



The Next Generation of Geomatics Practitioners



Integrating Geodesy, GNSS, GIS, Remote Sensing and Geospatial Data Science

A Student's Perspective

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One profession — an expanding skillset



The opportunity is not to replace traditional geomatics skills, but rather to connect them.

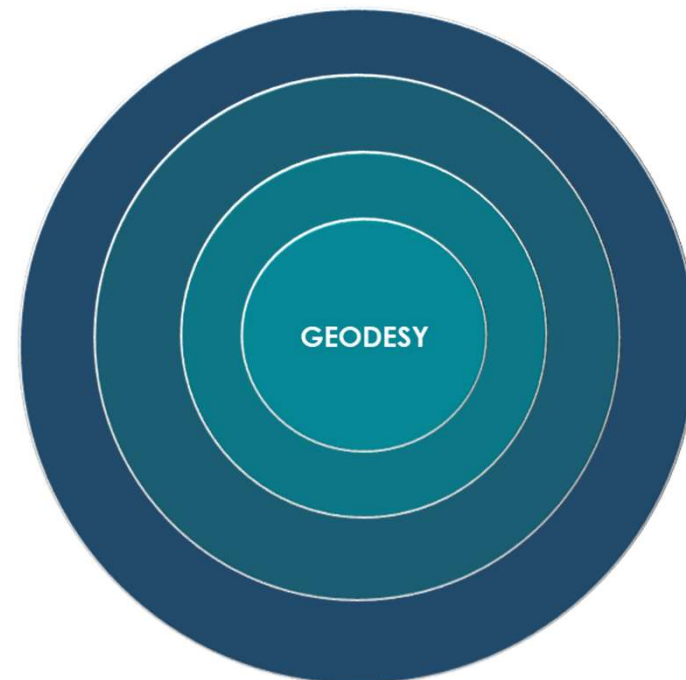
The modern practitioner works across measurement, reference, integration, analysis and communication.



● Geodesy is the foundation

Every advanced geospatial workflow still depends on a trusted answer to: Where is it?

- 01 **Reference frames**
Provide the stable spatial framework
- 02 **Datum & coordinate systems**
Give coordinates their reference and meaning
- 03 **Transformations**
Connect data expressed in different systems
- 04 **Uncertainty**
Shows how confidently position is known
- 05 **Infrastructure**
Makes positioning repeatable and nationally consistent



- **A coordinate is not just a number**

- **What gives a coordinate meaning**

Position — latitude, longitude, height

Reference — datum, frame, epoch

Projection — grid, zone, central meridian

Quality — σ , confidence, residuals

- **Before comparing coordinates**

Identify the coordinate system

Check datum and reference frame

Check epoch where relevant

Confirm projection parameters

Compare positional quality / uncertainty

Different coordinate systems can describe the same physical point, but their numerical values are not directly comparable.

● A practical geodesy exercise 1

A practical chain from national geodetic infrastructure to a defensible final coordinate.

TrigNet CORS → GNSS processing → baseline modelling → quality assessment → coordinate transformation

- TrigNet CORS — 24 h L1/L2 RINEX data
- GNSS processing — AUSPOS / reference stations
- Baseline modelling — double differences, ambiguity and atmosphere
- Quality assessment — precision, reliability and least-squares adjustment
- Transformation — geographic coordinates to Gauss Conformal

● TrigNet: infrastructure behind the coordinate

1

24 h L1/L2 RINEX

Dual-frequency
observations

2

CORS

Continuous reference
observations

3

Processing

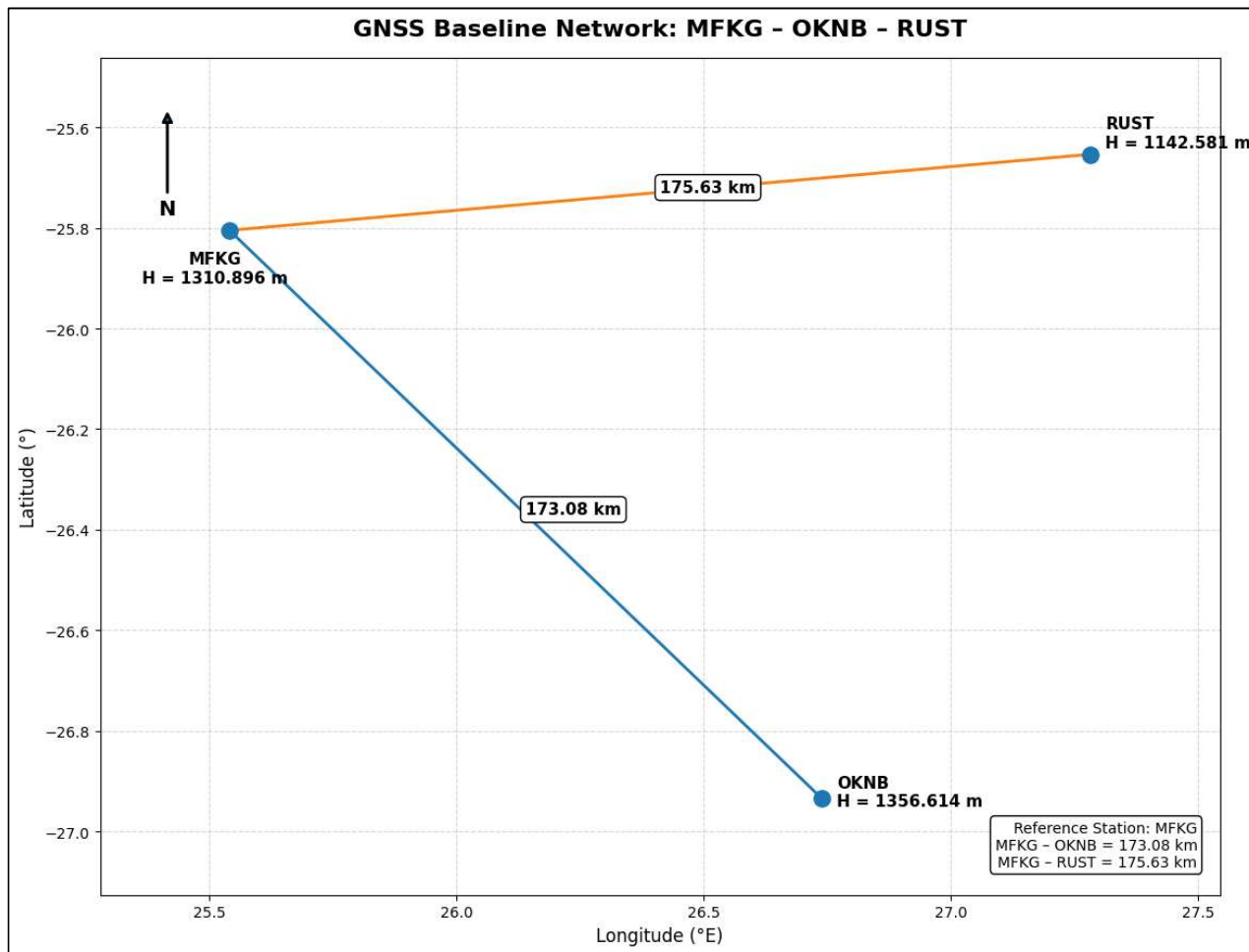
Reference stations +
precise processing

4

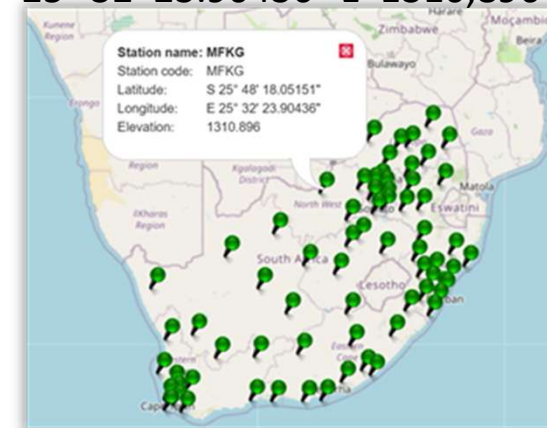
National value

Supports surveying,
mapping & spatial
information

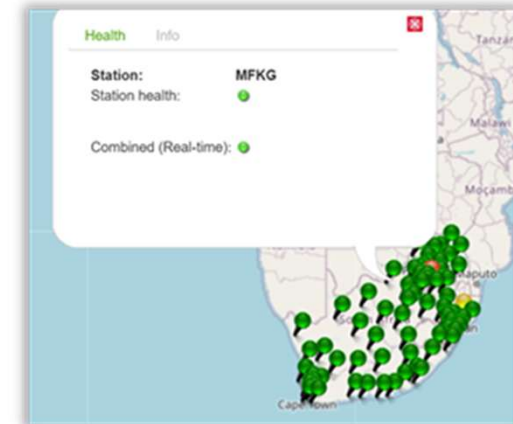
● CORS station of choice



MFKG 25° 48' 18.05151" S
25° 32' 23.90436" E 1310,896 m



Healthy, no reported outages



AUSPOS



24h hour period

Reference Data Shop - Date & Time Selection

You have selected the following reference station(s):
(MFKG) MFKG

Please enter your desired observation period:

Observation Period	
Date:	01/04/2026
Start time:	06 h 01 m 0 s
Duration:	24 h 00 m
Interval:	30 s
Time system:	GPS

<< Back: Reference Stations Next: Add to order >>

2880 observations over the 24 hours
32 GPS and 24 GLN geometry

Reference Data Shop - Your current Order

The following items are currently in your order. You may add further items, remove items or proceed with delivery options and data generation.

Station	Start time	End time	Duration (min.)	Interval (sec.)	Epochs	Est. Price*
(MFKG) MFKG	01/04/2026 06:01	02/04/2026 06:01	1440	30	2880	0.00
Total:			1440		2880	0.00

Applying to selected item: [More data for station](#) [More data for time period](#) [Remove](#)

Login used for this order: TALEfenyo

[^ Back to Overview](#) [Cancel order](#) [Add more stations](#) [Next: Delivery Options >>](#)

A 24-hour GNSS observation period improves positioning accuracy by increasing satellite availability, reducing atmospheric and multipath effects, improving ambiguity resolution, and providing more redundant observations (Janssen & McElroy, n.d.)

● Accuracy and quality assessment



Final Results for: MFKG

ITRF2014 @ epoch 2010.00		
Measurement method: Antenna Ground Point (AGP)		
Geoid model: South Africa Geoid 2010		
Coordinate	Value	σ [m]
X [m]	5185375.399	0.001
Y [m]	2477739.378	0.001
Z [m]	-2760200.968	0.001
Latitude	25° 48' 18.05166" S	0.001
Longitude	25° 32' 23.90420" E	0.001
Ellipsoidal height [m]	1310.898	0.001
Orthometric height [m]	1284.807	0.001

+/-0.001m accuracy for the latitude, longitude and ellipsoidal height, which is 1σ . At 95% confidence level +/-0.002m (HIGH PRECISION)

Baselines

Station Code	Distance [km]	Observations (# total / # usable / # used / %)	Used satellites
MFKG	0.00	85736 / 2858 / 2858 / 100%	32 GPS / 24 GLN
OKNB	173.08	85872 / 2862 / 2858 / 100%	32 GPS / 20 GLN
RUST	175.63	85551 / 2852 / 2851 / 100%	32 GPS / 20 GLN

Ambiguity Resolution report is 100% of all usable observations being used for the computation of the observed station, and a millimetre accuracy fixing.

OKNB had 85872 observations, 2858/2862 usable observations. While RUST had 85551 observations, 2851 used out of the 2852 usable ones. Therefore, the longer observation period supported improved satellite geometry, atmospheric modelling and ambiguity fixing.

LSA accuracy assessment can be done by employing statistical evaluations to estimate precision and uncertainty, resulting in the quality assessment of the computed position. (Ogundare,2018; Zhou,et.al.,2016)

● Coordinates Transformation



AUSPOS Geographic Coordinates Transformed using CDNGI Coordinate Conversion Utility
v1 Sept 2009

Datum Used: Hartebeesthoek 94 (WGS84 Ellipsoid) [Click here to](#)

Geographical -> Gauss Conform, Transverse Mercator, Universal T

Name	Geographical				Gauss Conform			Transverse Mercator		
	Latitude (S)			Longitude (E)			Ellipsoidal height (m)	y (m)	x (m)	CM (Lo)
	dd	mm	ss.ssss	dd	mm	ss.ssss				
Example	33	01	0.0000	23	12	0.0000	12.000	-18687.144	3654614.225	23 E°
MFKG	25	48	18.0517	25	32	23.9042		-54150.336	2855343.873	25 E°

GEOGRAPHIC COORDINATES

Latitude = -25.8050143083°
Longitude = 25.5399734333°

STANDARD TRANSVERSE MERCATOR

Easting = 54,150.340 m
Northing = -2,855,343.868 m

GAUSS CONFORM Lo25

y = -54,150.340 m
x = 2,855,343.868 m
h = 1,310.898 m

'A coordinate has a lineage.
Accuracy must be demonstrated.
Reference systems matter.
Infrastructure and computation are
inseparable.' TA

● Direct and inverse geodetic computation

To determine the coordinates of an unknown station ST1X from the known station ST1 $32^{\circ}22'48.74479''$ S, $20^{\circ}48'37.67911''$, using a known distance 18,425.650 m and forward azimuth $132^{\circ}18'24.50''$, and then verify the result through an inverse calculation. Assumed spherical radius $R = a = 6\,378\,137\text{m}$

1. Prepare the angular observations, DMS $\rightarrow$ DD $\rightarrow$ rad
2. Direct geodetic computation
3. Reverse direction
4. Independent distance check

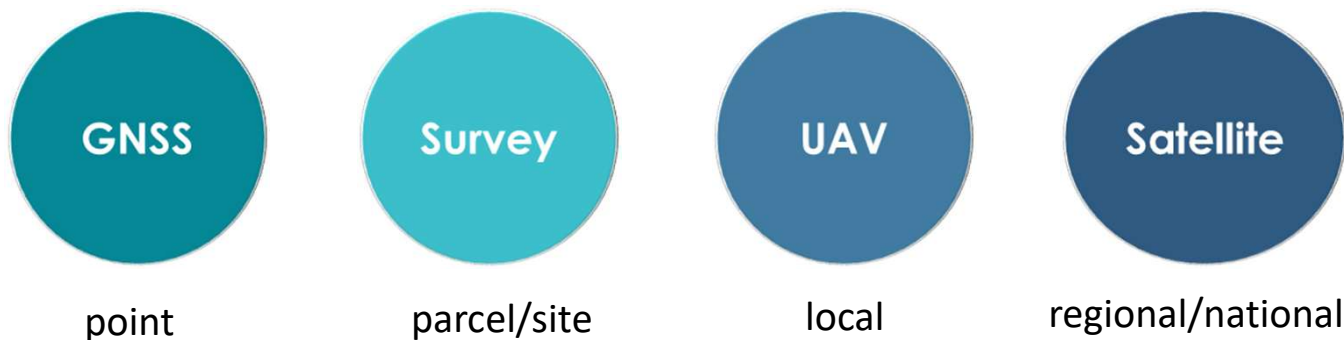
Known coordinate + azimuth + distance $\rightarrow$ calculate new coordinate $\rightarrow$ reverse the calculation $\rightarrow$ check the result

Inverse-calculated distance= 18,425.800 m, **Difference approximately 0.150 m**



Future practitioners need to understand the mathematics behind coordinates, not simply obtain positions from GNSS receiver screen.

- **Remote sensing expands the scale. Geodesy preserves trust**



- **What this shows**

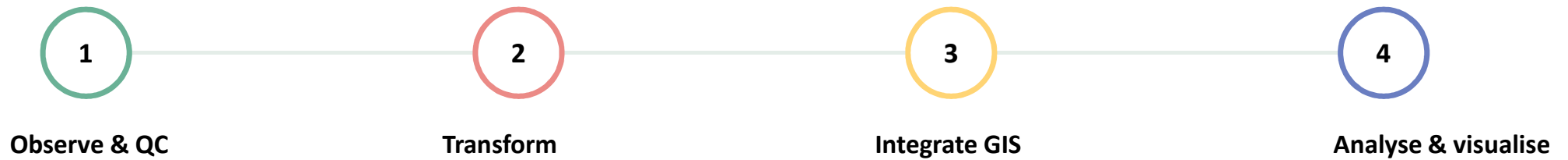
Scale changes from point observations to regional Earth observation. The need for georeferencing, positional accuracy and coordinate reference integrity does not.

Earth observation can cover provinces in minutes; reference systems keep those observations spatially meaningful.
Scale changes. The need for positional integrity does not.

● Python: from manual calculation to reproducible workflow



Understand the mathematics first, then automate repetitive calculations, consistent quality checks and large spatial workflows transparently.



● Geospatial data science: the next analytical layer

From measuring location to explaining spatial patterns.

Possible applications

Land administration

Deformation monitoring

Infrastructure

Agriculture

Environmental change

Spatial planning

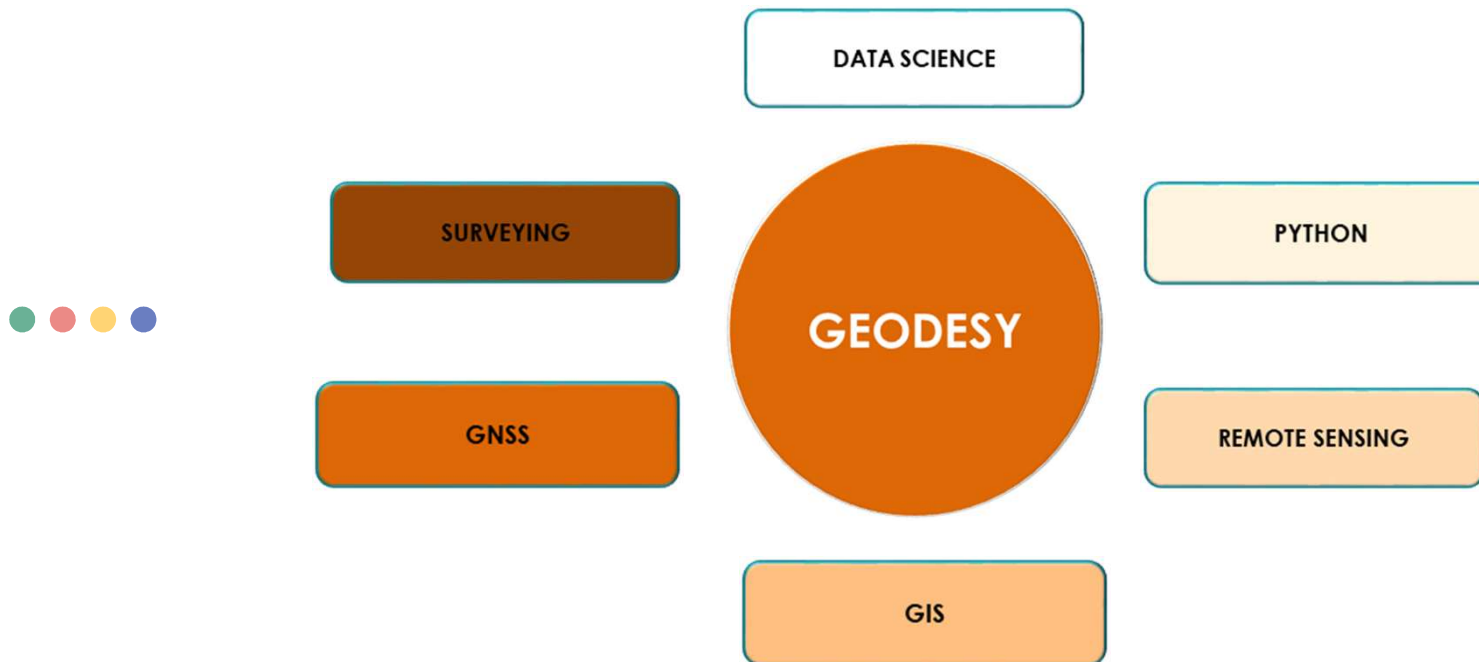
Balanced capability model for emerging Geomatics Practitioners



The next generation needs literacy across geodesy, GNSS, surveying, GIS, remote sensing, programming, data science and communication, good enough to work in integrated teams and interrogate data quality.



Building the Next Generation



Build the infrastructure. Build the skills. Keep geodesy at the foundation.



Thank you 😊

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