ESA - MOST Dragon 2 Programme

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"龙计划"二期2011年学术研讨会

Dragon-II Project 5305

SEISMOLOGY

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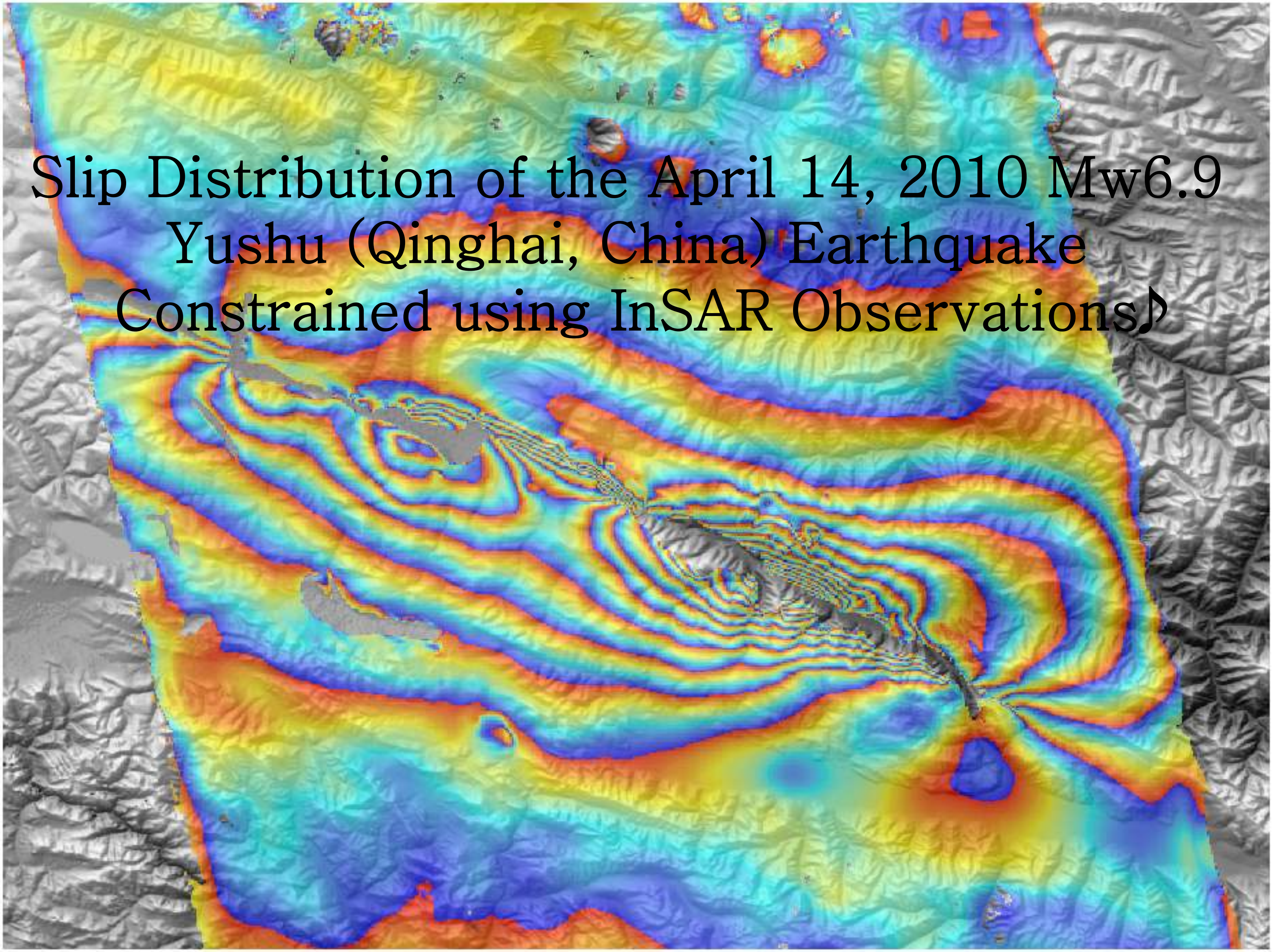
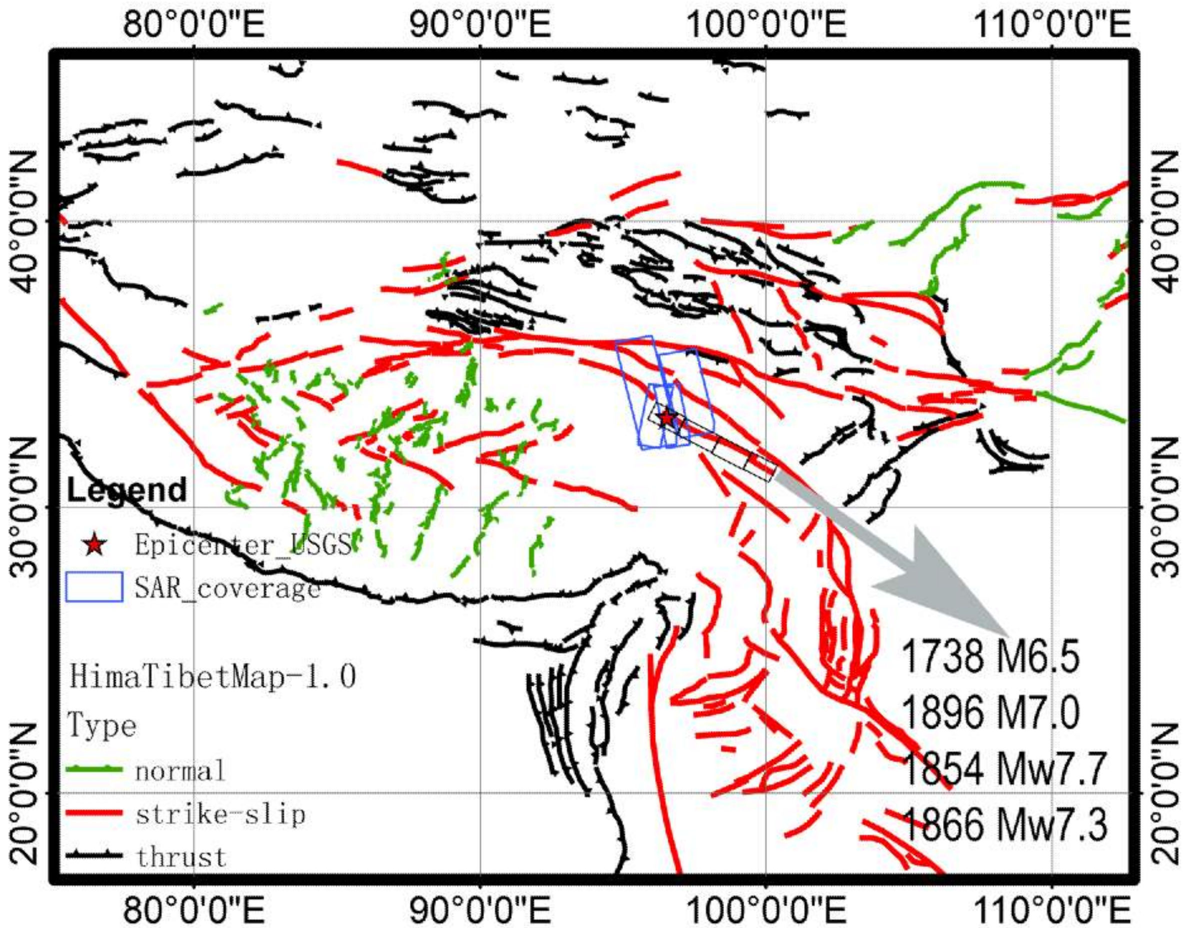
捷克 布拉格 2011年6月20-24日


Slip Distribution of the April 14, 2010 Mw6.9
Yushu (Qinghai, China) Earthquake
Constrained using InSAR Observations♪

Outline of the report♪

1.Introduction and tectonic settings♪
2.Field observations and GPS work♪
3.InSAR data and processing♪
4.First round of coseismic deformation inversion ♪
5.Second round of coseismic deformation inversion♪
6.Conclusions♪

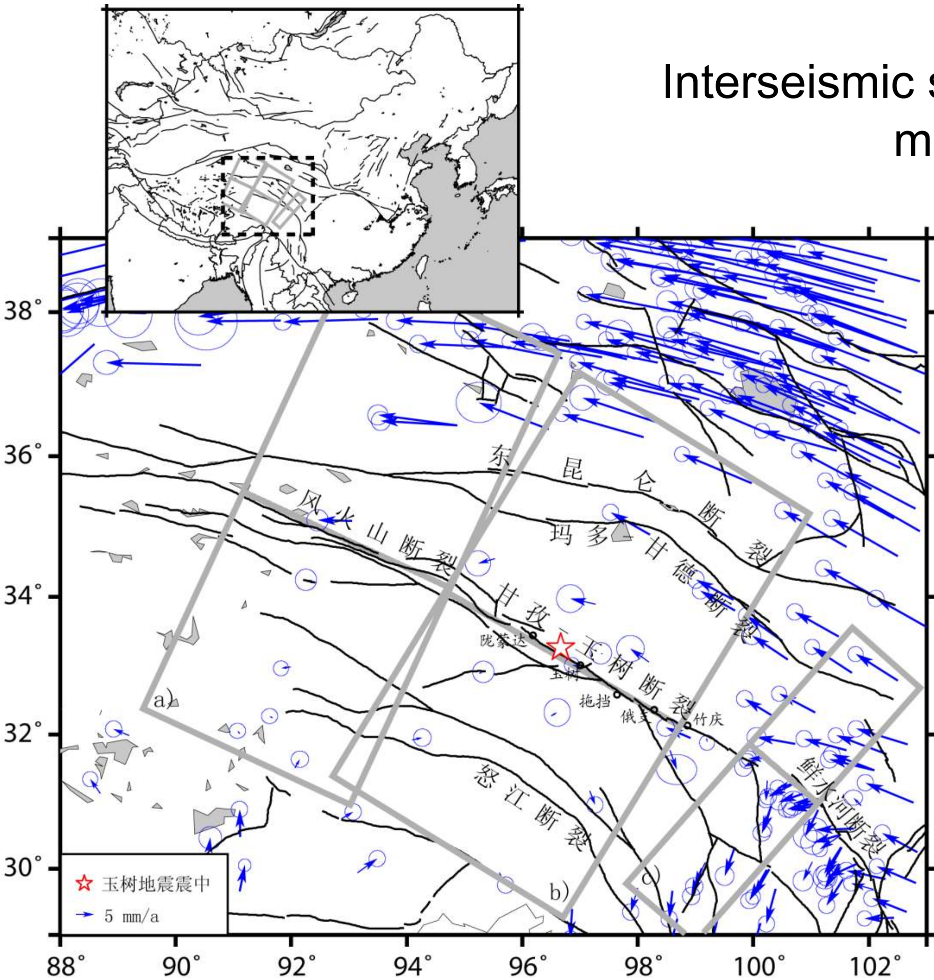
1.Introduction and tectonic settings♪



The four black rectangles in the inset map denote the approximated rupture locations of four large historic earthquakes along the Ganzi-Yushu fault.

The blue polygons show the SAR data ground coverage of this study.

Interseismic slip rate of the Ganzi-Yushu fault from a more complete GPS coverage

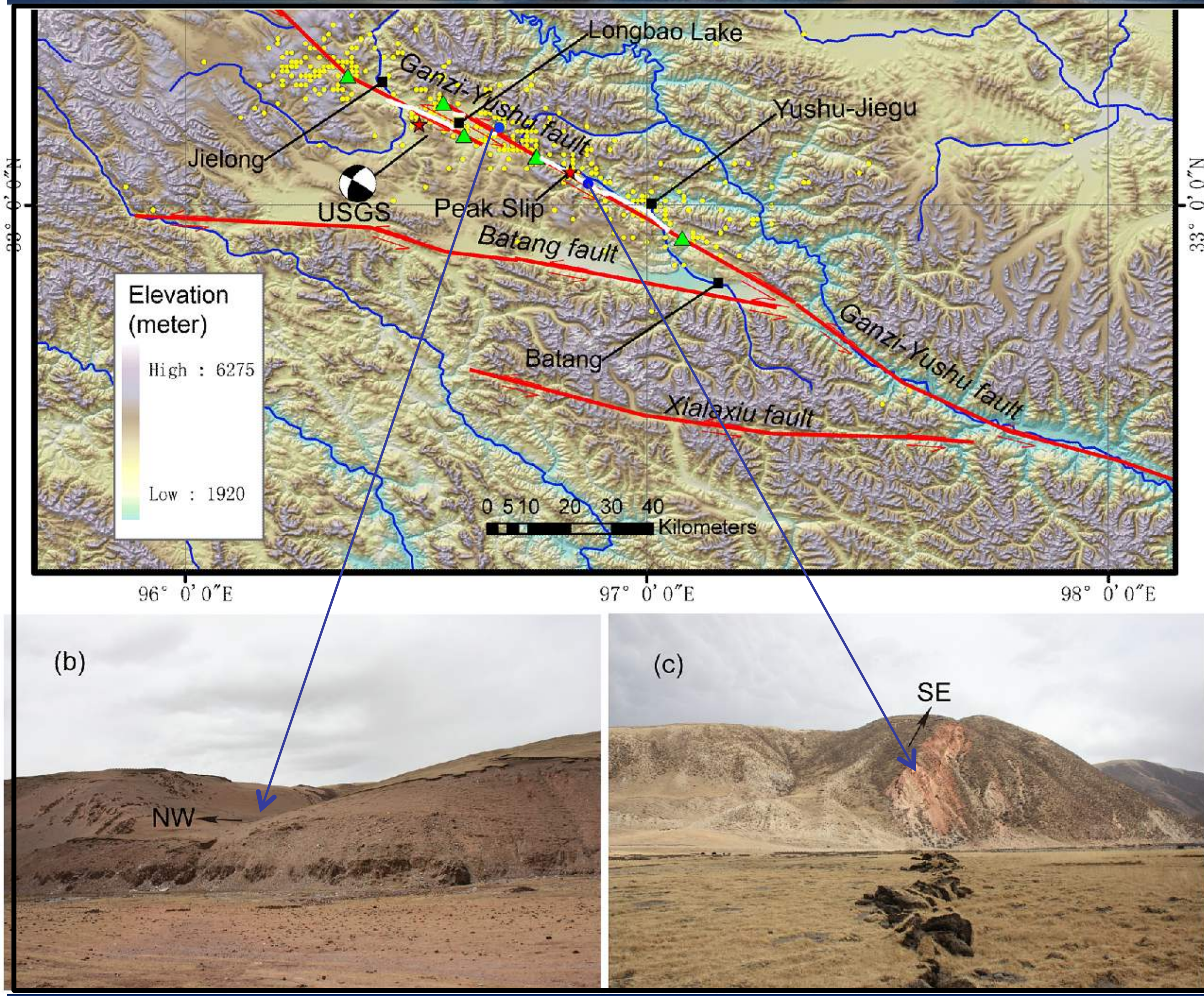


Wang Y. et. al, 2010 in review

Using regional GPS data Thatcher (2007) developed a block motion model which yielded ~7 mm/yr left slip and ~8 mm/yr extension across this section of the Ganzi-Yushu fault.

A similar study by Meade [2007] placed 9-12 mm/yr left slip and 10-15 mm/yr extension across this segment of block boundary.

A recent study using a more complete GPS dataset yielded an estimate of ~7mm/yr left slip and ~2 mm/yr shortening across this section of the Ganzi-Yushu fault [Y Z Wang et al., 2010], which is a bit slower than the slip rate of the Xianshuihe segment.



2. Field measurements ♪ and GPS work♪

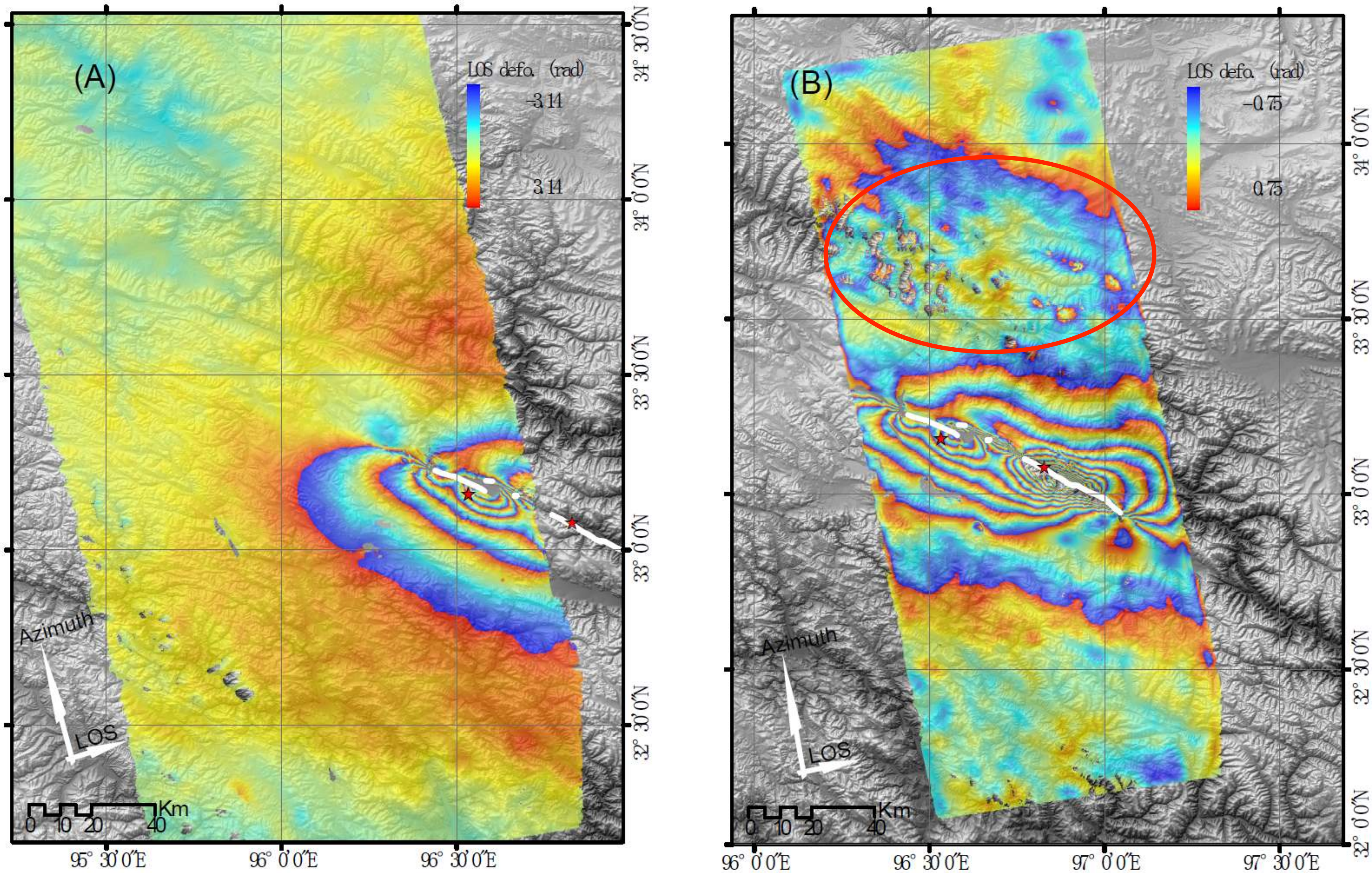
Fault scarp photos from field investigation at the west and east blue point respectively

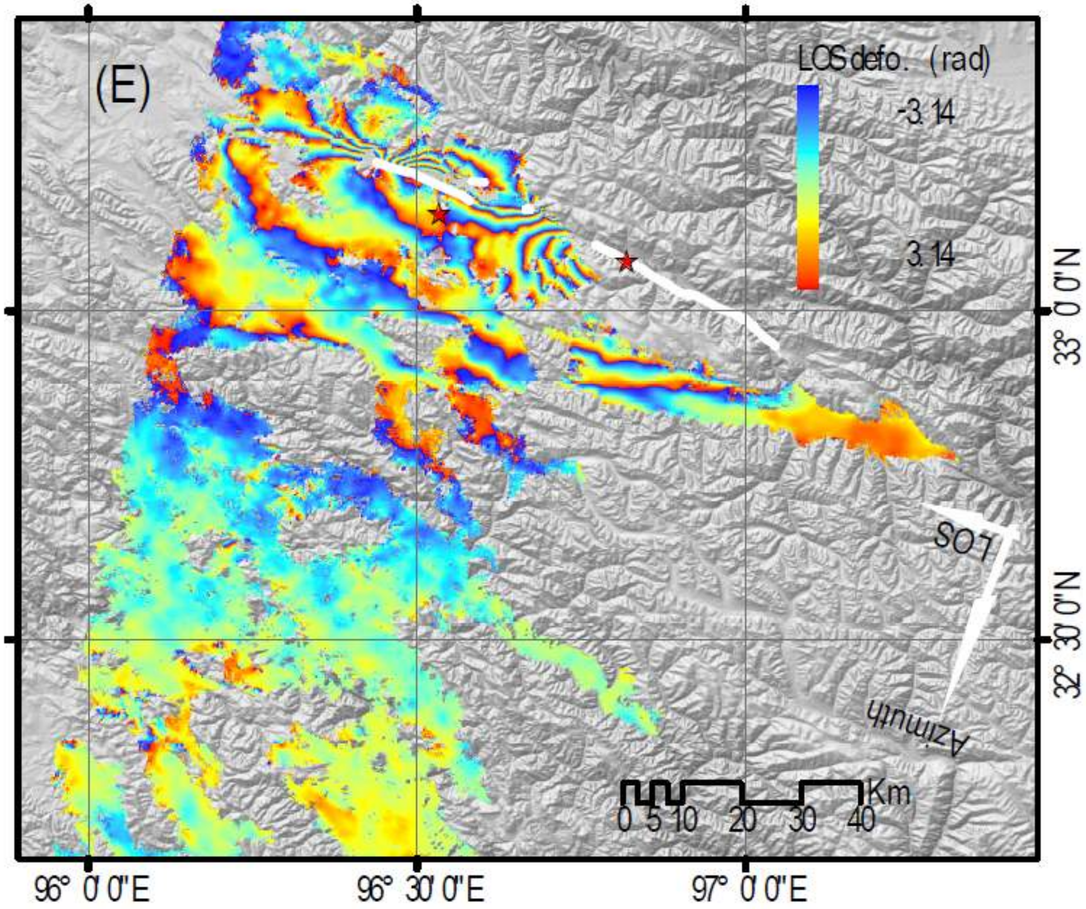
NRSCC esa

New GPS stations Installed after two weeks of the quake.

3. InSAR data and processing♪

Data source and mode	Master image date	Slave image date	Path or track [#]	Frame number	Perpendicular baseline (m)	Data quality (Figure No.)
PALSAR FBS	Jan. 15, 2010	April 17, 2010	487A[#]	640~660	~682.6	High coherence (Figure 2B)
PALSAR FBS	Nov. 28, 2008	April 18, 2010	138D[#]	2940~2960	~3410.9	Low coherence (Figure S2)
PALSAR WS	Dec 18, 2009	May 5, 2010	139D[#]	2950	~1193.0	
PALSAR WS	May 4, 2008	May 10, 2010	142D[#]	2950	~788.0	
Envisat ASAR IS2	Feb. 15, 2010	April 26, 2010	498A[#]	32.0° - 34.5°N[*]	~12.5	High coherence ((Figure 2A))
Envisat ASAR IS2	Jan. 8, 2010	April 23, 2010	455A[#]	32.5° - 35.5°N[*]	~571.8	Low coherence (Figure S1)
Envisat ASAR IS2	Nov. 3, 2009	June 1, 2010	004D[#]	32.0° - 34.5°N[*]	~165.0	Moderate coherence (Figure 2E)
Envisat ASAR IS2	Nov. 3, 2009	April 27, 2010	004D[#]			Data problem

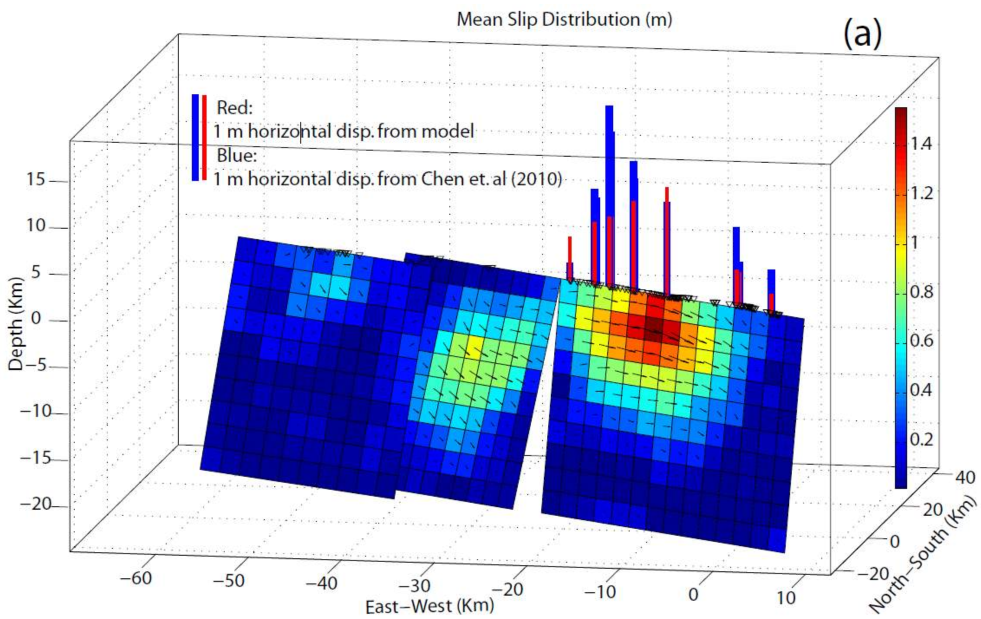

(A)
LOS defo. (rad)
-3.14
3.14
Azimuth
LOS
0 10 20 40 Km
95° 30′0″E
96° 0′0″E
96° 30′0″E
34° 30′0″N
34° 0′0″N
33° 30′0″N
33° 0′0″N
32° 30′0″N
(B)
LOS defo. (rad)
-0.75
0.75
Azimuth
LOS
0 10 20 40 Km
96° 0′0″E
96° 30′0″E
97° 0′0″E
97° 30′0″E
34° 0′0″N
33° 30′0″N
33° 0′0″N
32° 30′0″N
32° 0′0″N



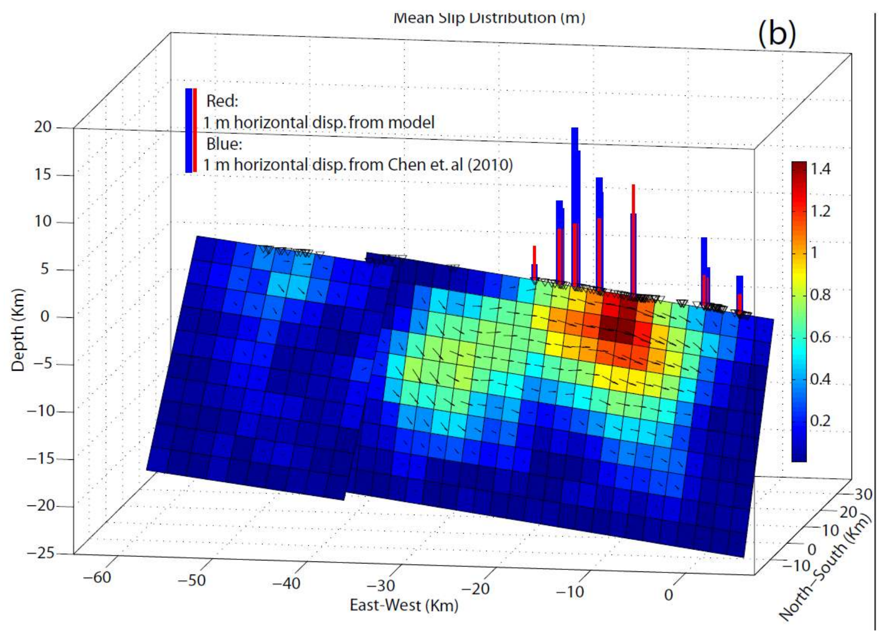
Interferogram in descending pass

This C-band data has a baseline of ~165.0m, and temporal baseline of <8 months. The result indicates the performance of the C-band data in this high-elevation area. We use this data because it's the only descending acquisition

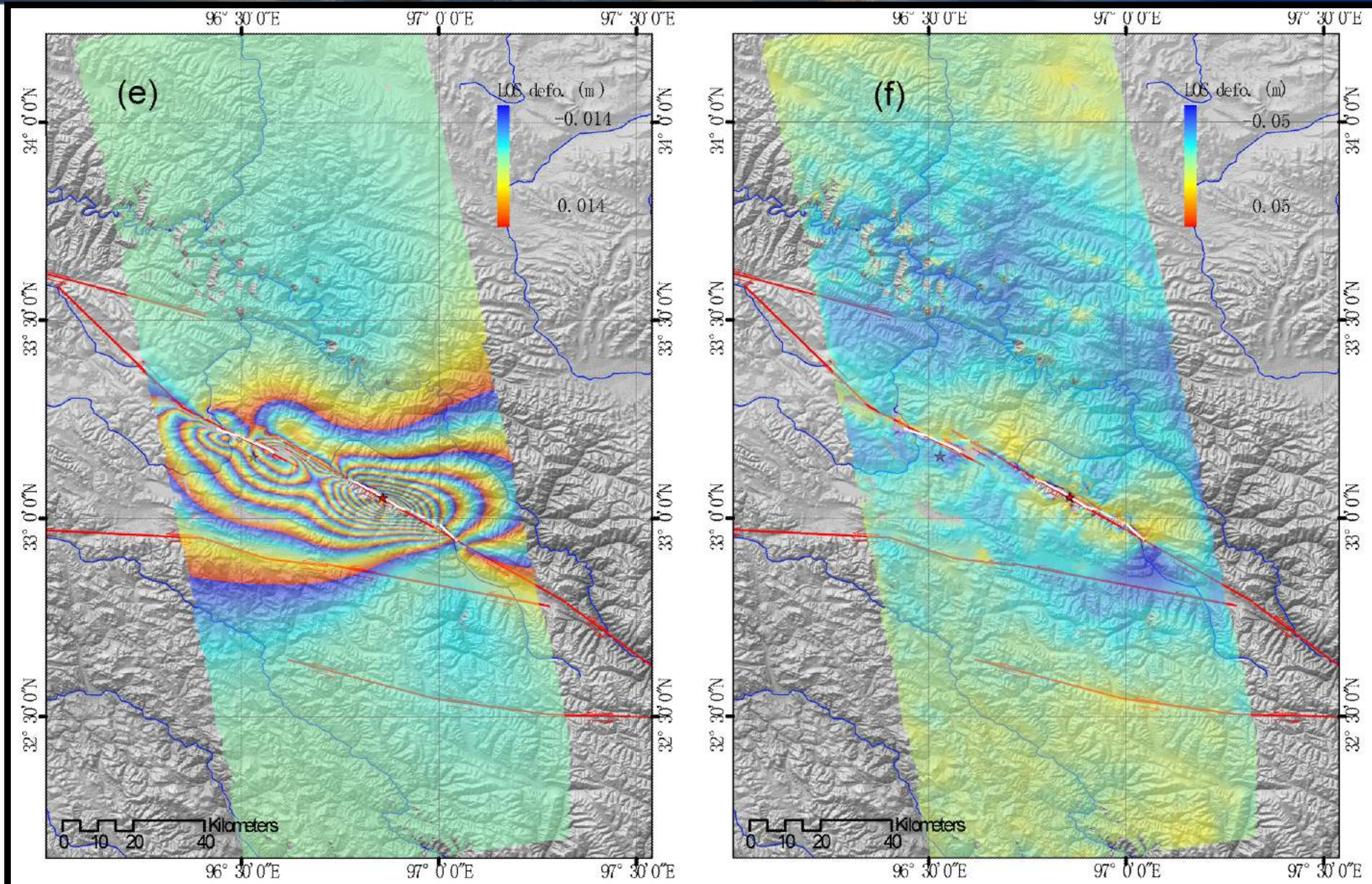
4. First round of coseismic deformation inversion ♪

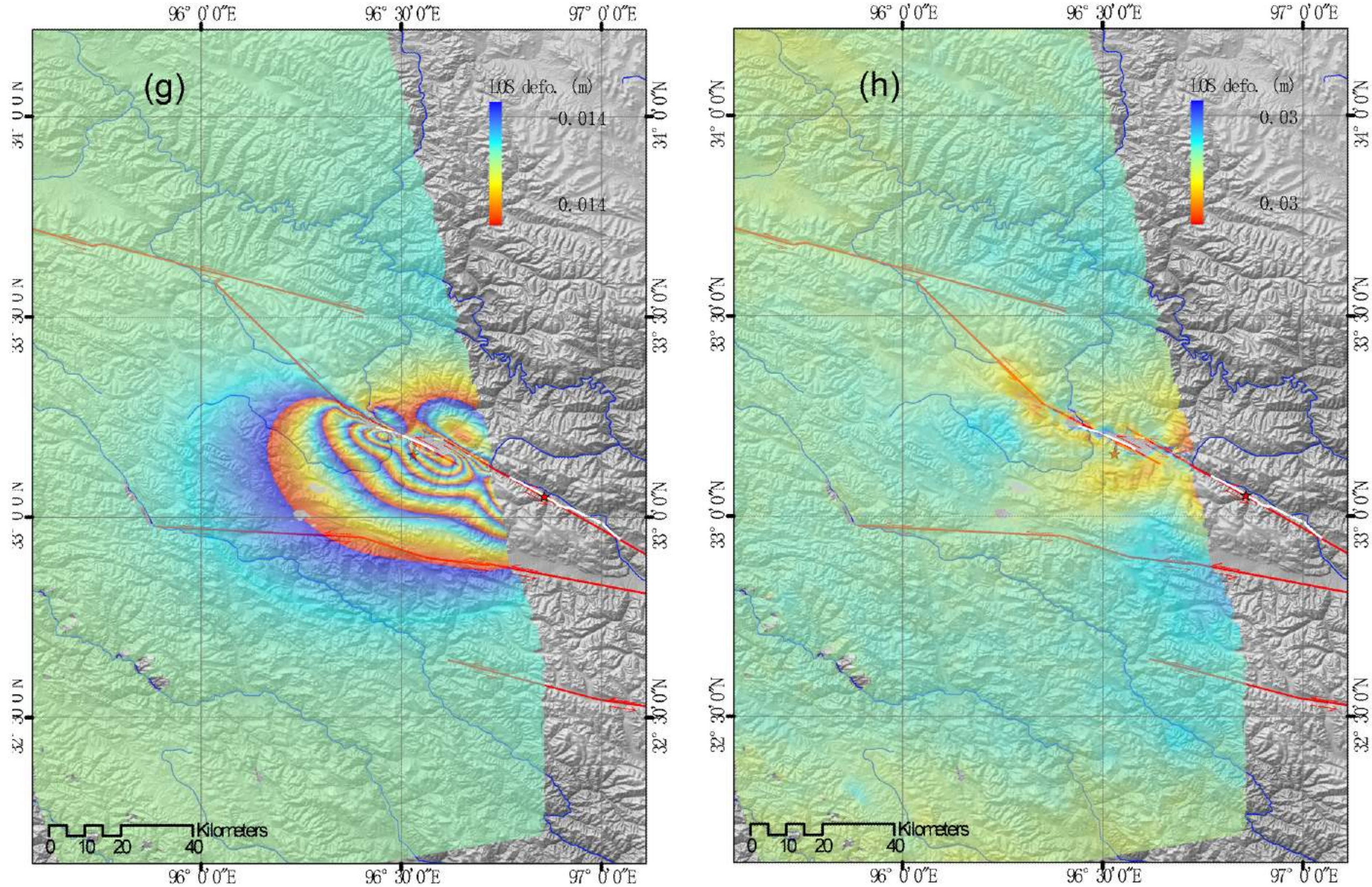


3-segment model

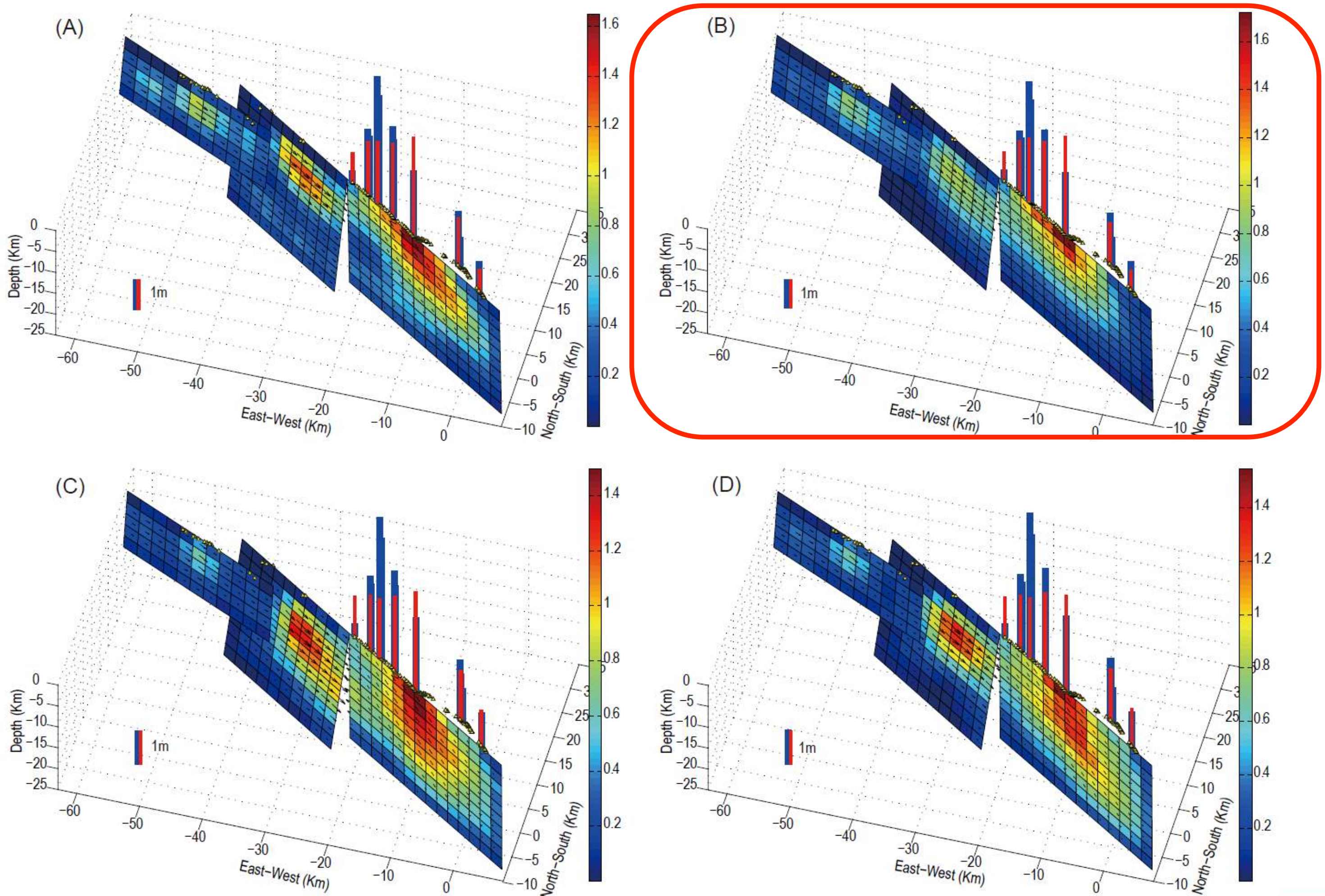


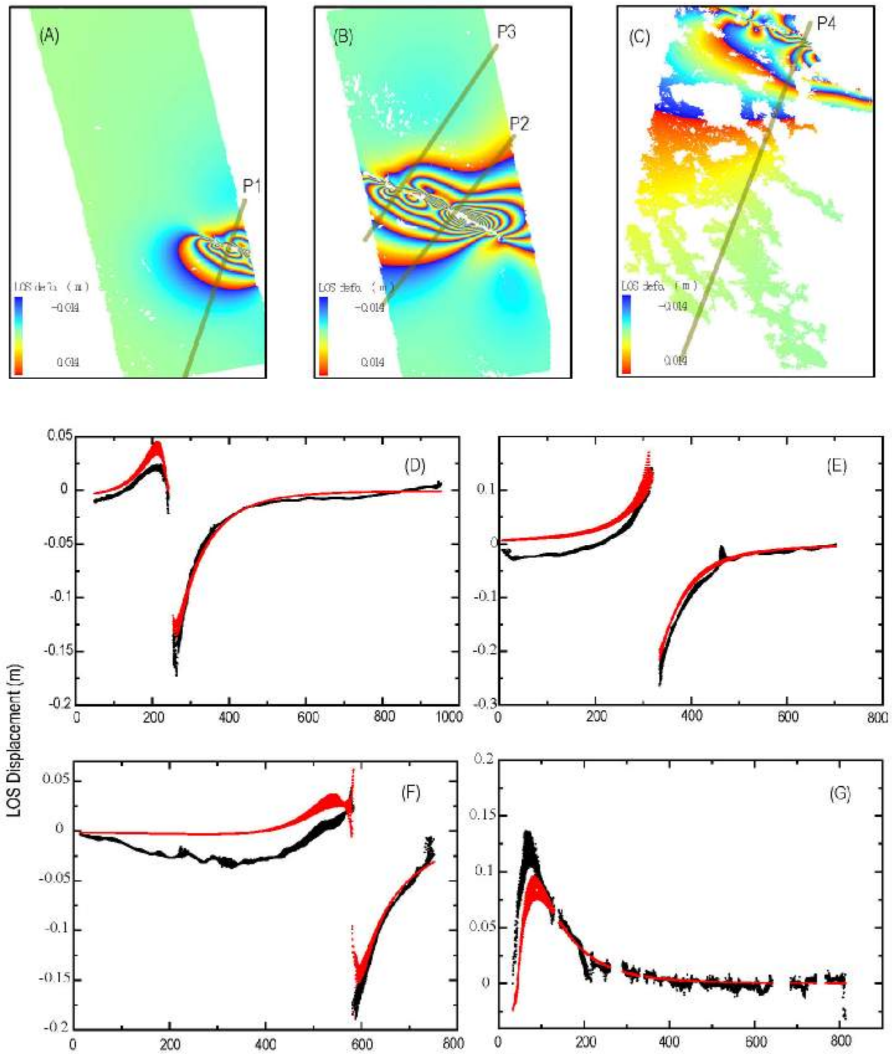
2-segment model


(e)
LOS defo. (m)
-0.014
0.014
(f)
LOS defo. (m)
-0.05
0.05
96° 30′0″E
97° 0′0″E
97° 30′0″E
34° 0′0″N
33° 30′0″N
33° 0′0″N
32° 30′0″N
Kilometers
0 10 20 40

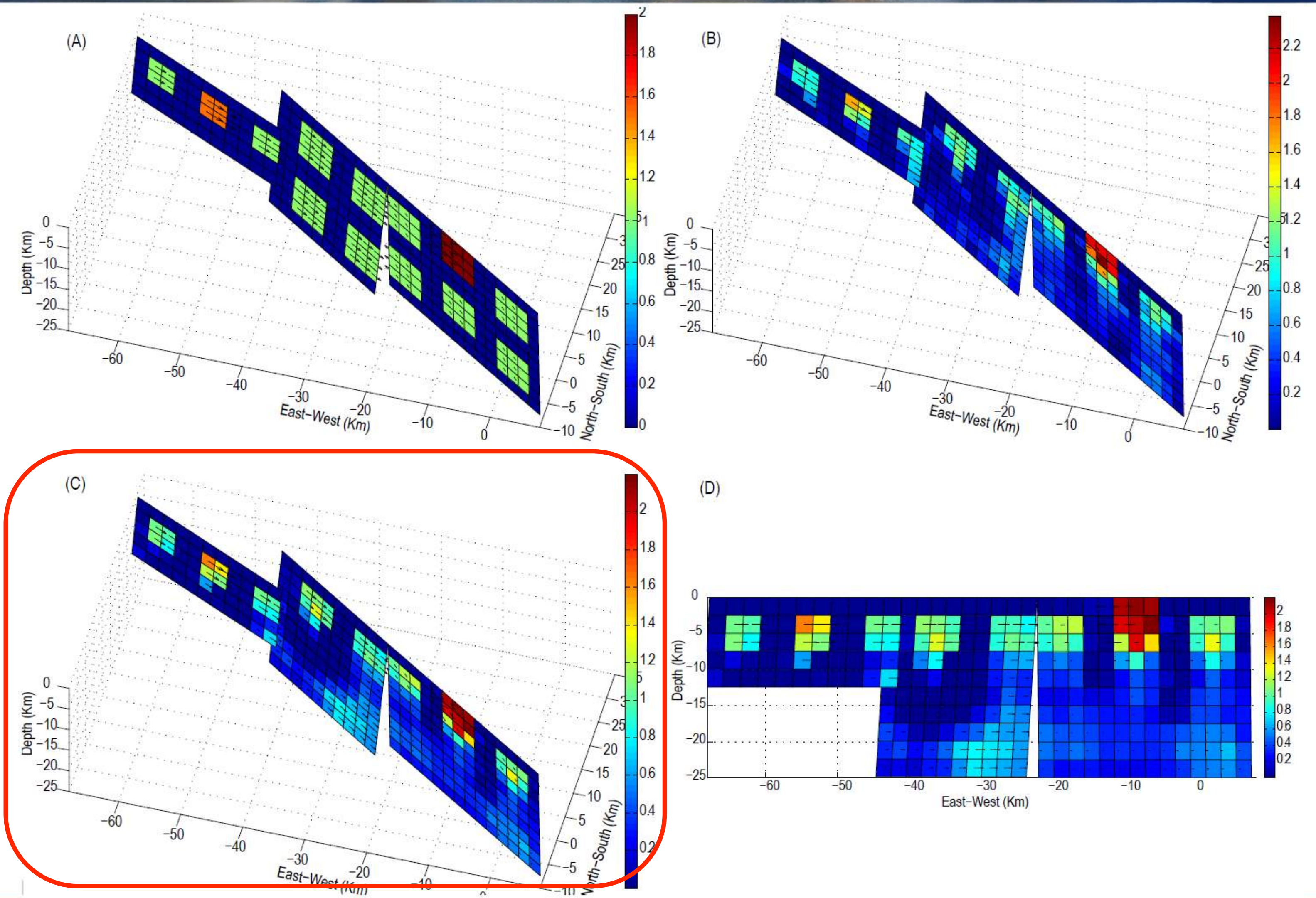

(g)
LOS defo. (m)
-0.014
0.014
Kilometers
0 10 20 40
96° 0'0"E
96° 30'0"E
97° 0'0"E
34° 0'0"N
33° 30'0"N
33° 0'0"N
32° 30'0"N
(h)
LOS defo. (m)
0.03
0.03

5. Second round of coseismic deformation inversion♪





Profiles across the fault. (a), (b) and (c) are the forward modeling results on track 498A, path 487A and track 004D respectively. The 4 profile P1, P2, P3, and P4 are plotted in (d), (e), (f) and (g) in red color with the corresponding observations in black color respectively. Note the profiles are plotted from the north to the south.


(A)
(B)
(C)
(D)
Depth (Km)
East-West (Km)
North-South (Km)

6. Conclusions♪

From the final results of the InSAR data inversion, we conclude that: 1) The Yushu earthquake is a nearly pure left-lateral strike-slip event with the rupture extending ~67 km. 2) The fault is composed of 3 segments. The eastern segment bears the main rupture reaching the surface and in proximity to the greatest earthquake damage area in Yushu County. The middle segment has a smaller slip peak at 5~10 km depth and is completely blind. The western rupture segment is offset to the south across the 4.5-km wide Longbao Lake pull-apart basin. 3) The maximum slip is ~1.72 m appearing on the eastern segment near the surface and most of the slip occurred within 15 km depth. 4) The total seismic moment released is estimated as 2.23e+19 Nm, which is consistent with the USGS seismic estimate of 2.50e+19 Nm.

Thanks for your attention!