surface ocean solas lower atmosphere study

Report for the year 2019 and future activities

SOLAS *Taiwan*

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First things first…Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?

PART 1 - Activities from January 2019 to Jan/Feb 2020

1. Scientific highlight

Typhoon or hurricane is a major natural disaster in many coastal regions. In the East Asia such as in Taiwan, mainland China, Japan, Korea, Philippines, typhoon threatens about one billion people living in the coastal areas. Understanding the interactions between typhoon and ocean is critical to forecast the changes in the strength and the route of typhoon.

Two buoys deployed in the western North Pacific successfully captured the super typhoon Nepartak (equivalent to Category 5) in July 2016 at distances less than 20 km from the centre of the typhoon's eye. Such unprecedented dataset combined with modelling results provide a new insights into typhoon-ocean interaction. This study shows a rapid temperature drop of about 1.5 °C in 4 hours in the surface ocean, largely due to the dramatic strengthening of velocity shear in the mixed layer and below. Such unprecedented atmospheric and ocean datasets gain our understanding of the evolution of physical conditions of the upper ocean responses to extremely strong typhoon. This study with those invaluable data help to validate certain related super typhoon-ocean interaction theories. Results will be incorporated into numerical forecast models, increasing the accuracy of forecasting the evolving processes of the super typhoon in the future.

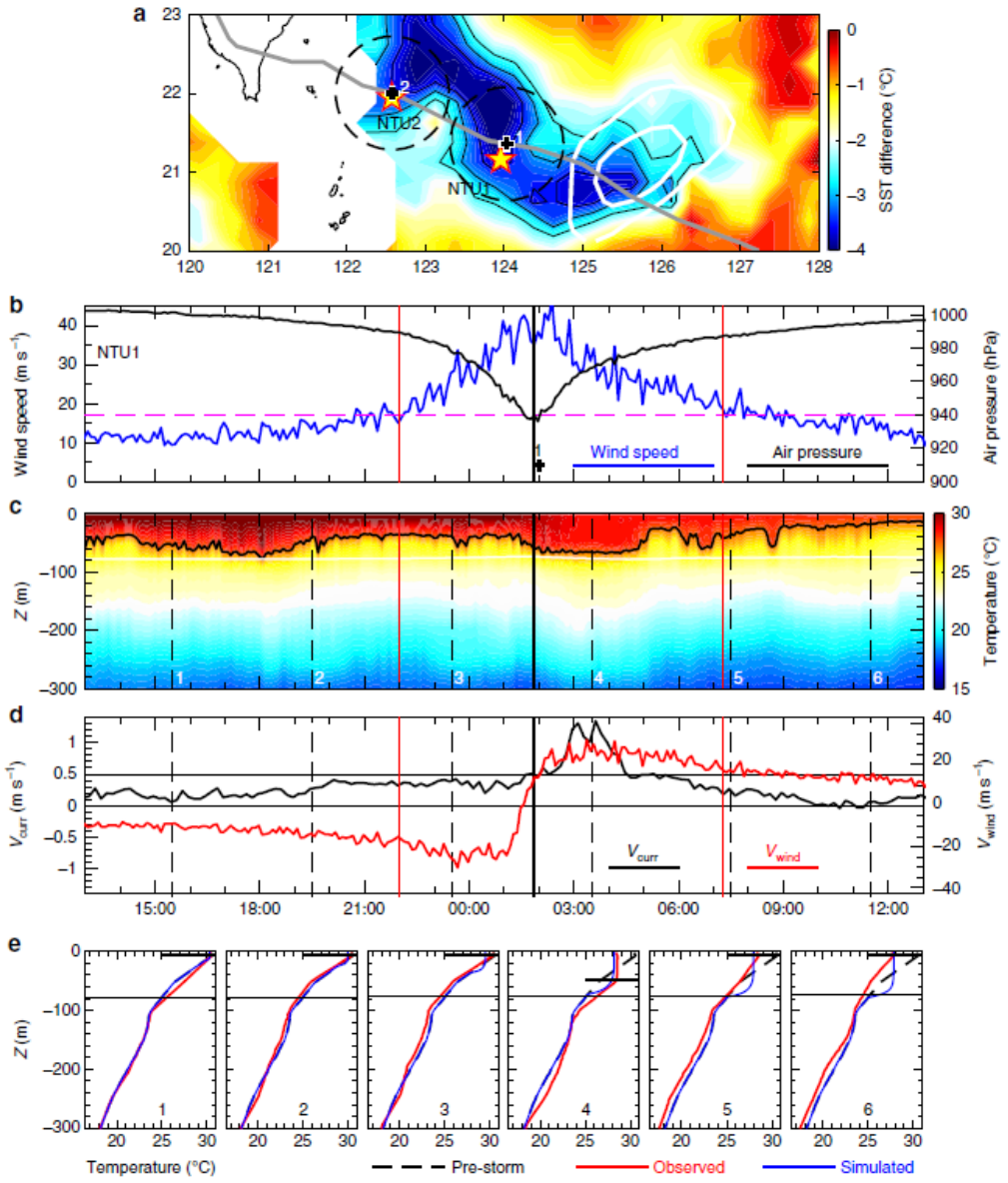

Figure: Satellite and buoy NTU1 observations of Nepartak. a Satellite SST difference between pre-storm sea surface temperature (SST) (5 July) and post-storm SST (8 July) with the typhoon track indicated by the gray line. Dashed circles and white contours in a indicate the radius of the Beaufort scale 10 wind and sea level anomalies of −0.1 and −0.2 m. Buoy NTU1 observed parameters: b air pressure (black line) and wind speed (blue line); c temperature in the upper 300 m; d meridional current velocity Vcurr at 75m (black line) and meridional wind velocity Vwind (red line). The two red vertical lines in b–d mark the beginning (left) and end (right) of the forced period. The black curve in c is the 27.2 °C isotherm. e Observed (red line), simulated (blue line), and pre-storm (black dashed line) temperature profiles at times 1–6 as indicated by the vertical black dashed lines in c and d. Black lines in e mark the mixed layer depth. The black vertical line in b–d marks the time of minimum sea level pressure.

Citation: Y.J. Yang et al. The role of enhanced velocity shears in rapid ocean cooling during Super Typhoon Nepartak 2016. *Nature Communications*, 2019, 10:1627.

2. Activities/main accomplishments in 2019 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

The Taiwan representative organized and leaded 5 meetings at the National Sun Yat-sen University, Taiwan, aiming to link scientists related to SOLAS in Taiwan together. An integrated three-year proposal “From marine aerosols towards understanding of the influences of a harbor-industry city on the air quality, climate changes, environmental ecosystem and their social impacts” was submitted to the Ministry of Science and Technology (MOST) of Taiwan at the end of 2019. The integrated 3-year proposal covers wide ranges of research interests, such as atmospheric chemistry, marine chemistry, marine ecosystem, management, education…etc.

The titles of the subprojects are as follows:

1. Impact of sea spray aerosol on enhancing PM2.5 formation in a coastal City

2. Characterization of the chemical composition, physico-chemical properties and anthropogenic effects of sea spray aerosols and air-sea microlayer using aerosol spectroscopy and mass spectrometric approaches.

3. Multiple-wavelength polarization and Raman LIDAR in NSYSU for detections of atmospheric aerosols above Kaohsiung harbor area and exhaust emissions from cargo ships.

4. Influence of marine aerosol on the mass transfer, equilibrium distribution, and health-effect potential of polycyclic aromatic hydrocarbons in a coastal region of southern Taiwan.

5. Impacts of natural and anthropogenic forcings on coastal acidification off southwestern Taiwan: Current status and its potential impacts on marine ecosystem.

6. Exploring possible impacts of natural- and human-induced environmental changes on small-scale marine resource based on spatiotemporal data of fishing vessels – a case on sergestid shrimp fishery of southwestern Taiwan.

7. Impact of Coastal Zone Land Use and Land Cover Changes on Port City Air Quality

8. Public Promotion of Key Sustainability Competencies through Education for Sustainable Development in the Contexts of Human, Ocean, Land, and Air.

3. Top 5 publications in 2019 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Y.J. Yang, M.H. Chang, C.Y. Hsieh, H.I. Chang, S. Jan and C.L. Wei. The role of enhanced velocity shears in rapid ocean cooling during Super Typhoon Nepartak 2016. *Nature Communications*, 2019, 10:1627.

C.R. Wu, Y.F. Lin and B. Qiu. Impact of the Atlantic Multidecadal Oscillation on the Pacific North Equatorial Current bifurcation. *Scientific Reports*, 2019, 9:2162.

S. Huang and L.Y. Oey. Land-falling typhoons are controlled by the meridional oscillation of the Kuroshio Extension. *Climate Dynamics*, 2019, 52, 2855–2867.

C.H. Chow, W. Cheah, J.H. Tai and S.F. Liu. Anomalous wind triggered the largest phytoplankton bloom in the oligotrophic North Pacific Subtropical Gyre. *Scientific Reports*, 2019, 9:15550.

W.C. Chou, P.J. Liu, Y.H. Chen and W.J. Huang. Contrasting changes in diel variations of net community calcification support that carbonate dissolution can be more sensitive to ocean acidification than coral calcification. *Frontiers in Marine Science*, 2019, 7:3.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2019? If yes, who? How did you engage?

PART 2 - Planned activities for 2019/2020 and 2021

1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).

An integrated three-year proposal “From marine aerosols towards understanding of the influences of a harbor-industry city on the air quality, climate changes, environmental ecosystem and their social impacts” was submitted (8 subprojects) to the MOST of Taiwan at the end of 2019. The integrated proposal is expected to start on 1st August, 2020. It covers wide range of research interests, including atmospheric chemistry, marine chemistry, marine ecosystem, management, as well as education. We welcome international collaborations.

2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).

The Taiwan representative plans to (1) organize 2 to three meetings for the SOLAS group in Taiwan in 2020, and (2) propose and chair a session in the topic of SOLAS Taiwan in the Annual Ocean Meeting in Taiwan in May, 2021.

3. Funded national and international projects/activities underway.

The funding is expected to come mainly from the MOST of Taiwan, and partly from the National Sun Yat-sen University and different industry-academia cooperative research projects of the participants.

4. Plans / ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).

Submitting an international proposal will be considered in 2021 or 2022, depending on the progress and the achievement of the 3-year integrated project.

5. Engagements with other international projects, organisations, programmes, etc.

The integrated 3-year proposal includes the collaborations between Taiwan SOLAS and University of California, San Diego (UCSD). Parts of the proposal is planned to be conducted with the Atmospheric Aerosol Research Center, UCSD.

Comments