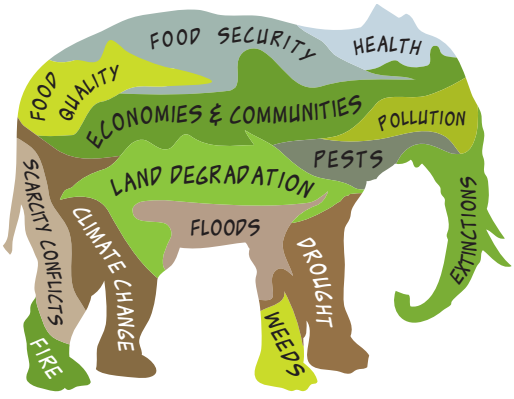
Atlas of biological work

> You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.
>
> Buckminster Fuller

Life, powered by a mere thousandth of incoming sunlight, is the most powerful and creative planetary force. Our planet's atmosphere, its soils, its blue, white, and green colors viewed from space, even the composition of its crust and oceans, are the products of eons of life's complex chemical wizardry. This work of life, which powers carbon cycling, nitrogen cycling, and leverages water cycling, is what makes the world go round in almost every way save for the actual physical spin. We are riding a never-ending flow of sunlight captured by complex communities of self-motivated living organisms, whose behaviors and relationships reflect our own. Learning to recognize, imagine, and work in alignment with this force and power is our natural opportunity for growing topsoil, growing clean water, and growing healthier communities and economies.

Though much more powerful than all our technology, this force is mostly invisible. It's quiet, gradual, diversified, and spread out. Key processes occur underground and undersea, at ordinary temperatures and pressures. With some exceptions in agriculture, we don't map or monitor this flow of energy. Instead we map and monitor species, land cover, legal status and conservation zones, and problems of too much and too little such as pollution, flooding, or drought. We see our situation in terms of materials and resources, scarcities and threats, and hard limits to possibility. The opportunity remains camouflaged by competing solutions, positions, and advocacies such as organic agriculture, carbon offset markets, geoengineering, or some type of business as usual. In managing against what we don't want, we end up rewarding increasing fragmentation, turf battles, and gridlock.



A different dynamic is possible if we can supplement the positions, advocacies, and predictions with sufficient open data on the actual, localized behaviors of this creative planetary force. We now have vastly increased capacity to acquire such data via multispectral satellite imagery, automated sensors of various types, and citizens who can and do collect and contribute field data. We can now share, view, and interpret such data, in increasingly participatory and citizen-usable formats, including layered digital maps.

With easy ways to share, the collection, curation, interpretation, and use of data becomes more participatory, which in turn grows the data. The availability of open, relevant data to an increasingly participatory public will naturally tend to replace predictions with facts, theory with demonstrated possibility, and policy with performance. The creative potential of these kinds of network effects is increasingly recognized. Currency, along with weights and measures, made markets possible. The internet and appropriate software made Wikipedia possible. "The enemy of the conventional wisdom" wrote J. K. Galbraith, "is not ideas but the march of events."

A digital atlas, a multilayered frame or container for data, observations, and monitoring of changes in the biological capture of sunlight, could be a transformative platform for recognizing, imagining, and working in alignment with the most powerful and creative planetary force. Such an atlas can coordinate and connect, and serve as infrastructure for, a variety of data sets including decentralized citizen-science efforts, with nuanced local and regional adaptations and areas of focus. It could enable wider participation in measuring, recognizing, and interpreting biological work, as well as fostering management capacity at all scales, enabling people to adapt, learn, and create change toward what we want and need.

Part of the needed development of our imaginations has to do with reconnecting what has become disconnected, such as soil issues and water issues. We have an almost complete absence of open and accessible data about localized, farm-scale changes over time in water, carbon, or nitrogen cycle function that could show us what might be practical and possible. Whether we like it or not, humans are managing nature's power plant. A visual or superficial inspection is not enough. We need to gauge power at all scales to grasp opportunities and possibilities for **function.** The Atlas will include mapped layers of **change over time** in:

photosynthesis, for which satellites, such as NASA's Landsat, provide a variety of approximations based on ratios of reflectance of various wavelengths; these can be supplemented and correlated with higher-resolution imagery and ground observations

water infiltration—using pieces of 6-inch pipe for example to time 1 inch of water moving into soil

soil cover and biomass, such as surface litter, canopy, dry matter—ground observations can be combined with some remote sensing

soil carbon, extended versions of the map at `soilcarboncoalition.org`

water quality and quantity, such as temperature, flow, and electrical conductivity. USGS has enormous data sets for the US, and there is an ongoing expansion of low-cost, open-hardware options.

economic and production measures such as gain of livestock per acre per year per inch of rainfall or per dollar of input costs, or crop yields per dollar or pound of input costs.

Open, mapped data can have substantially different social impact than data that is only published for and interpreted by insiders and experts. Open, mapped data can show that management, over time, can increase biological work, that change is possible though not guaranteed, and that it is possible to measure some of it. Open, mapped data encourages repeatability, as the raw data for a baseline measurement for example remains visible and accessible, and thus gauging change over time becomes more feasible.

Open, mapped data challenges the traditional privacy around soil and money in agriculture, thus broadening and enriching the connections between our treatment of our soils and the consequences, such as large public expenditures for flood mitigation, irrigation infrastructure, and water treatment.

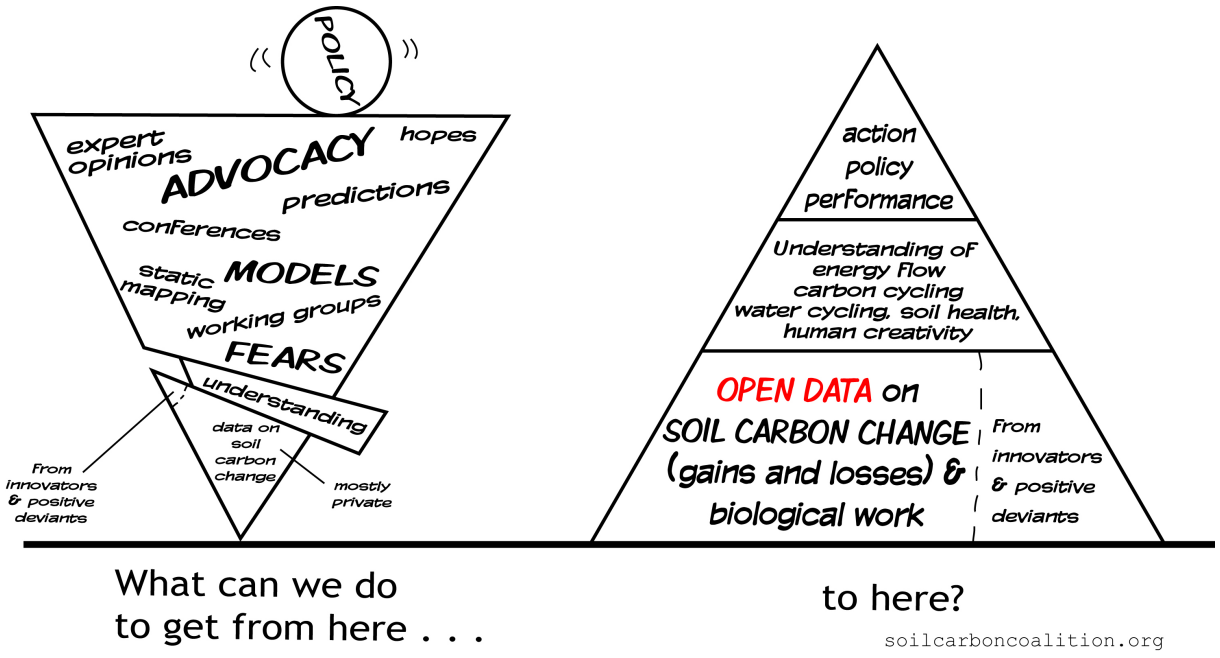
Open, mapped data spreads the story, and invites people to participate, engage, and interpret, often with broader, more diverse contexts, frames, and questions than typically occurs with peer-reviewed research behind subscription paywalls. Open data allows and can promote networking, discovery, shared learning, citizen science, and policy analysis. It allows the entire globe to become an experimental farm or research station. An open, mapped display of raw data can distribute and decentralize the power of framing important questions and seeking solutions for larger issues. It can open a true dialogue with the most powerful planetary force, and help develop the imagination of all, from individual land managers to institutions to society at large.

While actual data on biological work, such as changes in soil carbon, is often still thin to nonexistent given the enormity of the subject, there are enormous data sets from agencies and institutions that can be mapped so as to connect issues that have had a tendency to remain separate, such as water issues, farm policies, and soil health. In addition to providing perspective and connection with data on biological work, these kinds of data sets can also provide visual tools for policy analysis, enabling people to see connections between, for example, crop insurance payments, soil cover, year-long photosynthesis, and risk of flooding. Such policy

analysis via mapping is more apt than argument-based policy critiques to suggest opportunities for managing wholes at a variety of scales.

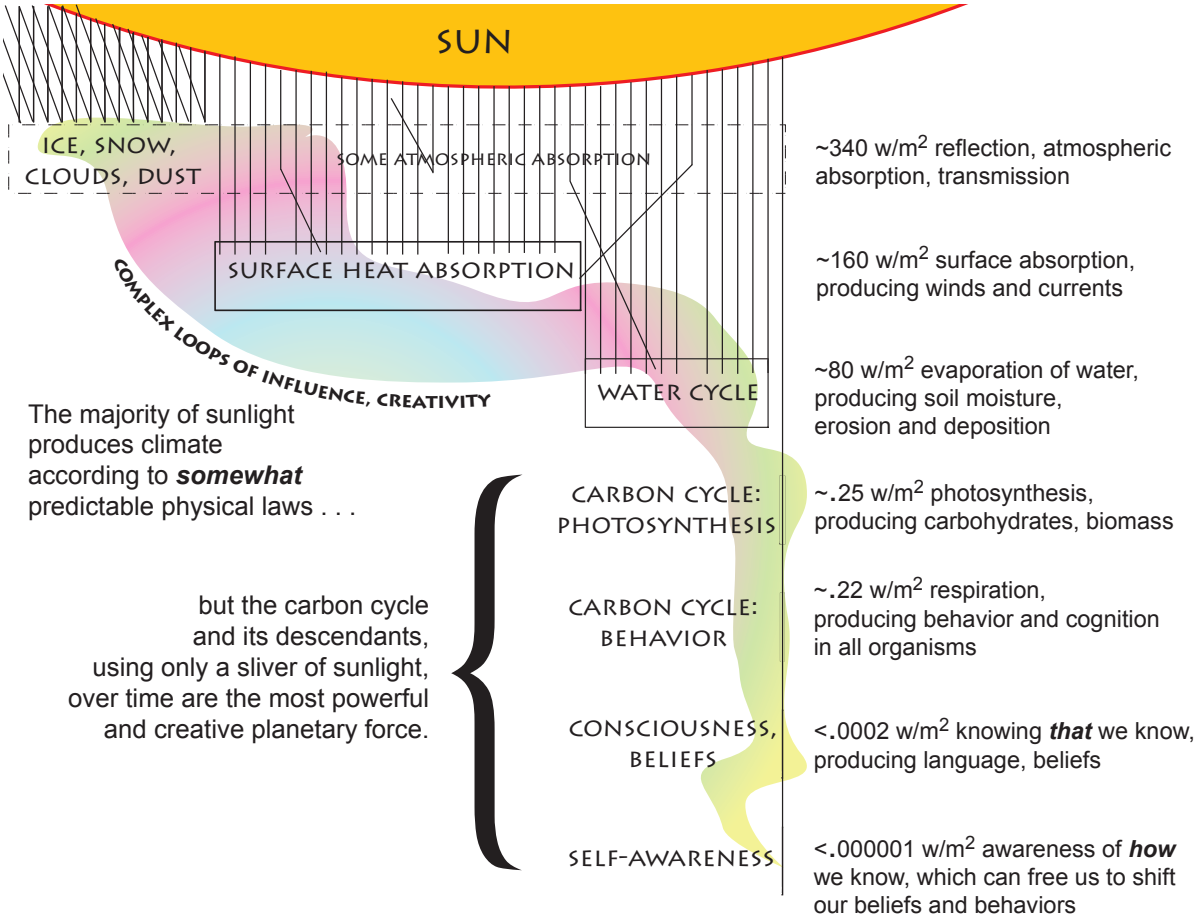
In 1958, Charles David Keeling began to gather time-series data on the concentration of carbon dioxide in the atmosphere. This Keeling curve has framed the climate issue for two generations now. It is time now to enlarge the issue, to frame the possibilities and opportunities of enlisting the most powerful and creative planetary force with specific, localized, time-series data. We can map function, not just the parts or the problems, and in so doing, build management capacity through participation. This will involve many surprises, and it will not be an instant fix.

The atlas is a network, using Google's Maps Engine as part of a collaborative framework. We're seeking partners and collaborators, designers and curators, global and local, on data layers, areas, and collection methods. Send us an email (managingwholes dot com at gmail dot com) if you have suggestions or would like to participate in design, data collection, data curation, data cataloguing, or any type of implementation, or if you have suggestions for data layers, partners, or support.



Peter Donovan is a founder of the Soil Carbon Coalition, a nonprofit that advances the practice, and engages people with the opportunity, of turning atmospheric carbon into water-holding, fertility-enhancing soil organic matter. The major project to date has been the Soil Carbon Challenge, which has emphasized repeatable and practical soil sampling and mapped, open data. This paper is available from `soilcarboncoalition.org`

Seven generations of sunlight



Seven generations of sunlight. Power is approximately quantified in terms of watts per square meter of earth's surface, averaged over day and night, all latitudes, all seasons. Vertical lines represent solar energy, some of which is reflected and scattered.

> Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals.
>
> Aldo Leopold

We are not in an equilibrium system. The work of life takes our planet into a state of chemical and thermodynamic **disequilibrium,** which enables small forces or perturbations to have disproportionate influence. Human behaviors and beliefs, for example, have (unintentionally) changed earth's climate. We're in a sensitive system, and **creation is now** as well as in the past.

How might we navigate this ladder of possibility?