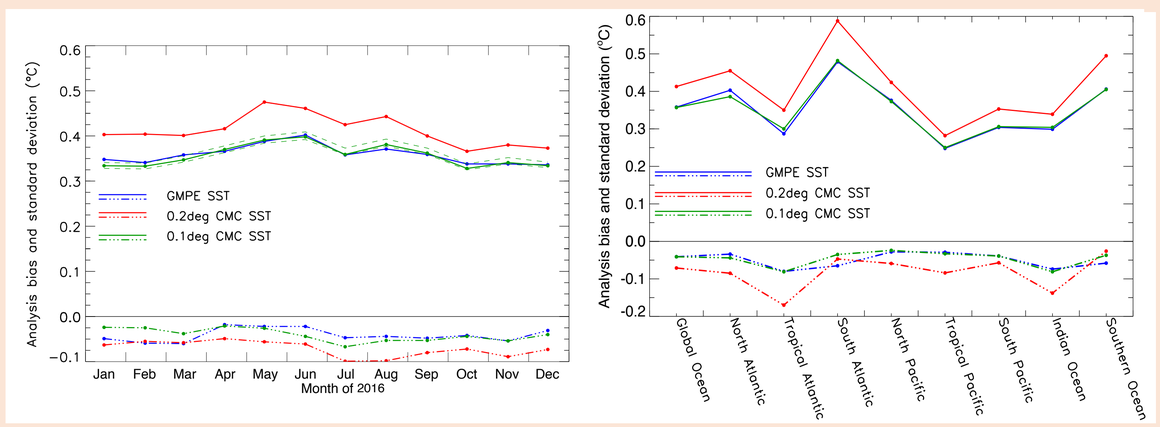


*Figure 2 Monthly verification statistics for 2016 using independent data from Argo floats as truth. Standard deviation and bias for the GMPE product, the 0.2° operational analysis and the 0.1° experimental analysis. b) Mean analysis bias and standard deviation for several regions in 2016.*

## 2. Using *in situ* observations in BUFR format

Until June 2016 the CMC SST analyses used in situ data from GTS in TAC format. Lately, WMO recommended to use BUFR format with higher precision. By conversion to our internal format (using one decimal), the higher precision was lost in conversion from ºC to K.

- When TAC and BUFR data are available for the same station, TAC data are used
- In the next version of the CMC SST analysis, higher precision BUFR data will be used in priority

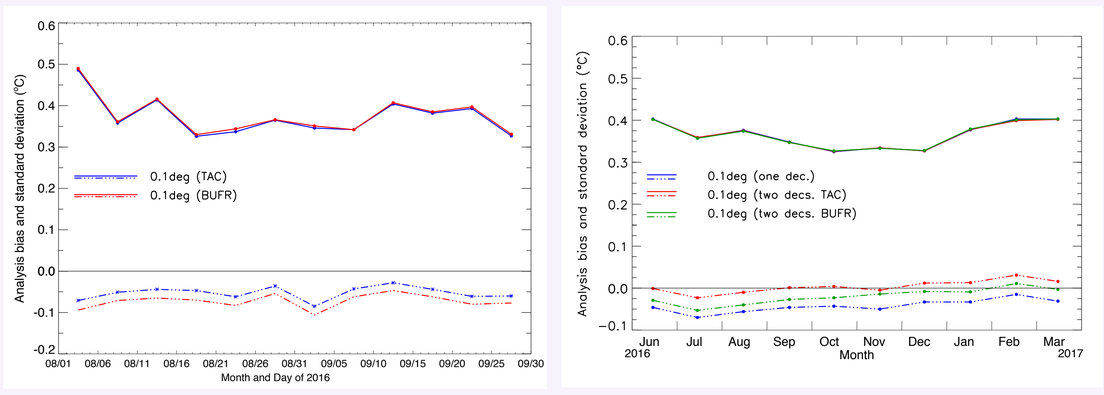


*Figure 3 Time series of standard deviation and bias for 0.1° CMC SST prioritizing TAC or BUFR data (a). The same statistics when observational data are represented in single or double decimal (b).*

## 3. Error estimates when satellite data are missing

Between August and October 2016, different problems have caused missing satellite data for the SST analyses.

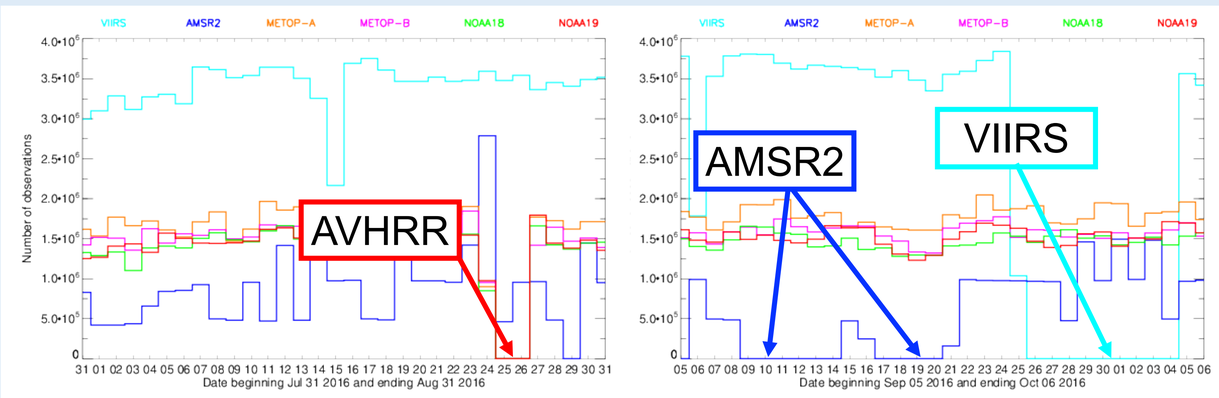


*Figure 4 Operational monitoring of the number of satellite retrievals available for SST analysis*

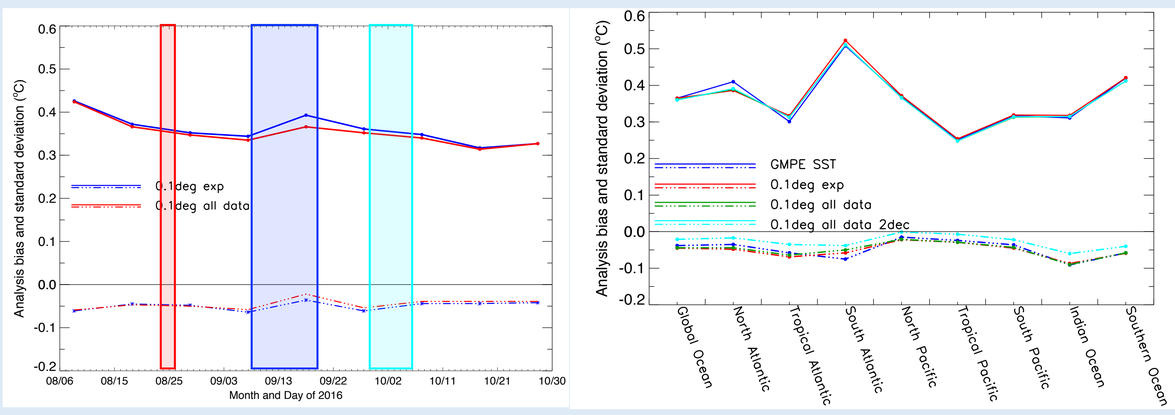


*Figure 5 a)Time series of standard deviation and bias of ten day means for the experimental analysis and for the same analysis but assimilating all data. b) Mean analysis bias and standard deviation for June 2016 - April 2017 for GMPE and 0.1° CMC SST for different setups*

- The lack of AVHRR data is compensated by VIIRS and AMSR2 data, but AMSR2 data are very important especially in summer

## Conclusion and future work

- CMC SST analyses performed well during 2016.
- The use of VIIRS L3U dataset instead of VIIRS L2P dataset reduced the volume of data without impacting the results.
- The transition of in situ data from TAC to BUFR was done for drifters and fix buoys.
- The assimilation of many satellite datasets into the experimental analysis allowed keeping the analysis performance almost constant.
- AMSR2 retrievals are very important for L4 products, less than 10 days of missing data produced a degradation of standard deviation equal to 0.02 K.
- Future work involves the operational implementation of 0.1º analysis including the use of observation data using two decimals.

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