Ministry of energy

In the name of God

Water Research Institute

Flood damage assessment on crop lands using Sentinel-1 and Sentinel-2 imageries in Khuzestan

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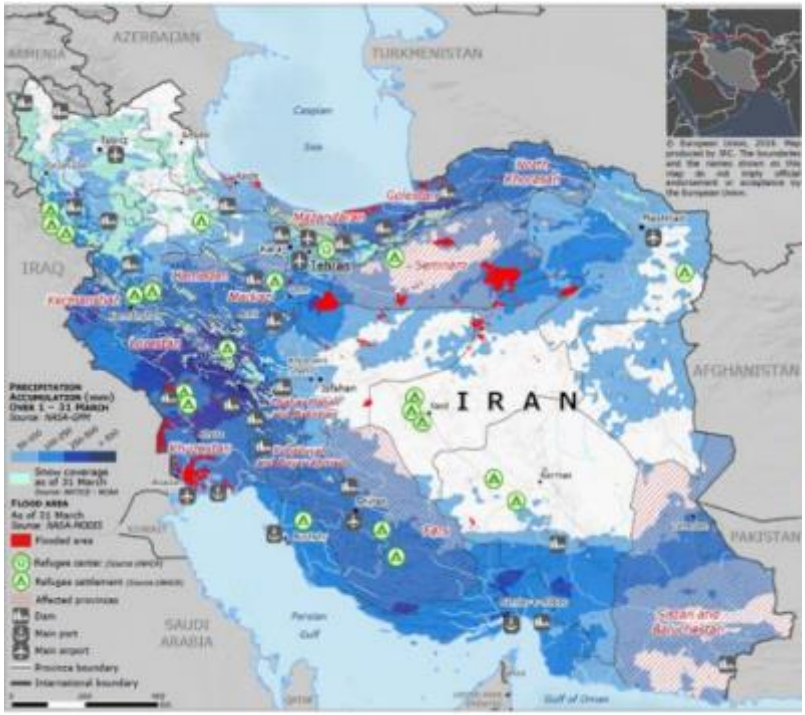
Overview

Flood inundation in Iran

- Iran is exposable country in Flood inundation (2016, 2018 and 2019)
- The northern and southern provinces are in a high risk
- Flash floods damage different sectors (infrastructures, agriculture, water, livestock)



UNSOOA (2019)

- 102838 ha croplands/Orchards
- 3339 livestock killed

Agenda for flood inundation mapping
Increase accuracy of croplands, fish-ponds & waterbodies Maps

Overview

Sentinel-1 and Sentinel-2 in WRI

✓**Mapping Flood extended area** (Sentinel_1,GRD)

- Create continues maps from the whole flooded area
- Data acquisition in cloudy condition
- water bodies and flood discriminating

✓**Crop Type detection** (Sentinel_1,GRD)

- Identifying crop type texture, water index

✓**Aquafers Subsidence mapping** (Sentinel_1,SLC)

- Radar interferometry

✓**Land cover/ Land use mapping** (Sentinel_2,Multi-Temporal)

Sentinel-1 for Flood inundation

Benefits

- Take images in different weather conditions
- Relatively consistent datasets
- Predictable image capture

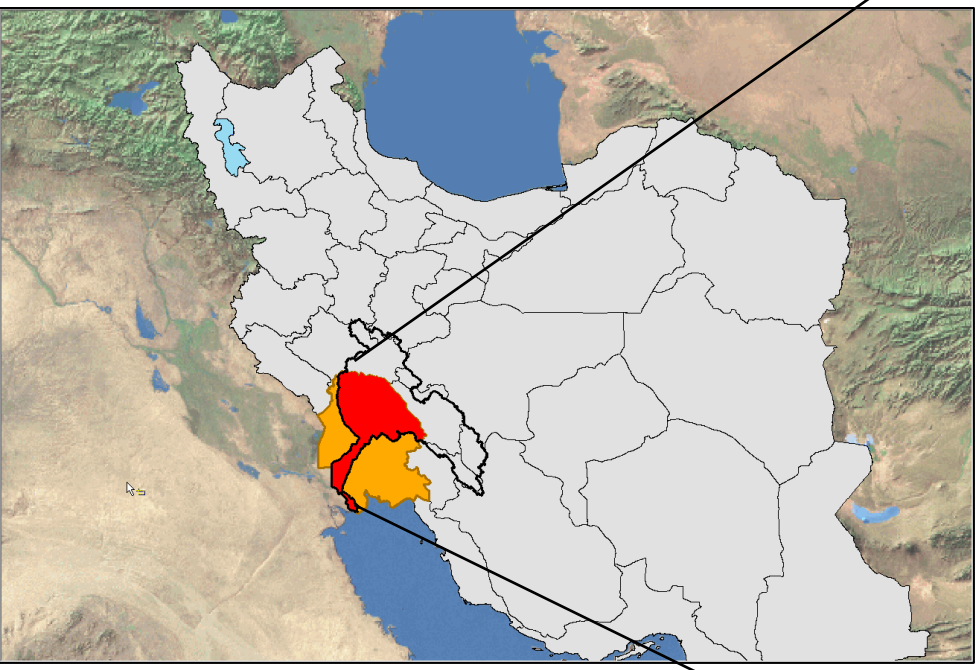
Limitation

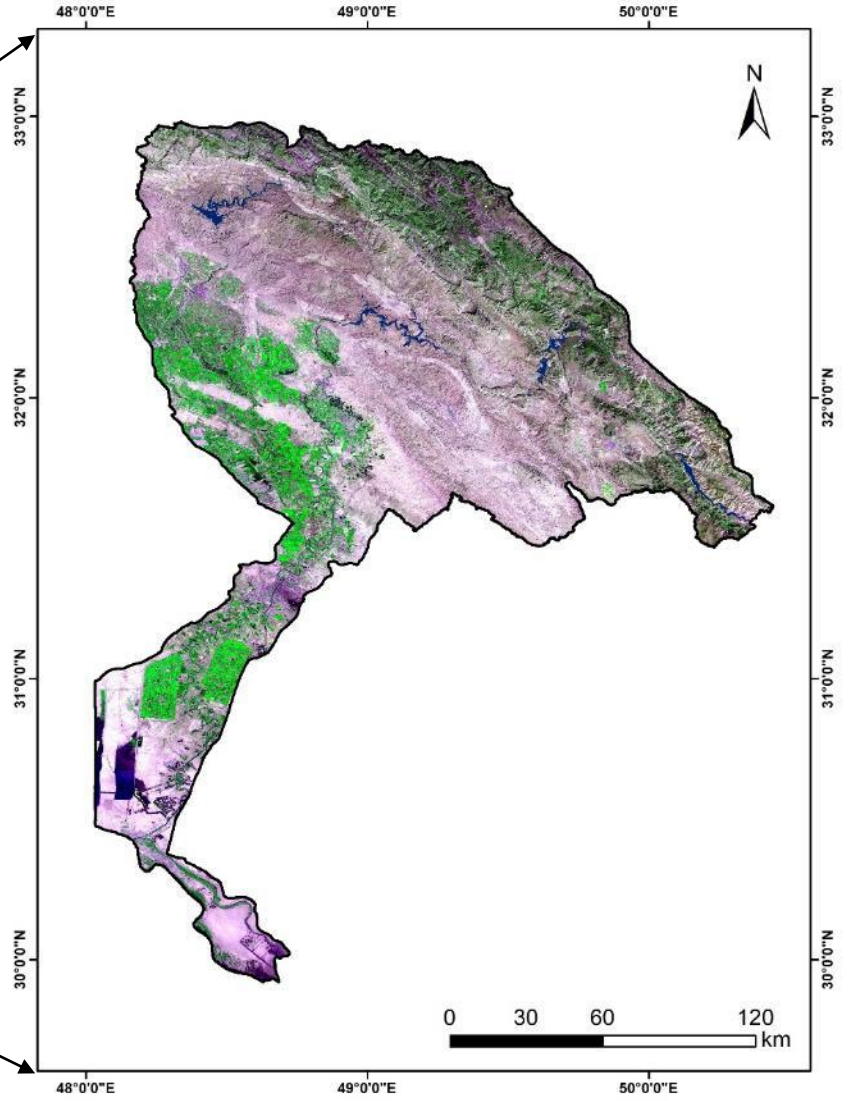
- Noisy imagery
- Affected by wind
- Urban areas and field boundaries poorly mapped
- Outputs easily miss-understood

Solution: Using S2 multi-temporal images to misclassified areas (Fields, cities) /to enhance outputs visual quality

How to Map? How much area are undergrown by flood?

Study area

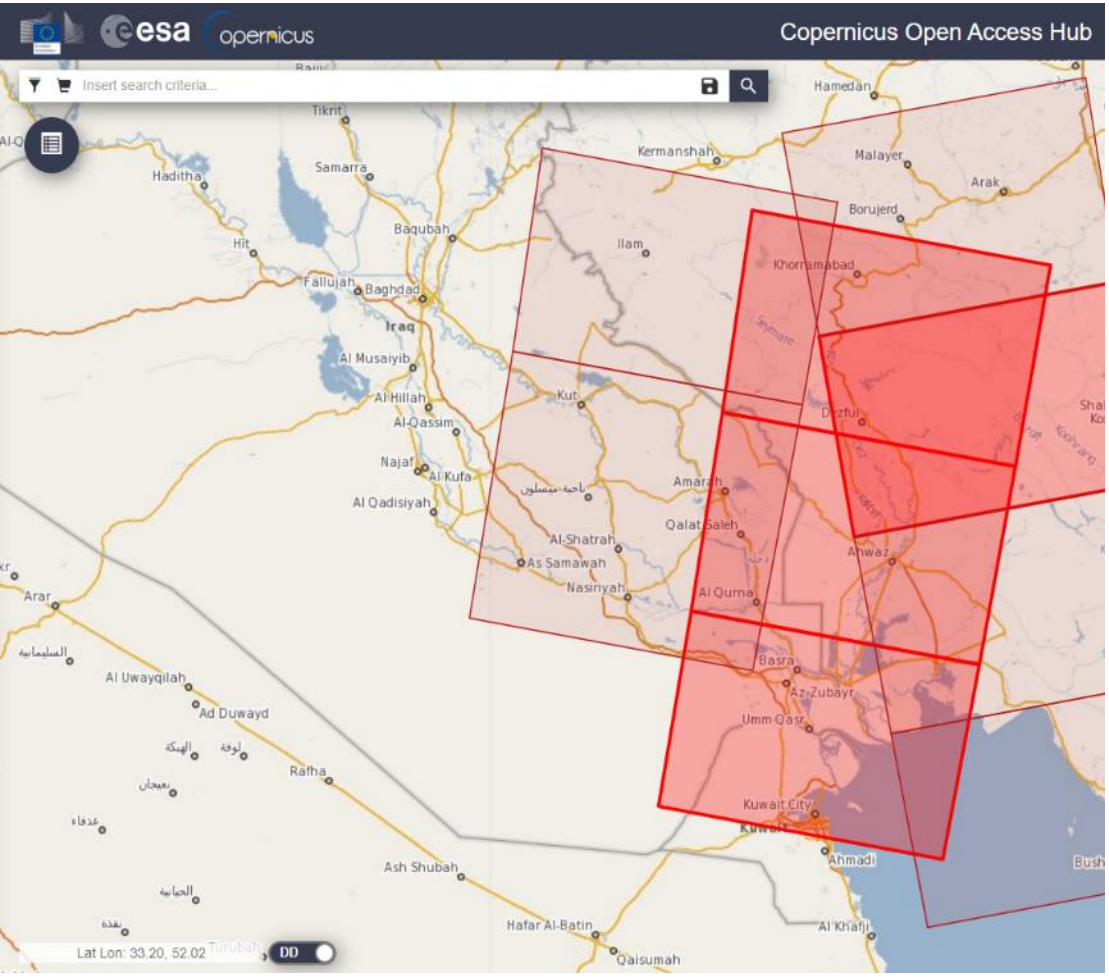




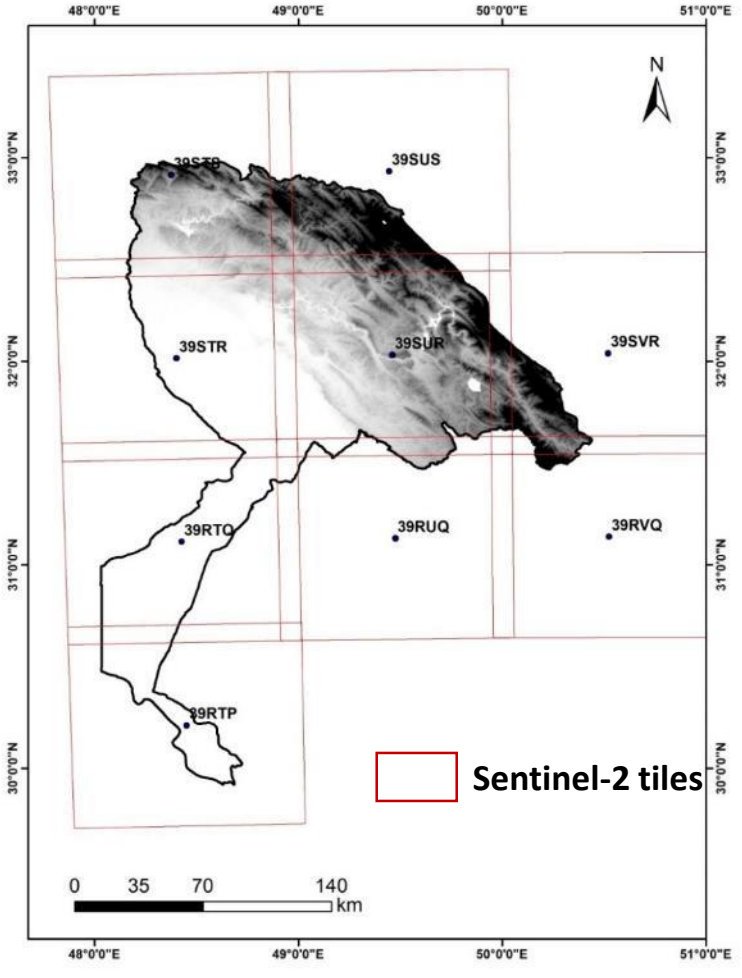
Sentinel-1 and Sentinel-2 tiles

Downloading Sentonel-1 and Sentinal-2 of Study area from ESA open access hub

- **The Tiles of Sentinel-1**



- **The Tiles of Sentinel-2**



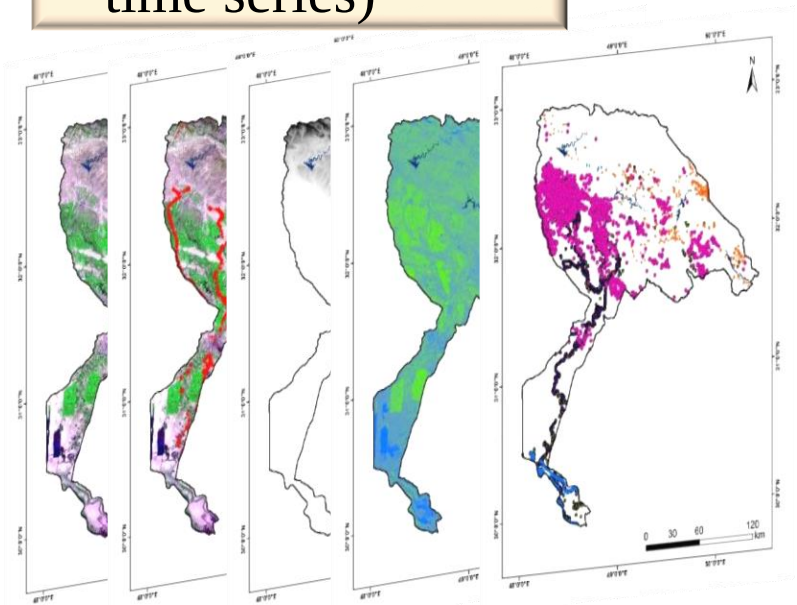
Flood mapping Method using Sentinel-1

1. Downloading Sentinel-1 GRD data, simultaneously with flood event
2. Opening the Amplitude-VV band and subset
3. Calibrate the band and output sigma-0 band
4. Remove Speckle noise by lee filter
5. Water threshold determination Using histogram picks, by trail and error
6. Correct the Geometric correction of the image (Range Doppler Terrain correction) with SRTM 3scd DEM
7. Extraction water area using Band math
8. Visualization and Mapping
9. Post processing (majority filter, generalization)

- **Which Land covers inundated by Flood?**
- **How many/much agricultural lands affected by Flood?**

Land use land cover mapping dataset

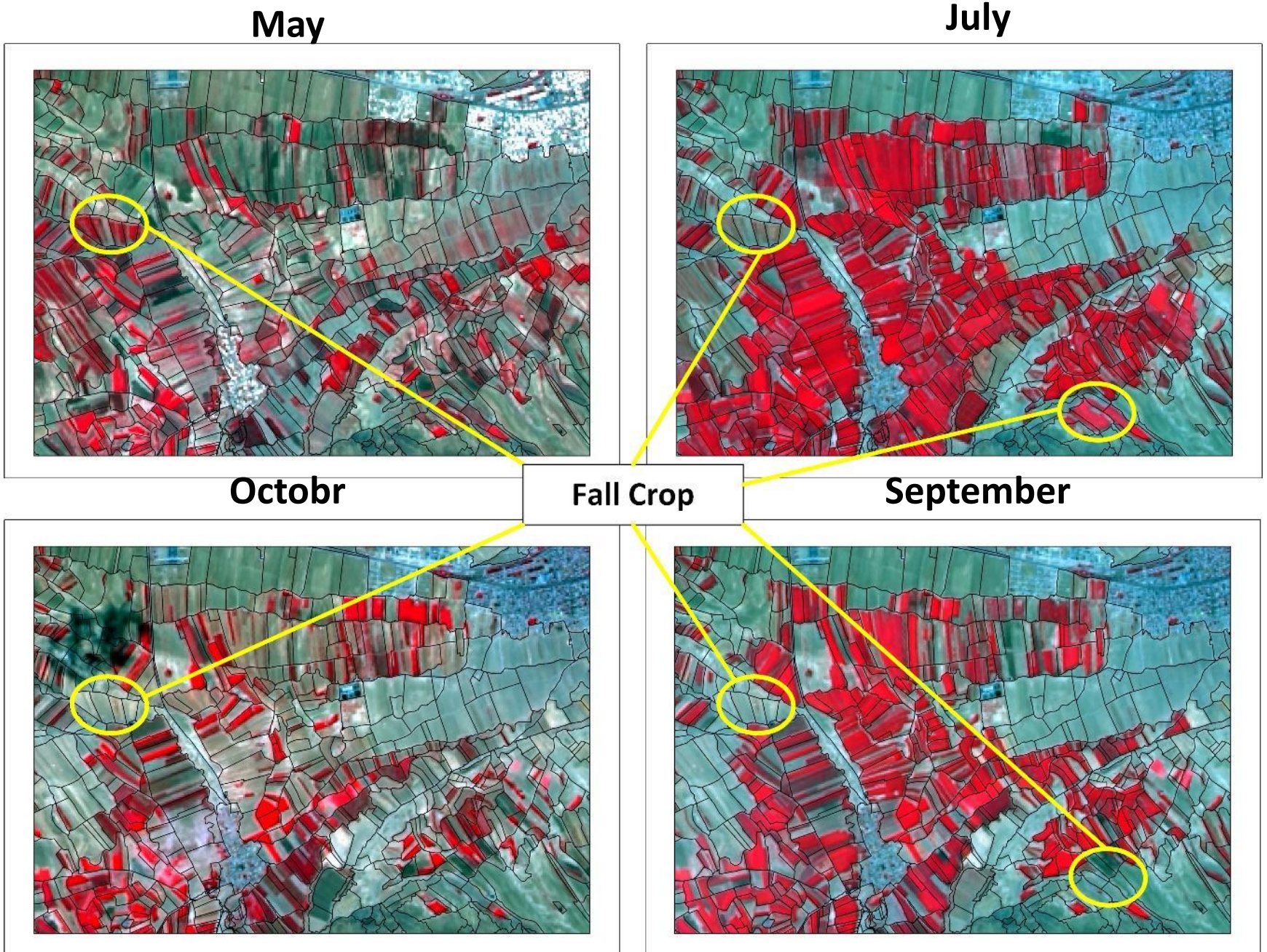
Remote Sensing data	Ancillary Data	Field Sampling
• Very High resolution images (Google Earth images) • High resolution images (S2 NDVI/NDWI time series)	• DEM • water resource Points	• Field observation sample • Sampling from Google Earth



NDVI: Normalized Difference Vegetation Index

NDWI: Normalized Difference Water Index

Why NDVI/NDWI time series?



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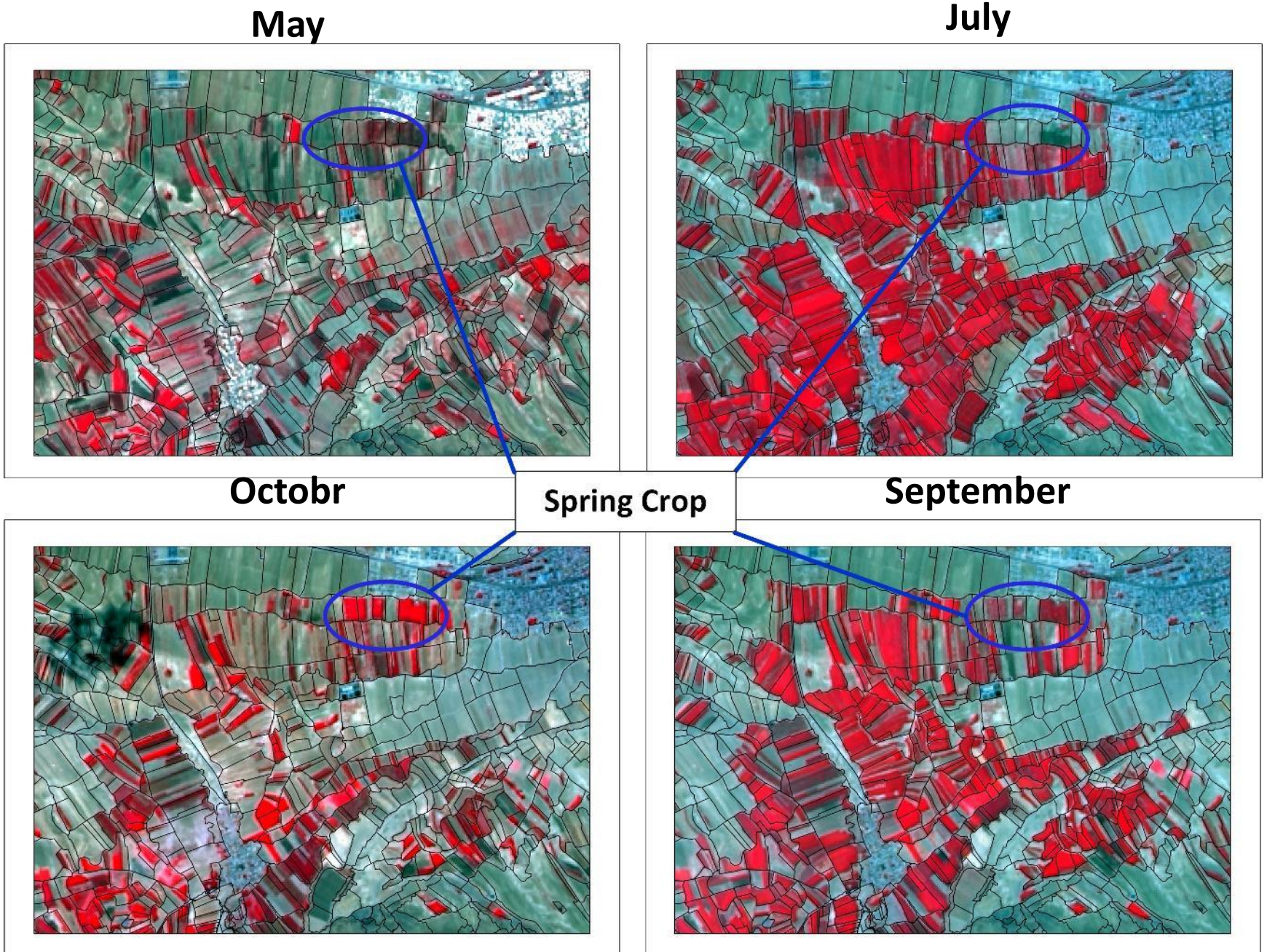

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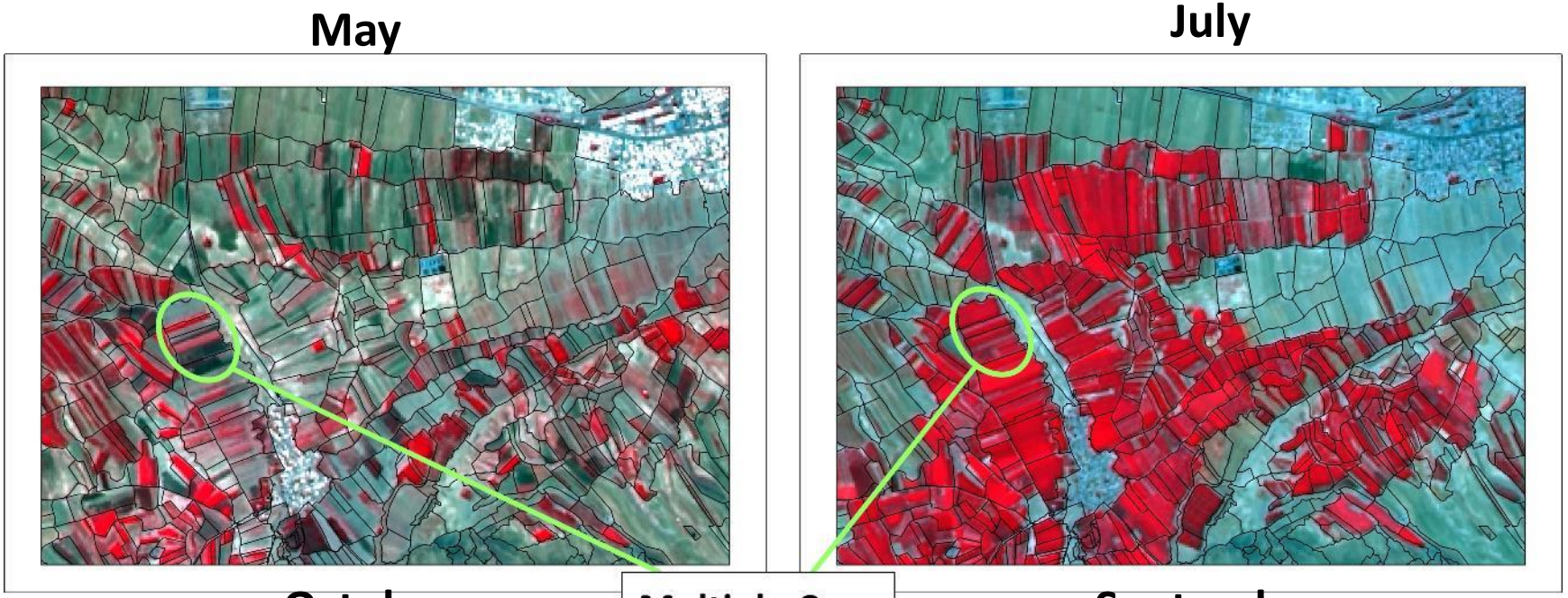
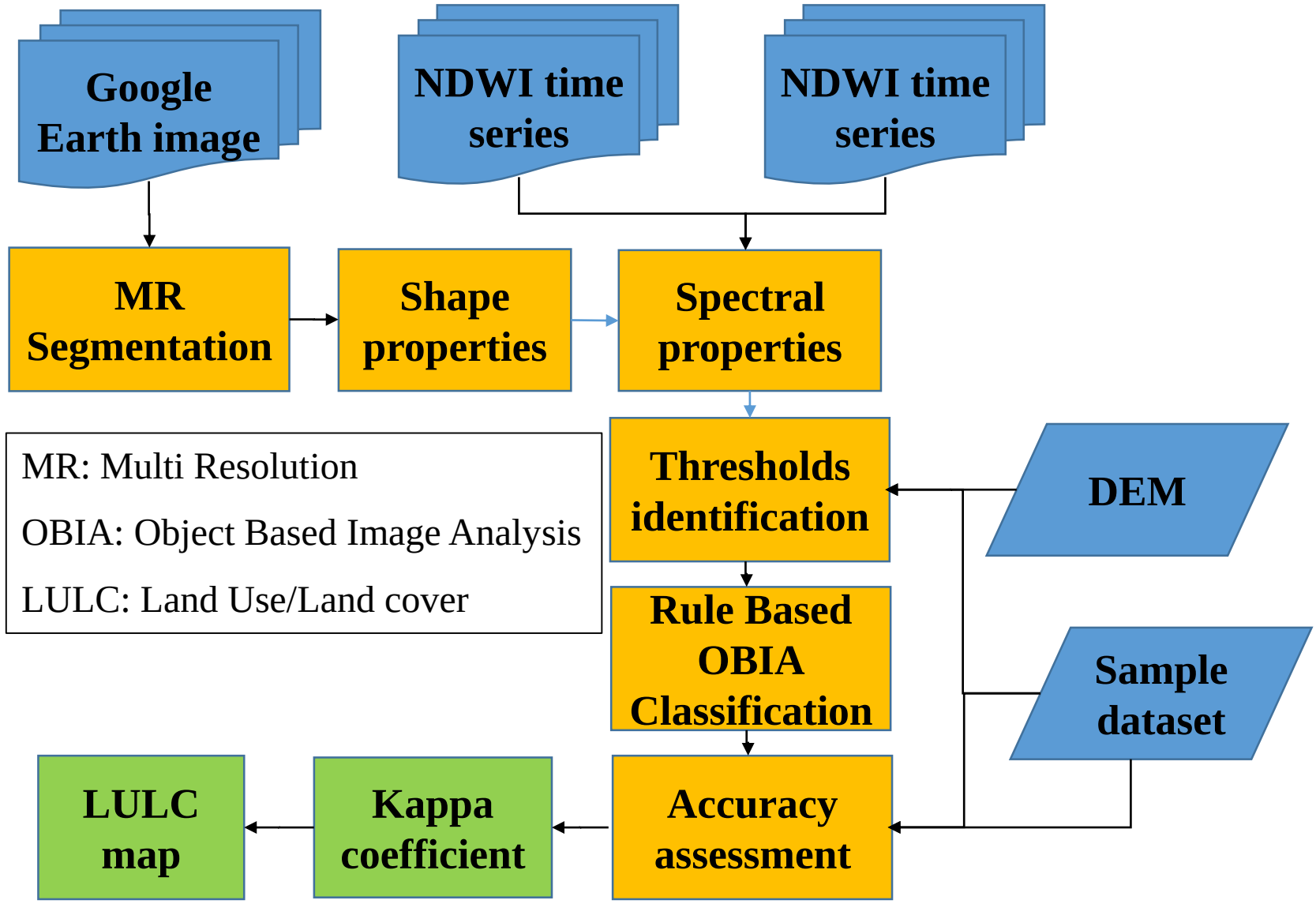


Land use land cover mapping method

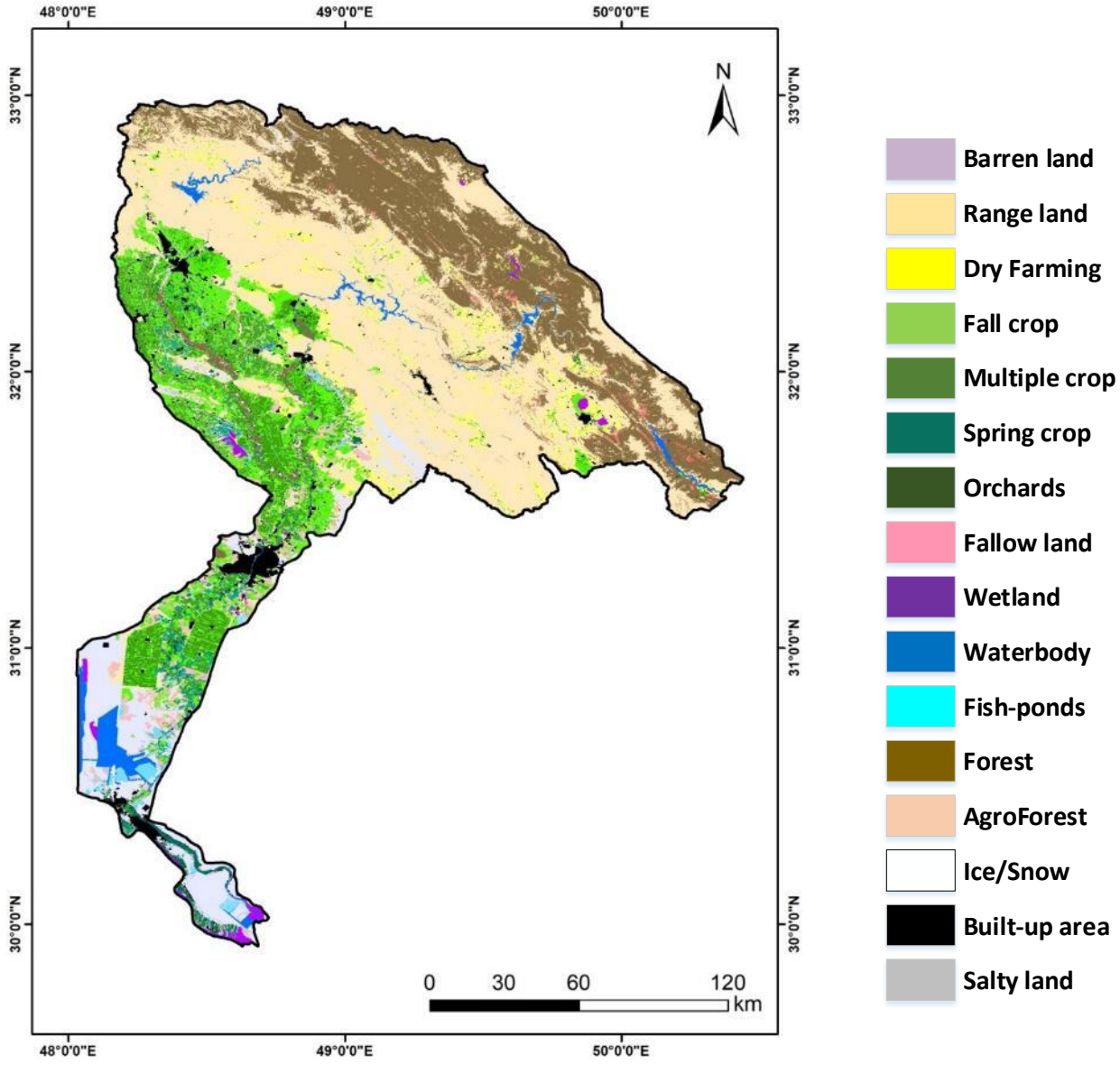


Accuracy Assessment

Using Mobile application

- **Training samples**
- **Accuracy assessment**

Results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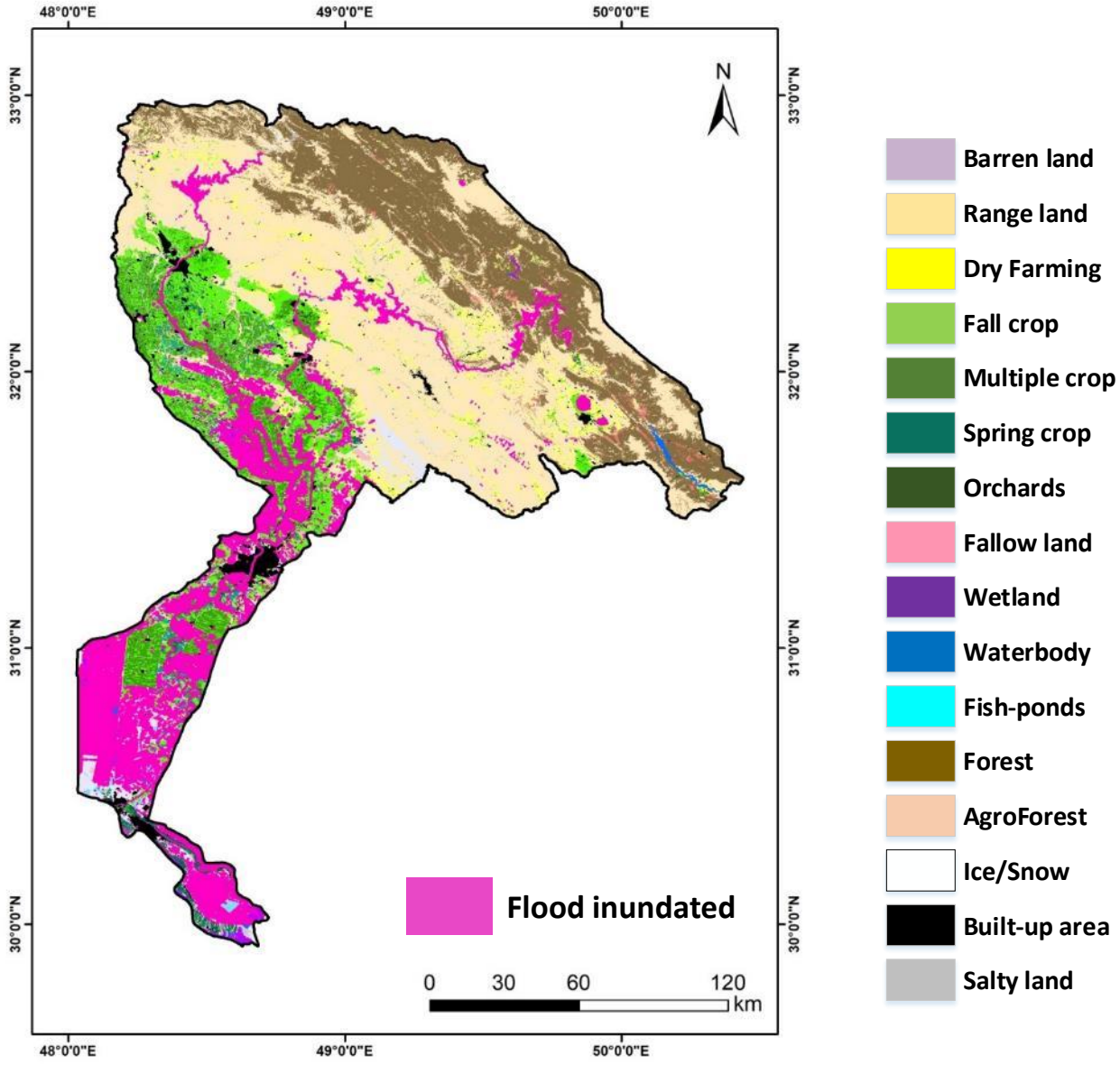
32°0'0"N
31°0'0"N
30°0'0"N
N
0
30
60
120
km
Barren land
Range land
Dry Farming
Fall crop
Multiple crop
Spring crop
Orchards
Fallow land
Wetland
Waterbody
Fish-ponds
Forest
AgroForest
Ice/Snow
Built-up area
Salty land

Results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N
Flood inundated
0 30 60 120
km
Barren land
Range land
Dry Farming
Fall crop
Multiple crop
Spring crop
Orchards
Fallow land
Wetland
Waterbody
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AgroForest
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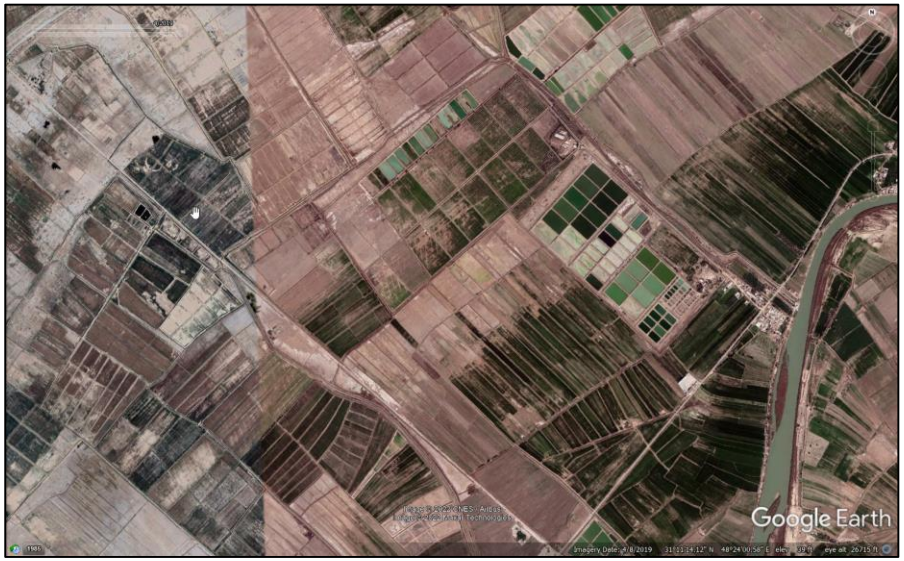
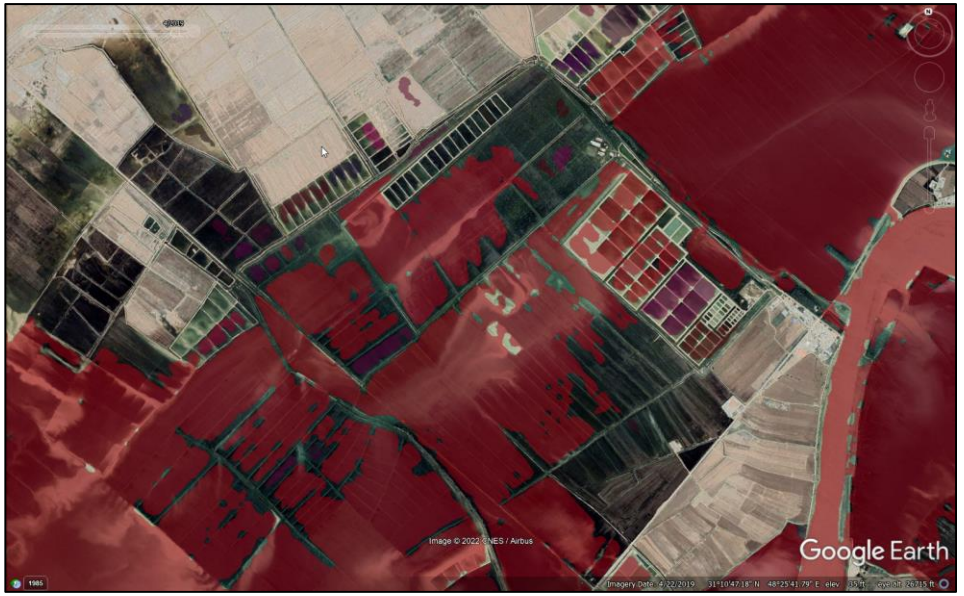
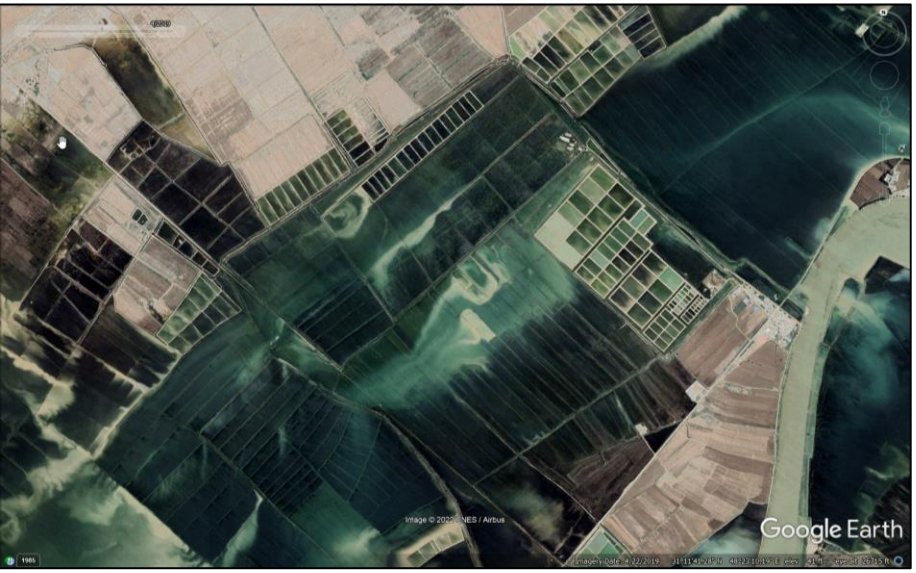
Built-up area
Salty land

Flood inundation of Khuzestan in 14th of April 2019 on Google Earth

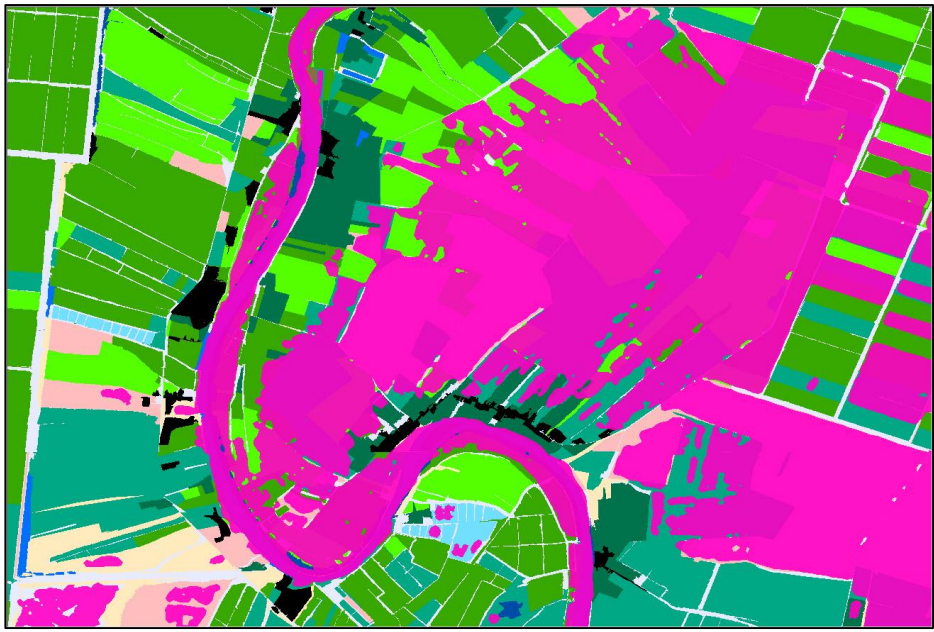






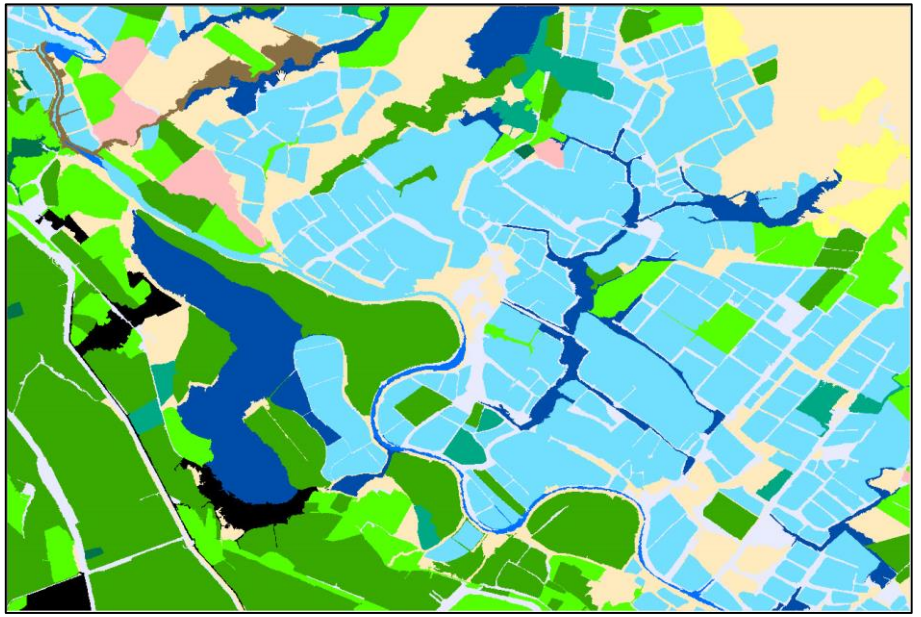
Flood inundated

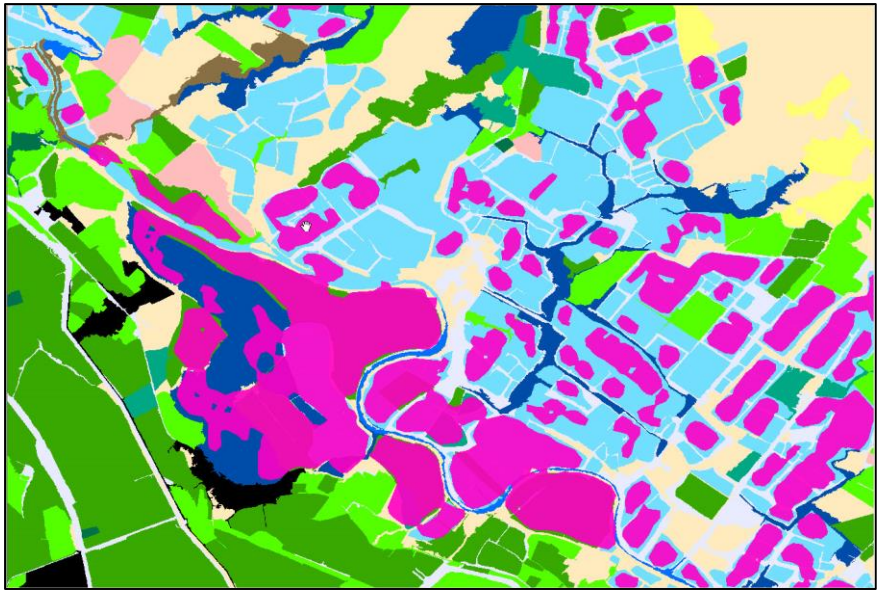
Flood inundation on crop lands



Flood inundated

Flood inundation on Fish-ponds

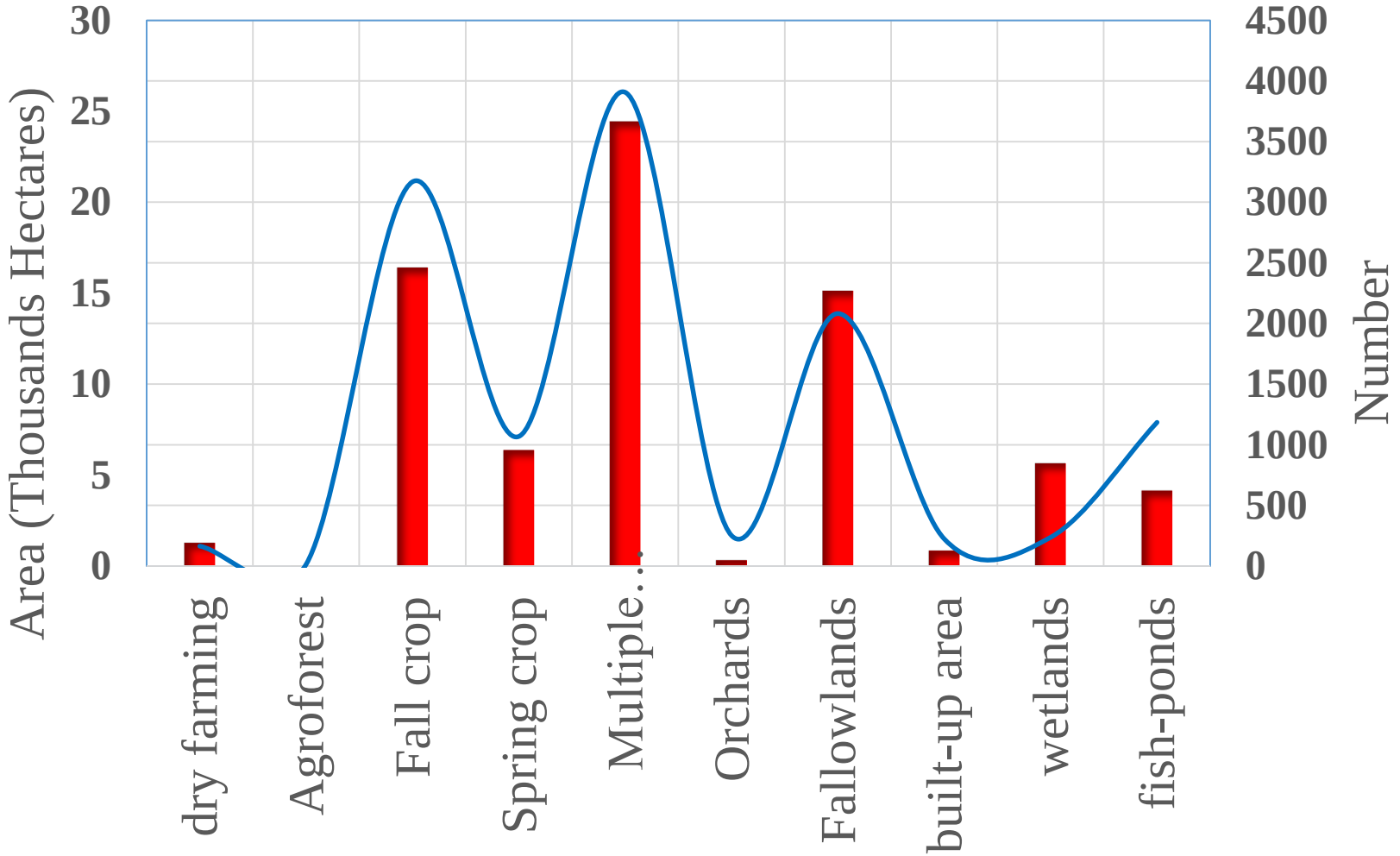




Flood inundated

Results

Number and the area of each land class affected by Flood



Results

Number and the Area of each land class affected by Flood

Land cover class	Number	Damaged Area (km^2)	Total Area	Damage (%)
Dry Farming	176	1296	16520	**8**
Irrigation Crops	8142	47214	74914	**63**
Orchards	2081	309	2378	**13**
Fallow-lands	250	15129	31197	**48**
Built- up area	222	852	39053	**2**
Fish-ponds	1184	4142	14489	**29**
Total	**12055**	**68942**		
	10473	**62652**		

Suggestion

1. Monitoring the LULC maps in the flood prone plains using 100/200/500 years flood maps with assistant of flood forecasting teams in WRI and IRIMO(Iran Meteorological Organization)
2. Evaluation the crop yield loss for each crop type (Wheat, barley, rice, corn, vineyards and orchards) by crop type mapping (using combination of S2 and S1 time-series) and high resolution images (SPOT, IRS, Landsat) cooperating with ISA (Iran Space Agency)
3. Comparison crop yield loss with data of Ministry of Agriculture
4. Estimating the recharge of wetlands/ waterbodies with cooperation of department of environment
5. Monitoring Land cover change on Flood Inundation rate using High temporal satellite images (Landsat, Spot)
6. Increase public knowledge about flood inundation, hazards and post effect by holding regular workshops/online webinars with cooperation of Foreign Agencies (UNOOSA, FAO)

Thank you