Detection and Calculation of Peatland Subsidence in Indonesia by using Interferometric Synthetic Aperture Radar

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ABSTRACT Peatland is a kind of wetlands with a thick waterlogged organic soil layer storing large amount of carbon. In recent years, peatland in the world has been destroyed due to drainage or fire for agricultural use. When peatland is affected by such human activities, its organic carbon is decomposed into the air as greenhouse gases, and the ground level goes down. This phenomenon is called “peatland subsidence”. In this study, peatland subsidence in Jambi, Indonesia, was assessed with time-series of ALOS/PALSAR data based on InSAR technique. Firstly, PALSAR raw data was converted into SLC data, and interferometric processings were conducted to generate interferograms from SLC images. Secondly, a group of time-series interferograms was created thorough PS-InSAR analysis. Finally, subsidence distribution, subsidence amount, and subsidence velocity were calculated spatially. As a result, significant land surface deformation originated from peatland subsidence was observed from 2007 to 2011.

Background

Peat is composed of accumulated vegetation or organic matter that is partially decayed. Peatland, an area where peat can be found, plays an important part in the environment since it has a unique ecosystem and can effectively store large amount of carbon. Recently, peatland in the world has been rapidly decreasing mainly due to the land use change for agriculture.

Indonesia, one of the largest peatland owners, suffers from peatland subsidence derived from inappropriate maintenance of peatland. Farmers near the seashore have experienced serious floods caused by tidal effect and heavy rain during the rainy season. In 2005, peatland emission was estimated to be about 772 Mt CO_2eq that accounted for 38 % of total Indonesia’s annual GHG (DNPI, 2010). Thus, under such circumstances, appropriate management of peatland is an urgent issue. To mitigate peatland emission and peatland subsidence, many research works have been ongoing in Indonesia.

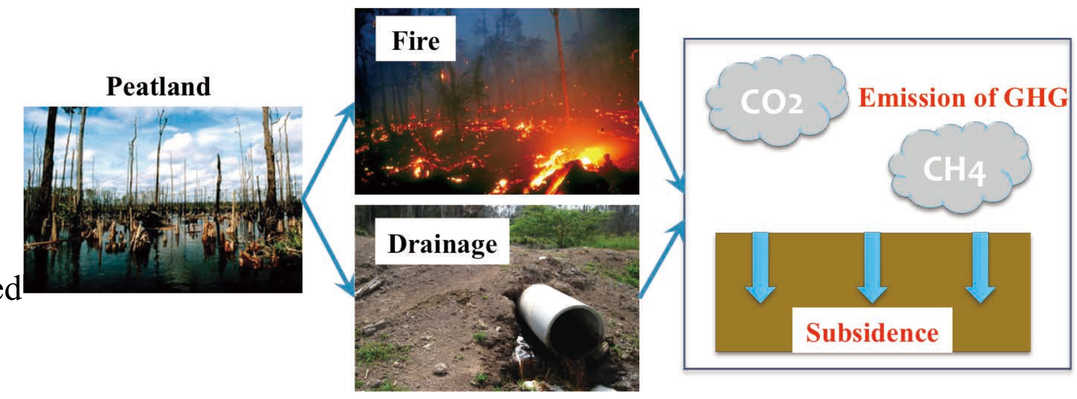


Fig 1. The mechanism of peatland subsidence

Objective

- To detect the distribution of peatland subsidence and to calculate the extent of subsidence in the study site by using InSAR technique
- To assess the subsidence velocity for the past few years in the study site

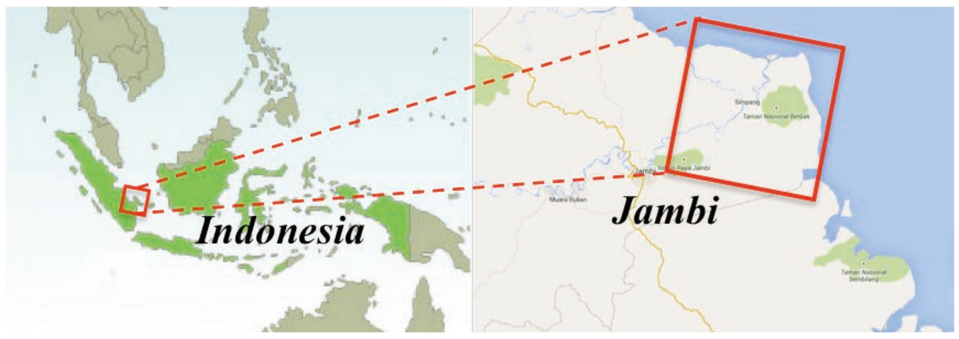
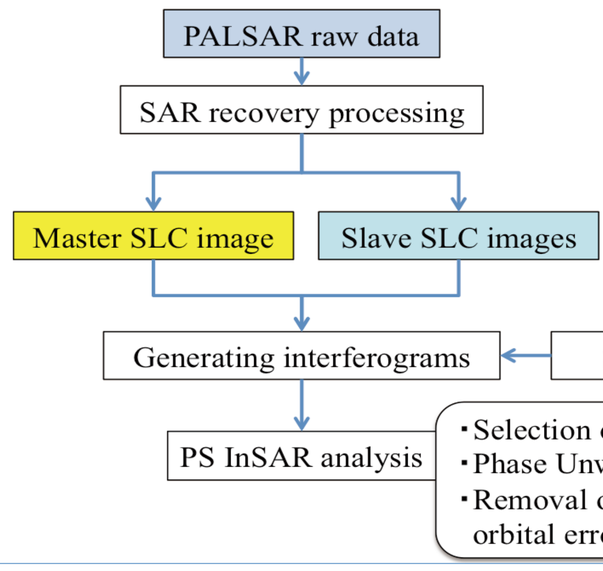


Fig 2. Study site (Jambi, Indonesia)

Methodology



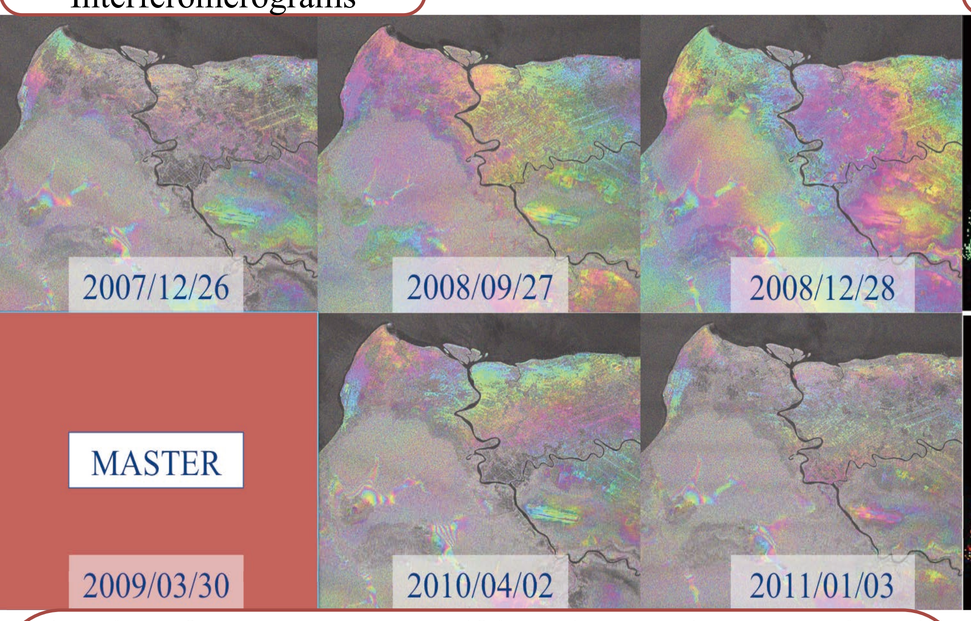
PALSAR HH Level 1.0 FBS
110-3640 (Descending)

Date	Bpara (m)	Bperp (m)	Day
2007/12/26	-269.79	-384.04	-460
2008/9/27	101.87	-60.07	-184
2008/12/28	-75.65	-289.69	-92
2009/3/30	0	0	0
2010/4/2	-192.66	-199.56	368
2011/1/3	-52.13	-4.88	644

Fig 3. Data processing flowchart with StaMPS software (Hooper *et al*., 2012)

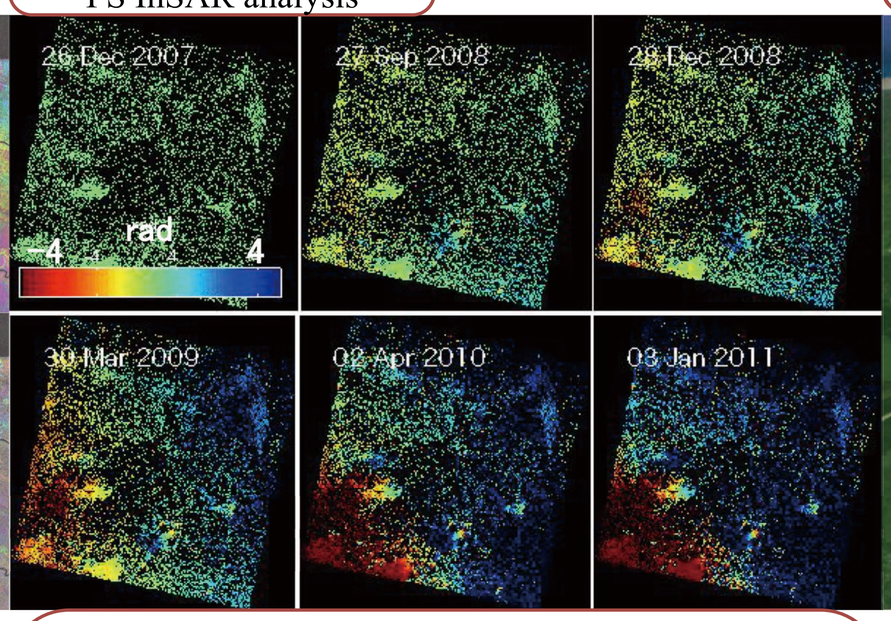
Results and Discussions

Interferomerograms



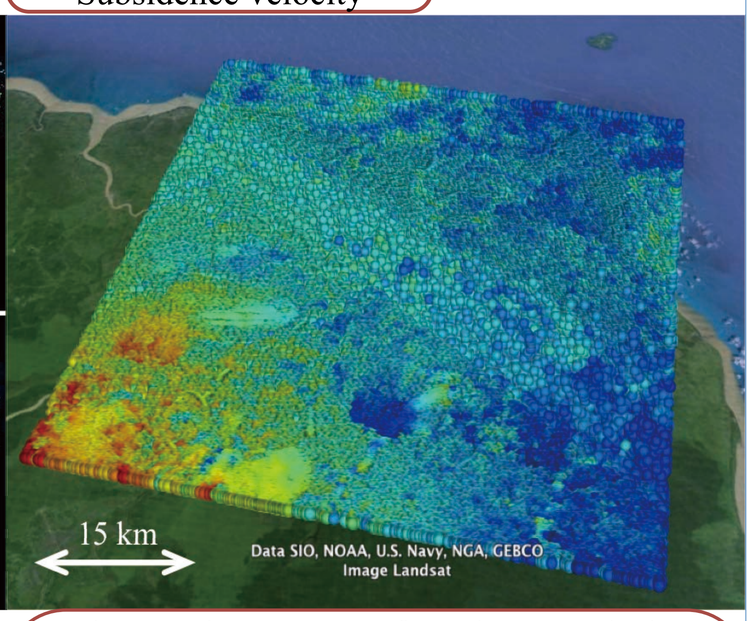
The interference patterns (fringes) can be seen in all interferograms, particularly in the image taken in December 2008 due to the short time difference of two observations. Although topographic errors were successfully removed with SRTM data, orbital errors and the influence of ionosphere still exist besides surface deformation.

PS InSAR analysis



These pixels represent PS points extracted by StaMPS. 87347 points were analyzed in this study area. As time goes by, the whole ground seems to move down (from green to blue) gradually. A large expansion deformation (or shifting to the east) was also observed in the southwest part of the images.

Subsidence velocity



In the southeast part of study area (colored blue), the subsidence had developed rapidly from 2007 to 2011 with the maximum velocity of 142.8 mm/year. In the southwest part of study area (colored red), the tendency of moving up was detected.

Summary

- PS-InSAR analysis was conducted to monitor pattern of subsidence phenomenon in Jambi, Indonesia, with StaMPS software.
- Subsidence distribution and subsidence amount were calculated spatially, and subsidence velocity was visualized.
- This study revealed that the subsidence had developed rapidly from 2007 to 2011 with the maximum velocity of 142.8 mm/year in the southeast part of study area.

References

Dewan Nasional Perubahan Iklim (DNPI), Indonesia, 2010. Indonesia’s greenhouse gas abatement cost curve.
Hooper, A., Bekaert, D., Spaans, K., Arikan, M., 2012. Recent advances in SAR interferometory time series analysis for measuring crustal deformation. Tectonophysics 514-517, pp.1-13.

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