APPLICATIONS OF REMOTE SENSING

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Outline

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- Material
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- Conclusion&challenges

Background Introduction

- Sebkhas are wet depressions in desert environments
- Sebkhas are sandflats that are formed along arid coastlines
- Rainwater is another source of water for these excavations

Introduction

- The primary objective of this paper was to monitor the evolution of water cavities in Sebkha over a certain period.
- Using the features of GEE to monitor Sebkha by extracting its wetness, salt, and humidity indices and contribute to the development of a GEE-based methodology.
- Using the radar/optic combination to extract hydrogeological and geomorphological information
- Using the random forest classification possibilities to improve the mapping accuracy in this desert region.

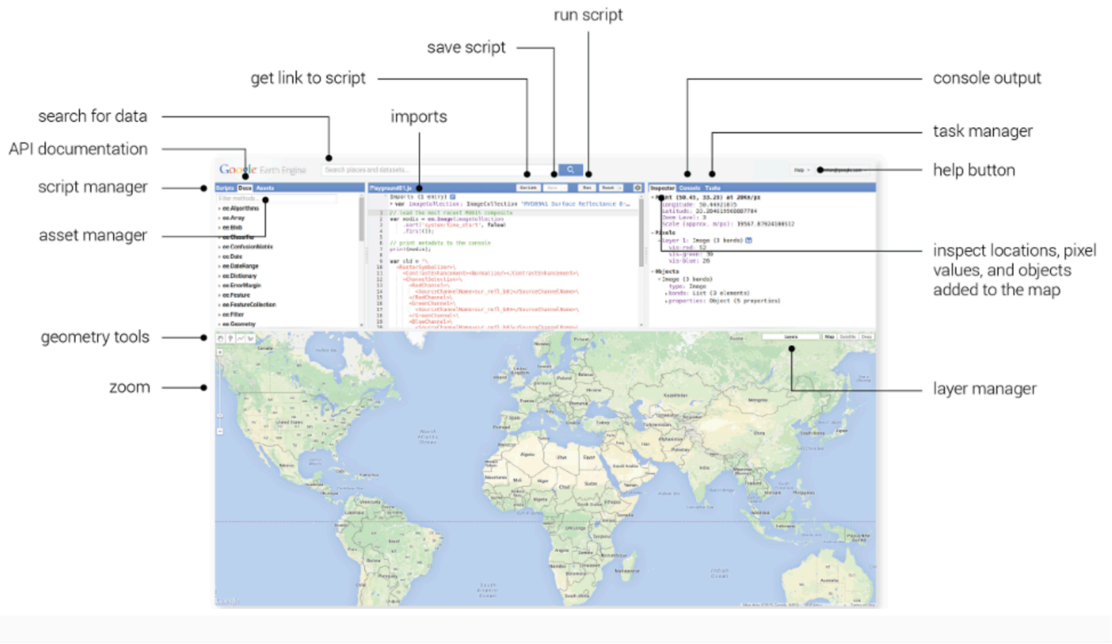
Google Earth Engine(GEE)

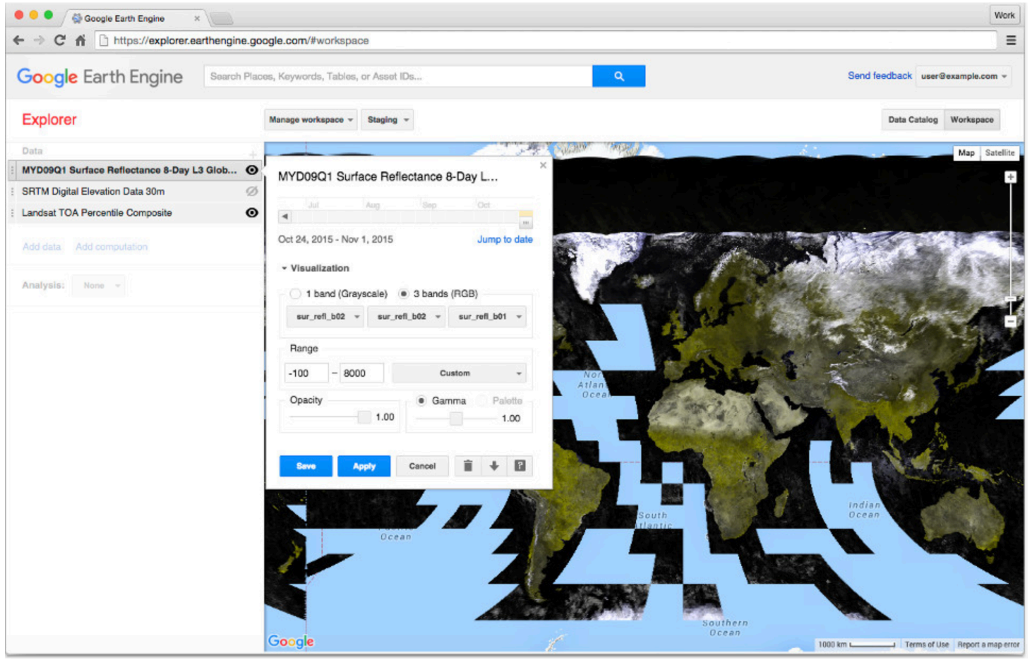
Google Earth Engine is a computing platform that allows users to run geospatial analysis on Google's infrastructure. There are several ways to interact with the platform.

The Code Editor is a web-based IDE for writing and running scripts.

The Explorer is a lightweight web app for exploring our data catalog and running simple analyses.

It provide Python and JavaScript wrappers around web API.





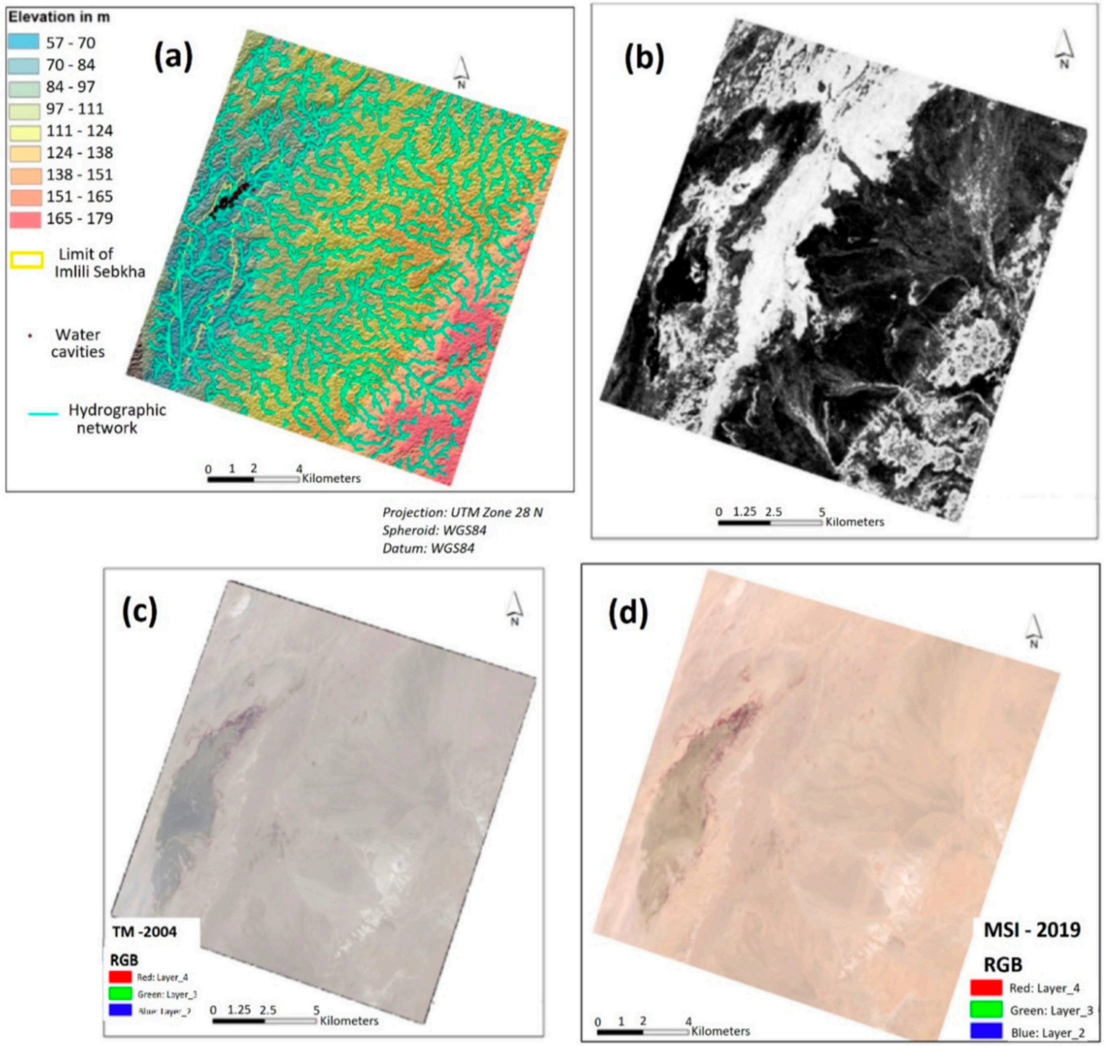
Google Earth Engine(GEE)

In this work, the GEE platform was used to

- monitor the salt states of permanent water cavities in Sebkha
- monitor the wet/dry conditions of these cavities
- assess the capability of cloud computing
- analyze the function of the Sebkha aquifer system

SAR

SAR is an active remote sensing technique that can penetrate the cloud cover, operate day or night, and allow an effective classification of surface water.



Material

The material of this research comes from 2 part:

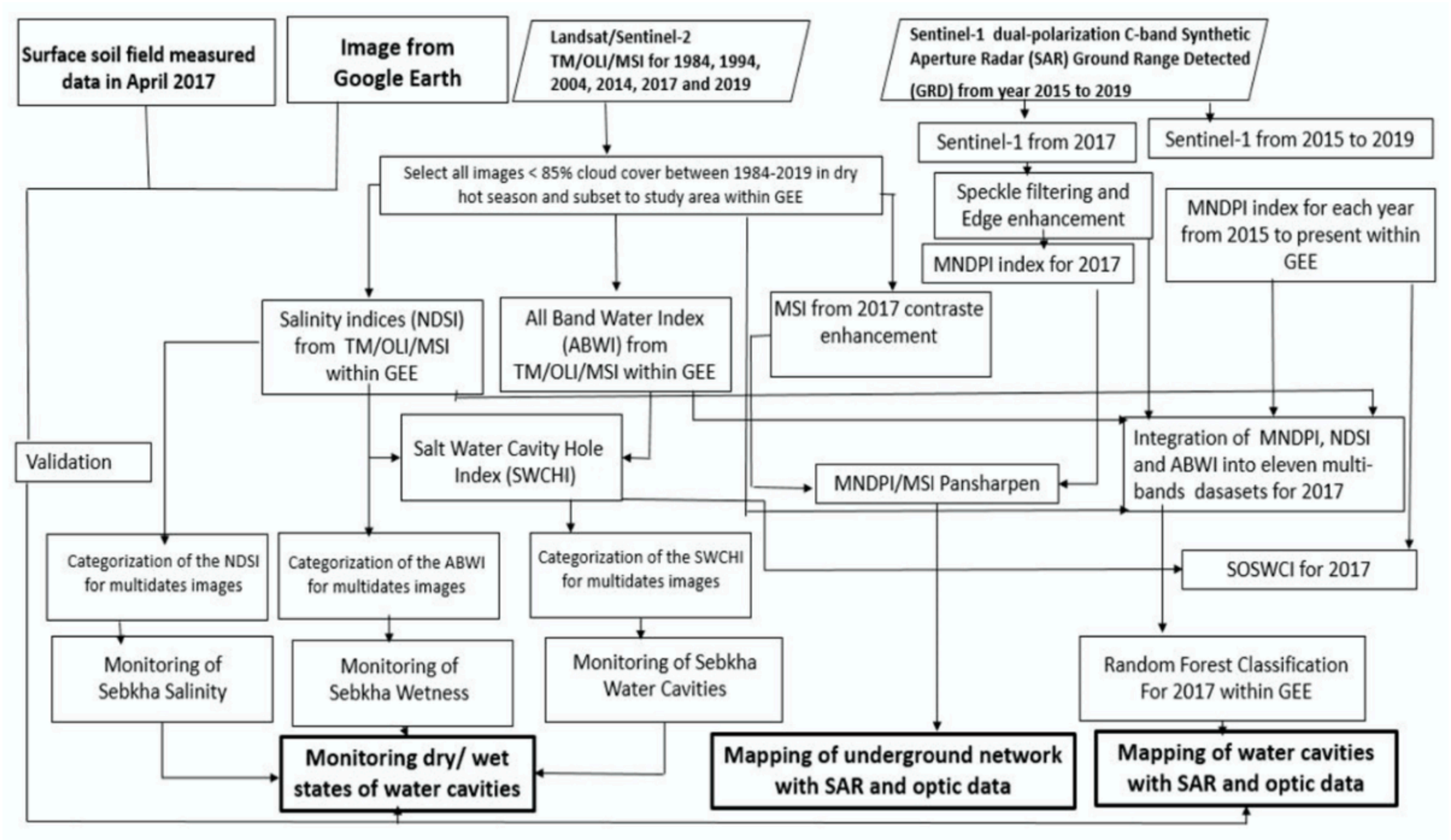
- Earth Observation Data
- Surface Soil Data Measured in the Field

Material

Dataset for deriving the spectral indices

Data Source	Characteristics	Extracted Indices
Optical Imagery	280 individual 30-m TM/Landsat-5 images acquired from the study area in 1984, 1994 and 2004	—Water index used in this study (ABWI) —Normalised Difference Salinity Index (NDSI)—Salt Water Cavity Index (*SWCI*) —Sar/Optic Saltwater Cavity Index (*SOSWCI*)
	83 individual 10-m MSI/Sentinel-2A images acquired from the study area in 2017	
	50 individual 10-m MSI/Sentinel-2A images acquired from the study area in 2019	
Radar Imagery	211 individual Sentinel-1 SAR ground-range-detected images collected at a 10 m spatial resolution from 2015 to present	—Microwave-Normalised Difference Polarisation Index (*MNDPI*) —SAR/Optic Salt Cavity Index (*SOSWCI*)
Reference Data CHIRPS Precipitation Data	Vector-point-based data that represent the position of water cavities Spatial: 0.05° Date range: 1985–2019	Water cavities characteristics in the attribute table Precipitation graph generated by ClimateEngine.org

Method

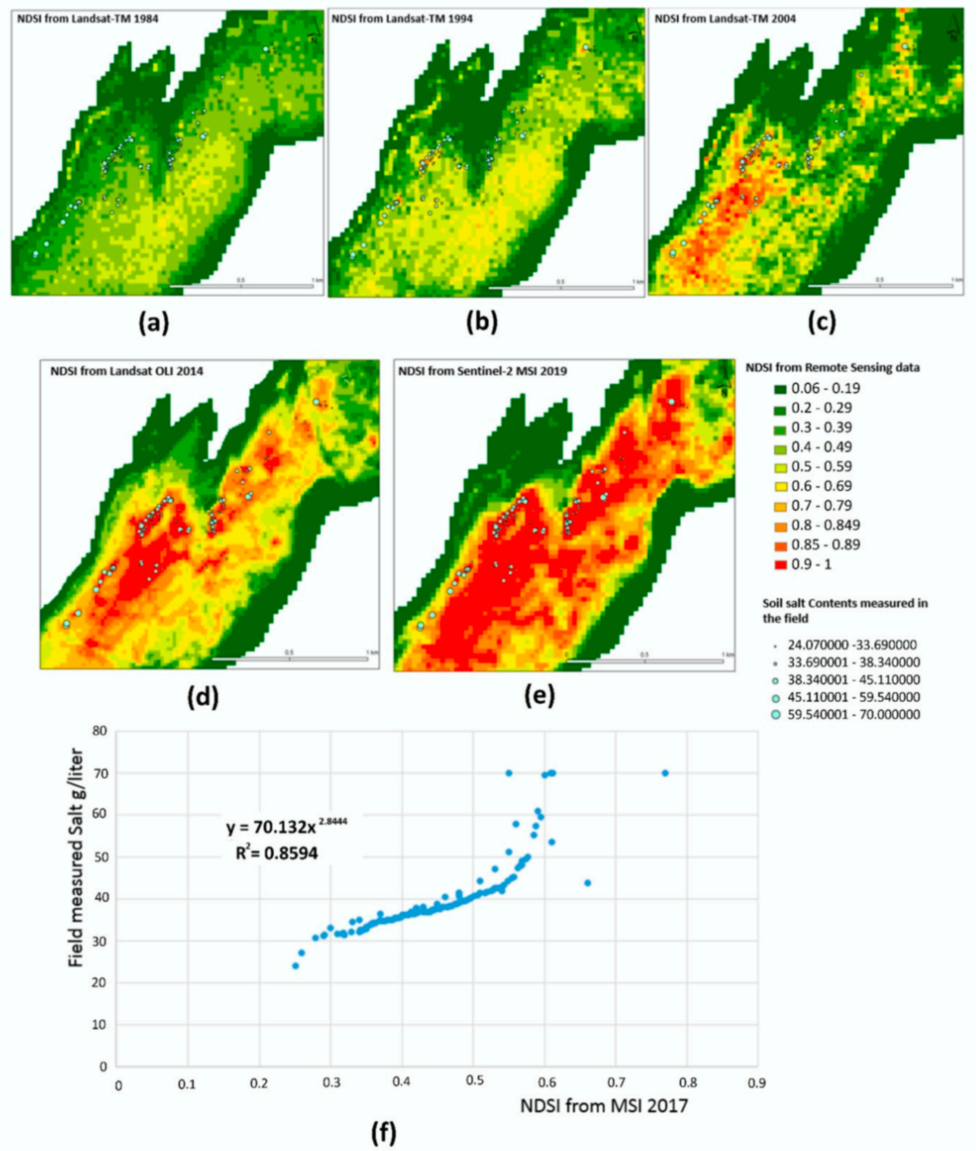


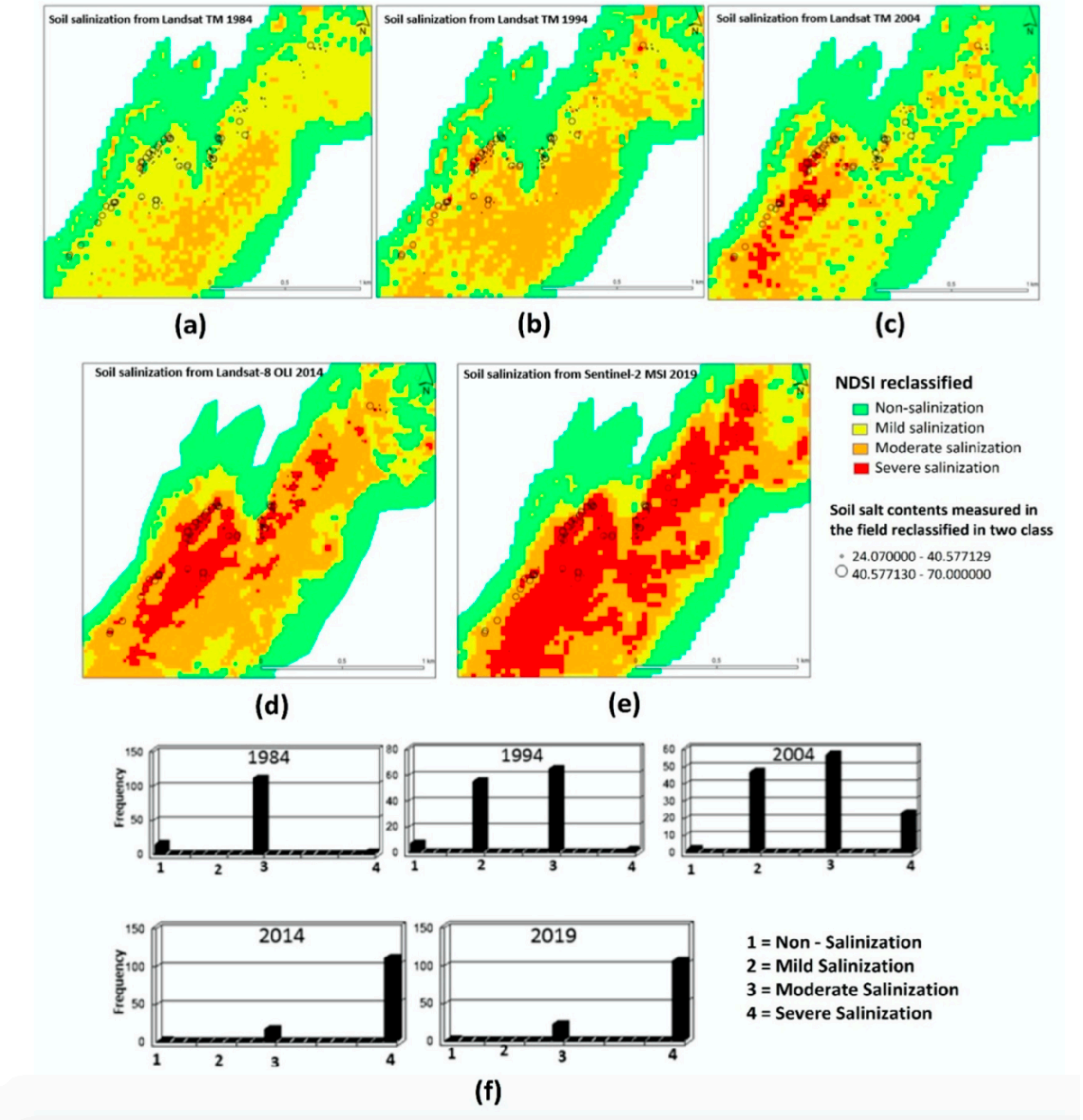
Surface soil field measured data in April 2017
Image from Google Earth
Landsat/Sentinel-2 TM/OLI/MSI for 1984, 1994, 2004, 2014, 2017 and 2019
Sentinel-1 dual-polarization C-band Synthetic Aperture Radar (SAR) Ground Range Detected (GRD) from year 2015 to 2019
Sentinel-1 from 2017
Sentinel-1 from 2015 to 2019
Select all images < 85% cloud cover between 1984-2019 in dry hot season and subset to study area within GEE
Speckle filtering and Edge enhancement
MNDPI index for each year from 2015 to present within GEE
MNDPI index for 2017
Salinity indices (NDSI) from TM/OLI/MSI within GEE
All Band Water Index (ABWI) from TM/OLI/MSI within GEE
MSI from 2017 contraste enhancement
Validation
Salt Water Cavity Hole Index (SWCHI)
MNDPI/MSI Pansharpen
Integration of MNDPI, NDSI and ABWI into eleven multi-bands dasasets for 2017
Categorization of the NDSI for multidates images
Categorization of the ABWI for multidates images
Categorization of the SWCHI for multidates images
SOSWCI for 2017
Monitoring of Sebkha Salinity
Monitoring of Sebkha Wetness
Monitoring of Sebkha Water Cavities
Random Forest Classification For 2017 within GEE
Monitoring dry/ wet states of water cavities
Mapping of underground network with SAR and optic data
Mapping of water cavities with SAR and optic data

Results

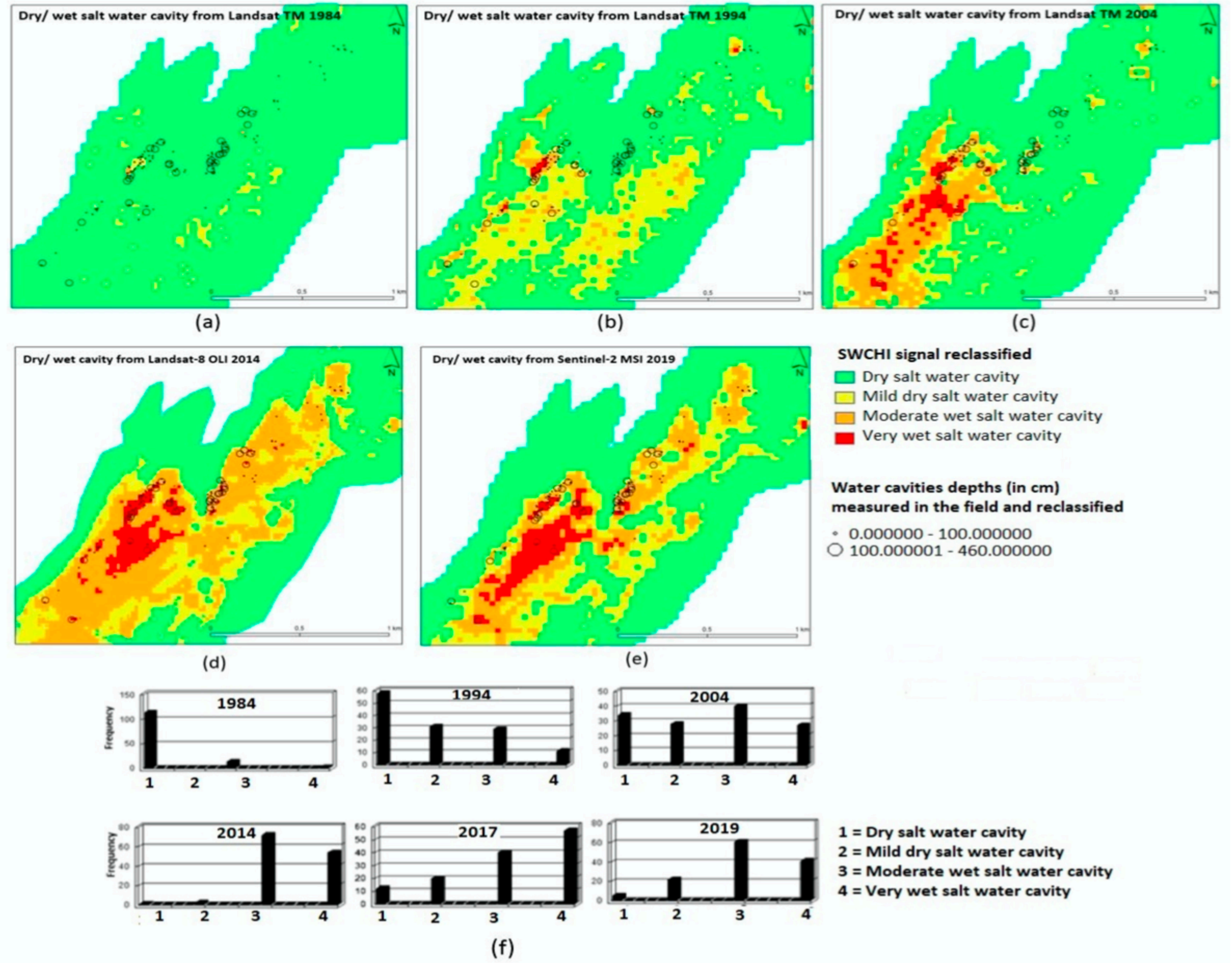
- Results from optical data
- Results from SAR data
- Results from data combined with optical and SAR
- Random tree verification

Results—from optical data

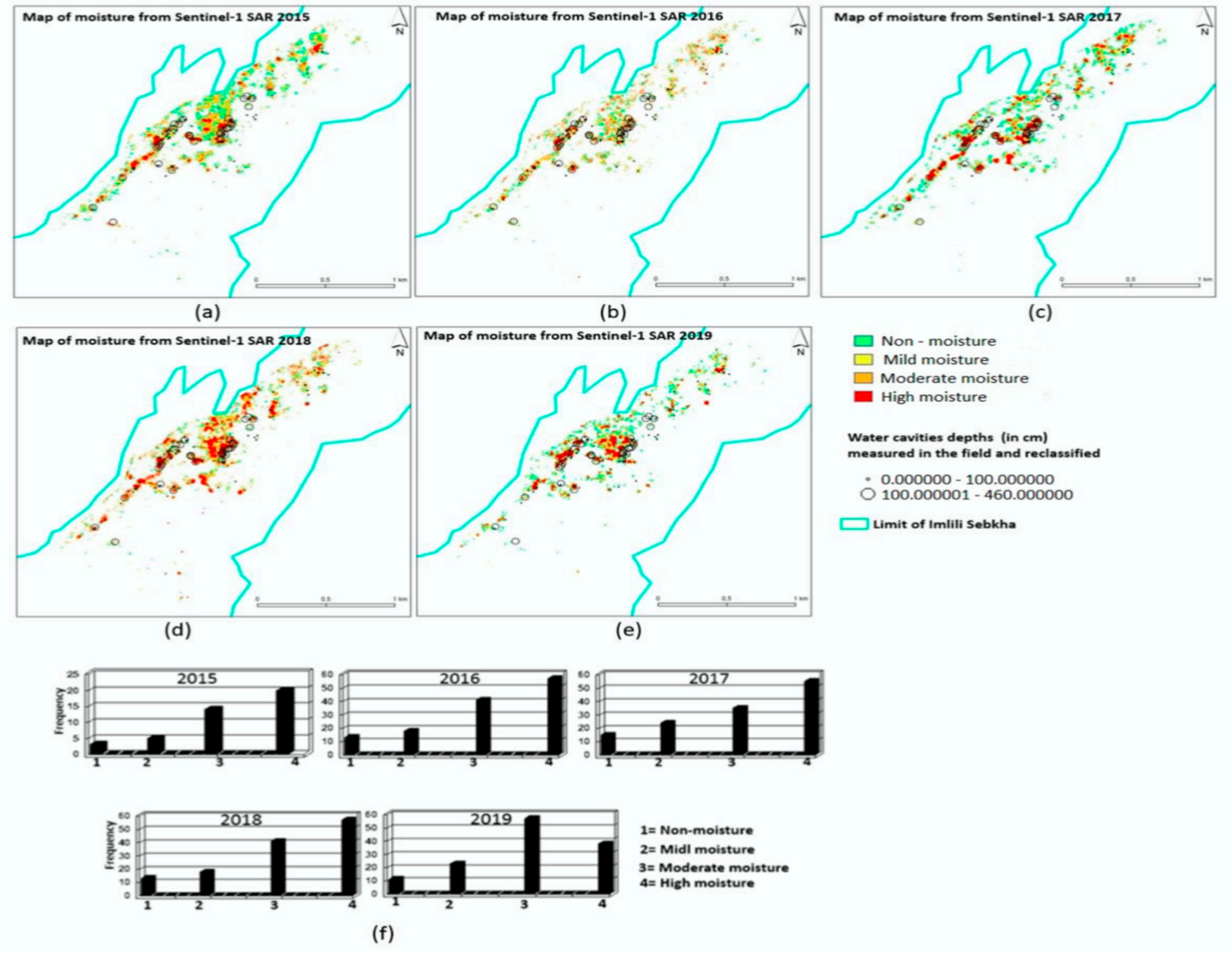




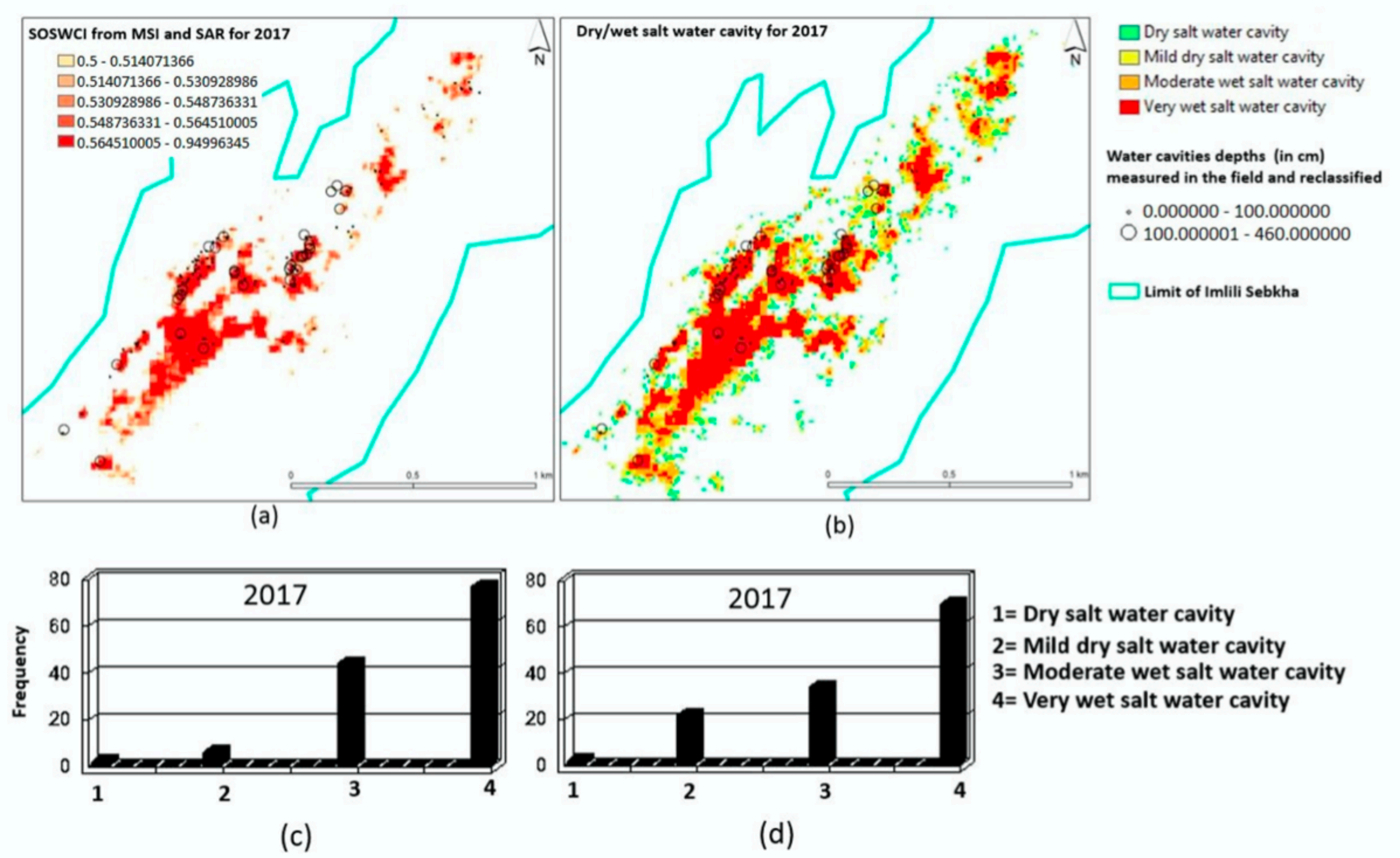
Results—from optical data



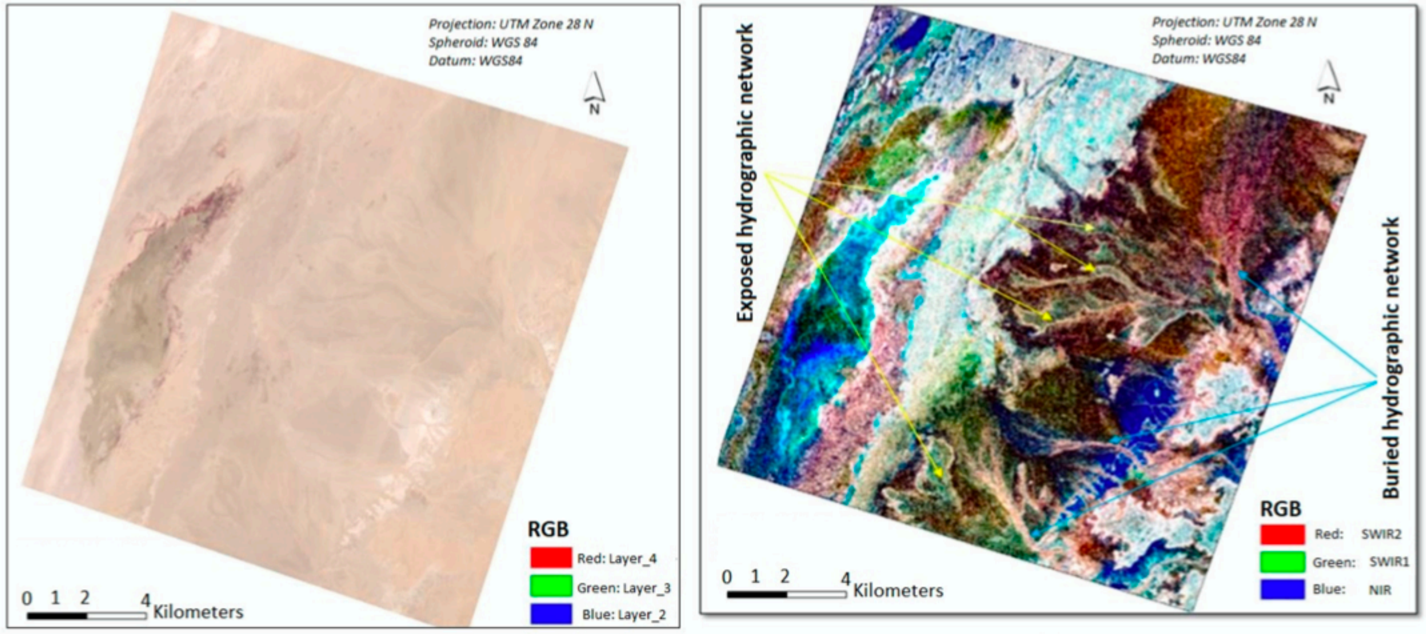
Results—from SAR data



Results—combined with optical data and SAR data

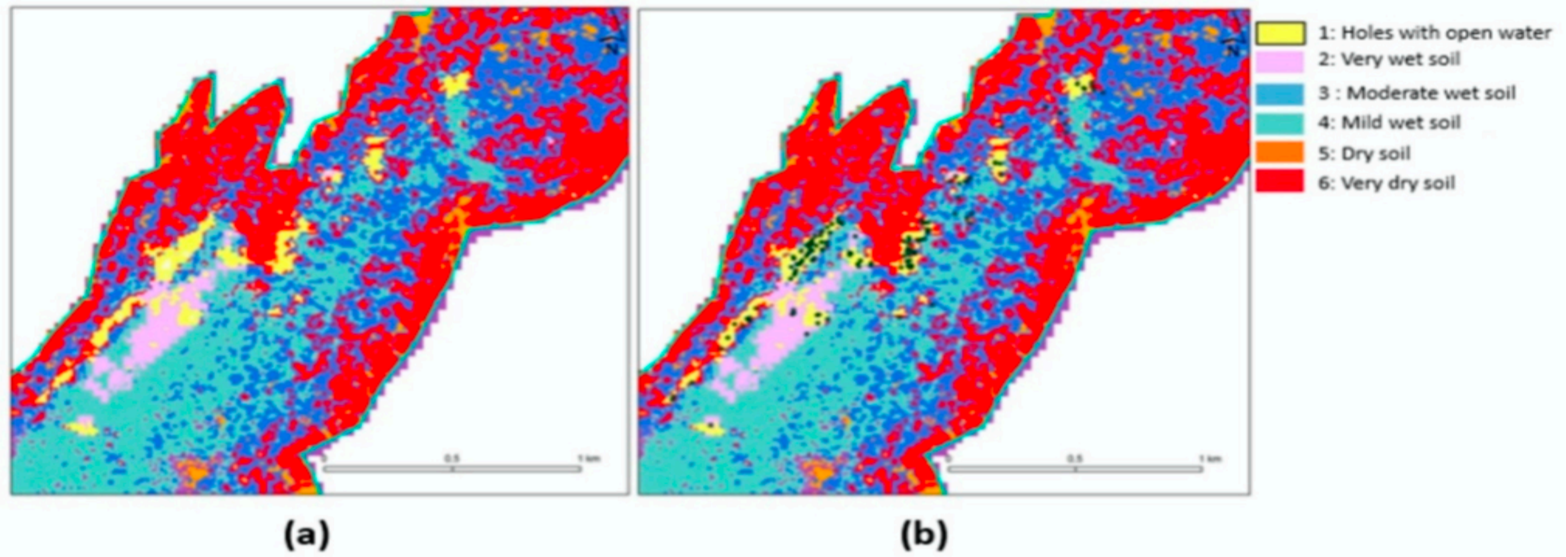


Results—combined with optical data and SAR data



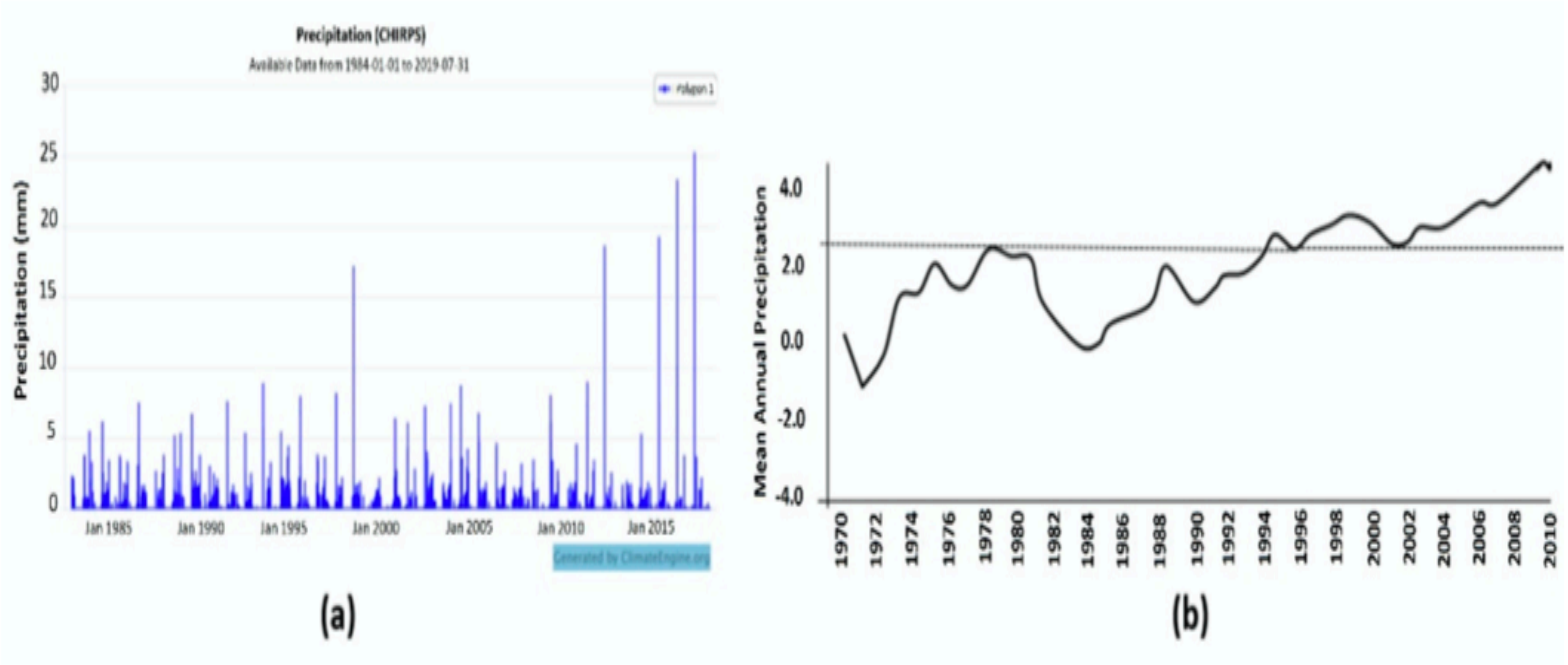
(a) (b)

Results—random tree



	Class						Accuracy Assessment %				
Reference (Ground Thruth)	1	2	3	4	5	6	n_{+j}	O_{er}	U_i	P_i	OA
1	77	2	2	0	1	2	84	8.3	91.7	96.2	93.2
2	0	74	1	0	2	0	77	3.9	96	92.5	
3	2	1	73	1	1	0	78	6.4	93.6	91.2	
4	0	1	2	76	1	0	80	8	92	95	
5	1	1	1	2	74	2	81	8.6	91.4	92.5	
6	0	1	1	1	1	75	79	5	95	95	
n_{+j}	80	80	80	80	80	97	479				
C_{er}	3.75	7.5	8.75	5	7.5	5					

Results—precipitation data from 1984 to 2004



Conclusion&challenges

- Multi-sensors
- Data cubes
- Cloud platforms
- More machine learning using

THANK YOU!