



FIG Working Week 2024

19-24 May

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A New Reference Fame for Oman, Derived by Precise Processing of the CORS Network

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History of Reference Frames in Oman

- Fahud
 - Single point
- WGS84
 - ITRF89
- ONGD14
 - One week of GNSS observations at each site
 - ITRF08 @2014.0
- ONGD17
 - One week of GNSS observations at each site
 - ITRF14 @2017.0

SULTANATE OF OMAN
(Shows Height below sea level)

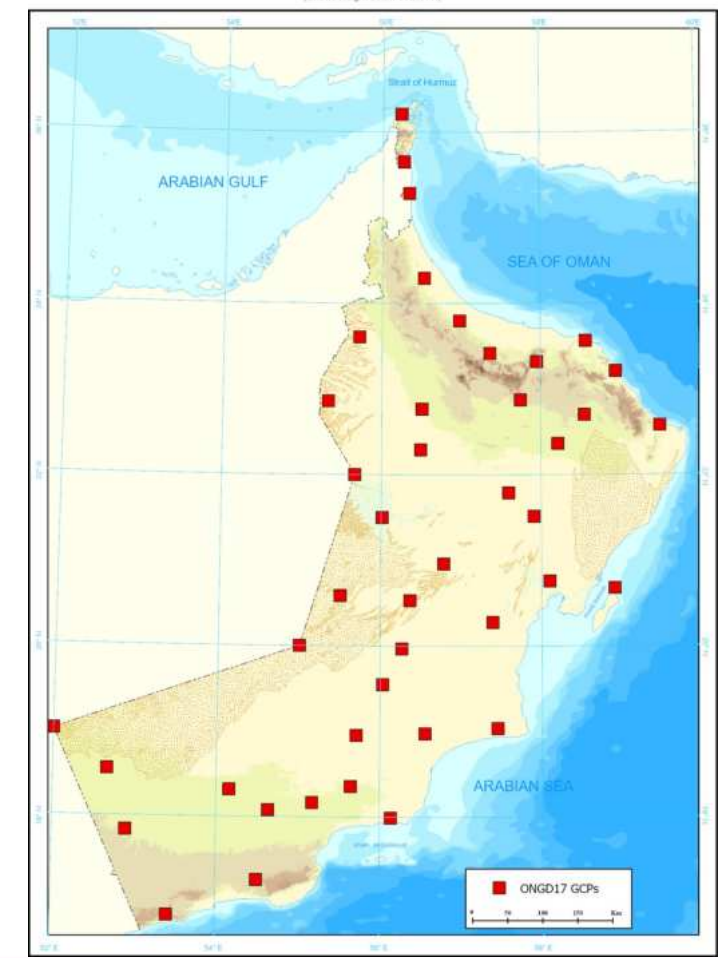




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Why a New Reference Frame?

- Reference frames **should be updated** regularly in order to keep up with the earth's surface motions, mainly due to tectonics
- This is the first reference frame in Oman that includes **epoch and velocity**, position can be calculated at any time:
- Local surveyors do not need to take care of **time** in an up-to-date reference frame

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Oman CORS Network

- 47 sites across the Sultanate
- Established mid-2016
- With stable site structures
- Geodetically precise instrumentation
- Originally as a reference network for Surveying and Mapping
- Results show higher precision than required for Surveying reference

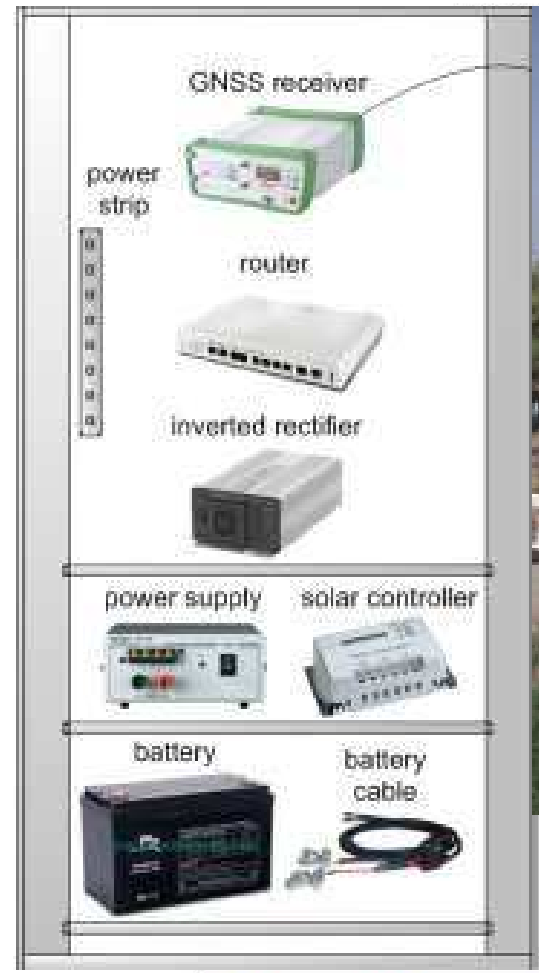




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Goal: New Reference Frame ONGD23

Method:

1. Calculate *Velocity* field of a combined network of CORS and IGS sites in ITRF20
2. Define *Oman block* with well behaving Oman CORS sites
3. Calculate positions for *epoch 2023.0*
4. Realize a *new reference frame* that rotates with Oman block in ITRF20, so that
 - Velocity field is *minimized*
 - Residual velocities = *deformation*
5. Solve for *transformation parameters* of the old RFs

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1. Combined Network of CORS and IGS Sites

We processed a network of

- 47 Oman CORS and
- 26 IGS

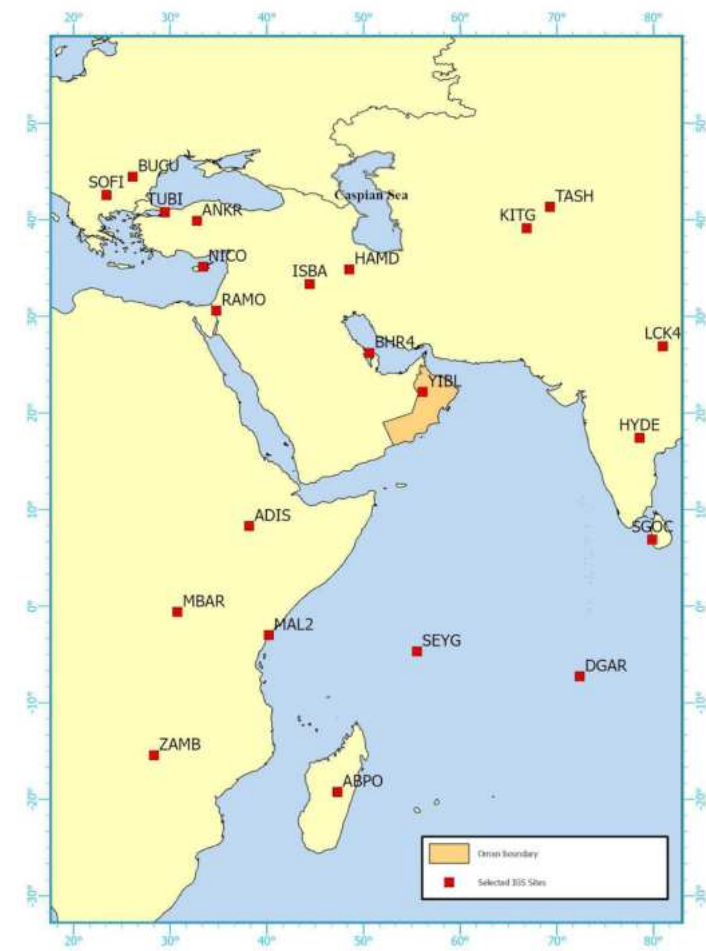




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Results of the Combined Network in ITRF20

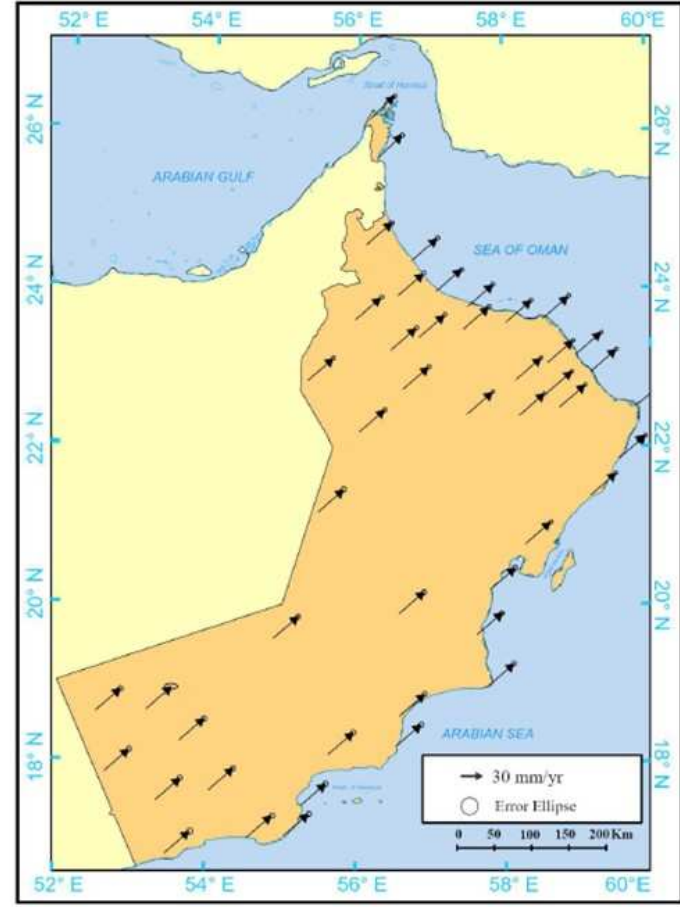
Average Horizontal Motion:

- 35 mm/yr East Direction
- 33 mm/yr North Direction

Average Vertical Motion:

- 1.5 mm/yr Uplift

Horizontal velocity



Vertical velocity

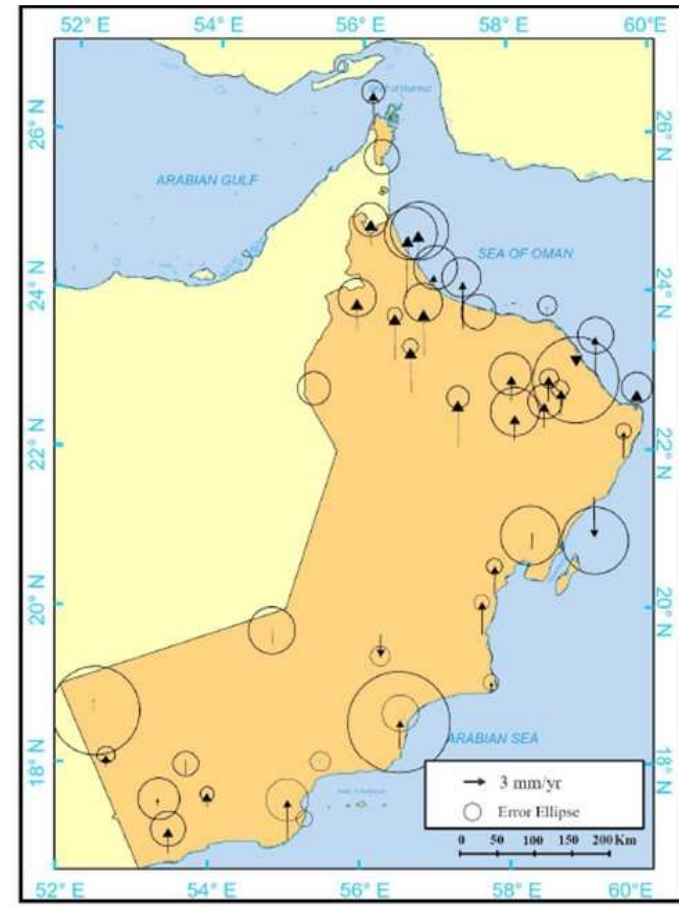




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2. Oman Block

Oman block is established by well-behaved CORS sites.

We should minimize the horizontal velocity field of this block.

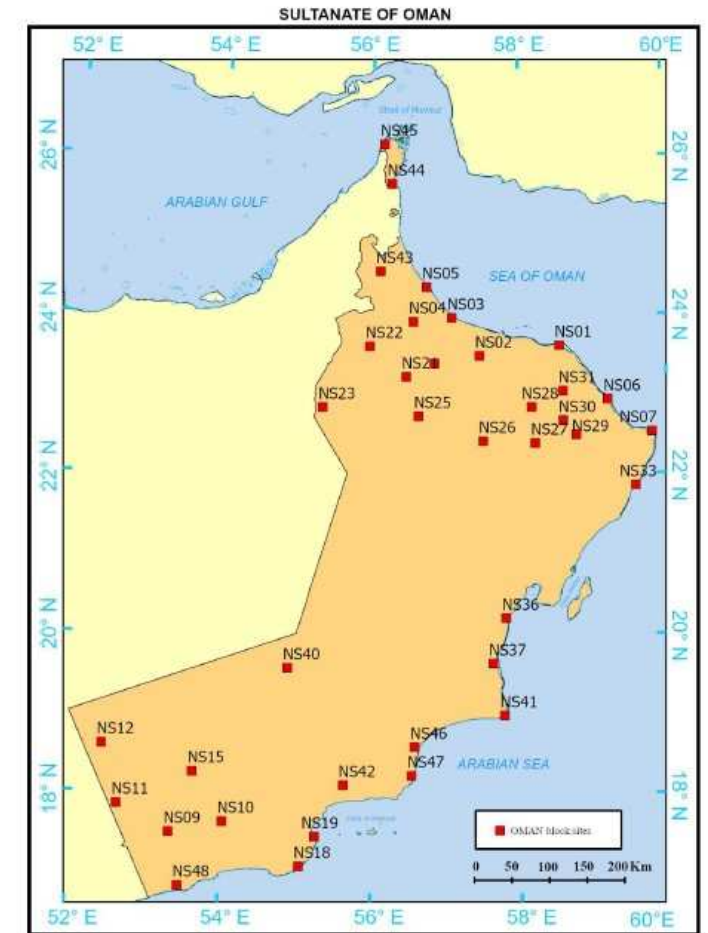




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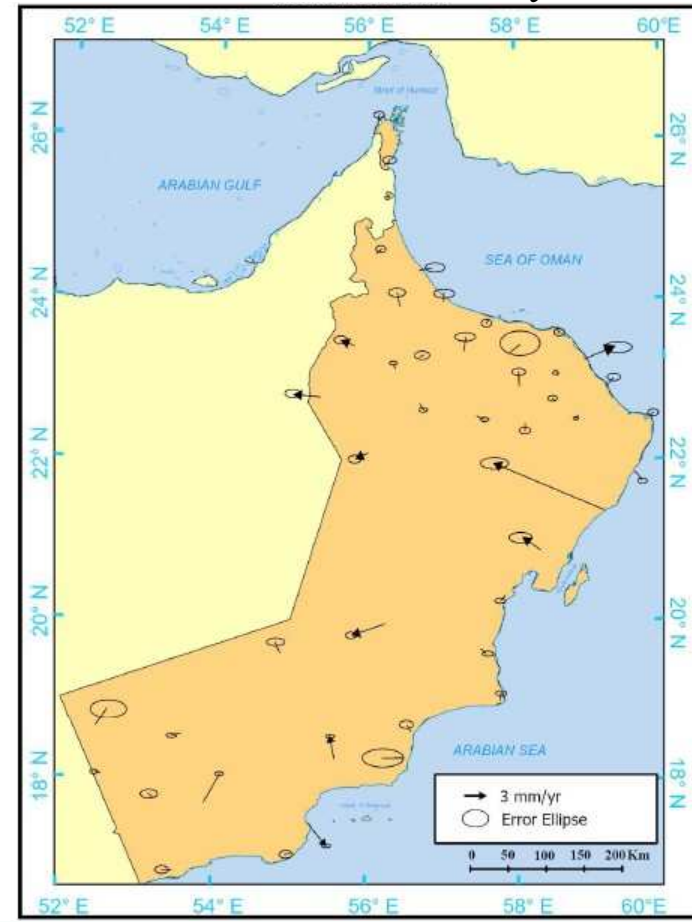
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Results: Velocity in ONGD23

$$V = V_{def} + V_{rigid}$$

- Rotate ITRF20 to minimize the horizontal velocity field
- Velocities in a local frame with the selection criteria directly presents block-internal-deformation

Horizontal velocity



Vertical velocity

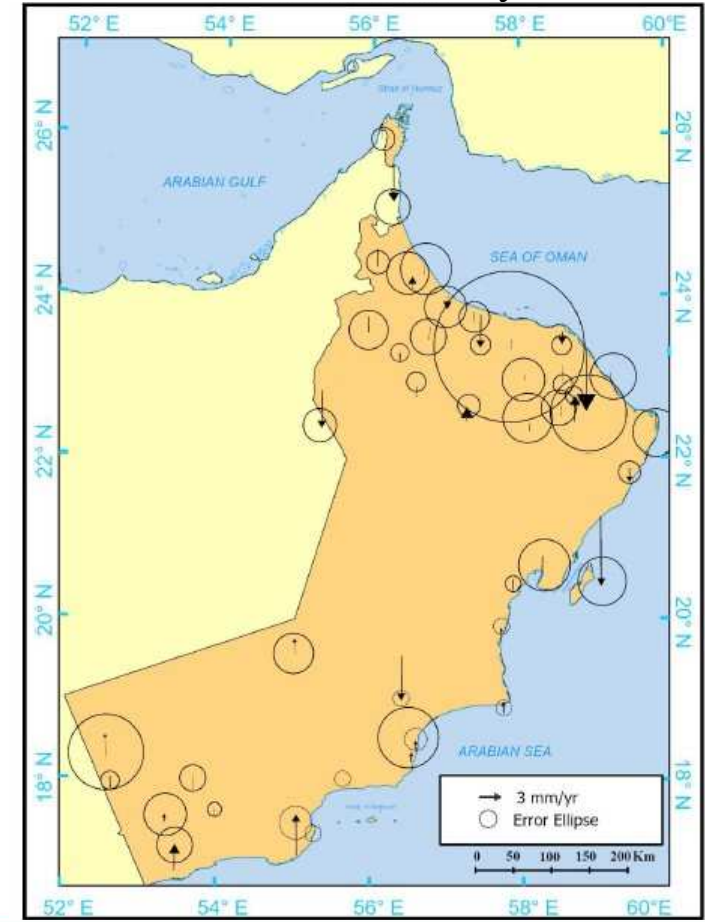




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4. Transformation Parameters

1. ONGD17 to ONGD23

$$T_x = 0.2171 \pm 0.1305 \text{ m}$$

$$T_y = -0.2409 \pm 0.1247 \text{ m}$$

$$T_z = 0.1157 \pm 0.1030 \text{ m}$$

$$R_x = -0.8316 \pm 3.7495 \text{ mas}$$

$$R_y = 3.2598 \pm 2.5239 \text{ mas}$$

$$R_z = -20.2781 \pm 4.9861 \text{ mas}$$

$$\delta s = -1.6731 \pm 11.6012 \text{ ppb}$$



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Summary and Conclusion

- ONGD23 is the first reference frame of Oman that considers *earth surface motion*, by including *velocity as well as epoch*.
- Local surveyors do not need to take care of *time*.
- *Transformation residuals* of the older frames to ONGD23 are negligible.

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SUSTAINABLE DEVELOPMENT GOALS

International Federation of Surveyors supports the Sustainable Development Goals

Commission

Commission's name

Serving Society for the Benefit of People and Planet

