# CATEGORIZATION OF THE EPN STATIONS

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#### **ETRS89 TUTORIAL**





# EPN STATION CATEGORIES version C1875



# QUESTIONS TO BE ANSWERED

- WHAT DOES THE CATEGORIZATION MEAN?
- WHY CATEGORIZATION IS NEEDED?
- HOW IS IT REALIZED AND MAINTAINED?
- WHO ARE THE USERS?
- HOW IS THE FUTURE?

# HISTORY

REMEMBER THE OLD EUREF TIMES WITH CAMPAIGNS AND CAMPAIGN VALIDATIONS . . .

CLASSICAL EUREF STATION CATEGORIES FOR CAMPAIGNS STATIC SOLUTION

- CLASS\_A: 1 cm accuracy independent of any epochs (only for permanent stations)
- CLASS\_B: 1 cm accuracy at a specific epoch, usually at the epoch of observations
- CLASS\_C: 5 cm accuracy at a specific epoch campaigns prior to 1993

IT WORKED FINE WITH CAMPAIGNS AND THE SPARSE, OCCASIONALLY PUBLISHED ITRS REALIZATIONS

# WHY A REVISION WAS NEEDED?

EUREF CAMPAIGNS OF PASSIVE GPS NETWORKS WERE PROGRESSIVELY REPLACED BY ACTIVE GNSS NETWORKS

- INCREASED DEMAND ON THE MORE FREQUENT ACCESS TO THE LATEST, UP-TO-DATE ETRS89 REALIZATION
- REGULAR PUBLICATION OF MULTI-YEAR COMBINED SOLUTIONS IN THE <u>ITRFyy STYLE</u> - POSITIONS (REFERRING TO A PRE-DEFINED EPOCH) AND VELOCITIES WERE NEEDED

**PRODUCT WITH CRITICAL ISSUE:** ACCURATE VELOCITIES WOULD BE NEEDED TO MAP POSITIONS TO THE DESIRED EPOCH

PROBLEM WITH NEWLY ESTABLISHED AND LOWER PERFORMANCE STATIONS, THOSE MUST BE SEPARATED.

STATIONS WITH SUFFICIENT LENGTH OF OBSERVATIONS AND HAVING HIGH QUALITY VELOCITIES SHOULD BE DISTINGUISHED FROM 'YOUNGER' SITES.

#### POSITION CONVERGENCE IN THE CONSECUTIVE SINEX SOLUTIONS MAPPED TO A COMMON EPOCH

CNIV\_15501M001 ( cat\_C )



Coordinate repeatabilities

## POSITION COVERGENCE WITHOUT MAPPING



EP2\_C1875\_weekly

## THEORETICAL BACKGROUND

Geoffrey Blewitt and David Lavallée

Effect of annual signals on geodetic velocity JGR, Vol. 107, No. B7, 10.1029/2001JB000570, 2002



VELOCITY BIAS DUE TO THE PRESENCE OF A SEASONAL SIGNAL OF 1 mm AMPLITUDE

NO NOISE CONSIDERED!



# WHY CATEGORIZATION IS NEEDED?

IN ORDER TO MAKE SURE THE HIGH LEVEL PRODUCT QUALITY AND EXCLUDE ERRONEOUS INFORMATION

ALLOW "BLIND", TRUSTFUL USE

QUALITY CHECKS TO SORT OUT UNRELIABLE DATA LEVEL\_0: RINEX DATA (TEQC, G-Nut/ANUBIS ...) LEVEL\_1: DURING GNSS ANALYSIS

LEVEL\_2: DURING DAILY/WEEKLY SINEX COMBINATION

- TIME SERIES FILTERING (OUTLIERS, OFFSETS, NOISY PARTS)
- RELIABILITY TESTING (YOUNG STATIONS WITH UNSTABLE POSITION ESTIMATE)

# **EPN STATION CATEGORIES**

CATEGORIES ARE BASED ON THE EUREF ANALOGY:

CLASS\_A: <1 cm accuracy ETRS89 position at any epoch <1 mm/year velocity

CLASS\_B: <1 cm accuracy ETRS89 position at the epoch of Minimum Variance (~mean epoch) velocities are not published

CATEGORIZATION CRITERIA:

- new stations enter to class\_A ASAP
- simple, pragmatic approach, designed to automatic qualification

### STATION CATEGORIZATION IN ETRS89 MAINTENANCE

- EACH 5 WEEKS AN INTERNAL CUMULATIVE SOLUTION IS COMPUTED CONTAINING ALL WEEKLY COMBINED EPN SOLUTIONS PRIOR TO THE COMBINATION
- THE LAST 6 INTERNAL SOLUTIONS (COVERING A HALF YEAR) ARE USED FOR TESTING AND STATION CATEGORIZATION UPDATE
- EACH 15 WEEKS A NEW MAINTENANCE SOLUTION IS PUBLISHED
- BOTH CATEGORY UPDATE AND DOWNGRADE ARE POSSIBLE

### STATION CATEGORIZATION 3 SELECTION CRITERIA, ALL SHOULD BE FULFILLED

1) SMOOTHNESS OF THE 5-WEEKLY STATION POSITION TIME SERIES, CHARACTERIZED BY THE RMS SCATTER OF THE WHOLE SERIES

#### THE LIMIT IS 2 MM FOR NE AND 5 MM FOR UP

2) CONVERGENCE OF THE VELOCITY ESTIMATE OF CONSECUTIVE SOLUTIONS APPROXIMATED AND REALIZED BY THE RMS SCATTER OF THE LAST 6 INTERNAL SOLUTIONS (25 WEEKS)

THE LIMIT IS 0.5 MM/YEAR

3) MAXIMUM ALLOWED VELOCITY SIGMA SQUARE BASED ON THE LAST 3 INTERNAL SOLUTIONS THE LIMIT IS 0.5

#### CATEGORIZATION TIME SERIES



EPN station categorisation (A-green dot; B-red dot)

LEON\_13475M001



EPN station categorisation (A-green dot; B-red dot)



EPN station categorisation (A-green dot; B-red dot)



EPN station categorisation (A-green dot; B-red dot)

### ARGUABLE POINT OF THE APPROACH: HANDLING OF THE SEASONAL SIGNAL

STATIONS EXHIBITING UNIFORM SEASONAL POSITION VARIATION WITH HIGHER AMPLITUDE ARE MOVED TO CLASS\_B



\_12223M001

#### THE DISTRIBUTION OF SUCH STATIONS IS NOT RANDOM



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#### STATION CATEGORIZATION HISTORY © EPNCB



10 [ˈɯɯ] -10 -10 North-component -20 -20 10 10 [mm] 0 East-component -10 10 20 10 10 [mm] 0 -10 10 -20 -20 -30 -30 850 900 950 1000 1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 GPS WEEK

13299S001

33 YOUNG STATIONS
17 DUE TO SEASONAL SIGNAL
9 HIGHER NOISE LEVEL
1 POST SEISMIC DEFORMATION

### USER EXPERIENCES, FEEDBACKS

ORIGINALLY PLANNED TO SERVE NATIONAL LEVEL ETRS89 REALIZATIONS

CATEGORIZATION IS FUNCTIONAL PART OF THE ETRS89 MAINTENANCE

- GENERALLY POSITIVE RESPONSES (SOMETIMES UNHAPPY STATION MANAGERS)
- ONLY FEW REQUESTS FOR CLASS\_B VELOCITIES
- USER FEEDBACK IS NEEDED ON THE PRACTICAL USE AND FOR GENERAL/SPECIAL DEMANDS

### NEAR FUTURE DEVELOPMENTS

REFINEMENT OF THE CATEGORIZATION IS CERTAINLY CONSIDERED AND TO BE PUBLISHED WITH THE ITRF2014/IGS14 MAINTENANCE SOLUTION

- RELYING ON THE ITF2014 PRACTICE THE CATEGORIZATION SHOULD BE TESTED WITH TIME SERIES WITH REMOVED SEASONAL SIGNAL
- PRIMARY CONCERN IS THE TIME SERIES STABILITY AND HOMOGENEITY
- BETTER TAILORING OF CATEGORY UP- AND DOWNGRADES – SHORTER SEGMENT FOR TESTING NOISE LEVEL