

Bimodal recurrence pattern of tsunamis in south central Chile

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Abstract

Establishing the recurrence time of large-scale tsunamis is one of the main objectives of paleotsunami research, as it is fundamental for any tsunami risk assessment. Typically, the result is given in form of the mean recurrence time and a standard deviation as a range of uncertainty, assuming a normally distributed recurrence. We present a 5.5 ka long coastal lake paleotsunami record from south central Chile, which contains 17 tsunami deposits, 9 of which were previously unknown. Our record matches all 3 of the historically known tsunamis, as well as all of the 5 known paleotsunami in the region without over- or underrepresentation. We used Bayesian age-depth modelling to calculate an age-depth model and extracted recurrence intervals for 16 recurrence intervals. Our findings confirm the previously published mean tsunami recurrence time on the Valdivia seismic segment of ~300 years. However, our analyses show a strongly bimodal recurrence pattern with one mode at ~115 years and the other mode at ~490 years. The least likely recurrence time between the modes is at ~300 years and coincides with the mean recurrence time. The reasons for the bimodal distribution remain speculative. They can be attributed to either spatial variability, e.g. incomplete segment rupture, splay fault rupture, up- or down-dip rupture, or to temporal variability, e.g. megathrust earthquake clustering, earthquake supercycles. Our findings highlight the importance of recognising the variability in tsunami recurrence patterns before using mean recurrence time for tsunami risk assessment.