

## Characteristics of Initial Perturbation of JMA GEPS during Sudden Stratospheric Warmings

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In order to sophisticate the ensemble forecasting and data assimilation system of the whole atmosphere, it is necessary to accumulate the knowledge about the uncertainty of the analysis in the stratosphere and mesosphere, which is poor in comparison with that in the troposphere. Therefore, this study investigates characteristics of initial perturbation of the Japan Meteorological Agency (JMA) Global Ensemble Prediction System (GEPS), which has been replaced in March 2017.

By focusing on two Sudden Stratospheric Warming (SSW) events occurred in 2017-2018 and 2018-2019 winters, several aspects of the new JMA GEPS are revealed as follows: (1) There is large uncertainty above the upper stratosphere (which has not been reflected in the previous system). (2) The analysis ensemble spread increases and penetrates downward from the upper stratosphere during the onset period of both SSW events, though its precursory nature is not so evident as pointed by previous studies (e.g. Enomoto et al. 2010). (3) After SSW events, the analysis ensemble spread in the middle and upper stratosphere shrinks in association with the change of dominant physical processes. However, relatively large spreads, which may have implications for the stratosphere-troposphere coupling, are sometimes found in the lower stratosphere.

The quality of forecasts and analyses above the upper stratosphere would be inevitable from the artificial effect of sponge layers near the model top. Therefore, it is worth comparing or communicating with results of some high-top system to validate the appropriateness of above-mentioned aspects (e.g. (1)) and recognize limitations of current operational settings.

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