Land Surface Albedo Determination: Remote Sensing and Statistical Validation

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Commission No. 8

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Skeleton

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Introduction

- Land surface albedo – one of the Essential Climate Variables (ECV)
- The receiving radiation from the Sun will interact with the atmosphere and reaching the ground surface and subsequently behaving differently according to the contacted earth features.
- The power of reflectivity will results in leaving radiance from the earth and thus keeping the earth surface cool.

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Figure 1

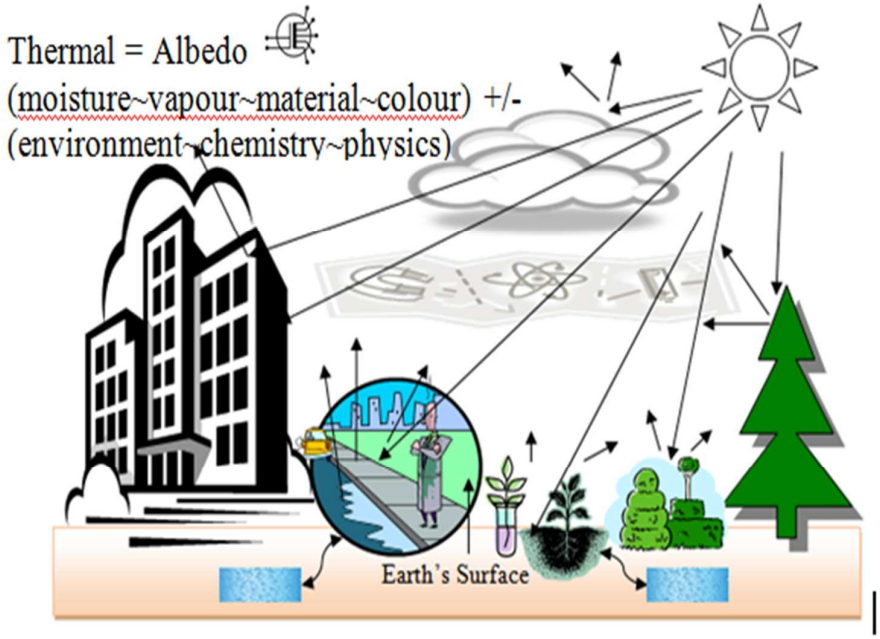

Figure 1: Conceptual Relationship of Albedo and the Earth Interaction

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Introduction

- Several studies have produced estimates of LSA using remote sensing images and verified through *in-situ* measurement (Franch Gras, 2013; Jacobsen, Carstensen, & Kamper, 2012; Román *et al*., 2013).
- These studies can easily be verified with the existing Baseline Radiation Network (BSRN) and in situ measurement given the cloud cover is less.
- Malaysia; with an abundance of cloud in addition to the absent of BSRN, studies involving LSA quantification may face difficulty to validate.

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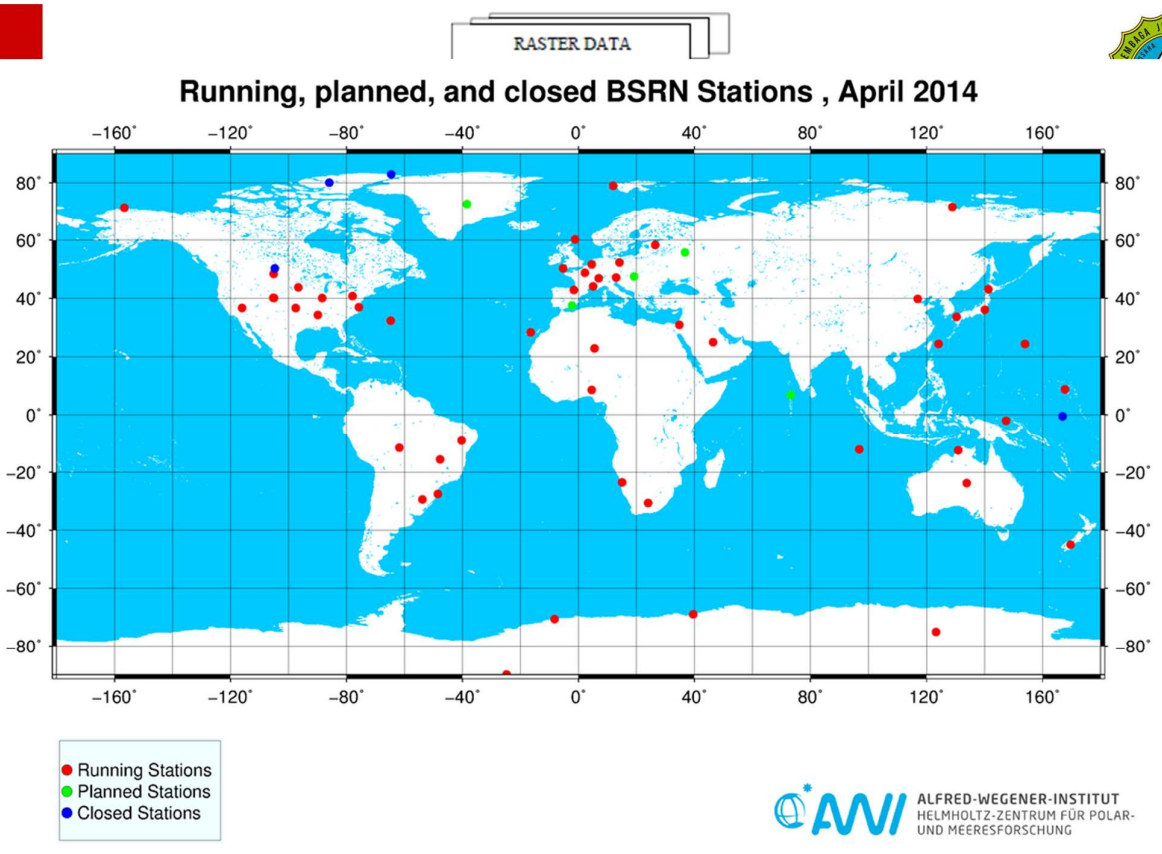

v. UHI WRF SIMULATION DOWNSCALED OFFSET AND IMPROVEMENT

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Opportunity and Objective

- The availability of 52 continous air quality monitoring station (CAQMs) in addition to METs
- The simulated air quality impacts of increased albedo = reveals that they are of the same order of magnitude (Taha, Douglas, & Haney, 1997)
- The objective of this paper is to investigate the relationship of the climatic variables from CAQMs in determining the LSA

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Methods

- **ASTER vnir land surface albedo determination**
  - VNIR is depicted through the equation developed by Mokhtari & Busu (2011) that further improved in (Mohammad H Mokhtari *et al*., 2013).
- **Selection of Climatic Variables Dependencies**
  - The climatic variables that were suggested to have a certain degree of influence toward the formation of LSA are humidity (Akbari, Matthews, & Seto, 2012; Bornstein *et al*., 2006; Menglin, 2011), wind speed (Bastiaanssen, Ahmad, & Chemin, 2002) and ambient temperature (Akbari *et al*., 2012; Bornstein *et al*., 2006; Menglin, 2011).

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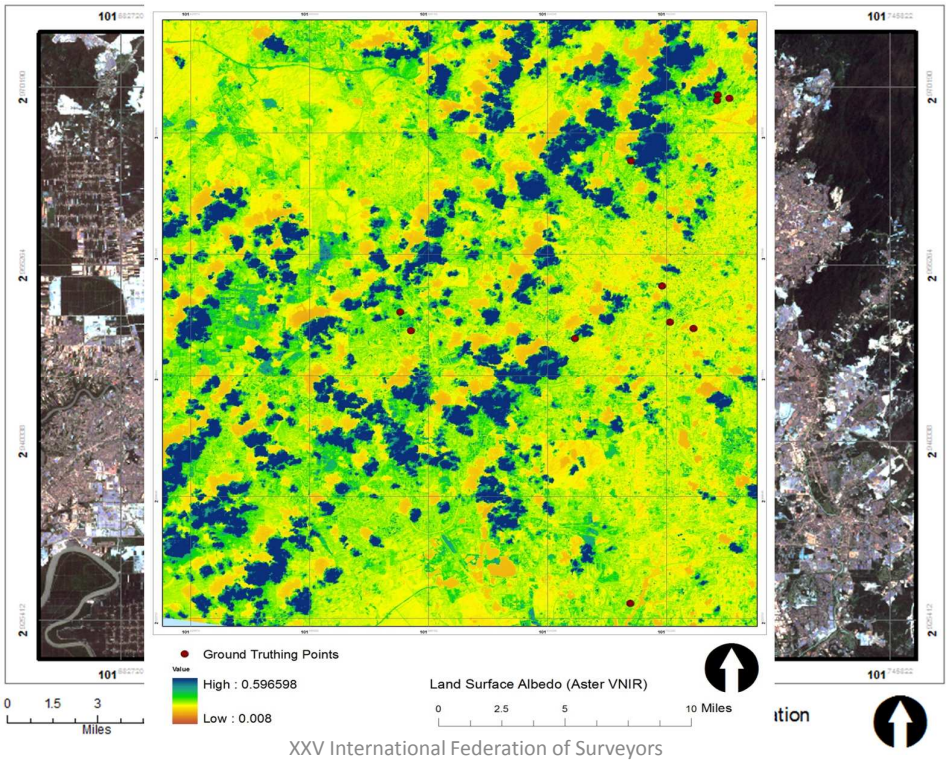
Methods

- **The Multiple Linear Regression testing the Assumptions**
  - 7 Assumptions
- **Statistical, Internal and Insitu validations**
  - Mean Absolute Error (MAE)
  - Relative Standard Error (RSE)
  - Root Mean Square Error (RMSE)
  - Bootstrap Resample and Regression

Insitu Validation



Results and Discussions

Table 1: Climate Predictor Correlations for N*ii*

		Albedo	Air_temperature	Rel_Humidity	Windspeed
Pearson Correlation	Albedo	1.000	-.912	-.490	-.066
	Air_temperature	-.912	1.000	.397	-.101
	Rel_Humidity	-.490	.397	1.000	.829
	Windspeed	-.066	-.101	.829	1.000
Sig. (1-tailed)	Albedo	.	.000	.012	.387
	Air_temperature	.000	.	.037	.331
	Rel_Humidity	.012	.037	.	.000
	Windspeed	.387	.331	.000	.

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Results and Discussions

Table 2: The Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. E of the Estimate	Durbin-Watson
1	.912[a]	.831	.822	.00477746703	2.179

a. Predictors: (Constant), Air_temperature
b. Dependent Variable: Albedo

Table 3: The ANOVA[b] N*ii*

Model		Sum of Squares	Mean Square	F	Sig.
1	Regression	.002	.002	93.648	.000[a]
	Residual	.000	.000		
	Total	.003			

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Results and Discussions

Table 4: The Coefficients[a] N*ii*

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.408	.027		15.085	.000
	Air_temperature	-.008	.001	-.912	9.677	.000

Model 1	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.351	.464					
Air_temperature	-.010	-.006	-.912	-.912	-.912	1.000	1.000

y= 0.008 (ATemp) + 0.408

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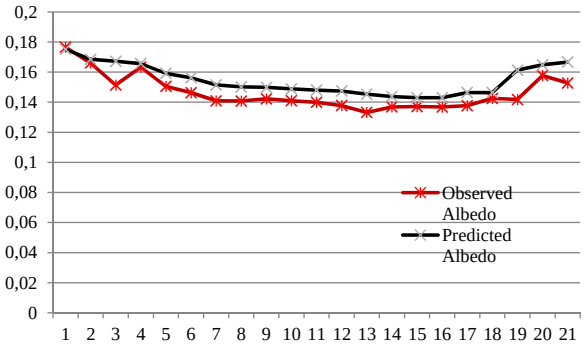
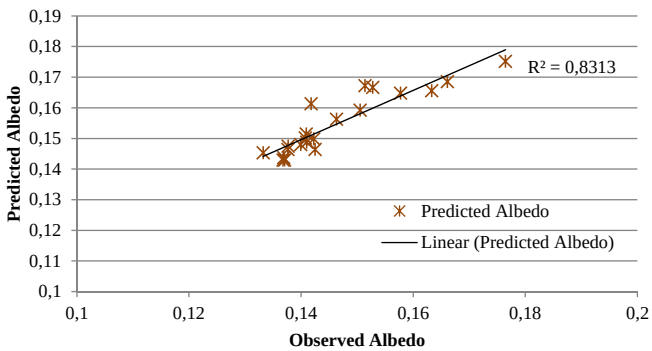
Bootstrapping

Table 5: Comparison of N*ii* with Bootstrap Regression

Samples	*n*	SE coefficient Const.	SE coefficient Ambient temperature	B coefficient	Confidence Interval Lower	Confidence Interval Upper
Original	21	0.027	0.001	-0.008(0.408)	-0.010(0.351)	-.006(0.464)
Bootstrap	1000	0.027	0.001	-0.007(0.357)	-.008(0.299)	-.005(0.405)





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ASTERvnir and Accuracy Assessment

y= 0.008 (ATemp) + 0.408

	N*ii* LSA	ASTERvnir LSA	D	%
Point 1	0.14536	0.259251	-0.113891	56.06921478
Point 2	0.144	0.229133	-0.085133	62.84559623
Point 3	0.13736	0.23527	-0.09791	58.38398436
Putrajaya CAQMs	0.172	0.239545	-0.067545	71.80279279
Bt. Muda CAQMs	0.1904	0.279282	-0.088882	68.17481972
P. Jaya CAQMs	0.1768	0.191914	-0.015114	92.12459748
Shah Alam CAQMs	0.1848	0.236881	-0.052081	78.01385506
Cheras CAQMs	0.1816	0.22658	-0.04498	80.14829199
P. Jaya METs	0.1848	0.241634	-0.056834	76.47930341
Subang METs	0.1816	0.248245	-0.066645	73.15353784

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ASTERvnir and Accuracy Assessment

y= 0.008 (ATemp) + 0.408

	RSE (%)	RMSE	MSE	MAE
N*ii* - Ambient Temperature	0.023	.00478	0.00002	0.004

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Conclusion

- There is a strong negative relationship (-0.822)
- Land surface albedo is able to suppress the surface temperature given the similar condition as the study area which also in line with studies conducted by several researchers (Huwald *et al.*, 2009; Jiang *et al.*, 2007).
- The bootstrap regression proves that the minimum samples biased were not questionable as the standard error exhibited the sample size adequacy.
- The model goodness of fits are tested using MAE, RMSE, MSE and RSE
- Well within the tolerance with low residual variance, consistent with the recommendation made by Browne *et al.,* (1993) of RMSE < 0.08.
- It is also recommended to examine the model on different sensor such as Landsat and MODIS to ensure the flexibility of air temperature at different temporal and spatial resolution.
- Suitable for evaluating climate model demand for land surface albedo with the level of uncertainty range from 0.02 to 0.05 as documented by Henderson-Sellers and Wilson (1983) and Sellers *et al.*,(1995).

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Thank you for your attention!

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