Country report - Thailand

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THEOS Calibration and Validation

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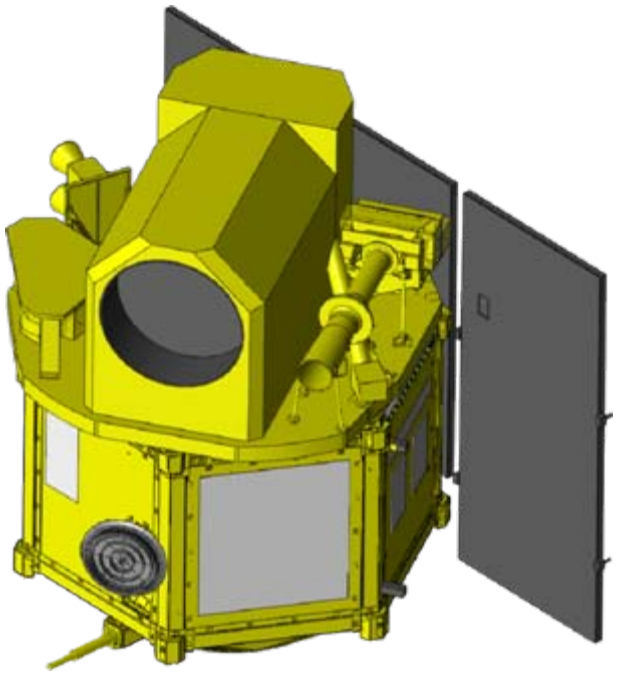
Geo-Informatics and Space Technology Development Agency
(Public Organization)

Content of Presentation

- THEOS Satellite
- Calibration and Validation Plan
  - Phase 1: Image commissioning and calibration
  - Phase 2: Image quality performance assessment
  - Phase 3: Routine quality monitoring

THEOS satellite



THailand Earth Observation System

- **Mass: 750 kg.**
- **Orbit: Sun Synchronous**
- **Altitude: 822 km.**
- **Inclination: 98.7 deg**
- **Repeat Cycle: 26 days**
- **LST (DN) : 10.00 a.m.**
- **Tilting: ± 50° (roll and pitch)**
- **Payload:**
  - **Panchromatic telescope**
  - **Multi-spectral camera**

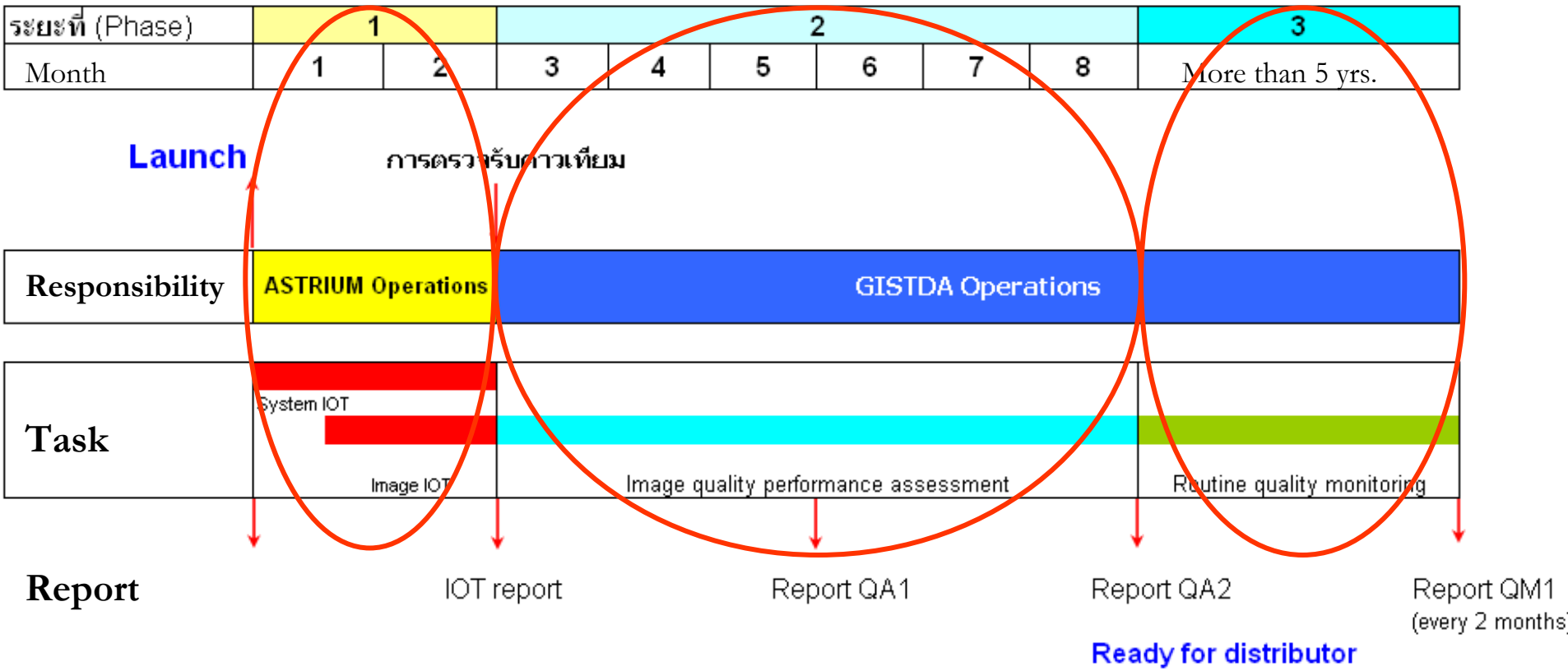
- **Design Life Time: 5 Years**
- **Launch schedule: Very soon by DNERP from Yasni, Russia**

"The satellite is now ready at launch site (Yasni). The launch campaign will be started as soon as possible after the finalize of 1st stage drop zone agreement.

THEOS satellite

Parameters	PAN	MS
CCD (Pixel)	12,000	4 x 6,000
Ground Sampling Distance (m)	2	15
Swath width (km)	22	90
Spectral band (um)	0.45 – 0.90	B1 (Blue): 0.45-0.52 B2 (Green): 0.53-0.60 B3 (Red): 0.62-0.69 B4 (NIR): 0.77-0.90
MTF	0.1	0.12
SNR	> 90	>100
Imaging dynamics	8 bits among 12 bits	
Image compression	JPEG	
Absolute localizations accuracy	< 350 m RMS	
Off-nadir viewing	±50° (roll and pitch) **±30° (Image quality guarantee)**	

Calibration and Validation Plan



Calibration and Validation Plan

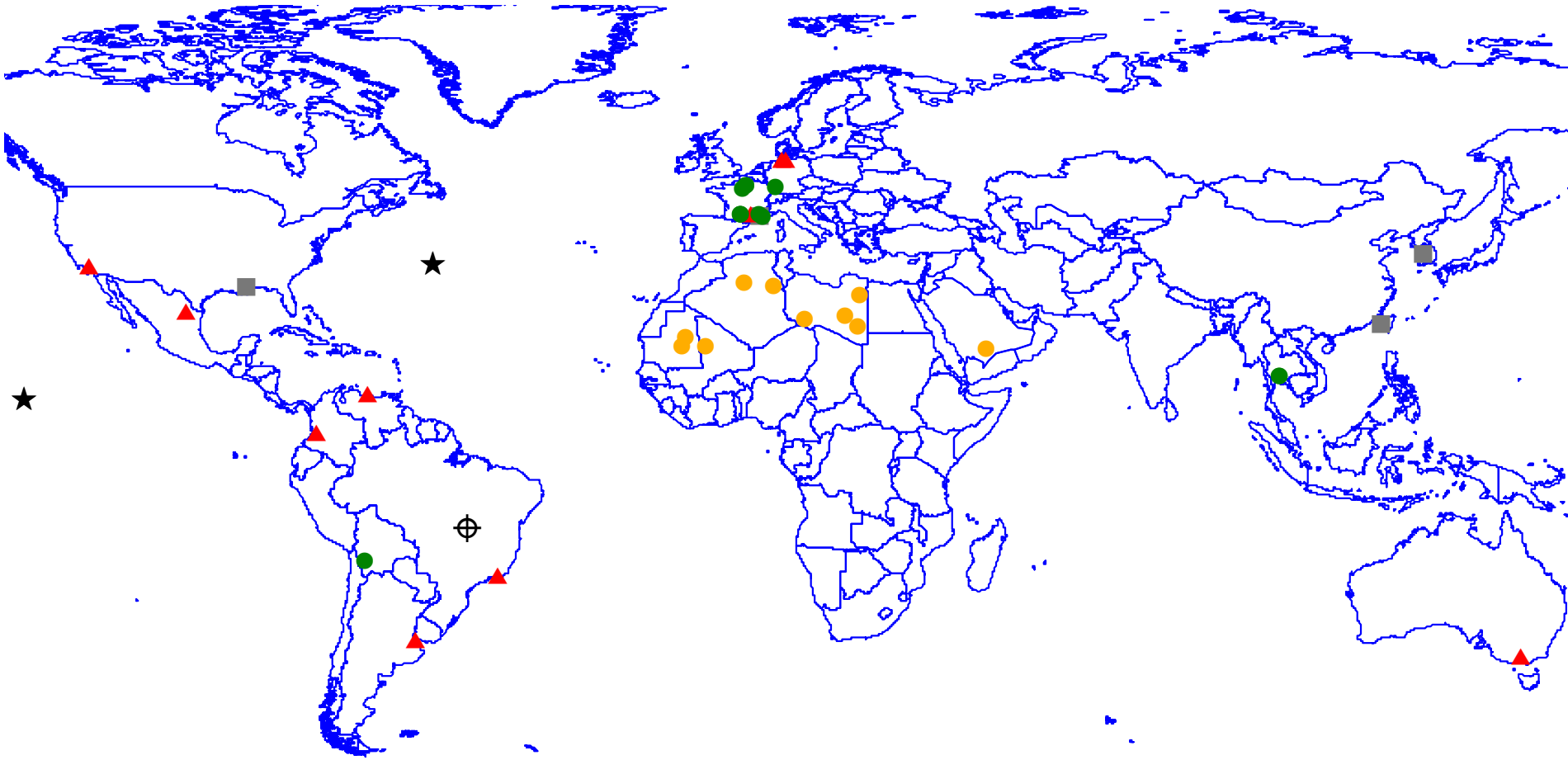
Task	Parameters		
	Radiometric quality	Geometric quality	Image quality
Phase 1 (2 Months)	• Dark Signal and Dark Noise (DSDN) • Photo Respond Non-Uniformity (PRNU) • Signal to Noise Ratio (SNR) • Dynamic Range and Saturation • Gain programming checking	• Ground Sampling Distance and (GSD) • Swath Width • Pointing Accuracy • Geolocation Accuracy • Band Registration	• MTF • Overall image quality (compression artifacts, noise, straylight etc.) • National Imagery Interpretability Rating Scale (NIIRS)
Phase 2 (6-8 Months)	• Dark Signal and Dark Noise • Absolute calibration • Photo Respond Non-Uniformity • Absolute calibration • Cross Calibration	• Pointing Accuracy • Geolocation Accuracy • Planimetric accuracy • Altimetric accuracy • Stereo capability (DEM), Ortho image	• Overall image quality (compression artifacts, noise, straylight etc.)
Phase 3 (> 5 yrs.)	• Dark Signal and Dark Noise • Photo Respond Non-	• Geolocation accuracy • Pointing Accuracy	• MTF • Overall image quality

Phase I: Image Commissioning and Calibration

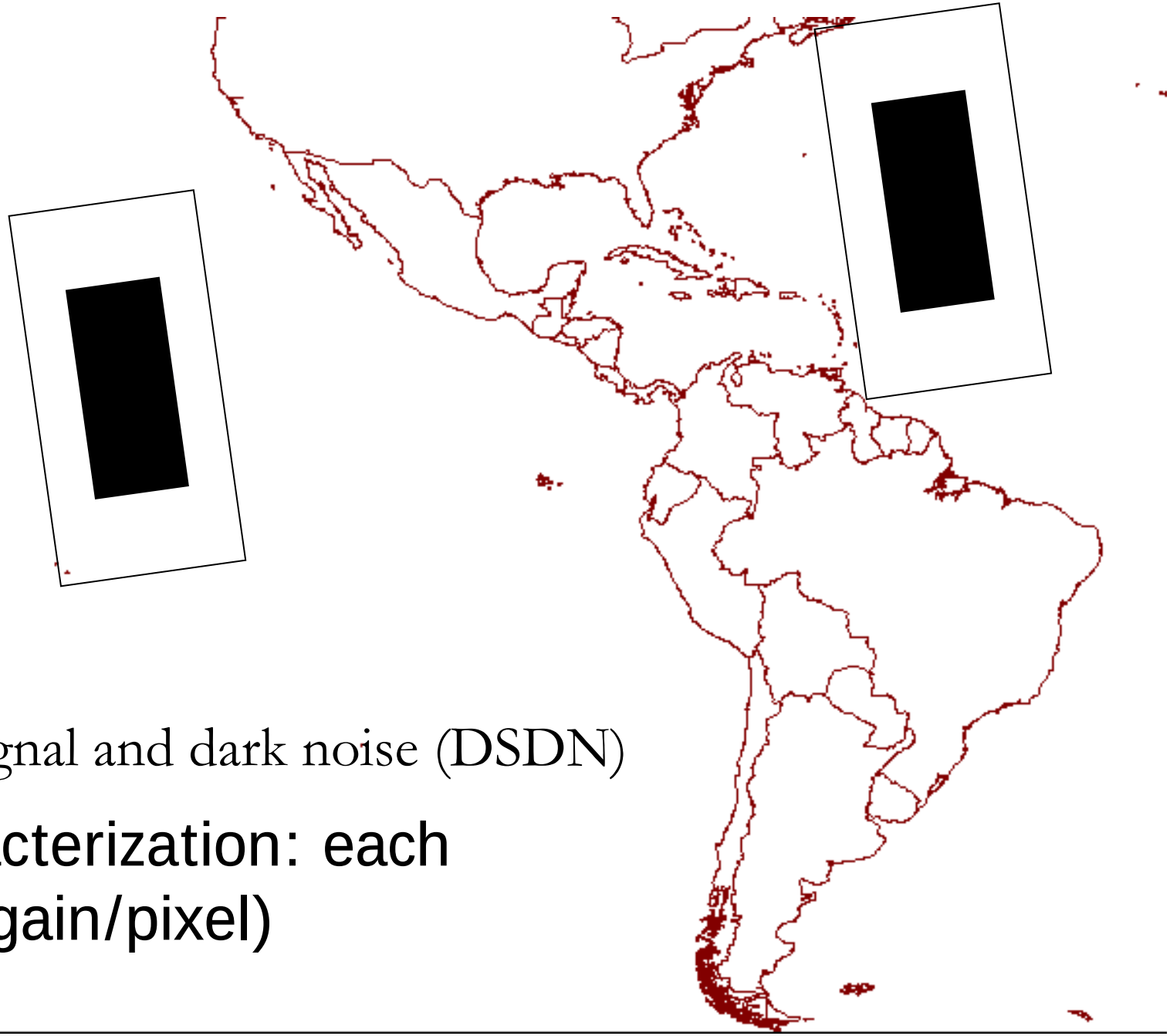
- To assess the image and system performance
- Verification the specification compliance
- To update configuration parameters file for image processing and production

Task	Parameters		
	Radiometric quality	Geometric quality	Image quality
Phase 1 (2 Months)	• Dark Signal and Dark Noise (DSDN) • Photo Respond Non-Uniformity (PRNU) • Signal to Noise Ratio (SNR) • Dynamic Range and Saturation	• Ground Sampling Distance and (GSD) • Swath Width • Pointing Accuracy • Geolocation Accuracy • Band Registration	• MTF • Overall image quality (compression artifacts, noise, straylight etc.) • National Imagery Interpretability Rating Scale

Phase I: Image Commissioning and Calibration



Test Site (Phase I)

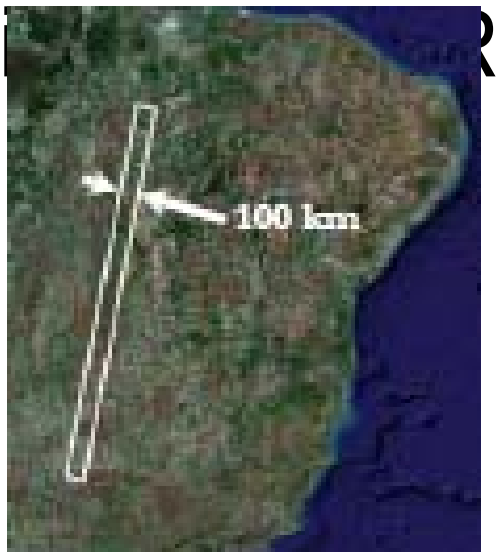


- Dark signal and dark noise (DSDN)

  (characterization: each band/gain/pixel)

Radiometric Quality

- Pixel response non-uni[illegible]RNU)



Amazon forest

DomeC, Antarctica

Geometric Quality

- Geolocation accuracy

- geolocation acc. verification
  > 350 m (RMS)
- GCPs selected from database
- 5-15 Pts/scene
- Chiang Rai, Chainat, Surat, Sakhonnakhon, Burirum, Korat, Mahasarakham.

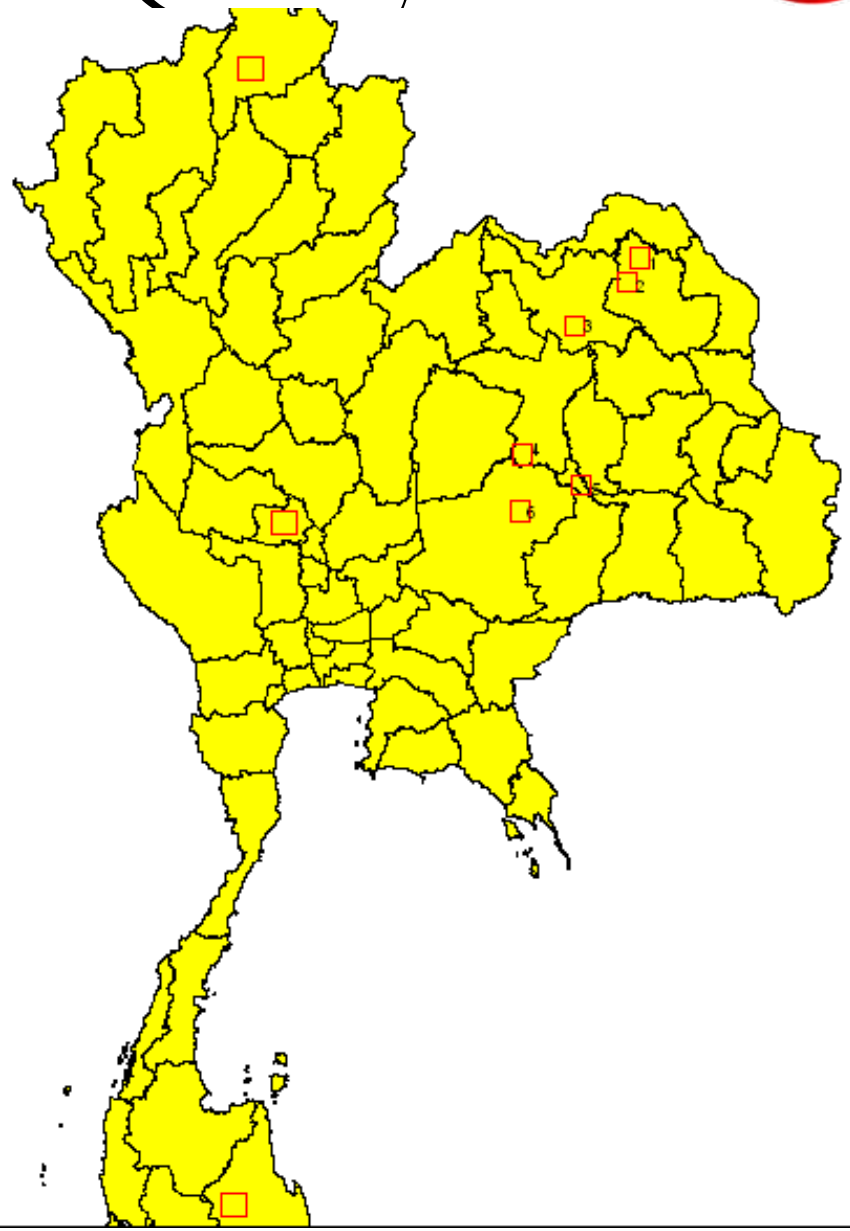


Image Quality

- Modulation Transfer Function (MTF)

MTF : **Commissioning Phase** and **Routine Phase**

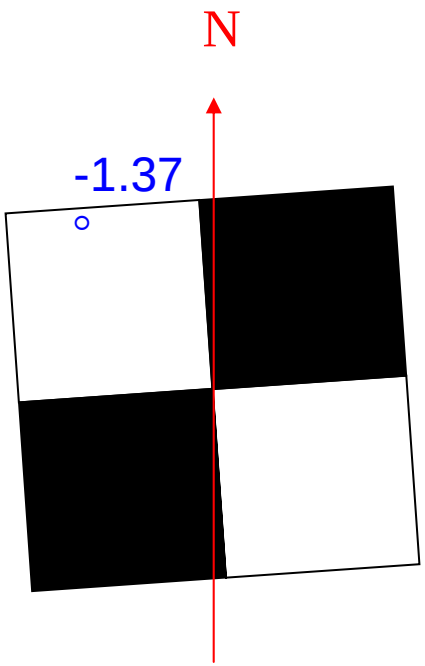
: Image acquisition at near-nadir, no cloud cover

- Astrium propose to use pattern in Salon-de-Provence, France for In-Orbit Test

- To implement another edge pattern in Thailand, for MTF quality monitoring and increasing edge target accessibility

Image Quality

- Modulation Transfer Function (MTF)



MTF semi pattern

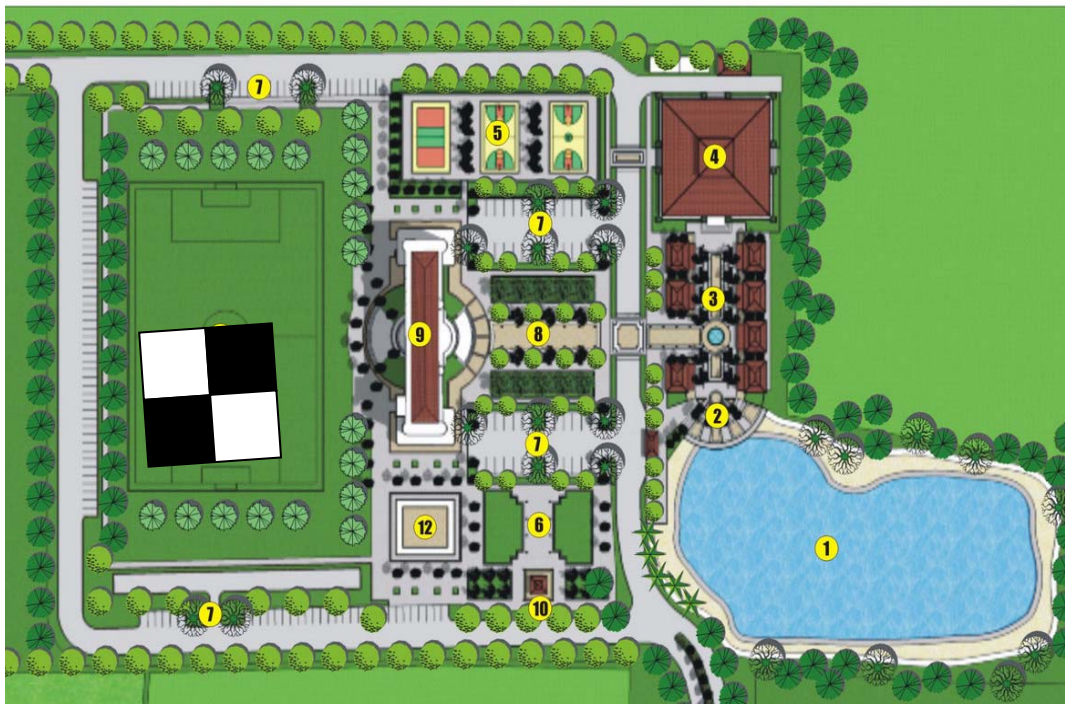
- Edge spread function method will be applied.
- Size and orientation is related to GSD and instrument scanning direction.
- Size 60x60 m^2
- Orientation angle wrt N -1.37 °

- Site in ChiangMai, Thailand (GISTDA – ChiangMai U., Far Eastern U.)
- Clear weather during Sep – Dec
- On going of procurement/implementation

Image Quality

- Modulation Transfer Function (MTF)

  - Semi pattern will be located on the soccer field.



Far Eastern University

Phase II: Image Quality Performance Assessment

– To assess and improve the image quality performance to be suitable for the applications

Task	Parameters		
	Radiometric quality	Geometric quality	Image quality
Phase 2 (6-8 months)	• Dark Signal/Dark Noise • Photo Respond Non-Uniformity • Absolute calibration • Cross Calibration	• Pointing Accuracy • Geolocation Accuracy • Planimetric accuracy • Altimetric accuracy • Stereo capability (DEM), Ortho image validation	• Overall image quality (compression artifacts, noise, straylight etc.)

Phase II: Image Quality Performance Assessment

- Geometric quality
  - Geolocation accuracy assessment
  - DEM capability, ortho-image validation
  - Field campaign on accurate/dense GCPs collection.

Phase II: Image Quality Performance Assessment

- Radiometric quality
  - Absolute radiometric calibration:
    - review document on methodology used
    - reference test site : (http://calval.cr.usgs.gov)
  - Cross calibration with other satellites
  - Discuss/consult with experienced agencies for the cooperative works
- GISTDA open for work cooperation on CalVal issue
- Research Opportunity on THEOS image data

Phase III: Routine Quality Monitoring

- To monitor and assure THEOS image quality through the satellite life time
- Update and distribute image configuration file for THEOS image ground segment

Task	Parameters		
	Radiometric quality	Geometric quality	Image quality
Phase 3 (> 5yrs)	• Dark Signal and Dark Noise (DSDN) • Photo Respond Non-Uniformity (PRNU) • Absolute calibration • Detector stability monitoring	• Pointing Accuracy • Geolocation Accuracy	• MTF • Overall image quality

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Khob Khun Kha

Thank you

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