Local Innovations for Global Goals: A Workshop on AI, Spatio-Temporal Data, and SDG Monitoring

Knowledge Generation and Management

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Spatiotemporal Knowledge Service Academician Workstation
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PART ONE

SDGs DATA AGGREGATION

1. BASIC DATA AGGREGATION
2. SDGs INDICATOR SYSTEM CONSTRUCTION
3. SDGs INDICATOR CALCULATION
4. SDGs INDICATOR INTERPRETATION
SDGs Data Management Subsystem
(for Data Analysts)
1. BASIC DATA AGGREGATION

- Geospatial data collection

- Image maps
- Administrative division data
- Village Plan maps
- Land use data
- Infrastructure points
- Road networks

Deqing Geographic Information Centre

Data desensitisation

Deqing Data Sharing Platform

Submit data requests

Obtain data or data interface
1. BASIC DATA AGGREGATION

- Socio-economic data collection

    ![GDP data]
    ![Meteorological data]
    ![Water consumption]
    ![Population]

Government departments
- Deqing County Government (deqing.gov.cn)
- Water Resources Bureau (hzwr.gov.cn)
- bureau of statistics (huzhou.gov.cn)
- …

Authoritative publications
- CCTV
- people
- CHINADAILY.cn

Volunteers
- [Logos of various organizations]
## Partial data list

<table>
<thead>
<tr>
<th>Title</th>
<th>Type</th>
<th>Title</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>National geoinformation land cover data</td>
<td>Vector</td>
<td>Sewage treatment plants</td>
<td>Vector</td>
</tr>
<tr>
<td>Village boundaries</td>
<td>Vector</td>
<td>Ecological wetlands</td>
<td>Vector</td>
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<tr>
<td>Environmental function zone</td>
<td>Vector</td>
<td>Enterprises with sewage treatment plants</td>
<td>Vector</td>
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<tr>
<td>Protection area of water resources</td>
<td>Vector</td>
<td>Enterprises without sewage treatment plants</td>
<td>Vector</td>
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<td>Status of green space in built-up areas</td>
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<td>Public bikes</td>
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<td>Cultural relics protection unit point</td>
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<td>Bus lines</td>
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<tr>
<td>Heritage Protection Unit Line</td>
<td>Vector</td>
<td>Bus stops</td>
<td>Vector</td>
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<tr>
<td>Inner line of township boundaries</td>
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<td>School bus stops</td>
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<tr>
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<td>Vector</td>
<td>The master plan map</td>
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<tr>
<td>Water system</td>
<td>Vector</td>
<td>0.5m image</td>
<td>Vector</td>
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<tr>
<td>Railway</td>
<td>Vector</td>
<td>30m image time series</td>
<td>Raster</td>
</tr>
<tr>
<td>Hospitals, schools, bus venues</td>
<td>Vector</td>
<td>250m MODIS NDVI</td>
<td>Raster</td>
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<tr>
<td>Meteorological observation stations</td>
<td>Vector</td>
<td>30m DEM</td>
<td>Raster</td>
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<tr>
<td>Bank</td>
<td>Vector</td>
<td></td>
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</tbody>
</table>
The aggregated data can be grouped and archived according to SDGs or other self-defined categorisation methods.
2. INDICATOR SYSTEM CONSTRUCTION

- The UN SDGs global indicator system contains 232 indicators covering 169 sub-goals (targets) of the 17 SDGs.

- It is designed for country-level assessment and monitoring and is globally universal, making it difficult to adequately reflect the particular circumstances of different regions and countries.

The subsystem enables to visually construct a localised indicator system:

define indicators from SDGs base data -> define the 17 SDGs -> build the SDGs indicator system

The SDG to which the indicator belongs can be previewed and managed in the indicator item module.
3. INDICATOR CALCULATION

- By configuring information, such as algorithmic models, and inputs and outputs for quantified indicators, **indicator analysis calculations** can be performed.

- At the same time, the subsystem provides a **quantitative assessment of the indicators** by referring to the report "SDGs Index and Indicator Board" published by the Bertelsmann Foundation and the UN Sustainable Development Solutions Network (SDSN) in 2017.

**Methodology for Calculating Quantitative Indicators**

(i) Use statistical data, calculated using ratios (or percentages), rates of change, indices, etc.

(ii) Use geospatial data, extracted using spatial density calculations, coverage extraction, etc.

(iii) Combine statistical data and geospatial information to calculate and analyse spatialised statistics based on accessibility, coverage, spatial relationships, etc.
3. INDICATOR CALCULATION

■ SDGs-6

Proportion: 6.1.1, 6.2.1, 6.3.1, 6.3.2

6.1.1 Proportion of population using safely managed drinking water services (Urban: 100% Rural: 99.6%)

6.2.1 Proportion of population using safely managed sanitation services (98%)

6.3.1 Proportion of wastewater safely treated (Municipal sewage: 91.06%; Rural sewage: 73.58%*)

6.3.2 Proportion of bodies of water with good ambient water quality (2016: 68.75%; 2017: 100%)

Rate of change: 6.4.1

6.4.1 Change in water-use efficiency over time

Index: 6.4.2

6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (2016: 25.08%)

\[
PLW = \frac{TWW}{TRWR - EFR} \times 100
\]

TWW: The volume of freshwater extracted from its source for agriculture, industries and municipalities;
TRWR: The sum of internal and external renewable water resources;
EFR: Environmental water requirements;
3. INDICATOR CALCULATION

6.6.1.a

Landsat series satellite data

Rate of change in the spatial extent of water-related ecosystems (11.14%)

\[ V_{wet} = \frac{S_{last\ 5\ years} - S_{history}}{S_{history}} \]

Changes in Xiazhuhu Wetland

Changes in wetland area over 33 years
4. INDICATOR INTERPRETATION

- Explore indicator knowledge through logic of indicator system.
- Find flexible interactions between highlighted labels and the corresponding spatio-temporal data.
SDGs Knowledge Design Subsystem
(for Knowledge Designers)
Subsystem Operational Process

1. Structured Modelling
2. Domain-based Extraction
3. Associated Processing
4. Visual Expression
5. Knowledge-based Service

Automatic structured data generation

SDGs Conceptual Model

Knowledge graph building tools

Knowledge Graph

Manual extraction of knowledge, connotations

Manual Extraction

Knowledge Fusion

Statistics, documents

Databases

Page Logic
- Page Layout
- Page Jumps
- Page Nodes

Page Knowledge
- Knowledge Editing
- Resource links
- Knowledge Links
- Indicator links
- Data facts

Data Fact
- Statistical charts
- Knowledge maps
- Images
- Video
- Basic components

Story knowledge
- Storytelling
- Story Elements
- Story Mode
1. KNOWLEDGE SERVICE TECH · Structured Modelling

Structured modelling of SDGs means structuring the relationships between relevant knowledge points (or concepts), entities and attributes to form a structured body of knowledge on SDGs.

Form a 5-level conceptual model of SDGs knowledge, including domains, SDGs, connotations, knowledge points and data facts, and determine the definition, connotations and structure of knowledge at each level.
**SDGs knowledge extraction** is to sort out the relevant data facts from the raw data and outcome information of the quantitative assessment based on the conceptual model; then condense and extract the entities, relationships and attributes of the entities through a combination of manual and automated methods to form the SDGs knowledge points.

SDGs Data Facts (maps, charts, multimedia, web resources...)

SDGs Knowledge Units

SDGs Knowledge

**Data, materials** → **Data Facts** → **SDGs Knowledge**

**Specialists Extraction**
Information extraction and parsing

**Natural Language Processing**
Knowledge integration

**SDGs Report**

**Multimodal Data Material**

**Open Knowledge Base and Web Resources**
The association process establishes the association relationship between knowledge points from three perspectives: spatial, logical (hierarchical, inclusive, communal) and semantic (similar, related) to form a knowledge network;

Then through processing and integration, knowledge disambiguation, integration and reasoning are carried out to finally form a structured SDGs knowledge graph.

A knowledge graph consisting of 3 cluster nodes, 16 SDG nodes, 44 local target nodes and over 700 data facts was formed.
The SDG knowledge content is spatially and dynamically structured by designing visual expression and interaction methods for the representation objectives and knowledge types.

**Dynamic maps**
- Interaction
- Evolution
- Flight

**Static maps**
- Images
- Surface coverage
- Thematic maps

**Multimodal materials**
- Charts
- Images
- Text
- Video/Audio

- Over 450 images, multimedia, external links
- 118 dynamic graphics
- 160 geo-information services
1. KNOWLEDGE SERVICE TECH · Knowledge-based Service

To provide knowledge-based service through visualised knowledge graph, knowledge pages, knowledge search and knowledge stories.

Organise the content of SDGs by knowledge networks, interactively providing hierarchically linked knowledge points and data facts.

Provide a knowledge search tool for users, parses their questions and organises and presents search results in a knowledge-based format.

Oriented towards the core themes, the layers of knowledge, indicators and data facts are restructured to design and customise complete SDGs stories for users.

The ibis population has increased significantly in the last few years.

- Refuse collection/Harmless disposal rate 100%
- AQI Attainment Rate 97.5%
- Drinking water quality II
- Forest coverage 46.1%
2. KNOWLEDGE CUSTOMISATION

The knowledge customisation module offers rich visual representation capabilities, material management of different types of data, and the ability to create stories.

Knowledge Point Customisation Page

Story Customisation Page

A large number of high-end hill stations have made the famous around the world.
PART THREE
SDGs KNOWLEDGE SERVICE

1 CONTENT ORGANISATION

2 TYPICAL SERVICES
   • Visual Expression
   • Knowledge-based Service

3 SYSTEM FEATURES
   • Knowledge-guided
   • Geospatial-enabled
   • Comprehensive
SDGs Knowledge Service Subsystem
(for professionals, government and the public)
1. CONTENT ORGANISATION

Home Page

Indicator

No Poverty
- Indicator
- ……

SDG N
- Indicator
- ……

SDG 17
- Indicator
- ……

Knowledge

Economic
- Connotation 1
- ……

Sociology
- Connotation 1
- ……

Environment
- Connotation 1
- ……

SDG 1
- Connotation 1
- Point 1
- ……
- Connotation 2
- Point 1
- ……

SDG N
- Connotation 1
- Point 1
- ……
- Connotation 2
- Point 1
- ……

SDG 17
- Connotation 1
- Point 1
- ……
- Connotation 2
- Point 1
- ……

Story

Story 1

……

Story N

Search

News
- News 1
- ……
- News N

About

Literature
- Paper 1
- ……
- Paper N
2. User Interface Design · Domain

Select the domain theme:
- View the corresponding domain's description;
- View the related SDG's from the SDGs turntable.

Click on "view" to browse the knowledge of the domain.
2. User Interface Design · Domain

**Domain Details**

- **Economic**
  - Economic targets 2, 7, 8, 9, and 10 have promoted the sustainable growth of the economy. The overall economy has developed fast with high quality driven by the technology-intensive industry structure in Deqing: the sustainable industrial park.

- **Conditions of Growth**
  - Constant improvement of infrastructure, sustainable agriculture, and industrial system have laid the foundation for upgrading industrial structure and economic growth.

- **Growth Trend**
  - The growth trend of labor productivity remains satisfactory with the rapid growth of tourism.

- **Internal Needs**
  - The comprehensive consumption of energy has been decreasing each year; the basic public services have become more equitable; and the income gap between urban and rural areas has been narrowing.

- **Three connotations of the domain**

- **Click the link to browse the corresponding connotation’s description**

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Natural health care and international leisure tourism in Mogan Mountain and the Naked Heart Castle, Deqing.

Local music exhibition.
2. User Interface Design · Domain

Domain’s Connotation Details

Internal Needs

Dongying County has made efforts to promote energy conservation and emission reduction in key areas and seize the transformation of low-energy enterprises, which resulted in declining comprehensive consumption of energy each year. It still has innovated ecological agriculture, integrated the construction of urban and rural areas, made the basic public services more equitable, and created more employment leading to the ratio of urban to rural income as low as 1:7:1.

- Energy efficiency – Energy substitute for coal has been promoted, and comprehensive consumption of energy has been declining each year. But there is room to strengthen the energy summary.
- Conditional Equality – The urban and rural development has been integrated, and equal access to the basic public services has been improved.
- Income Equality – Factors of production in urban and rural areas have flowed freely, and the income gap between urban and rural areas has been narrowed.

Related Knowledge Points

- Integration of Urban and Rural Sewage Treatment Facilities
- Integration of Urban and Rural Sanitation Infrastructures

Knowledge Atlas Index

Over View of the Urban-Rural Integration in Dongying
2. User Interface Design · SDG

Select the SDG from the SDGs turntable

- View the corresponding SDG's description and the number of associated “indicators”, “connotations”, “knowledge points”, and “data facts”.

Click on “view” or “connotations”, “knowledge points”, “data facts” to browse the knowledge of the goal.
2. User Interface Design · SDG

SDG Knowledge Overview

SDG evaluation overview, and its involved connotation title (blue link) with explanation.
2. User Interface Design · SDG

**SDG’s Connotation**

**Knowledge Content**

- Reduced Mortality
  - Focusing on the health of key population, providing some basic drugs free of charge for chronic diseases, building green channels for pregnant and parturient women, popularizing the fundamental knowledge of children’s health. Deqing has been reducing mortality year by year; therefore, in 2017, the probability of dying from cardiovascular disease, cancer, diabetes or chronic respiratory disease was lower than the 60% of the world average levels, the mortality of pregnant and parturient women was zero, and both neonatal and under-five mortality are below national average levels.

**Knowledge Expression**

- Pointing to the icon brings up the related indicator title;
- Allows to click to access the indicator overview

**Knowledge Atlas Index**

- Explains relevant content in the form of interactive diagrams, dynamic maps, etc.
- Expand the whole knowledge atlas to access interested knowledge nodes.
2. User Interface Design · SDG

Click the SDG icon to browse the SDG’s indicator details

Indicator Interactive:
1. Offer the shift between Indicator Definition and Indicator Explanation.
2. Show the explanation of corresponding labels in detail.
3. Show the knowledge points of the specific explanation.
2. User Interface Design · SDG

SDG’s Indicator Index

Involved indicator list

- Allows to click on any to access the details.
- Offer the SDG shifts, and the shifts among “target introduction”, “target analysis”, and “Inclusion index”.
2. User Interface Design · Indicator

Access the Indicator page from Navigation

According to the United Nations SDGs global indicator framework, comprehensive use of geographical and statistical information, combined with local specific conditions, from 16 targets, 102 indicators, the implementation of SDGs in Deqing County is evaluated and analyzed quantitatively, qualitatively and positively, and the research results are formed.

Click the domain or SDG to browse the list of related indicators.

- Domain list
- Goal list
- Indicator List

Allows to click on any to access the indicator details.
2. User Interface Design · Search

Access the knowledge search page through Homepage or Navigation

Directly to the search results page
2. User Interface Design · Search

- Guided, recommended search
- Knowledge-based search
2. User Interface Design · Story

Access the story page through Homepage or Navigation

Directly to each story page
A story about “A Mountain”

关于“一座山”的故事
3. FEATURES · Knowledge-guided

Knowledge Graph > Domain

Deqing SDGs Knowledge Graph

Environment Domain Homepage
3. FEATURES · Knowledge-guided

Domain > SDG > Connotation

SDG6 Homepage

Connotation Homepage
3. FEATURES · Knowledge-guided

Two knowledge points are included in Water Resources Utilisation

1: Improvement Needed for Water Utilisation

2: Significant Improvement in Water Quality
3. FEATURES · Knowledge-guided

Knowledge Point > Evidences & Indicators

Diagnostic Knowledge
- spatial and temporal influences
- descriptive knowledge (100% compliance rate)

Details of Indicator 6.3.2 "Proportion of water bodies with good ambient water quality"

Knowledge Content
The blue links refer to evidences

Significant Improvement in Water Quality

The water quality of Daguangtou gradually improved from 2013 to 2017, and its acceptable proportion of major rivers in 2017 reached 100%.

Deqing implemented the strictest water resources management system, and the wastewater treatment in the Natun and Yuanxun areas, and management of import pollutants has achieved remarkable results.

The "Yushu Bridge" emerged and Yuanan Stream was repaired with the progress of the lake and river management project. The remains of the water culture have become a unique landscape in Deqing.
3. FEATURES • Geospatial-enabled

Significant Improvement in Water Quality

The water quality of Daqing improved gradually from 2013 to 2017, and its acceptability of 14 major rivers in 2017 reached 100%.

Daqing implemented the strictest water resources management system, and the wastewater treatment in urban and rural areas, and management of non-point source pollution has achieved remarkable results.

The “Xinbi Bridge” emerged and “Xuan'er Stone” was repaired with the progress of the lake and river management project. The remains of the water culture have become a unique landscape in Daqing.
3. FEATURES · Comprehensive

- Support static expressions of pictures, videos, external links, etc.
- Support visual dynamic representations of charts and geographic information services, and can be operated interactively.
3. FEATURES · Comprehensive

- Support interaction between the knowledge contents and data facts.
Feasible system deployment models

1. Deploy the system on Technical Supporter’s servers, applying processed data in the forms of map service, API, etc.

2. Deploy the system on cloud servers with proper user permissions.

3. Deploy the system on local servers, with maintenance by remote.
Thank You!

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