LINKING IN-SITU OBSERVATIONS WITH REMOTE SENSING EFFORTS WILL BE ESSENTIAL TO CREATING IMPROVED DATA PRODUCTS.

Within the commercial space, actors such as Ecometrica[38], Earth Knowledge[39] and others have built upon the open data space to create improved data portfolios, generating their own data products to fill temporal gaps or improved resolution through techniques like backfilling. However, many of the key environmental topics, such as biodiversity, cannot be developed purely from remote sensing but require in-situ ground data much of which is held by the NGOs or intergovernmental institutions. Linking in-situ observations with remote sensing efforts will be essential to creating improved data products. And until this is resolved, open or private sector developments are likely to continue to face restrictions or will require entirely novel technical approaches to improve the global environmental data portfolio.

The question that comes next is, considering these limitations, what can be achieved now? To give insight into the extent of what is possible, we provide an example from the commercial space on the next page, showing how complex models are capable of overcoming many of the data limitations to provide greater insights than the sum of their geospatial parts. From there we explore three case studies across multiple scales in Brazil, showcasing step by step the various insights which can be gained and the various data challenges involved, starting at the asset level, looking at mining in Brazil.

BOX ONE

EARTH KNOWLEDGE

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The Earth Knowledge Planetary Intelligence Platform continually assesses Earth systems. Our platform leverages a 'digital twin' of the Earth integrating authoritative data and models of the Earth's interconnected systems, from the subsurface to the upper atmosphere. This digital Earth represents the varying conditions of landscapes and seascapes at multiple spatial and temporal resolutions, from approximately 125 years into the past to 150 years into the future.

The Earth Knowledge Platform translates scientific data, geospatial data and Earth-systems models into 300+ indicators related to the direct drivers of global change and the commonly described three pillars of sustainability (Natural Capital, Social Capital, and Economic Capital). These direct drivers of global change, which lead to biodiversity loss and habitat degradation, include climate change, pollution, invasive species and disease, over-exploitation of natural resources, and land and sea conversion. The indicators help assess global change and sustainability actions and provide a quantitative way to measure impacts and related potential risks and opportunities at any location on the globe.

Earth Knowledge's framework aligns to the same five drivers of global change developed by the IPBES in their global assessment of biodiversity and ecosystem services,[40 41] the WWF in their Living Planet Database and Report,[42] the WEF in their Nature Risk Rising Report,[43] and which were originally defined by the IUCN in their Standard Lexicon of Biodiversity Conservation.[44] This fundamental alignment of the Earth Knowledge's Indicators Framework, or indeed any platform, to these authoritative bodies is foundational. It provides consistency in process and language so that more direct translation can be made between science conclusions and global change and sustainability outcomes evaluated by financial institutions.

Vitally the data generated from Earth Knowledge Indicators are structured to identify and forecast both discrete environmental processes and the interrelated resulting conditions of global change on biodiversity and other aspects of natural capital. Each Indicator is a composite measure of different conditions aggregated at multiple spatial resolutions at different time periods for specific locations across a landscape or a seascape.

THE SPECIFICS

Earth Knowledge generates its 'digital twins' by constructing and running numerous Earth system and Earth subsystem process models to characterize past, present and potential alternative future environmental processes and conditions. Where required, lower resolution (more global) data or model outputs are appropriately downscaled using spatial, statistical or dynamical downscaling methods that are suitable for the data and the model from which the data originated.

Process models used to describe biophysical processes at multiple spatial and temporal scales must meet several key criteria in order to be used. These include that the biophysical process models must:

1. Be developed or available in the public domain
2. Have undergone significant peer review in many different journals and/or organizations
3. Be used in many different landscape environments and settings
4. Be used in many different geographic locations
5. Be applicable at multiple spatial and temporal scales and
6. Be used by a broad user community

For each Earth system and Earth subsystem model, Earth Knowledge identifies and selects authoritative data sources based on:

1. Global uniformity and extent (global, regional, locally specific data set)
2. Date of collection (or future projection)
3. Spatial resolution
4. Methodology of data acquisition and development
5. Official verification of the data developers and their organization and
6. Assessment of their source organization's quality assurance and quality control procedures

Candidate source datasets are profiled, qualified and sampled to establish their suitability for acquisition and processing.

Once the models are calibrated and evaluated to determine how well the models represent natural conditions over the 125-year historical period, the models are then re-run under varying conditions that represent different potential future states that may occur as a result of climate change and other forms of global change.

Future projections of a 150-year period are calculated beginning in 1950 and simulated through to 2100. The overlap period from 1950 through 2020 is used so that there is sufficient repetition in the historical model and the forward-looking projections to determine the potential for any model bias that could exist that may be introduced from field observation data.