

# The NKG 2008 GPS campaign

## - transformation results

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LANTMÄTERIET



# The NKG 2003 Official Transformations to National ETRS89 realizations

1. ITRF 2005 epoch 2008.10.01 → ITRF 2000 epoch 2008.10.01  
(IERS 14 par.)
  2. ITRF 2000 epoch 2008.10.01 → DK\_ETRS89  
(NKG 2003 transformation)
- (i.e. using the ITRF 2000 Plate velocities and the NKG2003\_vel model from epoch 2008.10.01 to DK\_realization\_epoch)

DK may be replaced by FI, NO and SE.

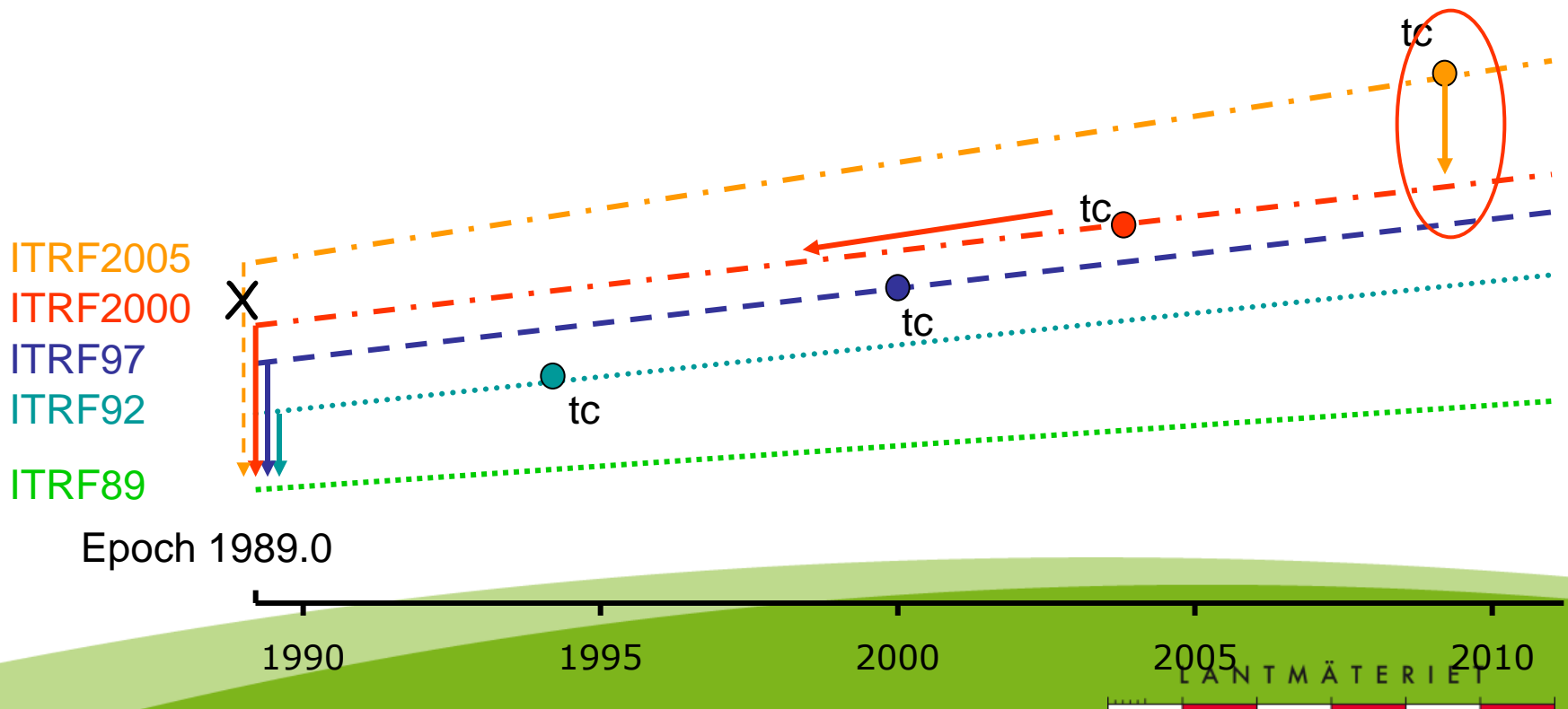
## ETRS89

coincident with ITRS at the epoch 1989.0 and fixed to the stable part of the Eurasian Plate.

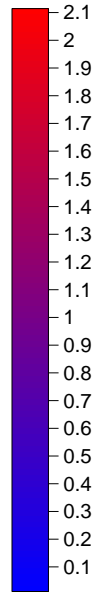
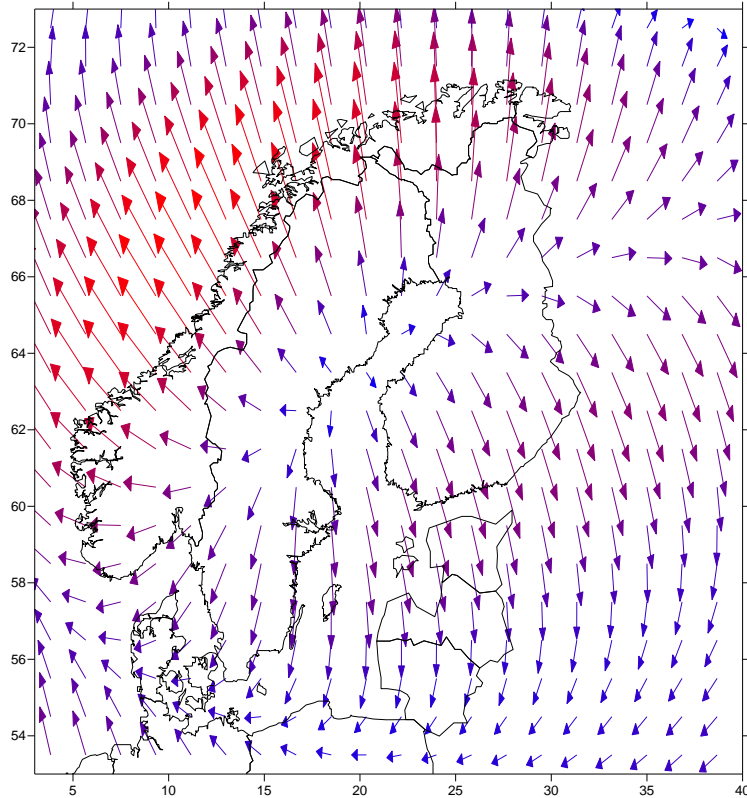
The formula for transformation from ITRF<sub>yy</sub> to ETRF<sub>yy</sub> (Boucher&Altamimi Memo v7, chapter 3)

$$X^E(t_c) = X_{YY}^I(t_c) + T_{YY} + \begin{pmatrix} 0 & -\dot{R}3_{YY} & \dot{R}2_{YY} \\ \dot{R}3_{YY} & 0 & -\dot{R}1_{YY} \\ -\dot{R}2_{YY} & \dot{R}1_{YY} & 0 \end{pmatrix} \times X_{YY}^I(t_c) \cdot (t_c - 1989.0)$$

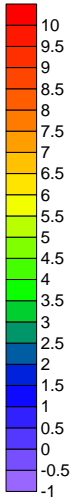
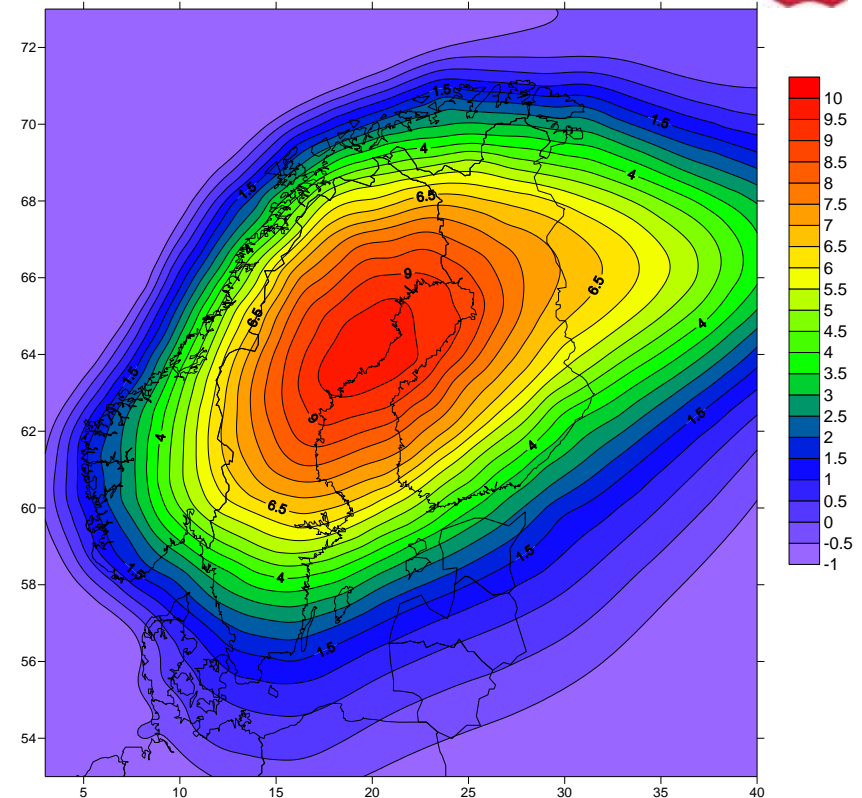
# Use ETRF2000 as the conventional frame for the ETRS89 system



# The NKG\_RF2003\_vel velocity model



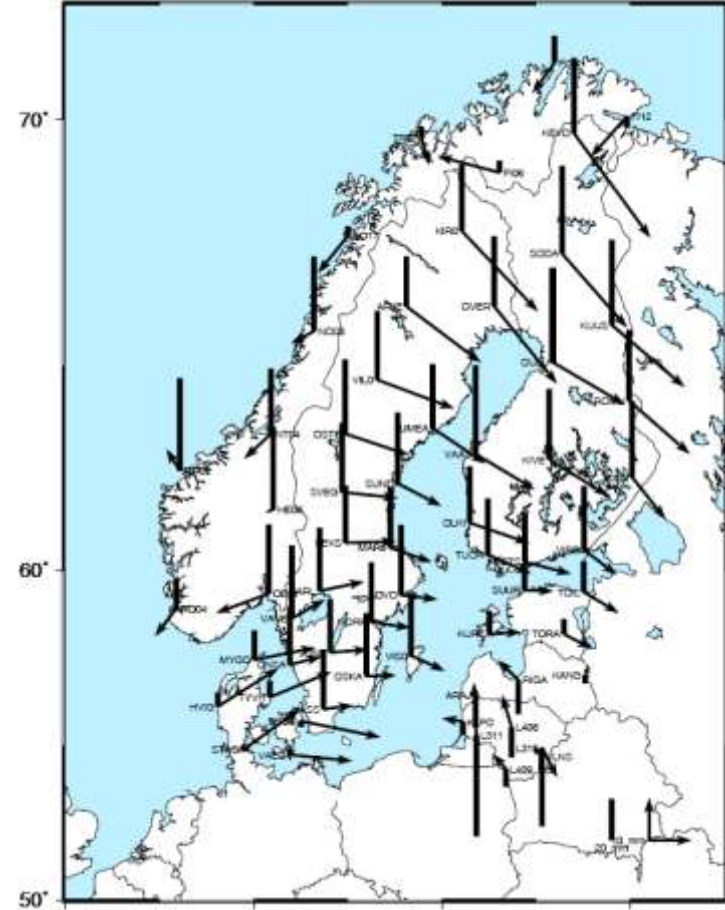
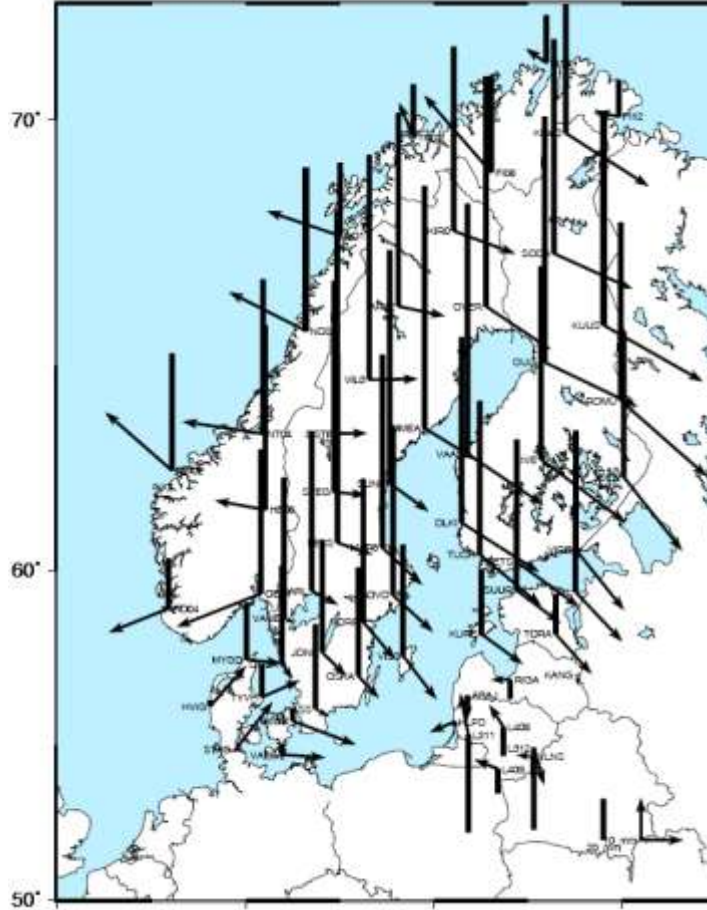
Horizontal (0 to 2 mm/yr):  
The GIA model transformed to  
the GPS-velocities.



Vertical (-1 to 10 mm/yr):  
The NKG2005LU(ABS) model  
Based on: TG, repeated levelling,  
and GPS.



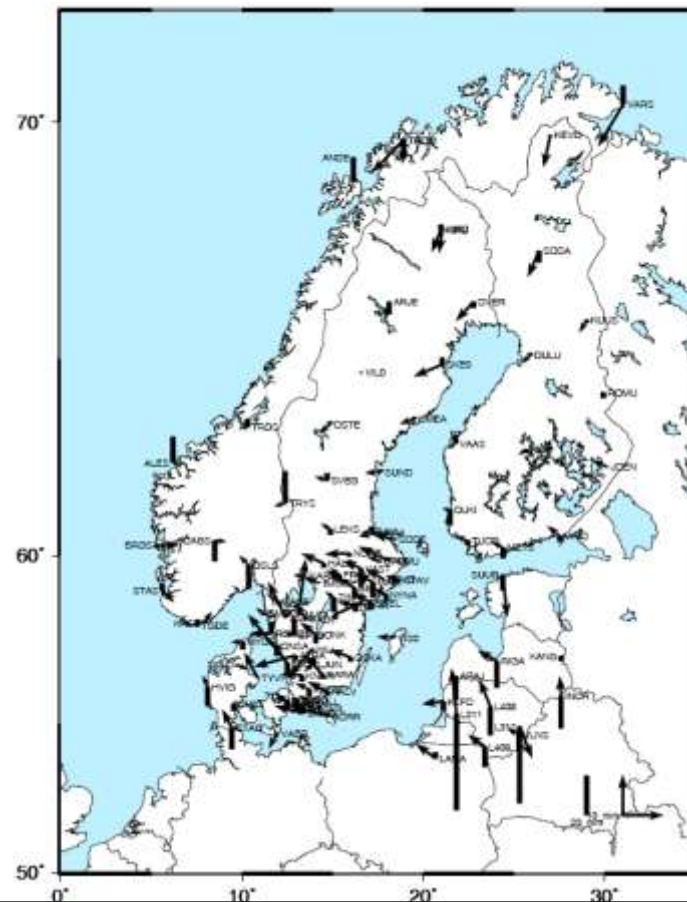
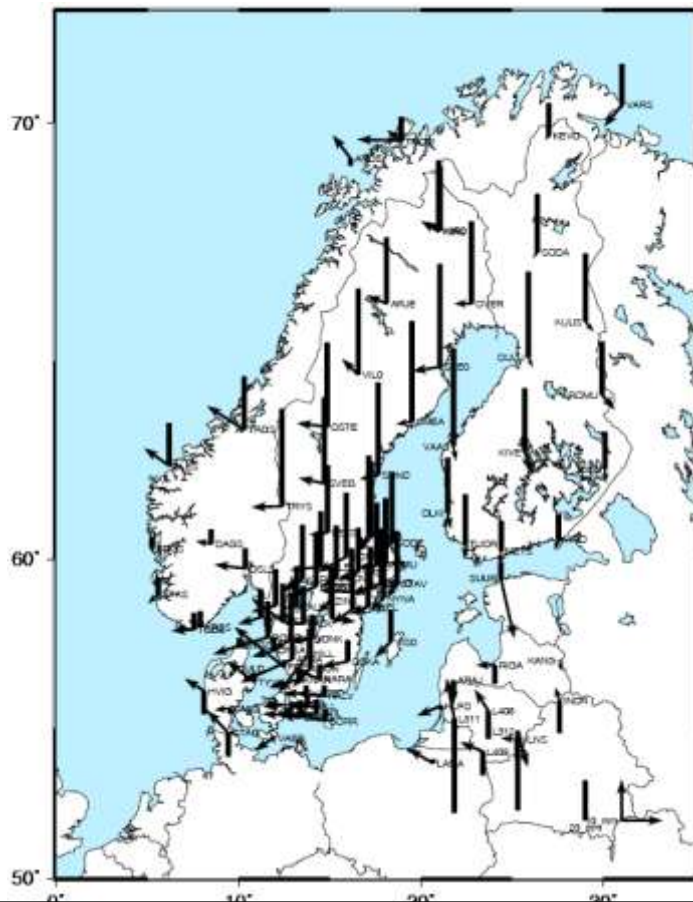
# Diff= NKG2008 – official ETRS89



Residuals, RMS/**mean** (mm), left @2008.75, right @2000.0

north	9 / -4		8 / -3
east	12 / 5		11 / 7
up	68 / 53		28 / 19

# Diff= NKG2008 – NKG2003 in ETRS89

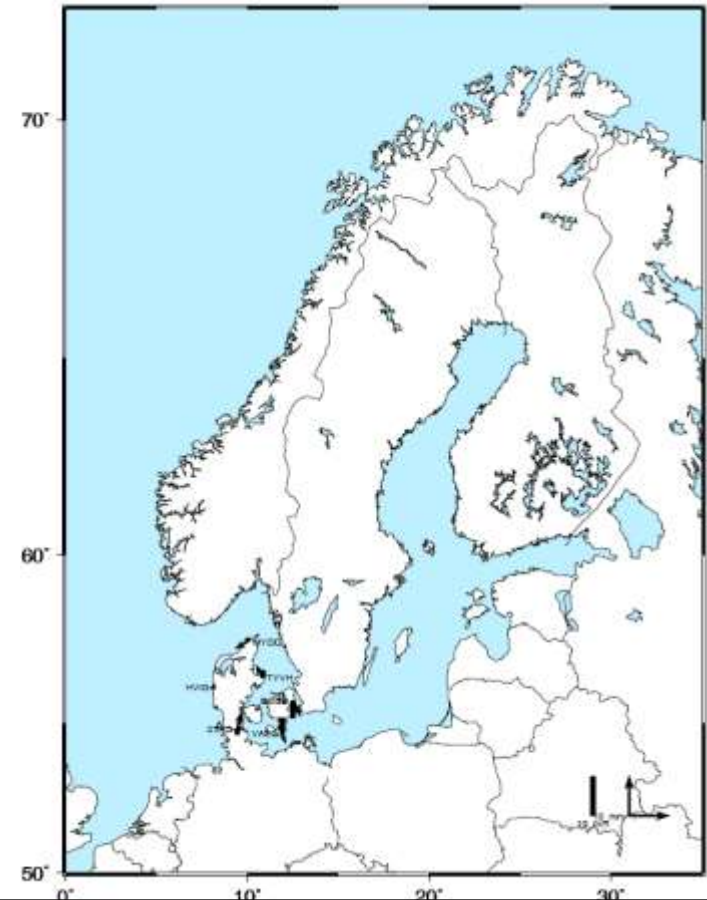
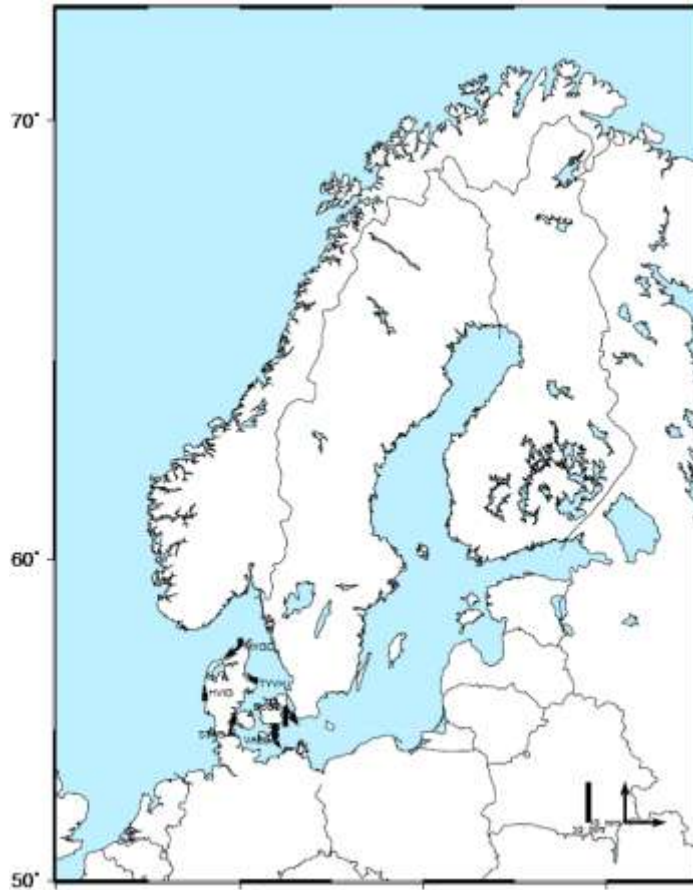


Residuals, RMS/**mean** (mm), left @2008.75, right @2003.75

north	4 / -5		4 / 0
east	5 / -4		4 / -3
up	24 / 16		8 / -3



# Denmark, ep 2000.0 ; ep 1994.7

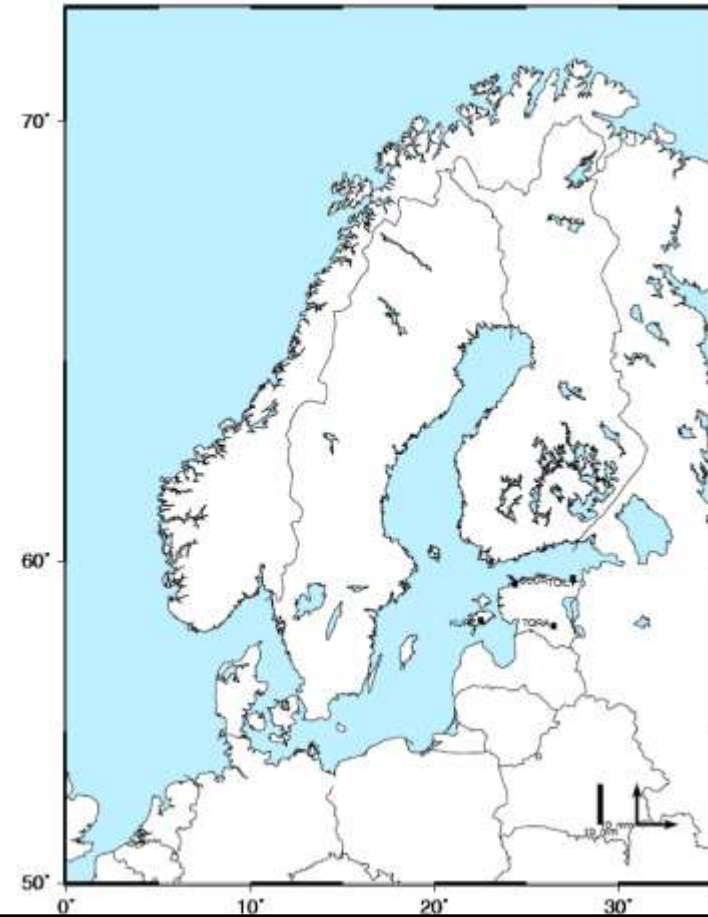
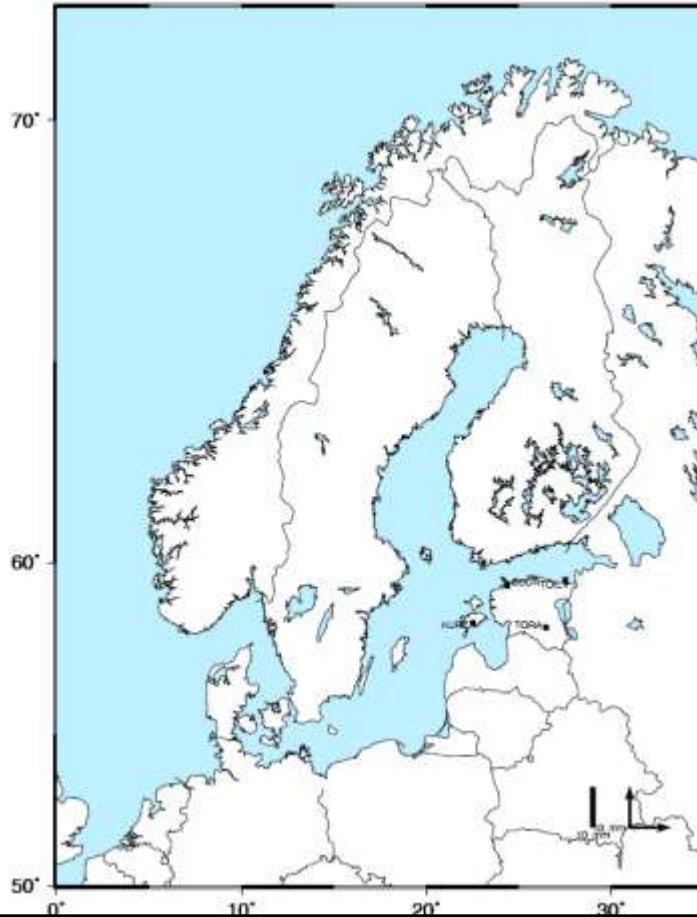


7-parameter fit; Residuals, RMS (mm)

north	3.5		3.0
east	2.4		1.8
up	3.0		2.7



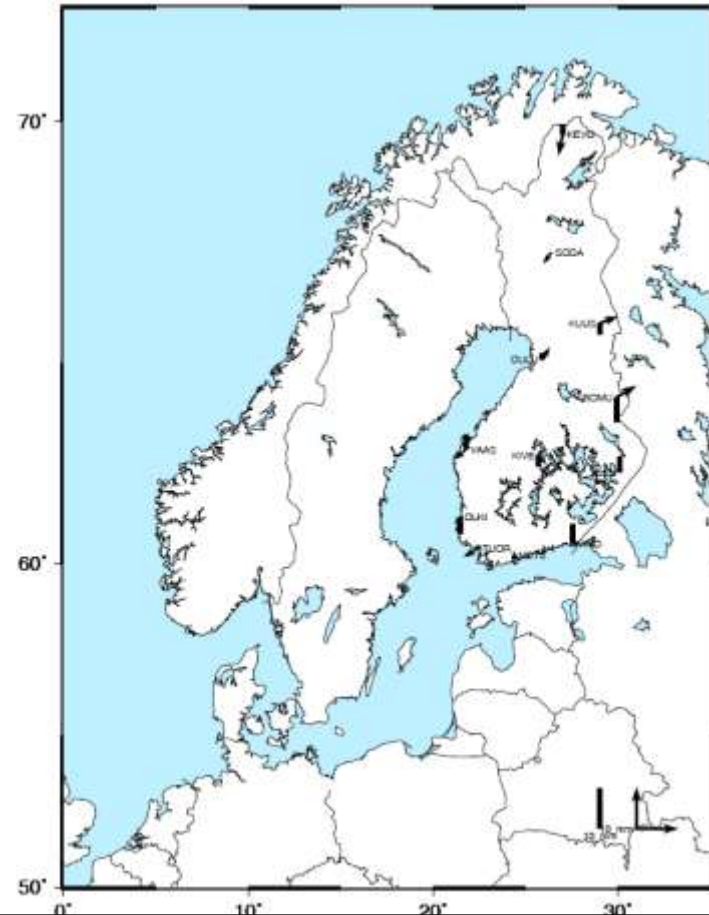
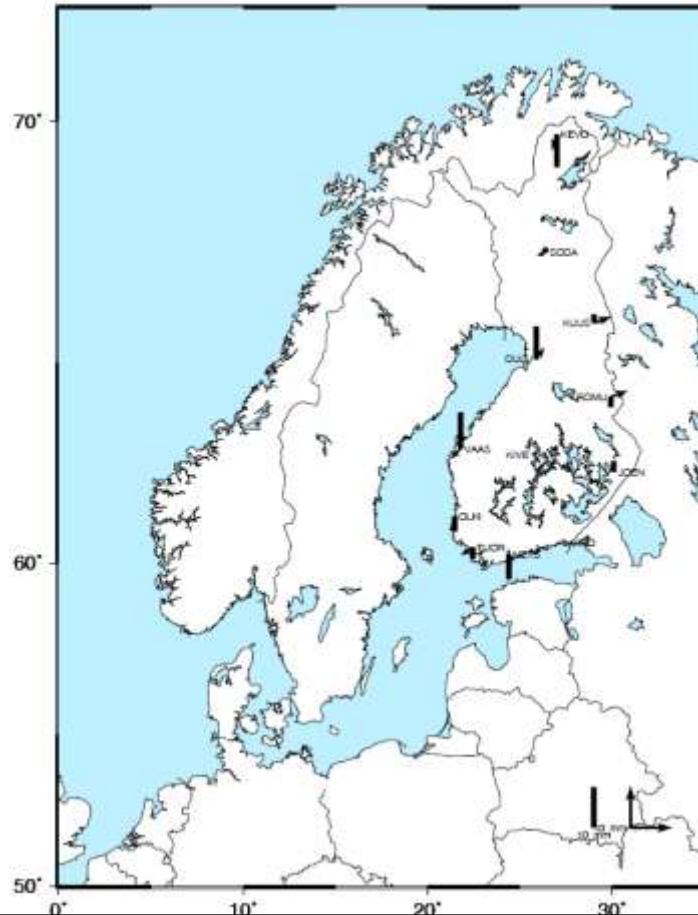
# Estonia, ep 2000.0 ; ep 1997.56



7-parameter fit; Residuals, RMS (mm)

north	0.7		0.8
east	1.0		1.2
up	1.4		1.6

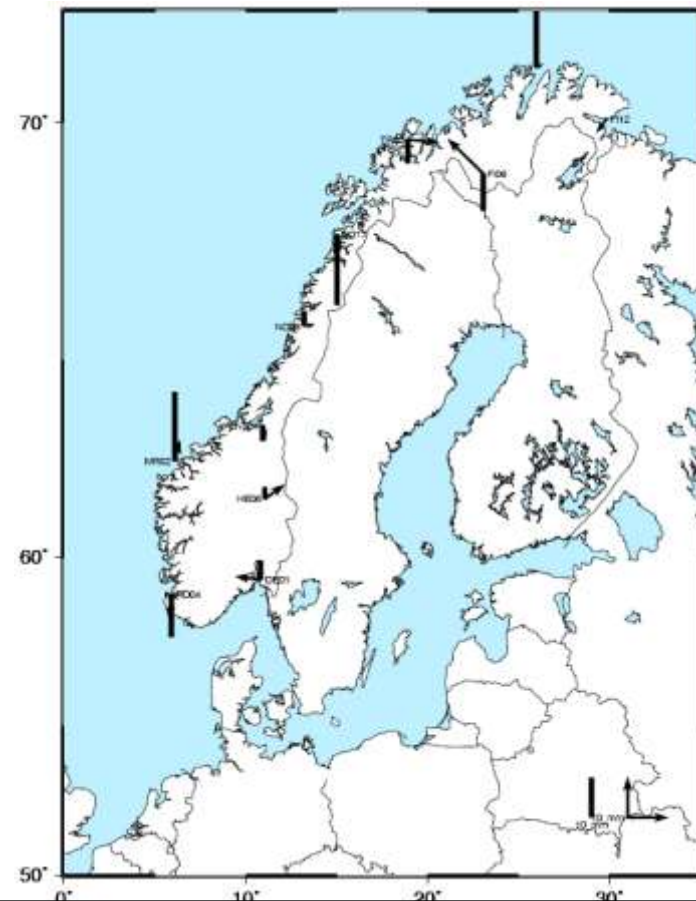
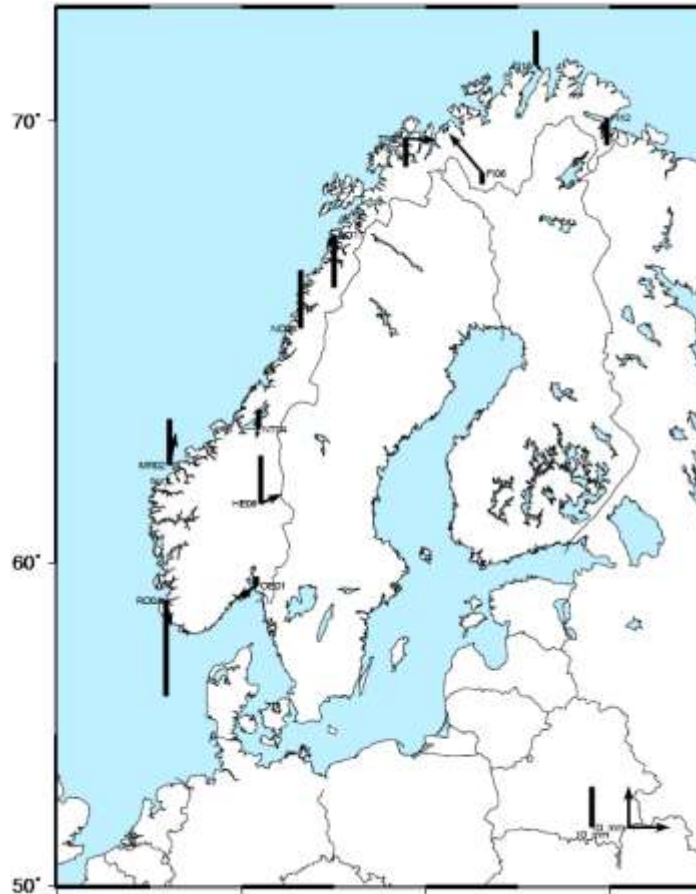
# Finland, ep 2000.0 ; ep 1997.0



7-parameter fit; Residuals, RMS (mm)

north	1.8		2.4
east	2.2		2.4
up	4.9		3.4

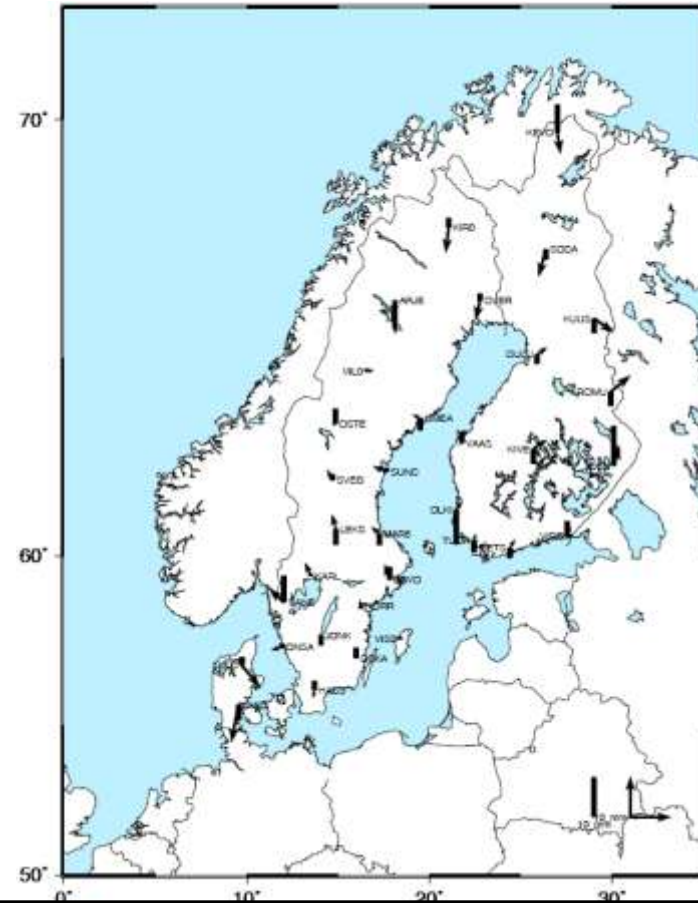
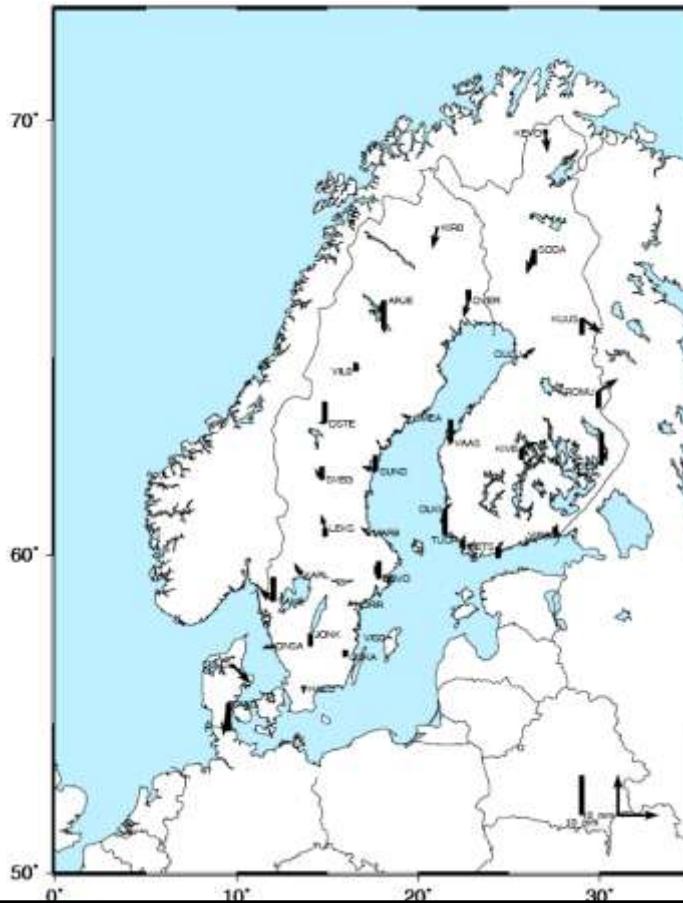
# Norway, ep 2000.0 ; ep 1994.7



7-parameter fit; Residuals, RMS (mm)

north	4.7		4.3
east	4.1		4.4
up	11.4		10.7

# Sweden, ep 2000.0 ; ep 1999.5



7-parameter fit; Residuals, RMS (mm)

north	3.0		3.5
east	2.1		2.1
up	3.8		4.0



# Conclusion/Remarks

- The NKG2008 and NKG2003 campaigns agree well also without 7-parameter fit!
- A “modern” campaign/realization of ETRS89 show systematic differences to our national official realizations, also when correcting for velocities
- The internal geometry agree well (few mm level!)
- But hardware changes at permanent stations is a problem we need to pay attention to
- Standardized epoch of 2000.0 perform practically equally well as epoch of national realizations!
- I.e. internal geometry is fine (however consider relative/absolute antenna PCV models) but reference frame realization is still an important issue!!
- Improvements of the velocity model desired...