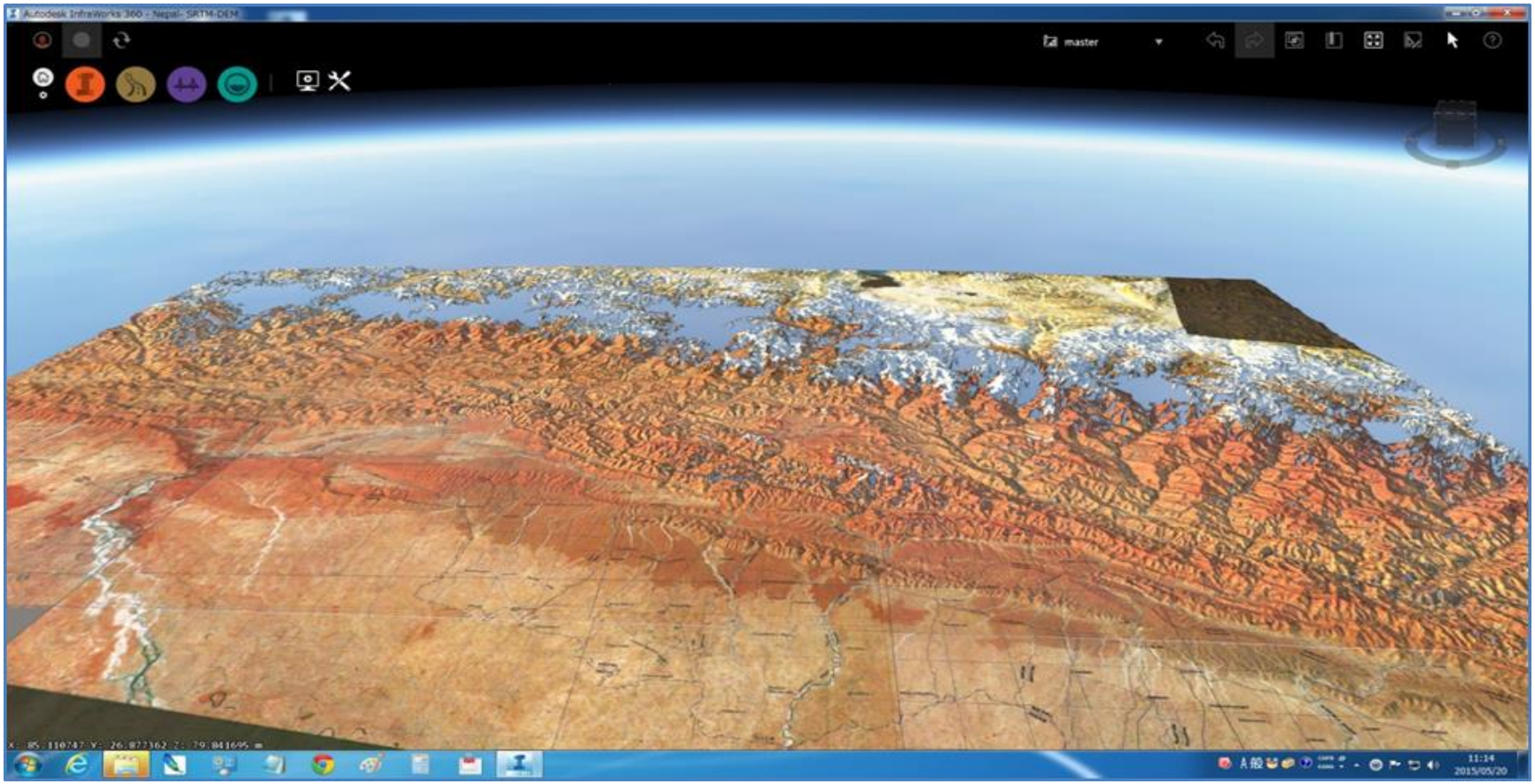
NEPAL EARTHQUAKE 4D-IMADAS 2015 FOR RECONSTRUCTION INITIATIVE

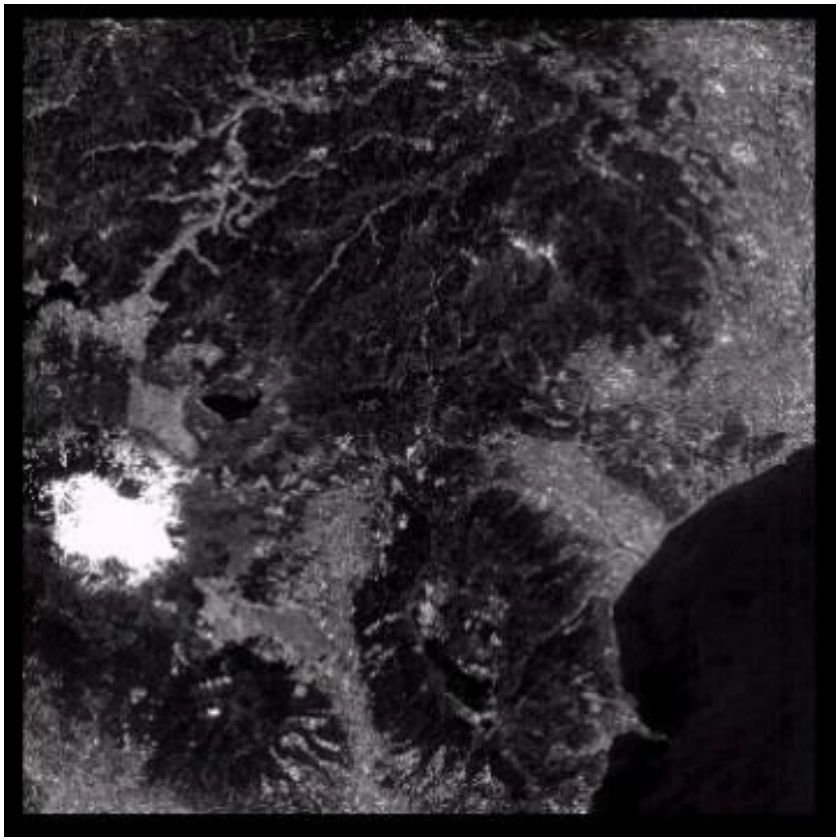
FROM REMOTE SENSING TO 3D REMOTE MODELING

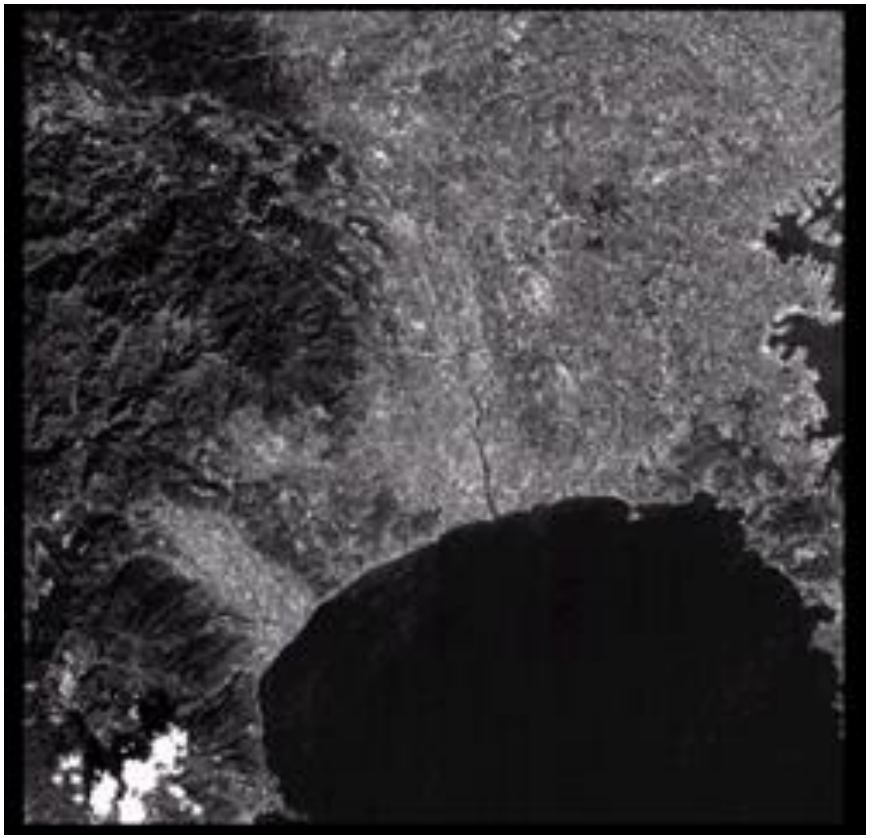
Hiroyuki Hasegawa
Center for South East Asian Studies (CSEAS) Kyoto University



1. NATURAL DISASTER
: 4D- IMAGE MAP ARCHIVE DESIGNED AERIAL SURVEY
(4D-IMADAS)

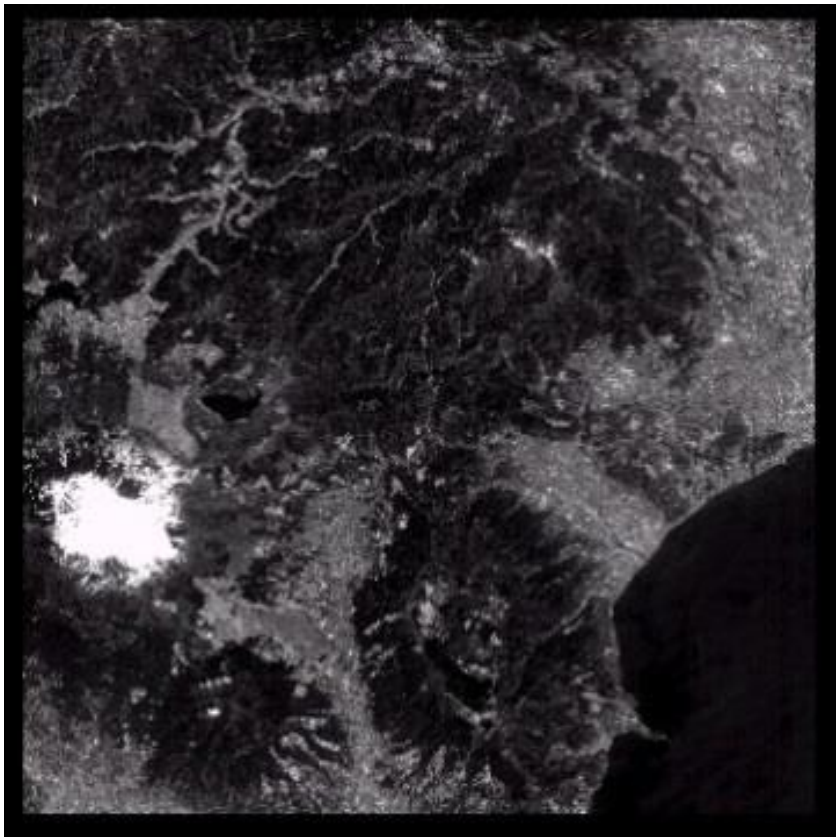
1.1 Aerial Photography and Satellite Imagery at natural disasters

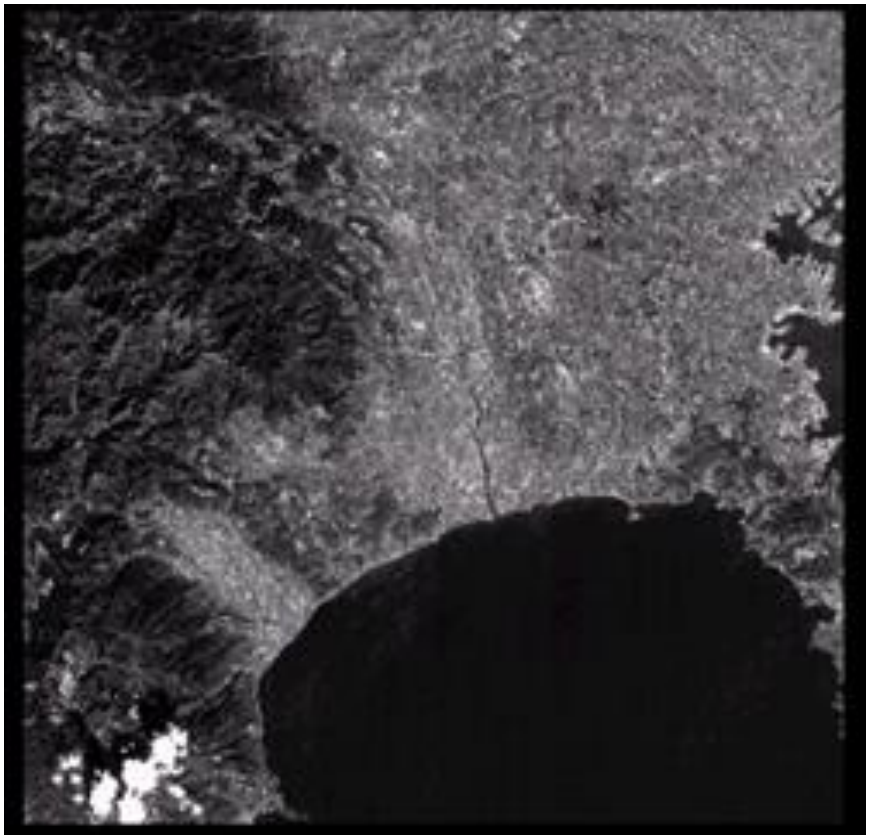




1.1 Aerial Photography and Satellite Imagery at natural disasters

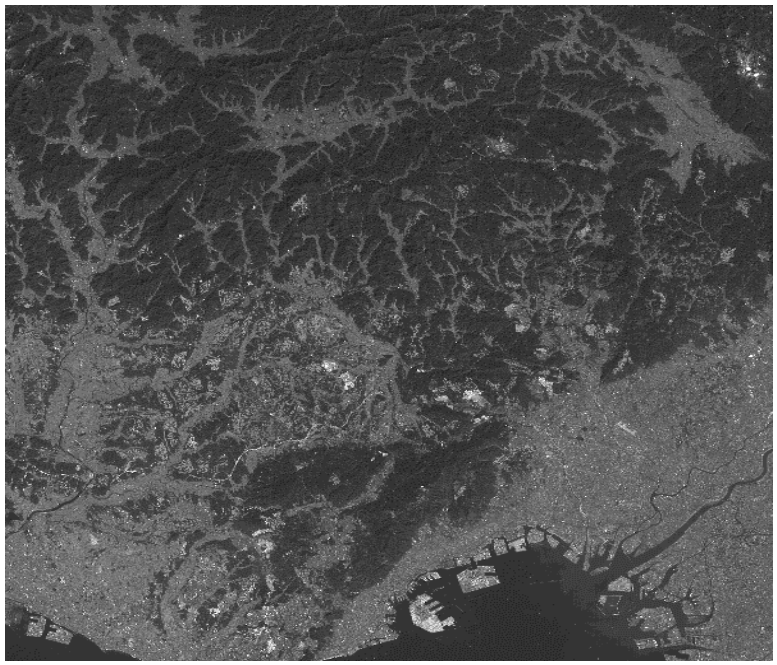
Mt. Fuji; Left ;950404 :: Right;961203

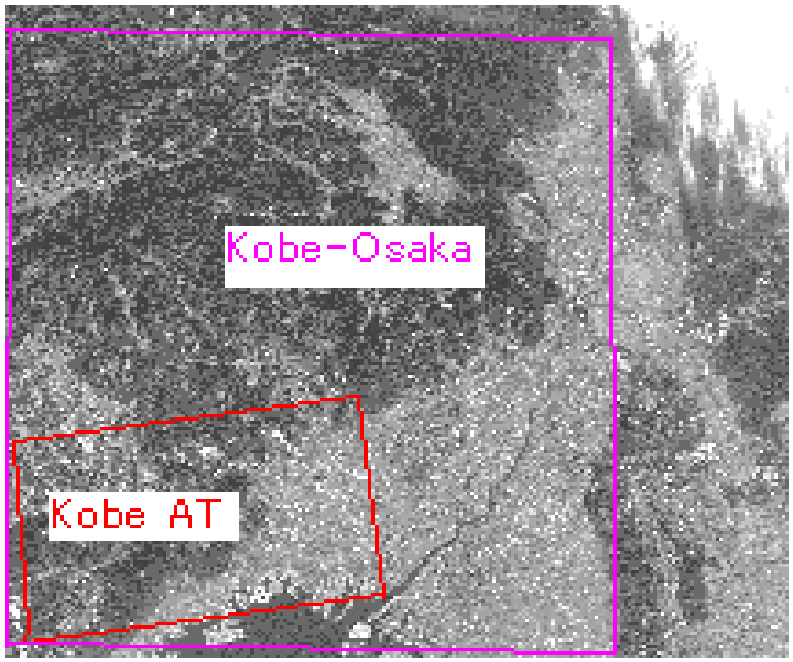




2.1 SPOT Stereo Images

- Kobe/Osaka/Kyoto area



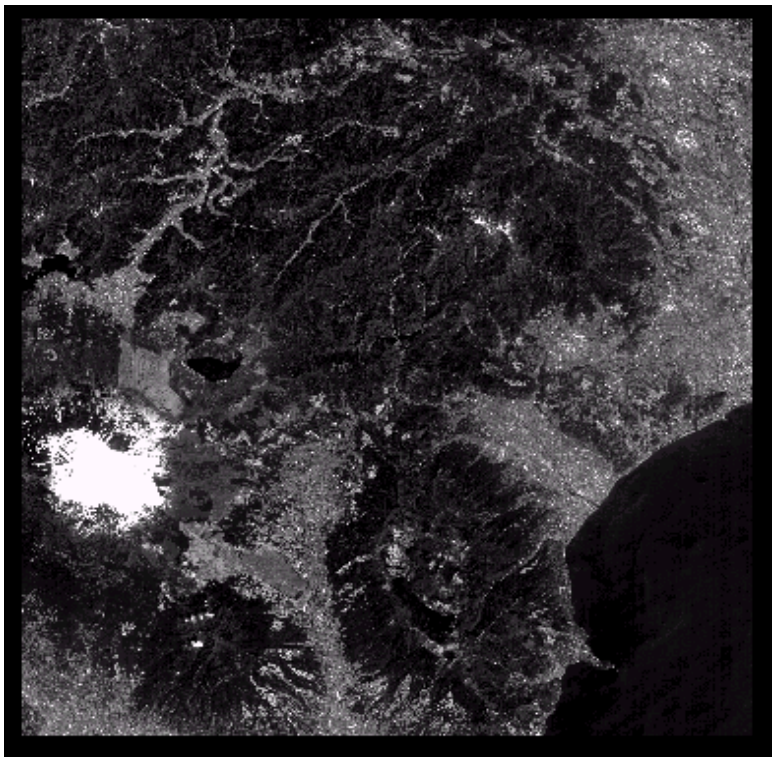


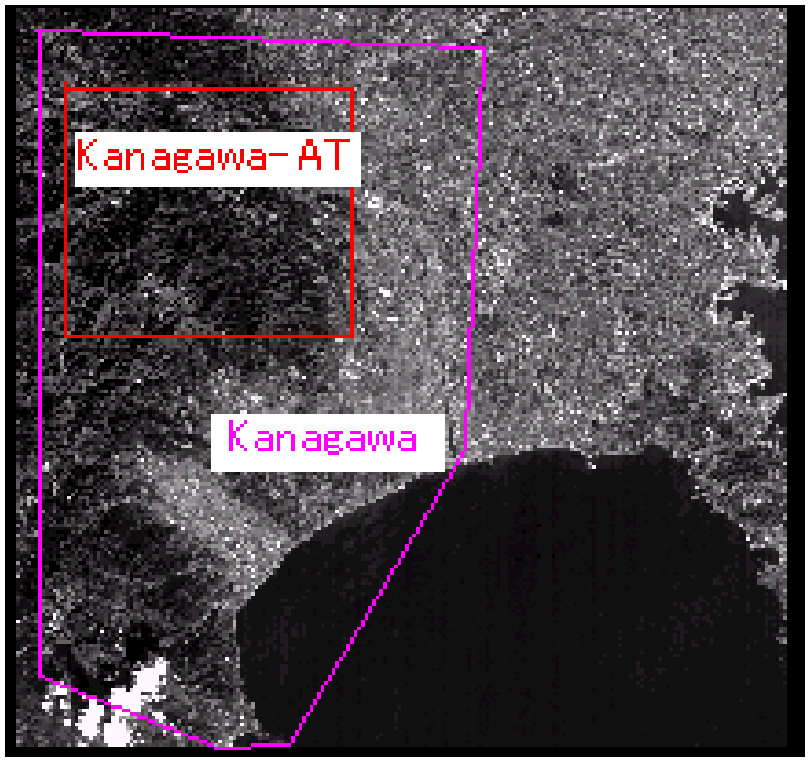
6 Orientation Methods are applied

for Satellite Line Sensor Image Stereo Models B/H ratio = 0.75

2.3 SPOT Stereo Images

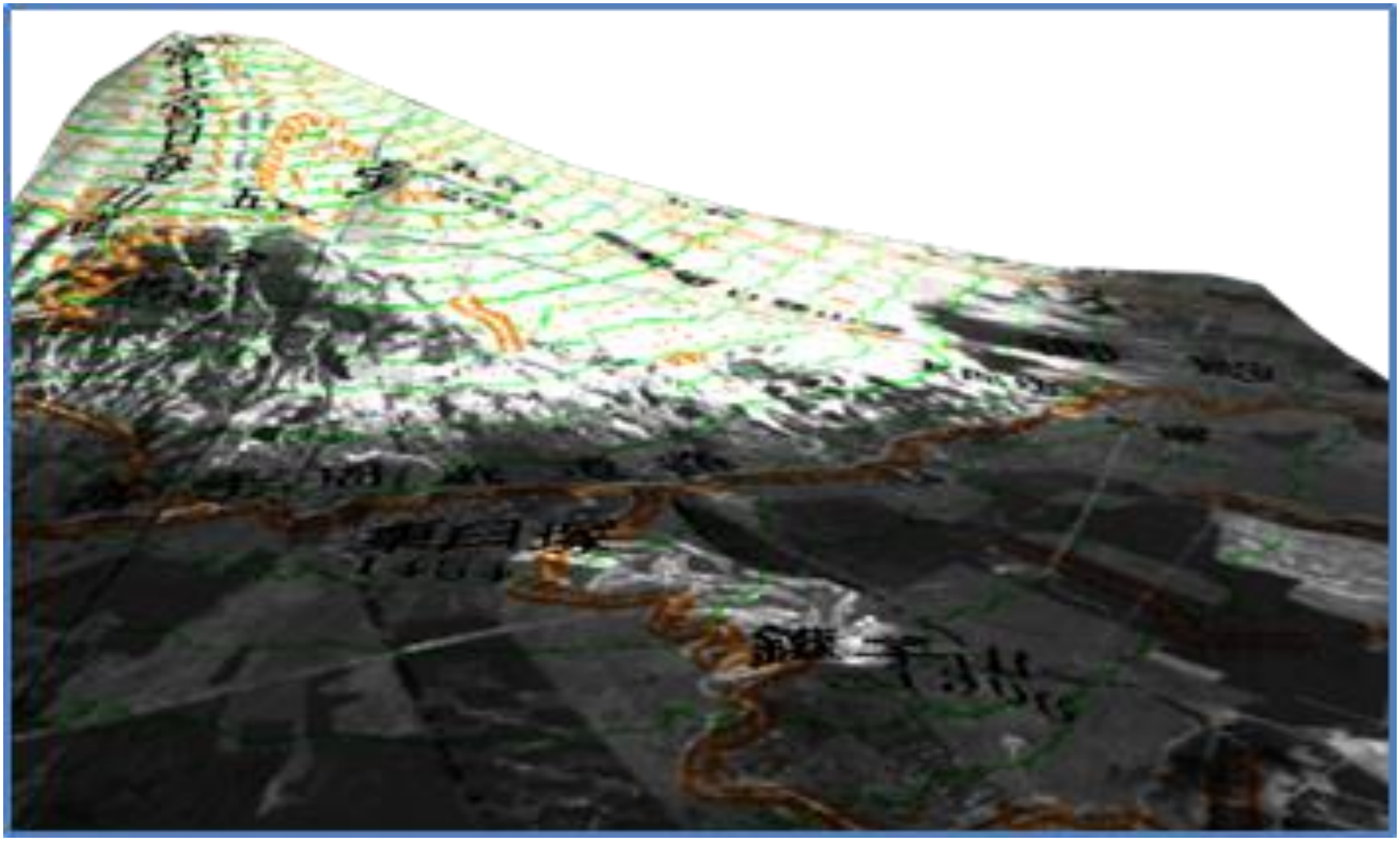
- Mt. Fuji and Kanagawa area



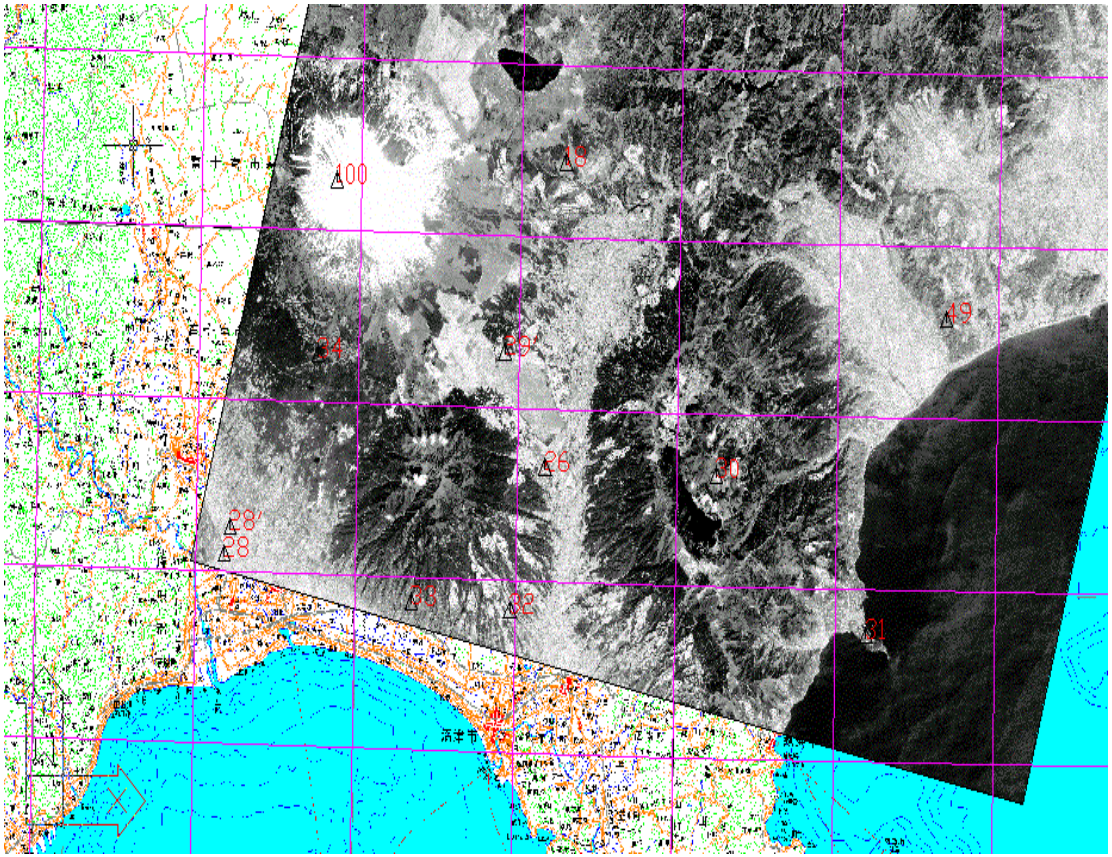


6 Orientation Methods for Mountainous Area (B/H ratio = 0.3)

Mt. Fuji : Map draped 3D diorama (1997)



Digital OrthoImages from Satellite Imagery via an Affine Orientation Model



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Kyoto University

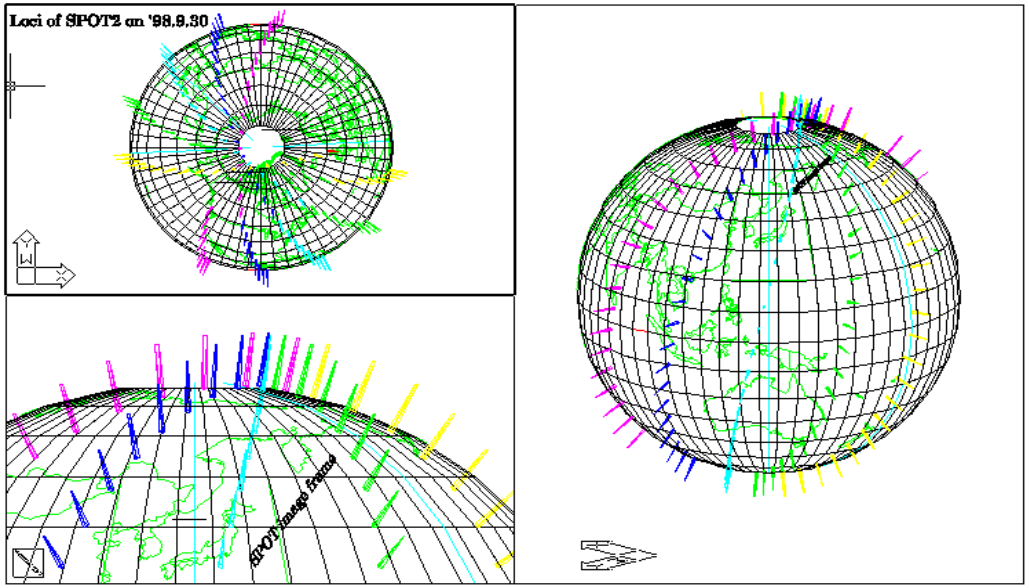
Hiroyuki Hasegawa PASCO Corporation

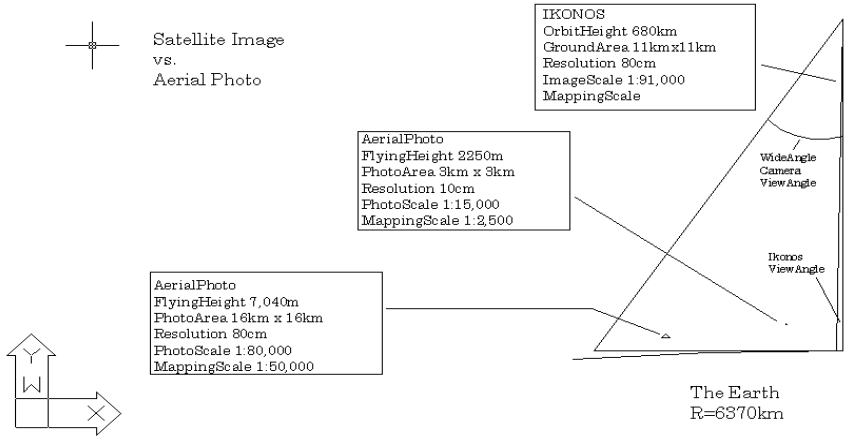
Clive Fraser
University of Melbourne

Tetsu Ono
Kyoto University

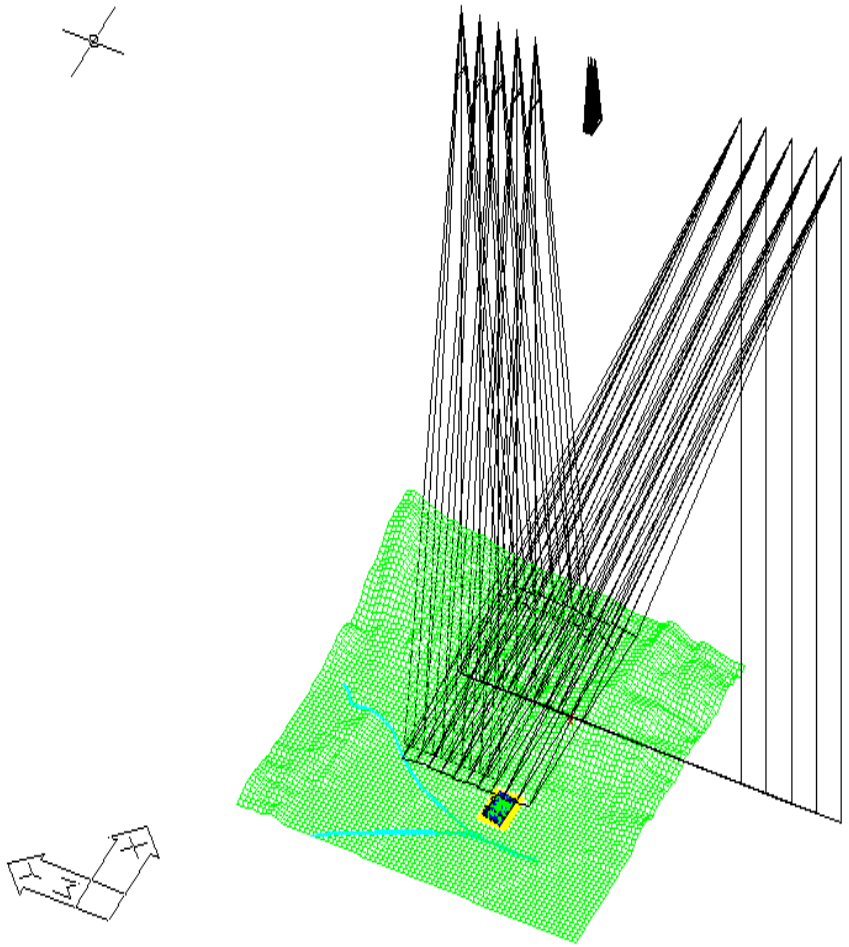
Susumu Hattori
Fukuyama University

1. Spatial Loci and ground tracks of the SPOT satellite



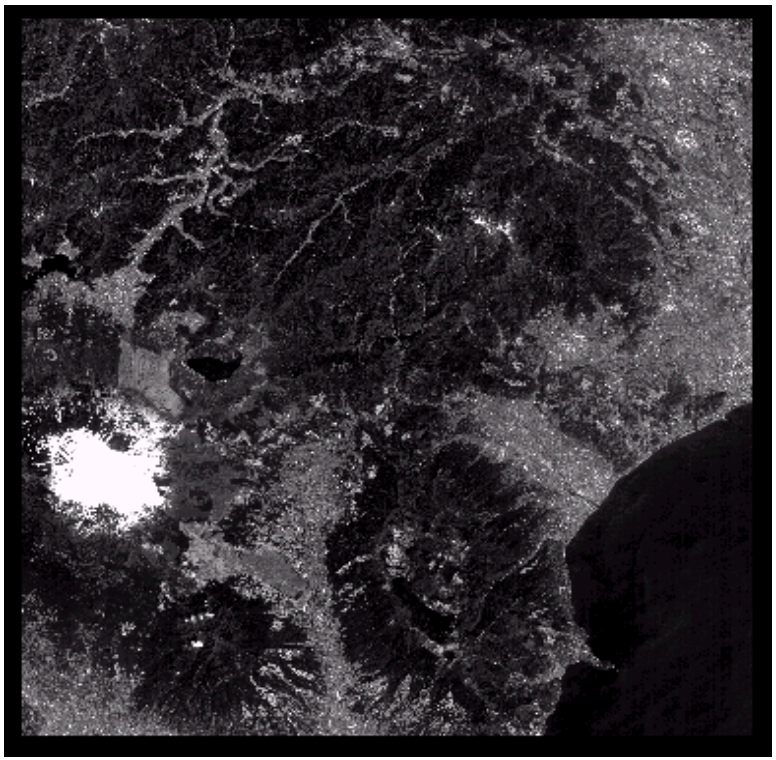


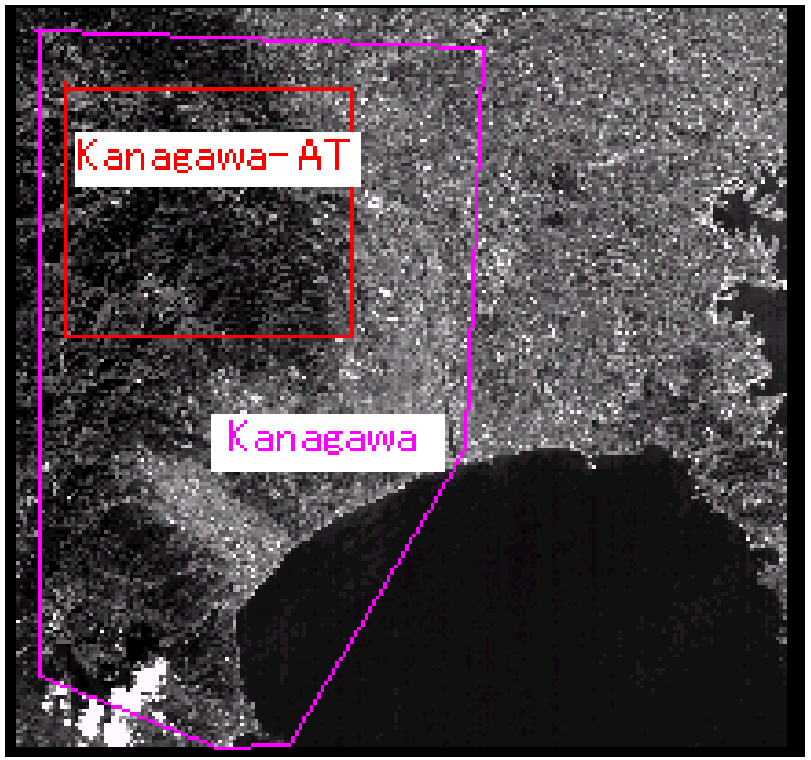
1.2 Stereo Model of Line Sensor Imagery



2.3 SPOT Stereo Images

- Mt. Fuji and Kanagawa area





6 Orientation Methods for Mountainous Area (B/H ratio = 0.3)

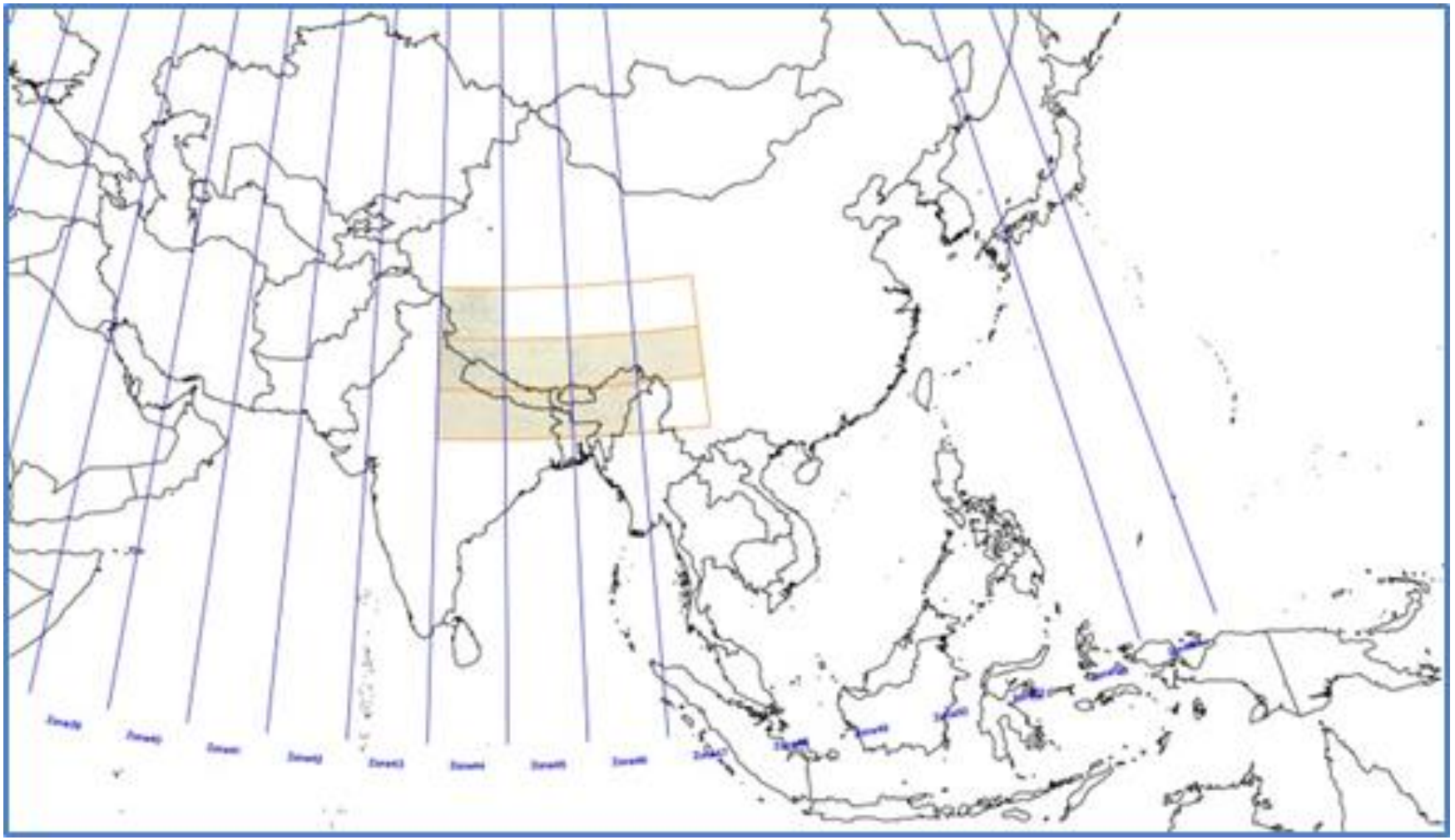
1.2 3D-CAD map production for reconstruction projects

GIS : "Get It Surveyed"
on 4D Image Map Archive

地図と地球儀

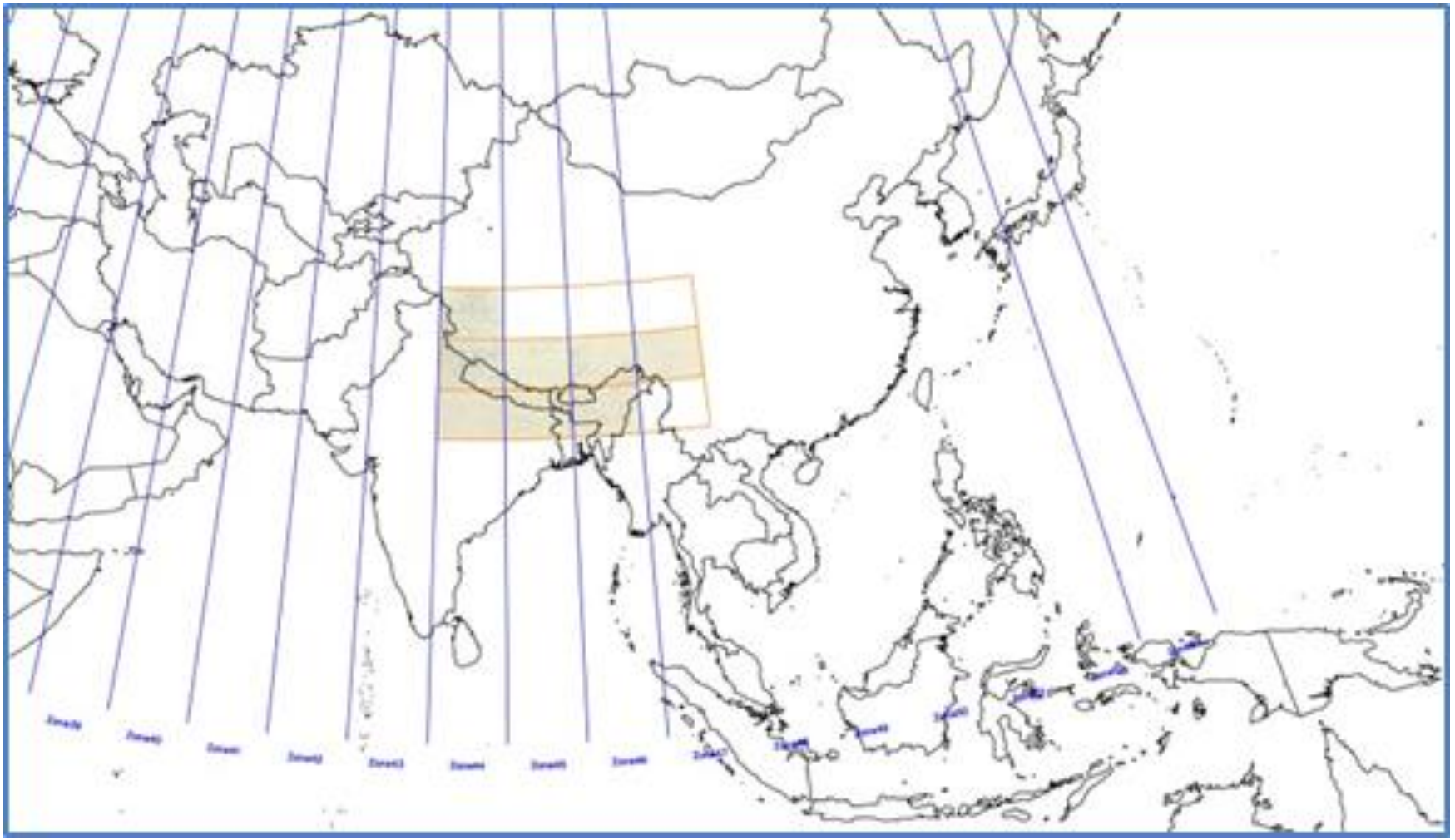
Map Projection, CAD-Globe in 3D Coordinate System
ISPRS Washington Congress 1992

1.2 3D-CAD map production for reconstruction projects Nepal , Bhutan and the Himalayas



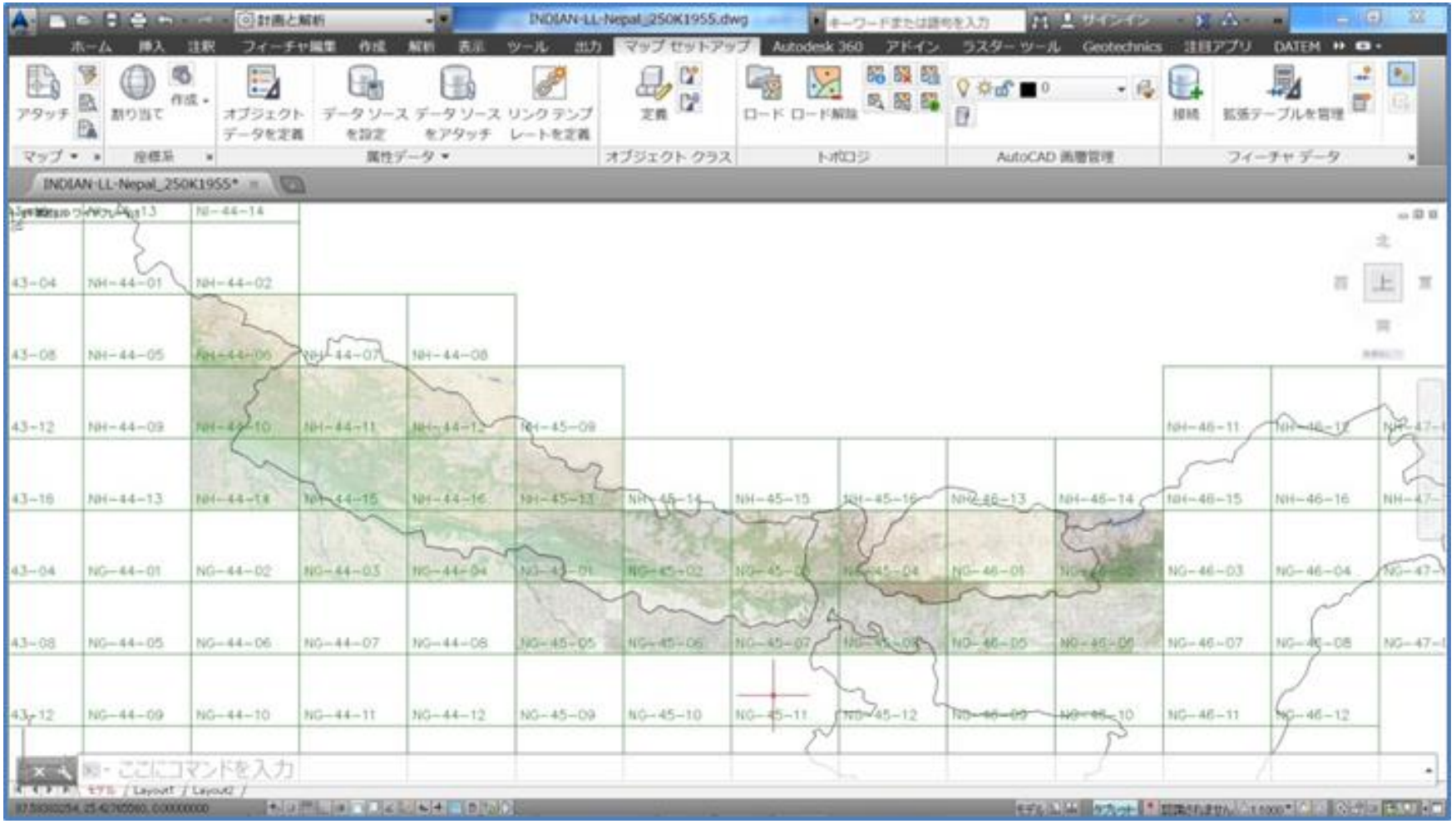
India-LCC map projection on WGS84 geodetic datum with 1: 1,000,000 maps

3D-CAD map production for reconstruction projects
Nepal , Bhutan and the Himalayas

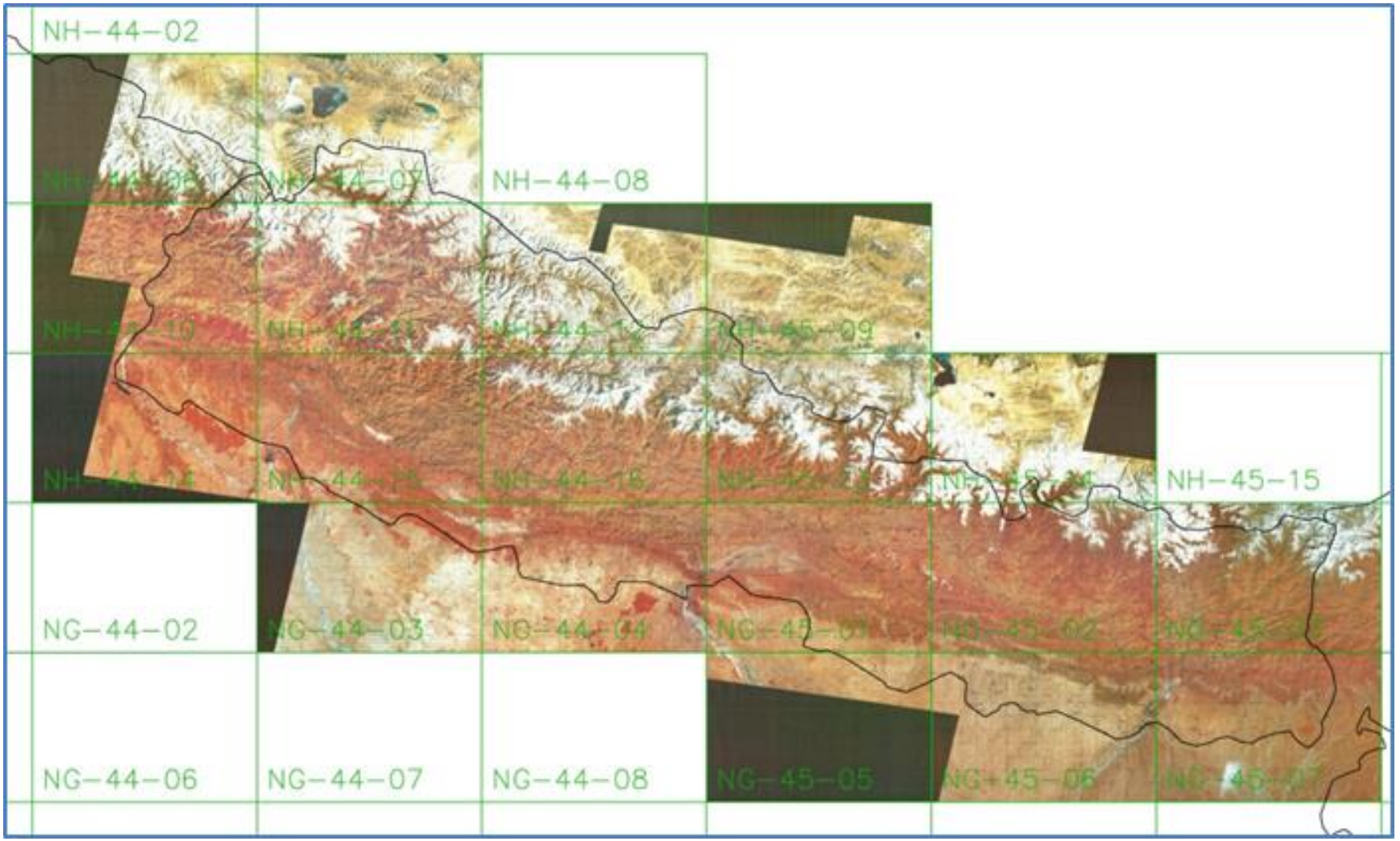


India-LCC map projection on WGS84 geodetic datum with 1: 1,000,000 maps

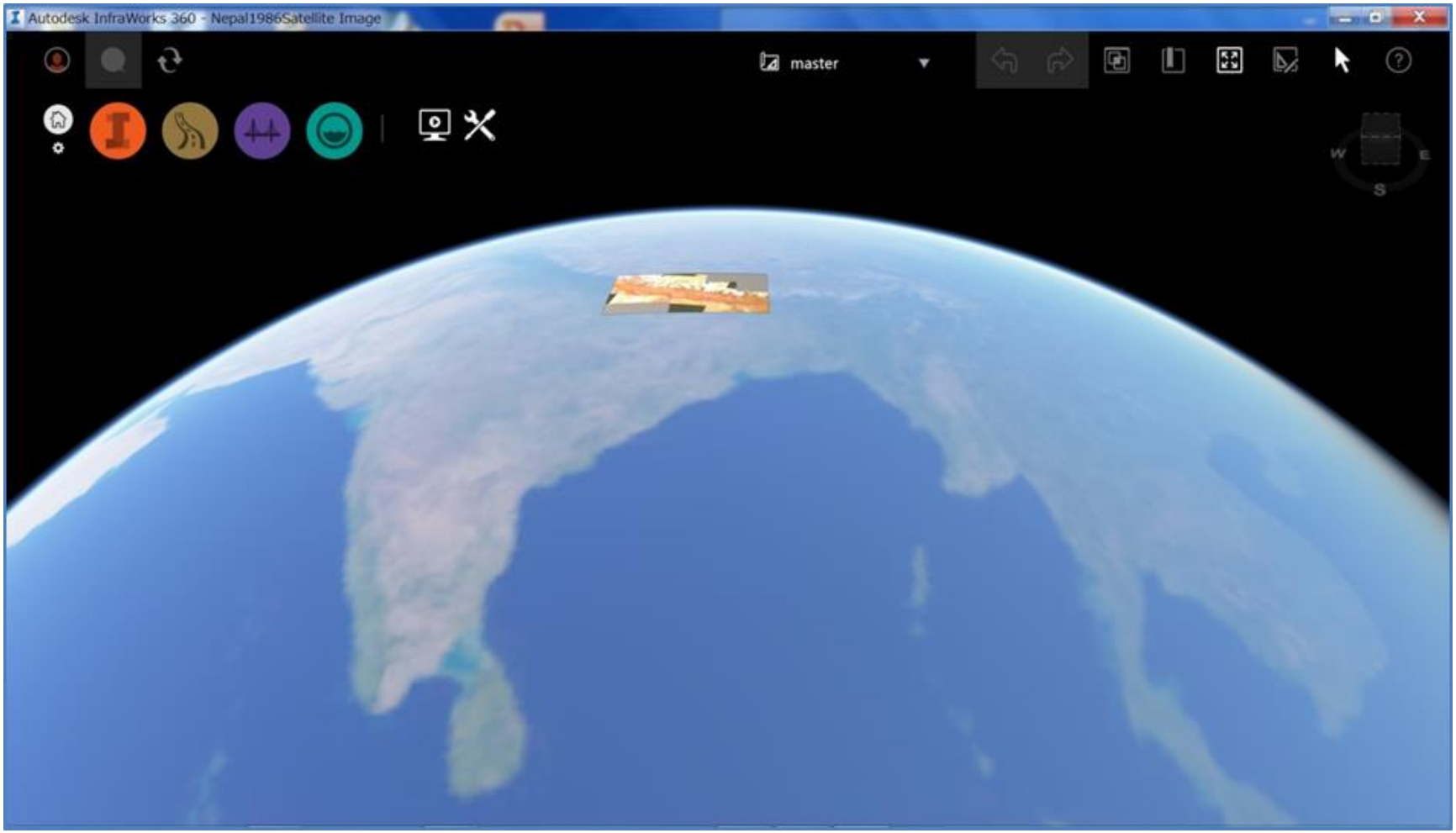
INDIAN-LL map projection on AutoCAD Map3D - Nepal_250K image maps;1955



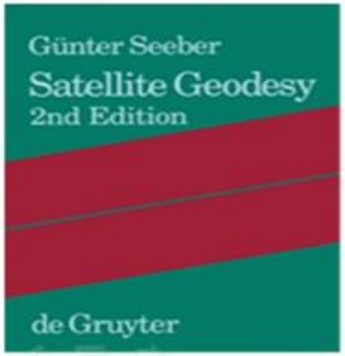
WGS84-LL map projection
: Nepal-250K satellite image ortho-mosaic map;1986

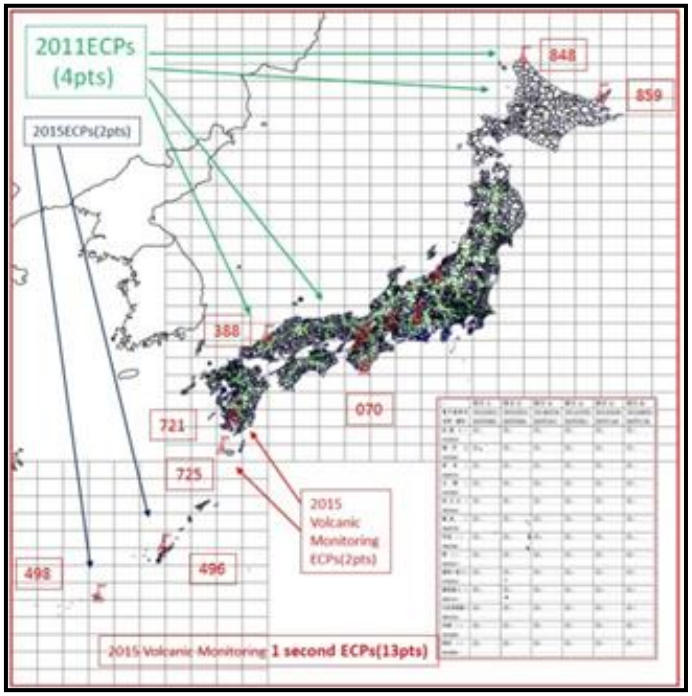


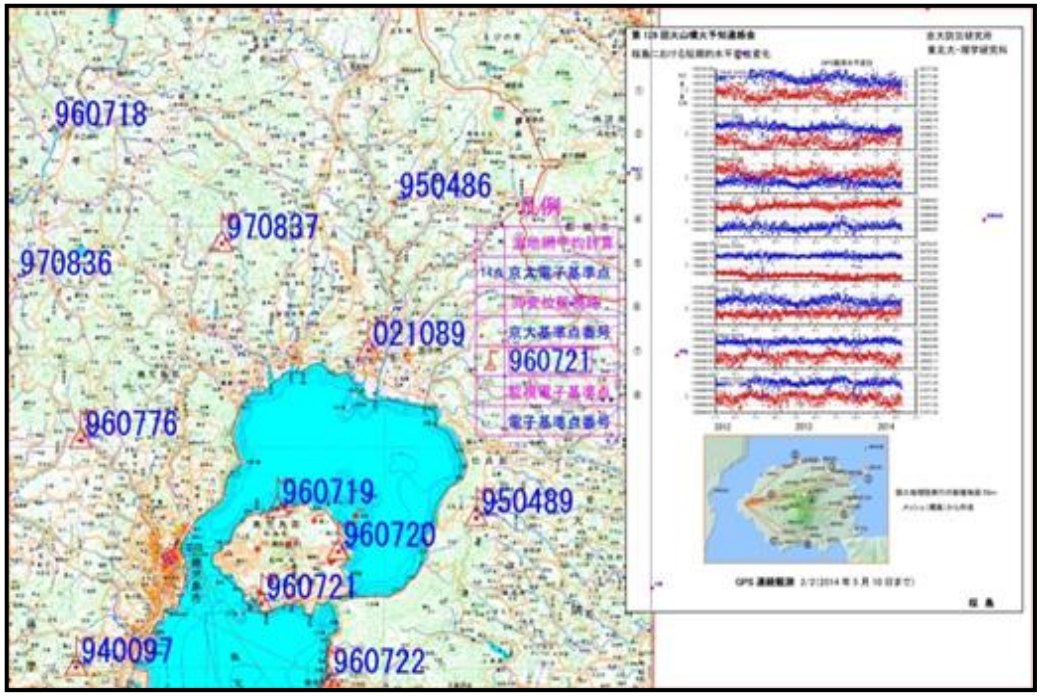
CAD-Globe and 3D diorama by Autodesk InfraWorks360



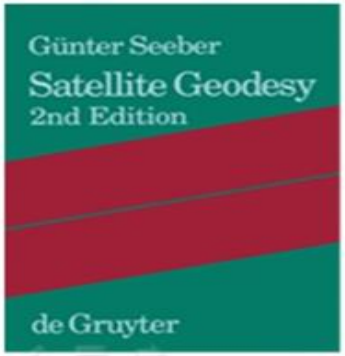
1.3 Ground Control Points by real time GNSS surveying

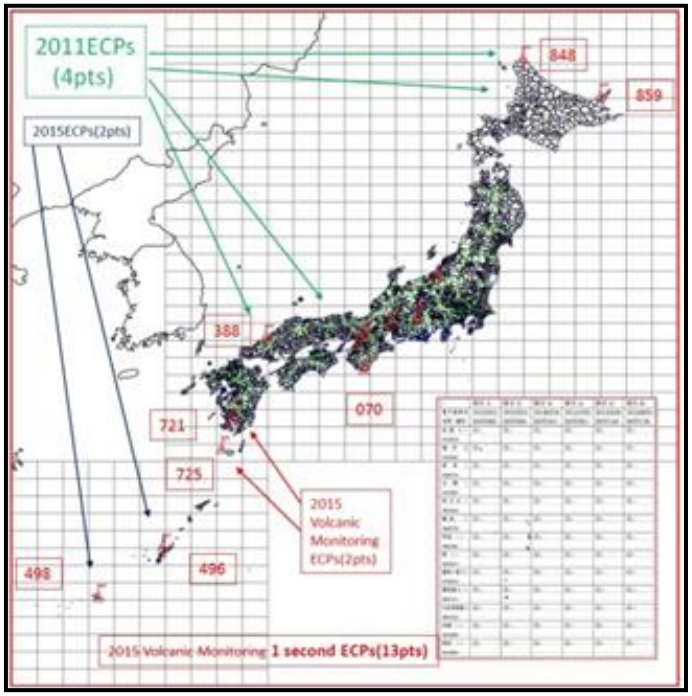


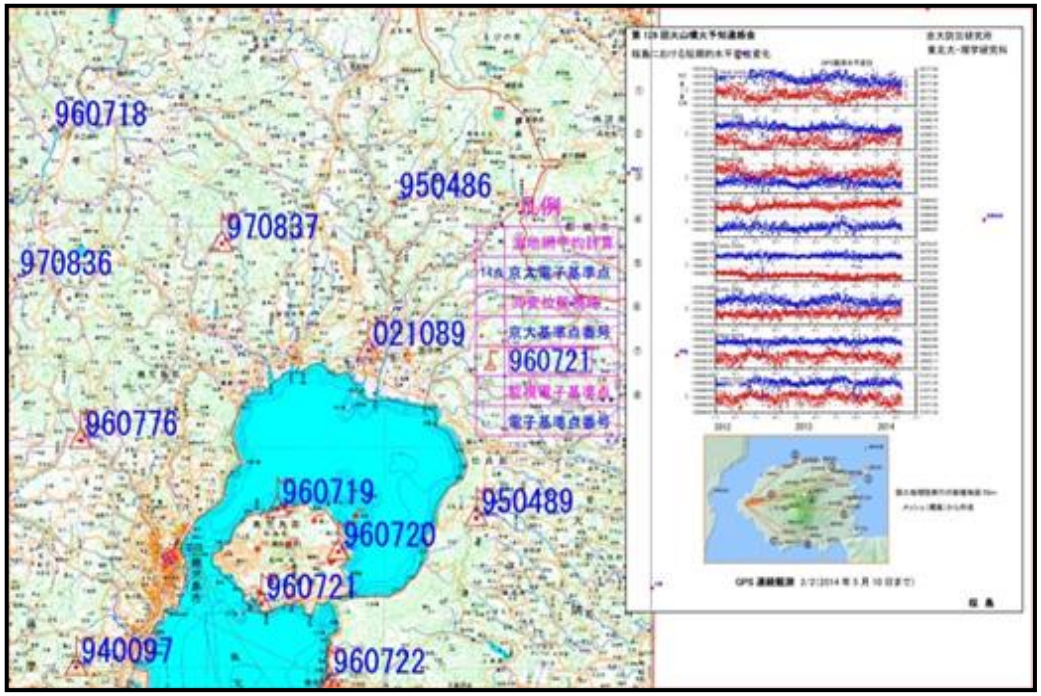




1 second – σ：1㎝　GNSS network adjustment
Parameter Estimation Gnss Assisted SUrveying System (PEGASUS)





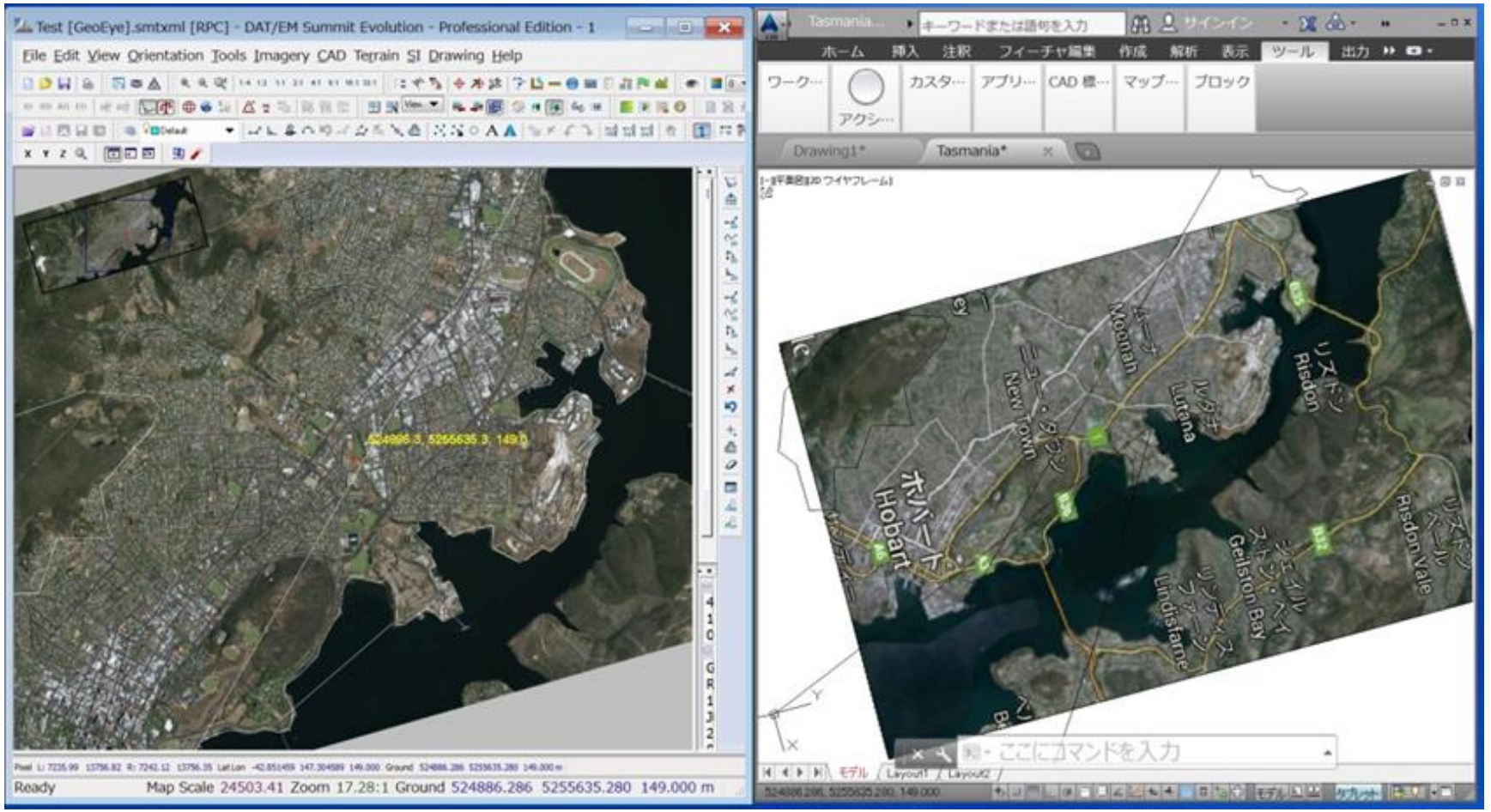


PEGASUS Meister of GNSS and TS surveying

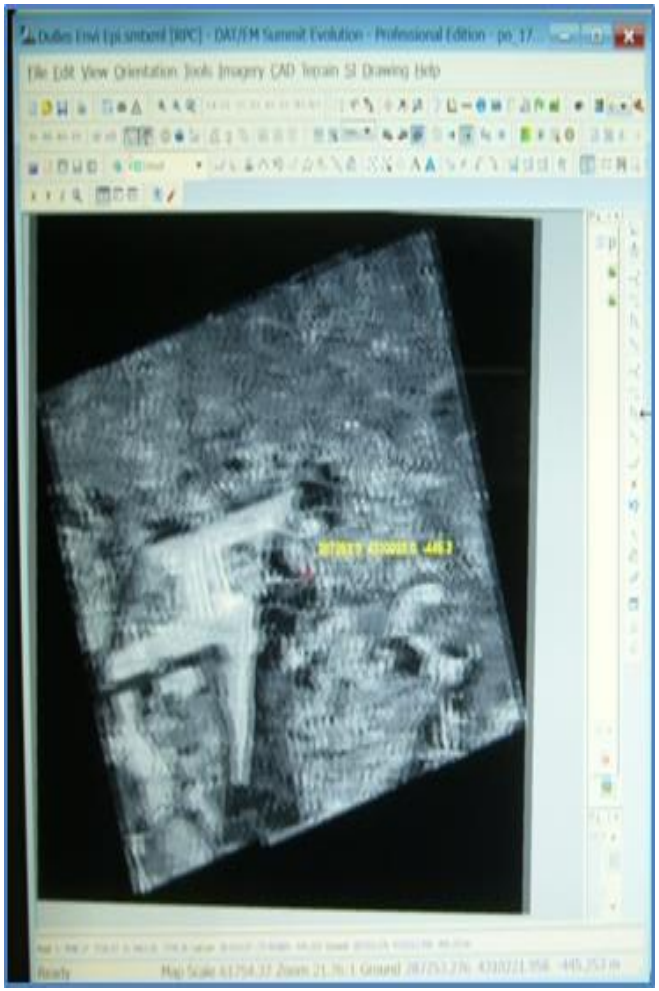
PEGASUS Meister (TS and GNSS – 3D CAD system)

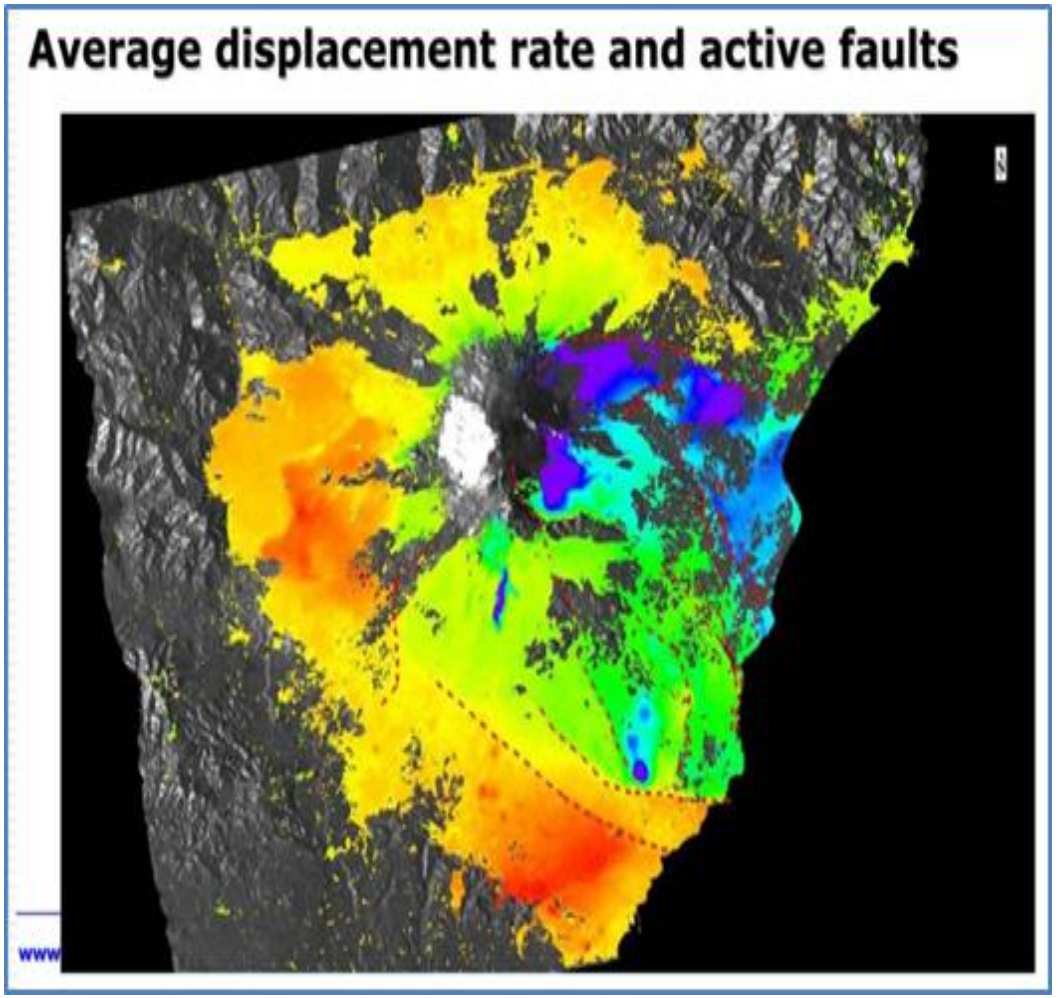
1.4 Satellite stereo 3D modeling and SAR imagery analysis and mensuration

GeoEye stereo model on Summit-AutoCAD
- Hobart- Tasmania- Australia



ENVI- epipolar images-stereo model and Etna volcano sarmap_2014-33-01

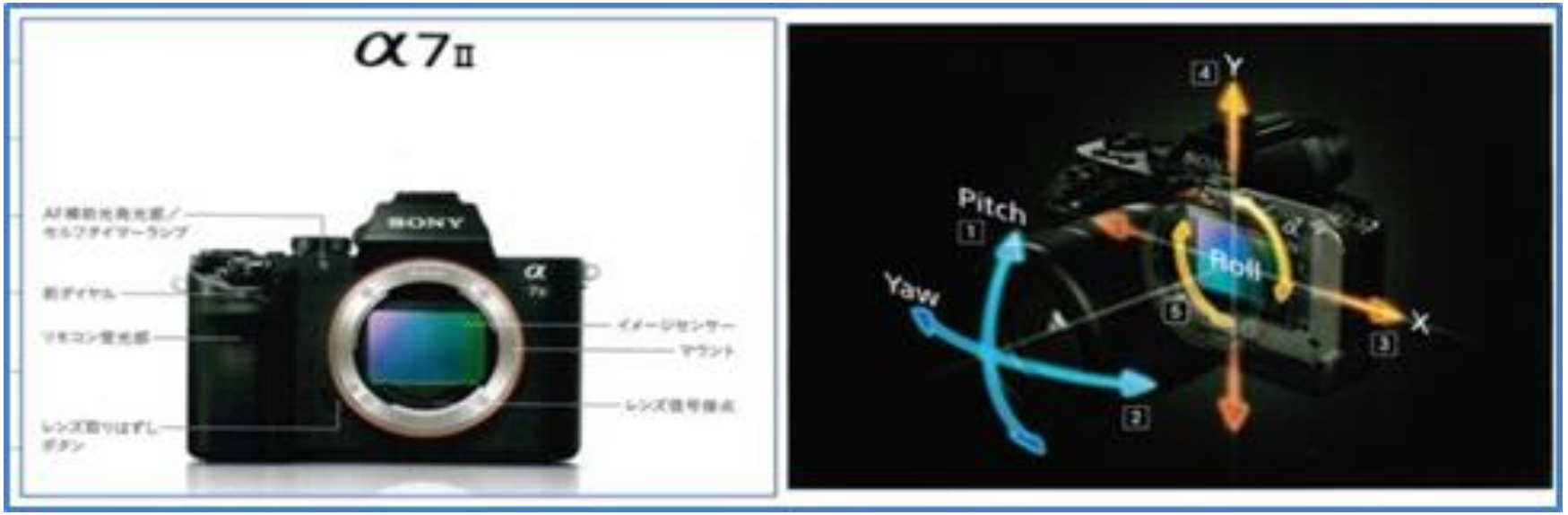


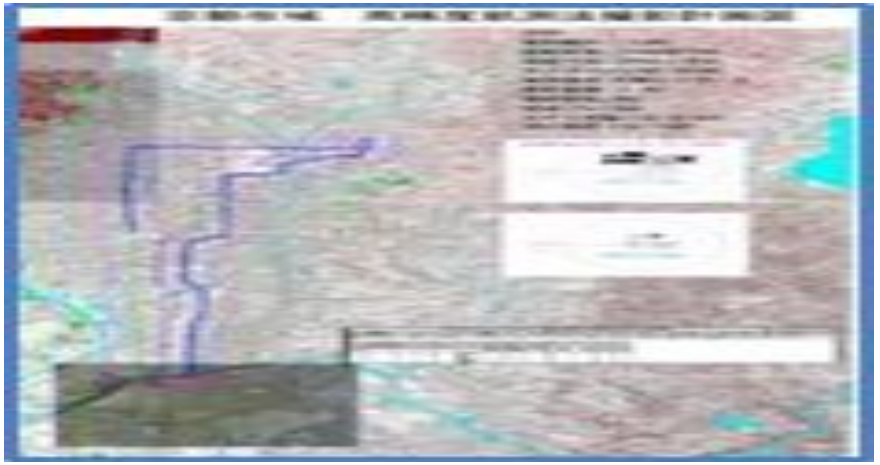


2. 3D-IMAGE MODELING FOR RECONSTRUCTION OF BUILDINGS AND FACILITIES

2.1 New aerial photogrammetry with digital camera and drones and helicopters

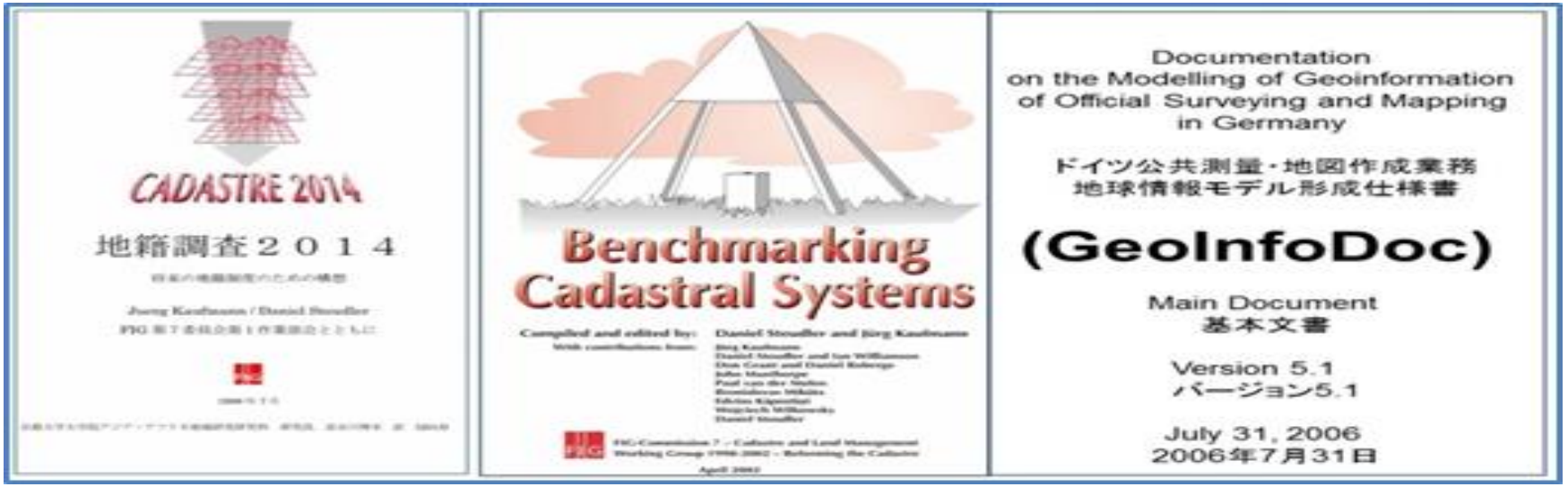
CMOS digital camera and anti- vibration devices, Helicopter (2014) and flight plan (2015)

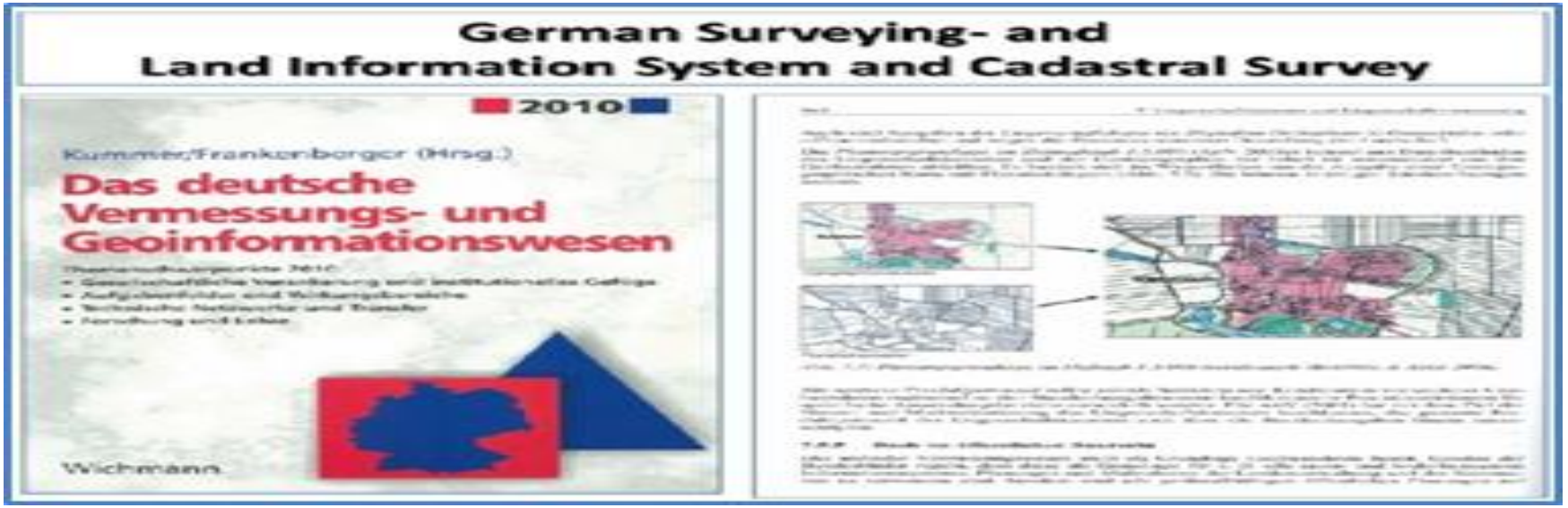




2.2 3D-Image models as 3D land information basis

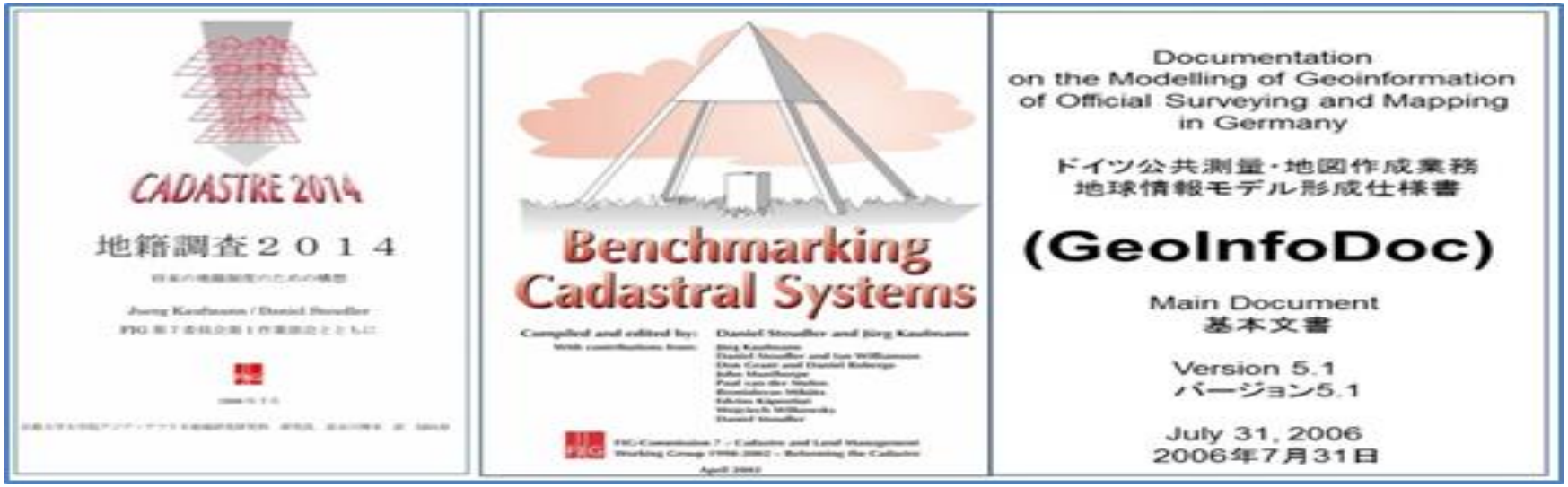
FIG-Cadastre2014 , GeoInfoDoc and German Land Information System

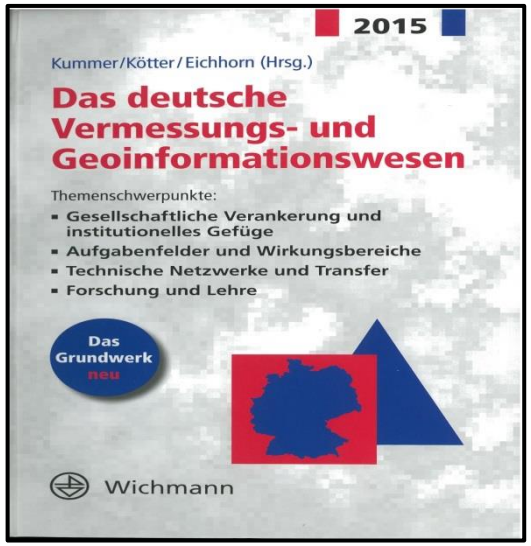


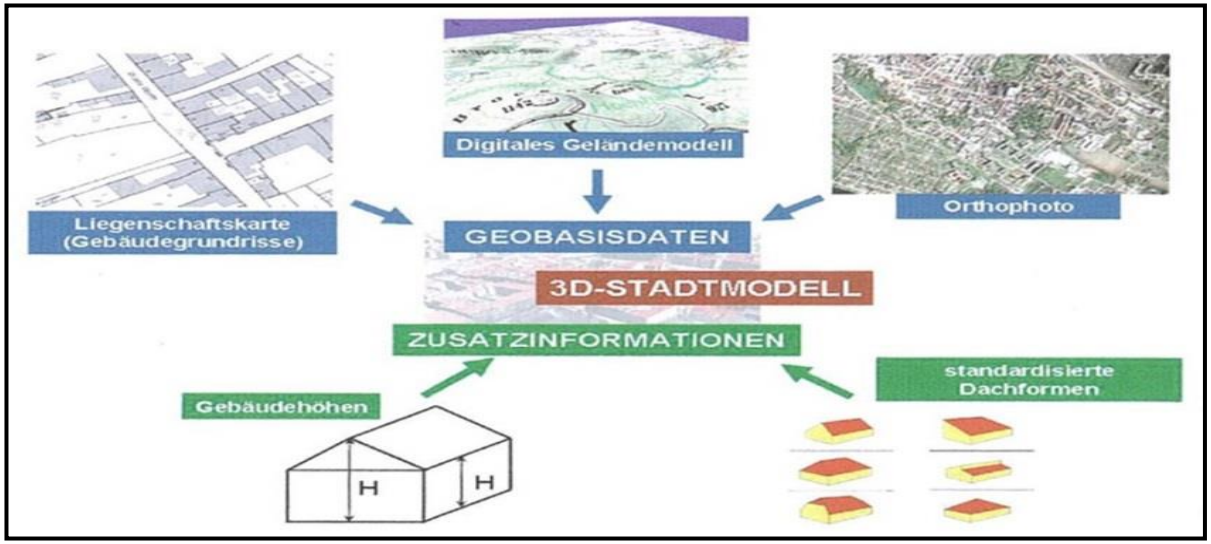


Reconstruction and National Land Information System

FIG-Cadastre2014 , GeoInfoDoc and German Land Information System







2.3 Spatial similarity transformation of Building models in 3D cadastral system
2.4 4D-Image Map Archive and 3D-diorama Modeling for 3D cadastral system

$$\mathbf{X} = \phi(X_M, Y_M, Z_M, m, \xi, \eta, \zeta, x, y, z) = \mathbf{X}_M + m \cdot \mathbf{R} \cdot \mathbf{x} \qquad (4.39)$$

oder

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} X_M \\ Y_M \\ Z_M \end{bmatrix} + m \cdot \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

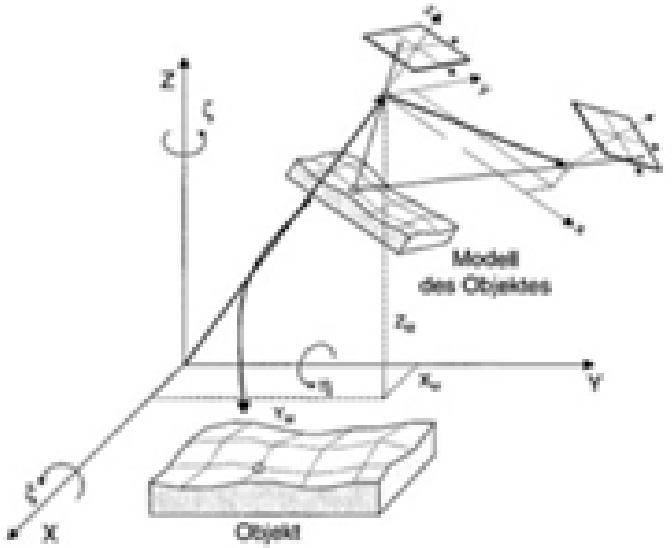
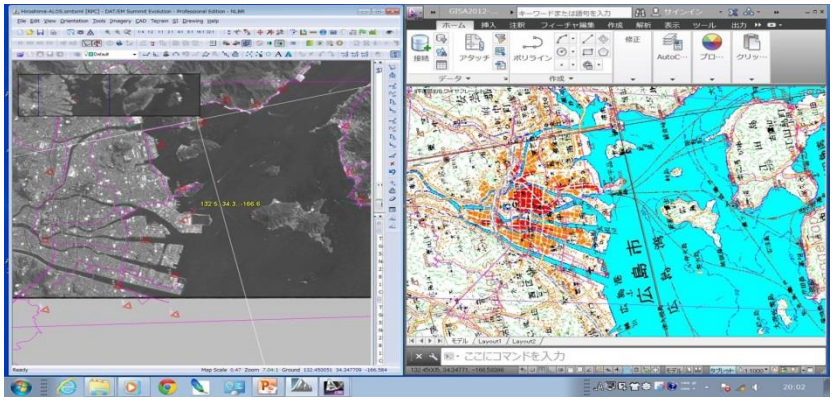


Abb. 4.21: Absolute Orientierung

Absolute orientation; concept: T. Luhmann (NahbereichsPhotogrammetrie; 2000)

3. NEPAL - 4D - IMAGE MAP ARCHIVE DESIGNED AERIAL SURVEY



3.1 Old map collections in Japanese Libraries and international Map Libraries

3.2 Unified Map Grid Numbering system for different production periods in Nepal

3.3 Nationwide Assembly of Image Maps for reconstruction projects on 3D-CAD

3.4 Database retrieval and usage on Nepal 4D- Image Map Archive

4. NEPAL 4D- IMAGE MAP ARCHIVE PROJECT

4.1 Configuration of Nepal-Image Map Archive for reconstruction project

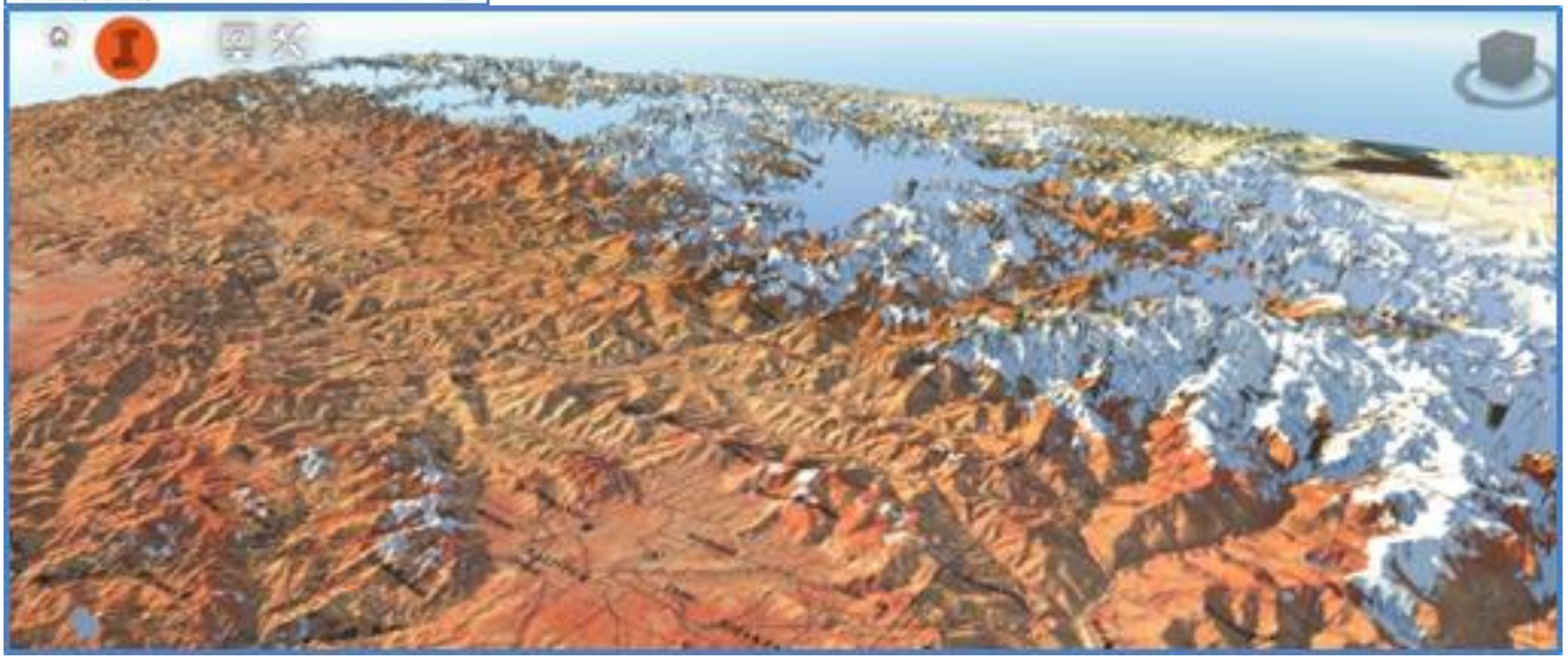
4.2 Contribution of the state of the art technology ; evolution of Aerial Survey

4.3 UN-GGRF initiative and 1cm accuracy real time satellite surveying

4.4 Earthquake disaster forecasting and world standard Cadastral system

Japan GSI; Global Map of central Nepal

and CSEAS satellite ortho-image 3D-diorama



References

Bauer, Rainer et.al. (2010)
, “Das deutsche Vermessungs- und Geoinformationswesen 2010”
; Wichmann

Hasegawa, Hiroyuki (2013)
, 3D Image Map Archive Designed Area Studies (3D-IMADAS)
Pacific Neighborhood Consortium :
Annual Conference and Joint Meetings 2013

Kraus, Karl (2000)
, ”Photogrammetrie” Band III; Duemmler

Luhmann, Thomas (2000)
, ”NahbereichsPhotogrammetrie”; Herbert Wichmann Verlag

References

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

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

Snyder, John P. (1987)
, “Map Projections-A Working Manual “
U.S. Geological Survey Professional Paper 1395

ACRS 2015; Manila, Philippines,

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Thank you very much
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