Short-term Variations of Sea Surface Currents Estimated From Geostationary Satellite Sea Surface Temperature Images

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Abstract

This study assesses the accuracy of the surface currents from simultaneous Himawari-8 SST images, as a proxy for GEOS-KOMPSAT-2A (Geostationary - Korea Multi-Purpose Satellite-2A) SST, by comparing the quality-controlled currents obtained by the Himawari-8 satellite with the estimated currents obtained from surface drifters in the East Sea region of Himawari-8. It is observed that the estimated current speeds and directions show good agreement with the drifters-based calculated values, with root-mean-square (rms) errors of 1.85 m/s (0.05 m/s) and 6.7° (1.4°), respectively. The estimated current field illustrates a rotating feature around a mesoscale anticyclonic eddy, as well as the characteristic meandering pattern of the Kuroshio Current. In addition, we present short-term hourly variations of the surface current and their potential causes, and address the importance of the role of high-resolution geostationary satellite SST measurements in understanding short-term surface current variations.

Introduction

Surface geostrophic currents have long been estimated with reliable accuracy from sea surface height anomalies observed by satellite altimeter measurements. Moreover, satellite-based ocean current fields contain inherent error related to the spatial distance and temporal discrepancy of measurements between altimeter tracks. Surface currents derived from geostrophic terms is calculated using satellite SST images of near-polar orbiting satellites who have already been acting for the small number of data samplings due to frequent cloud cover or other meteorological and oceanic condition over relatively long time intervals. Such sparse samplings can be overcome, in part, by high-resolution and frequently observed geostationary satellite SST images.

Data

- Himawari-8 ALI L1B and L2 Data from KMA - (CCD 18.4 pm) Brightness Temperature
  - Resolution: Temporal 10 min, Spatial 2 km
  - Period: 2016-2018
- Cloud mask (from NOAA) and Land/Sea Mask
- Surface Drifter Data
- MADT (Maps of Absolute Dynamic Topography)

SSC Retrieval Algorithm

1. Surface circulation is calculated from the SST images using the Multivariate Coefficient Correlation (MCC) Method.
2. The calculated circulation is then compared with the observed surface drifter currents.
3. The correlation coefficient threshold for the comparison is 0.8.
4. The direction threshold for the comparison is 50°.

Mesoscale Anticyclonic Eddy

- The estimated current field illustrates the characteristic meandering pattern of the Kuroshio Current, which also appears in the SST image.
- The current retrieved from the SST image is advantageous for understanding the detailed structure of the currents rather than the drifter current due to its high resolution.
- Sea surface currents calculated from NOAA SST data and Himawari SST data are both illustrating well the mesoscale anticyclonic eddy located in the East Sea.
- Compared to AVISO geostrophic current, it shows relatively good accuracy.

Summary and Conclusion

- The sea surface currents were estimated from the geostationary satellite SST images and validated with drift data and AVISO geostrophic current data.
- The accuracy was affected by the magnitude of brightness temperature gradient and the time interval between satellite data and drifter data.
- The detailed structure of the Kuroshio surface currents along the main reaches of the current were observed by both of the estimated estimated currents and drift data.
- It addressed the importance of the role of high-resolution geostationary satellite SST measurements in understanding short-term surface current variations.

Acknowledgments

This work was supported by “Development of Geostationary Meteorological Satellite Ground Segment” program funded by NMSC (National Meteorological Satellite Centre) of KMA (Korea Meteorological Administration) and a grant of the Korean Ocean Research and Development Promotion Center funded by the Ministry of Oceans and Fisheries, Korea.

References

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Note: The diagrams and figures mentioned in the text are not included in the text representation.