International Cartographic Association
Association Cartographique Internationale

A Coastal Asset Risk Index (CARI) based on multi-criteria spatial analysis: New Zealand pilot study

Antoni Moore[a*], Quyen Nguyen[b], Ivan Diaz-Rainey[c], Greg Bodeker[d], Simon Cox[b], Owyn Aitken[a]

[a] *University of Otago, New Zealand, Antoni Moore - tony.moore@otago.ac.nz, Owyn Aitken – aitow445@student.otago.ac.nz*
[b] *GNS Science, New Zealand, Quyen Nguyen – q.nguyen@gns.cri.nz, Simon Cox – s.cox@gns.cri.nz*
[c] *Griffith University, Australia, Ivan Diaz-Rainey - i.diaz-rainey@griffith.edu.au*
[d] *Bodeker Scientific, New Zealand, Greg Bodeker – greg@bodekerscientific.com*

* Corresponding author

Keywords: Sea level rise, Coastal asset risk, Multi-criteria evaluation, Flooding risk

Abstract:

There is a high likelihood that physical hazard phenomena such as sea level rise, rising groundwater, storm surges and extreme precipitation will combine in effect to increase the frequency and severity of climate change-related flooding hazards in the not-too-distant future. The New Zealand-based Strand research project has been examining the impacts of these hazards on residential property values and financial stability, initially through physical models that have been developed to link climate change projections to some aspects of the current physical state. Physical criteria could be grouped into hazards (potentially destructive physical phenomena, such as those listed above) and vulnerability criteria (for example, elevation and slope, which affect the likelihood that assets will be affected when exposed to a hazard).

However, a wider range of social, economic and cultural criteria may also influence coastal risk. These can be divided into exposure (assets, such as property and culturally-significant landmarks, that are important to a community and can be affected by a hazard) and resilience (the capacity of systems that are in place to mitigate the effects of a flooding hazard, such as infrastructure for emergency access / evacuation) groupings. Hazards, vulnerability, exposure and resilience can be defined as objectives that together constitute coastal asset risk.

In this presentation, we outline developments with the Coastal Asset Risk Index (CARI), which is derived using a multi-criteria spatial analysis technique. Operation of CARI is based on expert knowledge-derived weightings, combined in a framework to prioritise these objectives and constituent criteria, in order to map coastal risk on property values. A pilot study of the coastal Otago region, based on a test dataset generated by final-year degree students in a spatial analysis and modelling paper, yielded instructive results.

Through the test data, we were able anticipate extremes of expert opinion on weightings and its effect on the risk map generated. We will now apply CARI nation-wide, on a wider set of criteria under all four objectives, with knowledge derived from a group of experts drawn from financial, physical, community and governance sectors. Another aspect highlighted in the pilot study is the reliance of the result on availability, quality and veracity of the supporting spatial data. Accordingly, we are developing a multi-criteria process that takes these factors into account. This pilot study is an initial demonstration of the need to integrate the decision maker's opinion in analysing coastal asset risk and the role of CARI as a complementary tool to physical modelling.

Abstracts of the International Cartographic Association, 7, 107, 2024.
European Cartographic Conference – EuroCarto 2024, 9–11 September 2024, TU Wien, Vienna, Austria.
https://doi.org/10.5194/ica-abs-7-107-2024