



**WORKING  
WEEK 2025**



**Locate25**   
THE NATIONAL GEOSPATIAL CONFERENCE



INTERNATIONAL FEDERATION  
OF SURVEYORS



**Geospatial**  
Council of Australia

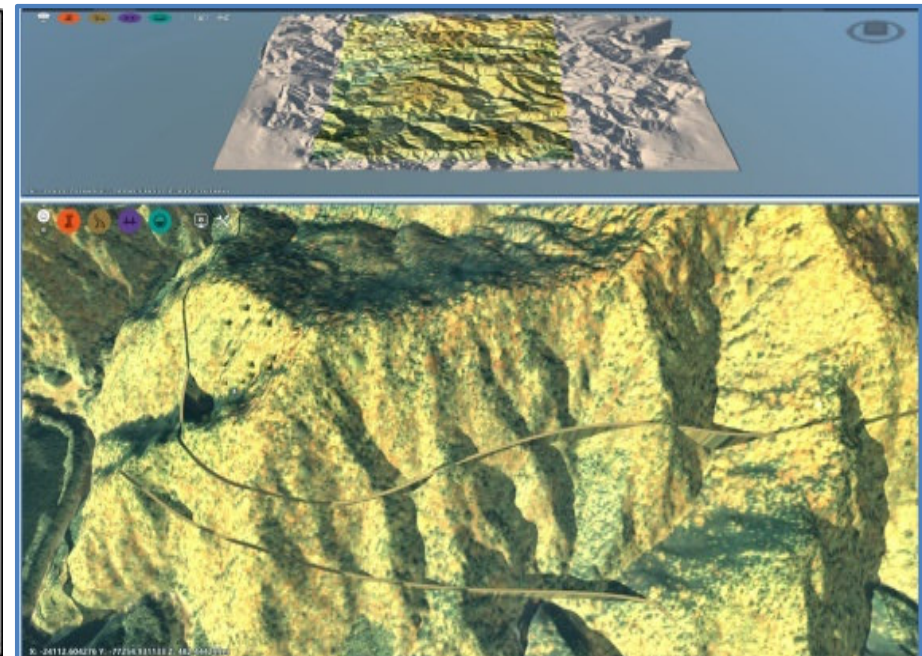
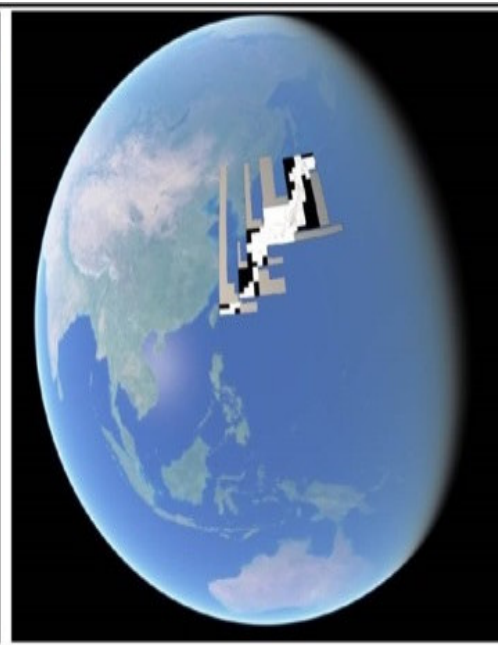
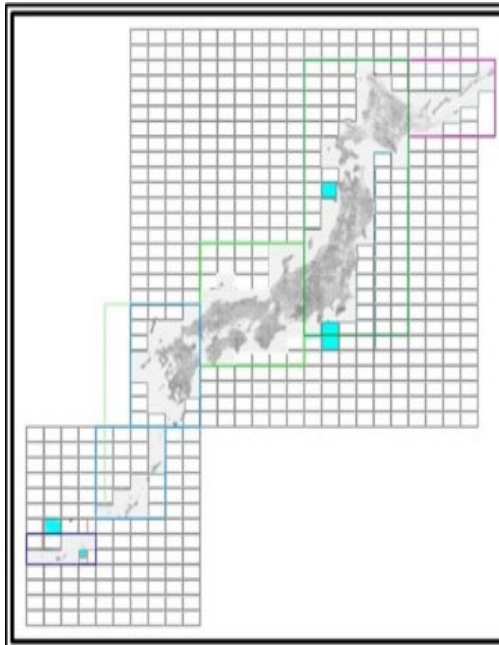
Collaboration, Innovation and Resilience:  
Championing a Digital Generation

Brisbane, Australia 6-10 April

Presented at the FIG Working Week 2025,  
6-10 April 2025 in Brisbane, Australia

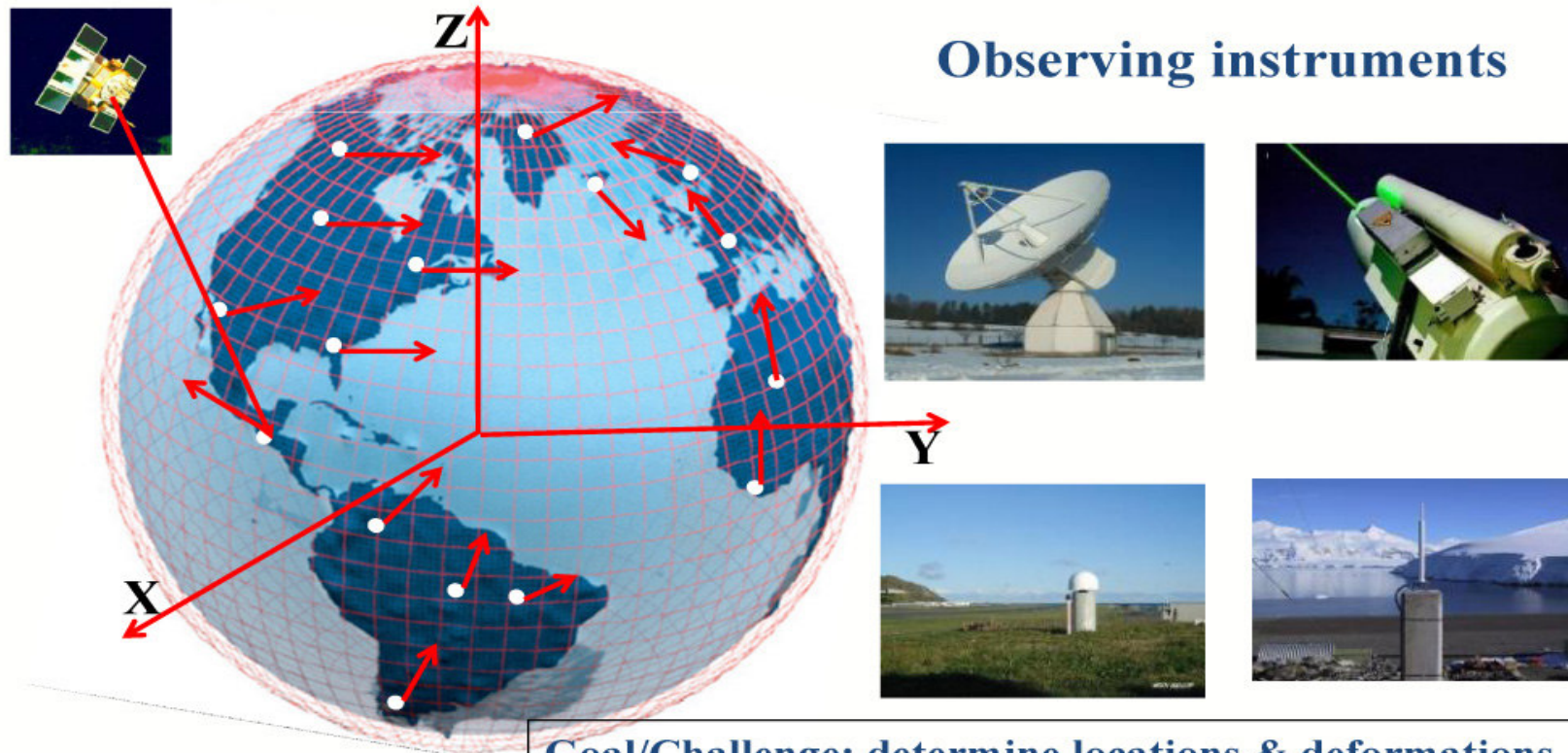
# **Fukui City - 3D-Cadastral Map and Kyoto University - 3D-Forest Map based on 4D-Image Map Archive Designed Aerial Survey ( 4 D-IMADAS)**

by **Mr. Hiroyuki HASEGAWA , President of GeoNet, Inc, Japan**



# 1.0 Origin of Ground Control Points / Boundary Control Points / Zone Control Points UN-GGIM and UN-GGRF initiatives

## The Global Geodetic Reference Frame



**Goal/Challenge: determine locations & deformations with an improved precision, Everywhere & Anytime on Earth, to satisfy societal and science requirements**



UN-GGIM

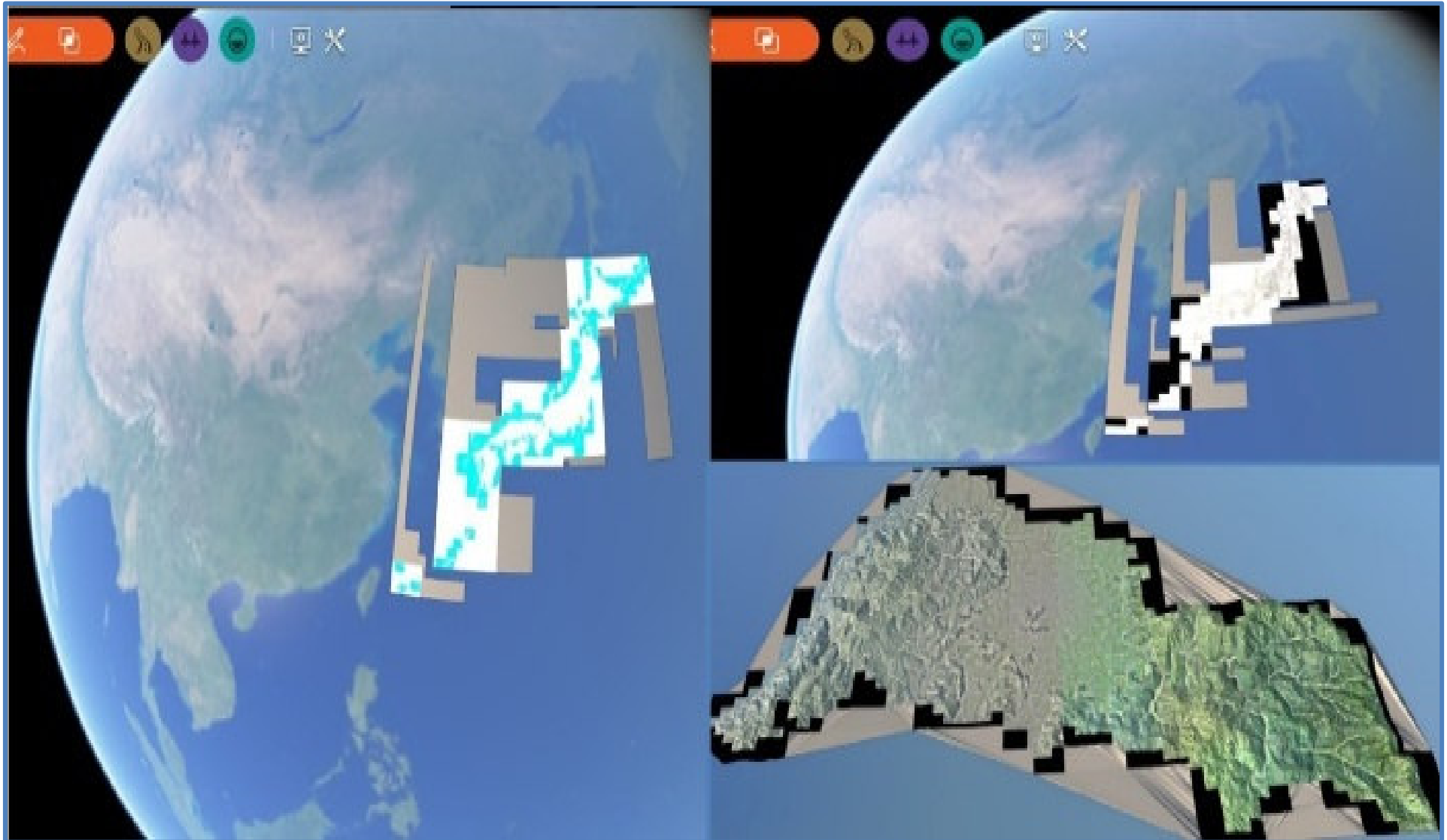
United Nations Initiative on  
Global Geospatial Information Management

*Positioning geospatial information to address global challenges*

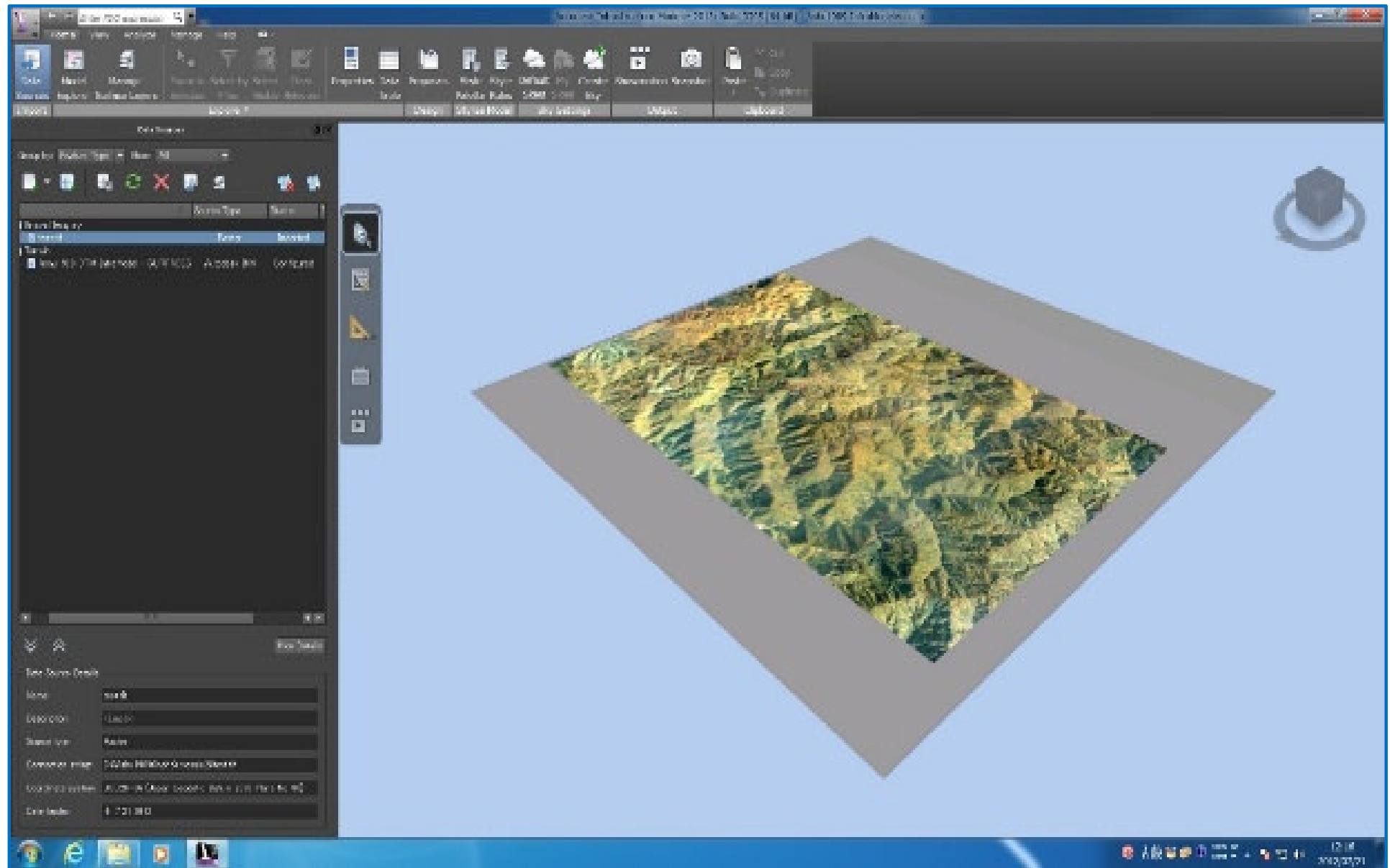
[ggim.un.org](http://ggim.un.org)



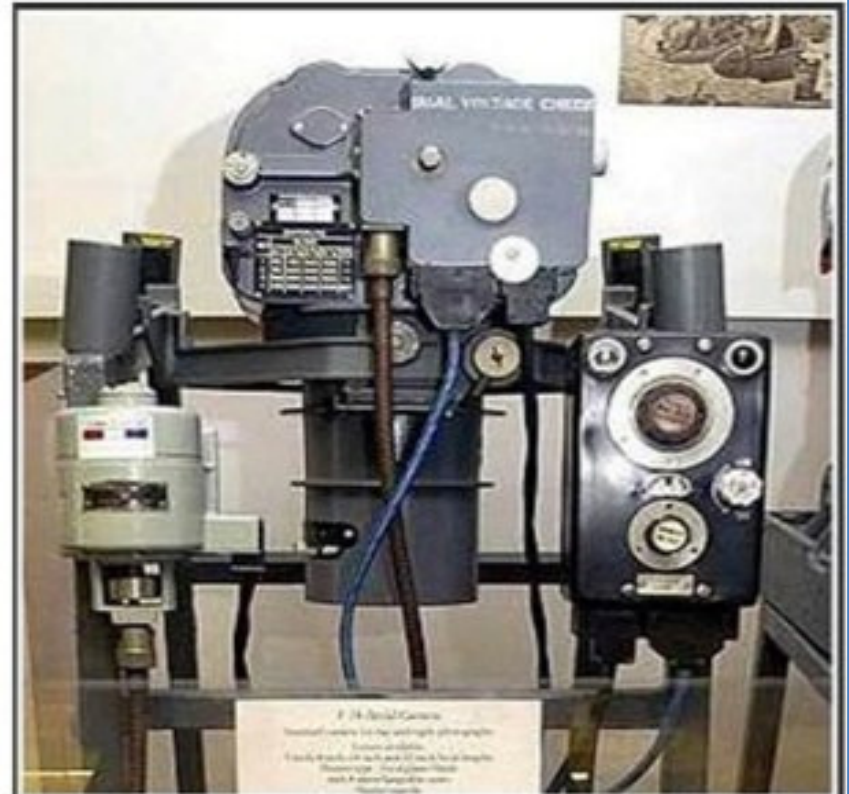
# 1.1 From 3D mapping to 4D Image Map Archive Designed Aerial Survey : CAD-Globe-Fukui City(2008)



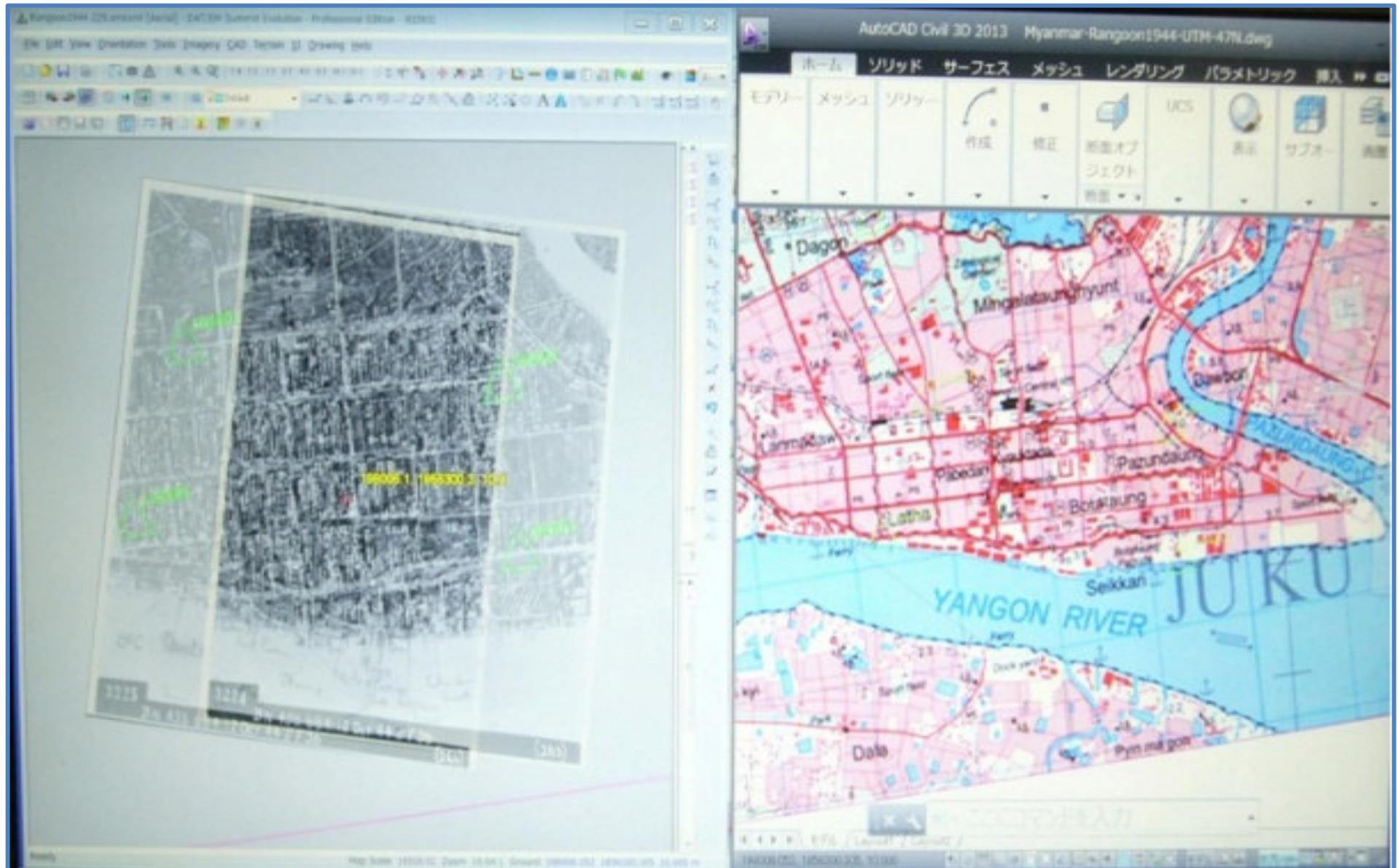
## 1.2 Kyoto University Ashu Research Forest 3D forest map and 3D Diorama Mode (1989)



## 2. 3D-DX Mapping (3D Forest Map, 3D Cadastral Map) - Standard Process - Objectives and Deliverables



## 2.01 3D-DX maps (3D forest maps, 3D cadastral maps) – Definition





## 2.02 Universitaet Goettingen: Prof Dr. C Kleinn : Forest Inventory and Remote Sensing



GEORG-AUGUST-UNIVERSITÄT  
GÖTTINGEN

Forest Inventory and Remote Sensing

[STAFF](#) [RESEARCH](#) [TEACHING](#) [PUBLICATIONS](#) [TOOLS|DEVICES](#) [\[HOME\]](#) [\[SITE MAP\]](#)

☐ ☐ STAFF

☐ SUCHEN ☐ DEUTSCH

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☐ **Head**

**Prof. Dr. Christoph Kleinn** | [CKleinn@gwdg.de](mailto:CKleinn@gwdg.de)

Remote Sensing, Forest Inventory and Assessment, Sampling Techniques, Statistical Research  
Methods



SEARCH FOR UNIVERSITY PERSONNEL

[UniVZ - University Schedules](#)

PERSONAL WEB PAGES

[Prof. Dr. Christoph Kleinn](#)

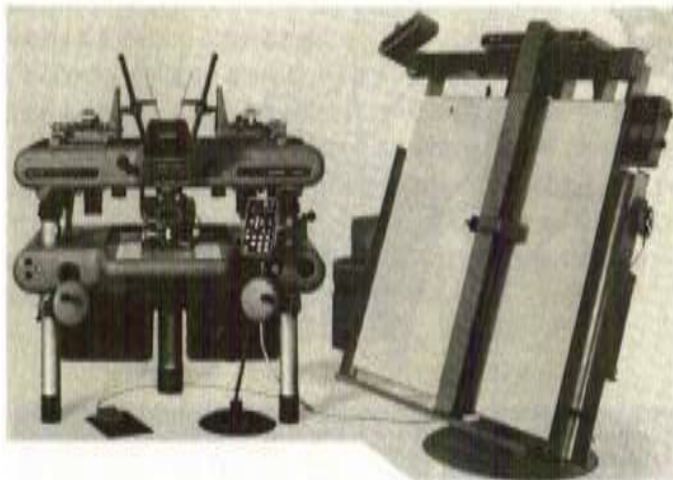
**MR. SCHLOTE | LENDING TOOLS**

YOU MAY BORROW FOREST TOOLS AND MEASURING INSTRUMENTS FROM  
MR. SCHLOTE (ROOM 1.160, PHONE 39-21226).

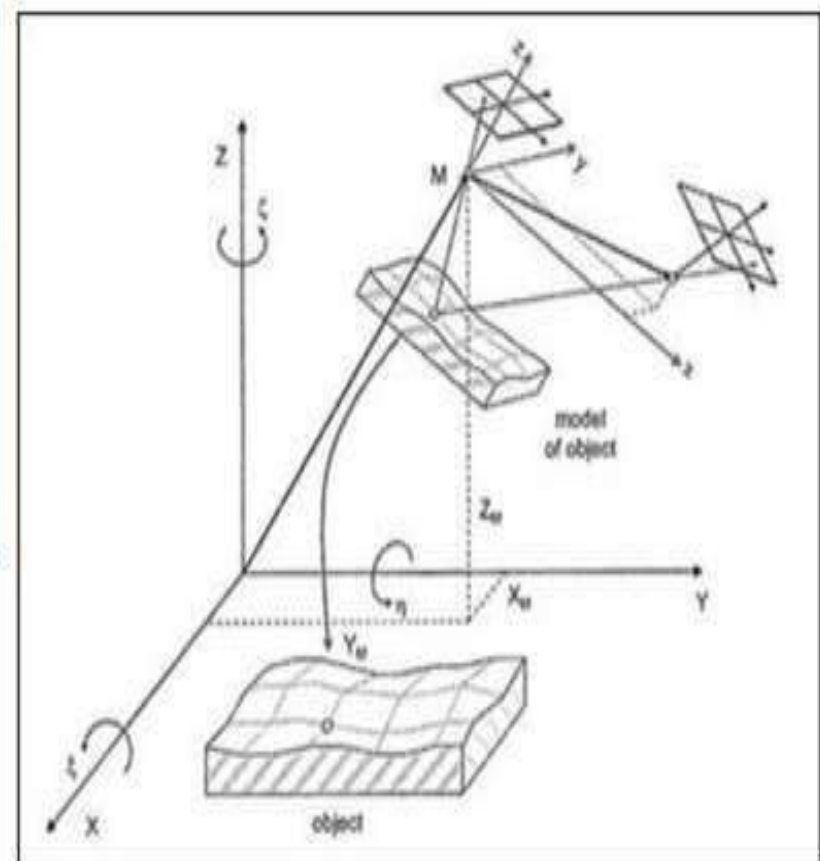
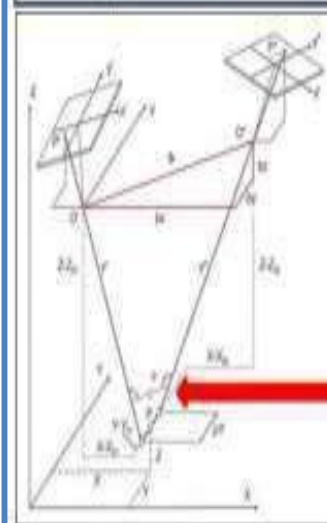
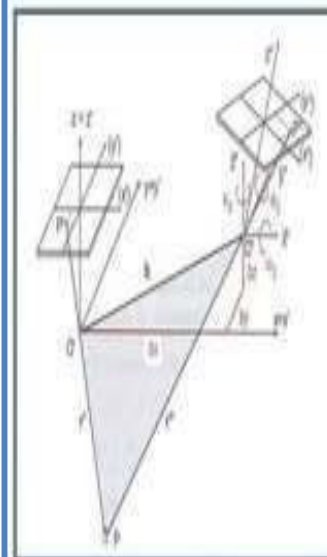
# 2.04 Photogrammetry

## : 3D-Image model- Display-Measurement-Archive

## : Spatial Similarity Transformation



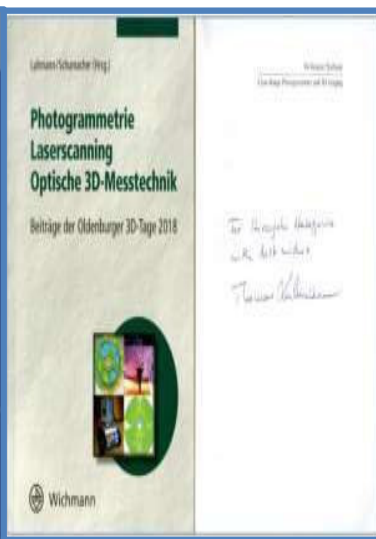
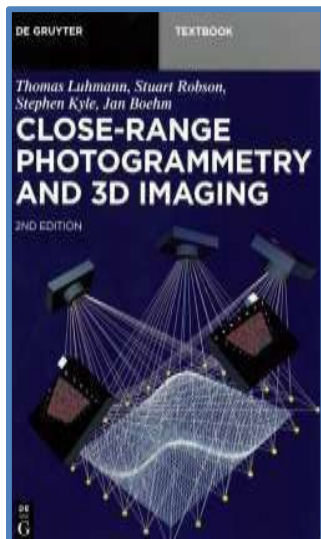
写真IV-3 アナログ図化機における機械（モデル）座標系と対象（地図）座標系の分離



直交中点較差( $\epsilon_d$ )

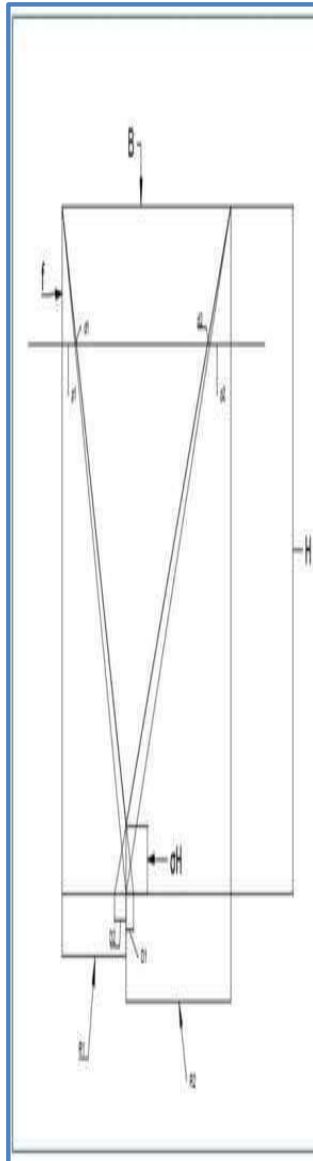
絶対標定:基準点残差( $\Delta X, \Delta Y, \Delta Z$ )

3D画像モデル形成単位:相対標定 :3D交会較差:直交中点較差





## 2.05-2 Planimetric accuracy : Altimetric accuracy of 3D image model



Scale in left image

$$: 1/sL = f/H = p1/R1$$

Scale in right image

$$: 1/sR = f/H = p2/R2$$

Scale of height displacement in left image

$$: 1/sL' = f/(H-\sigma H) = (p1+d1)/R1$$

Displacement in left image

$$: p1+d1 = f/(H-\sigma H) * R1$$

Scale of height displacement in right image

$$: 1/sR' = f/(H-\sigma H) = (p2+d2)/R2$$

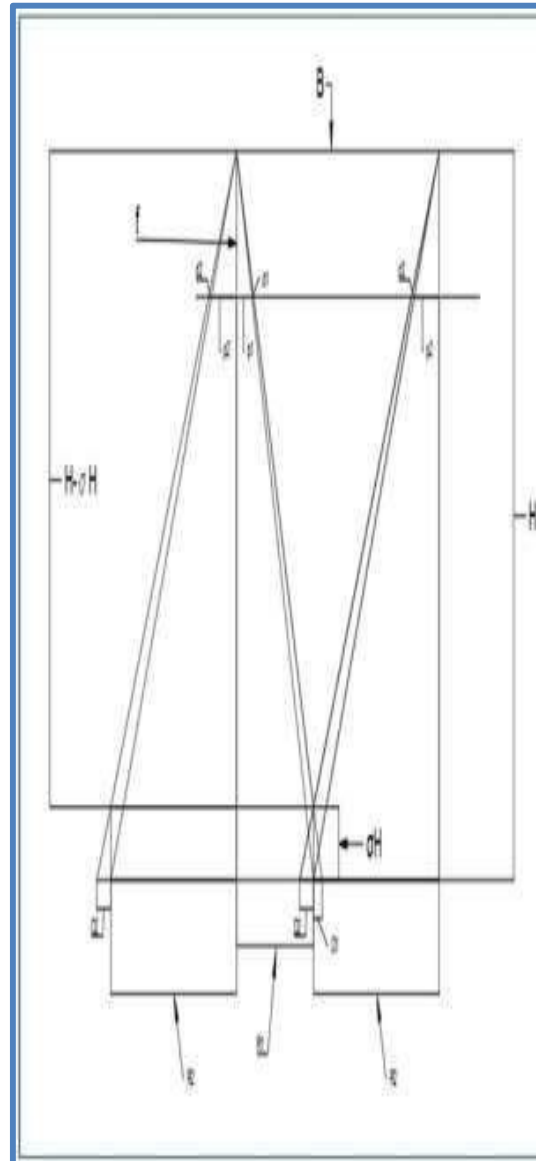
Displacement in right image

$$: p2+d2 = f/(H-\sigma H) * R2$$

Accuracy in Planimetry

$$: D1 = d1 * (H/f) \quad : D2 = d2 * (H/f)$$

$$\sigma P = D1 + D2 = (d1 + d2) * (H/f)$$



$$: p = p1 + p2 = f/H(R1 + R2) = (f/H) * B$$

$$\rightarrow H = (f/p) * B$$

$$d1 + d2 = f/(H - \sigma H) * (R1 + R2) - (p1 + p2)$$

$$= f/(H - \sigma H) * (R1 + R2) - f/H(R1 + R2)$$

$$= (R1 + R2) * \{ (f/(H - \sigma H)) - (f/H) \}$$

$$= (R1 + R2) * (f * \sigma H) / \{ (H - \sigma H) * H \}$$

$$= (f/H) * (R1 + R2) * \{ \sigma H / (H - \sigma H) \}$$

$$= \{ (p1 + p2) / (H - \sigma H) \} * \sigma H$$

$$= \{ p / (H - \sigma H) \} * \sigma H$$

$$= \Delta p$$

(by definition) then the next expression

$$p * \sigma H = \Delta p * H - \Delta p * \sigma H$$

$$\sigma H = \{ \Delta p / (\Delta p + p) \} * H$$

$$= \{ (d1 + d2) / (d1 + d2 + p1 + p2) \} * H$$

$$= [\Delta p / \{ (f/H) * B \}] * H$$

$$= (\Delta p * H) / \{ (B * f) / H \}$$

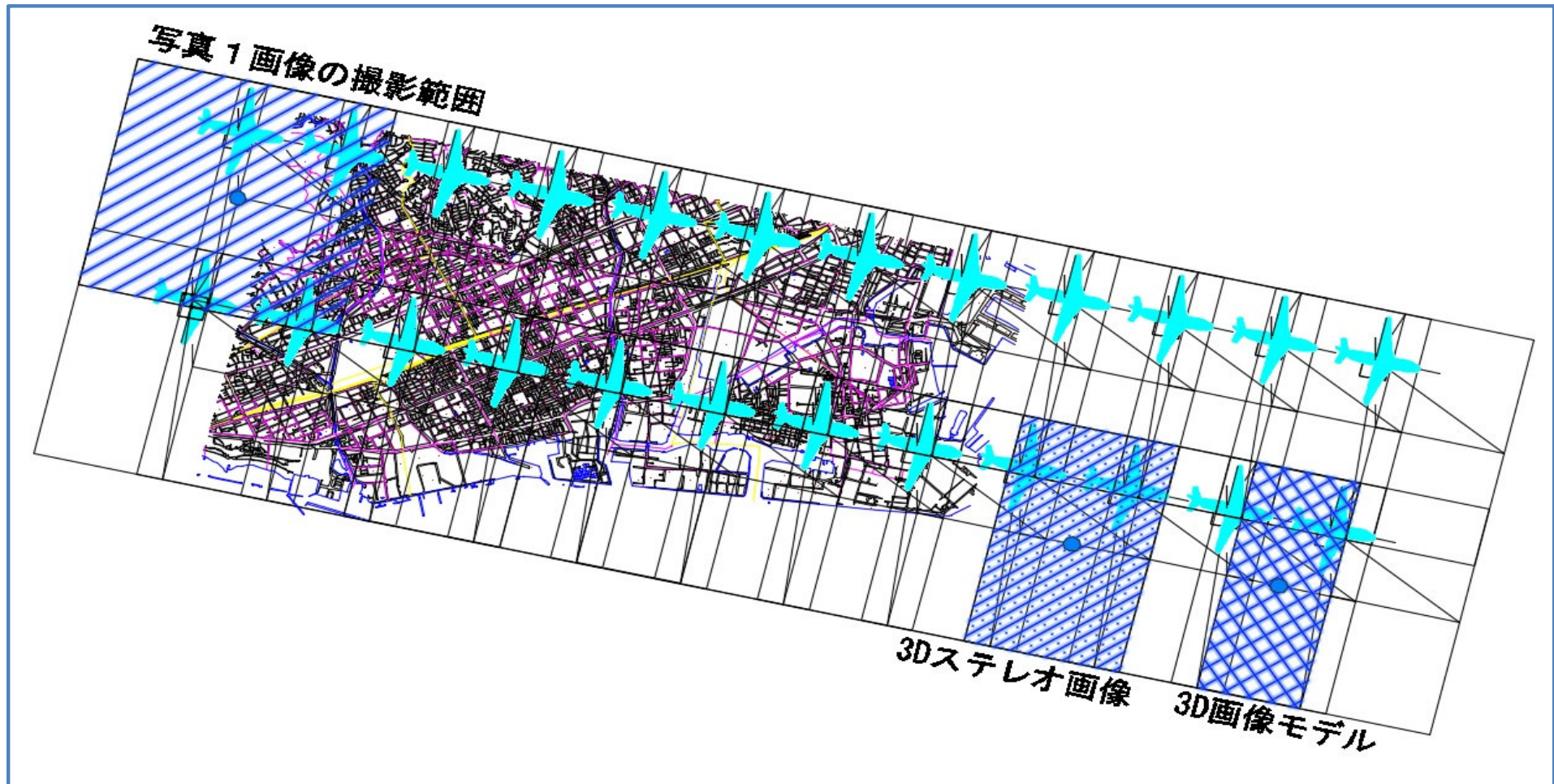
Accuracy in Altimetry (Height)

$$\sigma H = (H/B) * (H/f) * \Delta p ; \Delta p = d1 + d2$$

## 2.06. 3D photogrammetric models

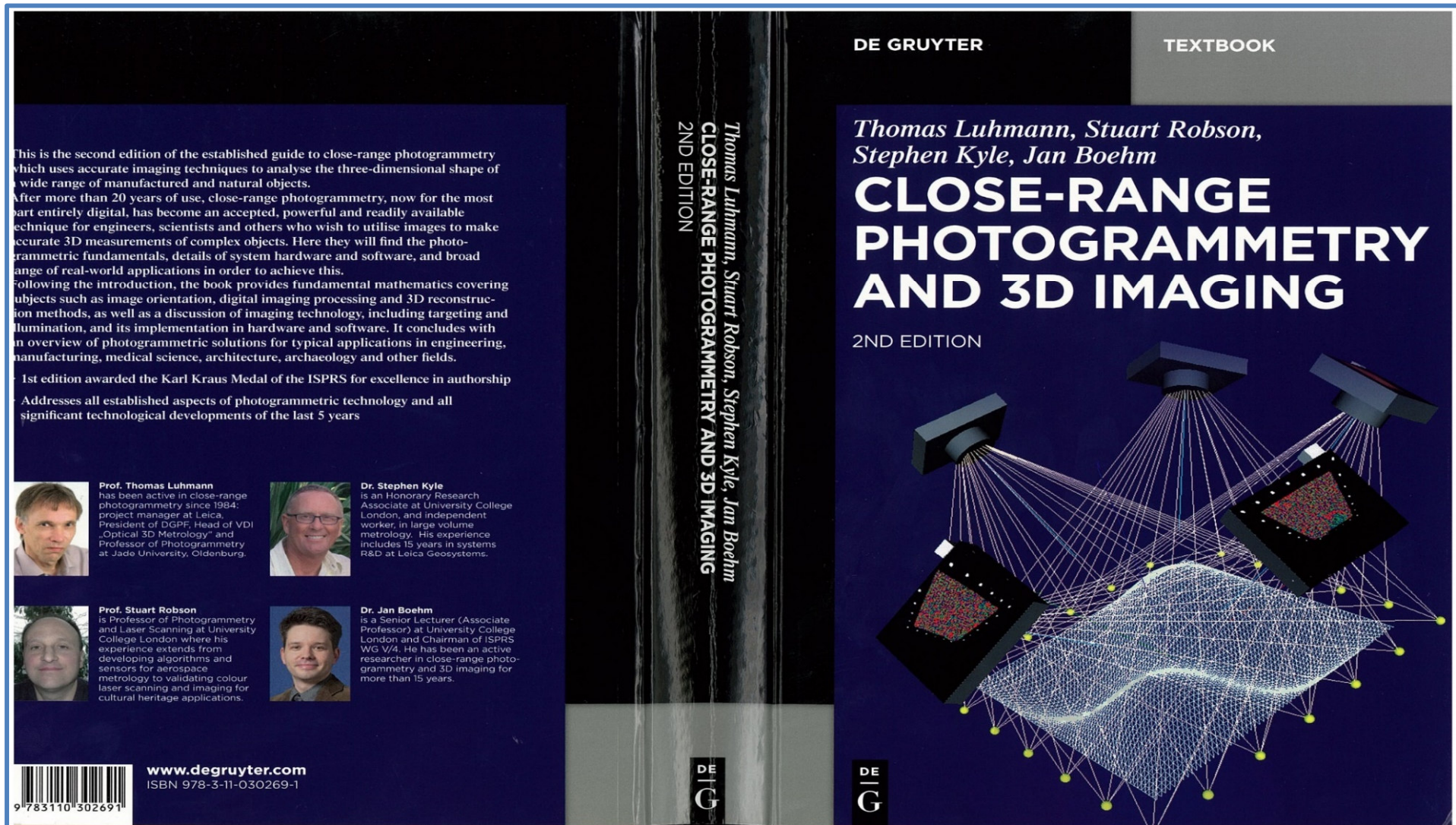
### Bundle Triangulation

: Kobe earthquake -1995- aerial triangulation





**Dr. Thomas Luhmann et. al.: translated in 2018**





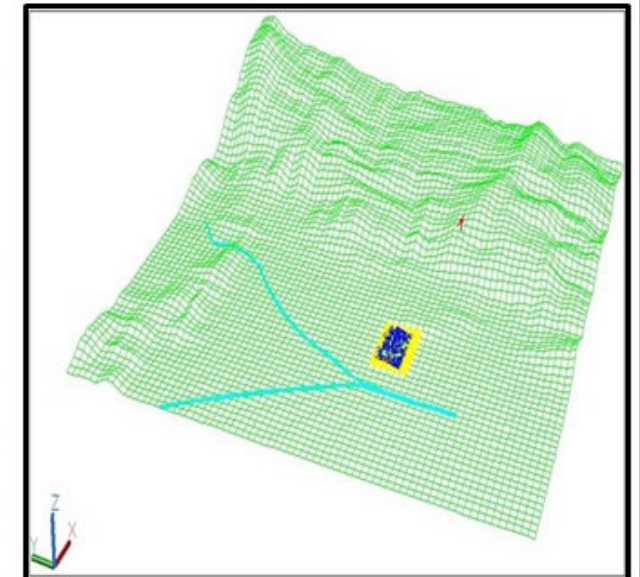
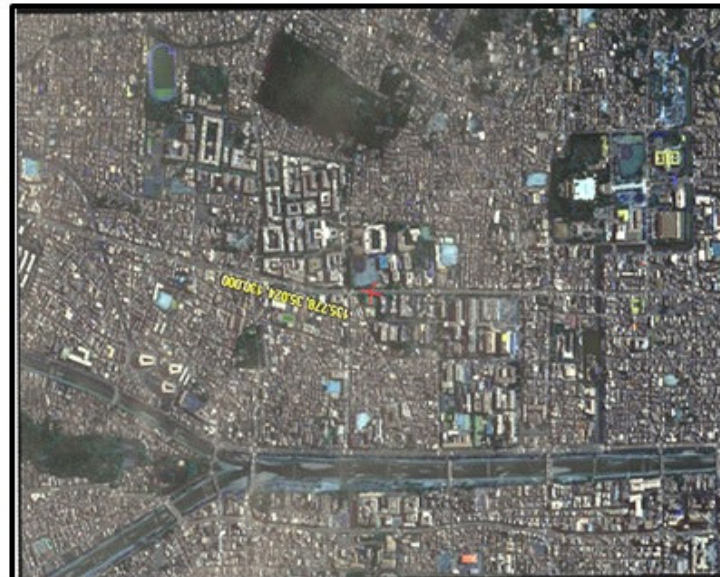
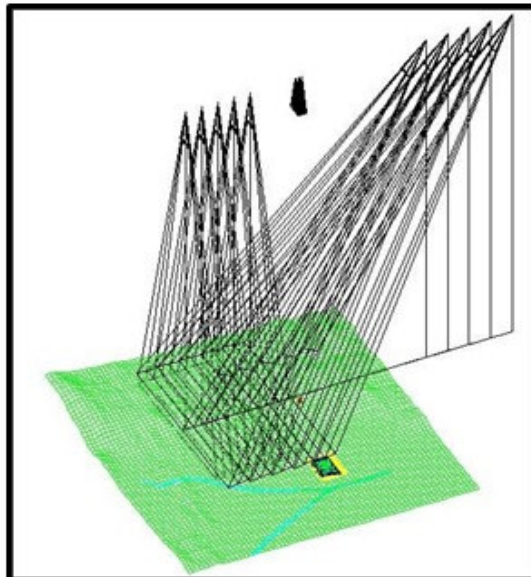
## 2.08 Satellite Photogrammetry

### Satellite stereo-image model – 3D Mapping

#### Kyoto University stereo Pair : World View2

##### 衛星画像3D-Mapping: Satellite stereo-image model – 3D-Mapping

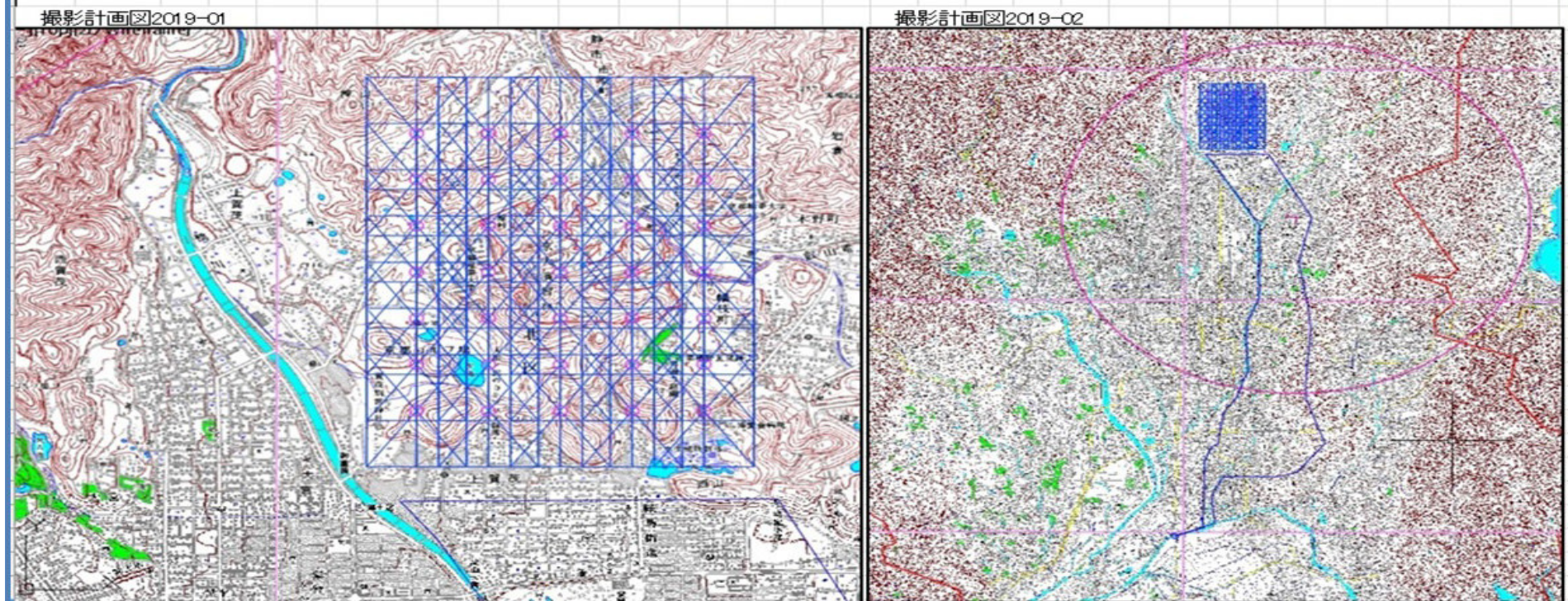
- (1) リモートセンシングは衛星画像3D-Mapping: 衛星画像航測法に進化する。  
Remote Sensing technology evolves to Satellite Image Photogrammetry for 3D-Mapping.
- (2) 高解像度衛星画像は航空撮影の精度: 地上精度10cmに達した。  
High resolution satellite imagery realizes ground accuracy of 10cm, as aerial photogrammetry reached.
- (3) 航測法(航空写真、衛星画像)は、3D-CADによる3D-Mappingに、3D画像モデルを提供する。  
3D Photogrammetric models, with CAD maps and CAD globe on 3D-CAD, represents Historical Reality.
- (4) 3D画像モデル-4D画像地図は、画像アーカイブとして、国土情報制度(GISe)の社会基盤である。  
3D-Image models and 4D-Image maps represent infrastructural basis of GeoInformationsSysteme.





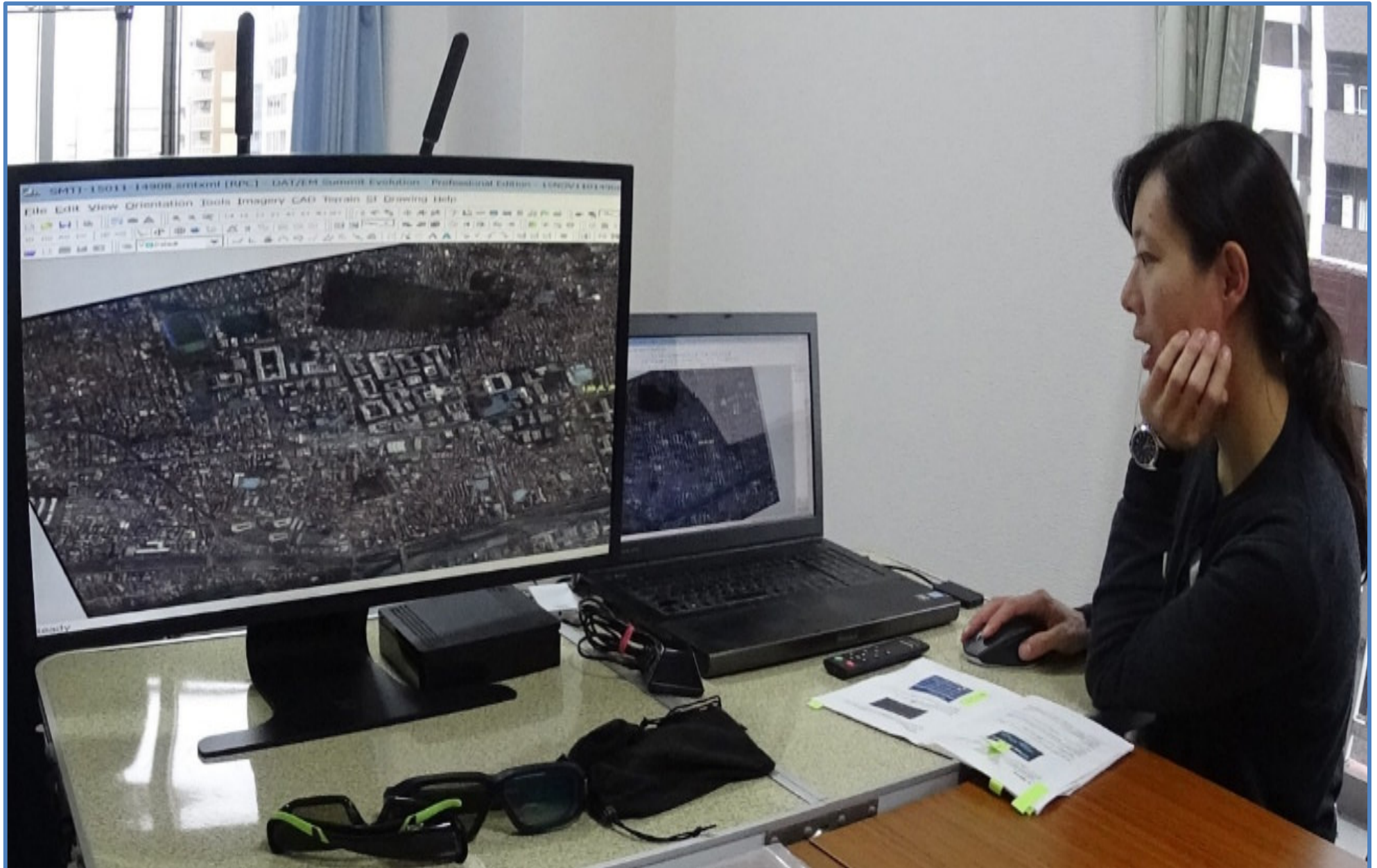
## 2.09 Helicopter photogrammetry - flight plan 2019

### Kyoto Univ. Kamigamo Forest

[illegible]



## 2-10 3D-displays without and with Glasses (GeoNet, Inc.)



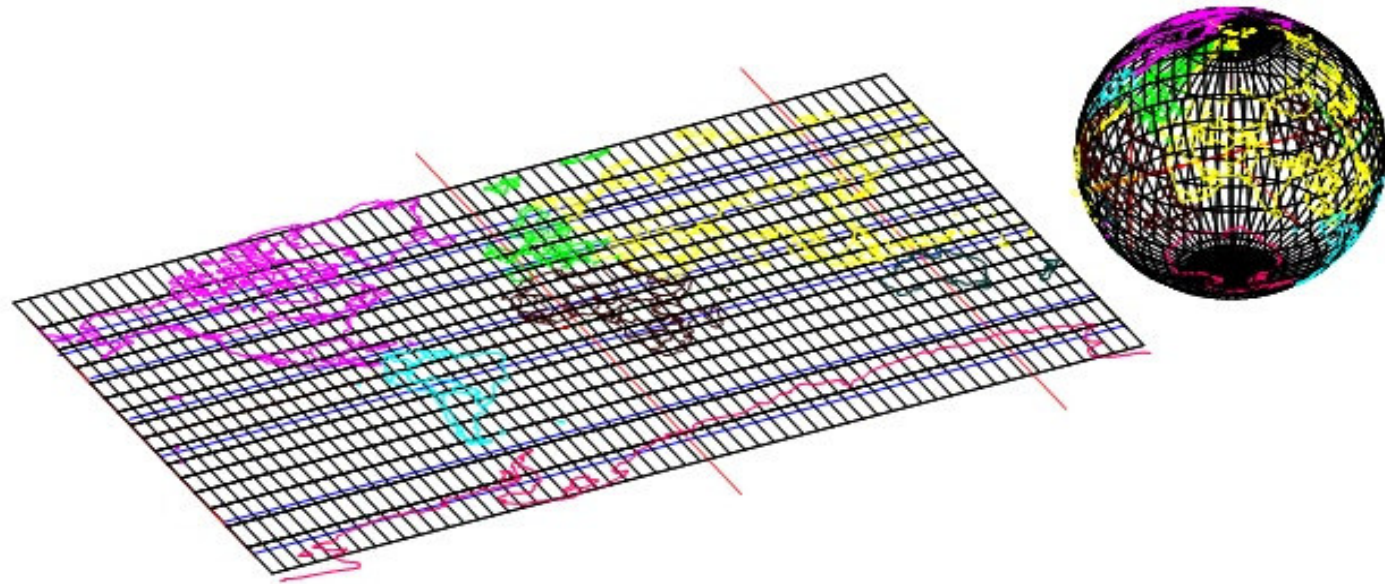
## **2.20 Historical Reality of old maps and photogrammetric 3D models based on 4D-Image Map Archive Designed Aerial Survey (IMADAS)**





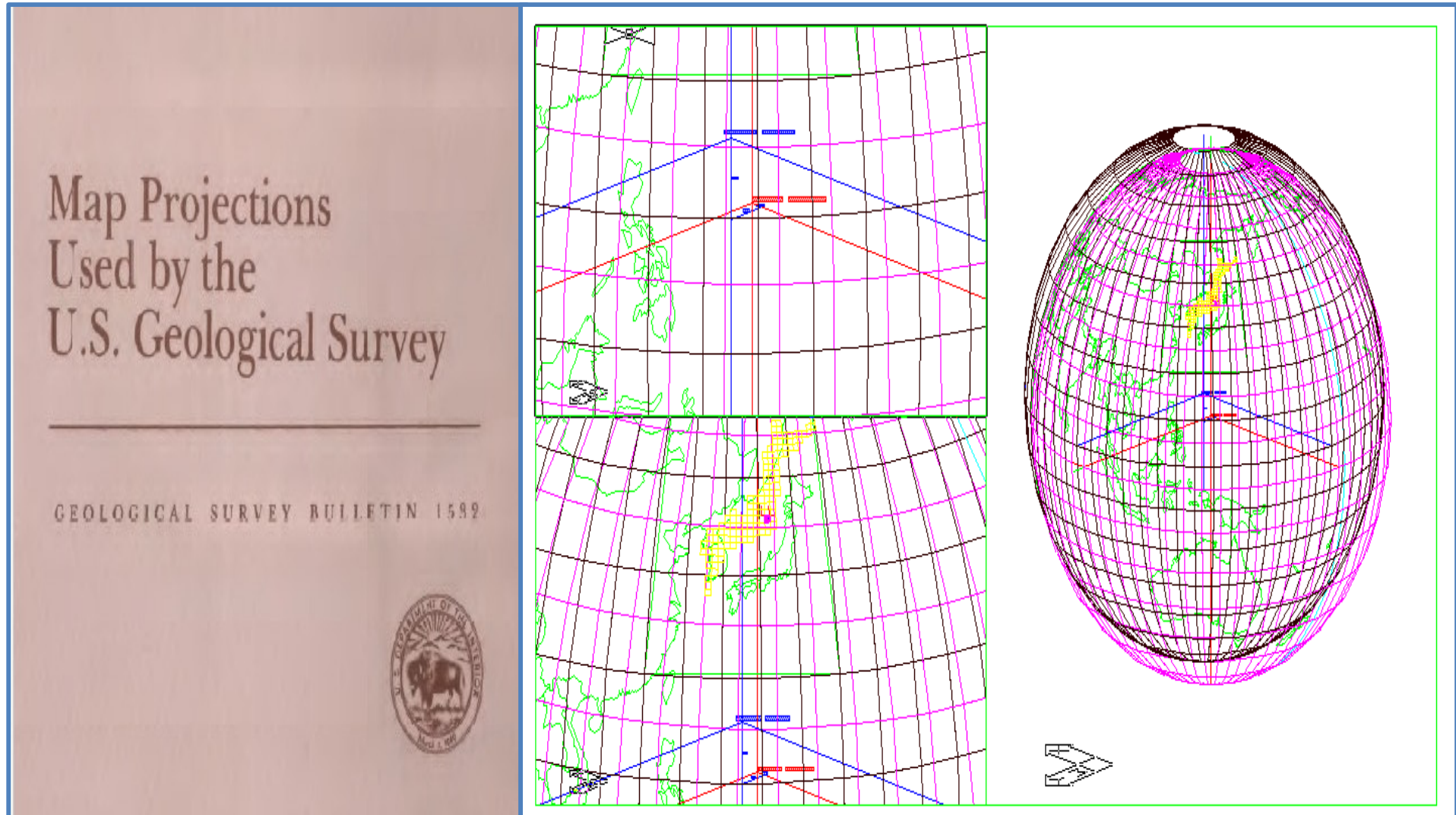
## 2.21 CAD-globe and Map projections on 3D CAD

地図と地球儀



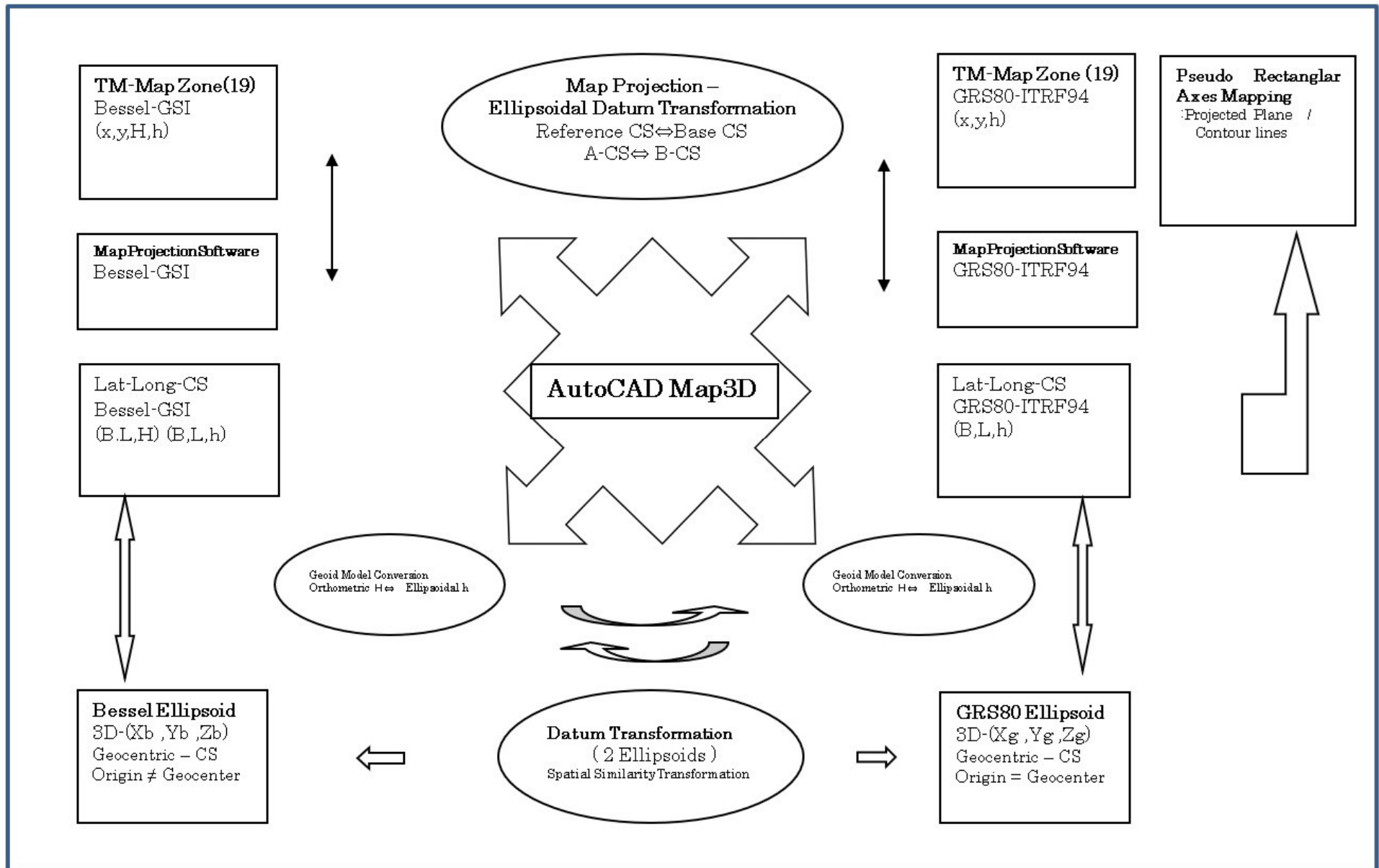
3D Coordinate System in Map Projection, CAD-Globe  
and Geophysical Global Coordinate System ( Frame ) 1992; ISPRS Washington

## 2.22 Map projection and Global rectangular coordinate system USGS-map projections-Bulletin-1532

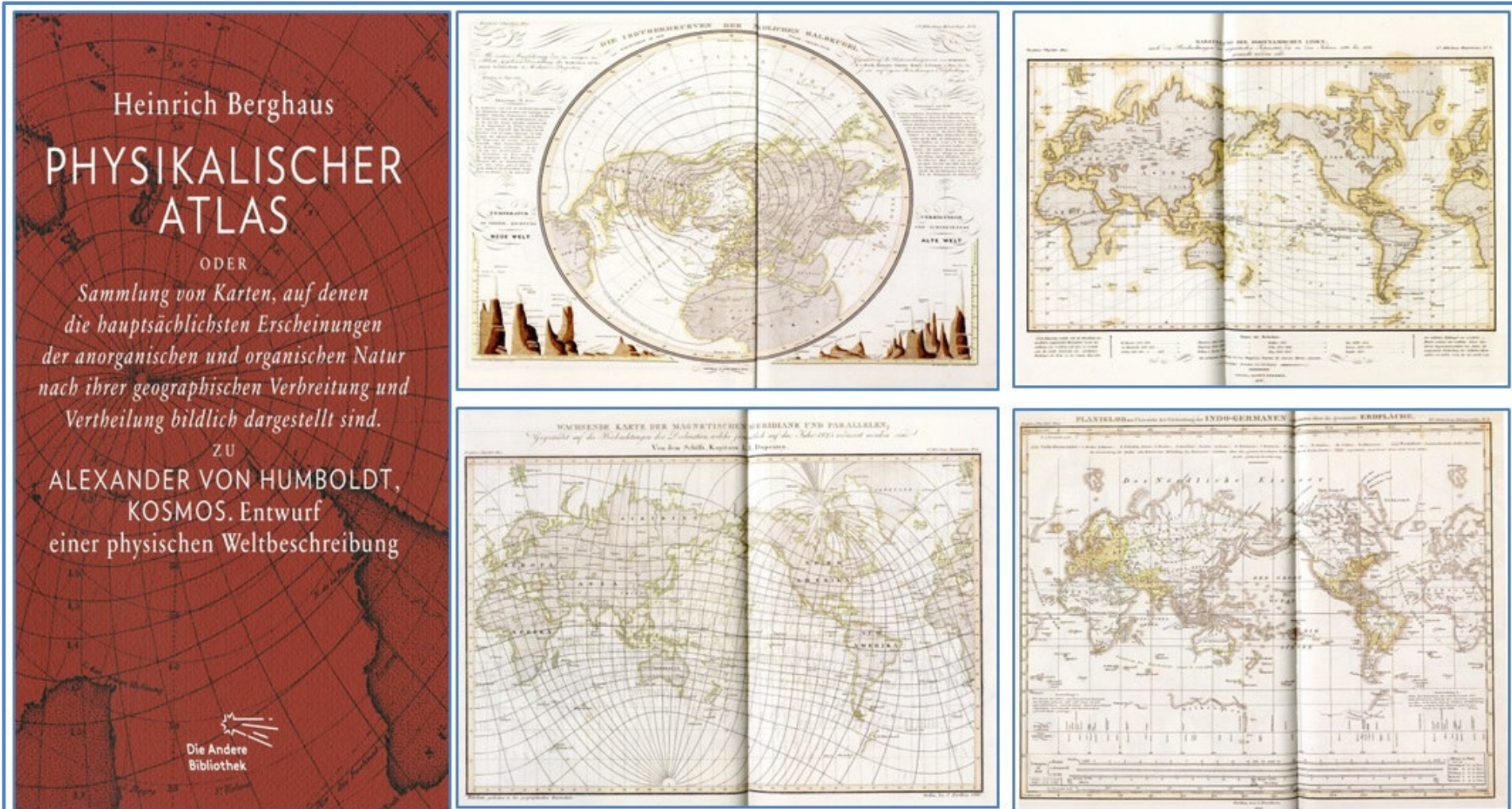




## 2.23 4D- Image Map Archive on World Geodetic System with Datum transformation



## 2.24 KOSMOS- Physikalischer Atlas (1848) : Ellipsoid and map projections



**“Heinrich Berghaus : Physikalischer Atlas zu Alexander von Humboldt, KOSMOS,  
Entwurf einer physischen Weltbeschreibung”**

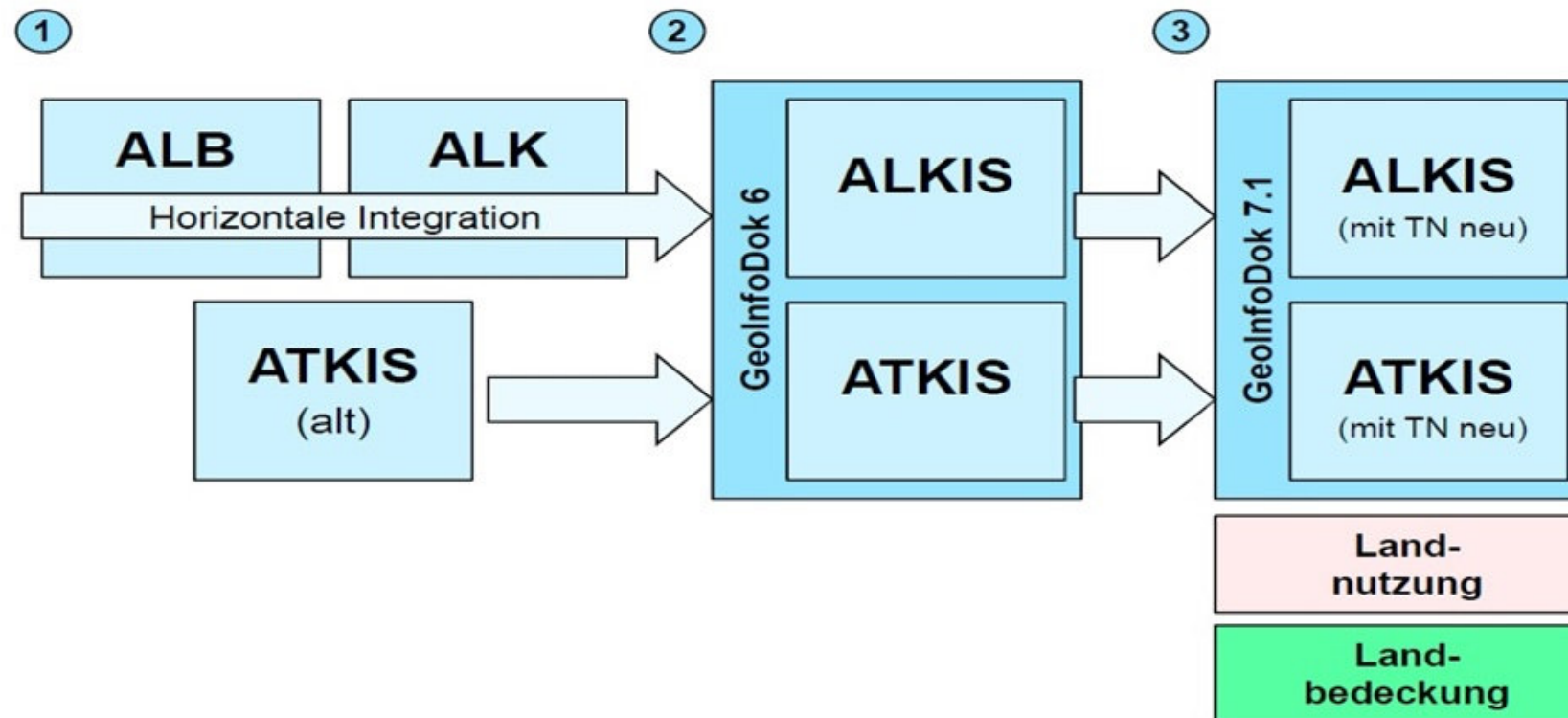


## 2.25 Cadastral registration in 3D-GIS standard : German GISE ; GeoInfoDok 7.1 ALKIS future



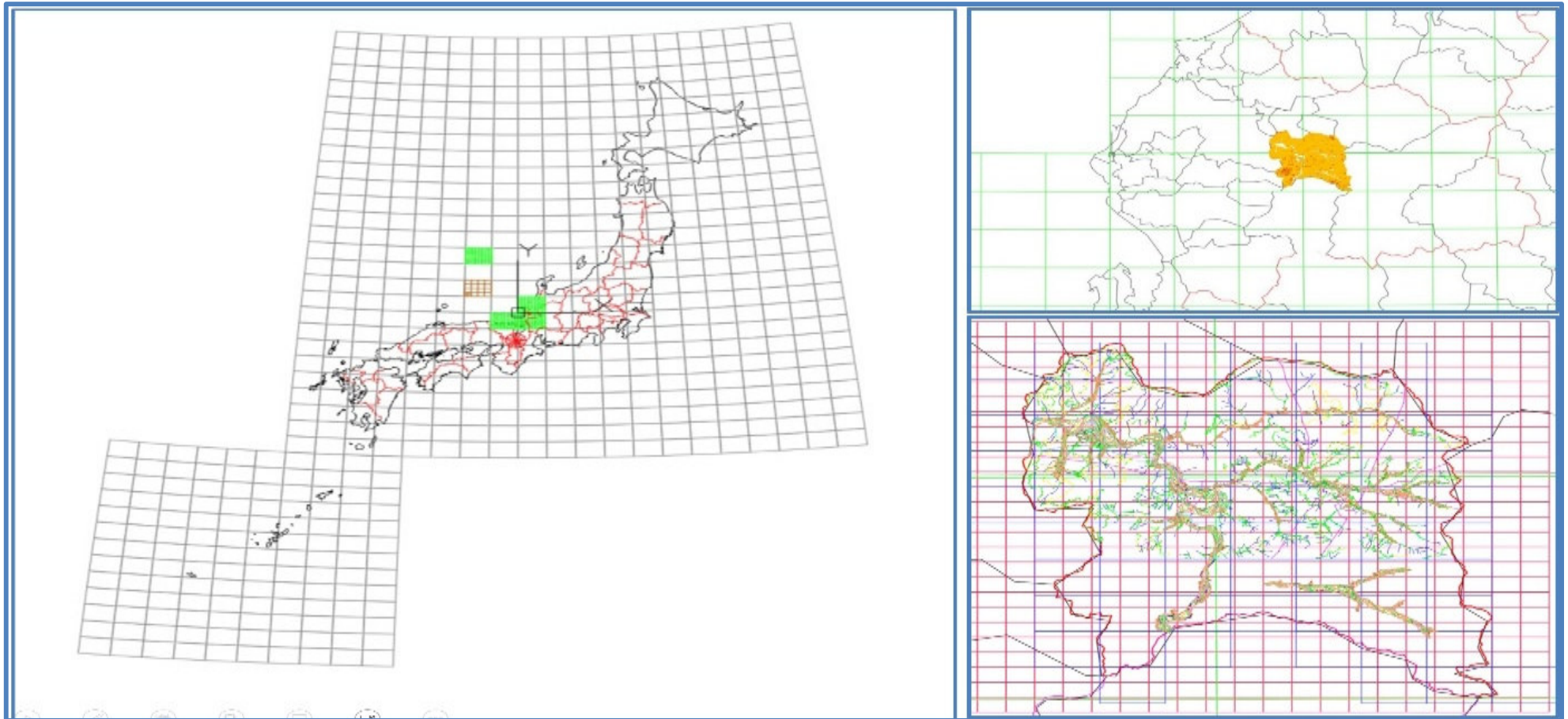
Arbeitsgemeinschaft der Vermessungsverwaltungen  
der Länder der Bundesrepublik Deutschland

Geobasisdaten morgen:  
GeoInfoDok 7.1 + LB + LN



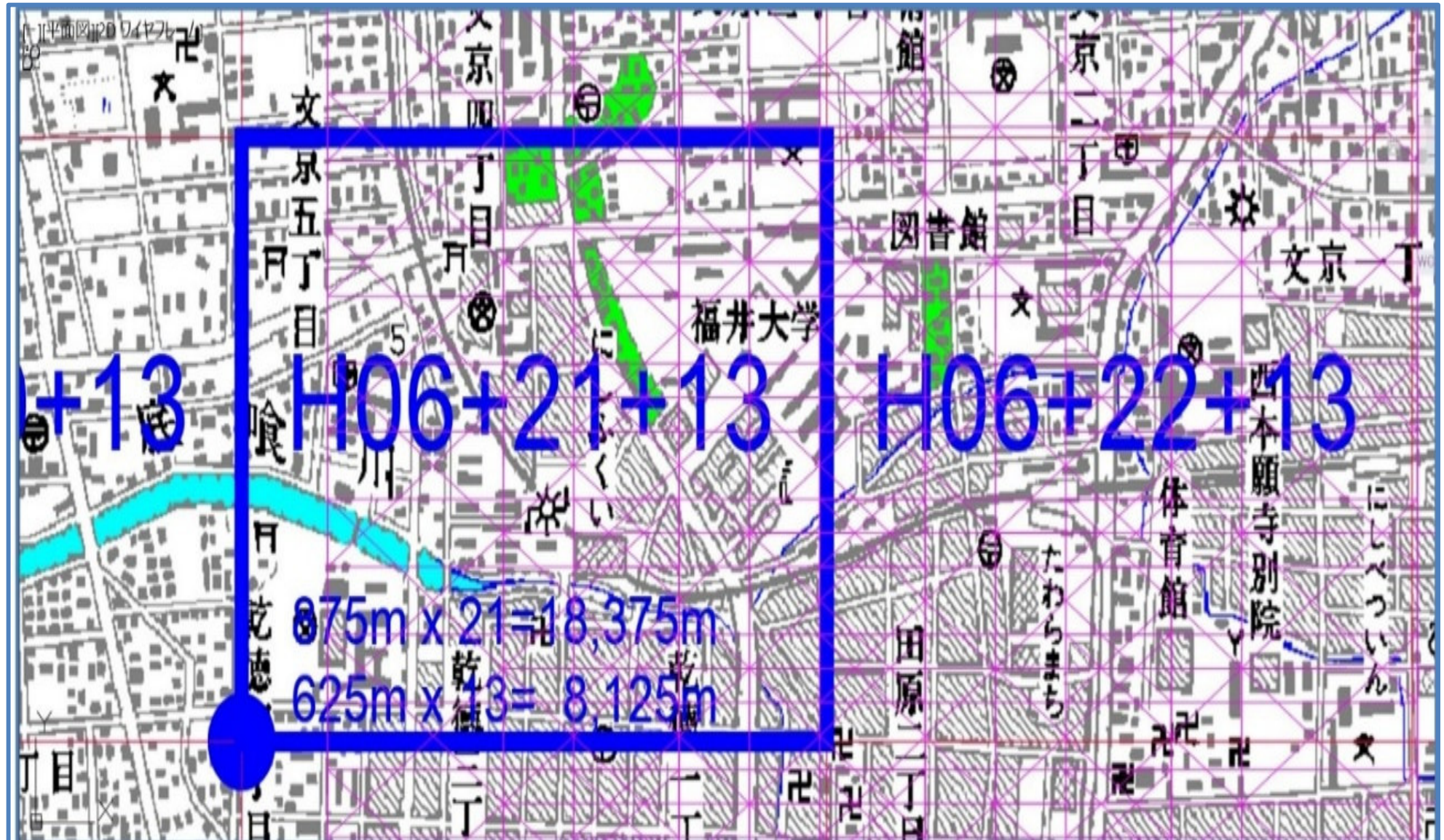
### **3. Fukui City - 3D-Cadastral Map and Kyoto University - 3D-Forest Map**

#### **3.10 Fukui City - 3D cadastral mapping in the national map-grid system**





### 3.11 Cadastral Map Grid-Number- Univ. of Fukui





## 3.20 Kyoto University - 3D-Forest Map

### ASHIU FOREST RESEARCH STATION

Ashiu, Miyama-cho, Nantan-shi, Kyoto, 601-0703

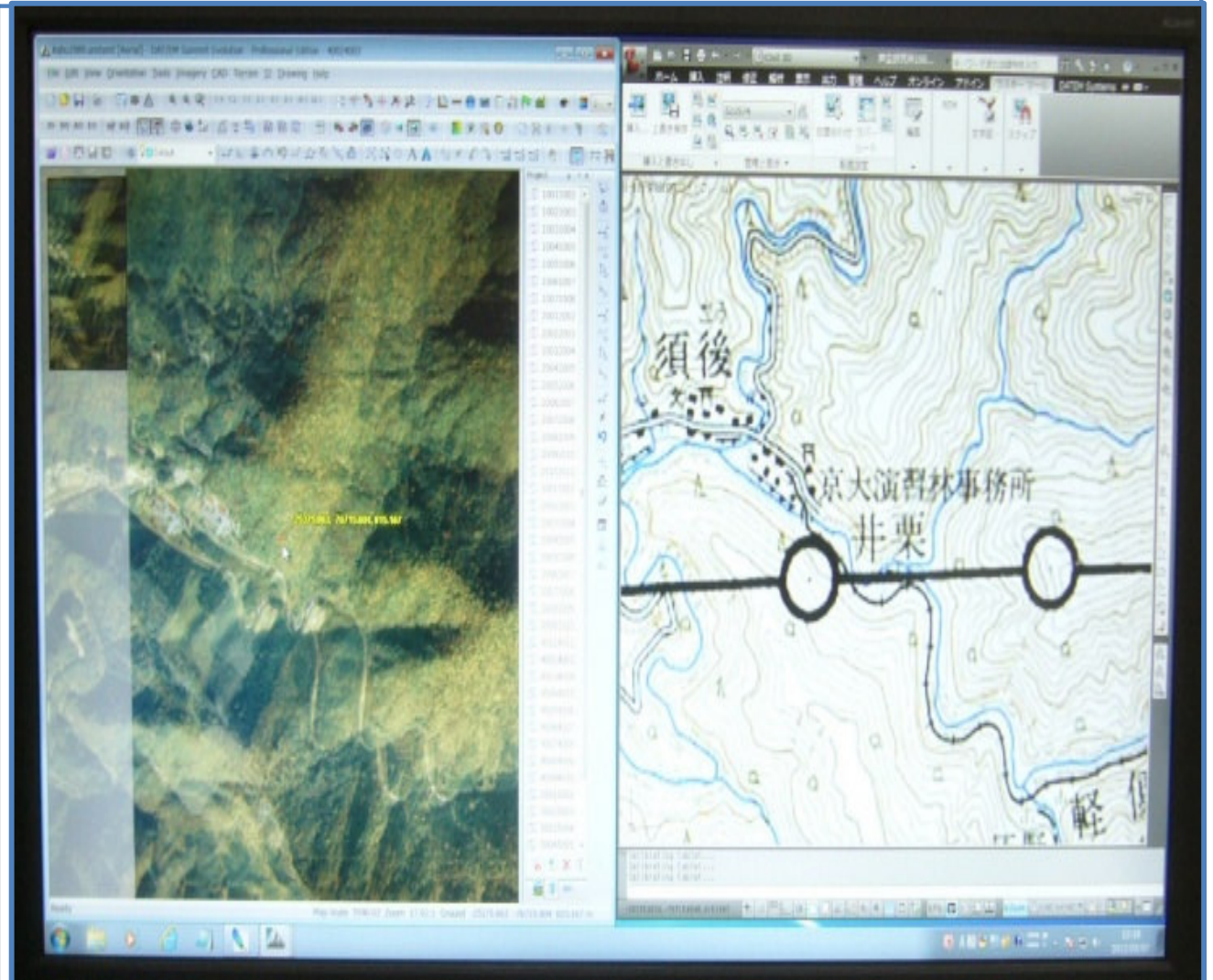
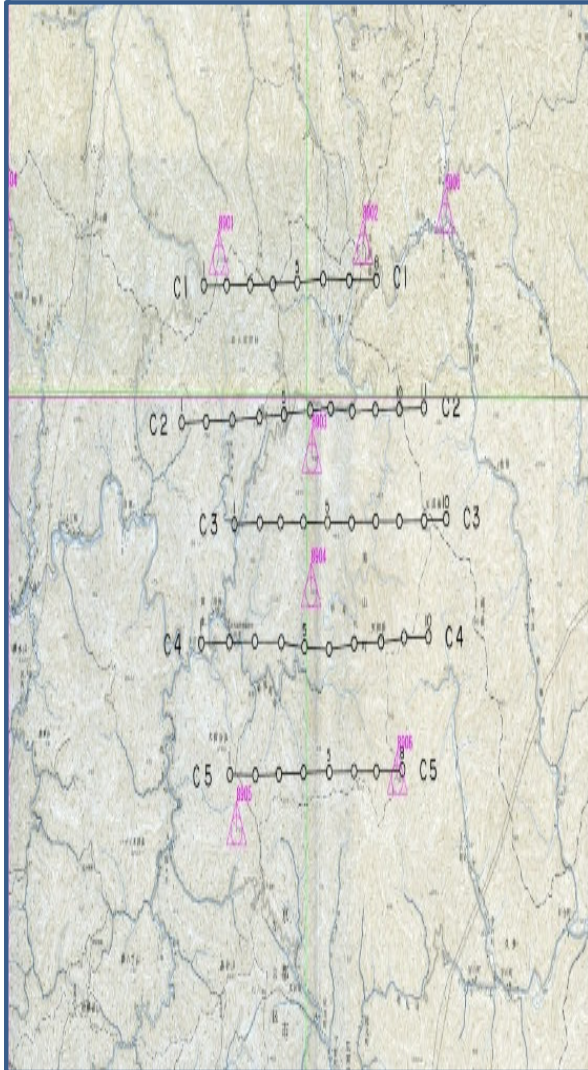
Tel. +81-771-77-0321 Fax. +81-771-77-0323

Mail. [ashiu.cans@mail2.adm.kyoto-u.ac.jp](mailto:ashiu.cans@mail2.adm.kyoto-u.ac.jp) (\* → @)



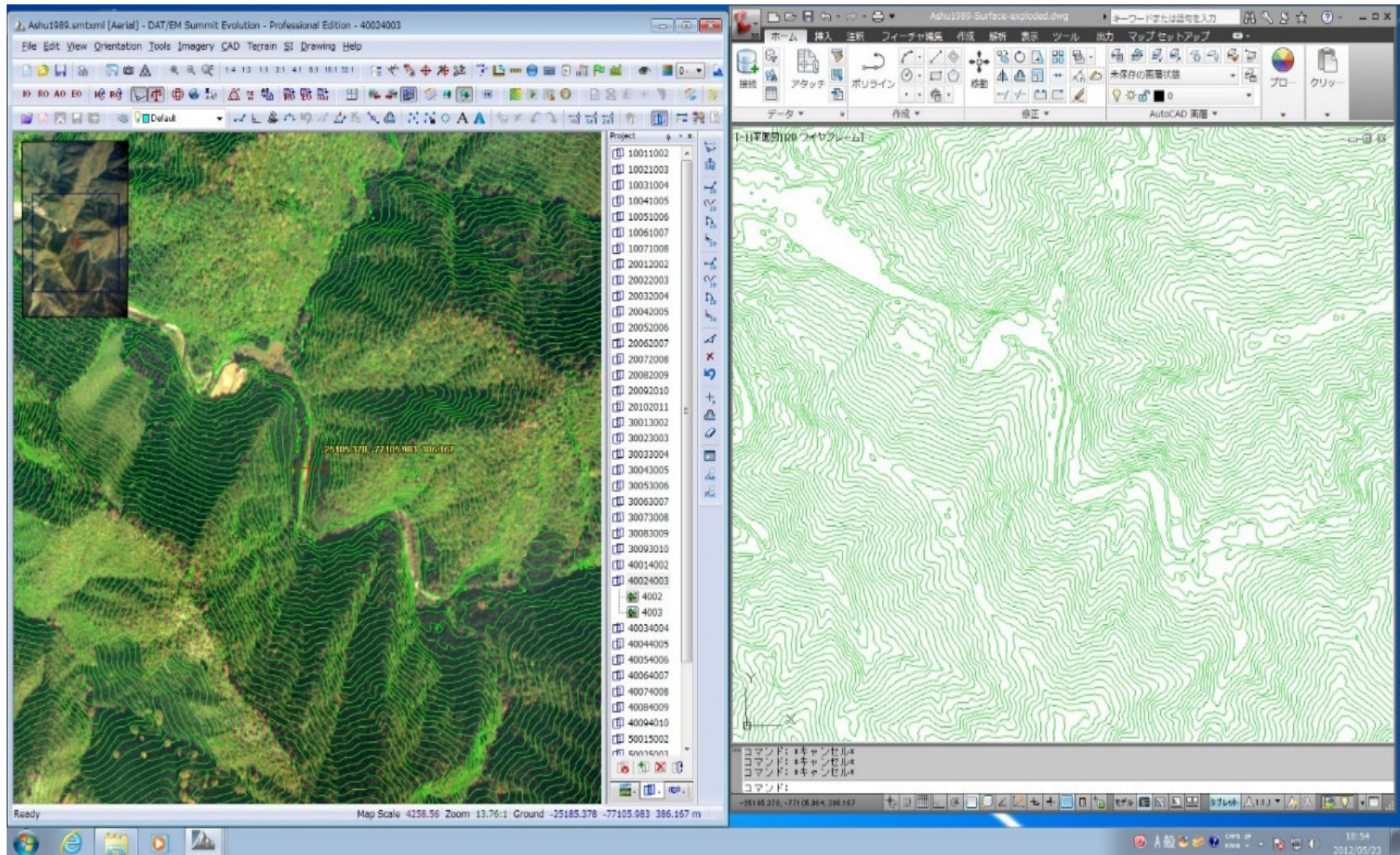


# 3.21 3D forestry mapping – procedure and products Aerial Photo Index map (1989) and 3D image model as 3D forest map



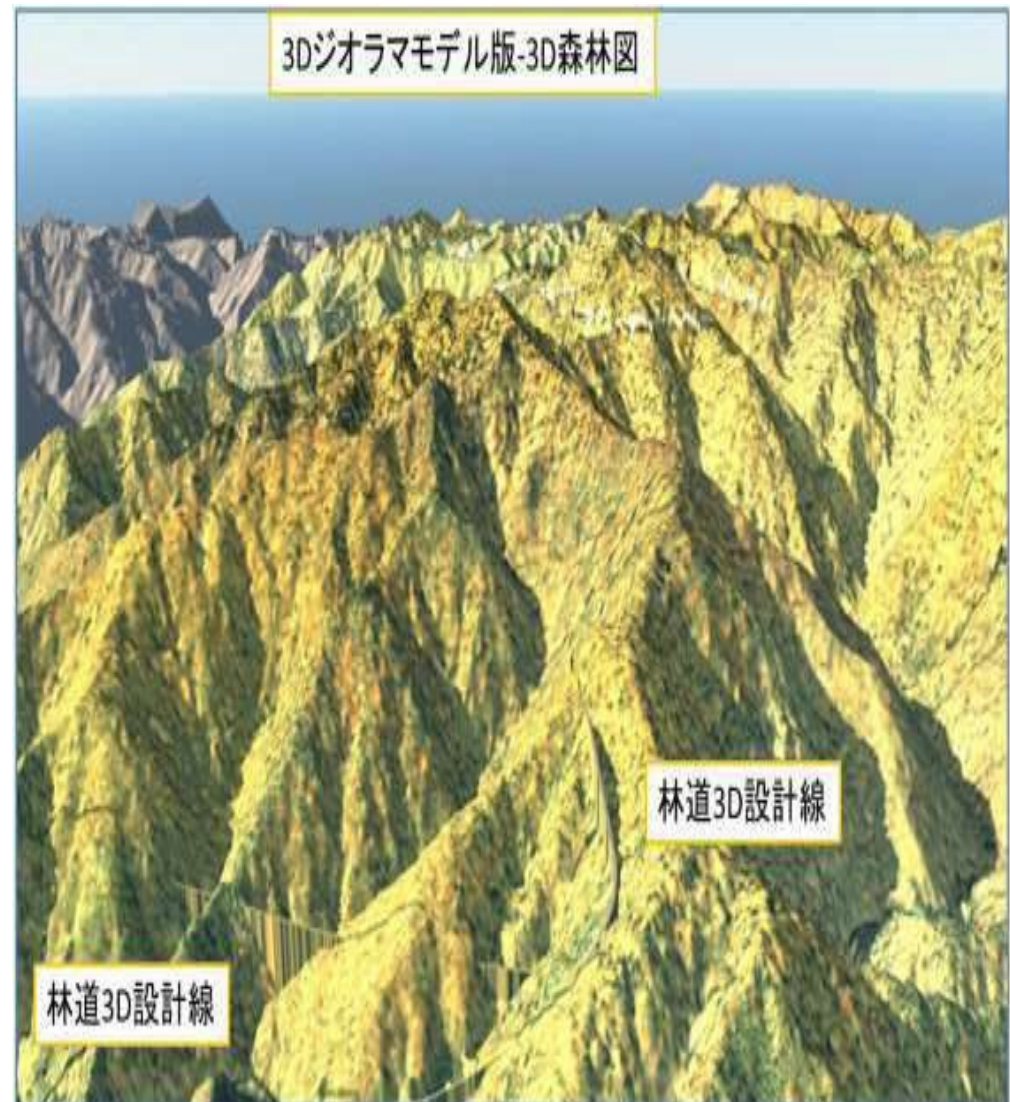
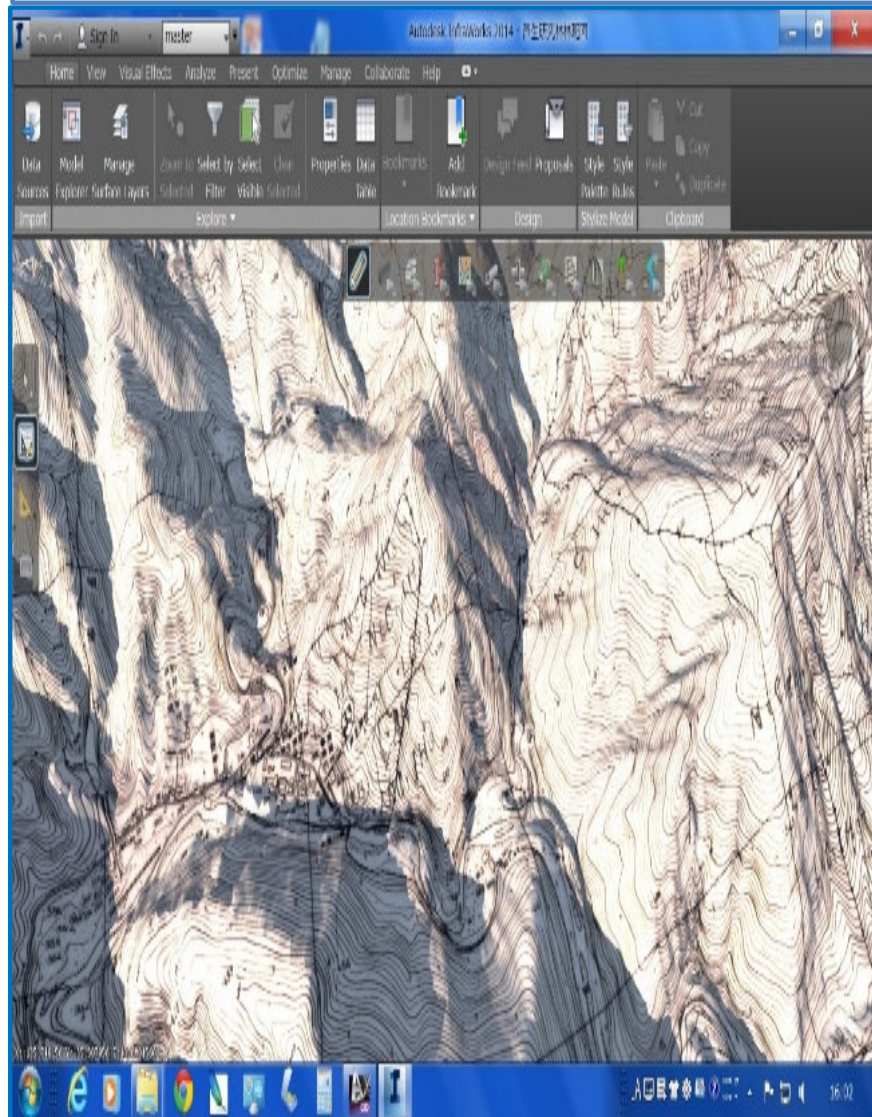


## 3.22 Contour lines from TIN surface model , on 3D forest map





## 3.23 3D forest compartment boundary : Forest-road design





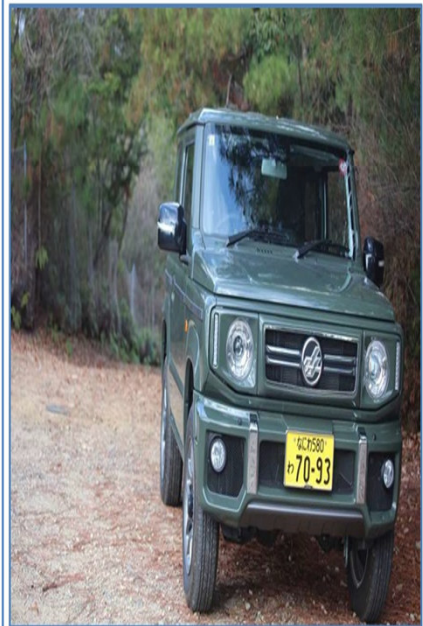
# 3-30 DGPS and GNSS survey(2023) and Harvester 3D mapping with TL-Scanner



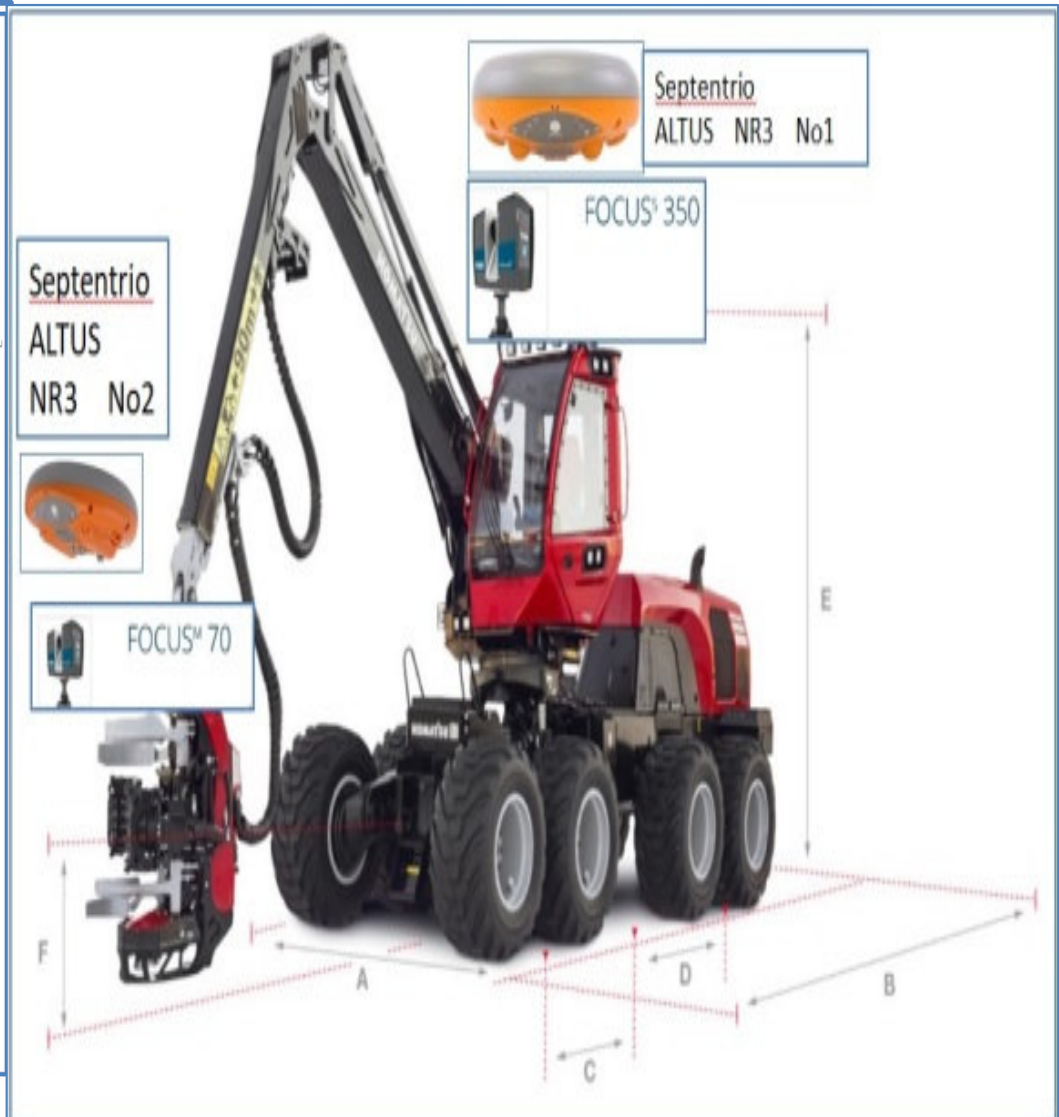
画像 1-19 京都大学上賀茂試験地基準点：基-1-1001



画像 1-20 京都大学上賀茂試験地基準点：基-2-1002



画像 1-21 20231219-基-2-1002.4 軽自動車 Jimny：車両屋根に DGPS アンテナ設置





# 3-31 Forest-road design (Japan Forestry Agency) and German Harvester vehicle

## 林道規程-6-設計車両：Design vehicle 林道規程-10-曲線半径：Curve radius

### 第3章 自動車道の構造

#### (設計車両)

第9条 自動車道の設計に当たっては、次の表の左欄に掲げる自動車道の区分に応じ同表の右欄に掲げる自動車は、安全かつ円滑に通行することができるようにするものとする。

| 区 分     | 設計車両  |
|---------|-------|
| 1 高速自動車 | 普通自動車 |
| 2 一般自動車 | 小型自動車 |

2 設計車両の種類ごとの諸元は、それぞれ次の表に掲げる値とする。

| 諸元(メートル) | 長さ  | 幅   | 高さ  | 前輪オーバーハング | 軸 距 | 後輪オーバーハング | 最小回半径 |
|----------|-----|-----|-----|-----------|-----|-----------|-------|
| 設計車両     | 4.7 | 1.7 | 2   | 0.8       | 2.7 | 1.2       | 6     |
| 小型自動車    | 12  | 2.3 | 2.8 | 1.5       | 2.5 | 1.2       | 12    |

この表において、次の各号に掲げる用語の意義は、それぞれ当該各号に定めるところによる。

- 1 前輪オーバーハング  
車体の前輪から前輪の車軸の中心までの距離をいう。
- 2 軸 距  
前輪の車軸の中心から後輪の車軸の中心までの距離をいう。
- 3 後輪オーバーハング  
後輪の車軸の中心から車体の後端までの距離をいう。

#### 【細部運用】

セムトラクタの通行する林道においては、次の平面的諸元に基づき構造を決定しなければならない。ただし、立体的諸元その他の性能に基づく構造については、普通自動車に準じて差し支えない。

| 諸 元    | 長さ   | 幅   | 前輪オーバーハング | 軸 距 | 後輪オーバーハング | 最小回半径 |
|--------|------|-----|-----------|-----|-----------|-------|
| 設計車両   |      |     |           |     |           |       |
| セムトラクタ | 16.5 | 2.5 | 1.3       | 4.0 | 9.0       | 2.2   |

#### (幅 員)

第10条 車道及び車道の幅員は、次の表の左欄に掲げる自動車道の区分に応じ、同表の右欄の幅員及び車道幅員の欄に掲げる値とする。

| 区 分 | 車道の幅員(メートル)      | 車道幅員(メートル)       |
|-----|------------------|------------------|
| 1 級 | 2車線のもの<br>1車線のもの | 2.75<br>—<br>4.0 |
| 2 級 | —                | 3.0              |
| 3 級 | —                | 2.0又は1.8         |

#### (曲線半径)

第18条 車道の曲線部の中心線の曲線半径(以下「曲線半径」という。)は、当該自動車道の設計速度に応じ、次の表の曲線半径の欄の各区分欄に掲げる値以上とする。ただし、車輦の状況その他の理由によりやむを得ない場合には、交通安全施設等を設置して、同表の曲線半径の欄の各区分欄の右欄に掲げる値より縮小することができるものとする。

| 設計速度(キロメートル毎時) | 区 分 | 曲 線 半 径 (メートル) |        |     |     |
|----------------|-----|----------------|--------|-----|-----|
|                |     | 2車線のもの         | 1車線のもの | 2 級 | 3 級 |
| 40             | —   | 60             | 40     | —   | —   |
| 30             | —   | 30             | 25     | 30  | 20  |
| 20             | —   | 20             | 15     | 15  | 12  |
| 15             | —   | —              | —      | 12  | 6   |

#### 【細部運用】

地形の状況その他の理由によりやむを得ない場合の縮小値を用いるときは、当該箇所における路面の摩擦係数、勾配、設計速度または通行速度の関係を十分に考慮し、必要に応じて

#### (曲線半径)

第16条 曲線半径、地

第1条 第1

もつは

ないこ

#### 【細部運用】

(1) 片勾

片勾

片勾

片勾

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片勾

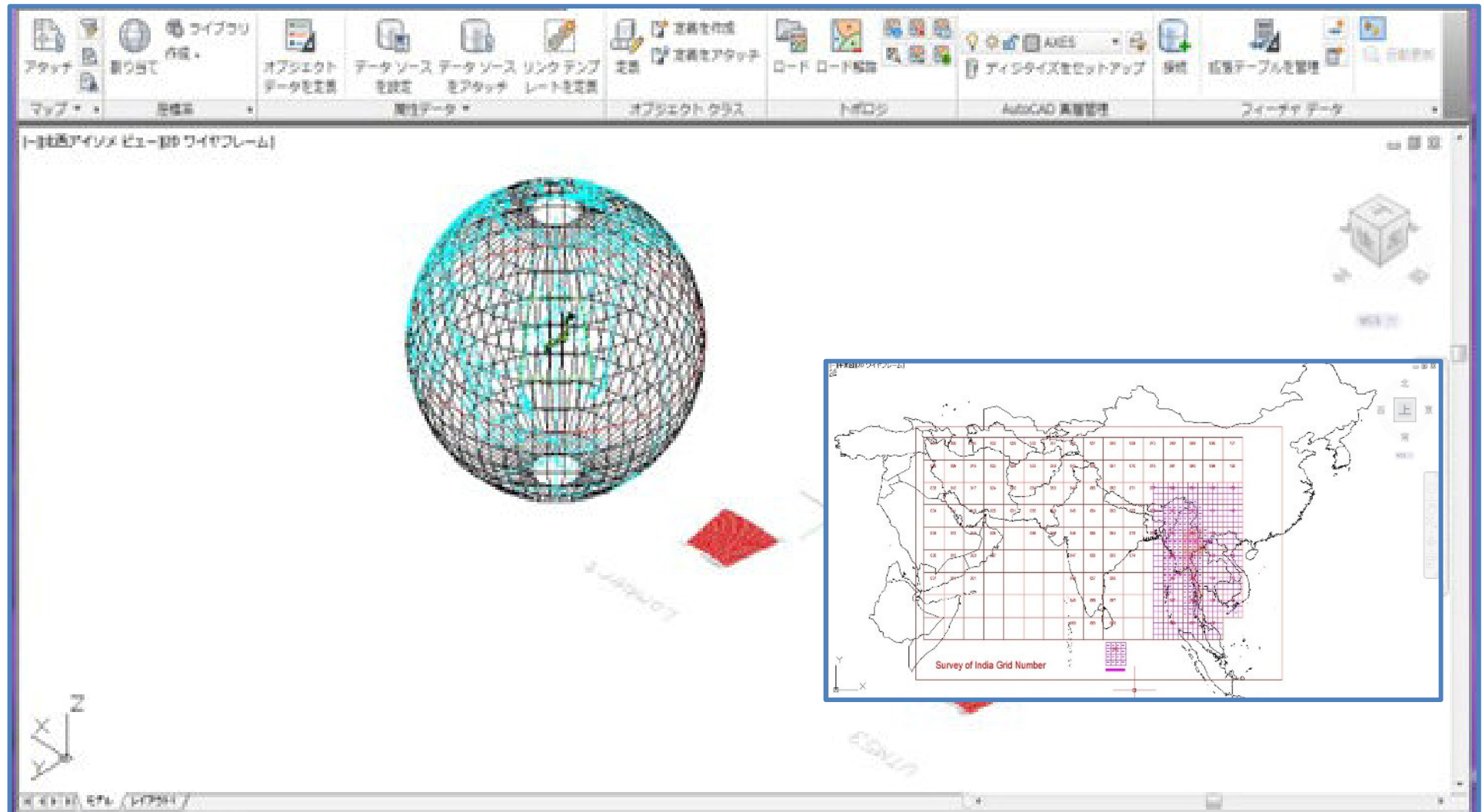
片勾



# 4. 3D cadastral map/forest map and 4D-IMADAS oriented CAD-Globe

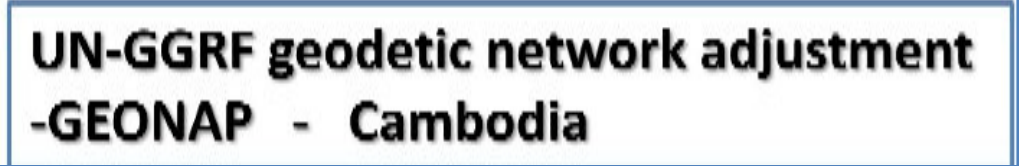
## 4.1 3D CAD maps and CAD-Globe in the same CAD coordinates system

CAD Globe and CAD Maps : Survey of India - Grid Number



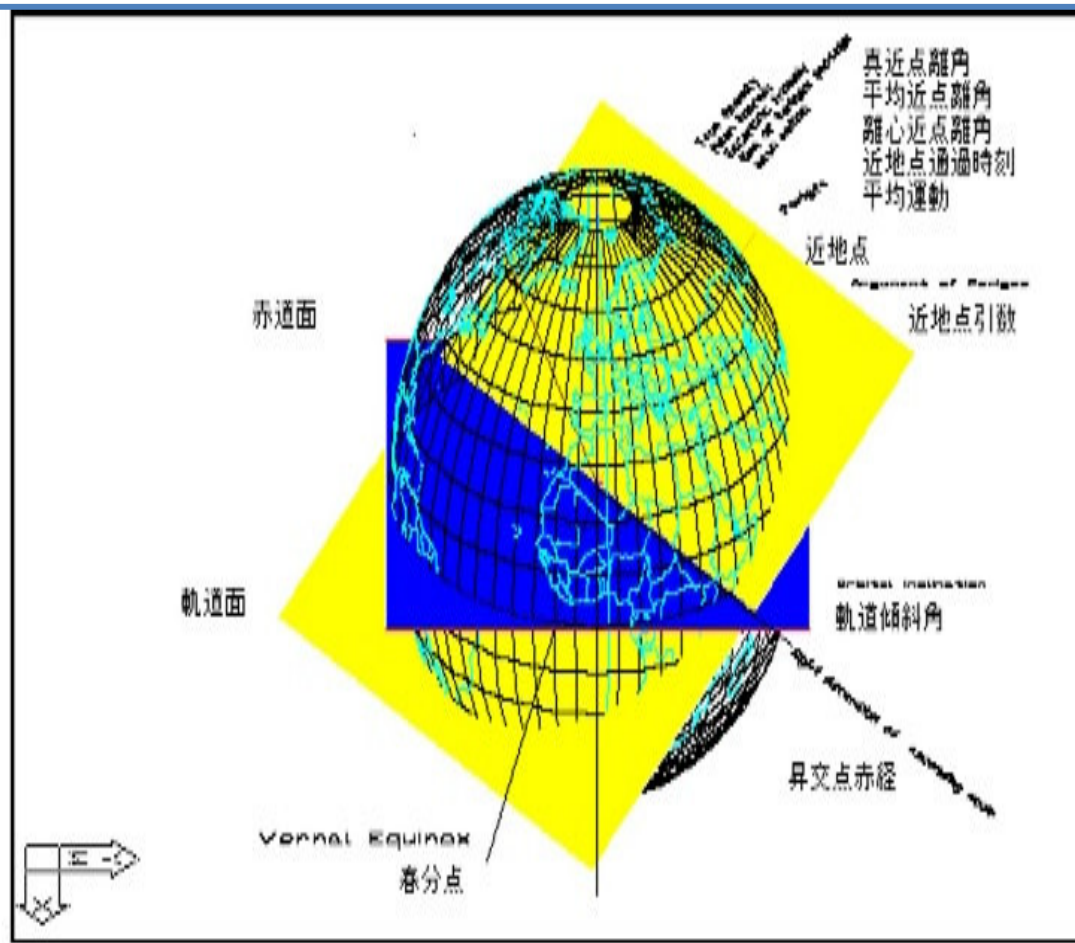
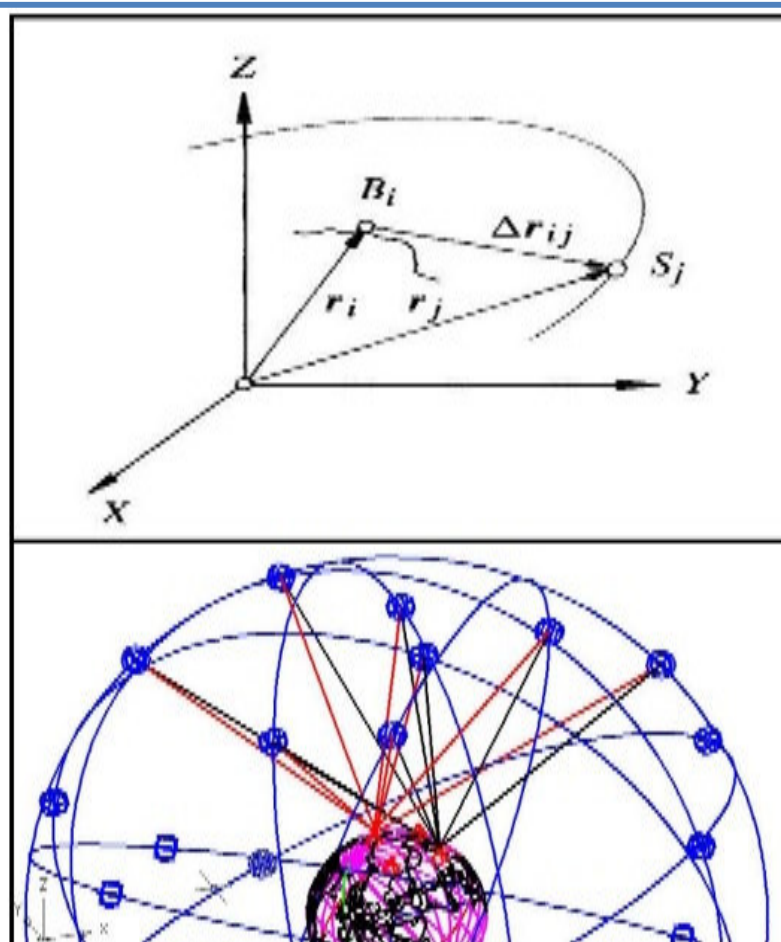


## 4.2 3D CAD maps as UN-GGIM platform , based on UN-GGRF initiatives



## 4.3 UN-GGRF – GEONAP -Japan – Cambodia

### Parameter Estimation Gnss Assisted Surveying System(PEGASUS)



**PEGASUS – GNSS satellites as Global Control Points**





**WORKING  
WEEK 2025**



**Locate25** | **G**  
THE NATIONAL GEOSPATIAL CONFERENCE



INTERNATIONAL FEDERATION  
OF SURVEYORS



**Geospatial**  
Council of Australia

Collaboration, Innovation and Resilience:  
Championing a Digital Generation

Brisbane, Australia 6–10 April

**Fukui City - 3D-Cadastral Map  
and Kyoto University - 3D-Forest Map  
based on 4D-Image Map Archive Designed  
Aerial Survey  
(4D-IMADAS)**

**Thank you very much  
for your kind attention !!!**

**Hiroyuki HASEGAWA, GeoNet, Inc. , Japan**

**2025.4.9**

# Yui Hasegawa : My favorite soccer player

Yui Hasegawa is the Best Midfielder in the WSL. Here's Why. | Analysis | Women's S...





# Acknowledgements

**This research paper has been supported by achievements of German authentic satellite geodesy. The author would like to express deep gratitude to Dr. Guenter Seeber and Dr. Gerhard Wuebbena, in the theoretical and practical sense.**

**New practices will be reflected to Japanese forestry specifications, which would be applied to forestry administration and national land survey project nationwide.**

## **References:** all are now translated in Japanese

**Bauer, Rainer et.al. (2015).**

**“Das deutsche Vermessungs- und Geoinformationswesen 2015”  
; Wichmann.**

**Luhmann, Thomas (2018). “Nahbereichsphotogrammetrie” ; Wichmann.**

**Niemeier, Wolfgang (2008). “Ausgleichungsrechnung”; Walter de Gruyter**

**Seeber, Guenter (2003). “Satellite Geodesy “; Walter de Gruyter**



# 20241204-Acceptance of FIG paper (no.13054)



FIG=fig.net@massmail.fig.net が代理で送信: FIG@fig.net  
宛先 hasegawa@geonetz.com

返信

全員に返信

転送

...

2024/12/04 (水) 18:38

i 2024/12/04 20:21 にこのメッセージに返信しました。  
このメッセージから余分な改行を削除しました。

Dear Hiroyuki Hasegawa,

Thank you for submitting an abstract (ID 13054) for peer review to the FIG Working Week 2025 in Brisbane, Australia PEER REVIEW .

Below is a summary of the information that was provided.

Please make sure that all of your contact information, name and country of the authors, the title of your presentation, and your abstract are complete and correct, as they will be printed as you have submitted them.

In particular, please ensure that your presentation title and abstract are not truncated due to character and word limits.

# TS07 : (13054)

## An analog earth in digital models, capturing world around us Presentation-2025-04-09-14hr

| WEDNESDAY 9 APRIL |                                                                                                                                         |                                                        |                                                                                   |                                                                                       |                                                                                            |                                                            |                                                                                        |                                                                                |                                                       |                                                                                                                                                                   |                                                                                                     |                                                                        |                                   |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------|
|                   | Plaza Ballroom                                                                                                                          | Auditorium                                             | P1                                                                                | P2                                                                                    | P4                                                                                         | P5                                                         | P6                                                                                     | P7                                                                             | P8                                                    | P9                                                                                                                                                                | P10                                                                                                 | P11                                                                    | Plaza Terrace Room                |
| 0730-0900         |                                                                                                                                         |                                                        | 0730-0845<br>Presidents Meeting<br>(by invitation only)                           |                                                                                       |                                                                                            |                                                            |                                                                                        |                                                                                |                                                       |                                                                                                                                                                   |                                                                                                     |                                                                        |                                   |
| 0900-1100         | <b>Plenary Session 3</b><br>Plaza Ballroom<br>Building Foundational Capabilities that Support People in the Built and Ocean Environment |                                                        |                                                                                   |                                                                                       |                                                                                            |                                                            |                                                                                        |                                                                                |                                                       |                                                                                                                                                                   |                                                                                                     |                                                                        | She Maps Teachers' Drone Workshop |
| 1100-1130         | MORNING TEA                                                                                                                             |                                                        |                                                                                   |                                                                                       |                                                                                            |                                                            |                                                                                        |                                                                                |                                                       |                                                                                                                                                                   |                                                                                                     |                                                                        |                                   |
| 1130-1300         | Technical Session - TS06                                                                                                                |                                                        |                                                                                   |                                                                                       |                                                                                            |                                                            |                                                                                        |                                                                                |                                                       |                                                                                                                                                                   |                                                                                                     |                                                                        |                                   |
|                   | Resilient PNT: What, Why, How, Who and When? (C5)                                                                                       | Marine Cadastre and Applications (C7)                  | The Nexus Between SDG's and Professional Education in Geospatial World – (SDG TF) | Is the Future of our Profession a Coherent and Merged Approach joint FIG/WGIC session | Writing a successful grant application - Joint Aubrey Barker Fund / FIG Foundation Session | Sustainability, Climate Change and Real Estate Values (C9) | Indigenous Mapping                                                                     | SIDS Meeting & Talanoa 2 Regional Capacity Development Asia Pacific / Americas | World Bank Initiatives in the Asia and Pacific Region | Geospatial for Everyone: The Diversity & Inclusion Paper Forum                                                                                                    | Platinum Member Session<br>Trimble: Transforming Industries Through Trimble Technology              | Geospatial Technologies for Climate Resilience (C3)                    | She Maps Teachers' Drone Workshop |
| 1400-1530         | Technical Session - TS07                                                                                                                |                                                        |                                                                                   |                                                                                       |                                                                                            |                                                            |                                                                                        |                                                                                |                                                       |                                                                                                                                                                   |                                                                                                     |                                                                        |                                   |
|                   | An Analog Earth in Digital Models: Capturing the World Around Us (C5)                                                                   | Stray'n Land Administration Innovations Session 2 (C7) | Academic Forum                                                                    | Fit-for-Purpose Land Administration II (C7)                                           | Regional Capacity Development Meeting - African Region (ARN)                               | She Maps Teachers' Drone Session 1                         | Advancing Hydrospatial Intelligence: Innovation and Resilience in the Digital Era (C4) | Digital Transformation Strategies in the Construction Industry (C10)           | Cadastral Digitisation and Automation (C7)            | The Role of Surveyors in Fostering Recovery and Reconstruction in Crisis-Affected Contexts: Changed Mindsets and Successful Practices - Partner session with GLTN | Surveying & Geospatial Opportunities with First Nation Peoples: Joint Session AP CDN & Commission 7 | Artificial Intelligence and Automation in Geospatial Applications (C3) |                                   |