Section MA: Mitigation and Adaptation

Readings: Parts of Chapter 17, 18, 20

Learning outcomes

- know the definitions of mitigation and adaptation
- understand how ecosystems participate in mitigation, especially in agriculture and forestry
- describe ways humans can facilitate adaptation of plants/animals/ecosystems to future climate change

Definitions

- mitigation = “actions to limit the magnitude and/or rate of long-term climate change”

- adaptation = “the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that moderates harm or exploits beneficial opportunities.” IPCC, Working Group 2, AR4, AR5; National Climate Assessment, 2014

Mitigation options in agriculture

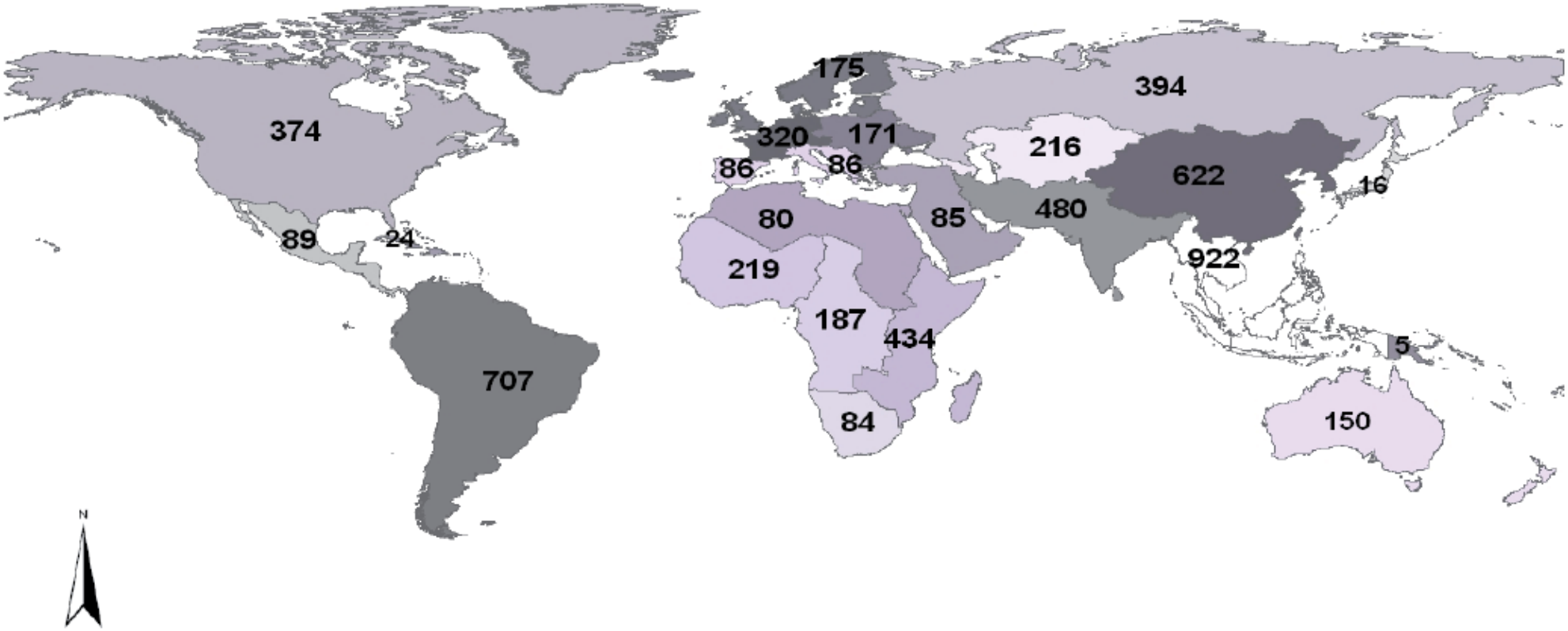


Figure 8.5: *Total technical mitigation potentials (all practices, all GHGs: MtCO2-eq/yr) for each region by 2030, showing mean estimates.*
Note: based on the B2 scenario though the pattern is similar for all SRES scenarios.
Source: Drawn from data in Smith et al., 2007a.

Sum = 6000 Mt CO_2-eq/yr
Current fossil fuel+cement emissions = 34,000 Mt CO_2/yr

Mitigation options in agriculture

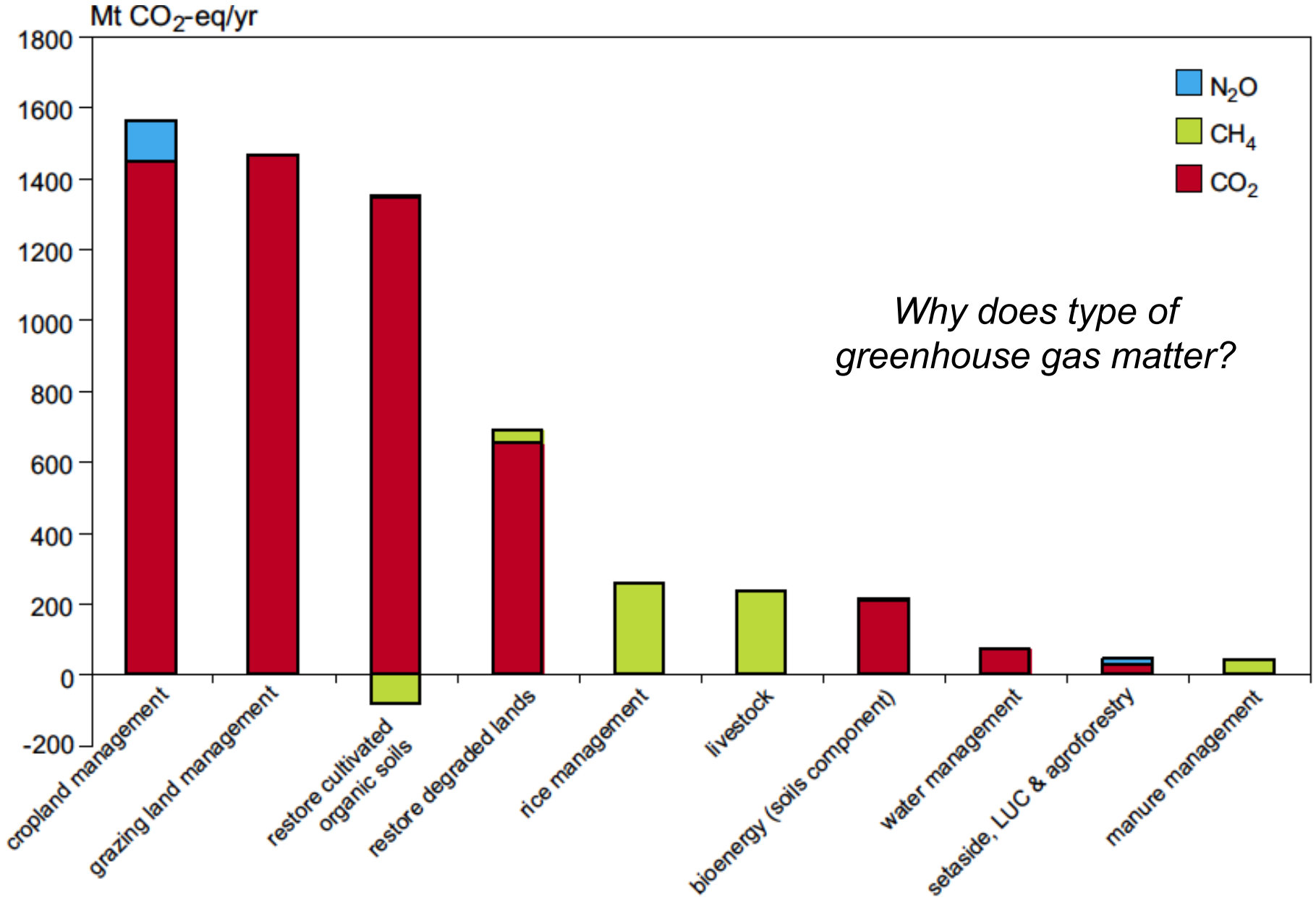
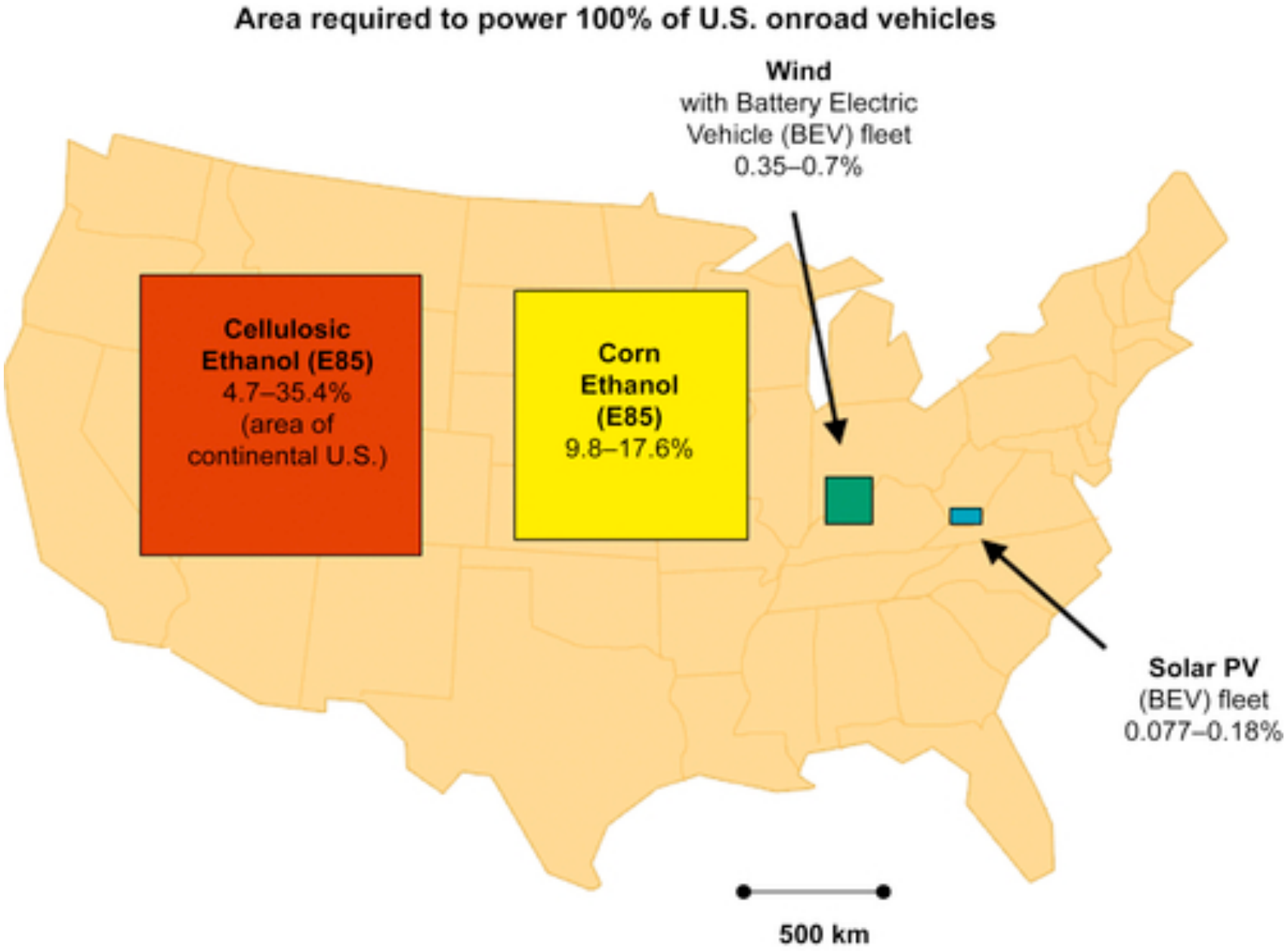


Figure 8.4: *Global technical mitigation potential by 2030 of each agricultural management practice showing the impacts of each practice on each GHG.*
Note: based on the B2 scenario though the pattern is similar for all SRES scenarios.
Source: Drawn from data in Smith et al., 2007a.

IPCC, Working Group III, 2007

Mitigation options in agriculture



Hannah, 2014

Mitigation options in forestry

(Current fossil fuel+cement emissions = 34 Gt CO_2/yr)

Cumulative C by 2050 and by 2100

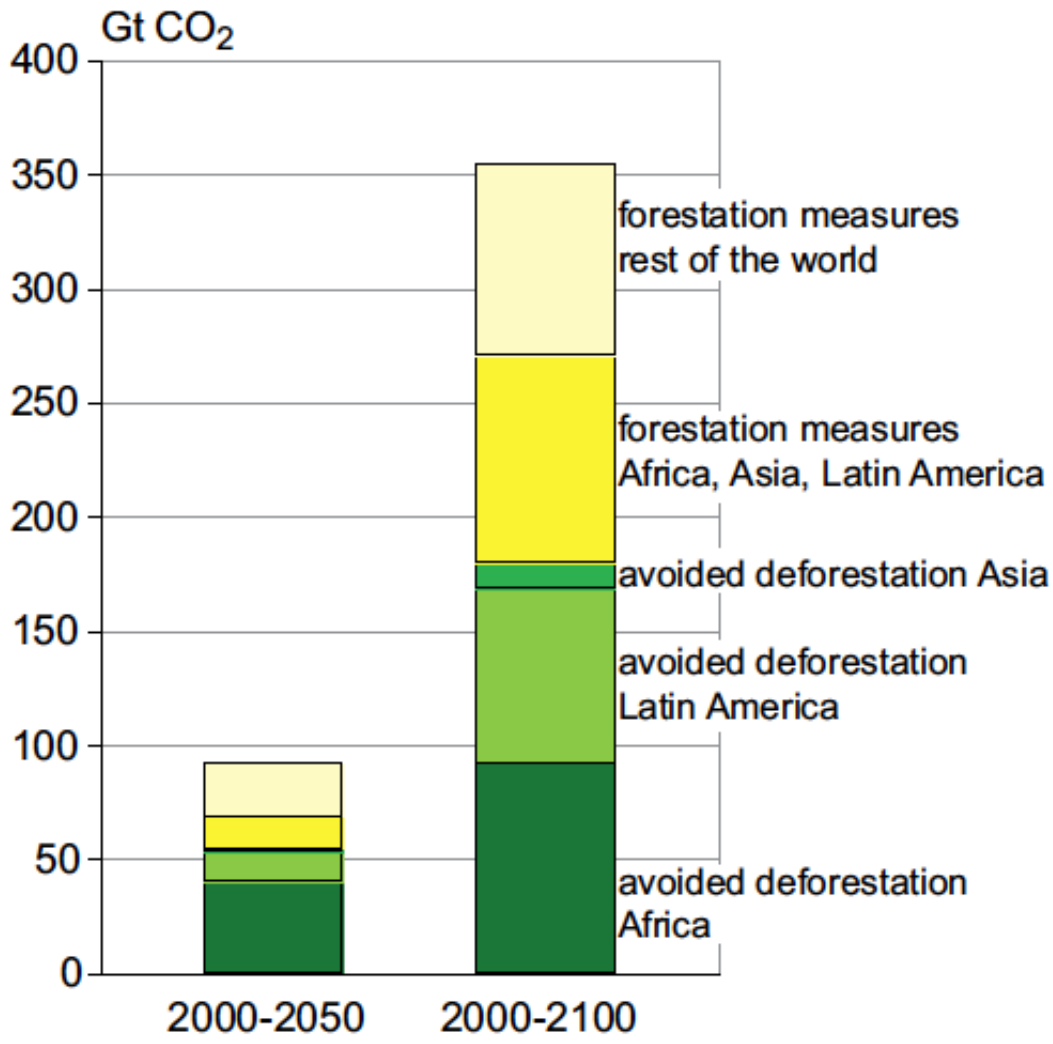


Figure 9.6: *Cumulative mitigation potential (2000-2050 and 2000-2100) according to mitigation options under the 2.7 US$/tCO2 +5%/yr annual carbon price increment*

Source: Sathaye et al., 2007.

IPCC, Working Group III, 2007

Mitigation options in forestry

Cumulative CO2 by 2055

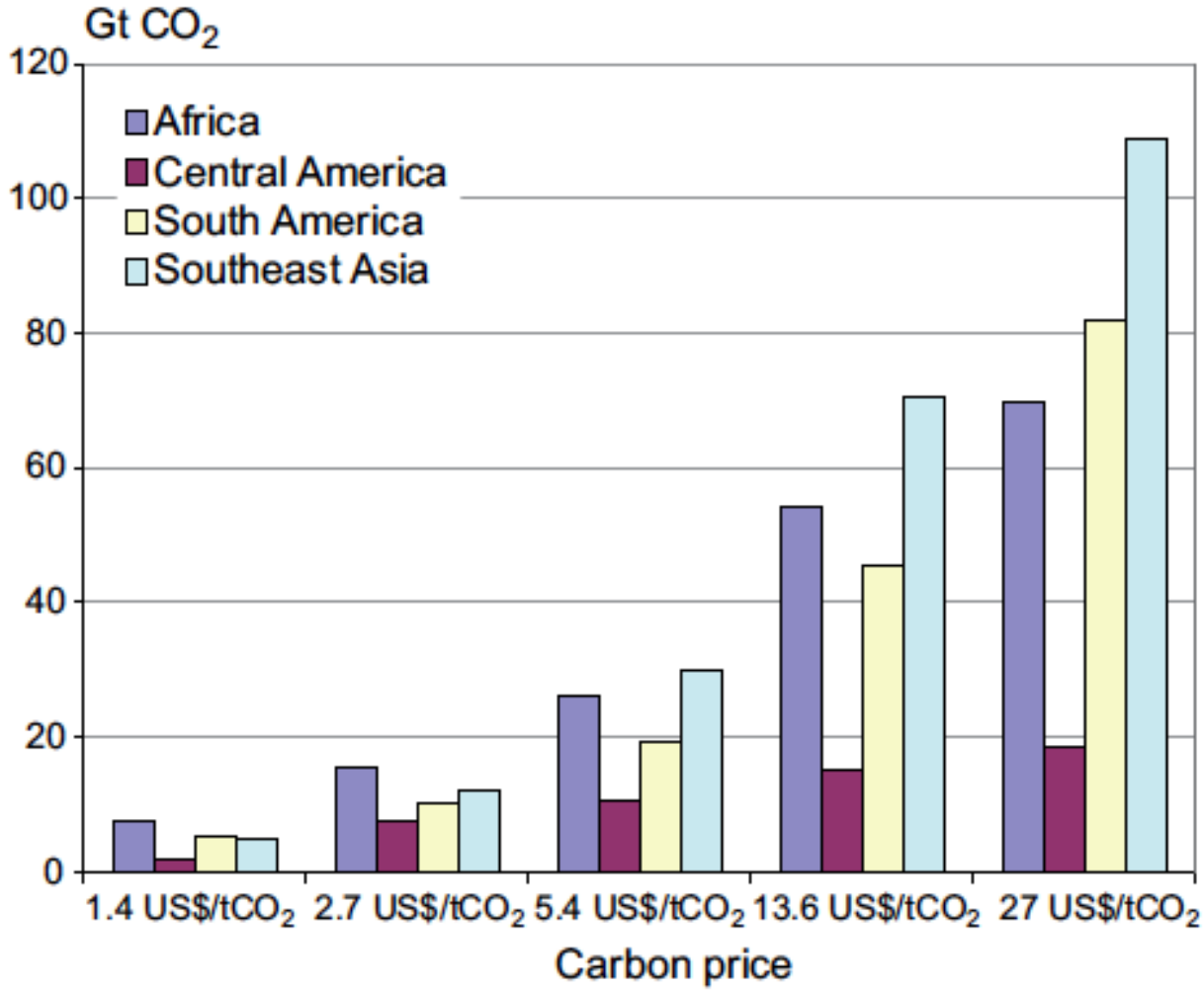


Figure 9.5: *Cumulative carbon gained through avoided deforestation by 2055 over the reference case, by tropical regions under various carbon price scenarios*
Source: Sohngen and Sedjo, 2006.

(Current fossil fuel+cement emissions = 34 Gt CO_2/yr)

IPCC, Working Group III, 2007

Mitigation potential of US forests

Item	Estimate (Tg C/yr)
Reference/context	
Forest growth	349
Forest sector C storage (includes harvested wood storage)	313
US CO2 emissions	1615
Fire emissions	67
Mitigation potential	
afforestation (1 Tg C/yr requires 262,000–1,133,000* ha of crop or pastureland suitable for tree growth)	1-225**
forest management (activities include longer harvest interval, increasing growth, establishing preserves)	29-105*
biomass energy	130-190

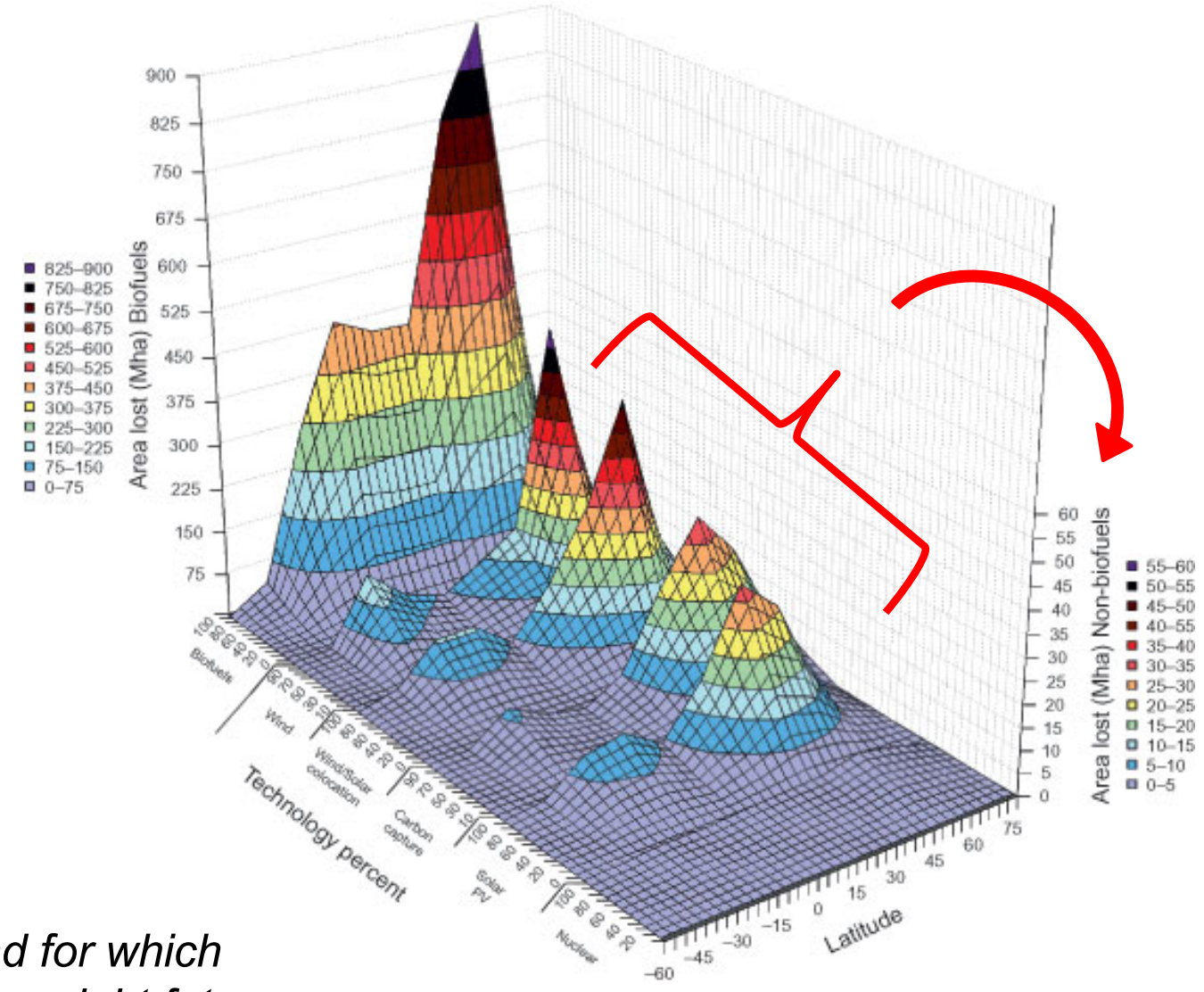
**size of 0.5xRhode Island-2xDelaware per 1 Tg C/yr
*depends on carbon price ($18-183 per Mg C)

McKinley et al., Ecological Applications, 2011

Example of afforestation

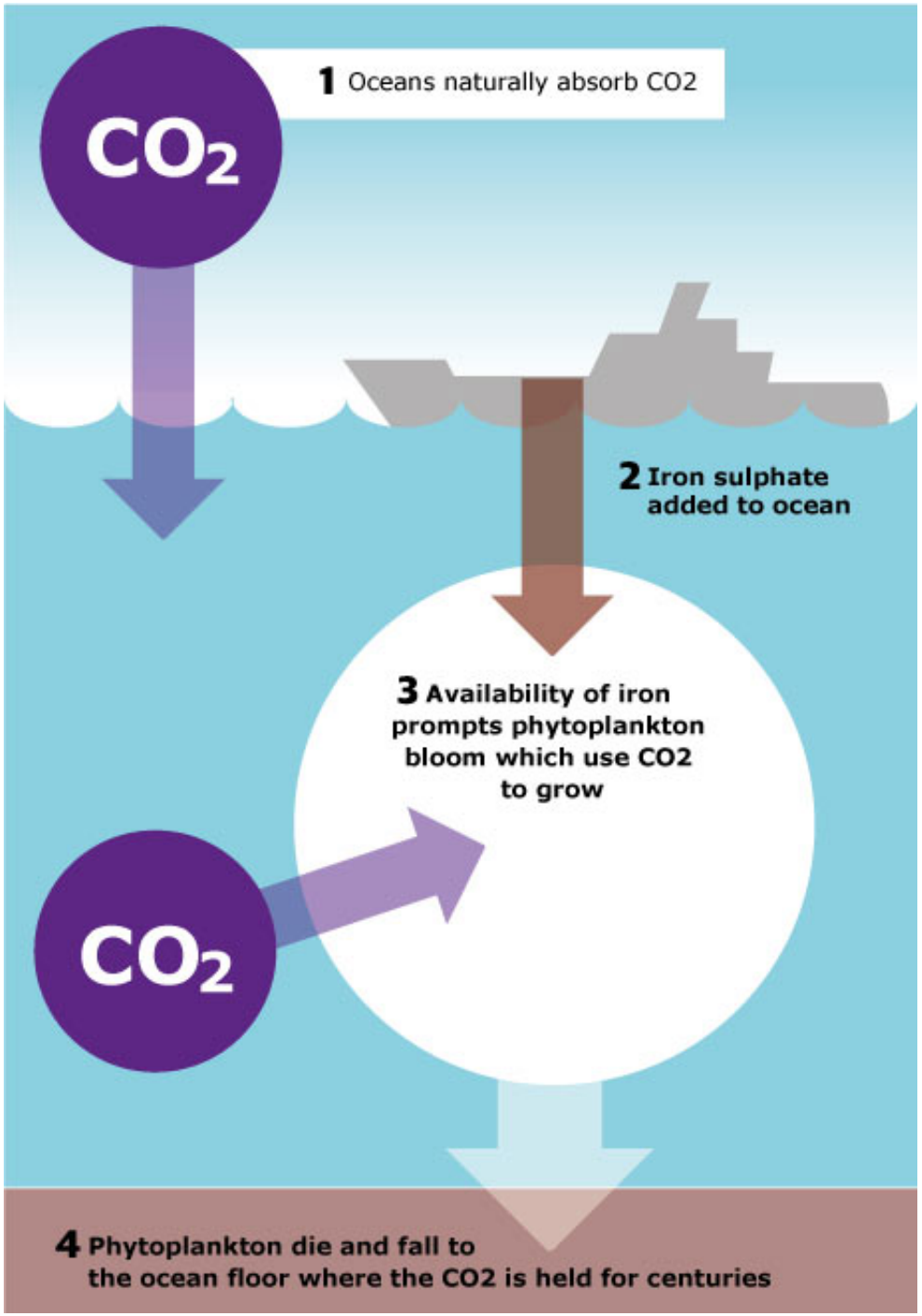
columbiariverimages.com/Regions/Places/potlatch_plantation.html

Mitigation options that affect land and biodiversity



Where and for which technology might future biodiversity loss be greatest?

Iron fertilization in the ocean to sequester carbon



static.guim.co.uk/sys-images/Environment/Pix/pictures/2012/7/18/1342625066906/Iron-filings-and-carbon-b-001.jpg

Prof. J. Hicke

Adaptation in wilderness areas

34 PARK SCIENCE • VOLUME 28 • NUMBER 3 • WINTER 2011–2012

Climate change: Wilderness's greatest challenge

By Nathan L. Stephenson and Constance I. Millar

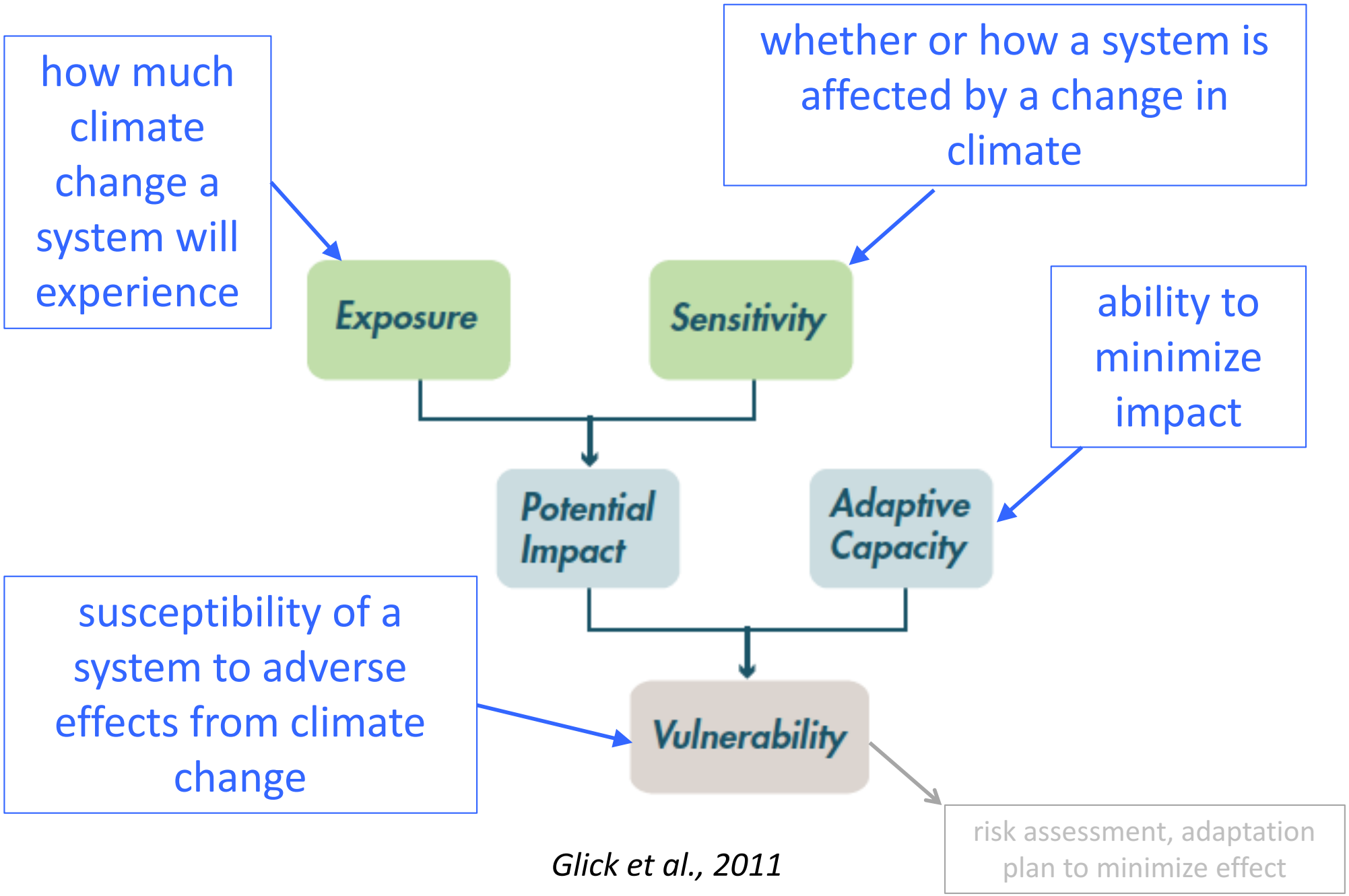
1. restraint (do nothing)

2. resilience (buy time)
   - facilitate an ecosystem's or organism's ability to rebound/recovery from a disturbance
   - remove other stressors (invasive species, human pressure)
   - thin forests to decrease drought vulnerability

3. resistance (buy time)
   - fuel breaks to stop wildfires
   - controlling insect outbreaks
   - drip irrigation

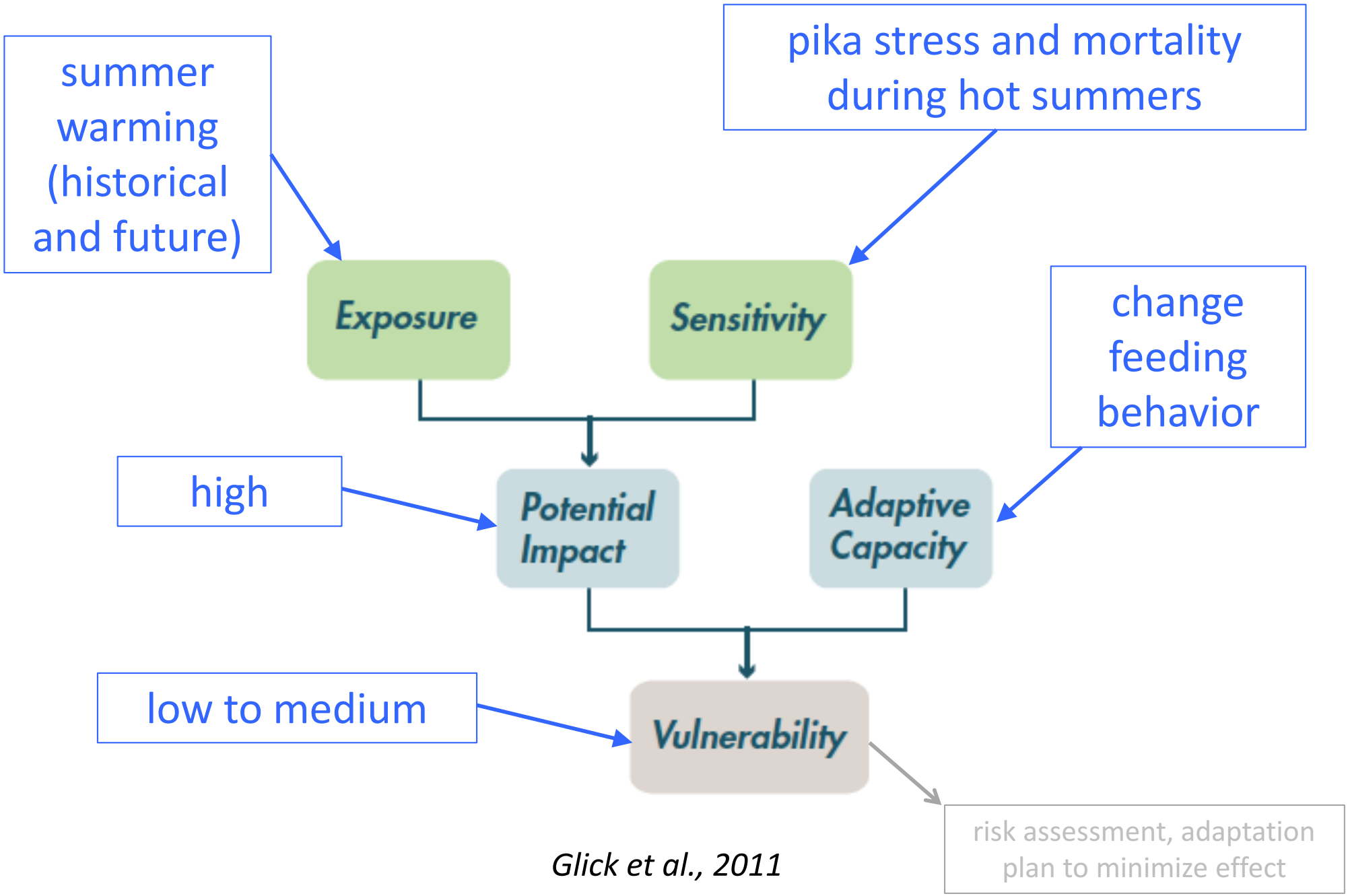
4. realignment (long-term change)
   - assisted migration
   - plant with species better adapted to new/future climate following severe disturbance
   - mixing genotypes from other regions (that may be more resilient/resistant)

Climate change impact and vulnerability assessments



Glick et al., 2011

Example: Pikas



Glick et al., 2011

California Climate Adaptation Strategy, 2009

www.climatechange.ca.gov/adaptation/strategy/index.html

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Climate Change Adaptation Strategies to Conserve California's Biodiversity

- Create a large scale well connected, sustainable system of protected areas across the State.
- Manage for restoring and enhancing ecosystem function to conserve both species and habitats in a changing climate.
- Adjust management actions as appropriate for threatened and endangered species
- Prioritize research needs and pursue collaborative partnerships with the research community to ensure that the best available science is informing management actions.
- Re-evaluate existing policies and programs to incorporate climate change and seek regulatory changes as appropriate
- Pursue endeavors that will support implementation of the strategies including funding, capacity building, collaborative partnerships, and education and outreach.

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Strategy 3 - Actions to Address Climate Vulnerabilities

Strategy 4 - Implement Priority Research Agenda

Strategy 5 - Implement Forest Health Monitoring in an Adaptive Management Context