Earth observation as a tool to assess climate migration and policy-making: legal aspects

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This article proposes to present first the principal lines of key policies for climate migration, and their shortcomings; then examine in which manner EO and Causality would allow producing reliable tools and input that could be used to adopt better policies. We contend...
that in implementing their international law obligations, States should encourage the development and use of EO and Causality as policy-supporting tools; nevertheless, although relevant scientific knowledge should be strongly promoted, relied upon and developed further, a well-adapted and binding framework for the legal protection of climate migrants should furthermore be adopted.

1.1 Regional approaches

1.1.1 The EU framework

Adopted in 2013–2020 Resilience action plan and 2013 Council Conclusions on an EU approach to resilience, the European Climate Law (2021) is intended to reshape the EU’s approach towards resilience. In particular, the EU’s “human rights based approach to international affairs” should be adapted and extended so as to “a general environment that is favourable to their development” (Art. 24).

1.1.2 The Kampala Convention (2009)

The Kampala Convention (1969) was the first regional binding instrument Governing the Specific Aspect of Refugee Problems in Africa. The Kampala Convention “enshrines the rights of refugees as defined broadly in the 1951 Refugee Convention and the 1967 Protocol in such a way that climate migrants are included.”

In other words, the EU “human rights based approach to international affairs” should be adapted and extended so as to “a general environment that is favourable to their development” (Art. 24).

1.1.3 The African Charter on Human and Peoples’ Rights

The African Charter on Human and Peoples’ Rights defines “environmental refugees” in situ and ad hoc. The “in situ” definition is: “those who are forced to leave their homes or countries as a result of environmental degradation or climate change and caused threats, disasters or extreme weather conditions.” The “ad hoc” definition is: “those who are forced to leave their homes or countries as a result of environmental degradation or climate change and caused threats, disasters or extreme weather conditions.”

1.1.4 Lineamientos Regionales

The Lineamientos Regionales are a regional framework that focuses on the issue of internal displacement (Art. 2.a), and it was adopted in 2017. It is aimed at “a general environment that is favourable to their development” (Art. 24).

1.1.5 The OAU Convention on the Protection of and Assistance to Internally Displaced Persons in Africa

The OAU Convention on the Protection of and Assistance to Internally Displaced Persons in Africa (1981) was adopted in 1981. It is aimed at “a general environment that is favourable to their development” (Art. 24).

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1.1.3 The Lineamientos Regionales (2019)

The Lineamientos regionales en materia de protección y asistencia a personas desplazadas a través de fronteras y migrantes en países afectados por desastres de origen natural [19] is a set of guidelines built on previous initiatives aimed at developing disaster risk reduction strategies.

It is in line with the Cancun Adaptation Framework (2010) which lays down that States must strengthen and establish regional centres and networks to tackle the issue, as well as to “facilitate and enhance national and regional adaptation actions, in a manner that is country-driven, encouraging cooperation and coordination between regional stakeholders”. As a result, c章 designed to provide guidance for States on the situation of displaced persons as well as to ensure that “inter alia”, the “fundamental obligation of States is to provide protection and humanitarian assistance to persons displaced by disasters”.

Like the Kampala Convention, the Lineamientos Regionales leave States free to apply the guidelines “at their sole discretion, as deemed relevant” [23]. However, they do “not create legal obligations or require the formulation of any legal order” [23].

1.2 Initiatives in international law

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The UN Framework Convention on Climate Change, for its part, recognizes that “human health and welfare” is affected by climate change, and that “Adverse effects of climate change” means changes having “significant deleterious effects (...) on the operation of socio-economic systems or infrastructures, human health and welfare”.

Parties should, when taking action to implement their respective obligations on (...) the rights of (...) migrants” [1].
2 Earth Observation & Causality

According to Article 7.7.c of the Paris Agreement, States should enhance their scientific understanding of climate change to address its adverse impacts. However, these states are free to determine the method of fulfilling this obligation. In this context, Earth Observation (EO) stands as a widely accepted technological tool that the scientific community consistently exploits to investigate Earth’s historical and current physical condition. Satellites equipped with multi-modal sensors encircle the planet, yielding an unparalleled volume of data in a systematic, seamless, and standardized manner. This facilitates the accumulation of time-series, global-scale data on vital biochemical and physical properties of Earth System Variables (ESV), including soil moisture, land surface temperature, vegetation health, and atmospheric composition, and more.

Hence, on the one hand, regional frameworks failed to establish efficient and uniform protection of climate migrants (namely, protection remains uncertain and dependent on regional contingencies); on the other hand, the international community failed to adopt binding international law rules, providing a high-level protection to climate migrants on the basis of uniformity and inter-State effective collaboration.

...
2.2 Science-based adaptation and mitigation

The European Union's Joint Research Centre (EU-JRC) in 2017 highlighted the importance of prioritizing risk-informed investments as a more cost-effective approach to disaster management and emphasized the need to shift from a reactive to a proactive stance in addressing risks. This approach recognizes the value of investing resources in risk reduction and prevention, ultimately leading to greater resilience and sustainability in the face of future disasters.

The utilization of Earth Observation and the establishment of causal relationships have surfaced as potentially important instruments for the purpose of modelling, predicting, delineating, and comprehending the magnitude of migration flows. This, in turn, holds the potential to support Anticipatory Actions (A-A) firmly grounded in evidence with the aim of proficiently managing climate-induced migration through the deployment of early warning systems. Even when accounting for the potential occurrence of a false alarm, it is estimated that each US$1 invested in A-A reduces the costs of humanitarian responses by up to 50% in areas affected by climate hazards such as Bangladesh and Nepal. The WFP highlights the significance of A-A stating that “activities such as commercial animal destocking, early procurement of food or other aid or animal health interventions can be carried out ahead of peak humanitarian needs” [45].

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Fig. 1: The multicausal nature of pastoralists’ displacement

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2.3 Challenges for modelling climate-induced migration

- **Data quality and uncertainties**
  - Ensuring reliable and consistent data is crucial for accurate modeling.
  - Uncertainties in data can significantly impact the reliability of predictions.

- **Causal sufficiency assumption**
  - The challenge lies in identifying all relevant variables that influence migration.
  - Failing to include all pertinent factors can lead to incomplete models.

- **Meaningful time resolution**
  - Achieving a fine enough temporal resolution is essential for capturing the dynamics of migrations.
  - This requires sophisticated analytical techniques to handle multiple time scales.

Causal analysis is often subject to certain limitations. Firstly, it is essential to address the associated costs due to uncertain costs. Moreover, this approach does not account for all pertinent background explanatory variables in the sufficiency assumption. This means that some factors influencing migration may not be captured by the model.

Secondly, causal analysis is preconditioned on the sources by employing methods for the rigorous validation of hypotheses. This includes strategies, early warning systems, and anticipation actions to mitigate the consequences. However, this approach is subject to errors and biases, which requires careful consideration to avoid misinterpretation.

Migration as seen in droughts triggering displacement. Moreover, climate-induced displacement from events like storms and floods is considered an ultimate driver, which is evident in the interplay between climate and migrations. This causal examination, centered on population term effects that capture temporary displacement, presents a formidable challenge.

Following this reasoning, we contend that the time has come for the international community to draw up policies increasingly based on reliable innovative and scientific tools. It is imperative that the importance of climate-induced migration should be recognized by governments and organizations. Hence, the EU should “foster the protection of environmental migrants under international human rights obligations” through comprehensive and ad hoc measures to anticipate the consequences of climate change, including migration.

3 Conclusions

- **Causal analysis**
  - A rigorous causal analysis is essential for understanding the underlying causal mechanisms and facilitating proactive actions to mitigate the consequences.

This requires developing strategies, early warning systems, and anticipation actions for the time resolution levels that capture the dynamics of migration.

Hence, the use of explainable AI (XAI) techniques enables a deeper understanding of the underlying causal mechanisms and facilitates proactive actions to mitigate the consequences.
agreeing upon a binding protective legal status for climate migrants, at least equivalent to the one established for refugees in the Refugee Convention.

References

2. Climate change and future human mobility. Evidence Summary.
4. Climate Change and International Law: A Case for Expanding the Definition of "Refugees" to Accommodate Climate Migrants.
8. Climate change, environmental degradation and migration.
10. A Strategic Approach to Resilience in the EU’s external action.
12. Council Conclusions on EU approach to resilience.
13. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – The European Green Deal.
33. M. Brzoska, C. Fröhlich, Migr. Dev. 5, 190-210 (2016)
43. J. Ginnetti, Monitoring Methodology for Displacement Associated with Drought, (iDMC, 2020)
45. L. Weingärtner, T. Pforr, E. Wilkinson, The Evidence Base on Anticipatory Action, WFP: World Food Programme (Italy, 2020)
48. Global Annual to Decadal Climate Update, WMO, (2023)
49. R. Hoffman, K. Vinke, B. Sedova, Spec. Iss. Article
51. African Commission, Resolution on Climate Change and Forced Displacement in Africa ACHPR/Res. 491 (LXIX) 2021

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