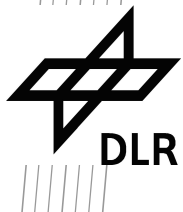


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Evaluation of High Resolution TanDEM-X Data for Urban Monitoring

TanDEM-X Science Team Meeting, 12 - 14 June 2013, DLR Oberpfaffenhofen

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The Commonwealth Scientific and Industrial Research Organisation
I. Hajnsek* and T. Busche
German Aerospace Center (DLR), *ETH Zurich



Motivation

Urban Monitor: - a Project of Western Australian State
Annually Fine-scale Monitoring of Urban and Peri-
urban Environments in Great Perth Metropolitan
Region using Aerial Photography since 2007...

Considering

Involvements of High Resolution TanDEM-X Data to
this Project: Possible Replacement or Supplement...

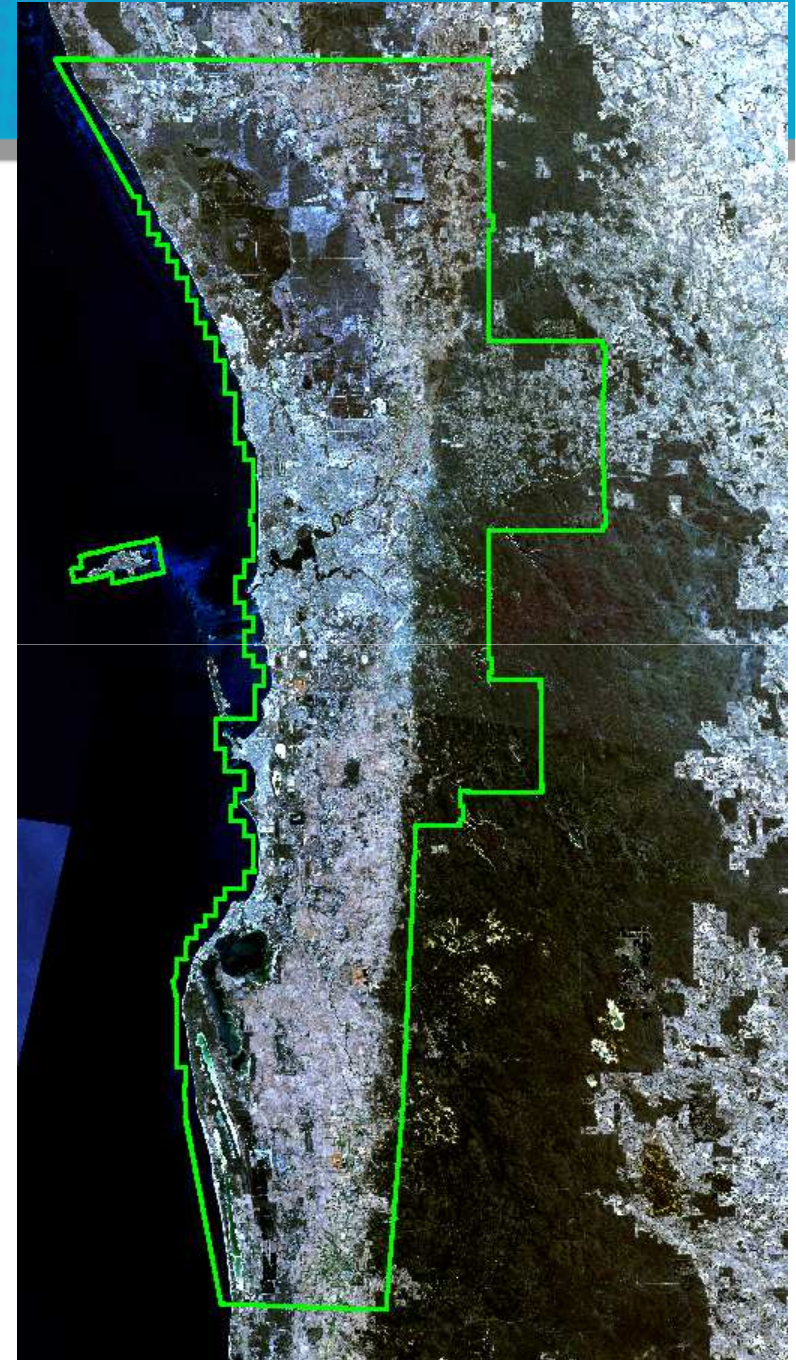
Acknowledgements:

Support of DLR for Proposal XTI_LAND0355 have made this
study possible.

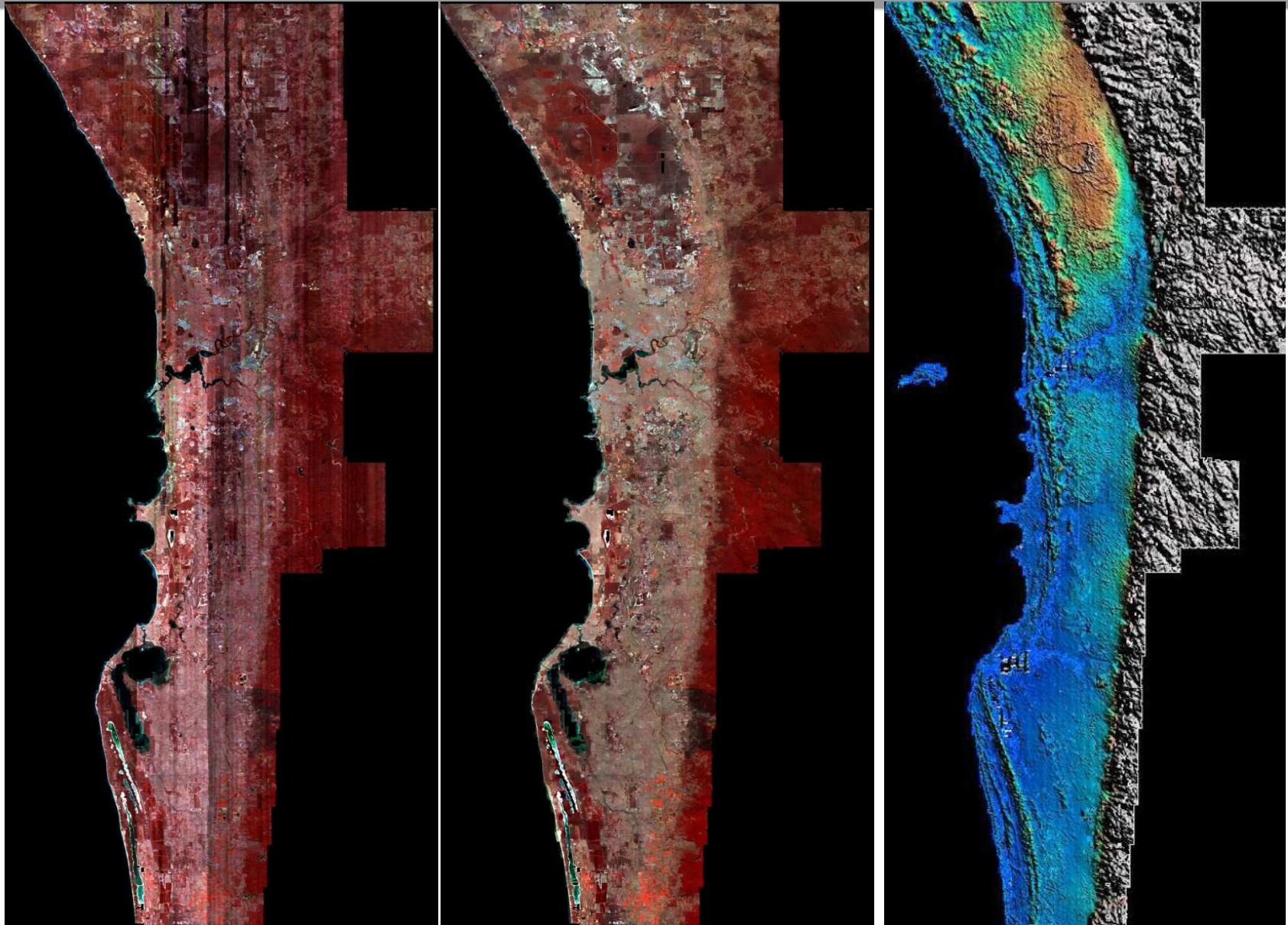
Urban Monitor

-Airbourne Photogrammetry

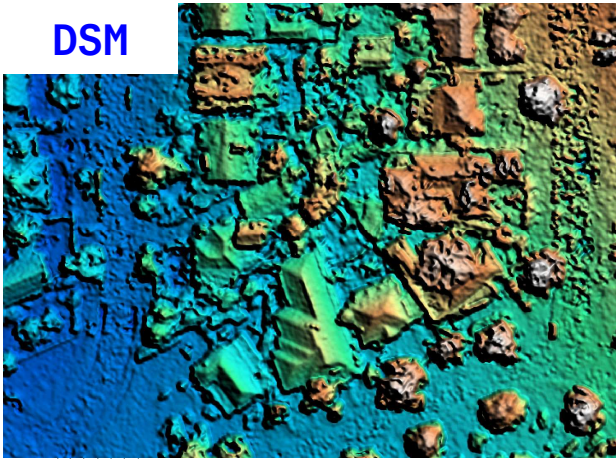
- Jan/March 2007, 2008, 2009, 2010, 2011, 2012, 2013 complete coverage
- 9,600 km² (green boundary shows)
- 19 days of cloud-free acquisition (2007)
- 34,398 frames (2007)
- 13TB (50TB)
- RGB + Near Infra Red ~30 cm Ground Sampling Distance (GSD) (10cm, 15cm)
- Panchromatic ~10 cm GSD (10cm, 15cm)
- Uncompressed
- Full dynamic range (12bit) (14bit)
- Solar noon +/- 2 hours acquisition
- 60% forward overlap (100% forward overlap)
- 30% side overlap
- Non-exclusive license
- 40-50TB raw datasets
- 2010+ Landgate (WA) licence



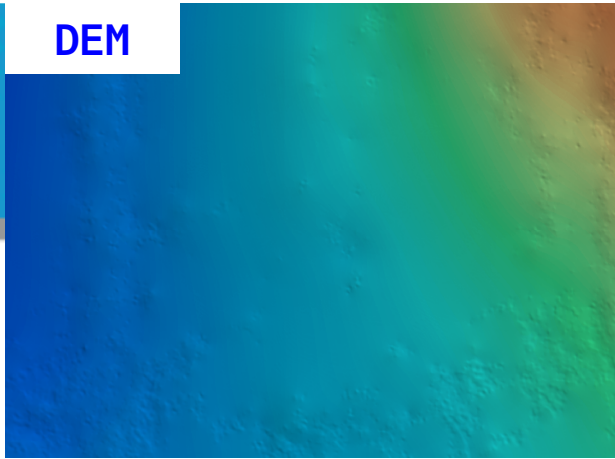
Calibrated Orthophotos to DSM



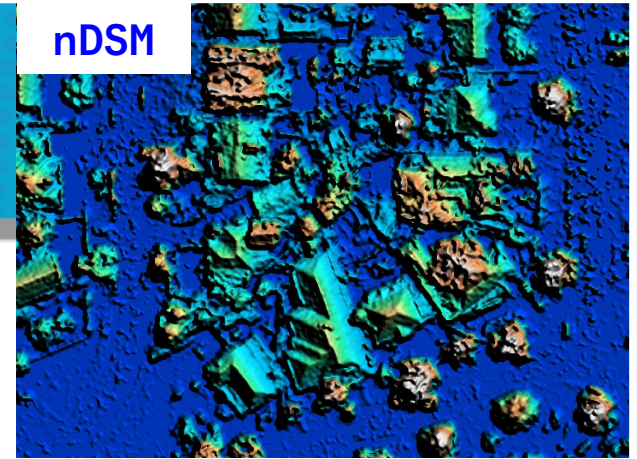
DSM



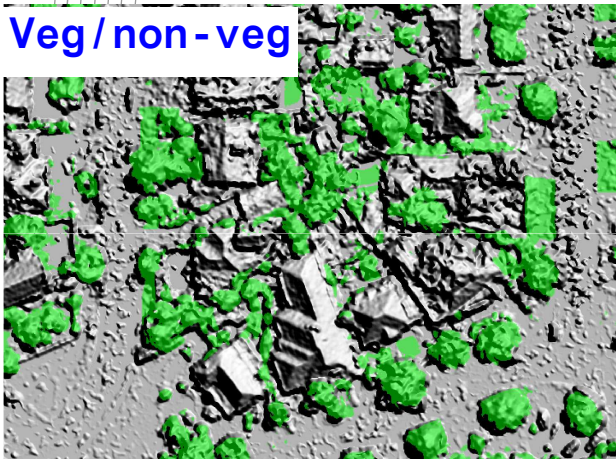
DEM



nDSM



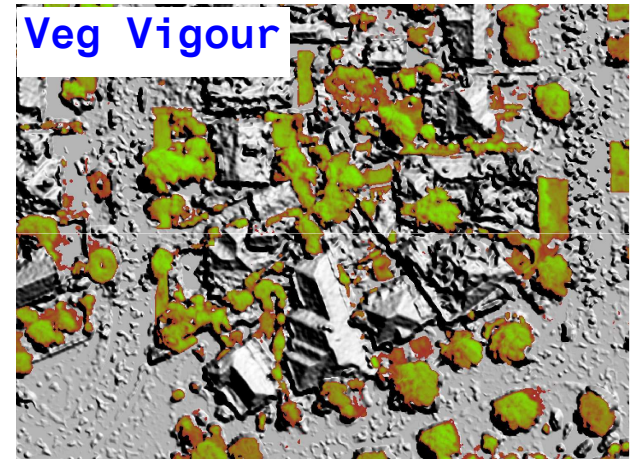
Veg/non-veg



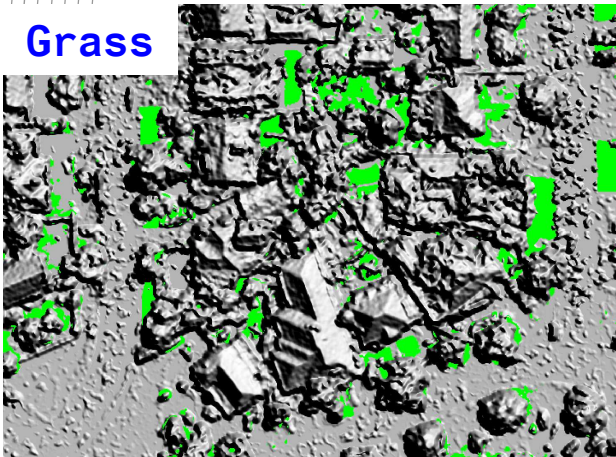
Orthophoto



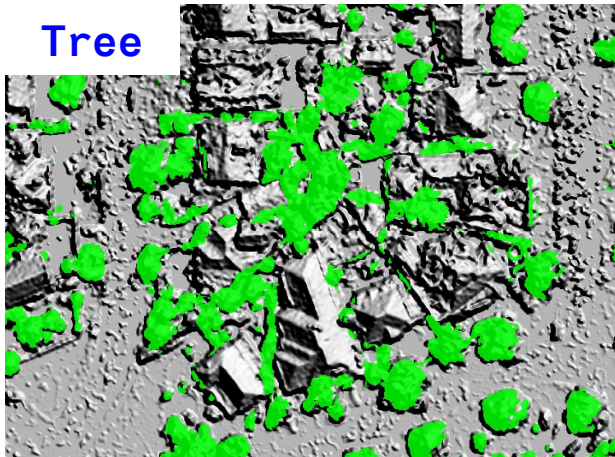
Veg Vigour



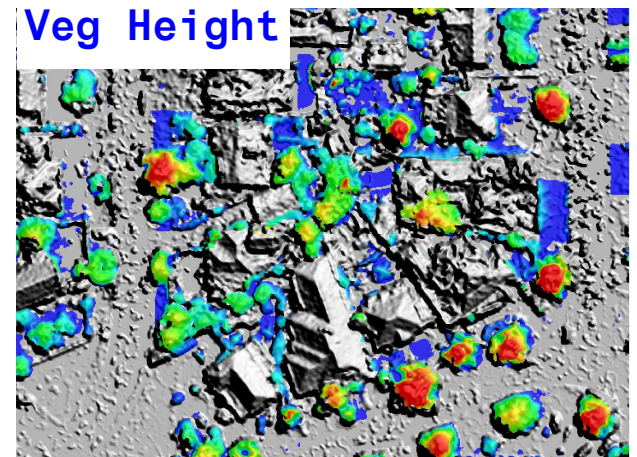
Grass



Tree

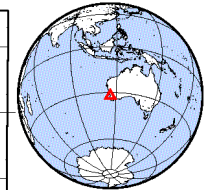
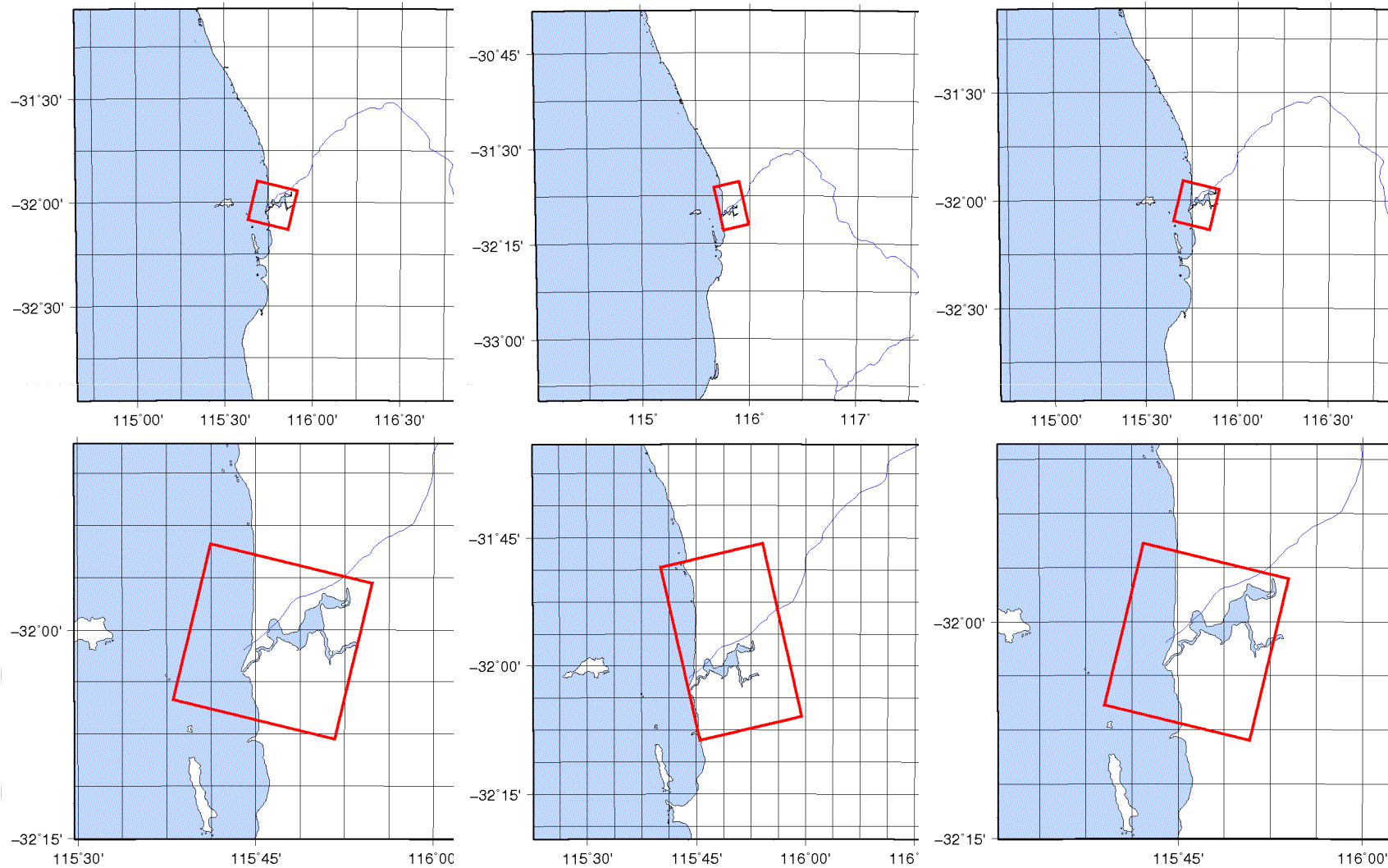


Veg Height



TanDEM-X Standard Stripmap Acquisitions

Single Look Complex Data: range_pixel_spacing: 0.909403 m
azimuth_pixel_spacing: 2.871039 m



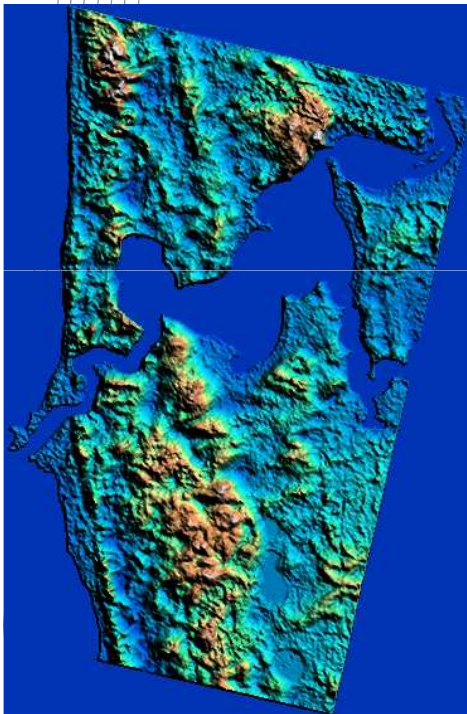
acquisition mode : "SM" / "stripFar_008" / "VV/VH" / "R"
product type : "SSC" /
start time UTC : "2012-05-17T21:45:00.711865"
stop time UTC : "2012-05-17T21:45:03.711553"
orbit cycle / no. / dir. : 164 / 27309 / 88 / "D"

20120425

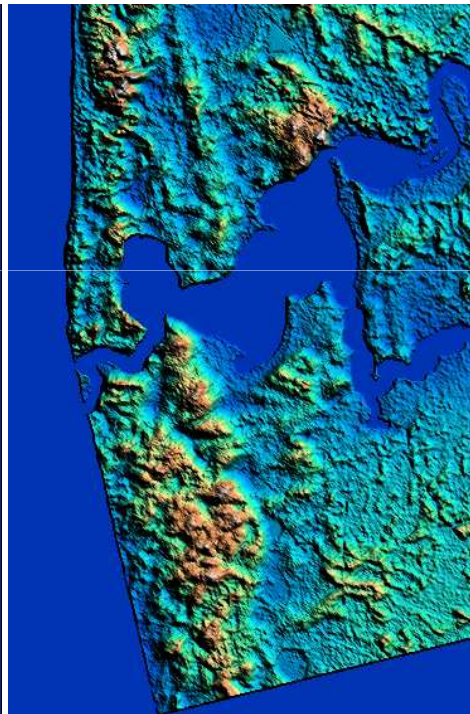
20120513

20120517

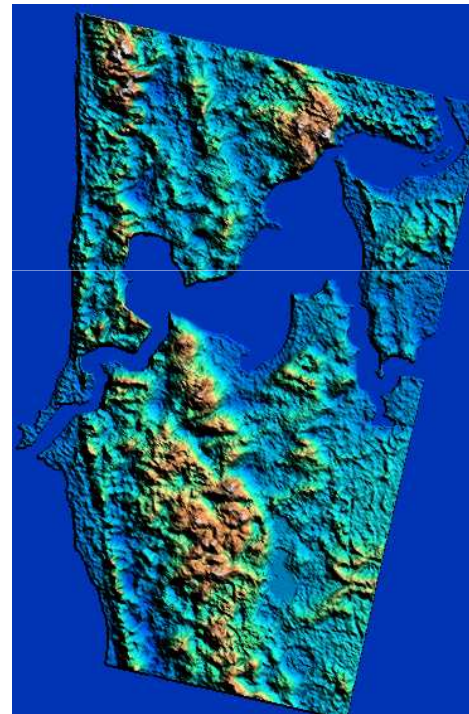
5m DSMs from TDX Stripmap Mode Acquisitions



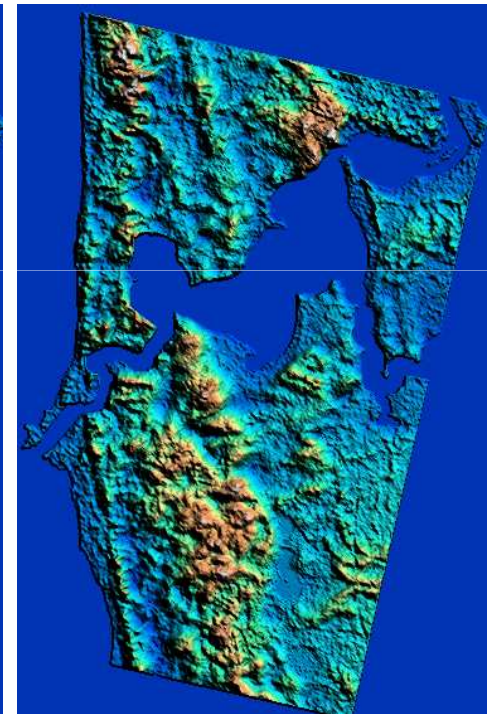
VV-20120425



HH- 20120513

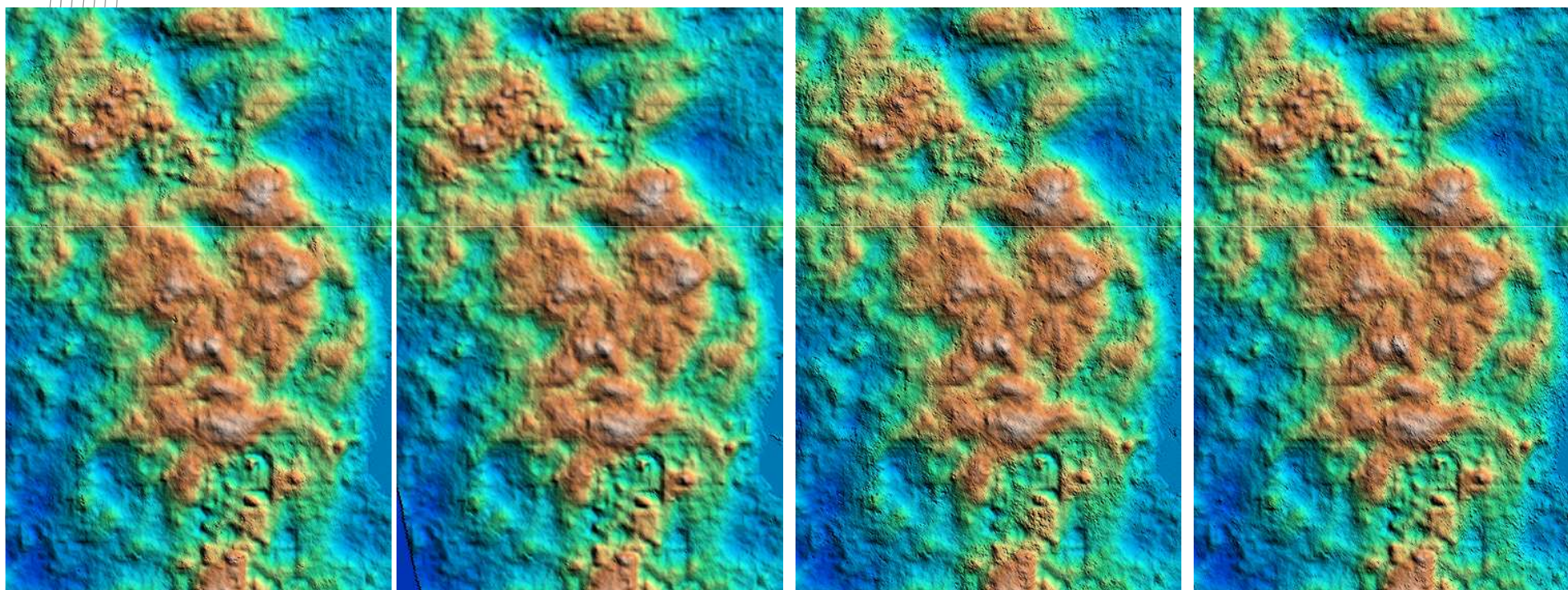


VV-20120517



VH-20120517

Close-up: 5m DSMs from TDX Stripmap Mode



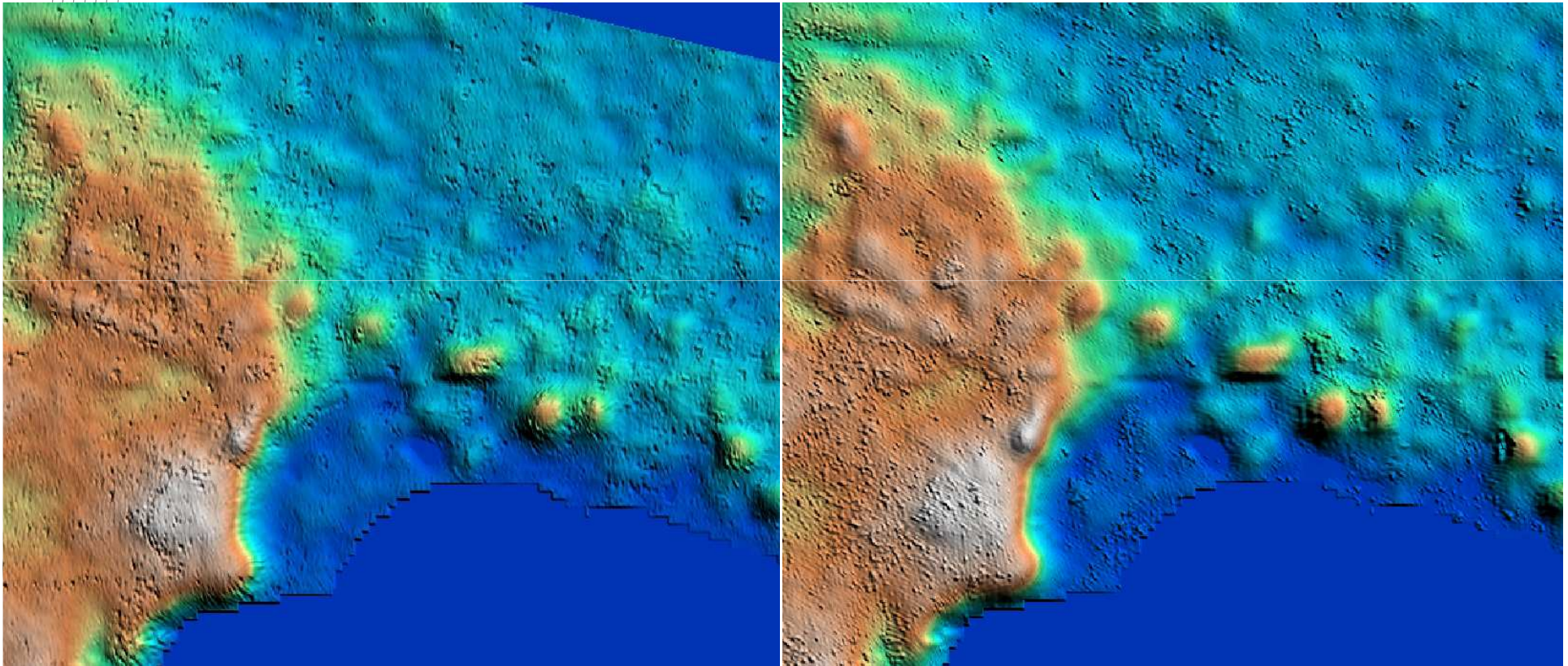
VV-20120425

HH-20120513

VV-20120517

VH-20120517

5m TDX Stripmap DSM: Descending (left) and Ascending (right)



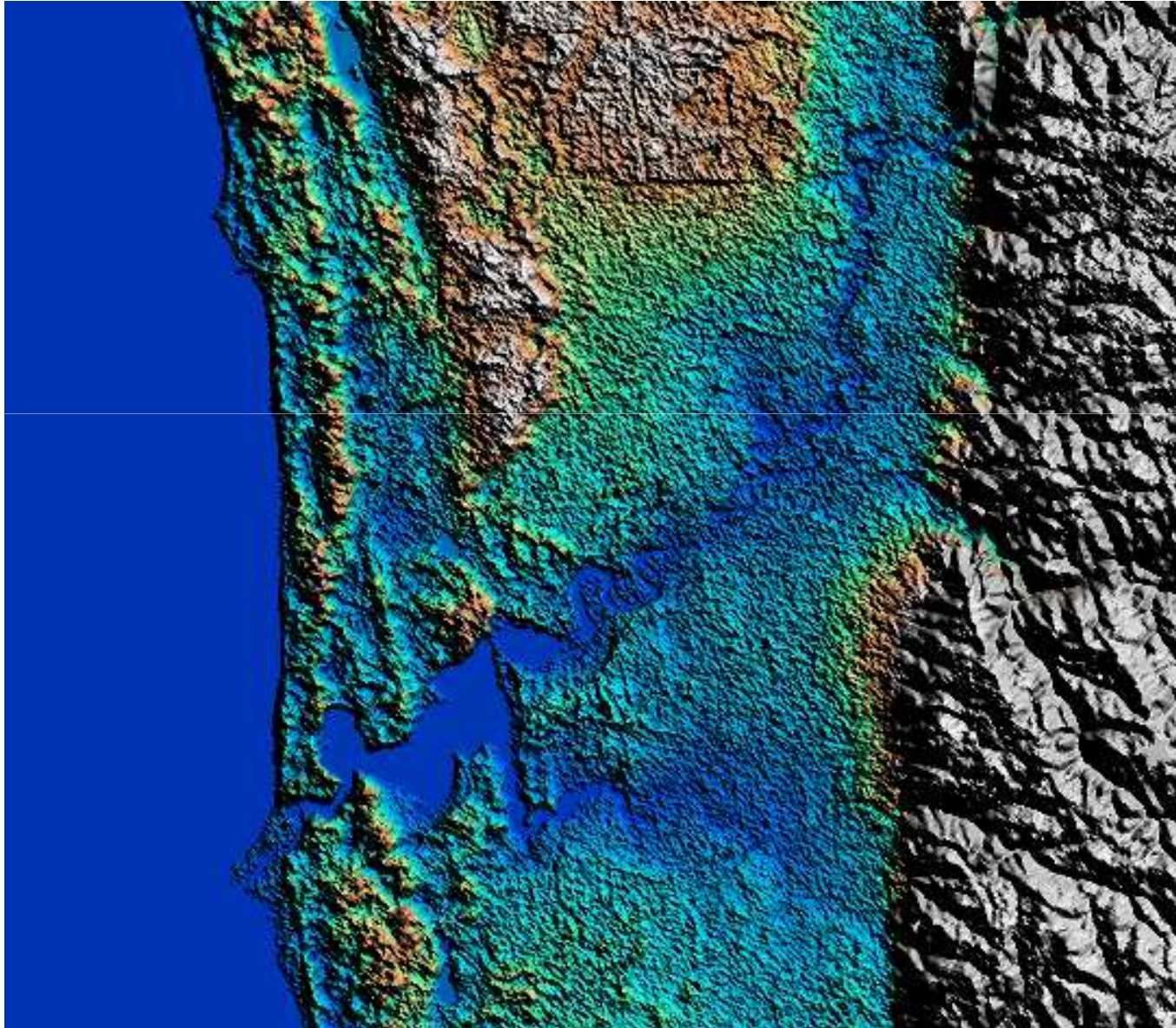
References

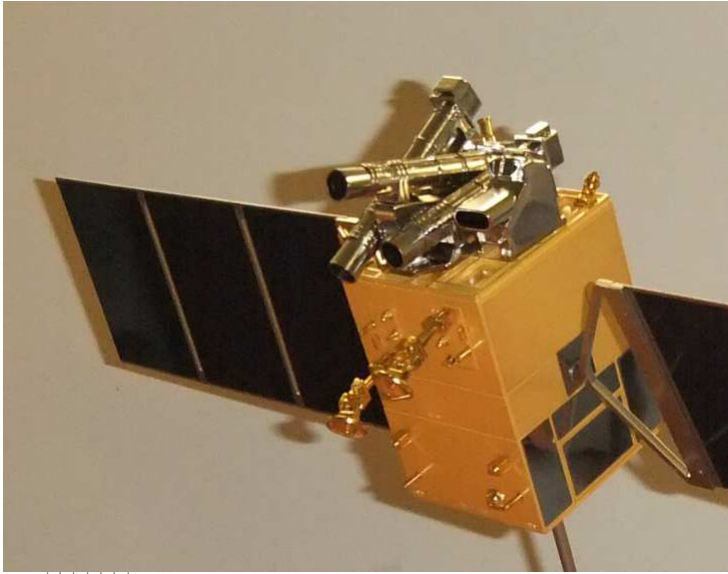
DSM from 1sec SRTM for WRON

5m DSM from ZY-3: China's First Stereo Mapping Satellite

0.2m DSM from Urban Monitor

DSM of 1sec SRTM for WRON (Australia's Water Resources Observation Network)





ZY-3: China's First Stereo Mapping Satellite

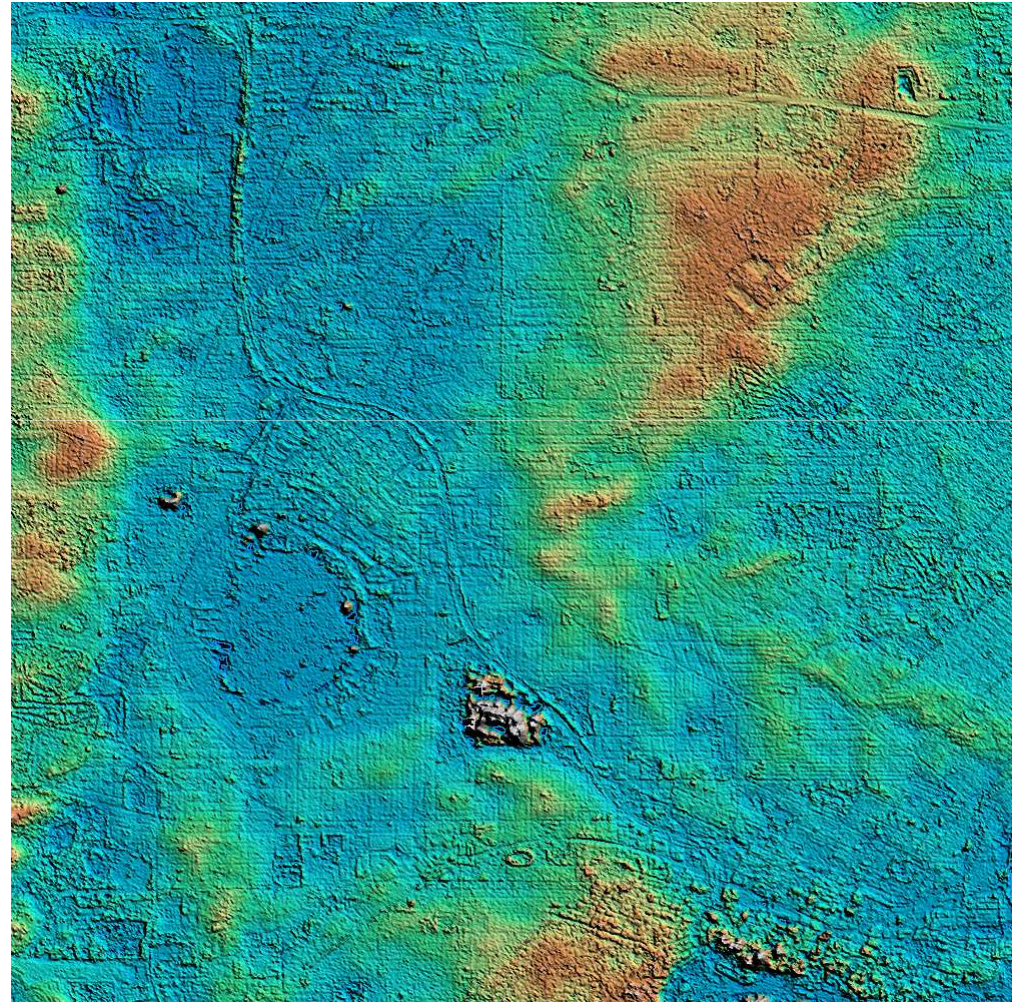
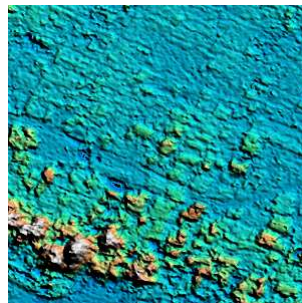
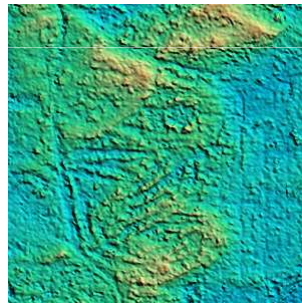
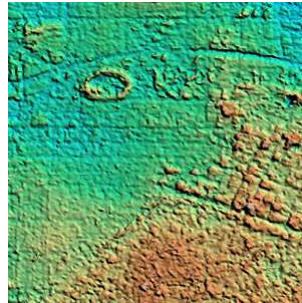
Imagery Specifications Bands and Resolutions

- 2.1m pan band (nadir view)
- 3.6m pan band (forward/backward views)
- 6m multispectral 4-band

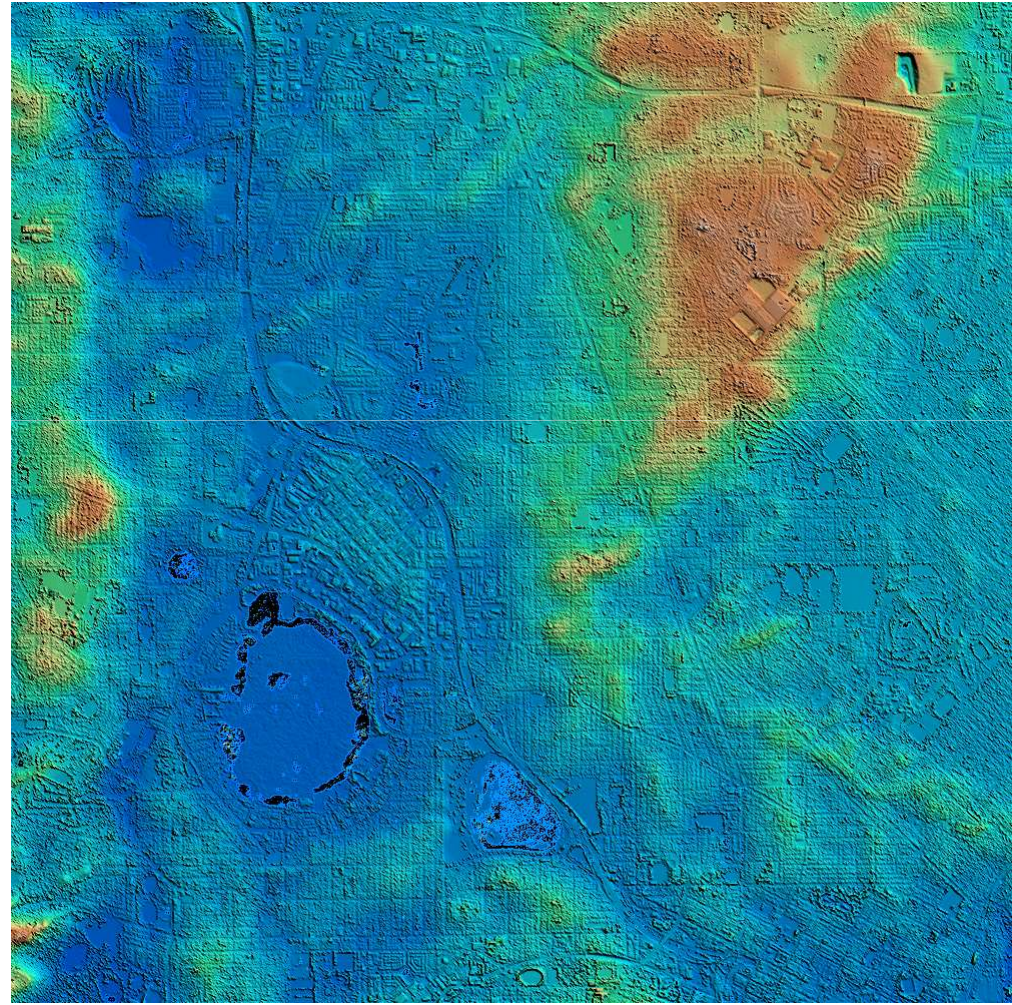
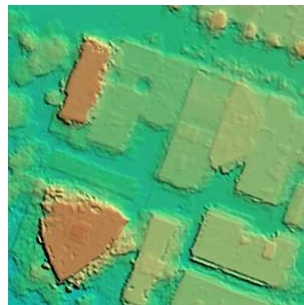
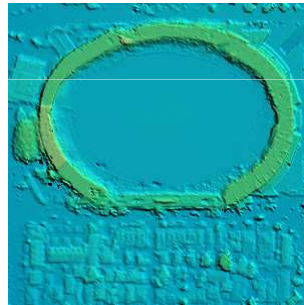
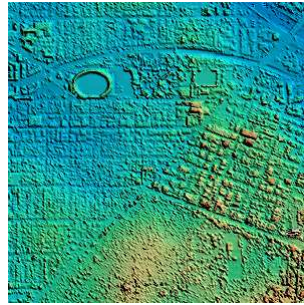
Multispectral image was acquired by ZY-3 on 18/06/2012 as a part of field calibration campaign in Perth



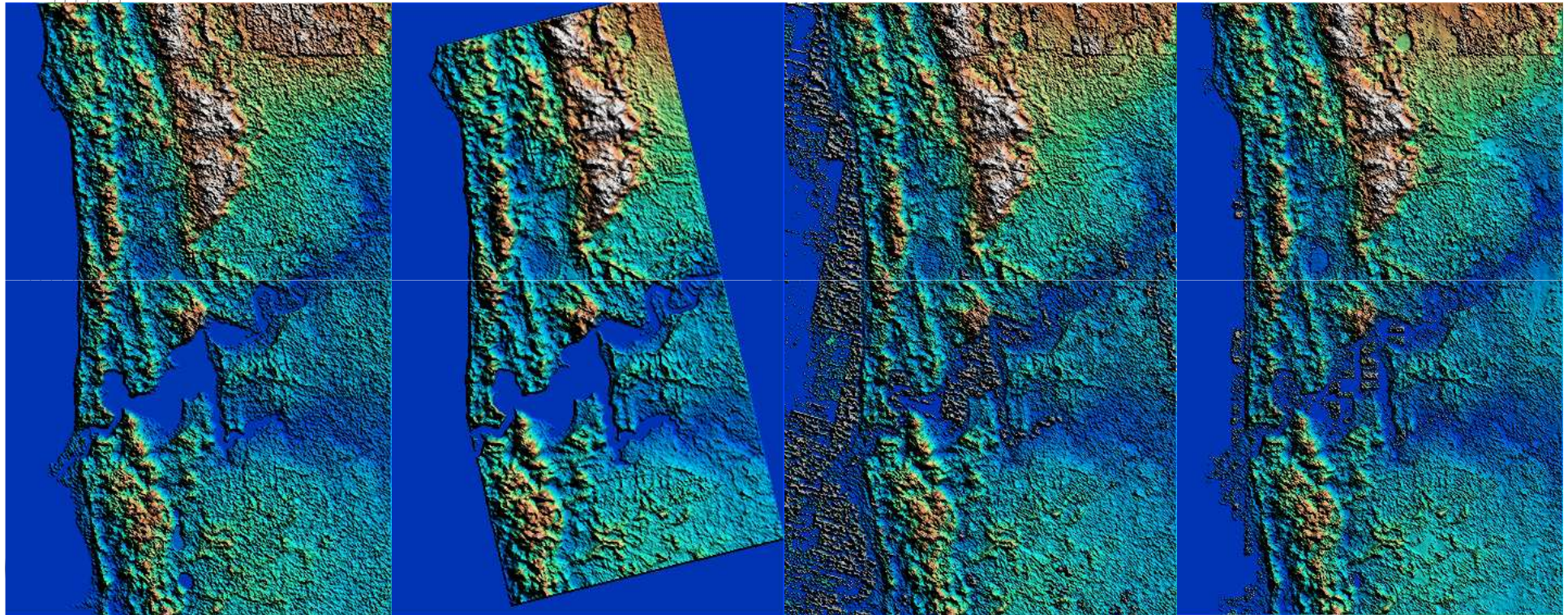
5m DSM from ZY-3



0.2m DSM from Urban Monitor



DSM Comparison



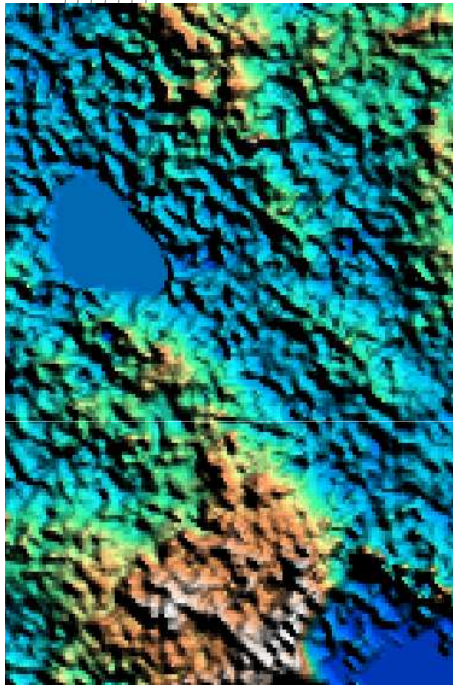
1sec SRTM

TDX- Stripmap

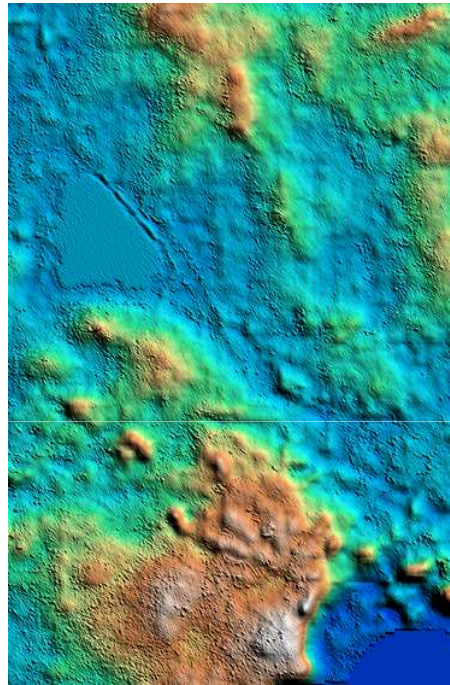
ZY-3

UM2009

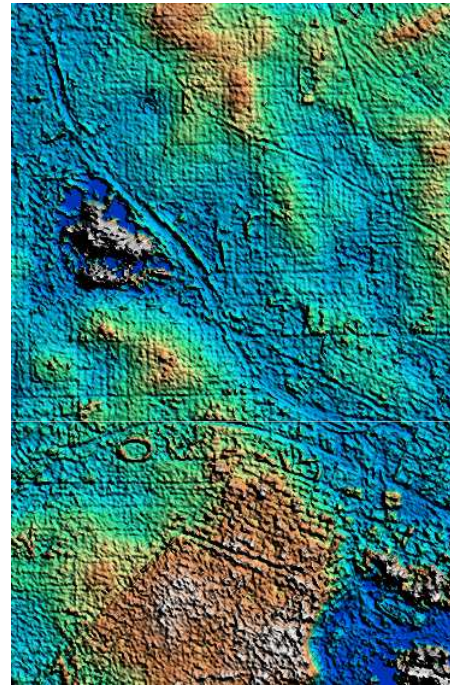
Close-up: 5m Spacing Stripmap DSM vs 1 Second SRTM, ZY-3, UM2009 DSMs



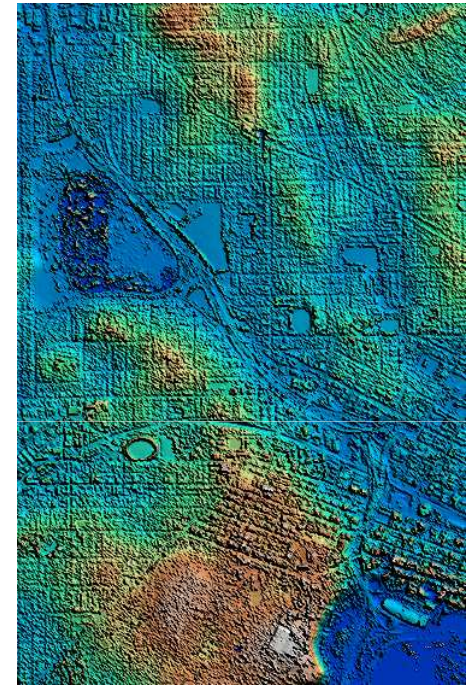
1sec SRTM



TDX- Stripmap



ZY-3



UM2009

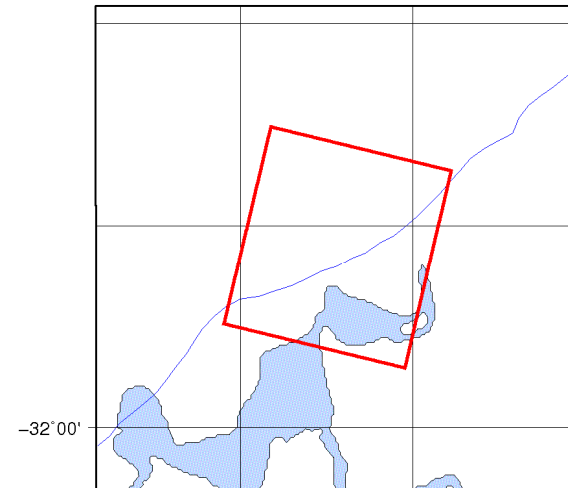
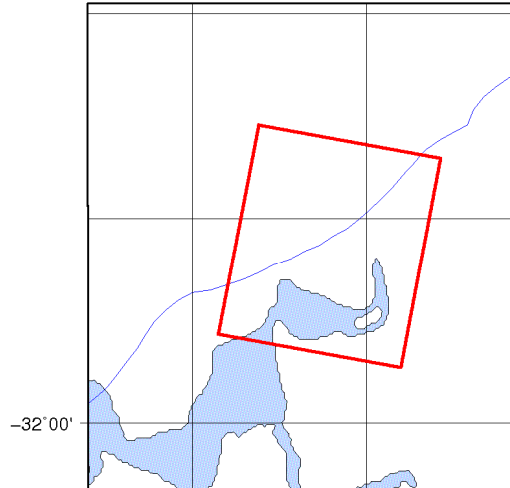
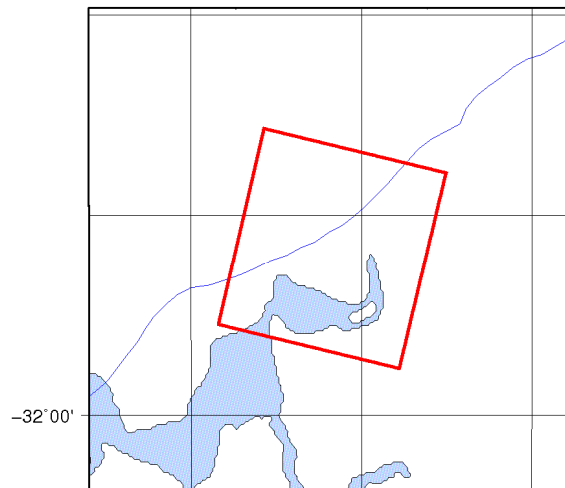
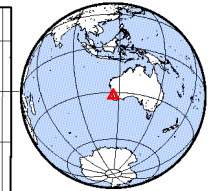
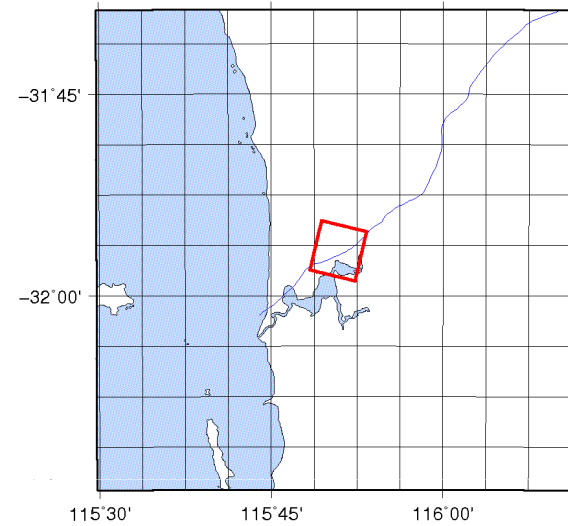
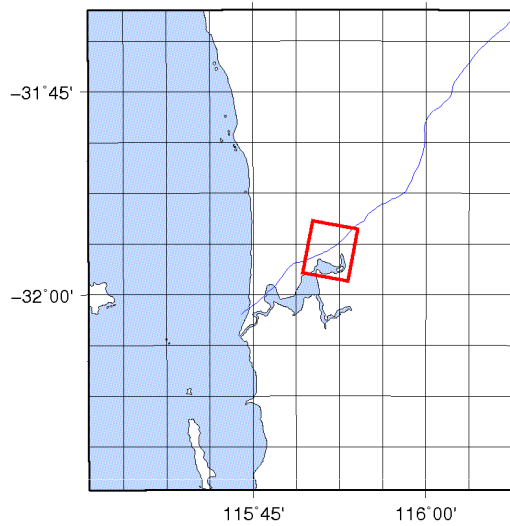
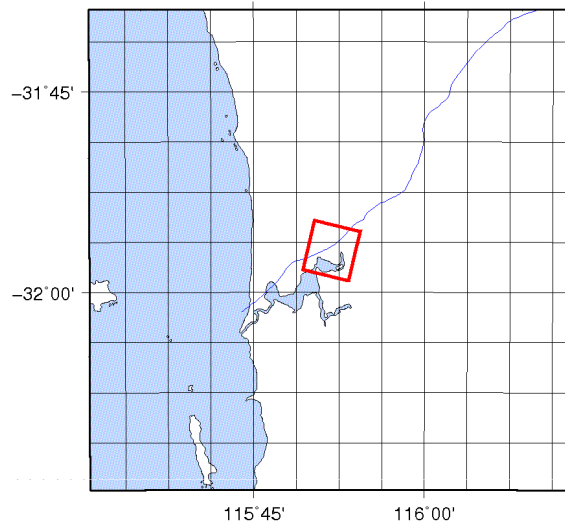
| | Mean Difference (m) | RMS Error (m) |
|----|---------------------|---------------|
| HH | 2.225 | 4.148 |
| VV | 2.081 | 4.147 |

Spotlight Mode Data Acquisitions

Single Look Complex Data:

range_pixel_spacing: 0.454702 m

azimuth_pixel_spacing: 1.812521 m



acquisition mode : "HS" / "spot_036" / "HHVV" / "R"
 product type : "SSC" /
 start time UTC : "2012-12-01T21:45:04.767573"
 stop time UTC : "2012-12-01T21:45:05.746035"
 orbit cycle / no. / dir. : 182 / 30315 / 88 / "D"

20120323

20120429

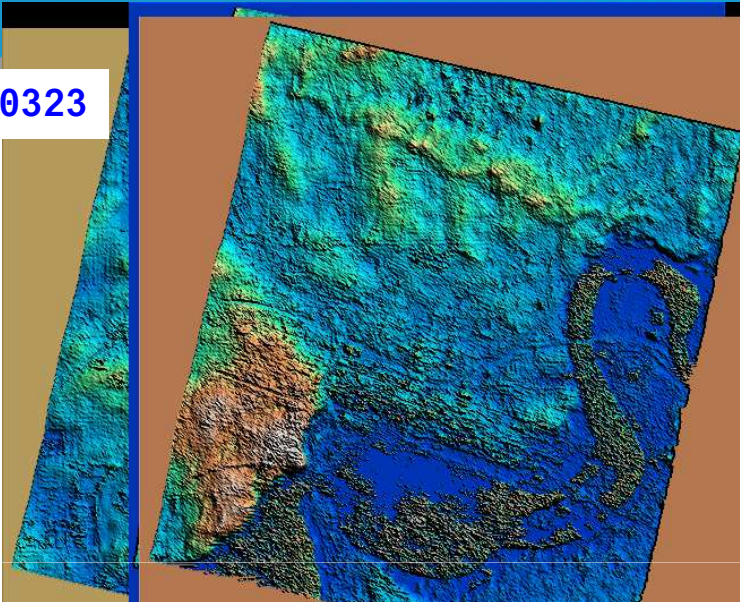
20121201

TDX Spotlight Mode Image Processing

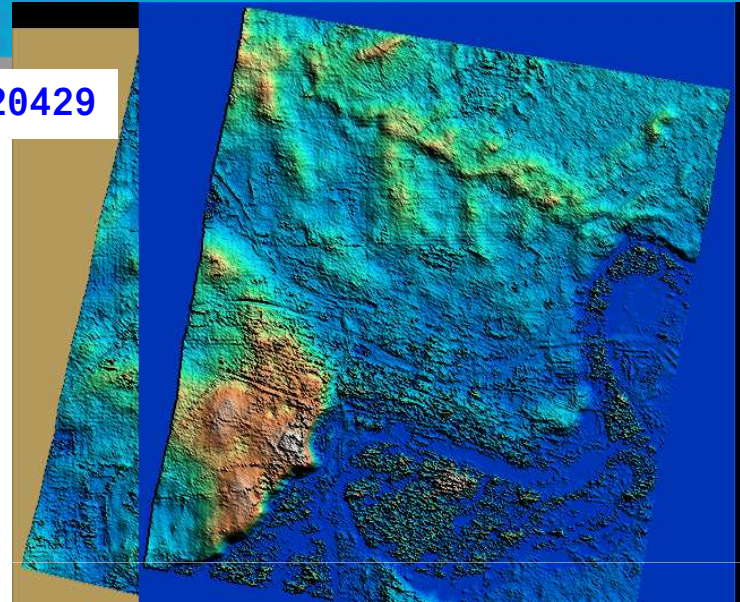


DSMs from TDX Spotlight Mode Images

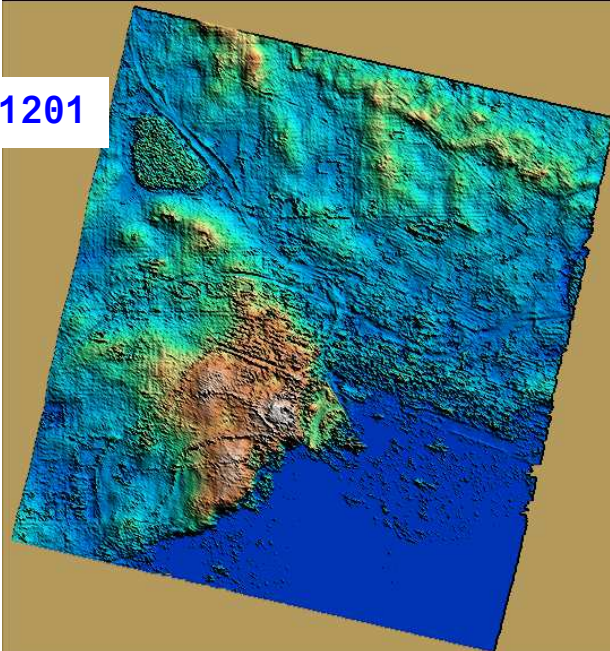
VV-20120323



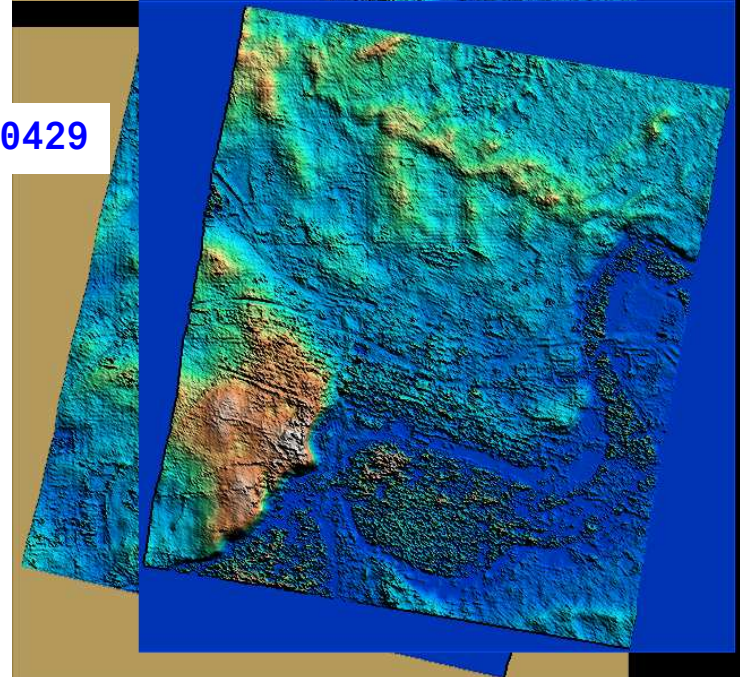
VV-20120429

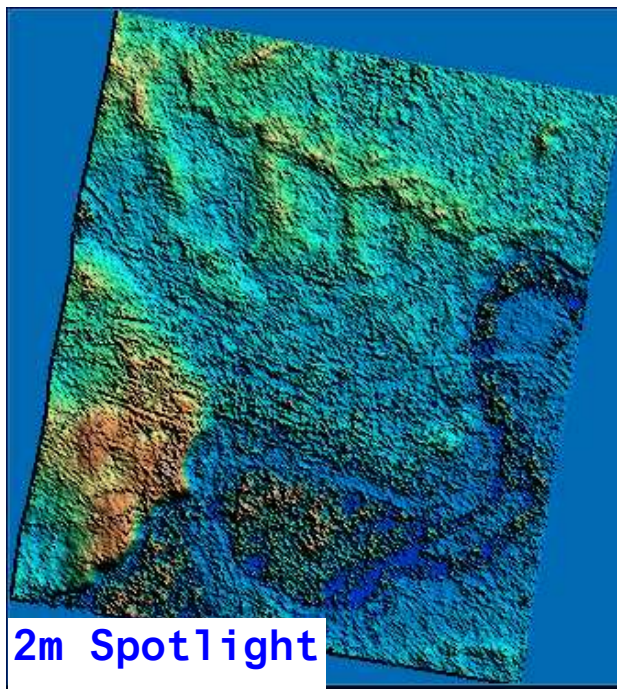
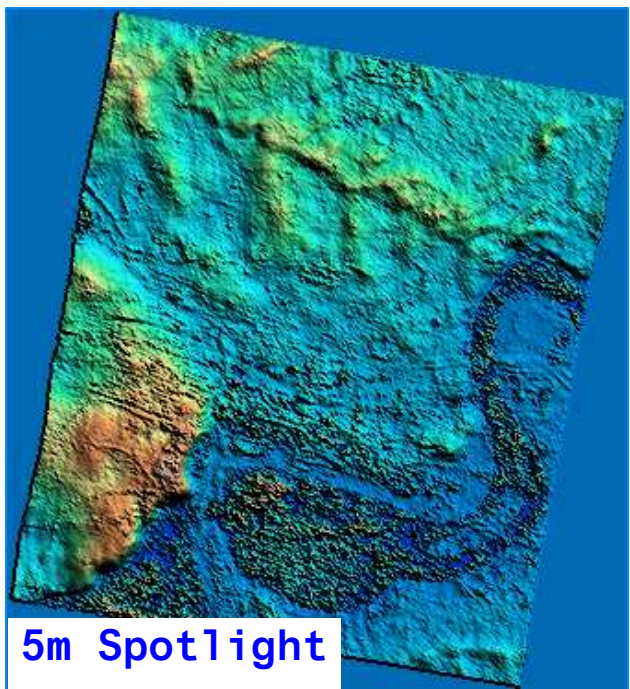
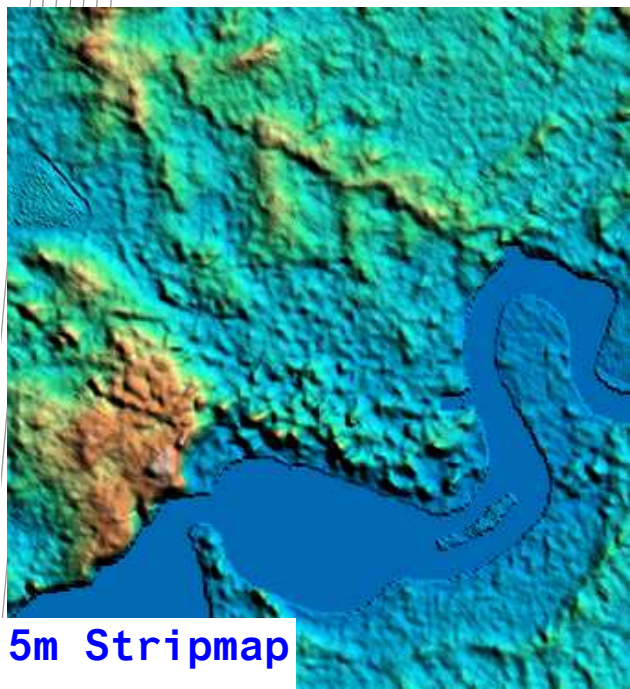
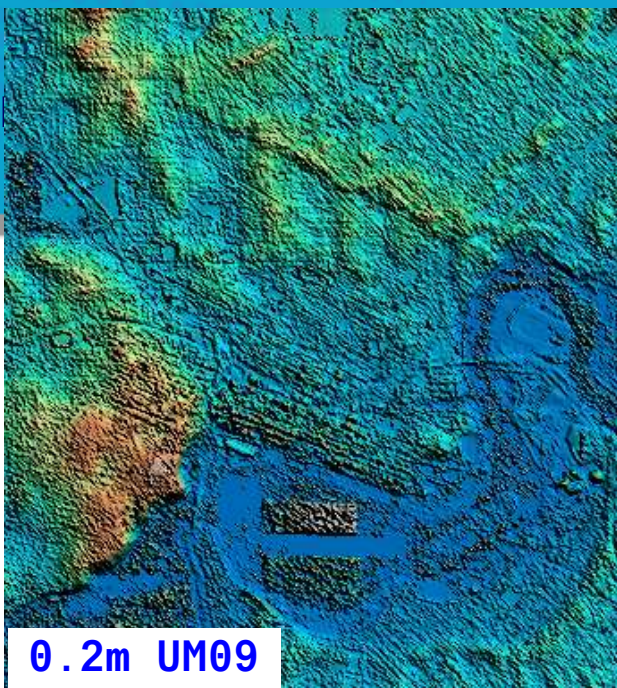
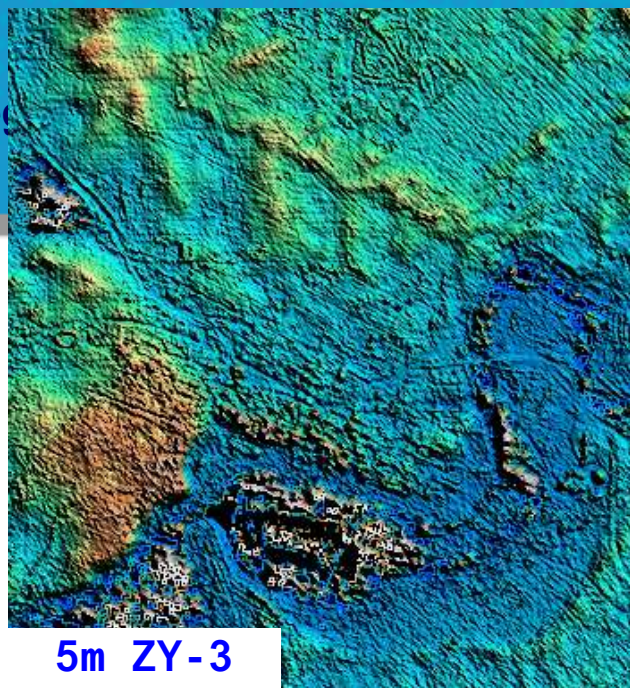
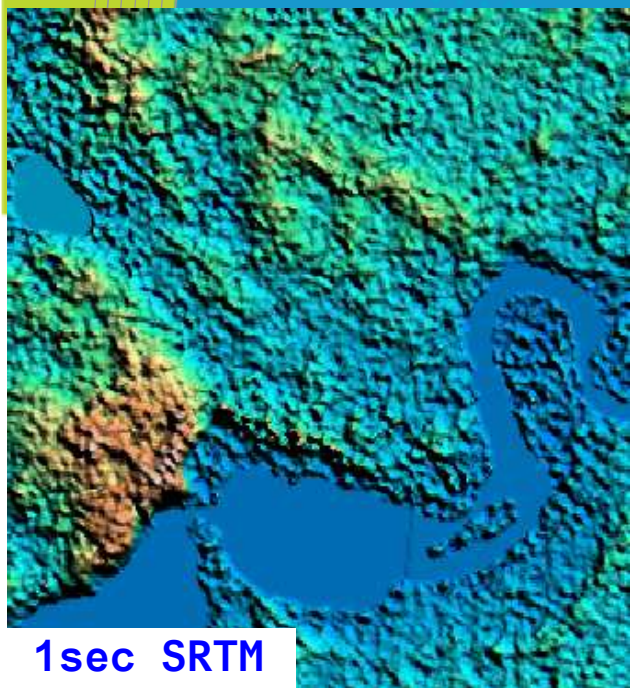


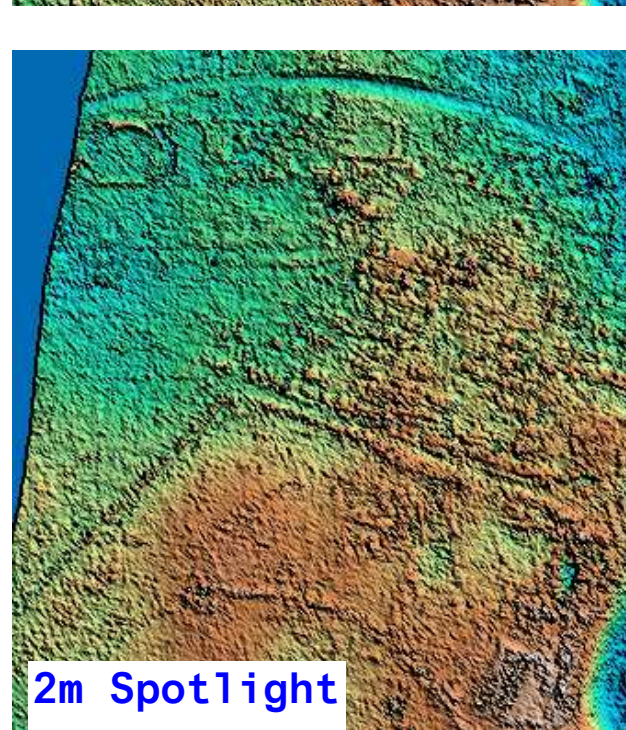
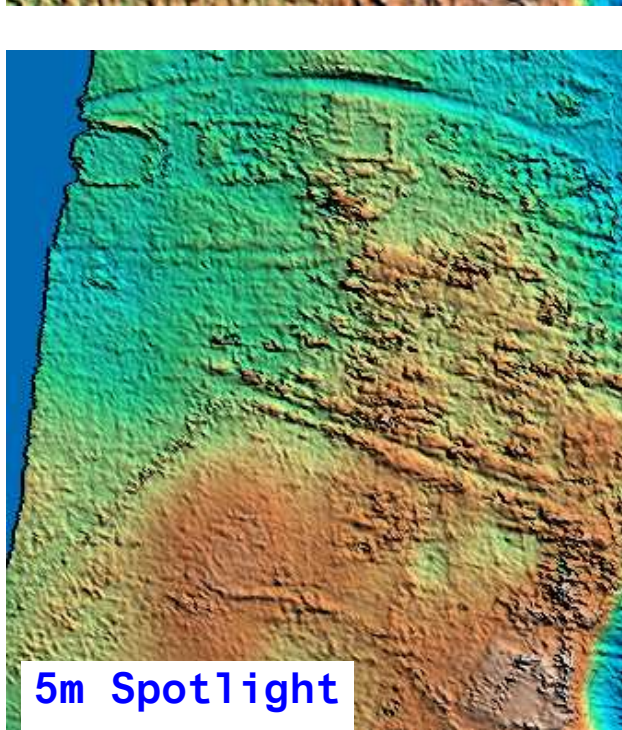
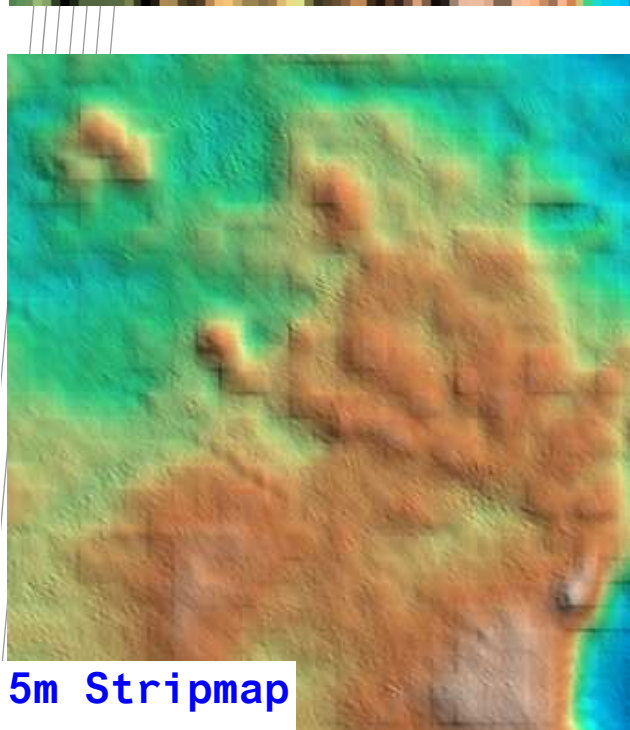
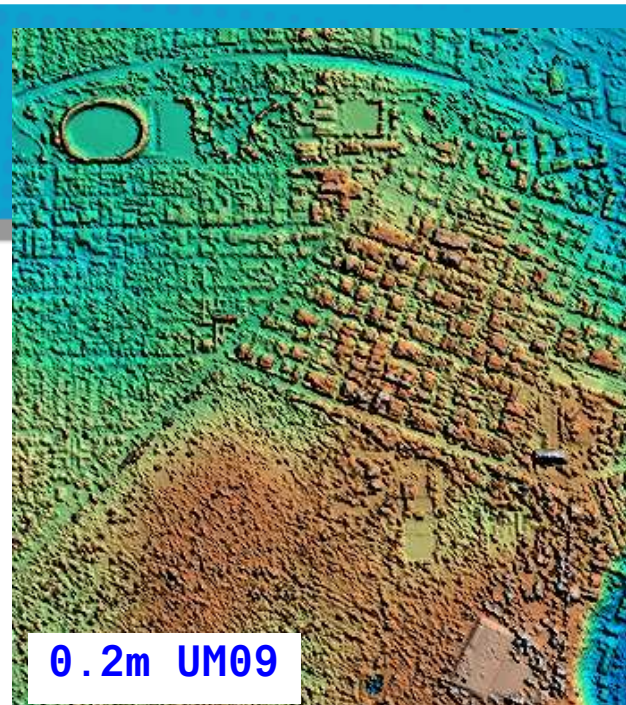
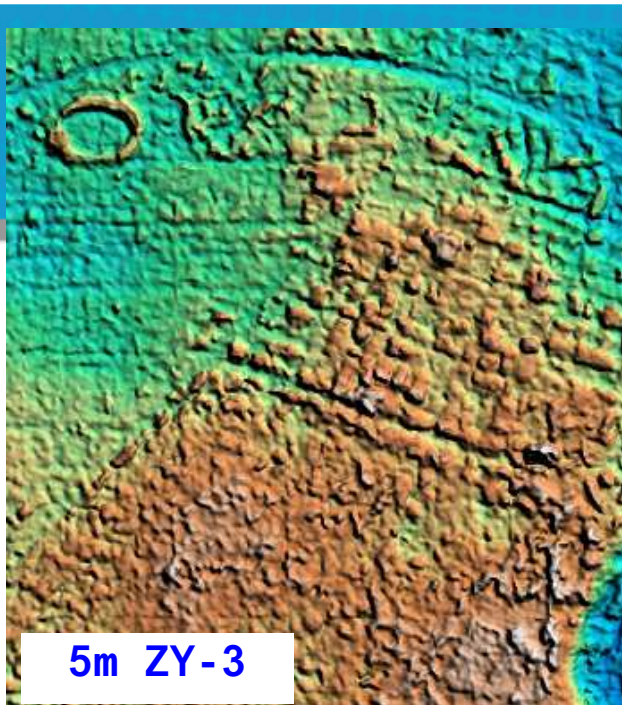
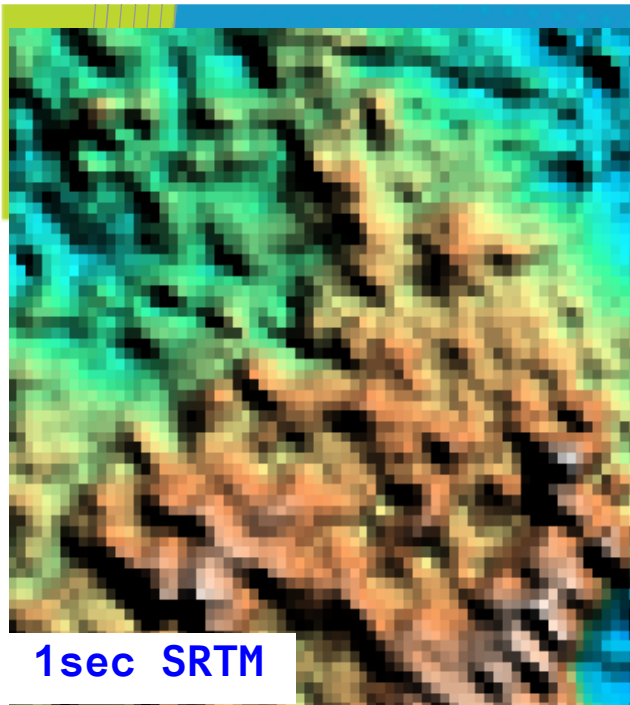
VV-20121201

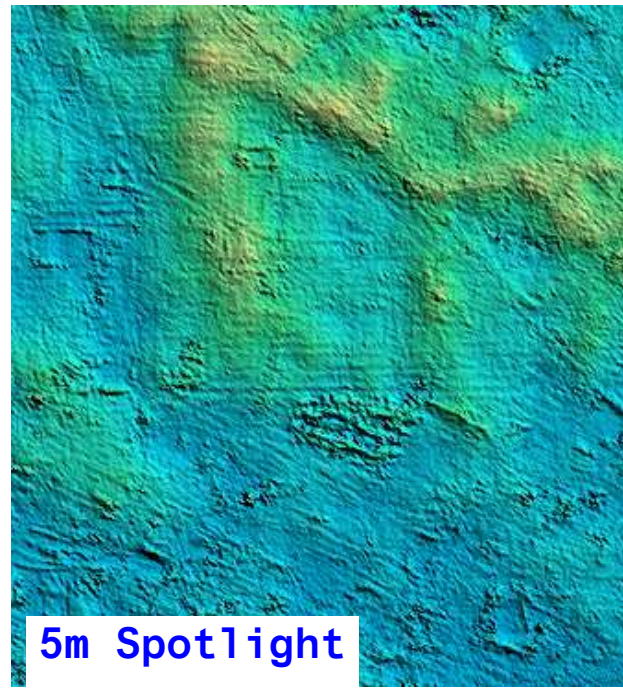
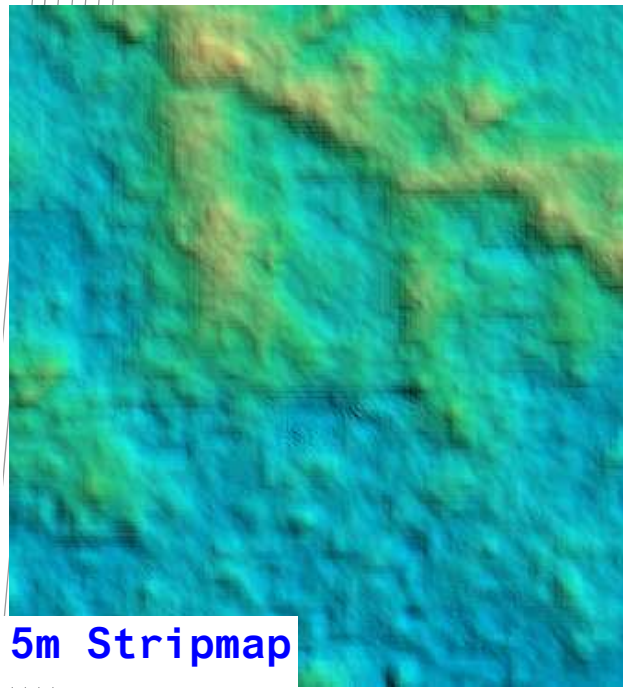
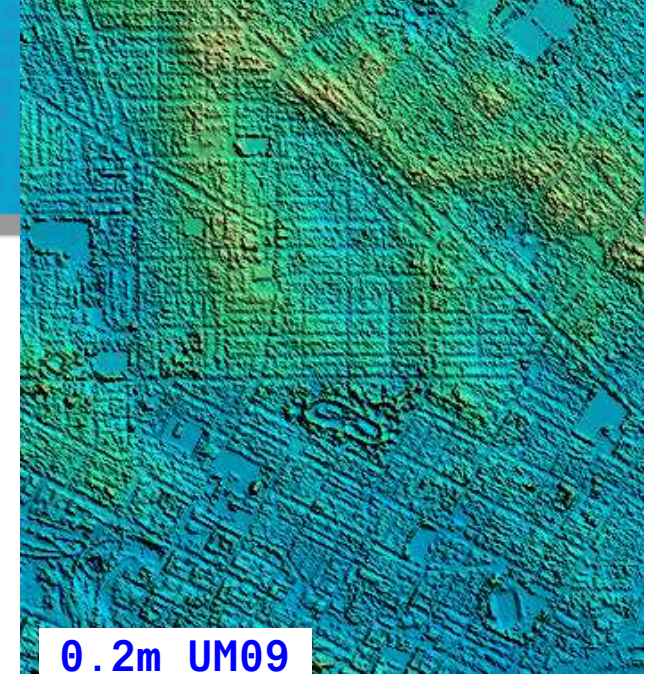
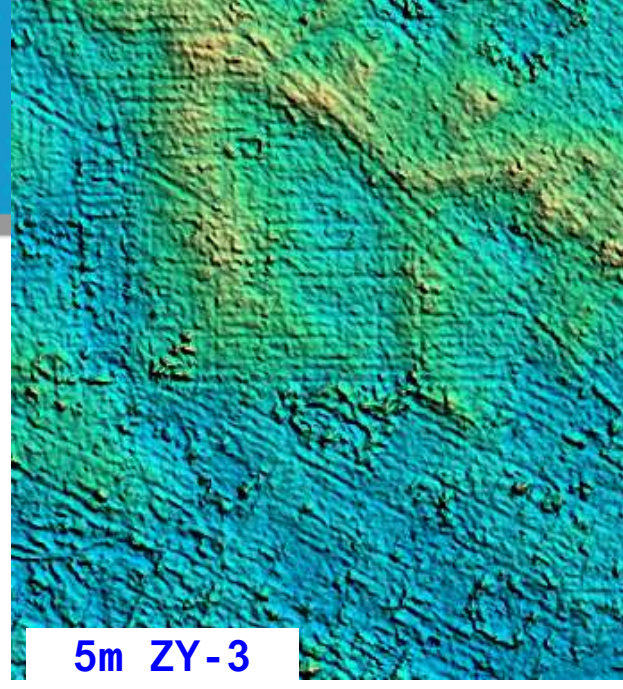
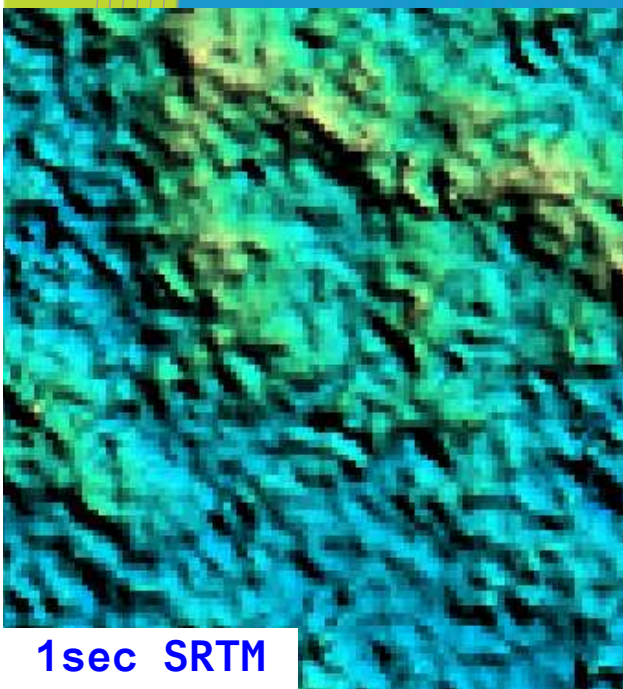


HH-20120429









DSM Accuracy Assessments against UM09

| | Mean Difference (m) | RMS Error (m) |
|-----------------|---------------------|---------------|
| 5m Spotlight HH | 2.032 | 4.879 |
| 5m Spotlight VV | 1.464 | 4.936 |
| 2m Spotlight VV | 0.727 | 4.763 |
| 5m ZY-3 | 1.877 | 4.315 |

* Urban Monitor achieved accuracies of better than half a meter according to Caccetta et al 2011

Summary

- Both TanDEM-X Stripmap and Spotlight Modes have provided extreme high quality of single pass interferometric pair
- Initial DSM Results have shown significant improvement comparing to all previous DSMs by mean of radar
- DSM derived from TanDEM-X Spotlight Mode has potential of well involvement of current Urban Monitor application development
- Look forward to more dense acquisitions with optimal baselines and also the upcoming Staring Spotlight Mode data
- Refinement of DSM generation processing from Spotlight Mode data might be of further help

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Thank you

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Email: enquiries@csiro.au Web: www.csiro.au

