

Simple Precise Coordinates Transformations for Geomatics Applications in Makkah Metropolitan Area, Saudi Arabia

G. Dawod^{}, M. Mirza^{*}, and K. Al-Ghamdi^{*}**

^{*} Center of Research Excellence in Hajj and Omrah, Umm Al-Qura
University, Saudi Arabia

^{**} Survey Research Institute, Giza, Egypt

Saudi Arabia

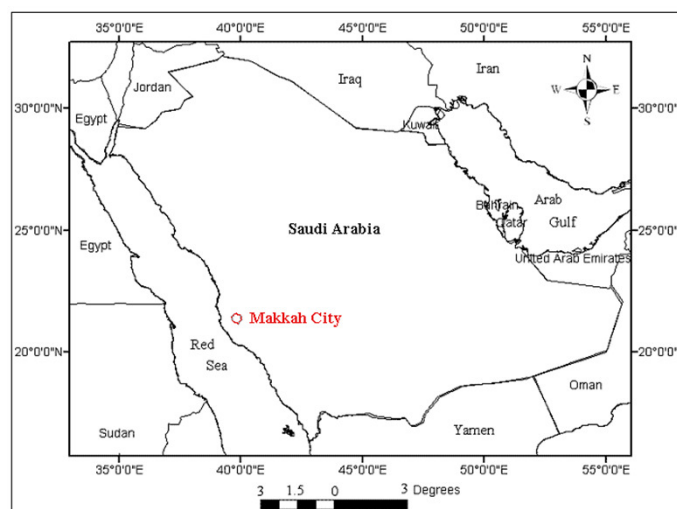
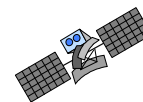


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Geomatics in Saudi Arabia



Wide spread of technologies' utilization for development activities in governmental and private sectors:

- Global Positioning System: **GPS**
- Geographic Information Systems: **GIS**
- Remote Sensing: **RS**
- Surveying and Mapping

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Geodetic Datums in Saudi Arabia



- **Current:** ***Ain El-Abd 1970***
- **Future:** ***SGD2000***

Datum Name	Ain El-Abd 1970	SGD2000
Reference Frame	N/A	ITRF2000
Coordinates Epoch	N/A	2004.0
Ellipsoid	Hayford 1909	GRS80
Map Projection	UTM	UTM

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Published Datums Transformation Parameters for Saudi Arabia



- By USA DMA
- Utilized in several commercial software:

System A	WGS 84
System B	Ain El-Abd 1970
Shift X	- 143 10 m
Shift Y	- 236 10 m
Shift Z	+ 7 10 m

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Objectives

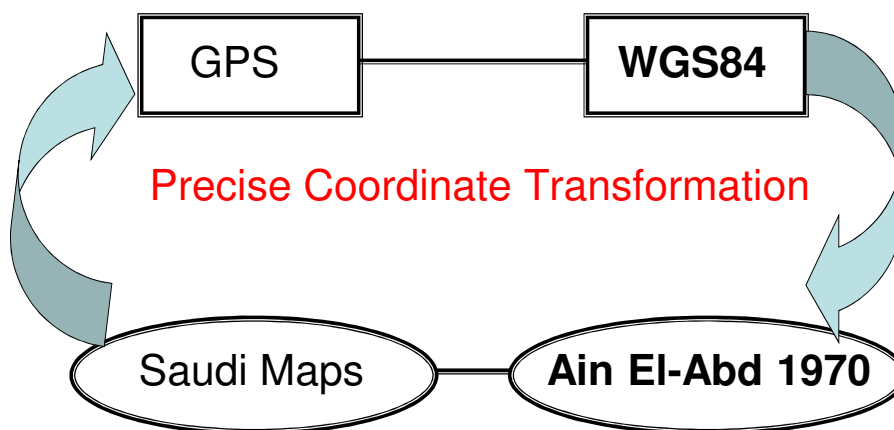


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Study Area

Makkah city:

- Most important city for Muslims all over the world
- Fast development, many surveying, mapping, GIS activities

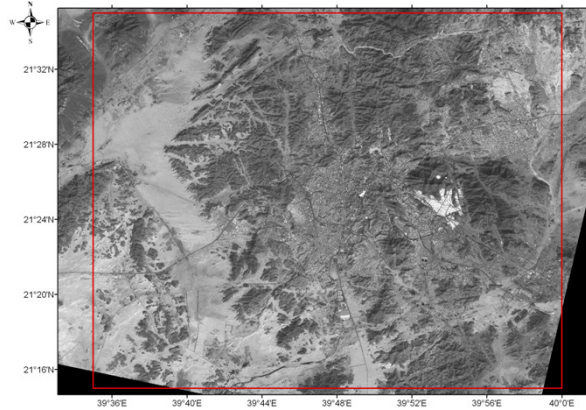


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Methodology

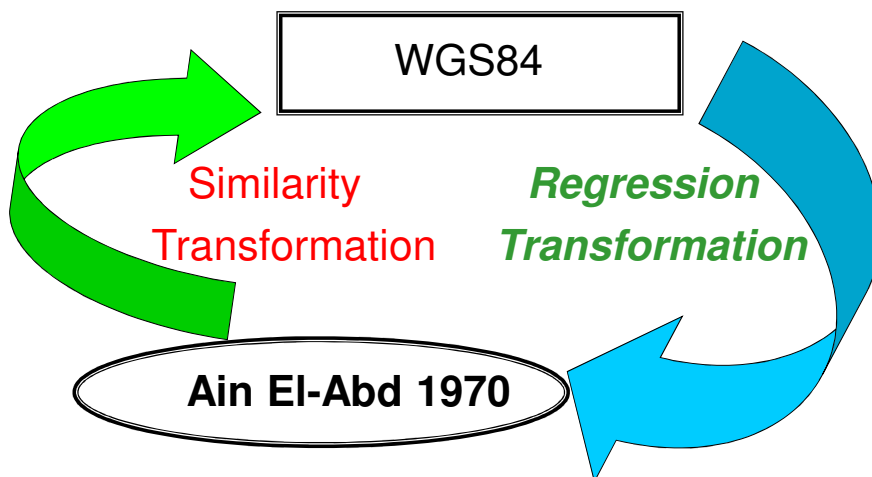


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Available Data

13 precise GPS/National stations:

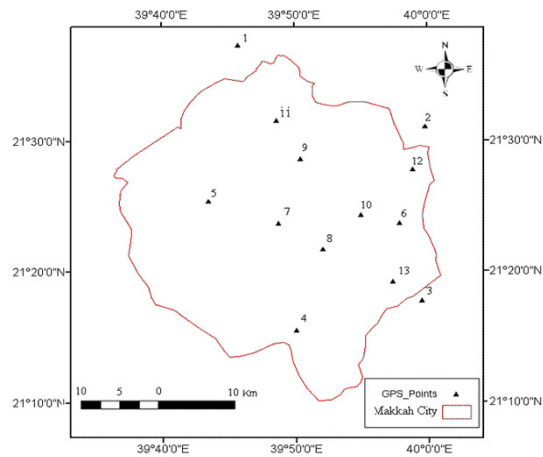


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Results

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Molodensky-Badekas Similarity Transformation

X_o	4559545.892 m
Y_o	3808252.221 m
Z_o	2314350.329 m
Shift X	41.650 m
Shift Y	286.321 m
Shift Z	89.132 m
Rotation X	-1.91577 "
Rotation Y	10.28662 "
Rotation Z	-14.08571 "
Scale Factor	-7.1256 ppm

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Results

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Regression formulas:

- **Geodetic:**

$$\Delta\varphi = - 0.001043117 + 0.0000208 \varphi_{84}$$

$$\Delta\lambda = - 0.003703158 + 0.0000462 \lambda_{84}$$

- **Projected:**

$$E_{\text{local}} = - 199.224 + 0.00000490 E_{84}$$

$$N_{\text{local}} = - 112.363 + 0.00000623 N_{84}$$

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Results

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Attained Accuracy:

- Using check points:

Similarity:

Average coordinate difference' SD: **± 0.212 m.**

Regression:

Average coordinate difference; SD: **± 0.267 m.**

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Recommendations



1. Utilize computed similarity transformation parameters for GPS data.
2. Utilize computed regression transformation formulas for GIS data.

Regression:

3. *Simple still precise WGS84->Ain El-Abd 1970 datums in Makkah city, Saudi Arabia.*
4. *Methodology could be applied in other regions if data available.*

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THANK YOU

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