Multicriteria Analysis and Ground Penetrating Radar for Disaster Mapping

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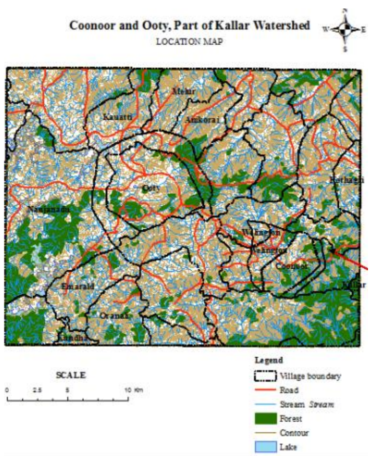
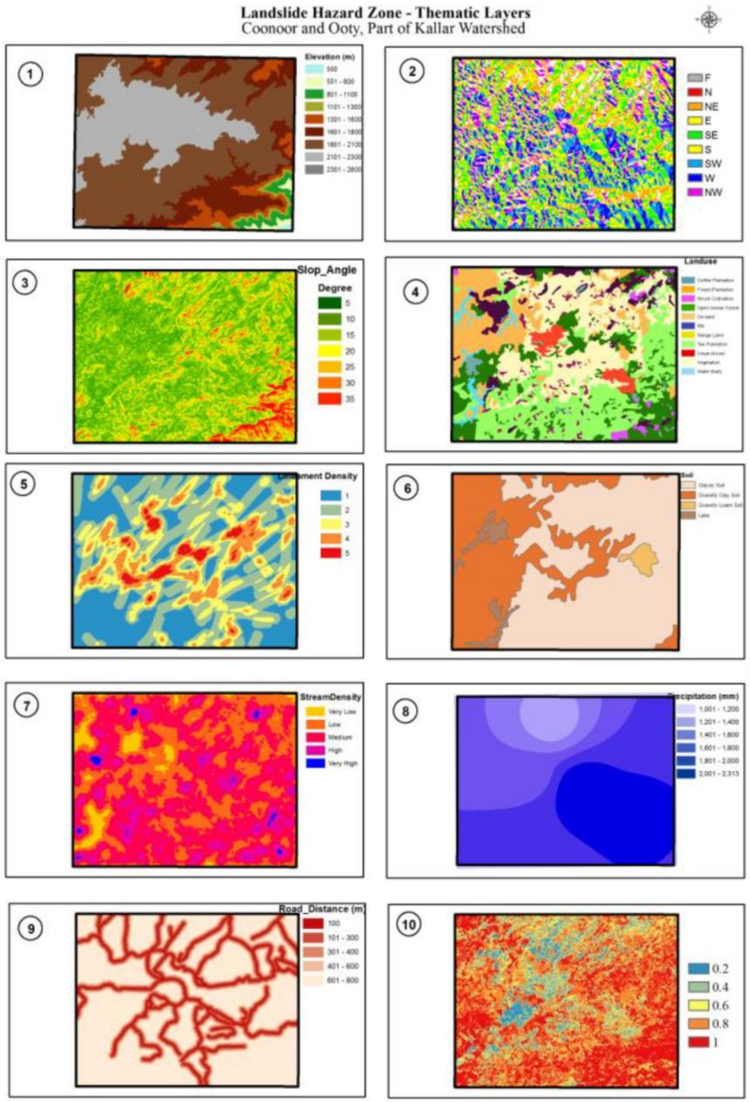
Geospatial Approach on Landslide Hazard Zonation Mapping Using **Multicriteria Decision Analysis**: A Study on Coonoor and Ooty, Part of Kallar Watershed, The Nilgiris, Tamil Nadu ***S. Abdul Rahamana, R. Jegankumar et. al***





DL	E	SAs	SAn	Dd	Dr	Ld	So	Lu	Rf	Nd	W
E	1										0.028
SAs	1	1									0.031
San	5	4	1								0.164
Dd	2	1/2	1/5	1							0.033
Dr	5	5	2	3	1						0.170
Ld	3	5	1/2	4	1/2	1					0.120
So	2	3	1/5	3	1/2	1/3	1				0.055
Lu	5	6	2	5	3	3	5	1			0.259
Rf	4	4	1/3	3	1/4	1/2	3	1/5	1		0.083
Nd	3	3	1/5	2	1/5	1/5	2	1/5	1/2	1	0.056
CR	0.0068										

Hazard Zones	**Hazard Index Range**	**% of Area**	**Number of Locations**
Low Hazard	0.06 – 0.10	4.61	0
Medium Hazard	0.10 – 0.18	43.63	17 (28.8)
High Hazard	0.18 – 0.26	48.19	37 (62.7%)
Very High Hazard	0.28 – 0.34	3.56	5 (8.5%)

Table 5. Distribution of known landslide location with predicted landslide vulnerability zone classes

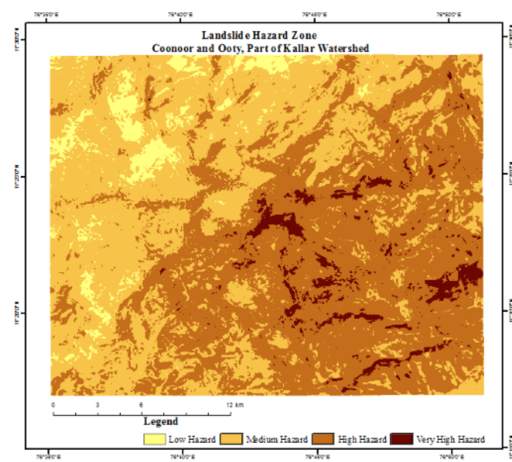


Figure 4. Landslide vulnerability zone map based on AHP

Modeling and Assessment of Land Degradation Vulnerability in Semi-arid Ecosystem of Southern India Using Temporal Satellite Data, AHP and GIS

P. Sandeep[1,2] · G. P. Obi Reddy[1] · R. Jegankumar[2] · K. C. Arun Kumar[1,2]

Table 2 Datasets used in the study

S. No.	Dataset	Variable	Temporal coverage	Temporal resolution	Spatial resolution
1	MODIS MOD13Q1	NDVI	2000 to 2016	16 days	250 m
2	MODIS MOD11A2	LST	2000 to 2016	8 days	1 km
3	TRMM 3B43	Rainfall	2000 to 2016	Monthly	27 km
4	SRTM DEM	Slope	–	–	30 m
5	Soil parameters	Soil depth, drainage, texture, pH	–	–	1:250,000

Parameters	N	R	T	SD	ST	pH	SDr	Sl	Weight
NDVI (N)	1	2	3	7	8	6	7	8	0.335
Rainfall (R)	0.5	1	4	5	6	7	7	8	0.269
Temperature (T)	0.33	0.25	1	2	2	5	8	6	0.136
Soil depth (SD)	0.14	0.2	0.5	1	1	2	8	6	0.088
Soil texture (ST)	0.12	0.17	0.5	1	1	2	4	8	0.079
Soil pH (pH)	0.17	0.14	0.2	0.5	0.5	1	3	3	0.046
Soil drainage (SDr)	0.14	0.14	0.12	0.12	0.25	0.33	1	2	0.026
Slope (Sl)	0.12	0.12	0.17	0.17	0.12	0.33	0.5	1	0.02

Consistency ratio = 0.076

$$\mathrm{LDVI} = (NDVICwi \times NDVISCwi) + (RCwi \times RSCwi) + (TCwi \times TSCwi) + (StCwi \times StSCwi) + (SdrCwi \times SdrSCwi) + (SdCwi \times SdSCwi) + (pHCwi \times pHSCwi) + (SlCwi \times SlSCwi), \ldots\ldots$$

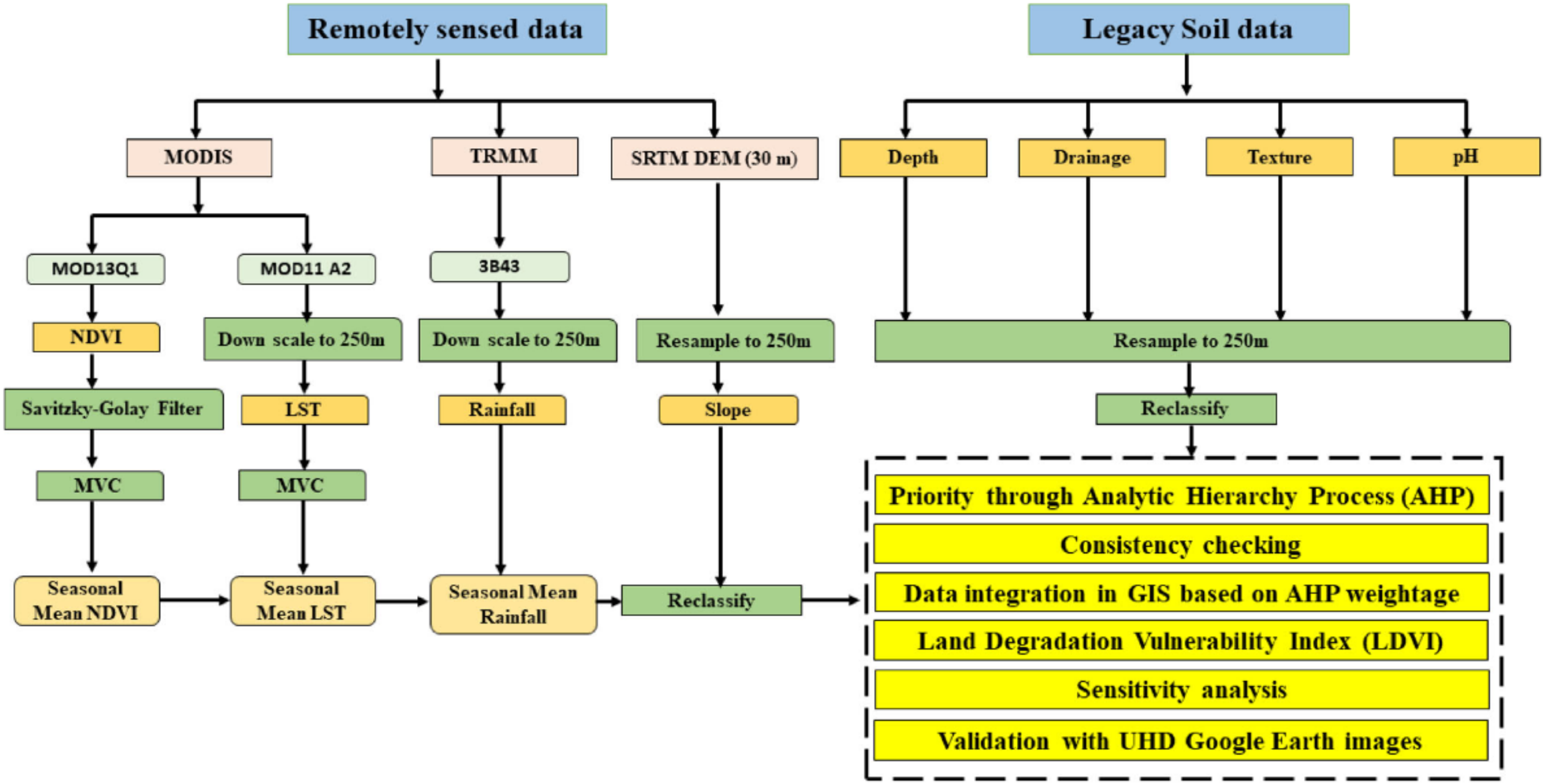


Fig. 1 Flowchart of the methodology followed in the study

Modeling and Assessment of Land Degradation Vulnerability in Semi-arid Ecosystem of Southern India Using Temporal Satellite Data, AHP and GIS

P. Sandeep[1,2] · G. P. Obi Reddy[1] · R. Jegankumar[2] · K. C. Arun Kumar[1,2]

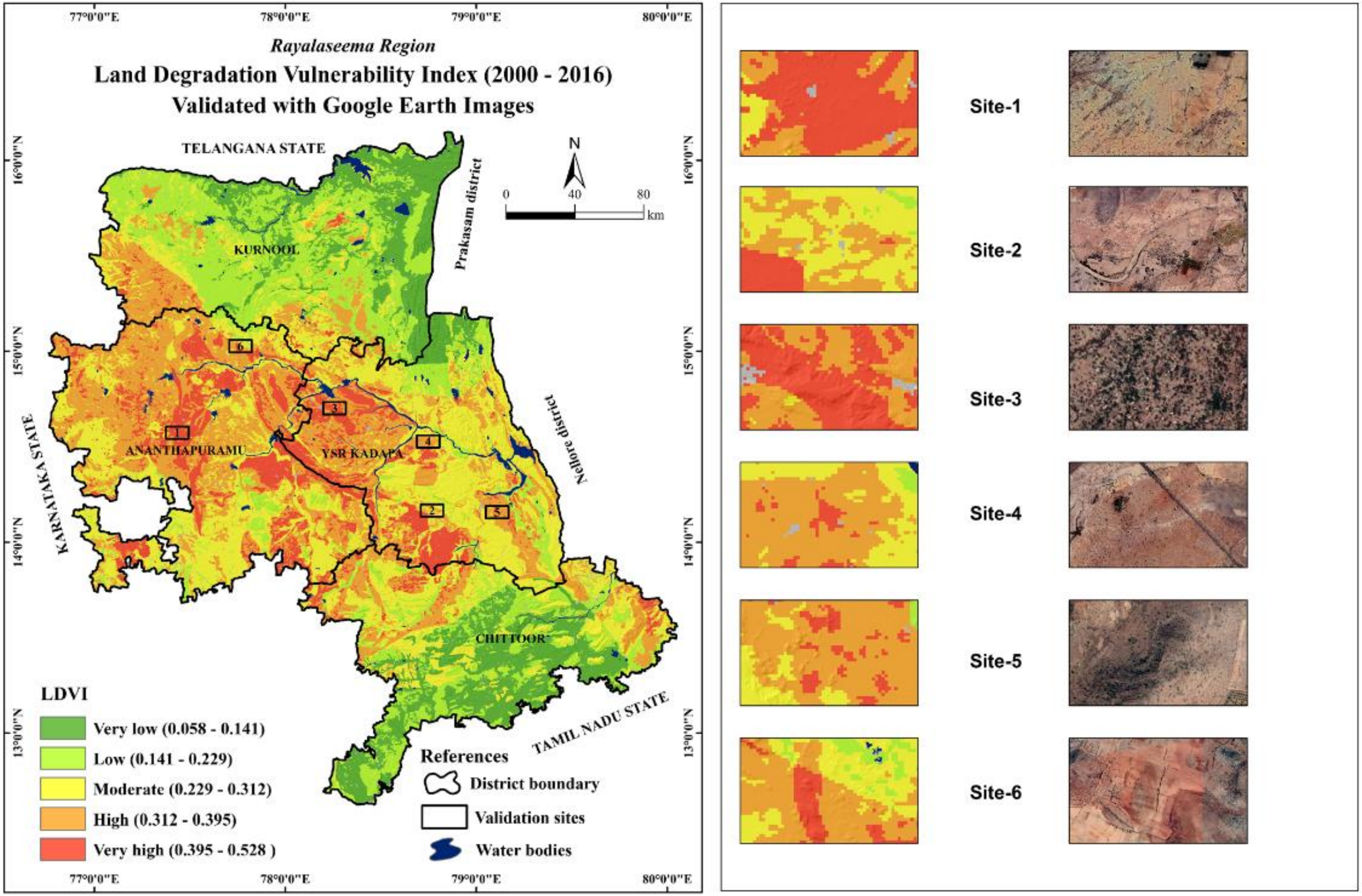


Fig. 2 Land degradation vulnerability index in Rayalaseema region (2000–2016)

Identification and validation of potential flood hazard area using GIS-based multi-criteria analysis and satellite data-derived water index

Pratik Dash[1] | **Jishnu Sar[2]**

[1]Department of Geography, School of Science, Adamas University, Kolkata, India

[2]Department of Geography, Banaras Hindu University, Varanasi, India

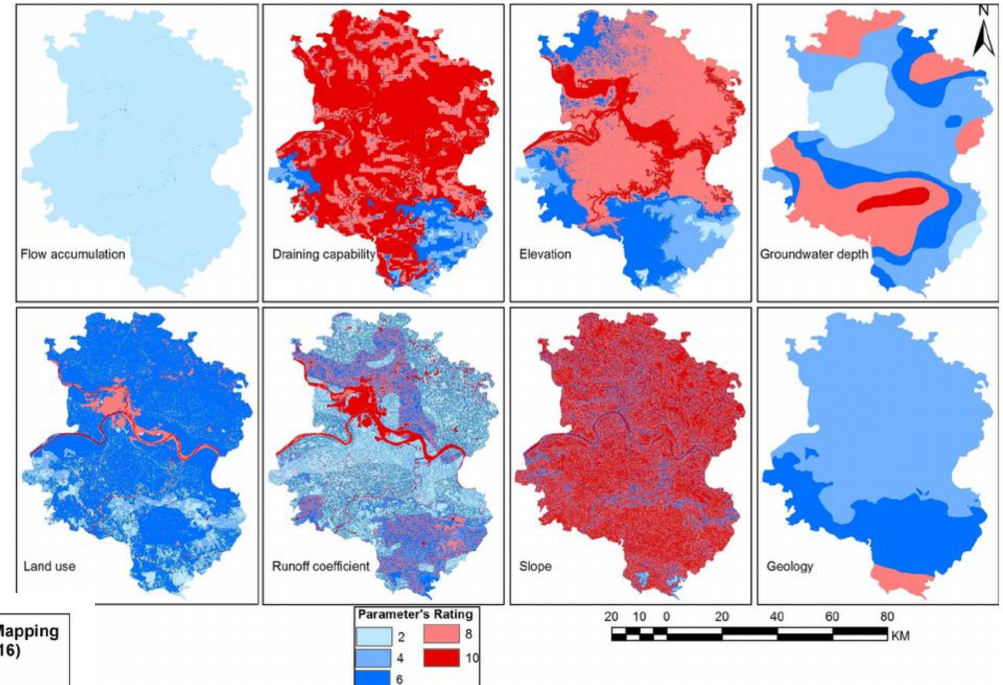
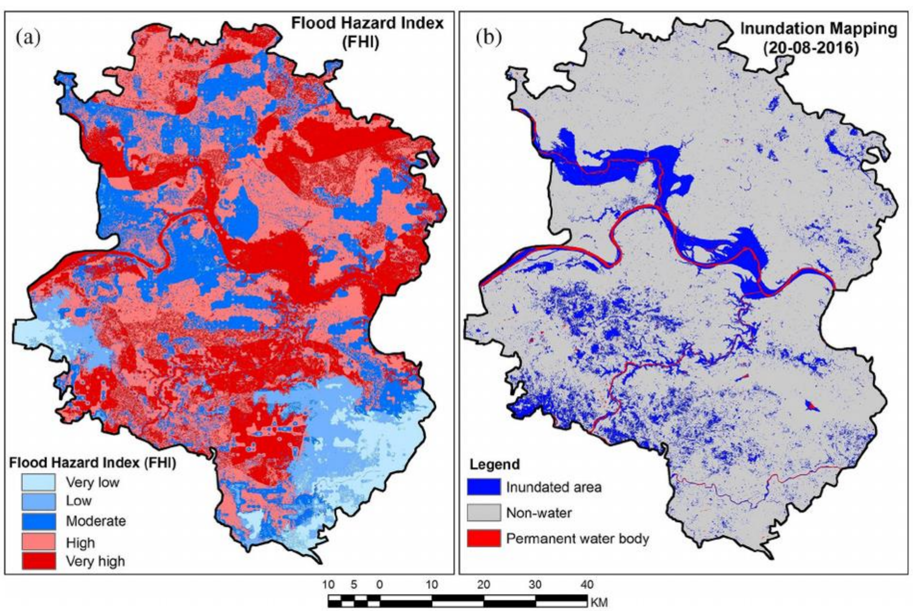


TABLE 1 Weight matrix of pairwise comparison for analytical hierarchy process

Parameters	Flow accumulation	Draining capability	Elevation	Groundwater depth	Land use	Runoff coefficient	Slope	Geology
Flow accumulation	1	2	2	3	5	7	7	9
Draining capability	1/2	1	1	3	4	5	6	7
Elevation	1/2	1	1	2	3	5	5	7
Groundwater depth	1/3	1/3	1/2	1	3	4	5	6
Land use	1/5	1/4	1/3	1/3	1	2	4	5
Runoff coefficient	1/7	1/5	1/5	1/4	1/2	1	3	5
Slope	1/7	1/6	1/5	1/5	1/4	1/3	1	3
Geology	1/9	1/7	1/7	1/6	1/5	1/5	1/3	1



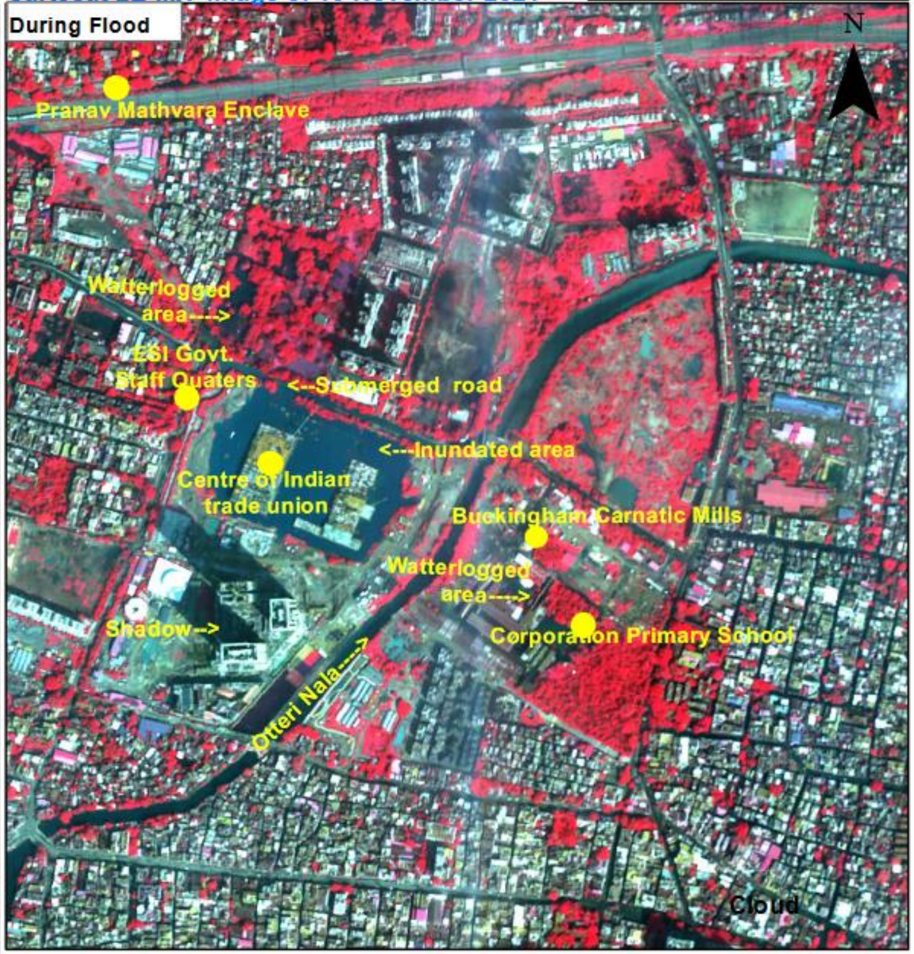
Date of Issue : 14.11.2021

DISASTER EVENT ID: 15-FL-2021-TN
MAP ID: 2021/16

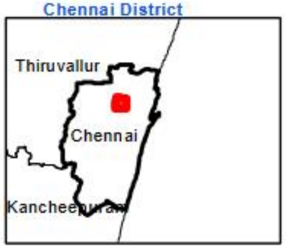
Inundated Area for a part of Chennai City, Chennai Corporation Taluk,Chennai District,Tamil Nadu State

Cartosat-2E-MX Image of 07-Febrauary-2021

Cartosat-2E-MX Image of 13-November-2021



Location Map



RRES
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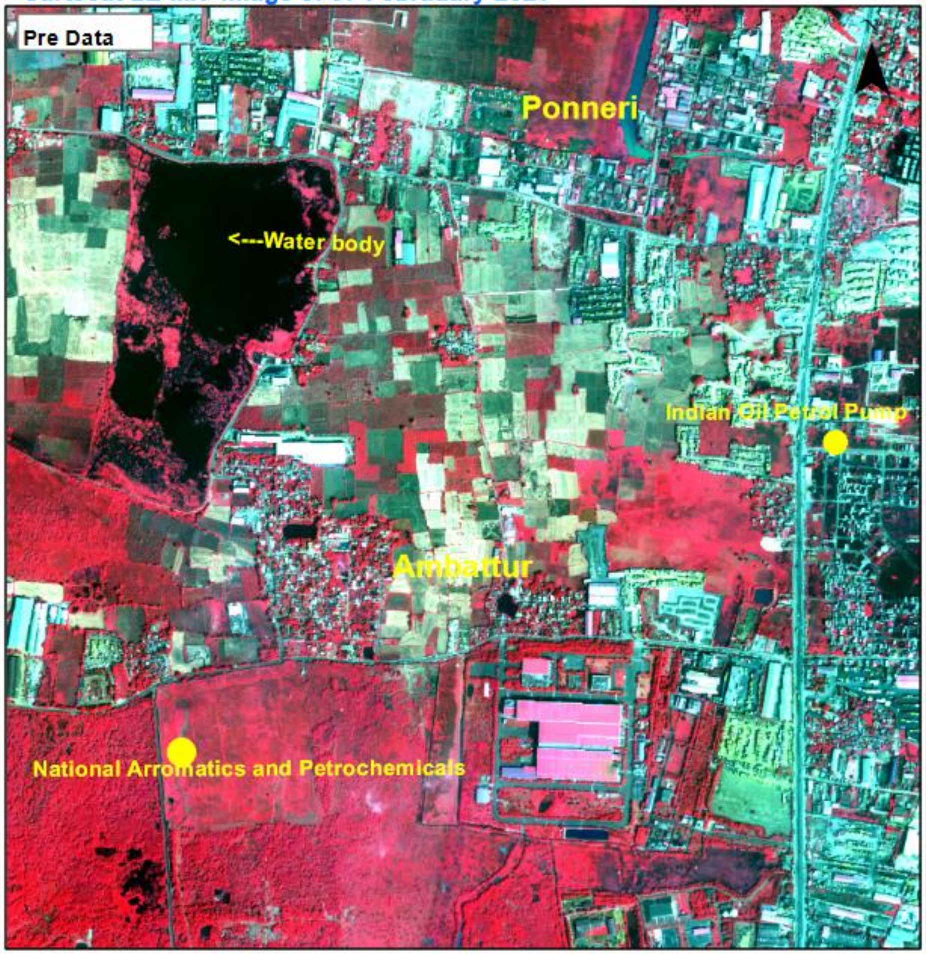
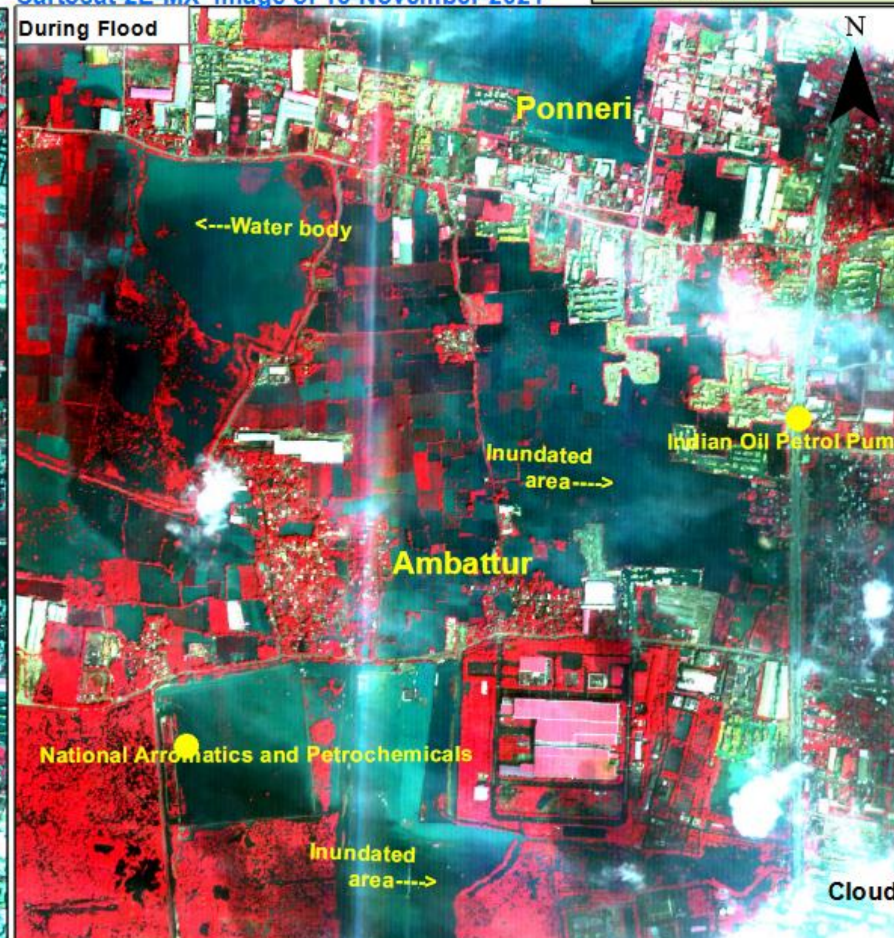
MAP ID: 2021/18

Inundated Area for a part of Ambattur taluk,Thiruvallur District,Tamil Nadu State

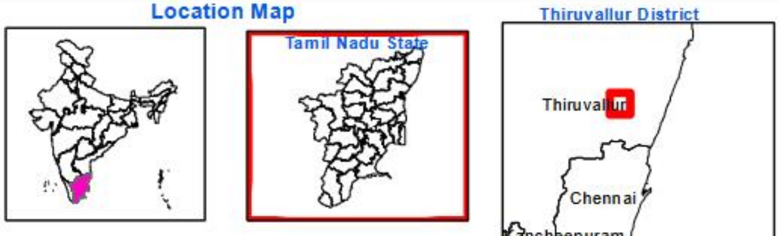
Cartosat-2E-MX Image of 07-Febrauary-2021



Cartosat-2E-MX Image of 13-November-2021



Location Map



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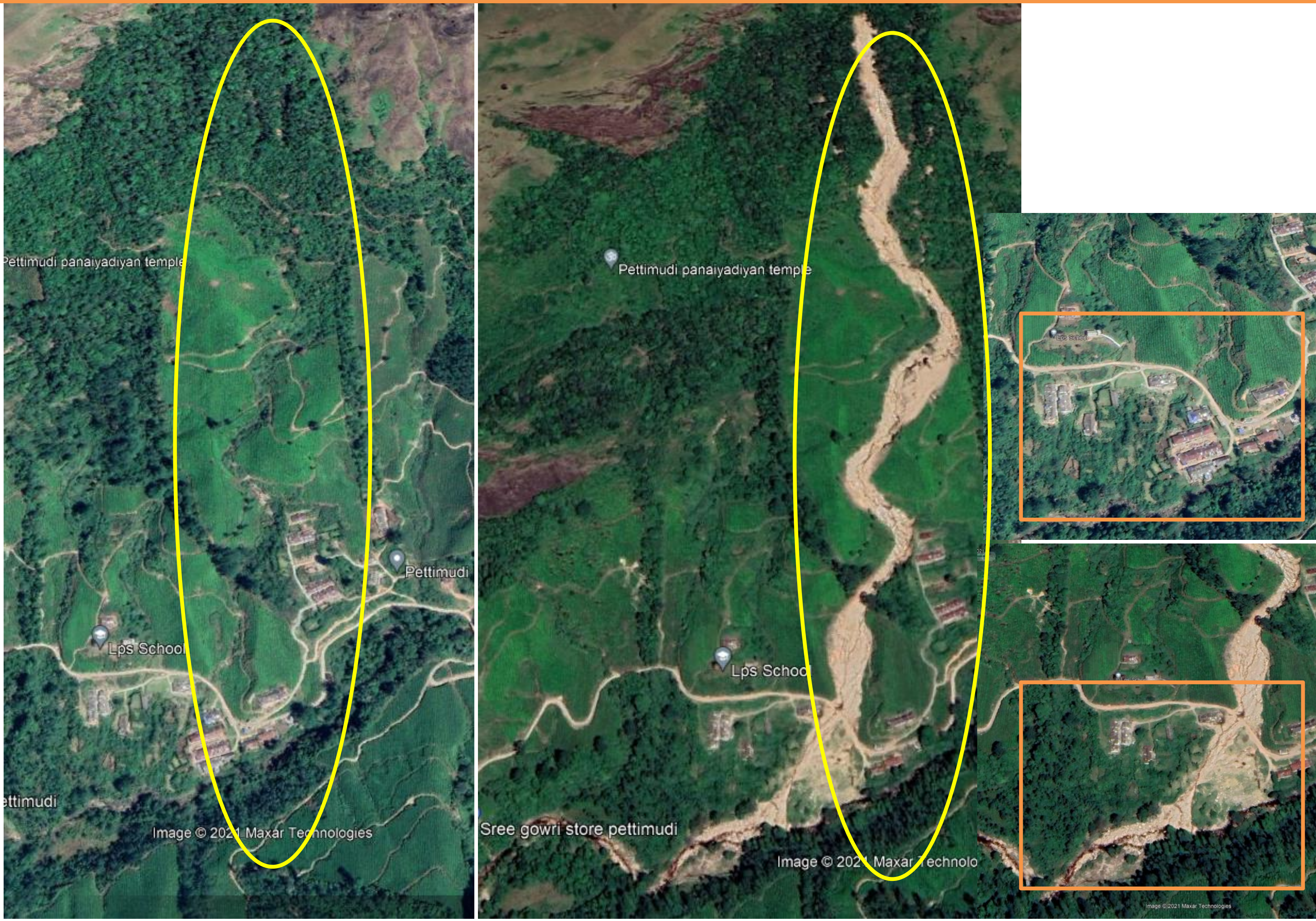
Landslide - Petimudi, Rajamala Hills, Idukki Dt, Kerala

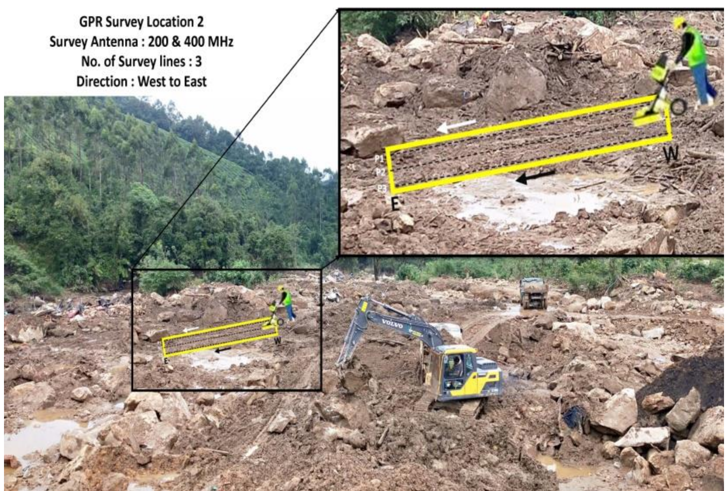


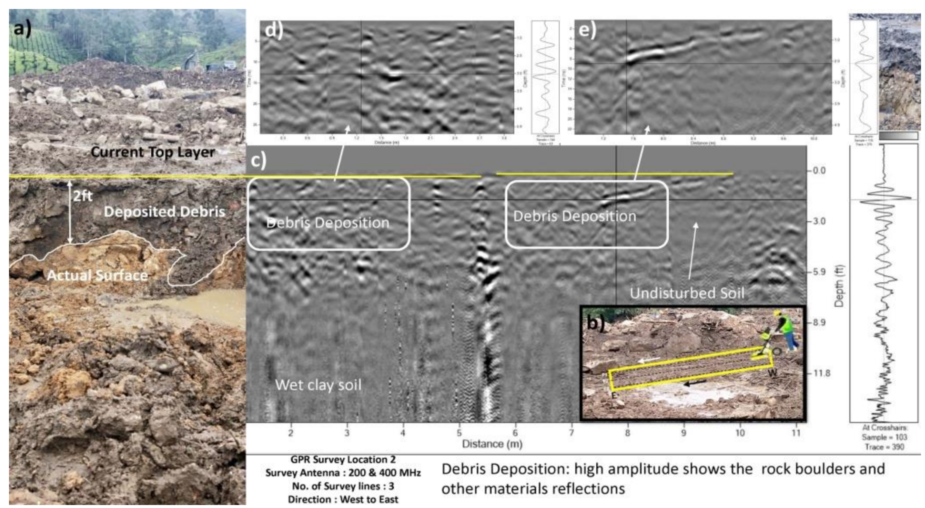
Source: Googlemap

Landslide - Petimudi, Rajamala Hills, Idukki Dt, Kerala

Dr. R. Jegankumar, Professor and Head, Dr. Abdul Rahman Guest Lecturer and SP. Dhanabalan Research Scholar Department of Geography, Bharathidsan University, Tiruchirappalli **supported to the Government of Kerala and National Disaster Relief Force (NDRF) in the devastative landslide occurred at Petimudi, Rajamala Hills, Idukki District, Kerala in the rescue operations** with the use of DST PURSE sponsored Ground Penetrating Radar (GPR) during 17-08-2020 to 19-08-2020 by the invitation of District Collectorate, Idukki, District, Kerala.





Debris Deposition: high amplitude shows the rock boulders and other materials reflections

Ground Penetrating Radar

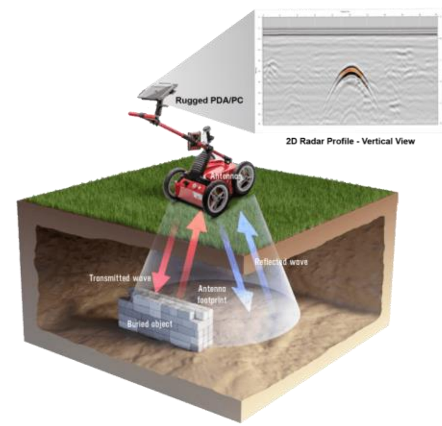
Facility @ Bharathidasan University

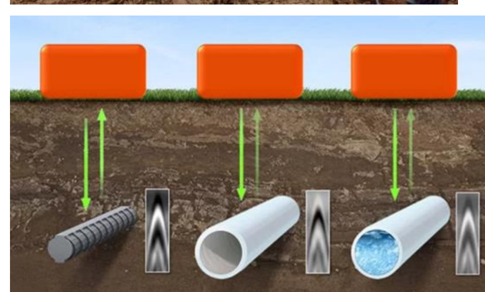
DST PURSE I

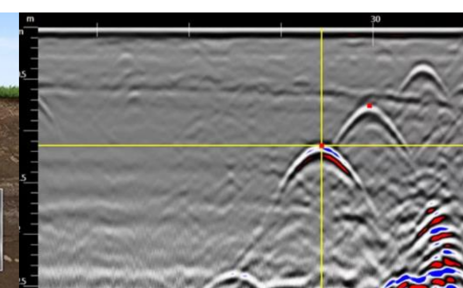
GPR's is used to identify and mark the position and depth of metallic and non-metallic objects; including utilities such as gas, communications and sewer lines as well as underground storage tanks and PVC pipes

SIR 30 Rugged, Multi-channel GPR Controller

The SIR 30 is the next-generation high-performance multi-channel radar control unit. This system can collect up to eight channels of data simultaneously with uncompromised performance, making it ideal for transportation infrastructure, large-scale utility, geology, and mining applications.







Ground Penetrating Radar Components (GPR)

Ground Penetrating Radar Technology Explained
This page is designed as a basic introduction to some of the key concepts of ground penetrating radar. Ground penetrating radar is also known as GPR, Geo-radar, and ground probing radar.

A GPR system is made up of three main components:

Control unit
Antenna
Power Supply

GSSI GPR equipment can be run with a variety of power supplies ranging from small rechargeable batteries to vehicle batteries and normal 110/220-volt. Connectors and adapters are available for each power source type. The unit in the photo above can run from a small internal rechargeable battery or external power.

Source: https://www.geophysical.com/whatisgpr

GPR Control Unit and Antenna

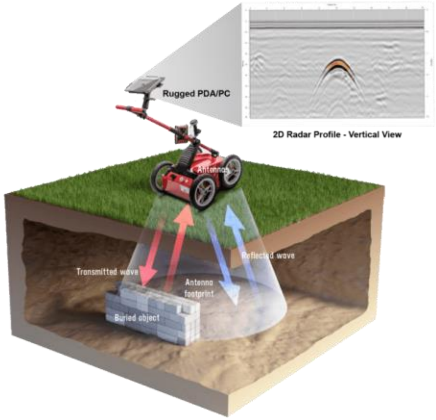
The control unit contains the electronics which trigger the pulse of radar energy that the antenna sends into the ground. It also has a built-in computer and hard disk/solid state memory to store data for examination after fieldwork. Some systems, such as the GSSI SIR 30, are controlled by an attached Windows laptop computer with pre-loaded control software. This system allows data processing and interpretation without having to download radar files into another computer.

The antenna receives the electrical pulse produced by the control unit, amplifies it and transmits it into the ground or other medium at a particular frequency. Antenna frequency is one major factor in depth penetration. The higher the frequency of the antenna, the shallower into the ground it will penetrate. A higher frequency antenna will also 'see' smaller targets. Antenna choice is one of the most important factors in survey design. The following table shows antenna frequency, approximate depth penetration and appropriate application.

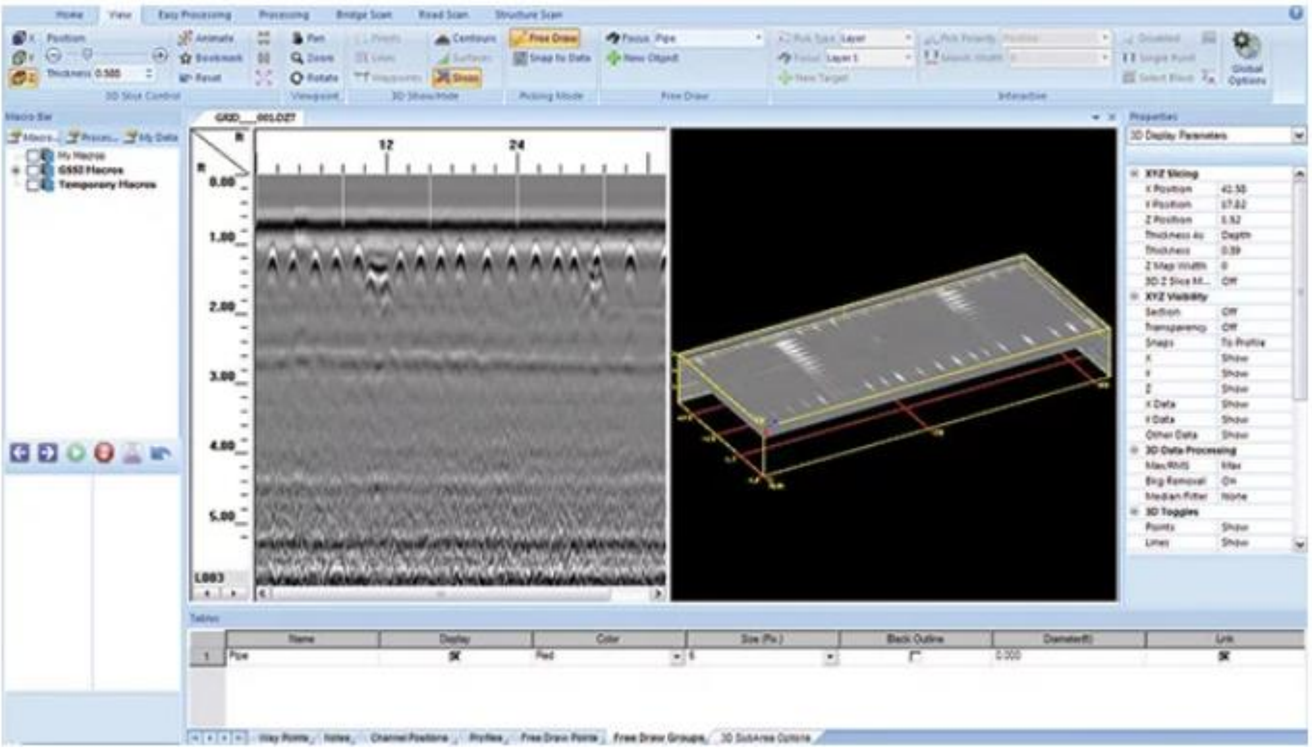
Source: https://www.geophysical.com/whatisgpr

The following table shows antenna frequency, approximate depth penetration and appropriate application:

APPROPRIATE APPLICATION	PRIMARY ANTENNA CHOICE	SECONDARY ANTENNA CHOICE	APPROXIMATE DEPTH RANGE
Structural Concrete, Roadways, Bridge Decks	2600 MHz	1600 MHz	0-0.3 m (0-1.0 ft)
Structural Concrete, Roadways, Bridge Decks	1600 MHz	1000 MHz	0-0.45 m (0-1.5 ft)
Structural Concrete, Roadways, Bridge Decks	1000 MHz	900 MHz	0-0.6 m (0-2.0 ft)
Concrete, Shallow Soils, Archaeology	900 MHz	400 MHz	0-1 m (0-3 ft)
Shallow Geology, Utilities, USTs, Archaeology	400 MHz	270 MHz	0-4 m (0-12 ft)
Geology, Environmental, Utility, Archaeology	270 MHz	200 MHz	0-5.5 m (0-18 ft)
Geology, Environmental, Utility, Archaeology	200 MHz	100 MHz	0-9 m (0-30 ft)
Geologic Profiling	100 MHz	MLF (16-80 MHz)	0-30 m (0-90 ft)
Geologic Profiling	MLF (16-80 MHz)	None	Greater than 30 m (90 ft)



Source: https://www.geophysical.com/whatisgpr



Data Processing

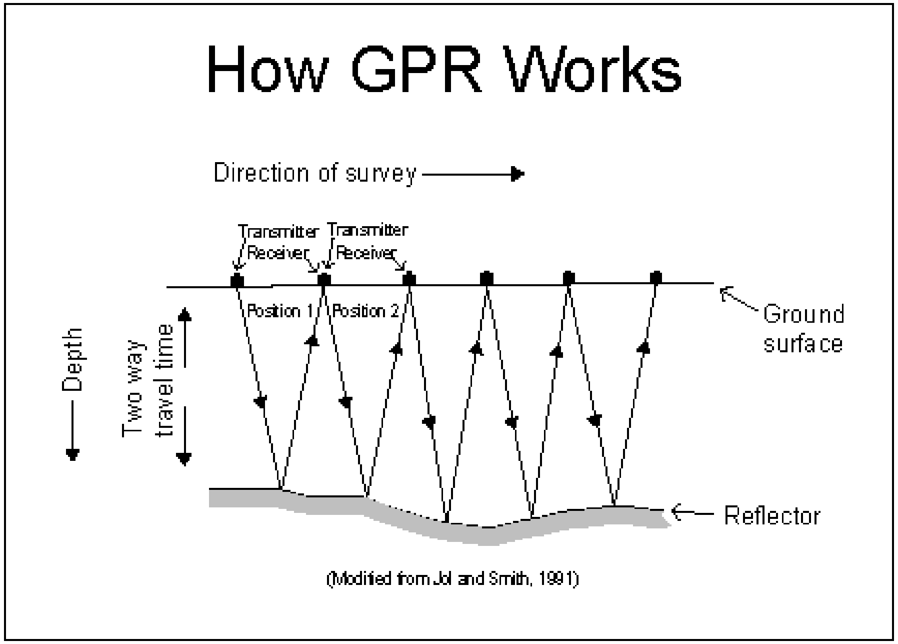
Data is collected in parallel transects and then placed together in the appropriate locations for computer processing in a specialized software program. The computer then produces a horizontal surface at a particular depth in the record. This is referred to as a depth slice, which allows operators to interpret a planview of the survey area.

Source: https://www.geophysical.com/whatisgpr

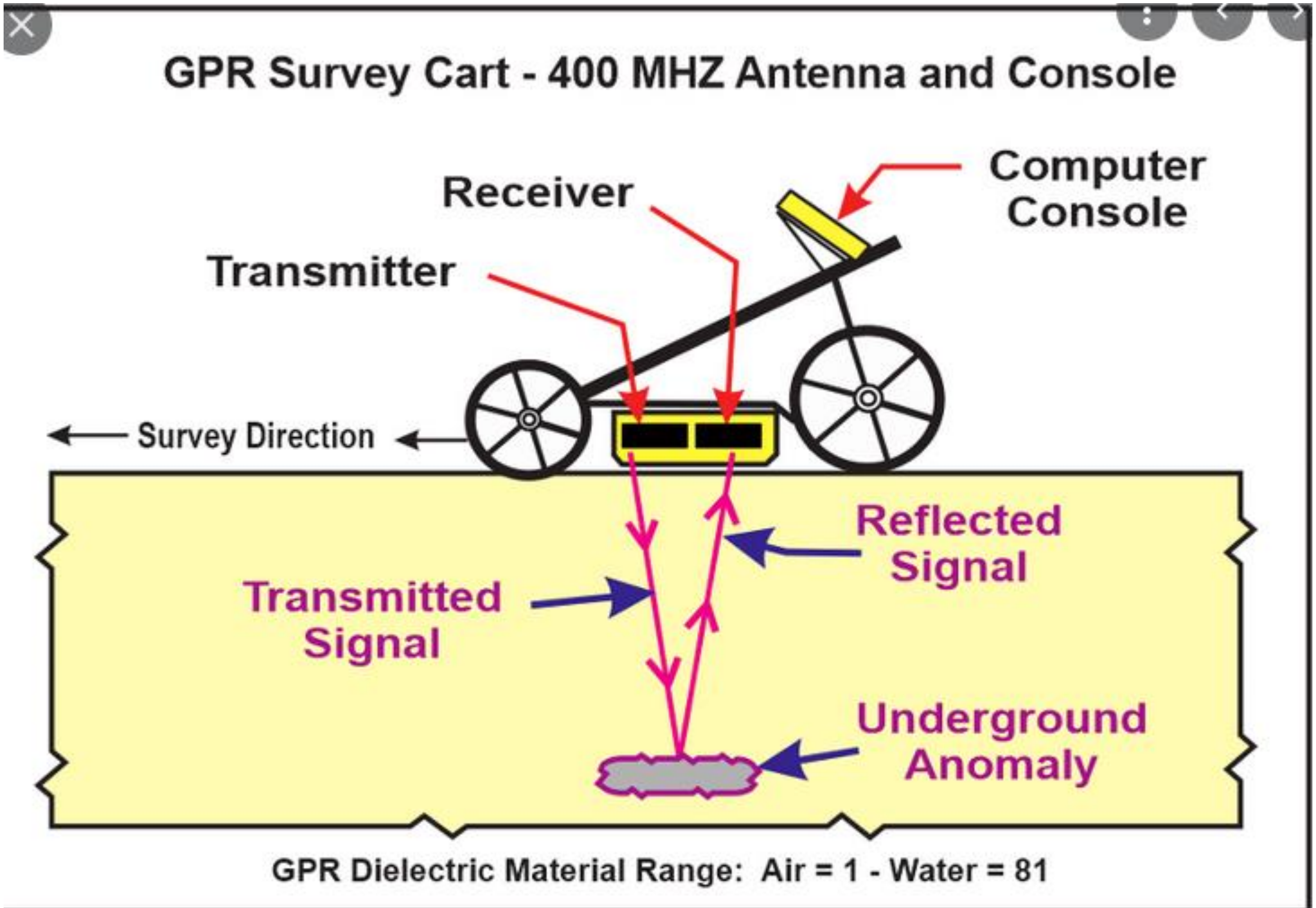
GPR Survey Methods

How GPR Works

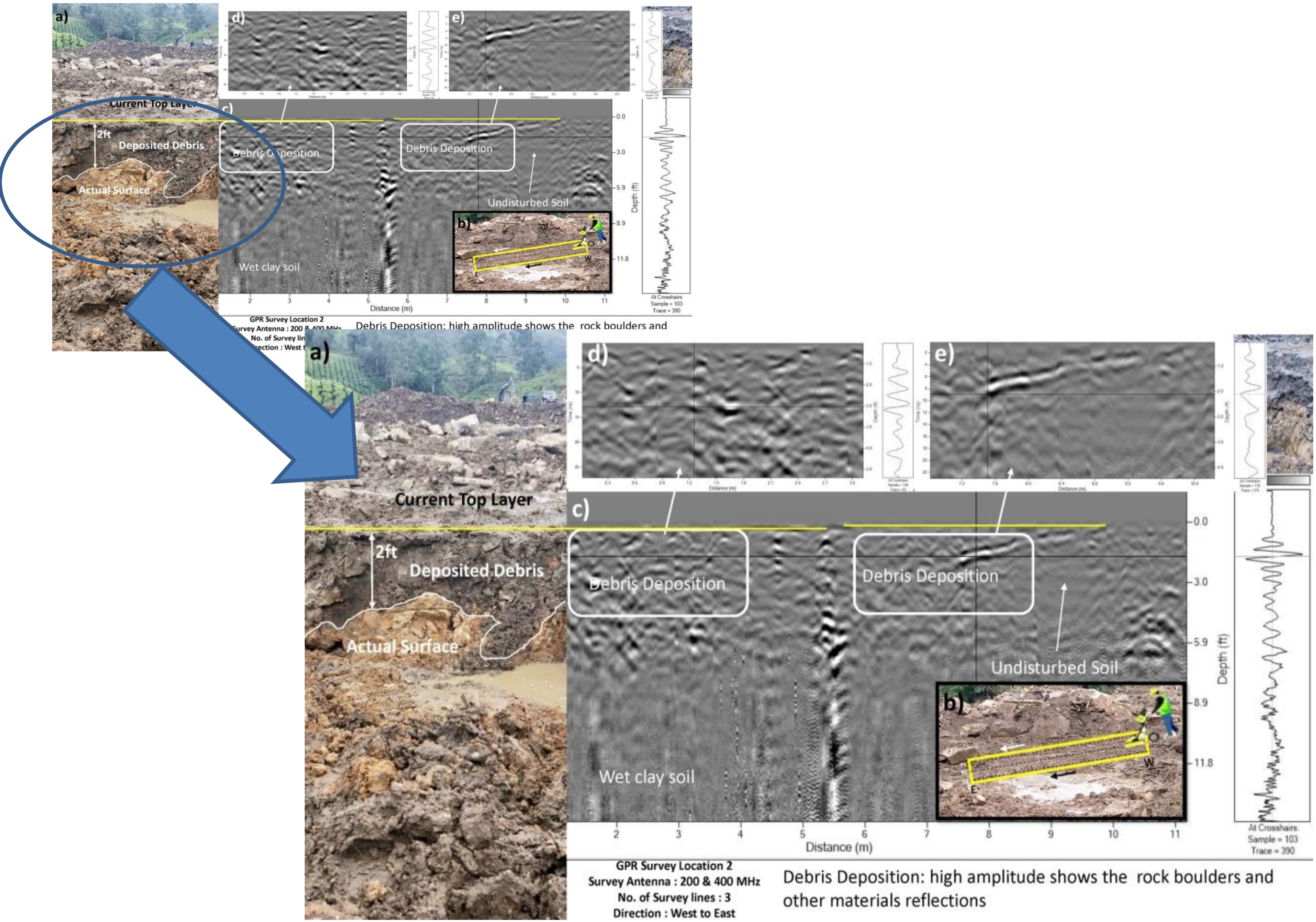
GPR involves a step-like procedure of repetitive moves of both the transmitter and receiver at a constant spacing. The transmitter sends a short pulse of electromagnetic energy (approximately radio frequency) into the ground which is reflected by boundaries in the penetrated medium and received by the receiver antennae before the ensemble moves. The two-way travel time of this process is measured and translated into depth using the electromagnetic velocity in the penetrated medium gained from a specialized GPR survey performed at each site (common mid-point, Jol and Smith, 1991).



https://people.uwec.edu/jolhm/Past_Students/Wenell/ncdune/methods.htm



https://www.topographix.com/ground-penetrating-radar/


a)
d)
e)
c)
Current Top Layer
2ft
Deposited Debris
Actual Surface
Debris Deposition
Debris Deposition
Undisturbed Soil
Wet clay soil
b)
Depth (ft)
Distance (m)
At Crosshairs:
Sample = 103
Trace = 390
GPR Survey Location 2
Survey Antenna : 200 & 400 MHz
No. of Survey lines : 3
Direction : West to East
Debris Deposition: high amplitude shows the rock boulders and other materials reflections

Thank You