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A framework for understanding the correlation between aggregated losses of compound events

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The risk from individual natural hazards (such as extratropical cyclones) can be large, but the aggregate loss over yearly timescales is significantly greater. For example, wind damage from the three major European windstorms in February 2022 caused more than €3.5 billion of insured losses.

This study proposes a random sum modelling framework for understanding the correlation between aggregate risks that occur from compound events. By considering the frequency and intensities of compound events as random variables, the framework provides an expression for correlation between two random sums (which each represent different types of loss from compound events).

The framework shows that this correlation will generally increase monotonically towards one as the dispersion (clustering) of the number of events increases. Under certain conditions, the correlation will always monotonically increase with dispersion.

The framework has been illustrated by applying it to annual sums from 1980-2020 using wind speed and precipitation as proxy measures for insured loss. This is calculated from ERA5 reanalysis data which includes 39587 storm events and covers the European region and Atlantic Ocean (from 30°N 100°W to 75°N 40°E).

The framework performs well, capturing the general behaviour of the correlation, with large positive correlation over the N. Atlantic Ocean and weaker correlations over European land regions.