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Economic damage of climate change: How far is it from the physical damage?

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Motivation

- Typically, Economic damage = Constant price * Physical damange

- However, the price may change dramatically since

  – Producers adapt to physical damage by adjusting inputs.
  – The adaptation is restricted by available technologies.
  – Other production activities are affected.
  – Consumers pay more due to the physical damage.

Methods: Theoretical illustration

- Production $Y_G = f(K_G, \bar{L}, T);\ Y_N = g(K_N) = g(\bar{K} - K_G)$
- Physical damage $Y_G = A(T)h(K_G, \bar{L}) \quad or\ Y_G = Ah(K_G, \tau(T)\bar{L})$
- Utility of consumers $U = u(C_G, C_N)$
- Prices $P_G = \frac{\partial u(C_G, C_N)}{\partial C_G}, \quad P_N = \frac{\partial u(C_G, C_N)}{\partial C_N}$

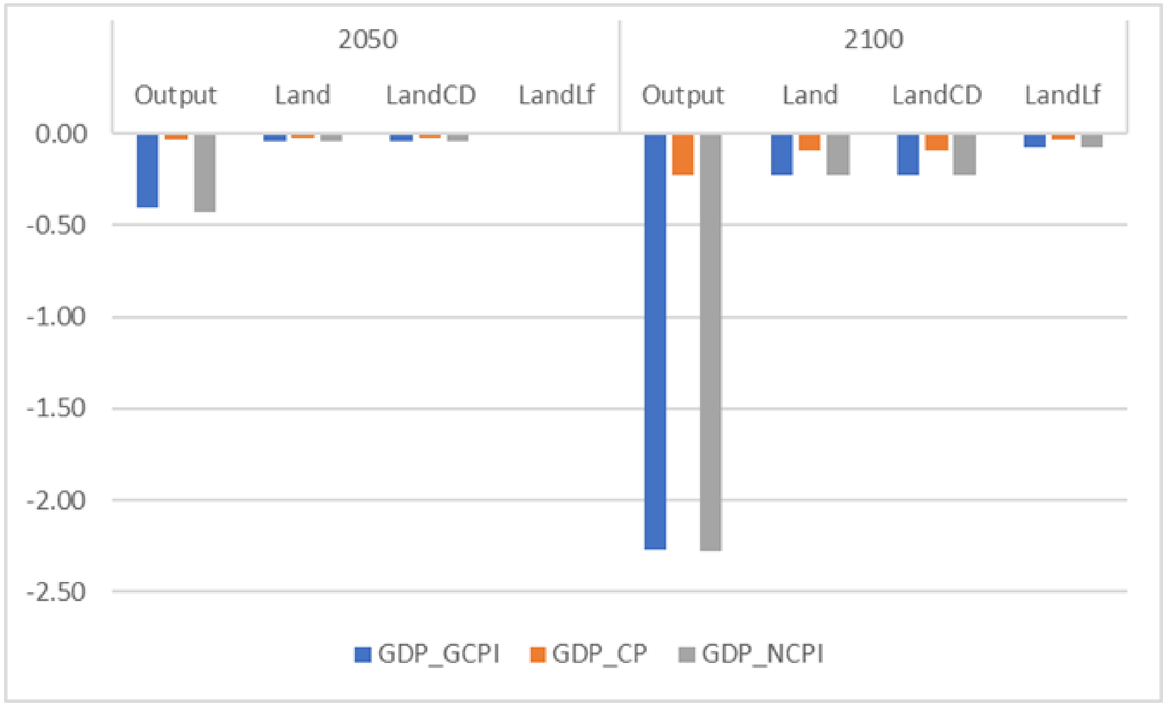
Methods: Numerical model and scenarios

- A static CGE model is used by assuming a given physical damage at 2.3% globally in RCP8.5 in 2100

		Average temperature 2050 (or 2100)			
Scenarios	BAU	Output	Land	LandCD	LandLf
The reference year	2011	2011	2011	2011	2011
External shock	NA	The same physical impact on grain yield			
Trigger point in grain production	NA	Grain output	Grain land	Grain land	Grain land
Consumption function	Default (CES)	Default	Default	Cobb-Douglas	Leontief

Results and discussion

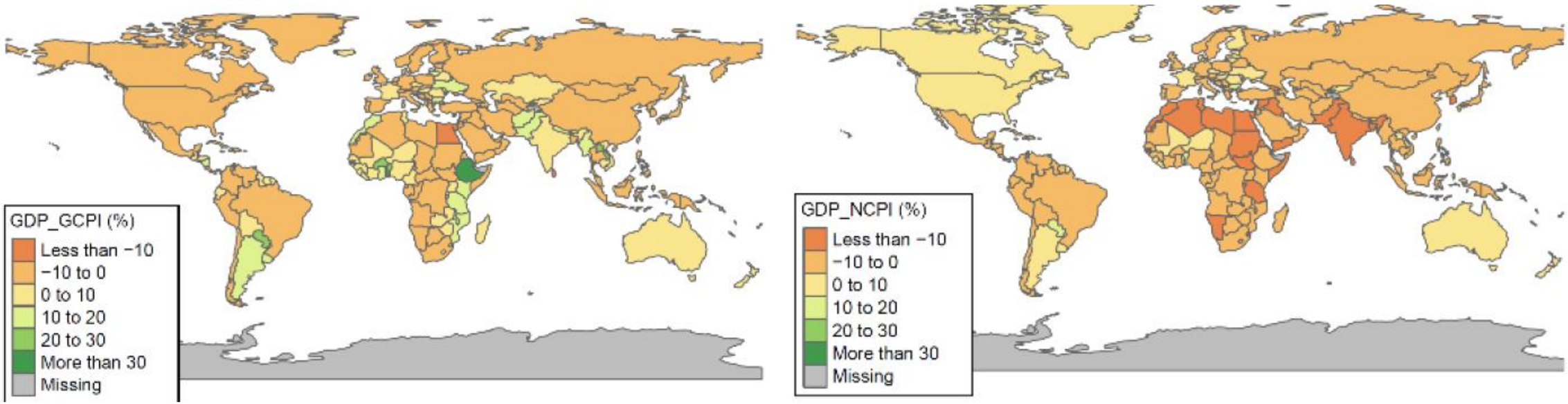
- GDP losses in “Output” are much larger than that in the other three scenarios
- GDP losses in “LandLf” are much smaller than that in “Land” and “LandCD”
- GDP losses calculated at current price (GDP_CP) are much smaller than the other two calculated at global CPI (GDP_GCPI) and national CPI (GDP_NCPI) respectively.



Damages on global GDP due to impacts of climate change on production of main grains including wheat, rice and maize if climates in 2050 or 2100 occur in 2011.

Results and discussion

- Damages on national GDP at current price deflated by Global CPI (GDP_GCPI, in the left panel) and national CPI (GDP_NCPI, in the right panel) in the 2100 “Output” scenario (corresponding to average global warming in RCP8.5).



Conclusion

- Changes in relative prices may modify the estimated economic damage considerably, which should not be omitted.

- If the aim is to compare economic damages (Welfare) across regions or countries, then GDP deflated by local CPI is recommended rather than GDP at Purchasing power Parity (PPP, which is indicated by Global CPI in this study).

- Some IAMs do not specify the utility function, and GDP is interpreted directly as an indicator of welfare. Then, the national CPI-deflated GDP is more plausible to estimate economic damage.

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