Supplement of Atmos. Chem. Phys., 24, 13101–13113, 2024
https://doi.org/10.5194/acp-24-13101-2024-supplement

Atmospheric Chemistry and Physics
Open Access
EGU

Supplement of

Development of a high-spatial-resolution annual emission inventory of greenhouse gases from open straw burning in Northeast China from 2001 to 2020

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Table S1. The geographic scope and temporal coverage of the data involved in this study

Data	Data Sources	Geographic scope	Temporal coverage
MODIS fire product (MCD14ML)	University of Maryland (sftp://fuoco.geog.umd.edu)	Northeast China	2001-2020
ChinaCropArea1km	http://www.nesdc.org.cn/	Northeast China	2001-2019
ChinaCropPhen1km	http://www.nesdc.org.cn/	Northeast China	2001-2019
HLJ-Soybean-map	https://figshare.com/articles/figure/HLJ_Soybean_map/14776500	Heilongjiang Province	2001-2012
Crop classification maps for Northeast China	https:// doi.org/10.6084/m9.figshare.20411424.v1	Northeast China	2013-2020
Output of major farm products	National Bureau of Statistics of China (NBSC) (http://www.stats.gov.cn/tjsj/ndsj/)	Heilongjiang Province, Jilin Province, Liaoning Province	2001-2020
Rural residential coal consumption	National Bureau of Statistics of China (NBSC) (http://www.stats.gov.cn/tjsj/tjcbw/)	Heilongjiang Province, Jilin Province, Liaoning Province	2001-2020

Note: Missing data for a certain year were replaced with those of the adjacent year, e.g. the distribution and phenology of corn, rice, and wheat in 2020 are supplemented with relevant data from 2019. In addition, since the bean lacked the corresponding phenology data, the mode of emergence and maturity dates of other crops were used to supplement. The above data processing process will produce errors, which we would like to clarify here.

Table S2. Pearson correlation coefficient of CO_2-eq emissions and straw yield

Study area	2003-2020	**Period I** (2003-2012)	**Period II** (2013-2017)	**Period III** (2018-2020)
Northeast China	0.673**	0.734**	-	-
Heilongjiang	0.614**	0.705**	-	-
Jilin	0.737**	-	-	-
Liaoning	-	-	-	-

Note:* * significance level at $p<0.01$; * significance level at $p<0.05$

Table S3. Pearson correlation coefficient of CO_2-eq emissions and rural residential coal consumption

Study area	2003-2020	**Period I** (2003-2012)	**Period II** (2013-2017)	**Period III** (2018-2020)
Northeast China	0.719**	-	-	-
Heilongjiang	0.608**	0.648**	-	-
Jilin	0.673**	-	-	-
Liaoning	-	-	-	-

Note:* * significance level at $p<0.01$; * significance level at $p<0.05$

Table S4. The straw burning bans in Heilongjiang, Jinlin, and Liaoning

Province	Number	Year	Straw burning bans
Heilongjiang	1	2015	Emergency Notice on Further Promoting Straw Burning Banning
	2	2016	Implementation Plan for Heilongjiang Province to Prohibit Burning Straw in the Field to Improve the Quality of Atmospheric Environment
	3	2017	Notice on Further Strengthening the Province's Straw Burning Banning Control Work
	4	2018	Three-year Action Plan for Comprehensive Utilization of Straw in Harbin City, Suihua City, Zhaozhou County and Zhaoyuan County
	5	2019	Implementation Plan for Heilongjiang Province to Comprehensive Utilisation of Straw in 2019
	6	2020	Implementation Plan for Heilongjiang Province to Comprehensive Utilisation of Straw in 2020
Jilin	1	2013	Notice on Prohibiting Open Burning of Crop Straw
	2	2014	Notice on Further Promoting the Banning of Straw Burning in Autumn and Winter
	3	2016	Instructions on Promoting the Comprehensive Utilization of Crop Straws
	4	2017	Decision on the Prohibition of Open Burning and Comprehensive Utilization of Crop Straw
	5	2018	Work Plan for Banning Straw Burning in Autumn and Winter in Jilin Province 2018
	6	2019	Notice on Enhancing Straw Programme Burning and Removal Work
	7	2020	2020 Autumn and Winter Key Areas Straw Burning Control Package Assistance Program
Liaoning	1	2016	Implementation Opinions on Promoting Comprehensive Utilization of Crop Straw and Banning Burning Work (2016-2018)
	2	2017	Liaoning Province 2017-2018 Autumn and Winter Comprehensive Air Pollution Control and Tackling Action Supervision Programme
	3	2018	Liaoning Province Straw Burning Prevention and Control Responsibility Measures
	4	2020	Straw Burning Control Work Programme for Liaoning Province during 2020-2021

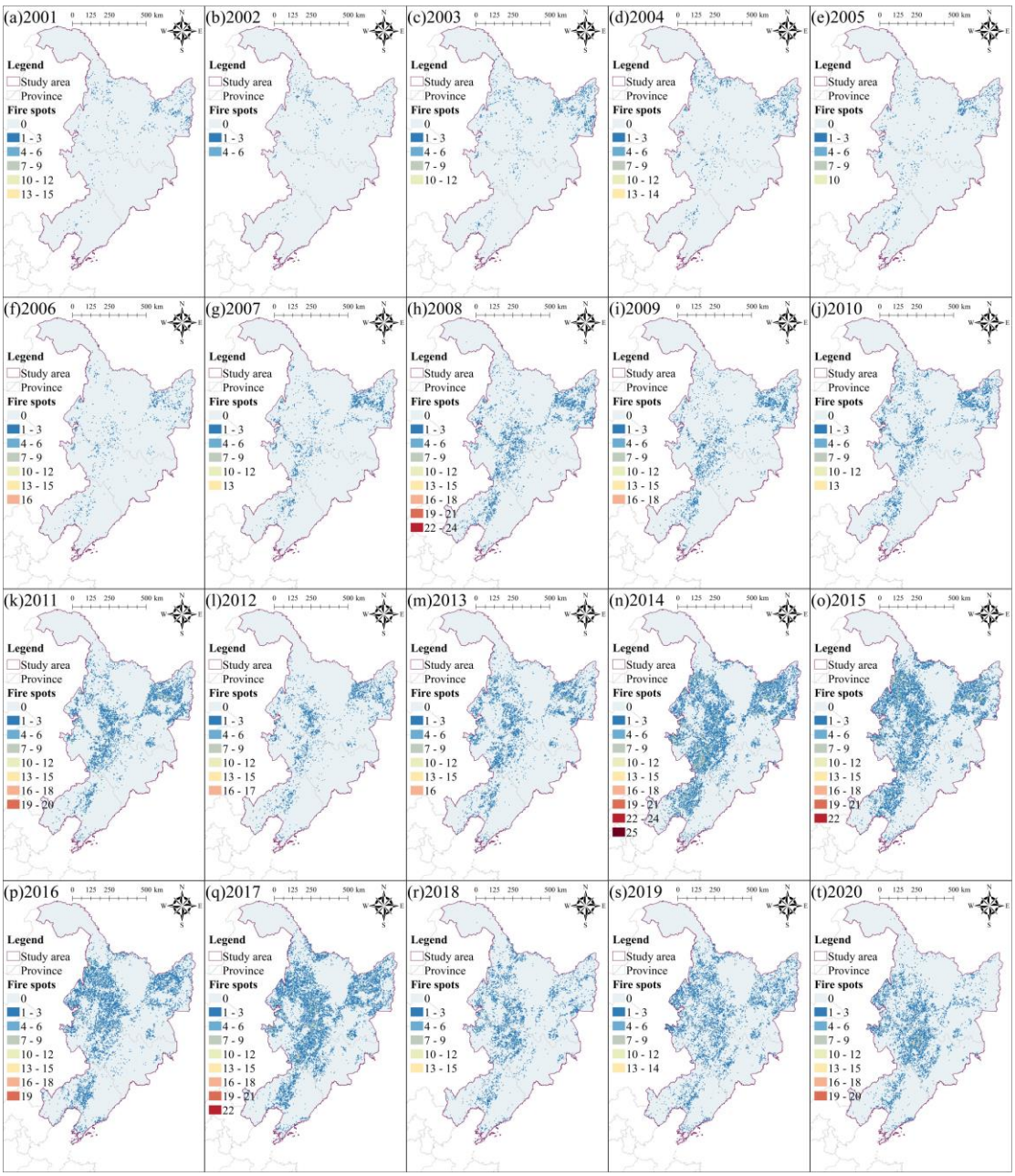

Fig. S1 The spatial distribution of annual fire spots from open straw burning in Northeast China from 2001 to 2020

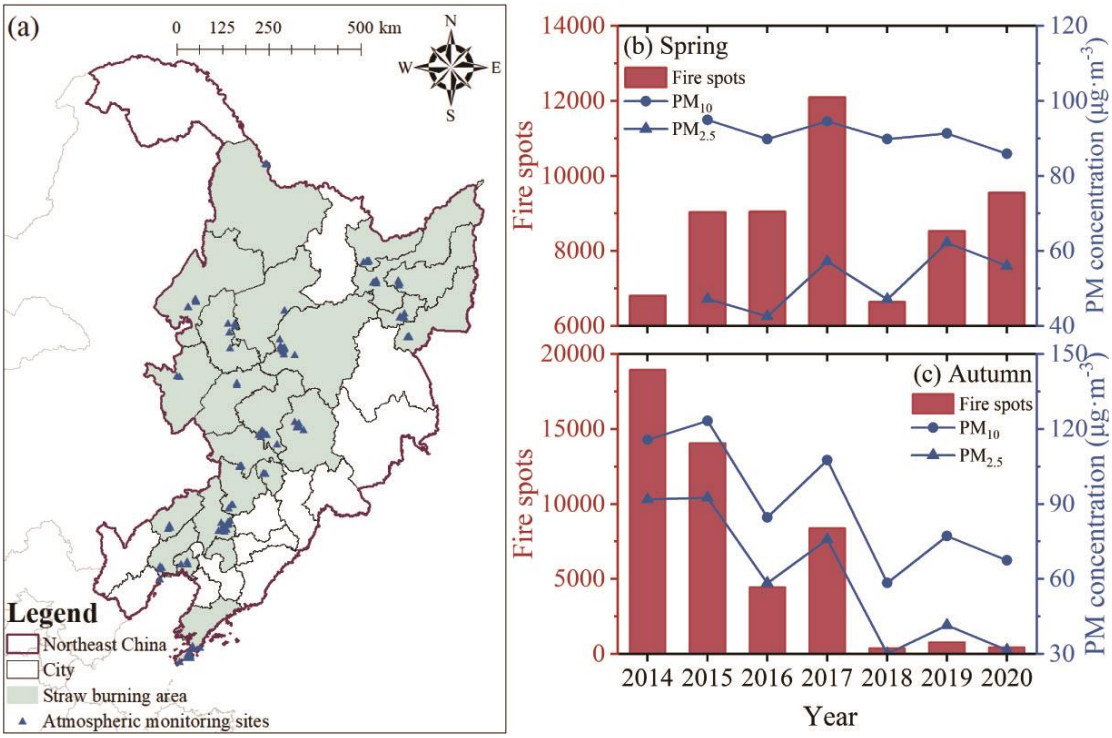

Fig. S2 (a) Spatial distribution of atmospheric monitoring sites in straw burning areas in Northeast China; (b) and (c) represent the variations of fire spots and particulate matter (PM_{10} and $PM_{2.5}$) concentrations (http://www.cnemc.cn) during the period of open straw burning in spring and autumn, respectively, in Northeast China from 2014 to 2020. Note: The range of y-axis is different for each season. The red y-axis indicates fire spots, with values ranging from 6000 to 14000 for spring, and 0 to 20000 for autumn; the blue y-axis indicates PM concentrations, with values ranging from 40 to 120 $\mu g \cdot m^{-3}$ for spring, and 30 to 150 $\mu g \cdot m^{-3}$ for autumn.

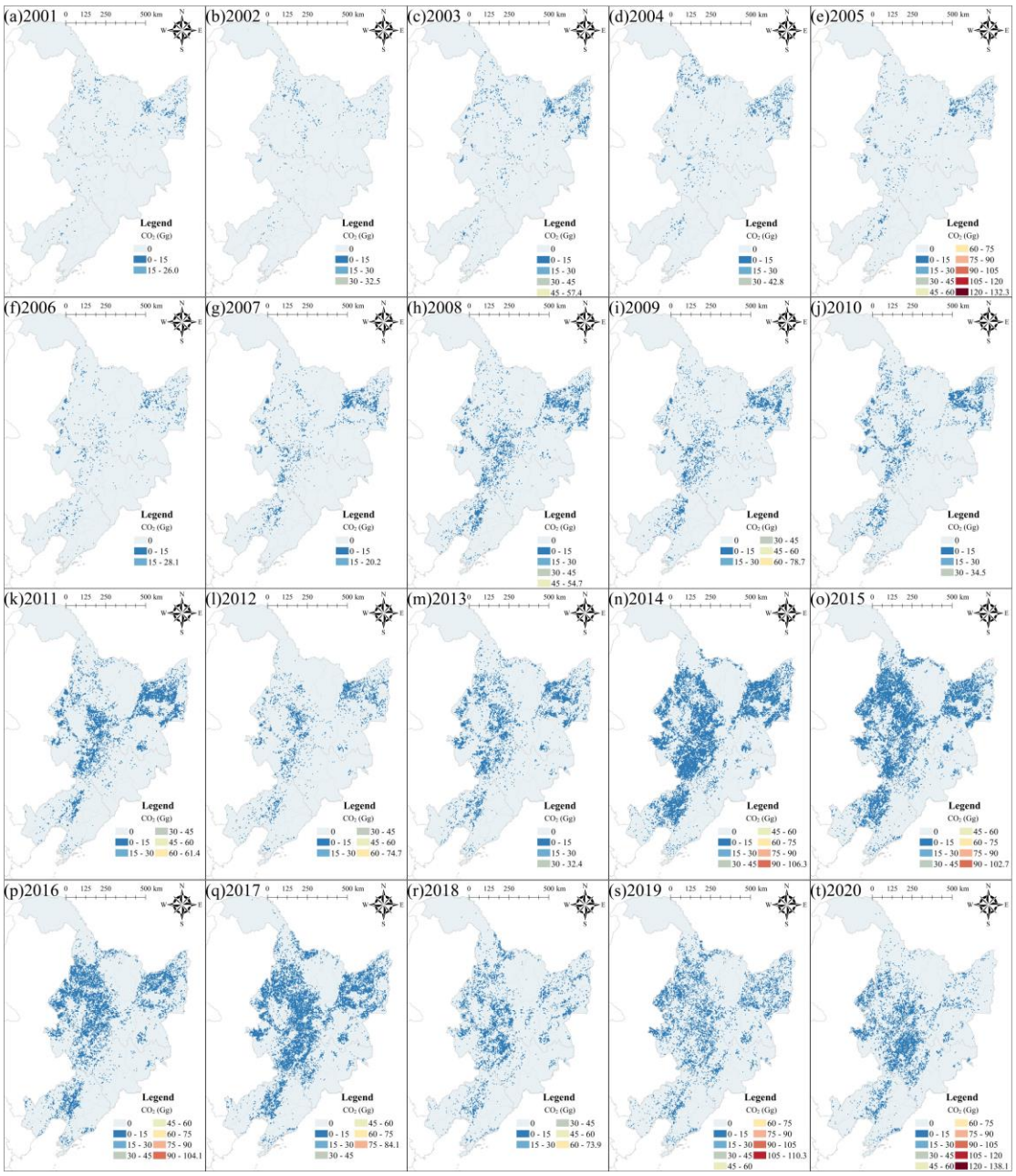

Fig. S3 The annual CO_2 emission inventory from open straw burning in Northeast China from 2001 to 2020

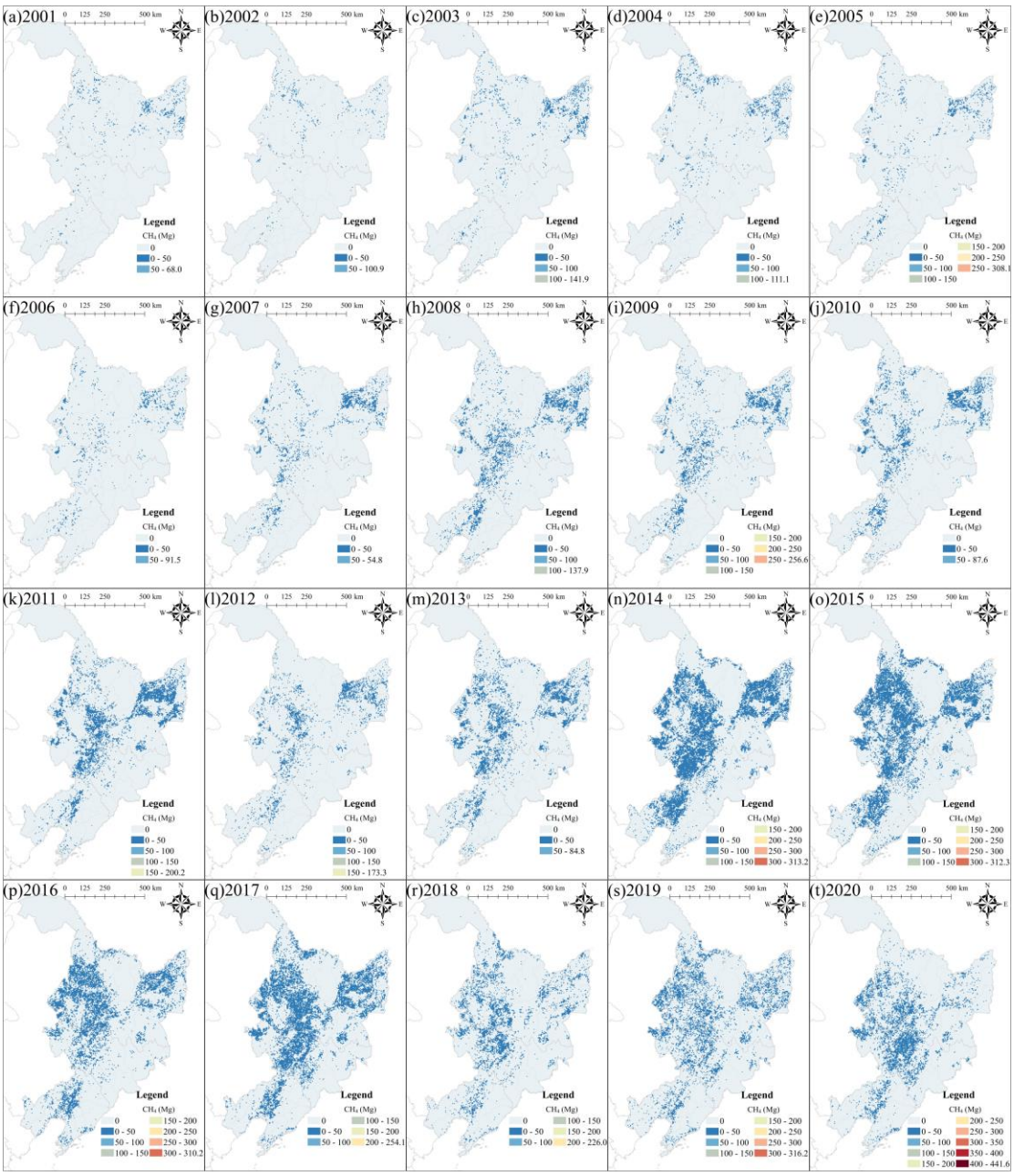

Fig. S4 The annual CH_4 emission inventory from open straw burning in Northeast China from 2001 to 2020

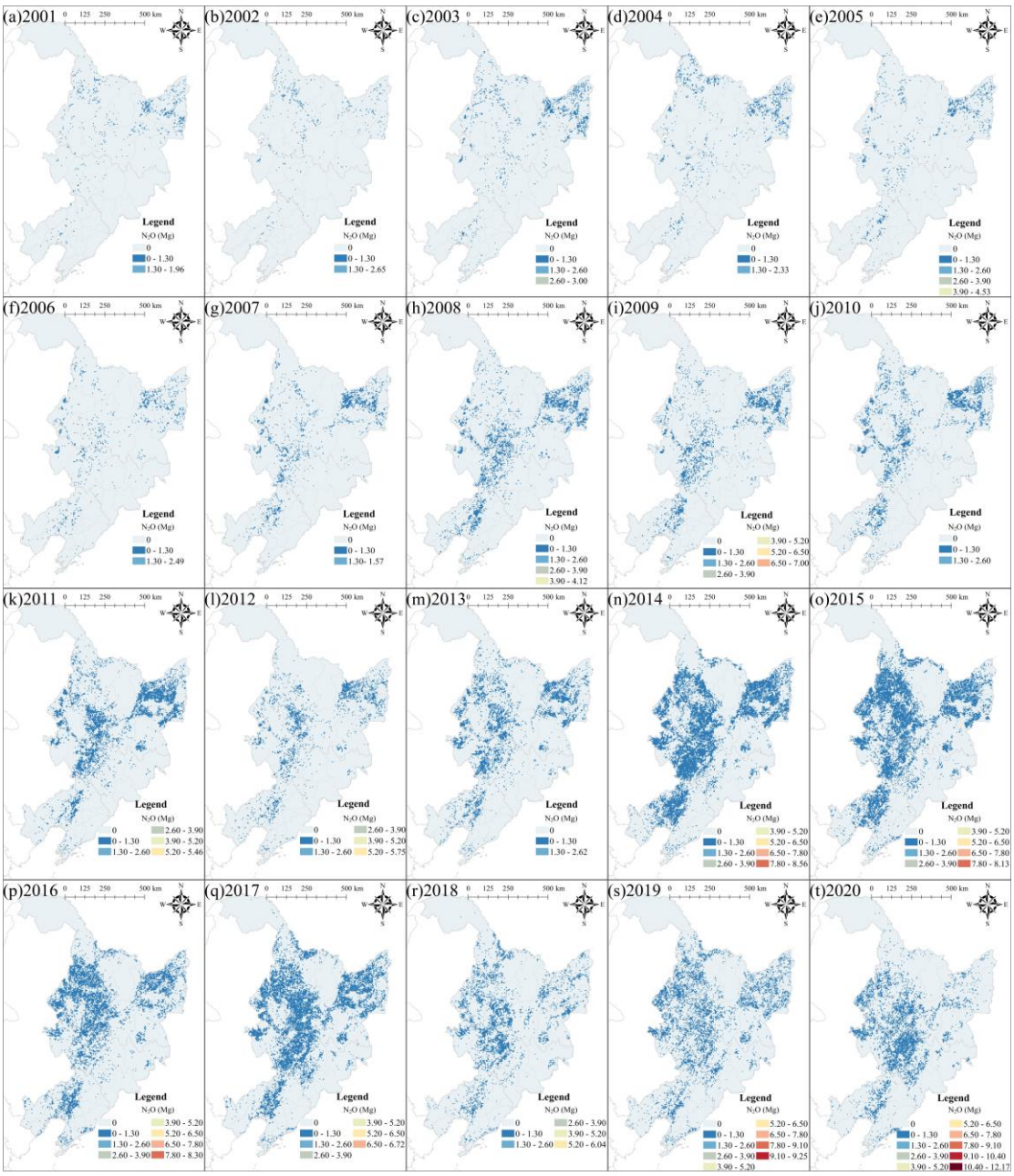

Fig. S5 The annual N_2O emission inventory from open straw burning in Northeast China from 2001 to 2020

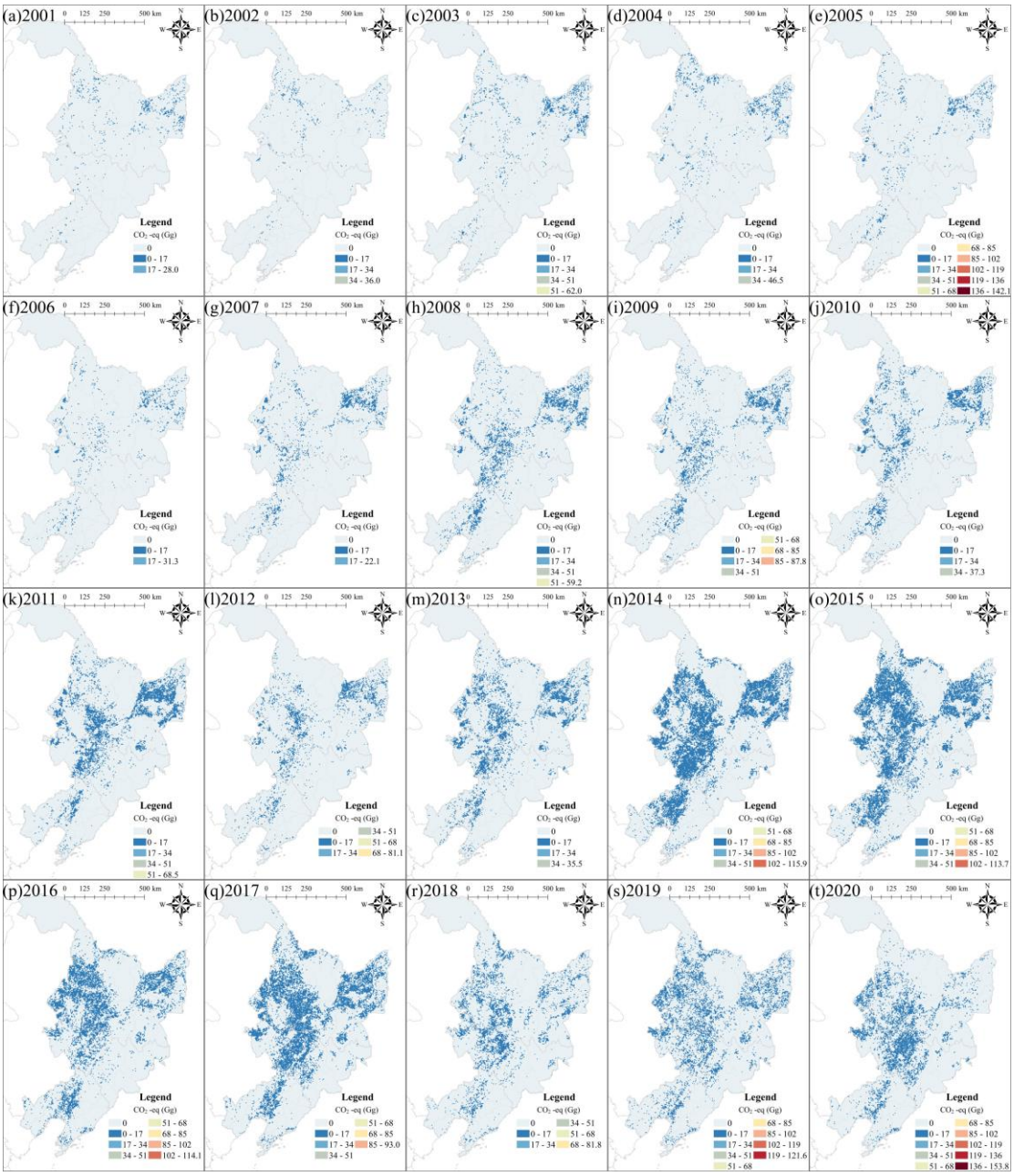

Fig. S6 The annual CO_2-eq emission inventory from open straw burning in Northeast China from 2001 to 2020.