OCEAN VISIONS

Working to Advance Marine Carbon Dioxide Removal This Decade

Ocean Visions is a nonprofit organization at the center of a robust network.

Ocean Visions catalyzes collaboration for the co-design, development, testing, and evaluation of solutions to the interlocking ocean-climate crisis.

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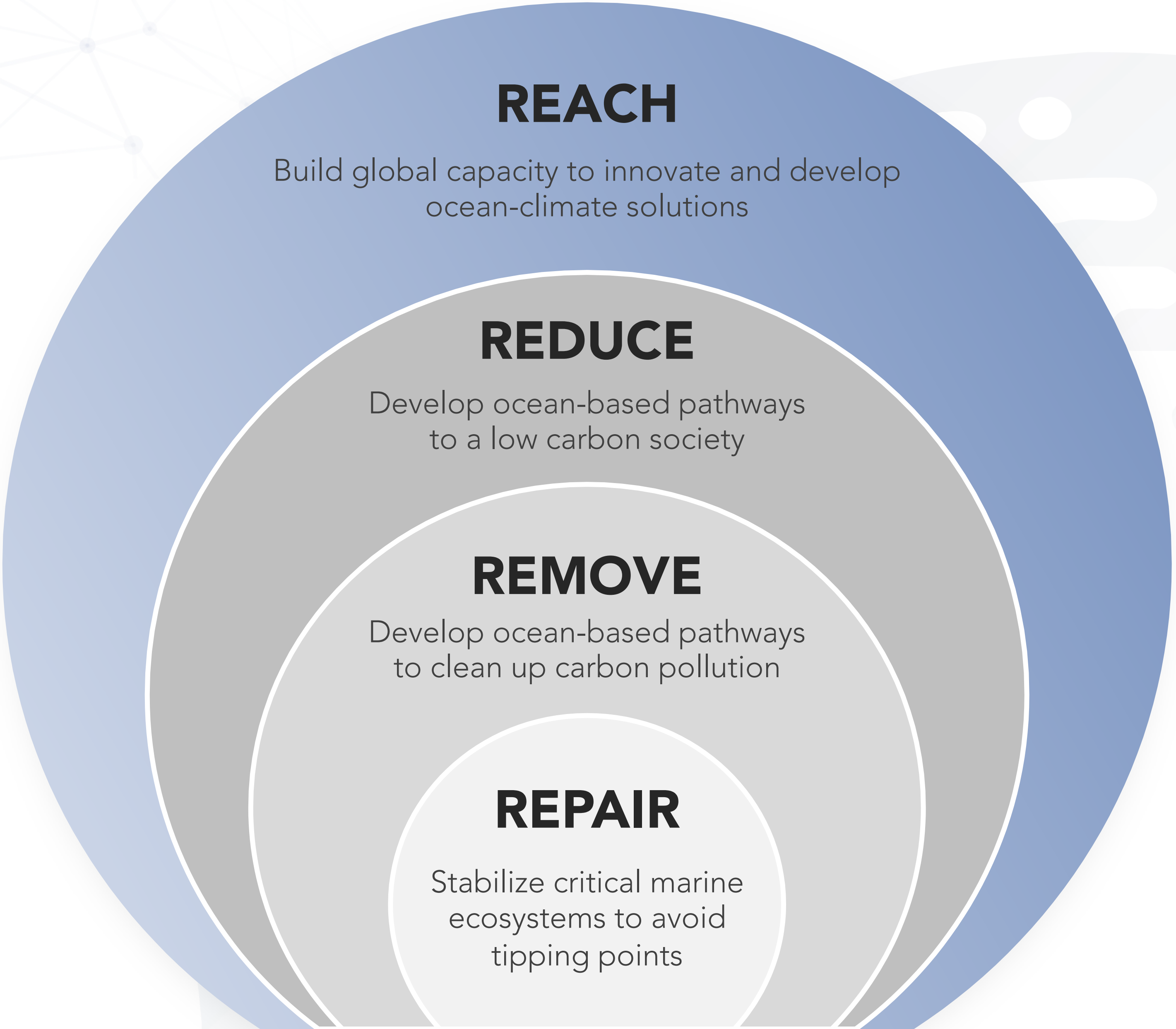
Ocean Visions is Advancing a Strategic Agenda to Address the Interlocking Ocean and Climate Crises:

4 R's



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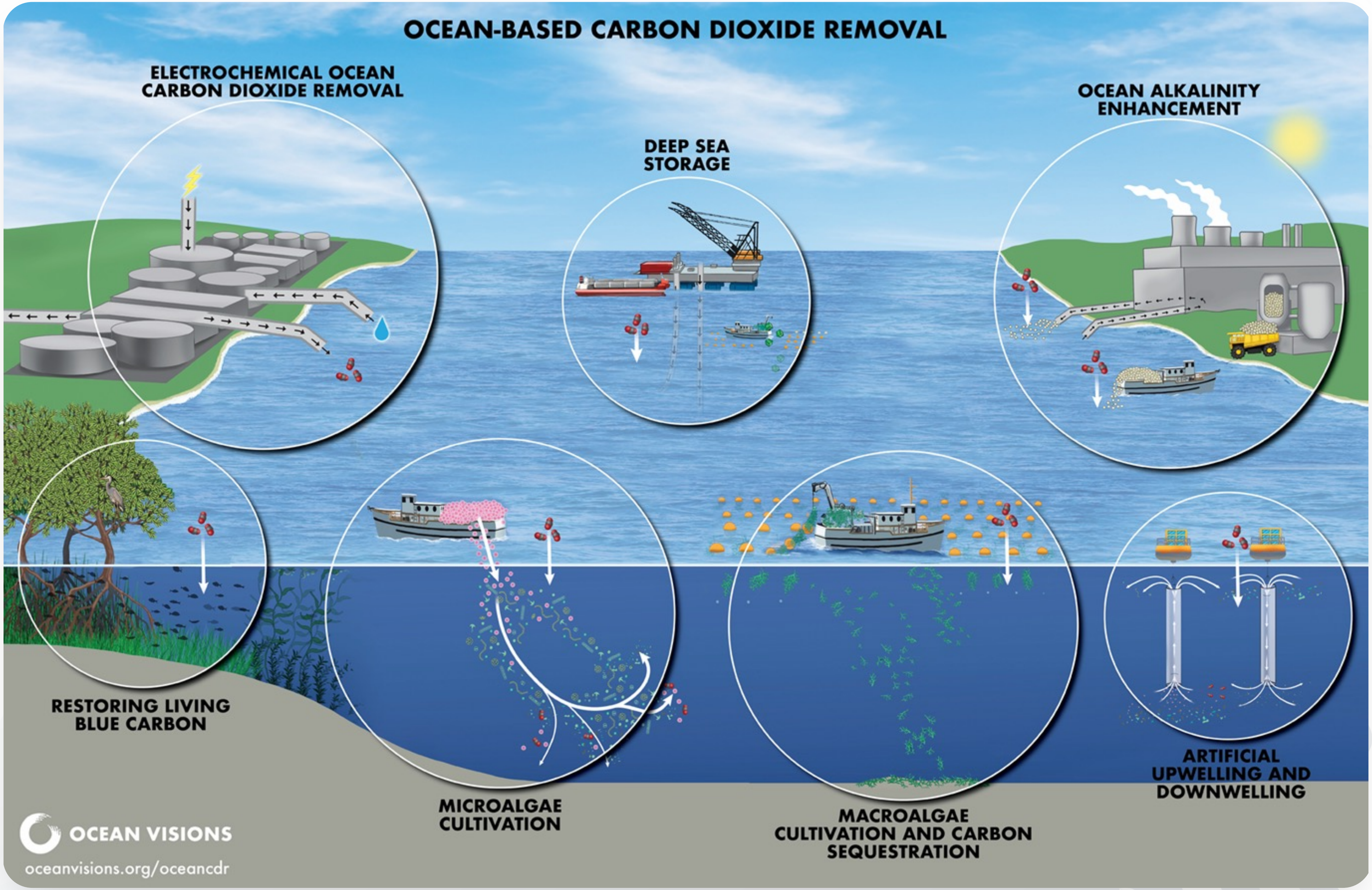

ACCELERATING OCEAN BIOLOGICAL AND CHEMICAL CARBON UPTAKE

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Bringing It All Together

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A Comprehensive Program to Prove or Disprove Marine Carbon Dioxide Removal Technologies by 2030

Released in October 2023; https://oceanvisions.org/high-level-road-map

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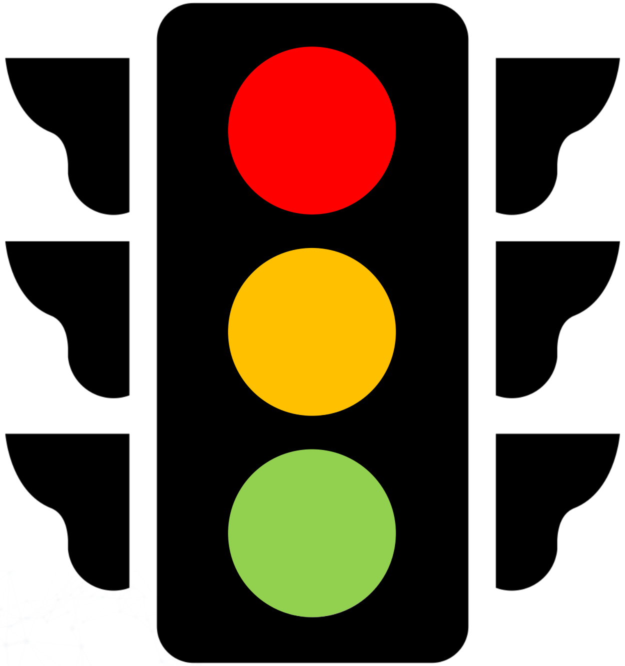

- Does the mCDR activity generate a measurable reduction in seawater carbon dioxide concentration?
- Can net additional ocean uptake of atmospheric carbon dioxide be tracked in response to the mCDR activity using a combination of sensors, platforms, and models?
- What are the impacts to marine ecosystems of mCDR activities and are they acceptable when compared with the impacts of the no-action alternative or of other feasible mitigation measures?
- What are the range of impacts to human populations and are they acceptable when compared with the impacts of the no-action alternative or of other feasible mitigation measures?
- What are the necessary materials for scaling an mCDR approach and can they be sourced, transported, and delivered to key regions with acceptable cost and environmental impact (from a lifecycle perspective)?
- What is the required suite of technical, economic, social, and political enabling conditions required to permit growth of a given mCDR technology to the scale of gigatons of annual CDR and what is needed to establish them?

Three (Interconnected) Pillars

- Science and Engineering
- Policy
- Scalability

Science and Engineering

- Controlled Field Trials
  - Pre-permitted test beds
- Fundamental laboratory and mesocosm science questions
  - NSF Ocean Acidification Program as an example
- Monitoring, Reporting, and Verification-related R&D
  - Sensors
  - Models
  - Model/data integrations
- A coordinated social science research program

Policy

Regulatory and Governance Frameworks

- Must enable **responsible** research
- Must be deployed at international, national, and subnational scales

Following a Code of Conduct for **Responsible** Research

Expanded communications for mCDR R&D

- Who are the target audiences?
- Who are the credible spokespeople?
  - Need geographic diversity, and more representation from the Global South

Scalability

- Scaling Analyses
  - Site suitability
  - Co-products
  - Supply chains
- What can we learn from other areas of innovations to advance mCDR?
- Regional Innovation Hubs

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What We're Doing in 2024 to Advance this Agenda

New mCDR Field Trials Database

mCDR Field Trial Database

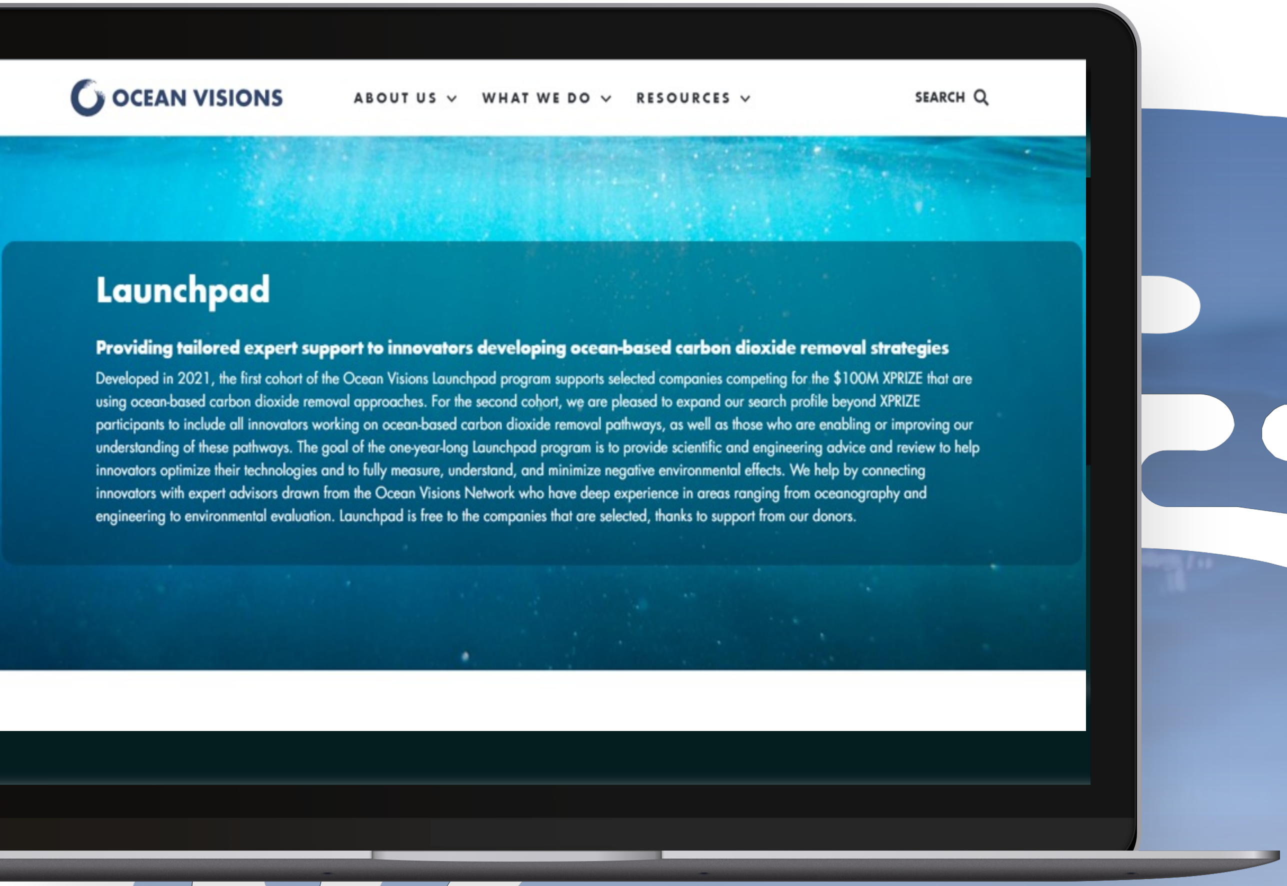
(Last updated December 14, 2023)

Hide fields · Filter · Group · Sort · ···

	Trial Name	Leading Organization	Other Leading Organiz...	O
28	First of a kind Direct Ocean Capture facility on the North Sea Coast	SeaO2		S
29	Pilot Integrating Direct Ocean Removal Process with a desalination facility in Maagan Michael, Israel	CarbonBlue	[C]Worthy	S
30	Impact of artifical upwelling on macroalgae growth in Aoshan Bay, Shandong Province, China	Xiamen University		A
31	Assessing the impact of OAE on a winter/ spring plankton community in Kiel Fjord, Germany	GEOMAR		R
32	Halifax Harbour OAE Net Carbon Removal Pilot	Planetary Technologies		S
33	Chesapeake Bay Wastewater Alkalinity Injection (NOPP)	Planetary Technologies	University of Maryland ...	A

Learn more here & add your field trial to the database

Science and Engineering
Support to Innovators



BANYU CARBON

Brilliant Planet

CAPTURE6

CarbonBlue

Carboniferous

SeaO2

Subtidal

VYCARB

Ocean Visions' 2024 mCDR Activities

- Advancing a research framework for OAE (in partnership with Carbon to Sea; more soon)
- Advancing technology development in mCDR through collaboration with adjacent fields not yet involved in mCDR (e.g., artificial intelligence, biotechnology, etc)
- Site suitability analyses to look at pathways for scaling, including for OIF….

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OIF Site Suitability Planning Tool

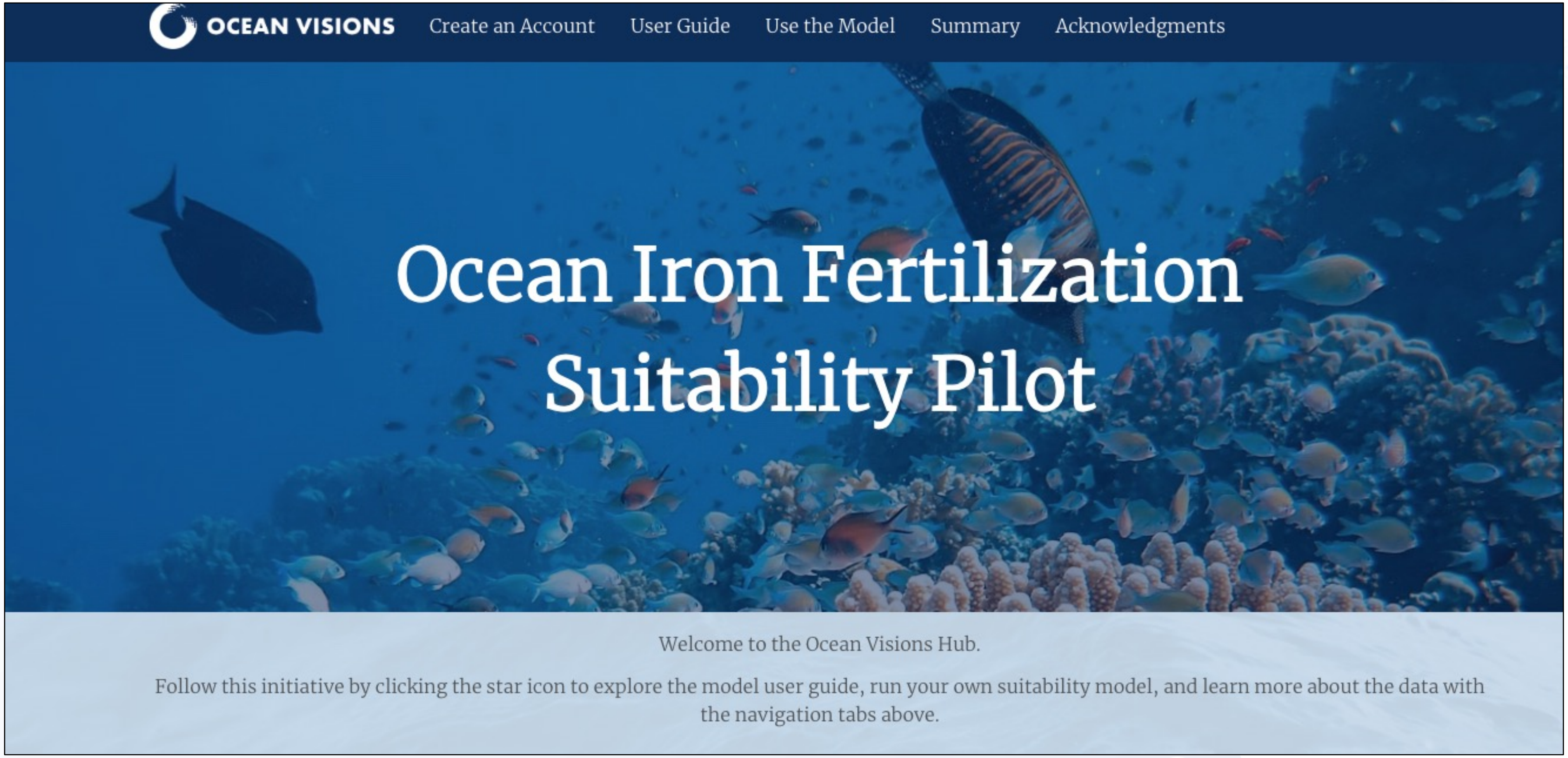
Why Ocean Iron Fertilization?

- Ocean iron fertilization (OIF) has been recognized as one of the high potential approaches for marine carbon dioxide removal

- Figuring out where OIF could scale (or not) is not easy. Scaling decisions must be based on science, engineering, economic, social, and political factors to name a few. These factors must be considered **together.**

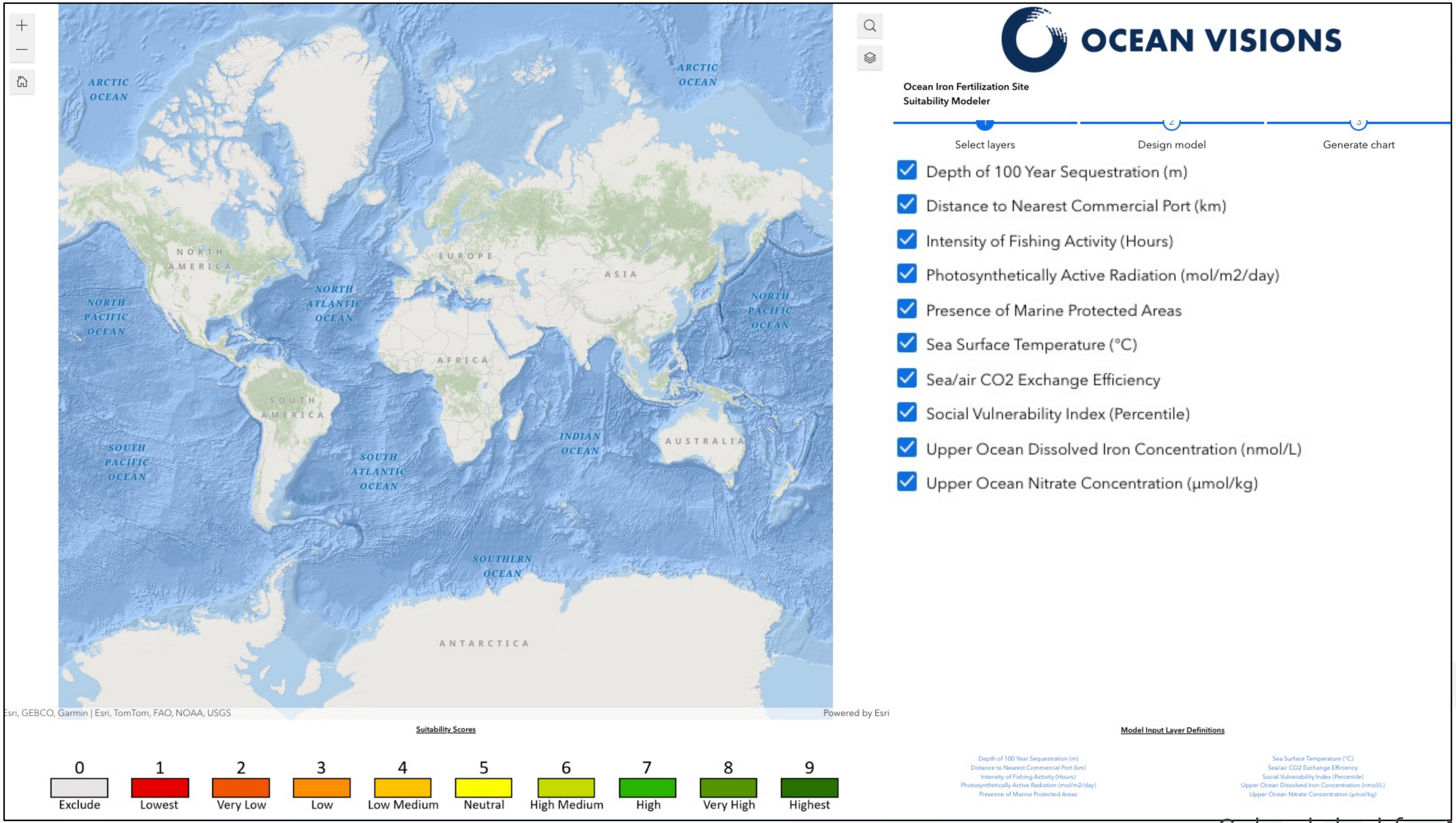
- Site suitability tools are a good way to consider complex environmental decisions based on many factors. One did not exist for OIF, so…

Ocean Iron Fertilization Site Suitability Planning Tool



Scheduled for March 2024 public release

Site Suitability Planning Tool: Ocean Iron Fertilizatio



10 layers: oceanographic, social, political, and logistical factors

Seasonally variable results:

- October-March
- April-September

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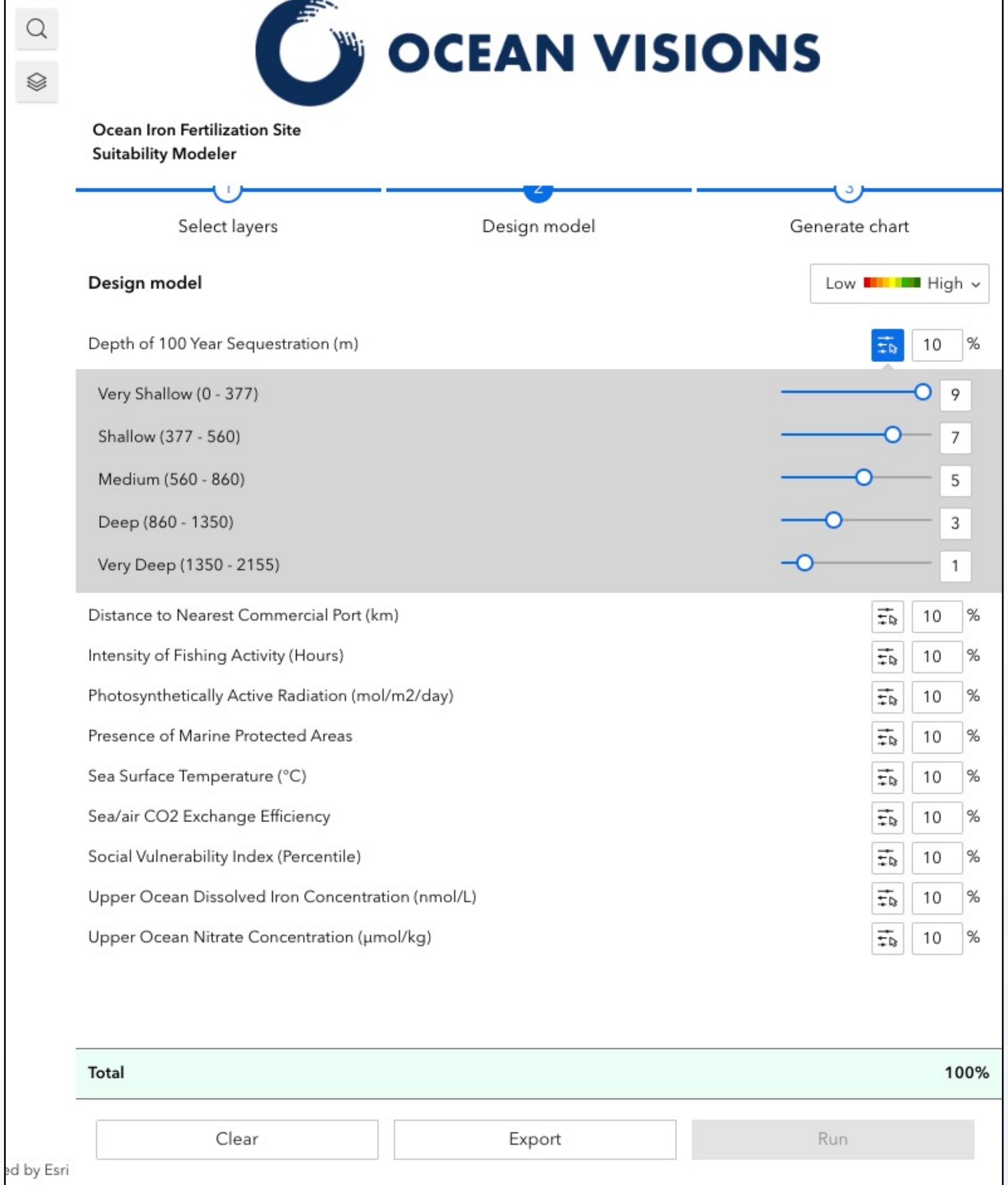

Customized Analysis

- All dimensional data converted to 1-9 scale; user control over data breaks let's you choose what's most important
- Choose which layers to include (or not) and how important each data layer should be in your results

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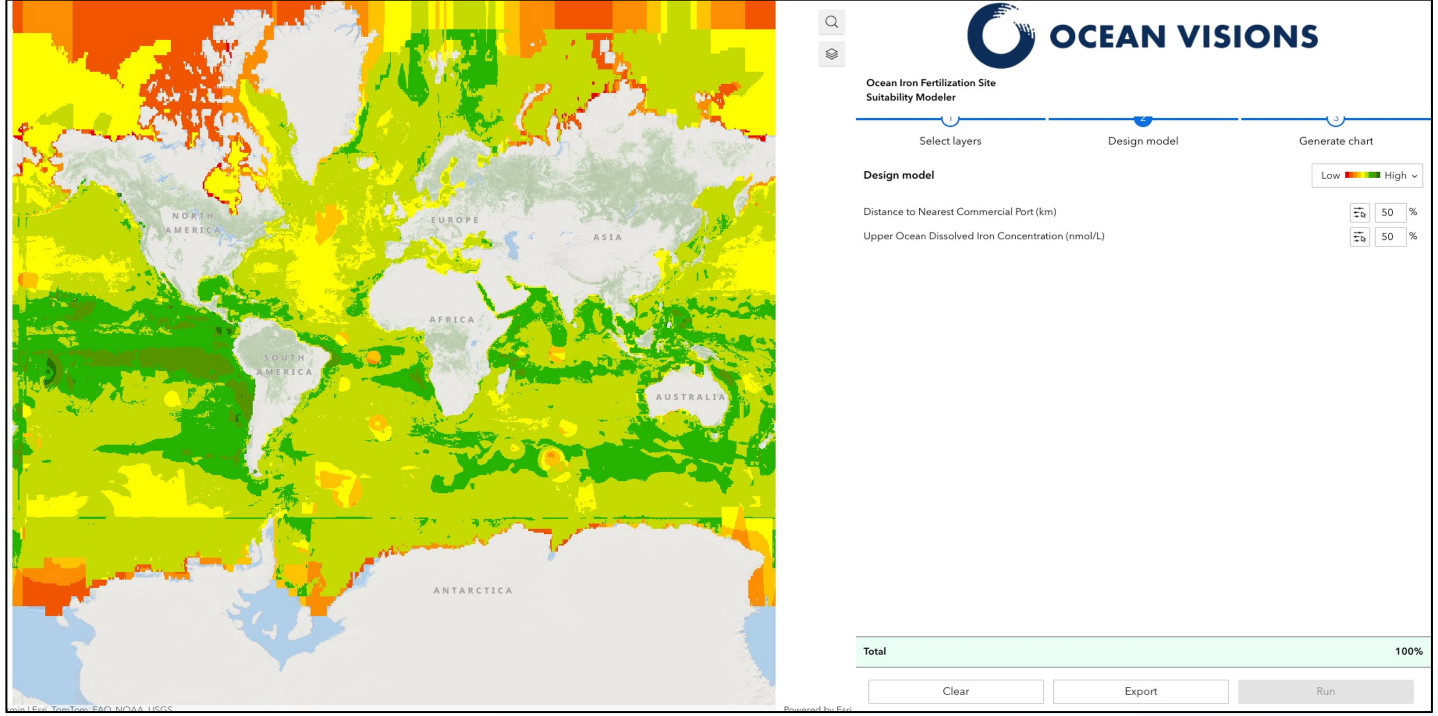

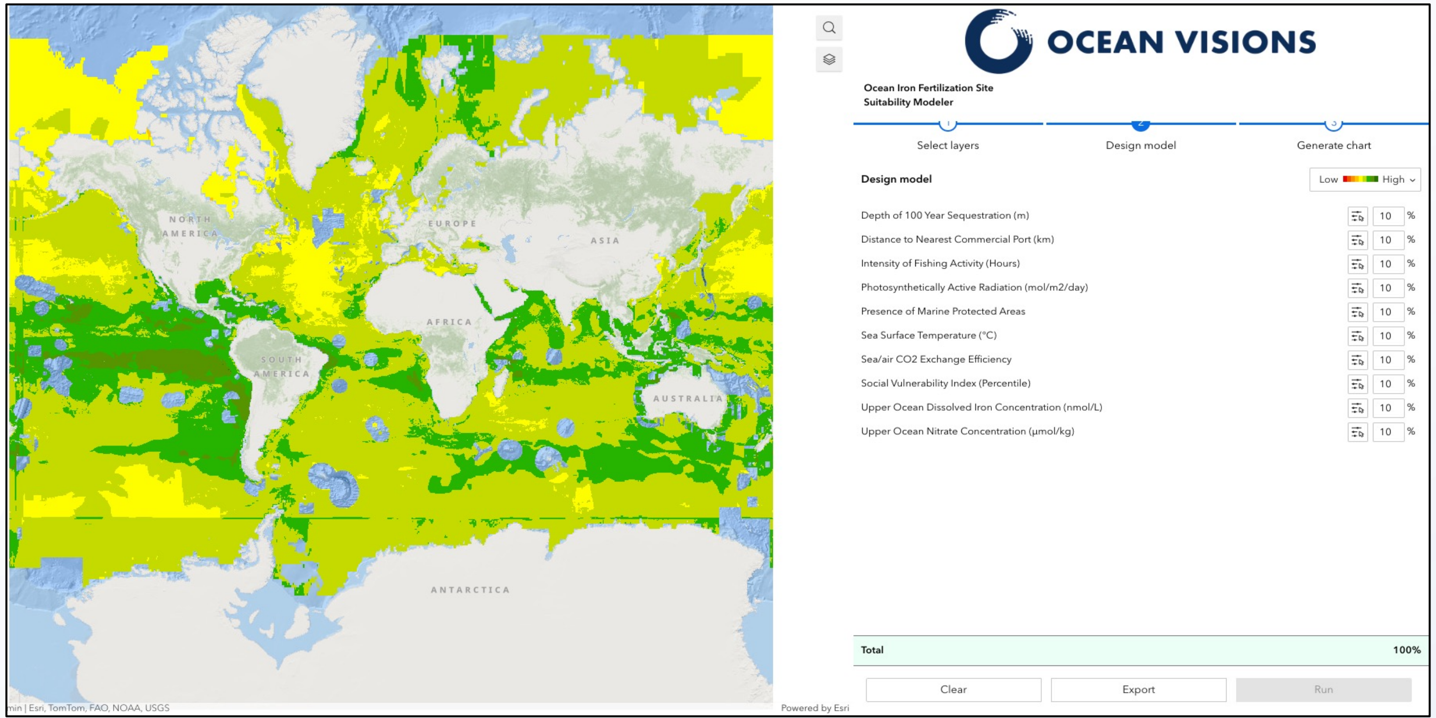

Explore Results

- See how different data layer inputs and weightings change suitability scores
- Export map displays of your results. Choose global or zoomed in local displays for regions of interest
- Overlay additional important geospatial layers such as EEZ boundaries for extra insight

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Built on Open Data

OCEAN VISIONS | Create an Account | User Guide | Use the Model | Summary | Acknowledgments

About the Data

Model Layers

Upper Ocean Dissolved Iron Concentration (nmol/L)

Source: Huang Y, Tagliabue A and Cassar N (2022) Data-Driven Modeling of Dissolved Iron in the Global Ocean. *Front. Mar. Sci.* 9:837183. doi: 10.3389/fmars.2022.837183

Data Access: https://zenodo.org/records/6994318 (Version 2)

Upper Ocean Nitrate Concentration (µmol/kg)

Source: World Ocean Atlas (2018)

Data Access: https://www.ncei.noaa.gov/access/world-ocean-atlas-2018/bin/woa18oxnu.pl?parameter=n

Sea Surface Temperature (°C)

Source: World Ocean Atlas (2018)

Data Access: https://www.ncei.noaa.gov/access/world-ocean-atlas-2018/bin/woa18.pl?parameter=t

Photosynthetically Active Radiation (mol/m2/day)

Source: NASA

Data Access: https://oceandata.sci.gsfc.nasa.gov/directdataaccess/Level-3%20Mapped/Aqua-MODIS/

Distance to Nearest Commercial Port (km)

Source: World Port Index

Data Access: https://msi.nga.mil/Publications/WPI

Social Vulnerability Index (Percentile)

Source: Halpern BS, Longo C, Hardy D, McLeod KL, Samhouri JF, Katona SK, et al. (2012) An index to assess the health and benefits of the global ocean. *Nature.* 2012;488: 615-620. doi: 10.1038/nature11397

All data sets used to feed the planning tool are publicly available, including data from NASA, NOAA, and others

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User Guide Helps Anyone Get Started Quickly

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Complex Climate Solutions Need Diverse Leaders

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Project Team

Ocean Visions gratefully acknowledges the contributions of the following individuals to the Ocean Iron Fertilization Site Suitability Pilot Project:

Expert Advisors

- Ken Buesseler, Ph.D. *(Woods Hole Oceanographic Institution)*
- Fei Chai, Ph.D. *(University of Maine - School of Marine Sciences)*
- Sara Nawaz, Ph.D. *(Institute for Carbon Removal Law and Policy)*
- Akash Rastogi, MBA *(Dalhousie University - Ocean Frontier Institute)*
- Steffen Swoboda, Ph.D. *(GEOMAR Helmholtz Centre for Ocean Research Kiel)*
- Romany Webb, LL.M. *(Columbia University - Sabin Center for Climate Change Law)*

Model Development

- Joseph Munyao *(Esri)*
- Mackenzie O'Brien *(Esri)*
- Robert Richard, Ph.D. *(Esri)*
- Carl Spangrude *(Esri)*
- Keith VanGraafeiland *(Esri)*

Project Management

- David Koweek, Ph.D. *(Ocean Visions)*
- Sarah Mastroni *(Ocean Visions)*
- Carl Spangrude *(Esri)*

Ocean Visions worked with ESRI and a team of advisors who spanned disciplines, sectors, and geographies to bring this project forward

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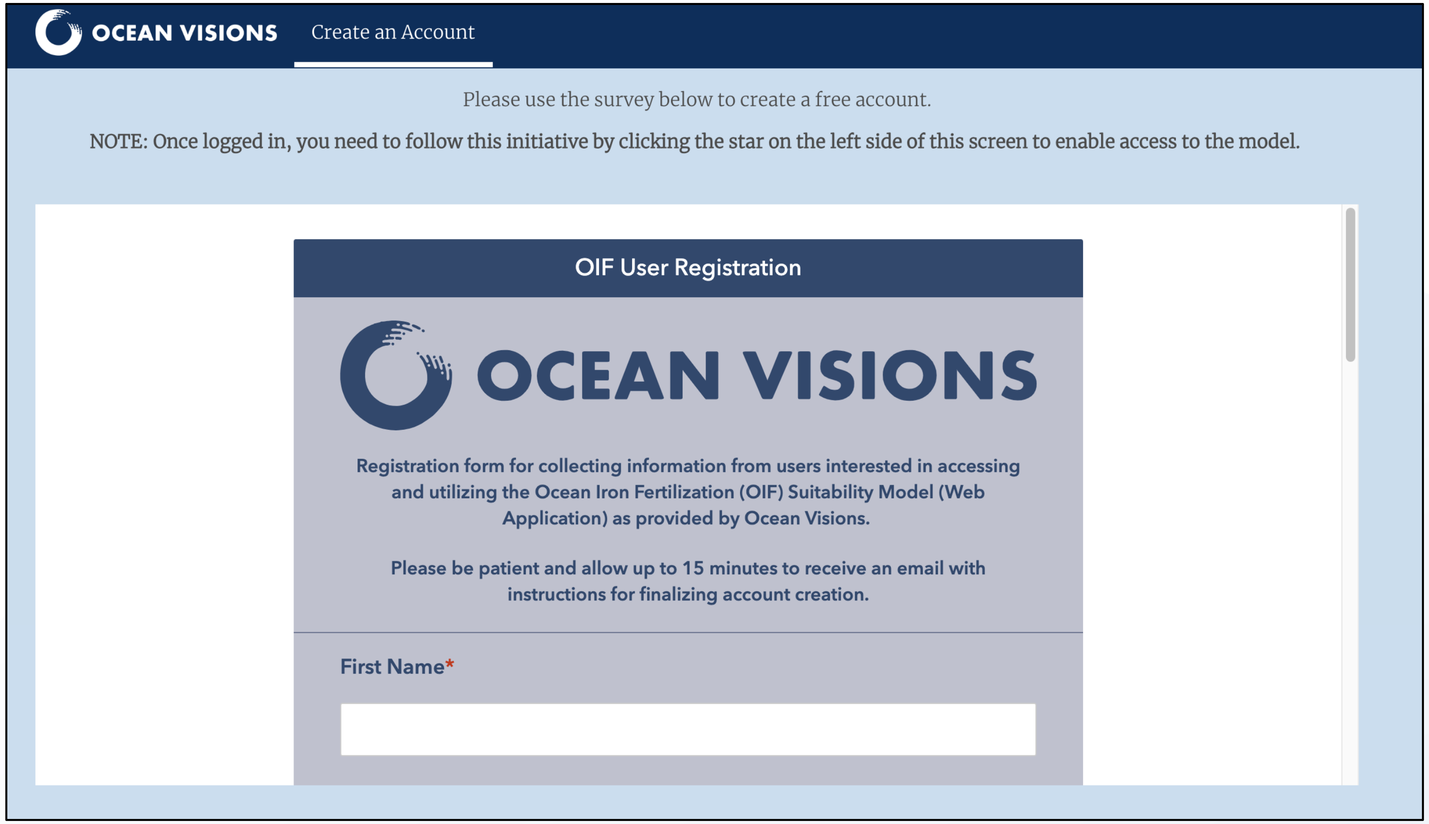
Open Access for Global Widespread Use



Once live, all you will need to do is sign up for a free account to get started using this tool yourself

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