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Surface pressure variation excited by cumulus convection

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It has been established that the free oscillations of solid earth are always excited with a small amplitude by some sources other than earthquakes(Nakajima and Notsuhara, 2001; Shimazaki and Nakajima, 2008). One of the candidate for excitation is acoustic waves excited by cumulus convection in the atmosphere. To examine this scenario, a numerical model that can simulate all kinds of atmospheric waves including acoastic waves is required. Tashima and Nakajima (2007) developed a numerical cloud model with full-compressible system of equation, and simulate the development of convective cloud and its ability to excite acoustic waves. The model, whose spatial resolution is 167m, covers 20km in the horizontal direction and extends up to 120km in the vertical direction to represent the 3.7mHz acoustic mode without severe distortion. Standard three category cloud physical parameterization is included. They also employed a linearlized one-dimensional model, which is used as a diagnostic tool to identify which of various cloud processes are responsible for the excitation of acoustic waves possibly related to the earth's free oscillation. In this presentation, short wavelength components, which would correspond to the pressure variations observed by networks of high precision barometers, will be examined.

Numerical experiment reproduced a typical life cycle of convective cloud. We examine the temporal evolution of the horizontal average of surface pressure, whose horizontal wavenumber (zero) is the nearest to the wavenumber of the earth's free oscillation (O(1/1000km)) in all of the waves in the model. The result shows that the temporal variation of surface pressure contains both a slow variation corresponding to the development of cloud as a whole and much faster variation, whose frequency corresponds to that of the enhancement of the earth's free oscillation.

The pressure variation is compared with the runs of the linearlized one-dimensional model driven by the horizontal averages of various non-linear or diabatic terms sampled in the full model. The result shows that the slow variation is mainly excited by the sink of water vapor due to condensation and the drag force of liquid water, whereas the fast component is excited by the latent heating of condensation.

On the other hand, non-averaged pressure time series contains much higher frequency components. The details will be examined in the presentation.

Keywords: cumulus convection, microbaroms, free oscillation, infrasound