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Are large submarine landslides in Polar Regions temporally random, or do current observations and age constraint make it impossible to tell?

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Submarine landslides are one of the major mechanisms through which sediment is transported across our planet, and it has been proposed that they can generate exceptionally damaging tsunamis. Polar margins represent one of the environmental settings where these events have been identified. A large number of triggers and preconditioning factors have been proposed as possible causes for these events; including earthquakes, rapid sedimentation and gas hydrate dissociation. Rapid climate change in the Arctic has the potential to impact on these preconditioning and triggering factors. First, crustal rebound associated with ice melting is likely to produce larger and more frequent earthquakes. Second, Arctic Ocean warming over the next few decades may lead to dissociation of methane hydrates in marine sediments, thereby weakening sediment. In order to better understand whether landslide frequency will increase in the future, we need to determine whether landslide frequency has been affected by previous episodes of rapid climate or eustatic sea level change.

Previous working whether landslide frequency is affected strongly by climatic change has been based predominantly on qualitative analysis, and has concluded that event clustering has occurred under specific environmental conditions. In contrast, two recent statistical investigations of submarine landslides have found events frequencies to follow a Poissonian distribution and thus are temporally random (Urlaub et al, 2013, QSR; Clare et al., Geology, Vol 42 (3)). However, these recent studies acknowledge the significant uncertainties in most landslide dates, and that these uncertainties could mask underlying relationships with climate or sea level. This presentation extends previous statistical work to assess whether landslide frequency is most likely temporally random, or whether the dating is just too uncertain to tell. Chi-Squared statistics are used to explore the extent to which we can be statistically sure that submarine landslides do indeed follow a Poissonian distribution. This is achieved by analysing the ease with which ordered frequency data can appear Poissonian according to the Chi-Squared statistic and the number of events needed before a certain distribution can be guaranteed. From this we are able comment on the extent to which we can use event frequency as a means with which to analyse triggers and preconditioning factors. We can also assess the implications for future submarine landslide risk analysis.