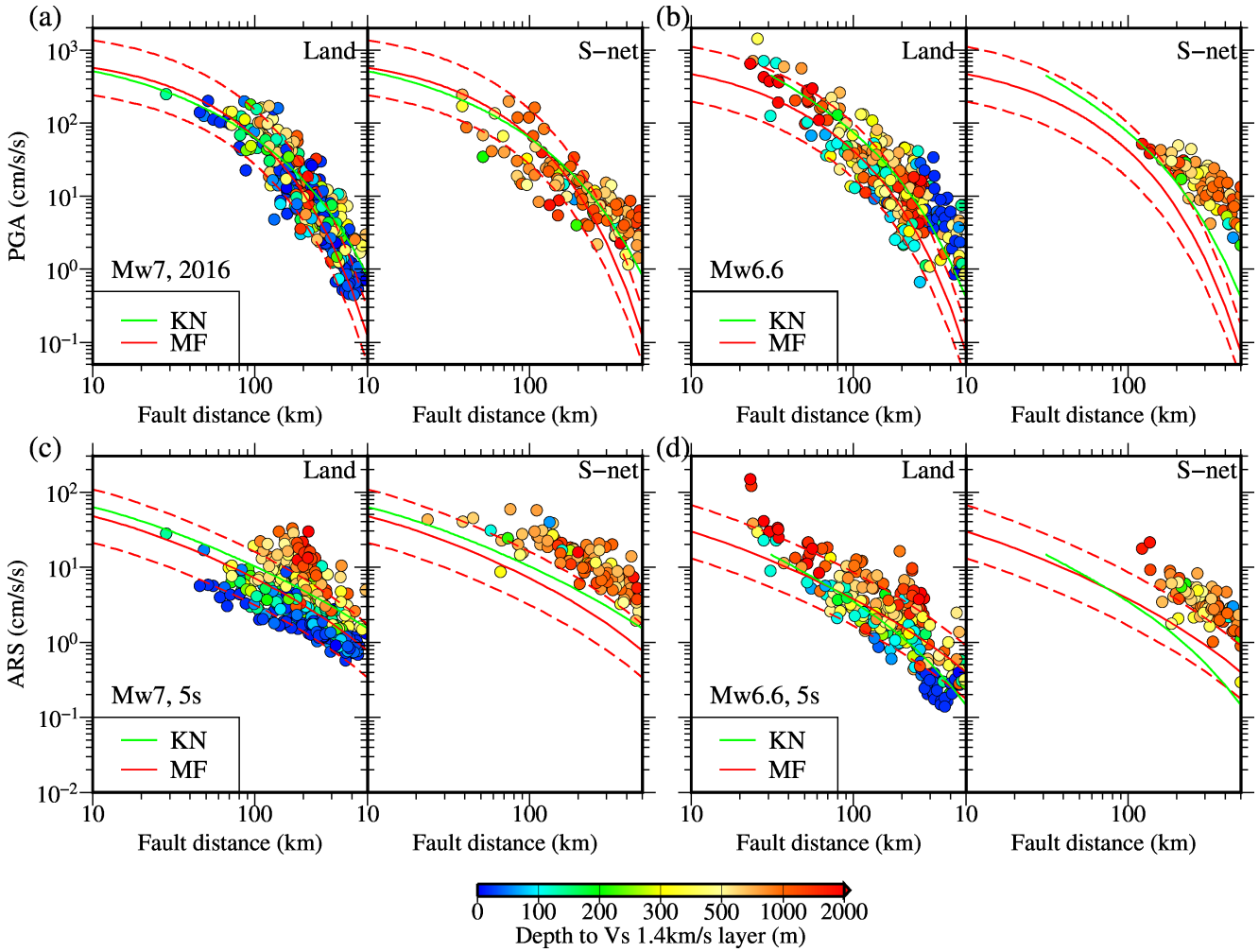
Comparison of PGA, PGV, and acceleration response spectra between the K-NET, KIK-net, and S-net strong-motion sites

*Yadab Prasad Dhakal[1], Takashi Kunugi[1], Wataru Suzuki[1], Takeshi Kimura[1], Nobuyuki Morikawa[1], Shin Aoi[1]

1. National Research Institute for Earth Science and Disaster Resilience

A large-scale ocean bottom (OB) seismograph network (S-net) has been accomplished in northeast Japan and brought in operation since 2016. To understand the ground motion characteristics at the S-net ocean bottom seismograph sites, we analyzed and compared the peak ground motion parameters of accelerograms recorded at the S-net stations with those recorded at the K-NET and KiK-net stations on land. The analyzed ground motion parameters are the horizontal vector peak ground accelerations (PGA), peak ground velocities (PGVs), and 5% damped acceleration response spectra (ARS) for several earthquakes (5.3≦Mw≦7.0) that occurred after the start of operation of S-net. The largest magnitude earthquake (Mw 7) recorded by S-net was the 2016 Nov 22, 05:59 (JST), which occurred off the Fukushima Prefecture beneath the S2 segment of S-net. All earthquakes considered in this study were offshore earthquakes except the 2018, Mw 6.6, Hokkaido Eastern Iburi earthquake. The offshore earthquakes were selected, such that a sizable number of good quality recordings were available at both land and S-net stations. We used the ground motion prediction equations (GMPEs) developed by Morikawa and Fujiwara (2013) and Kanno et al. (2006) as a basis of comparison between the land and S-net strong-motion data. The former and the latter papers are hereafter referred to as MF and KN, respectively.

Our analysis revealed that the PGAs and short period (T= 0.1, 0. 2 s) ARS at the S-net sites were generally similar to the values at the land sites. In contrast, the PGVs and ARS for periods longer than about 0.3 s were larger at the S-net sites, on average. Based on the subsea velocity model obtained from Japan Seismic Hazard Information Station (J-SHIS) (Fujiwara et al. 2012), it was found that most of the OB sites were underlain by thick sediments. The observed values at the S-net and land stations were generally comparable at sites located on deep sedimentary deposits. Also, the high Q path effect was found on short-period ground motions at distances beyond about 200 km at the S-net stations similar to those previously known in the forearc region in northeast Japan for deeper earthquakes. The tendency was seen for the deeper earthquakes in the present study, also for land sites located in the forearc region. Example plots of PGAs and ARS (5s) as a function of fault distance are shown in the image for the two largest earthquakes mentioned above. The panels (a) and (b) show the PGAs for the 2016, Mw 7 event and 2018, Mw 6.6 event, respectively. Similarly, the panels (c) and (d) show the ARS for the two events, respectively.


(a)
(b)
(c)
(d)
Land
S-net
PGA (cm/s/s)
ARS (cm/s/s)
Mw7, 2016
Mw6.6
Mw7, 5s
Mw6.6, 5s
KN
MF
Fault distance (km)
0 100 200 300 500 1000 2000
Depth to Vs 1.4km/s layer (m)