



UNGEONOW 2025
第二届联合国地信周



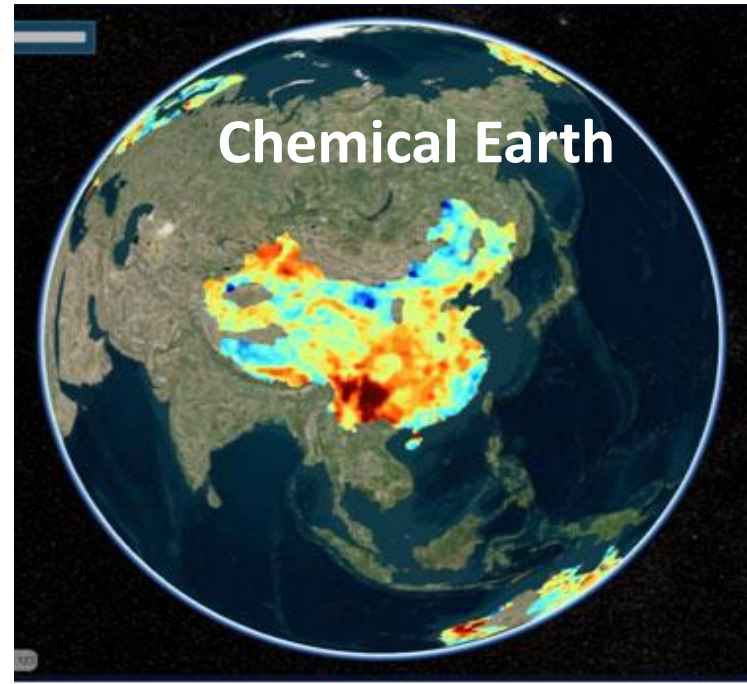
数字 “化学地球” Digital Chemical Earth

王学求

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China Geological Survey

- Global data are critically needed for better understanding of the earth, for solving major issues on global resources and environments, and for harmony between man and nature.
- There are many kinds of digital Earth characterized by physics, such as Google Earth, but digital Earth characterized by chemistry are still in the beginning stage.



背景Background

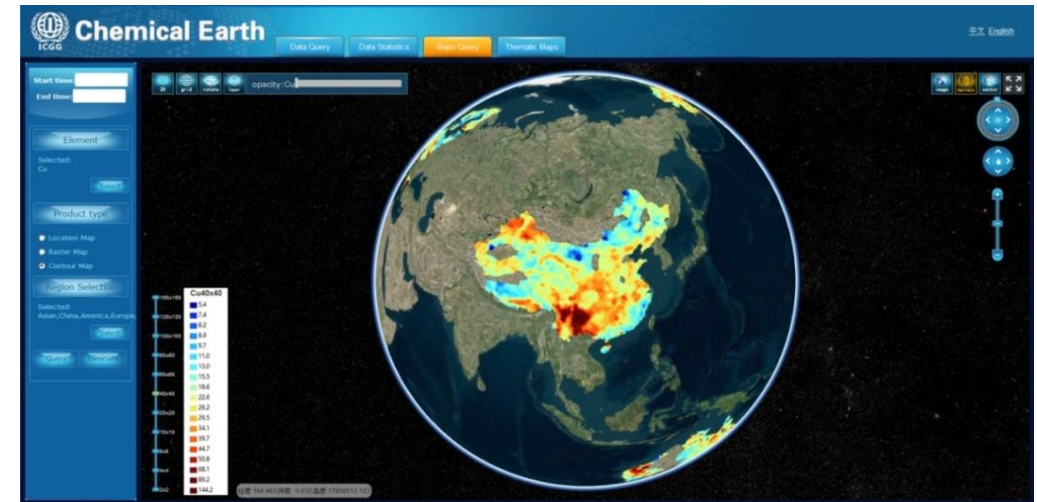
数字化学地球Digital Chemical Earth



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- ◆ **“Chemical Earth”** is a digital Earth presenting data and distribution maps for all naturally occurring chemical elements.
- ◆ The International Big Science Program of “Chemical Earth” initiated by the UNESCO International Centre on Global-scale Geochemistry (ICGG) in 2013.
- ◆ The implementation of “Chemical Earth” was included in the agreement between China government and the UNESCO (resolution 37C/33) in 2023.



背景Background

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The Goal is to create a digital Chemical Earth presenting data and distribution maps of all naturally occurring chemical elements on the Earth by global geochemical observation for sustaining harmonious development of natural resources and environments.

元素周期表(Periodic Table of (Chemical) Elements)																		2 氦 He Helium 4.0026			
1 氢 H Hydrogen 1.0079																					
3 锂 Li Lithium 6.941	4 铍 Be Beryllium 9.012															5 硼 B Boron 10.811	6 碳 C Carbon 12.011	7 氮 N Nitrogen 14.007	8 氧 O Oxygen 15.999	9 氟 F Fluorine 18.998	10 氖 Ne Neon 20.17
11 钠 Na Sodium 22.989	12 镁 Mg Magnesium 24.305															13 铝 Al Aluminum 26.982	14 硅 Si Silicon 28.085	15 磷 P Phosphorus 30.974	16 硫 S Sulfur 32.06	17 氯 Cl Chlorine 35.453	18 氩 Ar Argon 39.94
		碱金属 alkali metals		碱土金属 alkaline-earth metals		镧系元素 lanthanide		锕系元素 actinides		过渡金属 transition metal											
		主族金属 Main group metals		类金属 metalloid		非金属 nonmetal		卤素 halogen		惰性气体 inert gases											
		气体 gas		液体 liquid		固体 solid		合成元素 synthetic element		未知元素 unknown element											
19 钾 K Potassium 39.098	20 钙 Ca Calcium 40.08	21 钪 Sc Scandium 44.956	22 钛 Ti Titanium 47.9	23 钒 V Vanadium 50.9415	24 铬 Cr Chromium 51.996	25 锰 Mn Manganese 54.938	26 铁 Fe Iron 55.84	27 钴 Co Cobalt 58.9332	28 镍 Ni Nickel 58.69	29 铜 Cu Copper 63.54	30 锌 Zn Zinc 65.38	31 镓 Ga Gallium 69.72	32 锗 Ge Germanium 72.5	33 砷 As Arsenic 74.922	34 硒 Se Selenium 78.9	35 溴 Br Bromine 79.904	36 氪 Kr Krypton 83.8				
37 铷 Rb Rubidium 85.467	38 锶 Sr Strontium 87.62	39 钇 Y Yttrium 88.906	40 锆 Zr Zirconium 91.22	41 铌 Nb Niobium 92.9064	42 钼 Mo Molybdenum 95.94	43 锝 Tc Technetium 99	44 钌 Ru Ruthenium 101.07	45 铑 Rh Rhodium 102.906	46 钯 Pd Palladium 106.42	47 银 Ag Silver 107.868	48 镉 Cd Cadmium 112.41	49 铟 In Indium 114.82	50 锡 Sn Tin 118.6	51 锑 Sb Antimony 121.7	52 碲 Te Tellurium 127.5	53 碘 I Iodine 126.905	54 氙 Xe Xenon 131.3				
55 铯 Cs Cesium 132.905	56 钡 Ba Barium 137.33	57 镧 La Lanthanum 138.905	71 镱 Lu Lutetium 174.96	72 铪 Hf Hafnium 178.4	73 钽 Ta Tantalum 180.947	74 钨 W Tungsten 183.8	75 铼 Re Rhenium 186.207	76 锇 Os Osmium 190.2	77 铱 Ir Iridium 192.2	78 铂 Pt Platinum 195.08	79 金 Au Gold 196.967	80 汞 Hg Mercury 200.5	81 铊 Tl Thallium 204.3	82 铅 Pb Lead 207.2	83 铋 Bi Bismuth 208.98	84 钋 Po Polonium (209)	85 砹 At Astatine (210)				
87 钫 Fr Francium (223)	88 镭 Ra Radium (226)	Lawrencium (260)		Dubnium (262)		Seaborgium (263)		Bohrium (264)		Hassium (265)		Meitnerium (266)		Darmstadtium (267)		Roentgenium (268)					
																unknown					
镧系 Lanthanide (Lanthanoids)		57 镧 La Lanthanum 138.905	58 铈 Ce Cerium 140.12	59 镨 Pr Praseodymium 140.91	60 钕 Nd Neodymium 144.2	61 钷 Pm Promethium 147	62 钐 Sm Samarium 150.4	63 铕 Eu Europium 151.96	64 钆 Gd Gadolinium 157.25	65 铽 Tb Terbium 158.93	66 镱 Dy Dysprosium 162.5	67 钬 Ho Holmium 164.93	68 铒 Er Erbium 167.2	69 钪 Tm Thulium 168.934	70 镱 Yb Ytterbium 173.0						
锕系 Actinides		Actinium 227.03	Thorium 232.04	Protactinium 231.04	Uranium 238.03	Neptunium 237.05	Plutonium 244	Americium 243	Curium 247	Berkelium 247	Californium 251	Einsteinium 254	Fermium 257	Mendelevium 258	Nobelium 259						



1. **Creation of Global Geochemical Baselines Networks for each grid of 80kmx80km. The database accompanying spatial maps can be used to establish a current geochemical baseline against which future human-induced or natural changes to the chemistry of the land surface may be recognised or quantified.**
2. **Creation of China Geochemical Observation Networks for Monitoring Chemical Changes induced by anthropogenic emission or natural process**
3. **Creation of digital Chemical Earth platform allowing anyone to access vast amounts of geochemical data and maps through the Internet**
4. **Assessment endowments of global mineral resources based on data**
5. **Environmental risk and green farmland assessment based on baselines data.**
6. **Exploration for knowledge of global changes induced by carbon spatiotemporal distribution and circles, and of major historic geological events, such as extinction based on trace elements.**

进展Progress

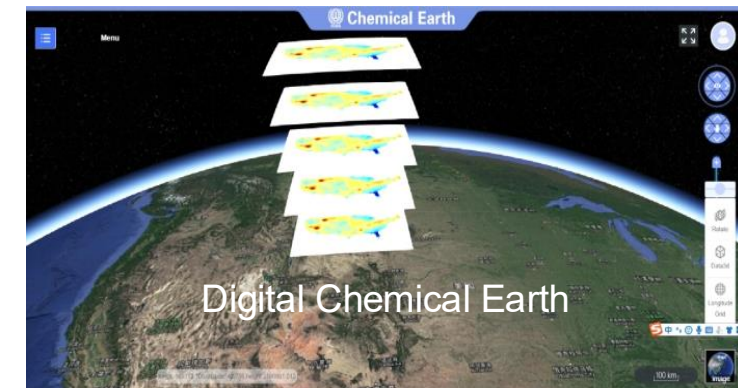
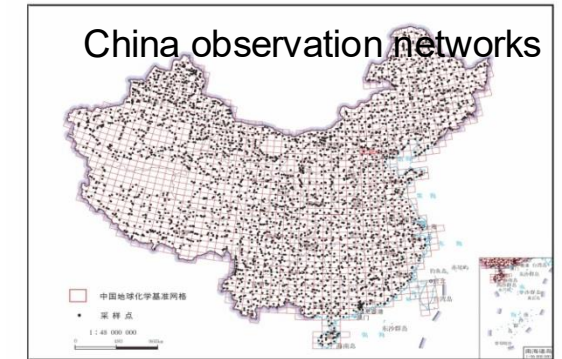
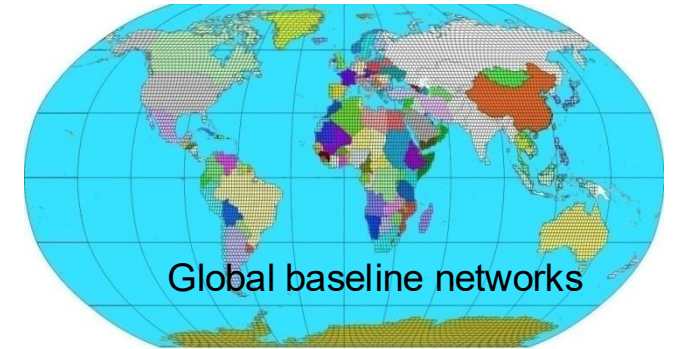
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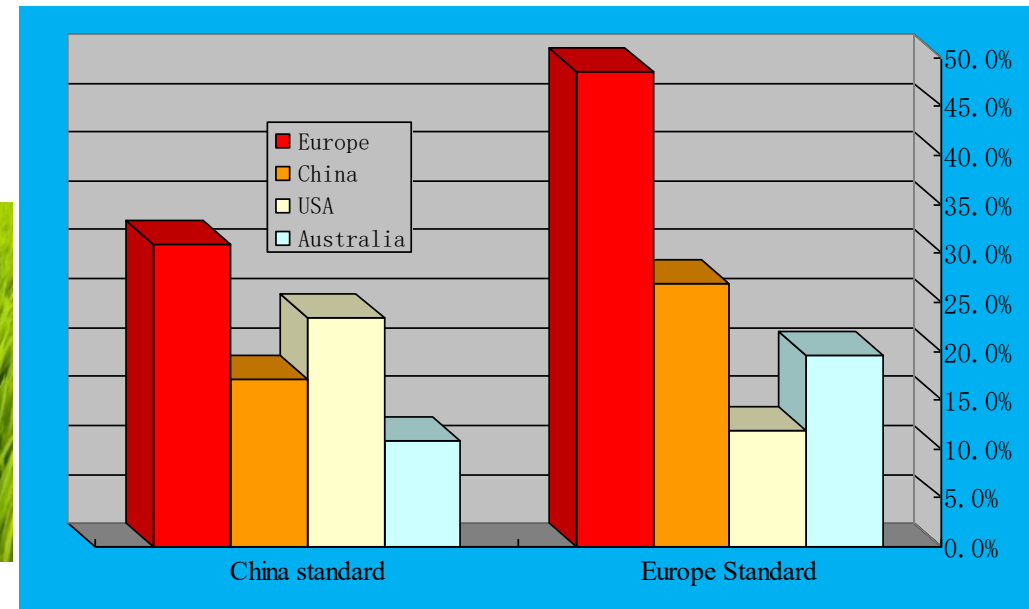
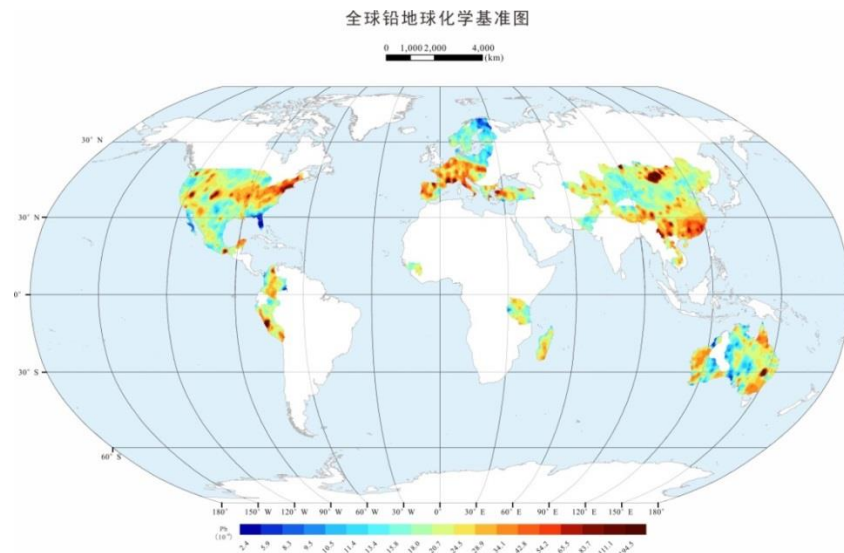


- ◆ 1. Created an International cooperation network with 42 countries
- ◆ 2. Global Geochemical Baselines covered approx. 1/3 of the land of the Earth, with 62-76 chemical elements.
- ◆ 3. China Geochemical Observation Networks completed 3-round observations with 81 chemical parameters.
- ◆ 4. Geochemical Mapping for Green Food Producing Areas: completion of 1 county with 391 villages and 5 farms.
- ◆ 5. Creation of digital Chemical Earth: 37TB with 62-76 elements (www.globalgeochemistry.com)



1. Application of Global Geochemical Baselines Data for the global risk assessment of toxic metals in soils

- ◆ The area with toxic metals (Cd, Hg, As, Sb, Pb, Zn, Cu, Ni) exceeding the safe risk limits of soils is 30.9%, 23.5%, 17.1%, and 10.9% in Europe, USA, China, and Australia respectively according to China Soil Risk Standard (GB 15618-1995), higher percentage in Europe according to Europe Standard (EU 2002, Anita, et al., 2010).
- ◆ The highest proportion of toxic metals exceeding the risk limit may be due to, as least in part, the long industrial history of Europe.

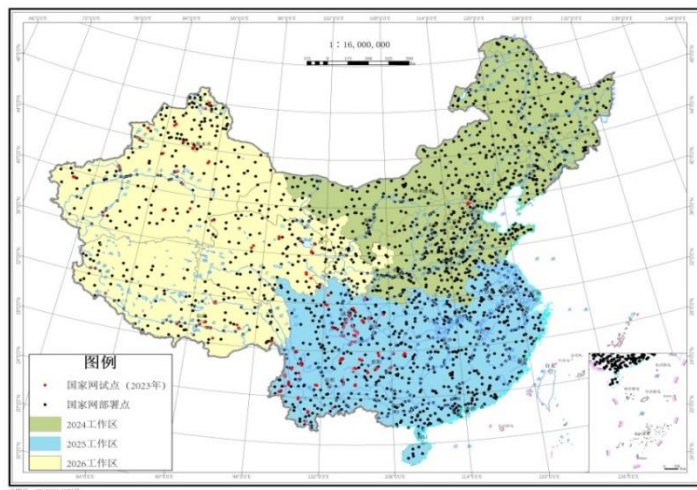


2. Soil Risk Results from China Geochemical Observation Networks

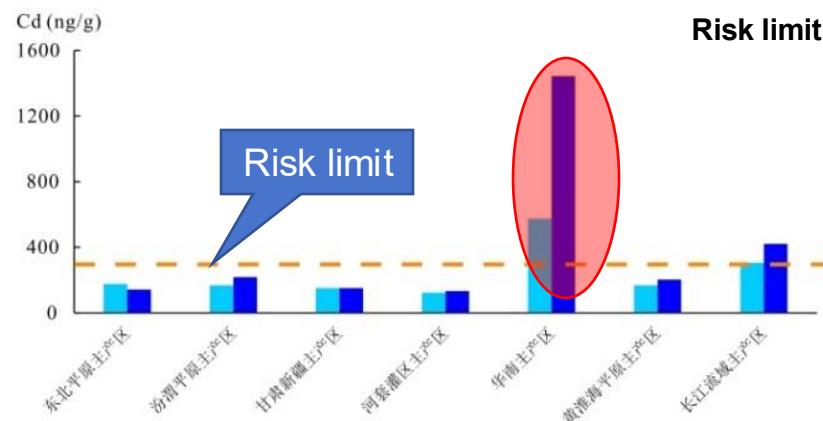
Comparing the 3-round observation data for toxic metals of As, Cd, Cr, Cu, Hg, Ni, Pb and Zn in 2000, 2010, and 2020 throughout China, the results shows that:

- ◆The areas exceeding the risk limits mainly occur in the Southwestern China where rocks contains high concentrations of base metals and at lower reaches of the Pearl River of southern China where the largest industrial region is located in China.
- ◆The 7 major grain producing areas: the concentrations of the toxic metals are generally under the risk limits except Cd exceeding the risk limit in the southern grain producing area.
- ◆The mining and industrials areas: the concentrations decreased from 2000 to 2020 in western mining and industrial areas.
- ◆The metropolis areas: the concentrations of toxic metals slightly increased in eastern China from 2000 to 2020.

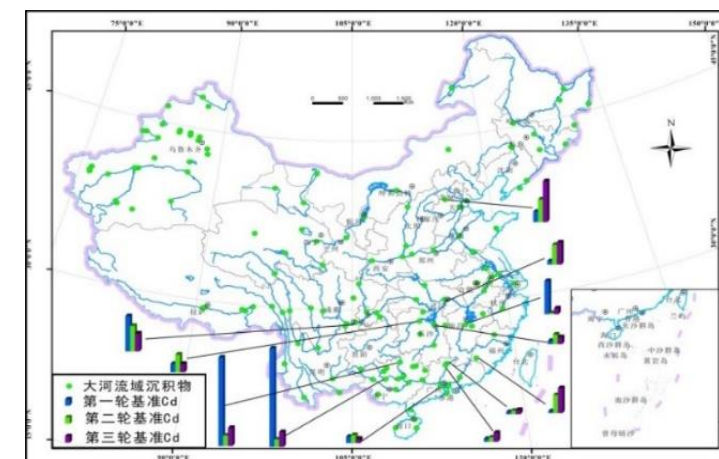
China Geochemical Observation Networks with sample locations



Concentration median of Cd in the major grain producing areas in China



The changes of toxic metals in typical observation locations



应用Application

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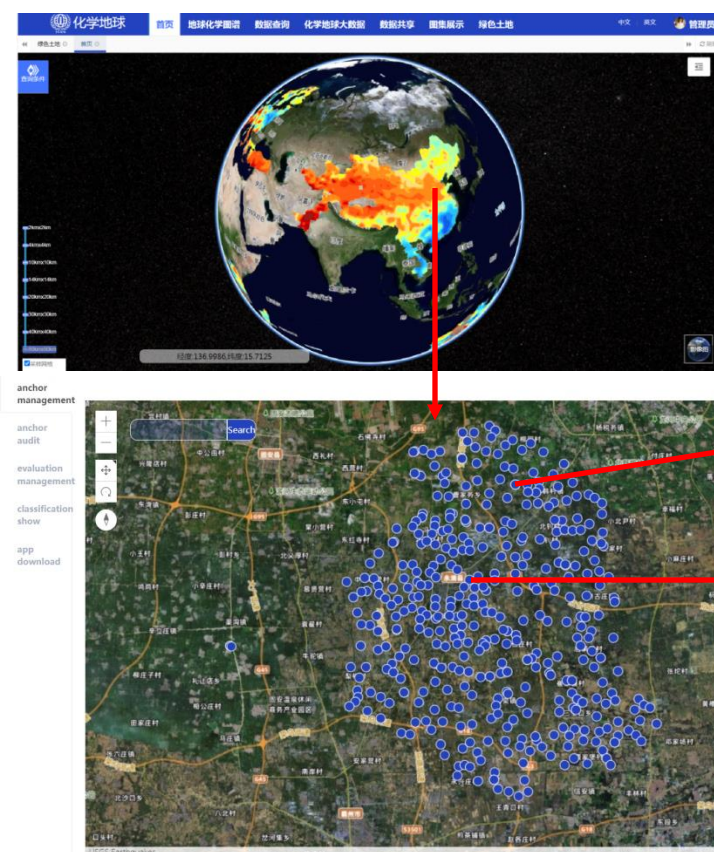
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3. Green farmland identification using QR code

Green farmland was certified to give a green color QR code allowing anyone to query the data through the website and mobile phone.

Greenland QR Code for each village farmland of Yongqing, Hebei Province



北岔口村农田

河北省永清县永清镇北岔口村

土壤采样编号: YQ091

水质采样编号: -

地点: 河北省永清县永清镇北岔口村

二维码:



Certification for greenland (NY391)
UNESCO ICGG
Key Laboratory of Geochemistry, MNR



艳芬农场

永清县艳芬家庭农场

土壤采样编号: YQ255

水质采样编号: -

地点: 永清县艳芬家庭农场

二维码:



Certification for greenland (NY391)
UNESCO ICGG
Key Laboratory of Geochemistry, MNR

Mobile phone



Chakou village,
Yongqing, Hebei
No: 47

Long.: 116° 25'54"

Lat.: 39° 19'39"

pH: 8.5

Beneficial

elements(ppm):

(N)852,(P)1097,(K₂O)
22700

Toxic metals(ppm):

(Cu)19.7,

(Pb)18.6,(Zn)60.7,(Ni)

24.5,(Cr)61.5,(Cd)0.12

,(As)8.35,(Hg)31

Others:(Se)0.14,(F)45

9,(I)3.65

meet the standards
for Green Food
Producing

- **1. Coverage of 33% world' s land surface**
- **Develop more state partners to further establish an international cooperation network**
- **2. Standardization of methods**

The methods improved to suitable for world' s diverse terrains

- **3. Big Data Application in sustainable development**

Environment and health

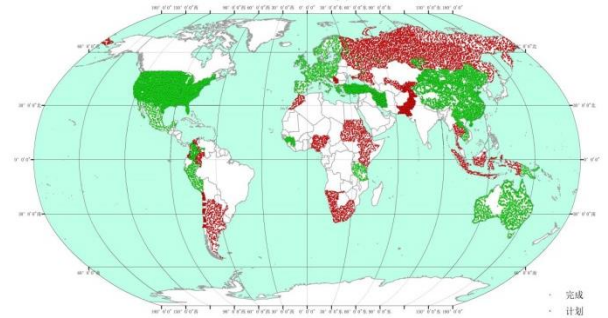
Land use and improvement of the agricultural output

Global change

Mineral resources

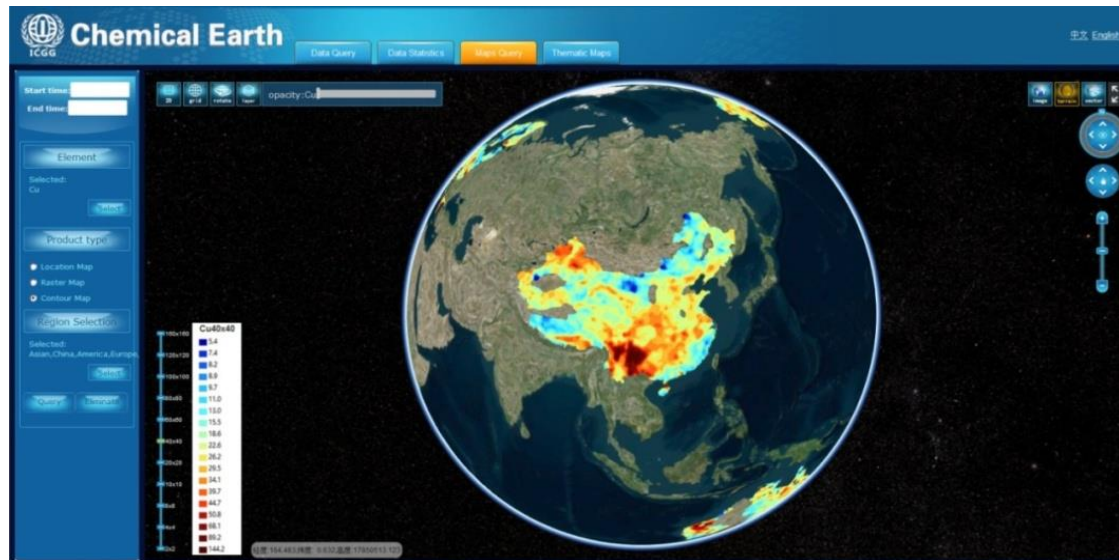
- **4. training to support the developing countries**

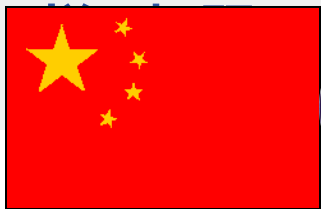
provide digital Chemical Earth knowledge and technical assistance to developing countries



We still have a long way to go, though a big step closer to our dream of a digital
Chemical Earth

All countries or scientists are welcome to participation in the Program.

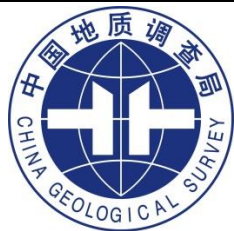




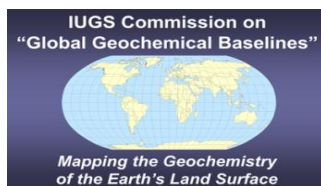
Ministry of Natural Resources



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China Geological Survey



谢谢Thanks



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