

PALSAR ScanSAR 干渉による 地殻変動抽出

Extraction of crustal movement using PALSAR ScanSAR interferometry

○宮脇 正典, 山口 志野(NEC 航空宇宙システム), 木村 恒一(NEC)

OM.Miyawaki, S.Yamaguchi (NEC Aerospace Systems), T.Kimura (NEC)

Sep.8 2009

京都大学防災研究所拠点形成研究集会
「高分解能レーダー・リモートセンシングによる災害観測の革新」

Contents

1. Comparison of stripmap-mode and ScanSAR-mode
2. Processing flow of ScanSAR-ScanSAR interferometry
3. Analysis result of ScanSAR-ScanSAR interferometry on 2008 China Sichuan Earthquake
4. Conclusions
5. Future work

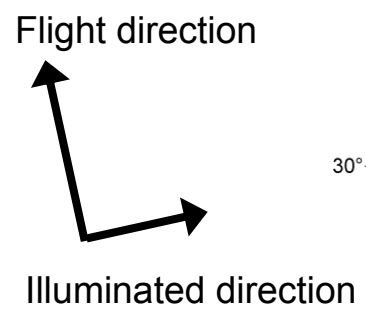
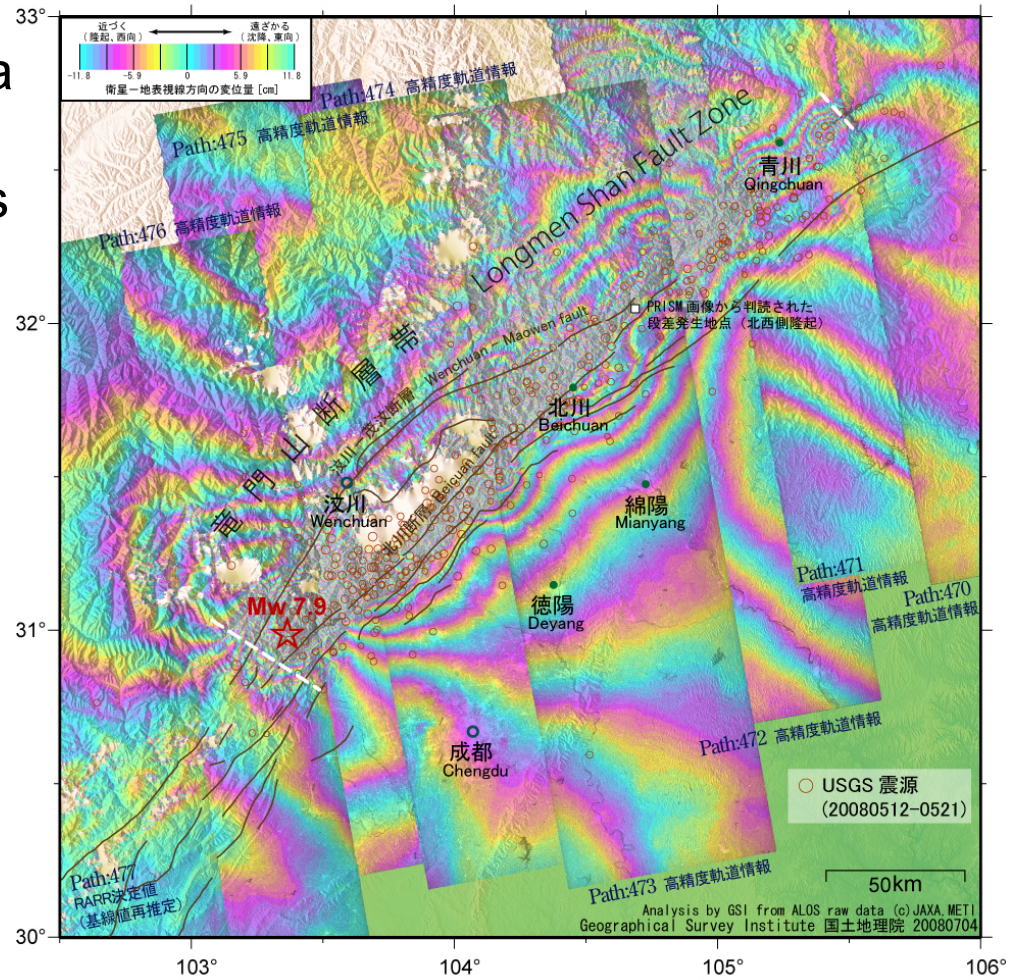
Comparison of stripmap-mode and ScanSAR-mode

Mode	Stripmap-mode	ScanSAR-mode
Swath	40~70km	250~350km
Resolution	10m	100m
Strong point	<ul style="list-style-type: none">➤High resolution➤High signal to noise ratio➤Suitable for detection of detail crustal movement ~ within 50km swath	<ul style="list-style-type: none">➤Wide swath➤Suitable for detection of widespread crustal movement ~ over 100km swath
Weak point	<ul style="list-style-type: none">✖Narrow swath✖Wide ranging crustal movement cannot be covered by one pass data✖Phase discontinuity is caused by the difference of the observation condition in the combination of the results of two or more pass data	<ul style="list-style-type: none">✖Low resolution✖Low signal to noise ratio✖Severe the interferometric condition (Baseline condition and fitting the burst timing)

Example of Analysis result by combination of stripmap-mode data (Analysis by GSI)

Analysis by GSI from ALOS raw data
 (c) JAXA, METI
 (<http://cais.gsi.go.jp/Research/topics/topic080604/index.html>)

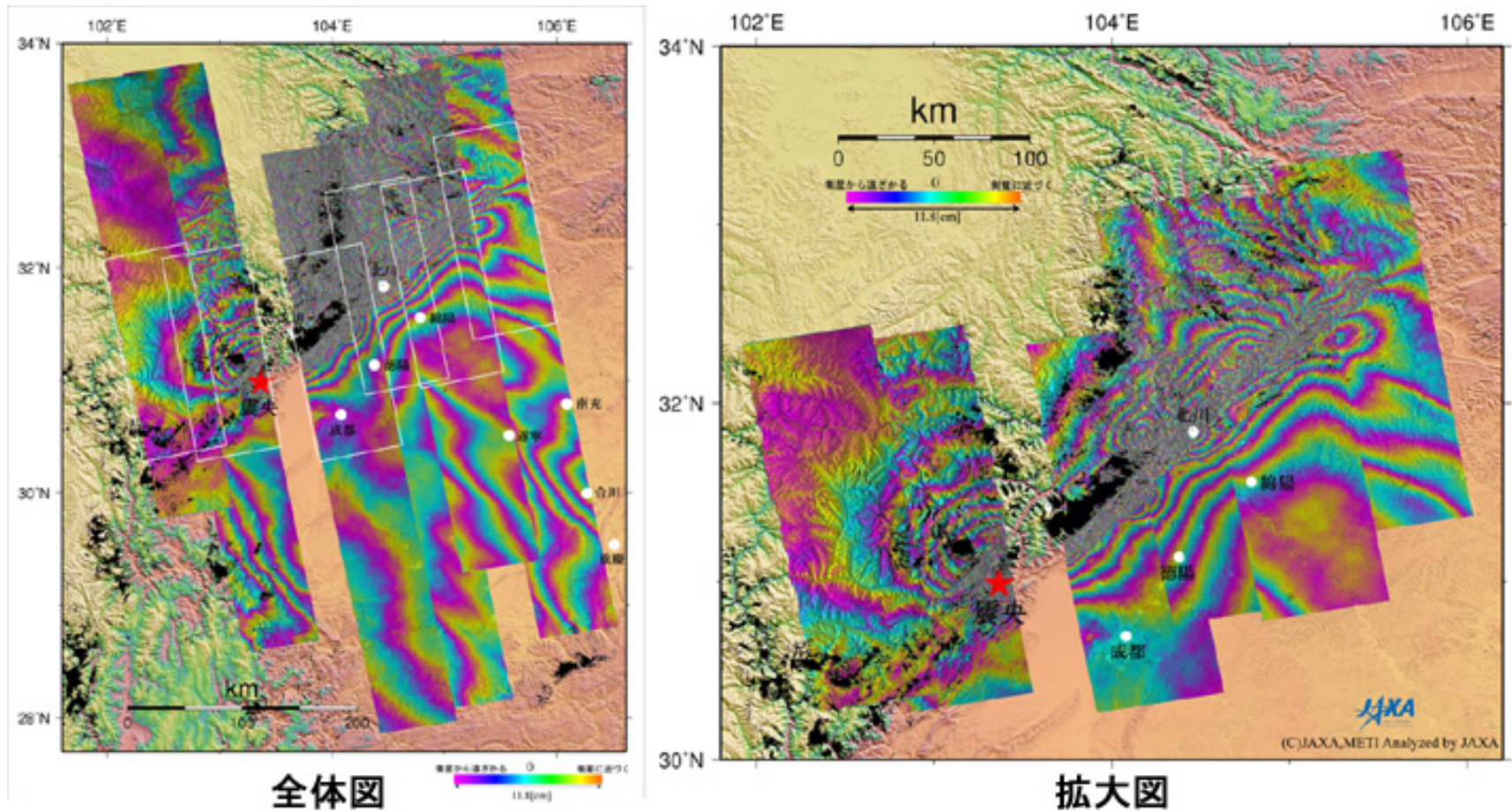
四川省の地震に伴う地殻変動 SAR 干渉画像集約図



陰影図はSRTM3-DEMを使用。
 断層トレースの出典は以下のとおり
 Densmore, A. L., M. A. Ellis, Y. Li, R. Zhou, G. S. Hancock, and N. Richardson (2007),
 Active tectonics of the Beichuan and Pengguan faults at the eastern margin of the Tibetan Plateau, *Tectonics*, 26, TC4005, doi:10.1029/2006TC001987

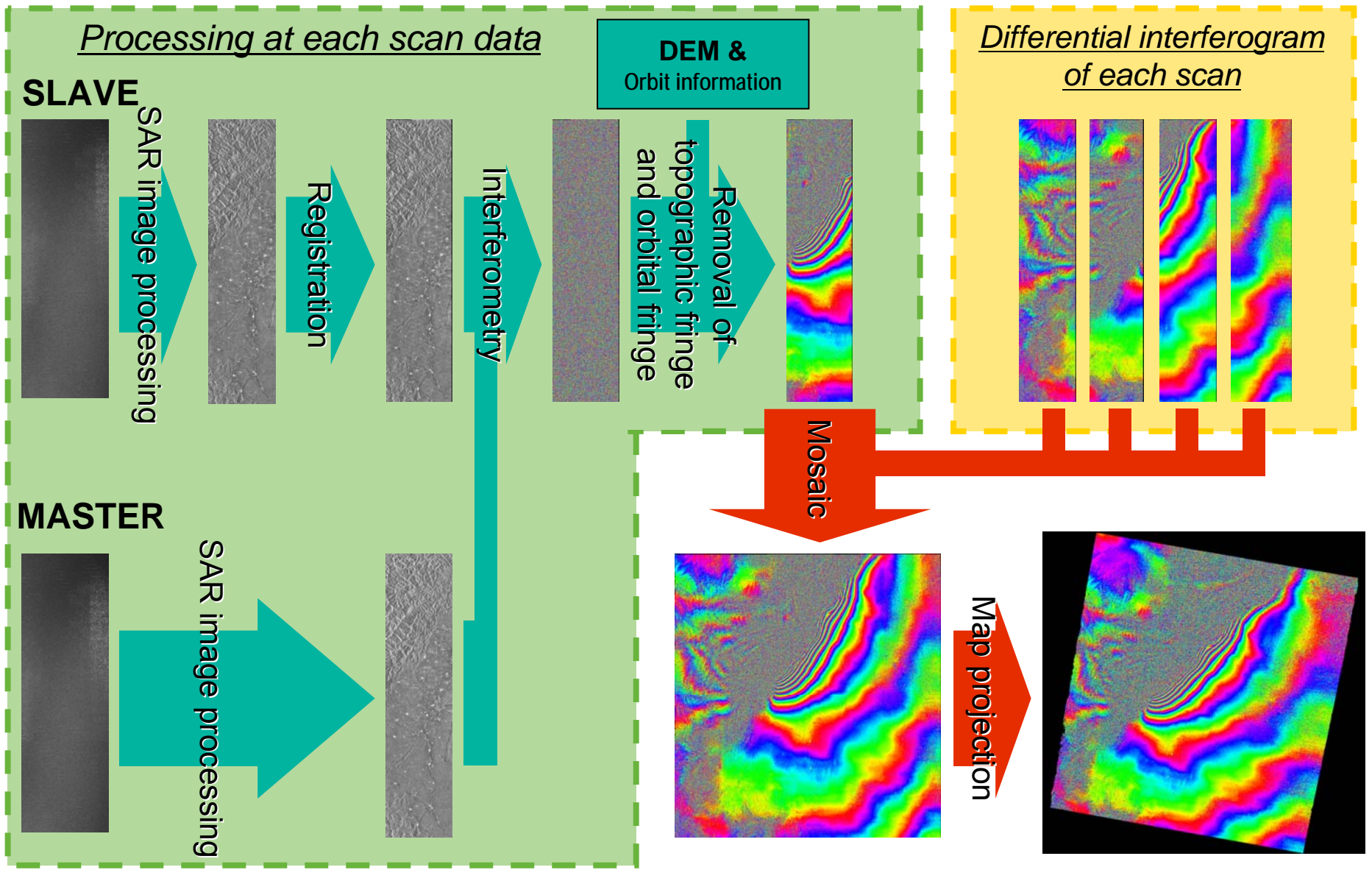
干渉画像から、震源断層両端の位置（白破線）がほぼ特定された。
 震源断層の長さは、約 285km±5km とみられる。
 地殻変動集中帯は、竜門山断層帯（龍門山断層帯）に沿っている。

Example of Analysis result by combination of stripmap-mode data (Analysis by JAXA)

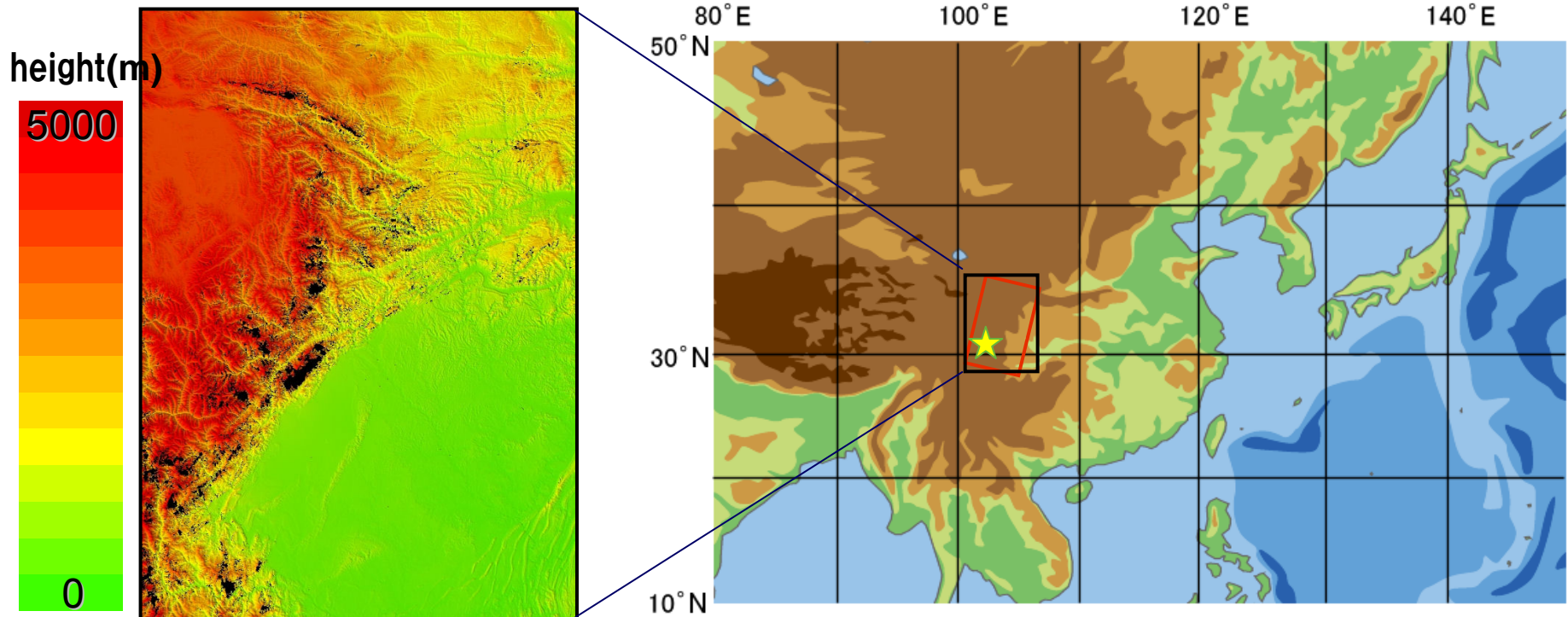


http://www.eorc.jaxa.jp/ALOS/img_up/jdis_china_eq_080618.htm

Processing flow of ScanSAR interferometry



Analysis area



□: ScanSAR Image area

□: Analysis area

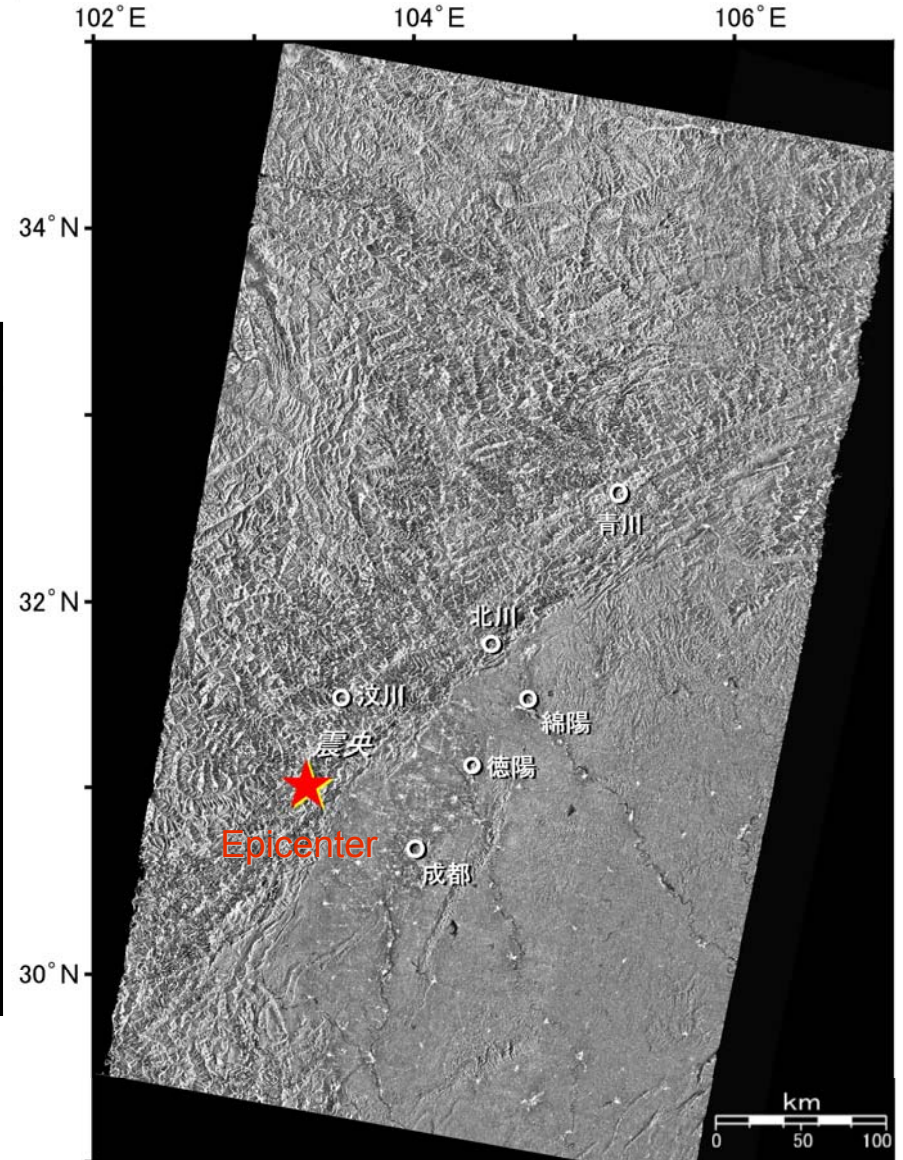
2008 China Sichuan Earthquake

Date Time	2008/5/12 6:28:01UTC
Epicenter	30.986° N, 103.364° E
Magnitude	M7.9
Kind of earthquake	Directly above its epicenter(Reverse fault)

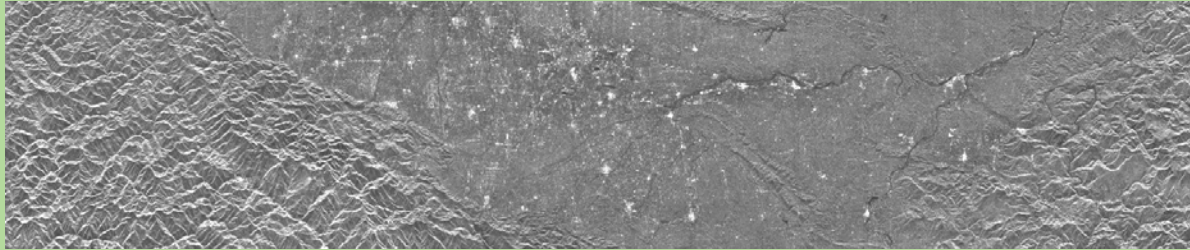
Analysis Data and Amplitude Image

Analysis Data

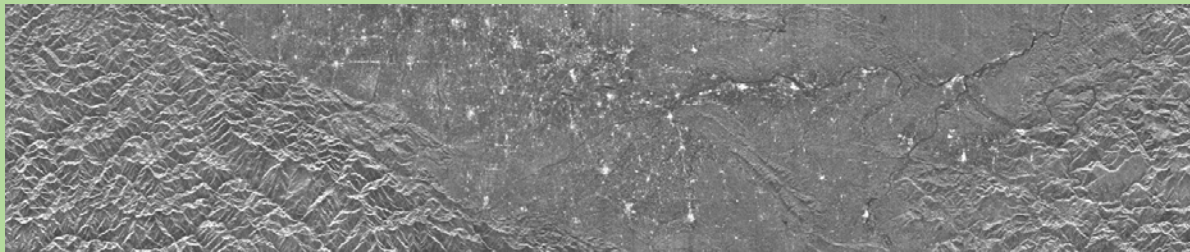
Observation mode	Scan-SAR Mode(5-scan)
Obsevation Date (UTC)	2008/01/03 (master data), 2008/05/20 (slave data)
Flight direction	Descending
Offnadia angle	20.1°, 26.1°, 30.6°, 34.1°, 36.5°
Illuminated direction	From right to left of image (east to west)
Interferometric Baseline	Bperp :477m, Bpara :440m
Scene number	2
Using DEM	SRTM 3arc-sec DEM



Example : Processing result (Scan3)



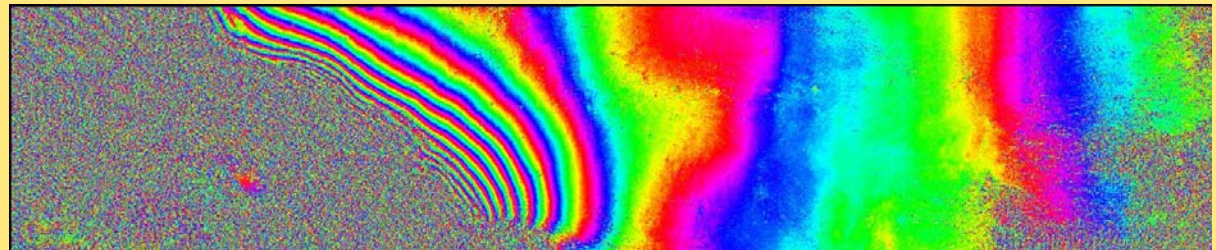
Master Image



Slave Image
(After Registration)



Interferogram



Coherence



Coherence Image

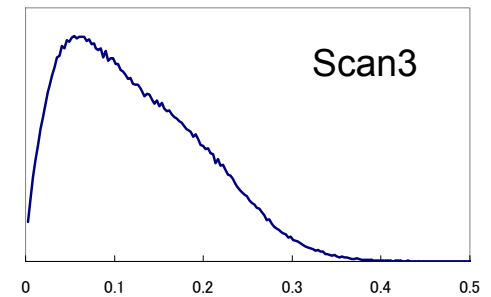
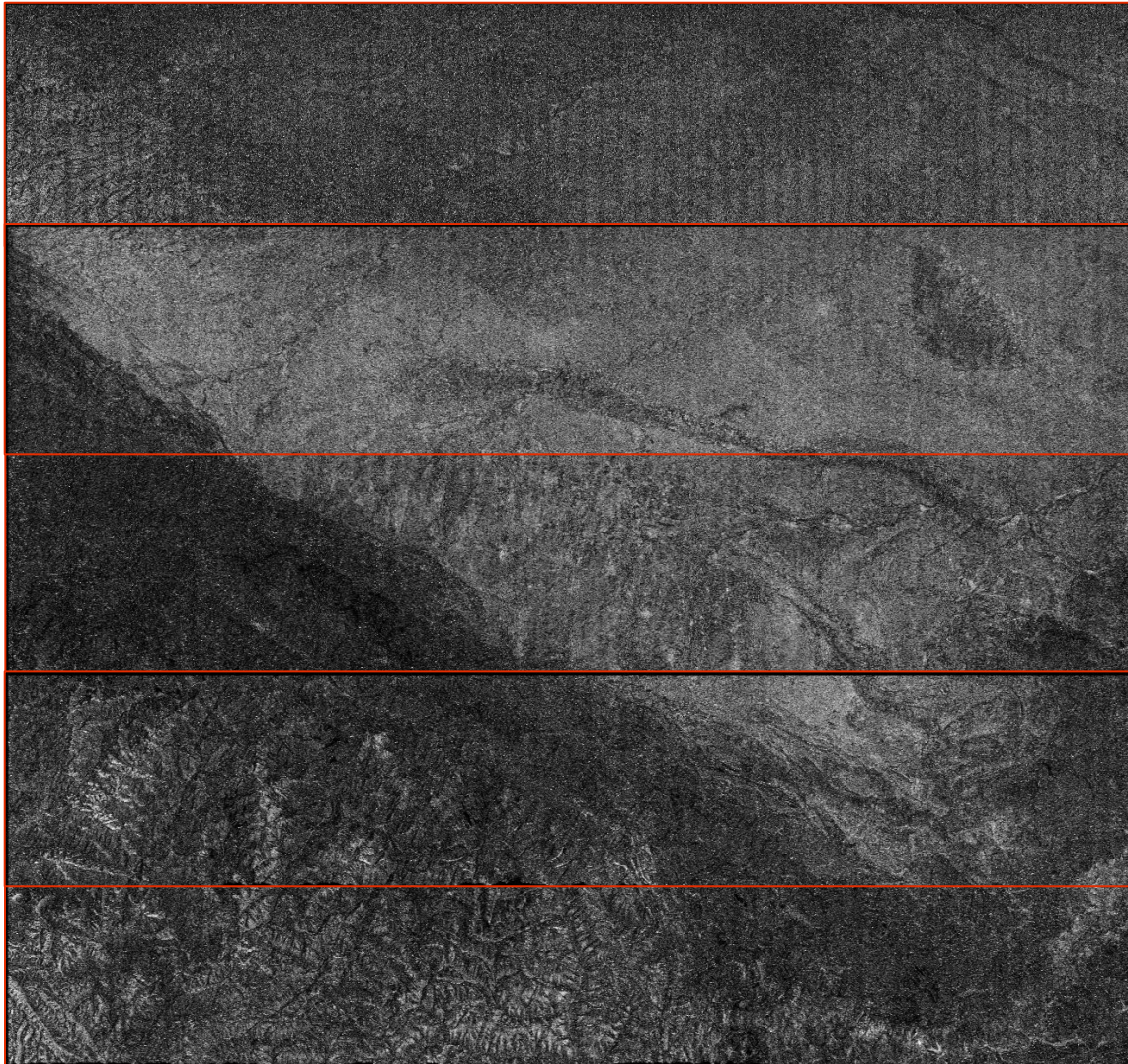
Scan1

Scan2

Scan3

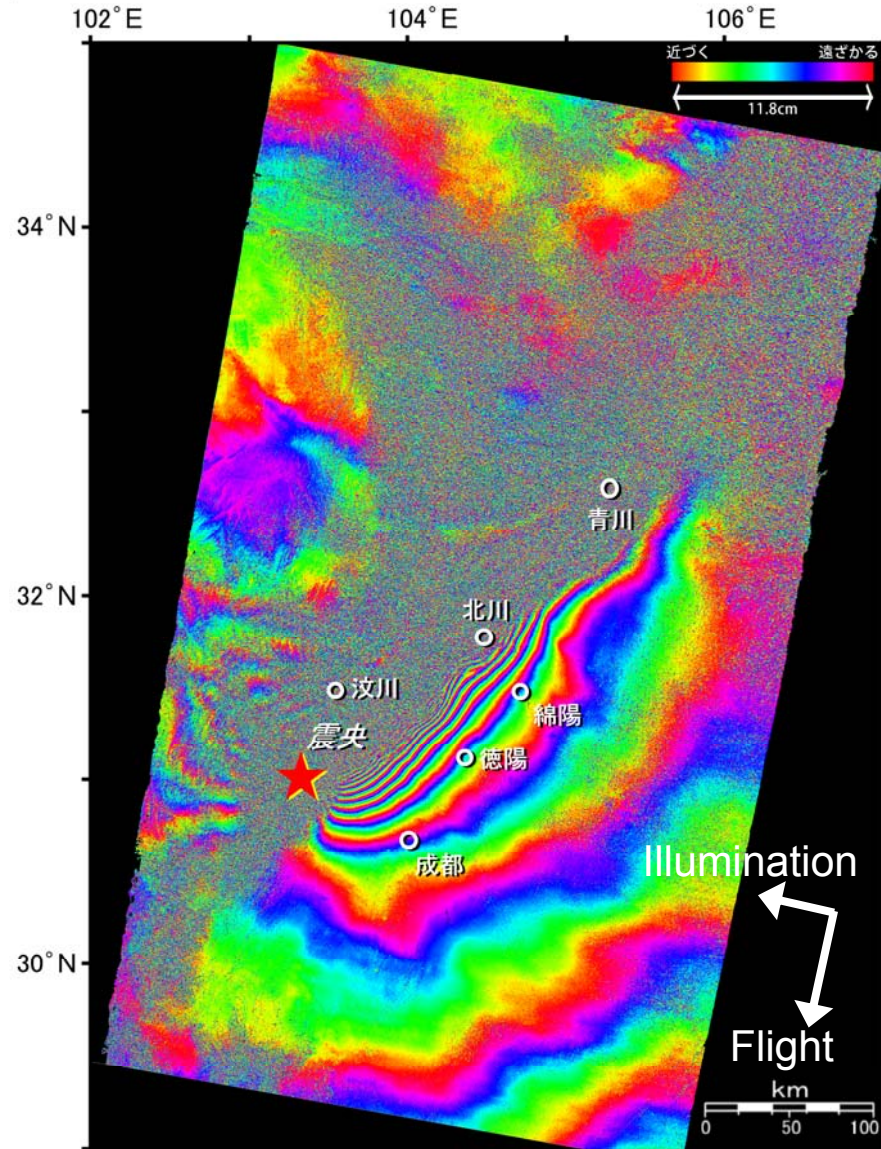
Scan4

Scan5

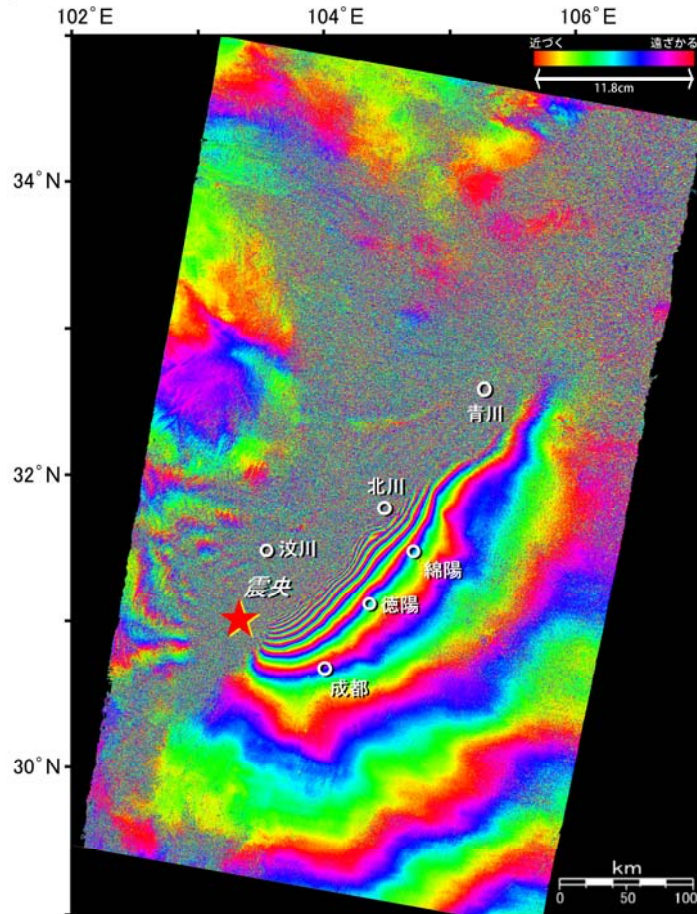


Coherence
(Az:64look, Rg:16look)

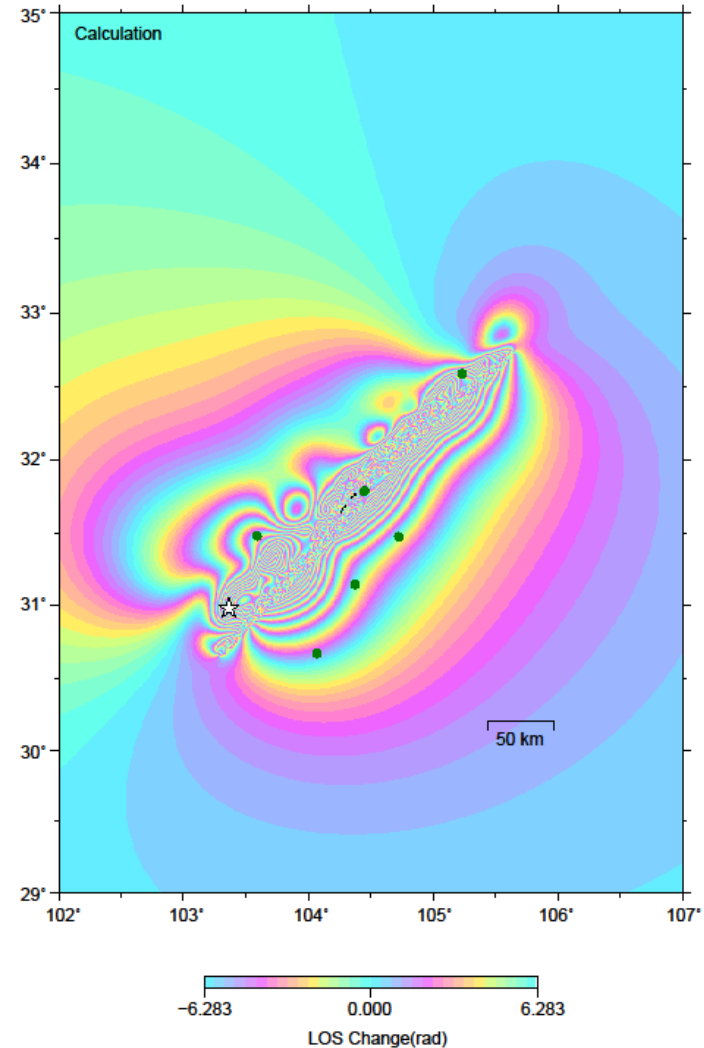
Differential Interferogram of PALSAR ScanSAR



Differential Interferogram of PALSAR ScanSAR



ScanSAR Interferogram by NEC



ScanSAR Simulated Interferogram by GSI fault model
Thanks Dr.Nishimura and Dr.Tobita (GSI) for calculation

Conclusions

- We tried to detect the crustal movement deformation on 2008 China Sichuan Earthquake by ScanSAR-ScanSAR interferometry analysis using the ALOS/PALSAR data.
- We could get the good interferogram without the phase discontinuity between scans.
- It was confirmed to be able to detect crustal movement by ScanSAR-ScanSAR interferometry analysis.
- It was shown that the ScanSAR-ScanSAR interferometry can be a very powerful tool of wider crustal movement analysis.

Example of the observation in Japan area by PALSAR ScanSAR mode

The screenshot displays the AUIG 3.0 web interface for PALSAR observation data. The main map shows the Japanese archipelago with several green rectangular swaths representing ScanSAR observations. One swath, labeled '499', is highlighted in yellow. The interface includes a search bar, a list of observation scenes, and a detailed information panel for the selected scene.

カテゴリー	番号	センサ	シーンID	運用モード	シーン中心日	観測パス	中心フレーム	雲量(%)	ボイテイング角(°)	ボイテイング角(°)	オフテイング角	総合品質評価	タウログセグメント
<input checked="" type="checkbox"/>	159	PALSAR	ALPSRS078332900	WB1	2007/07/15	76	2900	-	-	-	27.1	-	W0538076001-01
<input checked="" type="checkbox"/>	160	PALSAR	ALPSRS078332950	WB1	2007/07/15	76	2950	-	-	-	27.1	-	W0538076001-01
<input checked="" type="checkbox"/>	161	PALSAR	ALPSRS078333000	WB1	2007/07/15	76	3000	-	-	-	27.1	-	W0538076001-01
<input checked="" type="checkbox"/>	201	PALSAR	ALPSRS130552900	WB1	2008/07/07	70	2900	-	-	-	27.1	-	W0896070001-01
<input checked="" type="checkbox"/>	202	PALSAR	ALPSRS130552950	WB1	2008/07/07	70	2950	-	-	-	27.1	-	W0896070001-01
<input checked="" type="checkbox"/>	241	PALSAR	ALPSRS129092850	WB1	2008/06/27	64	2850	-	-	-	27.1	-	W0886064001-05
<input checked="" type="checkbox"/>	242	PALSAR	ALPSRS129092900	WB1	2008/06/27	64	2900	-	-	-	27.1	-	W0886064001-05

検索条件	詳細情報	地名検索
No.499	印刷	
センサ	PALSAR	
シーンID	ALPSRS052362750	
運用モード	WB1	
シーン中心日	2007/01/18	
観測パス	52	
中心フレーム	2750	
雲量(%)	-	
ボイテイング角(°)	-	
ボイテイング角	-	
オフテイング角	27.1	
総合品質評価	-	
タウログセグメント	X0360052001-01	
衛星飛行方向	ディセンディング	
地上局コード	HEOC	
校正フラグ	含まれない	
軌道データ種別(シーン情報作成時)	高精度軌道情報	
ボイテイング角(°)	-	
ボイテイング角(°)	-	
ボイテイング角(°)	-	
ボイテイング変更	-	
レベルステータス	正常	
チャネル番号	80(HHScan)	
シーン中心時刻	00:58:01.432	
シーン中心経度	145.829	
位置X成分	-4567.890266	
位置Y成分	2599.272348	
位置Z成分	4726.448828	
速度X成分	-3.389000	
速度Y成分	4.025282	
速度Z成分	-5.474731	
コースアソシエーション	有	

The entire Japan can be covered by about 10 scenes.

Acknowledgement

- ➡ 本研究にあたり、国土地理院の西村氏および飛田氏に、国土地理院殿解析の断層モデルによるScanSAR観測時のシミュレーションインタフェログラムを計算し、御提供いただきました。両氏に感謝いたします。

Empowered by Innovation

NEC