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

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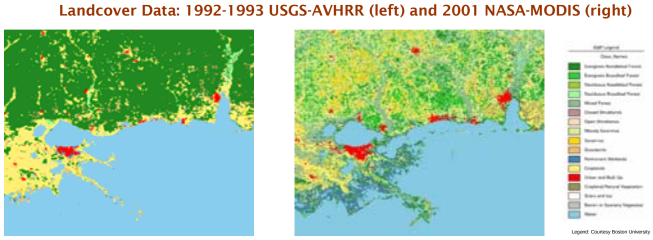
1. Introduction

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, staring 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.

Landcover Data: 1992-1993 USGS-AVHRR (left) and 2001 NASA-MODIS (right)



The landcover data for the 3-km nested domain of COAMPS are shown above. The MODIS data show 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

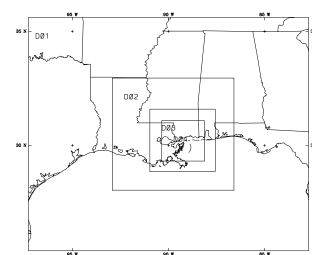
The OGEF scheme uses 94 classes whereas the IGBP scheme only 17 landcover classes. In COAMPS, the 94 OGEF classes are assigned monthly climatological values for albedo, surface roughness, and ground wetness fraction. A methodology was adopted in order to derive a new set of climatological coefficients, 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 Corn and Beans Cropland Cool Crops and Towns	74.1% 15.6% 9.5%
Croplands / Natural Vegetation Mosaic (8.0%)	Forest and Field Crops, Grass, and Shrubs Cool Forest and Field	41.4% 38.6% 11.7%
Deciduous Broadleaf Forest (2.9%)	Mixed Forest Cool Mixed Forest	63.2% 32.9%

4. Experiments and Results

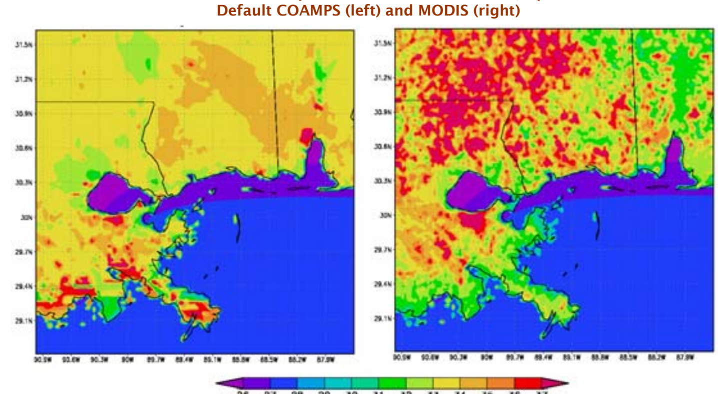
COAMPS Nested Domains



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.

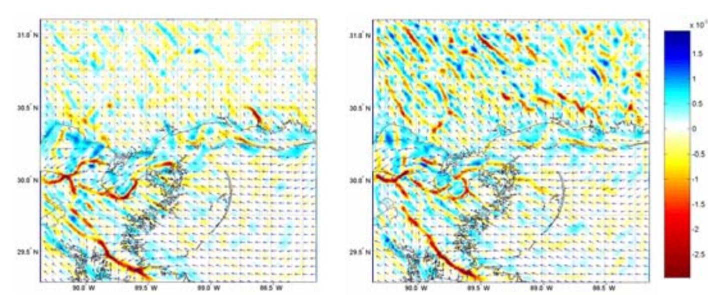
The model was run on a SGI Origin 2000 using 24 processors. The 1 km nested run requires approximately 3.5 hours of wall clock time for every forecast hour whereas at 3 km resolution the model requires only 30 minutes of wall clock time for every forecast hour.

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 in 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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