How to prove the 3D forward solver?

2D vs. 3D responses

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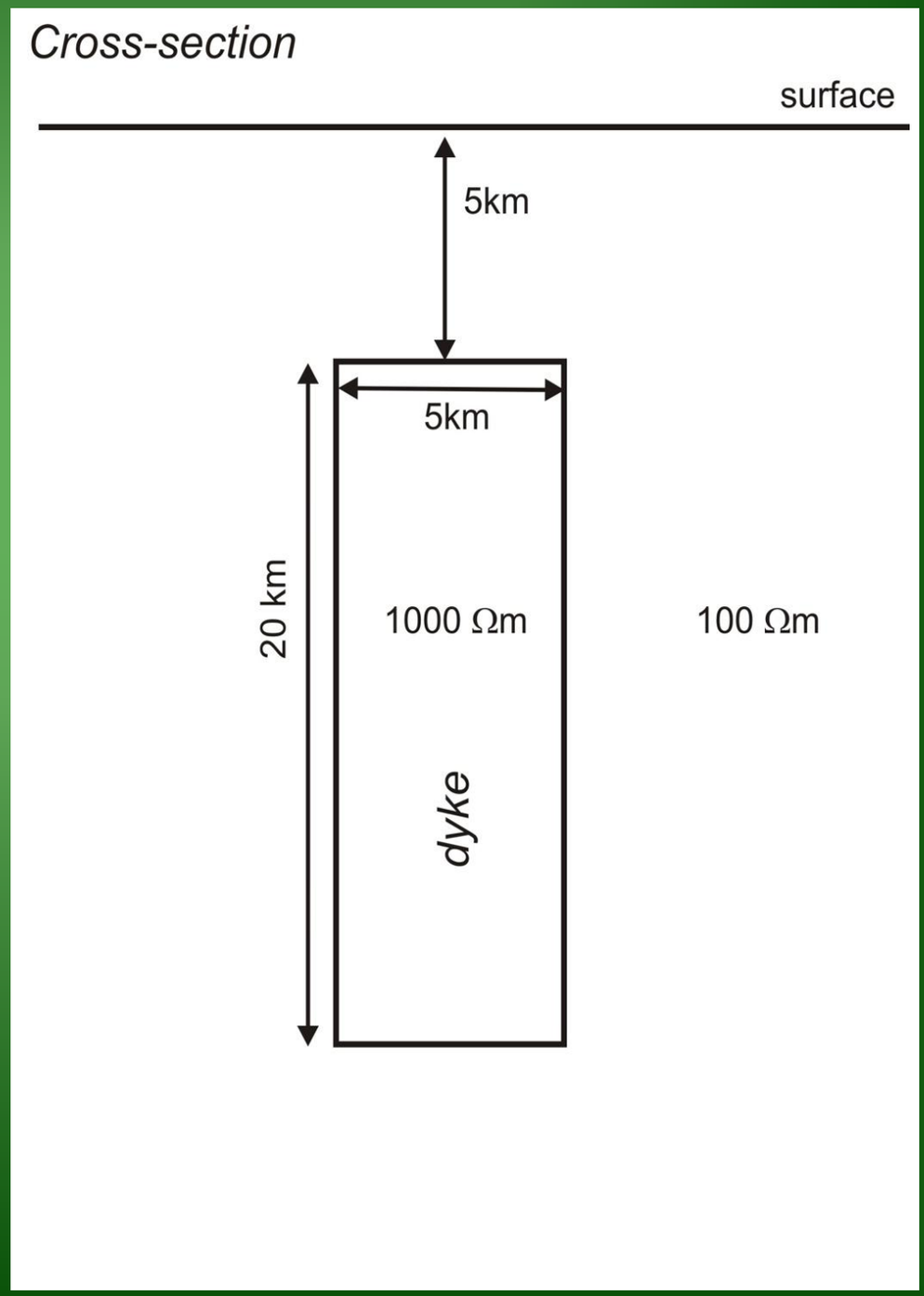
2nd Annual St. Patrick's Workshop, MT 3D inversion , 12th – 14th March 2008

The first approach

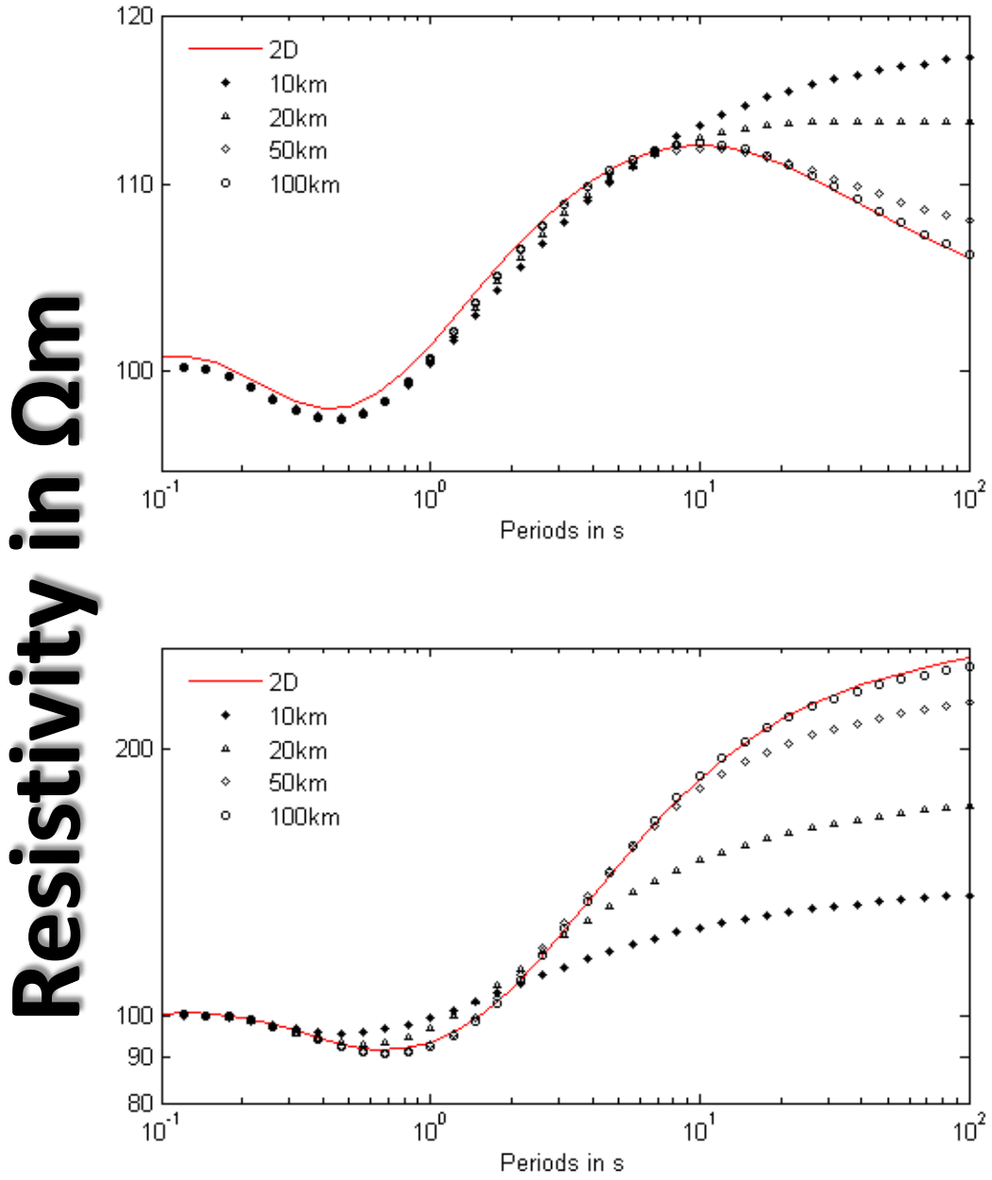
2D model: 1000 Ωm dyke in 100 Ωm surrounding; 5 km wide and 20 km thick

3D model: same dyke structure but with different length

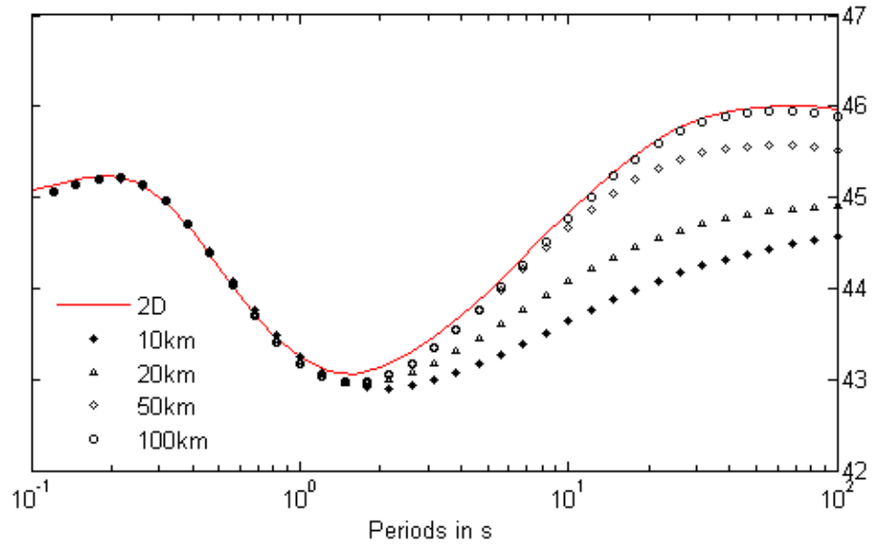
Idea: with increasing length approach of 3D responses to the 2D model



Example sounding curves

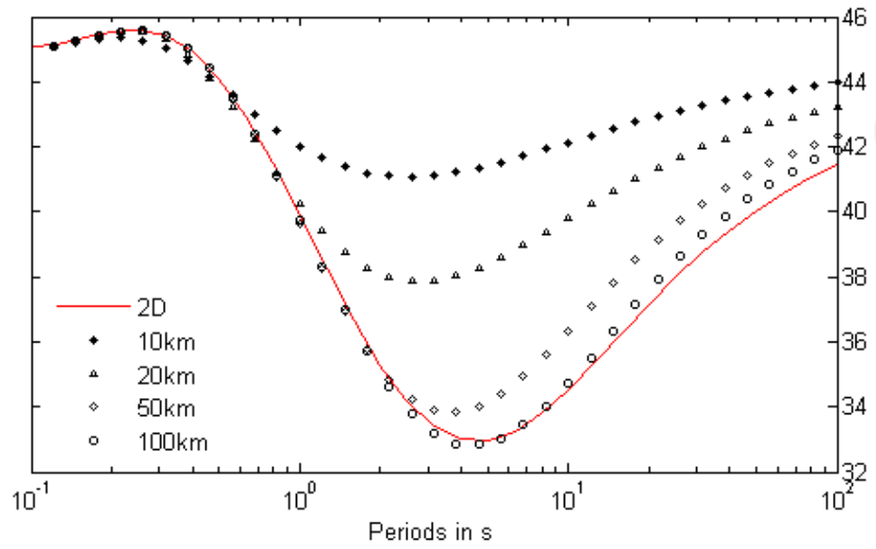


XY



Phase in degree

YX



The problem

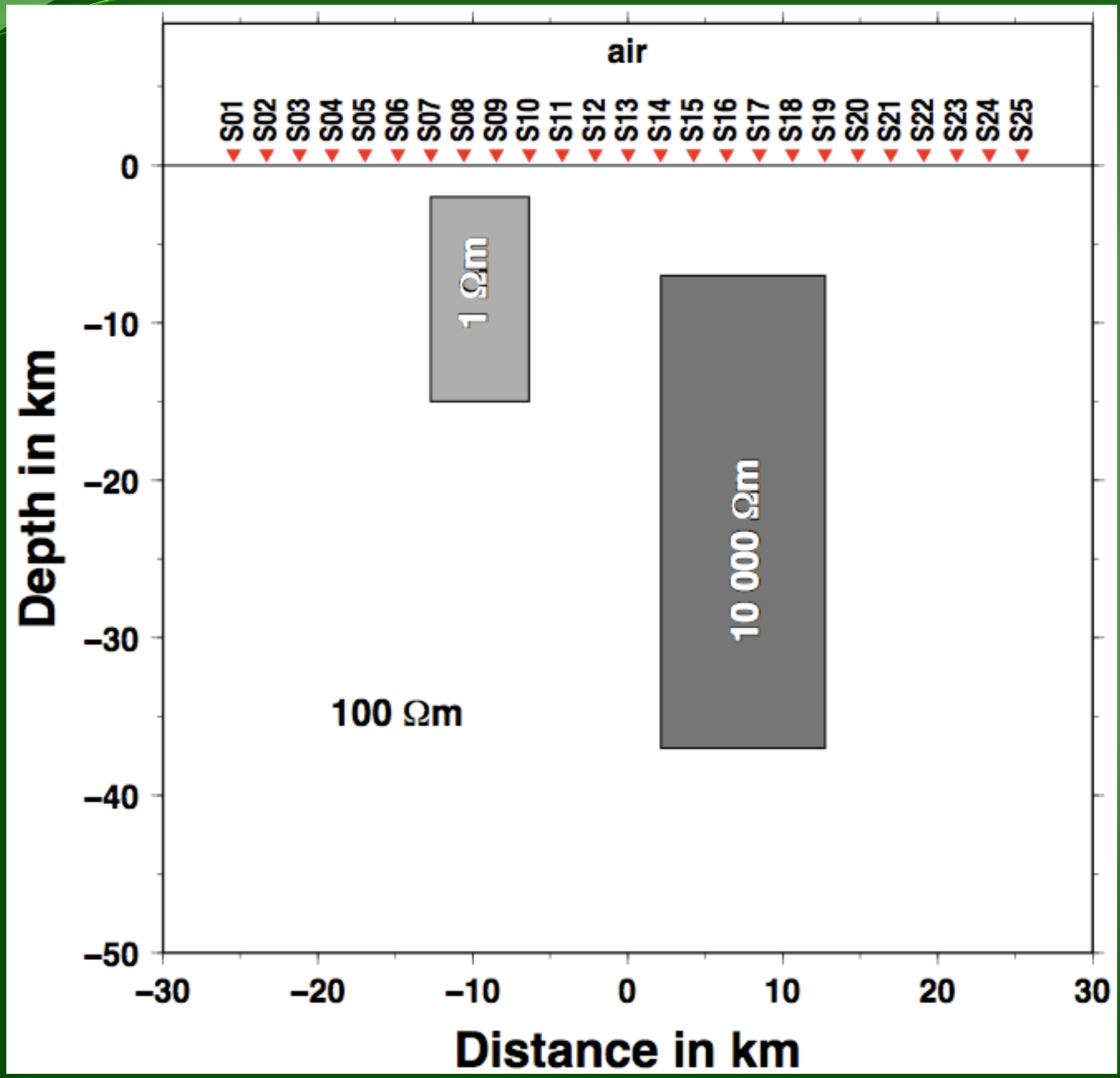
This test ONLY addresses the off-diagonal elements!!!

The second approach

2D modeling of real data -> rotate perpendicular to strike (minimize the diagonal elements)

testing the diagonal elements of the 3D solver do it the other way round

2D model



2 dykes with N-S strike direction

profile orientation W-E

Rotation of the coordinate system

$$\mathbf{Z}_{2Drot} = \mathbf{R}\mathbf{Z}_{2D}\mathbf{R}^{'}$$

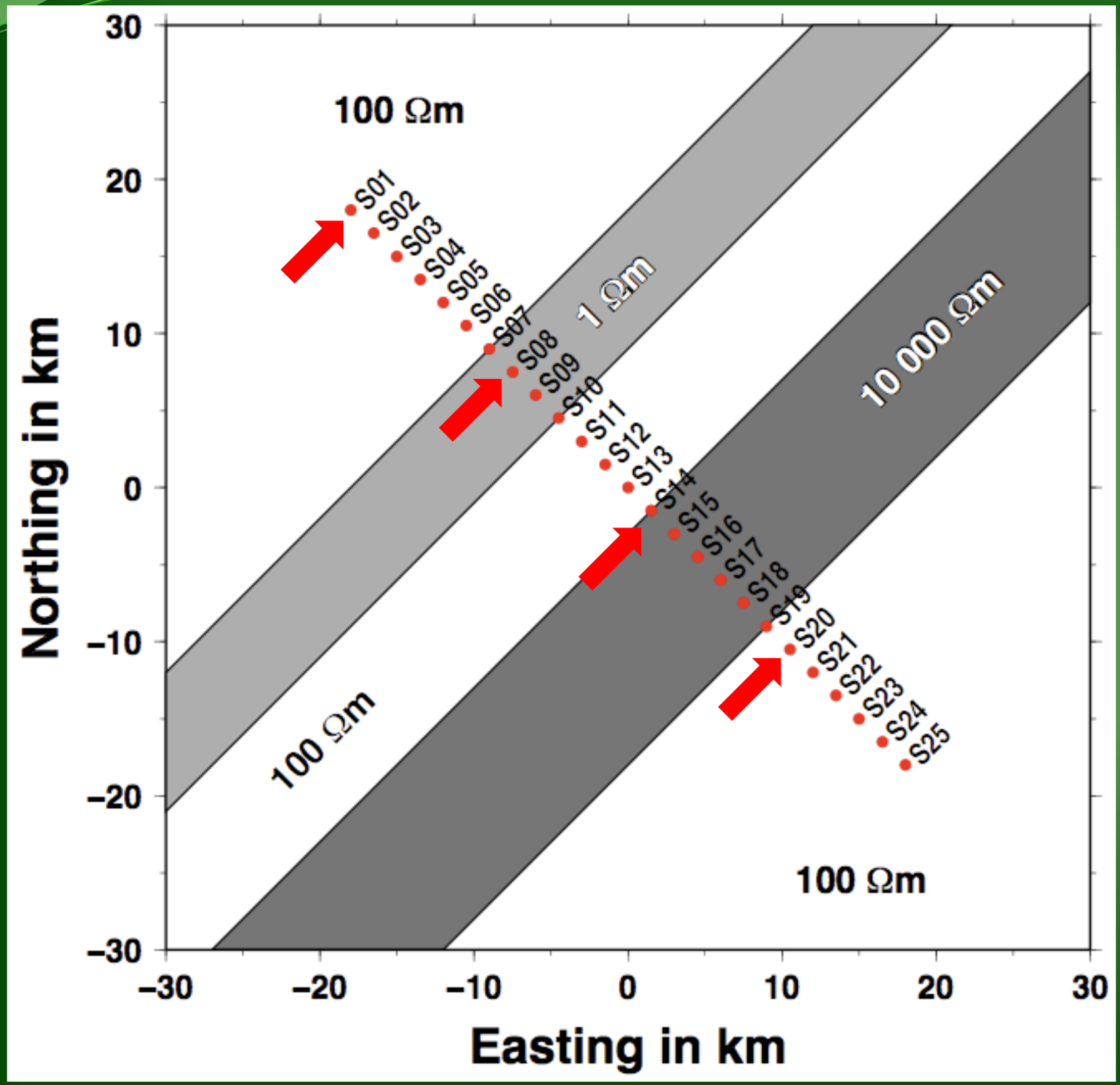
$$\mathbf{R} = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$$

2D
dyke: N-S
profile: W-E

rotate by
-45 degrees

rotated 2D
dyke: NE-SW
profile: NW-SE

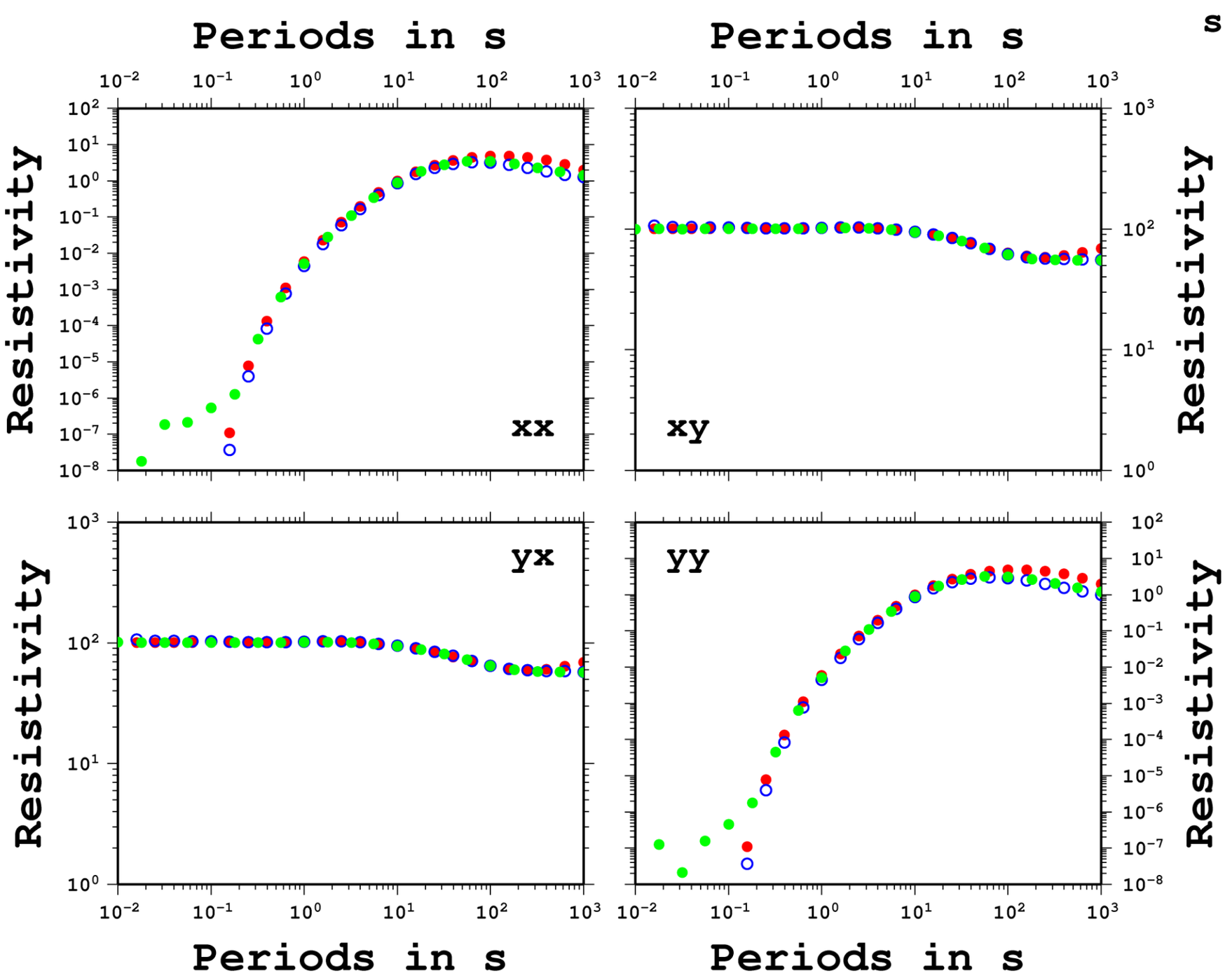
3D model



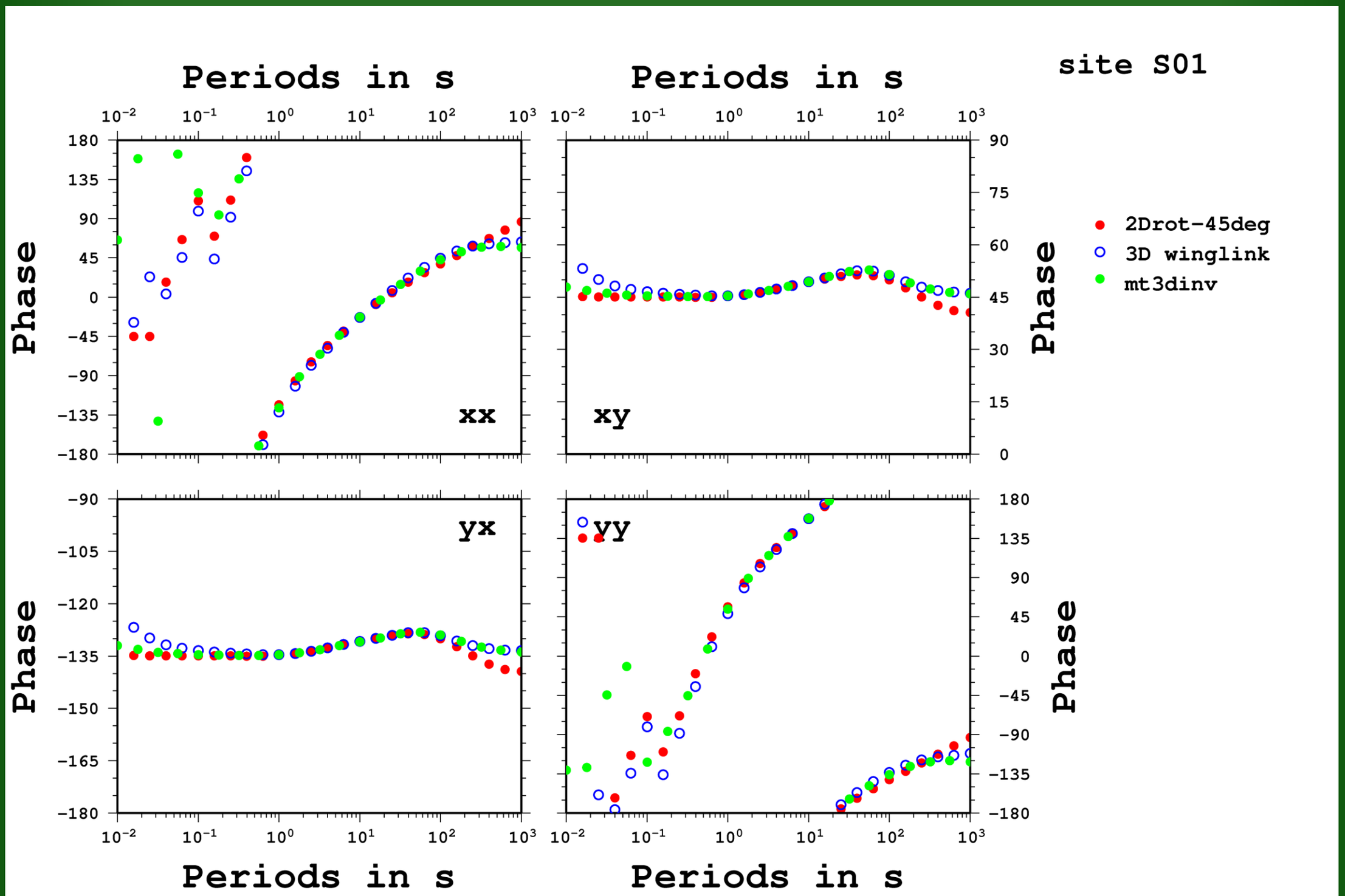
2 dykes with NE-SW strike direction

profile orientation NW-SE

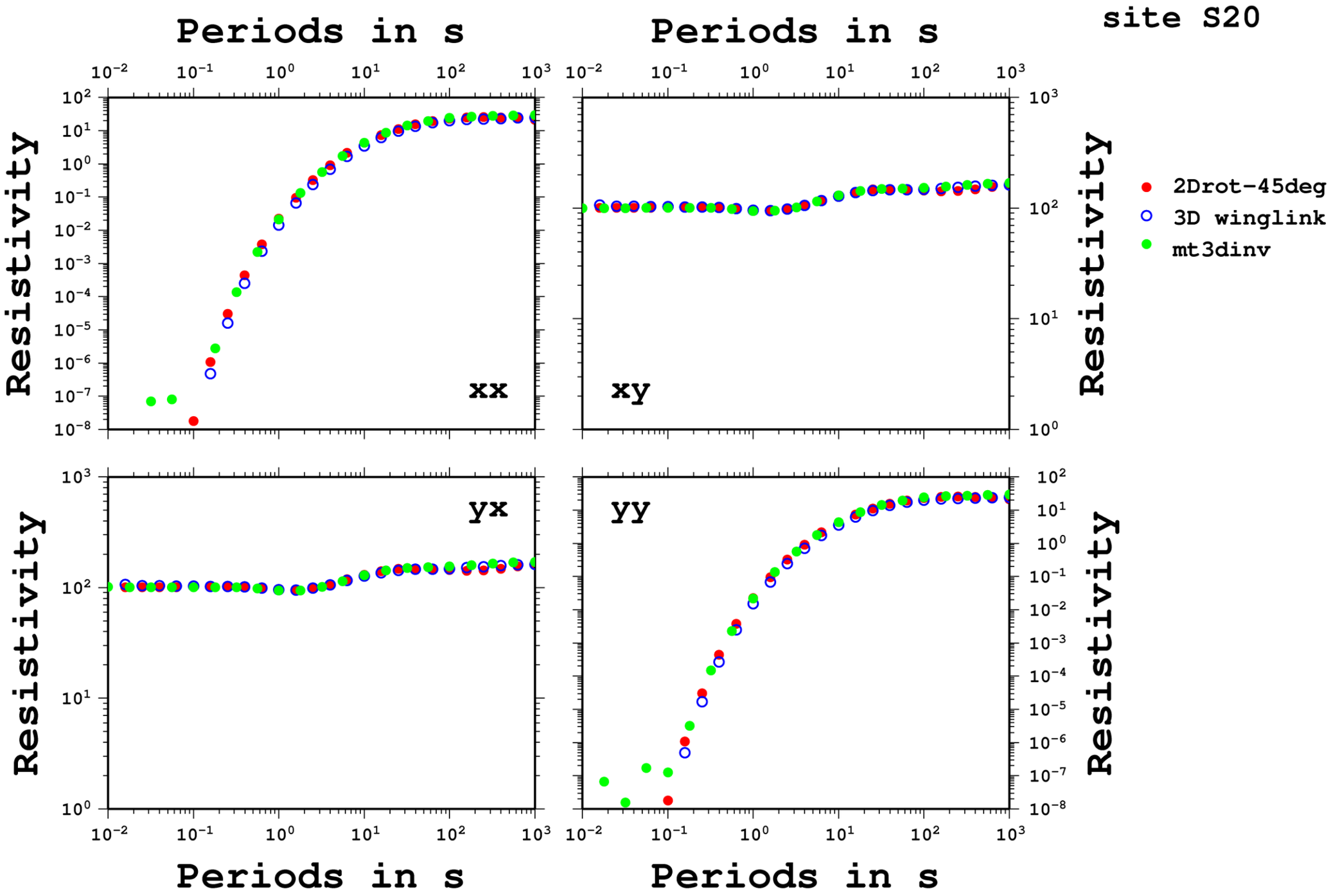
Site S01


site S01
Periods in s
Periods in s
xx
xy
yx
yy
Resistivity
Resistivity
Periods in s
Periods in s
2Drot-45deg
3D winglink
mt3dinv

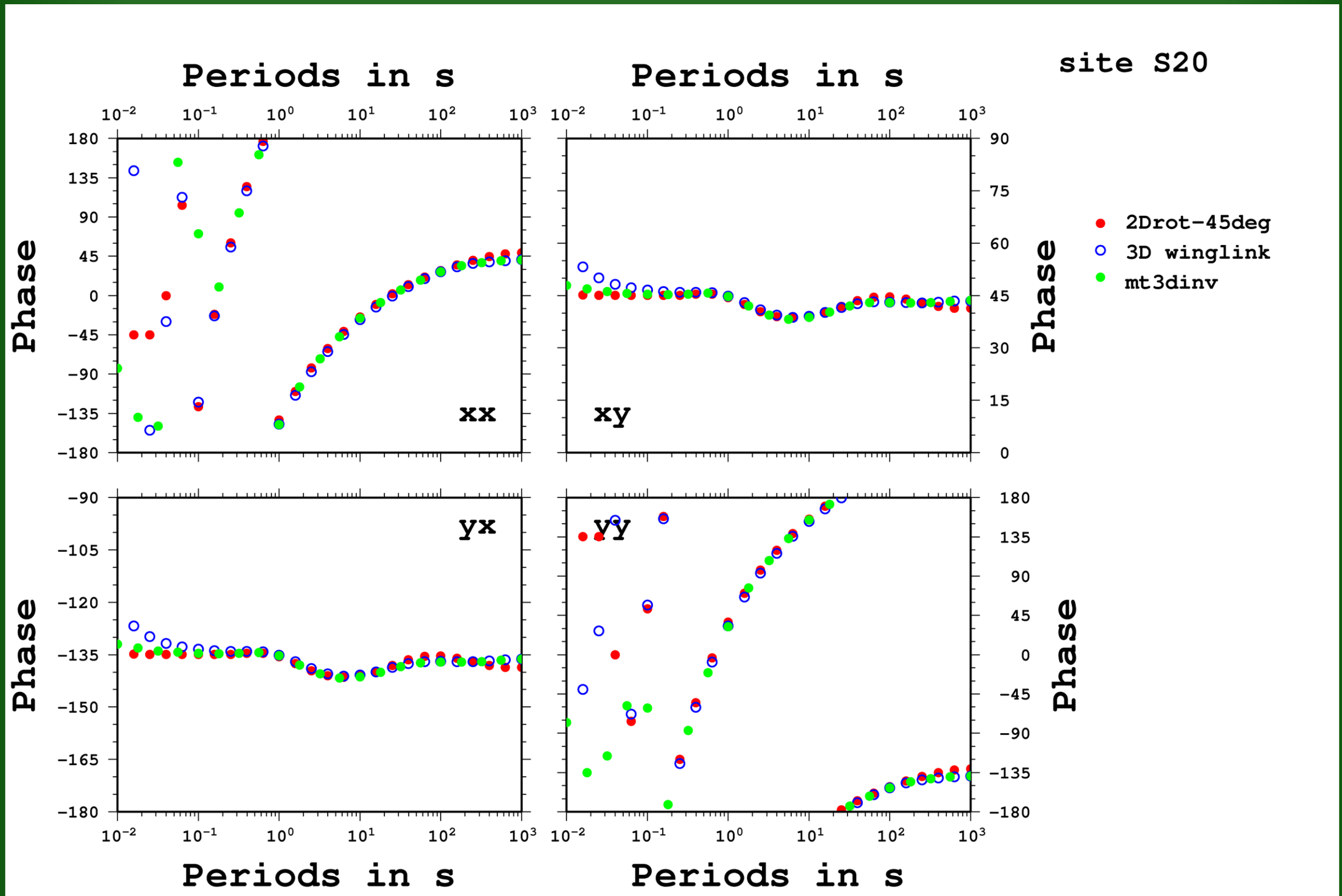
Site S01


Periods in s
Periods in s
site S01
Phase
xx
xy
yx
yy
2Drot-45deg
3D winglink
mt3dinv
Periods in s
Periods in s

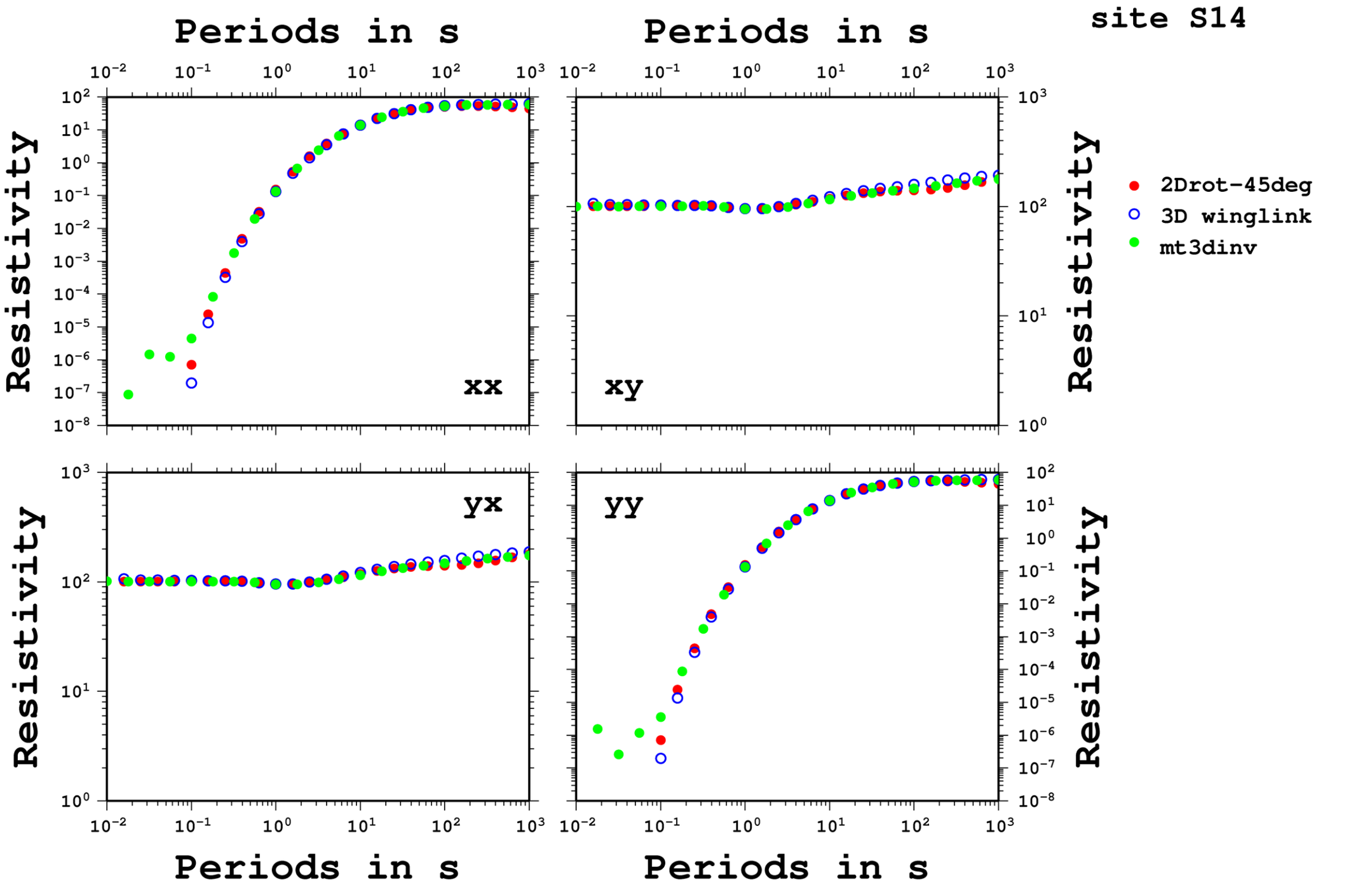
Site S20


Periods in s
Periods in s
site S20
Resistivity
xx
xy
yx
yy
2Drot-45deg
3D winglink
mt3dinv
Periods in s
Periods in s

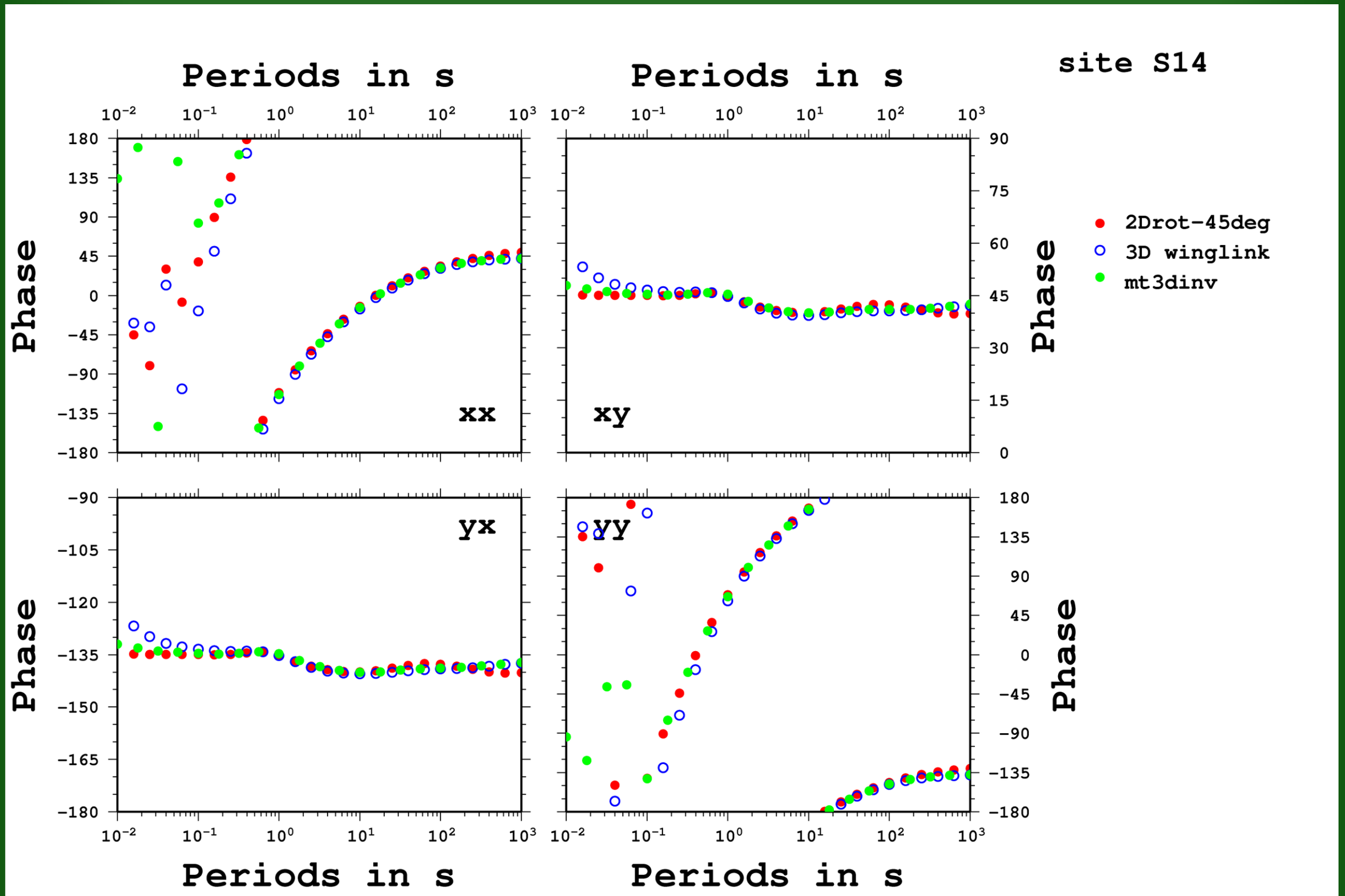
Site S20


Periods in s
Periods in s
site S20
Phase
Phase
xx
xy
yx
yy
2Drot-45deg
3D winglink
mt3dinv
Periods in s
Periods in s

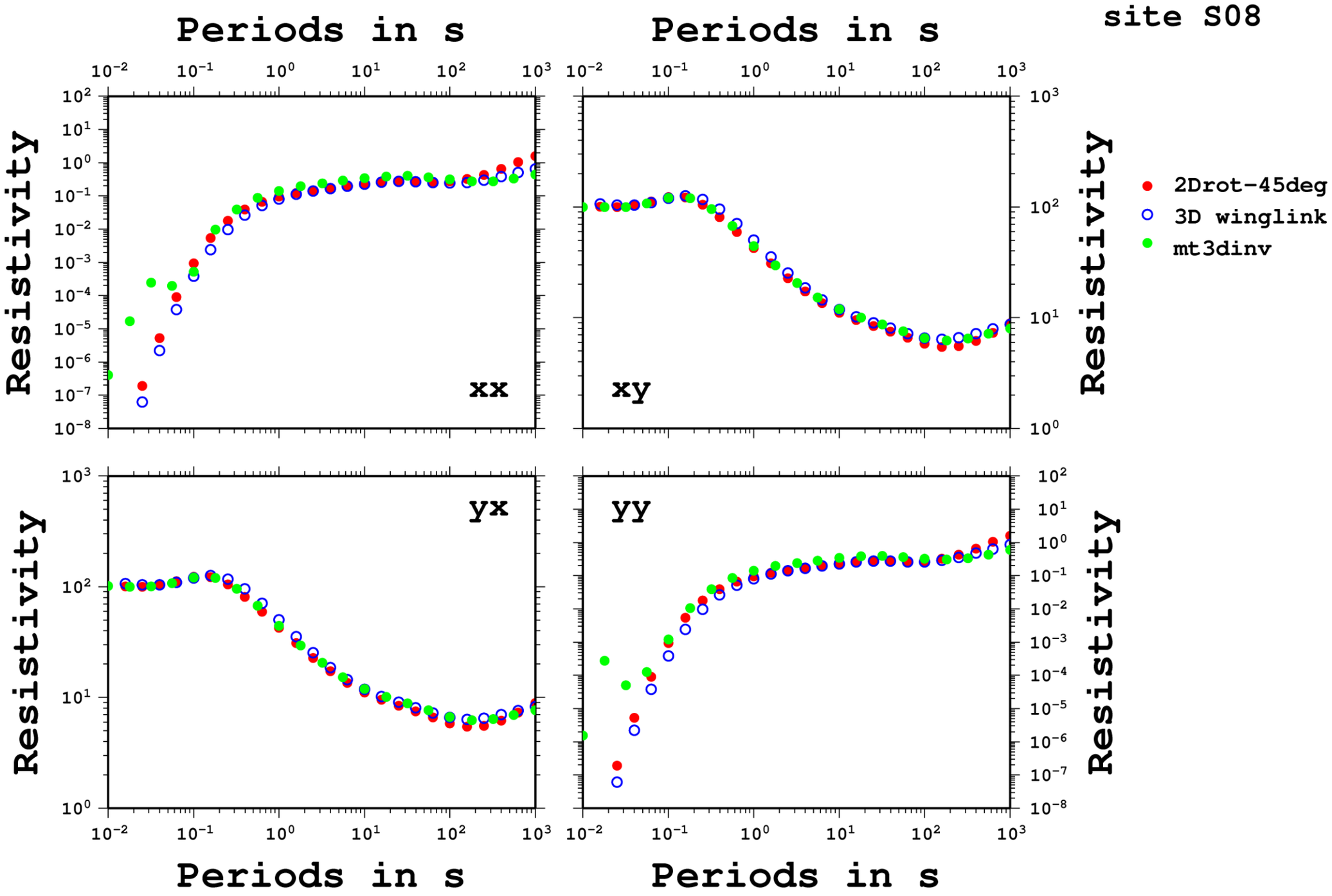
Site S14


Periods in s
Periods in s
site S14
Resistivity
xx
xy
yx
yy
2Drot-45deg
3D winglink
mt3dinv
Periods in s
Periods in s

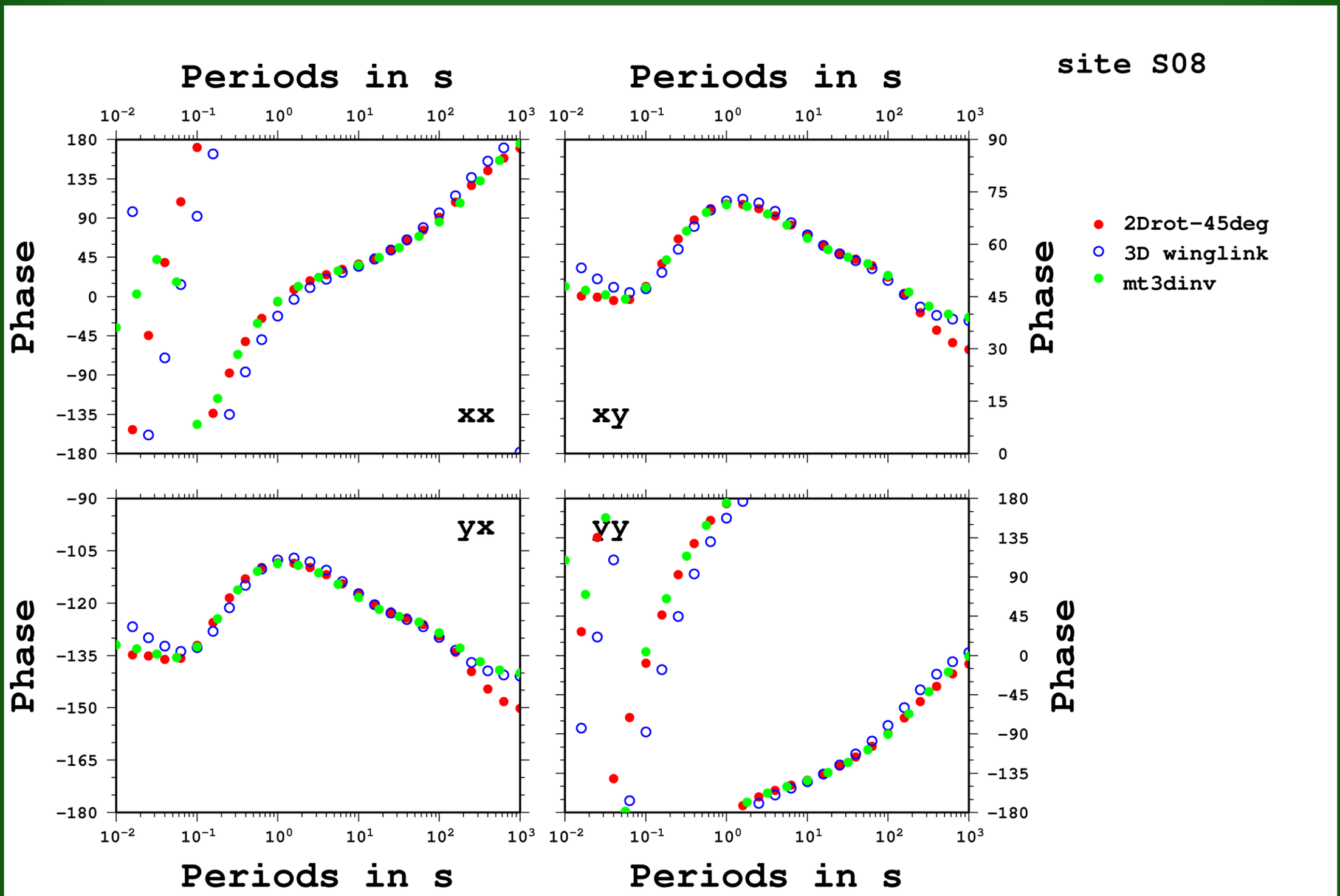
Site S14


Periods in s
Periods in s
site S14
Phase
Phase
xx
xy
yx
yy
2Drot-45deg
3D winglink
mt3dinv
Periods in s
Periods in s

Site S08


Periods in s
Periods in s
site S08
Resistivity
xx
xy
yx
yy
2Drot-45deg
3D winglink
mt3dinv
Periods in s
Periods in s

Site S08


Periods in s
Periods in s
site S08
Phase
Phase
xx
xy
yx
yy
2Drot-45deg
3D winglink
mt3dinv
Periods in s
Periods in s

Conclusion

We are able to prove all 8 impedance elements and resistivity and phase curves respectively

Diagonal phase are not related to a specific quadrant

Should a threshold be introduced for the diagonal elements (based on the resistivity value)?