中国农业大学
China Agricultural University

College of Plant Protection
Plant Quarantine and Invasion Biology Lab

Potential geographical distribution of fall armyworm (*Spodoptera frugiperda*) in China

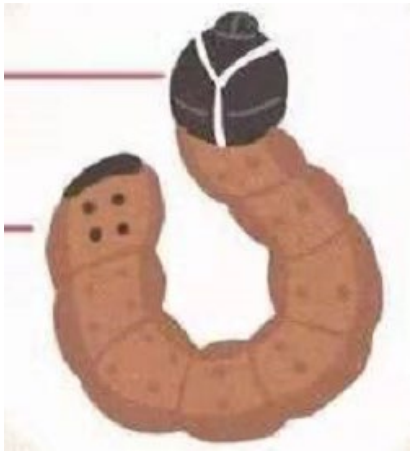
QIN Yujia[1]，LAN Shuai[1]，ZHAO Zihua[1]，SUN Hongyu[1]，ZHU Xiaoming[2]，YANG Puyun[2]，LI Zhihong[1]

（1. *College of Plant Protection, China Agricultural University,Beijing* 100193, *China*; 2. *National Agro-Tech Extension and Service Center*, *Beijing* 100125, *China*）

Reporter：Yujia Qin

2019-9-5

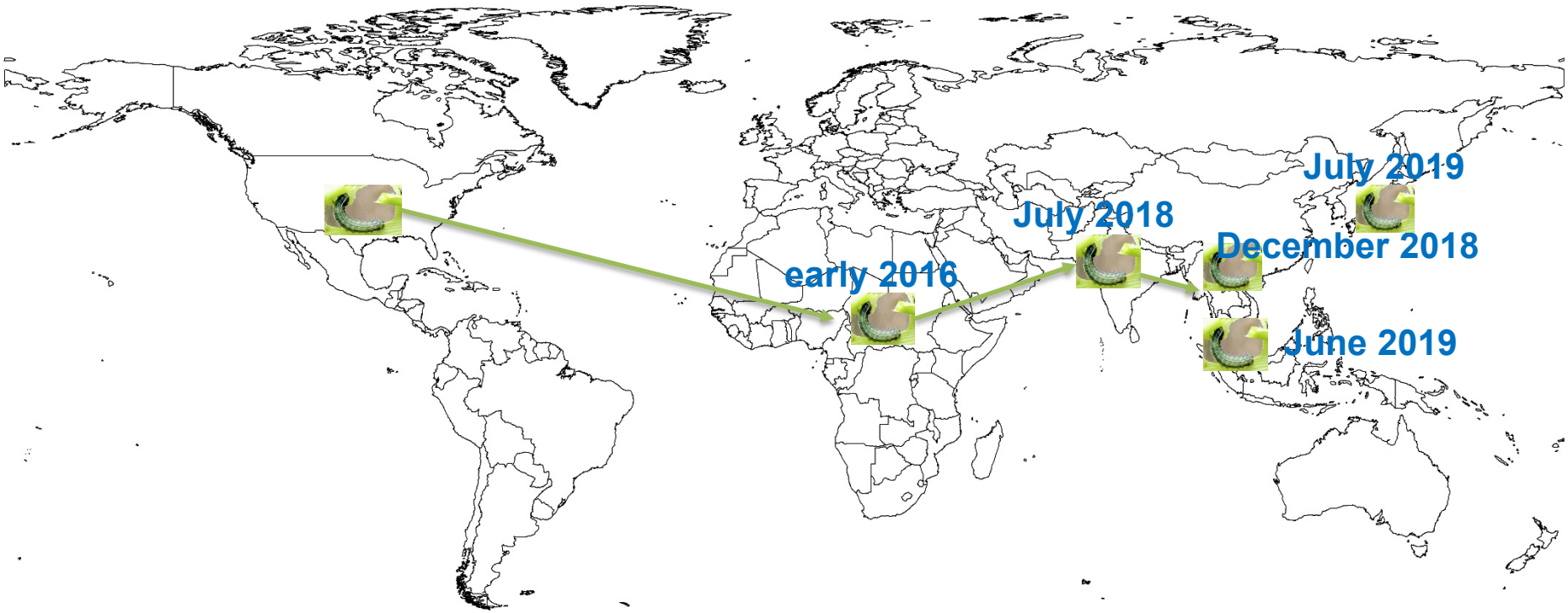
Study object



- It prefers **maize**, but can feed on more than 80 additional species of crops, including rice, sorghum, millet, sugarcane, vegetable crops and cotton .
- The moth can fly up to 100 km per night and the female moth can lay up to a total of 1000 eggs in her lifetime

(FAO，2019)

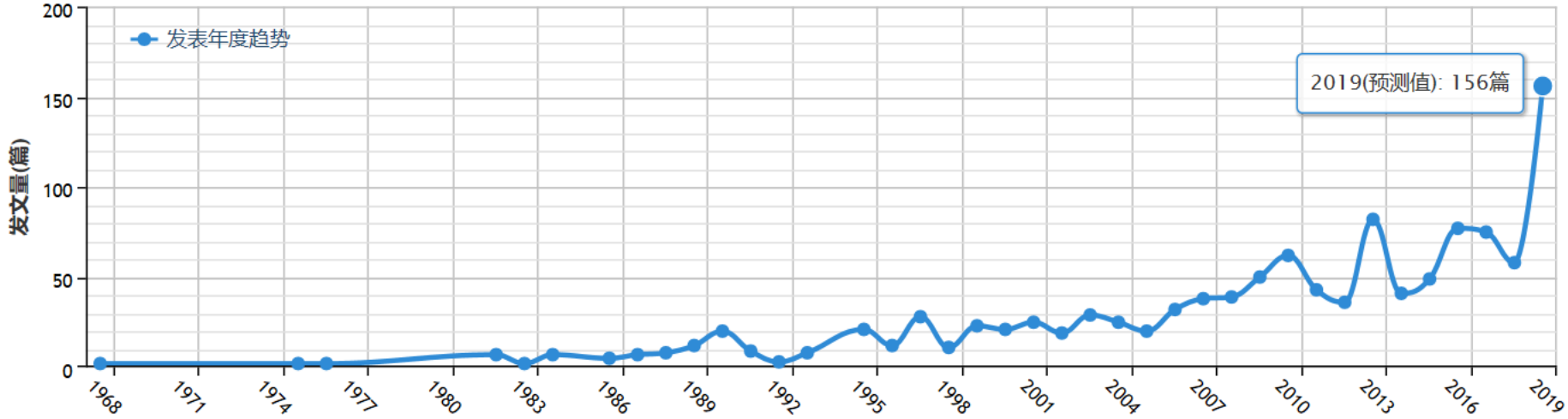
Study object



Distribution and invasion history of FAW

Study object

Study object



Publication of Chiese journal of FAW

PGD development of FAW

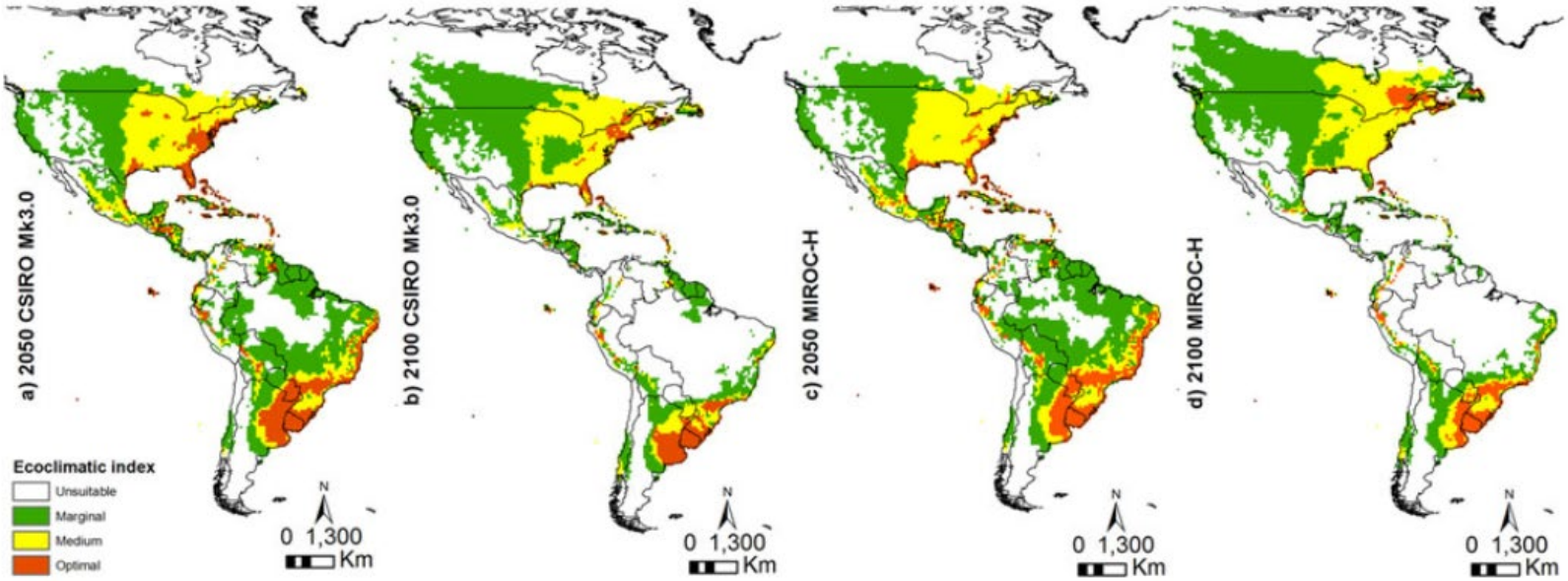


Fig. 2. The EI for future climate conditions of FAW (*Spodoptera frugiperda*) (*a*) by 2050 under CSIRO-Mk3.0, (*b*) by 2100 under CSIRO-Mk3.0, (*c*) by 2050 under MIROC-H and (*d*) by 2100 under MIROC-H. Colour online.

Future climate scenarios project a decrease in the risk of fall armyworm outbreaks (Ramirez-Cabral et al., 2017)

PGD development of FAW

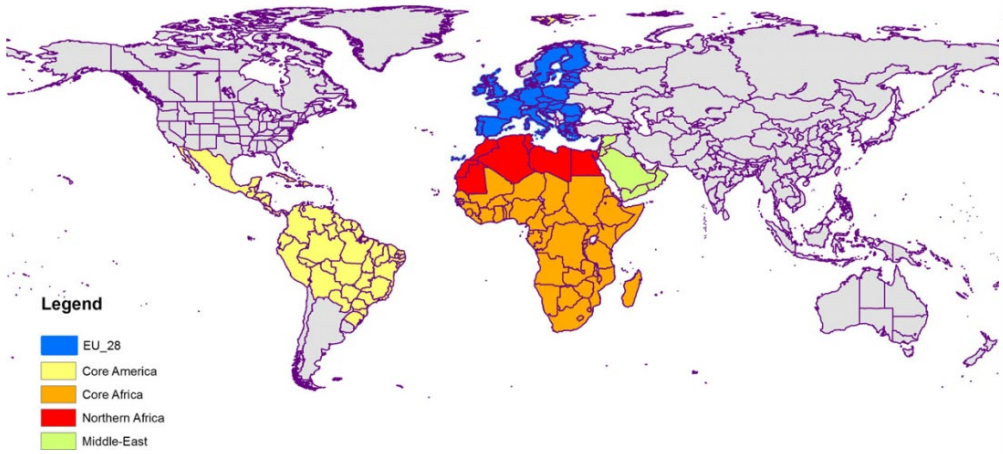
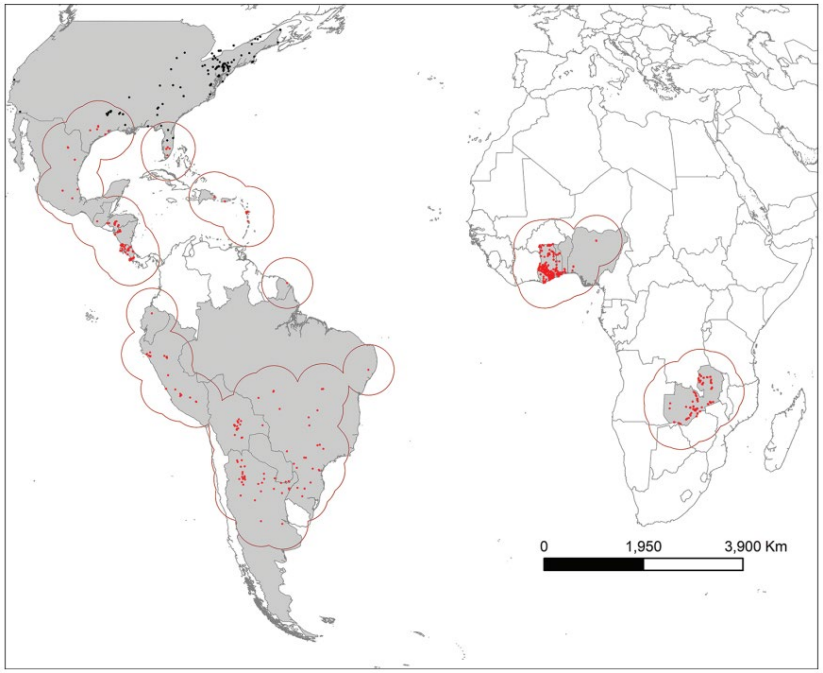


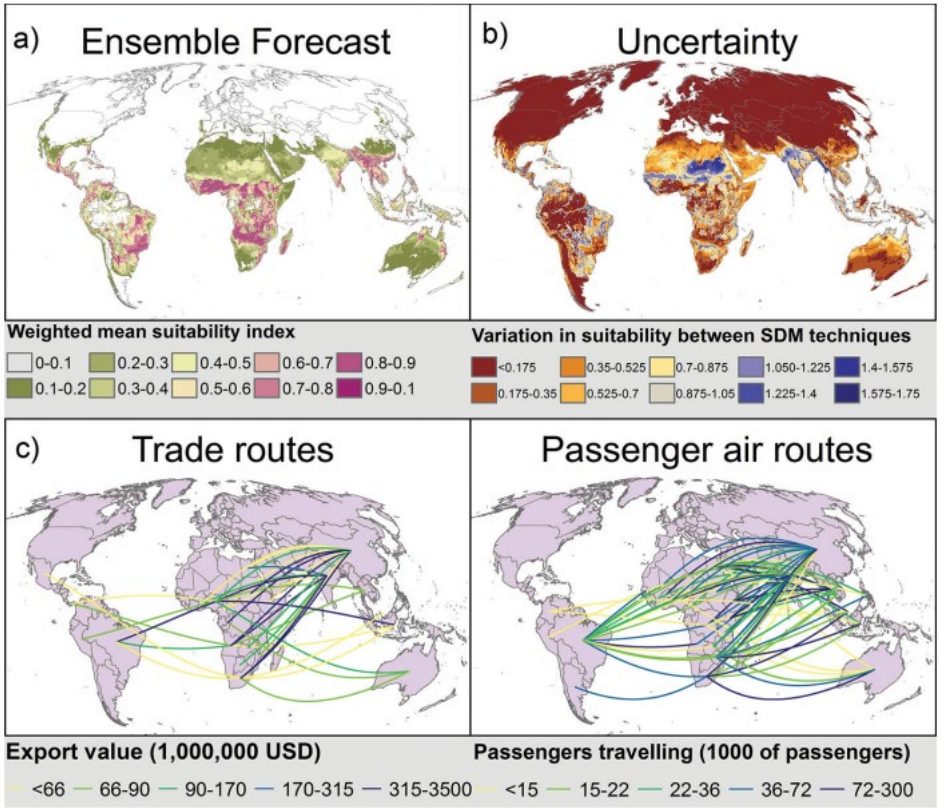
Figure 1: Regions of interest in this assessment. Immediate sources of *S. frugiperda* occur in 'core America' and 'core Africa' (sub-Saharan Africa). The EU 28 is the risk assessment area. North Africa and the Middle East are future potential sources of *S. frugiperda* spreads from core Africa. The focus of this partial assessment is on plant products from core-America and sub-Saharan Africa

Figure 18: Climate suitability for *S. frugiperda* in Africa and Europe modelled using CLIMEX. Parameters from du Plessis et al. (2018) with irrigation scenario

Pest risk assessment of *Spodoptera frugiperda* for the European Union (EFSA PLH Panel , 2018)

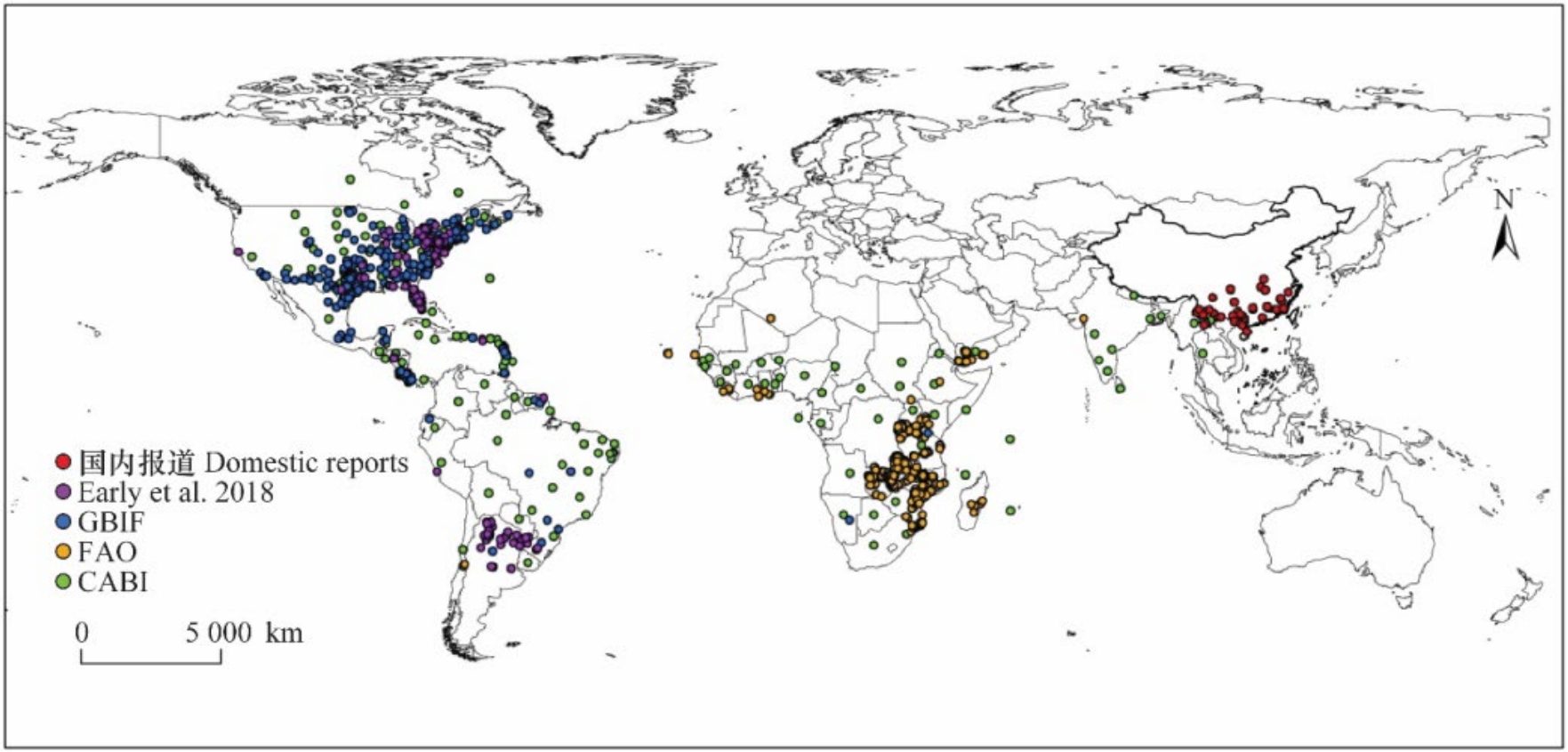
PGD development of FAW





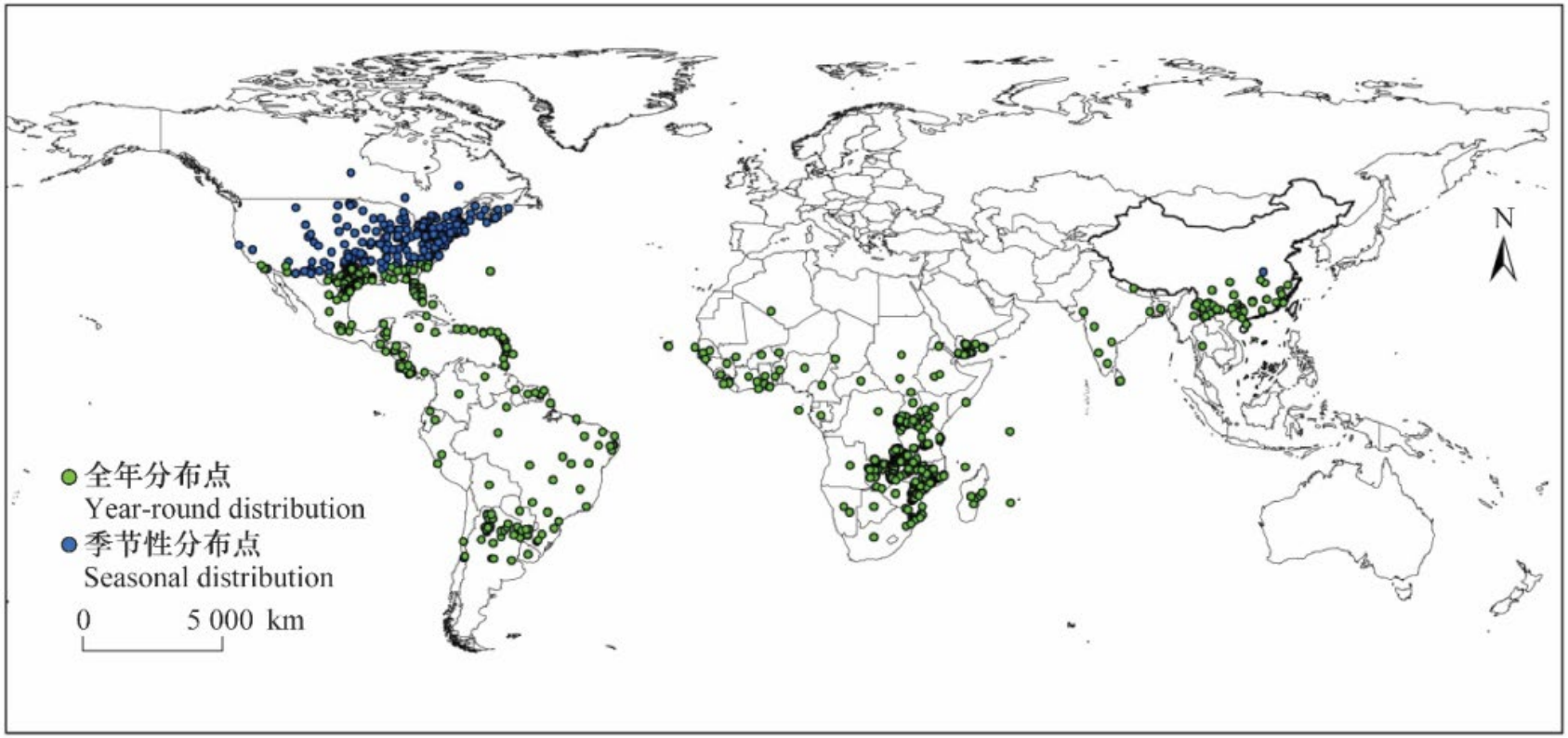
Forecasting the global extent of invasion of the cereal pest *Spodoptera frugiperda*, the fall armyworm (Early et al., 2018)

Distribution data



Global distribution of the fall armyworm (14 provinces occurred in China until 2019.5.21)

Distribution data



Year-round and seasonal distributions of the fall armyworm (divided by 0°C, 1618 year-round, 1217 seasonal distribution points)

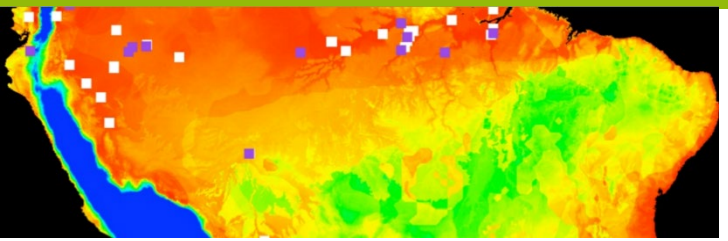
bioclimatic variables (1950-2000, 5min)

WorldClim - Global Climate Data

Free climate data for ecological modeling and GIS

变量	英文名	中文名
BIO1	Annual Mean Temperature	年平均气温
BIO2	Mean Diurnal Range	月平均昼夜温差
BIO3	Isothermality	平均日温/年温变化范围
BIO4	Temperature Seasonality	气温季节性变化
BIO5	Max Temperature of Warmest Month	最热月的最高温
BIO6	Min Temperature of Coldest Month	最冷月的最低温
BIO7	Temperature Annual Range	气温年变化范围
BIO8	Mean Temperature of Wettest Quarter	最湿月的平均气温
BIO9	Mean Temperature of Driest Quarter	最干月的平均气温
BIO10	Mean Temperature of Warmest Quarter	最热季节的平均气温
BIO11	Mean Temperature of Coldest Quarter	最冷季节的平均气温
BIO12	Annual Precipitation	年降水量
BIO13	Precipitation of Wettest Month	最湿月的降水量
BIO14	Precipitation of Driest Month	最干月的降水量
BIO15	Precipitation Seasonality	降水的季节变化
BIO16	Precipitation of Wettest Quarter	最湿季节的降水量
BIO17	Precipitation of Driest Quarter	最干季节的降水量
BIO18	Precipitation of Warmest Quarter	最暖季节的降水量
BIO19	Precipitation of Coldest Quarter	最冷季节的降水量

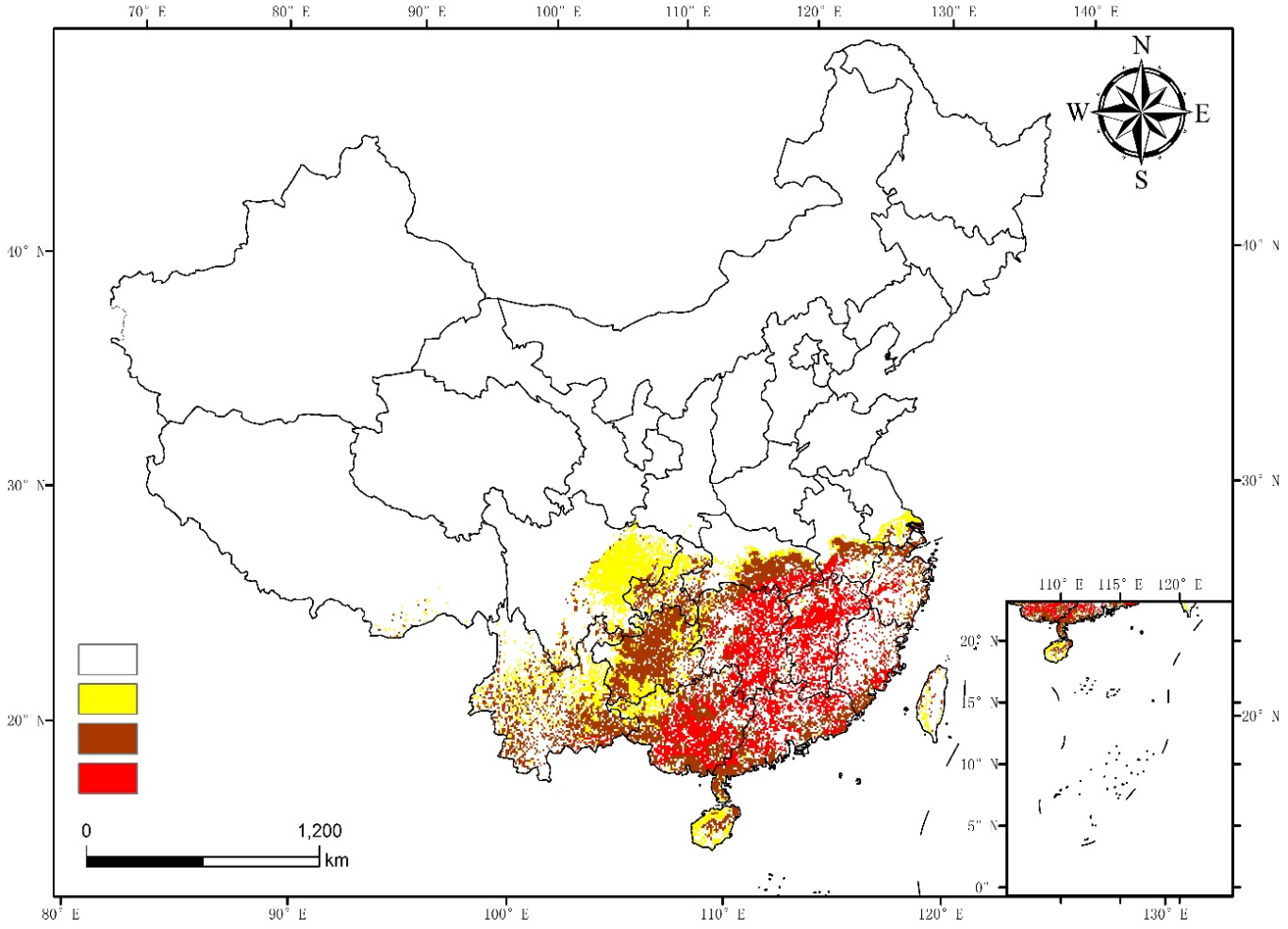
Maxent software for modeling species niches and distributions



Maxent modelling （version 3.3.3k）

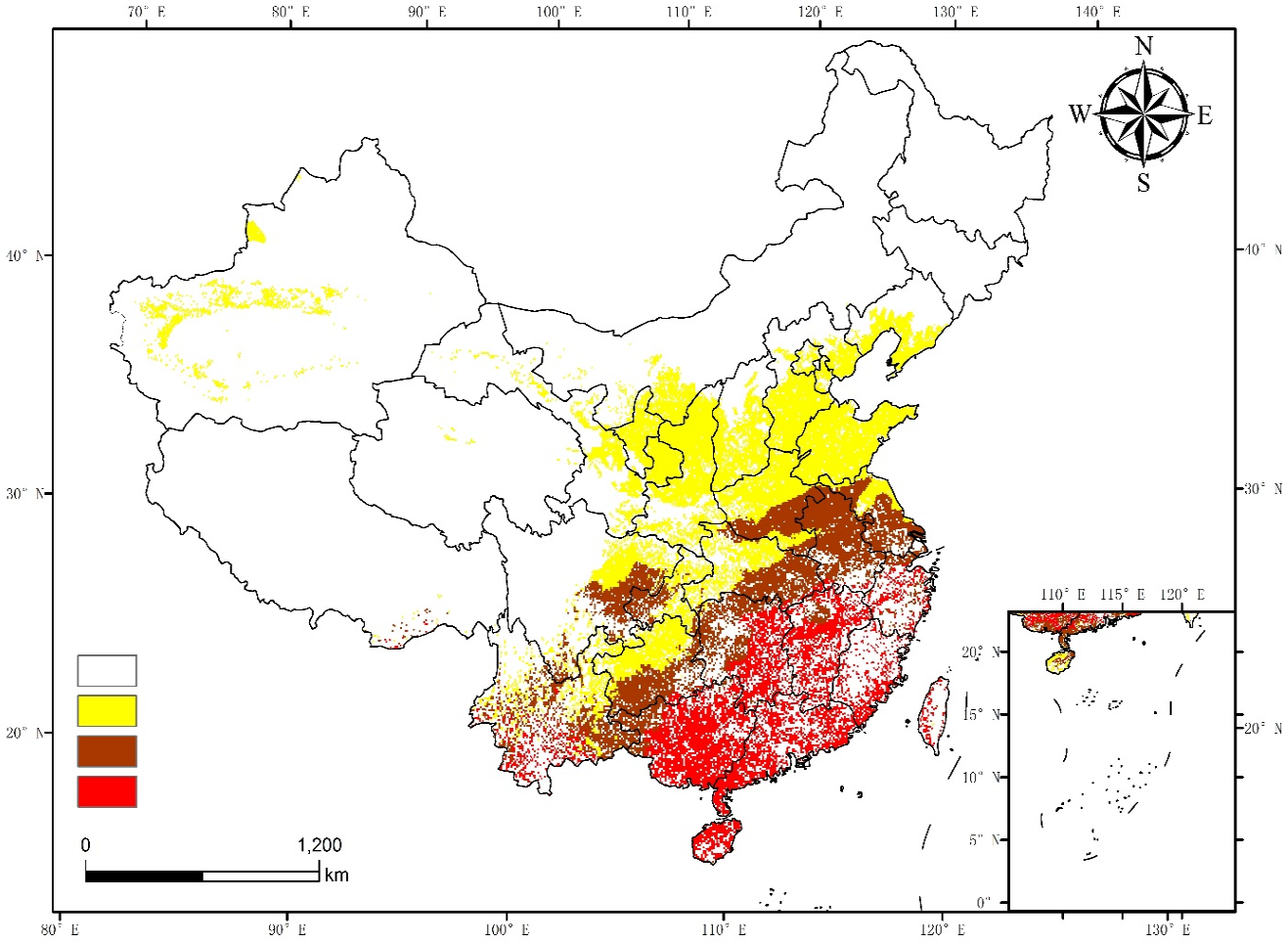
- ✓ **Random test percentage** **25**
- ✓ **Replicates** **10**
- ✓ **Replicated run type** **subsample**
- ✓ **Maximum iterations** **5000**
- ✓ **Apply threshold rule** **10 percentile training presence**

Current PGD based on dataset of year-round distribution



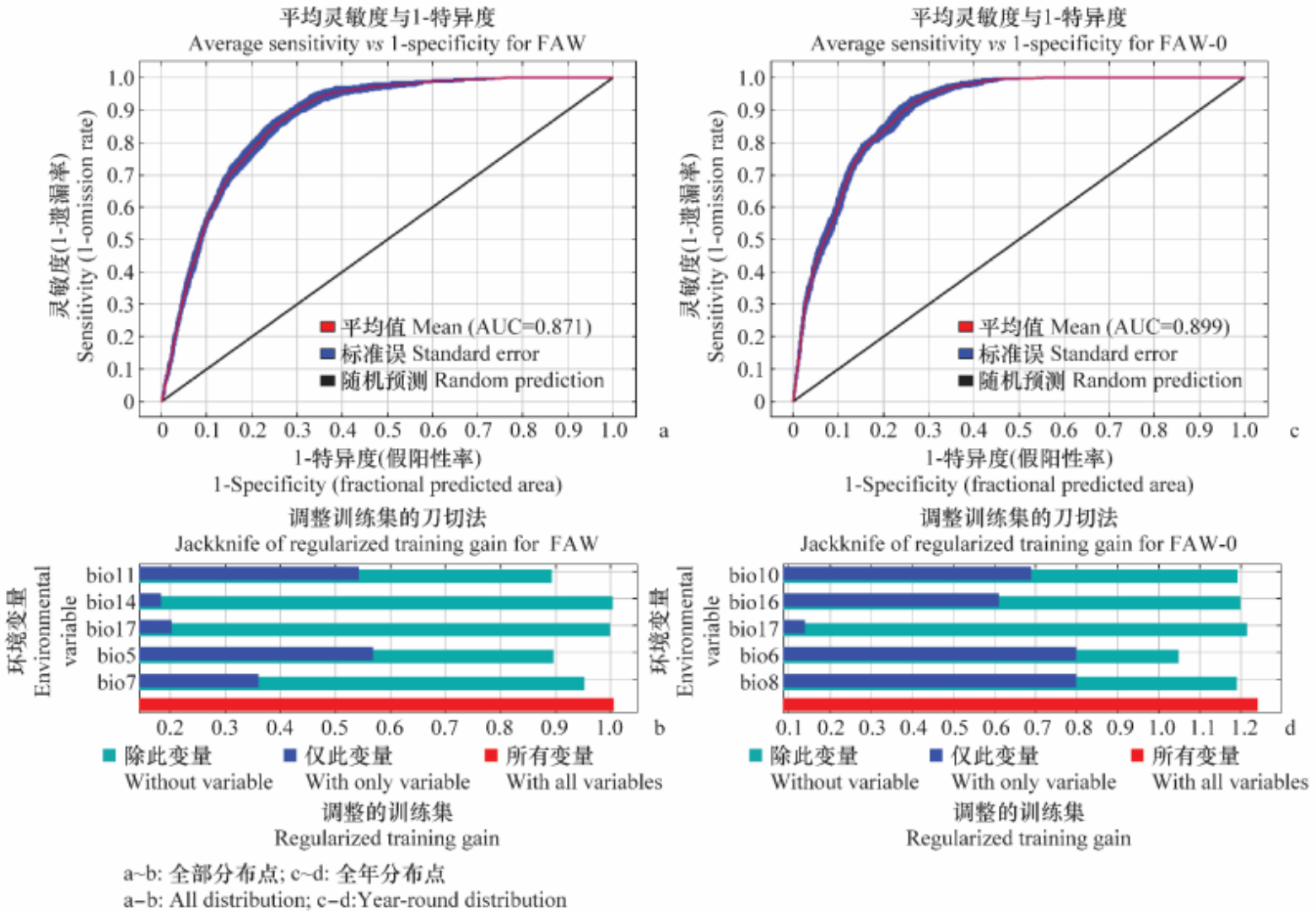
Potential geographical distribution of the fall armyworm (based on dataset of year-round distribution)

Current PGD based on dataset of all distribution



Potential geographical distribution of the fall armyworm (based on dataset of all distribution)

Model performance and contribution rate of environmental variables



Model performance and contribution rate of environmental variables a,b: All distribution; c,d:Year-round distribution

Summary

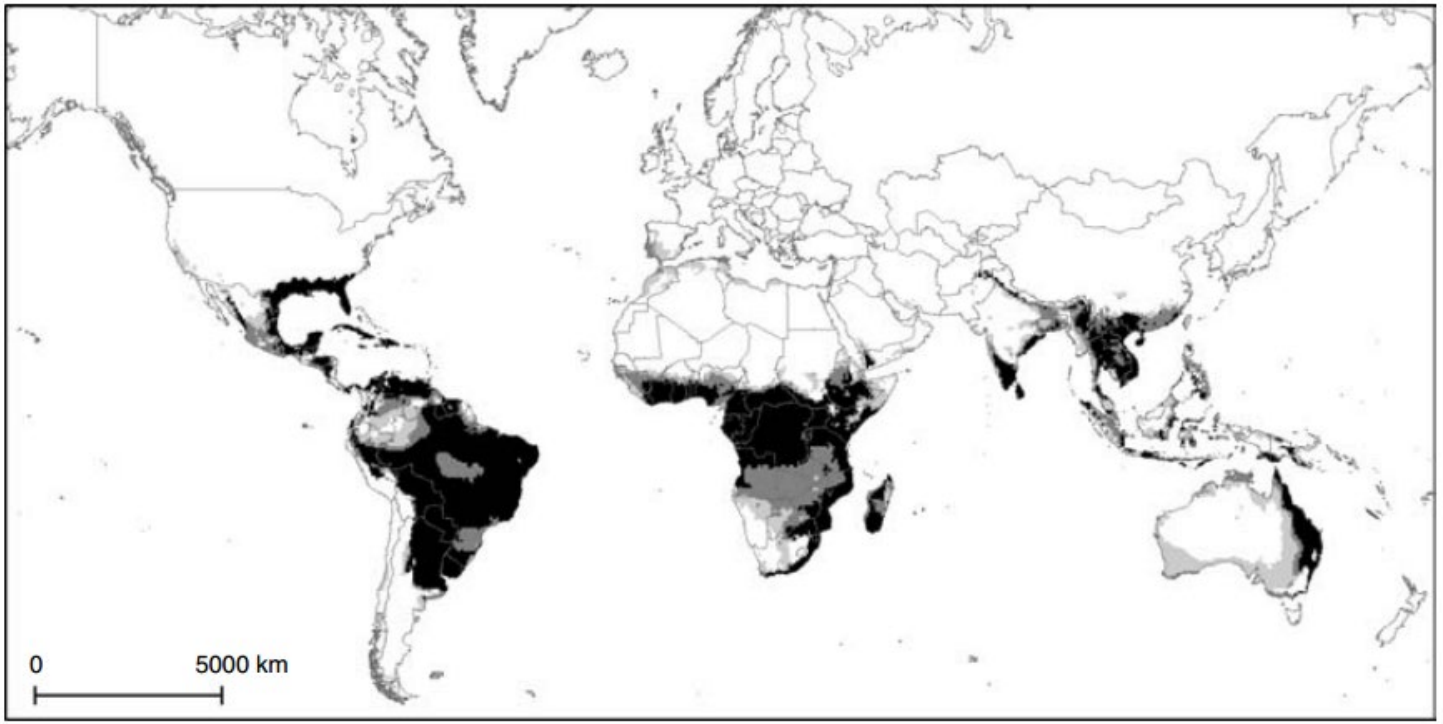
- The results showed that year-round surveillance should be done in Hainan, Yunnan, Guangxi, Guangdong, Fujian, Zhejiang, Jiangxi, Hunan, Guizhou, Sichuan, Chongqing, Hubei, Anhui, Jiangsu provinces.
- seasonal surveillance in spring, summer and autumn should be done in Shandong, Henan, Hebei, Beijing, Tianjin, Shanxi, Shaanxi, Ningxia, Gansu, Qinghai, Inner Mongolia, Xinjiang and Liaoning.
- Bio5 (Max temperature of warmest month) and bio7 (Temperature annual range) were the key variables for all distribution model, bio6 (Min temperature of coldest month) was the key variable for year-round distribution model.

Discussion

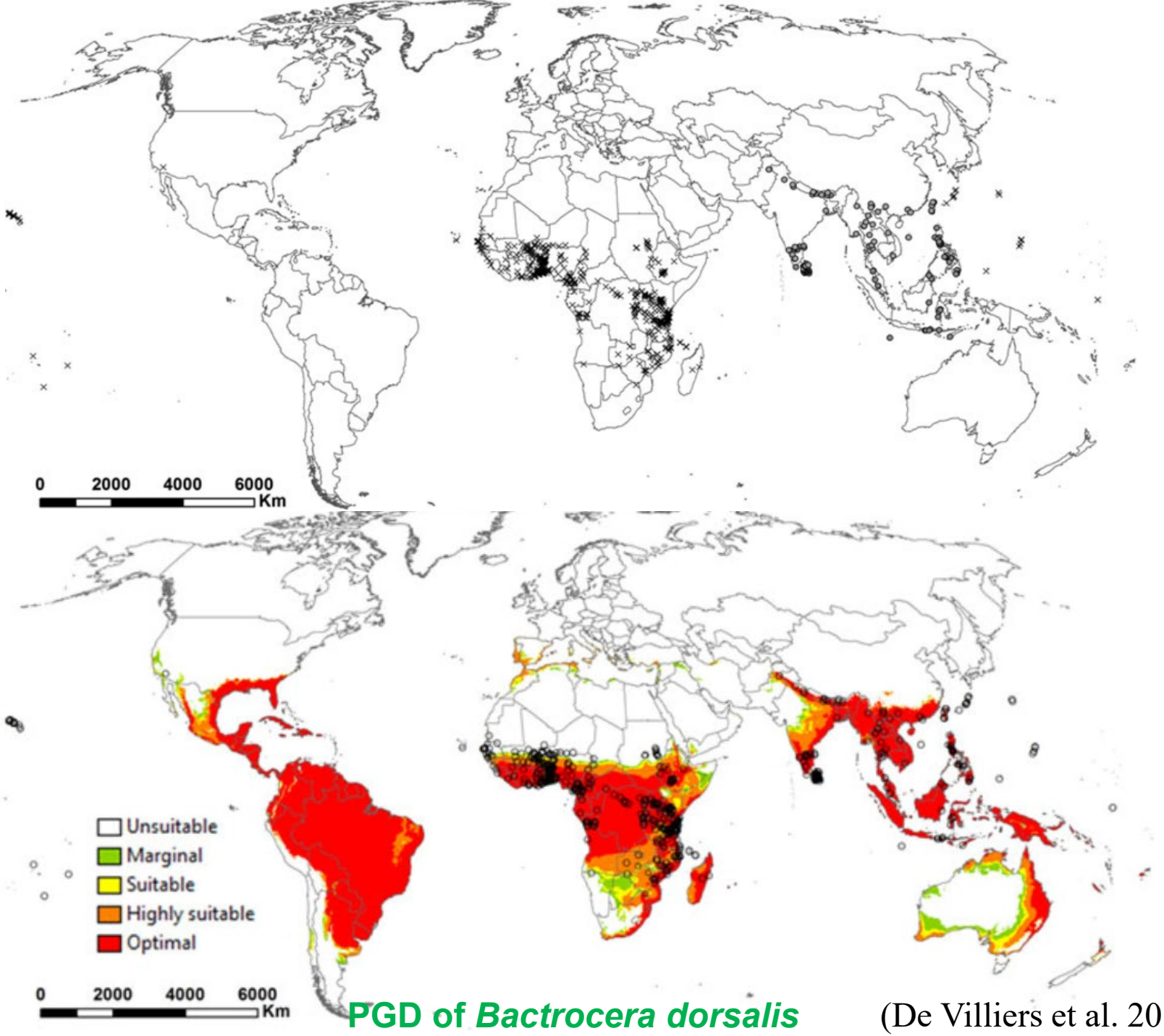
Time effective of the model?

Currently FAW was occurred in 22 provices, is the model built on 5.22 (14 provinces) still working?

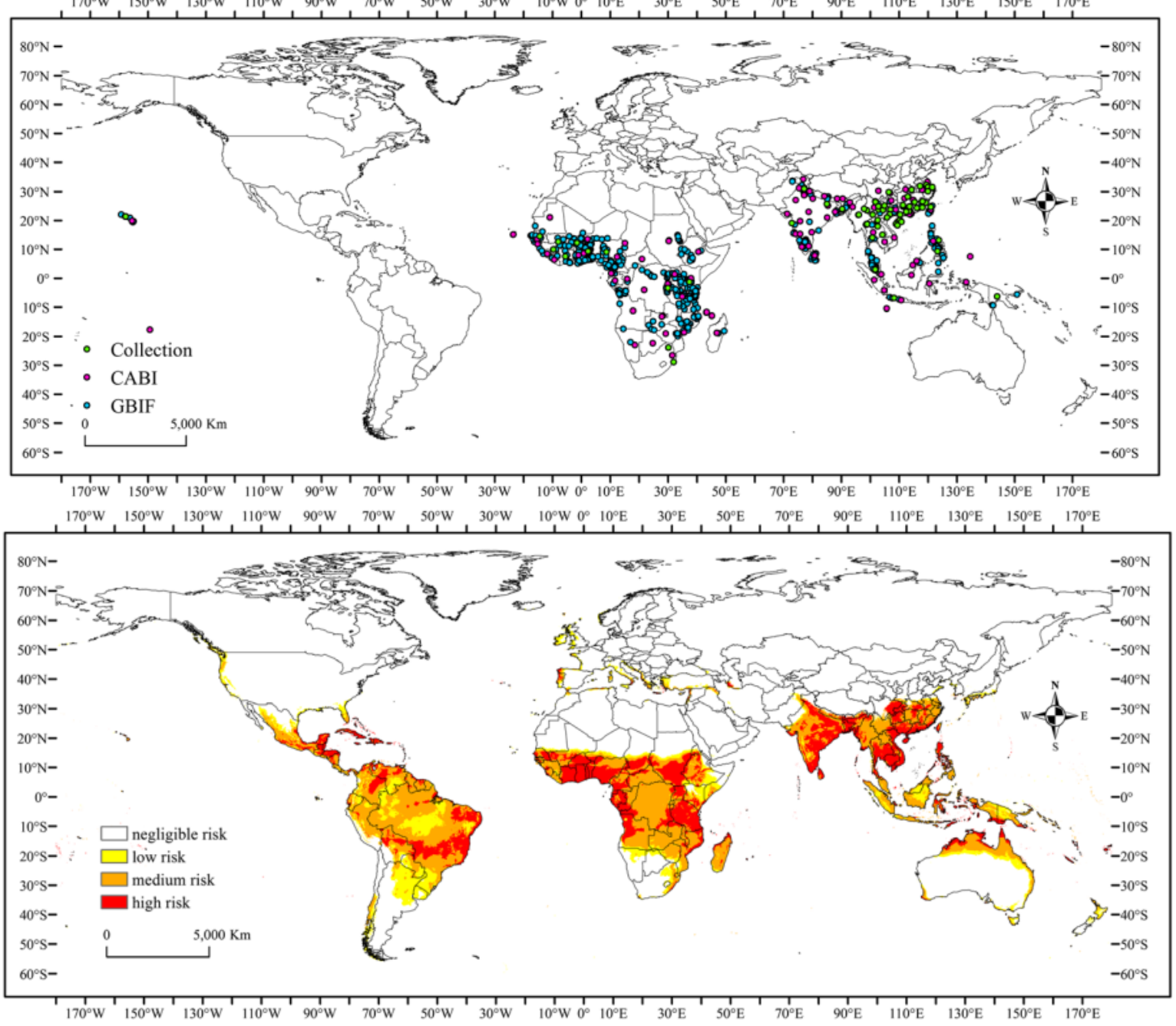
Not in time to consider Climate change.



PGD of *Bactrocera dorsalis* (Stephens et al. 2007)



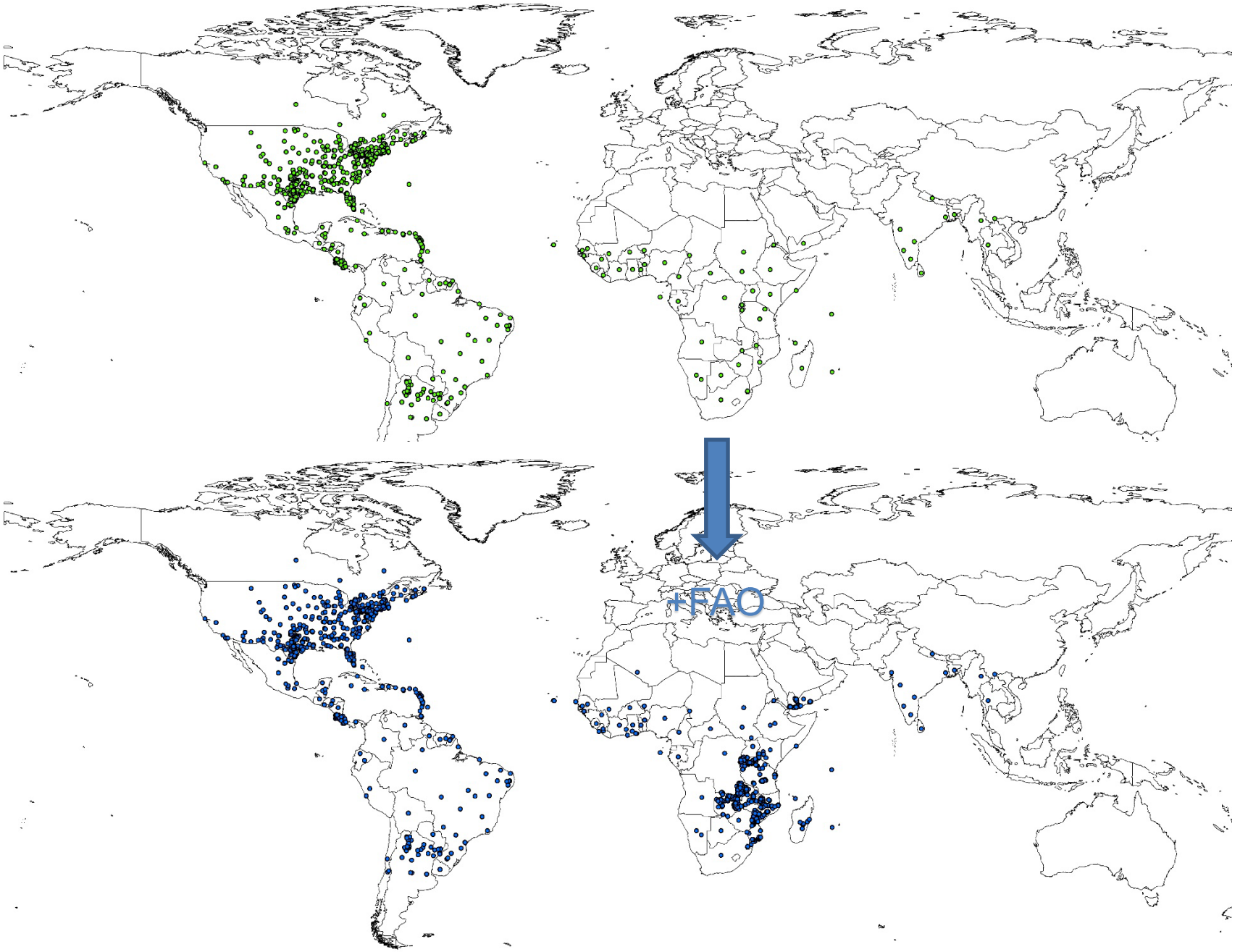
PGD of *Bactrocera dorsalis* (De Villiers et al. 2016)



PGD of *Bactrocera dorsalis* (Qin et al. 2019)

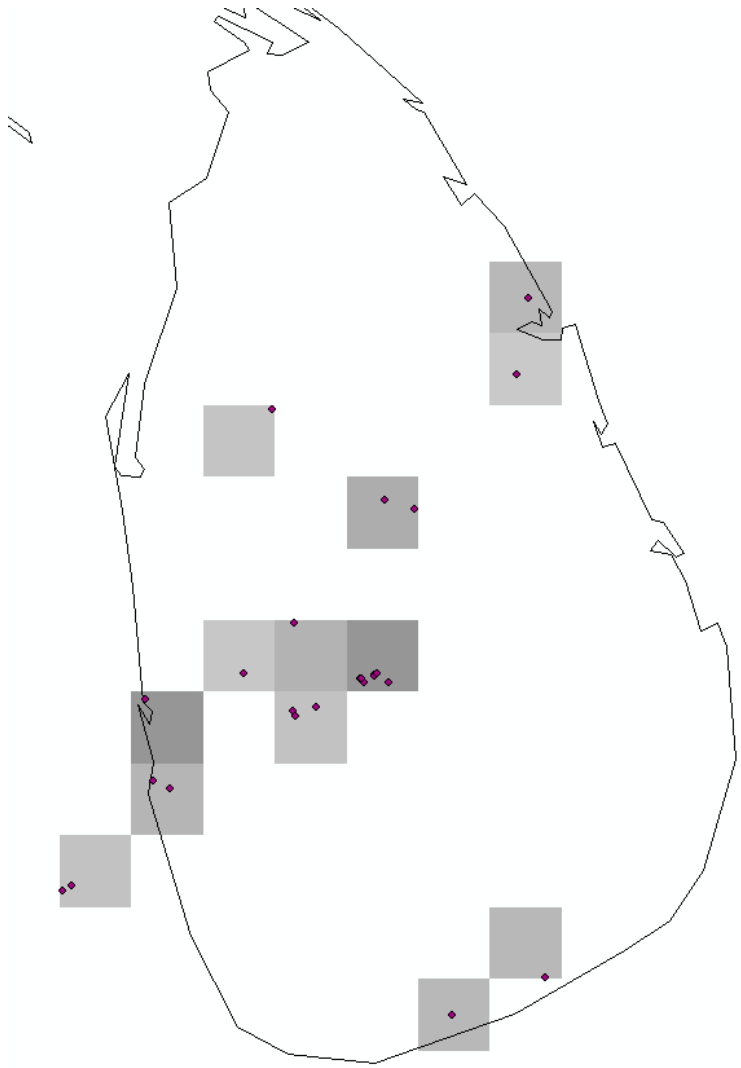
Discussion

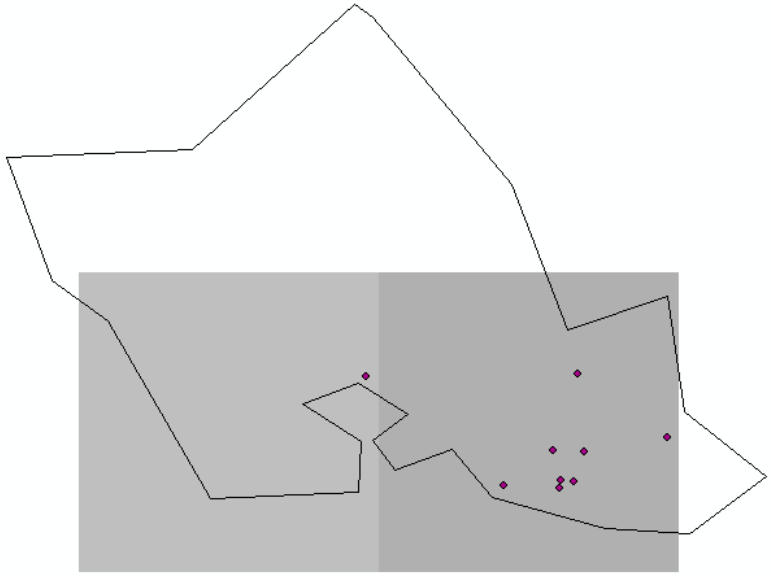
Distribution density effect on the model?



Global distribution of the fall armyworm (2019.3.20)

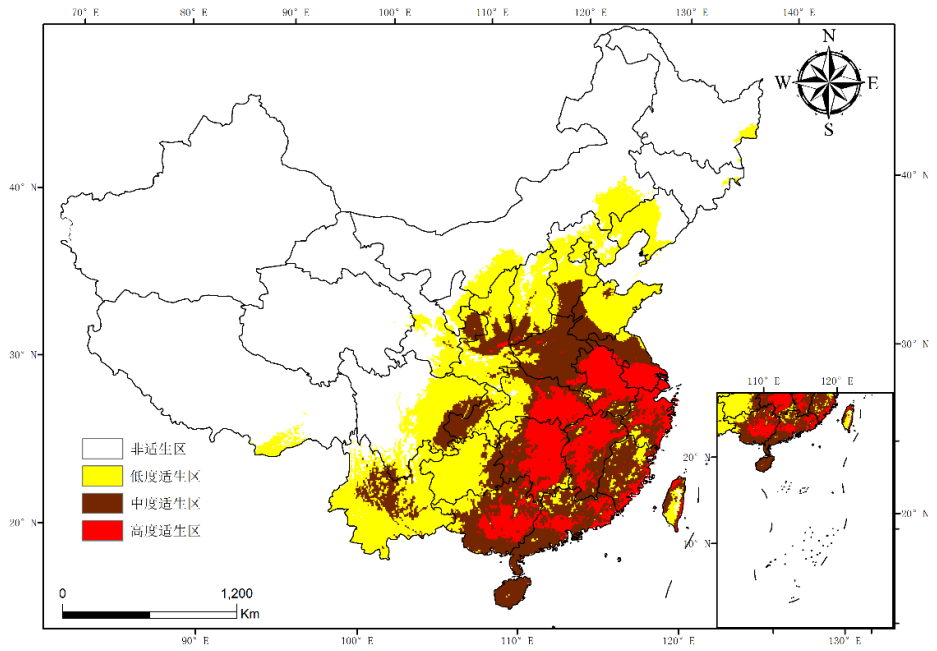
Sampling bias correction

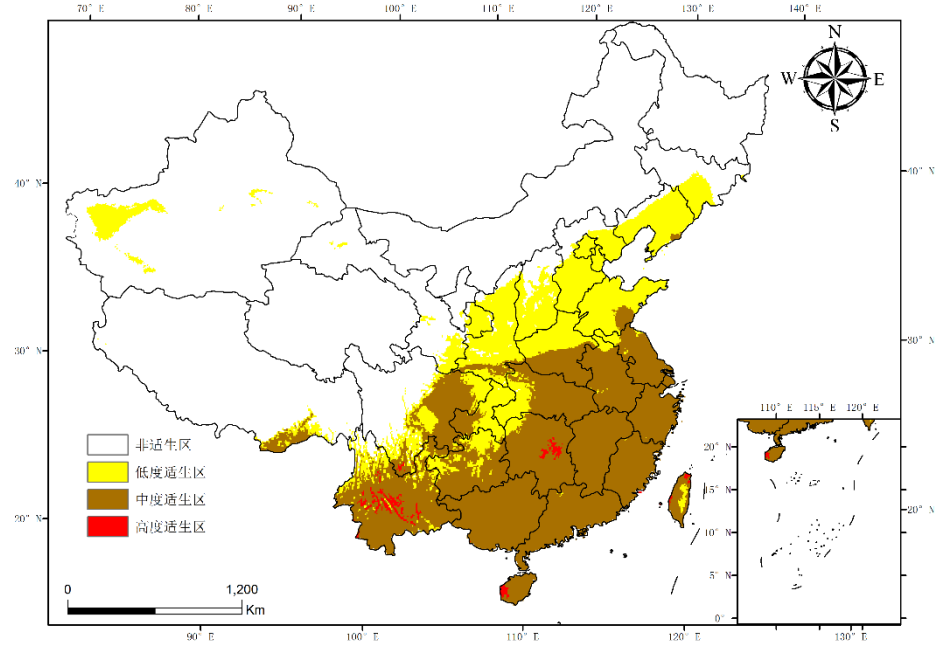




Assigned the distribution data to the same Cellsize as the climate data (0.0833, 0.0833)

+FAO





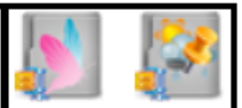
Potential geographical distribution of the fall armyworm (2019.3.20)

Discussion

Historical PGD or current PGD?

Current distribution vs historical climate data?

1961 - 1990
(30 years centred on 1975)



WorldClim - Global Climate Data

Free climate data for ecological modeling and GIS

- **Current** conditions (interpolations of observed data, representative of 1960-1990)

中國農業大學
China Agricultural University

College of Plant Protection
Plant Quarantine and Invasion Biology Lab

Thank you for your attention!

Department of Entomology
College of Plant Protection
China Agricultural University
Beijing, 100193
P. R. China
E-mail: **yujia_qin@cau.edu.cn**