



Development of Topographic Correction Algorithms for ADEOS-II GLI Data

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Objectives of the Research

- ◆ Evaluate the accuracy of the generalised topographic correction algorithm (Combai *et al.*, 2000; Trotter *et al.*, 1999).
- ◆ Derive a look-up table or function that normalises the topographic effect.
- ◆ Determine the effect of image and terrain scale on the need for topographic correction.

Basis of Topographic Correction

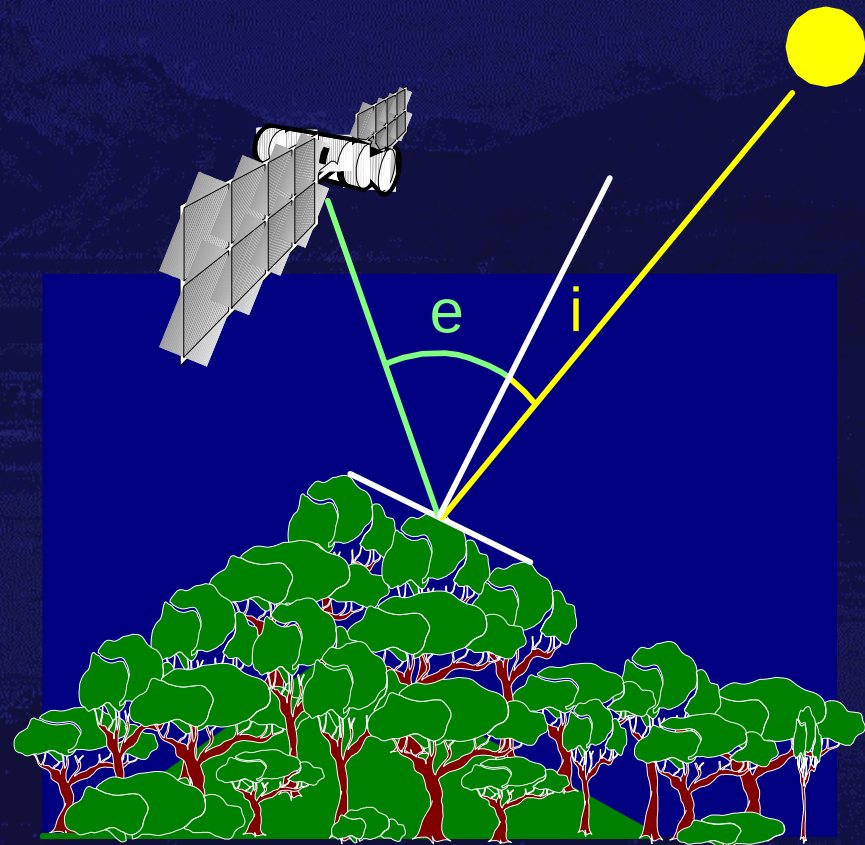
For direct beam irradiance, the variation in canopy radiance with slope is given by:

$$L = L_H(\cos i / \cos i_H) \rho / \rho_H$$

L, ρ - total radiance and reflectance for an inclined canopy

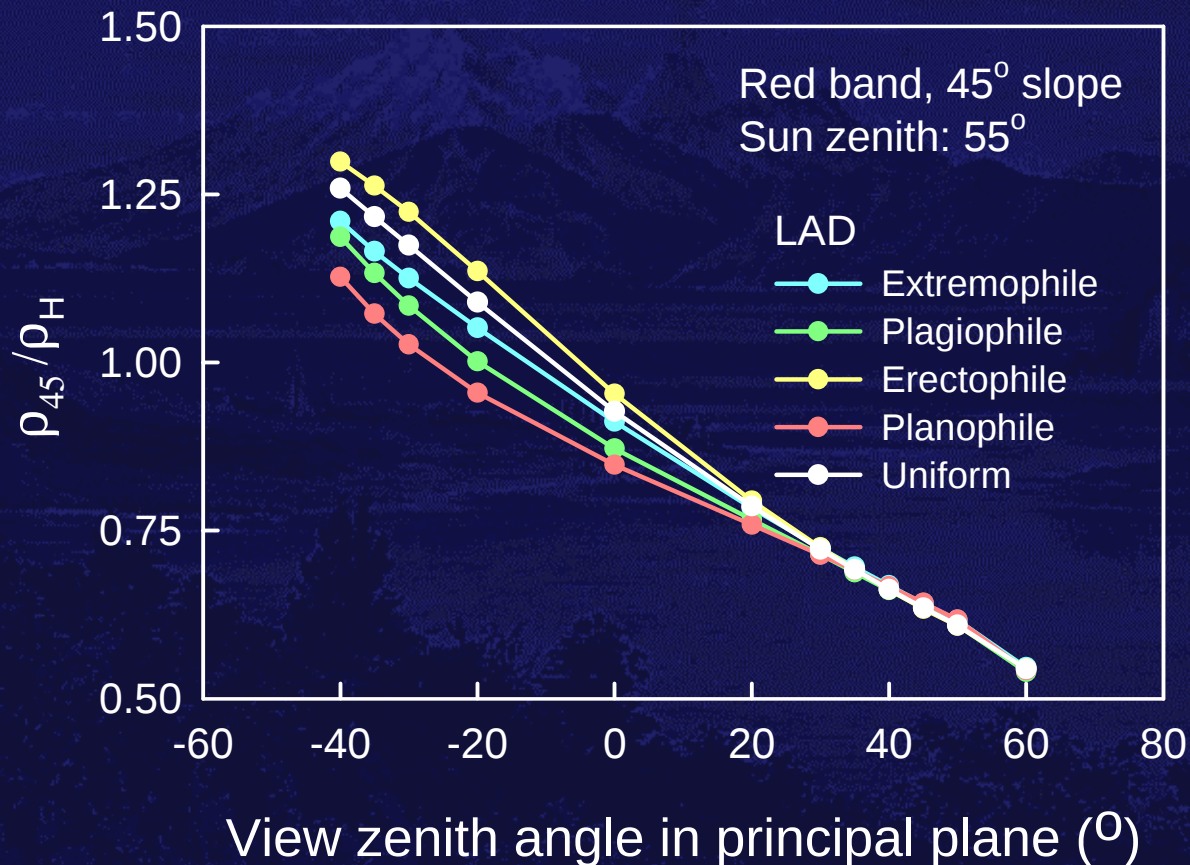
L_H, ρ_H - above parameters for a horizontal canopy

i, e - incidence, exitance angles



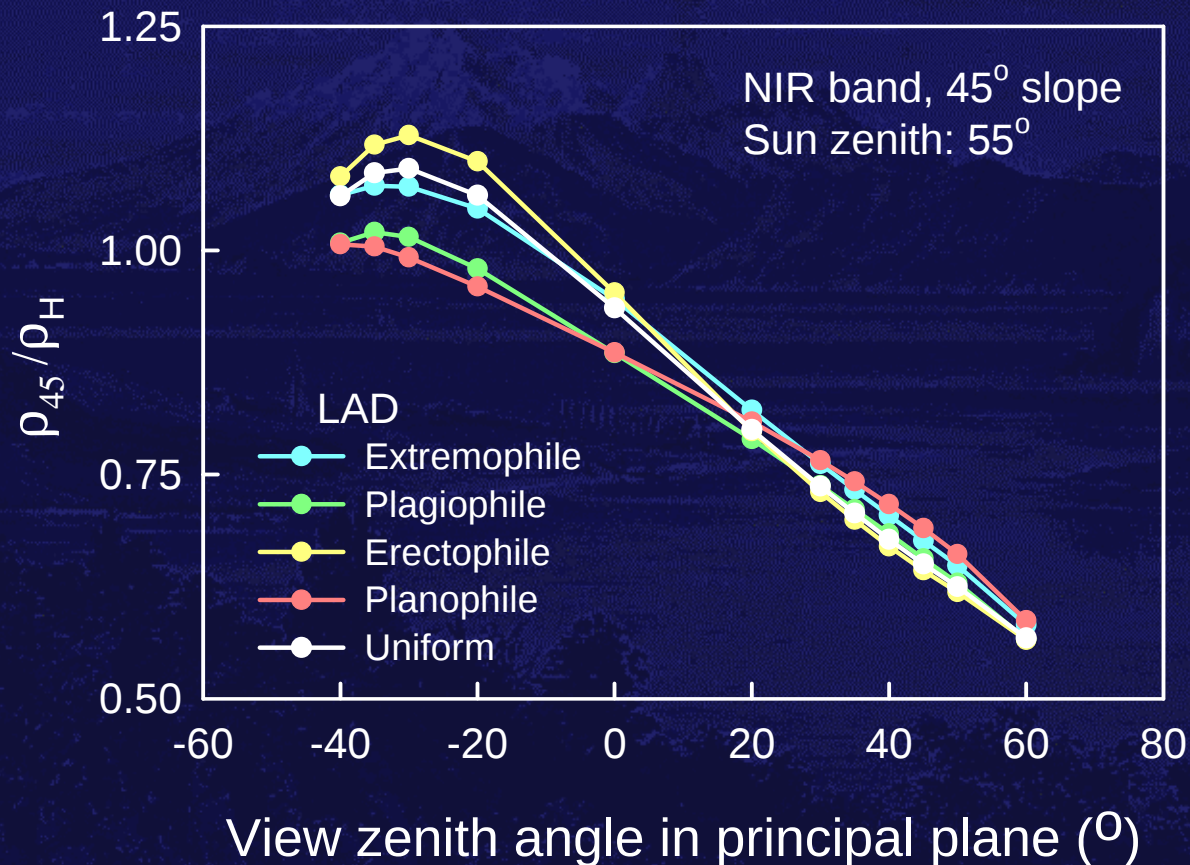
VVM Topographic Effect Simulation

- ◆ Effect on ρ/ρ_H of leaf angle distribution



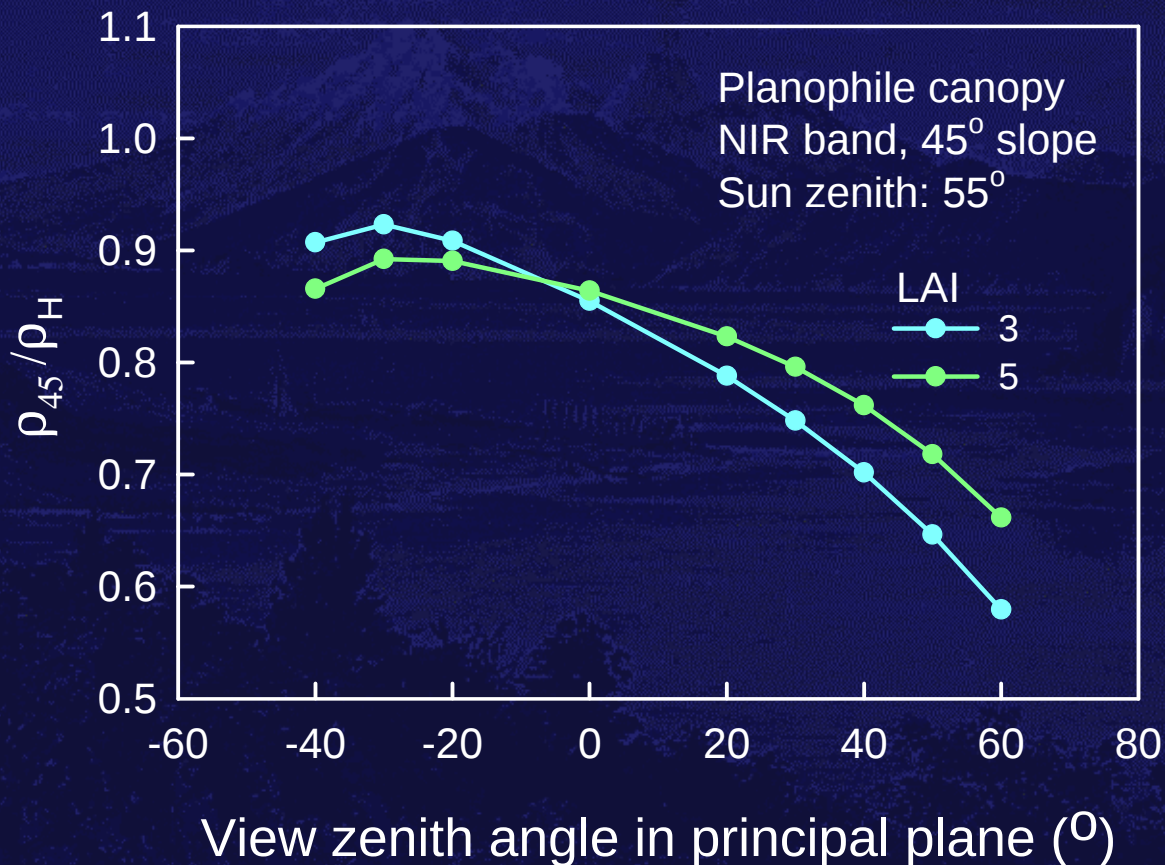
VVM Topographic Effect Simulation

- ◆ Effect on ρ/ρ_H of leaf angle distribution



VVM Topographic Effect Simulation

- ◆ Effect on ρ/ρ_H of leaf area index

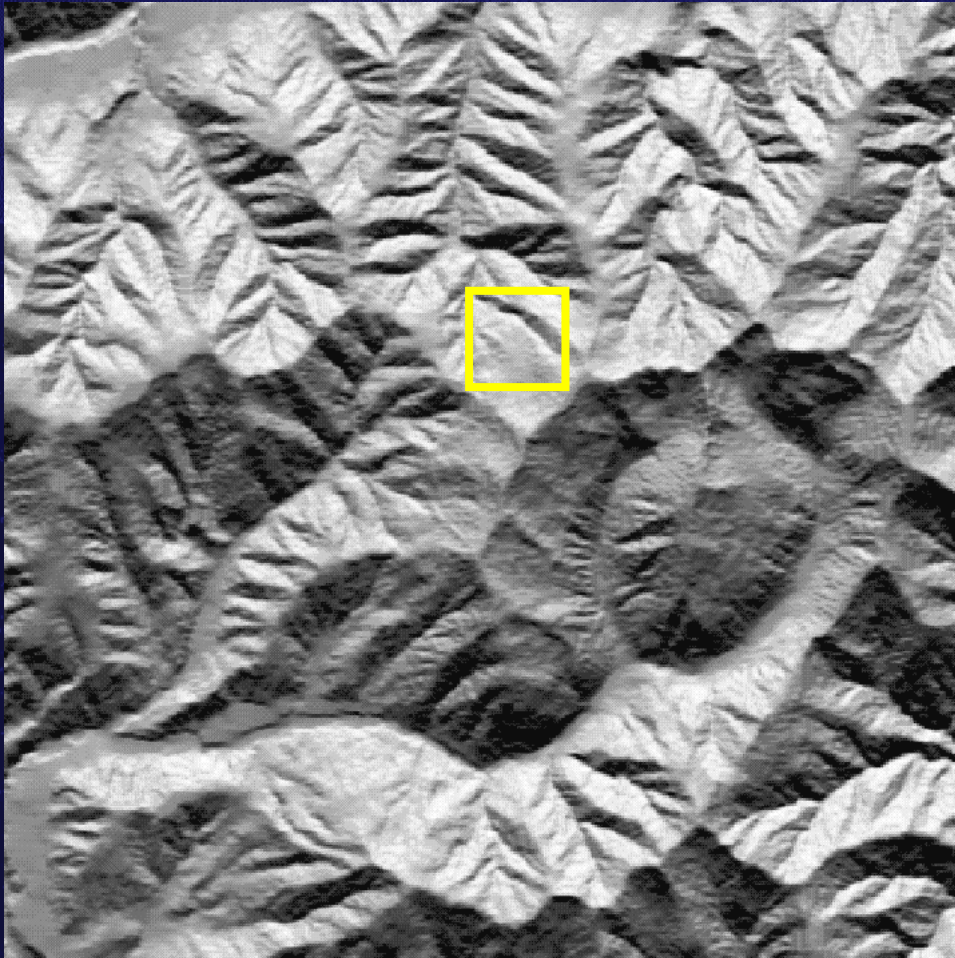


The Topographic Effect and GLI Data

- ◆ Is topographic correction required for GLI data?
- ◆ When is the factor $((\cos i / \cos i_H) \rho / \rho_H)^{-1} \approx 1$?
[$L ((\cos i / \cos i_H) \rho / \rho_H)^{-1} = L_H$]
- ◆ Determine the variation in the topographic correction factor as a function of illumination and observation geometry, pixel scale, and terrain spatial scale.

The Topographic Effect and GLI Data

- ◆ Terrain element spatial scale.



Hard rock mountainland

Slope statistics

Mean: 25°

SD: 9°

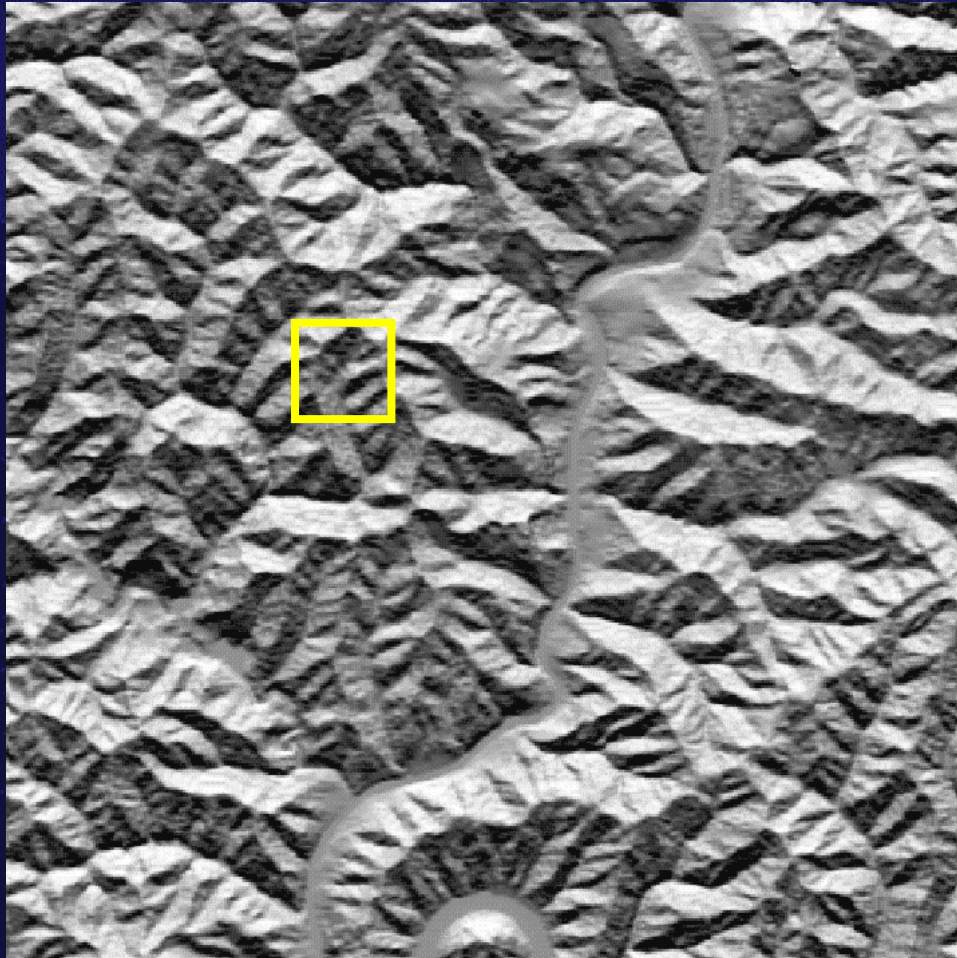
Median: 26°

Mode: 28°

Max: 58°

The Topographic Effect and GLI Data

- ◆ Terrain element spatial scale.



Soft rock hill country

Slope statistics

Mean: 25°

SD: 9°

Median: 26°

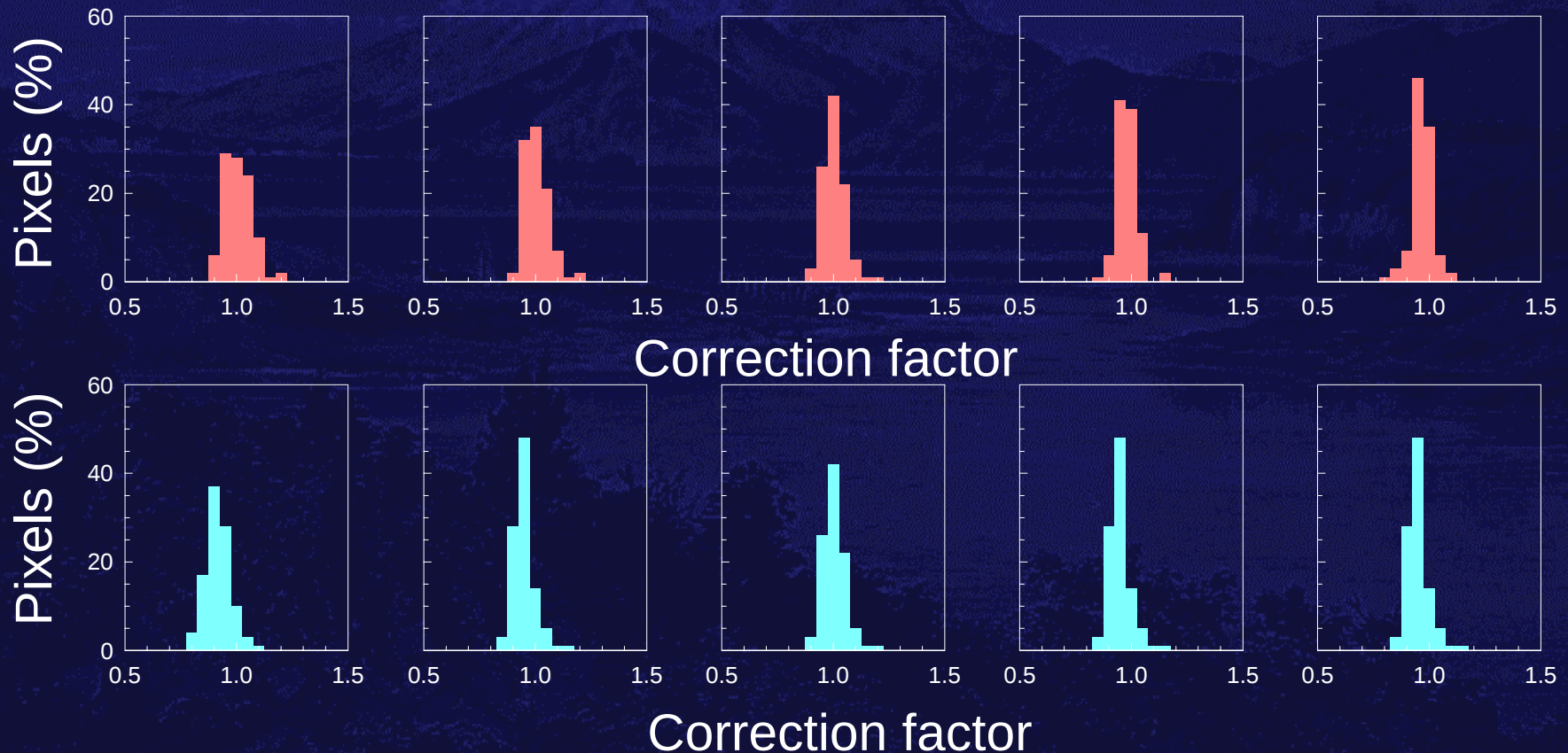
Mode: 28°

Max: 75°

The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

View zenith angles: -45° , -30° , 0° , 30° , 45°



The Topographic Effect and GLI Data

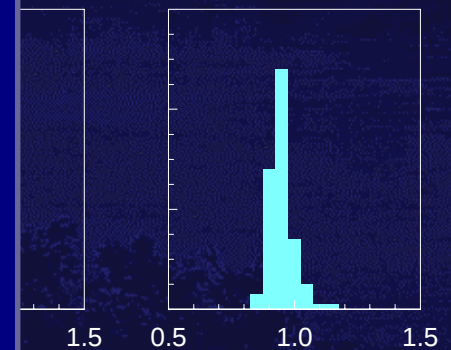
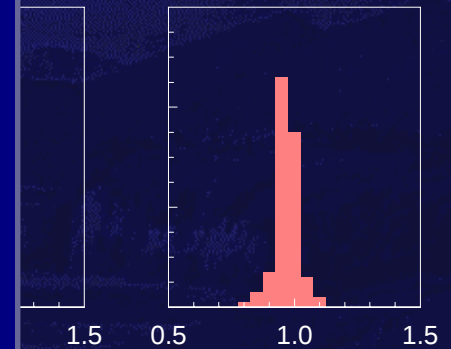
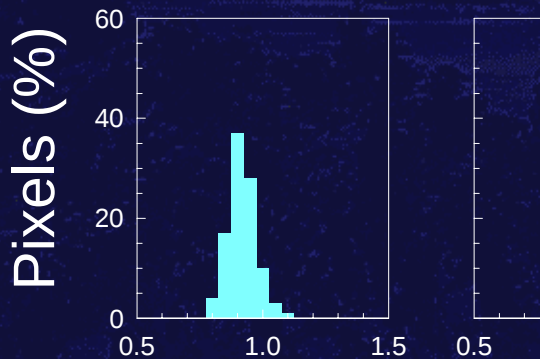
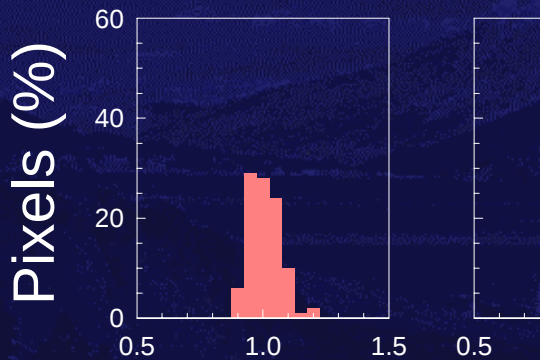
- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

Reference

Mean factor: 1.02
95% pixels: 0.10

Comparison

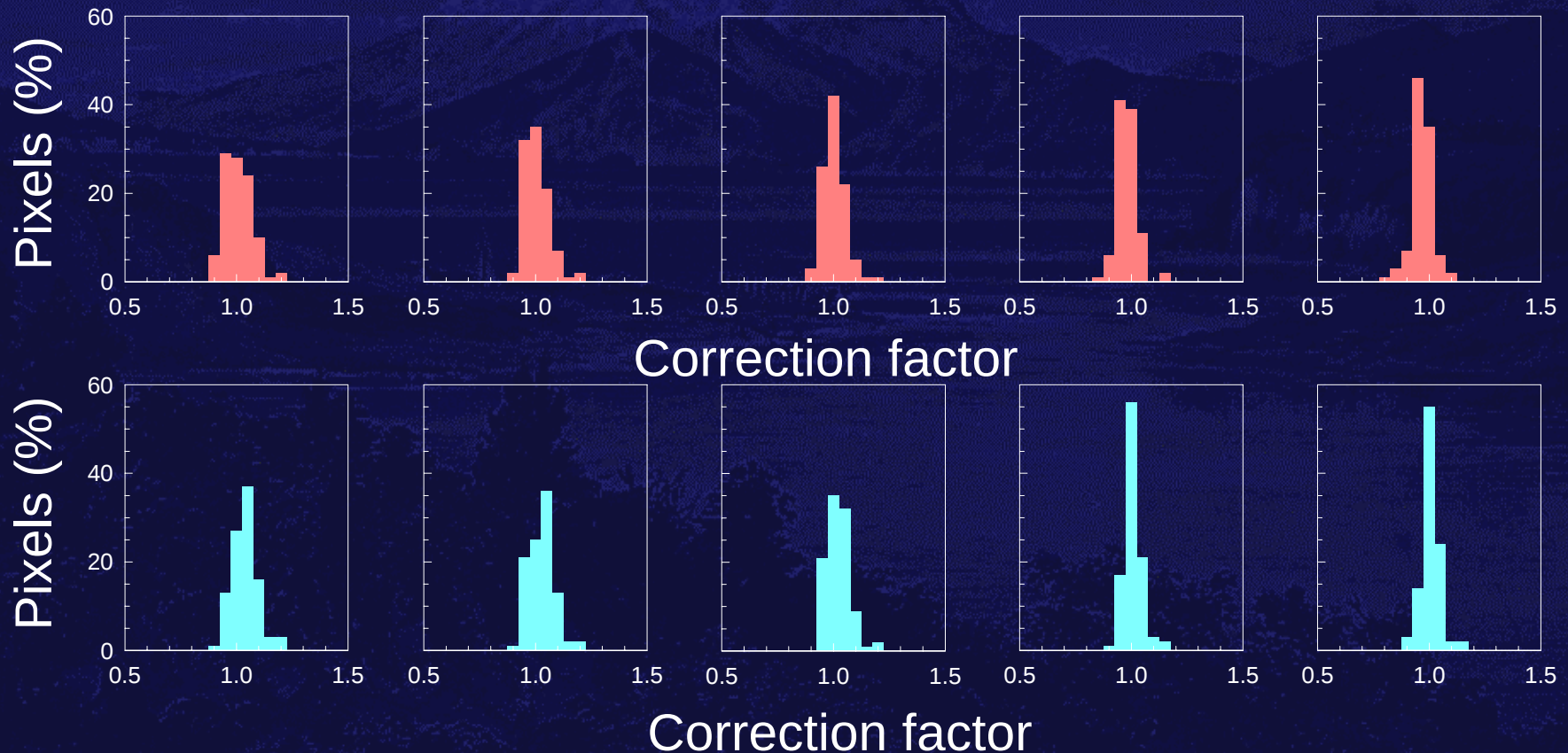
Right angles to PP
Mean factor: 1.04
95% pixels: 0.13



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

View zenith angles: -45° , -30° , 0° , 30° , 45°



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30°, principal plane, red wavelengths, 1 km pixel size, dissected terrain.

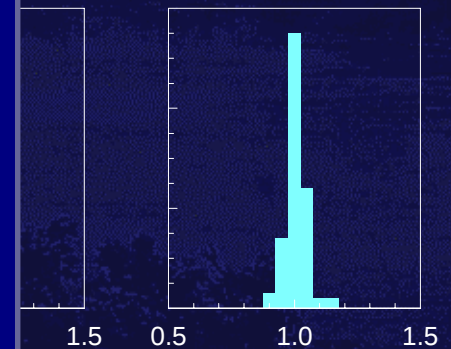
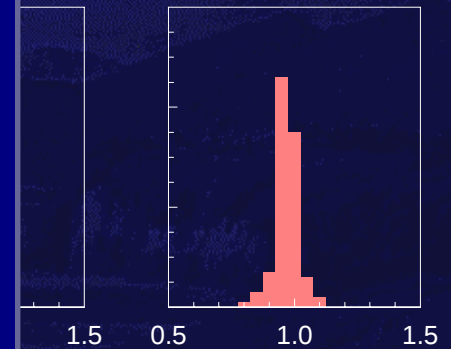
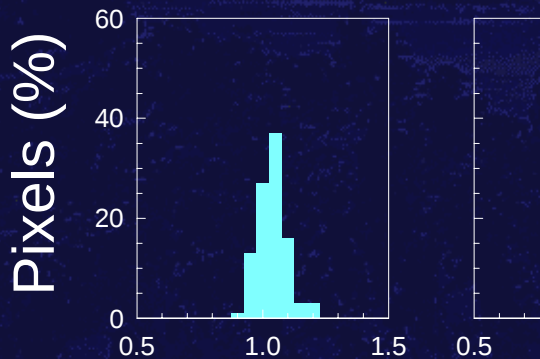
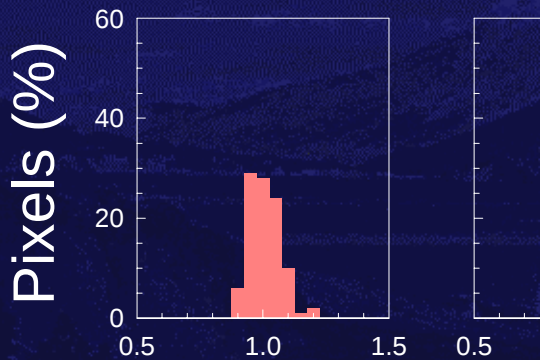
Reference

Mean factor: 1.02
95% pixels: 0.10

Comparison

NIR wavelengths

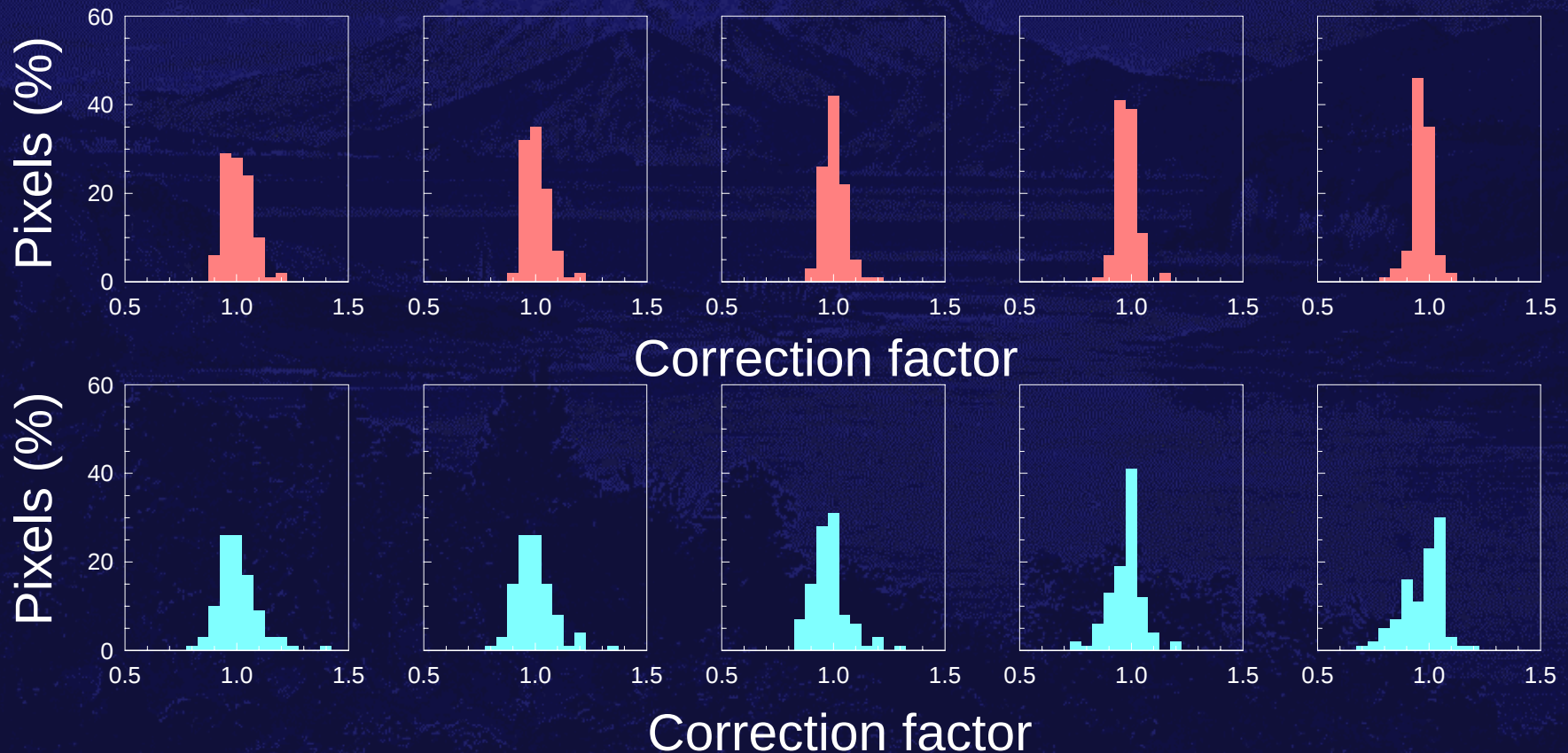
Mean factor: 1.04
95% pixels: 0.10



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

View zenith angles: -45° , -30° , 0° , 30° , 45°



The Topographic Effect and GLI Data

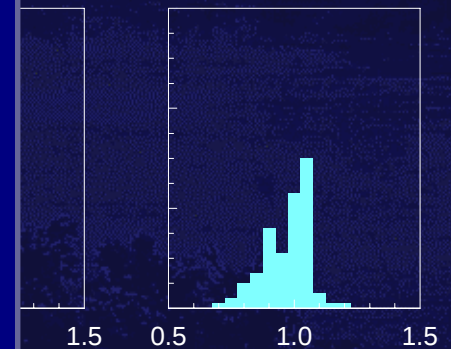
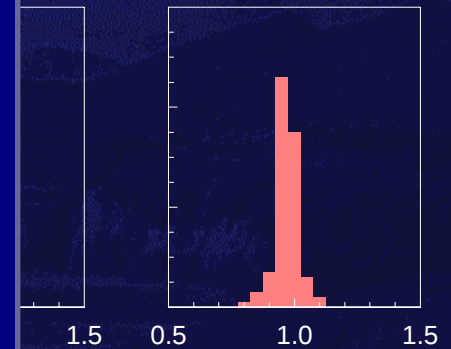
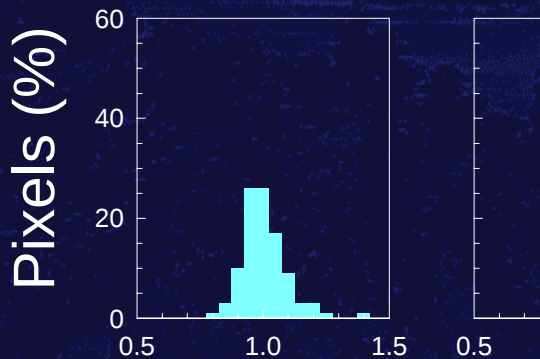
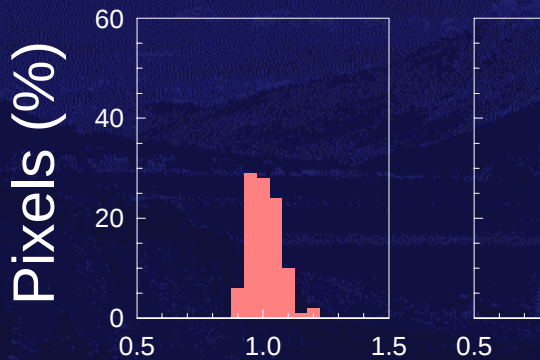
- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

Reference

Mean factor: 1.02
95% pixels: 0.10

Comparison

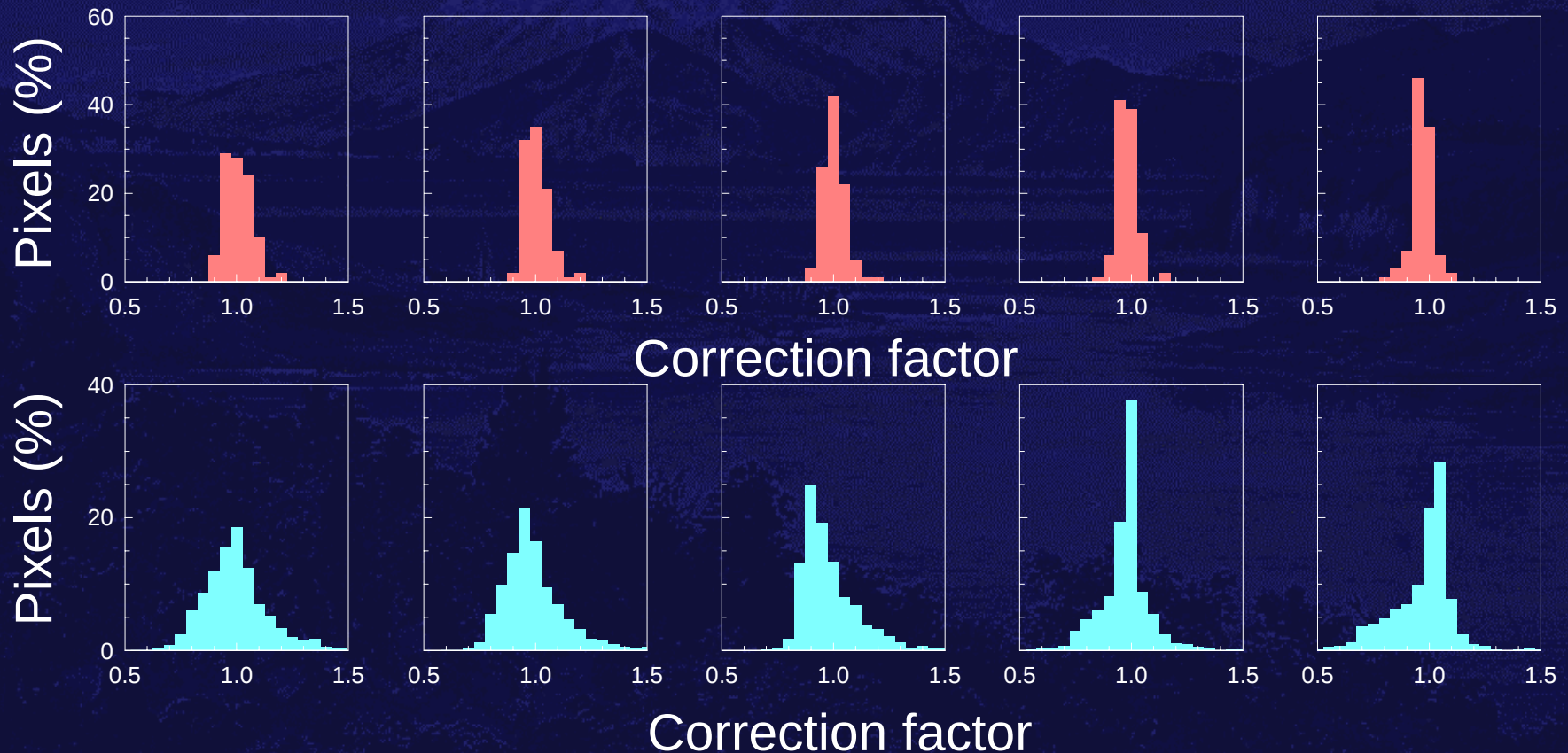
Large scale terrain
Mean factor: 1.01
95% pixels: 0.17



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

View zenith angles: -45° , -30° , 0° , 30° , 45°



The Topographic Effect and GLI Data

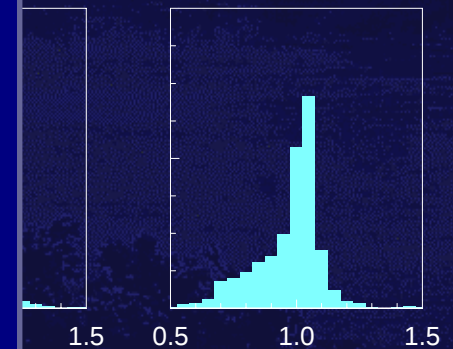
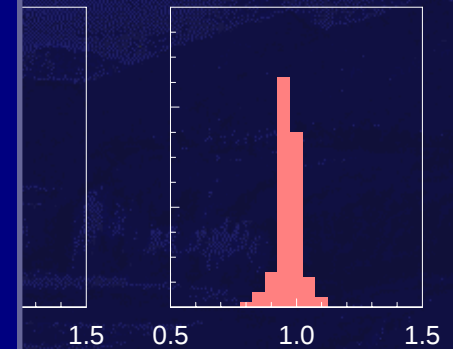
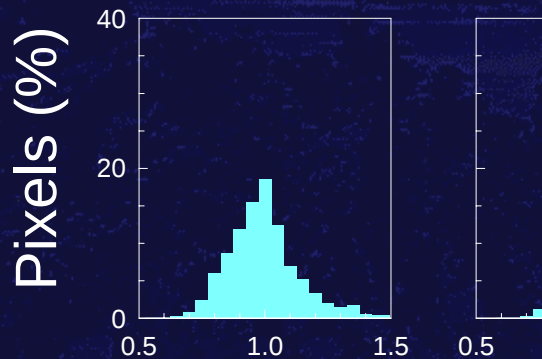
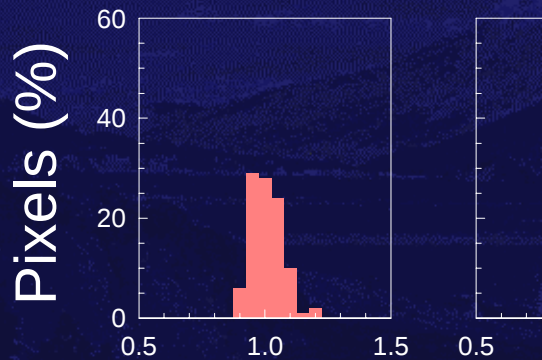
- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

Reference

Mean factor: 1.02
95% pixels: 0.10

Comparison

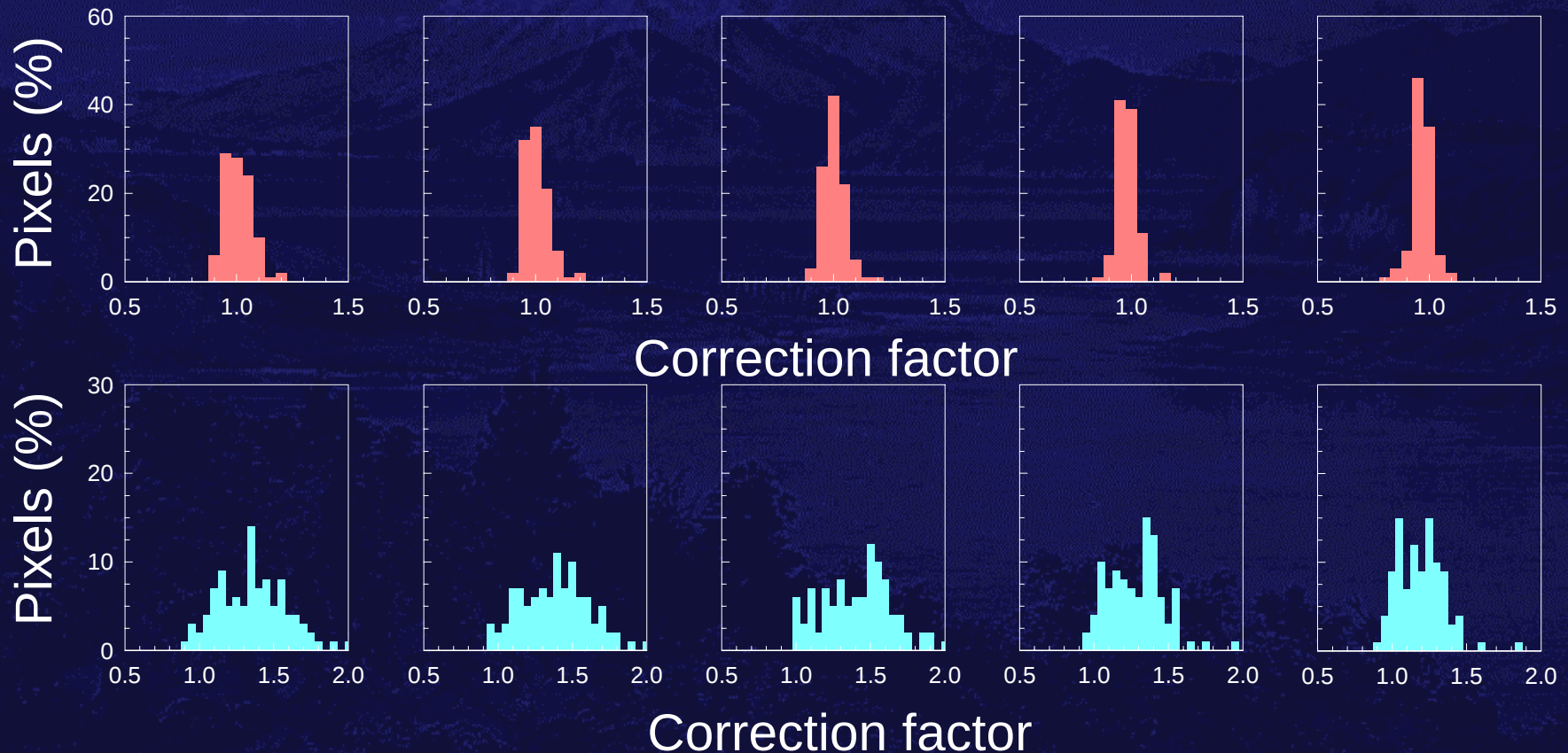
Large terrain, 250 m
Mean factor: 1.01
95% pixels: 0.27



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

View zenith angles: -45° , -30° , 0° , 30° , 45°



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

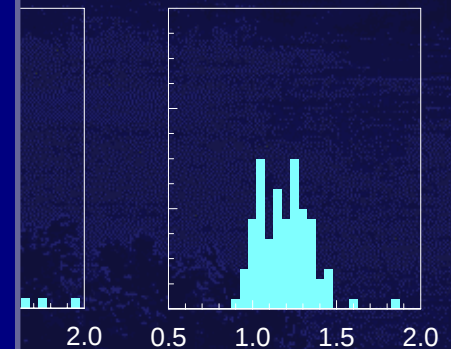
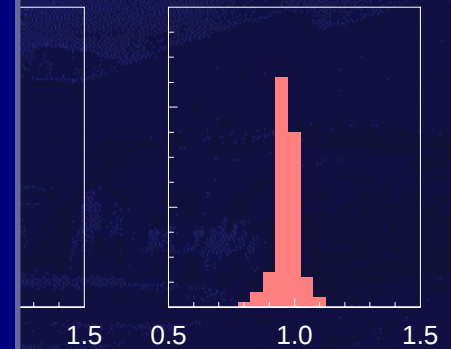
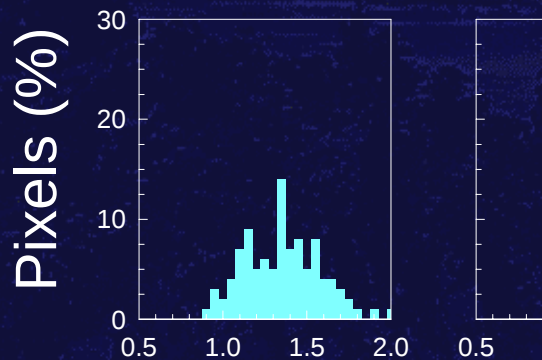
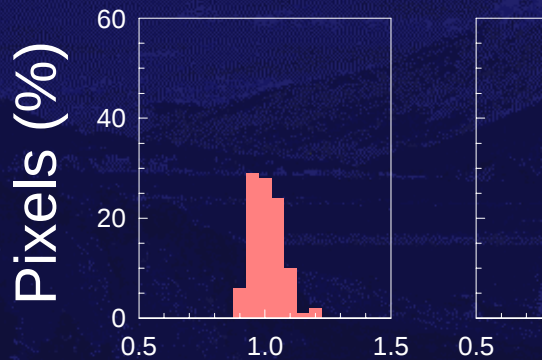
Reference

Mean factor: 1.02
95% pixels: 0.10

Comparison

60° Sun zenith

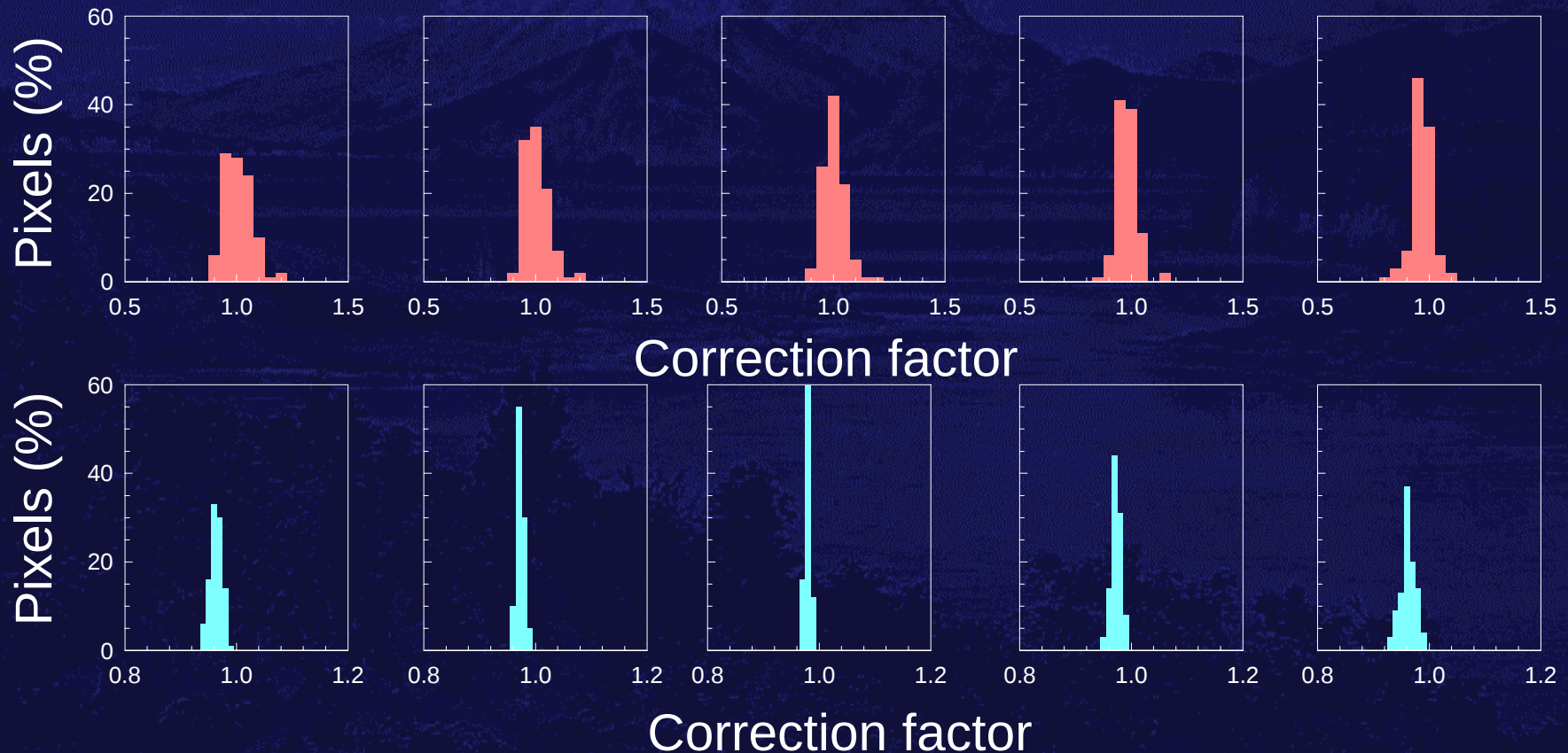
Mean factor: 1.34
95% pixels: 0.41



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

View zenith angles: -45° , -30° , 0° , 30° , 45°



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

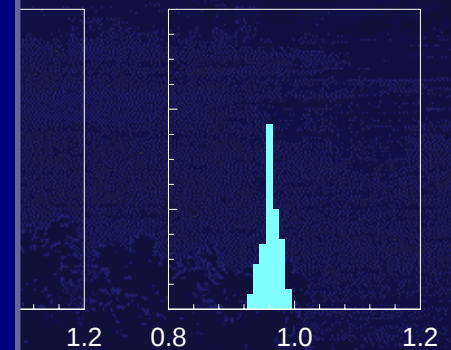
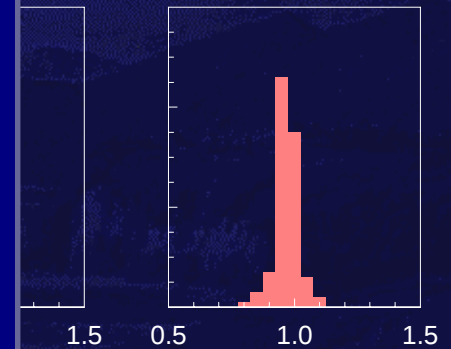
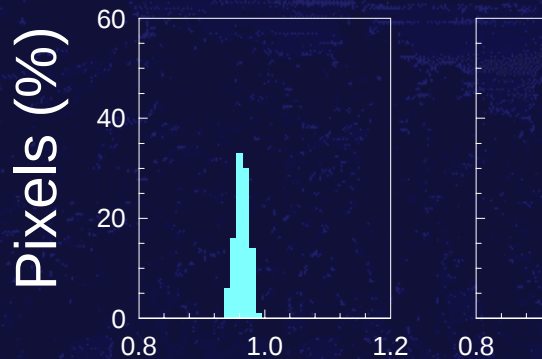
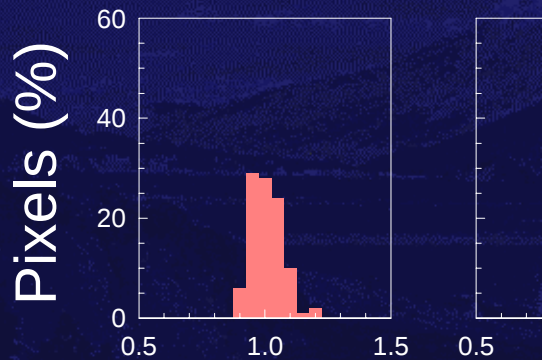
Reference

Mean factor: 1.02
95% pixels: 0.10

Comparison

Simple VI

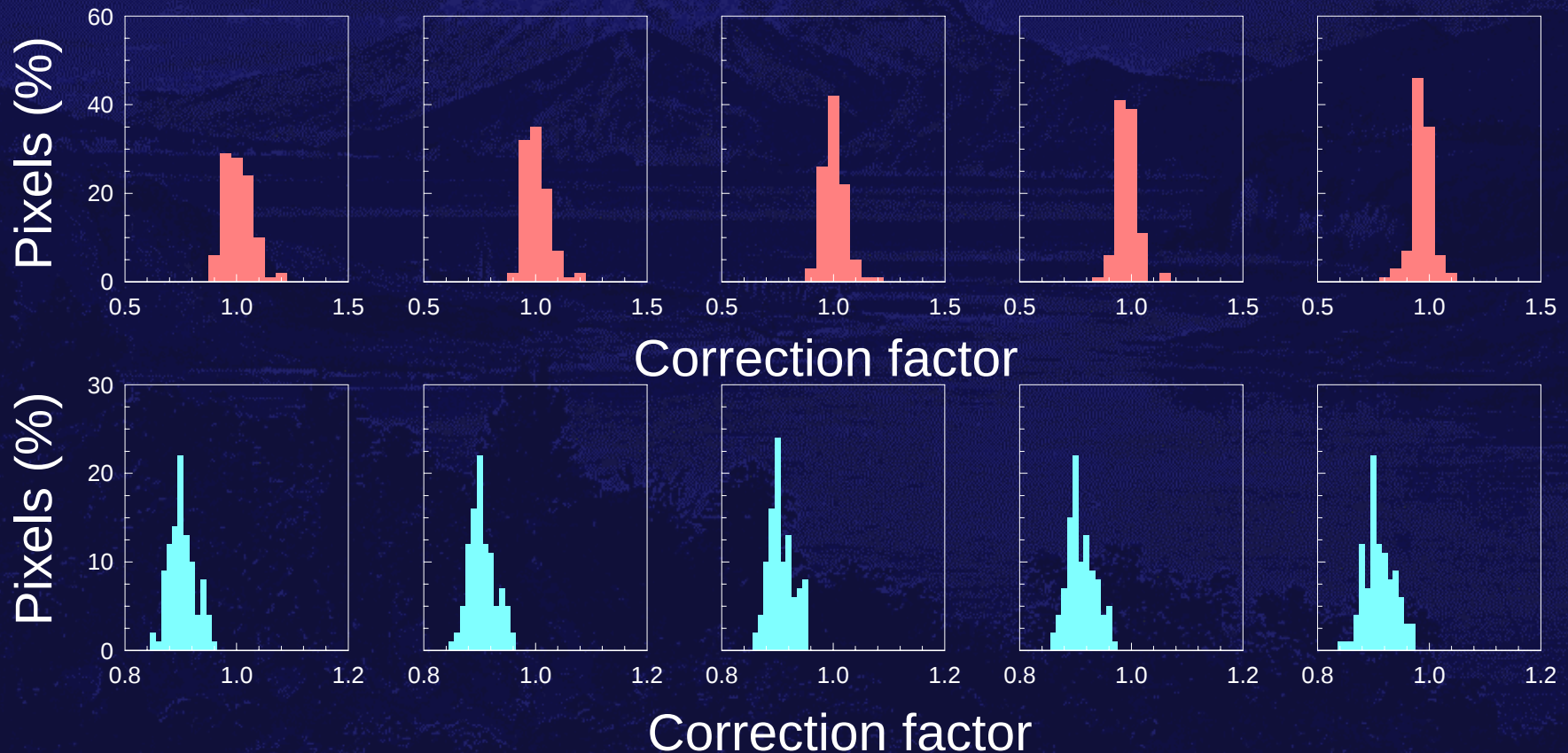
Mean factor: 0.98
95% pixels: 0.06



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

View zenith angles: -45° , -30° , 0° , 30° , 45°



The Topographic Effect and GLI Data

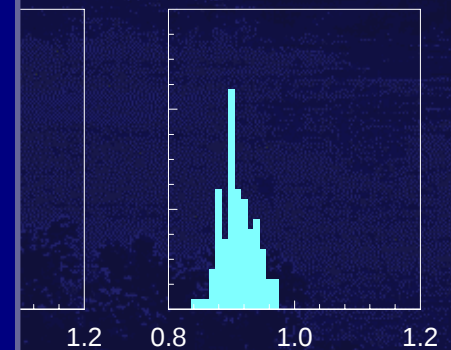
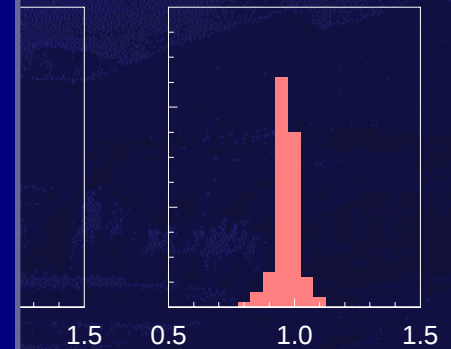
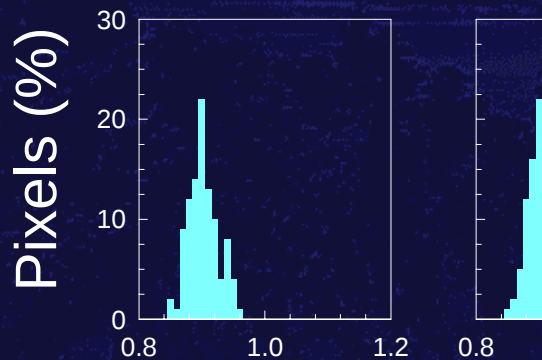
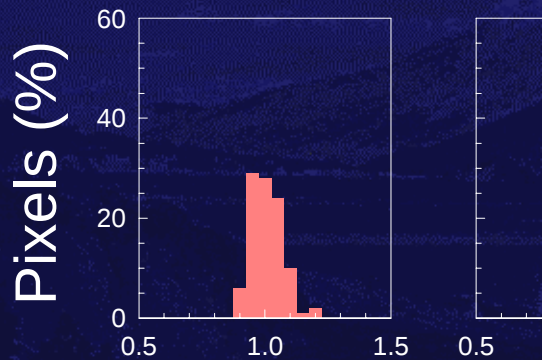
- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain.

Reference

Mean factor: 1.02
95% pixels: 0.10

Comparison

60° Sun zenith, VI
Mean factor: 0.92
95% pixels: 0.05



The Topographic Effect and GLI Data

- ◆ Reference: Sun zenith 30° , principal plane, red wavelengths, 1 km pixel size, dissected terrain, view zenith angles: -45° , -30° , 0° , 30° , 45°

Change from reference	Mean factor	95% pixels
None	1.02	0.10
Right angles to PP	1.02	0.13
NIR wavelengths	1.04	0.10
Large terrain elements	1.01	0.17
Large terrain, 250 m pixels	1.01	0.27
60° Sun zenith	1.34	0.41
Simple VI	0.98	0.06
Simple VI, 60° Sun zenith	0.92	0.05

Conclusions

- ◆ At small Sun zenith angles and 1 km pixel sizes, over areas with terrain elements small compared with the pixel size, GLI reflectance data can be considered largely unaffected by terrain.
- ◆ GLI standard products involve band ratios, and so will be affected much less by topography—although a reduction in accuracy will occur as the Sun zenith angle approaches the mean slope angle.
- ◆ To obtain accurate reflectance values when the Sun zenith angle is less than 30° above the mean slope angle, for either 1 km or 250 m pixels, topographic correction is advisable.

Acknowledgements

The authors would like to thank Mr Ted Pinkney for preparation of data used in this presentation.

The work presented here was been jointly funded by the National Space Development Agency (NASDA) of Japan; and the New Zealand Foundation for Research, Science, and Technology.