Estimation of Land Surface Albedo from GCOM-C/SGLI Surface Reflectance

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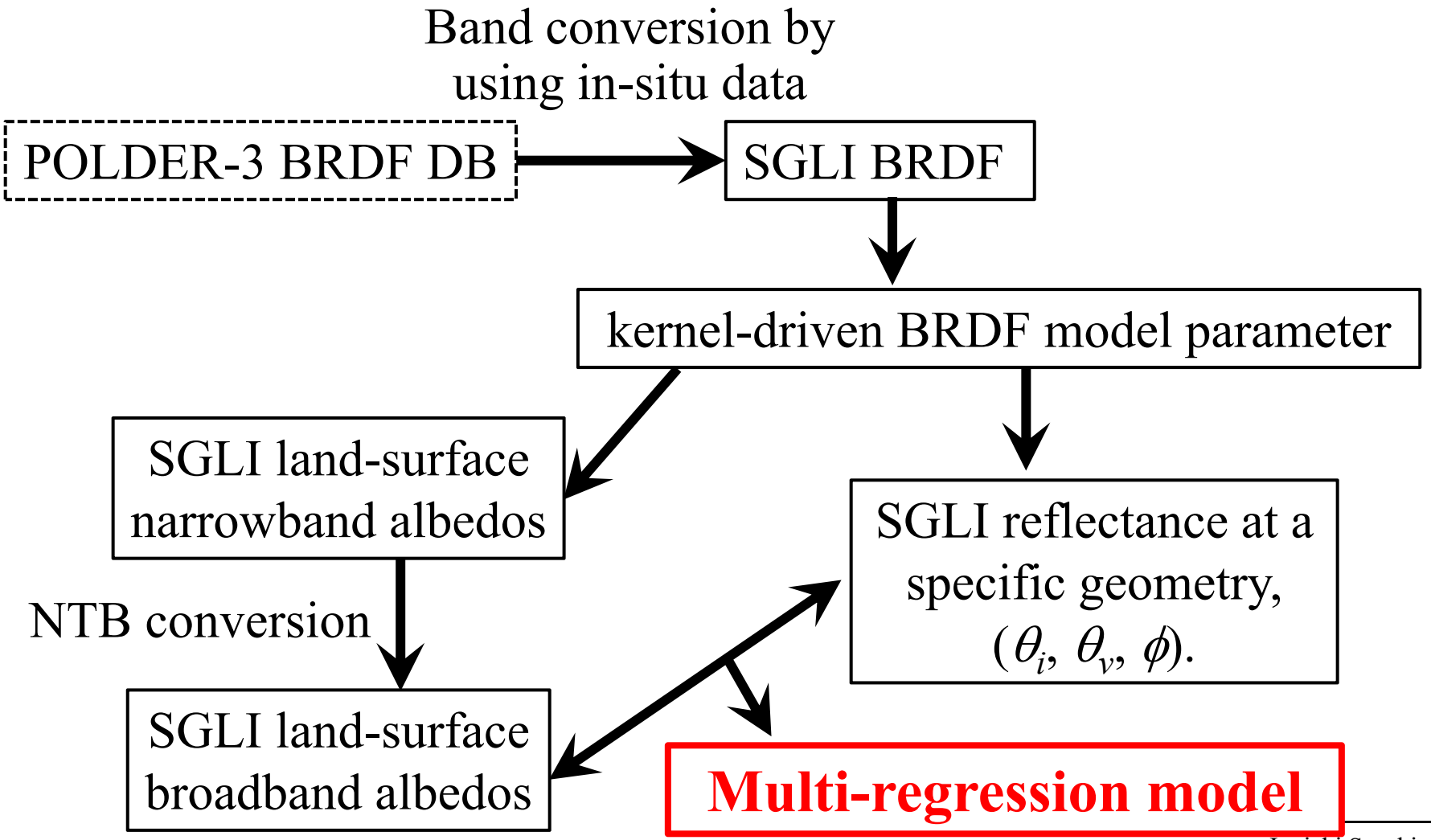
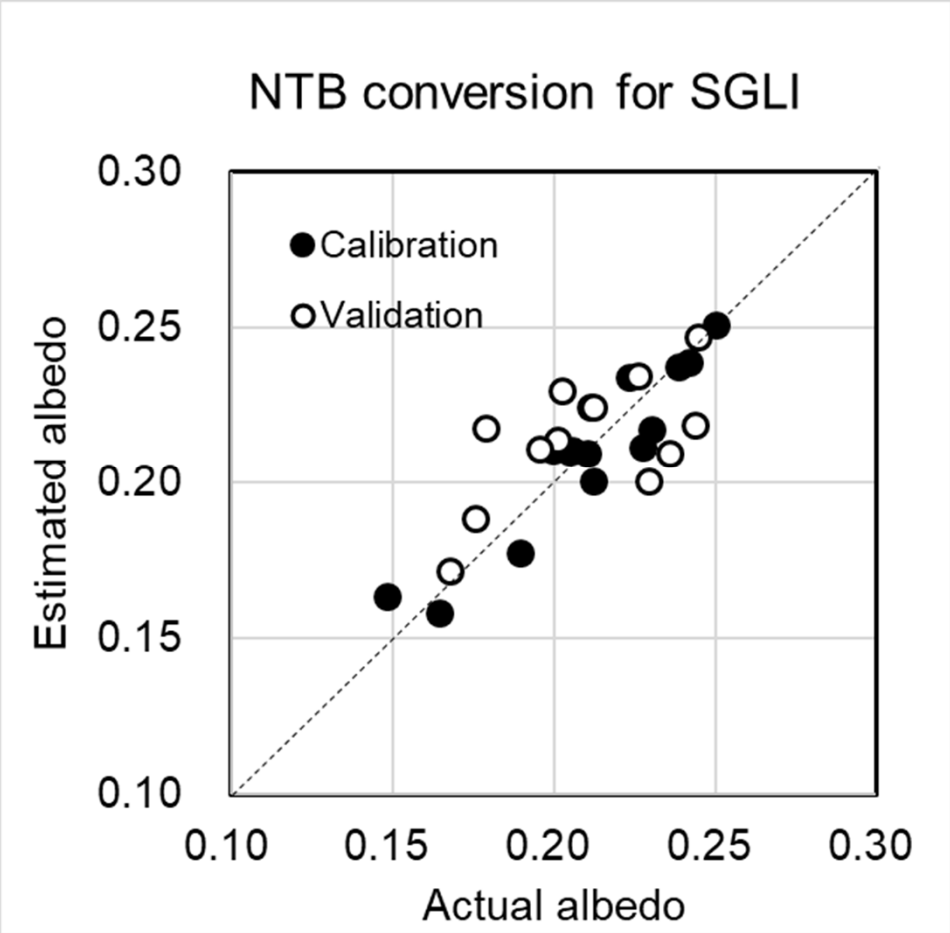
Objective

- We examined the approach to estimate daily albedo by using a single-day reflectance of GCOM-C1/SGLI.
  - Look-up-table (LUT) approach by using multi-angular observations of POLDER-3
  - BRDF model parameter-based approach by using several days, e.g. 8-day, of observations

Method for estimating SGLI albedo



NTB Conversion

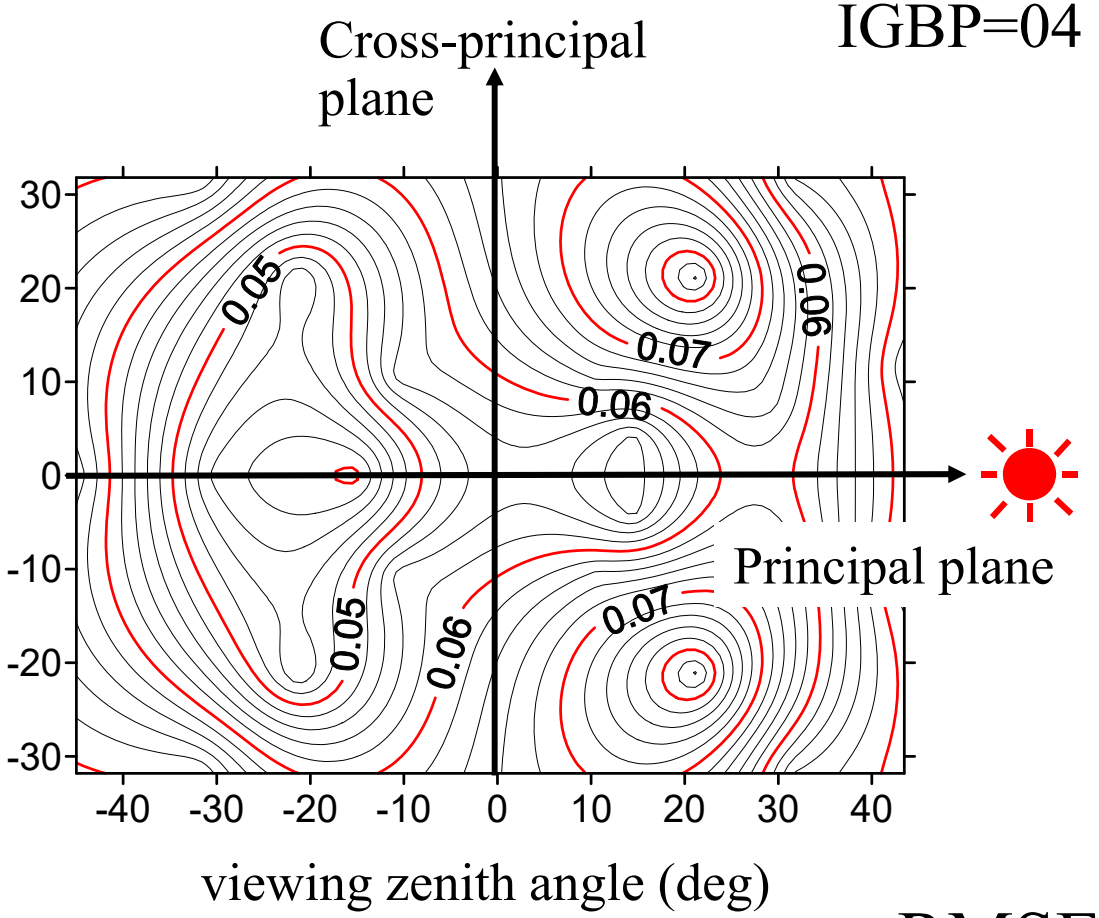


[Constraint]
Coefficients are non-negative.

RMSE
0.010 for calibration
0.023 for validation

alb = 0.2233 VN8 + 0.4005 VN11 + 0.1463 SW3

Residual of albedo: Forest

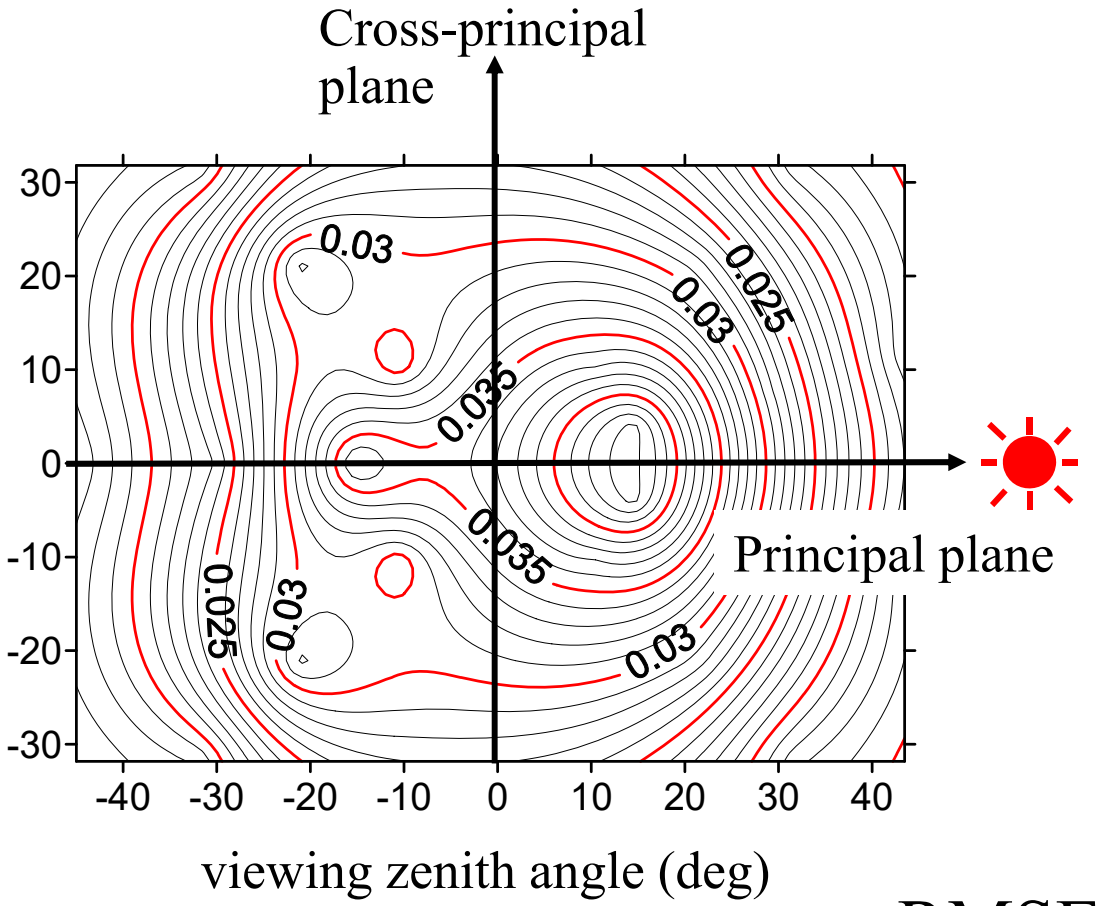


IGBP=04 (Deciduous broadleaf forest)

vz (deg)	az (deg)	RMSE
15	15	0.051
15	45	0.065
15	135	0.057
15	180	0.039
30	15	0.065
30	45	0.084
30	135	0.044
30	180	0.043
45	15	0.047
45	45	0.054
45	135	0.070
45	180	0.065

RMSE for all direction: 0.058

Residual of albedo: Bare soil



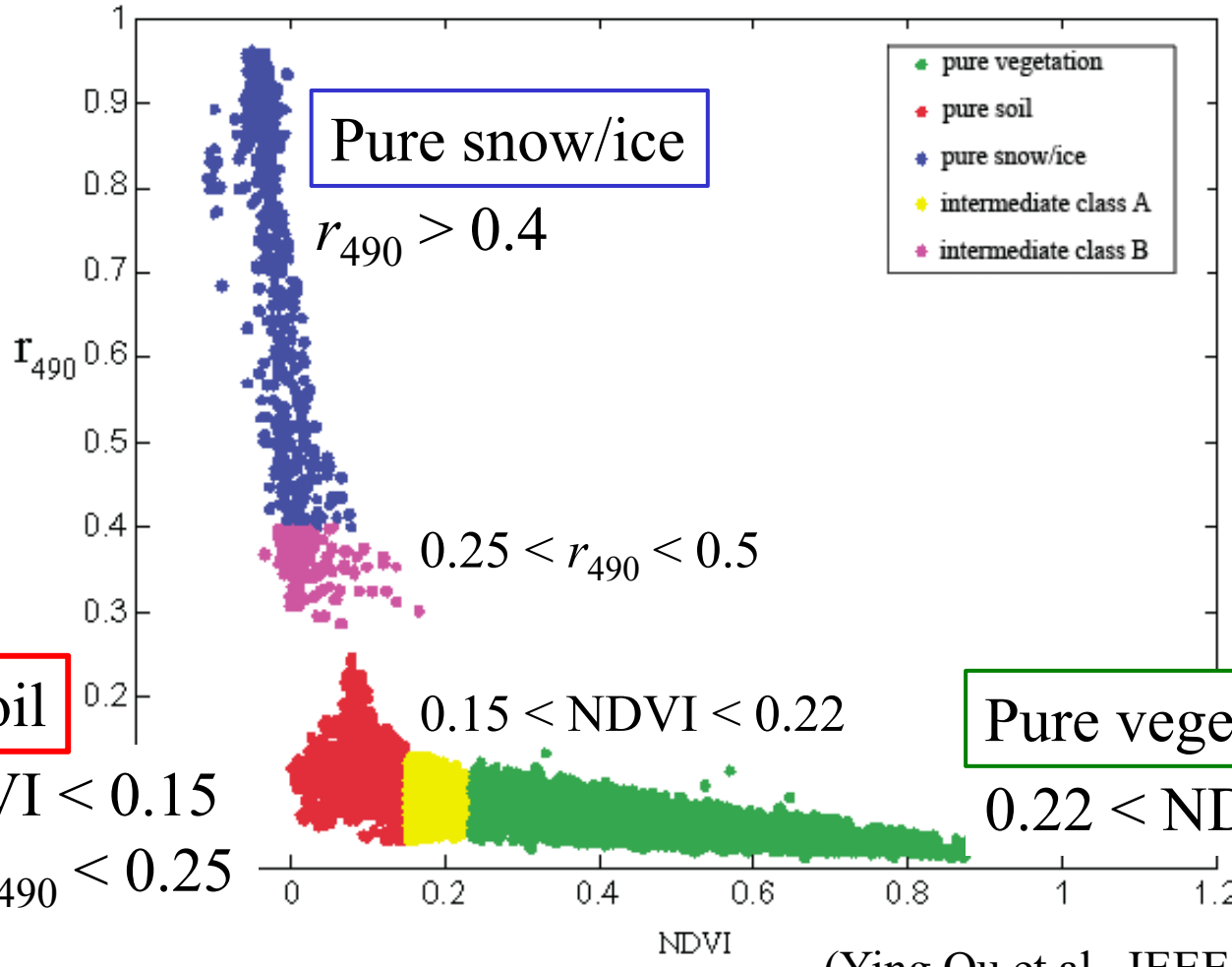
vz (deg)	az (deg)	RMSE
15	15	0.043
15	45	0.037
15	90	0.036
15	135	0.029
15	180	0.037
30	15	0.028
30	45	0.029
30	90	0.034
30	135	0.032
30	180	0.023
45	15	0.016
45	45	0.017
45	90	0.027
45	135	0.018
45	180	0.016

RMSE for all direction: 0.030

Validation using long-term data observed at towers

- Location
  - Fuji-yoshida: Evergreen needle-leaf forest
  - Takayama 1: Planted evergreen coniferous Forest
  - Takayama 2 : Cool temperate deciduous forest
  - Yamashiro: Deciduous broadleaved secondary forest
- Period: Jan. 2018 to Dec. 2020

Classification for POLDER-3/PARASOL BRDF database



Pure snow/ice

$r_{490} > 0.4$

$0.25 < r_{490} < 0.5$

$0.15 < \text{NDVI} < 0.22$

Pure soil

$-1 < \text{NDVI} < 0.15$

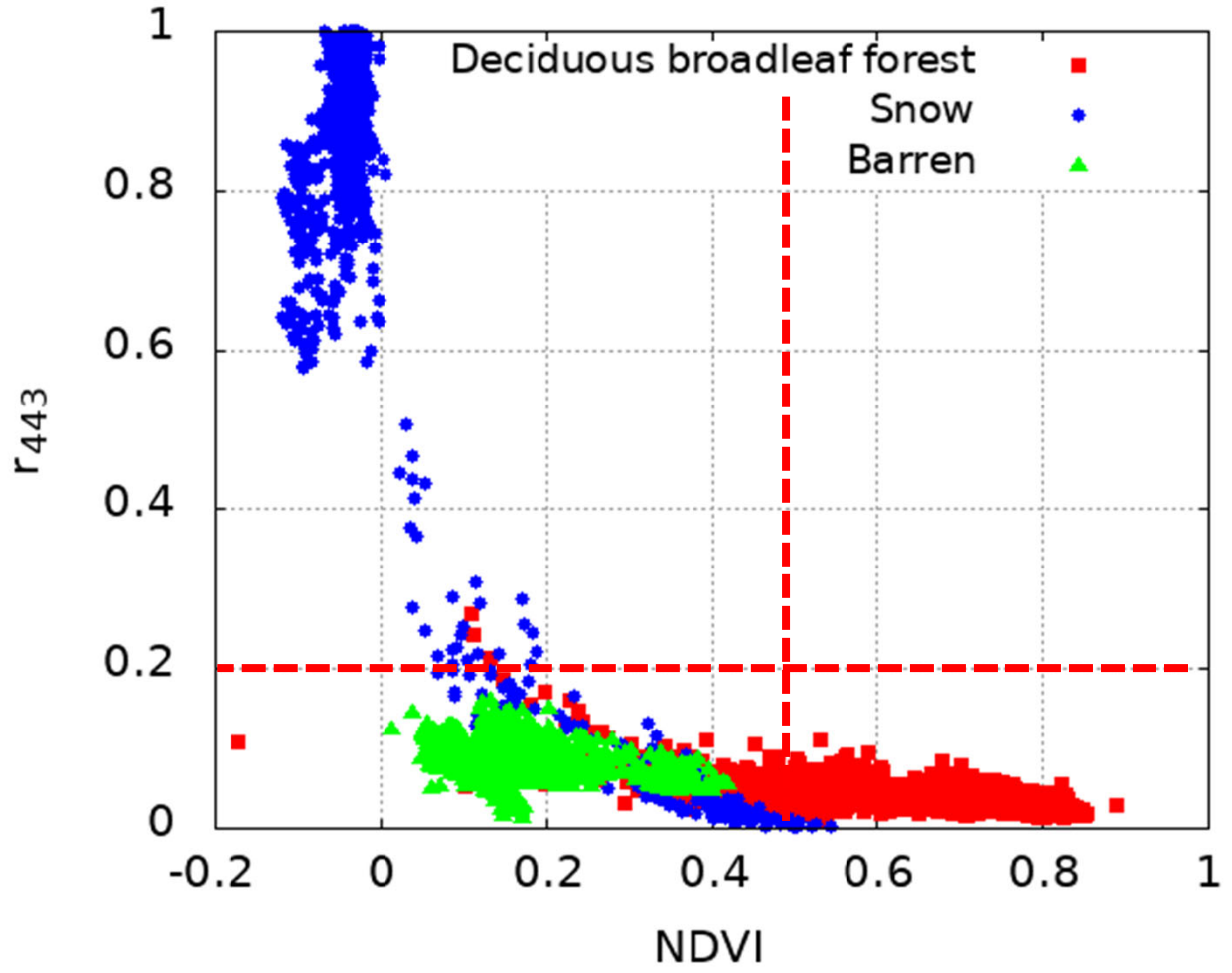
and $0 < r_{490} < 0.25$

Pure vegetation

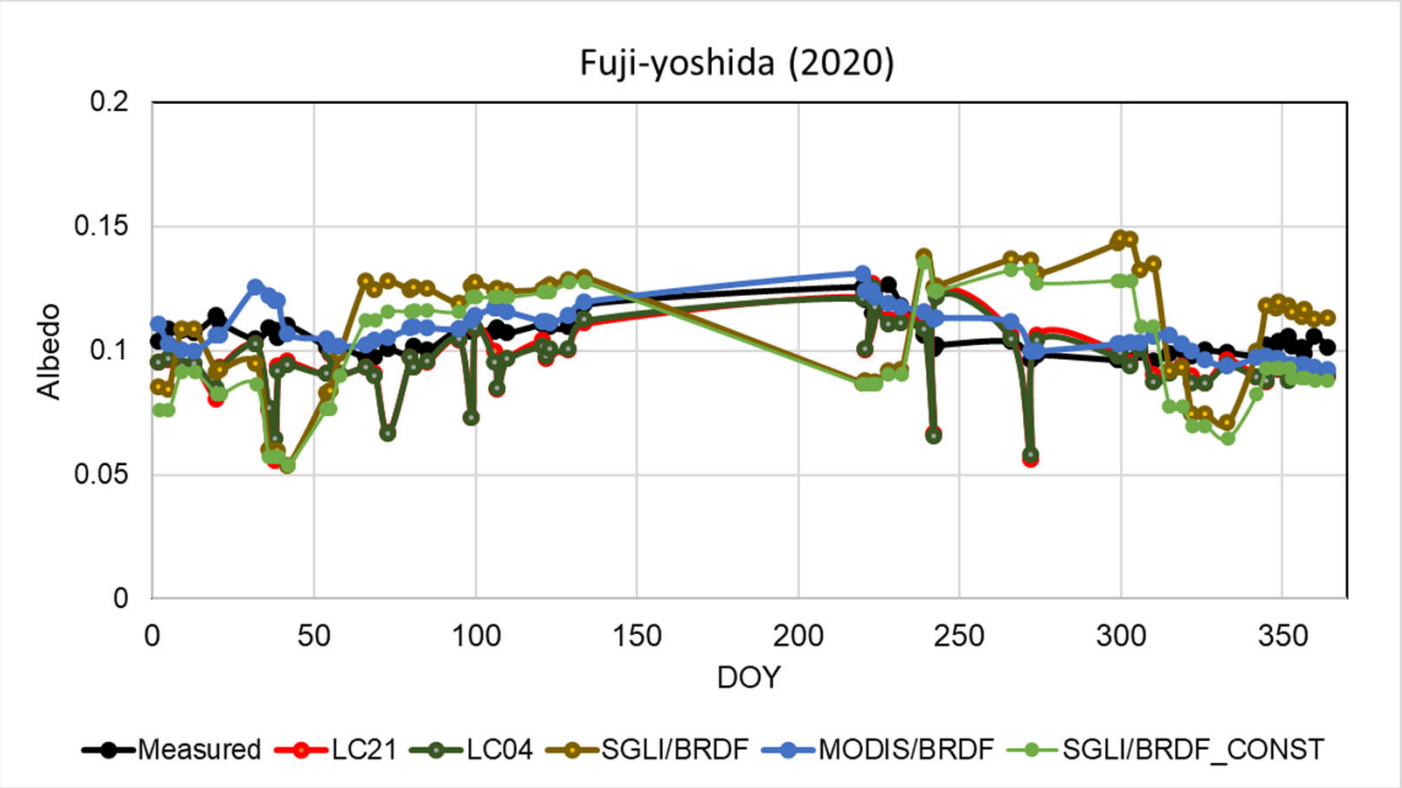
$0.22 < \text{NDVI} < 1$

(Ying Qu et al., IEEE TGRS, 2014)

- vegetation: NDVI ≥ 0.5 and $r_{443} \leq 0.2$;
- non-vegetation: $0 \leq$ NDVI < 0.4 and $r_{443} \leq 0.2$;



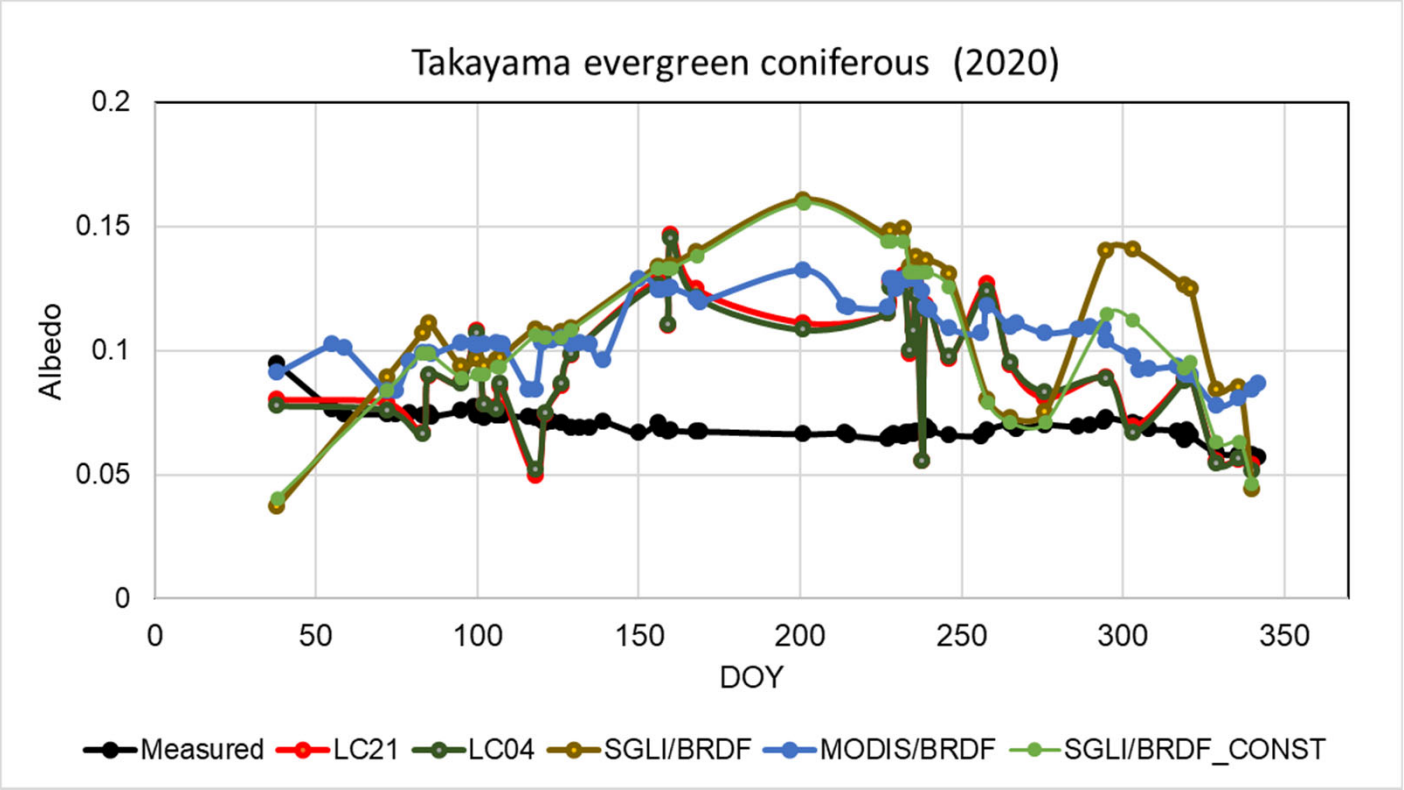
1. LC21: Regression models for SGLI generated by using the data sets of “Barren or sparsely vegetated (IGBP LC16)” and “Deciduous broadleaf forest (IGBP LC4)” in POLDER-3 BRDF DB. The applied model was selected by referring to NDVI.
   - vegetation: NDVI ≥ 0.5 and $r_{443} \leq 0.2$;
   - non-vegetation: $0 \leq$ NDVI < 0.4 and $r_{443} \leq 0.2$;
2. LC04: Regression models for SGLI generated by using the data sets of “Deciduous broadleaf forest (IGBP LC4)” in POLDER-3 BRDF DB
3. SGLI/BRDF: BRDF model parameter-based estimation for SGLI
4. MODIS/BRDF: BRDF model parameter-based estimation for MODIS
5. SGLI/BRDF const: the albedo calculated by using only isotropic parameter (constant) to examine the contribution of the angular dependent parameters



Vegetation type	Natural evergreen needle-leaf forest
Domestic species (Overstory)	Japanese red pine (Pinus densiflora)
Dominant species (Understory)	Japanese holly (Ilex edunculosa)
Canopy height	20 m

Year (sample #)	lc21	lc04	SGLI/ BRDF	MODIS/ BRDF	SGLI/ BRDF const
2018 (47)	0.0151	0.0147	0.0185	0.0166 (126)	0.0189
2019 (67)	0.0156	0.0158	0.0204	0.0073 (116)	0.0204
2020 (65)	0.0157	0.0153	0.0267	0.0076 (116)	0.0251

http://asiaflux.net/index.php?page_id=55



Vegetation type	Planted Evergreen Coniferous Forest
Domestic species (Overstory)	Cyptomeria japonica
Dominant species (Understory)	Shurabs, herbs, ferns
Canopy height	20 m

Year (sample #)	lc21	lc04	SGLI/ BRDF	MODIS/ BRDF	SGLI/ BRDF const
2018 (42)	0.0438	0.0427	0.0646	0.0372 (96)	0.0611
2019 (70)	0.0362	0.0359	0.0534	0.0432 (107)	0.0515
2020 (37)	0.0354	0.0344	0.0538	0.0407 (69)	0.0480

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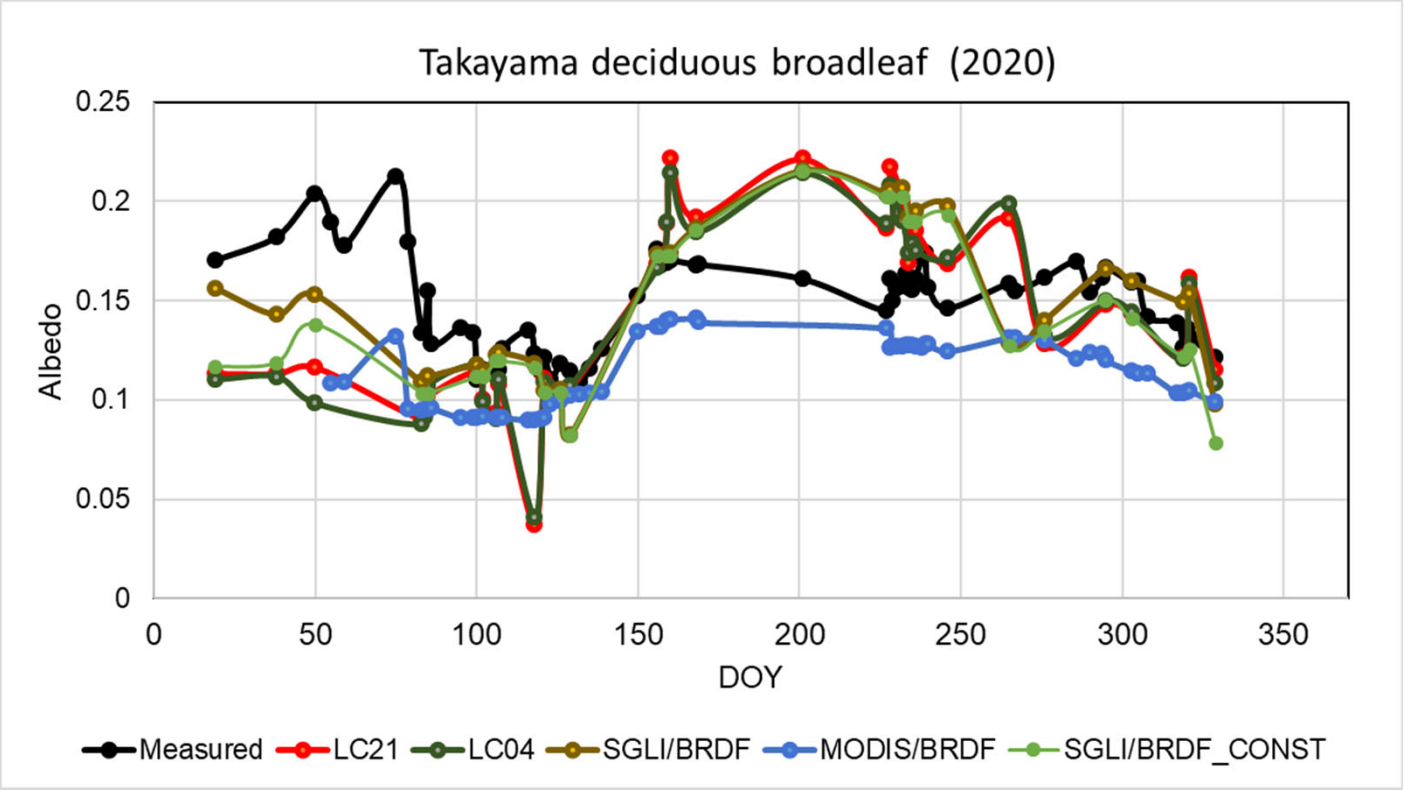

Vegetation type	Cool temperate deciduous forest
Domestic species (Overstory)	Birch (Betula), Deciduous oak
Dominant species (Understory)	Bamboo grass
Canopy height	15-20 m

Year (sample #)	lc21	lc04	SGLI/ BRDF	MODIS/ BRDF	SGLI/ BRDF const
2018 (35)	0.0283	0.0258	0.0382	0.0248 (92)	0.0370
2019 (61)	0.0478	0.0477	0.0383	0.0261 (78)	0.0422
2020 (32)	0.0389	0.0389	0.0302	0.0371 (59)	0.0337

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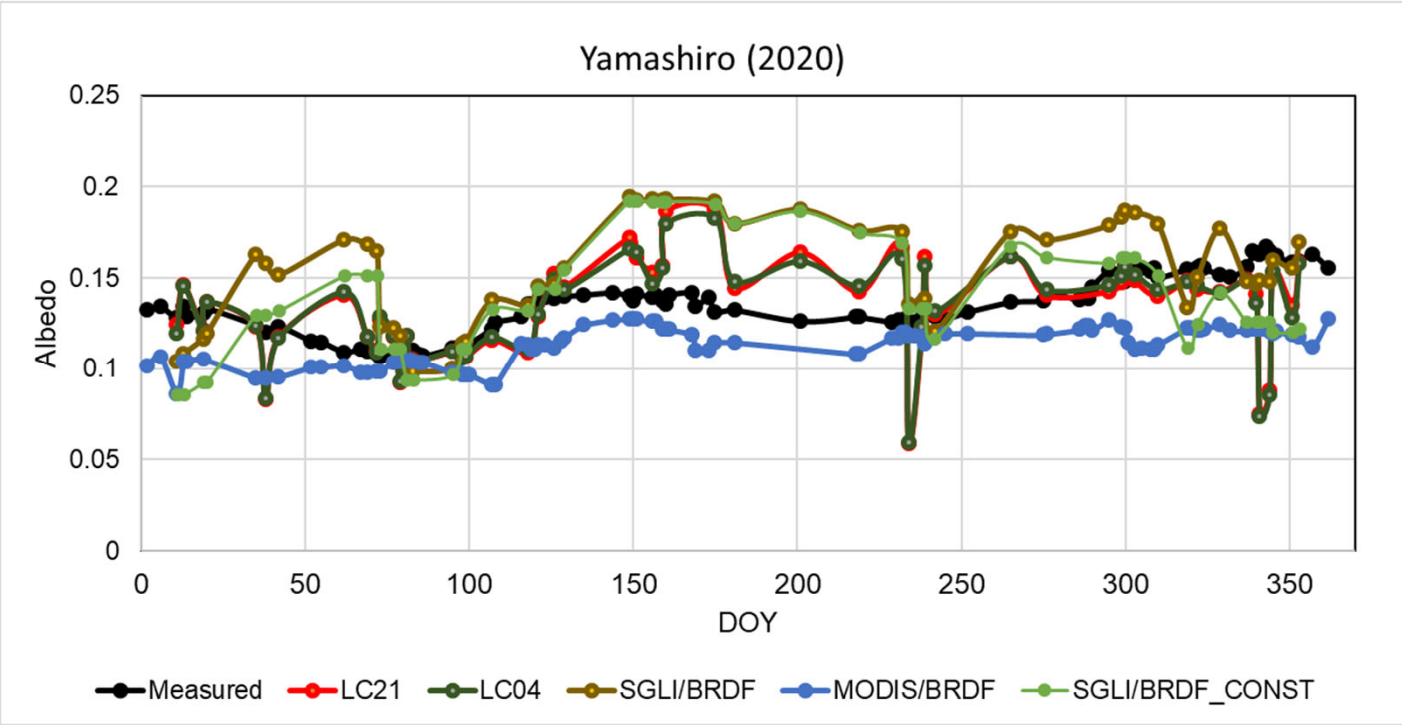

Vegetation type	Deciduous broadleaved secondary forest
Domestic species (Overstory)	Quercus serrata, Ilex pedunculosa
Dominant species (Understory)	Rhododendron reticulatum
Canopy height	6-20 m

Year (sample #)	lc21	lc04	SGLI/ BRDF	MODIS/ BRDF	SGLI/ BRDF const
2018 (55)	0.0245	0.0235	0.0305	0.0161 (99)	0.0294
2019 (62)	0.0195	0.0182	0.0355	0.0207 (94)	0.0360
2020 (54)	0.0261	0.0256	0.0322	0.0256 (102)	0.0337

Discussion

- The LUT approach did not generate the best accuracy among several approaches. However, in Takayama 1 (evergreen) and Yamashiro (deciduous), LU04 approach generated acceptable results.
- In total, the BRDF model based approaches can generate the stable and reasonable results, even though the estimated results represent averaged albedos.

Conclusions & Future Plan

- We proposed a method for daily generating terrestrial albedo from a single-day reflectance with LUT generated beforehand.
- However, the results showed that the BRDF model-based approach generated better results than the LUT-based approach.
- The SGLI/BRDF model-based approach will be investigated to improve the better results.