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A REGIONAL PERSPECTIVE ON EUROCODE 8 SEISMIC INPUTS IN THE CONTEXT OF A HARMONISED EUROPEAN SEISMIC HAZARD MODEL

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The creation of the 2013 European Seismic Hazard Model (ESHM13), delivered by the European Commission Funded Project "Seismic Hazard Harmonisation in Europe (SHARE)", provides an opportunity to re-assess elements of the seismic input described in Eurocode 8. ESHM13 provides, for more than 120,000 locations across Europe, a comprehensive set of probabilistic seismic hazard curves, hazard maps, uniform hazard spectra (UHS) and disaggregation for many different intensity measure types (e.g. PGA, PGV, spectral acceleration at multiple periods) and, in the case of hazard maps and UHS, for different return periods. This extensive data set permits the construction of the design spectra optimised to fit the UHS across Europe for different sites of interest, and to compare the values of the controlling parameters of the design spectra with those recommended by the European regulations for seismic design (Eurocode 8). The Eurocode 8 formulation of the design spectrum and its controlling parameters (peak ground acceleration on rock (a_g) acceleration amplification factor (F_0), constant acceleration, velocity and displacement corner periods, T_B, T_C, and T_D respectively) are shown for the elastic design acceleration spectrum (($S_e(T)$), and displacement spectrum, in Figure 1.

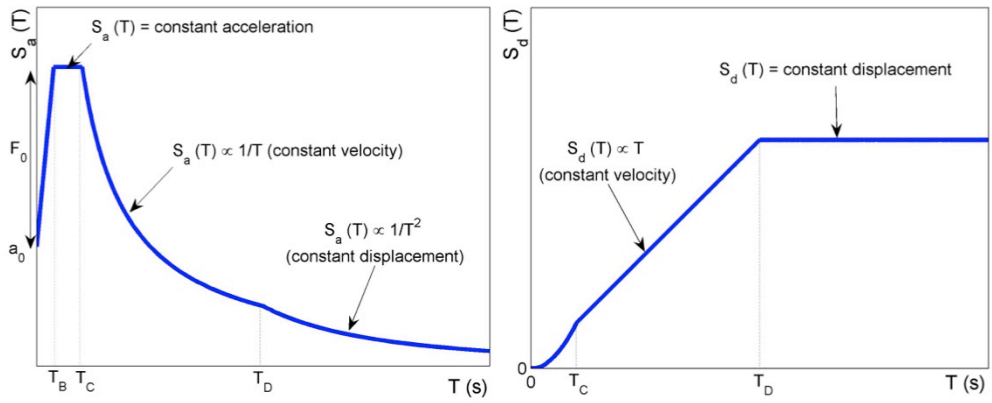

Figure 1. Eurocode 8 (CEN, 2004) formulation of the acceleration and displacement response spectra

Eurocode 8 permits the modification of these parameters within national annexes of the code. The SHARE outputs can be used to help inform national annexes to modify the parameters in such a manner as to best reflect the nature of the seismic hazard within their region. The spatial variation in the four primary controlling parameters, derived using an optimised fit to the uniform hazard spectrum, is shown in Figure 2. These illustrate considerable spatial variation across the continent, with significant differences between low to high hazard regions. These reflect the narrowing of the

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spectral shape, currently accounted for in Eurocode with the adoption of classifications of Type I and Type II, to reflect “high” hazard and “low” hazard response spectra.

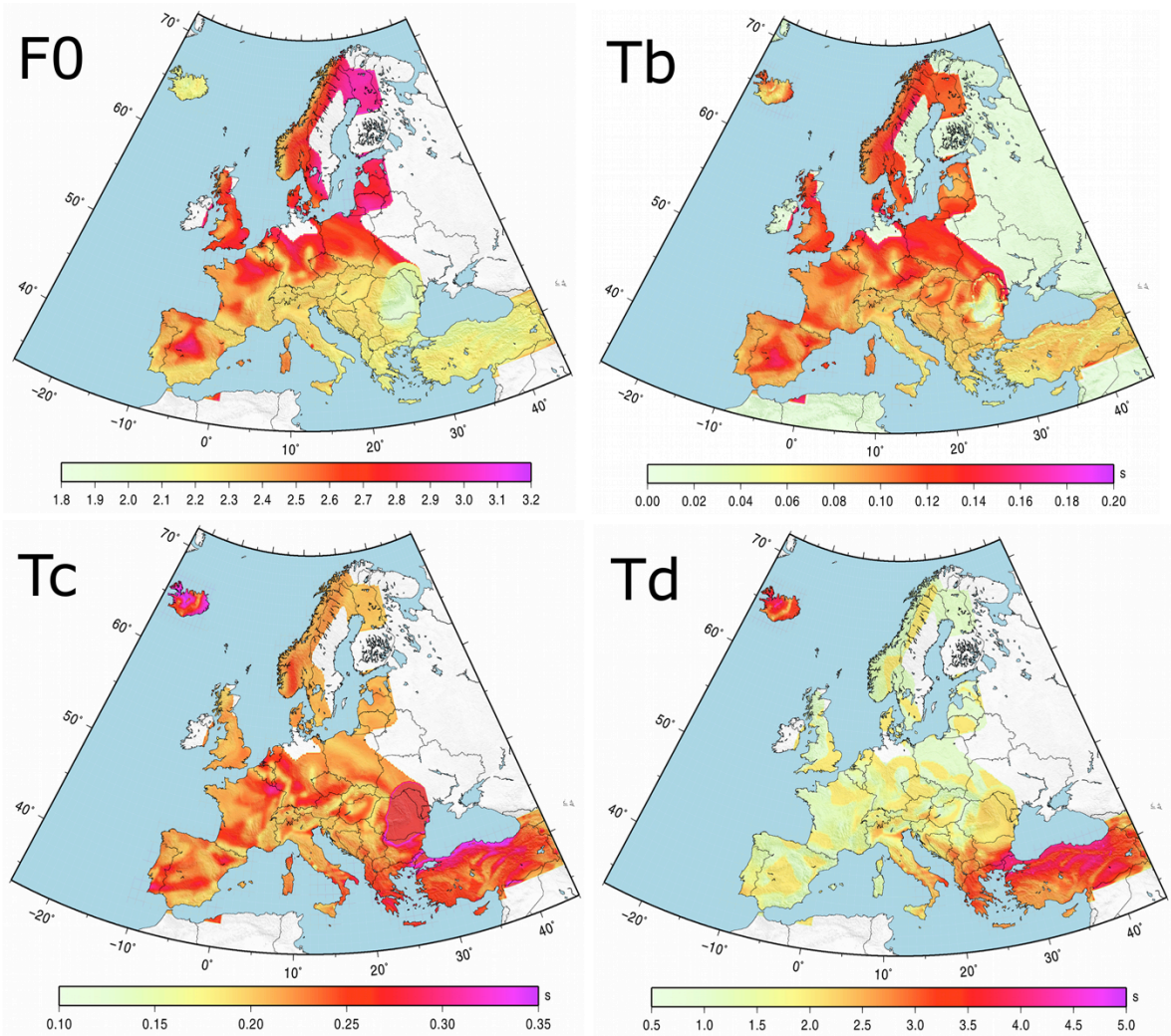

Figure 2. Variation in the Eurocode 8 controlling parameters (F_0, T_B, T_C and T_D) optimised to fit the SHARE uniform hazard spectrum

In addition to providing new insights into the shape of the design spectrum, the large set of hazard data allow for the exploration of additional elements of assumptions made in the code and to assess their validity in specific regions. One such example of this is in the “k-value”, a parameter derived from the slope of the hazard curve, which can assist designers in scaling hazard to higher or lower return periods in accordance with design requirements. Currently Eurocode suggests the value to be approximately equal to 3, yet as we see in Figure 3 its actual value can vary considerably across Europe.

Analyses such as these represent the first step towards understanding the potential engineering implications of the new European Seismic Hazard Model. Initial recommendations, both short- and long- term, for updates to Eurocode provisions have been made within the project. The results shown within can guide Eurocode participating countries in understanding the potential modifications that could be implemented within the current scope of nationally determined parameters. Such modifications should, however, be undertaken only after a critical analysis of the ESHM13 within each country in order to understand both how and why design ground motion levels may be different from existing codes, in addition to an appraisal in terms of the changes in the context of seismic risk and acceptable building performance within each country.

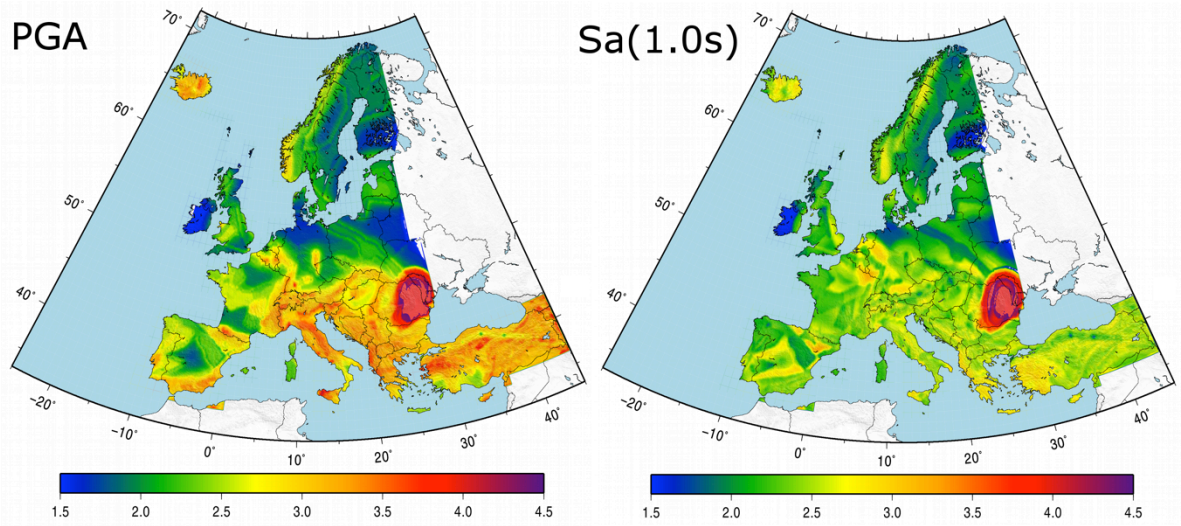

Figure 3. Variation in "*k*-value" across Europe for the PGA (left) and Sa (1.0s) (right) hazard curves