Team Building Meeting for effective use of space applications for drought monitoring in Central Asia

DroughtWatch extension

WU Bingfang, Nana Yan, Sheng Chang

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

18-19 March 2019, UNCC, Bangkok, Thailand

Outline

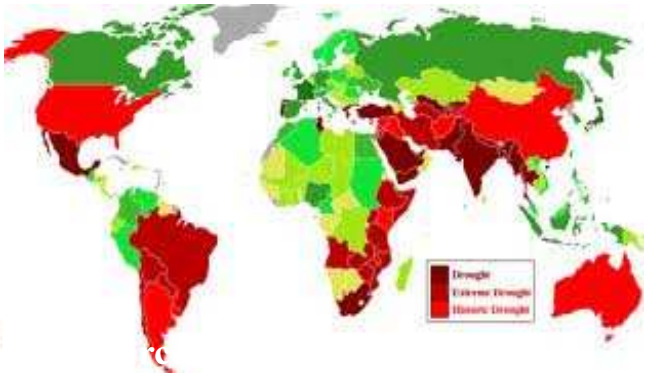
- Introduction
- DroughtWatch
- DroughtWatch for Mongolia
- CropWatch Cloud
- Recommendations

Drought characteristics

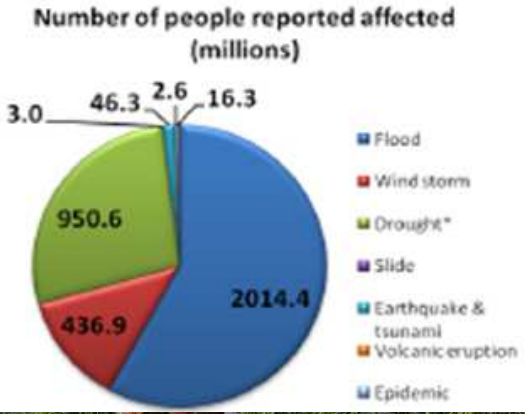
- It builds over a period of time (may be even a year or two) with increased scarcity of water.
- It does not have a well-defined start. It is a creeping phenomenon.
- Drought may be localized covering a district or a group of districts, and even widespread covering a few provinces or several countries.
- Drought intensity, duration and frequency may be different in a district or a piece of land.
- Drought produces a complex and serious impacts on the economic, environmental and social respects.

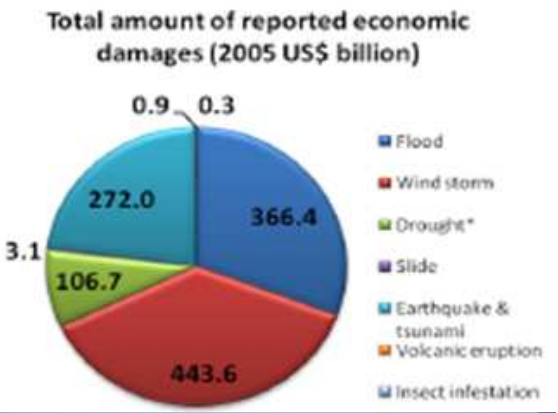
Background

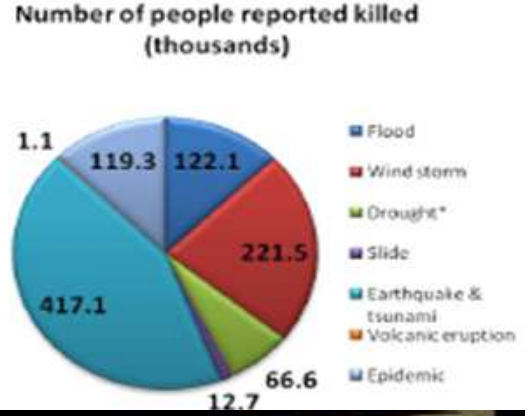
- **Drought has happened in most areas of globe.**
- **Global drought affects more people and brings out large economic damages.**



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

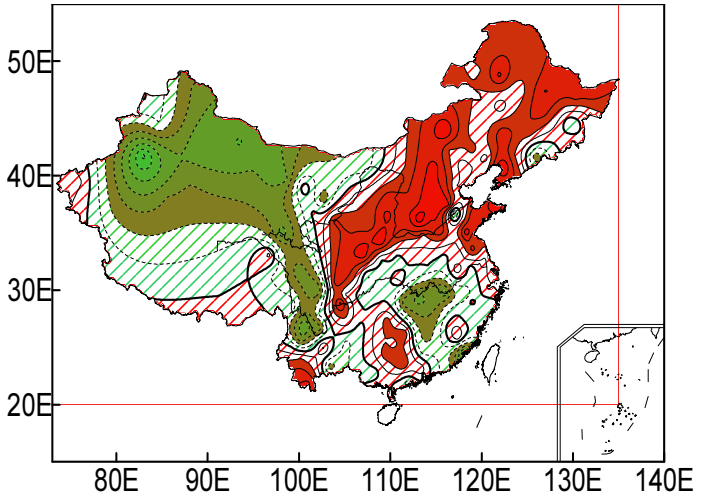




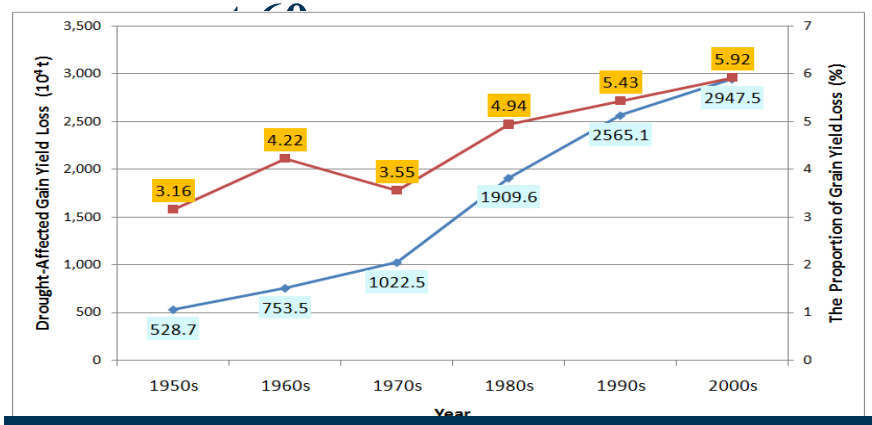


Background

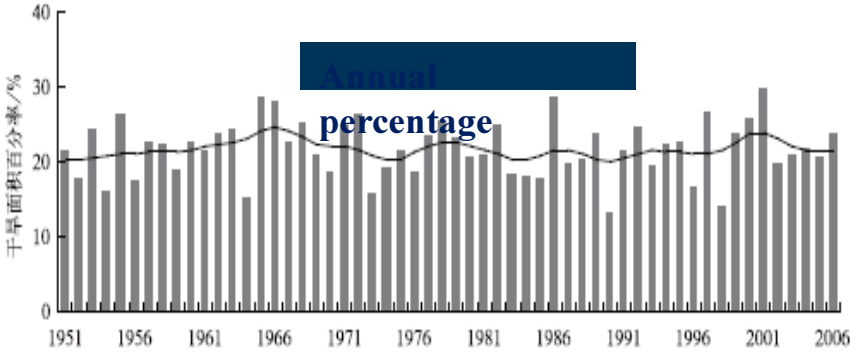
- **High frequency of Drought in China, which gradually increased during 1951-2006**
- **Drought area is about 20% of the whole country annually**
- **In China, the grain yield loss due to drought is increasing significantly in**



Drought frequency 1951 – 2006 (Yang Guijun, 2011)



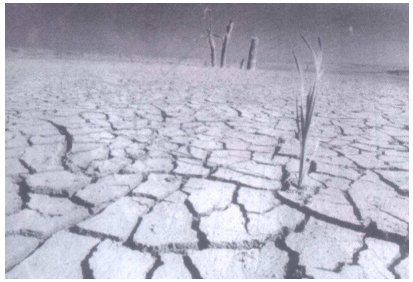
The grain yield loss affected by drought during different periods



Annual percentage of drought impact areas over China during 1951-2006

Drought Definition

More than 150 published definitions of drought in the academic literature were found.



Meteorological drought: a prolonged period of below average precipitation

Agricultural drought: there is not enough moisture to support average crop growing

Hydrological drought: water reserves in aquifers, lakes and reservoirs fall below an established statistical average

Outline

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- CropWatch Cloud
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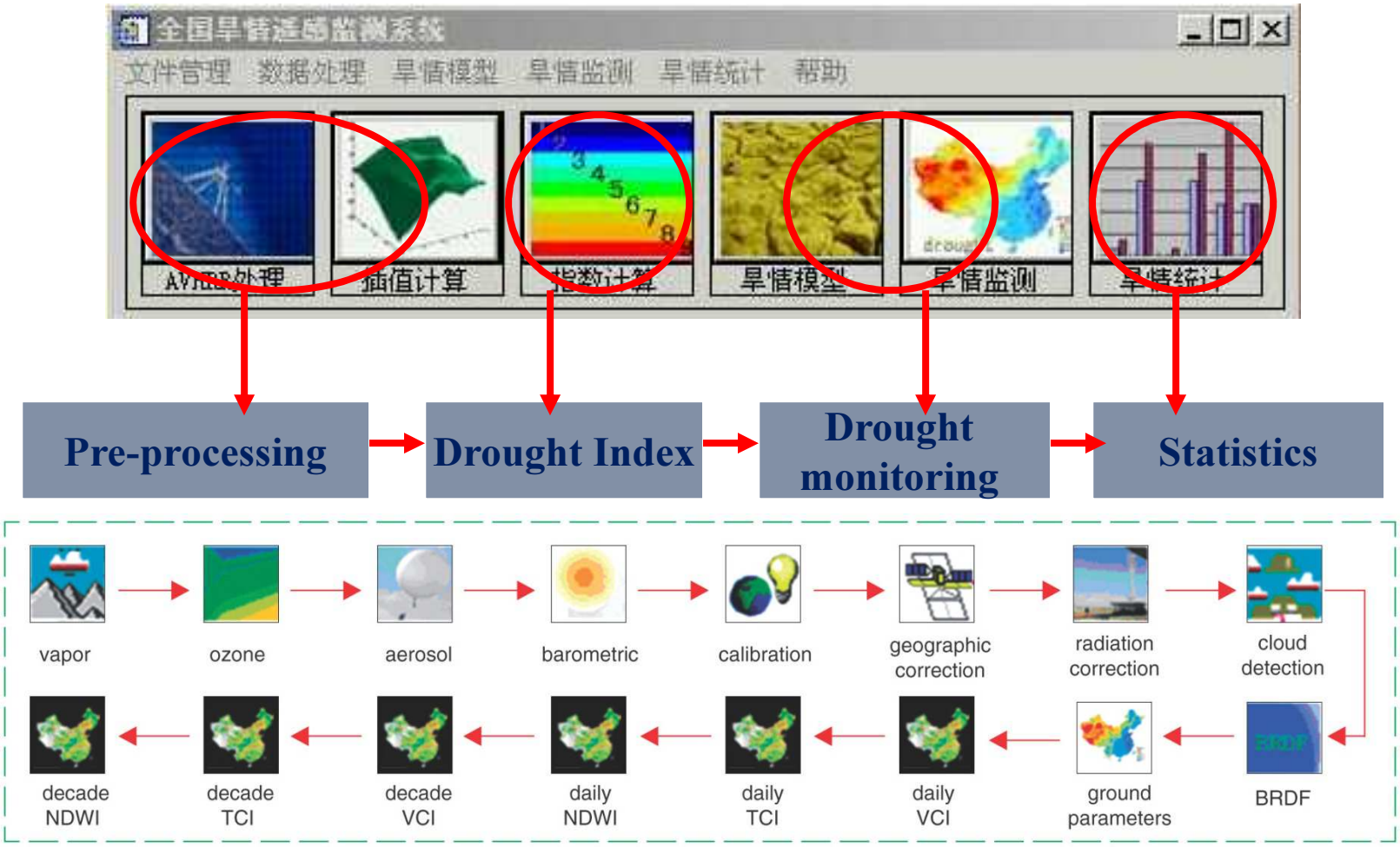
DroughtWatch

- **Established for**
  - Ministry of water resources and Center of disaster mitigation
- **Meteorological Drought (5 indices) (1996-)**
  - Rainfall Anomaly Index (RAI)
  - Annual Rainfall Anomaly Index (ARAI)
  - Deciles (DECILE)
  - Standardized Precipitation Index (SPI)
  - Palmer Drought Severity Index (PDSI)
- Agriculture Drought (DroughtWatch) (4 to multiple indices) (1998-)
  - Vegetation Condition Index (VCI)
  - Temperature Condition Index(TCI)
  - Vegetation Health Index(VHI)
  - Normalized Difference Water Index(NDWI)
- Hydorlogical Drought (4 indices) (2000-demon; 2005-operation)
  - Soil Moisture Index(SMI) SMI=SM/FC
  - Soil Moisture Anomaly Percentage Index (SMAPI) SMAPI=SM/SMavg

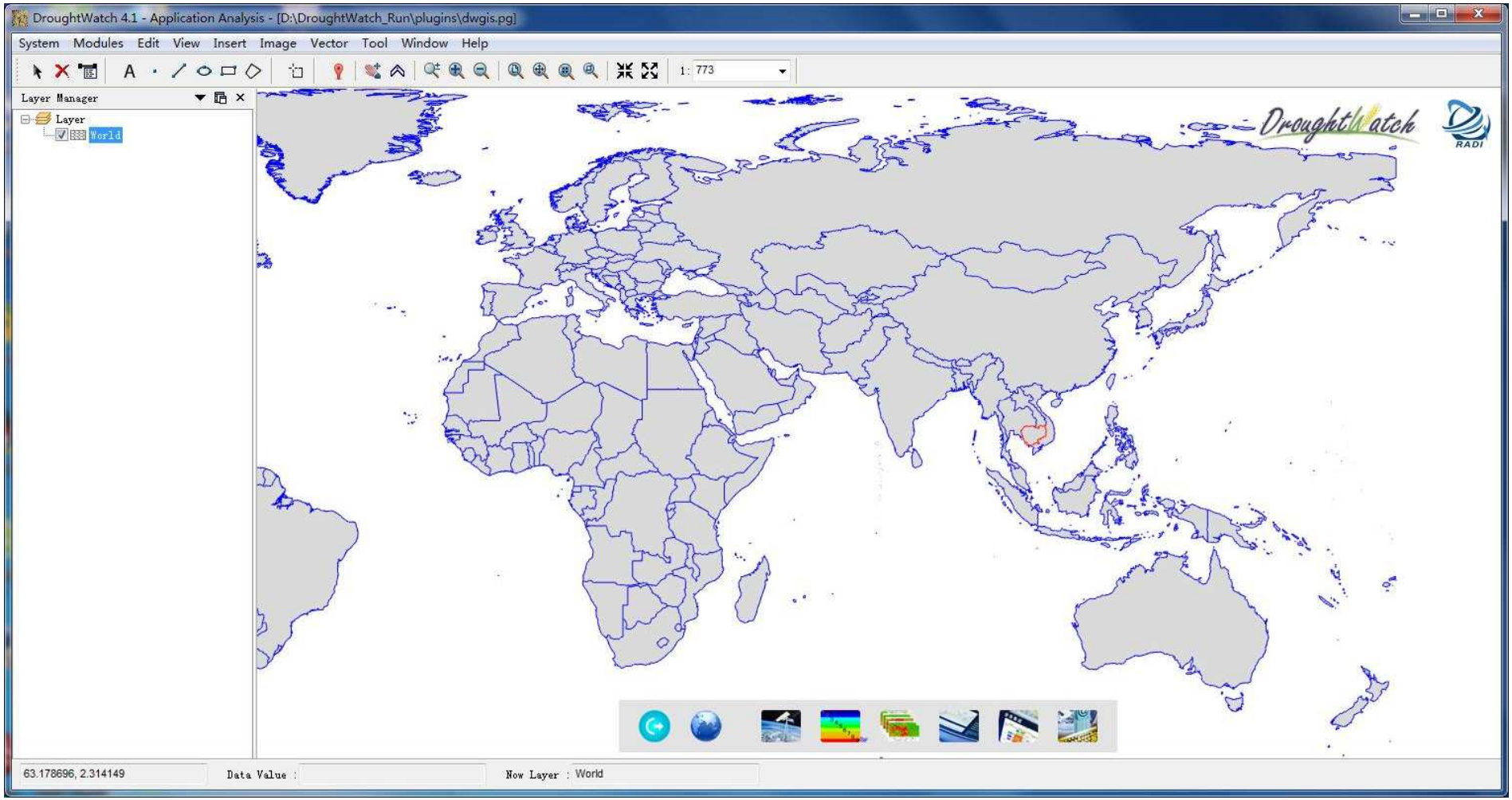
Evolution of DroughtWatch

Version	Major Revision	Improvement	Time
V1.1	Several calculation modules built by program	Try to finish the part of drought monitoring by the computer	1998
V1.2	The drought monitoring system based on AVHRR, named as DroughtWatch for China	Drought monitoring can be calculated automatically	2006
V1.3	Replacement of AVHRR with MODIS	MODIS is beyond AVHRR specially in image quality and geometry location accuracy	2008
V2.1	automatic operation system was emerged	The system can be automatically run	2009-2010
V2.2	Update the basedata(cropland, maxmin data)	Improving the accuracy and stability	2012
V3.1	Extend to the other countries	Developing the system applicability	2013-2014
V4.1	Interactive drought monitoring system for globe	Interaction functions and information demonstration were involved	2015-2017
V4.2	Drought forecasting in short terms	Improving drought forecasting functions	2018-2019

DroughtWatch1.1



DroughtWatch4.1



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Extension

Global

Data:
- TRMM/GPM;
- AMSR-E/
- MWRI/SMAP;
- MODIS/VIIRS

Methodology:
- SPI/VHI
- SM anomaly
- NDVI anomaly

Temporal and spatial resolution:
- Daily-Monthly
- 1km-25km

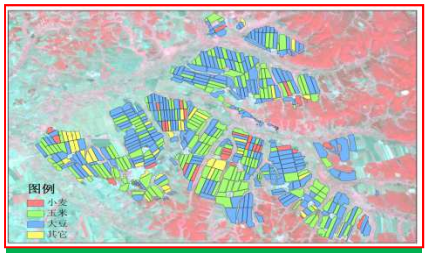
Country/region

Data:
- MODIS
- FY-3/MERSI
- VIIRS

Methodology:
- VCI/TCI/NDWI
- ESI/TANDVI
- SM anomaly

Temporal and spatial resolution:
- Daily-Monthly
- 250m-1km

Field



Data:
- HJ-1A/B CCD
- GF-1/2
- Sentinel-1/2

Methodology:
- NDWI
- MPDI
- ESI

Temporal and spatial resolution:
- variable
- 30m/10m

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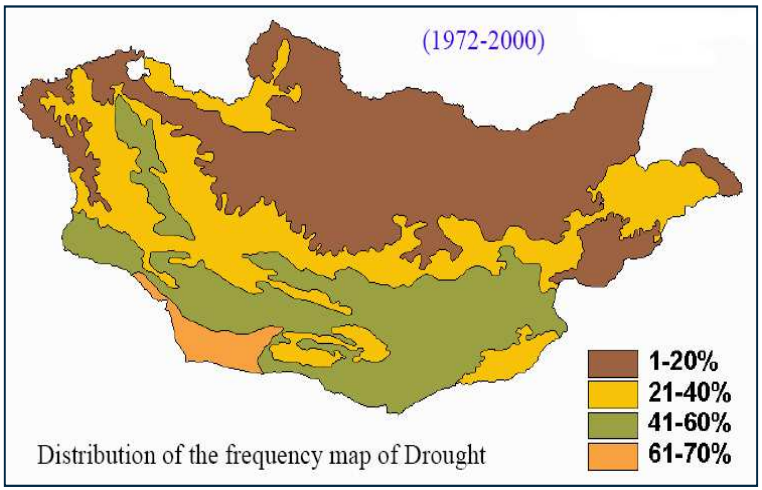
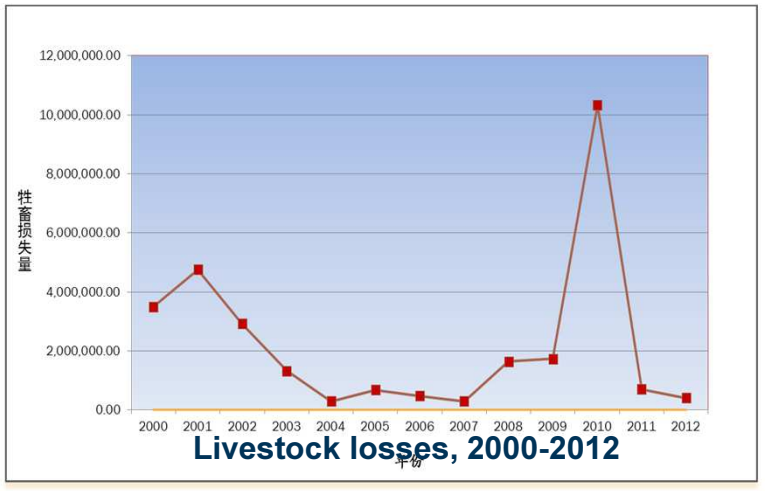
Mongolian Drought

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).**



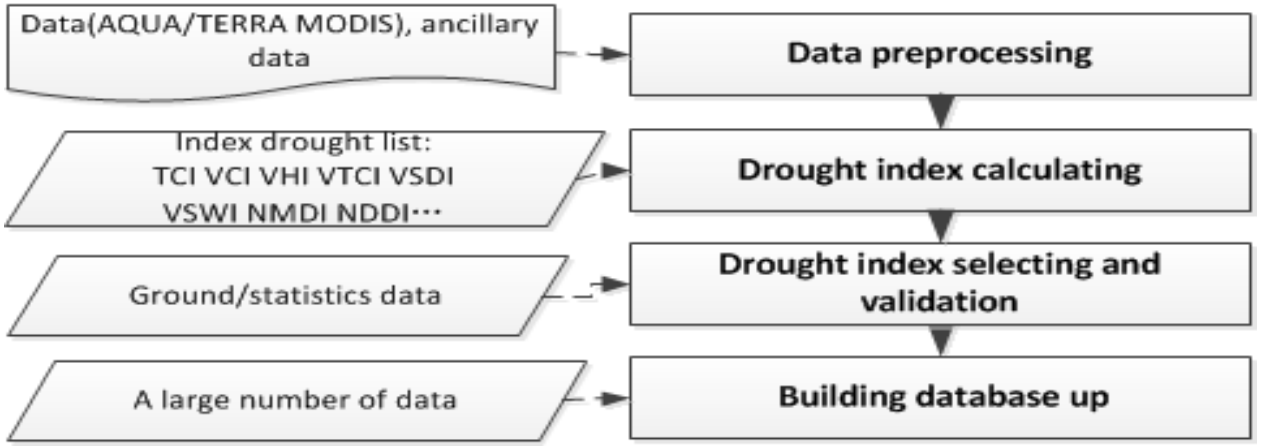


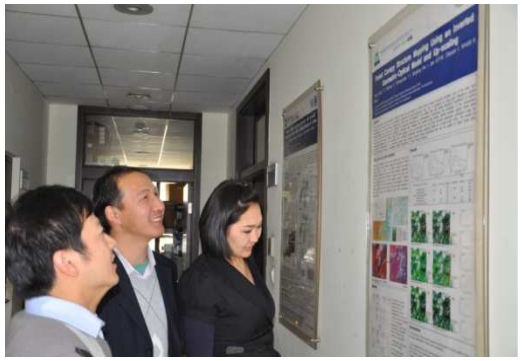
Objectives and Contents

- **Developing drought monitoring methods for Mongolia**
  - Indicator selection
  - Validation
  - Localization
  - Building up the spatial information database
- **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

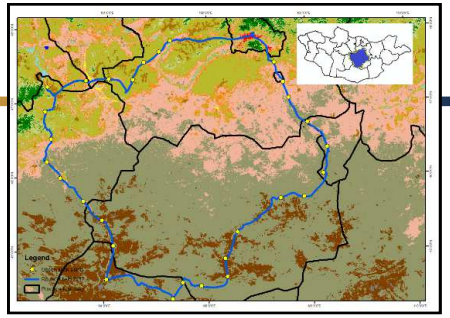
Joint work on data processing

Data processing, building database, indices selection were achieved jointl by China and Mongolia experts in RADI (2014-2018)

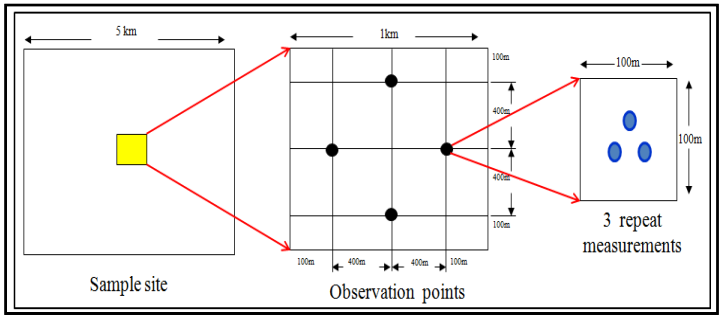




Joint field works

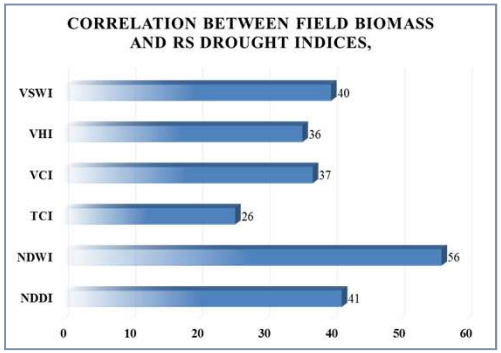


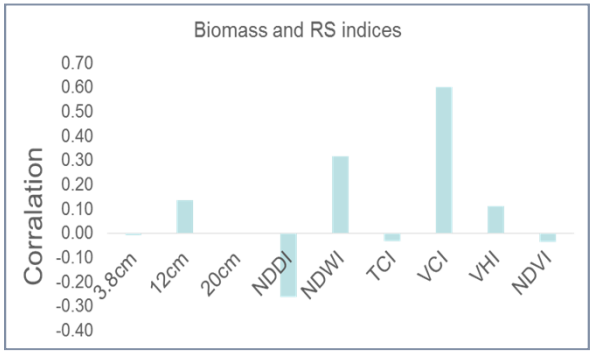
- Parameters: Soil moisture, vegetation biomass, height, coverage, biodiversity, livestock loss number by drought and spectrum.
- Participants: IRIMHE and RADI.
- 2014 to 2017 (July to August)



Joint Validation

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

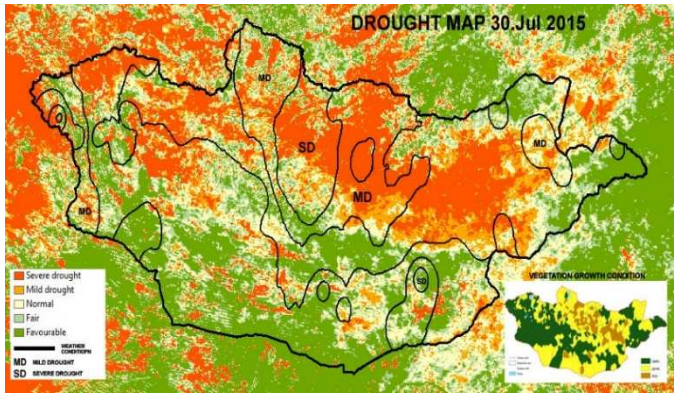




	BIOMASS ce/ha (averaged by two plot)	NORMAL	ANOMAL
VHI	0.42	0.76	0.69
TCI	0.55	0.78	0.67
VCI	0.45	0.29	0.09
NDDI	0.29	0.09	0.12
VSWI	-0.13	-0.05	0.34
NDVI	0.55	0.08	-0.45

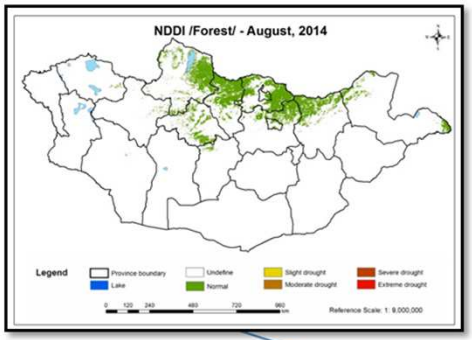
Decade	5_3	6_1	6_2	6_3	7_1	7_2	7_3	8_1	8_2	8_3	9_1	9_2	9_3
May-I-VHI	-0.09	0.16	-0.12	0.05	0.16	0.31	0.13	0.08	0.08	0.11	0.22	0.37	-0.23
May-II-VHI	0.11	0.33	0.19	0.32	0.47	0.47	0.41	0.14	0.22	0.25	0.35	0.45	0.16
May-III-VHI	0.25	0.52	0.48	0.62	0.53	0.11	-0.03	0.01	-0.13	0.06	-0.11	0.12	-0.29
June-I-VHI		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							0.60	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

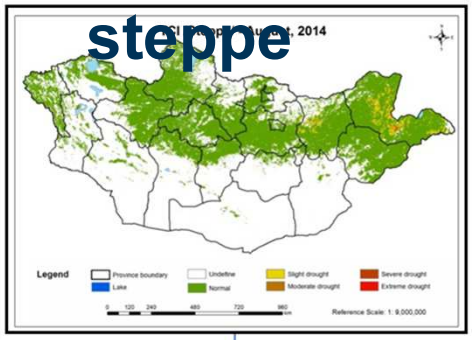
R2	NDDI	VSWI	TCI	VCI	VHI
Soil moisture(TDR,12CM)	0.545	0.690	0.774	0.773	0.877
Soil moisture(TDR,20CM)	0.765	0.623	0.823	0.749	0.890
Soil moisture(EBA,10CM)	0.073	0.194	0.171	0.189	0.204

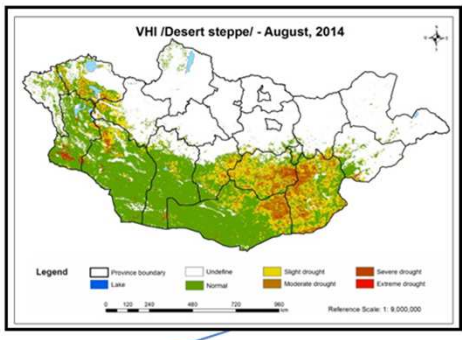


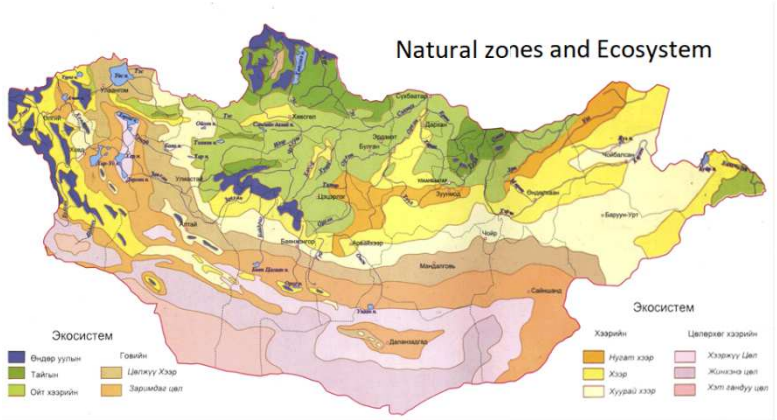
Localization for local ecosystem

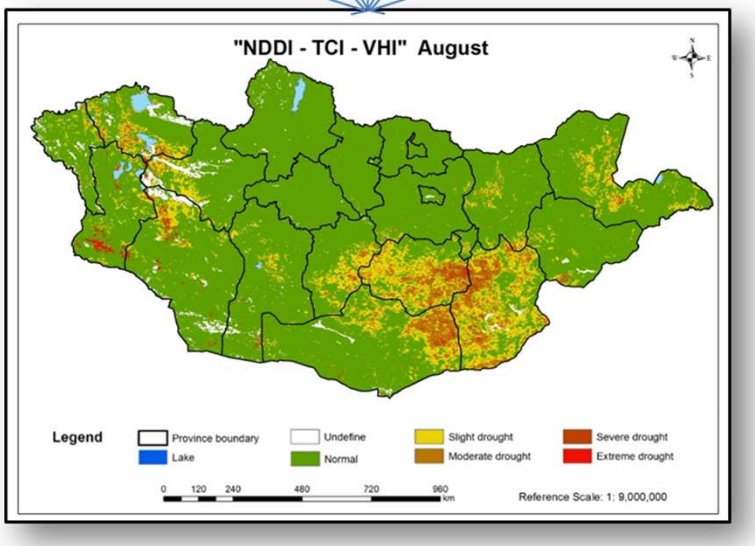
Forest steppe & steppe & desert steppe







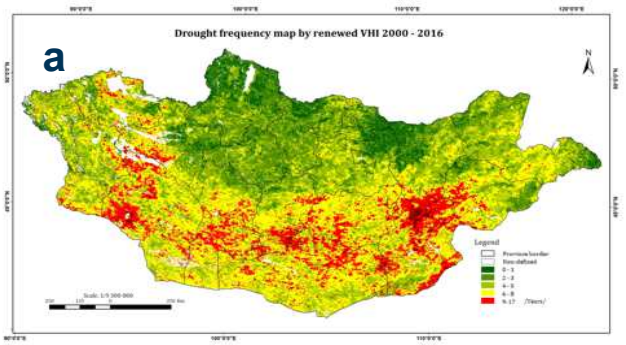


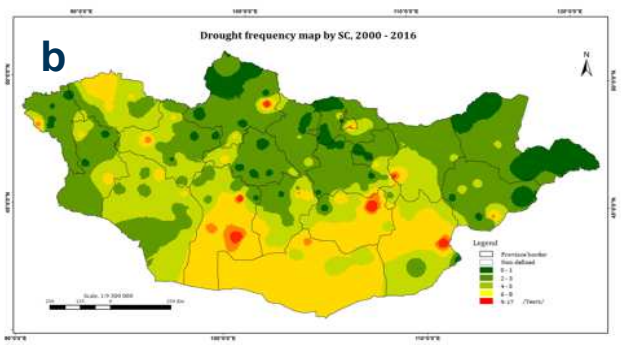


Localization for seasonal variation

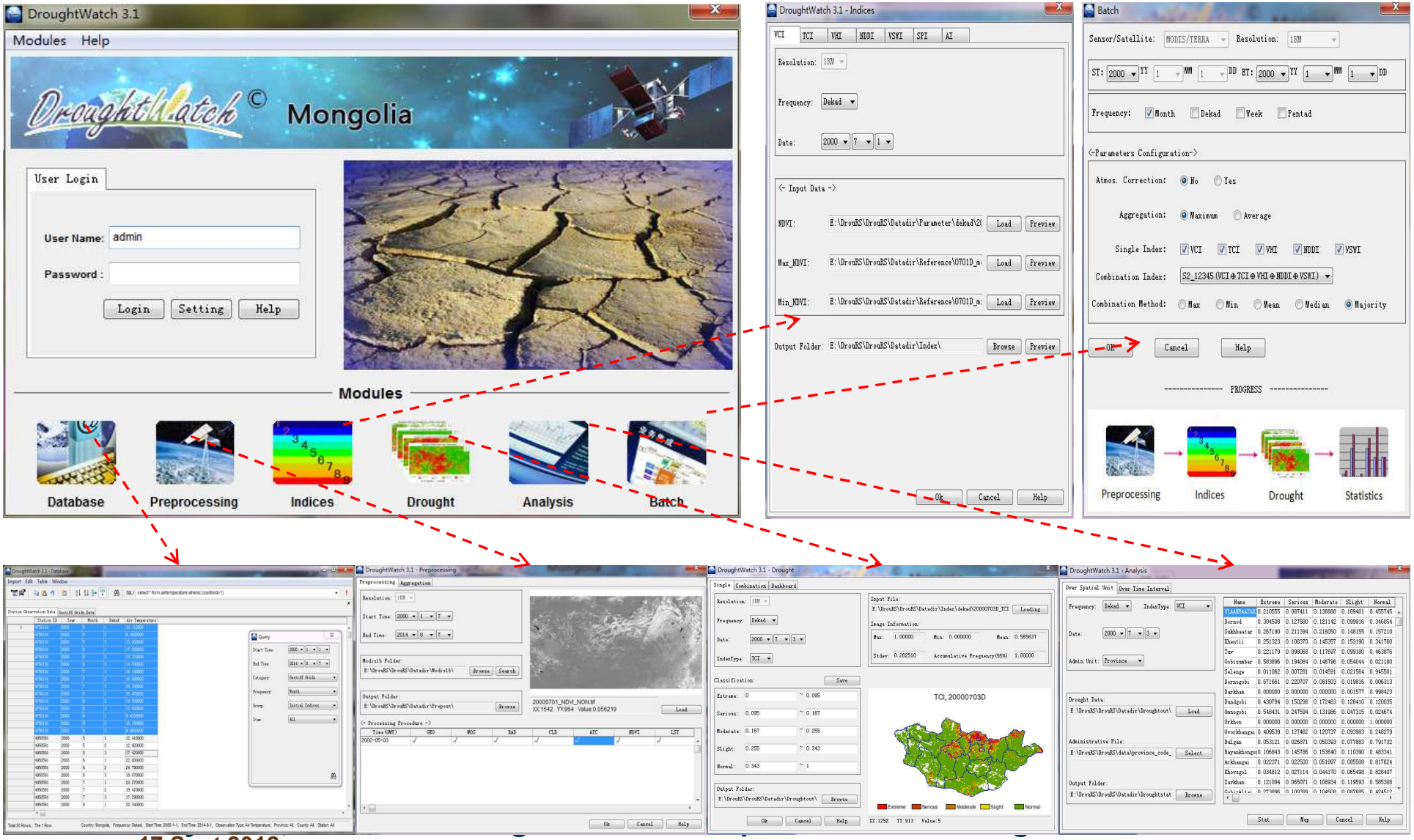
- **Calculated the regression coefficients using fenced biomass against the two variables (TCI, VCI)**
- $nVHI = Wvci * VCI + Wtci * TCI$
- **The drought frequency maps based on nVHI and Summer condition 2000 – 2016**

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





System Customization



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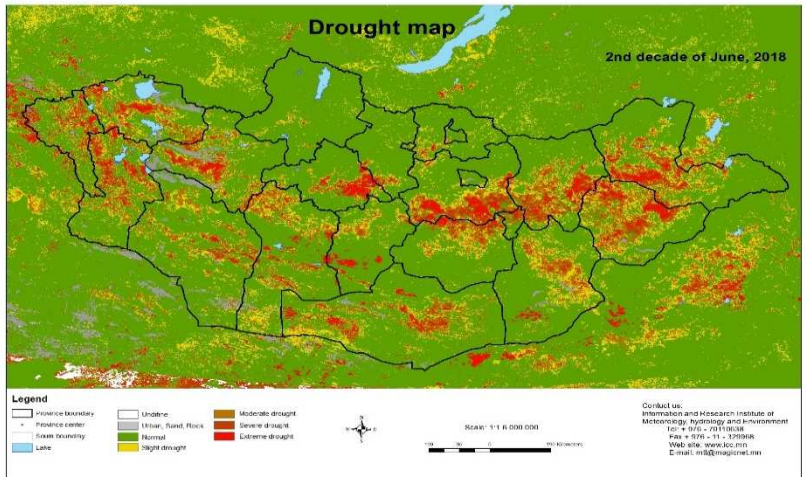
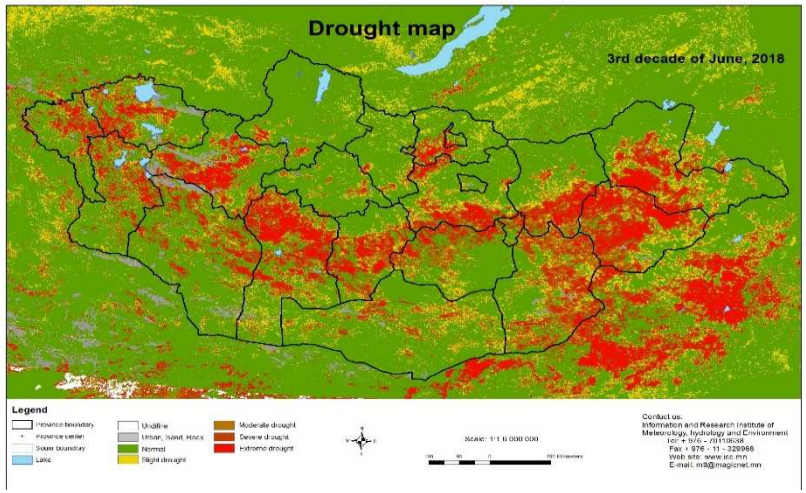
to 15.00 the operational aspects of the

Monitoring Results

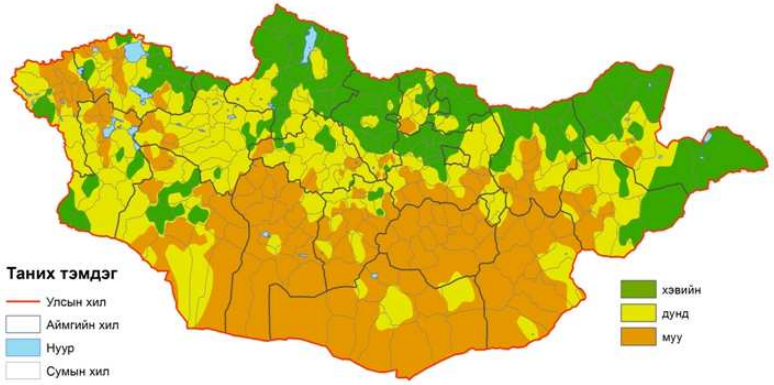
Remote sensing drought map /2nd decade, June 2018/



/3rd decade, June 2018/

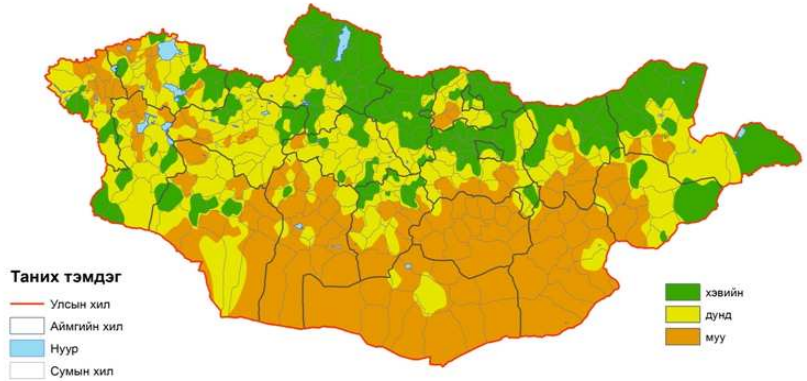


Summer condition /2nd decade, June 2018/



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

/3rd decade, June 2018/

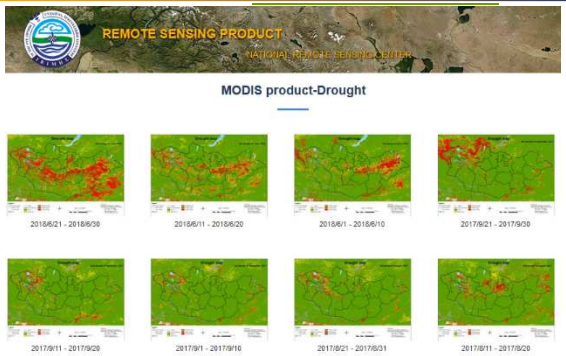


3 дугаар зураг. Ургамлын ургалтын байдал
2018 оны 6 дугаар сарын 30-ны байдлаар

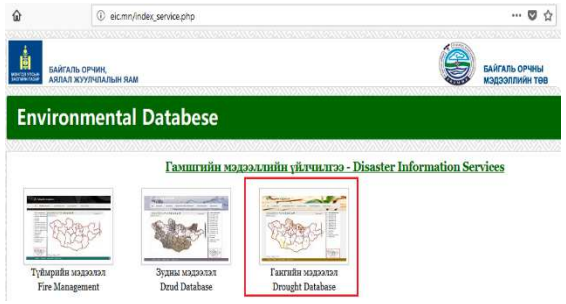
Summer condition assessed by observers at Meteorological stations

Products dissemination to users

www.icc.mn



www.eic.mn



http://irimhe.namem.gov.mn

Drought product dissemination to local meteorological departments by internal network

Servicing to organizations

Ministry of Nature, Environmental and Tourism

Ministry of Food, Agriculture and Light Industry

THE GOVERNMENT OF MONGOLIA
NATIONAL EMERGENCY MANAGEMENT AGENCY
101
105

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




Experiences and Lessons

- **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**
- **Stakeholder engagement**
  - Need to give more training or advertisement to other users about the drought products
  - Make stakeholder use of products
- **Extending to other fire, dzud, and crop**

CropWatch for Mongolia

- **Odbayar was invited to Sanya meeting in last August,**
- **One student is studying Crop Monitoring for Mongolia**
- **Customizing CropWatch for local requirements**
- **Following the regional drought mechanism**
  - ESCAP coordination and support
  - Ownership and full technical transfer
  - CAS support and commitment

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CropWatch Cloud

Cropwatch **Pro**

Enter

CropWatch-Pro

- An online tool for people to produce crop monitoring products at any time and anywhere.

CropWatch **Explorer**

Enter

CropWatch-Explore

- An online interface for people to explore and analysis all the crop information data easily.

Cropwatch **Project**

Enter

CropWatch-Project

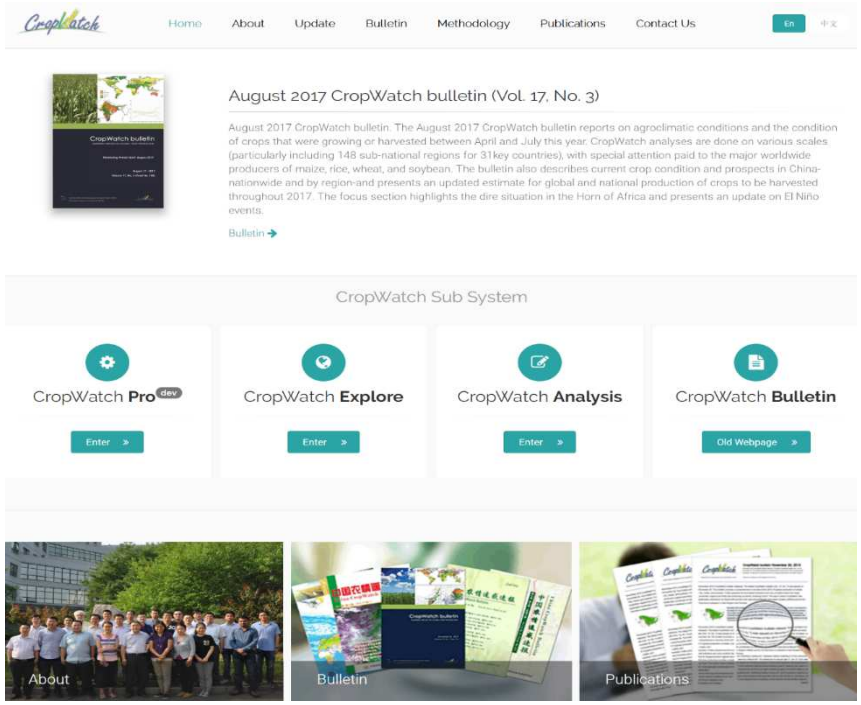
- An online platform for people to create and write the crop bulletin.

Cropwatch **Bulletin**

Enter

CropWatch-Bulletin

- An webpage for people to read CropWatch bulletin.

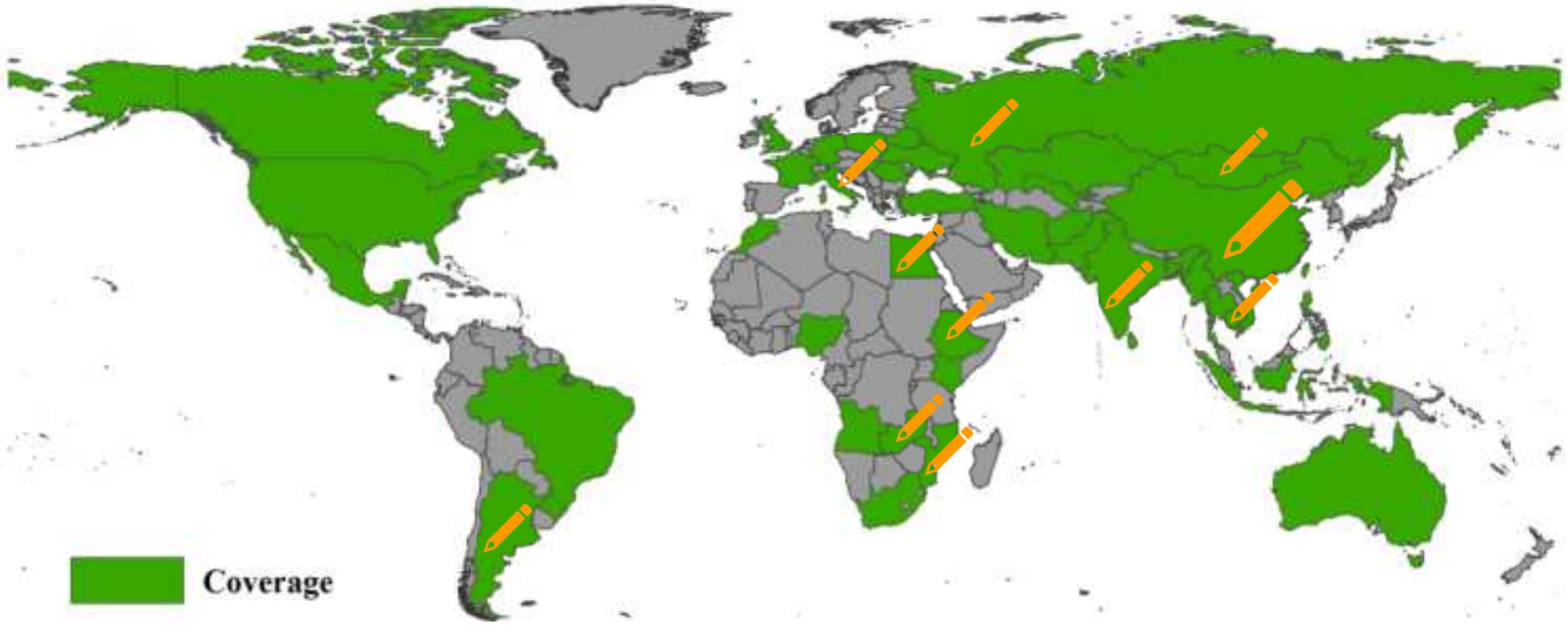


Comprehensive report

- Quarterly CropWatch Bulletins
- Annual report

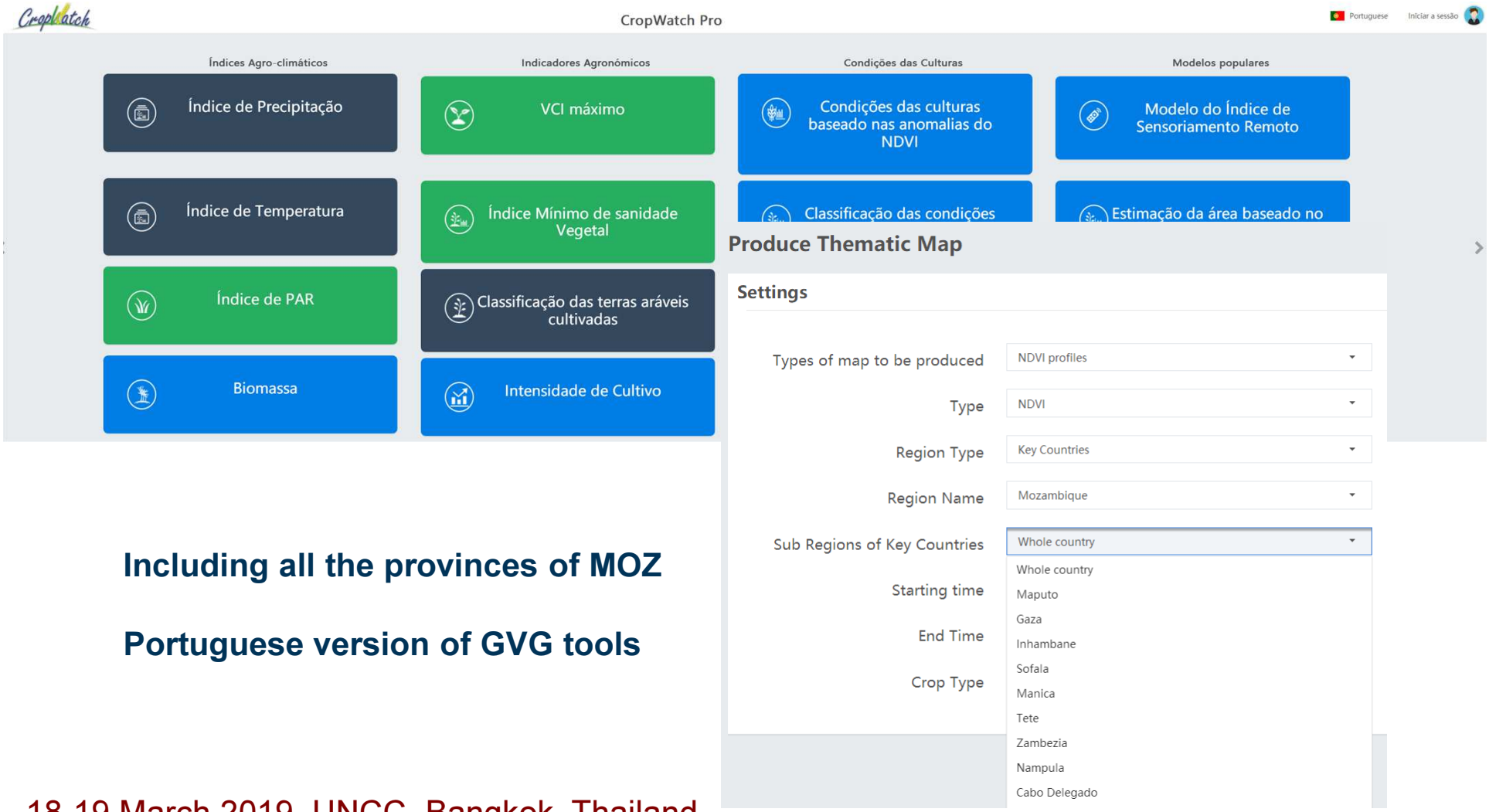
Joint Analysis

37 experts for 42 countries



CropWatch for Mozambique

Portuguese Interface

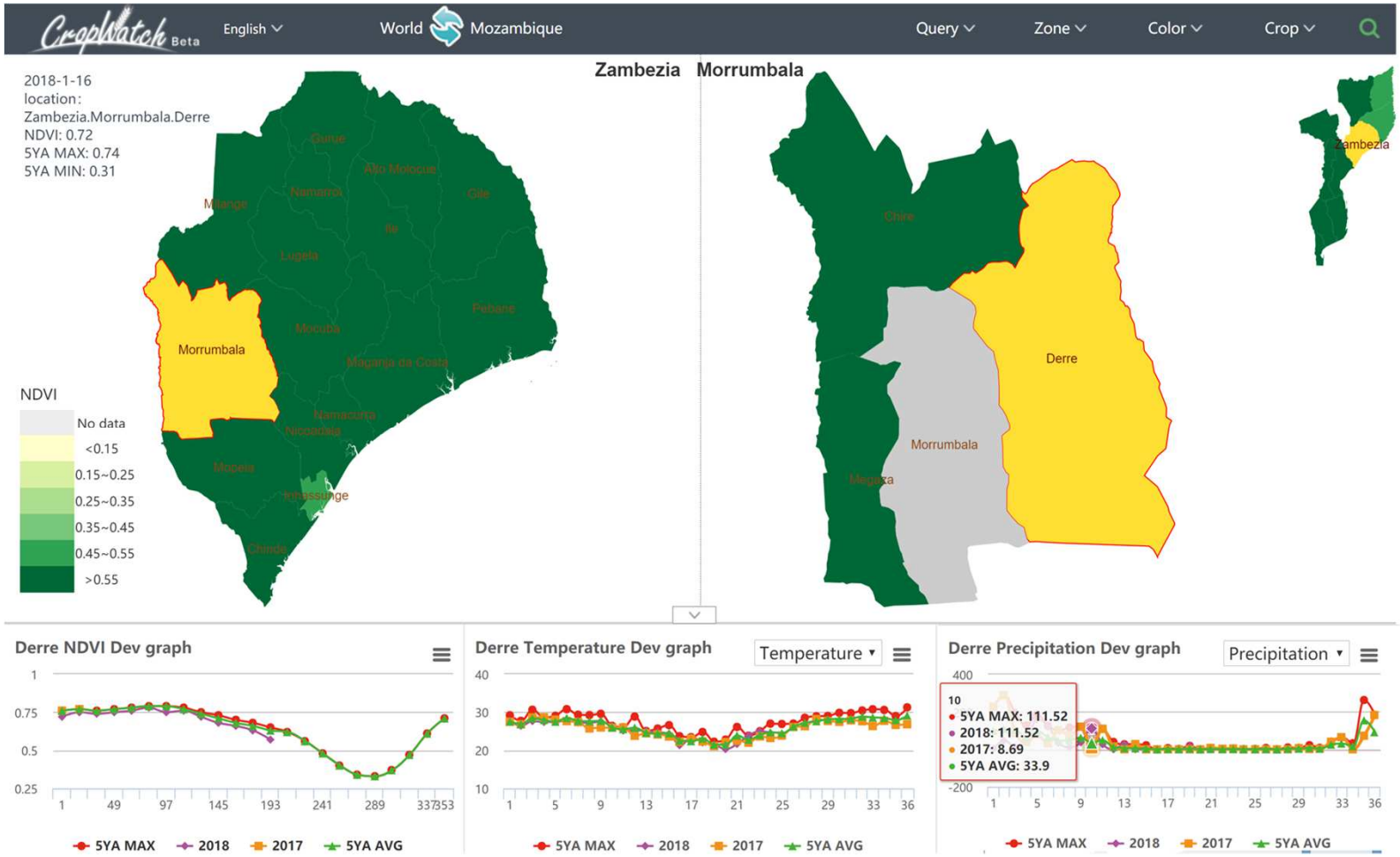


Including all the provinces of MOZ

Portuguese version of GVG tools

CropWatch for Mozambique

Crop condition for every districts and regions for Mozambique



18-19 March 2019, UNCC, Bangkok, Thailand

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DIRECÇÃO NACIONAL DE AGRICULTURA E SILVICULTURA–MASA

DEPARTAMENTO DE CULTURAS E AVISO PRÉVIO

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Campanha Agrícola 2017/18
Publicado em: 15/06/2018

BOLETIM AGROMETEOROLÓGICO

Em Foco

- *Registo de precipitação muito abaixo do normal, na região Sul do país e* ***acima do normal*** *nas regiões Centro e Norte, no período de Outubro de 2017 à Março de 2018;*
- *Registo de perda de cerca de* ***275 mil hectares*** *de culturas diversas devido aos efeitos combinados de inundações, estiagem e lagarta do funil ao nível do país;*
- *Boas Perspectivas de Produção das principais culturas alimentares na Campanha Agrícola 2017/18;*
- *Preços de principais produtos agrícolas, com tendências de redução ao nível dos principais mercados do país;*

PRECIPITAÇÃO REGISTADAS E ACUMULADA DE OUTUBRO DE 2017 Á MARÇO DE 2018

O período entre Outubro e Dezembro de 2017 foi caracterizado por precipitação irregular e escassa nas regiões Sul e partes do Centro do País. Na região Norte, incluindo as províncias de Sofala e Zambézia (região Centro), a precipitação registada no mês de Dezembro, mostrou-se regular, com valores entre 300 e 500 mm, tendo atingido valores superiores a 500 mm em alguns distritos isolados, no mês de Dezembro.

De Janeiro a Março de 2018, houve queda regular e excessiva de precipitação em quase todo o país, sobretudo no mês de Janeiro. Na região Sul, a precipitação registada não foi sufuciente para as culturas, o que causou stress hídrico e falhas no desenvolvimento das culturas.

Na região Centro, as chuvas foram intensas sobretudo nas províncias de Sofala, Manica e Zambézia, com registo acumulado entre 500 e 1000 mm, causando igualmente inundações. Na província de Tete a precipitação foi inferior a 500 mm, excepto nos distritos situados no planalto, onde tiveram registo entre 500 e 1000 mm.

Na região Norte do País, as chuvas foram intensas com valores superiores a 500 mm verificado níveis aceitáveis para um bom desenvolvimento das culturas nesta região, não obstante o registo de inundações ocorridas no mês de Janeiro. (fig. 1).

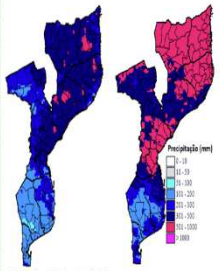


Fig.1: Precipitação registada durante a Época Chuvosa 2017/18

DESVIO DE PRECIPITAÇÃO REGISTADO DE OUTUBRO DE 2017 Á MARÇO DE 2018

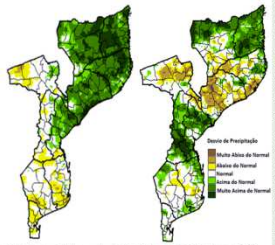


Fig.2: Desvio padrão da precipitação durante a Epoca Chuvosa 2017/18

Em geral, a precipitação registada entre os meses de **Outubro e Dezembro de 2017** no país, foi irregular e esteve **abaixo do normal**, nas regiões Sul (Maputo, Gaza e Inhambane) e partes da região Centro (Manica, Tete e distritos a Sul de Sofala). Nas restantes provincias de Centro e Norte, a precipitação foi regular e **acima do normal.** (Fig.2)

Entre os meses de **Janeiro e Março de 2018**, a precipitação esteve **muito acima do normal** nas provincias de Manica, Sofala (região Centro), Cabo Delgado e Niassa (região Norte) e **abaixo do normal** nas regiões Centro (Tete e Zambézia) e Norte (Nampula e Sul de Niassa).

Na região Sul, em geral, registou-se precipitação **normal e abaixo do normal** em alguns distritos do interior de Gaza e Inhambane.

1

ÍNDICE DE SATISFAÇÃO HÍDRICA DAS CULTURAS

O **Índice de Satisfação Hídrica (WRSI)** das cultura da 1ª época em geral **foi considerado bom** para região Norte, médio à medíocre para a região Centro e pobre para a região Sul do país.(fig. 3)

Na **Regiões Sul**, as culturas da 1ª época foram colhidas até o mês de Março. O índice de satisfação hídrica (WRSI) foi pobre, o que pressupõe produtividade das culturas baixa e consequentemente produção não satisfatória.

Na **Região Centro**, as culturas da 1ª época foram colhidas até o mês de Abril. Em geral, o WRSI nesta região é considerado de médio, pese embora em alguns distritos da província de Tete, Manica, Sofala e Zambézia, o índice ter sido afectado pela irregularidade da precipitação.

Na **Região Norte**, as culturas foram colhidas até finais do mês de Maio. O WRSI foi considerado bom a muito bom, o que pressupõe boa produtividade e produção nas principais culturas da 1ª época.

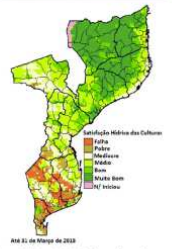


Fig.3: WRSI até finais de Março de 2018

ANÁLISE DE NDVI

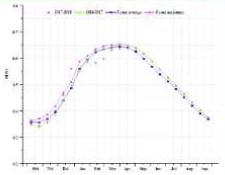
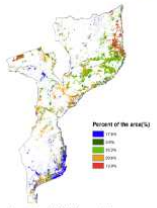


Fig.4: NDVI Profile ao nível do País

A análise de desenvolvimento das culturas baseado no NDVI a nível nacional (fig 4), demonstram que as condições para desenvolvimento das culturas foram desfavoráveis desde o inicio do mês de Março, estas condições foram recuperando, chegando a situar-se próximo da média dos últimos 5 anos.

O gráfico abaixo (fig 5), mostra que os padrões de partida de NDVI epacial associados aos perfis de NDVI, indicam diversidade de comportamento antes do mês de Fevereiro, com partes das provincias de Cabo Delgado, Nampula, Tete e Gaza acima da media e outras abaixo (5.6%). A partir de Fevereiro, os padrões de NDVI estiveram situados notavelmente perto da media. Em resum, entre os meses de Janeiro a Abril de 2018, a maior parte das áreas cultivadas (43%), estavam em condições abaixo da média dos últimos cinco anos.



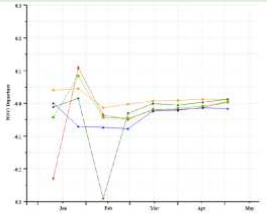


Fig.5: Padroes departida do NDVI espacial

3

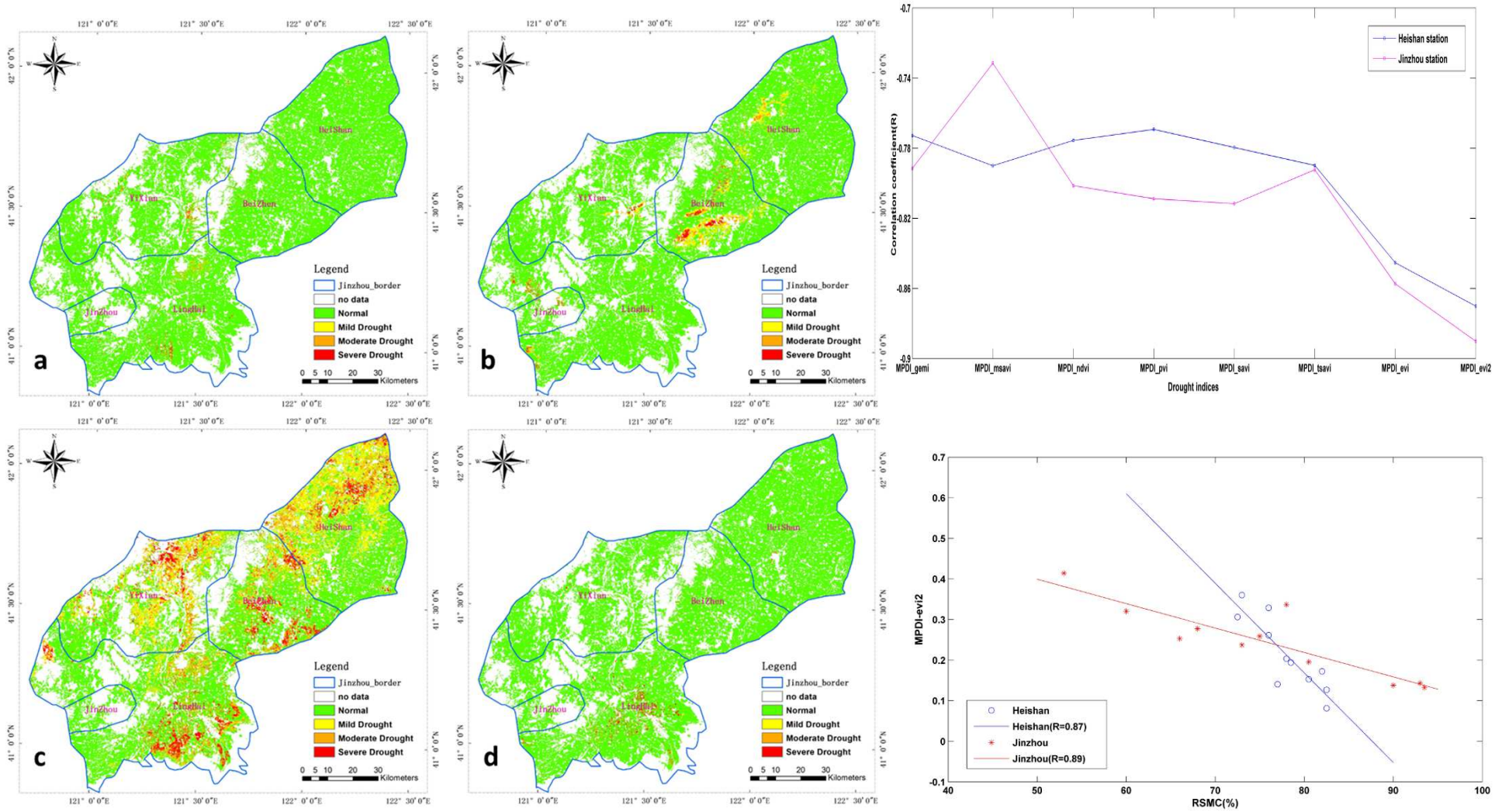
Outline

- Introduction
- DroughtWatch
- DroughtWatch for Mongolia
- CropWatch Cloud
- Recommendations

Recommendation

- **Ownership**
- **Full technical transfer and capacity building**
  - On job training
  - Degree students
  - Localization of models
- **Stakeholders needs to engage at the earlier stage**
- **Drought forecast and impact assessment,**
  - Crop
  - Rangeland
- **Use new satellite data to detect drought impact at detail**

GF-1 Drought detection (16m)



Thank you for your attention!