

Influences of MODIS land use data on high resolution numerical weather simulations in Mississippi Gulf Coast domain

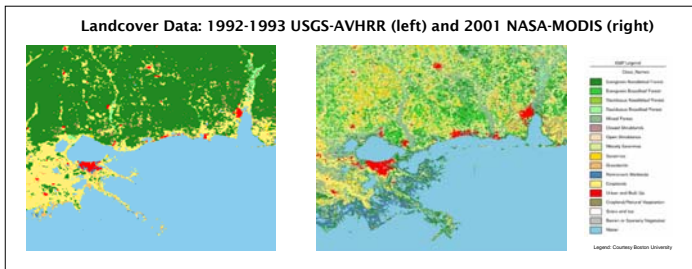
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1. Introduction

The bio-physical properties of the earth's terrain, ocean, and land cover at the surface boundary layer influence the weather forecasts in numerical weather prediction (NWP) models [1]. High resolution numerical weather prediction models are sensitive to changes in the prescribed land use data [2]. The Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) uses the LULC information as a surrogate to specify climatological estimates of *albedo*, *surface roughness*, and *ground wetness*. A methodology has been developed to substitute the default COAMPS land use data, derived from AVHRR in 1992-1993 [3], with the 2001 MODIS land cover data [4]. A set of 36 hour forecast simulations, starting from 8 June 2004 1200 UTC, have been performed to assess the performance of the model for the two land use scenarios. The changes in the prescribed land use affect the characteristics of some of the atmospheric processes and phenomenon.

2. Landcover Data

The USGS-AVHRR LULC data are made available in several different classification schemes including the *Olson Global Ecosystems Framework (OGEF)*, used by COAMPS, and the *International Geosphere-Biosphere Programme (IGBP)*. The 2001 MODIS landcover data are available as IGBP classes but not as OGEF classes.



The landcover data for the 3-km nested domain of COAMPS are shown above. The MODIS data shows greater variability over the domain and better coverage in the coastal areas of Louisiana, and the classification of urban areas are more realistic.

3. Methodology

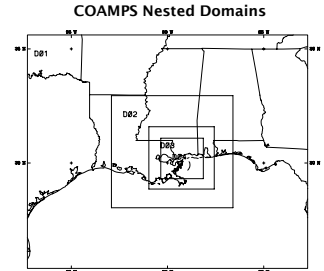
The OGEF scheme used 94 classes whereas the IGBP scheme only 17 landcover classes. In COAMPS, the 94 OGEF classes are assigned monthly climatological values for albedo, surface roughness, and ground wetness fraction. A methodology was adopted in order to derive a new set of climatological coefficients, for the three surface variables, corresponding to the 17 IGBP classes. The steps involved include:

- Compute the two-dimensional distribution of OGEF vs. IGBP classes
- Derive the new coefficients for IGBP classes using a linear combination of the percentage of OGEF classes that correspond to a given IGBP class.

IGBP	OGEF	
Evergreen Needleleaf Forest (58.2%)	Conifer Forest	99.3%
Croplands (27.9%)	Broadleaf Crops	74.1%
	Corn and Beans Cropland	15.6%
	Cool Crops and Towns	9.5%
Croplands / Natural Vegetation Mosaic (8.0%)	Forest and Field	41.4%
	Crops, Grass, and Shrubs	38.6%
	Cool Forest and Field	11.7%
Deciduous Broadleaf Forest (2.9%)	Mixed Forest	63.2%
	Cool Mixed Forest	32.9%

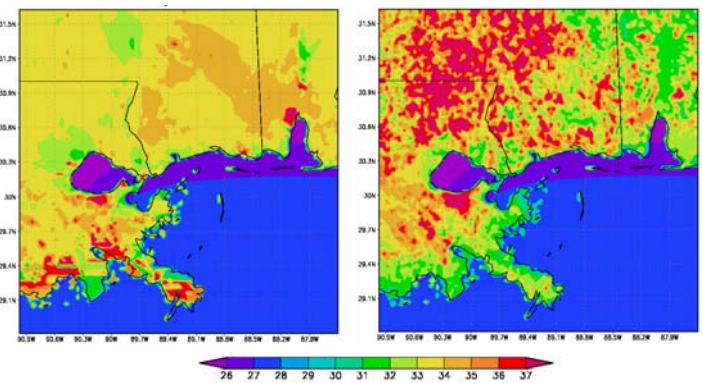
4. Experiments and Results

The COAMPS model was configured in 4 nested domains of 27, 9, 3, and 1 km spatial resolutions, with grid dimensions of 61x51, 79x73, 127x121, and 247x235 respectively. The model was first run in cold start mode for the first 12 hours starting at 8 June 2004, 00 UTC. It was then initialized with data assimilation at 1200 UTC and run for 36 forecast hours.



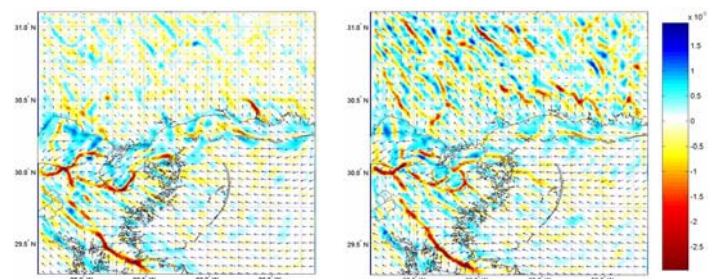
The model was run on a SGI Origin 2000 using 24 processors. The 1 km nested run requires approximately 3.5 hours of wall clock time for every forecast hour whereas at 3 km resolution the model requires only 30 minutes of wall clock time for every forecast hour.

Forecast Surface Temperatures Valid at 1800 UTC July 9 2004
Default COAMPS (left) and MODIS (right)



The surface temperature fields showed greater spatial variability when MODIS landcover was prescribed. In the example above, MODIS temperatures were higher in the northwestern part of the domain and lower in the NW and SW. The near surface wind patterns are similar (below), but from the MODIS case are a little stronger near the MS coast.

Divergence and Winds at 10m
Default COAMPS (left) and MODIS (right)



5. References

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2. Pielke, R., A. (Sr), 2001: Influence of the Spatial Distribution of Vegetation and Soils on the Prediction of Cumulus Convective Rainfall. *Rev. of Geophys.*, 39, 151-177.
3. Loveland, T. R., B. C. Reed, J. F. Brown, D. O. Ohlen, Z. Zhu, Y. Yang, and J. W. Merchant, 2000: Development of a global land cover characteristics database and IGBP DISCover from 1km AVHRR data. *Int. J. of Rem. Sens.*, 21, 1303-1330.
4. Boston University, 2003: *MODIS MOD12 Landcover and Land Dynamics Products User Guide*.
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