Climate Risk Assessment

An Introduction

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EUROPEAN COMMISSION

Objectives

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Participants should understand:

- nature of climate change risks to development
- the wider CRA context (screening, integration)
- risk frameworks & key concepts
- key elements of how to design & apply CRA
- where to find climate information & how to use it

Course structure

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Part 1. Introduction: recap of science and key concepts

The science of climate change (recap); climate change as a threat to development; key concepts (risk, vulnerability, adaptation); the relationship between adaptation and development

Part 2. CRA in context

CRA in the cycle of operations; steps leading up to CRA - screening & scoping; the role and use of climate information

Part 3. CRA: elements and approaches

Key concepts, different approaches to CRA, examples

Part 4. Adaptation

Adaptation criteria, examples of adaptation activities

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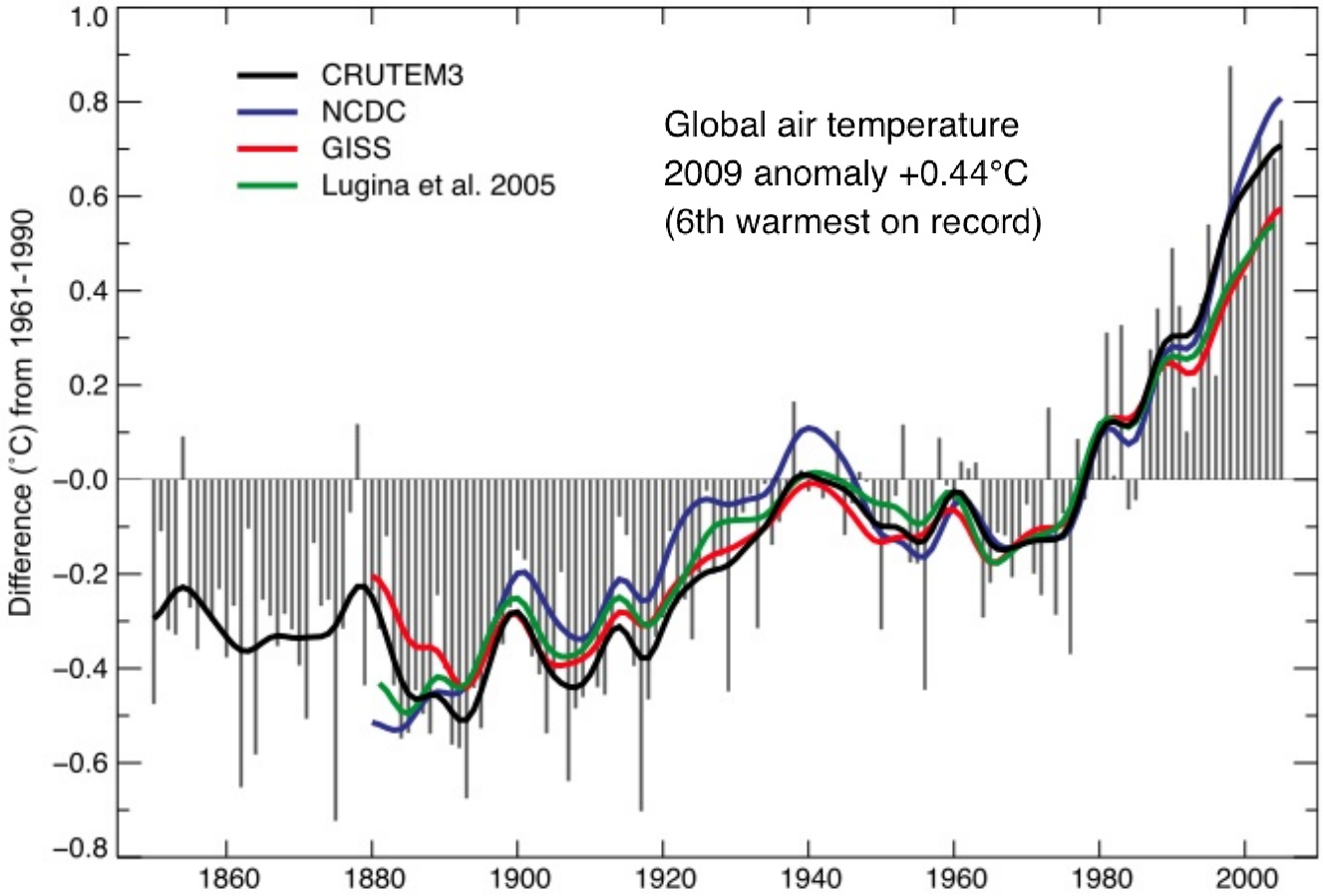
1. Introduction

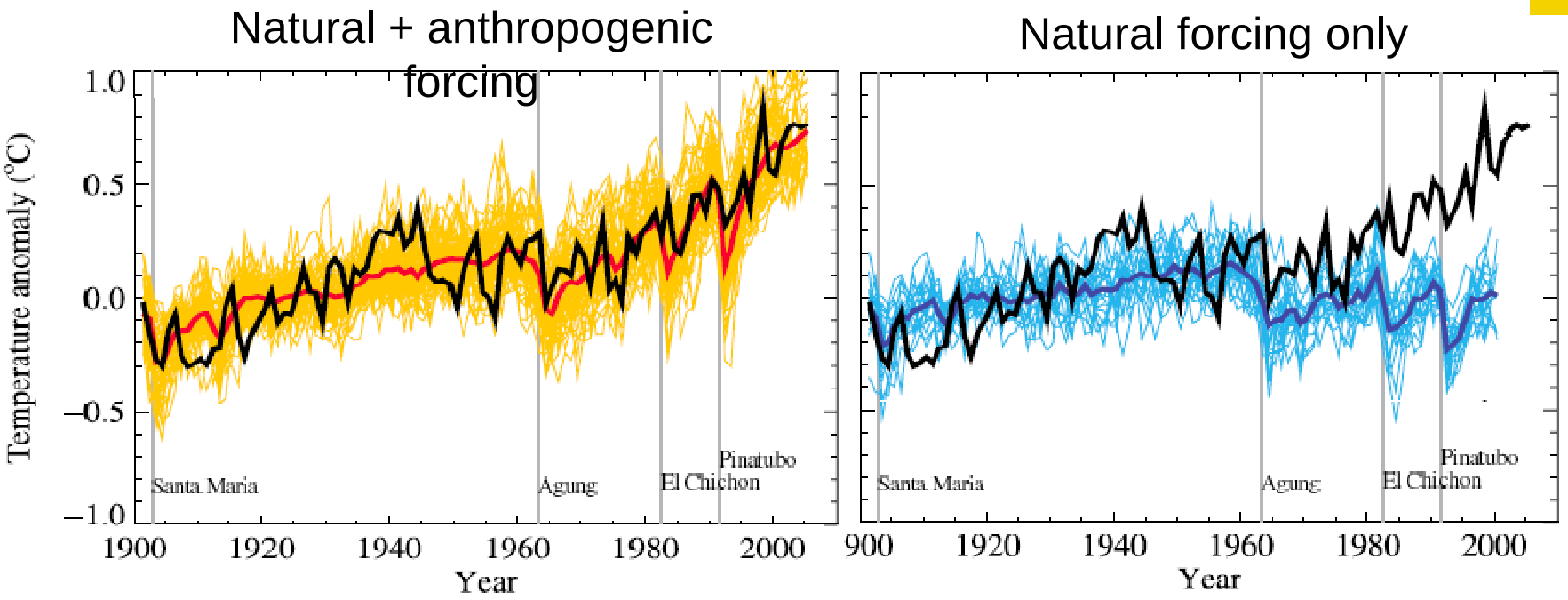
Recap of science, and key concepts

Recent warming

- Warming of ~0.76° C over past ~century (IPCC, 2007)



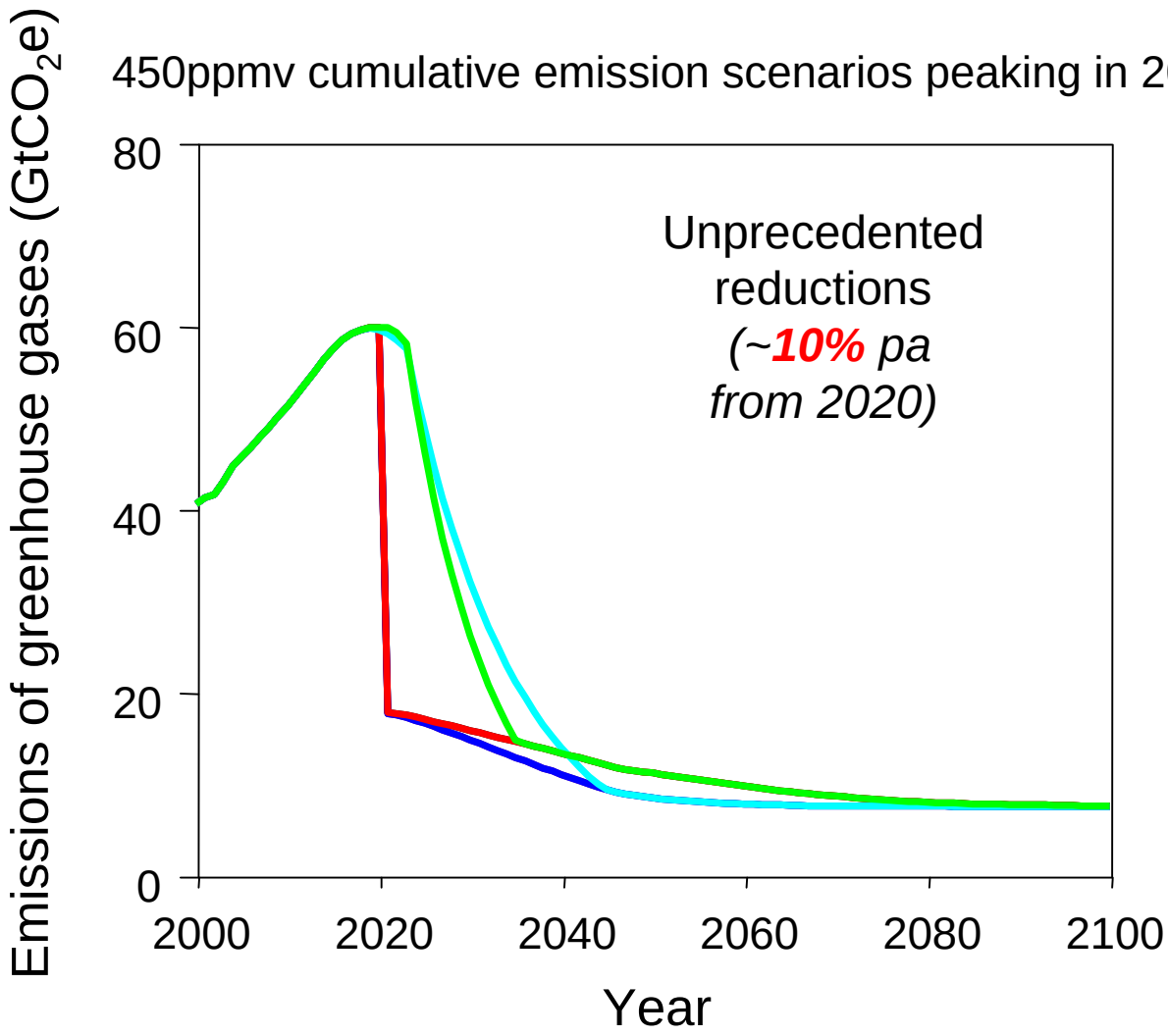
Climate change and human activity



Global mean surface temperature anomalies from observations (black) as as simulated by a variety of global climate models.

Source: IPCC AR4 WGI Ch. 9 (Hegerl et al., 2007, p. 684)

The 2º C target



10% - 60% chance of exceeding 2°C & with a 2020 peak

(Anderson & Bows. 2008 Philosophical Transactions A of the Royal Society. 366. pp.3863-3882)

Graphic courtesy of Kevin Anderson

The development challenge

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Aim for 2º C

Mitigation, low-carbon development

Plan for 4º C

Adaptation

Climate change hazards

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- Changes in variability and extremes
  - Rainfall variability, seasonality - droughts, predictability
  - Changes in peak precipitation intensity (flood risk)
  - Changes in storm activity/behaviour/geographic distribution
  - Heat waves, wild fires, pollution events, etc
- Long-term changes/trends in average conditions
  - Warmer, wetter, drier, more saline groundwater, etc
  - Shifts in climatic zones, ecological/species ranges
- Abrupt/singular changes
  - Monsoon shifts, circulation changes
  - landscape & ecosystem transitions
  - glacial lake outbursts, etc.

The development challenge

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"Climate change...calls into question the Enlightenment principle that human progress will make the future look better than the past"

(UNDP Human Development Report, 2007, p.1)

"combating ... climate change is fast becoming the defining challenge of our generation"

José Manuel Barroso, President of the EC, 25/05/2009

Activity 1
Climate Change Debate

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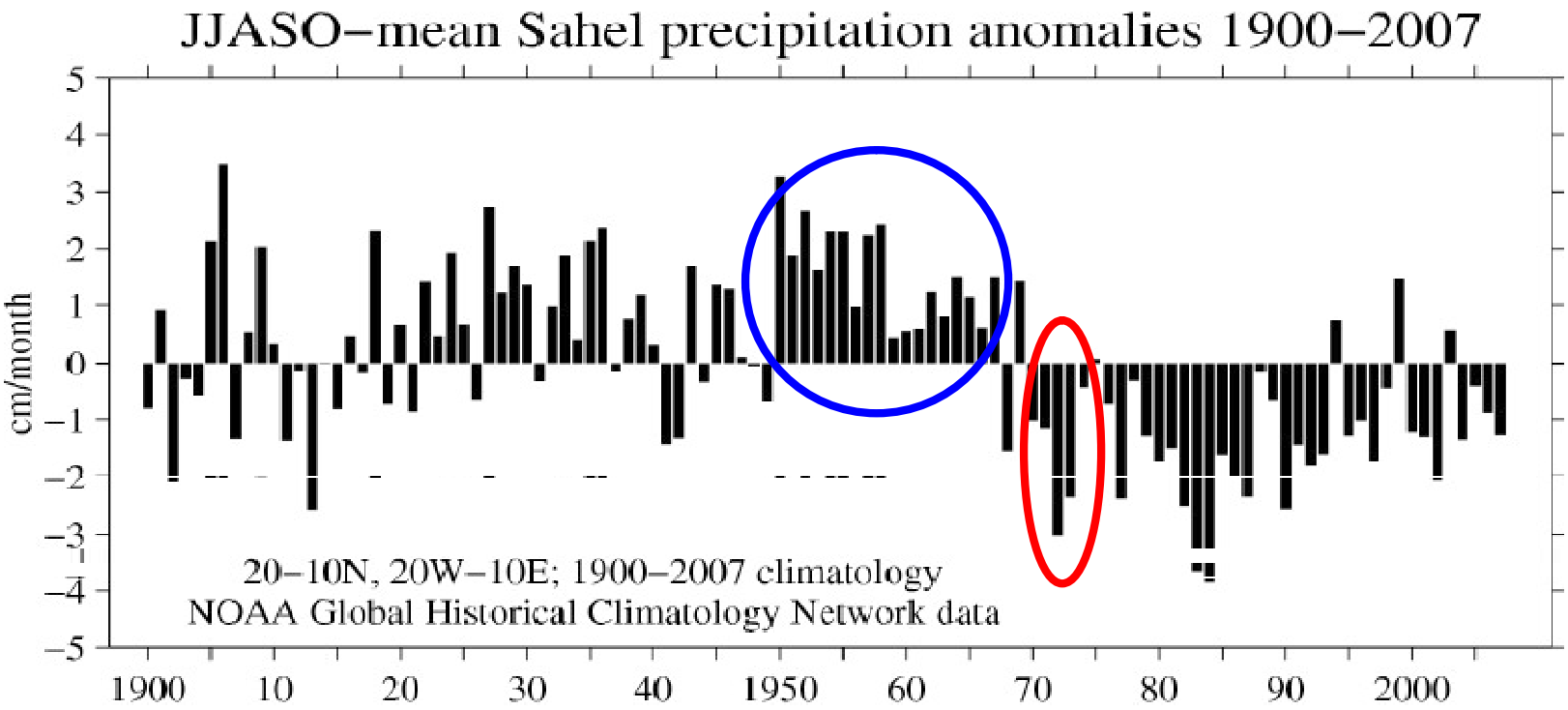
"Climate change is a distraction from more urgent development priorities"

Discuss

Example: 20th century Sahel



Colonial development: agricultural modernisation - intensification, expansion into “idle lands”

Shift to more arid climate: severe drought, famine, ~100,000 people dead, severe social disruption

NOAA Global Historical Climatology Network. Graphic from Todd Mitchell, University of Washington

Example: 21st century Jordan

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- Current surface water usage 296 MCM/yr
- Current surface water resources ~540 MCM/yr
- Climate change ~50% loss feasible: availability below current use
- Development plans currently assume further development of surface water resources, & additional water from desalination
- CC means further development may be impossible; significant proportion of “additional” water may be needed to offset CC impacts
- Climate change needs to be addressed - business as usual likely to create dependence on threatened resources

Key concepts: risk

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Many different ways to define risk, e.g.

- Risk = probability x consequence
- Event risk: probability of occurrence of event associated with adverse outcomes
- Outcome risk: probability of occurrence of adverse outcome (linked to event risk & mediated by sensitivity/vulnerability of exposed system)
- Risk is associated with “trigger” event or “hazard”, and impacts mediated by characteristics of the exposed system exposed
- Risk = f (hazard, vulnerability)

Key Concepts: Vulnerability

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1. IPCC "official" definition of vulnerability (2001, 2007)

"…the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity."

IPCC, 2001, WGII, p. 995 and IPCC, 2007, WGII, p. 883

2. IPCC "alternative" definition of vulnerability (2001)

"Degree to which a system is susceptible to injury, damage, or harm (one part - the problematic or detrimental part - of sensitivity)"

IPCC, 2001, WGII, p. 894

1. similar to that of risk as arising from interaction of HAZARD & underlying SENSITIVITY/VULNERABILITY of exposed system
2. sometimes referred to as "social vulnerability"

Key Concepts: Adaptation

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"Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." IPCC, 2007, WGII, p. 869

- Anticipatory: takes place before climate change impacts are observed
- Autonomous: "unconscious" adaptation in response to stimuli
- Planned: resulting from deliberate policy decision based on awareness of change

Adaptive Capacity (IPCC, 2007, WGII, p. 869)

"The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."

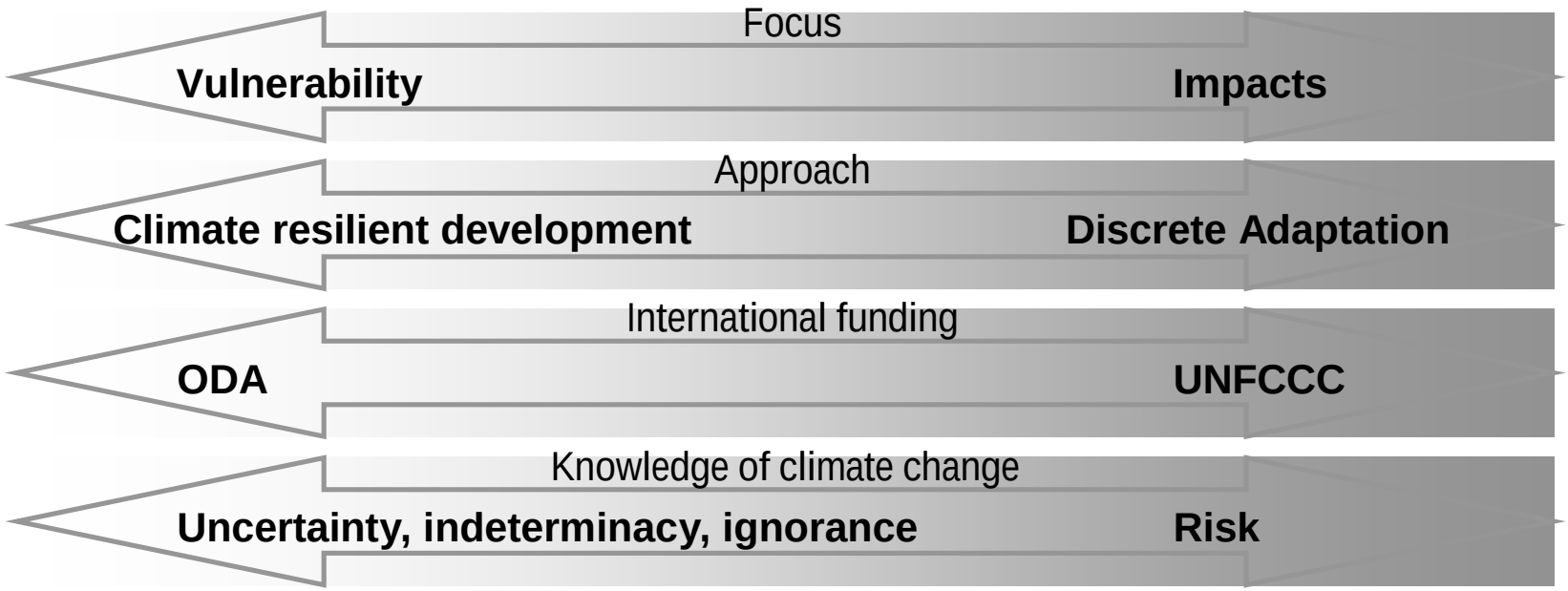
- For changes unfolding over significant period (i.e. not "instantaneous"), adaptive capacity may be seen as inversely related to vulnerability

Key questions

- What is the relationship between adaptation and development?
- Is adaptation just "good development"

Adaptation-development continuum

Addressing the Drivers of Vulnerability	Building Response Capacity	Climate Risk Management	Confronting Climate Change
Improving fundamental factors to reduce vulnerability to poverty and harm, with limited direct attention to climate factors, e.g. health, education, women's rights, accountability.	Building robust systems for problem solving for both climate and non climate related activities, e.g. communications and planning processes, weather monitoring, and natural resource management practices.	Integrating climate information into decisions to reduce negative effects on resources and livelihoods, e.g. disaster management, drought-resistant crops, "climate-proofing" infrastructure.	Focusing almost exclusively on climate change impacts, typically targeting climate risks that are outside historic climate variability, e.g. tackling sea level rise or glacial lake floods.



Tanner and Mitchell, 2008; from McGray *et al* 2007

Key Concepts: Mitigation

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In climate change context, refers specifically to actions to reduce the magnitude of anthropogenic climate change through reductions in greenhouse gas emissions (relative to baseline case in which no such actions taken).

- Generally implies avoiding emissions at source (including carbon sequestration e.g. in geological reservoirs)
- Geoengineering encompasses measures remove carbon from atmosphere and action to offset warming by greenhouse gases by managing solar radiation reaching the earth - generally viewed as separate from mitigation

Mitigation and adaptation are not alternatives - the less we mitigate, the harder it will be to adapt, as climate change will be more pronounced

Key concepts: opportunities

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Development programmes & projects (PPs) offer opportunities to

- Promote development that is more resilient in the face of climate change and variability (even if PP not at direct risk)
- Promote low-carbon development that delivers genuine development benefits (e.g. through energy security, price stability, microgeneration in remote rural areas, etc)
- We need to address opportunities as well as risks to make development more sustainable

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2. CRA in context

Cycle of operations, screening, scoping

What is CRA & why do we do it?

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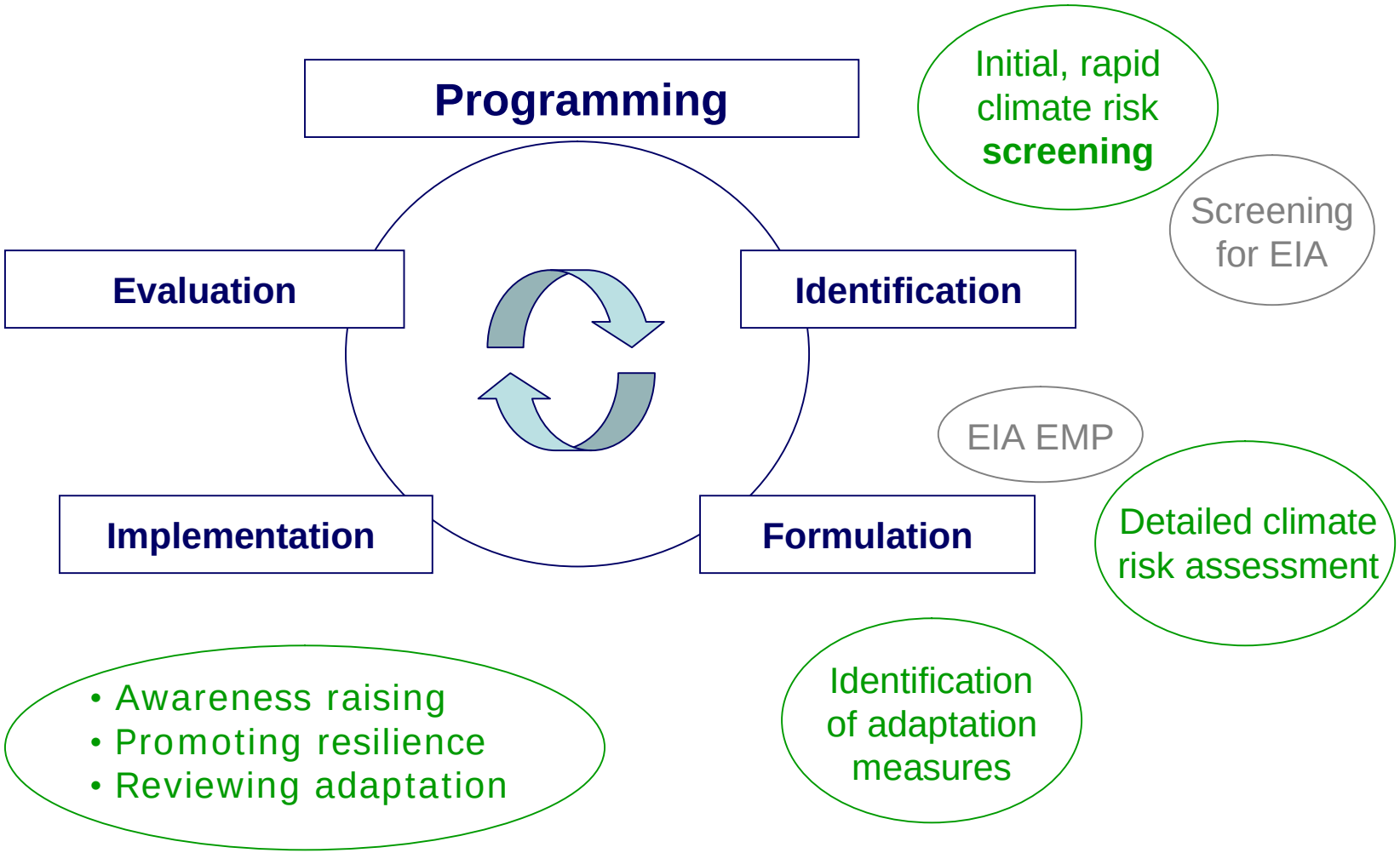
What is it?

- Identification of risks to development activities arising as a result of CC, and of opportunities to address CC

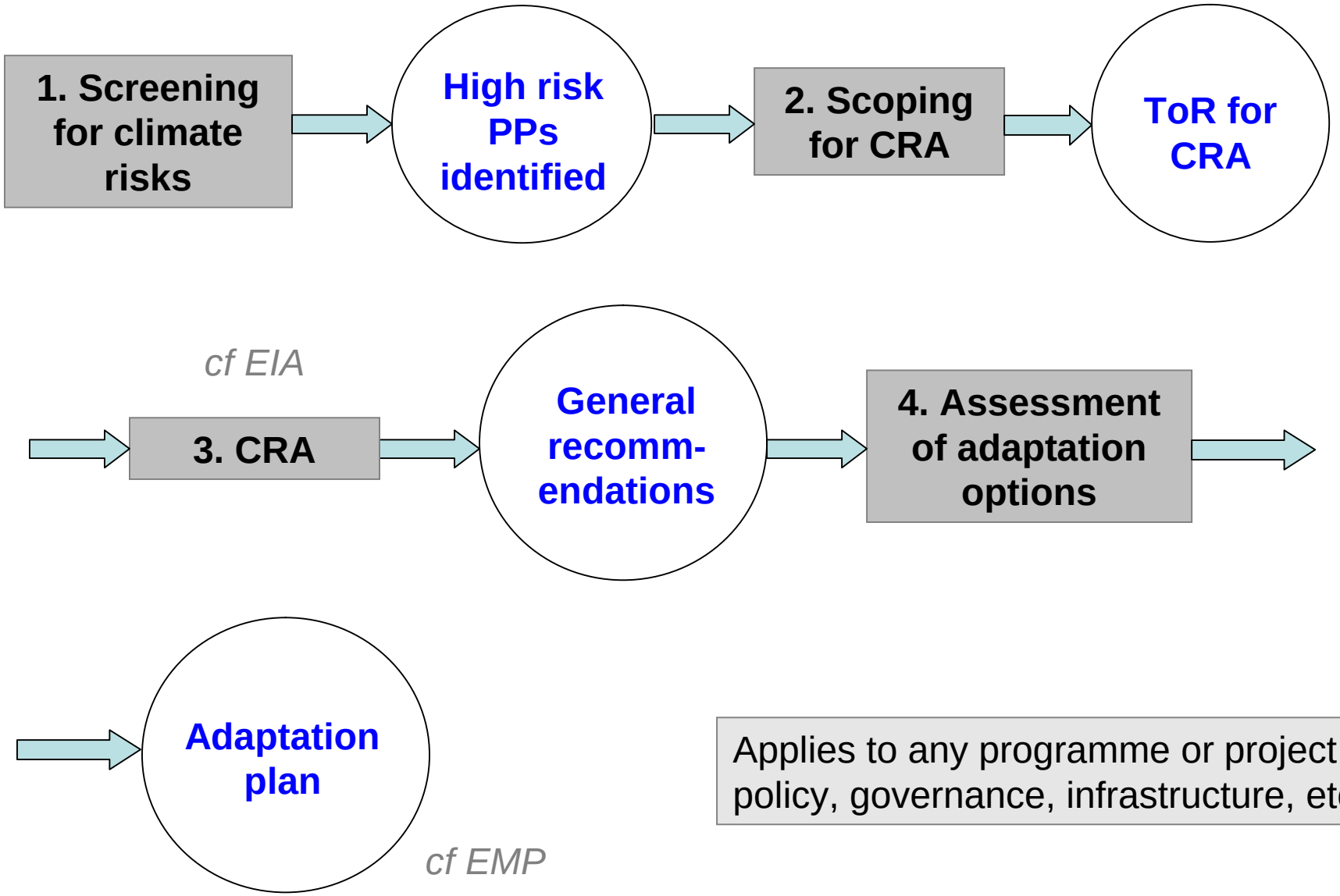
Why do we do it?

- To ensure that CC does not undermine goals, objectives & outcomes of programmes and projects (PPs)
- To ensure PPs do not inadvertently increase vulnerability and drive maladaptation
- To ensure that opportunities to make development climate-resilient and “climate friendly” are identified and exploited
- To ensure that development is appropriate, viable and sustainable in the face of climate change

CRA & the Cycle of Operations

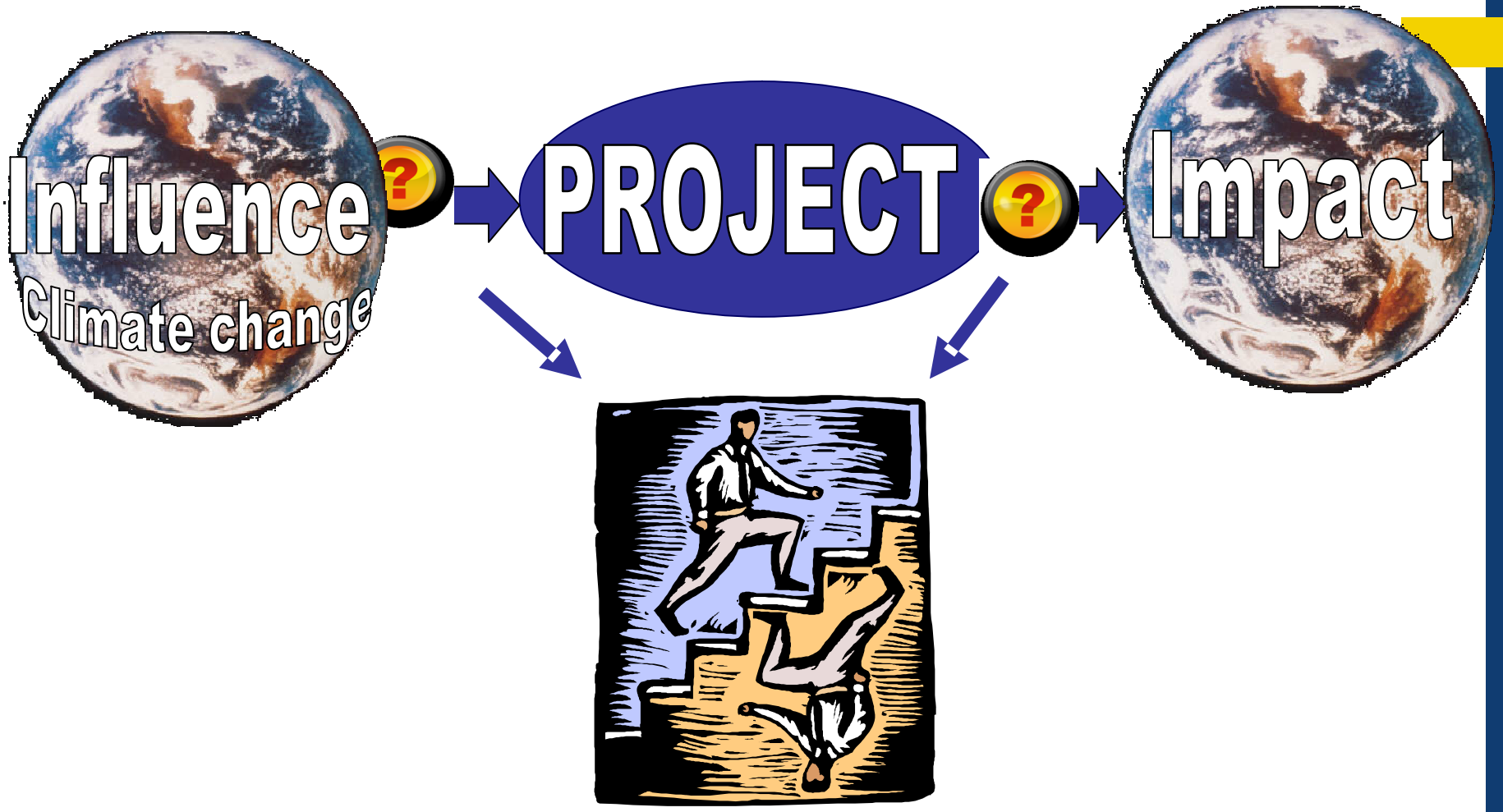


Steps in the process



Applies to any programme or project - policy, governance, infrastructure, etc

Project screening – concept



Screening process

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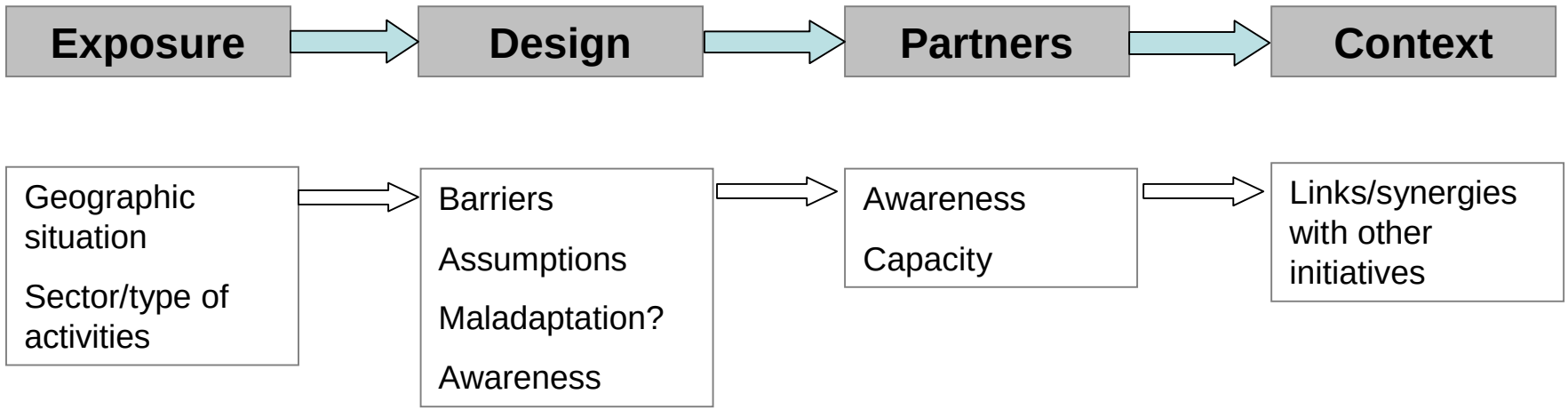
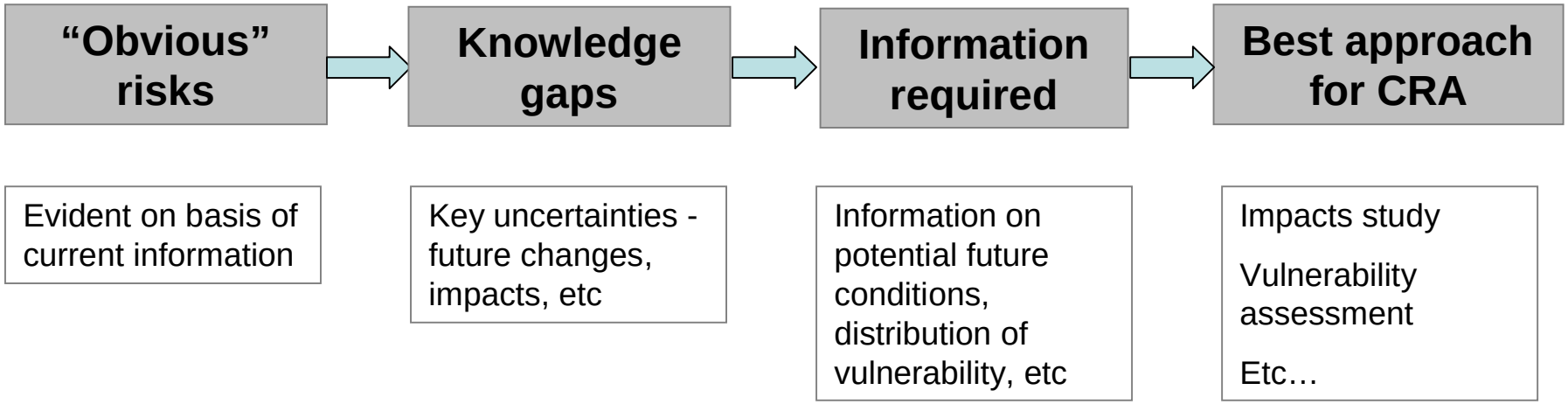
- As early as possible in cycle, alongside screening for EIA
- Guidance in Annex 7 of Guidelines on the Integration of Environment and Climate Change in Development Cooperation



- Is project high risk?
- Does project already consider/address climate change risks?
- Are risks such that they can be addressed alongside implementation?
- Is a more detailed risk assessment needed?

Scoping process

- Effectively a rapid, “in-house” climate risk assessment
- Identifies knowledge gaps & needs, provides framework within which more detailed CRA can be performed, if required



- Where PP identified as potentially at risk (screening), CRA may or may not be required
- Some risks may be easily identified & addressed during formulation & implementation

Scoping versus screening

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- Screening process (Annex 7) does not require any consideration of climate information
- Scoping is about identifying potential risks by matching info on programme/project with info on climate change

Framing questions for a scoping study

- Can climate risks be identified and assessed adequately in-house, on basis of information already available?
- Is more information needed? Do we know what, and where to find it? Can we access and assess this in-house?
- Do we need to commission a CRA by external experts?

Performing a scoping study

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Option 1: basic, in-house CRA

- Use limited set of prescribed information sources to assess implications of climate change in more detail
- Identify strategies & measures to address risks
- Incorporate into project/programme design/implementation

Option 2: commission detailed, external CRA

- Scoping study to identify information gaps & required information
- Draw-up ToR for detailed CRA
- Identify expertise to carry out CRA
- How much time to allocate?

- Both involve scoping activities based on assessment of readily accessible climate information and/or identification of key questions regarding risks linking climate change & development activities
- 1 may lead to decision that 2 is required

Climate information needs

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- Current & emerging hazards (observations, experience)
  - Variability and recurrent extremes ("normal" climate hazards)
  - Emerging trends & changes in mean conditions
  - Changes in variability & extremes, new hazards?
  - Emerging impacts, extrapolations
- Projected changes & climate scenarios
  - Key variables (temp., rainfall; means, extremes, abrupt change?)
  - How many scenarios/projections considered - representative?
  - What is range of uncertainty?
- Potential implications
  - CC impacts, vulnerabilities, wider risks?
  - Implications for goals, objectives, outcomes of PP in question?

Finding climate information

- IPCC reports
  - Working Group I, Ch. 11 on regional climate projections
  - Working Group II, various regional & sectoral chapters

    www.ipcc.ch
- NAPAs & NCs
  - National reports: trends, projections, vulnerabilities, priorities

    http://unfccc.int/national_reports/items/1408.php
- National Communications Support Programme
  - Country documents (including NCs, others)

    http://ncsp.undp.org/
- Climate Change Country Profiles
  - Key data on climate trends & projections, selected countries

    http://country-profiles.geog.ox.ac.uk/

Web-based data platforms

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- GLOBALIS (UNU) Interactive maps (projections etc)
  - http://globalis.gvu.unu.edu/
- World Bank Climate Change Data Portal (temp. & precip. variability)
  - http://iridl.ldeo.columbia.edu/maproom/.Global/.World_Bank/
- World Bank Climate Change Data Portal
  - http://sdwebx.worldbank.org/climateportal/
- NCAR GIS Climate Change Scenarios (selected variables)
  - http://www.gisclimatechange.org/CCSMDownloadWizard.htm

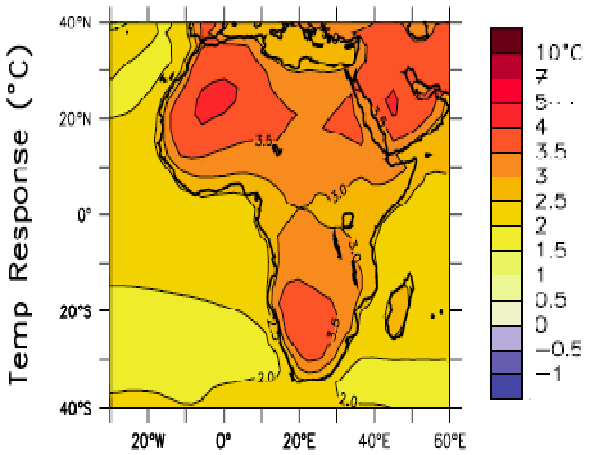
- When looking at projections, note that IPCC high emissions A2 scenario is closest to current emissions rates. Lower emissions scenarios likely to be conservative.

Informational contexts

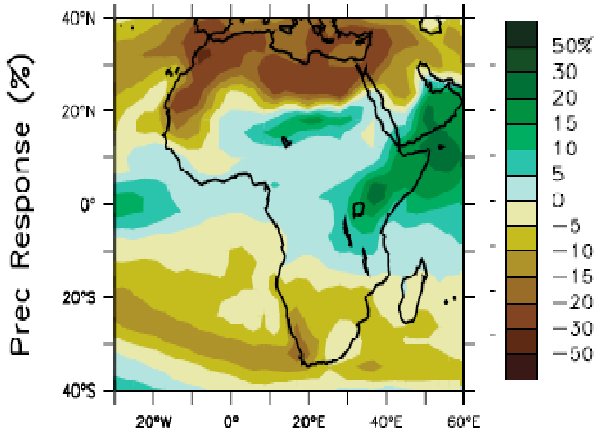
- Different types of risks in different parts of Africa
- N. Africa & southern Africa - desiccation, desertification
- E. Africa - wetter, focus on variability & extremes
- Sahel - wetter? Planning needs to address high uncertainty

Projections for 2081-2100 relative to 1981-2000, A1B scenario

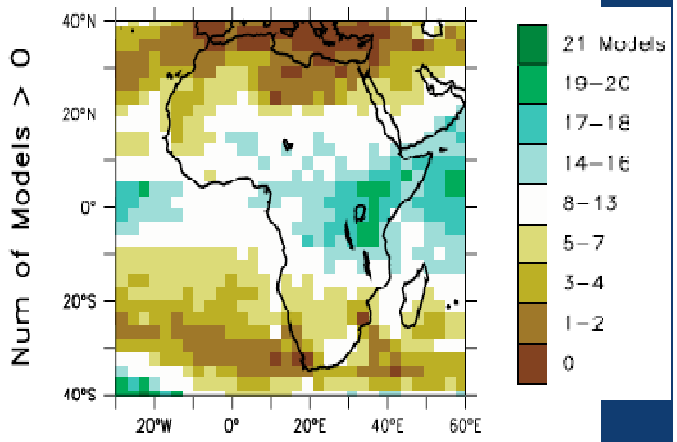
Mean annual temp



Mean annual precipitation



Models predicting higher precip.



Graphic Source: IPCC AR4 WGI Ch.11 (Christensen et al.,2007, p.869)

Infrastructure scoping (example)

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World Bank 2nd Port Cities Dev. Project (Yemen)

- Ø Infrastructure Development ($32 million)
- Ø Technical Assistance & Training ($1.5 million)
- Ø Project Management ($1.5 million)
- Ø Infrastructure at fishing port & around district markets; service delivery in coastal settlements; airport & road improvements; asset management; training/capacity; budgeting; project management

- Hazards: current & future extremes, sea-level rise
- Risks: physical damage, disruption, demand, long-term deterioration
- Knowledge gaps, existing capacities, expertise, awareness
- Questions for CRA
  - Ø Rate of SLR, frequencies of extremes, uncertainties, range of scenarios
  - Ø Areas at greatest risk, vulnerable groups
  - Ø Costs of impacts & adaptation measures
  - Ø Measures to reduce risks, monitor, build capacity, etc

Agriculture scoping (example)

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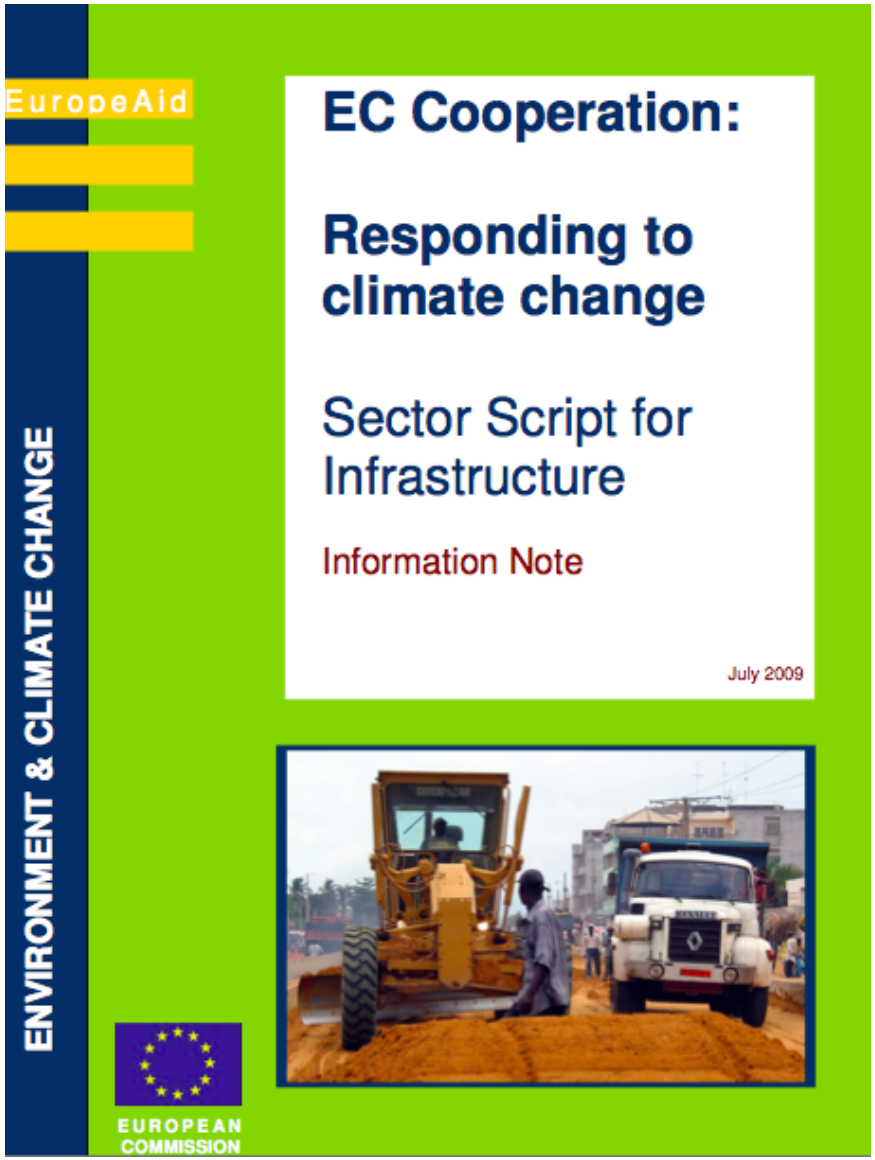
World Bank Niger Agro-Pastoral Export & Market Development Project

- Ø Supply chains: coordination, key operator support ($12 million)
- Ø Finance: grants, credit access, technology etc ($17 million)
- Ø Securing irrigation potential: boreholes, micro-dams, site protection, feeder roads for markets, environmental Monitoring & management ($7 million)

- Hazards: drought, desiccation, heavy rains (floods)
- Risks: irrigation/production failure, crop/infrastructure damage, etc
- Knowledge gaps, existing capacities, expertise, awareness
- Questions for CRA
  - Ø Range of possible changes in rainfall (mean, extremes, seasonality)
  - Ø Sustainability of agric. & irrigation under different climate change scenarios
  - Ø Risks to infrastructure, costs/feasibility of adaptation

Climate change sector scripts



- Agriculture and rural development
- Ecosystems and biodiversity management
- Education
- Energy supply
- Health
- Infrastructure
- Solid waste management
- Trade and investment
- Water supply and sanitation

EuropeAid/E6 Intranet pages

http://www.environment-integration.eu/component/option,com_docman/task,cat_view/gid,109/Itemid,278/lang,en/

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3. CRA: elements & approaches

CRA: some general considerations

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- Alongside EIA (project) or as part of SEA (sector/programme)
- EIA looks at impacts of policy/programme/project ON environment
- CRA looks at
  - Impacts of PP on env. (e.g. vulnerability, maladaptation)
  - Impacts of env. (i.e. climate) ON PP (e.g. sustainability, costs)
- All types of CRA require assessment of climate-related information
- Key consideration will be how to deal with uncertainty
- Expert judgment will play key role (e.g. national, international consultants)

CRA process

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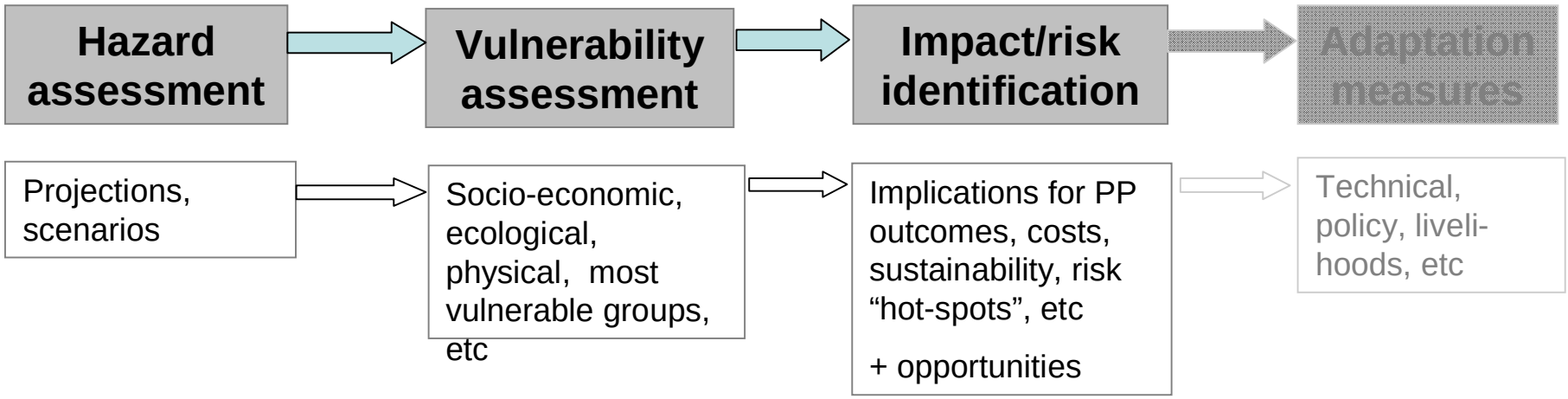
Ideally will consist of

1. Characterisation of future climate changes & associated hazards (type, rate of change, magnitude, distribution)
2. Assessment of vulnerability of systems of interest
3. Combining of above to identify what sort of impacts are likely, when they will occur, how they are distributed, etc



- However, such a detailed assessment may not be possible given information available - may be more emphasis on hazard than vulnerability or vice versa
- Different approaches are therefore required for different CRA contexts

Different approaches to CRA

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- Risk mapping
- Vulnerability assessment
- Participatory assessment
- Impacts studies / modelling
- Sensitivity studies
- Expert judgment / review
- Combination of above

Which CRA approach to use?

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Method chosen will depend on a variety of factors

- Context (e.g. infrastructure, poverty reduction, etc),
- Scale of analysis (e.g. global, regional, national, district)
- Intervention target (e.g. region, sector, community, project)
- Emphasis (e.g. immediate benefit, long-term planning)
- Availability & quality of information
- Time, expertise & funding available
- Investment, impacts & lifetime of proposed intervention

1. Risk mapping

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- Risk = f (exposure to hazard, underlying vulnerability)
- Map distribution of hazards & vulnerability separately
- Risk "hot-spots" where both hazards & vulnerability high

- Requires indicators to represent hazards & vulnerability
  - Eg. Hazard indicators: projected changes in temperature, rainfall, runoff, evapotranspiration, etc
  - E.g. Vulnerability indicators: existing water stress, access to improved water sources, dependence on agriculture, average household income, etc

Example: risk mapping for natural hazards in Columbia

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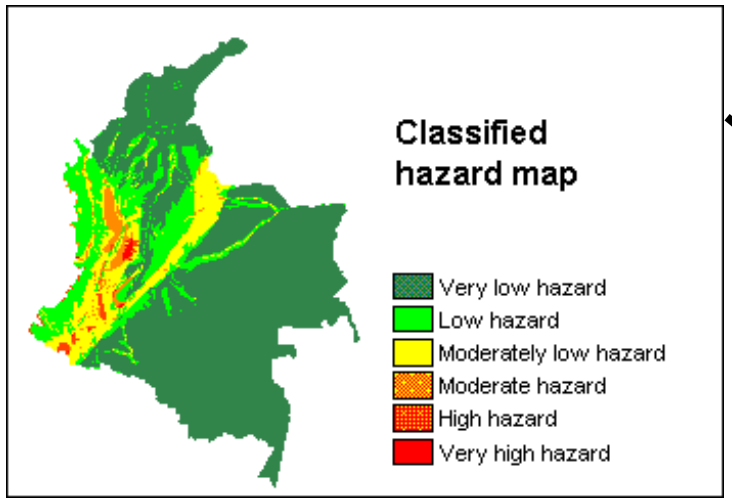
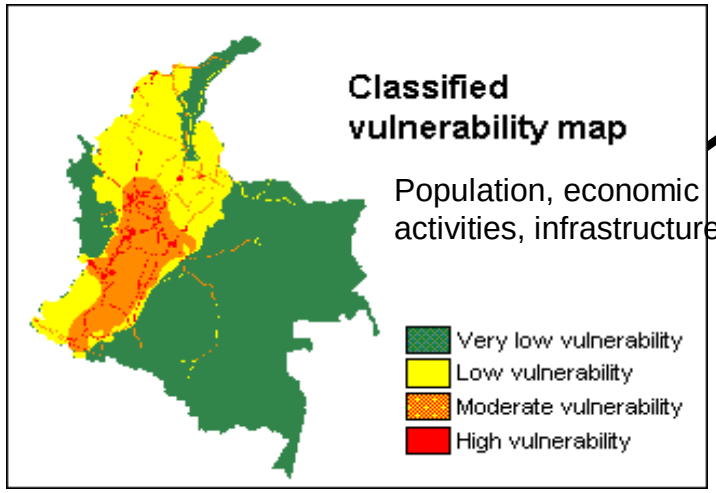
1. Map distribution of hazard

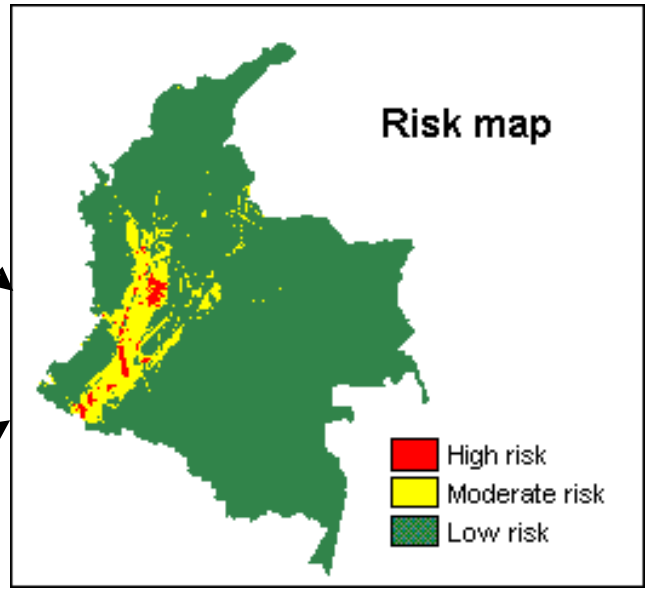


2. Map distribution of vulnerability



3. Combine information:

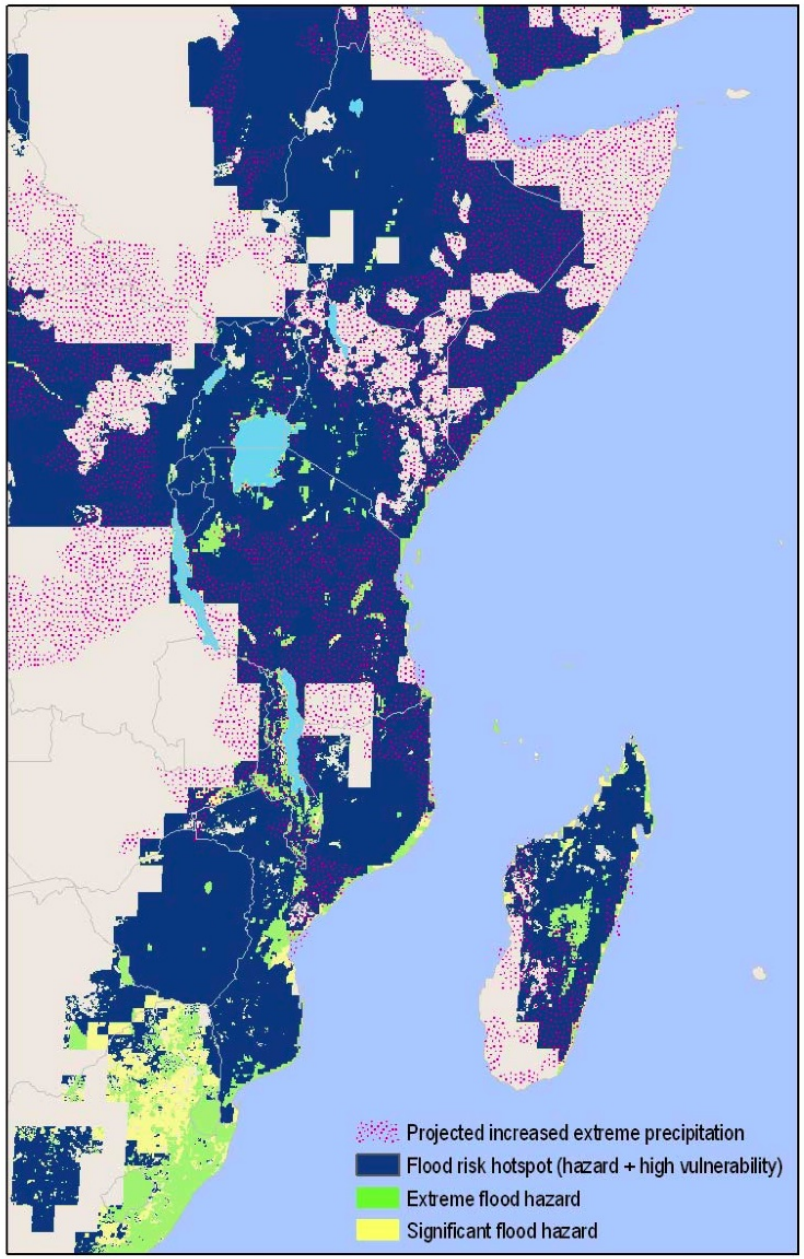
risk = hazard x vulnerability



4. Prioritize high-risk areas / communities for assistance

Source: www.itc.nl/ilwis/applications/application01.asp

Example: Mapping flood risks in East Africa



Flood risk hotspots based on interaction of extreme & significant flood hazard & high overall human vulnerability.

Also shown are areas with significant or extreme flood hazard but lower human vulnerability and areas where climate models predict an increase in extreme precipitation.

Hazard represented by flood mortality + projected changes in extreme precipitation

Vulnerability represented by variety of social, environmental, economic, governance & other indicators

"Climate change and human vulnerability: Mapping emerging trends and risk hotspots for humanitarian actors" Copyright © 2008 Cooperative for Assistance and Relief Everywhere, Inc. (CARE). Used by Permission.

Source: http://www.reliefweb.int/rw/lib.nsf/db900SID/AMMF-7HUJ4T?OpenDocument

2. Vulnerability assessment

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Focus on vulnerability rather than hazard (qualitative and/or based on quantitative indicators/mapping), where future hazard evolution uncertain, intensification of current hazards, or similar exposure (e.g. differentiated risks driven by relative vulnerability)

Example: Vulnerability Assessment, Atapeu Province, Lao PDR[1]

- Existing vulnerability to floods (current climate variability)
- Field study at village level, focus groups
- Identification of impacts (+ mechanisms), coping strategies
- Qualitative extrapolation, recommendations
- Focus on understanding processes & mechanisms

- Other studies might focus more on identifying most vulnerable based on qualitative reasoning, indicators, mapping

Principle that addressing current vulnerability will contribute to adaptation

[1]http://www.mekongwetlands.org/Common/download/Laos_Vulnerability_Assessment_w_cover.pdf

3. Participatory assessment

How do people perceive risks, and drivers of vulnerability? Might be component of wider vulnerability assessment

Example: Zimbabwe Coping with Drought & CC (UNDP)[1]

- Adaptation of rural agricultural & pastoralist communities
- "Problem tree analysis to help communities identify why they were vulnerable to drought"
- Participants identified 5 types of drought & prioritised for adaptation
- Little meteorological data, but participatory analysis illuminated spatial differences in risk
- Some modelling results validated by participatory analysis
- Value added to agro-met data (more info on drought dynamics)

Scenario planning

- Participants discuss potential impacts of projected changes
- Identify risks, potential adaptation options

[1]http://www.adaptationlearning.net/experience/coping-drought-and-climate-change

4. Impacts studies

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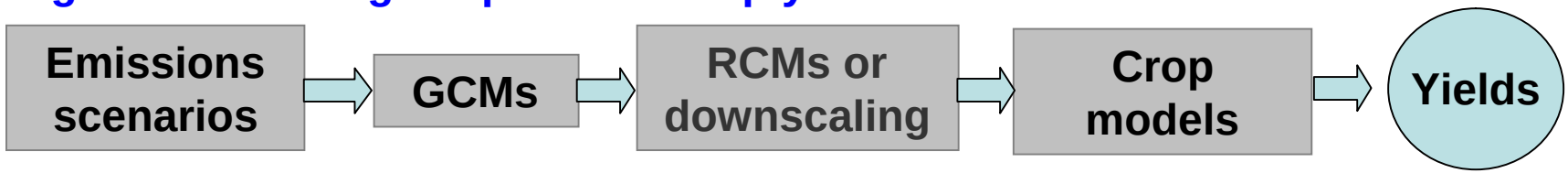
Technical studies, usually involving elements of modelling, for example using output from global climate models (GCMs) as input to other models

E.g. climate change impacts on crop yields:



Example: IFPRI CC Impact on Agric. & Costs of Adapatation[1]

- A2 emissions scenario drives 2 GCMs
- Temp. & precip. changes input into DSSAT biophysical crop model
- DSSAT results input into IMPACT agric. supply & demand model
- Global study - many other regional or country studies

- Other examples include studies of costs of climate change and costs of adaptation, e.g. Economics of CC in Kenya (SEI), which uses model out put and more qualitative methods to estimate costs

[1]http://www.ifpri.org/publication/climate-change-impact-agriculture-and-costs-adaptation

5. Sensitivity studies

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Examine impacts of plausible changes in key variables, e.g. where future changes uncertain or climate model output not available

Example: Agoumie (2003) - water resources in Morocco

- Impact of 1º C warming over catchment of largest dam in Morocco
- Indicated such a warming would reduce surface runoff by ~10%
- Did not consider changes in rainfall, prescribed warming small
- >3.5º C warming & •40% rainfall decline by 2100, A1B scenario
- Actual warming could be significantly greater
- Broadly indicative, large water losses - entry point for further studies

- Other examples include studies of sensitivity of groundwater recharge to changes in precipitation & runoff; sensitivity of crops to prescribed changes in temperature & precipitation, etc.

6. Expert judgment/review

Likely solution where time, resources & internal capacity limited - external consultants combining in-depth review of relevant literature & studies with some additional quantitative or qualitative analysis

E.g. Red Sea Dead Sea Water Conveyor (RSDSC)[1]

- 30 day climate change study to assess (i) direct risks of CC to project, (ii) implications of CC for project impacts
- Review of scientific literature, consultation with regional experts, expert judgment of consultant, synthesis
- Broadly qualitative assessment with some quantitative elements as reasonable given uncertainties & available data/projections
- CC implications for RSDSC feasibility (e.g. meeting water demands from desalination, achieving Dead Sea “rehabilitation”)
- CC mediation of environmental impacts (e.g. on Gulf of Aqaba circulation & along proposed route in Wadi Araba)

[1]http://go.worldbank.org/9BEGALRN40

Designing a CRA

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Perform scoping study & use as basis for CRA ToR

- What are main risks (broadly defined) likely to be?
- What are the key knowledge gaps?
- What further information is required for PP design & adaptation?
- What sort of information is available/required?
- Which CRA approach(es) is/are most appropriate?
- What will the CRA outputs be?
- Who should perform the CRA, with what tools, & how much time?

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Activity 2

Developing ToR for a CRA

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4. Adaptation

CRA as a basis for adaptation

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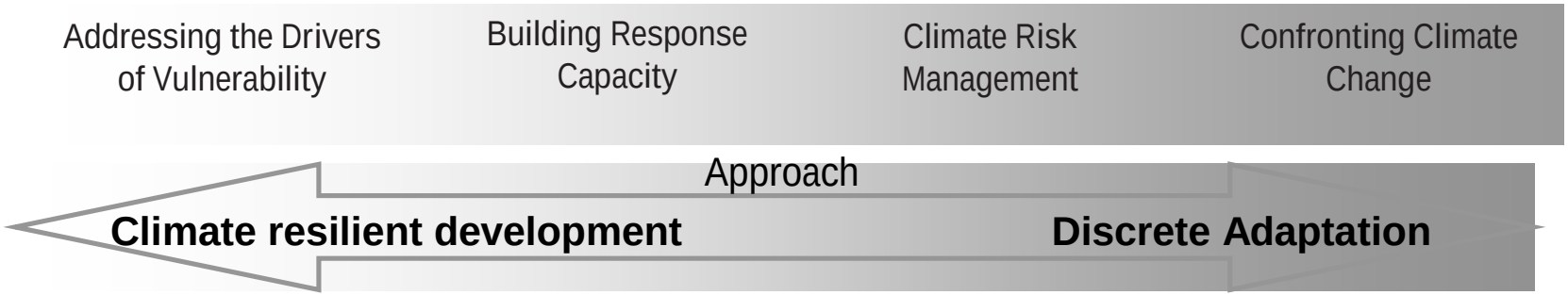
- Ultimate purpose of CRA is to facilitate adaptation
- CRA forms basis for identification of adaptation interventions
- Such interventions heavily context dependent but need to
  - ø fulfill criteria of feasibility, efficacy, acceptability
  - ø be costed (financial, economic, social, environmental)
  - ø be - as far as possible - “win-win” (dev. benefits anyway)
  - ø be sustainable (e.g. short-term measures complement long-term strategies)

Ø Adaptation plan might be output of CRA

Examples of adaptation measures



- Livelihood diversification
- Soil & water conservation
- Better information systems, including seasonal forecasts
- Risk spreading, e.g. insurance
- Climate sensitive building design
- Improved infrastructure (roads, drainage)
- Better NRM

Scenario planning

Awareness raising - risks, options

Piloting new crops, livelihoods

- Upgrading coastal infrastructure for specified sea level rise
- Developing desalination capacity to replace water lost to CC
- Planned substitution of economic activities threatened by CC
- Assisted, voluntary location away from areas at high risk

Web-based adaptation resources

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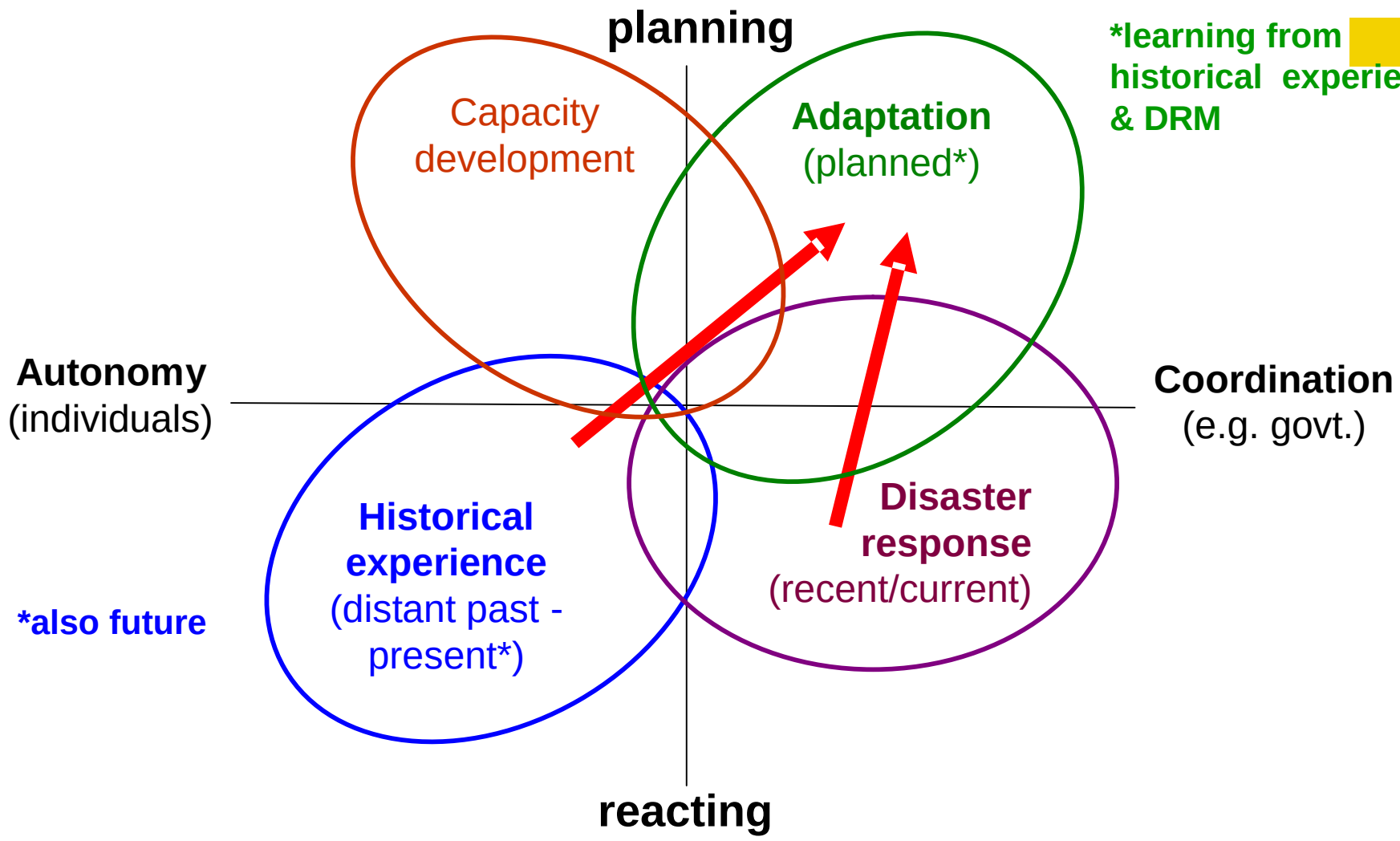
- Examples of EU Development Cooperation to address climate change
  - http://ec.europa.eu/europeaid/climate-change-actions/
- Adaptation Learning Mechanism
  - http://www.adaptationlearning.net/
- Eldis Climate Change Adaptation web resources
  - http://www.eldis.org/go/topics/dossiers/climate-change-adaptation
- WRI Climate Change Database (Vulnerability & Adaptation)
  - http://projects.wri.org/adaptation-database
- AIACC Reports
  - http://www.aiaccproject.org/Final%20Reports/final_reports.html
- Climate Funds Update Project (including adaptation funding)
  - http://www.climatefundsupdate.org/Home

The evolution of adaptation



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