4.3 Case study 2: Assessment of overtopping at the Dai Nippon Causeway

Issue: You have been asked to prepare a couple of slides for a case study demonstrating the impacts of climate change on critical infrastructure over the next 50 years in Kiribati. You decide to look at how wave overtopping from the ocean side of the Dai Nippon causeway may change and what implications this has.

Resources available:

- Google earth.
- Photographs from a site visit.
- Survey going from the lagoon side over to the ocean side of the causeway.

STEP 1: Decide on the process. Using the flow chart in Figure 5 we can identify the steps required to assess wave overtopping.
STEP 2: Under the *scenario* page the same decisions as in the previous case study need to be made.

The group decided that:

- The baseline year would be the 1980-1999 average (to be consistent with the IPCC).
- The datum to be used would be the University of Hawaii datum as the issue under consideration concerns land levels.
- The timeframe selected would be the 2050’s.
- That the upper end of the A1FI emission scenario with a 0.2 m allowance for increased ice sheet discharge would be used.
STEP 3: The ‘Tarawa’ tab at the bottom of the screen is then selected.

The first step is to select the ocean side location, so in this case the: **Ocean Shoreline: South Coast.**

**Input data**

1. **Select future climate change scenario and baseline year**

<table>
<thead>
<tr>
<th>Baseline year:</th>
<th>1990-1999 average (IPCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tarawa datum:</td>
<td>University of Hawaii datum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Future timeframe comparison:</th>
<th>2050s (2050-2059)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions scenario:</td>
<td>A1FI</td>
</tr>
<tr>
<td>Emission model range:</td>
<td>Upper range of model output (95%)</td>
</tr>
<tr>
<td>Scaled up ice-sheet discharge:</td>
<td>Additional 0.2 m by 2000s</td>
</tr>
<tr>
<td>Change extreme wave heights by:</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Input data**

1. **Select location**

| Location on Tarawa: | OCEAN SHORE: South coast |

**STEP 4:** Information on the **Ocean Shoreline reef flat characteristics** now need to be entered.

The **reef width**, and **angle of reef face slope** can be measured with the assistance of Google Earth (see appendix) and are approximately **400 m** and **1:6** respectively.

The **level of the landward edge of the reef** and the **average reef flat level** can be estimated from the profile survey.
The level of the landward edge of the reef was assumed to be approximately $1.435\ m$ relative to University of Hawaii datum and the average reef flat level approximately $0.539\ m$ relative to University of Hawaii datum.

**STEP 5:** To calculate overtopping we now need to enter information on the seawall characteristics of the causeway on the ocean side.
Full details of each parameter are included in the appendix of this report. Information that needs to be entered includes:

- The *shoreline type* which in this case is selected as *Sloping (revetment) seawall*. 
• The Seawall crest level is obtained from the survey information and is taken as the level at the top of the sloping part of the seawall. From the survey, this elevation is approximately 3.735 m above University of Hawaii datum.

• The Seawall (revetment) slope (I in x) is taken as the slope of the revetment between the toe of the wall and the crest. Tool 9 under the help menu can be used to calculate the slope, which in this case is 1 in 1.5.

• The Seawall crest width is estimated to be around 0.65 m based on the survey profile information.

• The Seawall (revetment) armouring selected from the drop-down menu as Concrete filled mattress.

• Yes is selected from the drop-down menu to recognize the occurrence of a Revetment crest wall.
STEP 6: The results are again accessed within the purple areas on the right-hand side of the Tarawa page.

For changes in the amount of water overtopping the wall, select *Changes in mean overtopping discharge*.

The overtopping discharge can also be related to safe overtopping discharge limits for different types of activities (*Compare to safe overtopping limits for*). For the causeway a suitable limit would be *Dangerous to vehicles*, i.e., the amount of water overtopping the wall is above this rate would make it dangerous for vehicles driving along the causeway.

The results for 10%, 2% and 1% AEP levels are now shown in the section below for the baseline year and for the selected future year and scenario.
The plot below the table shows the same numbers as in the table but in form of a bar chart.

At the right hand side of the results section the % increase column shows the percentage increase in overtopping rate for the particular AEP due to the effect of the particular climate change scenario selected. As an example for an event with a 10% chance of occurring in any one year, the overtopping rate may increase by 151% by 2050 under the climate change scenario selected.
5. References

