1. Introduction

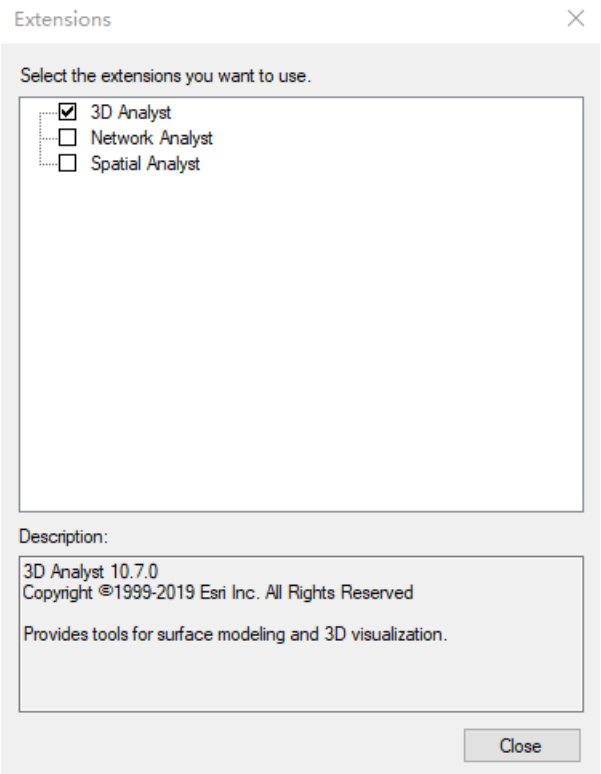
The **sky-view factor (SVF)** is one of the most critical indicators to characterize urban physical environments. The SVF in the urban street canyon is a single point-specific measurement that can only represent the ratio of the visible sky of a specific point rather than the ratio of the entire urban street canyon. The change in the location of the SVF observation point will cause significant variation in the SVF value. The **positional error of the SVF observation point (PE-SVFOP)** to the measurement of the SVF for specific applications is often ignored.

This project is developed for the evaluation of positional error in SVF measurements (PE-SVF) by comparing the SVF estimated at the **desired SVF observation point (DOP)** and the corresponding **actual SVF observation point (AOP)**.

2. Install the Toolbox in ArcGIS 10.6

1) Enabling extensions for ArcGIS for Desktop

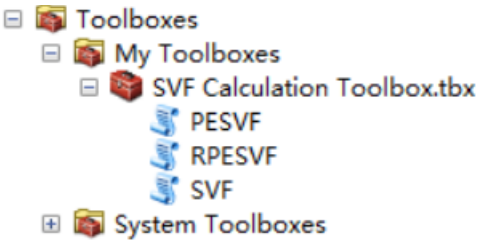
Click **Customize > Extensions** from the main menu in any ArcGIS application. In the **Extensions** dialog box, choose the **3D Analyst** extensions and click Close.



2) Add SVF Calculation Toolbox to My Toolboxes in the user system

Right click **SVF Calculation Toolbox.tbx** SVF Calculation Toolbox.tbx —> **copy** from the Home folder and paste it to **My Toolboxes** My Toolboxes under **Toolboxes** Toolboxes in the **Catalog.**

After this step, we have installed the tools we need in **Toolboxes**.



3. Tools in the Toolbox

1) Script tool 1: SVF

Description: Calculate SVFs of 3D points in a **3D points shapefile** and output the results in the form of attribute fields and tables. The results are added to the original shapefile in the form of a property field. In addition, the result file **SVF.csv** is output in

the specified **Output path**.

Input dataset:

(1) 3D buildings

(2) 3D point of SVF observation points

Output:

(3) SVF observation points with the attribute of SVF

(4) Table of SVF value

2) Script tool 2: PE-SVF

Description: Calculate the positional error in SVF measurements of **actual SVF observation points** and that of corresponding **desired SVF observation points**. The result file **PESVF.csv** is output in the specified **Output path**.

Input dataset:

(1) 3D buildings

(2) 3D point of actual SVF observation points

(3) 3D point of desired SVF observation points

Output:

(4) Table of **PE-SVF**

3) Script tool 3: RPE-SVF

Description: Calculate the relative positional error in SVF measurements of **actual SVF observation points** and that of corresponding **desired SVF observation points**. The result file **RPESVF.csv** is output in the specified **Output path**.

Input dataset:

(1) 3D buildings

(2) 3D point of actual SVF observation points

(3) 3D point of desired SVF observation points

Output:

(4) Table of **RPE-SVF**

4. Evaluate the positional error in SVF measurements with Sample Data

In this section we have arranged three tasks so that you may familiarize yourself with the operational process of the whole experiment. The three tasks are: SVF Calculation Task, PE-SVF Calculation Task and RPE-SVF Calculation Task. When you go through this section, we hope you can enjoy yourself using our customized script tools.

To calculate the SVF value for particular SVF observation points, 3D building data and 3D SVF observation points data are needed.

In the **sample input data folder**:

(1) ***3d_building.shp*** is the 3d building data that makes up the street canyon

(2) ***point1.shp*** is the 3D point data containing a single SVF observation point

(3) ***AOP.shp*** is 3D point data of five actual SVF observation points for illustration.

(4) ***DOP.shp*** is 3D point data of corresponding five desired SVF observation points for illustration.

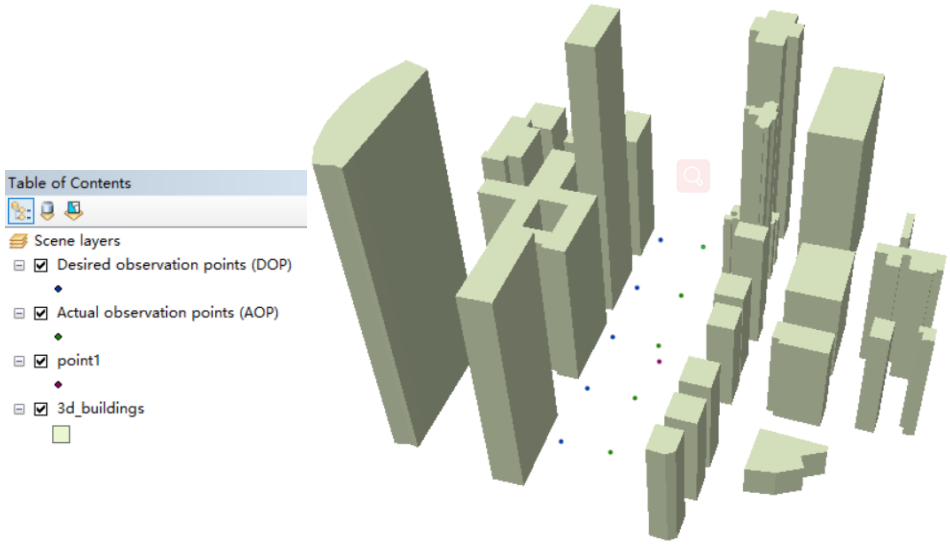
Task 1: SVF Calculation Task

Goal: Use the SVF script to calculate SVFs of 3D points in a **3D points shapefile**.

With 3D city data, you can calculate the SVF of observation points through simulation method. But even with the tools provided by ArcGIS, simulation calculation still has tedious steps. SVF tool integrates the relevant tools and optimized code to help you quickly complete the calculation of SVF values for given observation points and display the output elegantly for your subsequent analysis.

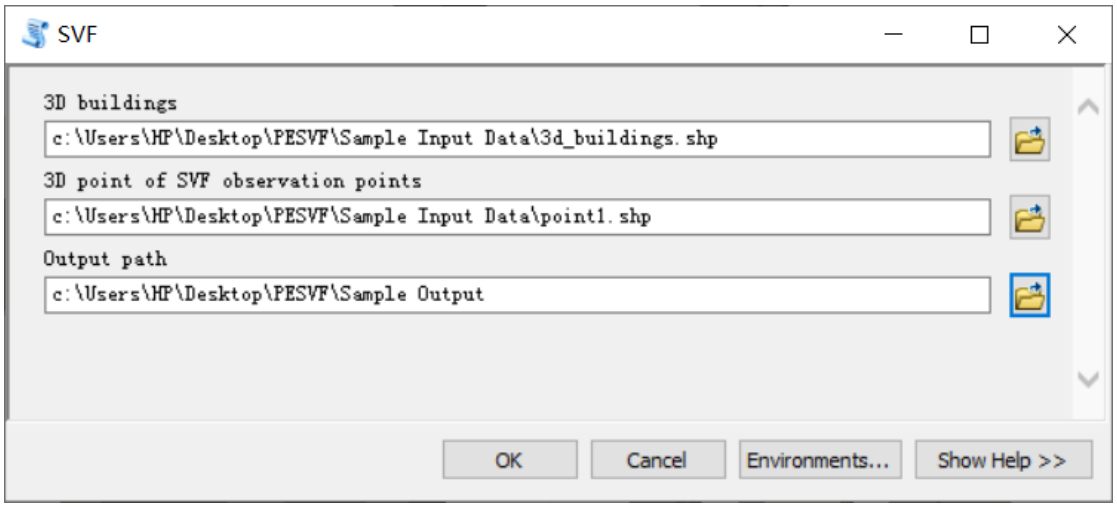
Open the arcscene file to add the input data to your view

Open the arcscene file SVF.sxd we provided and you will see the data in your view.



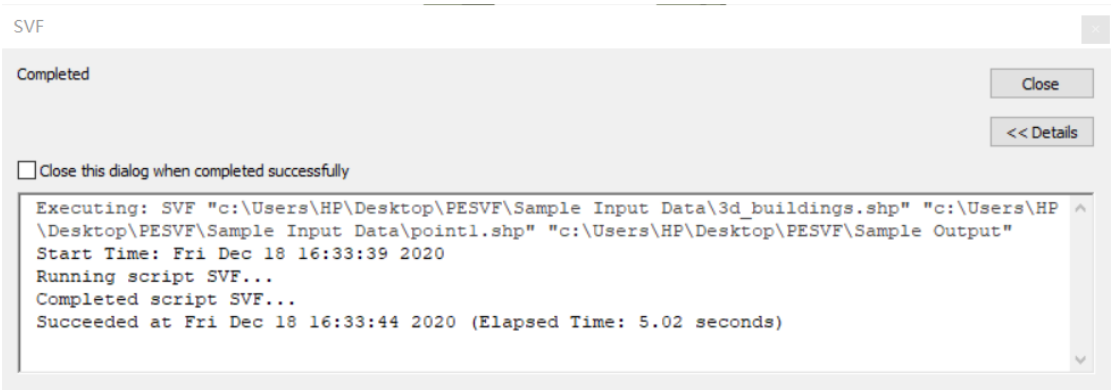
Open the SVF tool to load the data needed for the experiment

Double click **SVF** SVF > load 3D buildings (.shp) in the **Sample Input Data** folder > load 3D point (.shp) in the **Sample Input Data** folder > select an Output path > click **OK** to run the script

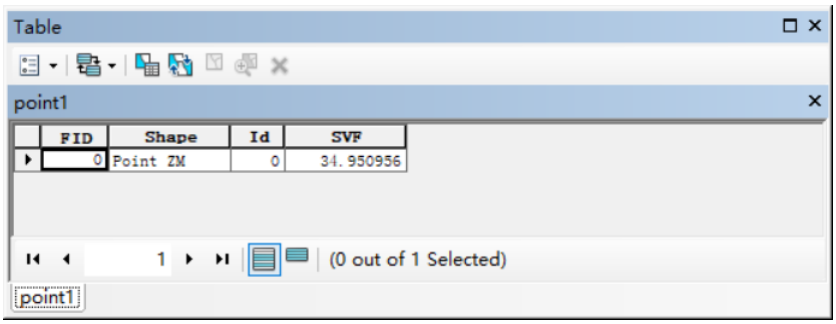


Check the results

When the script is finished running, you will see “Complete” in the console



The SVF value have already add in to the attribute table.



In the Output folder, you can also find the result **SVF.csv**

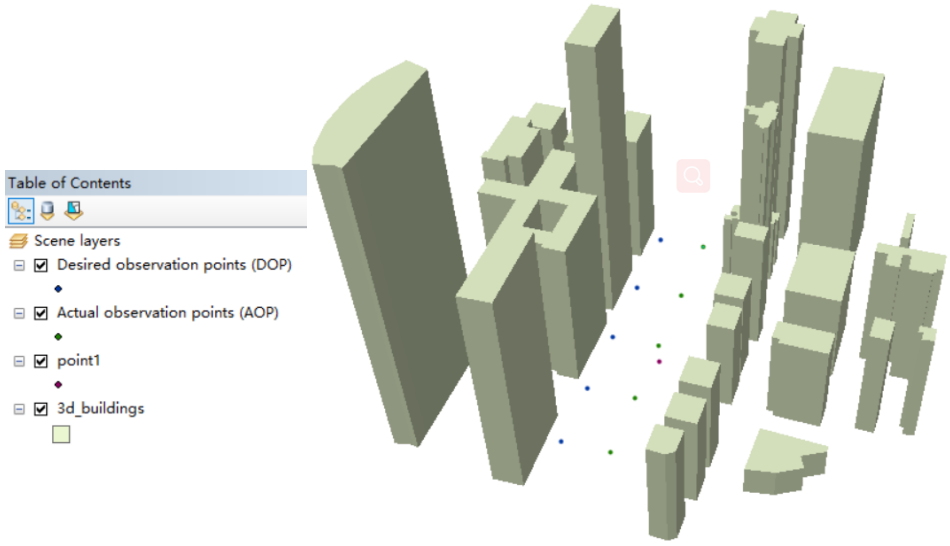
	A	B	C
1	id	SVF(10^-2)	
2	0	34.950956	
3			

Task 2: PE-SVF Calculation Task

Goal: When performing SVF calculations in urban street canyons, the lateral and height positional error in SVF observation points can significantly affect the calculation results. In this case, it is necessary to quantitatively analyze the positional error of SVF calculation. PE-SVF tool will help you to calculate **the positional error in SVF measurements** of **actual SVF observation points** and that of corresponding **desired SVF observation points**.

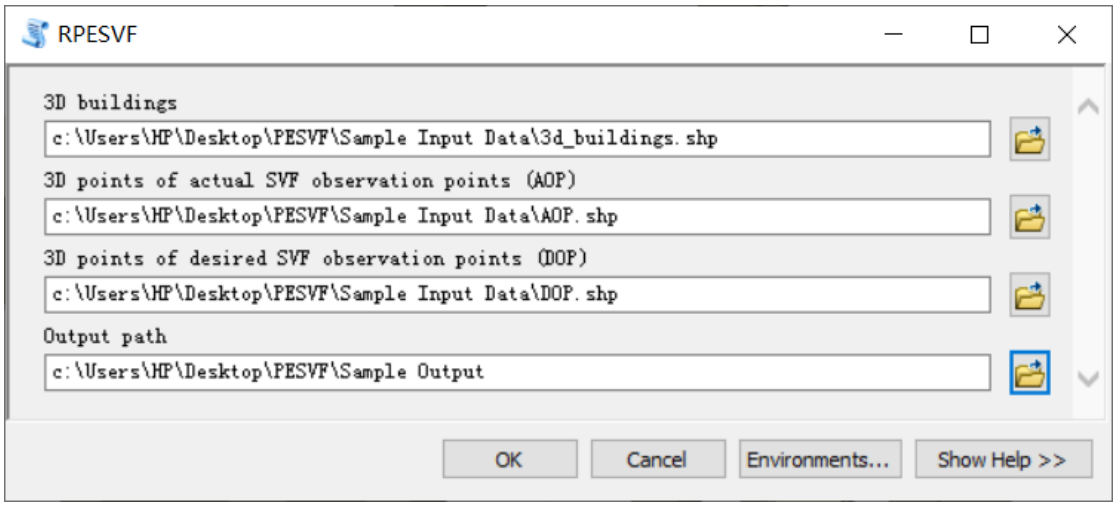
Open the arcscene file to add the input data to your view

Open the arcscene file SVF.sxd we provided and you will see the data in your view.



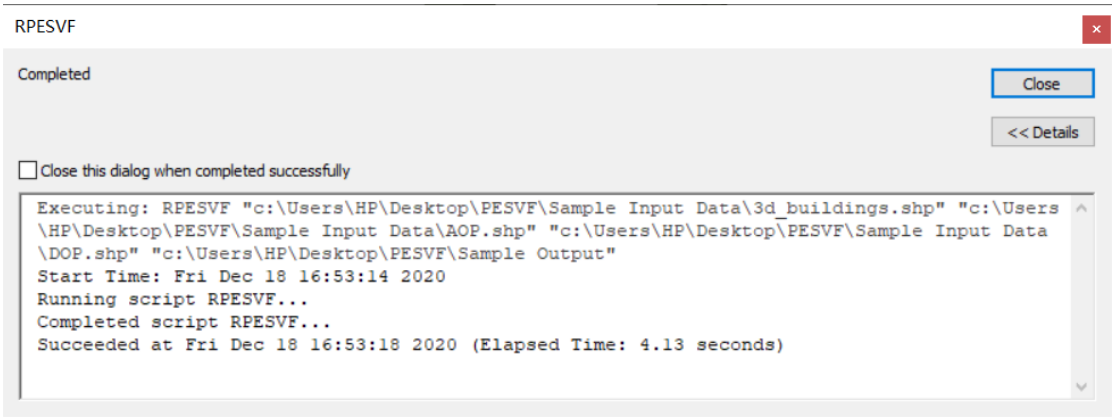
Open the PESVF tool to load the data needed for the experiment

Double click **RPESVF** RPESVF > load 3D buildings (.shp) in the **Sample Input Data** folder > load **actual SVF 3D observation points** (.shp) in the **Sample Input Data** folder > load **desired SVF 3D observation points** (.shp) in the **Sample Input Data** folder > select an Output path > click **OK** to run the script



Check the results

When the script is finished running, you will see “Complete” in the console



In the Output folder, you can also find the result **PESVF.csv**

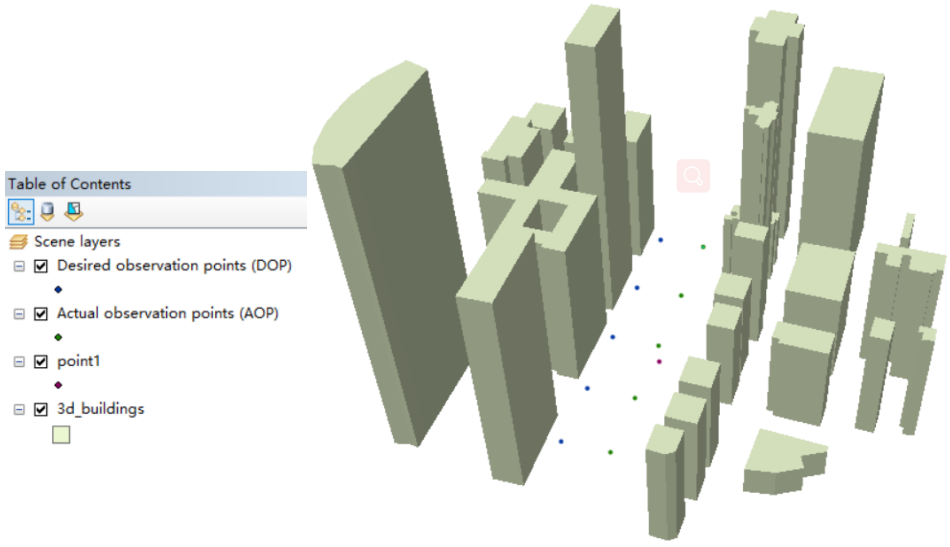
	A	B	C	D	E	F
1	DOPid	DOP_SVF(10^-2)	AOPid	AOP_SVF(10^-2)	PE_SVF(10^-2)	
2	0	37.965133	0	41.997081	4.031948	
3	1	29.798855	1	32.546246	2.747391	
4	2	31.423688	2	34.639716	3.216028	
5	3	36.462913	3	39.146521	2.683608	
6	4	39.196845	4	45.197889	6.001044	
7						

Task 3: RPE-SVF Calculation Task

Goal: When performing SVF calculations in urban street canyons, the lateral and height positional error in SVF observation points can significantly affect the calculation results. In this case, it is necessary to quantitatively analyze the positional error of SVF calculation. RPE-SVF tool will help you to calculate **the relative positional error in SVF measurements** of **actual SVF observation points** and that of corresponding **desired SVF observation points**.

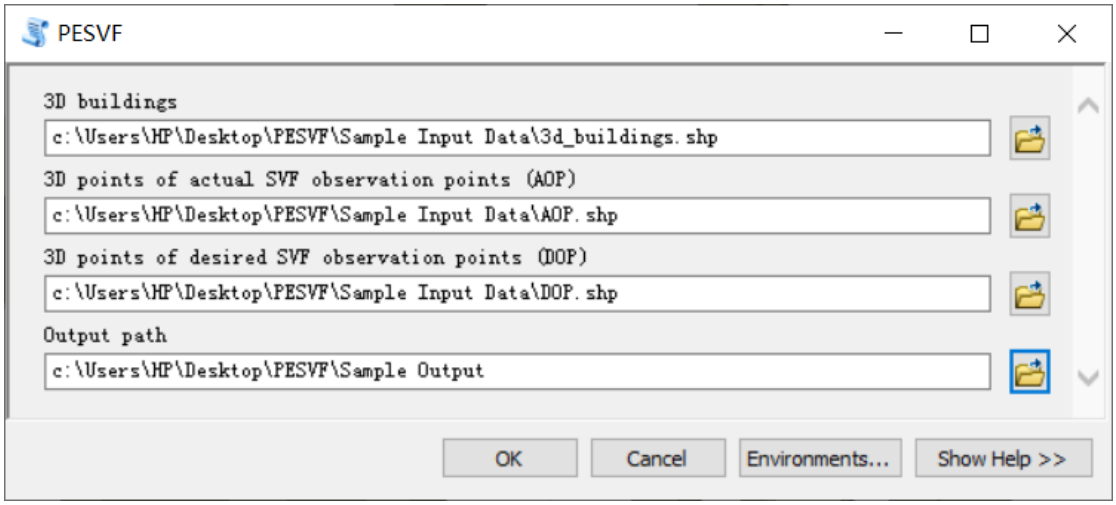
Open the arcscene file to add the input data to your view

Open the arcscene file SVF.sxd we provided and you will see the data in your view.



Open the PESVF tool to load the data needed for the experiment

Double click **PESVF** PESVF > load 3D buildings (.shp) in the **Sample Input Data** folder > load **actual SVF 3D observation points** (.shp) in the **Sample Input Data** folder > load **desired SVF 3D observation points** (.shp) in the **Sample Input Data** folder > select an Output path > click **OK** to run the script



Check the results

When the script is finished running, you will see “Complete” in the console

In the Output folder, you can also find the result **RPESVF.csv**

	A	B	C	D	E	F
1	DOPid	DOP_SVF(10^-2)	AOPid	AOP_SVF(10^-2)	RPE_SVF(%)	
2	0	37.965133	0	41.997081	10.62013401	
3	1	29.798855	1	32.546246	9.219787136	
4	2	31.423688	2	34.639716	10.2344066	
5	3	36.462913	3	39.146521	7.359828876	
6	4	39.196845	4	45.197889	15.31001794	
7						