



ALOS DATA for Industrial Applications

**Geographical observation of the landslide of
the roadside slope and its background hill
and its prediction measure**

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**Tatsuji Miura
Information Server Lab., Inc.**



Rev.F

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About Fukuyama Consultants Co., Ltd.

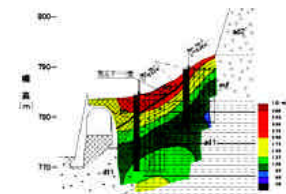
Established: Mar. 1949.

Service

- Traffic Management
- Road Disaster Prevention
- Structural Design
- Construction Management
- etc.



City Planning



Geological Survey

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Remote Sensing Research Activities

1981 – 2001 A.D.

Participate in the Study Group for the Application of Remote Sensing Technology to Civil Engineering.

1983 – 1992 A.D.

Dispatch of Staff to the Remote Sensing Society of Japan.

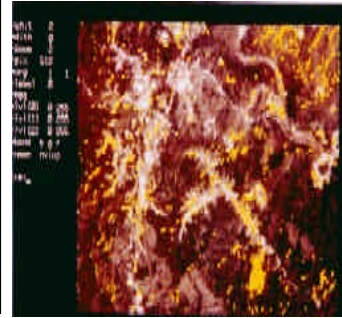
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A Chronicle on the Research on Sub-surface Foundation by the use of Remote Sensing

Year	Research	Sensor
1980	Landslide Hayakawa, YAMANASHI	TM / LANDSAT
1983	Hot spring spots Mt. Chichibu, SAITAMA	TM / LANDSAT
1993	Landslide Takaoka, MIYAZAKI	TM / LANDSAT
2000 –	Landslide Hoshino , FUKUOKA	SAR / JERS-1



False Color Image (*)

1993 Takaoka, MIYAZAKI

(*) Copyright NASDA

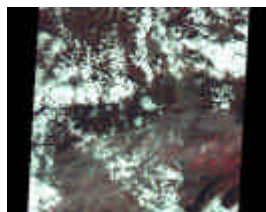
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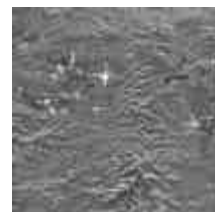


A Revolution in Remote Sensing with the use of SAR

- Replacing the conventional OPS observation method which has been prevented by cloud to active SAR.
- Obtaining detailed ground surface cover data using polarized wave.



JERS-1 VNIR(*)



JERS-1 SAR(*)

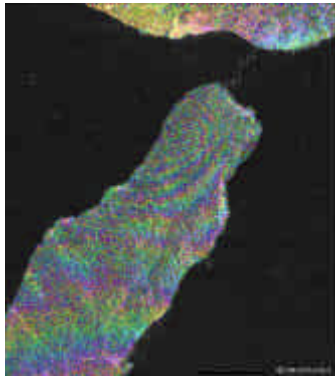
(*) Copyright NASDA

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Examples of Geographical Observations on Changes of Earth Crust using InSAR.



- Mar. 6, 1997 Sendai, KAGOSHIMA
- Sept. 3, 1998 Shizukuishi, IWATE
- etc.

Jan. 17, 1995 Awaji, Hyogo (*)

(*) Copyright NASDA

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Why landslide observation by Remote Sensing?

- Landslide Site
Over 20,000- (in Japan)
- Inaccessible areas such as mountainous region.
- Periodic observations.
(at every interval of several weeks)
- Detection of disaster areas and issuing alerts or warnings.



Tamanoki, NIIGATA

Feb.15, 1985

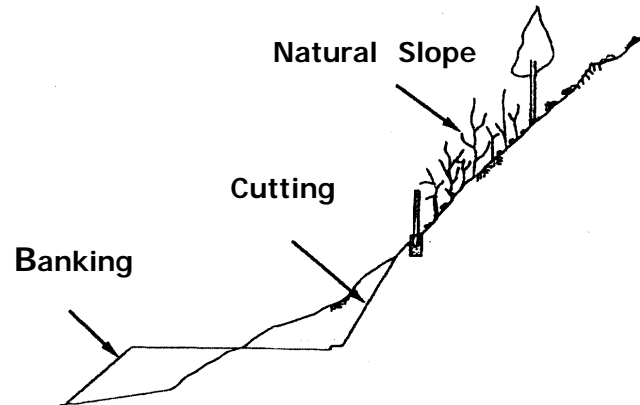
Size : 110[m] x 70 [m]

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A Slope Model

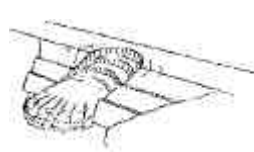


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A Landslide Model



Slope Corruption



Land Slide

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Our Target

- Observing Landslide Prone Areas.
(Scale : more than 100 meter x 100 meter)
- Landslide magnitude from several milli-meter to several centi-meter.

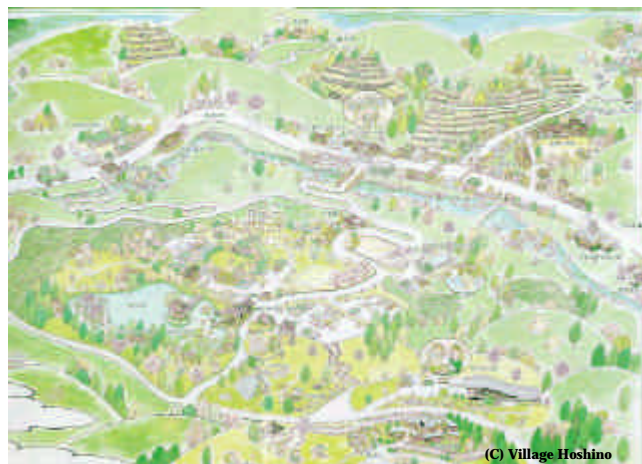


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Sketch of the Study Site in Village HOSHINO.



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Over View of Study Site

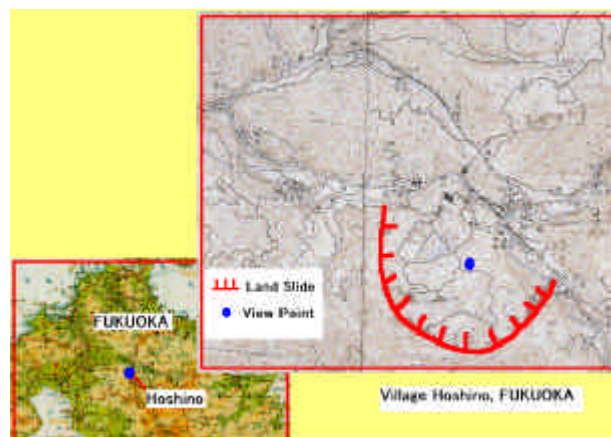
- Hoshino Village, Yame-Gun, Fukuoka Pref.
- Designated in 1959 as a landslide prone area.
- Commencement of a research study in 1998.
- Landslides caused by concentrated heavy rainfall and ground water.
- Annual landslide magnitude from several milli-meter to several centi-meter.

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Location Map

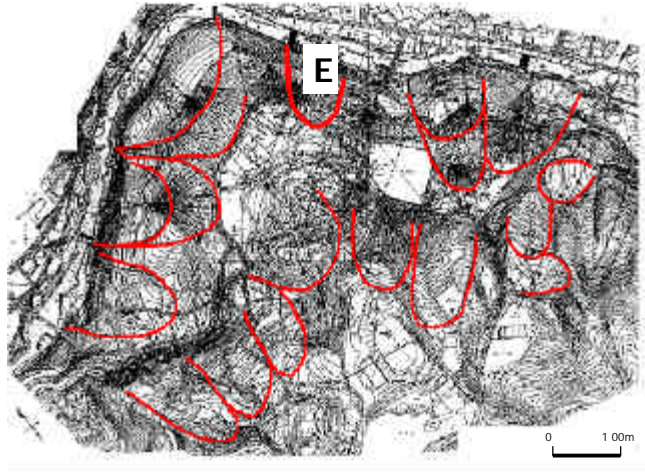


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Landslide Blocks



Landslide Area

Approx.

800[m] x 600 [m]

Total: 18 Blocks

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Detail of Block E



Block: E

Size : 90[m] x 100 [m]

— : Crack

— : Border(Estimated)

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Analytical Data Set(*) of JERS-1 SAR

Path – Row : 79-245, Processing Level : 0

Set	Date	Period (Month)	B[m](*)	Bp[m](*)	Bh[m](*)
1	1994/01/13	38	78.07	58.48	51.72
	1997/03/02				
2	1995/08/08	36	165.39	93.96	136.11
	1998/08/12				
3	1995/08/08	37	439.99	38.71	438.28
	1998/09/25				
4	1996/04/28	27.5	441.07	331.35	-291.12
	1998/08/12				
Original 1 (DEM)	1998/08/12	1.5	307.19	55.29	302.17
	1998/09/25				
Original 2 (DEM)	1996/04/28	3	254.44	195.58	162.76
	1996/07/25				

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(*)issued by NASDA 17



Analytical Method

Classified by DEM

Set	GSI(*1)	Original 1 (*2)	Original 2 (*2)
1		N/A (*3)	N/A
2			N/A
3			N/A
4		N/A	

(*1) GSI :Numerical Map 50 m mesh issued by the Geographical Survey Institute
For 2 Pass Interferometry.

(*2) Original 1, 2 : Partial Scene / Produced from the SAR Images.
For 3 Pass Interferometry.

(*3) Not Applicable.

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Tools

- EarthView (*)
APP1.62
EV InSAR 1.21
- Personal Computer (PC-AT Compatible)
CPU AMD Duron 700 MHz
Memory 256MB
HDD 20GB

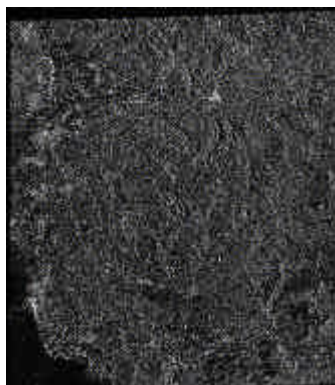
(*) Copyright ATLANTIS SCIENTIFIC INC.

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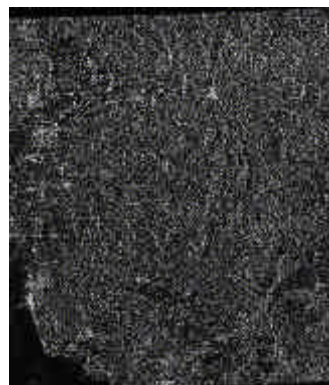
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Image Processing



Master: 1998/08/12



Slave: 1995/08/08

Sample images of Input Data

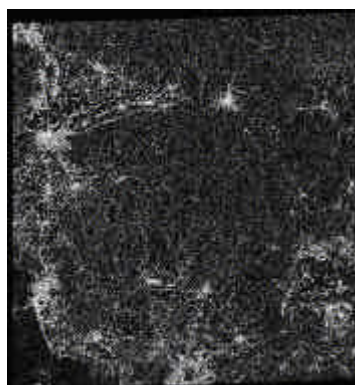
Copyright NASDA

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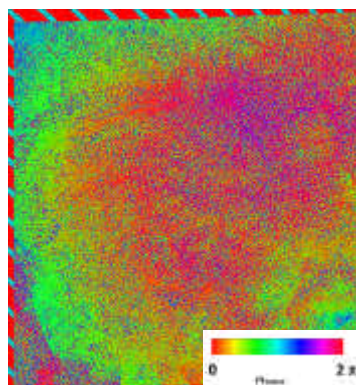
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Image Processing



Coherence: **Full scene**
(Set1:GSI)



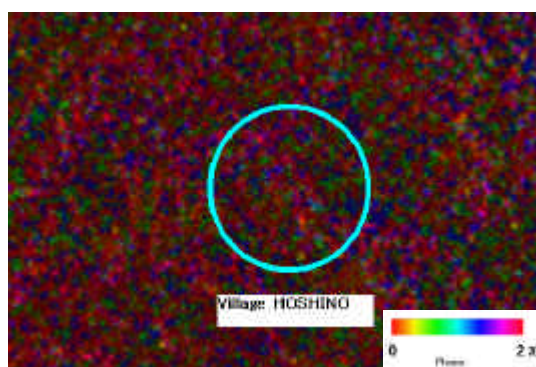
Interferometry: **Full scene**
(Set1:GSI)
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Image Processing



Interferometry + Magnitude
(Set1:GSI)

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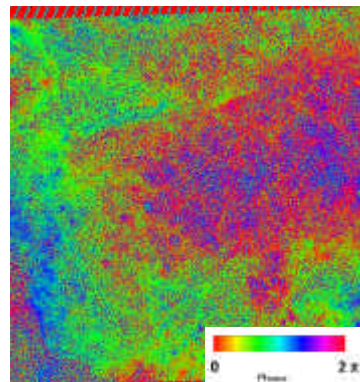
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Image Processing



Coherence: **Full scene**
(Set3:GSI)



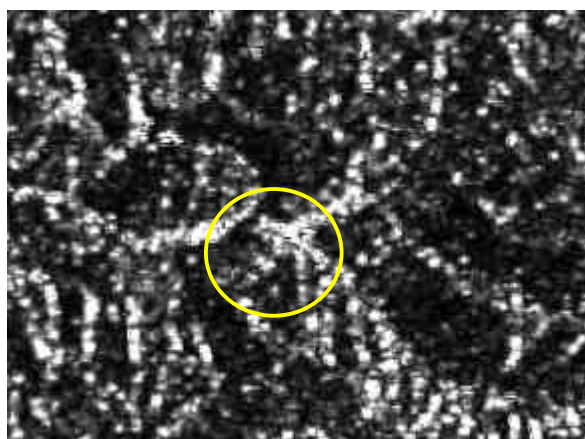
Interferometry: **Full scene**
(Set3:GSI)
Copyright NASDA

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Image Processing



Magnitude of Study Site.

(Set3:GSI)

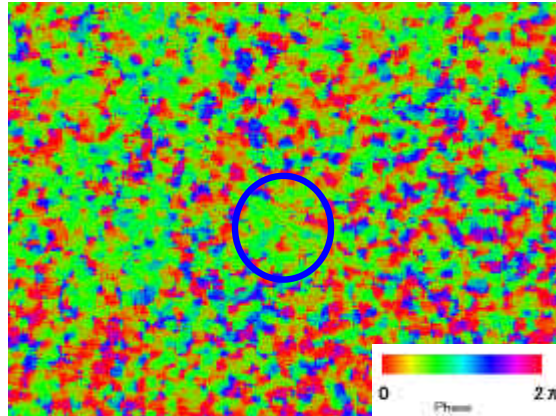
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Image Processing



Interferometry of Study Site.

(Set3:GSI)

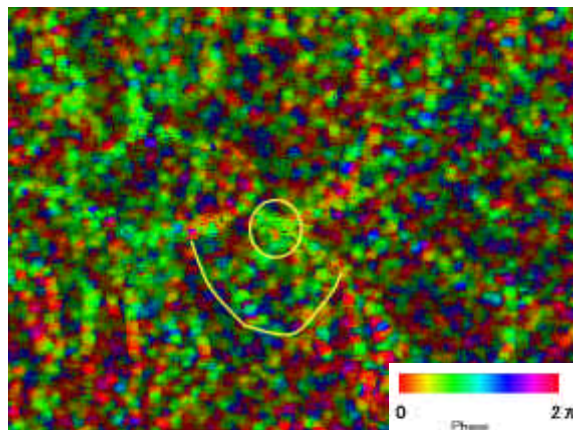
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Image Processing



Interferometry + Magnitude

(Set3:GSI)

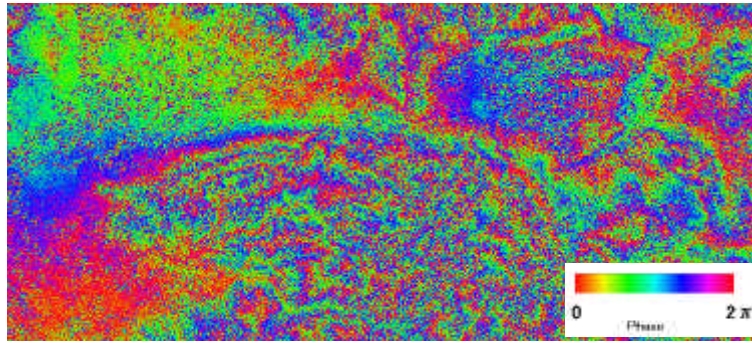
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Image Processing



Interferometry: Partial Scene
(Set2:GSI)

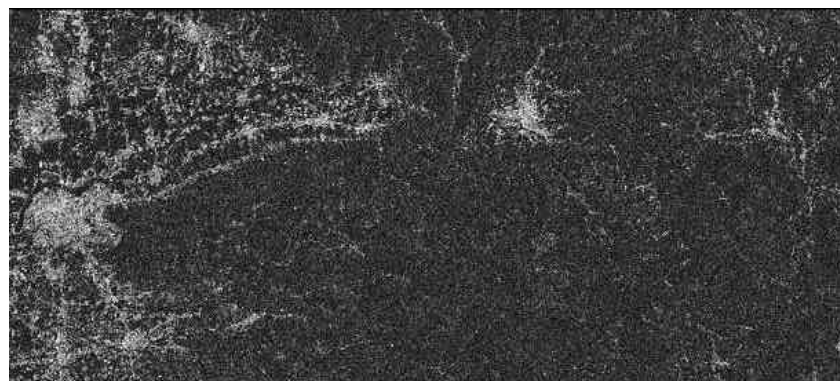
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Image Processing



Coherence: Partial scene
(Set2:GSI)

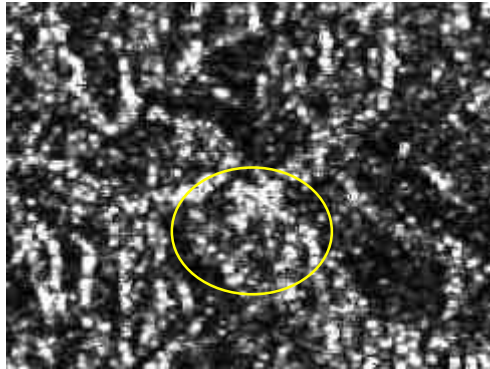
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Image Processing



Magnitude of Study Site.
(Set2:GSI)

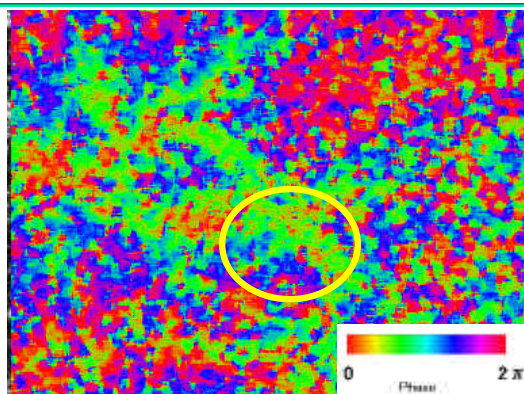
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Image Processing



Interferometry of Study Site.
(Set2:GSI)

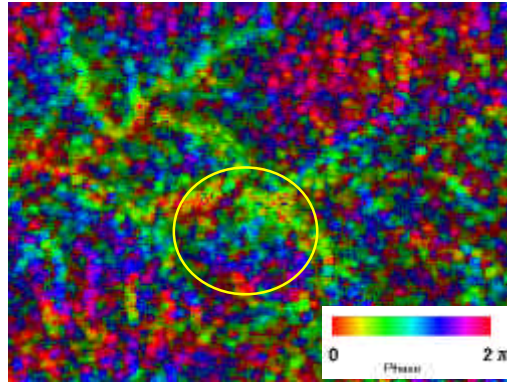
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Image Processing



Interferometry + Magnitude
(Set2:GSI)

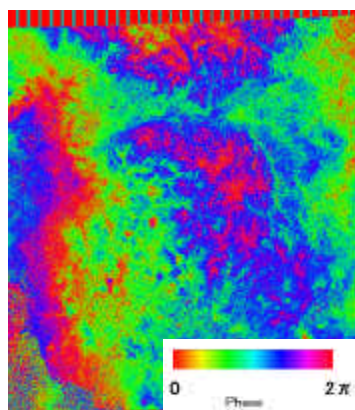
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Image Processing



Interferometry of Original 1

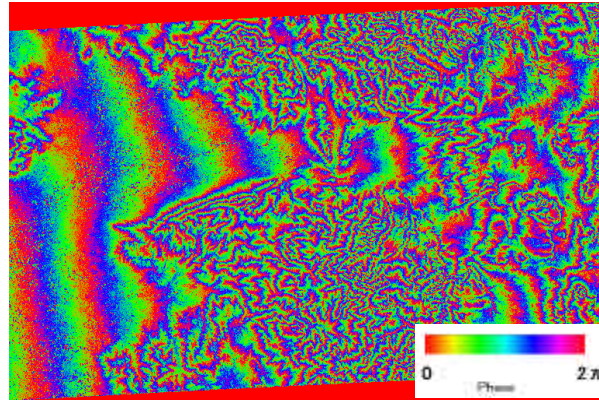
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Interferometry of Original 2

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Image Processing



DEM of Original 2

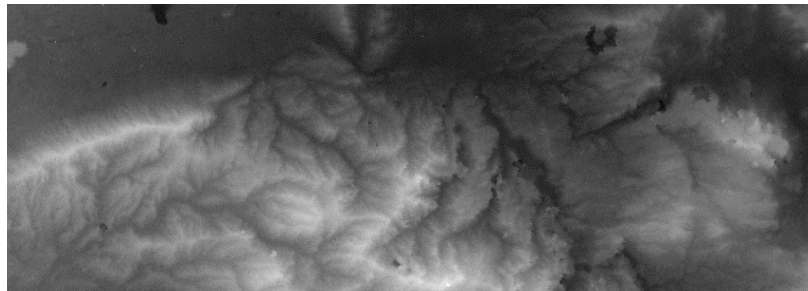
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Image Processing



DEM of Original 2

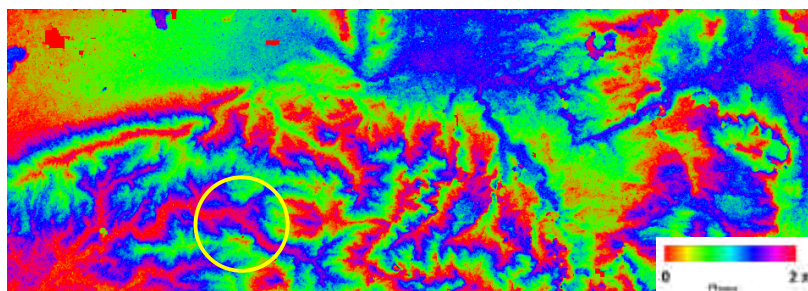
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Image Processing



Interferometry of Study Site
(Set4:Original2)

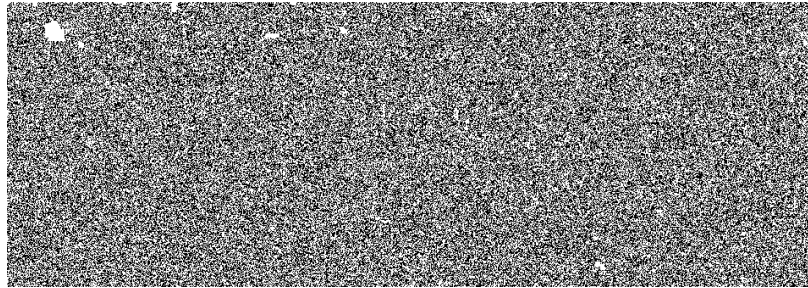
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Image Processing



**Magnitude of Study Site
(Set4:Original2)**

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Further Examinations

Reasons for inability to detect landslides.

- **Observation time period. (Required Correct Tiepoint)
Changes of Ridge Line along Mountainous region
over the years.**
- **Required High Resolution DEM.**

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Issues for Follow-up Studies

- To identify symptoms of landslides using InSAR.
- To develop a procedure for determining the temporal changes of landslide symptoms.
- To detect landslide by measuring the displacement of Corner Reflector by InSAR.
- To establish a landslide detection method by analyzing other forms of data sets.

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Further Studies

- Countermeasures for the detected landslide area and results of site inspection surveys.
- Accuracy in landslide detection.
- Until a new observatory and analytical method can be developed using Differential InSAR, the present method of analysis is to incorporate the use of OPS technique.
- For wide application of remote sensing in landslide prediction in the future, more advanced research studies are needed.

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Future Prospects of ALOS (from the perspective of landslide observation)

- Production of DEM for InSAR by the use of PRISM.
- Distinguish surface cover using polarized wave data.
- Accessibility to essential data.
(within a short time and low cost)