NATIONAL CADASTRE & MAPPING AGENCY S.A.

Observing co-seismic displacements using 1-Hz GPS data from a network of reference stations: A comparison of different data processing methods

M. Gianniou

National Cadastre and Mapping Agency S.A.

Outline

1. Introduction
2. Earthquake investigated
3. Data analysis
   - PPP results
   - Baseline results
4. Conclusions

1. Introduction

Objective of the work

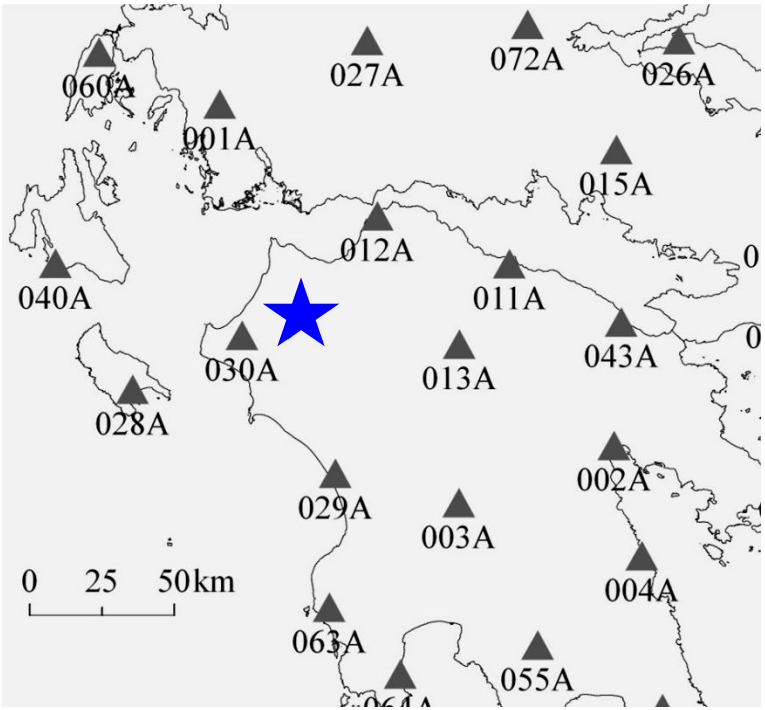
- **1Hz GNSS data from permanent reference stations are useful for the detection of co-seismic displacements:**
- **Two positioning methods are being tested:**
  - **Geodetic relative positioning in kinematic mode** (double-differenced carrier phase observations)
  - **Precise Point Positioning (PPP)**
- **The two methods are compared using data from HEPOS, the Hellenic RTK network.**

1. Introduction

Comparison of the two methods for kinematic positioning

- **PPP:**
  - **No need for a base station**
  - **Increased noise level**
- **Geodetic relative positioning:**
  - **Potential for highest accuracy and precision, but performance depends on the baseline length.**
  - **If the base station is close to the epicenter, it can be also in motion. To ensure unbiased results the base station should be far enough.**
  - **the distance between the stations is important for the performance of the method.**

2. Earthquake investigated

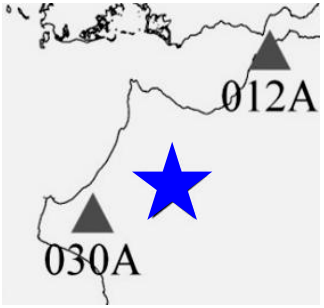


- **June 8, 2008**
- **Magnitude: 6.4 Mw**
- **Depth: 25 km**

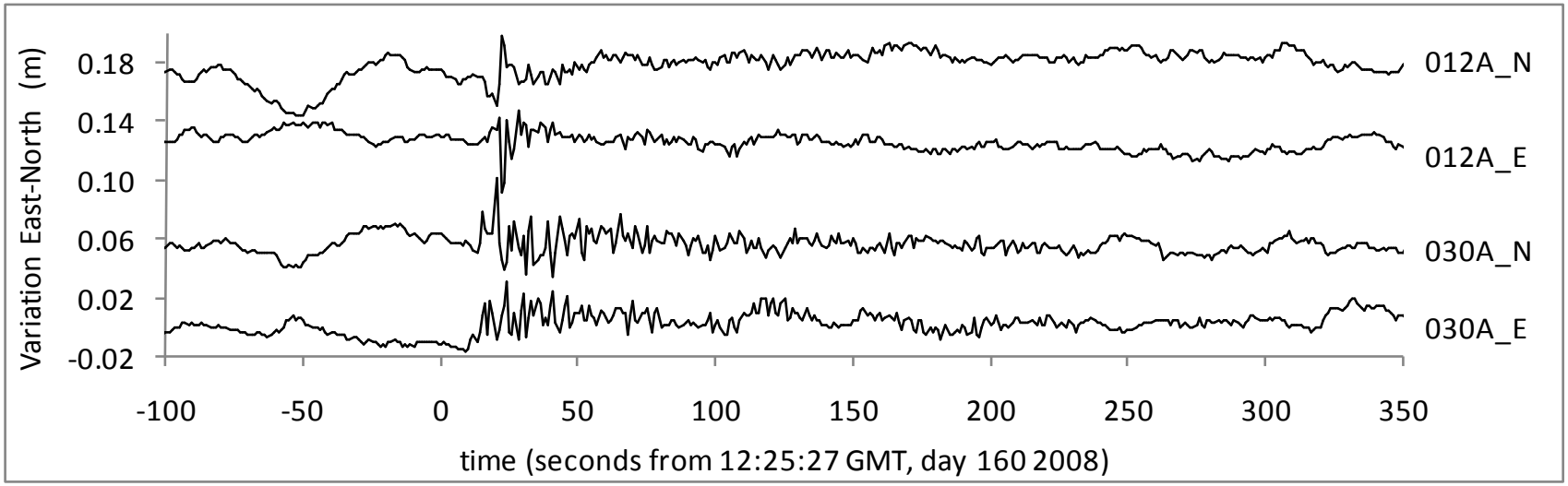
Besides its characteristics (Magnitude, depth) this event was chosen for the investigation, because the epicenter is surrounded by HEPOS stations.

3. Data Analysis

PPP results



Time-series of coordinates:
stations 030A, 012A.



3. Data Analysis

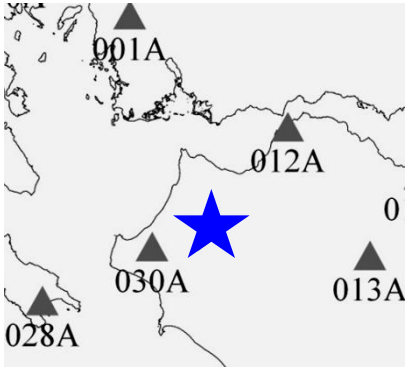
PPP results

- Due to the noise level of the coordinate time-series it is difficult to estimate:
  - the arrival time of the seismic wave
  - the duration of the co-seismic displacements.

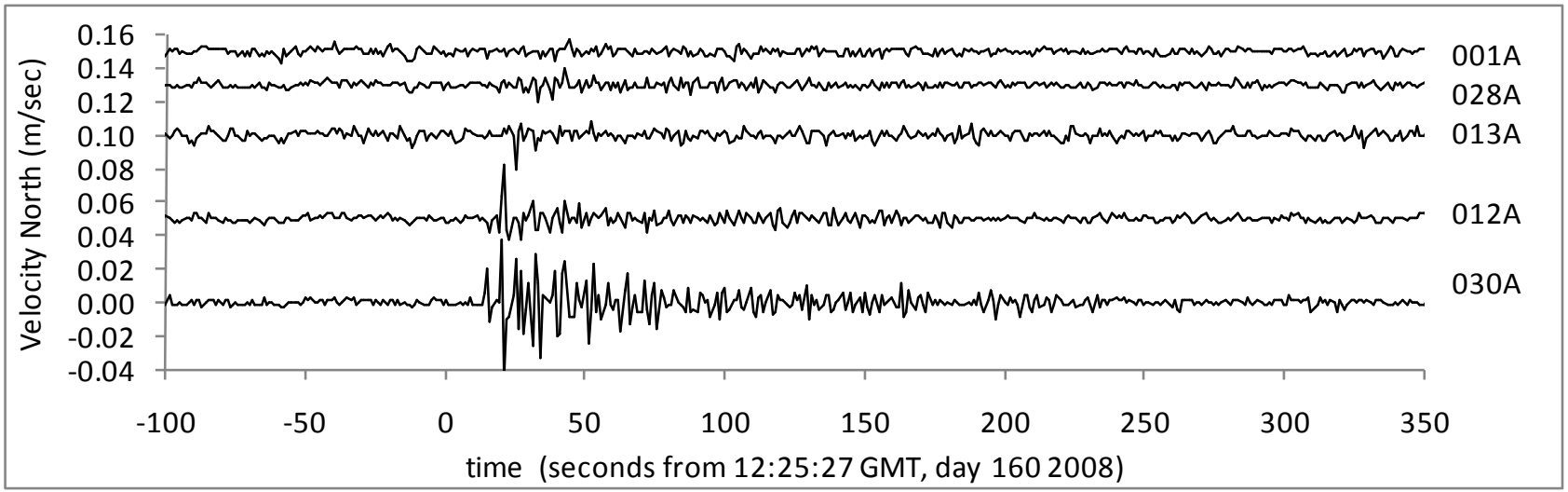
- To overcome this problem velocities are being computed.

3. Data Analysis

PPP results

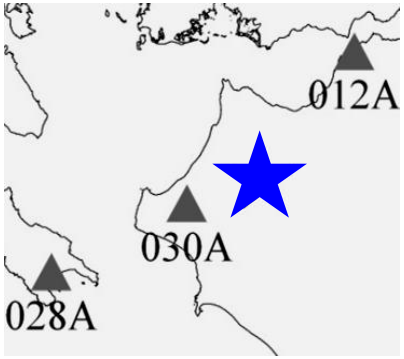


Time-series of velocity (North component):
stations 030A, 012A, 013A, 028A, 001A.

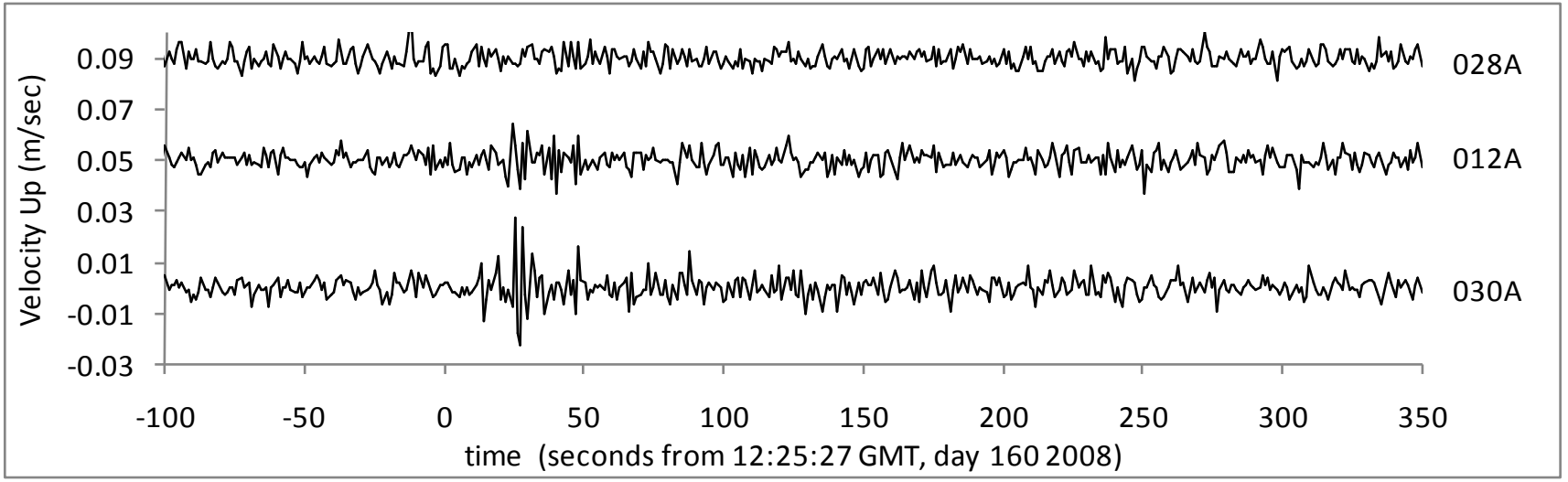


3. Data Analysis

PPP results

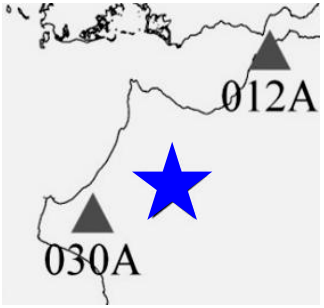


Time-series of velocity (Up component):
stations 030A, 012A, 028A.

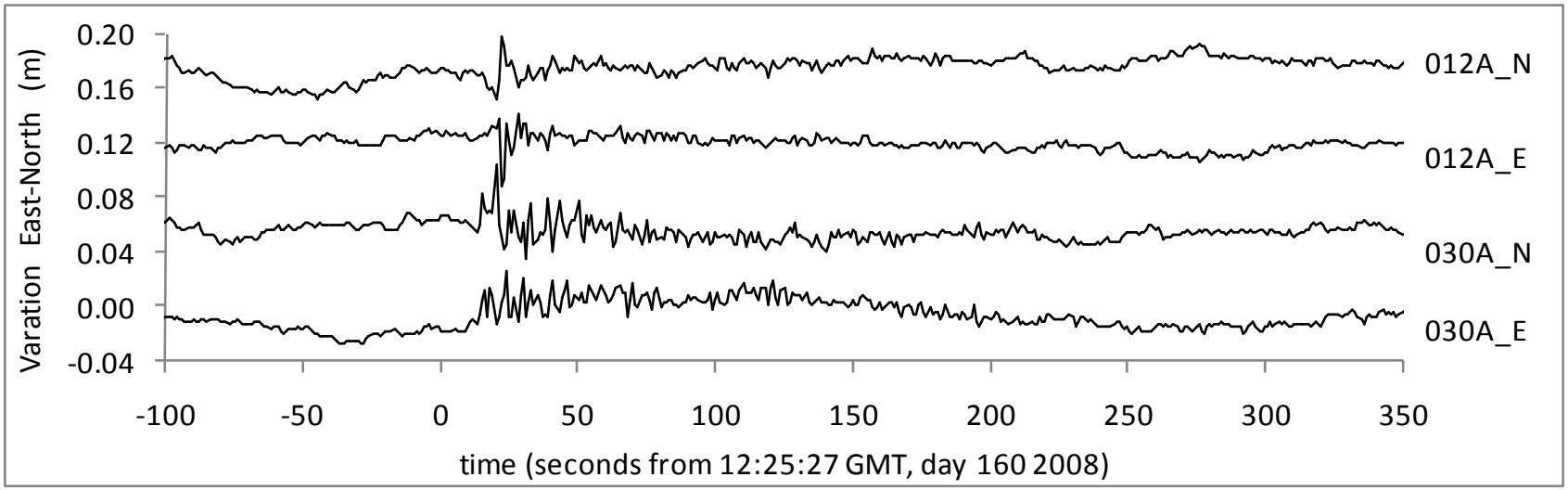


3. Data Analysis

Baseline results

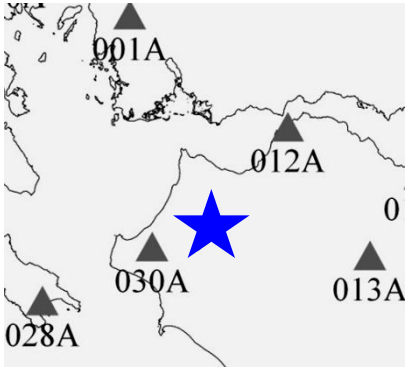


Time-series of coordinates:
stations 030A, 012A.

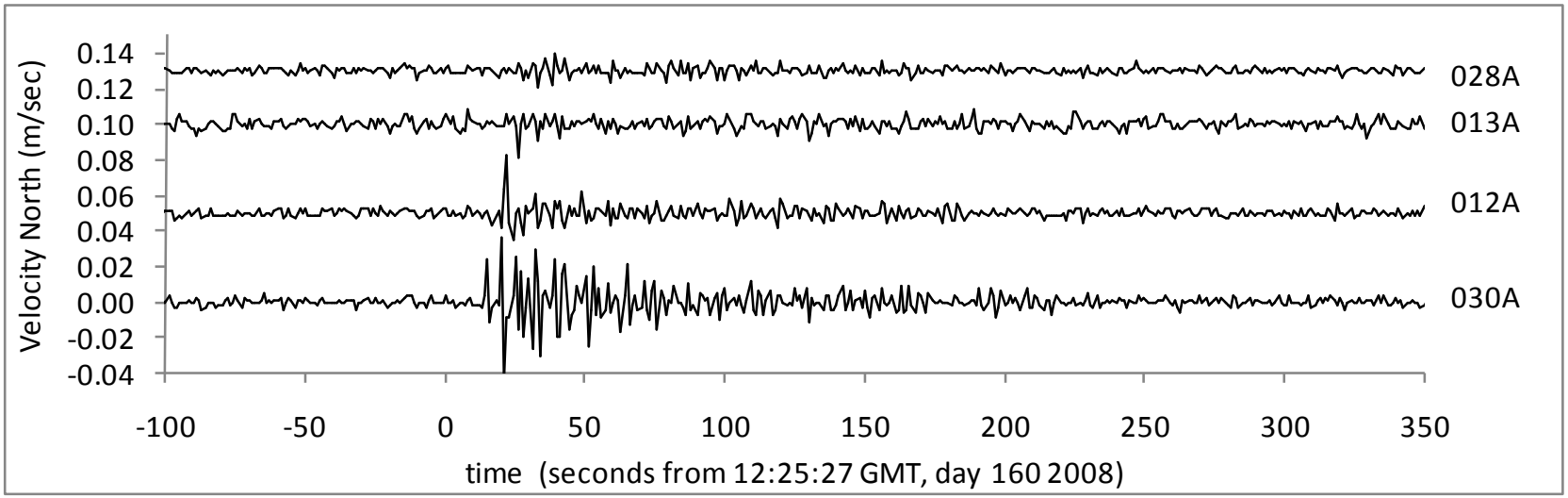


3. Data Analysis

Baseline results

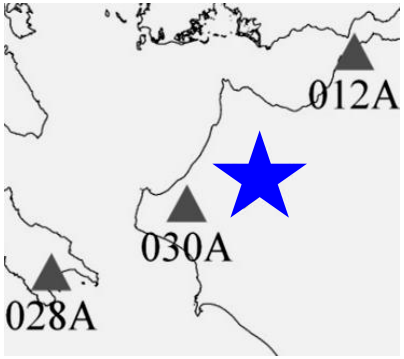


Time-series of velocity (North component):
stations 030A, 012A, 013A, 028A, 001A.

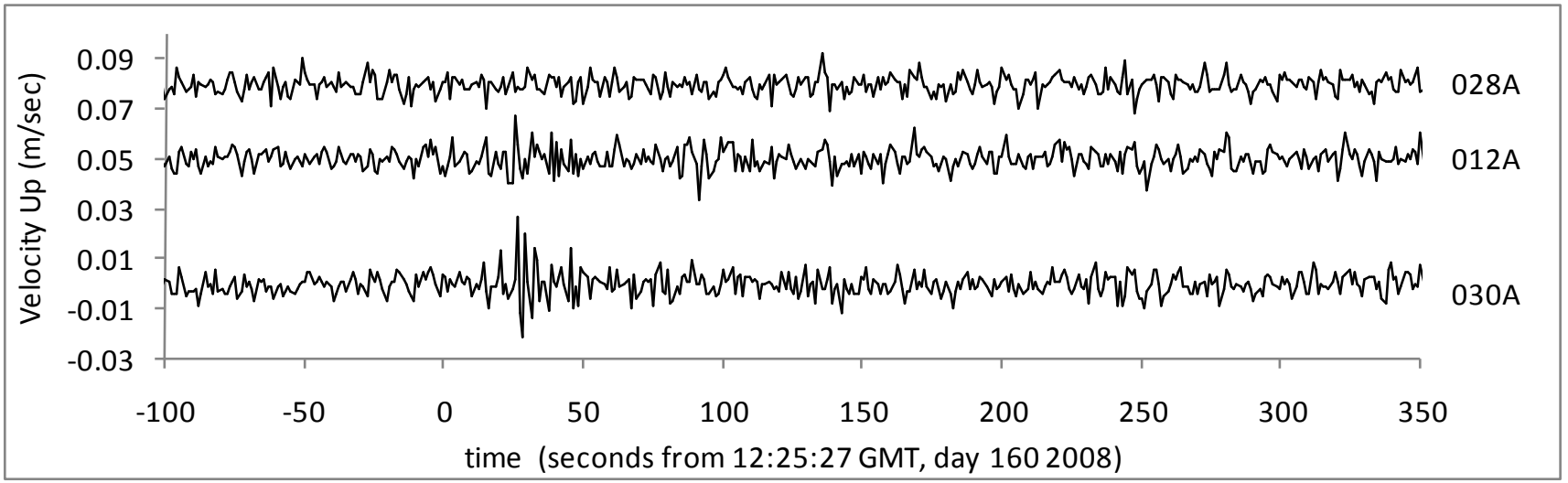


3. Data Analysis

Baseline results



Time-series of velocity (Up component):
stations 030A, 012A, 028A.



3. Data Analysis

Comparison of PPP and Baseline results

East-North-Up displacements (mm) during the event (peak to peak values)

	030A			012A			013A			028A		
	E	N	U	E	N	U	E	N	U	E	N	U
PPP solution	47	67	42	56	47	-	-	-	-	-	-	-
Baseline solution	40	69	-	53	46	-	-	-	-	-	-	-

East-North-Up velocities (mm/sec) during the event (peak to peak values)

	030A			012A			013A			028A		
	E	N	U	E	N	U	E	N	U	E	N	U
PPP solution	58	82	50	94	44	27	12	28	-	9	20	-
Baseline solution	57	79	48	91	47	23	12	25	-	11	19	-

4. Conclusions

- **Peak-to-peak motions exceeding 6 cm have been revealed using both PPP and baseline solutions.**
- **Regarding the estimation of the displacements' amplitude, the PPP and the baseline approaches complement each other: Short-baselines show lower noise, but usually yield relative displacements (motion of the base station), whereas PPP solutions offer absolute displacements.**
- **The velocities proved to be more appropriate than the coordinates for estimating:**
  - **the arrival time of the seismic wave**
  - **the duration of the co-seismic displacements.**

Acknowledgments

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