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Earth Observation Dependency and the Case for a New Global Norm

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Abstract

Earth observation (EO) satellites play a critical role in disaster preparedness and climate response, yet the majority of vulnerable nations lack direct access to this infrastructure. This essay examines how dependency on EO data from space powers poses a hidden risk in climate security governance. Drawing on international relations and postcolonial STS literature, it argues for the establishment of an international norm guaranteeing timely and equitable access to EO data, particularly during emergencies. The article proposes realistic steps toward norm-building and explores how this can address structural knowledge inequality in global environmental governance.

Policy Recommendations

- Prioritise equitable EO access in principle through recognition in a UN General Assembly resolution and integration into the post-2025 climate governance framework.
- Create a slow-onset activation window for EO support via a sister mechanism to the International Charter on Space and Major Disasters, coordinated with GEO and CEOS using objective triggers.
- Integrate EO access into climate finance mechanisms, mandating the Green Climate Fund and Adaptation Fund to cover data subscriptions, processing infrastructure, and domestic analytic capacity within funded projects.
- Embed open-data clauses in public procurement and licensing, requiring that EO data acquired with public or multilateral funding be released under open or tiered-access conditions.
- Promote regional EO cooperation through frameworks such as the African Union, ASEAN, and CELAC, supporting shared data infrastructures and collective bargaining with commercial providers.
- Create an EO Access Accountability Dashboard, hosted by the GEO, to track activation times, localisation of processing, and access equity metrics, ensuring transparency and measurable progress.

In 2022, Pakistan experienced a generational flooding event that had a devastating impact on the country. It has been estimated that as many as 33 million people were affected, representing some 12% of the country's population (Qamer et al., 2023). If it had not been for its ability to access crucial satellite-based Earth Observation (EO) data, the outcome would have been much worse. A recent remote sensing study (Chen et al., 2024) used data from NASA's SMAP mission, ESA's land cover archives, and Landsat 9 to map flooded croplands and identify where staple crops had been destroyed. With this externally provided EO support, planners were able to visualise the full extent of crop loss and floodwater spread across the Indus Basin, allowing them to more effectively respond to the crisis and direct their response efforts. Now imagine a scenario in which this data had not been available. If access to such international satellites were restricted, Pakistan's ability to assess the scale of the disaster would have been dramatically reduced. Aid allocation might have been delayed or misdirected, further compounding the crisis. In the short term, this might mean further avoidable deaths and injuries as authorities struggled to prioritise relief in the absence of accurate situational awareness. In the longer term, disruptions to crop production risked cascading into wider food insecurity, loss of livelihoods, and increased migration from affected areas. Environmental degradation from prolonged inundation or mismanaged land recovery could have lasting effects on ecosystems and agricultural viability.

This alternative scenario is not a far-fetched possibility. While Pakistan was able to draw on US and European EO support in 2022, this access is neither sovereign nor guaranteed. Much of it operates on informal goodwill, discretionary sharing, or external aid frameworks. As geopolitical tensions rise and space assets become more contested, the fragility of this model becomes increasingly visible. This fragility points to a deeper issue: the dependence of climate-vulnerable states on EO systems controlled by a handful of spacefaring powers.

This essay argues that such reliance is not only technically precarious but structurally unjust, reinforcing epistemic inequalities in global science and technology. To develop this claim, the paper first examines the practical problems generated by EO dependency, then reframes these challenges through the lens of postcolonial Science and Technology Studies. It goes on to outline a normative path forward, applying Finnemore and Sikkink's "norm life cycle" model to propose how equitable EO access might be institutionalised as a new international norm, before concluding with the wider implications for climate governance.

Challenges affecting how developing countries access EO data

Access pathways for EO in the Global South reveal how dependency is structurally embedded into the system. A handful of emerging powers such as India and Brazil have built modest EO capacity, but most climate-vulnerable states lack the infrastructure to generate or process satellite data independently. As a result, their ability to observe their own environments depends on mechanisms controlled elsewhere. According to a 2022 report by the European Space Agency, developing countries receive just 0.4% of global revenue from upstream EO data, which underscores how little technical capacity and market involvement the Global South demonstrates in this field (Sabri, Mohammed and Taverner, 2022). As Codyre et al. (2025) note, low and middle-income countries often depend on foreign satellite operators or platforms, which can lead to data bottlenecks, vendor lock-in, and disruptions in service delivery. Even when data is available, inadequate bandwidth and computing infrastructure can reproduce dependency at the level of practice

(Thorpe, 2023). To mitigate this, organisations like UN-SPIDER have emphasised capacity-building, but progress is fragile since locally trained analysts often leave for better-paid opportunities abroad, draining local expertise (Mehmood, interview 17/07/2025).

In acute crises, countries typically must request EO support through international mechanisms such as the International Charter on Space and Major Disasters or regional platforms like Sentinel Asia, which provide access to vital data during those flashpoint moments. Yet outside such emergencies, access remains heavily restricted, conditional, or prohibitively expensive. The result is a system where Global South states are formally dependent on the goodwill, funding, and priorities of external providers, underscoring the asymmetry at the heart of EO access. These constraints operate not only at the point of access but within the deeper structural dynamics of how EO is governed, prioritised, and sustained – highlighting why EO cannot be treated as a discretionary good but as a governance issue.

EO dependence creates epistemic inequalities

The dependence of climate-vulnerable states on foreign-controlled EO systems is not simply a technical gap; it reflects a deeper asymmetry in global knowledge production. Postcolonial Science and Technology Studies (STS) has long argued that science and technology are not neutral or universal, but situated within particular epistemological traditions and geopolitical histories (Harding, 2011; Anderson, 2009). In practice, this means that infrastructures like EO tend to embody the priorities and assumptions of their Northern operators, while marginalising alternative ways of knowing.

In the EO domain, this imbalance is visible not only in who owns the satellites but in upstream decisions over what data is collected, data is structured and processed, and who possesses the authority to interpret it. EO thus functions as a *dominant epistemology* – privileging Northern institutions and actors, while leaving Southern states dependent on external permission to visualise their own environments. For climate-vulnerable countries, the very instruments needed to understand and govern local risks are often produced, operated, and interpreted elsewhere, reinforcing the structural hierarchies of the global knowledge economy.

A clear example of this epistemic imbalance is the use of AI in EO-based modelling and analysis. The majority of EO datasets originate from Global North sources and have been shown to exhibit a US and Eurocentric bias (Shankar et al., 2017). Algorithms trained on such datasets may internalise assumptions about environmental patterns, land use, or infrastructure that do not apply in the Global South. In effect, bias is baked into the system at the data level. Without sufficient local data to correct for these biases, outputs can misrepresent local realities, potentially skewing policy decisions, disaster forecasts, or resource allocation in vulnerable regions (Mehmood, 2025).

While developing countries have been able to access EO data in some capacity, especially during a crisis, that access is by no means guaranteed, and there are reasons to think it is under threat. As countries like the US cut back on both foreign aid and their space programmes, platforms meant to provide access to this technology to developing countries are likely to be reduced or to disappear altogether. Recasting EO access as a matter of epistemic justice makes clear that the issue is not simply about distributing data more efficiently, but about ensuring that vulnerable states are not permanently dependent on the goodwill of external actors. These structural inequalities are not merely theoretical; they manifest in the very practical difficulties states encounter when seeking to access, process, and act upon EO data.

The next section examines these concrete problems in detail.

Practical problems caused by dependency

These epistemic inequalities materialise in practice as problems of time, terms, and power. First, latency and limited processing capacity blunt the value of "free" data; second, access is conditional and short-lived; third, control over EO infrastructure creates strategic vulnerability.

The first challenge is also one which is widely overlooked – the problem of data latency and processing capacity. EO's value lies in its ability to provide near real-time situational awareness during crises such as floods or cyclones. Synthetic aperture radar, for instance, can map floodwater spread through cloud cover and darkness, a capacity that proved crucial in Pakistan's 2022 floods. Yet for many developing countries, the barrier is not the lack of imagery but the inability to process it quickly enough to guide relief in the first 24-72 hours. As Hamid Mehmood of UN-SPIDER noted (2025), disaster authorities often face "data overflow": torrents of raw satellite data that they lack the trained personnel or infrastructure to interpret rapidly. In these cases, EO's monitoring potential is blunted, and states remain dependent on external actors who may not share their operational timelines or priorities.

A second challenge arises from conditional access and temporal limits. EO can anticipate long-term threats such as droughts, shifting rainfall, or desertification by tracking changes in soil moisture, vegetation, and land cover. But current international mechanisms, such as the International Charter on Space and Major Disasters, grant data access almost exclusively during acute, short-lived emergencies. There is no equivalent framework for slow-onset crises, even though their cumulative effects on livelihoods and migration can be just as devastating (DARA and Climate Vulnerable Forum, 2012). One of the most beneficial programs supporting developing countries access satellite data to help them manage climate-related issues, NASA's SERVIR initiative, was forced to shut down in March 2025 following cuts to USAID, which it depended on. As the US steps back from such commitments, China has begun to play an increasing role as a provider and partner in developing space infrastructure in developing regions. While China may play an important role in filling the gap left by the US's departure from the space, it may not be doing so for purely philanthropic reasons. Future North-South cooperation may increasingly come in the form of quid pro quo arrangements which deepen their dependency. Commercial platforms also exist and their role in EO space is expected to only increase in the future, however accessing such platforms is expensive, which poses a challenge given the limited resources developing countries typically have (Sabri, Mohammed and Taverner, 2022). This dynamic leaves them in a perpetual state of reactivity, undermining the capacity for proactive climate risk management.

A third and more politically charged constraint is strategic vulnerability. EO is indispensable for post-disaster response and recovery, mapping crop loss, assessing infrastructure damage, or planning resettlement. But the sustainability of these data streams depends on the domestic priorities of a small number of EO providers. The Trump administration's decision to defund NASA's Orbiting Carbon Observatory missions in its FY2026 budget illustrated how quickly political decisions in the Global North can erase critical capabilities, with cascading consequences for dependent states (Webber, 2025). Without alternatives, climate-vulnerable countries risk being data-poor in precisely the domains where visibility is most needed, leaving their recovery and resilience planning hostage to external political winds. In a global system where geospatial intelligence is central to climate resilience, development planning, and even diplomatic positioning, this vulnerability compounds existing inequities in the international order.

In effect, many developing countries lack the guaranteed ability to observe their own territories from space without external permission or assistance. This asymmetry of visibility produces an asymmetry of agency, not only during moments of acute crisis, but also across long-term governance and planning horizons. Absent a stable, rights-based framework for EO access, climate-vulnerable states are left navigating an escalating global emergency with partial vision, reliant on the continued goodwill and political stability of external actors.

A normative path forward

Addressing EO dependency requires more than technical fixes; it demands a shift in the principles that govern access. Climate risk operates within a triangular structure of cause and consequence: Northern states have historically produced the bulk of emissions (Roberts and Parks, 2007); Southern states bear the brunt of exposure and vulnerability; and the destabilising consequences, from food insecurity to cross-border migration, ultimately rebound on the North (National Intelligence Council, 2021). In this sense, ensuring equitable EO access is not just a moral imperative but a form of collective security, mitigating risks that otherwise spill across borders. To confront this imbalance, it is necessary to construct a new international norm: that all countries, regardless of economic standing, should have equitable, timely access to EO data, particularly in climate-related emergencies and slow-onset crises.

Finnemore & Sikkink's (1998) "norm life cycle" model provides us with a useful framework for understanding how this type of international norm can emerge and be developed. They describe three phases in the development of international norms: *emergence*, *cascade*, and *internalisation*. Using this as our guide, let's consider how this process could look for this specific case.

Norm emergence: who can drive it

The emergence of an EO access norm requires multi-level norm entrepreneurs: technical agencies to frame the issue, vulnerable states to supply moral authority, Northern allies to provide diplomatic leverage, and non-state actors to bridge knowledge gaps. At the technical level, UN-SPIDER provides a ready-made platform. Its mandate aligns directly with equitable access, and its track record of capacity-building projects demonstrates that cooperation is both possible and impactful. Its limitation, however, is the absence of enforcement powers, which makes state champions indispensable.

Among vulnerable states, countries such as Pakistan, Bangladesh, and Tuvalu have repeatedly raised EO access concerns in climate negotiations, especially in the wake of catastrophic disasters. Alone, their leverage is limited, but coalitions like the G77 or AOSIS amplify their voice and can embed EO into broader South-South solidarity agendas.

Non-state actors add a crucial translational role. International NGOs and academic networks have shown they can turn global EO archives into locally usable products, exemplified by the Open Data Cube's operations in developing countries in Africa and South America.

Finally, strategic Northern allies can lend weight where vulnerable states cannot. Countries with strong open-data traditions (Norway, the Netherlands) could align EO access with their wider climate diplomacy. Migration-destination states such as the UK also have incentives:

stabilising EO access reduces the drivers of displacement that ultimately reach their borders.

Taken together, these actors illustrate that EO norm emergence is feasible when framed as both a humanitarian good and a shared security interest.

Norm cascade: where and how it could gain traction

For a new norm to cascade, it must move from niche advocacy into the mainstream agendas of global forums**,** regional organisations, and technical coalitions.

The UN General Assembly and SDG review processes offer high-visibility venues where emerging norms are debated and recorded. If major EO providers were to resist or vote against proposals for equitable EO access in these forums, their opposition would carry reputational costs: appearing out of step with international climate justice commitments and exposing them to criticism from vulnerable states, NGOs, and global public opinion. The Sendai Framework for Disaster Risk Reduction already affirms the importance of EO in disaster response and thus provides a normative foothold.

At the regional level, the African Union Space Policy, (2016) commits all AU members to promoting space applications for sustainable development, including EO access, and could serve as a model for similar commitments within other supranational organisations such as ASEAN. Such regional precedents normalise the expectation that EO access is not optional but integral to resilience.

Within the COP process, the CREWS Initiative already links donor finance to delivery of EO-enabled early-warning capabilities in vulnerable states, demonstrating how a norm can be embedded through climate finance commitments rather than abstract resolutions.

At the technical level, coalitions such as the Committee on Earth Observation Satellites (CEOS) and the Group on Earth Observations (GEO) already promote open-data principles, and GEO's Data Sharing Principles enjoy broad soft-norm recognition. Existing mechanisms like the Copernicus Emergency Management Service prove that even commercially sensitive data can be shared globally under publicly funded models.

Resistance here is likely since commercial EO providers may object on revenue grounds, and powerful states may invoke security or competitive concerns, but the fact that tiered-access and public-funding offsets already work in Copernicus shows that such objections can be managed.

Norm internalisation: institutionalising practice

For the EO access norm to endure, it must be embedded in routine practice, legal frameworks, and funding streams. Once the norm is articulated, it must be made operational through concrete institutional design:

First, codify triggers for both rapid-onset and slow-onset hazards via a sister mechanism interoperable with the International Charter: automatic activation upon disaster declarations and slow-onset activation on objective indices to end the current discretionary gap. CEOS and GEO should issue the technical playbooks regarding minimum product sets, metadata, and latency targets.

Second, adopt a tiered access model to balance public good with commercial concerns. This can include near real time products during declared emergencies; 7-30-day delayed release or coarser resolution for routine monitoring; and premium, cost-recovered tasking for specialised analyses.

Procurement by multilateral banks, UN agencies, and major donors should include open-access clauses that mandate this tiering in vendor contracts; where necessary, create offset payments from climate finance to compensate providers.

Third, establish a dedicated finance window building on CREWS and complemented by the Green Climate Fund or the Adaptation Fund to cover (i) data subscriptions/tasking during activations, (ii) preprocessing pipelines and cloud credits, and (iii) domestic capacity (analyst posts, retention incentives, and localisation of models). Country programmes should be required to include a localisation plan (baseline layers, community validation, and bias audits for AI models).

Finally, make the norm measurable. An independent dashboard (hosted by GEO) should track time-to-product, number of activations served, share of products generated/validated in-country, and data availability by hazard. Launch a 2-3 year pilot to road-test triggers, tiering, and finance flows before scaling globally. The goal is to move EO access from ad hoc benevolence to predictable obligation with clear triggers, stable funding, and accountability for delivery, where withholding access would be diplomatically untenable and reputationally costly.

Conclusion

The analysis presented here has argued that equitable access to EO is not merely a matter of benevolence but of epistemic justice, climate security, and long-term governance stability. The reliance of developing countries on Northern-controlled EO infrastructure illustrates a wider imbalance in global science and technology: those most vulnerable to climate risk remain least empowered to "see" their own territories from space. While current mechanisms such as the International Charter on Space and Major Disasters provide essential emergency access, they do so selectively and temporarily. Slow onset climate phenomena fall through the cracks of these arrangements, even though their cumulative impact may be greater than sudden disasters.

At the same time, geopolitical volatility exposes the fragility of the current access regime. The recent termination of NASA EO missions under the Trump administration was not only a loss for climate science but also a reminder of how quickly domestic politics in provider states can reverberate across the global system. Dependent states, with no alternative infrastructure, remain perpetually exposed to such shifts. To treat EO as a discretionary good rather than a shared global necessity is to institutionalise vulnerability and inequity at precisely the moment when climate resilience demands the opposite.

The essay has also shown that these dynamics are not merely technical but embedded within a postcolonial knowledge order. EO infrastructures reflect the epistemological dominance of the Global North, shaping what counts as knowledge and who gets to generate it. AI-driven EO models, trained on Northern datasets, risk reproducing biases that misrepresent realities in the South, embedding structural disadvantage into the very tools meant to alleviate it.

Moving forward, the case for a new international norm is compelling. Drawing on Finnemore and Sikkink's norm lifecycle, this essay proposed an "EO access norm" to treat timely, equitable EO provision as a rights-based obligation. The seeds of such a norm already exist. The International Charter demonstrates that even commercially sensitive imagery can be mobilised for humanitarian purposes. The African Union's Space Policy and initiatives like the CREWS programme reveal a growing appetite for collective commitments. And coalitions of climate-vulnerable states, from the G77 to the Alliance of Small Island States, have shown that moral authority can be leveraged to push climate justice agendas onto global platforms.

The wider stakes are clear. If EO access remains governed by goodwill and market logic, climate-vulnerable states will continue to navigate the unfolding crisis with partial vision, their agency curtailed by postcolonial legacies. If, however, EO access becomes institutionalised as a global norm, it could transform from a symbol of dependency into a tool of empowerment. Just as humanitarian access has become an accepted principle of international conduct, so too can EO access be normalised as a shared responsibility in the age of climate emergency. The challenge is not one of technical feasibility but of political will: whether the international community can reframe EO not as a privilege granted, but as a right guaranteed.

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