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Sea Level Rise in Macau and Adjacent Southern China Coast: Historical Change and Future Projections

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Global warming-related SLR (sea level rise) constitutes a substantial threat to Macau, due to its low elevation, small size and ongoing land reclamation. This study was devised to determine the long-term variation of sea level change in Macau, as well as to develop future projections based on tide gauge and satellite data and GCM simulations, aiming to provide knowledge for SLR mitigation and adaptation.

Based on local tide gauge records, sea level in Macau is now rising at an accelerated rate: 1.35 mm yr^{-1} over 1925–2010 and jumping to 4.2 mm yr^{-1} over 1970–2010, reflecting an apparent acceleration of SLR. Furthermore, the sea level near Macau rose 10% faster than the global mean during the period from 1993 to 2012. In addition, the rate of VLM (vertical land movement) at Macau is estimated at -0.153mm yr^{-1}, contributing little to local sea level change.

In the future, as projected by a suite of climate models, the rate of SLR in Macau will be about 20% higher than the global average. This is induced primarily by a greater-than-average rate of oceanic thermal expansion in Macau, together with enhanced southerly anomalies that lead to a piling up of sea water. Specifically, the sea level is projected to rise 8–12, 22–51 and 35–118 cm by 2020, 2060 and 2100 with respect to the 1986–2005 baseline climatology, respectively, depending on the emissions scenario and climate sensitivity. If we consider the medium emissions scenario RCP4.5 along with medium climate sensitivity, Macau can expect to experience an SLR of 10, 34 and 65 cm by 2020, 2060 and 2100. If the worst case happens (RCP8.5 plus high climate sensitivity), the SLR will be far higher than that in the medium case; namely, 12, 51 and 118 cm by 2020, 2060, and 2100, respectively. The SLR under the lower emissions scenario is expected to be less severe than that under the higher emissions scenarios: by 2100, an SLR of 65–118 cm in Macau under RCP8.5, almost twice as fast as that under RCP2.6. The key source of uncertainty stems from the emissions scenario and poor knowledge of climate sensitivity. By 2020, the uncertainty range is only 4 cm, yet by 2100 the range will be increased to 83 cm.