Captions for figures

Figure 1. Geography of Hulhumalé, Maldives. a) Location of North Malé Atoll (inset, location of Maldives in the Indian Ocean), b) Location of Malé and Hulhumalé within North Malé Atoll; c) Setting of Malé and Hulhumalé with connecting bridge; d) Infrastructure and land elevation on Hulhumalé (Phase 1). Outline data courtesy of Ministry of Environment and Energy and the Hulhumale Development Corporation.

Figure 2. a) The heavily engineered coast around Malé showing a sea wall protected by armour units. b) The coastal defence structure on the eastern side of Hulhumalé.

Figure 3. Data sets used in this analysis.

Figure 4. Flood extent on Hulhumalé for the baseline with sea-level rise scenario and with adaptation options a) Overtopping volumes; b) Area affected by flooding; c) Number of properties affected.

Figure 5. Flooding on Hulhumalé associated with sea-level rise and wave conditions of the extreme swell wave event of May 2007. Examples of flooding extent with baseline conditions with approximately a) 0.6m; and b) 0.9m of sea-level rise.

Figure 6. Magnitude of timing of sea-level rise, impacts and adaptation on the baseline scenario with sea-level rise on Hulhumalé.

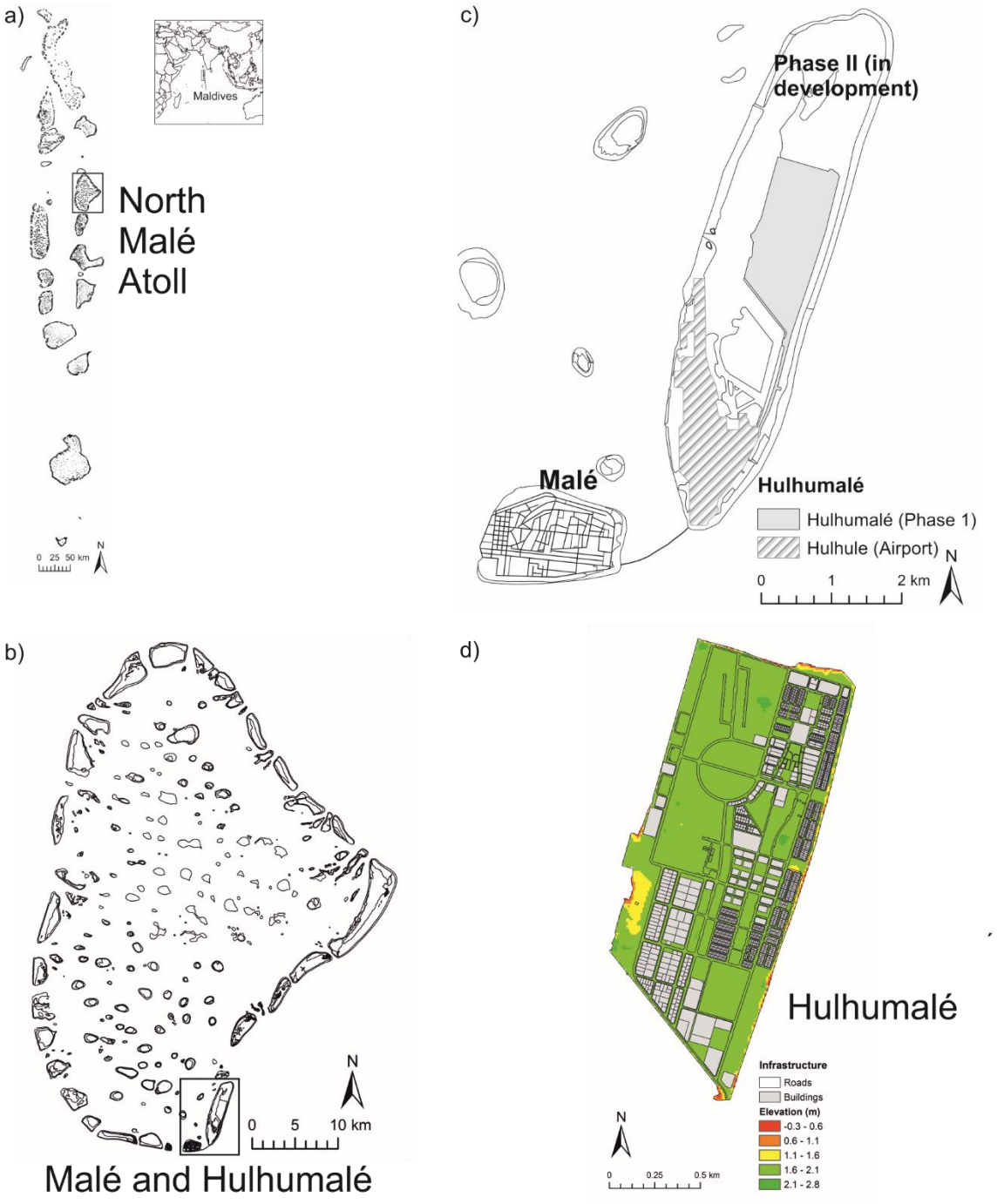
a)
Maldives
North
Malé
Atoll
0 25 50 km
N
c)
Phase II (in development)
Malé
Hulhumalé
Hulhumalé (Phase 1)
Hulhule (Airport)
0 1 2 km
N
b)
N
0 5 10 km
Malé and Hulhumalé
d)
Hulhumalé
Infrastructure
Roads
Buildings
Elevation (m)
-0.3 - 0.6
0.6 - 1.1
1.1 - 1.6
1.6 - 2.1
2.1 - 2.8
N
0 0.25 0.5 km

Figure 1

Figure 2

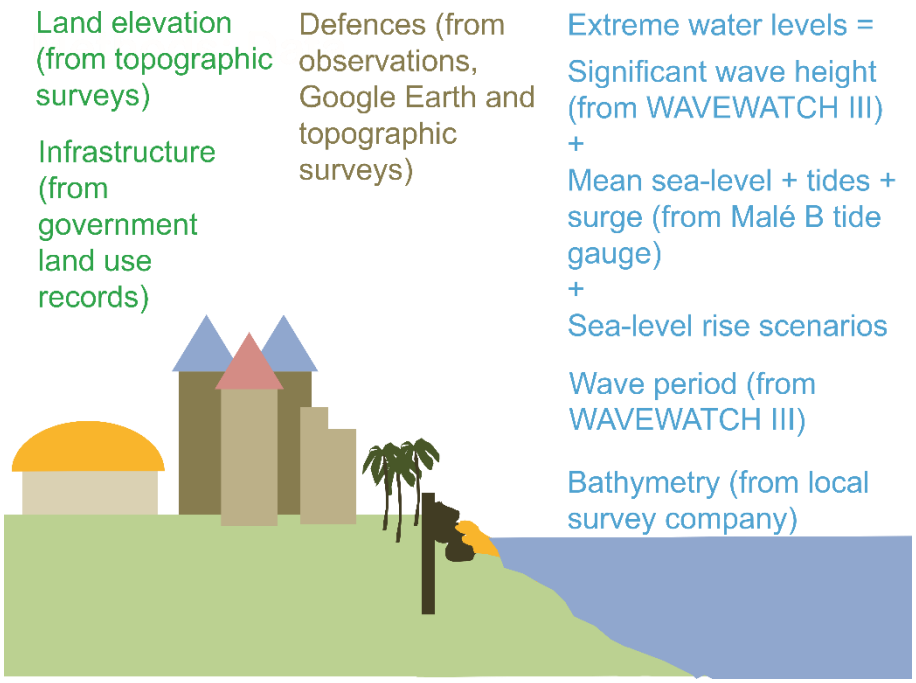
Land elevation (from topographic surveys)
Infrastructure (from government land use records)
Defences (from observations, Google Earth and topographic surveys)
Extreme water levels =
Significant wave height (from WAVEWATCH III)
+
Mean sea-level + tides + surge (from Malé B tide gauge)
+
Sea-level rise scenarios
Wave period (from WAVEWATCH III)
Bathymetry (from local survey company)

Figure 3

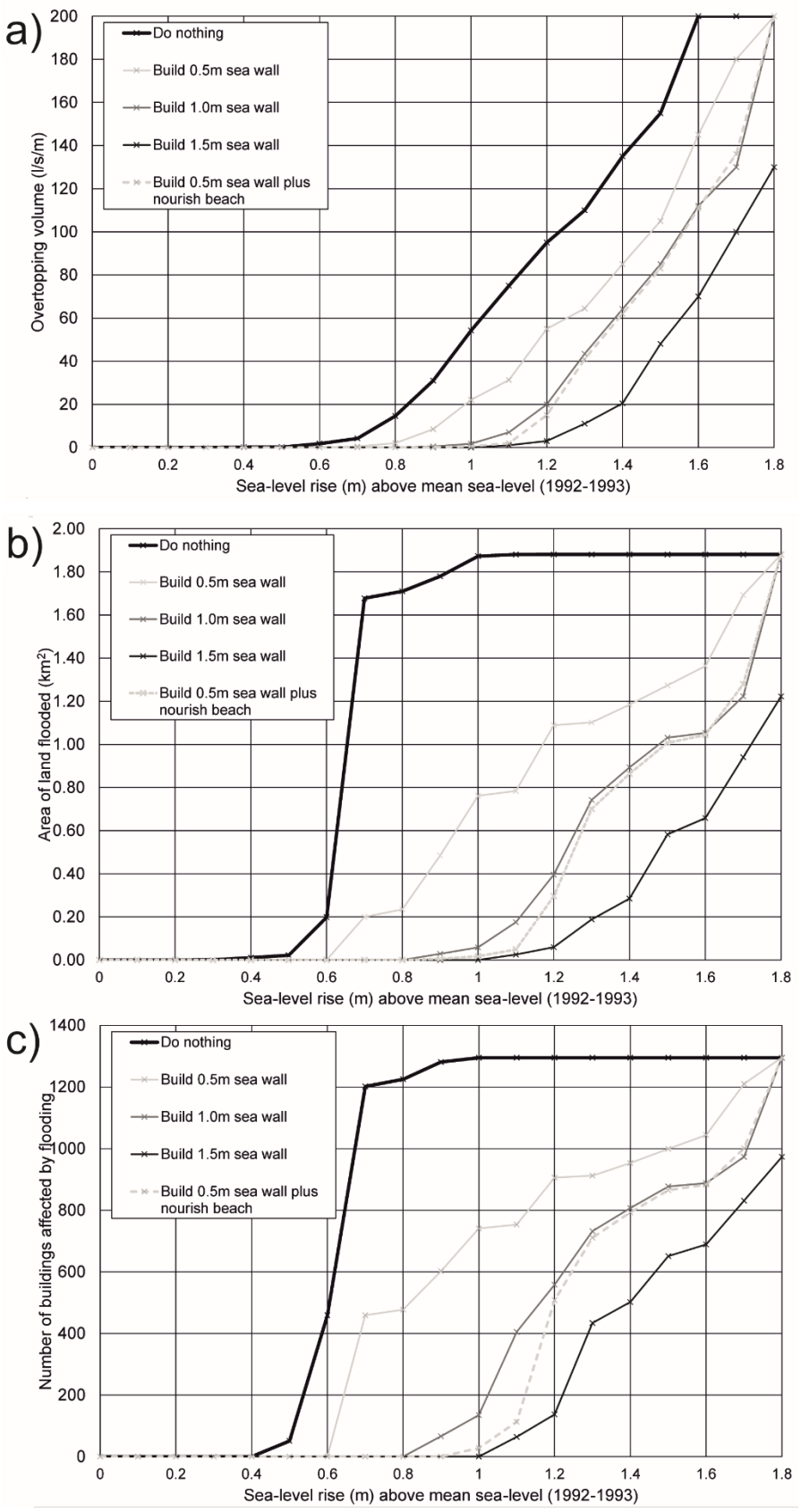
a)
Do nothing
Build 0.5m sea wall
Build 1.0m sea wall
Build 1.5m sea wall
Build 0.5m sea wall plus nourish beach
Overtopping volume (l/s/m)
Sea-level rise (m) above mean sea-level (1992-1993)
b)
Area of land flooded (km²)
c)
Number of buildings affected by flooding

Figure 4

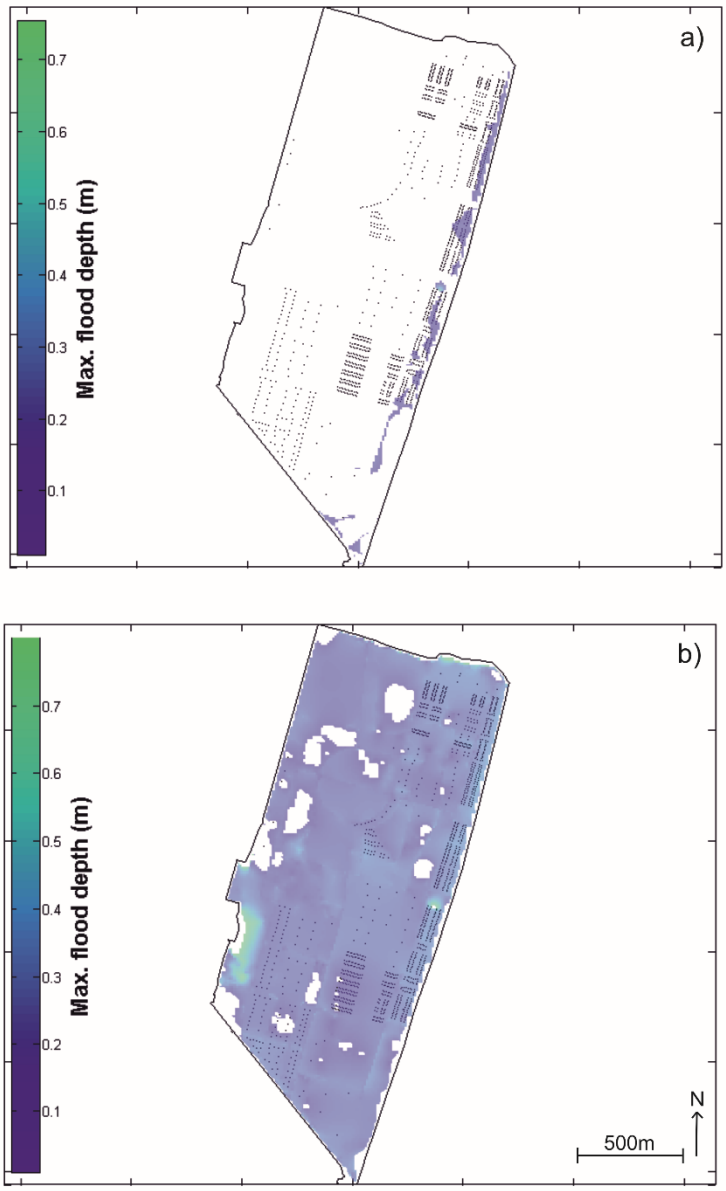
a)
Max. flood depth (m)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
b)
Max. flood depth (m)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
500m
N

Figure 5

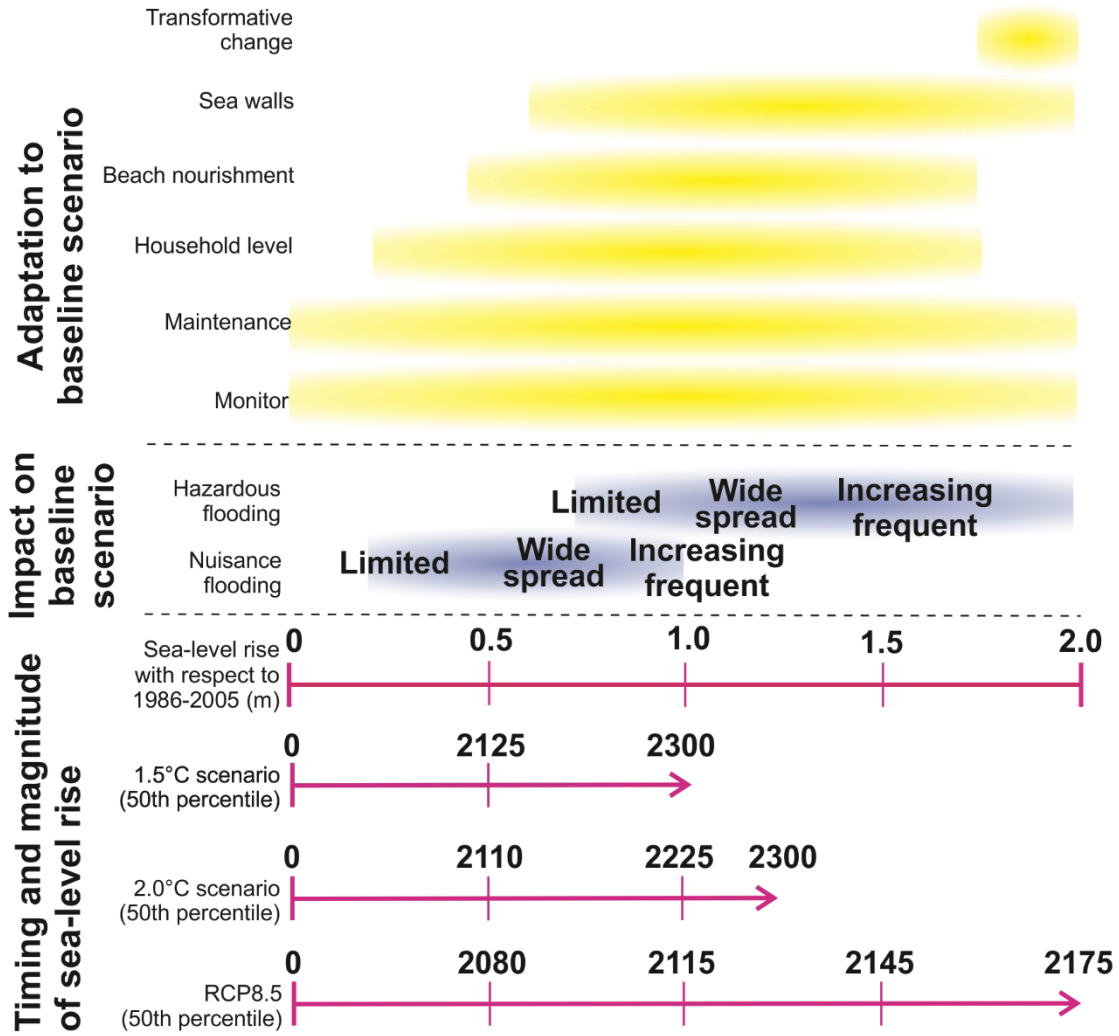
Adaptation to baseline scenario
Transformative change
Sea walls
Beach nourishment
Household level
Maintenance
Monitor
Impact on baseline scenario
Hazardous flooding
Limited
Wide spread
Increasing frequent
Nuisance flooding
Limited
Wide spread
Increasing frequent
Timing and magnitude of sea-level rise
Sea-level rise with respect to 1986-2005 (m)
0
0.5
1.0
1.5
2.0
1.5°C scenario (50th percentile)
0
2125
2300
2.0°C scenario (50th percentile)
0
2110
2225
2300
RCP8.5 (50th percentile)
0
2080
2115
2145
2175

Figure 6

Table 1. Adaptation and sensitivity scenarios tested for future flooding in Hulhumalé.

Scenario name	Conditions tested		
	With reef growth	Standard bed roughness	Adaptation assumptions
Baseline	No	Yes	No change
With adaptation	No	Yes	Seawall height increases by 0.5m
	No	Yes	Seawall height increases by 1.0m
	No	Yes	Seawall height increases by 1.5m
	No	Yes	Seawall height increases by 1.5m, plus beach nourishment
Sensitivity	With SLR	Yes	No change
	Half the rate of SLR	Yes	No change
	No	Increase in friction	No change
	No	Yes	Loss of beach material

Table 2. Sensitivities tested in the overtopping model

Sensitivity parameter	**Variation**	**Magnitude of variation of overtopping volume**
Reef growth	Same rate of sea-level rise	Decreased by ~5%
	Half the rate of sea-level rise	Decreased by ~15%
Friction	Rougher	Decreased by ~ 10%
Beach material	Loss of original beach material	Increased 1.5-1.8 times