



UNGEONOW 2024
首届联合国地信周



Sustainable Development Supported by Geo-Modeling and GeoSpatial Intelligence

Prof. Min Chen
Nanjing Normal University
2024.10.21

A Round table for post-2030 SDGs



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Date: 24 April, 2024 Venue: University of Groningen



Moderator:

Frank Biermann, PI of GlobalGoals Research Project

Panelist:

- Astra Bonini (Senior Sustainable Development Officer, Division for Sustainable Development Goals, UN DESA)
- Sandra Pellegrom (National Sustainable Development Goals Coordinator, Netherlands)
- Lily Talapessy (Strategic Advisor, Ministry of Foreign Affairs of the Netherlands)
- Tim Benton (Director of the Environment and Society Programme at Chatham House, UK)
- Min Chen (President of CPGIS and VP of IEMSs, Nanjing Normal University, China)

Hope

&

Dream

Introduction of SDGs



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17
Goals
169
Targets
232
Indicators



- The 17 Sustainable Development Goals (SDGs) serve as the overall framework to **guide global and national development action** by 2030.
- The SDGs are **integrated and indivisible**, and they **balance the three dimensions** of sustainable development: the economic, social, and environmental.
- The SDGs promise to “leave no one behind” and “reach those furthest behind first”.

——Transforming our world: the 2030 Agenda for Sustainable Development (2015.09)

Remote Sensing and Ground Observation



SDGSAT-1
satellite

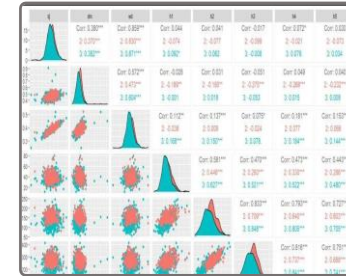


Unmanned Aerial
Vehicle Measurement

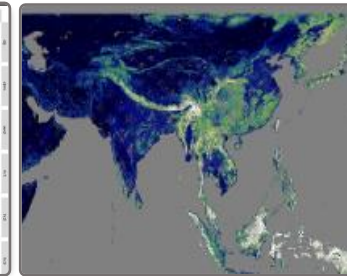


Ground
observation ...

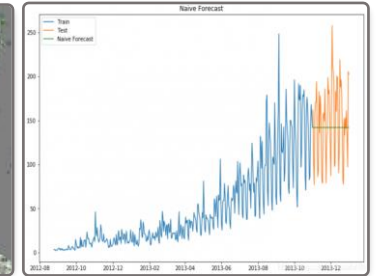
Indicator Analysis Methods



Statistical Analysis



Spatial Analysis



Temporal Analysis ...

Visualization and Interactive Technologies

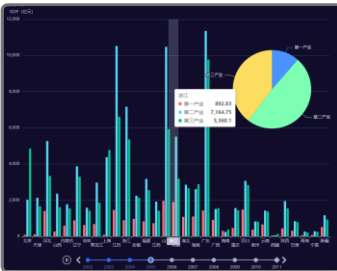
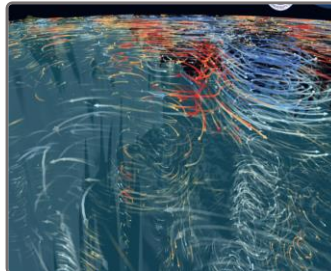
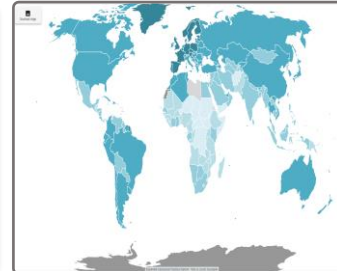


Chart Visualization

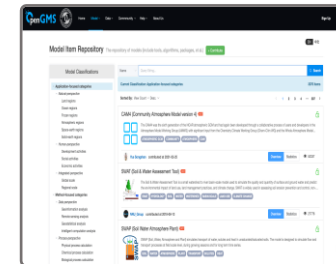


3D Visualization

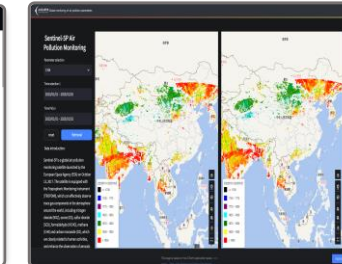


Spatial Visualization ...

Decision-making Support System



Model-driven
Decision making



Data-driven
Decision making

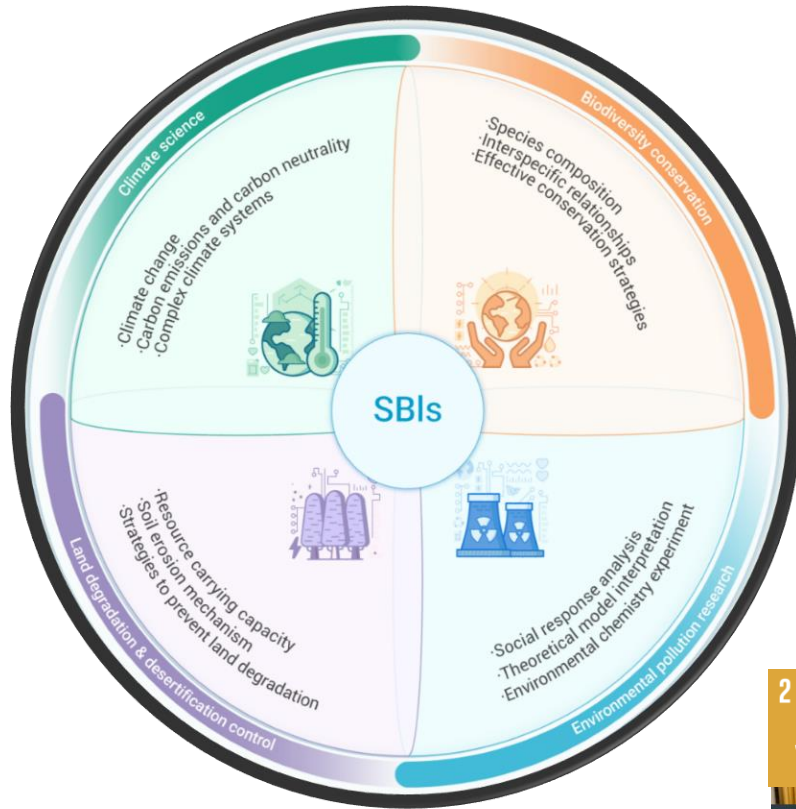


Knowledge-driven
Decision making ...

Assessment of SDGs



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Luo Lei, et al. "Innovations in science, technology, engineering, and policy (iSTEP) for addressing environmental issues towards sustainable development." *The Innovation Geoscience* 2.3 (2024): 100087-1.

Released the reports on **Big Earth Data in Support of the Sustainable Development Goals** from 2019 to 2024.

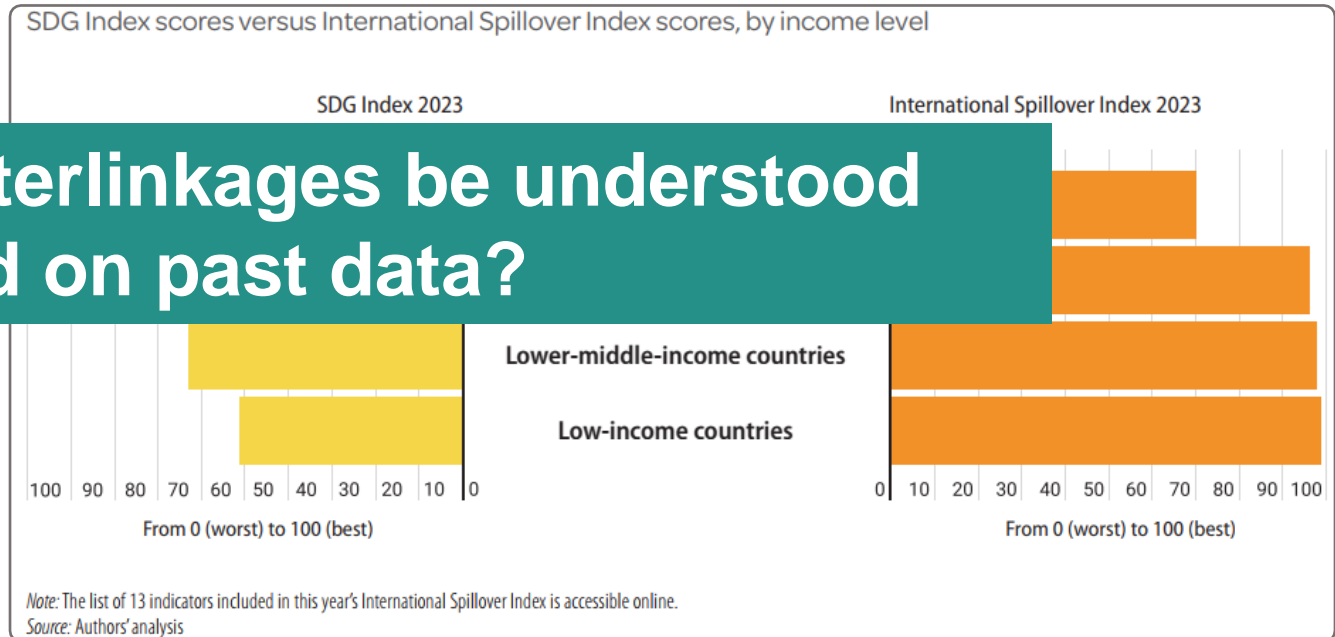
Challenges in SDG Interactions



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- The SDGs are designed to be integrated and indivisible. In this context, the concept of **SDG interlinkages** refers to the **complex network of interactions** existing within and between SDGs.
- Understanding SDG interlinkages is important for shaping coherent policies that **maximize synergies and minimize trade-offs** in SDG implementation.



SDG interlinkages

— <https://opendevlopmentmekong.net>

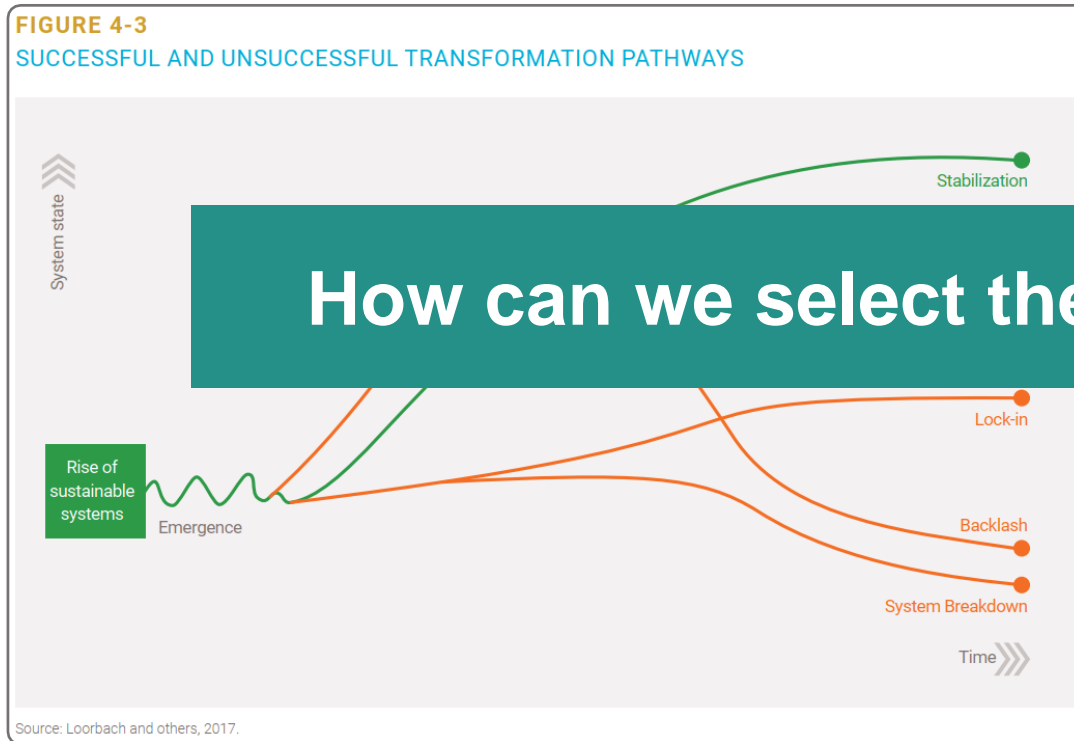
SDG international spillovers

— Sustainable development report (2024)

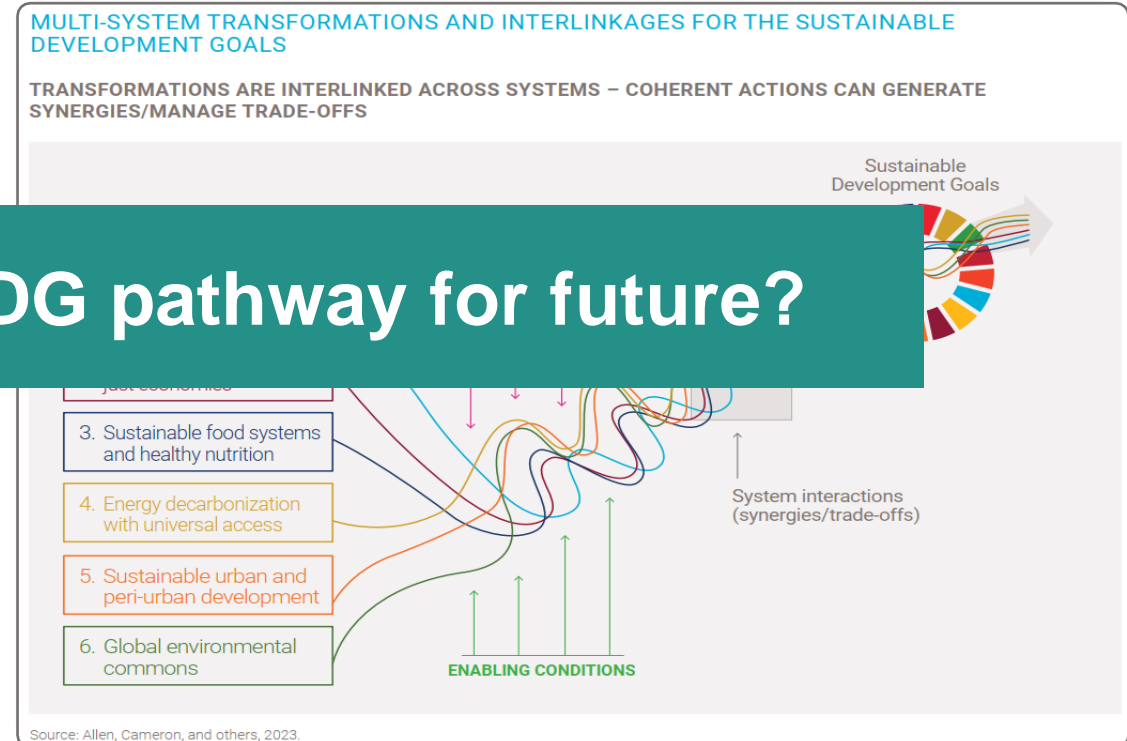
Challenges in SDG Future Progress



- Understanding SDG future pathway is based on **tracking the multiple SDG interactions between different systems**, as well so for identifying prioritized synergies, trade-offs, and important driving factors.
- For different sustainable development scenarios, systematic projections under different pathways could **identify the impact of policies and transformations on the SDG progress in the future**.



How can we select the SDG pathway for future?



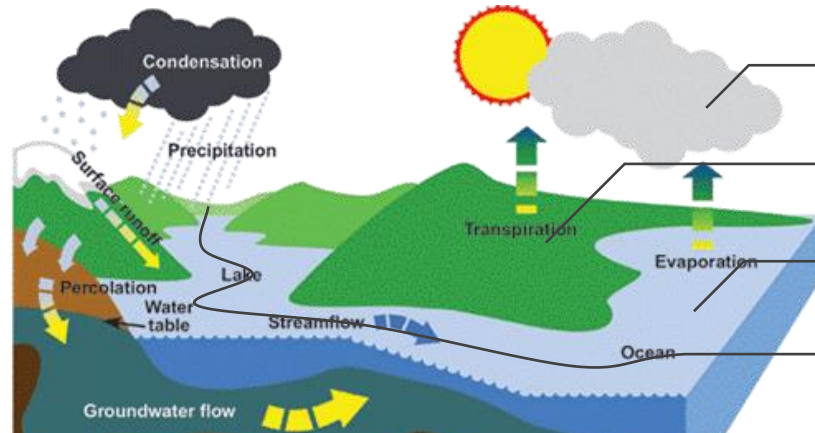
SDG future pathways

— 2023 Global Sustainable Development Report

SDG transformations

— 2023 Global Sustainable Development Report

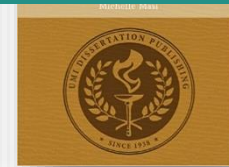
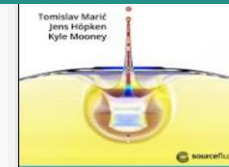
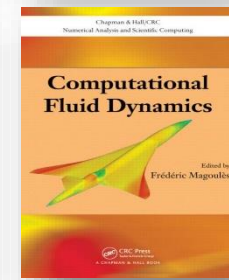
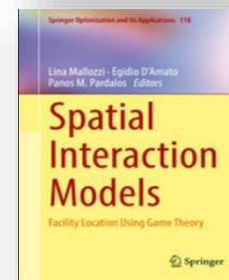
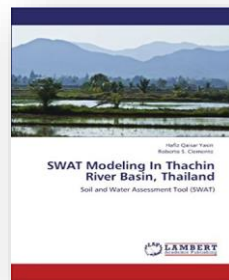
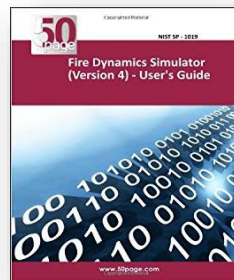
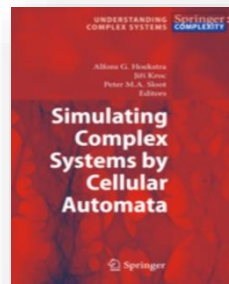
Not only Data !!!



- MM5, WRF, OPA, RCO, UMO...
- RCA-soil, MOSES, ISBA, LSS, ORCHIDEE...
- POM, FVCOM, PPTAR, MOM, ECOM, TOM...
- SWAT, DAFLOW, PRMS, BASINS, ModFlow...

How to make full use of these resources and facilitate easy-to-use?

- ◆ At different spatial and temporal scales
- ◆ To represent different processes



Towards SDG to 2030 and after 2030-The three interconnected foci (SDG interactions, modeling, and tools) at the science-policy interface to address challenges.

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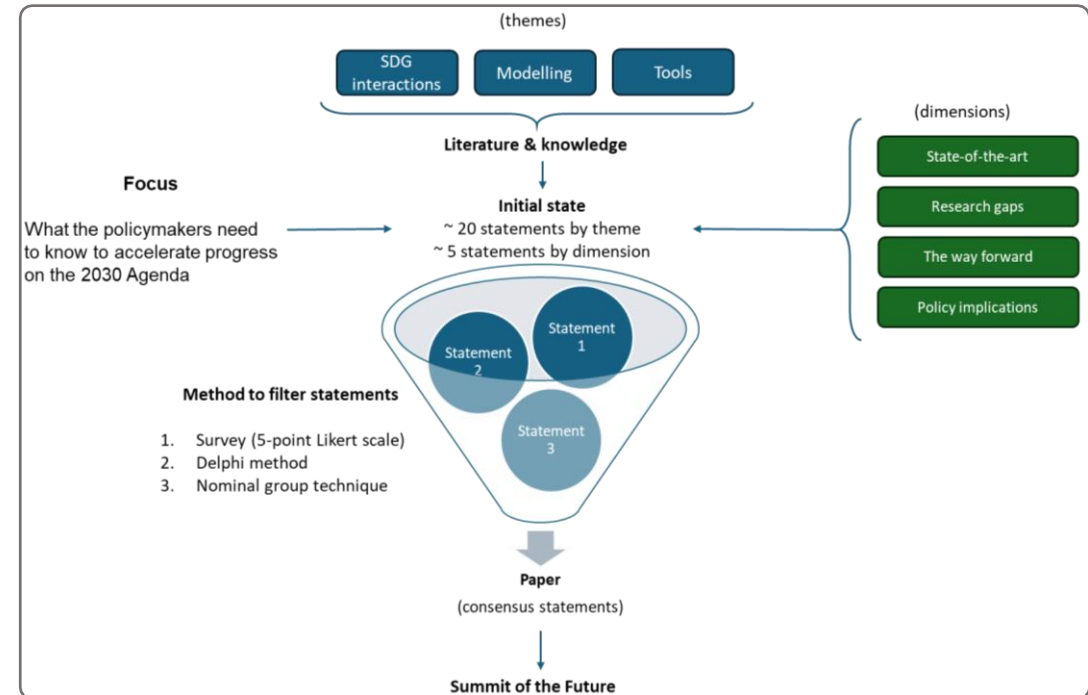
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Three foci at the science-policy interface for systemic Sustainable Development Goal acceleration

[Prajal Pradhan](#), [Nina Weitz](#), [Vassilis Daioglou](#), [Gabriel M. Abrahão](#), [Cameron Allen](#), [Geanderson Ambrósio](#), [Frederike Arp](#), [Furqan Asif](#), [Therese Bennich](#), [Tim G. Benton](#), [Frank Biermann](#), [Min Cao](#), [Henrik Carlsen](#), [Fang Chen](#), [Min Chen](#), [Michiel N. Daams](#), [Jonathan H. P. Dawes](#), [Shobhakar Dhakal](#), [Elisabeth Gilmore](#), [Luis J. Miguel](#), [Klaus Hubacek](#), [Yuanchao Hu](#), [Wander Jager](#), [Samir KC](#), ... [Caroline Zimm](#)

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Nature Communications **15**, Article number: 8600 (2024) | [Cite this article](#)



- Understanding SDG interactions is crucial to designing strategies that promote multiple SDGs
- Utilizing scientific models can facilitate the implementation of the SDGs
- Tools can translate scientific findings from SDG interactions and models into practical solutions for policymakers

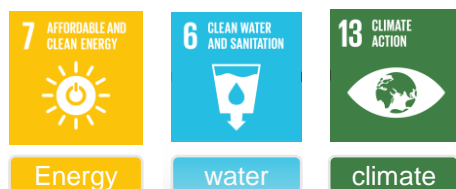
Past

Future

Single

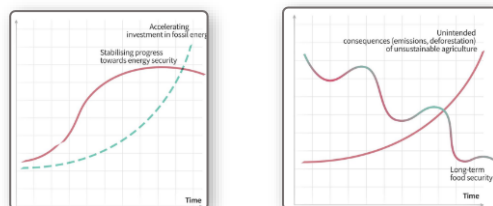
Single SDG Analysis

Assessing and analyzing the progress of single SDG



Multiple SDG Analysis

Analyzing the interactions between SDGs



Synergies

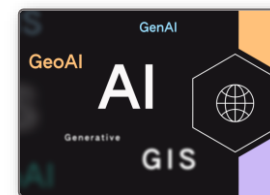
Trade-offs

Intelligent Modeling for SDGs

AI Assistant of SDGs Modeling



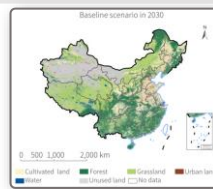
AI-Algorithms



GIS Tools

SDG Scenarios Simulation

Creating new SDG scenarios and analyzing socioeconomic factors under SDG scenarios



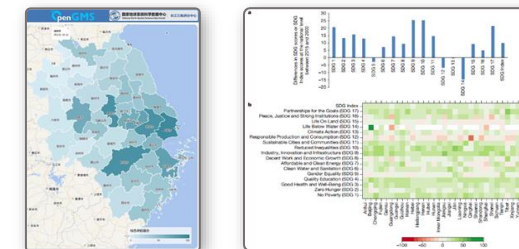
Land use



Carbon storage

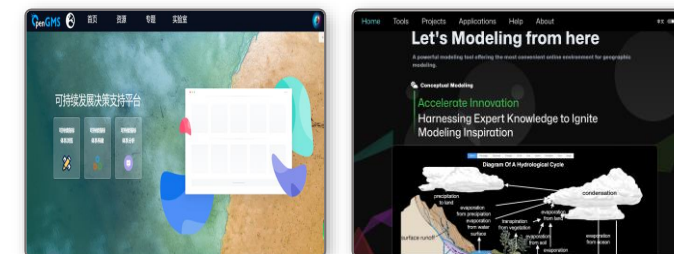
Comprehensive Assessment

Comprehensive assessment through different perspectives



New Technology-enhanced Decision Support System

User-friendly and Open Support



Multiple

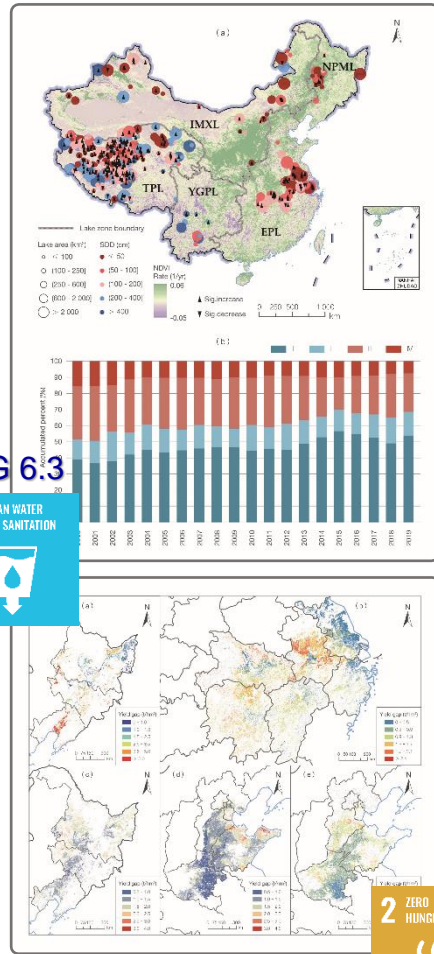
Single SDG Analysis



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Focusing on a single SDG provides valuable insights into its progress and insightful solutions



SDG 6.3

6 CLEAN WATER AND SANITATION



SDG 2.4

2 ZERO HUNGER



	11.2	11.3	11.5	11.6	11.7
Beijing	→	→	→	→	→
Tianjin	→	→	→	→	→
Hebei	→	→	→	→	→
Shanxi	→	→	→	→	→
Inner Mongolia	→	→	→	→	→
Liaoning	→	→	→	→	→
Jilin	→	→	→	→	→
Heilongjiang	→	→	→	→	→
Shanghai	→	→	→	→	→
Jiangsu	→	→	→	→	→
Zhejiang	→	→	→	→	→
Anhui	→	→	→	→	→
Fujian	→	→	→	→	→
Jiangxi	→	→	→	→	→
Shandong	→	→	→	→	→
Henan	→	→	→	→	→
Hubei	→	→	→	→	→
Hunan	→	→	→	→	→
Guangdong	→	→	→	→	→
Guangxi	→	→	→	→	→
Hainan	→	→	→	→	→
Chongqing	→	→	→	→	→
Sichuan	→	→	→	→	→
Guizhou	→	→	→	→	→
Yunnan	→	→	→	→	→
Tibet	→	→	→	→	→
Shaanxi	→	→	→	→	→
Gansu	→	→	→	→	→
Qinghai	→	→	→	→	→
Ningxia	→	→	→	→	→
Xinjiang	→	→	→	→	→

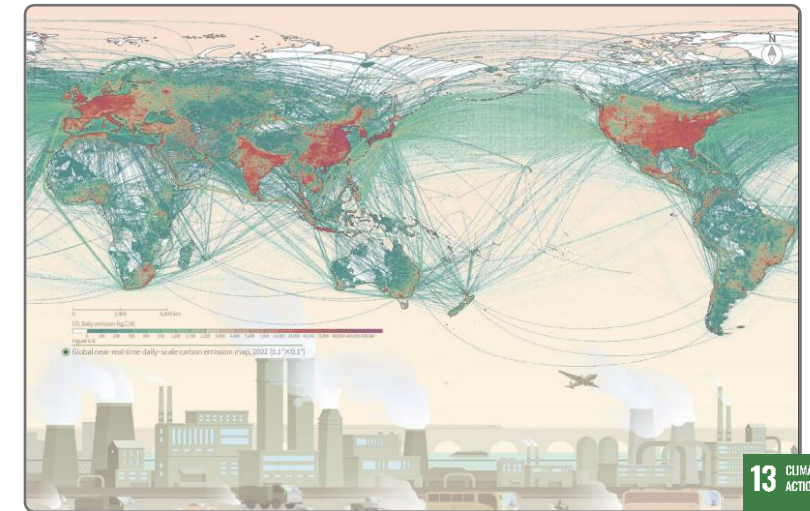
Distance to SDG realization
very close close far very far

SDG 11

11 SUSTAINABLE CITIES AND COMMUNITIES



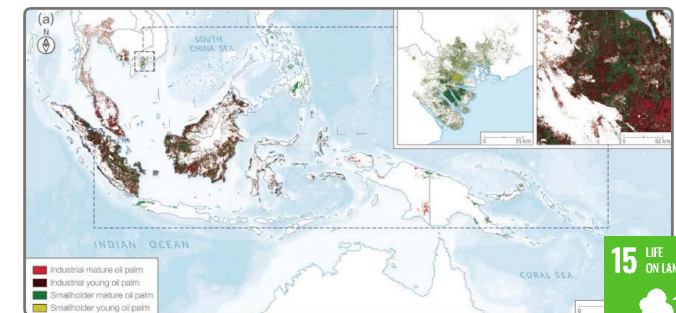
Integrated index-based approach for overall progress of SDG 11 (Sustainable Cities)



A method based on sector activity levels estimating near real-time global carbon emissions for SDG 13.2 (Integrated Climate Change Measures)



SDG 13.2



A pixel-oriented classification approach conducting global-scale mapping of oil palm subclasses for SDG 15.2 (Sustainable Management of Forests)

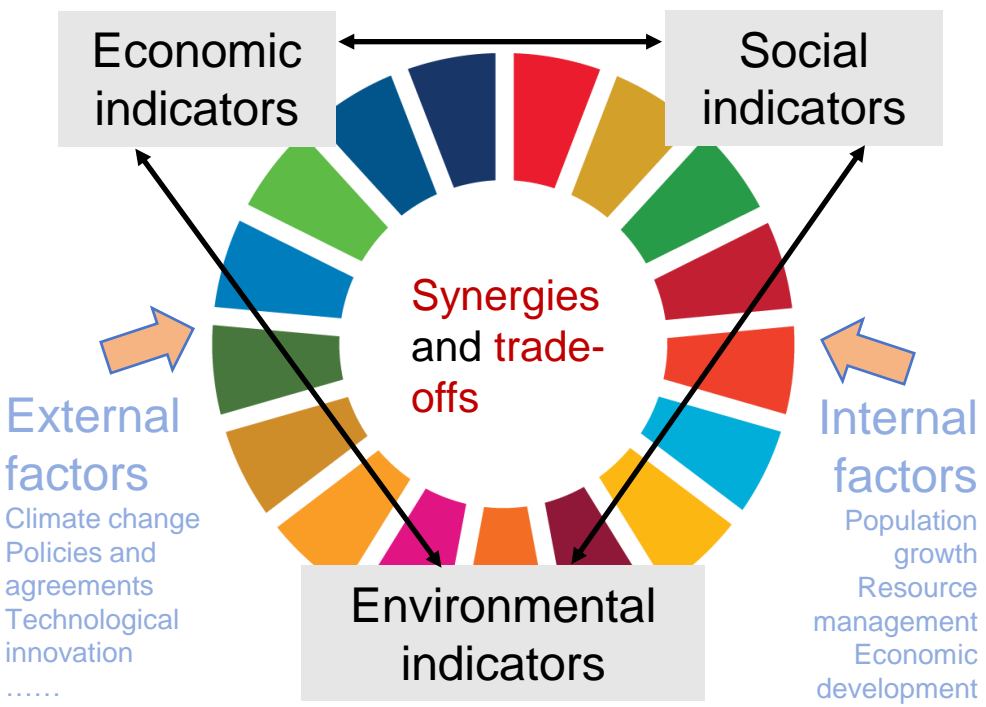


SDG 15.2

Remote sensing algorithms assessing water transparency & crop yields for SDG 6.3 (Clean Water) & SDG 2.4 (Sustainable Food Production)

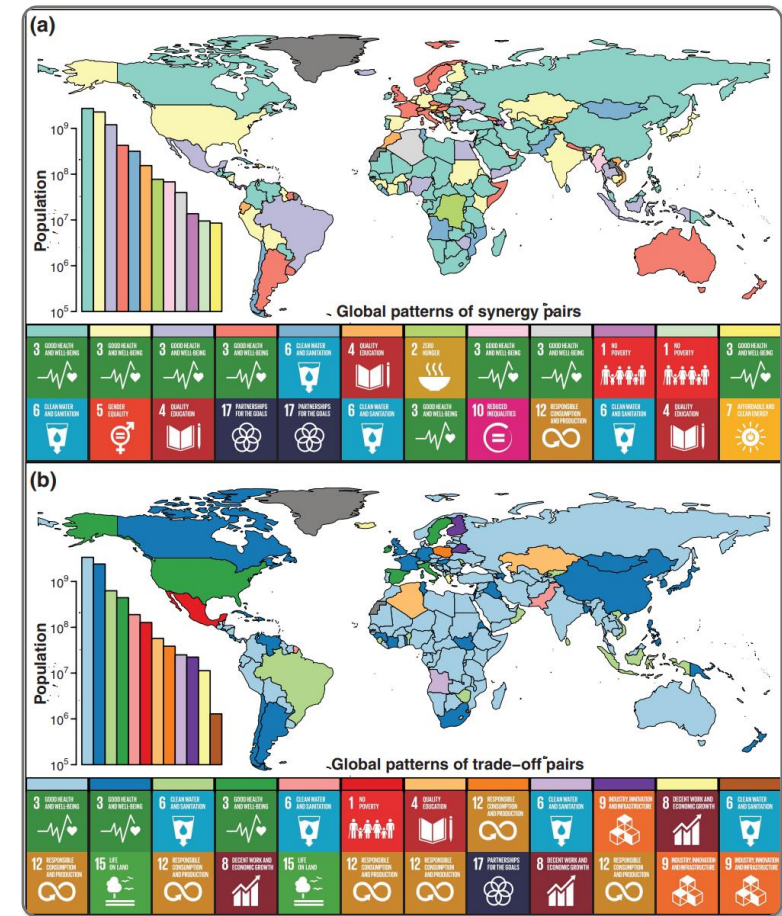
Multiple SDGs Analysis

Focusing on multiple SDGs reveals their interactions and offers coherent policy suggestions

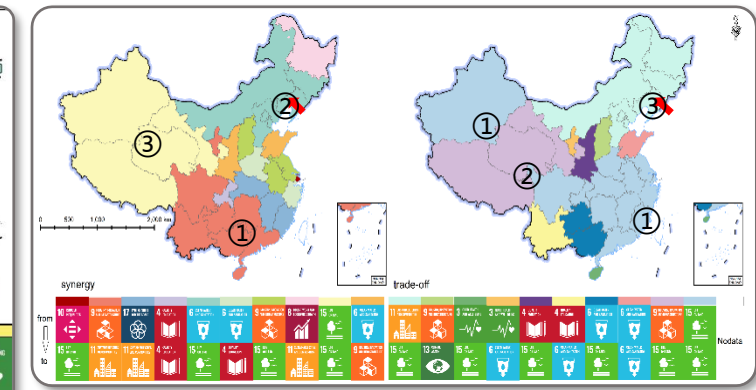


SDG interactions include synergies and trade-offs:

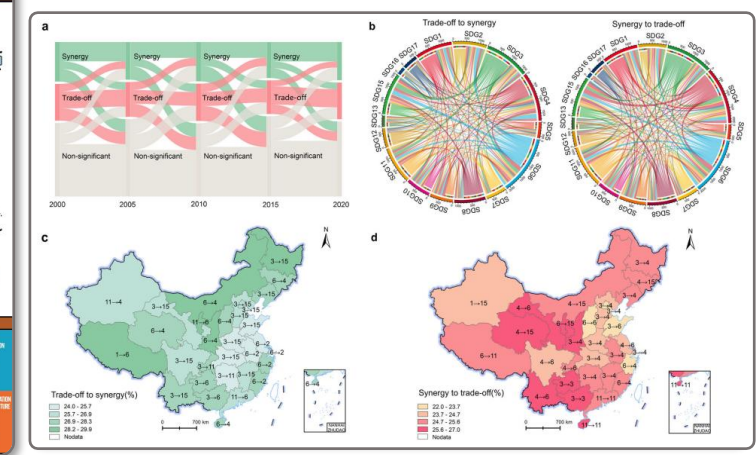
- **Synergies**: one goal boosts another.
- **Trade-offs**: one goal hinders another.



Global **synergy** and **trade-off** pairs



Transformation of trade-off relationship indicator pairs

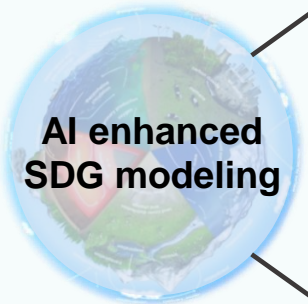


Spatio-temporal changes in the **causal interactions** among SDGs

Provide high-performance and intelligent methods for SDGs modeling and analysis

Modeling Methods

- SDG modeling challenges**
- Data Availability and Quality
 - Complex System Interactions
 - Hidden Relationships and Uncertainty

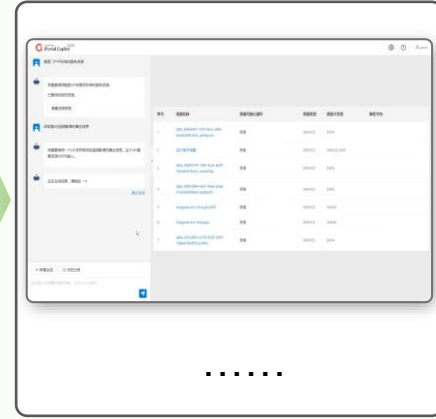
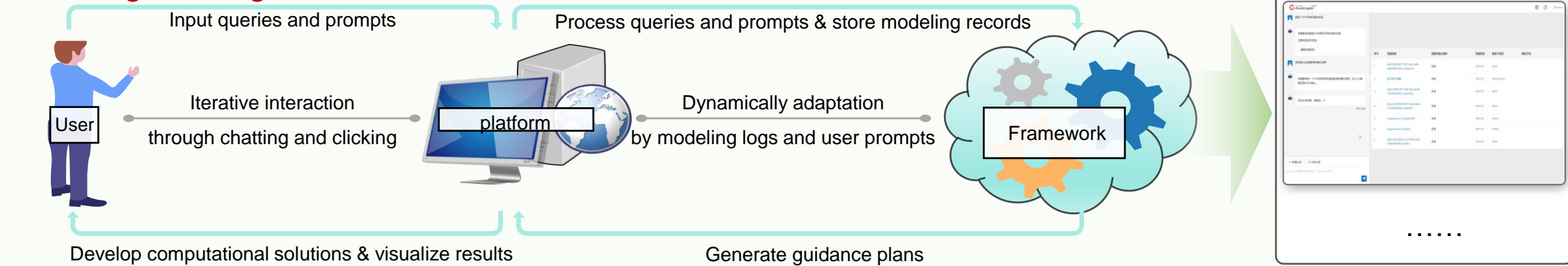


- Optimized Data Processing**
 - Transforms raw observations into curated data
 - Reconstructing observational data
 - Recognizes distribution pattern
- Modelling and Prediction**
 - Accurate modeling of complex systems
 - Enhanced algorithms like Transformer
 - Real-time forecasting
- Enhancing Understanding**
 - Uncovers hidden relationships in complex systems
 - Facilitates decision-making
 - Accelerates sustainable research

GANs

Transformers

Modeling Paradigm



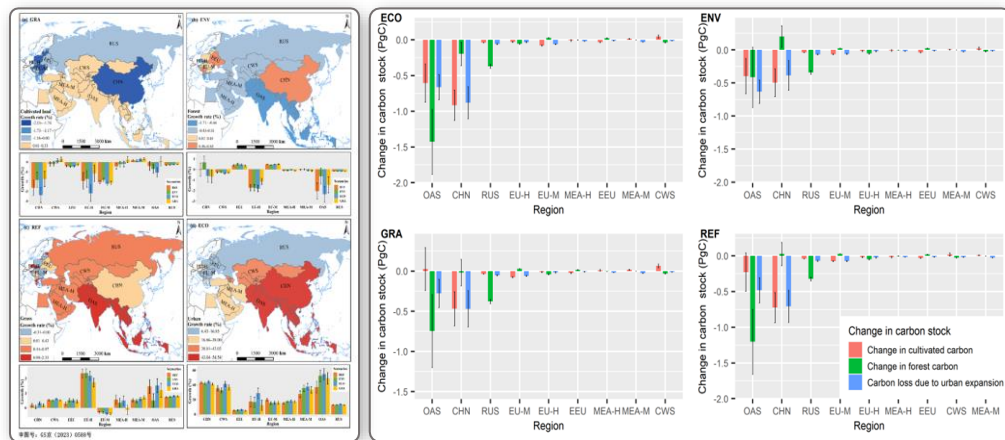
SDG Scenarios Simulation



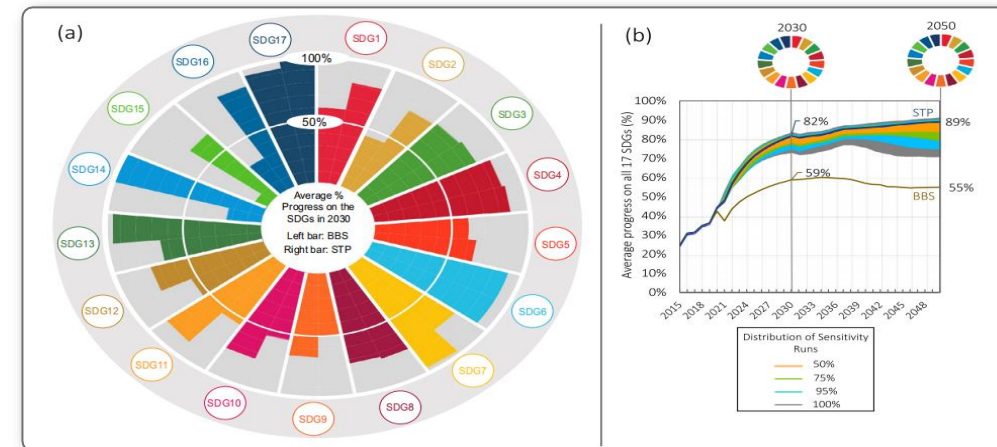
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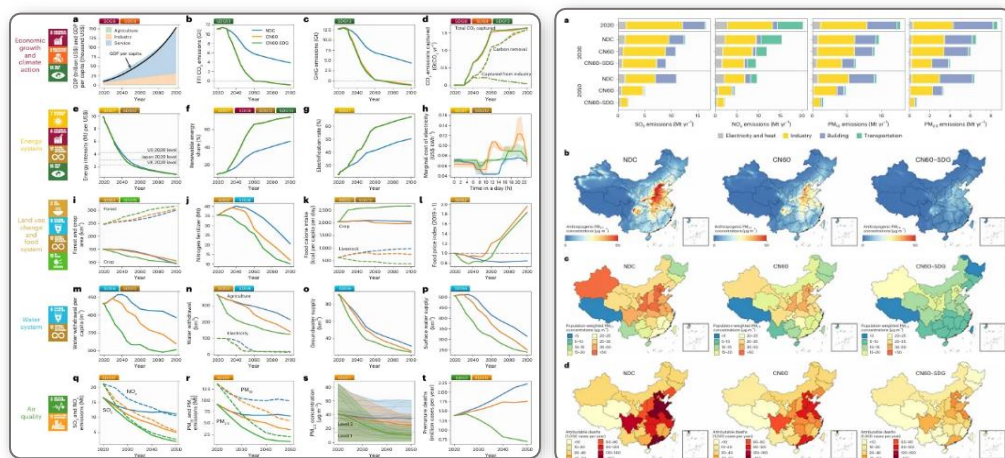
Helping predict and choose the “right” pathway cohere with the changing world



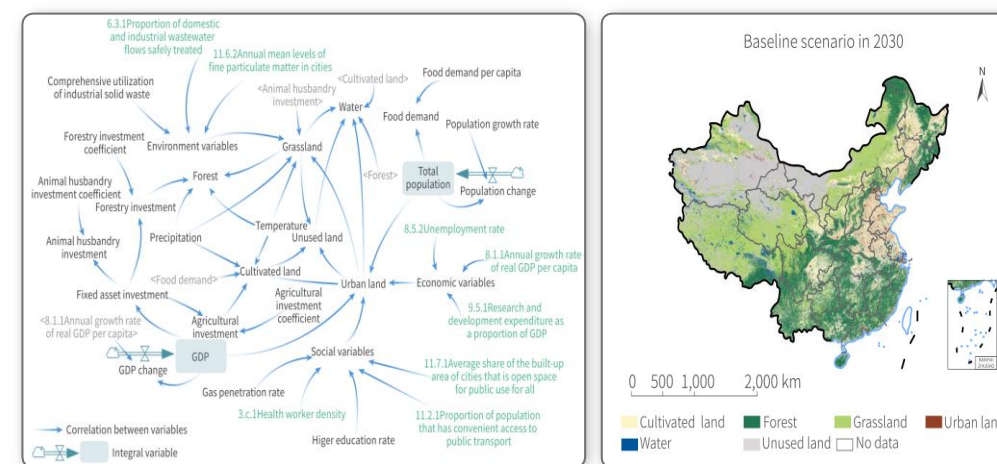
Impact on terrestrial ecosystem carbon pool along the Silk Road



SDG score of six transformations in Australia

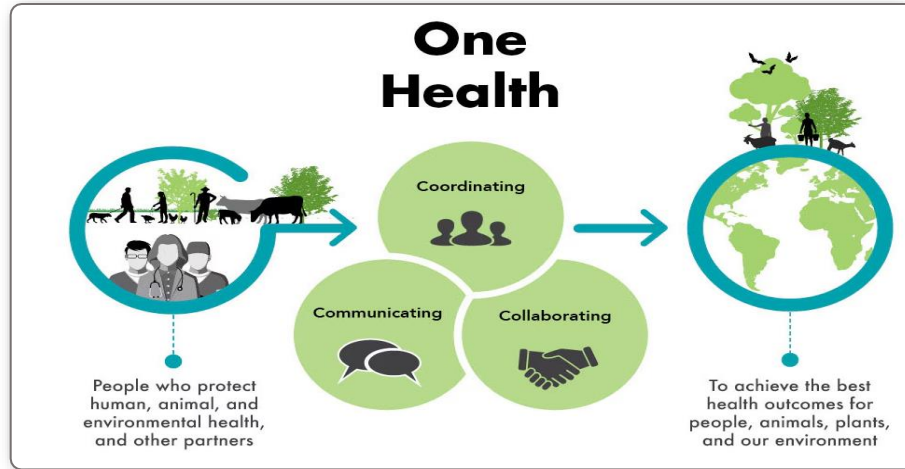


Impact of climate action on China's environment-related SDGs

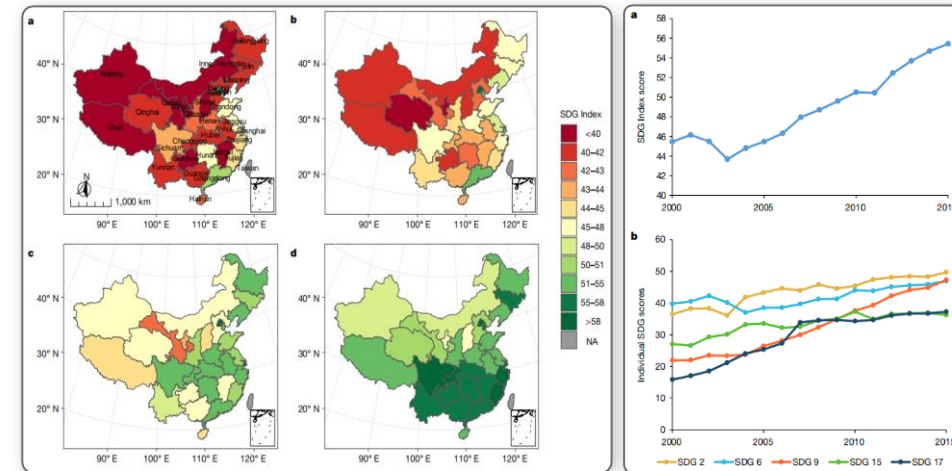


Future land use change in China

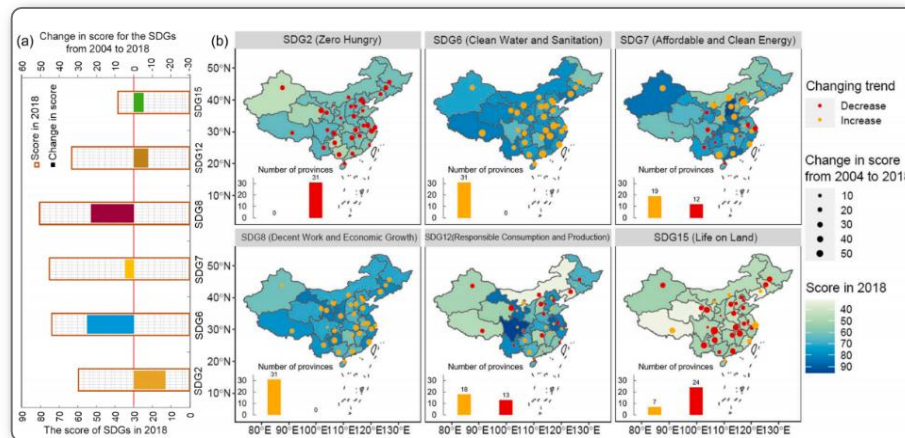
Towards a comprehensive understand of the progress toward SDGs, currently and future



Constructing an assessment framework of global one health

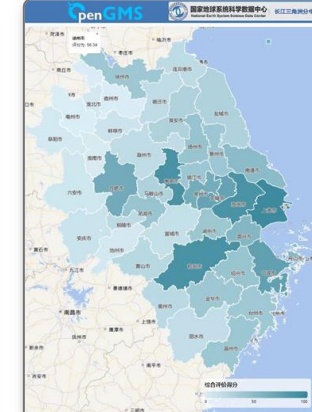


Discovering the future SDG pathways in China



Revealing the water-energy-food nexus in China

目标	主要指标	目标值
环境领域	PM2.5年均浓度	35微克/立方米
	PM10年均浓度	70微克/立方米
	优良天数比率	80%
	地表水优良水质断面比例	85%
民生领域	居民人均可支配收入	4.5万元
	城镇新增就业	1100万人
	城镇调查失业率	5.5%
	基本养老保险参保率	95%
经济领域	国内生产总值	100万亿元
	人均国内生产总值	1.5万美元
	研发经费投入强度	2.5%
	数字经济核心产业增加值占GDP比重	10%
社会领域	常住人口城镇化率	65%
	户籍人口城镇化率	45%
	常住人口城镇化率	65%
	户籍人口城镇化率	45%
文化领域	文化产业增加值占GDP比重	5%
	人均公共文化消费支出	2000元
	全国人均阅读量	40册
	群众体育经常参加体育锻炼人数比例	45%



Measuring the progress of high-quality development in Yangtze River Delta

New Technology-enhanced Decision Support System

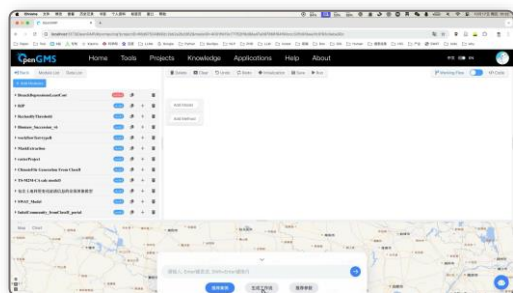


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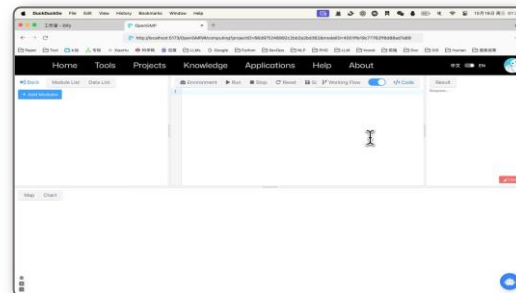


Support SDG decision-making with new GI and SI technology

AI-assisted modeling



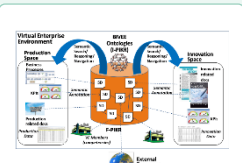
Drag-and-drop Modeling



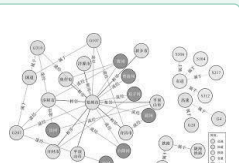
Customizable Programmatic Modeling

Intelligent support

Provide knowledge and experience



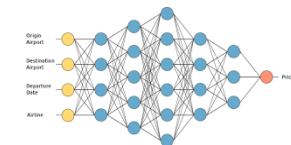
Geographical mechanism law



SDG Modeling Knowledge

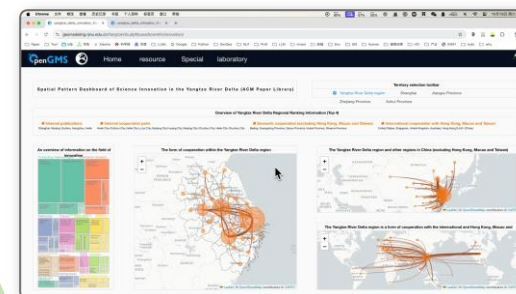


Provide methods and decisions



Intelligent reasoning algorithms and models

Open resource based analysis



Evaluation of Scientific Development in the Yangtze River Delta



Regional Innovation Development Assessment

Service-based decision support



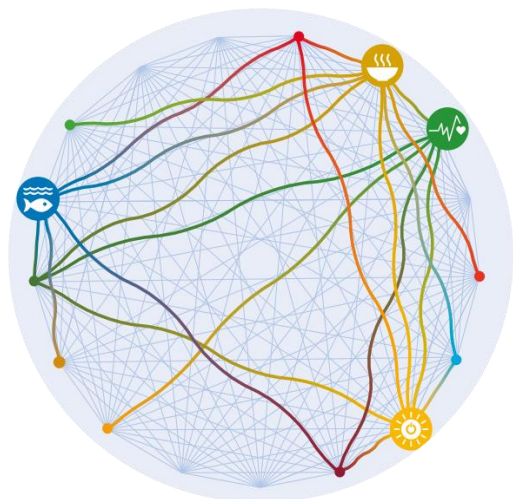
Intelligent Decision Support



SDG Big Data Platform

Sustainable Development Goals are **holistic and dynamic**

- More than just focusing on a single goal, we need to consider the overall progress of the SDGs in a holistic manner
- More than just focusing on the SDG interactions in the past, we should be concerned about whether and when future SDGs will be achieved
- More than just focusing on the isolated model and knowledge, we should integrate various resources and advanced intelligent technologies to build an SDG analysis platform that facilitates broad communication and decision support



SDG system

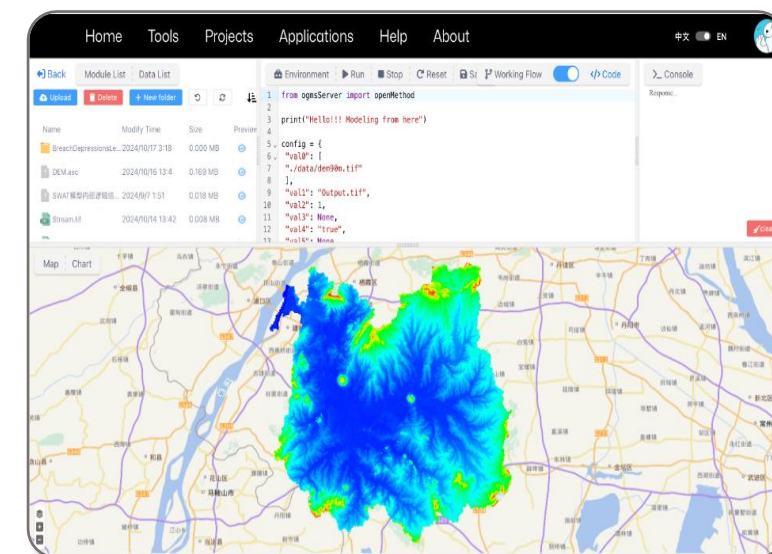
— A guide to SDG interactions (2017)

CURRENT STATE OF PROGRESS TOWARD THE SUSTAINABLE DEVELOPMENT GOALS BASED ON SELECT TARGETS

GOAL	INDICATOR	DISTANCE FROM TARGET (2023) ¹	TREND OF SDG PROGRESS (2023) ²	CHANGE IN TREND OF SDG PROGRESS BETWEEN 2020 AND 2023 ³
1	1.1.1 Eradicate extreme poverty	Very far from target	Limited or no progress	Backward
	1.3.1 Implement social protection systems	Far from target	Fair progress but acceleration needed	N/A
	2.1.2 Achieve food security	Moderate distance to target	Deterioration	None
2	2.2.1 End malnutrition (stunting)	Close to target	Fair progress but acceleration needed	None
	3.1.2 Increase skilled birth attendance	Target met or almost met	Fair progress but acceleration needed	Backward
	3.2.1 End preventable deaths under 5		Fair progress but acceleration needed	Backward
3	3.3.3 End malaria epidemic		Limited or no progress	None
	3.b.1 Increase vaccine coverage		Deterioration	Backward
	4.1.2 Ensure primary education completion		Limited or no progress	Backward
4	5.3.1 Eliminate child marriage		Fair progress but acceleration needed	None
	5.5.1 Increase women in political positions		Fair progress but acceleration needed	None
5	6.1.1 Universal safe drinking water		Limited or no progress	None
	6.2.1 Universal safe sanitation and hygiene		Fair progress but acceleration needed	None
6	7.1.1 Universal access to electricity		Fair progress but acceleration needed	Backward
	7.3.1 Improve energy efficiency		Fair progress but acceleration needed	None
7	8.1.1 Sustainable economic growth		Deterioration	Backward
	8.5.2 Achieve full employment		Limited or no progress	None

Current state and future trend of SDGs

— 2023 global Sustainable development report



Intelligent modeling platform for SDGs

(<https://geomodeling.njnu.edu.cn/OpenGMP/#/>)



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SDG Updates

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