Estimation of Building Damage due to the 2016 Kumamoto Earthquakes Using PALSAR-2 Images

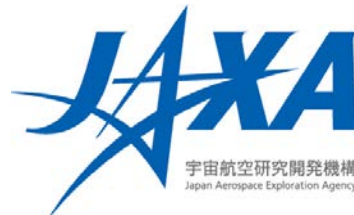## PALSAR-2画像による2016年熊本地震の建物被害の推定

Masashi Matsuoka, Kento Kagawa

Tokyo Tech, Japan

東京工業大学

松岡 昌志，賀川 健人

Tokyo Tech

Background and Objective

- For estimation of damaged buildings in large area, satellite remote sensing is one of the powerful tools.

- We already developed damage estimation models based on the Synthetic Aperture Radar (SAR) images captured by the 1995 Kobe, Japan and the 2007 Pisco, Peru earthquakes (Nojima et al. 2006, Matsuoka and Nojima 2009, Matsuoka and Estrada, 2013).

- In this preliminary analysis, the damage estimation was carried out using ALOS-2 PALSAR-2 (Phased Array type L-band Synthetic Aperture Radar 2) images of the 2016 Kumamoto, Japan earthquakes.

地震による広域被害の把握には，人工衛星画像の利用が有効である。本報告は，2016年4月14日，15日の熊本地震（M6.4）を観測したPALSAR-2画像を利用して，既往手法（Nojima et al. 2006, Matsuoka and Nojima 2009, Matsuoka and Estrada, 2013）により建物被害の抽出を試みた。
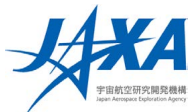
Calculation Flow (Matsuoka and Estrada, 2013)

- Co-registered SAR multi-look intensity images are prepared (two taken before the earthquake and one taken after). Each image is filtered using a Lee filter (Lee 1980) with a 21 x 21 pixel window.

- The difference in backscattering coefficient d and correlation coefficient r within a local window (13 x 13 pixels) are calculated from the two filtered images. Then, combined index (discriminant score, Z_{Rp}) which is corresponding to severe damage ratio of buildings using ALOS PALSAR imagery of the 2017 Pisco, Peru earthquake, is calculated by d and r.

- Finally, the building damage ratio is estimated by the normalized likelihood function based on the discriminant score, $Z_{Rp.}$

地震前後の合成開口レーダ（SAR）画像の位置合わせとノイズ軽減の後，後方散乱係数の差分d（地震後–地震前）と相関係数rを算出，dとrから判別スコアを介して建物の被害率を推定した。

M. Matsuoka and M. Estrada: Development of Earthquake-induced Building Damage Estimation Model Based on ALOS/PALSAR Observing the 2007 Peru Earthquake, Journal of Disaster Research, Vol.8, No.2, pp.346-355, 2013.3.

ALOS-2 PALSAR-2 Coverage

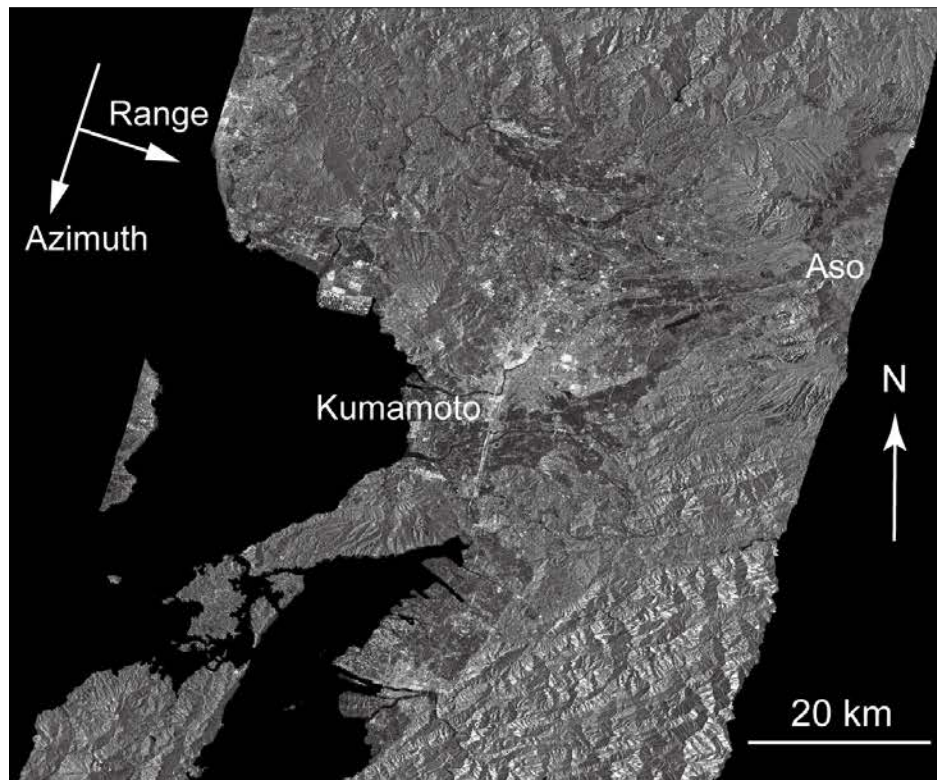Date: 2016/4/15 12:30 (JST), Mode: FBS (HH), Offnadir angle: 29.1 degree, Orbit: Descending
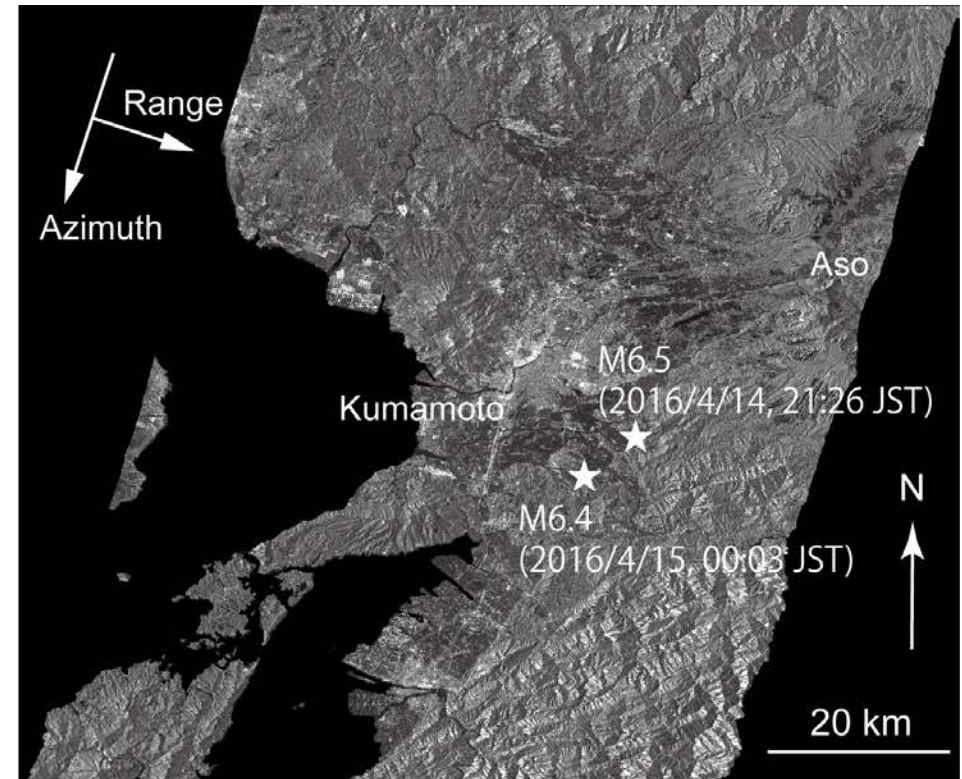
PALSAR-2 Multi-look Images

Mode: FBS (HH), Offnadir angle: 29.1 degree, Orbit: Descending, Pixel Spacing: 10m

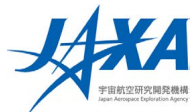The M6.5 and M6.4 earthquakes were occurred between two acquisition dates.

2時期の間には，2016/4/14 21:26 と 4/15 00:03 にM6.5とM6.4の2つの地震が発生
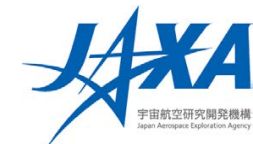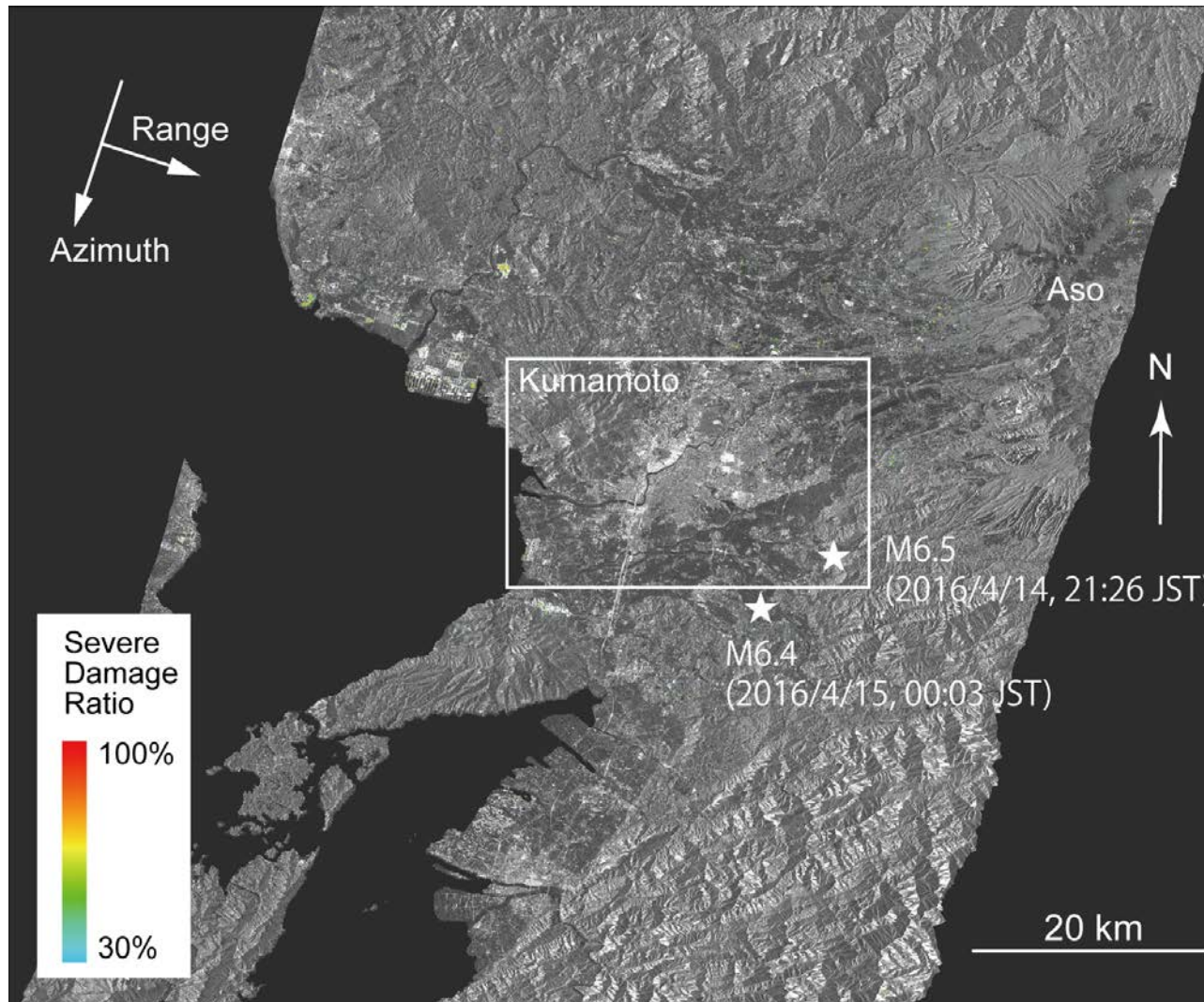

(a) 2014/11/17
(b) 2016/4/15

Damage Ratio Estimation

Some changed points (relatively high damage ratio) are extracted, but is not a wide area.
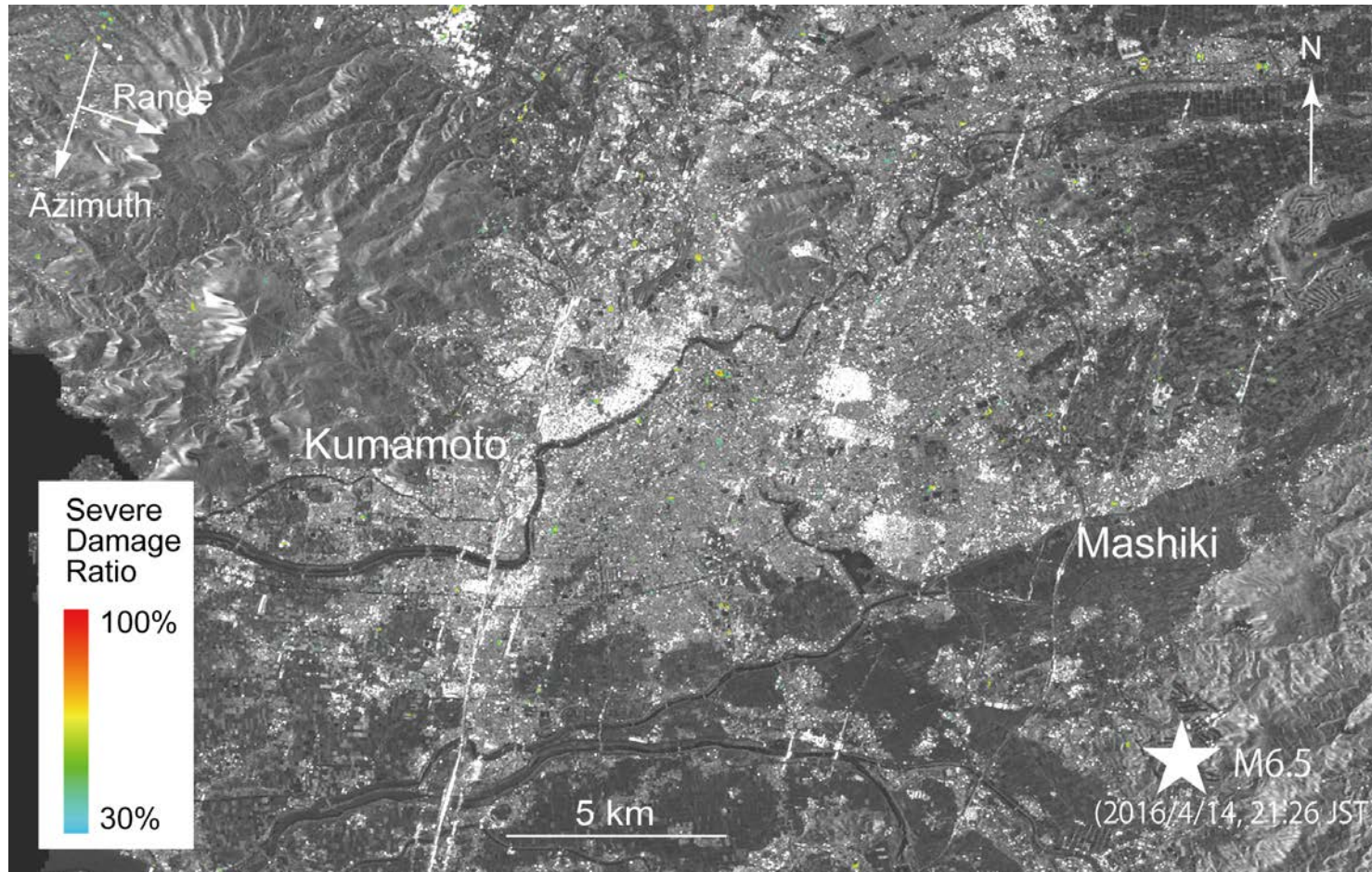
局所的に変化箇所（比較的高い被害率）が推定されるが，広域ではない。

Damage Ratio Estimation

Some changed points (relatively high damage ratio) are extracted, but is not a wide area.

局所的に変化箇所（比較的高い被害率）が推定されるが，広域ではない。

Acknowledgement

ALOS-2 PALSAR-2 image is owned by JAXA, and the dataset was provided by JAXA under the activities of International Charter Space & Major Disasters, Sentinel Asia, and Image Analysis Working Group for Large-scale Disasters.