



中国科学院遥感与数字地球研究所  
Institute of Remote Sensing and Digital Earth, CAS



*United Nations International Conference on Space-based Technologies for  
Disaster Risks Reduction*

# **DroughtWatch for Mongolia Experiences and lessons**

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25th October, 2018 – Beijing

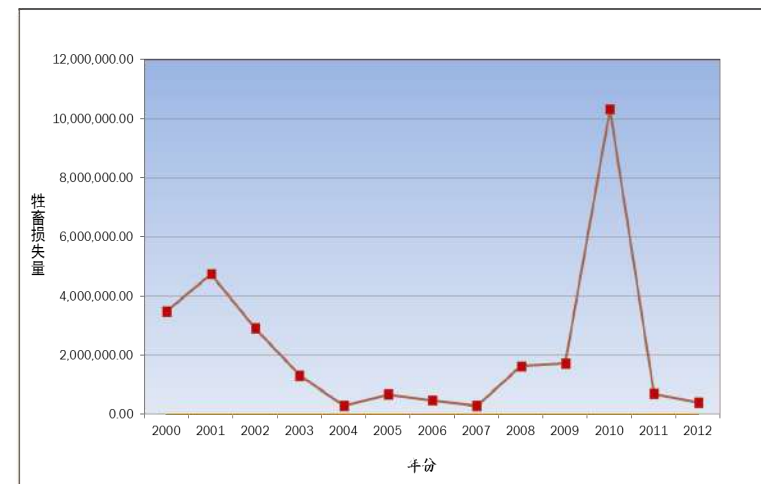
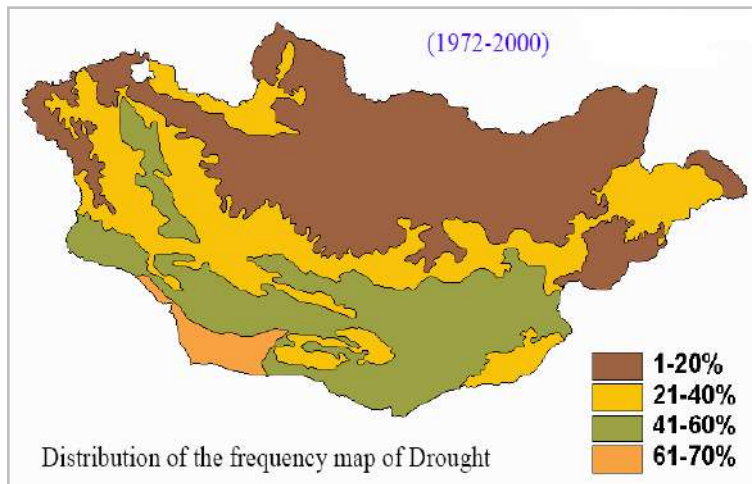


# Mongolian Drought



Drought is mainly nature disaster in Mongolia(global warming, climate change), and result in enormous economic losses.

- ❑ 30-70% areas happens drought in Mongolia.
- ❑ In 2010, one third of total livestock died. One reason is the poor condition of many pastures as a result of last summer's drought (2009).



# Challenges

- ❑ The timeliness needed in drought information
- ❑ Mongolia underutilized low spatial information technique
- ❑ Paucity of appropriate drought monitoring system due to constraints of professional knowledge, financial capacity, as well as human resources.
- ❑ Mongolia is the **first pilot** for ESCAP's Regional Collaborative Mechanism on Drought Monitoring and Early Warning by China service node.

# Objectives and Contents



- ❑ Developing drought monitoring methods and system for Mongolia
  - ❑ Drought monitoring methods
  - ❑ Building up the spatial information database
  - ❑ Drought monitoring system for Mongolia
- ❑ Enhancing capacity for Drought Monitoring in Mongolia
  - ❑ On the job training and joint academic research
  - ❑ Customizing and deploying the drought monitoring system
  - ❑ Field campaign support and validation work
  - ❑ Academic workshops
  - ❑ Information services and technical support

# System Customization



**DroughtWatch 3.1**

Modules Help

*DroughtWatch* © Mongolia

User Login

User Name:

Password:

**Modules**

Database Preprocessing Indices Drought Analysis Batch

**DroughtWatch 3.1 - Indices**

Resolution: 15M

Frequency:

Date: 2000

Input Data:

NDVI:

Max\_NDVI:

Min\_NDVI:

Output Folder:

**Batch**

Sensor/Satellite:  Resolution:

ST: 2000    DT: 2000

Frequency:  Month  Decad  Year  Pentad

Parameters Configuration:

Atmos. Correction:  No  Yes

Aggregation:  Maxima  Average

Single Index:  VCI  ICI  VHI  SDDI  VSMI

Combination Index:

Combination Method:  Max  Min  Mean  Median  Majority

PROCESS

Preprocessing Indices Drought Statistics

**DroughtWatch 3.1 - Database**

Dataset ID	Name	Band	Start Time	End Time	Resolution
00001	MODIS	2	2000-01-01	2000-01-01	15M
00002	MODIS	2	2000-01-02	2000-01-02	15M
00003	MODIS	2	2000-01-03	2000-01-03	15M
00004	MODIS	2	2000-01-04	2000-01-04	15M
00005	MODIS	2	2000-01-05	2000-01-05	15M
00006	MODIS	2	2000-01-06	2000-01-06	15M
00007	MODIS	2	2000-01-07	2000-01-07	15M
00008	MODIS	2	2000-01-08	2000-01-08	15M
00009	MODIS	2	2000-01-09	2000-01-09	15M
00010	MODIS	2	2000-01-10	2000-01-10	15M
00011	MODIS	2	2000-01-11	2000-01-11	15M
00012	MODIS	2	2000-01-12	2000-01-12	15M
00013	MODIS	2	2000-01-13	2000-01-13	15M
00014	MODIS	2	2000-01-14	2000-01-14	15M
00015	MODIS	2	2000-01-15	2000-01-15	15M
00016	MODIS	2	2000-01-16	2000-01-16	15M
00017	MODIS	2	2000-01-17	2000-01-17	15M
00018	MODIS	2	2000-01-18	2000-01-18	15M
00019	MODIS	2	2000-01-19	2000-01-19	15M
00020	MODIS	2	2000-01-20	2000-01-20	15M
00021	MODIS	2	2000-01-21	2000-01-21	15M
00022	MODIS	2	2000-01-22	2000-01-22	15M
00023	MODIS	2	2000-01-23	2000-01-23	15M
00024	MODIS	2	2000-01-24	2000-01-24	15M
00025	MODIS	2	2000-01-25	2000-01-25	15M
00026	MODIS	2	2000-01-26	2000-01-26	15M
00027	MODIS	2	2000-01-27	2000-01-27	15M
00028	MODIS	2	2000-01-28	2000-01-28	15M
00029	MODIS	2	2000-01-29	2000-01-29	15M
00030	MODIS	2	2000-01-30	2000-01-30	15M
00031	MODIS	2	2000-01-31	2000-01-31	15M

**DroughtWatch 3.1 - Preprocessing**

Resolution: 15M

Start Time: 2000-01-01

End Time: 2000-01-31

Metadata Folder:

Output Folder:

Preprocessing Parameters:

Param (ID)	Min	Max	Unit	File	Att	Mask	Unit
00001							
00002							
00003							
00004							
00005							
00006							
00007							
00008							
00009							
00010							
00011							
00012							
00013							
00014							
00015							
00016							
00017							
00018							
00019							
00020							
00021							
00022							
00023							
00024							
00025							
00026							
00027							
00028							
00029							
00030							
00031							

**DroughtWatch 3.1 - Drought**

Resolution: 15M

Start Time: 2000-01-01

End Time: 2000-01-31

Metadata Folder:

Output Folder:

Drought Parameters:

Param (ID)	Min	Max	Unit	File	Att	Mask	Unit
00001	0	0.099					
00002	0.099	0.197					
00003	0.197	0.295					
00004	0.295	0.393					
00005	0.393	1					

Input File:

Single Information:

Min	Max	0	0.00000	Max	0.56897
0.00000	0.56897	0.00000	0.00000	0.56897	0.56897

Classification:

Extreme: 0  0.099

Severe: 0.099  0.197

Moderate: 0.197  0.295

Slight: 0.295  0.393

Normal: 0.393  1

Output Folder:

**DroughtWatch 3.1 - Analysis**

Over Spatial Unit (Over Time Interval)

Frequency:  IndexType: VCI

Date: 2000-01-01

Area Unit:

Area	Extreme	Severe	Moderate	Slight	Normal
000001	0.21255	0.09441	0.13668	0.19493	0.45743
Drought	0.30658	0.12760	0.22142	0.29950	0.14454
DroughtRate	0.29718	0.21704	0.21620	0.14015	0.13720
Abnormal	0.28193	0.10830	0.14587	0.15319	0.34176
Low	0.22119	0.08666	0.11847	0.09310	0.43776
Indicator	0.59296	0.18404	0.14716	0.09494	0.01193
Percentage	0.05102	0.03691	0.05000	0.07160	0.74757
DroughtRate	0.27161	0.22077	0.26150	0.01814	0.02613
DroughtRate	0.00000	0.00000	0.00000	0.00197	0.99803
DroughtRate	0.43704	0.15008	0.17245	0.12910	0.10025
DroughtRate	0.54843	0.24764	0.13168	0.04715	0.02874
DroughtRate	0.00000	0.00000	0.00000	0.00000	1.00000
DroughtRate	0.49638	0.12142	0.12917	0.09783	0.04574
Percentage	0.05102	0.03691	0.05000	0.07160	0.74757
DroughtRate	0.29243	0.14796	0.15540	0.11030	0.03344
AbnormalRate	0.02271	0.02550	0.03191	0.05050	0.17124
DroughtRate	0.03492	0.02114	0.04410	0.05498	0.20407
DroughtRate	0.12104	0.08501	0.10624	0.11493	0.56838
AbnormalRate	0.27286	0.19986	0.14616	0.09763	0.28117

Output Folder:



Institute of Remote Sensing and Digital Earth  
Chinese Academy of Sciences

*DroughtWatch*

Version 3.1

July 1, 2018

## DroughtWatch Manual



UNITED NATIONS  
**ESCAP**  
Economic and Social Commission for Asia and the Pacific

“Strengthening Mongolia’s capacity to monitor and warn  
drought/Duzd project” under Regional Drought Mechanism

## Validation Report 2017

Training period: 13 December to 9 January, 2018

Venue: RADI Olympic campus

Contributors:

Sheng Chang, Babuudorj Ganbat, Bulkhbai Amanjol,  
Bingfang Wu, Nana Yan

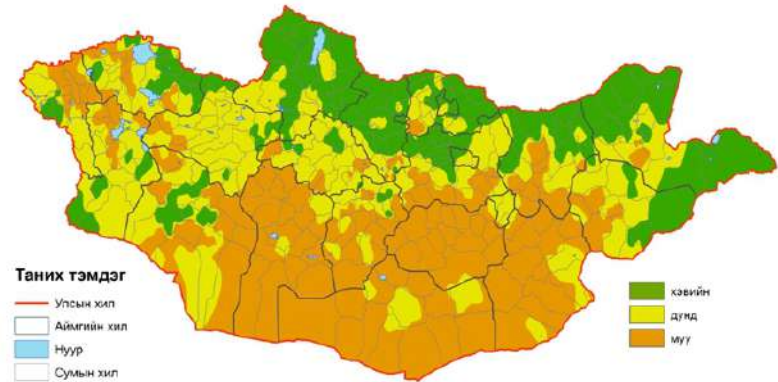
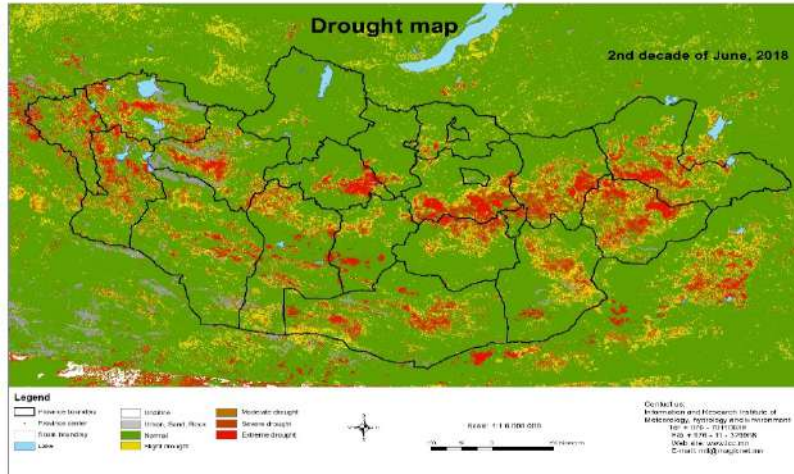
Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of  
Sciences (CAS)

Information and Research Institute of Meteorology, Hydrology and Environment  
(IRIMHE), Mongolia

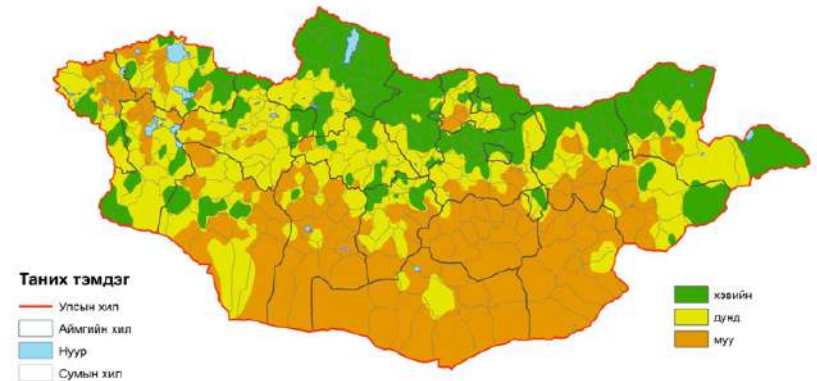
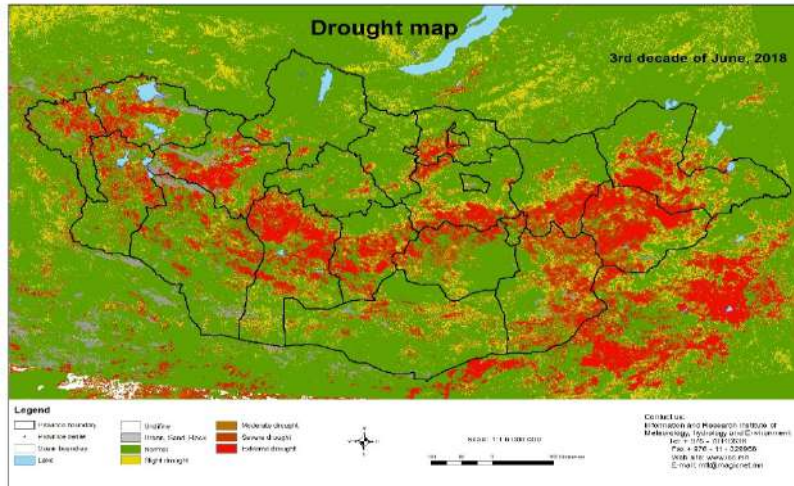
# Monitoring Results



Remote sensing drought map /2<sup>nd</sup> decade, June 2018/ Summer condition /2<sup>nd</sup> decade, June 2018/



3 дугаар зураг. Бэлчээрийн ургамлын ургалтын байдал, балл 2018 оны 6 дугаар сарын 20-ны байдлаар



3 дугаар зураг. Ургамлын ургалтын байдал 2018 оны 6 дугаар сарын 30-ны байдлаар

# Products dissemination to users



[www.icc.mn](http://www.icc.mn)

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Ministry of Food, Agriculture and Light Industry



REMOTE SENSING PRODUCT

MODIS product-Drought

30/06/21 - 20/06/21

20/06/11 - 20/06/20

20/06/01 - 20/06/10

20/05/21 - 20/05/20

20/05/11 - 20/05/10

20/05/01 - 20/05/20

20/04/21 - 20/04/20

20/04/11 - 20/04/10

20/04/01 - 20/04/20

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Environmental Database

Төрийн мэдээллийн үйлчилгээ - Disaster Information Services

Түргэлж хариуцаж  
Fire Management

Сүүлийн мэдээлэл  
Drought Database

Төрийн мэдээлэл  
Drought Database

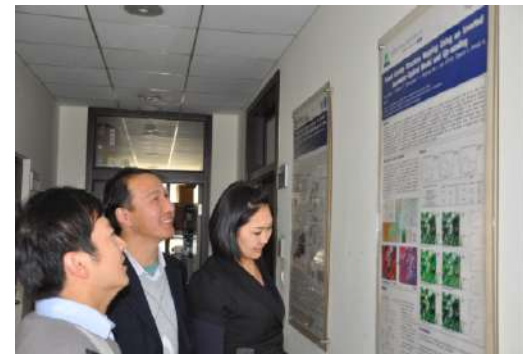
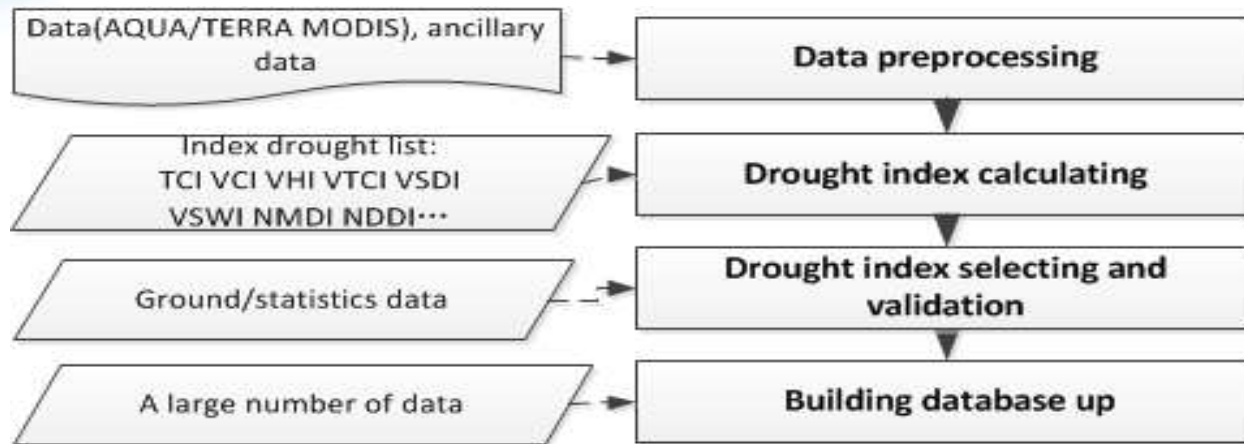
Drought product dissemination to local meteorological departments by internal network



# Joint work on data processing

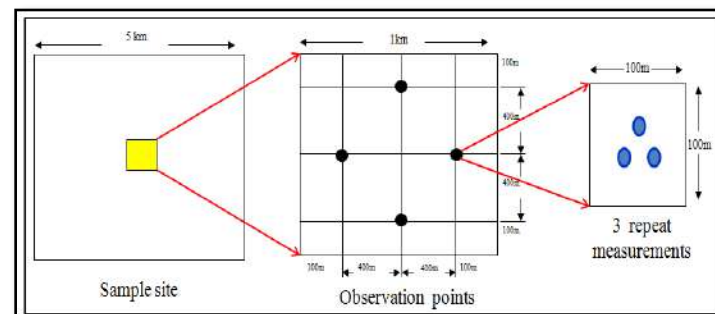
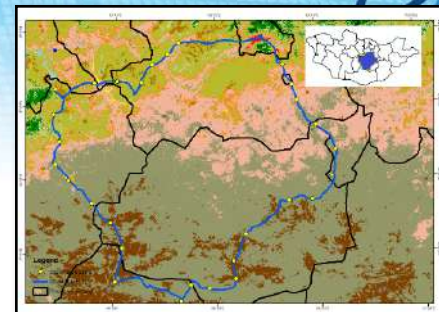


Data processing, building database, indices selection were achieved jointly by China and Mongolia experts in RADI, China(2014.02-04).



# Joint field works

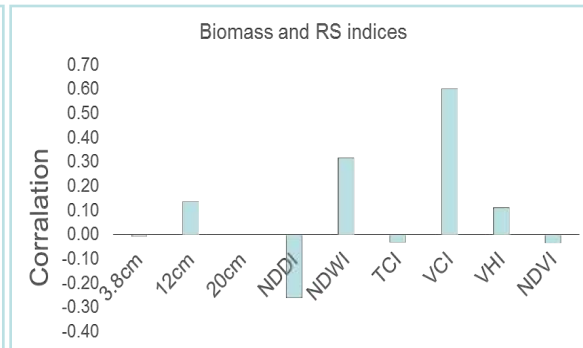
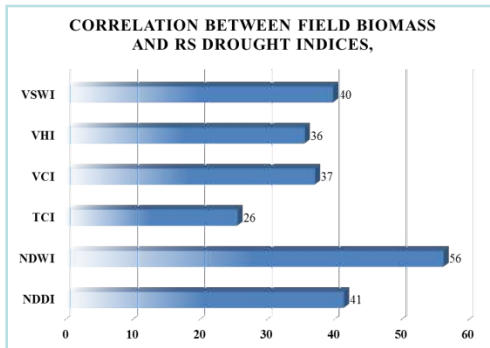
- Parameters: Soil moisture, vegetation biomass, height, coverage, biodiversity, livestock loss number by drought and spectrum.
- Participants: IRIMHE and RADL.
- 2014 to 2017 (July to August)



# Joint Validation



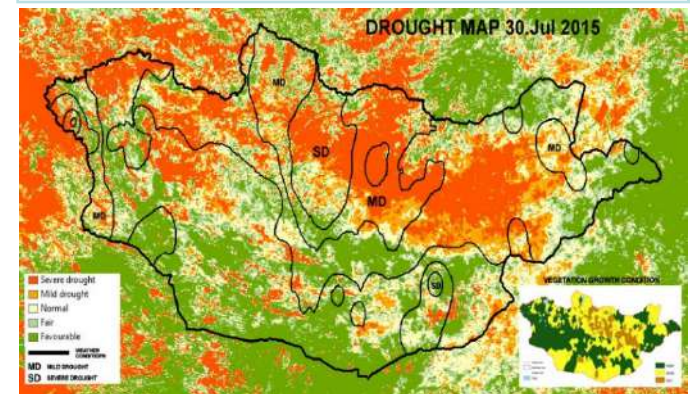
- ❑ Drought products validation with field data from 2014-2017:
  - ❑ Soil moisture
  - ❑ Biomass
  - ❑ Regional drought affected data from field observation
  - ❑ Annual validation report



	BIOMASS ce/ha (averaged by two plot)		
	NORMAL	ANOMAL	
VHI	0.42	0.76	0.69
TCI	0.55	0.78	0.67
VCI	0.45	0.29	0.09
NDDI	0.29	0.09	0.12
VSWI	-0.13	-0.05	0.34
NDVI	0.55	0.08	-0.45

Decade	5_3	6_1	6_2	6_3	7_1	7_2	7_3	8_1	8_2	8_3	9_1	9_2	9_3
May-I-VHI	-0.09	0.16	-0.12	0.05	0.16	0.31	0.13	0.08	0.08	0.11	0.22	0.37	-0.23
May-II-VHI	0.11	0.33	0.19	0.32	0.47	0.47	0.41	0.14	0.22	0.25	0.35	0.45	0.16
May-III-VHI	0.25	0.52	0.48	0.62	0.53	0.11	-0.03	0.01	-0.13	0.06	-0.11	0.12	-0.29
June-I-VHI	0.47	0.54	0.71	0.44	0.00	-0.16	-0.17	-0.30	-0.14	-0.18	-0.10	-0.48	
June-II-VHI	0.58	0.74	0.48	0.06	-0.11	-0.11	-0.21	0.00	-0.10	-0.06	-0.25		
June-III-VHI	0.52	0.74	0.54	0.49	0.39	0.38	0.50	0.38	0.54	0.36			
July-I-VHI	0.71	0.62	0.62	0.52	0.54	0.62	0.49	0.58	0.38				
July-II-VHI	0.66	0.64	0.78	0.76	0.81	0.46	0.54	0.67					
July-III-VHI	0.69	0.71	0.73	0.78	0.53	0.45	0.62						
Aug-I-VHI	0.67	0.60	0.70	0.28	0.40	0.57							
Aug-II-VHI	0.58	0.69	0.34	0.36	0.65								
Aug-III-VHI	0.74	0.46	0.51	0.53									
Sep-I-VHI					0.44	0.49	0.85						
Sep-II-VHI					0.40	0.65							

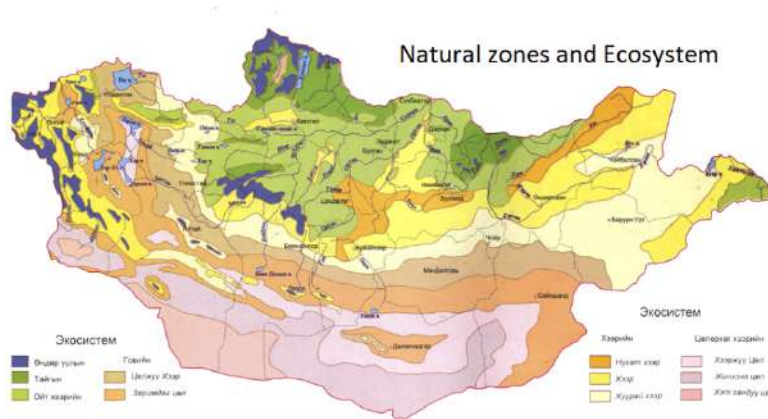
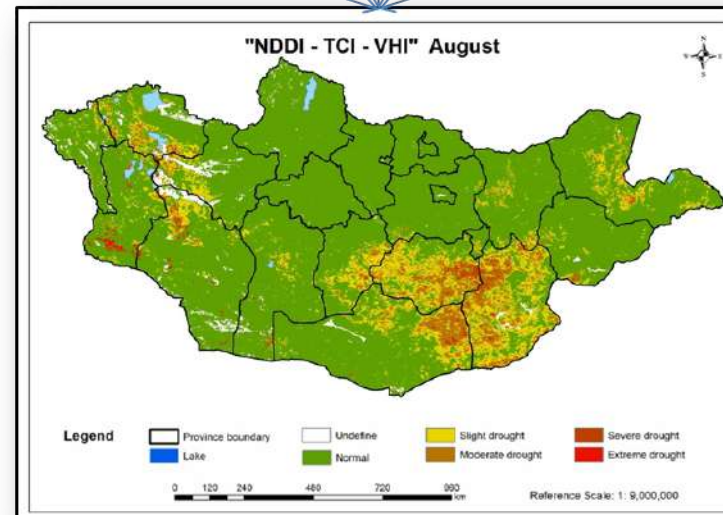
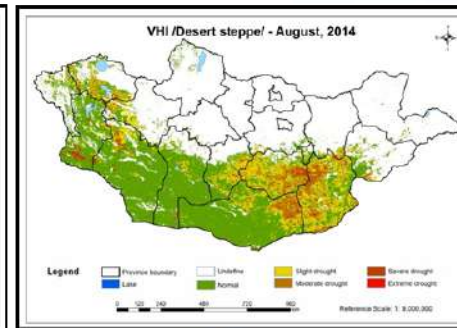
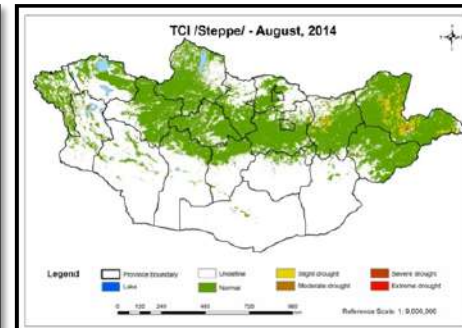
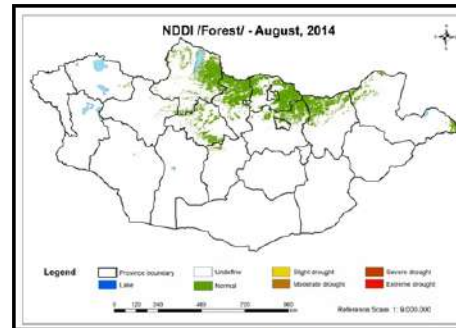
R2	NDDI	VSWI	TCI	VCI	VHI
Soil moisture(TDR,12CM)	0.545	0.690	0.774	0.773	0.877
Soil moisture(TDR,20CM)	0.765	0.623	0.823	0.749	0.890
Soil moisture(EBA,10CM)	0.073	0.194	0.171	0.189	0.204



# Localization for local ecosystem



## Forest steppe & steppe & desert steppe

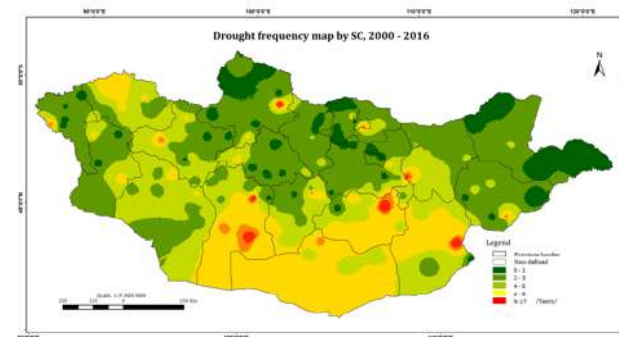
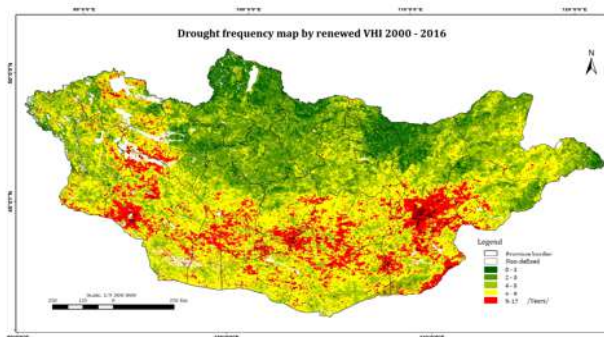


# Localization for seasonal variation



- ❑ Calculated the regression coefficients using fenced biomass against the two variables (TCI, VCI)
- ❑  $nVHI = Wvci * VCI + Wtci * TCI$
- ❑ The drought frequency maps based on nVHI and Summer condition 2000 – 2016

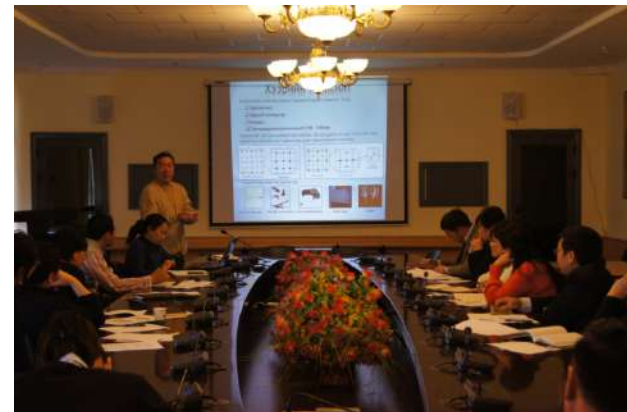
Weights	May	June	July	August	September
Wtci (VHI a)	0.41	0.31	0.27	0.31	0.42
Wvci (VHI b)	0.59	0.69	0.73	0.69	0.58



# Ownership



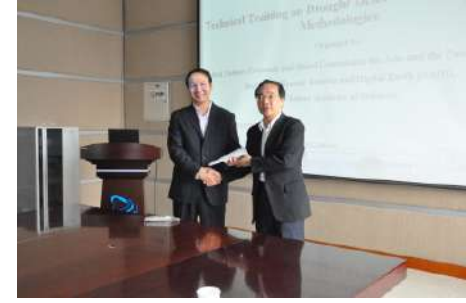
- ❑ DroughtWatch system have been deployed in NRSC of Mongolia in 2014, and fully operated by NRSC staff on monitoring, field work, and analysis.
- ❑ Now, DroughtWatch products and results are useful for planning, decision making at crop farming, forest and pastoral animal husbandry sector in Mongolia.



# Full Technical Transfer



- ❑ Technical advisory and support
- ❑ Technical Training
- ❑ On the job training
- ❑ Joint work from 2014 to 2017.
- ❑ Customization
- ❑ Localization
- ❑ Ph.D fellowships



# Lessons



- Stakeholder engagement
  - Need to give more training or advertisement to other users about the drought products
  - Make stakeholder use of products
  
- Impact assessment for DroughtWatch enhanced



# Summary and recommendation



- ❑ ESCAP coordination, Mechanism of ownership and full technical transfer are essential to the success
- ❑ ESCAP and CAS support are guarantee to the commitment
- ❑ A good partnership between RADI and IRIMHE
- ❑ In this mechanism, extended to Cambodia and Sri Lanka
- ❑ Increase data resolution and capacity building.
- ❑ Stakeholders needs to engage at the earlier stage
- ❑ Incorporating climate forecast for drought forecast
- ❑ Extending to other applications as fire, dzud, and crop