

# MAREJADAS (COASTAL STORMS) IMPACT SCALE FOR WARNING SYSTEMS

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## MAREJADAS AND THEIR IMPACTS

The magnitude of the impact produced by extreme waves events on the coast (such as run-up, erosion of beaches, structure overtopping and damage) depends on the combination of the magnitude of local wave, tide level and coast features (Ciavola & Coco 2017). All these factors, considering mainly those necessary to determine the magnitude of local wave, show that the impact that can be observed by this phenomenon can present important differences in nearby coasts.

In Chile, the events of July 3, 2013, August 8, 2015, and January 2016 were the most energetic of the last decades from each generation zone (Winckler et al. 2017), those that caused considerable damage in specific places on the Chilean coast. Since these events, the term Marejadas became popular and the phenomenon calls for high interest to this day.

## TROUBLES WITH MAREJADAS WARNINGS

Marejadas warnings issued by the Chilean maritime authority characterize the entire event with the maximum significant wave height (without indication where is this expected) and the offshore direction, differentiating only the arrival date with am / pm, for stretches of coastline between 500 and 1000 [Km] long. In 2013, "abnormal Marejadas" classification was incorporated to distinguish those that can generate damage to the coastal infrastructure. Despite this incorporation, the low level of detail of the warnings generally produces confusion in the population, since there is no estimate of the level of impact, authorities tend to assume the worst condition, for the entire coast, generating expensive overreactions, tourism affection, and weakening the warning credibility.

## THE MAREJADAS WARNING SYSTEM

In August 2017, the Universidad de Valparaíso develops a Marejadas warning system ([marejadas.uv.cl](http://marejadas.uv.cl)), with a prototype in the Bay of Valparaíso, which allows obtaining wave and tide hourly forecasts for each coastal section with a uniform section. With this tool it was possible to improve the information regarding the "when" and the "where" related to the Marejadas impact, however, in spite of running run-up and overtopping calculations, it was not possible to easily and quickly transmit the "how much" of the impact because it is too technical content.

## MAREJADAS AND IT IMPACT SCALE

Based on the review of the historical background in Chile (Campos 2016) and the author's experience in field observations, a definition of Marejadas concept and a scale of classification of its impacts are proposed to improve communication with the population (Table 1).

Marejadas: The combination of waves and tides that affect the usual socio-economic activities in the coast and that can cause damage to its infrastructure.

Table 1 - The Marejadas impact scale proposed

Scale	Combination of waves and tides in which ...
M1	the entrance to sea is dangerous, affecting the normal development of aquatic activities. Caution should be exercised in shore activities. Water comes out occasionally on beaches.
M2	performing coastal activities is dangerous. Beaches are flooded frequently, low erosion occurs. Occasional and low overtopping in structures.
M3	approach the wet area is dangerous. Beaches have erosion close to usual maximum, coastal structures have frequent overtopping causing minor flooding, damage to fragile structures. Similar to the maximum annual event
M4	the evacuation of the coast is suggested. The beaches erode more than normal, definitive structures are damaged, water leaves the borders of the beaches, properties are flooded. An exceptional event.
M5	the evacuation of the coast is necessary. Structures are severely damaged or destroyed, persistent overtopping generates flows in structures and streets, significant damage or destruction of property. A historical event used as design criteria for definitive works

## SCALE APPLICATION IN MAREJADAS WARNING SYSTEM

The proposal was implemented in the Marejadas Warning System using a combined run-up and overtopping scheme that uses the thresholds associated with the 95th and 99th percentiles and the 1, 5 and 25 year return periods to assign a category to each coastal zone for each sea state in forecast.

The proposal has allowed the population and authorities to communicate effectively and quickly about the expected impacts of a given event. Although it has been noted that the learning of the detail of the scale is not yet achieved, the intuitive character associated with the numbering has allowed coastal users to take the necessary safeguards that minimize the damages and losses associated with Marejadas, keeping a balance with the optimal use of the coast.

## REFERENCES

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