IAV Hassan II

CRASTE-LF

Assessment of the Geometric Accuracy of GNSS-RTK for Road Pavement Monitoring

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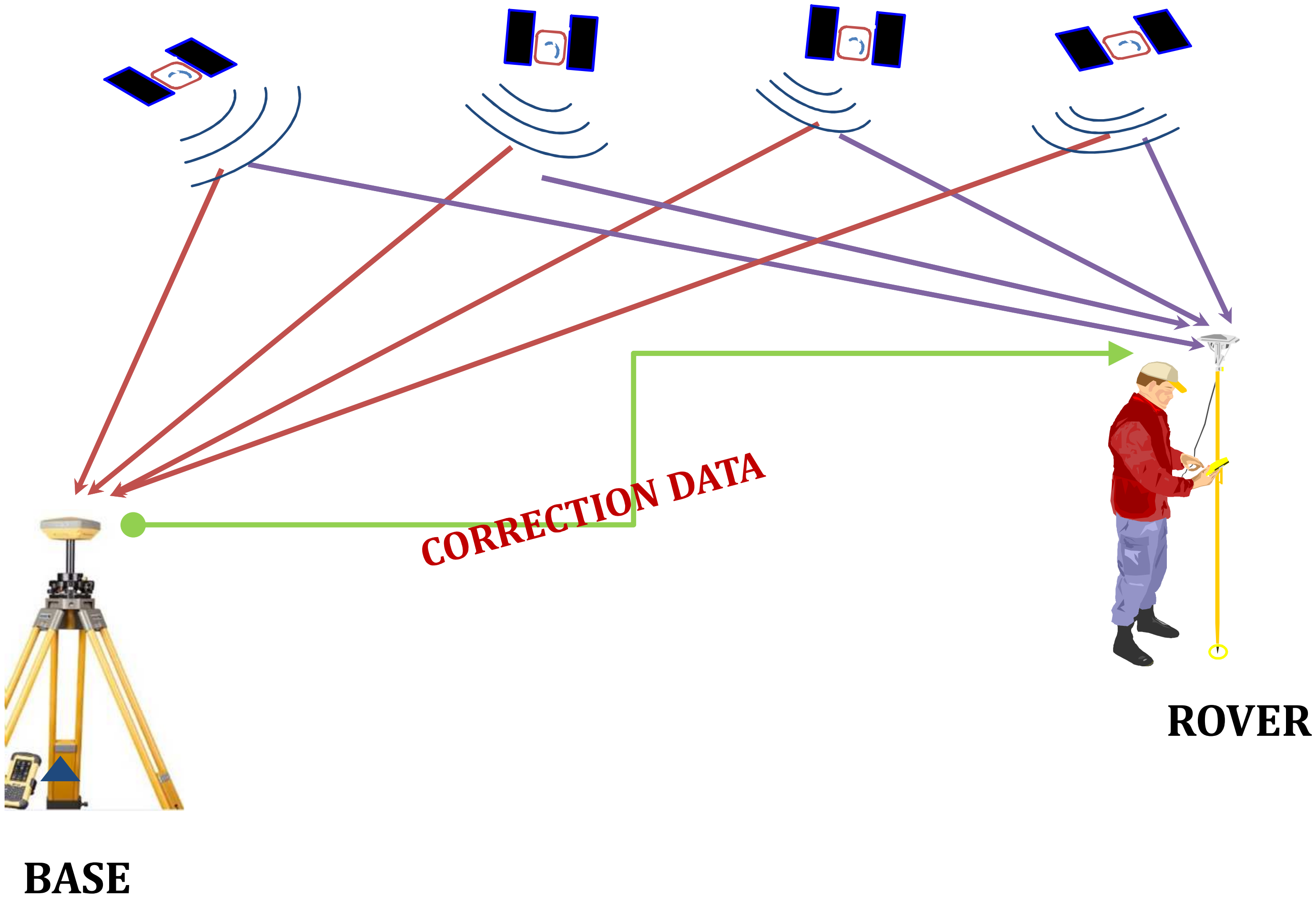
European Space Solutions, 30 mai – 03 june 2016
The Hague, The Netherlands

OUTLINE

- GNSS-RTK
- ERROR SOURCES
- EXPERIMENTATION
- RESULTS
- PRESENTATION OF CRASTE-LF

1. Principle of GNSS-RTK



2. Error Sources

- Poor satellite geometry
- Interference
- Multipath
- Communication
- Ionosphere
- Troposphere
- Reference Station

Ionospheric Effect

MAR 2015

DoY	68	69	70	71	72	73	74	75	76	77	78
Kp	8	16	15	11	11	14	19	48	39	30	28
Ap	4	9	8	6	5	6	12	108	47	26	22
Cp	0.1	0.5	0.4	0.3	0.2	0.3	0.7	1.9	1.5	1.2	1.1

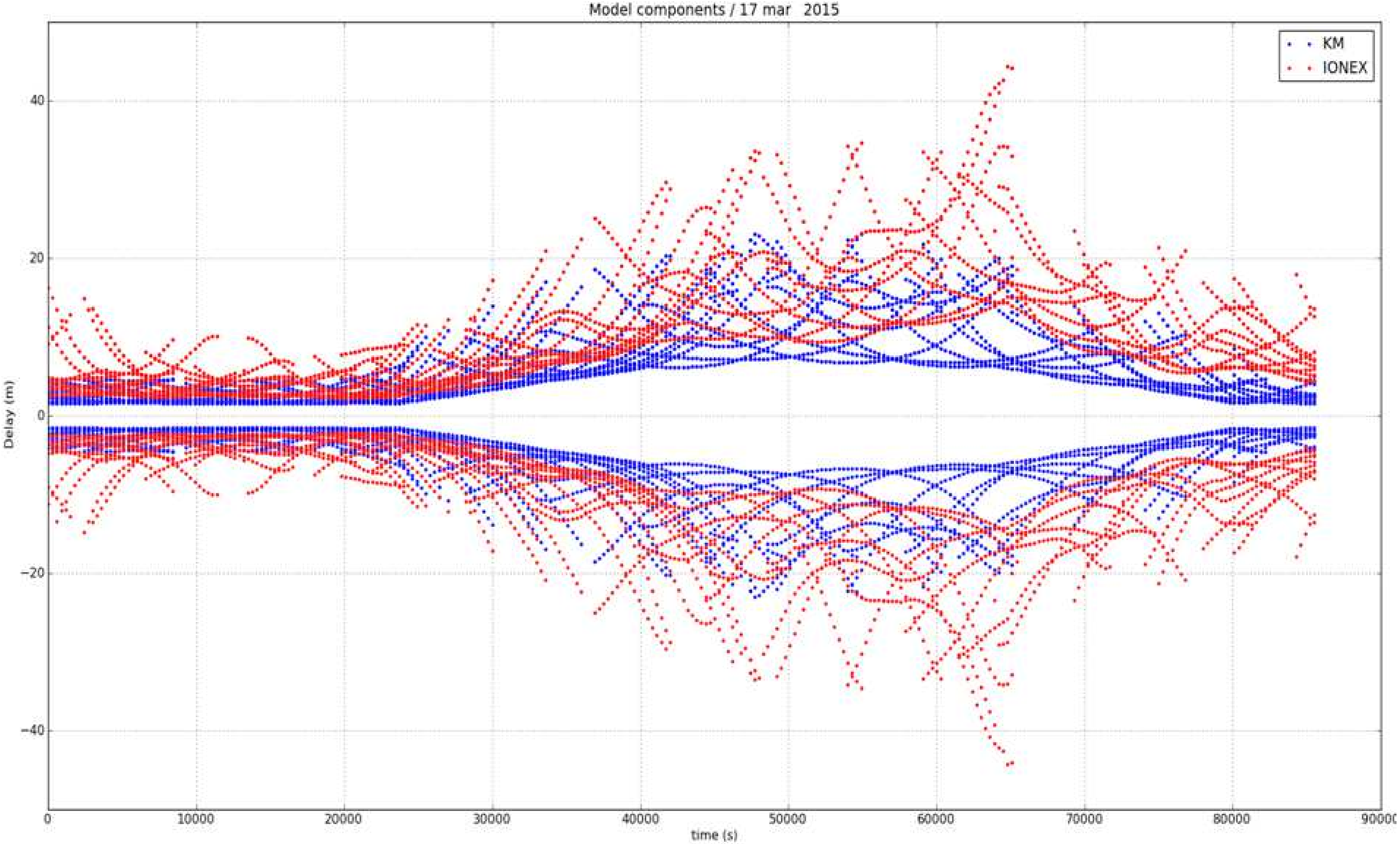
Geomagnetic Indices

ftp://ftp.gfz-potsdam.de/pub/home/

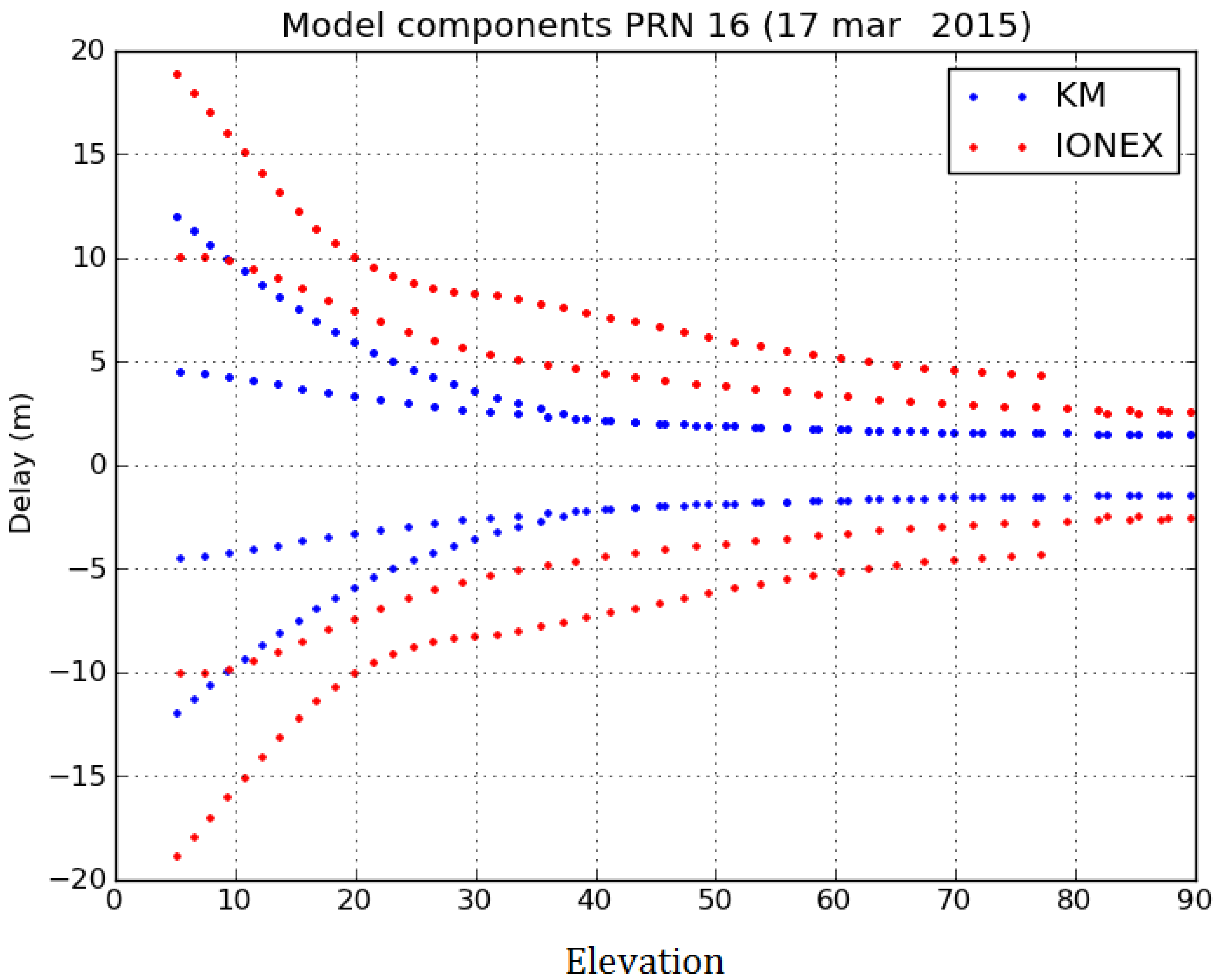
STATION ID	LOCATION	POSITION WGS 84
RABT	Rabat	Lat 33° 59' 53" N Long 6° 51' 15" W
IFR1	Ifrane	Lat 33° 31' 01" N Long 5° 07' 37" W
TETN	Tetouan	Lat 35° 33' 42" N Long 5° 21' 47" W

GNSS Reference Stations

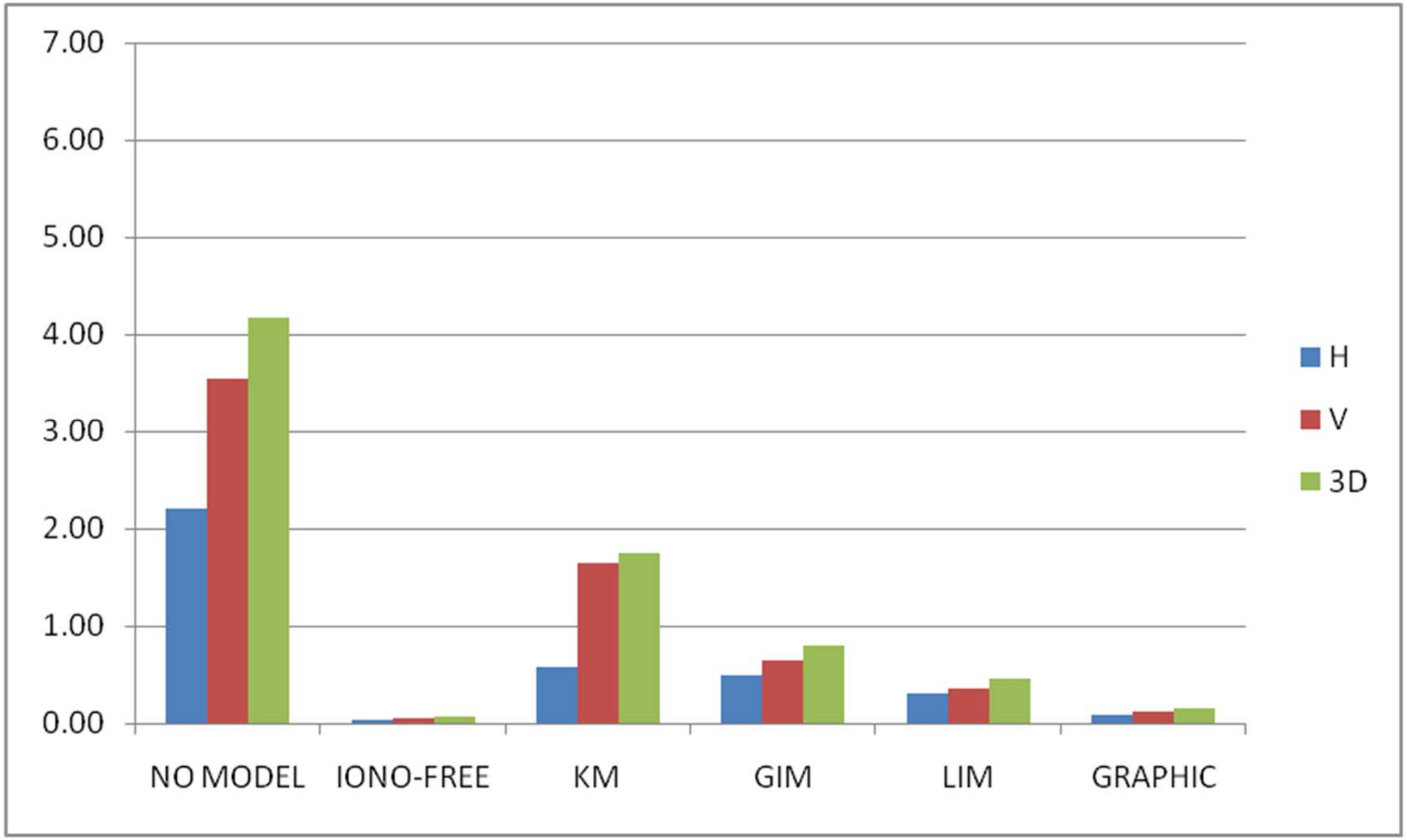
Ionospheric Effect



Ionospheric Effect



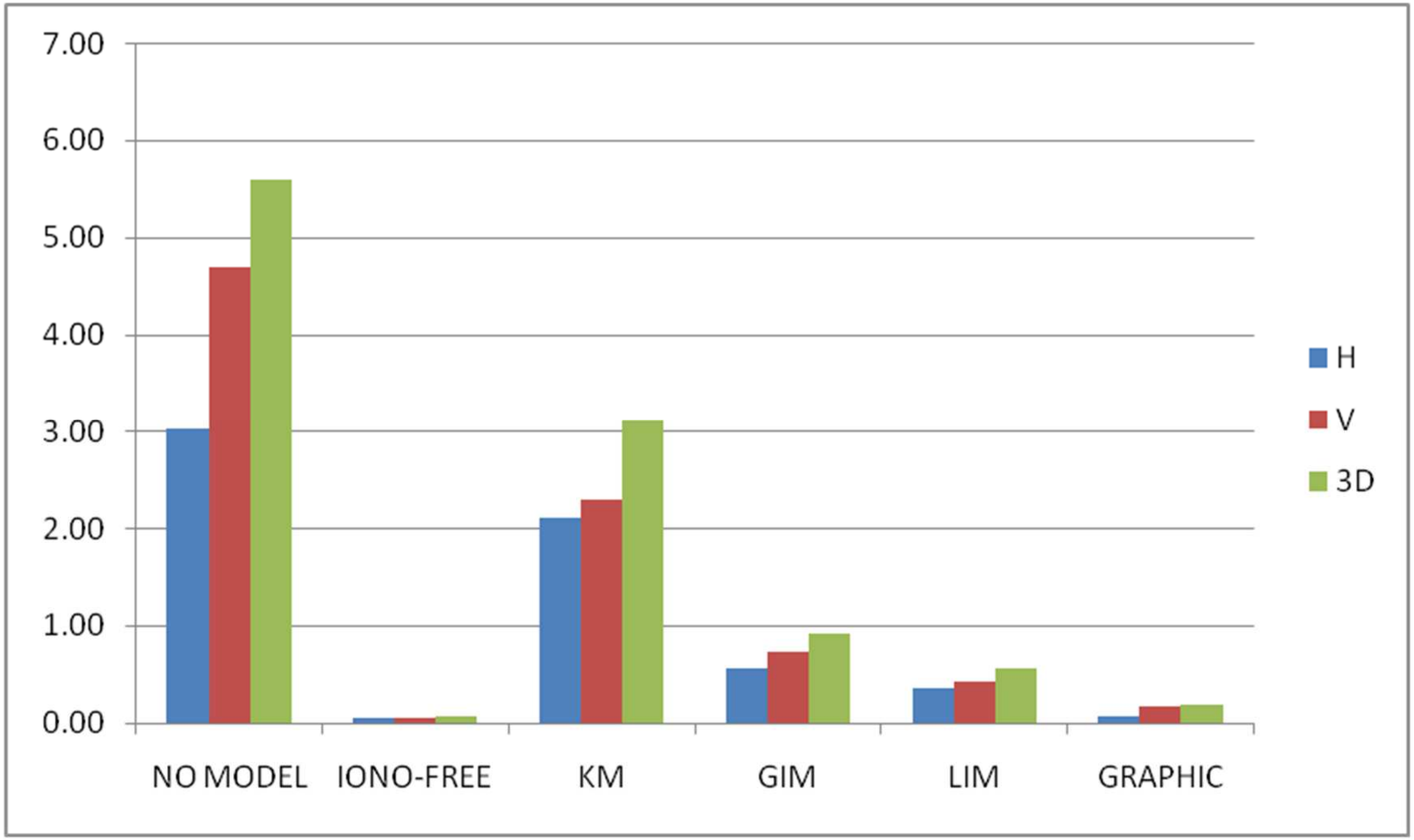
RMS Errors (m) (*Quiet days, 2015)*



HORIZONTAL IMPROVEMENTS : KM 60-70%, GIM 70-75%, LIM 78-85%, GRAPHIC 90-95%.

VERTICAL IMPROVEMENTS : KM 45-52%, GIM 80-84%, LIM 82-88%, GRAPHIC 85-95 %.

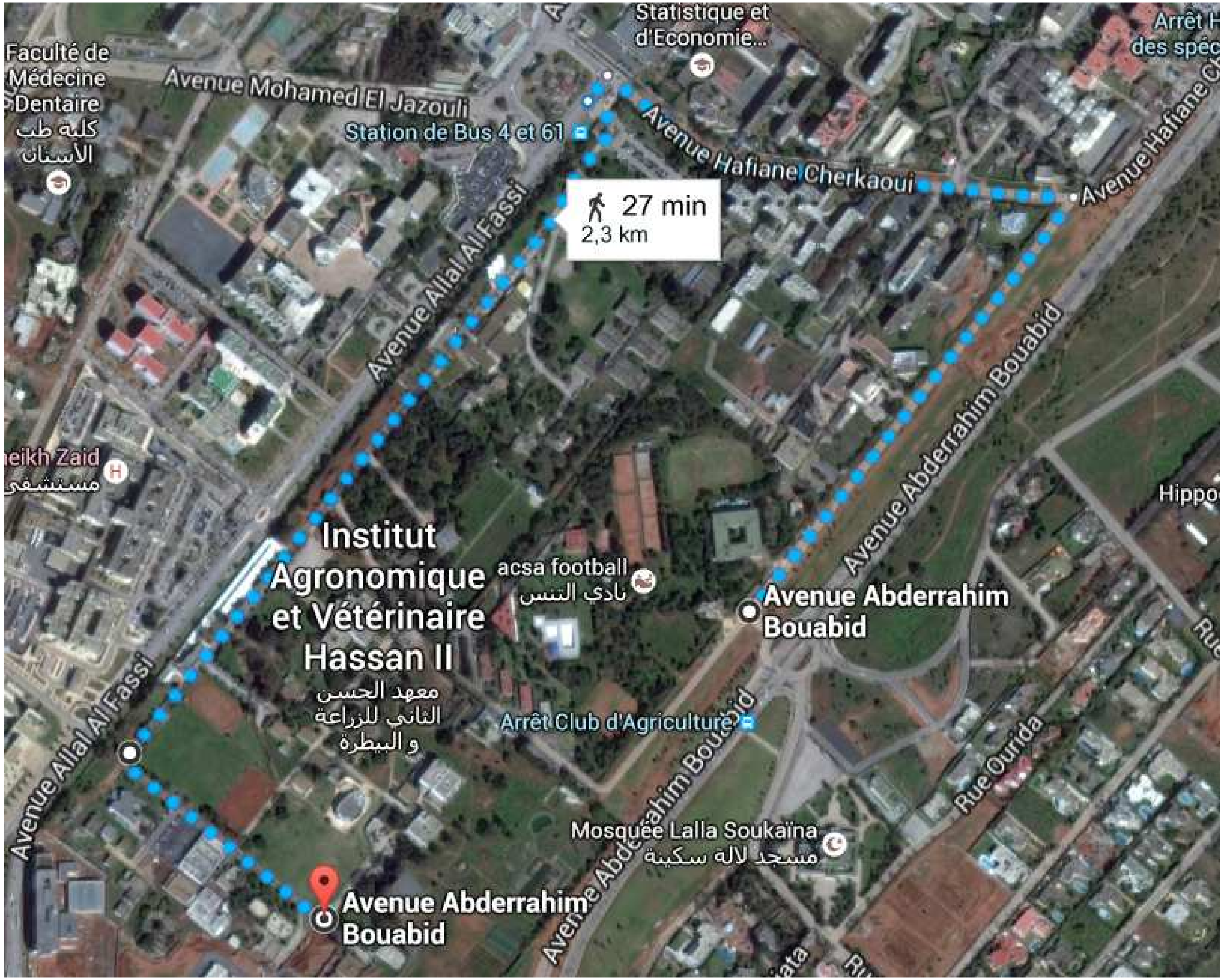
RMS Errors (m) (*Disturbed days, 2015)*



HORIZONTAL IMPROVEMENTS : KM 35-40%, GIM 71-76 %, LIM 80-84 %, GRAPHIC 88-93%.

VERTICAL IMPROVEMENTS : KM 25-30%, GIM 70-80%, LIM 80-89%, GRAPHIC 90-94 %.

3. RTK Experimentation



BASE

ROVER

3. RTK Experimentation

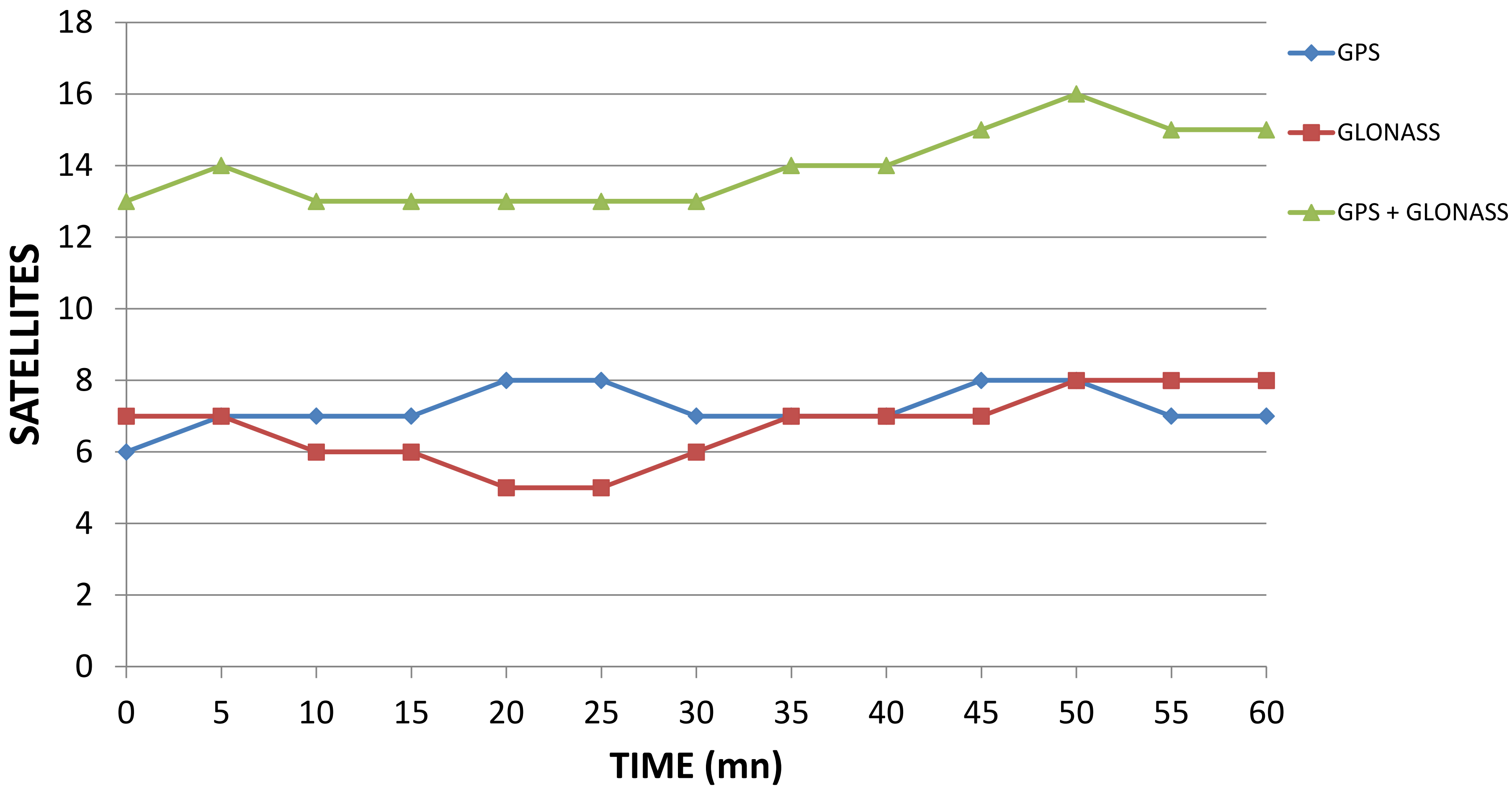
Road Degradation

- Roads require follow-up and ongoing maintenance.
- Over time, roads suffer damage caused by traffic, weather conditions and aging.
- Pavement degradations are of different kinds: ***potholes, cracks, upheavals and sink holes..***

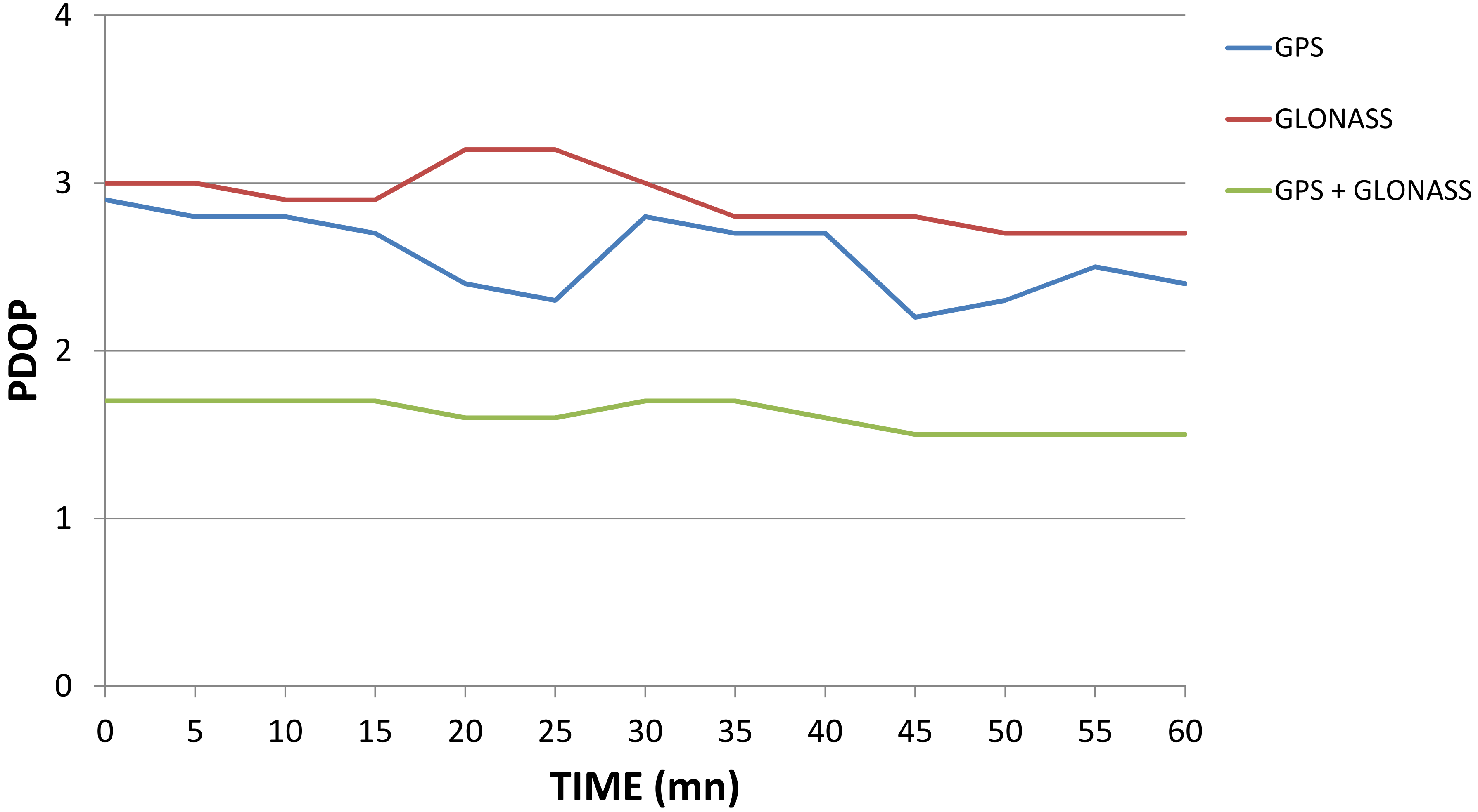




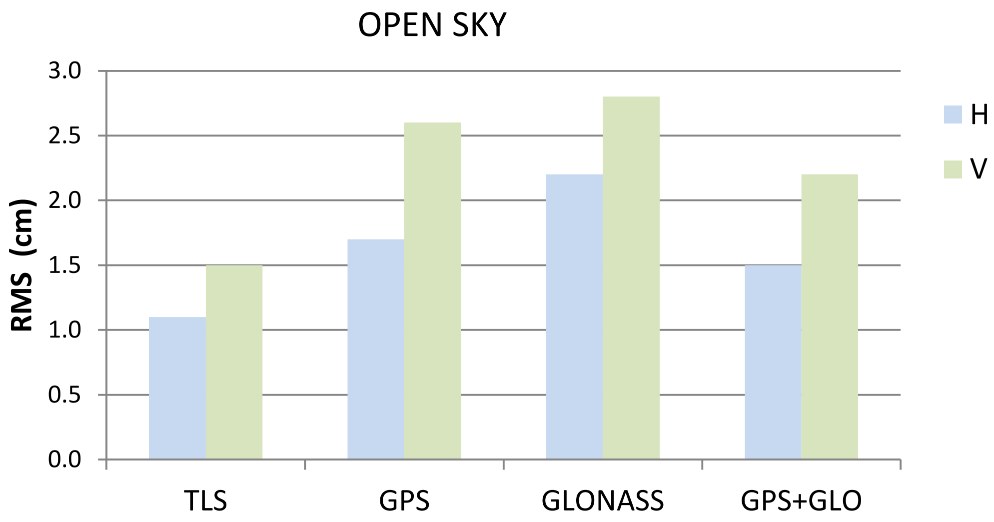

Multi-Constellation Satellites



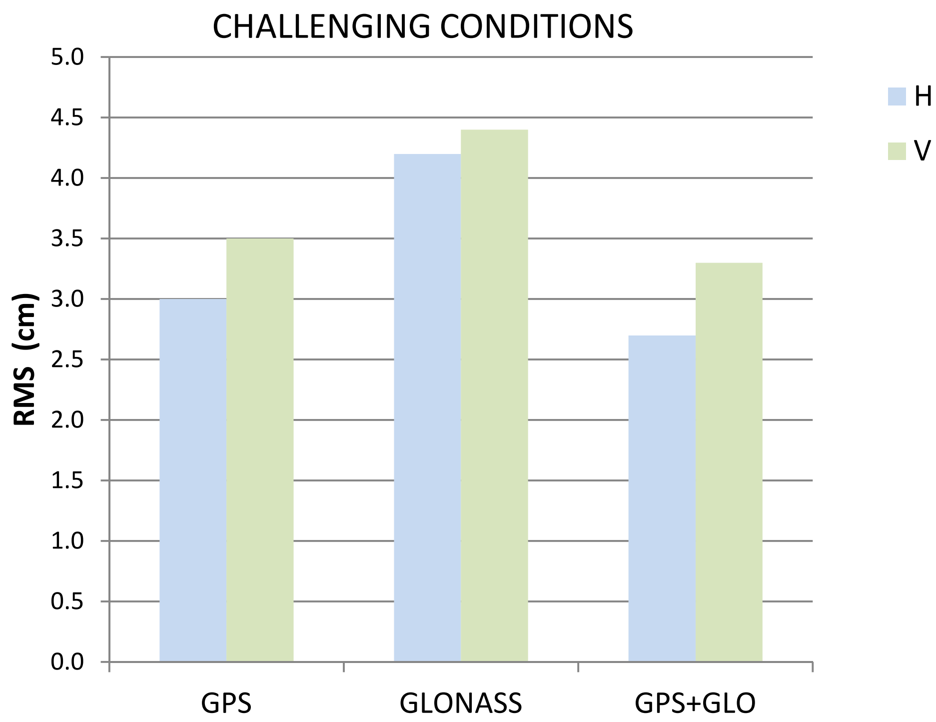
Multi-Constellation Geometry



4. RESULTS

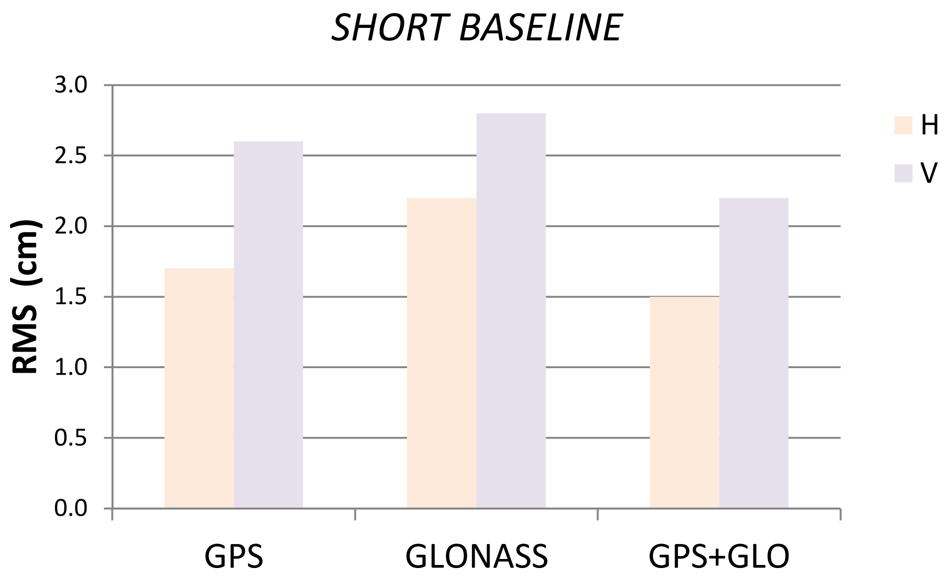


OPEN SKY
RMS (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
TLS
GPS
GLONASS
GPS+GLO
H
V

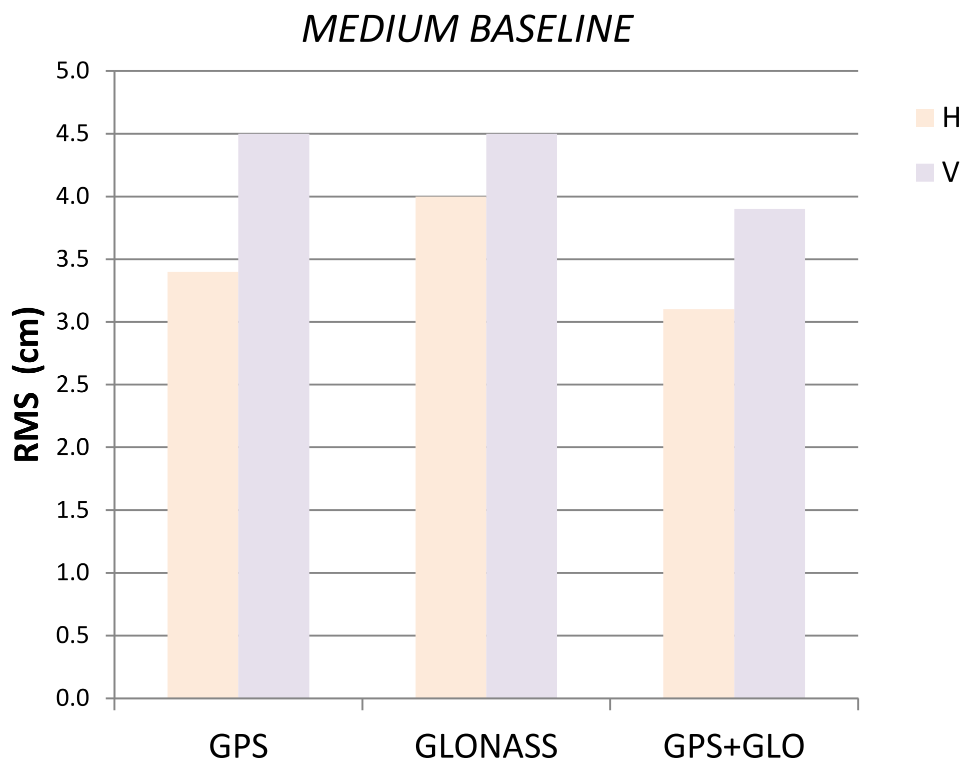


CHALLENGING CONDITIONS
RMS (cm)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
GPS
GLONASS
GPS+GLO
H
V

4. RESULTS



SHORT BASELINE
RMS (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
GPS
GLONASS
GPS+GLO
H
V



MEDIUM BASELINE
RMS (cm)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
GPS
GLONASS
GPS+GLO
H
V

CONCLUSION

- *Best results obtained in open sky condition, for Multi-constellation use and for short baselines.*
- *Potholes, Upheavals and Sink Holes are precisely identified.*
- *Use of TLS + GNSS RTK for Cracks identification.*
- *Time to Fix for ambiguities increase for poor geometry, mono-constellation use and for medium baseline.*
- *Problem of interference.*

CRASTE-LF

CRASTE-LF

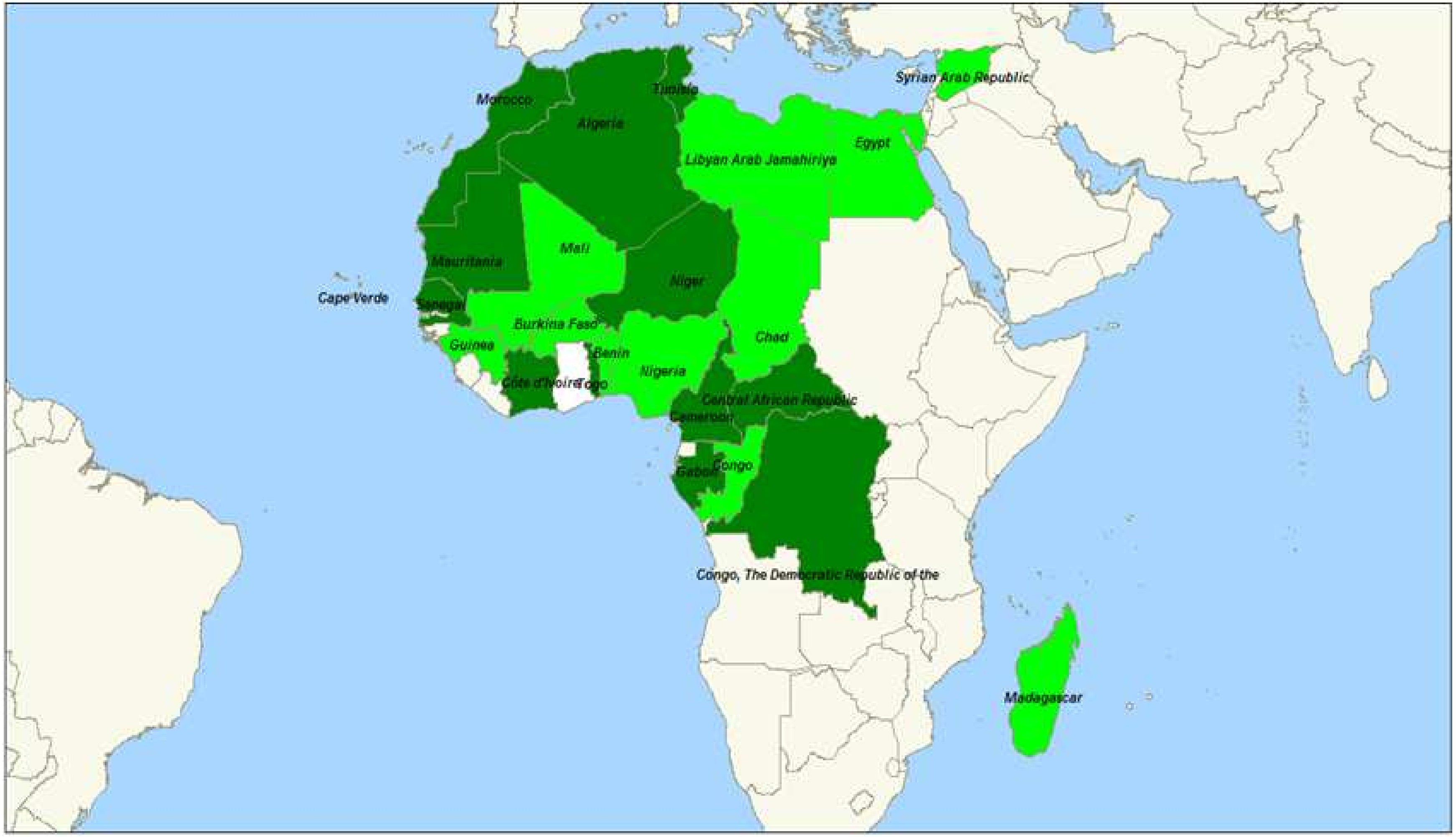
The CRASTE-LF has been established in Rabat on October 23, 1998. Initiative of the UN-OOSA.

Education and training on Space Science and Technology for sustainable development

13 Member States : Algeria, Cameroon, Cape Verde, Central African R., Ivory Coast, D. R. of Congo, Gabon, Morocco, Mauritania, Niger, Senegal, Togo and Tunisia.

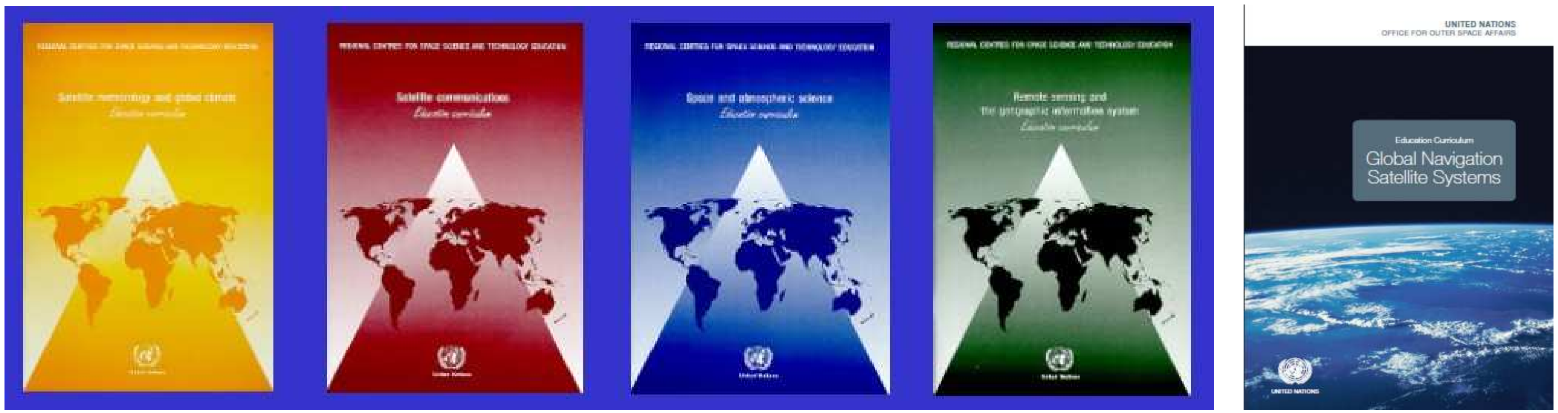
Building of CRASTE-LF

Origine of candidates (1998-2015) CRASTE-LF



CRASTE-LF
Education Programmes

- **Remote Sensing and Geographic Information Systems,**
- **Satellite Communications,**
- **Satellite Meteorology and Global Climate,**
- **Space and Atmospheric Sciences**
- ***Global Navigation Satellite Systems***



Education Curricula established and Published by UN-OOSA

Training Course on GNSS

"Satellite Navigation and Location Based Services" ,
28 September – 24 October 2009, with participation of 35 trainees from 19 Countries & from 32 different organizations and supervised by 10 experts.

Trainees supervised by METIS project team attending the demonstration at Mohamed V Airport, Casablanca , Morocco.

Regional Training Workshop

24 trainees from 07 African countries

- Datums : Ellipsoid, Geoid.
- Coordinate Reference Systems
- Cartographic Projections
- Satellite Orbits.
- Navigation Signal.
- Errors and Precision.
- Positionning Techniques.
- Laboratories.




« Global Navigation and Based Services on Satellite Positioning »

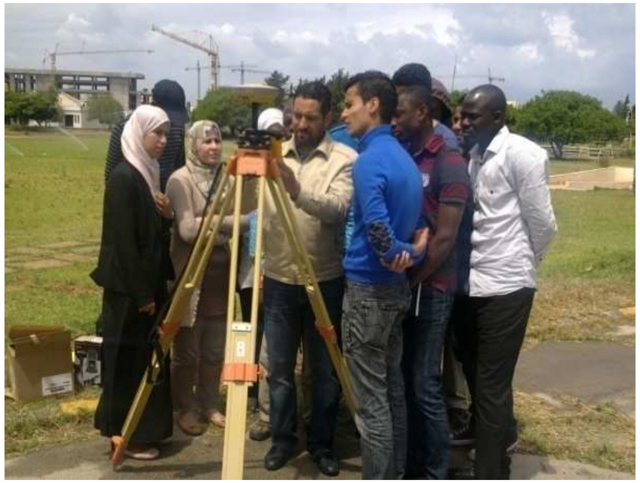
Lomé, Republic of Togo, 3 - 7 October 2011

Master on GNSS

Post Graduate training courses on GNSS :

- **1st SESSION : Nov. 2013 – Aug 2015, 12 trainees from 6 member Countries & 8 different institutes.**

- **2nd SESSION : Sep. 2016 - Jul 2018.**



Training on GNSS

CRASTE-LF organized :

- **Training on Beidou : International Institute for GNSS Education, Beijing China, *July 2014*.**

- **Training on GLONASS: ISS RESHETNEV - Russia, *May 2016*.**

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