Slide 1

**ENHANCING THE INTEGRITY
OF THE NATIONAL GEODETIC
DATA BASES IN EGYPT**

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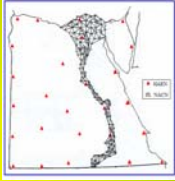Nile Research Institute

National Water Research Center

EGYPT

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Slide 2

Geodetic Data Bases in Egypt

❖ **High Accuracy Reference Network (HARN)**
❖ **1995: 30 stations, 200 Km apart**
❖ **precision 1:10,000,000**

➢ **National Agricultural Cadastral Network (NACN)**
➢ **112 stations, 50 km apart**
➢ **precision is 1:1,000,000**

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Slide 3

Objectives

❑ **H from OSU91A global geoid model**
❑ **Accuracy ≈ 1.5 m**

➢ Performance of recent global geopotential models
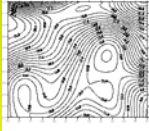❖ Analysis of local geoid models

❖ **Develop a new precise geoid**
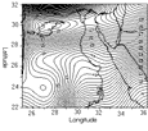
**Recent GPS net along Nile
+
New Geoid**

**more reliable H of national GPS reference
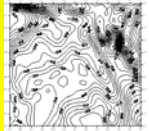framework in Egypt**

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**Recent Global Spherical Harmonic
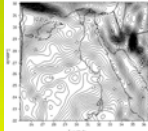Geopotential Models**

OSU91A   UCPH2002

EGM96   PGM2000A

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**Performance of Global Spherical
Harmonic Geopotential Models
over Egypt**

ΔN Over check points:

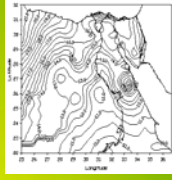|	OSU91A	EGM96	PGM2000	UCPH2002
Min	-0.53	-0.11	-0.15	-3.95
Max	-1.97	1.89	1.92	3.94
Mean	-1.53	-0.43	-0.47	1.59
RMS	1.86	0.78	0.80	2.19

➢ EGM96 is the "best" global model
➢ All models do not precisely represent the gravitational field over Egypt

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**Recent national geoid models
in Egypt**

Grav.Geoid -> GPS/Levelling -> Comb.Geoid

❖ **Saad and Dawod 2002:**

**Check: –0.01 to –0.28
mean –0.10 , RMS 0.49**

❖ **Abdel-Motaal 2002:
a single GPS point 0.09**

❖ **Hassouna 2003:
Check: –0.39 to 0.93
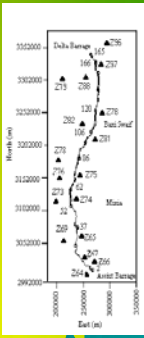mean 0.07, RMS 0.27
Data distribution**

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Available Data

□ **Hydrographic Survey of NILE**

□ Reach 4: 408 km

□ GPS control Networks:
    Int. Spec. 1st order net
    1 ppm accuracy
    168 GPS
    130 h/H

□ Tie to HARN+NACN
    20 stations
    Mean distance 5.7 km

❖ **Nile2004 Geoid**

Processing

❖ Nile2004+SRI2002 -> more reliable geoid

❖ Kriging interpolation:
$$\Delta N_{i,j} = N_j - N_i$$

❖ $\Delta h_{i,j} = h_j - h_i$

❖ $H_i = h_i - N_i$ and $H_j = h_j - N_j$

❖ $\Delta H_{i,j} = \Delta h_{i,j} - \Delta N_{i,j}$

❖ $H_{NACN} = H_{GPS} + \Delta H$

❖ Least-squares adjustment

Results

❖ H for 15 NACN points

❖ Over 5 check points:

    ΔH: from 0.06 m to 0.42 m

    Average 0.18 m   (0.80 EGM96)

    1 cm/km level of relative precision

❖ **Economical benefits**

Conclusions

✓ H of national GPS nets from OSU91A

✓ Global geoid models:
    OSU91A, EGM96, PGM2000A & UCPH2002
    Precision: 0.80 ~ 2.19 m
    EGM96 is still the **"best"** global geoid model

✓ Integrate 2 geoid models for Nile Valley
    A geoid with ≈ **5 cm** accuracy

✓ Estimated H for NACN points: **0.18** m accuracy

✓ National GPS data bases: φ, λ, h, **H**

Recommendations

➢ **Apply developed geoid in surveys of water resources management**

❖ **Apply same strategy for other NACN & HARN nets**

□ **Unify efforts ⟶ national geodetic database**

✓ **Local data in ⟶ new global geoid models**