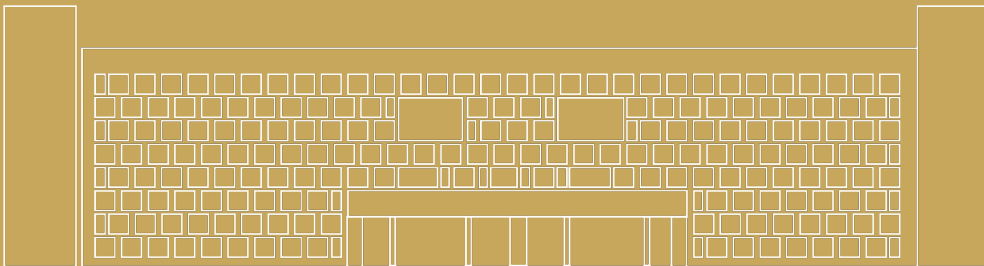


An interactive geospatial platform for earth environmental data visualization and real-time mathematical modeling



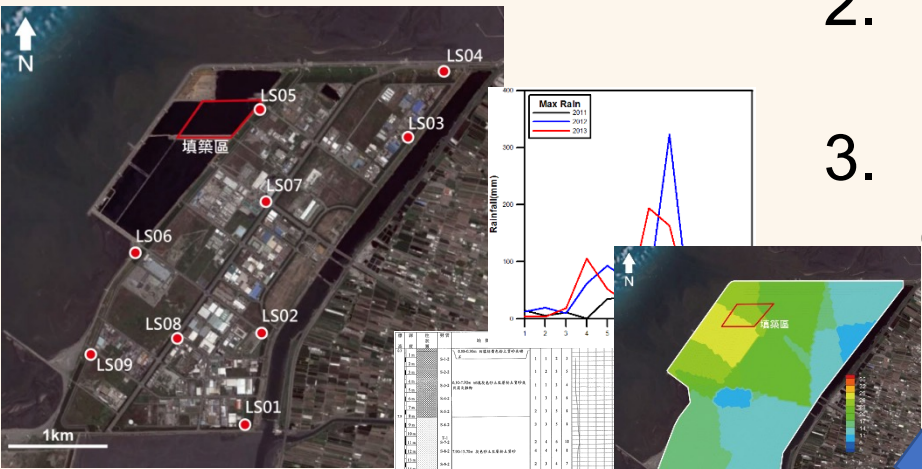
Chuen-Fa Ni, Ph.D., P.E.,
Professor and Director
Center for Environmental Studies, National Central
University, Taiwan

Dr. I-Hsien Lee and EASE working groups

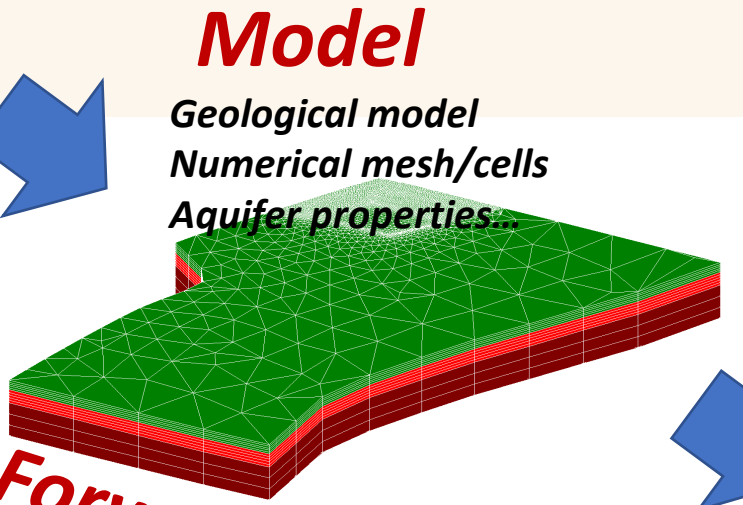


Motivations

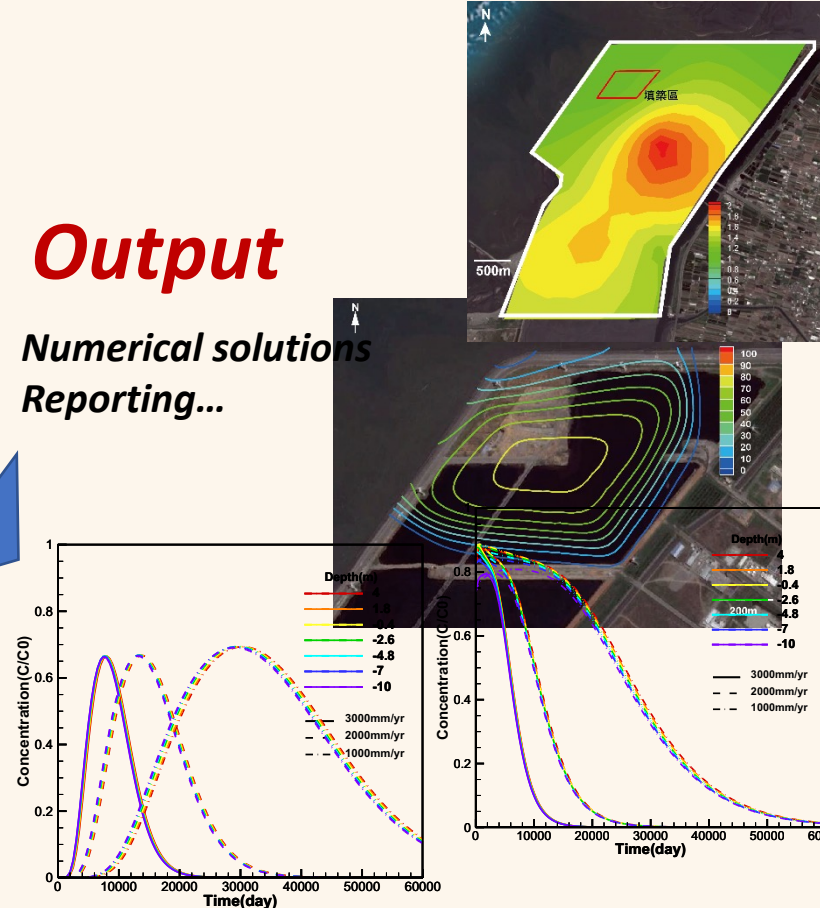
1. Maps are essential for the assessment & presentation throughout the entire workflow in modeling projects
2. Integrating online maps and models is beneficial to project management
3. 3D interactive visualization enhances the understanding of model results



Input
 Hydrological monitoring data
 Soil samples
 Field tests
 Surface /sea water samples and lab. tests

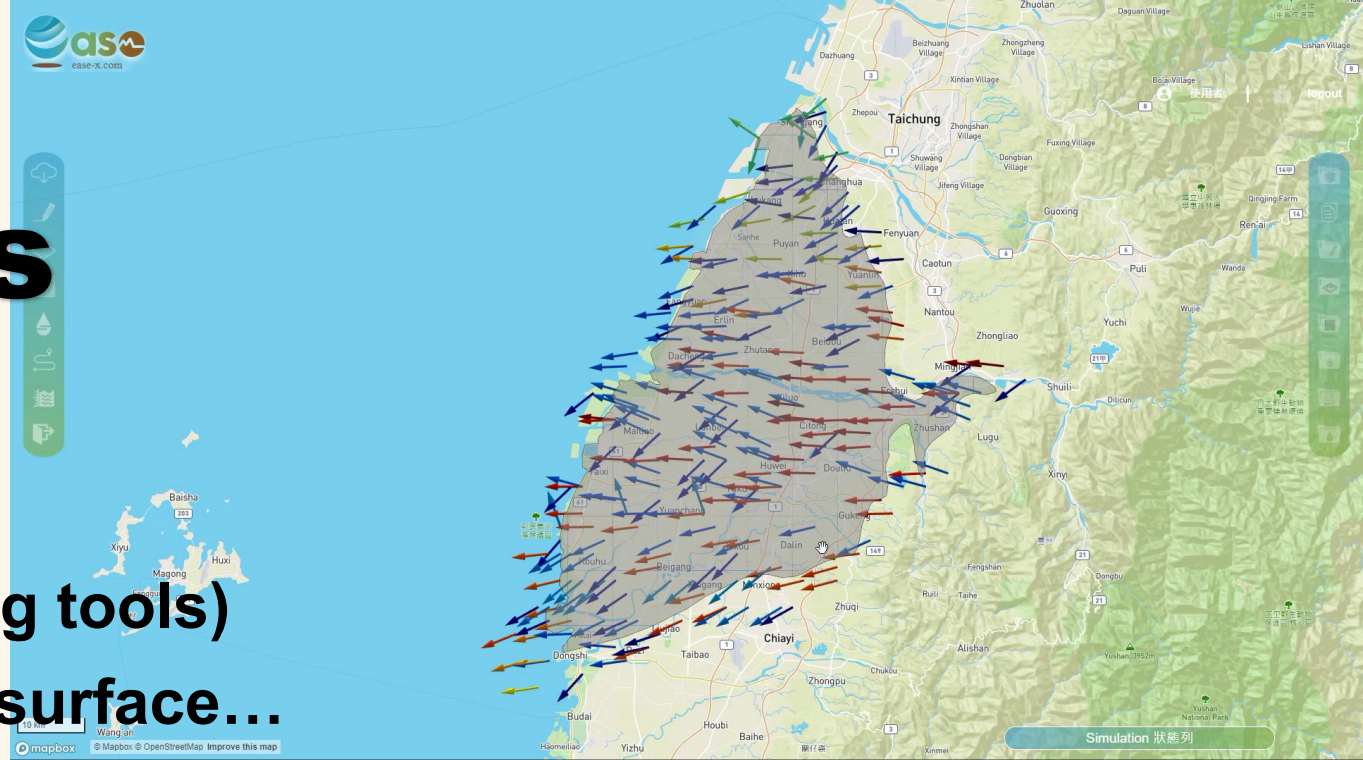


Output
 Numerical solutions
 Reporting...



Forward workflow
Inverse workflow

Tasks & Features



- Interactive Map
- 3D visualization (Professional plotting tools)
- Real 3D, including 3D mesh/cell, iso-surface...
- 3D physical model, machine learning, time series analysis...
- IoT-enabled data visualization (time series and animation)
- Open source
- Data sharing, project workspace,.... complex collaboration activities
Similar concept: Dropbox, Google Workspace, or Microsoft 365...

Available Monitoring Data (open) and Interactive Visualization (Taiwan)

<http://hydro.moeacgs.gov.tw/plain/>
CGS hydrogeological database, Taiwan

Database & Users

TGOS(Taiwan Geospatial One Stop), 開放地籍資訊平台

https://map.tgos.tw/TGOSCloud/Web/Map/TGOSViewer_Map.aspx?switch=y



Water Resource Agency, Taiwan

<https://gic.wra.gov.tw/Gis/Map>

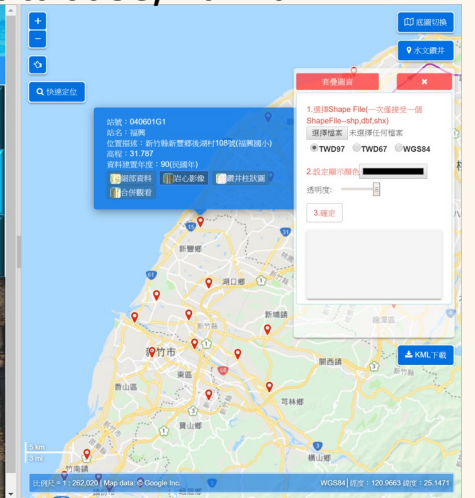


Soil & Groundwater Remediation, Taiwan

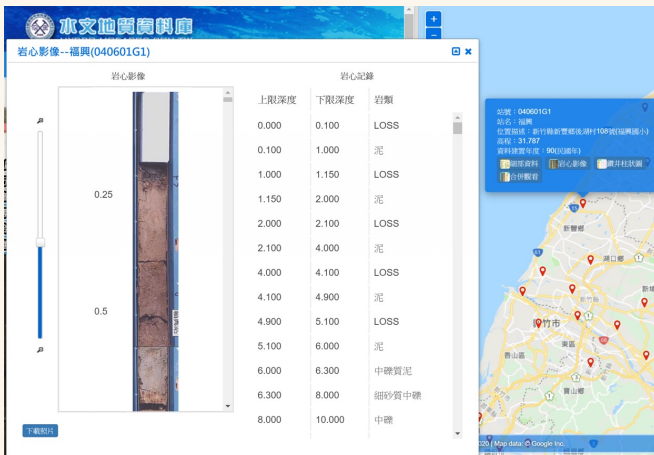
<https://sgw.epa.gov.tw/public/>

<https://wq.epa.gov.tw/Code/Default.aspx?Water=Gdwater>

EPA, Taiwan

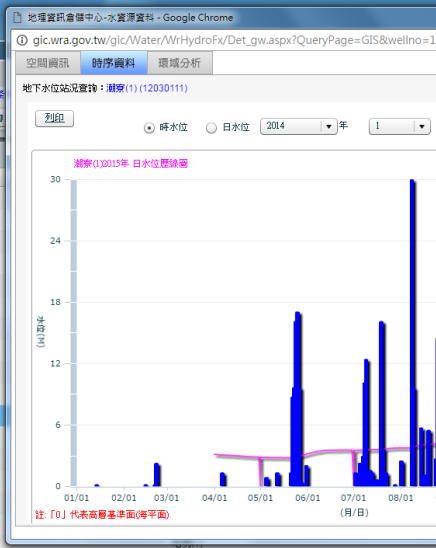


Online Analysis Tools → Data filtering & visualization



即時水情

縣市	站名	單位	量測項目	量測值	備註
桃園市	蘆竹	桃園市	局屬無人測站	6.4 mm	定位
桃園市	國一五	桃園市	局屬無人測站	34 mm	定位
桃園市	龜山	桃園市	局屬無人測站	17 mm	定位
桃園市	埔心	桃園市	局屬無人測站	16 mm	定位
桃園市	觀音	桃園市	局屬無人測站	16 mm	定位
桃園市	龍巖社	桃園市	局屬無人測站	15.5 mm	定位
桃園市	中壢	桃園市	局屬無人測站	15 mm	定位
桃園市	農工中心	桃園市	局屬無人測站	9 mm	定位
桃園市	八德	桃園市	局屬無人測站	8 mm	定位
桃園市	中央大學	桃園市	局屬無人測站	7.5 mm	定位
桃園市	新屋	桃園市	局屬無人測站	6.5 mm	定位
桃園市	大溪永福	桃園市	局屬無人測站	6.5 mm	定位



空間分析

請於地圖上選取兩點以上點位，雙擊後點選分析按鈕即可進行地形剖面分析。

選取長度需小於 10,000 公尺

起始點位:

結束點位:

數值資料: TW DLA 92-94 20M DEM

推估間隔: 100 10-100 公尺

分析

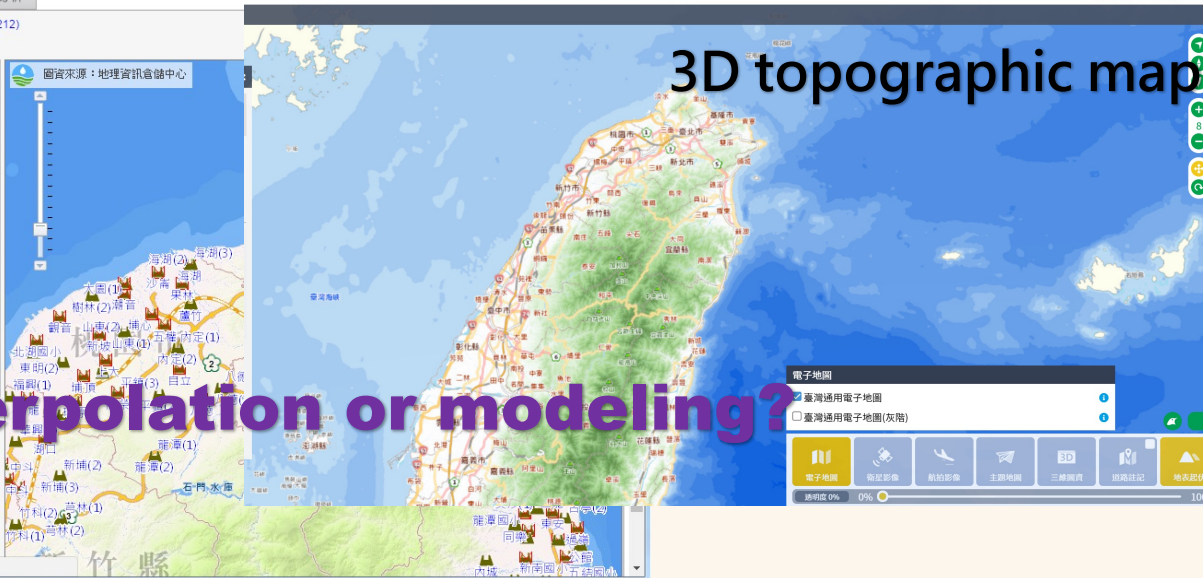
Real-time time series data!

Filtering and data extraction!



Buffering!!!

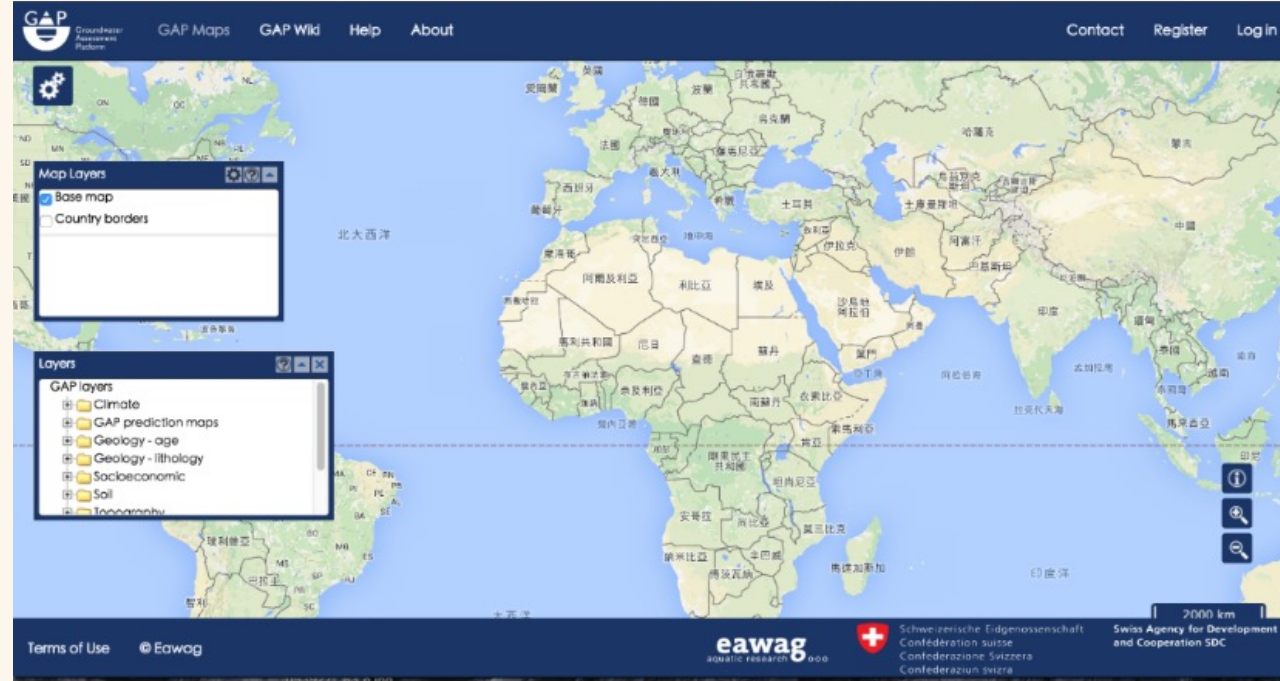
How about online interpolation or modeling?



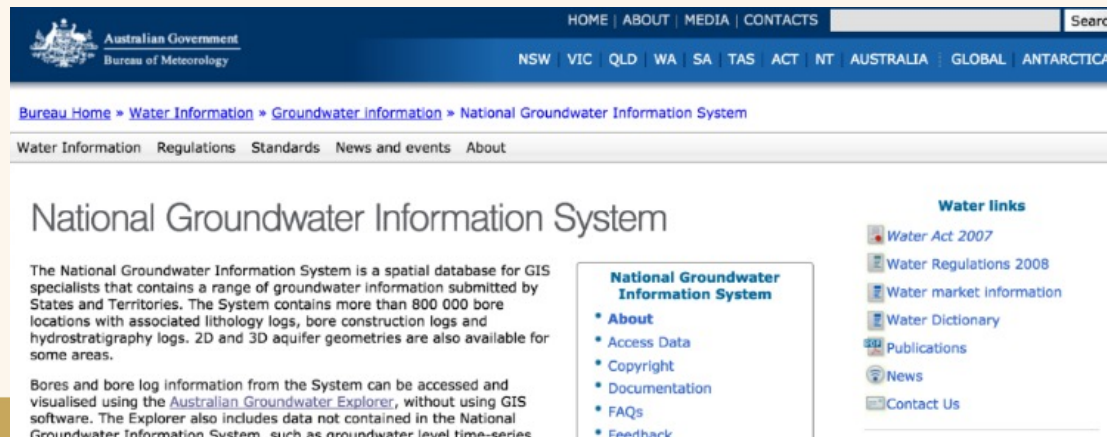
Data source : <http://gic.wra.gov.tw/gic/Water/Space/Main.aspx>

Other cases

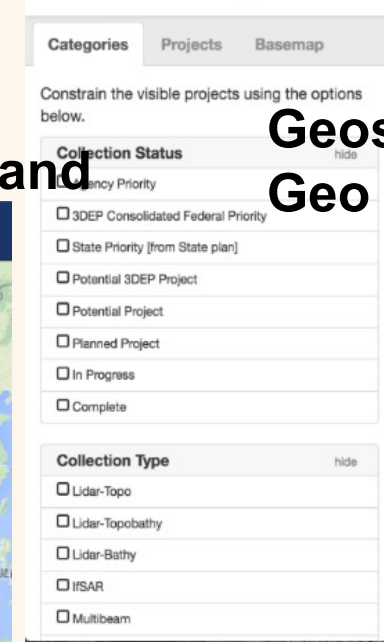
Groundwater Assessment Platform, GAP, Switzerland



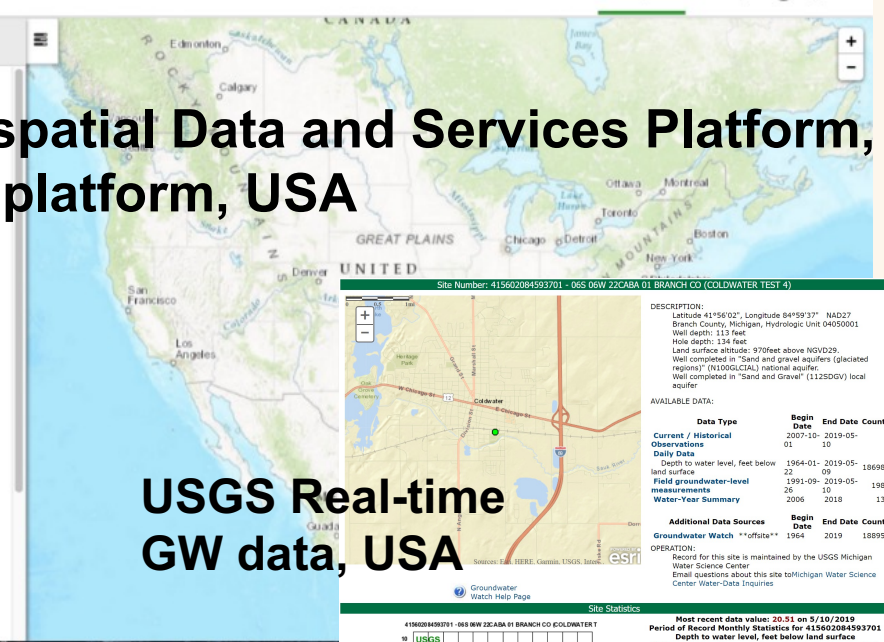
National Groundwater Information System, Australia



GeoPlatform Marketplace Preview

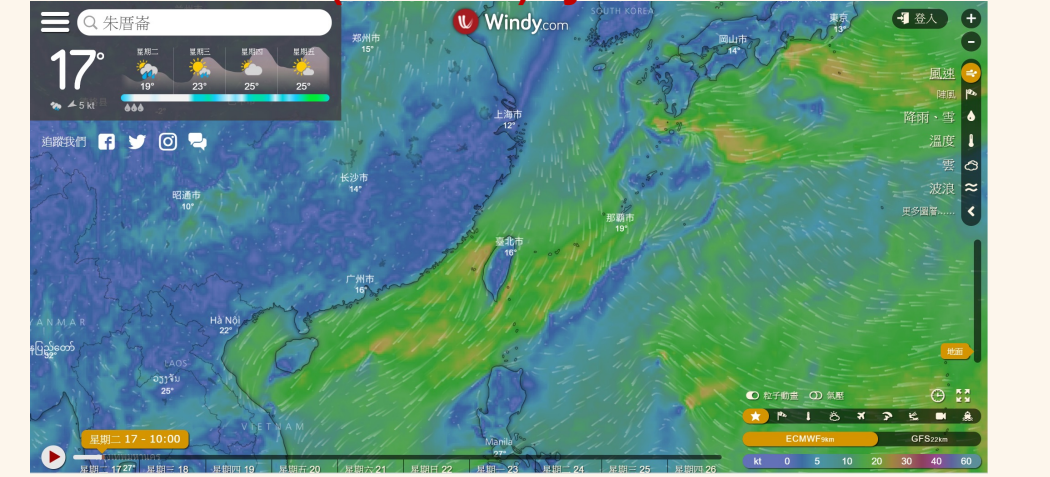


Geospatial Data and Services Platform, Geo platform, USA



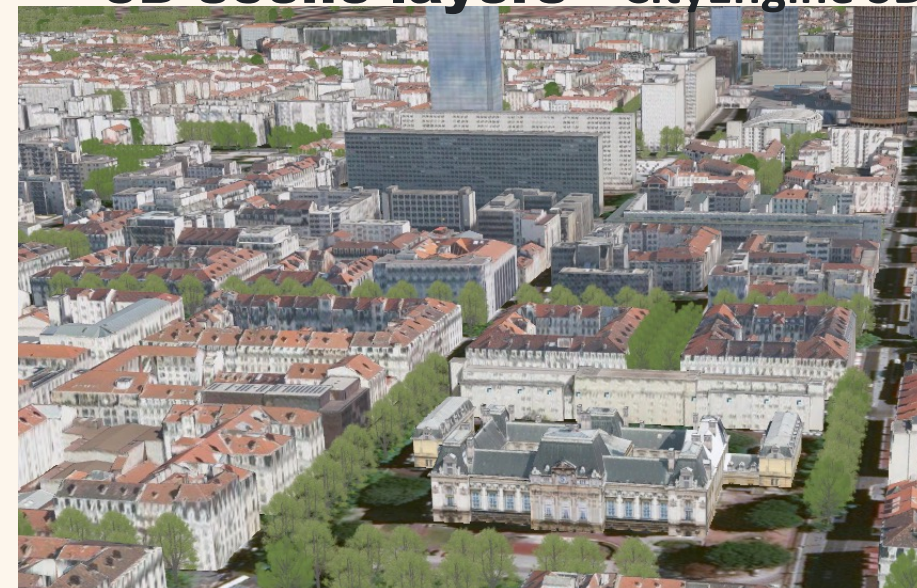
USGS Real-time GW data, USA

Windy.com (Pseudo)dynamic visualization!



Potential Solution for 3D Objects on a Map

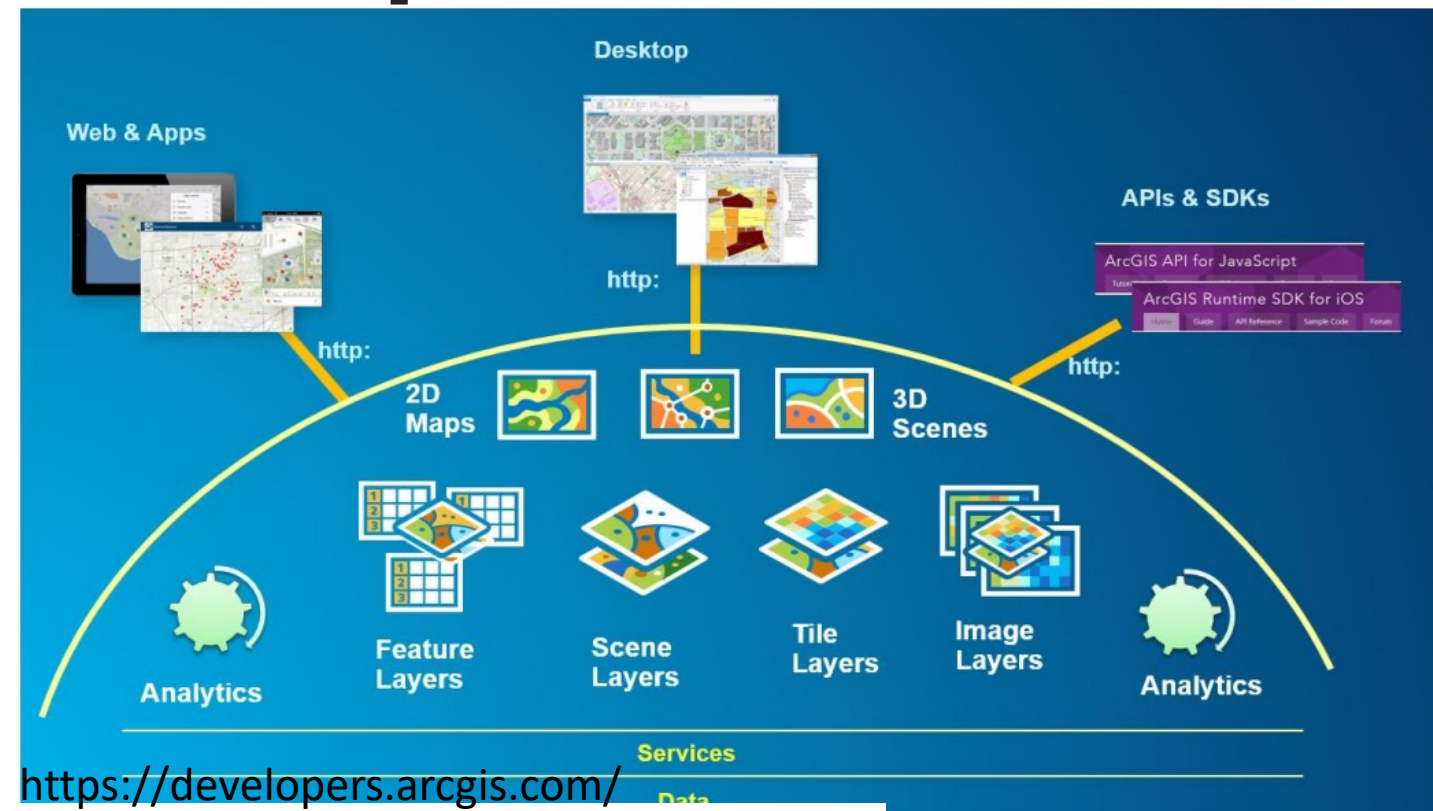
3D scene layers - CityEngine SDK



Realistic 3D Object Scene Layer w/wo textures



https://github.com/Esri/i3s-spec/blob/master/docs/1.9/3Dobject_ReadMe.md



<https://developers.arcgis.com/>

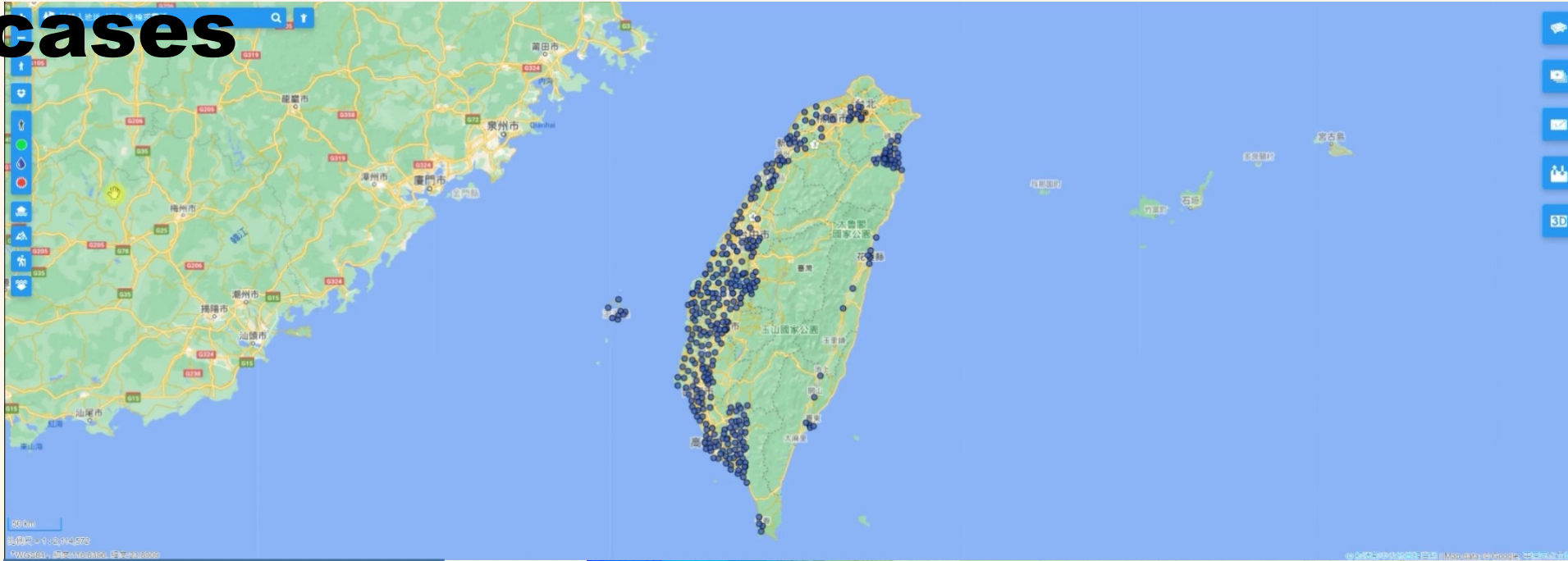
UAV + BIM + 3D GIS

Integration and application of Building Information Modeling (BIM) and 3D GIS, Architecture and building research Institute, MOI, Taiwan



2-5 May 2023, Rotterdam, The Netherlands

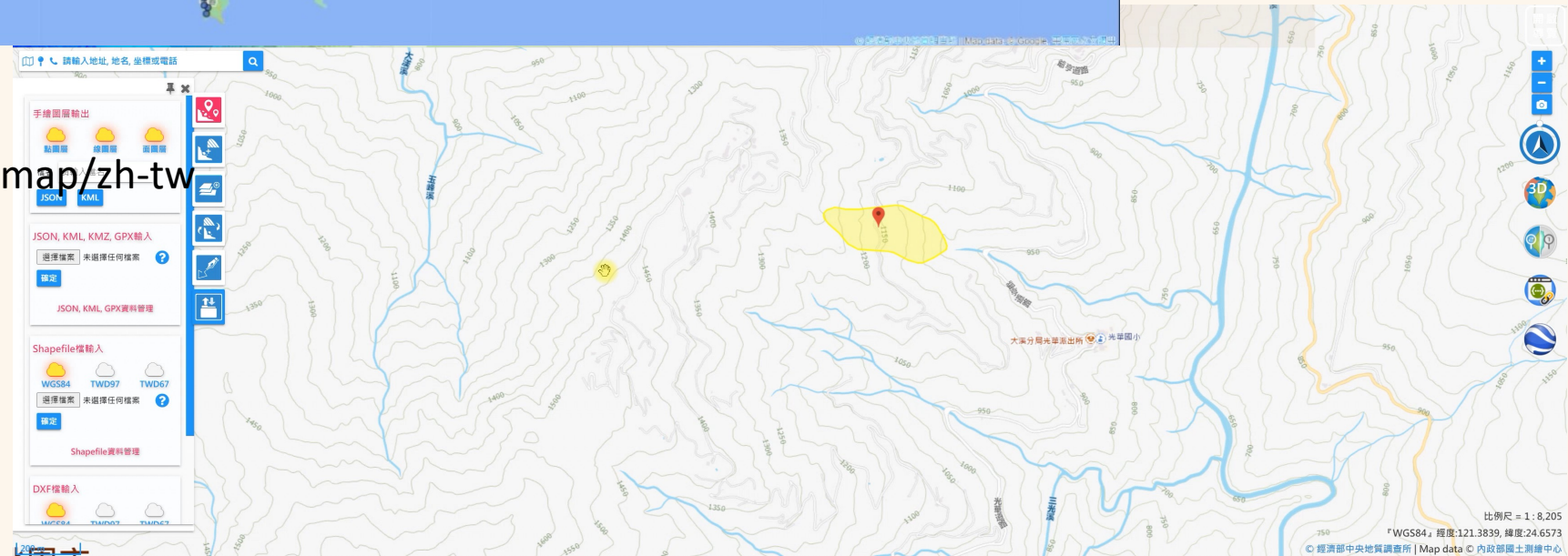
3D Online, Interactive visualization – Taiwan's cases



Geological data cloud

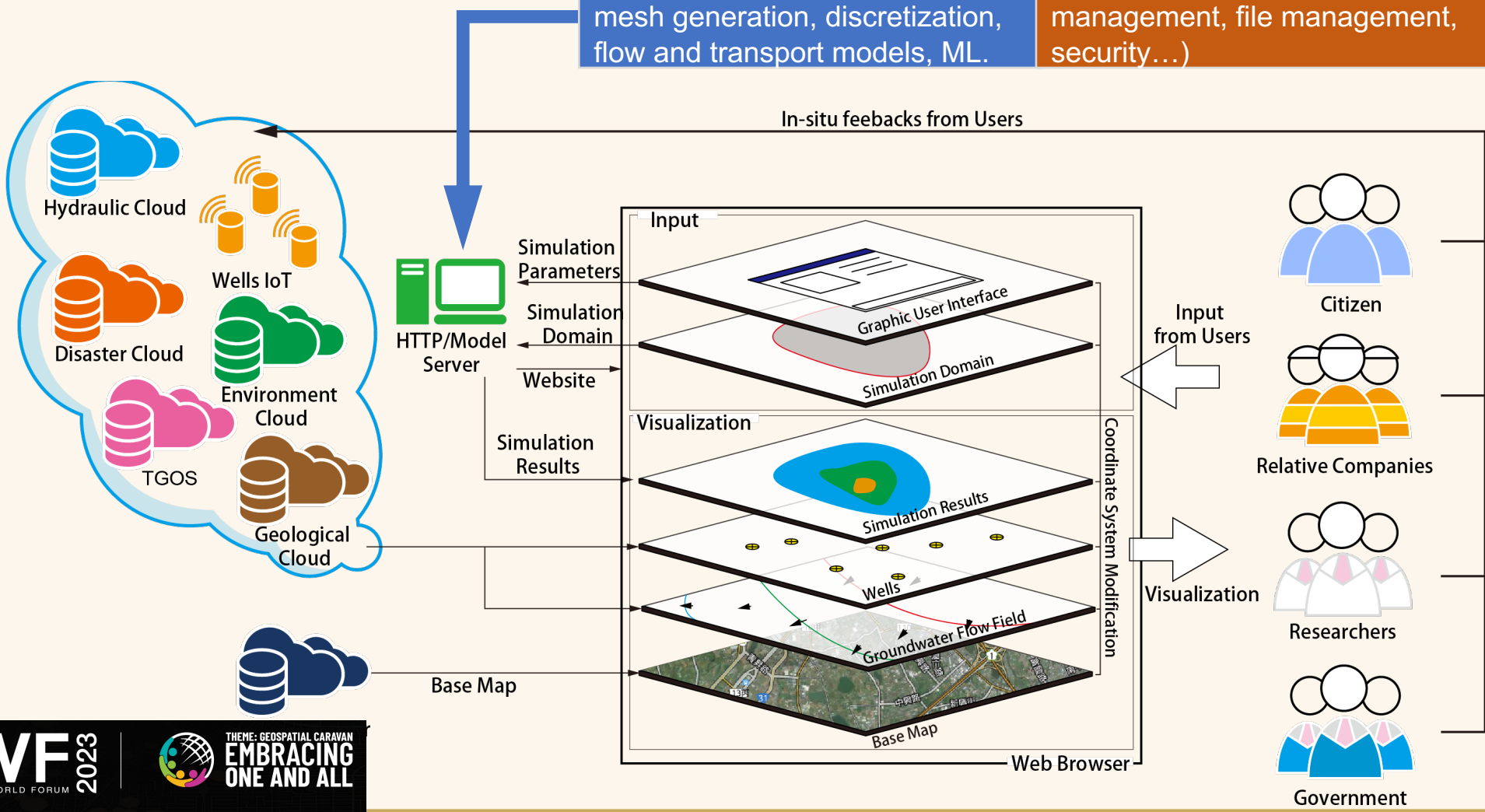
<https://landslide.geologycloud.tw/map/zh-tw>

Cut an area of the map for a 3D scene



The Idea of Our Web-based Modeling & Visualization Framework

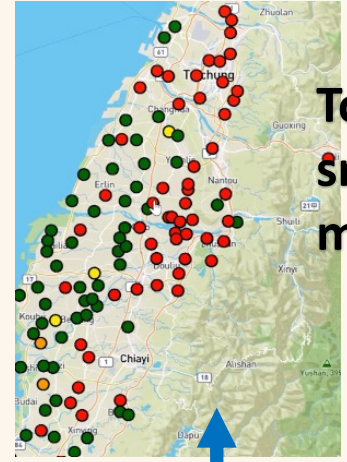
Data format, coordinate system converter, base map.	Output format, coordinate system converter, real-time visualization
Data analysis, particle tracking, mesh generation, discretization, flow and transport models, ML.	UI/UX (2D/3Dvisualization, layer management, file management, security...)



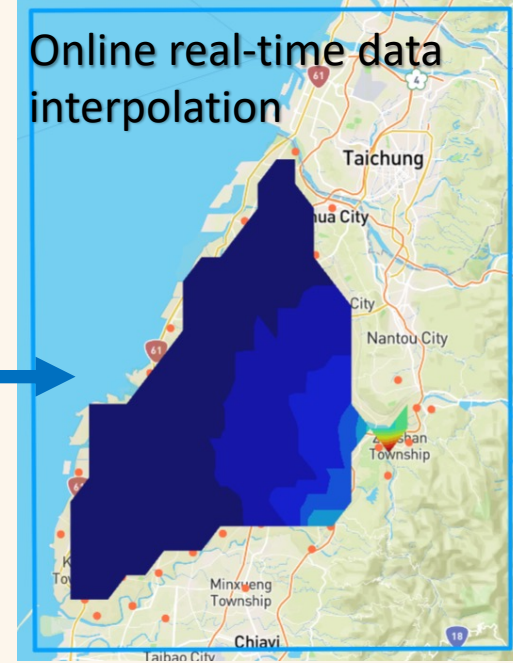
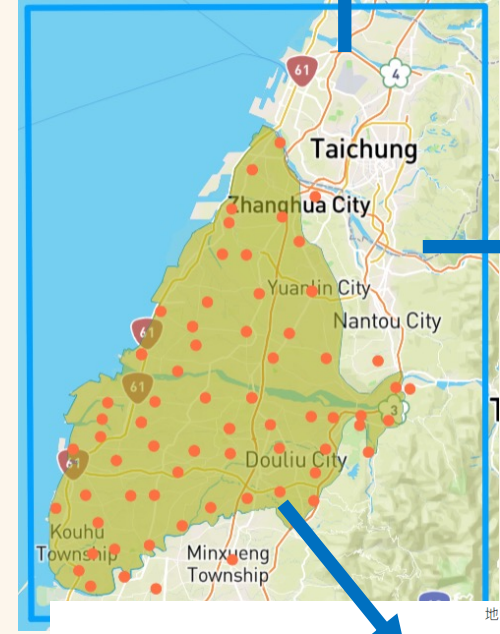
AIoT and more



- The platform provides easy access to connect types of IoT devices on a map project.
- Editable functions, user-defined interpolation models, and AI/ML algorithms are available to improve the professional visualization.



Total solution for smart monitoring and management



NB-IoT, 3G, 4G..

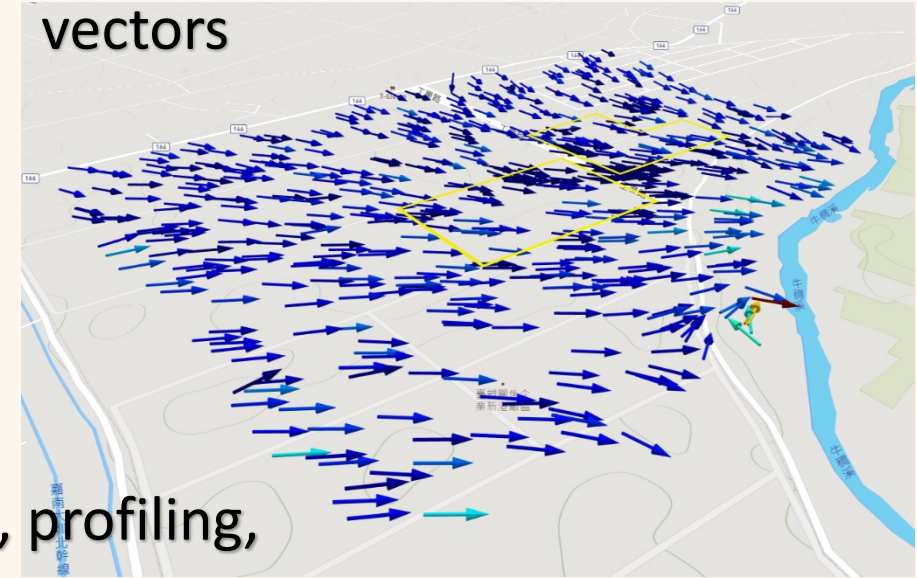


3D map + professional visualization



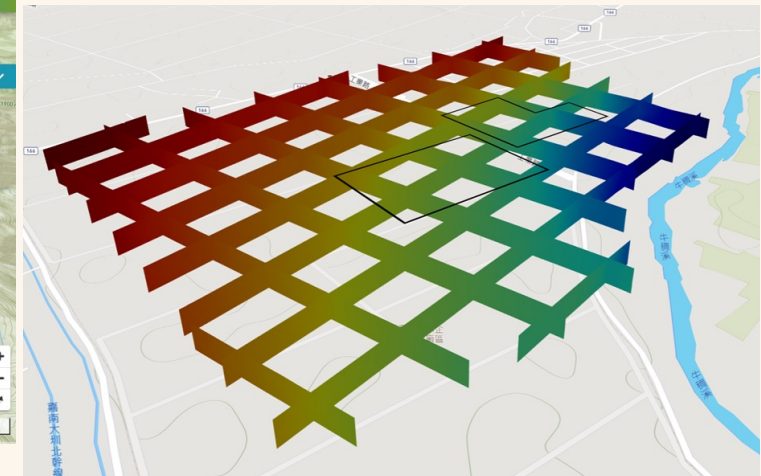
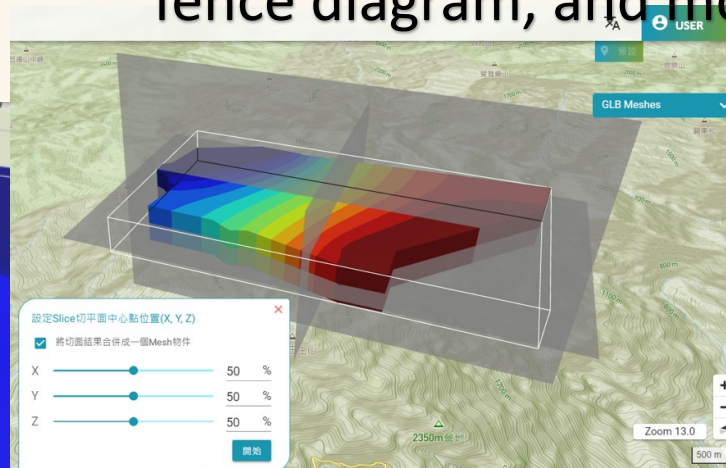
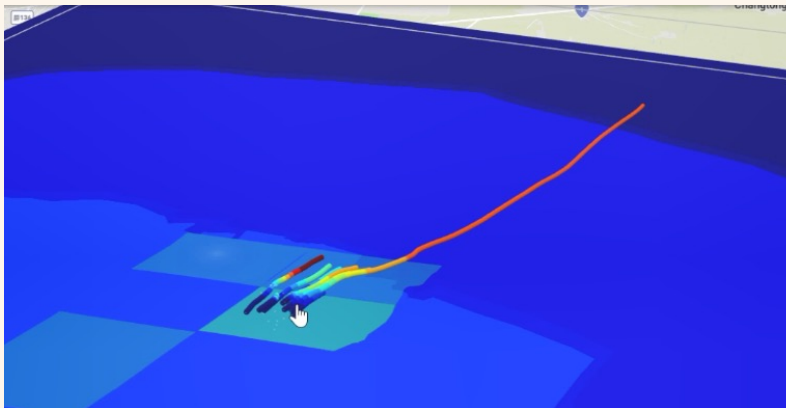
- The advanced 3D interactive visualization modules enable professional presentation for multiple data types on map projects.
- Interactive and professional plotting features make real-time adjustments feasible.

3D high-resolution velocity vectors



Interactive visualization, profiling, fence diagram, and more

3D particle traces and tubes



NEW PROJECT

Project workspace

OWNER PROJECTS

JOINED PROJECTS

A grid of project cards, each with a green header and a list icon. The cards are:

- 核研所 (8dadf040-d417-455f-a14f-db...)
- 台塑第四工場 (f0117f5c-b343-4bdb-8997-82...)
- 水保局蘭台 (540d5647-9c16-4516-90c5-1...)
- 台塑新港 (e8b1bf6e-937b-464a-866d-16...)
- TaiCoast_NCU (f18244d1-e487-4979-bdaa-6e...)
- 工研院CO2灌注 (f3d26306-1766-4ce6-9081-8c...)

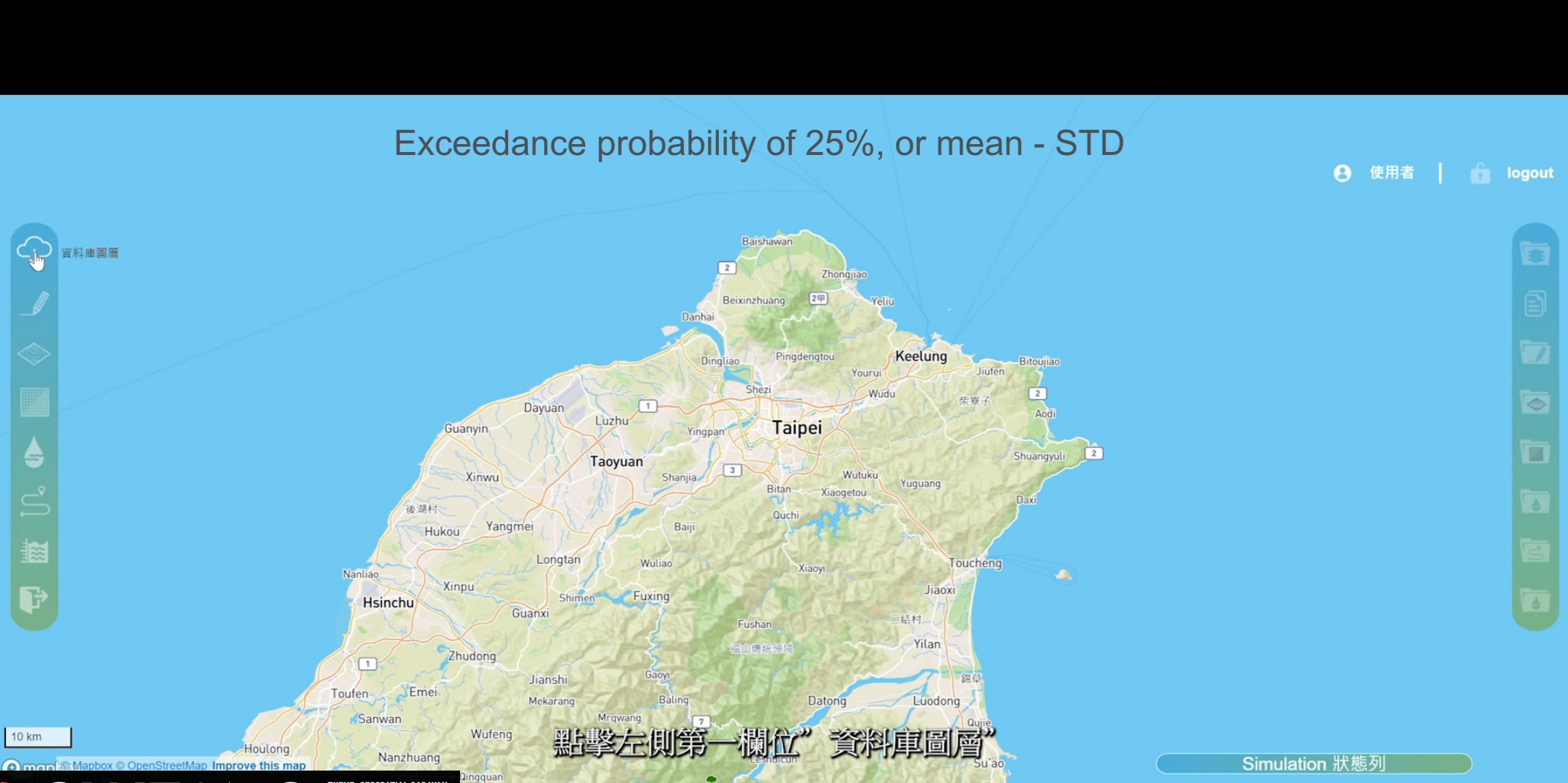


Two overlapping modal forms. The 'New Project' form has a blue header, a text input with 'Test1', a text area with 'This is a test project', and a 'CANCEL' button. The 'New Team' form has a blue header, a 'Team name' input with 'Test new team', and an 'Add your team members' button.

Few clicks to create teams and collaborative projects

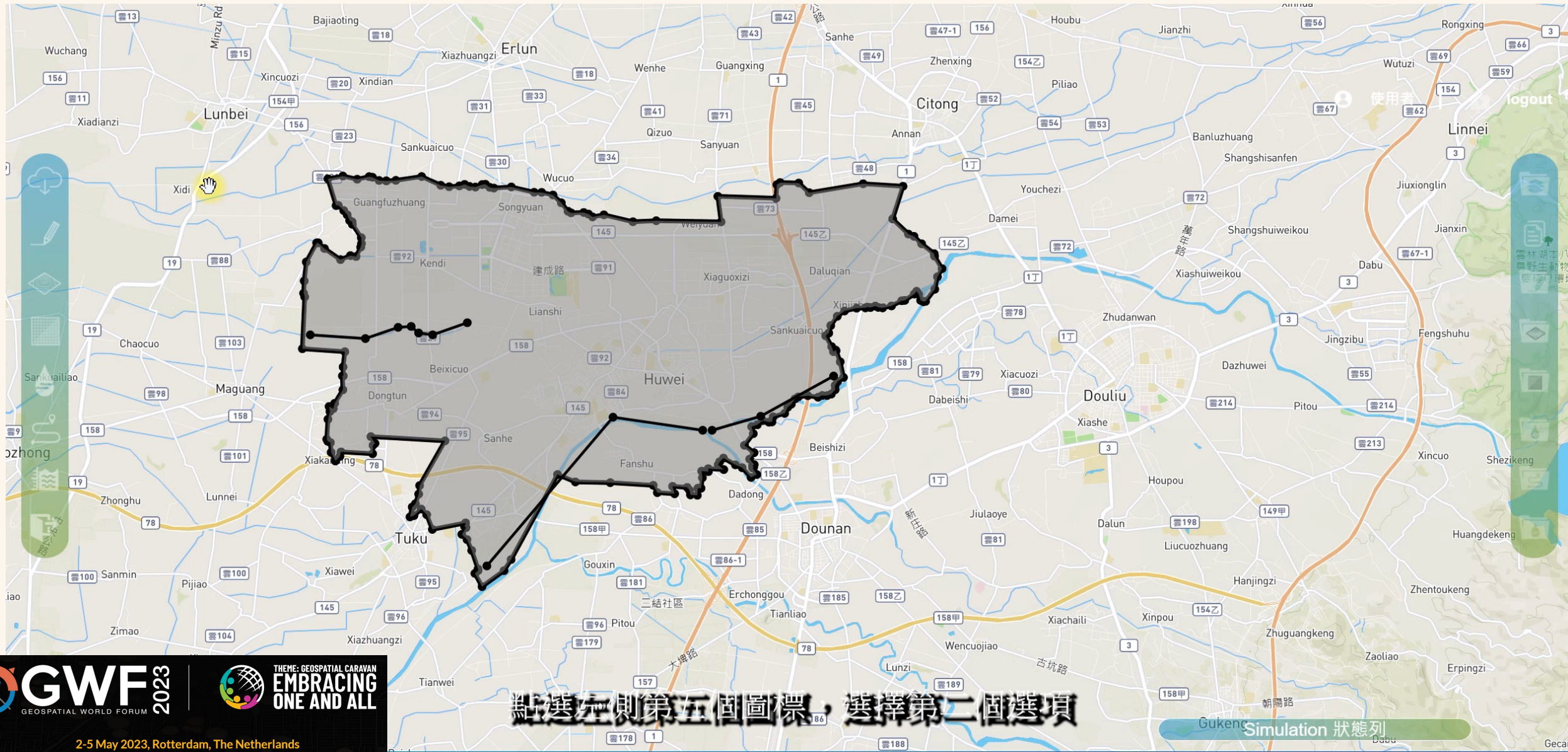
Two overlapping modals. The 'invite Members' modal shows a search bar and a list of email addresses: 091176183..., 86194096..., a01, a02, a03, a04, a05, a06, a07. The 'Data Authority Management' modal shows a dropdown for 'Test new team' with '3 Members' and a 'Data Authority' table with 'Test new team' and 'Guest' roles.

Groundwater Management



點擊左側第一欄位“資料庫圖層”

Online numerical modeling and visualization



Online pollution tracking

ase
8888-2.com

檔案總管 數據加值 動畫管理 手繪工具

SFDF327

資料夾 Folder

- 01 農試所

地圖集 Documents

- 01 farm02
- 01 con001.glb
- 02 測試溶質傳輸
 - 01 質點傳輸.glb
 - 02 農田.json
 - 03 穩態地下水流場.glb

載入2D圖資

Zoom 13.5

Mapbox OpenStreetMap Improve this map

Challenges & Remain issues

- **Technical solutions for Interactive Map, 3D visualization, 3D mesh/cell, iso-surface...**
- **3D physical model, machine learning, IoT-enabled data visualization (time series and animation)**
- **Data sharing, project workspace for collaboration activities**
- **Underground visualization integrated with map
→ layers vs. 3D**
- **3D scenes for real-time interactive visualization, especially for time-varied (transient) simulations**
- **Other fields: surface water, oceanic sciences, air pollution, and geophysical surveys..**

Thank you.

- ◆ Email: nichuenfa@geo.ncu.edu.tw
- ◆ Tel: +886-3-4227151 ext. 65874
- ◆ Fax: +886-3-4263127



CONTACT/JOIN US

