

InSAR短基線長時系列解析による2008年 岩手宮城内陸地震の地震前変位場検出の試み

An attempt to detect pre-seismic displacement field of the 2008 Iwate-Miyagi Nairiku Earthquake using InSAR small baseline (SB) time-series analysis

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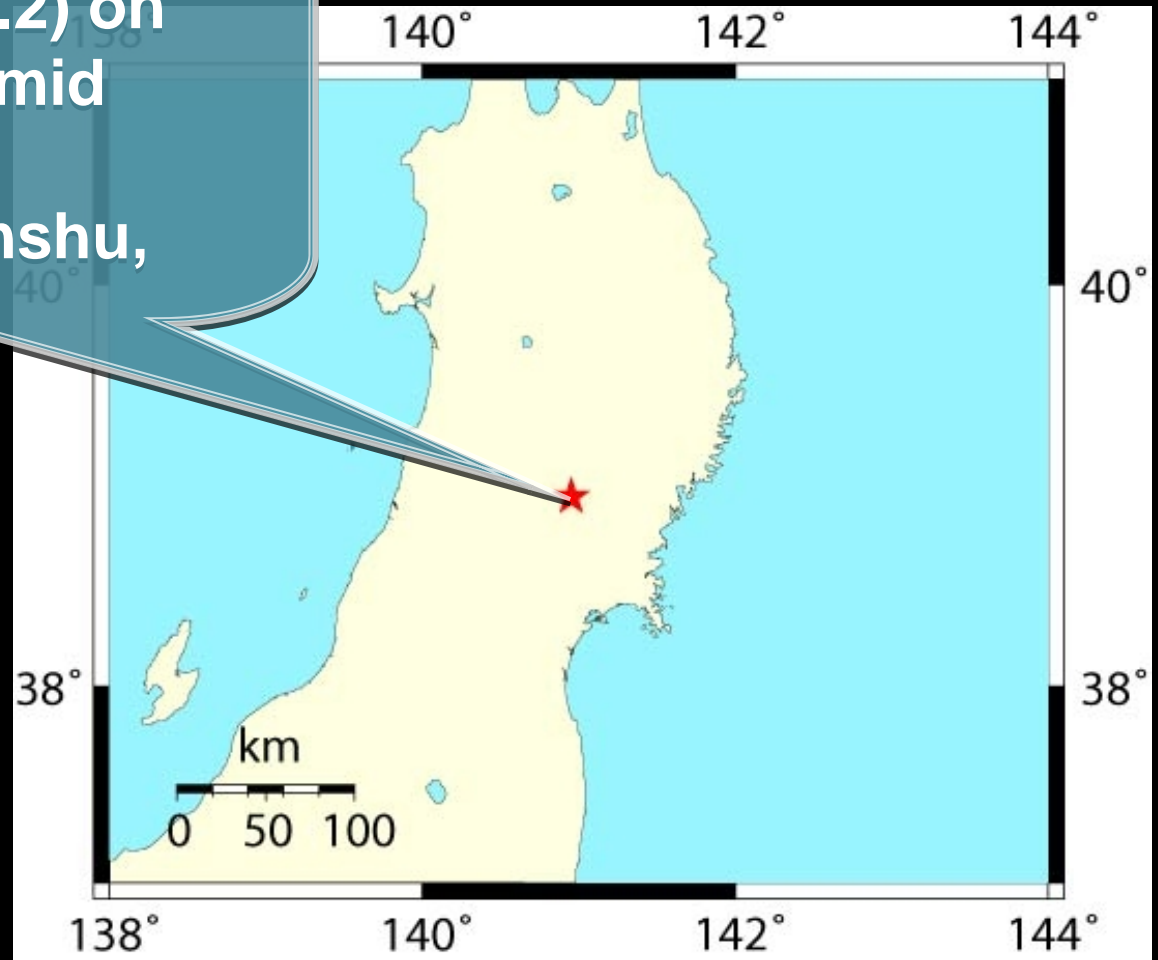
#Mika Arimoto (Department of geophysics, Kyoto University),
Yo Fukushima (Disaster Prevention Research Institute, Kyoto University),
Kazuro Hirahara (Department of geophysics, Kyoto University),
Manabu Hashimoto (Disaster Prevention Research Institute, Kyoto

Acknowledgement

PALSAR data are shared among PIXEL (PALSAR Interferometry Consortium to Study our Evolving Land surface), and provided from JAXA under a cooperative research contract with ERI, Univ, Tokyo. The ownership of PALSAR data belongs to METI (Ministry of Economy, Trade and Industry) and JAXA

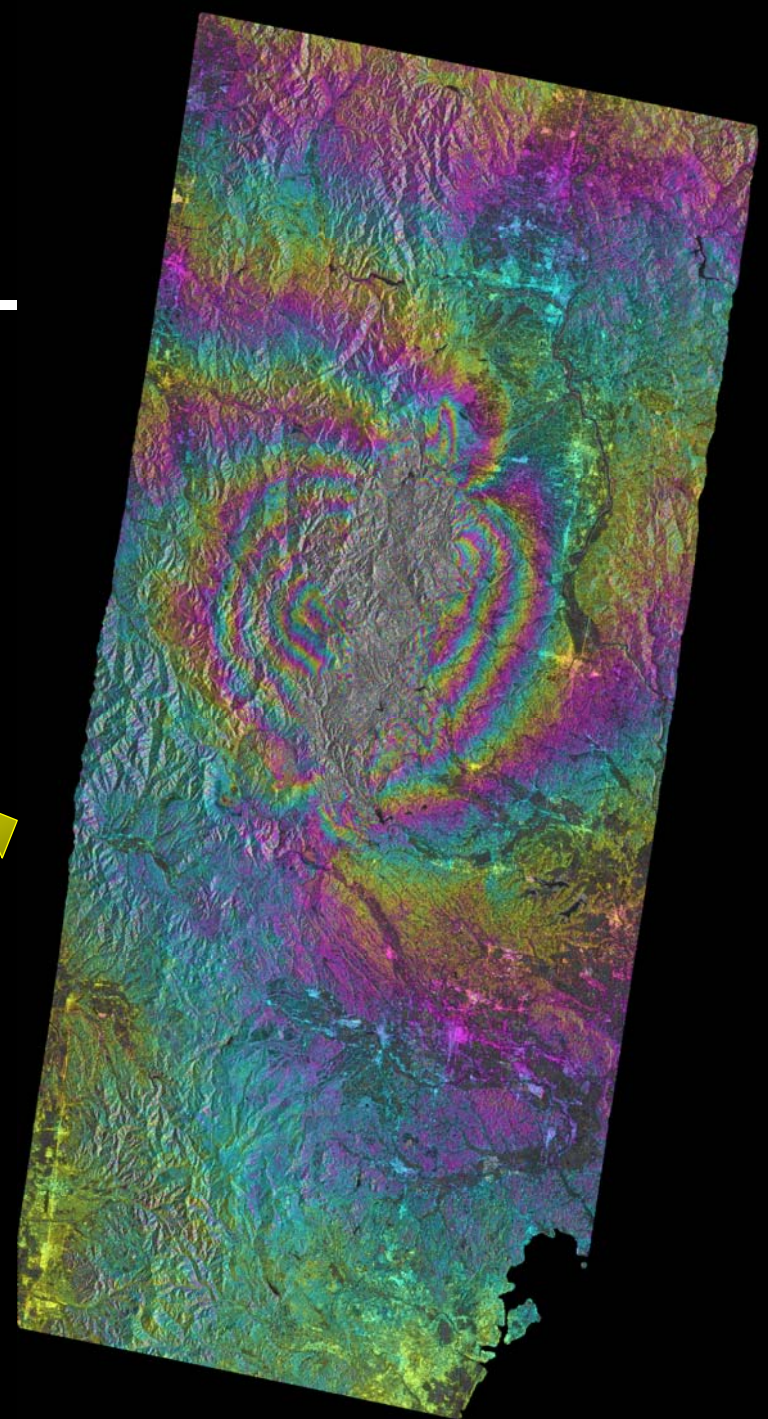
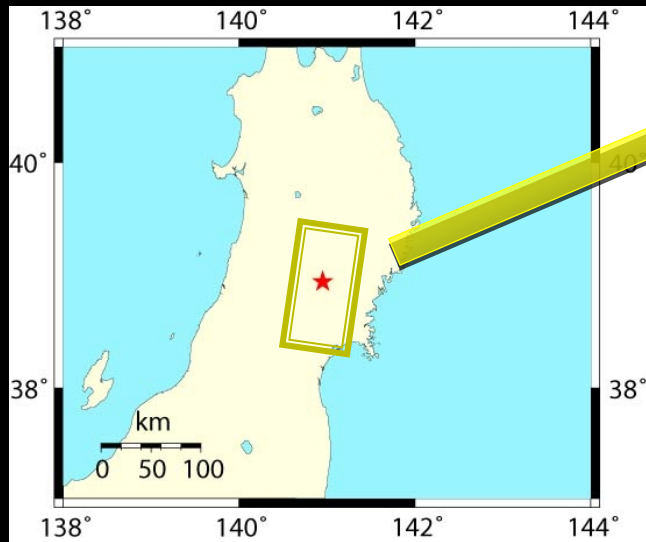
Introduction

Iwate-Miyagi Nairiku Earthquake (Mj 7.2) on June 14 2008, in mid Tohoku region, northeastern Honshu, Japan.

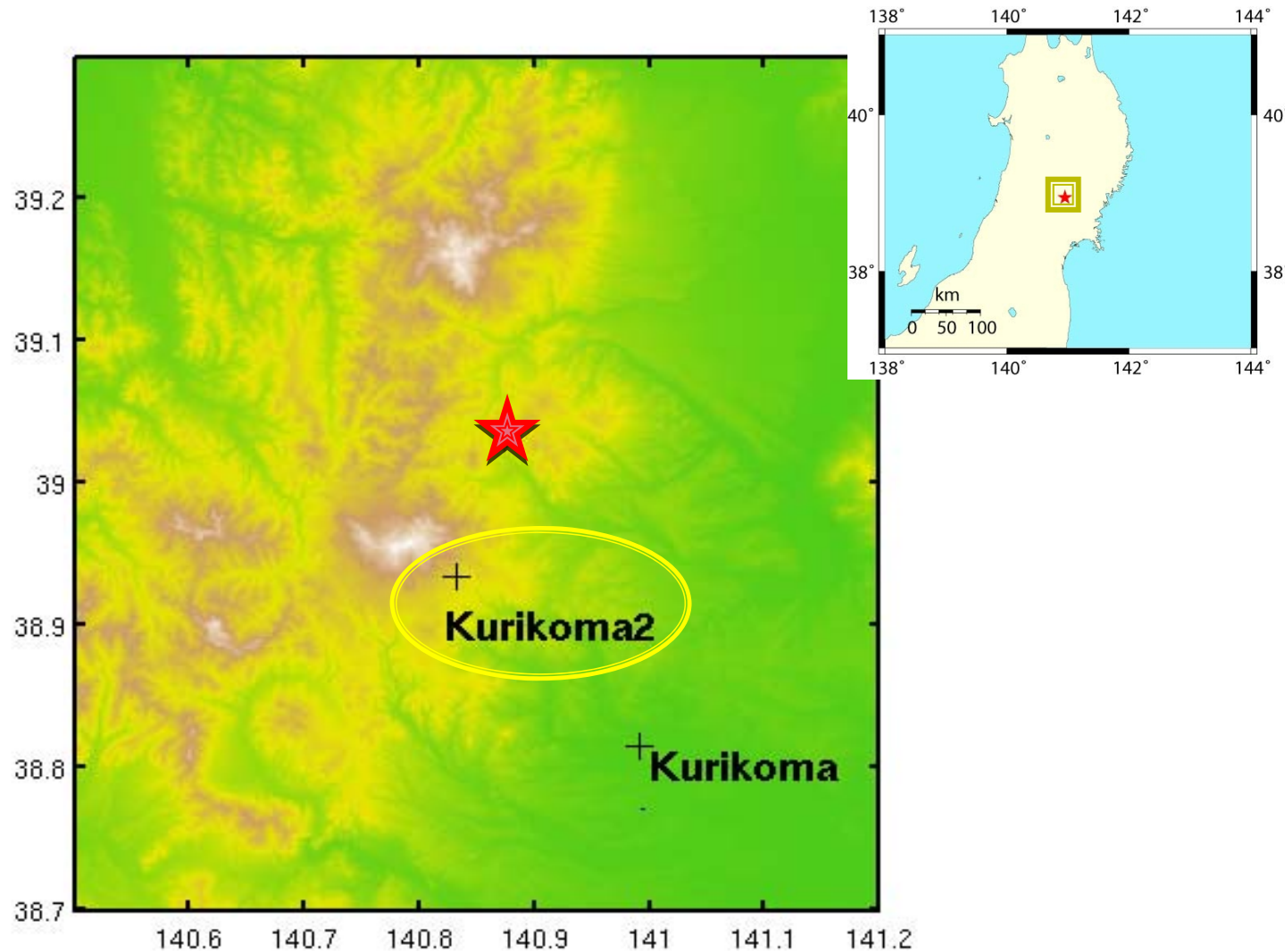


Introduction

Path:57 frame:2830-2840
Off-nadir angle:34.3
FBS, Decending

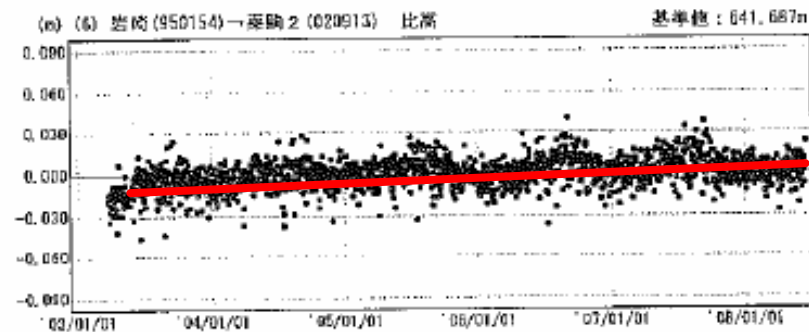
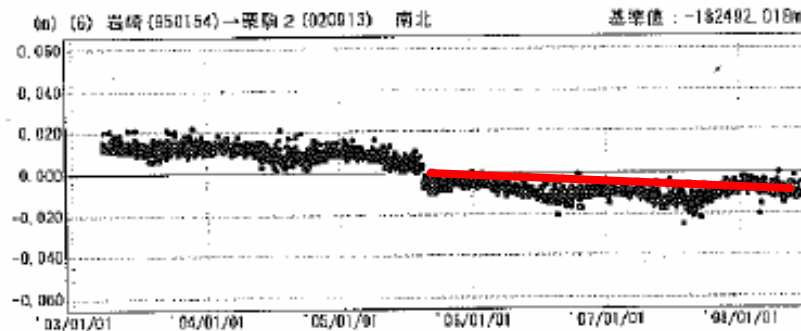
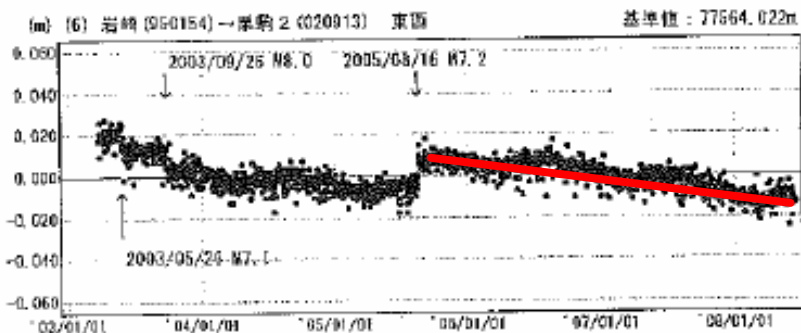


Introduction



Introduction

期間：2003/01/01～2008/06/13 JST



栗駒 2

2005/08/16 ~
2008/06/13

上1cm 南東2cm

本研究の解析データ

01/11/2007

07/14/2007 08/29/2007

10/14/2007

11/29/2007 01/14/2008

05/31/2008

上に約0.5 cm,南東に約1cmの変動が見えればよい

SB analysis processing

1. PIXELのサイトからデータをダウンロード
2. SLC画像作成 (gamma)
3. Small baselineの選択
4. SAR干渉画像作成 (gamma)
5. 解析対象領域(栗駒2周辺)の干渉データを切り出す
6. Unwrap (snaphu)
7. SAR取得日を時間ステップとするrange changeの時間変化を求める (matlab)

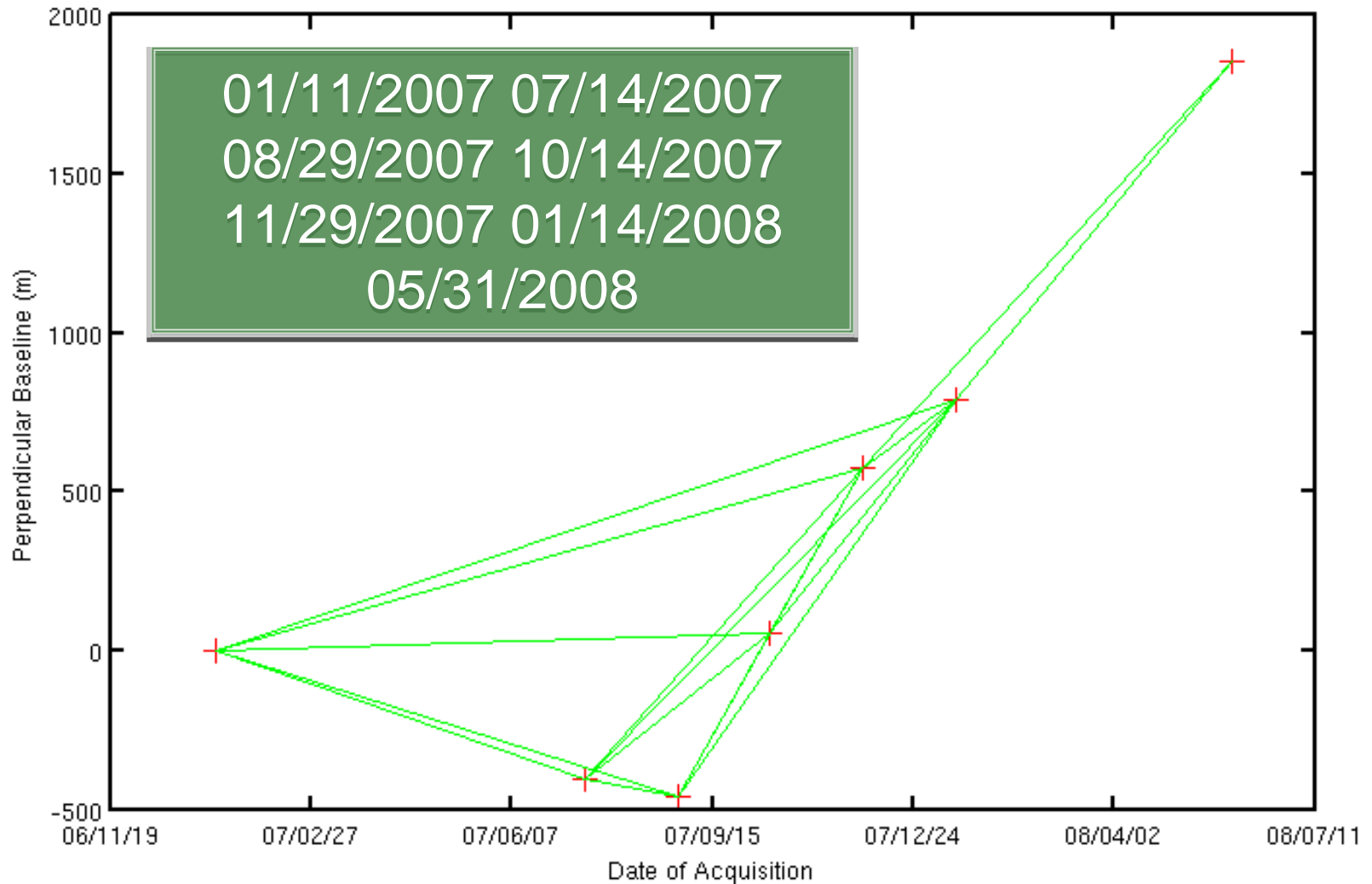
Small baselineの計算

Perpendicular
baseline 1500 m
Temporal baseline
1000 days

→ 17 pairs

070111	070714	-403.1967	184
070111	070829	-462.2657	230
070111	071014	56.4604	276
	070111	071129	573.266
		322	
070111	080114	790.7401	368
070714	070829	-59.069	46
070714	071014	459.6571	92
070714	071129	976.4627	138
070714	080114	1193.9368	184
	070829	071014	518.7261
		46	
070829	071129	1035.5317	92
070829	080114	1253.0058	138
071014	071129	516.8056	46
	071014	080114	734.2797
		92	

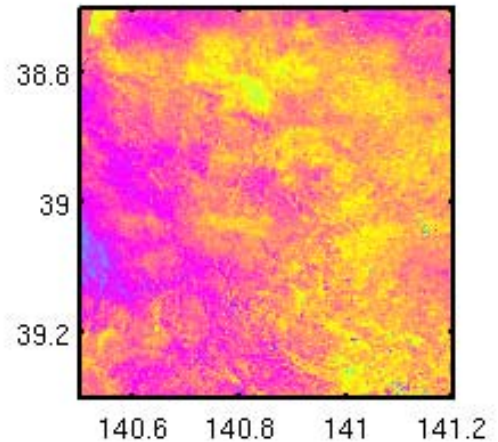
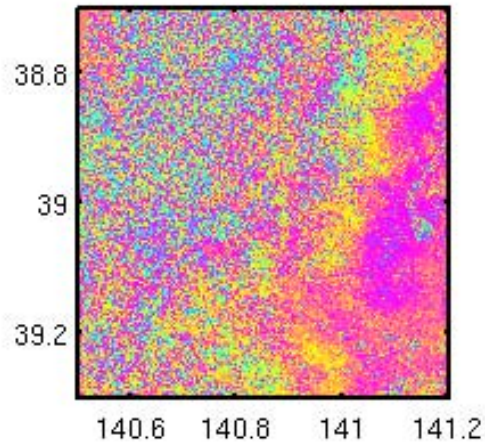
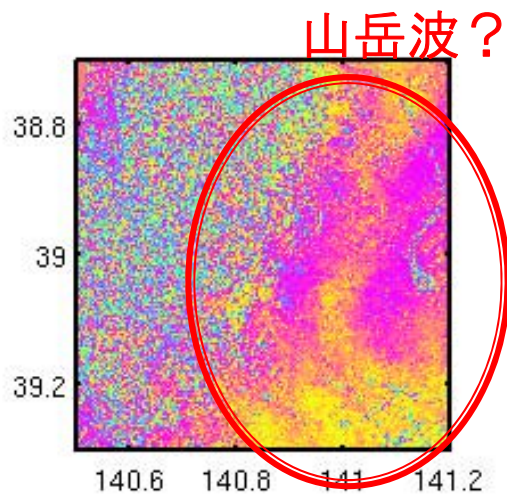
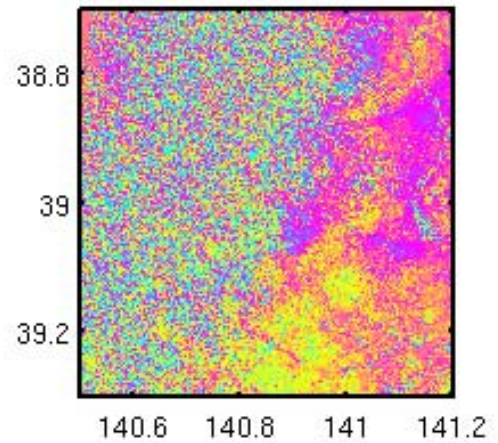
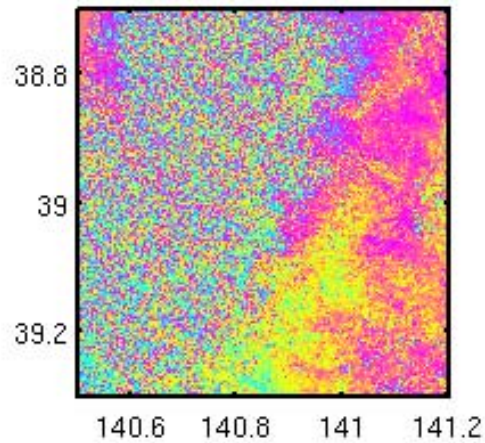
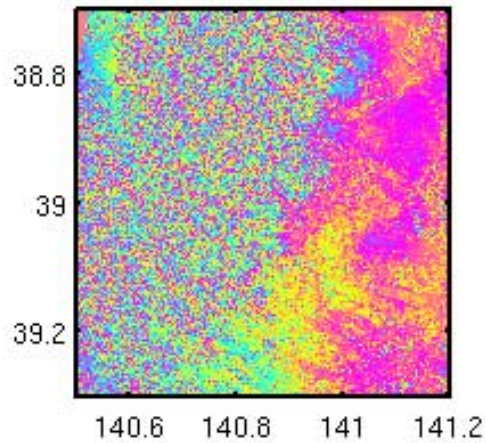
Data-Perpendicular & temporal baseline-



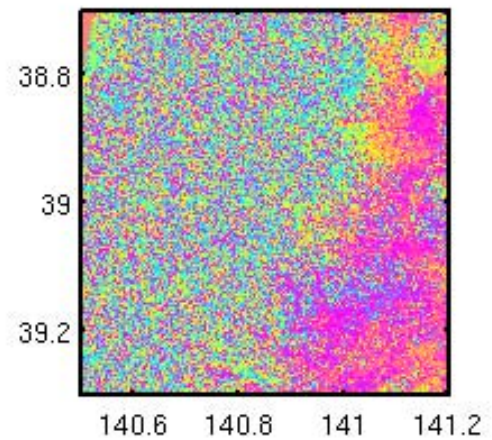
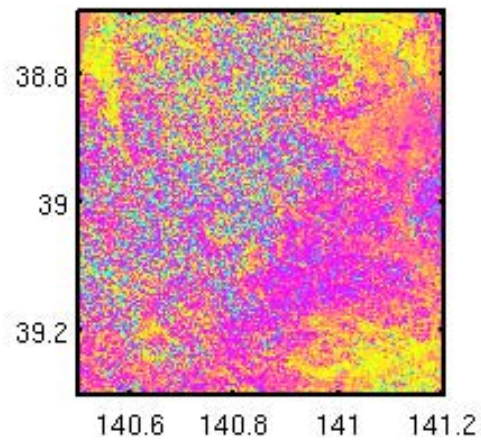
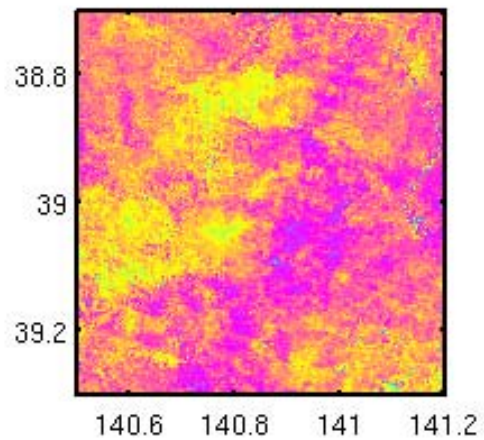
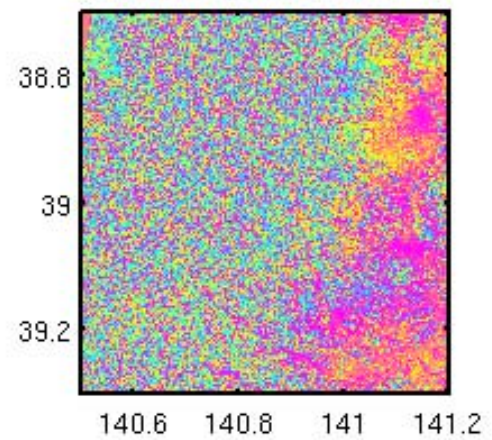
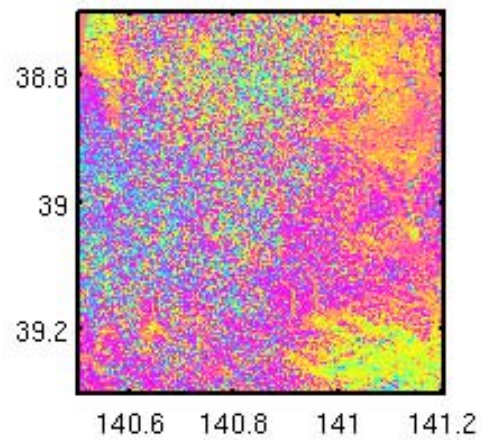
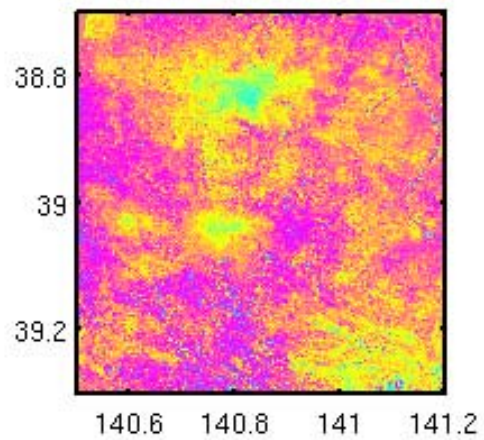
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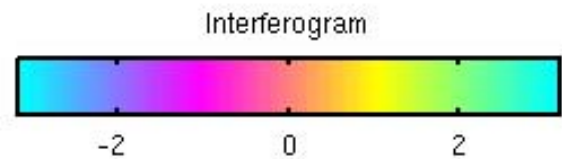
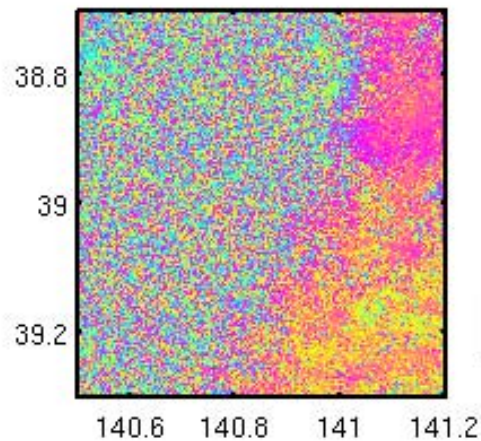
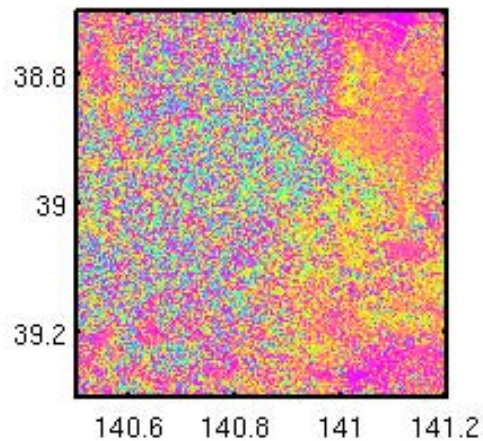
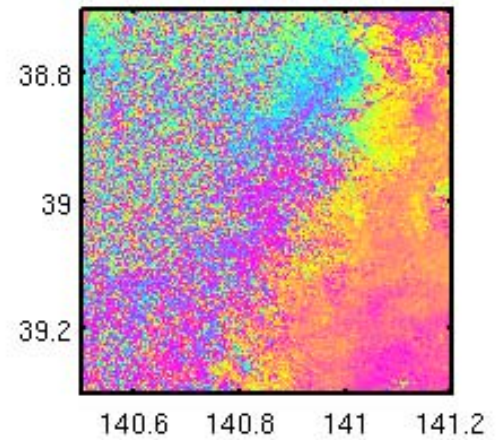
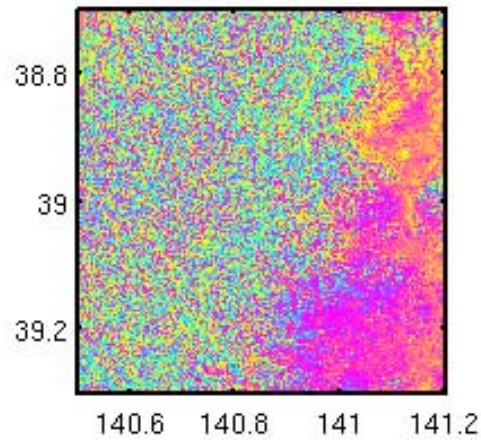
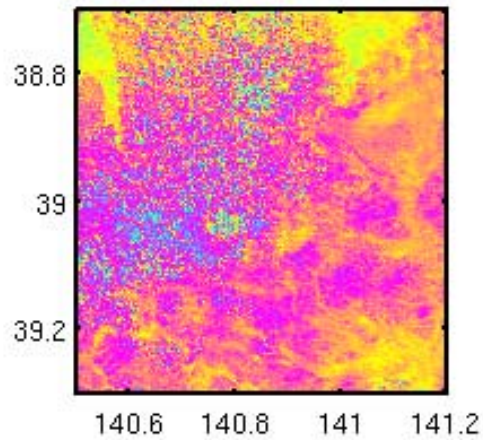
Interferogram 1



Interferogram 2

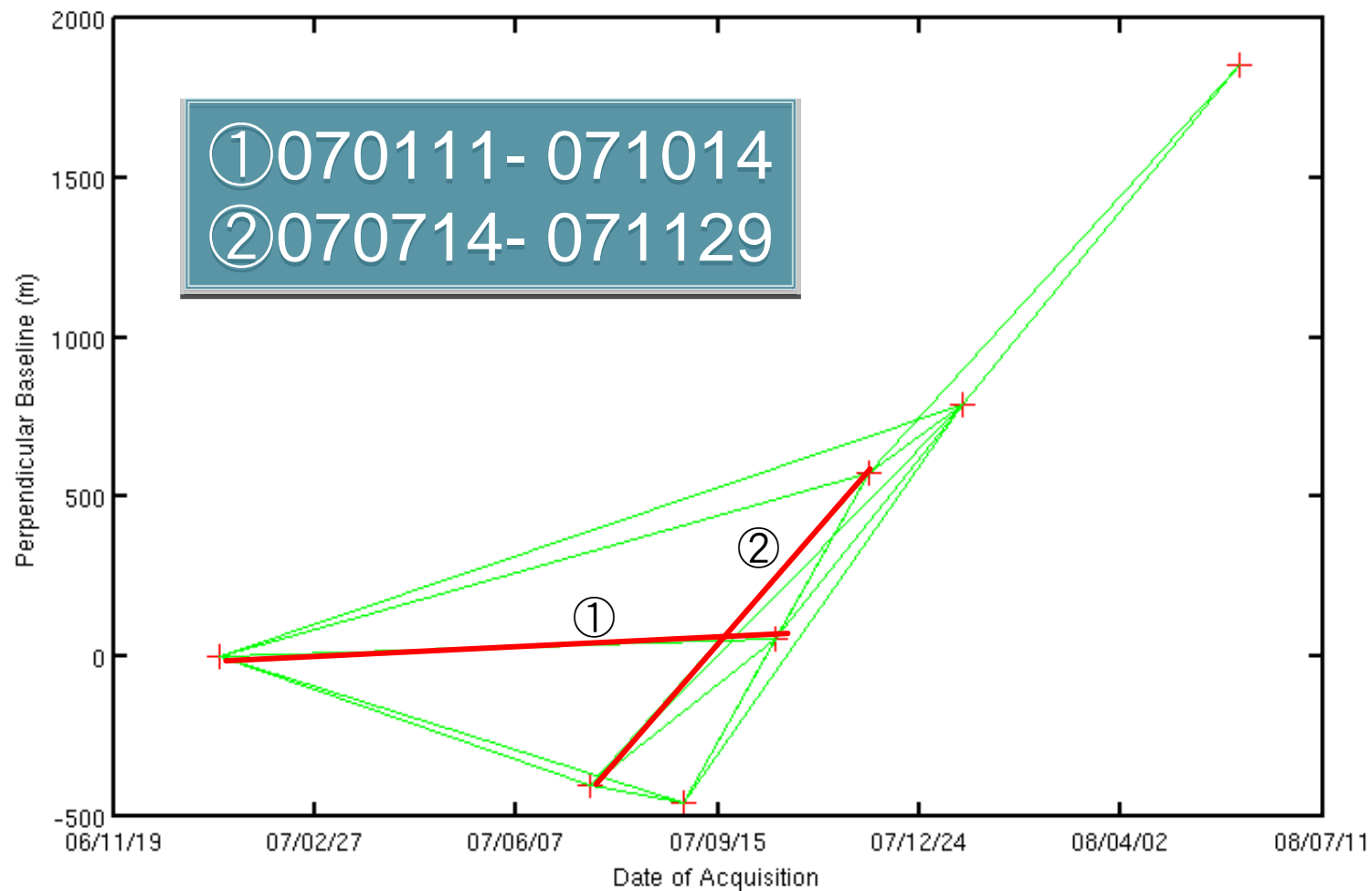


Interferogram3

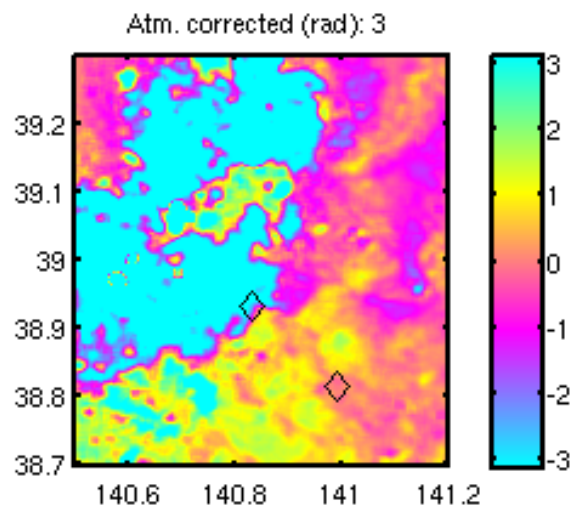
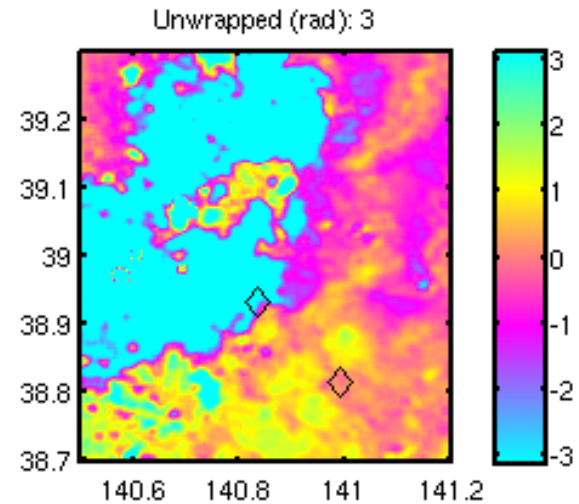
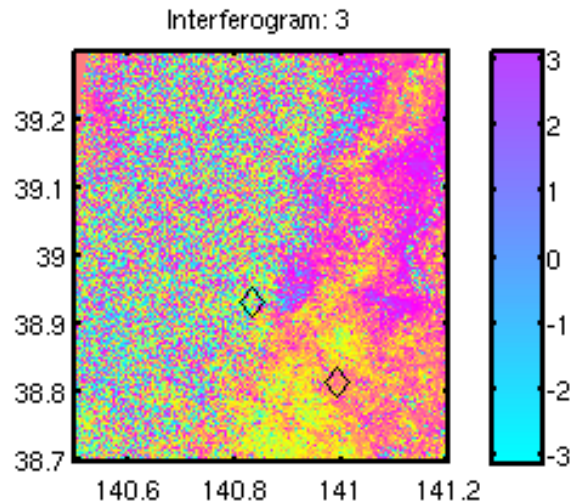


Stacking result

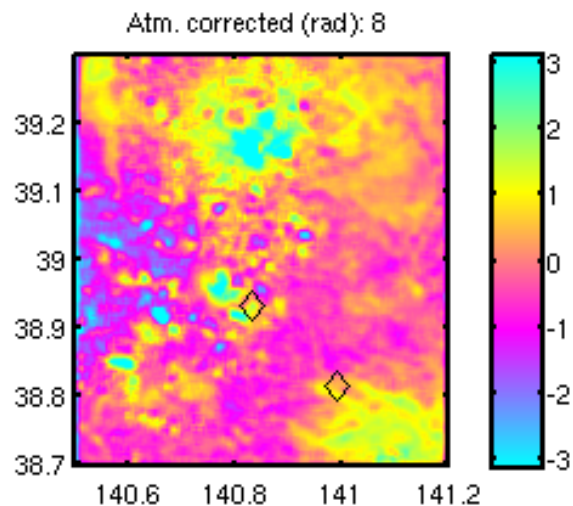
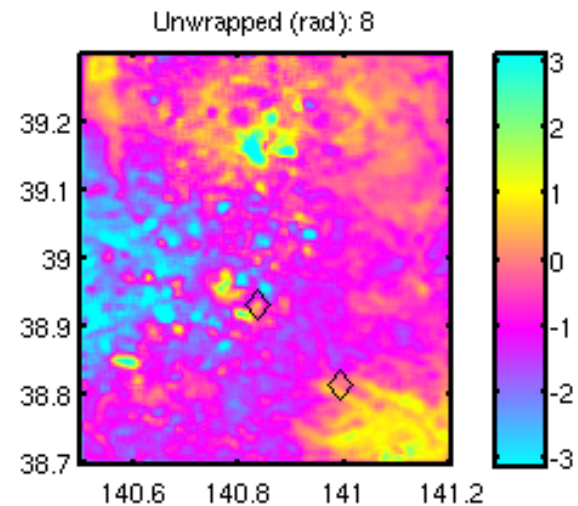
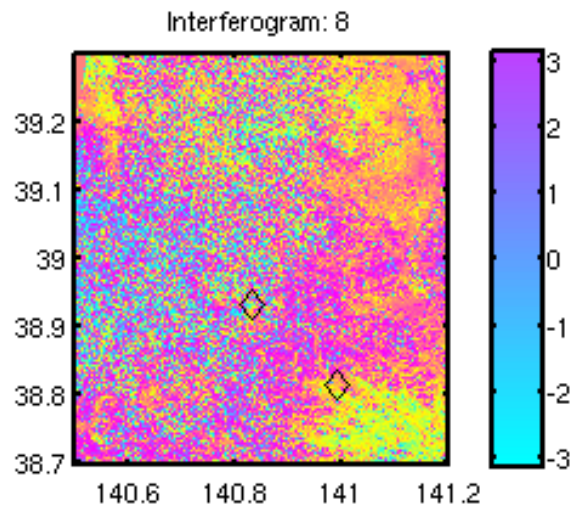
Stacking



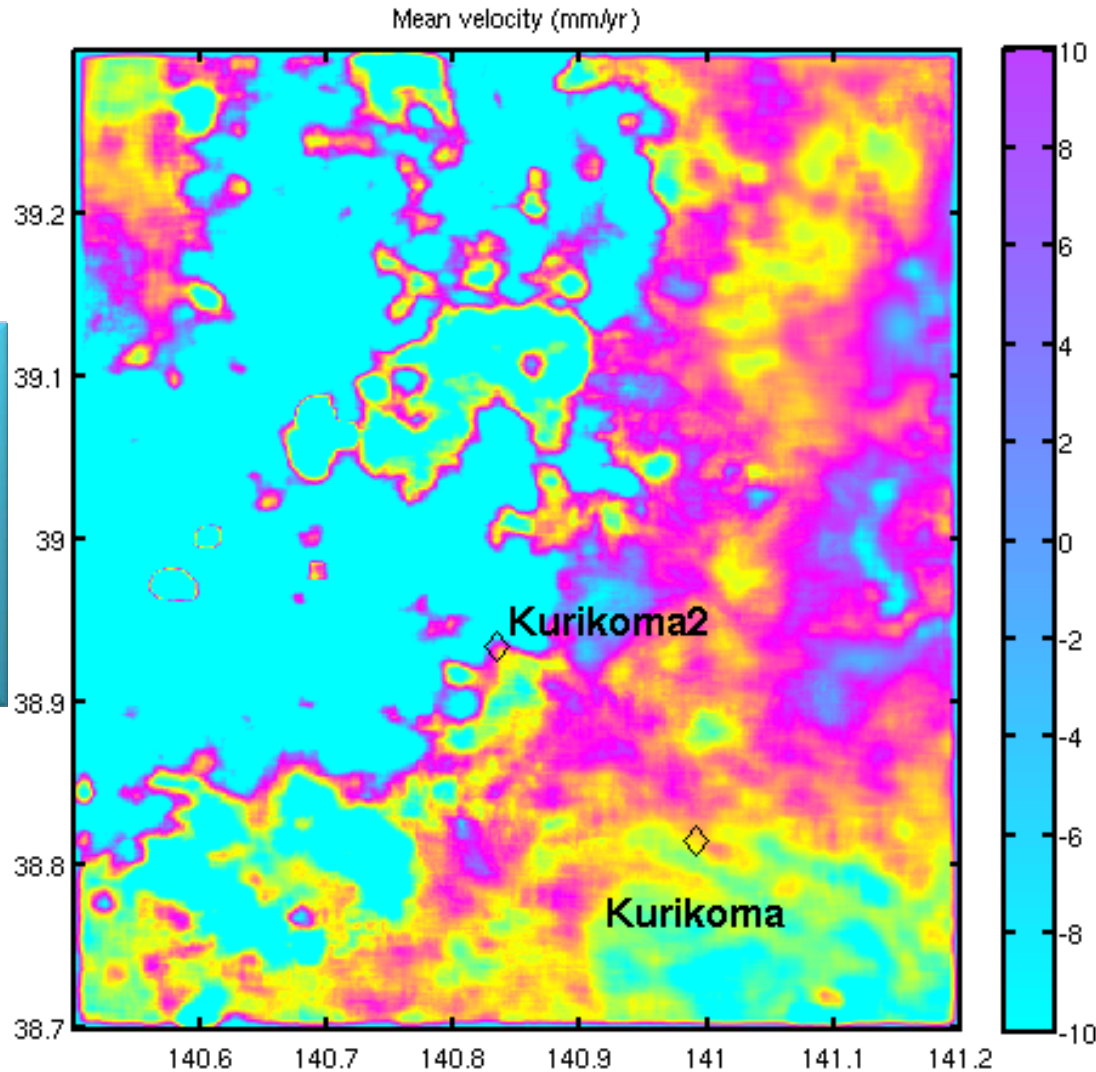
Comparison of Interferogram &unwrap image ①



Comparison of Interferogram &unwrap image ②



Mean velocity (mm/yr)



栗駒固定

栗駒2周辺
で変動

InSAR SB time-series analysis

$$d = Gm$$

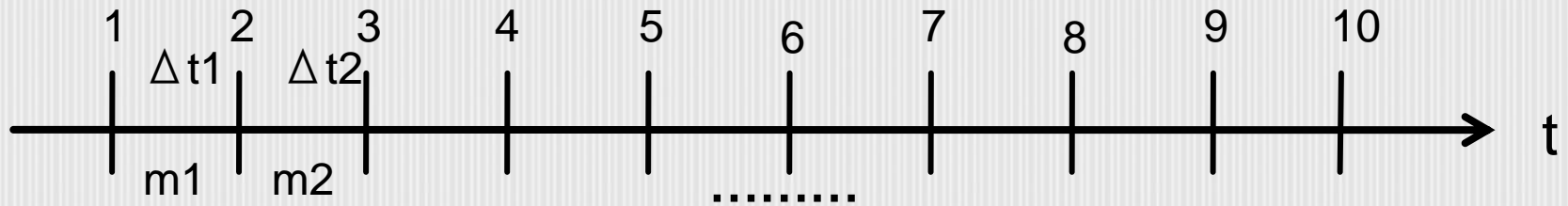
$$G = \begin{bmatrix} 1 & 1 & 0 & \dots \\ 1 & 1 & 1 & \dots \\ 0 & 1 & 1 & \dots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix} \quad d = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \end{bmatrix} \quad m = \begin{bmatrix} m_1 \\ m_2 \\ \vdots \end{bmatrix}$$

G : design matrix

d : range change date from all interferograms at a
common
pixel

m : incremental range change between SAR acquisitions
for a

SB analysis

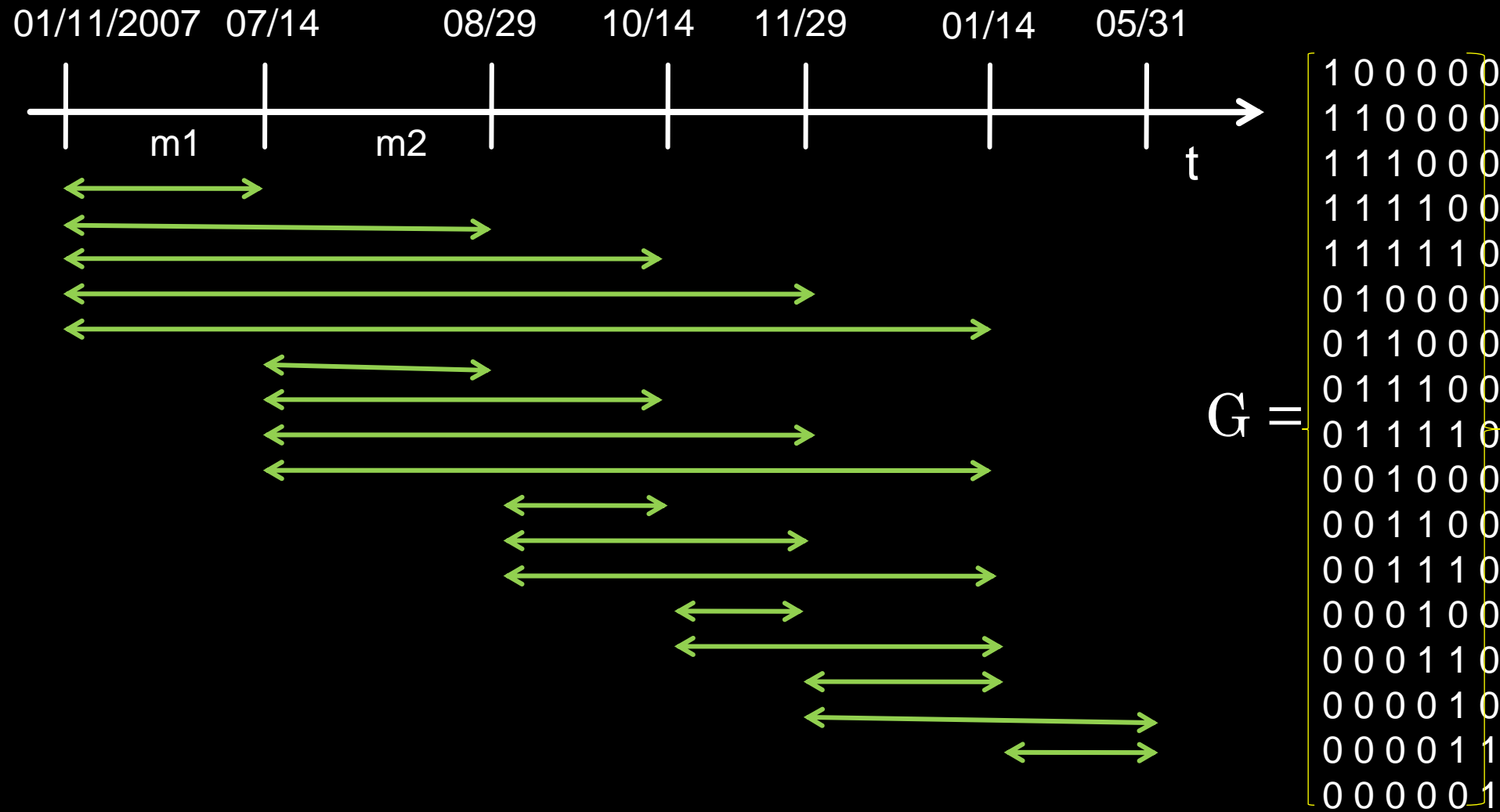


$$d = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \end{bmatrix} \quad m = \begin{bmatrix} m_1 \\ m_2 \\ \vdots \end{bmatrix}$$

$$G = \begin{bmatrix} 1 & 1 & 0 & \dots \\ 1 & 1 & 1 & \dots \\ 0 & 1 & 1 & \dots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix}$$

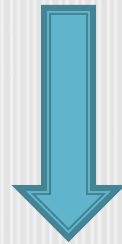
$$\begin{aligned} d_1 &= m_1 \\ d_2 &= m_1 + m_2 \\ d_3 &= m_2 \end{aligned}$$

データ



InSAR SB time-series analysis

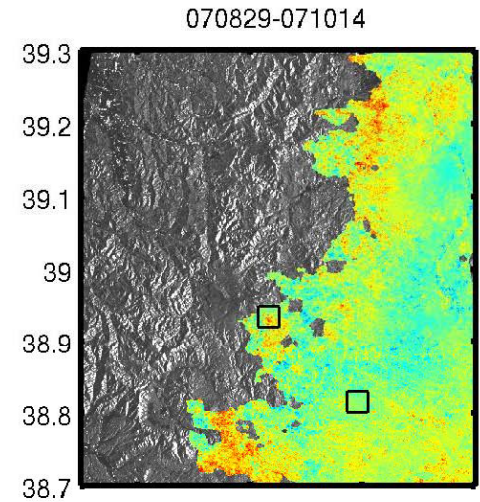
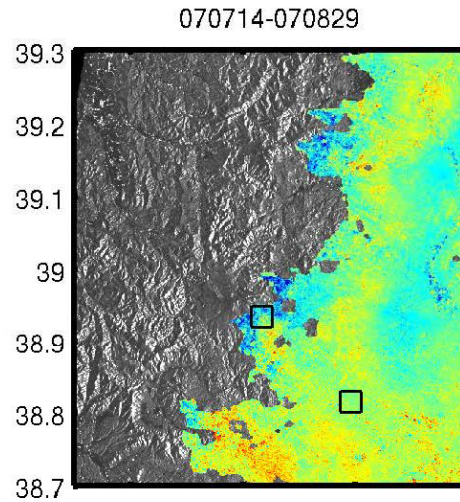
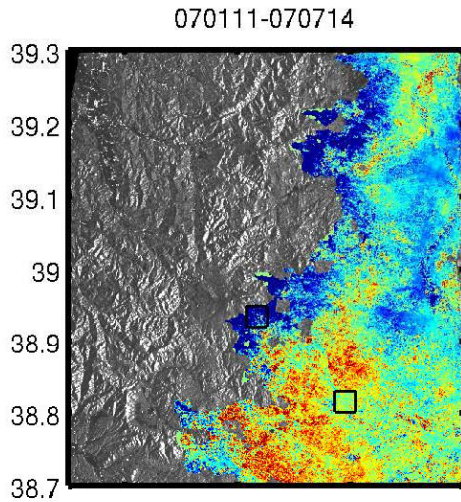
$$d = Gm$$



+ smoothing

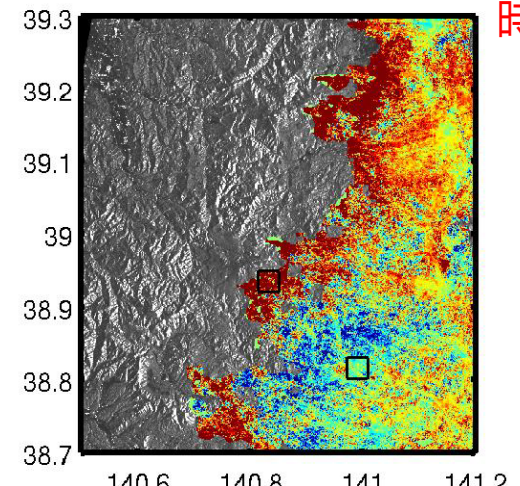
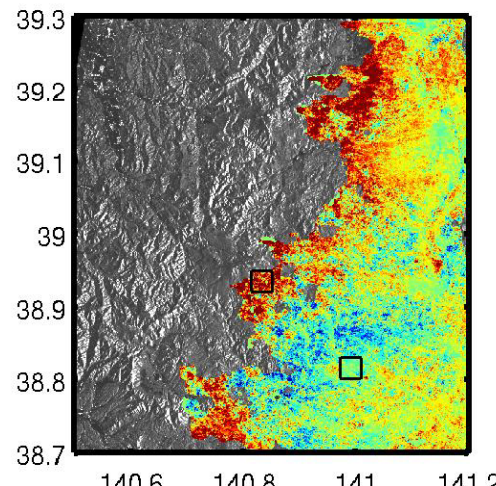
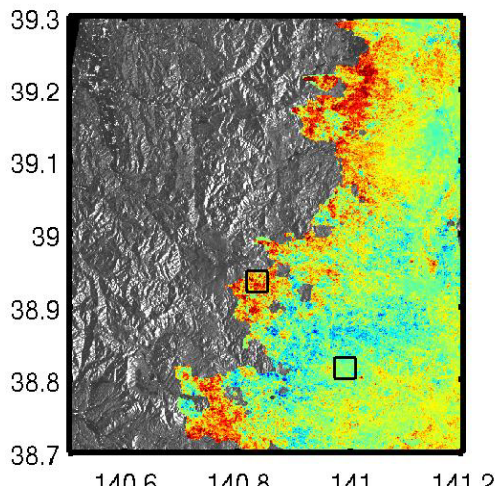
$$\begin{bmatrix} d \\ 0 \end{bmatrix} = \begin{bmatrix} G \\ r * \frac{d^2}{dt^2} \end{bmatrix} m$$

Result

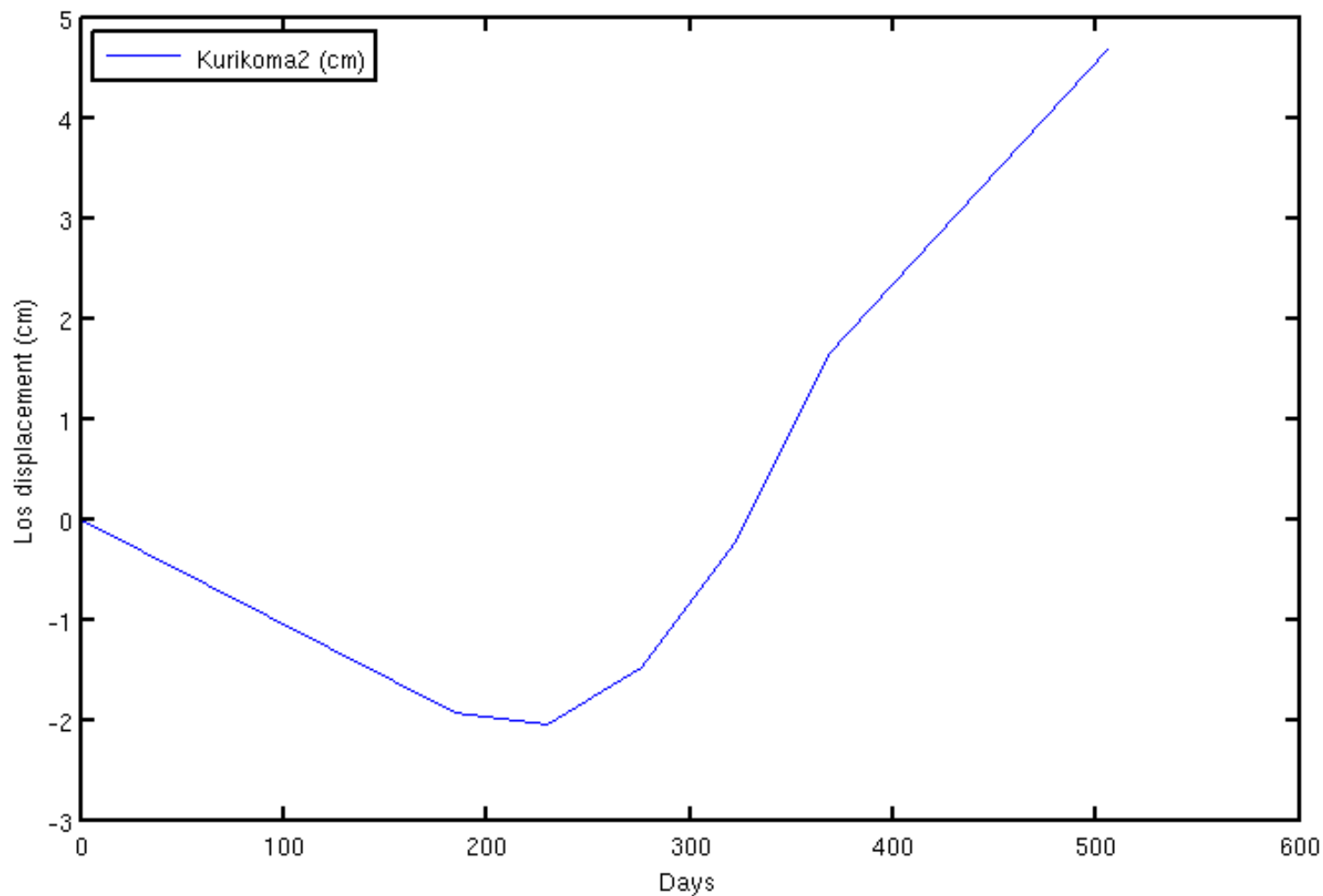


大気遅延とみられるノイズが依然支配的。

時間



Time series change



↑伸長・短縮↓

Summary

- 岩手宮城内陸地震の前兆的変動を検出するため、SB解析を行った。
- 大気遅延ノイズが支配的だということが明らかになった。
- 予測されるシグナルを検出するためにはGPSデータなどを用いたより複雑な大気遅延補正が必要