

EPN DENSIFICATION

*** PREPARED TO PUBLISH ***

AMBRUS KENYERES

CHAIR OF EPN DENSIFICATION WORKING GROUP

A BARON - A CAPORALI - F DE DONCKER - B DROSCAK - A DURET -
P FRANKE - I GEORGIEV - D HANSEN - L HUISMAN - L JIVALL - O KHODA -
K MOROZOVA - J NAGL - X PAPANIKOLAOU - E PARSEULINAS -
P PIHLAK - G STANGL - M VALDES - M RYCZYWOLSKI

C BRUYNINX - J LEGRAND

AND MANY MORE . . .

EUREF 2017 Symposium

WROCLAW May 17-19, 2017



ZIMM00CHE

DELFO00NL

WROC00POL

POTS00DEU

FLRS00PRT

OSLS00NGR

TUBO00CZE

MARS00FRA

GRAZ00AUT

KLOP00DEU



MILESTONES / HISTORY

- **2007-2011-2015 - IAG WORKING GROUPS ON DENSE VELOCITY FIELDS**
 - GLOBAL AND REGIONAL COMBINATION TRIAL ON VELOCITY LEVEL
 - METADATA ISSUES PREVENTED THE SUCCESSFUL COMPLETION
 - RESTRICTED TO GLOBAL COMBINATION USING REGIONAL SINEX SERIES
- **2009 - EUPOS COMBINATION CENTRE (5 CE COUNTRIES)**
 - WEEKLY SINEX COMBINATION USING THE FULL VAR-COV INFORMATION
 - SUCCESSFUL PROOF OF THE APPROACH
- **2010 - EPN DENSIFICATION (GAVLE, RESOLUTION #4)**
 - GRADUAL EXTENSION OF TERRITORIAL AND TEMPORAL COVERAGE
 - **BIG STRUGGLE WITH META DATA COLLECTION AND HOMOGENIZATION**
 - RESULTS ARE IN FULL AGREEMENT WITH THE EXPECTATIONS
- **2016 - EPOS COMBINATION**
 - DAILY LEVEL COMBINATION
 - INVOLVEMENT OF NEW DATA
 - IMPORTANT EUREF ROLE ALSO IN THE GEOPHYSICS COMMUNITY
- **2017 - PUBLICATION**

EPN DENSIFICATION

TARGET

COMBINATION OF NATIONAL WEEKLY SINEX SOLUTIONS TO REALIZE HOMOGENEOUS, DENSE EUROPEAN LEVEL **POSITION AND VELOCITY** PRODUCT, CONSIDERED AS DENSIFICATION OF THE ITRF AND ETRS89

MAIN FACTS

- DISTRIBUTED ANALYSIS, NO CENTRALIZED PROCESSING IS NEEDED
- CLEANED AND HOMOGENIZED (station naming) SINEX BACK TO DATA PROVIDERS,
- INDEPENDENT TEST OF THE NATIONAL NATIONAL ETRS89 REALIZATION,
- **COMBINED SOLUTION FREED FROM OCCASIONAL REFERENCE FRAME DEFINITION WEAKNESSES,**
- **MATHEMATICALLY RIGOROUS COMBINATION WITHOUT ANY COMPROMISE!**
- **GEODESY: POSSIBLE EXTENSION OF ETRS89 OVER THE NON-STABLE PART OF EUROPE (VELOCITY MODEL - DEFORMATION WG),**
- **GEOPHYSICS: CONTRIBUTION TO LARGE SCALE TECTONIC INTERPRETATION**

ACHIEVEMENTS

- CONTINENTAL COVERAGE - NORDIC EXTENSION IN PROGRESS
- NATIONAL NETWORKS “INTERNATIONALIZED”
 - LONG TERM **LEARNING AND TEACHING** PROCEDURE
 - META DATA AS CRITICAL INFORMATION
 - **80% DOMES NUMBER** ATTRIBUTED (missing e.g PT, UA)
 - **1094 SITE LOGS** AVAILABLE AT EPNCB
- PRODUCTS (POSITION AND VELOCITY) WILL COME SOON

STILL NEED TO DO

- METADATA COLLECTION TO CONTINUE
- WHITE SPOTS TO BE COLORED
- REPROCESSING

DATA AVAILABILITY - MAY 2017

ASG	Poland	: 1632 -	1929	daily , reprocessed
EST	Estonia	: 1448 -	>1934	
GGI	Latvia	: 1461 -	>1934	
GKU	Slovakia	: 1408 -	>1934	
CZE	Czech R	: 1565 -	>1934	
SGO	Hungary	: 1200 -	>1934	EUPOS contributions
AMON	Austria	: 1356 -	>1934	
MON	Middle East	: 1400 -	>1934	
GRE	Greece	: 1721 -	>1934	
CEGRN	CE-Europe	: 1400 -	>1934	G.Stangl
BUL	Bulgaria	: 1434 -	>1934	daily GAMIT
UPA	Italy	: 1623 -	>1934	
GRAF	Germany	: 1554 -	>1934	
IGN Spain	Spain/Portugal	: 1400 -	>1934	daily
CAT	Catalonia	: 1408 -	>1934	
AGRS	The Netherlands	: 0782 -	1929	
NGI	Belgium	: 1787 -	>1934	
MAO	Ukraine	: 1400 -	>1934	
DSO	Greece	: 0834 -	1877	
ARA	ARANZADI, Spain	: 1750 -	>1934	
LTU	Lithuania	: 1456 -	1876	reprocessing in progress
LM	Lantmateriet, Sweden	: 0860 -	1929	reprocessed
SGN	France	: 0900 -	>1934	GLOBAL
BIGF	UK	: 0900 -	1831	GLOBAL

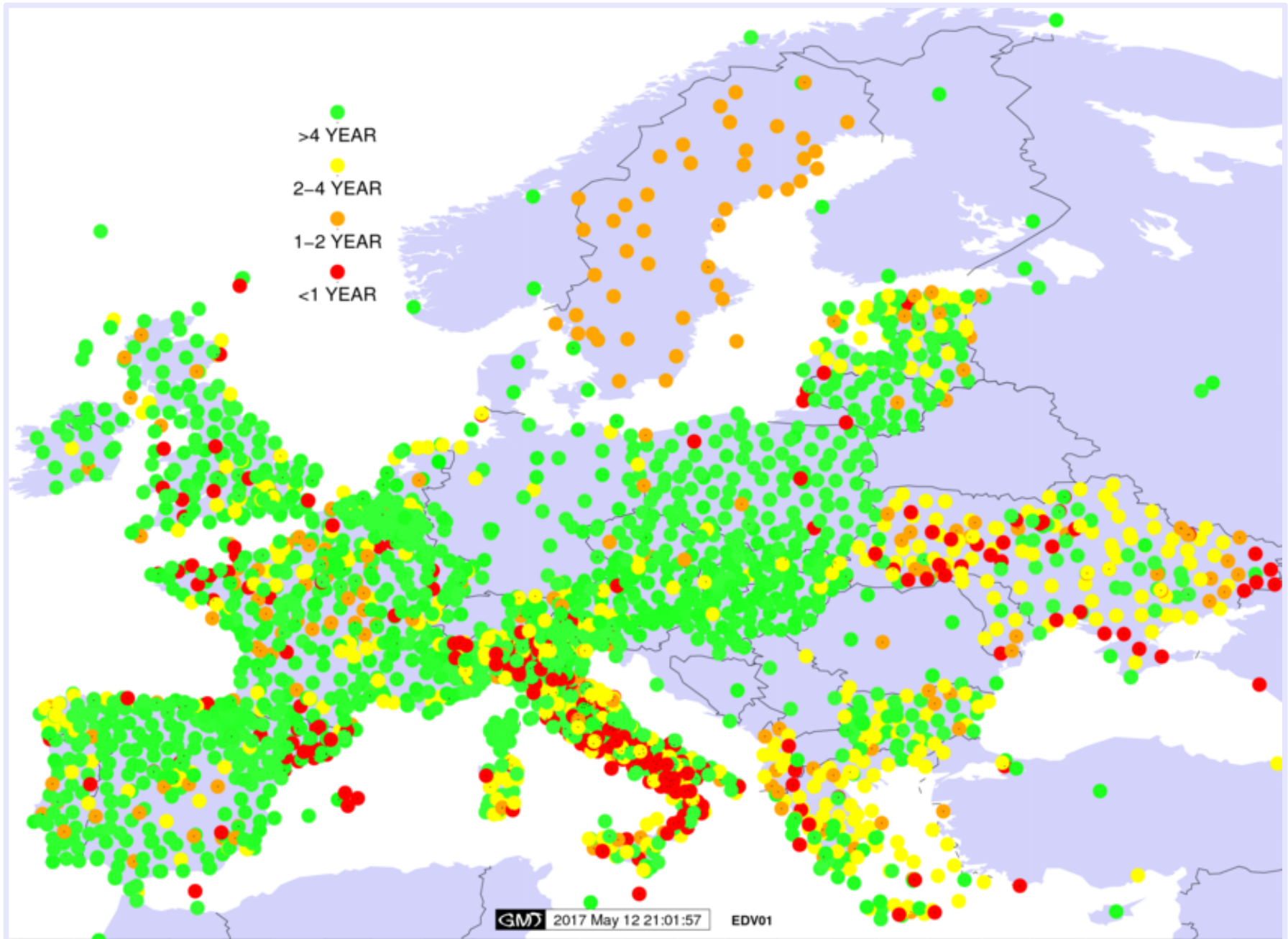
SINEX AVAILABILITY



WannaCry INFECTED SITES



SINEX AVAILABILITY

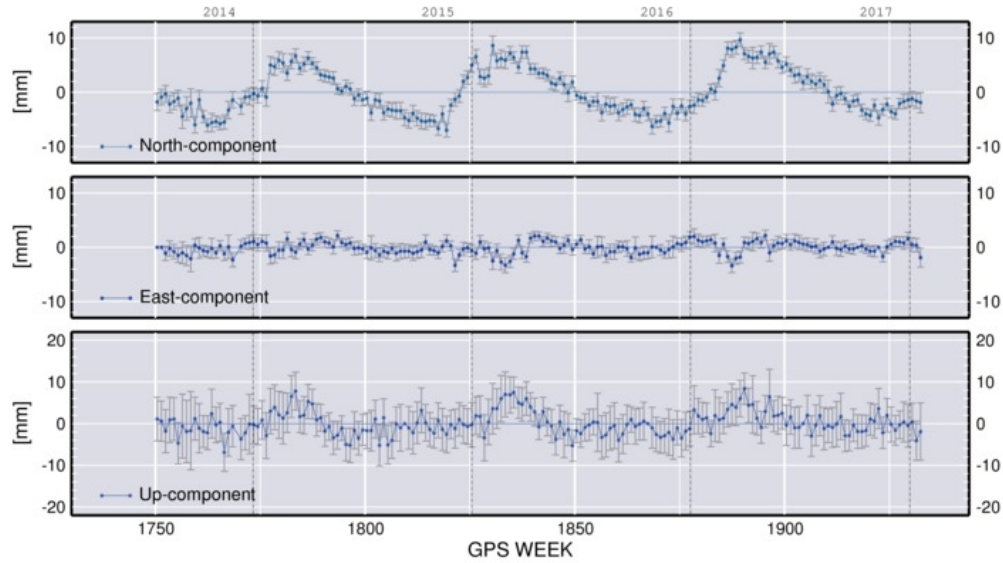


SOME STATISTICS, AS OF TODAY

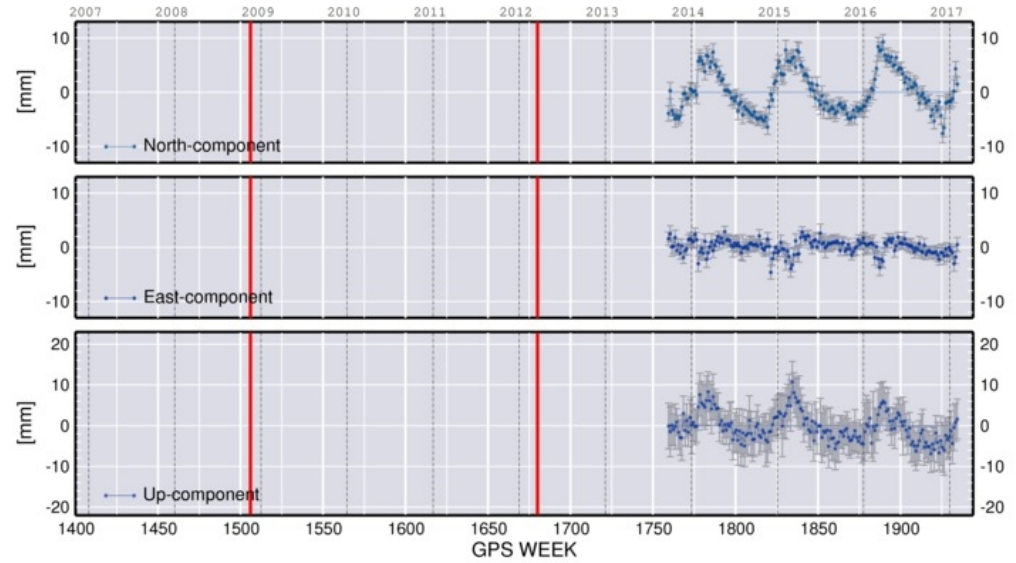
- 118 COUNTRIES (GLOBAL!)
IT/717 - ES/401 - FR/321 - GB/170 - UA/210 - GR/143
- **3117 STATIONS** KEPT, 328 STATIONS REMOVED (SHORT OR BAD)
- 12678 WEEKLY SINEX FILES (up to week 1934!)
- >37 GB OF SINEX DATA
- DATA AVAILABILITY MOSTLY SINCE 2007 (AFTER WEEK 1400)
- >4000 SINGLE OUTLIERS/SHORT OUTLIER PERIODS DELETED
STORED IN A META-DATA BASE
- RUNTIME: 36 HOURS IN A MULTI-CORE COMPILER ENVIRONMENT
- 1.0 GB cumulative SINEX
- [28422 x 28420] COV matrix

TIME SERIES INTERCOMPARISON - RMS

ALDA_19383M001

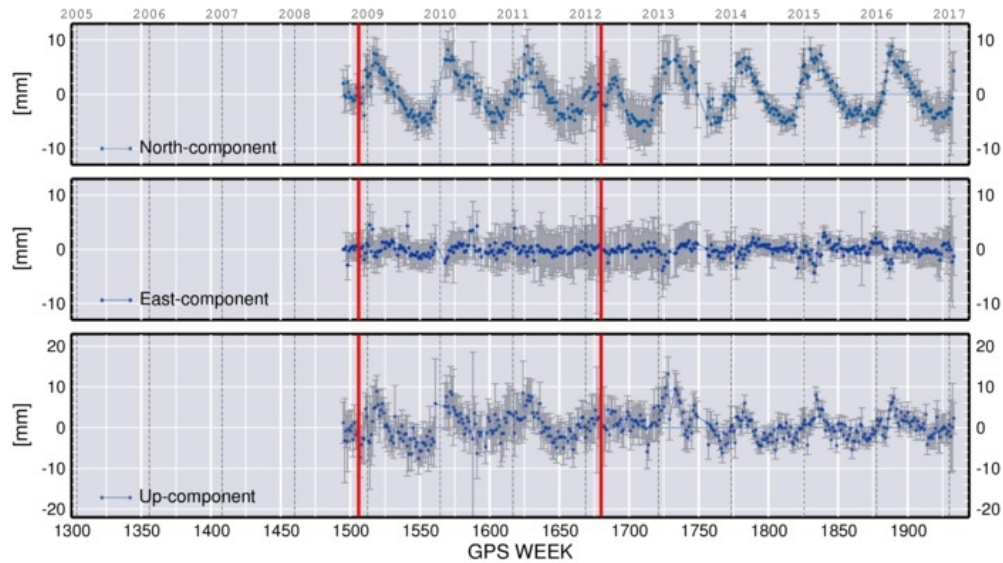


ALDA_19383M001



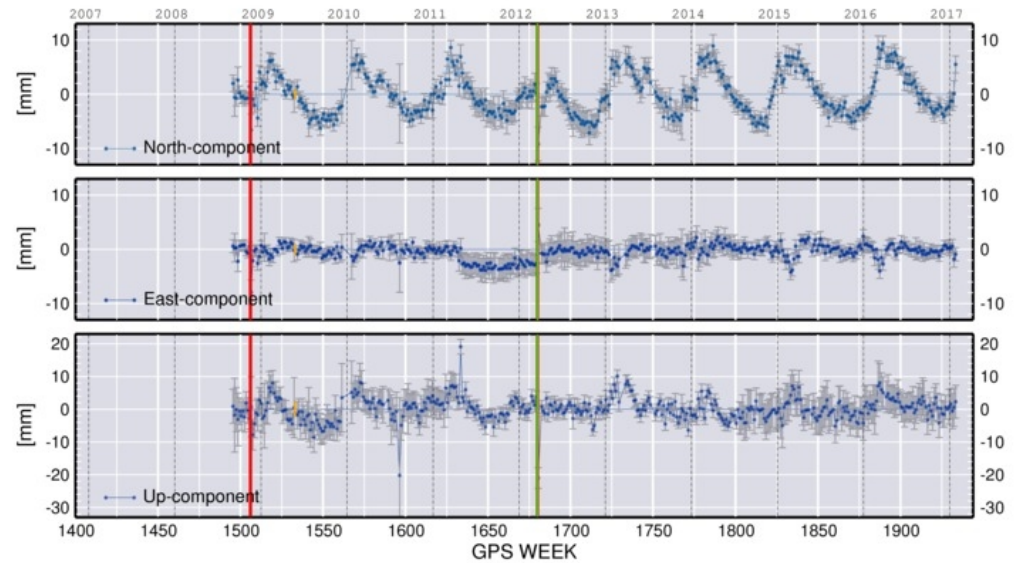
ARA_ARA00_weekly

ALDA_19383M001



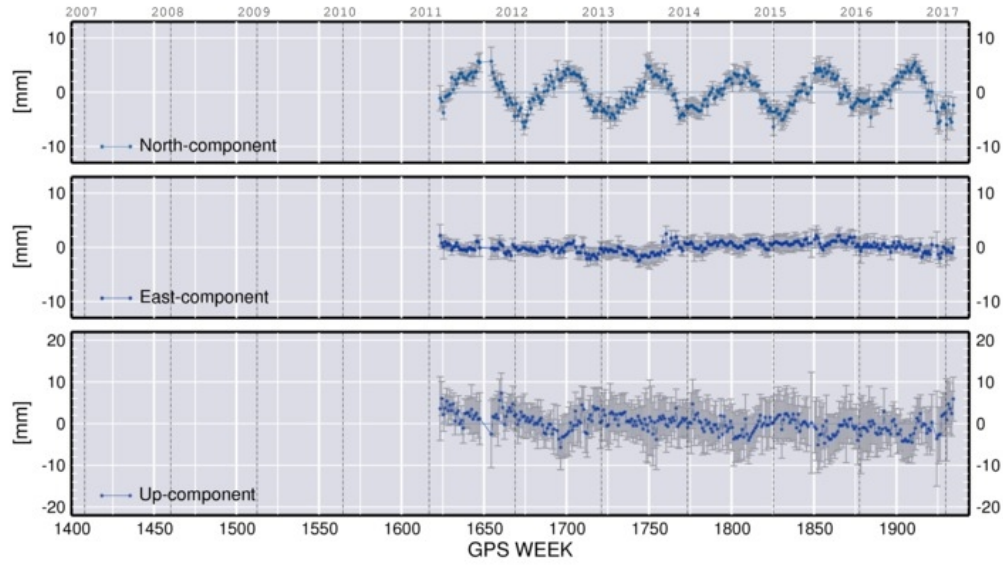
CAT_CAT00_weekly

ALDA_19383M001

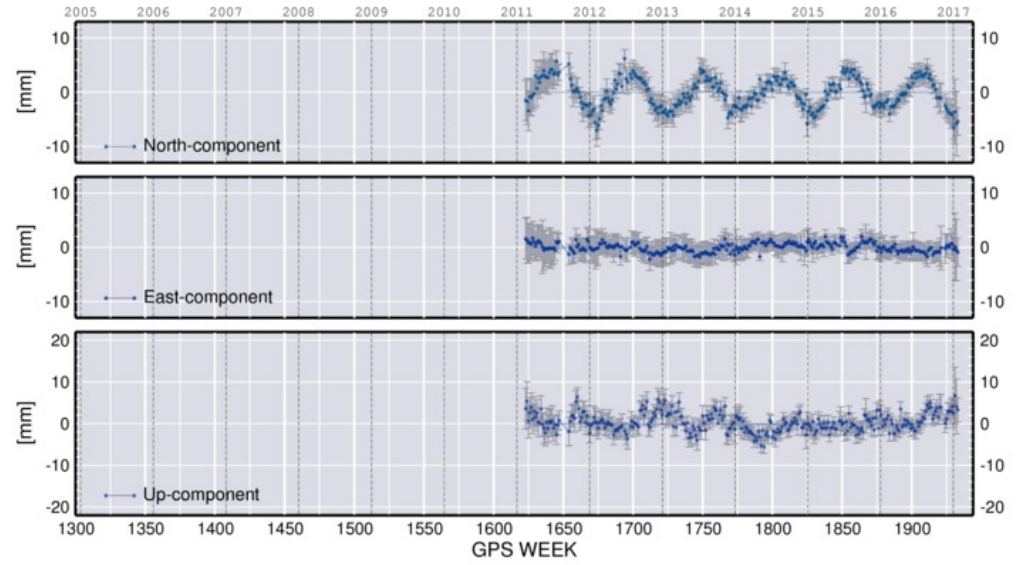


TIME SERIES INTERCOMPARISON - AC ISSUES

AICI_19923M001

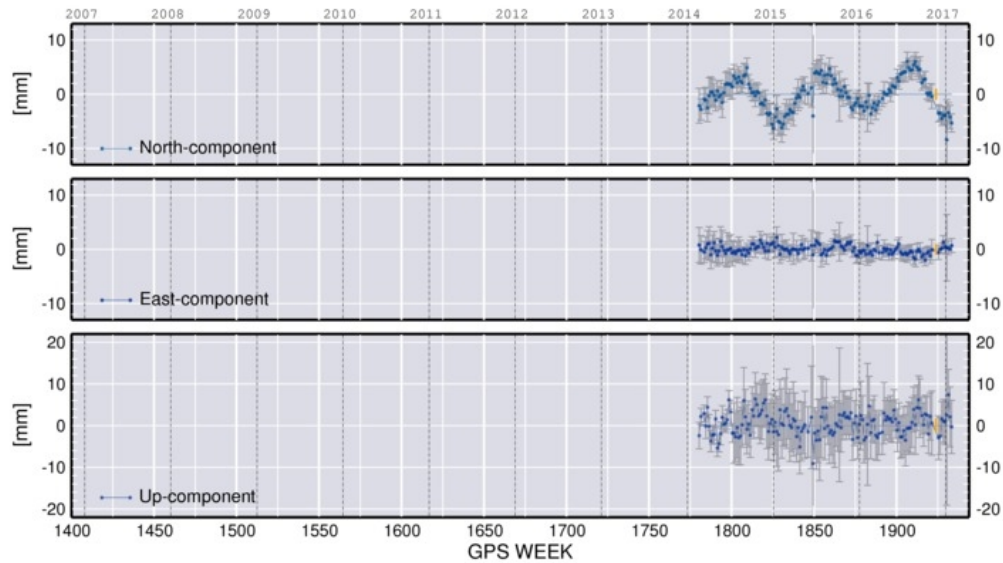


AICI_19923M001



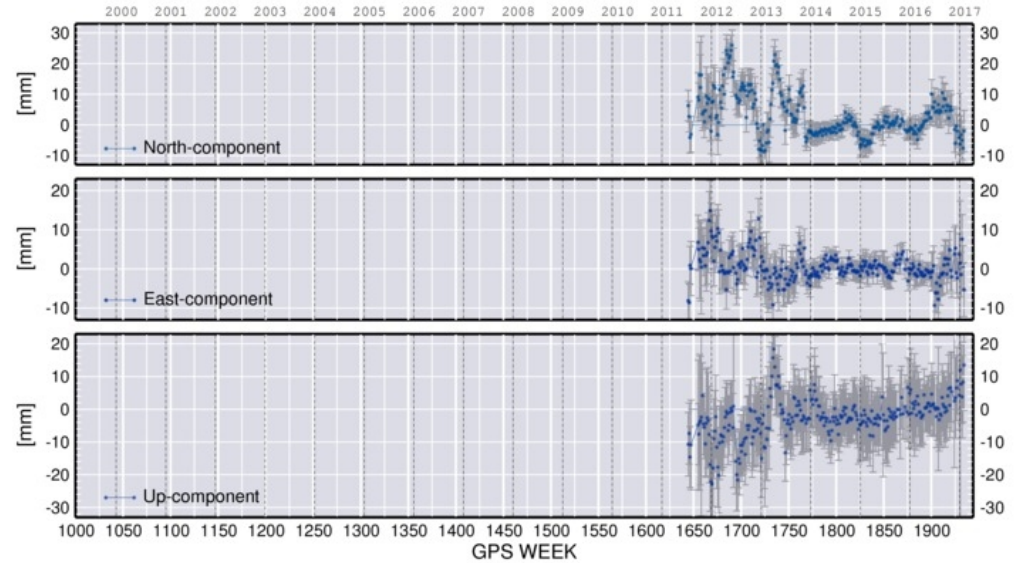
CAT_CAT00_weekly

AICI_19923M001

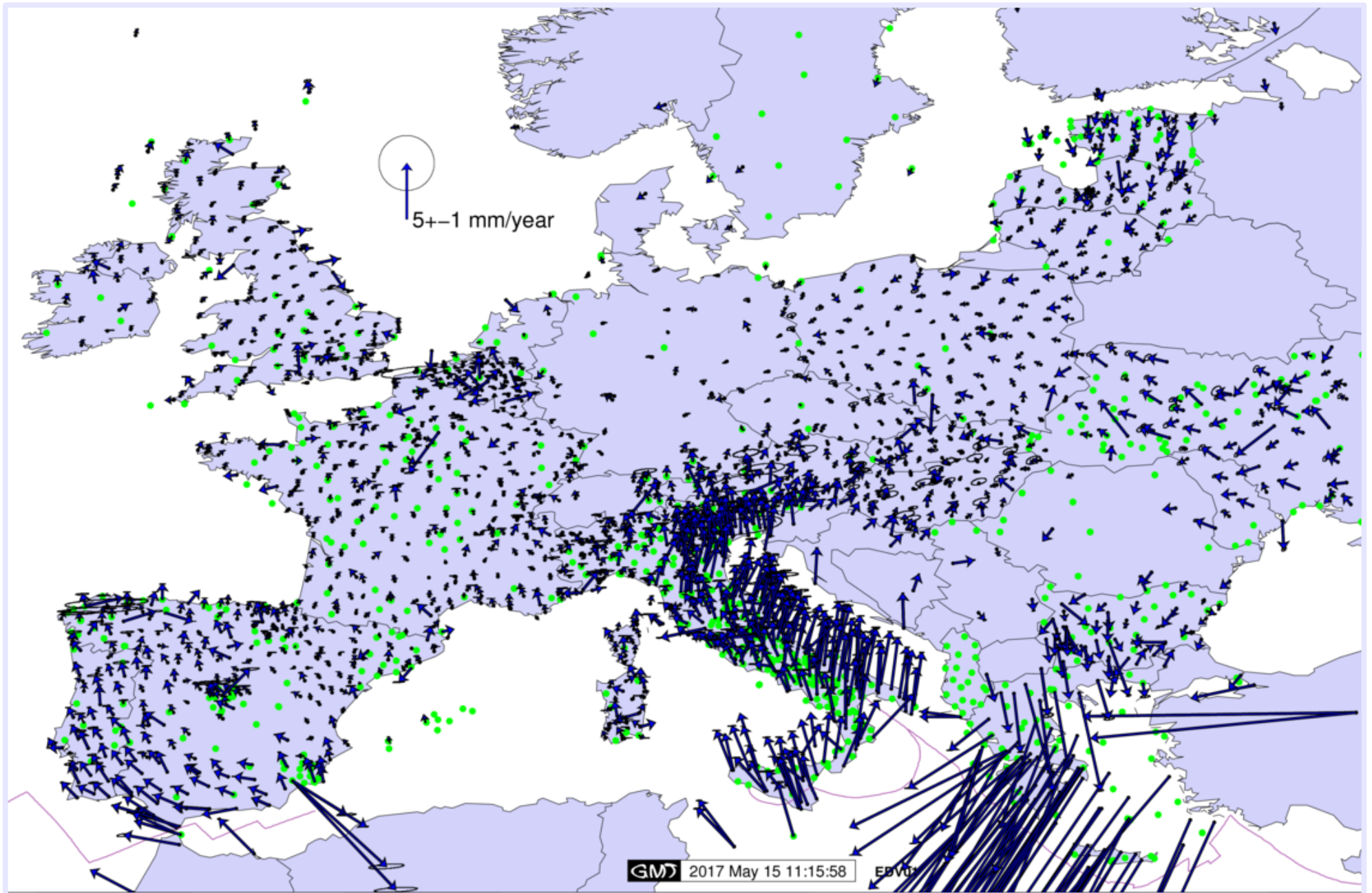


EDV_EDV01_weekly

AICI_19923M001

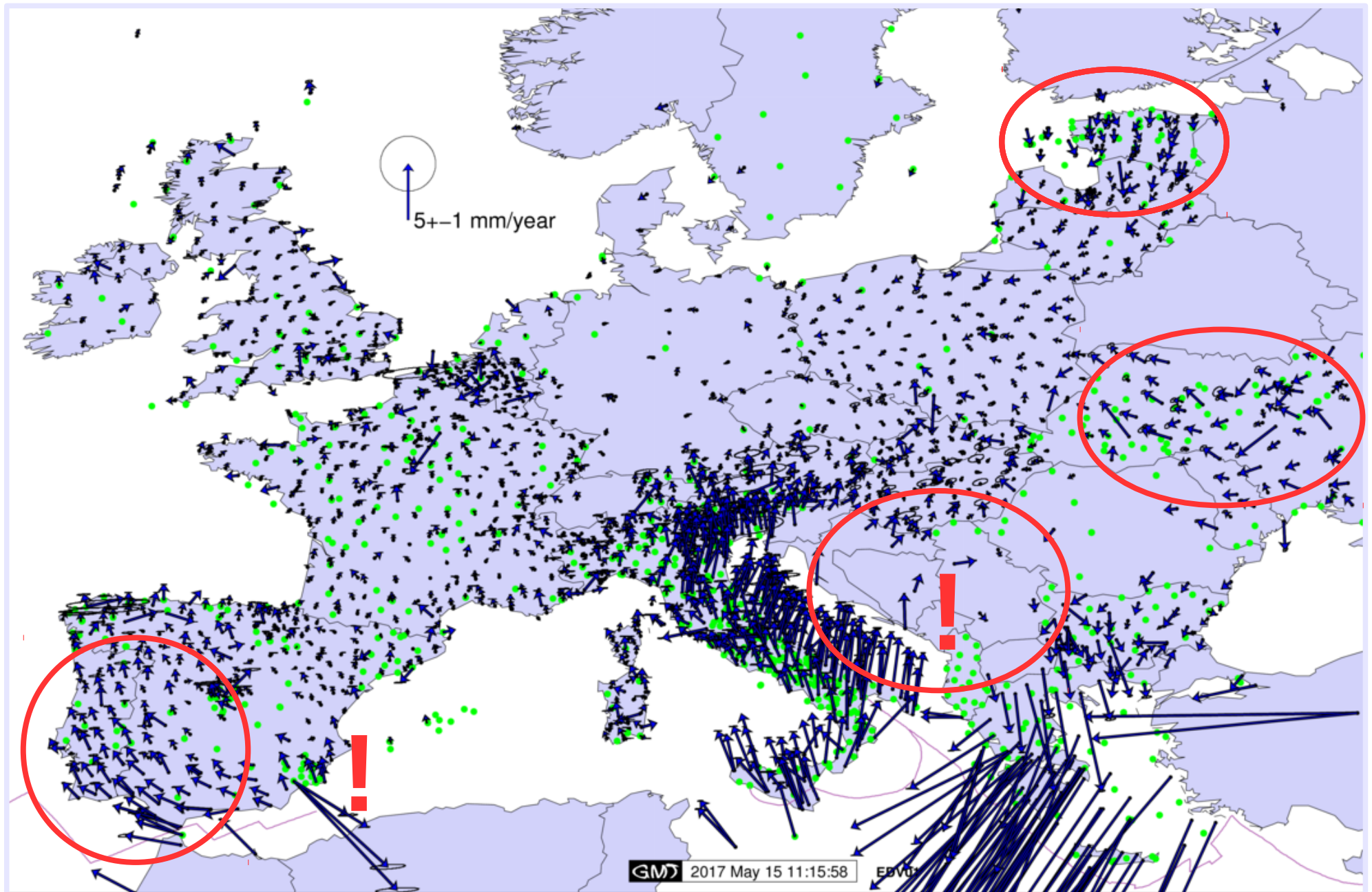


ETRF2000 VELOCITIES $L > 3$ years



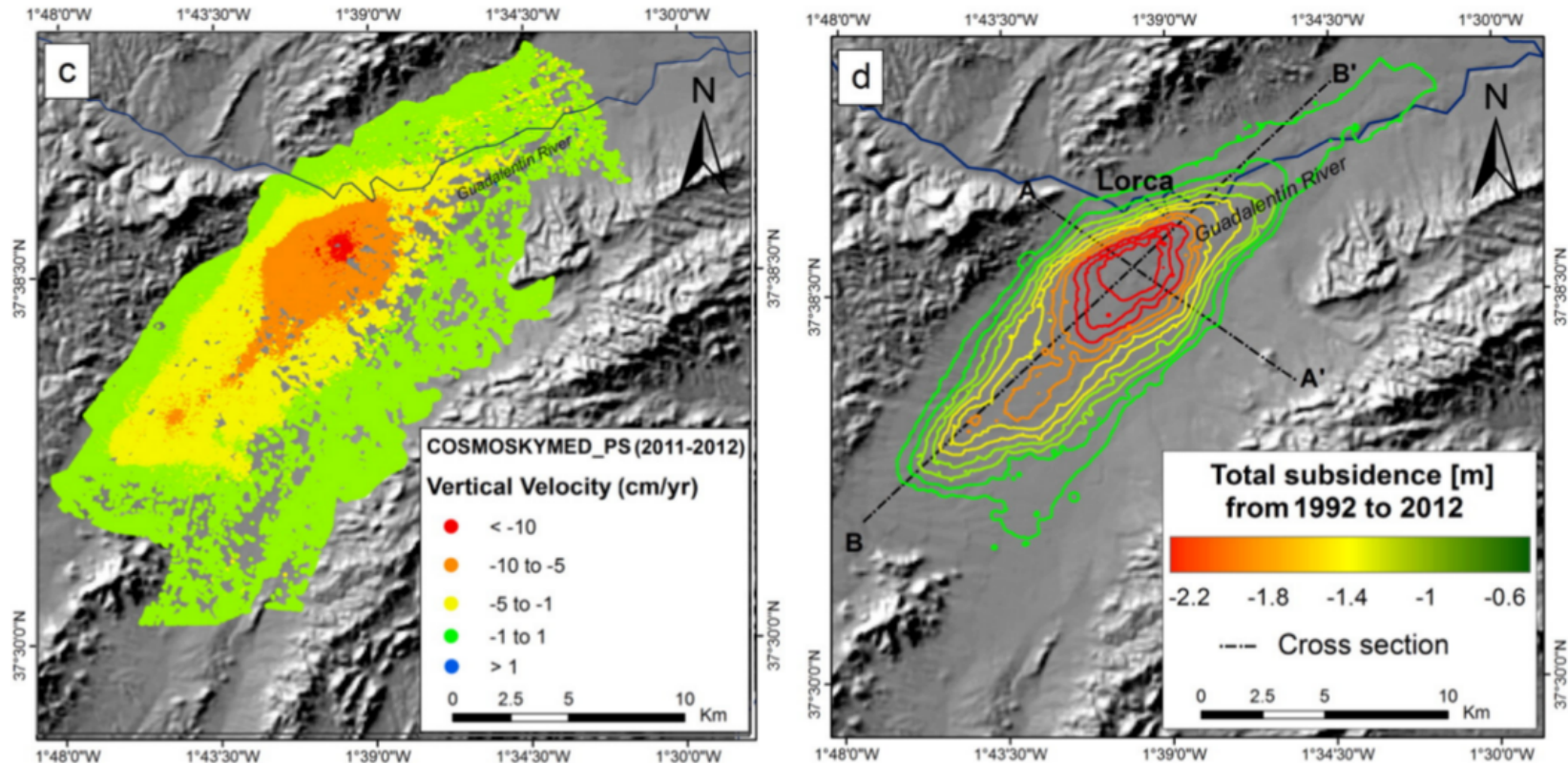
ETRF2000 VELOCITIES $L > 3$ years

CLEAR TECTONIC PATTERNS ARE OBSERVED



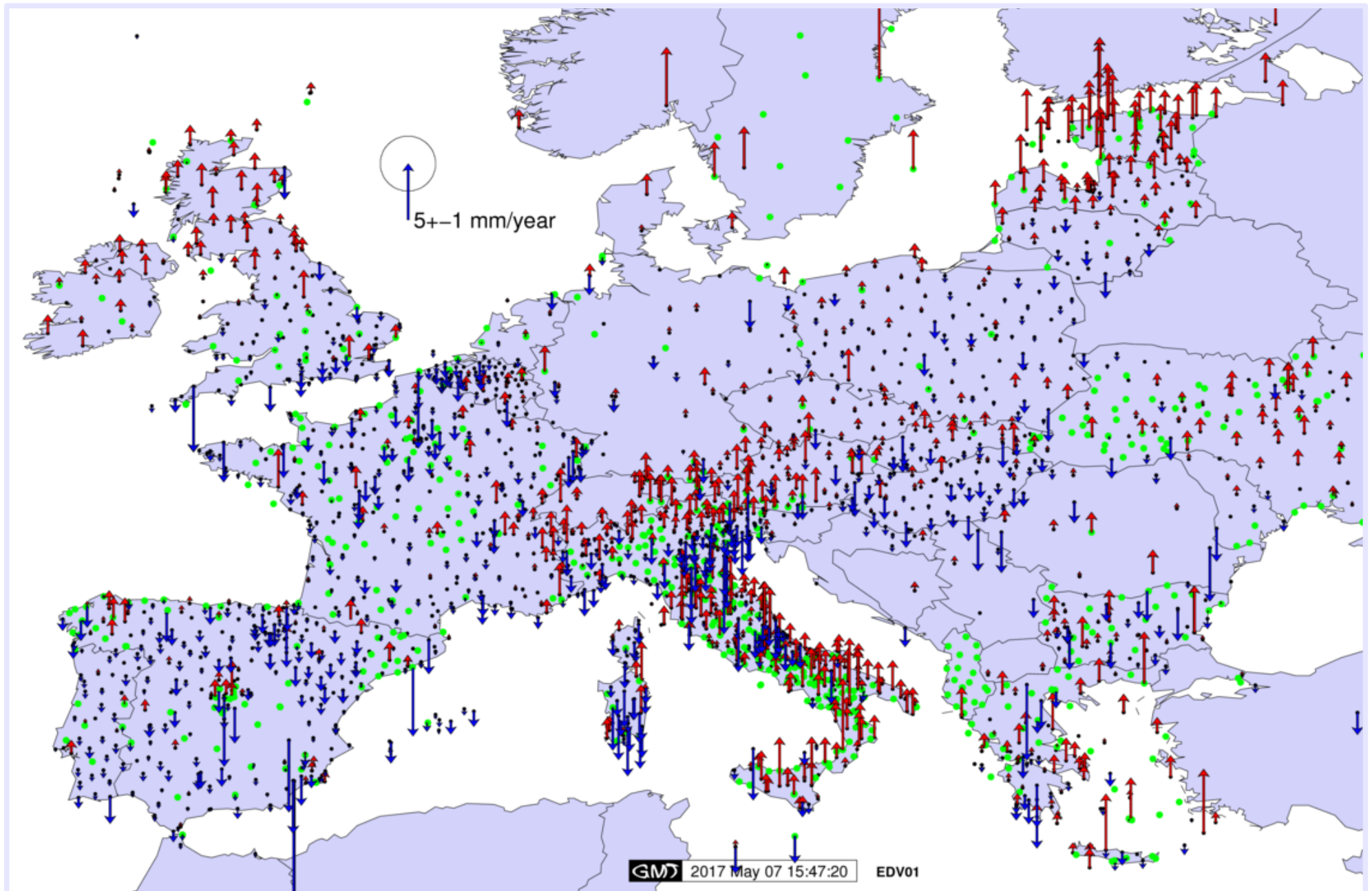
LORCA STATION

2.5 m subsidence over 20 years due to the 100-200 m ground water level drop.
We observe 100 – 73 mm/y subsidence and 13 – 8 mm/y 2D velocity



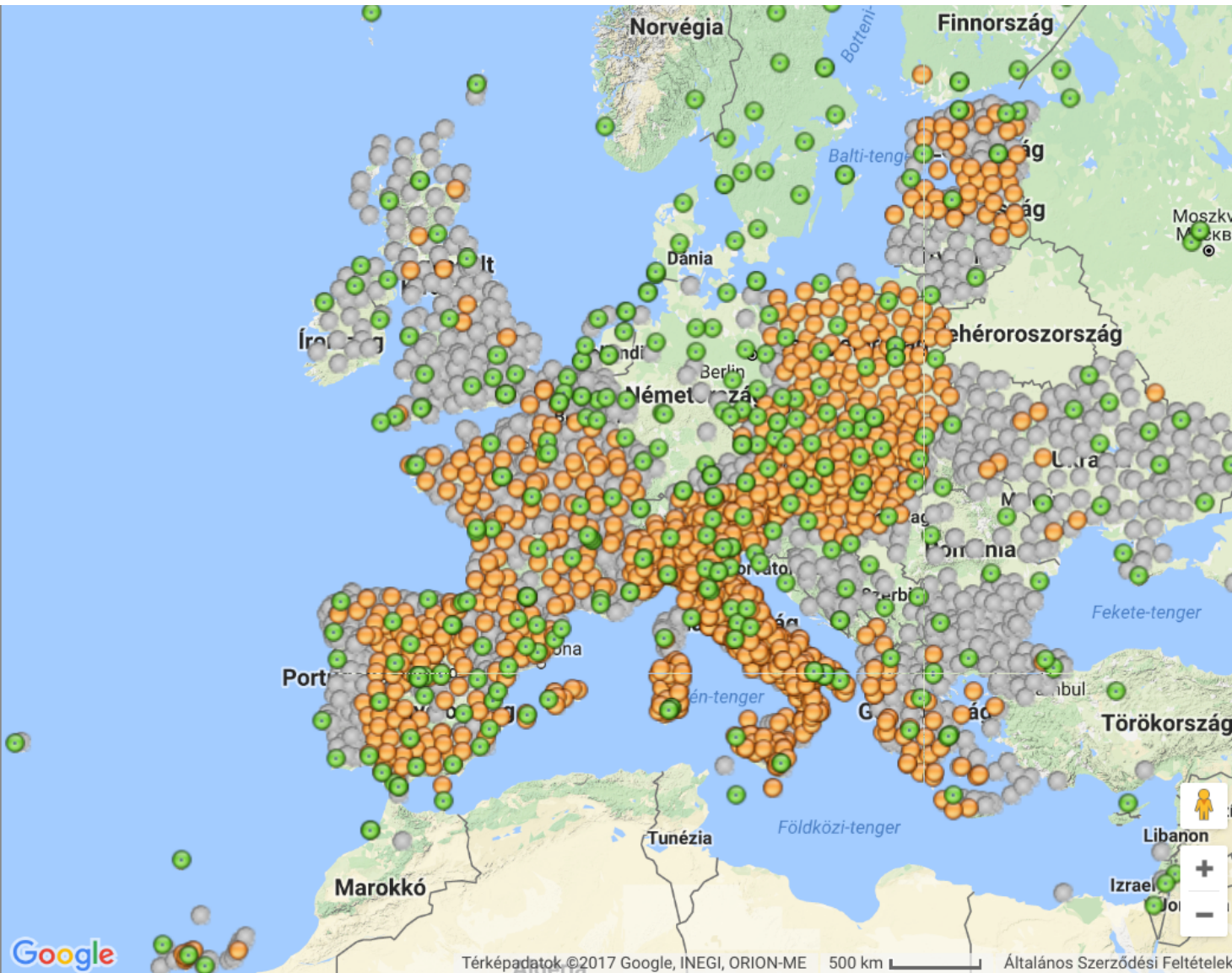
© Roberta Boni, ... , Jose Fernandez, ... , Oscar Mora:
Twenty-year advanced DInSAR analysis of severe land subsidence: The Alto Guadalentín Basin (Spain) case study. Engineering Geology 198 (2015) 40–52

UP VELOCITIES $L > 3$ years



EPN DENSIFICATION WEBSITE

www.epncb.oma.be/_densification



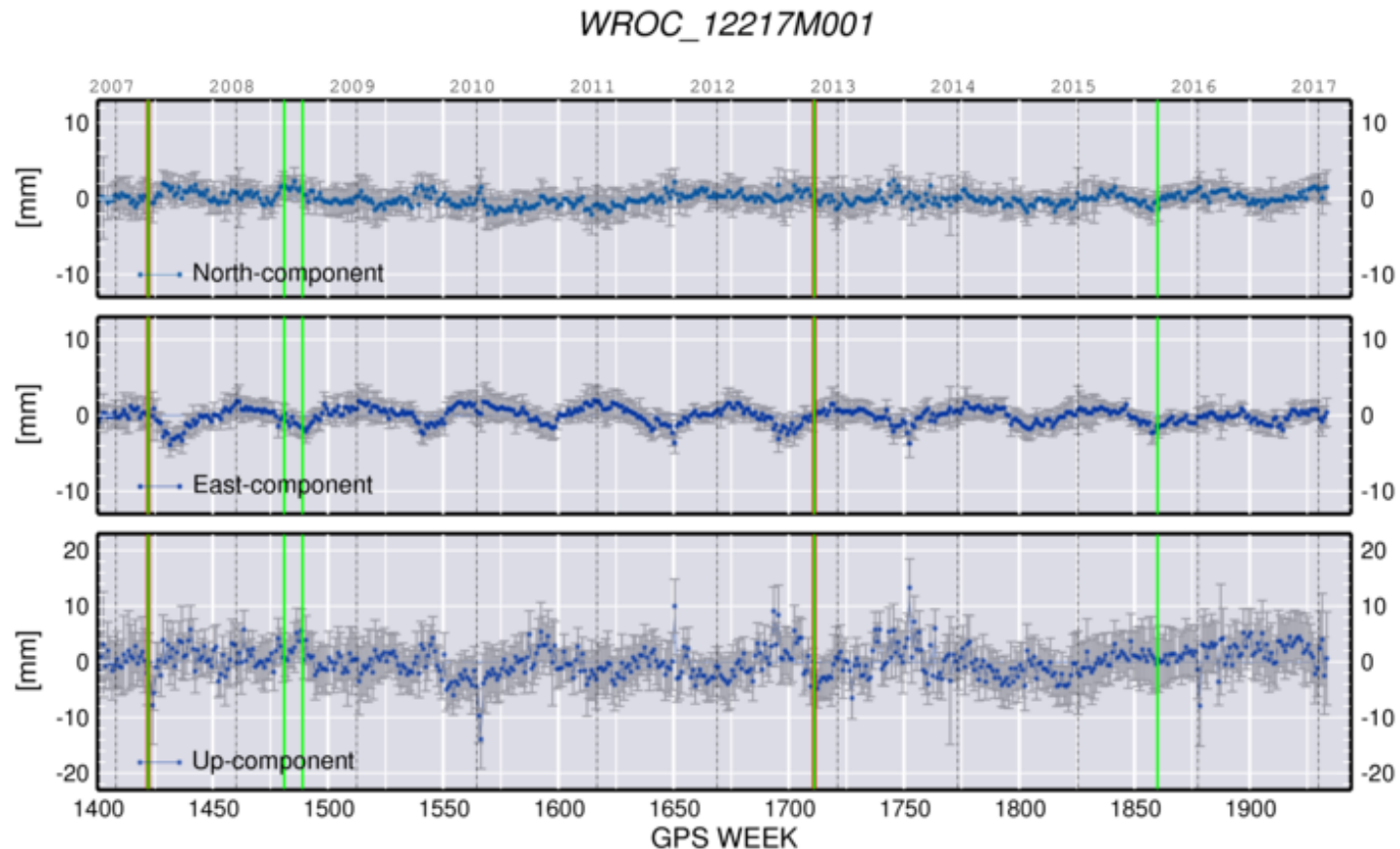
- *.AC and *.OC forms are prepared and available
- partners are working on site logs
- site log submission like at EPN
- results section is still empty, BUT

TIME SERIES DATA AND PLOTS ARE AVAILABLE
for ACs PROVIDING SOLUTIONS



TIME SERIES DATA AND PLOTS ARE AVAILABLE for ACs PROVIDING SOLUTIONS

**PLEASE CHECK THE FTP SERVER, WHERE YOU UPLOAD
THE SINEX SOLUTIONS AND IN THE “results” DIRECTORY
YOU WILL FIND THE RESIDUAL TIME SERIES DATA AND
THE CORRESPONDING PLOT IMAGES AND SOME MORE ...**



NEXT STEPS

- ALL RESULTS WILL BE IN THE EPNCB DENSIFICATION WEBSITE - FIRST AVAILABLE FOR THE PROVIDES ONLY, FOR REVIEW



Official Time Series up to week 1934

Extended Time Series up to week 1947/5

Residual Position Time Series

Position Time Series in ITRS (IGb08)

Position Time Series in ETRS89 (ETRF2000)

Official Station Velocities published by EUREF:

Frame	V_{North} [mm/yr]	V_{East} [mm/yr]	V_{Up} [mm/yr]
IGb08	14.9 ± 0.03	20.2 ± 0.02	0.2 ± 0.08
ETRF2000	0.0 ± 0.03	-0.4 ± 0.02	-0.7 ± 0.08

- COMMON PUBLICATION IS PREPARED
- EPN DENSIFICATION IS BEING SENT TO TWG FOR APPROVAL

PREPARE THE PRODUCT FOR EXPLOITATION

- INSPECTION OF INDIVIDUAL STATION BEHAVIOR IN COOPERATION WITH THE STATION OPERATORS AND GNSS DATA ANALYSTS
- USE CASES
- INTERCOMPARISON OF VELOCITIES FROM DIFFERENT SOURCES
- VELOCITY MODELING: DATA TO EUREF WG
- DEEPENING CONNECTION TO GEOPHYSICISTS
 - CONTACT NATIONAL EXPERT GROUPS
 - EPOS INFRASTRUCTURE MAY USED FOR DISSEMINATION