SURVEY OF INDIA

Department of Science and Technology

GEO-SPATIAL ACTIVITIES : HIGH RESOLUTION MAPPING

6th September, 2019

OUTLINE

- SURVEY OF INDIA ACTIVITIES
- GEODETIC INFRASTRUCTURE DEVELOPMENT
- HIGH RESOLUTION MAPPING
- DRONE TECHNOLOGY IN MAPPING
- APPLICATIONS OF FOUNDATION BASE IMAGE MAP
- CAPACITY BUILDING & TRAINING
- DISCUSSIONS/QUESTIONS

Survey of India Mandate

National Map Policy (NMP)-2005 mandates Survey of India (SoI) To:

- Provide, maintain and allow access and make available the NTDB (National Topographical Data Base)
- Promote the use of Geospatial knowledge and intelligence through partnerships and other mechanism

A. National Spatial Reference Frame

- National Ground Control points (GCPs) Library
- Precision Bench marks (BMs)
- Tidal observations and prediction of tides
- Field gravity observations across country
- Field Geo-magnetic observations across country

B. National Digital Elevation Model (DEM)

- National DEM of ± 10 metre accuracy
- High Resolution DEM of ± 3 metre accuracy
- Ultra high Resolution DEM of ± 50 cm accuracy

C. National Topographical Template

- Topographic maps on all scales
- Aeronautical charts
- Special surveys for Airports /Air fields of AAI/ Navy/ Coast guard.
- Special maps for Indian Air Force

D. Administrative Boundaries

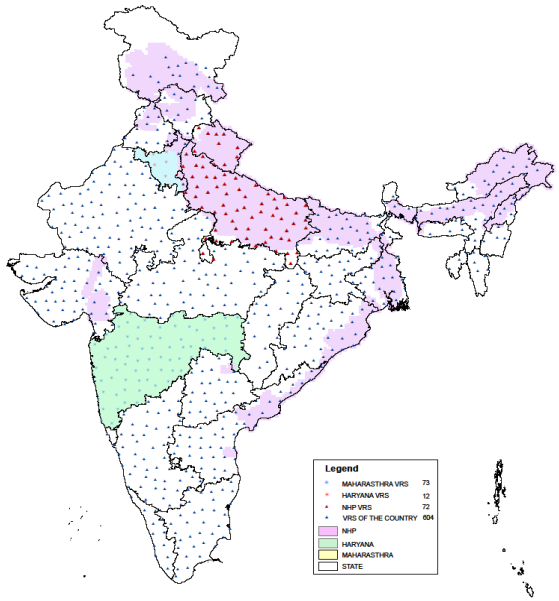
- International, state, district, tehsil and Village boundaries
- International Boundary (IB) Survey
- Inter-state Boundary (ISB) Survey
- Administrative boundaries data up to district and village level

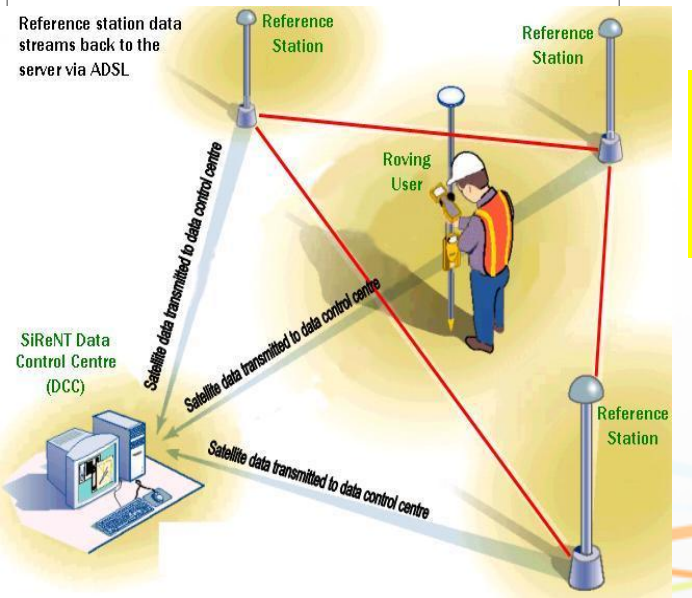
E. Toponymy (Place names)

Standardized Geographical names database

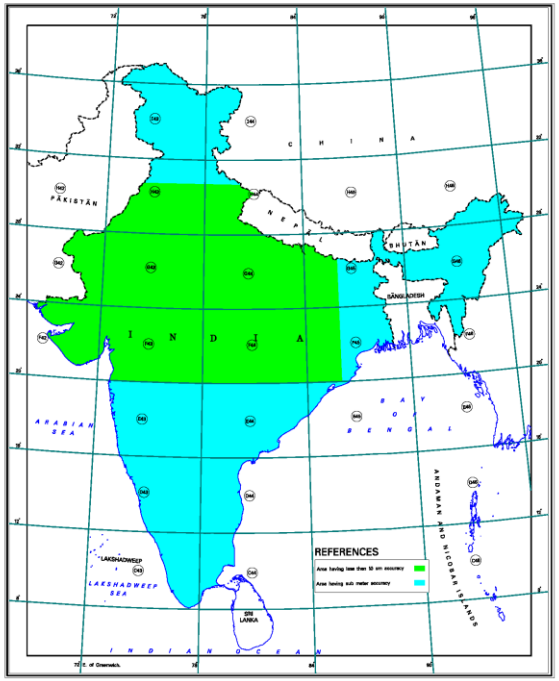
GEODETIC INFRASTRUCTURE DEVELOPMENT

CORS Network

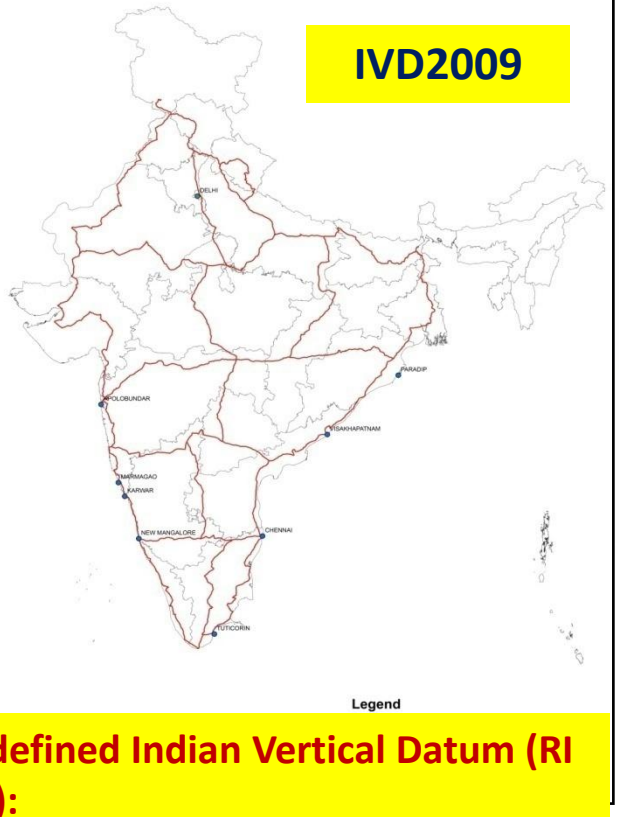




GEOID MODEL OF INDIA



IVD2009



National GCP Library

Phase-I : 250-300 km

Phase-II: 30-40 km

Redefined Indian Vertical Datum (RI VD):

Permanent BMs across Country with precise heights

Geoid Model : (Beta version)

35% area of country ≤ 10 cm

65% area of country ≤ 100 cm

WHY GEOID MODEL?

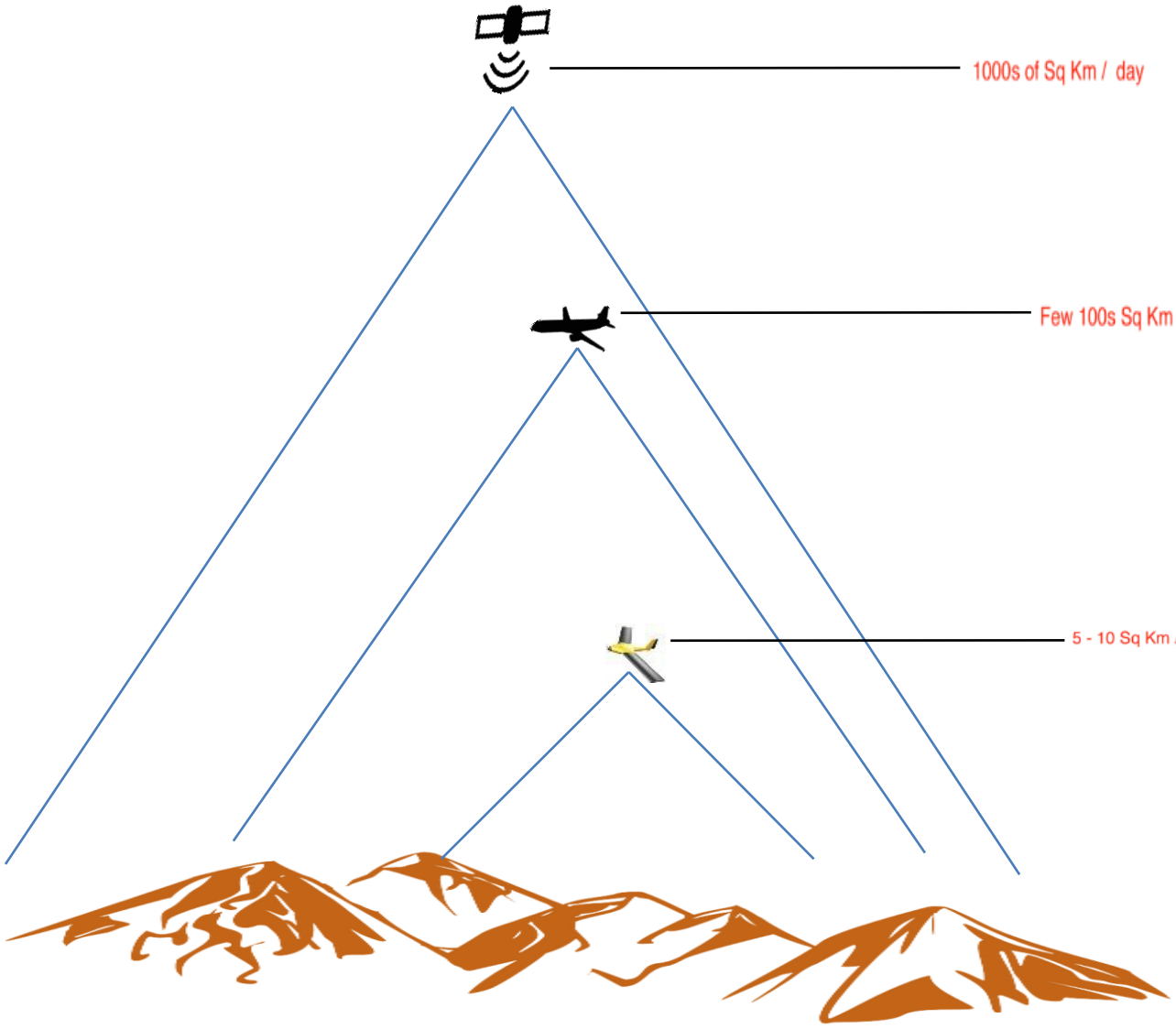
- **Precision spirit Leveling is used to provide accurate orthometric heights in MSL i.e. CM level accuracy.**
- **Time Taken for Spirit Leveling is one of the major factor in long project timelines for such Surveying & Mapping projects.**
- **GNSS heights or ellipsoidal heights can be directly converted to MSL heights with Geoid Model.**
- **Availability of Geoid Model will facilitate reduced project costs and completion time of Engineering Survey & mapping projects.**

HIGH RESOLUTION MAPPING

- Mapping as per Scale (Small/Medium/Large) was carried out with objective to prepare a Hard copy map on a particular scale based on following source inputs:
  - ✓ Satellite Imageries with coarse resolution or No Satellite Imagery
  - ✓ Airborne Analog Aerial Photography
  - ✓ Ground methods

- High Resolution Mapping is based on input source data resolution with objective to prepare digital database :
  - ✓ High Resolution Satellite imageries (HRSI) with 30/50 cm or better resolution
  - ✓ Airborne Digital Aerial Photographs with 9 cm or better resolution
  - ✓ UAV/Drone Images with 5 cm or better resolution
  - ✓ LIDAR Point cloud data
  - ✓ Ground methods using GNSS (RTK/Network RTK)+ ETS

HIGH RESOLUTION MAPPING TECHNIQUES



1000s of Sq Km / day

Expensive | 30 to 200 cm | Update Rate > 30 Days

Few 100s Sq Km / day

Expensive | 20 to 60 cm | Permission time > 60 Days

5 - 10 Sq Km / day

Inexpensive | 2 to 8 cm | Update Rate = Area Coverage Time

Manual Met

HIGH RESOLUTION MAPPING : COMPARISON

PARAMETERS FOR COMPARISON	GROUND SURVEY ETS/GPS	DRONE SURVEY (OPTICAL SENSOR)	AERIAL SURVEY (OPTICAL SENSOR)	SATELLITE SURVEY (STEREO)	SATELLITE SURVEY (MONO)
ACCURACY PLANIMETRY	5-10 CM	5-10 CM	9-30 CM	50-100 CM	70-200 CM
ACCURACY HEIGHT(DTM)	10-20 CM	10-20 CM	40-100 CM	150-300 cm	----------
SPEED	0.1-0.2 SQ KM/DAY	8-10 SQ KM/DAY	100s SQ KM/DAY	1000sSQ KM/DAY	1000sSQ KM/DAY
RELIABILITY OF DATA	GOOD(GROUND VERIFIED)	Very GOOD	GOOD	LESS RELIABLE	LESS RELIABLE
COST EFFECTIVENESS	VERY EXPENSIVE	ECONOMICAL	EXPENSIVE	EXPENSIVE	EXPENSIVE
SUITABILITY FOR SMALL AREA	YES	YES	NO	NO	NO
AVAILABILITY OF TRAINED MANPOWER	YES	YES	YES	YES	YES
NEED TO REVISIT FIELD	NO	NO	YES	YES	YES
FLEXIBILITY IN REVISITING (PERMISSION)	NOT REQUIRED	GOOD	LESS FLEXIBLE	LESS FLEXIBLE	LESS FLEXIBLE

ACCURACY REQUIREMENTS FOR CADASTRAL

As per DILRMP Guidelines for cadastral mapping :

Horizontal Accuracy requirement:

± 10 CM or better for Urban areas &
± 20 CM or better for Rural areas

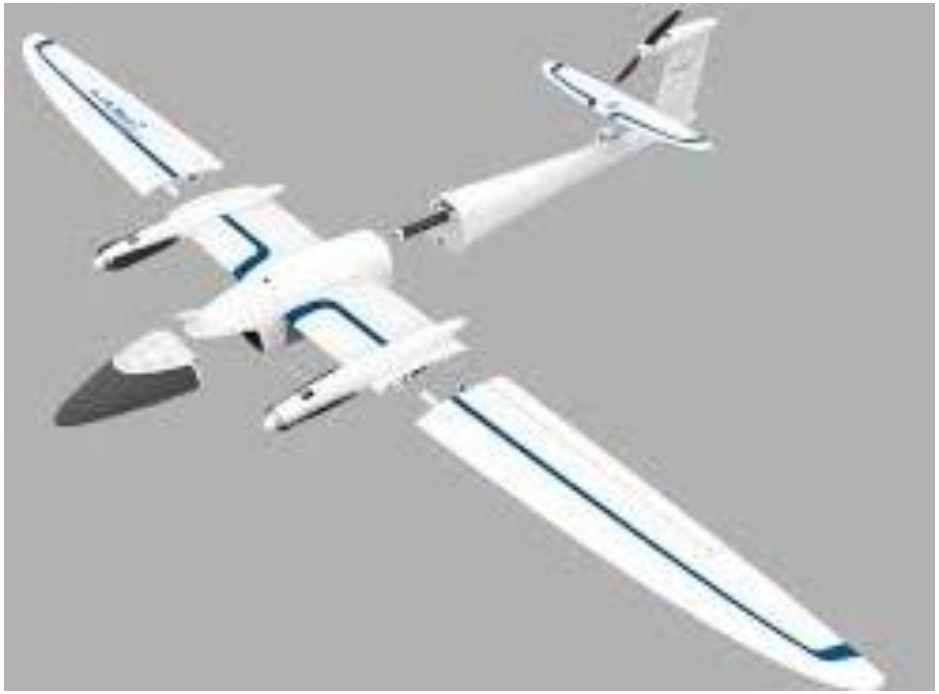
Good quality Source Image of better than 5 cm GSD is ideally required for these accuracy requirements.

PARAMETERS	HARYANA			MAHARASTRA	KARNATAKA
	RURAL	VILLAGE LALDORA/ABADI	URBAN		
GSD	10CM	5CM	5CM	5CM	10CM
ACCURACY PLANIMETRY	**20 CM**	**10 CM**	**10 CM**	**12.5CM**	**12.5CM**
ACCURACY HEIGHT (DTM)	20CM	20CM	20CM	20CM	50CM
SCALE OF MAP	**1:1000**	**1:800**	**1:500**	**1:500**	**1:500**

UAV OR DRONE BASED MAPPING

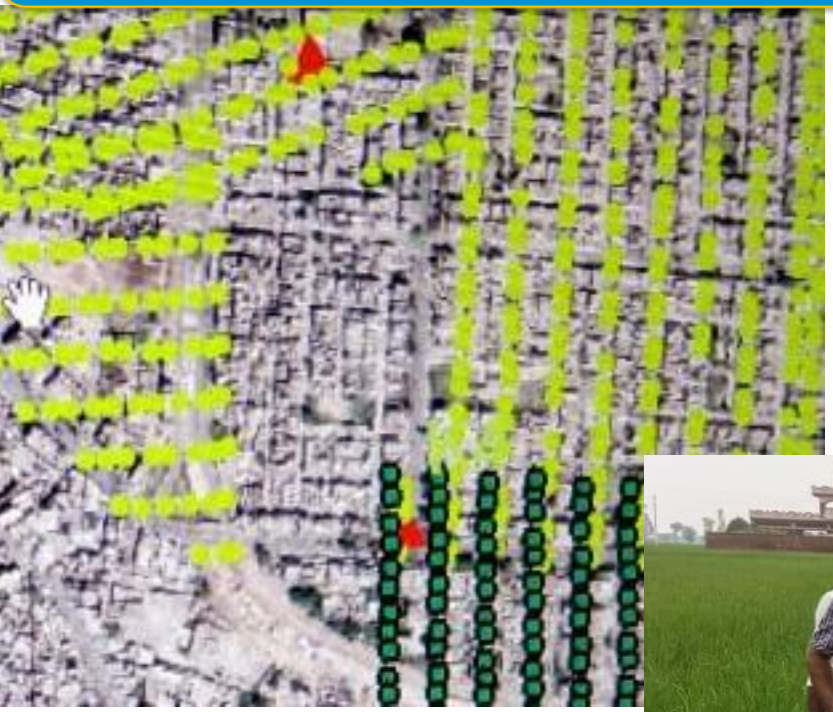
- VTOL or Copter UAV
- GSD: Less than 5 cm
- Good Coverage
- High Resolution ORI
- Mapping at 1:500 Scale
- Data Capturing time is very less
- PPK/RTK Enabled UAV require very less GCPs
- Data Processing is convenient and faster.

  Payload Options:
  Optical or LIDAR



DRONE PHOTOGRAPHS

PLANNING BEFORE FLYING



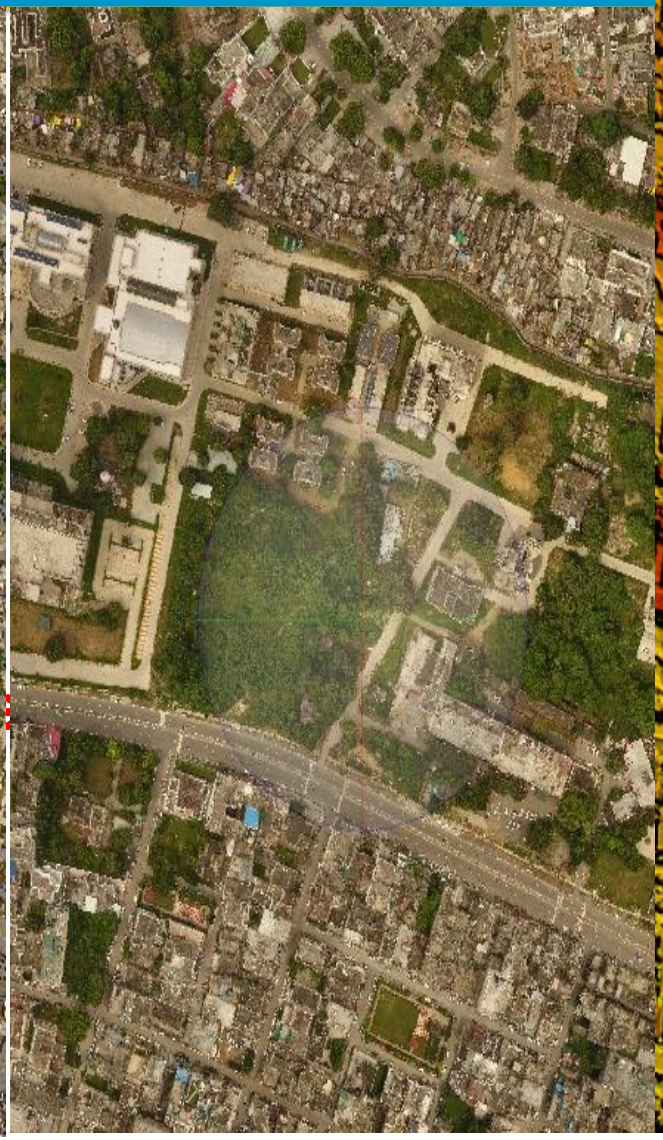
FLIGHT PLANNING

GPS OBSERVATION

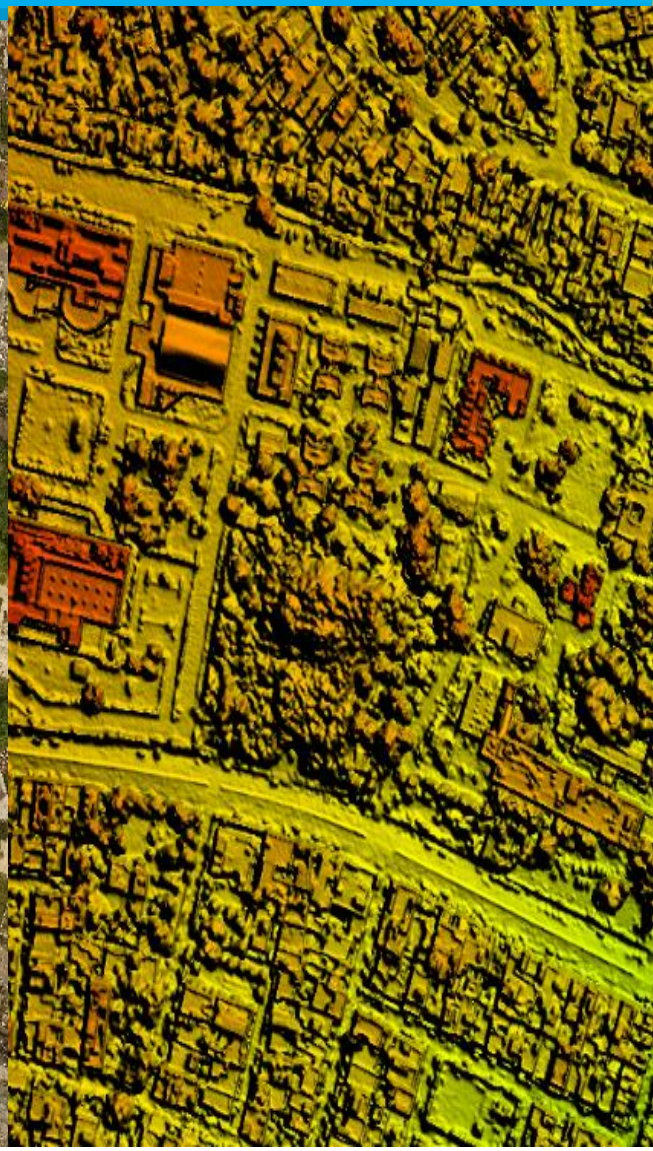
PLACING MARKERS

DATA PROCESSING

SPARSE POINT CLOUD
(TIE POINTS)



DENSE POINT CLOUD

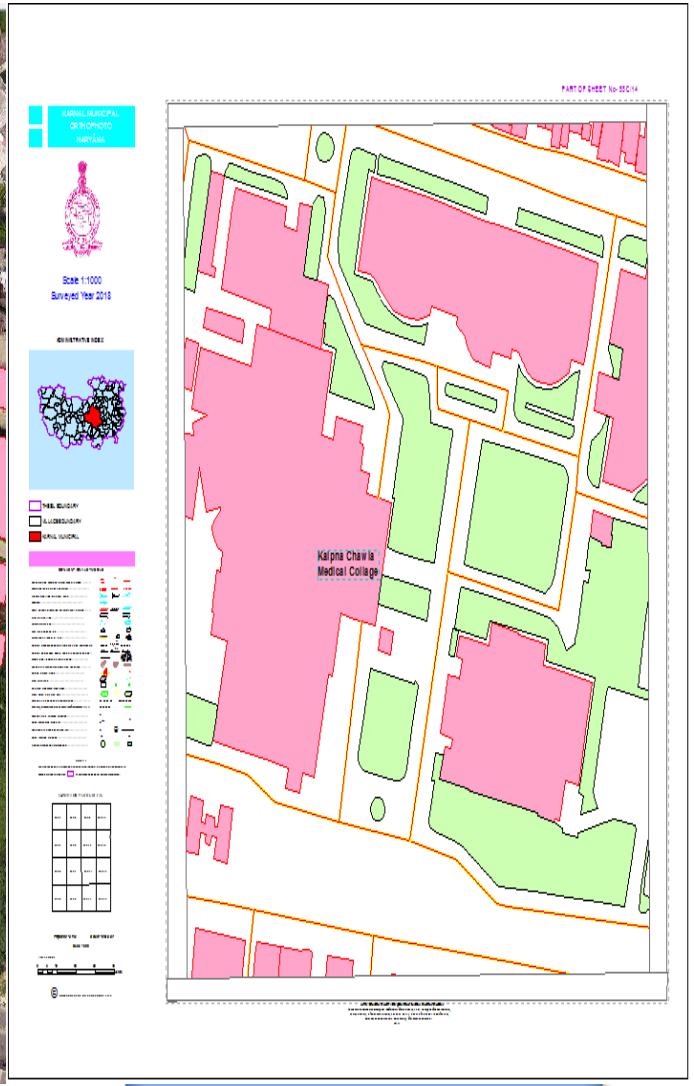


DIGITAL ELEVATION MODEL

FEATURE EXTRACTION AND GENERATION OF MAP

ORTHOPHOTO
(SCALE 1:500)

FEATURE EXTRACTION
(SCALE 1:500)



FINAL MAP
(SCALE 1:500)

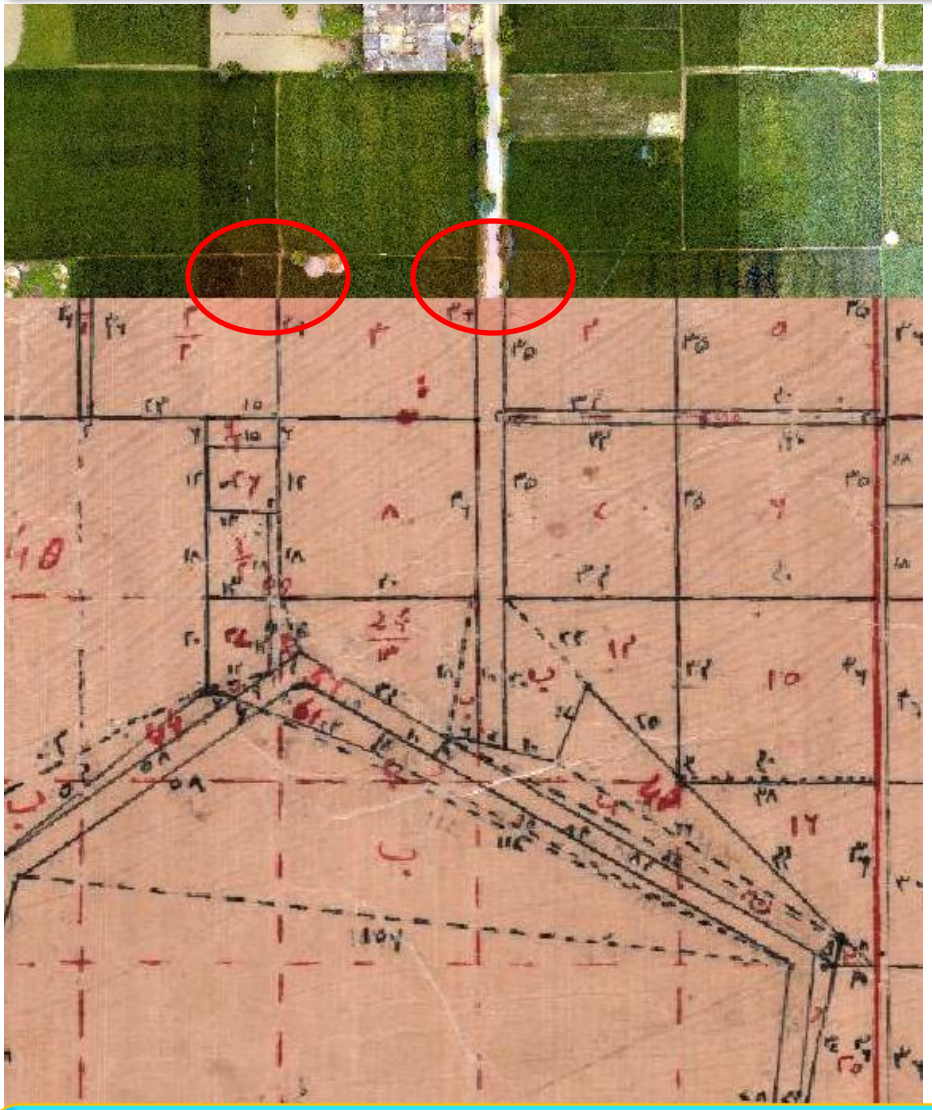
ORTHOPHOTO OUTPUT

FINAL ORTHORECTIFIED PHOTO AT 1:4000 SCALE

FINAL ORTHORECTIFIED PHOTO AT 1:1000 SCALE

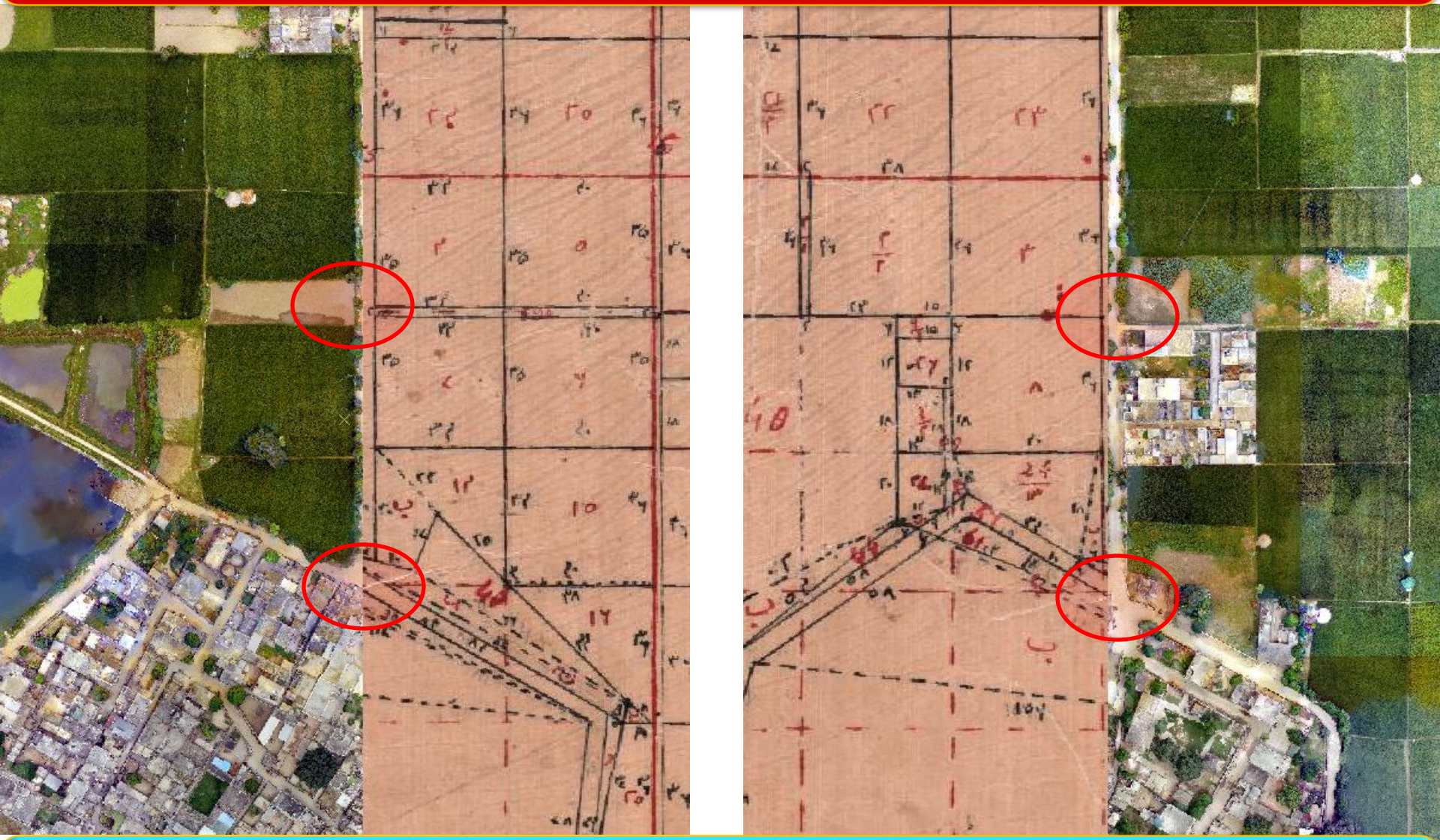
FINAL ORTHORECTIFIED PHOTO AT 1:500 SCALE

COMPARISON : REVENUE RECORD & ORI



GEO-REFERENCED REVENUE MAP WITH ORI

COMPARISON : REVENUE RECORD & ORI



GEO-REFERENCED REVENUE MAP WITH ORI

COMPARISON : REVENUE RECORD & ORI

GEO-REFERENCED REVENUE MAP WITH ORI

3D CITY MODEL

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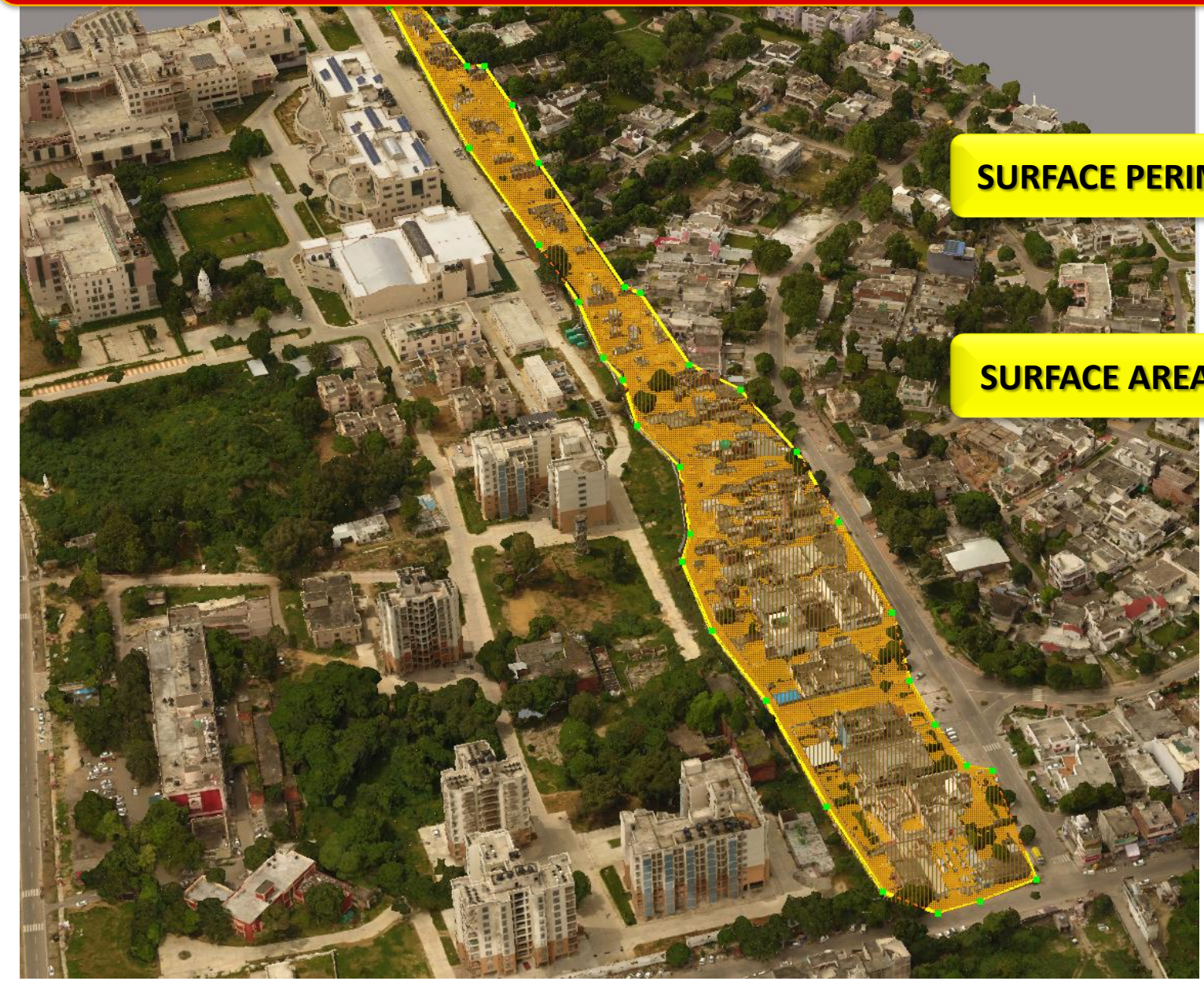


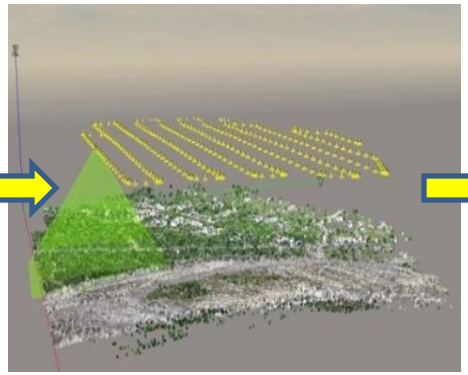
SURFACE PERIMETER=1427.90M

SURFACE AREA= 24918.29 SQ M

MAPPING BY DRONE TECHNOLOGY

FLIGHT PLG FOR DATA A QUISITION

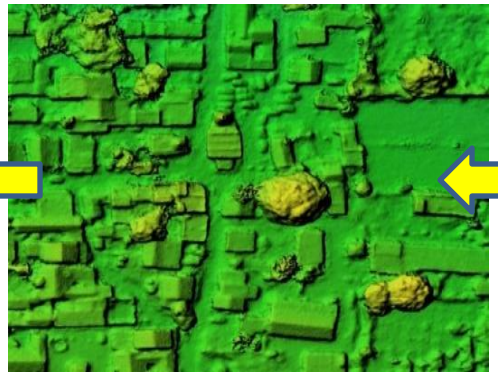
PLACING OF MARKERS ON GROUND & GPS OBSN



CAPTURING OF PHO TOS BY DRONE

ALIGNMENT OF PHOTOS ON SOFTWARE

DENSE POINT CLOUD

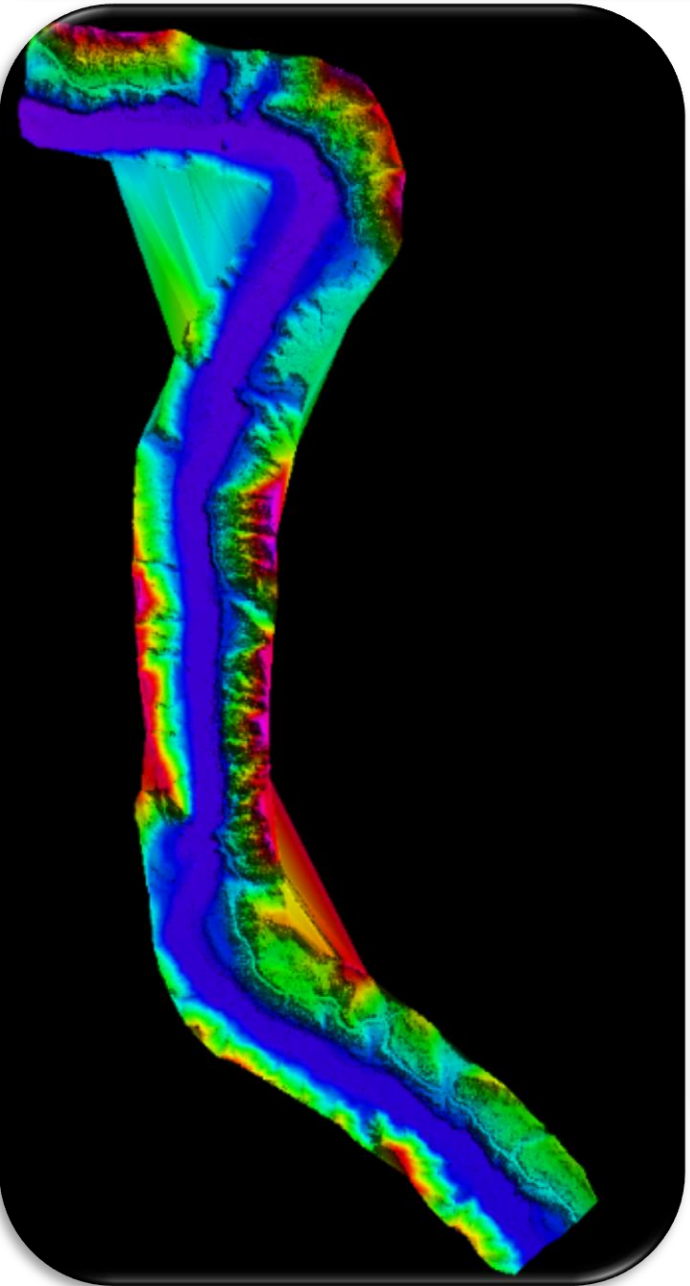


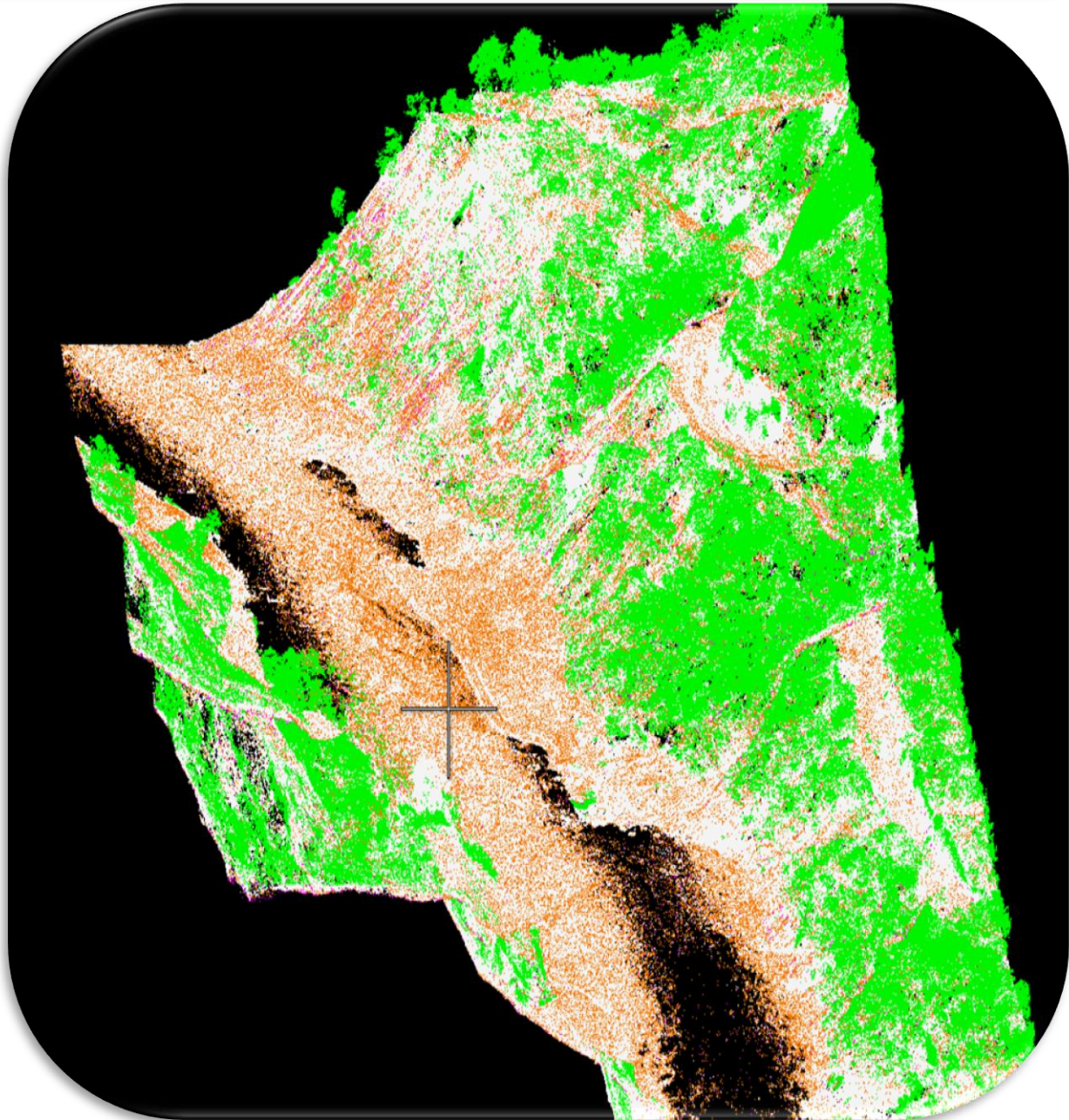
DIGITAL ELEVATION MODEL

3 DMODEL

FINAL ORTHORECTIFIED PHOTO

PILOT PROJECT USING DRONE BASED LIDAR





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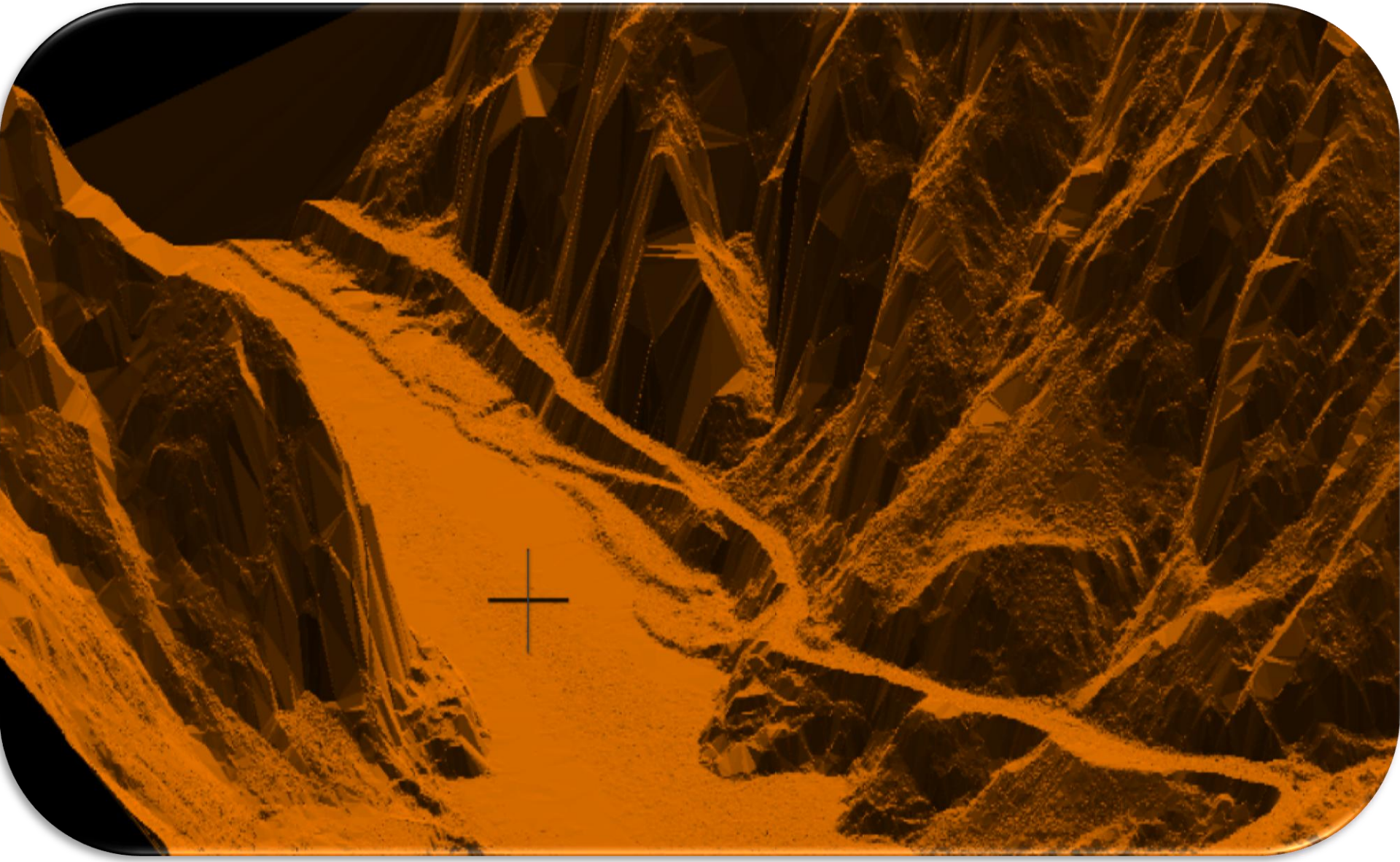

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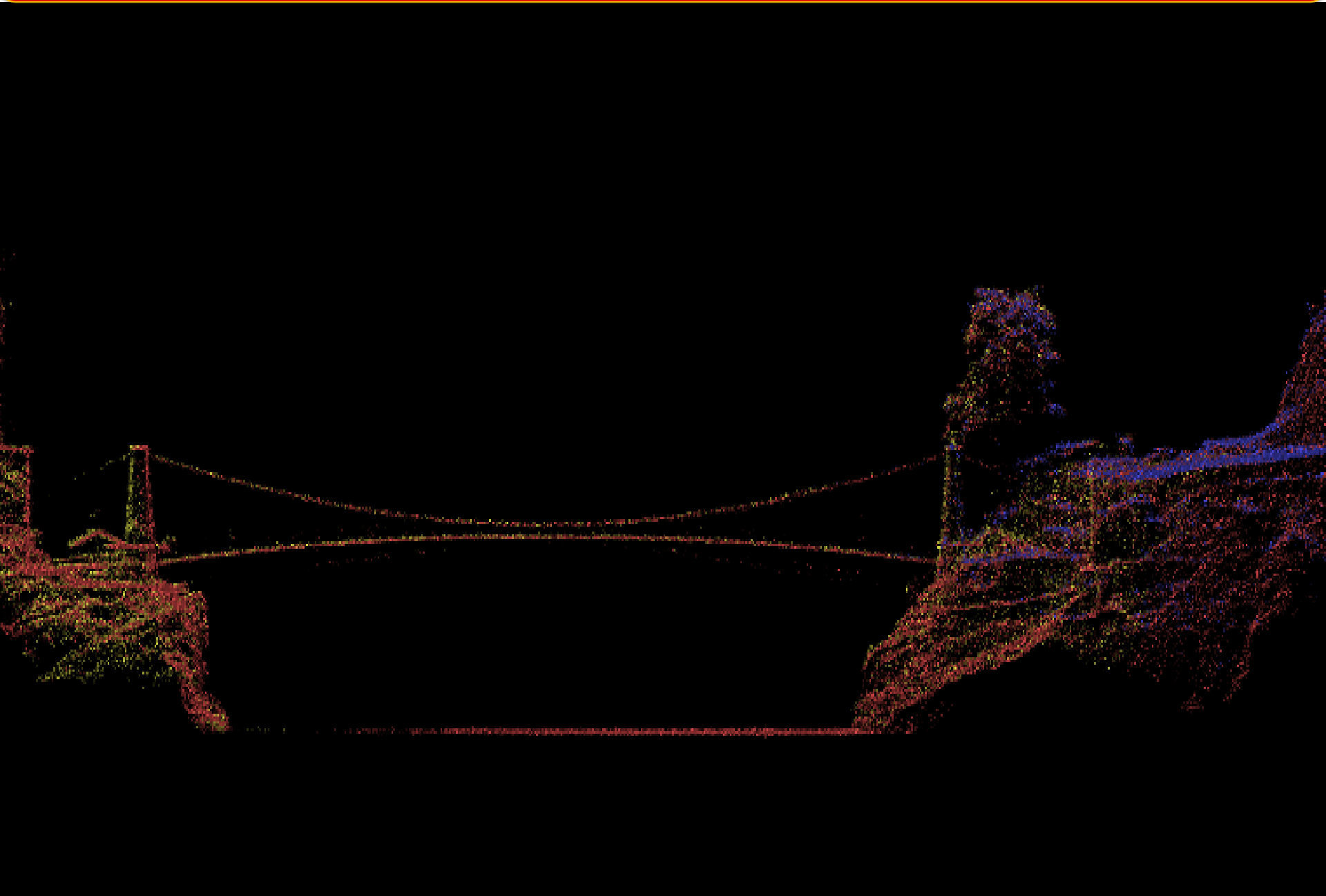

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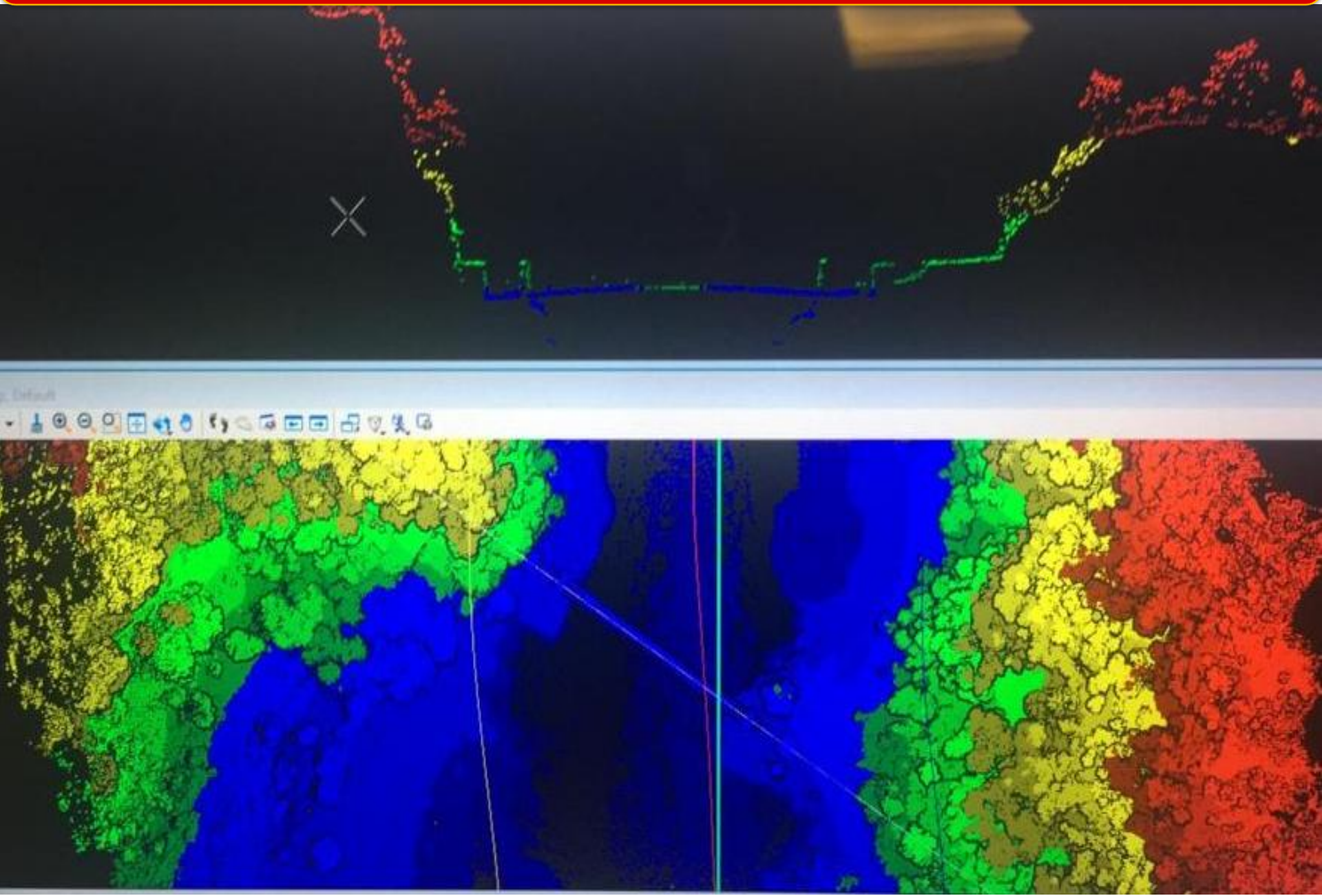


High Resolution National Topographic Database (HRNTDB)

❑ HRNTDB Source data:

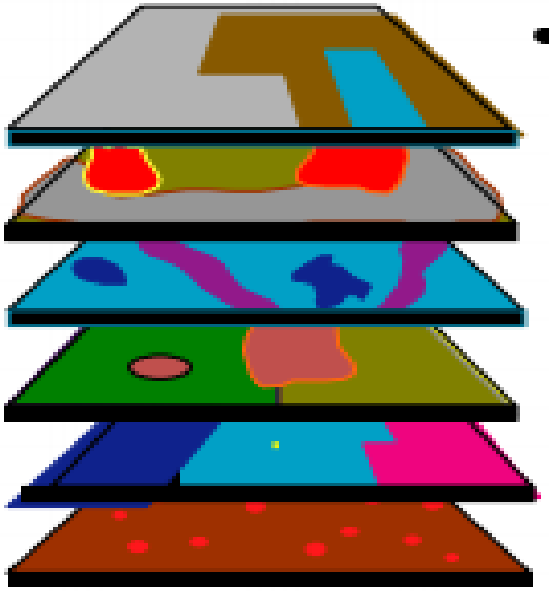
- ✓ High resolution Satellite Imageries (HRSI)
- ✓ UAV/Drone Image
- ✓ LIDAR Point Cloud

❑ HRNTDB Data Preparation Work Stages:

- ✓ Source data Capturing/Procurement
- ✓ Ground Control for Geo-referencing of Source data
- ✓ Ortho-rectified Image (ORI) preparation
- ✓ Feature Extraction as per SDMS
- ✓ Ground Validation & Attribute data Collection
- ✓ Delivery of Final Deliverables: GIS Database; Maps on 1:10K/25K

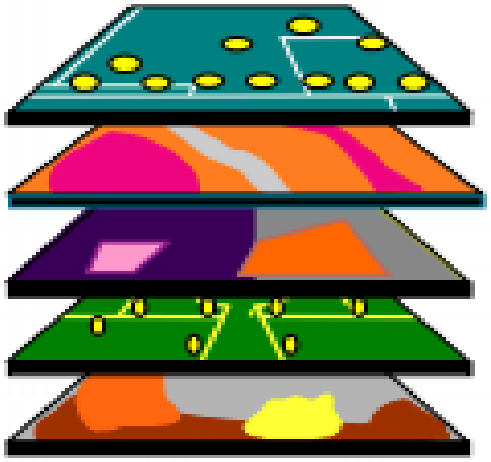
High quality, timely and reliable data

Geodetic
Elevation
Water/Ocean
Land use/cover
Transport
Cadastre
Population
Infrastructure
Settlements
Admin. Bdys.
Imagery
Geology/soils
Observations
etc.

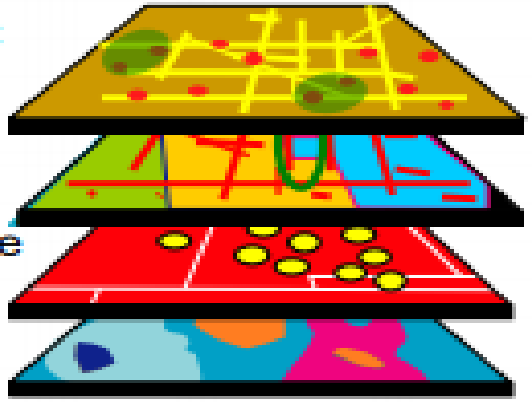


National Spatial Data Infrastructure

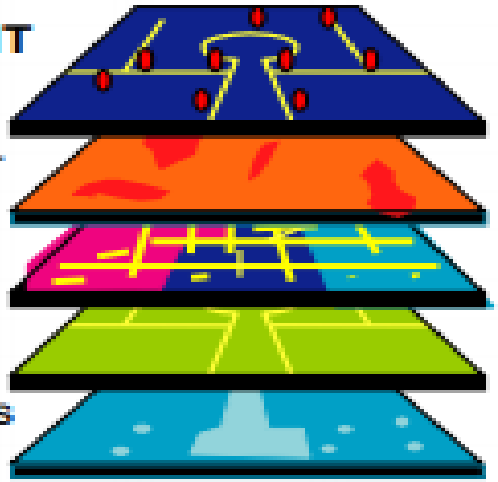
SOCIAL
Society
Poverty
Education
Health
Population
Employment
Water
Sanitation
Equality
Gender
Governance



ECONOMIC
Well-being
Cities
Water
Energy
Infrastructure
Industry
Sanitation
Economy

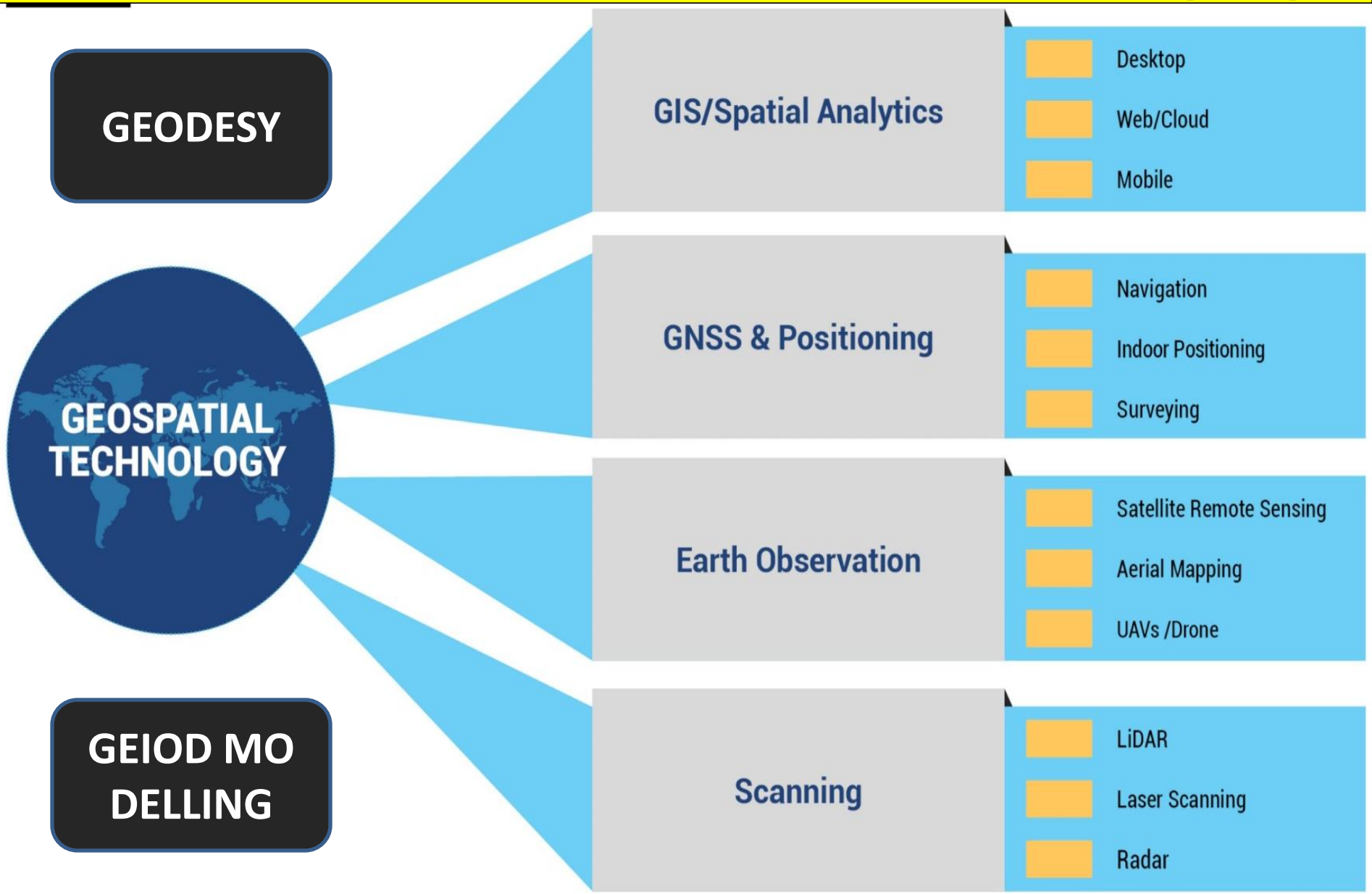


ENVIRONMENT
Water
Seas/oceans
Land use/cover
Ecosystems
Forests
Agriculture
Climate
Biodiversity
Natural hazards
Pollution



TRAINING & CAPACITY BUILDING

INDIAN INSTITUTE OF SURVEYING AND MAPPING (IISM)



Discussions/Questions

THANK YOU

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