# Use of MODIS BRDF/Albedo, Vegetation Fraction, Type, and Snow in Global and Regional Models

Zhuo Wang, Michael Barlage, Jesse Miller, and Xubin Zeng (PI)

Dept. of Atmospheric Sciences, The Univ. of Arizona, Tucson, AZ 85721, zhuowang(barlage or xubin)@atmo.arizona.edu

## 1. Introduction

Overall goal of our MODIS project: Integration of remote sensing data with global climate models.
Data: MODIS, CERES, GOES, AVHRR, In-situ
Models: NCAR, NCEP, GMAO
Progress: Represented by 7 peer-reviewed papers:

Wang, Z., X. Zeng, M. Barlage, R. E. Dickinson, F. Gao, and C. B. Schaaf, 2004: Using MODIS BRDF/albedo data to evaluate global model land surface albedo. J. Hydrometeor., 5, 3-13.

Wang, Z., M. Barlage, X. Zeng, R. E. Dickinson, and C. B. Schaaf, 2005: The Solar Zenith Angle Dependence of Desert Albedo. Geophys. Res. Lett., 32, doi:10.1029/2004GL021835.

Wang, Z., X. Zeng, and M. Barlage, 2006: MODIS BRDF-based land surface albedo parameterization for weather and climate models. J. Geophys. Res. -Atmosphere, in press.

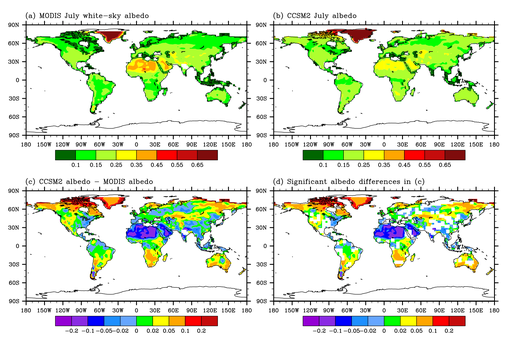
Barlage, M. X. Zeng, K. Mitchell, and H. Wei, 2005: A global 0.05-deg maximum albedo dataset of snow-covered land based on MODIS observations. Geopgys. Res. Lett., 32, doi:10.1029/2005GL022881.

Barlage, M., X. Zeng, H. Wei, and K. Mitchell, 2006: Sensivity of WRF-NMM to a new MODIS maximum albedo dataset. J. Hydrometeoro., in preparation.

Miller, J., B. Barlage, X. Zeng, H. Wei, K. Miechell, and D. Tarpley, 2006: Sensitivity of the NCEP NOAH land model to the MODIS green vegetation fraction dataset. Geophys. Res. Lett., 33, doi:10.1029/2006GL026636.

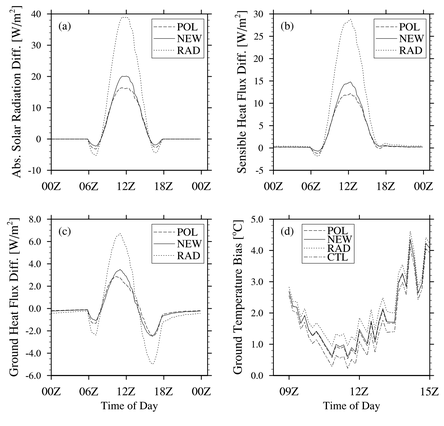
## 2. Albedo/BRDF data

- Evaluated the monthly averaged albedo from NCAR CCSM2 using the MODIS white-sky albedo.



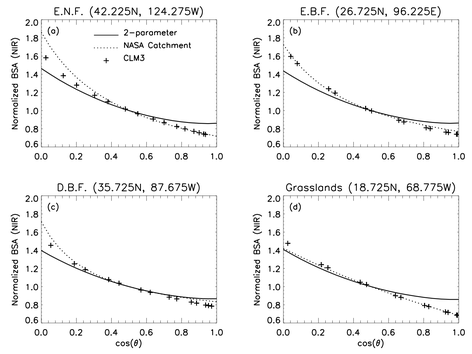

The MODIS white-sky albedo in July 2001 and CCSM2 monthly albedo (10-year averaged).

- Reformulated the MODIS BRDF algorithm to develop a new parameterization of land surface albedo for land modeling and remote sensing.



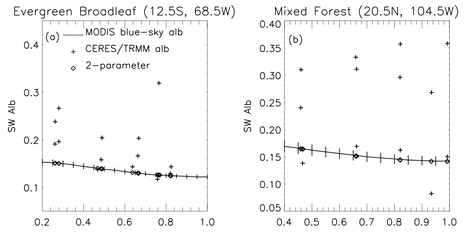

The sensitivity of the NOAH land model to the SZA dependence of the bare soil albedo at a Sahel site.

- Evaluated the impact of the new formulation on the NCEP NOAH land model.
- Evaluated the SZA dependence of MODIS desert albedo using the in situ data.
- Identified model deficiencies in surface albedo, and provide the first step towards developing a BRDF-based parameterization of radiative transfer through canopy in climate models.
- Compared this new scheme with those used in the land models at NCEP NOAH land model, NCAR CLM3, and NASA Catchment Model.




Comparison of the SZA dependence of normalized black-sky albedo from our two-paramter scheme with those from CLM3 and NASA Catchment land model.

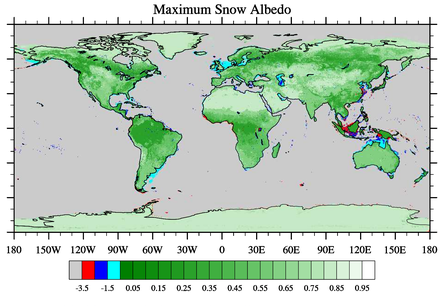
- Compared MODIS albedo data (including its SZA dependence) with other remote sensing data (CERES and GOES). Suggestions are then made regarding how to better treat the SZA dependence of land albedo in modeling and remote sensing retrieval.




Comparison of the albedo from two-parameter scheme with MODIS blue-sky albedo and CERES/TRMM albedos.

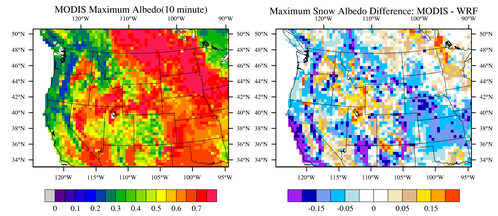
## 3. Maximum Snow Albedo

- Using global MODIS BRDF/albedo, land cover, and NBAR data, we created a new maximum snow albedo database at 0.05° resolution which is higher than the resolution of the current dataset used in the NCEP NOAH model (1°). Maximum snow albedo dataset reflects global vegetation characteristics.

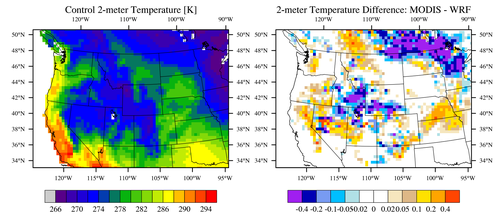



The final 0.05° albedo product. This high resolution product allows us to scale to any current operational model resolution.

- The Weather Research and Forecasting(WRF) model is used to test the sensitivity of near-surface energy components to the new maximum snow albedo dataset. The albedo dataset is coverted to a resolution of 0.144° using simple averaging. The model is initialized with ETA model output and run for 24 hours beginning 00Z 10 Feb 2005 at 40km resolution. Results below indicate differences up to 0.5°C in 2-meter temperature and also more than 5 W/m$^2$ changes in sensible heat flux (not shown) over snow-covered regions.



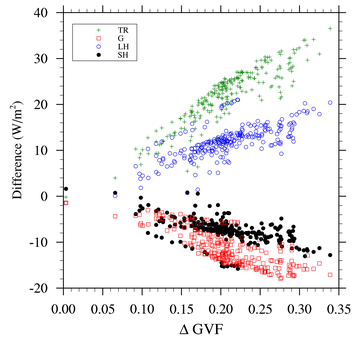

New snow albedo dataset interpolated to WRF 40km grid and difference from 1° default snow albedo dataset.




2-meter air temperature[°C] in the control simulation and the resulting differences due to the addition of the new snow albedo dataset at 21Z 10 Feb 2005.

## 4. Green Vegetation Fraction

- Generated the global green vegetation fraction (GVF) data using MODIS NDVI data.
- Compared with AVHRR-based data over the continental United States.
- Examined the impact of new MODIS GVF data on surface processes over North America using the NCEP NOAH land model. The largest differences between the GVF dataset currently used by the NOAH model and the new MODIS GVF dataset occur in winter and for thee-dominated vegetation classes.
- The greatest impact of the new GVF data on the surface energy and water balance is seen during the summer when the transpiration is increased by more than 10 W/m$^2$ on average for most vegetation types and the July averaged daily transpiration rate is increased by up to 50 W/m$^2$ for evergreen needleleaf sites.




Annual GVF Cycle for both old and new data sets over pixels of specified vegetation type within a 2° box.