Geo-Art Technique for Virtual Reality Bird's Eye View

- Makoto Watanabe, HCC, Japan
- Shunji Murai, Univ. of Tokyo, Japan
- Masanobu Kobayashi, HCC, Japan
- Akira Tsutsumi, HCC, Japan
- Yousuke Seki, HCC, Japan

Outline of Presentation

- Introduction
- Level Slicing of Elevation
- Assignment of Colors and Textures
- Procedures for “Geo-Art”
- Conclusions

Introduction

- HCC has developed “Geo-Art” technique by converting a designer’s sense to a scientific model
- Integration of hill shading, colors and textures corresponding to sliced elevation zones were used to create a “Geo-Art”

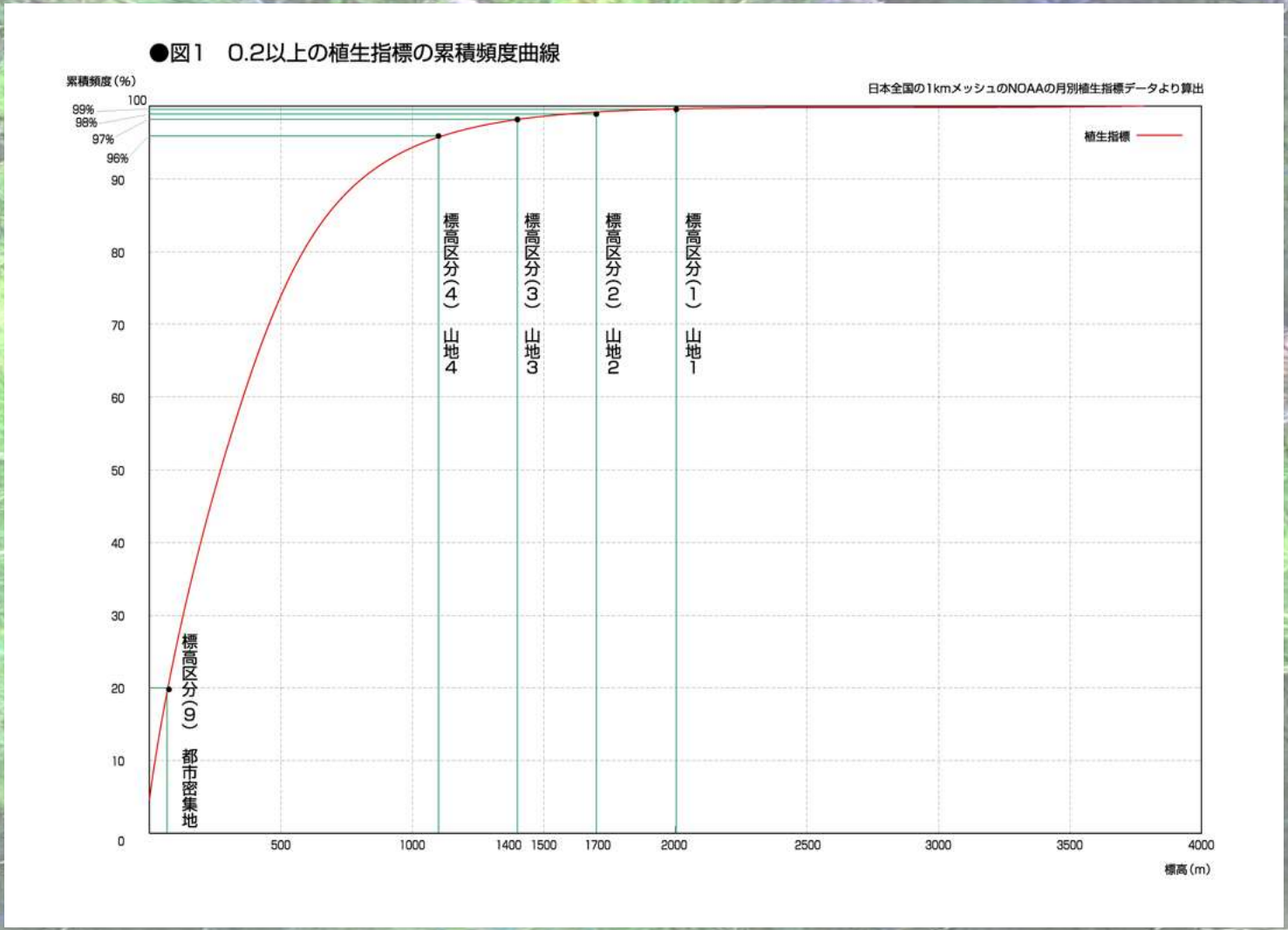
Level Slicing of Elevation
- in case of Japanese mountains-

- A scientific approach for classifying nine elevation zones was taken with NOAA NDVI, land use data and DEM
- 1) 2000- 2) 1700-2000 3) 1100-1700
- 4) 1100-1400 5) 700-1100 6) 200-700
- 7) 100-200 8) 50-100 9) 0-50

Classification of Mountains and Urban with NDVI

- Accumulated histogram (%) of NDVI distribution with respect to Z (height) was used
- Zone 1: 2000m- ANDVI: 99-100%
- Zone 2: 1700-2000m ANDVI: 98-99%
- Zone 3: 1400-1700m ANDVI: 97-98%
- Zone 4: 1100-1400m ANDVI: 96-97%
- Zone 9: 0-50m (urban) ANDVI: 0-20%

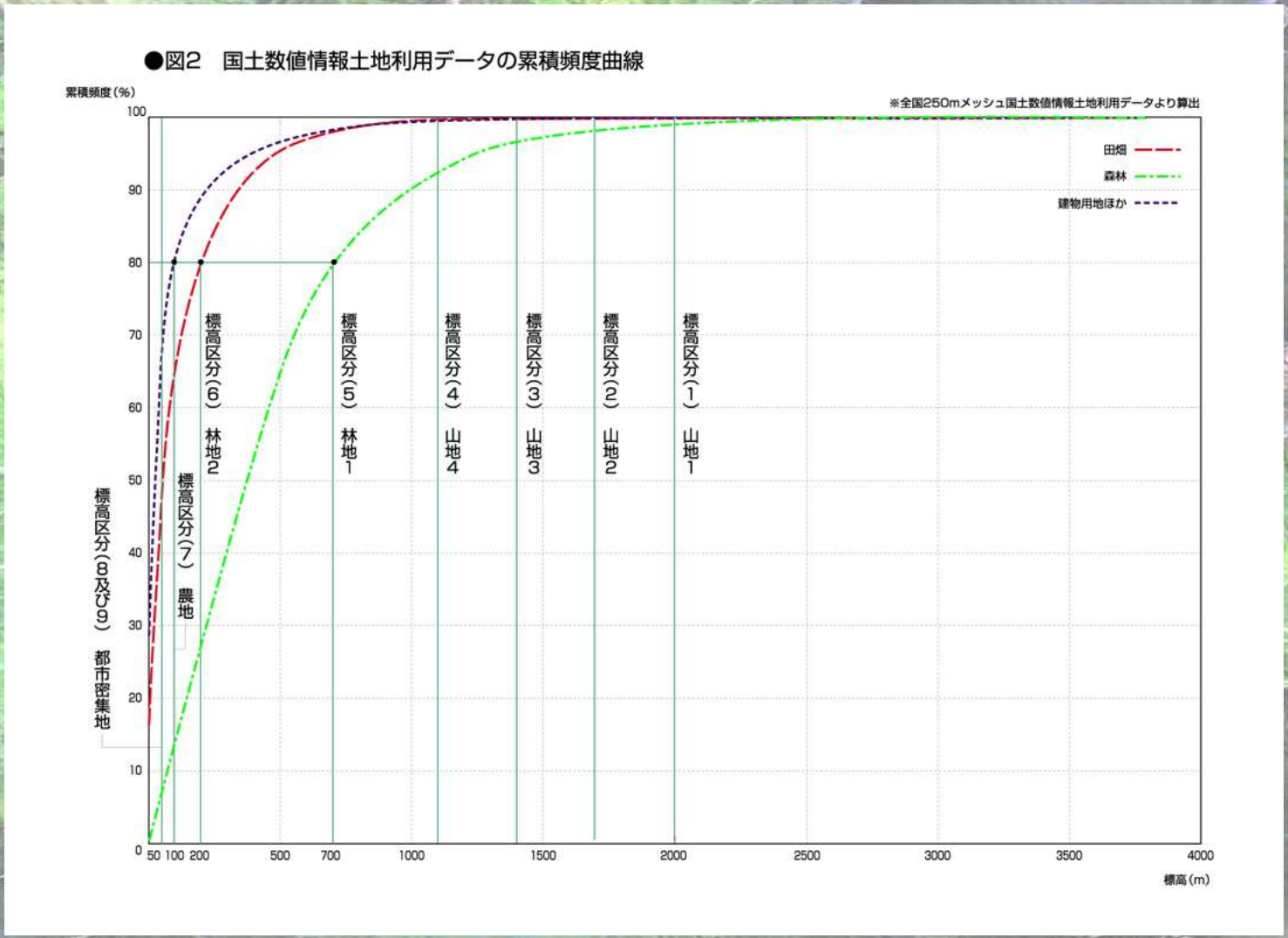
Accumulated Histogram of NDVI



Classification of Forest Land and Crop Land with Land Use Data

- Accumulated histogram of crop land, forest and urban were used to classify Zone 5, Zone 6 and Zone 7
- Zone 5: 700-1100m Forests: AHF: 80-%
- Zone 6: 200-700m Forests: AHC: 80-%
- Zone 7: 100-200m Crop Land: AHU80-%
- Zone 8: 50-100m Crop Land: AHU –80%

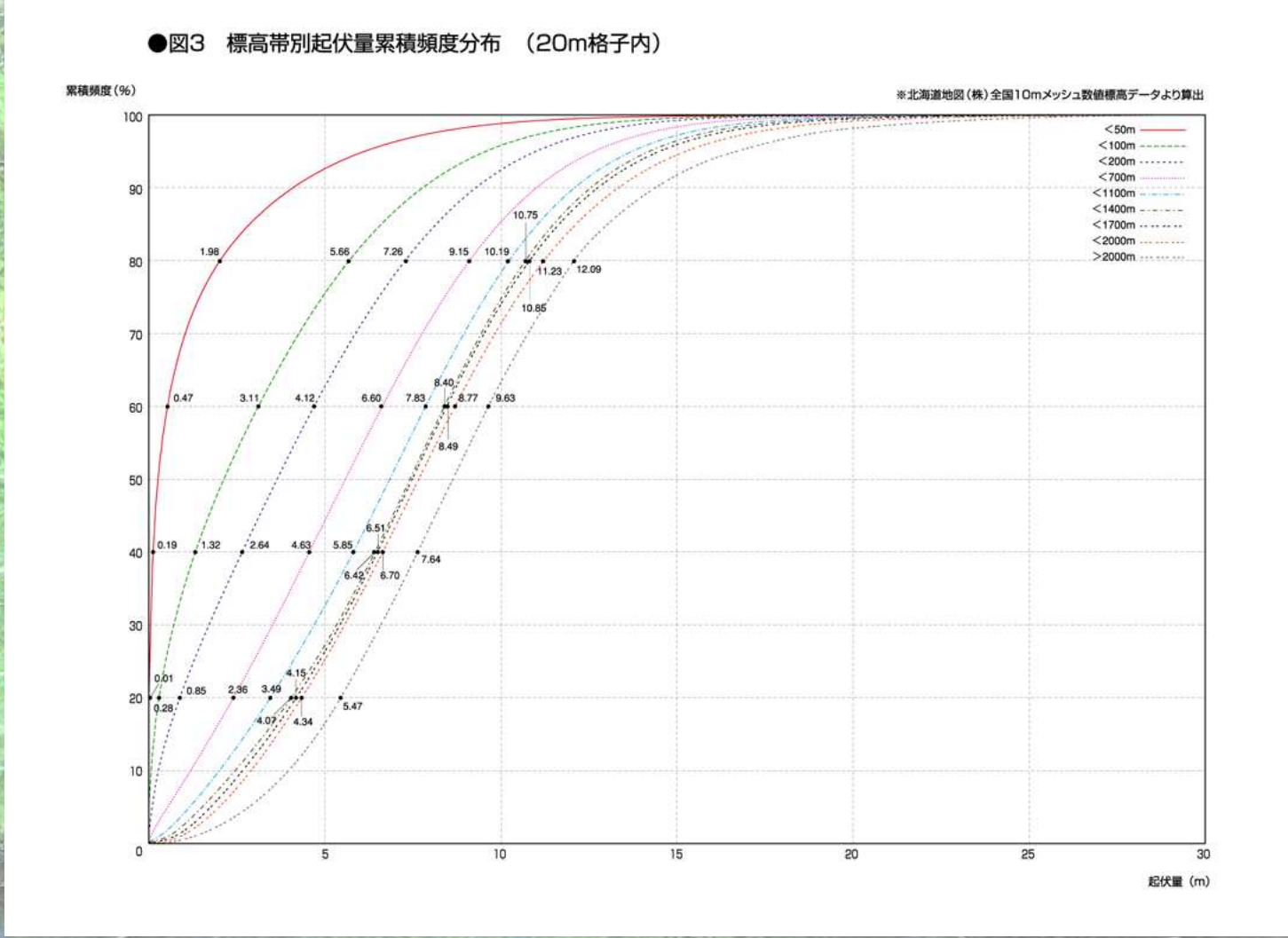
Accumulated Histogram of Land Use



Classification of Terrain Roughness

- Roughness is defined as height difference in a unit area
- Accumulated histogram of roughness with respect to 9 zones was used to classify 5 categories in each zone, which makes 45 classes in total
- 10m grid DEM were used to compute roughness in a unit area of 500m square

Accumulated Histogram of Roughness



Assignment of Colors

- Colors: to be assigned to nine elevation zones
- Saturation (S) should be changed and reduced depending on the roughness
- Zone 1 is estimated rocky mountain with brown color

Color Chart for Zones and Roughness

●図4　標高帯別テクスチャ

等高帯		テクスチャ
1	H ≧ 2000m	
2	1700m ≦ H < 2000m	
3	1400m ≦ H < 1700m	
4	1100m ≦ H < 1400m	
5	700m ≦ H < 1100m	
6	200m ≦ H < 700m	
7	100m ≦ H < 200m	
8	50m ≦ H < 100m	
9	H < 50m	

●表1（色）

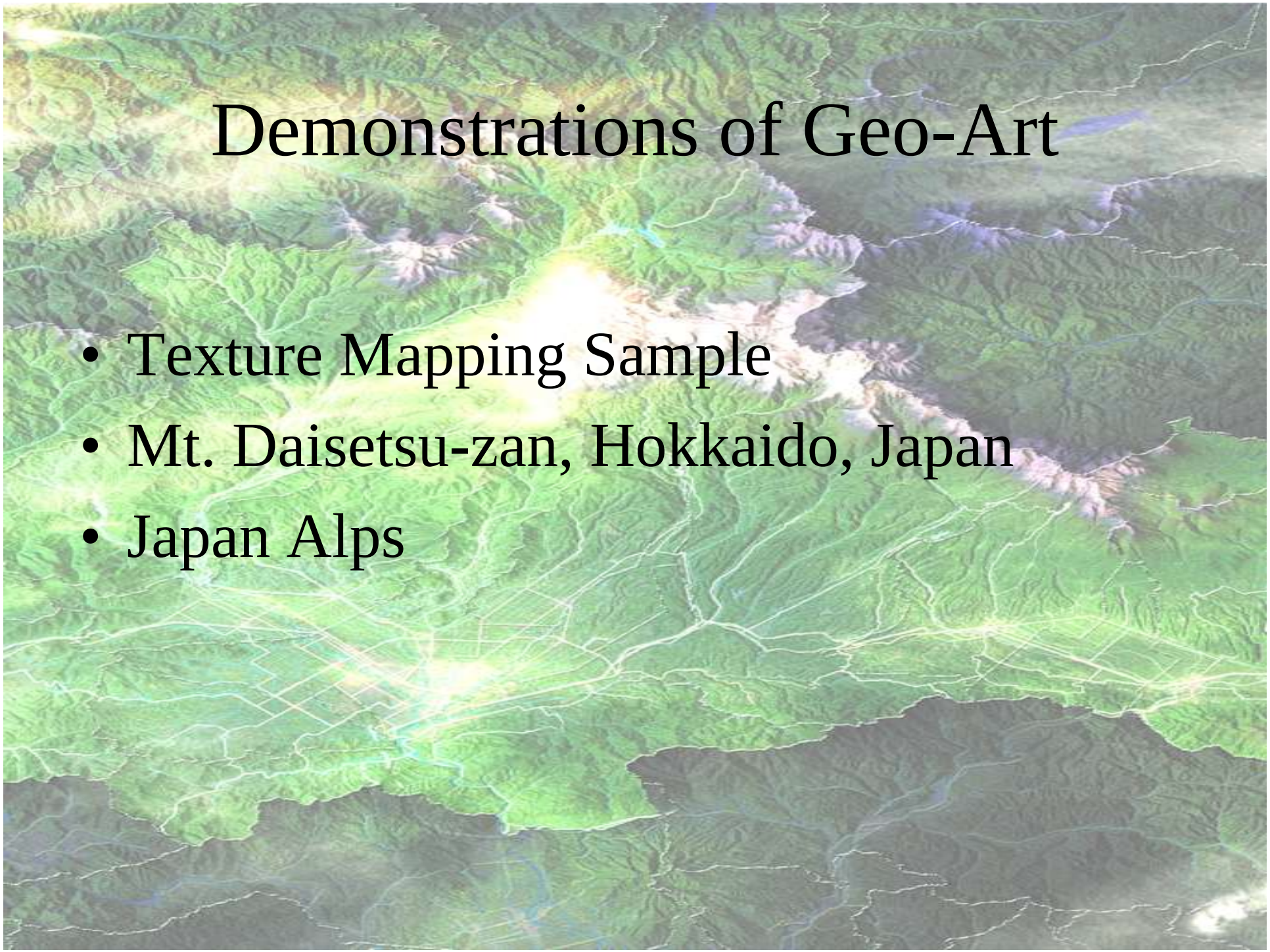
		起伏量（m）				
等高帯		1	2	3	4	5
1	H ≧ 2000m					
2	1700m ≦ H < 2000m					
3	1400m ≦ H < 1700m					
4	1100m ≦ H < 1400m					
5	700m ≦ H < 1100m					
6	200m ≦ H < 700m					
7	100m ≦ H < 200m					
8	50m ≦ H < 100m					
9	H < 50m					

Assignment of Textures

- Textures were extracted from actual aerial photographs by checking the elevation, roughness and land use
- Textures were combined with each color chart
- Textures increase the effect of virtual reality

Procedures of Geo-Art

- Step 1: Compute hill shading from DEM
- Step 2: Classify DEM into 9 zones
- Step 3: Assign colors to each zone
- Step 4: Assign textures to each category and zone
- Step 5: Composite all products
- Step 6: Generate clouds and snows


Demonstrations of Geo-Art
• Texture Mapping Sample
• Mt. Daisetsu-zan, Hokkaido, Japan
• Japan Alps

Geo-Art of Texture Mapping Sample

Geo-Art of Mt. Daisetsu-zan

Geo-Art of the Japan Alps

Conclusions

- Bird’s eye view with hill shading, colors and textures gave more realistic images
- Level slicing of elevation zones with NOAA NDVI reflected more scientific approach
- Geo-Art revealed more value added