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# Contribution of subsidence on relative sea level in Europe

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While the understanding and modelling of relative sea level rise (SLR) due to ocean density and mass changes have greatly improved over the past few decades, SLR contributions due to vertical ground motions (VGMs) remain a major source of uncertainty. Here, VGMs relate to ground motions that have imprints of a few kilometers, as opposed to broad scale land motion such as Glacial Isostatic Adjustment (GIA). VGMs are caused by processes such as natural resource extraction or the load of anthropogenic infrastructure on recent sediment deposits or natural processes (e.g. sismotectonics, volcanism, landslide), all of which vary in space and time, and can strongly inflate SLR locally.

Here, we present a pan-European analysis of relative sea-level changes in Europe considering VGMs based on trends retrieved from the European Ground Motion Service (EGMS). EGMS allows identifying hot spots of robust subsidence along the European coastline such as the north Adriatic coast in Italy, areas such as Palavas (France), Groningen (Netherlands) and many coastal infrastructures such as dikes in La Rochelle (France) where subsidence was not documented earlier. Hence the service delineates where subsidence can have a significant impact to relative sea-level changes in coastal areas. This satisfies a major need from coastal adaptation stakeholders concerned with SLR. EGMS results are complemented and compared with VGMs estimates from permanent Global Navigation Satellite System (GNSS) network stations. The precision of the measurements is discussed: VGMs from GNSS stations derived from 4 different solutions (ULR, NGL, JPL and GFZ) allow accounting for uncertainty in trends estimation techniques. We estimate VGMs residual trends after removing the effect of the GIA from geophysical modelling, but also the effect of contemporary mass redistribution on solid Earth deformation. The results from both GNSS and EGMS suggest that the precision of ground motion velocities can be in the order of a millimetre per year.

Overall, these estimates and their uncertainty can be used to produce a new coastal pan-European relative sea-level set of projections that respond to one major user need, namely the identification of areas where sea level rise is amplified by subsidence. However two other user needs remain unachieved: the local attribution of observed sea-level changes to components with a submillimetric per year accuracy and a quantified projection of subsidence, which would at least

require subsidence models.