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## The impact of upper tropospheric temperature change on tropical cyclone

Nawo Eguchi<sup>1</sup>, Kenta Kobayashi<sup>2</sup>, Kosuke Ito<sup>3</sup>, and Tomoe Nasuno<sup>4</sup>

<sup>1</sup>Research Institute for Applied Mechanics, Kyushu University, Kasuga, Japan (nawo@riam.kyushu-u.ac.jp)

<sup>2</sup>Interdisciplinary Graduate School of Engineering Science, Kyushu University, Kasuga, Japan (kkobayashi@riam.kyushu-u.ac.jp)

<sup>3</sup>Faculty of Science, University of the Ryukyus, Nishihara, Okinawa, Japan (itokosk@sci.u-ryukyu.ac.jp)

<sup>4</sup>Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokohama, Japan (nasuno@jamstec.go.jp)

We evaluate the impact of temperature at the upper troposphere and lower stratosphere (UTLS) on the tropical cyclone (TC) generation and its development by using the nonhydrostatic atmosphere-ocean coupling axisymmetric numerical model [Rotunno and Emanuel, 1987; Ito et al., 2010]. In the case of cold simulation at UTLS, the maximum wind and the minimum sea level pressure are increased and decreased than the control run, respectively. The magnitude of intensity change is the approximately 4 times larger than the change estimated from the MPIs (Maximum Potential Intensity [Bister and Emanuel, 1998; Holland, 1997]). Further, during the development phase, the cold air mass intrudes to the middle troposphere from the upper troposphere at the center of TC, which is not seen in the warm case, leading the atmosphere unstable and enhanced the upward motion and then the TC got stronger.