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EPN VS. GLOBAL NETWORK ANALYSIS: INFLUENCE ON GNSS POSITIONS, VELOCITIES AND RESIDUAL POSITION TIME SERIES

J. Legrand[(1)], C. Bruyninx[(1)], N. Bergeot[(1)], A. Santamaría-Gómez[(2,3)], M.N. Bouin[(4)], G. Wöppelmann[(5)], Z. Altamimi[(3)]

(1) Royal Observatory of Belgium, Brussels, Belgium,
(2) Instituto Geográfico Nacional, Madrid, Spain,
(3) LAREG/IGN, Marne-la-Vallée, France,
(4) CNRM / Centre de Météo Marine, Brest, France,
(5) UMR LIENSS, Université de La Rochelle-CNRS, La Rochelle, France

Acknowledgment: Xavier Collilieux

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MOTIVATION

- Background: Regional GNSS reprocessing / EPN
- Is it necessary to add global GNSS stations to the data processing of a regional network (e.g. the EPN) in order to estimate reliable site positions, velocities & residual position time series ?
- Quantify the network effect on a regional network
  - positions
  - velocities
  - residual position time series

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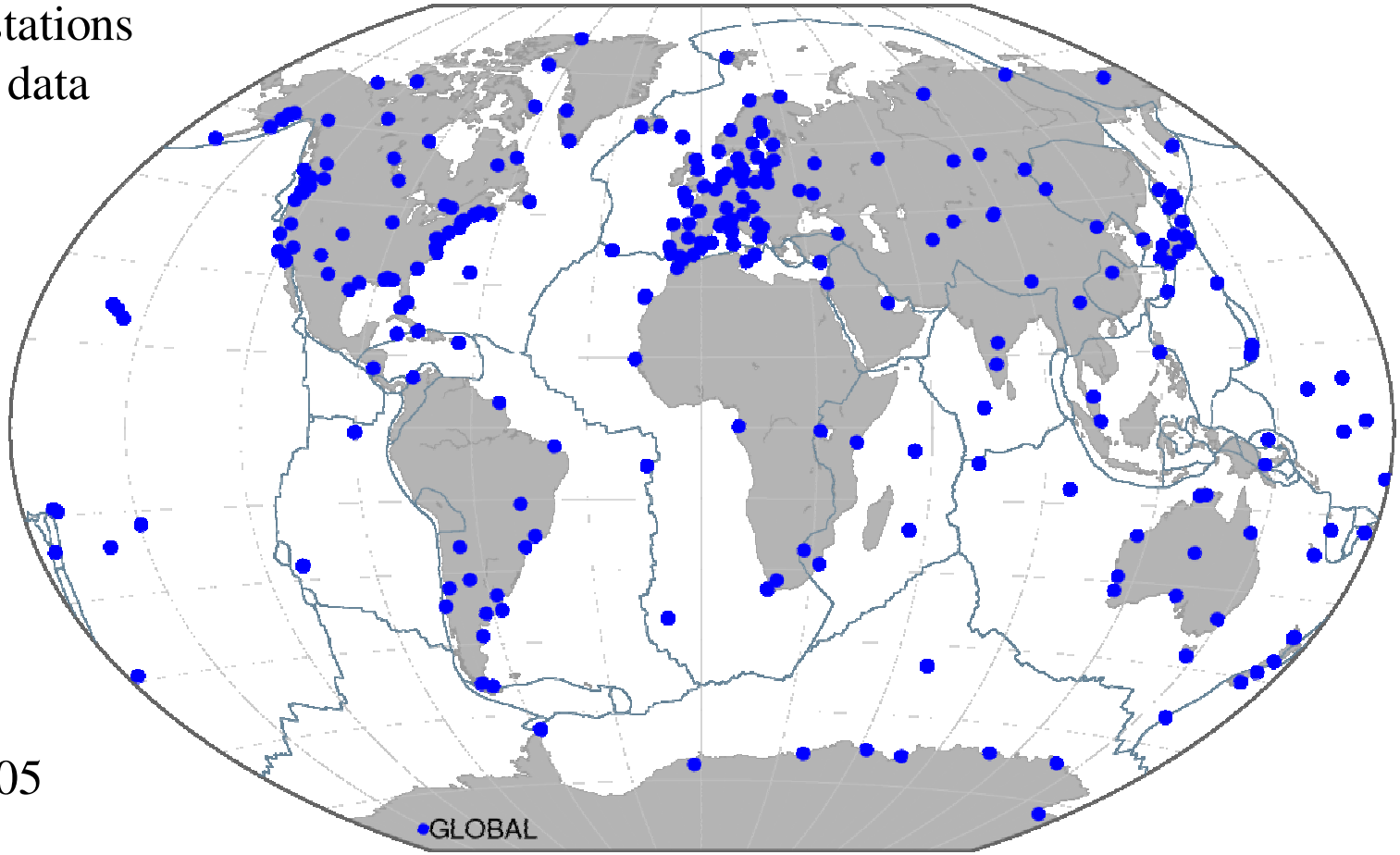
DATA AND NETWORK

ULR reprocessing: contribution to TIGA project [Santamaría-Gómez et al., in press]

Weekly global SINEXs from 1996-2009

265 continuous GPS stations
with >3.5 years of data



Weekly SINEXs
expressed in ITRF2005

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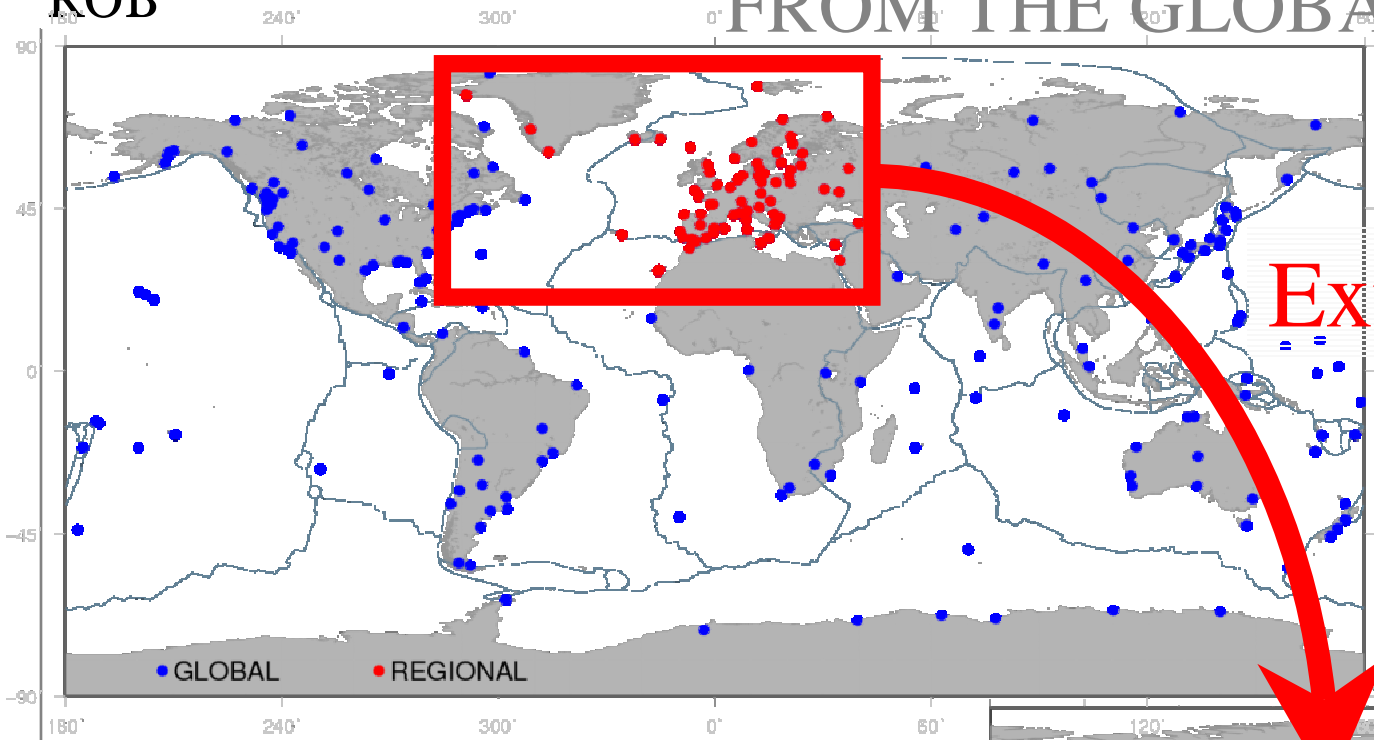
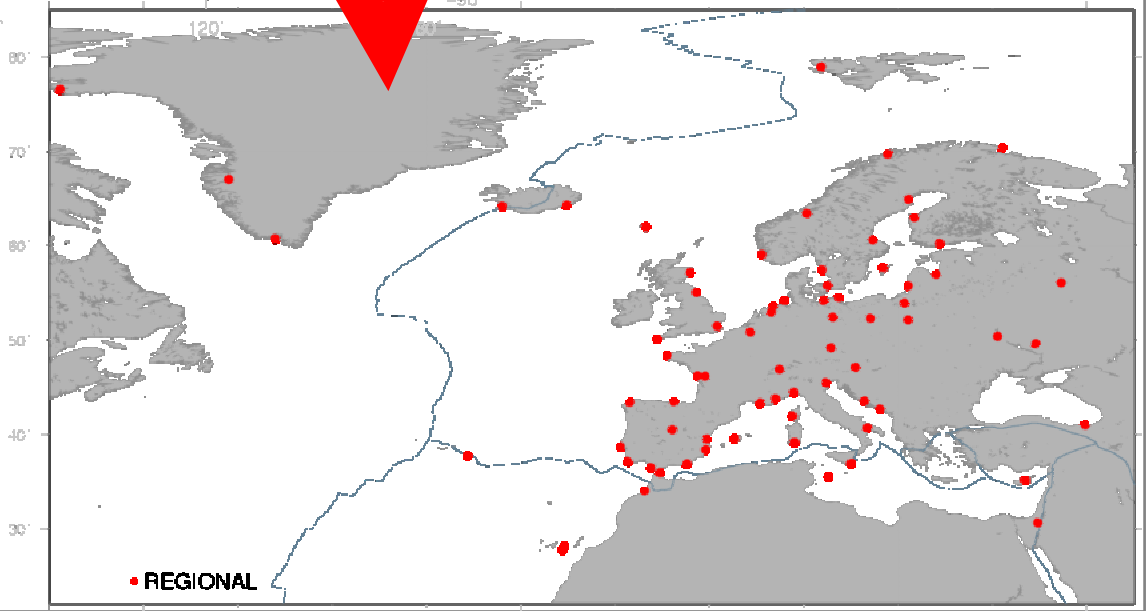
CREATION OF THE REGIONAL WEEKLY SINEXS FROM THE GLOBAL WEEKLY SINEXS



Global weekly SINEXs
265 stations

Extraction

Regional weekly SINEXs
74 stations
which belong to the EPN



Same coordinates and covariance information for the common stations !!

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POSITION AND VELOCITY ESTIMATIONS

- Regional and Global weekly SINEXs
- Stacked with CATREF Software [Altamimi, 2007]

  Reject outliers and properly handle discontinuities
- Regional and Global cumulative solutions

  (positions & velocities)

- Datum definition:

  expressed in ITRF2005 under minimal constraints approach (14 parameters) using a selection of reference stations:
  - good agreement between the solution and the ITRF2005
  - at least 3 years of data in the ITRF2005 and in the ULR time series

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INITIAL RESULTS

Several sets of reference stations were tested

Global network:

behave in a stable way

Regional network:

more sensitive to the set of reference stations

- Outliers
- Geometry

Quantify the network effect with 3 representative solutions

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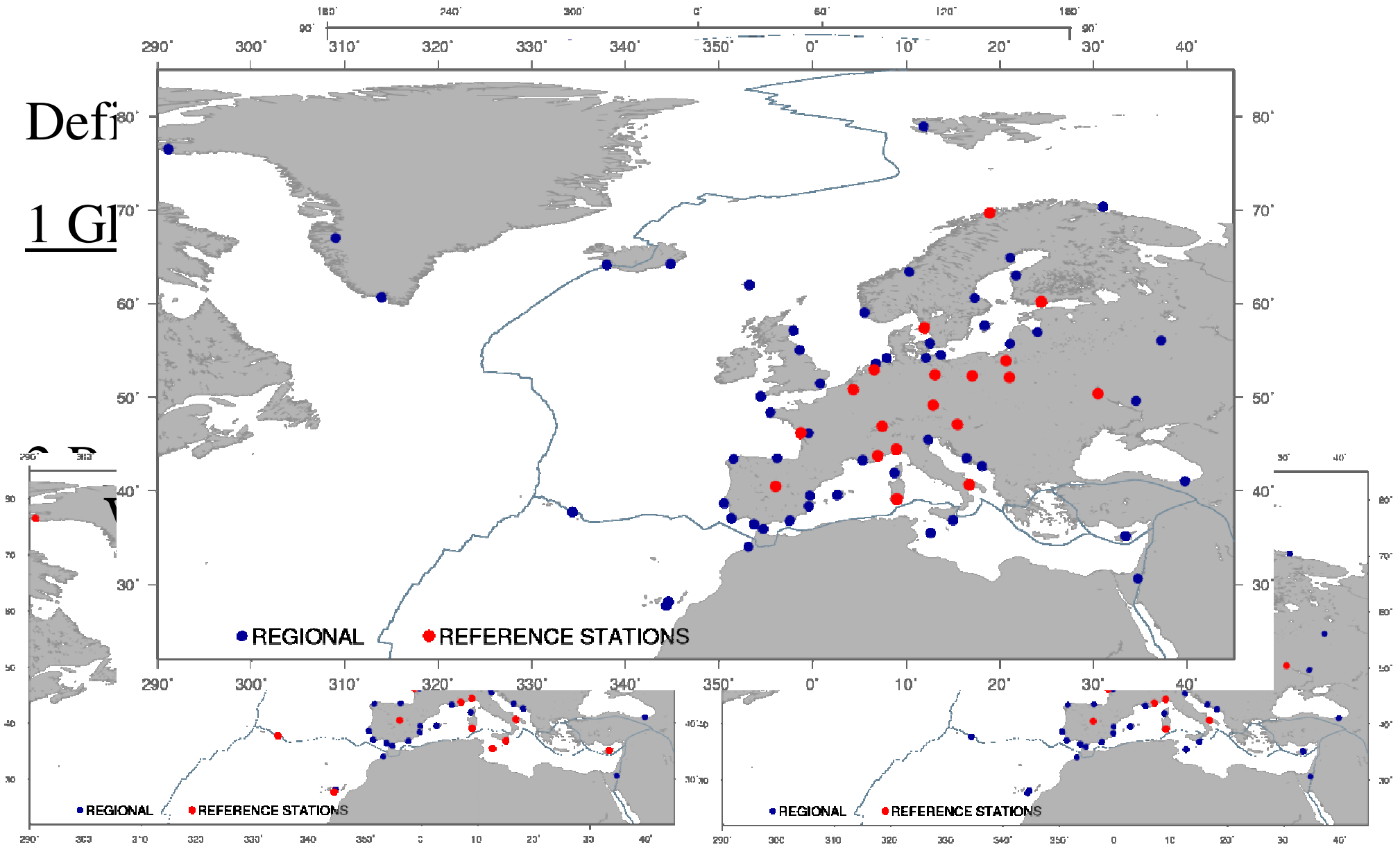
3 REPRESENTATIVE SOLUTIONS

Defi

1 Gl



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DIFFERENCE BETWEEN GLOBAL AND REGIONAL POSITIONS AND VELOCITIES

Long term cumulative positions and velocities

Position differences [mm]		RMS	Max.
Horizontal	Reg. A – Global	0.9	2.5
	Reg. B – Global	1	3.2
Vertical	Reg. A – Global	1.7	6.8
	Reg. B – Global	2.1	7.8

Velocity differences [mm/yr]		RMS	Max.
Horizontal	Reg. A – Global	0.3	0.6
	Reg. B – Global	0.5	1.1
Vertical	Reg. A – Global	0.6	1.4
	Reg. B – Global	0.6	1.7

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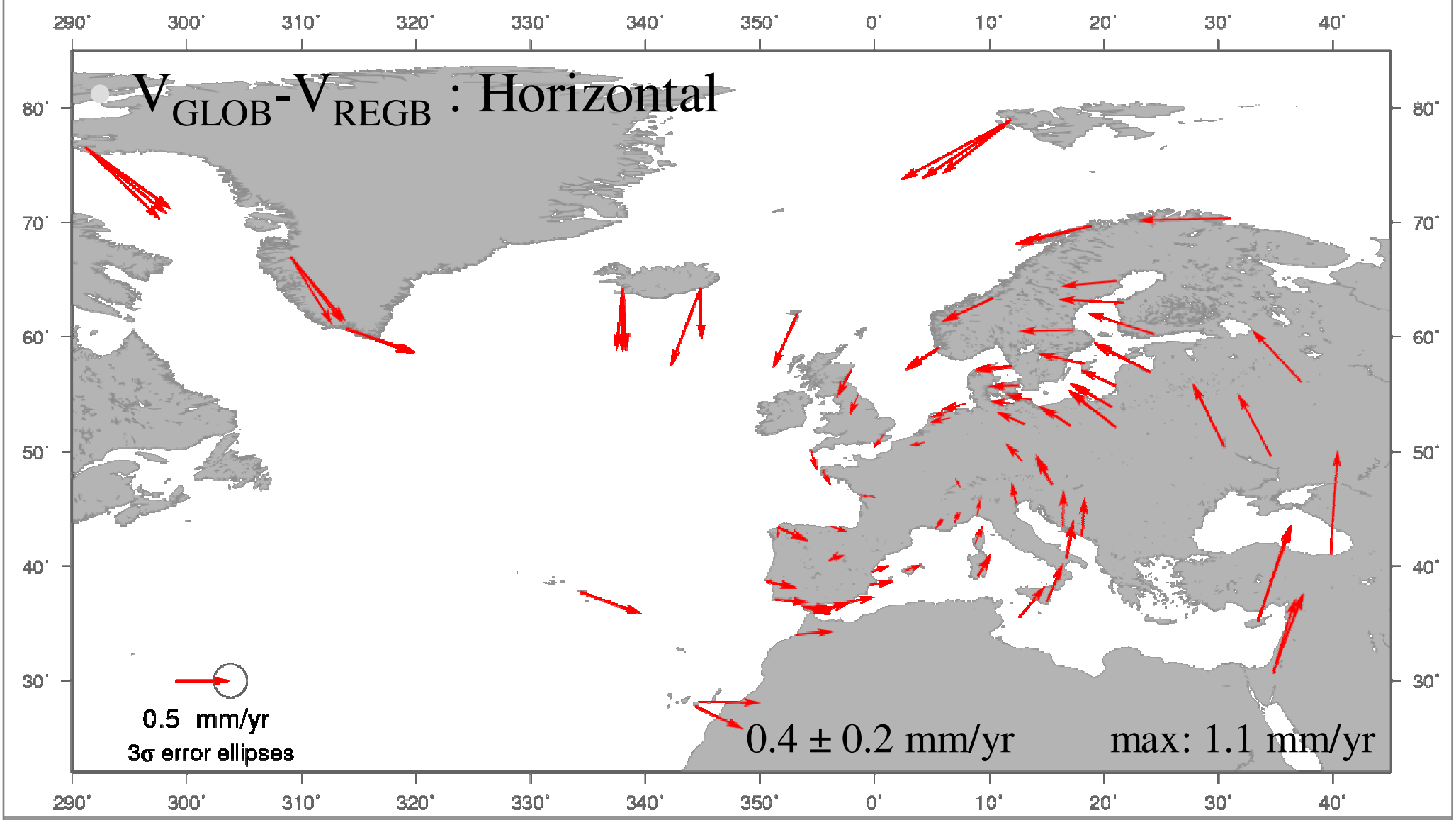
DIFFERENCE BETWEEN GLOBAL AND REGIONAL VELOCITIES (1)



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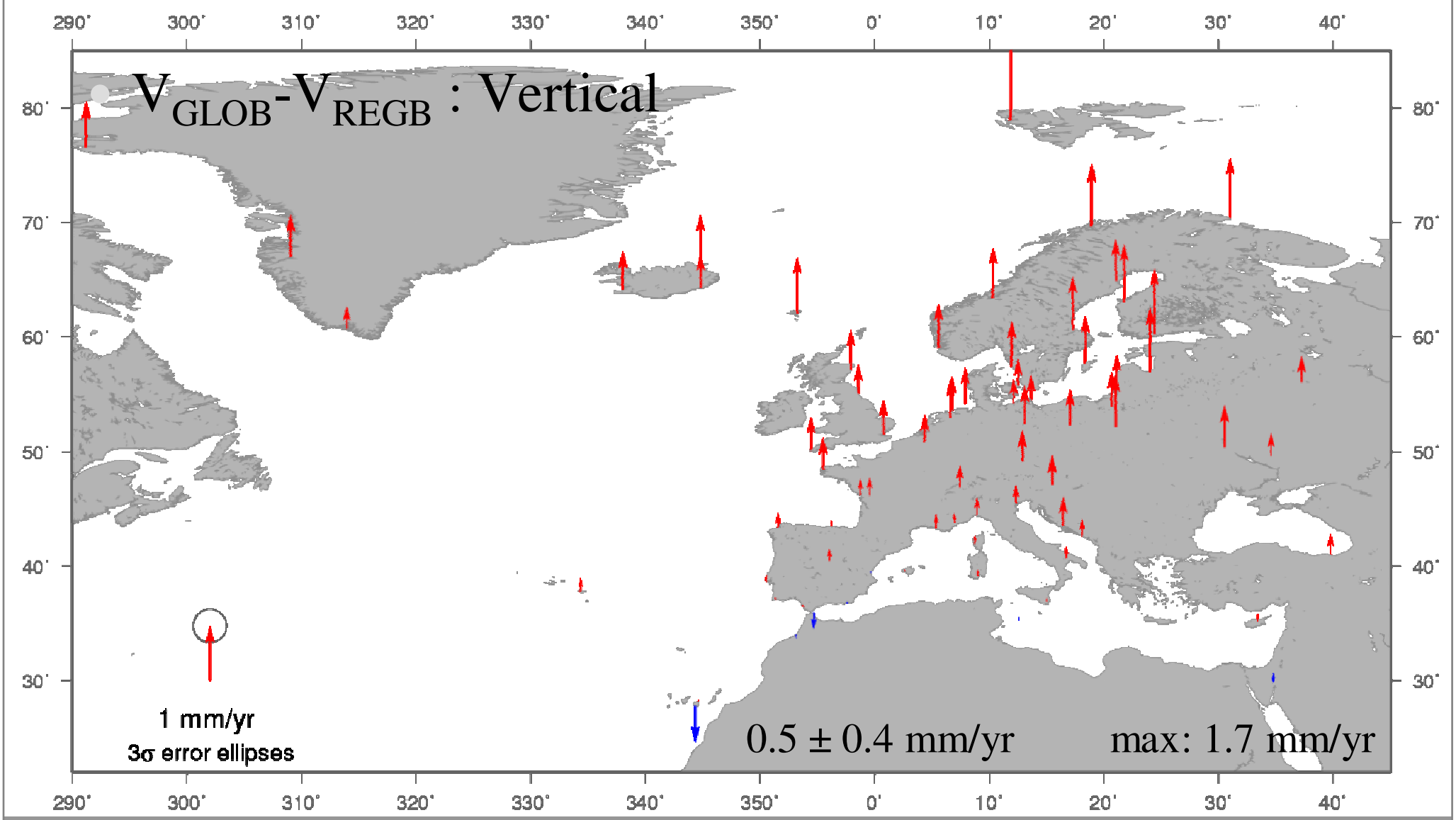
DIFFERENCE BETWEEN GLOBAL AND REGIONAL VELOCITIES (2)



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SUMMARY
POSITION AND VELOCITY DIFFERENCES

- Network effect causes discrepancies between two regional solutions or between regional and global solutions
  - Short-term positions [Legrand et al., 2009]:
    - Horizontal components: 8 mm
    - Up component: 2 cm
  - Long-term positions:
    - Horizontal components : 3-5 mm
    - Up component: 1 cm
  - Velocities:
    - Horizontal components : 1 mm/yr
    - Up component: 2 mm/yr

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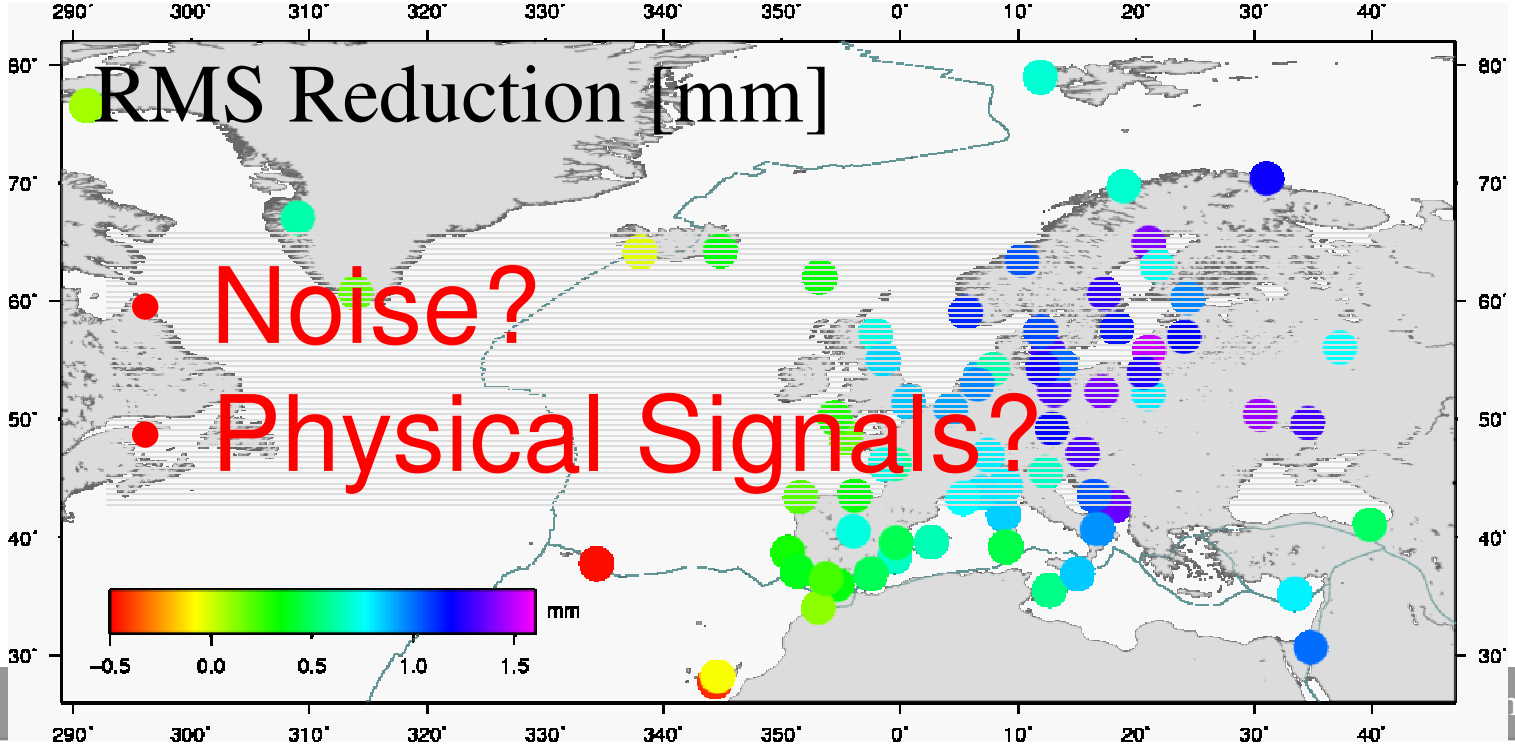
RESIDUAL POSITION TIME SERIES

~ 30 % RMS reduction for the 3 components when processing a regional network instead of a global network

Median RMS residual time series	Global [mm]	Regional [mm]	Reduction
Horizontal	1.3	1.0	30.0 %
Vertical	4.2	3.3	27.3 %



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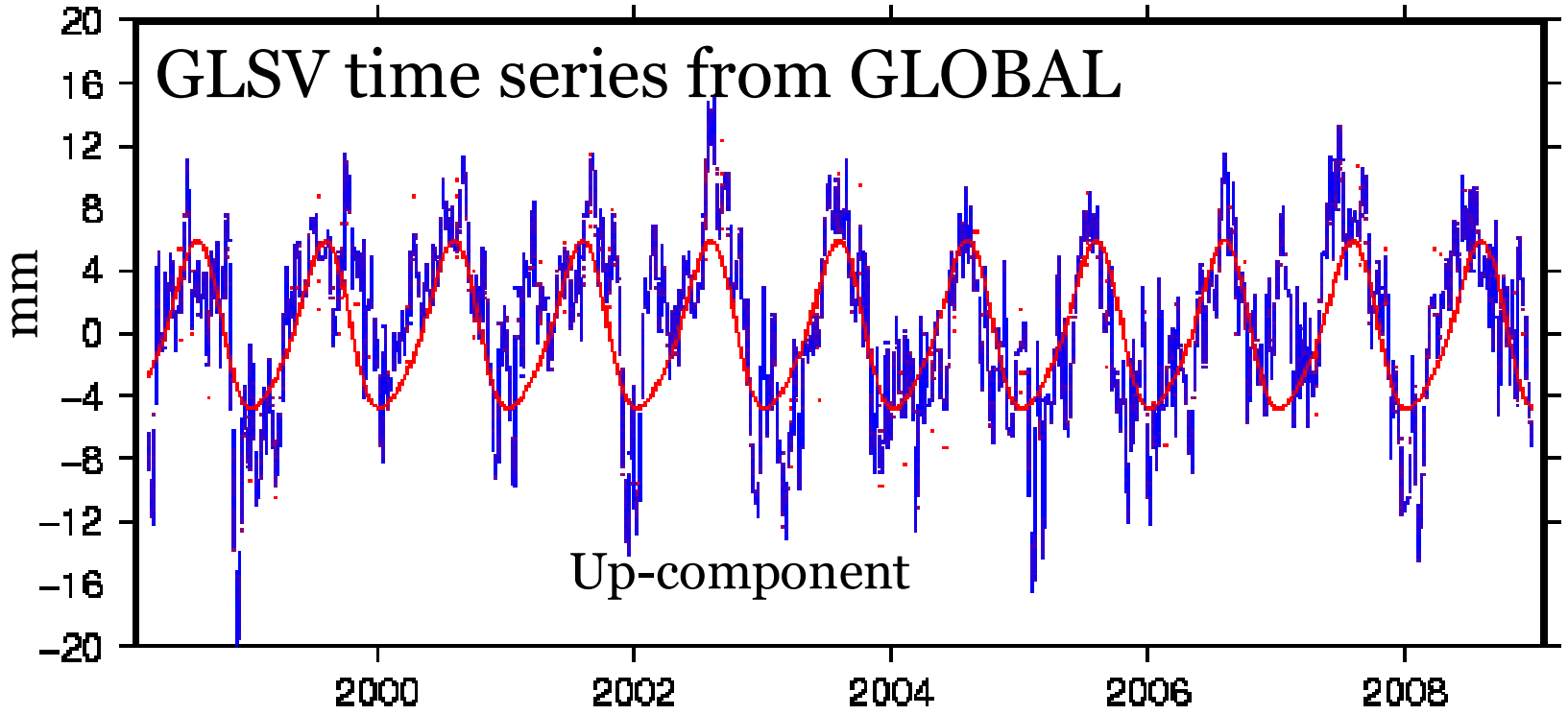
RESIDUAL POSITION TIME SERIES (UP) (1)

- The annual and semi-annual terms have been estimated.



RMS:	5.8 mm
Annual signal amplitude:	5.2 mm
Semi-annual signal amplitude:	0.9 mm

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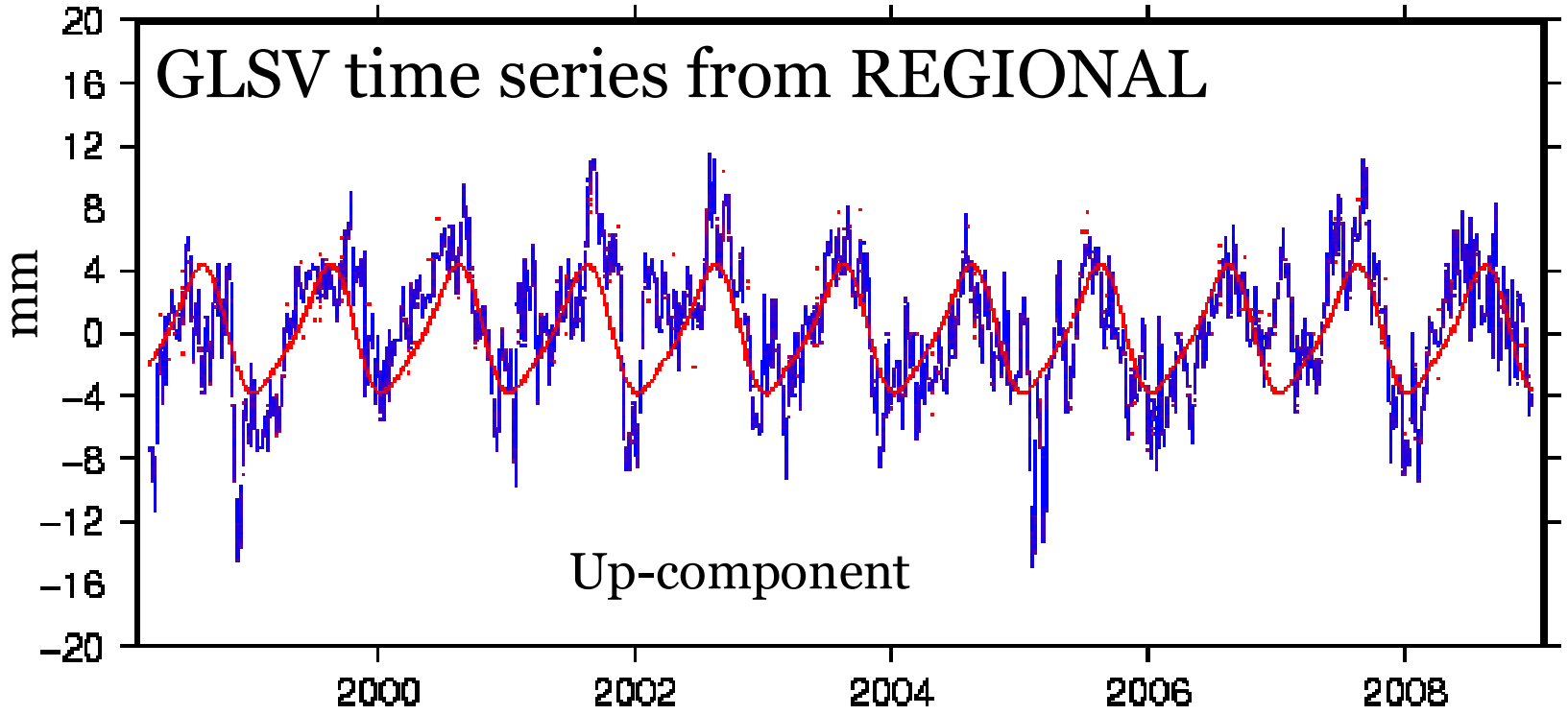
RESIDUAL POSITION TIME SERIES (UP) (2)

- The annual and semi-annual terms have been estimated.



RMS:	4.3 mm
Annual signal amplitude:	3.8 mm
Semi-annual signal amplitude:	0.8 mm

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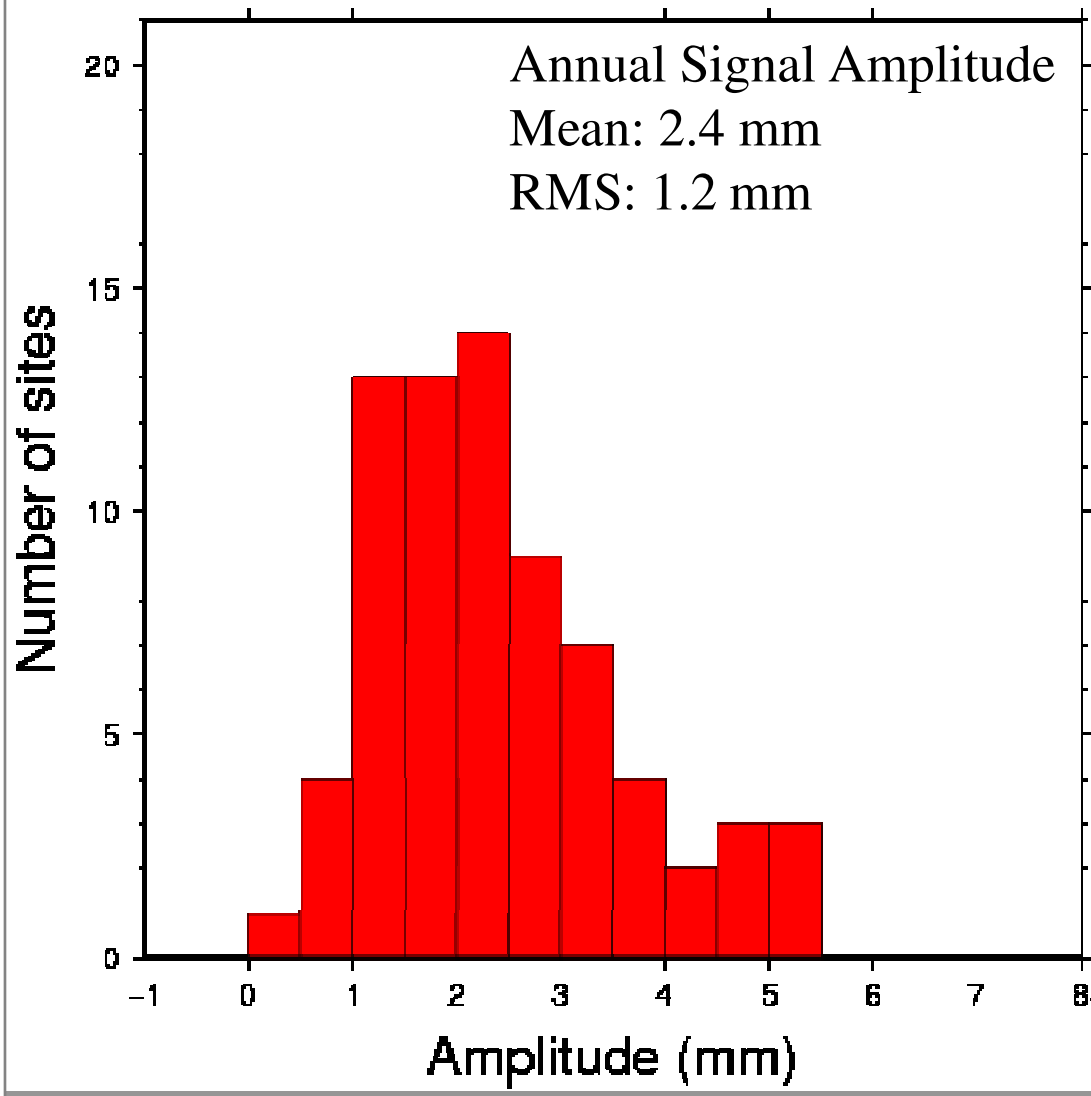
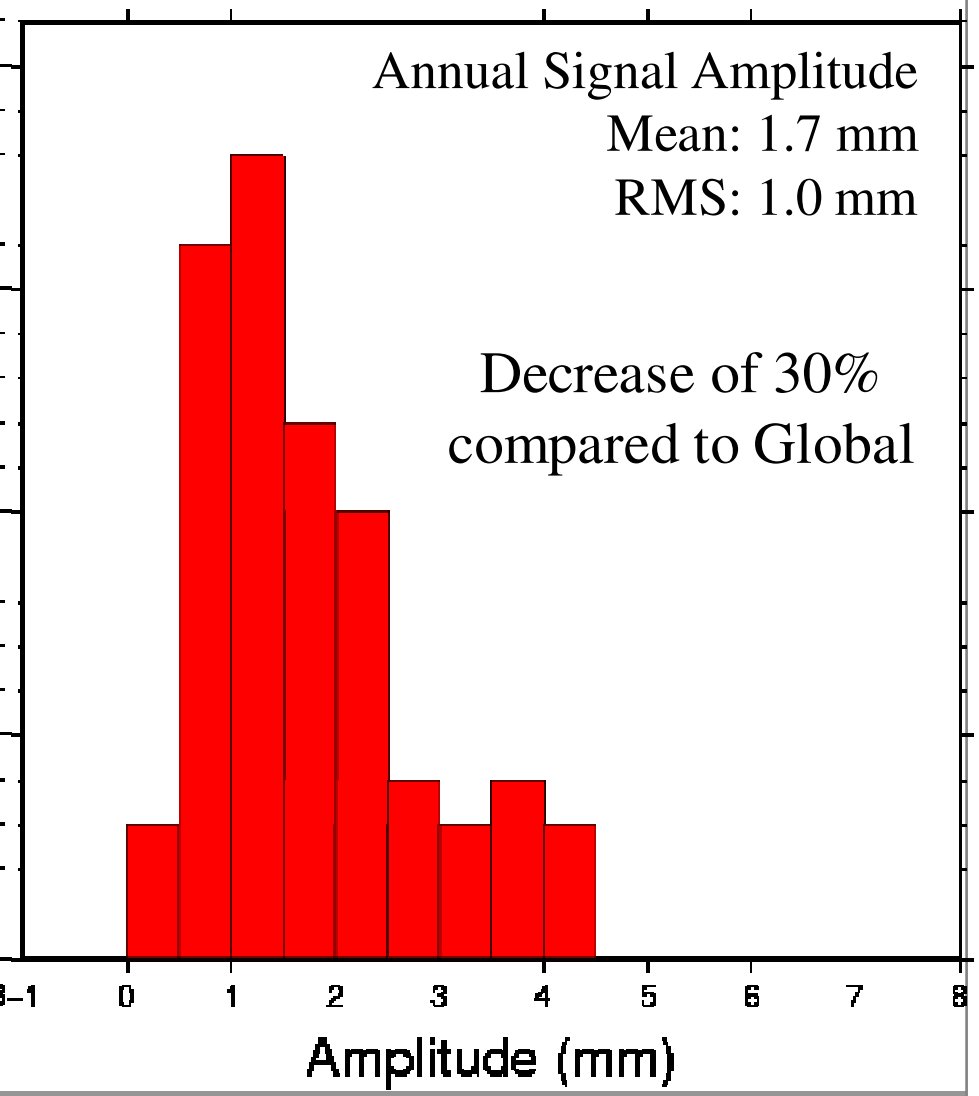
ANNUAL SIGNALS IN RESIDUAL POSITION TIME SERIES (UP) (1)

GLOBAL



REGIONAL



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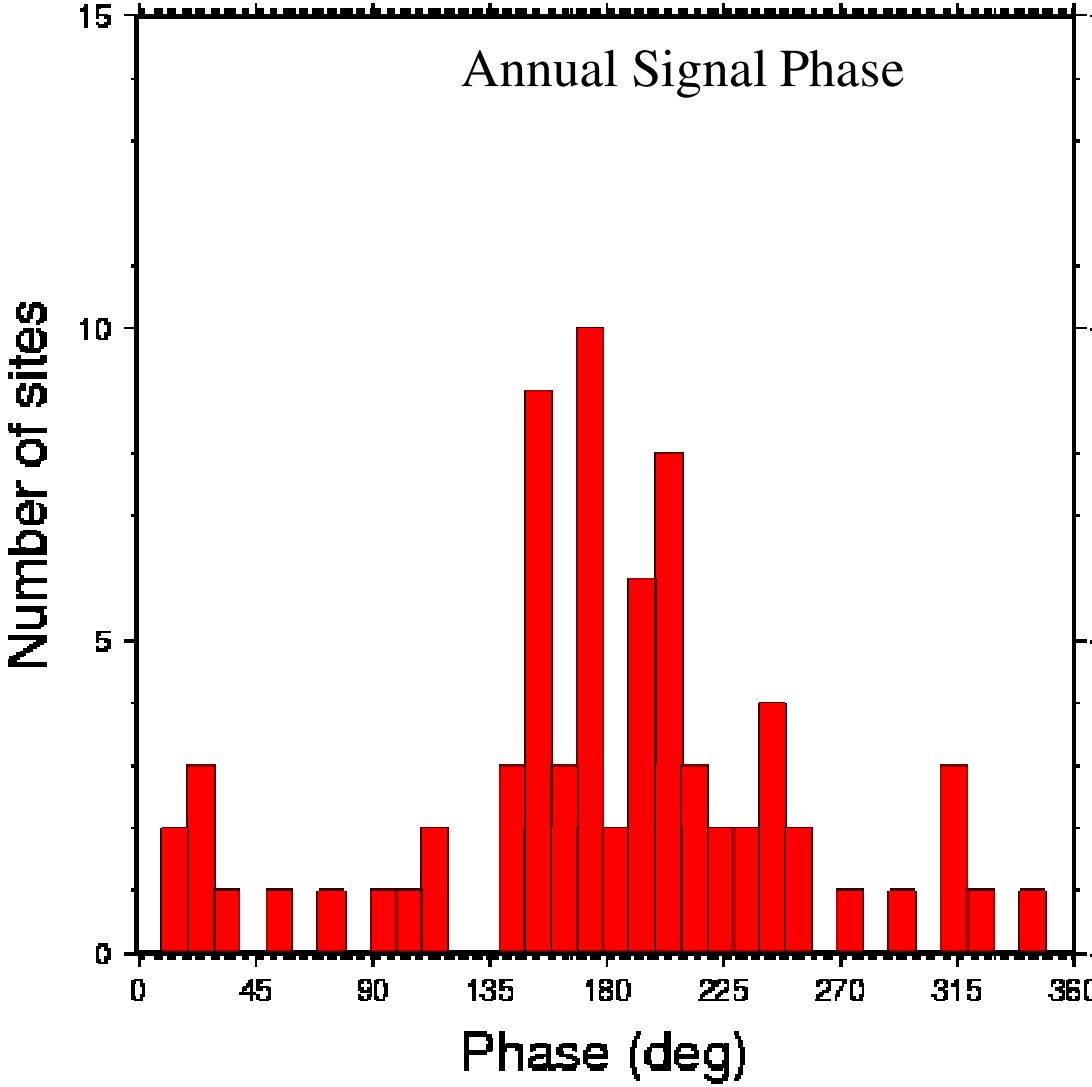
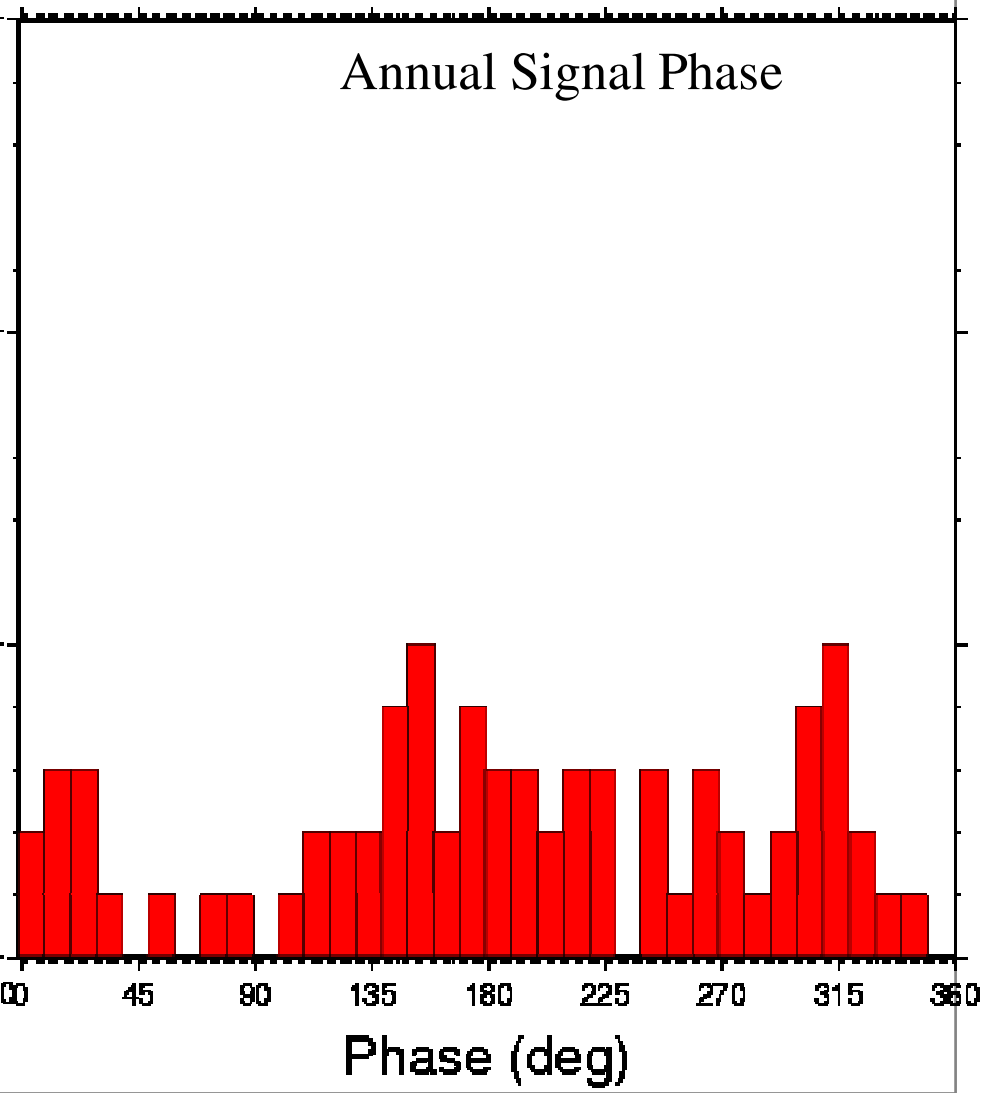
ANNUAL SIGNALS IN RESIDUAL POSITION TIME SERIES (UP) (2)

GLOBAL



REGIONAL



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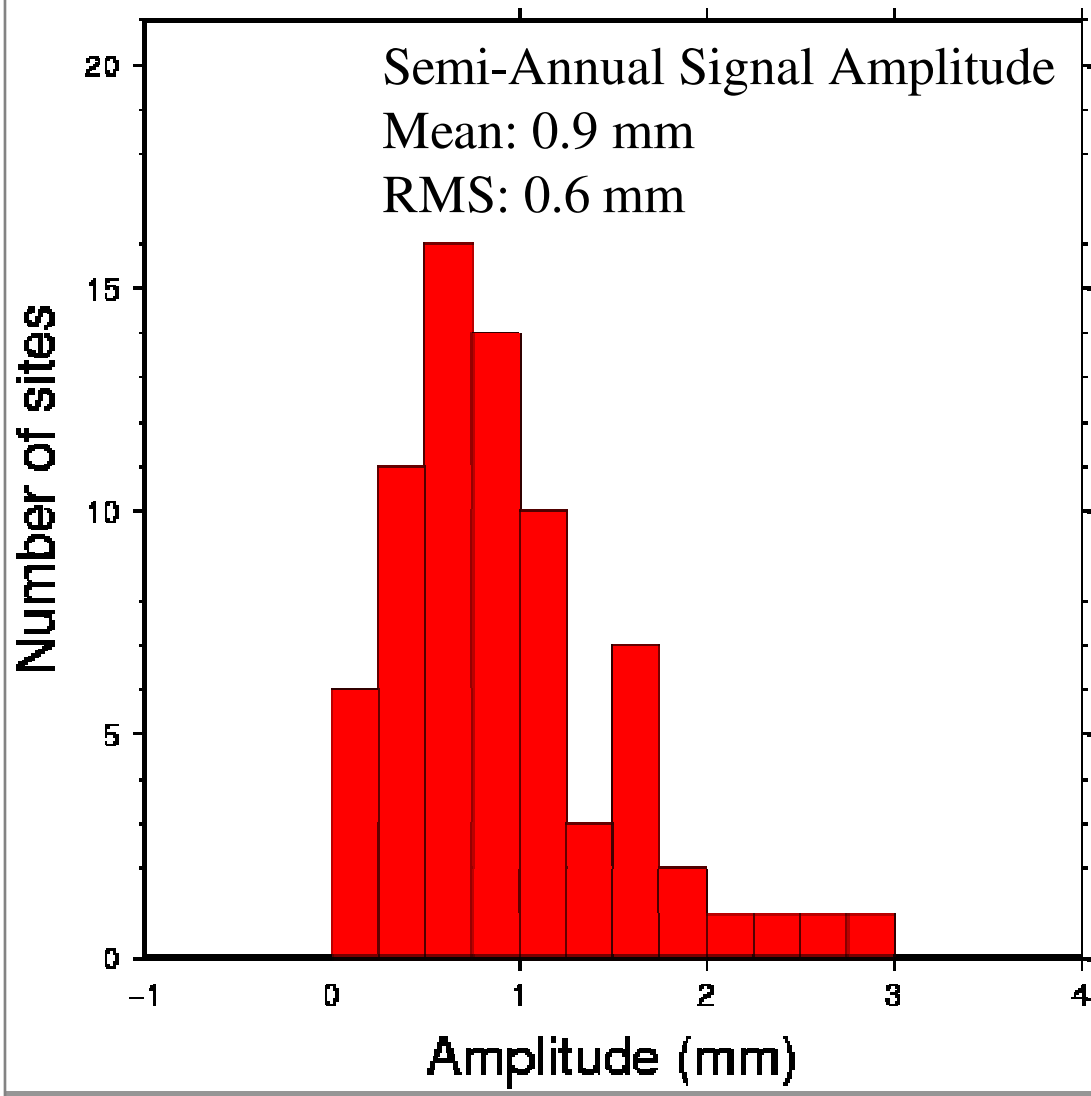
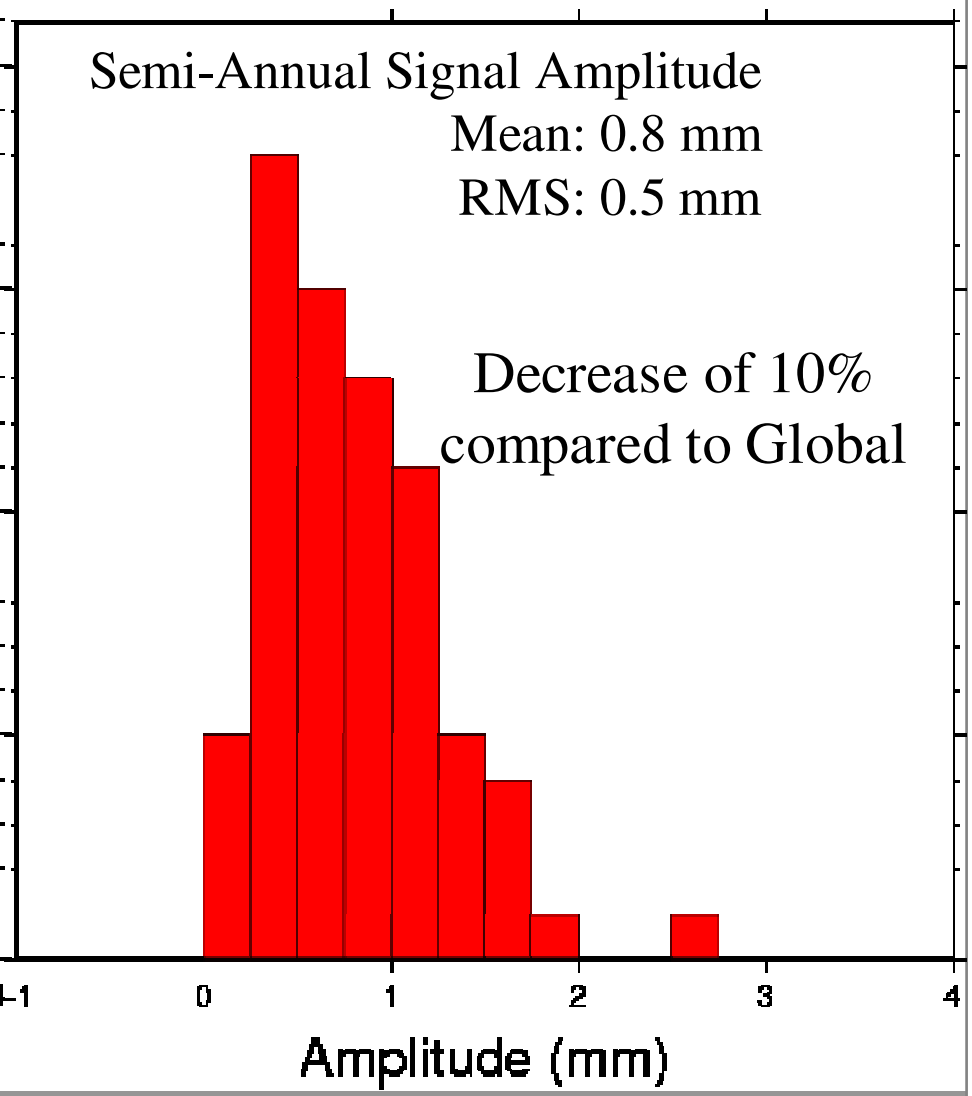
SEMI-ANNUAL SIGNALS IN RESIDUAL POSITION TIME SERIES (UP)

GLOBAL



REGIONAL



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SUMMARY
RESIDUAL POSITION TIME SERIES

- Change in Annual and Semi-annual signals
  - Amplitude reduction

Amplitude Reduction	Annual signal	Semi-annual signal
East	8%	9%
North	15%	9%
Up	27%	10%

  - Change in phase
- Common mode signals are absorbed during the stacking, inducing that the regional network underestimates the amplitude of the annual and semi-annual signals.

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SUMMARY
REGIONAL VS. GLOBAL

- Regional Positions and Velocities
  - Systematic effects which exceed the noise level
  - Effects are amplified when the regional reference stations cover a smaller geographical area
- Signals in regional residual position time series :
  - Decrease in amplitude (~30 %)
  - Change in phase
  - Regional and global networks can lead to different geodynamic or geophysical interpretations
  - Global positions, velocities and residual position time series are more reliable than Regional one