

Remote Sensing Applications to Drought Risk Management

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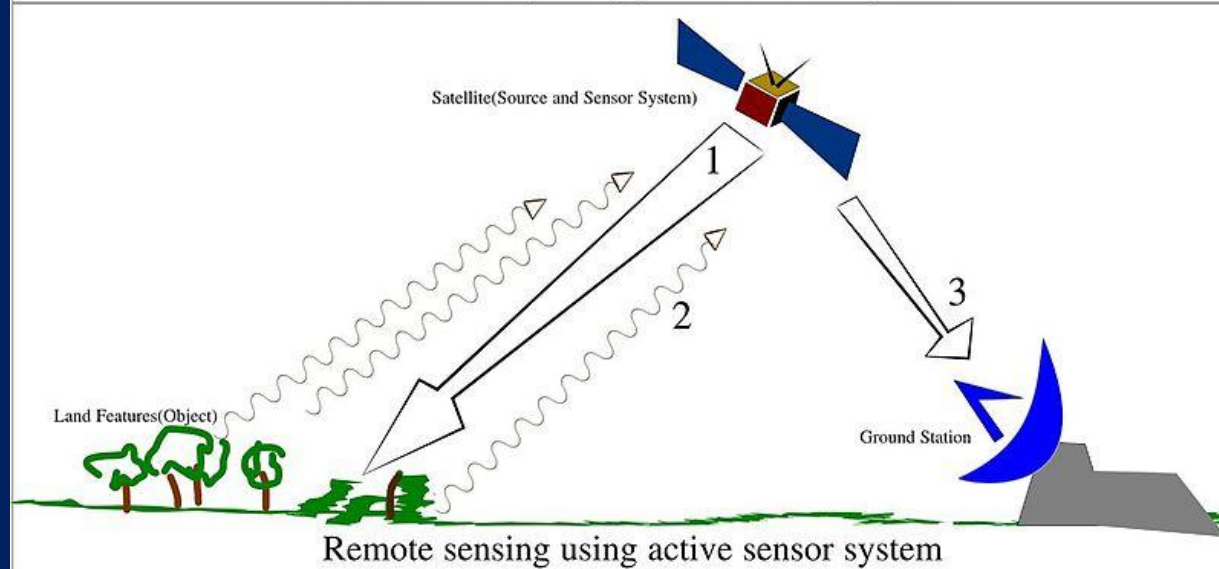
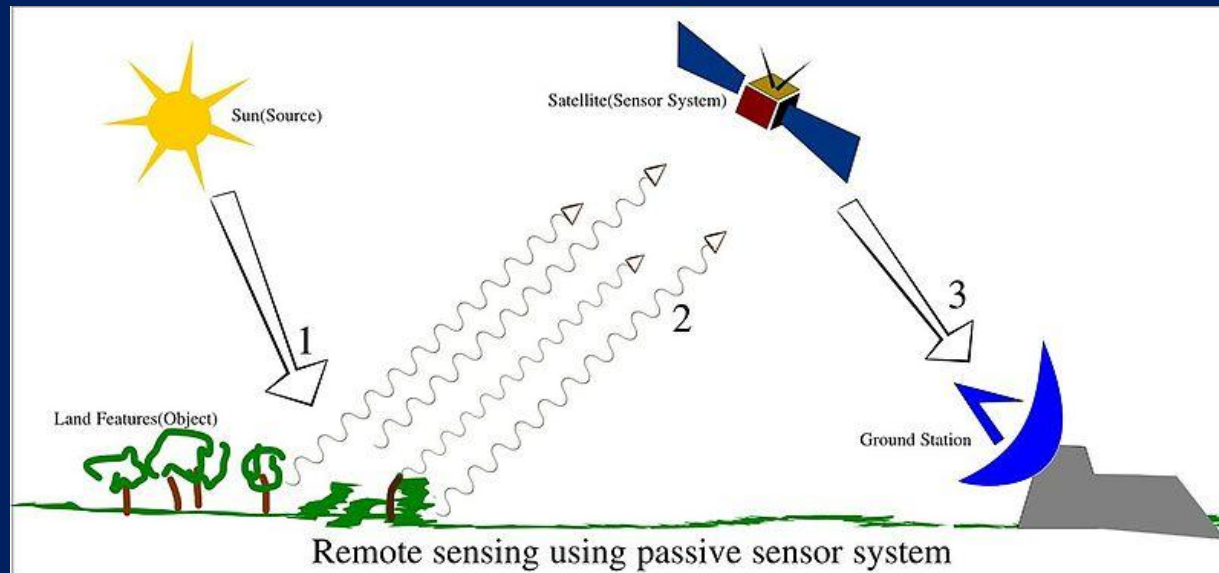
Vientiane, Laos

April 28, 2016

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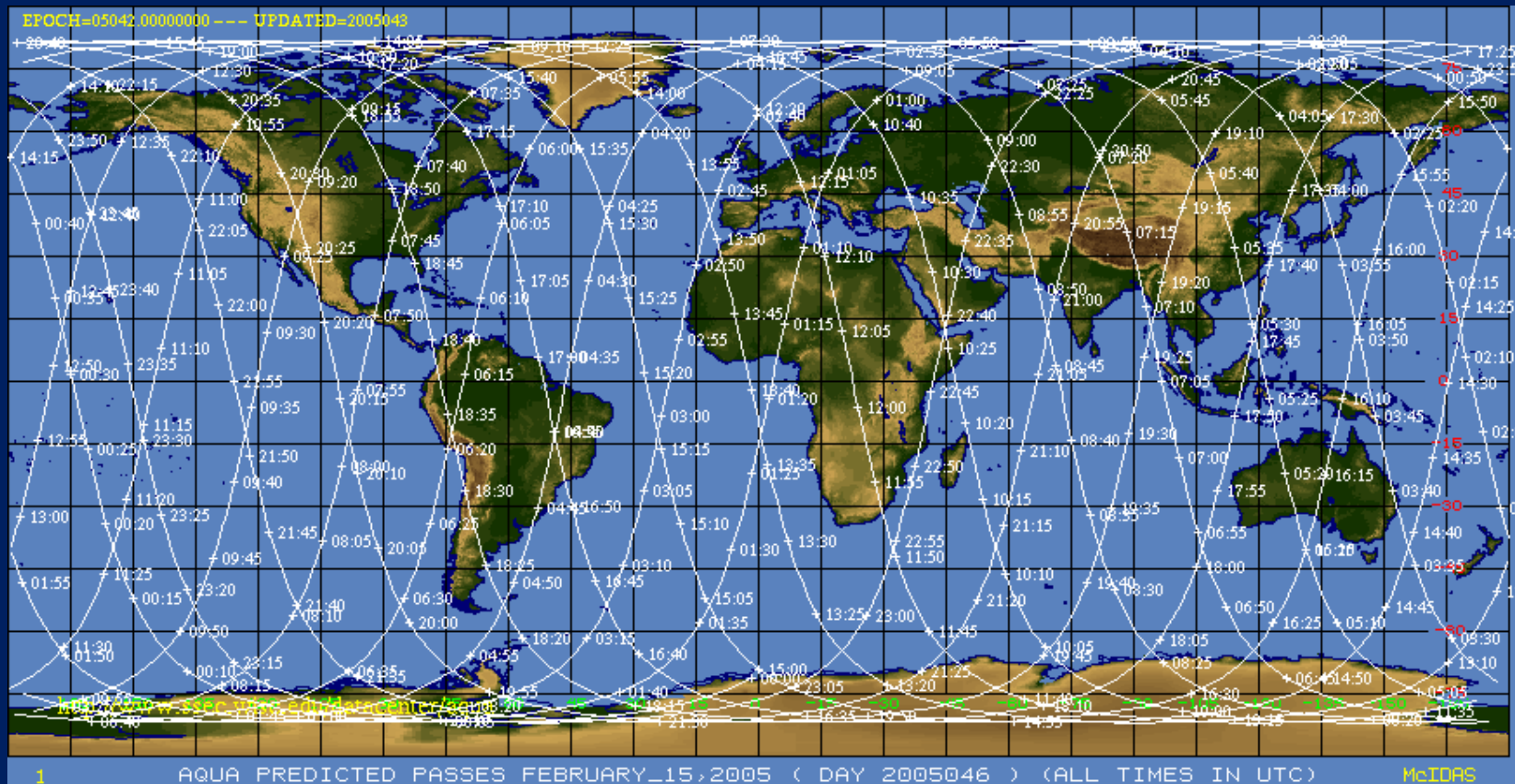
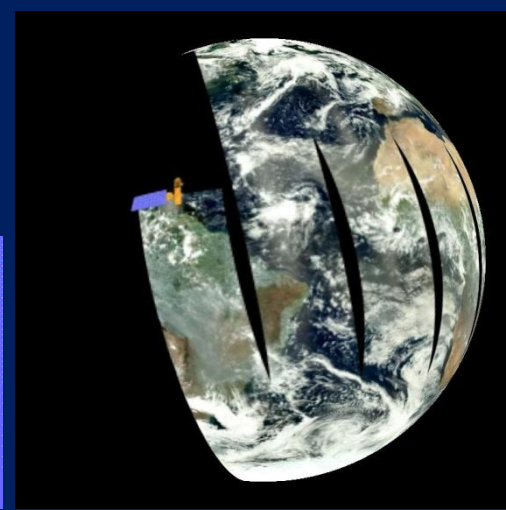
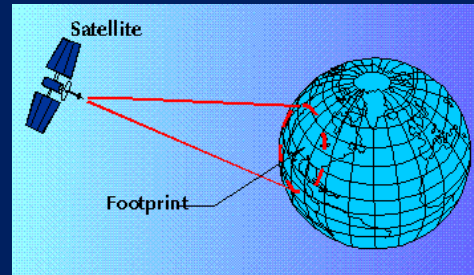
- **Briefly about Remote Sensing**
- **Remote Sensing Sensors**
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- **Medium, High and Very-High Spatial Resolution Satellite Imagery**
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- **Land use cover, Land use Change using Remote Sensing data**
- **Satellite Data Products - indices**
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 - **Drought Indices**
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 - Keetch–Byram drought index (KBDI)
 - Standardised Precipitation Index (SPI)
 - Standardised Precipitation-Evapotranspiration Index (**SPEI**)
- **Demonstration about **SPEI** data**

Briefly about Remote Sensing



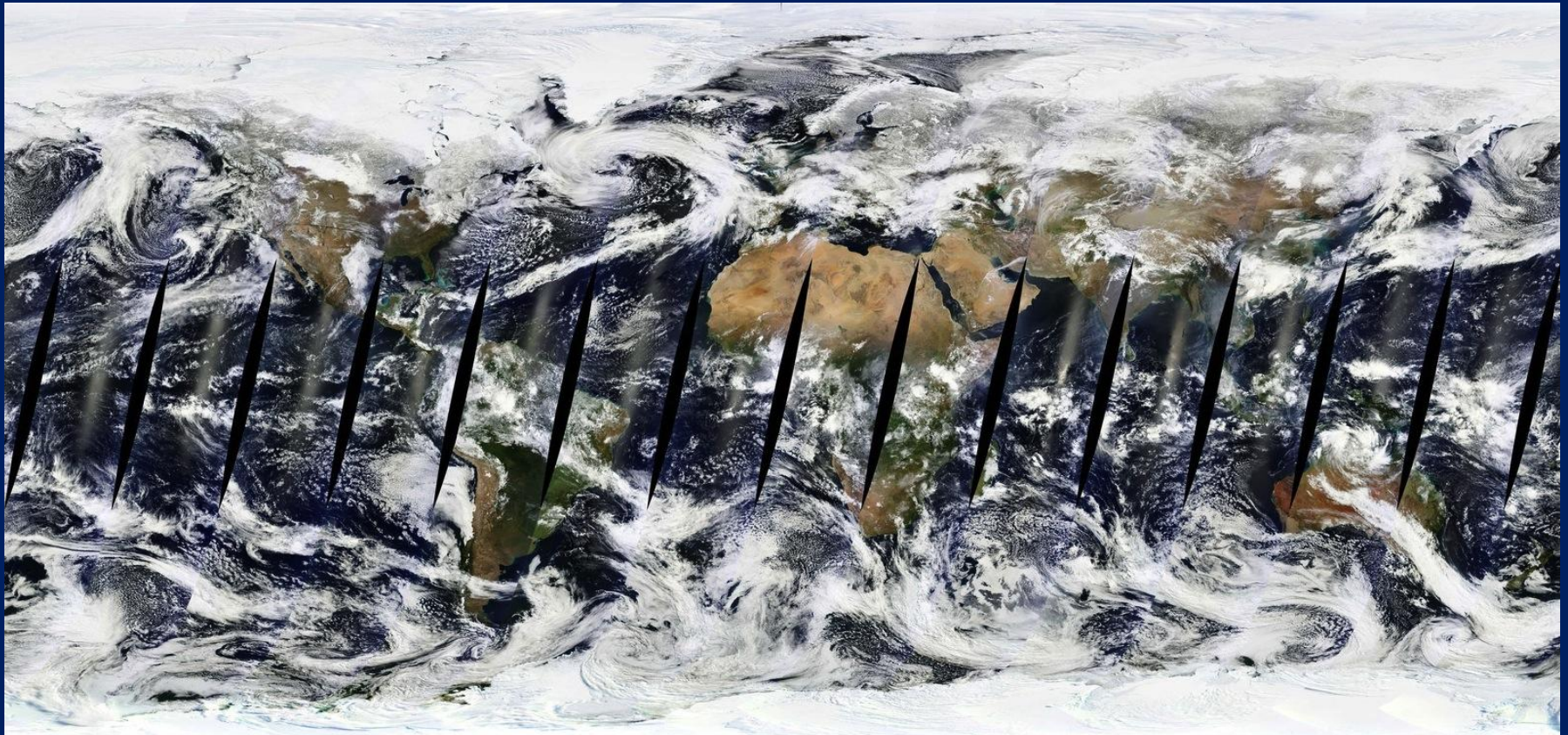
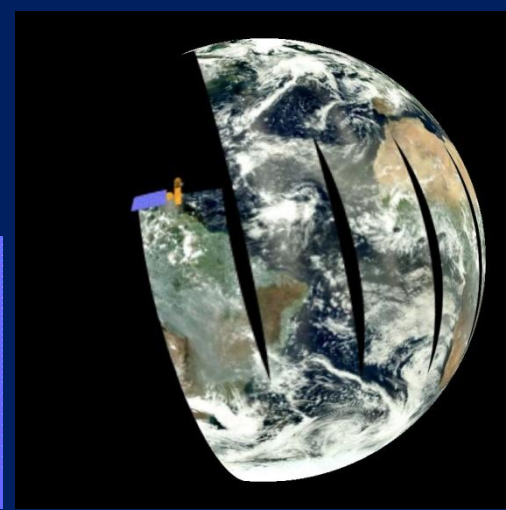
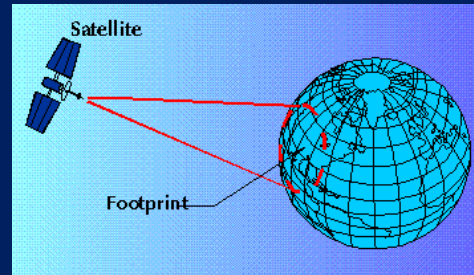
Remote Sensing Sensors

- Coverage



Remote Sensing Sensors

- Coverage

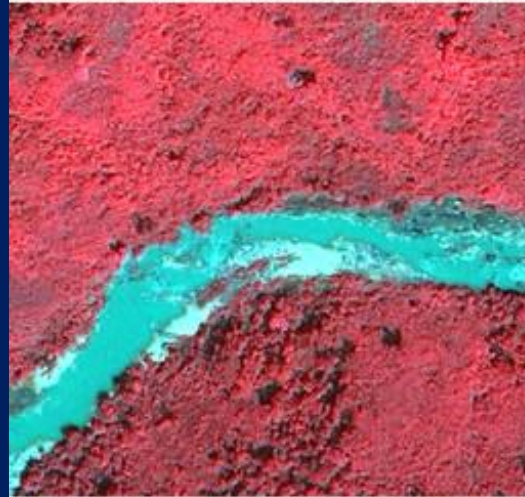


Remote Sensing Sensors

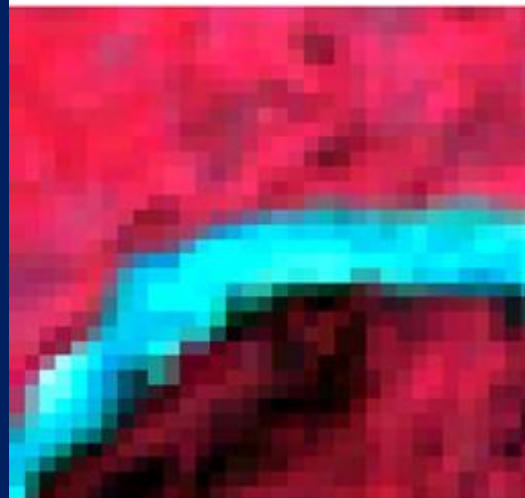
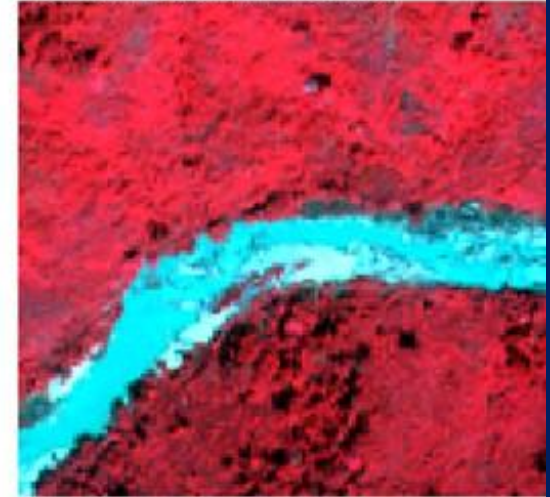
- Resolution
 - Spatial Resolution



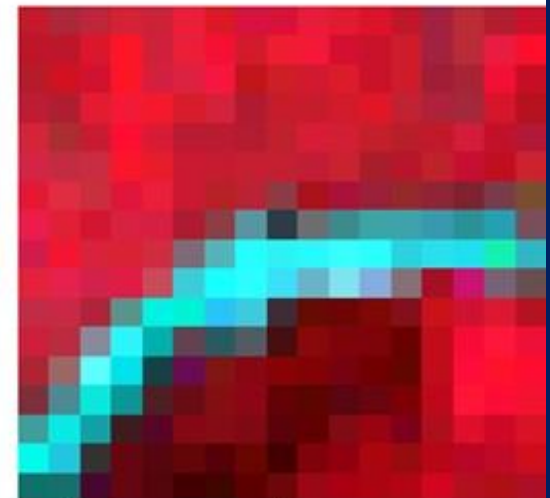
IKONOS 1m panchromatic merge 1m resolution



IKONOS multispectral 4m resolution



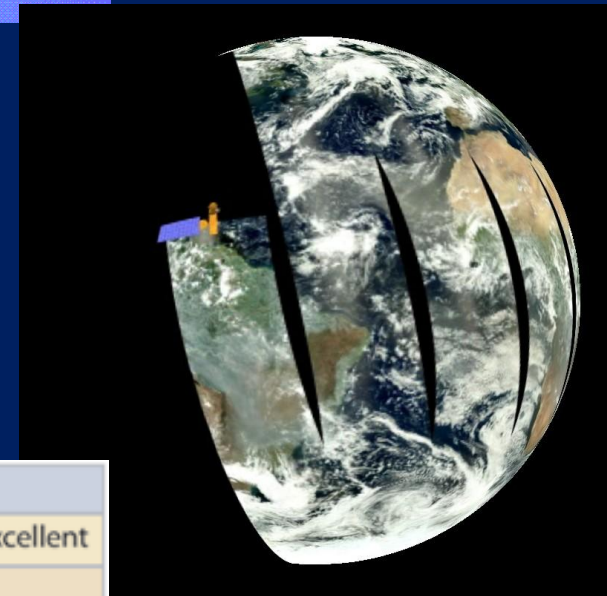
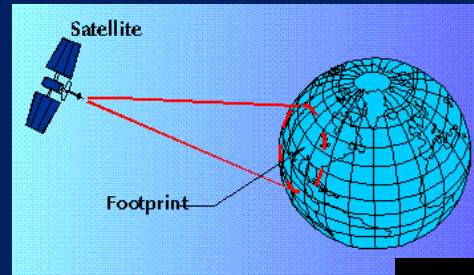
ASTER 15m resolution



Landsat ETM+ 30m resolution

Remote Sensing Sensors

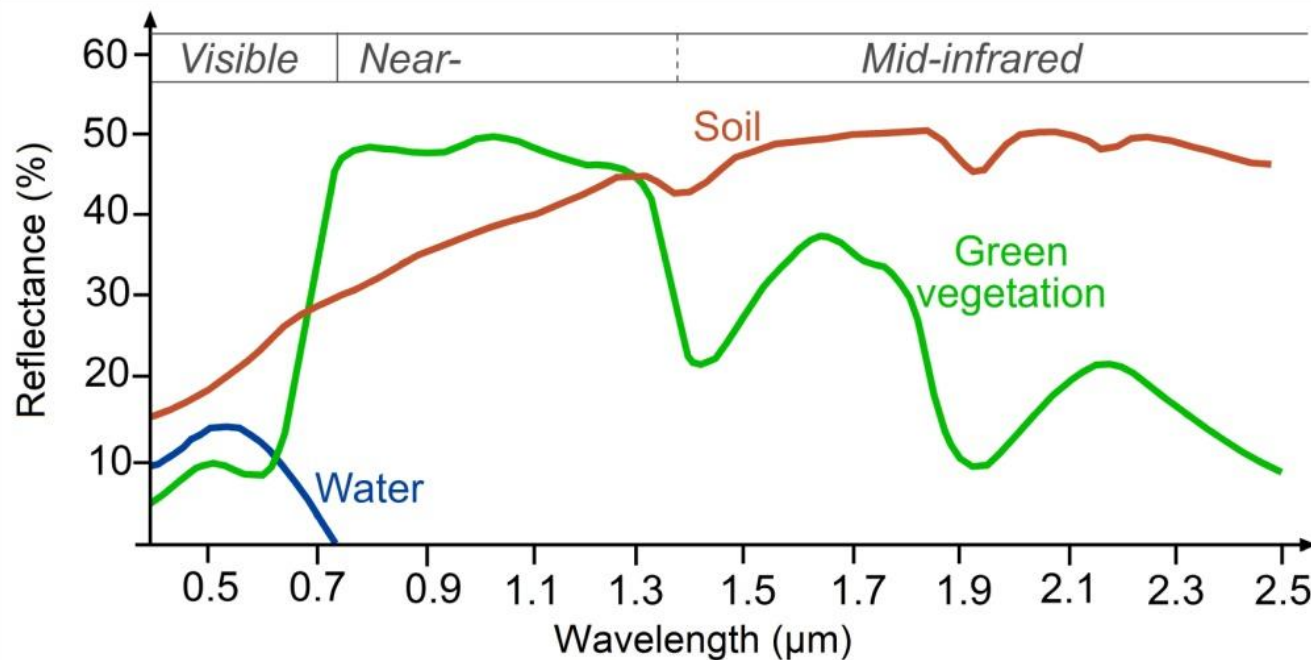
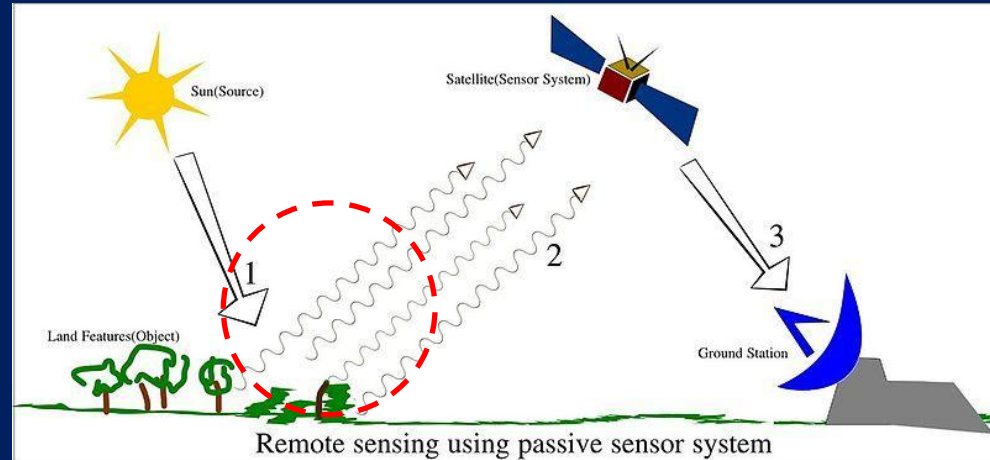
- Resolution
 - Temporal Resolution
 - Repeat Re-visit Time



Satellite	Spatial	Spectral	Temporal
GOES	1 km/poor	1 visible band/poor	15 minutes/excellent
Landsat TM	30 m/excellent	6 bands/good	2 weeks/poor
Landsat MSS	75 m/good	4 bands/fair	2 weeks/poor
WiFS	200 m/fair	2 bands/fair-poor	5 days/poor
SeaWiFS	1 km/poor	8 bands/good	1 day/fair-poor
AVHRR	1 km/poor	2 bands/fair-poor	1 day/fair-poor
MODIS	1 km/500 m/250 m poor-fair	36 bands/excellent	1 day/fair-poor

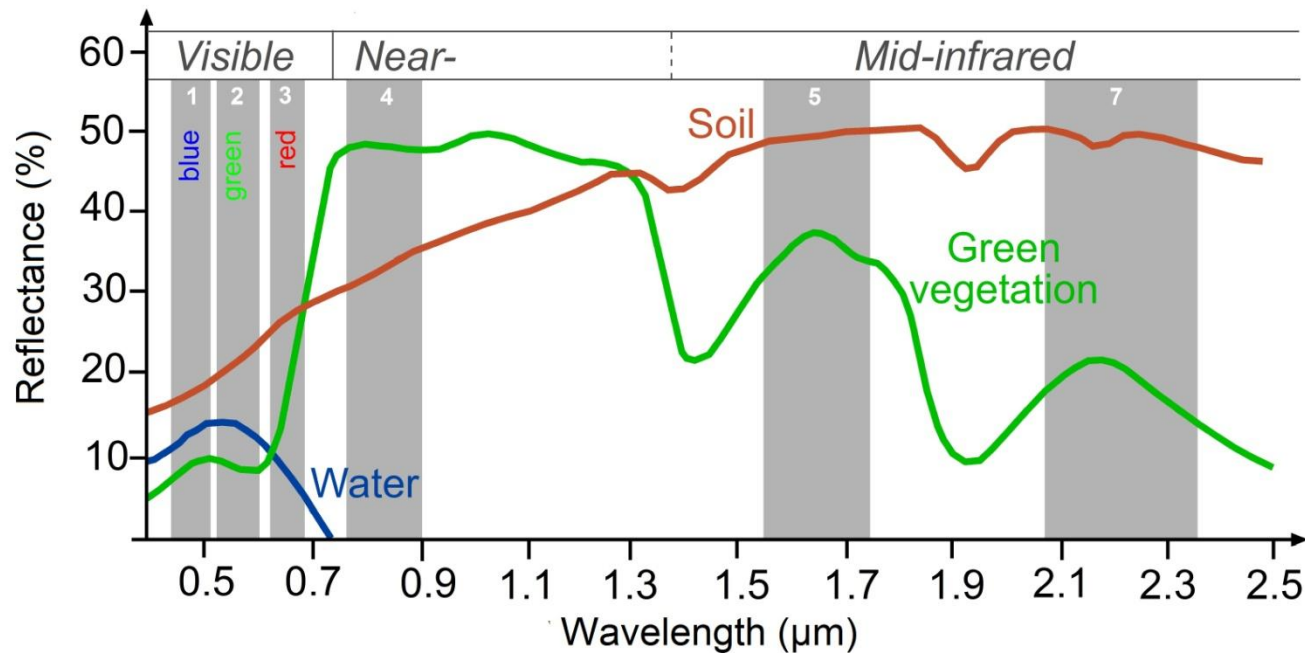
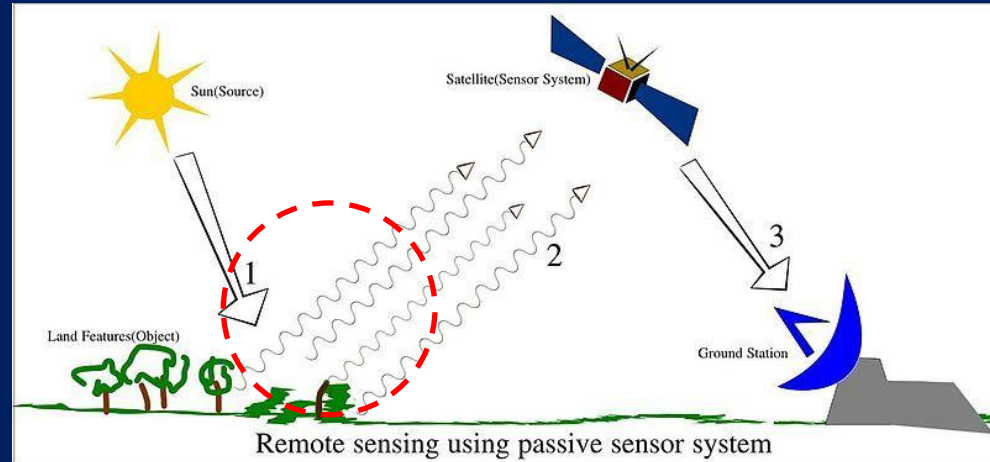
Remote Sensing Sensors

- Resolution
 - Spectral Resolution



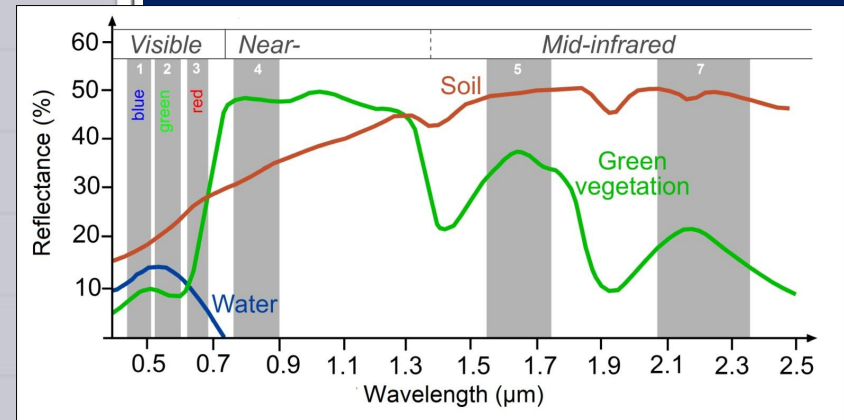
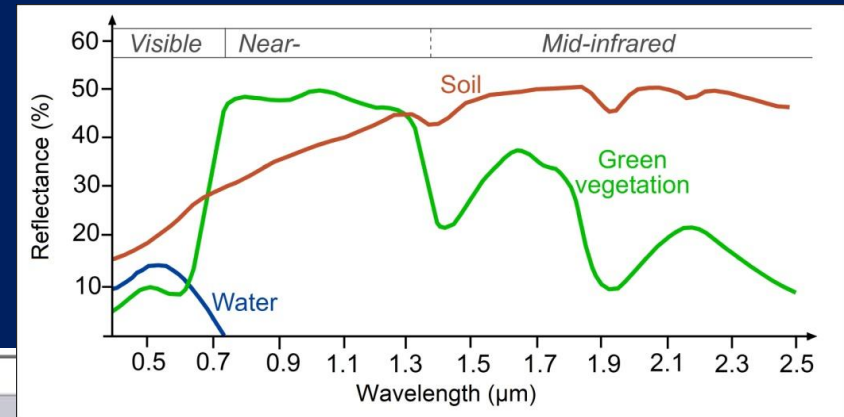
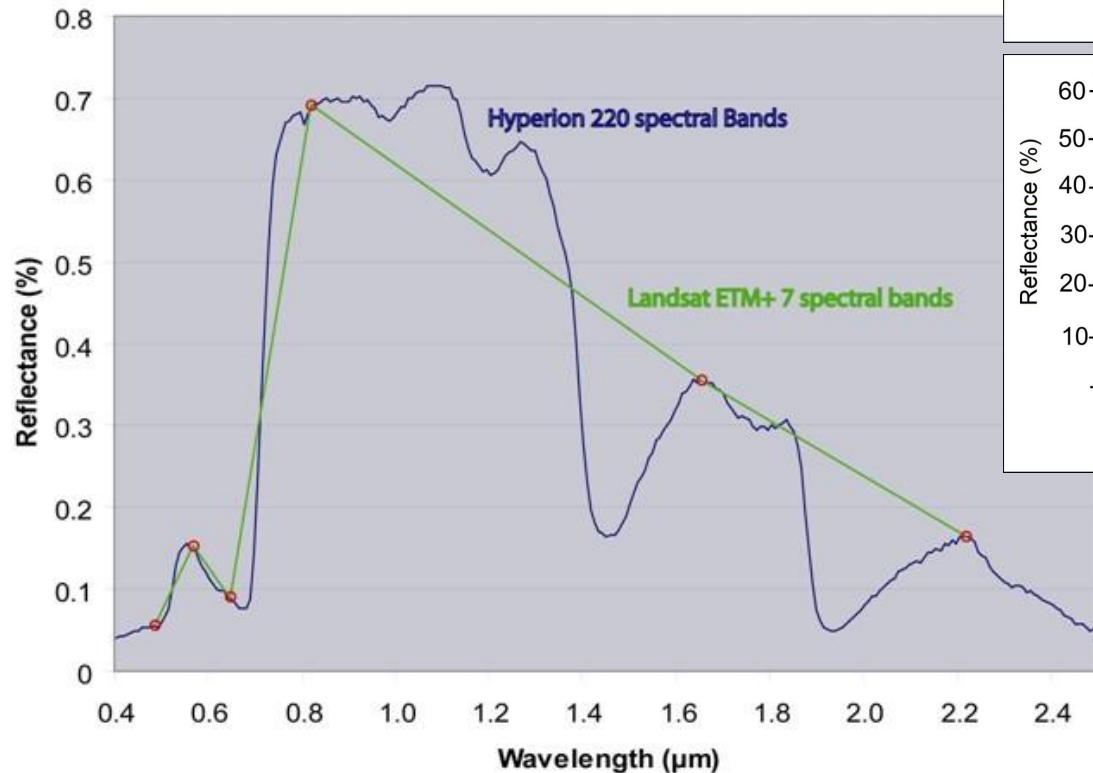
Remote Sensing Sensors

- Resolution
 - Spectral Resolution



Remote Sensing Sensors

- Resolution
 - Spectral Resolution



Remote Sensing Sensors

- Resolution
 - Spectral Resolution



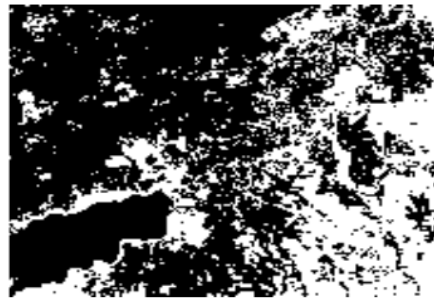
16 Values (4 bit)



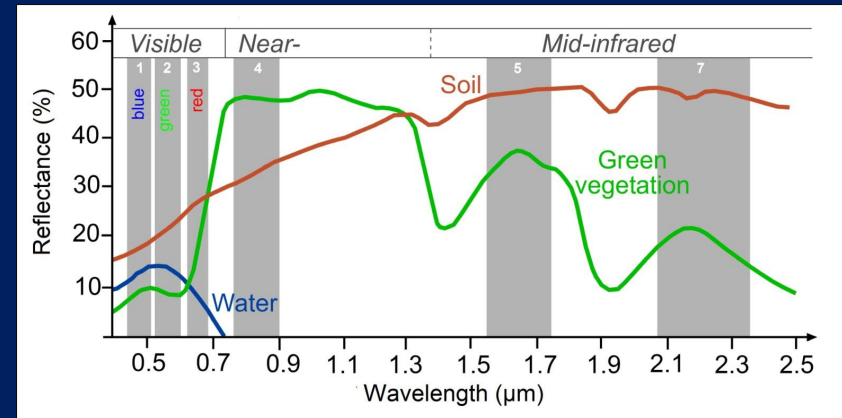
8 Values (3 bit)



4 Values (2 bit)



2 Values (1 bit)



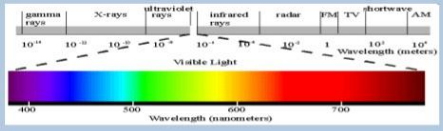
Bits	Wertebereich	Grauwerte
1Bit	$2^1 = 2$ (0-1)	0  1
4Bit	$2^4 = 16$ (0-15)	0  15
8Bit	$2^8 = 256$ (0-255)	0  255

An Introduction to GIS

Spectral Resolution

It is the range of wavelengths that an imaging system (satellite) can detect

Higher the wavelength range, higher is the spectral resolution.



Spectral resolution can also be defined as the **number of frequency bands** recorded.

Higher the number of Bands Higher the spectral resolution

Muhammad Haris
Lecturer GIS Center PUCIT

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Medium, High and Very-High Spatial Resolution Satellite Imagery



15 metres



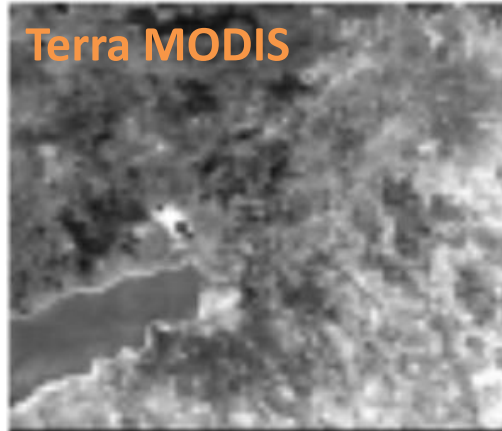
30 metres



60 metres



120 metres



240 metres



480 metres

Medium, High and Very-High Spatial Resolution Satellite Imagery

Landsat ETM+



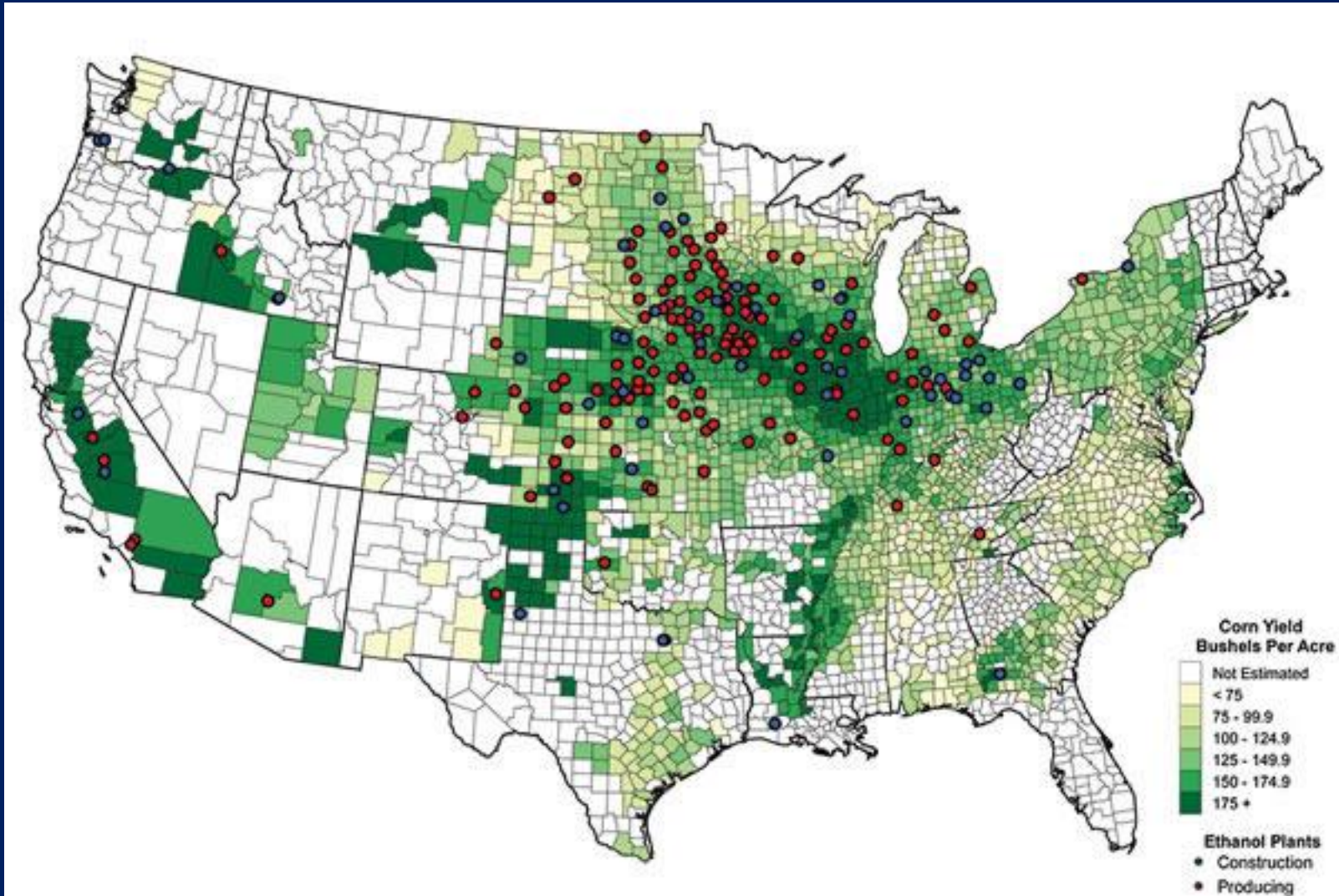
30 meters per pixel

The Advanced Land Imager (ALI)



10 meters per pixel

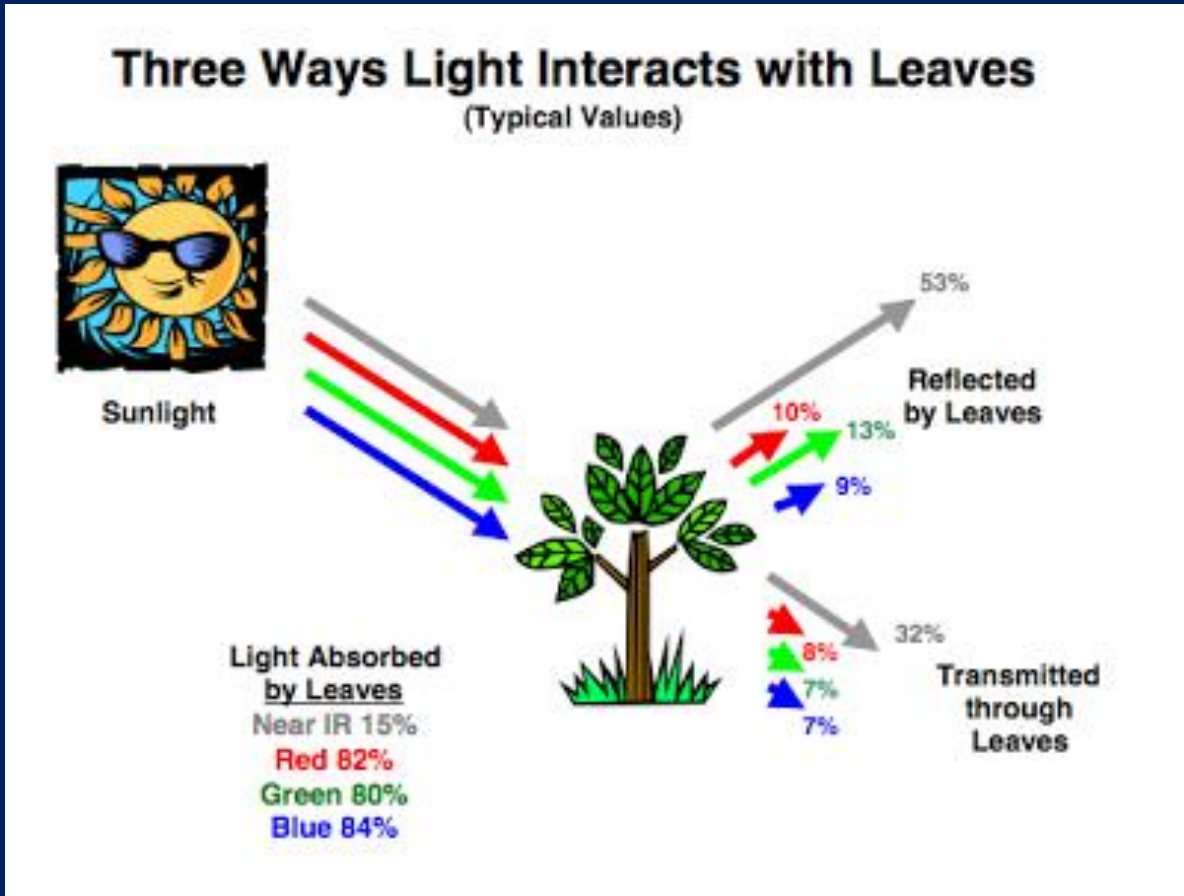
Land use cover, Land use Change using Remote Sensing data



Satellite Data Products - indices

□ Vegetation Index

- The Normalized Difference Vegetation Index (NDVI)

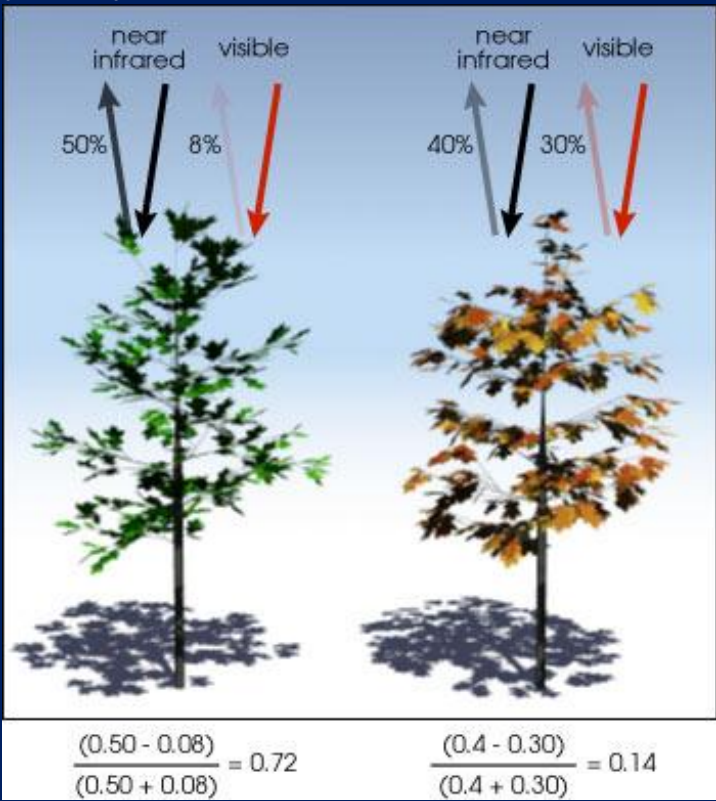
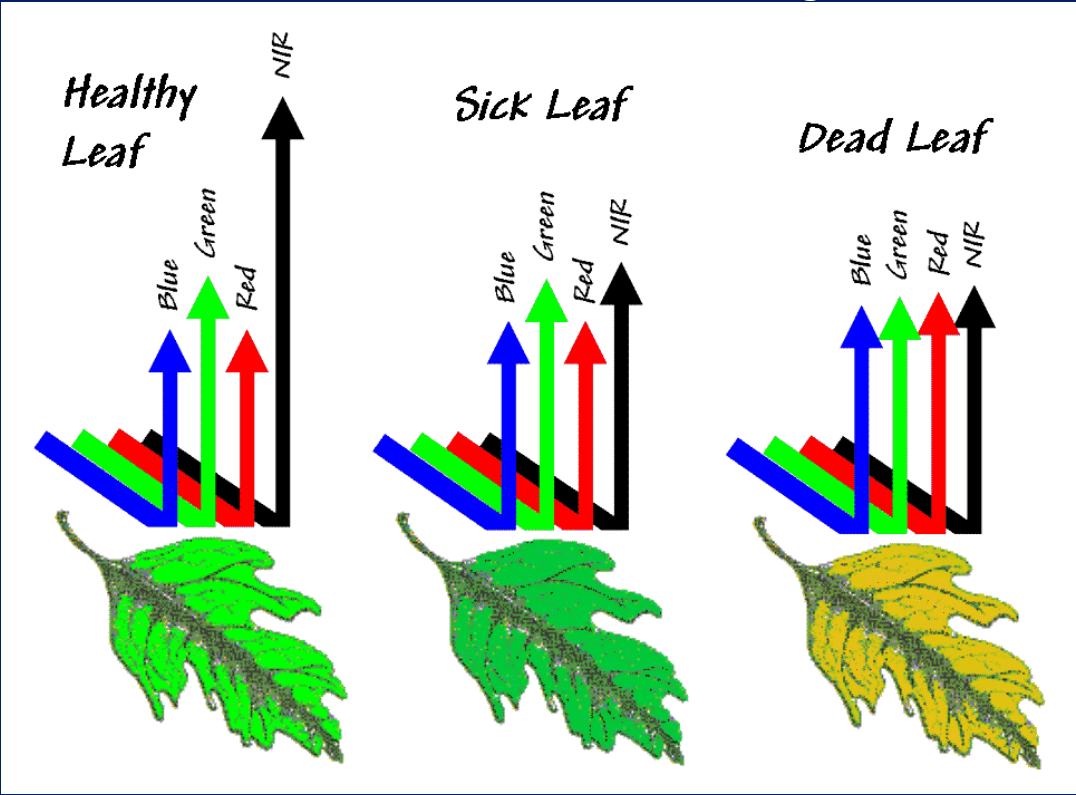


Satellite Data Products - indices

□ Vegetation Index

- The Normalized Difference Vegetation Index (NDVI)

$$NDVI = \frac{\rho_{nir} - \rho_{red}}{\rho_{nir} + \rho_{red}}$$

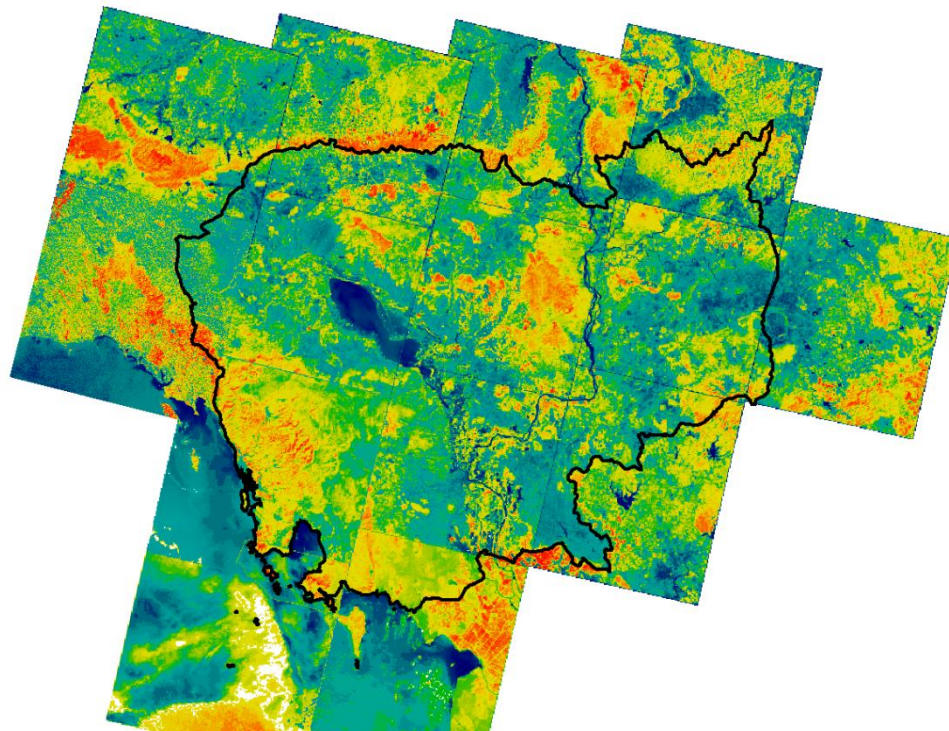


Satellite Data Products - indices

□ Vegetation Index

- The Normalized Difference Vegetation Index (NDVI)

$$\text{NDVI} = \frac{\rho_{\text{nir}} - \rho_{\text{red}}}{\rho_{\text{nir}} + \rho_{\text{red}}}$$



Example Landsat-8 derived NDVI products computed for Cambodia

Satellite Data Products - indices

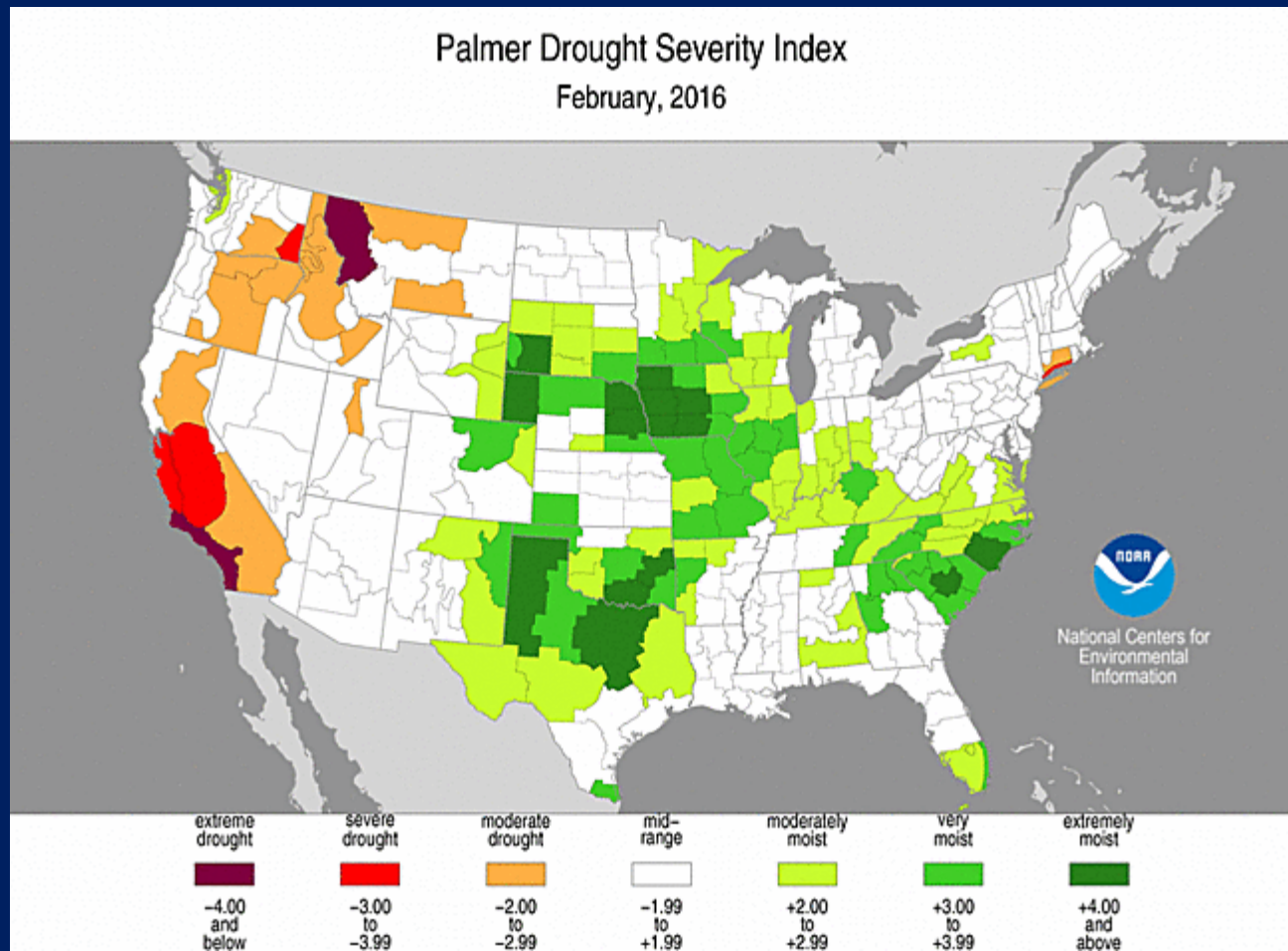
❑ Drought indices

- Palmer Drought Severity Index or (PDSI),
- Keetch–Byram drought index (KBDI)
- Standardised Precipitation Index (SPI)
- Standardised Precipitation-Evapotranspiration Index (**SPEI**)

Satellite Data Products - indices

□ Drought indices

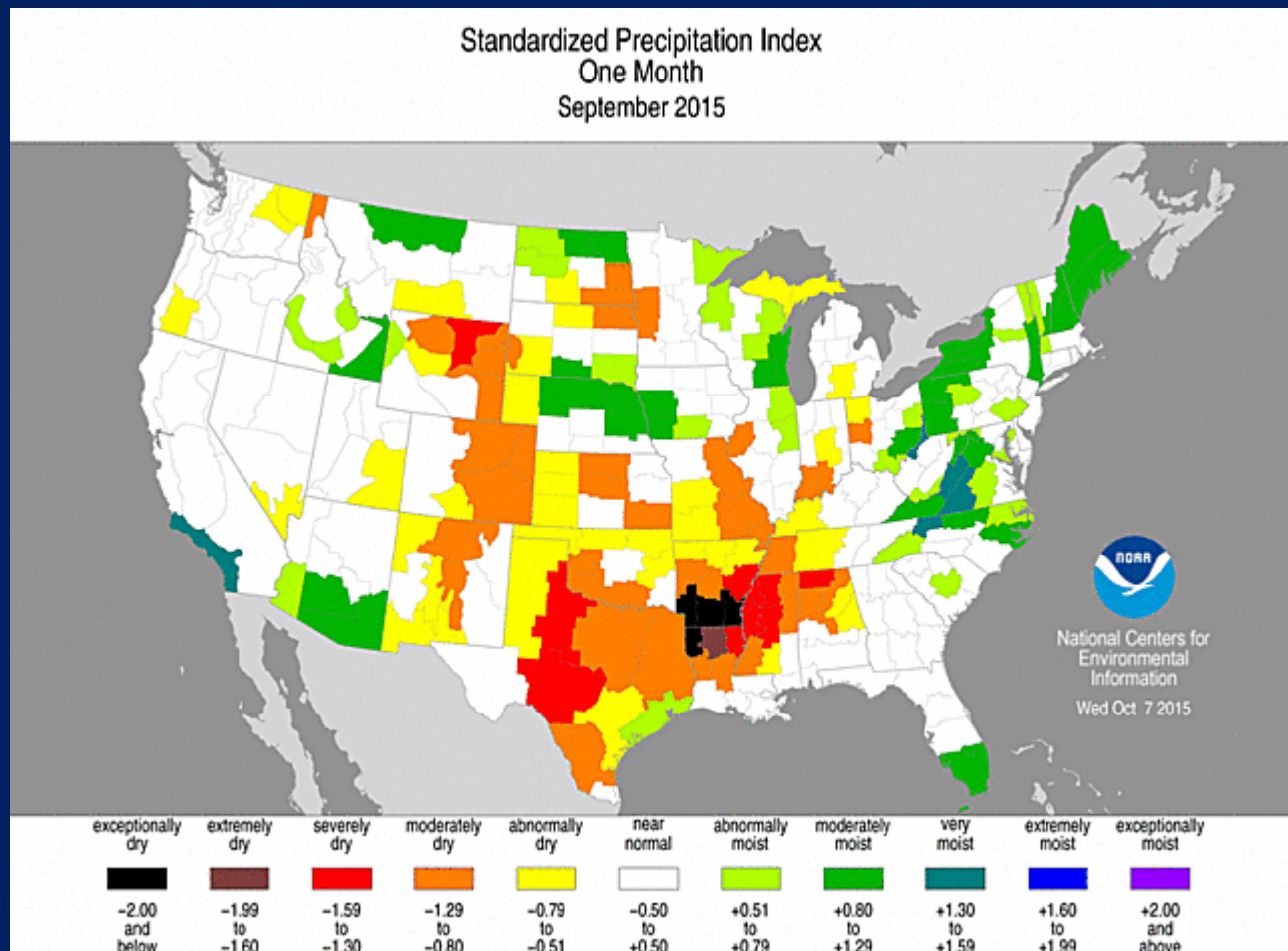
- Palmer Drought Severity Index or (PDSI)



Satellite Data Products - indices

□ Drought indices

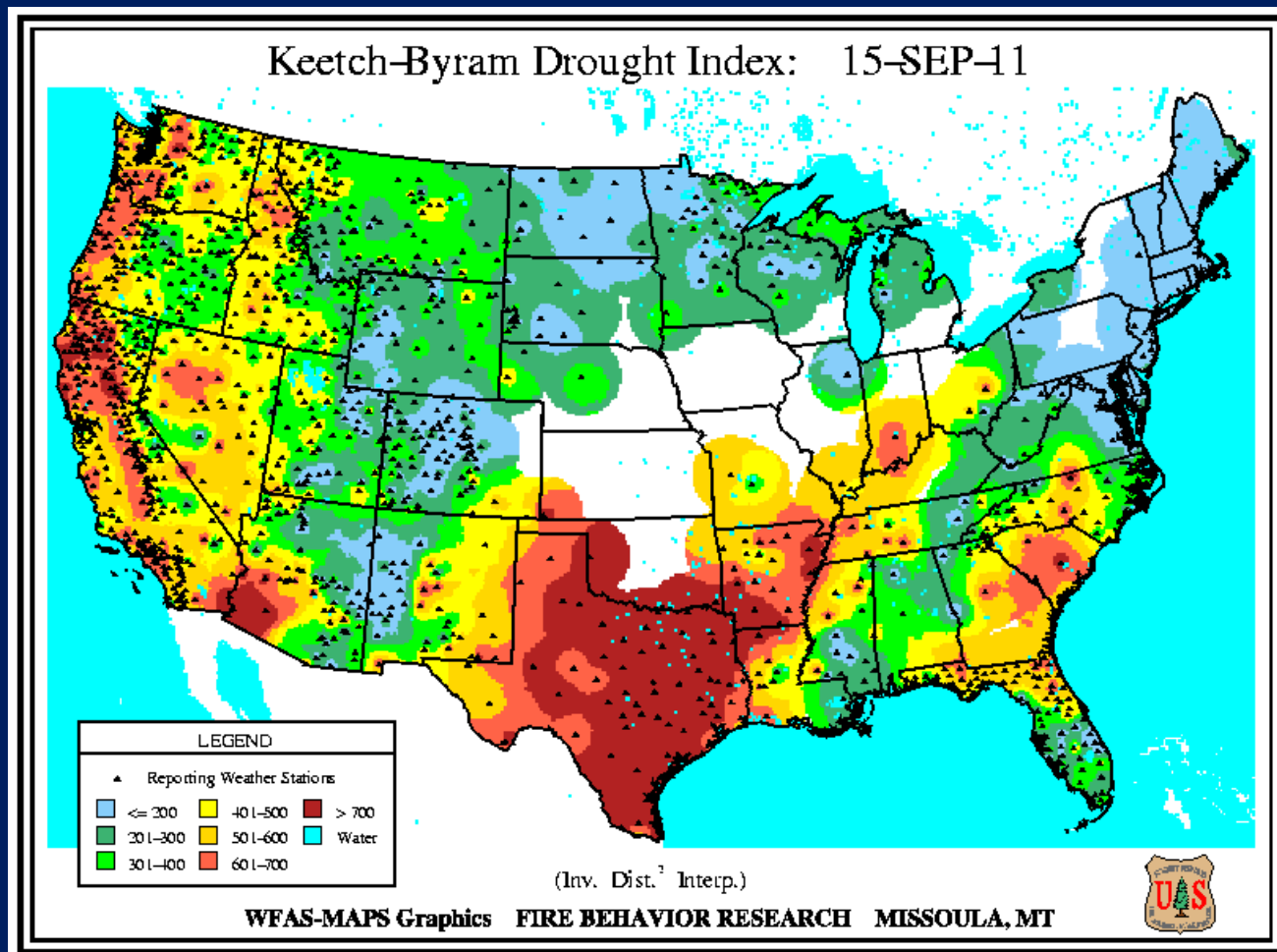
- Standardised Precipitation Index (SPI)



Satellite Data Products - indices

□ Drought indices

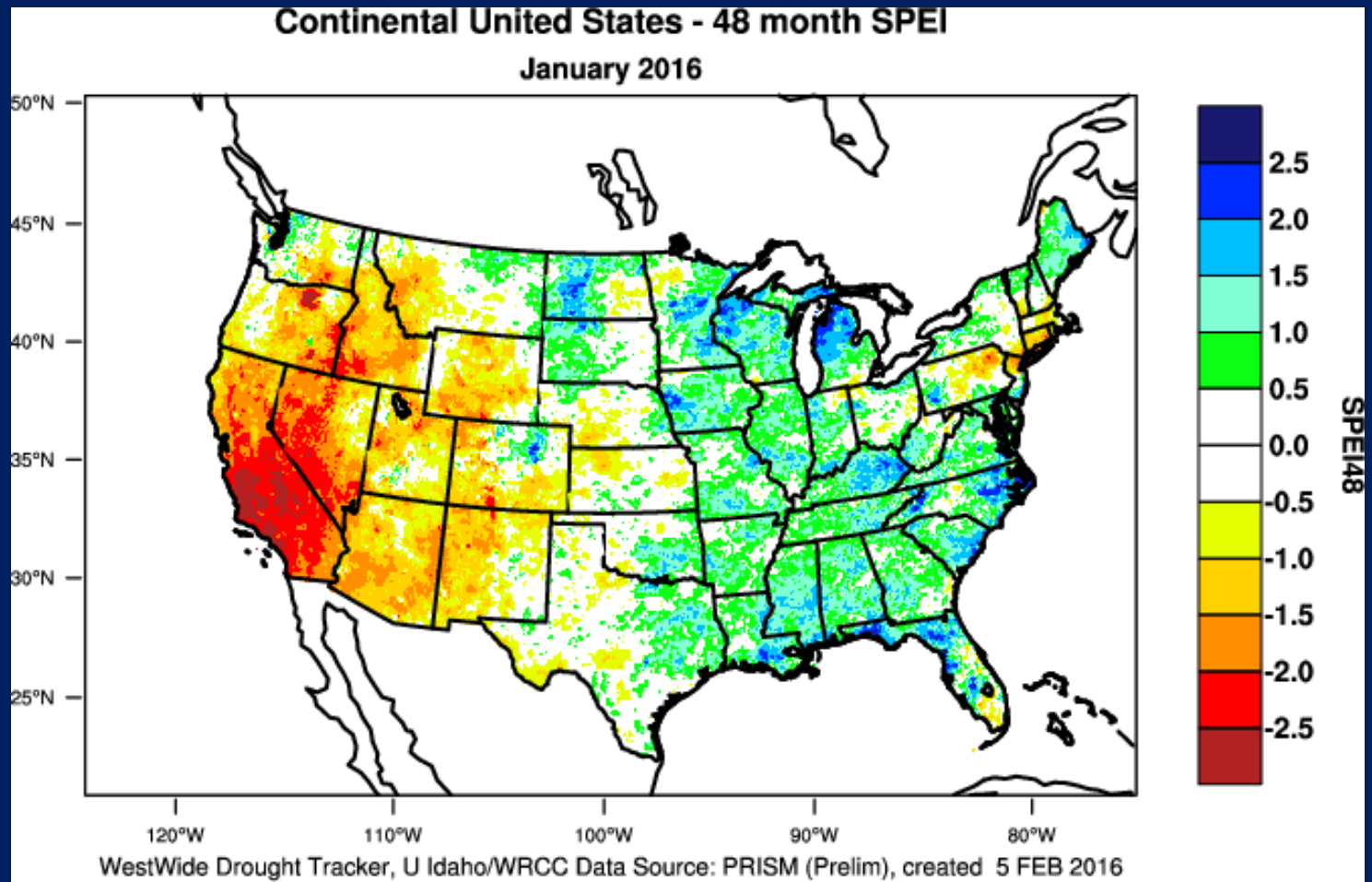
- Keetch–Byram drought index (KBDI)



Satellite Data Products - indices

□ Drought indices

- Standardised Precipitation-Evapotranspiration Index (**SPEI**)



Demonstration about SPEI data for Laos

SPEI – Standardized Precipitation Index

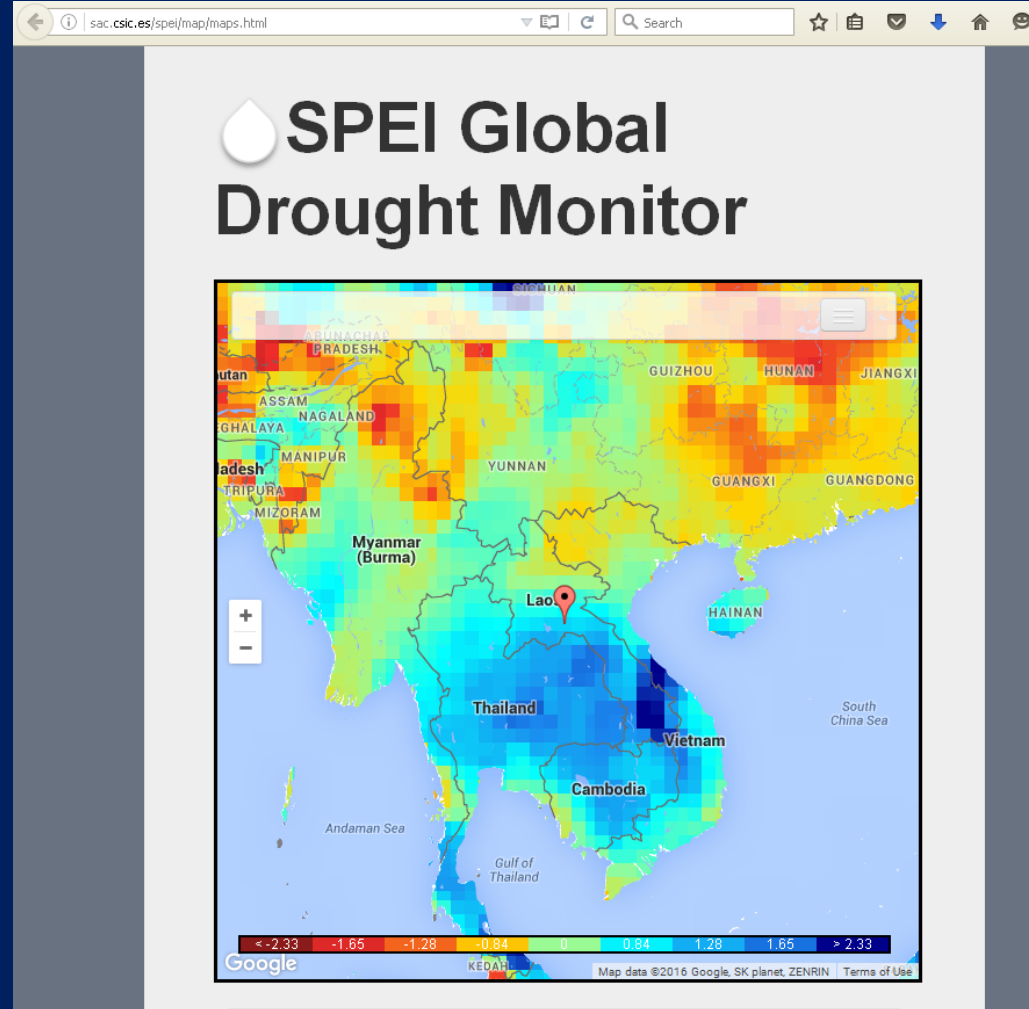
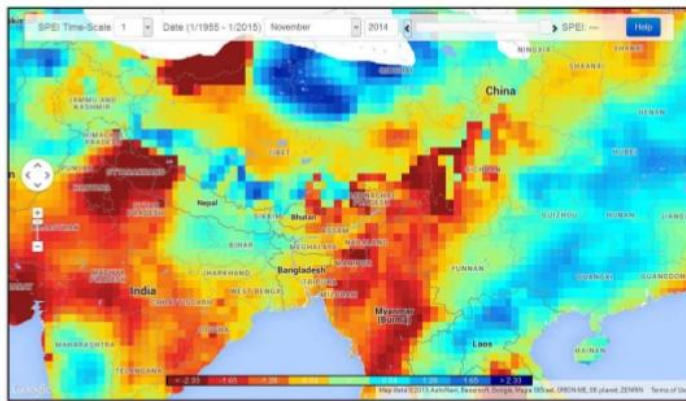
- Precipitation – Evapotranspiration
(calculated from temperature)

Probability of recurrence			
SPEI	Category	Number of times in 100 years	Severity of event
0 to -0.99	Mild dryness	33	1 in 3 yrs.
-1.00 to -1.49	Moderate dryness	10	1 in 10 yrs.
-1.5 to -1.99	Severe dryness	5	1 in 20 yrs.
< -2.0	Extreme dryness	2.5	1 in 50 yrs.

SPEI Values	
2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

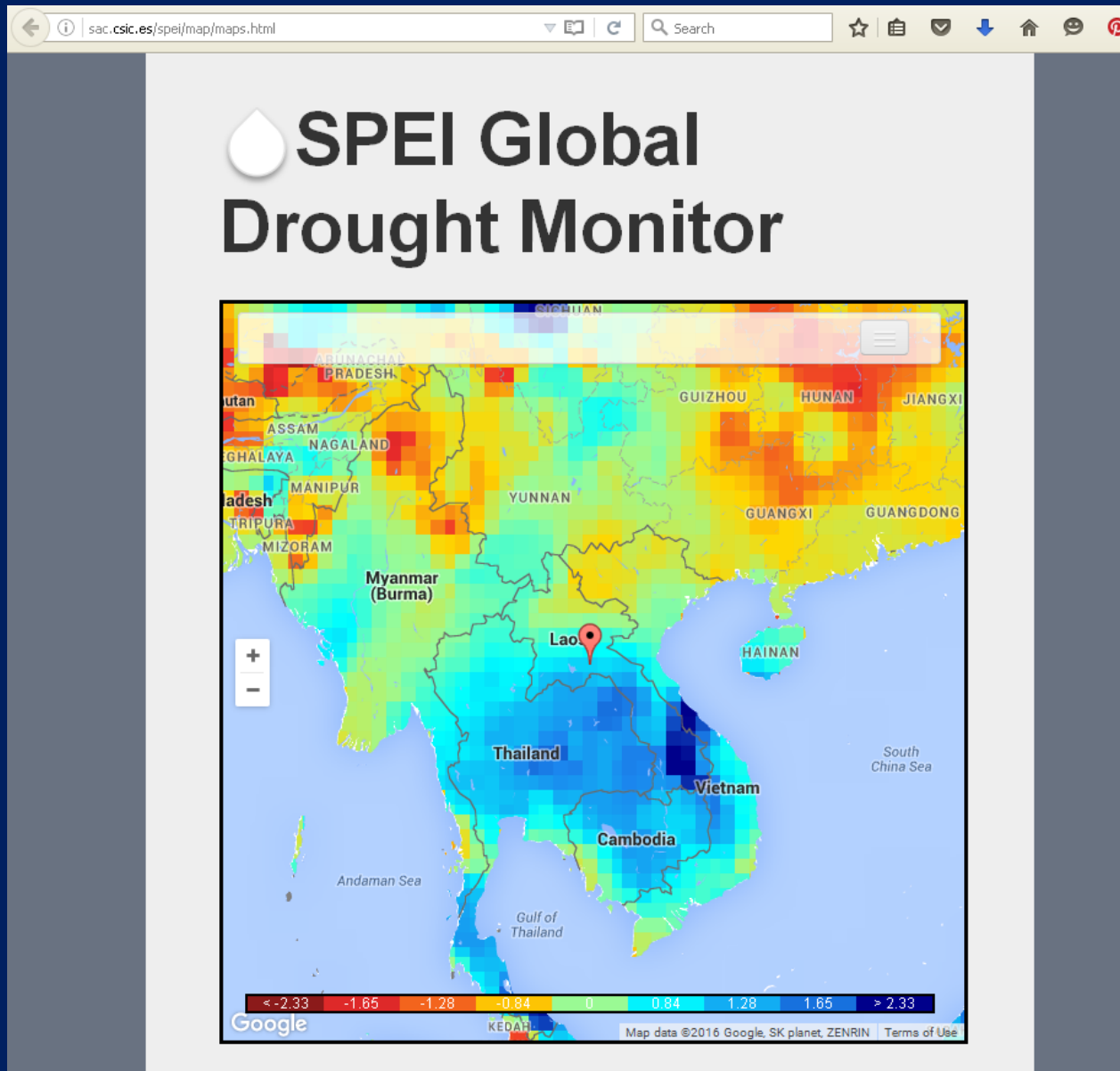
WMO. 2012. Standardized Precipitation Index User Guide.
Available at: http://www.wamis.org/agm/pubs/SPI/WMO_1090_EN.pdf

Monitoring SPEI - November 2014



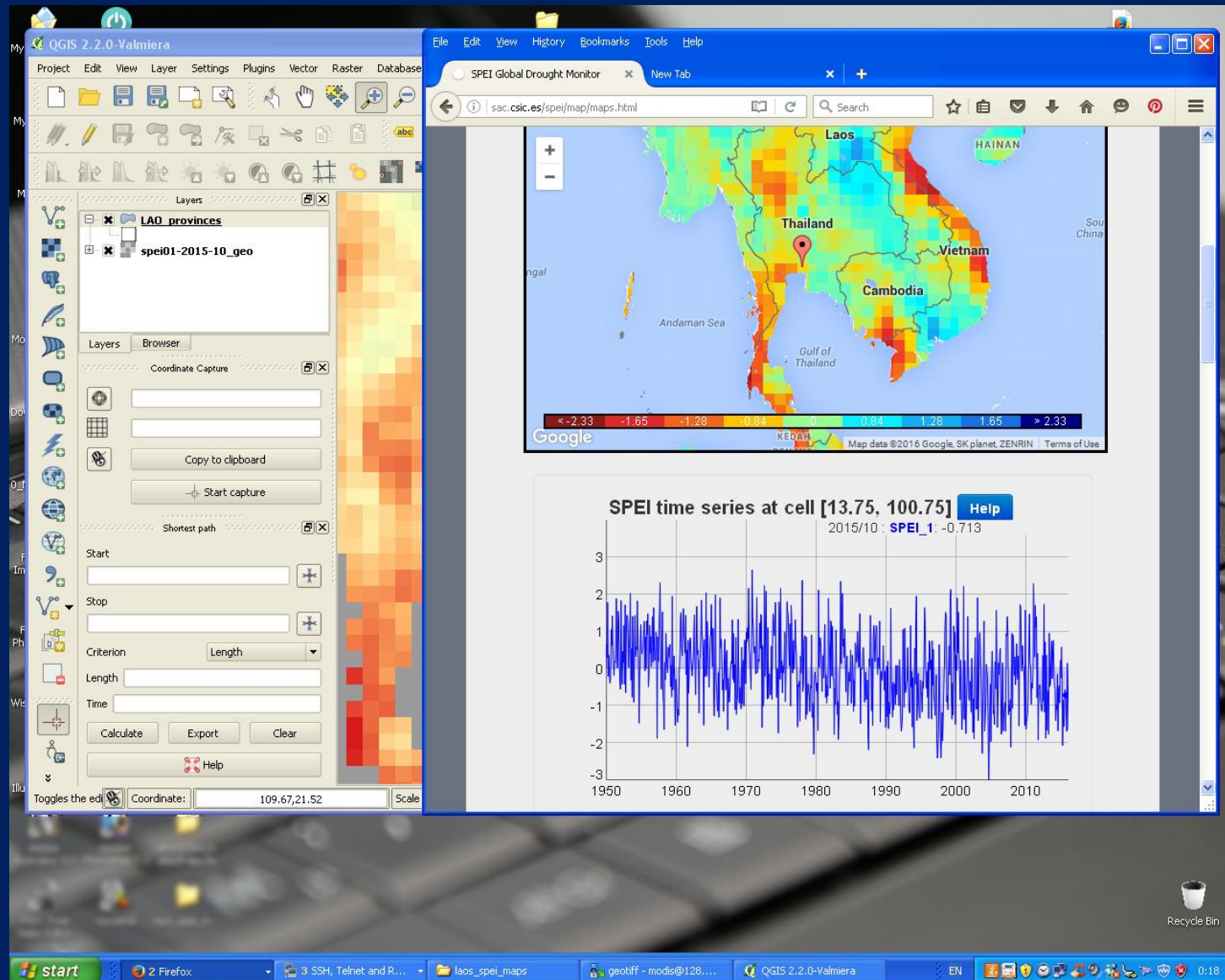
<http://sac.csic.es/spei/map/maps.html>

Demonstration about SPEI data



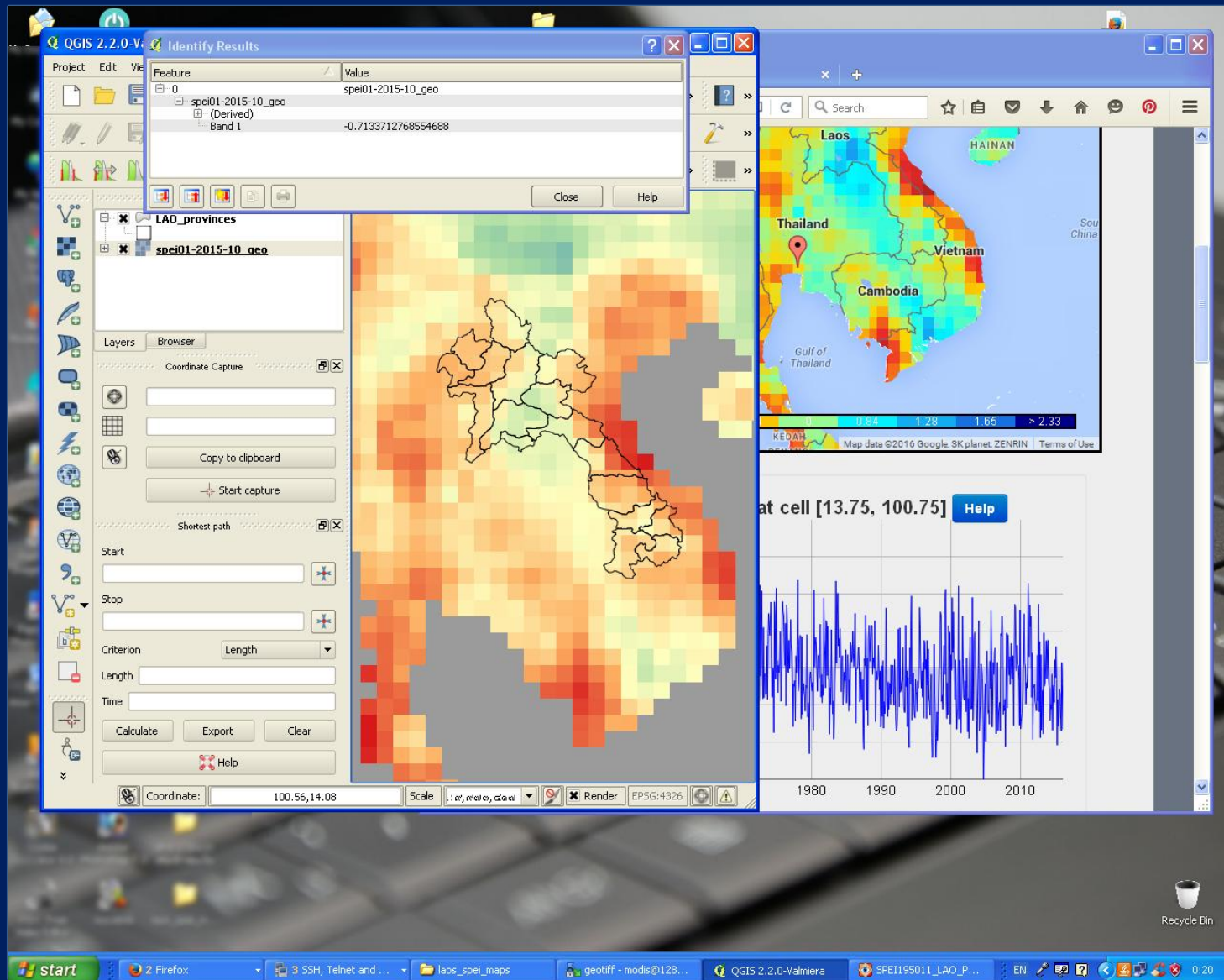
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Demonstration about SPEI data



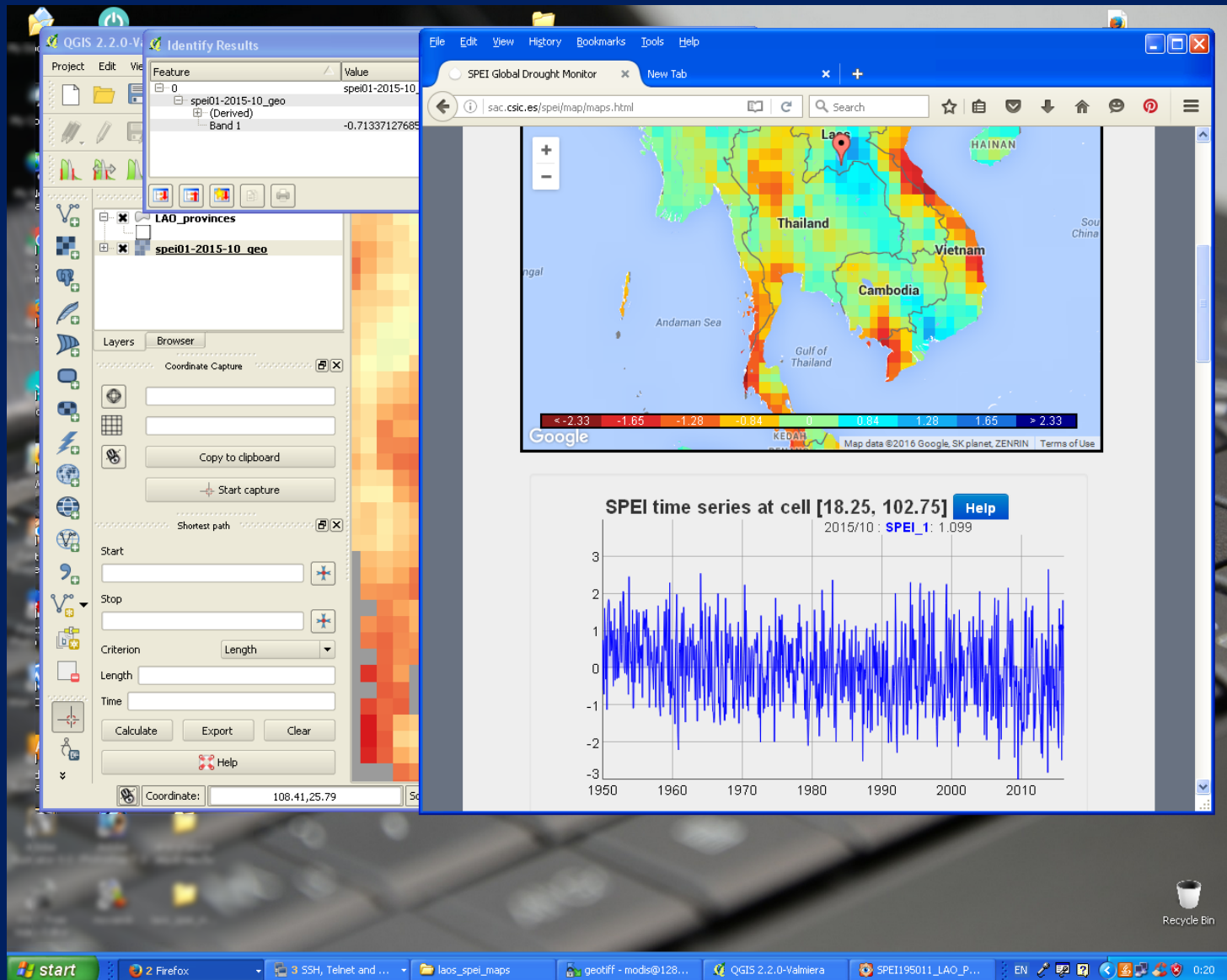
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Demonstration about SPEI data



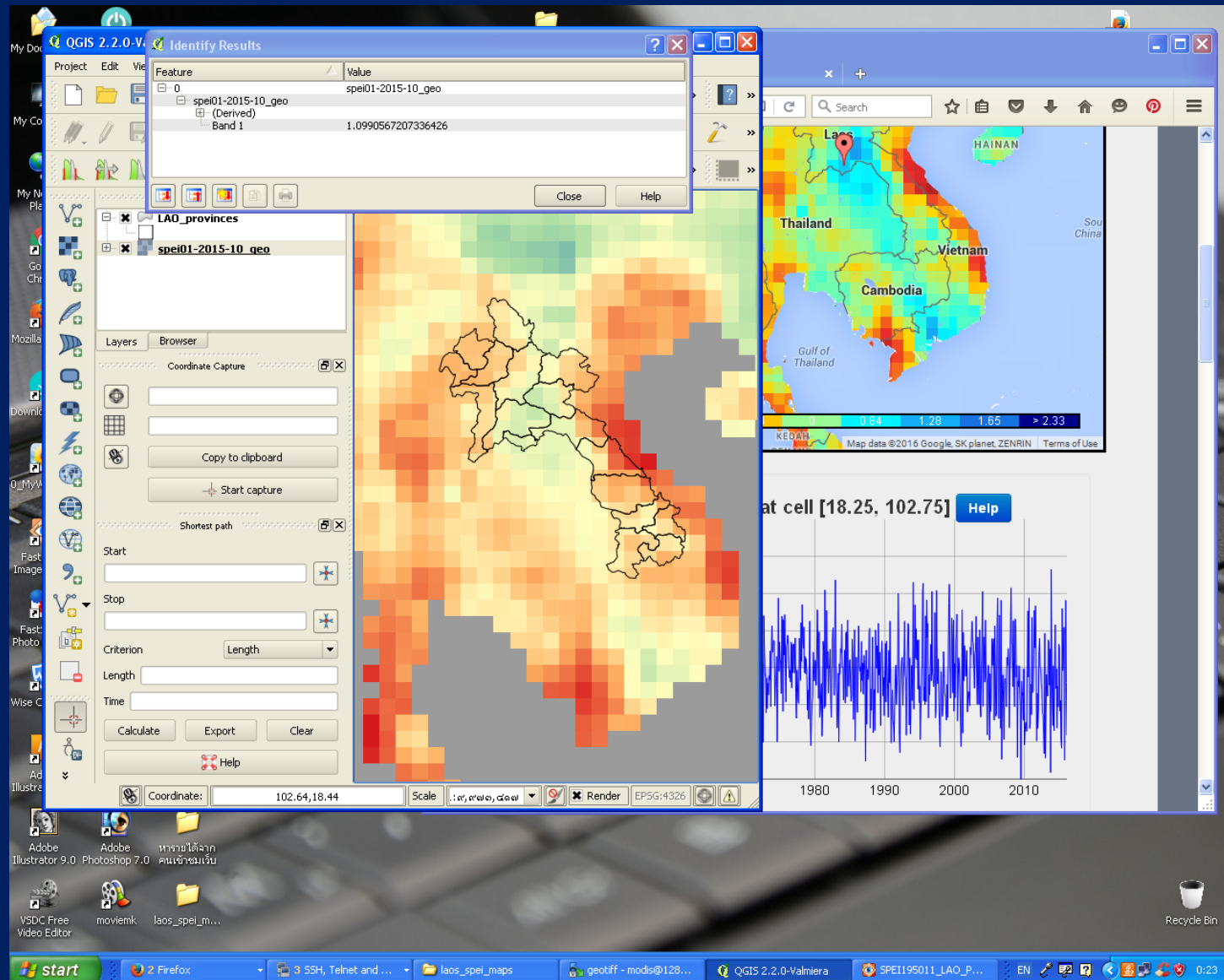
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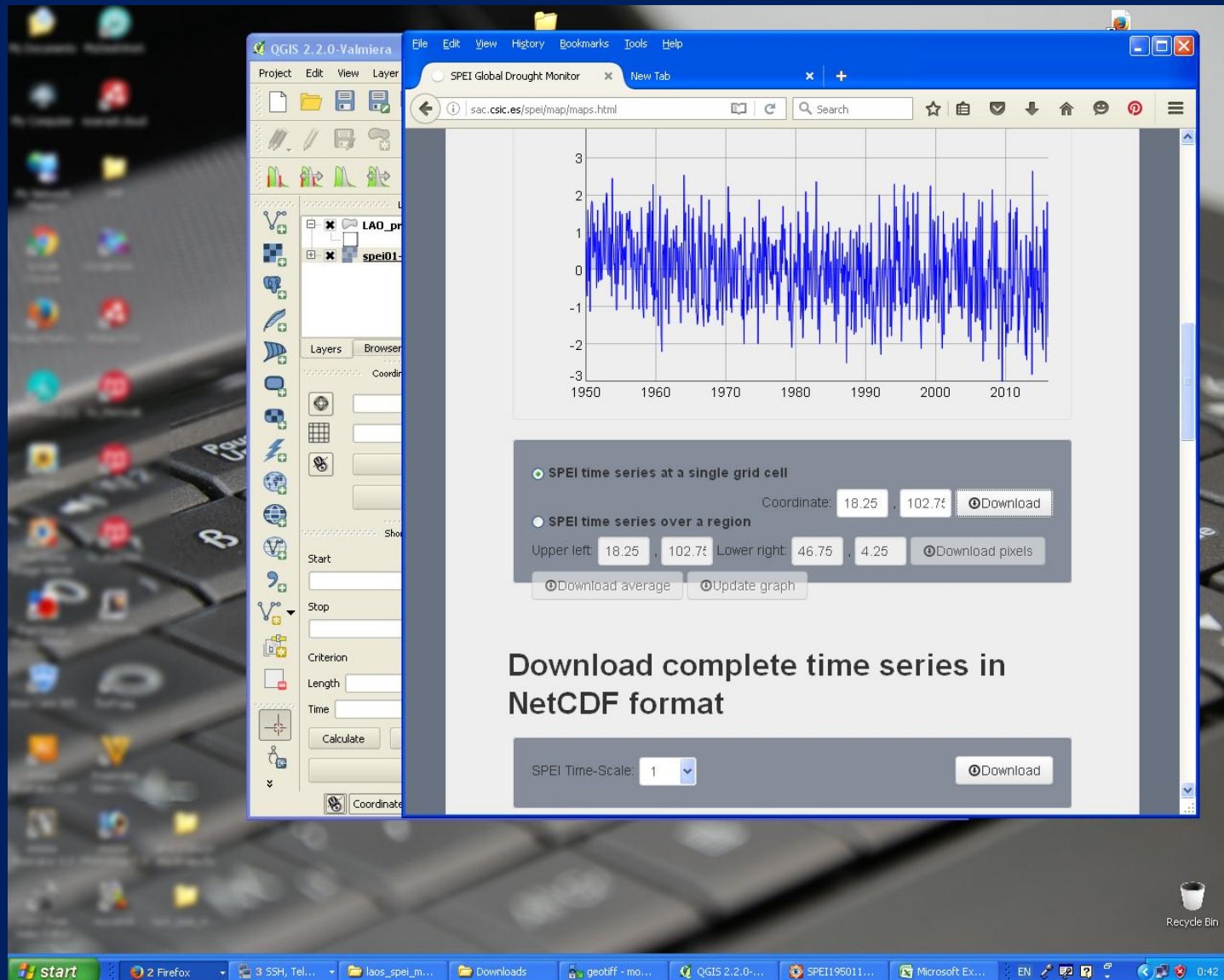
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Demonstration about SPEI data



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Demonstration about SPEI data



<http://sac.csic.es/spei/map/maps.html>

Demonstration about SPEI data

The screenshot displays a desktop environment with a Windows taskbar at the bottom. The taskbar includes the Start button and several open applications: 2 Firefox, 3 SSH, Tel..., laos_spei_m..., Downloads, geotiff - mo..., QGIS 2.2.0..., SPEI195011..., Microsoft Ex..., and a clock showing 0:42. The desktop background is a dark blue gradient. A QGIS 2.2.0 Valmiera window is open on the left, showing a map of Laos with layers 'LAO_pr' and 'spei01'. A web browser window titled 'SPEI Global Drought Monitor' is open in the center, displaying the URL 'sac.csic.es'. The browser shows a table of SPEI data for a specific region (18.25, 102.75). A Microsoft Excel window titled 'SPEI_18.25_102.75 - Microsoft Excel' is also open, showing the same data table. The table has columns for DATA, SPEI_1, SPEI_2, SPEI_3, SPEI_4, SPEI_5, SPEI_6, SPEI_7, and SPEI_8. The data rows show values for months from Jan-50 to Aug-50. Below the table, there are controls for downloading the data in NetCDF format, including a 'Download' button and a 'SPEI Time-Scale' dropdown set to 1.

DATA	SPEI_1	SPEI_2	SPEI_3	SPEI_4	SPEI_5	SPEI_6	SPEI_7	SPEI_8
Jan-50	-0.59267							
Feb-50	0.75629	0.19588						
Mar-50	0.5723	0.73151	0.44167					
Apr-50	-0.70531	-0.29209	-0.06782	-0.19827				
May-50	1.61257	1.06492	1.09002	1.12781	1.06242			
Jun-50	1.02759	1.61579	1.29519	1.31166	1.32912	1.27646		
Jul-50	-0.30093	0.3633	1.27527	0.89	0.93401	0.97883	0.92188	
Aug-50	0.87004	0.34471	0.73929	1.31668	1.07804	1.10677	1.14531	1.10677

Download complete time series in NetCDF format

SPEI Time-Scale: 1 [Download]

<http://sac.csic.es/spei/map/maps.html>

Demonstration about SPEI data

The screenshot shows a desktop environment with a Windows taskbar at the bottom. The taskbar includes the Start button and several open applications: Firefox, SSH, Tel..., laos_spei_m..., Downloads, geotiff - mo..., QGIS 2.2.0-..., SPEI195011..., and Microsoft Ex... The desktop background is a blurred image of a keyboard. The QGIS 2.2.0-Valmiera application is open on the left, showing a map of Laos with a layer named 'spei01'. The web browser in the center displays the 'SPEI Global Drought Monitor' interface. The interface includes a search bar with the coordinates '18.25, 102.75' and a 'Download' button. Below the search bar, there are options to download the 'SPEI time series over a region' or 'SPEI pixels'. The 'SPEI time series over a region' option is selected, and the 'Download' button is highlighted. The Microsoft Excel application is open on the right, displaying a table of SPEI time series data for the region '18.25, 102.75'. The table has columns for Date, SPEI, and other metrics. The data is for the period from August 15, 2015, to March 16, 2016. The table is as follows:

Date	SPEI	Other Metrics
Aug-15	-0.0695	1.14405
Sep-15	0.2866	0.02254
Oct-15	1.09906	0.79296
Nov-15	-2.47749	0.48257
Dec-15	0.08319	-1.10717
Jan-16	1.82505	1.45233
Feb-16	-0.38927	0.81818
Mar-16	-1.81099	-1.56882

End of Presentation

For any questions about remote sensing & GIS

For environment and disaster

Please feel free to contact:

vivarad@gmail.com or **thatheva@gmail.com**



LINE id: **Vivarad2954**