TESTING OF PPP SOLUTION AIDED WITH ENHANCED ALGORITHMS OF INTEGER AMBIGUITY RESOLUTION

ION GNSS+ 2019, Miami, Florida

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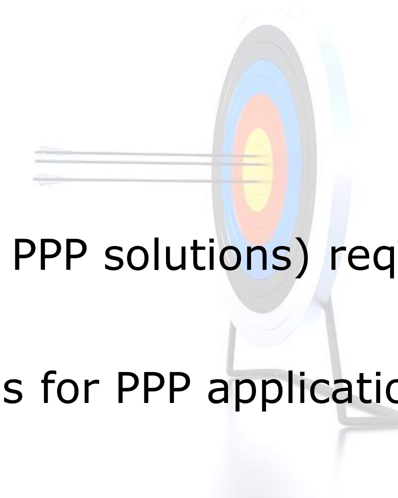
GMV, Spain

INNOVATING SOLUTIONS

CONTEXT



Why Integer Ambiguity Resolution (IAR)?

New applications (e.g. very precise orbits and clocks for PPP solutions) requiring better accuracy

Convergence requirements on the order of a few seconds for PPP applications

Advantages

- Better accuracy
- Improved convergence time (cold and hot) for PPP applications

Difficulties

- Management of biases
- Risk of wrong ambiguity fixing
- Best results used together with regional information

POSITIONING ALGORITHMS

WHY IAR?

Code $R = RX + TR + \rho + I + w + \epsilon$

Phase $\lambda \cdot \varphi = RX + TR + \rho - I + \lambda \cdot N + w + \epsilon$

- ***λ*** is the associated wavelength
- ***RX, TR*** are the receiver and satellite hardware delays
- ***ρ*** is the pseudorange, including geometric distance, clock biases, tropospheric and relativistic corrections, common to all the frequencies and to the code measurements
- ***I*** is the ionospheric delay
- ***N*** is the integer ambiguity
- ***w*** is the phase wind-up correction
- ***ε*** is the measurement noise, including the multipath contribution

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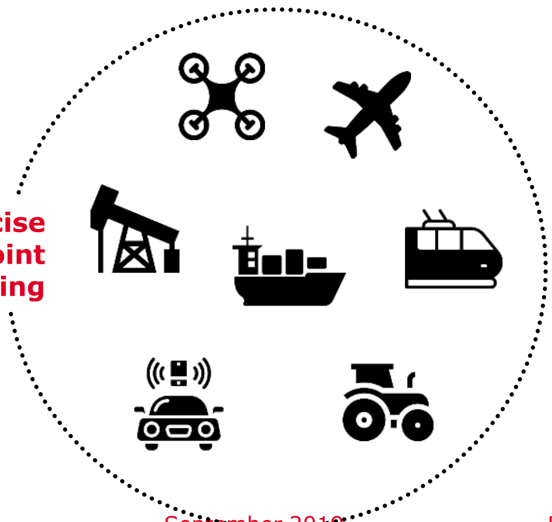
Low Noise

Needs proper estimation of ambiguities

Centimetric Accuracy

Precise Point Positioning



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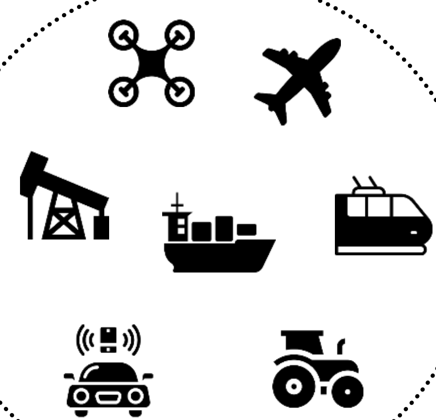
Low Noise → **Needs proper estimation of ambiguities** → **How?**

Centimetric Accuracy

Precise Point Positioning



Integer Ambiguity Resolution

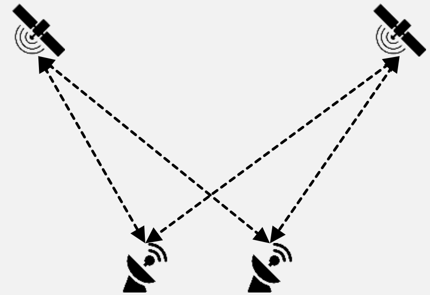
Orbits and Clocks estimation

Positioning Solutions

PRECISE POSITIONING WITH IAR

SERVER SIDE

Orbits and Clocks Estimation



Double Differences

PROBLEM:

Impact of satellite and station biases

gmv

PRECISE POSITIONING WITH IAR

SERVER SIDE

Orbits and Clocks Estimation

Double Differences

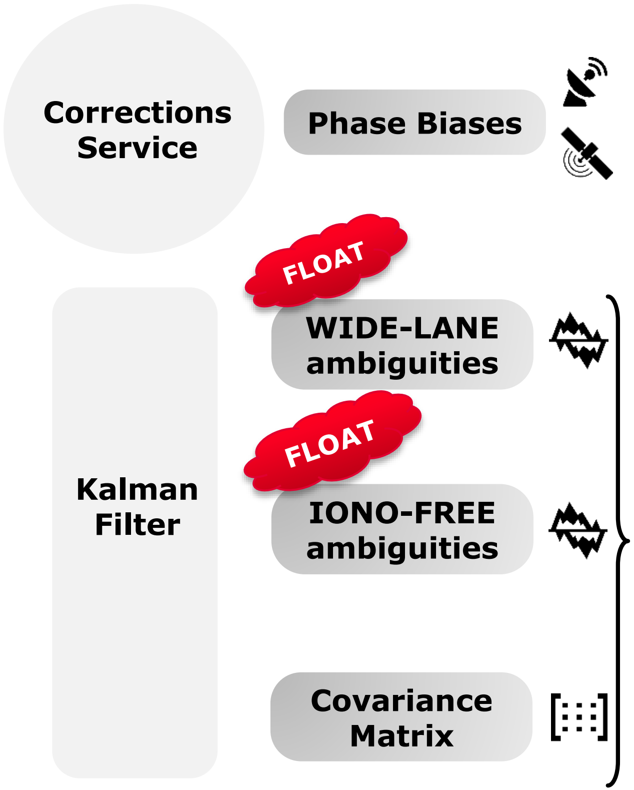
PROBLEM:

Impact of satellite and station biases

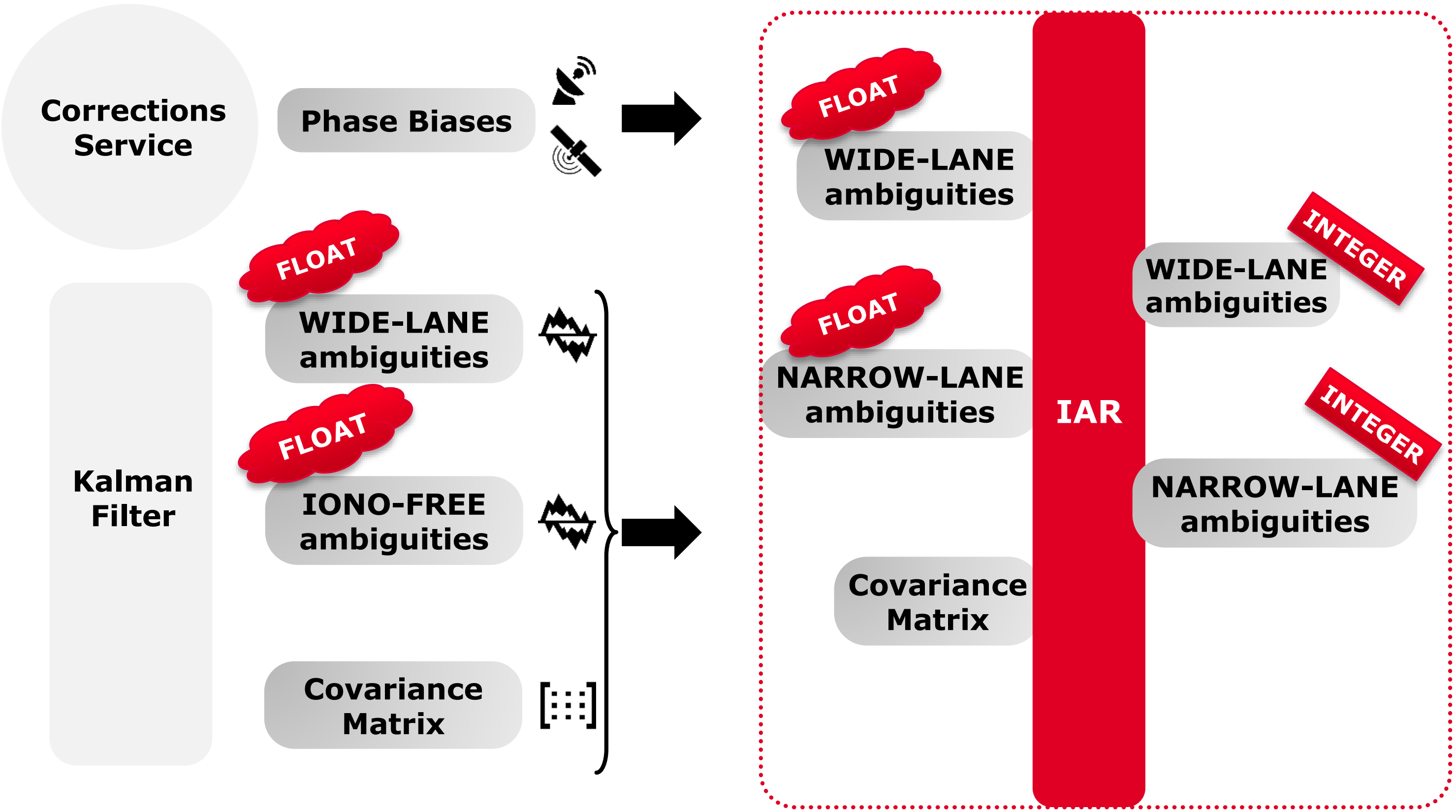
USER SIDE

Precise Orbits & Clocks + **Ionospheric Corrections** + **Phase Biases** = **Positioning Solutions**

IAR ALGORITHMS



IAR ALGORITHMS



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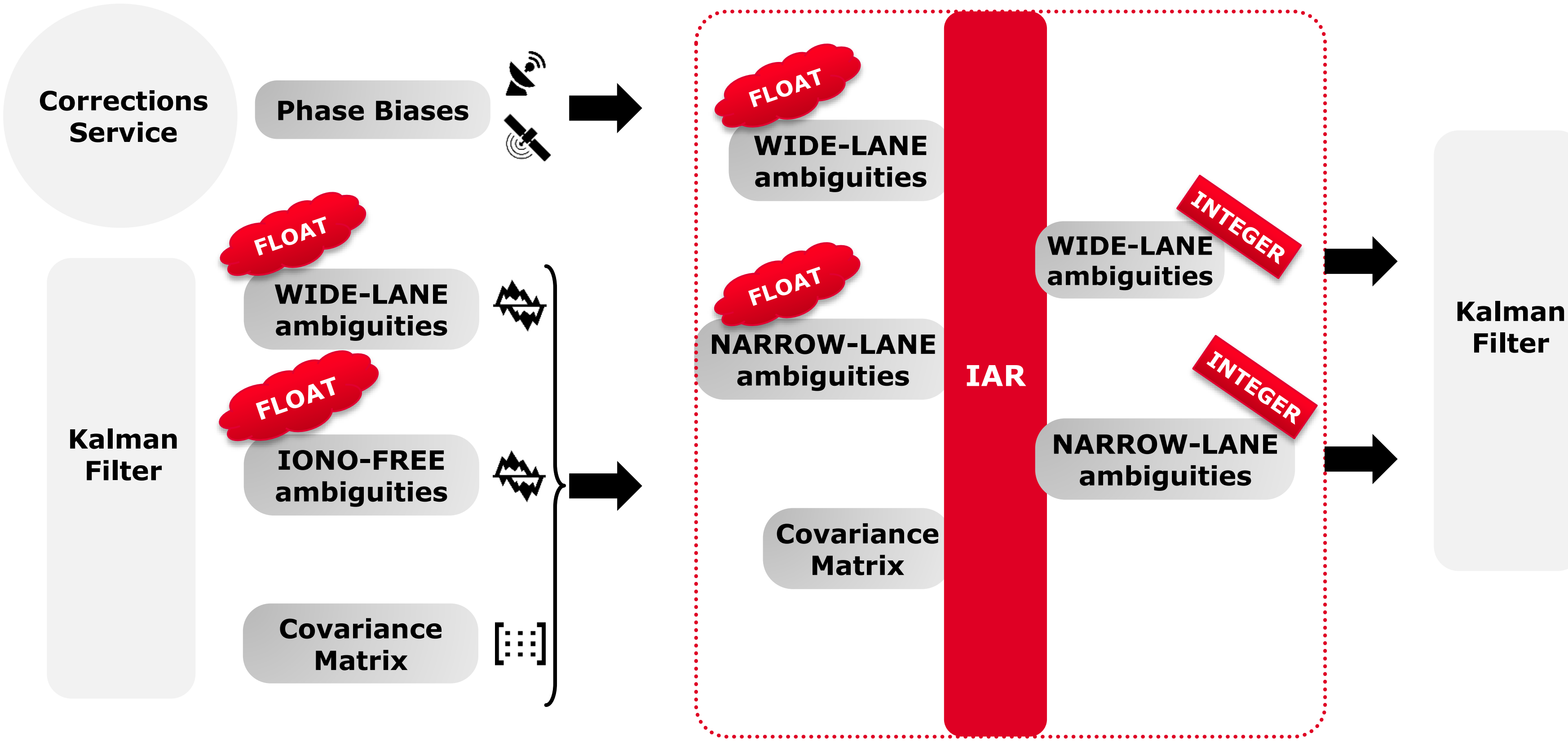


PERFORMANCES

ORBITS AND CLOCKS

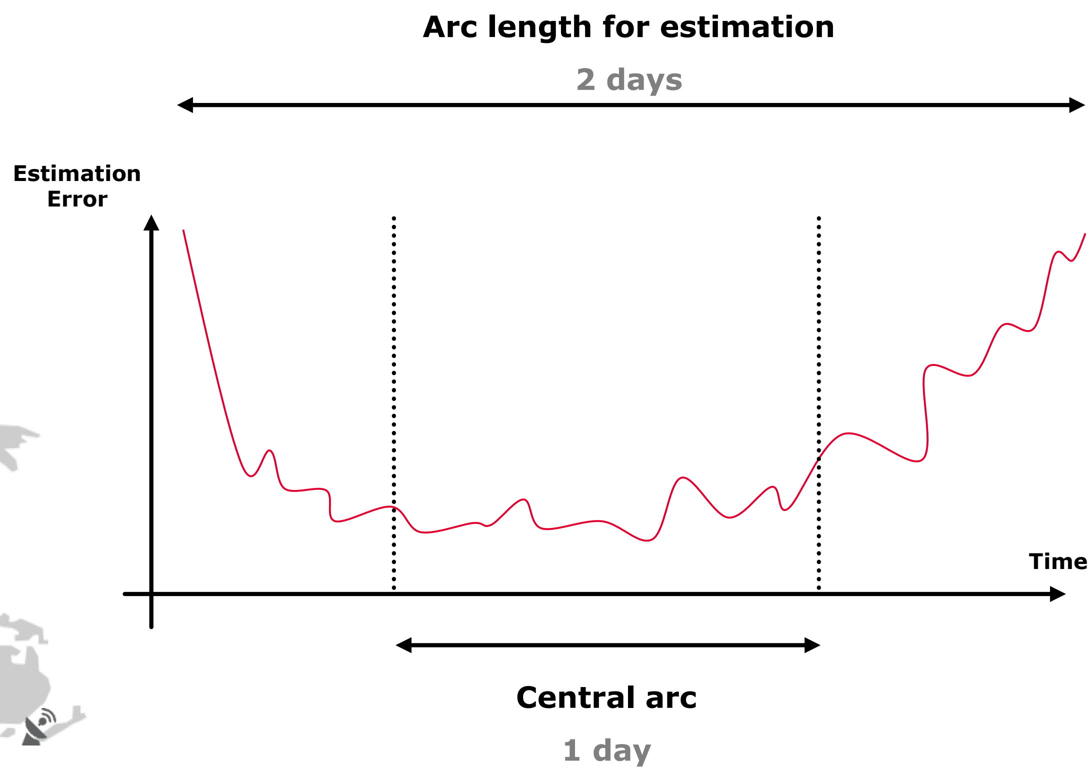
OFFLINE ODTS ANALYSIS CHARACTERIZATION

Constellations

GPS ✚ **Galileo**

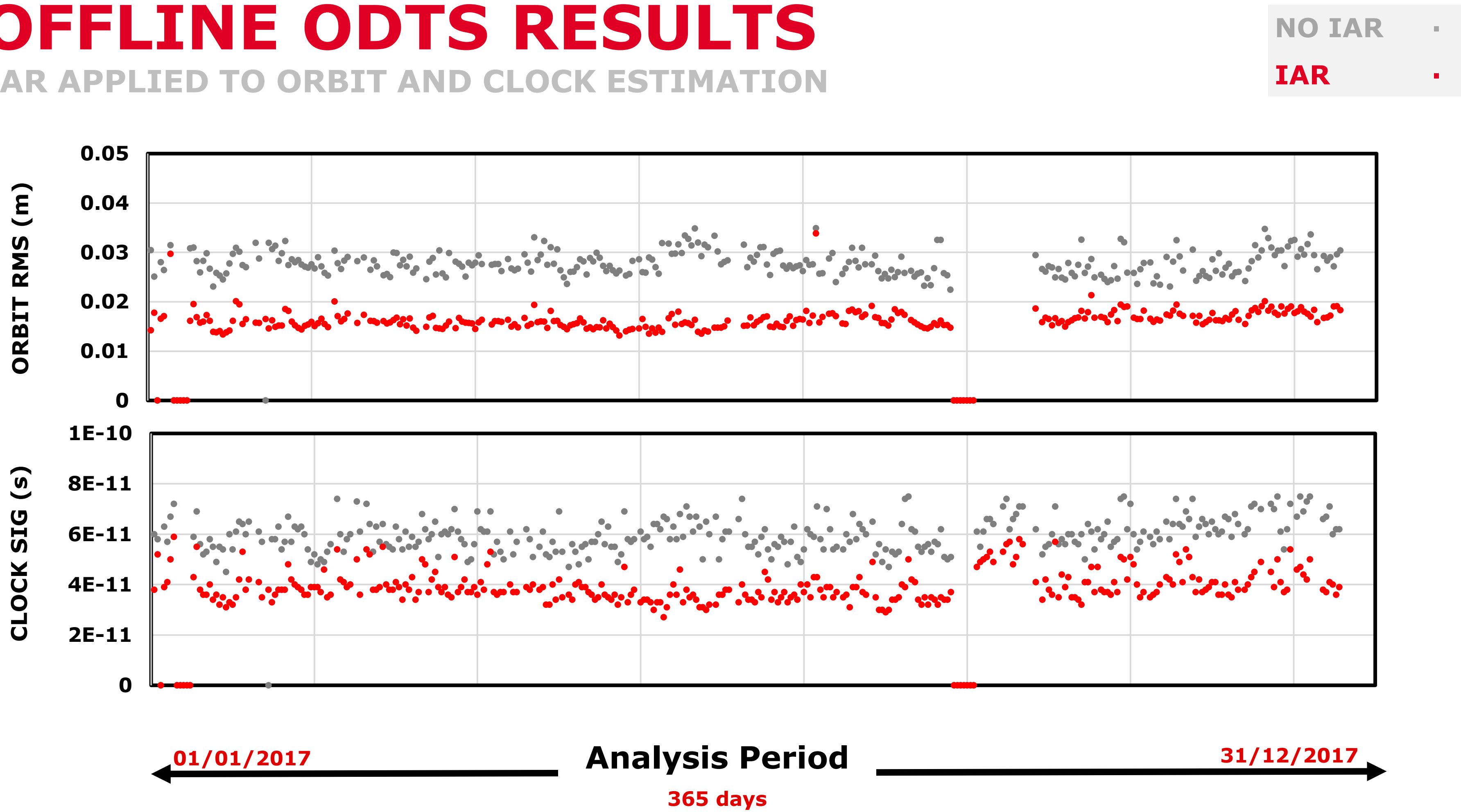
GPS	Galileo
IONOFREE	IONOFREE
G1P – G2P	E1C – E5Q

59 STATIONS



OFFLINE ODTS RESULTS

IAR APPLIED TO ORBIT AND CLOCK ESTIMATION



REAL-TIME ODTS ANALYSIS CHARACTERIZATION

Constellations

GPS + **Galileo**

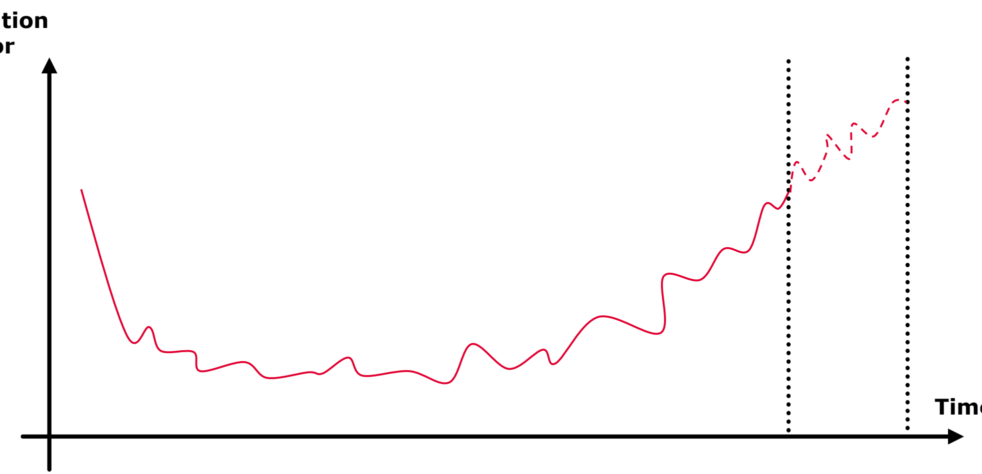
IONOFREE
G1P – G2P

IONOFREE
E1C – E5Q

52 STATIONS

Arc length for estimation

1 day



Prediction arc

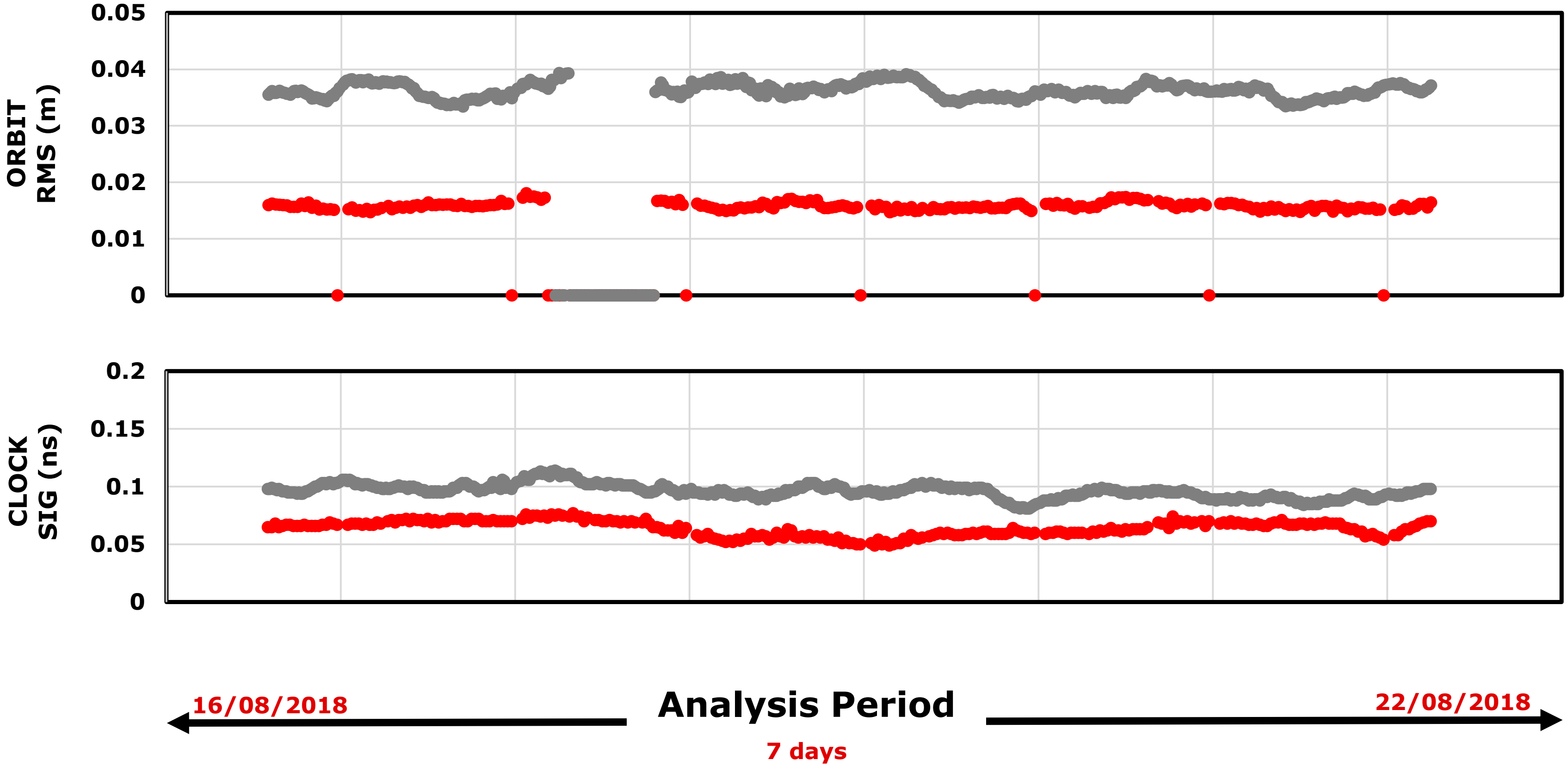
15 minutes

REAL-TIME ODTS RESULTS

IAR APPLIED TO ORBIT AND CLOCK ESTIMATION

NO IAR

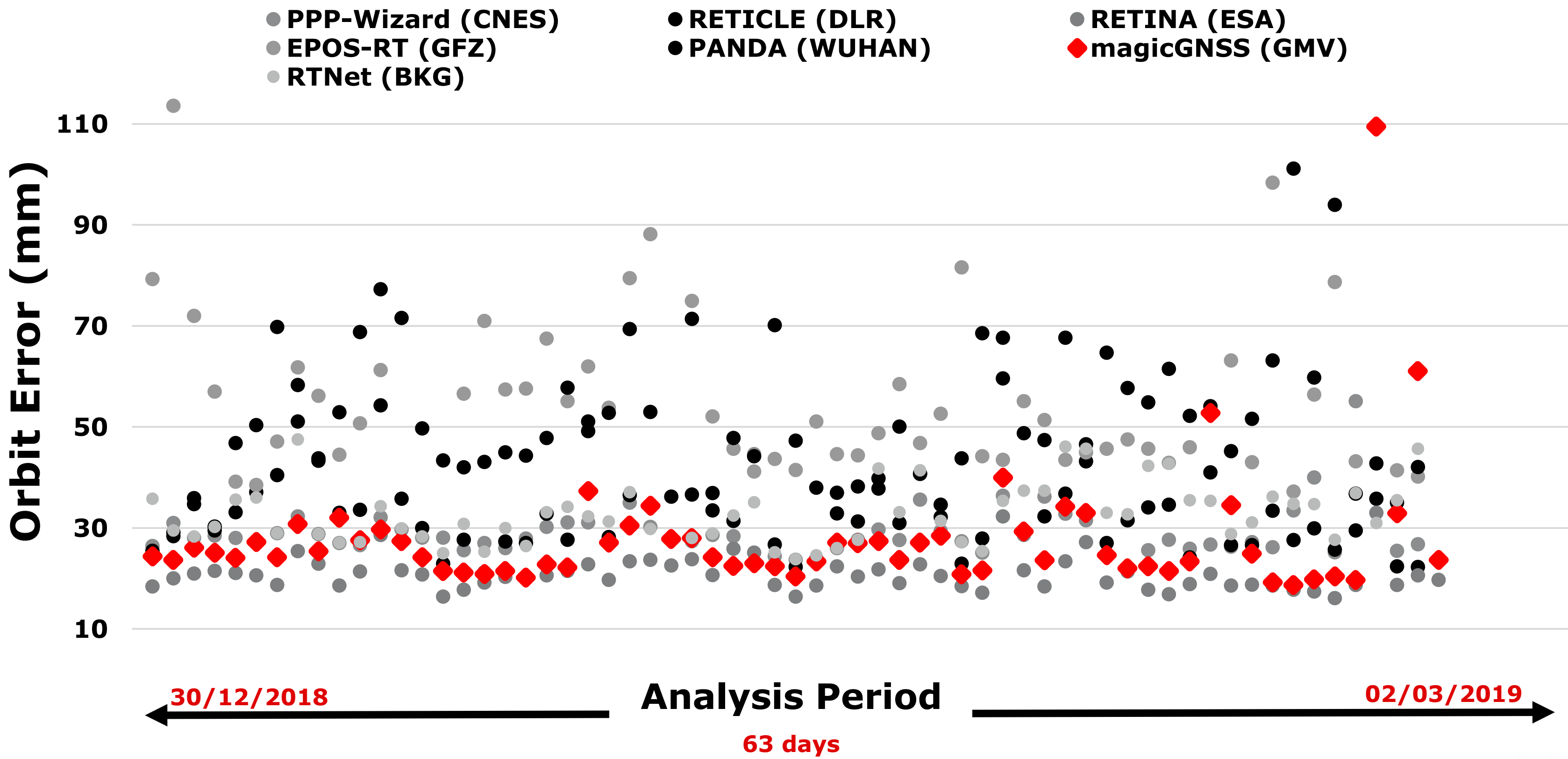
IAR



COMPARISON

ORBITS AND CLOCKS

REAL-TIME ODTS COMPARISON WITH OTHER REFERENCE CENTERS



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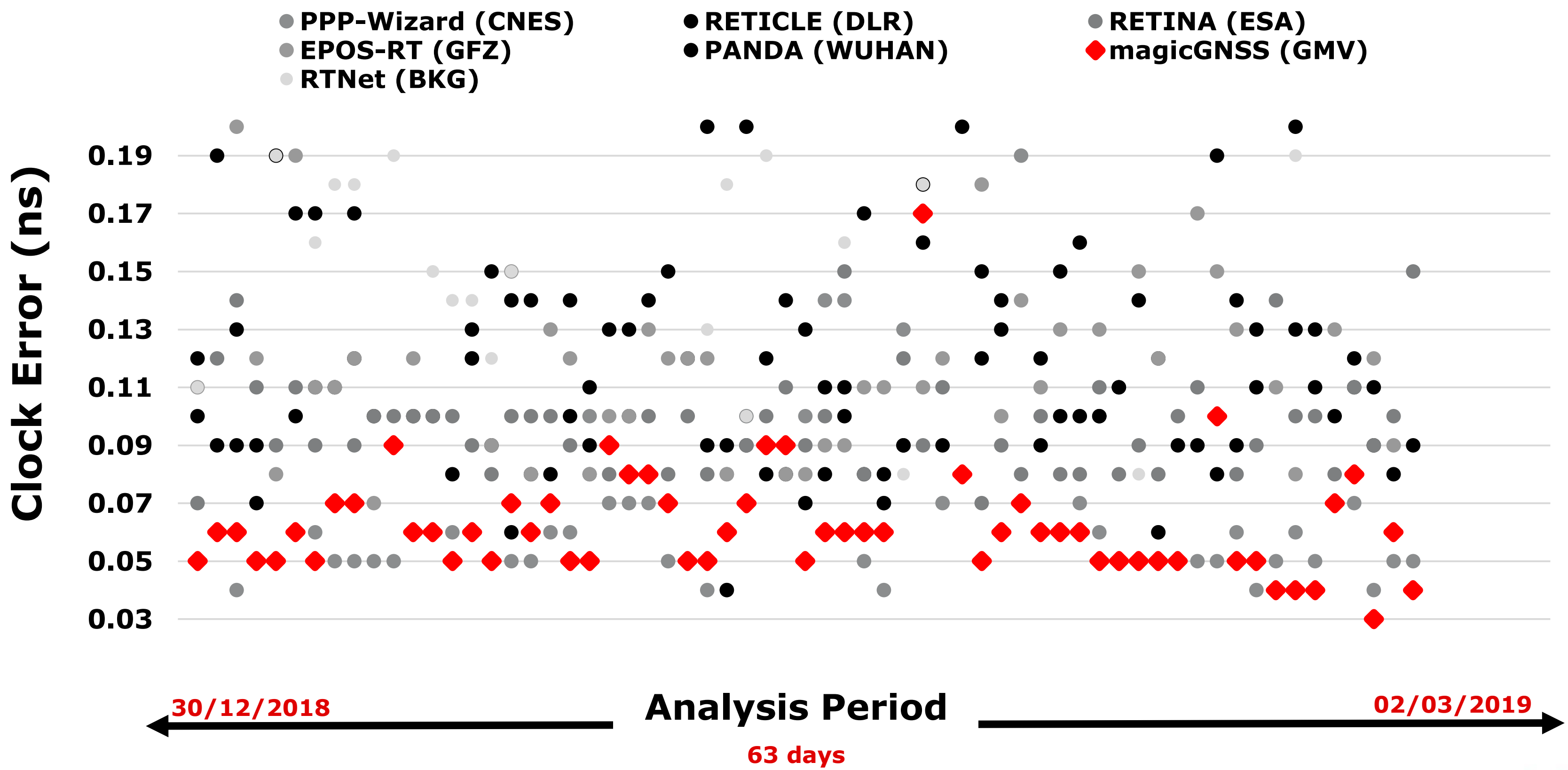


KINEMATIC SCENARIOS

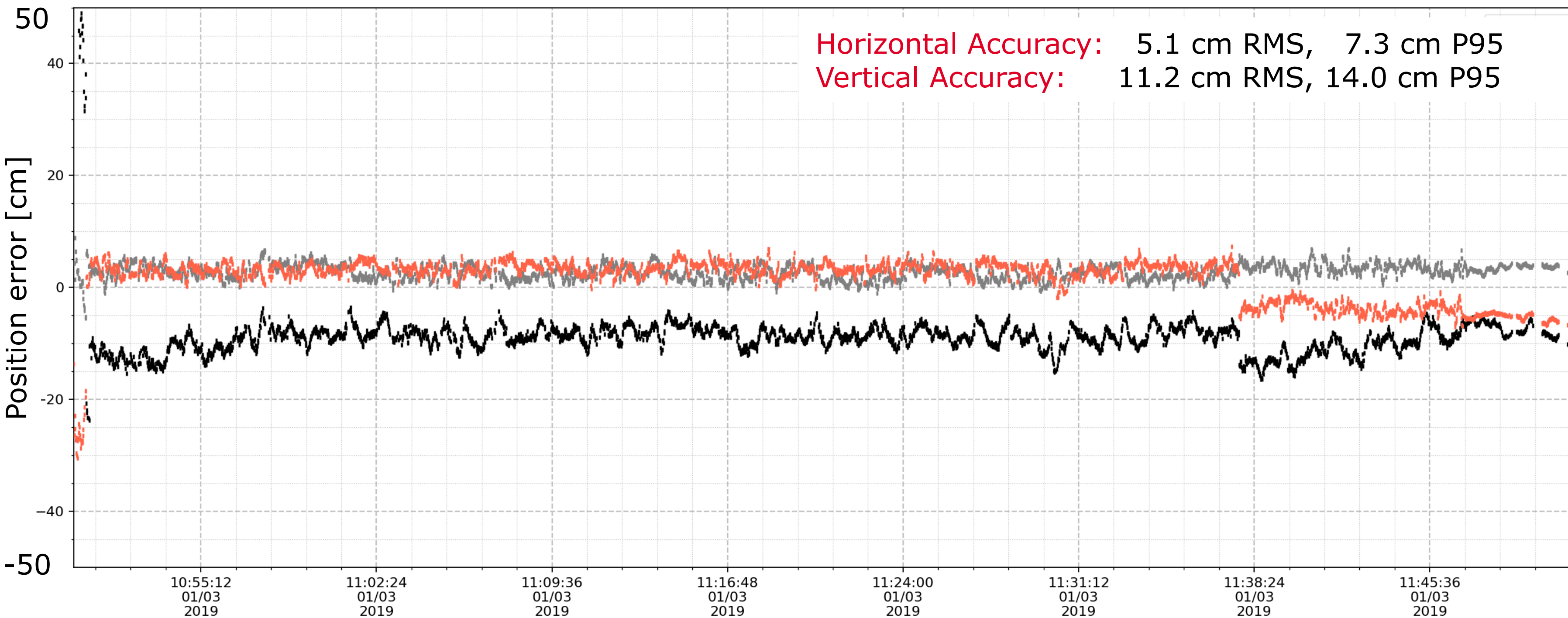
OPEN SKY

OPEN SKY SCENARIOS

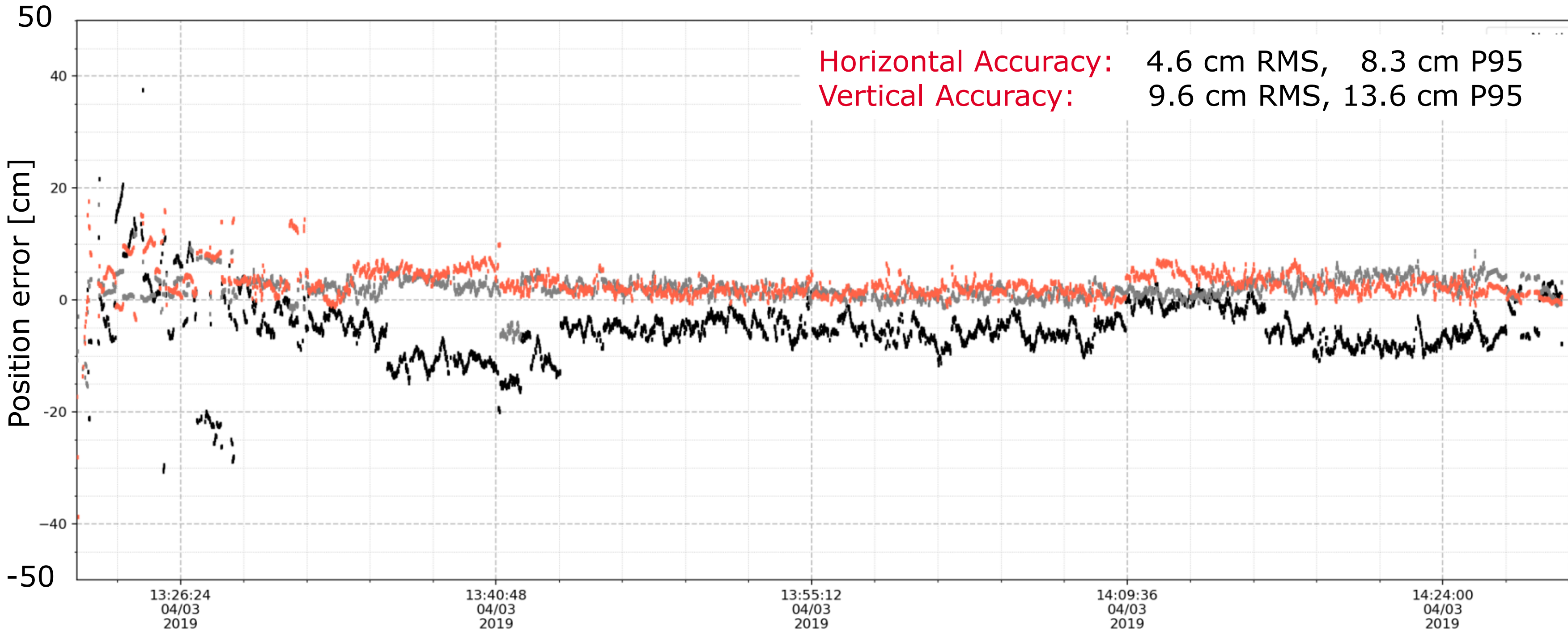
Equipment	Type	Algorithms		
High-End	OS	Regional Corrections	+	IAR

Tres Cantos, Madrid

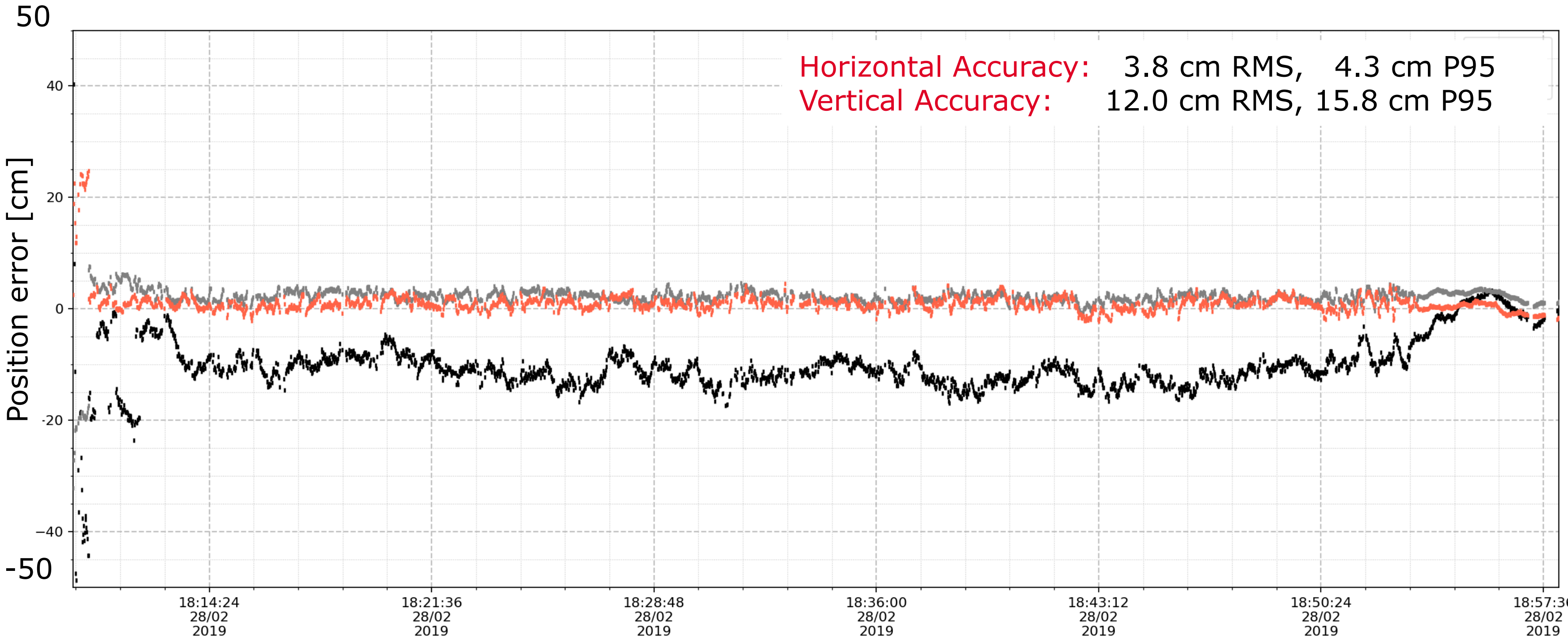
HIGH-END OPEN SKY PERFORMANCES #1



HIGH-END OPEN SKY PERFORMANCES #2



HIGH-END OPEN SKY PERFORMANCES #3

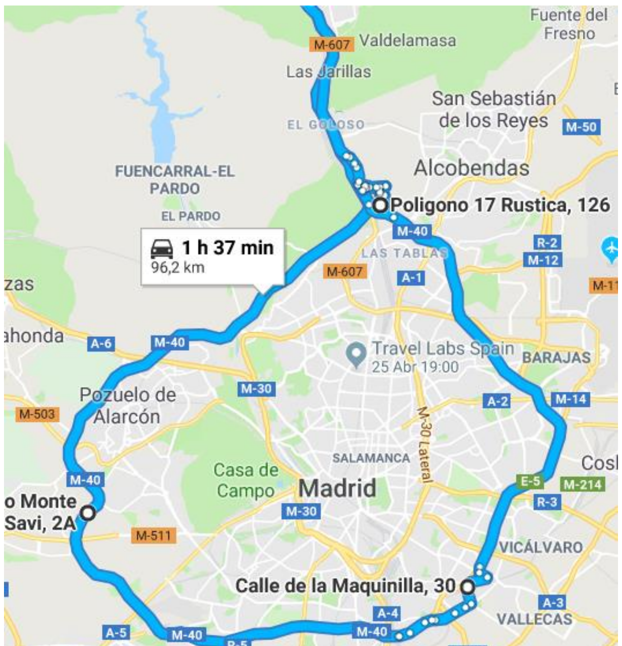


KINEMATIC SCENARIOS

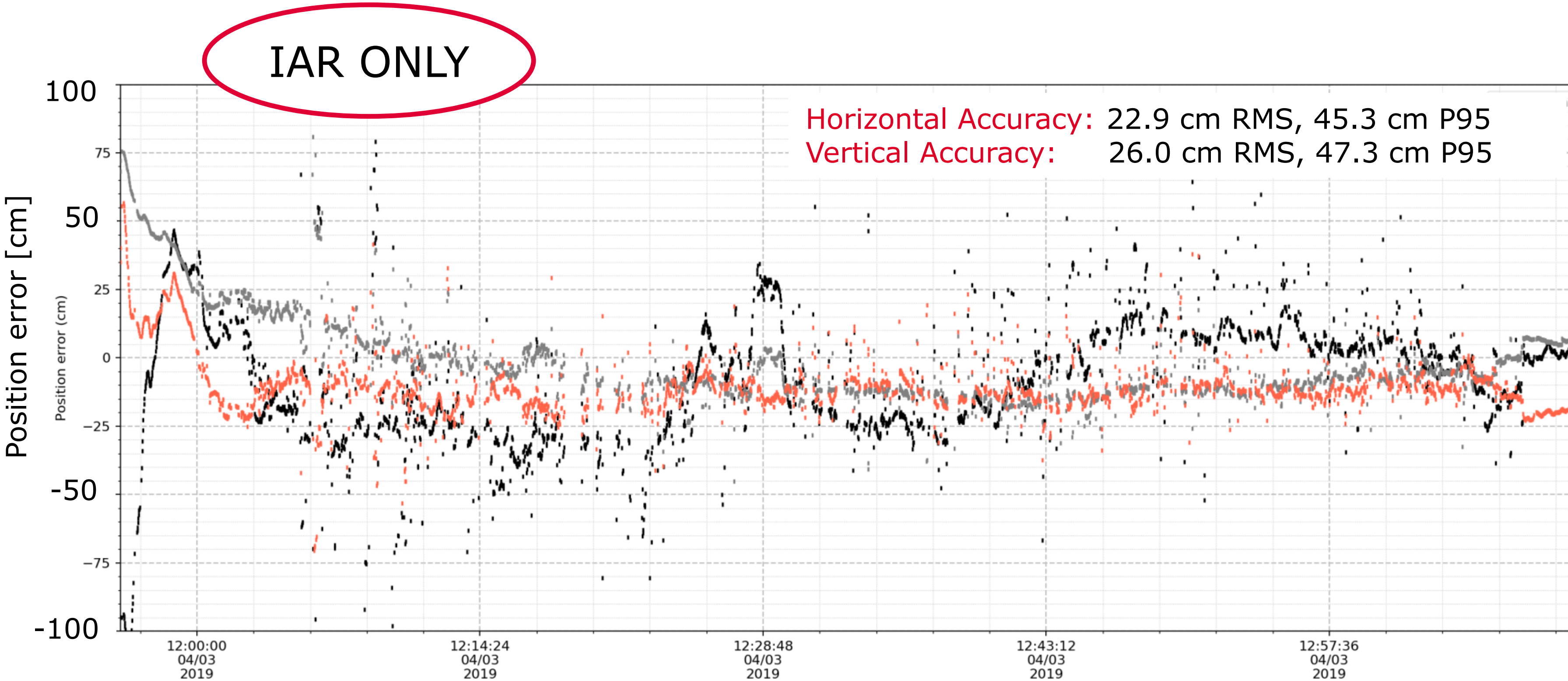
HIGHWAY

HIGHWAY SCENARIO

- Circular highway in Madrid (M40)
  - High multipath
  - Multiple overpasses
  - Max speed 100km/h
  - Medium-High level traffic during whole day
  - Considered worst use case



HIGH-END SUBURBAN HIGHWAY PERFORMANCES



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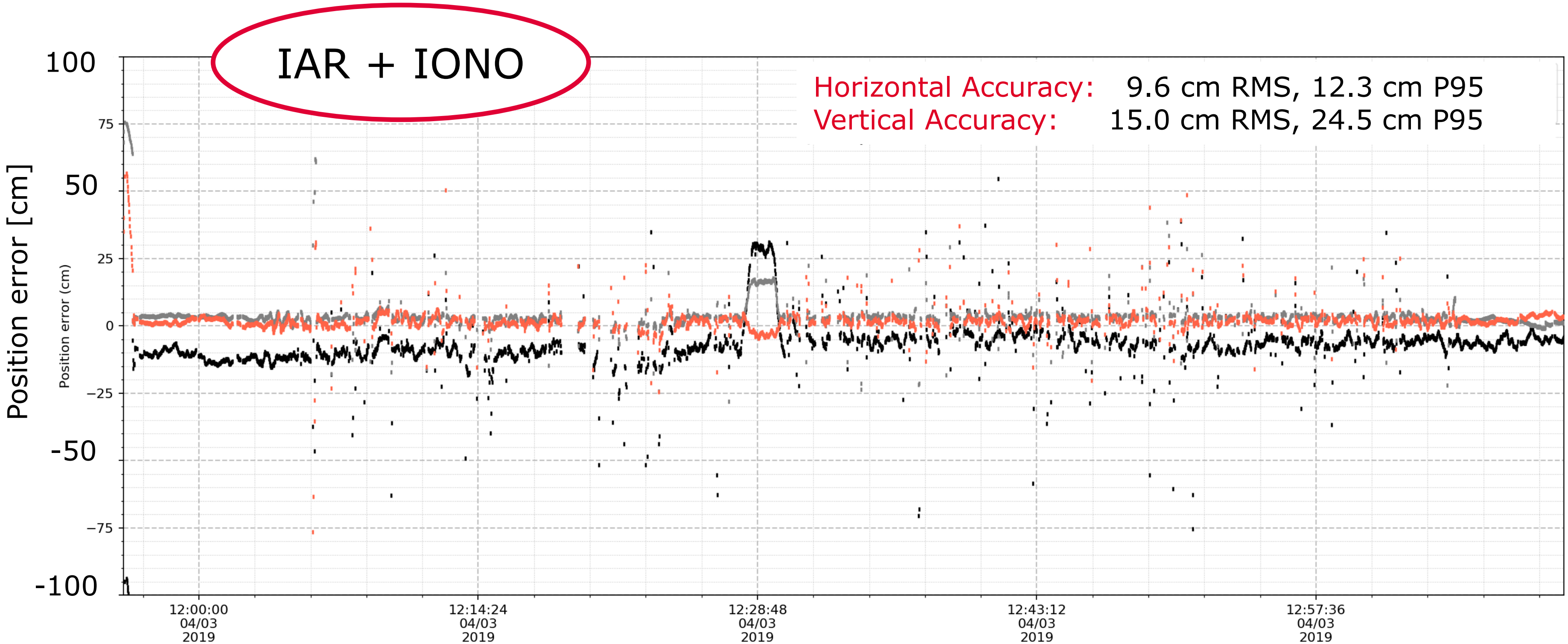

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