# 中国北方地区不同耕作方式对CO2排放的影响

# Carbon dioxide emissions after application of different tillage systems in northern China


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# 温室气体特征 The character of greenhouse

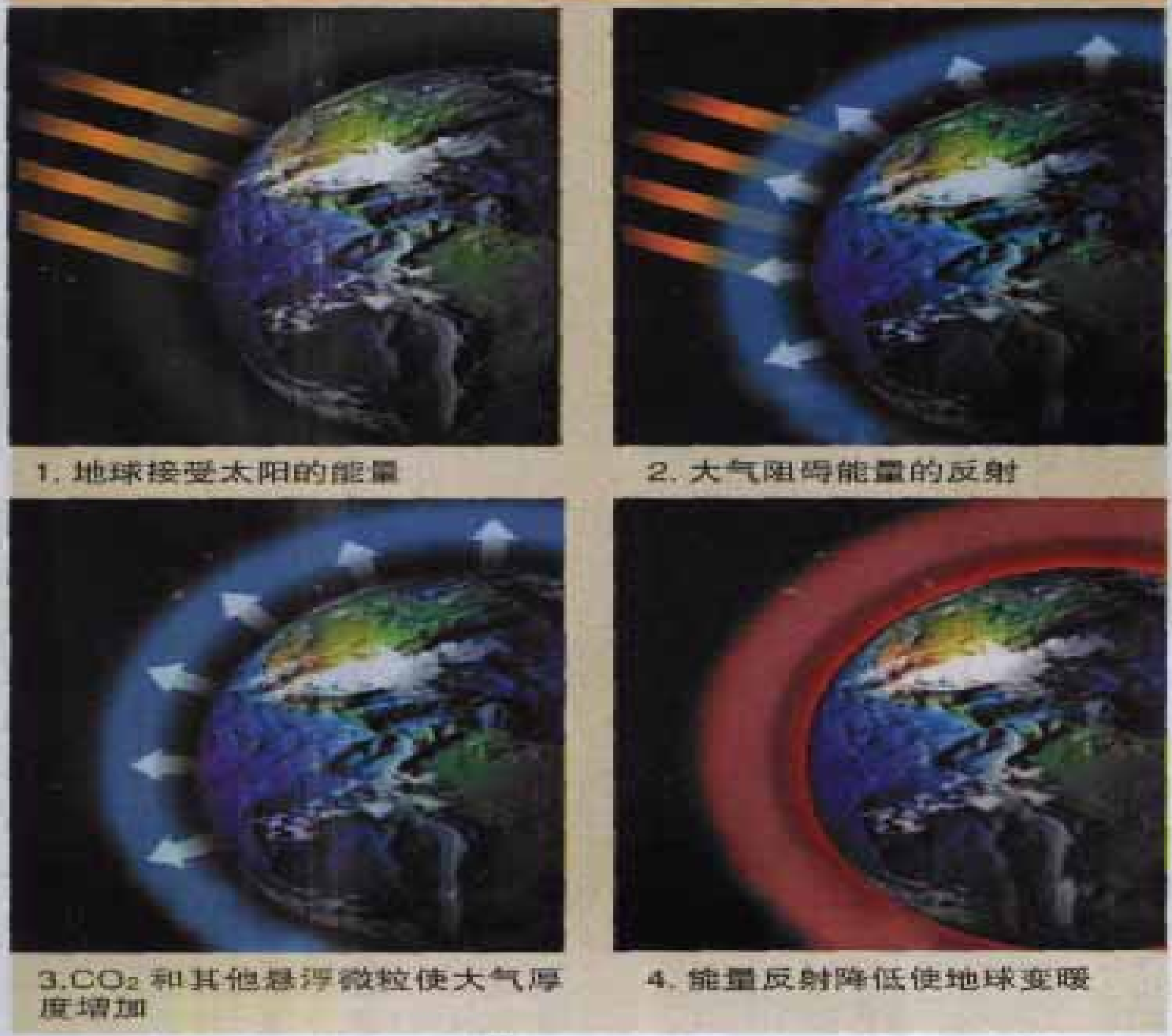
| 种类 sort | 增温效应% greenhouse effect | 生命期/a activity years | 种类 sort | 增温效应% greenhouse effect | 生命期/a activity years |
|---|---|---|---|---|---|
| $CO_2$ | 63 | 50~200 | HFCs | 11 | 13.3 |
| $CH_4$ | 15 | 12~17 | PECs | | 50000 |
| $N_2O$ | 4 | 120 | $SF_6$ | 7 | 不详 |

来源 《京都议定书》 From:Kyoto Protocol

二氧化碳等气体在大气中的增加是全球变暖，气候变化的主要原因

Global Warming due to increasing greenhouse gas concentrations in the atmosphere

# 温室效应的产生

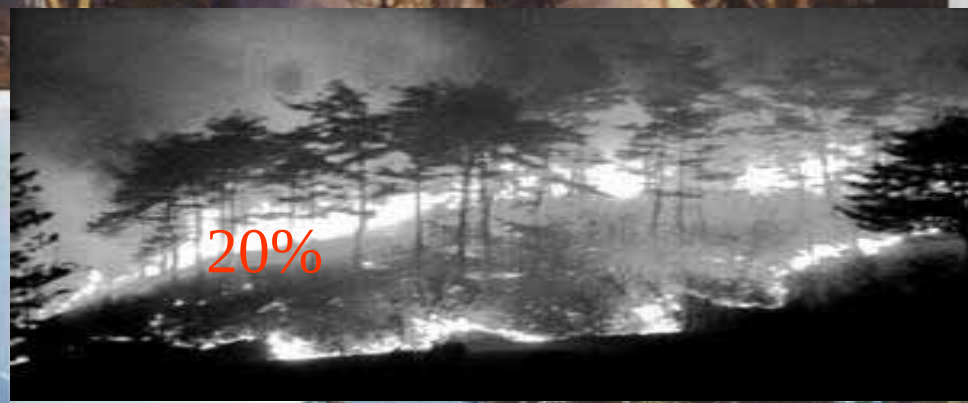



温室效应的机理

the course of greenhouse effect


No President but Nobel Peace Prize !


65%
工业排放 Industry


20%


生活排放 household; travel et al


森林砍伐 焚烧
Burn forest

| 气体 gas | 来源及途径 Source and approach | 在农业生态系统中 in agricultural ecosystem | | |
|---|---|---|---|---|
| | | 每年释放量(t) Emission amount | 占全部释放量的比例(%)proportion | 主要的来源 main source |
| $CO_2$ | 燃料、土壤和植被 fule soil vegetation | $10^8$—$10^9$ | 30 | 森林、烧荒 forest |
| $N_2O$ | 土壤、水体、有机物的燃烧 soil water fire | 约$10^6$ | 90 | 土壤 soil |
| $CH_4$ | 潮湿的土壤 Wet soil | $10^7$—$10^8$ | 70 | 稻田、湿草原、沼泽 rice field |

大气中70%的$CH_4$和90%的$N_2O$来源于农业活动和土地利用方式的转换，$CO_2$也有大约30%来自土地利用的变化

From agricultural practice or land change use

## 1农机耗能过程 agricultural machine

耕地和收获耗能最大，采用“免耕法”或“减少耕作法”每年每公顷能节省23kg燃料C。在少耕情况下，每公顷可节省47.51Kg油耗，相当于125.4Kg$CO_2$的量，总的$CO_2$释放量相比传统耕作减少15－29％

Tillage and harvest using many oil energy and many C were release by this way

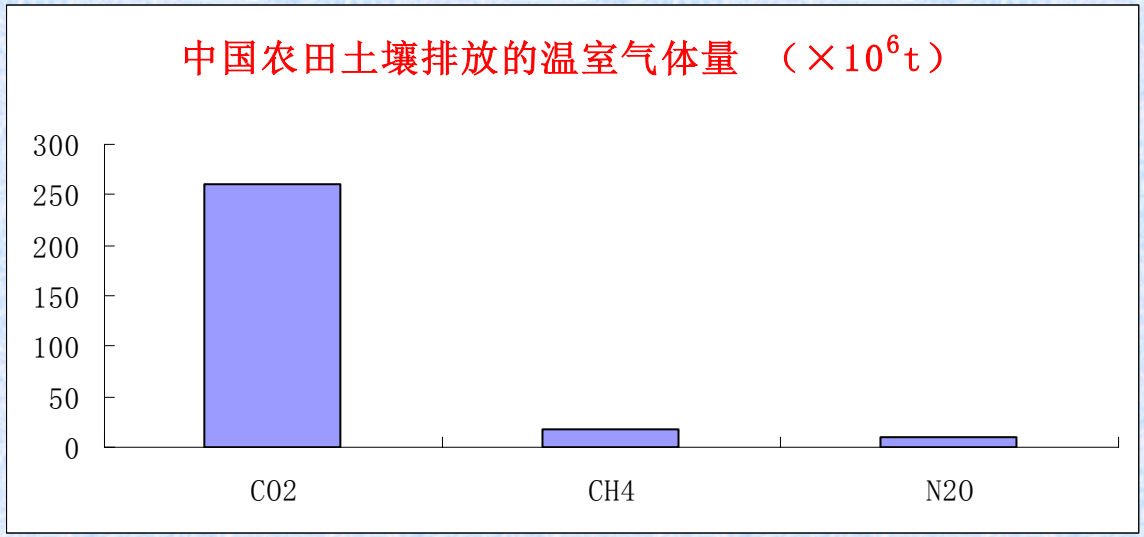
## 2 农田土壤排放 soil respiration

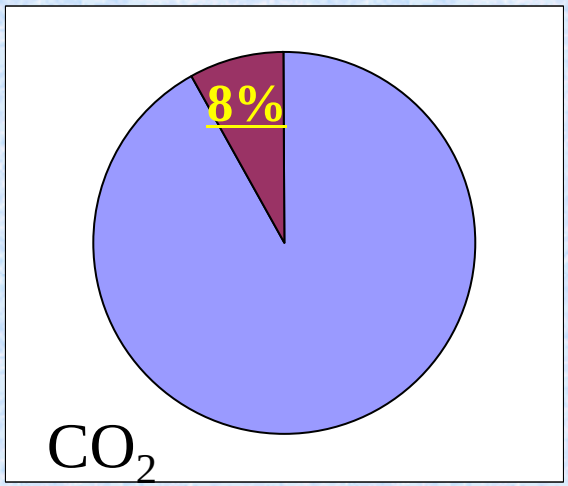
土壤是大气$CO_2$的主要来源之一，也是土壤碳库的主要输出途径，不同利用方式及不同农田管理对土壤$CO_2$排放通量均有显著影响 。

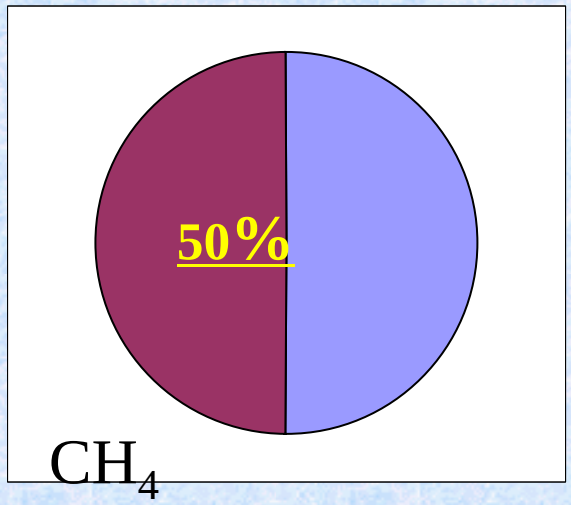
Land use and soil management can influence carbon dioxide emission

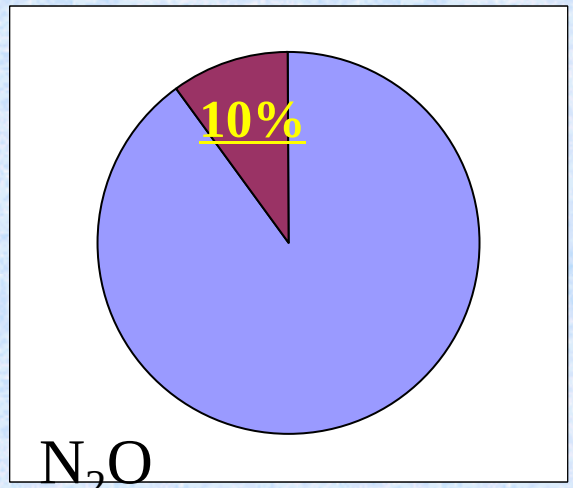
农田与大气之间的气体交换对全球碳循环以及大气中CO2浓度的增加有重要作用

The exchange of greenhouse gases between croplands and atmosphere plays an important role in the global carbon cycle and the carbon concentration in the atmosphere.


中国农田土壤排放的温室气体量 （×10^6t）
300
250
200
150
100
50
0
CO2
CH4
N2O

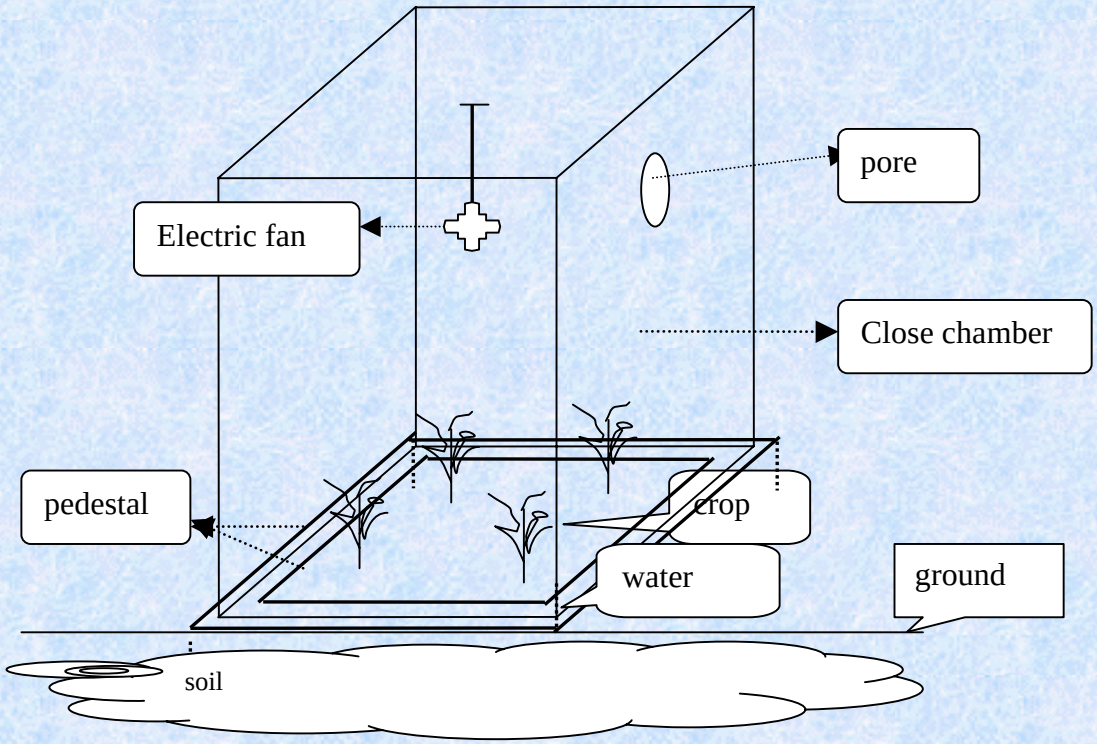

8%
CO2


50%
CH4


10%
N2O

# 北方区域以及典型农业生产模式

## North area and main agricultural mode



pore
Electric fan
Close chamber
pedestal
crop
water
ground
soil

$F = \triangle m/\triangle t \cdot DV/A = hd\triangle m/\triangle t$

where F refers to flux of $CO_2$, V is the volume of the chamber, A the earth area sealed the chamber at four sides, D is the gas density of the chamber( $D=n/v=P/RT$, $mol/m^3$, P the air pressure, T the temperature inside the chamber and R the air constant), $\triangle m/\triangle t$ denotes linear slope of concentration change with time over measurement period and h represents the height of the chamber.


No tillage cropland
Close chamber
straw
geothermometer

In the North of China (37° 50′ N, 114° 40′ E).

average annual temperature is 12.5℃

196 frost free days.

60% of annual rainfall occurs from June to July.

winter wheat-maize rotation

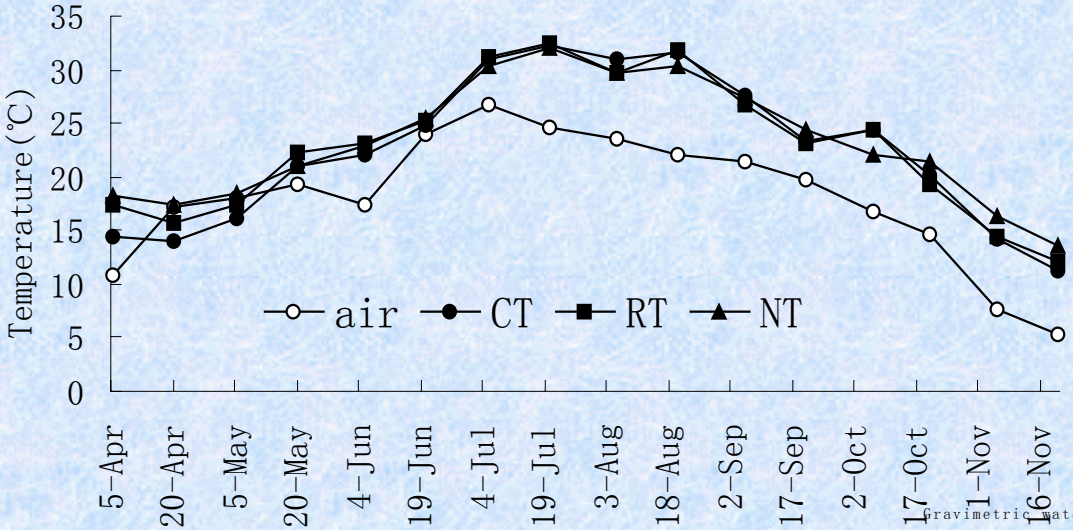
| *Texture* | *Bulk density (g $cm^{-3}$)* | *Total N (g $kg^{-1}$)* | *Hydrolysable N (mg $kg^{-1}$)* | *Available P (mg $kg^{-1}$)* | *Available K (mg $kg^{-1}$)* | *Organic matter (g $kg^{-1}$)* |
|---|---|---|---|---|---|---|
| Sand loam | 1.39 | 0.69 | 34.27 | 51.3 | 102.5 | 12.6 |

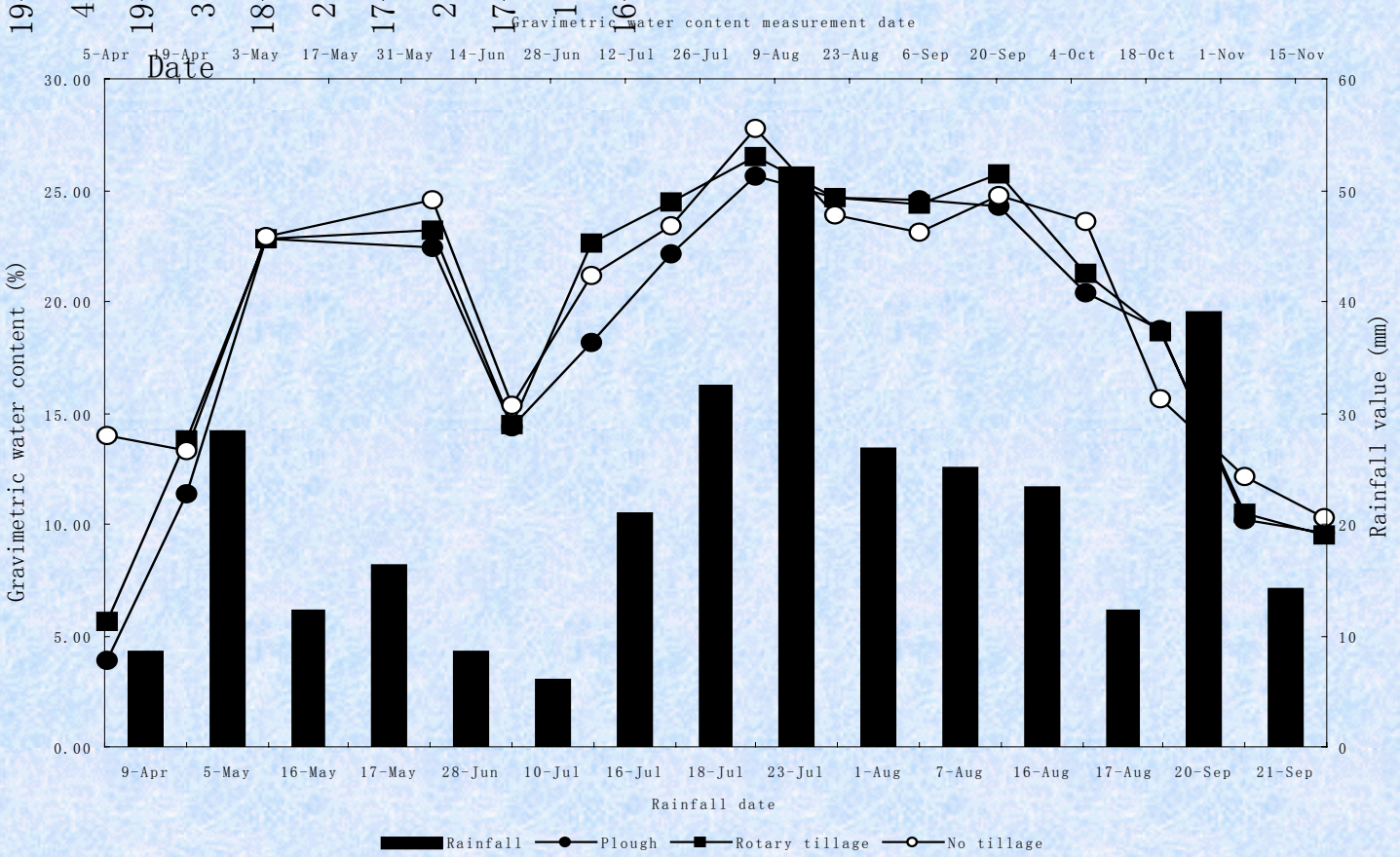
(1) conventional tillage by plough , (2) rotary tillage , (3) no tillage .

CT operations disturbed the soil to approximately 20 cm depth,

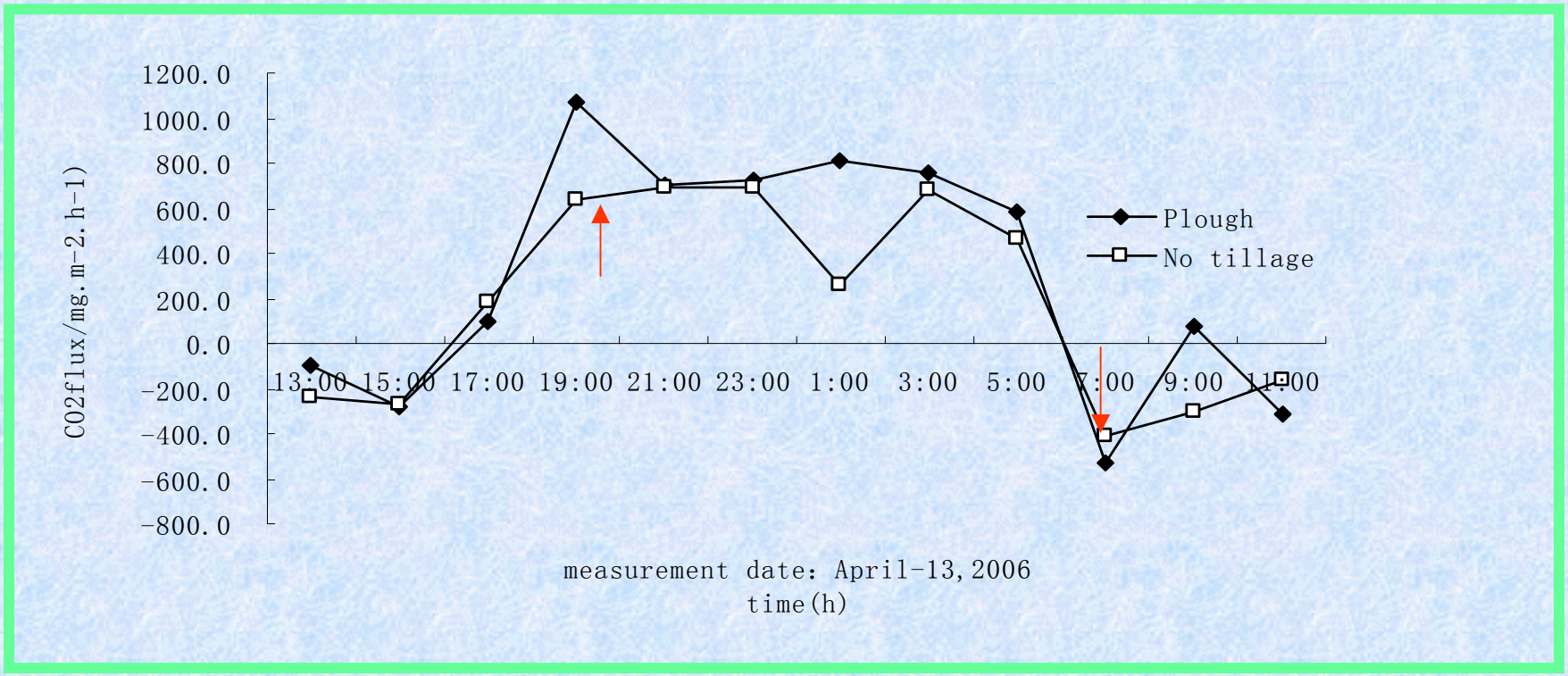
RT to 5 cm.

No tillage was applied before maize sowing in June.


Temperature(℃)
35
30
25
20
15
10
5
0
air
CT
RT
NT
5-Apr
20-Apr
5-May
20-May
4-Jun
19-Jun
4-Jul
19-Jul
3-Aug
18-Aug
2-Sep
17-Sep
2-Oct
17-Oct
1-Nov
16-Nov
Date


Gravimetric water content measurement date
5-Apr
19-Apr
3-May
17-May
31-May
14-Jun
28-Jun
12-Jul
26-Jul
9-Aug
23-Aug
6-Sep
20-Sep
4-Oct
18-Oct
1-Nov
15-Nov
Gravimetric water content (%)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Rainfall value (mm)
60
50
40
30
20
10
0
9-Apr
5-May
16-May
17-May
28-Jun
10-Jul
16-Jul
18-Jul
23-Jul
1-Aug
7-Aug
16-Aug
17-Aug
20-Sep
21-Sep
Rainfall date
Rainfall
Plough
Rotary tillage
No tillage

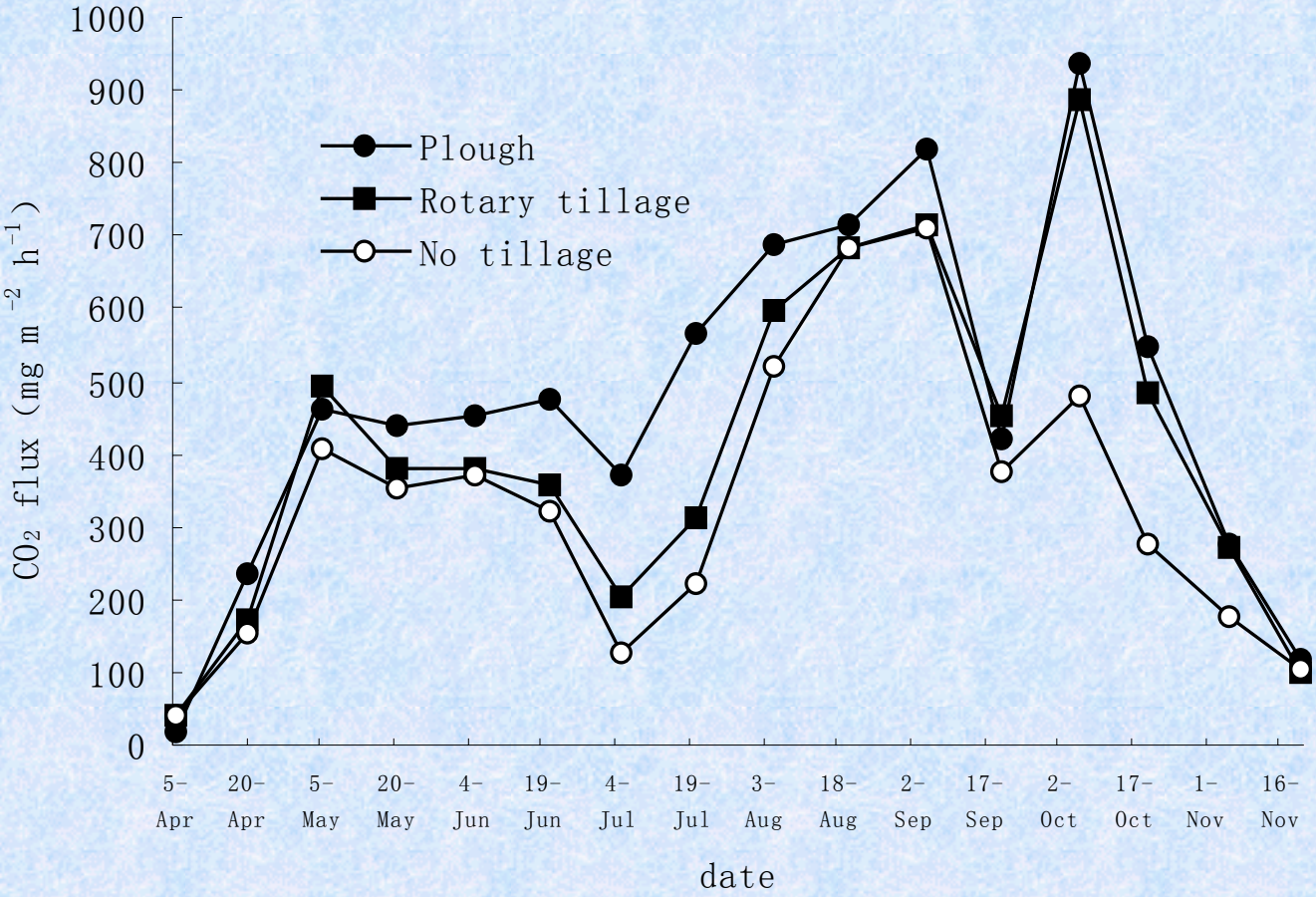
# Daily $CO_2$ emission

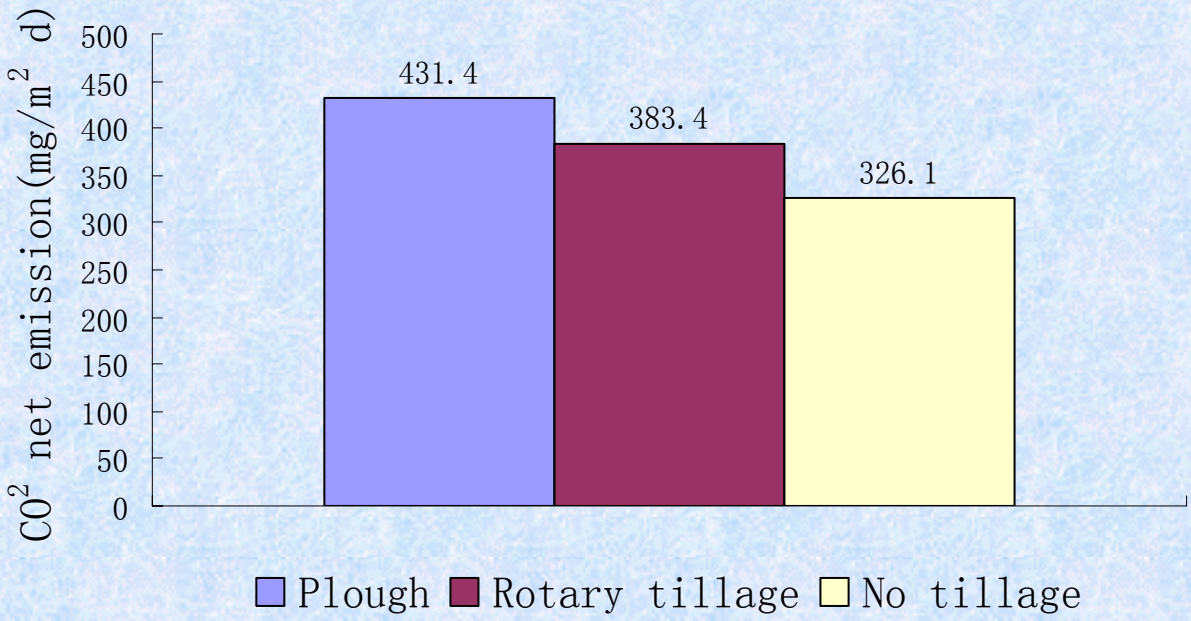


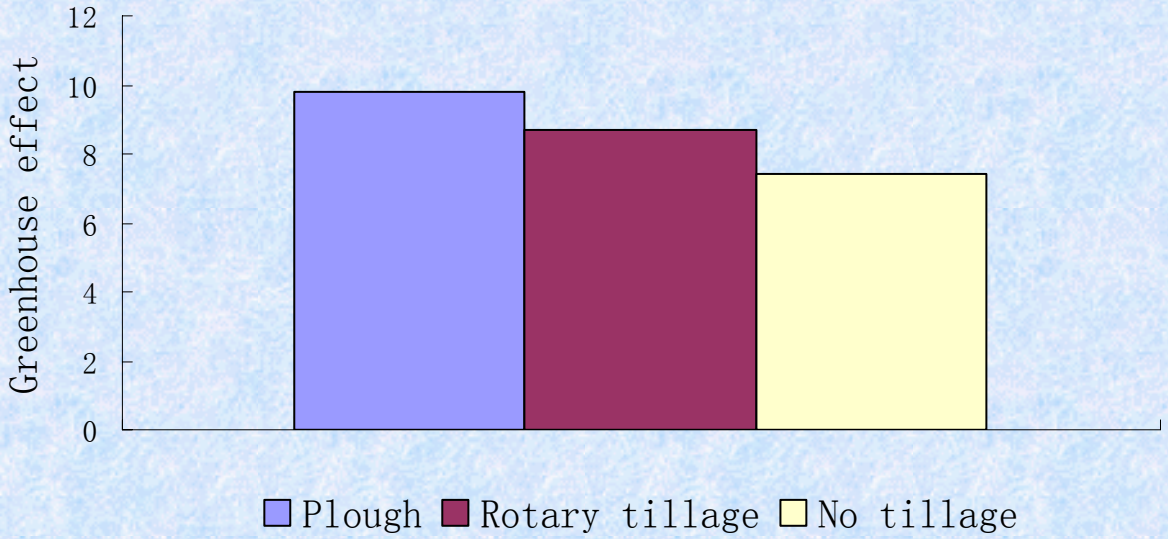

最低排放时间在清晨6—7点the lowest $CO_2$ net emission is in 6-7clock at the morning

最高排放时间在晚上19—21点The largest $CO_2$ net emission l in 19-21 clock at the night ,

# Season change of $CO_2$flux






免耕比翻耕$CO_2$排放通量减少了24.5%

**The $CO_2$ flux Lower 24.5%**

**No tillage than plough**

# 发展保护性耕作 减缓农田温室气体

Develop conservation tillage
Reduce greenhouse gas emission


Thank you!
谢 谢 !