EVALUATING PORT OPERATION DOWNTIME UNDER RCP8.5 CLIMATE CHANGE SCENARIO IN CHILEAN PORTS

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The economic costs of port operation downtime due to ocean swells under the RCP8.5 climate change scenario at 8 ports in Chile is evaluated. First, wave statistics (significant wave height Hs, mean period Tm and mean direction θm) for the historical period (1985-2004) and projection (2026-2045) are computed using WWIII and 6 wind models with good performance in Southeastern Pacific Ocean (Hemer, 2016). The model is calibrated with data from directional wave buoys and satellite tracks between 1980 and 2015 in Chilean coasts (Beyá et al., 2016). Offshore wave data is transferred using SWAN to point in the vicinity of each port. Then, the downtime is computed by comparing wave climate and 4 different threshold values of Hs for port closure (PPEE, 1999) for representative vessels at each site. Historical and projected downtimes are expressed in hours per year. The difference in downtime between both periods is attributed to climate change. The economic impact associated with the downtime for both periods is finally estimated.

Figure 1a and 1b depict the wave climate for the projection and the climate-driven difference between the projection and the historical period, respectively, expressed in terms of Hs. Figure 1c shows the wave patterns for median conditions at Valparaíso, during the historic record. Figure 2 shows the difference, in hours per year, between projected and historical values of downtime for one of the four threshold values analyzed (i.e. Beam seas acting of the vessels during berthing operations) at each port. Overall, Iquique, Antofagasta, Coquimbo and San Antonio show and increase in downtime, the latter being significantly affected with nearly 72 additional hours of projected downtime. In contrast, Mejillones, Quintero, Valparaíso and San Vicente show an improvement of operational conditions. In the port of Valparaíso, for example, this enhancement is explained by the poleward shift of the South Pacific Anticyclone, which in turn will produce a southward shift in θm and utterly an improvement of the sheltering conditions at the port (Figure 1c). The local behavior of some of these ports and the costs of downtime will be discussed at the presentation.

REFERENCES

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Hemer, Trenham (2016). Evaluation of a CMIP5 derived dynamical global wind wave climate model ensemble. Ocean Modelling 103, 190-203.

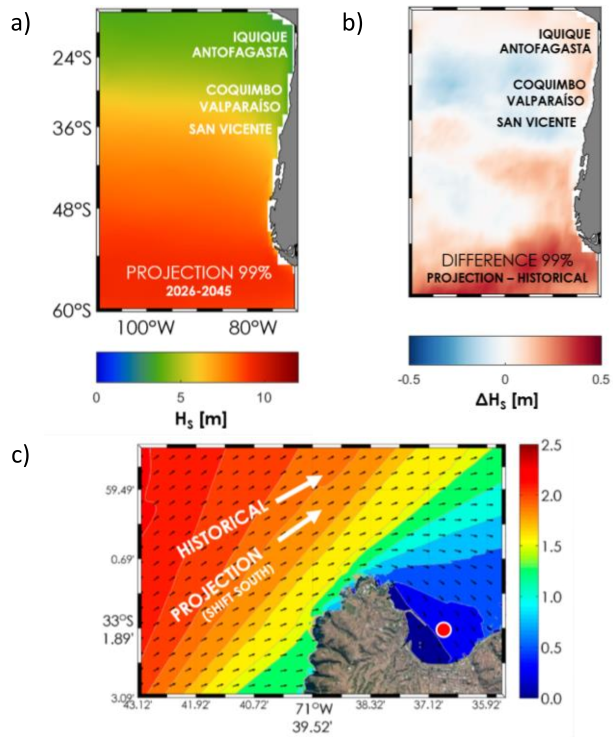

Figure 1 – a) Percentile 99% of Hs and b) difference between projected and historical Hs based on the median of 6 models. c) Median of Hs and θm in Valparaíso.

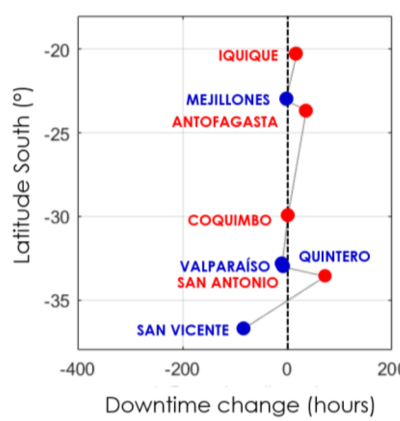

Figure 2 – Difference in downtime for 8 ports between projected and historical periods for a threshold of Hs = 1.5 [m]. Dots in red (blue) show an increase (decrease) in downtime rates.