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Limits to Adaptation

Case Study Evidence from around the World

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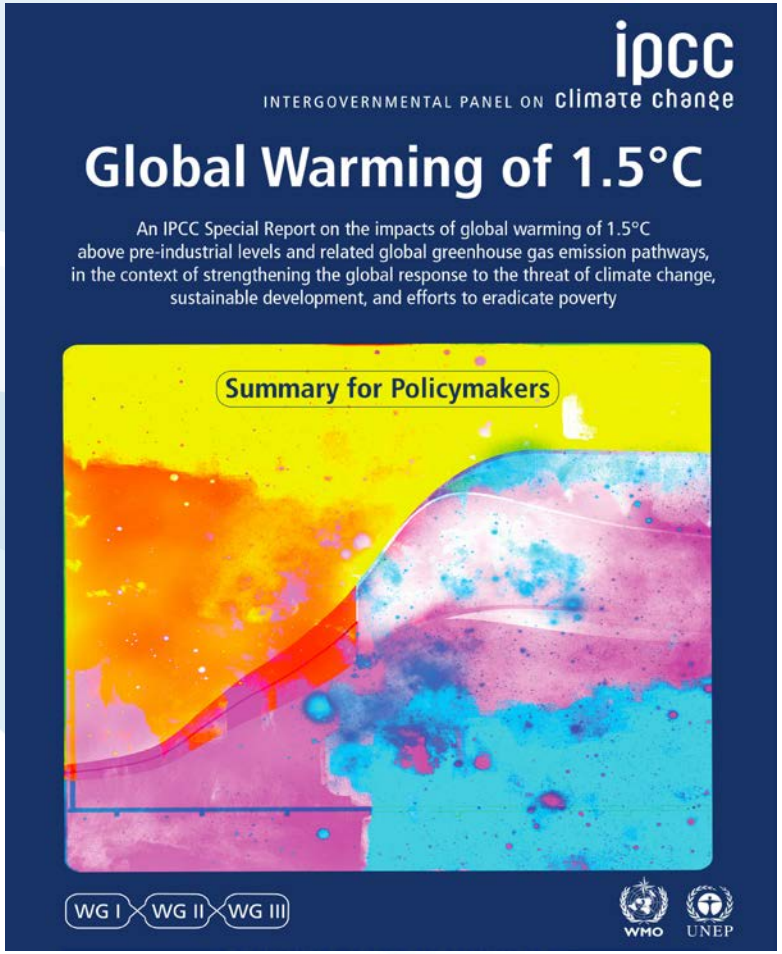
Klimatag 2019

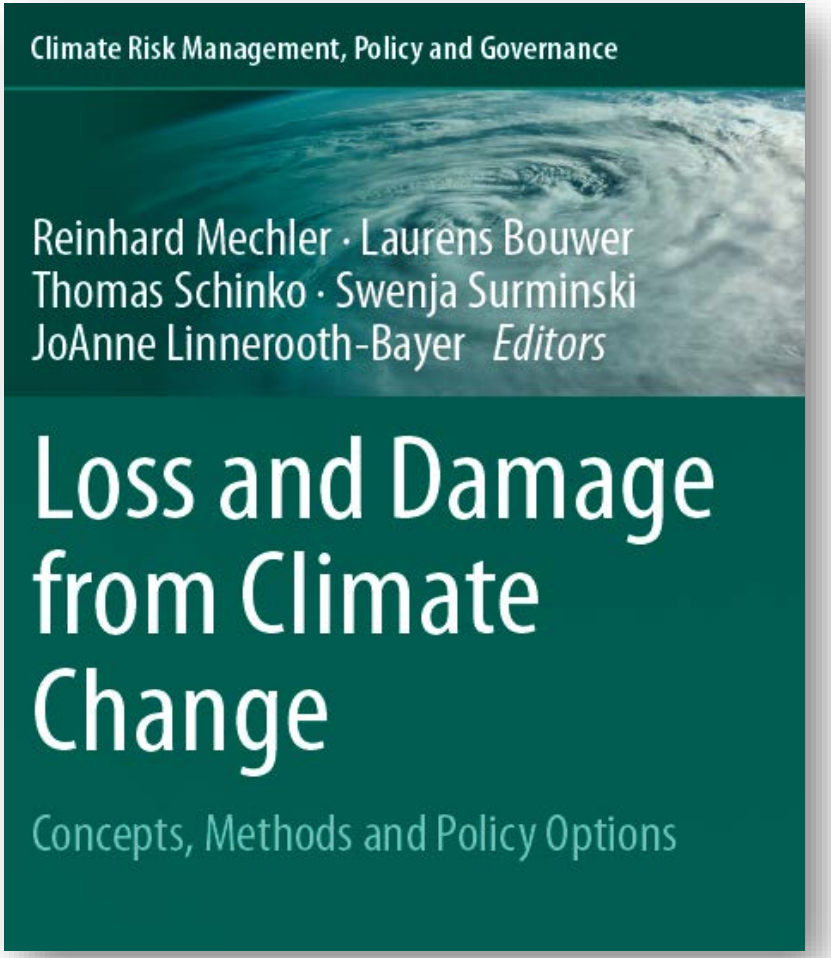
Wien, 26.4.2019

Overview

- Context: Loss and Damage debate
- Adaptation limits & frontiers
- Emerging evidence
- Conclusions and Implications

Publications

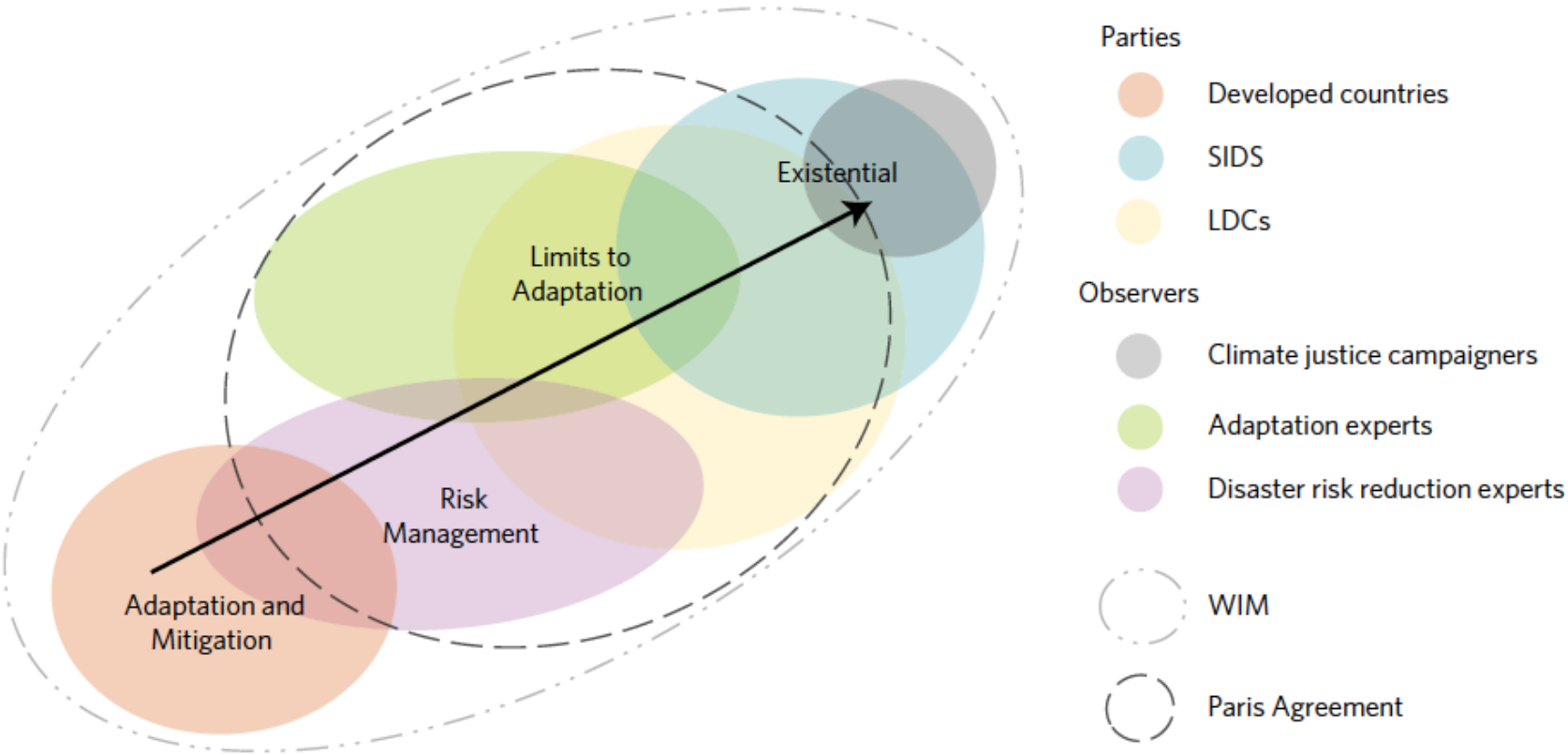




The Loss & Damage Debate

- **AOSIS** in **1991** proposed establishment of a compensation scheme for the most vulnerable small island and low-lying coastal states
- **Warsaw Loss and Damage mechanism institutionalised** in **2013**
- L&D has **stand-alone article in Paris agreement 2015**
- **Contested policy space**
- Warsaw mechanism to be reviewed at COP25 end 2019
- IPCC picked up the debate in the SR1.5

Perspectives on Loss and Damage



Boyd et al., 2017

Adaptation limits & frontiers
Definitions

- Loci at which adaptation actions can no longer guarantee key actor objectives or system's needs can no longer be achieved (*Klein et al. (2014):*

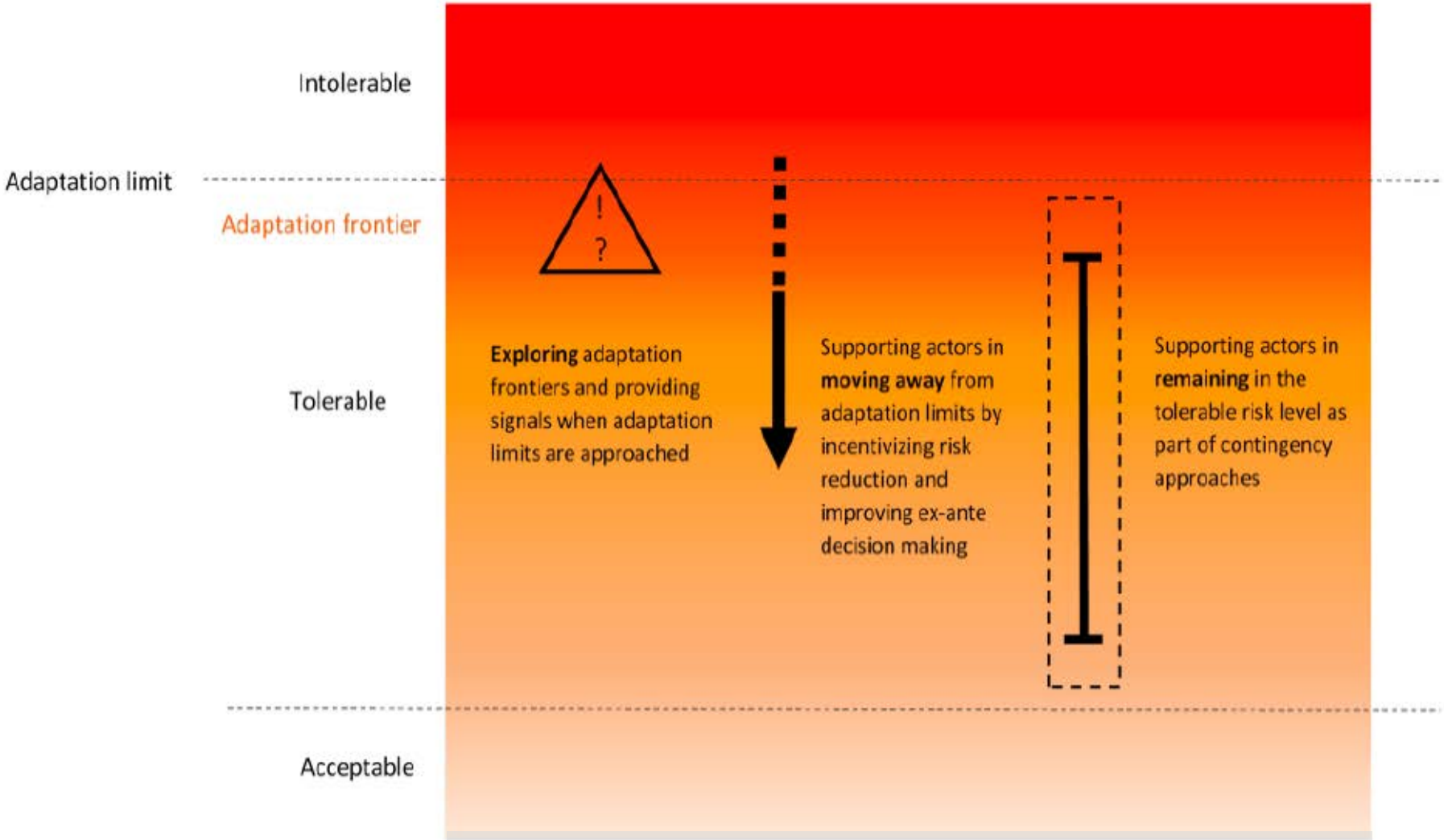
- *Hard Limit:* "The point at which no actions are possible to avoid irreversible impacts."
  ---> Typical for natural systems with no/little adaptive capacity

- *Soft limits:* options are <u>currently</u> not available to avoid intolerable risks through adaptive action. Depending on context, soft limits become hard, if the exposed have no means and space to move
  ---> Typical for social systems

- *Intolerable risks* suggest a point where an actor/population/sector must either live with the risk of escalating losses and damages, or transform to avoid the risk (Dow et al. 2013).

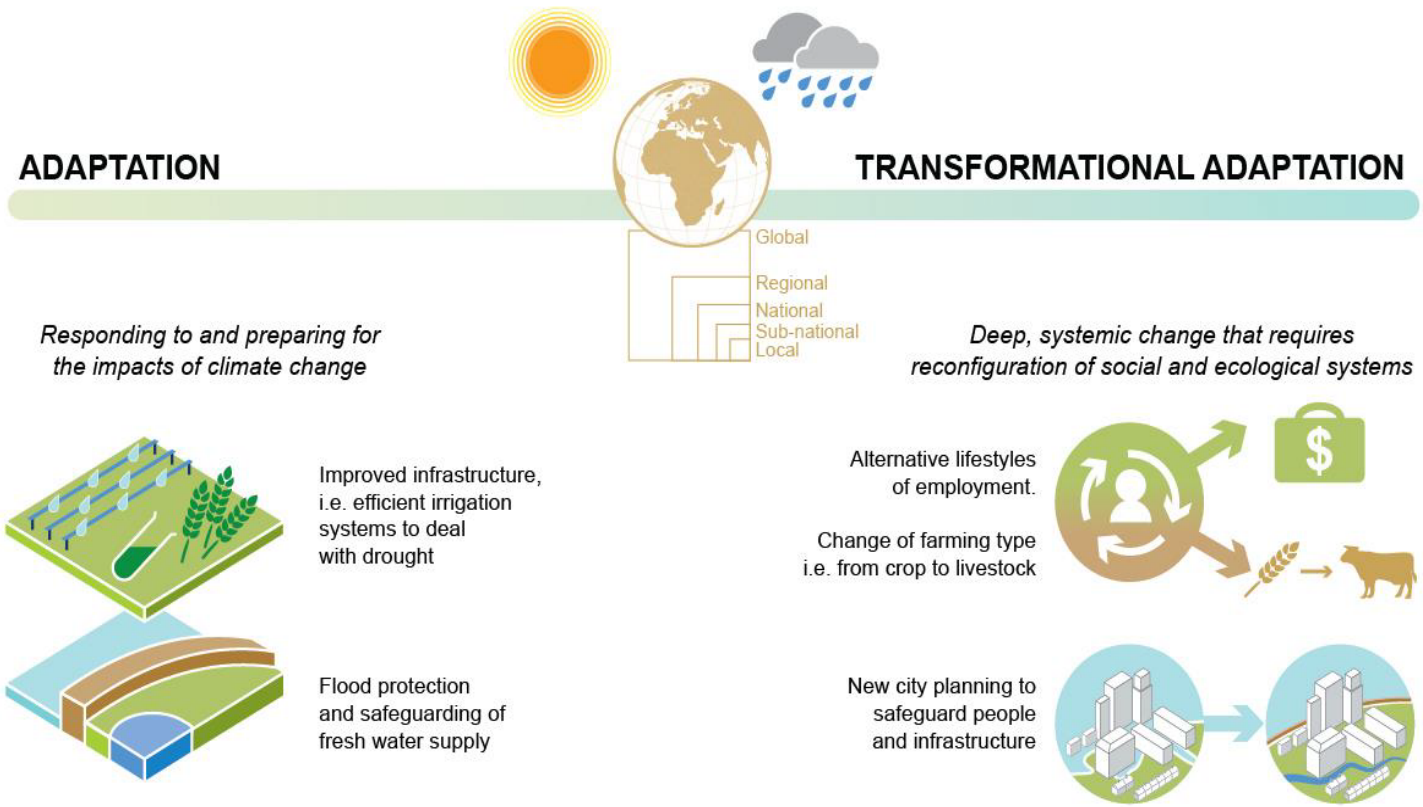
- *Adaptation frontier:* a "socio-ecological system's transitional adaptive operating space between safe and unsafe domains" (Preston et al. 2014)

Limits, adaptation, frontiers



Chapter 13: Laura Schäfer, Koko Warner, Sönke Kreft.
Exploring and Managing Adaptation Frontiers
with Climate Risk Insurance.

IPCC SR1.5 report: Incremental and transformational adaptation



De Coninck et al. 2018
(IPCC SR1.5, Ch. 4)

Multiple Methods

- Conceptualization
- Biophysical impact modelling & climate scenarios
- Expert-based compound risk analysis & climate scenarios
- Surveys, focus groups, stakeholder workshops on risks and responses
- Risk comparisons

Evidence: Soft and hard limits

Table 5.2: Soft and hard adaptation limits in the context of 1.5°C and 2°C of global warming

System/Region	Example	Soft Limit	Hard Limit
Coral reefs	Loss of 70-90% of tropical coral reefs by mid-century under 1.5°C scenario (total loss under 2°C scenario) (se Chapter 3, Sections 3.4.4 and 3.5.2.1, Box 3.4)		✓
Biodiversity	6% of insects, 8% of plants and 4% of vertebrates lose over 50% of the climatically determined geographic range at 1.5°C (18% of insects, 16% of plants, 8% of vertebrates at 2°C) (see Chapter 3, Section 3.4.3.3)		✓
Poverty	24-357 million people exposed to multi-sector climate risks and vulnerable to poverty at 1.5°C (86-1,220 million at 2°C) (see Section 5.2.2)	✓	
Human health	Twice as many megacities exposed to heat stress at 1.5°C compared to present, potentially exposing 350 million additional people to deadly heat wave conditions by 2050 (see Chapter 3, Section 3.4.8)	✓	✓
Coastal livelihoods	Large-scale changes in oceanic systems (temperature, acidification) inflict damage and losses to livelihoods, income, cultural identity and health for coastal-dependent communities at 1.5°C (potential higher losses at 2°C) (see Chapter 3, Sections 3.4.4, 3.4.5, 3.4.6.3, Box 3.4, Box 3.5, Cross-Chapter Box 6; Chapter 4, Section 4.3.5; Section 5.2.3)	✓	✓
Small Island Developing States	Sea level rise and increased wave run up combined with increased aridity and decreased freshwater availability at 1.5°C warming potentially leaving several atoll islands uninhabitable (see Chapter 3, Sections 3.4.3, 3.4.5, Box 3.5; Chapter 4, Cross-Chapter Box 9)		✓

Cross-chapter box in Roy et al. 2018 (IPCC SR1.5 ch. 5)

Evidence on risks, adaptation and limits

System (RFC)	Regions	1.5°C	2°C	Adaptation	Scope for adaptation	Limit
Coral reefs (1)	**Tropics**	**70-90% loss**	**99% loss**	**Artificial reefs, water clean-up and cooling**	**Very limited**	**Hard**
Terrestrial and wetland ecosystems (1)	Global	6% of insects, 8% of plants and 4% of vertebrates lose over 50% of the climatically determined geographic range	18% of insects, 16% of plants and 8% of vertebrates	Water & vegetation management, increased connectivity	Limited	Hard
Human Health (2,3,4)	Global, part. tropics	+ 350 million people exposed to deadly heatwaves in megacities by 2050	[not reported]	Hydration, cooling zones, green roofs	Medium, low in tropics	Soft and hard (e.g. for outdoor workers)
Coastal livelihoods and islands (2,3)	Global, Asia, SIDS in Pacific and Caribbean	31-69 million people at risk. Sea level rise, increased wave run up, increased aridity & decreased freshwater availability leaving several atoll islands uninhabitable	32-79 million people at risk	Coastal defences, ecosystem-based adaptation,	Low-medium	Hard

Based on IPCC, 2018

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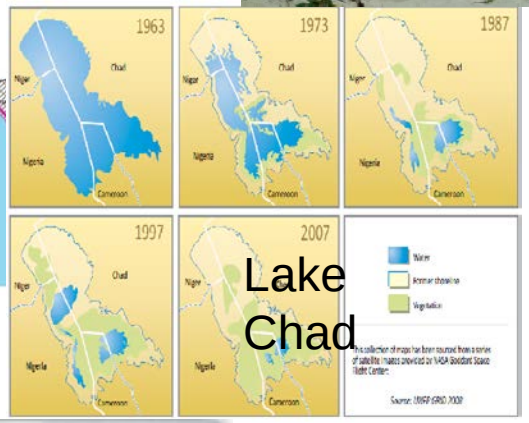
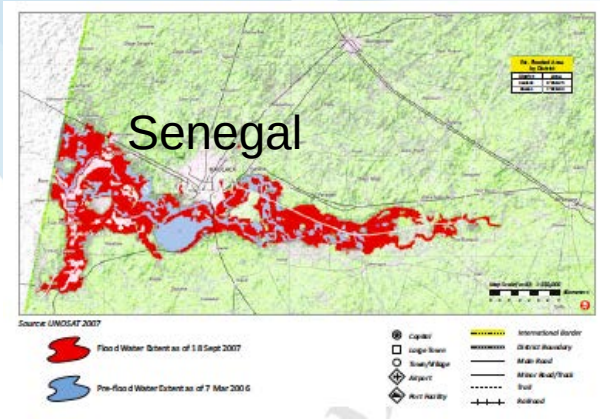
Based on IPCC, 2018

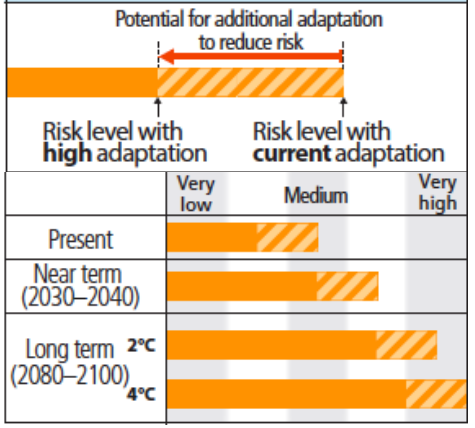
L&D book: further tentative evidence of limits and frontiers





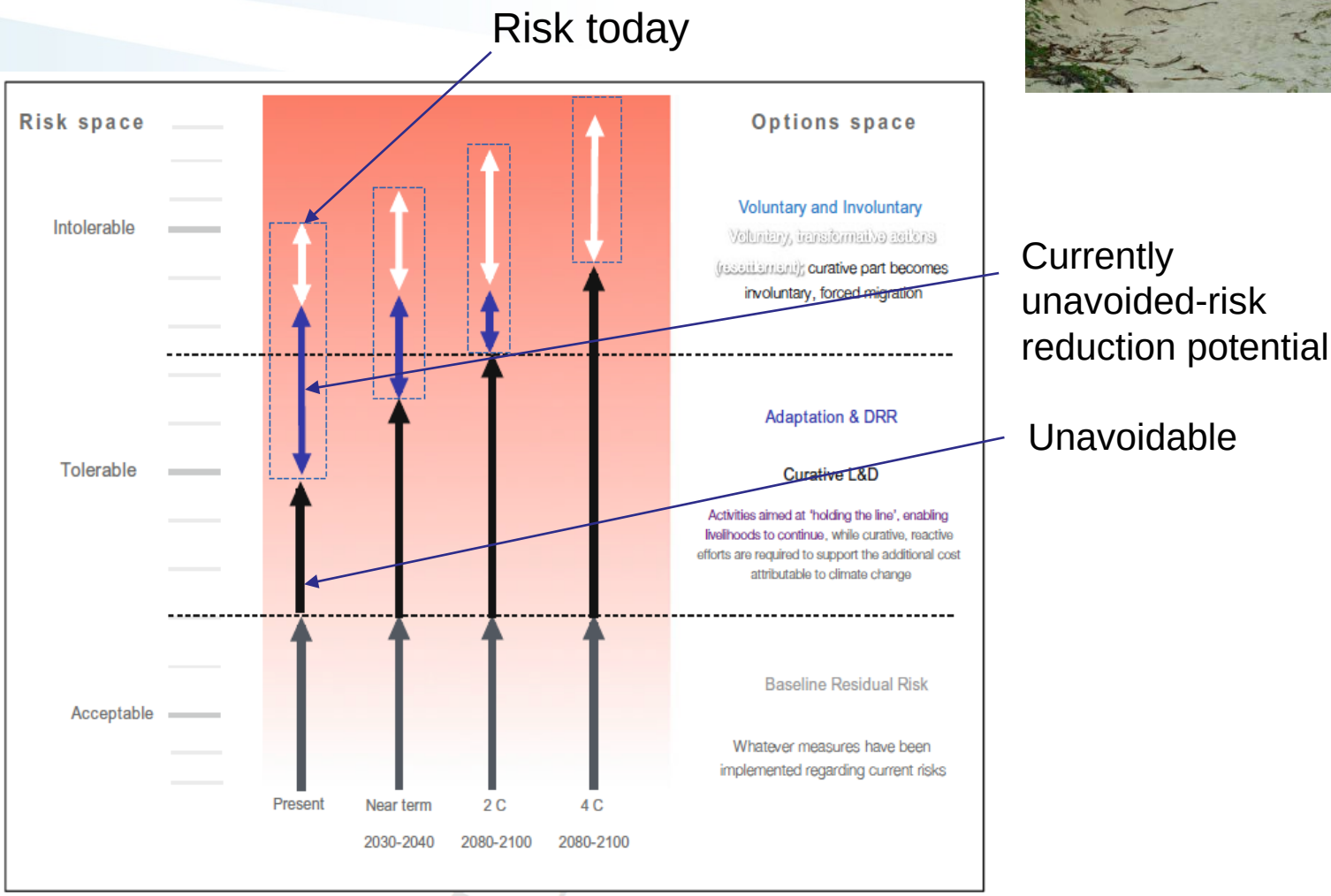
SIDS: IPCC expert risk analysis

Climate-related drivers of impacts								Level of risk & potential for adaptation
Warming trend	Extreme temperature	Drying trend	Extreme precipitation	Damaging cyclone	Sea level	Ocean acidification	Sea surface temperature	
The interaction of rising global mean sea level in the 21st century with high-water-level events will threaten low-lying coastal areas (*high confidence*) [29.4, Table 29-1; WGI AR5 13.5, Table 13.5]	• High ratio of coastal area to land mass will make adaptation a significant financial and resource challenge for islands. • Adaptation options include maintenance and restoration of coastal landforms and ecosystems, improved management of soils and freshwater resources, and appropriate building codes and settlement patterns.							



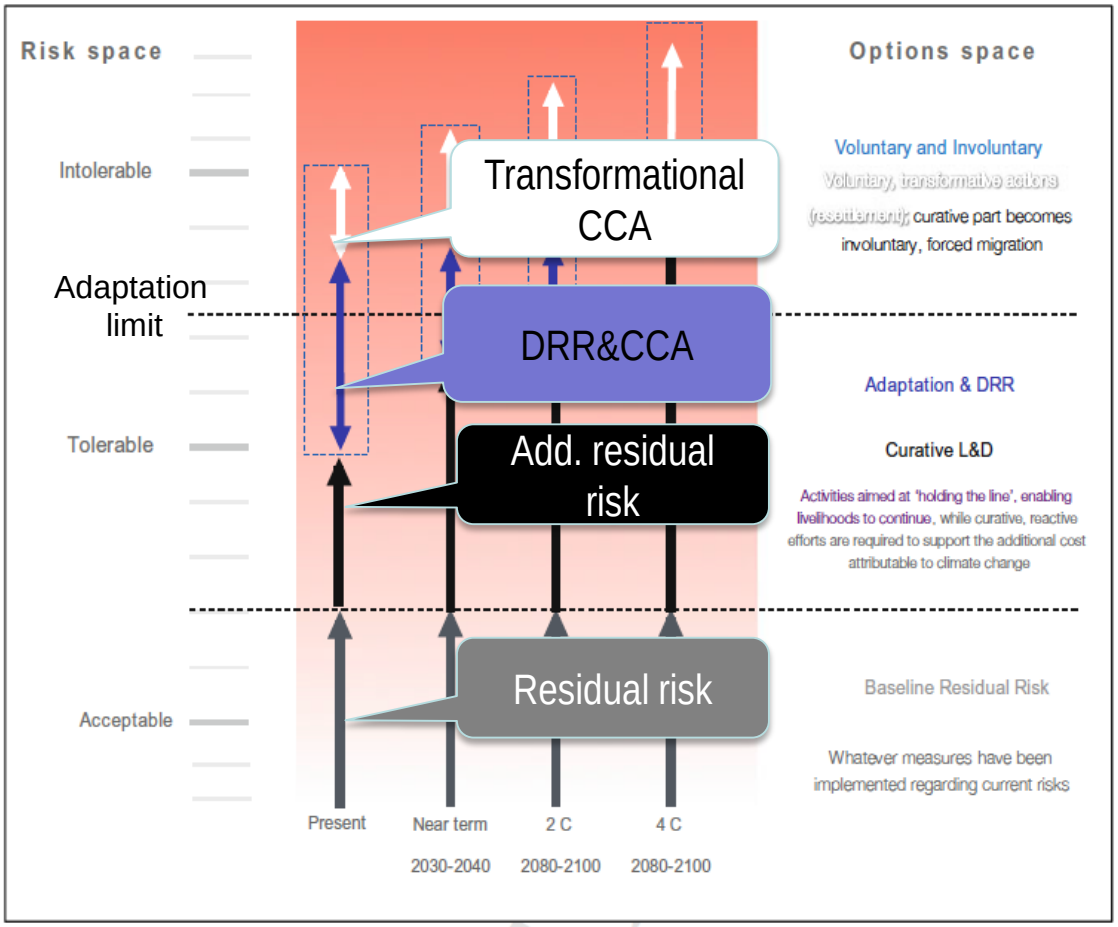
Nurse et al., 2014

Risk and policy space
Pacific SIDS



Chapter 15: John Handmer and Johanna Nalau. Understanding Loss and Damage in Pacific Small Island Developing States

Risk and policy space Pacific SIDS



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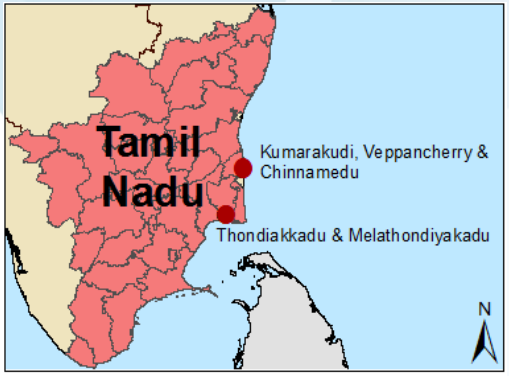
India Tamil Nadu
Household survey on risk perception and options

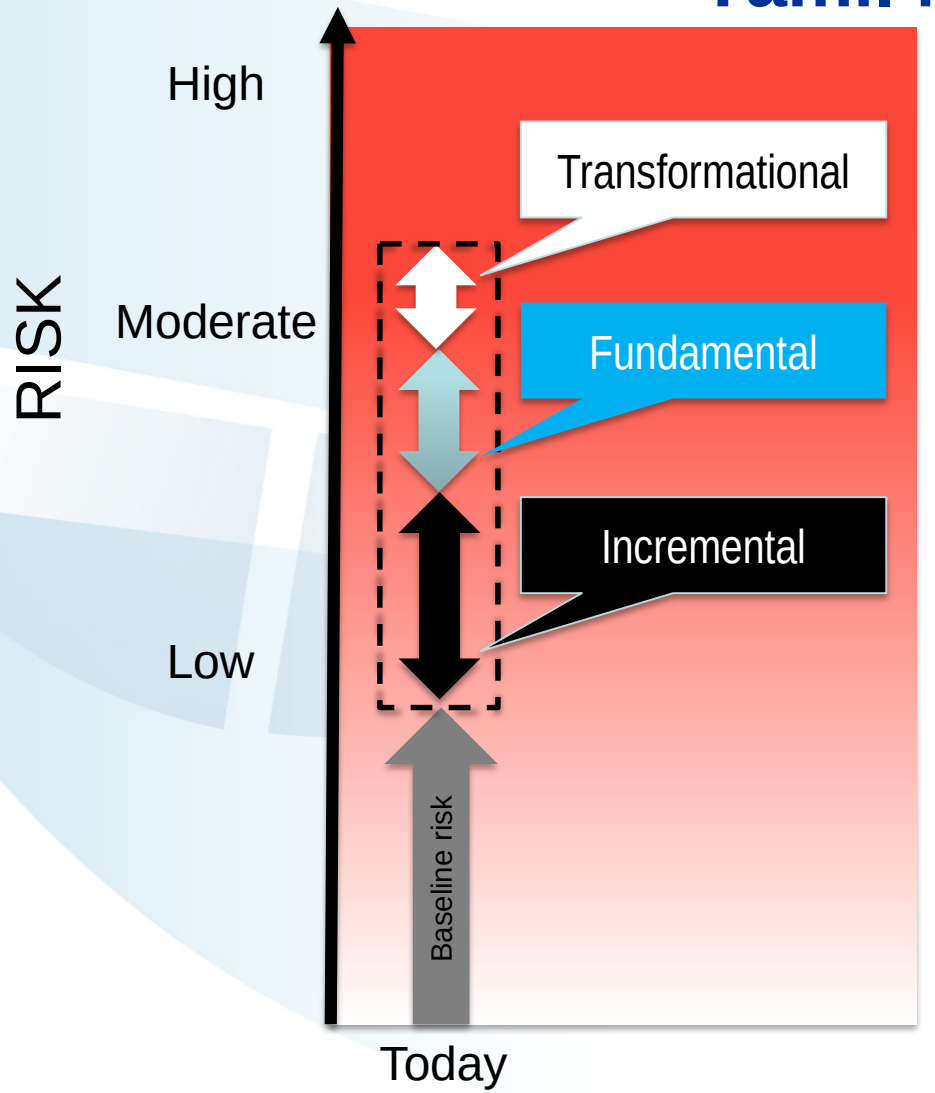
Risk and Shocks	Very High & High		Moderate		Low & Very Low		No Response	
	No.	%	No.	%	No.	%	No.	%
Cyclonic Storms	14	21.54	21	32.31	17	26.15	13	20.00
Floods (Storm Surge)	8	12.31	13	20.00	23	35.38	21	32.31
Salinization	13	20.00	6	9.23	40	61.54	6	9.23
Health Problem	22	33.85	6	9.23	18	27.69	19	29.23
Price shock	29	44.62	9	13.85	9	13.85	18	27.69
Marriage	0	0.00	12	18.46	3	4.62	50	76.92
Others	0	0.00	1	1.54	5	7.69	59	90.77



Characteristics	Options	Category
Farm Level	• Farmers keep land uncultivated	Transformative: Negative Coping
	• Salt tolerant high yielding varieties of paddy seeds • Fertilizers (mixed with gypsum)	Fundamental: Non-standard actions for managing risks
	• Agricultural insurance • Sea dyke/bund • Increasing height of field bunds • Desalinization of land • Desilted canal through • Created sand bund with urea bag filled with mud • Constructed overhead water tank • Building up of new pond • Renovation of tank and reservoirs	Incremental: Actions out of DRR and CCA toolbox
Household Level	• Availing both formal and informal loans to smoothen both income and consumption	Fundamental: Non-standard actions for managing risks
	• Repair the damaged nets and boats	Incremental: Actions out of DRR and CCA toolbox
Public Sector	• Public provision of insurance (agriculture and cyclones) • Compensation scheme (only cyclones and during rough season for loss of life, boat and net for fishermen	Incremental: Actions out of DRR and CCA toolbox

GIZ&IIASA, 2018

Risk and adaptation
Cyclones, flooding and salinization
Tamil Nadu



Keep land uncultivated & seek alternative livelihoods

Salt-tolerant high-yielding varieties of paddy seeds

Sea dyke
Desalinization of land
Desalted canal
Overhead water tank

Risk and options space in Tamil Nadu as identified from household responses (farm level)
GIZ and IIASA *unpublished*

Conclusions and implications

- First time Loss and Damage picked up by the IPCC - framed around limits
- Some, tentative evidence on limits
- Hard limits: robust for some natural systems and hard limits (coral reefs: *high confidence*)→ informing need for **transformational mitigation**
- Soft limits
  - shaped by social processes - social constructions
  - Frontiers can be a useful concept
  - Soft limits observable through ex post responses → **informing need/potential for transformational adaptation**
- Quant&qual evidence important for discussion on “beyond adaptation:” Loss and Damage

L&D Book (open access):
https://link.springer.com/book/10.1007/978-3-319-72026-5

Loss and Damage Network

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Deltares Enabling Delta Life

Example: Barnett et al., 2015

Table 2. Methods used in each case study.

Study Area	Research Methods
The Australian Alps	Literature review Semistructured telephone interviews, n = 16
The Coorong and Lower Lakes	Literature review Semistructured face to face interviews, n = 36
The Great Barrier Reef	Literature review Scenario development Stakeholder workshops (2 workshops, 19 participants) Semistructured interviews, n = 7
The Macquarie Marshes	Literature review Climate scenarios and response modeling Stakeholder workshop (22 participants) Semi structured interviews, n = 5
Small inland communities affected by drought	Literature review Policy Analysis Historical climate analysis (observed local climate data) Semistructured face to face interviews, n = 35 Scenario planning workshop (15 participants)
The Torres Strait Islands	Literature review Semistructured face to face interviews, n = 28