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## Introduction

STAR-BME (Space-Time Analysis Rendering with Bayesian Maximum Entropy) is a specialized software tool for geostatistical analysis of spatial and space-time data. In its current format, it is built as a plugin for [QGIS](#), which is a fast-growing and increasingly popular, open-sourced Geographical Information System software.

Spatiotemporal modeling with STAR-BME performs many common geostatistical tasks and extends its functionality with unique features based upon the modern geostatistics framework proposed by Christakos (Christakos 1991, Christakos 2000). This framework is known as Knowledge Synthesis, and its techniques are based on the Bayesian maximum entropy (BME) methodology. Knowledge Synthesis extends the conventional geostatistical methods by means of an epistemic approach which:

- can synthesize core knowledge bases, empirical evidence, and multi-sourced system uncertainty.
- generates a meaningful picture of real-world systems using space-time dependent probability functions and associated maps.

In the present version, the main features of STAR-BME include:

- Integration of multi-sourced space-time data in different data formats
- Incorporation of space-time data of multi-sourced uncertainties
- Analysis of space-time dependence (empirical and mathematical spatiotemporal models)
- Prediction and mapping in space and time
- Model cross-validation for prediction
- Data export in multiple formats

If you think you have found a bug in STAR-BME, or if you would like to suggest an improvement or enhancement, please submit a new issue through ([管道](#))

## Installation

### 1. System Requirement

- a. QGIS2.0 or higher(Recommend QGIS2.18.9)

### 2. Dependencies

- a. Pandas 0.20.1 or higher
- b. NumPy1.7.0 or higher
- c. SciPy 0.19.0 or higher

### 3. Quick start configuration

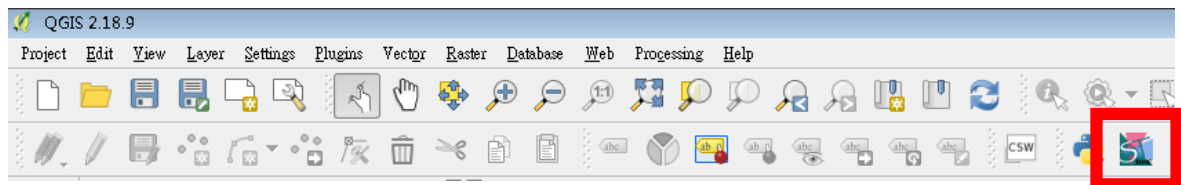
### 4. Set-up configuration

#### ➤ Windows

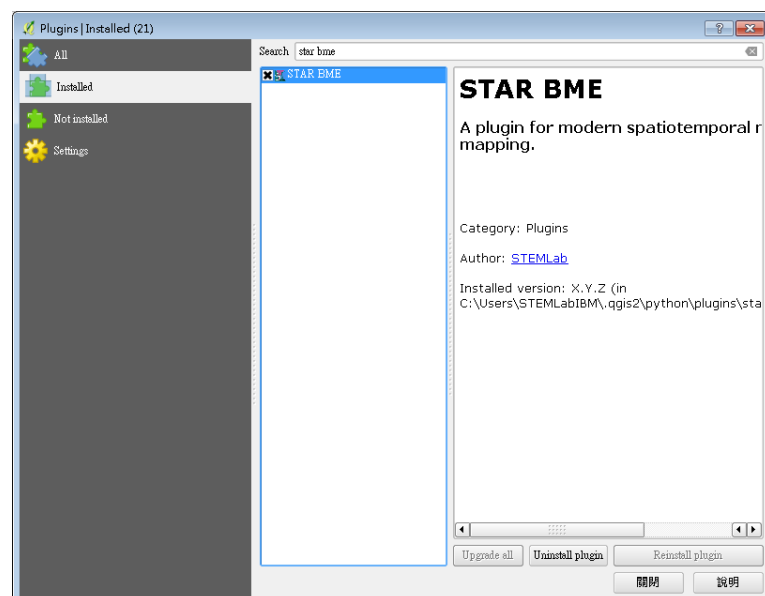
- I. Copy downloaded file to C:\Users\“Username”\qgis2\python\plugins

[\[1\]](#)

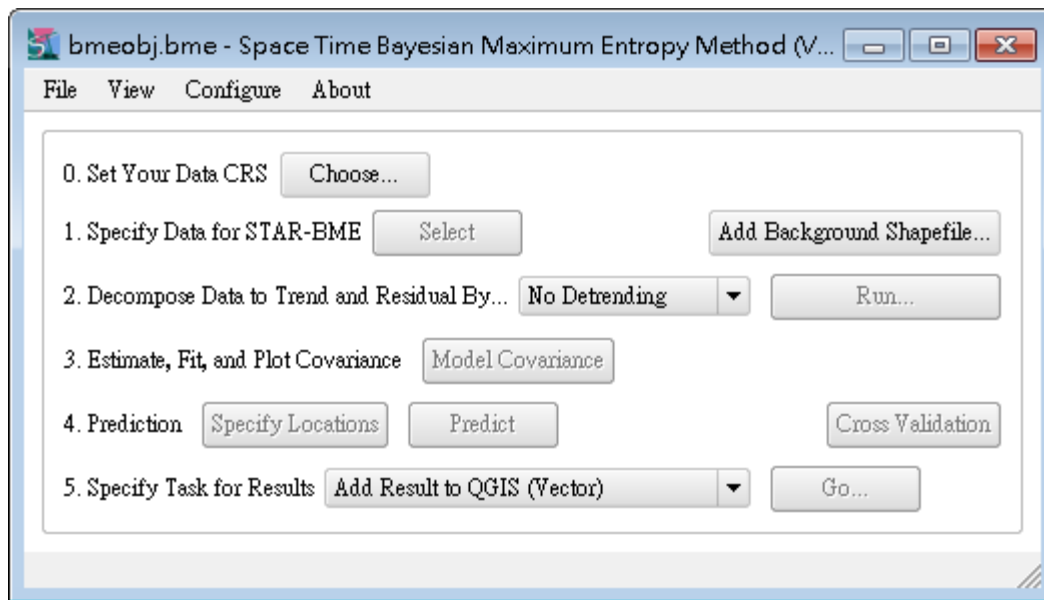
- II. Restart QGIS, STARBME will available in QGIS toolbar.



If STARBME plugin does not exist in toolbar, select Plugin-Manager and Install Plugins. Search “star bme” and checked the box of STARBME plugin.



### III. STARBME successfully install in QGIS.

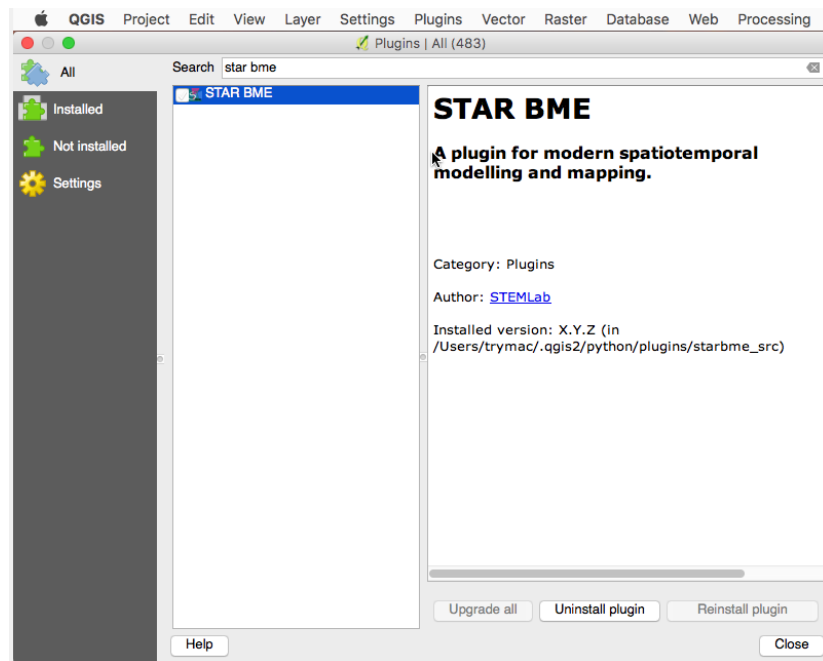


➤ **Mac-OS**

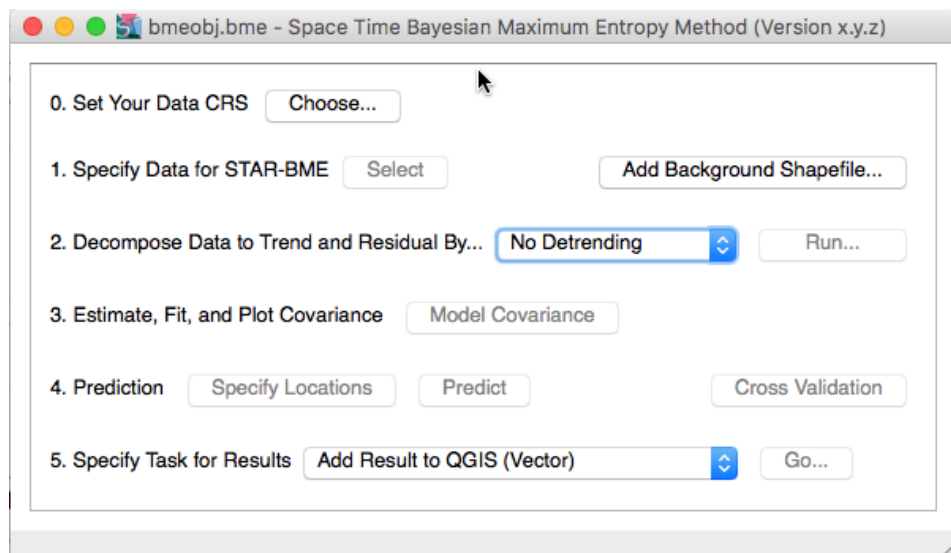
- I. Copy downloaded file to /Users/"Username"/.qgis2/python /plugins.
- II. Restart QGIS, STARBME will available in QGIS tool bar.



If STARBME plugin does not exist in tool bar, select Plugin-Manager and Install Plugins. Search “star bme” and checked the box of STARBME plugin.



- III. STARBME successfully install in QGIS.



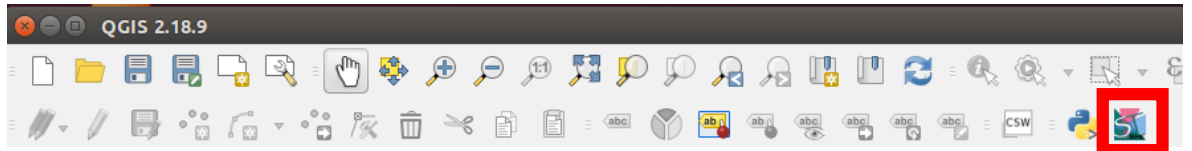
## ➤ Linux

- I. Copy downloaded file to /usr/share/qgis/python/plugins.

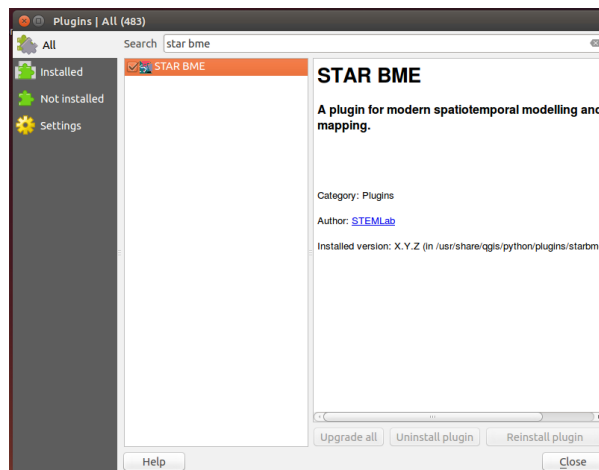
Example:

```
sudo cp -r /home/Username/Desktop/starbme_src  
/usr/share/qgis/python/plugins
```

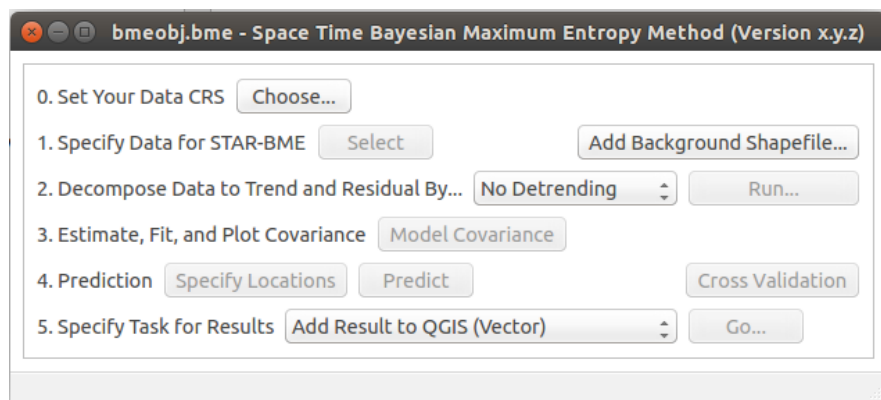
- II. Restart QGIS, STARBME will available in QGIS tool bar.



If STARBME plugin does not exist in tool bar, select Plugin-Manager and Install Plugins. Search “star bme” and checked the box of STARBME plugin.



- III. STARBME successfully install in QGIS.



## 5. Maintenance, Error message and Troubleshooting

### ➤ Windows

#### 5.1 Troubleshooting

I. If file path does not exist, please create folder name named “plugins”

#### 5.2 Error message

For step below, remember to change direction to your downloaded file path before execute command.

Example: If your ez\_setup.py in on your desktop:

cd C:\Users\”Username”\Desktop\

##### 5.2.1 Import error

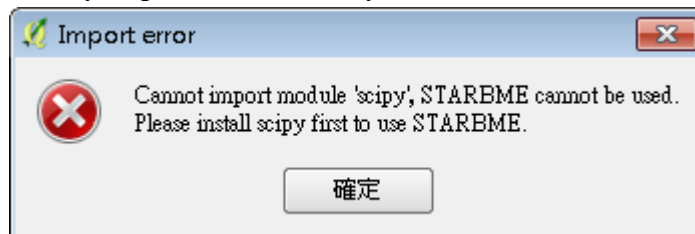
Due to Python module is not available in QGIS, therefore user needs to install this module to QGIS. For able to install python module to QGIS, the user needs to install pip to OSGeo4W. Below show step by step on how to install pip to OSGeo4W. **(All steps below must run as Administrator of OSGeo4w)**

- Download [ez\\_setup.py](#).
  - Search “OSGeo4W” on window start, and **run it as Administrator**.
  - Run “python ez\_setup.py” on the OSGeo4W shell.
  - Run “ easy\_install pip” on the OSGeo4W shell.
- Pandas import error



Run “pip install pandas” on OSGeo4W shell.

- SciPy import error or SciPy version error



Run “pip install scipy” to install or “pip install scipy --upgrade” to upgrade on OSGeo4W shell.

##### 5.2.2 Numpy lapack/blas resources error

If occurs above error, please download scipy whl from [Unofficial](#)

## [Windows Binaries for Python Extension Packages.](#)

pip install “wheel file name”

Download wheel file according to your python version and windows operating system.

### ➤ **Mac-OS**

#### a. Error message

Due to Python module is not available in QGIS, therefore user needs to install this module to QGIS. For able to install python module, user can use pip to install.

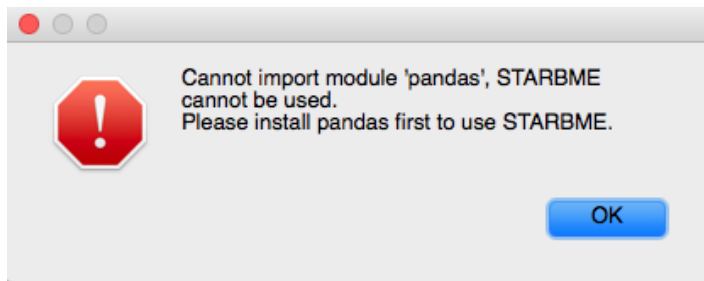
#### I. Import error

##### a. Install pip

```
curl -O https://bootstrap.pypa.io/get-pip.py
```

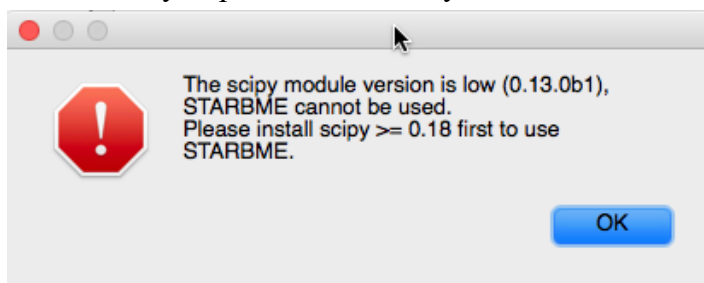
```
sudo python get-pip.py
```

##### ● Pandas import error



Run “sudo pip install pandas” on terminal to install.

##### ● SciPy import error or SciPy version error



Run “sudo pip install scipy --upgrade” on terminal to upgrade. If occurs “Operation not permitted” of NumPy. Use “sudo pip install --ignore-installed scipy -- upgrade” to upgrade both numpy and scipy.



➤ **Linux**

a. Import error

I. If python module dependency error occurs, to update or install python module of QGIS.

a. Install pip

```
sudo apt-get install python-pip
```

● Install Pandas

```
sudo apt-get install python-pandas
```

● Upgrade SciPy

```
sudo pip install scipy -- upgrade
```

● Install matplotlib

```
sudo apt-get install matplotlib
```

II. If libblas and liblapack are not installed.

```
sudo apt-get install libblas-dev liblapack-dev
```

III. If Fortran is not installed.

```
sudo apt-get install gfortran
```

## Reference

Christakos, G. (1991). "On certain classes of spatiotemporal random fields with applications to space-time data processing." IEEE transactions on systems, man, and cybernetics **21**(4): 861-875.

Christakos, G. (2000). "Modern Spatiotemporal Geostatistics: Oxford Univ." Press, New York, NY.