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State Estimation of the Crust by Machine Learning for Time Series Data of Dense Ocean-floor Network system for Earthquakes and Tsunamis observatory

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If we know feature quantities which change their state corresponding to earthquake activity, we will be able to save lives and reduce economic losses by preparation. Such quantities must be extracted by observed real-time data. It is likely that the crust shows precursor phenomenon like micro cracks before a main shock. In that case, the observed physical quantities will be affected in the different manner. Thus, when we have multi-channel observatory, the transfer function between different channels will magnify the precursor signals and can be the feature quantities.

On the basis of the above idea, we focused on the 2016 earthquakes offshore of Kii peninsula which occurred near Dense Ocean-floor Network system for Earthquakes and Tsunamis (DONET) observatory. We extracted a non-linear transfer function between the observed data from DONET using a neural network. We set a time window in which the neural network learned the transfer function, and we get time dependence of the transfer function by sliding the window in time. As a result, we extracted a feature quantity set which shows simple trajectory which reflects earthquake activity. It is expected that these quantities distinguish whether an earthquake activity will be calm down or not.