Trading Time with Space – Development of subduction zone parameter database for a maximum magnitude correlation assessment

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Subduction zones are generally the sources of the earthquakes with the highest magnitudes. Not only in Japan or Chile, but also in Pakistan, the Solomon Islands or for the Lesser Antilles, subduction zones pose a significant hazard for the people. To understand the behavior of subduction zones, especially to identify their capabilities to produce maximum magnitude earthquakes, various physical models have been developed leading to a large number of various datasets, e.g. from geodesy, geomagnetics, structural geology, etc. There have been various studies to utilize this data for the compilation of a subduction zone parameters database, but mostly concentrating on only the major zones. Here, we compile the largest dataset of subduction zone parameters both in parameter diversity but also in the number of considered subduction zones. In total, more than 70 individual sources have been assessed and the aforementioned parametric data have been combined with seismological data and many more sources have been compiled leading to more than 60 individual parameters. Not all parameters have been resolved for each zone, since the data completeness depends on the data availability and quality for each source. In addition, the 3D down-dip geometry of a majority of the subduction zones has been resolved using historical earthquake hypocenter data and centroid moment tensors where available and additionally compared and verified with results from previous studies.

With such a database, a statistical study has been undertaken to identify not only correlations between those parameters to estimate a parametric driven way to identify potentials for maximum possible magnitudes, but also to identify similarities between the sources themselves. This identification of similarities leads to a classification system for subduction zones. Here, it could be expected if two sources share enough common characteristics, other characteristics of interest may be similar as well. This concept technically trades time with space, considering subduction zones where we have likely not observed the maximum possible event yet. However, by identifying sources of the same class, the not-yet observed temporal behavior can be replaced by spatial similarity among different subduction zones.

This database aims to enhance the research and understanding of subduction zones and to quantify their potential in producing mega earthquakes considering potential strong motion impact on nearby cities and their tsunami potential.