Signal Filtering Methods of InSAR

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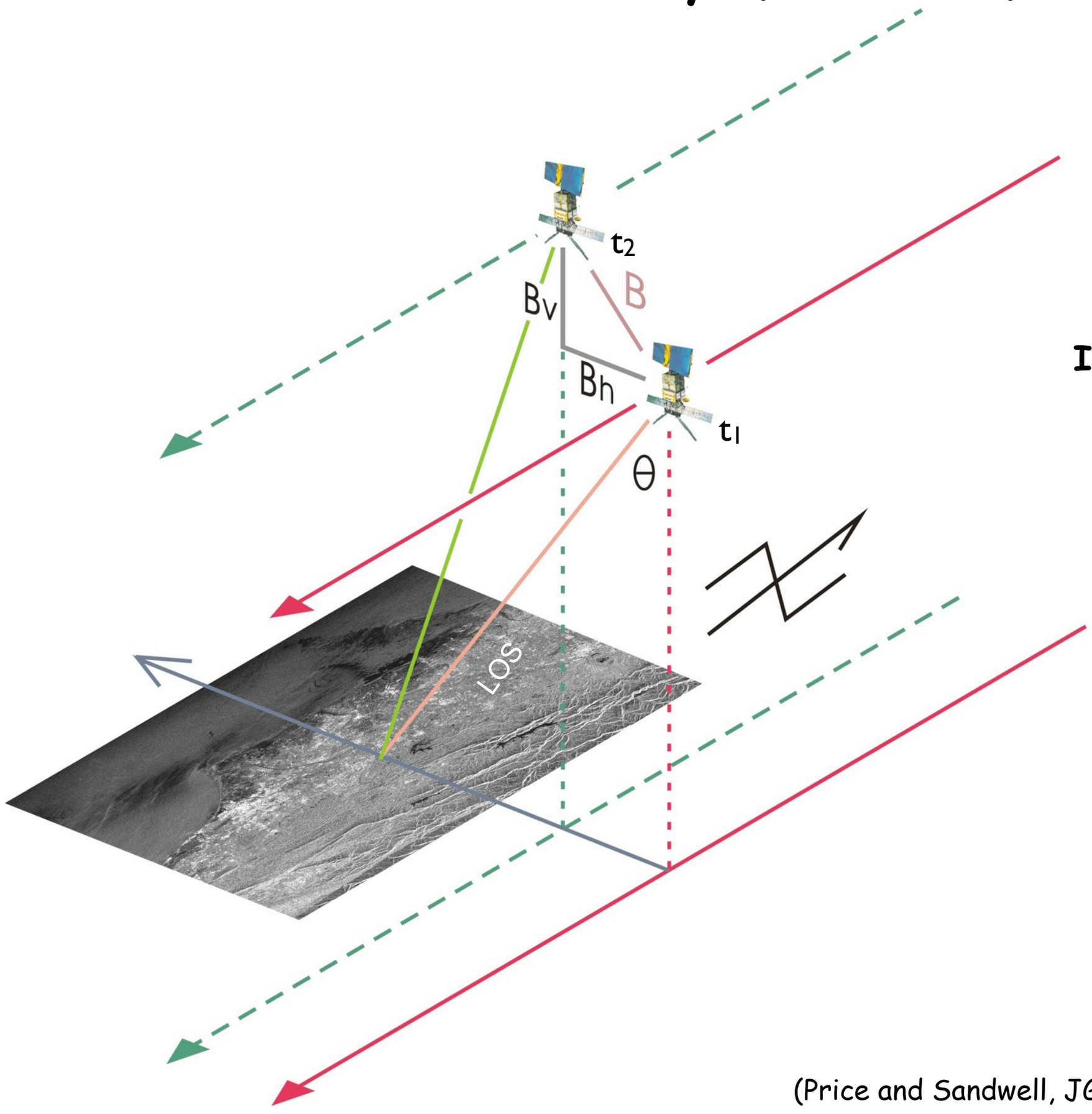
27 April

SAR interferometry (InSAR)



Wavelength – 23.6 cm

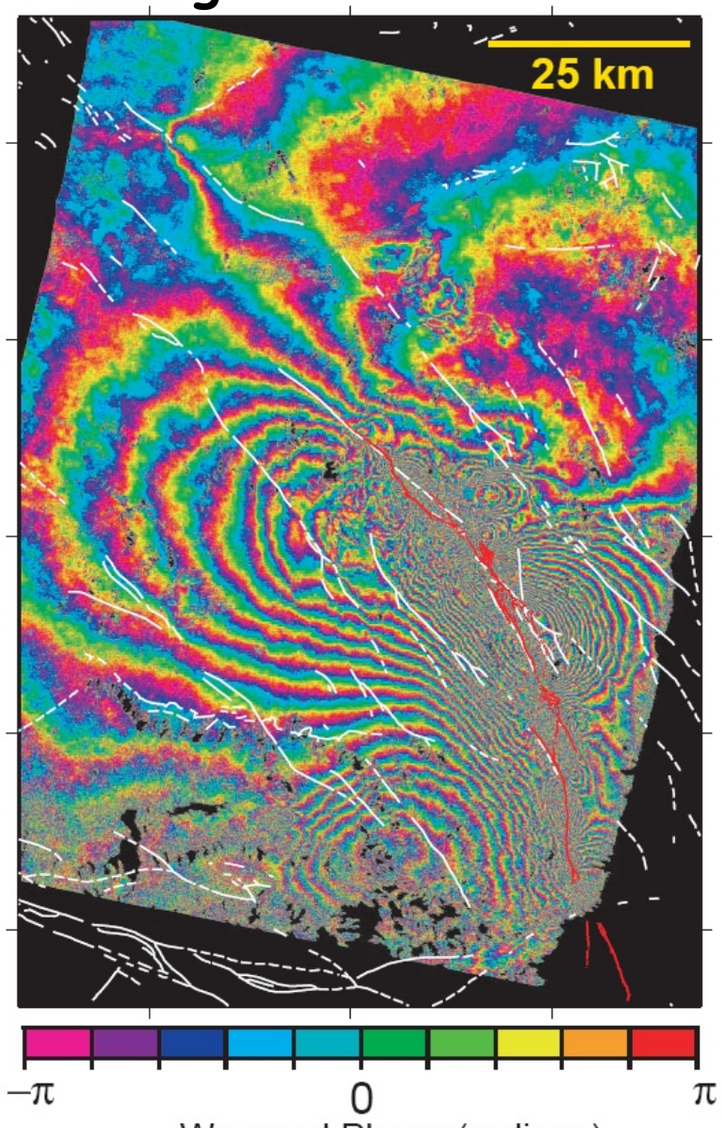
Height – 800 km

Velocity ~ 7 km/s

B – baseline

Θ – looking angle

Interferogram



(Price and Sandwell, JGR, 1998)

Wenchuan Coseismic Deformation (ALOS PALSAR InSAR)

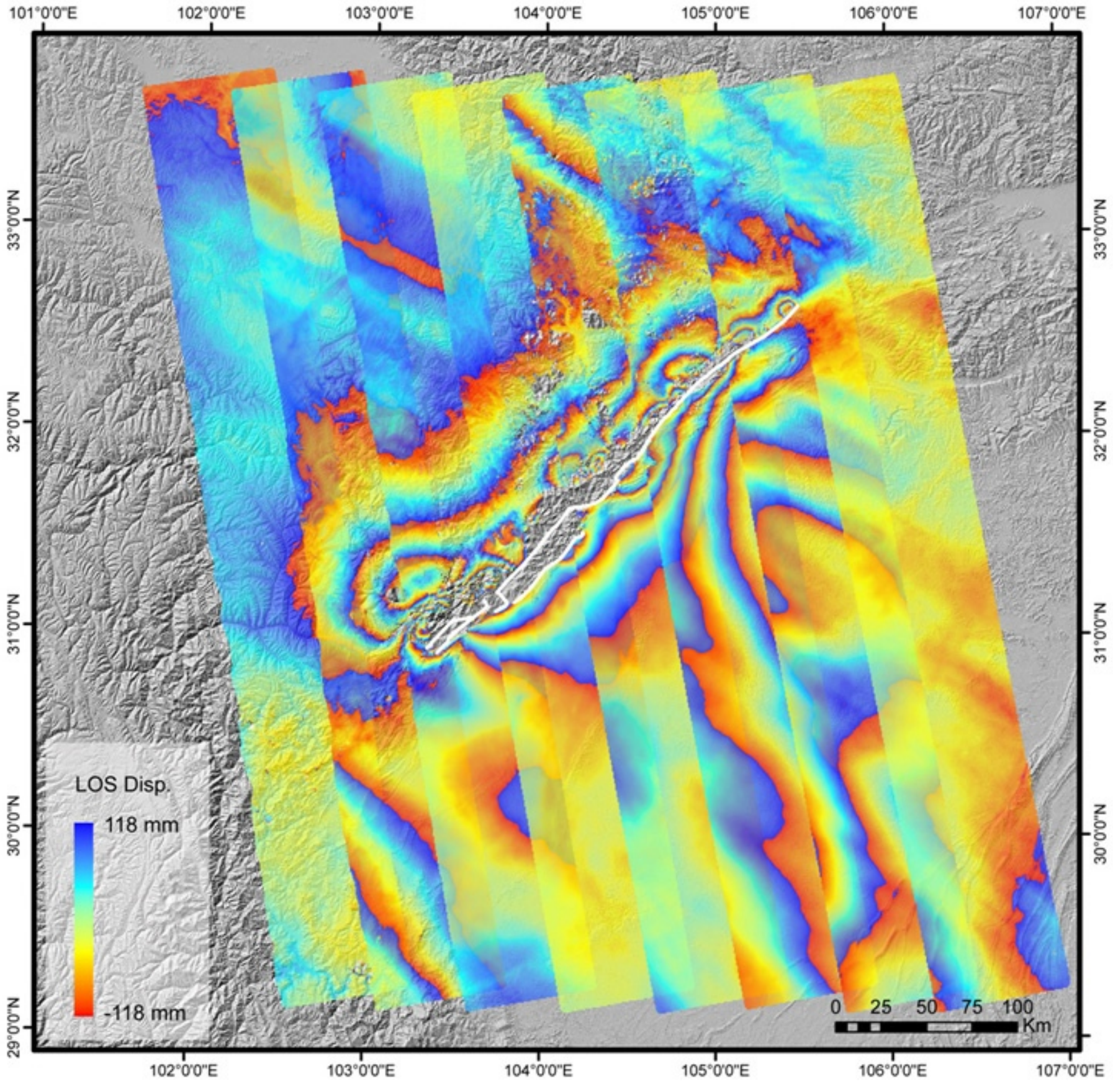
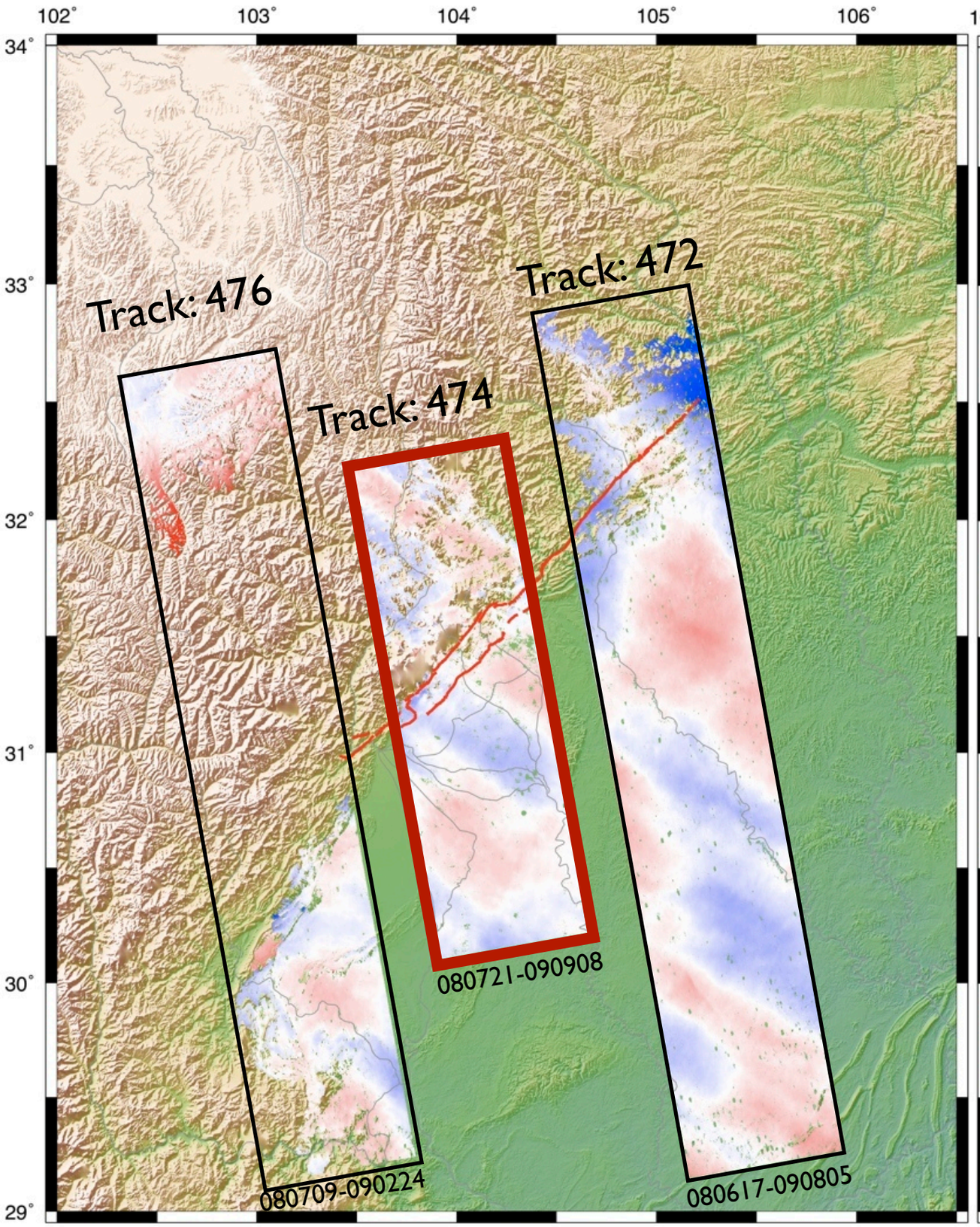
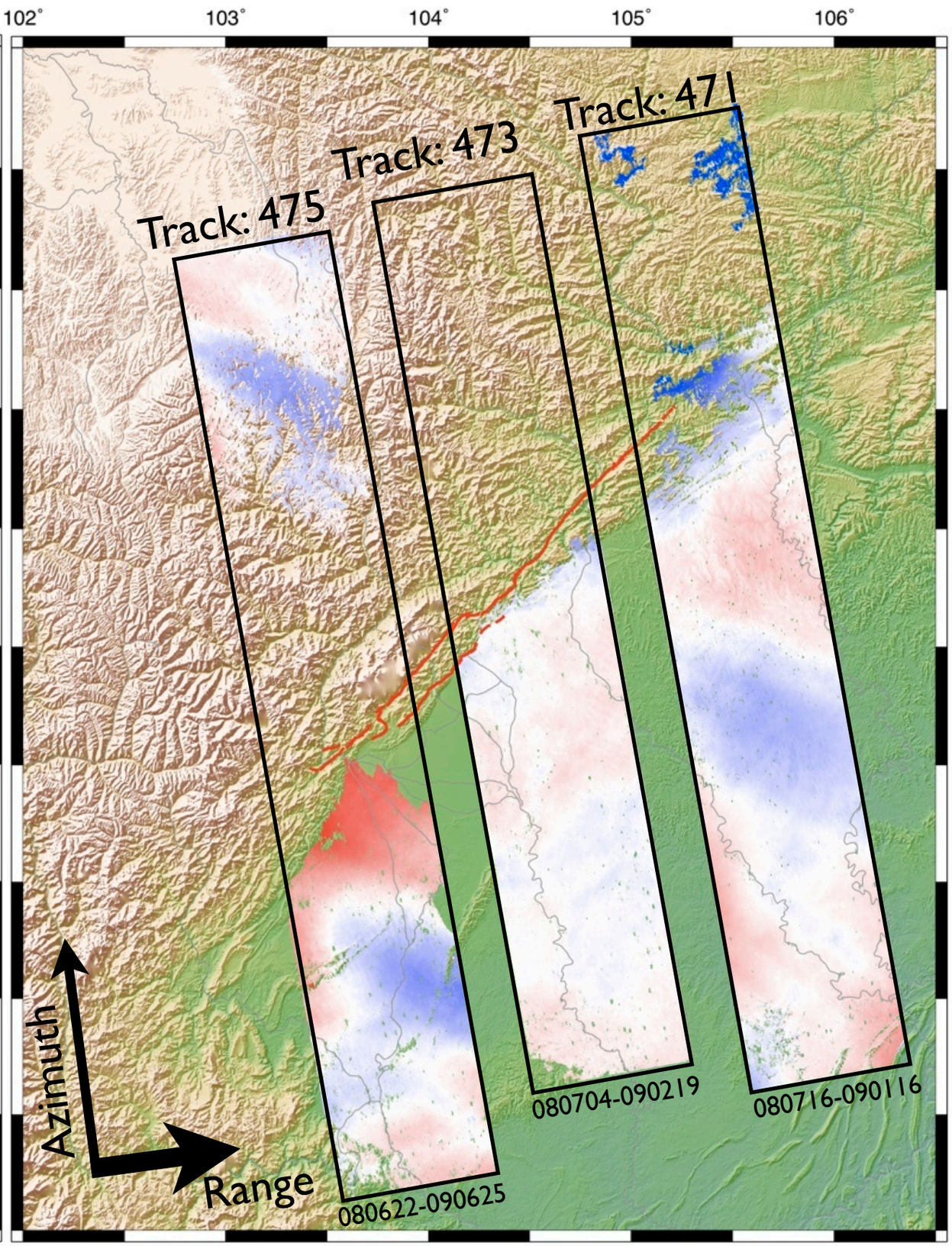


Image from
JAXA, 2009

Wenchuan Postseismic Deformation (ALOS PALSAR InSAR)





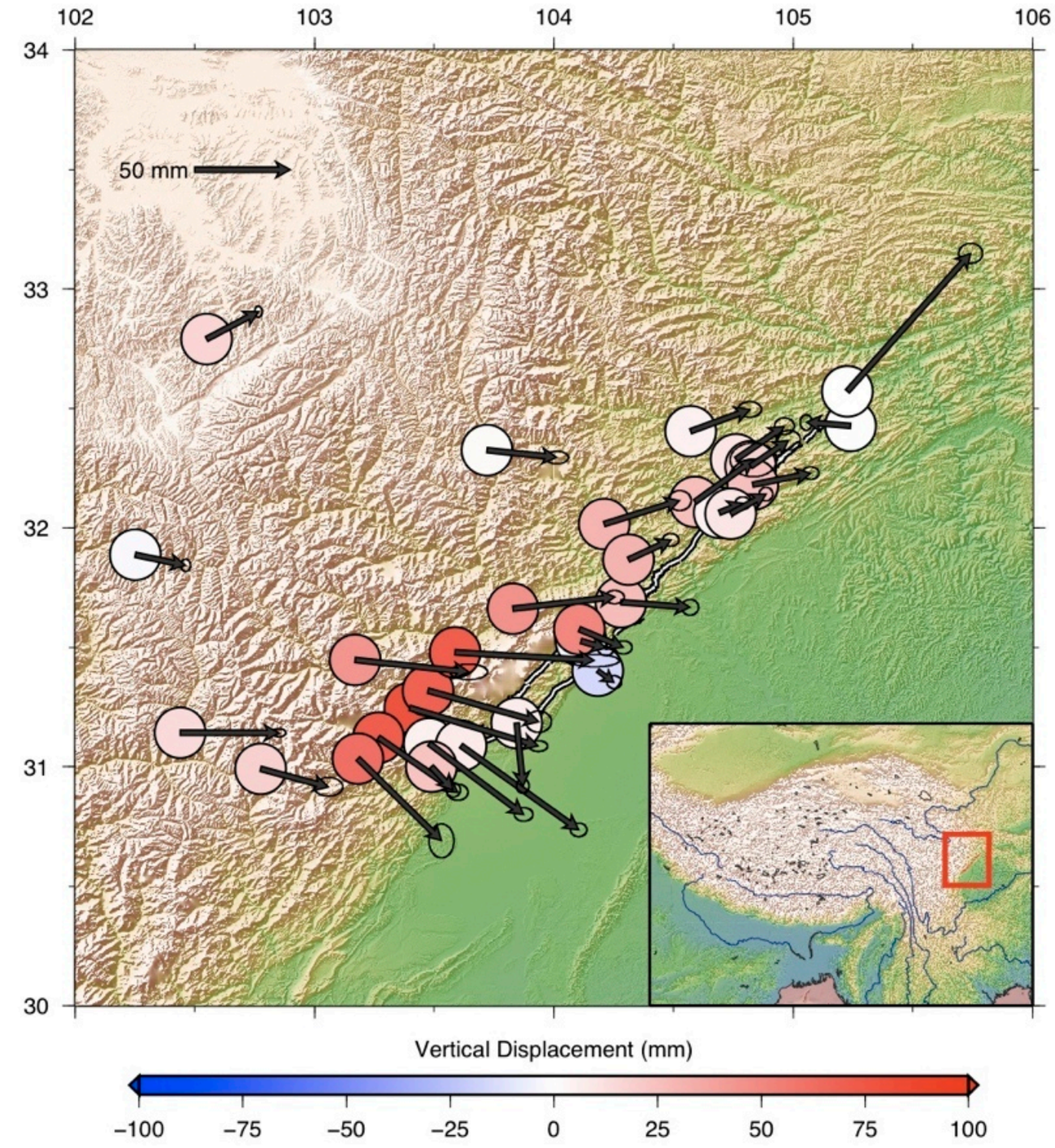
Slant Range Displacement (cm)

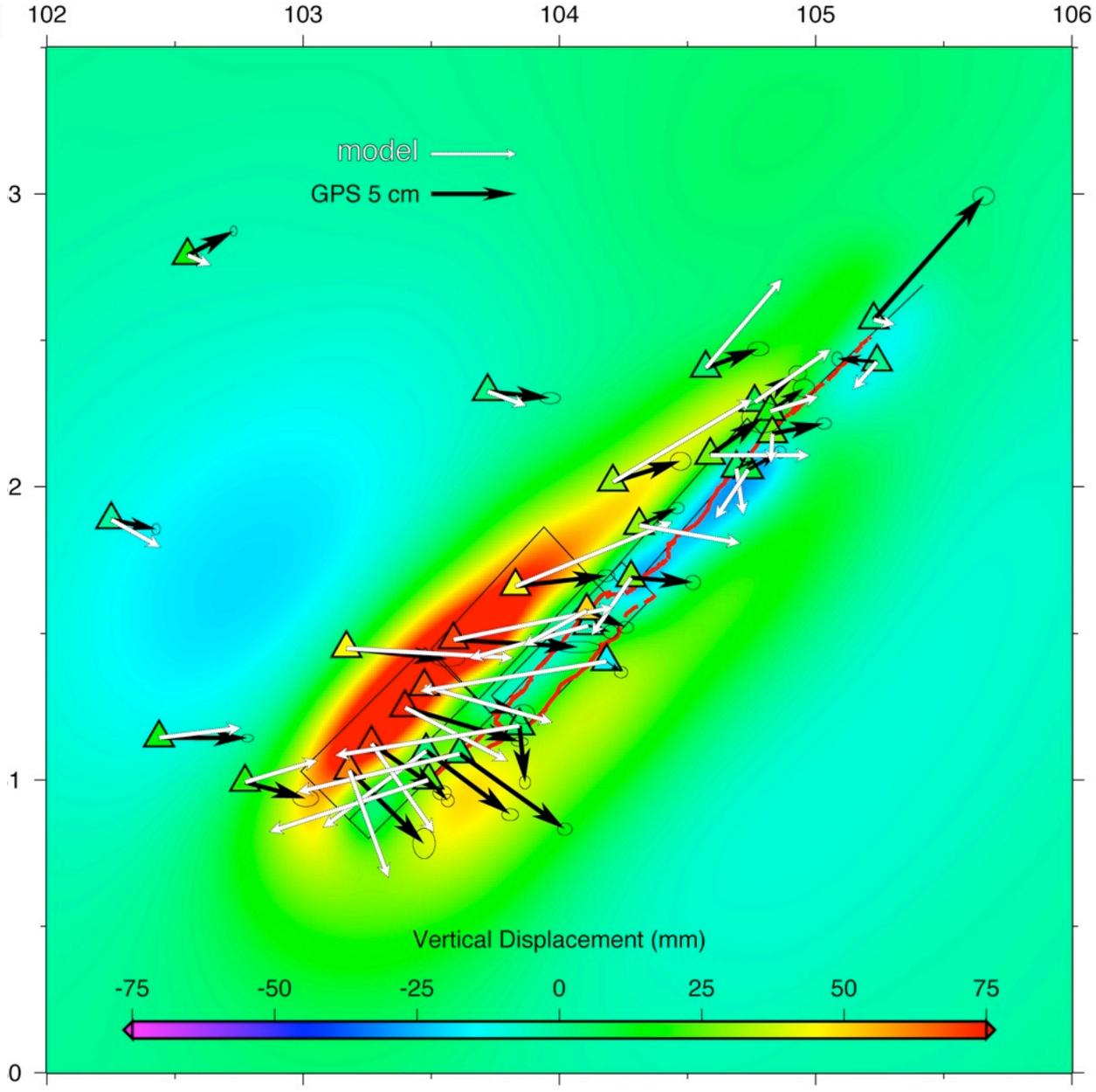
−20 −18 −16 −14 −12 −10 −8 −6 −4 −2 0 2 4 6 8 10 12 14 16 18 20

Slant Range Displacement (cm)

−20 −18 −16 −14 −12 −10 −8 −6 −4 −2 0 2 4 6 8 10 12 14 16 18 20

Wenchuan Postseismic Deformation (GPS & model)





Noise: topographic related & ionospheric related

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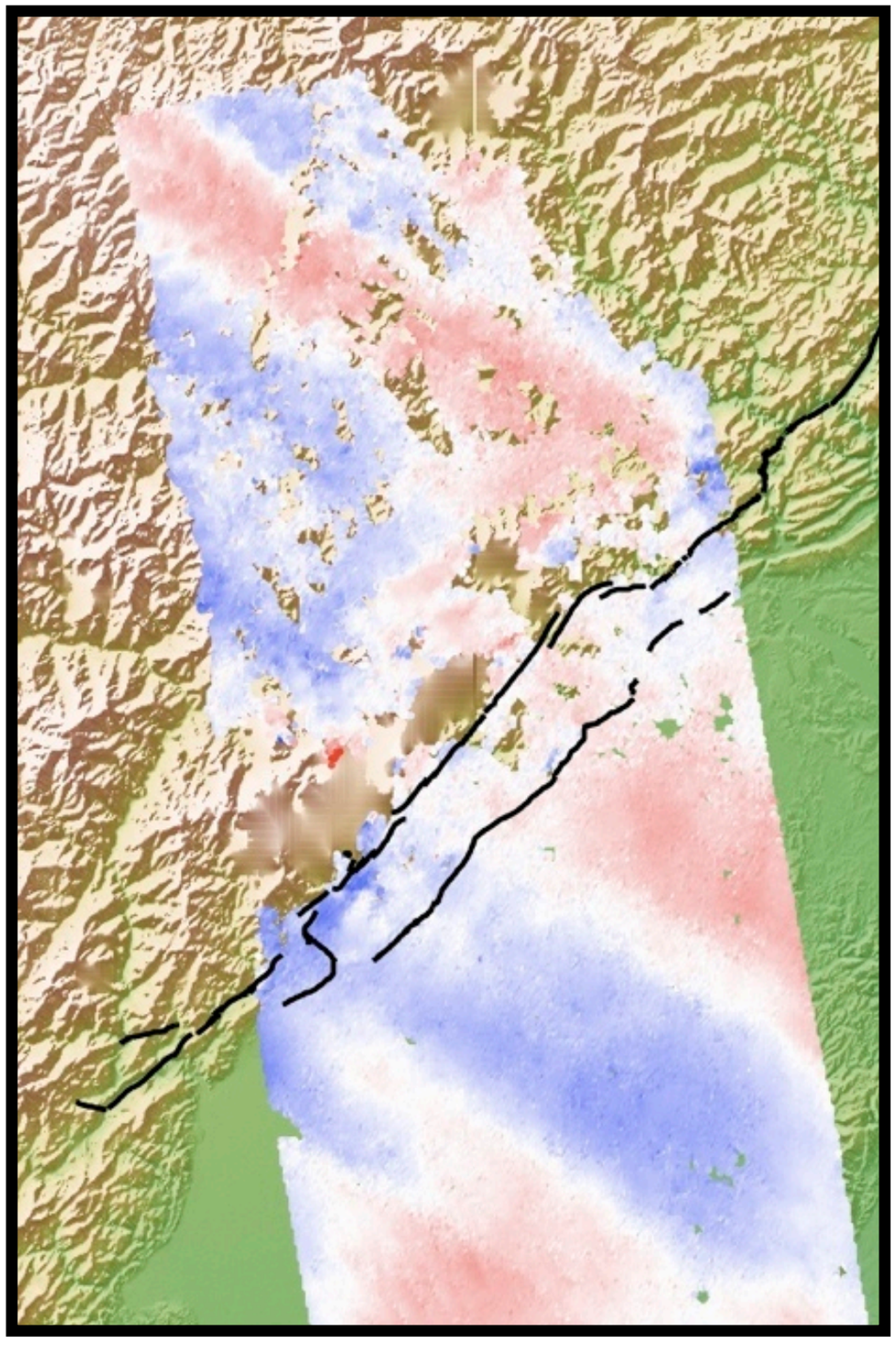

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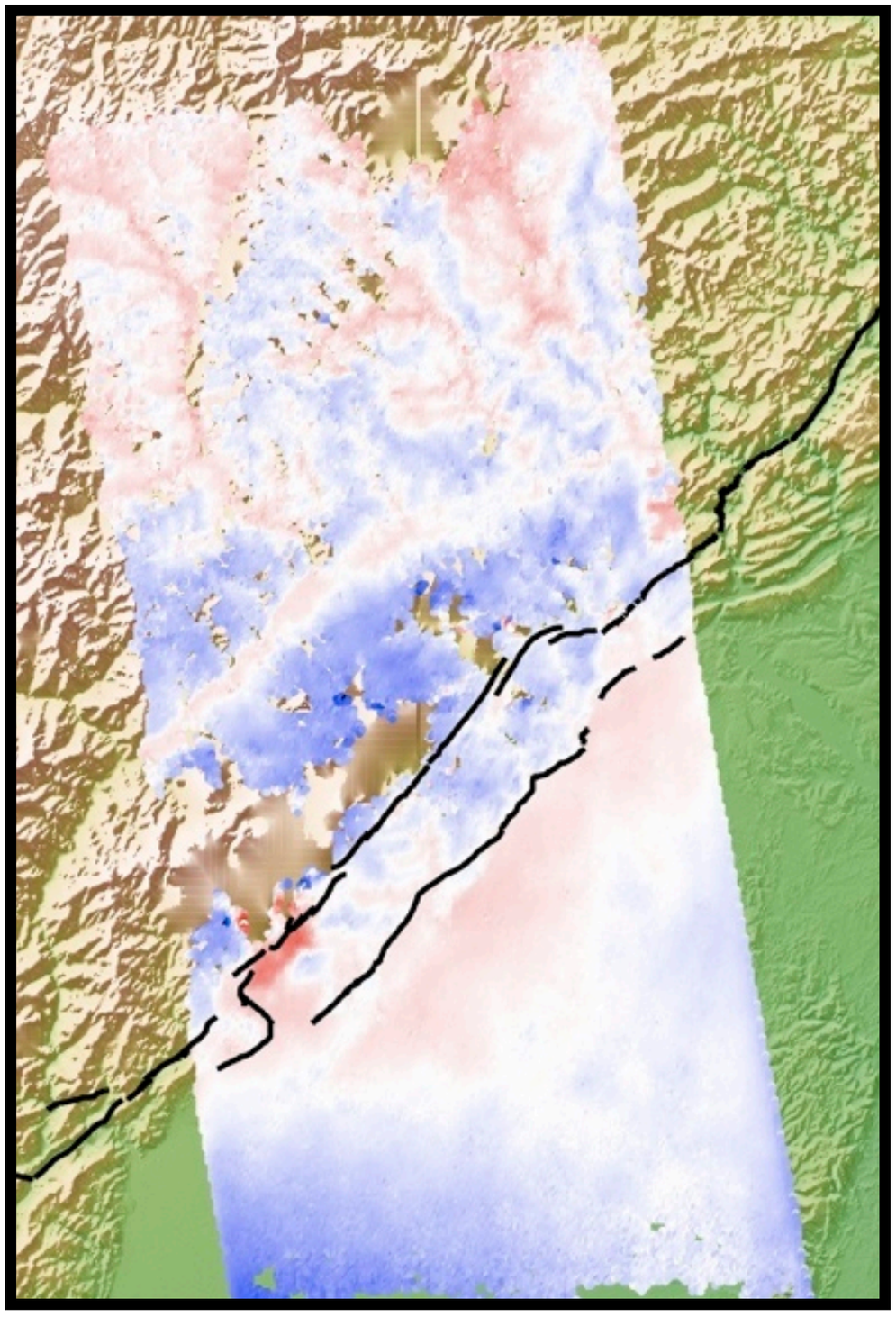


Method

Y_1: signal 1 (InSAR); Y_2: signal 2 (dem)

Fourier transform

$$X_k = \sum_{n=0}^{N-1} x_n e^{-\frac{2\pi i}{N} kn}$$

$Z_1 = \text{fft}(Y_1)$

$Z_2 = \text{fft}(Y_2)$

Coplex cross-correlation

$$\gamma = \frac{\mathrm{E}[z_1 z_2^*]}{\sqrt{\mathrm{E}[|z_1|^2]\mathrm{E}[|z_2|^2]}} = D\exp(j\beta)$$

$D = |\gamma|$

(Degree of coherence)

Decorrelation

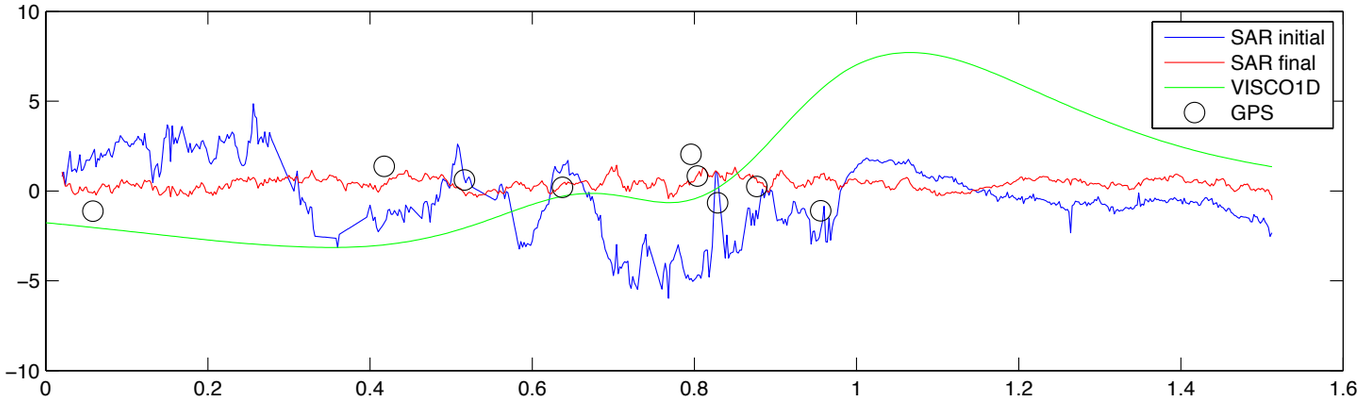
$\delta = 1 - \text{smooth}(D)$

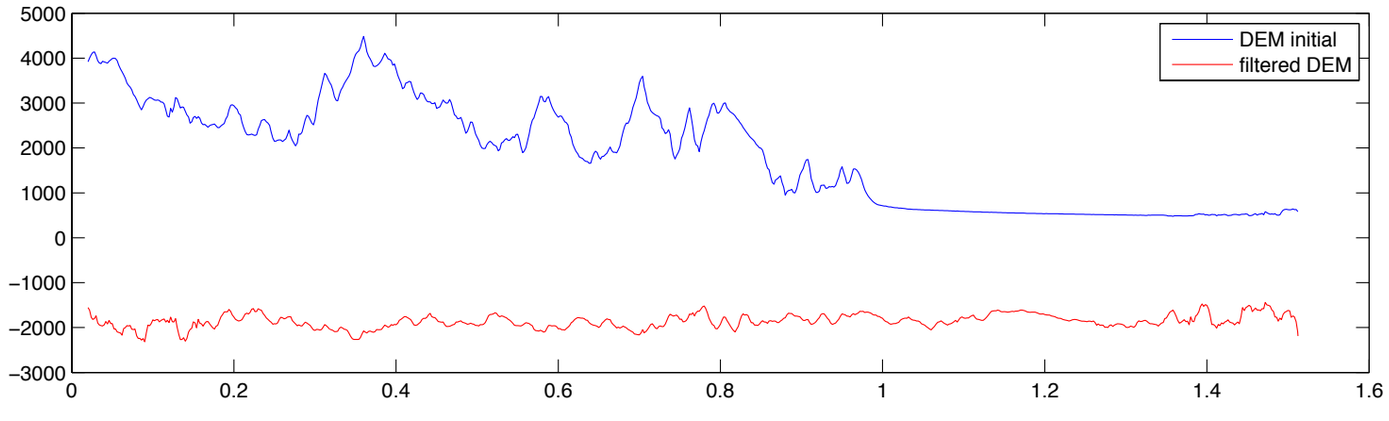
Inverse Fourier transform

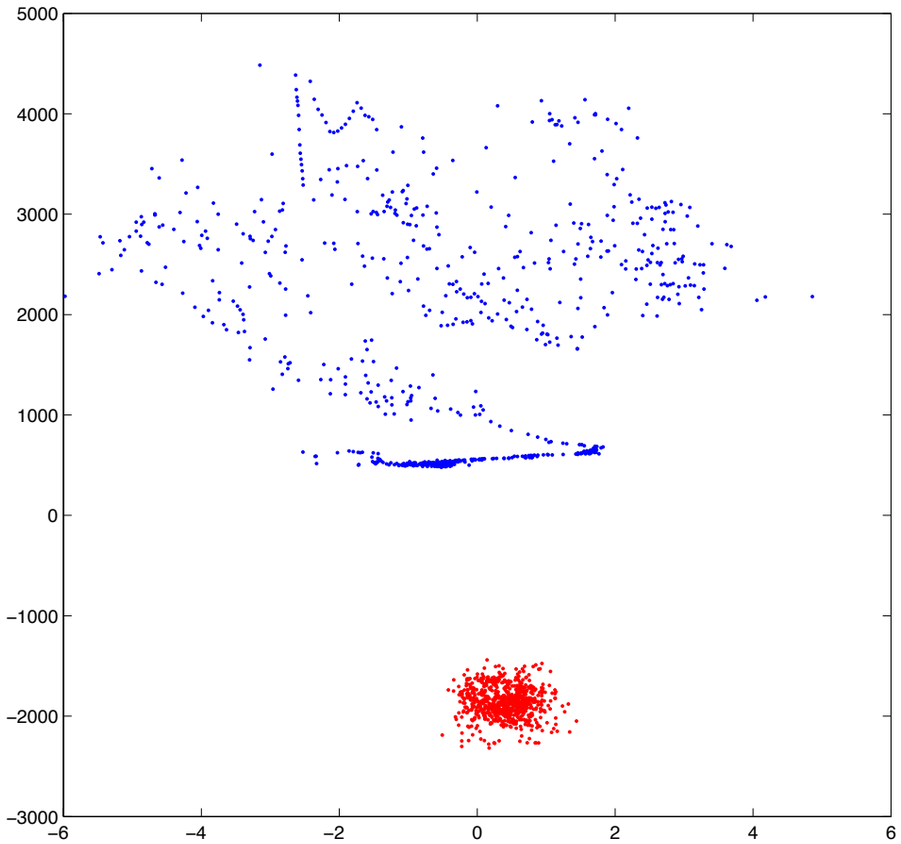
$$x_n = \frac{1}{N} \sum_{k=0}^{N-1} X_k e^{\frac{2\pi i}{N} kn}$$

$Y_1 = \text{ifft}(\delta Z_1)$

$Y_2 = \text{ifft}(\delta Z_2)$

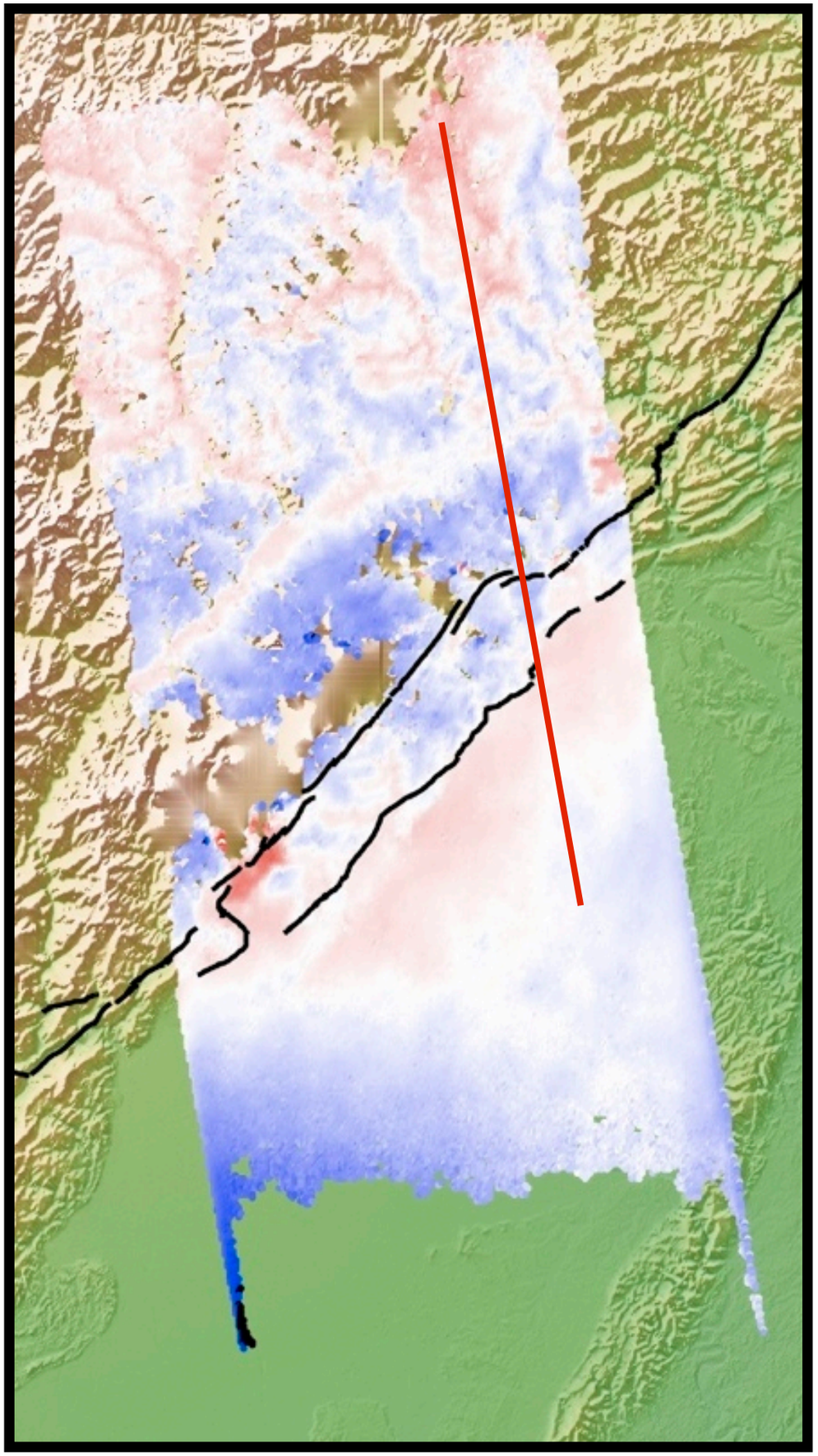


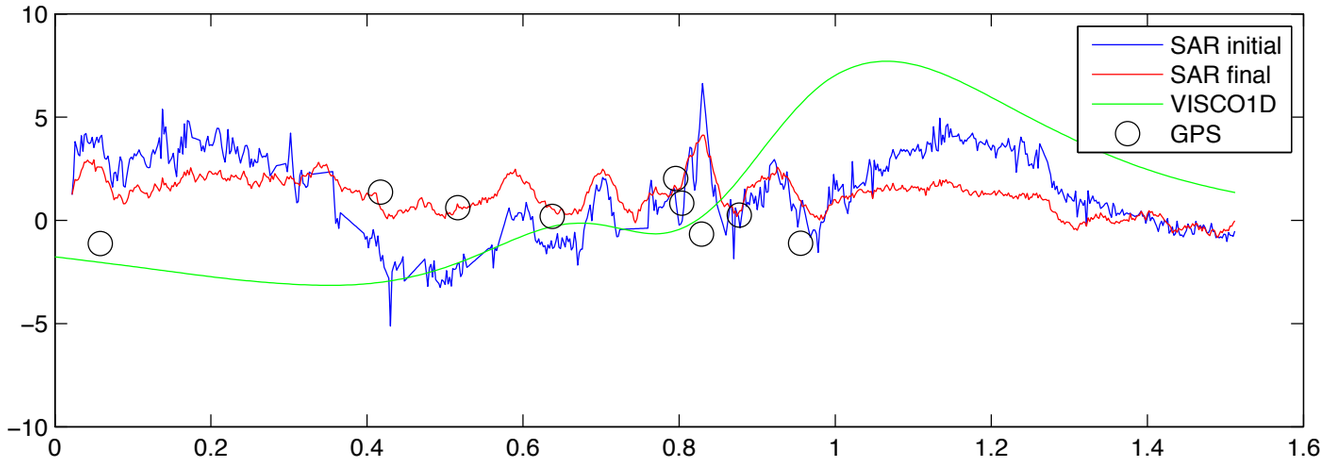


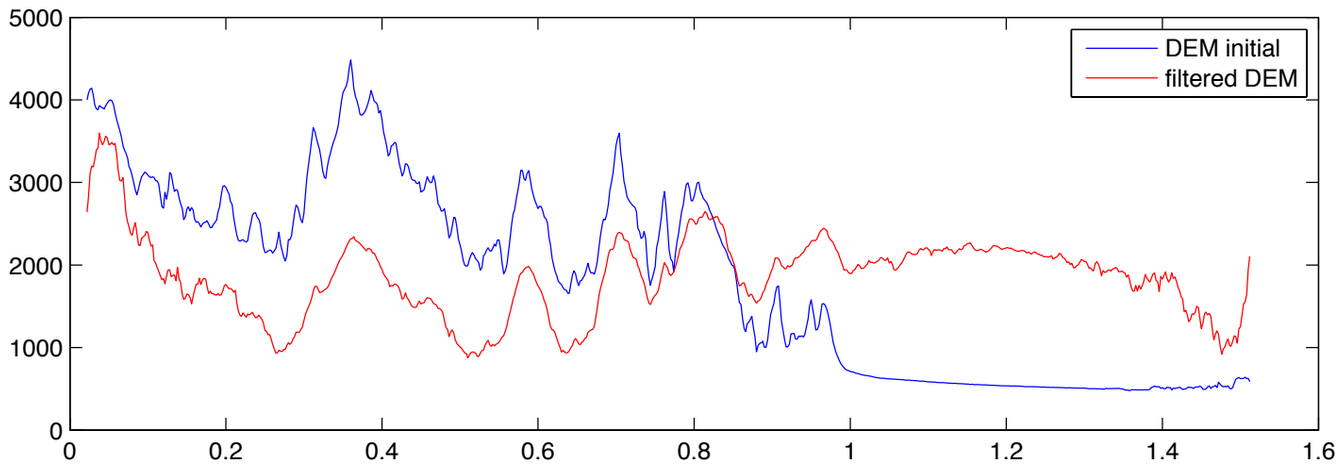


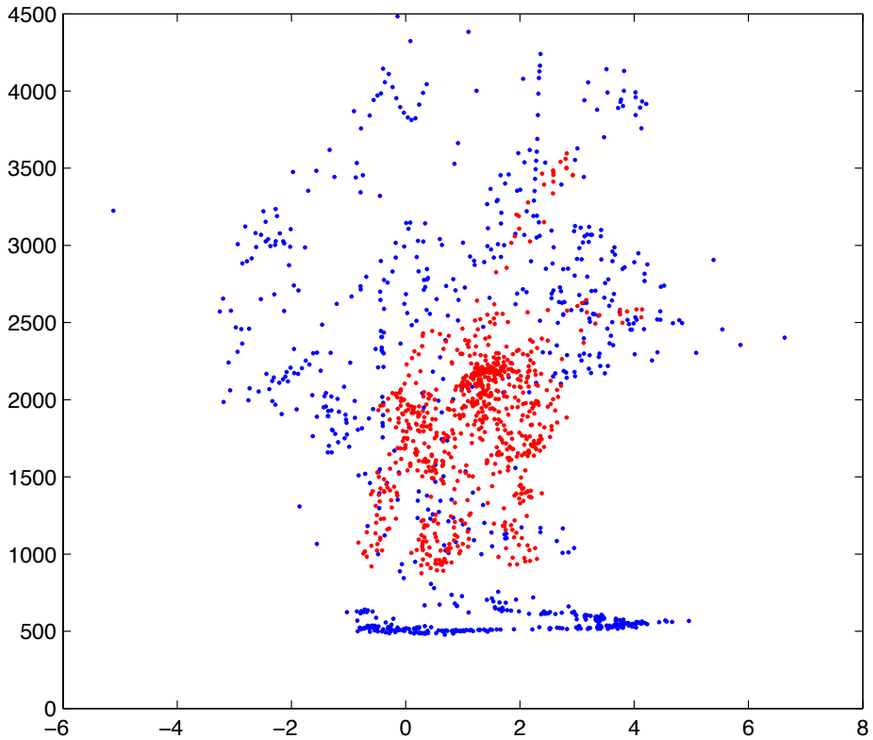
before

after



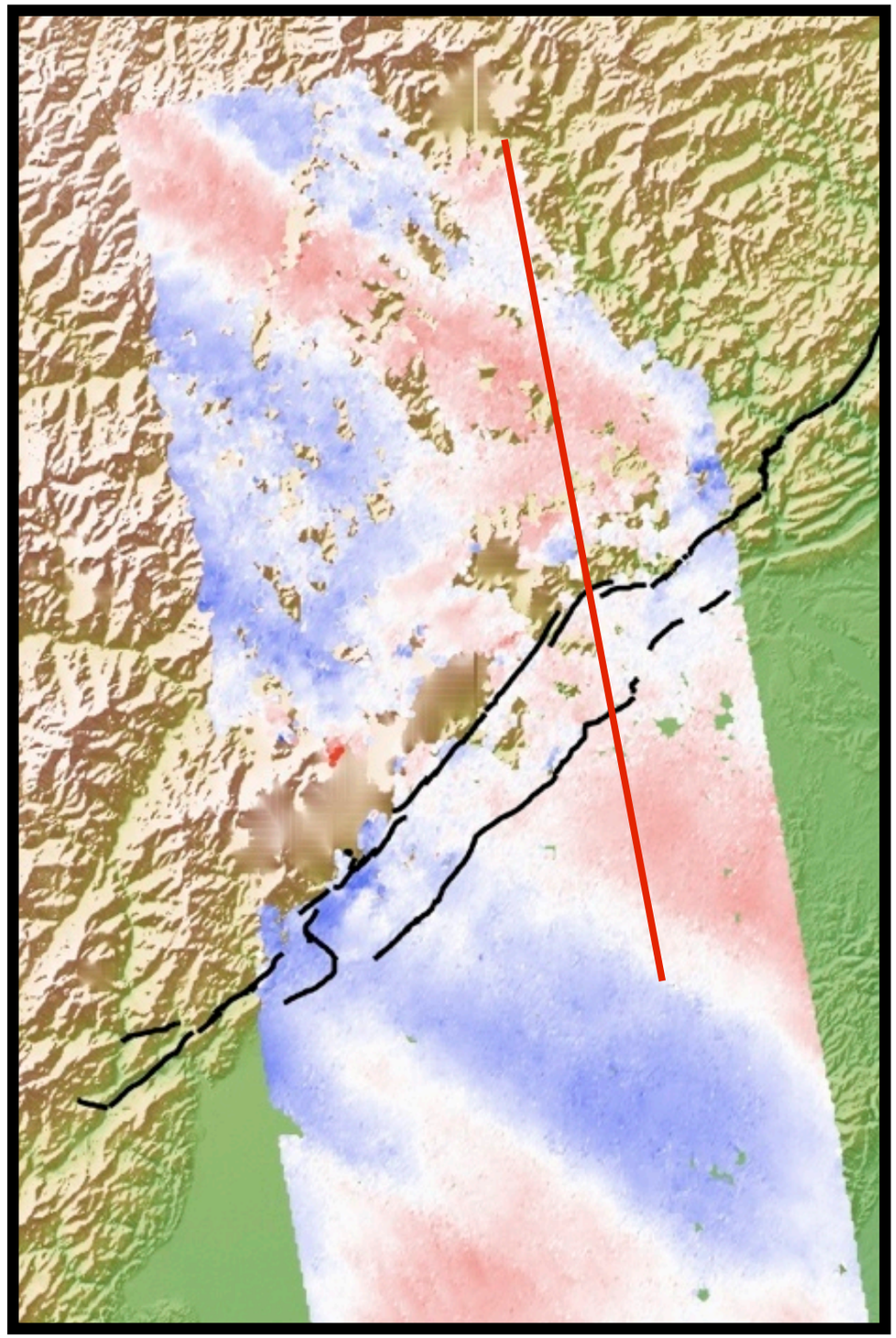






before

after



whole SAR images

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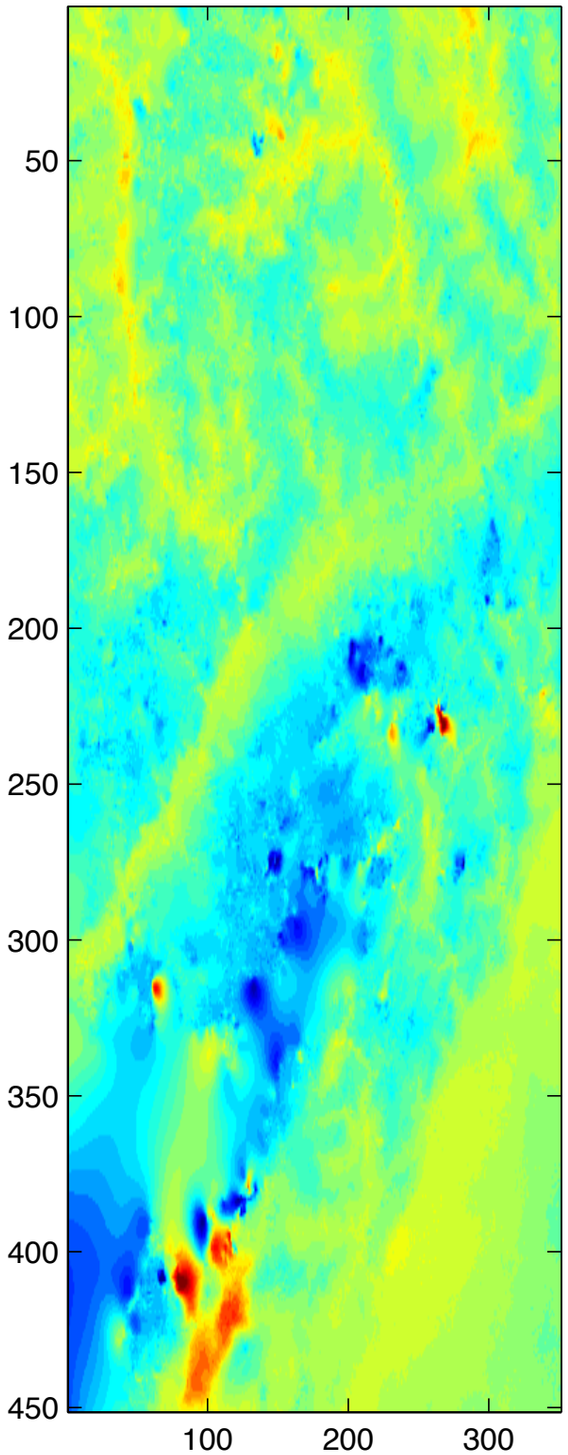

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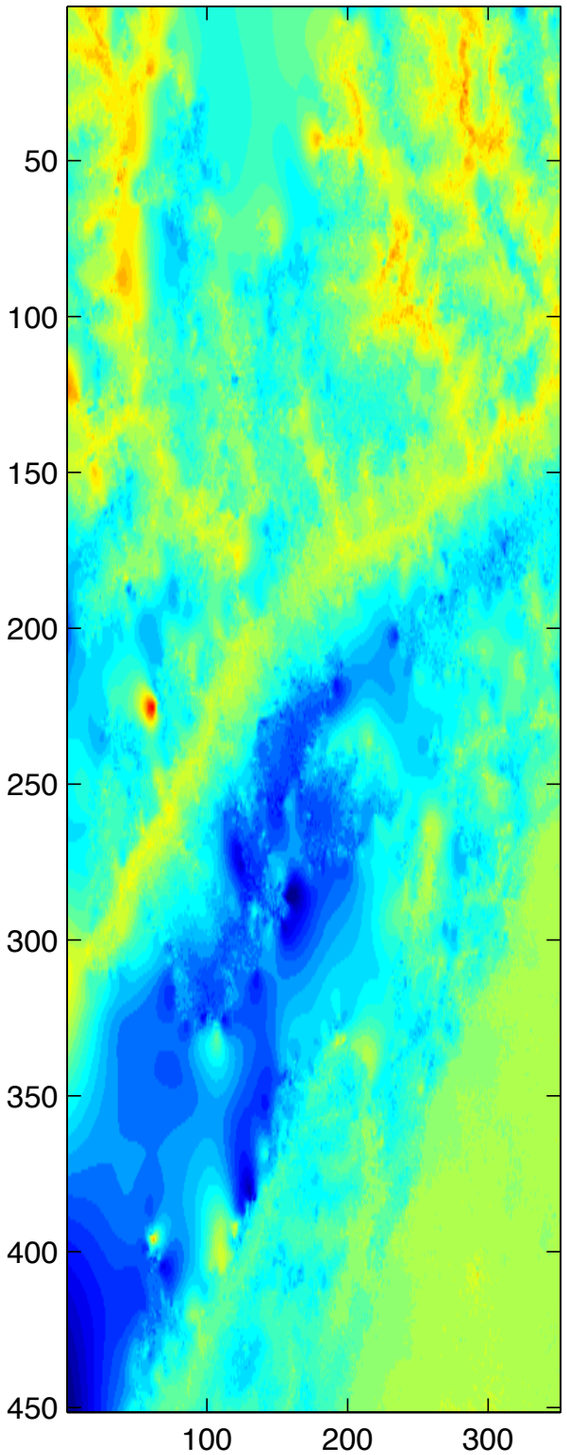

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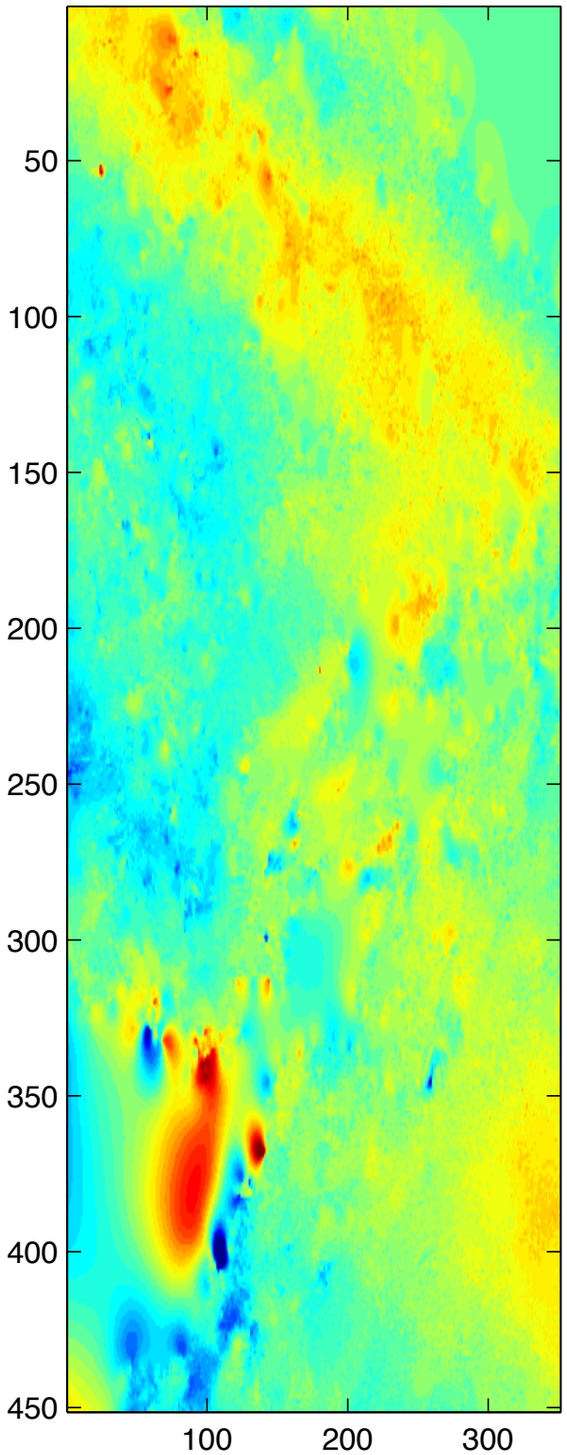
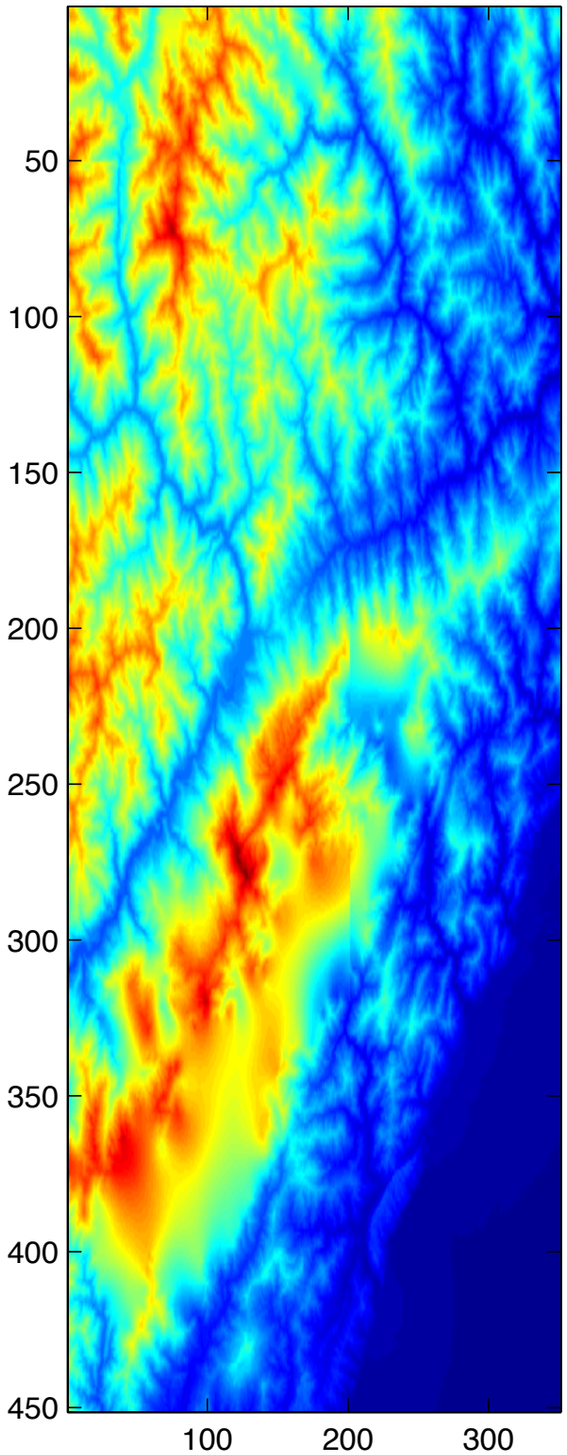


DEM



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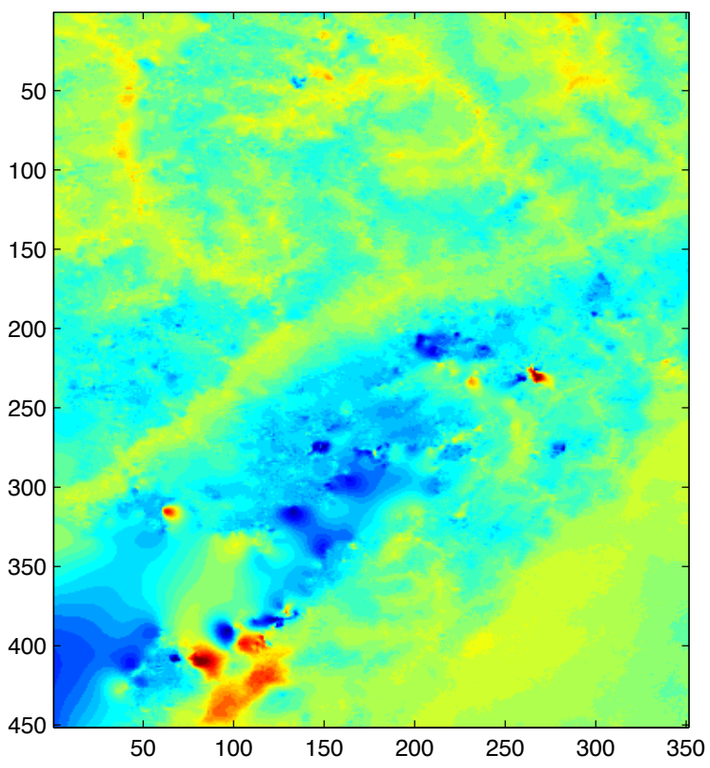

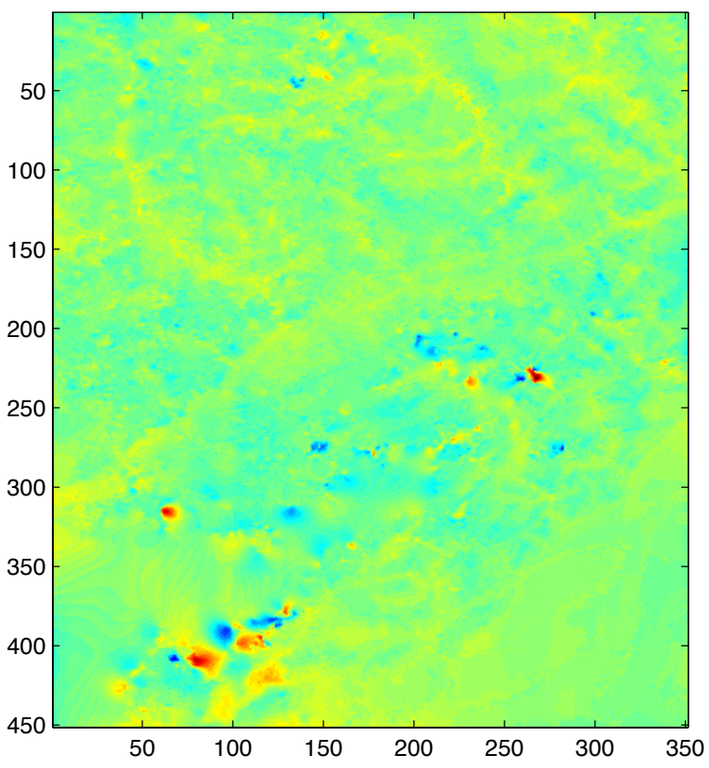

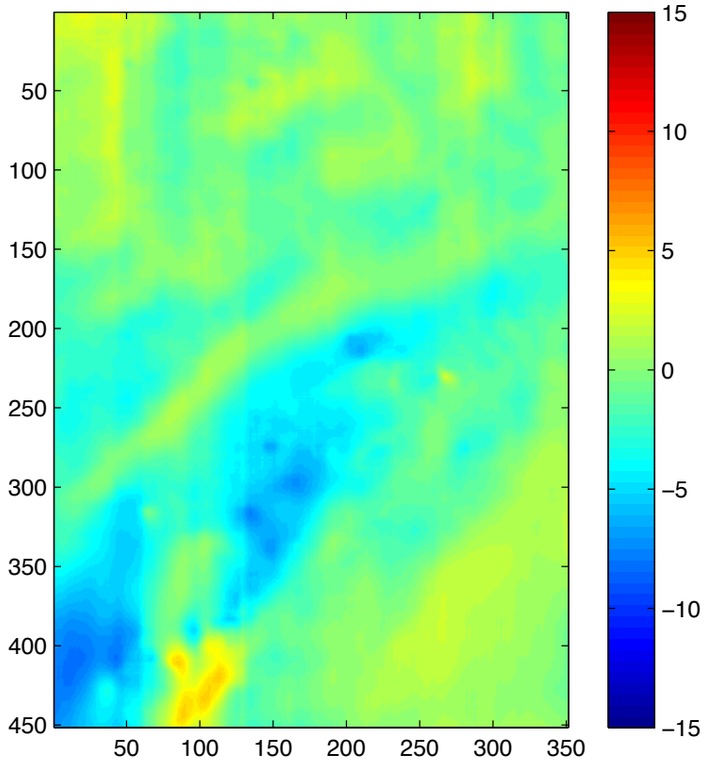

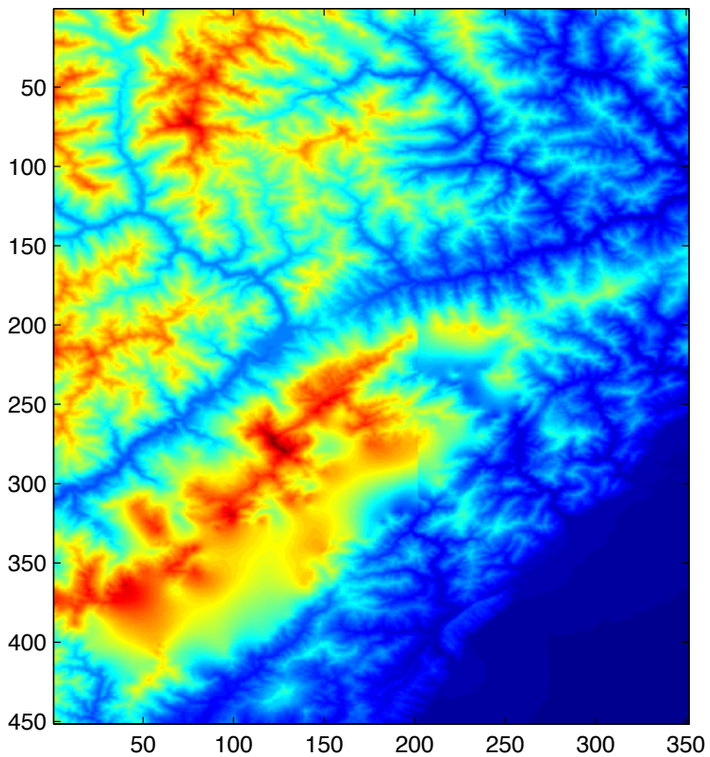

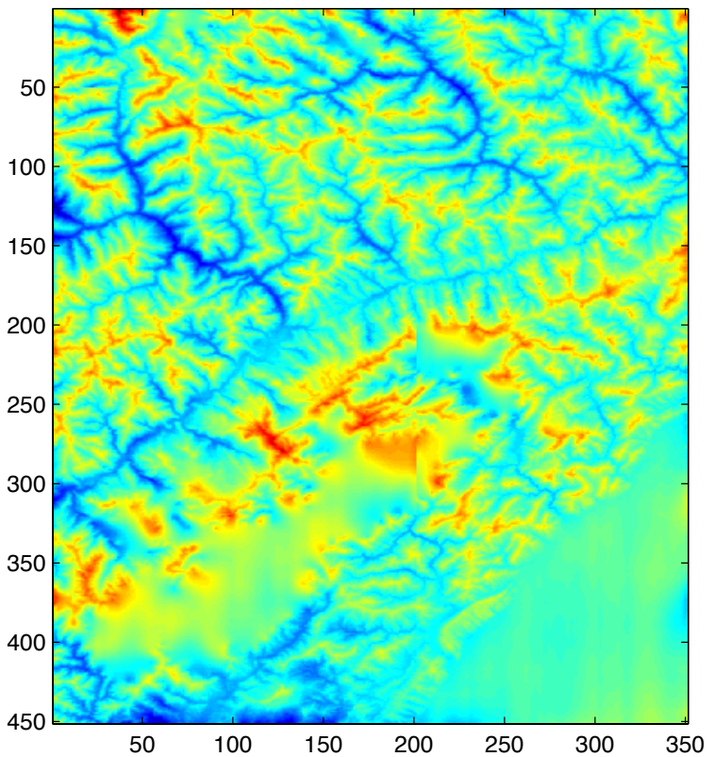

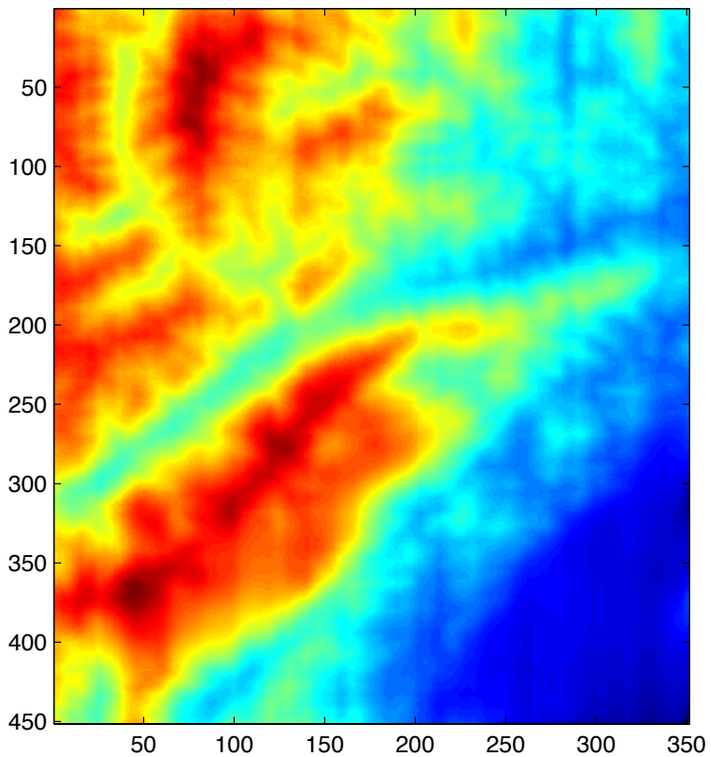

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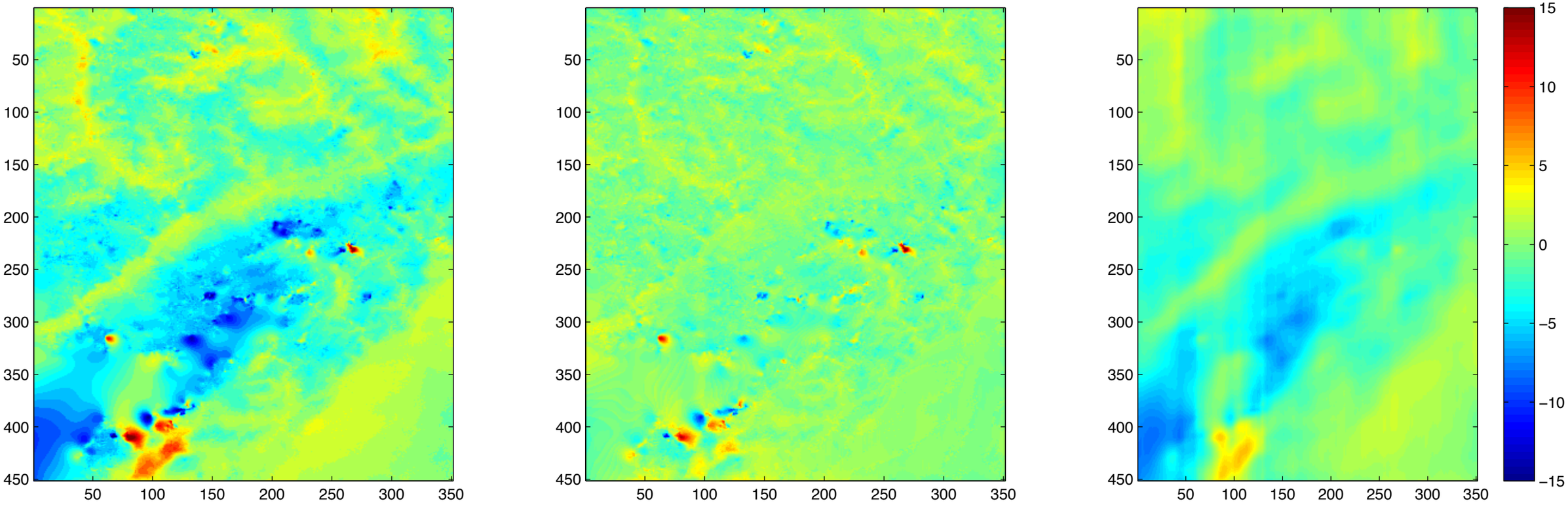

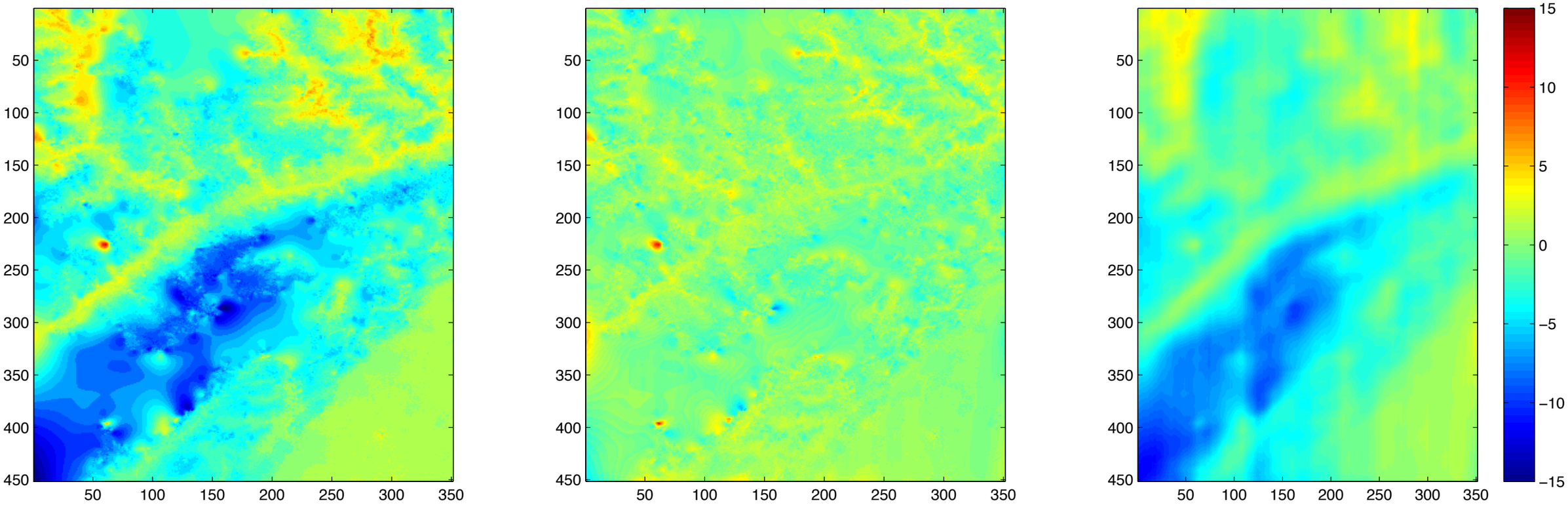

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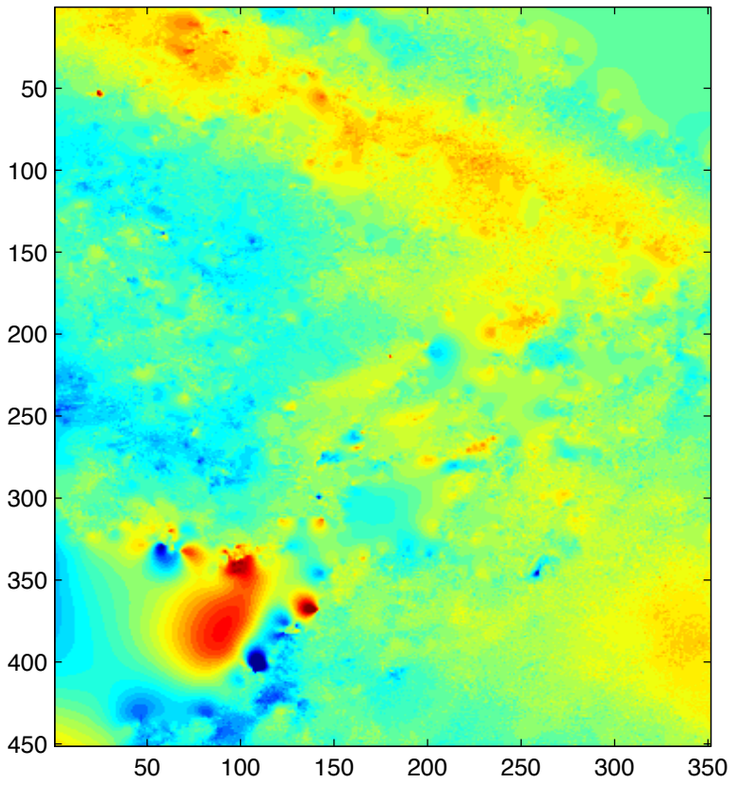

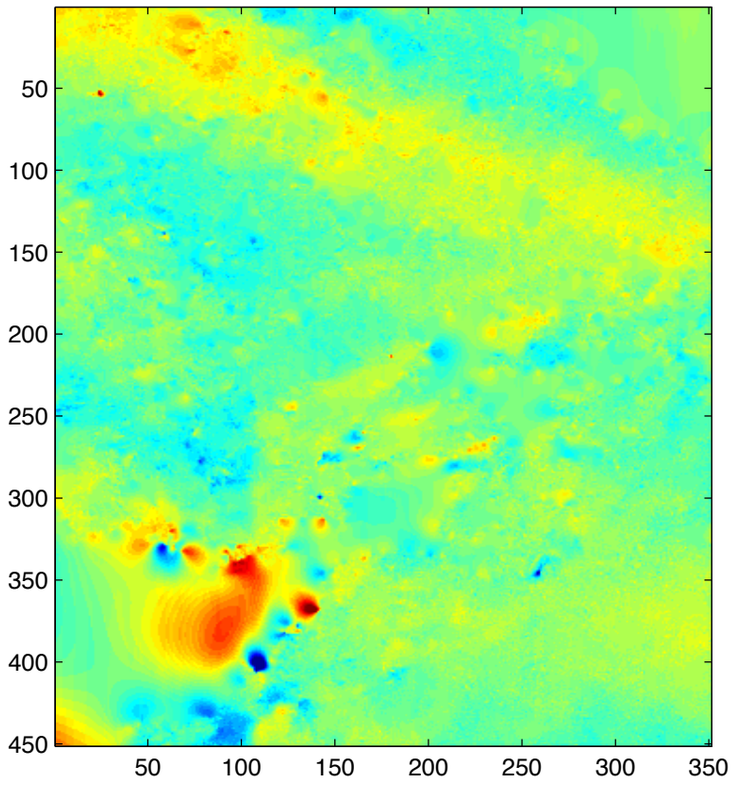

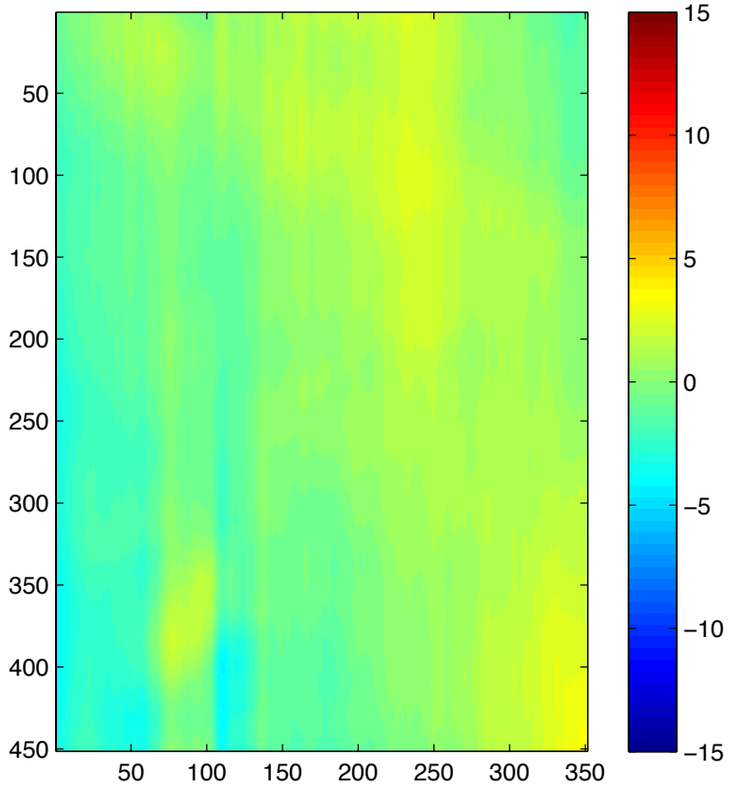

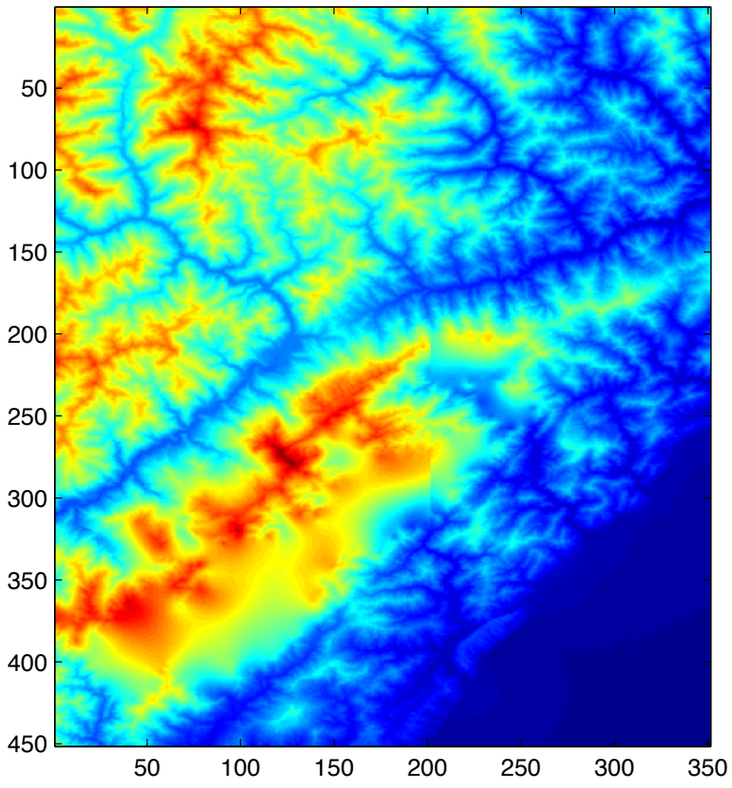

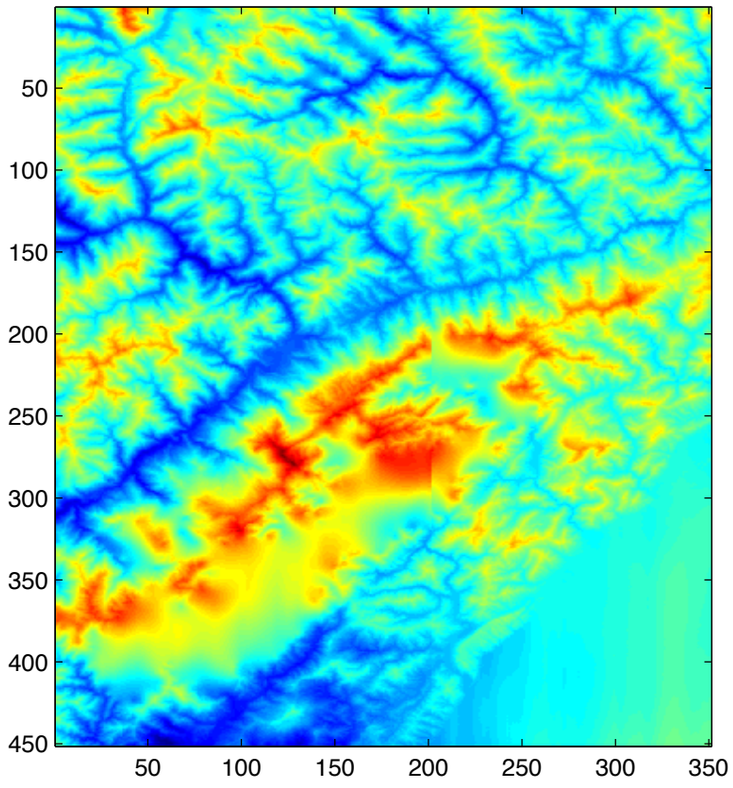

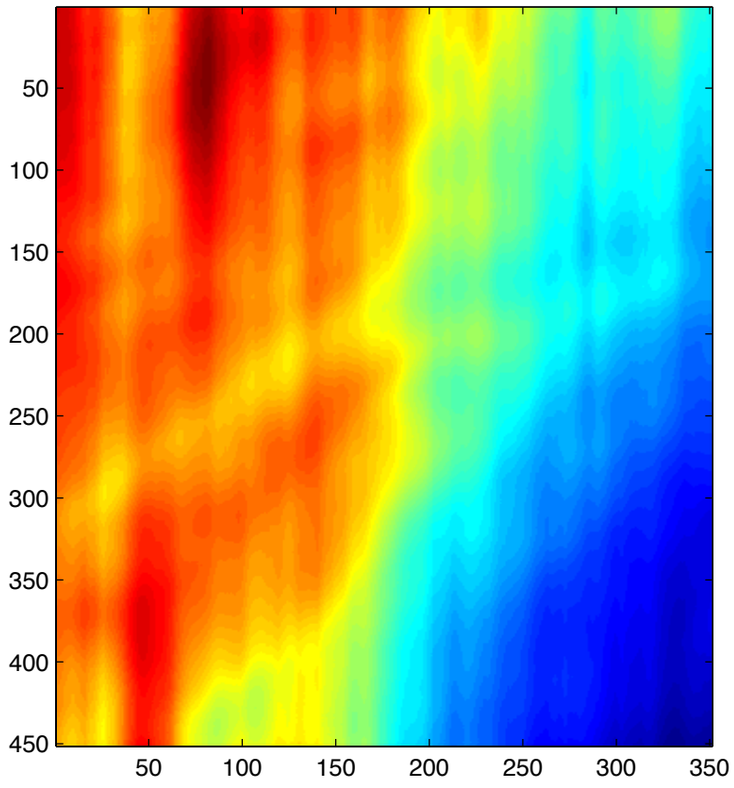

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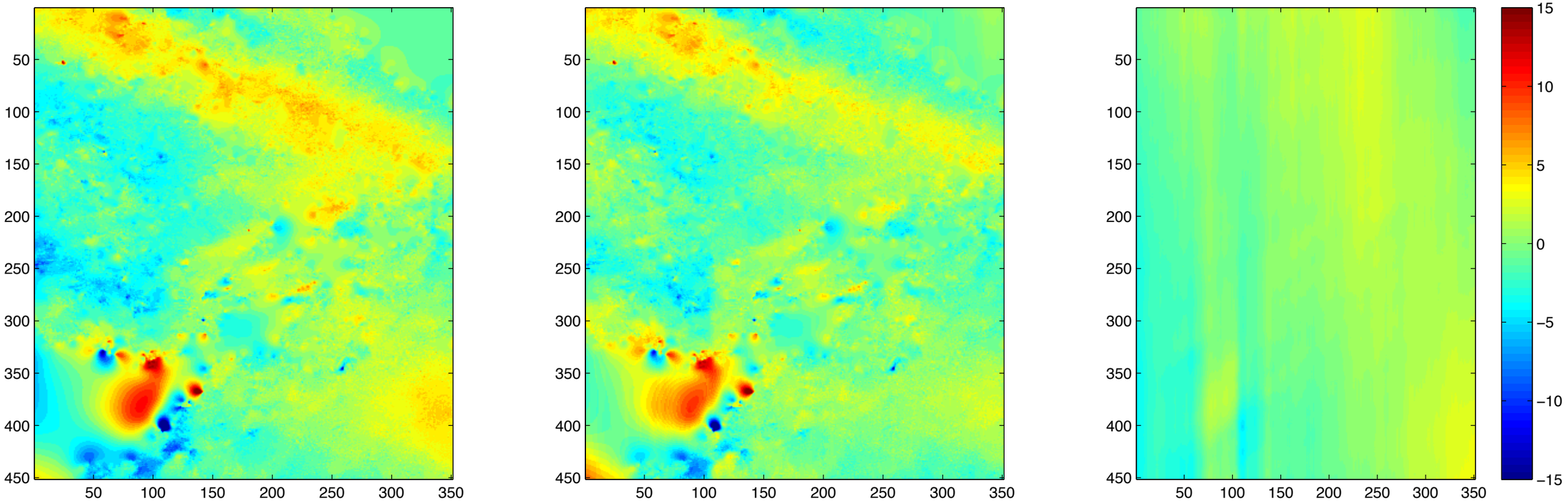
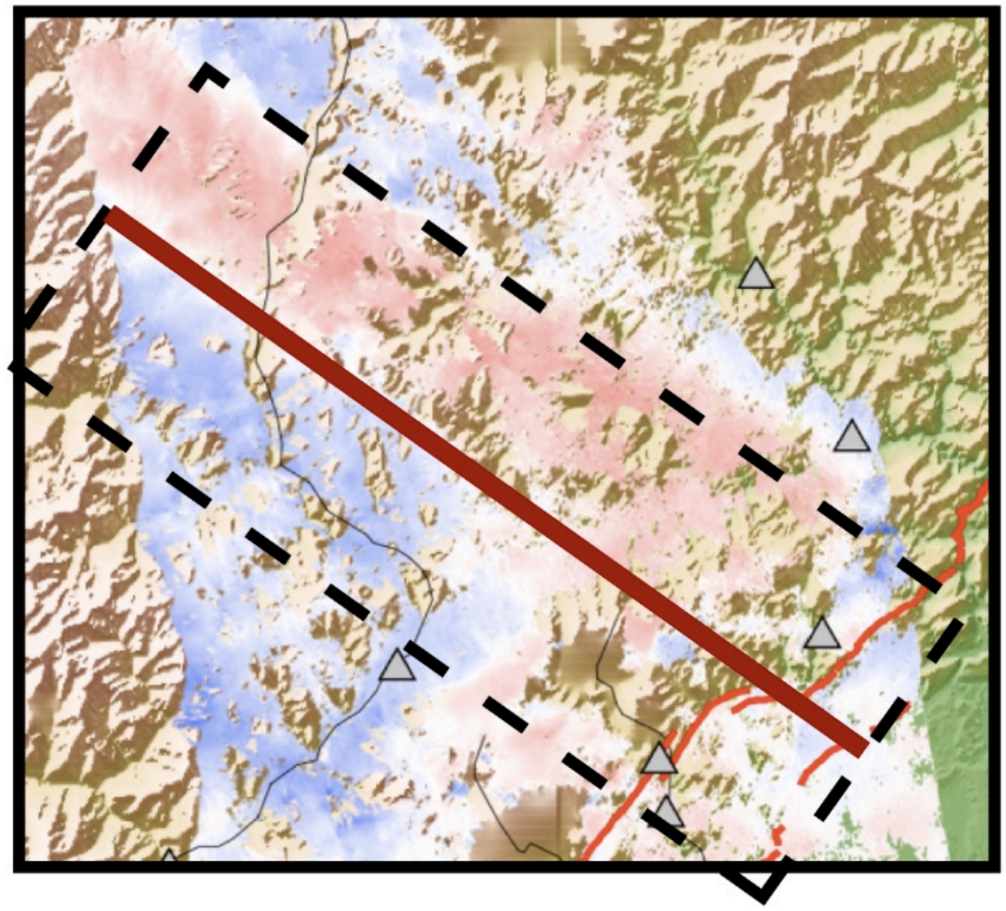


Another Approach

average SRD

modeled SRD

GPS in LOS



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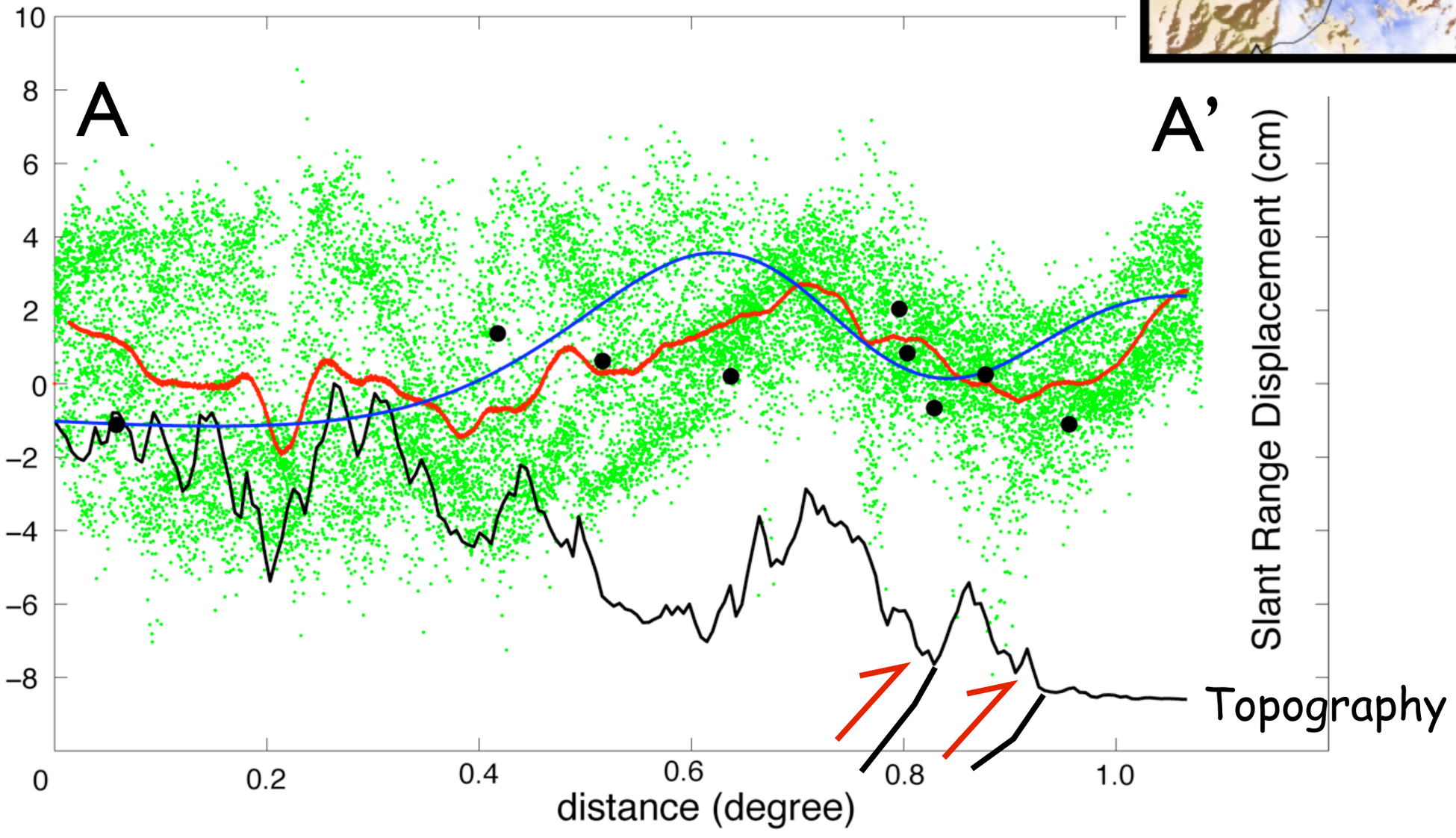

103˚
104˚
34˚
33˚
32˚
31˚
080519-110110
10
0
−10
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Slant Range Displacement (cm)
−20 −18 −16 −14 −12 −10 −8 −6 −4 −2 0 2 4 6 8 10 12