EarthKnowledge
INTEGRATED PLANETARY INTELLIGENCE

Earth Knowledge's System of Systems Approach:

Achieving Success with Nature Positive Investments

ZHAW School of Management & Law

Swiss Sustainable Finance

November 2022

Transform Decision-Making
to Mitigate Financial Risk & Harness Investment Opportunities

Global ESG assets are on track to exceed $53T by 2025, representing more than a third of total AUM. Yet there is a perceived lack of reliable, authoritative data upon which to make the best investment decisions.

$44 trillion of economic value generation – over half the world's total GDP – is moderately or highly dependent on nature and its services.

Nature loss is a planetary emergency. Humanity has already wiped out 83% of wild mammals and half of all plants and severely altered three-quarters of ice-free land and two-thirds of marine environments.

"Climate risk is investment risk." (BlackRock) Investors are demanding that corporations reveal their climate and environmental risks.

ESG (Environmental, Social and Governance) ratings have depended on what the companies say that they are doing rather than more accurate fully-objective methodology.

Financial Regulations for Climate Risk and Environment, Social and Governance (**ESG**) are going mainstream…and soon Nature-related Financial Risk Regulations.

Earth Knowledge – Integrated Planetary Intelligence™ Platform

The Earth is a system of systems.

We have built a Digital Twin of the Earth,
tracking global changes of these systems and the interaction of these systems
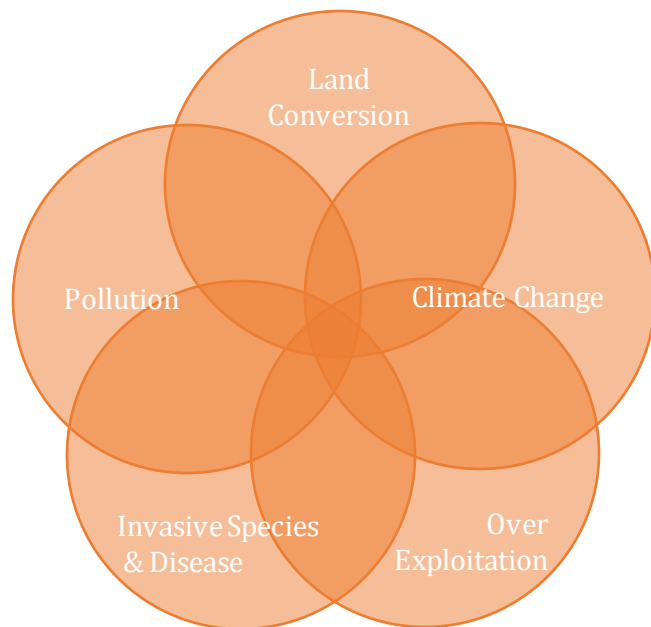from subsurface to atmosphere.

For any location on the globe, Earth Knowledge provides you the
understanding of the earth systems and global change interactions
for the best forward-thinking intelligence.

5th Largest Economy in World: California

We help them manage drought, water availability, infrastructure, forest health, biodiversity, ecosystem services, wildfire risk, and opportunities.

EarthKnowledge
INTEGRATED PLANETARY INTELLIGENCE

Living Scientific Network

Land Conversion

Climate Change

Pollution

Invasive Species & Disease

Over Exploitation
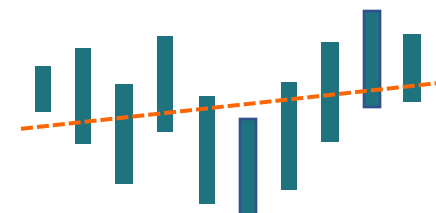
Earth Knowledge Indicators

300 Global Change & Sustainability Indicators

Sustainability Risk

Operational Risk

Economic Risk

Better Financial Performance
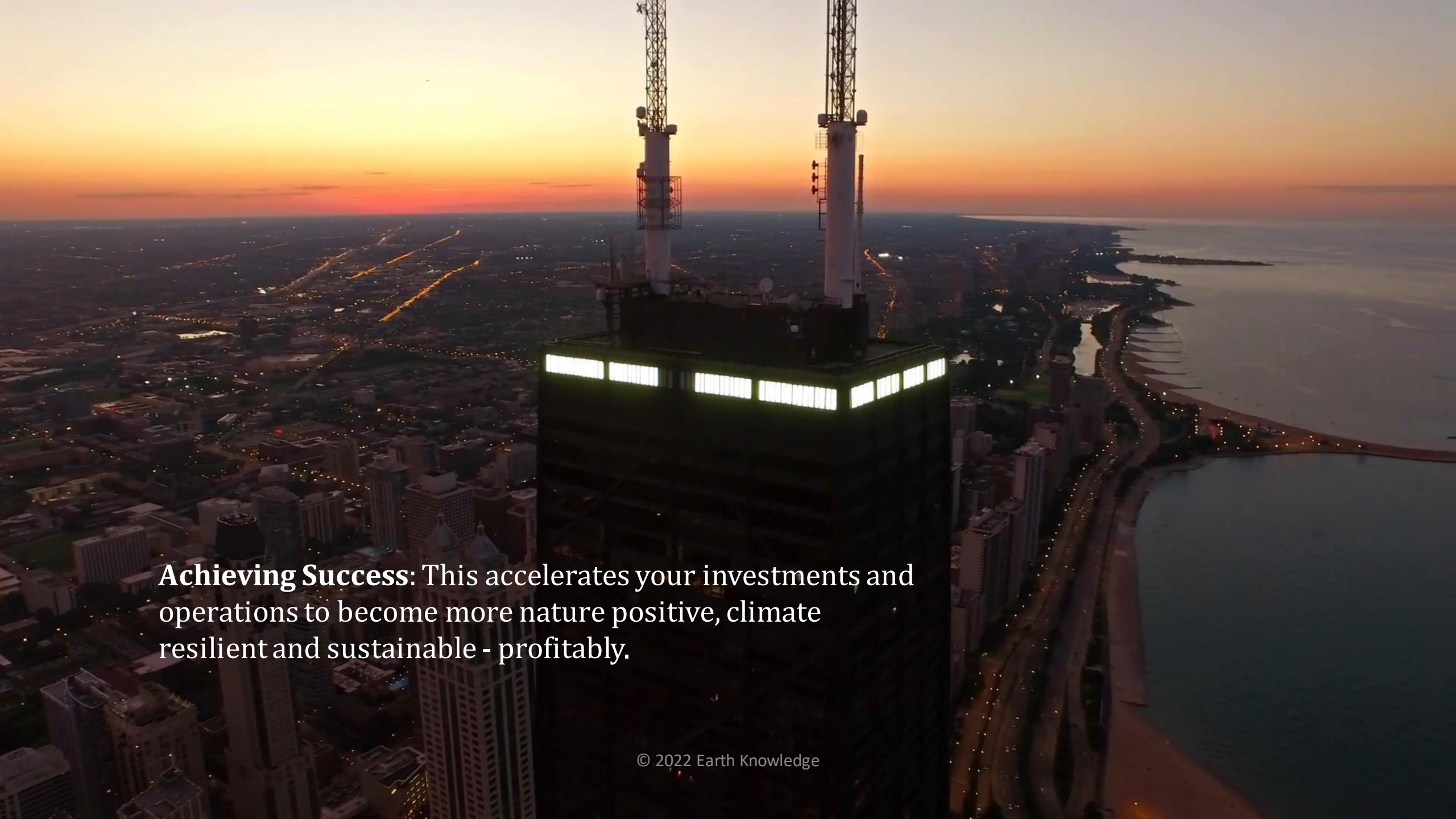
Step change in Risk forecasting & mitigation

Earth Knowledge's Digital Twin of the Earth integrates the highest caliber of models and data of the Earth's Systems illuminating human-planet interactions and key global change current and forecasted data patterns.

Earth Knowledge Indicators aggregate decades' worth of current and forecasted planetary data in a single platform to simplify, measure operational, supply chain and investment risks and opportunities.

Achieving Success: This accelerates your investments and operations to become more nature positive, climate resilient and sustainable - profitably.
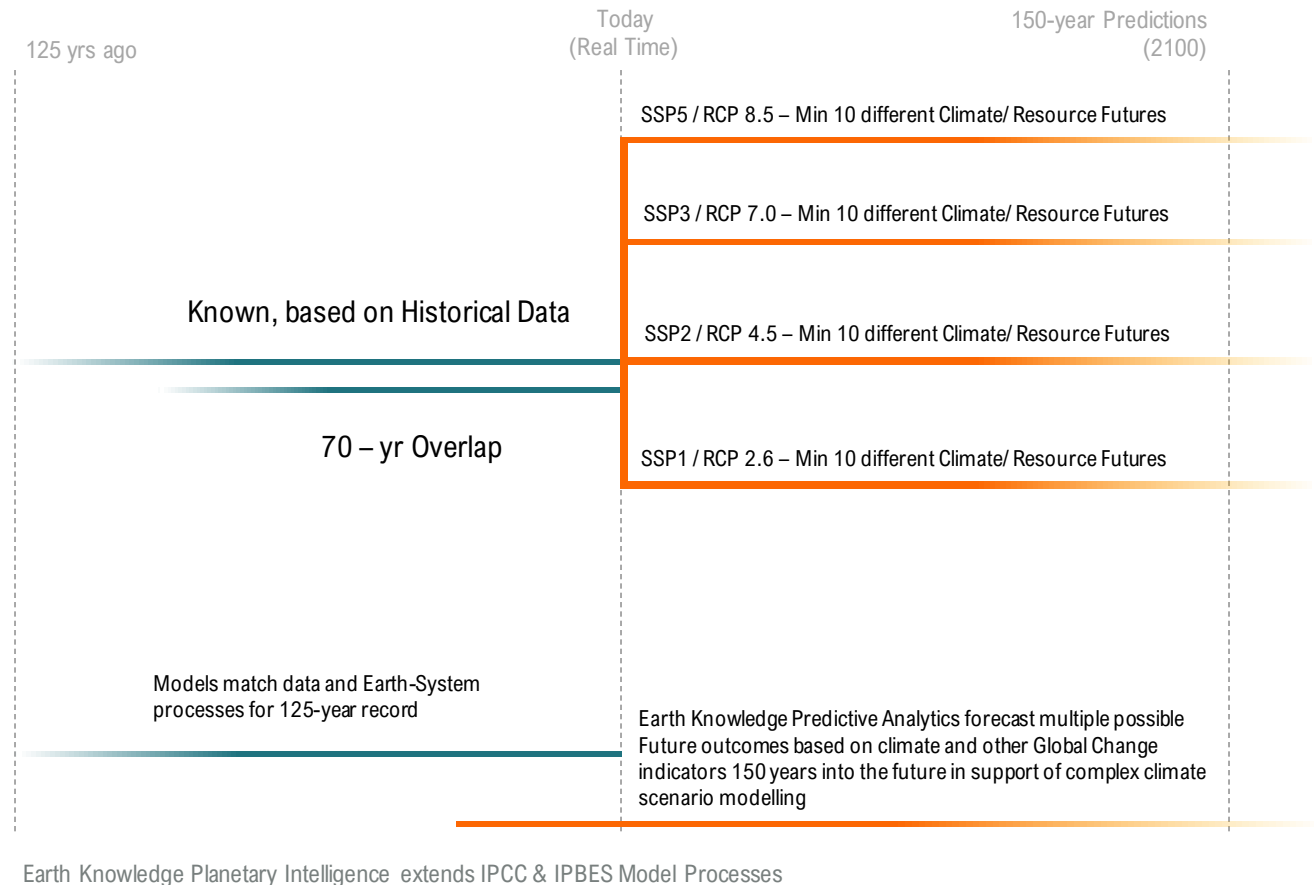
Trusted, Authoritative Data Analytics and Modeling Processes

All data, models, and indicators are linked to geographic location and time

- Deployed using MS Azure and Esri Cloud GIS

- Consistent, normalized, seamless, updated

- Global to Local (100km to 10 m) scales

- Biophysical processes are calculated at each model cell

- Outputs included 1000's of variables

- Digital Twin containing Petabytes to Exabytes of authoritative data, analytics, and simulation

125 yrs ago

Today
(Real Time)

150-year Predictions
(2100)

SSP5 / RCP 8.5 – Min 10 different Climate/ Resource Futures

SSP3 / RCP 7.0 – Min 10 different Climate/ Resource Futures

Known, based on Historical Data

SSP2 / RCP 4.5 – Min 10 different Climate/ Resource Futures

70 – yr Overlap

SSP1 / RCP 2.6 – Min 10 different Climate/ Resource Futures

Models match data and Earth-System processes for 125-year record

Earth Knowledge Predictive Analytics forecast multiple possible Future outcomes based on climate and other Global Change indicators 150 years into the future in support of complex climate scenario modelling

Earth Knowledge Planetary Intelligence extends IPCC & IPBES Model Processes

Indicator Scores

Theme	Score
⊞ Biodiversity	48.6
⊞ Temperature	26.2
⊞ Precipitation	25.0
⊞ Flood	10.8
⊞ Water Availability	8.6
⊞ Sea-Level Rise	1.4
Total	**28.1**

Assets in Risk Category

Moderate 100

198

High 78

Extreme 20

Hybrid

©2022 TomTom ©2022 CNES/ Airbus/ Planet Observer (Copernicus) Microsoft

Locations

Themes

Heatmap
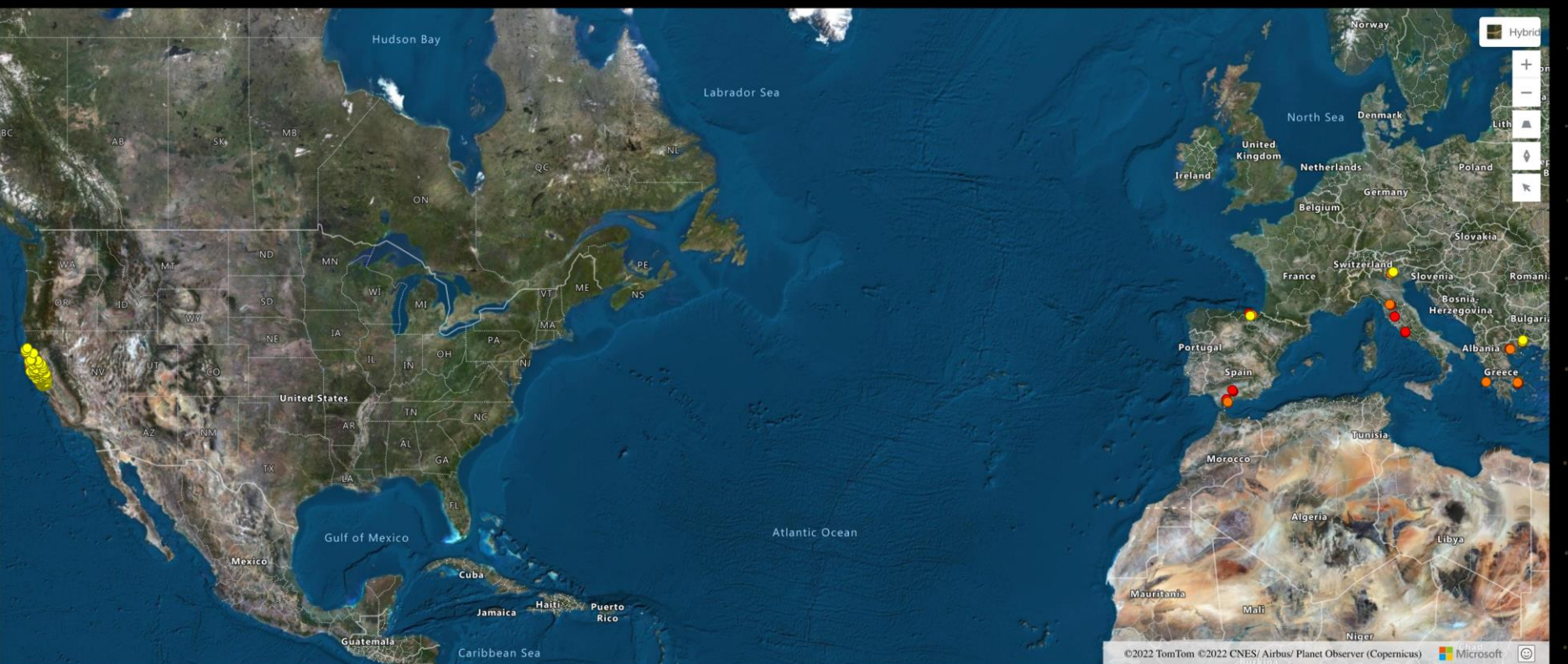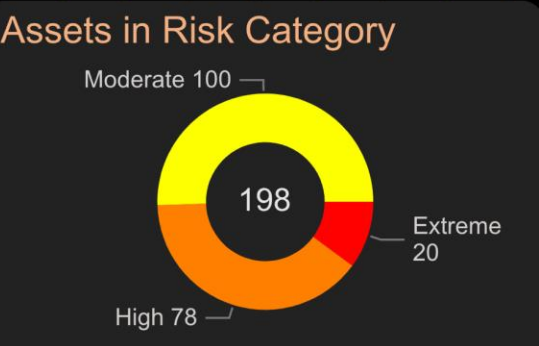
Company	Score	Symbol / Asset Type	Industry / Asset Status	Value (mm)	Broad Biome	Conservation Status	Biodiversity Hotspot
⊟ **Acme Commercial Real Properties**	33.2	ACME	53112 - Lessors of Nonresidential Buil...	$28.1			
Executive Building 1	35.9	Office Building	Current	$12.3	Boreal/Alpine	Nature could reach Half Protect...	No
Office Park 1	34.4	Office Park	Current	$7.3	Boreal/Alpine	Nature could reach Half Protect...	No
Warehouse 1	29.4	Warehouse	Current	$8.6	Boreal/Alpine	Nature could reach Half Protect...	No
⊟ **Allied Facilities**	31.4	ALLF	53112 - Lessors of Nonresidential Buil...	$31.0			
Executive Building 2	31.6	Office Building	Current	$11.1	Boreal/Alpine	Nature could reach Half Protect...	No
Office Park 2	31.2	Office Park	Current	$9.0	Boreal/Alpine	Nature could reach Half Protect...	No
Warehouse 2	31.2	Warehouse	Proposed	$10.8	Boreal/Alpine	Nature could reach Half Protect...	No
⊟ **Alto Facilities**	76.1	ALTO	53112 - Lessors of Nonresidential Buil...	$32.0			
Executive Building 2	74.7	Office Building	Current	$12.7	Boreal/Alpine	Nature could reach Half Protect...	No
Total	**28.1**			$756.2			

© 2022 Earth Knowledge

Theme / Company	Biodiversity Score	Biodiversity Trend	Flood Score	Flood Trend	Precipitation Score	Precipitation Trend	Sea-Level Rise Score	Sea-Level Rise Trend	Temperature Score	Temperature Trend	Water Availability Score	Water Availability Trend	Total Score	Total Trend
Acme Commercial Real Properties	58.3		14.7		17.6		0.5		42.1		1.8		33.2	
Allied Facilities	54.9		9.0		20.3		4.1		36.5		2.0		31.4	
Alto Facilities	81.4		0.3		92.9		0.4		81.1		31.7		76.1	
Amalgamated Offices	56.2		6.8		11.7		1.4		36.8		0.3		28.8	
Andalusia Real Properties	40.6		0.5		68.7		0.0		74.1		65.5		58.5	
Athens Renewables	77.0		0.0		53.4		0.1		40.0		28.2		48.1	
CAL Cell	48.7		20.1		22.2		0.2		16.8		0.9		23.9	
California Main Energy	58.6		4.0		18.4		0.8		30.2		0.3		28.9	
Castelvecchio	59.5		0.0		60.1		0.0		53.4		22.8		51.0	
Costa del Sol Coastal Energy	30.3		0.0		55.3		0.1		29.3		67.2		36.5	
CP Cellular	45.3		19.9		20.6		0.0		15.4		0.4		22.1	
Espana Estates	40.3		0.0		68.9		0.0		55.0		63.7		51.8	
ETG Mobile	48.3		10.9		17.0		4.0		21.3		2.2		23.7	
Gemelli Wine Company	46.3		19.0		35.5		0.6		22.4		1.5		29.6	
Geppetto Wood Products	36.8		0.7		33.6		0.0		15.8		11.7		24.3	
Greco Wine Company	67.5		0.0		32.4		0.2		25.5		47.7		35.1	
Half Moon Sustainable Forest Products	46.6		23.0		34.4		0.0		14.2		0.0		26.5	
Hauser Wood Products	40.4		8.5		14.3		0.0		14.9		0.0		18.5	
Iera Sustainable Forest Products	42.6		0.0		37.0		0.0		33.3		29.0		33.4	
Total	48.6		10.8		25.0		1.4		26.2		8.6		28.1	

Locations

Themes

Heatmap

Show Any Score in Range
0.0 — 100.0

Show Indicators with Total Score in Range
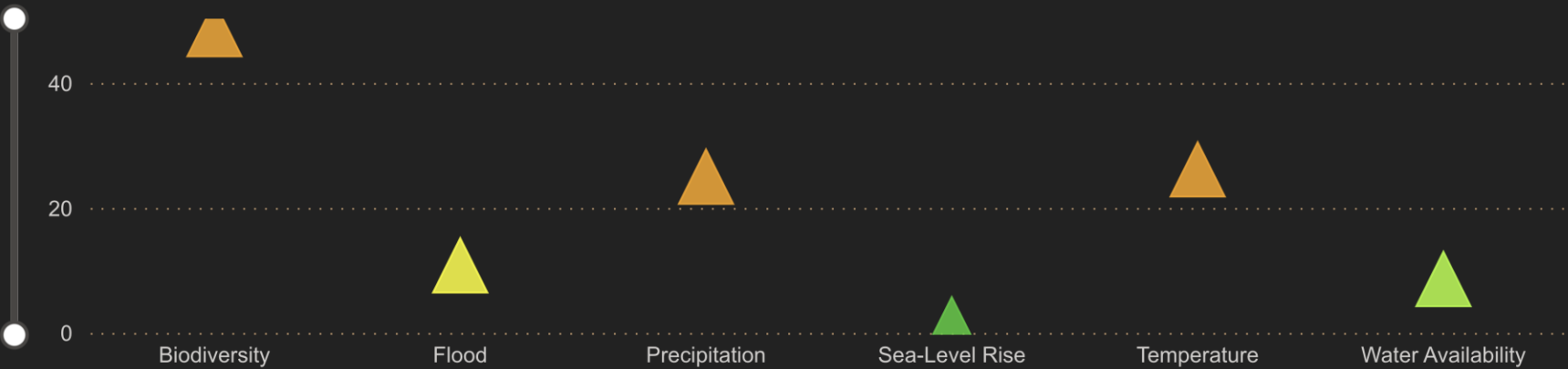1.4 — 67.3

Show Assets with Total Score in Range
11.5 — 78.1

Score by Theme

40

20

0

Biodiversity | Flood | Precipitation | Sea-Level Rise | Temperature | Water Availability

Score over Time

Annual Precip	Annual Temp	Annual Temp Ra...
39.9 19.2 23.9 24.1	11.5 6.2 36.0 54.0	24.5 13.8 24.1 25.2

Coldest Month	Diurnal Temp Ra...	Driest Qtr Precip
37.2 12.2 37.8 54.5	15.5 21.6 28.8 28.3	4.3 6.4 6.1 5.4

Ecosystems Biodiversity	Hottest Month	Land Conversion
22.1 22.1 22.1 22.1	12.7 10.5 26.9 42.4	68.2 67.0 67.0 67.0

Peak Flow	Sea-Level Rise	Species Biodiver...
20.9 0.8	1.1 1.4 1.7	56.4 56.4 56.4 56.4

2000 2020 2040 2060 | 2000 2020 2040 2060 | 2000 2020 2040 2060

● SSP585

Company	Score	Symbol / Asset Type	Industry / Asset Status	Value (mm)	Broad Biome	Conservation
⊞ Acme Commercial Real Properties	33.2	ACME	53112 - Lessors of Non...	$28.1		
⊞ Allied Facilities	31.4	ALLF	53112 - Lessors of Non...	$31.0		
⊞ Alto Facilities	76.1	ALTO	53112 - Lessors of Non...	$32.0		
⊞ Amalgamated Offices	28.8	AMAL	53112 - Lessors of Non...	$28.2		
⊞ Andalusia Real Properties	58.5	ARPR	53112 - Lessors of Non...	$21.8		
⊞ Athens Renewables	48.1	ATRE	22112 - Electric Power ...	$20.7		
⊞ CAL Cell	23.9	CALC	51731 - Wired and Wir...	$34.3		
⊞ California Main Energy	28.9	CALM	22112 - Electric Power ...	$11.6		
⊞ Castelvecchio	51.0	CAST	31213 - Wineries	$19.4		
⊞ Costa del Sol Coastal Energy	36.5	CDS	22112 - Electric Power ...	$26.0		
⊞ CP Cellular	22.1	CPC	51731 - Wired and Wir...	$19.7		
⊞ Espana Estates	51.8	EES	31213 - Wineries	$28.0		
⊞ ETG Mobile	23.7	ETGM	51731 - Wired and Wir...	$113.1		
⊞ Gemelli Wine Company	29.6	GWI	31213 - Wineries	$27.5		
⊞ Geppetto Wood Products	24.3	GEPP	11531 - Support Activiti...	$29.5		
⊞ Greco Wine Company	35.1	GRWI	31213 - Wineries	$11.1		
⊞ Half Moon Sustainable Forest Products	26.5	HALF	11531 - Support Activiti...	$10.5		
⊞ Hauser Wood Products	18.5	HWP	11531 - Support Activiti...	$17.3		
⊞ Iera Sustainable Forest Products	33.4	IERA	11531 - Support Activiti...	$22.9		
Total	28.1			$756.2		

Locations

Themes

Heatmap
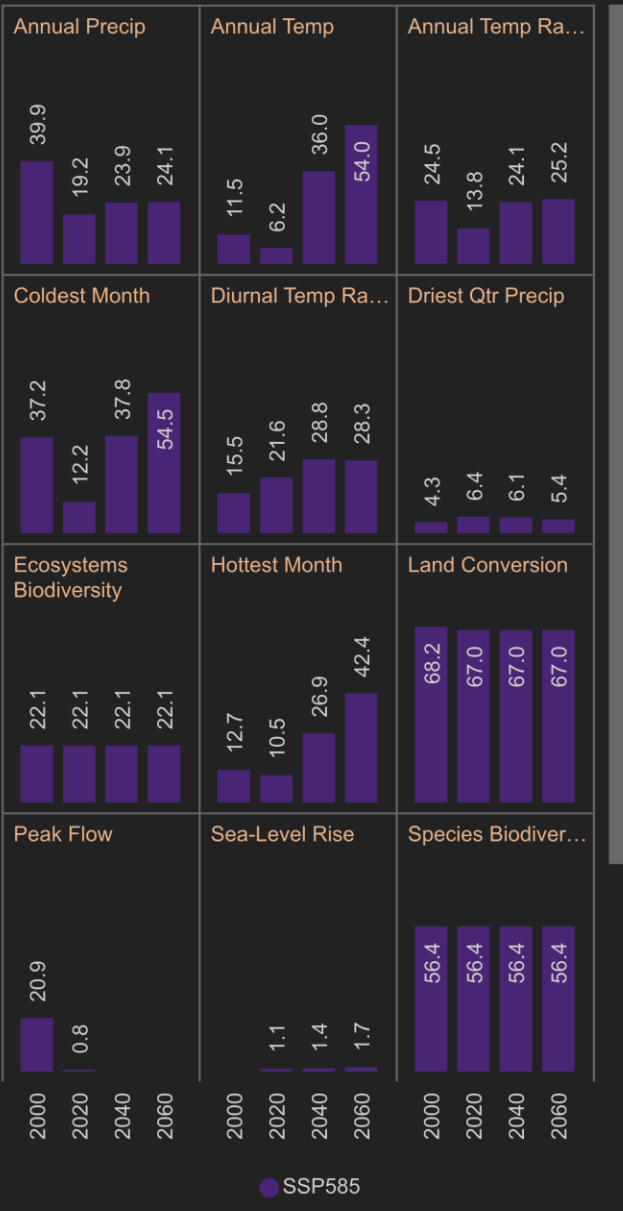
Earth Knowledge Natural Capital Indicators (Partial List)

Naturally Functioning Ecosystems

Biodiversity

- Ecosystems (Communities, Food Web, Structure)
- Species (Habitat, Composition, Population)

Atmosphere

- Atmospheric Conditions / Composition
- Extreme Weather (Storms, Heat Waves, Cold Fronts)
- Climate Change (Droughts, Floods, Wildfire)

Water

- Oceans (Acidification, Sea Levels, Environments, Coastal Hazards)
- Snow & Ice (Snow, Glaciers, Permafrost, Ice [sheets, shelves, sea]
- Groundwater (Movement, Availability, Quality)
- Surface Water (Streams, Rivers, Lakes, Wetlands, Reservoirs Quantity/Quality)

Earth Resources

- Earth Materials (Mineral, Rock and Soil Resources)
- Plate Tectonics (Earthquakes, Volcanoes, Tectonics)
- Earth Processes (Weathering, Landslides, Sedimentation, Metamorphism)

Land-use / Land Conversion

Land Conversion

- **Developed Land** (Cities, Villages, Croplands, Rangelands)
- **Shared / Used Land**
- **Wild Land** (Woodlands/Grassland)

Ecological Land-Use

- **Productive Rural Areas** (Forestry, Agriculture, Fisheries, Ecotourism)
- **Towns and Cities** (Neighborhoods, Green Building, Mass Transit, Eco-Infrastructure, Urban Growth Boundaries)
- **Connected Wildlands** (Core Reserves, Buffer Zones, Corridors)

Ecosystem Services

Provisioning Services

- Energy, Food, Materials, Medicine

Regulating Services

- Air and Water Quality, Climate, Pollination, Habitat Maintenance

Non-Material Services

- Cultural, Indigenous, Educational Experiences

Comprehensive Digital Twin of the Earth

Now
5km Global – Decades
1km Continental – Decades
  • Natural Capital - Pillars, Themes, Indicators
  • ~20 Indicators

This Year
5km Global – Decades/Years
1km Continental – Years/Months
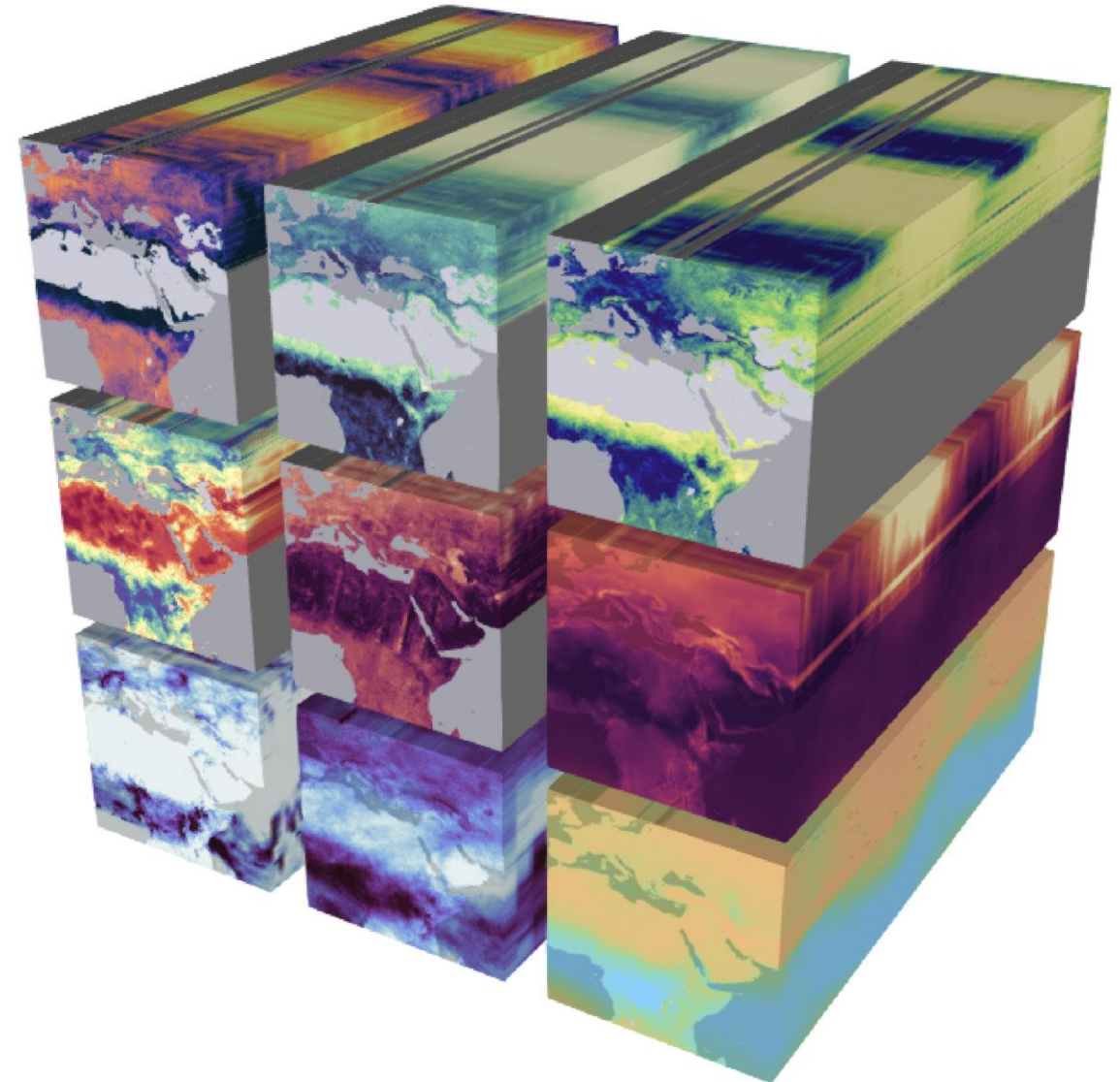 • Natural Capital - Pillars, Themes, Indicators
  • Additional ~40 Indicators

Future / Custom
250 m Regional – Years/Months
50m Landscape – Months (for Select Megaregions)
Local Scale – for Select Megaregions
Site Scale – for Select Megaregions

Mahecha, M. D. and others, 2020, Earth system data cubes unravel global multivariate dynamics, Earth Syst. Dynam., 11, pp. 201–234.

A Digital Twin that Is…

Seamless

Harmonized

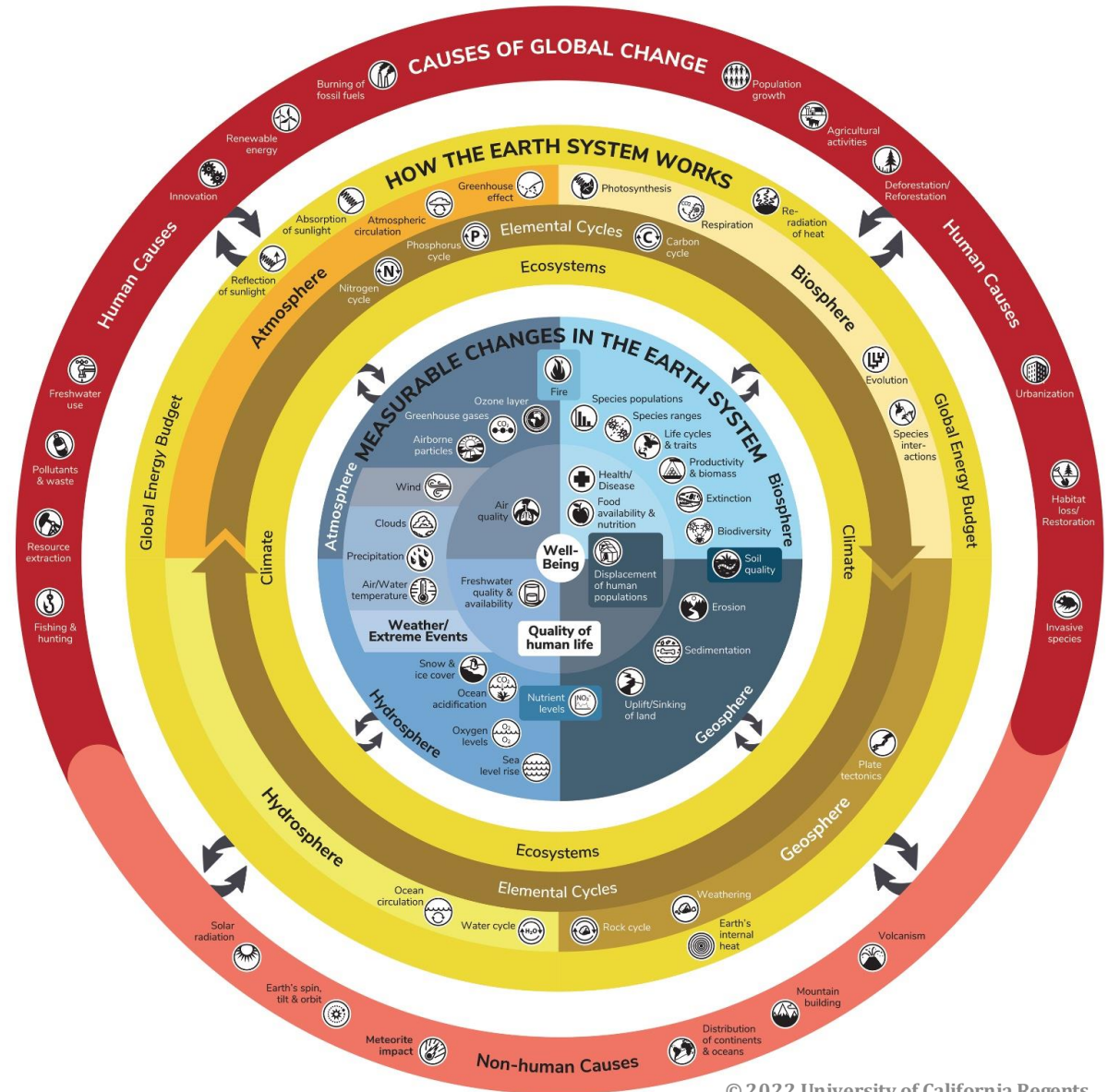Queryable

Updatable

Interoperable

Multidimensional

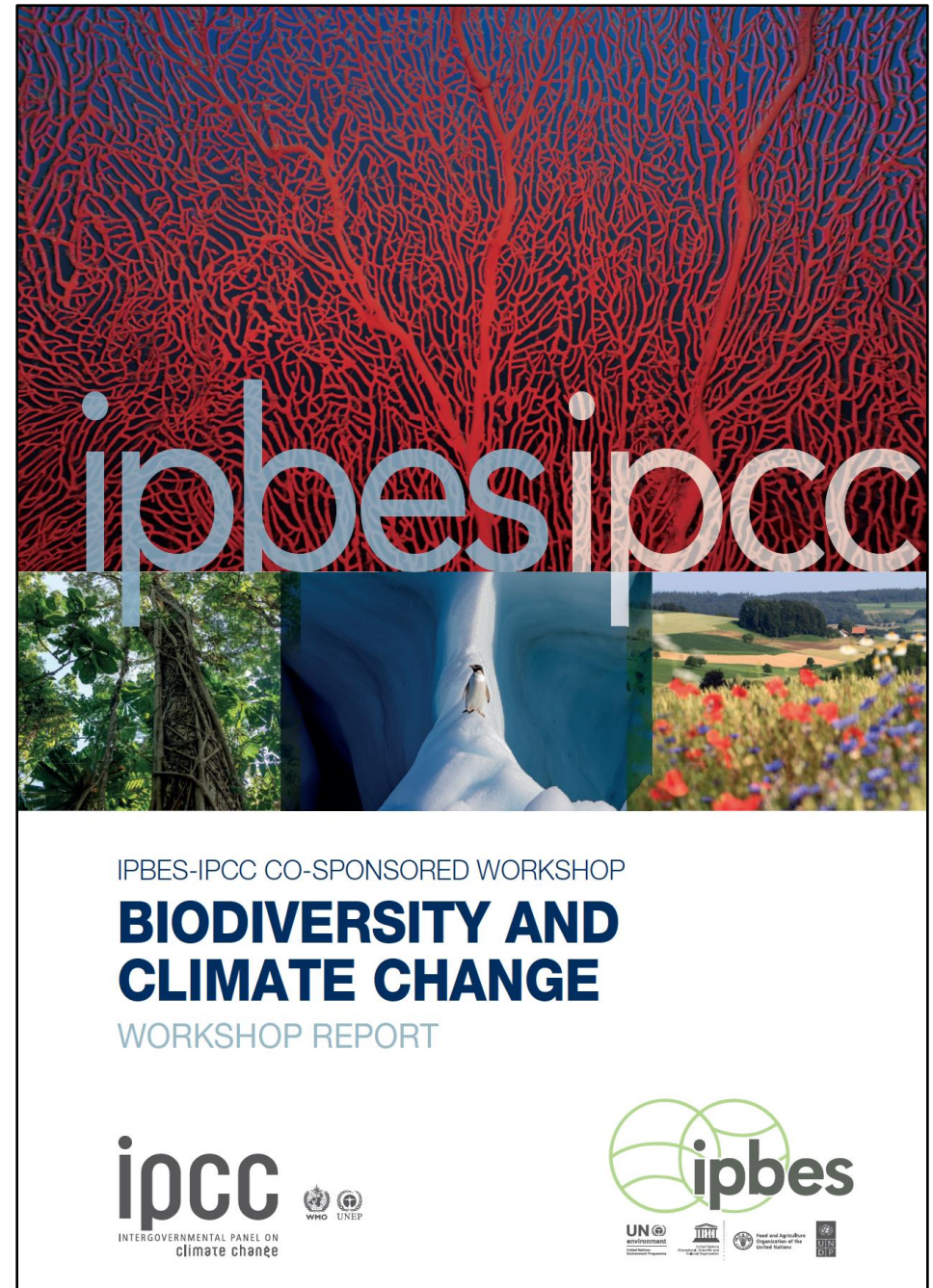- space, time, indicators

Dynamic

Varying Resolutions

Multiple Likely Future Outcomes

Uncertainty Indicated

IPBES – IPCC Workshop Findings

- Limiting global warming to ensure a habitable climate and protecting biodiversity are *mutually supporting goals*, and their achievement is essential for sustainably and equitably providing benefits to people.

- Land- and ocean-based actions to protect, sustainably manage and restore ecosystems have *co-benefits for climate mitigation, climate adaptation and biodiversity objectives*.

- Measures narrowly focused on climate mitigation and adaptation *can have direct and indirect negative impacts on nature and nature's contributions to people*.

- Measures narrowly focusing on protection and restoration of biodiversity have generally important cascading benefits for climate change mitigation, but those *benefits may be sub-optimal compared to measures that account for both biodiversity and climate*.

- *Treating climate, biodiversity and human society as coupled systems is key to successful outcomes* from policy interventions.

- *Transformative change* in governance of socio-ecological systems can help create climate and biodiversity resilient development pathways.

© 2022 Earth Knowledge

IPBES-IPCC CO-SPONSORED WORKSHOP

BIODIVERSITY AND CLIMATE CHANGE

WORKSHOP REPORT

Thank you.

Julia Armstrong D'Agnese
Chief Executive Officer
julia@earthknowledge.net

Frank A. D'Agnese
President/CTO
frank@earthknowledge.net