SuperMap

The Innovation & Applications of SuperMap New Generation 3D GIS

Li Meng

3D R&D Center

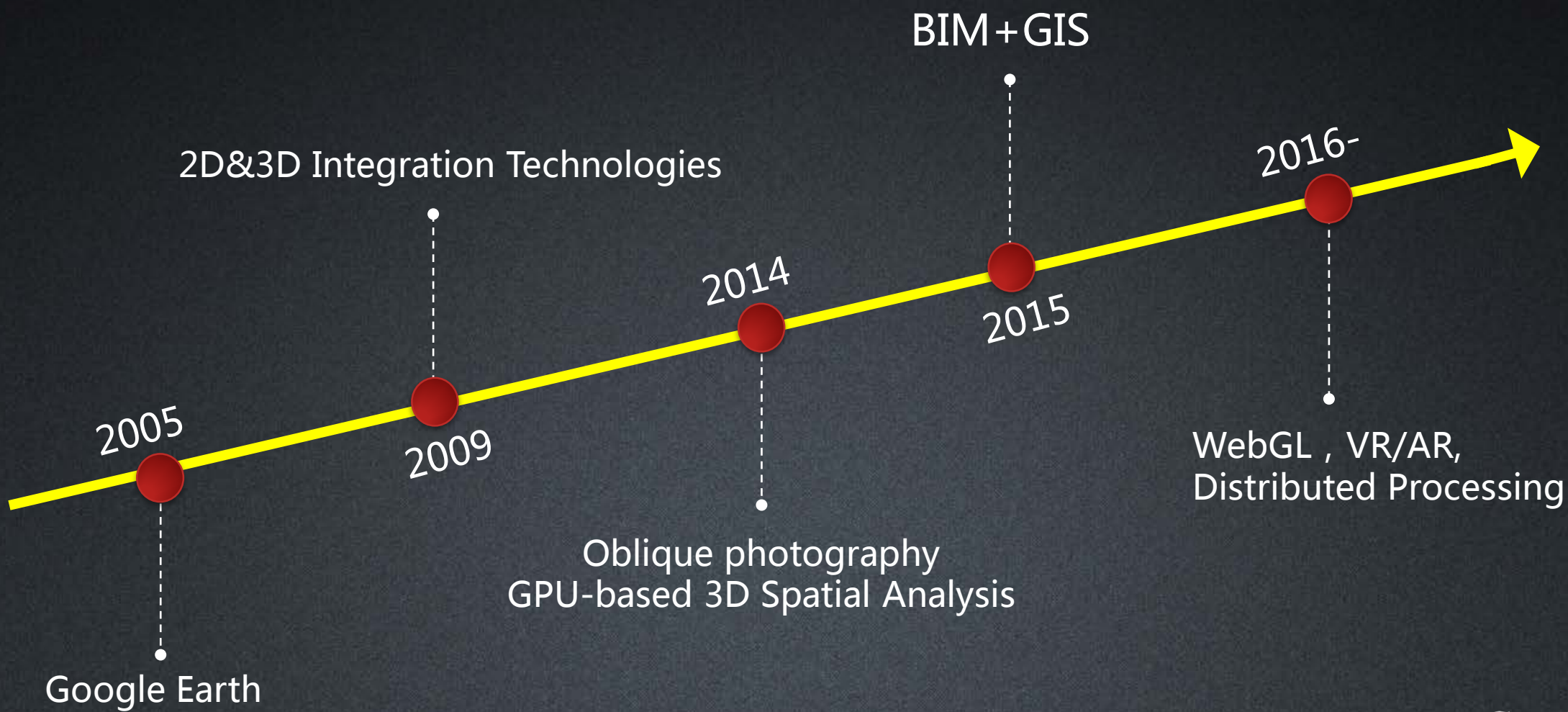
SuperMap Research Institute

GIS Forum Online

Introduction

- Li Meng
- Product Director at 3D R&D Center
- Experienced in user scenarios
- Committed to 3D GIS product management
- Thrive on solving user’s problems

SuperMap 3D GIS Technologies Development



SuperMap

Driving Forces of SuperMap 3D GIS Technology System

IT→ WebGL、VR/AR、3D printing…

Data→ Oblique Imagery, Point Clouds, BIM…

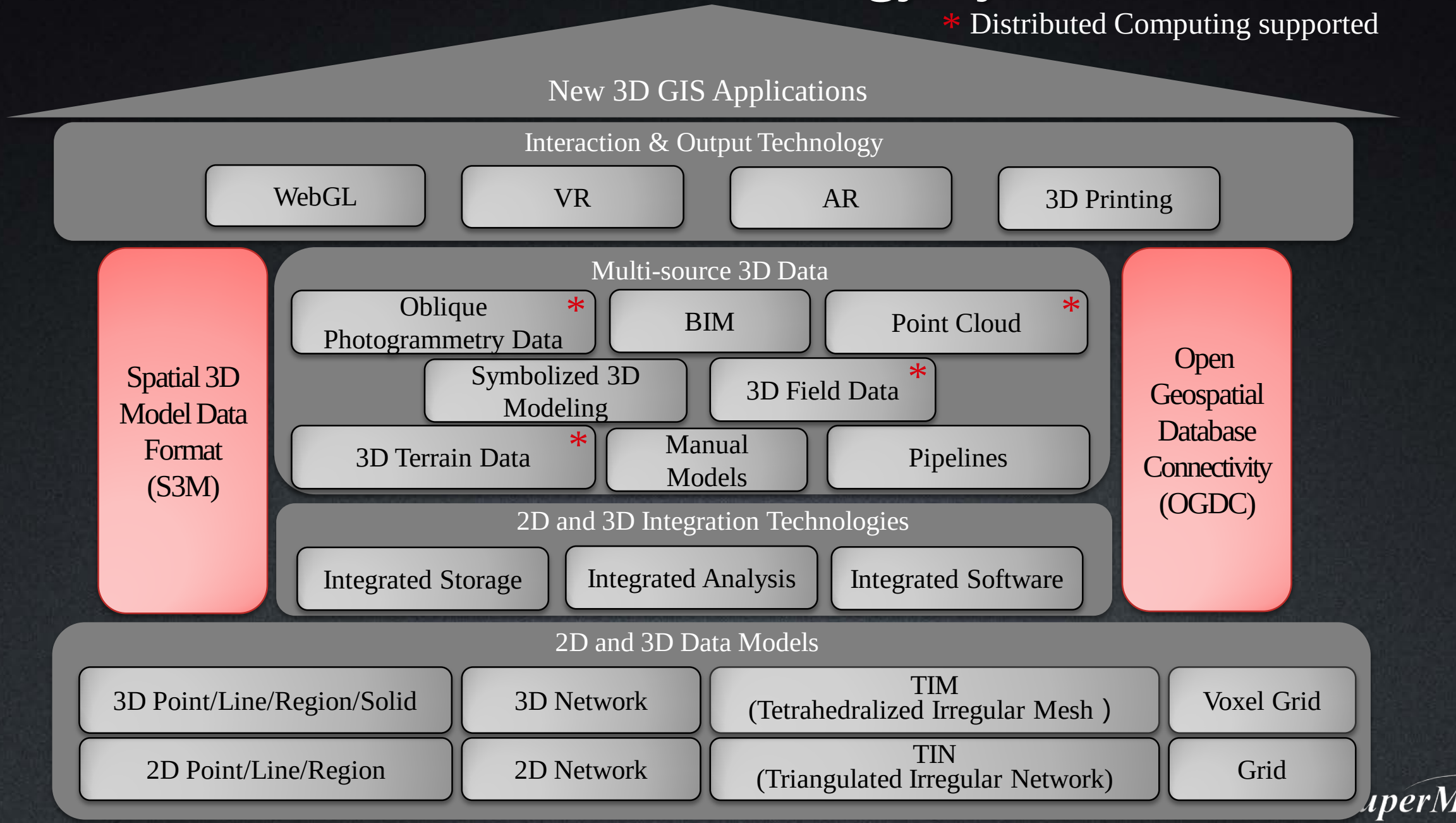
Application→ BIM+GIS/CIM、3D China

Platform→Mobile, WebGL, Linux3D…

Technology→2D&3D Integration、New 3D GIS Technology

New 3D GIS Technology System

* Distributed Computing supported



1. Interaction and Output
2. 3D Data Model System
3. Multi-source Data and Distributed Technology
4. 3D Data Standard

Immersive

VR/AR brings a new experience to 3D GIS

SuperMap

BIM+GIS+AR

SuperMap iClient3D for WebGL 10i

SuperMap

SuperMap iClient3D for WebGL

High realistic 3D scene

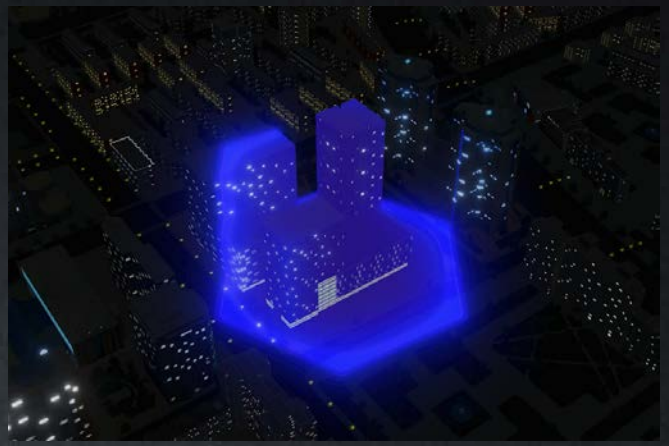
Rich data representation

Powerful performance

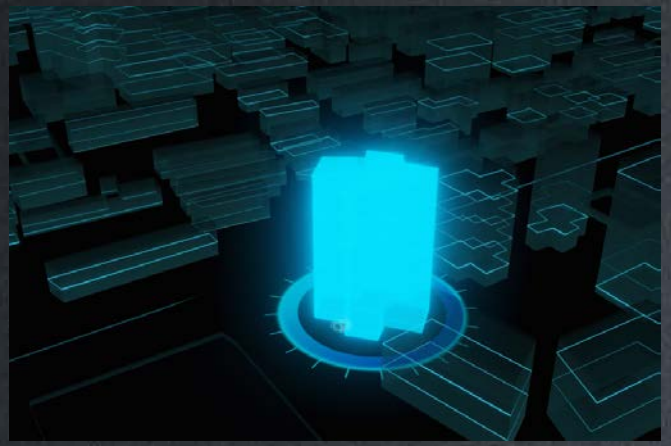
Effects in WebGL

Custom light-source

Dynamic texture + self-illumination

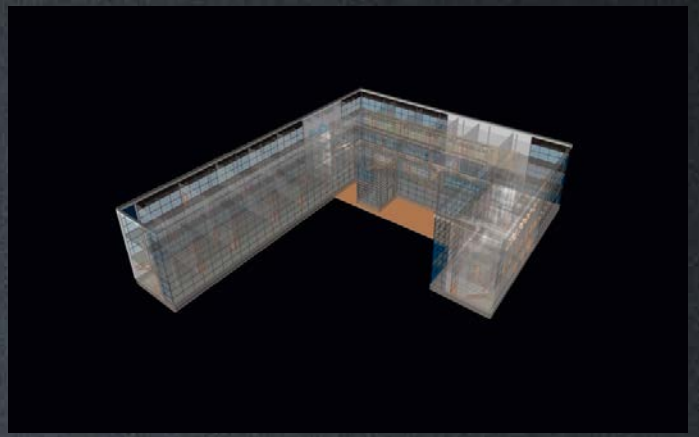


Scanline effects + bloom effect



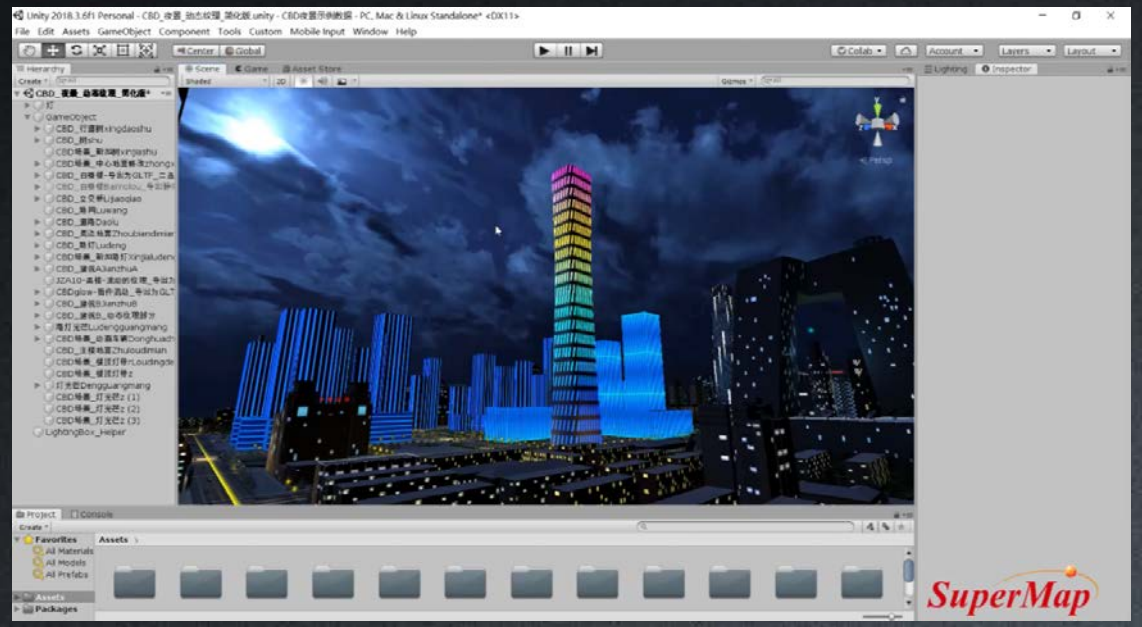
Custom light source + bloom effect

Physically-based rendering

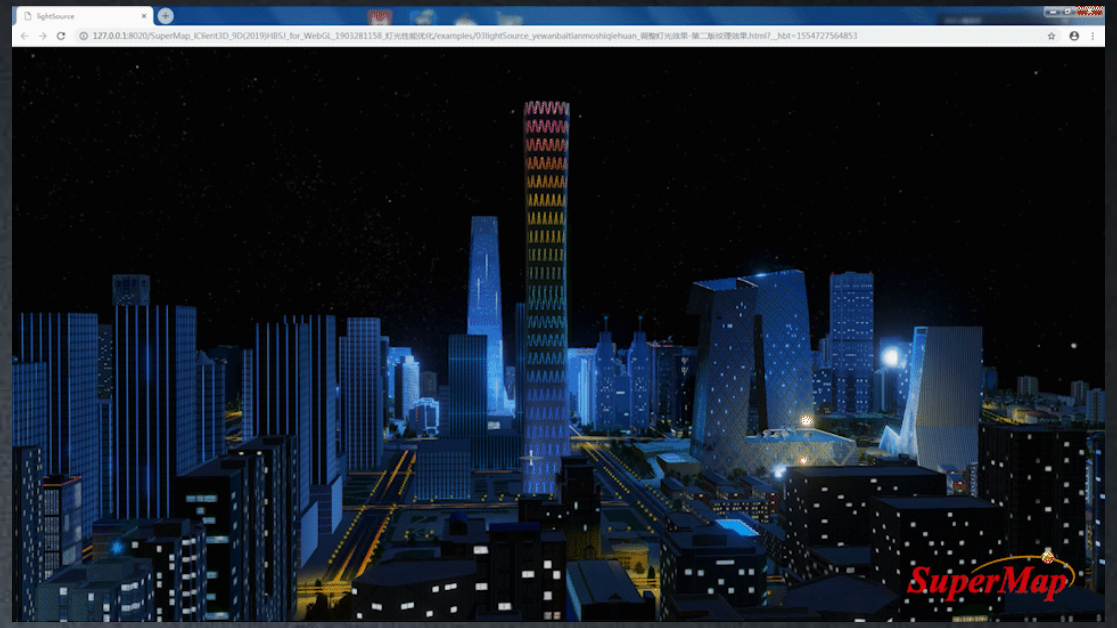


OIT transparent rendering

Unity3D Effects Exporter



Unity3D



SuperMap iClient3D for WebGL

From C/S to B/S

SuperMap

Smart City/District Operation Platform

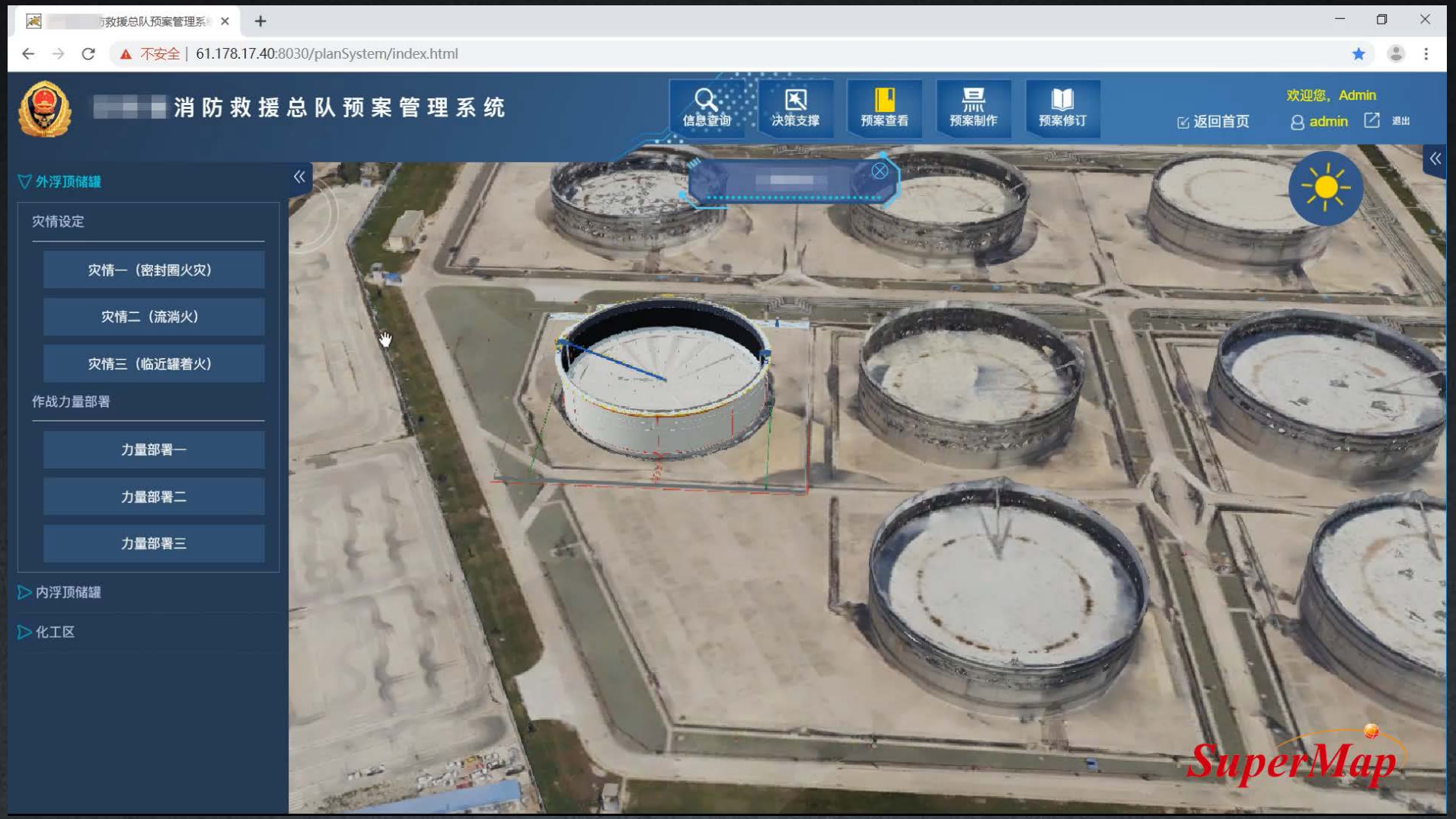
SuperMap

WebGL: High-performance Particle System

SuperMap

Case: Emergency Management System

GanSu Bolijiang 3D Ltd



SuperMap

SuperMap iClient3D for WebGL

High realistic 3D scene

Rich data representation

Powerful performance

Multi-source Data

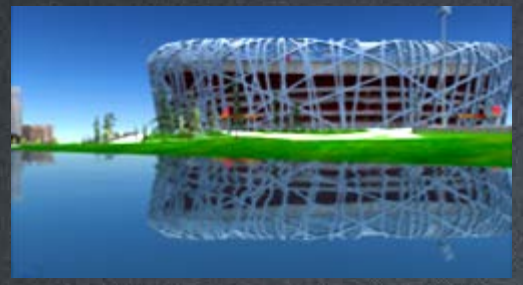
Terrain

Oblique Imagery

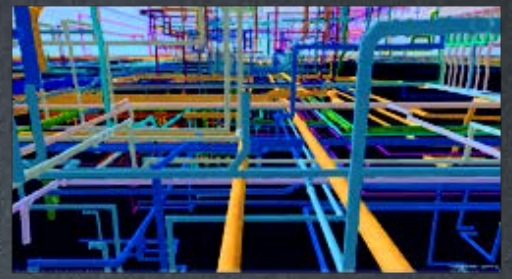
BIM

Points Cloud

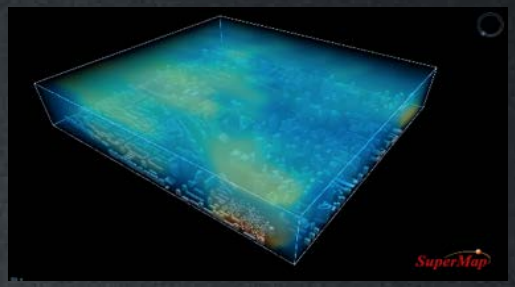
Fine Model



Water Surface



Pipelines

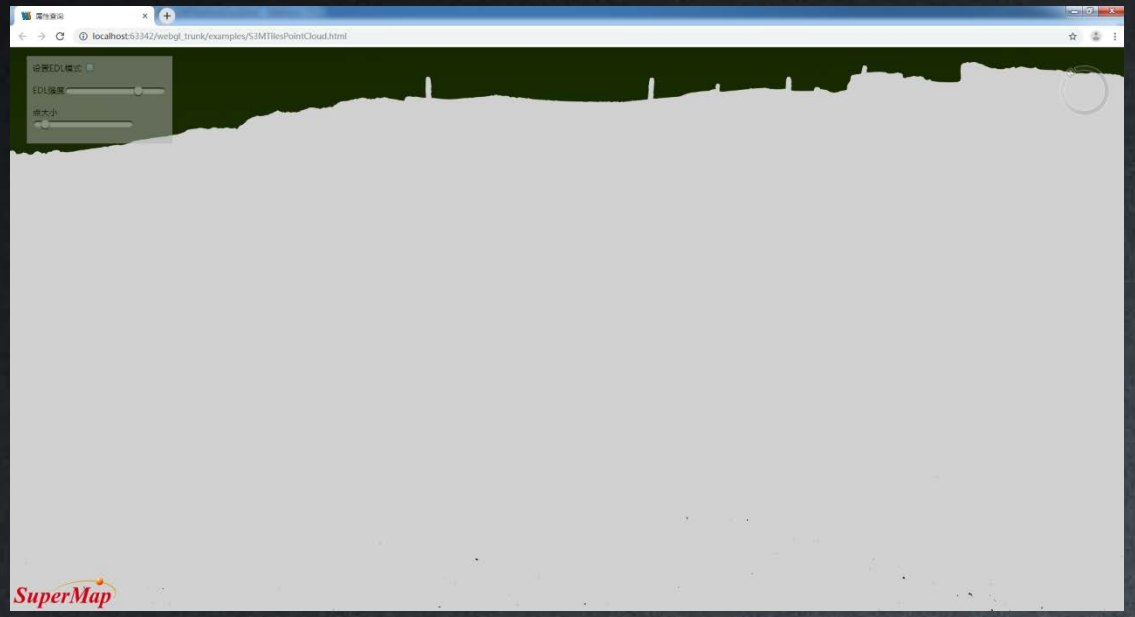


Filed Data

Streaming data

Editing symbolic objects in instanced layer

Point cloud: EDL(Eye-Dome Lighting)



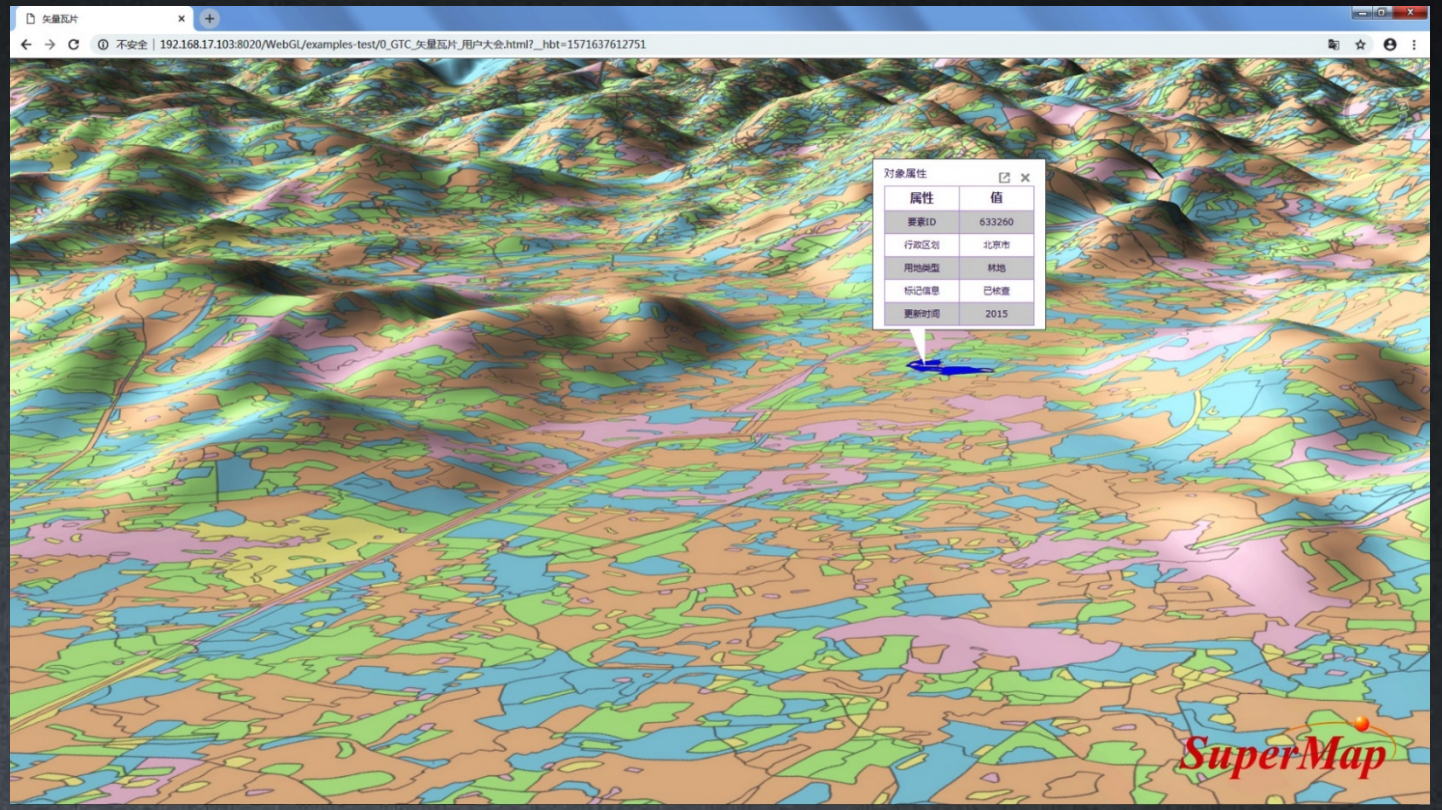
Ordinary rendering

EDL Rendering

SuperMap

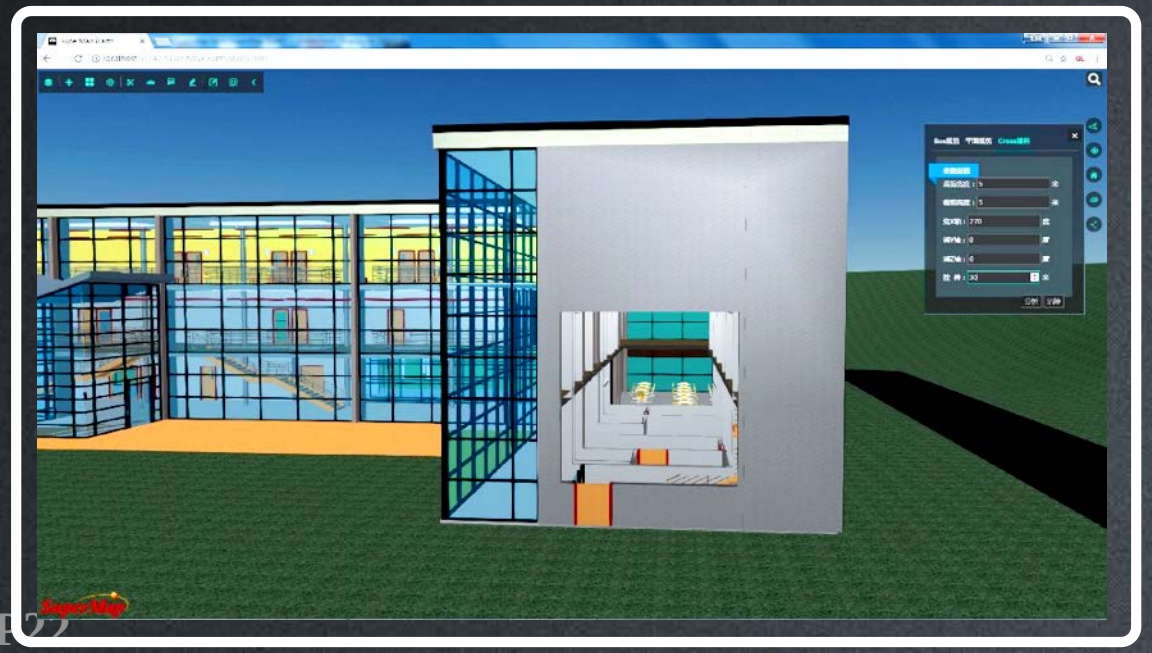
MVT

- Selection, attribute querying
- Color setting and visibility based on field values
- Large-scale vector data efficient rendering (100 million objects)

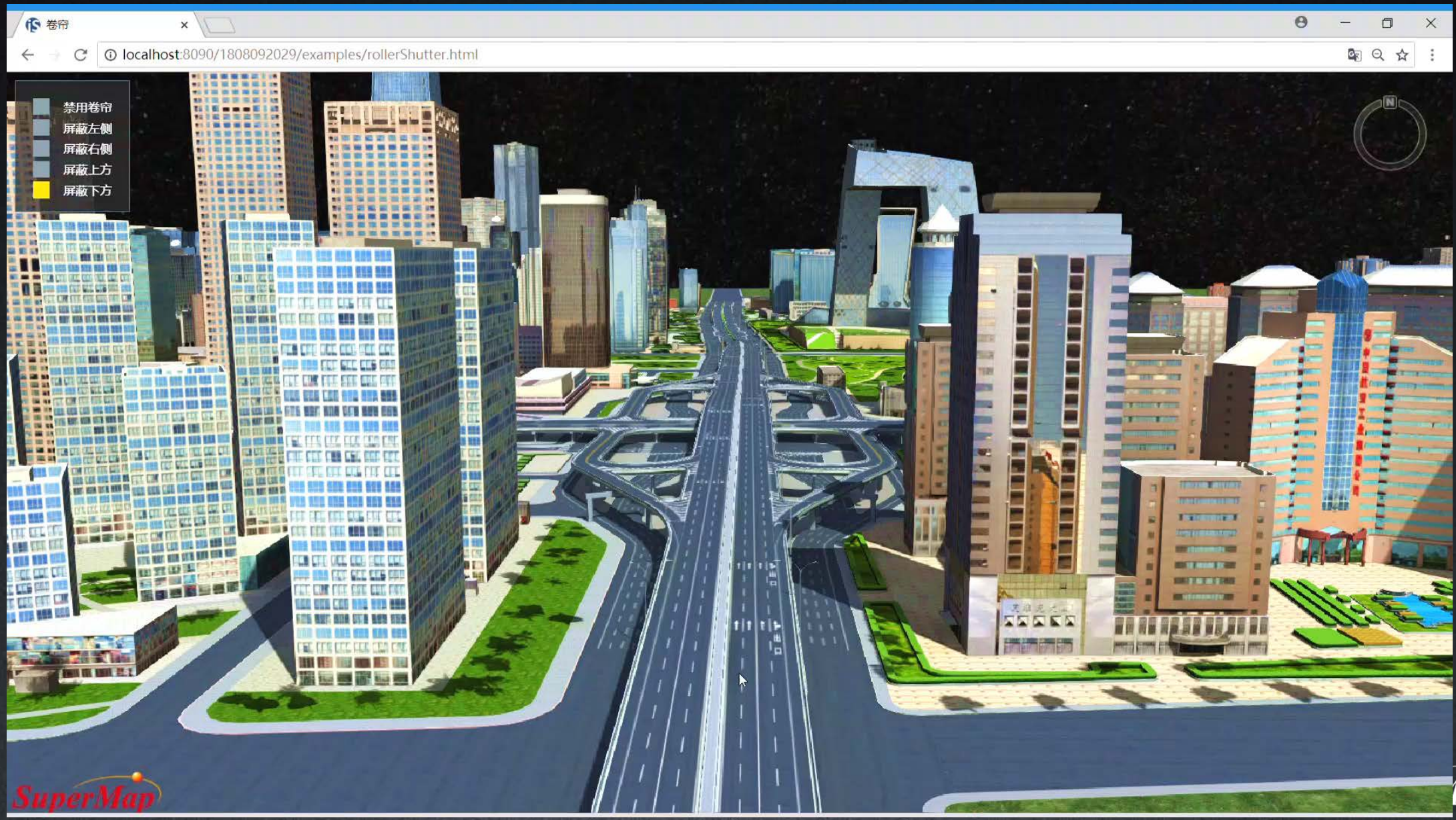


SuperMap

Sectioning



Split


卷帘
localhost:8090/1808092029/examples/rollerShutter.html
禁用卷帘
屏蔽左侧
屏蔽右侧
屏蔽上方
屏蔽下方
SuperMap

SuperMap iClient3D for WebGL

High realistic 3D scene

Rich data representation

Powerful performance

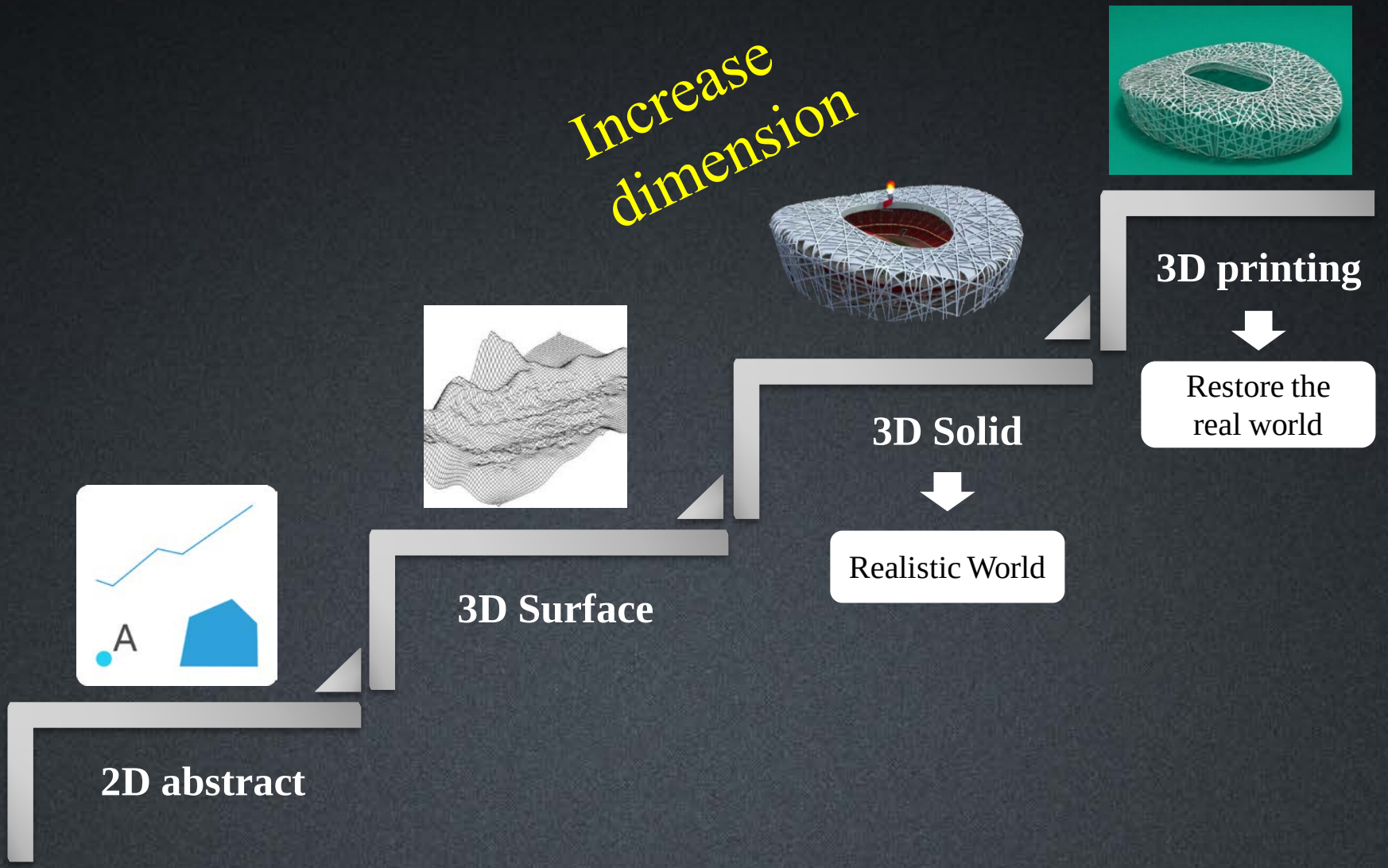
1. Interaction and Output
2. 3D Data Model System
3. Multi-source Data and Distributed Technology
4. 3D Data Standard

Soul of GIS

Spatial Analysis !

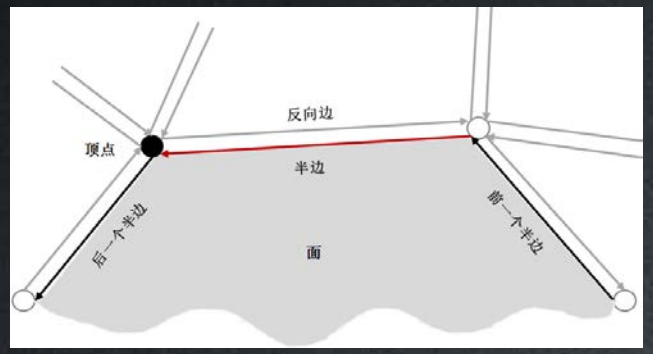
Spatial Data Model !

1）Object Models

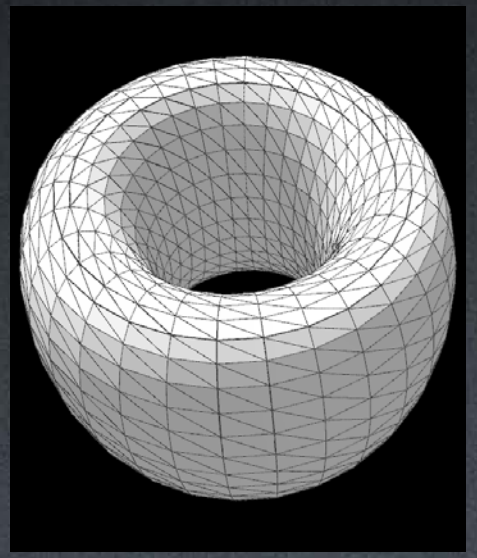


SuperMap

Solid Object Model



High-precision,
Topologically closed



3D Solid Data

Boolean Operation :
Intersect, Union and Difference

Spatial Relation:
Contain, Overlap, Adjacency…

Calculations:
Volume, Area

Dimensional Reduction:
Projection plane

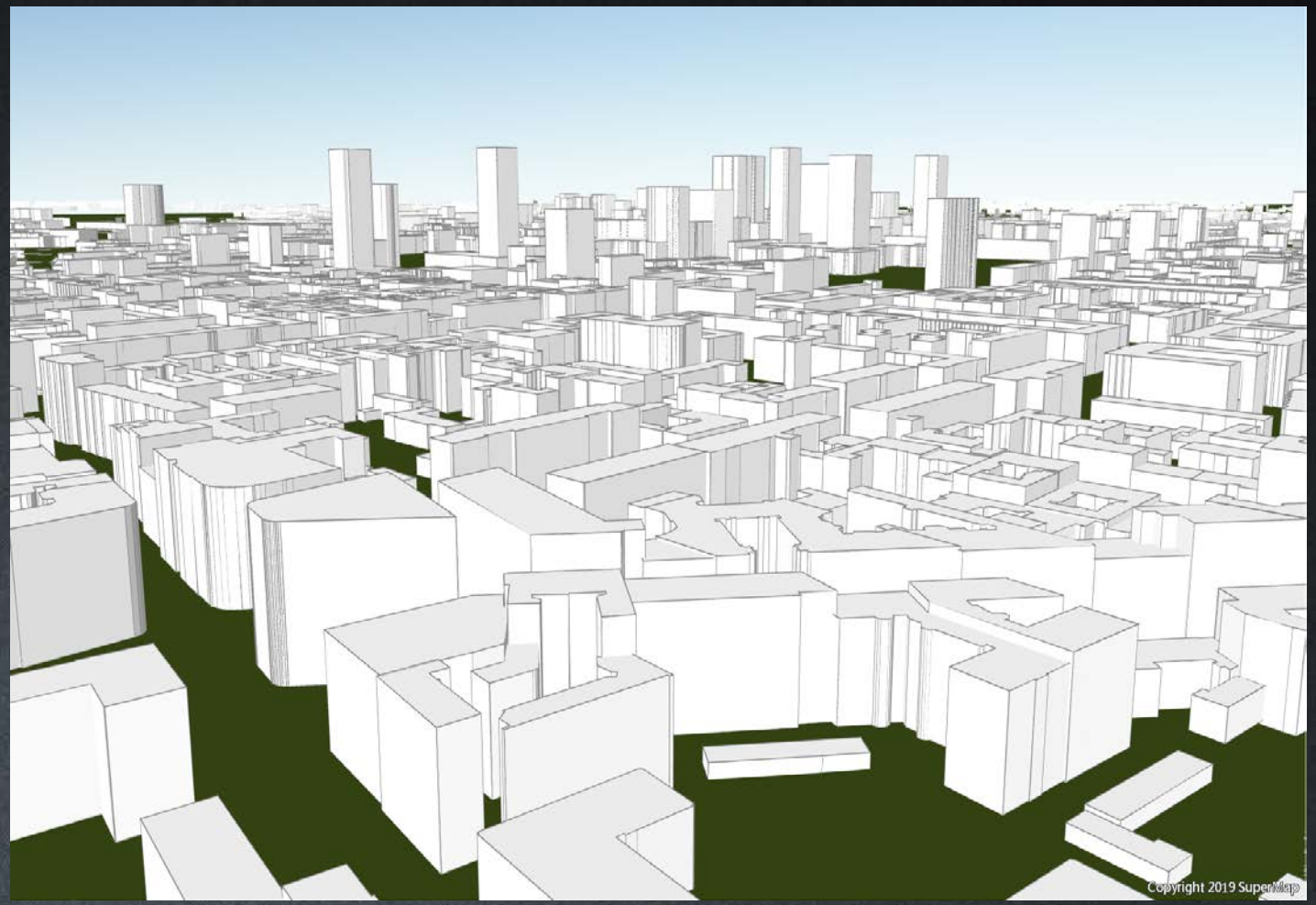
3D printing

SuperMap

CityGML

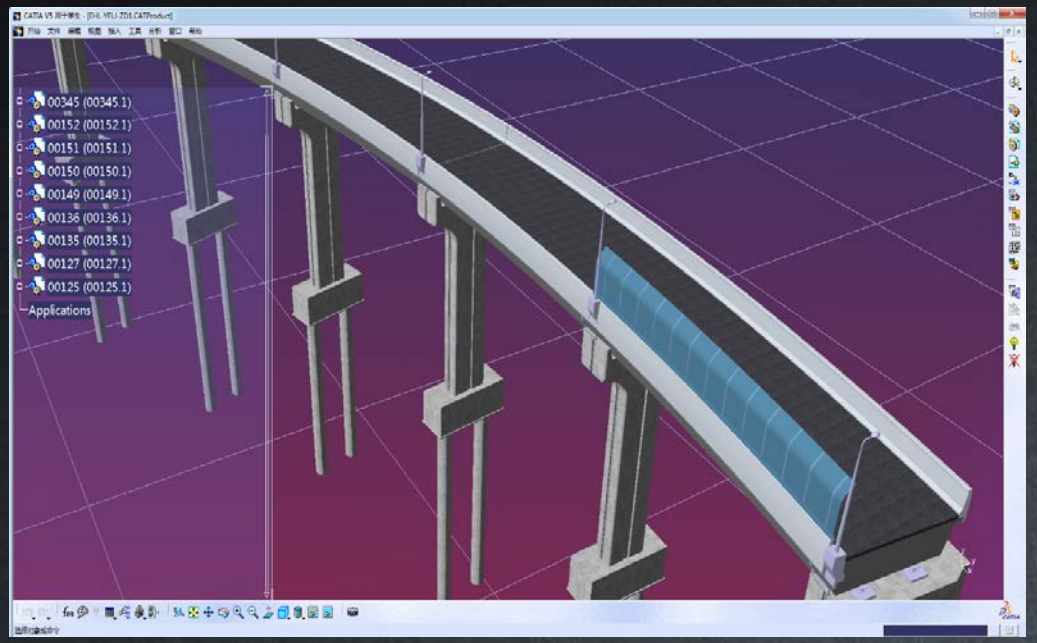
- Directly Import CityGML into SuperMap
  - Materials & Textures
  - LOD & Subsurfaces
  - Attributes

- Export To CityGML

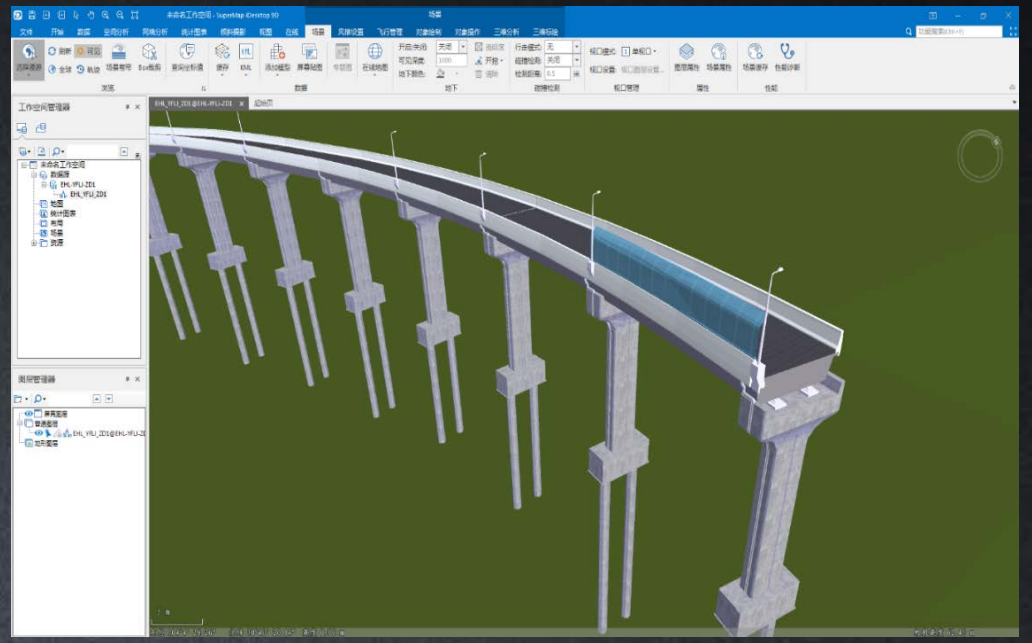


SuperMap

3D Solid Model for BIM



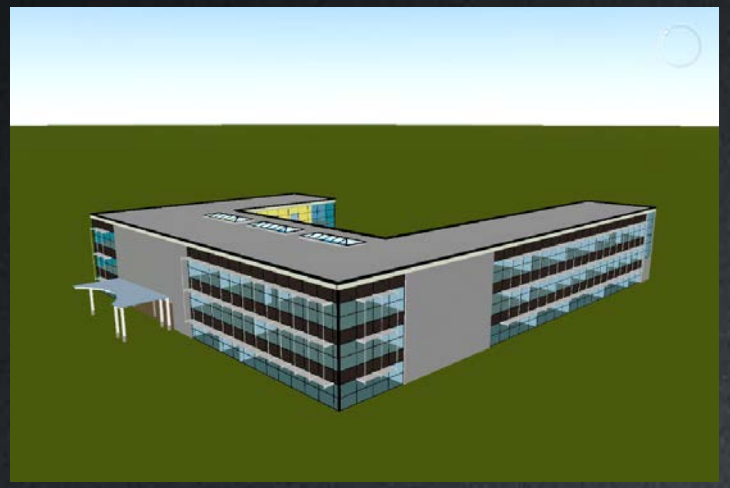
BIM from Dassault



SuperMap GIS

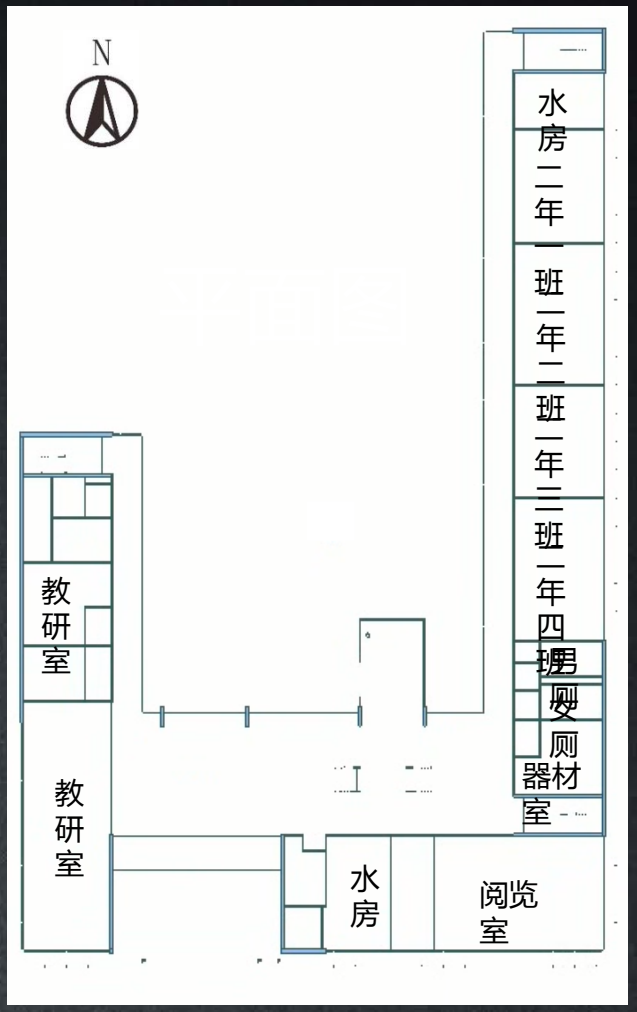
SuperMap

Get Section plane from BIM model



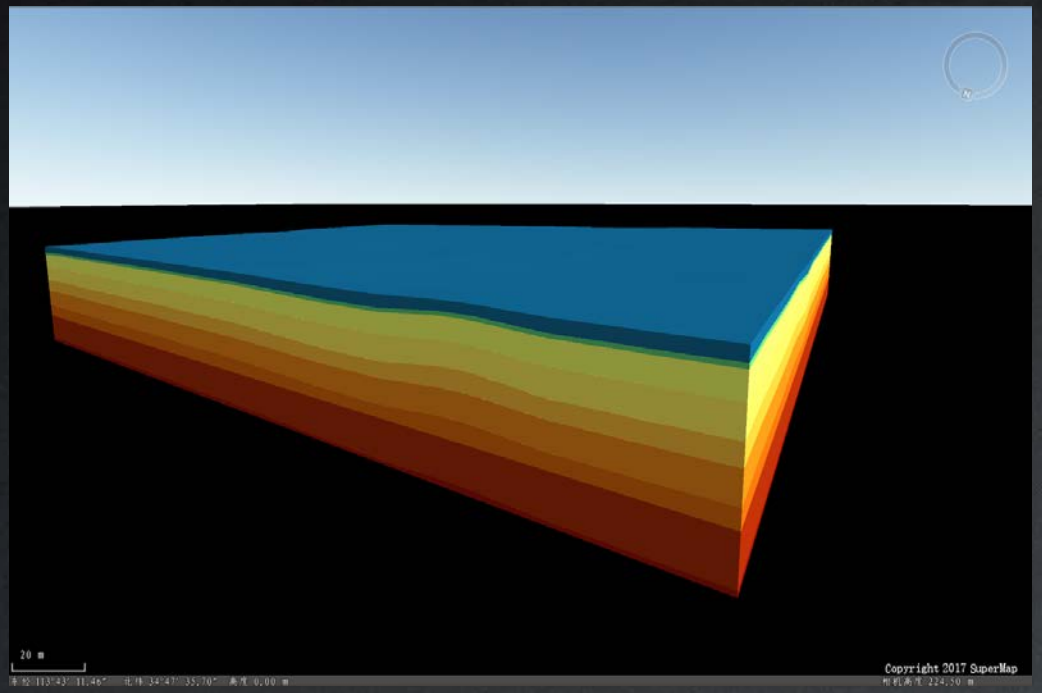
BIM (3D Solid)

Cross section

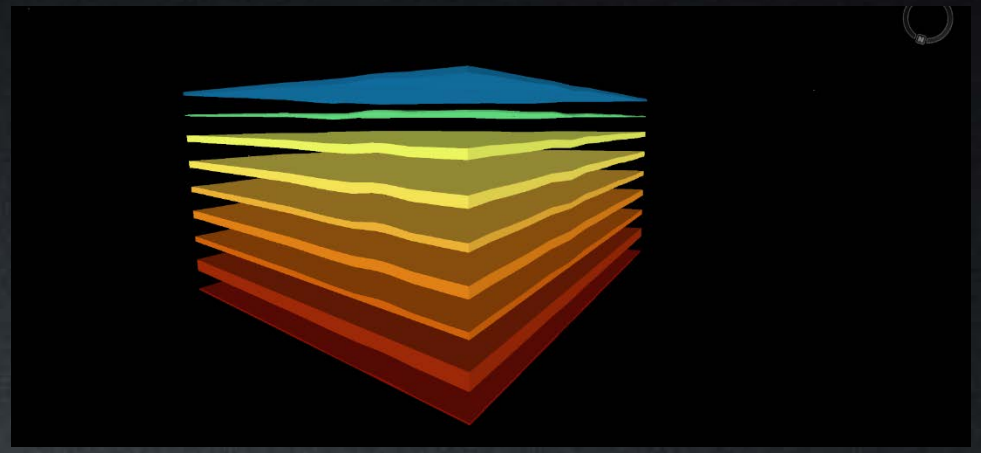


SuperMap

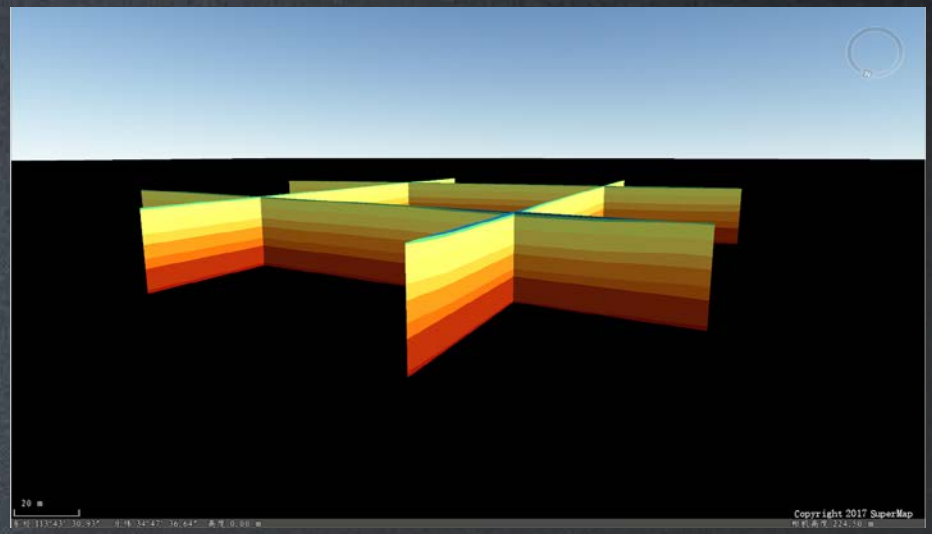
Geological Body



Geological Body



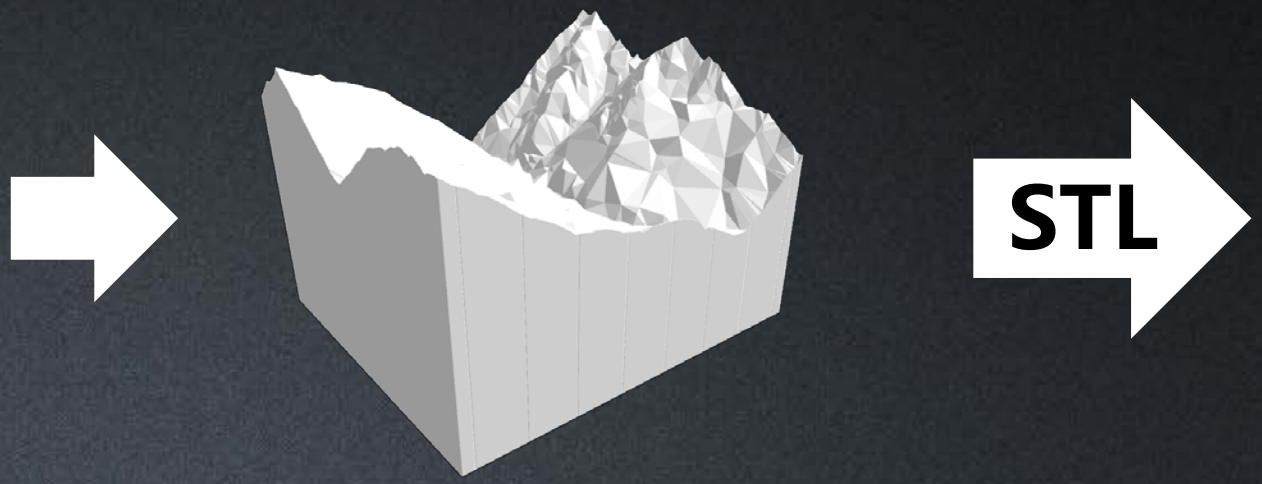
Each layer is represented by solid object



Slices & Cut

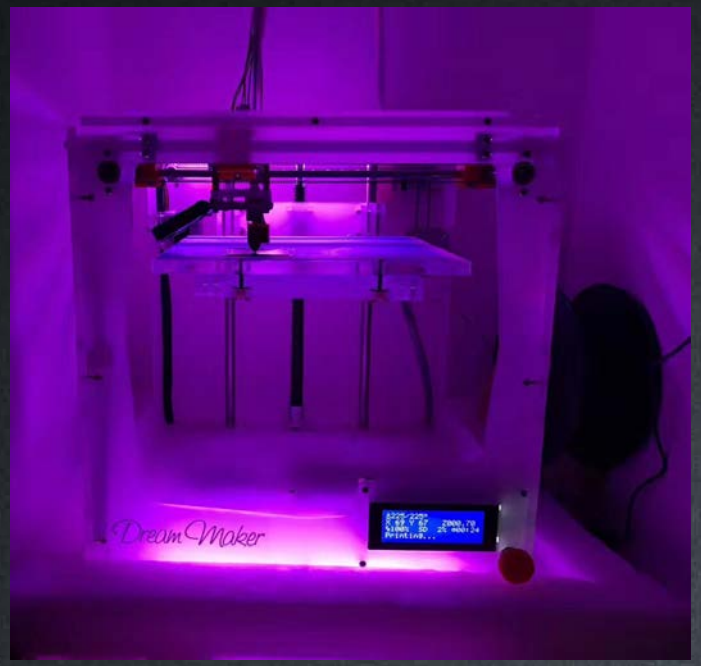
SuperMap

Object Model in 3D Printing

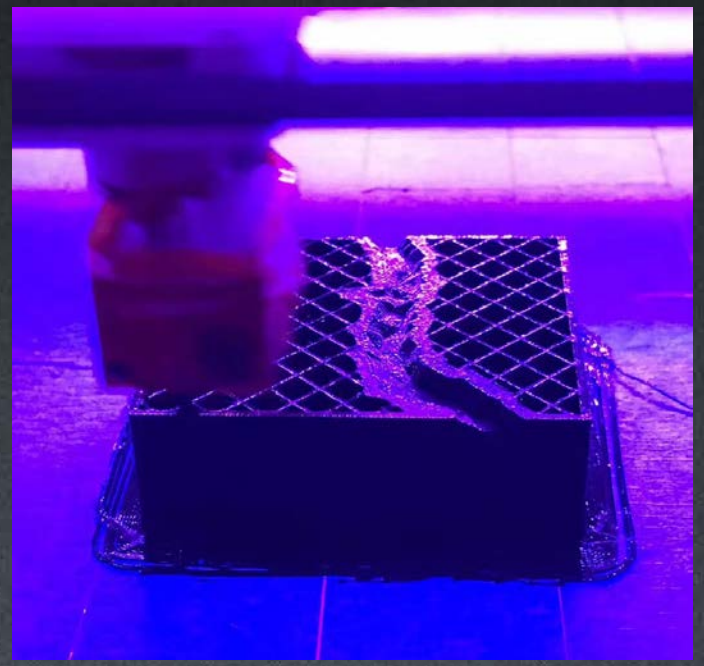


3D Printing…

STL



Printing Device



Printing

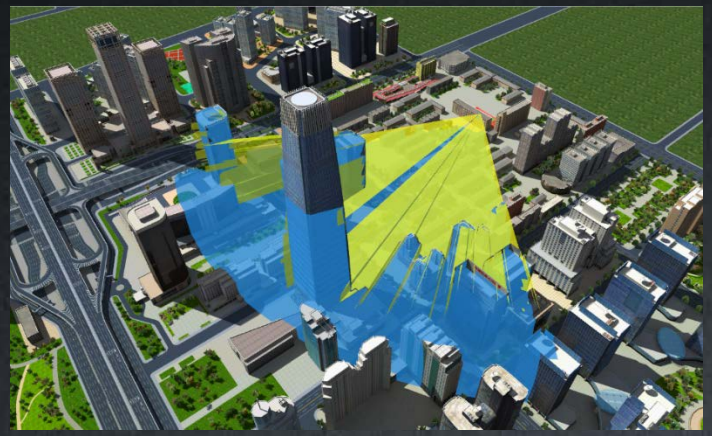
Result

SuperMap

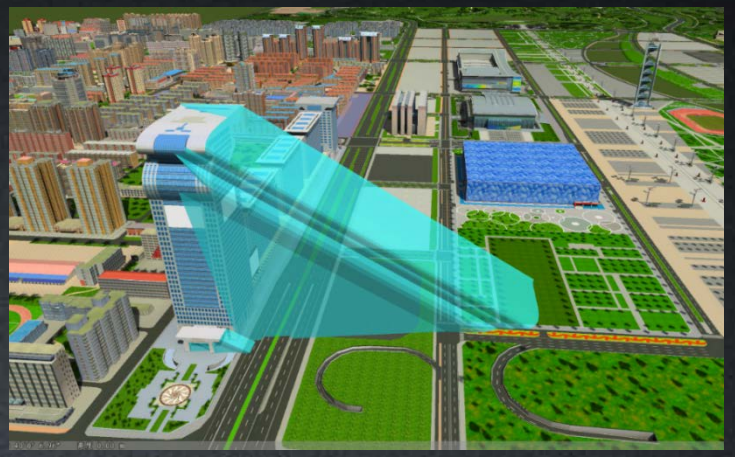
Telecom Model

SuperMap

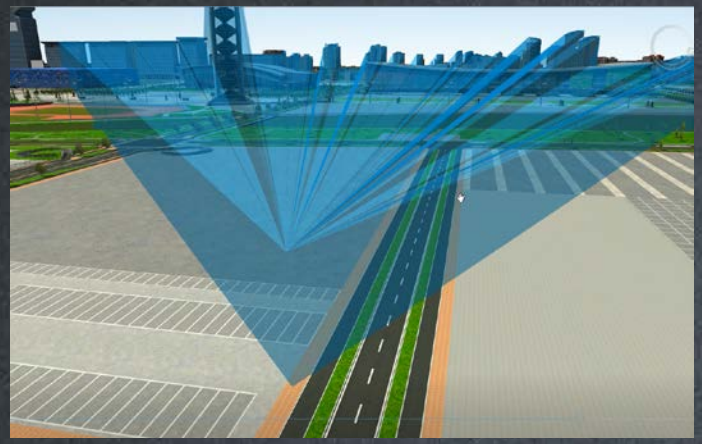
3D Spatial Analysis



Viewshed



Shadow



Skyline

View Dome

Urban Planning & Zoning

Digitalized Translation

Urban planning Regulations → Digitalized Rules

Spatial Calculation

Spatial Analysis

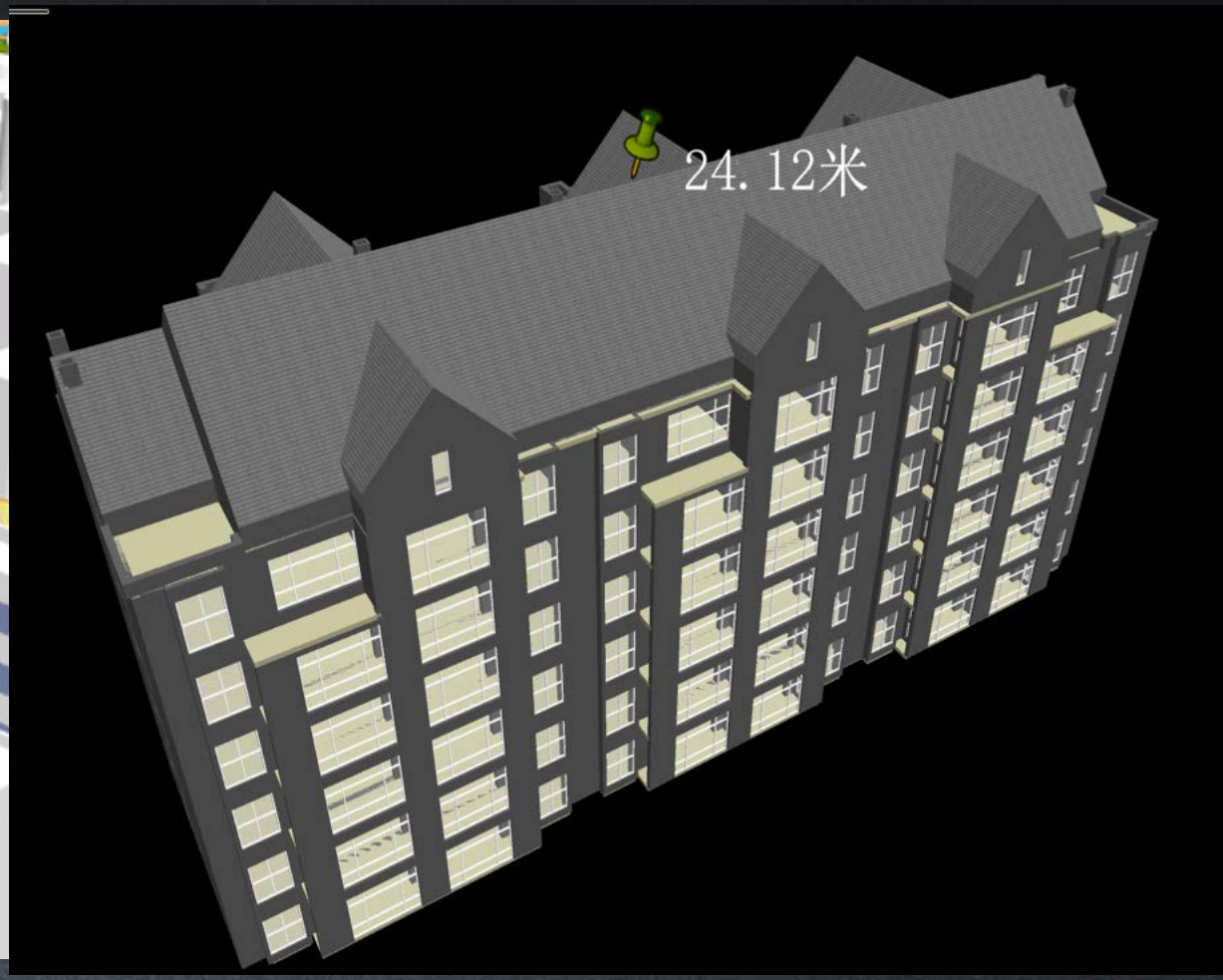
2D and 3D data models

SuperMap

Automatic Examination

Building heights	Floor-to-Area Ratio	Setbacks	Building coverage	Building Intensity	Building Density
Sunshine	Vertical	Parking	Plantings	……	

Building Heights



SuperMap

Viewdome

83% obstruction

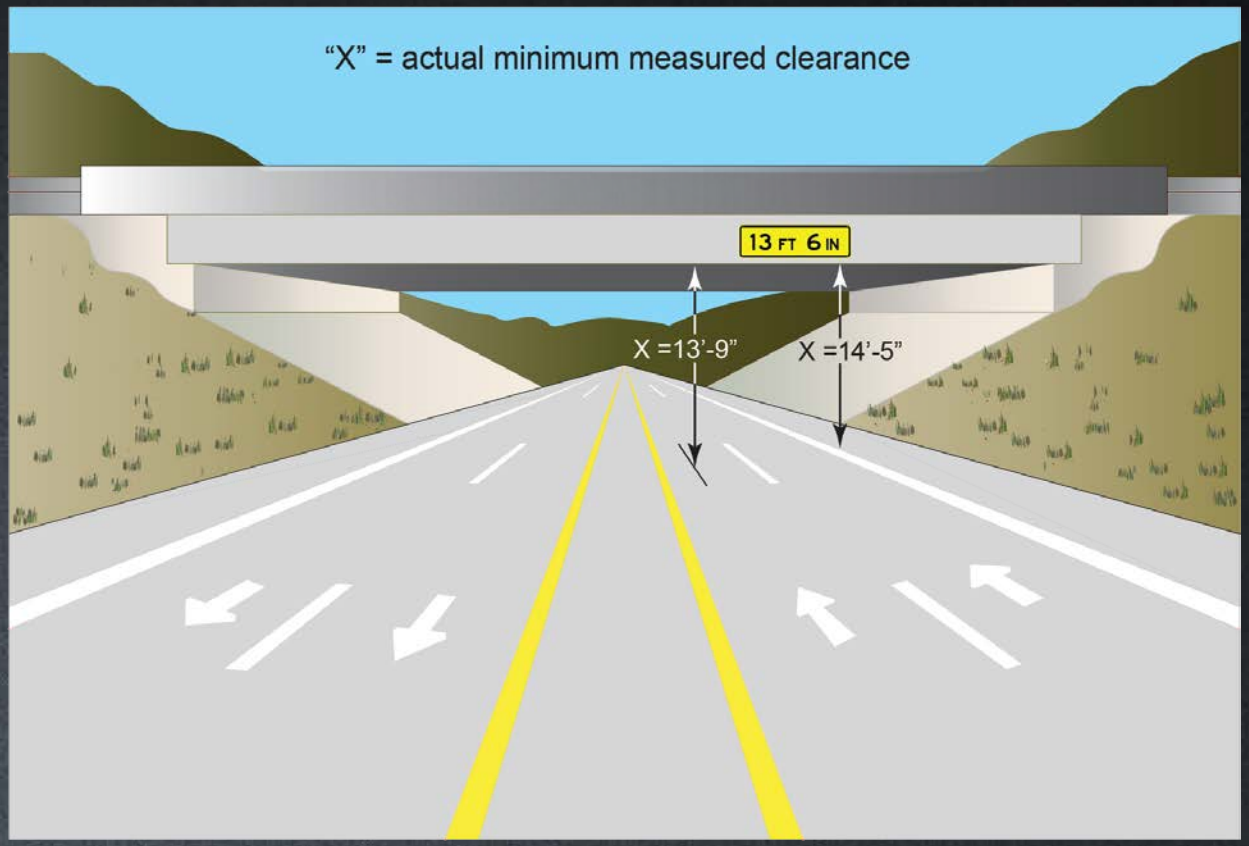
Minimum Vertical Clearance

VERTICAL CLEARENCE

✓Minimum vertical clearance of 5m should be ensured over the full width of the roadway at all underpasses and similarly at overhanging cliffs and any semi-tunnel sections etc

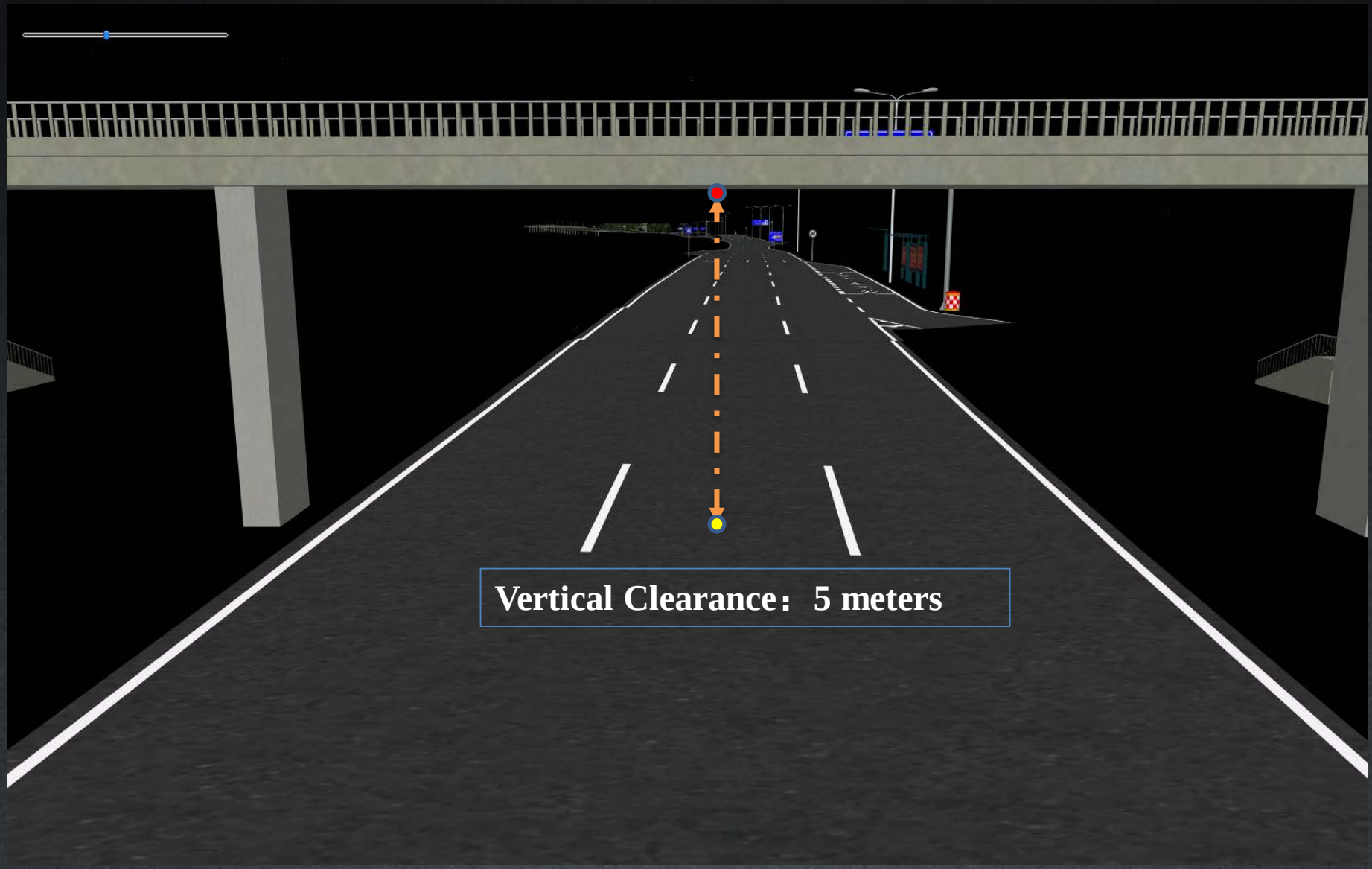
✓The vertical clearance should be measured with regard to the highest point of carriageway(the crown or the super elevated edge of the carriageway)

✓Allowance for any future raising/strengthening of pavement is also be made)



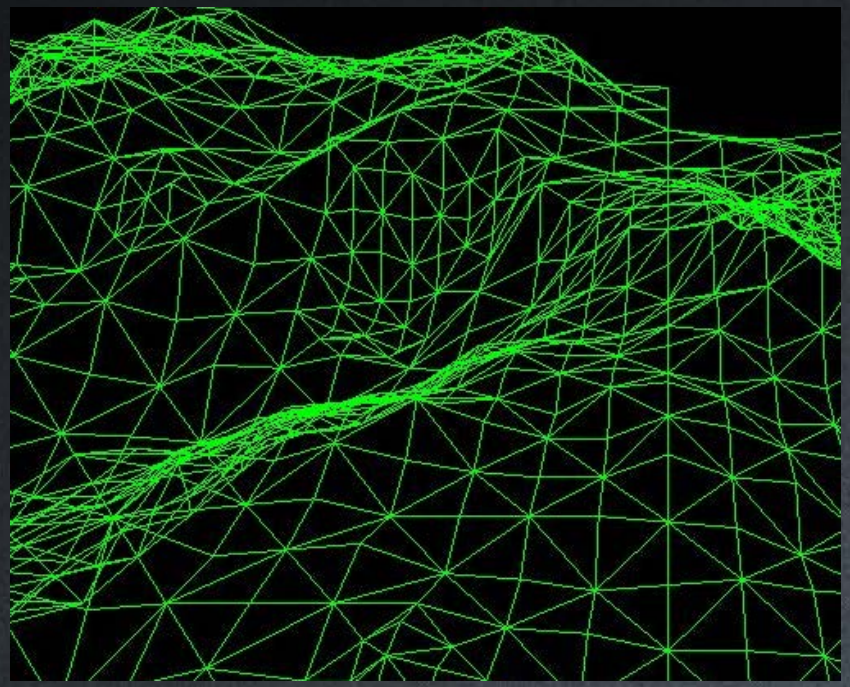
SuperMap

Calculate Minimum Z value via X, Y

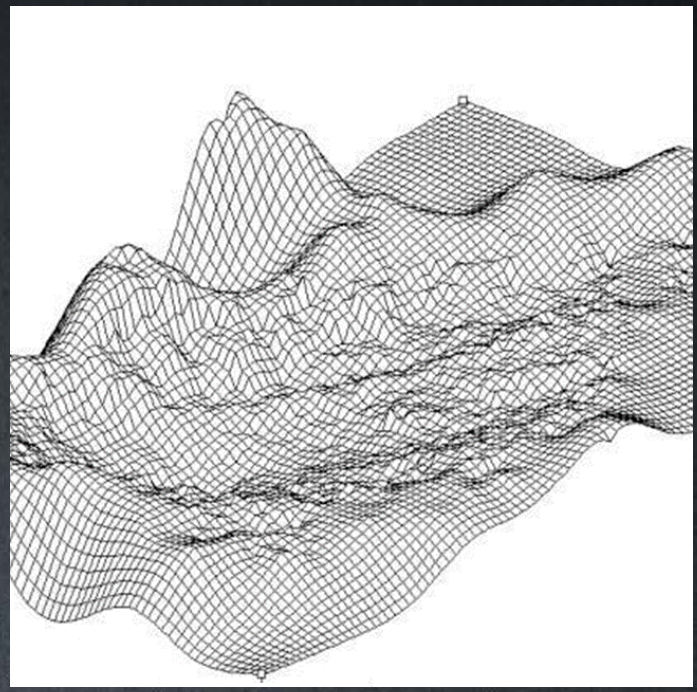


SuperMap

2) Field Model



TIN

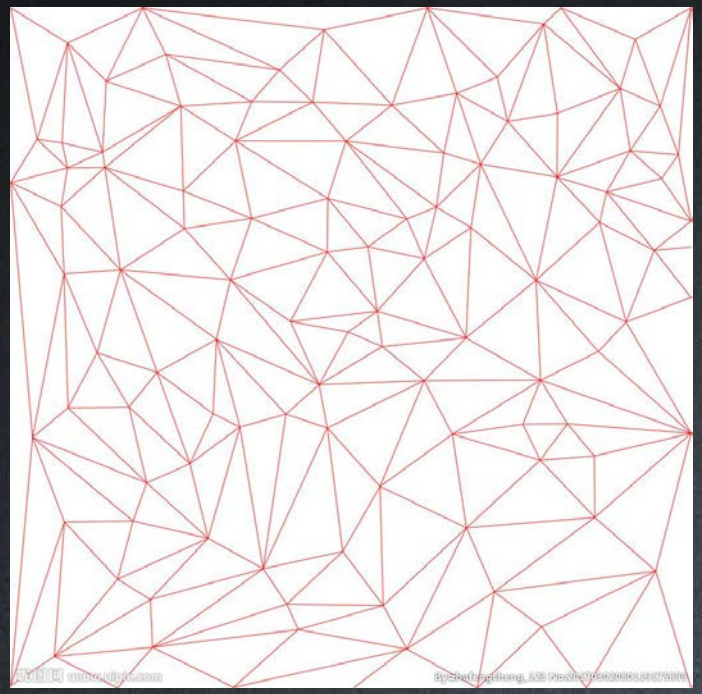


Grid

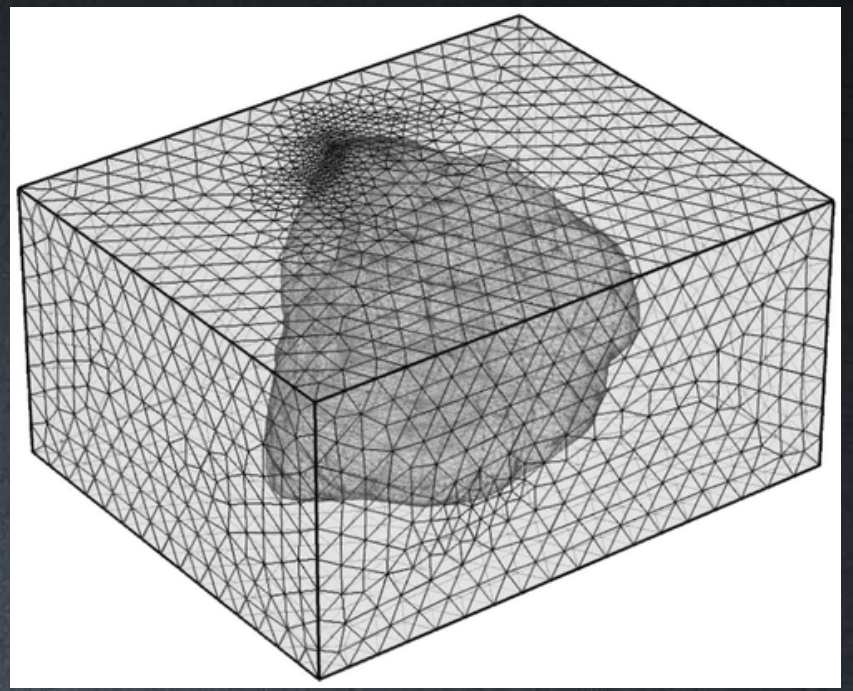
How to represent continuous and heterogeneous data in 3D space ?

Air Field	Electromagnetic Field	Geological field
• Pollution • Temperature • Humidity	• Mobile signal	• Density • Porosity • Young's modulus • Poisson's ratio

From TIN to TIM

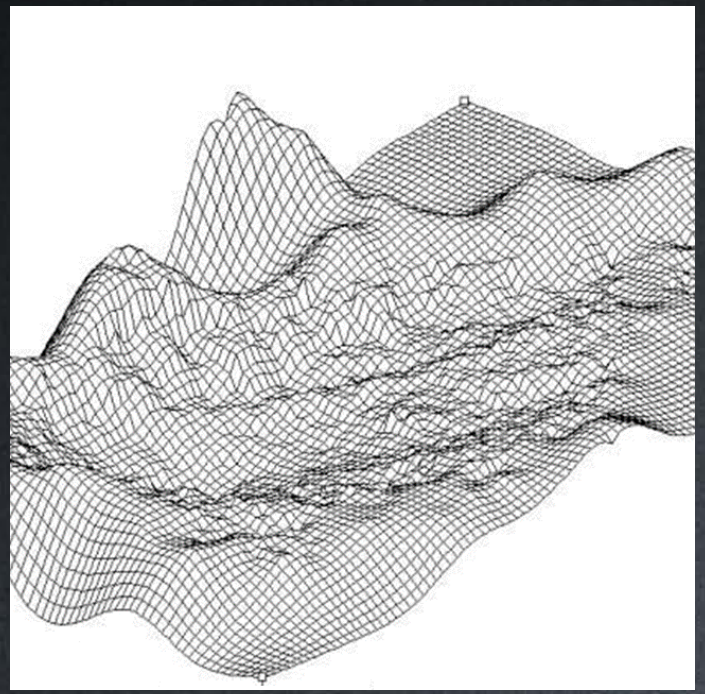


TIN
(Triangulated Irregular Network)

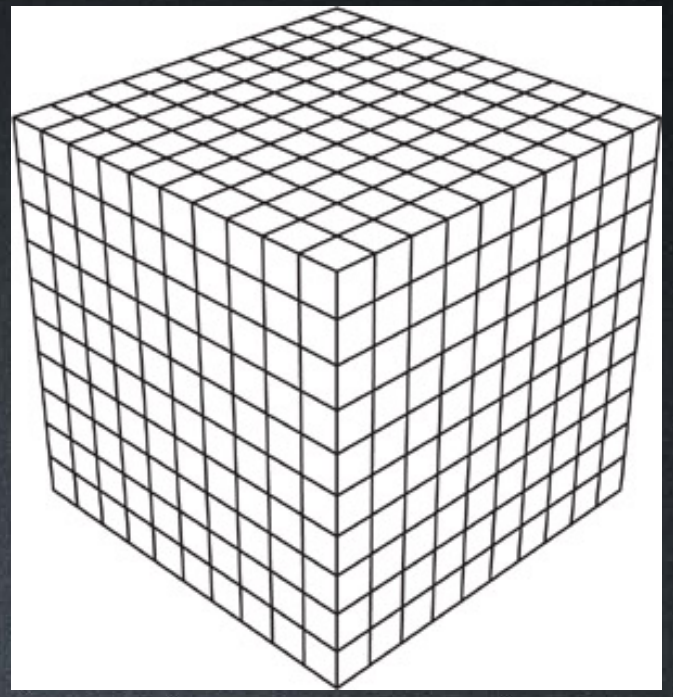


TIM
(Tetrahedral Irregular Mesh)

From Grid to Voxel Grid

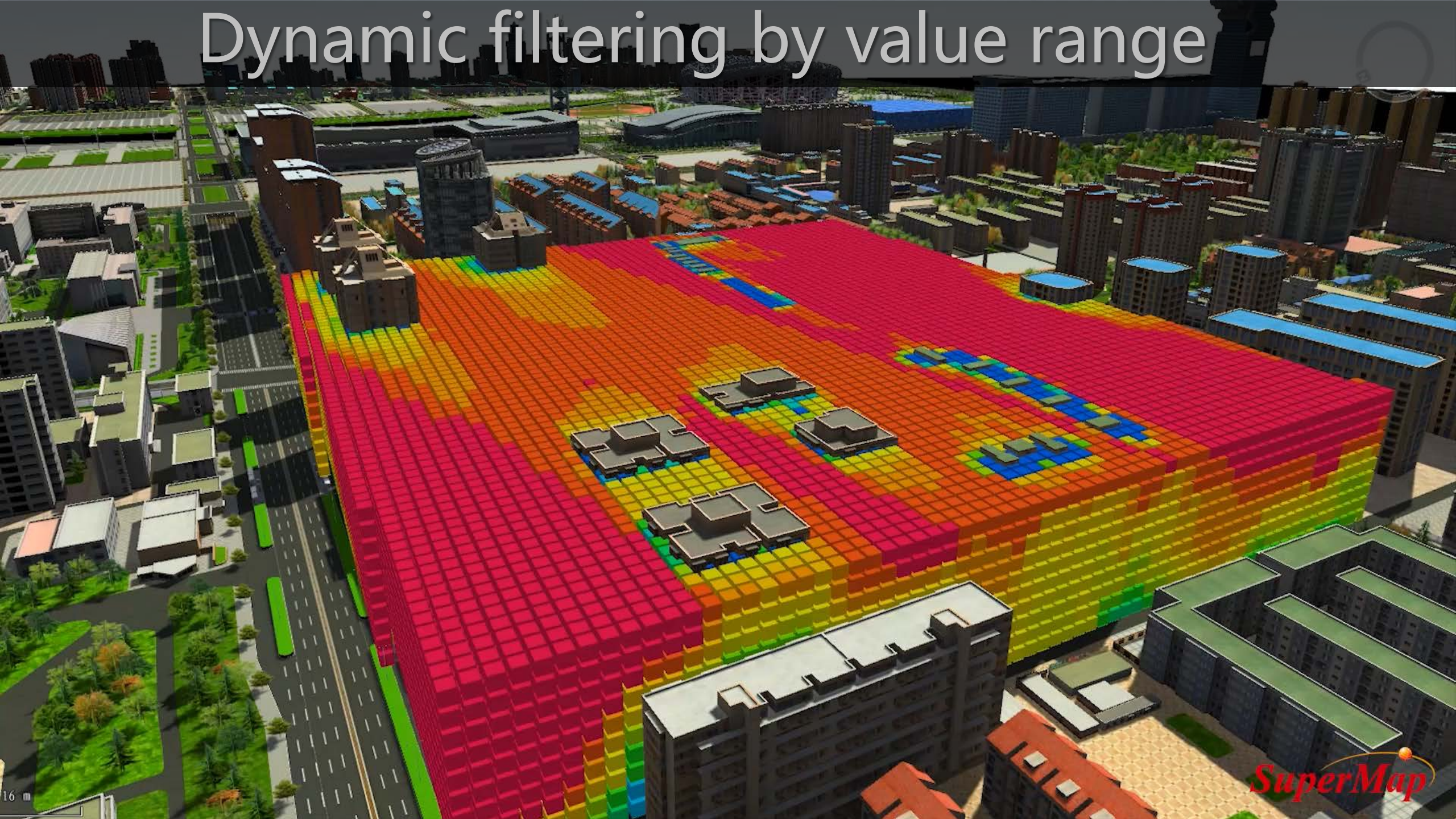


Grid

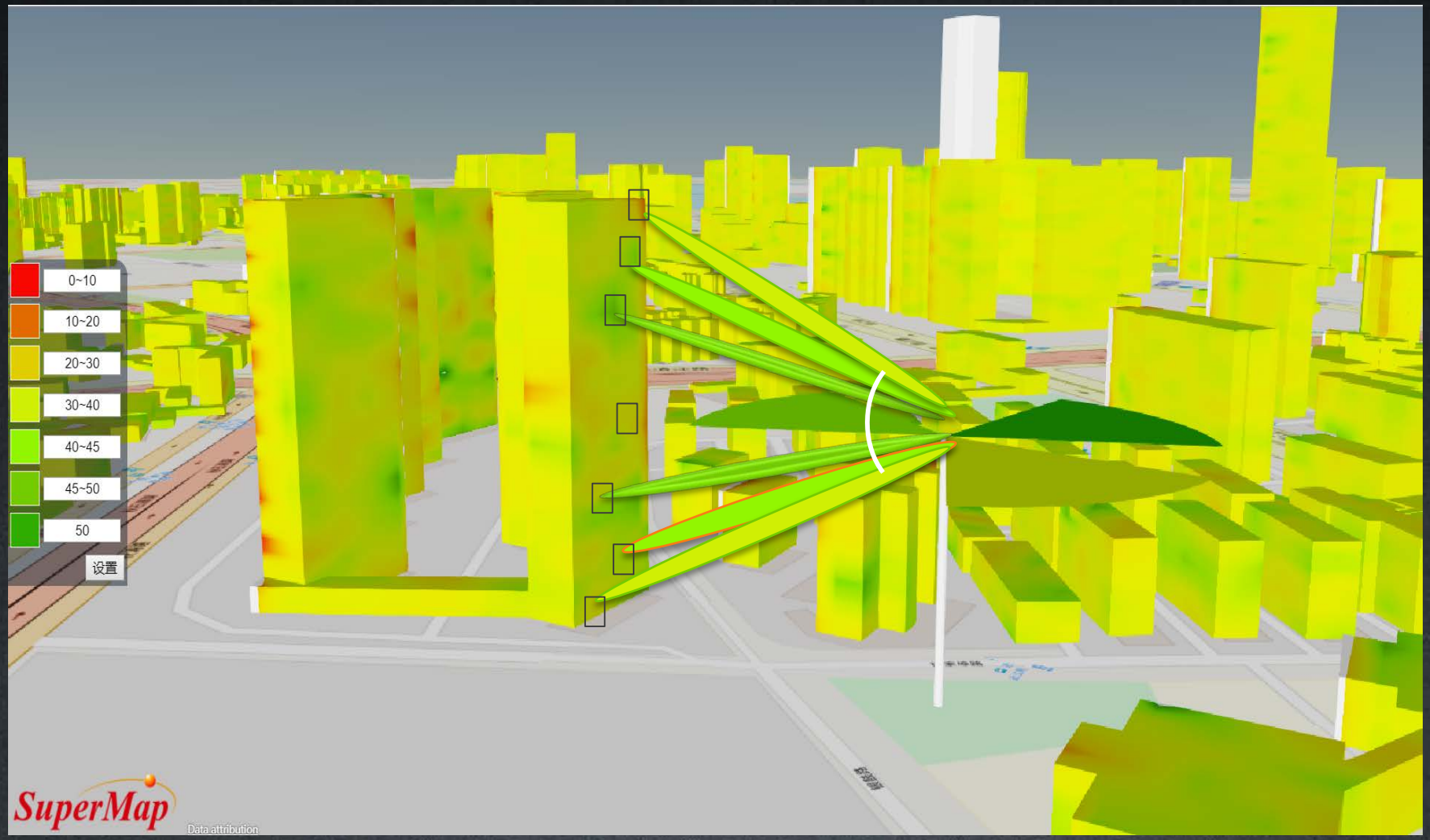


Voxel Grid

Dynamic filtering by value range

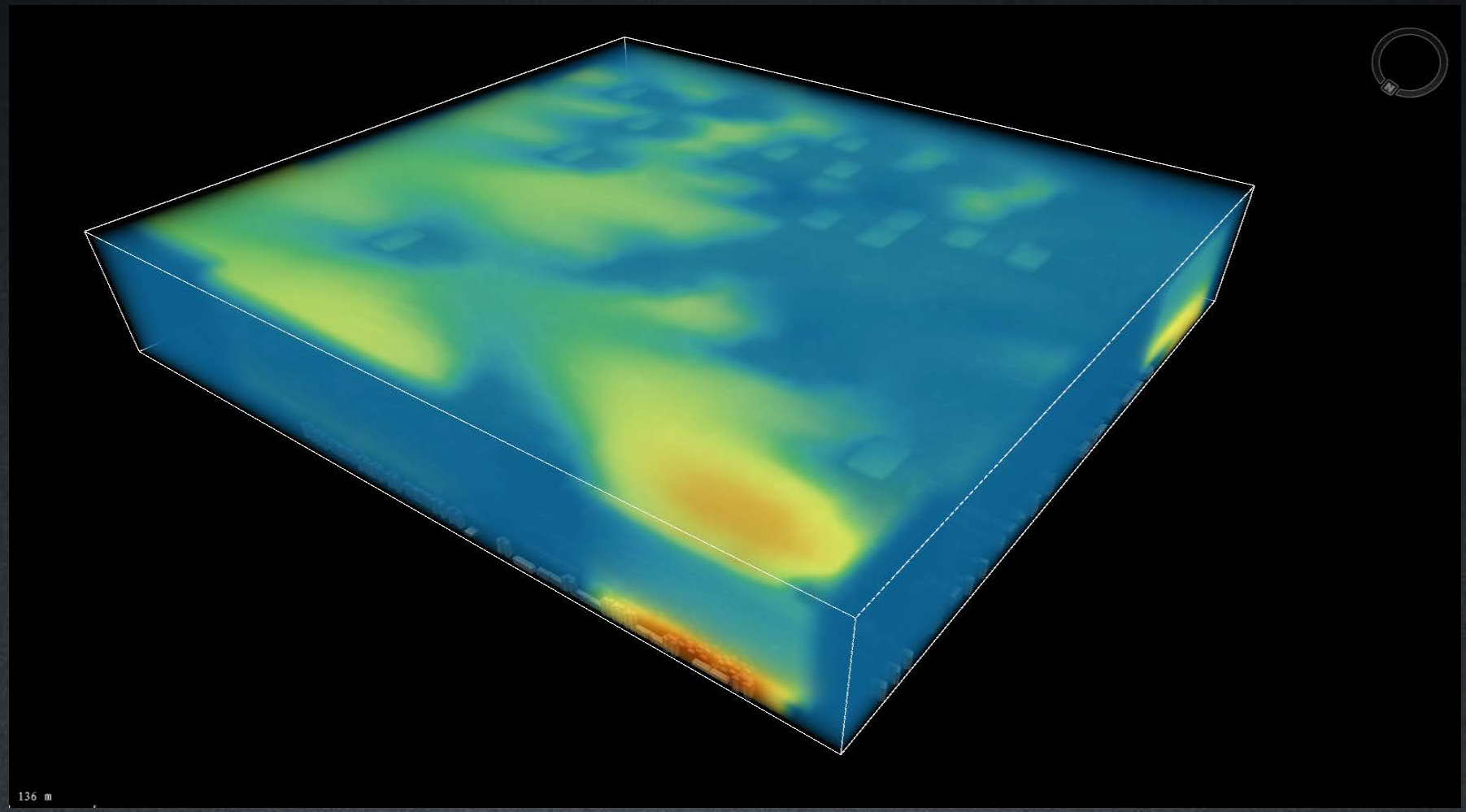


Case: Voxel Grid used in communication networking optimization



SuperMap

Voxel Grid for Air Pollution



SuperMap

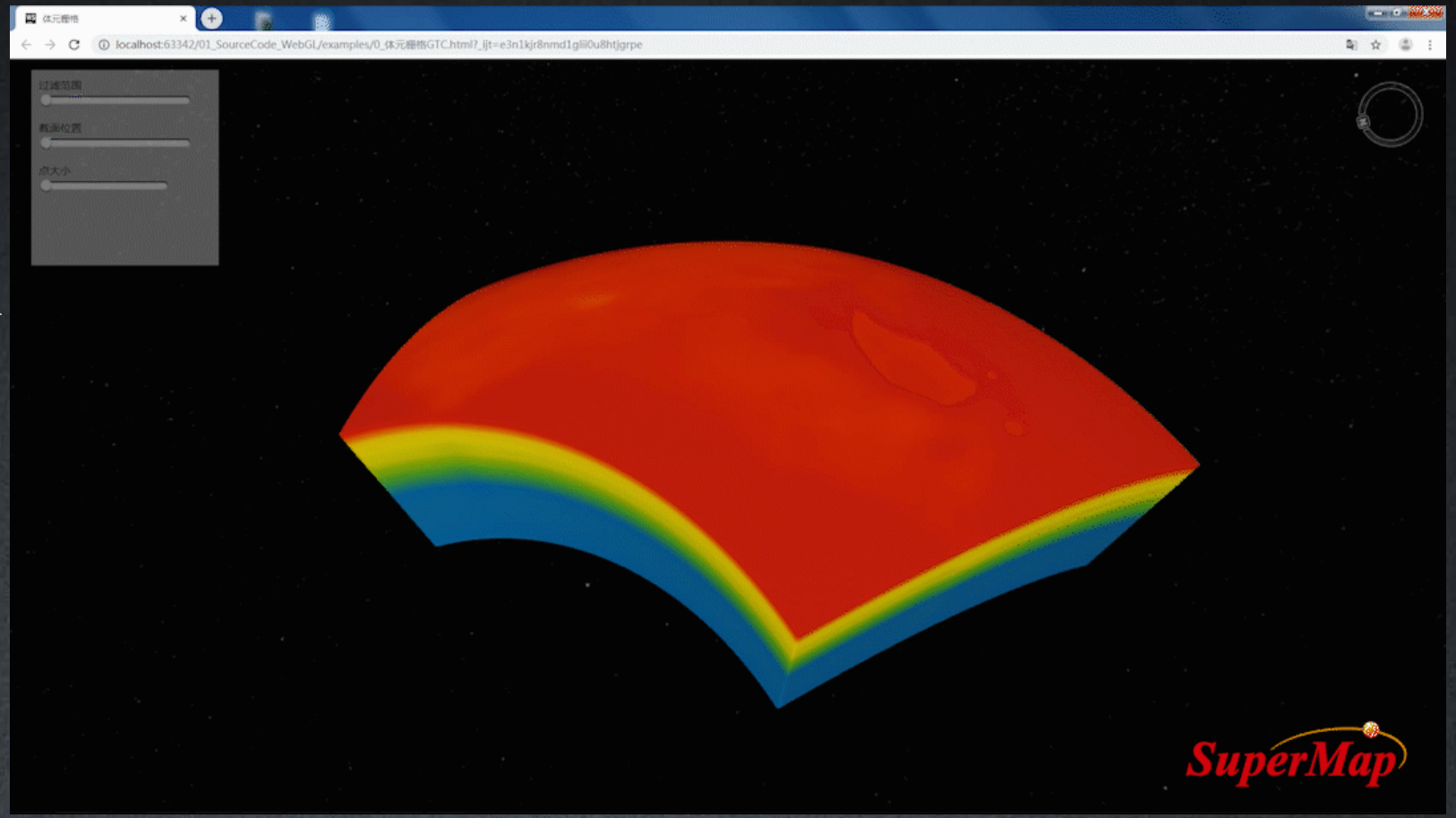
Case: 3D seismic velocity structure model represented by Voxel Grid

Seismic velocity sampling data

Interpolation

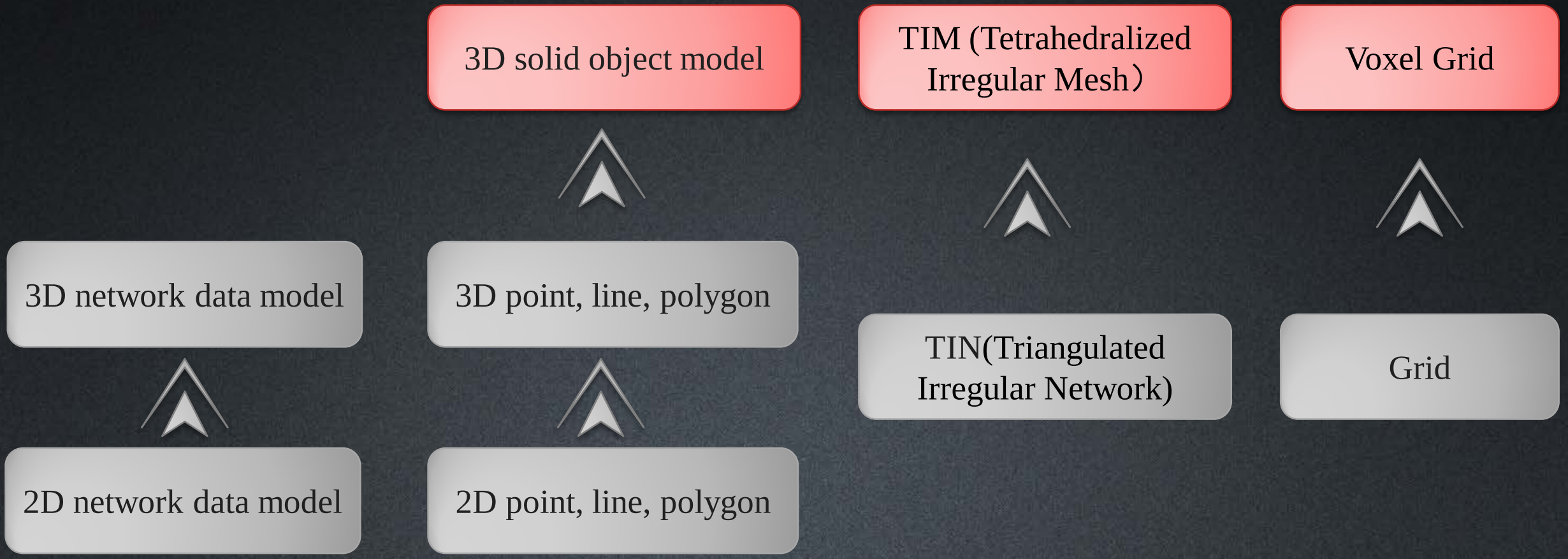
Voxel Grid

S3M



SuperMap

Data Models Evolution



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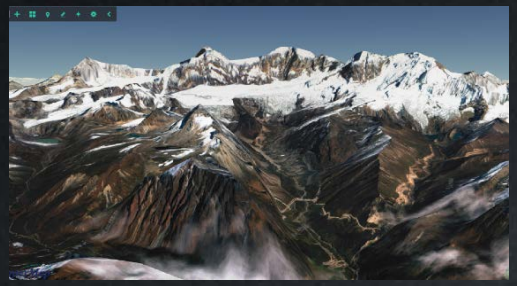
2. 3D Data Model System
3. Multi-source Data and Distributed Technology
4. 3D Data Standard

Multi-source Data



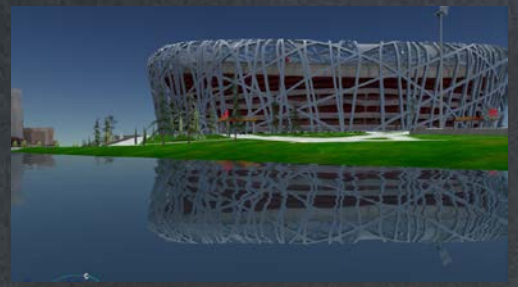
Terrain

Oblique Imagery

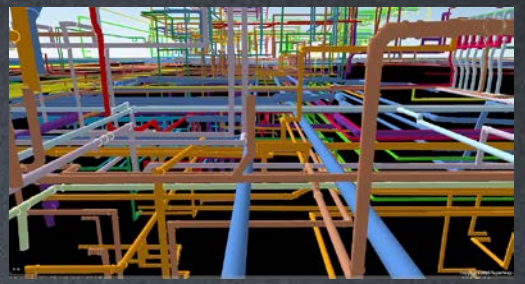
BIM

Points Cloud

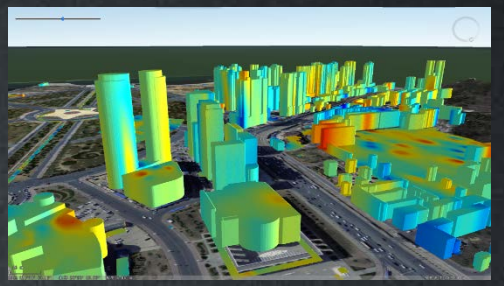
Fine Model



Water Surface



Pipelines



Filed Data

How to represent BIM in GIS?

AUTODESK REVIT

Bentley Advancing Infrastructure

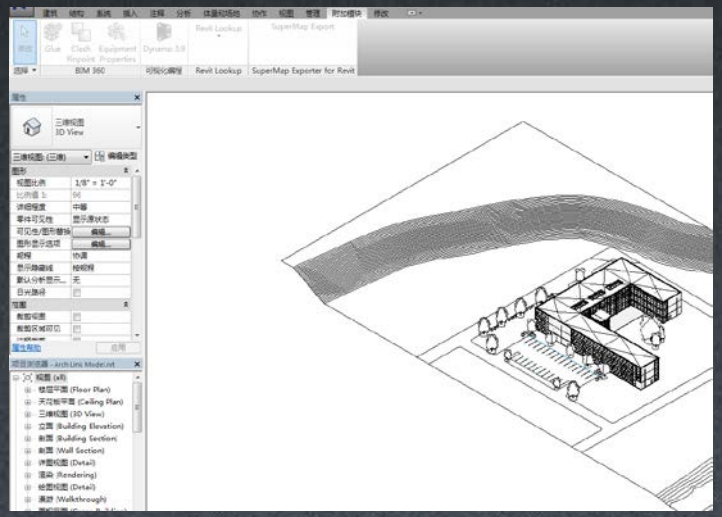
CATIA

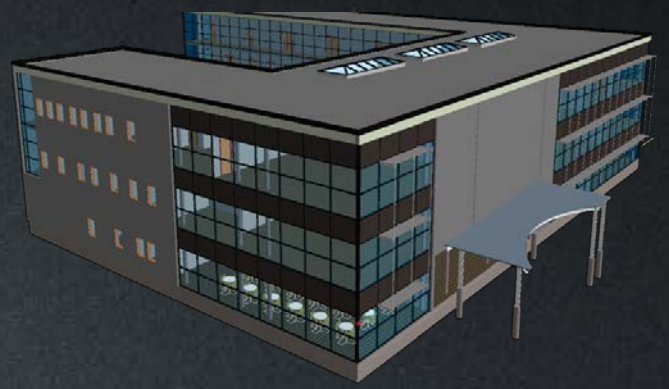
PKPM

AUTODESK CIVIL 3D

IFC

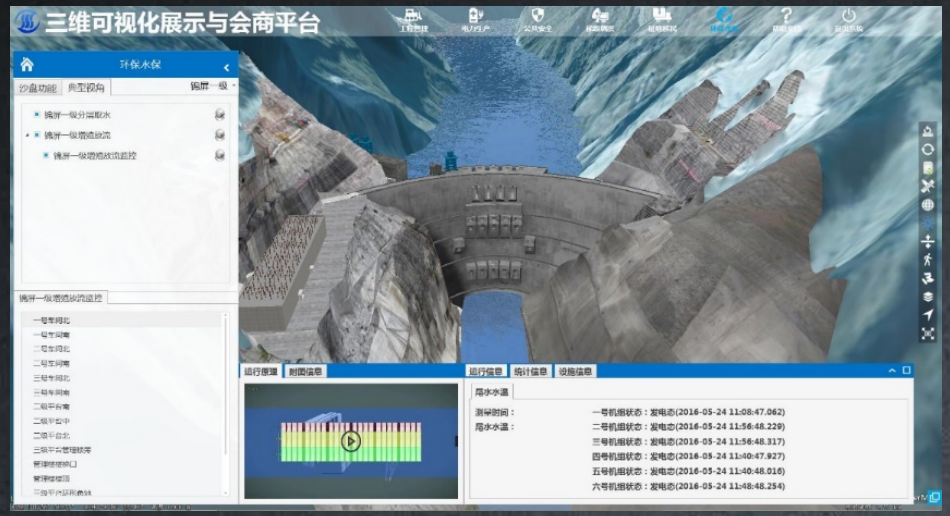
TEKLA new

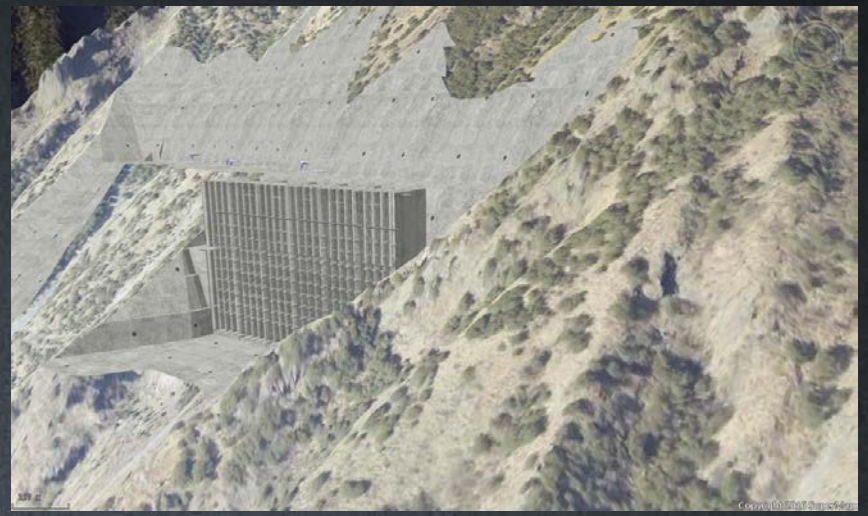




SuperMap

Integration of BIM, Oblique imagery and DEM





SuperMap

3D Data Integration

Coordinate transformation

- Points cloud, BIM and oblique imagery

Spatial calculation and operations for Terrain

- Polygon clipping, polygon holing
- Polygon modification for terrain (supports setting gentle slope)
- Boolean operations with 3D solid objects

Spatial computing and operation for oblique imagery

- Polygon clipping, polygon holing
- Polygon modification for terrain (supports setting gentle slope)

Multi-source heterogeneous data Integration

Oblique imagery with road model

Oblique imagery with terrain

Oblique imagery with BIM

BIM with terrain

From BIM to CIM empowered by GIS

- Establishing a unified coordinate system;
- Provide a base map for 2D and 3D integration;
- Manage the network of links between BIM monomers, such as roads, corridors and pipelines;
- Provide 3D spatial analysis and 3D spatial query capabilities;
- Provide BIM data management capabilities for large-scale buildings;
- Provide support for multiple terminals to fully meet CIM applications;

CIM
City
Information
Modeling

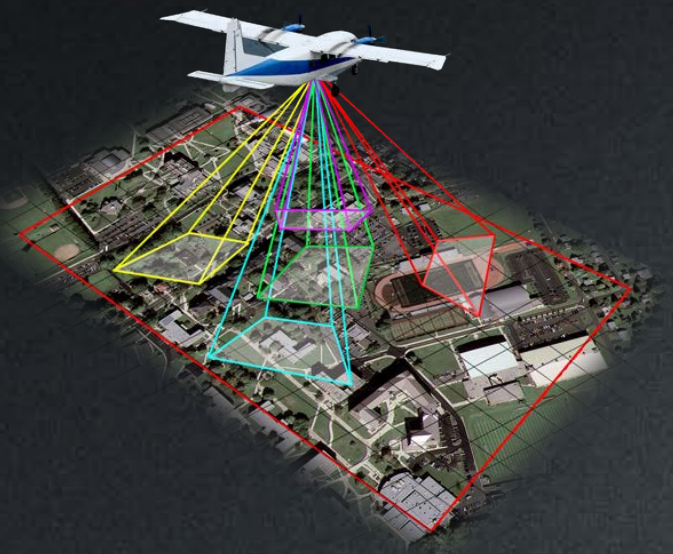
BIM
Building
Information
Modeling

+

GIS
Geographic
Information
System


中铁十一局集团有限公司
CHINA RAILWAY 11 BUREAU GROUP CO.,LTD.
中国铁建
DASSAULT SYSTEMES

Oblique Imagery

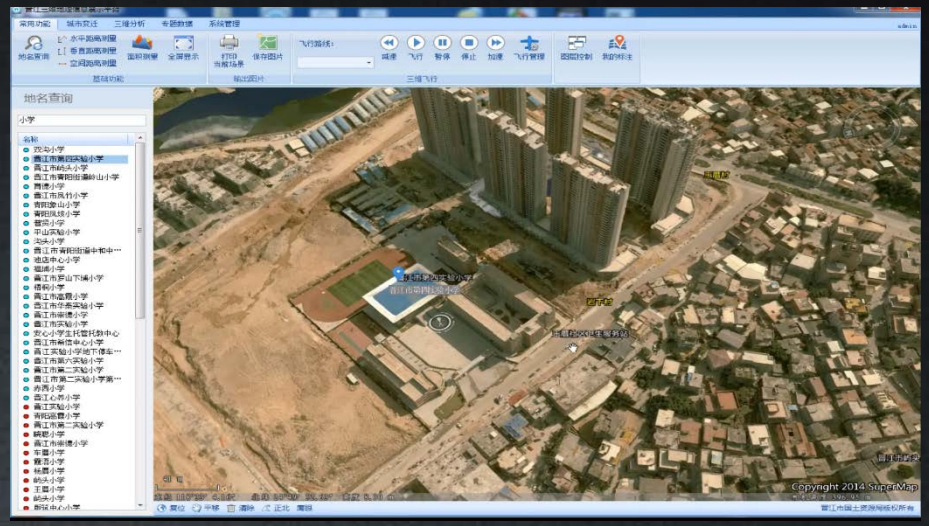


CC

Street Factory

…

OSGB



SuperMap 3D

SuperMap

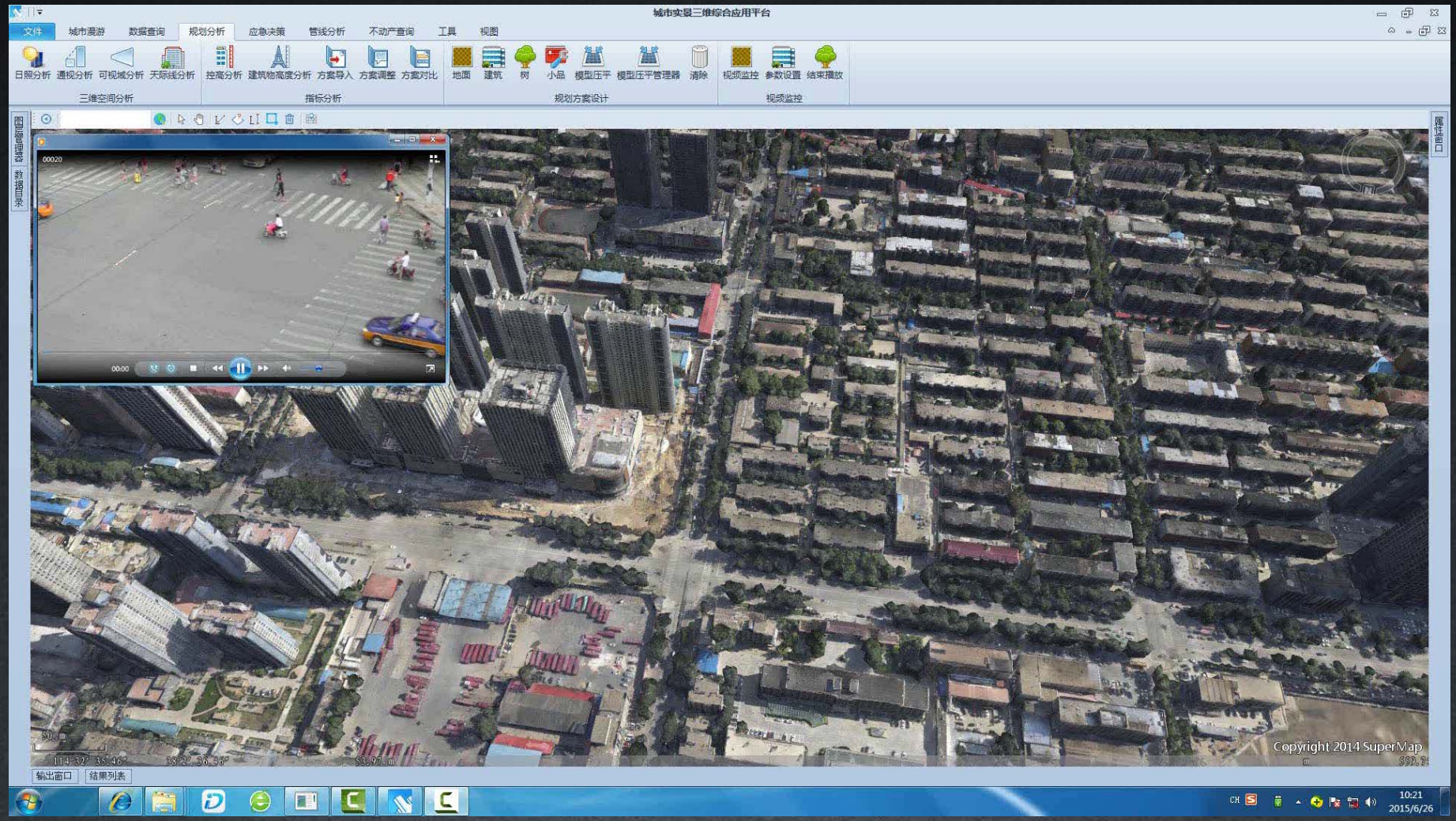
Challenge：Oblique imagery for objectified expression

Objectified expression

With vector plane

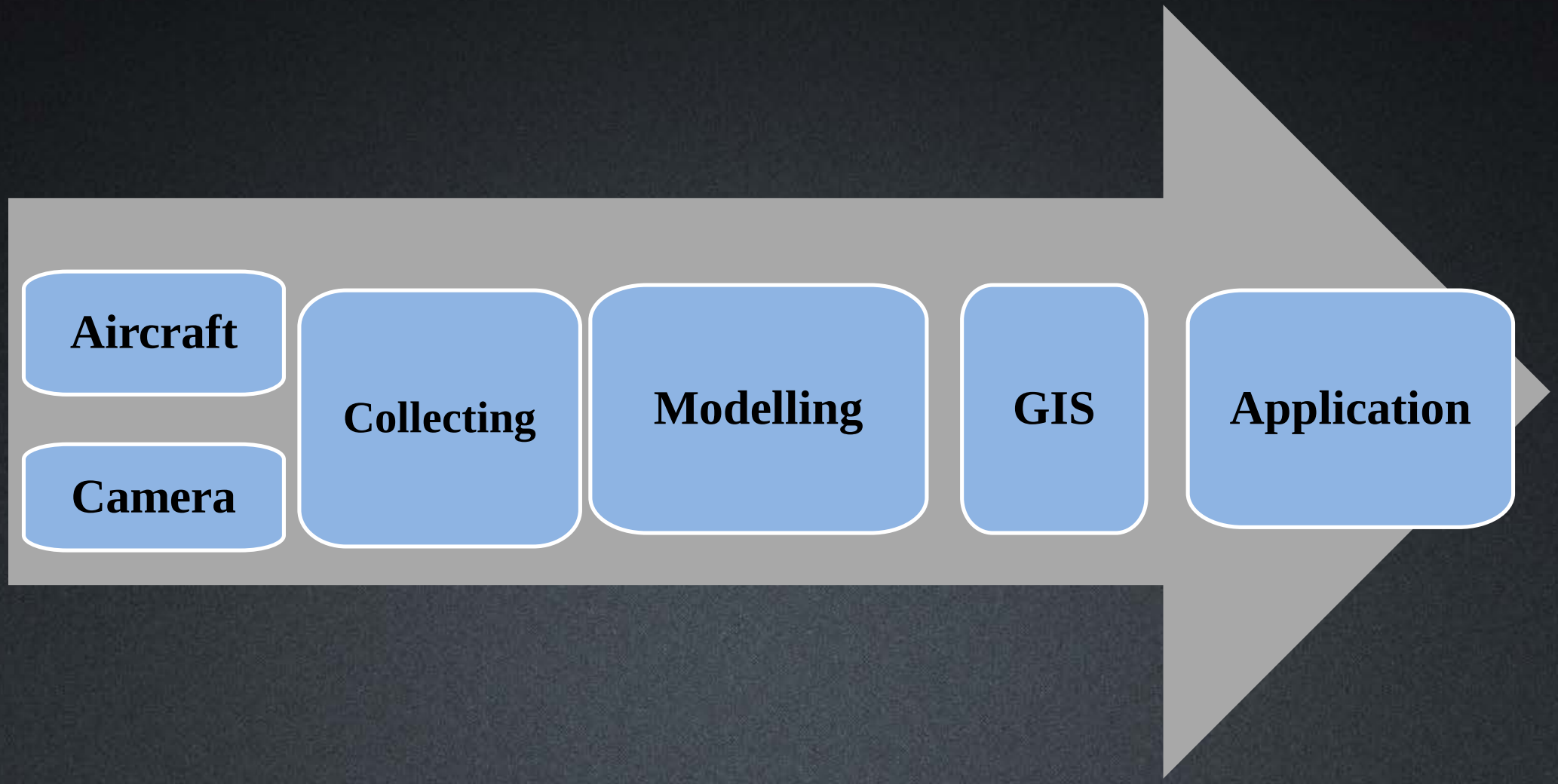
SuperMap

Overlaying video on Oblique Photography Data



SuperMap

Eco-system of Oblique Photography and GIS



DJI Terra

Oblique Imagery/
Points cloud(S3M)

SuperMap GIS

dji

SuperMap


杜觀
SuperMap

How to support the management and application for large-scale 3D data?

Processing problems of massive oblique photography data

oblique photography data (500 km^2)

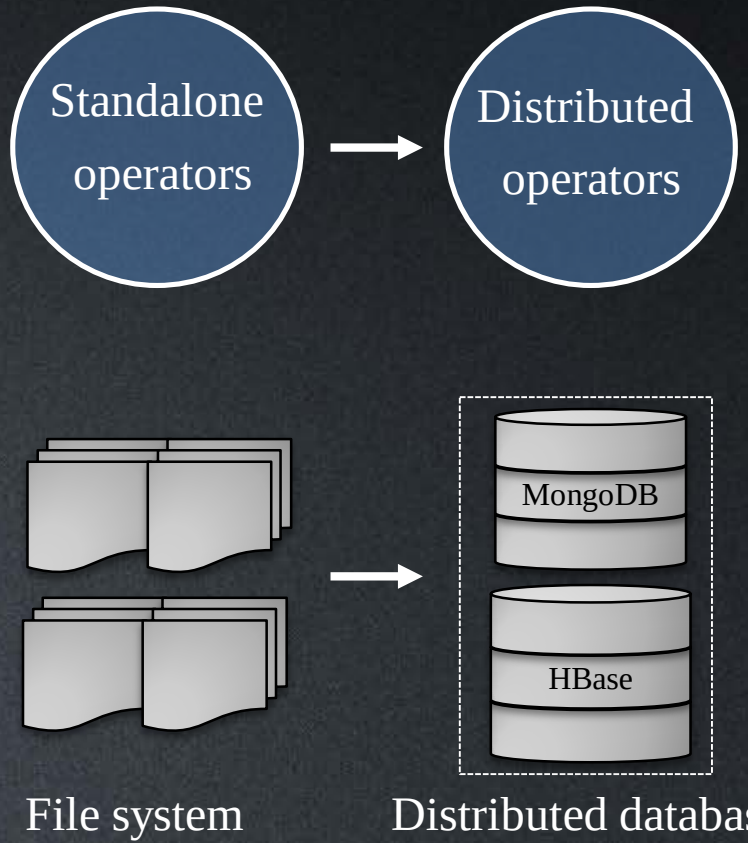
- 3 cm accuracy, 3TB, over 30 million files

Low processing efficiency

- Take several days to process TB level oblique photography data.

Limited storage management

- insufficient performance and scalability for relational database



SuperMap

Distributed processing of oblique photography data

292 GB
OSGB

Standalone Mode

21 hours

4CPU Core

Distributed Processing Mode

3 hours

6 nodes：4CPU Core（24CPU core）

6 times faster

Computing Capacity

7times faster

Performance

Acceleration ratio greater than 1, and scalable

Distributed computing accelerates the processing of point cloud data

180GB(las)

Standalone Mode

15 hours

4CPU Core

Distributed Processing Mode

2 hours

6 nodes：4CPU Core（24CPU core）

6 times faster

Computing Capacity

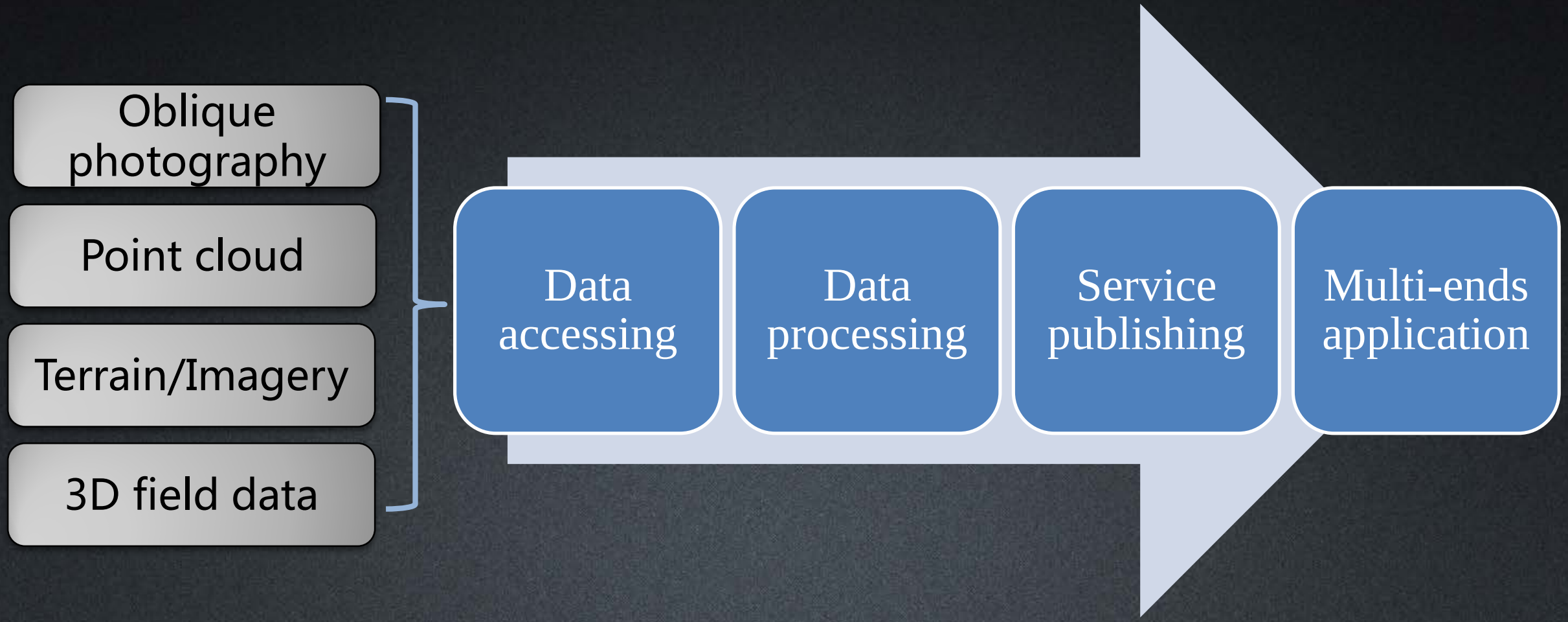
7times faster

Performance

Acceleration ratio greater than 1, and scalable

SuperMap

Efficient, full-process management capability on various 3D data



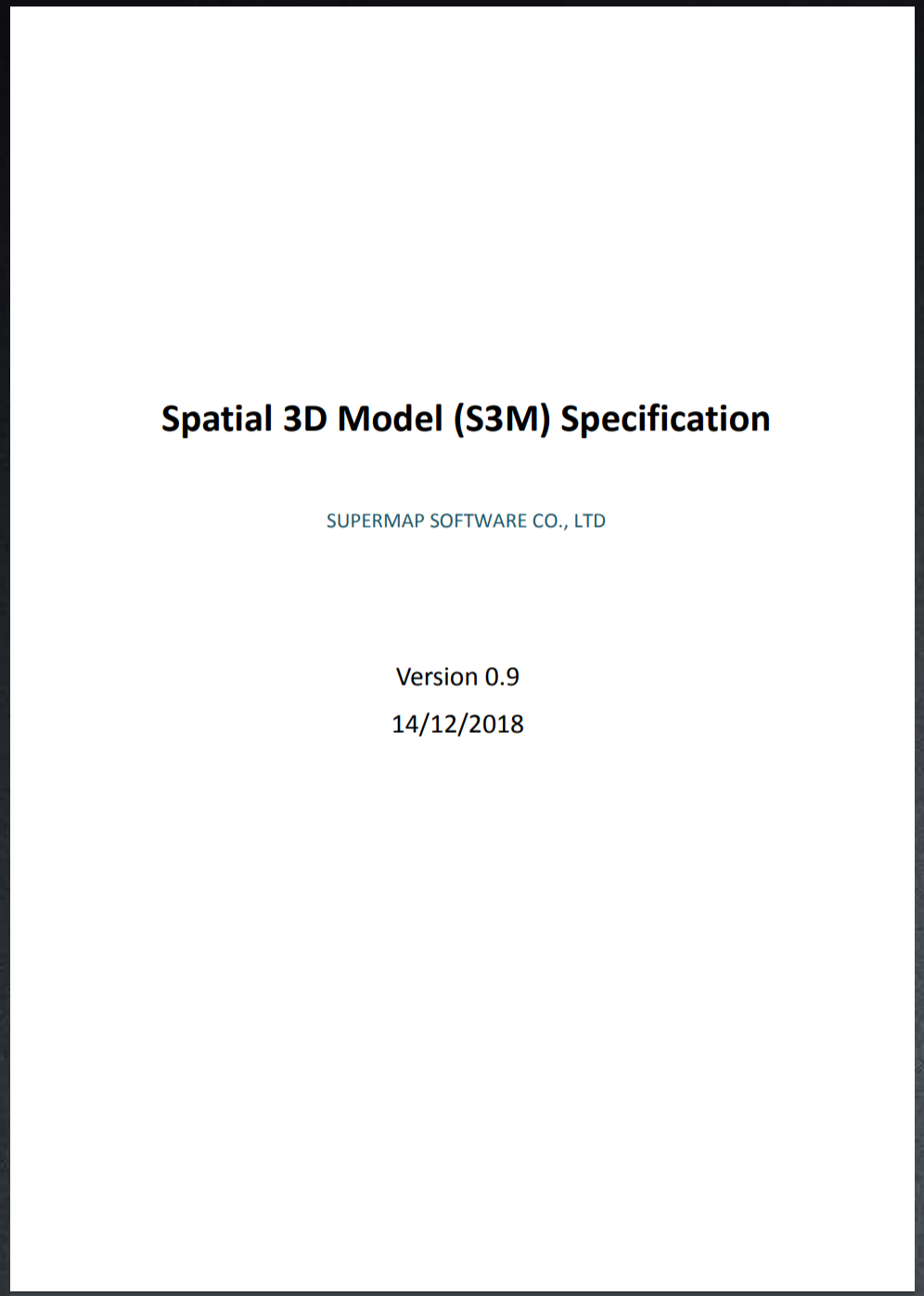
1. Interaction and Output
2. 3D Data Model System
3. Multi-source Data and Distributed Technology
4. 3D Data Standard

Open-source S3M

User requirements: Can SuperMap support the format conversion between S3M and 3D-Tiles?

We open-sourced S3M at GitHub in September of 2017

Provided an open data standard for 3D GIS



S3M officially published on 31st August of 2019

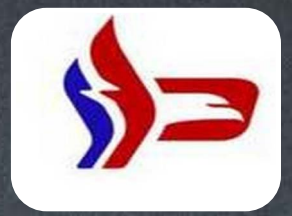
The first group standard in the national 3D GIS field published by China Association of Geographical Information System (CAGIS)

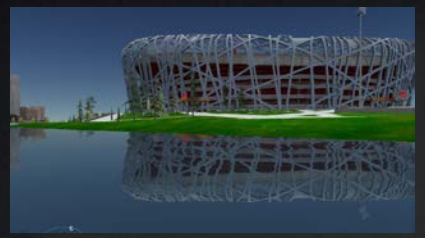
SuperMap

12 organizations involved

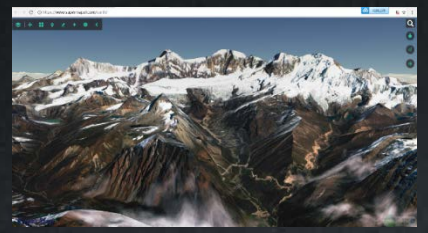




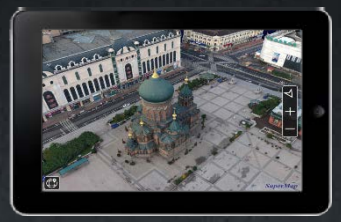


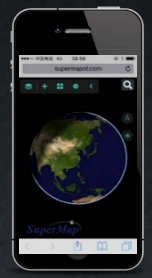
PC



Web



Pad



Cellphone

High efficient transmission and visualizing

3D GIS application for multi-ends

Spatial 3D Model data format (S3M)

Provides an open 3D data format standard for data sharing between different platforms

Oblique photography

Point cloud

Manual models

BIM

3D Pipelines

2D&3D Point, Line, Region

3D field data

…

Massive, multi-source 3D geospatial data

SuperMap

Free Data Access Tools

Establish an open community for S3M

S3M toolkit for data reading/writing (C++)

- Development tools, sample data, technical document

Data format conversion tool

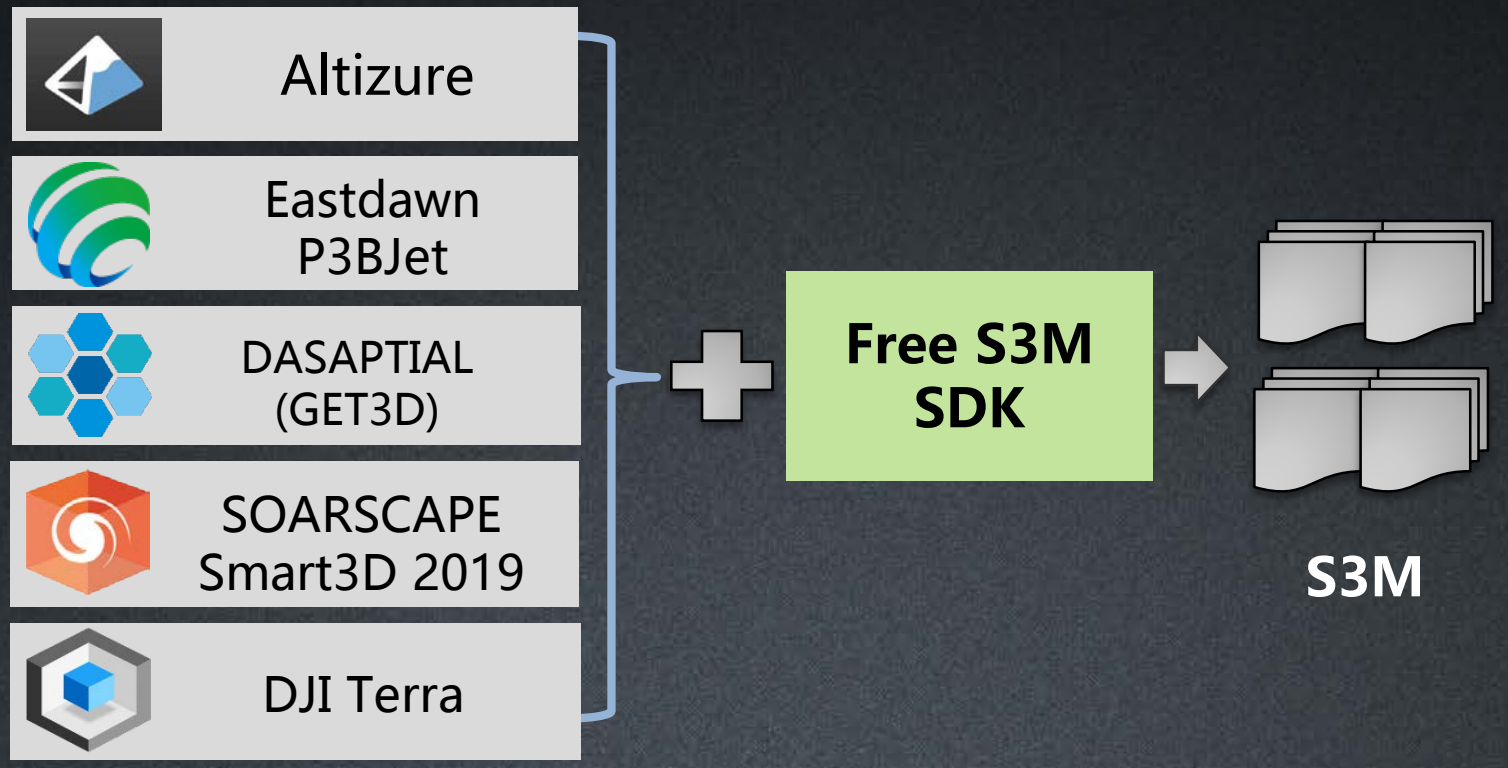
- Conversion tool for oblique photography model (OSGB, XML+OBJ)
- Conversion tool for 3D-Tiles to S3M

S3M reading SDK for Web-ends

- Sample codes, technical documents

SuperMap

More Software Supporting S3M Now



SuperMap

Establish an open community by OGDC

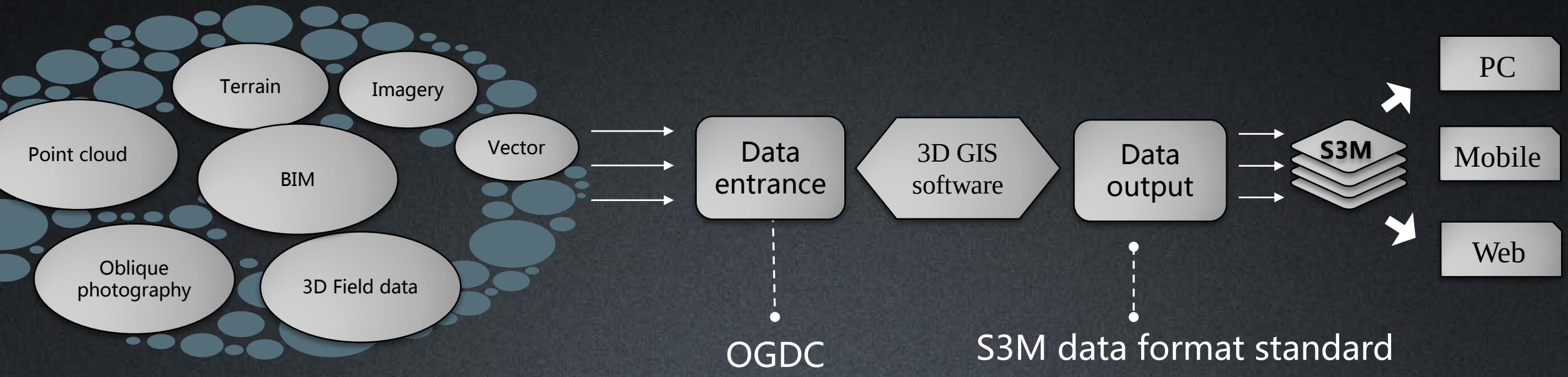
BIM, Geological data, etc → OGDC (free SDK) → SuperMap GIS

OGDC sample code：

1、 IFC importer

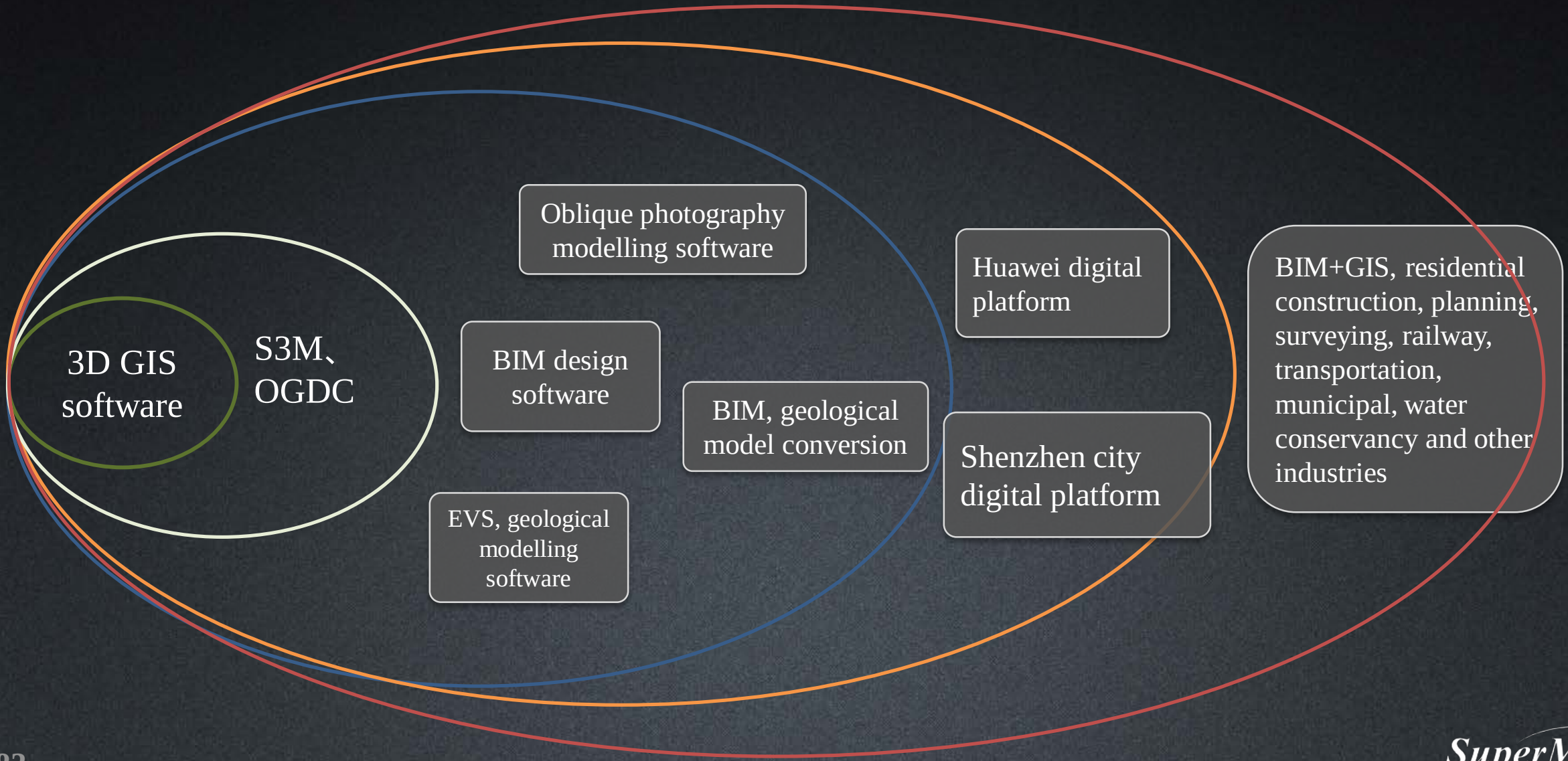
2、 3ds Max importer

Establish an open 3D GIS standard system



SuperMap

Open 3D data standard → Open 3D GIS eco-system



SuperMap

SuperMap

Thank You!

GIS Forum Online