UN GEONOW 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

UN GEONOW 2024
首 届 联 合 国 地 信 周

Date: 24 April, 2024 Venue: University of Groningen

Hope & Dream

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)

Introduction of SDGs

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)

Technology for SDGs

UN GEONOW 2024
首 届 联 合 国 地 信 周

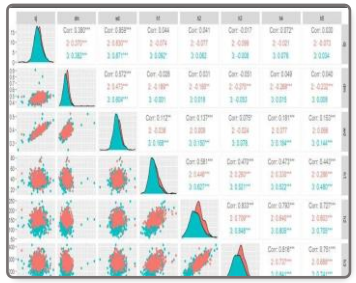
Remote Sensing and Ground Observation

SDGSAT-1 satellite

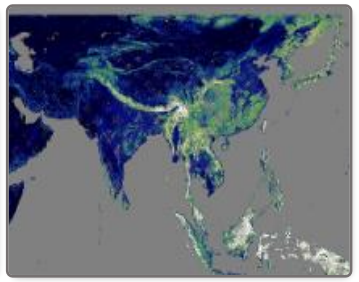
Unmanned Aerial Vehicle Measurement

Ground observation •••

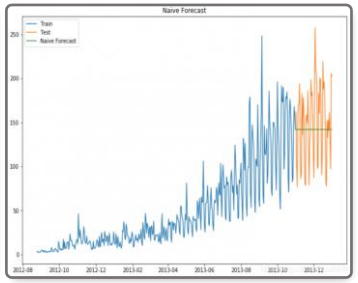
Indicator Analysis Methods



Statistical Analysis



Spatial Analysis



Temporal Analysis •••

Visualization and Interactive Technologies

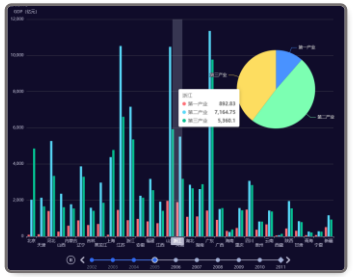


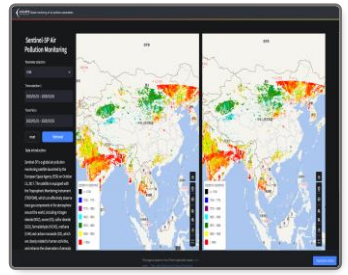
Chart Visualization

3D Visualization

Spatial Visualization •••

Decision-making Support System

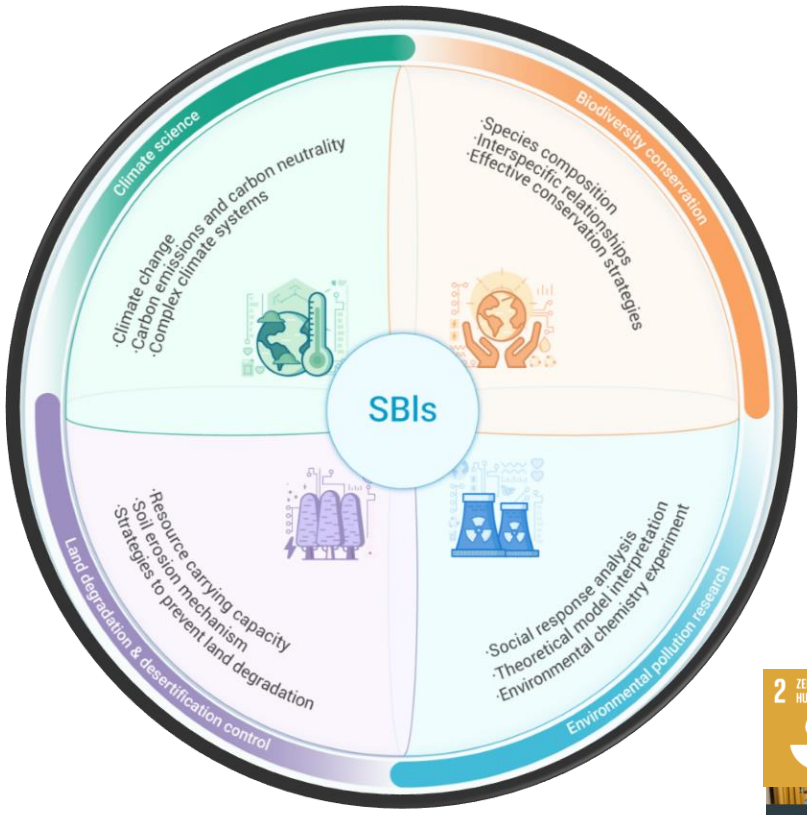
Model-driven Decision making



Data-driven Decision making

Knowledge-driven Decision making •••

Assessment of SDGs



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.

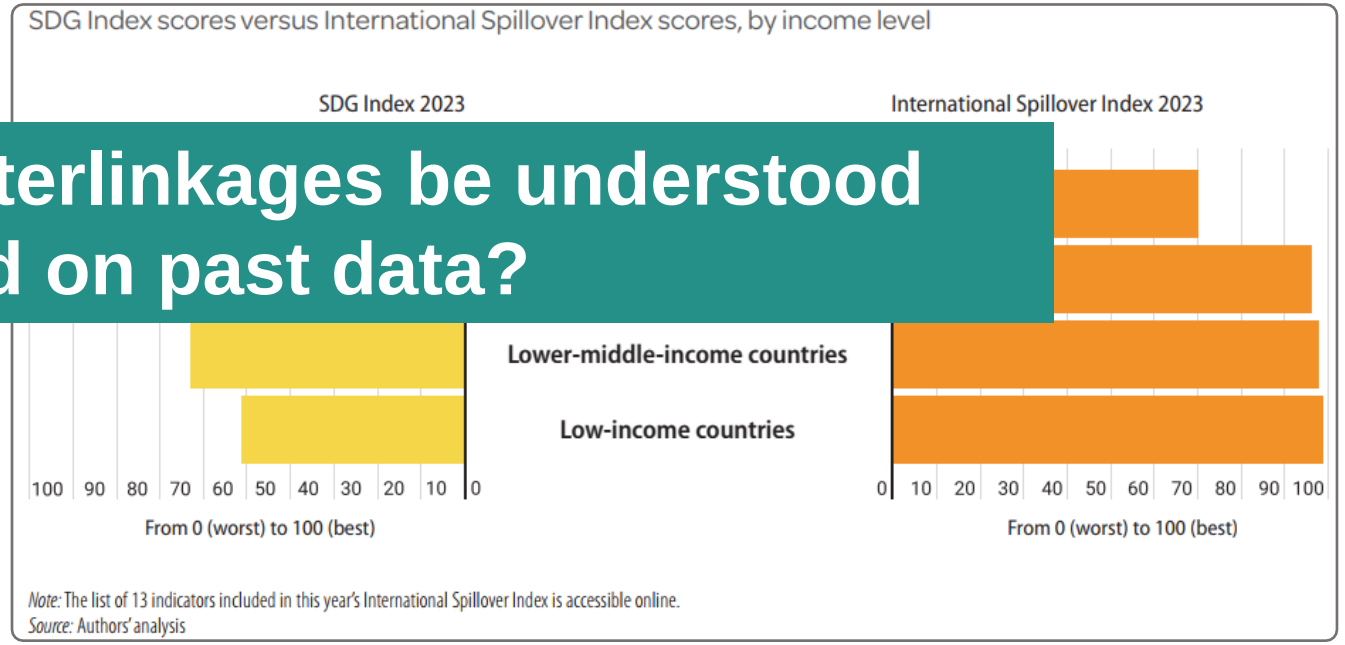
Released the reports on Big Earth Data in Support of the Sustainable Development Goals from 2019 to 2024.

Challenges in SDG Interactions

- 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.

How can SDG interlinkages be understood based on past data?

SDG interlinkages
—— https://opendevelopmentmekong.net

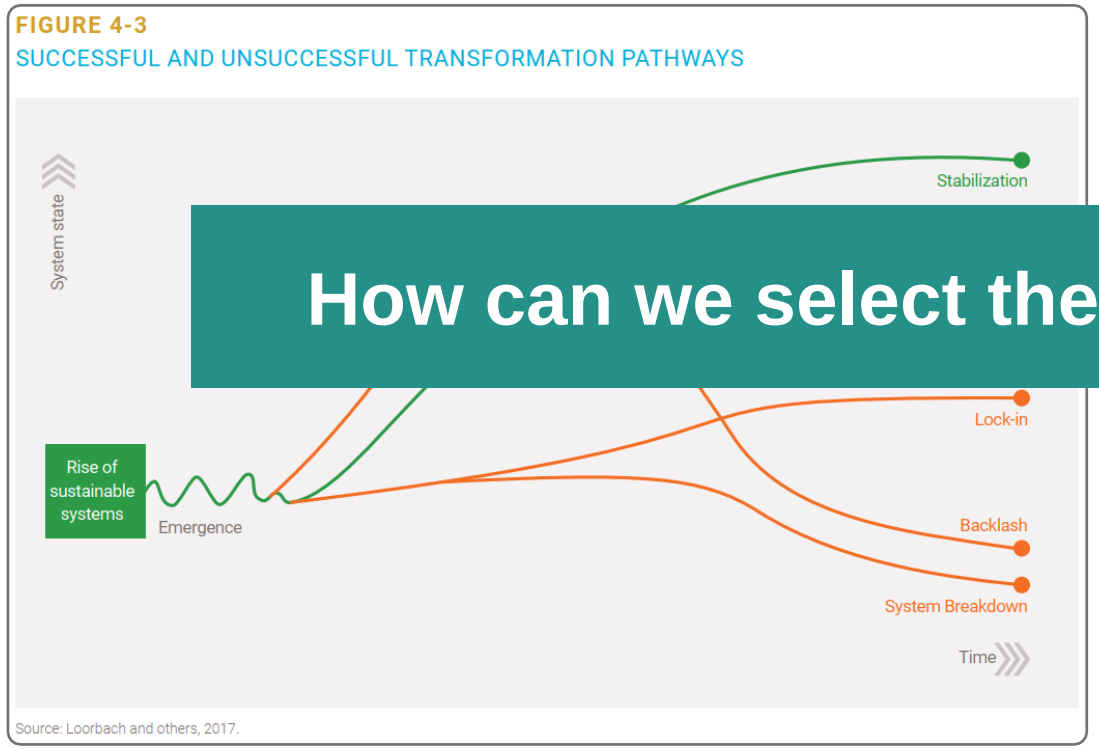


SDG international spillovers
—— Sustainable development report (2024)

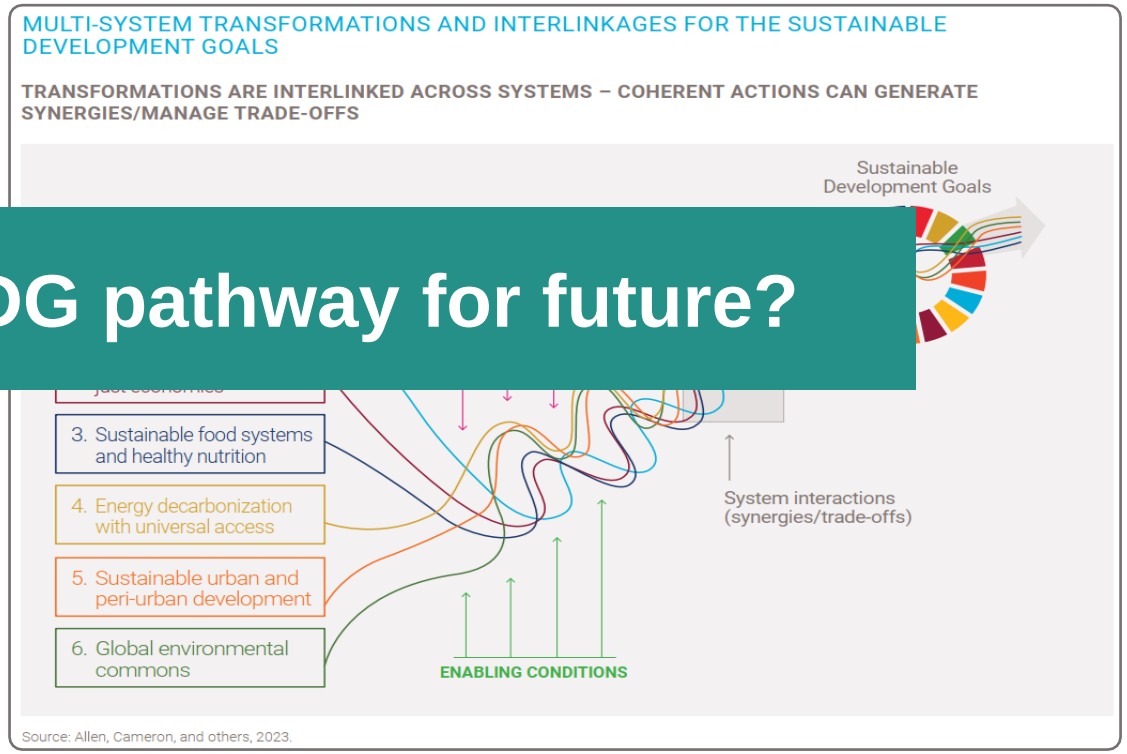
Challenges in SDG Future Progress

- 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?



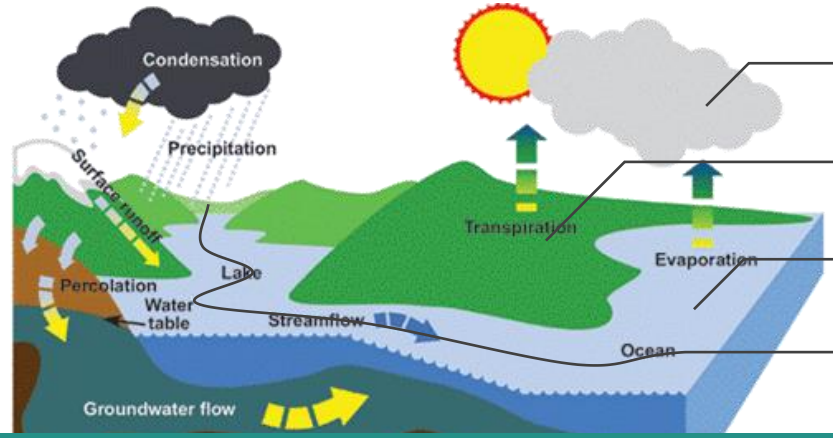
SDG future pathways
——2023 Global Sustainable Development Report



SDG transformations
—— 2023 Global Sustainable Development Report

Challenges in Support SDG Research

Not only Data !!!



MM5, WRF, OPA, RCO, UMO…

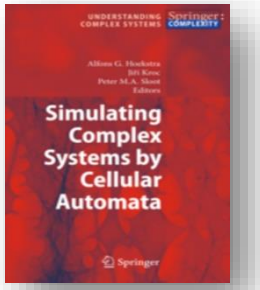
RCA-soil, MOSES, ISBA, LSS, ORCHIDEE…

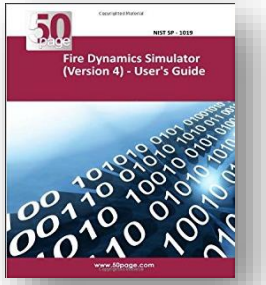
POM, FVCOM, PPTAR, MOM, ECOM, TOM…

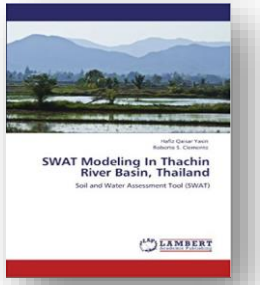
SWAT, DAFLOW, PRMS, BASINS， ModFlow…

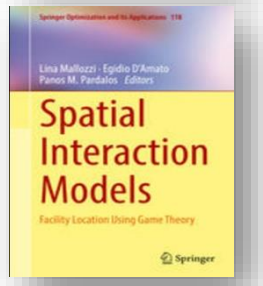
How to make full use of these resources and facilitate easy-to-use?

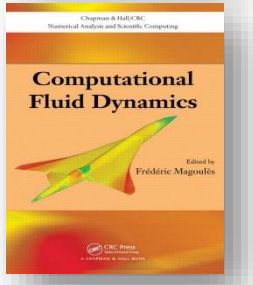
- At different spatial and temporal scales
- To represent different processes











Science-Policy Interface to Address Challenges

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

nature communications

Explore content ⌄ About the journal ⌄ Publish with us ⌄

nature › nature communications › comment › article

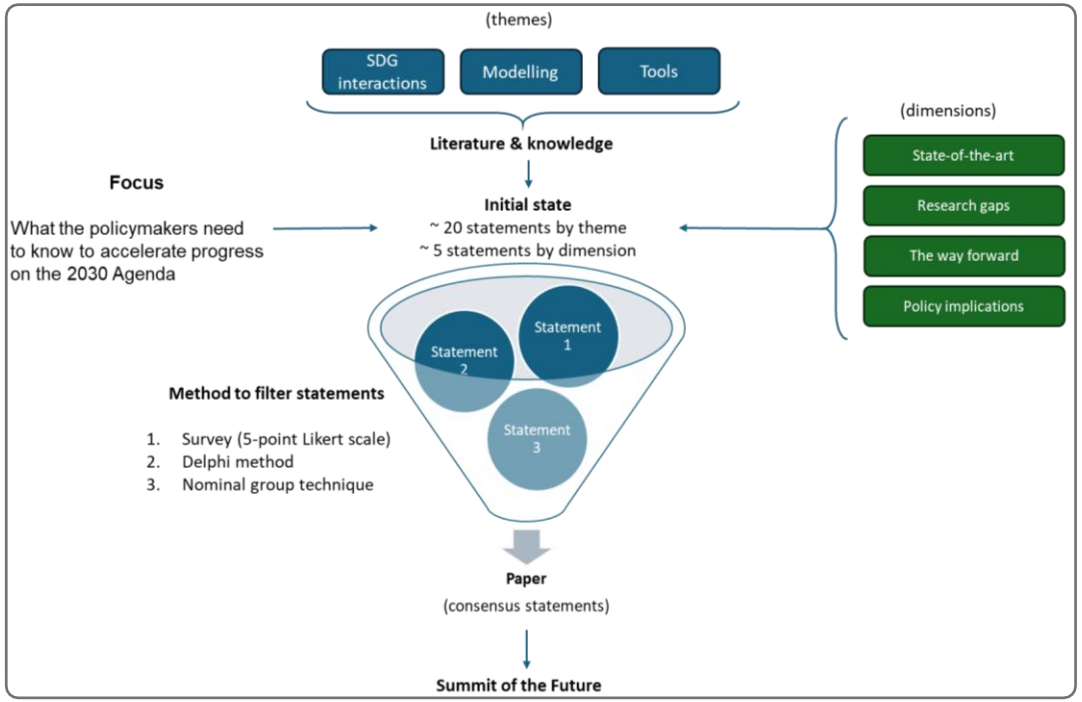
Comment | Open access | Published: 10 October 2024

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

+ Show authors

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

Framework for Further SDG Study

UN GEONOW 2024
首 届 联 合 国 地 信 周

Past → Future

Single ↓ Multiple

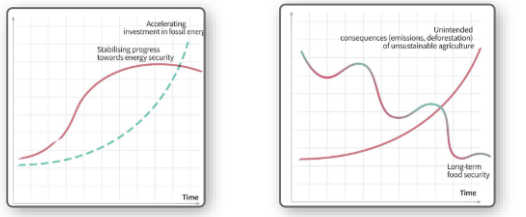
Single SDG Analysis

Assessing and analyzing the progress of single SDG

Energy | water | climate

Multiple SDG Analysis

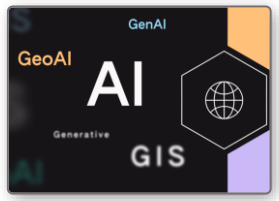
Analyzing the interactions between SDGs



Synergies | Trade-offs

Intelligent Modeling for SDGs

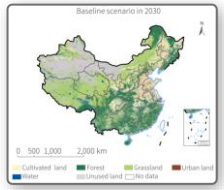
AI Assistant of SDGs Modeling

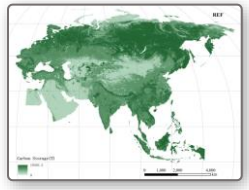


AI-Algorithms | GIS Tools

SDG Scenarios Simulation

Creating new SDG scenarios and analyzing socioeconomic factors under SDG scenarios

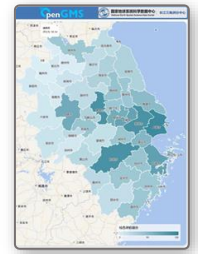


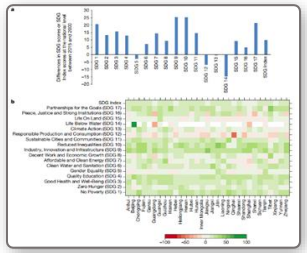


Land use | Carbon storage

Comprehensive Assessment

Comprehensive assessment through different perspectives



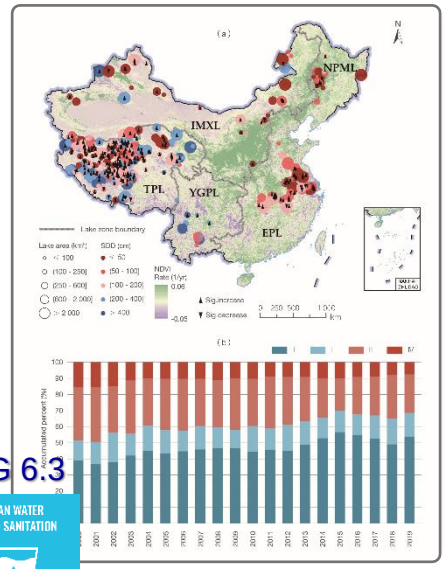


New Technology-enhanced Decision Support System

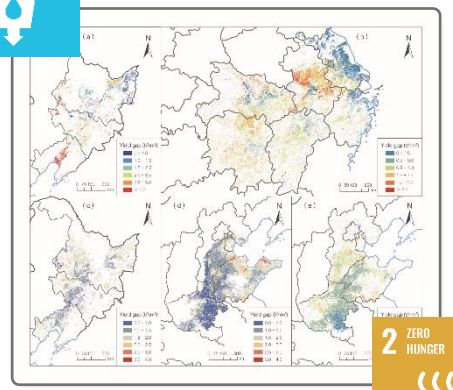
User-friendly and Open Support

Single SDG Analysis

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



SDG 6.3



SDG 2.4

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

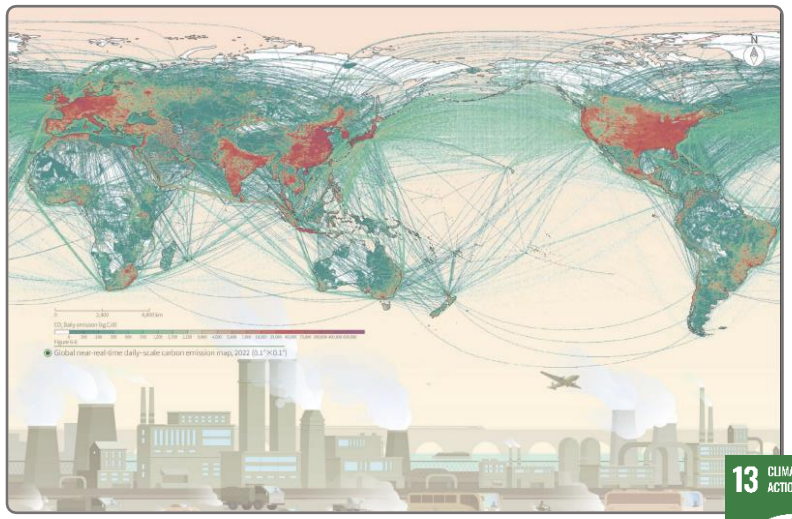
	11.2	11.3	11.5	11.6	11.7
Beijing	→	↘	↘	→	↘
Tianjin	→	→	↘	↘	↘
Hebei	↗	↘	↗	↘	→
Shanxi	↗	→	→	↗	↘
Inner Mongolia	↗	↗	→	↗	↗
Liaoning	↗	↗	→	↗	→
Jilin	↗	↘	↗	↗	↘
Heilongjiang	↗	→	↘	→	↗
Shanghai	→	→	↘	↘	↘
Jiangsu	↗	→	↘	↘	↘
Zhejiang	→	→	→	↘	↘
Anhui	↗	→	↗	→	↘
Fujian	→	→	↘	↘	↘
Jiangxi	↗	→	↗	↗	→
Shandong	↗	→	→	→	→
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 trend from 2015 to: stagnating, increasing, d

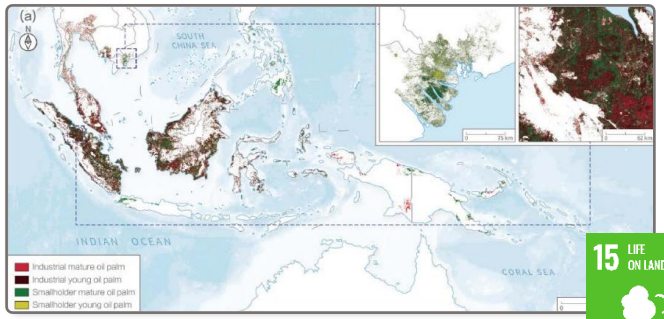
SDG 11

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

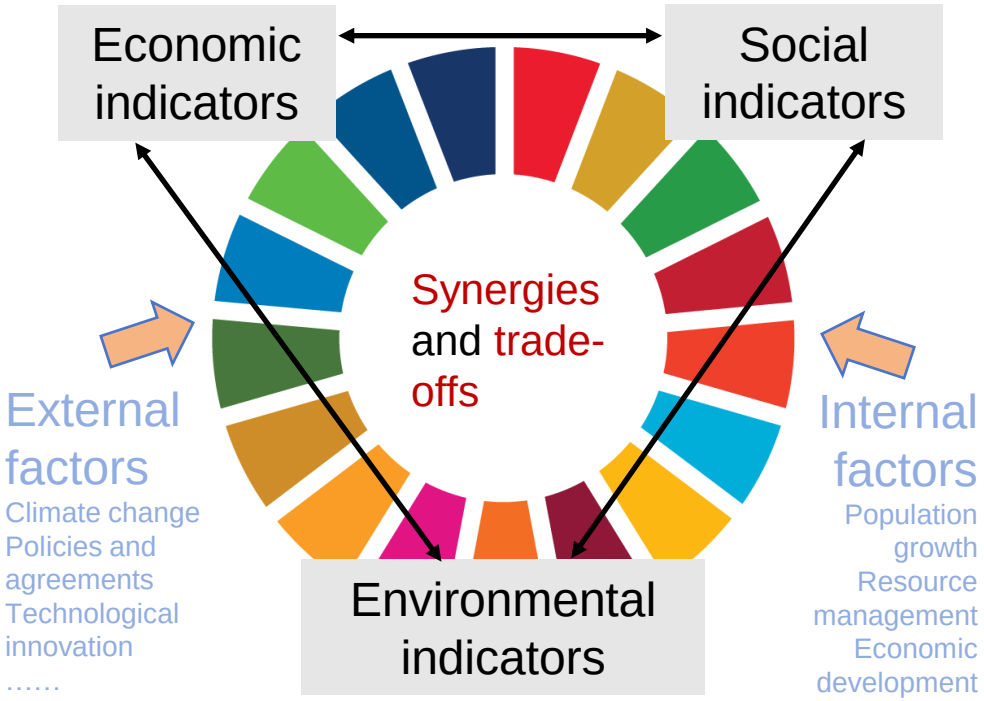


A pixel-oriented classification approach conducting global-scale mapping of oil palm subclasses for SDG 15.2 (Sustainable Management of Forests)

SDG 15.2

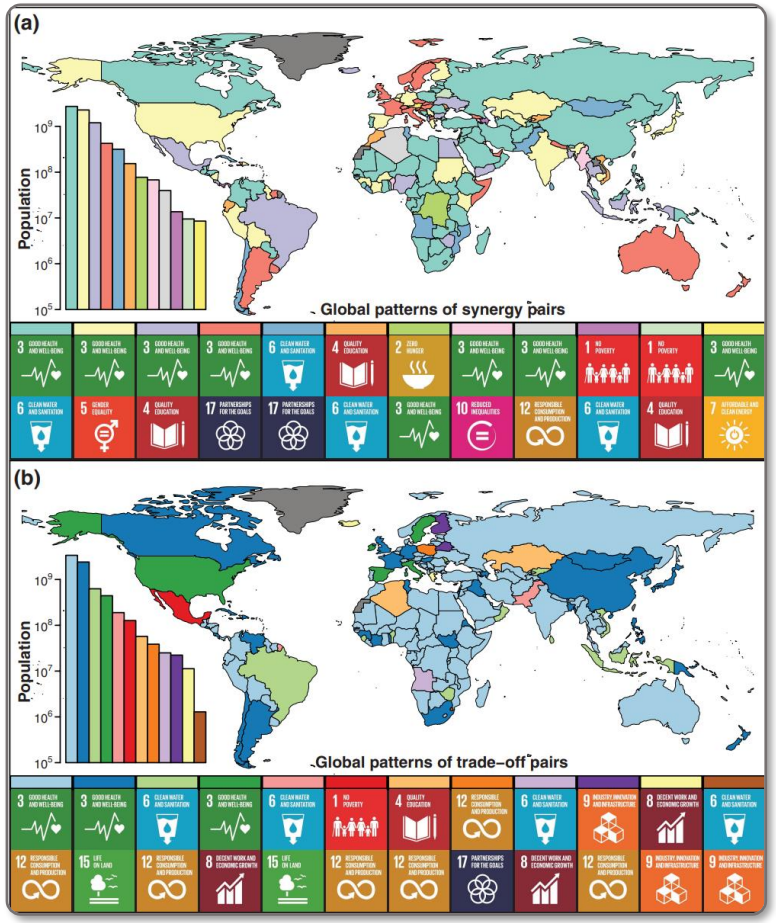
Multiple SDGs Analysis

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

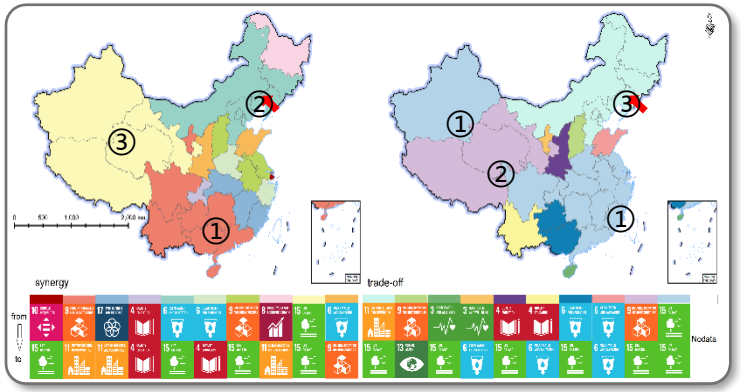


SDG interactions include synergies and trade-offs:

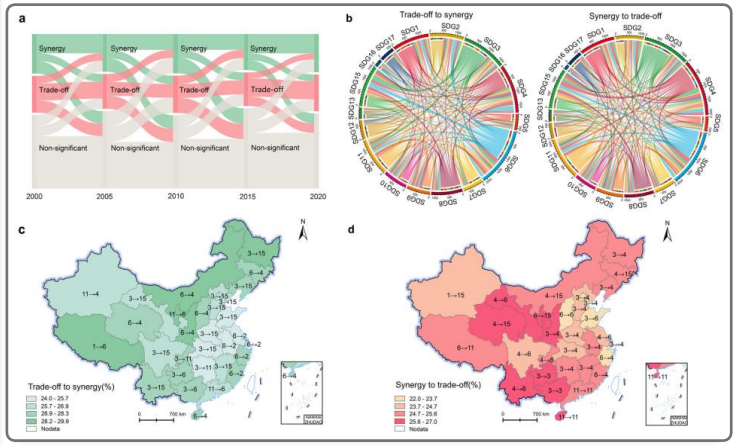
- Synergies: one goal boosts another.
- Trade-offs: one goal hinders another.



Global synergy and trade-off pairs



Transformation of trade-off relationship indicator pairs



Spatio-temporal changes
in the causal interactions among SDGs

AI-enhanced SDG Modeling

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

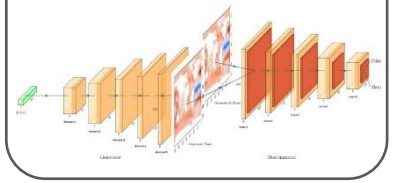
AI enhanced SDG modeling

Optimized Data Processing
- Transforms raw observations into curated data
- Reconstructing observational data
- Recognizes distribution pattern

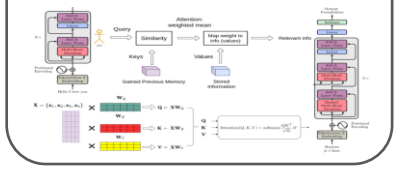
Modelling and Prediction
- Accurate modeling of complex systems
- Enhanced algorithms like Transformer
- Real-time forecasting

Enhancing Understanding
- Uncovers hidden relationships in complex systems
- Facilitates decision-making
- Accelerates sustainable research

GANs

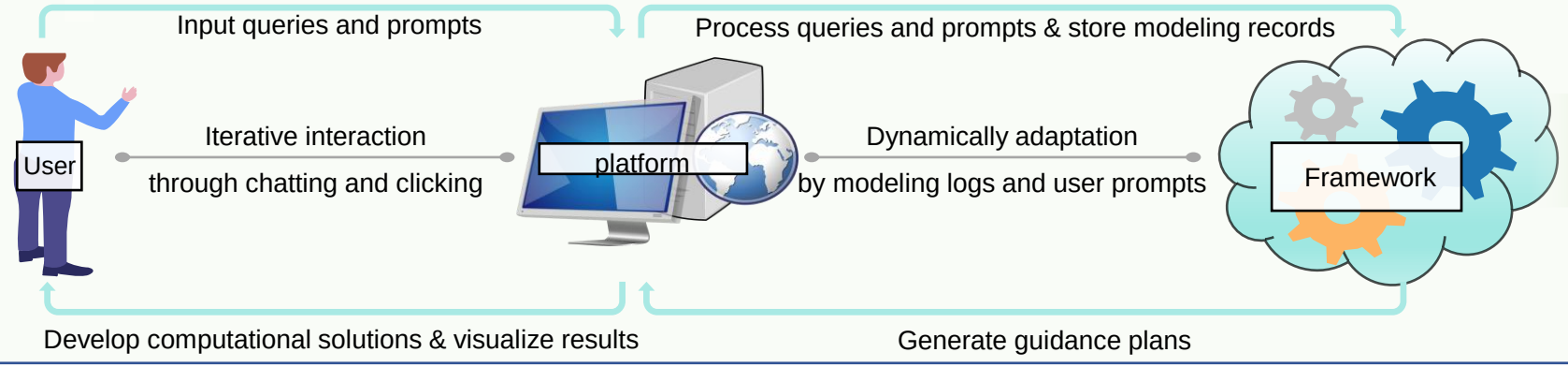


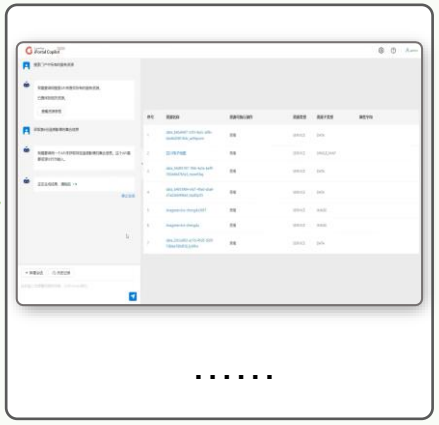
Transformers



.....

Modeling Paradigm





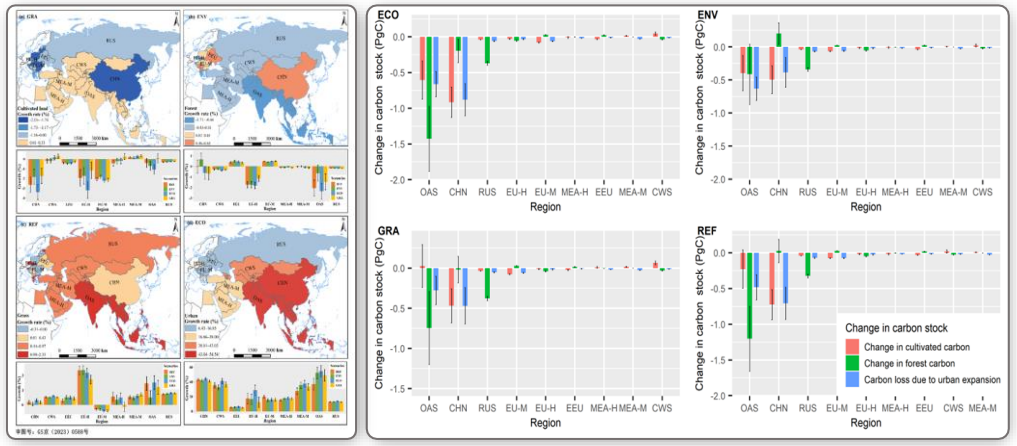
.....

Chen Min et al., Iterative integration of deep learning in hybrid Earth surface system modelling, Nature Reviews Earth & Environment, 2023.

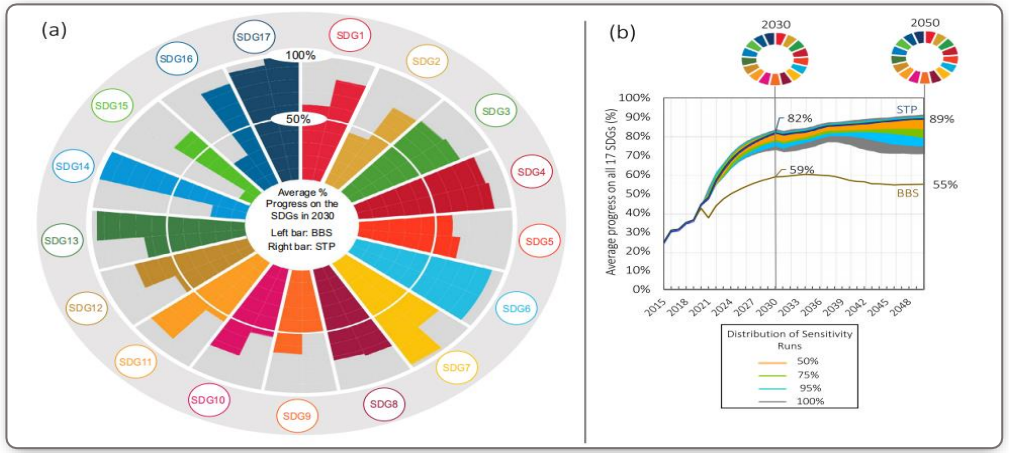
SDG Scenarios Simulation

UN GEONOW 2024
首 届 联 合 国 地 信 周

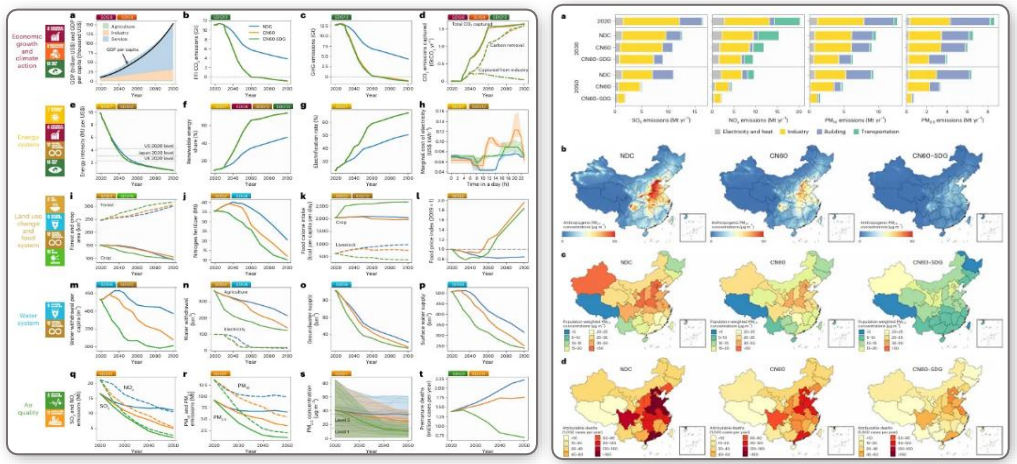
Helping predict and choose the “right” pathway cohere with the changing world



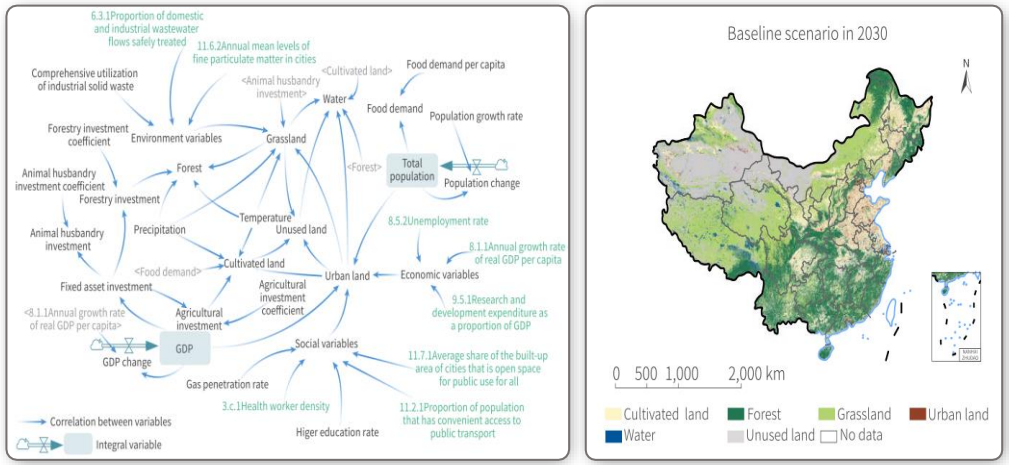
Impact on terrestrial ecosystem carbon pool along the Silk Road



SDG score of six transformations in Australia



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

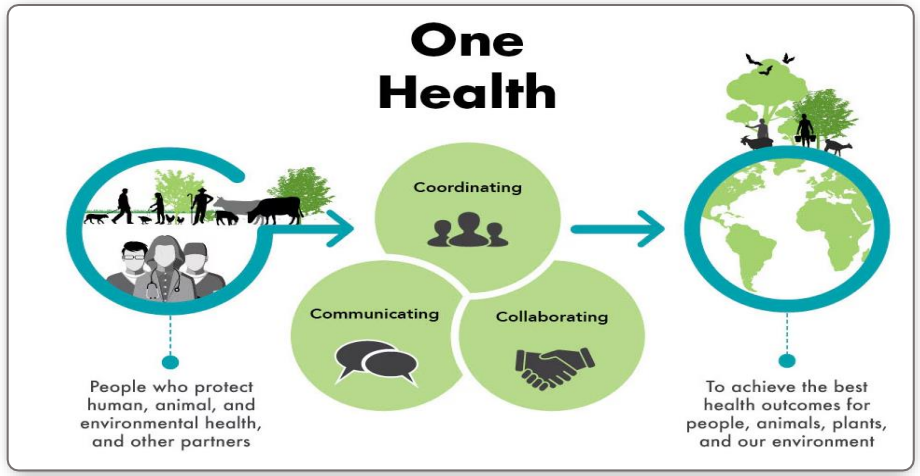


Future land use change in China

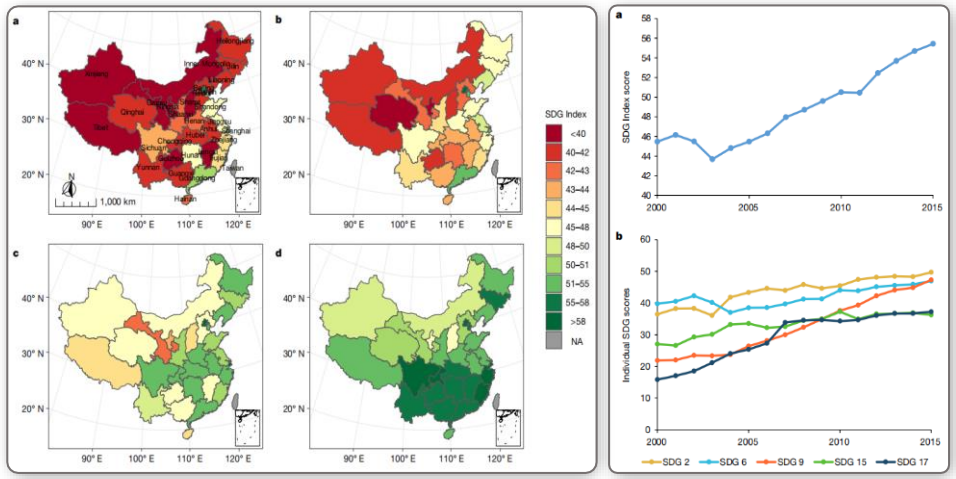
Comprehensive Assessment

UN GEONOW 2024
首 届 联 合 国 地 信 周

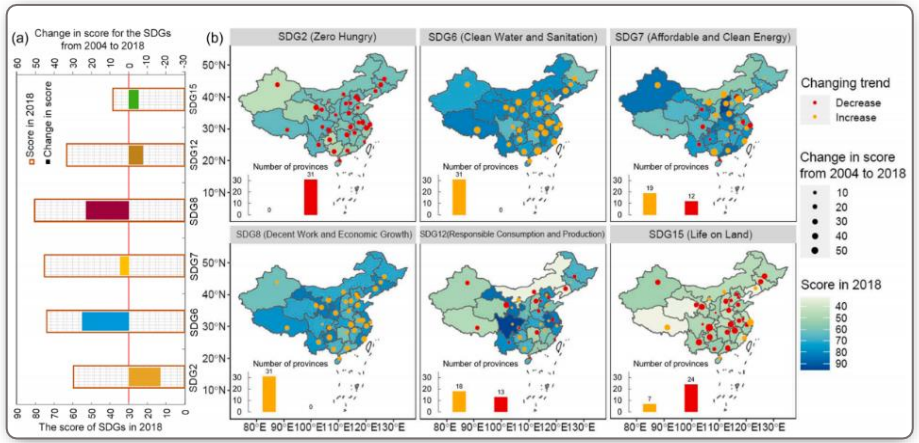
Towards a comprehensive understand of the progress toward SDGs, currently and future



Constructing an assessment framework of global one health



Discovering the future SDG pathways in China



Revealing the water-energy-food nexus in China

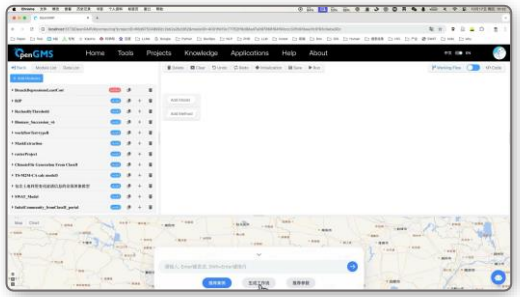
Measuring the progress of high-quality development in Yangtze River Delta

New Technology-enhanced Decision Support System

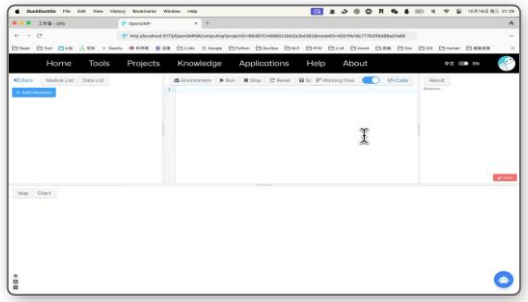
UN GEONOW 2024
首 届 联 合 国 地 信 周

Support SDG decision-making with new GI and SI technology

AI-assisted modeling



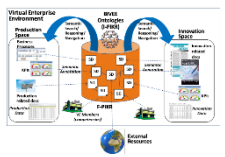
Drag-and-drop Modeling



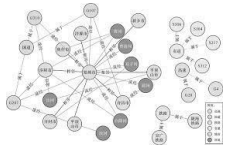
Customizable Programmatic Modeling

Intelligent support

Provide knowledge and experience

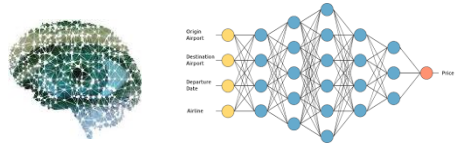


Geographical mechanism law



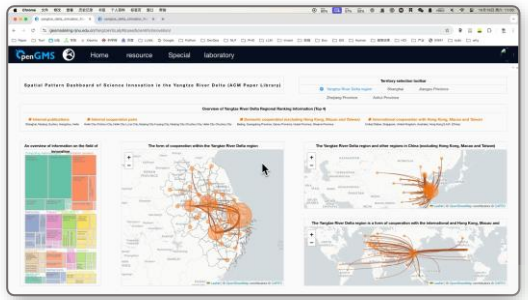
SDG Modeling Knowledge

Provide methods and decisions



Intelligent reasoning algorithms and models

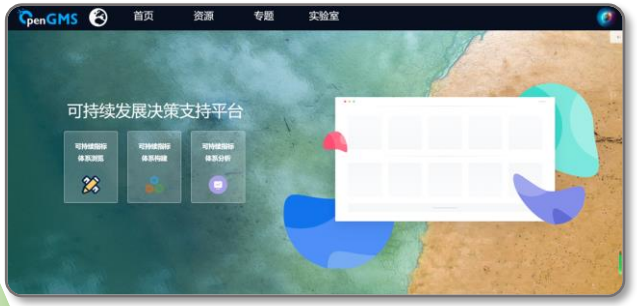
Open resource based analysis



Evaluation of Scientific Development in the Yangtze River Delta

Regional Innovation Development Assessment

Service-based decision support



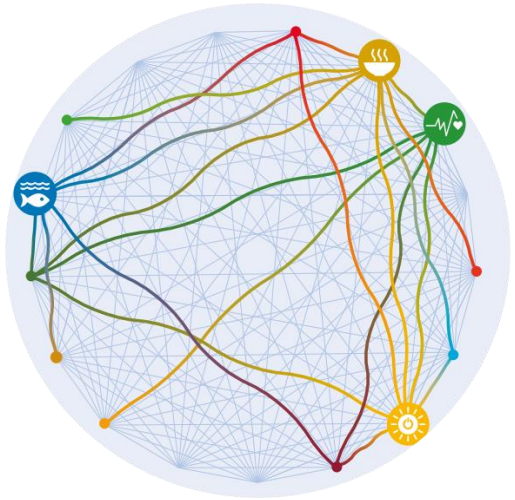
Intelligent Decision Support

SDG Big Data Platform

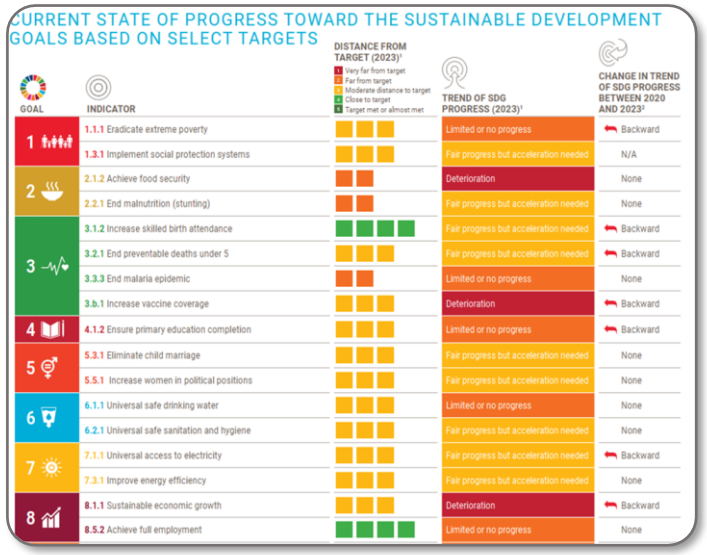
Summary

Sustainable Development Goals are **holistic and dynamic**

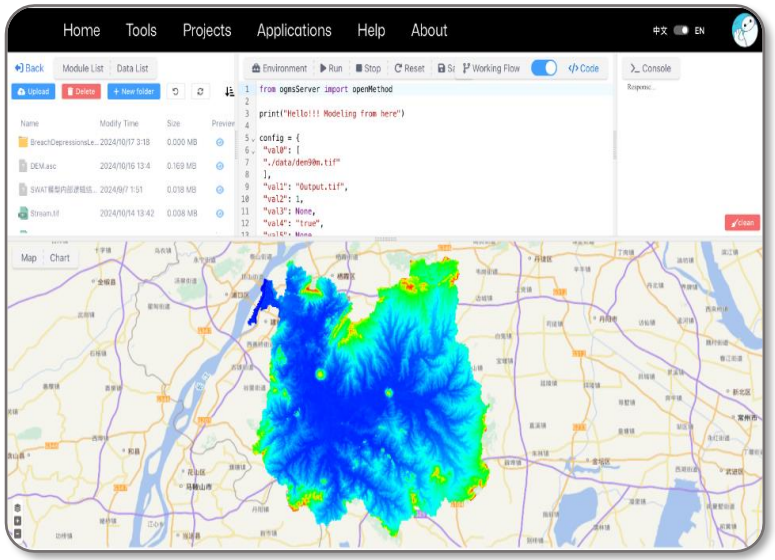
- More than just focusing on a single goal, we need to consider the overall progress of the SDGs in a holistic manner
- More than just focusing on the SDG interactions in the past, we should be concerned about whether and when future SDGs will be achieved
- More than just focusing on the isolated model 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 and future trend of SDGs
— 2023 global Sustainable development report



Intelligent modeling platform for SDGs
(https://geomodeling.njnu.edu.cn/OpenGMP/#/)

UN GEONOW 2024
首 届 联 合 国 地 信 周

THANK YOU