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Editorial: Advances in observations and modeling of physical processes in the marine environment

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Editorial on the Research Topic
Advances in observations and modeling of physical processes in the marine environment

Marine meteorology is a subfield of meteorology, which deals with the weather and climate and the associated processes in the ocean environment. It is always challenging to understand the atmospheric variability over the ocean and complex interplay of the dynamic and thermodynamic processes in the marine environment (North et al., 2014). Analyses and modeling of high winds, wind surges, tropical cyclones, hurricanes, typhoons, fog, lightning, and thunderstorm over the ocean are relevant to scientific interests and practical applications. This Research Topic highlights various methods of using observations and modeling to investigate physical processes in the marine environment.

The contributions of the 14 articles in this Research Topic can be divided into four main areas: A) Fog observations and modeling; B) Analysis and modeling of tropical cyclones and typhoons; C) Observations and mechanisms of explosive cyclones and high winds; and D) Analytical and modeling techniques to investigate ocean and atmospheric processes.

Understanding the spatial and temporal variability of marine fog is important, and how to improve the forecast skill is also a concern (Koračin and Dorman, 2017). Li et al. investigate the atmospheric circulation and marine atmospheric boundary layer structure associated with marine fog over the northeast Pacific (NEP) in winter, and suggest the eastern flank of the Aleutian low and the northwestern flank of the Pacific subtropical high jointly contribute to a northward air flow over the NEP favoring warm and moist air flows through a cooler sea surface and facilitates the formation of advection-cooling fog. Based on hourly observations from buoys and automatic weather stations distributed in Qingdao and its adjacent islands, Song et al. analyze composite sea fog penetration

(SFP) events to reveal their spatio-temporal features and further show that the daytime anomalous moistening, together with the following diurnal cooling at night facilitates SFP. Zhou et al. examine the differences in sea fog properties at Xuwen and Zhanjiang harbors, and develop new different monitoring and early warning schemes of sea fog prediction for the harbors. Based on the operational version of the China Meteorological Administration Typhoon Model, Huang et al. demonstrate that the equitable threat score for the hindcasting sea fog increases by 61% through several improvements such as a more accurate sea surface temperature dataset, an optimum boundary layer turbulence parameterization scheme, and higher vertical resolution. Gao et al. also propose another data assimilation method to increase the equitable threat score of simulated fog area by including temperature constraint into the satellite-derived humidity.

The tropical cyclone (TC) intensity accompanied with precipitation and thunderstorm are main components of TC research (Emanuel, 2005). Zhang et al. study the rapid intensification process of Super Typhoon Rammasun (1409) in the South China Sea, and show vertical wind shear influenced by diurnal radiation cycle is a key factor in the TC rapid intensification. Zhou and Cao use a hybrid integral method to partition the horizontal wind fields in a limited domain with high accuracy to investigate development and evolution of a typhoon, and emphasize the relative importance of the divergent and non-divergent winds in the kinetic energy budget during the TC pre-development, re-intensification and dissipation stages. Xiang et al. examine the detailed characteristics of the inner rainbands distribution of both RI (rapid-intensification) and non-RI landfall TCs (LTCs) in the South China Sea during 2015–2020 with a multi-source merged precipitation dataset, and find that RI LTCs exhibit a relatively higher averaged rain rate in the inner core region than that of non-RI LTCs. Zhang et al. examine the radial and asymmetry distributions of thunderstorm as a function of TC intensity, landing location, and vertical wind shear with lightning data from the World Wide Lightning Location Network, indicating the effects of dry continental air intrusion and the enhanced surface frictional convergence.

The explosive cyclones are key phenomena in the middle and high latitudes, and important for understanding the atmosphere-ocean interactions there (Marco et al., 2019). Gao et al. compare explosive cyclones (ECs) and non-explosive cyclones (or ordinary cyclones) using 10 years of ERA5 reanalysis data, and find potential vorticity is important for ECs development. Wang et al. analyze vorticity and kinetic energy budgets for typical explosive extratropical cyclones, and show that the lower-level convergence-related vertical stretching and the vertical transport of vorticity are important for increasing the cyclone's cyclonic vorticity. Because observations of marine wind are rare, the estimation and forecasting of gusts over sea are difficult. Hu et al. establish a gust estimation equation applicable to the Bohai Sea based on reanalysis data and observations on the coast and offshore stations.

In addition, some special analytical and modeling techniques to investigate physical processes in the marine environment are also included. Lu et al. analyze transient luminous events from space-borne platform to reveal properties of continental and oceanic thunderstorms, and verify that negative cloud-to-ground strokes spawned by oceanic thunderstorms are more readily to produce sprites based on the existing ground-based observations in both Caribbean Sea and near the coast of South China. They further argue that the production of negative sprites heavily depends on the size of parent thunderstorms. With assimilation experiments, Sun et al. show that the sea surface temperature assimilation into a coupled Earth system model can significantly improve the strength of the Pacific Equatorial Undercurrent, the North Equatorial Countercurrent and the South Equatorial Current through reducing biases in the air–sea turbulence flux.

All these results can contribute to broadening a global vision of marine meteorology and guiding best decisions for human activities relevant to the marine environment. The proposed observational techniques as well as modeling and forecasting methodologies can be applied to the open sea and coastal regions worldwide.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Emanuel, K. (2005). *Divine wind: The history and science of hurricanes*. London & New York: Oxford University Press. ISBN: 978-0195149418 296P.

Koračin, D., and Dorman, C. E. (2017). "Marine fog: Challenges and advancements in observations and forecasting," in *Springer atmospheric sciences series* (Cham, Switzerland: Springer International Publishing), 537. doi:10.1007/978-3-319-45229-6

Marco, R., Liberato, M. L. R., Lionello, P., Joaquim, G., Pinto, J. G., Salon, S., et al. (2019). A global climatology of explosive cyclones using a multi-tracking approach. *Tellus A Dyn. Meteorology Oceanogr.* 71, 1611340. doi:10.1080/16000870.2019.1611340

North, G. R., Zhang, F., and Pyle, J. (2014). *Encyclopedia of atmospheric sciences*. Second Edition. Elsevier. 2902P.