



# Validation of reference frame consistency of GNSS service products

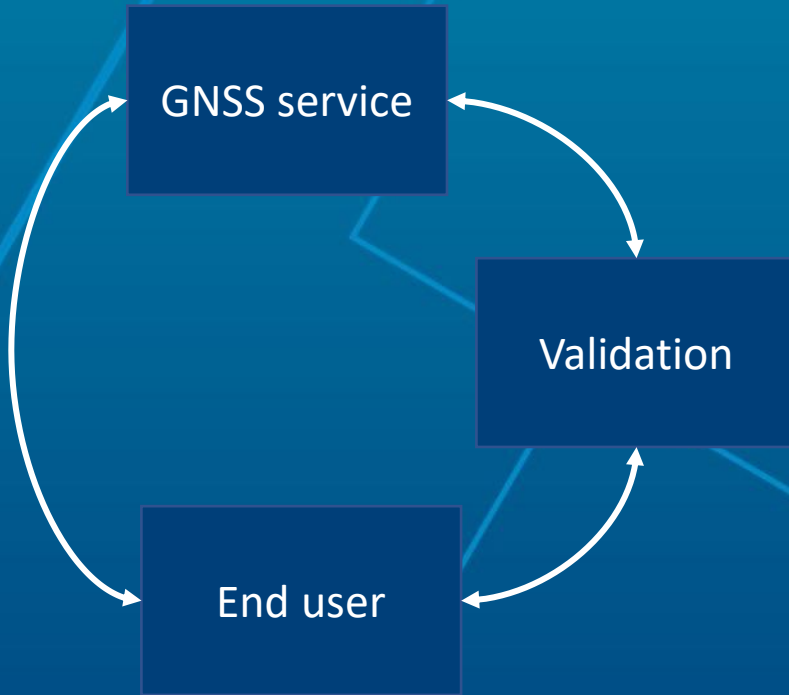
Lennard Huisman and Huib de Ligt  
REFAG 2022 – Thessaloniki - Greece

# Outline

- Motivation
- Current approach
- Grid approach and results
- Next steps



# Motivation

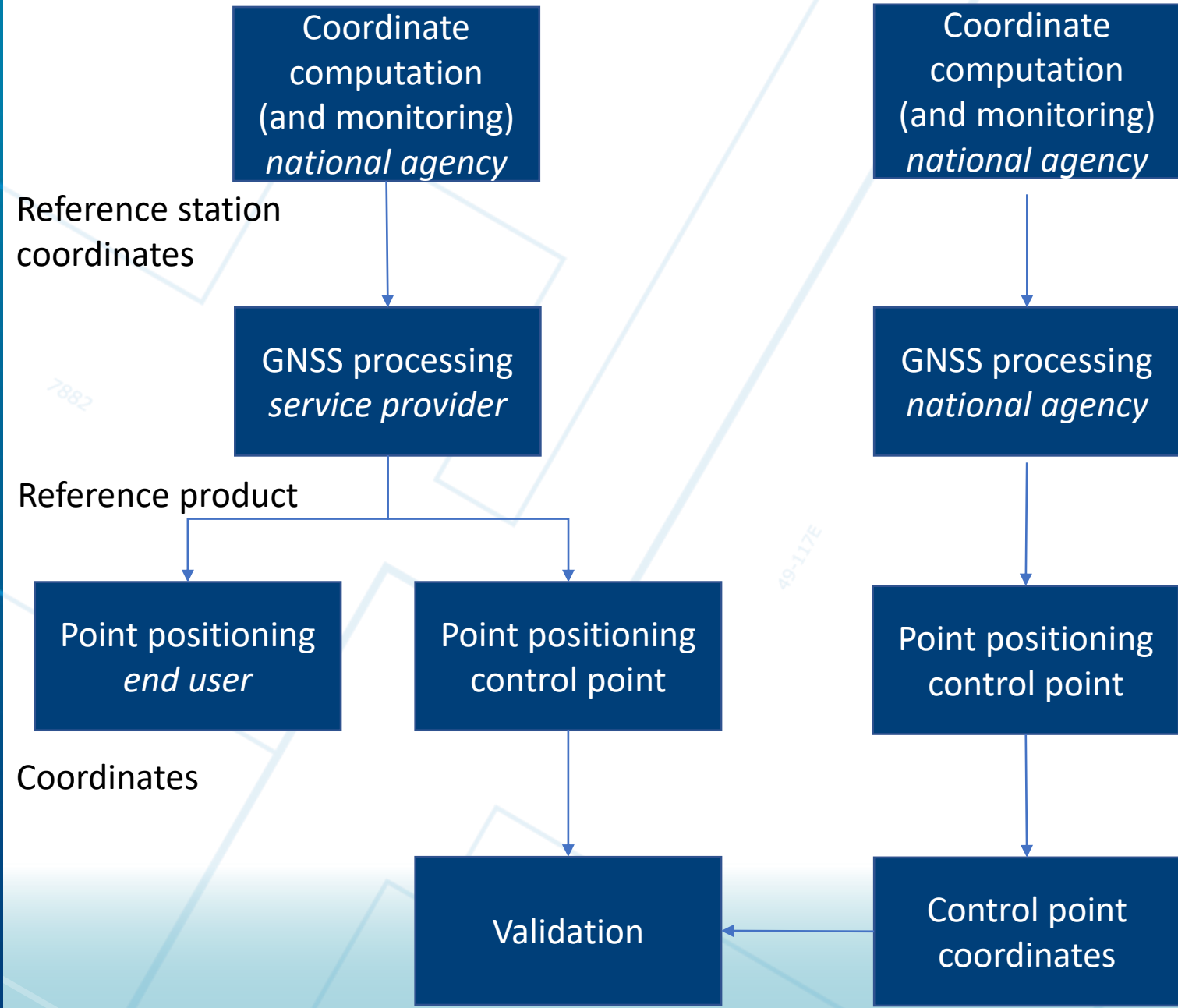
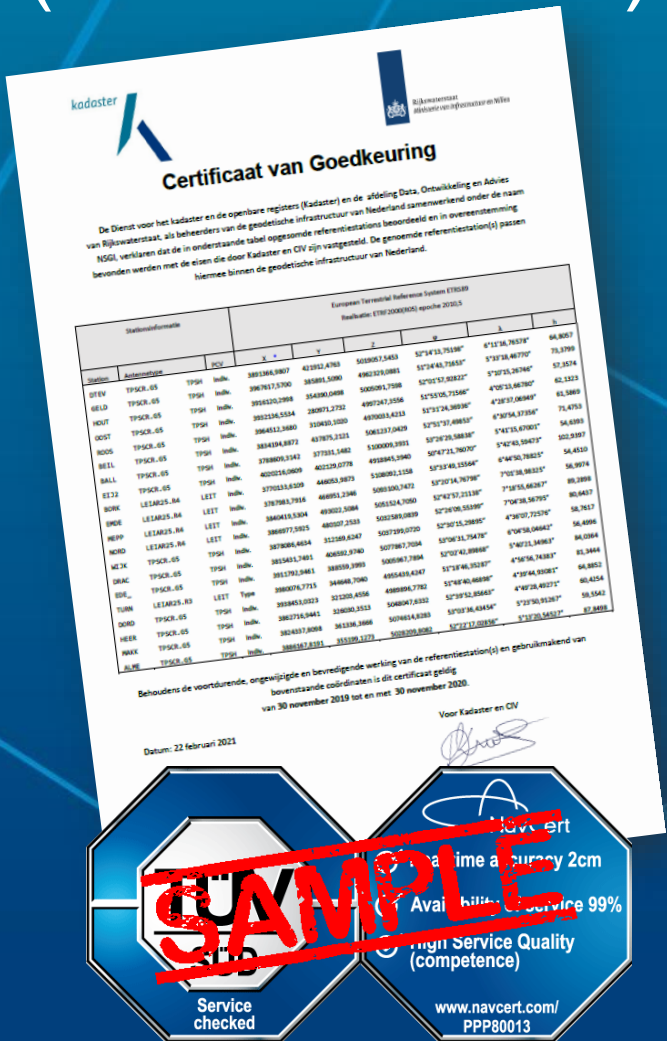


- Validate the reference frame of GNSS point positioning services
- Need for consistency in analysis
- Different approaches at national level (and usually RTK services only)
- Need for new approach
  - Possibility to implement international / cross border
  - Validate PPP and RTK
  - Focussed on end user product

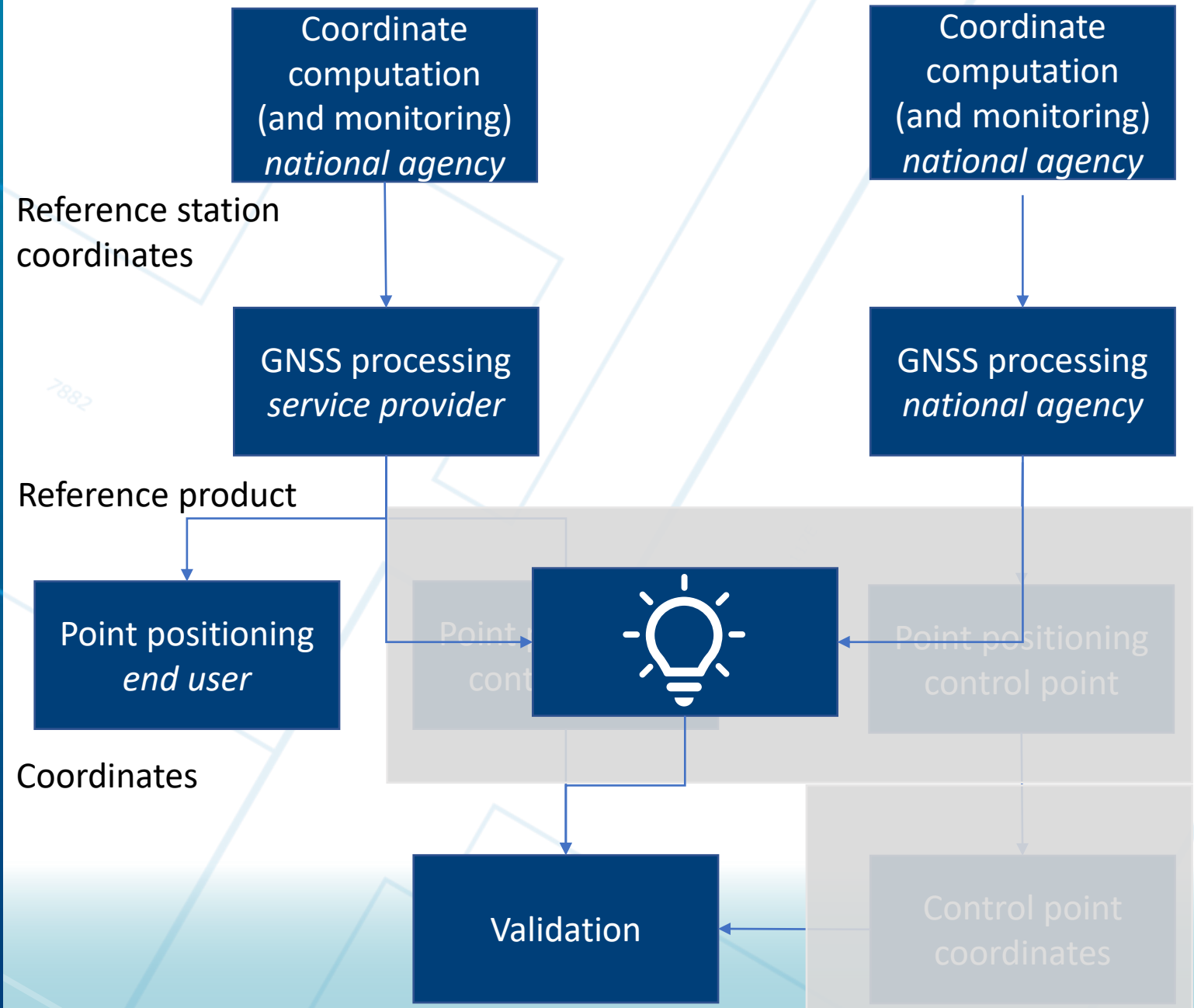




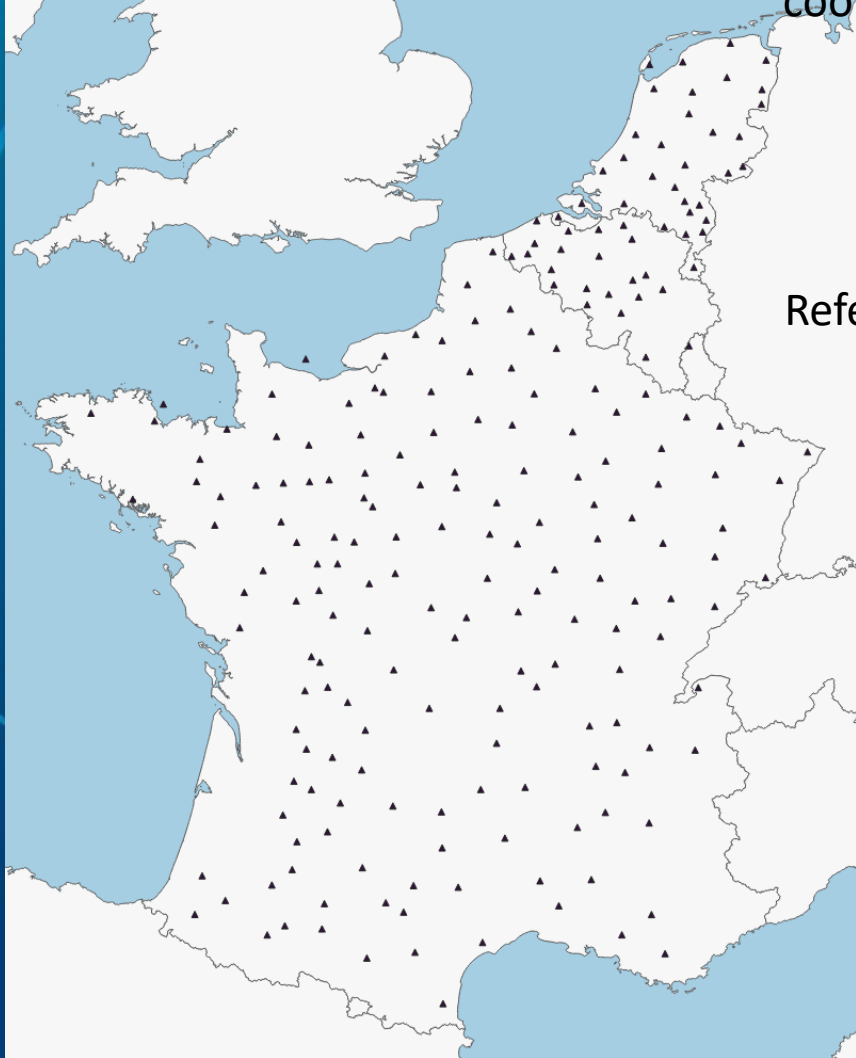
# Current approach (RTK services)



# Other approach (RTK services and PPP and SPP, ...)



# Grid check (RTK services)



Reference station  
coordinates

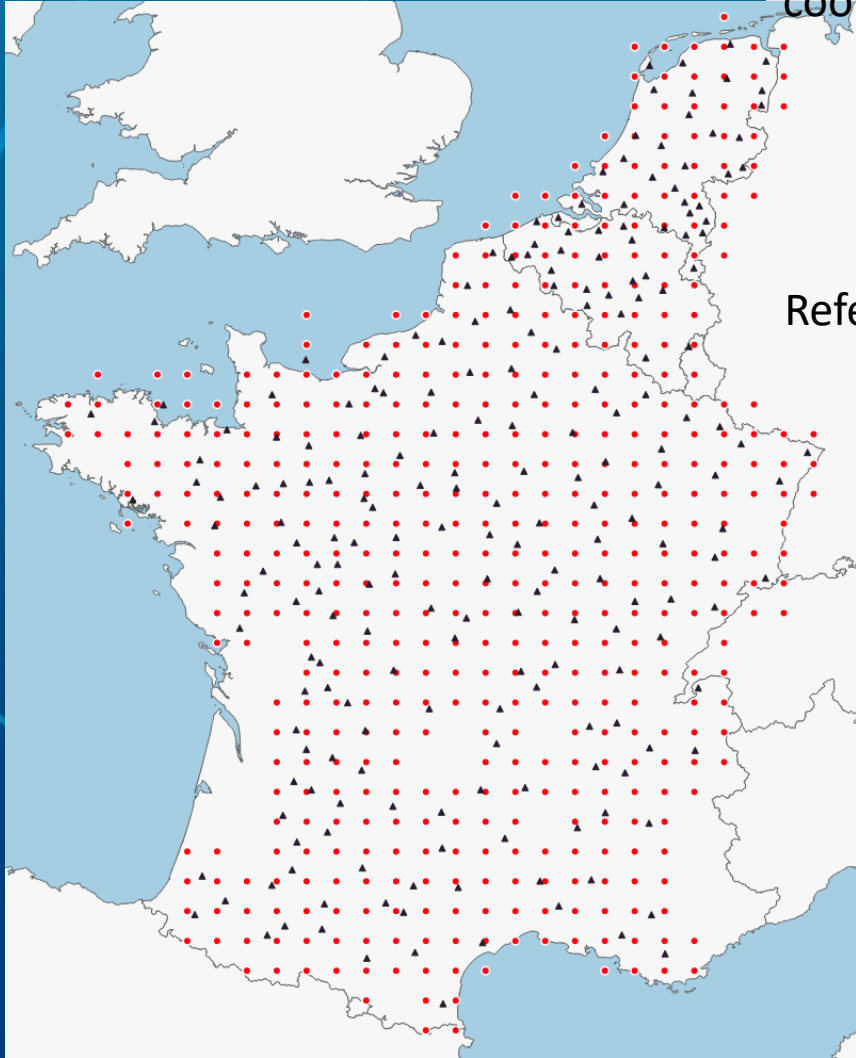
Coordinate  
computation  
(and monitoring)  
*national agency*

GNSS processing  
*service provider*

Reference product



# Grid check (RTK services)



Reference station  
coordinates

Coordinate  
computation  
(and monitoring)  
*national agency*

GNSS processing  
*service provider*

Grid coordinates  
*national agency*

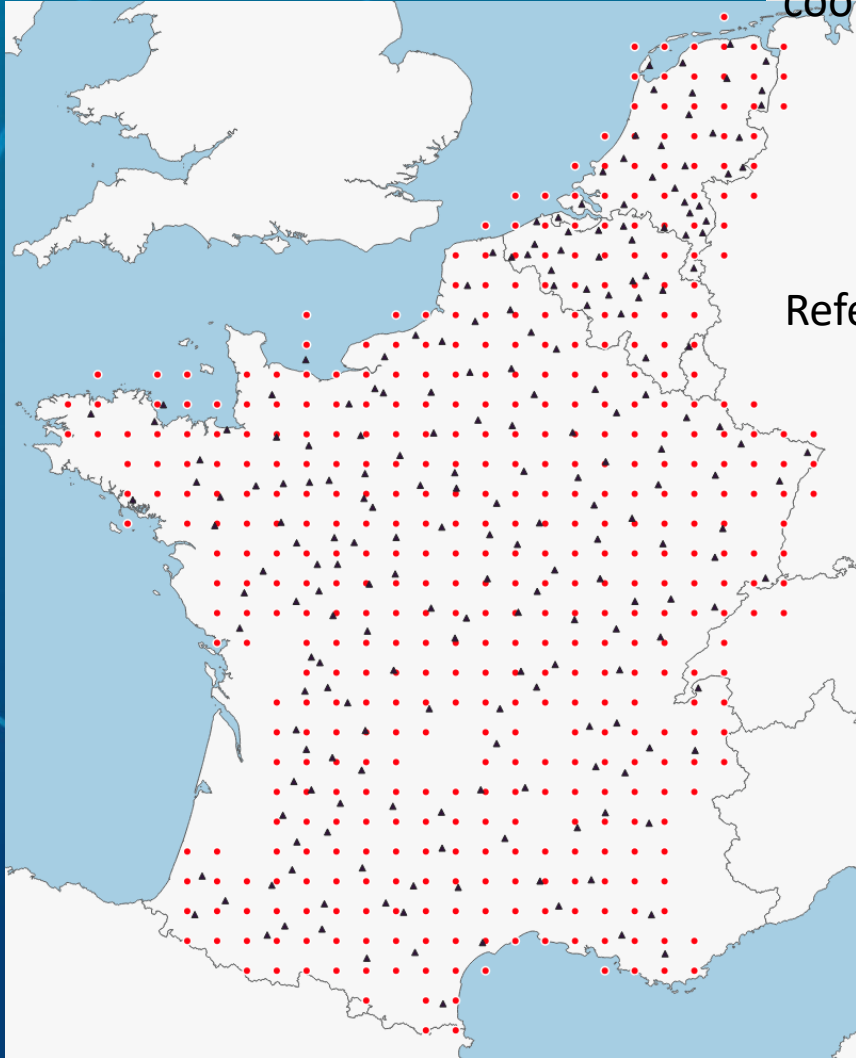
Reference product

Virtual station  
data (RINEX)  
*service provider*





# Grid check (RTK services)



Reference station  
coordinates

Reference product

Coordinate  
computation  
(and monitoring)  
*national agency*

GNSS processing  
*service provider*

Grid coordinates  
*national agency*

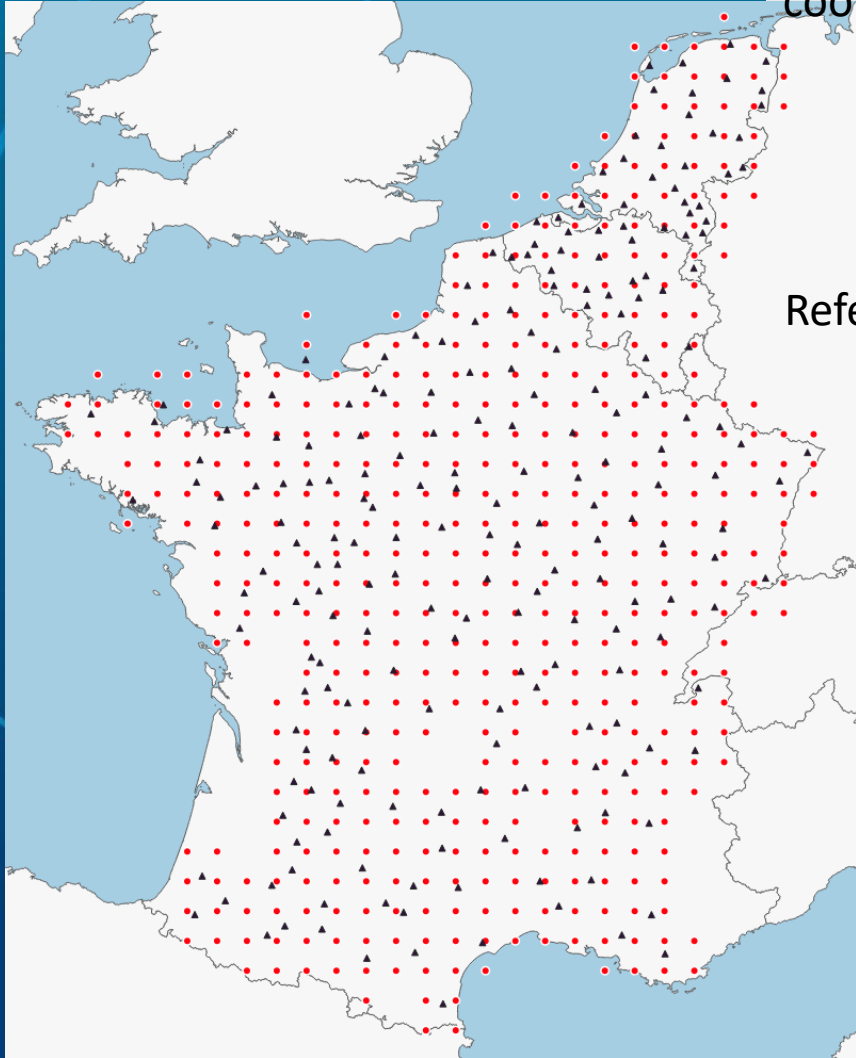
Validation

Virtual station  
data (RINEX)  
*service provider*

Coordinate  
computation  
(and monitoring)  
*national agency*



# Grid check (RTK services)



Reference station  
coordinates

Reference product

Coordinate  
computation  
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*national agency*

GNSS processing  
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Grid coordinates  
*national agency*

Validation

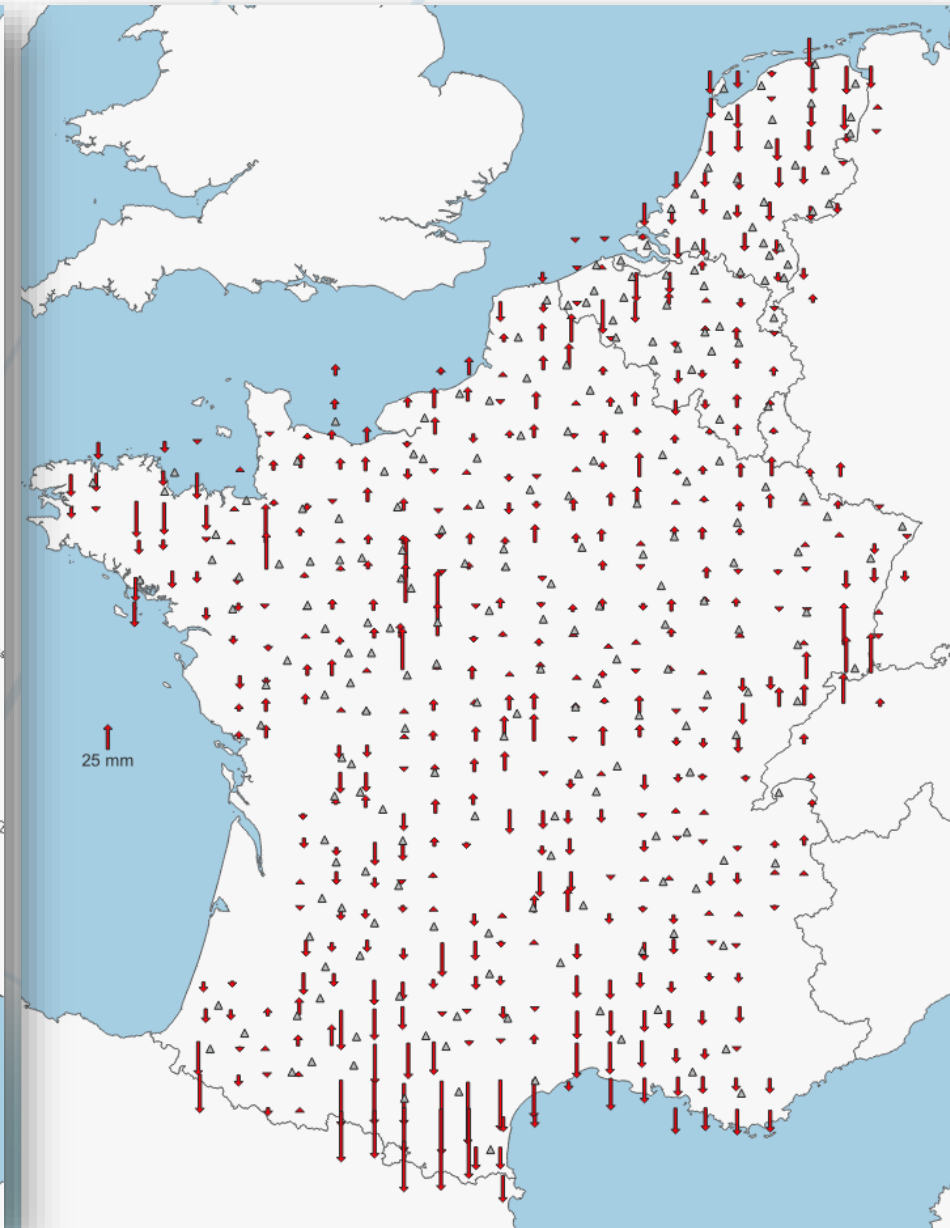
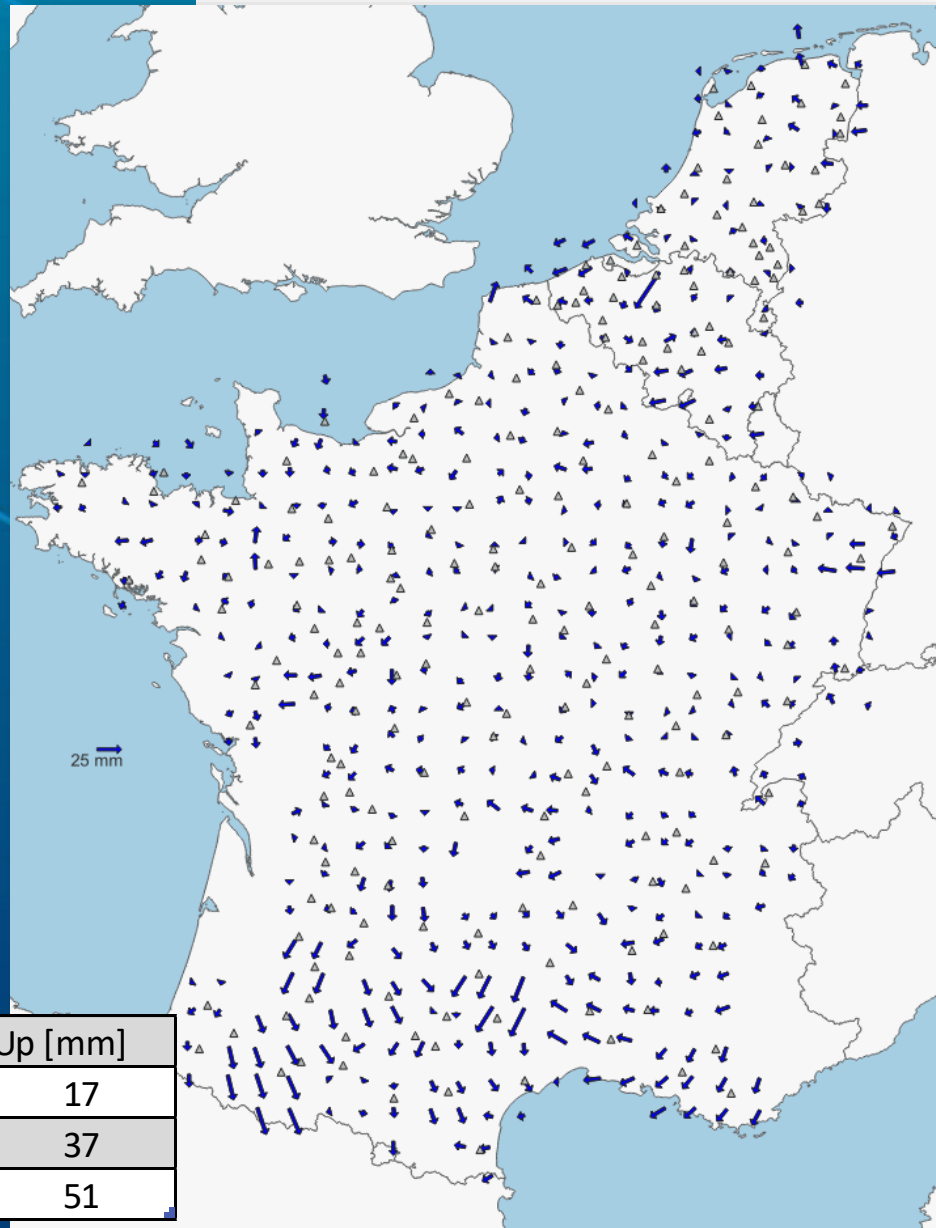
Virtual station  
data (RINEX)  
*service provider*

Coordinate  
computation  
(and monitoring)  
*national agency*



# Grid check

Difference between computed ETRF2000 coordinates and coordinates provided by GNSS service (VRS coordinates)



	North [mm]	East [mm]	Up [mm]
RMS	8	7	17
95-percentile	16	13	37
99-percentile	25	18	51

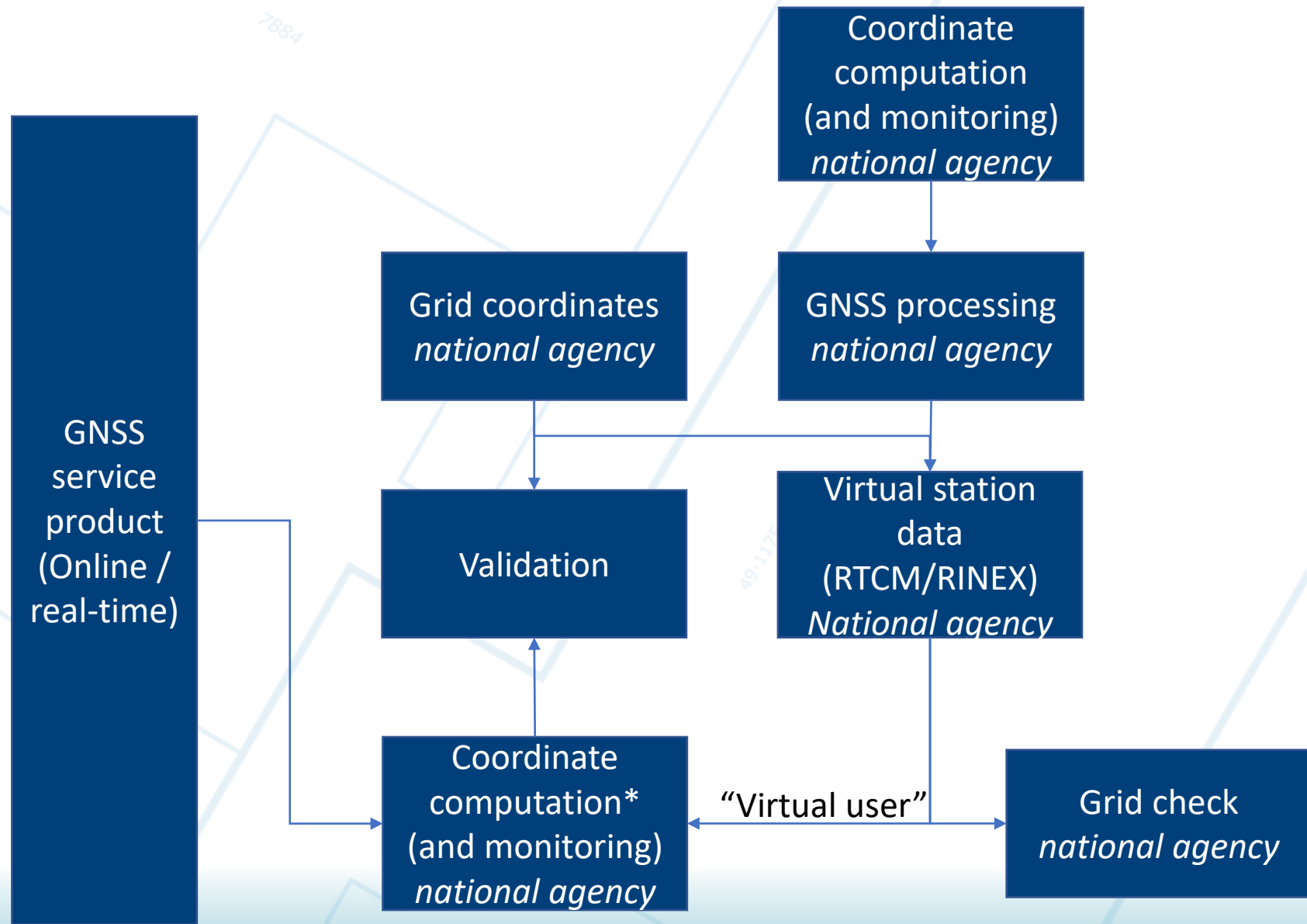
# Systematic QC

- Grid check only available when RINEX files can be created from the services
- Create “virtual users” from benchmark network
- Validate GNSS service with these virtual users



# Systematic QC

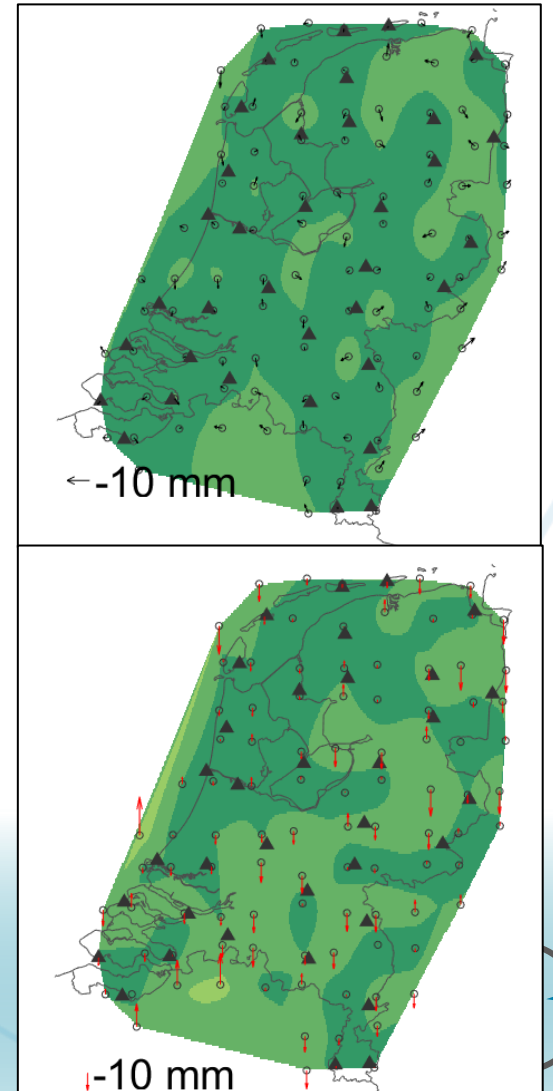
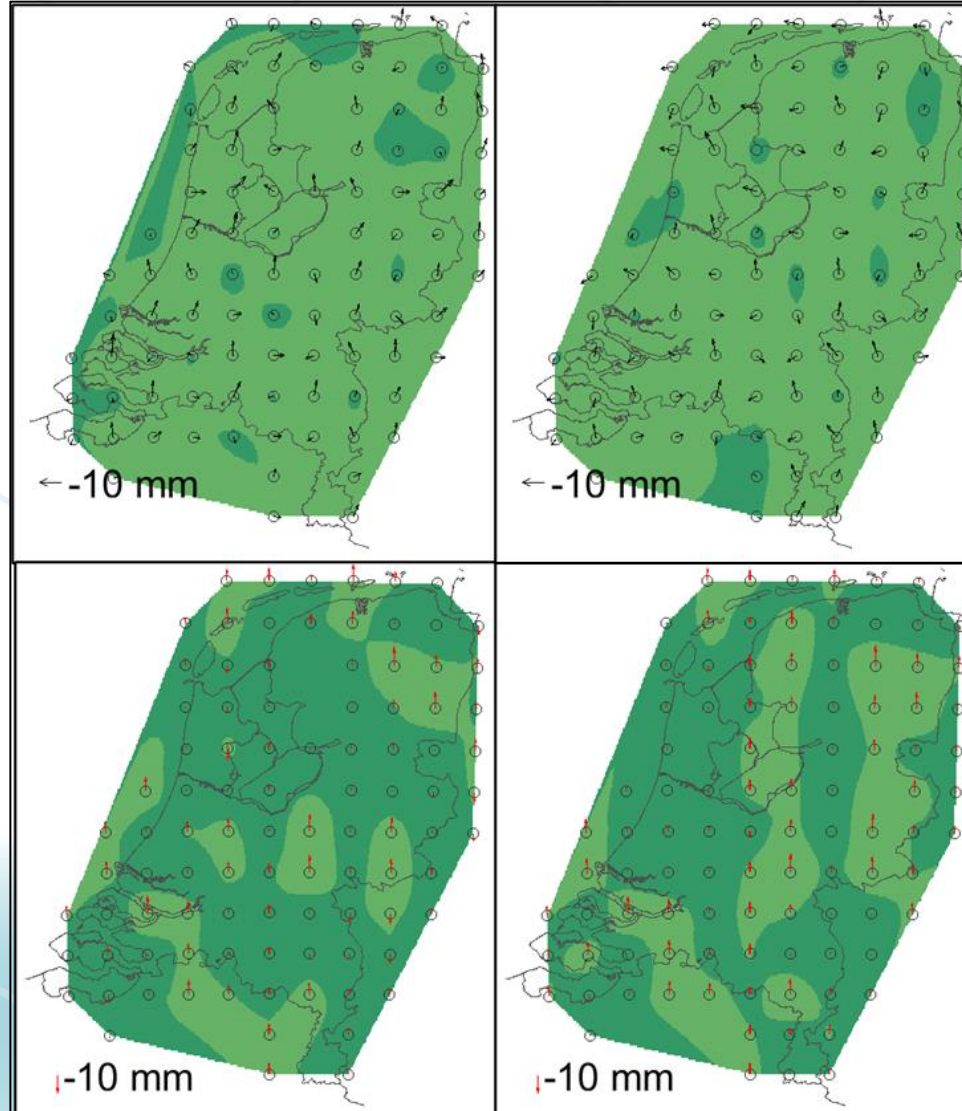
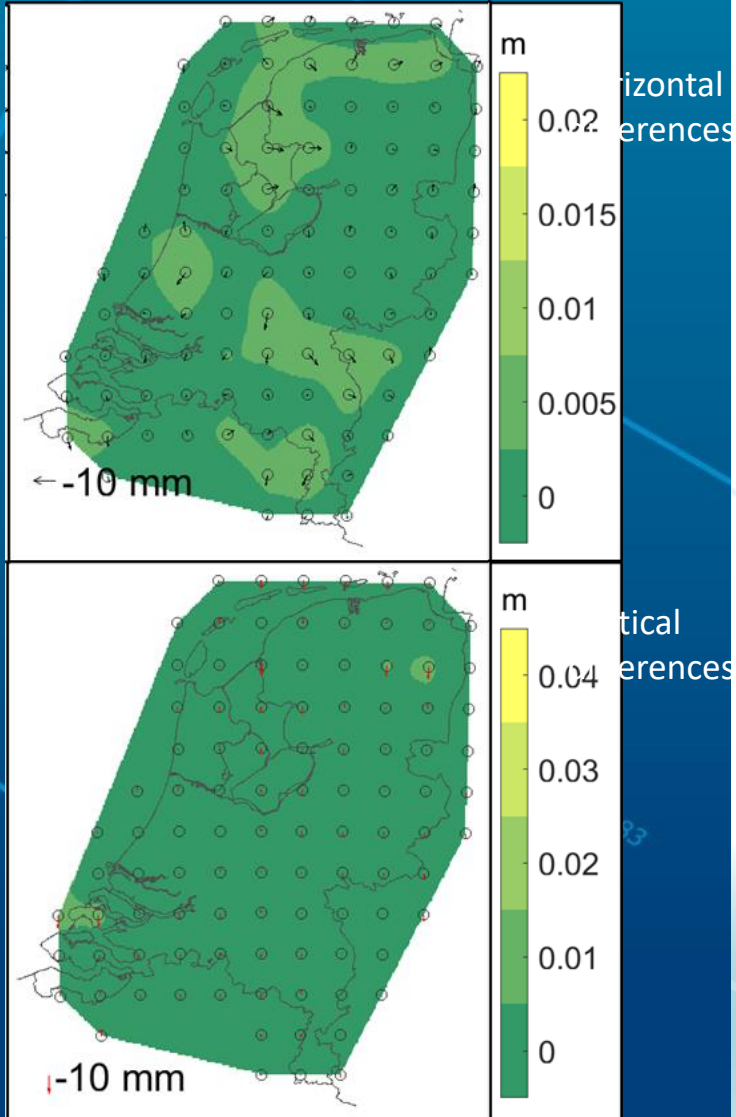
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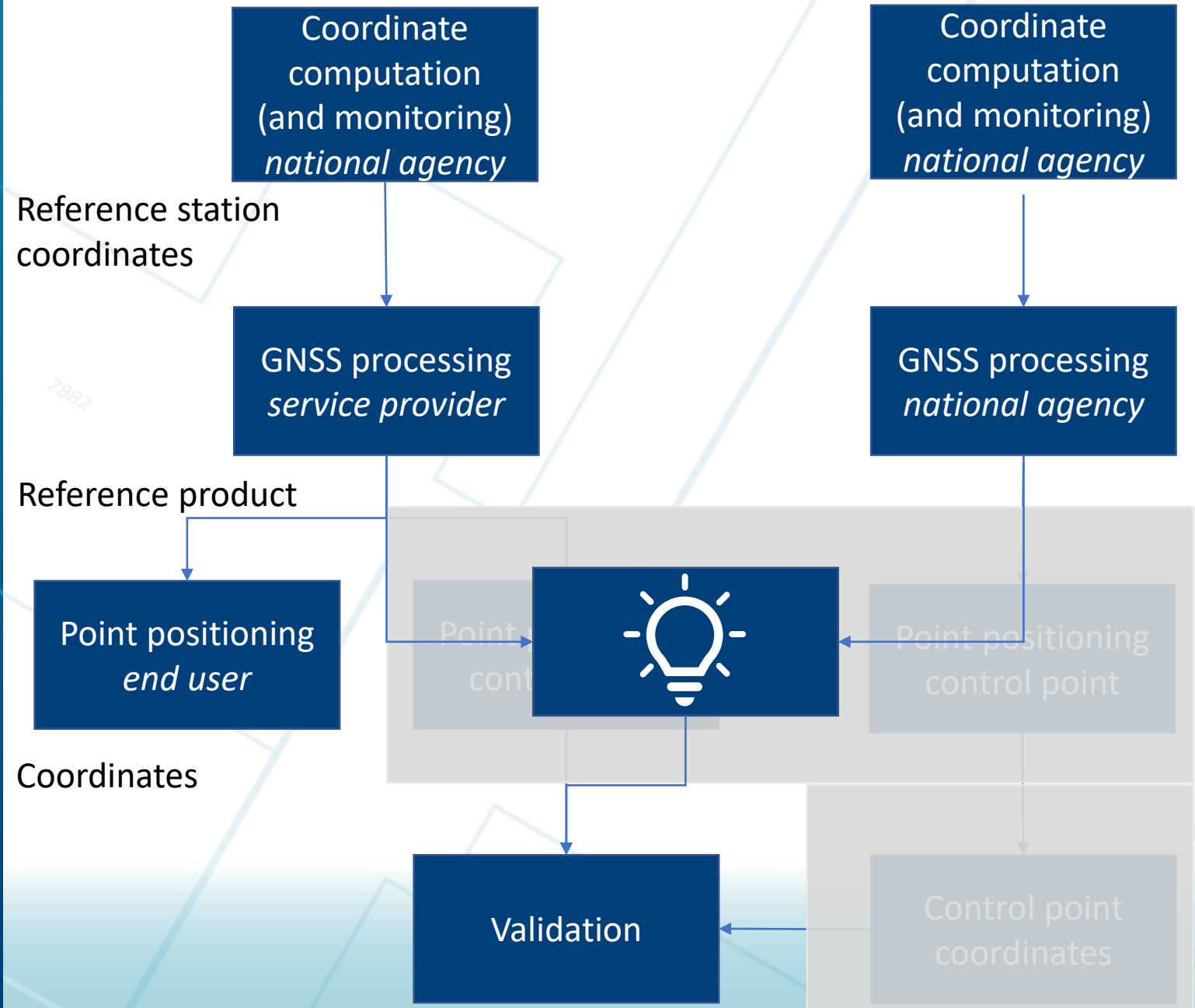
# Systematic QC

Grid check for 'benchmark network'

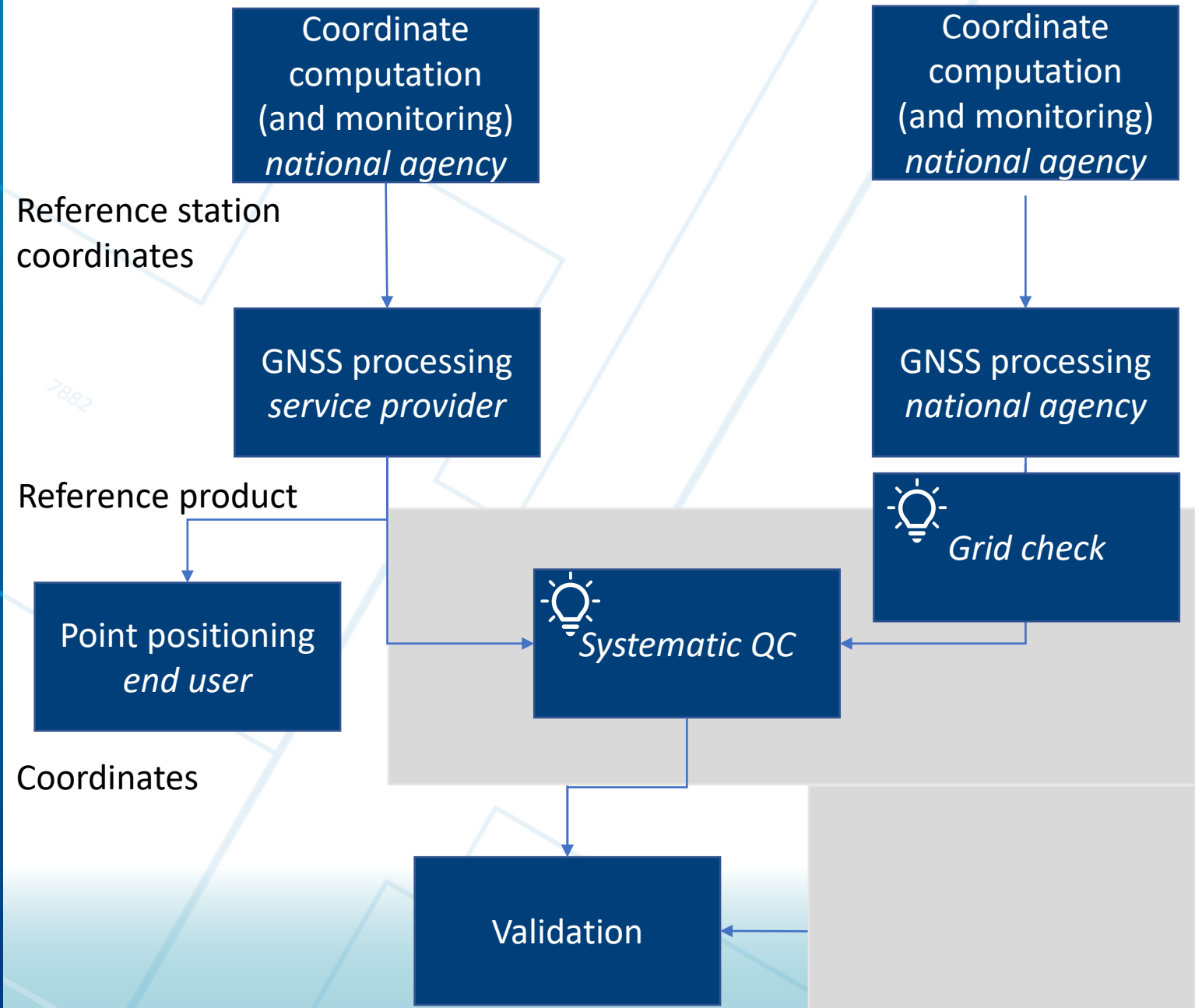
	RMS [mm]		
	North	East	Up
NRCAN CSRS-PPP (24 hour session)	2.6	3.0	5.0
Trimble RTX post-processing (24 hour session)	2.8	2.6	4.6
Real-time RTK-service (1 month 8 minute sessions (~160 per point))	1.6	1.9	7.1



# Other approach (RTK services and PPP and SPP, ...)



# Other approach (RTK services and PPP and SPP, ...)



7883

7882



# Next steps

- Further analysis
  - Grid density
  - Observation time
  - Processing algorithms
  - Metrics
- Create support
  - Service providers
  - End user
  - International partners (other agencies)





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