

APPLICATIONS OF GEODESY IN REJUVENATION & MANAGEMENT OF FRESH WATER SYSTEM



BY

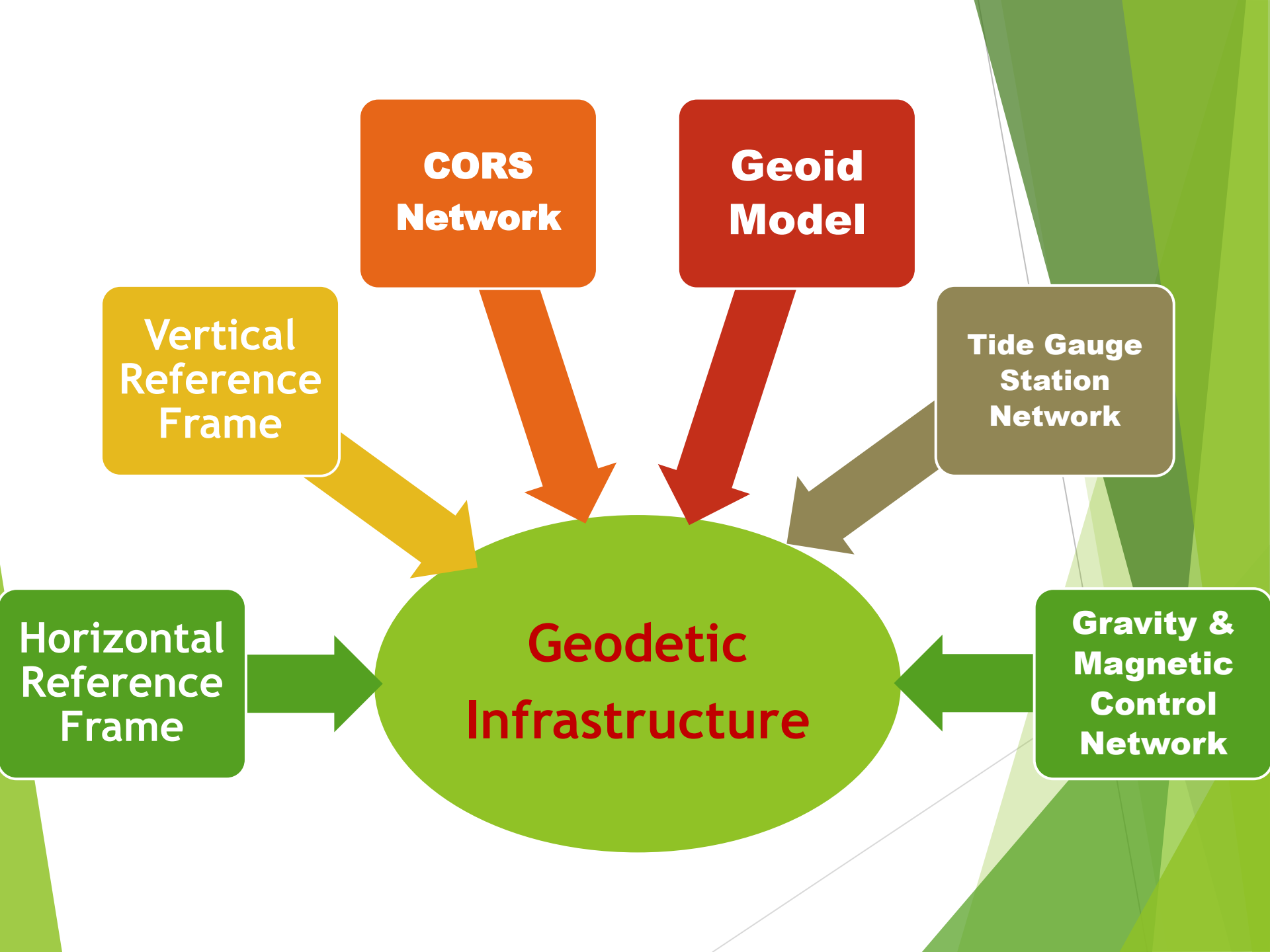
DR. S.K. SINGH

PROJECT DIRECTOR

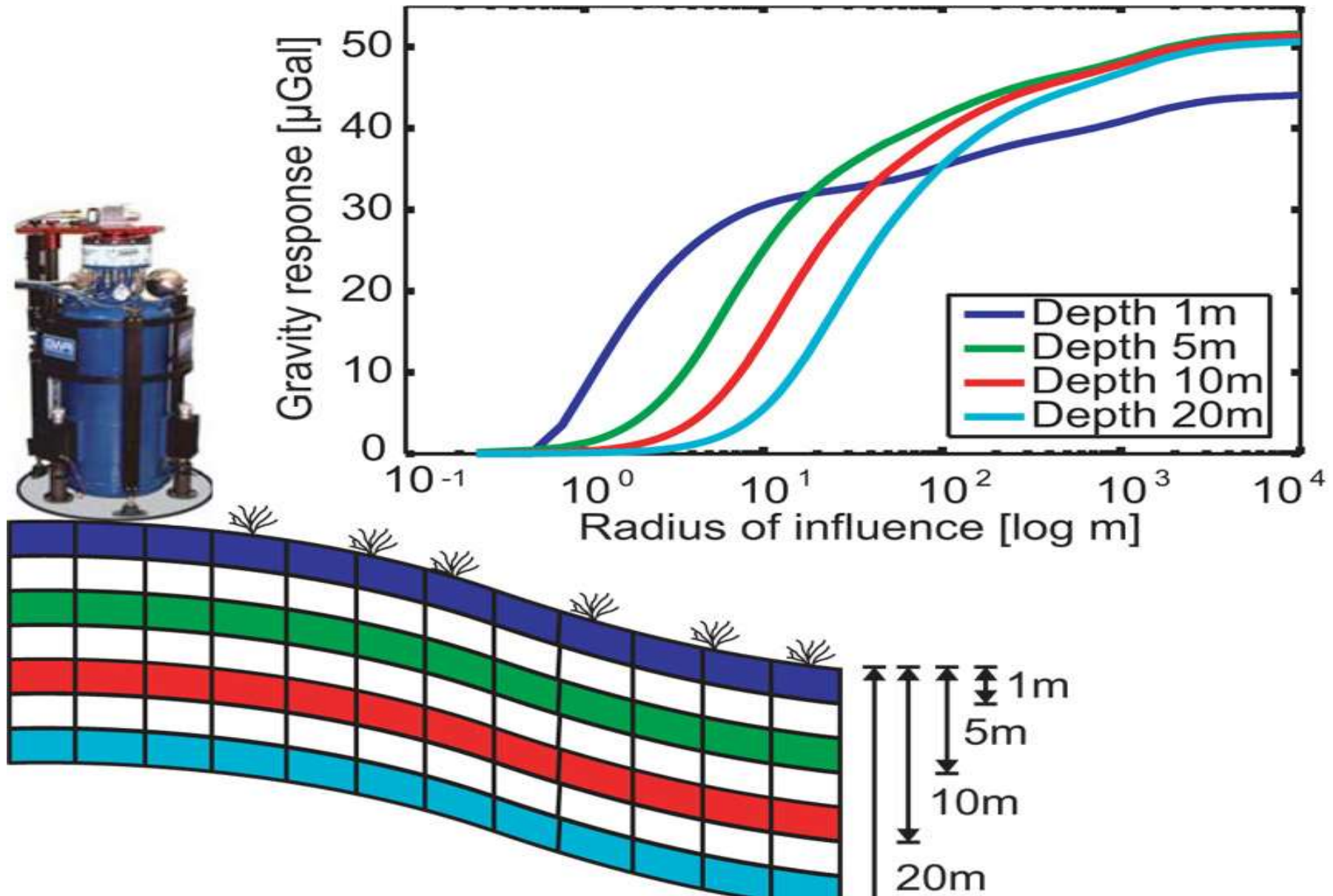
SURVEY OF INDIA

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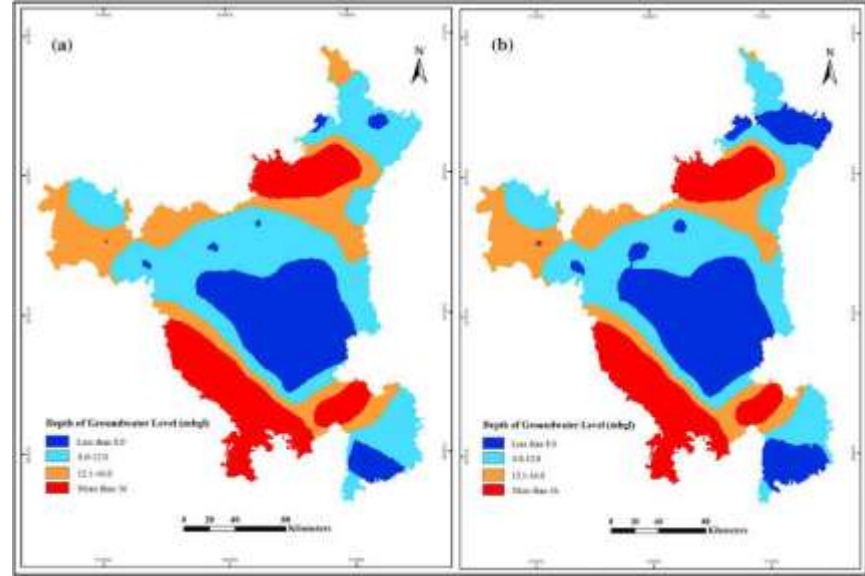




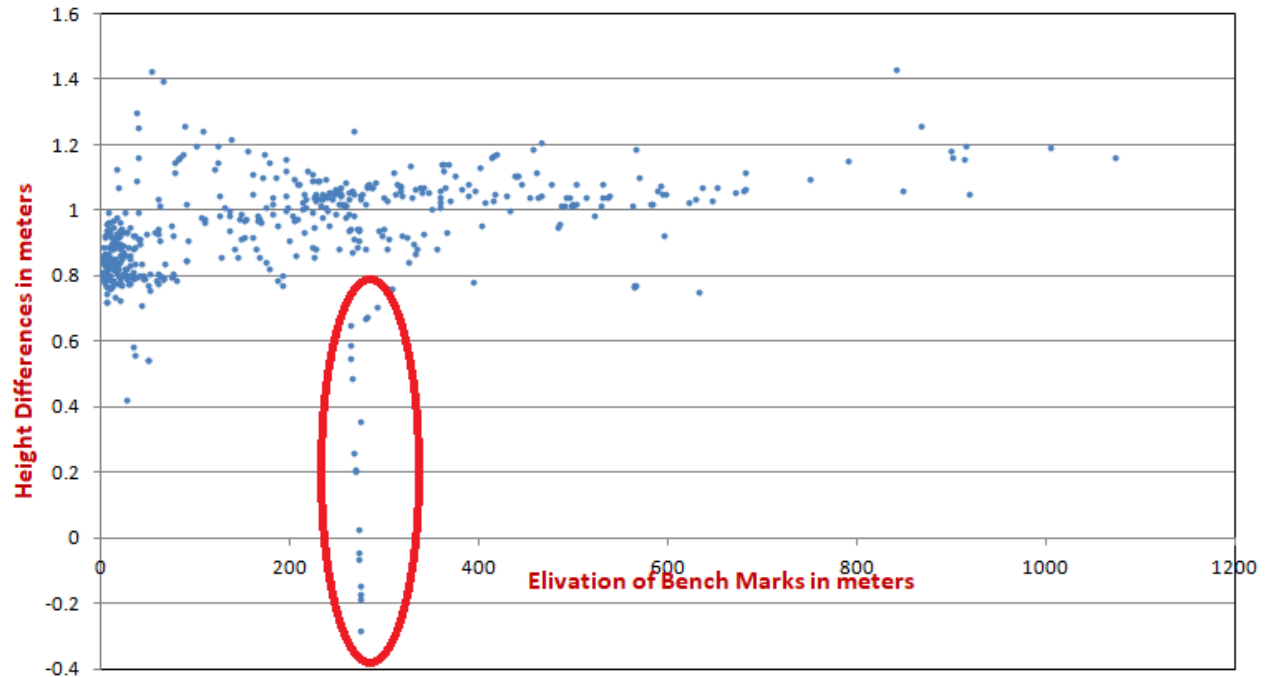
GRAVITY MEASUREMENTS FOR GWS



Traces of Land Subsidence by Levelling



Difference between IVD2009 Orthometric heights and Old MSL heights



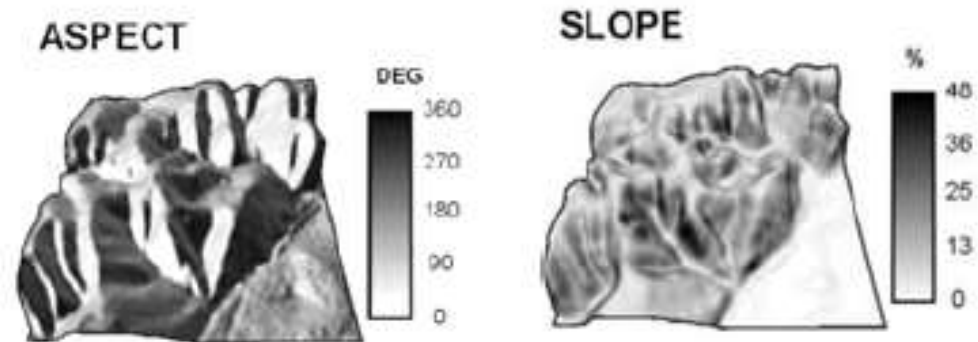
Digital Elevation Model & Its Uses

- It is a quantified representation of terrain, i.e. an elevation map.
 - It gives an improved understanding and information in hydrological, geological, geomorphological, climatological and biological applications.
 - It helps in improving the environmental information in planning and decision making processes.
- ✓ Earth surface (& biophysical) processes depend on topography / elevation

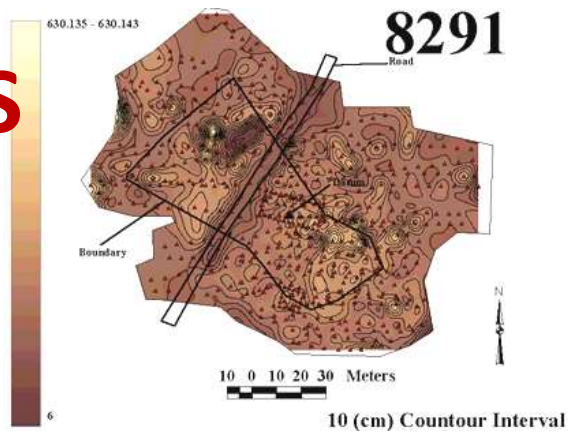
DEM is an important data source for terrain analysis.

✓ Various terrain variables can be derived from a DEM:

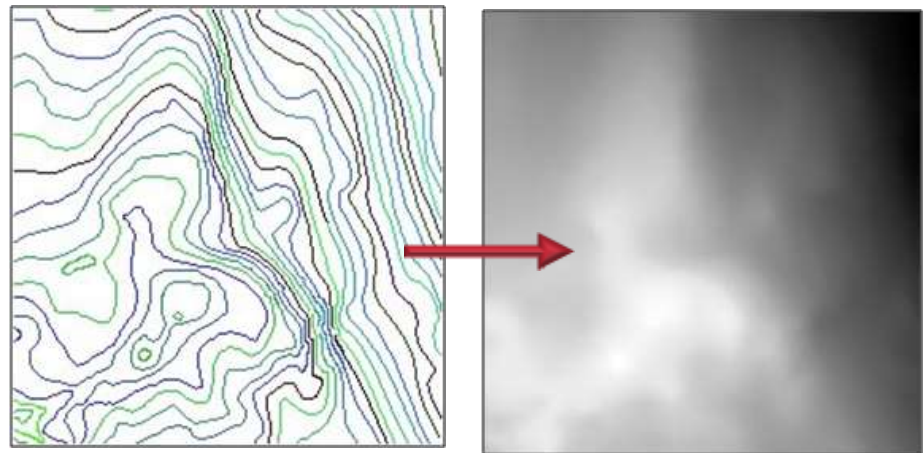
- Slope steepness,
- Slope form,
- Slope aspect
- Internal relief, etc.



SOURCES OF DEM

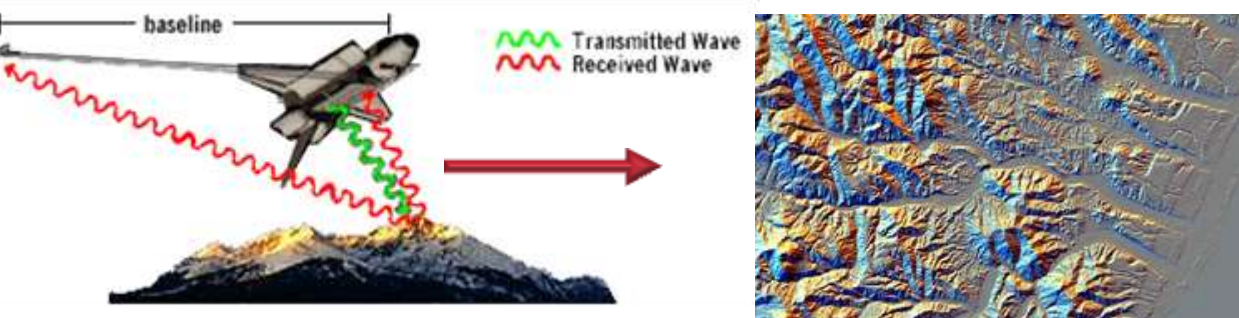


Point Elevation Data

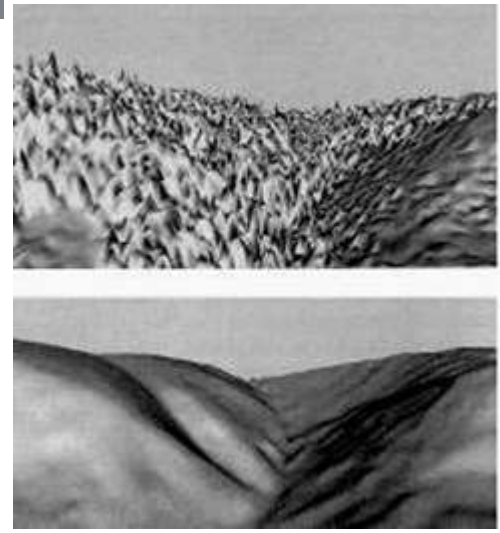
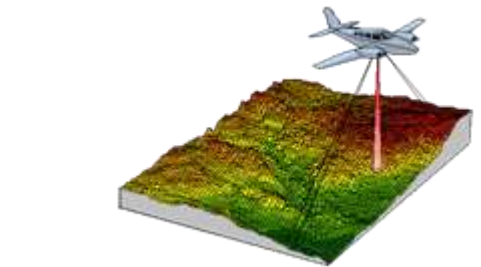
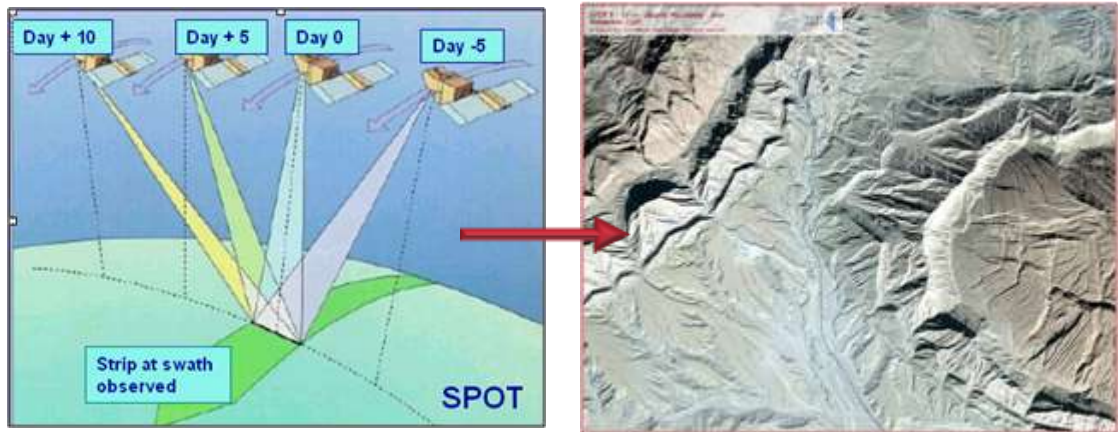


Contour and Stream line Data

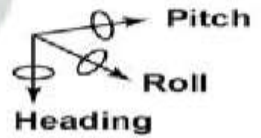
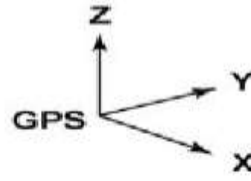
RADAR Data



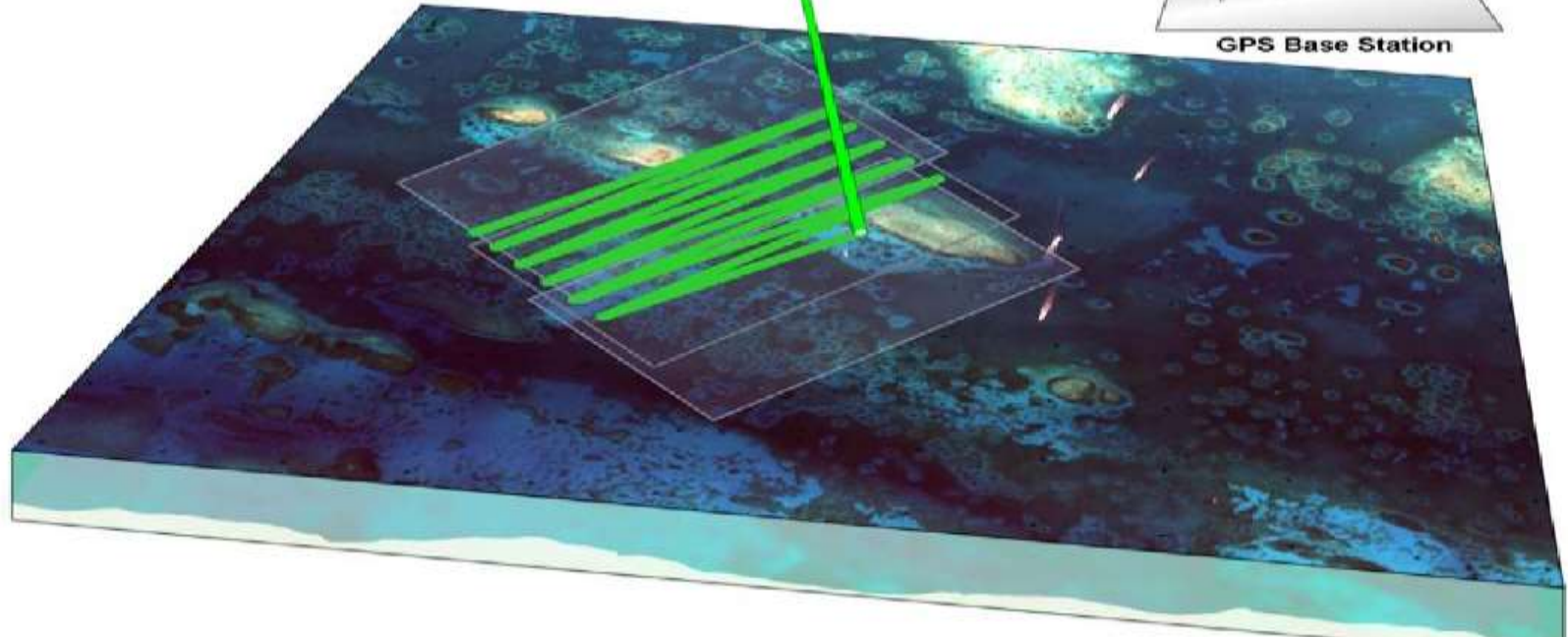
Stereoscopic 3-D Data



DSM
DEM

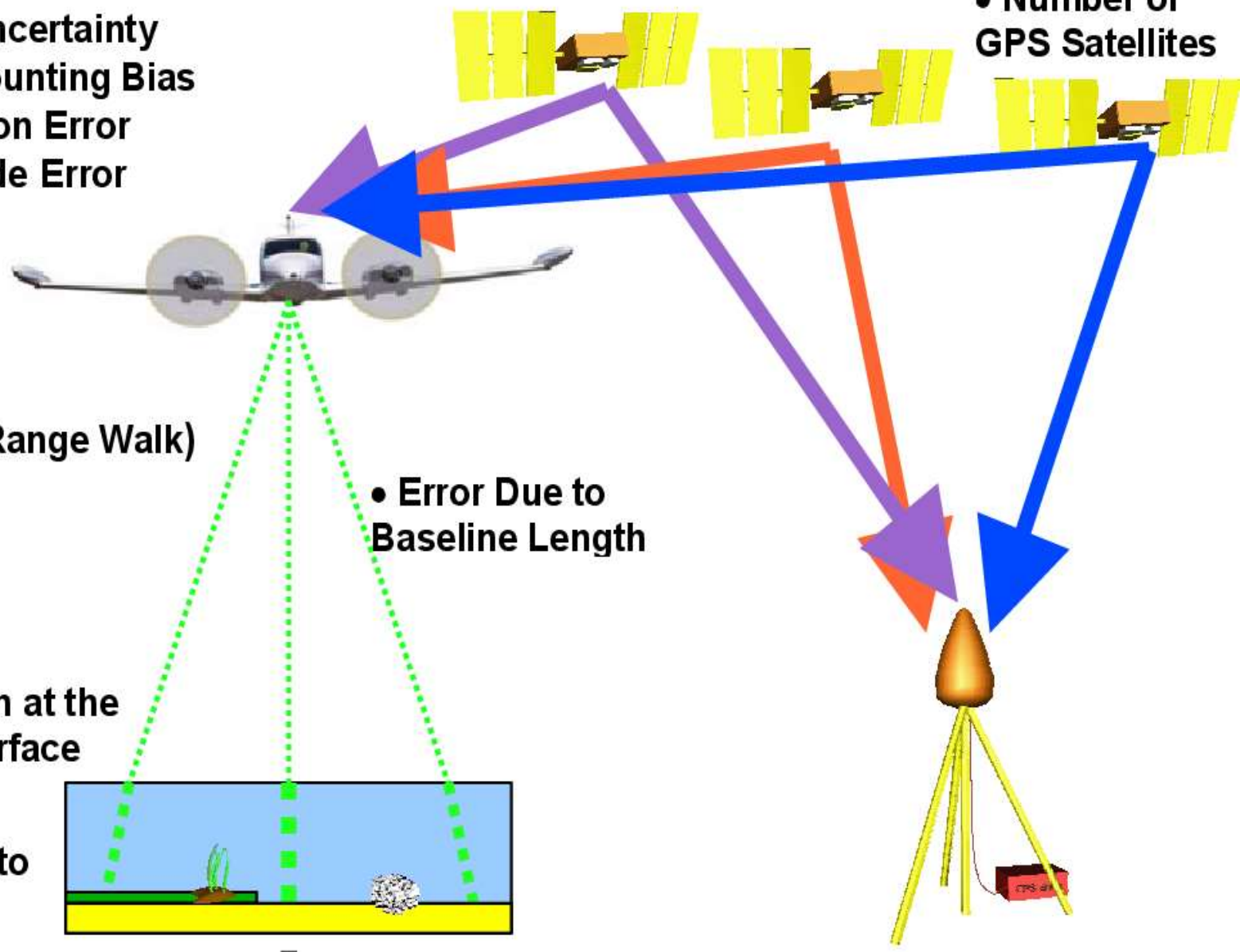


LIDAR OBSERVATION



Scan Angle Uncertainty
Instrument Mounting Bias
Aircraft Position Error
Aircraft Attitude Error

• Number of GPS Satellites



• Range (Range Walk) Error

• Error Due to Baseline Length

• Refraction at the Water Surface

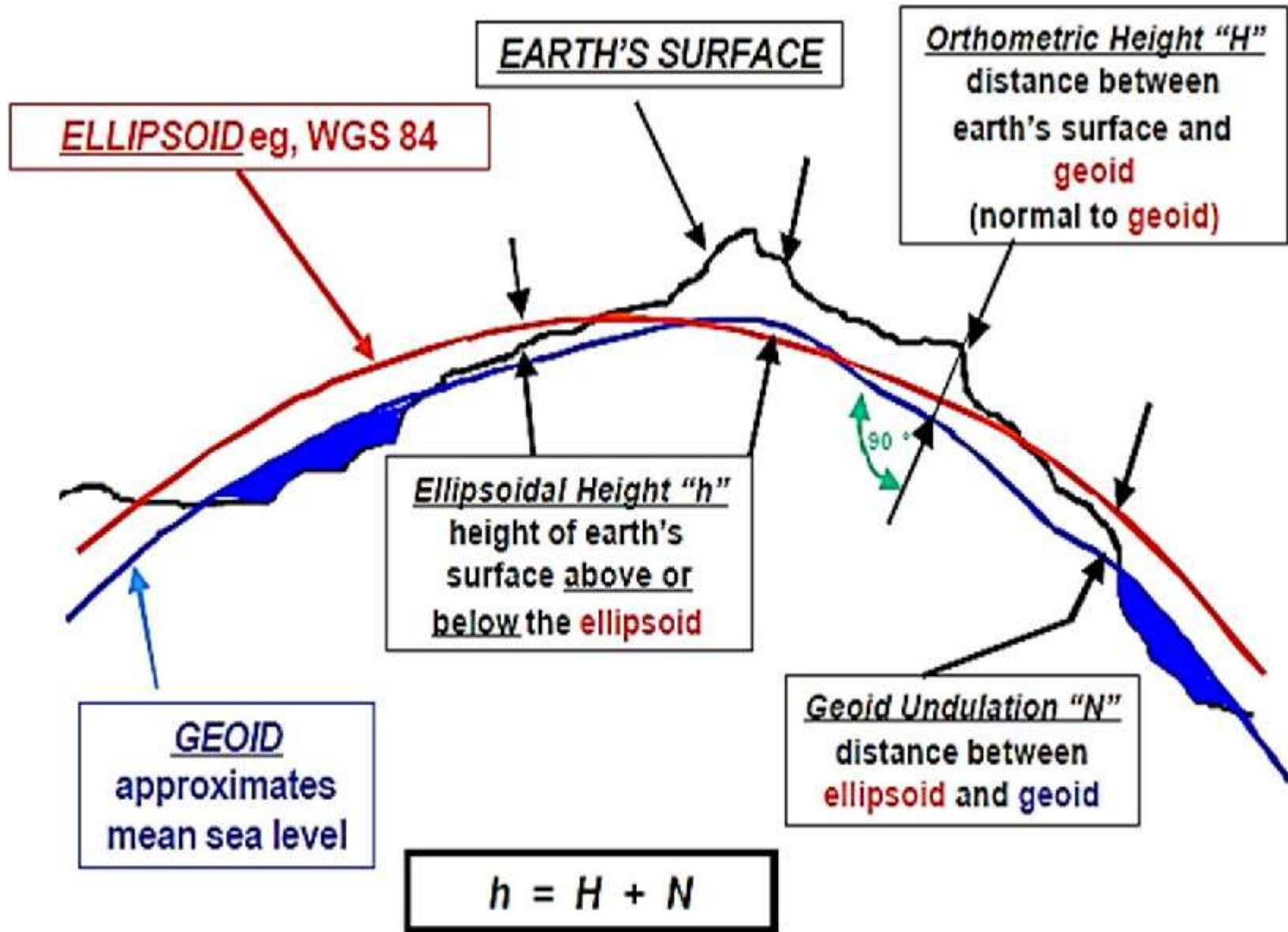
• Error Due to Spot Size

• Local Geoid Error

• CONVERSION TO NATIONAL VERTICAL DATUM

ELEVATION

CONVERSION OF ELLIPSOIDAL TO ORTHOMETRIC HEIGHT



STOKES' FORMULA

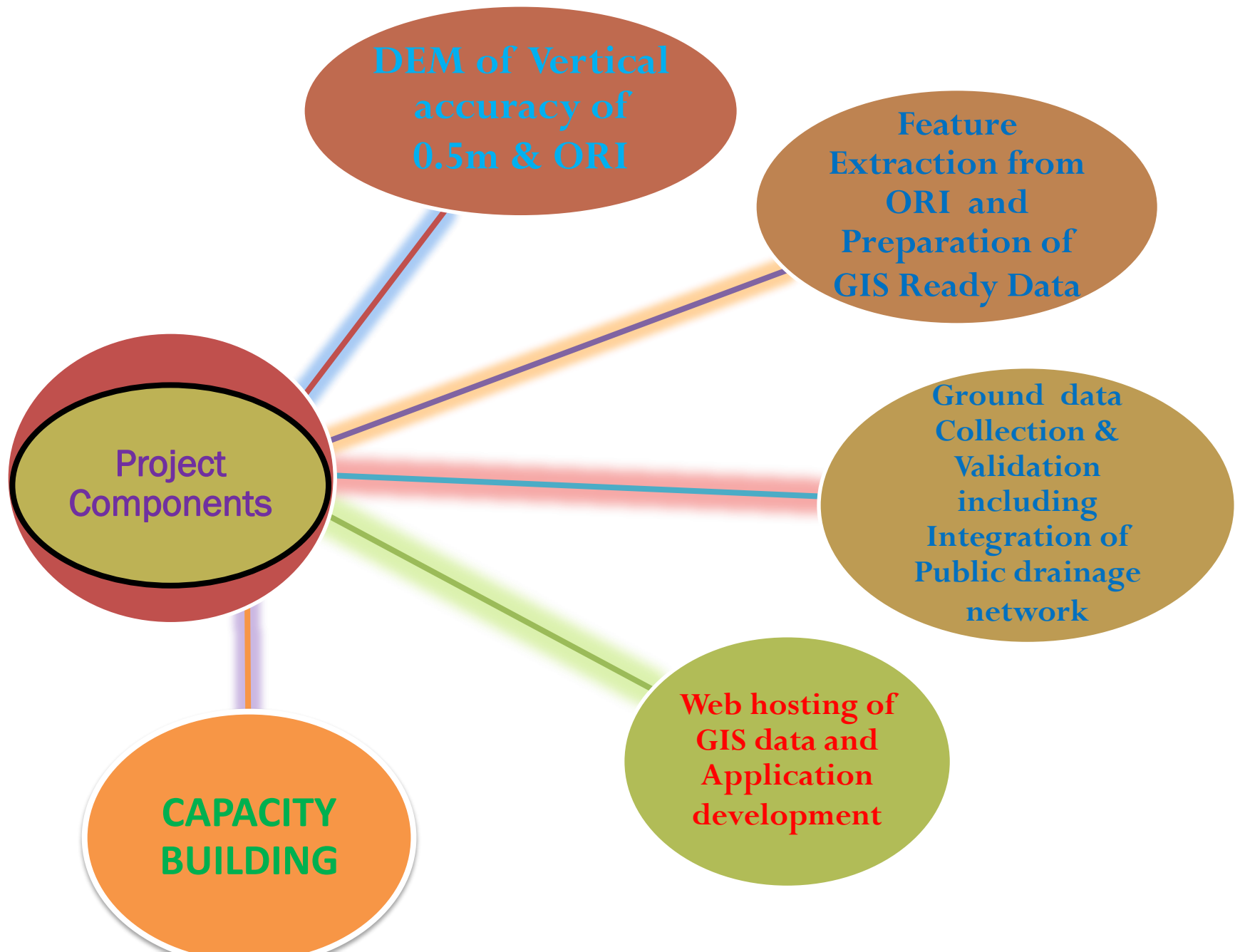
- Stokes' formula states that geoidal height and gravity anomaly at any point on the Earth's surface are related as:

$$N(\theta, \lambda) = \frac{R}{4\pi\gamma} \iint_{\sigma} \Delta g(\theta, \lambda) S(\psi) d\sigma$$

Stokes' original theory is based on the assumptions:

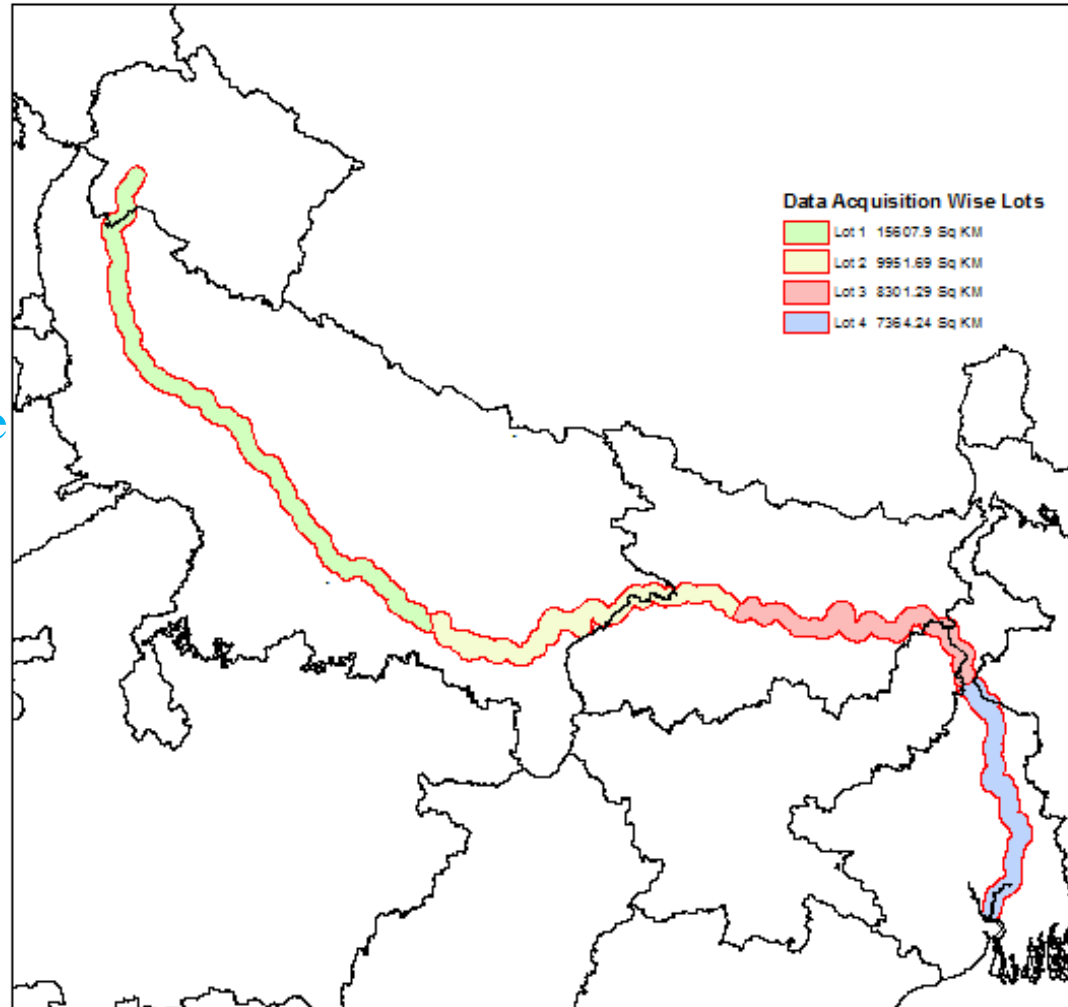
1. Earth mass equals that of reference ellipsoid.
2. Geoid potential equals ellipsoid surface potential.
3. The ellipsoid is geocentric.
4. Gravity data are available over the entire earth.
5. No masses exist external to geoid.

NMCG- PROJECT IN SURVEY OF INDIA



Project Area

- Total Area $\approx 43,084 \text{ km}^2$ along Ganga
- Fresh Survey & Mapping for $\approx 22892 \text{ km}^2$ area will be undertaken for generation of DEM, Ortho-Rectified Image (ORI)
- Balance area of 19107 km^2 will be covered under NHP project



DEM CREATION

Data acquisition
using suitable
sensors on Airborne
Platform for
generation of high
resolution DEM and
ORI

Development of Geoid
Model for Project Area

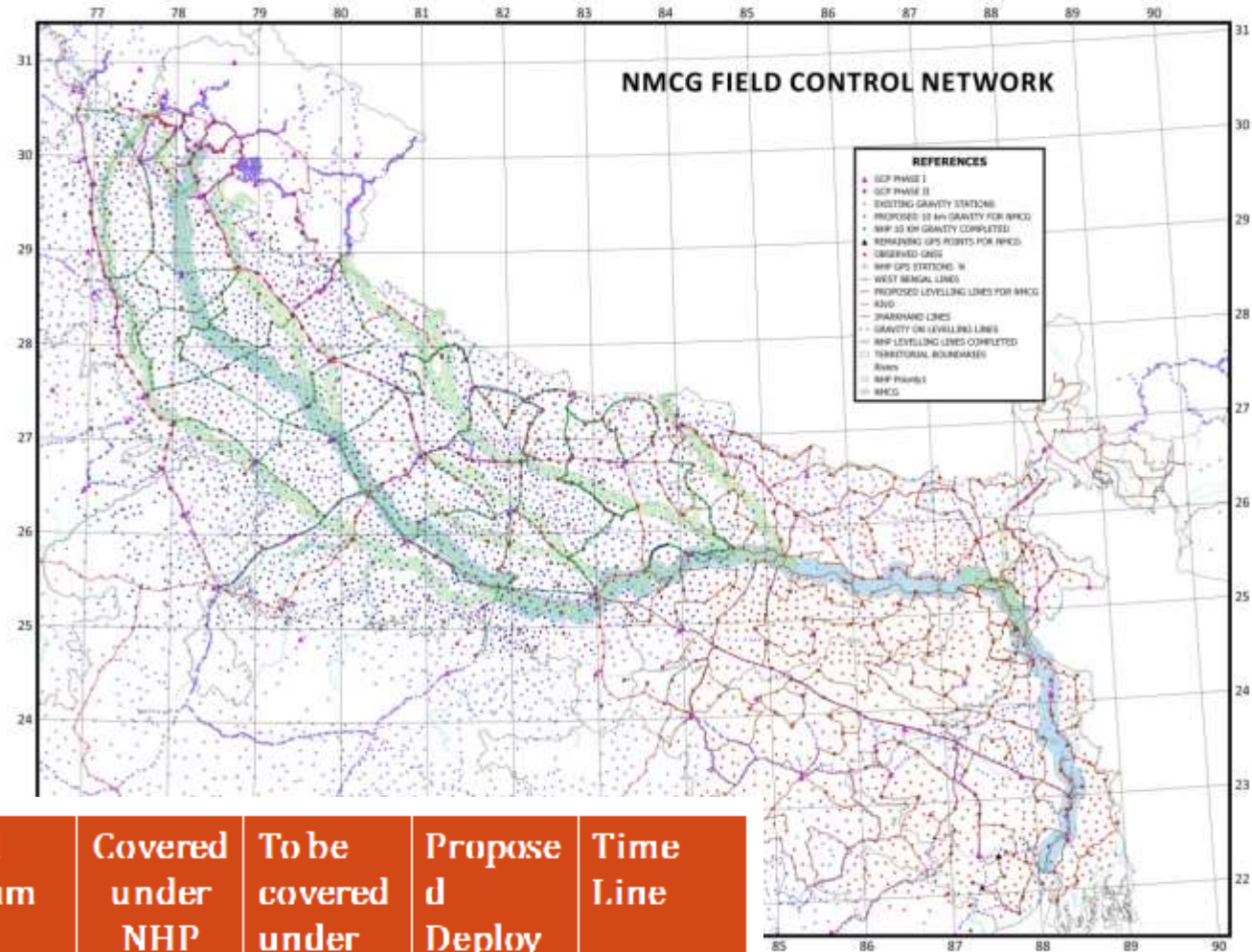


Gravity
Observation

High Precision
Levelling

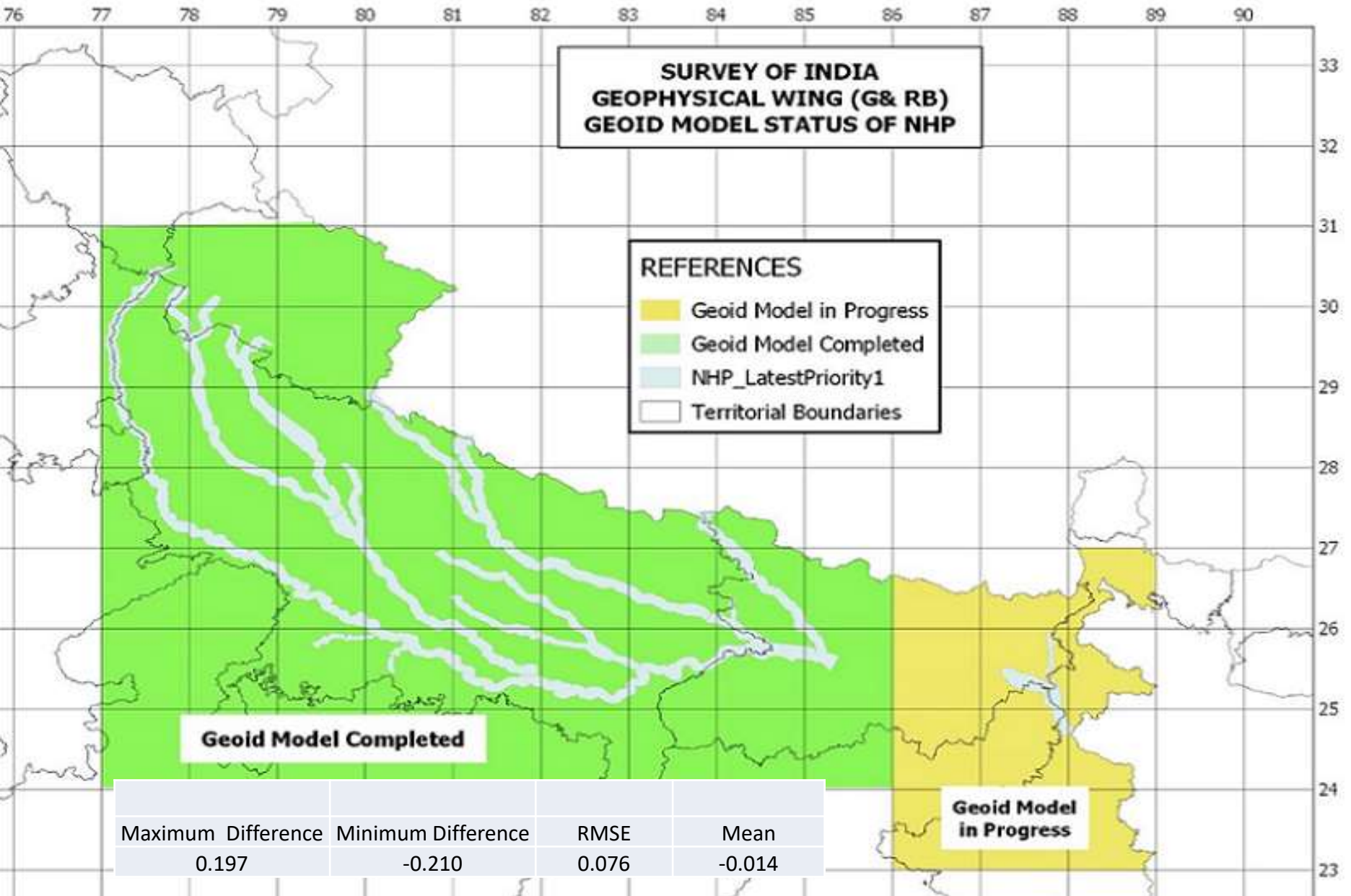
GNSS
Observation

Field Plan for Development of Geoid Model



Sl no	Field Work	Total Quantum	Covered under NHP	To be covered under NMCG	Proposed Deployment	Time Line
1	Gravity Observation	5000 Points	2500 Points	2500 Points	3 Teams	8 Months
2	High Precision Levelling	37000 Lin Km	12000 Lin Km	25000 Lin Km	38 Teams	6 Months
3	GNSS Observation	600 points	350 points	250 points	5 Teams	6 Months

GEOID MODEL FOR NHP PROJECT



CONCLUSION

- Obtaining physical heights of points from GPS measurements using a precise geoid model in the region of study is the most advantages solution.
- A precise geoid model meant for routine applications of geodesy and surveying
- Geoid models play an important role in deriving flood plain maps because water flows downhill relative to the undulating geoid surface.
- Results have shown that the Gravity measurements are a promising new hydrological tool to monitor the hydrological systems effectively.



Thank
you