

山形月山地区におけるSAR干渉画像を用いた 地すべり性地表変動の検出

Landslides-movement detection using SAR
interferometry image in Gassan area, Yamagata Prefecture

鈴木 啓 佐藤 浩 雨貝知美 関口辰夫 小荒井 衛 *齋藤克浩 *鈴木邦章

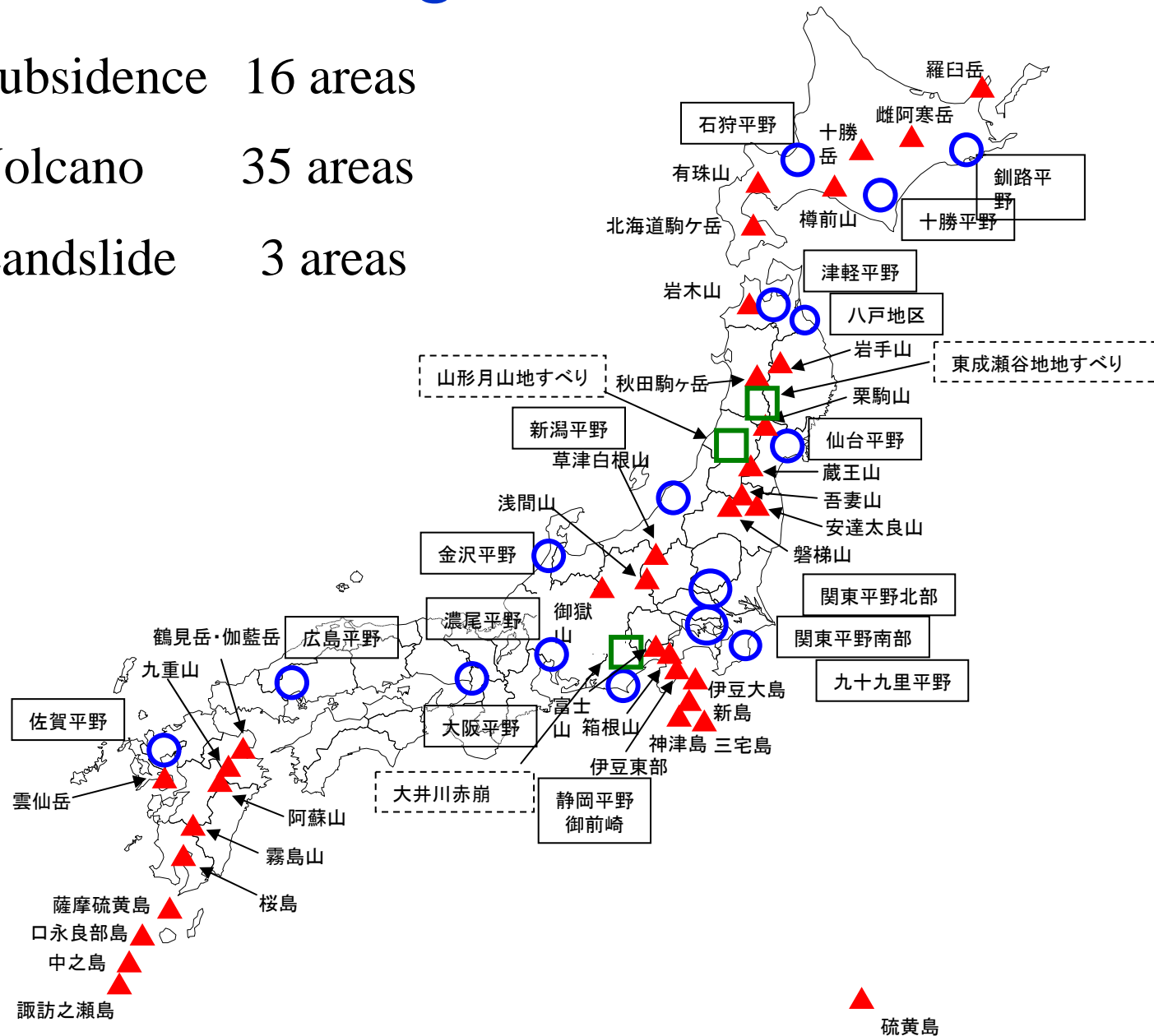
A. Suzuki, H.P. Sato, T. Amagai, T. Sekiguchi, M. Koarai, *K. Saito, *K. Suzuki

国土地理院 *新庄河川事務所

Geographical Survey Institute (GSI), *Shinjo Office of River

Regular monitoring areas

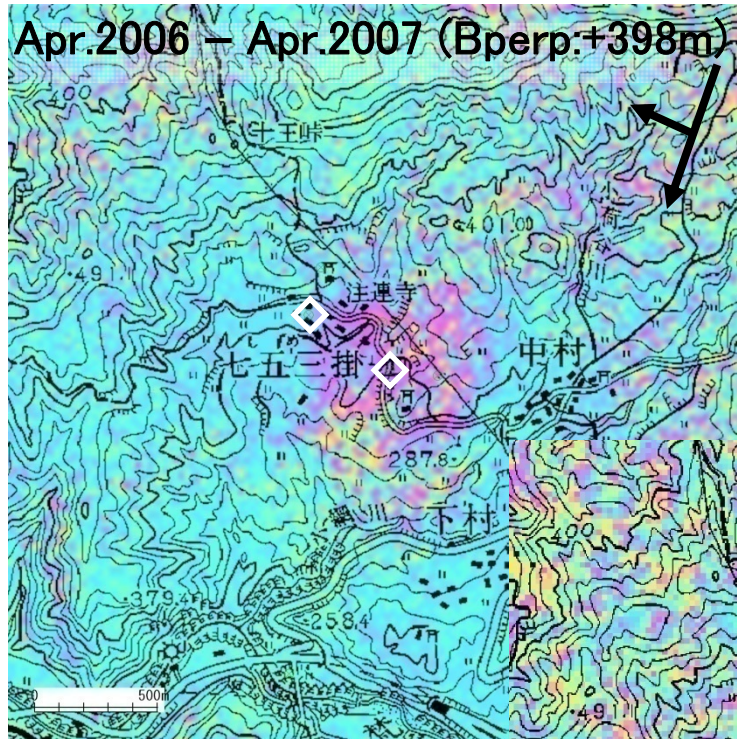
- Subsidence 16 areas
- ▲ Volcano 35 areas
- Landslide 3 areas



A) 七五三掛地区 (Shimekake area)

1. Before the damage (~Feb. 2009)

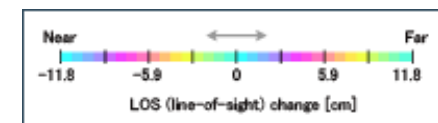
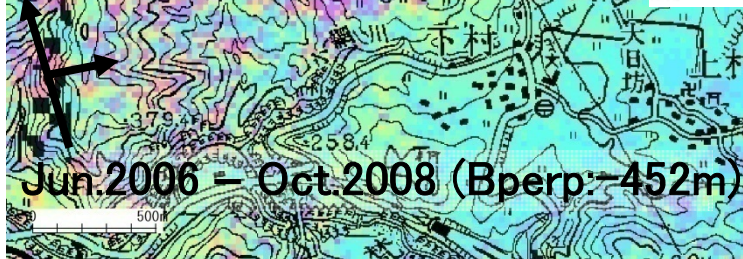
Apr.2006 – Apr.2007 (Bperp:+398m)

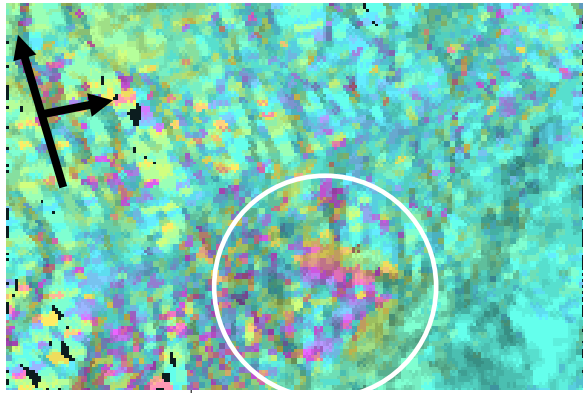


Sep.2006 – Sep.2008 (Bperp:+104m)



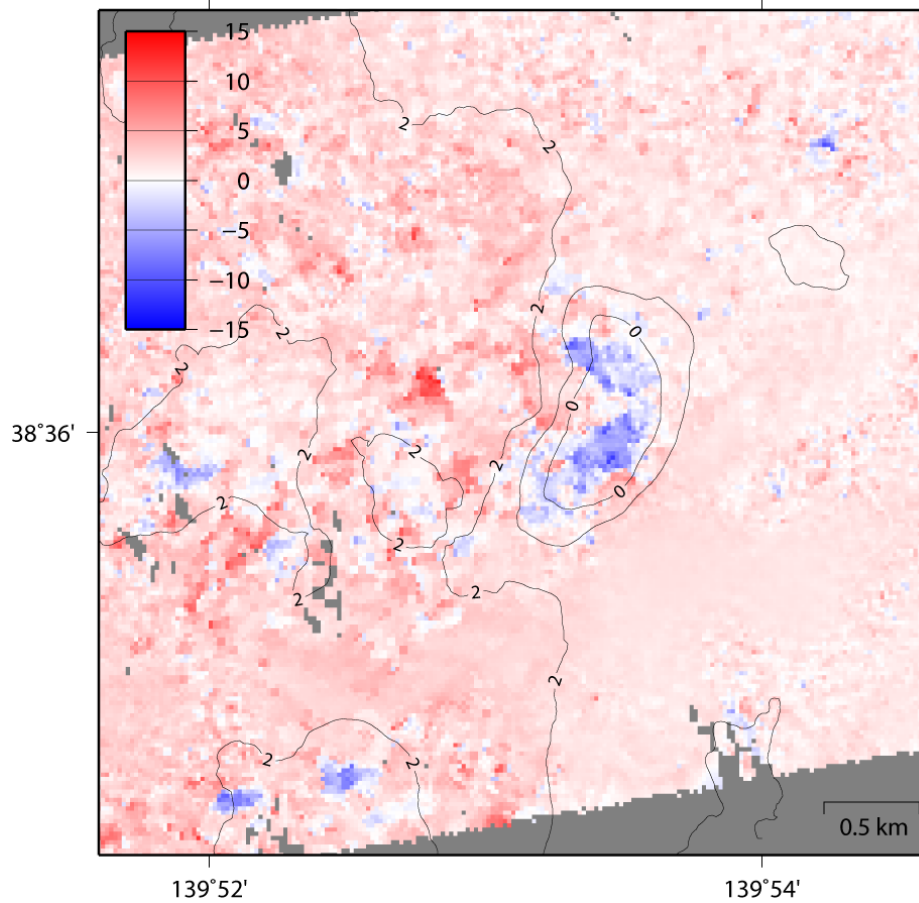
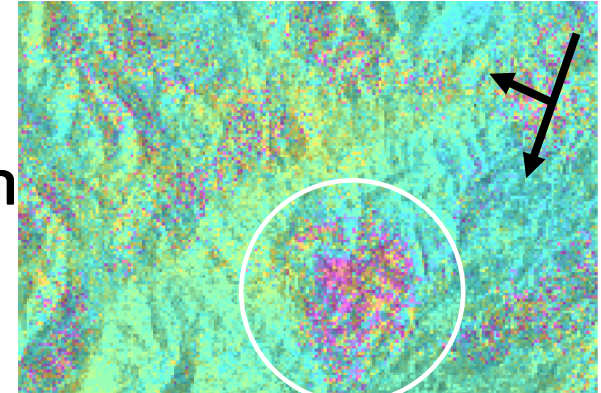
Jun.2006 – Oct.2008 (Bperp:-452m)



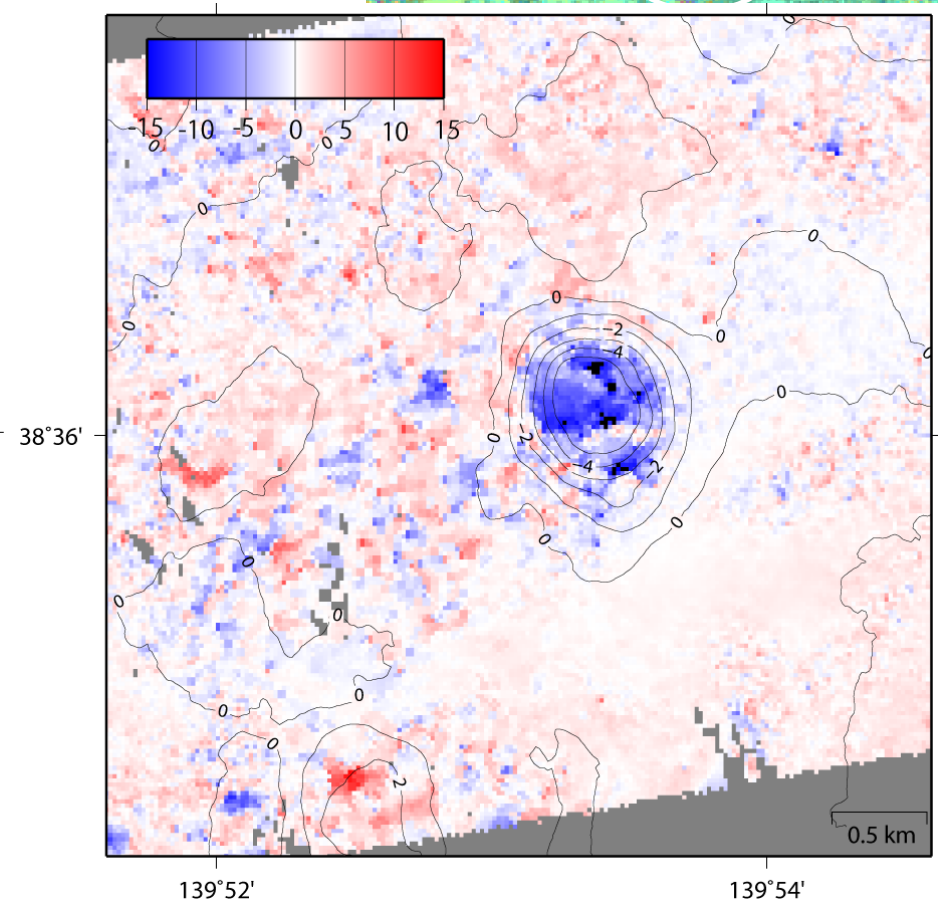


2-D displacement calculation

- Up-down component of the landslide movement was smaller than E-W component



Quasi U-D



Quasi E-W

2. GPS Monitoring (Mar. 2009~)



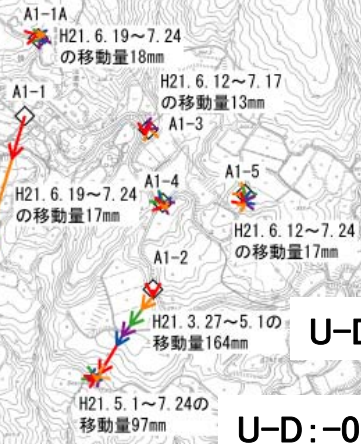
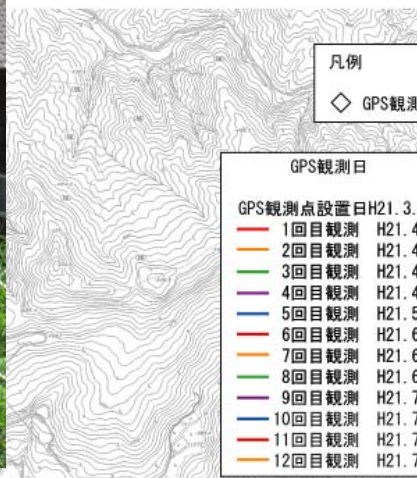
2009/5/1	-23	-13	26	2009/7/17	10	20	22
合計	-138	-88	164	2009/7/24	-10	0	10



2009/6/12	0	0	0
2009/6/19	-1	1	1
2009/6/26	-9	-5	16
2009/7/3	0	-5	5
2009/7/10	-1	-3	3
2009/7/17	-6	7	9
2009/7/24	0	1	1
合計	-17	-4	17

H21. 3. 27~5. 1
の移動量1141mm
6.12亡失確認

平面図スケール
0 500m



U-D: -2.8cm

U-D: -0.2cm

U-D: -24.6cm

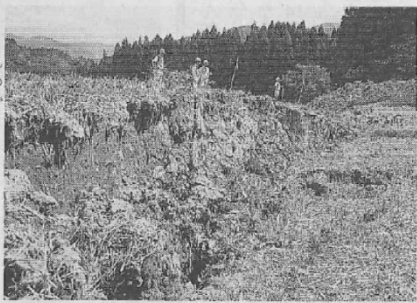


地滑り28死、5世帯避難 山形「おくりびと」ロケ地も

山形県鶴岡市大網の七五三掛地区で4月以降、地滑りによる被害が拡大している。田んぼや道路のあちこちに亀裂が広がり、最大で2層を越す段差も。家屋にも損傷が出ており、5世帯が市営住宅などに避難した。地区は水アカデミー賞を受賞した映画「おくりびと」のロケ地の一つ。地滑りの範囲は現在、幅400m、長さ700mほど面積は約28ha。同地区は農林水産省が91年に地滑り防止区域に指定し、地下水を抜く井戸を掘るなど対策を取ってきた。今回の地滑りは、住民が2月に道路の亀裂を発見。県が対策工事をしたが、4月9日に警戒水準を越す亀裂の拡大（1時間あたり2cm以上）が確認され、住民に自主避難を要請した。

29日に現地調査した国土交通省と農水省の専門家によると、深さ約24・5mの地点に「すべり面」があり、雪解け水がこの面にしみ込んで地滑りを引き起こしたらしい。調査を委託された独立行政法人土木研究所・地すべりチームの藤沢和範・上席研究員は「これから梅雨に入り、また水がしみこむので動きはしばらく止まらないだろう」と話した。

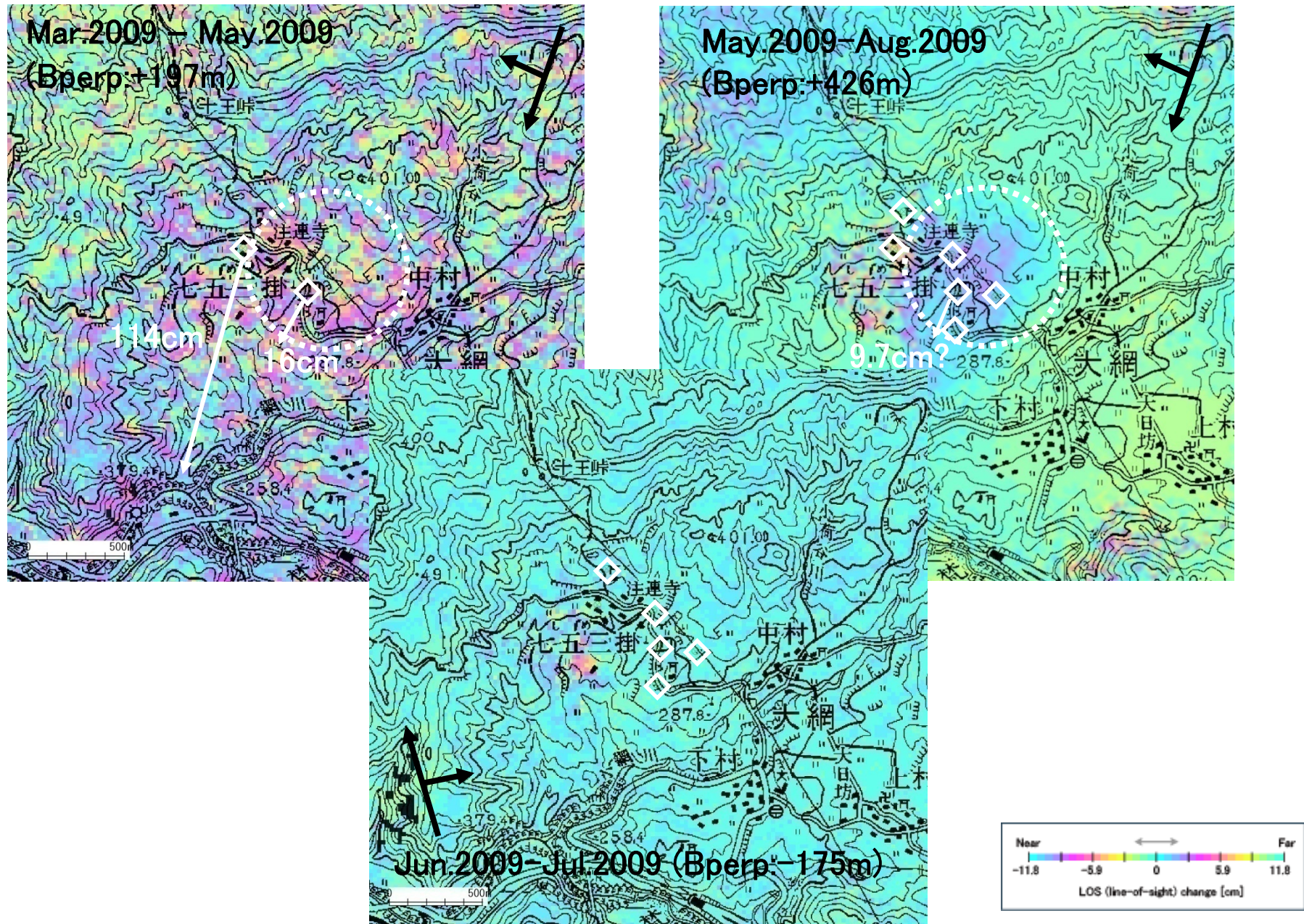
「おくりびと」が撮影されたのは07年春で、妻の葬儀に遅刻した主人公らに怒っていた夫が、納棺師の仕事ぶりに感激し、帰る際に干し柿を渡して謝る場面があるが、このシーンを撮影した民家と、赤い煙突から煙が上がる場面など外観を撮影した1軒が同地区内にある。（川原千夏子）



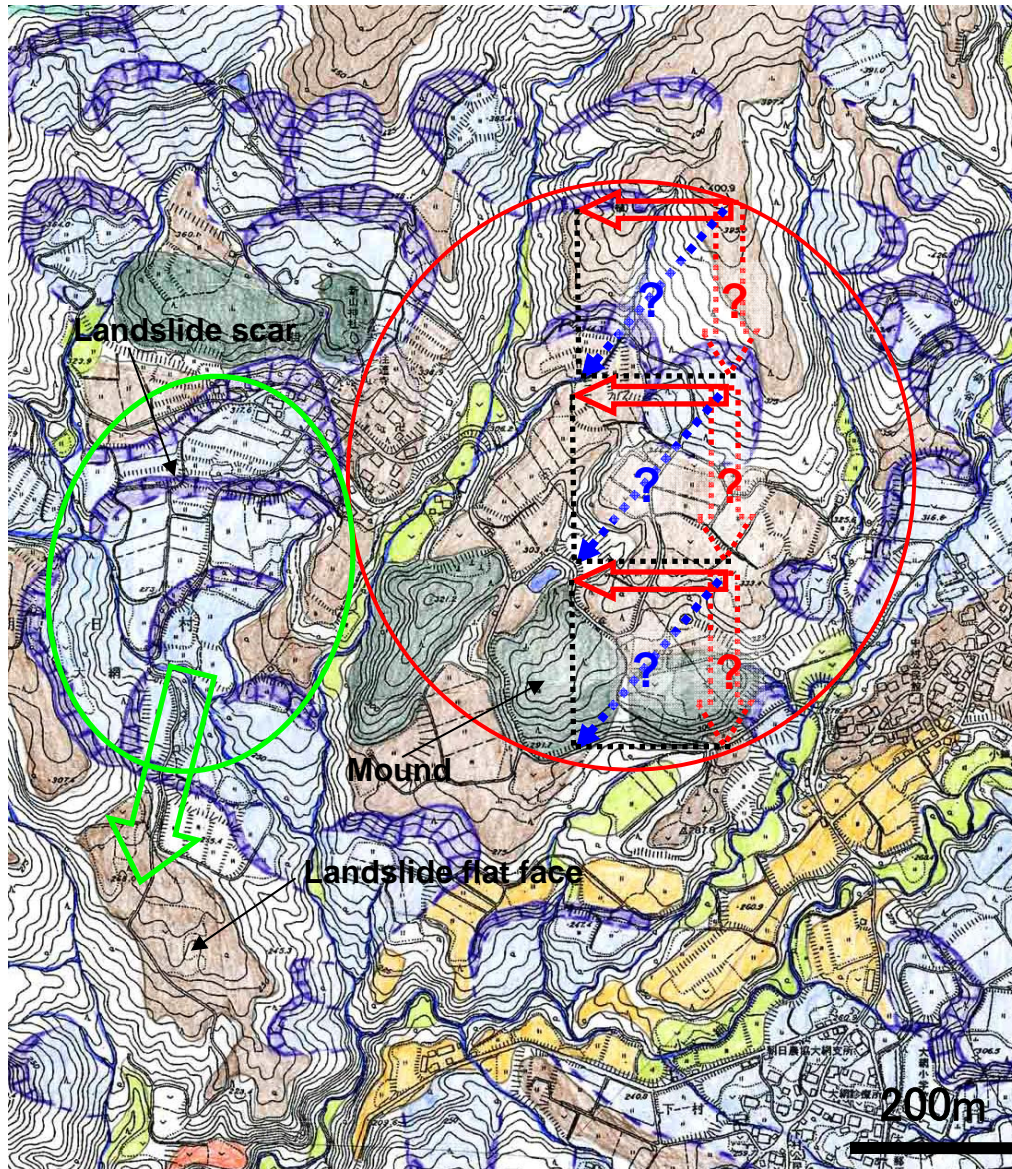
地滑りで亀裂が広がった田んぼ
＝山形県鶴岡市大網、川原写す

5/30 朝日

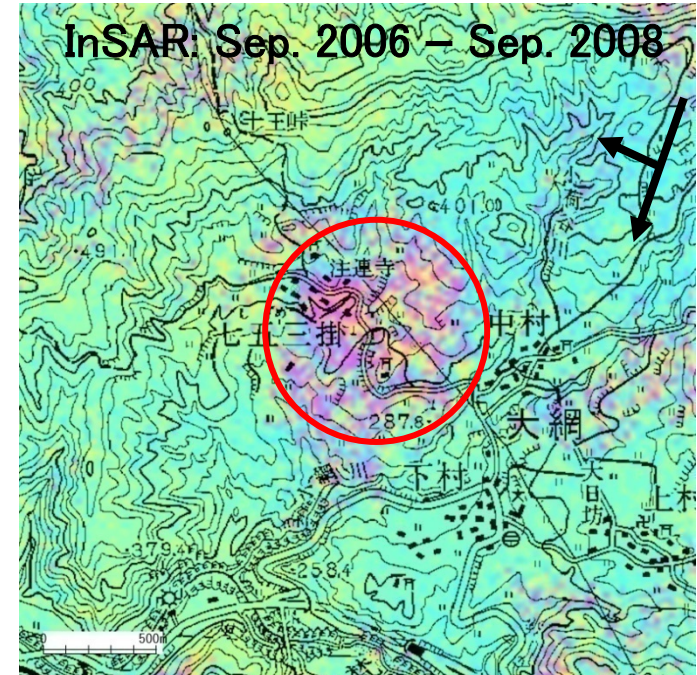
3. Regular monitoring after the damage (Feb. 2009~)



4. Model of Landslide-movement

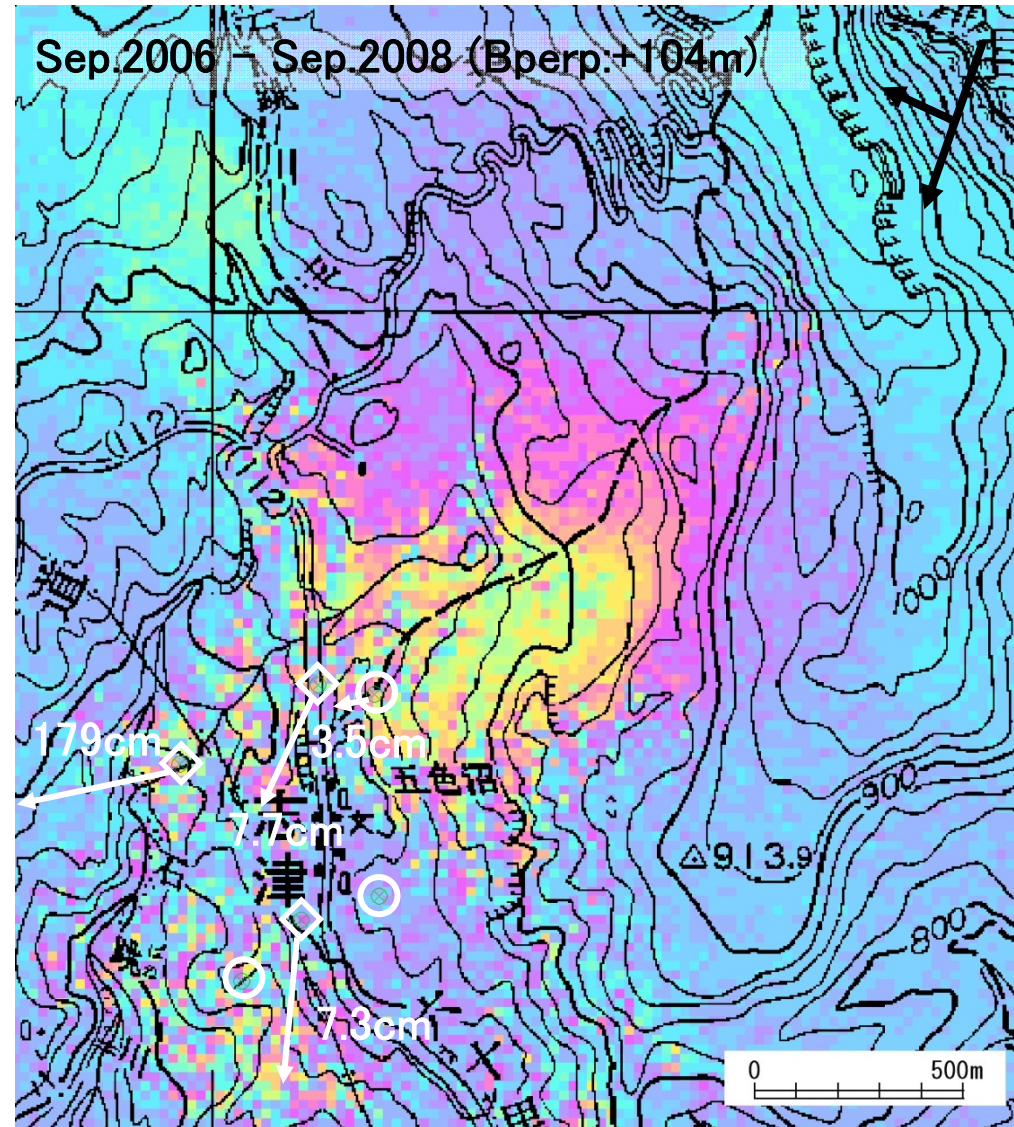
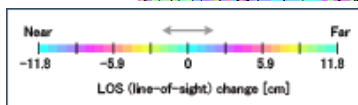
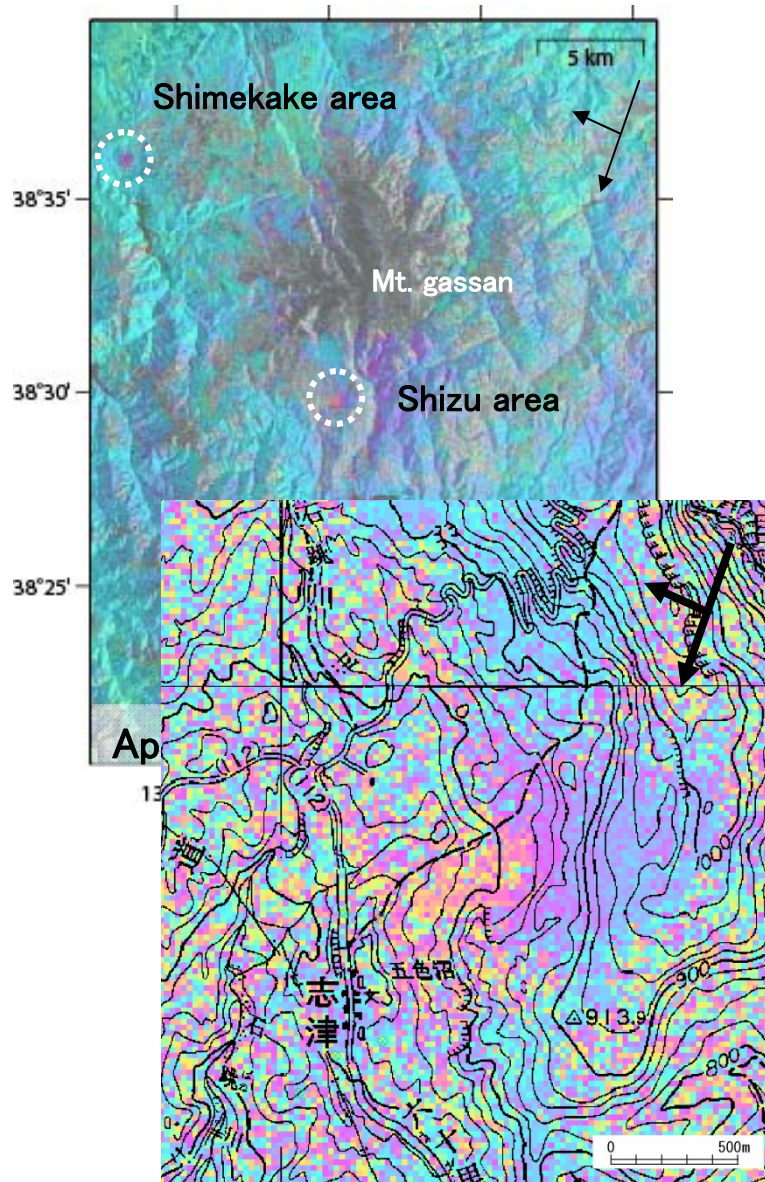


Landform classification map (1/5,000),
Sekiguchi, original figure



- Landslide where the deformation was detected by InSAR
- ↓ Movement including west component, induced by snowmelt and precipitation
- Notable activated landslide since Feb 2009, that gave the damage in Shimekake area.

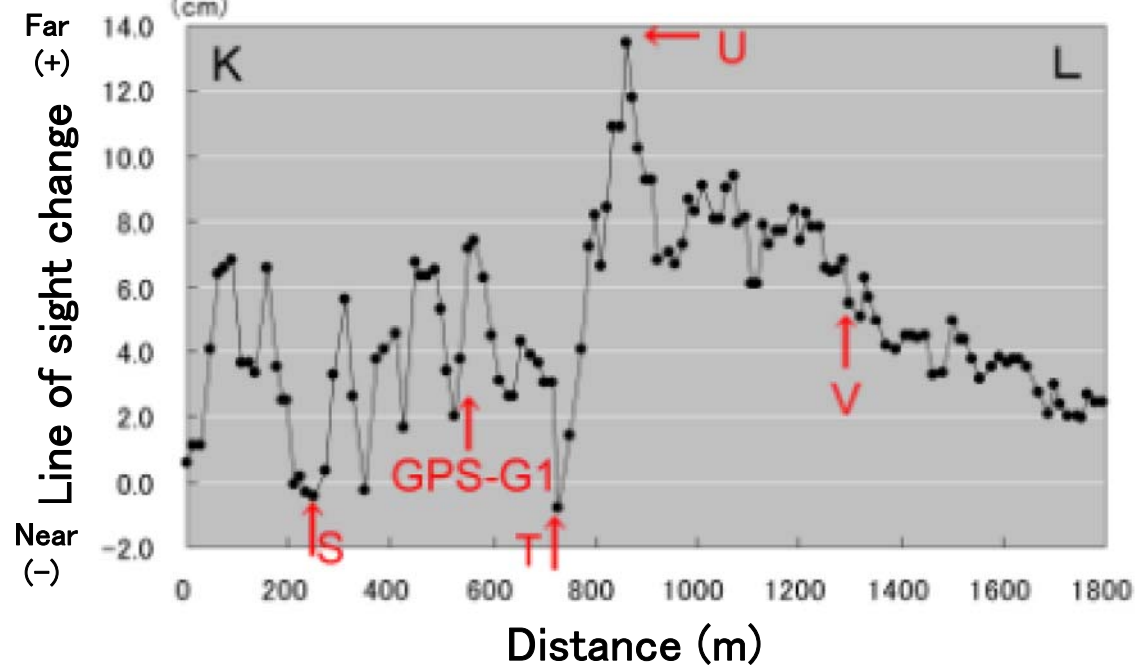
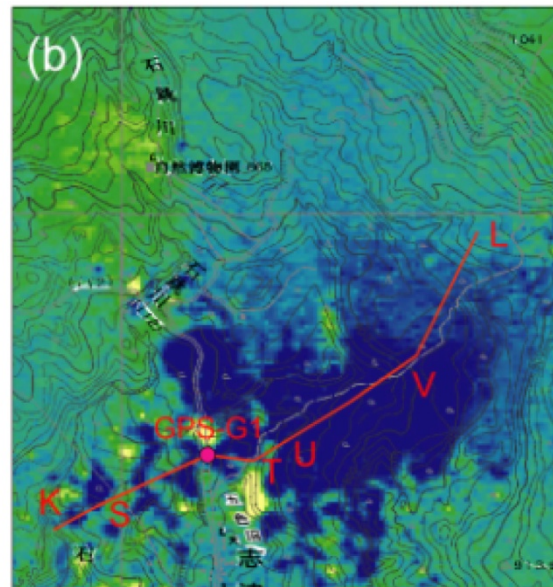
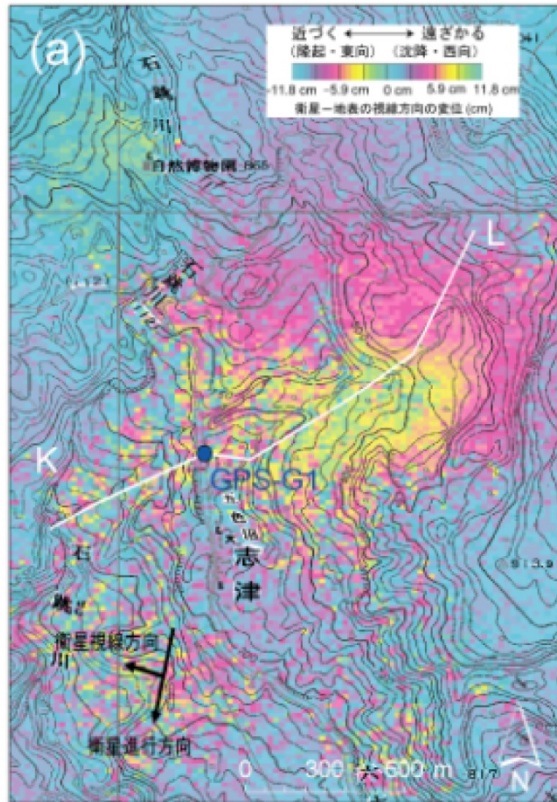
B) 志津地区 (Shizu area)



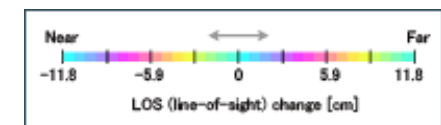
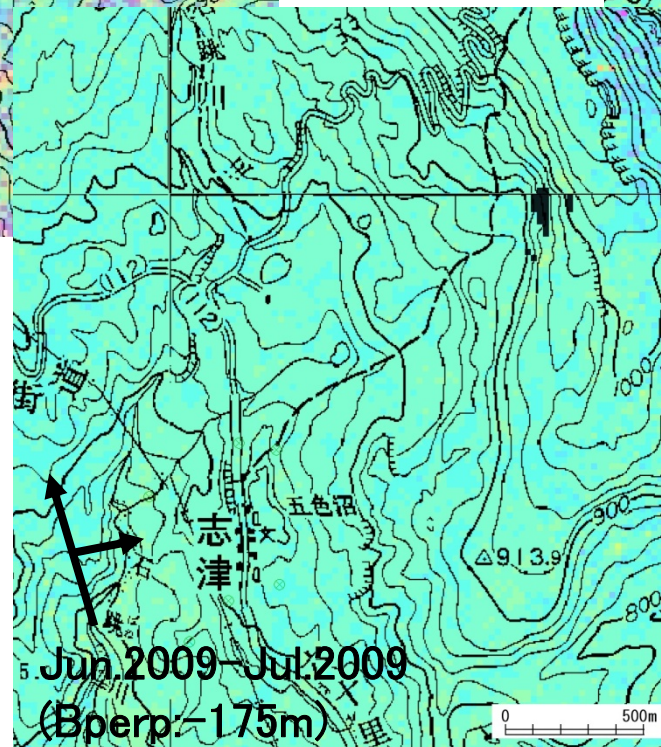
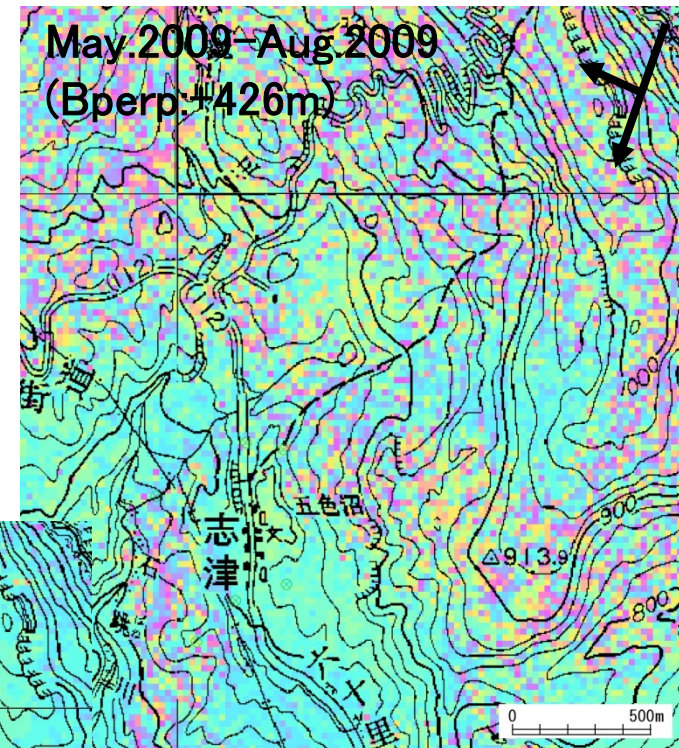
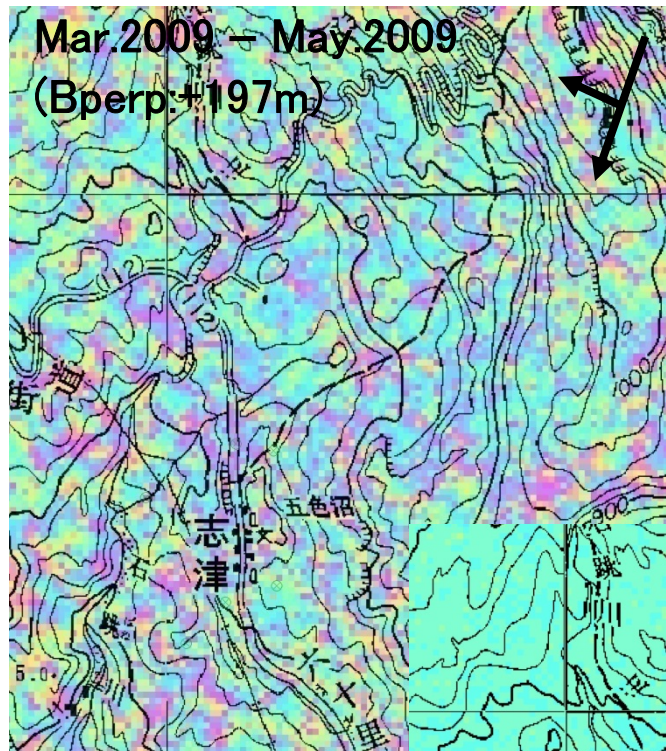
◇ GPS period: Oct. 2006 - Oct. 2008

○ GPS period: Dec. 2007 - Oct. 2008

Profile of Shizu area for Sep.2006 – Sep.2008



Landslide movement of Shizu area after Mar. 2009



Summary

<Shimekake area>

- Subtle land deformation before the activated landslide since Feb 2009 was detected using the two SAR interferometry images (Apr 2006-Apr 2007; Sep 2006-Sep 2008).
- Shimekake area has been damaged since Feb 2009 by the activated landslide, that may be related with the landslide movement detected by the two SAR interferometry images (Apr 2006-Apr 2007; Sep 2006-Sep 2008).

<Shizu area>

- Deformation in landslide was detected between Apr 2006 and Sep 2008 (for more than 2 yrs), using SAR interferometry.
- Remarkable deformation was not detected between Jun 2009 and Jul 2009 (for the short period of 46 days).

<Advantage of SAR interferometry for landslide monitoring>

- Precursory deformation is detectable in landslide areas, where in-situ patrol plan or in-situ monitoring (such as GPS monitoring) plan will be suitably made in the initial response.
- By investigating not only in-situ monitoring results but also SAR interferometry images, it will be possible to make suitable plan for landslide prevention measures and to confirm the effect of the measures.

<Acknowledgement>

Any copyright relating to the observed raw data used in this presentation shall belong to Ministry of Economy, Trade and Industry (METI) and the Japan Aerospace Exploration Agency (JAXA).

(本発表でを使用したPALSARプロダクトの観測原データは経済産業省および宇宙航空研究開発機構(JAXA)に帰属します。)

We would like to express thanks to Prof. Yagi, who showed the landslide sites and gave the comments on their geomorphological features in our field survey.