Adaptation Options for Future Risks from Monsoon-driven Sea Level Extremes in a Coastal Agricultural Community Ban Ko Klang, Krabi, Thailand

Anond Snidvongs

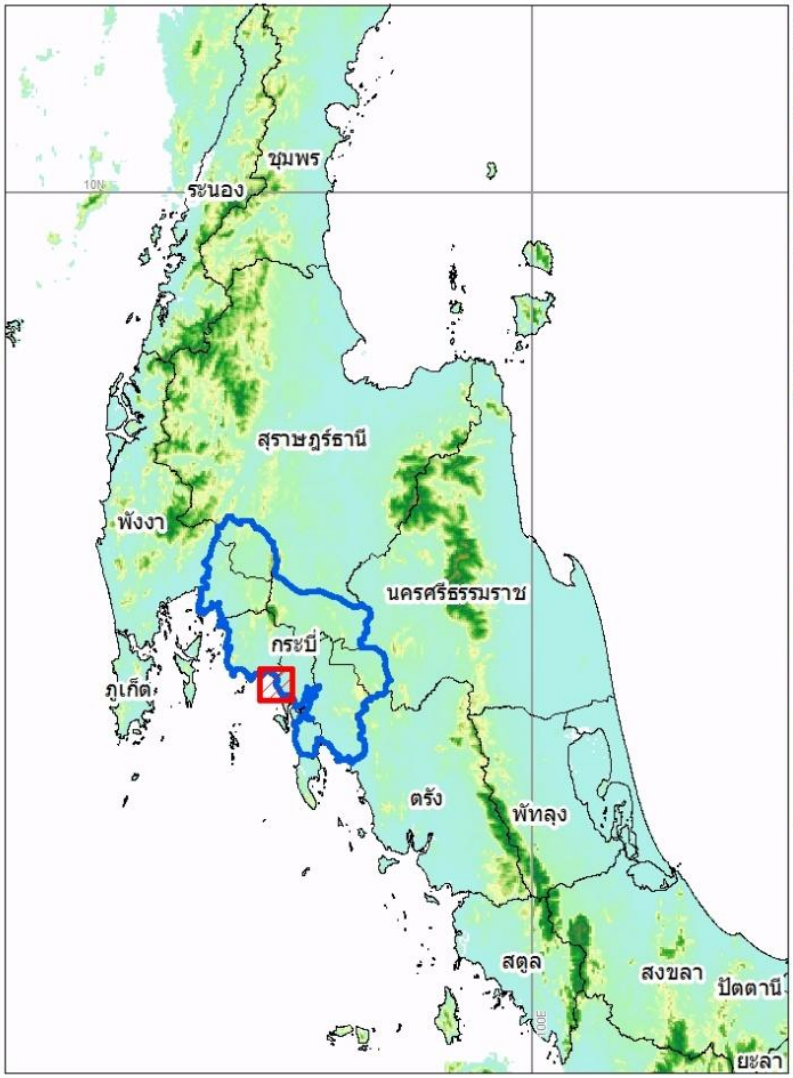
Climate Change Knowledge Management Center

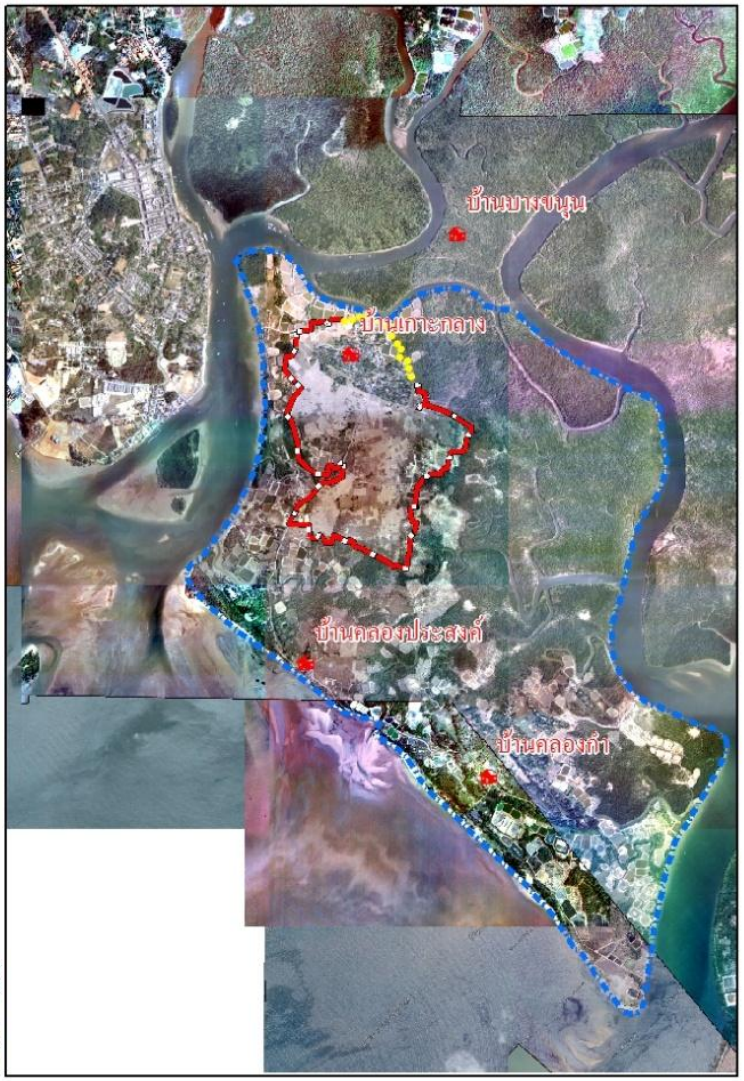
National Science and Technology Development Agency

Ministry of Science and Technology

Thailand

Study Area


ชุมพร
ระนอง
สุราษฎร์ธานี
พังงา
นครศรีธรรมราช
กระบี่
ภูเก็ต
ตรัง
พัทลุง
สตูล
สงขลา
ปัตตานี
ยะลา


บ้านบางขนุน
บ้านเกาะกลาง
บ้านคลองประสงค์
บ้านคลองกำ

Rice Fields and harvesting in 2009

Current Saltwater Intrusion


Proposed Dyke (6.7 km)

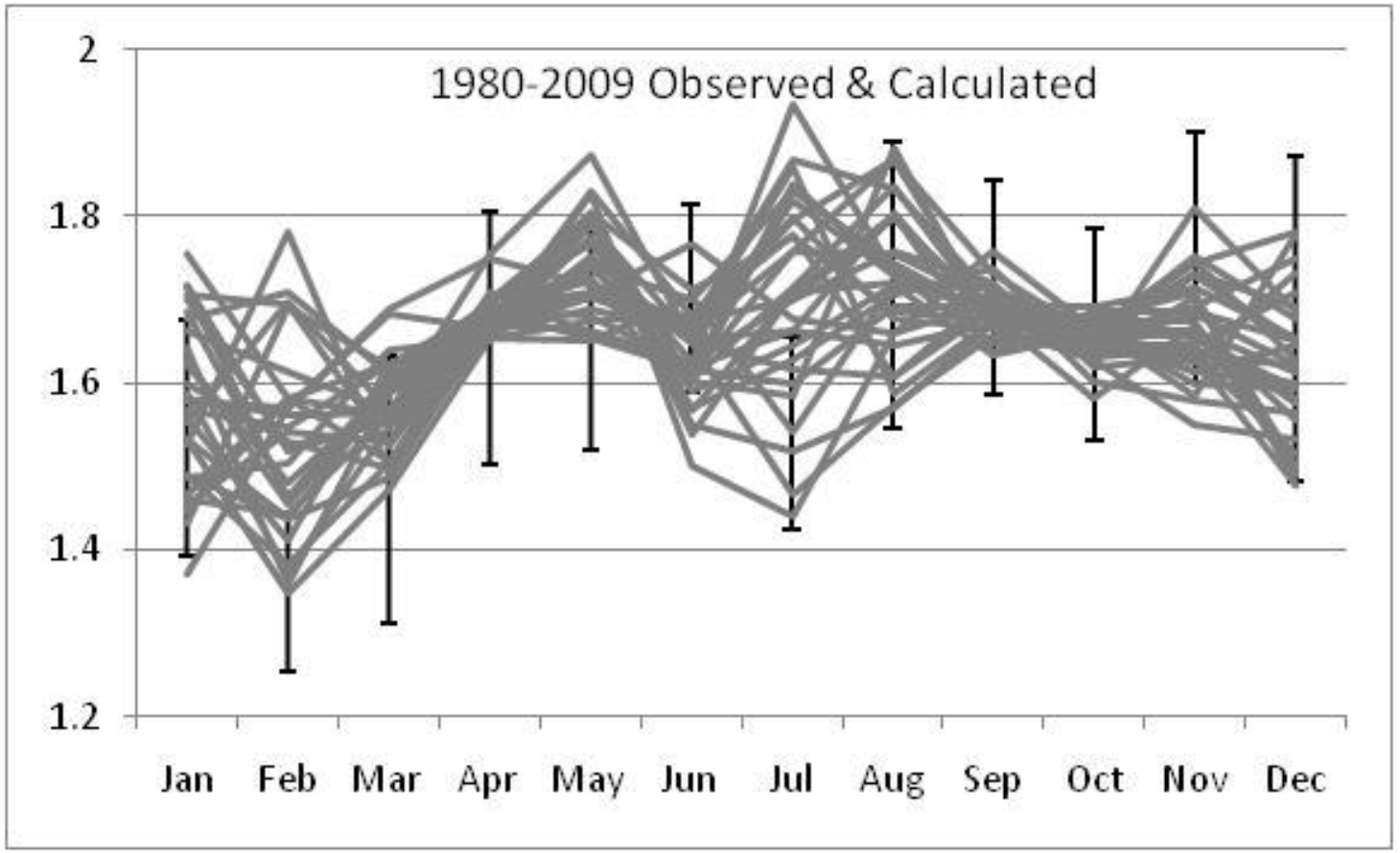
Dyke Construction in 2009-2010

Monsoon-driven Local Sea Level: Dynamic and Statistic Downscaling Approach

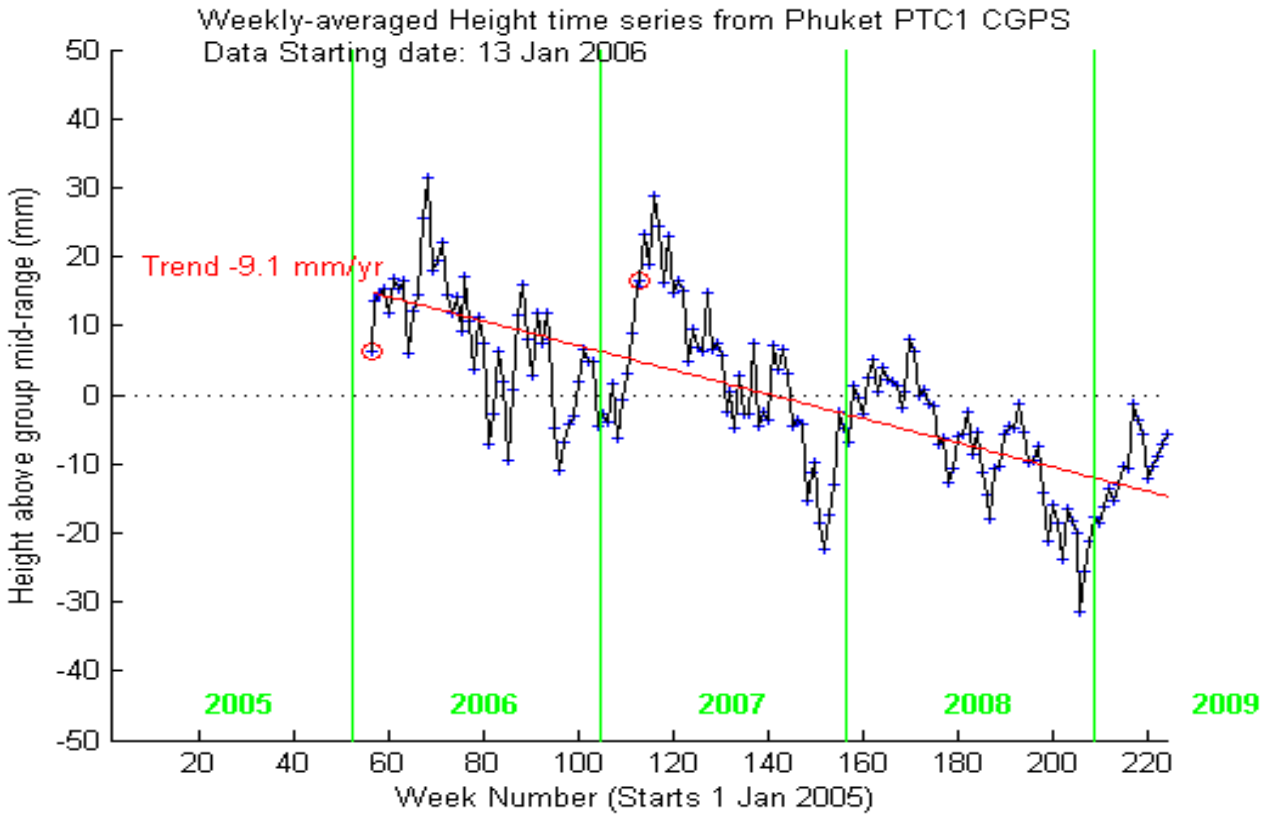
- ECHAM4 A2 GCM was downscaled to 0.2^{o} (~22 km) using PRECIS RCM (dynamic)
- Monthly mean sea level at a local site is driven by landward wind stress (u and v at sea level)
- Astronomical tide estimated from harmonic constituents that have periods up to 30 days
- Take into consideration land subsidence and global sea level rise (thermal expansion)
- Non-linear regression of monthly mean and extreme sea levels of the form:

$$z_m = au^2 + bv^2 + cuv + du + ev + MSL_0 + landsubsidence + sealevelrise$$

Comparison of Model Monthly Highest High Water (HHW) levels (Lines) with Observed HHW for baseline period (1980-2009) (mean 1S.D.)

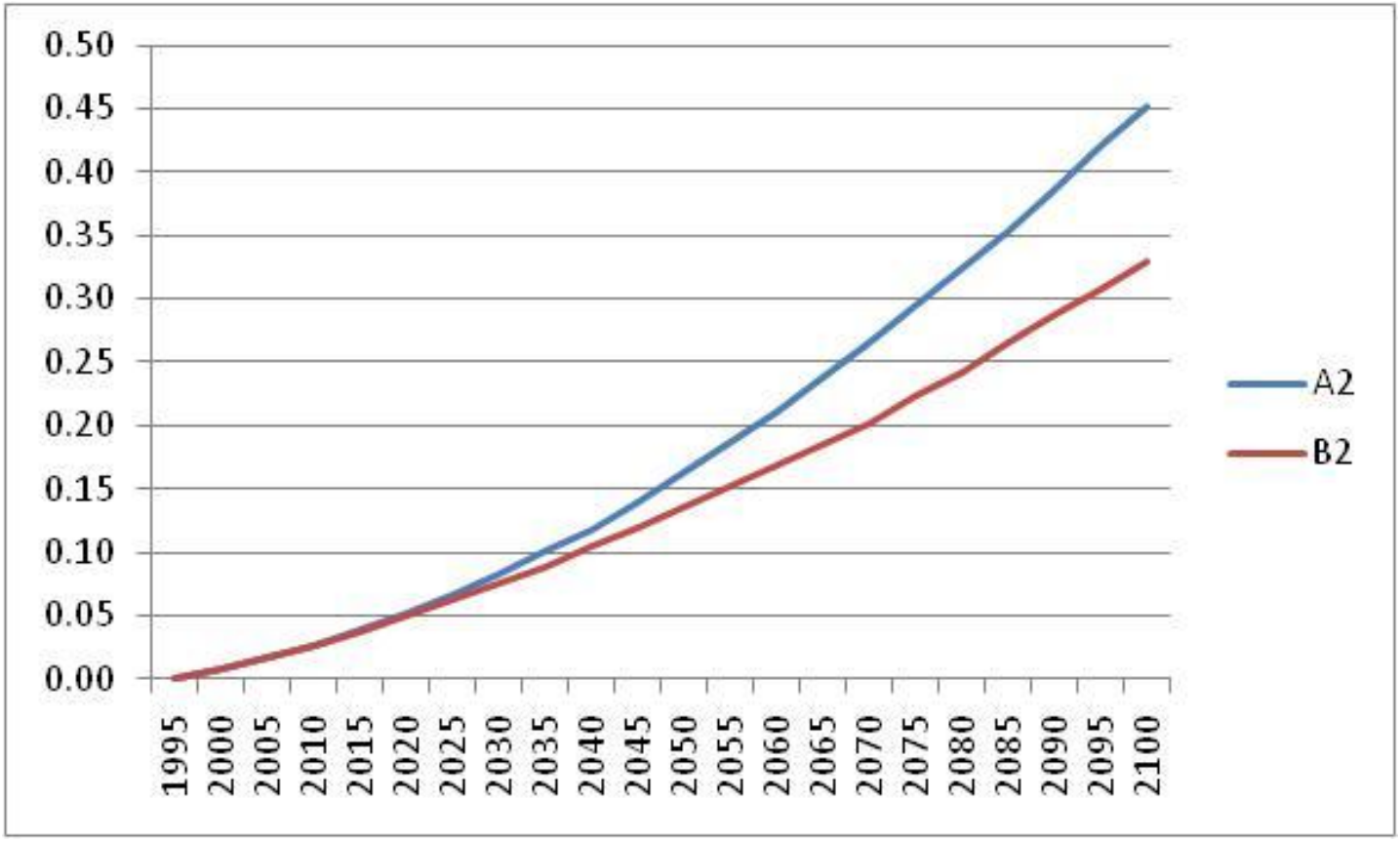


Land subsidence at Phuket from very high reposition GPS permanent station



From Itthi (2009)

Mean Sea Level Rise for Krabi from PRECIS



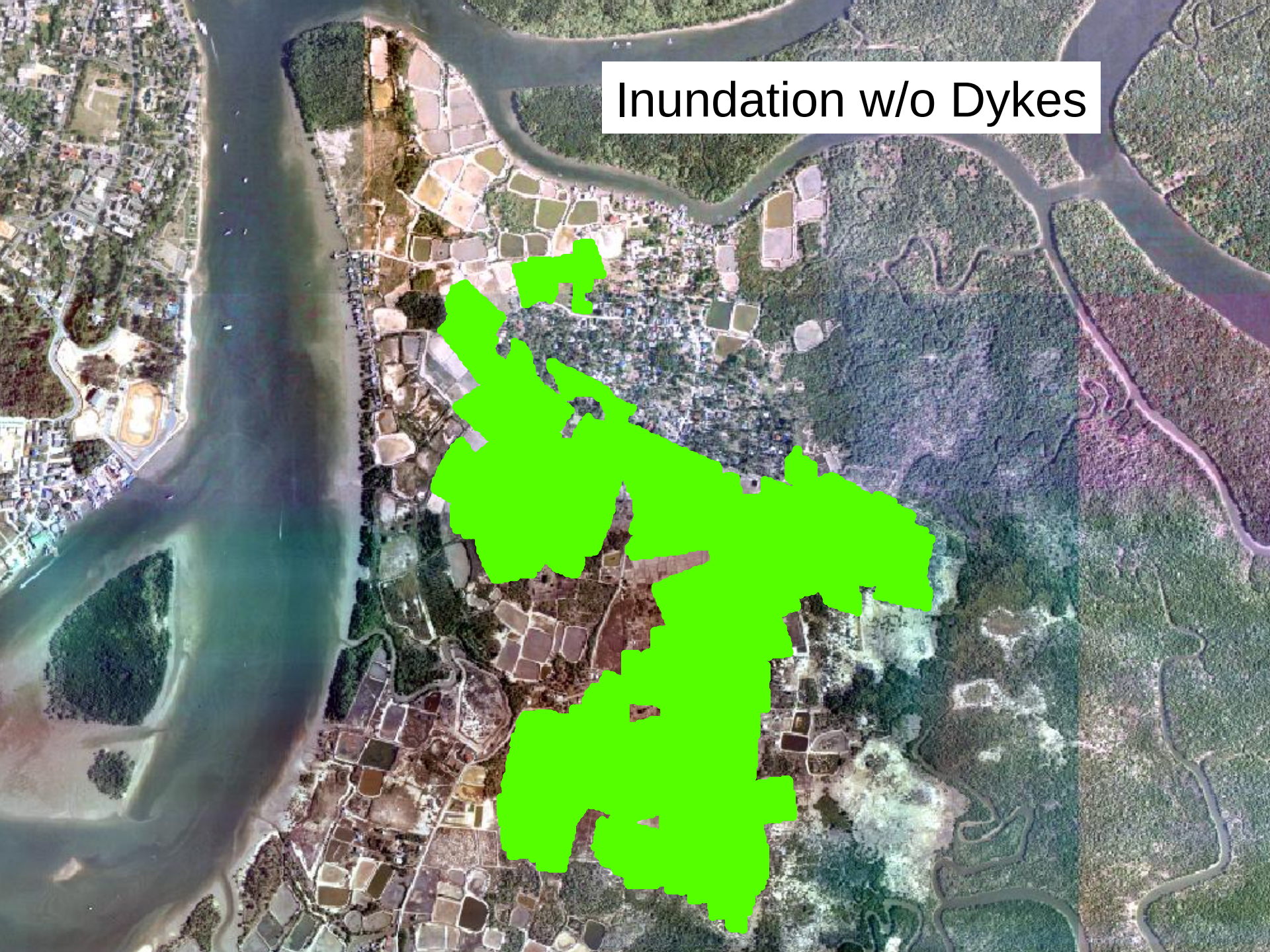
Vertical Displacement Corrections

Period	Mid Year	Sea Level Rise relative to baseline (m)	Land subsidence correction (m)
1980-2009	1995	0	0
2010-2039	2025	+0.14	+0.27
2040-2069	2055	+0.40	+0.54
2070-2099	2085	+0.78	+0.81

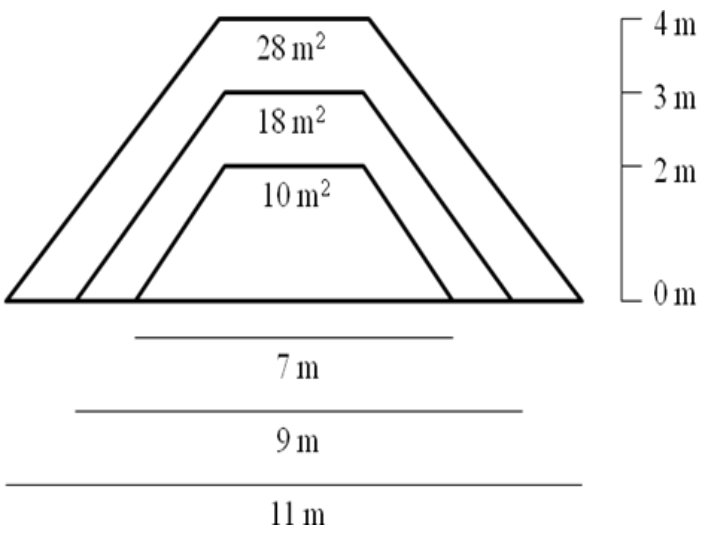
Mean and Variability of High Water Levels Corrected for Eustatic SLR, Monsoon Driven Wind Stress, and Land Subsidence

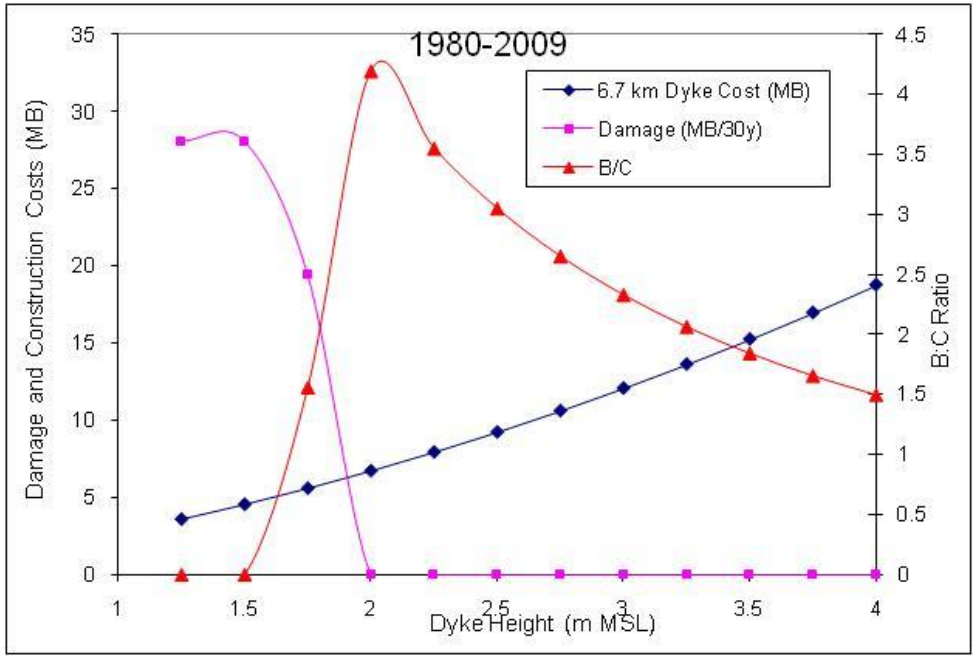
Period	MHW (m MSL)	HHW (m MSL)	LHW (m MSL)	SD	CV (%)
1980-2009	1.65	1.94	1.35	0.097	5.9
2010-2039	1.79	2.22	1.13	0.105	5.9
2040-2069	2.05	2.31	1.79	0.089	4.3
2070-2099	2.41	2.59	2.09	0.088	3.6

		Flood frequency (per 30y)			
Baseline Height above MSL_o	Rice Field (Rai)	1980-2009	2010-2039	2040-2069	2070-2099
<1.50	56.7	30	30	30	30
<1.75	166.0	13	30	30	30
<2.00	382.9	0	30	30	30
<2.25	498.4	0	6	30	30
<2.50	569.8	0	0	30	30
<2.75	600.0	0	0	3	30
<3.00	608.4	0	0	0	30
<3.25	613.1	0	0	0	27
<3.50	615.3	0	0	0	0
<3.75	616.6	0	0	0	0
<4.00	617.0	0	0	0	0


Inundation w/o Dykes

Response Option I: Defense





Maximize profit

Maximum Benefit:Cost for Dyke Options

	1980-2009		2010-2039		2040-2069		2070-2099	
Dyke	No	Yes	No	Yes	No	Yes	No	Yes
Height (m MSL_o)	0	2.00	0	2.50	0	2.75	0	3.50
Construction Cost (MB)	0	6.7	0	9.2	0	10.6	0	15.2
Rice Yield (MB/30y	140.4	168.4	58.9	168.4	13.7	152.2	3.0	168.4
Rice Damage (MB/30y	28.1	0	109.6	0	154.7	16.2	165.4	0
Benefit:Cost	0	4.19	0	11.90	0	13.07	0	10.85

Response Option II: Dyke and Compensation

Dyke Height (m MSL_o)	Construction Cost (MB)	Compensation for Rice Damage (MB/30y			
		1980-2009	2010-2039	2040-2069	2070-2099
1.25	3.6	28.1	109.6	154.7	165.4
1.50	4.5	28.1	109.6	154.7	165.4
1.75	5.6	19.4	109.6	154.7	165.4
2.00	6.7	0	109.6	154.7	165.4
2.25	7.9	0	26.9	154.7	165.4
2.50	9.2	0	0	154.7	165.4
2.75	10.6	0	0	16.2	165.4
3.00	12.1	0	0	0	165.4
3.25	13.6	0	0	0	149.0
3.50	15.2	0	0	0	0

Response Option III: Adaptation

Mud Crab Raising

	1980-2009	2010-2039	2040-2069	2070-2099
Upper limit of crab zone (reference to current contour line above MSL)	2.00	2.50	2.75	3.25
Crab zone area (Rai)	166	498	570	442
Pond construction cost (MB)	9.7	26.8	21.5	9.7
Crab profit (MB/30y)	29.9	89.7	102.6	79.6
Rice area remain (Rai)	458	125	54	15
Compensation (MB/30y)	0	0	0.8	1.1
Benefit:Cost	3.09	3.35	4.74	8.10

Comparison between Dyke and Crab Options