S1/S2 Atmosphere Loading in VLBI Analysis

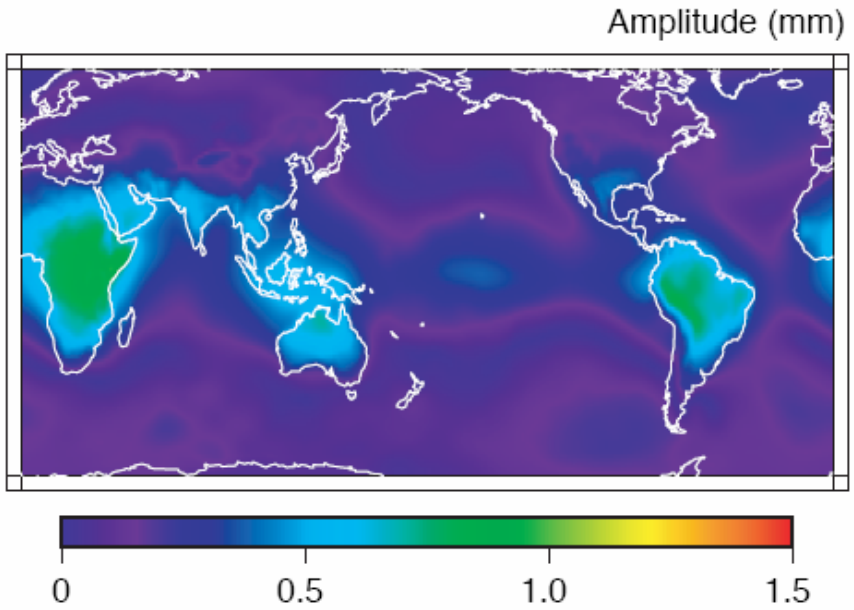
J. Böhm, V. Tesmer

Introduction

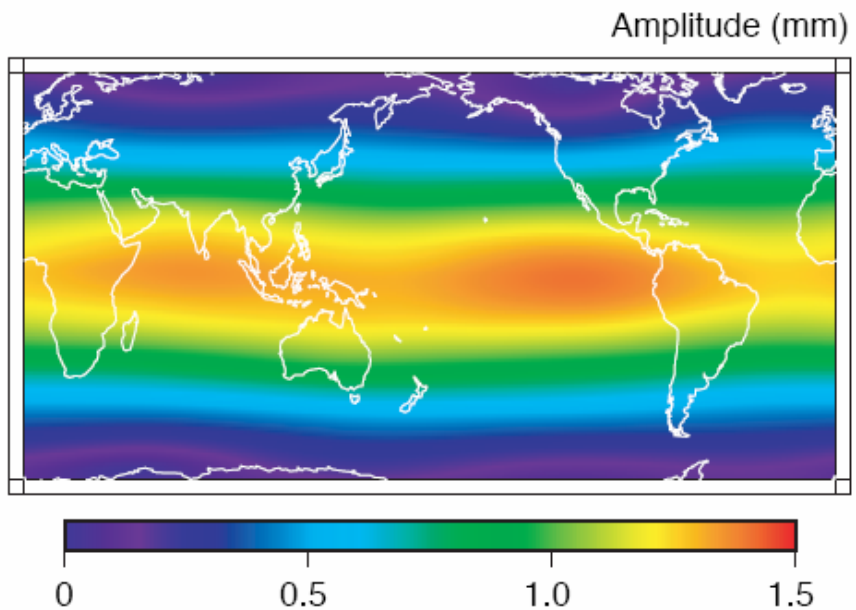
- Atmosphere loading can be divided into
  - tidal atmosphere loading (small)
  - non-tidal atmosphere loading
- How to validate S1/S2 tidal loading?
  - GPS: orbital parameters soak up S1/S2
  - VLBI delay residuals can be used
  - (VLBI coordinates only if observations are not evenly distributed over the 24 hour sessions)

S1/S2 Atmosphere Loading

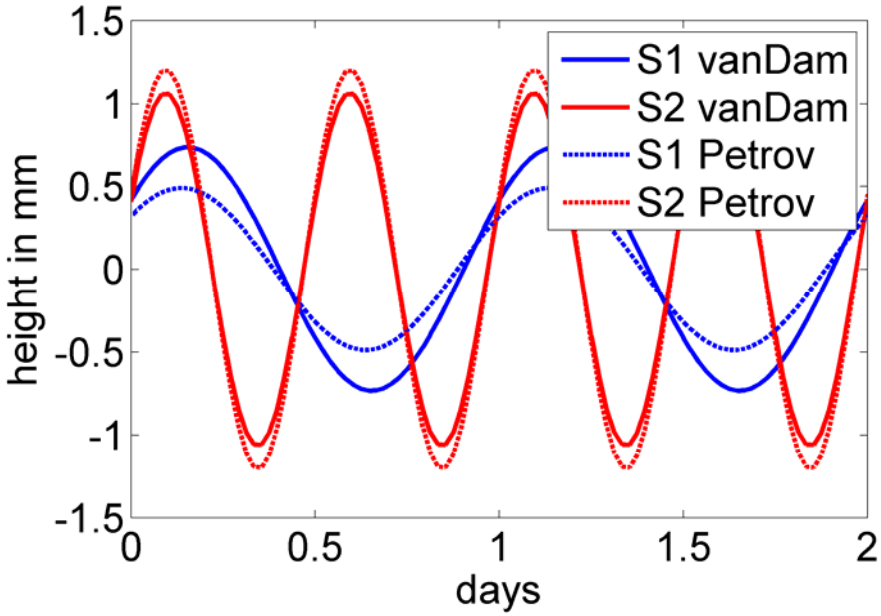
S1 load displacement vertical



S2 load displacement vertical

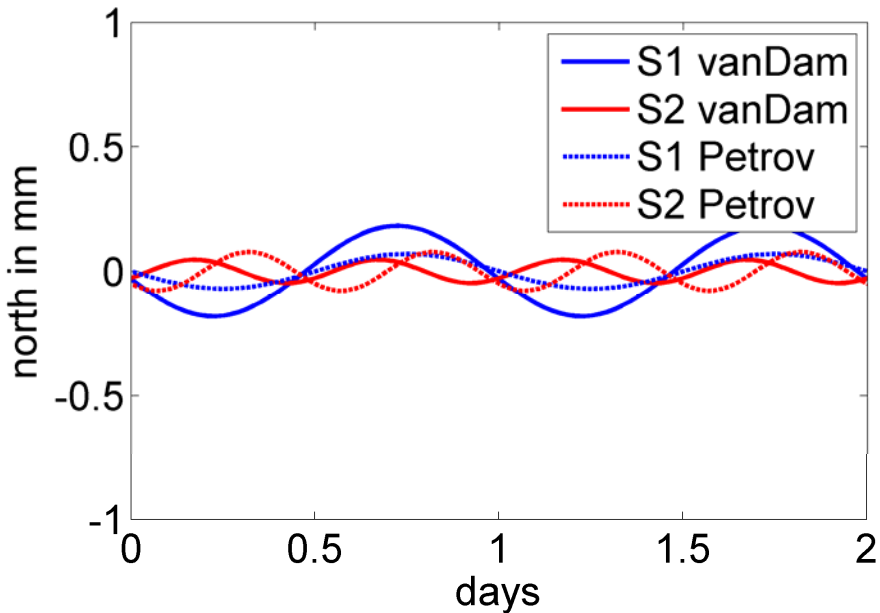


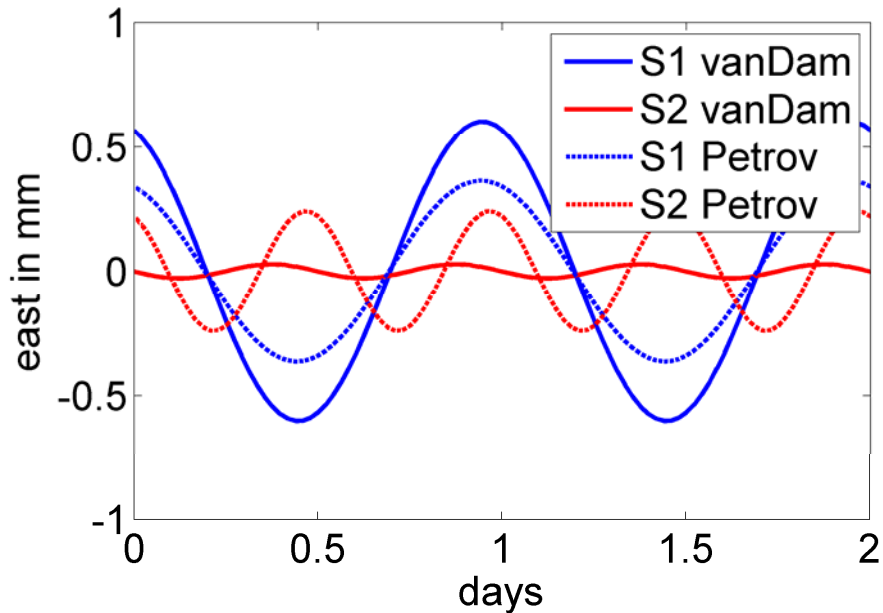
van Dam and Ray (2007) (based on Ponte and Ray 2003)



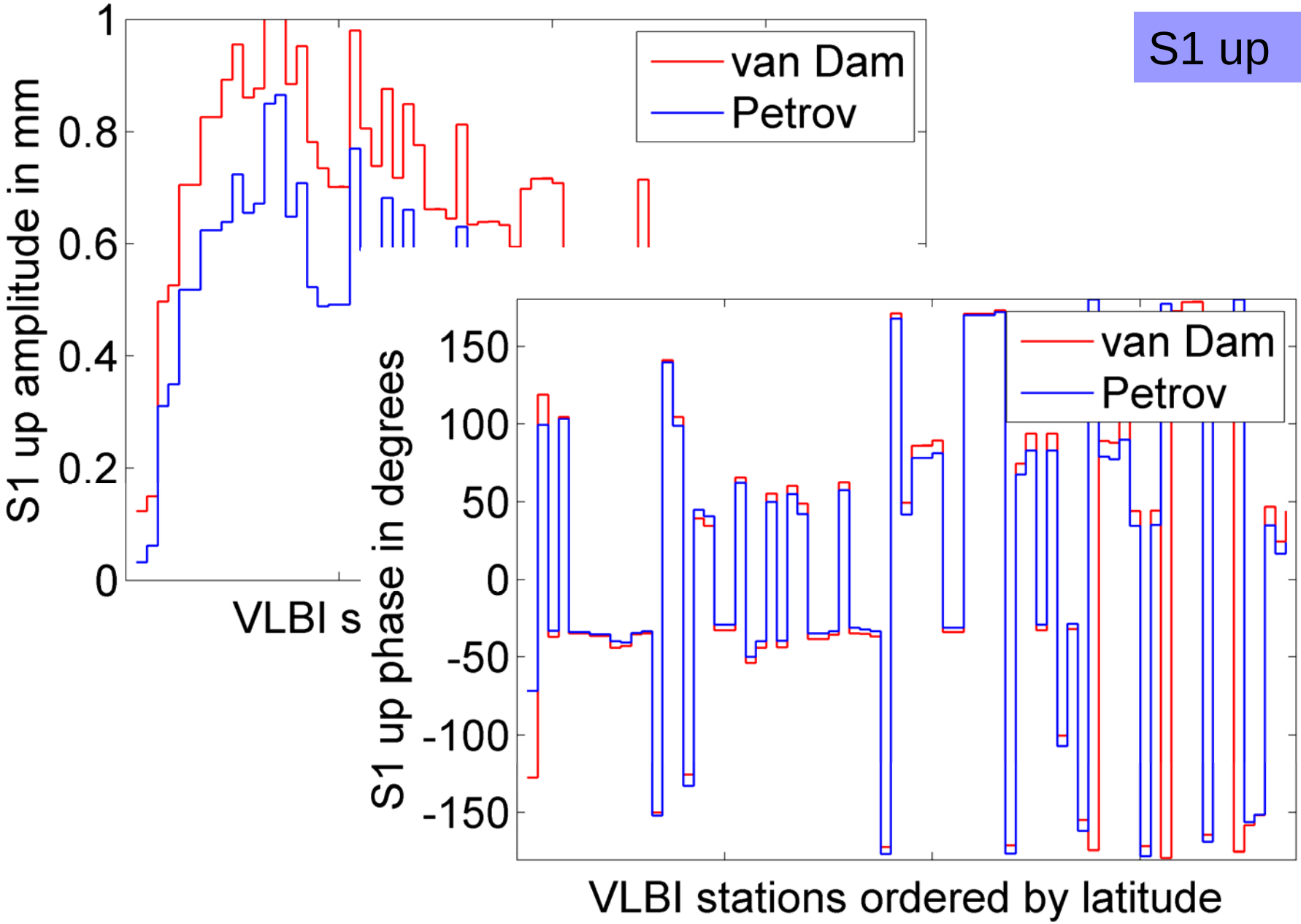
Fortaleza

Center of mass, non-IB

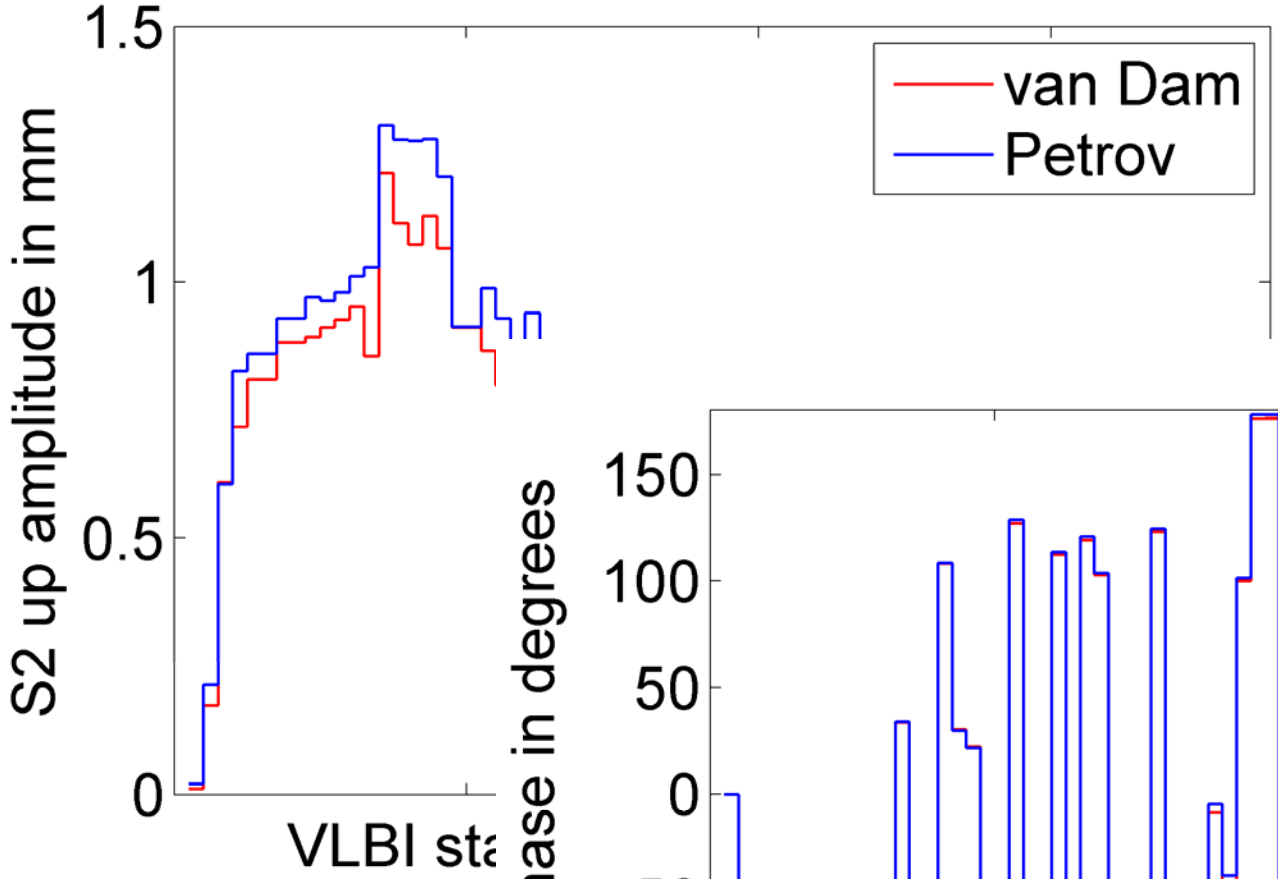


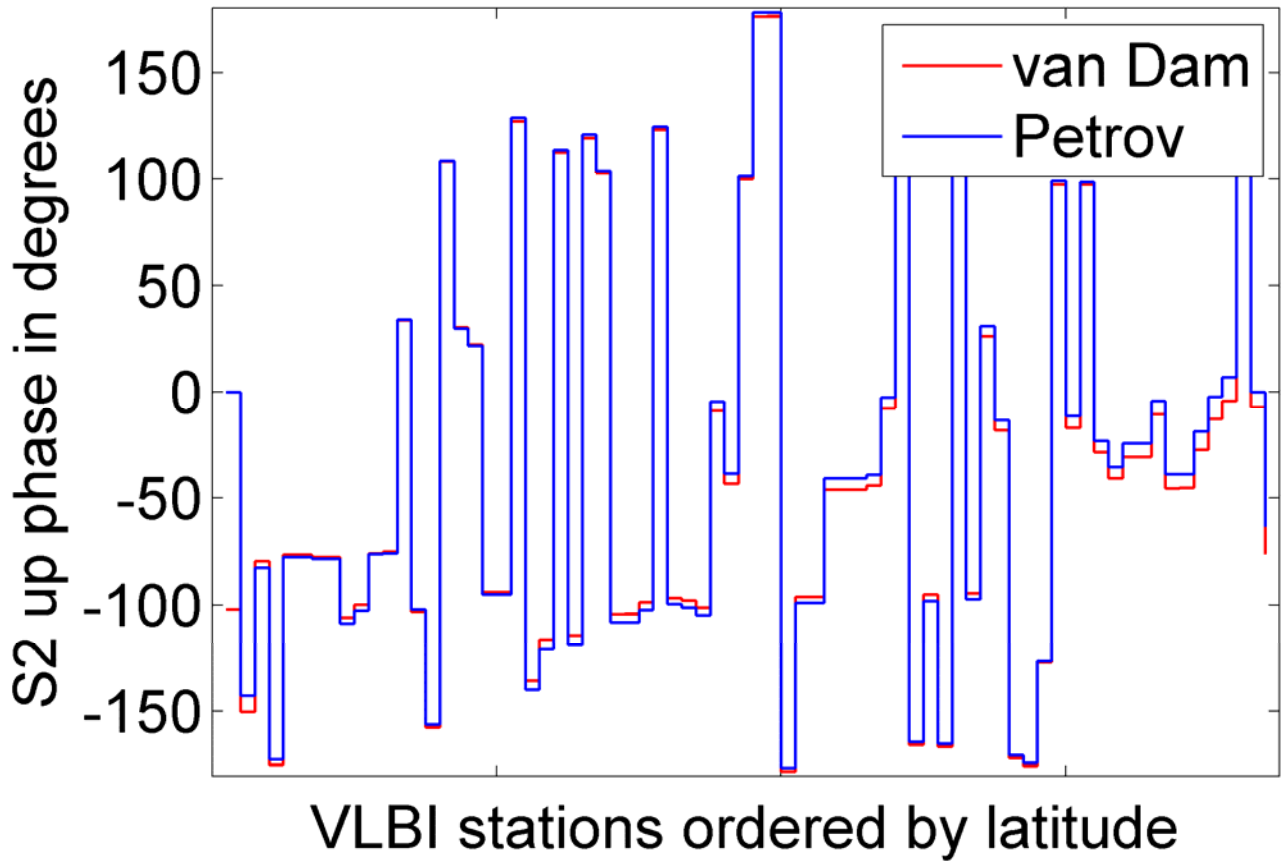


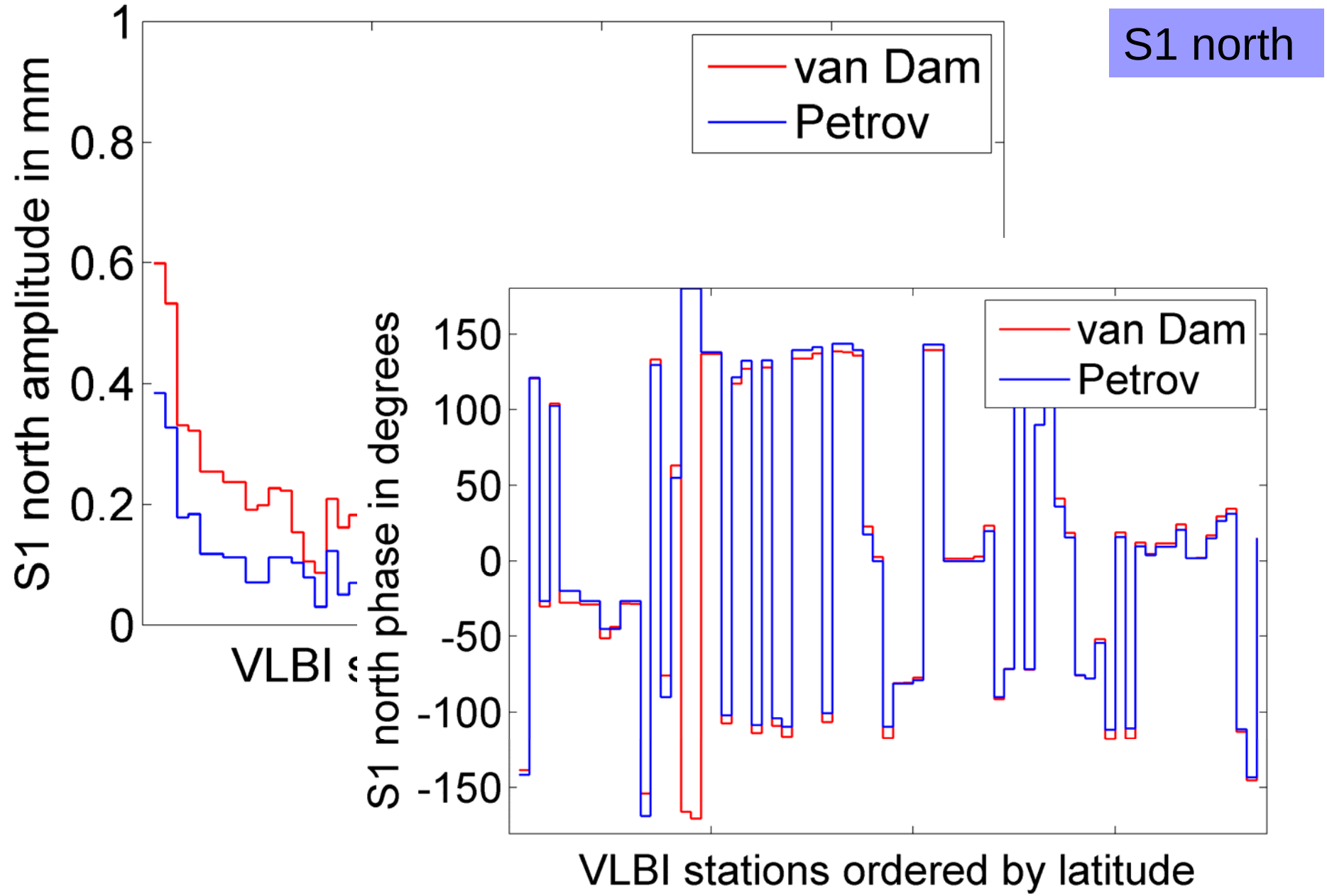
S1 up


S1 up amplitude in mm
1
0.8
0.6
0.4
0.2
0
VLBI s
van Dam
Petrov
S1 up phase in degrees
150
100
50
0
-50
-100
-150
VLBI stations ordered by latitude
van Dam
Petrov

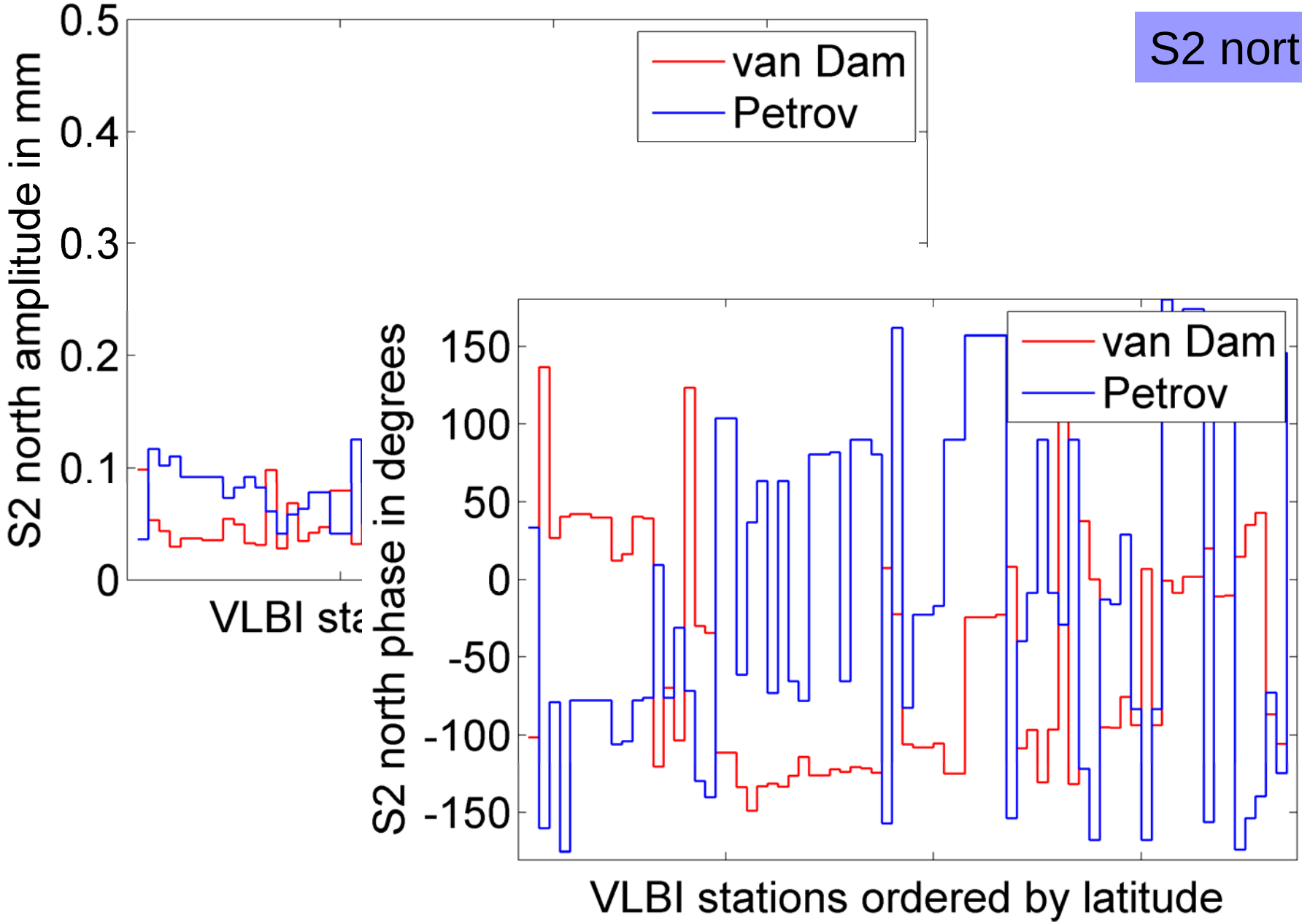
S2 up


1.5
1
0.5
0
S2 up amplitude in mm
van Dam
Petrov
VLBI sta


150
100
50
0
-50
-100
-150
S2 up phase in degrees
van Dam
Petrov
VLBI stations ordered by latitude


S1 north
van Dam
Petrov
S1 north amplitude in mm
1
0.8
0.6
0.4
0.2
0
VLBI
van Dam
Petrov
S1 north phase in degrees
150
100
50
0
-50
-100
-150
VLBI stations ordered by latitude

S2 north


0.5
0.4
0.3
0.2
0.1
0
S2 north amplitude in mm
van Dam
Petrov
VLBI sta
150
100
50
0
-50
-100
-150
S2 north phase in degrees
van Dam
Petrov
VLBI stations ordered by latitude

Global VLBI solution

- Global solution
  - ~ 2880 sessions
  - ~ 4.000.000 delay observables
- OCCAM LSM 6.1 VLBI software
  - no thermal deformation considered
  - NMF
  - no estimation of S1, S2, Sa, Ssa

Global VLBI solution

- 3 Solutions
  - No S1/S2 deformation model
  - S1/S2 provided by T. van Dam
  - S1/S2 provided by L. Petrov

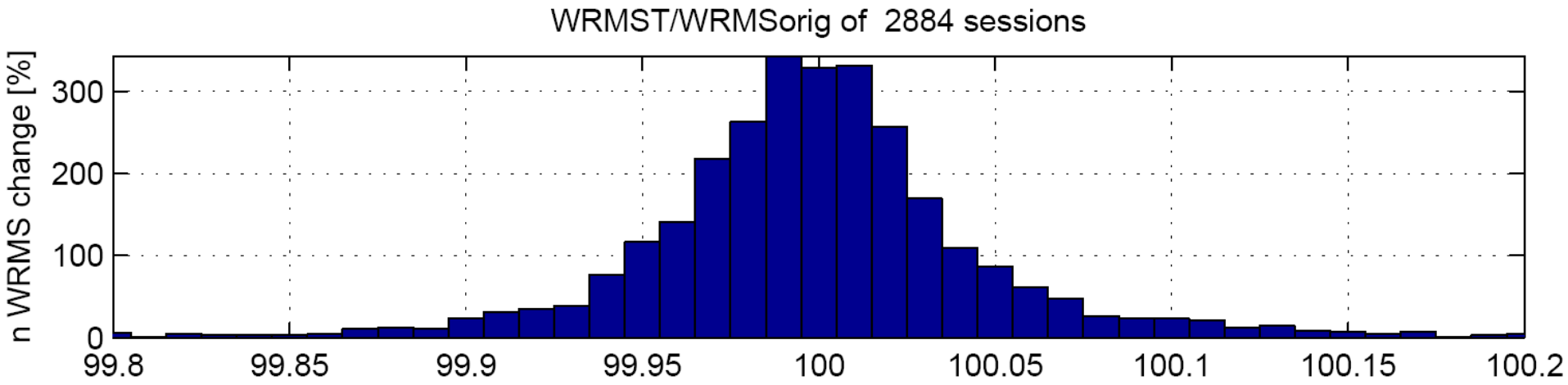
$$wrms = \sqrt{\frac{v^T P v}{P}}$$

(No S1/S2) –	vanDam	Petrov
Mean diff.	0.00008 ps	-0.00027 ps
Median diff.	0.00020 ps	-0.00010 ps

improvement

degradation

/ (No S1/S2)	vanDam	Petrov
Mean ratio	99.99891	100.00228
Median ratio	99.99823	100.00107



Station components

[cm]		WRMS	
	Lat	Lon	Up
No S1S2	0.2734	0.2569	0.5263
van Dam	0.2733	0.2571	0.5261
Petrov	0.2734	0.2571	0.5262

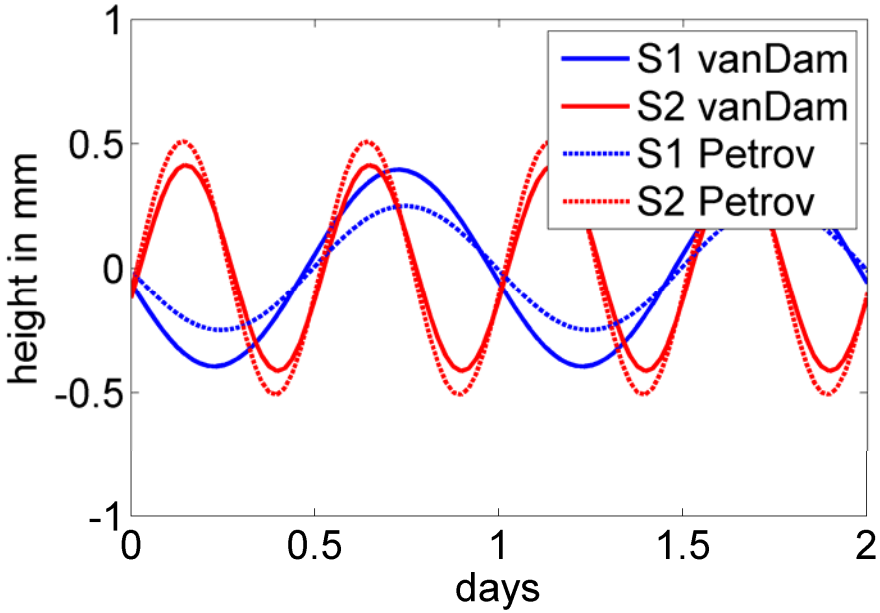
improvement

degradation

Conclusions

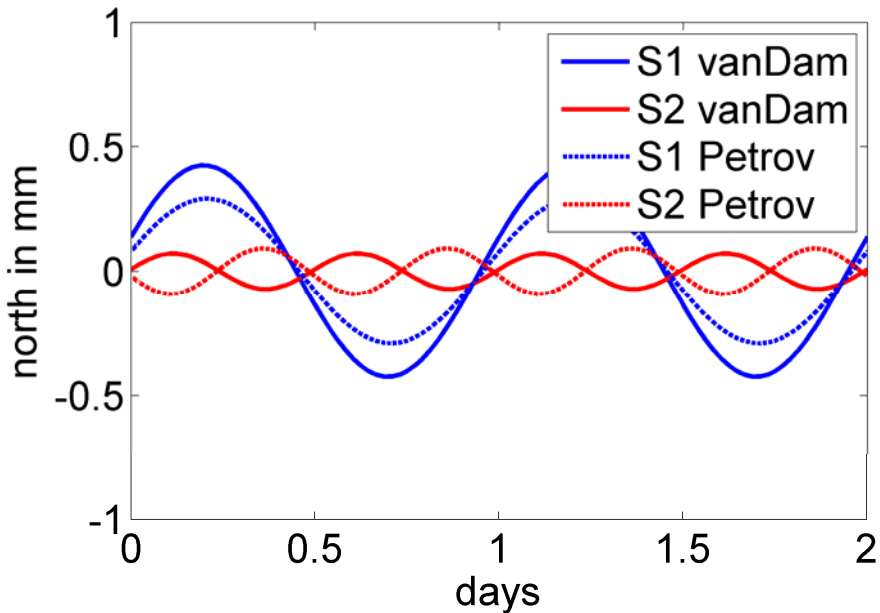
- Consequences of the model are not geodetically significant
- What causes the differences in the models by van Dam and Petrov?
- There is other mismodelling at S1/S2
  - e.g., troposphere
  - thermal deformation
  - ocean loading

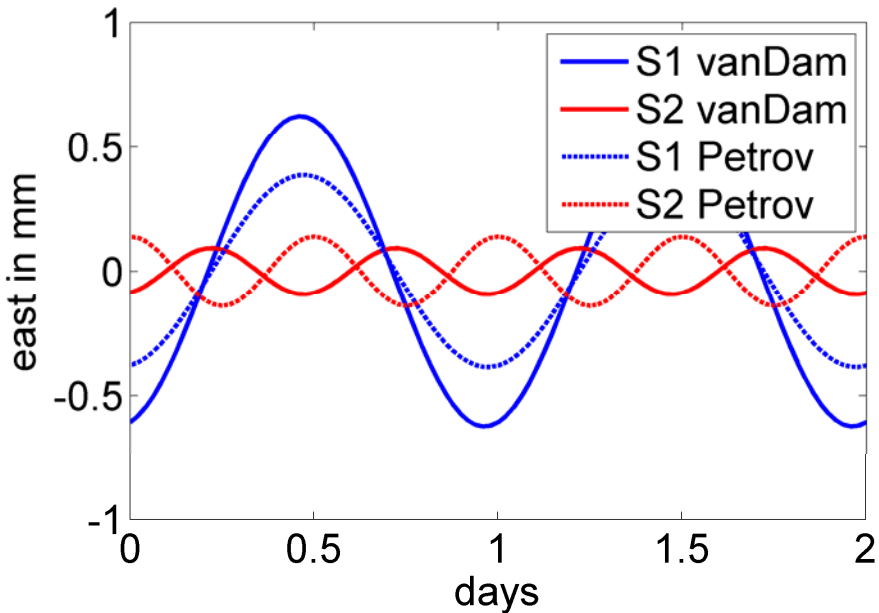
Thanks for your attention!



Wettzell

Center of mass, non-IB





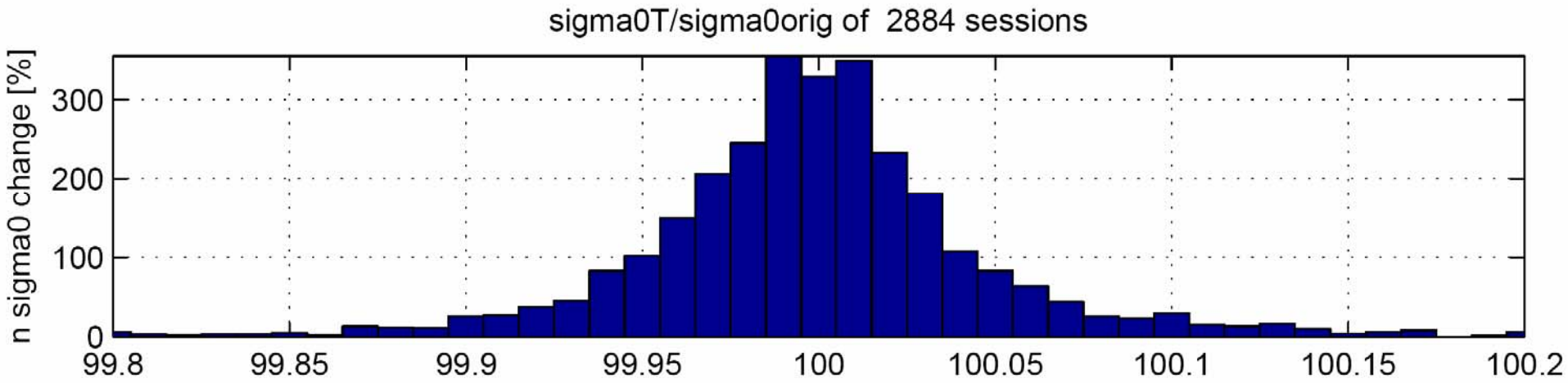
$$s_0 = \sqrt{\frac{v^T P v}{n - u}}$$

(No S1/S2) –	vanDam	Petrov
Mean diff.	0.00001	-0.00002
Median diff.	0	0

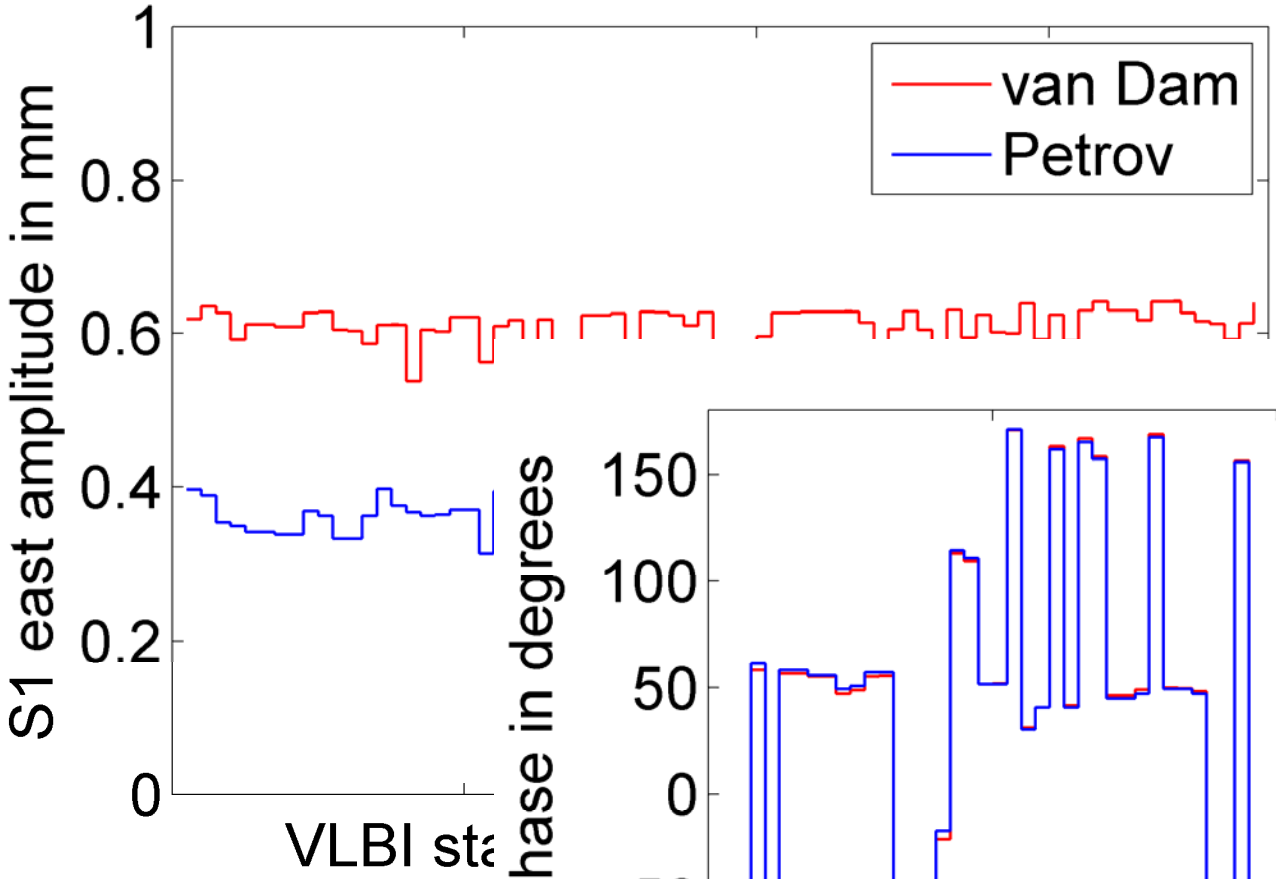
improvement

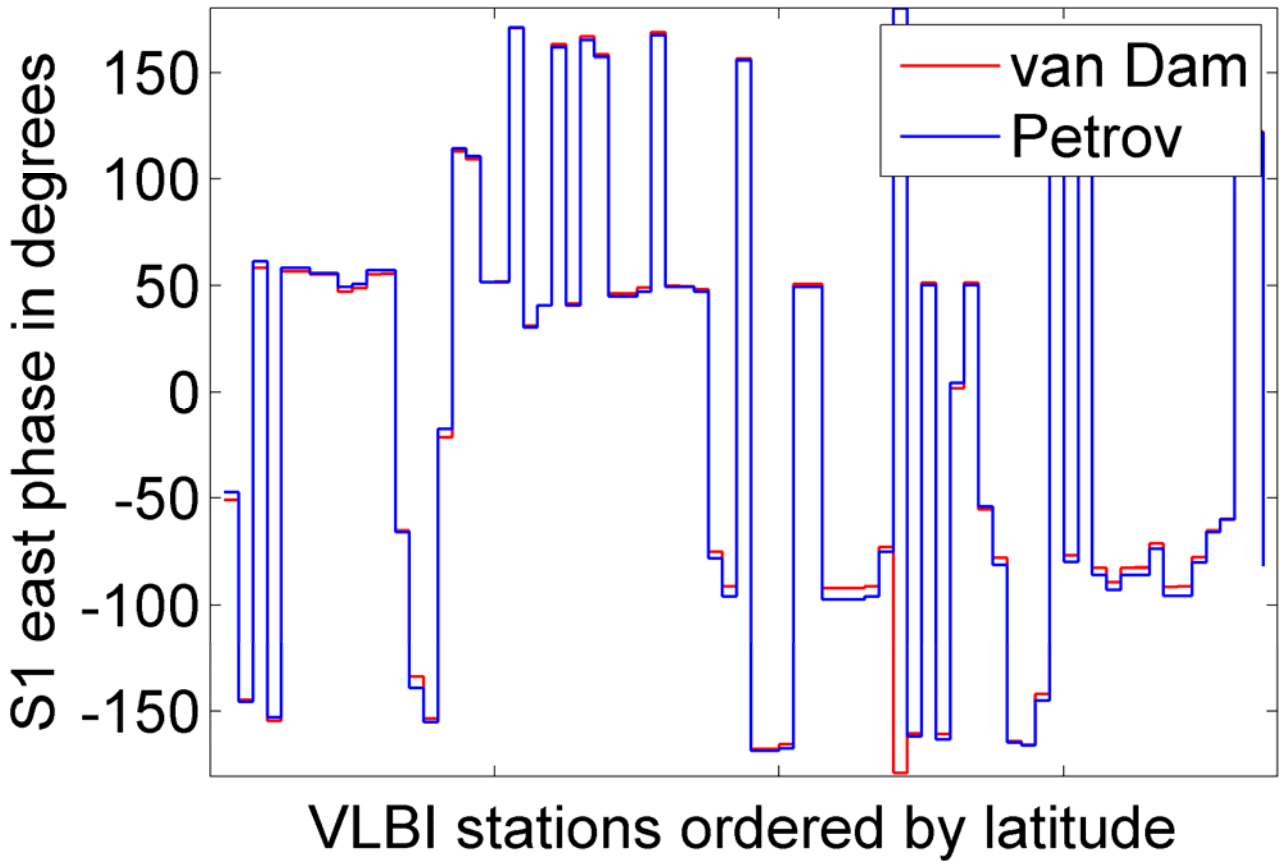
degradation

/ (No S1/S2)	vanDam	Petrov
Mean ratio	99.99885	100.00222
Median ratio	100	100

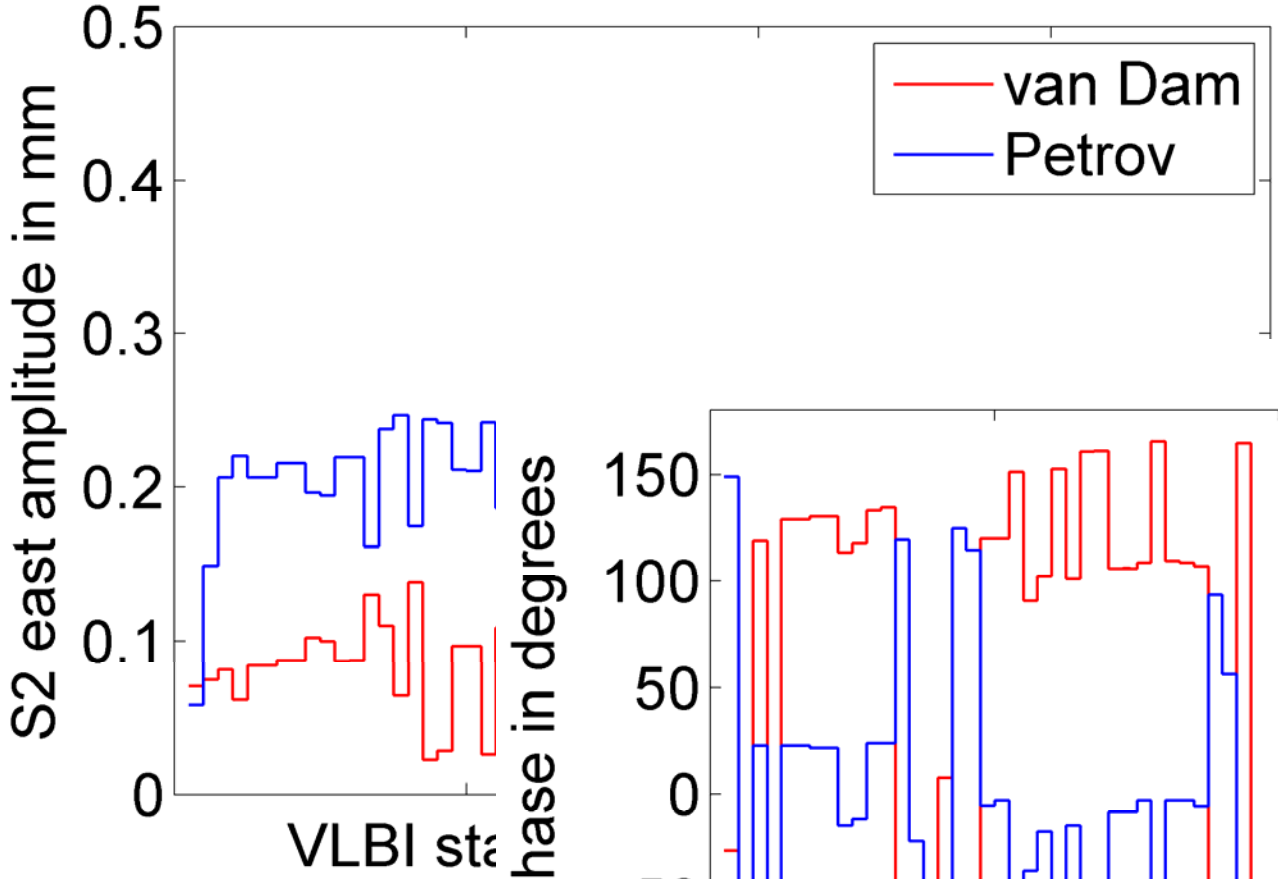


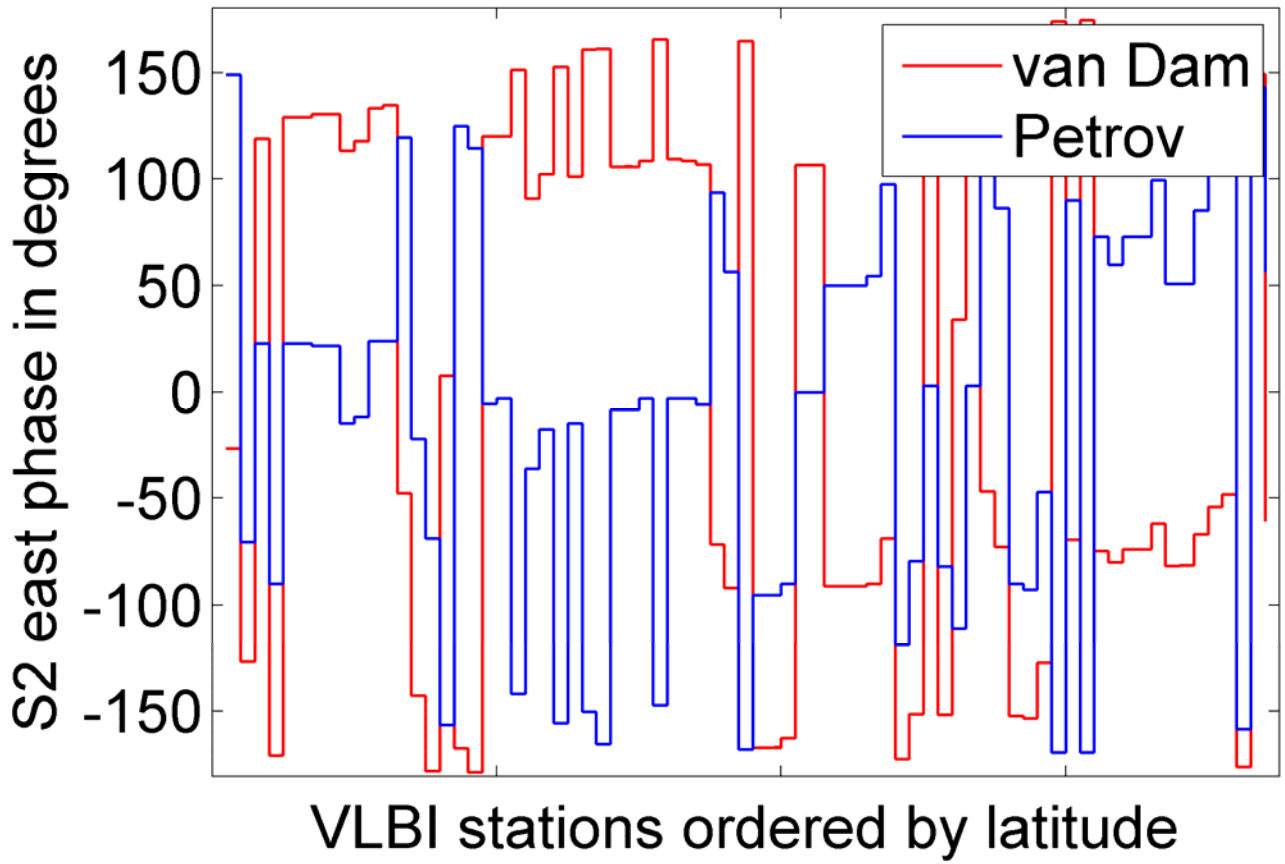
S1 east


van Dam
Petrov
S1 east amplitude in mm
1
0.8
0.6
0.4
0.2
0
VLBI sta


van Dam
Petrov
S1 east phase in degrees
150
100
50
0
-50
-100
-150
VLBI stations ordered by latitude

S2 east


0.5
0.4
0.3
0.2
0.1
0
S2 east amplitude in mm
van Dam
Petrov
VLBI sta


150
100
50
0
-50
-100
-150
S2 east phase in degrees
van Dam
Petrov
VLBI stations ordered by latitude