Institute of Urban Environment,
Chinese Academy of Sciences

High-resolution mapping of direct CO_2 emissions and uncertainties at the urban scale

Author: Shaoqing Dai, Shudi Zuo, Yin Ren

Speaker: Shaoqing Dai, M.S. Candidate

Institution: Institute of Urban Environment, Chinese Academy of Sciences

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sqdai@iue.ac.cn

Study

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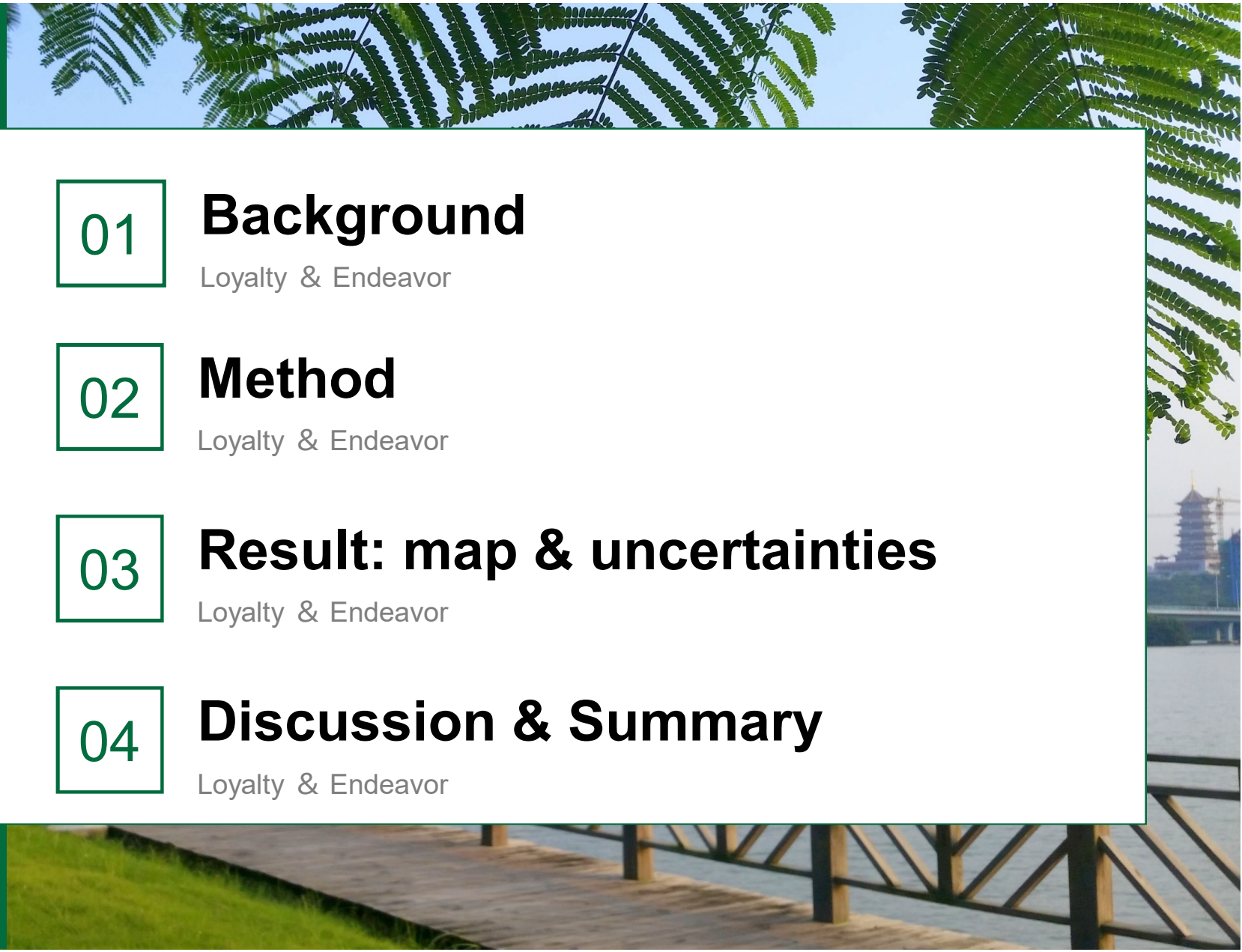

01 Background

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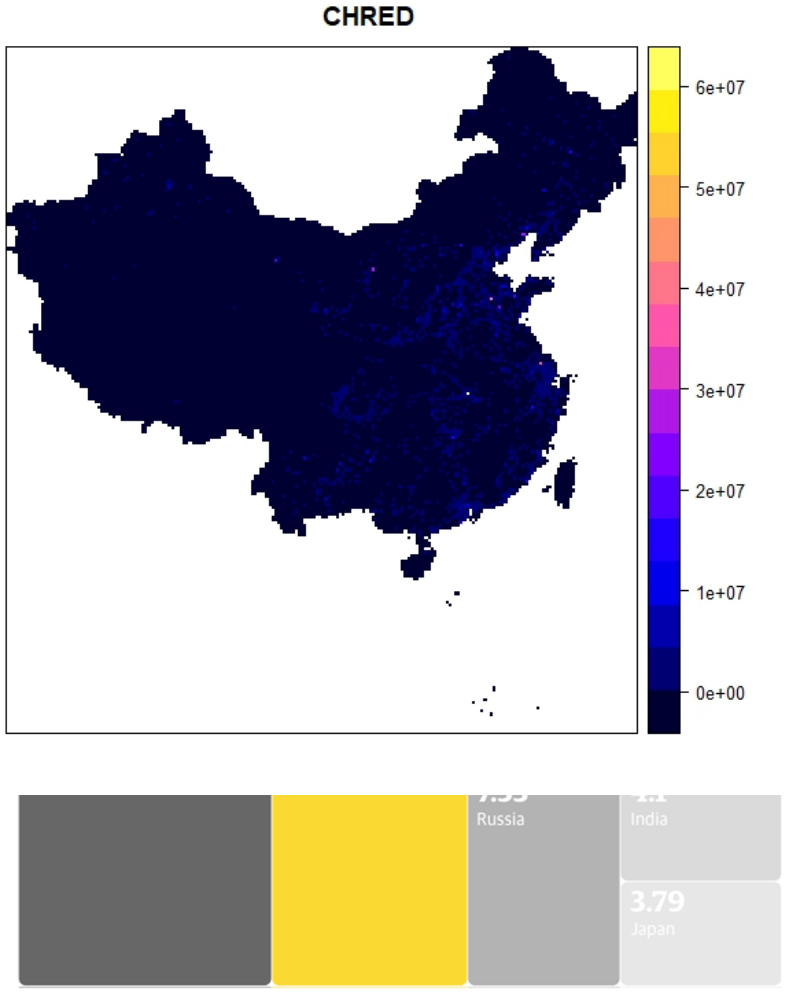
01 Background



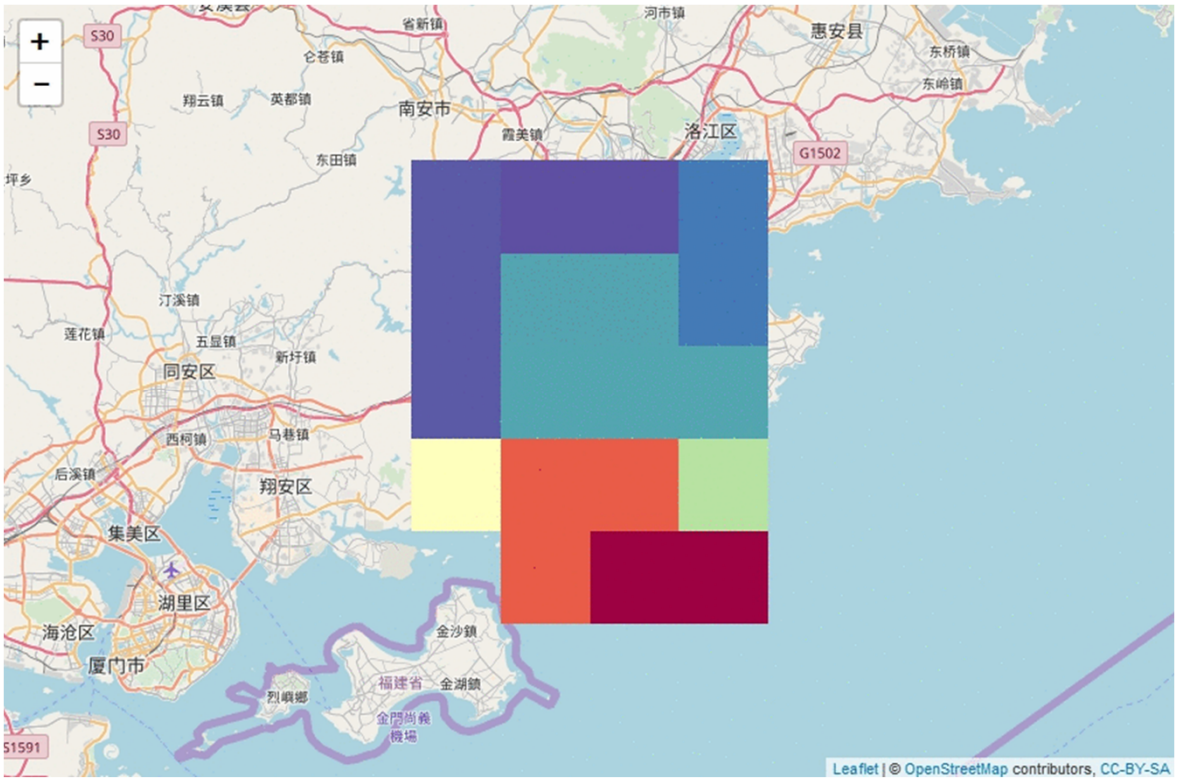
From: theguardian.com, CDIAC(Boden et al. 2016)), PKU-CH4-China-v1(Wang et al. 2013), CHRED(Cai et al. 2018)

(1) Background

Paris Agreement

1. China is facing the great pressure to reduce carbon emissions
2. Most of carbon emission researches are based on administrative units of countries, provinces, and prefecture-level cities. Besides, there are many 1° to 1 km resolution of global carbon emission distribution open products.
3. Lack of uncertainty analysis research in carbon emission map.

01 Background



(2) Contributions

1. A high-resolution mapping method for the direct carbon emissions at urban scale
2. A study framework of four Monte-Carlo simulation scenarios to analyze the uncertainties
3. Provide the data base

02 Method

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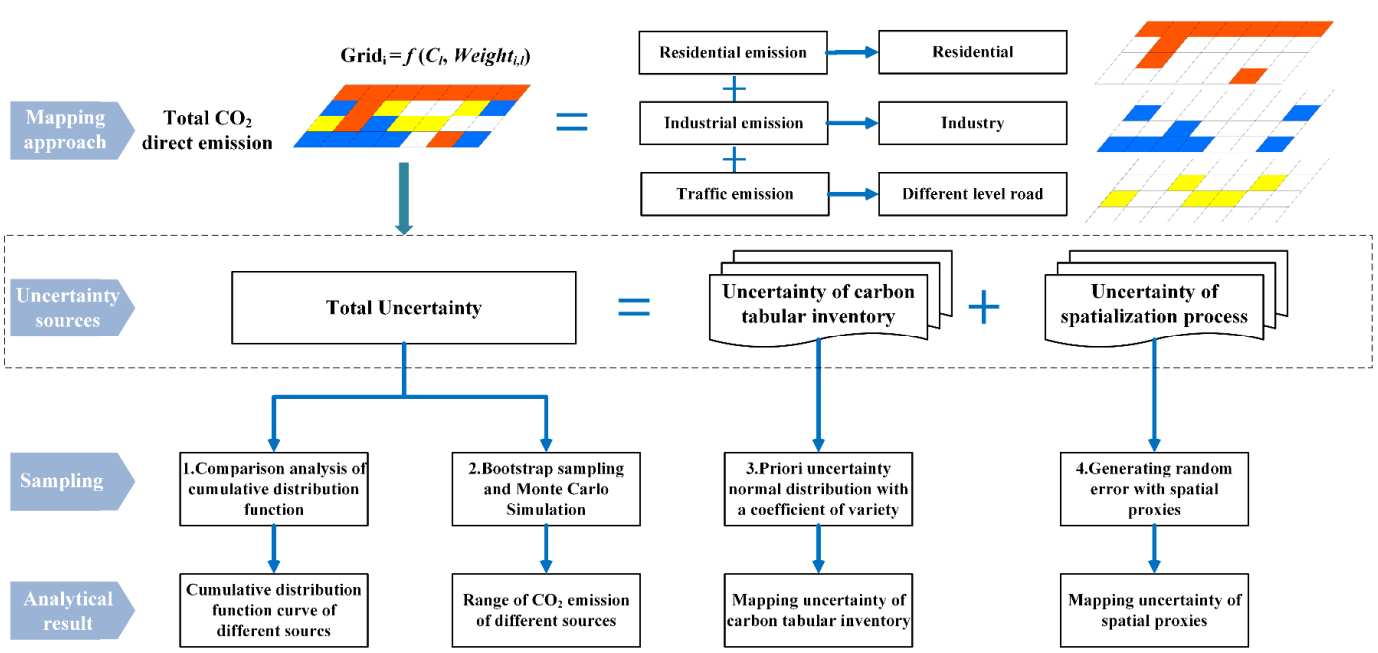
02 Method



$$Grid_{i,co_2} = f(C_l, Weight_{i,l})$$

$$Uncertainty = \frac{CI_{95}}{\overline{CO}_{2,N}}, CI_{95} = \frac{CO_{2,97.5} - CO_{2,,2.5}}{2}$$

$$error = \frac{\sum_{i=1}^{n} Difference_{i,l}}{C_l} = \frac{\sum_{i=1}^{n} |realvalue_{i,l} - simulation_{i,l}|}{C_l} \times 100\%$$

Theoretical framework

1. Calculated direct carbon emissions by IPCC guidelines including residential emission, industrial emission and traffic emission.
2. Uncertainty analysis based on four Monte Carlo simulations schemes during the process of spatialization.

03 Result: map & uncertainties

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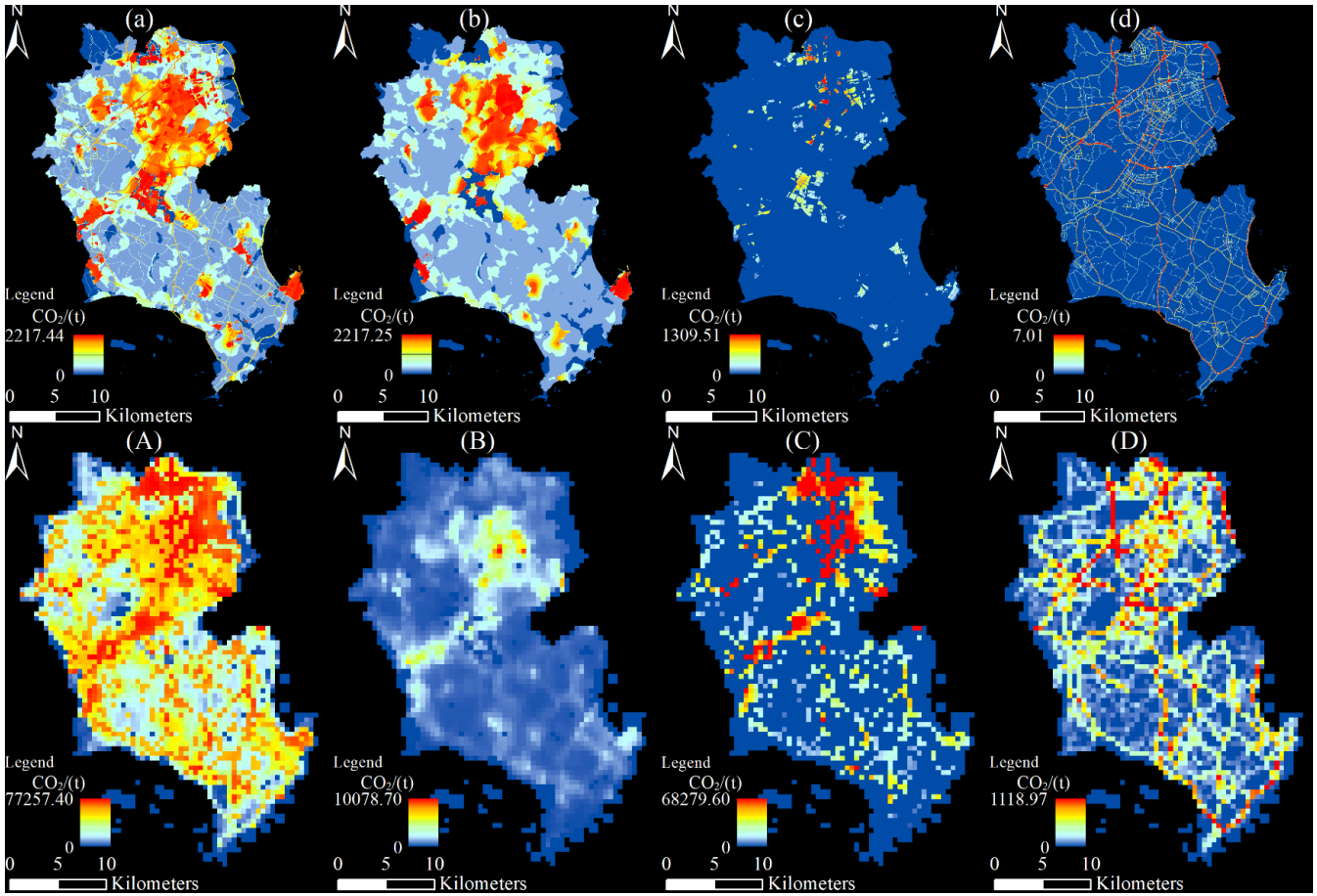
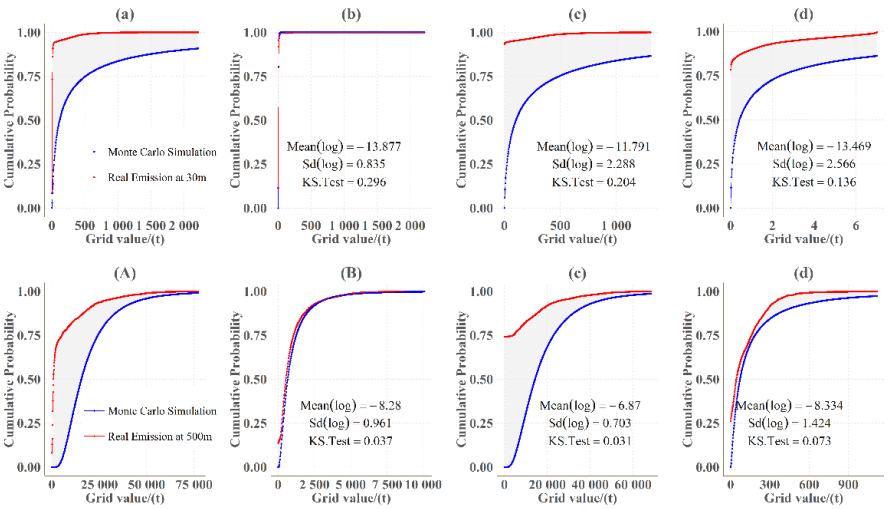
03 Result: map & uncertainties



(1) Map

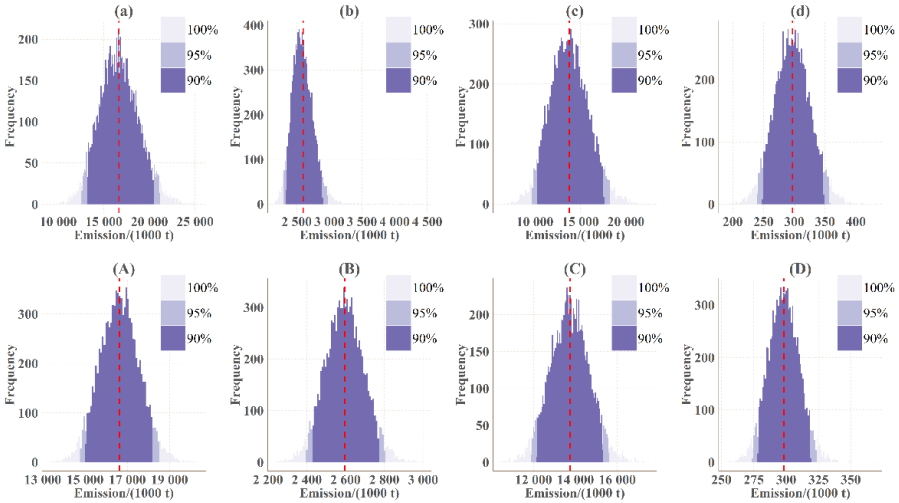
1. The grids with the highest values were located in the northern urban living area and the industrial areas in the central region.
2. Residential and industrial sectors had opposite emission patterns in the two maps

03 Result: map & uncertainties



(2) Uncertainties

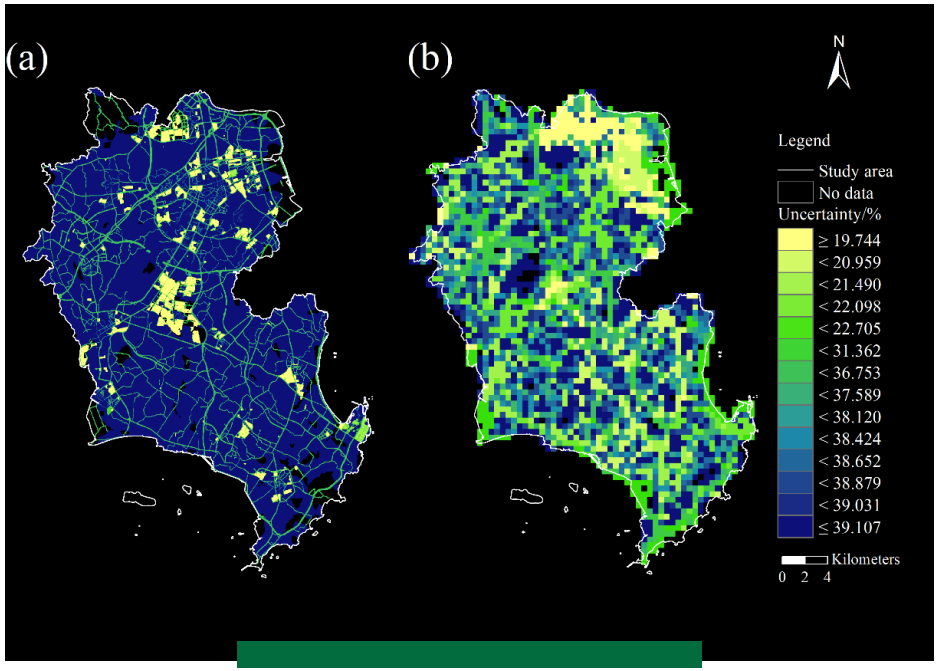
The uncertainty of residential emissions was smallest, while that of transport emissions was slightly higher, and that of industrial emissions was the largest.



(2) Uncertainties

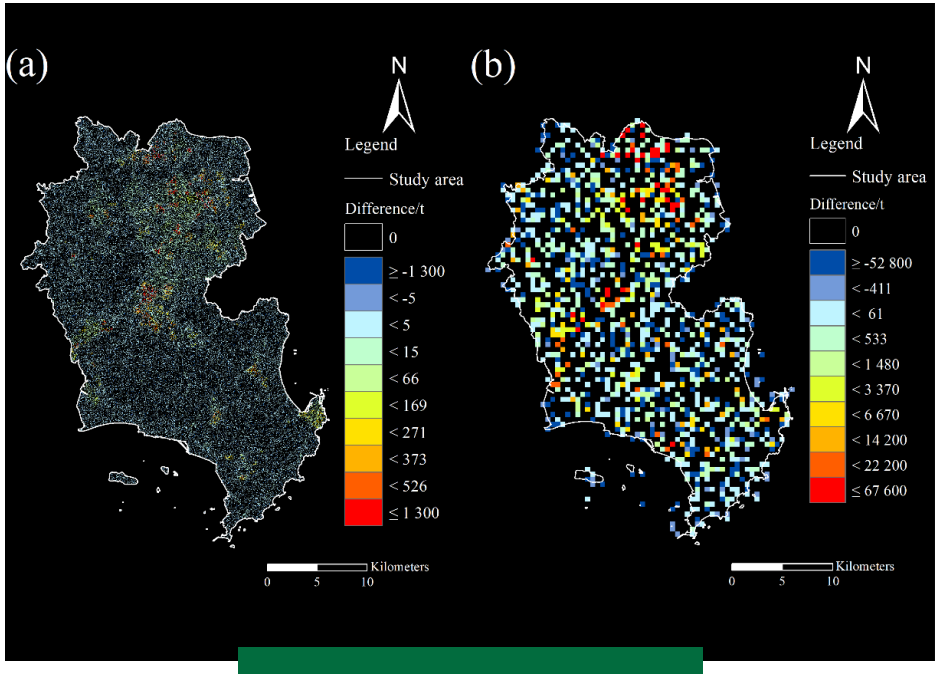
The relationship between the overall uncertainty of emissions and the uncertainty of the three sectors was a nonlinear change.

03 Result: map & uncertainties



(2) Uncertainties

Large areas with low uncertainty in the northern part of the 500 m resolution map had high uncertainty in the 30 m resolution map.



(2) Uncertainties

The overall error was greater than any initial error, and was less than the sum of the errors for the three sectors.

04 Discussion & Summary

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04 Discussion & Summary

(1) Discussion

1. Compared these previous studies, ours was more cost-effective, as a full-scale census of industrial sources was not needed.

2.The random error of total emissions was reduced by compensating the error mechanism through overlaying emissions from different sectors.

3. coarser resolution maps have less uncertainty compared to fine resolution maps at the urban scale.

(2) Summary

we proposed a method to spatially map direct carbon emissions at high-resolution, in parallel to developing a theoretical analysis framework for the distribution and transmission of uncertainties.

THANKS

sqdai@iue.ac.cn