

Future urban development exacerbates coastal exposure in the Mediterranean

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Urban extent in low-lying coastal areas is increasing faster than in the hinterland, thus leading to increased exposure to sea-level rise and associated hazards. Societies' risk to future coastal flooding will,

therefore, not only depend on the physical drivers of change but also on the rate and pattern of urban growth. Researchers at Kiel University (CAU), together with partners from Berlin and Athens, have now developed a new set of spatially explicit projections of urban extent for ten countries in the Mediterranean, with a high spatial and temporal resolution. These future urban projections indicate that accounting for the spatial patterns of urban development can lead to significant differences in the assessment of future coastal urban exposure. Depending on the urban development scenario chosen, the exposure of certain coastal regions can vary by up to 104 percent until 2100. These results have recently been published in the international journal *Scientific Reports*.

"The findings of our study clearly show that in order to reduce the risk of coastal flooding, future urban development would have to focus on areas outside the coastal zones. Our new urban projections can be an important tool for incorporating both socio-economic and physical aspects in coastal flood risk assessments," says first author Claudia Wolff from the Coastal Risks and Sea Level Rise Working Group at the Institute of Geography at Kiel University, who is working on the topic as part of her dissertation.

The Mediterranean coastal region is considered a hotspot of urban sprawl as a large share of urban development takes place along the coast where most of the industry and services are located. According to a study led by American scientists, the population in low-lying areas (below 10 meters of sea level) grew by 20 percent between 1960 and 2010 in the Mediterranean coastal zones. Overall, the Mediterranean region is expected to experience a 160 percent increase in urban extent between 2000 and 2030. Therefore, many Mediterranean cities will be potentially exposed to climate-related hazards such as coastal flooding and erosion. Even though the current level of risk is not high in the Mediterranean, it is likely to increase in the long term, also due to socio-

economic development.

One way to investigate how urban development influences future coastal flood risk is by accounting for spatiotemporal urban land cover change with the use of spatially explicit future urban projections in coastal impact assessments. Until now, however, existing spatially explicit projections of urban extent have been available at coarse spatial resolutions, local geographical scales or for short time horizons, which has limited their suitability for broad-scale coastal flood impact assessments. With the new developed urban change model, the research group from Germany and Greece has now closed this gap. The scientists use an artificial neural network that is trained with input variables such as elevation, population density or the distance to the road network to predict urban land developments. "However, these parameters do not account for uncertainties in future socio-economic development. In order to take this uncertainty into account, we use the quantitative and qualitative assumptions of the five socio-economic development pathways, which are currently used as the basis for the IPCC assessments," says Professor Nassos Vafeidis, co-author of the study and head of the Coastal Risks and Sea Level Rise Working Group at the Institute of Geography at Kiel University.

These five socio-economic development pathways (IPCC's Shared Socio-economic Pathways) comprise narratives that describe five plausible pathways of societal development and also include information on future urban outcomes. The researchers were thus able to develop scenarios for ten countries with a resolution of 100 m, which is 10 to 140 times finer than existing gridded urban extent projections. For users such as political decision-makers, for example, these projections can be a useful tool to account for urban development in long-term adaptation planning on a regional scale. "We would therefore like to apply our modeling approach in the future to other potentially exposed regions worldwide," says geographer Wolff.

More information: Claudia Wolff et al. Future urban development exacerbates coastal exposure in the Mediterranean, *Scientific Reports* (2020). [DOI: 10.1038/s41598-020-70928-9](https://doi.org/10.1038/s41598-020-70928-9)

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