ITRF2005 densification and product validation

SUMMARY OF THE DETAILED REPORT
no “bla-bla”

prepared by
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former EPN Time Series Project

OUTLINE

- DATUM DEFINITION
- VALIDATION OF THE CUMULATIVE SOLUTION (GPSWEEK 860 - 1355)
- INTERCOMPARISONS WITH THE AC SOLUTION

DATUM DEFINITION

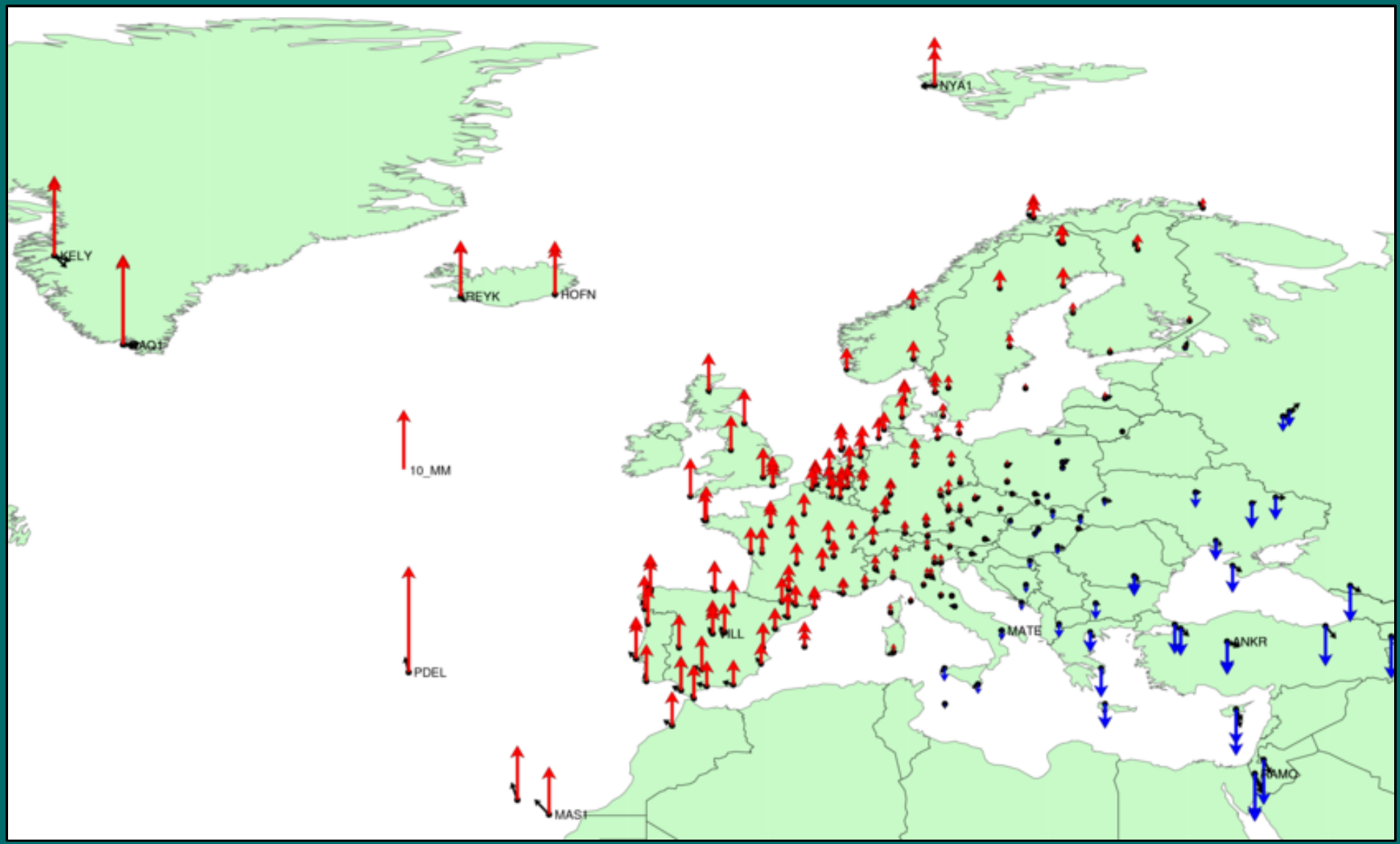
- Minimum Constraint
  - no direct constraints allowed, because of the site specific differences in ITRF/IGS and EPN
  - MC over 3 (T) or 7 (TRS) parameters
- ITRF2005 versus ~~IGS05~~

  ITRF/IGS – EPN discontinuity table
- Reference network selection

  Criteria: optimal agreement with ITRF2005
  - Geometry – extend EPN as broad as possible
  - Quality – catch 22
  - Number of sites (22 with 43 solution numbers)

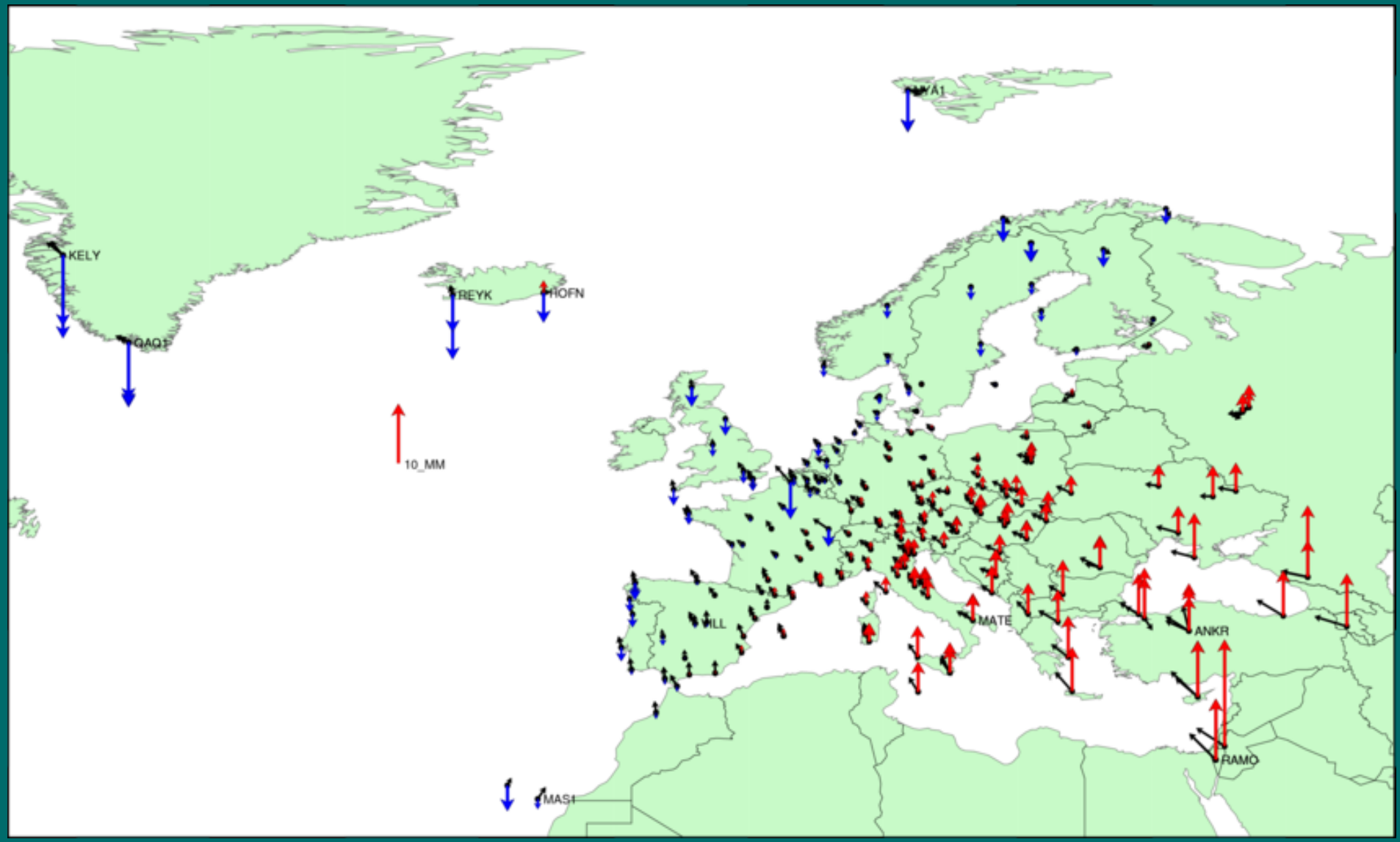
NETWORK EFFECT IN MC

COORDINATE DIFFERENCES



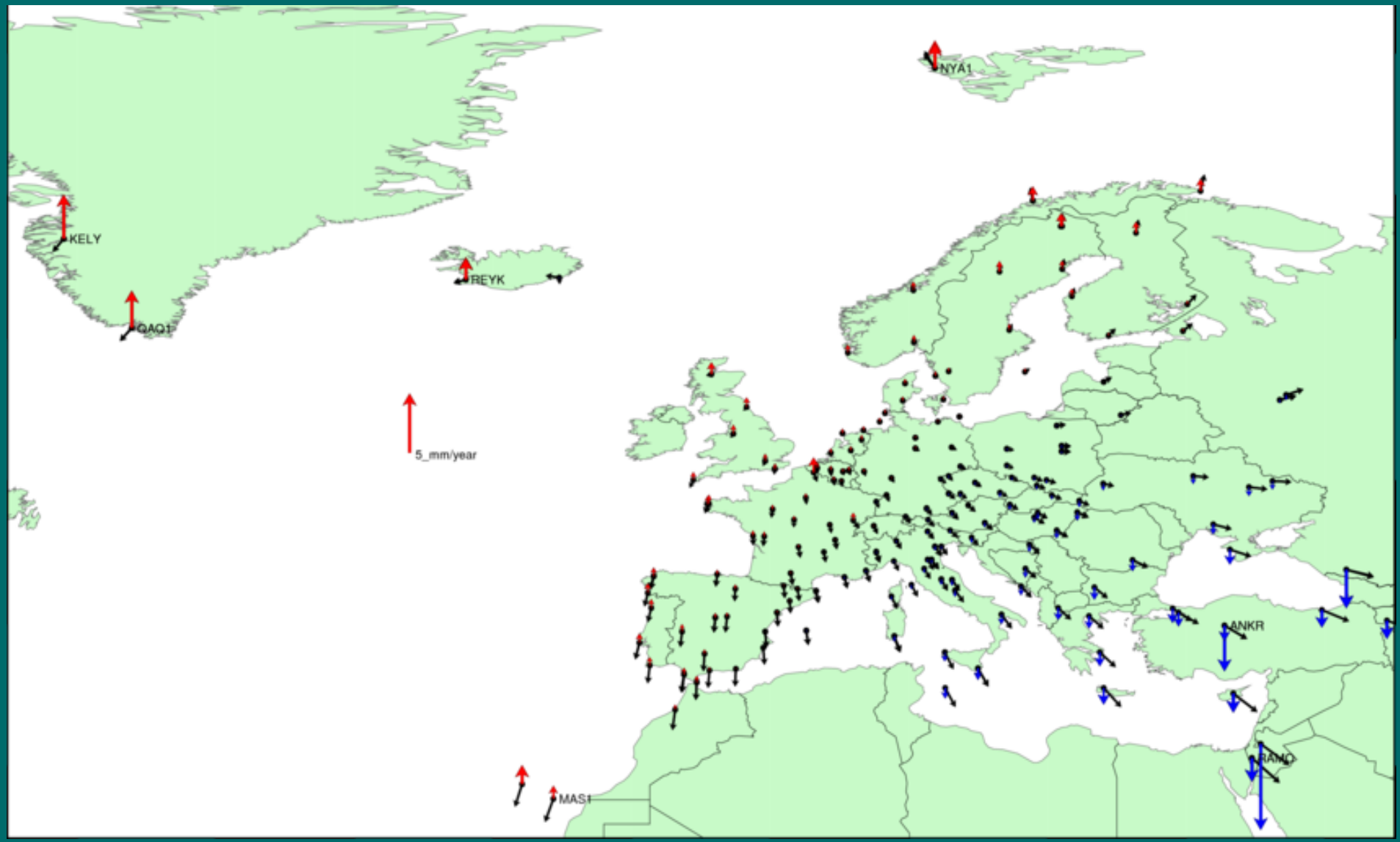
MC over T and TRS

COORDINATE DIFFERENCES



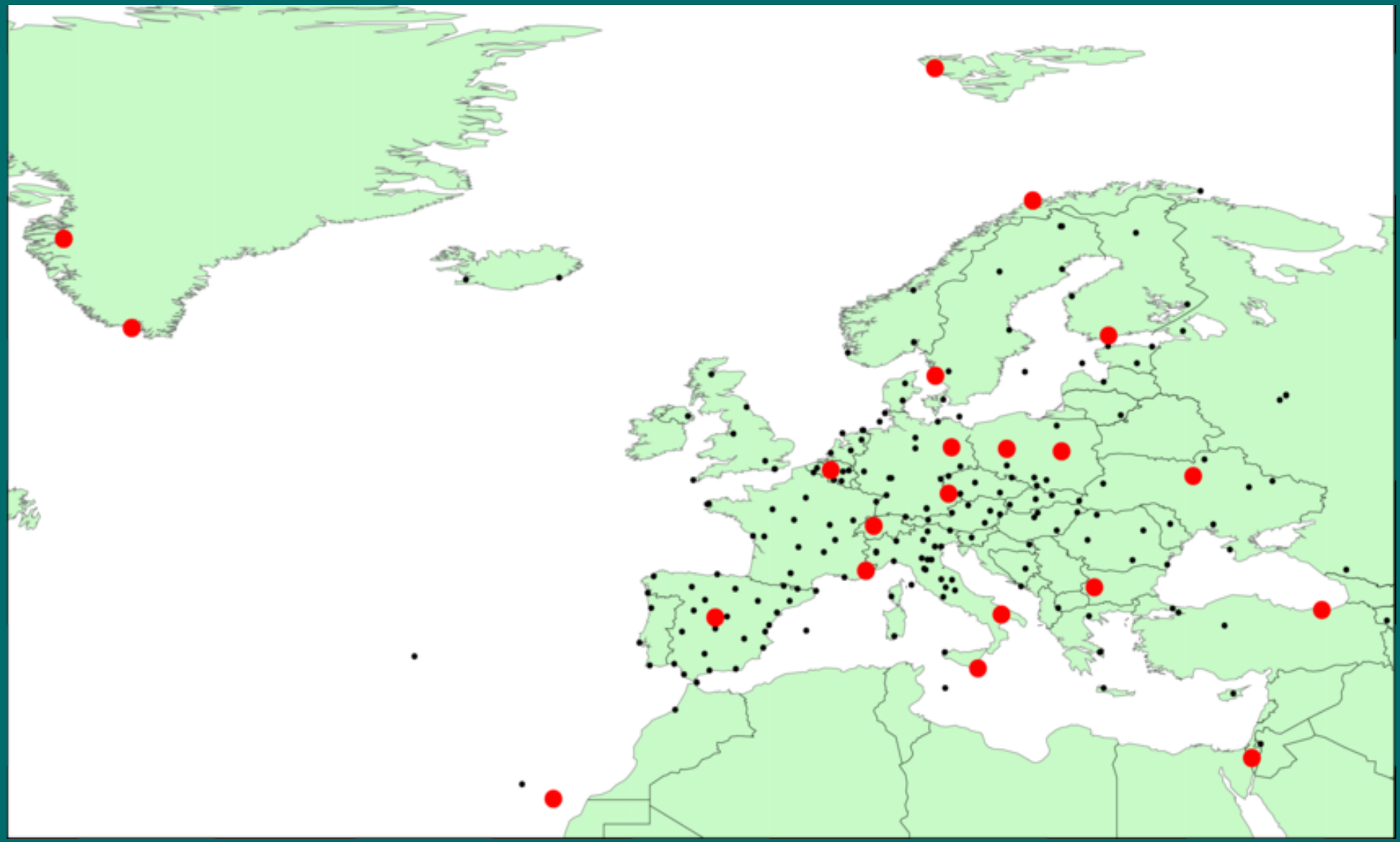
MC over T and TRS

VELOCITY DIFFERENCES



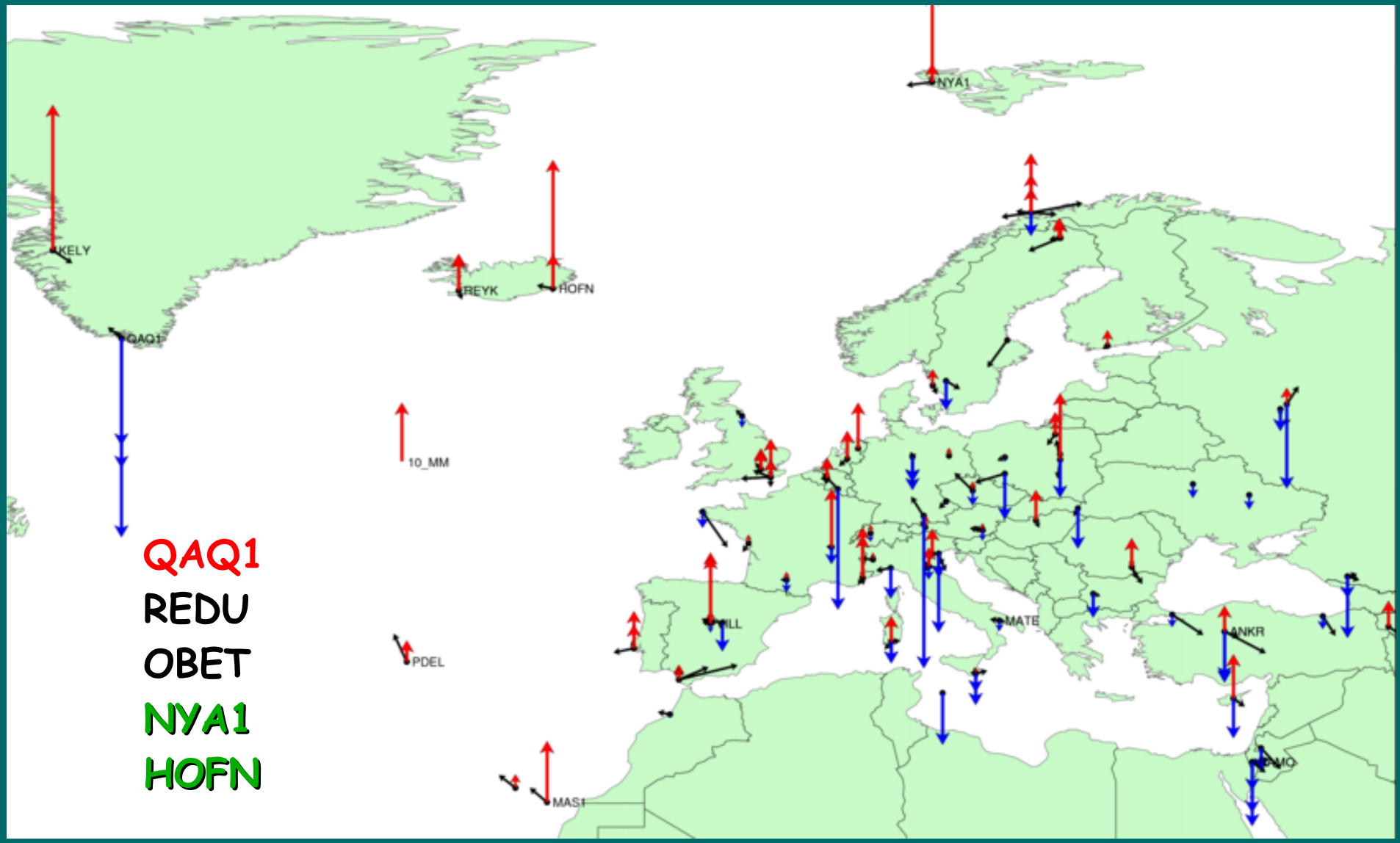
SELECTED REFERENCE NETWORK

22 SITES, 43 SOLUTION NUMBERS



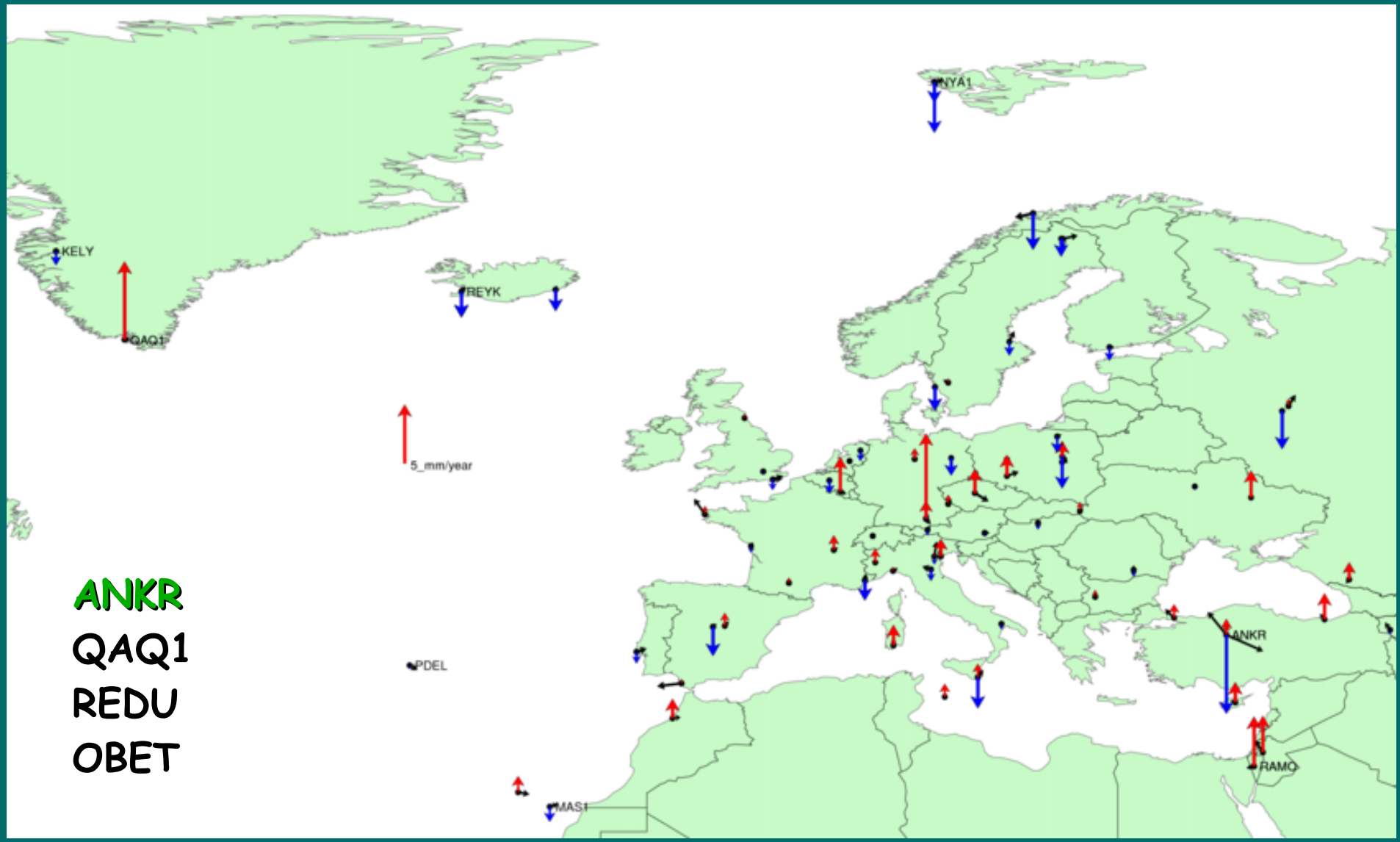
VALIDATION WITH ITRF2005

COORDINATES



VALIDATION WITH ITRF2005

VELOCITIES



INTERCOMPARISONS WITH THE AC SOLUTION

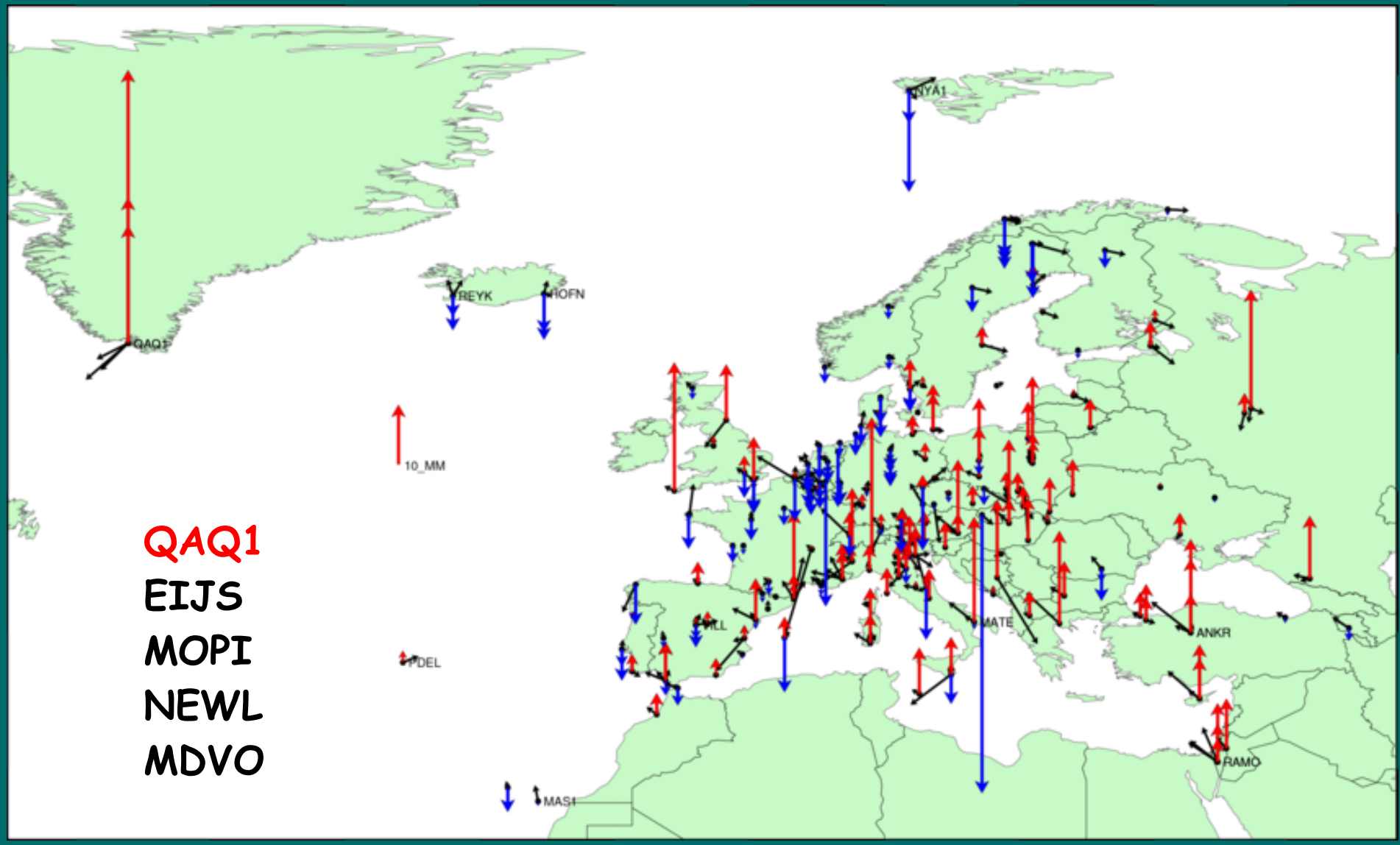
DATUM DEFINITION DIFFERENCES

- 22/43 versus 40/51 sites/solution numbers

  Not all solutions used available in ITRF2005
- Heavily constrained versus MC solution

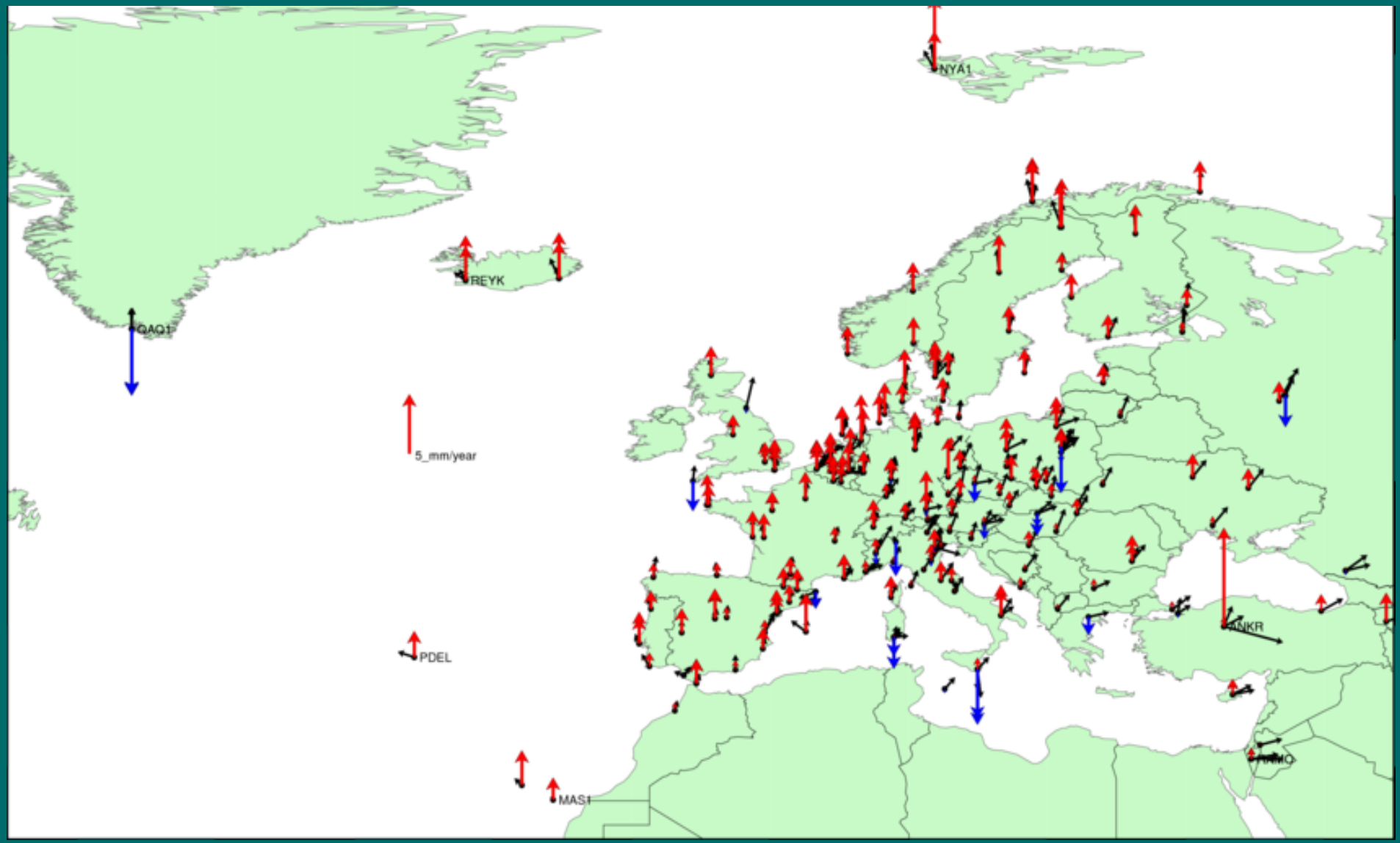
  limits the validity/reality of the comparison

COMPARISON of the AC and TSP COORDINATE SOLUTIONS



COMPARISON of the AC and TSP

VELOCITY SOLUTIONS



SUMMARY, CONCLUSIONS

- DETAILED ANALYSIS ON DATUM REALIZATION

  'STATISTICALLY OPTIMAL' SET OF REFERENCE SITES
- EPN CUMULATIVE SOLUTION VALIDATION

  RMS AGREEMENT WITH ITRF2005: CRD-(1.7; 2.3; 7.7 mm)

  VEL-(0.4; 0.7; 2.1 mm/y)
- COMPARISON WITH AC SOLUTION

  LIMITATION: CONSTRAINED vs MC
  - ACCEPTABLE AGREEMENT OF THE COORDINATES
  - BIASED AC VELOCITY SOLUTION

MAINTENANCE OF THE EPN ETRS89 COORDINATES / MAINTENANCE OF THE ETRS89 USING EPN

AMBRUS KENYERES

EUREF TWG 2008 FALL MEETING,
MUNICH 3-4 NOVEMBER 2008

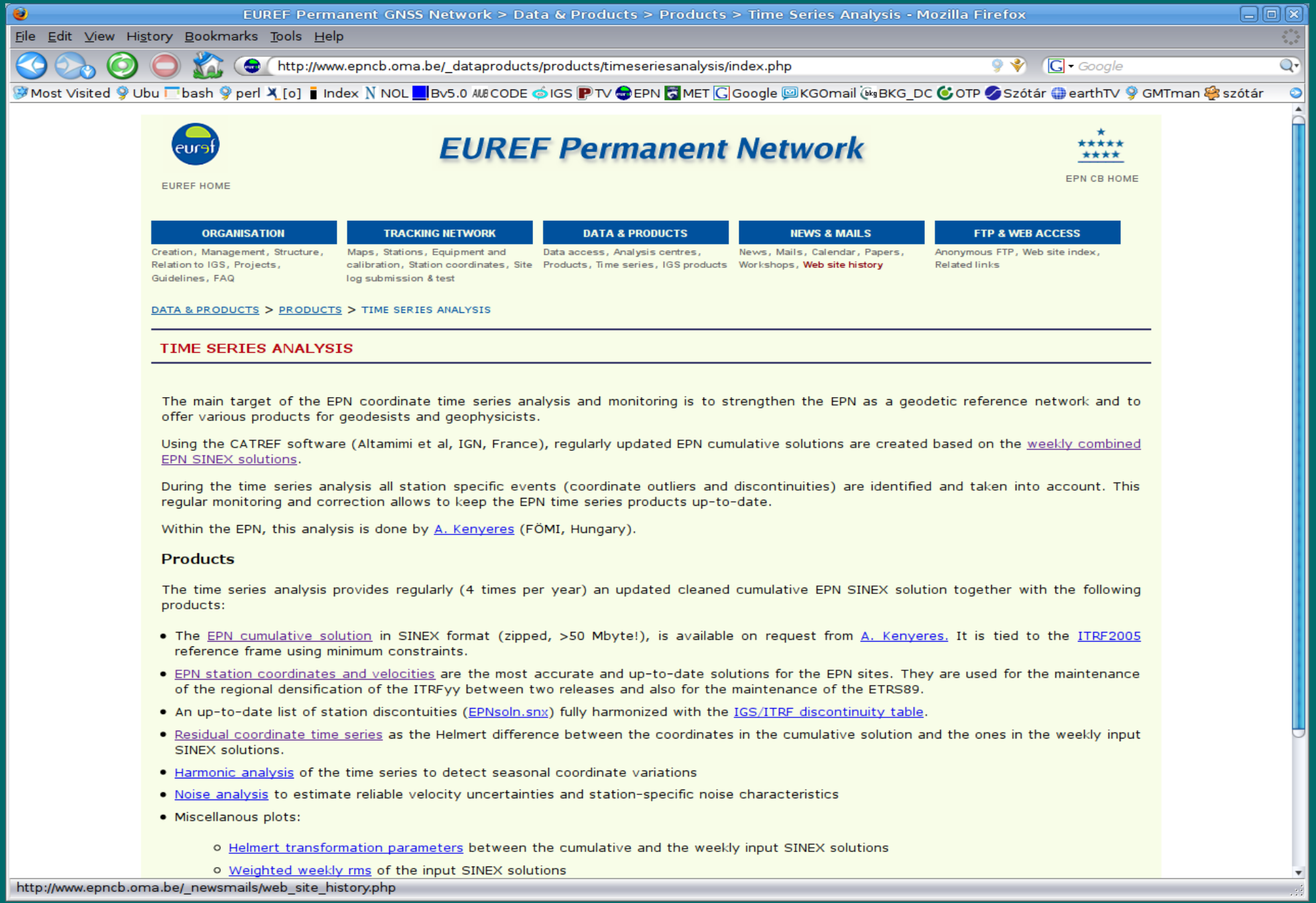
INITIAL POINT: EPN CUMULATIVE SOLUTION

- Created with CATREF and MC approach using the weekly combined EPN solutions,
- Solution details and ITRF2005 validation presented before,
- Regularly (3-4 / year) updated since 2002

EPN CUMULATIVE SOLUTION

- Up-to-date CRD&VEL (SSC) estimates in ITRFyy and ETRFyy
- EPN discontinuity table (SINEX), harmonized with IGS (conversion tools)
- EPN cumulative SINEX solution
- Availability on the EPBCB website

UPDATED WEB PAGES



UPDATED WEB PAGES

EUREF Permanent GNSS Network > Data & Products > Products > Time Series Analysis > Determination of realistic coordinate and velocity uncertainties - Moz

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http://www.epncb.oma.be/_dataproducts/products/timeseriesanalysis/coordinatesandvelocities.php

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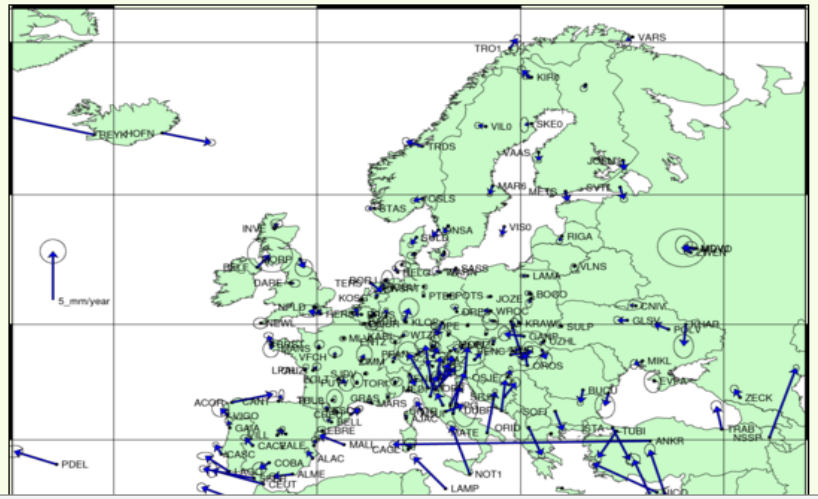
DATA & PRODUCTS > PRODUCTS > TIME SERIES ANALYSIS > EPN STATION COORDINATES AND VELOCITIES

EPN STATION COORDINATES AND VELOCITIES

The EPN following station coordinates and velocities result from the regular time series analysis and are the most accurate and up-to-date solutions for the EPN sites. They are used for the maintenance of the regional densification of the ITRFyy between successive ITRFyy release and for the maintenance of the ETRS89:

- EPN station coordinates and velocities in the latest realization of the ETRS89: ETRF00(R05)
- EPN station coordinates and velocities in the latest realization of the ITRS: ITRF2005



http://www.epncb.oma.be/_newsmails/mails.php

EPN CUMULATIVE SOLUTION

- CRD&VEL data in SINEX and SSC format
- Pre-defined single epoch for ALL stations

  all site coordinates are mapped from their mean epoch to the common epoch
- The younger a station, the bigger the epoch difference and the weaker the velocity value!
- Consequence: new stations show VERY high coordinate variation at the common epoch!

EPN station categorization

STATIONS WITH SUFFICIENT LENGTH OF OBSERVATIONS (say 3 years) AND HIGH QUALITY VELOCITIES SHOULD BE DISTINGUISHED FROM 'YOUNGER' SITES.

AS IN THE EUREF NETWORK:

CATEGORY A: 1 CM ACCURACY ETRS89 COORDINATES AT ANY EPOCH

CATEGORY B: 1 CM ACCURACY ETRS89 CRD AT THE MEAN EPOCH

Categorization in the practice

EPN_CWWWW.SNX — EPN cumulative SINEX

snx2ssc — conversion tool

- EPN_**A**WWWW**I**.SSC — ITRFyy CRD & VEL
- EPN_**B**WWWW**I**.SSC
- EPN_**A**WWWW**E**.SSC — ETRFyy CRD & VEL
- EPN_**B**WWWW**E**.SSC

A – pre-defined single epoch (2000.0)

B – the actual mean epoch of each single station

SSC format (Set of Station Coordinates)

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          EPN ITRF2005 STATION POSITIONS (EPOCH 2000.0) AND VELOCITIES
                       CUMULATIVE SOLUTION OF GPSWEEKS [ 0860 - 1355 ]
                       CREATED BY THE EPN TIME SERIES SP USING CATREF

DOMES NB. SITE NAME        TECH. ID.       X/Vx          Y/Vy          Z/Vz          Sigmas        SOLN  DATA_START   DATA_END
                                                        ----------------------m/m/Y-------------------------
-------------------------------------------------------------------------------------------------------------------------------
13434M001 ACOR             GPS ACOR  4594489.746  -678367.887  4357066.065  0.001  0.000  0.001  1 99:248:00000 00:009:00000
13434M001                            -0.0100       0.0235       0.0107 0.0003 0.0001 0.0003
13434M001 ACOR             GPS ACOR  4594489.746  -678367.885  4357066.073  0.001  0.000  0.001  2 00:009:00000 02:209:00000
13434M001                            -0.0100       0.0235       0.0107 0.0003 0.0001 0.0003
13434M001 ACOR             GPS ACOR  4594489.736  -678367.883  4357066.059  0.001  0.000  0.001  3 02:209:00000 03:313:00000
13434M001                            -0.0100       0.0235       0.0107 0.0003 0.0001 0.0003
13434M001 ACOR             GPS ACOR  4594489.752  -678367.888  4357066.073  0.002  0.001  0.002  4 03:313:00000 06:309:00000
13434M001                            -0.0100       0.0235       0.0107 0.0003 0.0001 0.0003
10077M005 AJAC             GPS AJAC  4696989.506   723994.380  4239678.481  0.001  0.000  0.001  1 00:051:00000 06:309:00000
10077M005                            -0.0139       0.0189       0.0116 0.0001 0.0000 0.0001
13433M001 ALAC             GPS ALAC  5009051.241   -42072.294  3935057.669  0.001  0.000  0.000  1 99:248:00000 06:148:00000
13433M001                            -0.0104       0.0196       0.0129 0.0001 0.0000 0.0001
13437M001 ALME             GPS ALME  5105220.136  -219278.615  3804387.059  0.001  0.000  0.001  1 01:021:00000 06:309:00000
13437M001                            -0.0081       0.0186       0.0131 0.0002 0.0001 0.0001
20805M002 ANKR             GPS ANKR  4121948.562  2652187.938  4069023.702  0.001  0.000  0.001  1 96:210:00000 98:259:00000
20805M002                            -0.0078      -0.0042       0.0081 0.0001 0.0001 0.0001
20805M002 ANKR             GPS ANKR  4121948.578  2652187.929  4069023.724  0.001  0.000  0.001  4 99:316:61020 06:309:00000
20805M002                            -0.0078      -0.0042       0.0081 0.0001 0.0001 0.0001
12757M001 AQUI             GPS AQUI  4592507.656  1089876.271  4276392.929  0.001  0.000  0.001  1 01:287:00000 06:309:00000
12757M001                            -0.0174       0.0185       0.0126 0.0002 0.0001 0.0002
13431M001 BELL             GPS BELL  4775849.450   116814.272  4213018.902  0.001  0.000  0.001  1 99:031:00000 06:309:00000
13431M001                            -0.0105       0.0188       0.0127 0.0001 0.0000 0.0001
```

ETRS89 MAINTENANCE TEST

- SERIES OF CUMULATIVE SOLUTIONS HAS BEEN COMPUTED

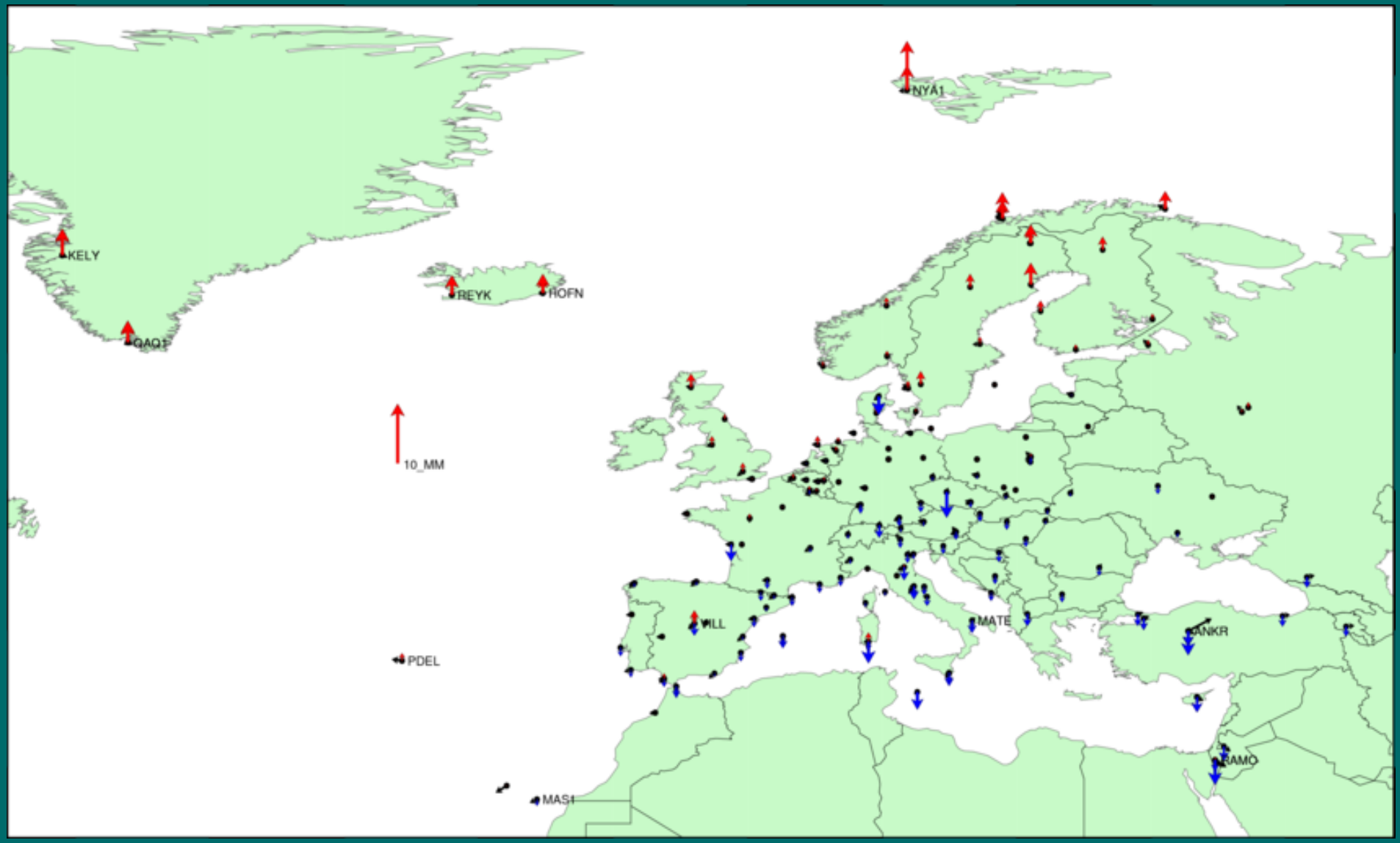
  GPSWEEK 860-1355;1399;1420;1440; ... 1494

- SAME DATUM DEFINITION AS SHOWN BEFORE (22 site / 43 soln)

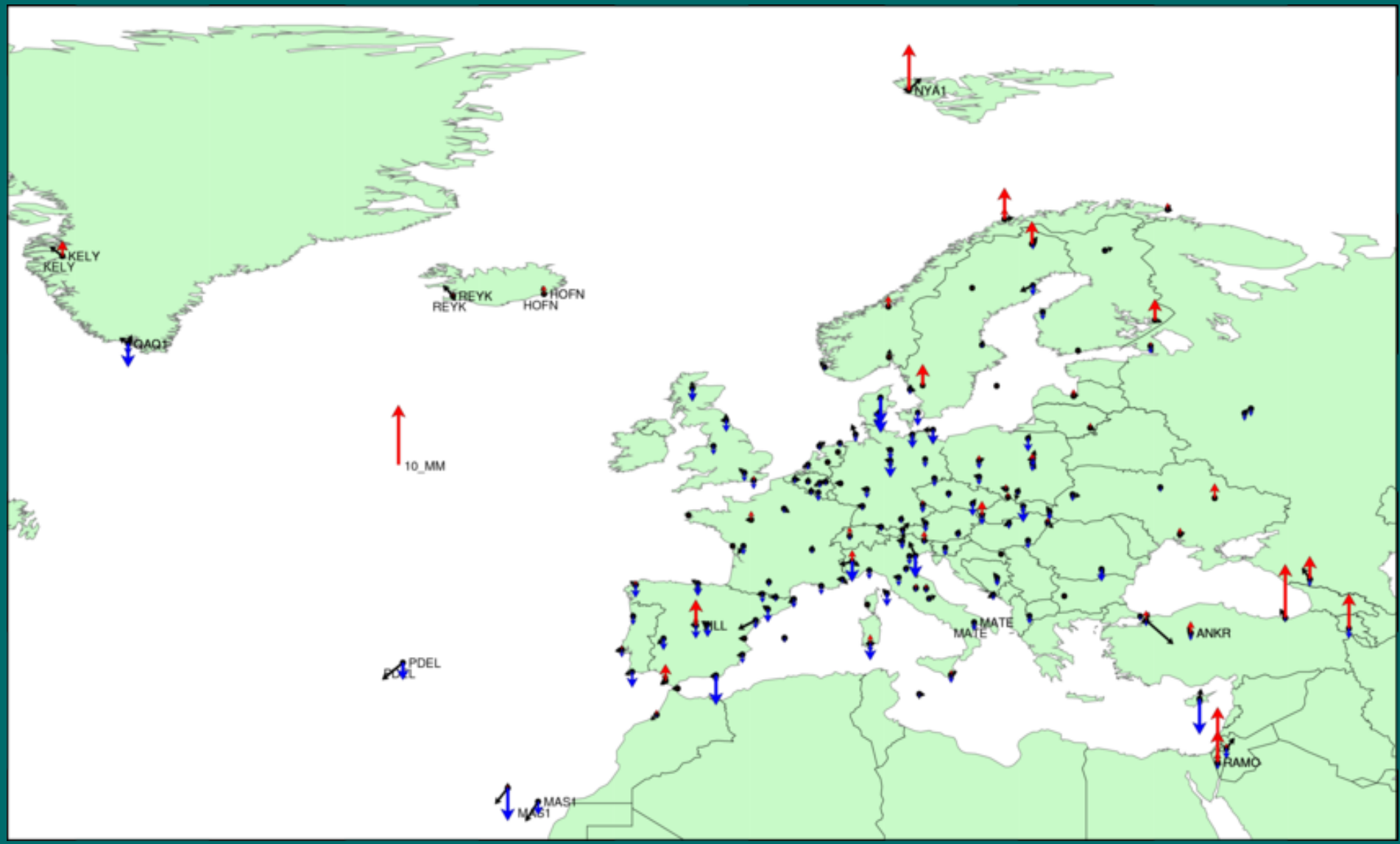
  SITES WITH SMALL OFFSET AT GPSWEEK 1400 WERE SELECTED - LIMITED VALIDITY DATUM DEFINITION

- THE SUBSEQUENT SSC SOLUTIONS [ETRF2000(R05)] WERE COMPARED

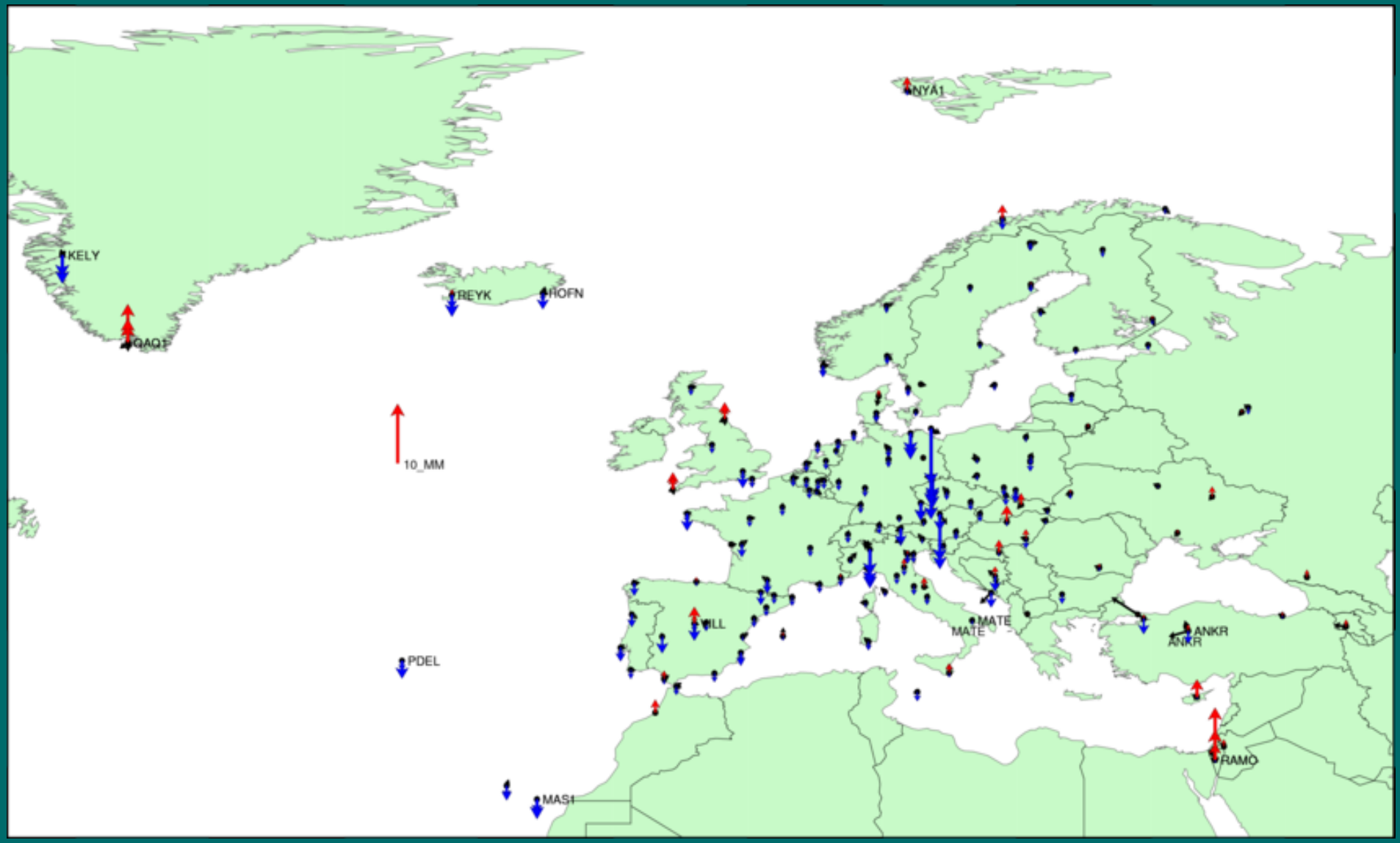
CAT_A: WK1399-1420 (CRD)



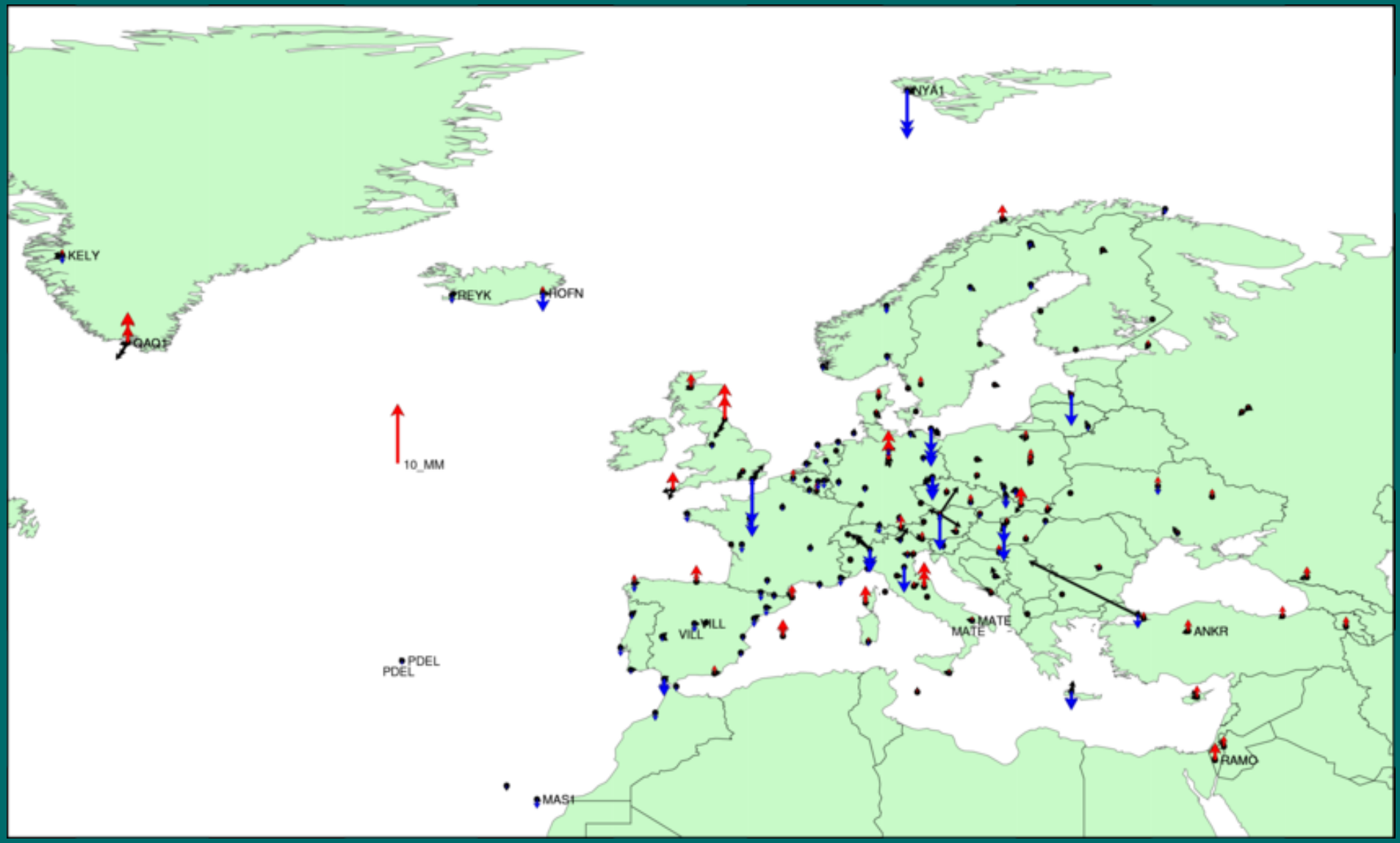
CAT_A: WK1420-1440 (CRD)



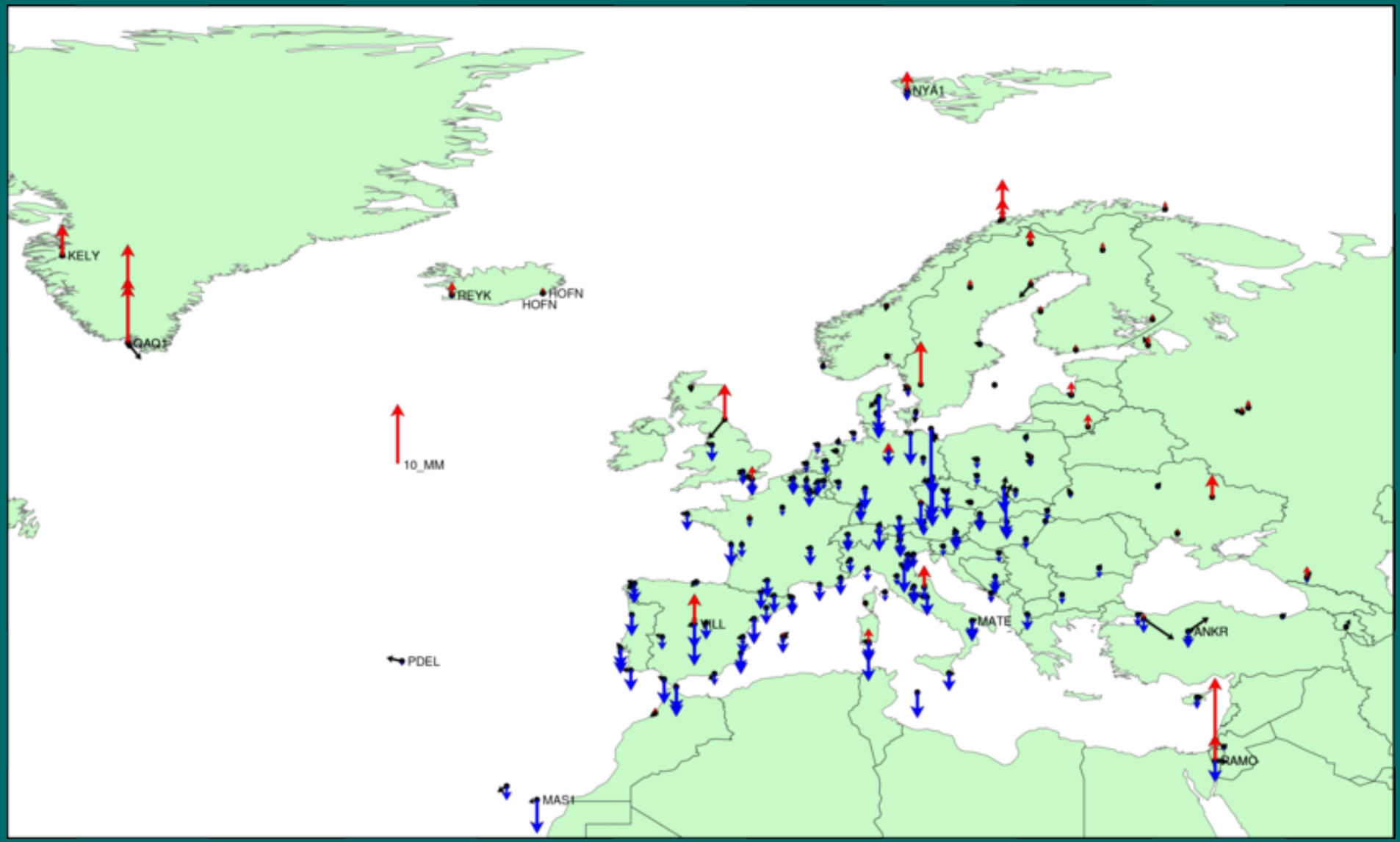
CAT_A: WK1440-1460 (CRD)



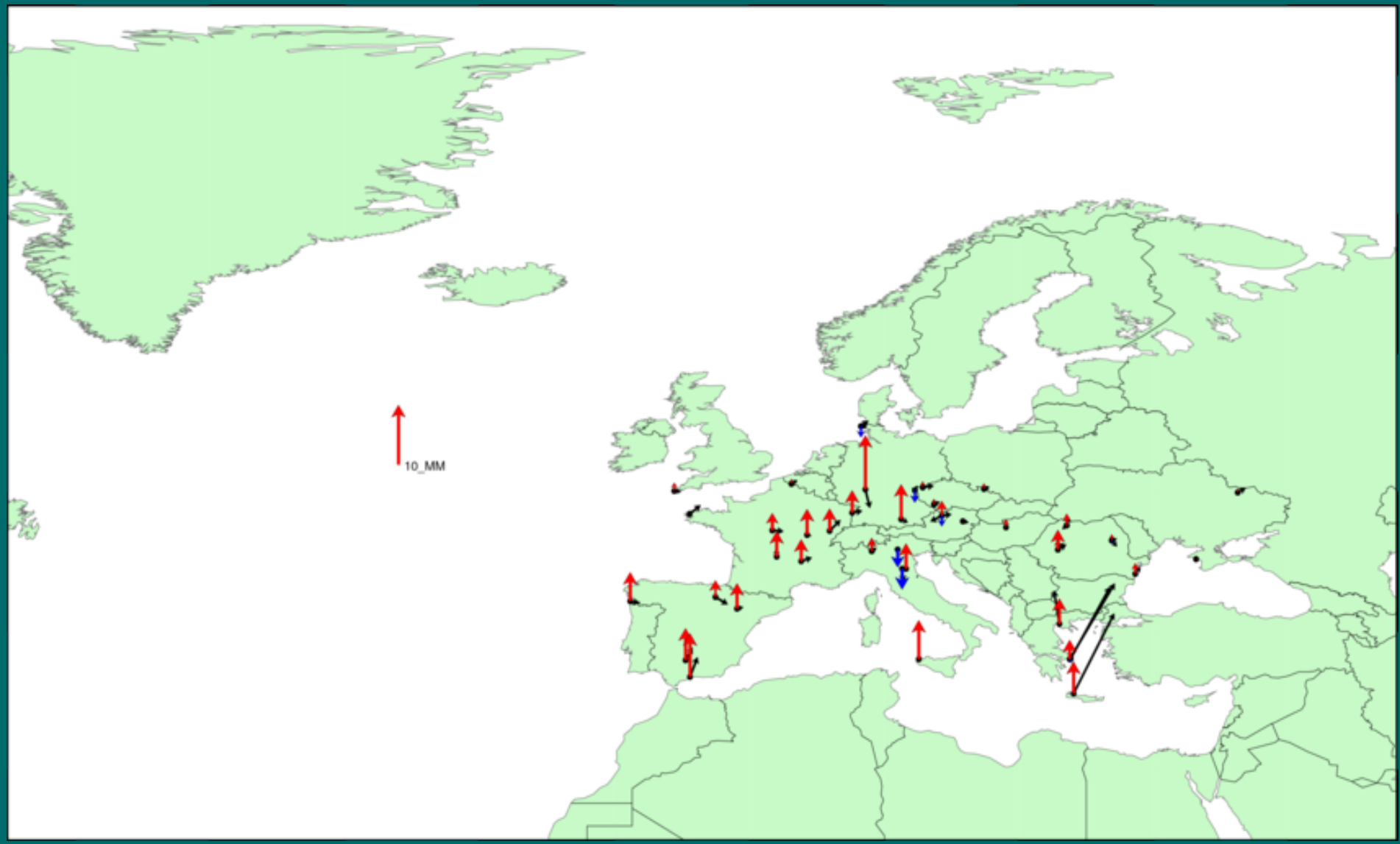
CAT_A: WK1460-1480 (CRD)



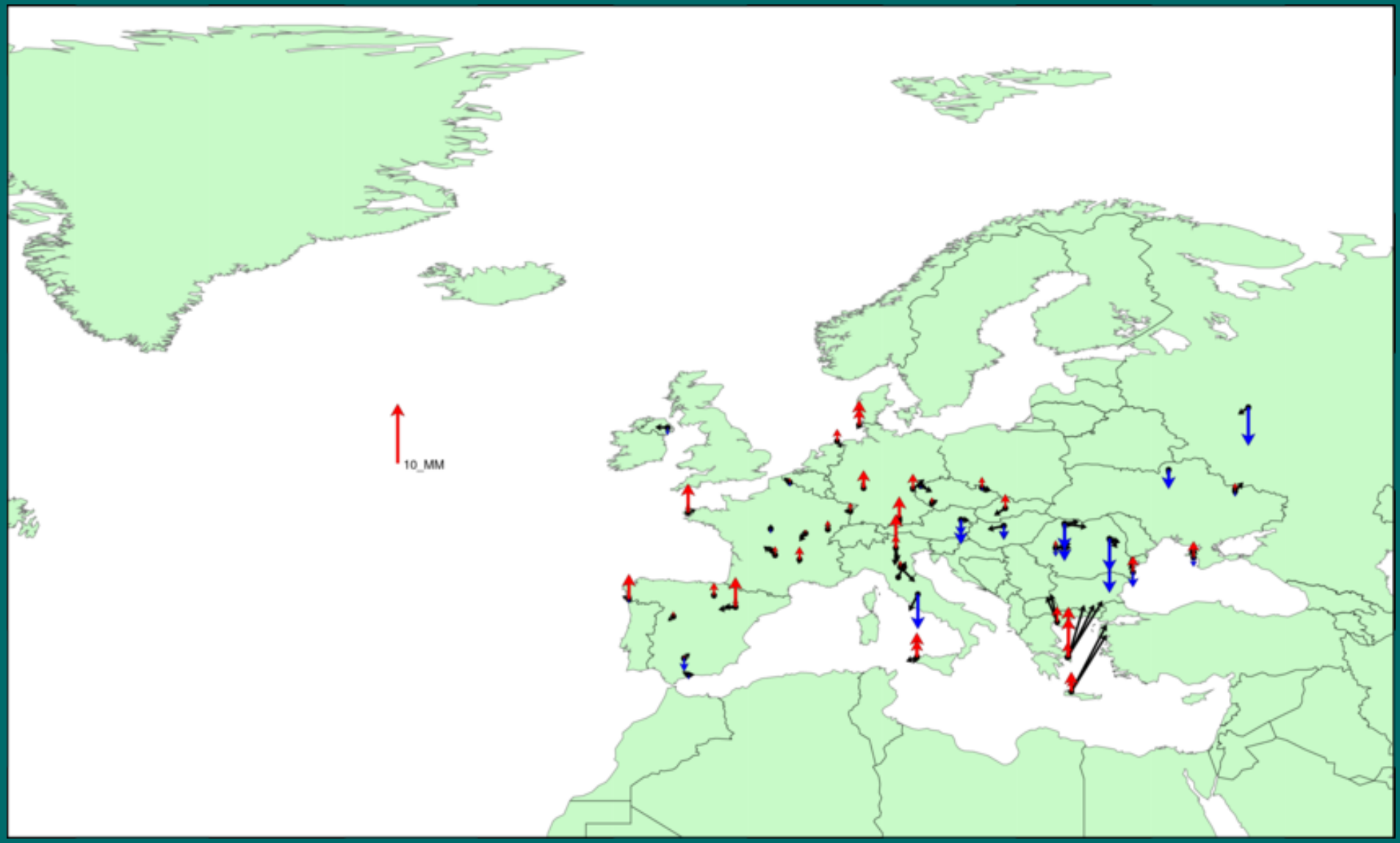
CAT_A: WK1399-1494 (CRD)



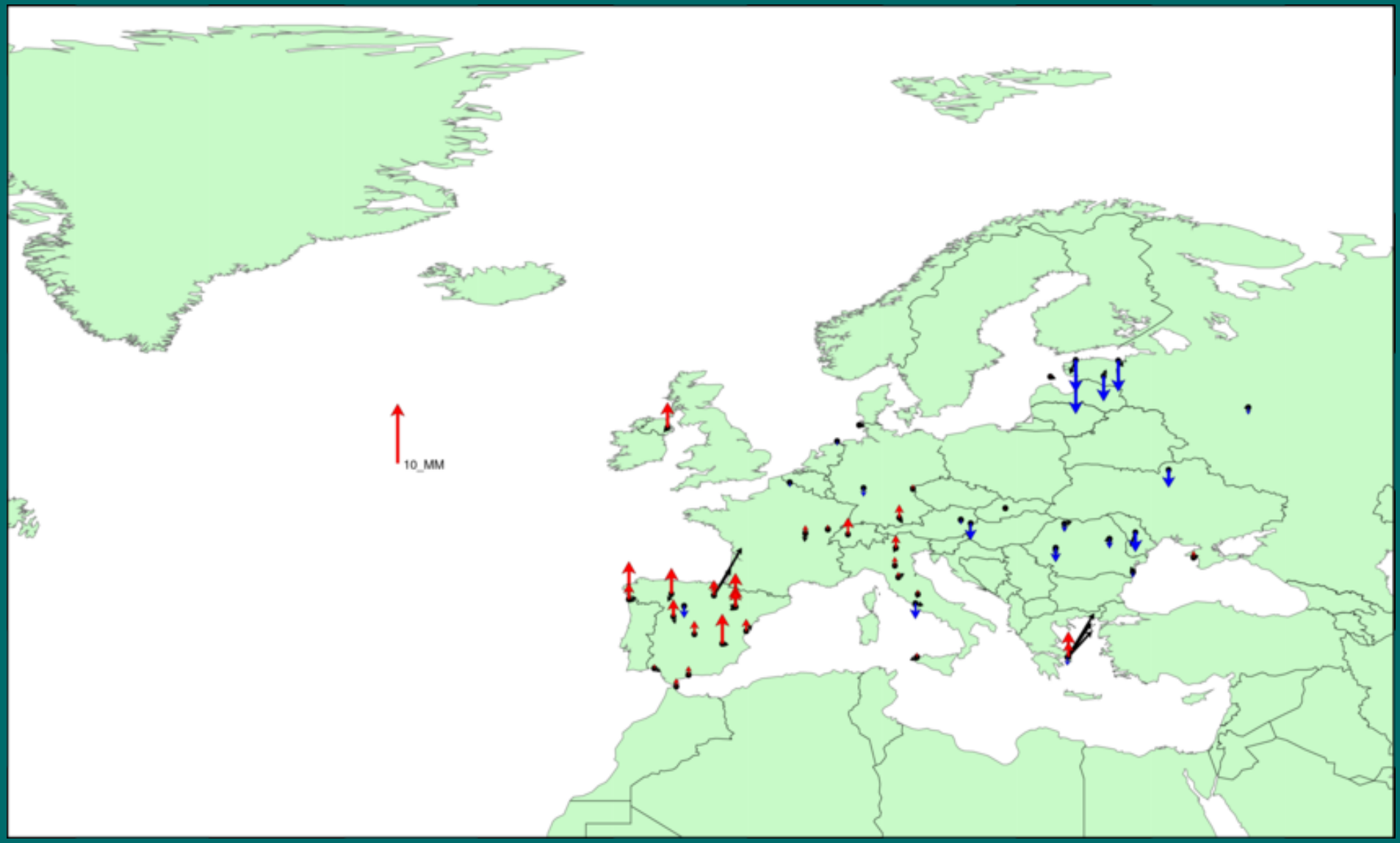
CAT_B: WK1399-1420 (CRD)



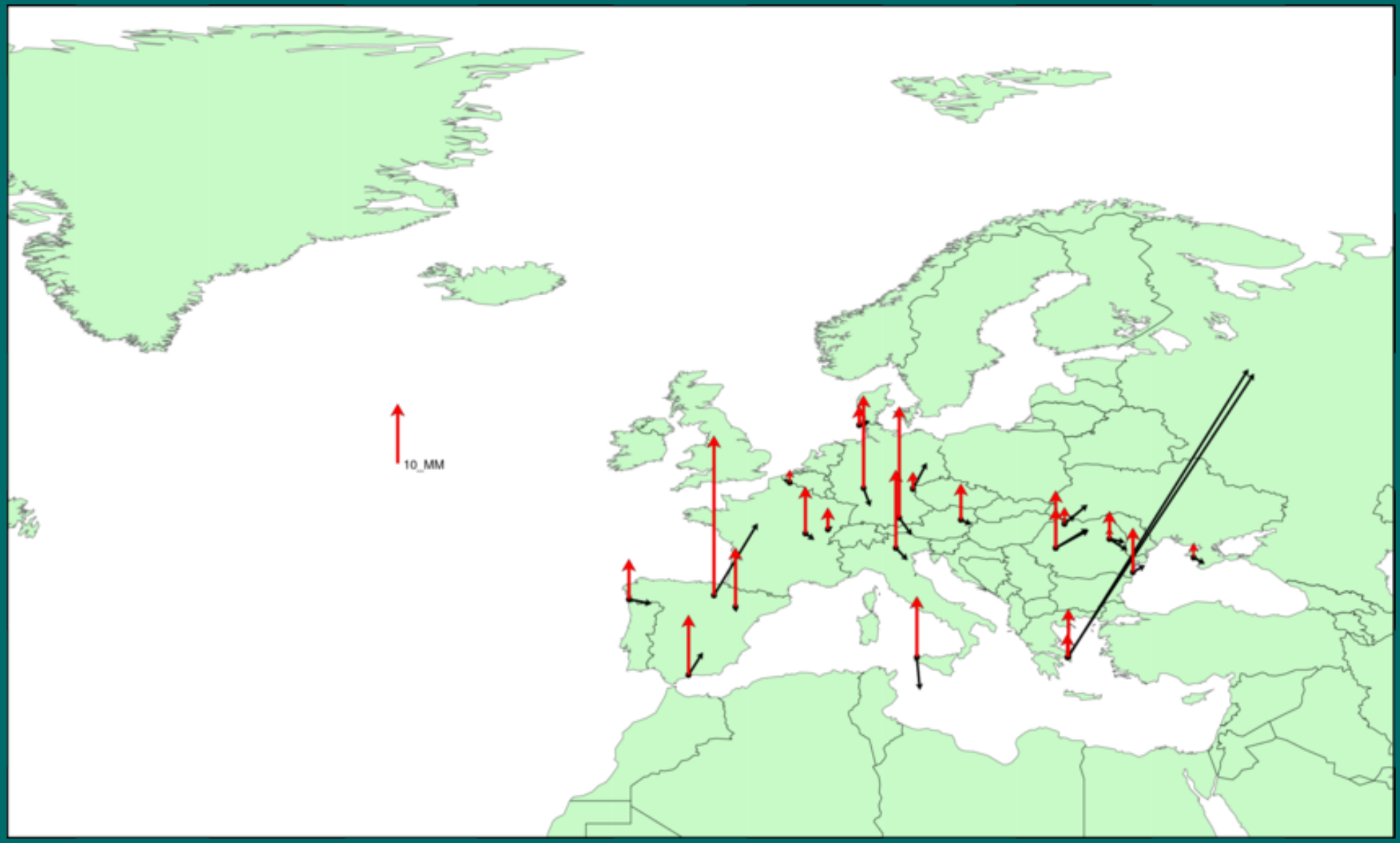
CAT_B: WK1420-1440 (CRD)



CAT_B: WK1480-1494 (CRD)



CAT_B: WK1399-1494 (CRD)



CONCLUSIONS

- THE EPN CUMULATIVE SOLUTION IS CAPABLE TO MAINTAIN 1 CM ACCURACY ETRS89 COORDINATES FOR THE EPN SITES!
- CONDITION: SITE CATEGORIZATION

  CAT_A – 1 cm AT ANY EPOCH

  CAT_B – 1 cm AT THE MEAN EPOCH
- FURTHER STUDIES, REFINEMENT
  - CATEGORY SEPARATION
  - FORMAT SPECIFICATIONS