

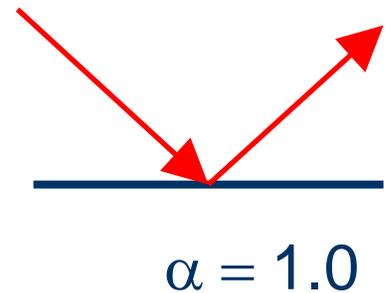
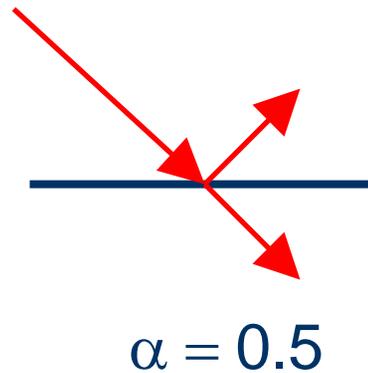
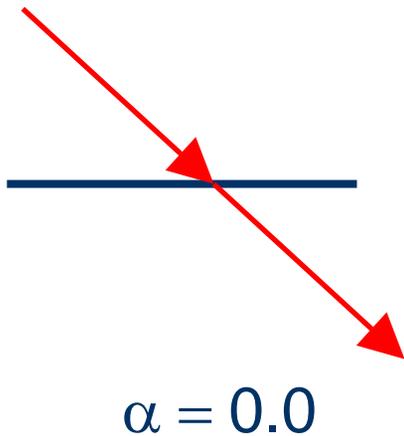
# The Impact of Albedo Change on Carbon Sequestration Strategies

Maithilee Kunda  
SURE Internship  
Program  
Summer 2004

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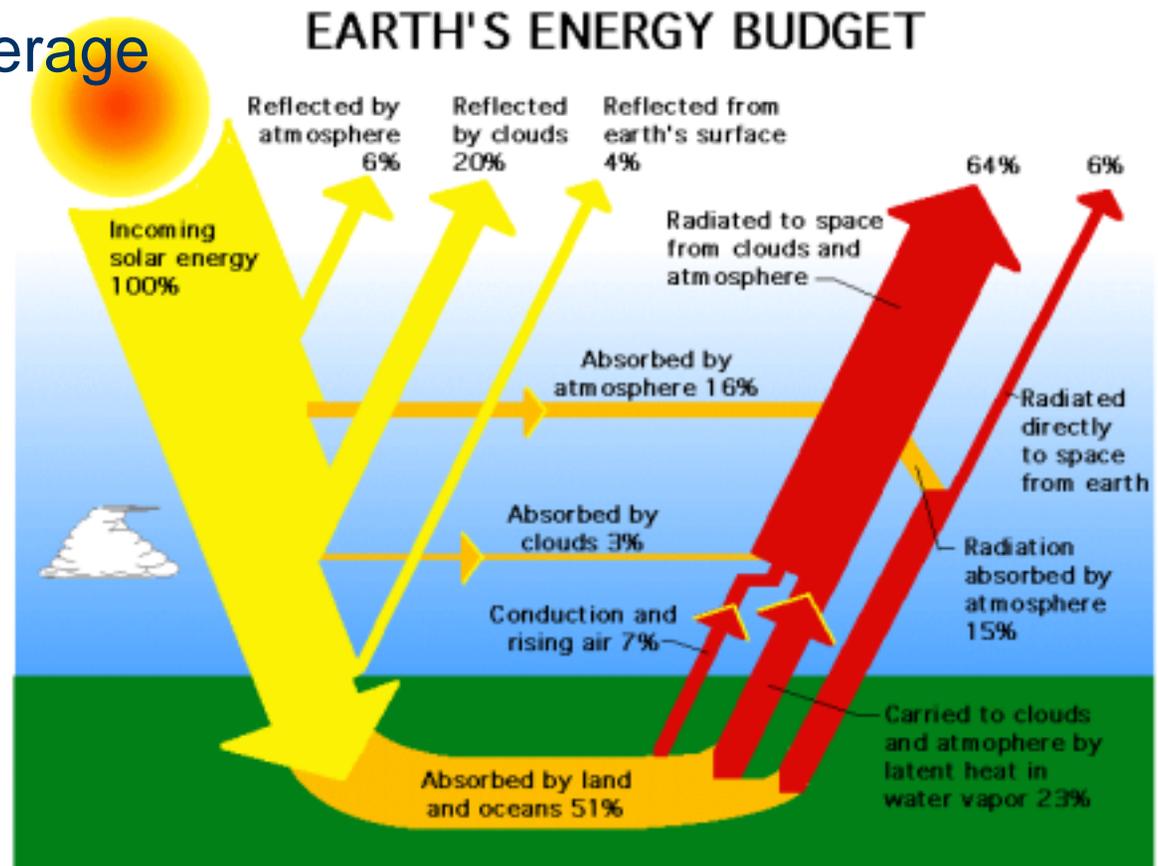
# What is albedo?

- $\alpha = \text{reflected} / \text{incident radiation}$
- varies from 0.0 to 1.0



# Albedo of the earth

- ~ 0.30 on average



# Terrestrial albedos

snow	0.80	
desert	0.30	
grassland	0.20	0.75
urban	0.15	
deciduous	0.15	0.25
coniferous	0.10	0.15

with  
snow



# Why do we care?

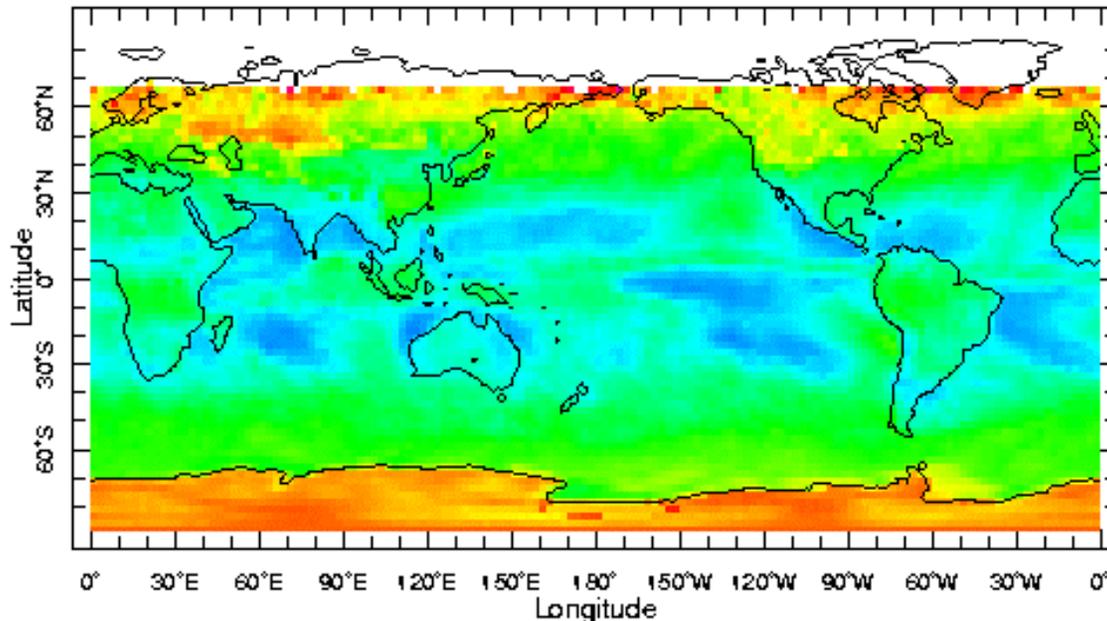
- land use change causes albedo change
- albedo decrease  warming

## reforestation:

- C-sequestration  cooling
- albedo change  warming

# Studying albedo change globally

- *Bonan et al. 1992, Myrhe & Myhre 2003:* removing boreal forests → cooling
- *Betts 2000:* reforestation → warming



NASA  
ERBE

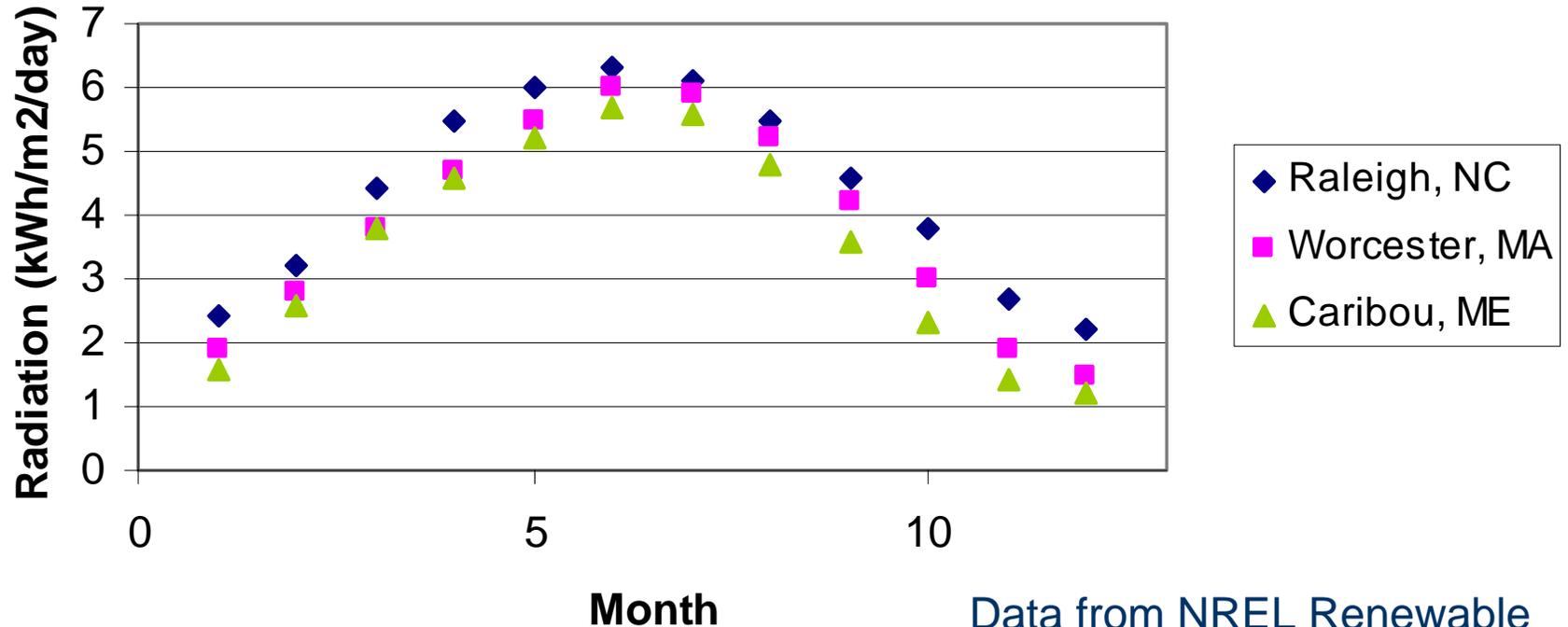
# Studying albedo change locally



- 1 hectare = 10,000 m<sup>2</sup>
- reforestation of grassland
  - deciduous or coniferous
- varying latitudes
  - snow cover
  - incoming solar radiation

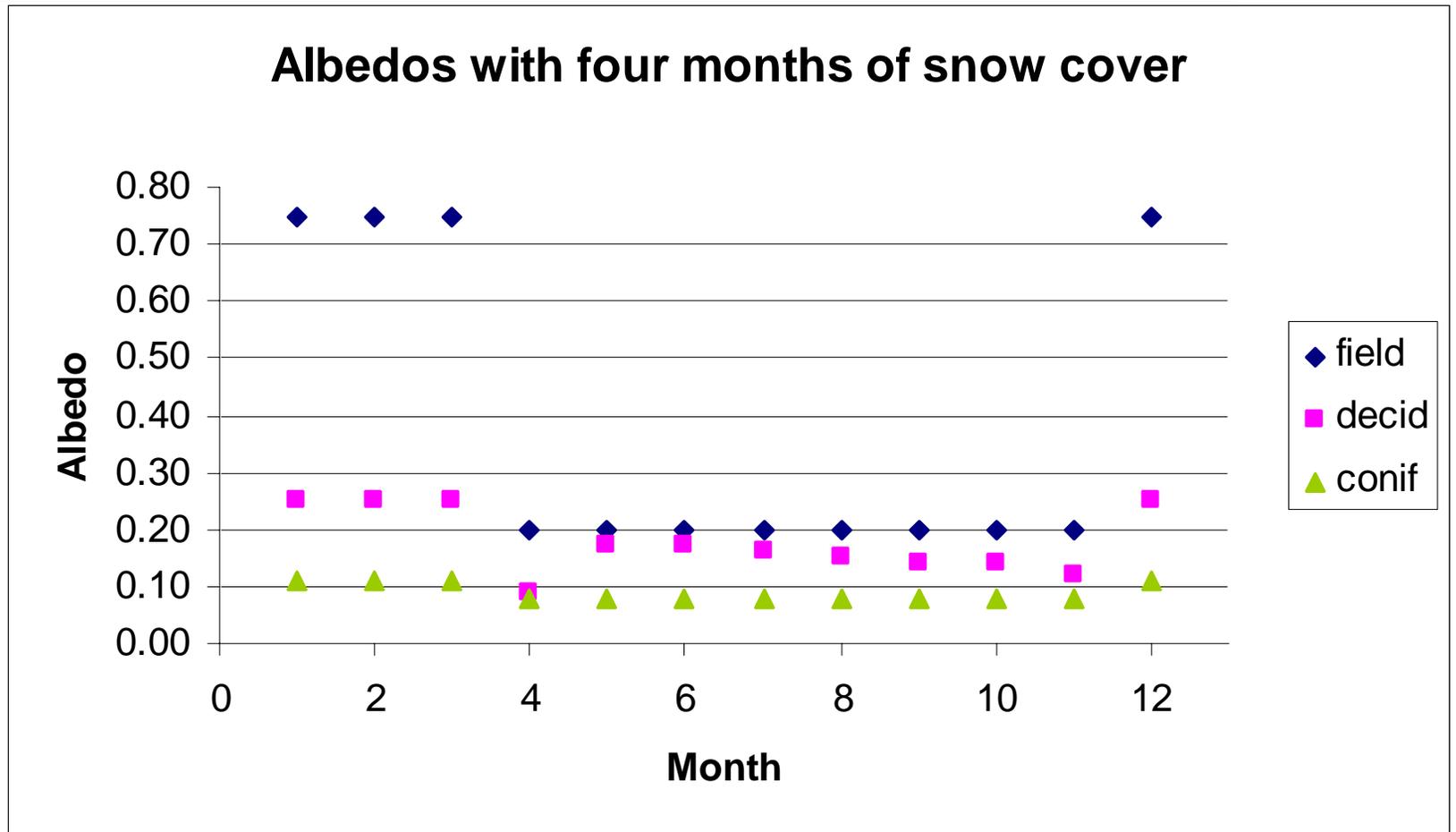
# Incoming solar radiation

Average monthly incoming solar radiation



Data from NREL Renewable Resource Data Center

# Example: Caribou, Maine



# Albedo change to carbon change

- Mean annual radiative forcing **F**
- CO2 equivalence:

$$F = 5.35 \ln (1 + \Delta C / C)$$

- Terrestrial carbon equivalence **T**:

$$T = 2 (M_c / M_a) m \Delta C$$

from Betts 2000

# Preliminary results

- field to deciduous forest:
  - no snow: 12.33 W/m<sup>2</sup> ~ 72 MgC
  - low snow: 13.13 W/m<sup>2</sup> ~ 76 MgC
  - high snow: 22.08 W/m<sup>2</sup> ~ 128 MgC
- field to coniferous forest:
  - no snow: 21.94 W/m<sup>2</sup> ~ 128 MgC
  - low snow: 22.75 W/m<sup>2</sup> ~ 132 MgC
  - high snow: 34.25 W/m<sup>2</sup> ~ 199 MgC

# Further albedo investigations

- better albedo representation
  - vegetation type, growth rates
  - snow cover, climate-vegetation feedbacks
- GORCAM model
  - carbon fluxes of forest, atmosphere, energy consumption, forest products, etc.
- comparing albedo and CO<sub>2</sub>

# Acknowledgements

- DOE GCEP
- Gregg Marland, ORNL