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Avulsion in inhabited deltas triggered by human-induced sea ingressions: a historical analogue from the first millennium AD in the Netherlands

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The shifting of river channels (avulsion) has consequences for people living in deltas as it is a key process in the distribution of sediment and water and thus transport and resources. These avulsions have many causes which are either upstream or downstream induced, such as base level rise, flooding events, or levee superelevation. However, a so far unexplored decisive factor in determining avulsion success is the development of sea ingressions and the role of human activities in forming them. The landward expansions of tidal channels significantly reduce the distance to sea for a potential new river course. In this contribution we infer the role of sea ingressions from a historical case study from the first millennium AD of a multiple-staged avulsion in the Rhine-Meuse delta, the Netherlands. This avulsion resulted in a major reorganisation of the river channel network: it was the first avulsion which successfully crossed an extensive peat area that separated the rivers Rhine and Meuse, thereby distributing a major part of the Rhine discharge towards another tidal inlet. This tidal inlet expanded into the peat area and connected to an active crevasse splay. Archaeological evidence surrounding this ingression strongly suggests that its expansion was accelerated by human-induced soil subsidence related to peat land reclamation. This case study demonstrates that an increase in tidal influence in a low gradient delta plain is an important mechanism determining avulsion success. Considering major subsidence and sediment depletion problems that many deltas are nowadays facing, human-induced sea ingressions will presumably become increasingly important for successful avulsions.