



2014 GDI APAC



Incorporating Multi-Source Technology into National Land Monitoring and Mapping to Support National Infrastructure and Administration

National Land Surveying and Mapping Center
Taiwan
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Outline



- Preface
- National Land Monitoring
- National Mapping Projects
- Unmanned Aircraft System (UAS)
- Mobile Mapping System (MMS)
- Web Map Service
- Future Prospective





Preface



- The data acquired from remote sensing and photogrammetry provided foundational information for national land monitoring and mapping
- Recently developed technologies include UAS, MMS have provided more mobile options to get ground information rapidly
- Devoted in user-friendly GIS platform or service to support national administration and infrastructure



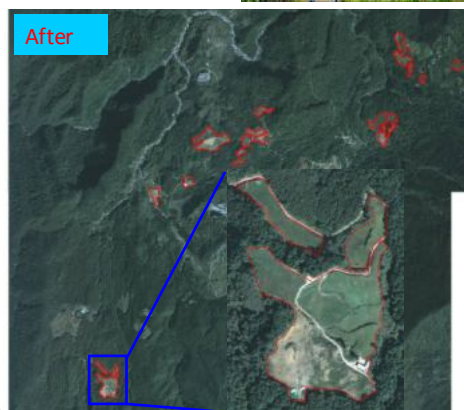
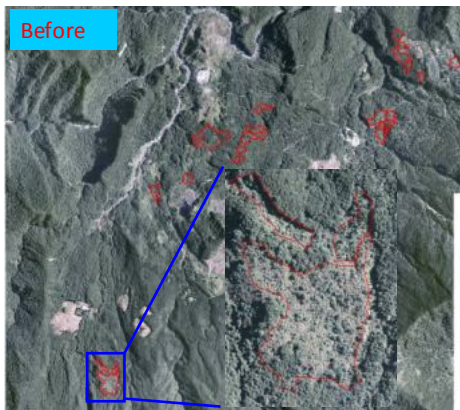
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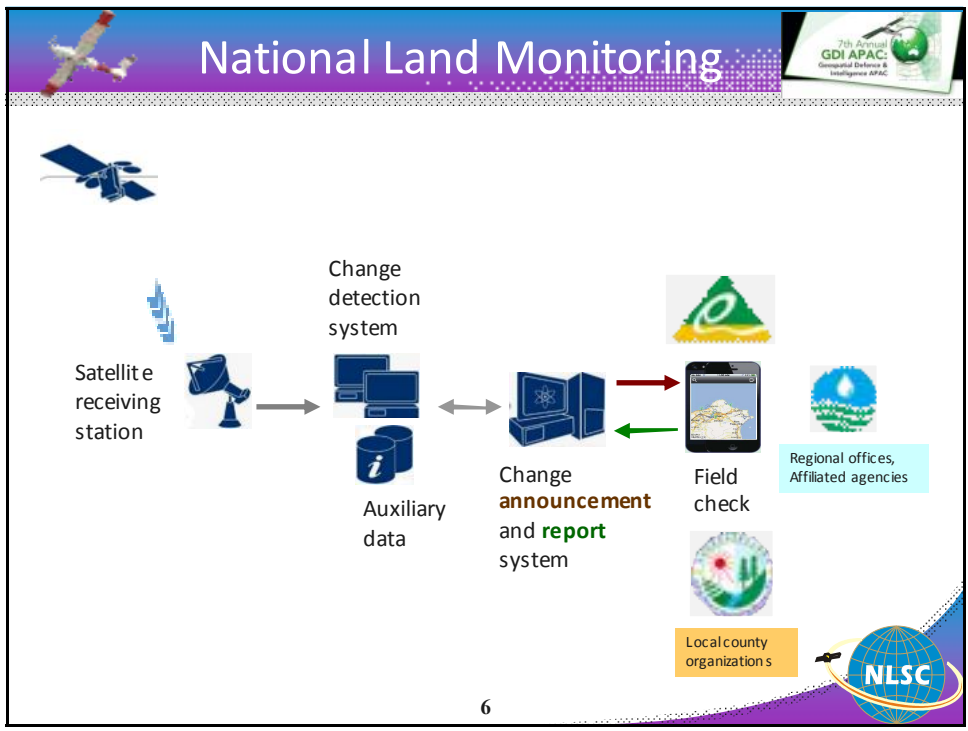
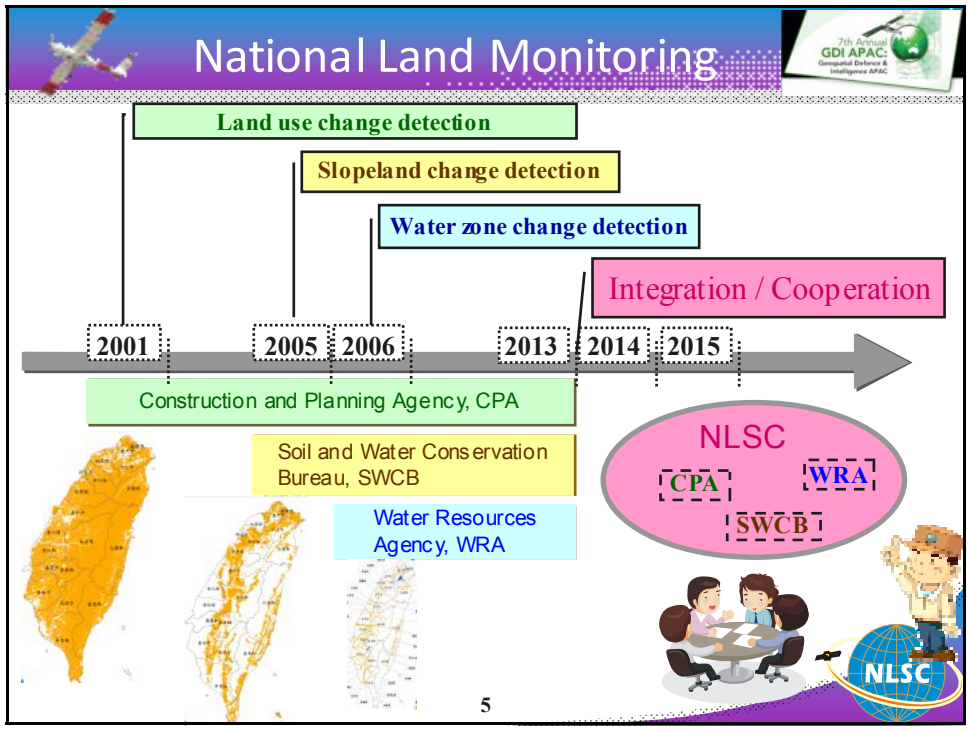
National Land Monitoring



- Goal
 - ◆ Assist the discover of illegal land exploitation
 - ◆ Detect the change in coast line and water way



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National Land Monitoring

- Work flow

1. Auto-detection

2. Human Interpretation (Reference data)

Changes type

ation : after

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National Land Monitoring

- Majority change type

- ◆ Newly-built

2013.2 2013.6

67.9 %

2012.5 2012.8

7.9%

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National Land Monitoring

- **Minority change type**
 - ◆ Recently-exploited
 - ◆ 3.7%
 - ◆ 2%

2012.8

2012.10

2012.5

2012.8

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National Land Monitoring

- ◆ **Coast line change detection**
 - ◆ port

Satellite images

before

after

Field photos

before

after

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National Land Monitoring



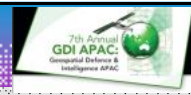
- Past experiences on illegal land use detection is around 30%.
- Case include : Newly-built/removed artificial structure, newly-built/removed water zone, land exploitation.....



Mapping projects

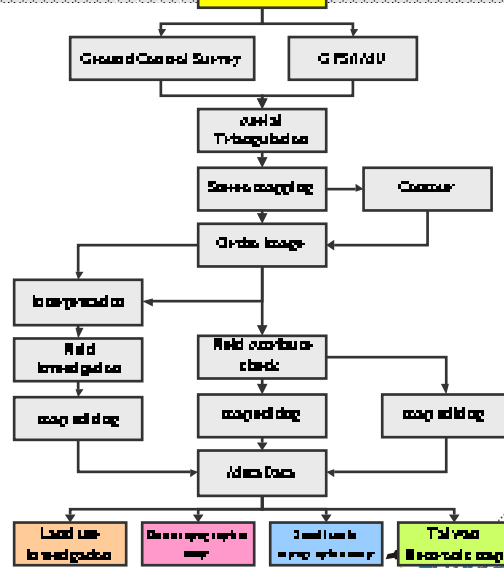
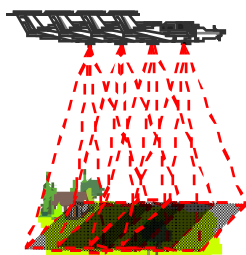
Mapping Project

Acquire Images




- Main topographic mapping technique : Photogrammetry

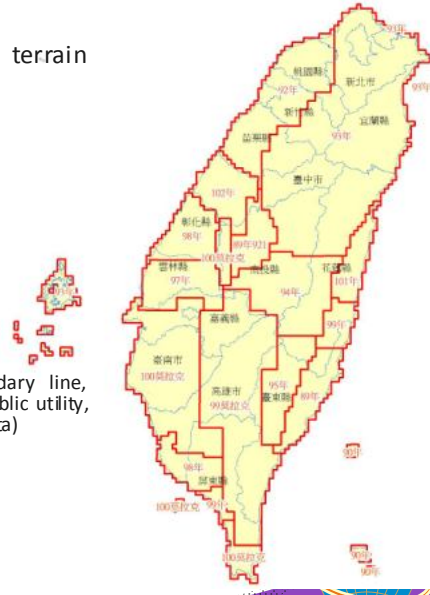
- ◆ Simulate the ground truth in stereo mapping
- ◆ Provide visual images as background
- ◆ High accurate result
- ◆ High efficiency



Mapping projects




- **Basic topographic map**
- Objective : Record the surface and terrain features, serve as base maps
- History :
 - ◆ Since 1976, in CAD format
 - ◆ Since 1997, apply digital photogrammetry
 - ◆ Since 2008, include CAD, GIS and Database
 - ◆ Till now, revised 5th time
- Scale : 1/5000
- Total map sheet : 5519
- Contents :
 - ◆ 10 major categories (control point, boundary line, artificial structure, transportation, water, public utility, land cover, land form, landmark, marginal data)
 - ◆ 55 divided categories
 - ◆ 133 subdivided categories
 - ◆ Nearly 400 layers




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Mapping Projects




- **Taiwan electronic map**
- Goal: satisfy common needs of the public
- History :
 - ◆ Pilot project in 2007
 - ◆ Completed the mapping of Taiwan from 2008 to 2011
 - ◆ Continue to revise since 2012
- Scale : 1/5000
- Total map sheet : 5611
- Contents :
 - ◆ 10 major categories (road, railroad, waterway, administrative boundary, block, building, landmark, control point, doorplate, colored orthophoto)
 - ◆ 25 layers, mostly to support the navigation and GIS analysis




■	2014 emap
■	2014 bmap

•Accuracy of position : 1.25 m
 •Resolution of orthophoto : 25 cm



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Mapping projects




- **Land Use Investigation**

Land use investigation

 - Aim : Understand the interaction of human activities in natural, economical, social and cultural aspect
 - History
 - ◆ 1993-1995
 - ◆ 2006-2008
 - ◆ 2009 : 5 year revision cycle
 - Contents :
 - ◆ 1st order : 9 classes (transportation, water, public utility, mineral, agricultural, forestry, building, amusement usage, others)
 - ◆ 2nd order : 41 classes
 - ◆ 3rd order : 103 classes

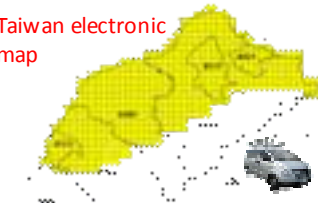


Mapping projects




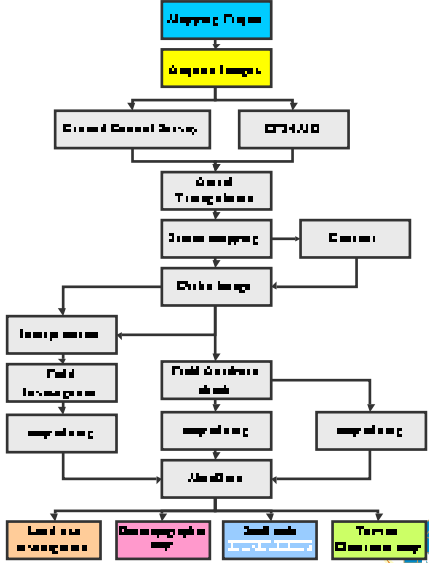
- Update strategies
 - ◆ common layers update
 - ◆ Integrate open data
 - ◆ Revise changed areas


Taiwan electronic map



Land use investigation

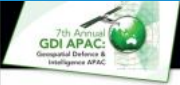







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Unmanned Aircraft System




- Charter
 - ◆ Mobile, flexibility, Efficiency
 - ◆ Cost-effective
 - ◆ Diversification

Fixed wing




Rotary wing



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UAS – Development course



2008~2009 Pilot plan

✓ Development strategy

2010 Research

✓ Tests on map update and application

2011~2014 Development


- ✓ Fixed wing UAS, auxiliary software and hardware
- ✓ Image process flow and system
- ✓ UAS photo-taking standard
- ✓ Assist emergency mission
- ✓ Fit in existed mapping procedure
- ✓ Till 2014, over 48 missions, 305 square km coverage

2015~2018 Refine the system

✓ Diversified UAS types

✓ Hyper spectral and Lidar payload

✓ 3D model




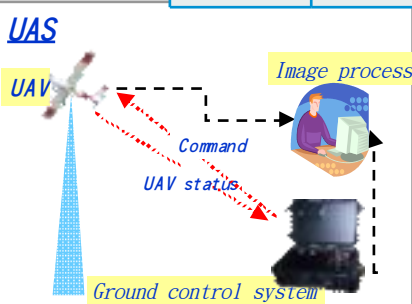
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UAS – Fixed wing

- **composition :**
 - ✓ Fixed wing UAV
 - ✓ Ground control system
 - ✓ Microwave antenna
 - ✓ Control panel

Specificaion	
Wing span	3.3m
Total loading	25Kg
Speed	100Km/hr
Cruising endurance	2.5hr
Payload	5kg
Flying height	3600m






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UAS - Payload

Main payload in fix-wing UAS


3 - 62C. C. gas engine




✓ 2 - Flight control computer




1 - Radio communication and image transmission sysytm

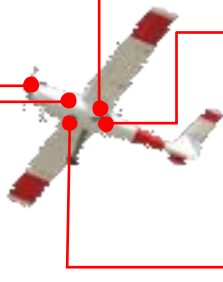


✓ 4 - GNSS - IMU



✓ 5 - Digital camera





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UAS – Camera

- Camera : Canon 5D2
 - Focal length : 24mm or 50mm
 - Sensor size : 5616 X 3744 pixel (21 million pixels)




Type	GSD (cm)	Focal Length (mm)	Flight Height (m)	Frame (m)
5D2	25	24	930	1404 X 936
5D2	25	50	1950	1404 X 936


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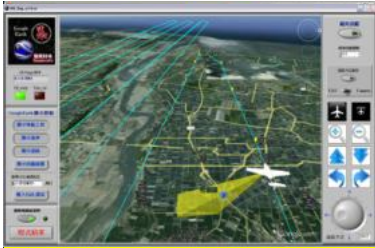
UAS - GCS

Ground control system (GCS)





★ Real-time image



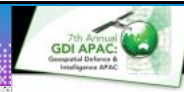
★ UAV path & coverage

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Unmanned Aircraft System



● Tests the ability of UAV in Chunghwa, 2011

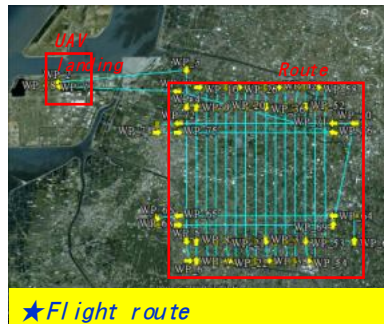
- ◆ Flat area : 8.4 X 4km
- ◆ Route : 15
- ◆ Flying height : 1000, 500m



★Target



★Ground control point



● Aerial triangulation accuracy analysis

- ◆ Horizontal accuracy 30 cm
- ◆ Vertical accuracy 50 cm

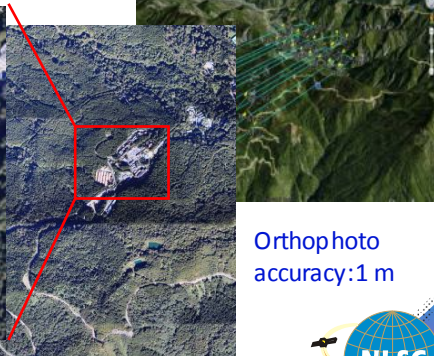


Unmanned Aircraft System



● Tests the ability of UAV in Chiayi, 2011

- ◆ Mountainous area : 4.7km x3.3km
- ◆ Flying height : 1000, 500m
- ◆ Average ground height : 2210 m



Orthophoto accuracy:1 m





UAS – Rotary wing



★ Multiple rotary-wing UAS

Wing size	82 cm	Flying height	300 m
Total loading	3.5 kg	Flying distance	1000 m
Payload	1.0 kg	Camera	Canon-5DM2 Canon-550D SONY-DV
Cruising endurance	15 min		

★ Singular rotary-wing UAS

Wing size	130 cm	Flying height	1000 m
Total loading	5 kg	Flying distance	5000 m
Payload	3 kg	Camera	Canon 5D II DSLR Canon 550D DSLR SONY DV
Cruising endurance	30 min		



UAS – Outputs



● Quick mosaic, panorama view

- ◆ Auto-matching
- ◆ multiple images into single image

● Orthophoto

- ◆ Position and attitude parameters
(X, Y, Z, ω , ψ , κ)

Emergency mission



Map update




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UAS — Maps Update


- Update Taiwan electronic map, 2011
 - ◆ An important landmark in Taichung



★ Taiwan electronic map, 2009



★ 6 rotary wings UAV, 2011



★ Orthophoto by afa si, 2008





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UAS — Maps Update

Update basic topographic maps, 2012
A bridge in East Taiwan (Hualian)







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UAS — Maps Update



Update basic topographic maps, 2013

Post-disaster rebuilt housing in middle Taiwan (Chiayi)

UAS flying height 130 m · GSD 4 cm



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UAS — Maps Update



- Update Taiwan electronic map
 - ◆ Taiwan provision road no.61 in Chunghua, 2014
 - ◆ UAS fly height 700 m · GSD 25 cm

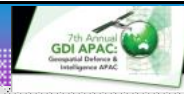


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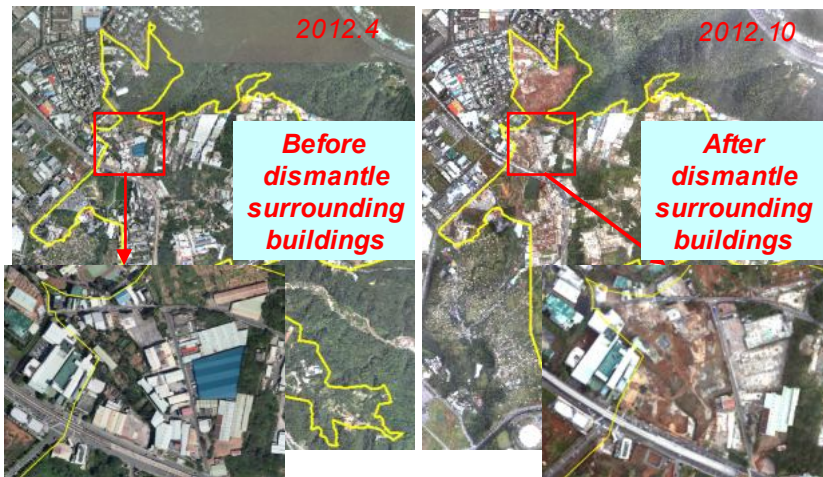




UAS — Land Exploitation



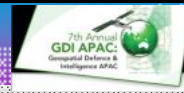
- Land exploitation, 2012
 - ◆ Taoyuan airport MRT neighborhood land levy



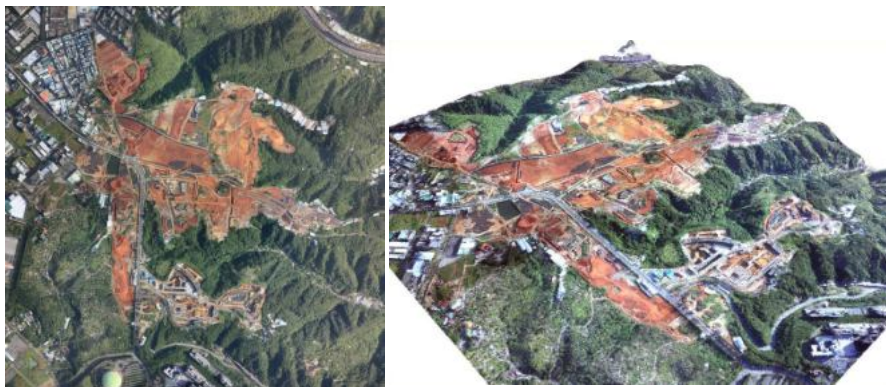
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UAS — Land Exploitation



- 3D topology model
 - ◆ 2013 UAV images



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UAS — Emergency Disaster Appli



● Torrential rain disaster in Nantou, 2012

- ◆ Images taken on different period



2011 photo taken by AFASI



2012 photo taken by UAV



UAS — Emergency Disaster Application



Torrential rain disaster in Nantou, 2012

Results



Quick mosaic



Overlay Google earth



UAS — Emergency Disaster Application



Torrential rain disaster in Nantou, 2012

360 degree panorama view



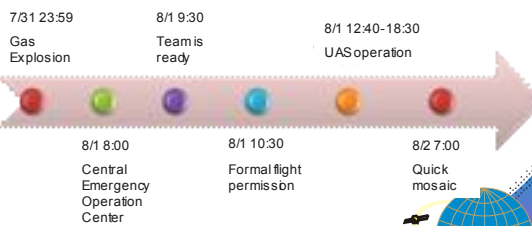
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UAS — Emergency Disaster Application



- Gas explosion in Kaohsiung, 2014
 - ◆ Exploded in the midnight on July. 31



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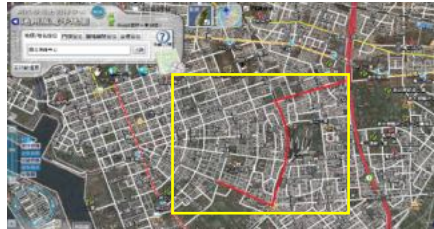




UAS — Emergency Disaster Appli



- Gas explosion in Kaohsiung, 2014
 - ◆ Disaster area coverage 6 km



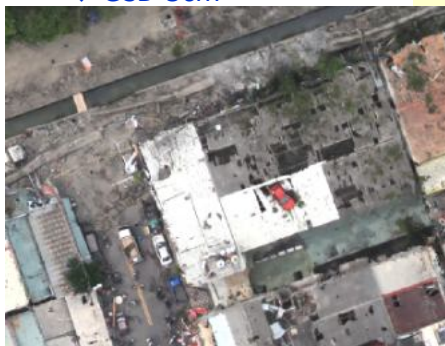
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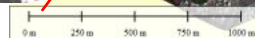
UAS — Emergency Disaster Appli



- Gas explosion in Kaohsiung, 2014
 - ◆ Quick mosaic orthophoto
 - ◆ Flying height 160m
 - ◆ GSD 5cm



[3D model video](#)



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Mobile Mapping System

- MMS vs. street view vehicle

	MMS	Street view vehicle
Viewpoint	Limited	720-degree panorama
Resolution	Better	Worse
Position accuracy	Better	Worse
Measurement system	IMU	none
Cost	High	Low

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MMS – Development course

The development course is shown as a green arrow pointing from the top-left to the bottom-right, divided into three main phases:

- 2008~2009 Pilot plan**
 - ✓ Data collection
 - ✓ Development strategy
- 2012~2014 Tests**
 - ✓ Land use investigation update tests
 - ✓ Taiwan electronic map update tests
- 2015~2018 Development**
 - ✓ Build MMS
 - ✓ Monitor system
 - ✓ Image process procedure
 - ✓ Speed up maps update frequency
 - ✓ UAS & MMS data fusion

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MMS



- Equipment
 - GPS & 8 cameras
 - Power supply in rear trunk
 - IMU & monitor system inside the car
- Monitor system
 - 3 monitor screen
 - 3 PC
 - Power supply

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MMS — Maps Update



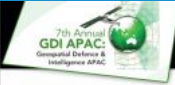
- ◆ A case in Tainan
 - Land use investigation






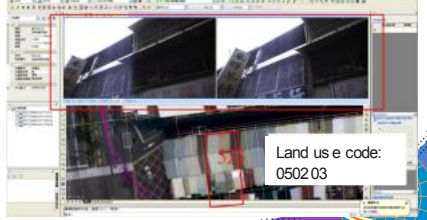
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MMS — Maps Update




◆ Building classification


1. Match the left and right image
 
2. Mark the scope of the building
 
3. Interpret the attribution
 
4. Building is classified
 

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MMS — Maps Update



- Suitable
 - ◆ Straight and broad road, in good order
 - ◆ Successful classification percentage 90%
- Unsuitable
 - ◆ Traditional tri be, narrow lane
 - ◆ The land use status cannot be viewed



Suitable zone



Unsuitable zone

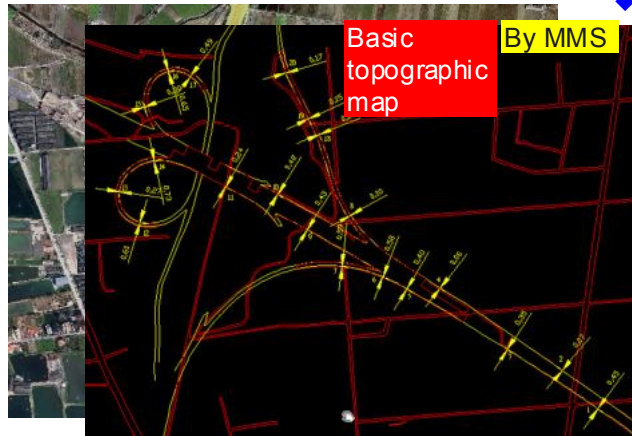
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MMS — Maps Update



- An Interchange update in Tainan



◆ Accuracy analysis

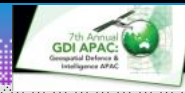
- Average difference on straight road: **0.34 m**
- Maximum difference in curve: **0.73 m**



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MMS




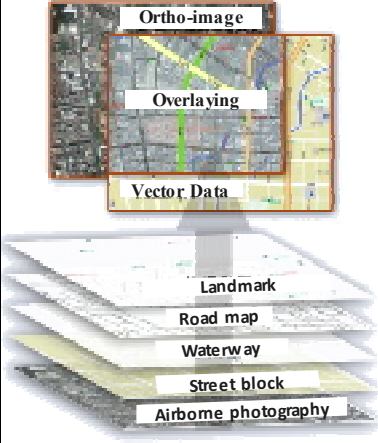
- Composition
 - GNSS
 - IMU
 - Digital cameras
 - 720-degree panorama camera




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Web Map Service







- Goal
 - ◆ Put the multiple maps at the hand of users
 - ◆ Maximum the usage of maps




Web map service



Government agencies, private sectors




users





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Web Map Service



- Platform
 - ◆ Positioning and Map overlap
 - ◆ Support mobile device
 - Android 、 iOS
- Service
 - ◆ Web Map API
 - For common users
 - For professional users
 - ◆ OGC WMS 、 WMTS





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Web Map Service




內政部國土測繪中心
National Land Survey and Mapping Center
國土測繪圖資
網路地圖服務系統



Map platform



Download



Write a recommendation



QR code

About the system

內政部國土測繪中心(以下簡稱本中心)為整合本中心通用版電子地圖、圖上利用調查成果圖等核心、基於「國土測繪圖資網路地圖服務系統(以下簡稱本系統)」發布Web Map API, 提供標準的共通平台與統一之圖資, 供本中心相關應用系統整合、資訊資料與應用系統複雜度、本系統伺服器端開發專屬服務系統, 瀏覽器端應用已廣泛採用美國次採用的OSGeo(Open Source Geospatial Foundation)提供的OpenLayers程式庫開發, 以降低採用商業軟體所需的授權費用。

系統發展之目標, 除滿足本中心業務之需要外, 並規劃以網路地圖方式對外提供服務, 讓全民共享最新的國土測繪圖資, 各機關及民間企業可輕易的介接本系統於其網站網頁上, 提供網頁地圖定位標示、瀏覽、查詢, 用於如企業機關所在地標示或需要顯示地理位置之相關應用等。本系統提供一般電腦網頁版及智慧型行動裝置(Mobile)應用兩種版本操作介面, 並提供QR-Code(於網頁上方)方便智慧型行動裝置使用者瀏覽, 支援自動定位及兩地連結地圖。

本系統現階段圖資為通用版電子地圖(含正射影像)、圖上利用調查成果圖、交通部運輸研究所路網數位圖(道路路網)。開放的 Web Map API服務有2項:

- 一、**一般使用者(個人網頁內疊加地圖)**: 適用於僅需將地圖加入網頁(如部落格)的使用者, 只要在畫面上輕點範圍以及新增自訂地圖, 系統即自動產生超連結網址(URL), 使用者即能快速產生疊加地圖, 加入部落格或是 e-mail 內使用。
- 二、**專業使用者(個人網頁內動態地圖)**: 適用於網頁設計者, 可輕易地在其設計的網頁內加入人員疊加大地圖。

Map introduction

內政部國土測繪中心(以下簡稱本中心)為整合本中心通用版電子地圖、圖上利用調查成果圖等核心、基於「國土測繪圖資網路地圖服務系統(以下簡稱本系統)」發布Web Map API, 提供標準的共通平台與統一之圖資, 供本中心相關應用系統整合、資訊資料與應用系統複雜度、本系統伺服器端開發專屬服務系統, 瀏覽器端應用已廣泛採用美國次採用的OSGeo(Open Source Geospatial Foundation)提供的OpenLayers程式庫開發, 以降低採用商業軟體所需的授權費用。

系統發展之目標, 除滿足本中心業務之需要外, 並規劃以網路地圖方式對外提供服務, 讓全民共享最新的國土測繪圖資, 各機關及民間企業可輕易的介接本系統於其網站網頁上, 提供網頁地圖定位標示、瀏覽、查詢, 用於如企業機關所在地標示或需要顯示地理位置之相關應用等。本系統提供一般電腦網頁版及智慧型行動裝置(Mobile)應用兩種版本操作介面, 並提供QR-Code(於網頁上方)方便智慧型行動裝置使用者瀏覽, 支援自動定位及兩地連結地圖。

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Q&A

內政部國土測繪中心(以下簡稱本中心)為整合本中心通用版電子地圖、圖上利用調查成果圖等核心、基於「國土測繪圖資網路地圖服務系統(以下簡稱本系統)」發布Web Map API, 提供標準的共通平台與統一之圖資, 供本中心相關應用系統整合、資訊資料與應用系統複雜度、本系統伺服器端開發專屬服務系統, 瀏覽器端應用已廣泛採用美國次採用的OSGeo(Open Source Geospatial Foundation)提供的OpenLayers程式庫開發, 以降低採用商業軟體所需的授權費用。

系統發展之目標, 除滿足本中心業務之需要外, 並規劃以網路地圖方式對外提供服務, 讓全民共享最新的國土測繪圖資, 各機關及民間企業可輕易的介接本系統於其網站網頁上, 提供網頁地圖定位標示、瀏覽、查詢, 用於如企業機關所在地標示或需要顯示地理位置之相關應用等。本系統提供一般電腦網頁版及智慧型行動裝置(Mobile)應用兩種版本操作介面, 並提供QR-Code(於網頁上方)方便智慧型行動裝置使用者瀏覽, 支援自動定位及兩地連結地圖。

本系統現階段圖資為通用版電子地圖(含正射影像)、圖上利用調查成果圖、交通部運輸研究所路網數位圖(道路路網)。開放的 Web Map API服務有2項:

- 一、**一般使用者(個人網頁內疊加地圖)**: 適用於僅需將地圖加入網頁(如部落格)的使用者, 只要在畫面上輕點範圍以及新增自訂地圖, 系統即自動產生超連結網址(URL), 使用者即能快速產生疊加地圖, 加入部落格或是 e-mail 內使用。
- 二、**專業使用者(個人網頁內動態地圖)**: 適用於網頁設計者, 可輕易地在其設計的網頁內加入人員疊加大地圖。

Web Map API 服務:

累積人數: 000019620
線上人數: 0000000

累積人數: 0000000
線上人數: 0000000

最新消息

20121212
內政部不動產交易信託保存本系統地圖。

20121206
本系統於101年12月7日, 經公告昇人士事。

20121203
本系統建議在瀏覽器採用 Firefox、Chrome、Opera




Web Map Service – map overlay





orthoimage



Land use investigation



Taiwan electronic map



Urban lands



Basic topographic map



Land sector



Map sheet



National park




Wild animal conservation area



Cadastral map



Road network



Non-urban lands



Drinking water source protection area



Sanitary landfill site



Potential debris flow torrent



Emergency shelter



Highway mileage



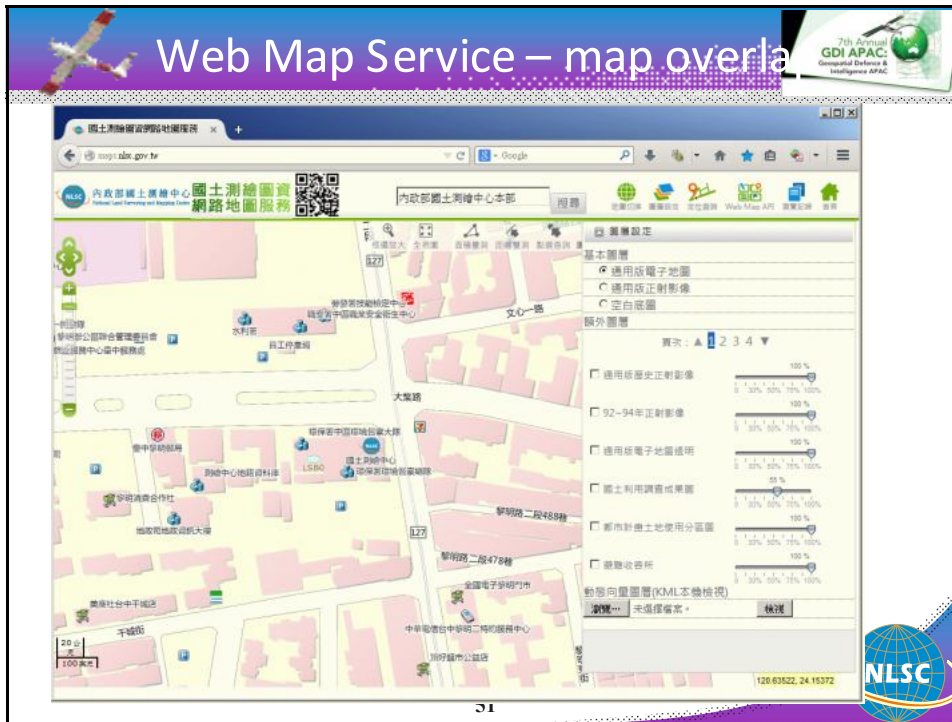
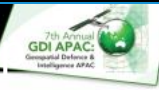
Country village boundary



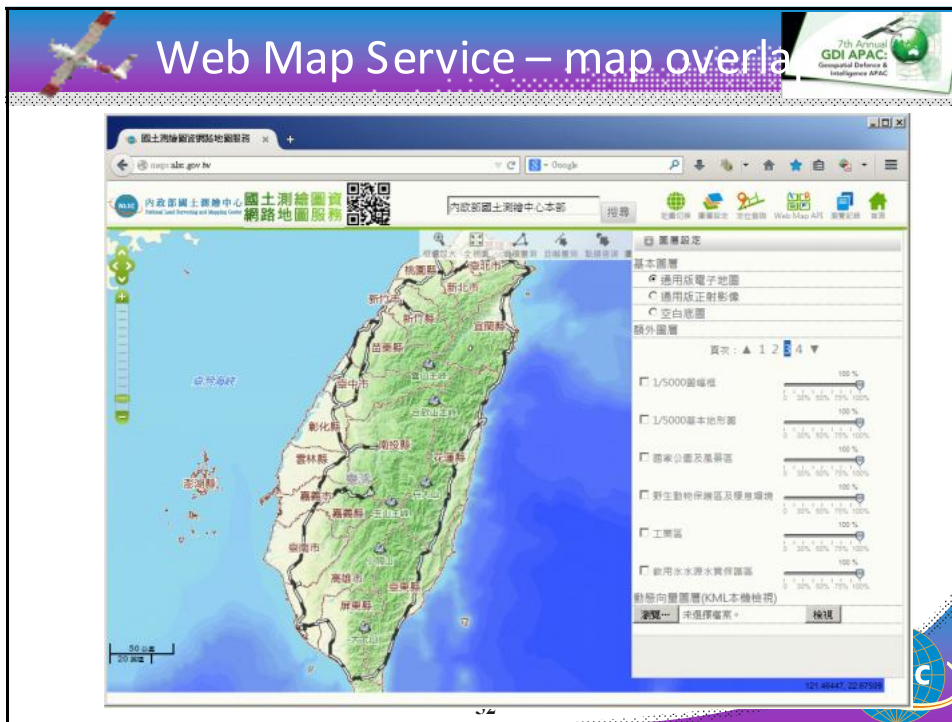
Industrial zone



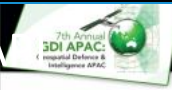
Web Map Service – map overlay



Web Map Service – map overlay



Web Map Service – Web Map A



The screenshot displays the National Geomatics Engineering Center's website. The main interface features a map of a city area with various landmarks. On the right side, there is a 'Web Map API 服務' (Web Map API Service) panel. A red dashed circle highlights this panel, which includes options for 'Web Map API 服務', 'Web Map API 服務', and 'Web Map API 服務'. Below these options, there are fields for 'Web Map API 服務', 'Web Map API 服務', and 'Web Map API 服務'. A red arrow points from the highlighted area to a smaller inset window on the right, which shows a zoomed-in view of the map area.

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Web Map Service – Web Map A

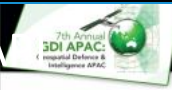


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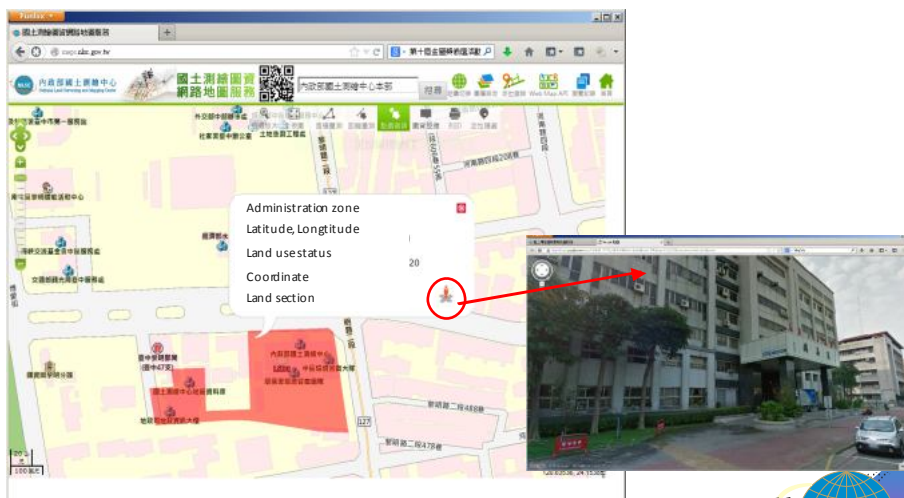
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Web Map Service – Web Map A

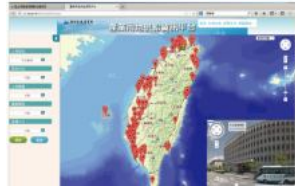


Web Map Service – Query



Web Map Service – OGC WMS, W

- Open WMS and WMTS (tile) service
- Open map type :
 - ◆ Taiwan electronic maps
 - ◆ Land use investigation map
 - ◆ Administration boundary
 - ◆ Land sector
 - ◆ Orthophoto



Land supply platform_ National development council



Real estate transactions price_ Ministry of the Interior



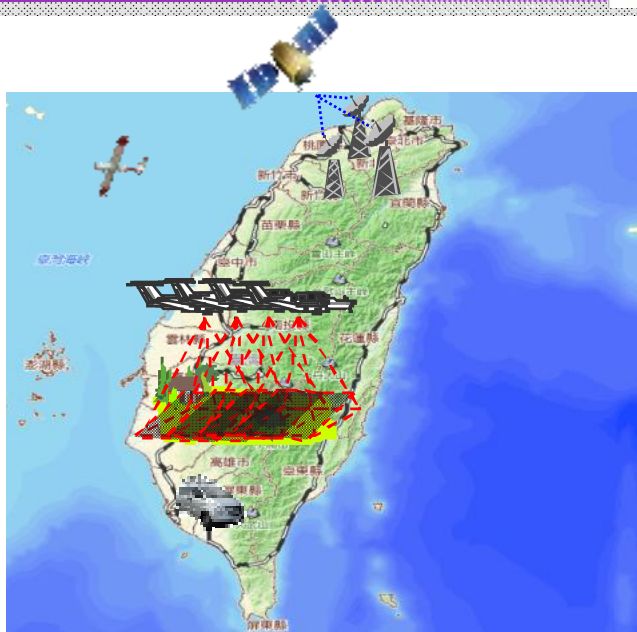
Housing e-map_ Construction and planning agency



Urban planning query system_ Hualian local government



Surveying and Mapping Techno



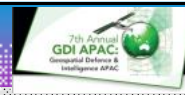


Conclusion and Perspective



- Using Satellites images to monitor land regularly does provide a useful land use change information and also stop illegal exploitation.
- Resources integration and circulation between governmental agencies
- Facilitated by the GIS, the common layers can and should be shared
- Tests on newly developed instruments' possibilities
- Explore the best solution to combine new technologies into existed map production procedure
- Establishing 3D city model and street view DB needed
- Combination of 3D model into web map services

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Thank you for your listening

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