Recent updates to the NCEP SST analysis and comparison with OSTIA and CMC products

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Introduction

An upgrade to NSST, the NCEP SST analysis, has been prepared to improve observational coverage by including additional two VIIRS satellites and reducing the thinning mesh from 145 km to 25 km for SST-sensitive satellite radiance data, and to further constrain data impacts locally by reducing the background error correlation length from 100 km to 25 km – 75 km. A tighter quality control for AVHRR radiance with cloud flag in the data set is included in this update as well.

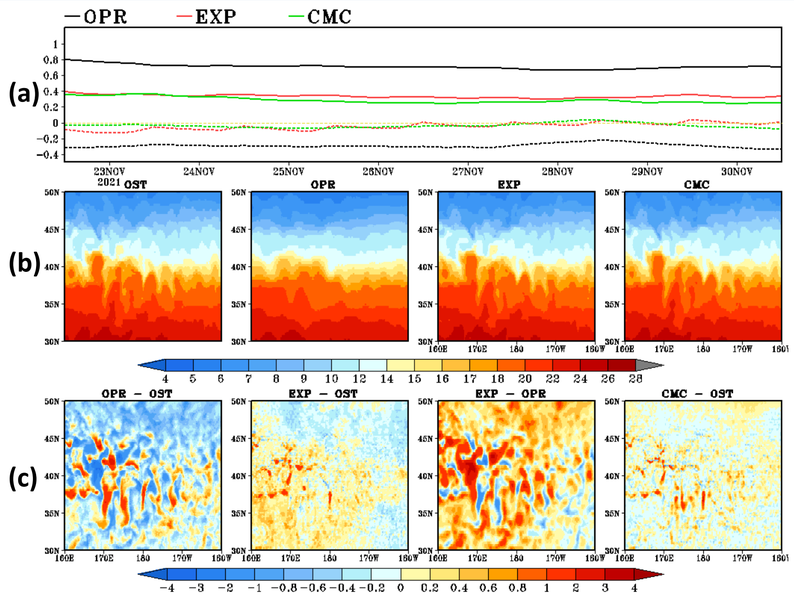
The inter-comparison among four L4 foundation temperature analysis products, **OPR** (operational NSST), **EXP** (experimental NSST with the update package), **OSTIA**, and **CMC**, are presented.

Foundation temperature analyses comparison: the RMS & Bias of two NSST and CMC against OSTIA, over global and 5 latitude bands

Area	RMS OPR, EXP, CMC	Bias OPR, EXP, CMC
Global	**0.50, 0.41, 0.30**	**-0.12, -0.14, 0.02**
N.Pole (50 N – 90 N)	**0.67, 0.51, 0.32**	**-0.20. -0.20, -0.00**
N.Mid (20 N – 50 N)	**0.67, 0.51, 0.41**	**-0.17, 0.01, 0.00**
Tropics (20 S – 20 N)	**0.31, 0.32, 0.20**	**0.00, -0.08, -0.00**
S.Mid (20 S – 50 S)	**0.52, 0.43, 0.37**	**-0.18, -0.21, 0.01**
S.Pole (50 S – 90 S)	**0.57, 0.51, 0.21**	**-0.30, -0.40, -0.02**

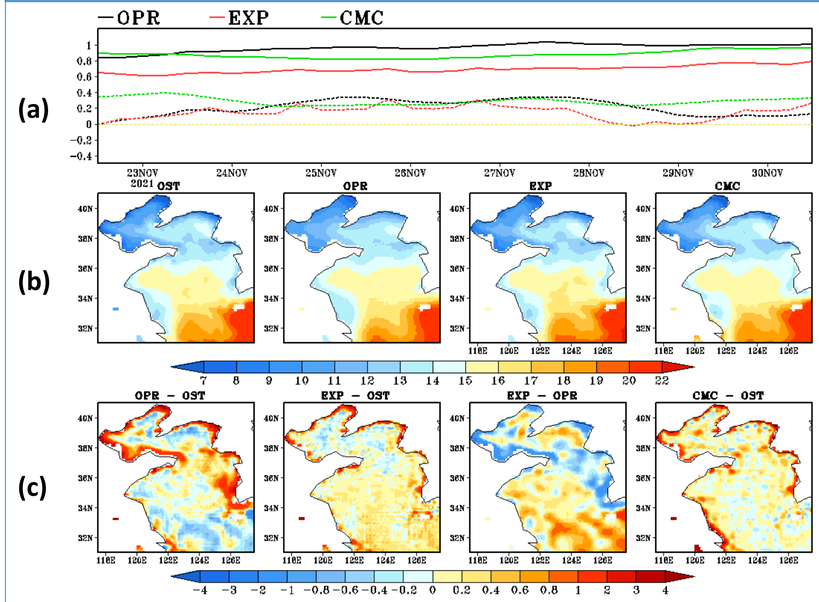
- **RMS**
  - **EXP and OPR vs OST:** RMS has been reduced from 0.50 in OPR to 0.41 in EXP, which is by about 19%, globally. The reduction is more significant in higher latitudes than in tropics.
  - **EXP and CMC vs OST:** CMC is closer to OSTIA than EXP, especially in higher latitudes
- **Bias**
  - **EXP and OPR vs OST:** No significant change in bias from OPR to EXP except for N.Mid area.
  - **EXP and CMC vs OST:** The NSST is generally cooler than OSTIA and CMC, especially in high latitudes, globally, NSST is cooler by about 0.12 K, and can reach -0.40 K in the S.Pole area.
- **Comments**
  - The O-B and O-A statistics of both OPR and EXP have been evaluated for in situ and satellite radiance observations, the results are: the fit to in situ data is slightly worse, and the fit to satellite data is significantly better (Not shown)
  - The reason to present the comparison to OSTIA and CMC L4 products is due to the more observations are used in them than in the operational NSST

The comparison of SST analyses. Area: (160 E-160 W; 30 N-50 N)



- For NSST, the RMS and Bias to OSTIA has been reduced significantly from OPR (0.8, -0.25) to EXP (0.4, 0.0), which becomes nearly the same as CMC (0.38, 0.00), see (a), the time series of the RMS and Bias of two NSST (OPR & EXP) and CMC against OSTIA. 00Z22Nov2021 to 18Z30Nov2022.
- OPR is smoother than OSTIA and CMC, however, the smaller spatial scale features have been resolved in the EXP, as expected due to the better observation coverage and the smaller correlation length, as seen from (b), the foundation temperature analysis of OSTIA, OPR, EXP and CMC.
- From (c), the differences among the analyses at 12Z27Nov2022, we can see the difference between NSST and OSTIA has been reduced dramatically from OPR to EXP, which is consistent with the changes in RMS and BIAS as seen in (a).
- It is interesting to see the similar pattern between EXP – OST and CMC – OST, which means OSTIA is the outlier over these areas, for example, in the area of (150 E – 180 E, 35 N – 45 N).

The comparison of SST analyses. Area: (117.5 E-127.5 E; 31 N-41 N)



The same as Figure on the left but for Yellow Sea area.

- By applying this NSST update, the RMS and Bias to OSTIA has been reduced significantly from OPR (0.95, 0.20) to EXP (0.66, 0.15), which is smaller than CMC to OSTIA (0.85,0.25), see (a), the time series of the RMS and Bias of two NSST (OPR & EXP) and CMC against OSTIA. 00Z22Nov2021 to 18Z30Nov2022, for Yellow Sea.
- The pattern in EXP becomes closer to OSTIA than in OPR, particularly in the most northern and southern part of this area, from (b), the foundation temperature analysis of OSTIA, OPR, EXP and CMC.
- From (c), the differences among the analyses at 12Z27Nov2022, we can see, there is a similarity between EXP – OST and CMC – OST, over most of the coast areas, except for the southwest coastline, where the CMC is warmer than both OSTIA and EXP. We also can see clearly EXP becomes much closer to OSTIA than OPR.

Conclusions and Discussions

- O – B and O – A become slightly worse for conventional observations, and significantly better for satellite radiance observations with this NSST update.
- As expected, the higher resolution spatial structures have been resolved better in EXP than in OPR by better observational coverage and smaller correlation length.
- The EXP becomes closer to OSTIA then OPR. Overall, OSTIA and CMC products are closer to each other than to NSST. However, for some local areas, any of the three can be the outlier. The evaluation suggests that the individual analysis can be improved by exploring root causes for the differences among products
- As to the cause of the cooler bias in the NSST analysis, some evidences have pointed to the variational bias correction in GSI
- The three L4 SST products have been compared here, more GHRSST L4 SST products will be included through GHRSST Task 2 of GHRSST IC-TT