Asia Regional Meeting on Scientific and Technical Support for Implementation of the Ramsar Convention

Climate Change

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Scientific and Technical Review Panel (STRP)

Objectives

Contribute to the preparation of advice on:

i) **the implications of climate change for maintaining the ecological character of wetlands, including strategies for assessing the resilience and vulnerability of wetlands to climate change**

ii) **developing ecosystem-based adaptation to climate change for coastal and inland wetlands.**

Objectives

iii) identify collaborative links with national agencies , wetland managers and researchers and investigate the contribution of wetlands to climate change mitigation and adaptation through case studies etc

iv) support the implementation of the Changwon Declaration – includes activities for climate change

Changwon Declaration

Resolution X.3 in 2008 “The Changwon Declaration on human well-being and wetlands”

- importance of wetlands for sequestering and storing carbon

- vulnerability of wetlands to climate change

- importance of managing water to adapt to climate change and ensure benefits for people

Ramsar Convention - climate change decisions in 2002, 2008 and 2012.

Resolution XI.14 in 2012 "*Climate change and wetlands: implications for the Ramsar Convention on Wetlands*"

- IPCC concluded that wetlands were amongst those systems especially vulnerable to climate change because of their limited adaptive capacity and that they may therefore undergo significant and irreversible damage.

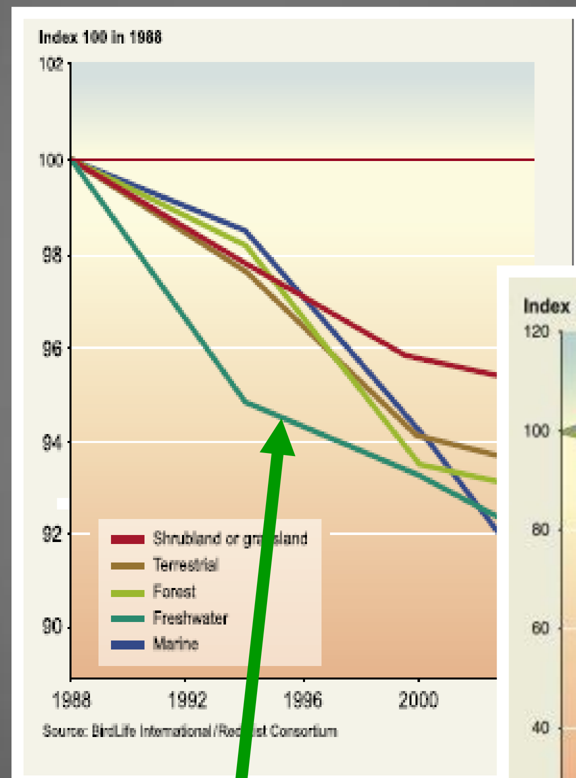
STRP - addressed climate change issues:

i) methods for assessing the vulnerability of different wetland types to climate change
ii) opportunities for adaptation to climate change
iii) wetland restoration as a tool for climate responses
iv) role and importance of different wetland types in the global carbon cycle

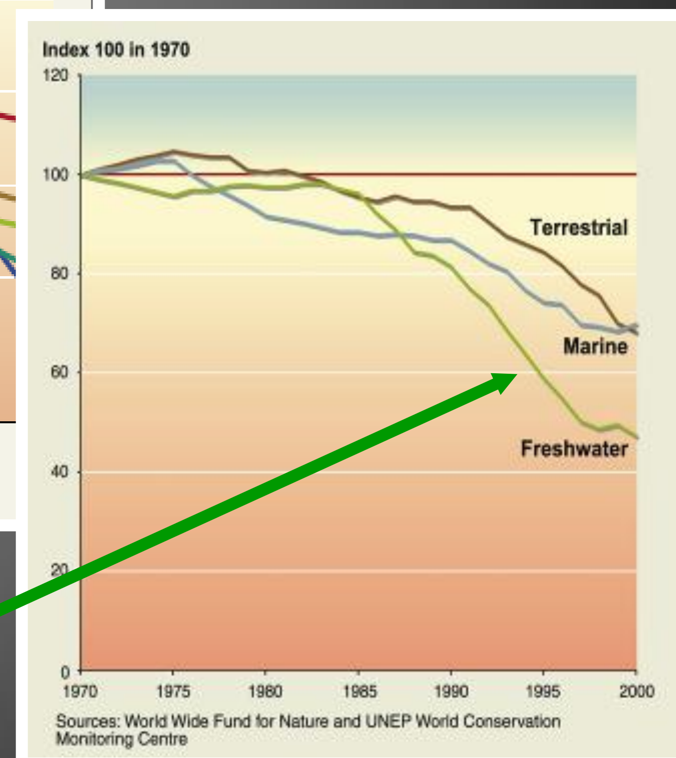
…..within the context of ongoing loss and degradation of wetlands

Condition of freshwater species

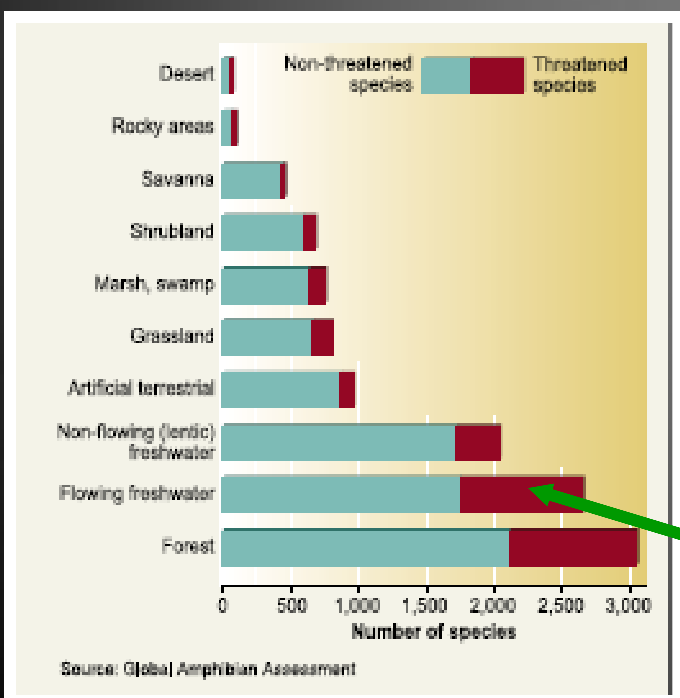
Red List for birds in different ecosystems



Living planet index



Number of threatened amphibians



Freshwater ecosystems

Extent of loss and degradation of aquatic ecosystems

- Estimated that more than 50% of wetlands lost – lacks authorative evidence for many wetland types (e.g. ephemeral or intermittent or regions)

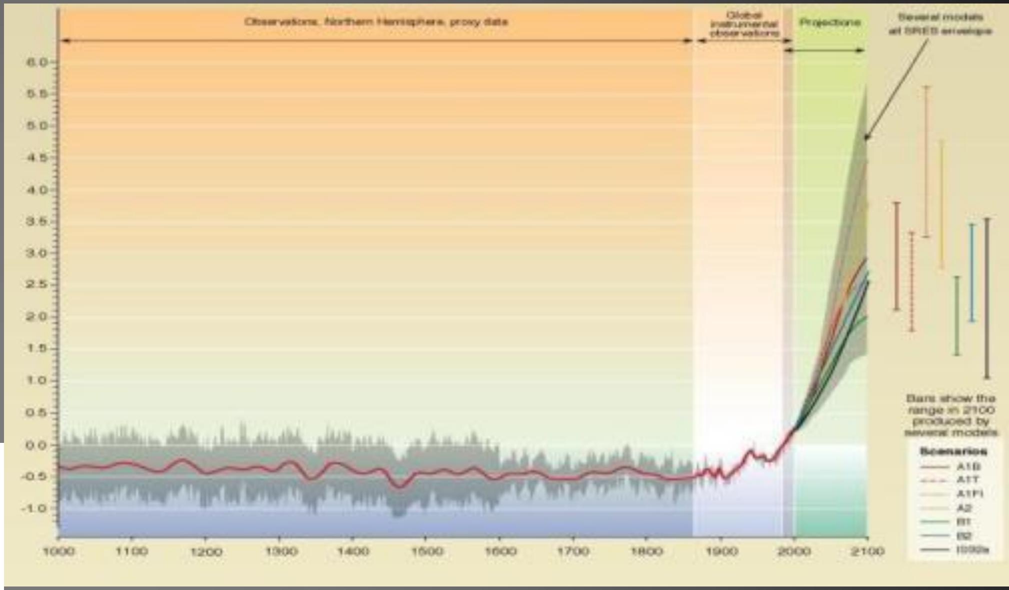
- Increased pressure on wetlands in Asia, Africa and southern America, and small islands

- Wetlands/rivers are seen as being in faster decline than rainforests and savanna grasslands

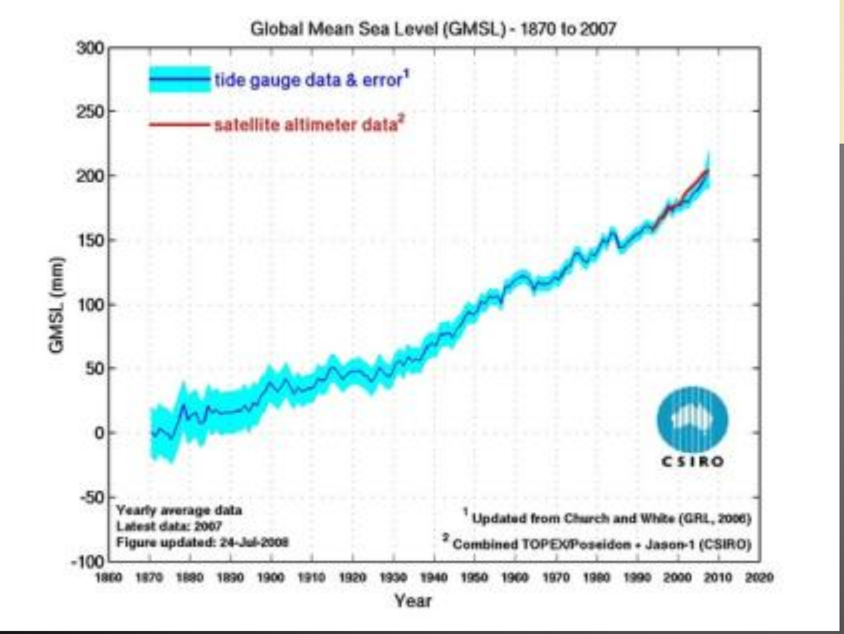
Wetland-dependent species

- Waterbirds – 20% extinct or threatened
- Mammals – 30% decline (dolphins, manatees, porpoises)
- Fish (freshwater) – 20% threatened or extinct
- Amphibians – 30% threatened (not all are aquatic)
- Turtles – 50% threatened
- Crocodiles – 45% threatened
- Crayfish (USA) – 50% at risk
- Molluscs (USA) - 66% at risk

Climate change and sea level rise – measured and projected changes



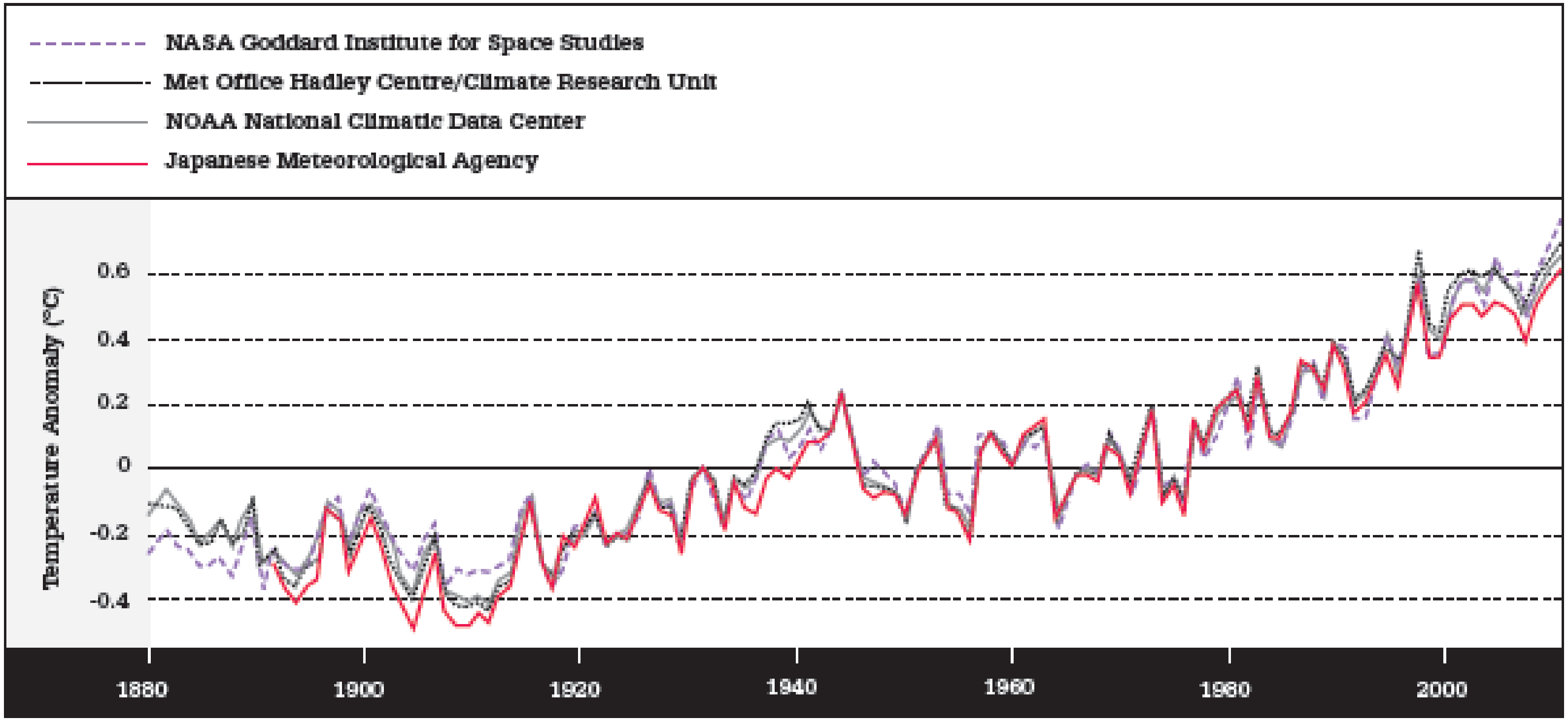
Projected temperatures during 21st C are significantly higher than at any time during the last 1000 years - IPCC 2001



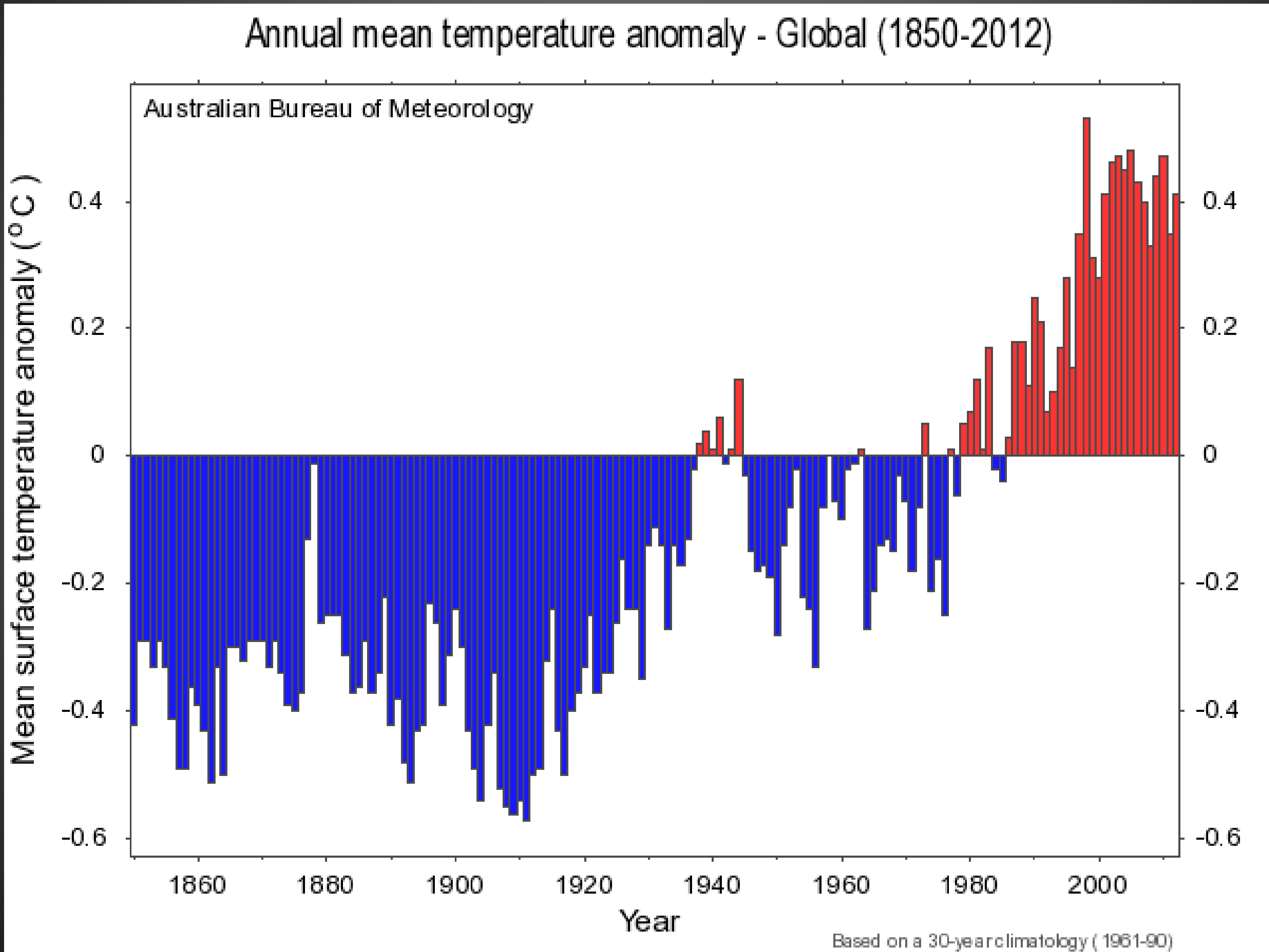
Global sea level rose 17 cm over past century; mostly due to warming of oceans; may be affected by melting of glaciers

– The average air temperature at the Earth's surface continues on an upward trajectory at a rate of 0.17 °C per decade over the past three decades.

Figure 1. Surface air temperature trend from the 1880s to the present. The baseline for the analysis is the 1951-1980 average.



Source: NASA GISS Surface Temperature Analysis.



Annual mean temperature anomaly - Global (1850-2012)
Australian Bureau of Meteorology
Mean surface temperature anomaly (°C)
0.4
0.2
0
-0.2
-0.4
-0.6
1860
1880
1900
1920
1940
1960
1980
2000
Year
Based on a 30-year climatology (1961-90)

Very large/intense storms

Expected fewer but larger storm events in tropical areas

Cyclone Yasi, Category 5 – 3 February 2011

Discuss:

i) resilience and vulnerability of wetlands to climate change

ii) ecosystem-based adaptation for wetlands to climate change

iii) carbon storage and sequestration

and find opportunities for collaboration and case studies

Vulnerability to climate change

-the propensity or predisposition to be adversely affected by climate change (IPCC 2012)

- has both a social and a biophysical dimension

- biophysical dimension focuses on exposure to hazards in terms of damage that occurs

-while the social dimension is concerned with social risks and capacities to absorb pressure

Vulnerability cont.

- Three elements to vulnerability: exposure, sensitivity and adaptive capacity

- Usually attributed to biophysical systems, but can apply to social systems as well

- Vulnerability is mediated by resilience (or coping capacity)

Ramsar
Technical
Reports

Ramsar Technical Report No. 5
CBD Technical Series No. 57

A Framework for assessing the vulnerability of wetlands to climate change

Habiba Gitay, C. Max Finlayson, and
Nick Davidson

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Vulnerability is the degree to which a wetland is sensitive to and unable to adapt to or moderate moderate the consequences of climate change and other (anthropocentric) pressures on its ecological character.

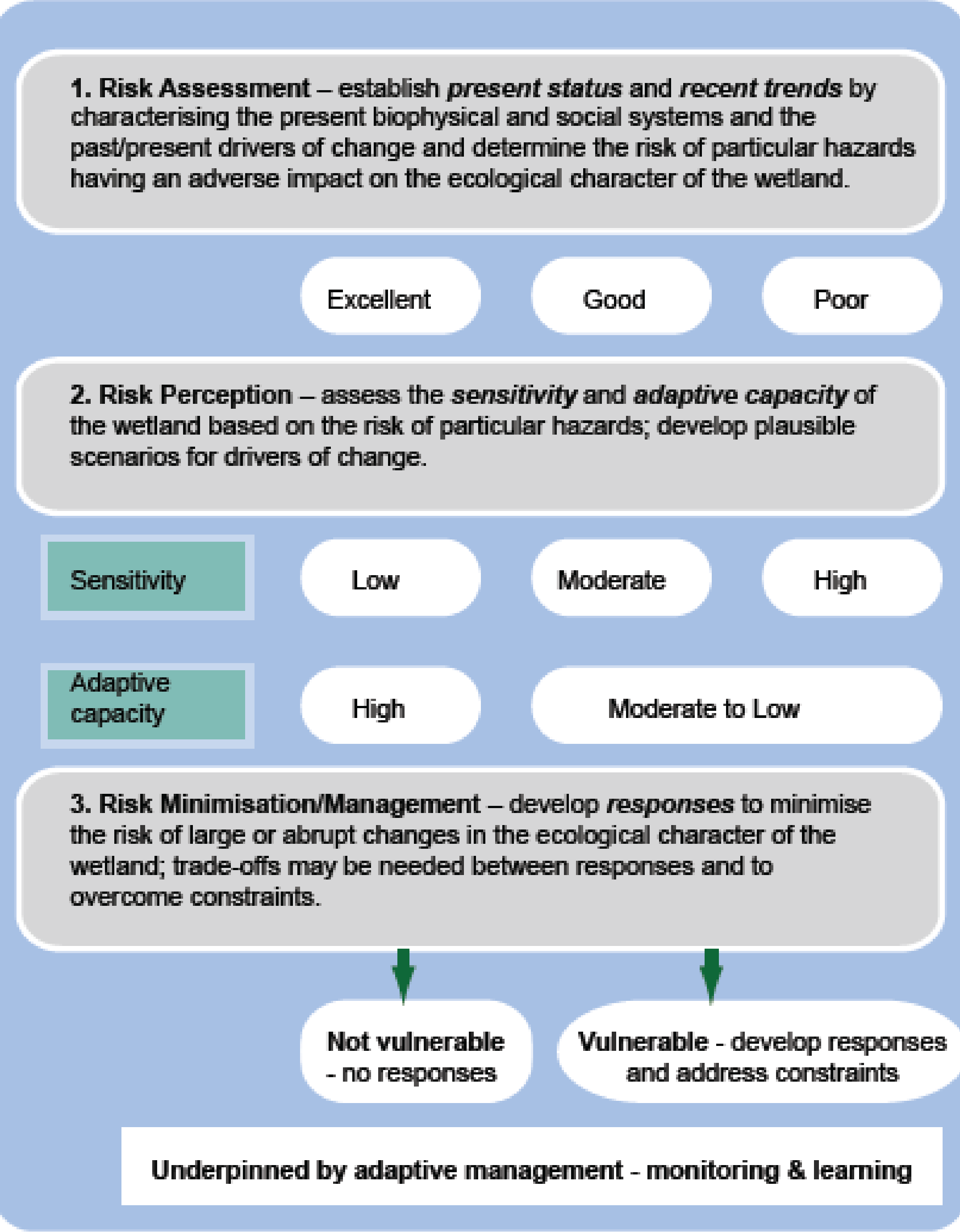

Figure 5. Vulnerability assessment framework for wetlands

Vulnerability = risk - coping

Sensitivity	Adaptive capacity		
	High	Medium	Low
High			Highly vulnerable
Medium		Vulnerable	
Low	Not vulnerable		

Figure 6. Vulnerability assessment as a function of sensitivity and adaptive capacity

Vulnerability Assessment to climate change of high altitude wetlands in the Himalayas, India

Summary Report

prepared by C. Max Finlayson
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Submitted to:
WWF International
Avenue du Mont Blanc, 1196 Gland, Switzerland


UMTSE





WE WELCOME
HIGHEST CAFETERIA IN THE WORLD




Figure 7: The Hind Kush/Himalayan Mountains (ICIMOD: Glaciers and Climate Change 2009).

3.3 Functions and values

Generic descriptions of the ecosystem services provided by High Altitude Wetlands are available, although not often supported by quantified analyses, nor investigations of the intricate links that can occur between the biodiversity components and ecological processes that support the service. A generalised listing of ecosystem services is provided below, based on the categorisation of services provided by the millennium Ecosystem Assessment[11].

Provisioning Services – products obtained from the ecosystem such as food, fuel and freshwater	
Food	• Production of fish, wild game, fruits and grains
Fresh Water	• Potable Fresh water (Water Tower of Asia) supply to local and up to 1.3 billion people downstream • Hydro Electric Power - local and for regional towns and areas • Agricultural Irrigation – local and downstream • provide water for pastoralists and farmers in rainshadow areas
Wetland Products	• Grazing in Alpine meadows and wetlands –local communities • Livestock fodder • Fuel wood for communities, military, road building camps and tourist camps

3.4 Biodiversity / fauna and flora species

Non-exhaustive lists of the fauna and flora are available, largely taken from Ramsar Information Sheets on wetlands above 3000m, but also other sources, with locations provided to reflect the source of the information and not the range. has been obtained and does not imply the species is limited to this location.

Mammals			
Common Name	**Zoological Name**	**IUCN Status** *	**Location** (may be found in other locations than indicated below)
Himalayan Marmot	*Marmota bobak*	-	
Royal's vole	*Alticola roylei*	NT	India
Hare	*Lepus oistolus*	-	
Himalayan weasel	*Mustela sibirica*	-	
Mole rat	*Bandicota spp.*	-	
Mouse hares	*Ochotona macrotis,*	-	
	O. curzoniae,	-	
	O. ladacensis	-	
Himalayan Ibex	*Capra sibirica hemalayanus*	-	
Alpine Musk deer	*Moschus chrysogaster*	EN	Afghanistan, Pakistan, northwestern India and western Nepal, southern Tibet
Himalayan Musk deer	*Moschus leucogaster*	EN	Himalayas of Bhutan, northern India (including Sikkim), Nepal, and China (southwest Xizang)
Wolf	*Canis lupus*	-	

5.2 Risks /Threats Direct Drivers

Observed and projected threats and risks to the ecological character of high altitude wetlands and the consequent effects on biodiversity are provided below[25].

Ecosystem goods and services

Biodiversity Impact Description **Provisioning Services**	Threats	Impacts	Drivers
Reduction in snow and ice (glacier melt)	Increases variability of downstream runoff	Reduces water storage capacity and reliability of water supply for human consumption	Precipitation change, snow melt change Temperature change
Hydro electric power	Variability in river flows Landslides Flash floods Siltation of HEP reservoirs	Decrease in flows during dry season, complexities predicting water availability	Precipitation change, snow melt change Temperature change
Decline in resources for forage and fodder	changes to traditional nomadic lifestyles, population increase	Threatens habitat of wild herbivores Desertification of Alpine meadows. Changes in composition of plant communities	Increasing numbers of domestic stock of goats, sheep and yak,
Increased crop diversity and	Longer and warmer growing	Demographic and socio-economic	Temperature change

Table 3: Climate change scenario for Tibetan Plateau for the years 2040 and 2100 (from IPCC 2007).

Sub-region	Months	2040		2100	
		Temperature C	Precipitation %	Temperature C	Precipitation %
Tibetan Plateau (30N-50N; 75E-100E)	DJF	2.05	14	7.62	31
	MAM	2	7	7.35	19
	JJA	1.74	4	7.2	9
	SON	1.58	6	6.77	12
	Annual Ave (1dp)	2	8	7	18

[16] IPCC 2007
[17] Cruz et al. 2007. IPCC, 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment

Table 1: Risk and vulnerability of values (ecosystem services) of Tsomoriri lake

Wetland Values	Threats	Risk	Vulnerability 2040	Vulnerability 2100
Medicinal Value - there are more than 100 different species of medicinal plants. These are used by local *Amchis* (local doctors). Some of these plants are used as incense in the *Gompas* e.g. *Tanacetum sp.*,*Artimesia, Armebia*	Illegal extraction; climate change resulting in shifting of these species to the upper mountain region e.g *Armebia, Thylocostar spermum*; more sedentary lifestyles of nomads and increased tourism is causing infrastructure development which is resulting in degradation of the biodiversity; excessive extraction of medicinal plants for fuel/fodder. e.g. *Caragana sp, Euratia*	Low	Low	
Pasture Ground - the pastures supported by the wetland region are important for livestock on which the livelihood of local people depend	Due to increased demand of *Pashmina*, more goats are reared. As their food requirement is met through a wide category of species, this is creating pressure on the species	Medium	Medium	Medium
Fuel wood - even though cleaner sources of fuel are available, population increase has resulted in over extraction of fuel. This is because most of the cleaner sources are available in Leh and villagers have to travel long distance to do so. In winters, the dependence on fuel wood increases.	Over-extraction e.g. *Caragana* and *Euratia*	Medium	Low	Low
Water resources - Tsomoriri lake is fed by springs (Korzok) and glaciers. In 1999, water level rose. When the lakes froze in winter , it is also used as a road by nomads	T he camping site generates lot of waste which ends up in the springs and degrades the water quality of the lake.	Medium	Low	Low

Adaptation / IPCC responses can be:

- technological (e.g. dams and weirs)

- behavioural (e.g. altered food and recreational choices)

- managerial (e.g. promoting different farm practices)

- policy-based (e.g. planning and regulation).

Specific adaptation strategies include:

• monitoring and adaptive management programs

• incorporating climate change into current management practices

•reducing the threats and impacts arising from climate adaptation initiatives in other sectors

• reducing/tackling non-climate stresses on freshwater resources and ecosystems

- protecting intact habitats that act as refuges

- ensuring appropriate connectivity between freshwater ecosystems

- preserving genetic stock (including the relocation of endangered species and
- captive breeding programs)

- reducing emissions and ensuring carbon capture

Constraints to adaptation include:

• physical – constrain performance of the option

• financial – absolute cost of the option and ability of implementing organisation to fund the option

• socio-political – reactions of stakeholders and pressure groups to each adaptation option

•Institutional - within implementing organisation, regulatory or market constraints for the option

All very academic – what are the practical management activities that occur in your wetlands?

Now, are these useful for climate change (adaptive) or a problem (maladaptive), or don’t we know?

Ecosystem-based approach to climate change adaptation

Interventions to improve environmental health are used to ameliorate climate change impacts, include:

- **maintenance and restoration of natural ecosystems**

- **protection of vital ecosystem services**

- **reduction of land and water degradation by controlling invasive alien species**

- **management of habitats that act as breeding, feeding and nursery grounds for wildlife species and ensure plant genetic diversity**

- **management of protected areas**

Ecosystem-based approaches

- Maintain ecosystem services by conserving ecosystems

- Recognize that ecosystems have limits, undergo change and are interconnected

- Manage ecosystems at appropriate time/spatial scales

- Participatory, decentralized & flexible decision-making

- Use information from all sources including traditional, local and scientific information.

Ecosystem-based adaptation – a case study

NCCARF
National
Climate Change Adaptation
Research Facility

Synthesis and Integrative Research
Final report

Identifying low risk climate change adaptation in catchment management while avoiding unintended consequences

Anna Lukasiewicz, C. Max Finlayson,
Jamie Pittock

- **There are many activities underway that, if extended and linked, would comprise a substantial ecosystem-based approach to adaptation.**

- **Many of these activities had not previously been considered in an adaptation context.**

- **There was a need to look at a suite of complementary actions that spread risk rather than investing in one or two perceived best actions.**

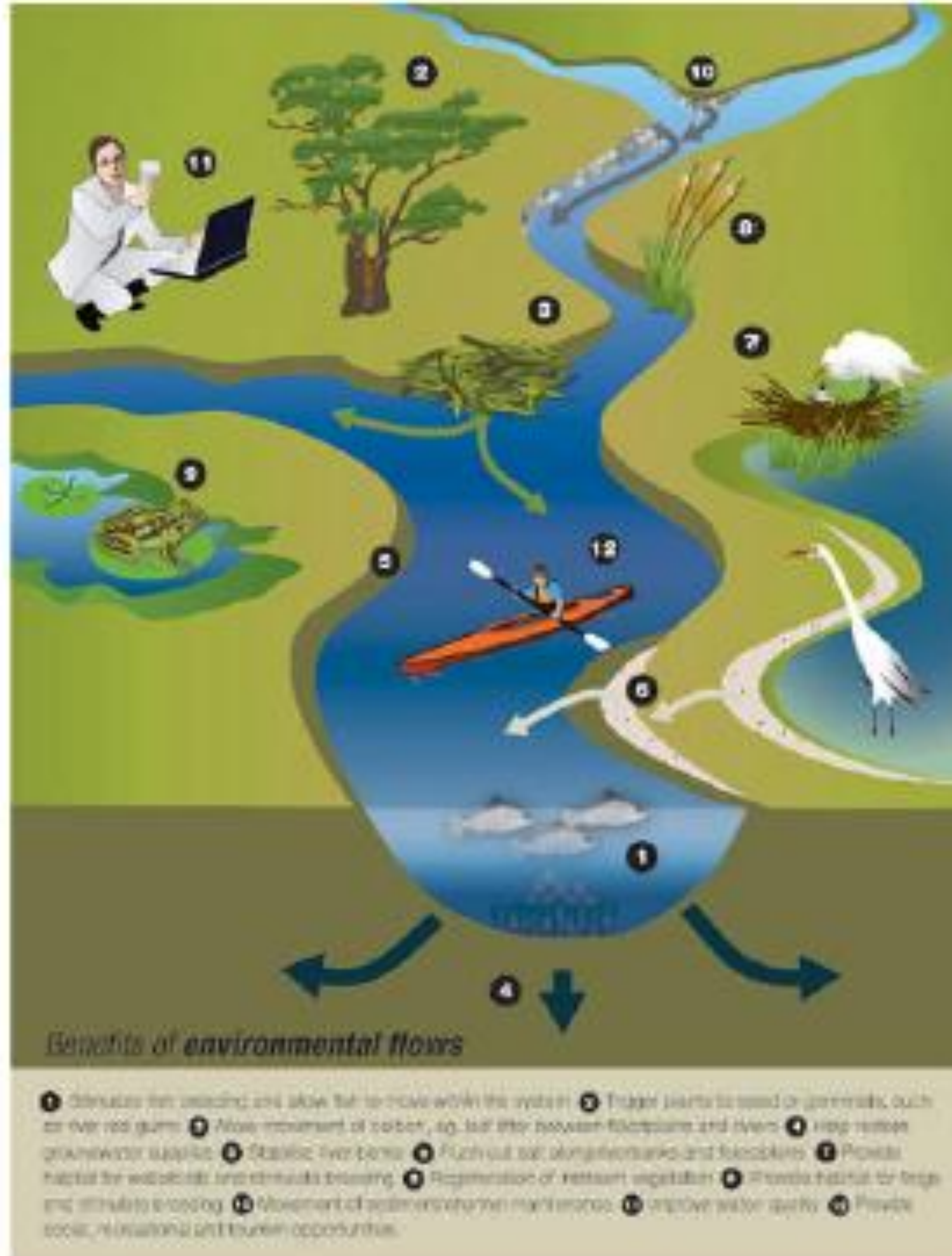
- **Adoption of an ecosystem-based approach is constrained by institutional complexity and socio-economic considerations that should be included in assessments of climate change adaptation.**

- **Adaptive management provides a basis for the implementation of an ecosystem-based approach to climate change adaptation.**

Environmental Flows

- River regulation has altered natural wetting and drying patterns
- Water diversion increased – not enough water left in the river systems
- Environmental flows: water put aside for environmental use, managed by government agencies
- Supplements natural flows in times of need


Hume Dam, Albury, 2010



Restoration of Riparian Vegetation

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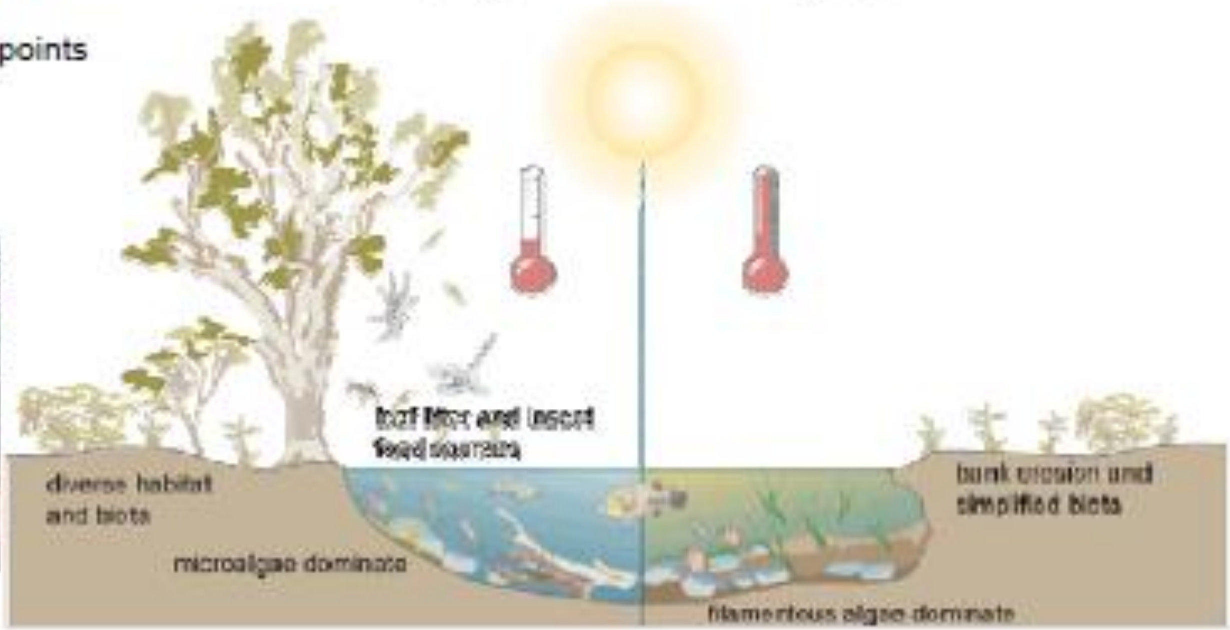
Actions include:

- planting riparian flora
- fencing off riparian zones
- ongoing weed control in riparian zones
- provision of off-river watering points for domestic stock
- Improves resilience
- Lowers water temperature

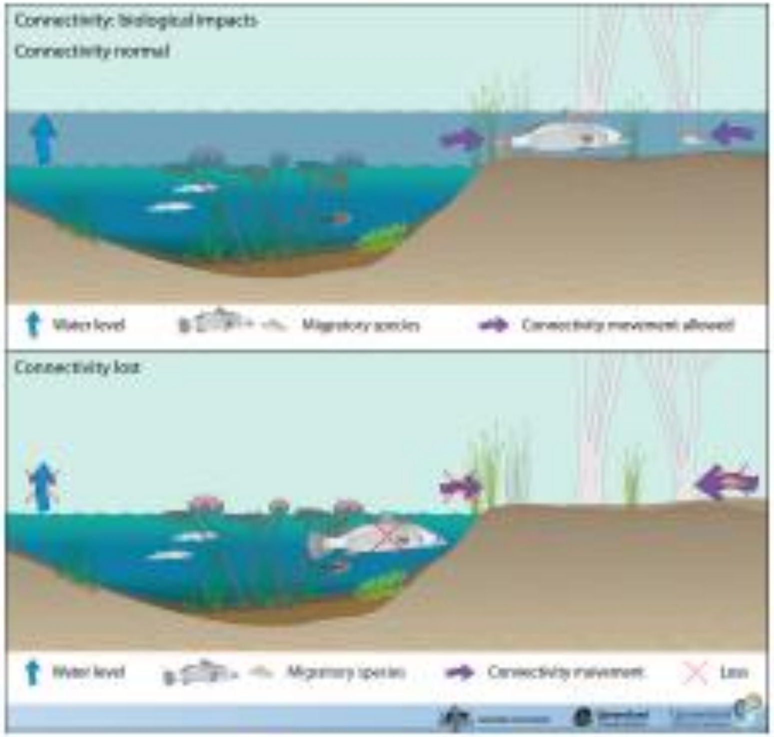
Effects of loss of riparian vegetation and catchment degradation on rivers.



Habitat Connectivity

Actions include:

- Removing unnecessary obstructions
- Providing fishways and ladders
- Reconnection of wetlands to rivers
- Allows species to migrate




Fish passage through dam


Fish passage through road


Fish ladder

Geomorphic Restoration

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Charles Sturt University

Actions include:

- conserving deep pools
- controlling bank instability and erosion
- stabilising or removing sand slugs
- re-snagging
- Increases habitat quality → resilience

Re-snagging in Macquarie Marshes

Riverbank erosion

Dredging needed in Port Hacking, NSW

Conservation of Gaining Reaches

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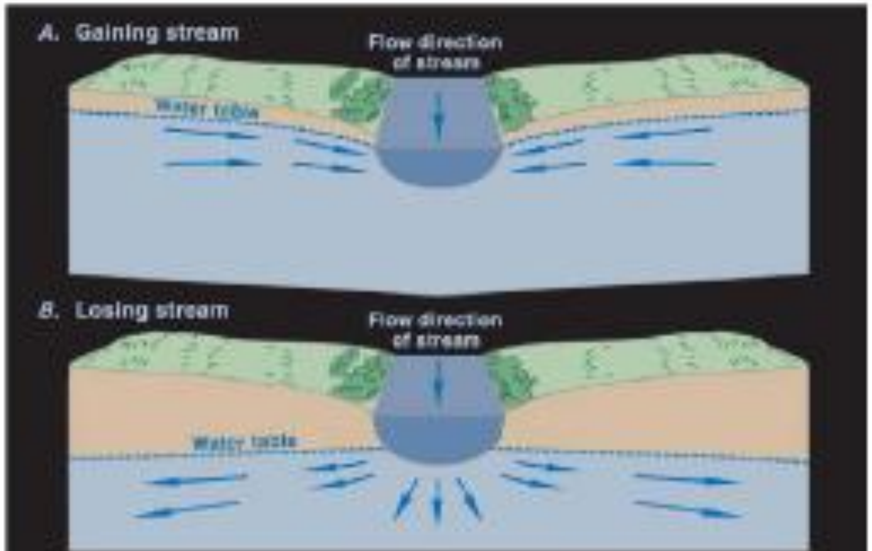
Actions include:

- Management of groundwater extractions
- Protection zones around gaining reaches
- Prioritising investment
- Provides refuges → less likely to dry out or heat up



In a gaining stream (A), water discharges from the surrounding soil into the stream, but in a losing stream (B), water infiltrates the ground.

Mal-adaptation

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- Actions that seek to avoid or reduce vulnerability to climate change but end up increasing it in other systems, sectors or social groups
- Actions that had the desired effect but also produced unintended consequences

6 types of Maladaptation	
Increasing emissions	Actions end up contributing to climate change
Disproportionate burden on the most vulnerable	In meeting the needs of one sector or group, actions increase the vulnerability of those most at risk
High opportunity costs	Where the economic, social, or environmental costs are higher relative to alternatives
Reducing incentive to adapt	By encouraging unnecessary dependence on others, stimulating rent-seeking behaviour, or penalising early actors
Path dependency	Decrease flexibility to respond to unforeseen changes in climatic, environmental, economic and social conditions
Increasing existing stressors	Adding further stress to already degraded ecosystems reduces their adaptive capacity to deal with climate change impacts

Source: Barnett & O'Neill, 2010; Barnett, et al., 2011

Carbon storage and mitigation

Environ. Res. Lett. 8 (2013) 015010 C R Lloyd *et a*

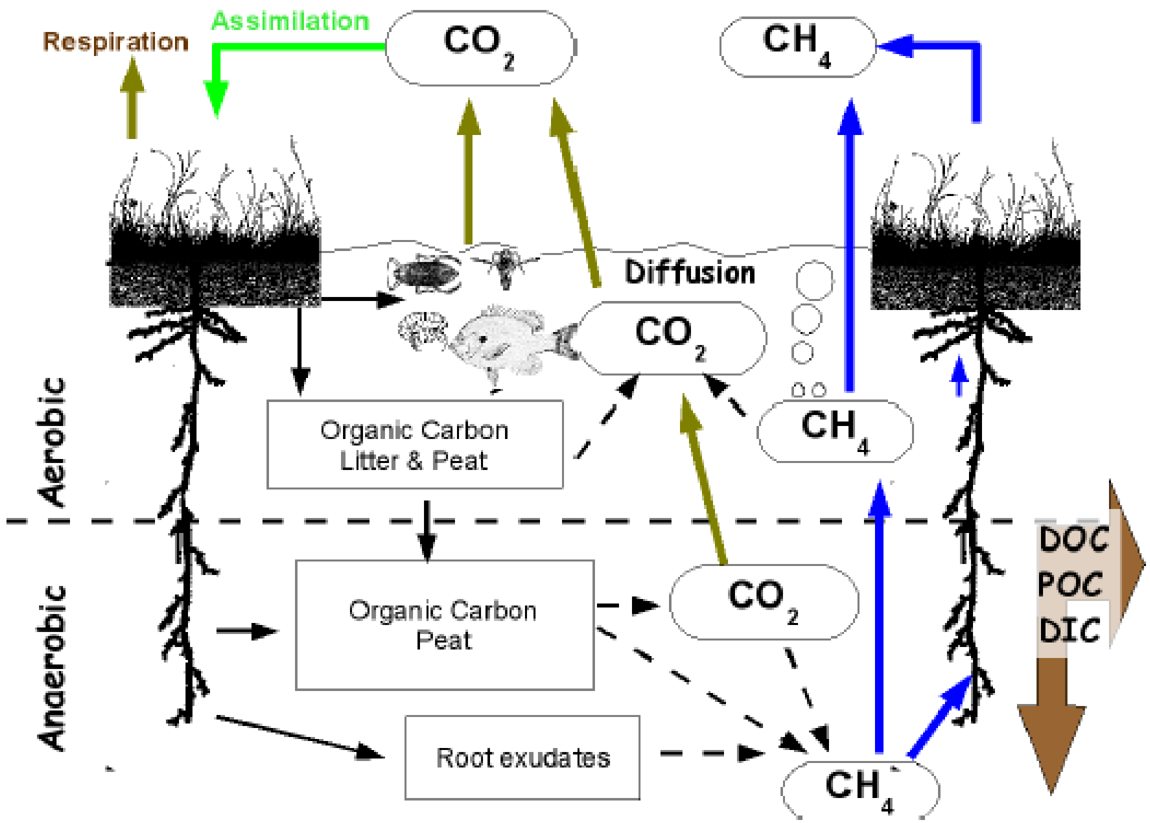

Figure 1. A representation of the carbon cycle in wetlands (redrawn from van der Valk 2006). DOC/POC (dissolved/particulate organic carbon), DIC (dissolved inorganic carbon).

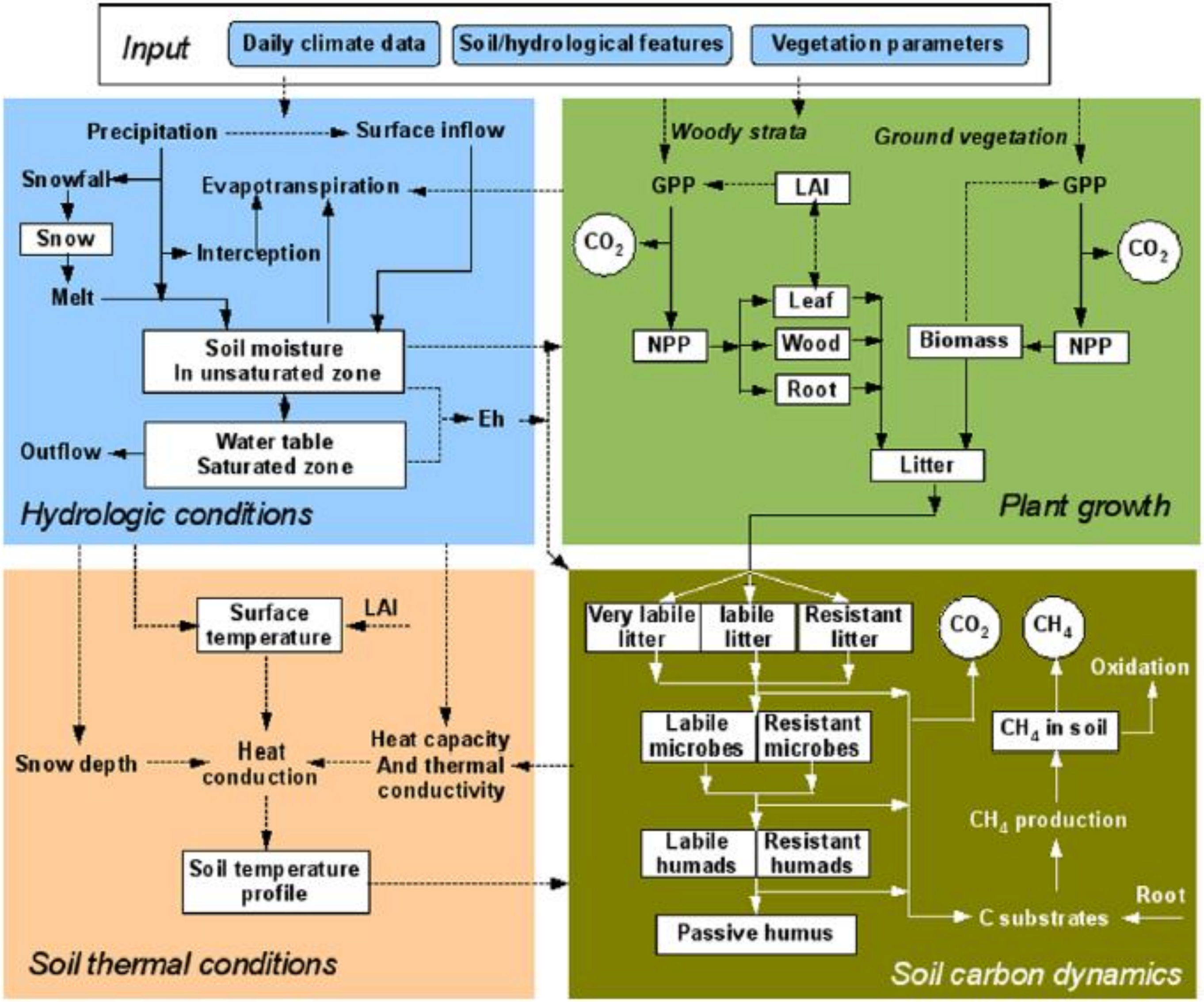

Figure 2. The conceptual structure of the Wetland-DNDC model. Redrawn from Zhang *et al* (2002).


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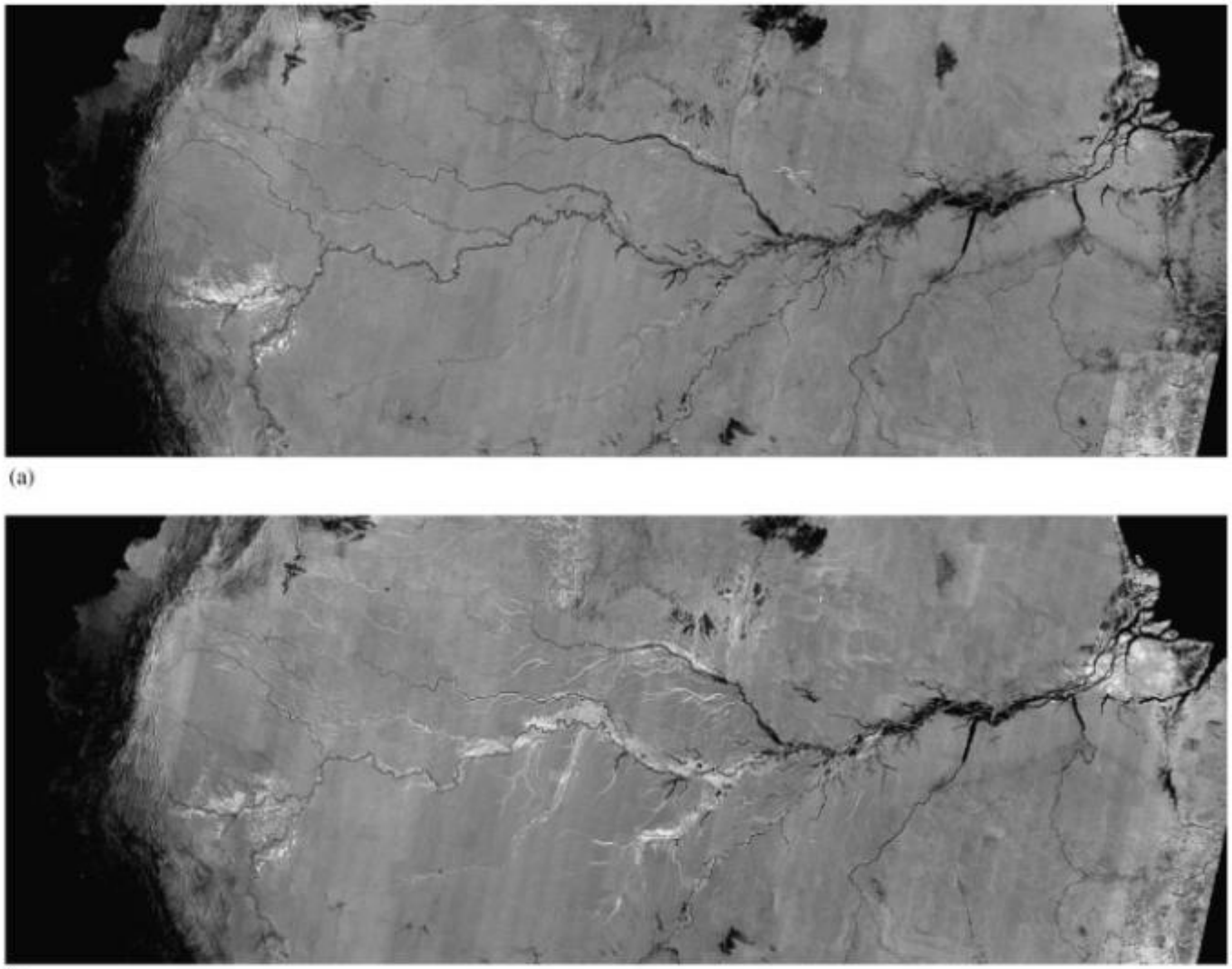
Satellite imagery – mapping mangroves

(Perak, West Malaysia – Rosequvist et al 2007)

Mapping inundation in Amazon

(Rosenqvist et al 2007)



(a)

(b)

Deterministic or process modelling provides the ability to simulate the physical, chemical and biological processes that comprise the exchange of greenhouse gases between the atmosphere, vegetation and soil.

The models, through their mechanistic approach, are transportable and can be used in different wetlands provided appropriate characteristic parameters are chosen when running the model.

variables include incoming solar radiation,
albedo, wind speed, air humidity, air and soil temperatures, as well as vegetation parameters such as ground level normalized difference vegetation index (NDVI).

For wetlands –

•variables include incoming solar radiation, reflectance, wind speed, air humidity, air and soil temperatures, as well as vegetation parameters such as ground level normalized difference vegetation index (NDVI).

•need to be extended to include microbial activity processes responsible for CH4 production,

•water table depth and seasonal changes in wetland expanse.

Lloyd et al 2013. Providing low-budget estimations of carbon sequestration and greenhouse emissions in agricultural wetlands. Environmental Research Letters vol 8. doi:10.1088/1748-9326/8/1/015010

Why measure carbon in wetlands?

-Important store of carbon; could sequester more carbon in wetlands?

-degradation and loss of some types of wetlands can cause release of large amounts of stored carbon and exacerbate climate change.

-maintaining wetlands has many benefits for people – they are important and we love them…

Thank you