BRDF / Albedo REPORT

ATBD Concerns

- Algorithm too complex & risky
- High processing load
- Combining spatial, spectral, two-instrument data not well specified
- Cloud problems
- Atmospheric correction circularity problem
- Collateral data needs

Revised Approach: Semi Empirical Models (Wanner)

Topographic Input: (Muller)

clouds — EDC 1-Km Prototyping: (Strahler ..... Moyer)

Atmospheric Correction: (Strahler .... Vermote)

Validation: (Strahler, Muller)

VI Inputs: (Dialogue w/ Alfredo)

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EDC Linkages

Clouds

- Dave Meyer reports 4-8 looks in 30 day period w/ AVHRR in midwest test site
- Li @ CCRS reports cloud screening takes out 70% of AVHRR observations in Canada
- Muller anticipates some cloud cover studies using GAC / CLAVR
- Conclusion: Possible 15-day or longer BRDF period; possibly sliding
- Note: Leroy & Roujean successfully did 30-day sliding fit to Roujean model

Albedo

- Dave Meyer developing techniques to do AVHRR Albedo
- Plans to try our semiempirical models (as well as others)
- Developed robust estimation technique so some cloud-influenced measurements can be used.

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Atmospheric Correction

- Resolve circularity with 1-pass iteration
- Procedure: (proposed by Eric Vermote)
  - Retrieve, archive Lambertian surface reflectances
  - Include atmospheric params: τ, t, s, $\bar{\rho}$
  - Extract BRDF (semiempirical fit)
  - Use BRDF & atmo. params to calculate new reflectances
  - Fit final BRDF
  - (MISR is already well-corrected)

Validation

- Algorithm Development
  1. Revisit fit of semiempirical models to Kimes's VEG datasets
  2. Fit semiempirical models to ASAS data
  3. Fit semiempirical models to AVHRR datasets: 20 x 20 & 100 x 100 window datasets; AFGL New England composite.
- Field testing & beyond ... Muller

MODIS BRDF/albedo output format

per pixel 3 sets:
- best-fit model
- (2nd-best model)
- always modified Walthall m.

per set:
- modeltype, RMSE
- quality flags: overall quality
  goodness of fit
  goodness over bands
  spread of view angles
  spread of sun angles
- history flags: overall history
  stability in time of model choice

  stability in time of parameters found
- parameters for each band
- white sky albedo: spectral, $< 0.7\ \mu m$, $> 0.7\ \mu m$, all bands
- black sky albedo: polynomial parameters for Θ_s - dependence, spectral, $< 0.7\ \mu m$, $> 0.7\ \mu m$, all bands

once every 9 days .... 1 km resolution

Example:

Savanah : grass + some trees

⇒ expected: K_{vol} = Ross-thin
K_{geo} = Li-sparse

⇒

$$BRDF = f_{iso}$$
$$+ f_{vol} \cdot \left\{ \frac{(\pi/2 - \xi)\cos\xi + \sin\xi}{\cos\theta_i \cos\theta_v} - \frac{\pi}{2} \right\}$$
$$+ f_{geo} \cdot \left\{ O - \frac{1}{\cos\theta_i'} - \frac{1}{\cos\theta_v'} + \frac{1}{2}\frac{(1+\cos\xi')}{\cos\theta_v'} \right\}$$

where ξ = phase angle, $\cos\xi = \cos\theta_i\cos\theta_v + \sin\theta_i\sin\theta_v\cos\phi$

O = overlap area = $\frac{1}{\pi}(t - \sin t\cos t)\cdot(1/\cos\theta_i + 1/\cos\theta_v)$

$\cos t = h/b\,(D^2 + (\tan\theta_i\tan\theta_v\sin\phi)^2)^{1/2}\cdot(1/\cos\theta_i + 1/\cos\theta_v)$

$D = (\tan^2\theta_i + \tan^2\theta_v - 2\tan\theta_i\tan\theta_v\cos\phi)^{1/2}$

$\tan\theta' = b/r\,\tan\theta$

$\frac{b}{r}$: crown shape → $\frac{b}{r}$ = 0.5, 1.0, 4.0
oblate round prolate

$\frac{h}{b}$: relative tree size → $\frac{h}{b}$ = 1.0, 2.0, 3.0 short.... tall

Ross-thin + Li-sparse-oblate-tall $\overset{\text{Inversion}}{\Rightarrow}$ $f_{iso}, f_{vol}, f_{geo}$

Semi-empirical models

$$BRDF(\lambda, \theta_i, \theta_v, \phi) = f_{iso}(\lambda) + f_{geo}(\lambda) \cdot K_{geo} + f_{vol}(\lambda) \cdot K_{vol}$$

- Parameters f_{iso}, f_{geo}, f_{vol} for each band
- Kernels $K_{vol}(\theta_i, \theta_v, \phi)$, $K_{geo}(\theta_i, \theta_v, \phi)$ independent of λ or parameters

⇒ linear models
- scale linearly
- matrix inversion technique (P. Lewis, unpublished)

KERNELS:

- **Ross-RT "thick"**: large LAI approx. (Roujean et al. 1992)
- **Ross-RT "thin"**: thin LAI approx. (Li 1993)
- **Roujean-GO "bricks"**: randomly placed bricks, NO mutual shadowing (Roujean et al.'92)
- **Li-GO "dense"**: based on Li-Strahler GO model WITH mutual shadowing, driven by illuminated visible crowns (Li 1993)
- **Li-GO "sparse"**: based on Li-Strahler GO-MS model, driven by shadows on ground (Li 1993)