



Institute of Remote Sensing and Digital Earth
Chinese Academy of Sciences

Introduction and operation of DroughtWatch

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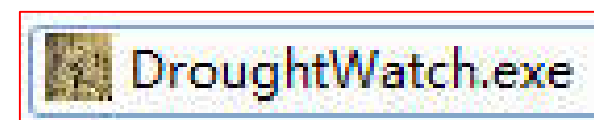
**Institute of Remote Sensing and Digital Earth (RADI)
Chinese Academy of Sciences (CAS)**



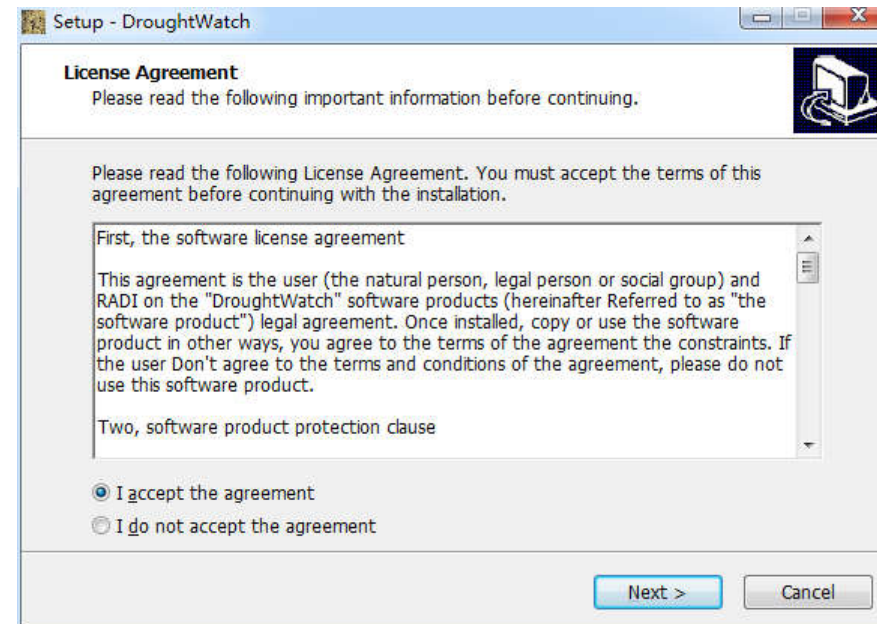
DroughtWatch installation



- ❑ Double-click the icon
- ❑ Installing the system step by step
- ❑ The DroughtWatch data directory should be given



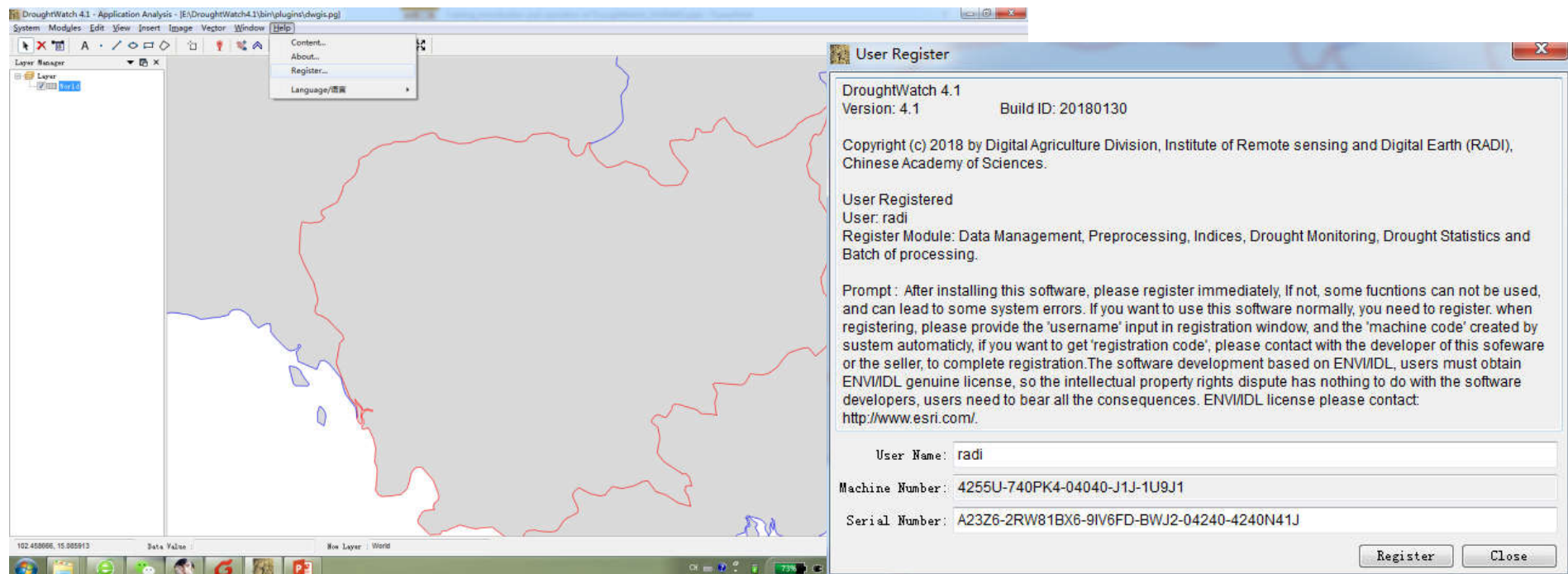
- ❑ Installing basic software(MRTSWATH)
- ❑ copy the whole folder to root path in C disk



DroughtWatch configuration



- ❑ Open the DroughtWatch system
- ❑ Select “help”, and then “Register”, see below picture:
- ❑ Please send your register information(user name and machine number) to my email(changsheng@radi.ac.cn)
- ❑ Then I will give you the serial number to you separately.
- ❑ Finally you should copy the serial number to your user register interface.



DroughtWatch configuration



- ❑ Satellite data should be put in the specified path.

Such as:

(E:\DroughtWatch4.1\bin\data\KHM\Originaldata\MODIS1b)

(E:) > DroughtWatch4.1 > bin > data > KHM > Originaldata > MODIS1b			
帮助(H)			
新建文件夹			
名称	修改日期	类型	大小
MOD03.A2015153.0320.006.2015153094547.hdf	2016/1/29 3:57	HDF 文件	38,626 KB
MOD03.A2015153.0325.006.2015153094545.hdf	2016/1/29 3:54	HDF 文件	30,463 KB
MOD03.A2015156.0350.006.2015156092359.hdf	2016/1/29 3:59	HDF 文件	44,180 KB
MOD03.A2015156.0355.006.2015156111046.hdf	2016/1/29 3:58	HDF 文件	30,712 KB
MOD021KM.A2015153.0320.006.2015153135555.hdf	2016/1/28 8:41	HDF 文件	155,513 KB
MOD021KM.A2015153.0325.006.2015153135628.hdf	2016/1/28 8:54	HDF 文件	168,073 KB
MOD021KM.A2015156.0350.006.2015156142031.hdf	2016/1/29 5:38	HDF 文件	156,182 KB
MOD021KM.A2015156.0355.006.2015156142116.hdf	2016/1/29 6:22	HDF 文件	168,427 KB

- ❑ Basic data should be put in the specified path.

Such as:

(E:\DroughtWatch4.1\bin\data\KHM\Reference)

(E:) > DroughtWatch4.1 > bin > data > KHM > Reference			
帮助(H)			
放映幻灯片 新建文件夹			
名称	修改日期	类型	大小
0601D_maxlst_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:26	TIF 文件	1,426 KB
0601D_maxndvi_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:25	TIF 文件	1,426 KB
0601D_minlst_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:26	TIF 文件	1,426 KB
0601D_minndvi_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:25	TIF 文件	1,426 KB
0601P_maxlst_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:26	TIF 文件	1,426 KB
0601P_maxndvi_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:25	TIF 文件	1,426 KB
0601P_minlst_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:26	TIF 文件	1,426 KB
0601P_minndvi_MODIS1b_KHM_1KM_MAX_2015.tif	2016/2/1 17:25	TIF 文件	1,426 KB

MODIS 1b data downloading



<https://ladsweb.modaps.eosdis.nasa.gov/search/order/>

Option of products

The screenshot shows the LAADS DAAC search interface. The top navigation bar includes links for About LAADS, Find Data, Data Discovery, Quality, Help, and Profile. The main search area has tabs for PRODUCTS, TIME, LOCATION, FILES, and REVIEW & ORDER. The PRODUCTS tab is active, showing a list of products under the MODIS/Terra collection. The left sidebar contains search filters for Filename Search, Image Viewer, Load/Save Search, and Past Orders. The main content area displays a list of products with their names and descriptions. The products are organized into categories: All [56], Level-0 / Level-1 [7], Atmosphere [10], and Land [29]. The Atmosphere category is expanded, showing a list of products including MOD00F, MOD01, MOD021KM, MOD02HKM, MOD02OBC, MOD02QKM, MOD02SSH, MOD03, and MOD04_3K. The MOD021KM and MOD03 products are highlighted in green.

Product Name	Description
MOD00F	MODIS/Terra Level 0 Raw Instrument Packets (5 minutes)
MOD01	Level 1A Scans of raw radiances in counts
✓ MOD021KM	Level 1B Calibrated Radiances - 1km
MOD02HKM	Level 1B Calibrated Radiances - 500m
MOD02OBC	Level 1B Onboard Calibrator/Engineering Data
MOD02QKM	Level 1B Calibrated Radiances - 250m
MOD02SSH	MODIS/Terra Level 1B Subsampled Calibrated Radiances 5km
✓ MOD03	Geolocation - 1km
MOD04_3K	MODIS/Terra Aerosol 5 Min L2 Swath 3km

MODIS 1b data downloading



Select the date range

NASA LAADS DAAC

About LAADS Find Data Data Discovery Quality Help Profile

1 PRODUCTS 2 TIME 3 LOCATION 4 FILES 5 REVIEW & ORDER

2 products selected 2017-06-01 .. 2017-06-02 W: 101°, N: 15°, E: 108°, S: 9° 6 files selected reset

Date Range Single Date

Display as: YYYY-MM-DD

2017-06-01 - 2017-06-02

Add Date

+ Advanced

Date Selection: Clear All

2017-06-01 .. 2017-06-02

Coverage Selection:

☒ Day (granules contain day data only)

☐ Night (granules contain night data only)

☐ Day-Night Boundary (granules contain data over the seasonal, latitude boundary between day and night)

MODIS 1b data downloading



Determine the range of needed data

The screenshot shows the LAADS DAAC website interface. The browser address bar displays the URL <https://ladsweb.modaps.eosdis.nasa.gov/search>. The page has a dark blue header with the NASA logo and "LAADS DAAC" text. Navigation links include "About LAADS", "Find Data", "Data Discovery", "Quality", "Help", and "Profile". A progress bar at the top indicates five steps: 1. PRODUCTS, 2. TIME, 3. LOCATION (active), 4. FILES, and 5. REVIEW & ORDER. Below the progress bar, search criteria are shown: "2 products selected", "2018-03-21 .. 2018-04-04", "W: 101°, N: 15°, E: 108°, S: 9°", and "No files selected.". A "reset" button is on the right. The main area features a world map with a red box highlighting a region in East Asia. On the right, a "SELECT AREA OF INTEREST" panel is open, showing options like "World", "Countries", "Tiles", "Validation Sites", and "Draw Custom Box (Classic)". The "Enter Coordinates" section is active, showing "Lon, Lat, Lon, Lat" selected with radio buttons. The input fields contain "Lon: 101, 15, 108, 9" and "Lat: 25.98°, Lon: 14.01°". The "Current selection:" section shows "W: 101°, N: 15°, E: 108°, S: 9°" with a red "X" icon. The footer includes the NASA logo, "Level-1 and Atmosphere Archive & Distribution System", and a link to "Privacy Policy and Important Notices".

MODIS 1b data downloading



Select the data

NASA LAADS DAAC

About LAADS Find Data Data Discovery Quality Help Profile

1 PRODUCTS 2 TIME 3 LOCATION 4 FILES 5 REVIEW & ORDER

2 products selected 2017-06-01 ... 2017-06-02 W: 101°, N: 15°, E: 108°, S: 9° 6 files selected reset

* Download selected files as json or csv

Search: Showing 1 to 6 of 6 entries Select All Clear All

Filename	Product (collection)	Image	Date / Time	Download
MOD021KM.A2017152.0400.006.2017152133257.hdf	MOD021KM (6)		2017-06-01 04:00:00	170 MB
MOD021KM.A2017153.0440.006.2017153132134.hdf	MOD021KM (6)		2017-06-02 04:40:00	160 MB
MOD021KM.A2017153.0305.006.2017153132206.hdf	MOD021KM (6)		2017-06-02 03:05:00	168 MB
MOD03.A2017153.0305.061.2017314185305.hdf	MOD03 (61)		2017-06-02 03:05:00	31 MB
MOD03.A2017153.0440.061.2017314190034.hdf	MOD03 (61)		2017-06-02 04:40:00	38 MB
MOD03.A2017152.0400.061.2017314200005.hdf	MOD03 (61)		2017-06-01 04:00:00	32 MB

Showing 1 to 6 of 6 entries Previous 1 Next

Query Results Selected (6) Images

Search by Product Online Archive Filename Search Image Viewer Load/Save Search Past Orders

MODIS 1b data downloading



Order the selected data

The screenshot shows the LAADS DAAC web interface at the 'REVIEW & ORDER' stage. The top navigation bar includes links for 'About LAADS', 'Find Data', 'Data Discovery', 'Quality', 'Help', and 'Profile'. The main interface has a sidebar on the left with icons for 'Search by Product', 'Online Archive', 'Filename Search', 'Image Viewer', 'Load/Save Search', and 'Past Orders'. The main content area displays a progress bar with five steps: 1. PRODUCTS, 2. TIME, 3. LOCATION, 4. FILES, and 5. REVIEW & ORDER (highlighted). Below the progress bar, a summary bar shows '2 products selected', the time range '2017-06-01 ... 2017-06-02', the location 'W: 101°, N: 15°, E: 108°, S: 9°', and '6 files selected'. The 'Files Summary' section lists two products: 'MOD021KM (Collection 6)' and 'MOD03 (Collection 61)', both with a 'Total: 3 files' and a red 'x' icon. On the right, there are three blue buttons: 'Apply Post-Processing', 'Select Delivery Method', and 'Add another search'. A green 'Submit Order' button is at the bottom right. A message states 'The order may generate as many as 6 files.' and a 'reset' link is available.

MODIS 1b data downloading



LAADS Web Order Notification ★

apache user for nonntp servers

发给 changsheng

2018-04-04 15:57 隐藏信息

发件人: apache user for nonntp servers <apache@modx.nascom.nasa.gov>

收件人: changsheng <changsheng@radi.ac.cn>

时间: 2018年4月4日 (周三) 15:57

大小: 6 KB

Your Order ID is: 501224369

FTP access has been DEPRECATED in LAADS. We strongly suggest you migrate to using the HTTP access instructions below.

Additional information on FTP deprecation and HTTP access methods is available at:

<https://ladsweb.modaps.eosdis.nasa.gov/tools-and-services/data-download-scripts/>

The data you ordered will be staged (in about 10 minutes), and you can retrieve the data through HTTP using wget.

If you do not have wget, options for downloading it are available at <https://www.gnu.org/software/wget/faq.html#download>

Alternatively, you may use an HTTP script from the data-download-scripts URL above, or manually download all files from <https://ladsweb.modaps.eosdis.nasa.gov/archive/orders/501224369/>

```
wget -e robots=off -m -np -A "*" -R "*.html" -R "*.tmp" -nH --cut-dirs=3 \  
https://ladsweb.modaps.eosdis.nasa.gov/archive/orders/501224369/ \  
--header "Authorization: Bearer <your appKey>" -P <target dir>
```

Replace the <your appKey> placeholder with your appKey. AppKeys can be created and retrieved at:

<https://ladsweb.modaps.eosdis.nasa.gov/profile/app-keys/>

Replace the <target dir> placeholder with the directory where you wish to save the files.

Explanation of additional options used:

- e robots=off : Bypass the robots.txt file, to allow access to all files in the order
- m : Enable mirroring options (-r -N -I inf) for recursive download, timestamping & unlimited depth
- np : Do not recurse into the parent location
- A "*" : Accept all file patterns for download
- R "*.html" : But reject HTML files (which are extraneous to the order)
- R "*.tmp" : And reject any .tmp files
- nH : Do not create a subdirectory with the host name (ladsweb.modaps.eosdis.nasa.gov)

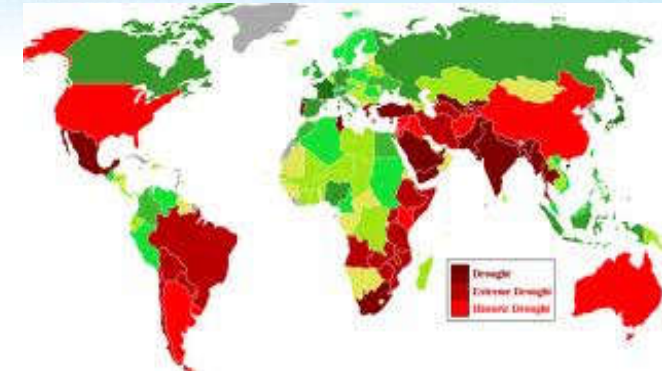
Outline



- **Background**
- Applications
- Methods
- Functions and operations
- Prospects

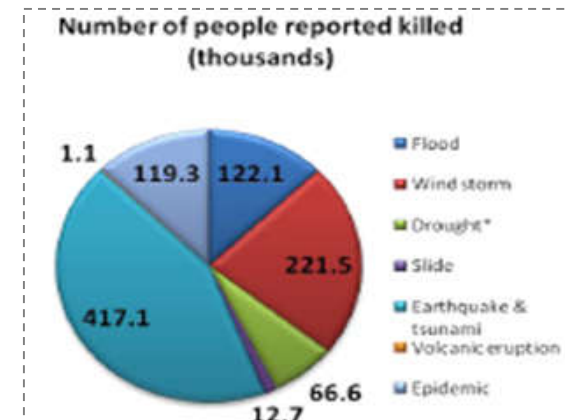
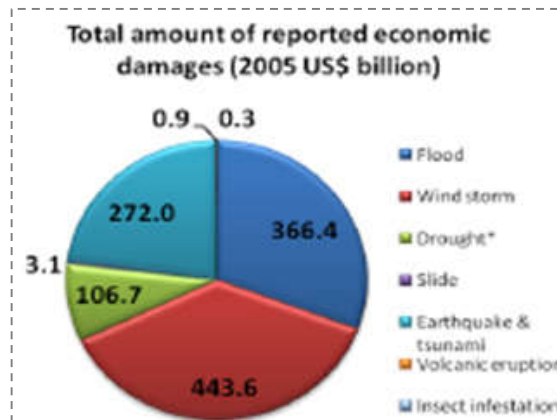
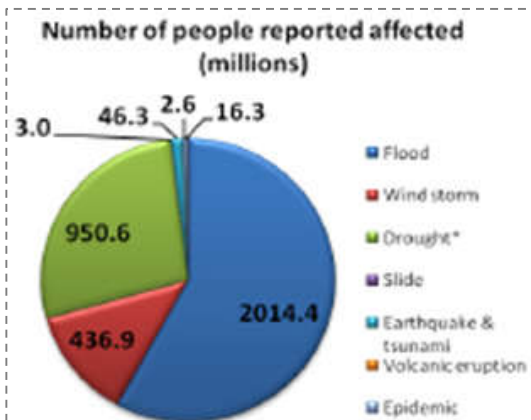
Background

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



(source:unitedcats.wordpress.com)

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



Background

- ❑ Drought produces a complex and serious impacts on the economic, environmental and social respects.
- ❑ Remote sensing technology provides temporally and spatially continuous data, has been useful for monitoring agricultural drought.
- ❑ To improve efficiency of drought monitoring, automatically operation system should be produced.
- ❑ Developing and updating about system for last ten years, the operational and robust drought system(DroughtWatch) emerged.

Outline



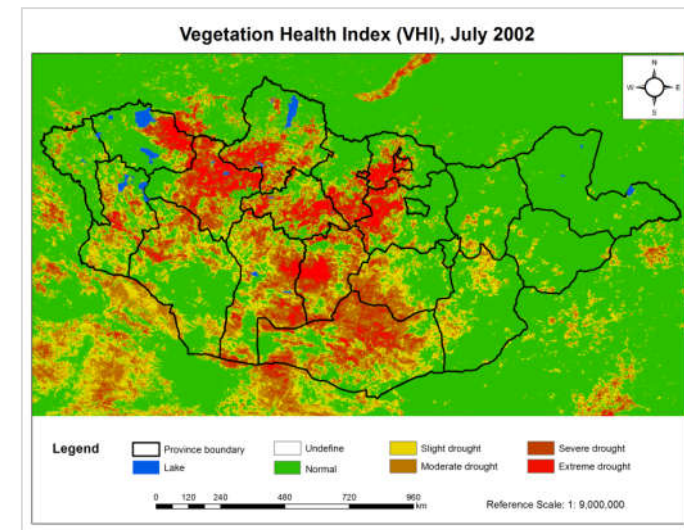
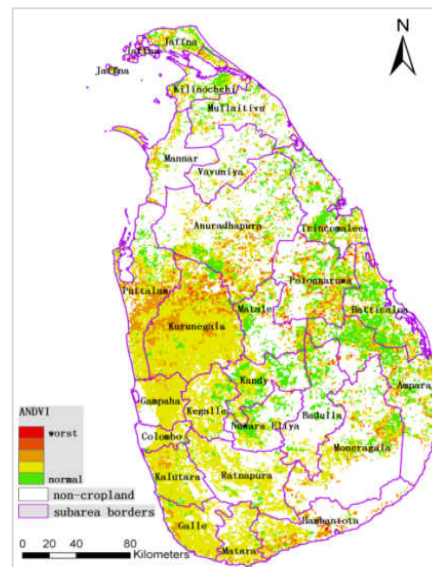
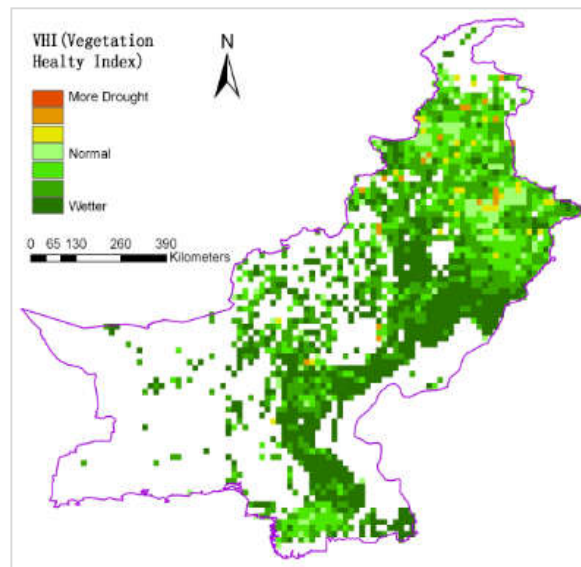
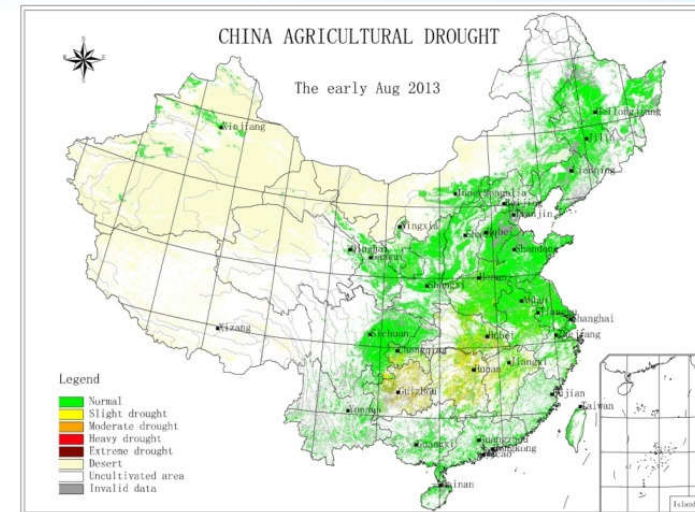
- Background
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Applications



Agricultural drought monitoring was carried out in some countries below by the DroughtWatch:

- ☐ China(2000-2018)
- ☐ Mongolia (2000-2018)
- ☐ Pakistan (2014)
- ☐ Sri lanka (2017)
- ☐ Extend to other countries



Applications



- ❑ DroughtWatch had been deployed to several relative departments of China (agriculture, meteorology, disaster mitigation, water resource and so on).
- ❑ DroughtWatch has been installed, and declaration about the system have been signed by the NRSC of Mongolia, Sri Lanka.

应用证明	
项目名称	国家 863 课题“粮食预警遥感辅助决策系统” 子课题“旱情遥感监测与验证”
应用成果名称	旱情遥感监测系统
应用单位	水利部水利信息中心
通讯地址	北京市宣武区白广路二条
联系电话	010-63202400
应用成果起止时间	2005 年 6 月--
应用情况及社会效益:	
<p>中国科学院遥感应用研究所承担的国家 863 计划“粮食预警遥感辅助决策系统”课题连续 2 年为我单位提供《全国旱情遥感监测报告》(旬报)。</p> <p>并于 2005 年 8 月将“旱情遥感监测系统”移植到水利部水利信息中心运行,通过调试已于 2005 年 9 月投入试运行。系统内容包包括遥感数据标定、几何纠正、气象数据处理、大气校正、BRDF 校正、地表参数提取、MVC 数据拼接、NDVI 与 TS 值计算、指数提取以及遥感指数旱情监测等。</p> <p>系统运行方便、操作简单,实现了 NOAA AVHRR 数据预处理、遥感指数计算以及旱情监测的无缝连接,是一个标准化、规范化的集成系统,在水利系统有很好的应用推广前景。</p> <p>系统提供的旱情监测结果已为全国抗旱决策提供服务。</p>	
用户签名(盖章): 水利部水利信息中心 2009 年 9 月 12 日	

应用证明	
项目名称	基于 MODIS 卫星遥感旱情监测系统改造
应用成果名称	基于 MODIS 的全国旱情遥感监测系统
移植单位	水利部水利信息中心
通讯地址	北京市宣武区白广路二条
联系电话	010-63203517
移植时间	2009 年 12 月
移植内容	系统路径设置, 数据获取子系统(遥感数据获取), MODIS 预处理子系统(文件读取模块、辐射校正模块、几何校正模块、大气校正模块、云标识模块、地表参数提取模块、参数设置模块), 旱情指数计算子系统, 旱情监测子系统。
系统评价:	
<p>基于 MODIS 的全国旱情遥感监测系统于 2009 年 12 月移植到中心, 试运行时间为 2010 年 1 月-2010 年 12 月。系统设置简单, 模块分布合理, 且功能齐全, 运行方便、操作简单, 将各个功能模块都集成在统一的界面下, 是一个标准化规范化的集成系统, 截止目前运行稳定, 可以满足中心业务运行的需求。</p>	
移植单位(盖章): 水利部水利信息中心 2010 年 9 月 11 日	

DECLARATION	
I, the undersigned (name), representing the National Remote Sensing Centre of Mongolia (hereafter referred to as NRSC), declare the following:	
<ul style="list-style-type: none">NRSC has received and installed a test version of DroughtWatch software, developed and owned by CropWatch Unit, Institute of Remote Sensing and Digital Earth (Radi), Chinese Academy of Sciences (hereafter referred to as CropWatch);NRSC will use the software for a period of time (not exceeding 6 months) on an experimental basis, and will report back to CropWatch about any requirements, bugs or deficiencies for improvement;NRSC will sign the licensee agreement with CropWatch once the final version of DroughtWatch has been received and installed in NRSC, the UN ESCAP Representative as witness.	
For NRSC: S. Khudulmur, Director Date: 20 August, 2010	

Outline

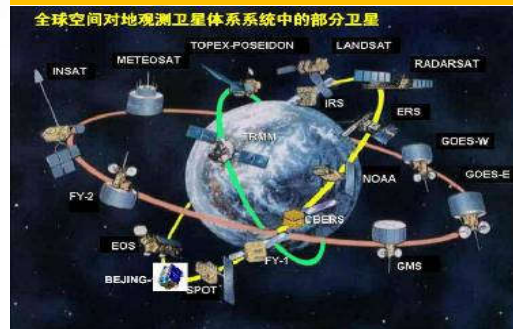


- Background
- Applications
- **Methods**
- Functions and operations
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Methodology



Multi-resource remote sensing



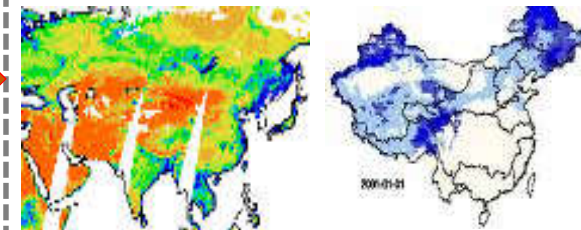
Field observation



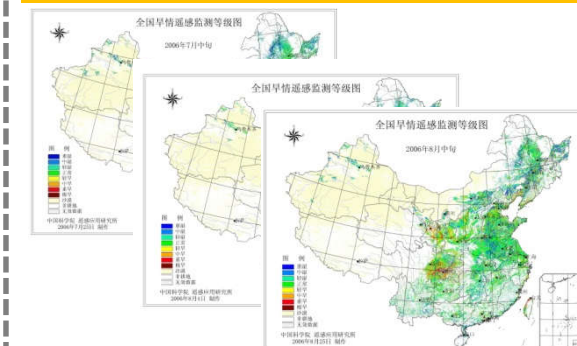
Meteorological data



Data processing Index calculating



Drought monitoring results



Methods



- ❑ By validating and testing, VCI, TCI, VHI, NDWI are suitable for monitoring drought in some countries (China, Mongolia, Pakistan and so on), also emerged NDDI and VSWI index.
- ❑ Later, we should develop **Cambodia drought indices** based on suitability analysis.
- ❑ To compare the RS drought with reference indices, AI and SPI indices calculation methods by meteorological data can be included.

Methods

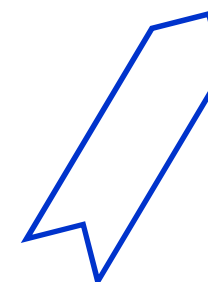
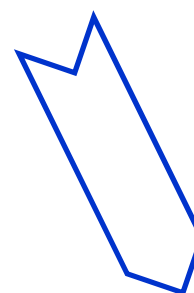


MOD021KM_A2015153_0320_006_2015153135555.hdf

- ☐ 1KM Reflectance (Band 1) [250M Aggr]
- ☐ 1KM Reflectance (Band 2) [250M Aggr]
- ☐ 1KM Reflectance (Band 3) [500M Aggr]
- ☐ 1KM Reflectance (Band 4) [500M Aggr]
- ☐ 1KM Reflectance (Band 5) [500M Aggr]
- ☐ 1KM Reflectance (Band 6) [500M Aggr]
- ☐ 1KM Reflectance (Band 7) [500M Aggr]
- ☐ 1KM Reflectance (Band 8)
- ☐ 1KM Reflectance (Band 9)
- ☐ 1KM Reflectance (Band 10)
- ☐ 1KM Reflectance (Band 11)
- ☐ 1KM Reflectance (Band 12)
- ☐ 1KM Reflectance (Band 13lo)
- ☐ 1KM Reflectance (Band 13hi)
- ☐ 1KM Reflectance (Band 14lo)
- ☐ 1KM Reflectance (Band 14hi)
- ☐ 1KM Reflectance (Band 15)
- ☐ 1KM Reflectance (Band 16)
- ☐ 1KM Reflectance (Band 17)
- ☐ 1KM Reflectance (Band 18)
- ☐ 1KM Reflectance (Band 19)
- ☐ 1KM Reflectance (Band 26)

- ☐ 1KM Emissive (Band 20)
- ☐ 1KM Emissive (Band 21)
- ☐ 1KM Emissive (Band 22)
- ☐ 1KM Emissive (Band 23)
- ☐ 1KM Emissive (Band 24)
- ☐ 1KM Emissive (Band 25)
- ☐ 1KM Emissive (Band 27)
- ☐ 1KM Emissive (Band 28)
- ☐ 1KM Emissive (Band 29)
- ☐ 1KM Emissive (Band 30)
- ☐ 1KM Emissive (Band 31)
- ☐ 1KM Emissive (Band 32)
- ☐ 1KM Emissive (Band 33)
- ☐ 1KM Emissive (Band 34)
- ☐ 1KM Emissive (Band 35)
- ☐ 1KM Emissive (Band 36)

NDVI/LST
VCI
TCI
VHI
NDWI
NDDI
VSWI



Red
Near infrared (NIR)
Shortwave infrared (SWIR)
Thermal infrared (TIR)

Methods



- **Vegetation Condition Index (VCI)**

$$VCI_j = \frac{NDVI_j - NDVI_{min}}{NDVI_{max} - NDVI_{min}} * 100\%$$

- **Temperature Condition Index (TCI)**

$$TCI_j = \frac{T_{max} - T_j}{T_{max} - T_{min}} * 100\%$$

- **Vegetation Health Index (VHI)**

$$VHI = 0.5 * VCI + 0.5 * TCI$$

- **Vegetation Supply Water Index (VSWI)**

$$VSWI = Ts / NDVI$$

- **Normalized Difference Water Index (NDWI)**

$$NDWI = \frac{\rho_{SWIR} - \rho_{NIR}}{\rho_{SWIR} + \rho_{NIR}}$$

- **Normalized Difference Drought Index (NDDI):**

$$NDDI = \frac{NDVI - NDWI}{NDVI + NDWI}$$

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Methods



- **Aridity Index (AI)** - De Martonne in 1926, (Livada and Assimakopoulos 2007) :

$$I_{dm} = \frac{P}{T + 10}$$

P- precipitation, T-temperature

- **Standardized precipitation index (SPI)**- (McKee et al. 1993):

$$SPI = \frac{x_i - \bar{x}}{s}$$

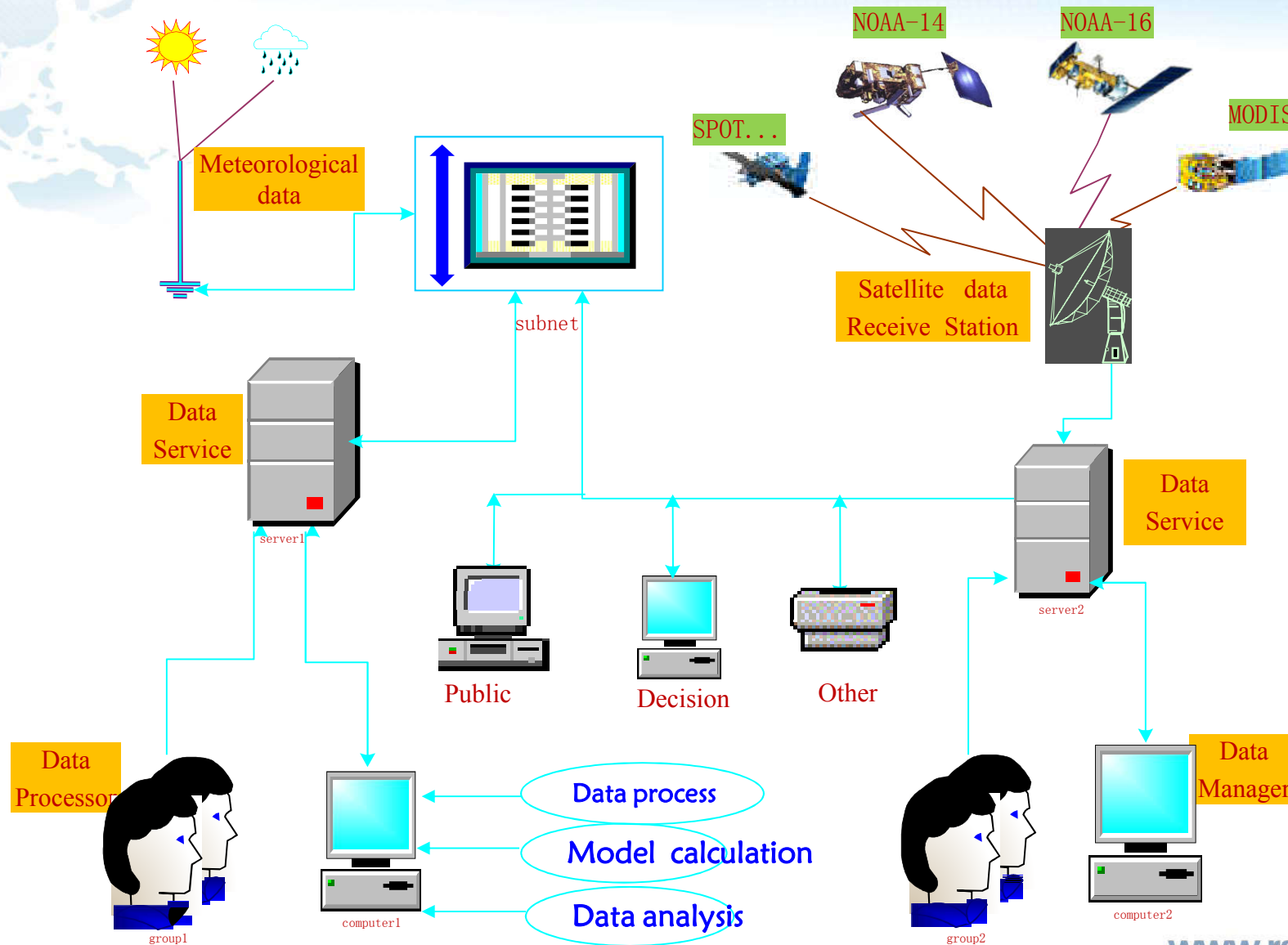
Where x_i is the monthly rainfall amount and \bar{x} , s are the mean and standard deviation of rainfall calculated from the whole time series of monthly values.

Outline



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DroughtWatch Architecture



Evolution of DroughtWatch (2003-2017)



Version	Major Revision	Improvement	Time
V1.1	Several calculation modules built by program	Try to finish the part of drought monitoring by the computer	2003
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

DroughtWatch 4.1(English)



- **Data preprocessing**

(RS data processing, composition)

- **Indices calculation**

(VCI,TCI,VHI,NDDI,NDWI,VSWI,SPI, AI)

- **Drought monitoring**

(by single index and combination indices, dashboard)

- **Statistics and analysis**

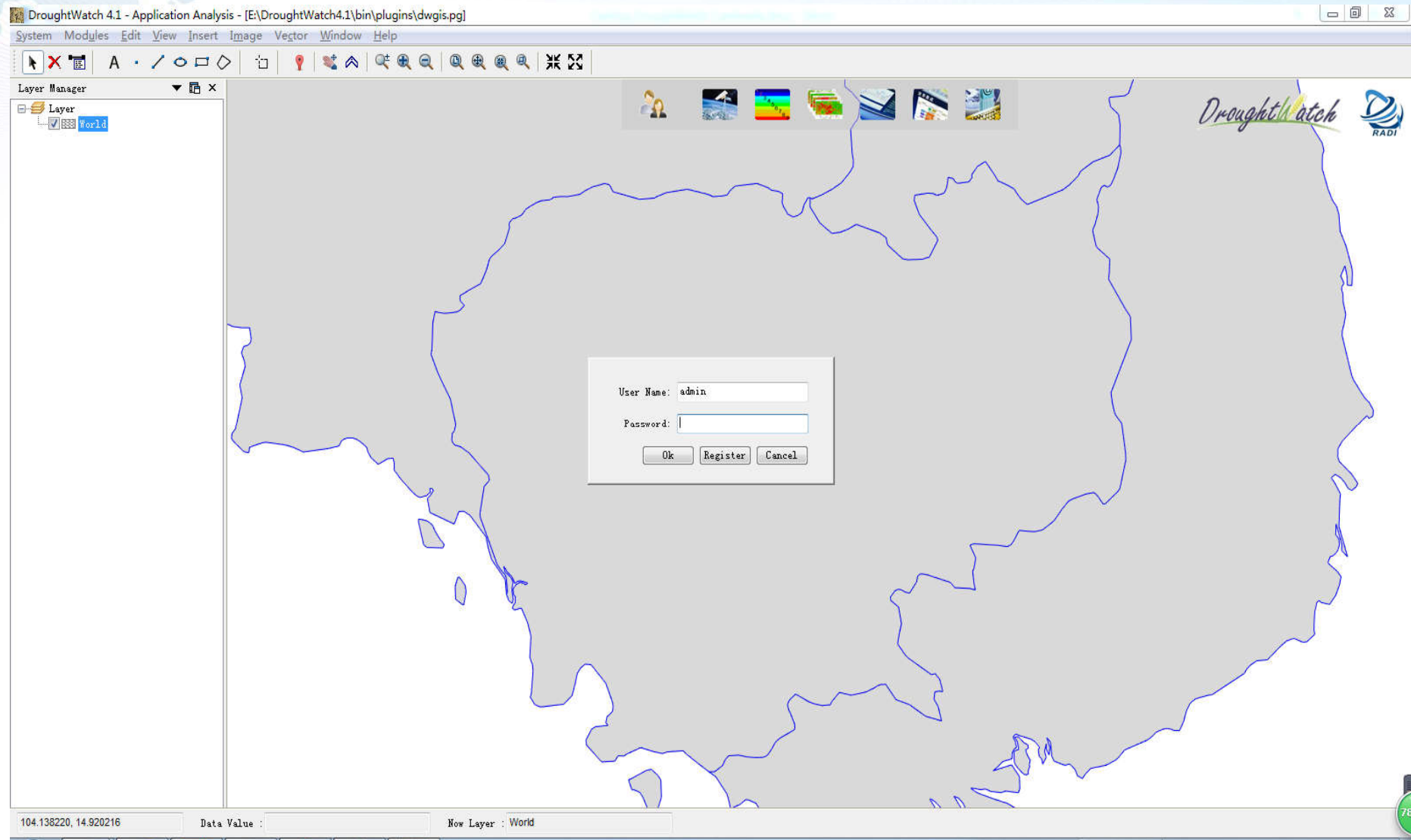
(over the spatial, over time interval)

- **Batch for the whole procedure**

- **Data management**

(in-situ, statistics, Geotiff etc.)

Main interface



Module-preprocessing



MODIS 1b data

NDVI, LST and bands data

MOD021KM.A2015153.0320.006.2015153135555.hdf

- 1KM Reflectance (Band 1) [250M Aggr]
- 1KM Reflectance (Band 2) [250M Aggr]
- 1KM Reflectance (Band 3) [500M Aggr]
- 1KM Reflectance (Band 4) [500M Aggr]
- 1KM Reflectance (Band 5) [500M Aggr]
- 1KM Reflectance (Band 6) [500M Aggr]
- 1KM Reflectance (Band 7) [500M Aggr]
- 1KM Reflectance (Band 8)
- 1KM Reflectance (Band 9)
- 1KM Reflectance (Band 10)
- 1KM Reflectance (Band 11)
- 1KM Reflectance (Band 12)
- 1KM Reflectance (Band 13lo)
- 1KM Reflectance (Band 13hi)
- 1KM Reflectance (Band 14lo)
- 1KM Reflectance (Band 14hi)
- 1KM Reflectance (Band 15)
- 1KM Reflectance (Band 16)
- 1KM Reflectance (Band 17)
- 1KM Reflectance (Band 18)
- 1KM Reflectance (Band 19)
- 1KM Reflectance (Band 26)

- 1KM Emissive (Band 20)
- 1KM Emissive (Band 21)
- 1KM Emissive (Band 22)
- 1KM Emissive (Band 23)
- 1KM Emissive (Band 24)
- 1KM Emissive (Band 25)
- 1KM Emissive (Band 27)
- 1KM Emissive (Band 28)
- 1KM Emissive (Band 29)
- 1KM Emissive (Band 30)
- 1KM Emissive (Band 31)
- 1KM Emissive (Band 32)
- 1KM Emissive (Band 33)
- 1KM Emissive (Band 34)
- 1KM Emissive (Band 35)
- 1KM Emissive (Band 36)

preprocessing

- 20150602_CLD_MODIS1b_KHM_1KM.tif
- 20150602_EVI_ACR_MODIS1b_KHM_1KM.tif
- 20150602_LST_ACR_MODIS1b_KHM_1KM.tif
- 20150602_NDVI_ACR_MODIS1b_KHM_1KM.tif
- 20150602_REF1_ACR_MODIS1b_KHM_1KM.tif
- 20150602_REF2_ACR_MODIS1b_KHM_1KM.tif
- 20150602_REF3_ACR_MODIS1b_KHM_1KM.tif
- 20150602_REF4_ACR_MODIS1b_KHM_1KM.tif
- 20150602_REF5_ACR_MODIS1b_KHM_1KM.tif
- 20150602_REF6_ACR_MODIS1b_KHM_1KM.tif
- 20150602_REF7_ACR_MODIS1b_KHM_1KM.tif
- 20150605_CLD_MODIS1b_KHM_1KM.tif
- 20150605_EVI_ACR_MODIS1b_KHM_1KM.tif
- 20150605_LST_ACR_MODIS1b_KHM_1KM.tif
- 20150605_NDVI_ACR_MODIS1b_KHM_1KM.tif
- 20150605_REF1_ACR_MODIS1b_KHM_1KM.tif
- 20150605_REF2_ACR_MODIS1b_KHM_1KM.tif
- 20150605_REF3_ACR_MODIS1b_KHM_1KM.tif
- 20150605_REF4_ACR_MODIS1b_KHM_1KM.tif
- 20150605_REF5_ACR_MODIS1b_KHM_1KM.tif
- 20150605_REF6_ACR_MODIS1b_KHM_1KM.tif
- 20150605_REF7_ACR_MODIS1b_KHM_1KM.tif

MOD03.A2015153.0320.006.2015153094547.hdf

MOD021KM.A2015153.0320.006.2015153135555.hdf

Module-preprocessing



DroughtWatch 4.1 - Preprocessing

Preprocessing | Composition

Sensor: MODIS/TERRA

Resolution: 1km

Start Time: 2015 6 1

End Time: 2015 6 30

Input Folder: E:\DroughtWatch4.1\bin\data\KHM\Originaldata\MODIS1b\

Output Folder: E:\DroughtWatch4.1\bin\data\KHM\Preout\

<- Processing Procedure ->

Time (GMT)	GEO	MOS	RAD	CLD	ATC	NDVI	EVI	LST
2015-06-02	✓	✓	✓	✓	✓	✓	✓	✓
2015-06-05	✓	✓	✓	✓	✓	✓	✓	✓

<- Processing Procedure ->

Time (GMT)	GEO	MOS	RAD	CLD	ATC	NDVI	LST
2002-05-03	✓	✓	✓	✓	✓		

❑ **Preprocessing** including geometric correction (GEO), mosaic (MOS), radioactive correction (RAD), cloud mask (CLD), atmospheric correction (ATC), and NDVI and LST calculations.

❑ You can also determine different processing steps in every operation from the table.

Module-preprocessing



DroughtWatch 4.1 - Preprocessing

Preprocessing Composition

Sensor: MODIS/TERRA

Resolution: 1km

Start Time: 2015 6 1

End Time: 2015 6 30

Input Folder:
E:\DroughtWatch4.1\bin\data\KHM\Originaldata\MODIS1b\ Browse Search

Output Folder:
E:\DroughtWatch4.1\bin\data\KHM\Prepout\ Browse Preview

<- Processing Procedure ->

Time (GMT)	GEO	MOS	RAD	CLD	ATC	NDVI	EVI	LST
2015-06-02	✓	✓	✓	✓	✓	✓	✓	✓
2015-06-05	✓	✓	✓	✓	✓	✓	✓	✓

Information
Finished.
Close

Run Cancel Help

Processing

MODIS1b Data Preprocessing

9%

Module-preprocessing



DroughtWatch 4.1 - Application Analysis - [E:\DroughtWatch4.1\bin\plugins\dwgis.pg]

System Modules Edit View Insert Image Vector Window Help

Layer Manager

- Layer
 - Province
 - 20150602_NDVI_ACR_MODIS1b_KHM
 - World

DroughtWatch 4.1 - Preprocessing

Preprocessing Composition

Sensor: MODIS/TERRA

Resolution: 1km

Start Time: 2015 6 1

End Time: 2015 6 30

Input Folder: E:\DroughtWatch4.1\bin\data\KHM\Originaldata\MODIS1b\ Browse Search

Output Folder: E:\DroughtWatch4.1\bin\data\KHM\Preout\ Browse Preview

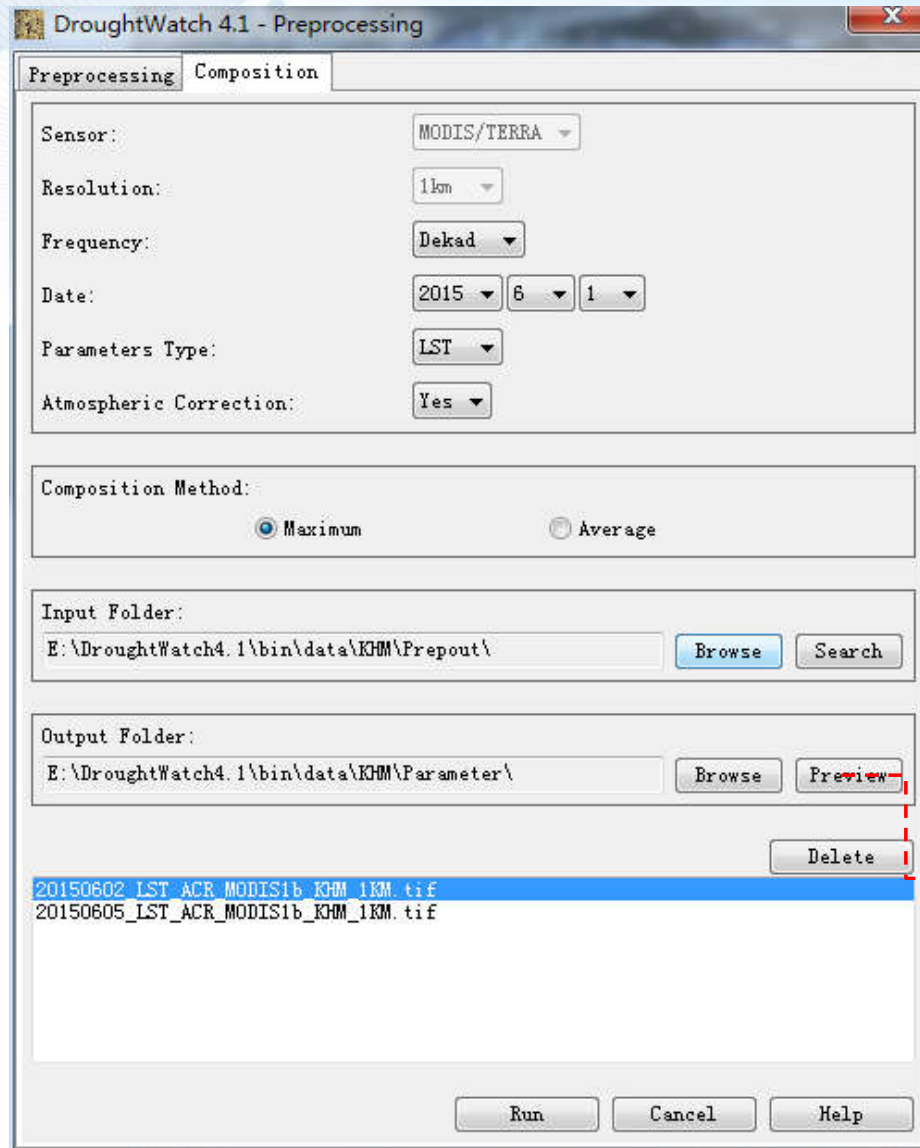
< Processing Procedure >

Time (GMT)	GEO	MOS	RAD	CLD	ATC	NDVI	EVI	LST
2015-06-02	✓	✓	✓	✓	✓	✓	✓	✓
2015-06-05	✓	✓	✓	✓	✓	✓	✓	✓

Run Cancel Help

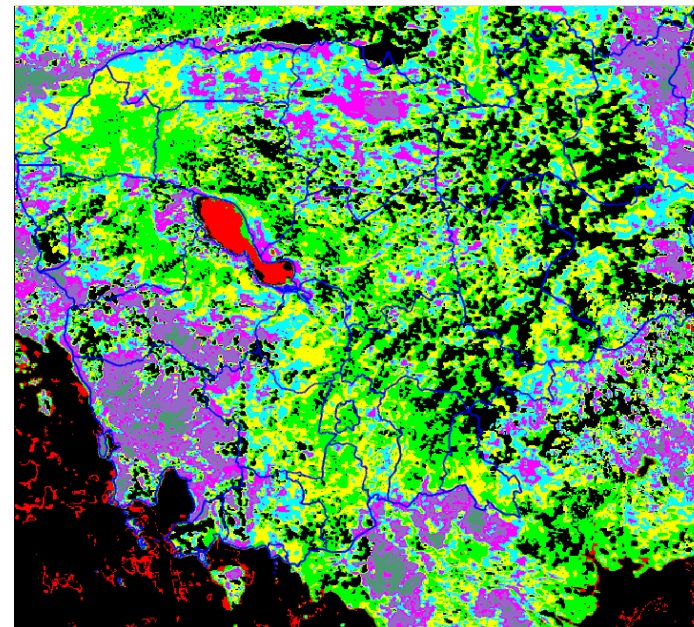
103.169696, 14.684291 Data Value : 0.130545 Now Layer : 20150602_NDVI_ACR_MODIS1b_KHM

Module-preprocessing



❑ The pentad, dekad and month parameters can be **composited** by daily data.

❑ **Output** is NDVI, LST, REF1, REF2, REF3, REF4, REF5, REF6 or REF7.





Practice by yourself, please.

Module-indices



Five remote-sensed drought indices (VCI, TCI, VHI, NDDI, NDWI and VSWI) ;

Two meteorological indices (SPI and AI) are calculated using composition parameters.

The screenshot shows the 'DroughtWatch 4.1 - Indices' software window. It has a tabbed interface with tabs for VCI, TCI, VHI, NDDI, NDWI, VSWI, SPI, and AI. The VCI tab is currently selected. The interface includes several input fields and buttons. At the top, there are dropdown menus for 'Sensor' (set to MODIS/TERRA), 'Resolution' (set to 1km), 'Frequency' (set to Dekad), and 'Date' (set to 2015, 6, 1). Below these is a section titled '<- Input Data ->' containing three rows of input fields for NDVI, Max_NDVI, and Min_NDVI, each with 'Load' and 'Preview' buttons. At the bottom of this section is an 'Output Folder' field with 'Browse' and 'Preview' buttons. At the very bottom of the window are 'Run', 'Cancel', and 'Help' buttons. The window title bar reads 'DroughtWatch 4.1 - Indices'.

Module-indices



DroughtWatch 4.1 - Indices

VCI TCI VHI NDDI NDWI VSWI SPI AI

Sensor: MODIS/TERRA
Resolution: 1km
Frequency: Dekad
Date: 2015 6 1

<- Input Data ->
LST: E:\DroughtWatch4.1\bin\data\KHM\Parameter\deks Load Preview
Max_LST: E:\DroughtWatch4.1\bin\data\KHM\Reference\0601 Load Preview
Min_LST: E:\DroughtWatch4.1\bin\data\KHM\Reference\0601 Load Preview
Output Folder: E:\DroughtWatch4.1\bin\data\KHM\Index\ Browse Preview
Run Cancel Help

DroughtWatch 4.1 - Indices

VCI TCI VHI NDDI NDWI VSWI SPI AI

Sensor: MODIS/TERRA
Resolution: 1km
Frequency: Dekad
Date: 2015 6 1

Factors
VCI: 0.40
TCI: 0.60

<- Input Data ->
NDVI: E:\DroughtWatch4.1\bin\data\KHM\Parameter\deks Load Preview
Maxmin_NDVI: E:\DroughtWatch4.1\bin\data\KHM\Reference\0601 Load Preview
LST: E:\DroughtWatch4.1\bin\data\KHM\Parameter\deks Load Preview
Maxmin_LST: E:\DroughtWatch4.1\bin\data\KHM\Reference\0601 Load Preview
Output Folder: E:\DroughtWatch4.1\bin\data\KHM\Index\ Browse Preview
Run Cancel Help

Module-indices



DroughtWatch 4.1 - Indices

VCI TCI VHI **NDDI** NDWI VSWI SPI AI

Sensor: MODIS/TERRA
Resolution: 1km
Frequency: Dekad
Date: 2015 6 1

<- Input Data ->

Red_Band(Band1): E:\DroughtWatch4.1\bin\data\KHM\Parameter\ Load Preview

Nir_band(Band2): E:\DroughtWatch4.1\bin\data\KHM\Parameter\ Load Preview

Swir_Band(Band7): E:\DroughtWatch4.1\bin\data\KHM\Parameter\ Load Preview

Output Folder: E:\DroughtWatch4.1\bin\data\KHM\Index\ Browse Preview

Run Cancel Help

DroughtWatch 4.1 - Indices

VCI TCI VHI **NDDI** NDWI VSWI SPI AI

Sensor: MODIS/TERRA
Resolution: 1km
Frequency: Dekad
Date: 2015 6 1

<- Input Data ->

Nir_Band(Band2): E:\DroughtWatch4.1\bin\data\KHM\Parameter\ Load Preview

Swir_Band(Band7): E:\DroughtWatch4.1\bin\data\KHM\Parameter\ Load Preview

Output Folder: E:\DroughtWatch4.1\bin\data\KHM\Index\ Browse Preview

Run Cancel Help

Module-indices



DroughtWatch 4.1 - Indices

VCI TCI VHI NDDI NDWI VSWI SPI AI

Sensor: MODIS/TERRA
Resolution: 1km
Frequency: Day
Date: 2015 6 2

<- Input Data ->

NDVI: E:\DroughtWatch4.1\bin\data\KHM\Prepout\201506 Load Preview

LST: E:\DroughtWatch4.1\bin\data\KHM\Prepout\201506 Load Preview

Output Folder: E:\DroughtWatch4.1\bin\data\KHM\Index\ Browse Preview

Run Cancel Help

DroughtWatch 4.1 - Indices

VCI TCI VHI NDDI NDWI VSWI SPI AI

Frequency: Month
Date: 2018 4
SPI Type: 3-Month

Input Station Data: Rainfall
Database

Output SPI (Station) Folder:
E:\DroughtWatch4.1\bin\data\KHM\Station\ Browse

Output SPI (Grid) Folder:
E:\DroughtWatch4.1\bin\data\KHM\Index\month\ Browse Preview

Run Cancel Help



Practice by yourself, please.

Module-drought



DroughtWatch 4.1 - Drought

Single Combination Dashboard

Sensor: MODIS/TERRA
Resolution: 1km
Frequency: Day
Date: 2015 6 5
IndexType: VCI

Input File:
E:\DroughtWatch4.1\bin\data\KHM\Index\Day\201506
Load Preview

Image Information:
Max: 1.00000 Min: 0.00000 Mean: 0.116151
Stdev: 0.228622 Accumulative Frequency (95%): 0.850000

Drought Classification: Edit Save

Extreme:	0	~ 0.095	
Serious:	0.095	~ 0.167	
Moderate:	0.167	~ 0.255	
Slight:	0.255	~ 0.343	
Normal:	0.343	~ 1	

Output Folder:
E:\DroughtWatch4.1\bin\data\KHM\Droughtout\singl
Browse Preview

Run Cancel Help

☐ **Classify** and produce drought results based on a single index.

☐ The image information, including the max, min, average, mean, standard deviation and cumulative frequency above 95% is displayed.

☐ For the drought classification, **edit** was used for modifying the values and saving them in the database automatically.

☐ Click **preview** to view all the input data. Select **pan**, **zoom in**, **zoom out**, **zoom fit window**, **zoom full size**, add **shape file**, and **setting color** as desired.

Module-drought



DroughtWatch 4.1 - Drought

Single | Combination | Dashboard

Sensor: MODIS/TERRA
Resolution: 1km
Frequency: Dekad
Date: 2015 6 1

Input Folder:
E:\DroughtWatch4.1\bin\data\KHM\Droughtout\singl Browse Preview

Index No.: 2

Index List:

- S2_12 (VCI&TCI)
- S2_13 (VCI&VHI)
- S2_14 (VCI&NDWI)
- S2_15 (VCI&NDDI)
- S2_16 (VCI&VSWI)
- S2_23 (TCI&VHI)
- S2_24 (TCI&NDWI)
- S2_25 (TCI&NDDI)
- S2_26 (TCI&VSWI)
- S2_34 (VHI&NDWI)**
- S2_35 (VHI&NDDI)
- S2_36 (VHI&VSWI)
- S2_45 (NDWI&NDDI)
- S2_46 (NDWI&VSWI)

Combination Method:
☐ Maximum ☐ Minimum ☒ Median
☐ Mean ☐ Majority

Output Folder:
E:\DroughtWatch4.1\bin\data\KHM\Droughtout\combi: Browse Preview

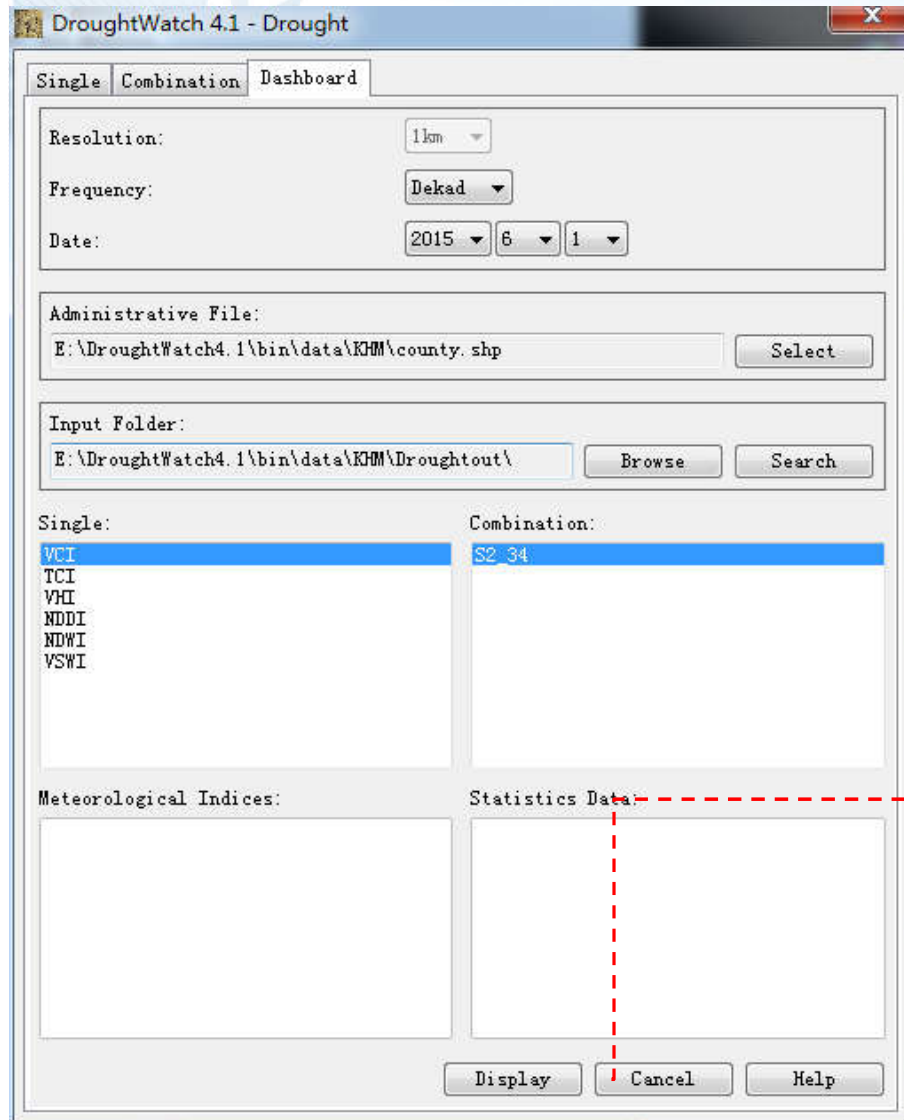
Run Cancel Help

☐ Produce **drought** results based on **combined indices**.

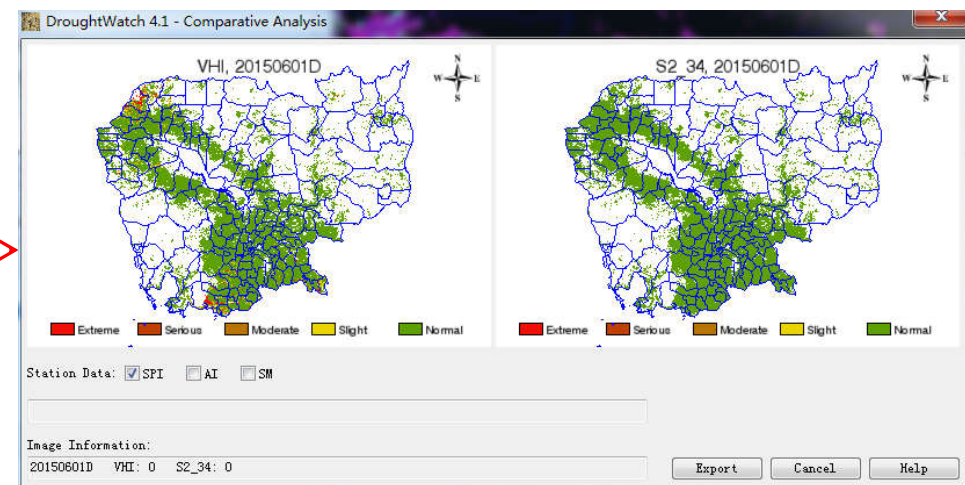
☐ Determine the indices to use for the combined calculation (see the index list). You can select one or more indices to calculate.

☐ Combination methods include maximum, minimum, median, mean and majority.

Module-drought



❑ Compare indices with other data (meteorological indices or statistics data) and add station data to the map to analyze the drought results in dashboard.





Practice by yourself, please.

Module-analysis



DroughtWatch 4.1 - Analysis

Over Spatial Unit Over Time Interval

Frequency: Day

Date: 2015 6 5

Admin. Unit: Province

Drought: VCI

Drought Data:
E:\DroughtWatch4.1\bin\data\KHM\Droughtout\single Load

Administrative File:
E:\DroughtWatch4.1\bin\data\KHM\province_code.tif Select

Output Folder:
E:\DroughtWatch4.1\bin\data\KHM\Droughtstat\ Browse

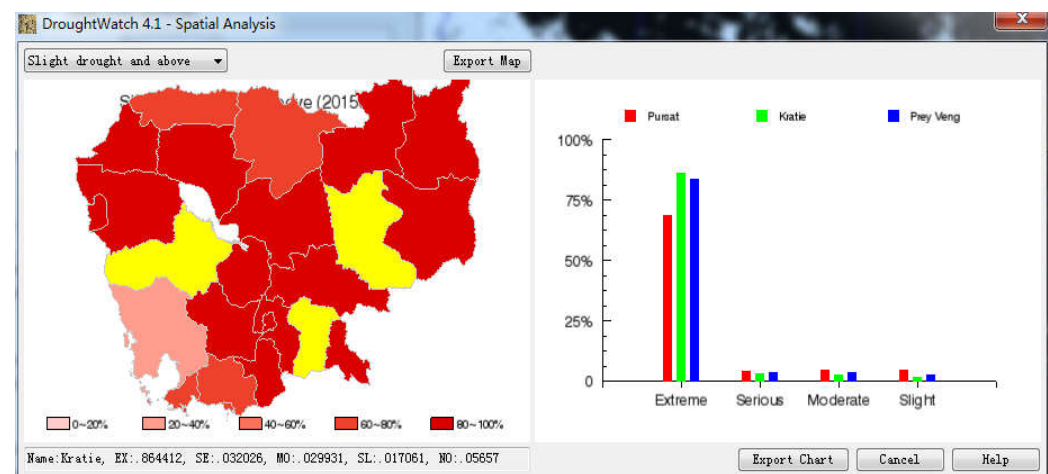
Stat. Map Cancel Help

Statistics Result

Storage

Name	Extreme (%)	Serious (%)	Moderate (%)	Slight (%)	Normal (%)	Sum (%)
Banteay Meanchey	66.03	6.86	7.51	6.0	13.6	100
Battambang	69.2	5.89	5.82	4.87	14.43	100.0
Kampong Cham	91.6				3.0	100
Kampong Chhnang	77.34				8.94	100
Kampong Speu	84.73				4.44	100.0
Kampong Thom	82.73				7.86	100
Kampot	65.5				21.09	100.0
Kandal	88.22				4.28	100.0
Koh Kong	22.01				69.06	100.0
Kep	38.13				33.13	100
Kratie	86.44				5.66	100
Sihanoukville	68.83				23.58	100.0
Mondul Kiri	94.54	1.71	0.94	1.11	1.71	100
Oddar Meanchey	42.06	6.43	8.17	11.12	32.21	100.0
Pailin	95.08	0.82	1.64	0.41	2.05	100
Phnom Penh	81.52	3.0	5.08	5.08	5.31	100.0
Preah Vihear	51.2	5.73	6.74	6.35	29.98	100.0

Information: Import 2 Records. 确定



- ❑ The results of the drought statistics are produced in different levels.
- ❑ To display the drought map and chart in a new window.

Module-analysis



DroughtWatch 4.1 - Analysis

Over Spatial Unit Over Time Interval

Start Time: 2015 6 1

End Time: 2015 6 5

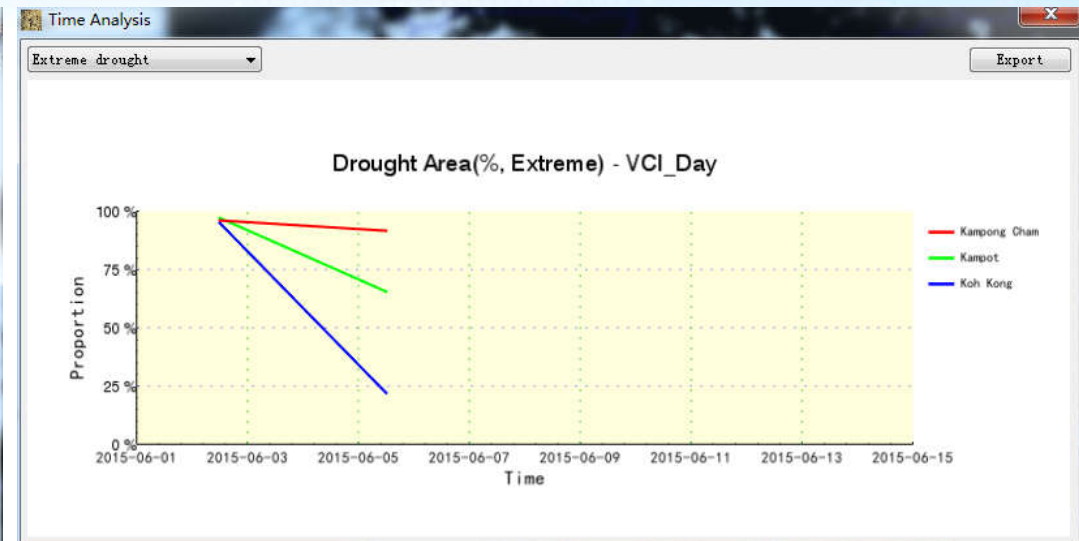
Frequency: Day

Drought: VCI

Admin. Unit: Province

Name: der National Adminis

View Cancel Help



- ☐ To show the **drought** statistics in a certain period.
- ☐ Obtain trends lines of different drought grades at the top left corner.
- ☐ Save the graph to the local path using the **Export** button.

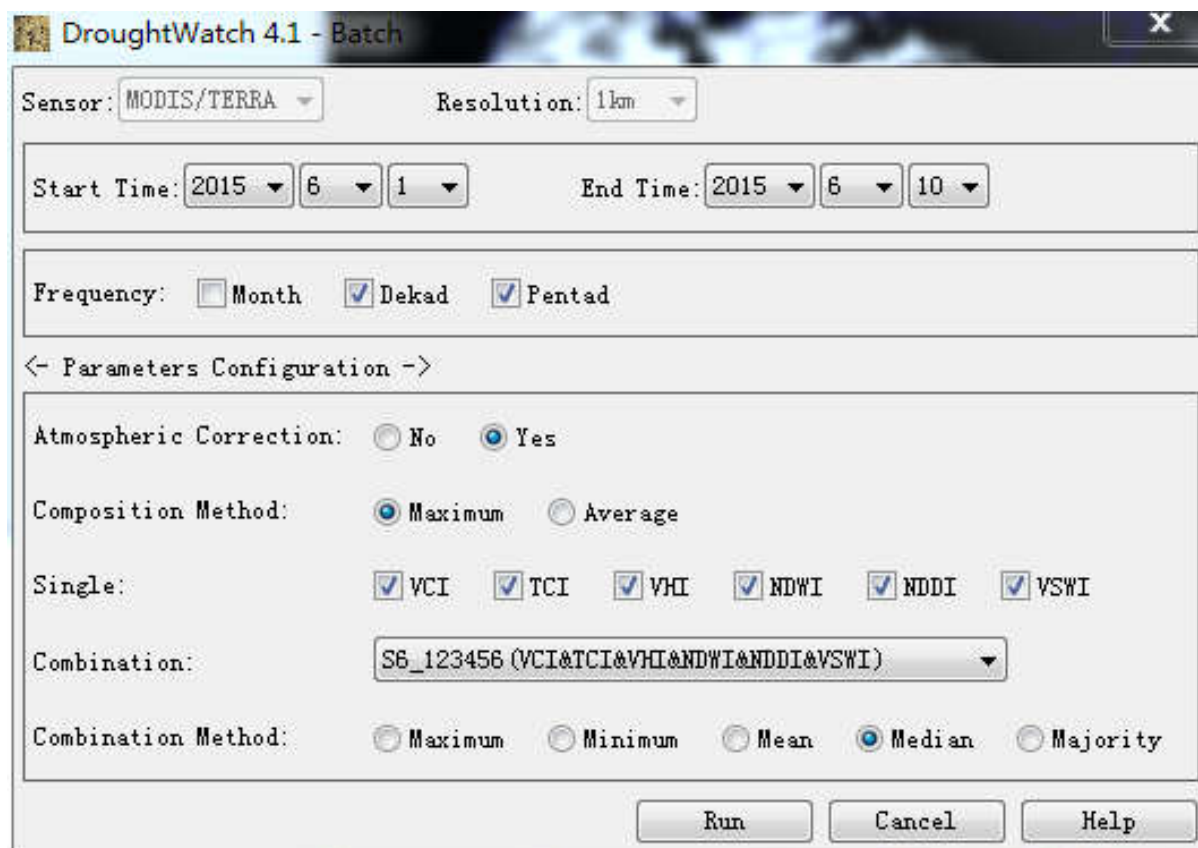


Practice by yourself, please.

Module-batch



Finish the entire procedure for drought monitoring automatically, including preprocessing, index calculations, and drought monitoring to drought statistics.



The screenshot shows the 'DroughtWatch 4.1 - Batch' window. It contains several configuration sections: 'Sensor' set to 'MODIS/TERRA' and 'Resolution' set to '1km'; 'Start Time' (2015, 6, 1) and 'End Time' (2015, 6, 10) dropdowns; 'Frequency' with checkboxes for 'Month', 'Dekad' (checked), and 'Pentad' (checked); a '< Parameters Configuration ->' section with 'Atmospheric Correction' (Yes selected), 'Composition Method' (Maximum selected), 'Single' indices (VCI, TCI, VHI, NDWI, NDDI, VSWI all checked), a 'Combination' dropdown showing 'S6_123456 (VCI&TCI&VHI&NDWI&NDDI&VSWI)', and 'Combination Method' (Median selected). At the bottom are 'Run', 'Cancel', and 'Help' buttons.

The progress seen in the window button, where the blue, rectangular, box-circling icon marks the current progress.

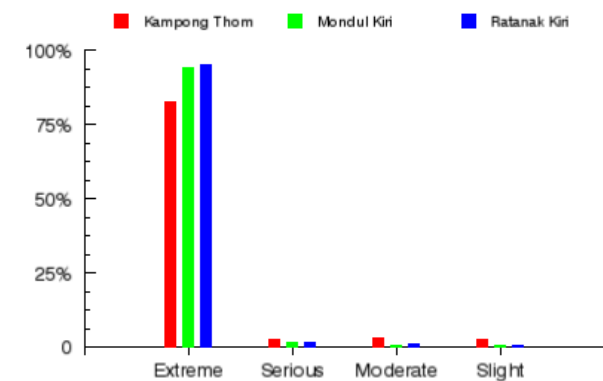
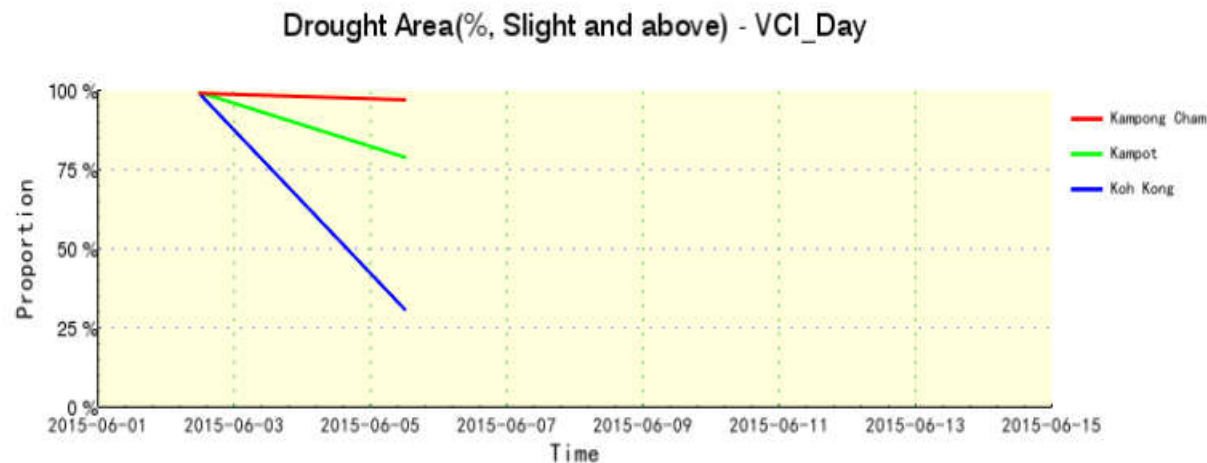
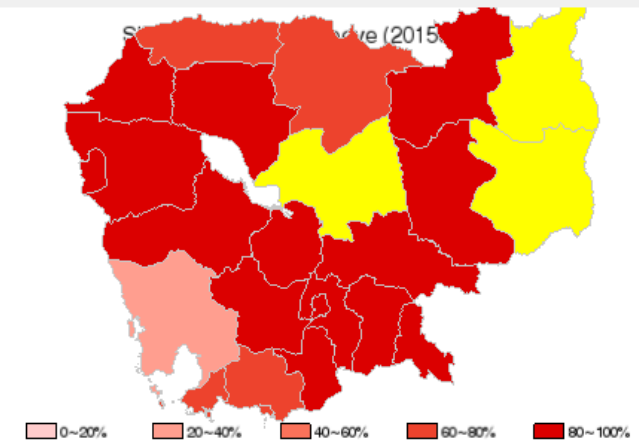
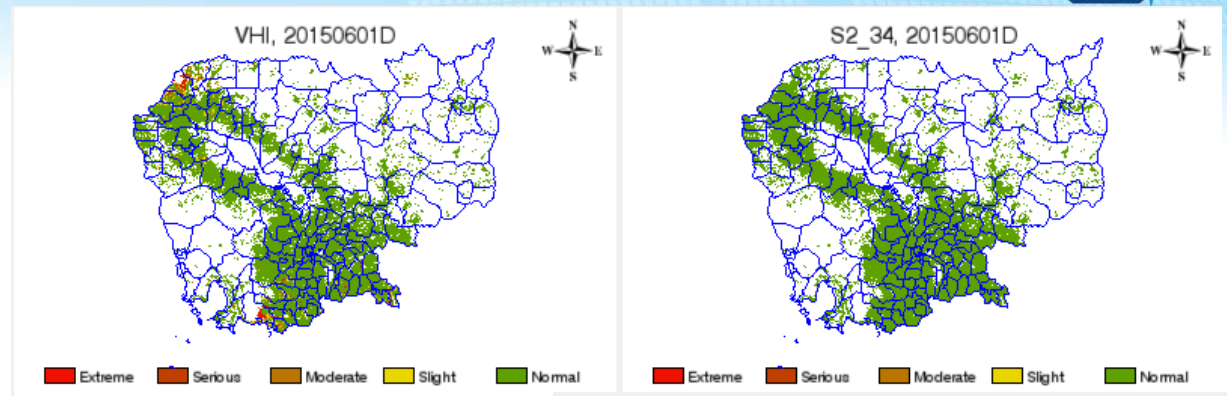
Output products



Products Forms

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

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

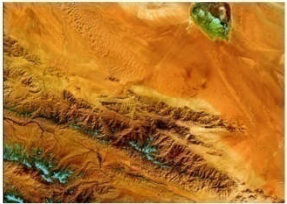


Prospects



- ☐ Finalizing the drought model for Cambodia
- ☐ Perfecting database by Cambodia field data
- ☐ Model finalization will be updated in the system
- ☐ Interactional tool will be perfected based on your comments

Thanks!



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