An alternative approach to extreme value analysisfordesignpurposes

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1. ABSTRACT

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The asymptotic extreme value distributions of maxima are a natural choice when designing against future extreme events like flood peaks or wave heights, given a stationary time series. The generalized extreme value distribution (GEV) is often utilised in this context because it is seen as a convenient single expression for extreme event analysis. However, the GEV has a drawback because the location of the distribution bound relative to the data is a discontinuous function of the GEV shape parameter. That is, for annual maxima approximated by the Gumbel distribution, the data is also consistent with a GEV distribution with an upper bound (no lower bound) or a GEV distribution with a lower bound (no upper bound). A more consistent single extreme value expression for design purposes is proposed as the Weibull distribution of smallest extremes, as applied to transformed annual maxima. The Weibull distribution limit holds here for sufficiently large sample sizes, irrespective of the extreme value domain of attraction applicable to the untransformed maxima. The Gumbel, Type 2, and Type 3 extreme value distributions thus become redundant, together with the GEV, because in reality there is only a single asymptotic extreme value distribution required for design purposes – the Weibull distribution of minima as applied to transformed maxima. An illustrative synthetic example is given showing transformed maxima from the normal distribution approaching the Weibull limit much faster than the untransformed sample maxima approach the normal distribution Gumbel limit. Some New Zealand examples are given with the Weibull distribution being applied to reciprocal transformations of annual flood maxima, where the untransformed maxima follow apparently different extreme value distributions.

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