

# The 8<sup>th</sup> Bilateral Geodetic Meeting Poland-Italy

## **Accuracy Evaluation of the SRTM Digital Elevation Model over Selected Sites in Australia and Brunei Darussalam**



Kazimierz Becek

Geography Department, Universiti Brunei Darussalam  
Wroclaw, Poland, 22<sup>nd</sup> – 24<sup>th</sup> June 2006

# Agenda

1. Objectives of the study
2. Characteristics of the Datasets
3. Methodology
4. Findings from the Australian Site
5. Findings from the Brunei Site
6. Conclusions

# Objectives of the study

- To verify the accuracy parameters of the DEM-C provided by NASA/JPL,
- To identify a relationship between the type of land cover and the accuracy of the DEM-C over two significantly different test sites

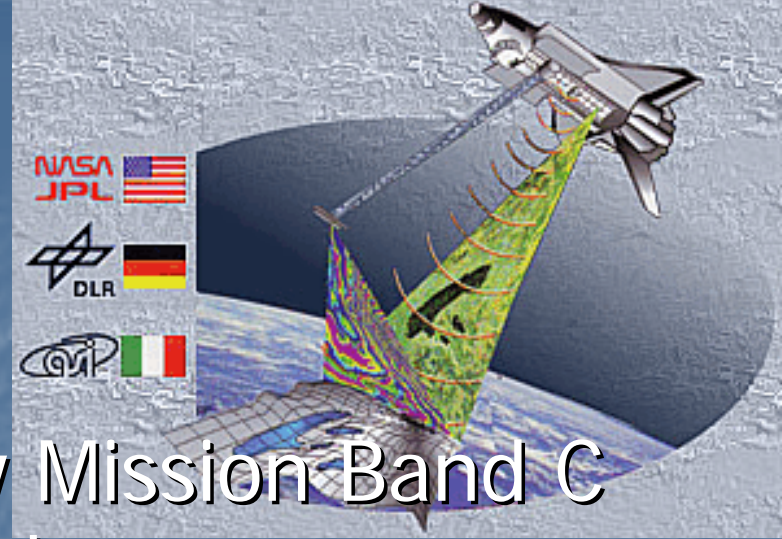


# Characteristics of the Datasets

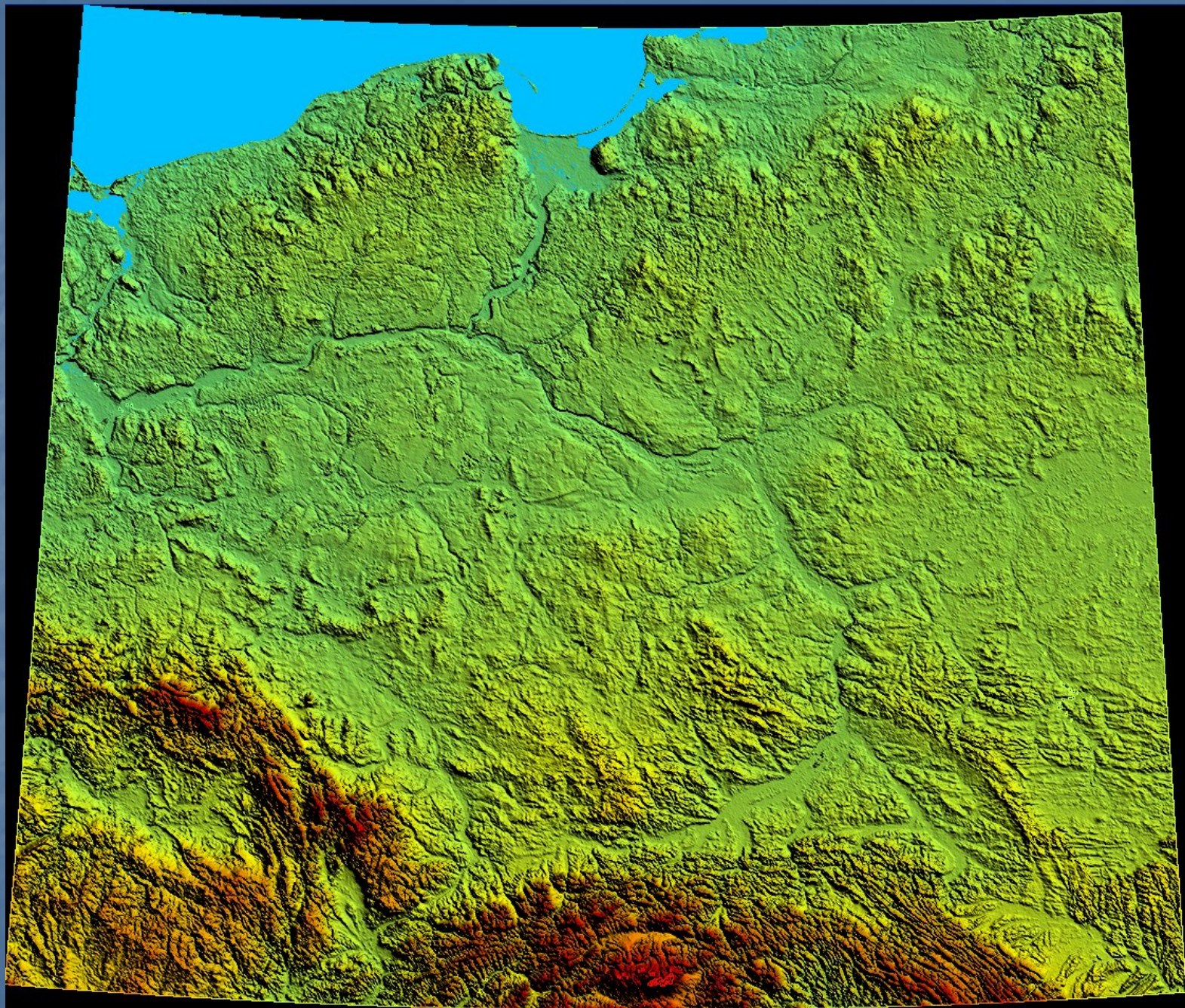
- 1:2.5k topographic maps including 1m contours and land cover classification (Australian site),
- SRTM Band C DEM (3") over both sites,
- 1:200k forestry map of Brunei Darussalam,
- 15m contours derived from 1:50k topographic maps (Brunei site).

# What is the SRTM Band C DEM?

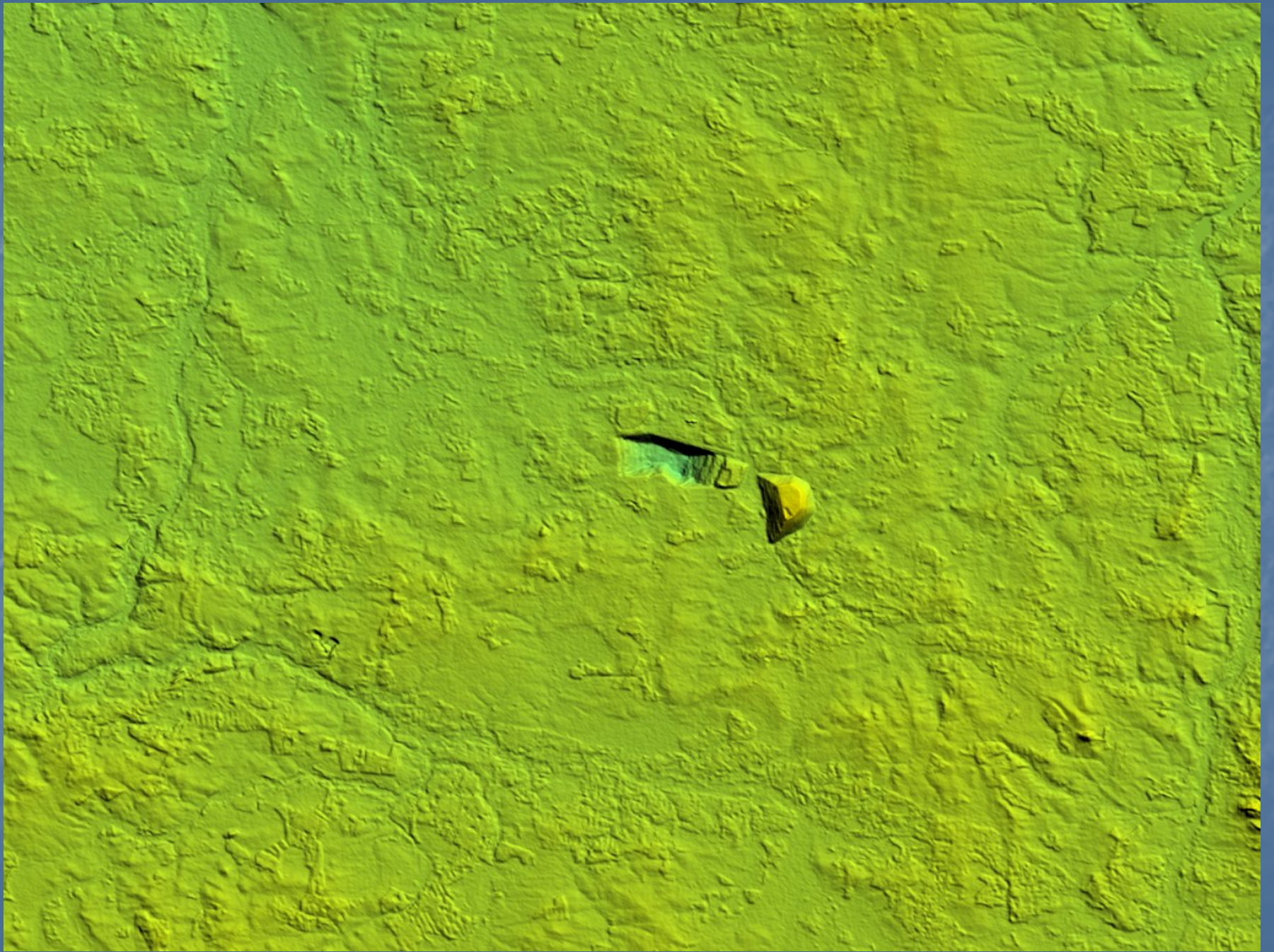
- Shuttle Radar Topography Mission Band C (5.6cm) or DEM-C for short,
- Acquired by the Endeavour shuttle during 10 days mission in February 2000,
- Available for about 80% of land masses of the earth free of charge,
- Spatial resolution 3" (about 90m at the Equator); 1" for the USA,
- 1m quantization level;



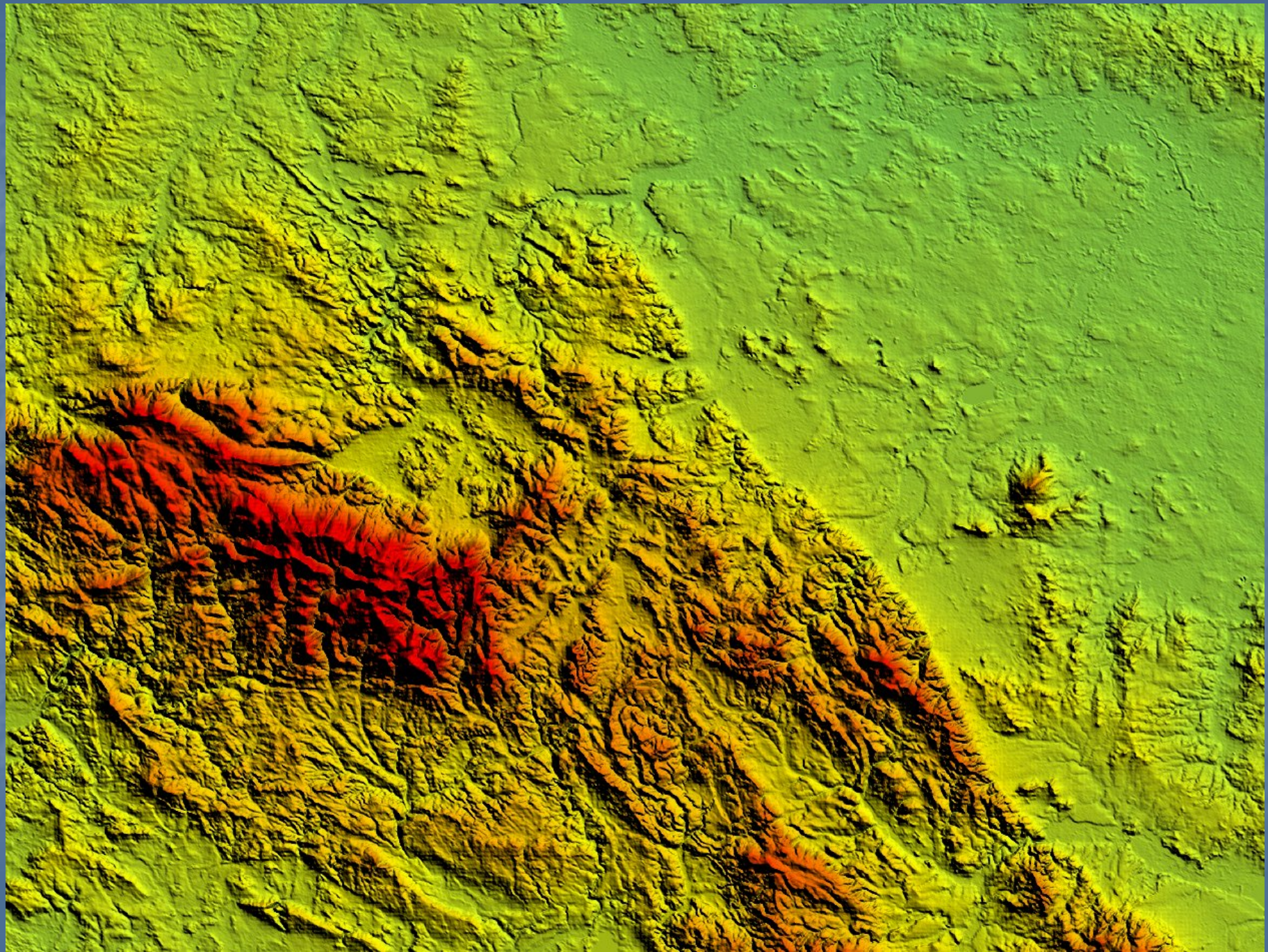




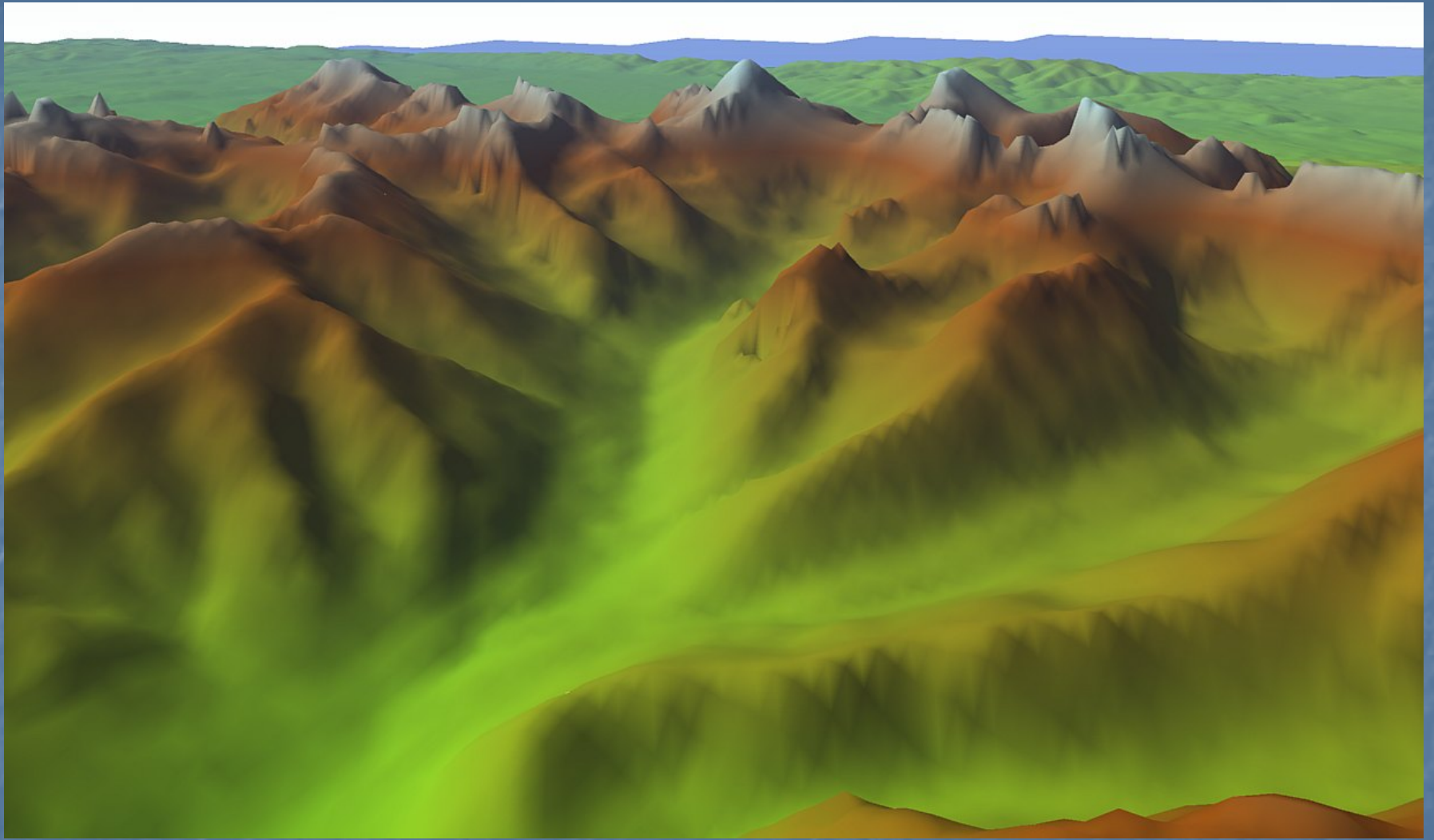




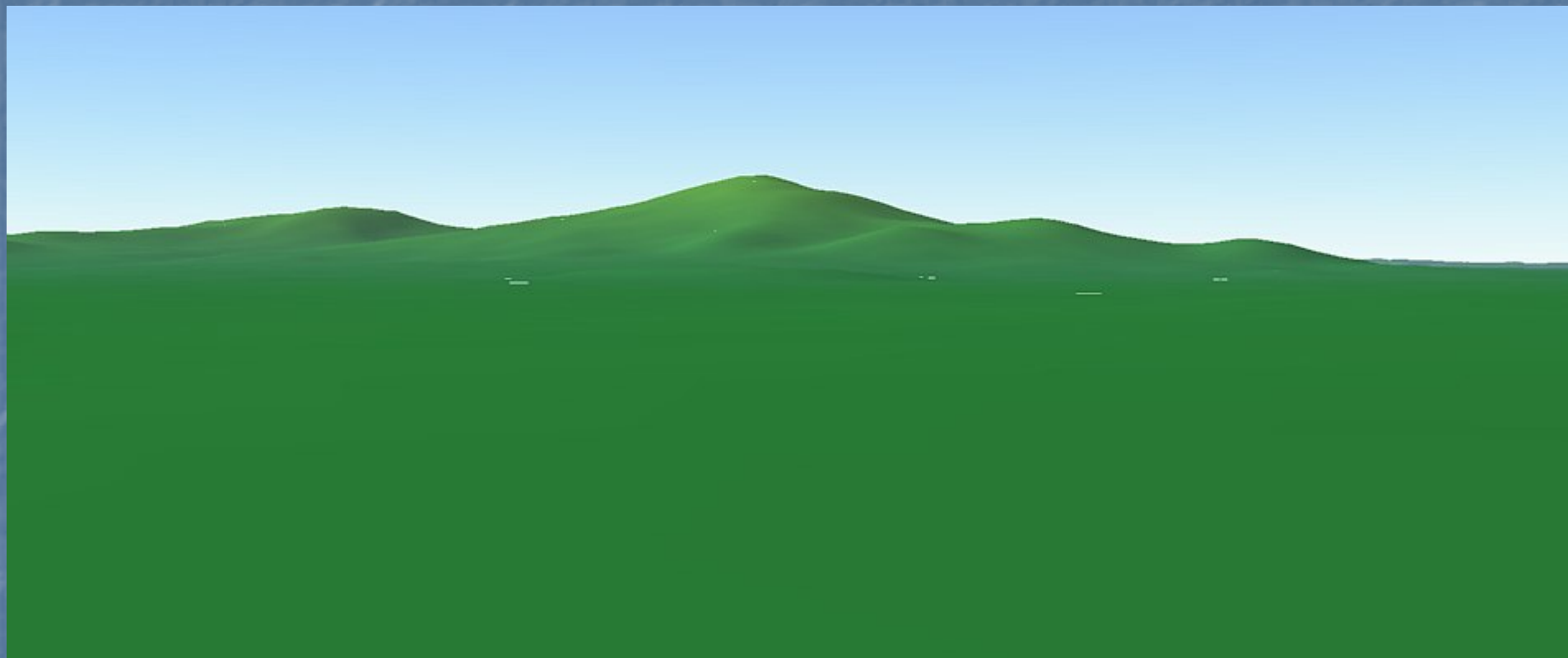














# Accuracy of the DEM-C

(90% confidence level – NASA/JPL)

Region/ Error Type	Africa	Australia	Euroasia	Islands	N. America	S. America
Absolute	5.6	$\pm 6.0$	$\pm 6.2$	8.0	9.0	6.2
Relative	9.8	$\pm 4.7$	$\pm 8.7$	6.2	7.0	5.5

Source:

Rodríguez E., Morris E. C., Belz J. E.,

*A Global Assessment of the SRTM Performance.*

Photogrammetric Engineering & Remote Sensing, vol. 72, no 3, 3/2006



# Australian Site

**Surface area of the site:**

- \* 30 km<sup>2</sup> (6.0 x 5.0 km)
- \* Lowest point 4 m
- \* Highest point 388 m (ASL)
- \* Reference data: 1m contours
- \* Land cover from 1:2500 maps (1994)

Test site







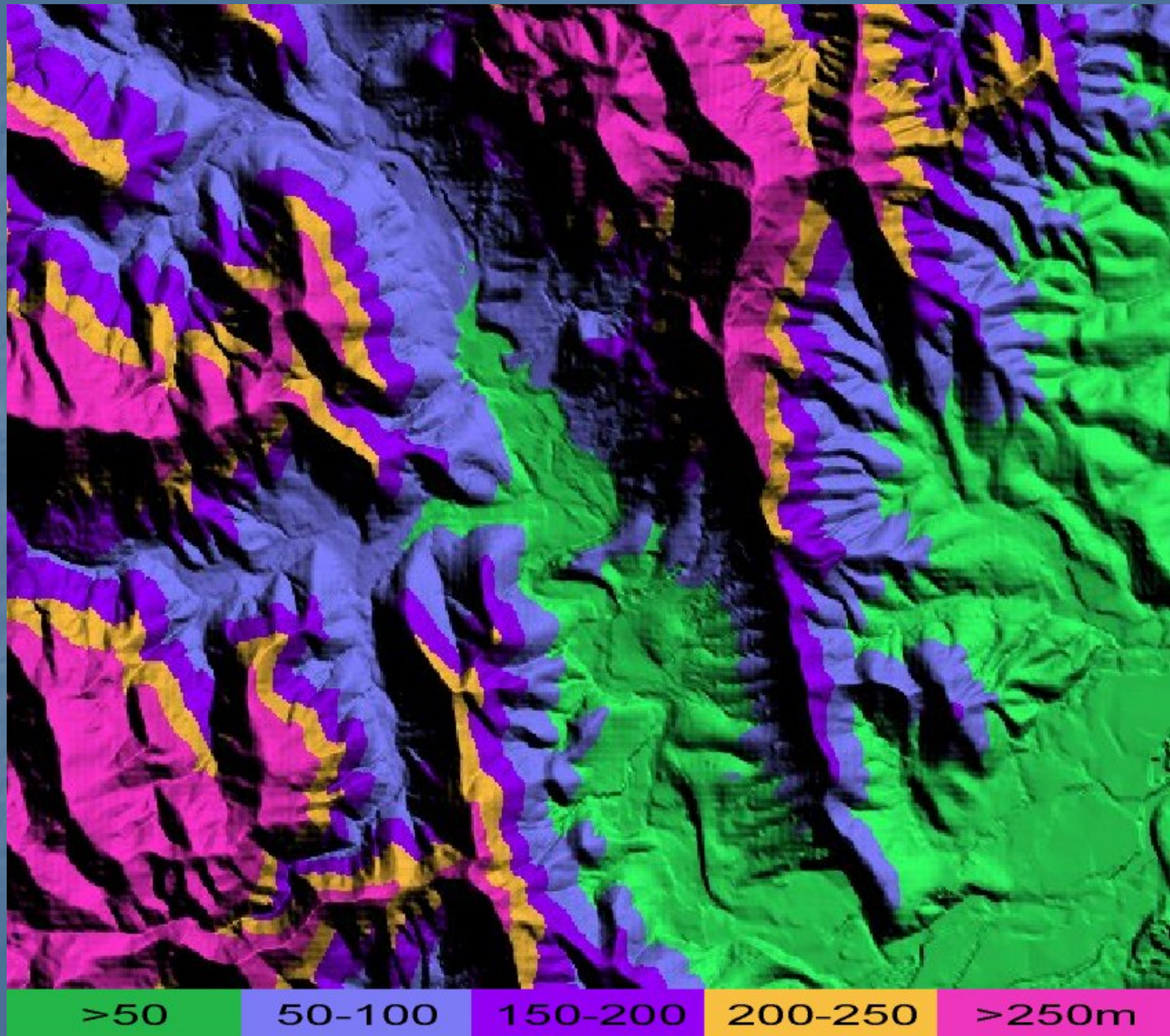
0 1 2km

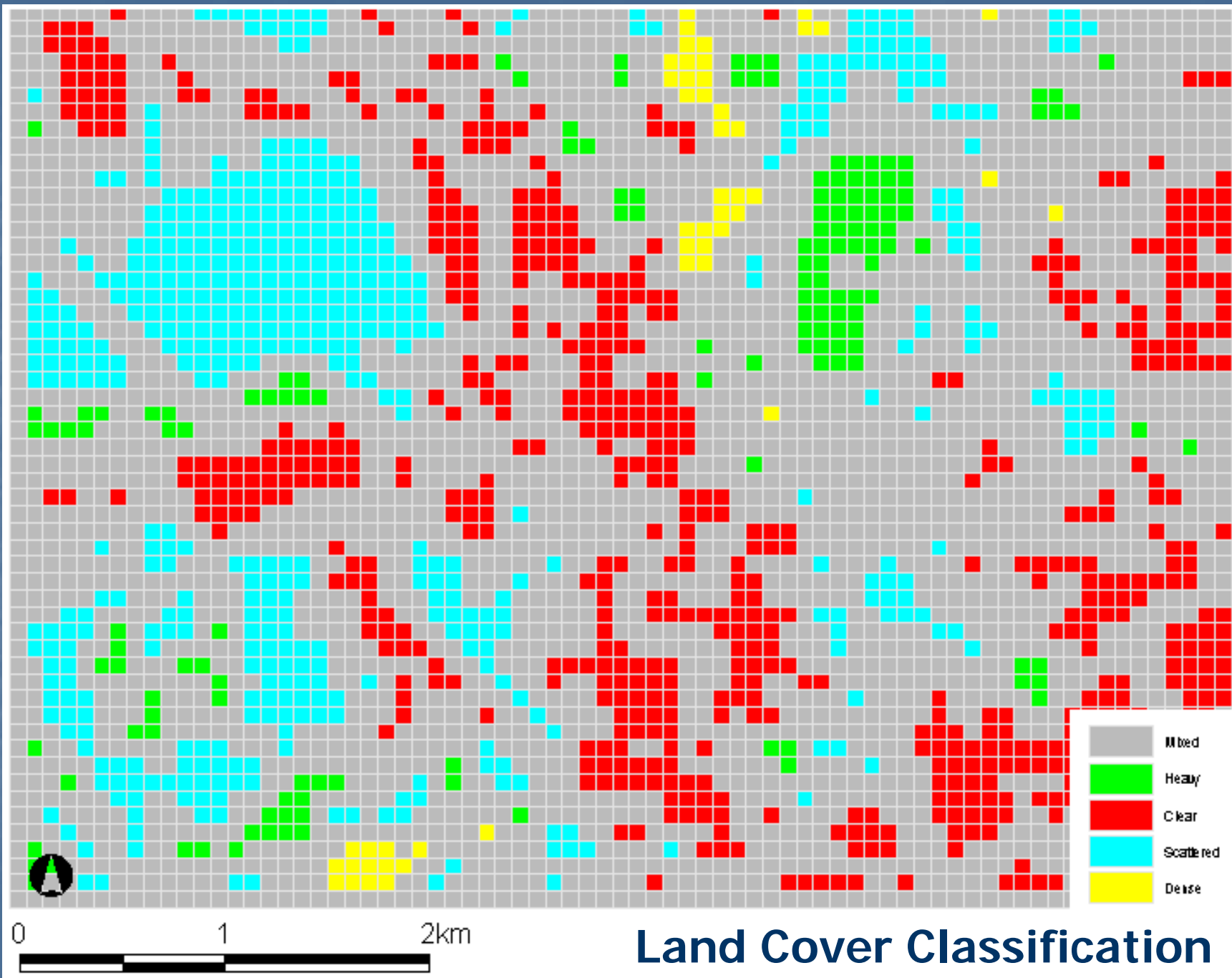
A horizontal scale bar with alternating black and white segments, used to indicate distance in kilometers.

**Aerial Photo of the Australian Site**



## DTM over Australian Site







# Results for the Australian Site

Type of cell	Diff.	Error	No. of Cells
Clear	2.9	$\pm$ <b>4.2</b>	636
Scattered	14.6	$\pm$ <b>9.1</b>	546
High	13.2	$\pm$ <b>12.6</b>	163
Dense	18.1	$\pm$ <b>9.1</b>	48
Mixels	10.0	$\pm$ <b>11.0</b>	2559
All	9.8	$\pm$ <b>11.5</b>	3952

Diff. := DEM-C – DTM<sub>(absolute)</sub>

Error := 1.6 x STD

# Brunei Darussalam in Asia





Brunei Darussalam

Capital city: Bandar Seri Begawan

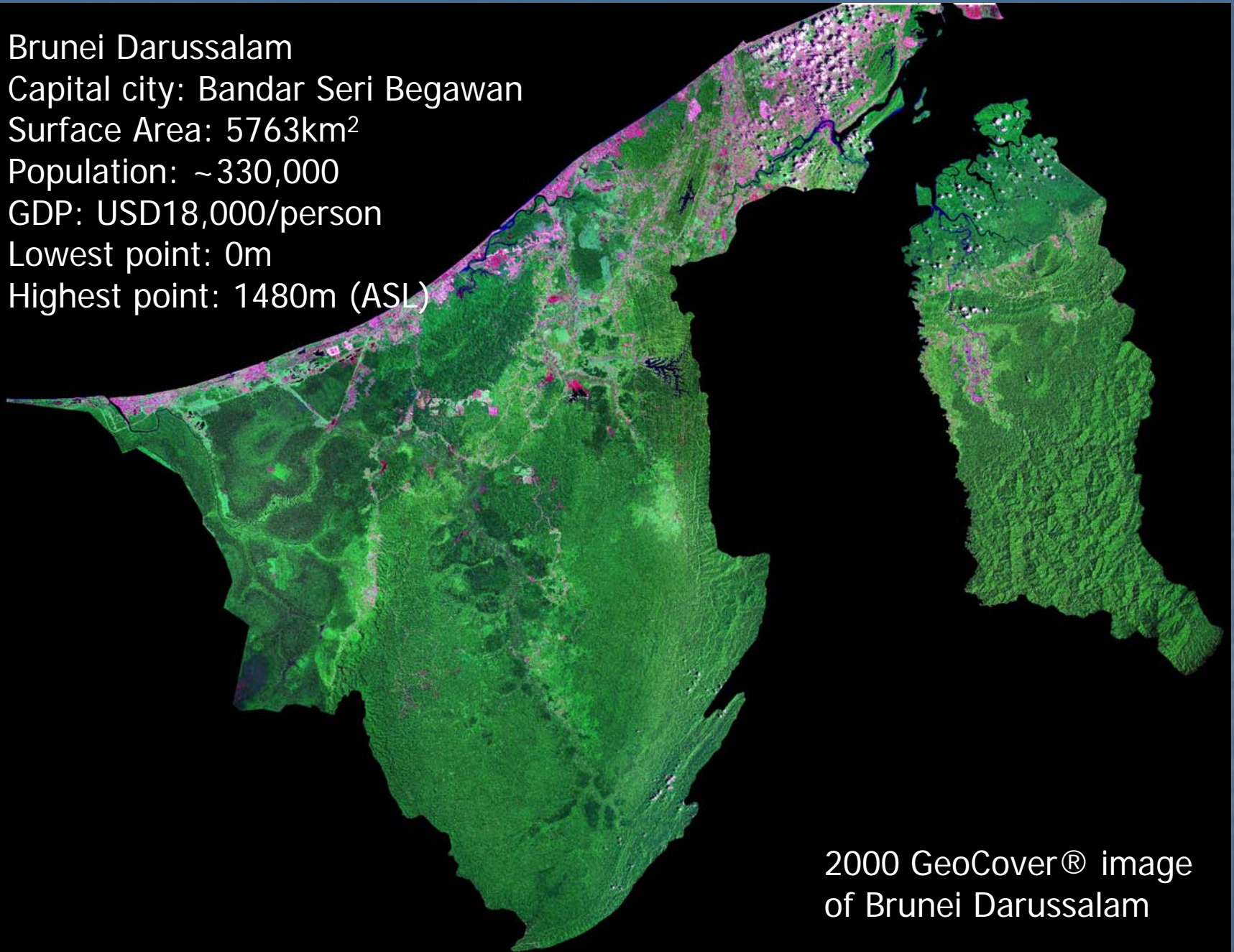
Surface Area: 5763km<sup>2</sup>

Population: ~330,000

GDP: USD18,000/person

Lowest point: 0m

Highest point: 1480m (ASL)



2000 GeoCover® image  
of Brunei Darussalam

# BRUNEI DARUSSALAM

0 10 20 30 40 50km



South China Sea

Sabah (Malaysia)

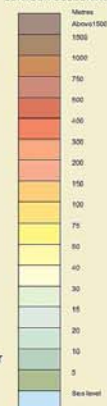
Teluk Brunei

Sarawak (Malaysia)

Sarawak (Malaysia)

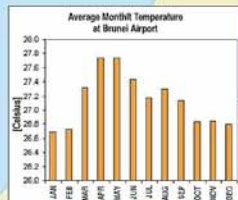
Sarawak (Malaysia)

CONTOUR COLOURING



## Legend

- ..... Highway
- ..... Major Road
- ..... Other Route
- ..... International Boundary
- ..... District Boundary
- ..... River
- ..... Capital City
- ..... Major Town
- ..... Town/Village
- ..... Airport
- ..... Seaport
- ..... Immigration Post
- ..... Build up Area
- ..... District



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BRUNEI FOREST RESOURCES PLANNING STUDY  
MAP2 STRATEGIC PLANNING

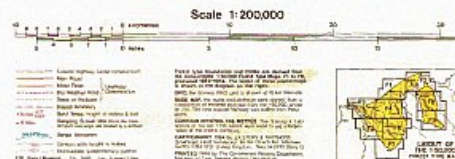
# Forestry Map of Brunei Darussalam

Study for the Government of Negara Brunei Darussalam  
by ANDERSON & MARDEN FORESTRY CONSULTANTS LTD  
K 55-01 Kuching Sarawak, Sarawak, Singapore 1343  
This map is not an authority on international boundaries

- Boundary of constituted forest reserve ..... F.R.
- Boundary of proposed forest reserve ..... P.R.  
& extensions to forest reserves ..... Ext
- MDF production forest
- PSF production forest
- Protection forest ..... P.F.
- Primary conservation area ..... C.A.(1)
- Secondary conservation area ..... C.A.(2)
- Conservation area proposed by  
The Director, Brunei Museum ..... C.A.(M)
- Recreational area ..... R.A.
- All land area other than that designated  
as production and protection forest,  
and conservation and recreation areas.

## KEY TO FOREST TYPES

1	Mangrove	1	Swampy forest	1	Swampy forest
2	Freshwater swamp forest	2	Peat swamp forest (PSF)	2	Peat swamp forest (PSF)
3	Peat swamp forest (PSF)	3	Swampy forest	3	Swampy forest
4	Kerangas	4	Mixed dipterocarp forest (MDF)	4	Mixed dipterocarp forest (MDF)
5	Mixed dipterocarp forest (MDF)	5	Montane forest	5	Montane forest
6	Secondary forest	6	Montane forest	6	Montane forest
7	Montane forest	7	Secondary forest	7	Secondary forest
8	Montane forest	8	Secondary forest	8	Secondary forest
9	Montane forest	9	Secondary forest	9	Secondary forest
10	Montane forest	10	Secondary forest	10	Secondary forest
11	Montane forest	11	Secondary forest	11	Secondary forest
12	Montane forest	12	Secondary forest	12	Secondary forest
13	Montane forest	13	Secondary forest	13	Secondary forest
14	Montane forest	14	Secondary forest	14	Secondary forest
15	Montane forest	15	Secondary forest	15	Secondary forest
16	Montane forest	16	Secondary forest	16	Secondary forest
17	Montane forest	17	Secondary forest	17	Secondary forest
18	Montane forest	18	Secondary forest	18	Secondary forest
19	Montane forest	19	Secondary forest	19	Secondary forest
20	Montane forest	20	Secondary forest	20	Secondary forest















# Results for the Brunei Site

Forest Type	Diff.	Error	No. of Cells
4 Kerangas – Tropical health forest	<b>7.4</b>	<b>± 13.4</b>	36
5(1) Dense even, or semi-open, canopy of mainly small-crowned trees	<b>4.7</b>	<b>± 10.6</b>	29
5(2) Canopy uneven, or moderately open, some medium or large emergents	<b>10.8</b>	<b>± 10.7</b>	86
5(3) Dense even canopy of medium crowns	<b>16.0</b>	<b>± 11.8</b>	19
5(4) Dense uneven canopy, of medium-sized and large crowns	<b>11.5</b>	<b>± 14.9</b>	48
5(5) Dense uneven canopy, mainly large crowns	<b>23.5</b>	<b>± 21.1</b>	29
8 - Generally over 25 years old	<b>4.7</b>	<b>± 10.6</b>	118
9 Land under urban and industrial use	<b>5.0</b>	<b>± 14.9</b>	116

Diff. := DEM-C – DTM<sub>(absolute)</sub>

Error := 1.6 x STD

# Conclusions

- The accuracy of the DEM-C appears to be better than published for the Australian site ( $\pm 6\text{m}$  versus  $\pm 4.2\text{m}$ ),
- The corresponding values for the Brunei site are much larger than published ( $\pm 6\text{m}$  v.  $\pm 14.9\text{m}$ ). This is most likely due to the quality of the reference DTM for the Brunei site (15m contour interval),
- The vegetation cover causes a systematic, positive shift of the DEM-C in a range from 14.6 – 18.1m (Australia), and 4.7 – 23.5m (Brunei)
- Further tests are required to quantify a relationship between the vegetation type and systematic shift of the DEM-C.