Institute of Remote Sensing and Digital Earth
Chinese Academy of Sciences

Application of remote sensing for agricultural disasters

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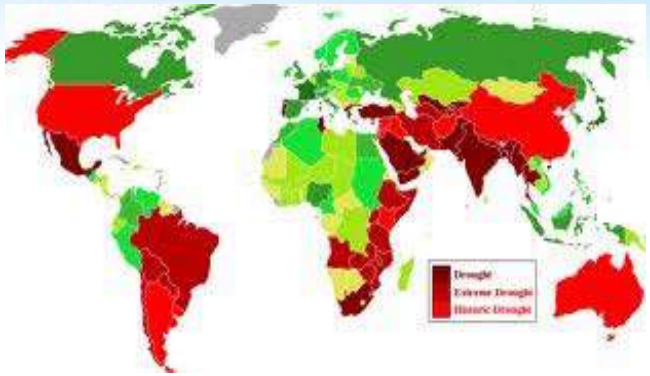
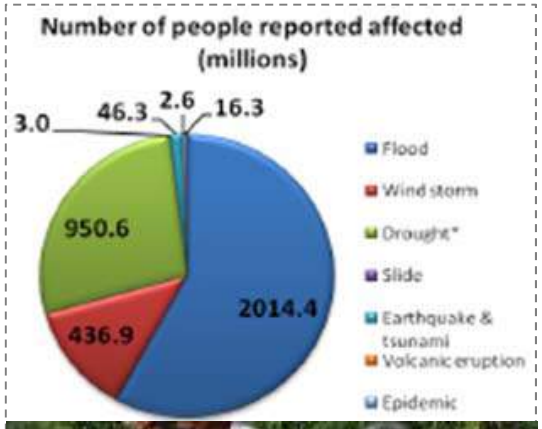
Background

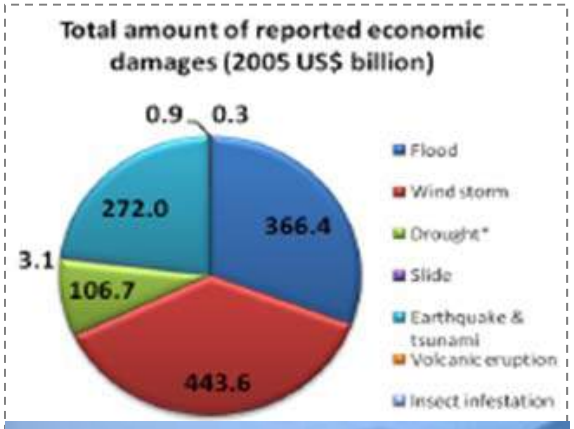
- Disasters have happened in most areas of globe.
- Global disaster affects more people and brings out large economic damages, environment changes and so on.

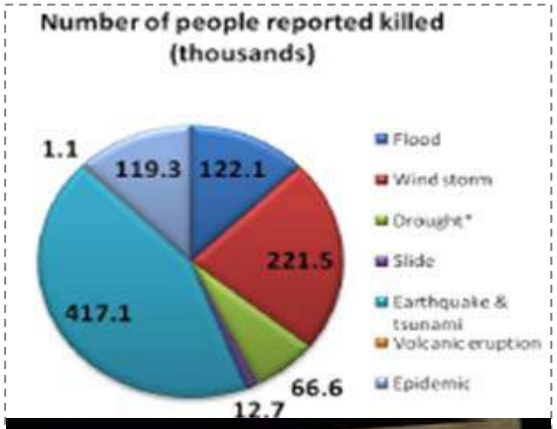


(source:unitedcats.wordpress.com)

Source: UN-ISDR (International Strategy for Disaster Reduction) – Period 1991-2005







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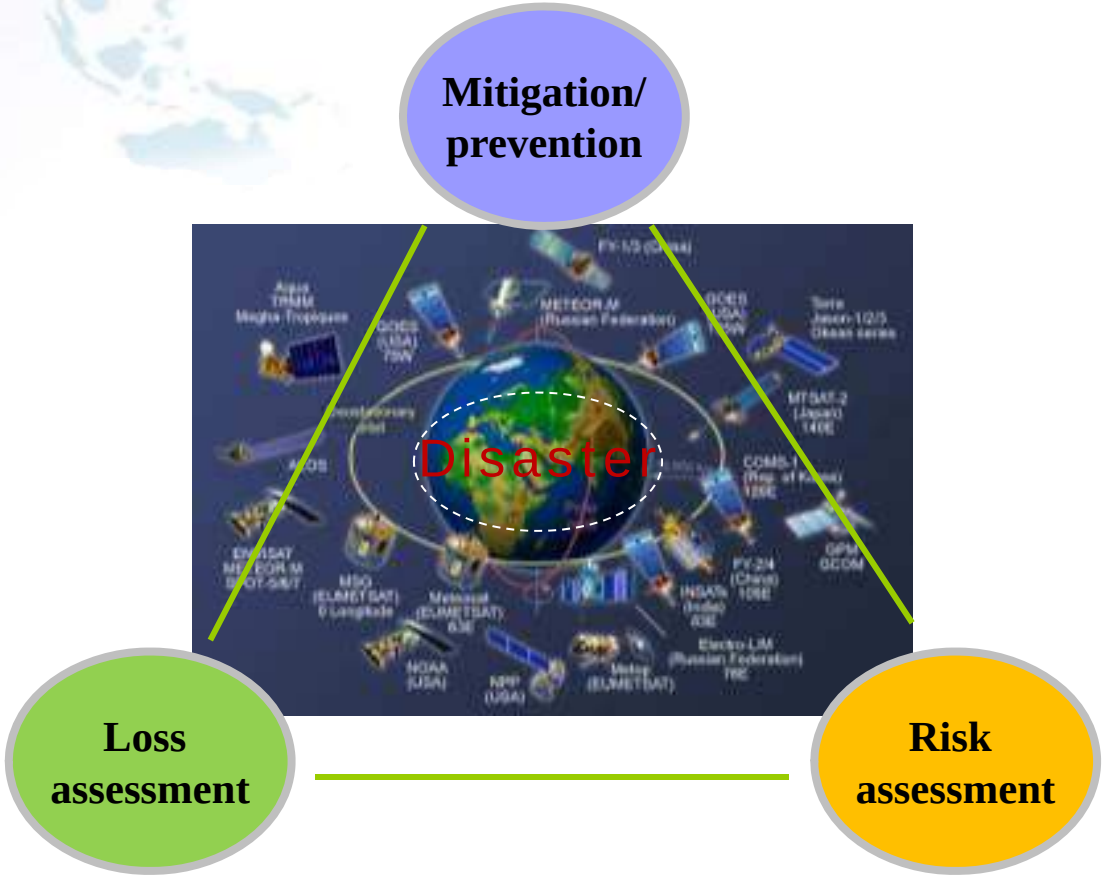


- Near real-time observation for current disaster movement;
- Obtaining information pre-disaster and post-disaster(extent, severity, duration, and so on).
- Long-term disaster related parameters for risk assessment and decision-making.
- Remote sensing-based disaster information monitoring loss assessment for disaster mitigation(later mentioned).

Outline

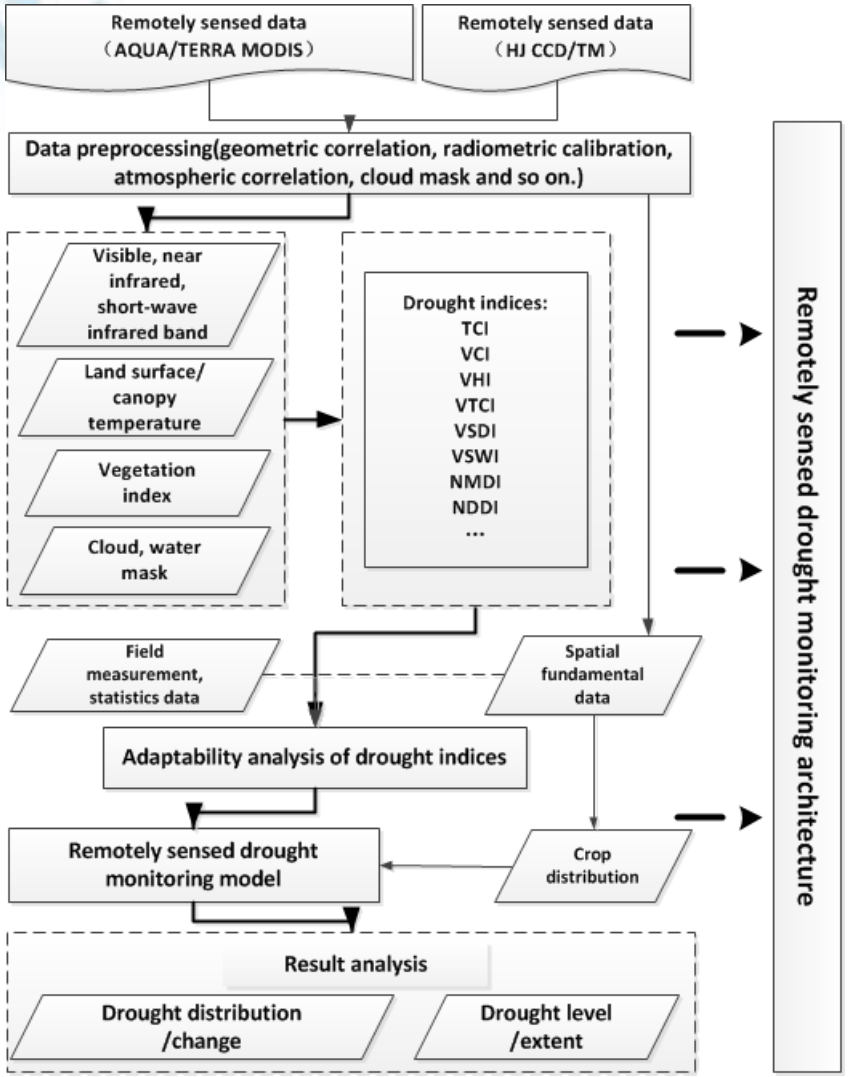
- Agricultural drought monitoring in Asia-Pacific
  - Mongolia
  - Sri Lanka
  - Cambodia
  - Other countries
- Assessment of agricultural disaster loss
- Agricultural disaster insurance
- Prospective

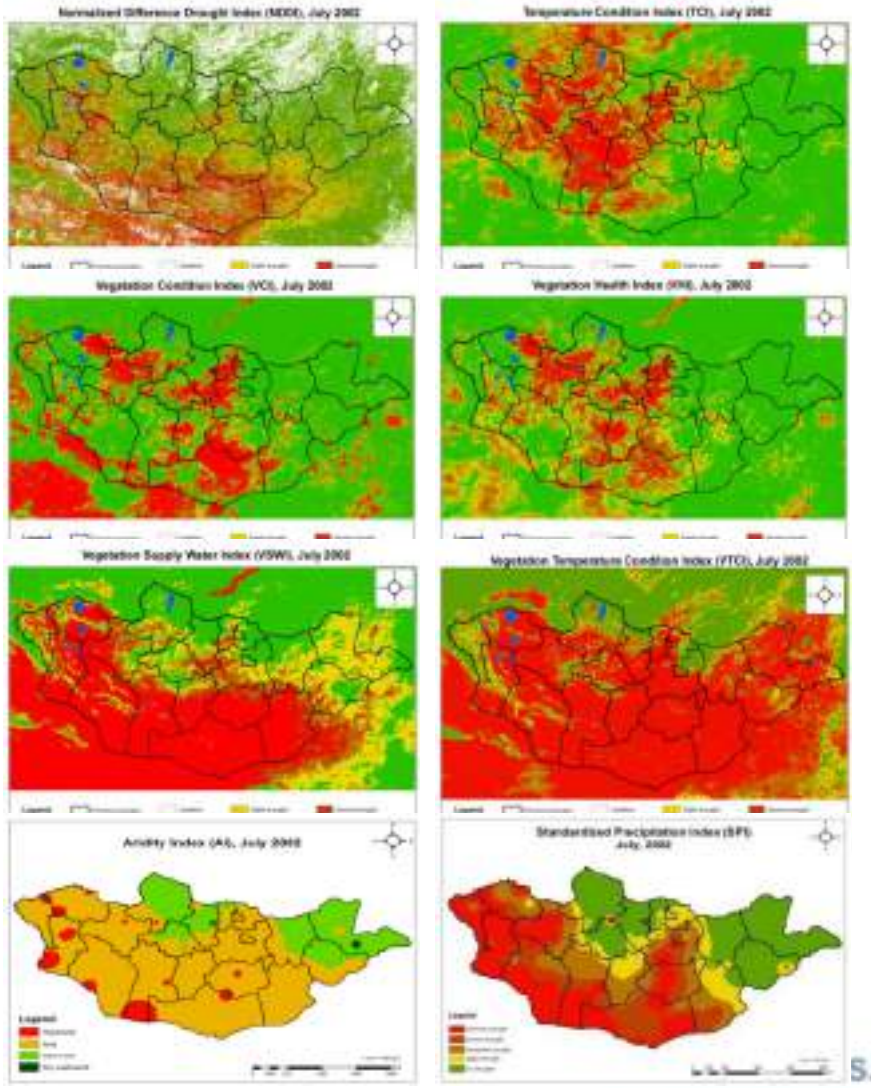
Drought monitoring for Mongolia

- Fact finding and requirement analysis
- Field data collection and assessment
- Satellite resources analysis and model development
- Field work plan and model validation
- Database and DroughtWatch system customization
- Capacity building: data processing, field work, model and system training (2014.2.17-4.15, 2014.11-12 ，2015.7-8,2015.10-11, 2016.7-8, 2016.7-8)

Model for Mongolia

Flowchart of Drought monitoring in Mongolia and drought products





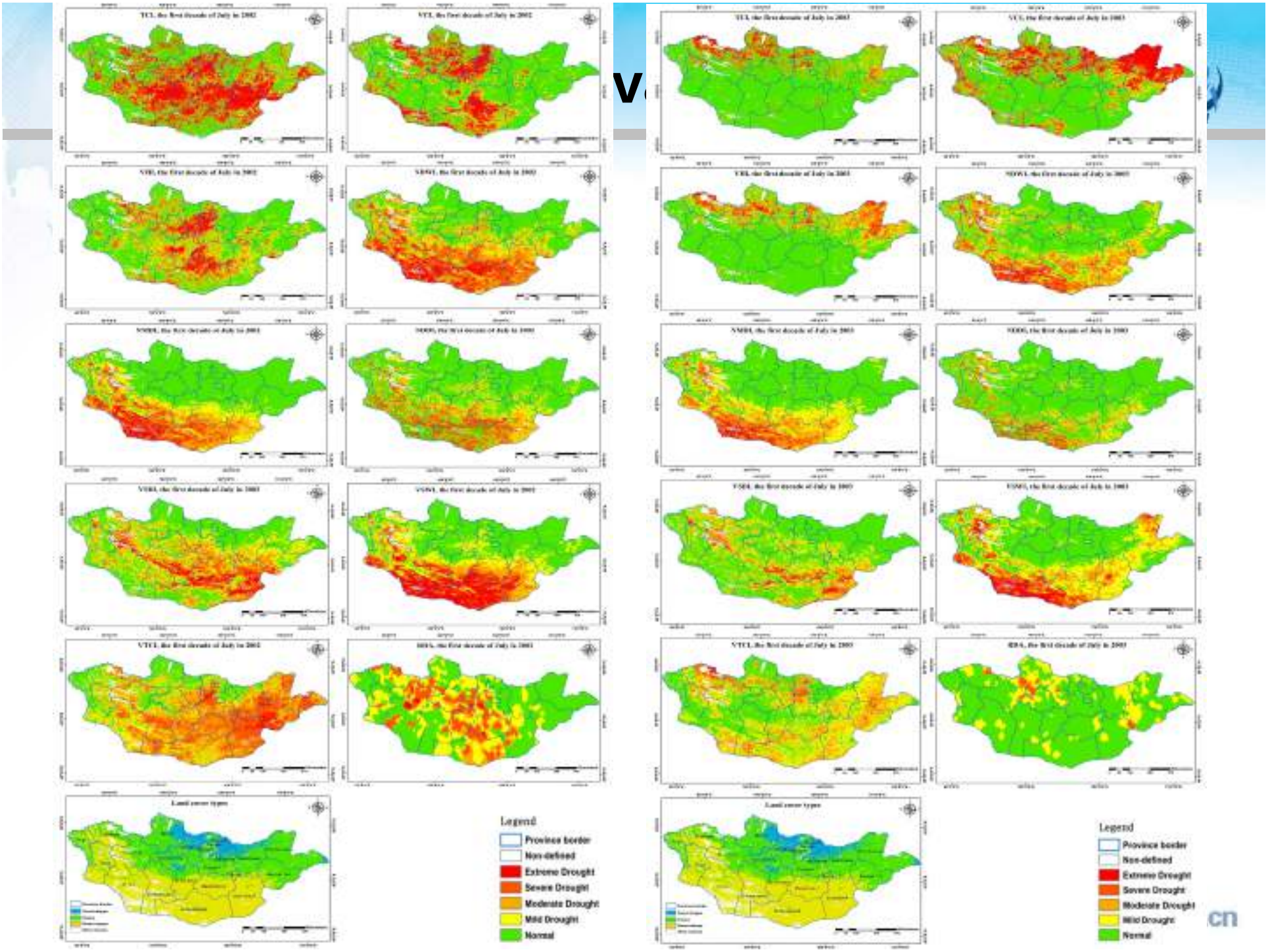
Results validation

R of the NorBio and RS-derived drought indices in three land-cover types across stations (at a 99% confidence level)

RS-Derived Indices	Forest Steppe	Steppe	Desert Steppe
TCI	0.70/0.04/0.43/0.19	0.80/0.09/0.45/0.21	−0.46/0.73/0.23/0.30
VCI	**0.83/0.35/0.64/0.16**	**0.94/0.12/0.57/0.16**	**0.92/0.28/0.67/0.15**
VHI	**0.87/0.30/0.62/0.17**	**0.94/0.38/0.60/0.14**	0.82/0.32/0.59/0.16
NDWI	**0.92/0.48/0.70/0.14**	**0.95/0.15/0.61/0.17**	**0.86/0.08/0.48/0.20**
NDDI	−0.81/0.14/−0.57/0.17	−0.80/−0.08/−0.50/0.19	−0.57/0.11/−0.33/0.17
VSWI	−0.78/0.38/−0.59/0.14	−0.88/−0.33/−0.59/0.14	**−0.83/−0.26/−0.60/0.12**
VTCI	0.61/−0.21/0.32/0.22	0.72/−0.32/0.31/0.25	0.68/−0.76/0.05/0.34
VSDI	0.49/−0.48/−0.08/0.25	0.73/−0.56/0.02/0.33	0.82/−0.70/−0.05/0.38
NMDI	0.69/0.00/0.39/0.22	−0.70/0.67/−0.16/0.38	−0.79/0.05/−0.36/0.23

R of soil moisture at a depth of 10 cm and the RS-derived indices in the three land-cover types across stations (at a 99% confidence level)

RS-Derived Indices	Forest Steppe	Steppe	Desert Steppe
TCI	**0.58/0.03/0.36/0.16**	0.63/0.05/0.39/0.15	0.49/0.13/0.32/0.13
VCI	0.17/0.13/0.08/0.10	0.49/0.10/0.24/0.13	**0.58/0.35/0.43/0.08**
VHI	**0.42/0.10/0.32/0.13**	**0.67/0.10/0.40/0.15**	**0.61/0.37/0.48/0.08**
NDWI	0.29/0.06/0.17/0.13	**0.69/0.02/0.26/0.17**	0.43/0.08/0.22/0.34
NDDI	−0.32/0.00/−0.18/0.10	−0.62/−0.10/−0.19/0.17	−0.19/0.00/−0.10/0.07
VSWI	−0.37/0.00/−0.28/0.12	**−0.65/0.00/−0.38/0.14**	**−0.58/−0.40/−0.48/0.07**
VTCI	**0.51/0.00/0.29/0.14**	0.60/0.00/0.33/0.14	0.47/0.03/0.25/0.17
VSDI	0.32/0.01/0.11/0.17	0.43/0.03/0.25/0.16	0.54/0.02/0.19/0.27
NMDI	−0.29/0.00/0.02/0.25	−0.39/0.00/−0.06/0.16	−0.49/0.00/−0.26/0.25

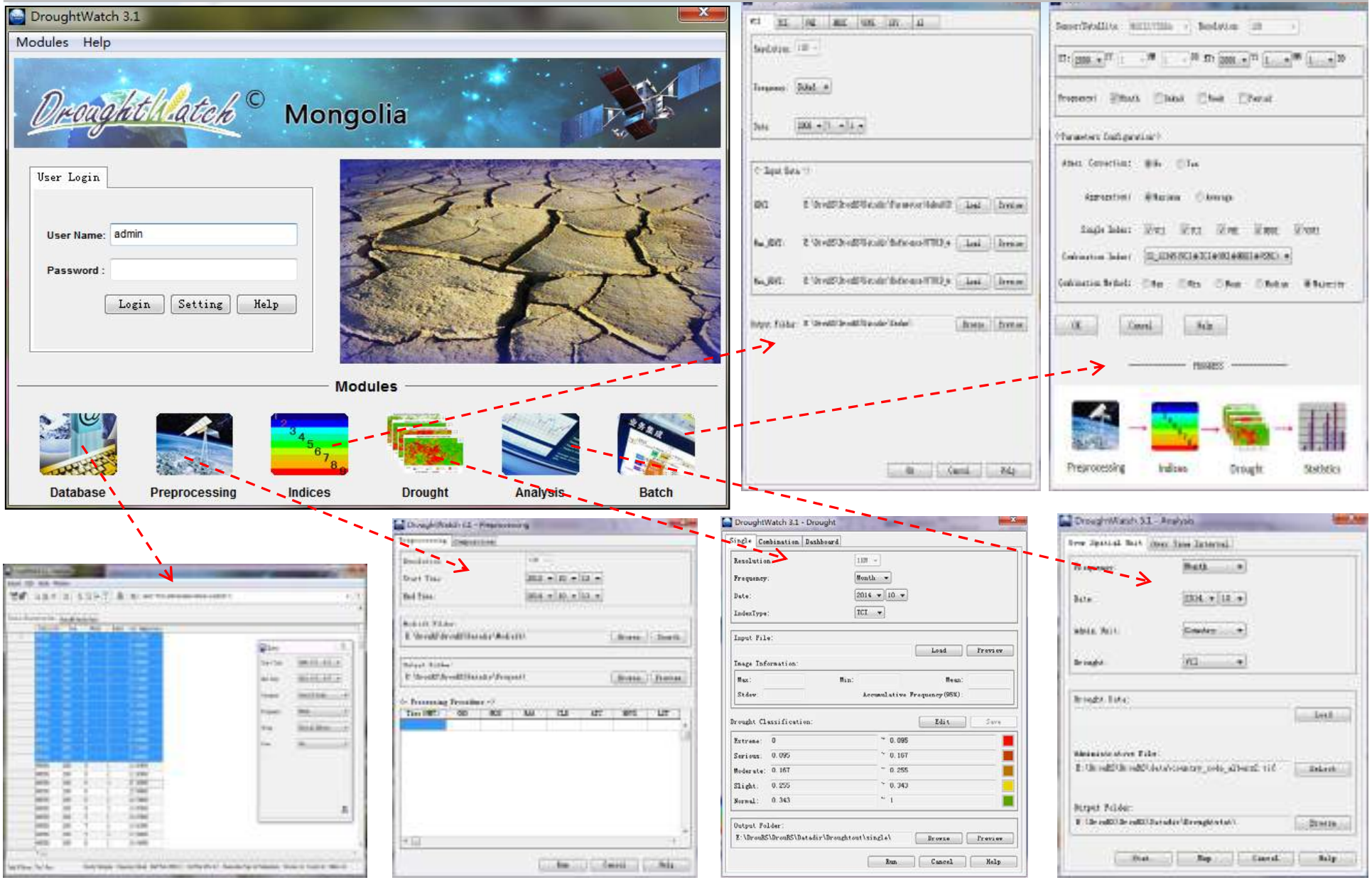

Legend
Province border
Non-defined
Extreme Drought
Severe Drought
Moderate Drought
Mild Drought
Normal
Land cover types
Legend
Province border
Non-defined
Extreme Drought
Severe Drought
Moderate Drought
Mild Drought
Normal

System for Mongolia

- **Data management**
  (in-situ, statistics, Geotiff etc.)
- **Data preprocessing**
  (RS data processing, composition)
- **Indices calculation**
- **Drought monitoring**
  (by single index and combination indices, dashboard)
- **Statistics and analysis**
  (over the spatial, over time interval)
- **Batch for the whole procedure**

- ***DroughtWatch3.1(English+Chinese)***

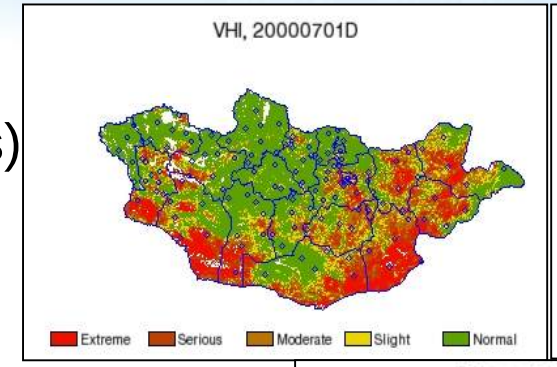
Main interface for Mongolia

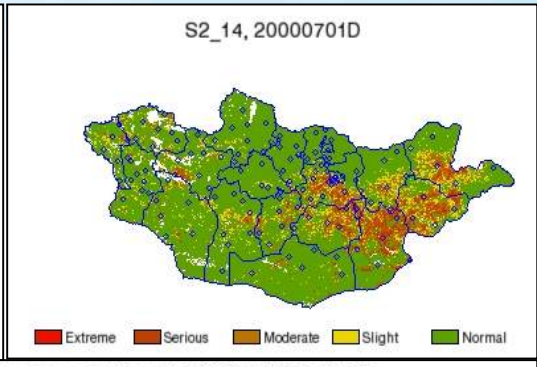


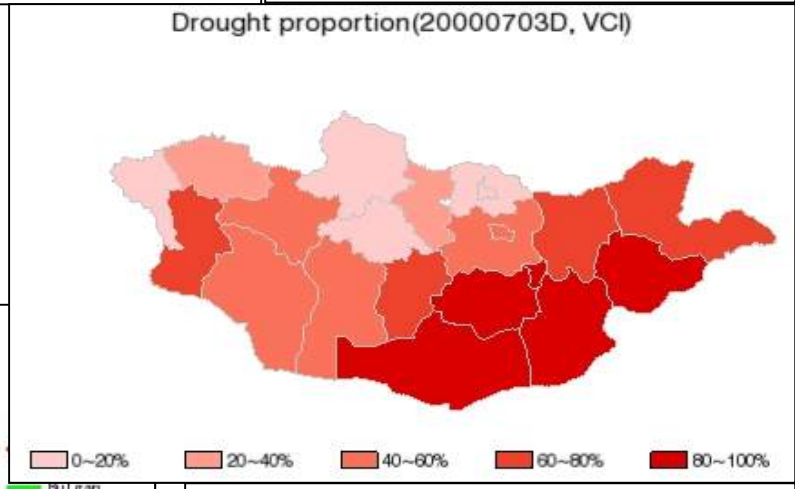
Output products

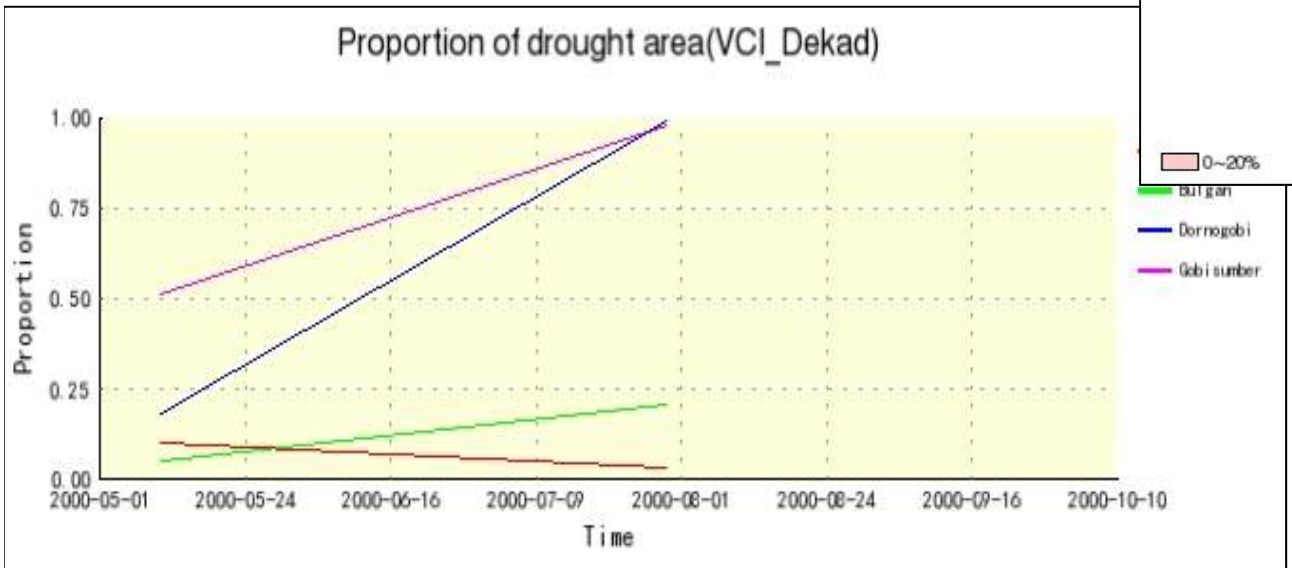
Products Forms(database, tables, files, maps, charts, graphs)

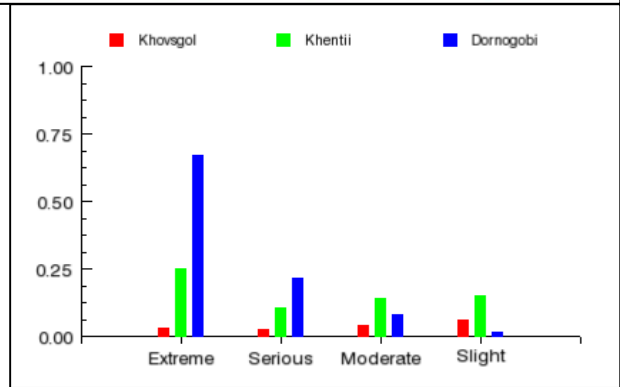
- Drought map and comparison results
- Spatial distribution maps
- Time change charts
- Drought classification graphs











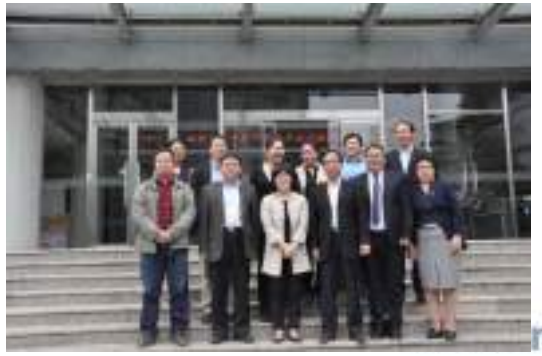
Training and workshop for Mongolia

Cooperative field campaign from 27 July to 5 August of 2015 had been carried out in the large region covering main steppe type of north Mongolia.

The latest version of drought monitoring system (DroughtWatch3.1) had been **installed and deployed** in Mongolia.

January of 2015, hand-on **training** meeting for two Mongolians about two weeks, later hand-on training meeting for two Mongolians about one month, the Chinese experts offered methodology and experiences about drought model validation.

February of 2014, **Workshop** on the Technology Service for Mongolia under the Cooperation Mechanism of Drought Monitoring for the Asia-Pacific regions



Training and workshop for Mongolia

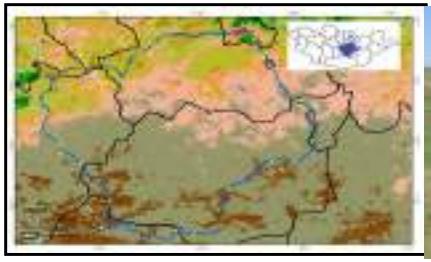
Field campaign: 23 July to 09 August, 2016; three Chinese specialists and six Mongolian specialists.





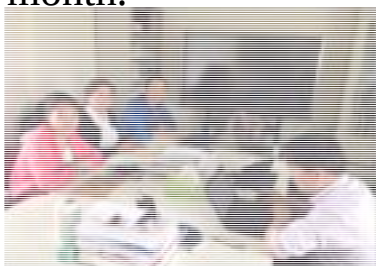
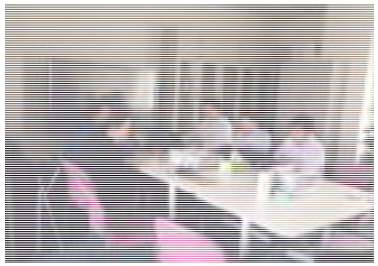
Validation training: 25 November-24 December, 2016; two specialists from Mongolia for 1 month.


Field campaign: 24 July to 11 August, 2017; three Chinese specialists and five Mongolian specialists.





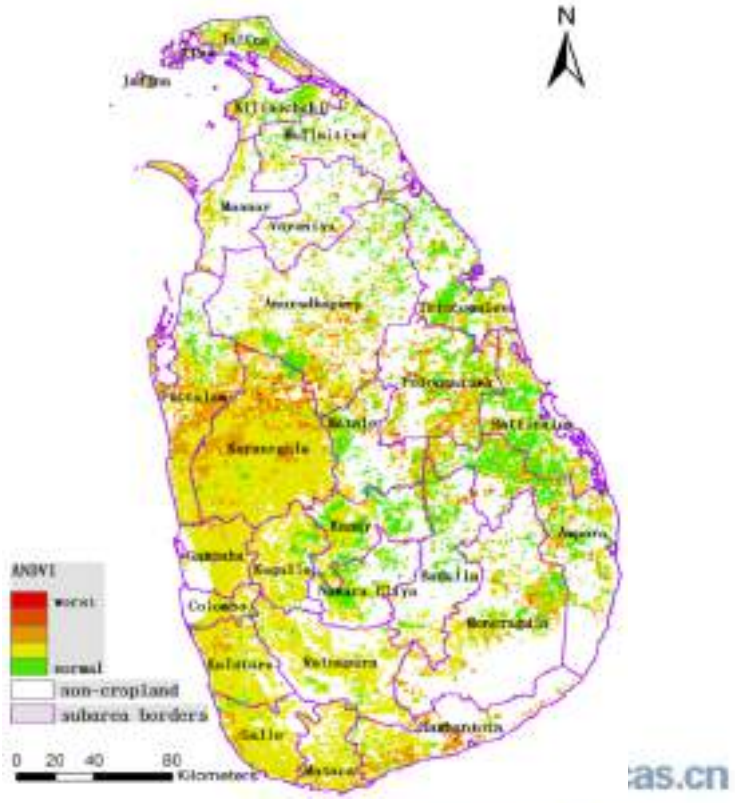
Revalidation training: 20 March to 16 April, 2017; three specialists from Mongolia for 1 month.

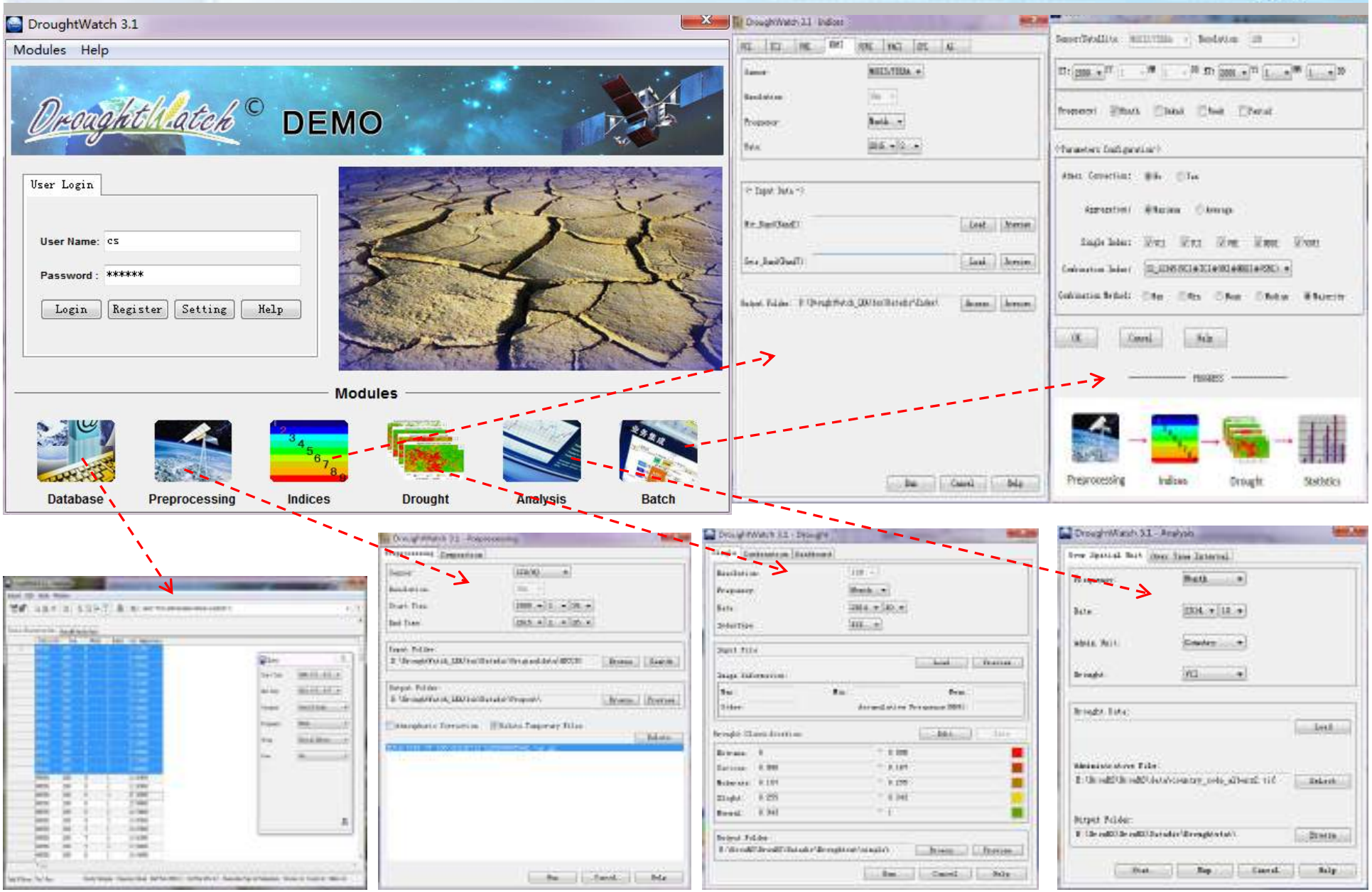
Drought monitoring for Sri Lanka

- ESCAP Regional Cooperative Mechanism for Drought Monitoring and Early Warning in Asia and the Pacific. Feb 17-22, 2014
- Drought monitoring results for March-April,2014
- Technology transfer: DroughtWatch system customization and technical training. Feb2015,April; 27-30,2016

Arthur C Clarke Institute for Modern Technologies



Main interface for Sri Lanka



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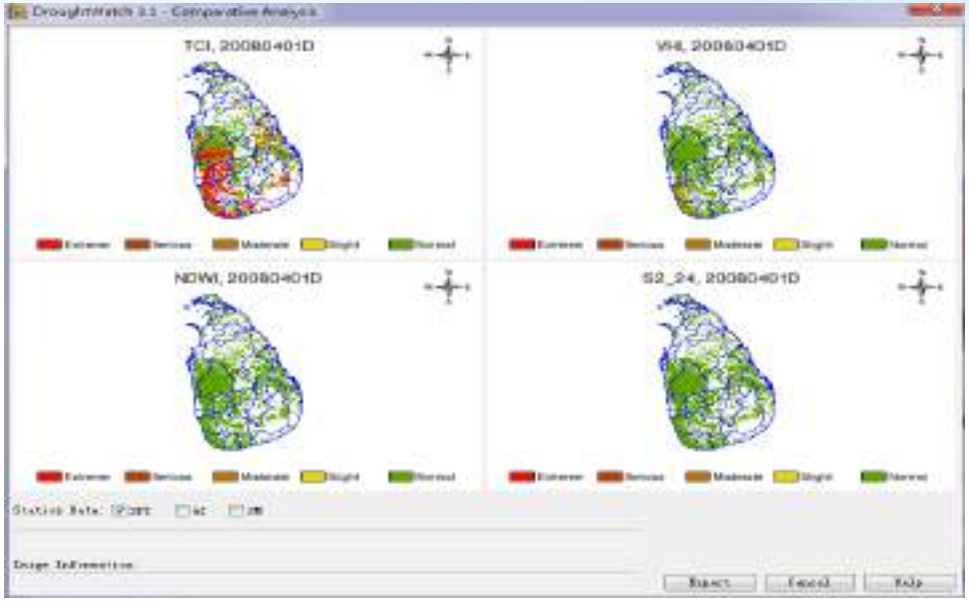
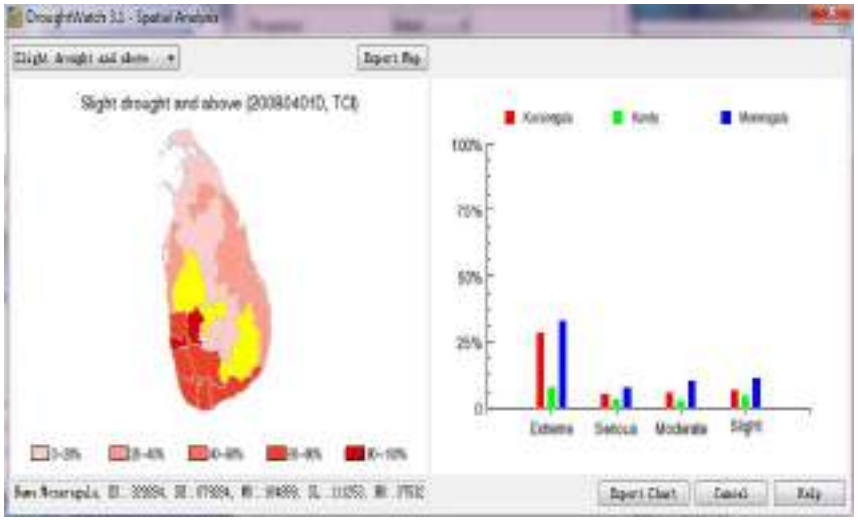
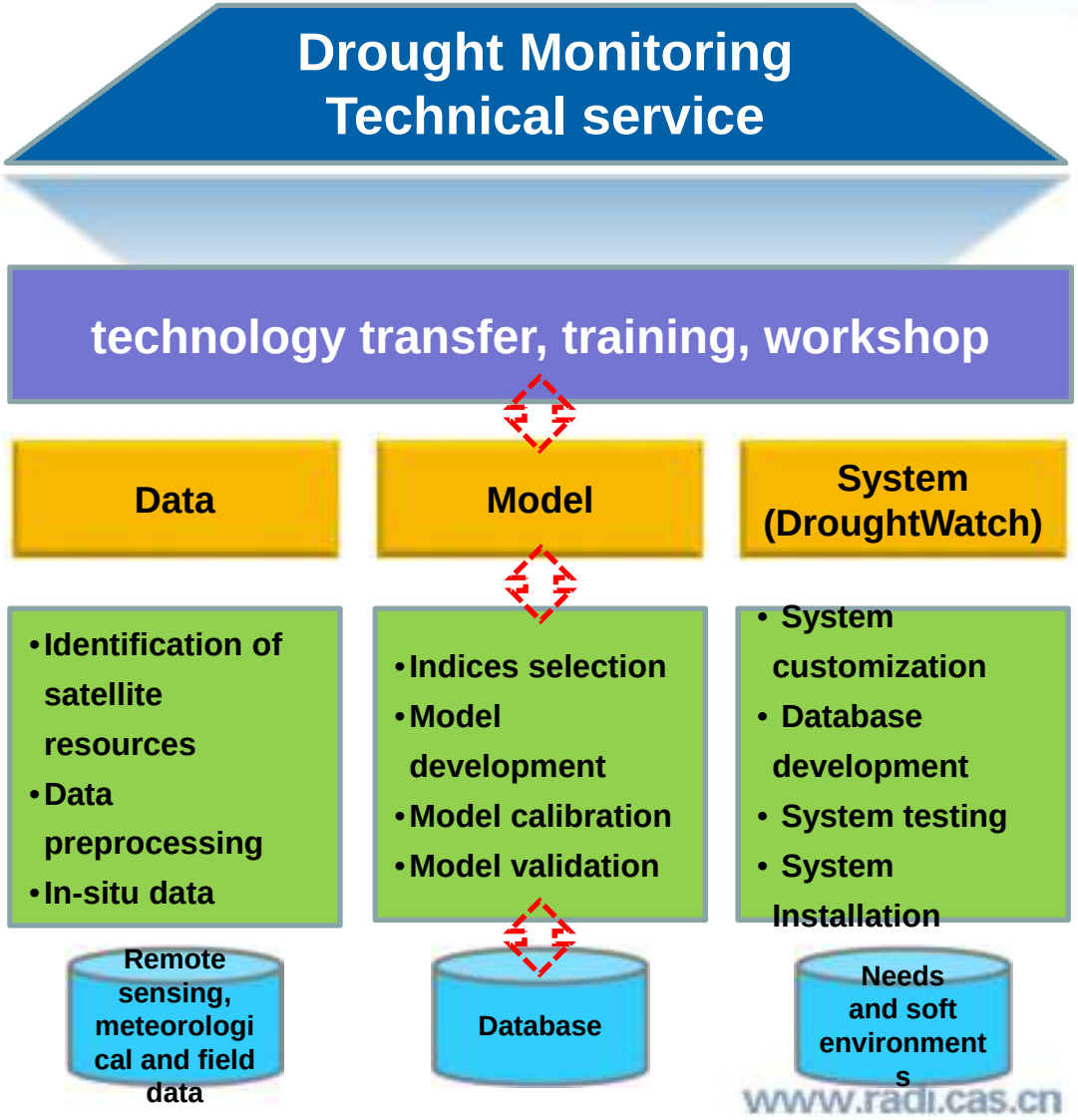




Drought monitoring for Cambodia

- Fact finding and requirement analysis (2015)
- Work plan for 2016
- Field data collection and assessment
- Satellite resources analysis and model development
- Field work plan and model validation
- Database and system customization
- Capacity building: data processing, field work, model and system training



Technical support and Training

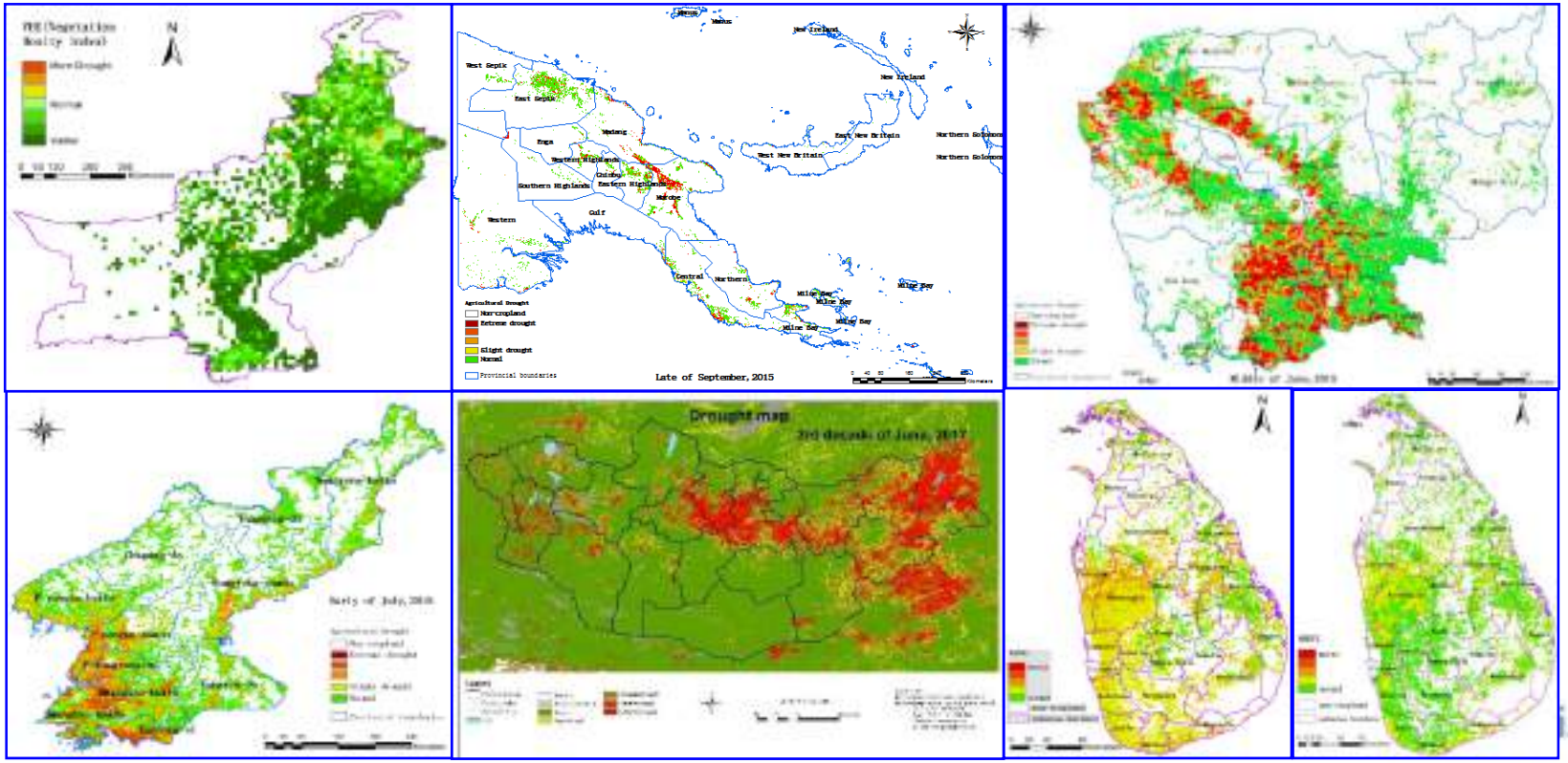
- Data requirement analysis(Feb, 2016)
- Training Workshop for Regional Drought Mechanism in Cambodia.(July 26-28, 2016)
- Hand-on training of data processing, indices calculation, indices suitable analysis, database development and final indices decision for Cambodia persons in RADI, China(Nov-Dec, 2017)



Drought monitoring for other countries

DroughtWatch system-derived drought monitoring:

- Pakistan: Oct 2014-Mar 2015; Sri Lanka: March-April,2014
- Democratic People's Republic of Korea(DPRK): April-early of July, 2015.
- Papua New Guinea (PNG): Sept-Oct, 2016.
- Cambodia：June to August 2015; April 2016.

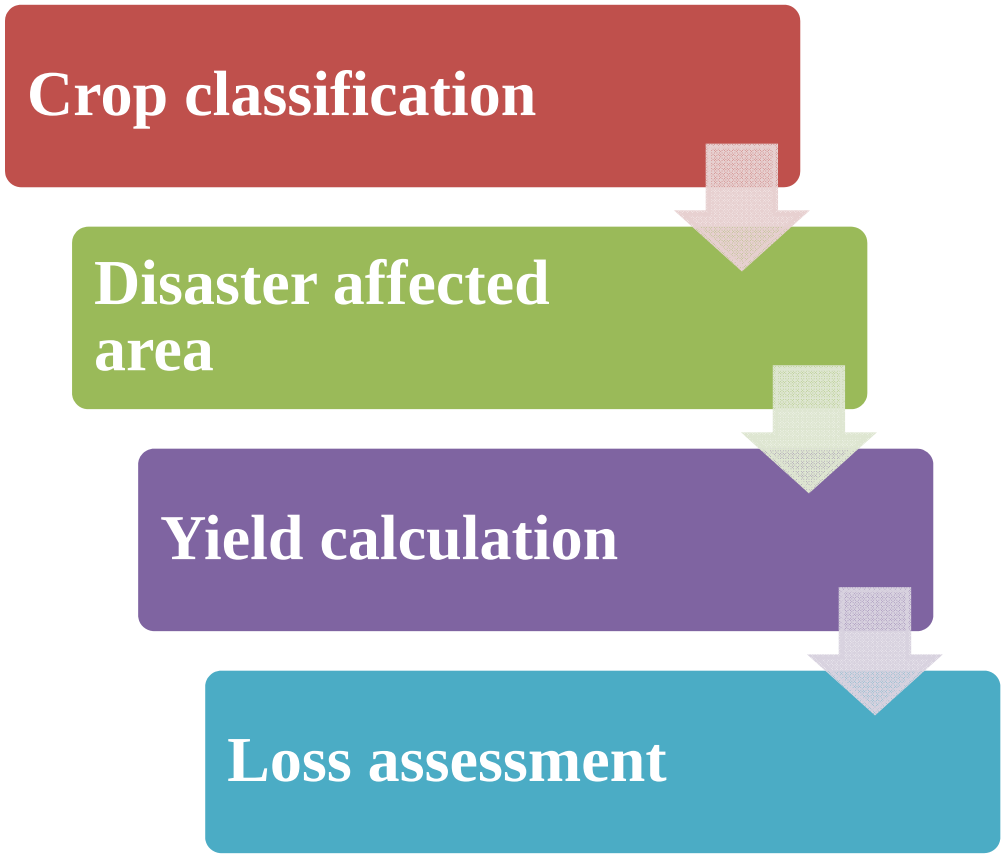


Outline

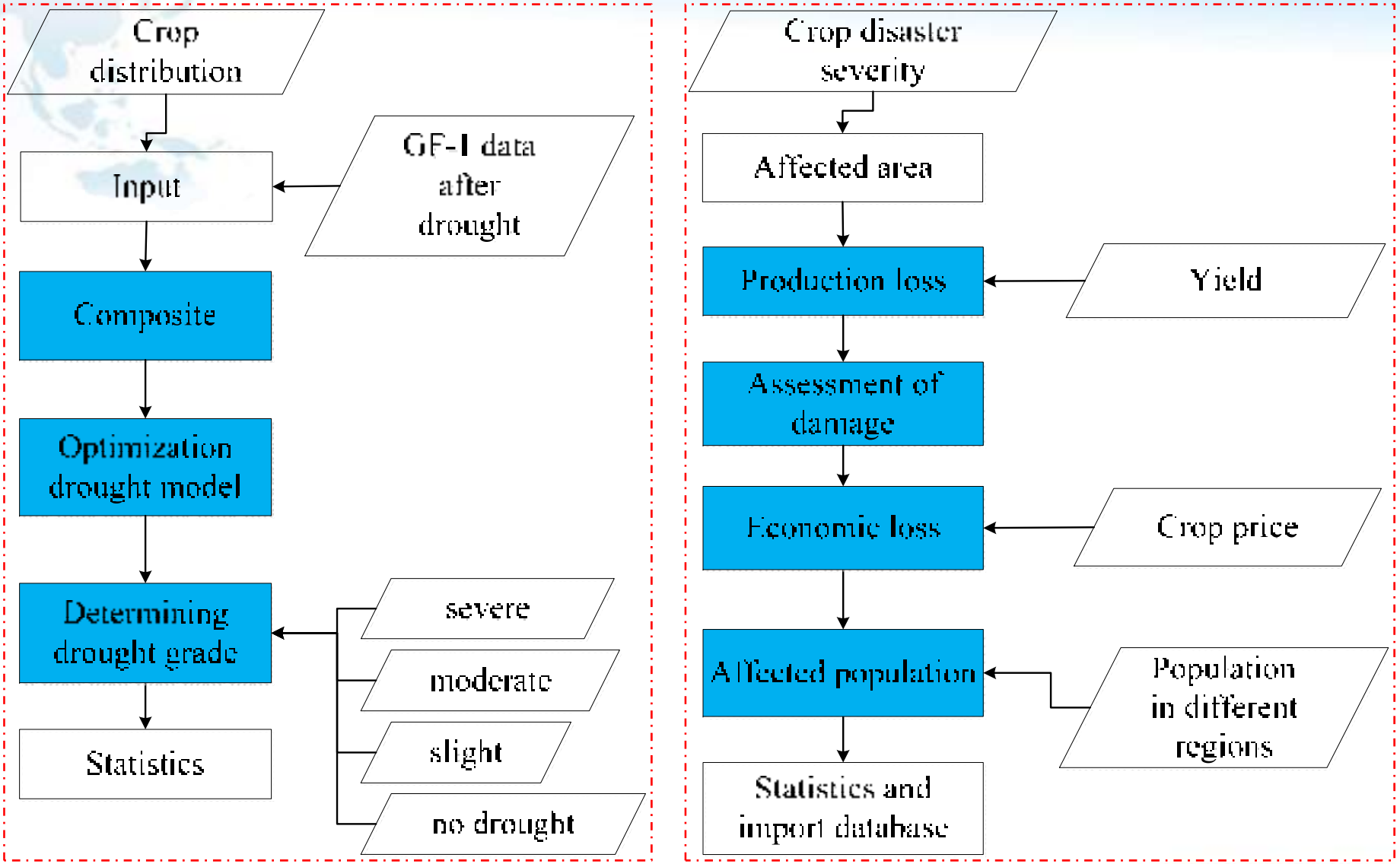
- Agricultural drought monitoring in Asia-Pacific
  - Mongolia
  - Sri Lanka
  - Cambodia
  - Other countries
- Assessment of agricultural disaster loss
- Agricultural index-based insurance
- Prospective

Agricultural disaster loss assessment

- Multi-source data(remote sensing, population, economy data and so on).
- Chinese high-resolution satellite image(GF-1/2) was utilized.
- Multi-temporal remote sensing data can be great helpful for crop classifying, disaster monitoring, loss assessment.

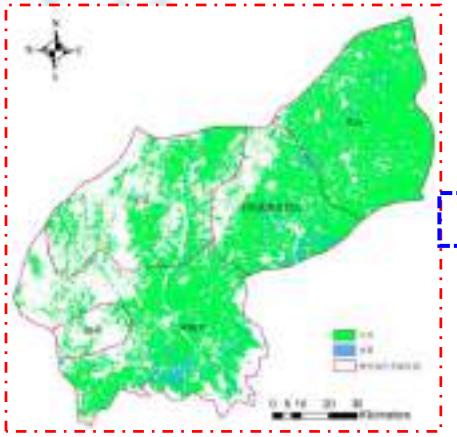


Agricultural disaster loss assessment

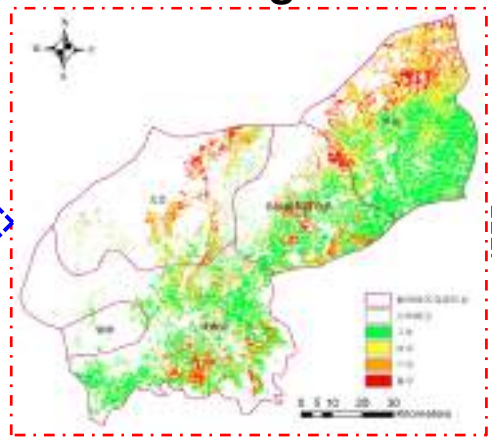


A case-Jinzhou of Liaoning province

Crop distribution



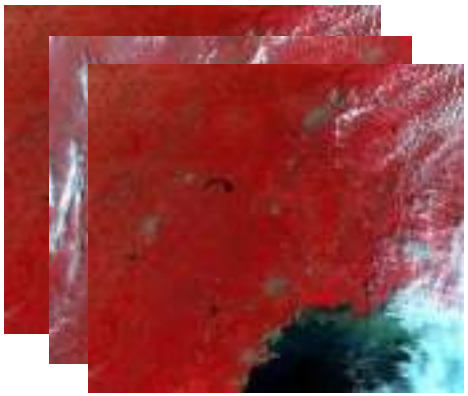
Drought



Loss assessment

Region	Time	Crop	Production loss(ten thousand ton)	Economic loss(ten thousand Yuan)	Affected population (ten thousand People)
Haishan	August 2,2014	Corn	22.02	41840.49	27.99
Haishan	August 2,2014	Rice	1.63	4893.65	27.99
Beizhen	August 2,2014	Corn	9.07	17239.48	17.83
Beizhen	August 2,2014	Rice	2.52	7557.44	17.83
Linghai	August 2,2014	Corn	4.37	8300.25	40.17
Linghai	August 2,2014	Rice	0.73	2184.28	40.17
Yixian	August 2,2014	Corn	16.23	30831.64	13.12
Yixian	August 2,2014	Rice	1.2	3606.04	13.12
Jinzhou city	**August 2,2014**	**-**	**57.77**	**116453.3**	**198.22**

GF-1/2 images

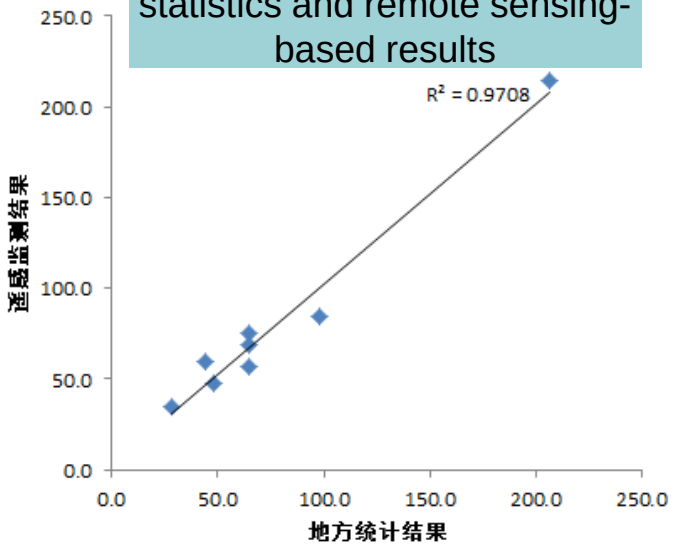


Multi-source data

A case-Jinzhou of Liaoning province

- Validation by local statistics data(released in August, 2014 in Water Resources Department of Liaoning province).
- The result was that the local statistics production loss is 633,000ton, compared with the assessment of 578,000ton. The accuracy is 91%.

The correlation between local statistics and remote sensing-based results



Region	Drought area(ten thousand mu)		Slight drought(ten thousand mu)		Moderate drought(ten thousand mu)		Severe drought(ten thousand mu)	
	Local Statistics	Remote sensing-based results	Local Statistics	Remote sensing-based results	Local Statistics	Remote sensing-based results	Local Statistics	Remote sensing-based results
Haishan	65	75.1	-	33.2	-	25.3	-	16.6
Beizhen	28.2	34.8	-	12.9	-	9.8	-	12. 1
Linghai	64.9	56.5	-	18.8	-	19.4	-	18.3
Yixian	48.4	47.8	-	19.1	-	13.7	-	15
Jinzhou city	**206.5**	**214.2**	**97.6**	**84**	**44**	**68.1**	**64.9**	**62.1**

Outline

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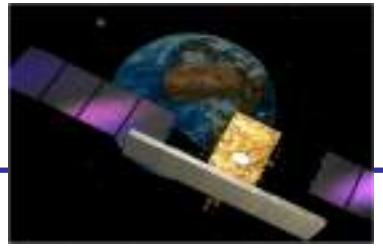
- Assessment of agricultural disaster loss
- Agricultural index-based insurance
- Prospective

Agricultural index-based insurance

- Index-based insurance uses a proxy for losses and not the losses themselves to trigger claim payments.
- Farmer behaviors can influence the extent of damage that qualifies for insurance payouts in losses-based insurance.
- When the index reaches a pre-specified level, the insured may receive timely payouts.

Building the insurance index

- Objective
- easy-operating
- quick payouts to stakeholders
- ...



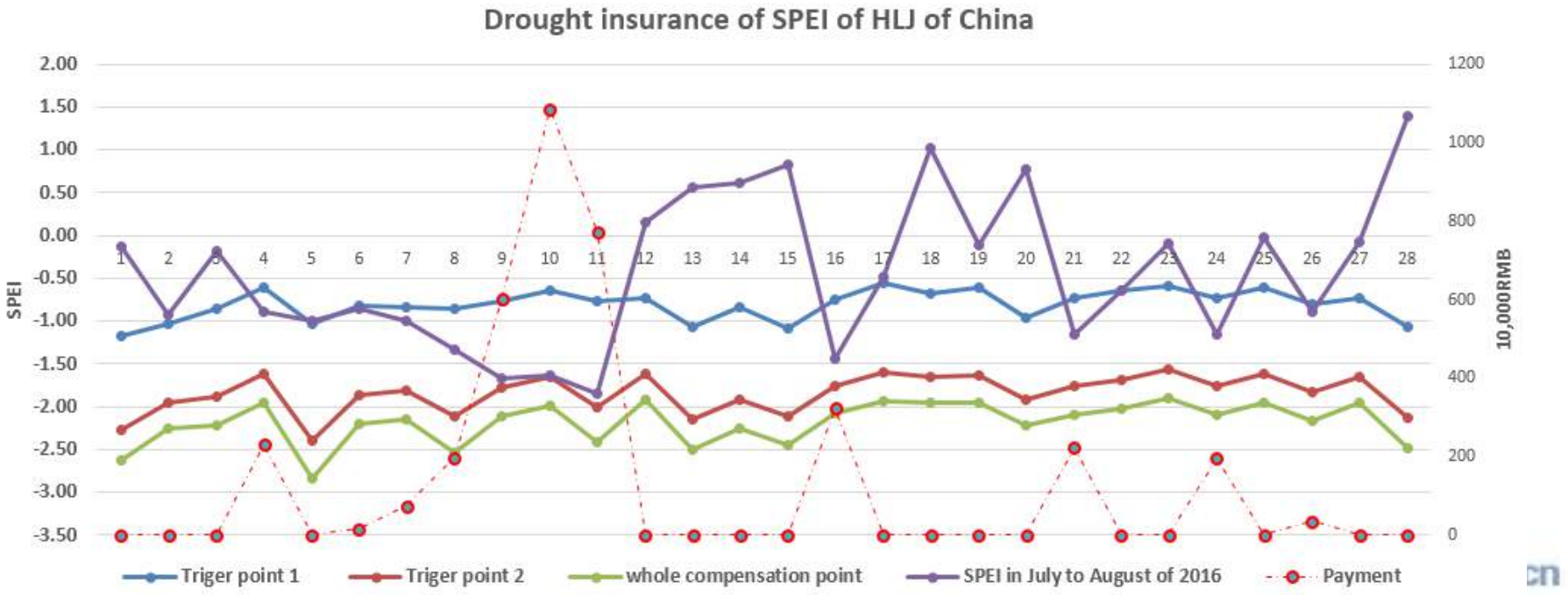
? trigger the contract

> (a pre-specified level)	No payment
<= (a pre-specified level)	Payment

? Payment to stakeholders

Agricultural index-based insurance

- Standardized Precipitation Evapotranspiration Index(SPEI) was selected for **drought insurance index**. SPEI is combined with temperature and rainfall factors resulting in drought.
- In 2016, about 40 million Yuan was paid to 11 drought counties in all pilot 28 countries. It is very power way to relief disaster.



Agricultural index-based insurance

Flood insurance index

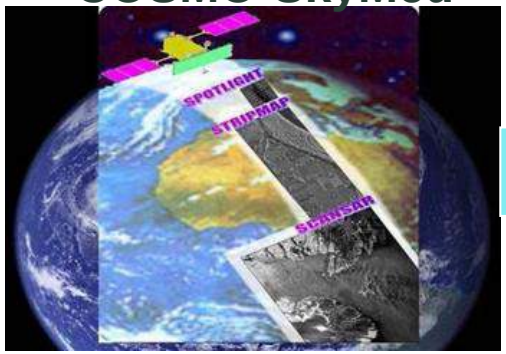
Satellite-derived flooded area

Exposed Values

Flood impact values

Payout formula

COSMO-SkyMed



Calculation

Report&Payment

Perspective

- Developing the drought monitoring models and deploying DroughtWatch to more Asia-Pacific countries, as well as providing effective technical support.
- Building diverse drought models based on different climate, hydrological and texture conditions.
- Risk prediction and disaster assessment should give more considerations for disaster-prone areas in the future.
- Insurance is power means for relieving disasters. Remote sensing data should play more role in index-based insurance, now it is a just start.

Thanks!



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