

A prototype Earth System Impact score for businesses and investors

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Abstract: Human activities are disrupting the Earth system's biophysical processes, which underlie human wellbeing. Corporations are responsible for a significant portion of observed impacts on the Earth system, including greenhouse gas (GHG) emissions, water extraction and land use change. These nature-related impacts are essential to consider and capture because they have local impacts on a range of ecosystem functions on which companies and economies depend, but they also fundamentally affect our ability to mitigate and adapt to a changing climate.

Furthermore, climate, land and water interact and affect each other in various ways, such that climate change can be exacerbated by degraded ecosystems, which in turn are dependent on water. Frameworks such as the planetary boundaries set 'safe' limits on these pressures, but a sub-global assessment of these pressures, their interactions and subsequent systemic effects is needed to enable corporate and public entities to assess the systemic environmental impacts of their decisions.

We developed a prototype Earth System Impact (ESI) score that is savvy to Earth system interactions (Lade *et al.* 2021). First, we quantified sub-global interactions between climate change, surface water runoff, and vegetation cover using the global dynamic vegetation model LPJmL (Lund-Potsdam-Jena managed Land). Second, we used a feedback model to study how these interactions amplify environmental impacts. Third, these impacts are scaled relative to planetary boundaries. We found, for example, that interactions more than double the Earth system impacts of deforestation in some tropical forests. Finally, we combined these amplification factors with an assessment of the current state of the Earth system to create a prototype Earth system impact metric.

We explored how such a tool could be used to improve assessments of corporate environmental impacts and support decisions on where to direct public and private investments (Crona *et al.* 2023). We use the mining sector as a test case to illustrate the applicability of the ESI score and examine the impact of the five largest (by market cap) mining companies in the precious metal mining sector and the top five in the non-precious metal mining sector. We find that many of the mining assets have non-negligible impacts on land and water, and we show that the ESI metric identifies a different set of assets for targeted action than conventional carbon intensity scores would do.

We envision that future versions of our prototype metric will allow corporate and public actors to better assess the systemic environmental impacts of their decisions. We describe ongoing work to advance the score and apply it to company and investor decision-making. Our ambition is that these results catalyse further scientific work to extend and improve this metric, as well as action by investors, companies, cities, and governments to deliver sustainable outcomes across the private and public sectors.

Keywords: Earth system, Climate, Land, Water, Business

REFERENCES

- Crona B, Parlato G, Lade SJ, Fetzer I and Maus V (2023) Going beyond carbon: An "Earth system impact" score to better capture corporate and investment impacts on the earth system, *Journal of Cleaner Production* 429 139523
- Lade SJ, Fetzer I, Cornell SE, Crona B (2021) A prototype Earth system impact metric that accounts for cross-scale interactions, *Environmental Research Letters* 16 115005