Detection of XCO$_2$ anomaly changes in space and time at a global

Reporter：Shaoqing Zhang

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Report Outline

- ➢ Atmospheric CO2 concentrations abnomal change

- ➢ Comparison of detection methods for abnormal XCO2 concentrations change

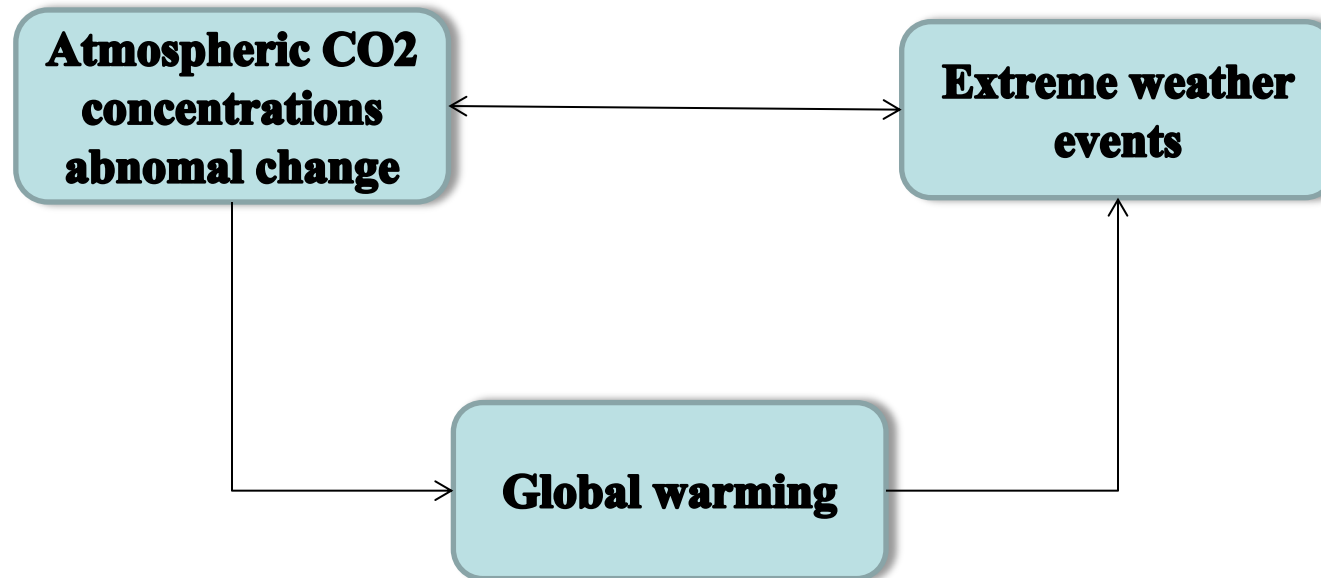- ➢ Comparison and analysis of abnormal detection results

Report Outline

➢ **Atmospheric CO2 concentrations abnomal change**

➢ **Comparison of detection methods for abnormal XCO2 concentrations change**

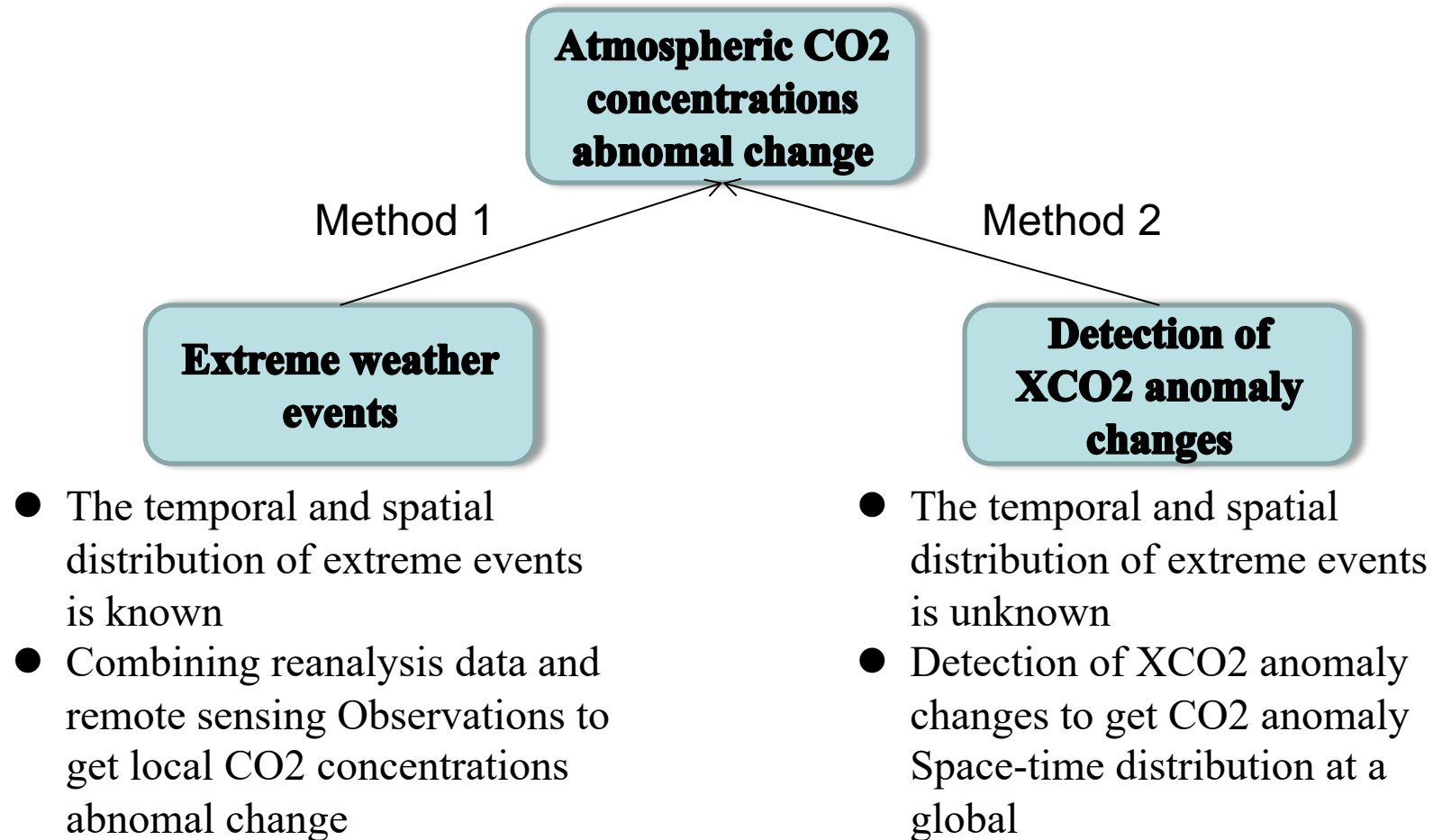➢ **Comparison and analysis of abnormal detection results**

1、Atmospheric CO2 concentrations abnomal change
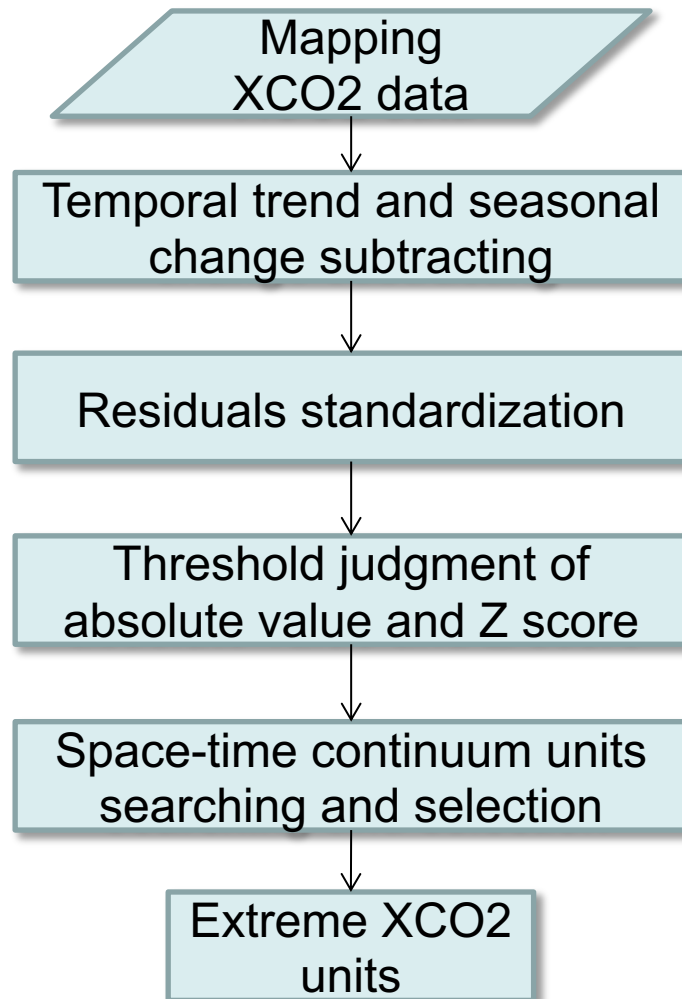
2、 Detection of XCO2 anomaly changes

Atmospheric CO2 concentrations abnomal change

Method 1

Method 2

Extreme weather events

Detection of XCO2 anomaly changes

- The temporal and spatial distribution of extreme events is known
- Combining reanalysis data and remote sensing Observations to get local CO2 concentrations abnomal change

- The temporal and spatial distribution of extreme events is unknown
- Detection of XCO2 anomaly changes to get CO2 anomaly Space-time distribution at a global

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➢ **Atmospheric CO2 concentrations abnomal change**

➢ **Comparison of detection methods for abnormal XCO2 concentrations change**

➢ **Comparison and analysis of abnormal detection results**

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1、Temporal and spatial anomaly detection method(RE method)

Mapping XCO2 data

↓

Temporal trend and seasonal change subtracting

↓

Residuals standardization

↓

Threshold judgment of absolute value and Z score

↓

Space-time continuum units searching and selection

↓

Extreme XCO2 units

Zhonghua He et al. propose a method（hereafter referred to **RE method**） for detecting the abnormal changes of atmospheric CO_2 concentration by using mapping **GOSAT XCO$_2$ data**

This method makes use of the **residual error（RE）** value after fitting seasonal variation of yearly detrended XCO_2 for anomaly detection.
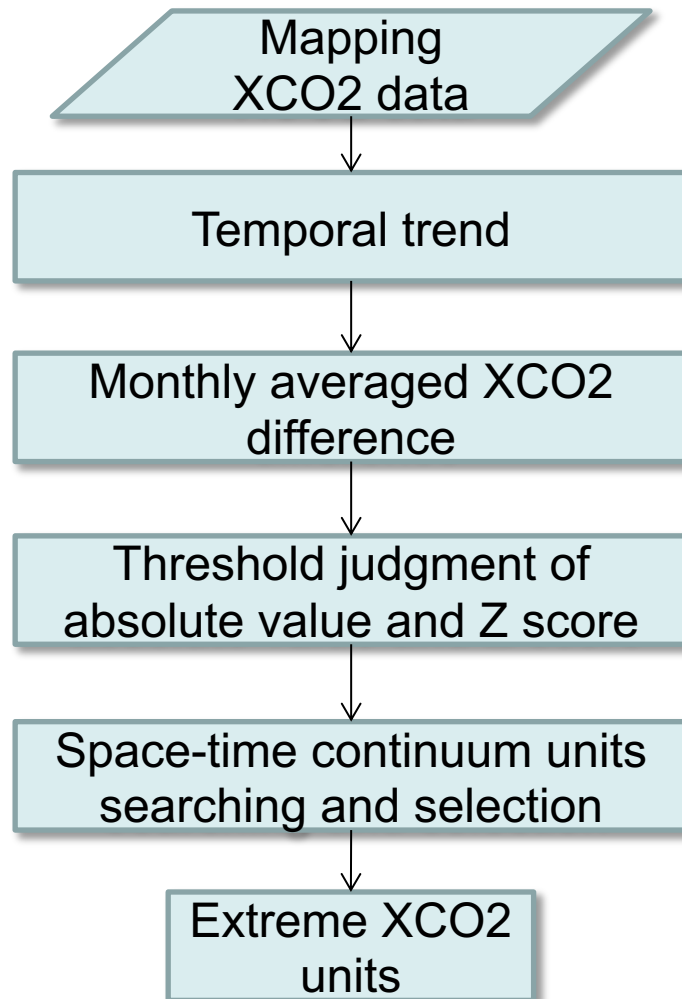However this **RE** should be evaluated as the fitting approach of seasonal variation is also applied in mapping XCO_2 data.

Zhonghua He , Liping Lei , Lisa R. Welp , Zhao-Cheng Zeng , Nian Bie , Shaoyuan Yang and Liangyun Liu . Detection of Spatiotemporal Extreme Changes in Atmospheric CO2 Concentration Based on Satellite Observations. Remote Sens. 2018, 10, 839.

2、Temporal and spatial anomaly detection method(MA method)

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┌─────────────────────┐
│  Mapping            │
│  XCO2 data          │
└─────────────────────┘
          │
          ▼
┌─────────────────────┐
│  Temporal trend     │
└─────────────────────┘
          │
          ▼
┌─────────────────────┐
│ Monthly averaged XCO2│
│ difference          │
└─────────────────────┘
          │
          ▼
┌─────────────────────┐
│ Threshold judgment of│
│ absolute value and Z score│
└─────────────────────┘
          │
          ▼
┌─────────────────────┐
│ Space-time continuum units│
│ searching and selection│
└─────────────────────┘
          │
          ▼
┌─────────────────────┐
│ Extreme XCO2        │
│ units               │
└─────────────────────┘
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On the other hand, R. G. Detmers et al. applied the monthly averaged XCO_2 after detrended yearly (hereafter referred to as **MA method**) to analyze the abnormal changes of atmospheric CO_2 concentration.

This method makes use of the XCO2 difference obtained by subtracting the mean of the same month over many years for anomaly detection rathet than residual error

Detmers, R.G.; Hasekamp, O.; Aben, I.; Houweling, S.; van Leeuwen, T.T.; Butz, A.; Landgraf, J.; Köhler, P.; Guanter, L.; Poulter, B. Anomalous carbon uptake in Australia as seen by GOSAT. Geophys. Res. Lett. 2015, 42, 8177–8184.
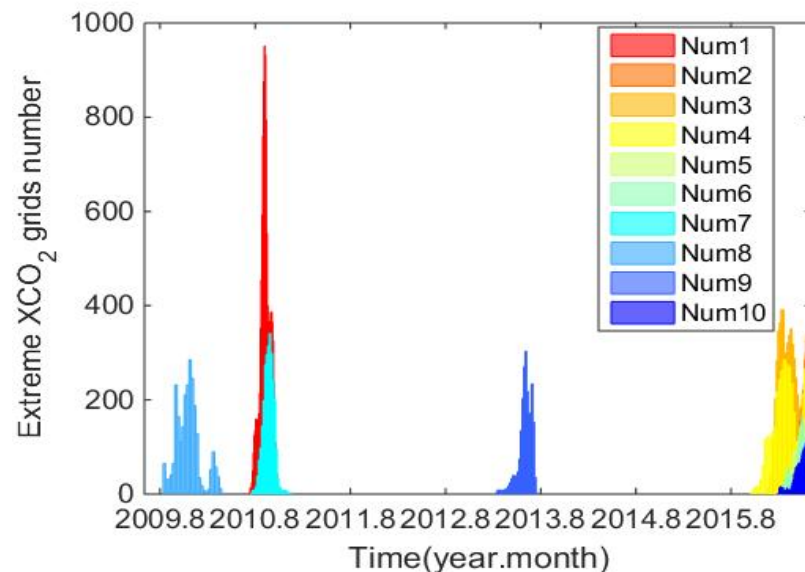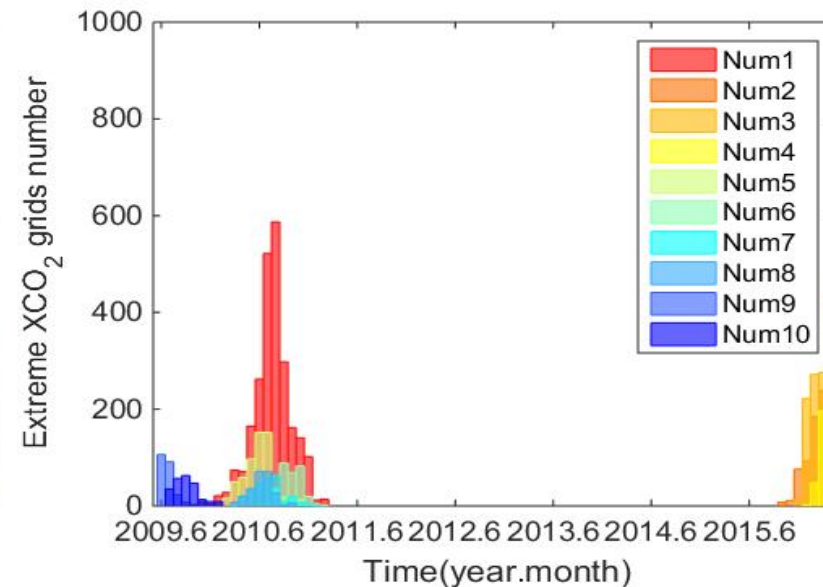
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➢ **Atmospheric CO2 concentrations abnomal change**

➢ **Comparison of detection methods for abnormal XCO2 concentrations change**

➢ **Comparison and analysis of abnormal detection results**

1、Temporal distribution of RE and MA results

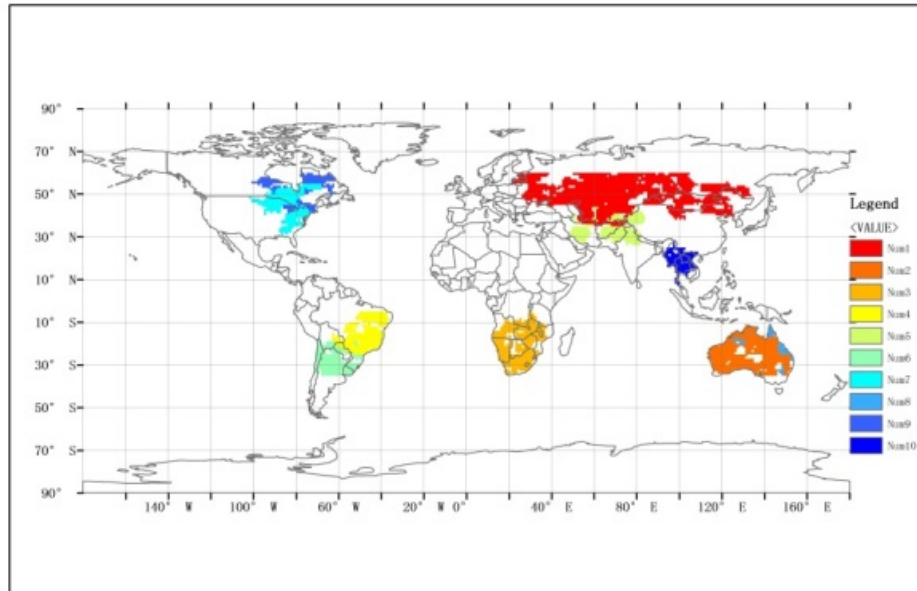We compare this two method using mapping GOSAT-XCO$_2$ from Zhonghua He's paper.
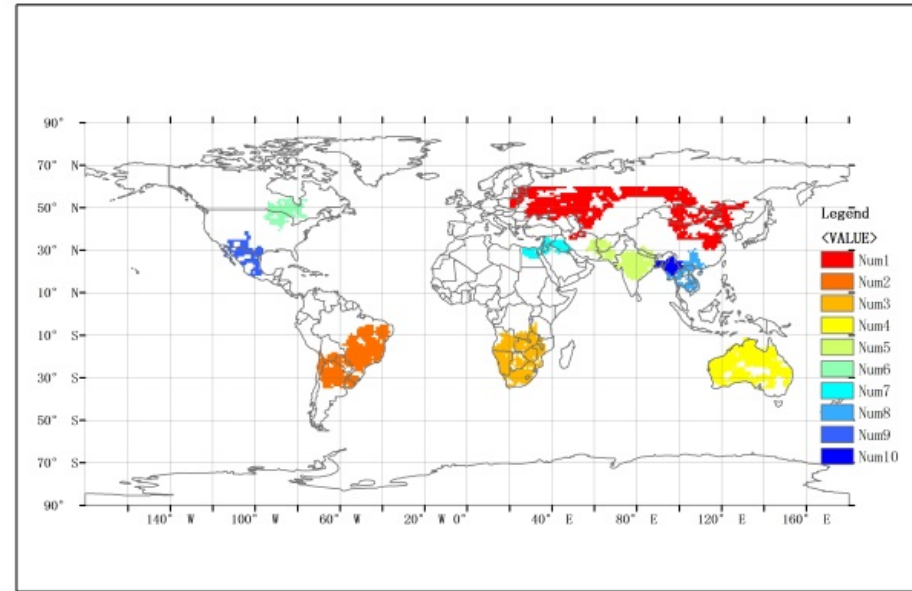

（a）RE method　　　　　　　　（b）MA method

The time of anomaly changes of XCO$_2$ detected by two methods
using mapping GOSAT XCO$_2$ data respectively.

2、Spacial distribution of RE and MA results

（a）RE method   （b）MA method

The spatial distribution of anomaly changes of XCO_2 detected by two methods using mapping GOSAT XCO_2 data respectively.