南極・昭和基地における遠地地震の検知能力の時間変化に関する統計解析

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Statistical analysis on the temporal variation in teleseismic detection capability at Syowa Station, Antarctica

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This study demonstrates a quantitative evaluation of temporal variation in teleseismic detection capability at Syowa Station, Antarctica. Kanao [2010] and Kanao et al. [2012] have already pointed out the seasonal variation in the detection capability on the basis of the magnitude-time history of teleseismic events observed at the station; as a general tendency, the minimum magnitude threshold of the detected events in summer is larger than that in winter (Fig. 1a). According to Kanao [2010] and Kanao et al. [2012], a suggestible reason of the seasonality is a climatic factor. In winter, the sea surface around Antarctica is covered with ice, and therefore the generation of sea wave, which is a source of strong noise, is restrained. As another reason, the aforementioned studies suggest higher human activity in the vicinity of the station during summer period than winter period.

The dataset analyzed in this study is the same as the examined one in Kanao [2010] and Kanao et al. [2012]. The data period ranges from 1987 to 2007 and the magnitude of the events are measured with the body-wave magnitude (*Mb*) scale. The temporal variation in detection capability is estimated through a statistical approach developed in Iwata [2008, 2012]. In this approach, the model representing a magnitude-frequency distribution of earthquake covering the entire range [Ogata and Katsura, 1993] is introduced. The distribution is assumed to be the product of the Gutenberg-Richter law [Gutenberg and Richter, 1946] and the detection probability of earthquakes at magnitude M. Following the suggestion of Ringdal [1975], the cumulative distribution of a normal distribution is frequently used as the detection probability [e.g., Ogata and Katsura, 1993; Iwata, 2008, 2012, 2013a, 2013b, 2013c]. Then, the temporal variation in the parameters contained in the above model was estimated by adopting a Bayesian approach with a piecewise linear approximation [e.g., Powell, 1981]. One of the model parameters is μ, the magnitude at which 50% of earthquakes are expected to be detected, and this parameter quantifies the quality of the earthquake detection capability; smaller value of μ corresponds to better detection capability and vice versa.

The estimated temporal variation in μ is shown in Fig. 1b. The estimated profile reveals the long-term decrease in μ during 1980s and 1990s, which may be attributed to the improvement of the earthquake-monitoring system at Syowa Station. Another distinctive feature is that higher value of μ in summer than in winter is found in several years. We should note that the seasonal variation does not appear in every year. This is because the seasonal variation would be governed by not only climatic factors (e.g., air and/or seawater temperature) but also the geometrical factors such as the distance between the teleseismic event and Syowa station. The spatial distribution of the teleseismic events has temporal variation may affect the estimated temporal variation in μ. To isolate the effect of the climatic factors on the earthquake detection capability at Syowa station from other considerable factors, a more sophisticated statistical approach is indispensable, which is reserved for future studies.

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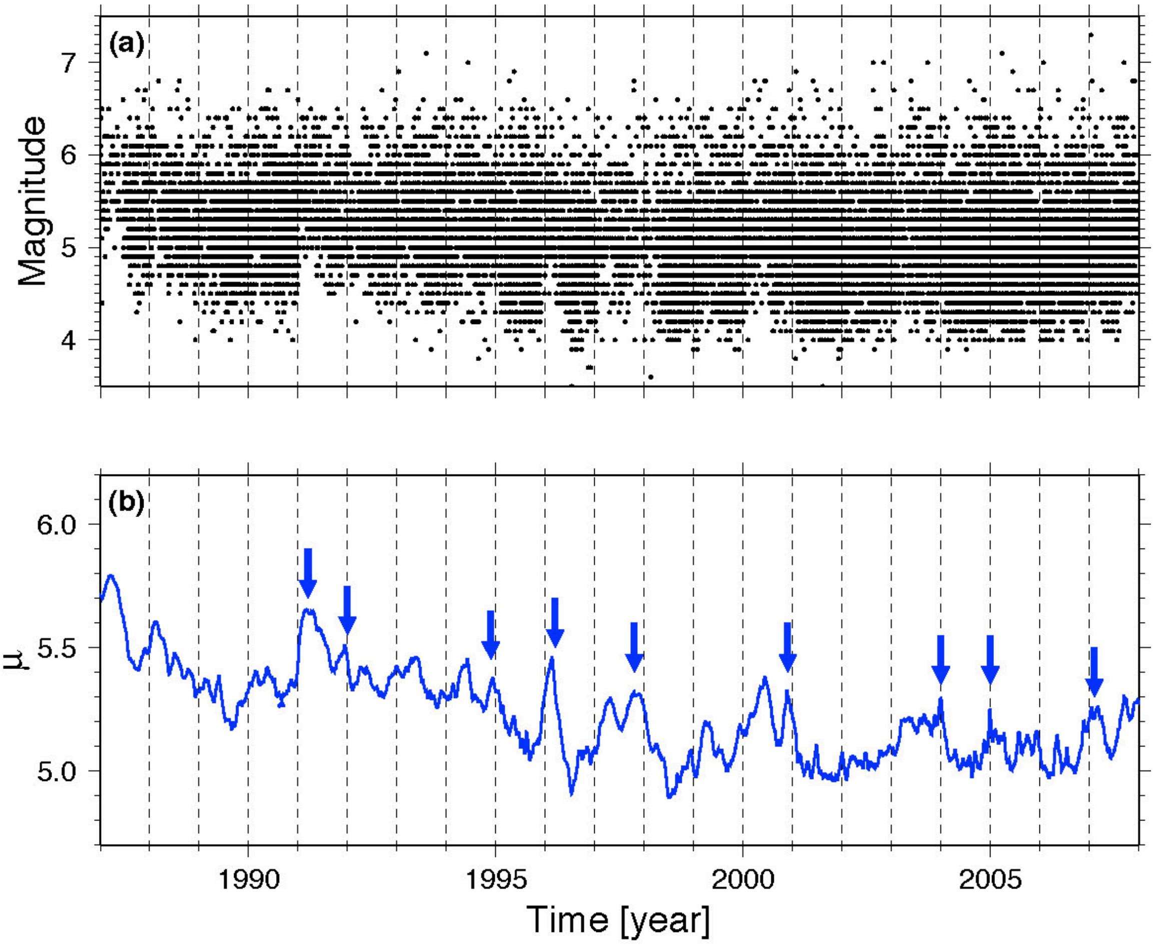

Figure 1. (a) Magnitude-time history for the teleseismic events detected at Syowa Station from 1987 to 2007. (b) Estimated temporal variation in μ, the magnitude at which 50% of earthquakes are expected to be detected. The vertical dotted lines correspond to 1 January of each year, and the arrows indicate higher value of μ in summer than in winter found in some of the examined years.