31 Effective Use of Satellite SAR Observation for River Embankment

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R&D Objectives and Subjects

Objectives

Utilize satellite observation to collectively monitor a wide range of embankments at a frequency of several times a year, and improve embankment monitoring efficiently.

Conventional Monitoring

Regular Cross Section Surveying

■ **Visual Check**
- Difficult to check wide area in short time
- Difficult to detect changes such as gentle subsidence

■ **Regular Cross Section Surveying**
- Difficult to confirm displacement of embankment between measurement points
- Difficult to monitor at high frequency

Satellite Observation

■ Features of Satellite Observation
- Covering wide area in short time
- Continuous monitoring along river embankment
- Monitoring several times a year

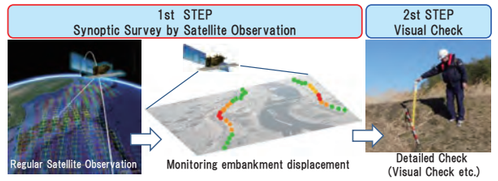
→Extracting of priority area for detailed visual check, etc.

L-Band Synthetic-aperture radar (PALSAR-2)

Subjects （2014-2017）

- Developing methods to calculate long-term displacement of river embankment
- Accuracy verification of calculated displacement
- Considering how to display the result of calculation

→ Conventionally, it was necessary to visually inspect all managed sections. However, it becomes possible to extract points for which detailed check is to be conducted.

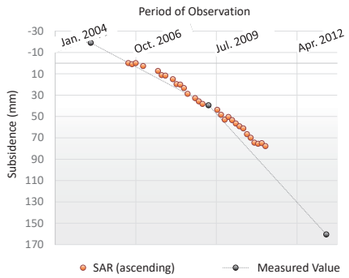


Current Accomplishments (1/2)

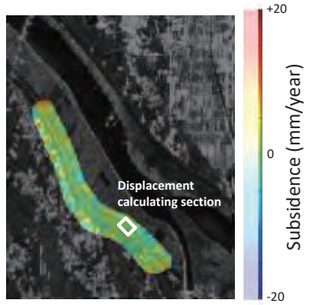
(2014-2015)

1. Establishment of displacement analysis model about ground level by using ALOS observation data

- Comparing analysis results by ALOS satellite observation with actual survey results
- We confirmed that we could obtain the displacement of average ground level in the certain section (displacement calculating section) inside the embankment.
- Based on this comparison verification, we examined a method of analyzing satellite images.
- This method can be applied to analysis using observation data by ALOS-2 (Operation period: from May 2014 to the present)



Orange points indicate the relative displacement of the mean ground level in the section including the crest of embankment (approximately 10 pixels. The pixel size is about 10m x 10m.) The straight line links the 3 survey results.



This diagram indicates subsidence amount of the embankment. The white rectangular frame indicates the section (displacement calculation section) in which the relative displacement of the average ground level was calculated.

- Accomplishment of grasping displacement of average ground level such as height of embankment crest by satellite image analysis
- It is possible to grasp long-term tendency of deformation of the height of embankment crest

Current Accomplishments (2/2)

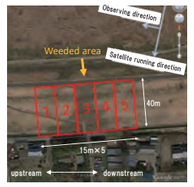
(2014-2015)

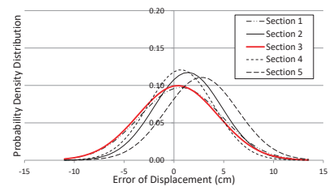
2. Evaluating Influence of Vegetation

The electronic wave used in our satellite monitoring is L-band with long wavelength, so the influence of vegetation is considered to be small. We conducted on-site verification as follows;

- We compared results of satellite image analysis in a constantly weeded area with those in un-weeded areas
- Compared analytical errors of displacement of ground level in Section 3 (constantly weeded) and Sections 1, 2, 4, and 5 (with plants of about 50 cm in height) in embankment slope (in the picture left below); no significant difference was shown (in the graph right below).

→ Confirmed that there is no significant influence of vegetation on displacement of ground level calculated by satellite image analysis.





【Detailed Description】We calculated the difference between the satellite image analysis and survey results for each displacement of a plurality of ground level analysis points in Sections 1 to 5, then determined probability density distribution. By comparing the red curve, which shows the distribution of errors in Section 3 (the weeded area), with the other distribution curves of errors in the other 4 sections (un-weeded areas), we confirmed that whether or not an embankment is weededdoes not cause any significant difference in the distribution of errors.

Even for ground with vegetation, it is possible to grasp displacement

Flow of utilization

1. Establishment of displacement analysis model about ground level by using ALOS observation data

2. Evaluating Influence of Vegetation

Verification of satellite image analysis using ALOS-2 observation data (under consideration)

Preparing satellite image processing tool (under consideration)

Monitoring by embankment manager using satellite image processing tool

Improve efficiency of river embankment monitoring by extracting priority inspection sections

Goals

Numerical target

Accuracy of several hundred square meters as a minimum area unit to grasp displacement amount of average ground height.

Users

River Offices（Ministry of Land, Infrastructure, Transport and Tourism, Prefectures)

How to use/Places of use

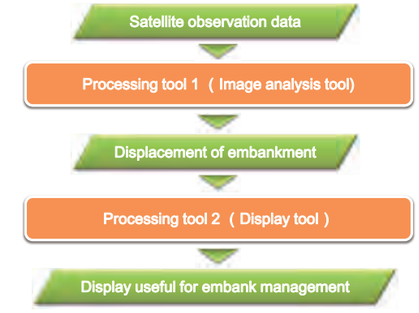
Obtaining displacement of crest height of embankments by using SIPT in River Offices.

Sales method

- Work on manualization of our technology and tools.
- Delivering the SIPT to river offices.
- Utilizing SIPT in the projects ordered by River Offices

Services to Offer

Providing the processing tool which can process satellite observed images and display image processing results. Monitoring long-term displacement of crest height of embankments through displayed images.



Satellite Image Processing

Obtaining long-term displacement of crest height of embankment by SIPT (sample image)

Threshold Setting for ground level displacement amount

It is possible to grasp long-term displacement of crest height of embankment continuously along rivers several times a year.

→Improve efficiency of river embankment monitoring by extracting priority inspection sections