FAIRY BOWER OVERTOPPING MONITORING AND DECISION SUPPORT SYSTEM

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BACKGROUND

A monitoring and decision support system has been developed to manage dangerous overtopping of the Marine Parade promenade seawall at Fairy Bower, Manly, Sydney Australia. The seawall fronts 750 m of highly used promenade at the southern end of Manly Beach, and experiences overtopping events that are hazardous to pedestrians and potentially damaging to infrastructure, several times per year.

The infrequent nature of the events results in members of the public being caught off-guard and unaware of the extent of the hazard. The local council has commenced a program of either deploying signs, staff for raising awareness, or completely closing access to the promenade during overtopping events. A decision support system for forecasting hazardous overtopping events, and a monitoring system for verifying the forecasts and observing conditions, allows the council to better manage the hazard.

MONITORING SYSTEM

The monitoring system consists of a solar-powered ethernet camera with a 4G modem inside a weatherproof enclosure. The camera provides a live video stream and stores timelapse images on a cloud server.

DECISION SUPPORT SYSTEM

The decision support system consists of three modules:

1. Water level forecast;
2. Wave forecast; and
3. Overtopping forecast.

The water level module uses a combination of predicted astronomical tides, and measured water level anomaly from a nearby tide gauge (accessed every 6 hours) to account for the inverse barometer effect, wind setup and coastally trapped waves, etc.

The wave module uses forecasts from the NOAA WaveWatch III (WW3) global wave model with a 3 hour time step (updated every 6 hours), driving a SWAN wave transformation model. The SWAN model consists of a coarse grid (100 m resolution) covering the broader Sydney coastline, and a second nested higher resolution (25 m) grid which focusses on the outer Sydney Harbour and Manly coastline areas.

The overtopping module uses outputs from the water level and wave modules, as well as the site specific characteristics of the nearshore zone along the Fairy Bower foreshore, to make forecasts of overtopping rates. Overtopping predictions are calculated using the "mean value" formulae for vertical seawalls under impulsive and non-impulsive conditions (EurOtop 2018).

After the overtopping rate has been calculated, the risk to pedestrians is classified according to the thresholds shown in Table 1, which have been developed based on two years of concurrent monitoring and forecasts. These thresholds are higher than those described in EurOtop (2018); ongoing work aims to reduce the known over-estimates of overtopping rates in the forecast system.

Table 1 – Adopted warning thresholds for Fairy Bower.

Overtopping rate (L/m/s)	Warning code	Qualitative description of overtopping hazard
q < 1	Nil	Nil to occasional spray/splash
1 < q < 2	Yellow	Uncomfortable
2 < q < 20	Red	Dangerous
q > 20	Black	Very dangerous

The decision support system automatically generates a new forecast every 6 hours. Council staff can access the latest wave overtopping forecast via a website. In addition to this, a forecast is delivered via e-mail to end users once per day when wave overtopping is forecast to be "uncomfortable" or worse during the next 7 days.

REFERENCES

EurOtop (2018), "*Manual on wave overtopping of sea defences and related structures: An overtopping manual largely based on European research, but for worldwide application*", Van der Meer, Allsop, Bruce, De Rouck, Kortenhaus, Pullen, Schüttrumpf, Troch and Zanuttigh.

Figure 1 – Overtopping event images from 3 March 2022; photographs taken by Ian Coghlan (left) and monitoring camera (right).