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Delta in Depth II 24/09/2014 in Rotterdam

Assessment of adaptation scenarios of coastal protections under global warming, in case of Mekong Delta

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Tri Van Pham Dang : Can Tho Univ., Viet Nam


6:30 AM (High tide) 18/09/2012 Can Tho City

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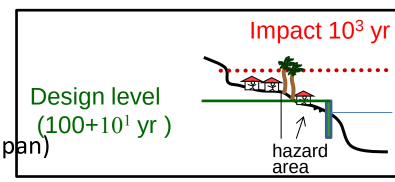
Introduction



Current and future hazard/risk!?

- ✓ Low frequency but huge impact disaster
  (Lesson learn last tsunami disasters in Japan)

  - flood from river/ coast(sea) : Combined Impact : Hao, et al.(2007)
- ✓ Storm surge - Low frequency and few disaster record in Mekong !?

PURPOSE
(Assessments test for practical tool)
Probabilistic hazard/risk area due to storm surges and S.L.R. in Mekong delta
(Taking account of dike heights)

Simple questions is how and when we should construct dikes to adapt the higher impact and reduce a hazard of the coastal flood.

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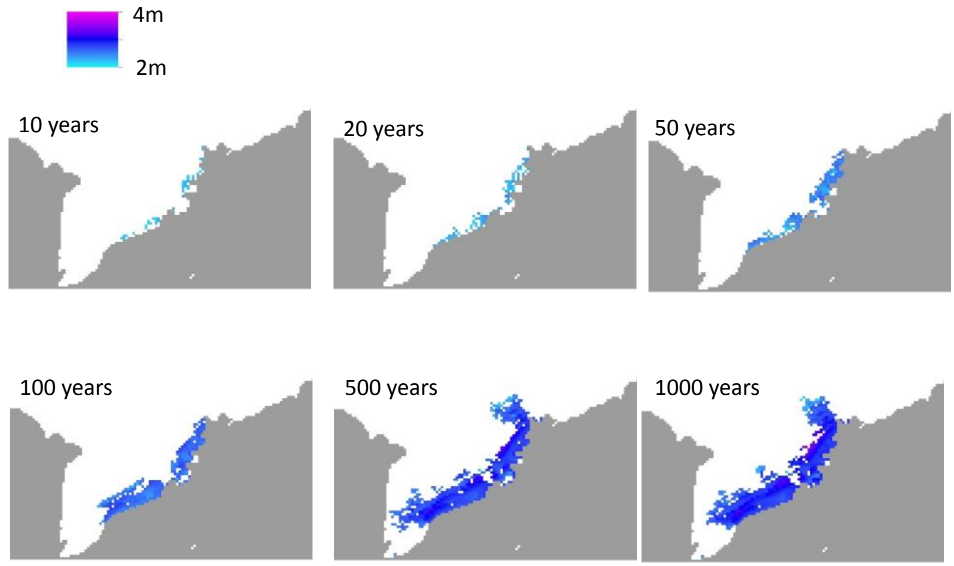
Computed Probability Flooded map (water level)



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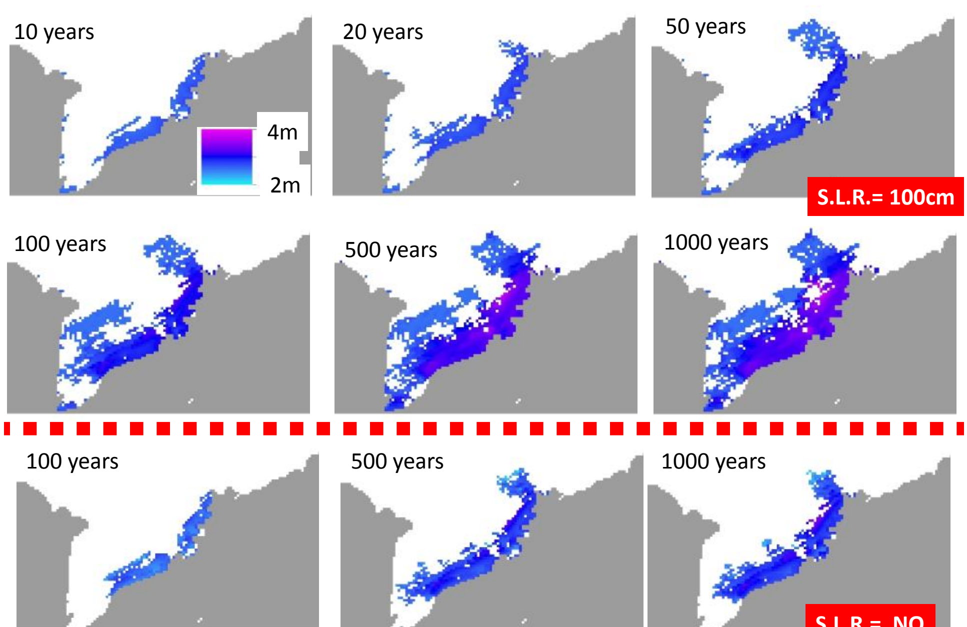
Computed Probability Flooded map (water level) 2



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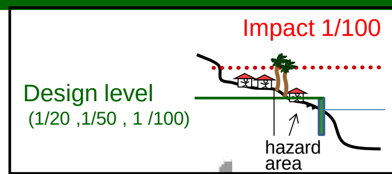
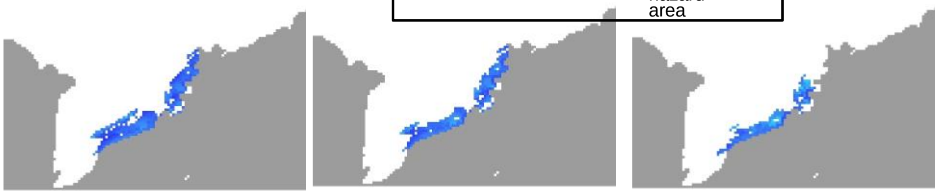
Counter Measures (Coastal Dykes)

100yr Return Period (R.P.)

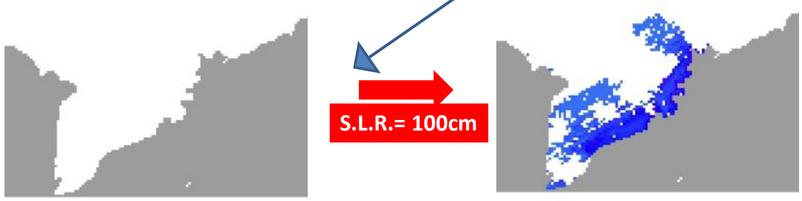




No Dyke

Dyke : Design level = 20yr R.P.

Dyke : Design level = 50yr R.P.



Dyke : Design level = 100yr R.P.

Dyke : Design level = 100yr R.P.

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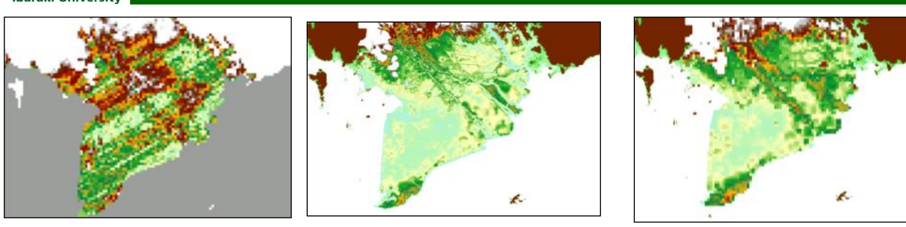
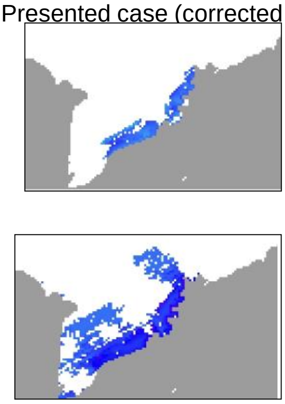
Case of higher accuracy topography



Presented case (corrected SRTM)

Demmk200 (15arc-sec)

Demmk200 (2arc-min)



Coastal Impact
100yr Return Period (R.P.)

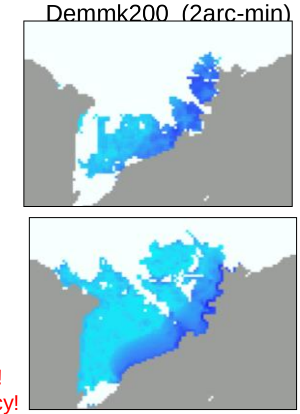
No Dyke

Dyke : Design level = 100yr R.P.

S.L.R.= 100cm

Test version!
Low accuracy!

Test version!
Low accuracy!



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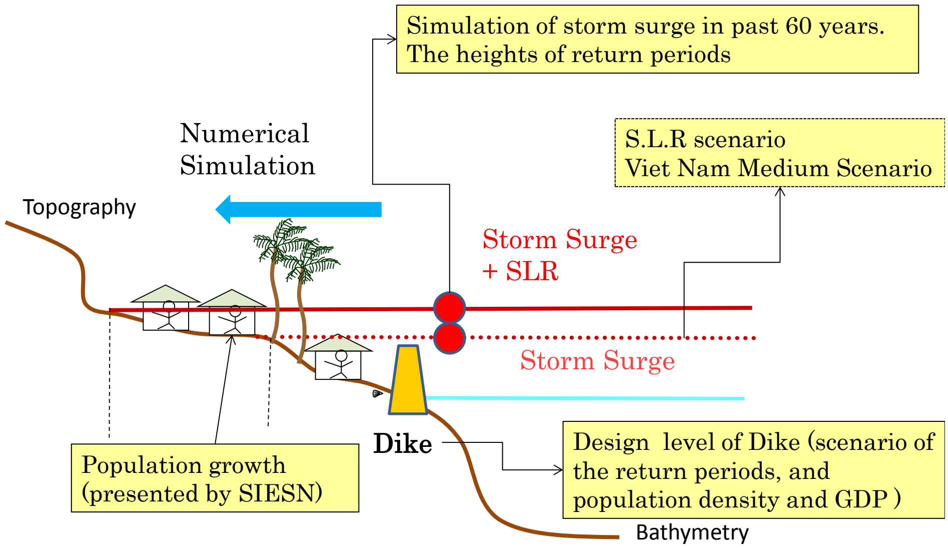
Outline of assessment for Mekong Delta



Assumption : No change of intensity of T.C. Retreat of resident etc…

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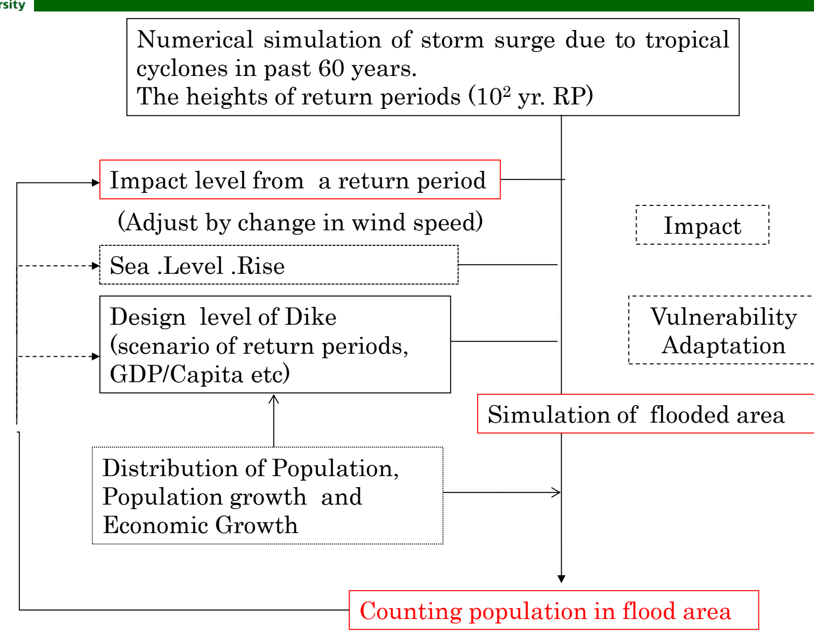
Flow Chart of this Assessment Methodology



Governing Equations for Wind and Storm Surge

Wind : Myers(1952)

$$P(r) = P_c + \Delta p \cdot \exp\left(-\frac{r_0}{r}\right)$$

$$V_{gr} = \sqrt{\left(\frac{rf}{2}\right)^2 + \frac{\Delta p}{\rho_a}\frac{r_0}{r}\exp\left(-\frac{r_0}{r}\right)} - \frac{rf}{2}$$

$$V_1 = C_1 V_{gr}$$

$$V_2 = C_2 \frac{V_1(r)}{V_1(r_0)} U_T$$

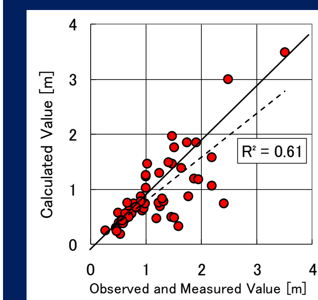
Storm Surge : shallow water equations

$$\frac{\partial M}{\partial t} - 2\Omega N \sin\phi + \frac{gh}{R\cos\phi}\frac{\partial \eta}{\partial \lambda} = \frac{h}{\rho_w R\cos\phi}\frac{\partial p}{\partial \lambda} + \frac{\tau_s^{(\lambda)}}{\rho_w} - \frac{\tau_b^{(\lambda)}}{\rho_w}$$

$$\frac{\partial N}{\partial t} + 2\Omega M \sin\phi + \frac{gh}{R}\frac{\partial \eta}{\partial \phi} = \frac{h}{\rho_w R}\frac{\partial p}{\partial \phi} + \frac{\tau_s^{(\phi)}}{\rho_w} - \frac{\tau_b^{(\phi)}}{\rho_w}$$

$$\frac{\partial \eta}{\partial t} + \frac{1}{R\cos\phi}\frac{\partial M}{\partial \lambda} + \frac{1}{R\cos\phi}\frac{\partial}{\partial \phi}(N\cos\phi) = 0$$

Storm Surges in Japan



Goda's Method of extreme value – statistic analysis

- Sampling : Maximum heights annual data
- Distribution Function

The Fisher-Tippett type I (Gumbel)

$$F(X) = \exp(-\exp[-(x-B)/A])$$

The Fisher-Tippett type II

$$F(X) = \exp[-(1+(x-B)/kA)^{-k}]$$

shape parameter K=2.5, 3.33, 5.5,10.0

Weibull distribution (three parameter)

$$F(X) = 1-\exp(-[(x-B)/A]^k)$$

shape parameter k=0.7, 1.0, 1.4, 2.0

- Rejecting unfitting distribution functions

Extreme statistic analysis : Goda's Method (1988, ….)

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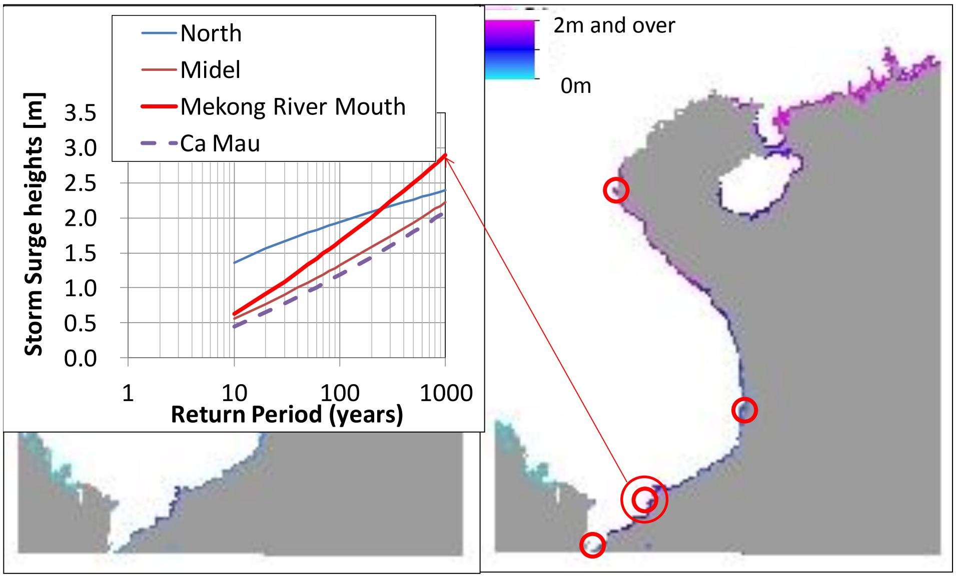
Computed 10 ~ 1000- years return period of storm surges



20 years

100 years

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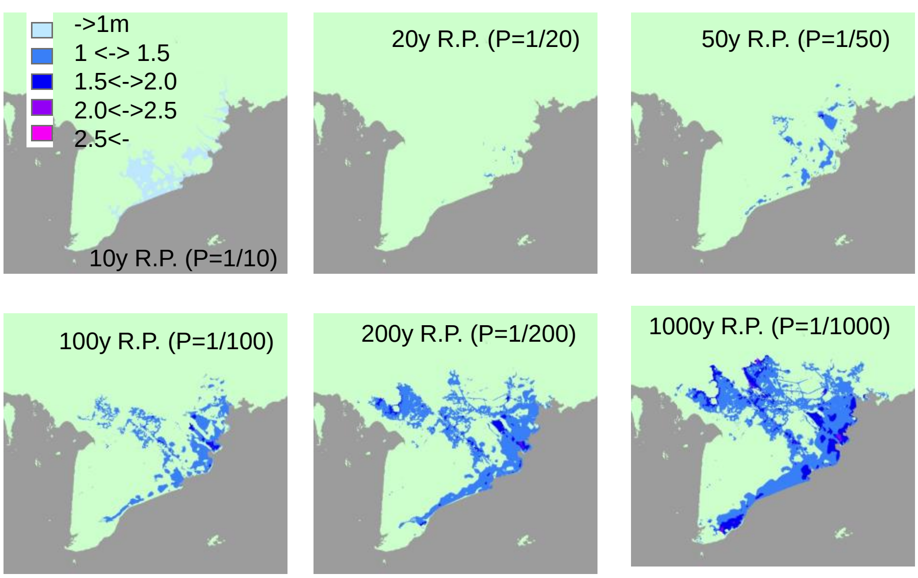
Flood Area in each probability (W.L. >1m)



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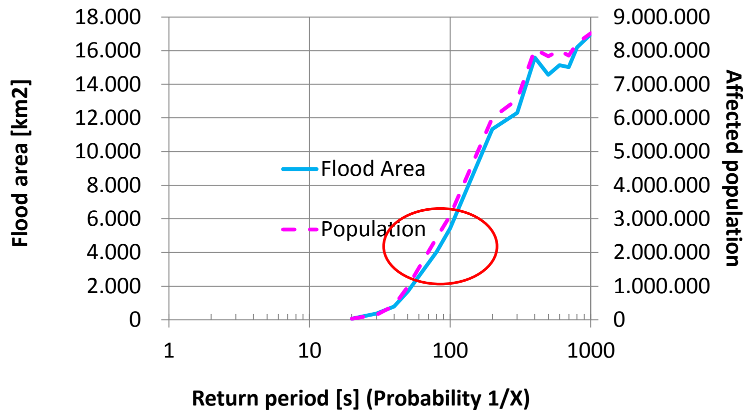
Hazard function of flood area and affected population



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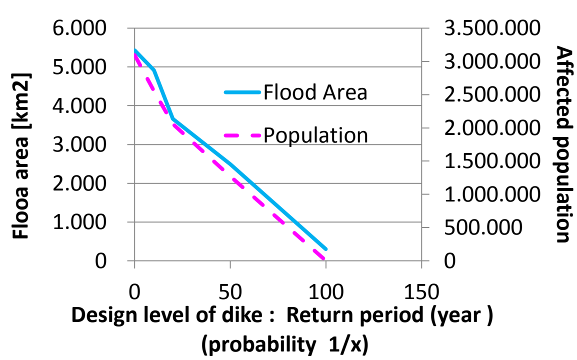
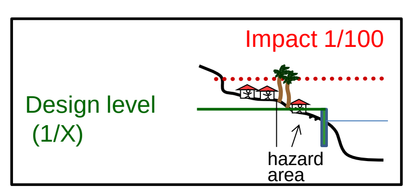
Design level of dike and Risk reduction





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Dike heights : Mitigation/Adaptation Scenario :

		Return Period [1/year]			
		1/10	1/50	1/100	1/1000
GDP per capita [US$ 1990]	Start Finish	600 3,000	2,400 10,000	5,000 100,000	10,000 1,000,000
Minimum construction length after start [grid/year]		25	25	25	25

From high population density grids

Nichols (2004; 30 years delay)

		Design frequency (Return Period [1/year])		
		1/10	1/100	1/1000
GDP per capita [US$]	If deltaic coast	<2400	2400-5000	>5000
	If non-deltaic coast	<600	600-2400	>2400

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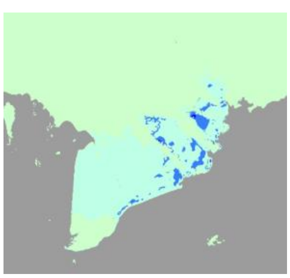
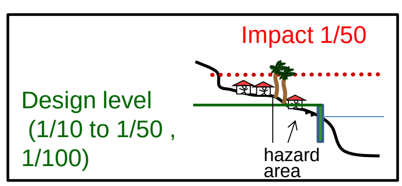
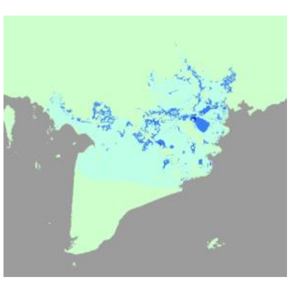
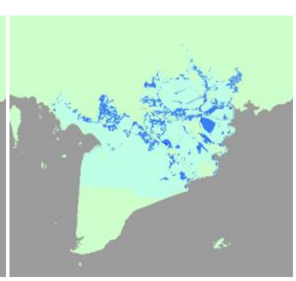
Time series of assessment map







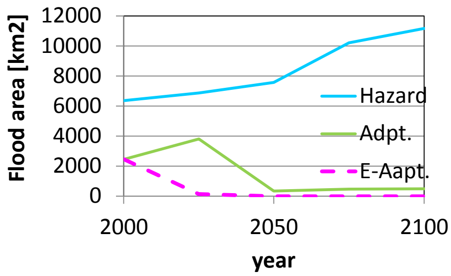
2000 year

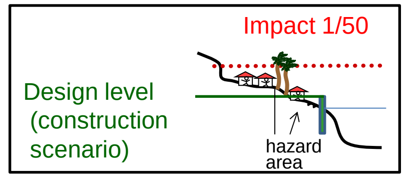


2025 year

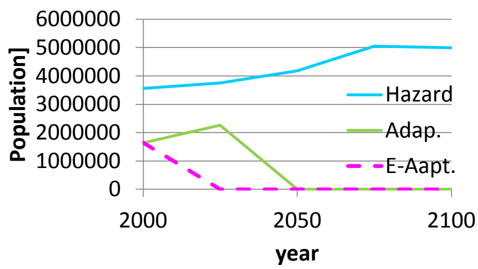
2050 year

Time series of assessment

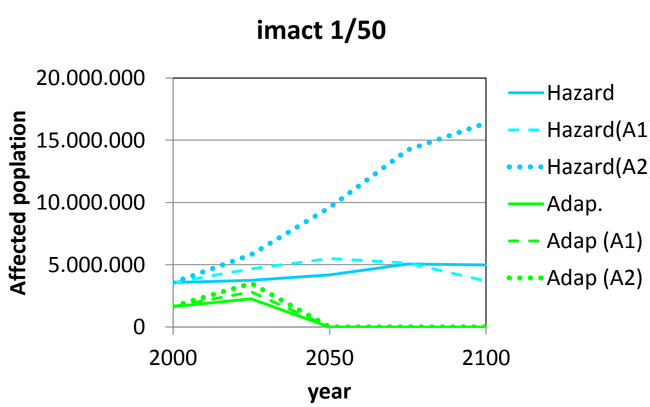




E-adaptation
early adaptation (20 yrs)



Time series of assessment continue



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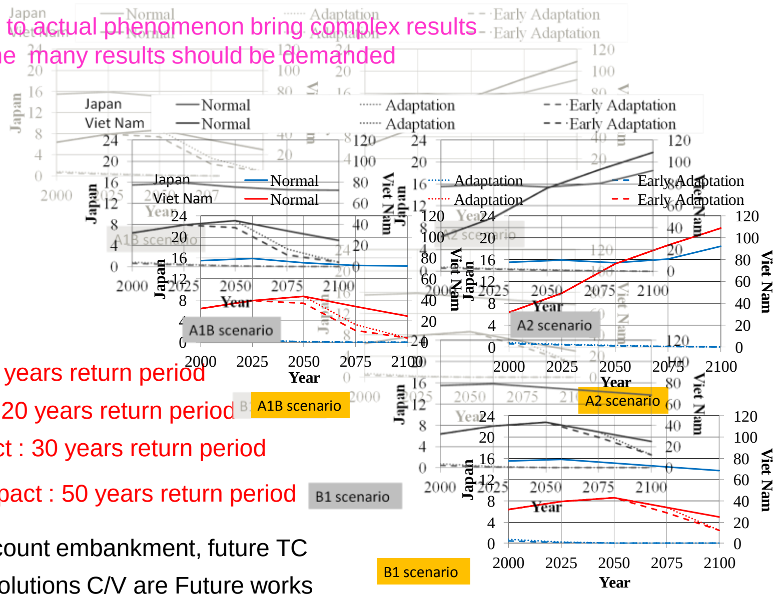
Current Work: Replace data, factors and Compile

Closing to actual phenomenon bring complex results
Combine many results should be demanded



Impact : 10 years return period

Impact : 20 years return period

Impact : 30 years return period

Impact : 50 years return period

Taking account embankment, future TC practical solutions C/V are Future works