Updates of Vulnerability Assessment and Adaptation to Climate Change

1. Assessment of Impacts and Vulnerability
   - What we know so far?
   - Next key questions for VA
   - New climate predictions
2. Adaptation
   - Role of adaptation
   - Potential of adaptation

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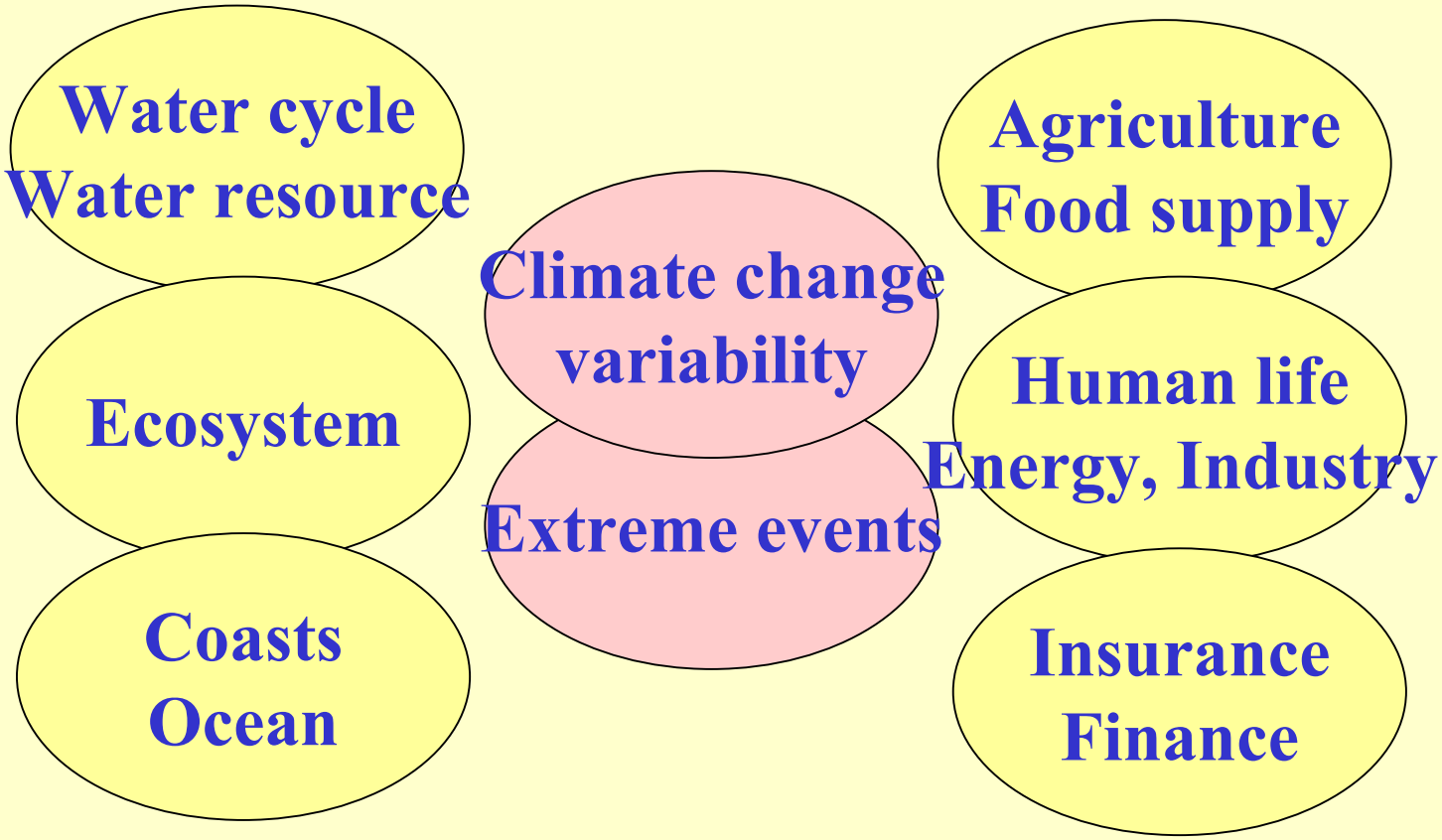
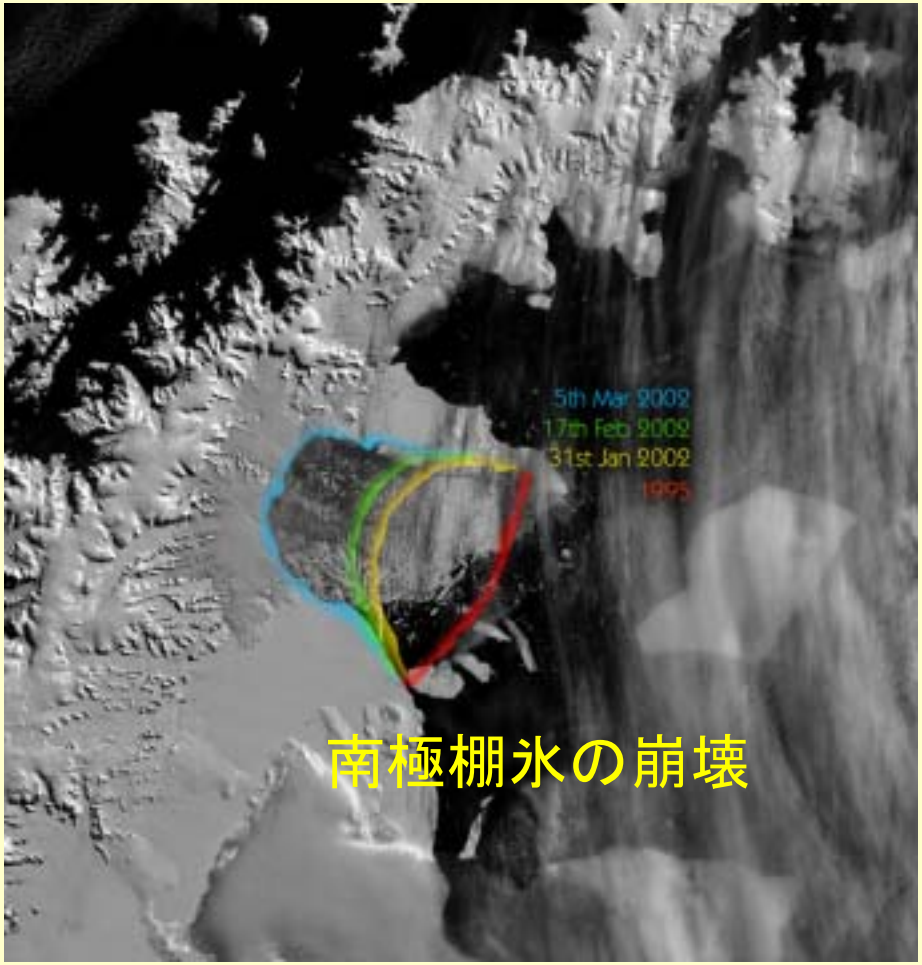
Impacts of Climate Change



Appearing Impacts

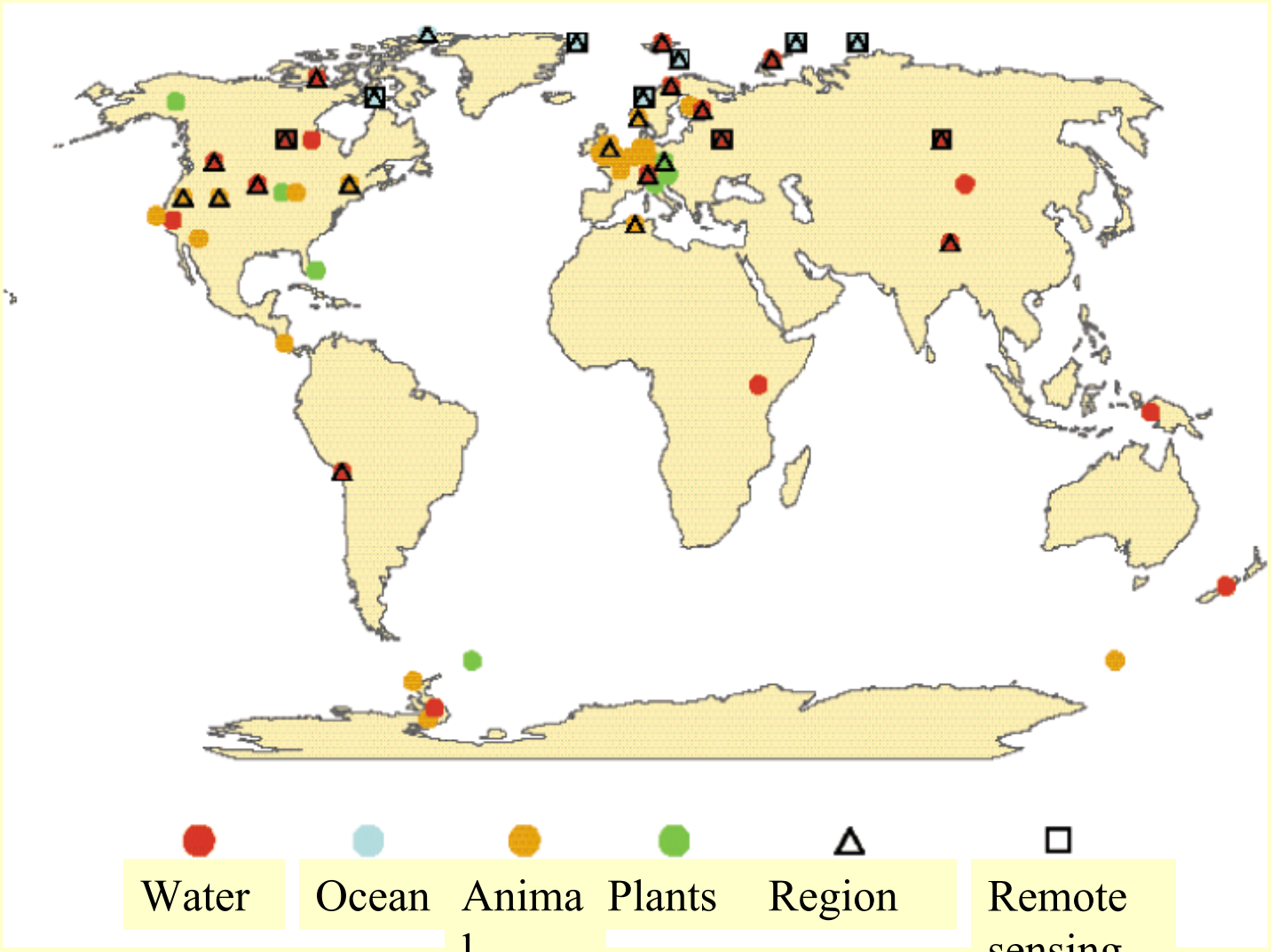
- Disruption of Antarctic ice sheet
- Melting of mountain glacier and ice caps
- Flooding in Asia and Europe
- Break out of West Nile fever in the US
- Heat waves in Europe
- Storms in Asia and US
- Early blooming of spring flowers in Japan



Melting Permafrost in Siberia

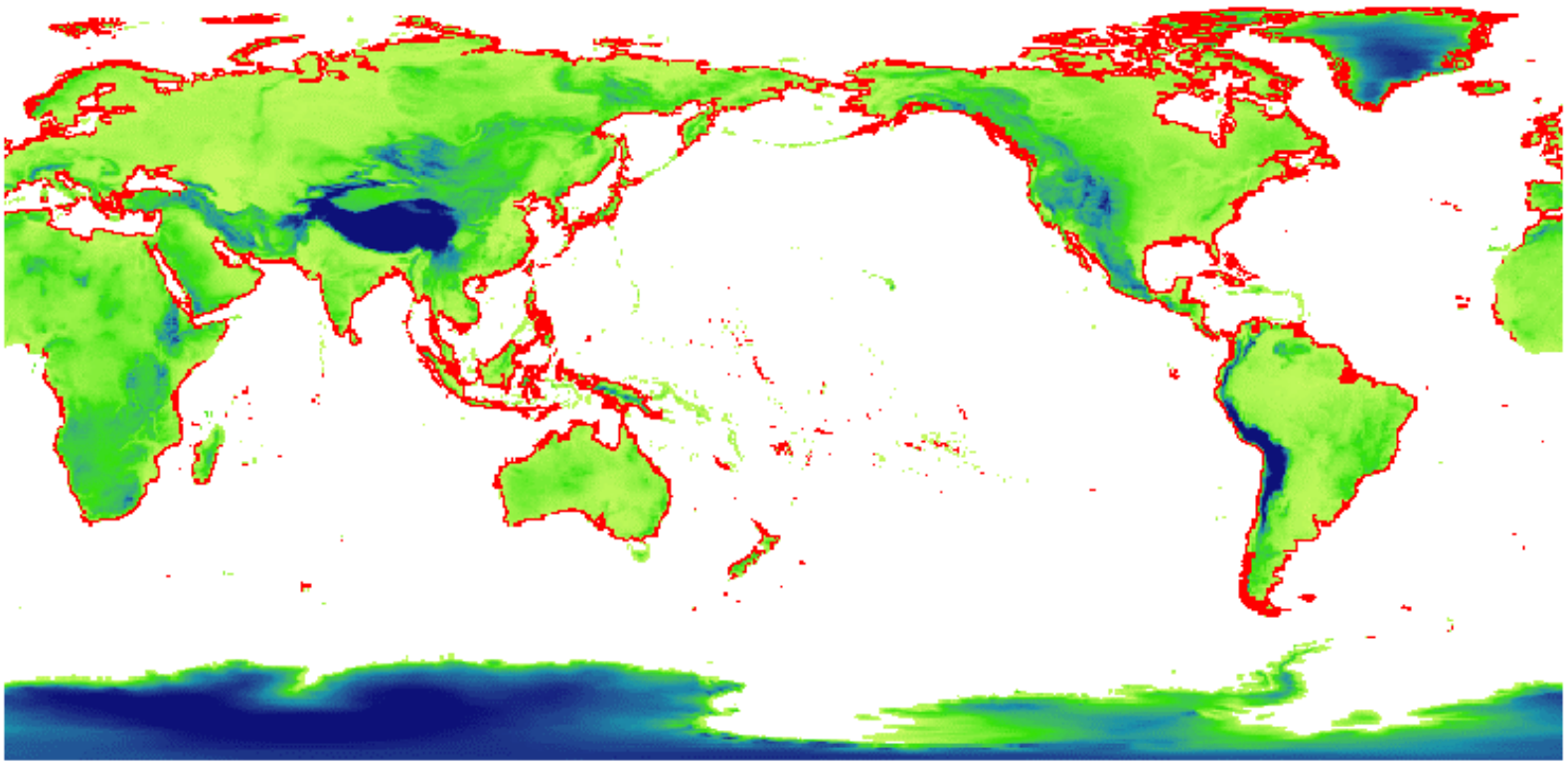
City	% of buildings in potentially dangerous state
Norilsk	10%
Tiksi	22%
Dudinka	55%
Dikson	35%
Pevek, Amderma	50%
Chita	60%
Vorkuta	80%

Impacts have been appearing on the ecosystem



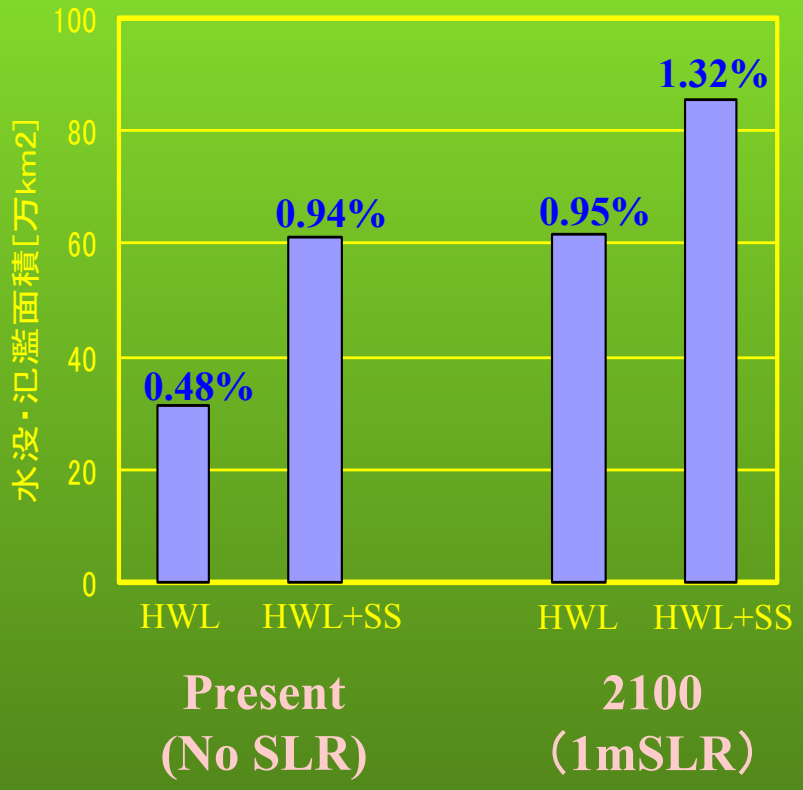
Inundation Areas by Accelerated SLR

SLR 1m

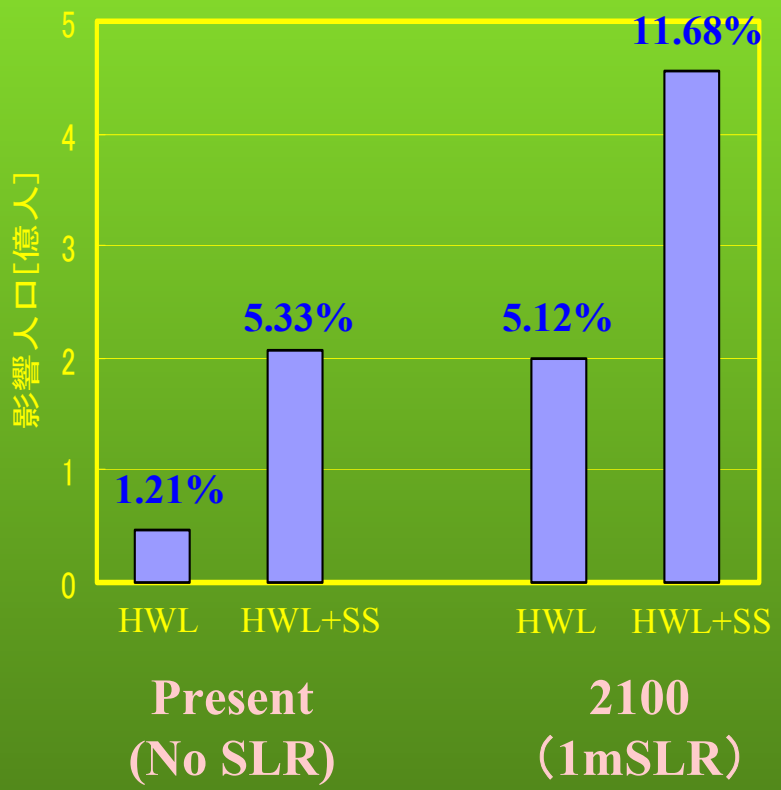


Affected Areas and Population in Asia and the Pacific

Inundated and Flooded Areas



Affected Population



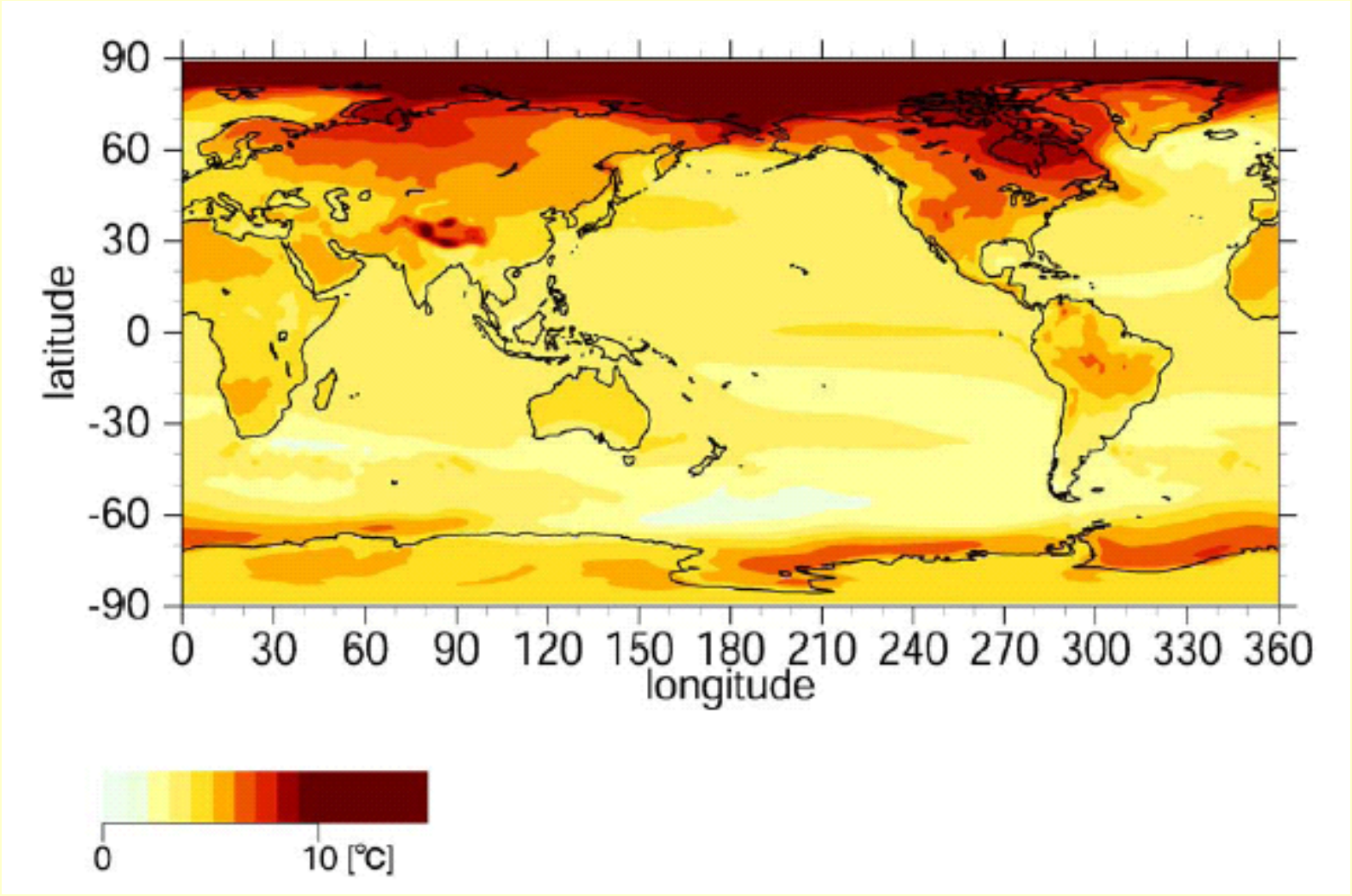
Key questions for VA

1. Impacts of climate change have appeared.
2. Impacts will be serious in a wide areas.
   e.g. total amount of damage costs,
   total number of affected people, etc

3. Which places and sectors would receive the most serious impacts?
4. What is the dangerous level of climate change in terms of the impacts?
   When will the climate change exceed the dangerous level?
5. How to respond or adapt to the impacts?

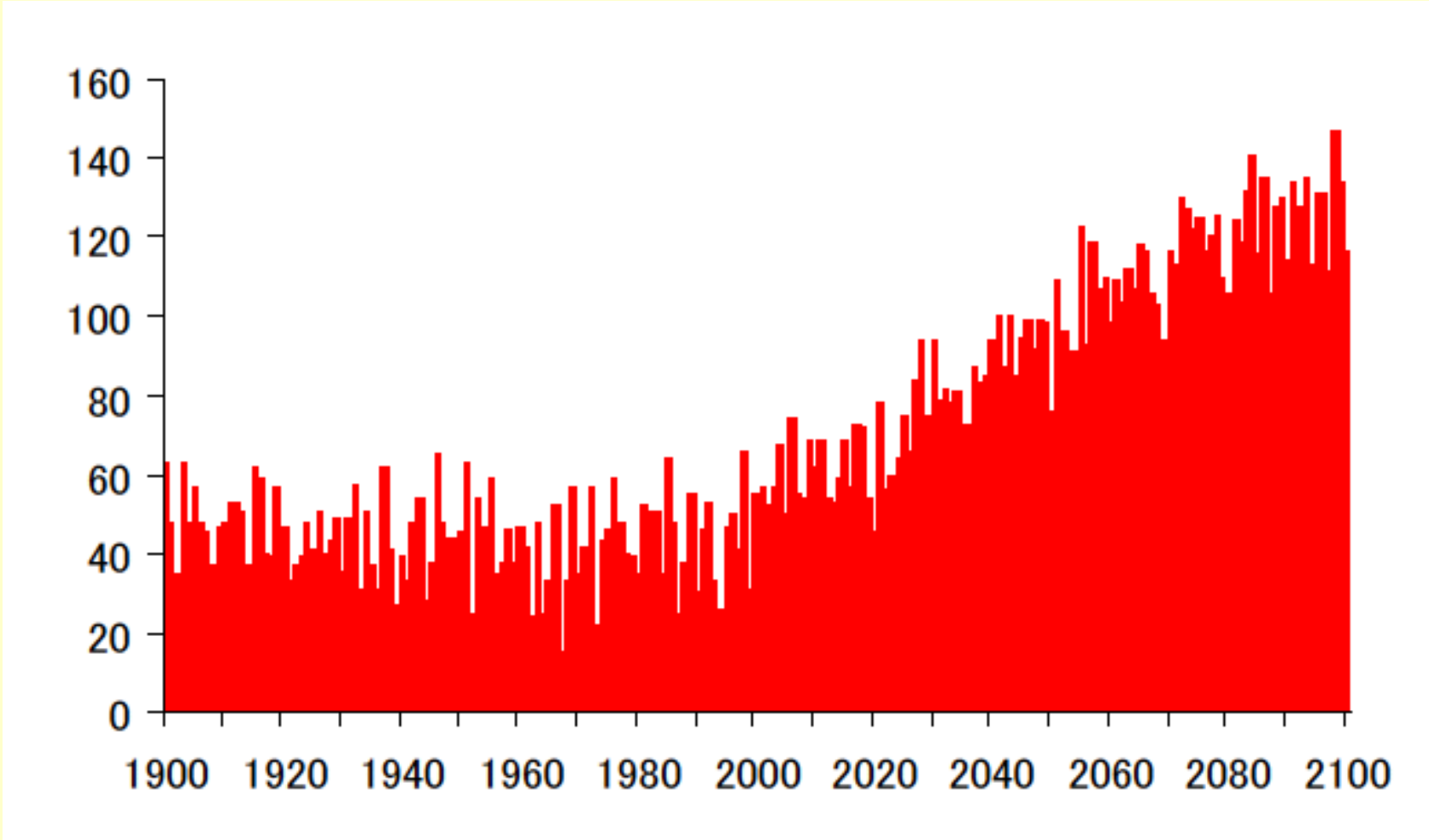
New Results from "Earth Simulator"

Temperature Rise from 1971-2000 to 2071-2100



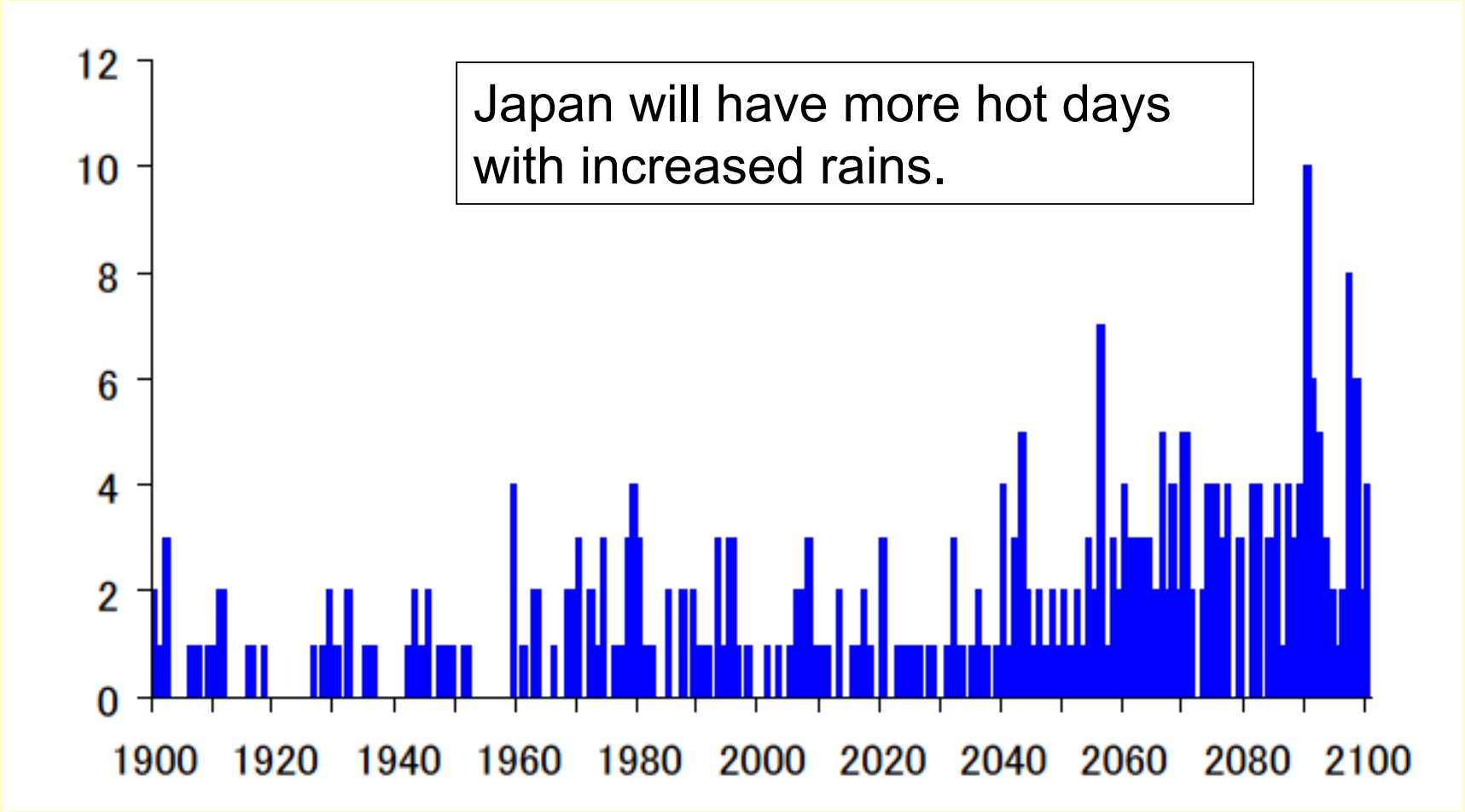
Increase in Japanese “Summer Days”

Summer Day: Daily maximum is over 30℃



Increase in Japanese “Heavy Rain Days”

Heavy Rain Day: Cumulative rainfall a day is over 100 mm



Increasing Hurricane/Typhoon Intensity

- Higher sea surface temperature will induce stronger cyclones

- Recent researches

Walsh (2004):

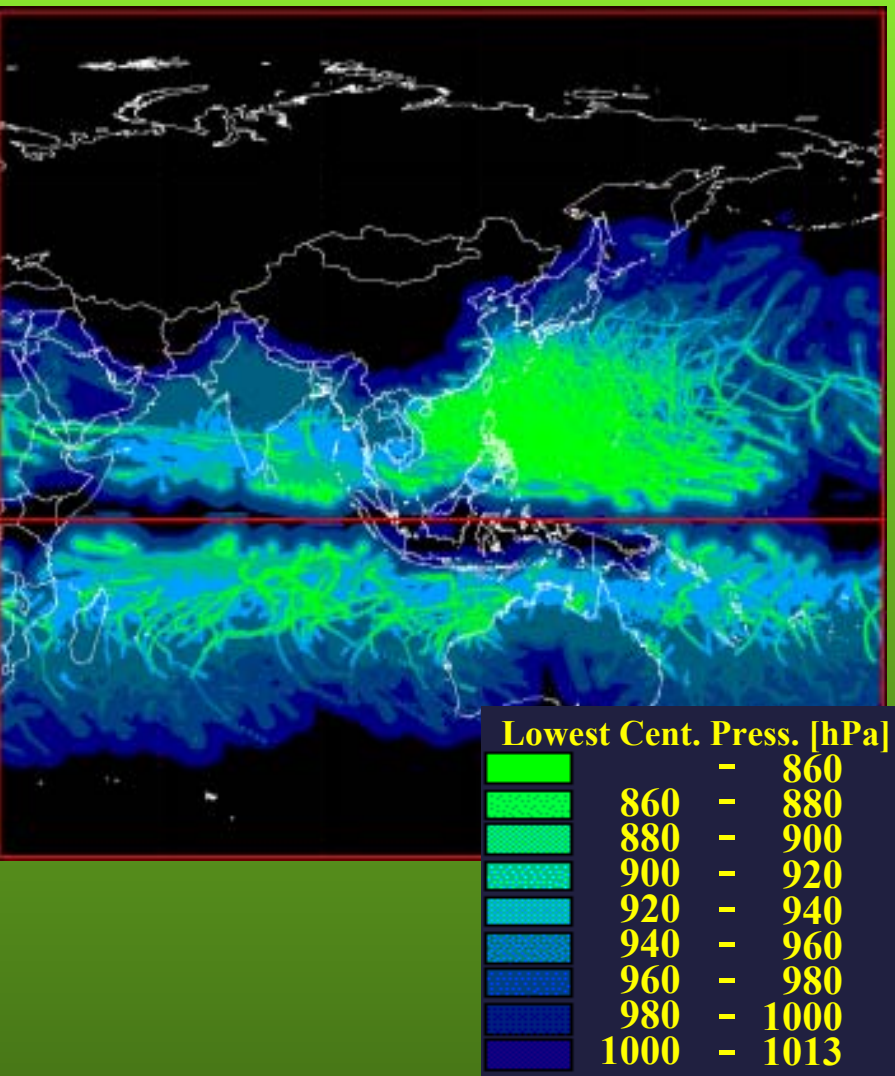
- maximum tropical cyclone intensities: + 5 -10% by 2050
- peak precipitation rate: + 25%

Oouchi et al (2005)

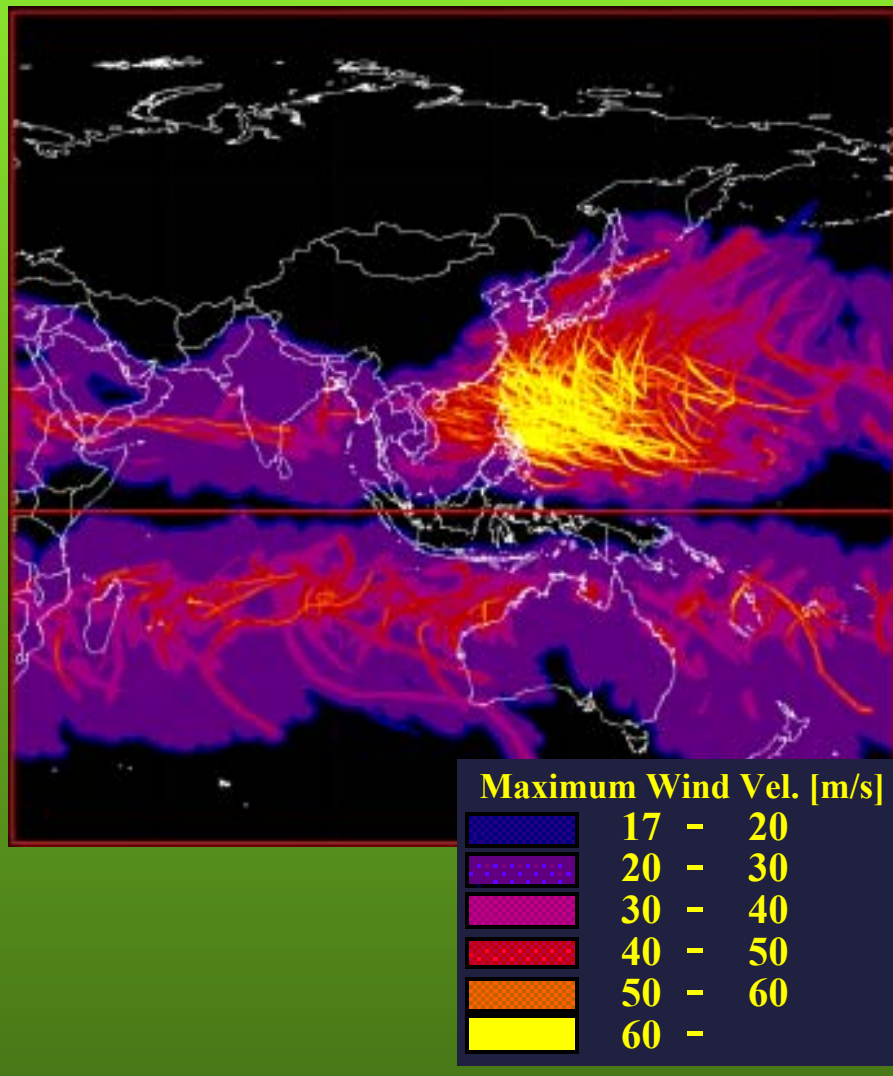
- tropical cyclone frequency: about - 30%
- tropical cyclones period: more long-lasting
- strong tropical cyclones: increases
- maximum surface wind speed: + 8.9 m/s (North)
  + 5.4 m/s (South)

Estimated Typhoon Parameters(1949～1988)

Lowest Center Pressure



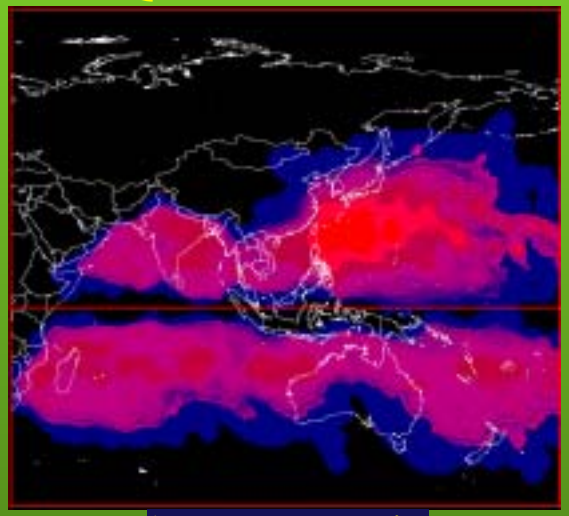
Maximum Wind Velocity



Characteristics of Typhoons（1949～1988）

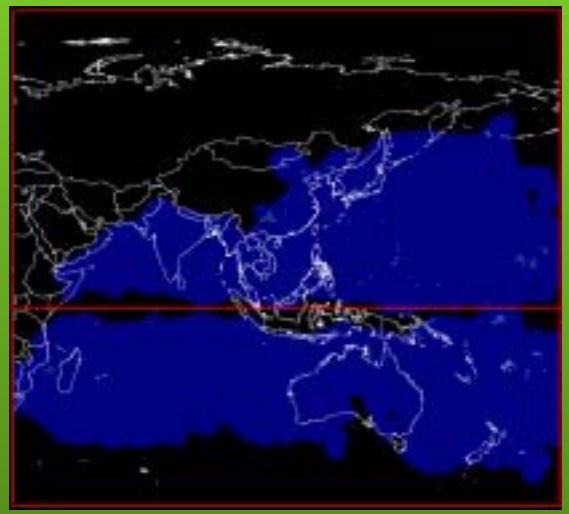
Cumulative Effect of Typhoon

$$\sum \left(\text{Average Wind Vel. (m／min)} \times \text{Retention Time (min/typhoon)} \times \text{Frequency (number/yr)} \right)$$



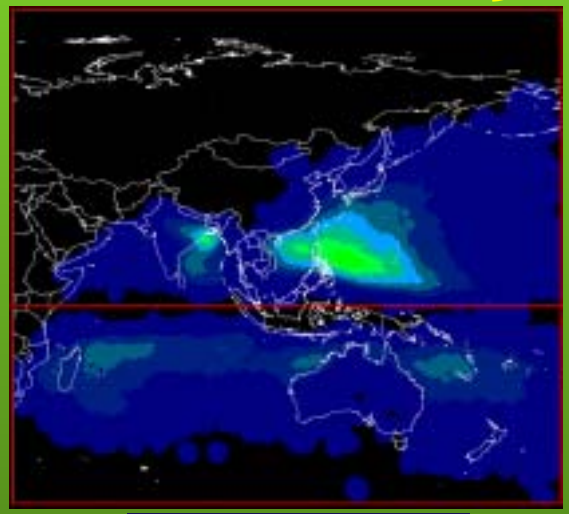
Average Vel. [m/s]

0.0 –	5.0
5.0 –	10.0
10.0 –	15.0
15.0 –	20.0
20.0 –	25.0
25.0 –	30.0
30.0 –	35.0
35.0 –	38.8



Retention Time [day]

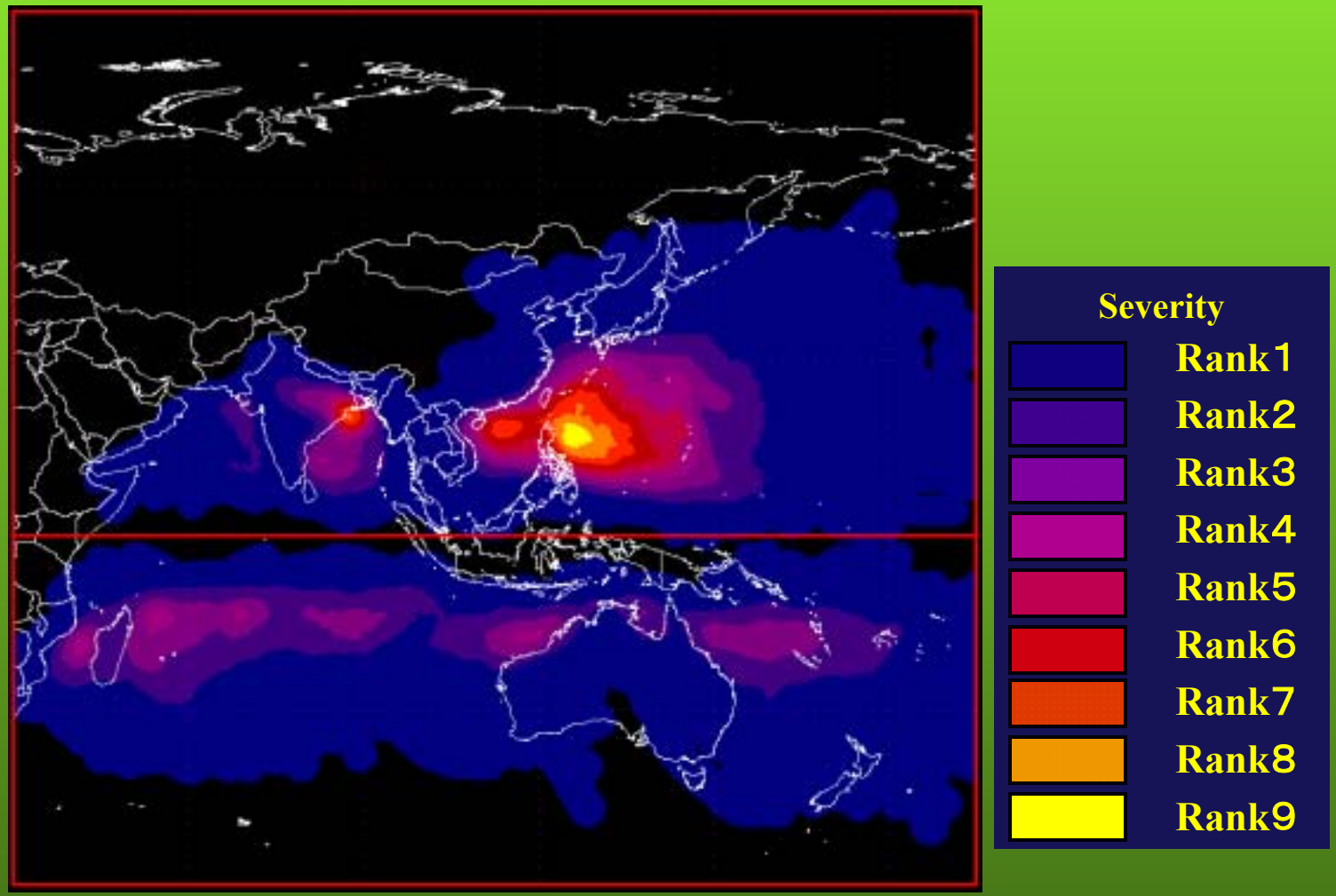
0.0 –	1.0
1.0 –	2.0
2.0 –	3.0
3.0 –	4.0
4.0 –	5.0
5.0 –	6.0
6.0 –	



Frequency [num./yr]

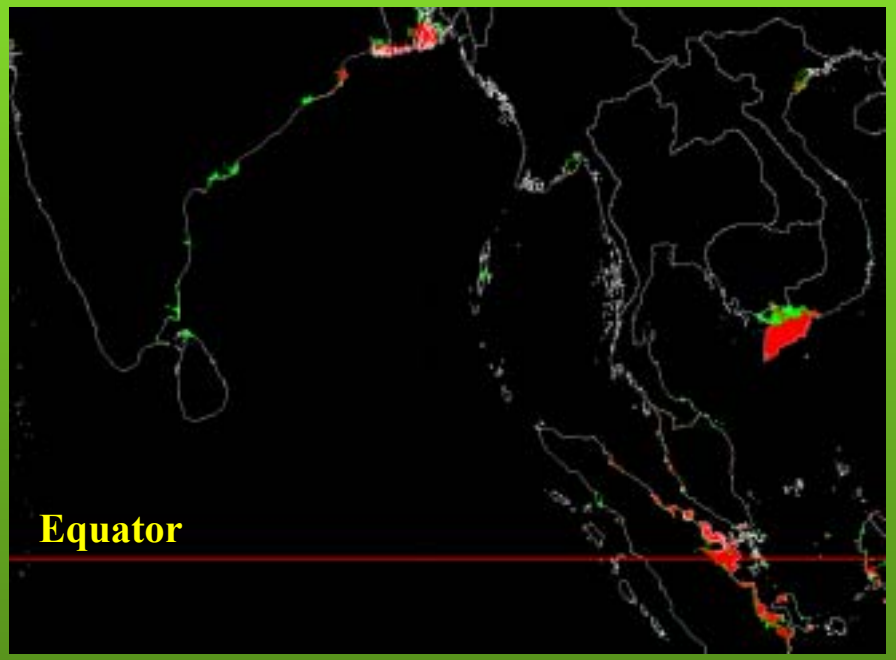
–	1.0
1.0 –	2.0
2.0 –	3.0
3.0 –	4.0
4.0 –	5.0
5.0 –	6.0
6.0 –	6.8

Severity of Typhoon Effect(1949～1988)
- Cumulative Effect



Inundated and Flooded Areas - Southeast and South Asia

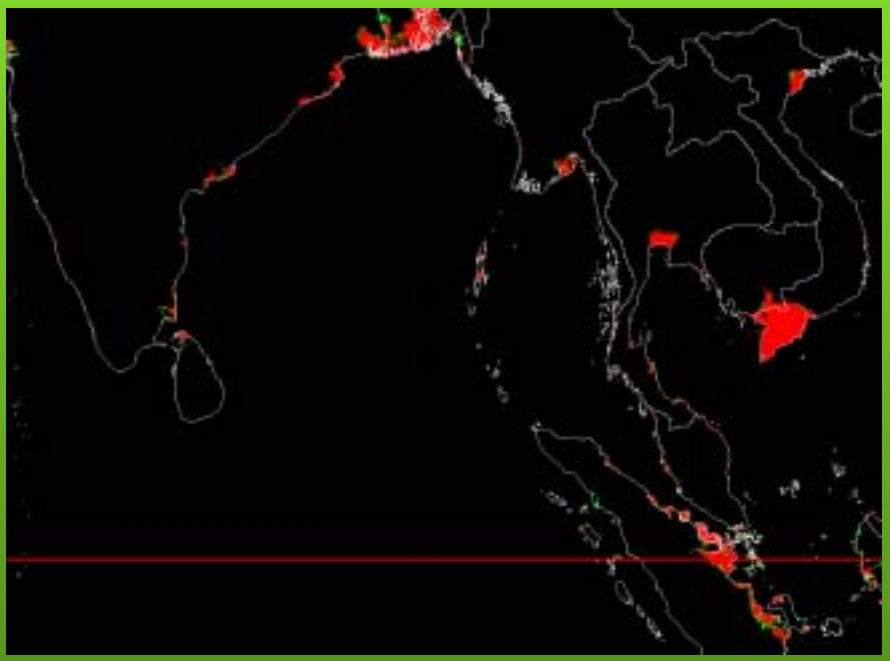
〈Inundation〉



Inundated by HWL

Inundated by HWL+1m SLR

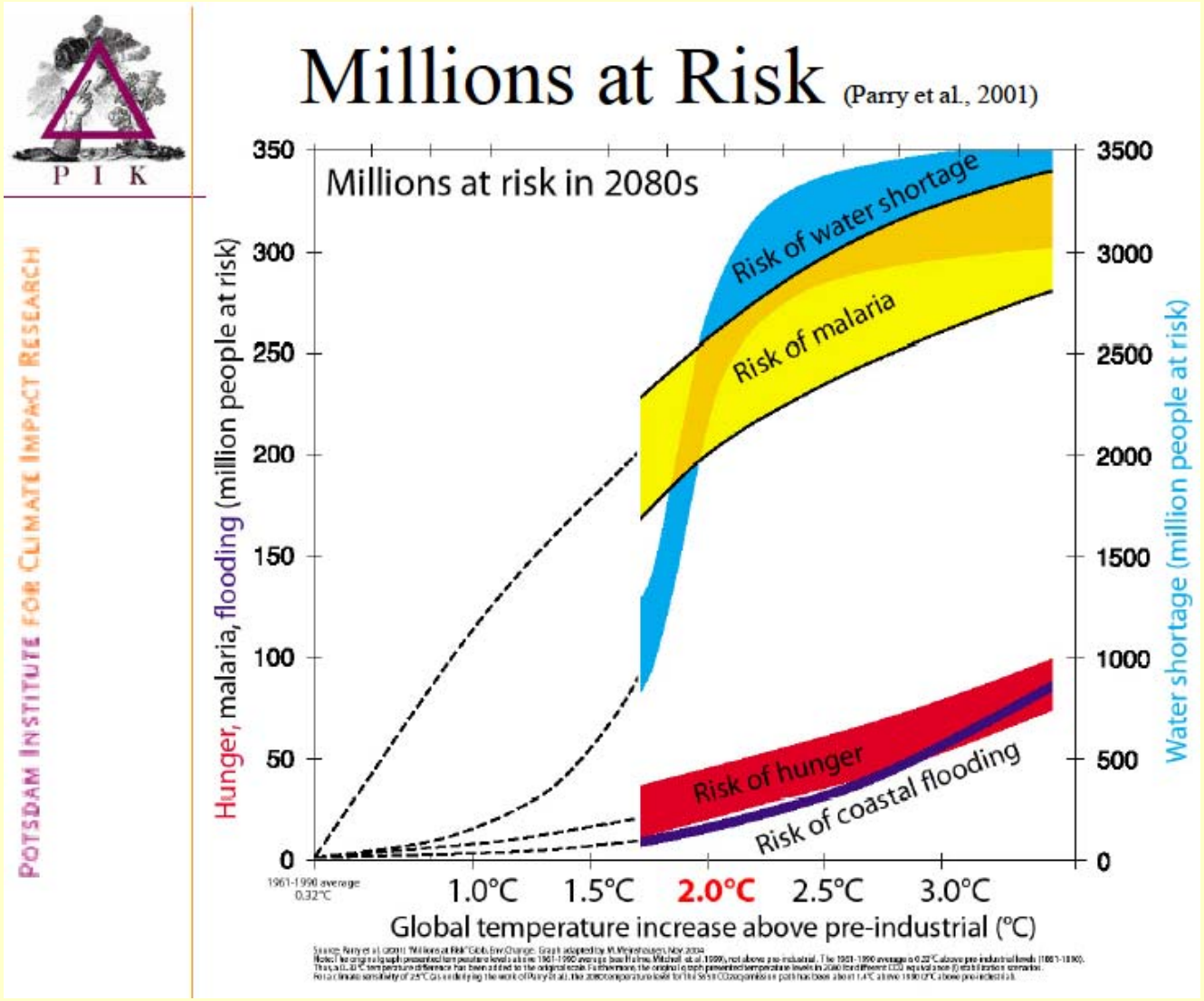
〈Flooding by Storm Surge〉



Flooded by HWL + SS

Flooded by HWL + SS + 1mSLR

Dangerous Levels in terms of Impacts



Examples of Thresholds of Impacts

Ecosystem	Plants in high mountain Mangrove	Apparent effects for 2℃ increase Cannot survive for 45cm SLR
Agriculture	Rice	Heat effect by over 35 ℃ during flowering
Marine Ecosystem	Coral	Bleaching by 1-2 ℃ increase in water temperature
Coastal Zone	Sandy beach Port and coastal structure	Erosion of 57% beaches by 30cm SLR 100 billion US$ of costs for 1mSLR
Human Health	Elder people	Increase of mortality rate for 33-35 ℃ of daily high temp.
Economy	Nations	Negative effects for 2-3 ℃ increase

Methodologies for Vulnerability Assessment

- Impacts on individual sectors
  - Process-based models (e.g. inundation and erosion)
  - Statistical models (e.g. health impacts)
- Economic Assessment
  - Economic models
- Spatial Distribution
  - GIS-based analysis
- Comprehensive analysis of impacts, mitigation, adaptation and their effects
  - Integrated Assessment Models (e.g. AIM model)

Adaptation

Basic relationship of vulnerability and adaptation

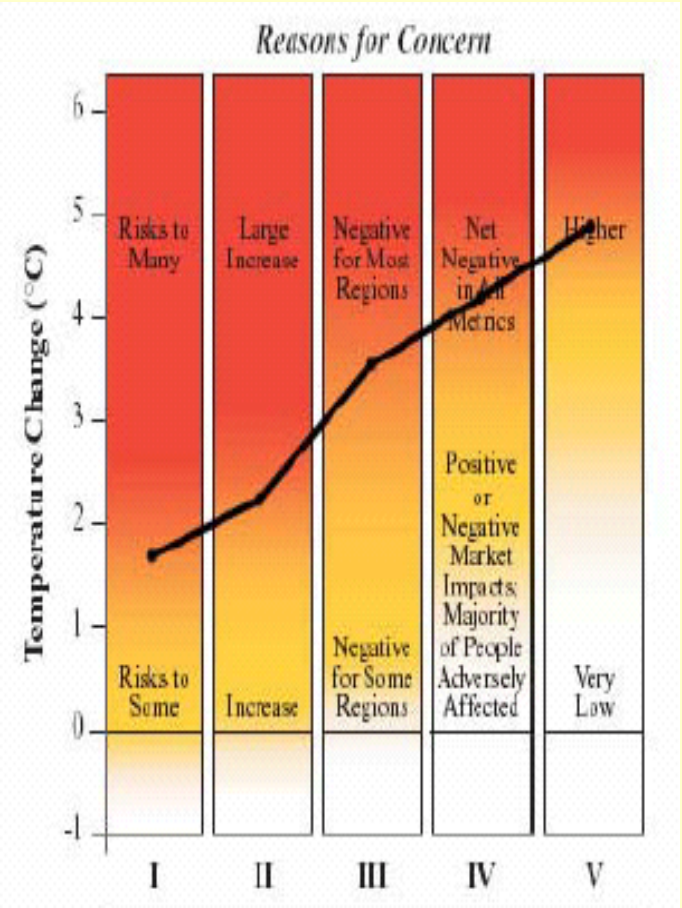
Vulnerability (V)= Sensitivity (S) – Adaptability (A)

V is large, if S is large

if A is small

Sensitivities

1) Unique and threatened systems
2) Extreme events
3) Distribution of impacts
   - Developing > Developed
   - Unmanaged > Managed
4) Aggregated impacts
5) Large scale events



Adaptation

3.1 Role of adaptation

- reduce adverse impacts of climate change
- enhance beneficial impacts

3.2 Nature of adaptation

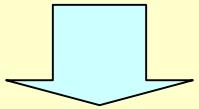
1) Planned adaptation has better potential.
2) Adaptation to current climate variability is consistent with adaptation to CC.
3) Costs of adaptation are marginal to other development.
4) Non-climatic stresses/existing policies are also important.

3.3 Adaptive capacities

1) AC changes with regions and countries.
2) AC is a function of financial potentials, scientific and technical knowledge, information, skills, infrastructure, institutions, etc.
3) AC for climate change is equivalent to those for sustainable development. Climate adaptation and sustainability can share the same goals.
4) Development modify the AC.

3.4 Adaptation and Policies

- Adaptation shares the same goal of sustainable development.
- Planned adaptation has better potential.
- Mainstreaming adaptation should be more focused.



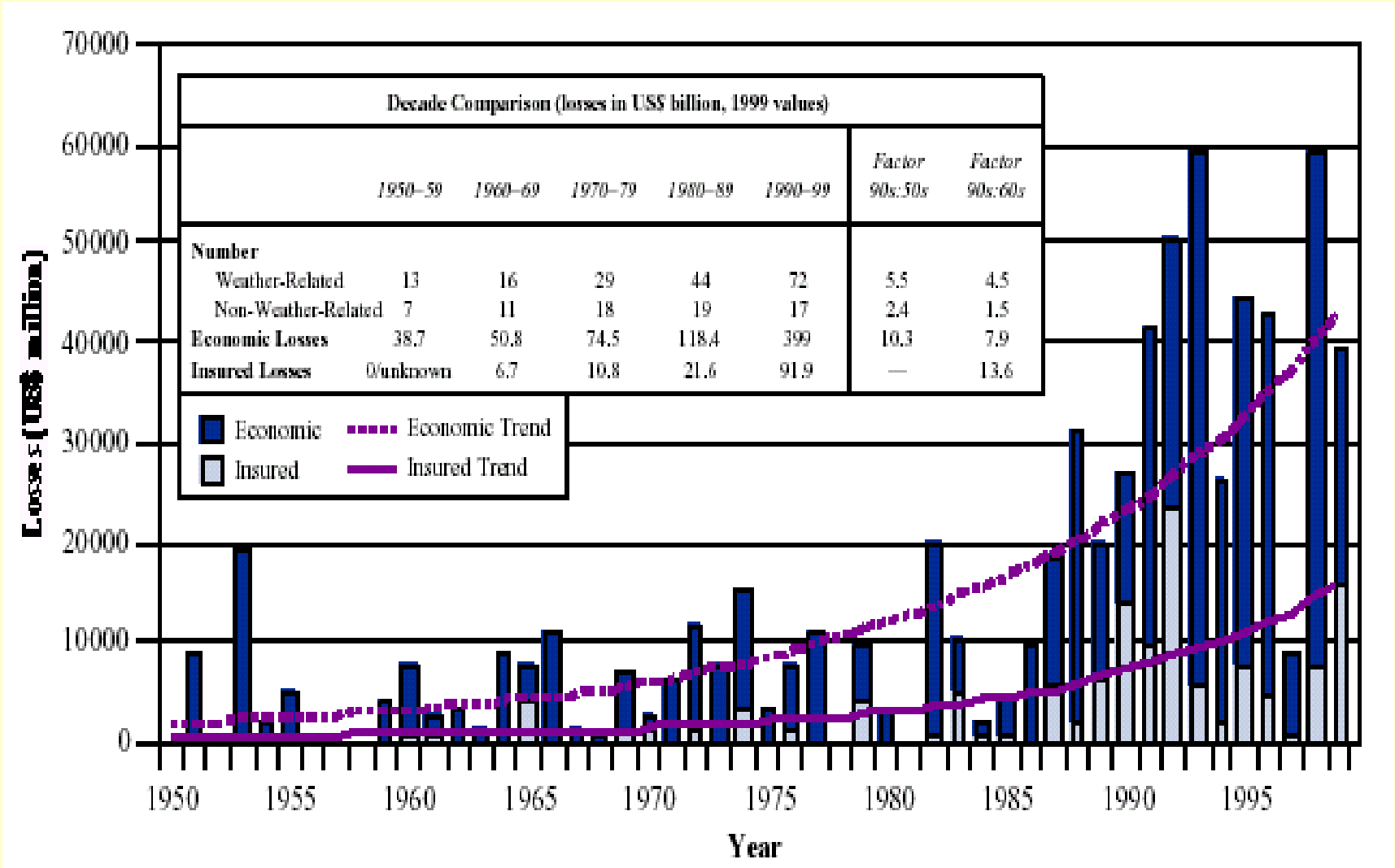
How to incorporate adaptation in other policies;

- disaster prevention
- environmental management
- urban/regional planning
- socioeconomic development, etc

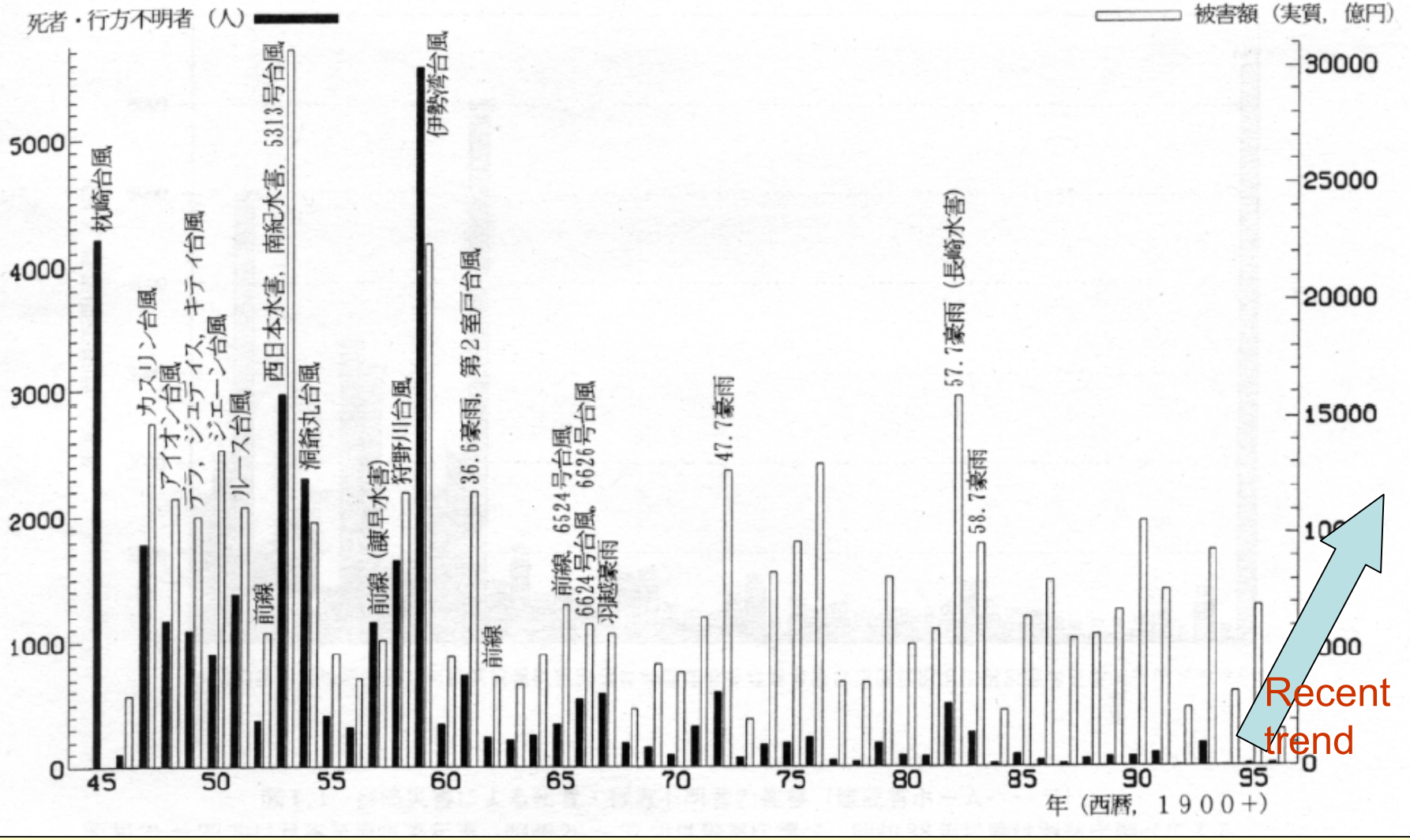
Where are the main gaps in knowledge?

1) Adaptation should be discussed in the context of effectiveness of the overall responses, i.e. mitigation and adaptation.
   - Changes in threshold: How can we shift the threshold of adverse impacts by adaptation?
   - Cost of responses: If we combine the mitigation and adaptation in an appropriate way, we can reduce the cost of mitigation in parallel with keeping the impacts less than the threshold level.

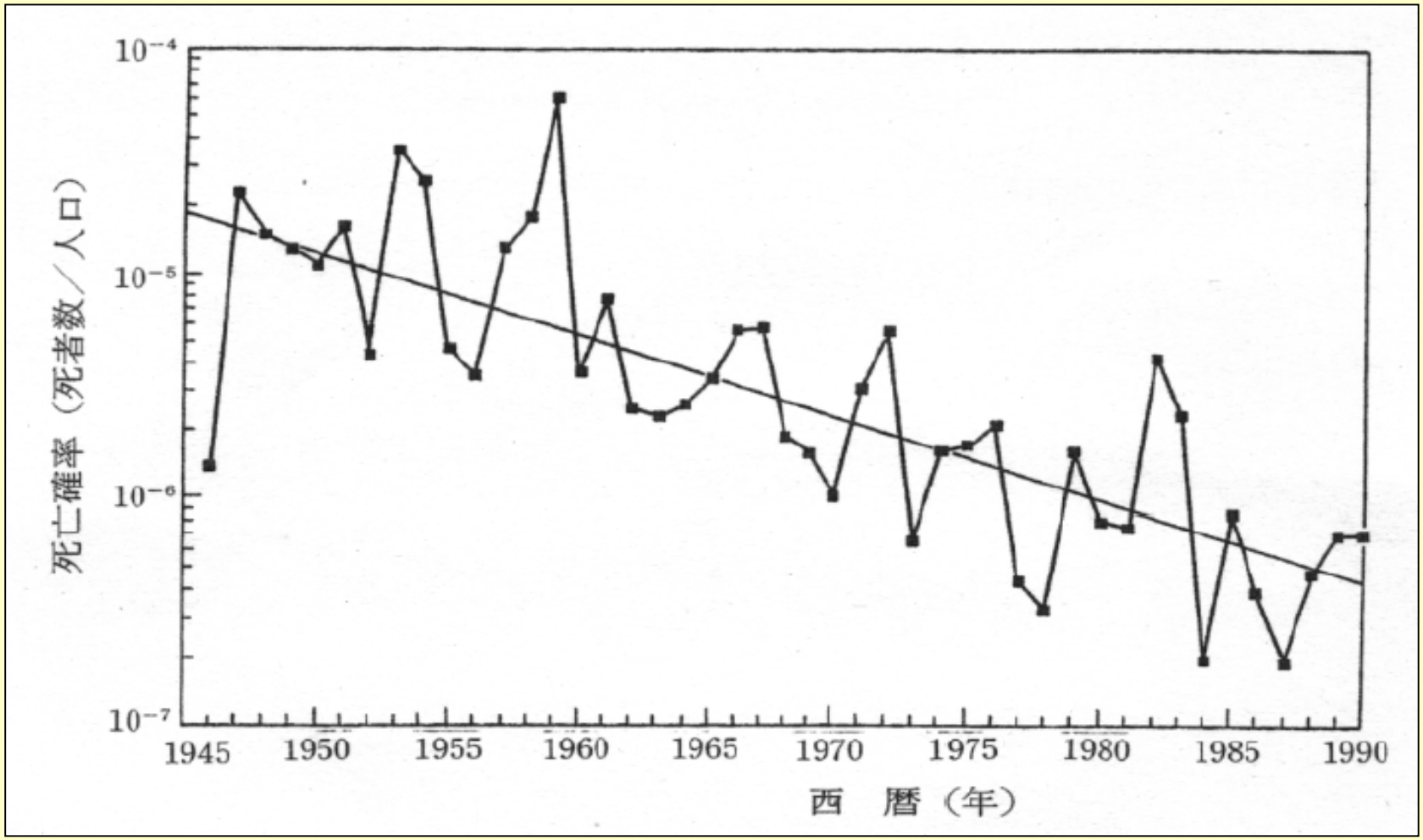
Trend of Natural Disasters



Trends of Water-related Disasters in Japan



Death Rate, Japan (1945～1990)

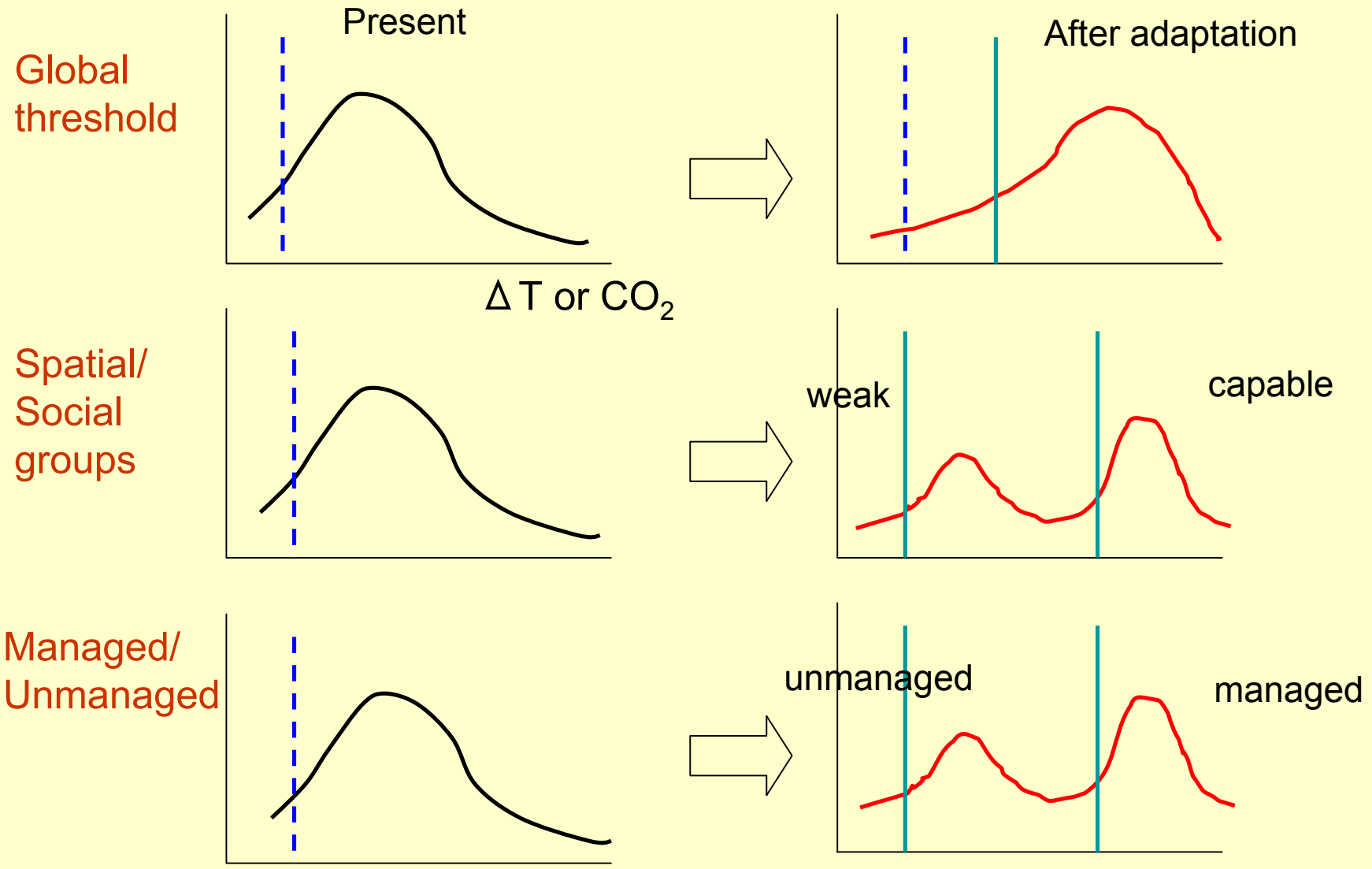



Cheap, community-level, effective

(c) West coast

(d) South-west coast

Changes of Threshold



2) Quantification of the effect of adaptation

Quantitative studies of the above indices (changes in threshold and costs of responses, both in systems, and regions and countries) are necessary to give a clear guidance for the future response policies.

3) Adaptation and development

How we can distinguish between development and adaptation, as both have the common targets of development.

We may not necessarily distinguish them, for adaptation to climate change is a component of sustainable development. If the relation of both is so close, what is the peculiar nature of adaptation to climate change?

Conclusions

1. Adaptation should be considered in the context of effectiveness of the overall responses, i.e. mitigation and adaptation.
   - changes in threshold
   - cost of responses
2. Quantitative studies of the above indices (changes in threshold and costs of responses) are necessary for developing future response policies.
3. Adaptation is an important component of sustainable development (co-benefit). Mainstreaming adaptation in the government level and community-based adaptation are both important.