Correlation and Discovery of Disaster Big Data - DRR Knowledge Service

Juanle WANG
Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences
April 4, 2019
Outline

1. Requirements of DRR Knowledge Service
2. Methodology of DRR Knowledge Service
3. Knowledge service applications online
4. Cooperation in the near future
1 Requirements of DRR Knowledge Service
UNESCO Role in Science for DRR

- Establishing / strengthening platforms for Knowledge Exchange and Scientific Cooperation
- Strengthening Scientific Capacities for Disaster Risk Reduction
- Making Disaster Risk Reduction a Priority through Policy Recommendations
- Multi Disciplinary Approach: Science & Education
Sendai Framework for Disaster Risk Reduction 2015 - 2030

The citations of ‘Data’ from the Sendai Framework can be summarized in 3 Pillars.

- Pillar 1: The Sendai Framework is promoting open exchange and dissemination (1,2,3,7,10)

- Pillar 2: The Sendai Framework calls for tools and voluntary mechanisms (3,4,8,9) and includes the use of social media (5)

- Pillar 3: The Sendai Framework finally asks for guidance on methodologies and standards for risk assessments, disaster risk modeling and the use of data (6)
Knowledge service

- Knowledge service was put forward in **1990s**.
- **It is a higher-level information service** based on advanced information acquisition, processing, analysis and application technology. **It is a product of knowledge intensive service**, which is a combination of knowledge management, knowledge organization and knowledge market.
The project is hosted by the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences.
Methodology of DRR
Knowledge Services
Function architecture

1. Metadata management and catalog collection
2. Resources construction
3. Services capacity building
4. Knowledge services application

- Metadata standards
- Theme info.
- Organization
- Expert
- Map
- Data

- Earthquake
- Flood
- Draught
- Domestic
- International
1) Metadata Disaster Standard

➢ Metadata packages

Through UML model diagrams and data dictionary to illustrates the Disaster Metadata Standard for Disaster Risk Reduction Knowledge Service System. This standard uses nine packages to describe Disaster Metadata standards.
1) Metadata Disaster Standard

Core Metadata

Core metadata consists of 23 metadata elements and 2 metadata entities.
1) Metadata Disaster Standard

Disaster metadata framework

The disaster metadata framework contains ten subsets, including the metadata entity set information, identifier information, content information, data quality information, restricted information, and dissemination information. The disaster metadata standards are constructed at two levels—disaster core metadata and disaster universe metadata. Overall, the disaster metadata standards consist of 39 entities and 114 elements.
1) Metadata Disaster Standard

➤ Metadata extension
2) DRR scientific data
2）DRR scientific data

- **Pregnant environment**: Basic national conditions database along One Belt One Road area;


- **Flood disaster**: Inversion dataset of chlorophyll-a concentration from 2009 to 2012 in Poyang Lake, China, Dataset of changes in spatial distribution of polders around Dongting Lake, China (1949–2013), et al.

- **Frozen rain and ice disaster**: Southern forest snow and ice damage assessment data set, southern ice and snow disaster intensity data set, et al.

By the end of November 2018, DRR has completed 45 countries’ basic national conditions database along One Belt One and 69 thematic disaster.
Data sets examples:

Global

National

Regional
Metadata and Data Documentation of Scientific Data

Dataset/atlas name (equivalent to resource name in metadata)

I. Dataset/atlas content features
   i. Abstract................................................. 4
   ii. Elements (content fields)............................ 4
   iii. Temporal cover...................................... 5
   iv. Spatial cover........................................ 5

II. Subject/industry scope of dataset/atlas
   i. Subject scope........................................... 5
   ii. Industry scope.......................................... 5
   iii. Other classifications (optional).................... 5

III. Accuracy of dataset/atlas
   i. Time frequency........................................... 5
   ii. Spatial reference, accuracy, and granularity........ 6

IV. Dataset/atlas storage management
   i. Data quantity............................................ 6
   ii. Type format............................................. 6
   iii. Update management.................................... 6

V. Quality control of the dataset/atlas
   i. Production mode....................................... 6
   ii. Data sources (condition selection).................. 6
   iii. Methods of the data acquisition and processing (condition selection).......... 6

VI. Sharing and usage method of the dataset/atlas
   i. Sharing methods and restrictions..................... 7
   ii. Contact information of the sharing service (condition selection)................. 7
   iii. Conditions and methods of usage.................... 7

VII. Intellectual property rights of the dataset/atlas
   i. Property rights (optional)............................. 7
   ii. Reference method of the dataset/atlas................ 7
   iii. Usage contacts of the dataset/atlas................ 8

VIII. Others (optional)...................................... 8
3) DRR Information Extraction from Web Pages

Collected 7500 news reports of global disasters, and extracted the news theme, release time, URL address and webpage text information.
Web information mining for historical disaster events in China from 2015.1 to 2018.3

Earthquake events distribution (2015.1-2018.3)

Meteorology disaster hot spots (2015.1-2018.3)

Flood disaster events distribution (2015.1-2018.3)
It has updated 150 experts metadatas and 170 Institutional metadatas.
5) DRR open resources and Disaster event database

- It has updated 100 open resources and 827 disaster events.
6) DRR thematic knowledge application

http://www.ikcest.org
7) International training

25 training videos have been released.
More than 16 multi-media science popularization works.
9) International training

- Resource & Environment Scientific Data Sharing and Disaster Risk Reduction Knowledge Service for the Belt and Road
From November 21 to 22, 2017, the **First International Workshop for Disaster Risk Reduction Knowledge Service** was convened in Beijing.

http://www.ikcest.org/article-55918.htm
The Second International Workshop for Disaster Risk Reduction Knowledge Service was held on Oct. 20-21, 2018, Beijing, China.

http://drr.ikcest.org/post/1d174
3. DRR Knowledge service applications online
Main functions

- DRR metadata service
- DRR scientific data service
- DRR experts database service
- **DRR knowledge APPlication**
- DRR training service
- DRR popular science service
1) Global Earthquake Daily Distribution Map Service

- Daily update of global seismic data, and the freshness of the data is 100%.
- It has updated 191357 global seismic records.
Earthquake occurrence map from 2000-2015 in BR area
Earthquake occurrence dynamic from 2000-2015 in BRI area
2) Visualization Services of China Historical Disaster Maps

- Continually update of history disaster maps.
- It has scanned and processed 2002 maps of natural disasters in China.
2) Visualization Services of China Historical Disaster Maps
3) Major Organization for Disaster Risk Reduction

- collection of the global disaster risk reduction institutions
- It has added 170 DRR institutions
Facing the urgent disaster relief requirement of Jiuzhaigou earthquake, an earthquake disaster risk reduction thematic knowledge service was launched immediately (in 48 hours).

Related data resources, disaster relief information and disaster risk reduction science popularization knowledge were integrated in the thematic knowledge service.

More than 156 independent IP users visited the service in August.
4) Emergency disaster relief service

- Related data resources, disaster relief information and disaster risk reduction science popularization knowledge were integrated in the thematic knowledge service. Such as: Chinese historical earthquake catalog, Seismic data of Qinghai Tibet Plateau, and so on.
Disaster Risk Reduction Knowledge Services System: Contingency Plan of Knowledge Services (CKS) for Disaster Risk Reduction

1. GENERAL PROVISIONS
   2. THE CONTENT OF THE CKS
      2.1 SCIENTIFIC DATA SERVICE
      2.2 DRR INFORMATION SERVICE
      2.3 POPULAR SCIENTIFIC KNOWLEDGE SERVICE FOR DRR
   3. WORKFLOW OF THE CKS
      3.1 PREPARATION OF THE CONTINGENCY PLAN
      3.2 ORGANIZATION OF THE DRR TEAMS
      3.3 DATA ORGANIZATION AND PROCESSING
      3.4 DEVELOPMENT OF THE CKS THEMATIC WEBSITE
      3.5 DATA UPLOAD AND CHECKING
      3.6 EXTERNAL RELEASE AND PROMOTION VIA APPLICATIONS
      3.7 OPERATIONAL SHIFTS
      3.8 ASSESSMENT AND OVERVIEW
   4. CONDITIONS FOR ACTIVATION AND IMPLEMENTATION TIMING
   5. MAINTENANCE INFORMATION ON THE CONTINGENCY PLAN OF THE CKS

---

Disaster Risk Reduction Knowledge Services System of IKCEST
Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences

September 2017
5) **China and International Experience in Natural Disaster Relief**

- Pictures, videos before or after disaster
- Disaster atlas with spatial reference
- Vector maps can be processed on line
- Carrying capacity evaluation modules
- Rebuilt policy or guidelines after disaster
- Popular science works
- Disaster loss data
**Wenchuan Earthquake**

The 2008 Sichuan earthquake, also known as the First Great Sichuan earthquake or Wenchuan earthquake, occurred at 14:28:01 China Standard Time on May 12, 2008. Measuring at 8.0 Ms the earthquake's epicenter was located 80 kilometres (50 mi) west-northwest of Chengdu, the provincial capital, with a focal depth of 19 km (12 mi). Over 69,000 people lost their lives in the quake, including 68,636 in Sichuan province. 374,176 were reported injured, with 18,222 listed as missing as of May 17. The tremor was felt across the western part of China.

**Zhouqu Debris Flow**

In the early hours of August 8, 2010, a huge mudslide struck the county town of Zhouqu in Gansu province, northwest China. The disaster left 1,765 people dead or missing, in addition to destroying buildings and roads. This is the most serious mountain torrent debris flow disaster since the founding of new China.

**Jiuzhaigou Earthquake**

A 7.0-magnitude earthquake hit Jiuzhaigou county in Southwest China's Sichuan province at 9:19 pm China Standard Time on August 8, 2017, at a depth of 20 kilometers, according to the China Earthquake Networks Center. As of August 14 twenty-five people died and 925 people were injured, lost six, affected 176,492 people (including visitors) and 73,671 people were still transiently housed.

**Cases in South Asia**

In May 2015, India was struck by a severe heat wave. As of 3 June 2015, it has caused the deaths of at least 2,500 people in multiple regions. The heat wave occurred during the Indian dry season, which typically lasts from March to July with peak temperatures in April and May. Although it typically remains hot until late October, Indian monsoons often provide some respite from the heat. The South Indian states of Andhra Pradesh and the neighbouring Telangana, where more than 1,735 and 585 people died respectively, were the areas most affected.

**Kubuqi Desertification**

The Kubuqi Desert is located in Inner Mongolia, on the southern bank of the Yellow River in Erdos, and is the seventh largest desert in China with a total area of 16.8 thousand km². The Kubuqi desert has implemented many key projects for ecological environment construction, including the construction of desert-crossing highway and the straw slope protection technology to lock the flow sand, and has achieved harmony between roads and ecological governance. The dynamic change in desertification in Kubuqi Desert can be observed in the area.

**Da Hinggan Mountains Forest Fire**

Da Hinggan Mountains, Heilongjiang, China, has occurred many forest-fires, because of the vast forest area and complex natural conditions, in the past fifty years. The lives and property of the people and the loss of the country's forest resources are heavy. These fires have caused very serious economic property losses and casualties, and produced a large amount of forest damage area. For example, on May 6, 1987, several forest farms in Da Hinggan Mountains, Heilongjiang Province, started burning.
Wenchuan Earthquake Disaster Relief Knowledge Service

Before disaster

Comparison of images before and after the Wenchuan earthquake

The picture above shows the situation of Dujiangyan before the earthquake, the right picture shows the situation of the same place after the earthquake.

The comparison of aerial remote sensing before and after the Wenchuan earthquake

The picture above shows the situation of Dujiangyan before the earthquake, the right picture shows the situation of the same place after the earthquake.

The scene of rescue before and after the Wenchuan earthquake

The scene of rescue before the earthquake, the right picture shows the situation of the same place after the earthquake.

Rescue in disaster

The picture of Wenchuan after the earthquake disaster

The picture shows the damage of Wenchuan after the earthquake. Released Time: 2008-05-10 Source: site Link: http://tech.sina.com....

Zhougu Debris Flow Relief Knowledge Service

Before disaster

The full view of Zhougu county before mudslide

The picture shows a peaceful Zhougu county before mudslide, which were taken on June 5, 2000. Released Time: 2010-09-09 Source:....

Zhougu county before mudslide

A longitudinal view of Zhougu county in Southwest China's Gansu province before it was flattened by a huge mudslide on Sunday....

Rescue in disaster

The street scene of Zhougu after the mudslide disaster

On August 8, 2010, a massive mudslide hit Zhougu county, Gansu province. The mudslide washed into the county seat and four other villages near the lake, killing at least 14 people and leaving two missing. The mudslide hit at 6:30 a.m. local time (1030 GMT) and sent several thousands of people to flee from the area.

Comparison of images before and after Zhougu mudslide

The left picture shows the sight of a street in Zhougu county, the right picture shows the situation of the same place after the mudslide.

Comparison of the aerial imagery map before and after Zhougu mudslide

The picture above shows the aerial imagery of Zhougu county before the mudslide, the right picture shows the aerial imagery after the mudslide.

Restoration after disaster

Firefighting force for Wenchuan

Firefighters make preparations in Chengdu, Southwest China, before heading for Wenchuan to join the earthquake relief efforts.
6) **Application of Flood Control Knowledge Service in Songliao Basin**

- The **Songliao Basin** is a large terrestrial sedimentary basin surrounded by the Greater Khingan, Lesser Khingan and Changbai mountains in northeast of China. This application shows the related data and information of basic geographic and hydrologic and flood disaster of Jilin Province, Liaoning Province, Heilongjiang province and Mongolia autonomous region.
This knowledge service utilized the Tropical Rainfall Measuring Mission satellite (TRMM) precipitation data to calculate the monthly spatio-temporal distribution of drought in the Belt and Road arable area from 2001 to 2013 based on the Precipitation Abnormality Percentage drought model. This knowledge service expects to provide the results of drought remote sensing monitoring and methods for drought disaster prevention and reduction as well as for agricultural development in the region.
8) Knowledge service of forest freezing, rain and snow disaster prevention and reduction in southern China

- The dataset is produced for the southern snowstorm disaster in early 2008, the specific time of which is from 2008/01/10 to 2008/02/02.
- The dataset covers Anhui, Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi and Zhejiang Province.
Drought is common in the Mongolian Plateau, and it is severe drought in some years. Based on the NOAA AVHRR NDVI-PathFinder 10d remote sensing data of 1981-1999 and MODIS vegetation index and the surface temperature 16d data of 2000-2012, the knowledge service inverted Temperature and Drought Vegetation Index (TVDI) by the Ts-NDVI general space.
Suspended solids concentration is an important parameter to evaluate the quality and environment of water. It has very important significance to get the time-spatial distribution information of suspended solids concentration in lakes for their environmental management based on the remote sensing technology. This application reveals the suspended solids concentration of the lake in annual spring, summer, autumn and winter seasons from year 2000 to 2013.
Poyang Lake is the largest freshwater lake in China, and it plays an important role in flood control regulation and storage and biodiversity protection. Chlorophyll-a concentration level can reflect the status of water primary productivity, and it is also an important indicator of evaluating the eutrophication degree. This application shows chlorophyll-a concentration distribution data of Poyang Lake in January, April, July and October from 2009 to 2012.
Cooperation in the near future
Analysis of the User Log for DRR

Since June 2017, the amount of user visits continue to increase, and form a stable group of international users.

Visiting time

China, USA, Japan, Russia, Canada, Australia, India, Brazil, Europe, South east Asia, Middle east, ……
Cooperation network in domestic and overseas

China

International
Discuss cooperation in the near future

- **Disaster Data Management** course and training
  - Master/Doctor joint education
- **Disaster Risk Reduction Knowledge Service network** for experts, database, application, best practice
- **Joint projects:**
  - OBOR disaster data sharing network
  - OBOR disaster information system/decision support system
  - **OBOR disaster data products or knowledge products**
  - Disaster management standards
  - **Disaster data mining using social media**
  - Disaster data mining using multi sources data (including RS)
  - **SDGs and Sendai Framework oriented research projects**
- .......

Thanks!

http://drr.ikcest.org/