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Understanding of crustal activity based on spatiotemporal relationships between various geophysical measures (3)

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For comprehensive understanding of the crustal activities, it is important to examine spatiotemporal relationships between different geophysical parameters. For inquiring into them, we first collected different kinds of geophysical data such as seismicity, GPS, gravity anomaly, and geothermal gradient, which reflect the crustal activities with different time scales. Then, we have created a database with a spatially and temporally gridded format from the geophysical data. Our goal is to understand the crustal activities through spatiotemporal relationships between different geophysical parameters for various regions using statistical approaches and develop some statistical indices which are useful for monitoring of crustal activities.
We previously reported the temporal changes in spatial relationships between seismic and geodetic parameters (seismic energy, the number of earthquakes, dilatation rate, and maximum shear strain rate) with high-resolution temporally and spatially gridded data format (half a year and 0.05 degree by 0.05 degree), which were obtained from the JMA hypocenter catalog and the GSI GEONET data. In the analysis, we noticed some regions surrounding the source areas of M6-class inland earthquakes and the time periods prior to these events. We mentioned that larger earthquake energy appeared to be radiated by relatively smaller-magnitude events before the occurrence of large events in areas with smaller strain rates rather than larger ones.
Furthermore, we quantitatively showed the spatiotemporal relationships between seismicity and geodetic parameters for more regions with and without M6-class inland earthquakes using a newly defined statistical index. The statistical index was calculated as follows:
(1) For a region and time window, the maximum value of a seismicity parameter is searched.
(2) The averaged value of a geodetic parameter is calculated from the grids with the seismicity parameter more than 80% of the maximum value obtained in the earlier process.
(3) By moving the time window, the process (1) to (2) is repeated.
As a further step to our goal, we developed an automatic system which compare different geophysical parameters, classify their spatiotemporal relationships, and evaluate the relations of classification results to the occurrence of large inland earthquakes. We here introduce the flow of the system, which requires input of the database and other parameters and leads to output of various figures and tables (text-format files) including those related to probability gains of prediction and alarm rate.

Keywords: seismicity, crustal deformation, crustal activity, strain rate, spatiotemporal relationship, probability gain