



Quantitative assessment of mangrove forest changes in China from 1985 to 2018

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Abstract: Mangroves in China have experienced various changes in different time periods due to anthropogenic disturbances, climate change and national restoration policy. However, few studies quantitatively analyzed these changes. This study detected the changes of mangroves in China from 1985 to 2018 by combining Landsat and ALOS PALSAR images. The results demonstrated that the total areas of China's mangrove in 1985, 1996, 2007, 2010 and 2018 were 20,086 ha, 18,033 ha, 22,428 ha, 23,639 ha and 24,602 ha respectively. Mangrove area began to increase after 1990s mainly due to the national conservation actions. The land-cover conversions in mangrove forests are various in different regions and time periods. However, most mangroves gained from aquaculture and mudflat and lost to built-up and aquaculture. This is the first study to quantify the long-term dynamics of mangrove forests in China by remote sensing which has potential importance to the mangrove protection and restoration programs in China, along with applicability to other developing countries.

1 Introduction



Fig. 1 In situ photos of mangroves in Zhejiang province, China.

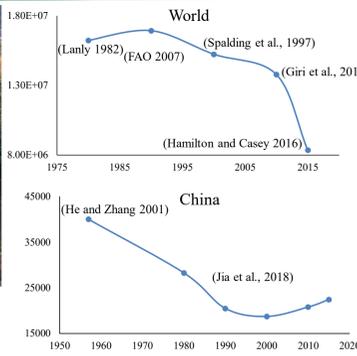


Fig. 2 Mangrove area changes.



Fig. 3 Location of study area.

2 Methodology

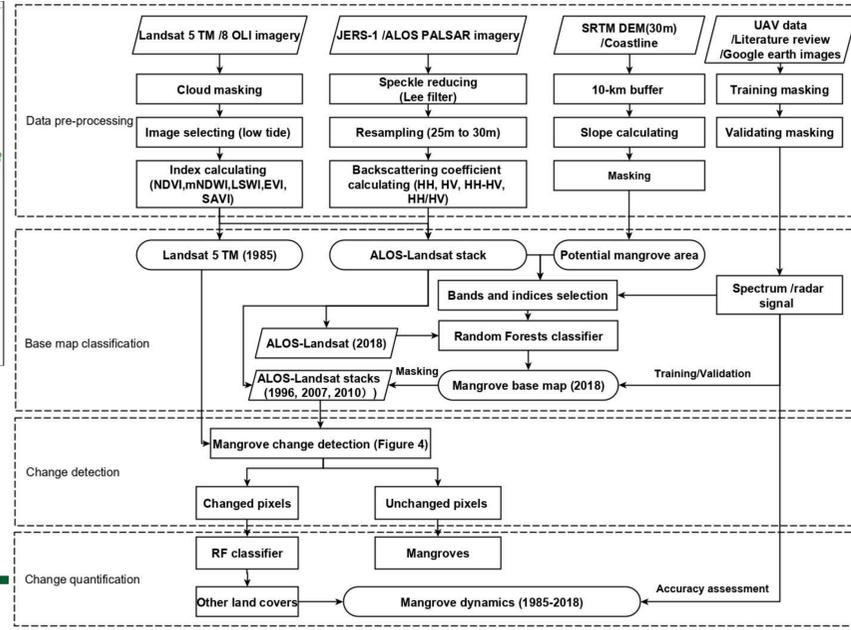


Fig. 4 Overall flowchart of mangrove mapping and change detecting.

Objectives:

- Quantify the long-term mangrove dynamics with high accuracy by combining Landsat and ALOS PALSAR images and analyze the main driving force for each province;
- Estimate the biocapacity changes in coastal ecosystems caused by the conversion between mangrove and other land covers.

3 Results

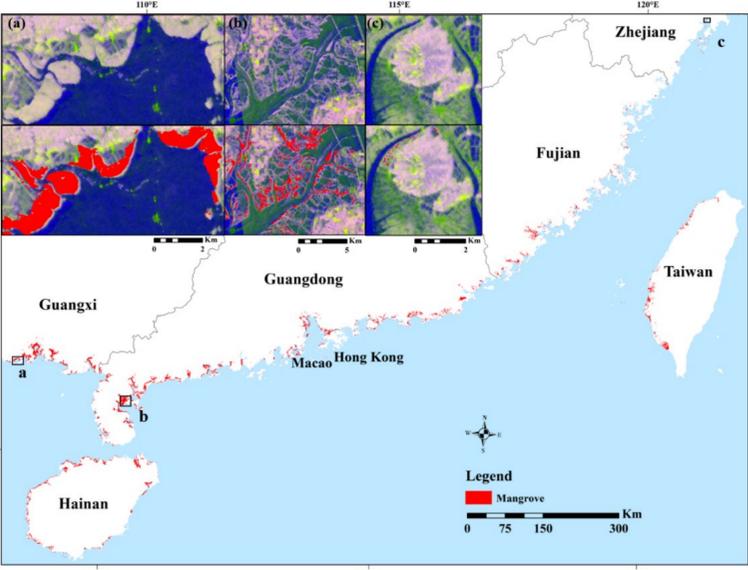


Fig. 6 Spatial distribution of China's mangroves in 2018 and zoom views of three mangrove natural reserves. The background of (a)-(c) are ALOS PALSAR-2 mosaic in 2018 shown in R: G: B = HH: HV: HH-HV composite.

Table 1. Classification accuracy.

Province	Area (ha)	Overall accuracy (%)	Kappa coefficient
ZJ	24.48	88.89	0.6200
FJ	908.55	98.76	0.9496
GD	9,214.63	96.22	0.9042
GX	9,095.71	98.30	0.9571
HN	4,269.78	93.25	0.8646
HK	533.34	99.02	0.9794
Macao	10.62	-	-
TW	542.34	93.83	0.8115
Total	24,602.45	96.03	0.8858

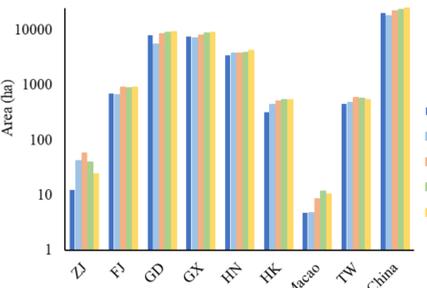


Fig. 7 Mangrove area changes in China.

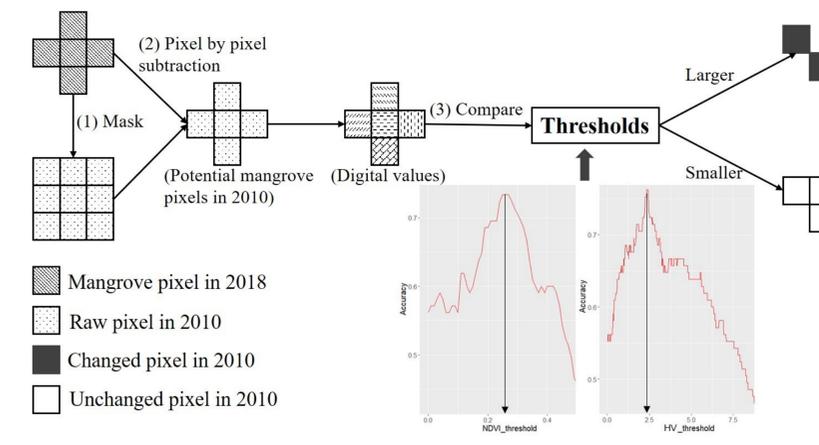


Fig. 5 The schematic diagram of mangrove change detection.

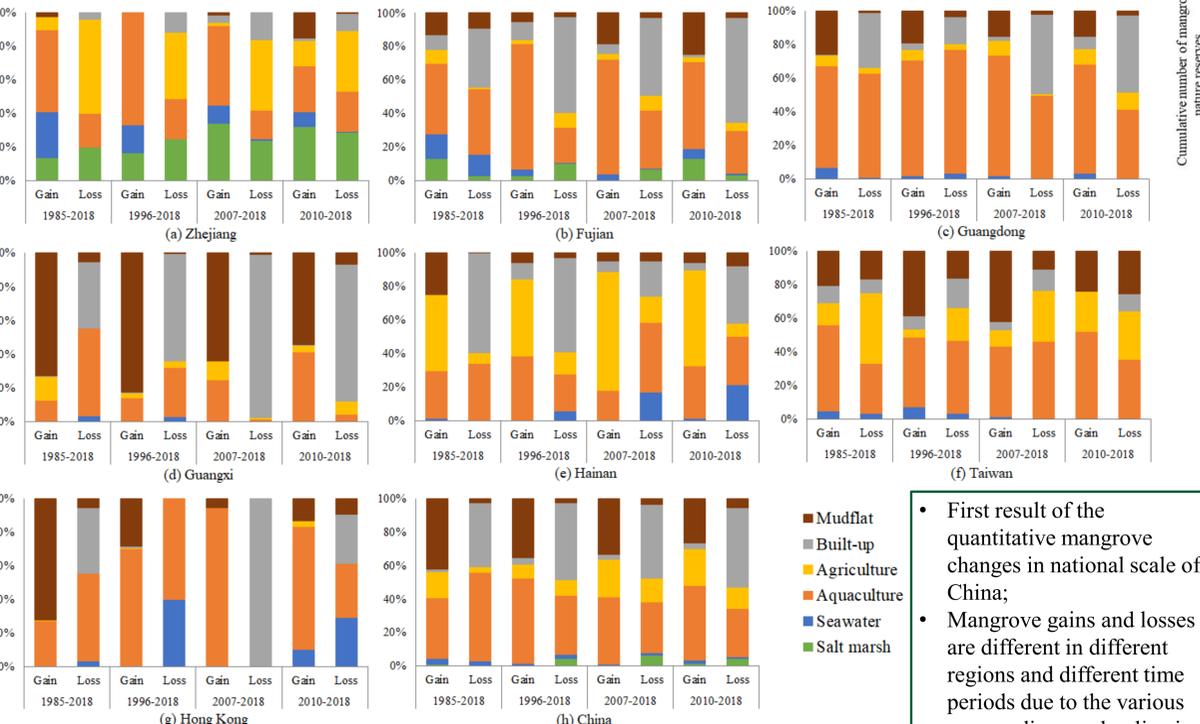


Fig. 8 Percentage of mangrove gain and loss in terms of different land cover.

- First result of the quantitative mangrove changes in national scale of China;
- Mangrove gains and losses are different in different regions and different time periods due to the various surroundings and policy in different provinces.

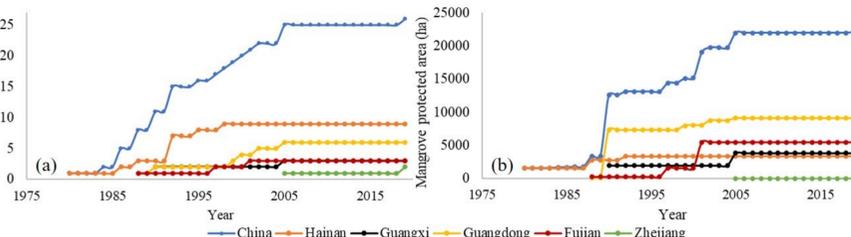


Fig. 9 Mangrove nature reserves in China during 1980 to 2020: (a) cumulative number; (b) protected area.

4 Conclusions and future work

- the China's mangrove forests in 2018 is about 24,602 ha with over 90% distributed along the southern coastline;
- mangrove forests in most regions have a tendency of loss first and recovery later from 1985 to 2018;
- most mangrove gains came from aquaculture and mudflat, whilst losses were mainly due to the occupation of built-up and aquaculture;
- the mangrove deforestations were mainly due to human-induced destructions, while the mangrove recoveries were strongly associated with the conservation and restoration actions.

Future work: classifying mangrove species; refining the carbon footprint and biocapacity for mangrove ecosystems.