Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AAS02-P01 Room:Convention Hall Time:May 25 09:00-12:15

Optimization of air-sea exchange coefficients in a tropical cyclone by use of a variational data assimilation system

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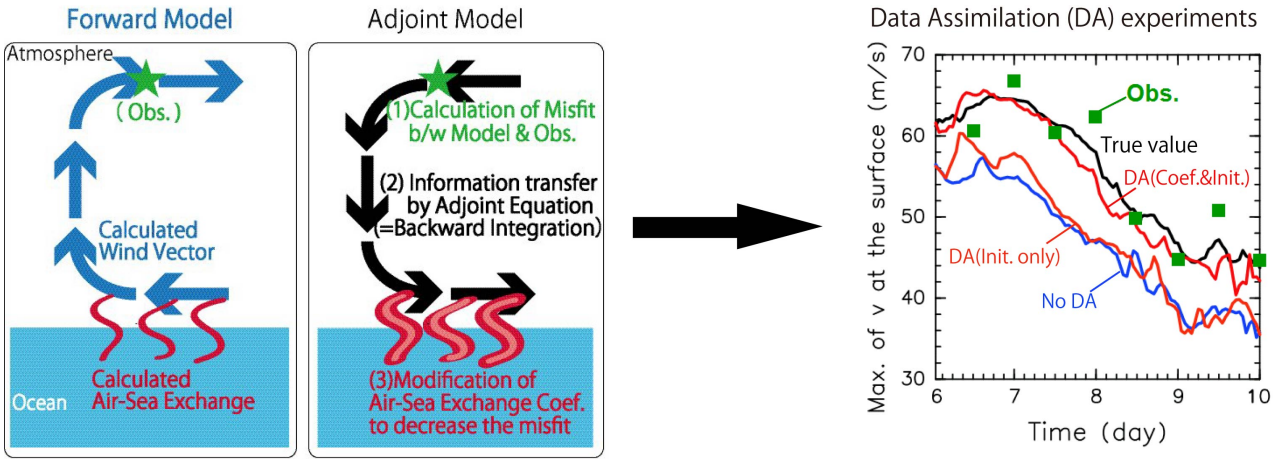
A tropical cyclone (TC) intensifies and maintains its circulation against surface friction through the self-inducement of anomalous heat fluxes from the sea surface. Therefore, uncertainty in the values of air-sea heat and momentum exchange coefficients has a detrimental effect on TC numerical modeling. Since a TC is one of the most destructive disasters, a method is required to reduce such uncertainty with respect to disaster prevention and scientific progress. In this study, impact of optimizing air-sea exchange coefficients by a variational data assimilation system is investigated for TCs. Our results show that the air-sea exchange coefficients are successfully improved by using the available observational data. The updated air-sea exchange coefficients yield improvements in the the maximum wind speed, the inner core structure and the location of vortex center in comparison with the data assimilation experiments in which the initial condition is selected as a control variable. Furthermore, it is implied that the optimization leads to enhanced prediction skill. See more details in Ito et al.(2010, SOLA).

Keywords: Data assimilation, Tropical Cyclone, Air-sea exchange coefficient



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Assessment of near-future typhoon risk in the Asia-Pacific region by using Stochastic Typhoon Model

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Typhoons generally trigger disasters, such as floods, landslides, storm winds and so on, often causing severe economic as well as human damages. The fourth assessment report of Intergovernmental Panel on Climate Change showed that tropical cyclones, including typhoons or hurricanes, are likely to become more intense in future due to global warming. Therefore, there is a possibility that damages caused by typhoons will become larger due to increase in number of intense typhoons. It is necessary to project the impact of climate change on typhoon characteristics, and subsequently estimate the risk associated with the typhoons. This study aims to project future typhoon characteristics and to assess the typhoons risk in Asia-Pacific region. There are some studies of numerical models designed to generate artificial typhoon. One example of those is output of General Circulation Model (GCM). GCMs can reproduce typhoon characteristics in principle because GCMs can calculate global climate change based on hydrodynamic equation and parameterized physical processes. However, it is difficult to repeat calculation in GCMs because computational resource is limited. The data extracted from GCMs are insufficient for assessing potential risk associated with typhoon damages. To solve these problems, Stochastic Typhoon Model (STM) based on statistical analysis is employed. STM is a kind of Monte Carlo simulation which stochastically calculates variation of typhoon characteristics from start to end of typhoon life based on observed typhoon statistics. For future typhoon projections, the statistical characteristics of the future typhoon tracks are produced as input data instead of the observed data. The future typhoon tracks are calculated by adding future trends by GCM to observed typhoon statistics. As a result of future projections, the typhoons track shift northeast in Western North Pacific. Especially around the Philippines, there is a remarkable tendency of decrease in number of typhoons in the future. Furthermore, the number of typhoons, with lower minimum central pressure, increases in near-future in WNP. Finally, typhoon risk is assessed stochastically using projection of typhoon characteristics under future climate change. Typhoon damage is determined by the characteristics of the typhoon such as intensity or track of the typhoon, the largeness of area where the typhoon affects, and the vulnerability of the area. In this study, the characteristics is represented as minimum central pressure, the largeness area depend on population and typhoon tracks, and GDP is used as indicator of vulnerability To assess the risk associated with typhoon, expected damage is calculated by using a relation between observed characteristics of a typhoon and the damage caused by it. Typhoon damages are estimated based on total cost of damages, which includes human damage as well as damage to physical infrastructures. The change of social conditions such as population or GDP is not considered to assess only climate change. As a result of typhoon risk, annual damage cost will decrease in almost all countries. For example, in Japan and China, damage cost per a typhoon also decrease. In this study, used parameters are minimum pressure when typhoon made landfall and the distribution of typhoon landfall. In these countries, minimum pressure is not changed. Therefore, the change of distribution of typhoon landfall affects to decrease of the damage cost per a typhoon. As conclusion, the methodological experience in this study will be helpful to build risk management.

Keywords: Stochastic Typhoon Model, General Circulation Model, Risk Assessment, Typhoon damages