WRF comparisons: *12 km* grid spacing versus *4 km* grid spacing

Model Setup:

Two WRF simulations were performed, one with 12 km grid spacing, and one with 4 km grid spacing. Each simulation used real-time NAM data (NAM has 12 km grid spacing).

- Date initialized: 00Z 29 May 2012
- Run time: 48 h
- PBL physics: MYJ
- Microphysics: 6-class WSM scheme
- Land Surface Physics: Noah Land Surface Model
- Cumulus physics: **12 km grid**: Kain-Fritsch **4 km grid**: no parameterization
- Short and long wave radiation: Rapid Radiative Transfer Model (RRTMG)

(These options were chosen following the Tallahassee NWS WRF model, which has consistently produced reliable results in the Gulf of Mexico region)

Logistics:

Processors Used for WRF: 128

12 km run time: 1h 14min

4 km run time: 4h 36min

Results:

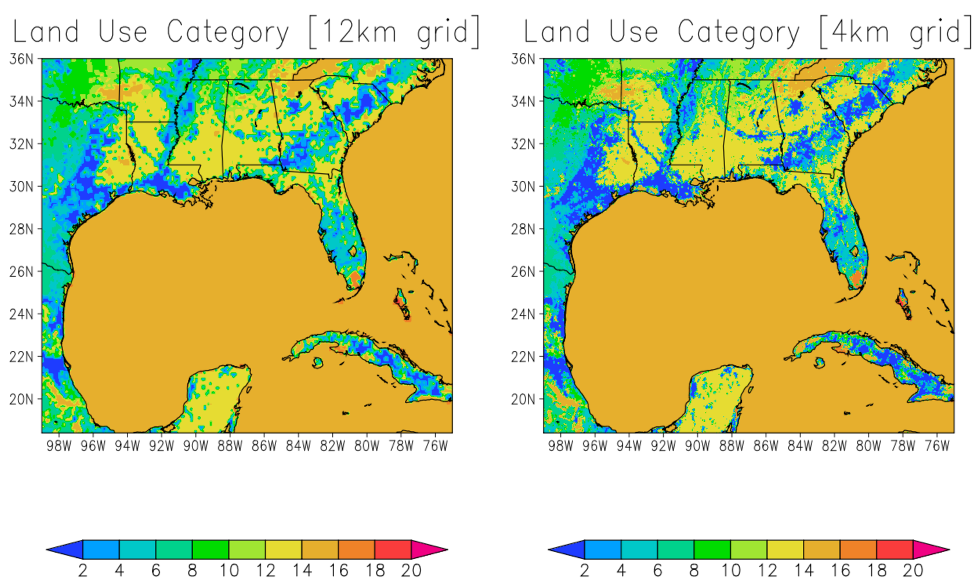

Figure 1 USGS land use categories that were used in the WRF simulations for 12 km grid spacing (left) and 4 km grid spacing (right). For reference, land use values and their corresponding categories are shown in Table 1.

Table 1 USGS land use categories.

Category Number	Classification
1	Urban and Built-Up Land
2	Dryland, cropland, and pasture
3	Irrigated cropland and pasture
4	Mixed 2 & 3
5	Cropland/Grassland Mosaic
6	Cropland/Woodland Mosaic
7	Grassland
8	Shrubland
9	Mixed shrubland/grassland
10	Savanna
11	Deciduous Broadleaf Forest
12	Deciduous Needleleaf Forest
13	Evergreen Broadleaf Forest
14	Evergreen Needleleaf Forest
15	Mixed Forest
16	Water Bodies
17	Herbaceous Wetland
18	Wooded Wetland
19	Barren or sparsely vegetated
20	Herbaceous tundra
21	Wooded tundra
22	Mixed tundra
23	Bare ground tundra
24	Snow or ice

The USGS (data collected in 1993) land use categories are given in Table 1 for completeness, but the main point of Figure 1 is to compare land use for the 12 km grid versus the 4 km grid. However, since these simulations were performed, I have looked into the land use categories further (at Takis's request). A newer (data collected in 2001) land use map has been established based off of MODIS data, and is available on a 1 km grid. I believe this would be a better choice for land use, but do not think it would substantially affect the results shown below.

Below, correlations of different surface variables are shown. These variables are likely to make the most impact on COAWST simulations. For the graphs, each point represents the correlation over the entire WRF domain at a specific time.

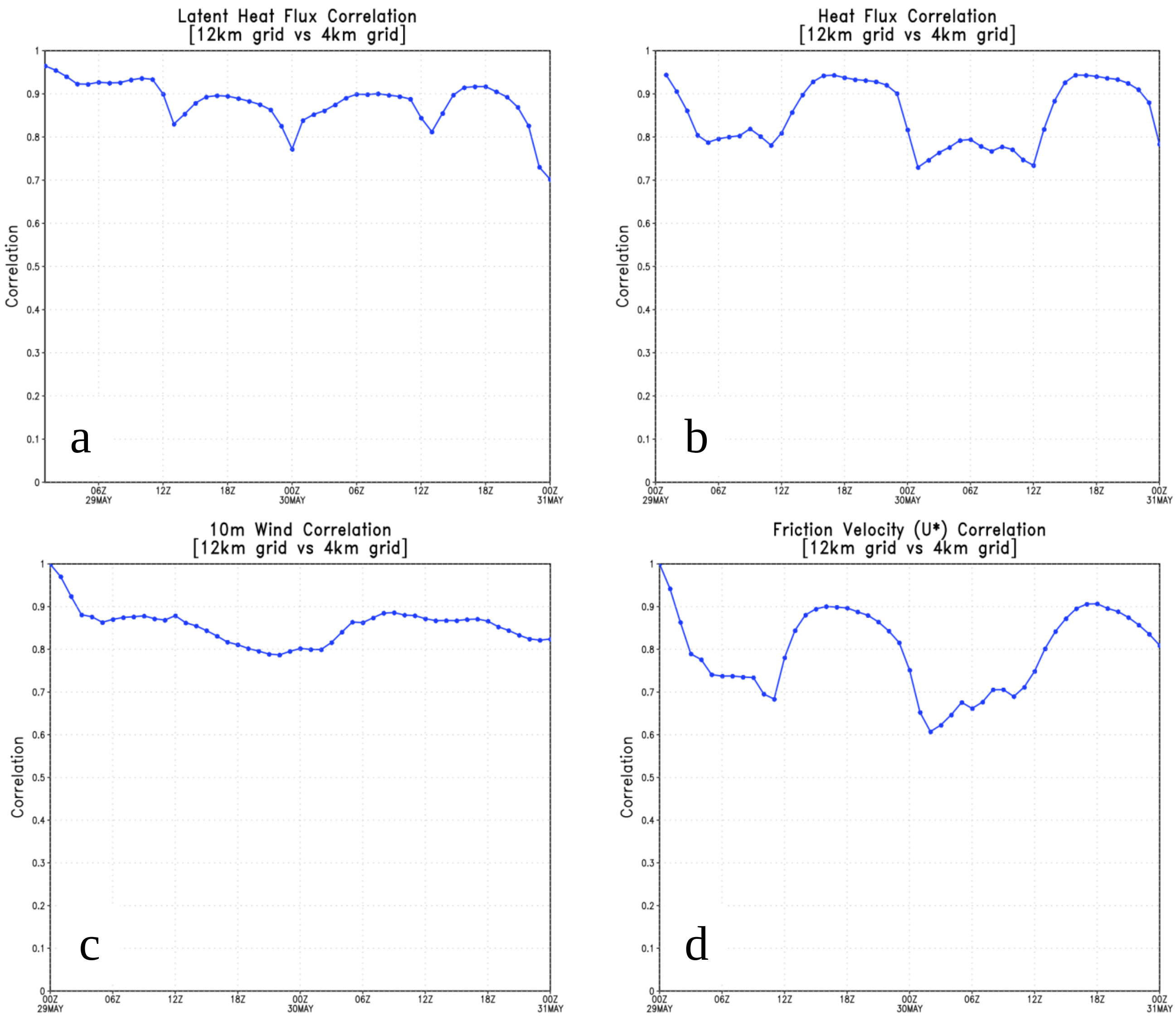

Figure 2. Correlations over the entire WRF domain of (a) latent heat flux, (b) upward heat flux, (c) 10 meter wind magnitude, and (d) friction velocity.

Animations of comparisons of latent heat flux for each grid, and 10 m wind magnitude for each grid, can be found at:

http://fuelberg.met.fsu.edu/pub/nheath/COAPS/Comparisons/Animations/

Conclusion:

Because of the high correlations (>0.6) among most of the important surface variables, and the decreased run time for the 12 km grid (~3 h less than the 4 km grid run time), I believe that using the 12 km grid will be more efficient, without losing quality, for the real-time COAWST system.

When performing case studies, however, a higher resolution (4 km or better) is desirable because final analyses or reanalysis data would be used as initial and boundary conditions, which are more accurate than real-time forecasts, and because run time would not be as big of an issue.

Caveats:

- This is only one comparison!
    - Multiple comparisons for different seasons and conditions would need to be done to feel confident in the results.
- Minor differences in fluxes between the two grids might lead to more notable changes in a coupled ocean-atmosphere simulation.
- The WRF parameters that the Tallahassee NWS use were chosen because their WRF model typically does well in the Gulf of Mexico region (anecdotally speaking), but for specific cases (e.g., a tropical cyclone), these settings might need to be changed.