Atelier 4C-Maroc

Adaptation aux changements climatiques, enjeux et solutions au Québec et au Maroc

Les enjeux de la résilience climatique au Maroc

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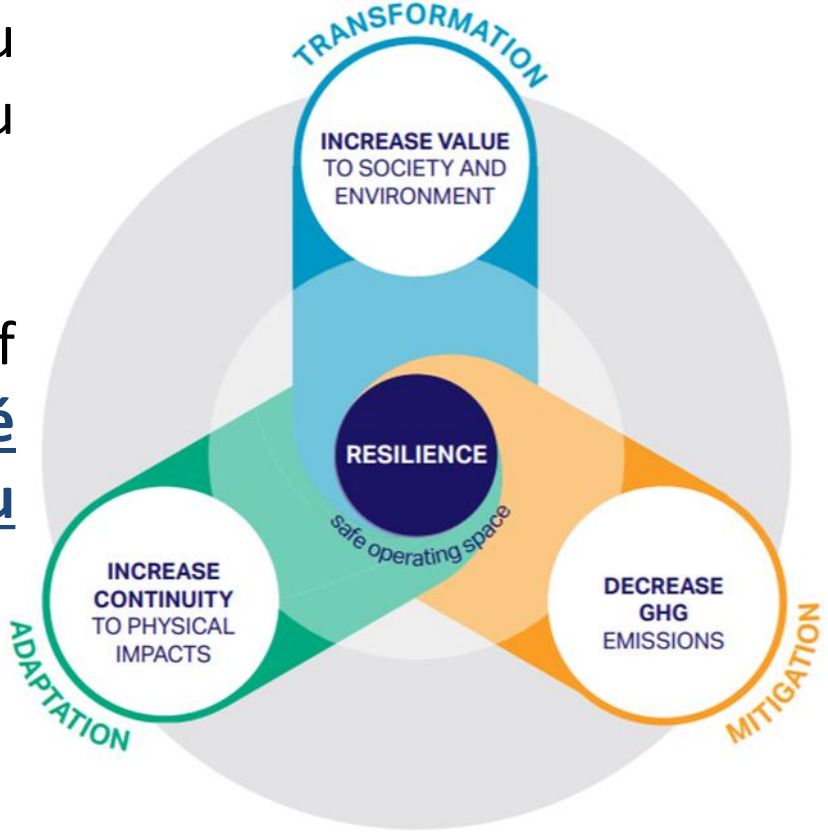
La résilience est la capacité de faire face au changement et de continuer à se développer

- La résilience climatique est la capacité **d'anticiper**, de **se préparer** et **de réagir** aux événements, tendances ou perturbations dangereux liés au climat.

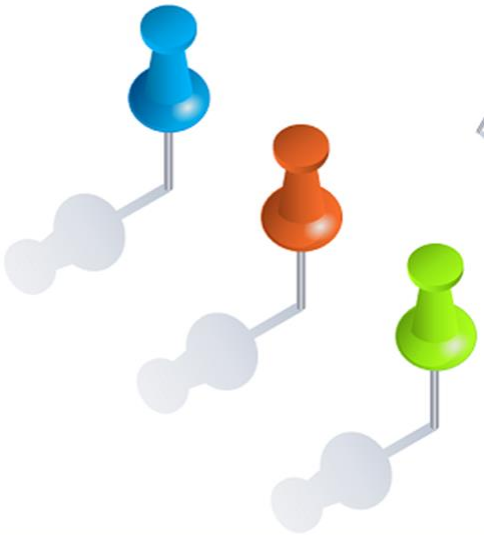
- La résilience est un attribut positif lorsqu'elle maintient une **capacité d'adaptation**, **d'apprentissage et/ou de transformation**

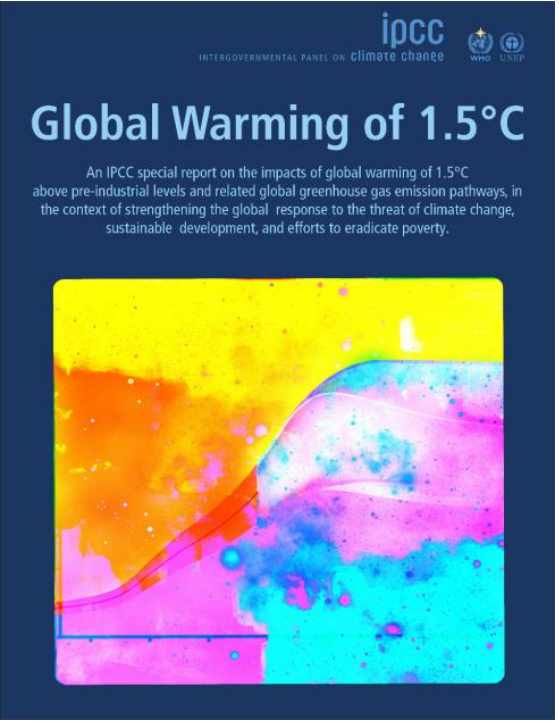


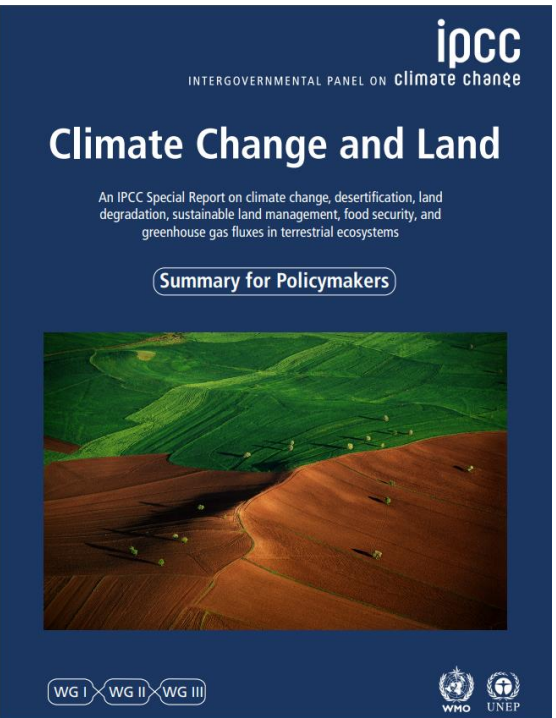
Business Climate Resilience: Thriving Through the Transformation (2019)

La résilience climatique part de la conviction que

- les systèmes humains et naturels sont fortement interconnectée aux variations et changements du climat
- L'action non correctement réfléchie de l'homme a des répercussion néfaste sur le climat et le système climatiques entier
- la capacité « d'innovation » qui nous a mis dans la situation/fragilité climatique actuelle peut également être utilisée pour nous en sortir

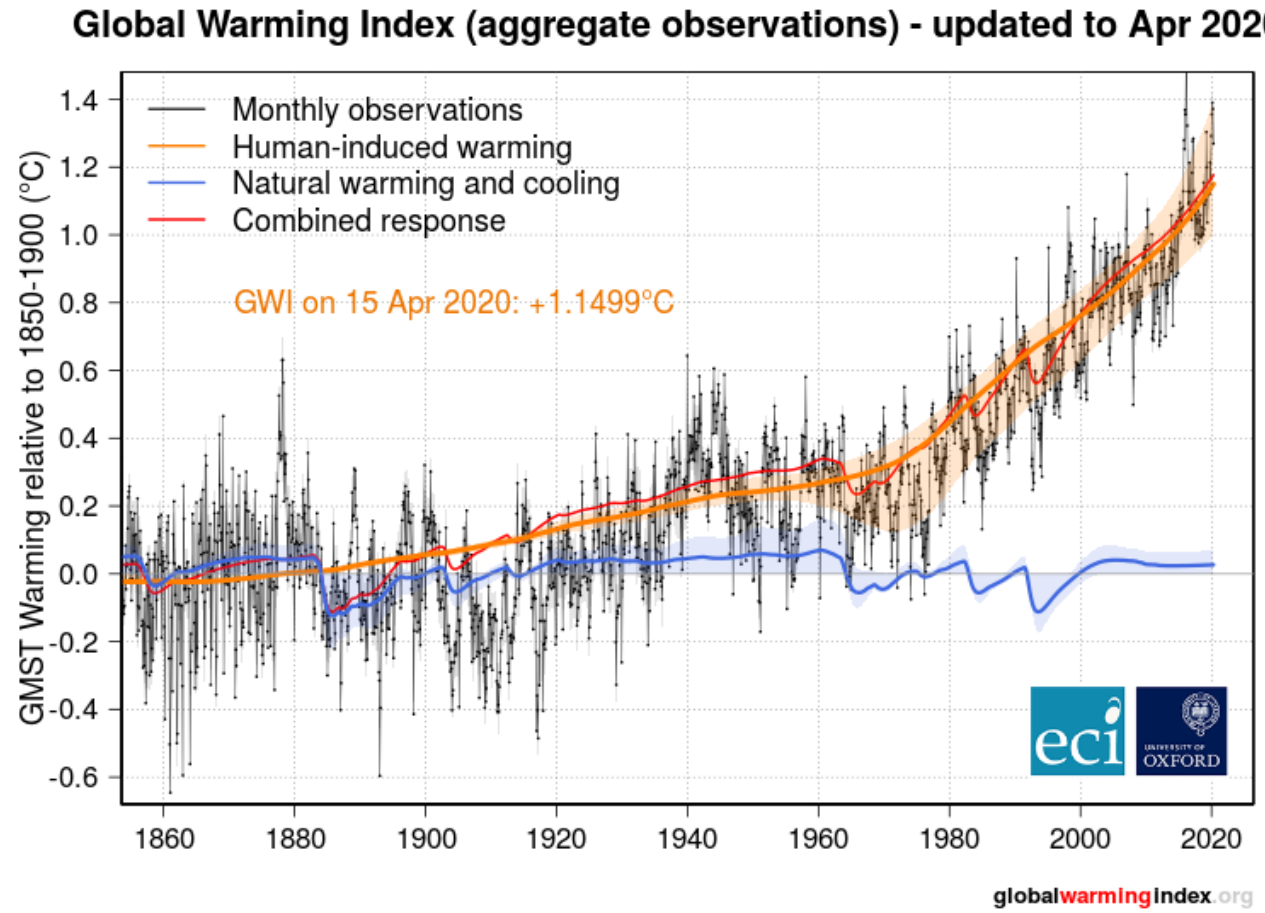




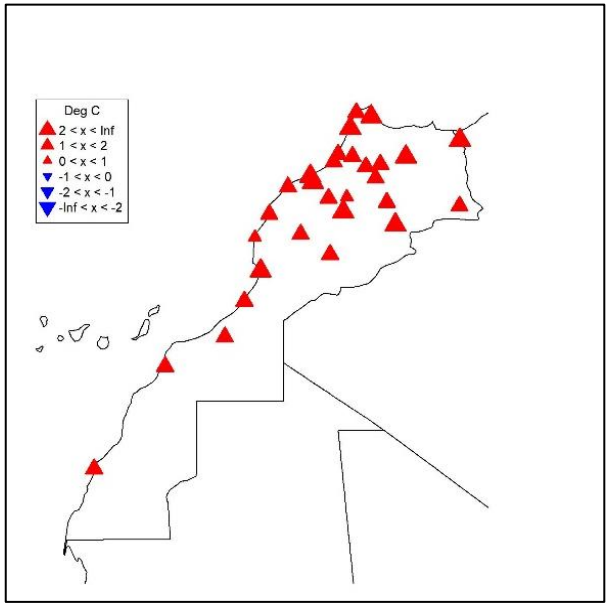


- Human-induced global warming has already caused multiple observed changes in the climate system.
- The global climate has changed relative to the preindustrial period with **multiple lines of evidence that these changes have had impacts on organisms and ecosystems, as well as human systems and wellbeing.**
- Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, **increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.**
- Limiting climate change would require substantial and sustained **reductions in greenhouse** gas emissions which, together with **adaptation,** can limit climate change risks.
- Past emissions alone do not commit the world to 1.5°C

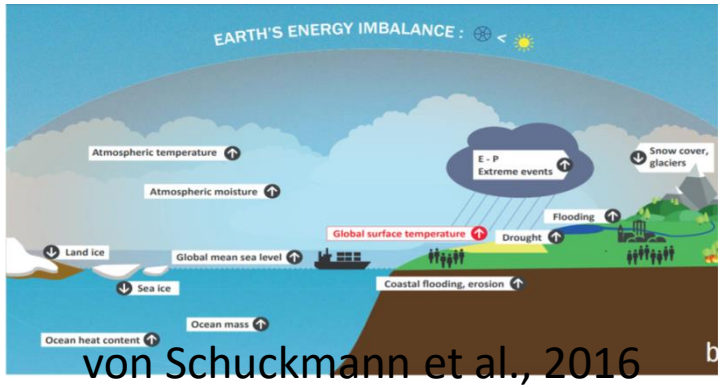
Réchauffement à la surface de la terre



Une échelle spatiale appropriée est nécessaire

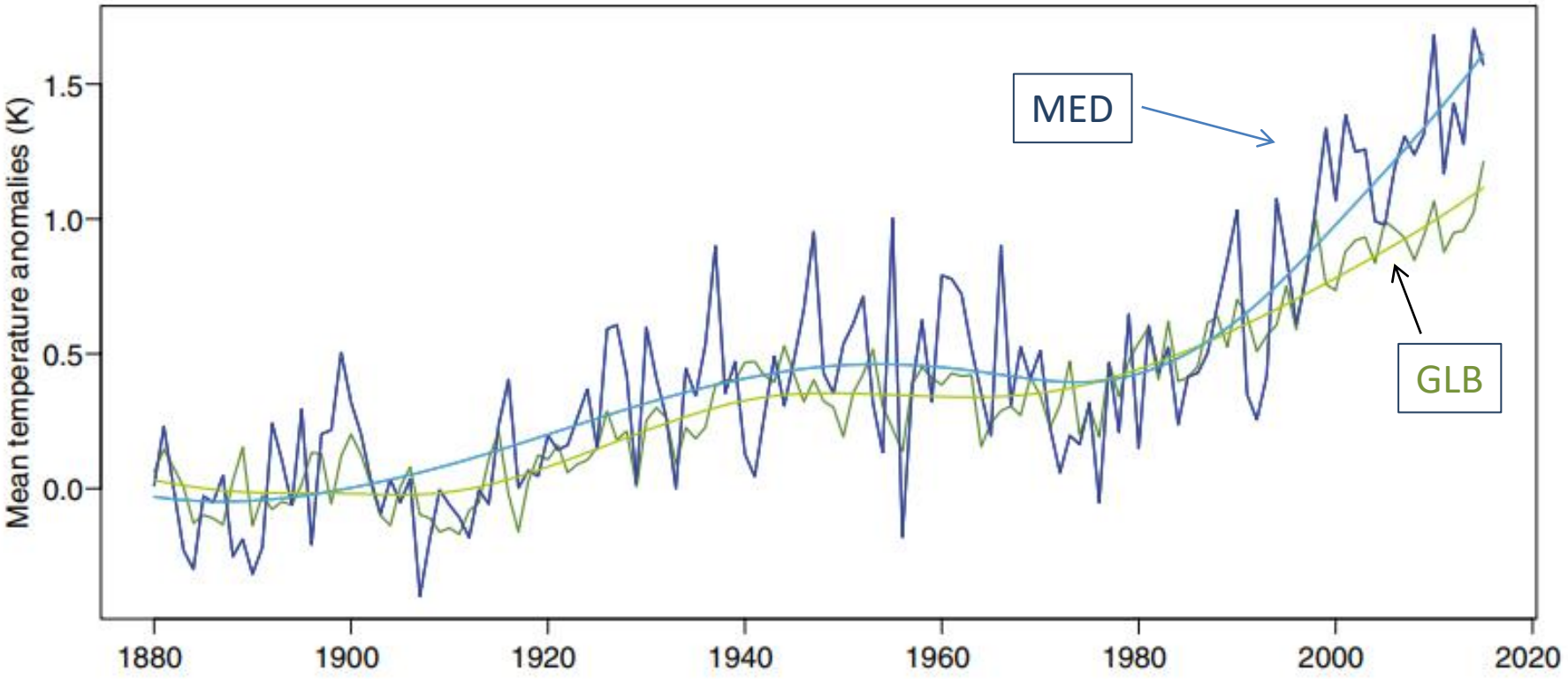


Driouech, et al.



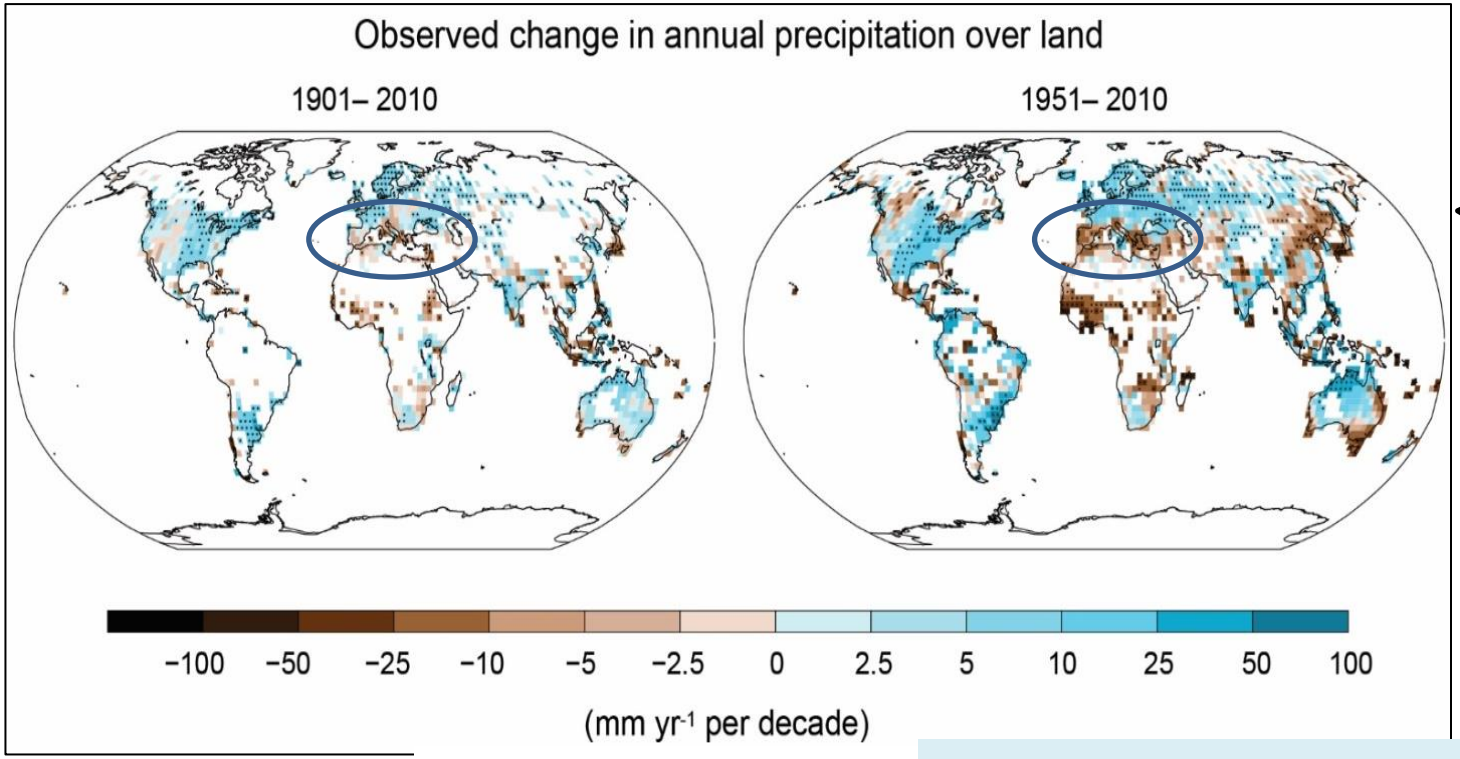
von Schuckmann et al., 2016

IPCC SRCCL: "Warming has resulted in an **increased frequency, intensity and duration of heat-related events**, including **heat waves** in most land regions (high confidence). Frequency and intensity of **droughts has increased** in some regions (including the **Mediterranean**, ..."



Historic warming of the atmosphere globally and in the Mediterranean Basin. Annual mean air temperature anomalies are shown with respect to the period 1880–1899, with the Mediterranean Basin (blue) and the globe (green) presented with (light curves) and without (dark curves) smoothing. (Cramer et al, 2018)

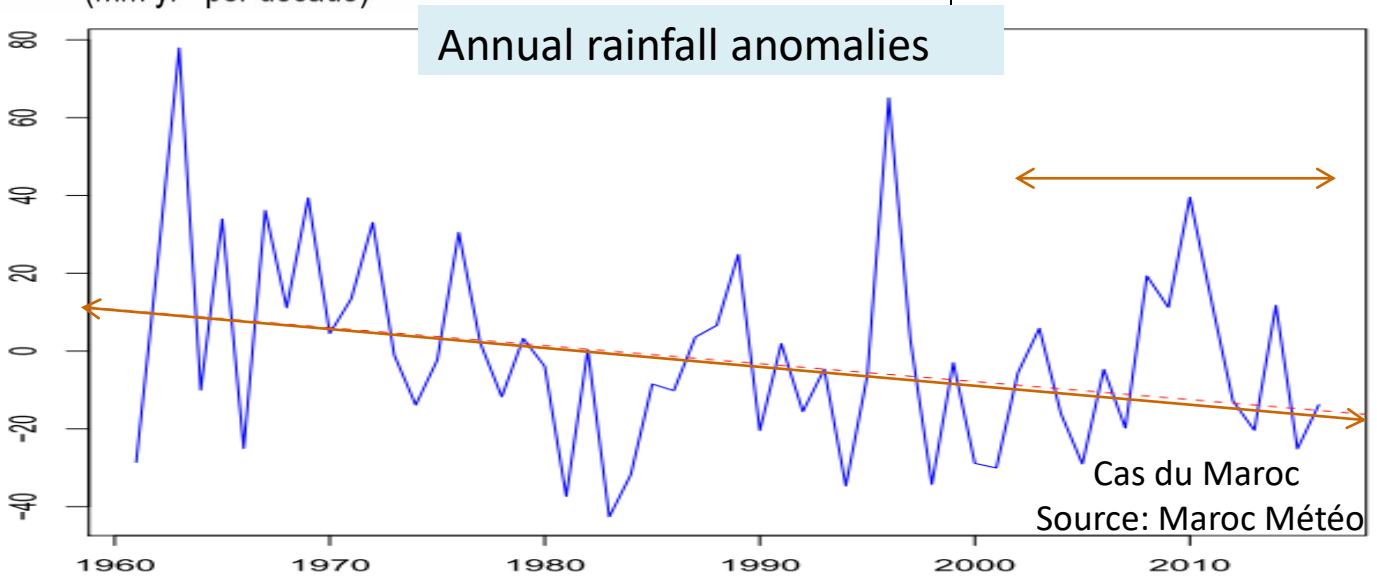
➔ Decrease in total rainfall amounts in the Mediterranean



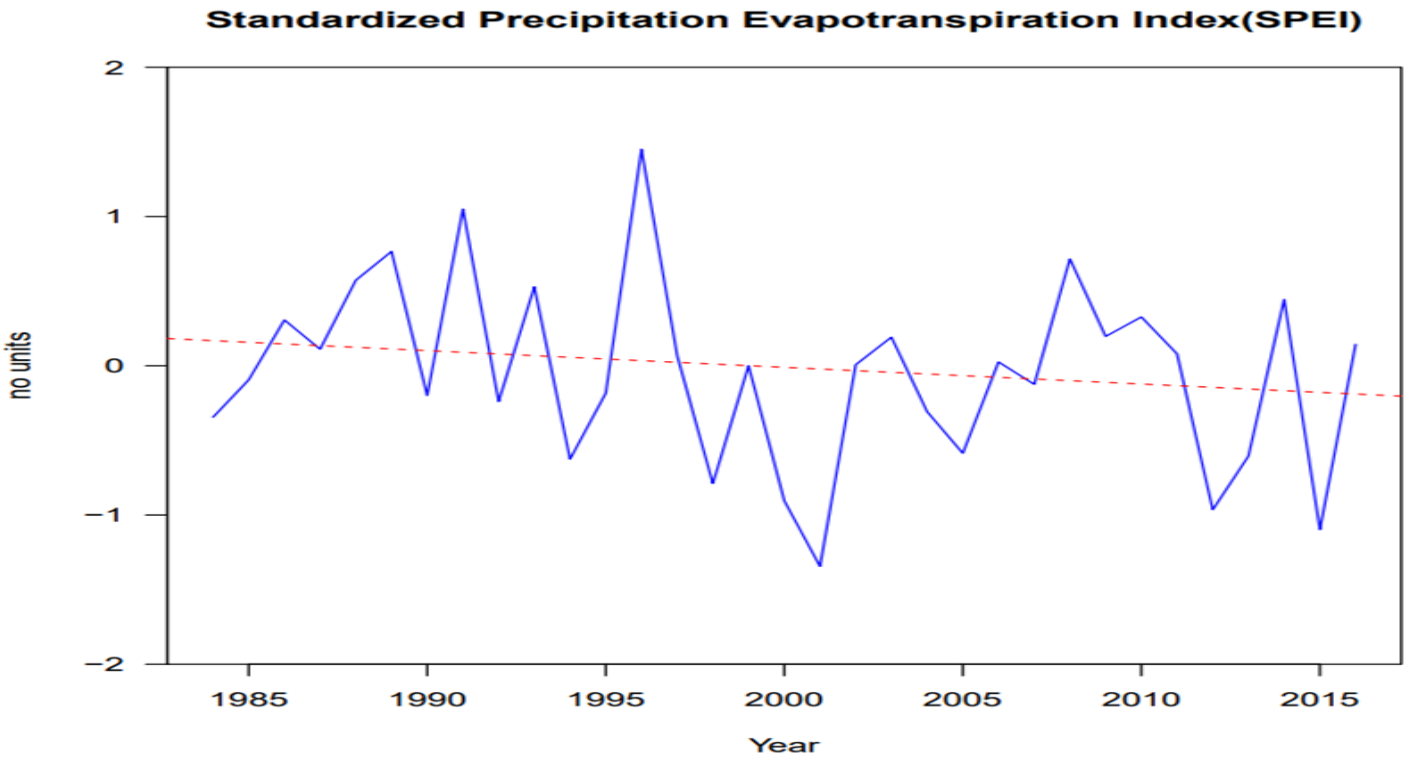
Une échelle de temps appropriée est nécessaire

IPCC AR5

Suivi & Evaluation



Une échelle spatiale appropriée est nécessaire



Driouech et al.

Climat

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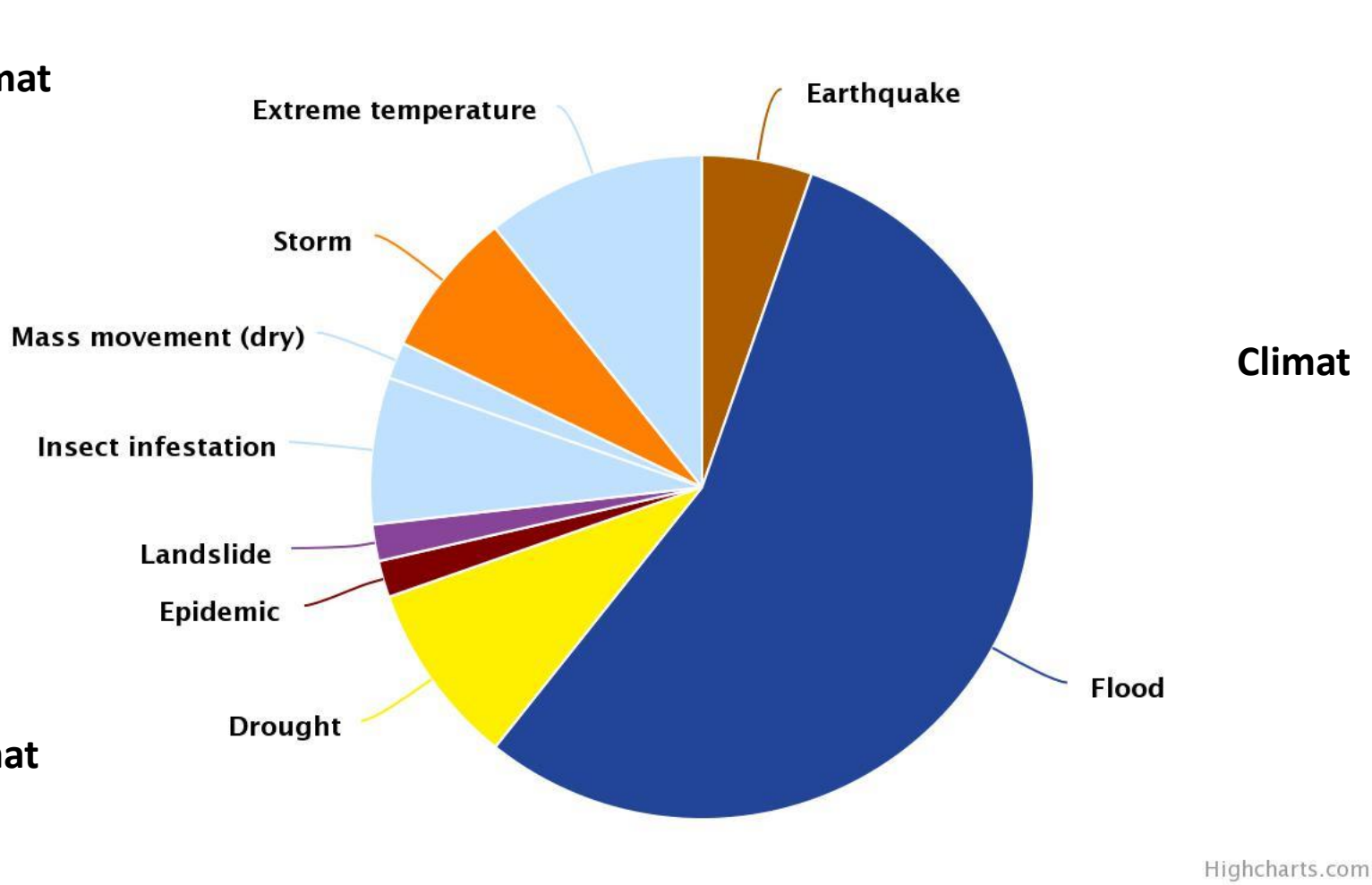

Les aléas climatiques comptent pour plus des 3/4

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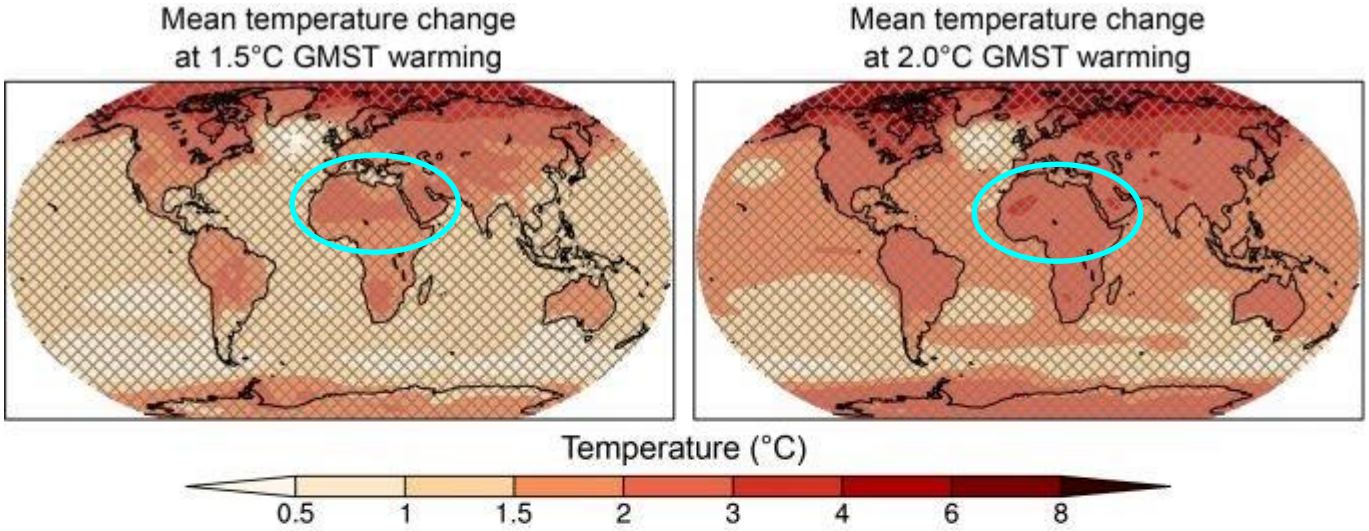
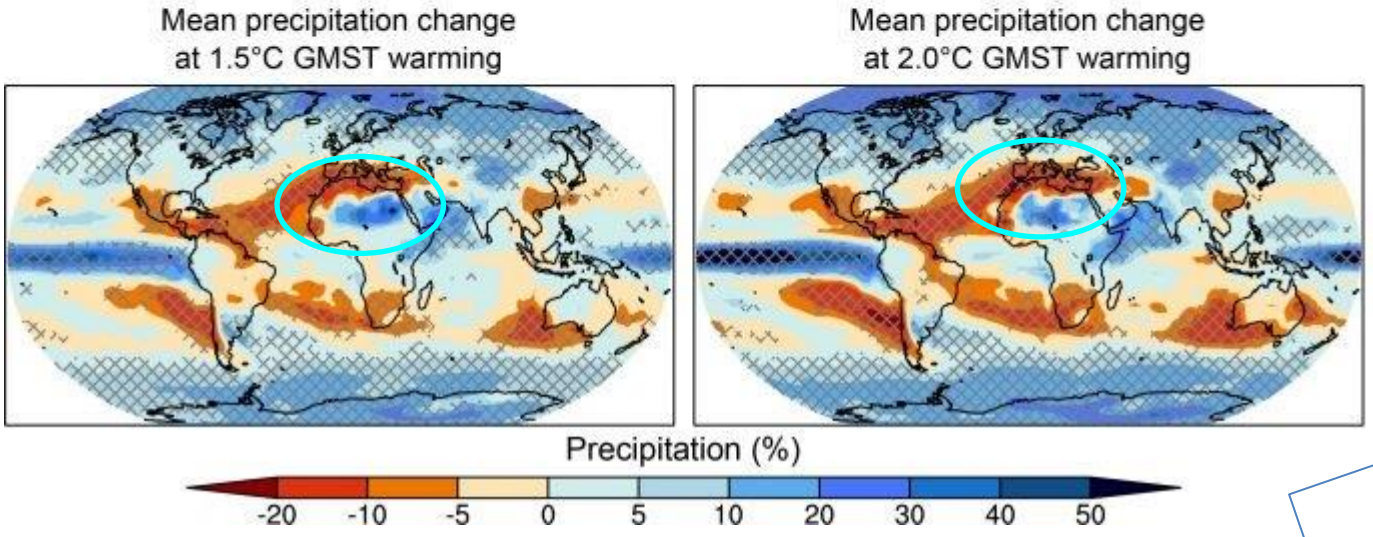
Changements futurs selon le degré de réchauffement global



Changement de température moyenne annuelle

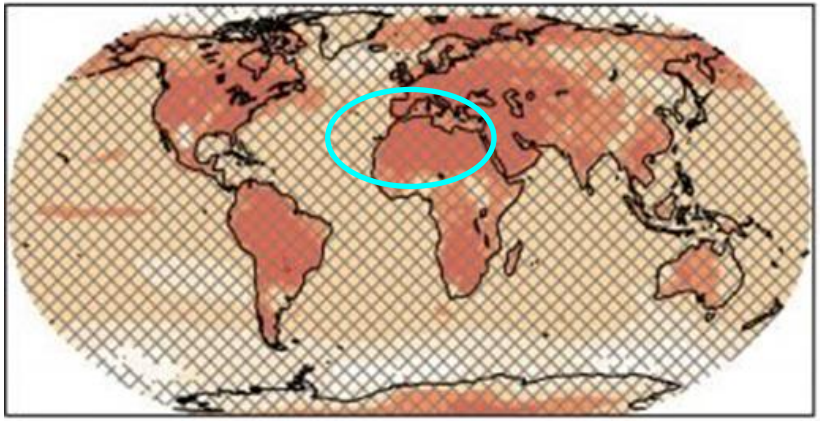


Changement de précipitation annuelle

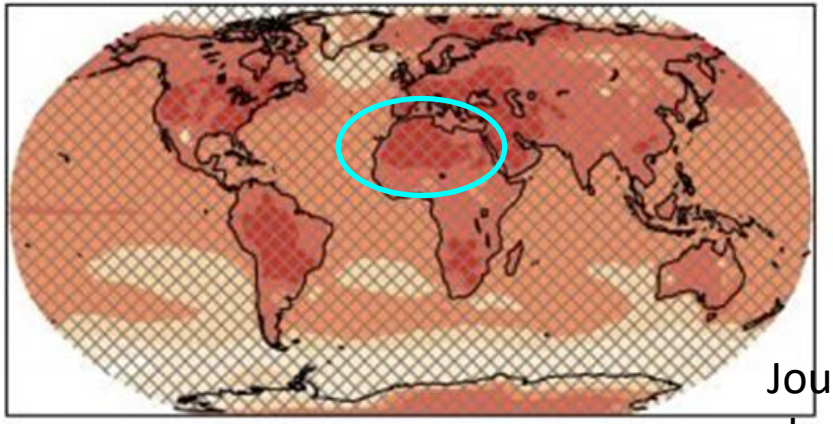
Evaluation des changements futurs pour anticiper

Changements futurs selon le degré de réchauffement global

Change in temperature of hottest days (TXx) at 1.5°C GMST warming

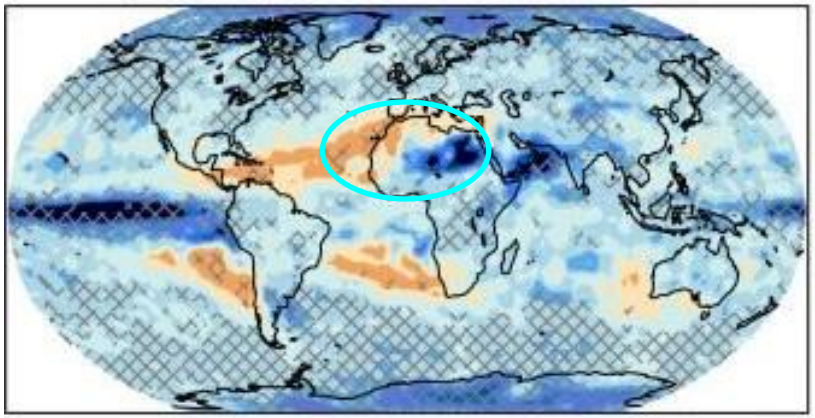


Change in temperature of hottest days (TXx) at 2.0°C GMST warming

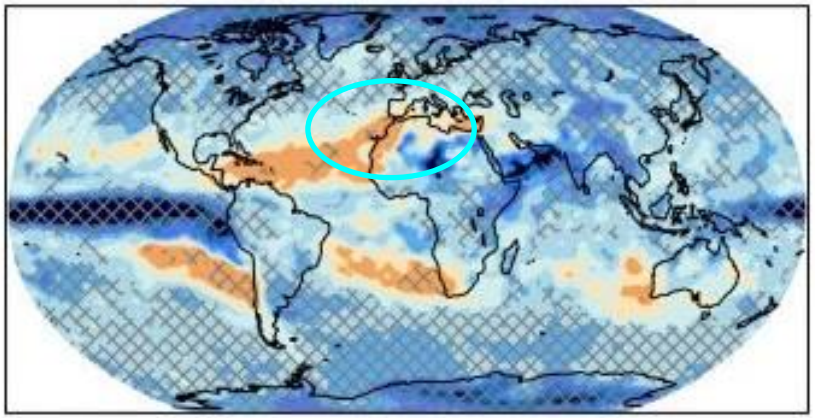


Jours très chauds

Change in extreme precipitation (Rx5day) at 1.5°C GMST warming

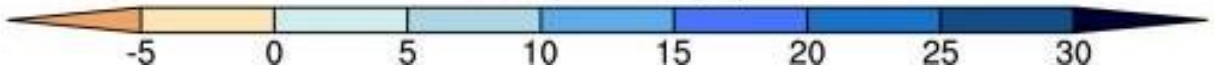


Change in extreme precipitation (Rx5day) at 2.0°C GMST warming

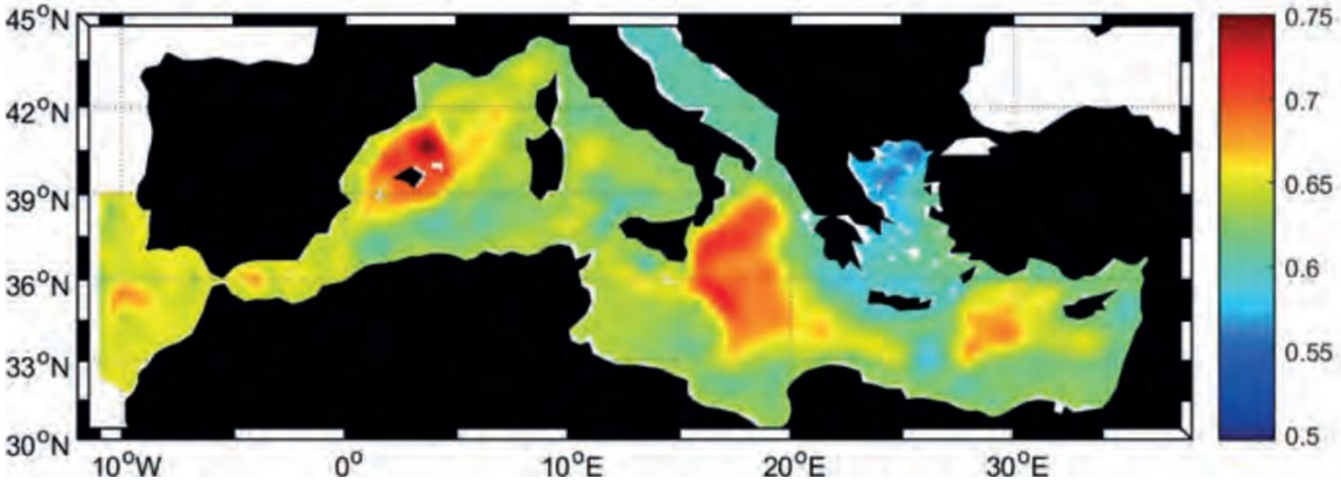


Pluies intenses

Precipitation (%)

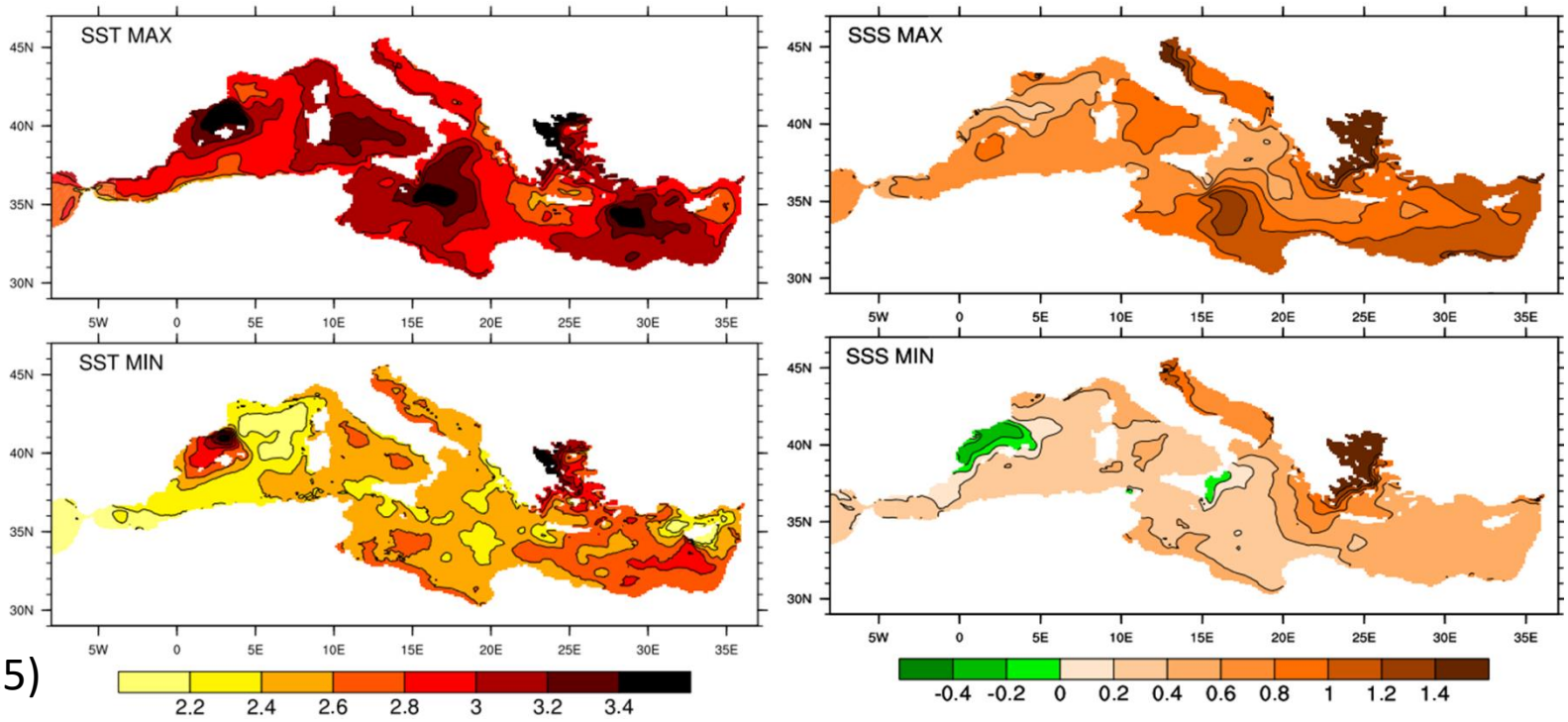


Future projections: Sea changes



Projection of sea level change for the period 2080-2100 with respect to the period 1980-2000. Under moderate GHG emission scenarios (A1b and RCP6.0). Somot et al (2016)

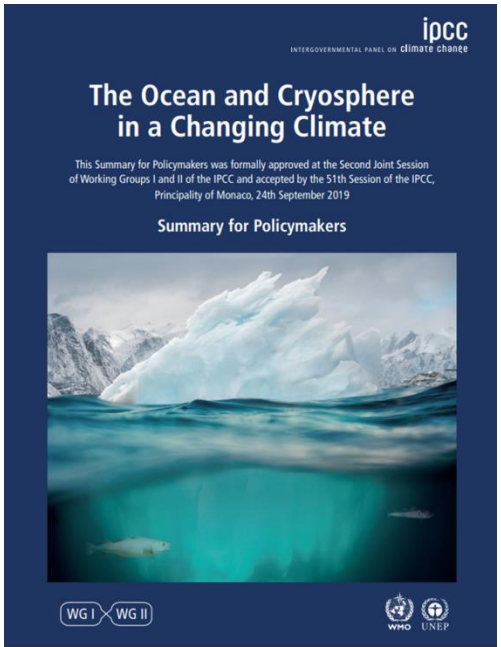
Projected changes of sea surface temperature and salinity . Max and Min changes

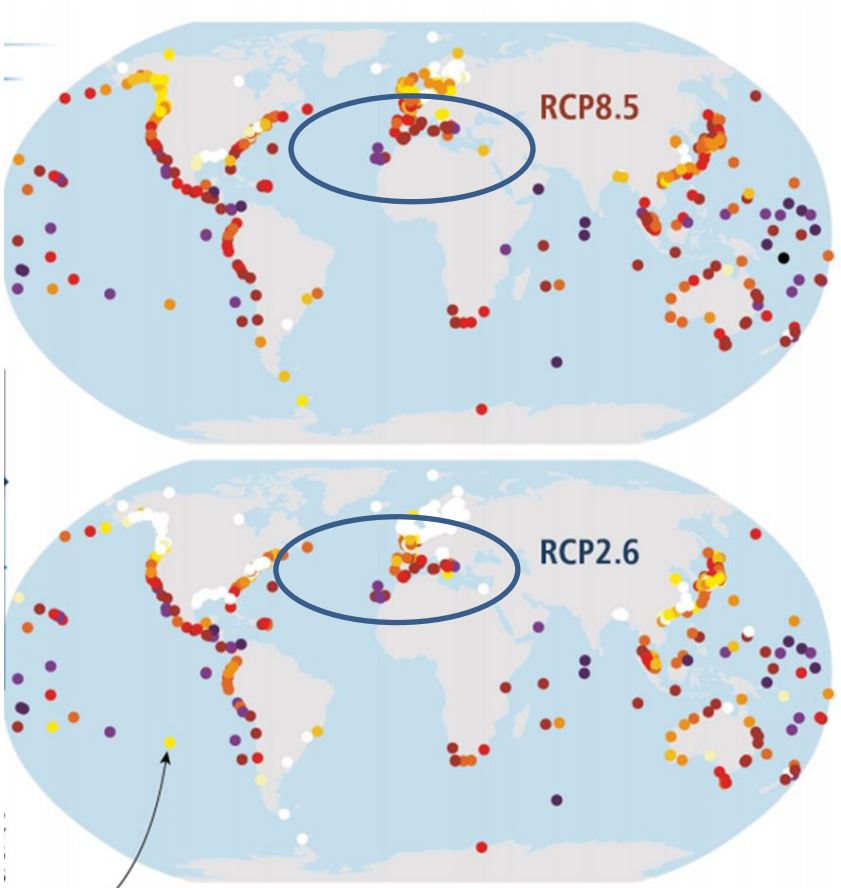


Adloff et al (2015)

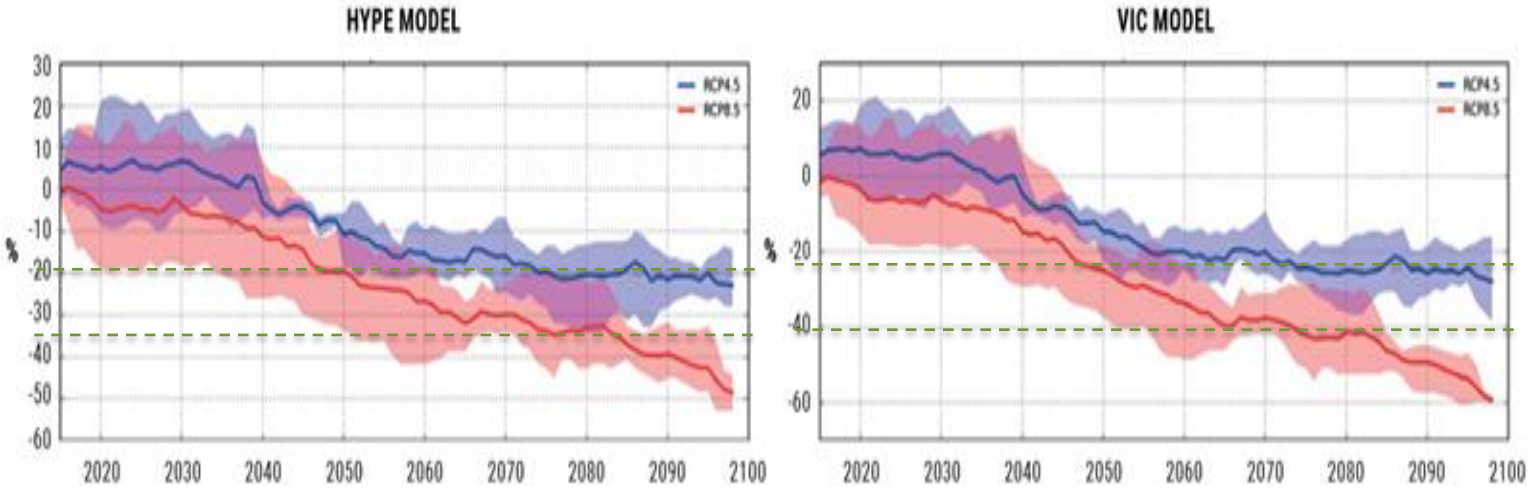
Les évènements de niveau de mer extrêmes (actuellement 1 fois par an) se produiront chaque année dans plusieurs régions dès 2030

Plusieurs changements au niveau de l'océan:
Baisse PH,
Peu de mélange,
Moins d'oxygène en profondeur,
Vague de chaleurs,
Risque pour écosystèmes



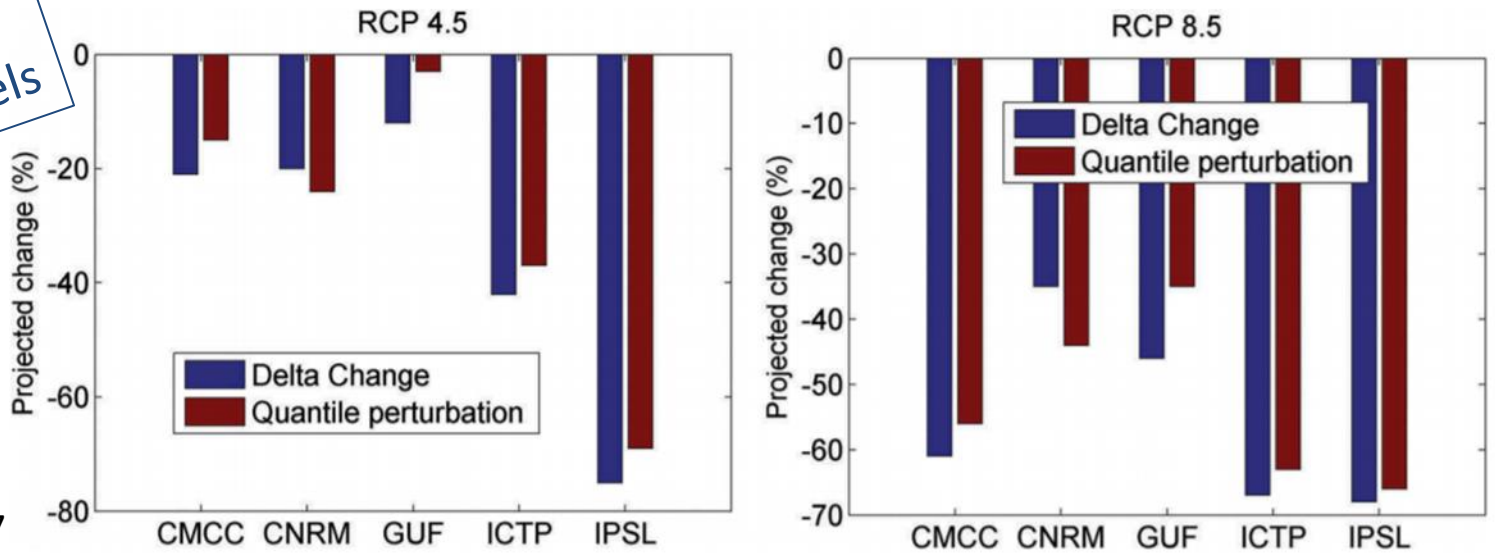


➔Baisse des débits annuels moyens au niveau des hauts plateaux



Changement futur de l'écoulement annuel moyen des hauts plateaux marocains (9W 1W 30N 35N) tels qu'issus de deux modèles hydrologiques HYPE (gauche) et VIC (droite) alimentés par différentes simulations climatiques sous les deux scénarios RCP4.5 et RCP8.5. Source : RICCAR (ESCWA et al., 2017)

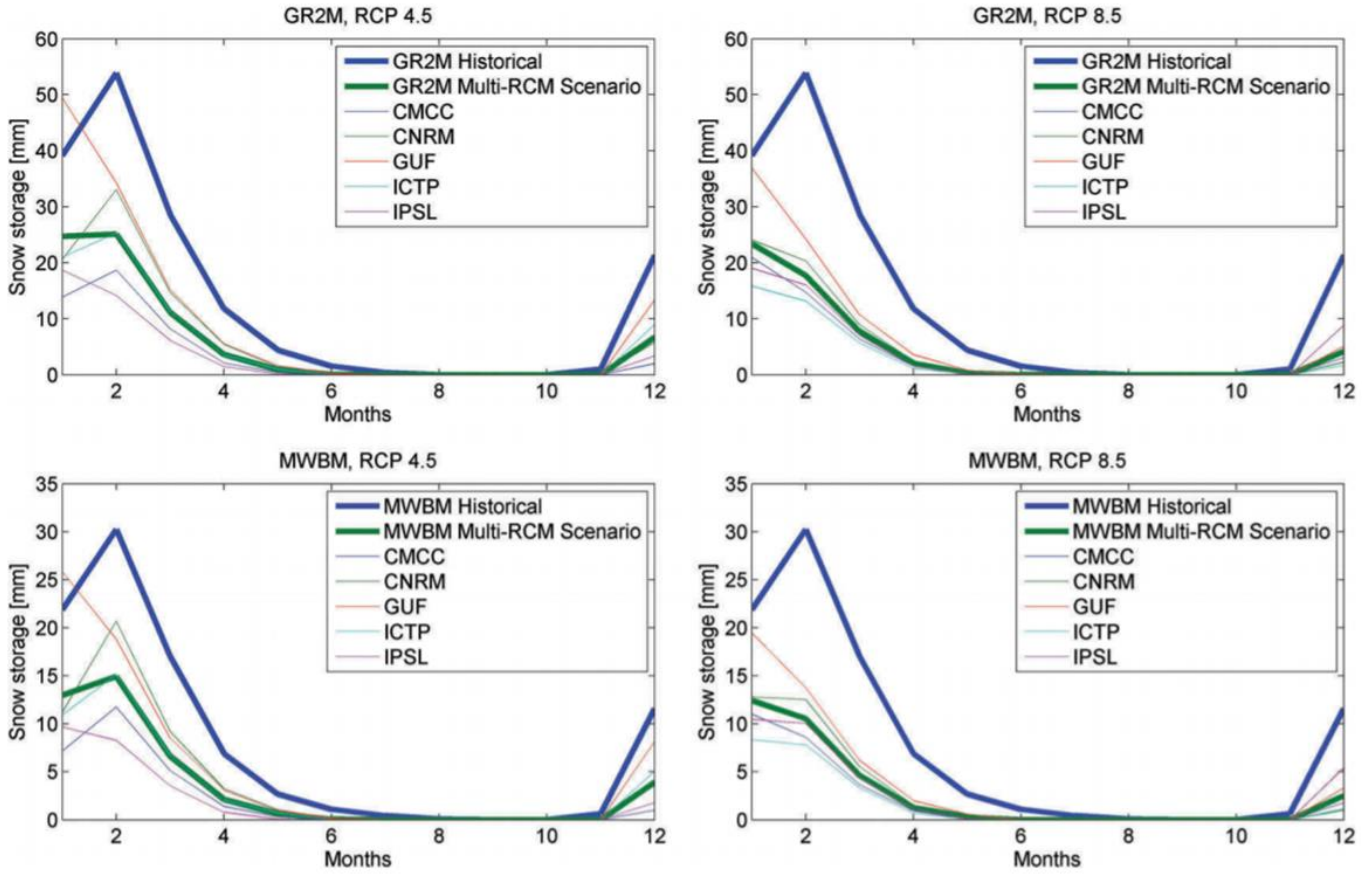
Estimation des Impacts potentiels



Marchane et al. 2017

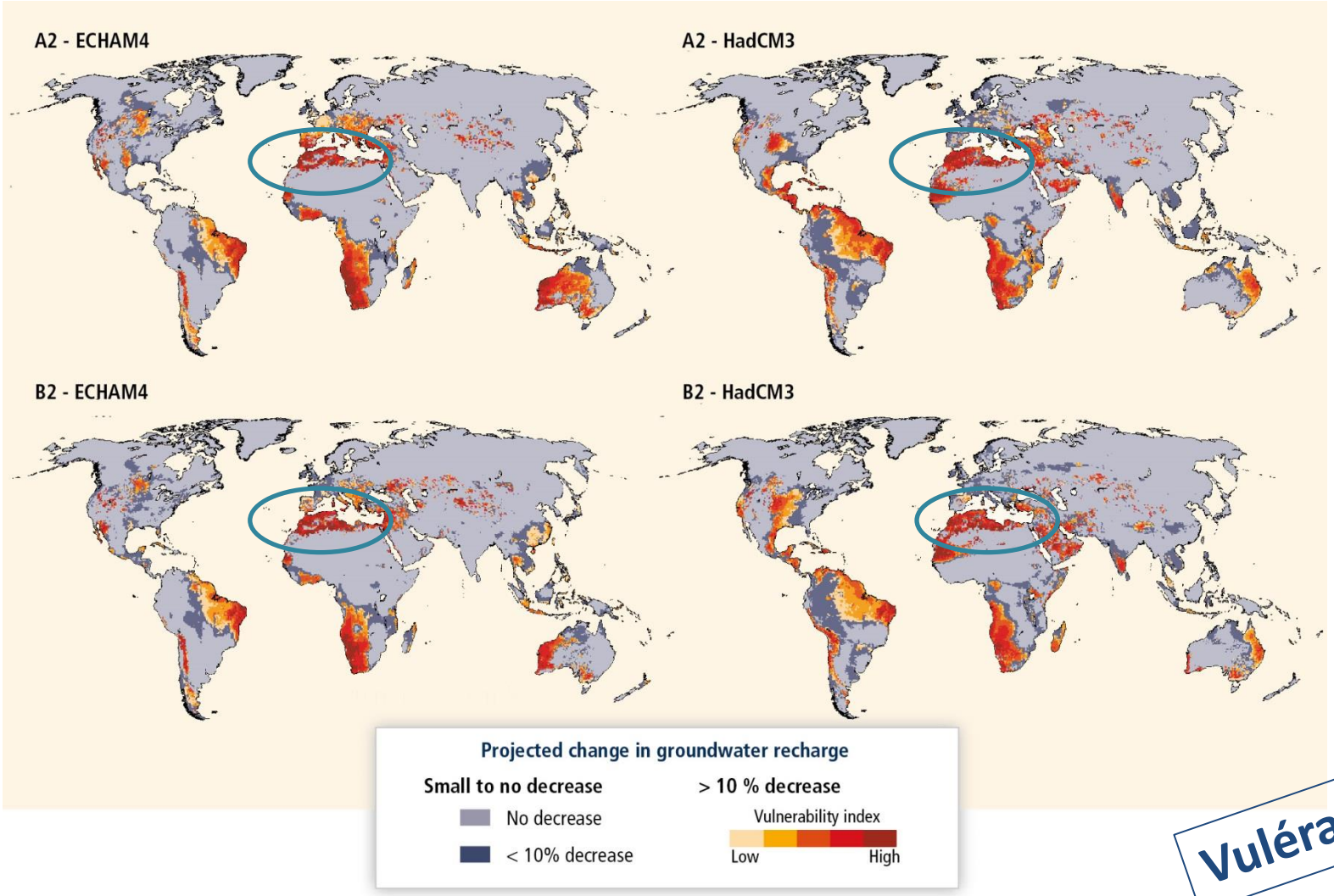
Comparison of the projected changes in runoff with delta-change and quantile-perturbation methods.

Changements futurs des réservoirs de neige sur le Haut Atlas



. Projected changes in snow reservoir levels from five RCM simulations for the future period 2049–2065.

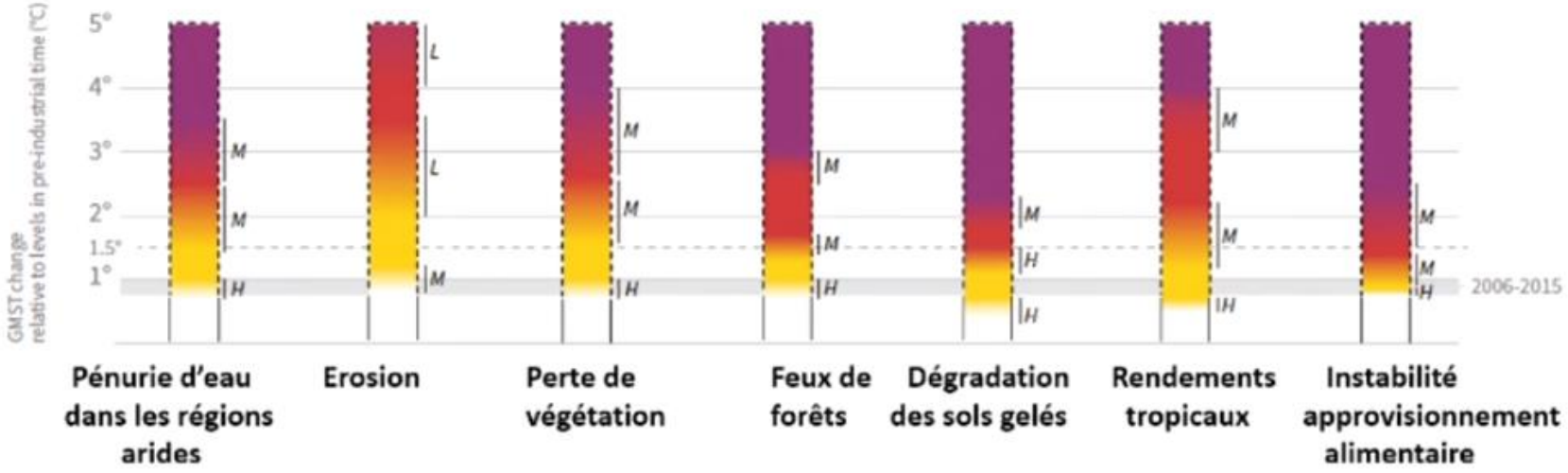
Marchane et al. 2017

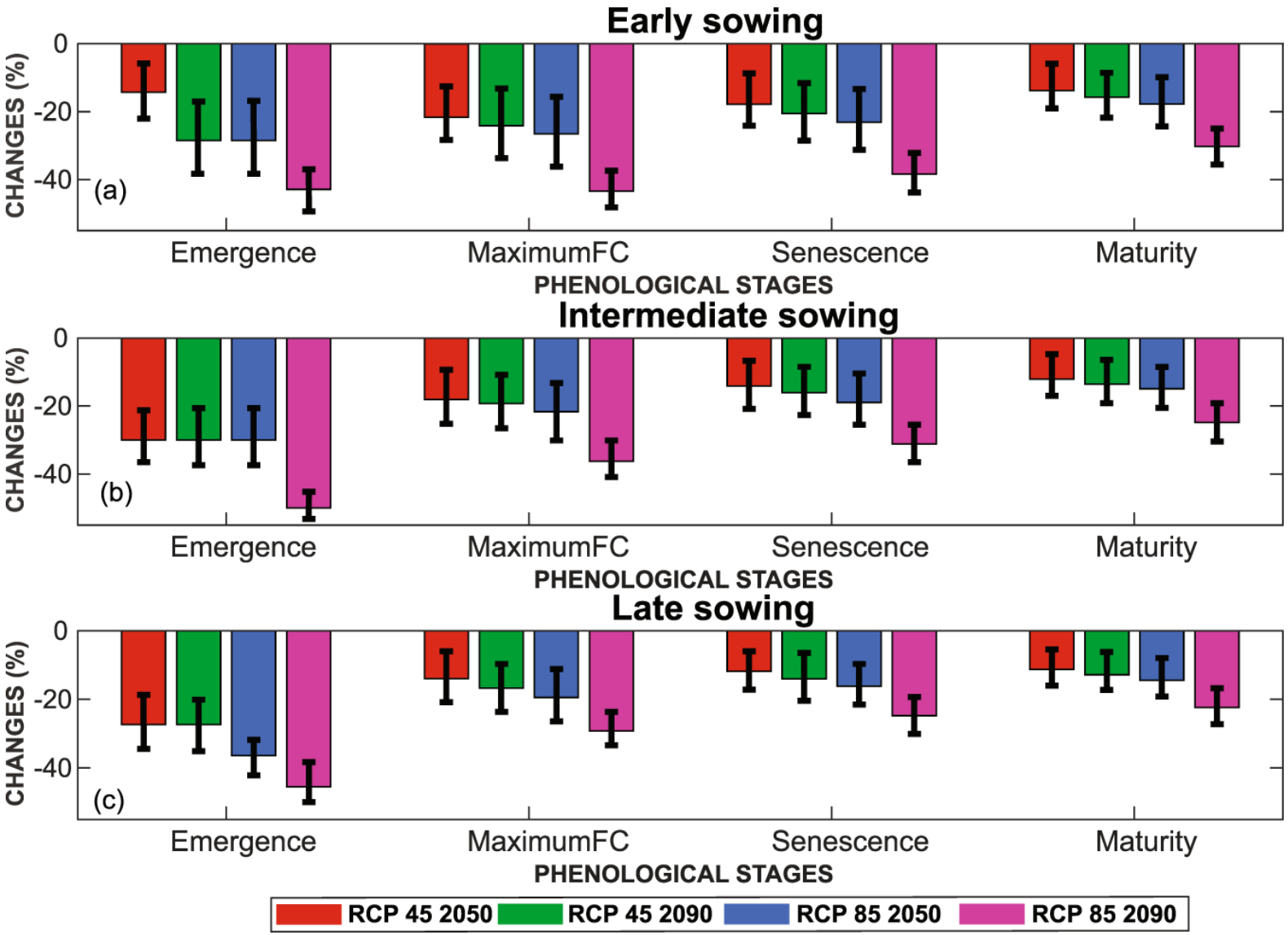


Vulérabilité

Human vulnerability to climate change–induced decreases of renewable groundwater resources by the 2050s. . The index is defined only for areas where groundwater recharge is projected to decrease by at least 10% relative to 1961–1990. IPCC- WGII AR5 (2014)

Risques liés aux processus terrestres du fait du changement climatique

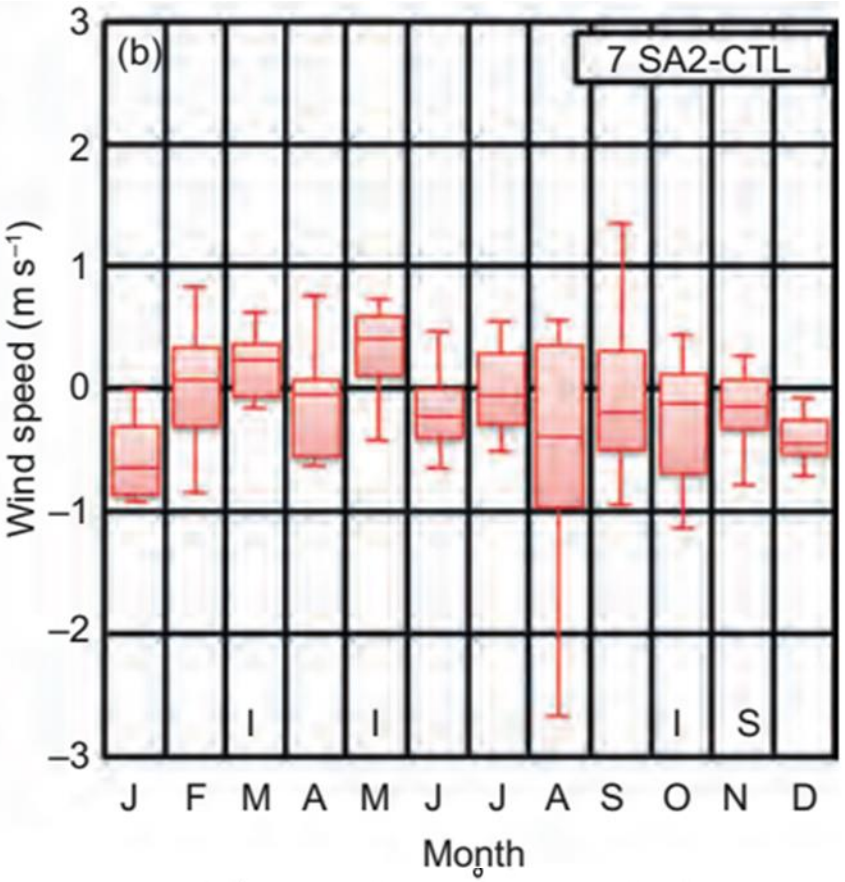




Reduction of the duration of the phenological stages of wheat (in %) for different climatic scenarios and horizon: (**a**) early sowing (**b**) intermediate sowing and (**c**) late sowing. Tensift region.

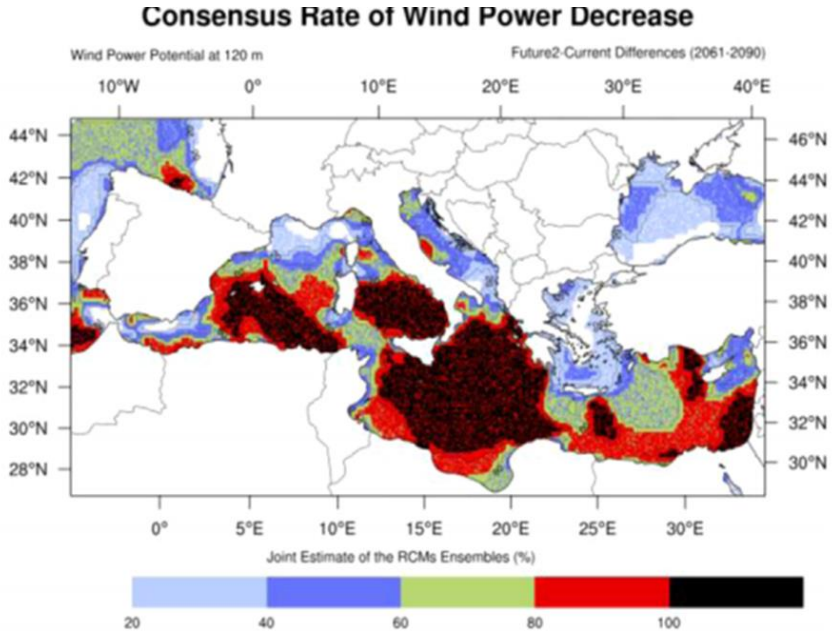
Bouras et al. (2019)

Wind and potential wind energy changes



Distribution of 99th percentile of daily mean wind speeds from 8 regional climate models, averaged over the land area of the Mediterranean region. Absolute values for present-day control simulations (CTL) and differences between future scenarios and control runs (SRES/A2-CTL).

Drobinski et al (2016)



Koletsis et al. 2016

Changes in wind patterns can have significant implications for the potential of wind as an energy resource

Examples of Main risks and role of adaptation and mitigation (Africa)

Key risk	Adaption issues & prospects	Climate drivers	Time frame	Risk & potential for adaptation
Stress on water Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future with drought stress exacerbated in drought-prone regions of Africa *(high confidence)*	• Reducing non-climate stressors on water resources • Strengthening institutional capacities for demand management, groundwater assessment, integrated water-wastewater planning, and integrated land and water governance • Sustainable urban development		Present Near-term (2030–2040) Long-term (2080–2100)	Very low / Medium / Very high 2°C 4°C
Crop productivity Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure *(high confidence)*	• Technological adaptation responses (e.g., stress-tolerant crop varieties, irrigation, enhanced observation systems) • Enhancing smallholder access to credit and other critical production resources, diversifying livelihoods • Strengthening institutions at local, national and regional levels to support agriculture (including early warning systems) and gender-orientated policy • Agronomic adaptation responses (e.g., agroforestry, conservation agriculture)		Present Near-term (2030–2040) Long-term (2080–2100)	Very low / Medium / Very high 2°C 4°C

Response Options

Importance de l'amélioration de la résilience et la capacité d'adaptation

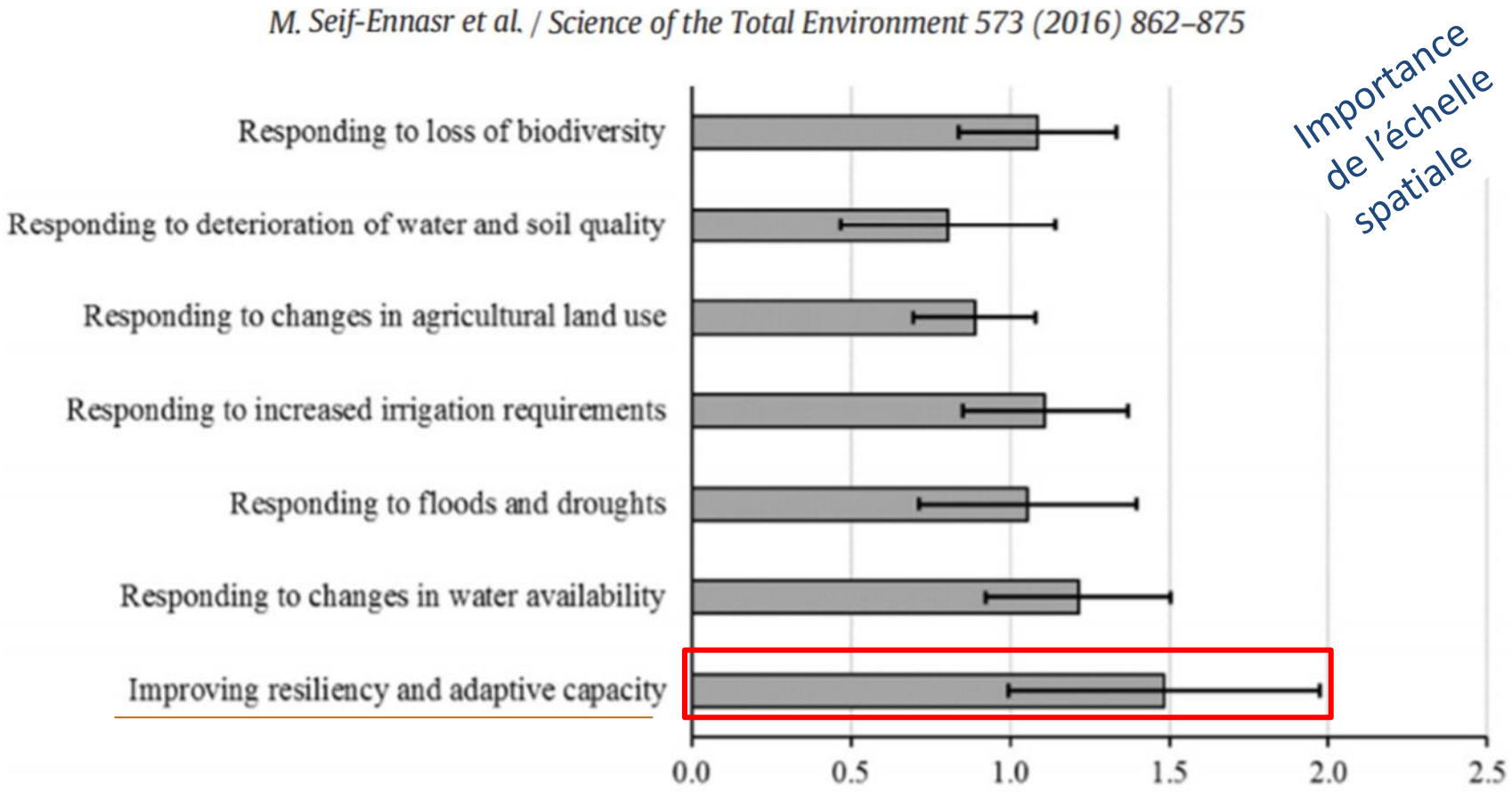


Fig. 12. Benefit to effort ratio of climate change adaptation measure according to their responses to changes.

Implement regional adaptation plans, Improved monitoring and early warning, Improve coordination planning, Innovation, technology and scientific research encouragement, Extension and awareness services, Control of irrigated area, pumping and inventory of existing wells and boreholes

Des actions en cours et d'autres prévues

Adaptation in Nationally Determined Contribution of Morocco (2016) :

- The country is **developing a national adaptation program** to better **coordinate its adaptation policies**, on which the country claims to have devoted 9% of all investment expenditures over 2005-2010.

- It also expects to dedicate several overall **investment budgets** on climate change adaptation in the future.

- The current **adaptation policies** are run through sectoral strategies and plans such as (among others)
  - National Plan for the Protection Against Floods,
  - National Strategy for Sustainable Development
  - and National Plan to Combat Global Warming

Adapted from climateknowledgeportal.worldbank.org

Research gaps (after WB)

- Research is needed on **technology options for adaptation** for water resources and agriculture.
- **Existing coping mechanisms of communities** to climate variability need to be **inventoried** and experiences that can be replicated or scaled-up should be identified.
- **Lack of knowledge and fragmentation in climate change information** in Morocco, which creates the absence of a clear and systematic approach to policy formulation in the midst of competing priorities.
- Decision makers presently lack the information necessary to **evaluate risk and to support risk reduction** for longer-term threats from climate change.
- Additional support is needed for the **design of comprehensive risk management strategies** at the **national, provincial and local** levels to enable long-term disaster risk reduction planning and mitigation measures.

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Renforcement de la résilience
Etapes importantes

- Evaluer les changements
- Évaluer la vulnérabilité et les risques
- Enquêter sur les options
- Prioriser et planifier
- Passage à l'action
- Suivi & évaluation

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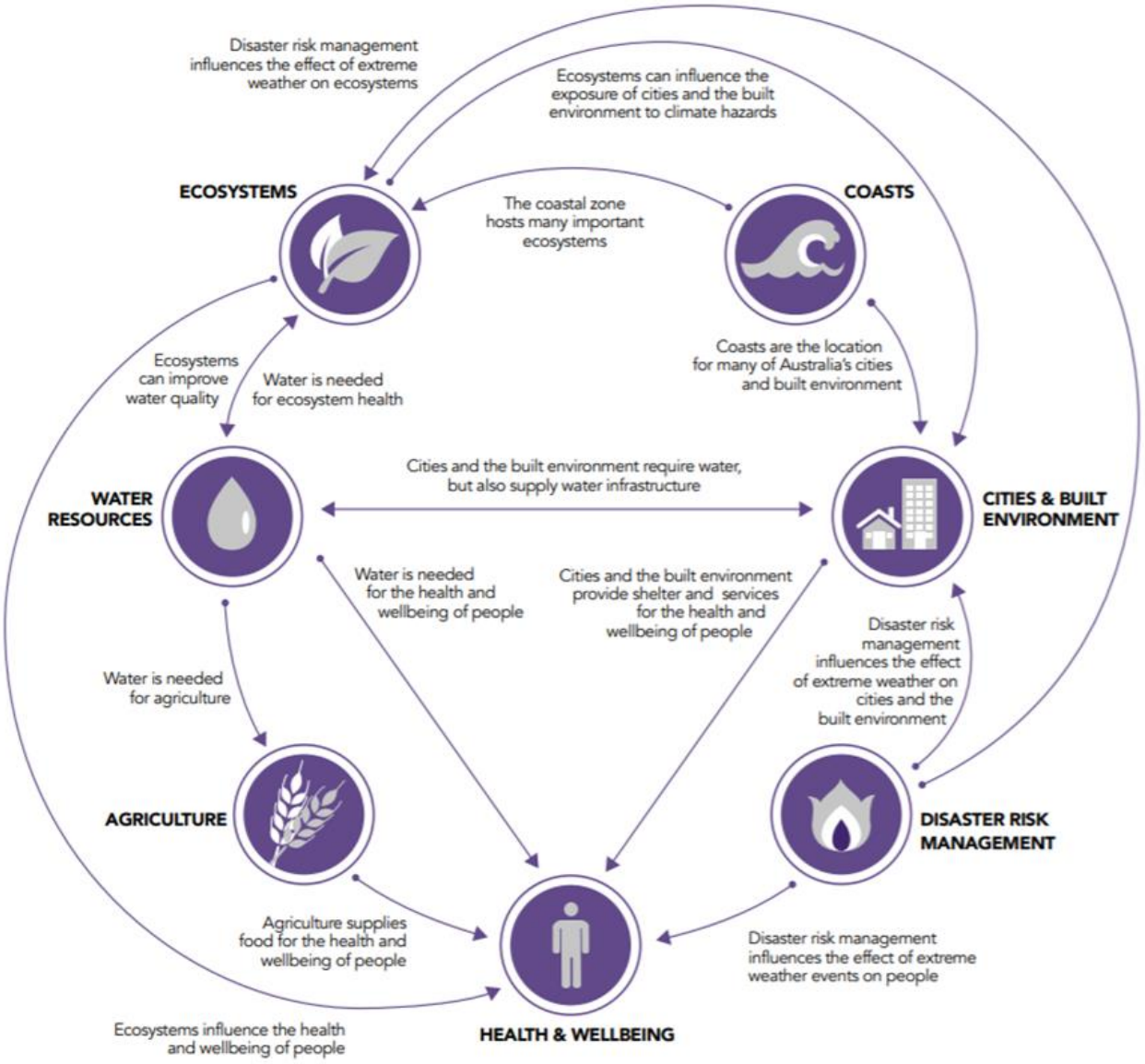
Besoin de priorisation Mais en approches intégrées



Exemples d'interdépendances entre secteurs priorisés dans le renforcement de la résilience. Source: National Climate Resilience and Adaptation Strategy 2015

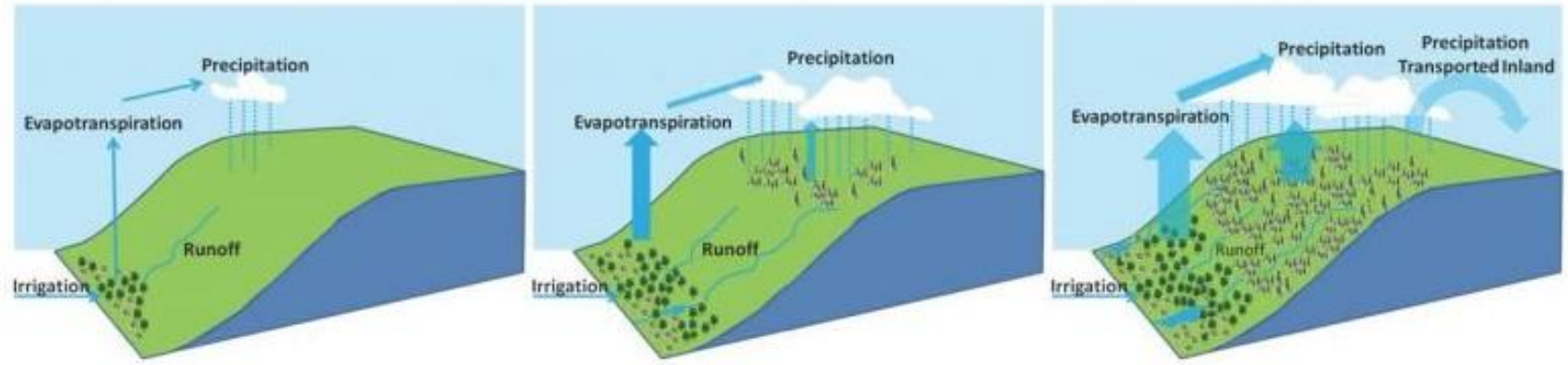
Diverses actions

à toutes les échelles

différents moments

différents coûts,

& Différents Résultats



Schematic illustration of how combined forestation and irrigation can influence downwind precipitation on mountainous areas, favour vegetation growth and feed back to the forested area via increased runoff.

IPCC SR CCLand


Merci de Votre Attention