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非静力学メソ４次元変分法 (JNoVA) における台風状況下の海面交換係数と初期値の同時最適化
Simultaneous optimization of air-sea exchange coefficients and initial condition around a tropical cyclone with JNoVA

伊藤 耕介 [1*], 川畑拓矢 [2], 斉藤和雄 [2], 本田有機 [3]
Kosuke Ito[1*], Takuya Kawabata[2], Kazuo Saito[2], Yuuki Honda[3]

[1] 海洋研究開発機構, [2] 気象研究所, [3] 気象庁
[1]JAMSTEC, [2]MRI, [3]JMA

Uncertainty in the values of air-sea exchange coefficients has a detrimental effect on tropical cyclone (TC) modeling (Emanuel, 1986). Since a TC is one of the most destructive disasters, a method is required to reduce such uncertainty. In this presentation, we first show the feasibility of specifying air-sea exchange coefficients in the high-wind regime by using an idealized variational data assimilation (VDA) system followed by the application to the operational system. Here, air-sea exchange coefficients are chosen as control variables together with the initial conditions.

Figure depicts the procedure for an advection-diffusion equation. Firstly, the misfit between the observation and model result is calculated. Then, the gradient to the air-sea exchange coefficients is formulated using the adjoint model, in which observations located downstream of the flow work in the correction of air-sea exchange coefficients. This approach is applied to the VDA system that uses the axisymmetric model of Rotunno and Emanuel (1987) as its base and the operational one used in Japan Meteorological Agency (JMA) (e.g., Honda and Sawada, 2009). Detailed configurations are found in Ito et al. (2010, 2013).

In our idealized experiment, the air-sea exchange coefficients are successfully improved toward the 'True' values by digesting the pseudo-observations mimicking the dropsonde observations. The updated air-sea exchange coefficients yield persistent improvements in the maximum wind speed and the inner core structures. Without adjustment of the exchange coefficients, the analysis field of the inner-core is contaminated, even if the initial state is modified by the adjoint method. We applied this approach to the operational VDA system for the case of Typhoon Chaba (2010). After some spin-up cycles, the misfit between model results and observational data decreases by 4.1-22.4% relative to the existing system, which adjusts the initial condition alone. The intensity and location of the TC are thereby brought close to those of the corresponding best track produced at JMA. Furthermore, our optimization approach holds the prospect of enhanced track forecast potential.

キーワード: 台風, データ同化, 海面交換係数
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