SAR 干渉解析による地表変位と八ヶ川沿いの地形履歴の関係 (2007 年能登半島地震)

Relationship between the ground deformation detected by InSAR and the geomorphic background along the river Hakka, 2007 Noto peninsula earthquake

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Objectives

- Prediction of the locations where reactivated landslides, slope failures, and ground subsidence will occur triggered by the strong ground motion as well as intense rainfalls.
- Establish the monitoring methods of landslide activity.
- Case study to achieve the prediction methods.

by InSAR.

Displacements detected by InSAR

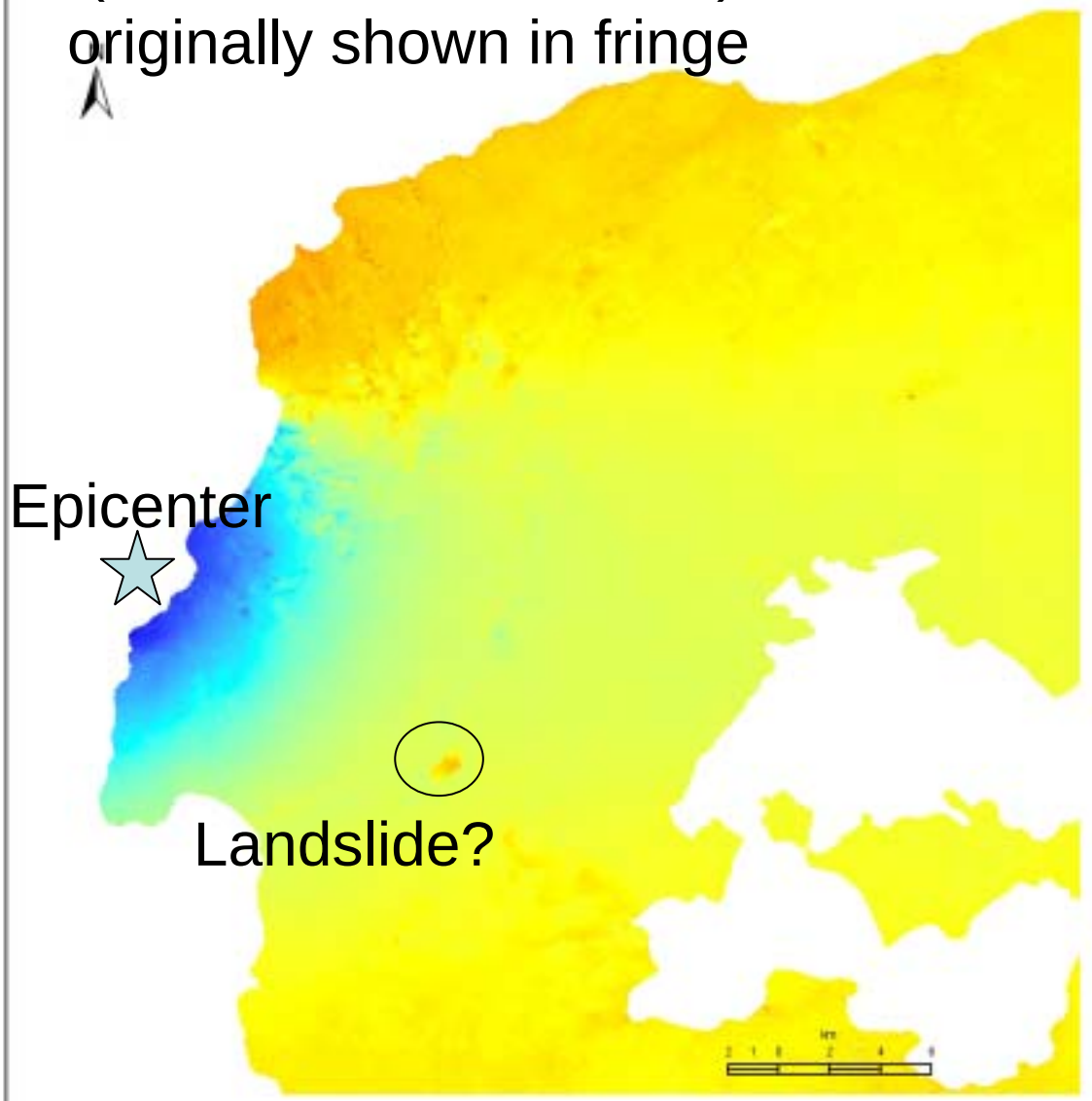
- Displacements by InSAR

  = Contributions of Crustal Movement and Local Geomorphic Changes triggered by the strong ground motion(ground subsidence, landslide, and slope failure)

  + Errors

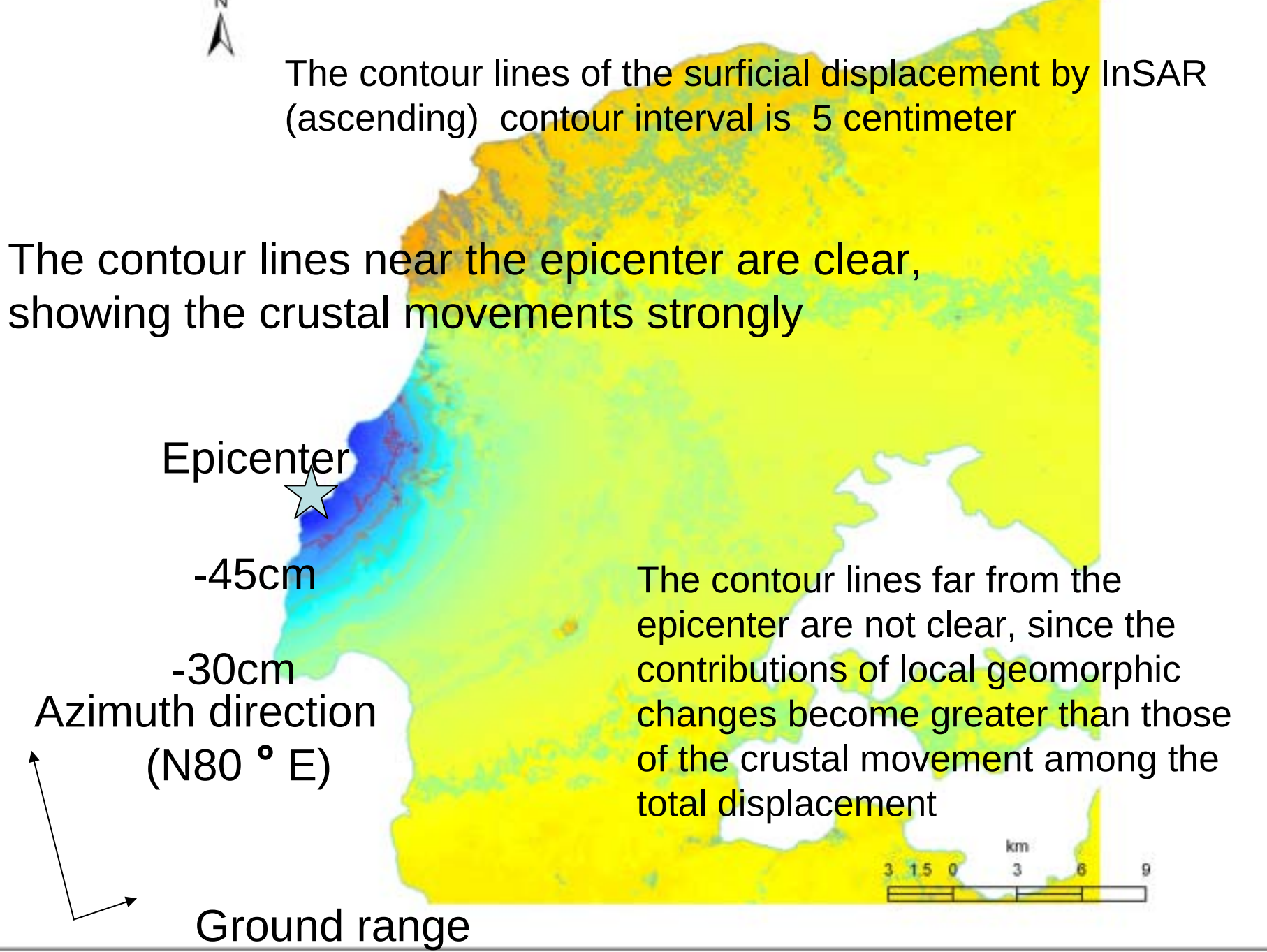
  Local Geomorphic changes by Eq. occur by affecting several conditions (hydrologic, geomorphic, geologic, and 3D material structure) as well as amplitudes and frequencies of the seismic wave. (specially in case liquefaction concerned)

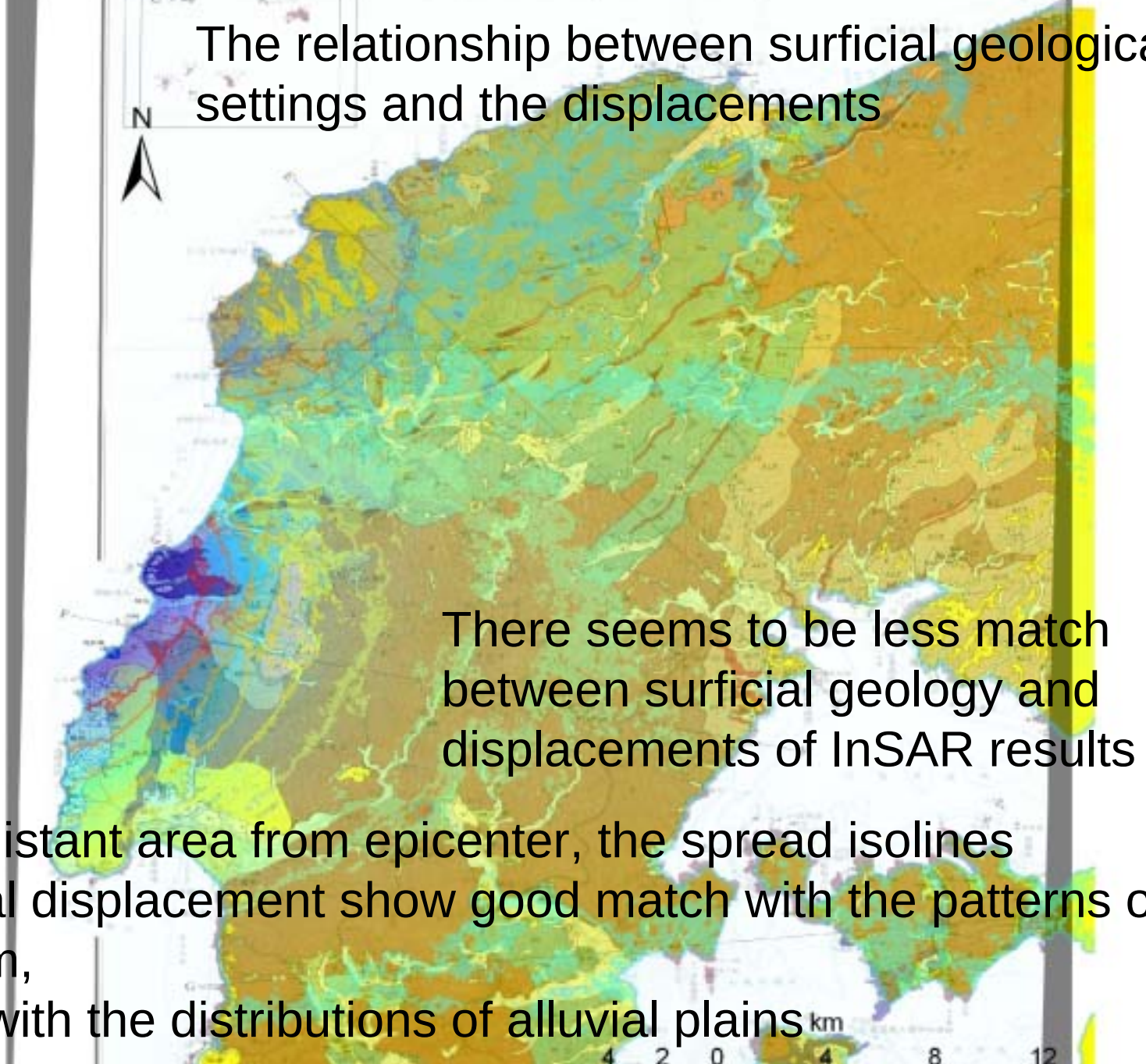
Surficial displacement by the InSAR analysis
(Fukushima et al.,2007)
originally shown in fringe



Satellite Daichi, PALSAR
Feb. 23, 2007-
Apr. 10, 2007
Ascending
Incident angle
47 degree
Azimuth direction
(N80 ° E)

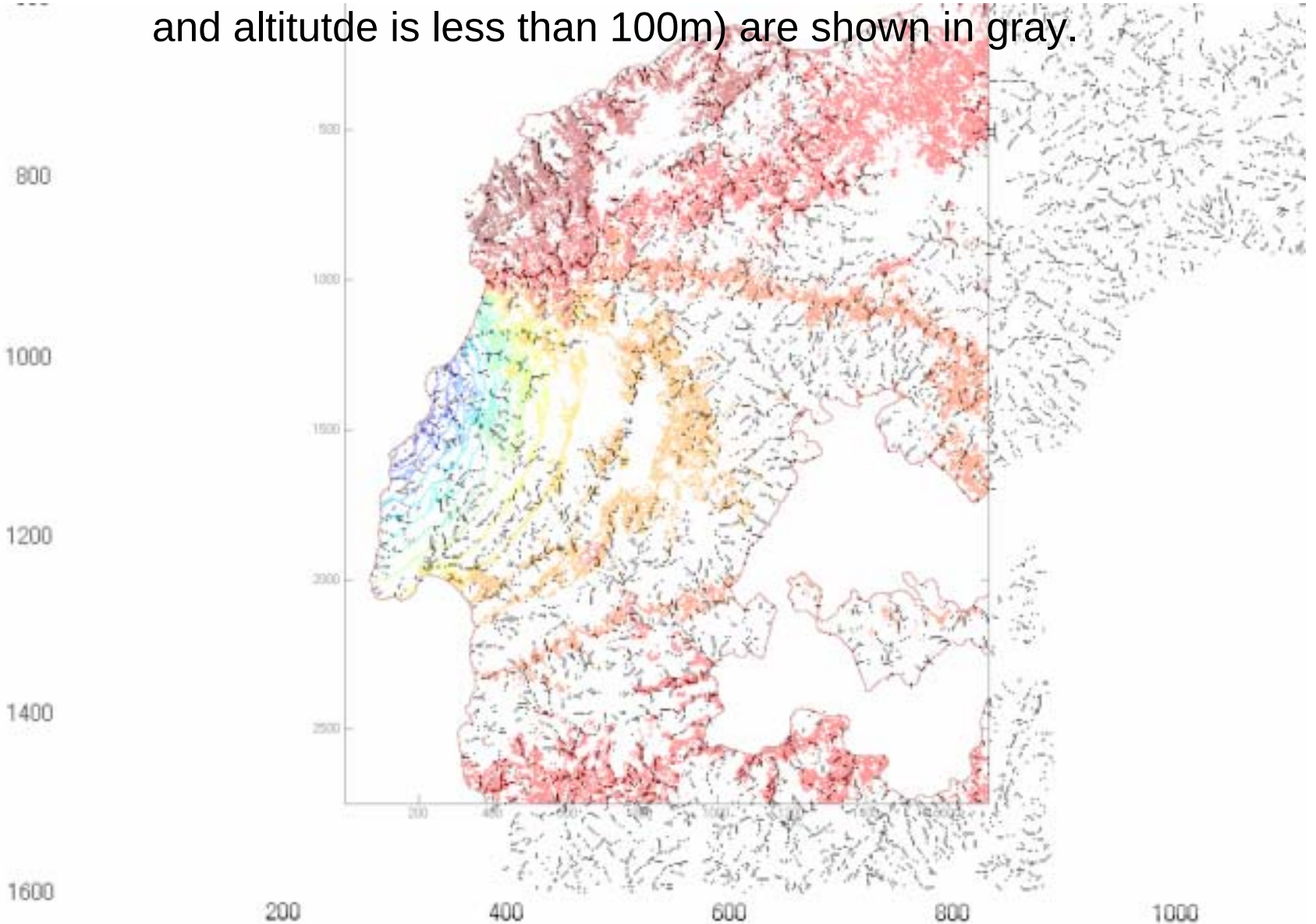
Ground range

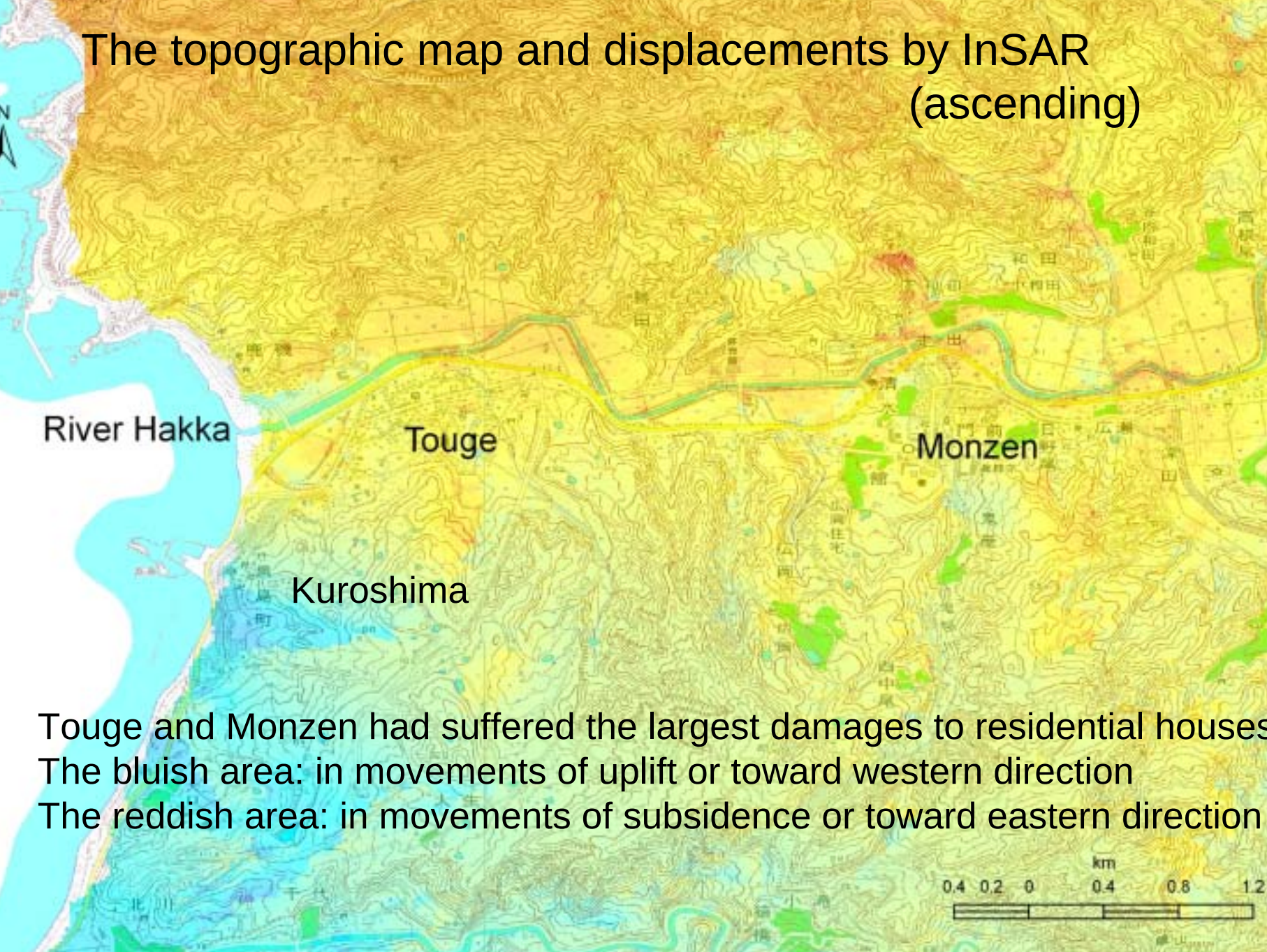

The contour lines of the surficial displacement by InSAR (ascending) contour interval is 5 centimeter
The contour lines near the epicenter are clear, showing the crustal movements strongly
Epicenter
-45cm
-30cm
Azimuth direction (N80 ° E)
Ground range
The contour lines far from the epicenter are not clear, since the contributions of local geomorphic changes become greater than those of the crustal movement among the total displacement
km
3 1.5 0 3 6 9


The relationship between surficial geologica
settings and the displacements
N
There seems to be less match
between surficial geology and
displacements of InSAR results
But in the distant area from epicenter, the spread isolines
of a surficial displacement show good match with the patterns o
river system,
especially with the distributions of alluvial plains
km
4 2 0 4 8 12

The contour of surficial displacements and river system

The grids (contributing area is greater than 50 grids and altitutde is less than 100m) are shown in gray.




The topographic map and displacements by InSAR
(ascending)
River Hakka
Touge
Monzen
Kuroshima
Touge and Monzen had suffered the largest damages to residential houses
The bluish area: in movements of uplift or toward western direction
The reddish area: in movements of subsidence or toward eastern direction
km
0.4 0.2 0 0.4 0.8 1.2

Methods

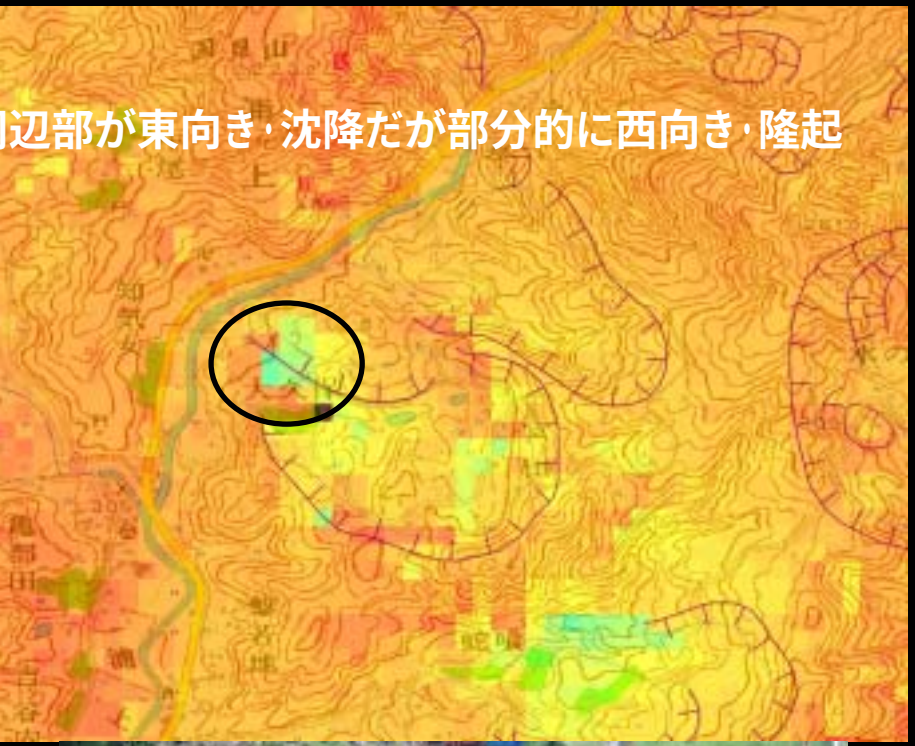
- GIS (Basically overly following information)
- Displacements by InSAR
- Topographic map
- Geological map
- Landslides distribution map
- Hydrogeomorphic analysis by 10mDEM
  (slope inclination, upstream area)
- Aerial photographs (stereo photo interpretation, repeat photography to detect the artificial land use change)
- Ground truth (recognition of surficial geomorphic change)

Topographic map + InSAR

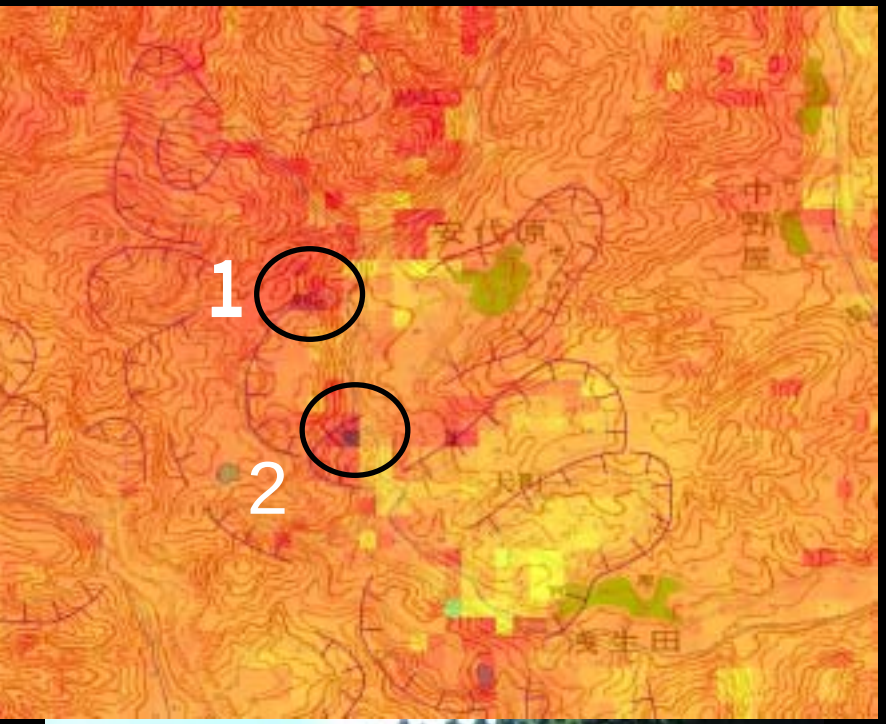
The ground subsidence at Monzen Bosai Center

Ground subsidence near Hokkoku Bank: Hashiride

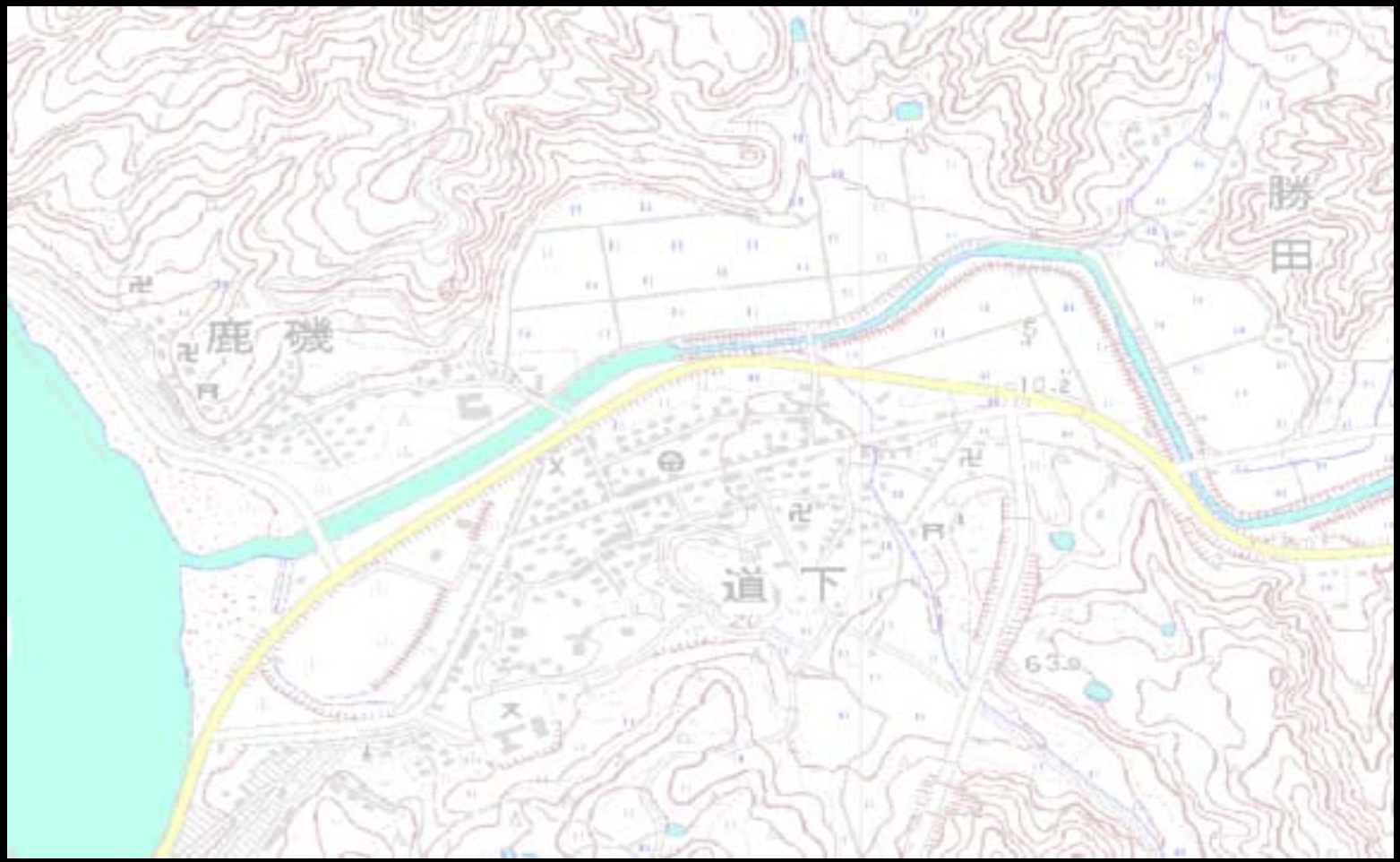
Landslide in Ohkubo



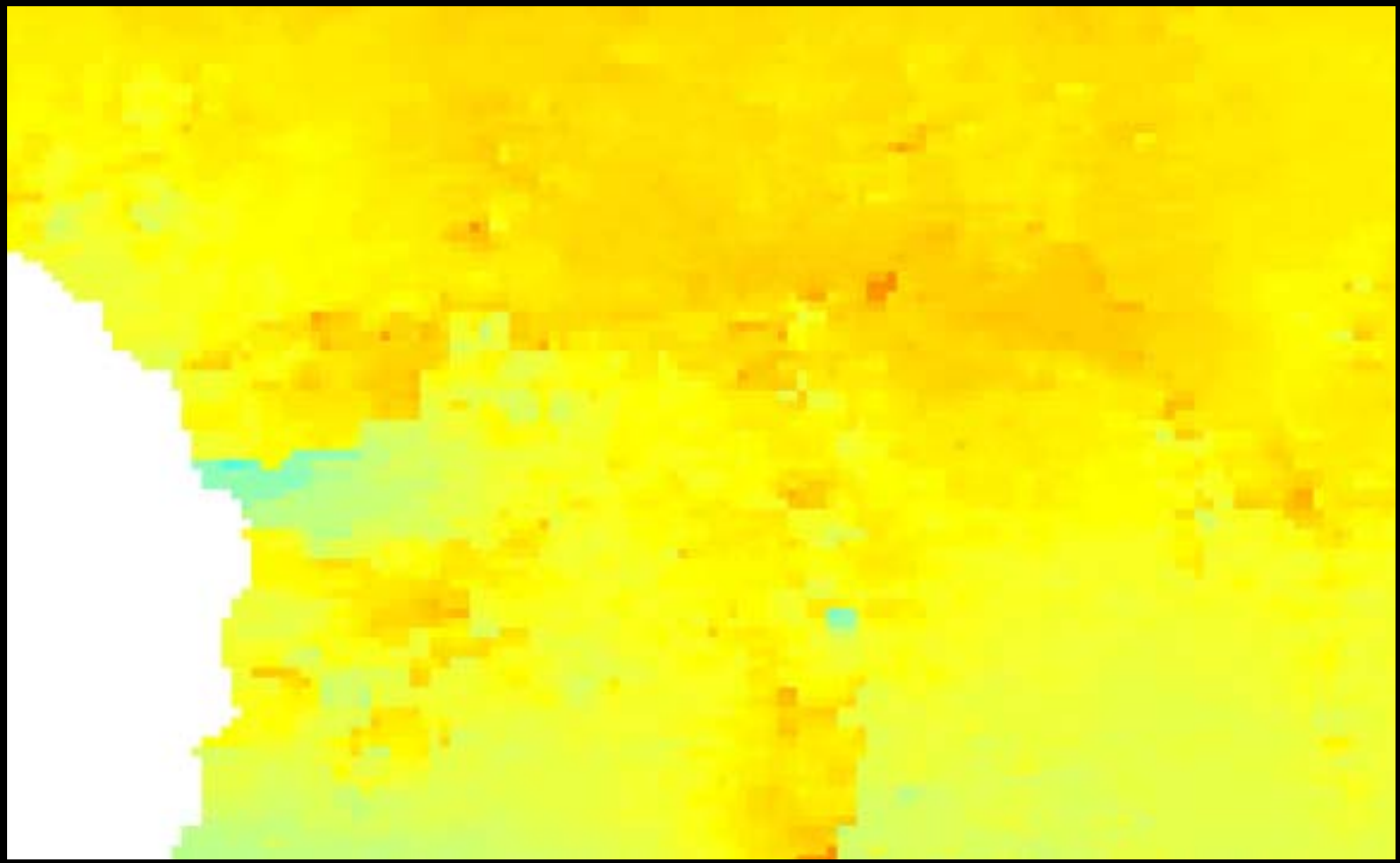
Slope failures at Asouda



Topographic map (Touge)



InSAR (ascending)



Topographic map + InSAR

Orthophoto 2007 after Eq.

Orthophoto 1947

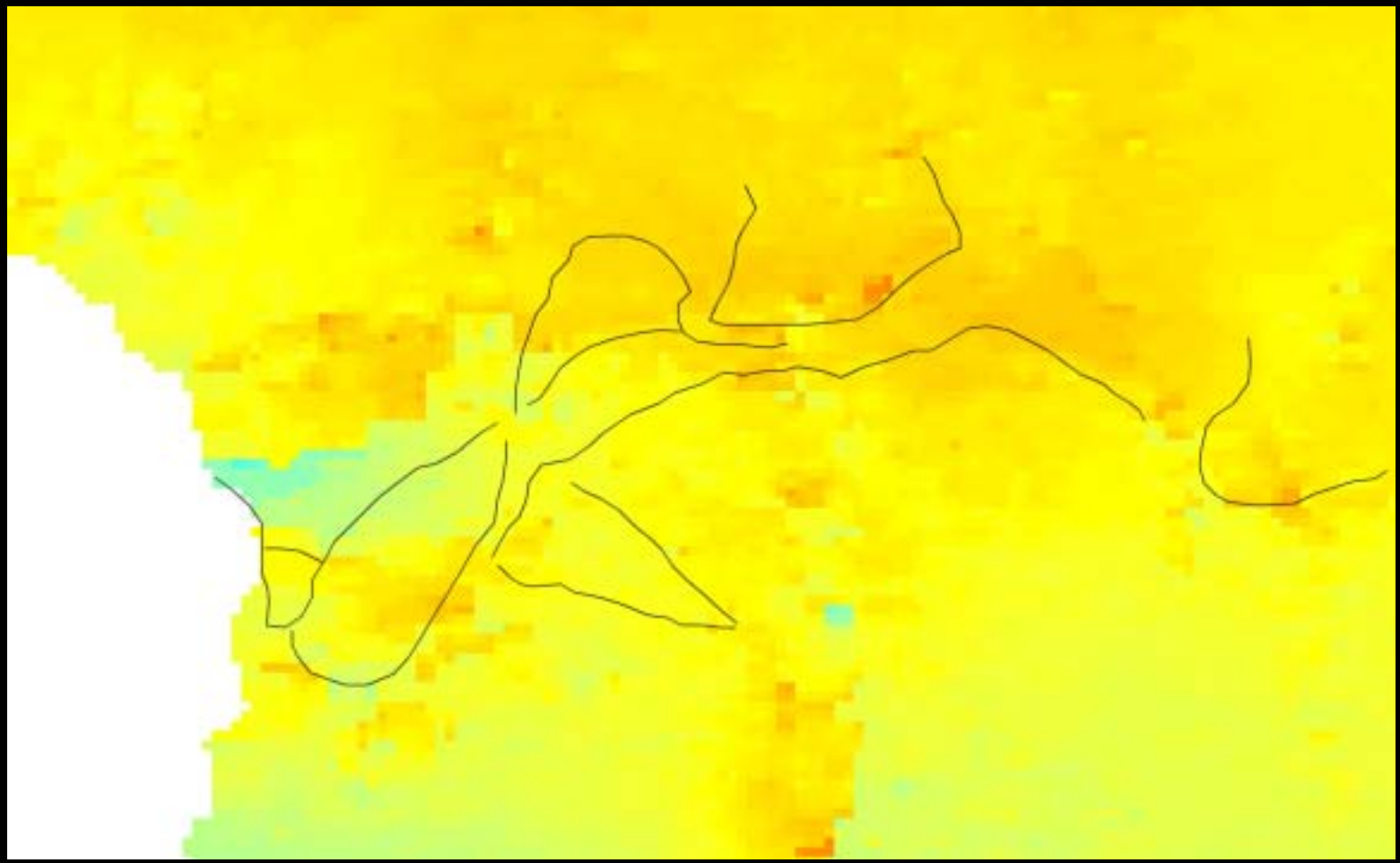
Orthophoto 2007 after Eq. + InSAR

Orthophotos 1947 and 2007

Orthophoto 1947 + InSAR

Orthophoto 1947 + fan margin

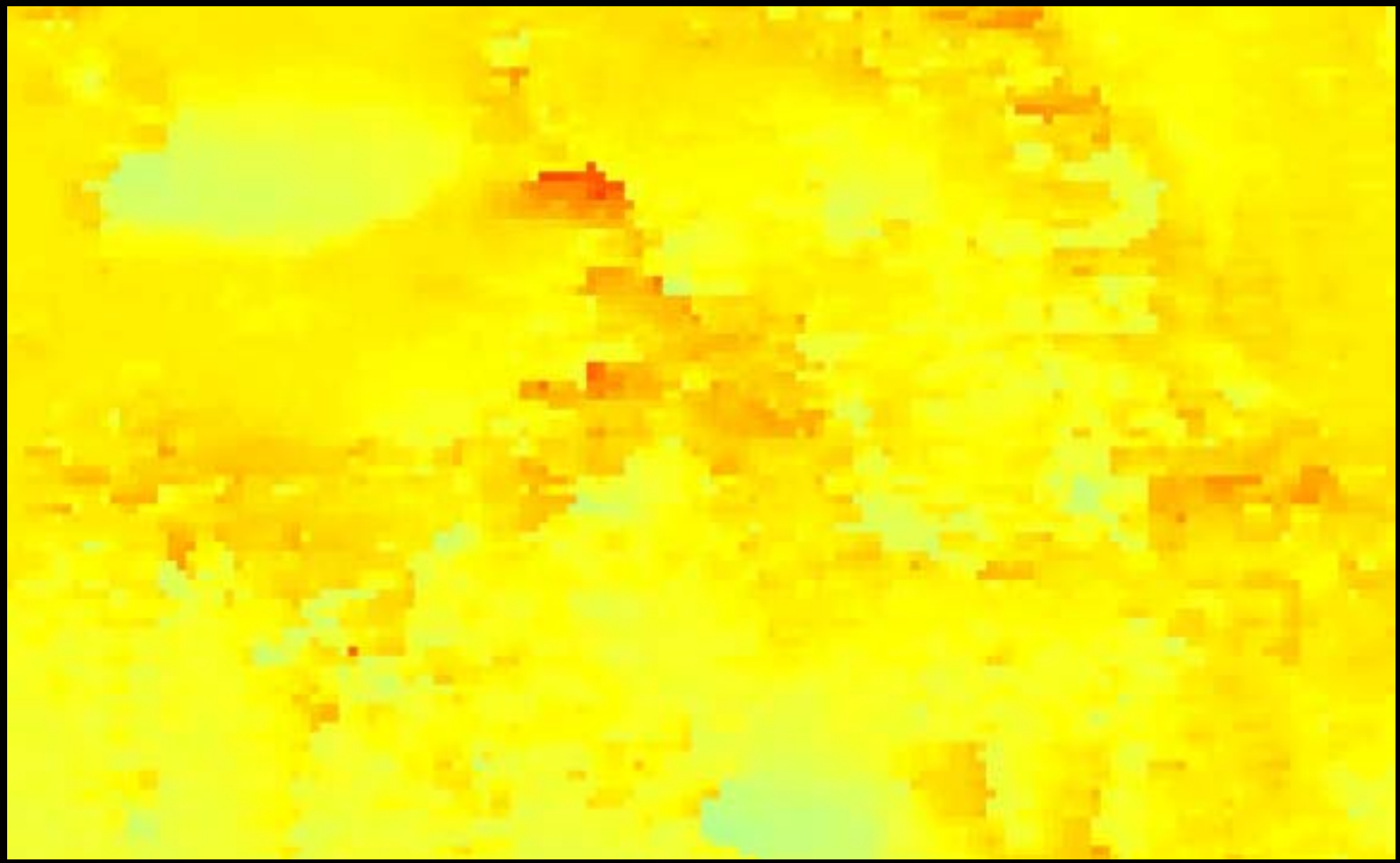
InSAR + fan margin



Orthophoto 2007 + fan margin

Topographic map (Monzen)

InSAR (ascending)



Topographic map + InSAR

The ground subsidence at Monzen Bosai Center

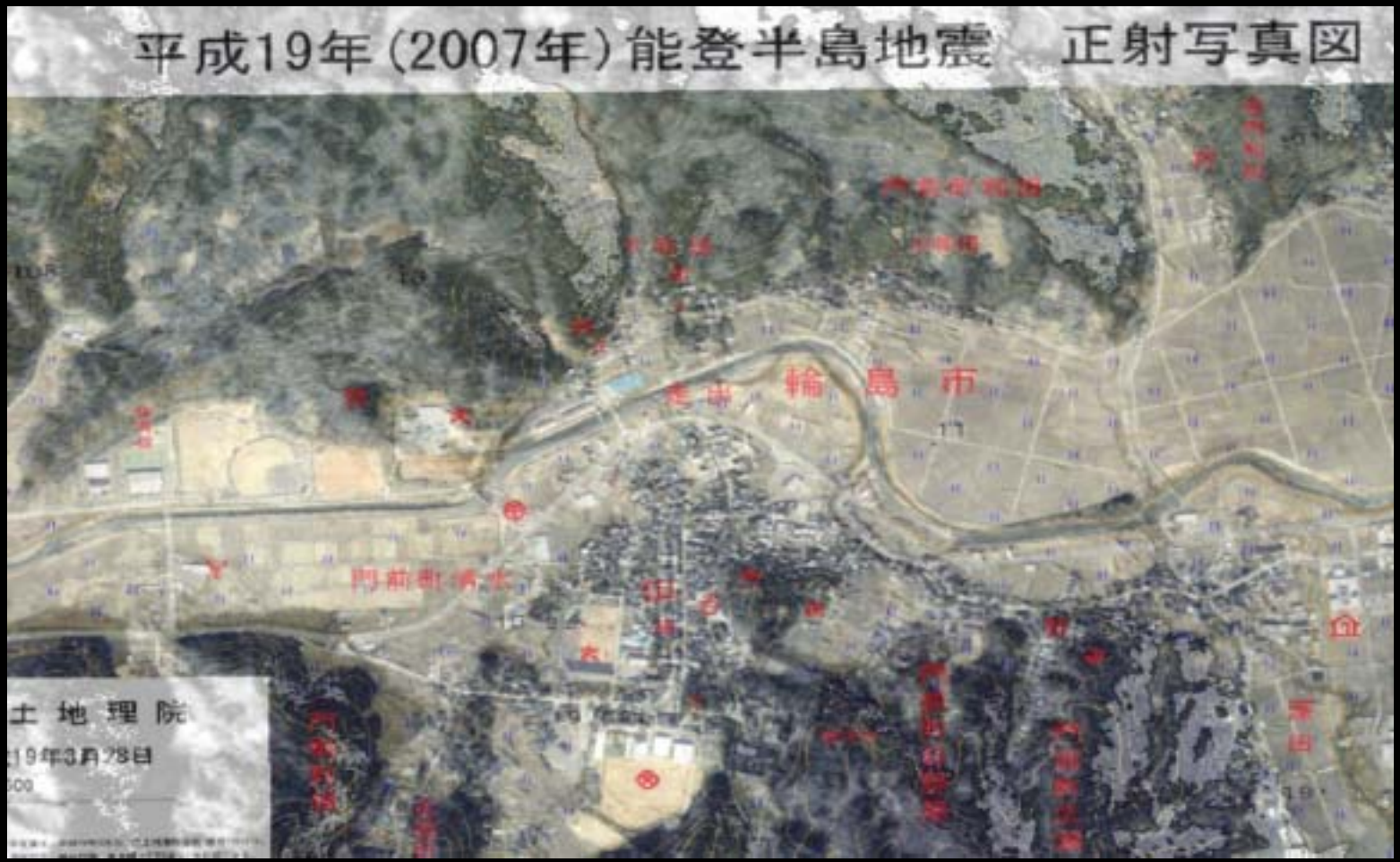
Topographic map + InSAR + Landslides

Orthophoto 2007 after Eq.

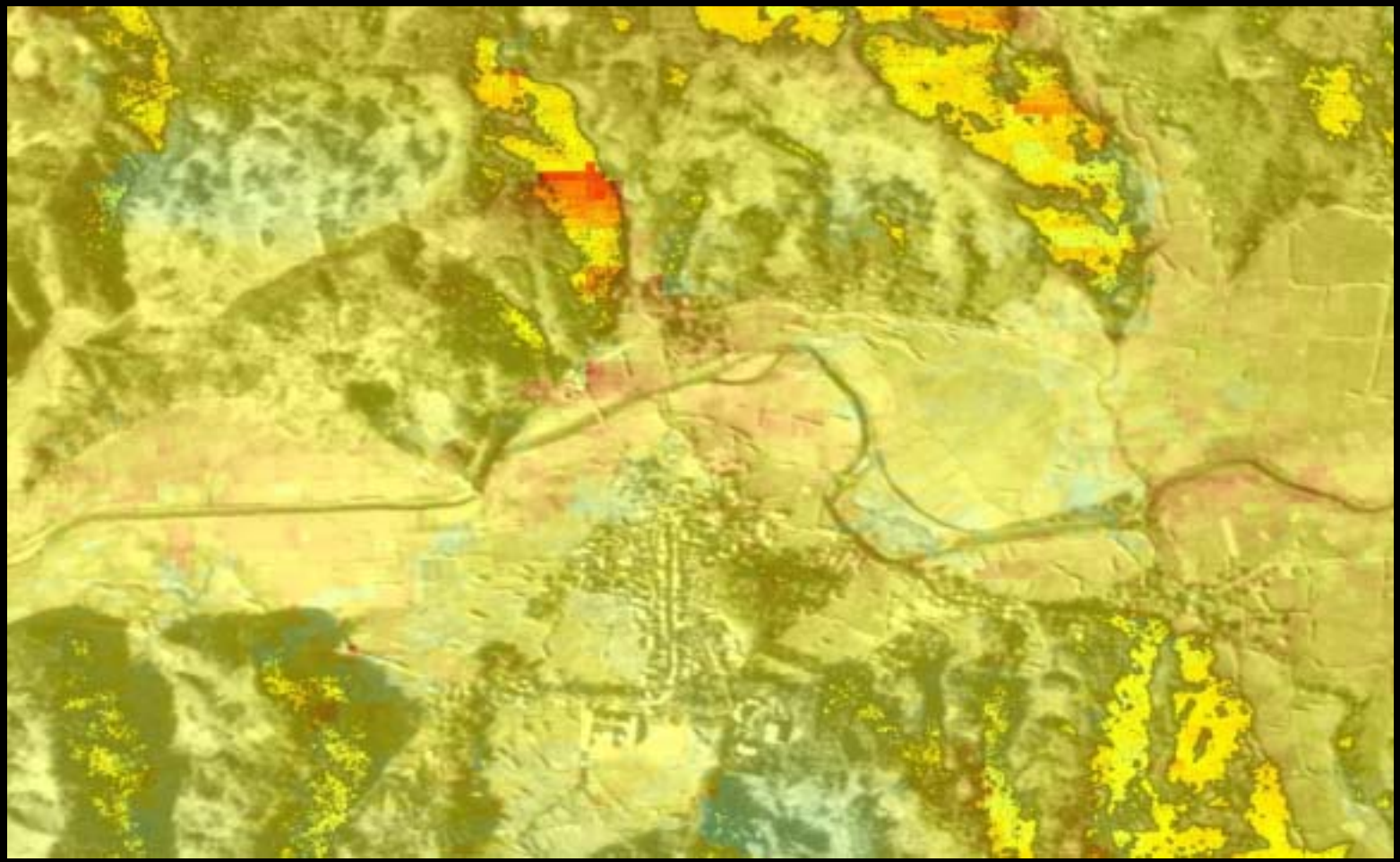
Orthophoto 1947

Orthophoto 2007 after Eq. + InSAR

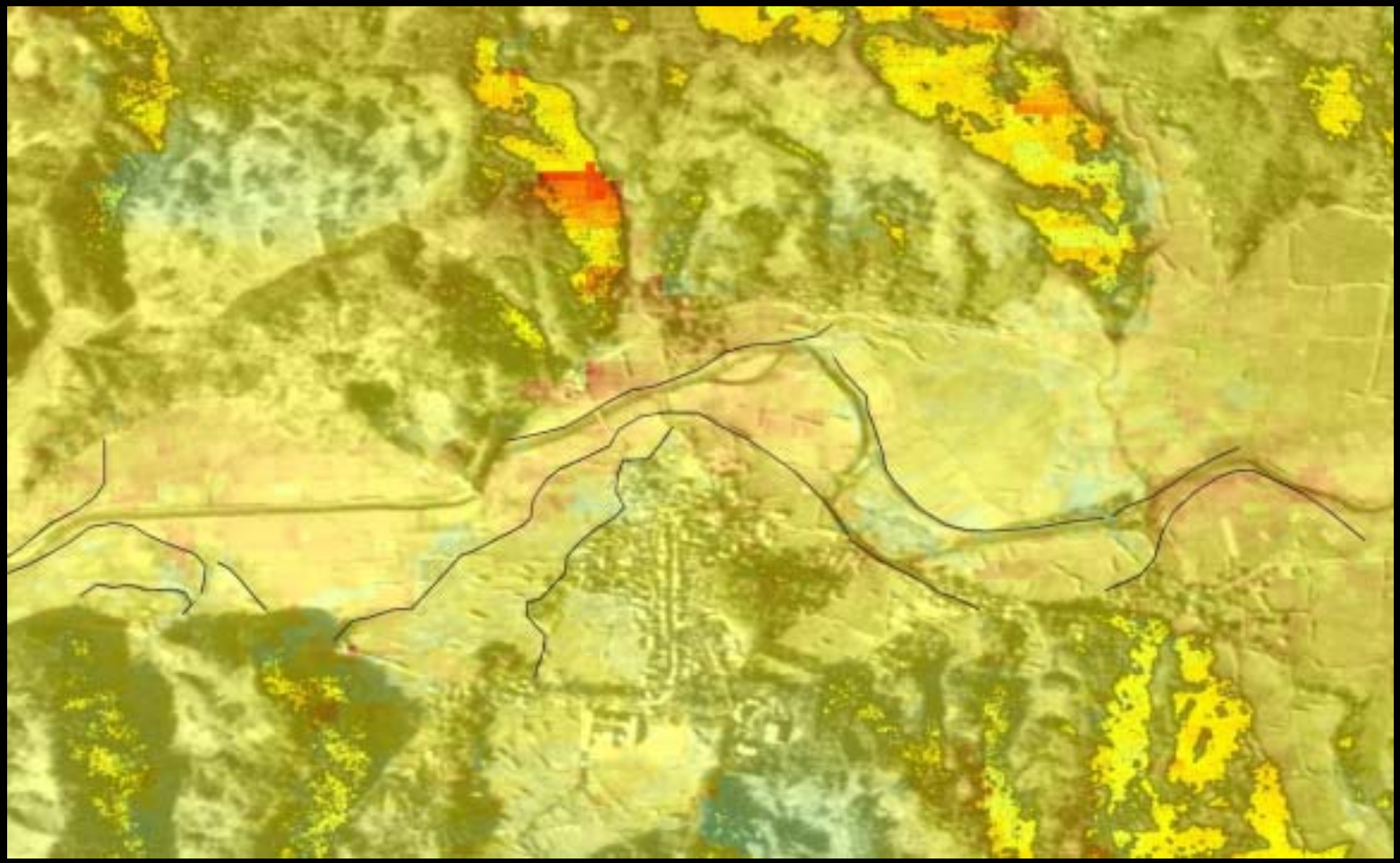
Orthophotos 1947 and 2007



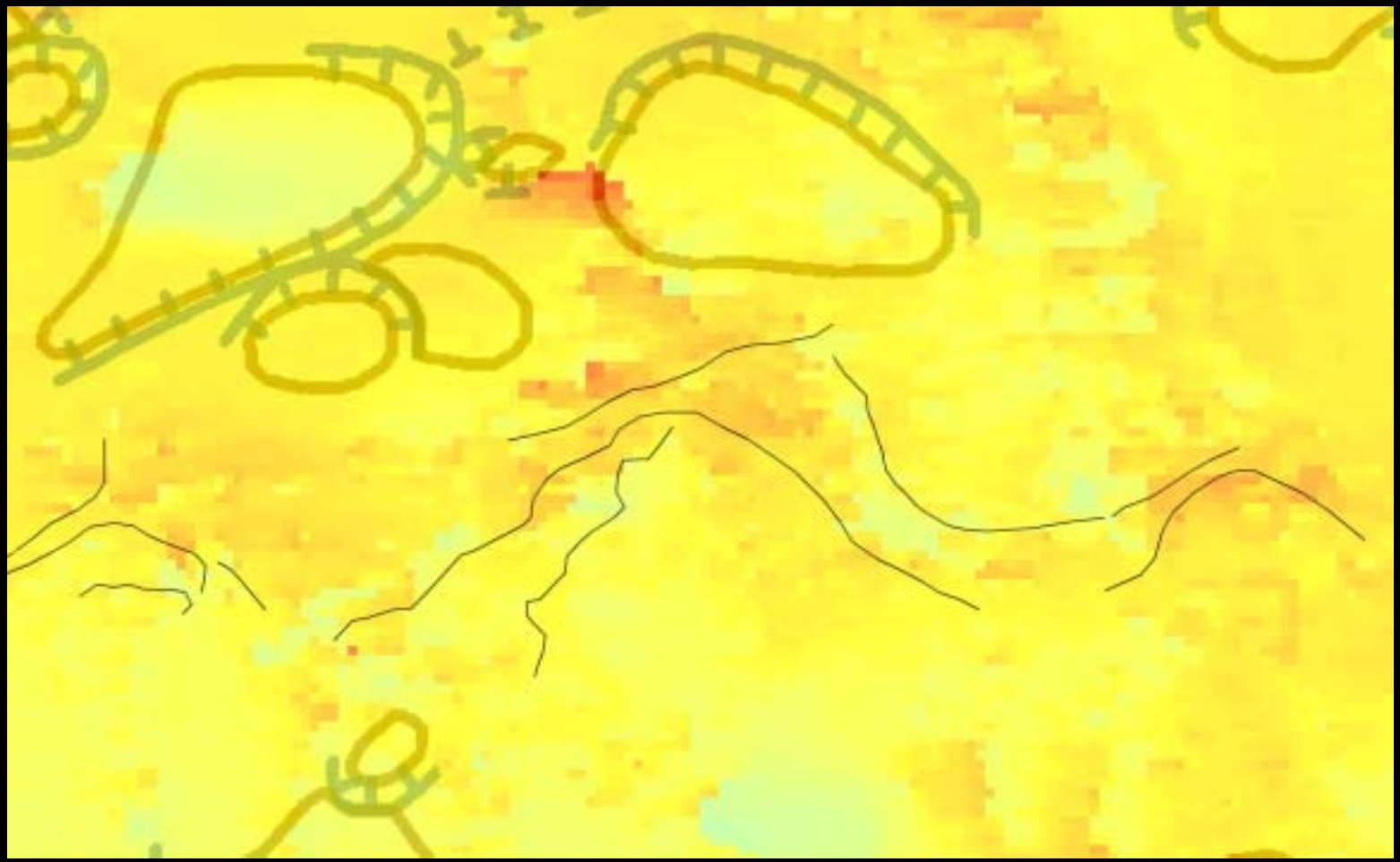
Orthophoto 1947 + InSAR



Orthophoto 1947 + fan margin

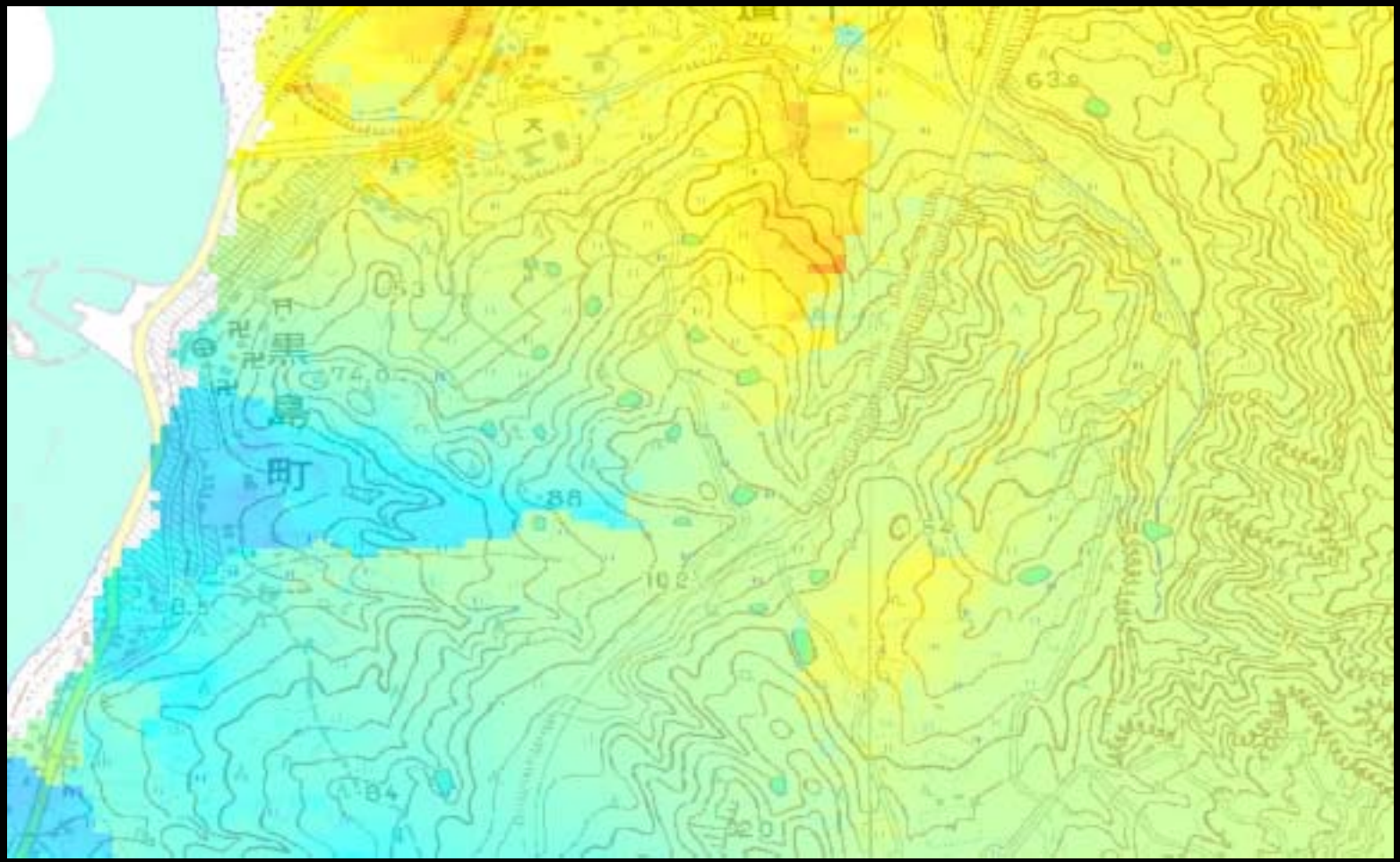


InSAR + fan margin + landslides

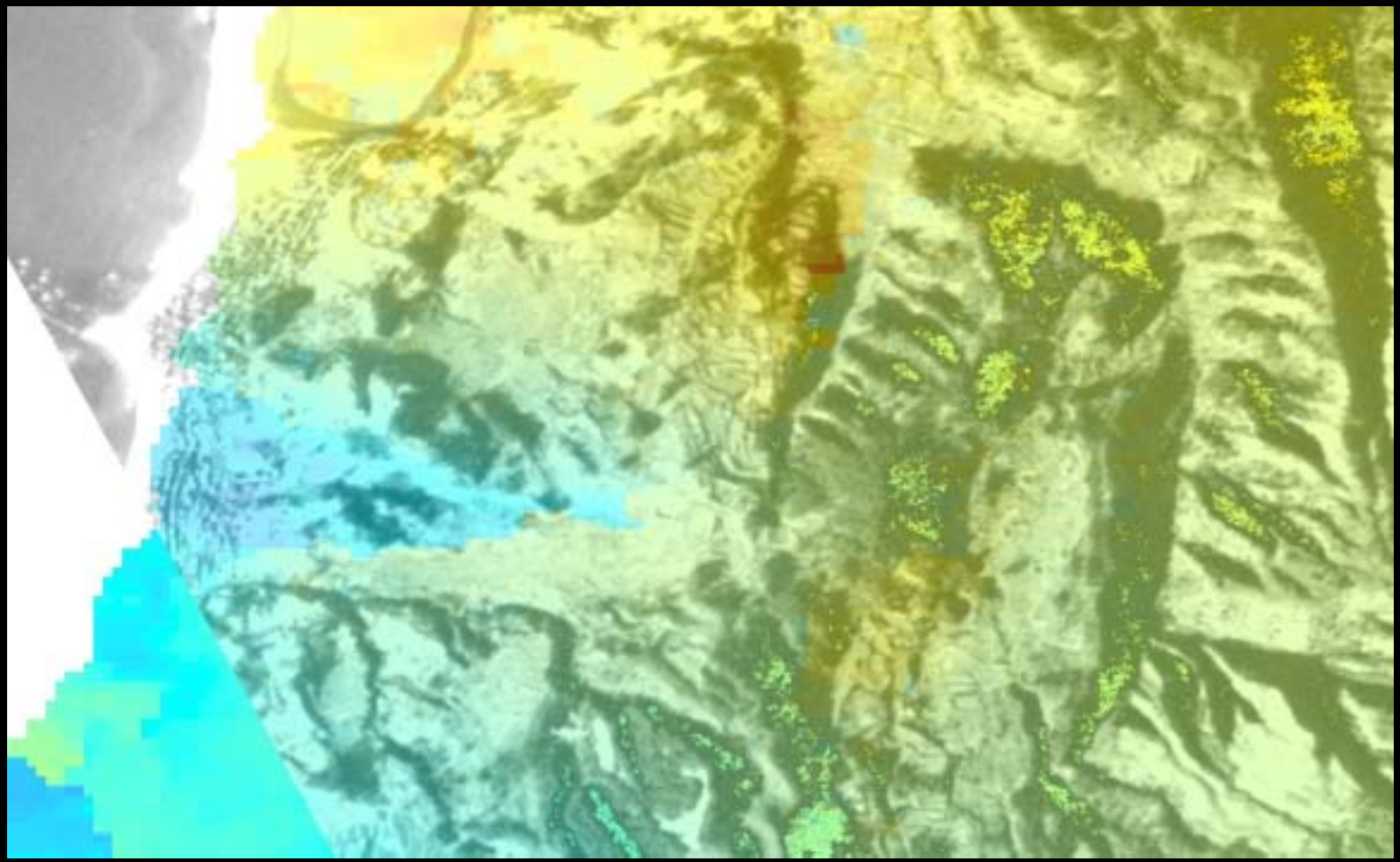


Orthophoto 2007 + InSAR + fan margin

Topograghic map + InSAR (Kuroshima)



Orthophoto 1947 + InSAR



Orthophoto 1947 + InSAR + Landslides

Summary

- The deformation by InSAR analysis recognized as the ground subsidence in situ are coincide with the

locations of old river channels, the marginal areas of sub-streams' fans and (artificial) embankments.

- In landslide areas, the directions of ground deformations detected by InSAR are also coincide with the downward of the slopes. (displacements of some landslides are not recognized in situ)
- InSAR would be possibly the powerful tool for detecting the local ground surface deformation as well as the crustal movements caused by the earthquakes