Natural Capital accounting case study using satellite EO data and the InVEST tool

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'I... a universe of atoms... an atom in the universe' reflected the physicist Richard Feynman on our interconnectedness to our environment and each other. Because, 'when we try to pick out anything by itself, we find it hitched to everything else in the universe' as the naturalist John Muir explained. In this blog post, we explore this interconnectedness through an example case study of peatland ecosystems in the North of England, as shown in Figure 1. We show how changes in one part of the system impacts everything else using latest data and tools from satellite Earth Observation (EO) and modelling. Moreover, we relate these potential impacts to the operations of surrounding industries, such as power plants, steel and cement factories.

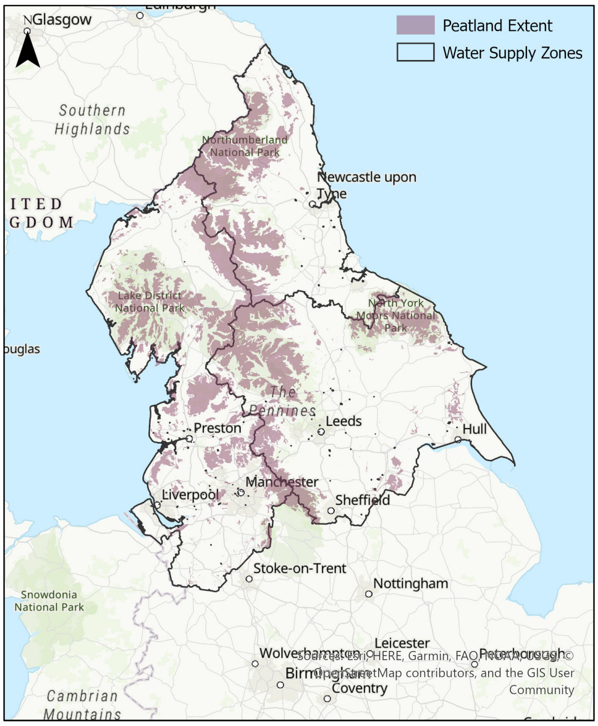

Figure 1: Peatland Extent and water supply zones of North England, UK.

The interconnectedness of nature, biodiversity and healthy ecosystems are being increasingly recognised by activists, poets, policymakers, companies and financial institutions. A key milestone is the recent Kunming-Montreal Global Biodiversity Framework, where almost 200 countries agreed to new goals and targets to address biodiversity loss and restore ecosystems at the United Nations Biodiversity Conference (COP15) in December 2022. What the implications of nature loss mean on the practical level for businesses and financial institutions is being explored by the Taskforce for Nature-related Financial disclosures (TNFD). TNFD is developing a framework to measure, manage and disclose information about nature-related dependencies and impacts. One methodology for putting a number on the dependence of businesses on nature is the United Nations Environment Programme's (UNEP) Nature Risk Profile. It tries to quantify the benefits and uses of nature - also dubbed, 'ecosystem services'. In short, the dependency of an asset such as a power plant on its surrounding nature is calculated based on three things, its reliance on ecosystem services, the resilience of these ecosystem services and any risk mitigation that may be in place.

This concept of quantifying the importance of nature for the operation of our industries and economy is also referred to as 'natural capital accounting'. For example, the UK government classify the different types of benefits related to peatlands, or its 'ecosystem services' into three categories. These include, **provisioning services** such as water supply, food / timber production and peat extraction; **regulating services** such as climate regulation through carbon storage, water quality regulation or flood hazard regulation; and **cultural services** ranging from archaeological, educational or recreational. In the North of England, most of the water is supplied from surface water instead of ground water (BGS).Therefore, peatlands play a large role in providing ecosystem services related to storing and supplying fresh water in this area. In this case study, we simulate the availability of surface water (i.e. water yield) based on peatland quality and explore its potential implications for operating power plants and cement, steel factories. The simulation is conducted using the fantastic InVEST tool (integrated valuation of ecosystem services and tradeoff). We employ the Annual Water Yield package to calculate the water yield, relying on globally available datasets as outlined in Figure 2. The majority of these datasets are derived from satellite EO technology. This means, they are accessible worldwide, open source and subject to regular updates, sometimes on the scale of days. Access to these data is possible through various platforms, and for our study, we utilized Google Earth Engine (GEE) as the means to access them. There are two datasets not based on EO: the depth to root restriction and the plant available water fraction layers. These datasets describe more static properties, which change over geological time scales. Consequently, they do not require regular updates like the other data. Additional information about these datasets can be found in the section below.

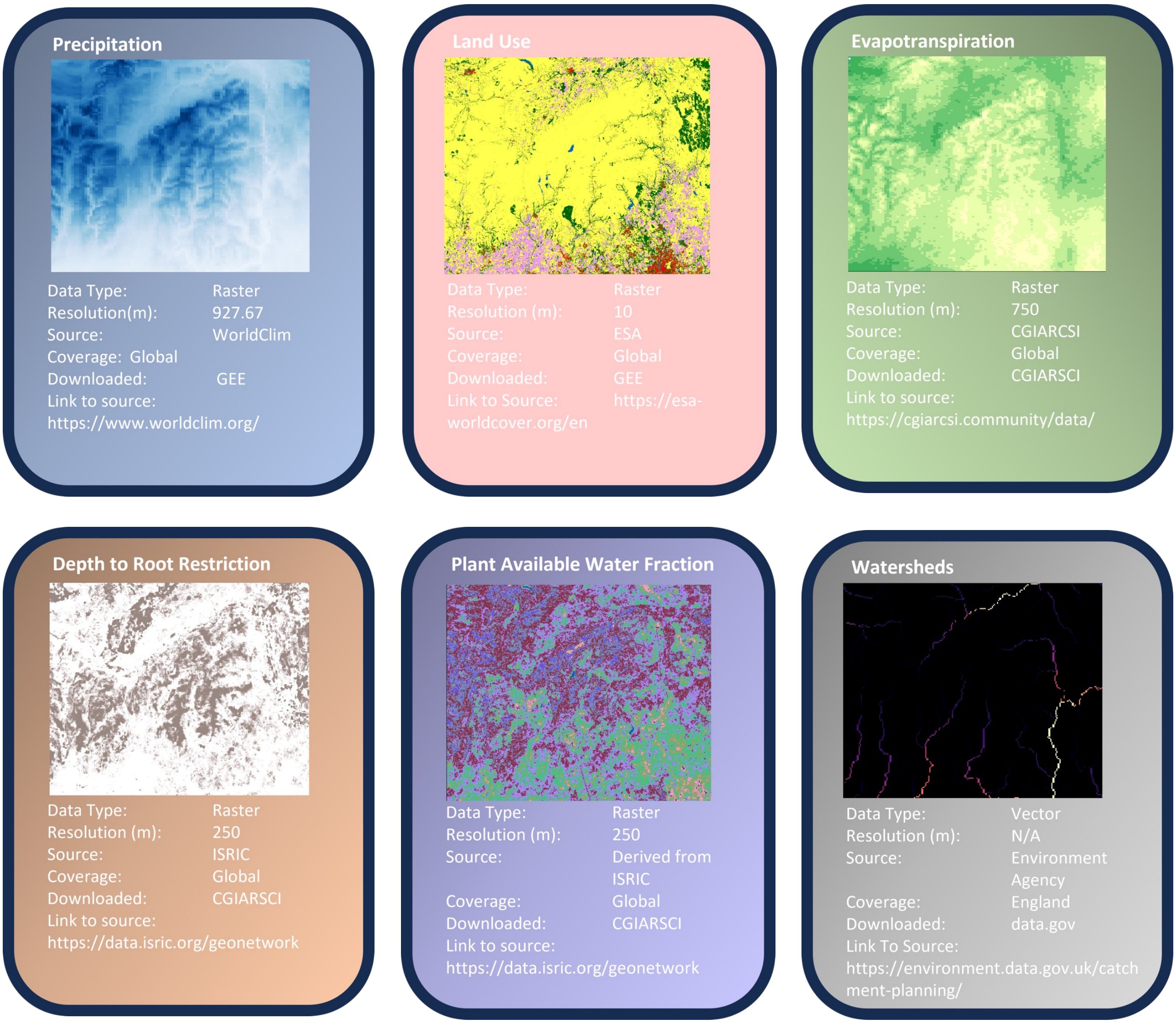

Figure 2: Globally available data sets used for calculating the annual water yield of our case study area.

Moreover, the plant available water content (PAWC) dataset served as a representation of simulations for both healthy and unhealthy peatland conditions. To depict degraded peatlands, an arbitrary value of 0.1 was subtracted from the PAWC data at peatland locations, indicating a reduced capacity for water storage.

Using the InVEST Annual Water Yield simulation, we conducted assessments over the North of England, considering both current and degraded peatland conditions. The resulting difference in water yield is depicted in Figure 3, providing insights into the potential impact of peatland degradation on water yield. The maps illustrate the potential impact peatland degradation may have on water yield.

In this analysis, we overlay the changes in water yield with the locations of water supply zones and industrial assets heavily reliant on water-related ecosystem services. By doing so, we can assess the potential high or very high impacts (shown in red) on cement, steel plants, and power plants due to peatland degradation. The maps offer valuable information on the most vulnerable industrial assets as a consequence of peatland degradation.

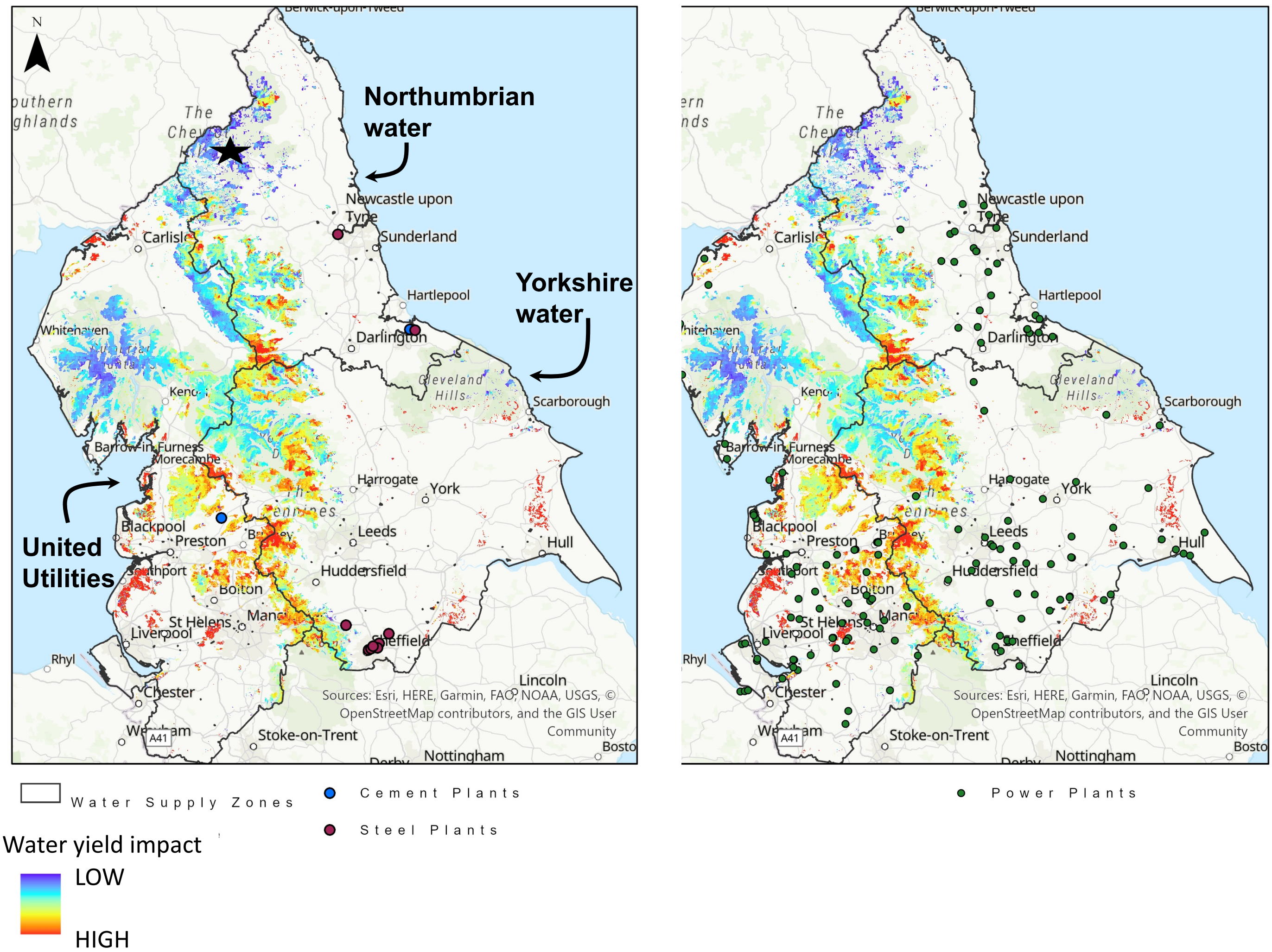

Figure 3: The impact of degraded peatland conditions on North of England water yield. Overlaid are the location of surrounding industries, power plants, cement and steel factories

The impact of peatland degradation on water yield varies between locations. The maps show that any peatland degradation will have the highest impact in the catchments of Yorkshire Water as well as Southern parts of United Utilities and the industries associated with those. Based on industry footprint, the operations of power plants near Liverpool will be most affected.

Industries near Newcastle will be least impacted. For example, Newcastle draw their water from the Kielder reservoir, as annotated by a star. According to the modelling, this is one of the less impacted reservoirs compared to the Southern reservoirs. While steel plants in the Sheffield area seem far removed from potential water stress areas, they may still be reliant on surface water or supplied water from waterways and reservoirs that source water from peatland catchments. There are many industry and asset specific complexities that need to be taken into account when analysing and quantifying nature-related risks, but it is obvious that geospatial datasets will play a key role.

In conclusion, combining satellite and geospatial data with modelling tools such as the InVEST tool, can play an important role in understanding an asset or company's reliance on ecosystem services, alongside the implications of degrading or improved ecosystems. The same approach can be used to assess the impact of other ecosystem services such as carbon or soil/sediment retention. This would then allow a comparison of the impacts on different types of ecosystem services and decisions can finally be made on real up-to-date data. By using frameworks such as those from TNFD and UNEP, these can then be translated into financial implications. Which will ultimate make an economic case for restoring and maintaining healthy ecosystems such as peatlands. So that our economy and future generations can continue benefiting from the many services nature has to offer.

There is huge impact to be realised immediately, right now, if practitioners and users can start to adopt today. At the Satellite Applications Catapult, we want to help reduce the barriers to this adoption and help push towards the sustainability goals. If you are a researcher, a user or a practitioner in this topic, we want to collaborate with you. Please do reach out to us.