# Statistical evaluation of NOAA's Real-Time Mesoscale Analysis (RTMA) using Florida and Georgia automated weather stations


Ana Wagner[1*], Clyde W. Fraisse[1], Kati Migliaccio[2] and Eduardo Gelcer[1]

[(1)]Agricultural and Biological Engineering, University of Florida, Gainesville, FL

[(2)]University of Florida, Gainesville, FL

[*]apwagner@ufl.edu


## Introduction

The Real-Time Mesoscale Analysis (RTMA) was implemented by the NOAA National Centers for Environmental Prediction (NCEP) as a component of the Reanalysis of Record (Horel and Colman, 2005) program to help satisfy the demand for high-resolution meteorological analysis at the National Weather Service (NWS) and in the environmental community.

## Purpose

The study compares RTMA grid-based 2-m temperature, 2-m dew point temperature, 10-m wind speed, and rainfall data to observations at Florida and Georgia state weather station networks.

## Material and Methods

### Data

**a) RTMA**

The RTMA layer is an hourly, continuous U.S. grid dataset, with 5-km spatial resolution. The database is available in Grib2 format.

Rainfall is obtained by bilinearly interpolating the so-called early version of the NCEP stage II multisensor (Glahn and Ruth, 2003). This stage is made from radar hourly precipitation estimates and hourly rain gauge data received at NCEP. Temperature, dew point and wind speed were capitalized and enhanced from existing analysis capabilities at NWS resulting at near-surface conditions on grids that match those of the National Digital Forecast Database (NDFD) (De Pondeca et al., 2011).

**b) Observed data**

- Daily rainfall observations from 107 weather stations from the Florida Automated Weather Network (FAWN) and the Georgia Automated Environmental Monitoring Network (AEMN);
- 15 min data values from 34 weather stations provided by FAWN for: 2-m temperature, 2-m dew point, and 10-m wind speed;

### Methods

Evaluation grid cells were selected for comparison based on the proximity of their central point to the weather stations. The RTMA valid analysis time were being the top of the hour and the variables were aggregated:

- air temperature, dew point, and wind speed to hourly average;
- maximum, minimum, and average temperatures; average wind speed, and total rainfall to daily periods;

The database was analyzed using exploratory analysis, frequency of occurrence, correlation indices, and deviation statistics.

## Results

### 1. Study area and point selection

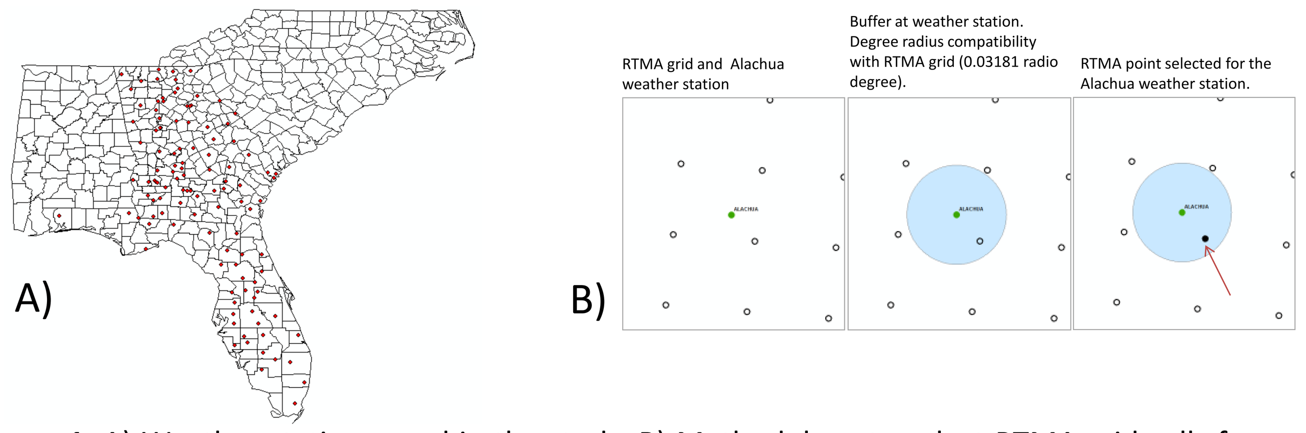


**Figure 1.** A) Weather stations used in the study. B) Methodology to select RTMA grid cells for comparison based on the proximity of their central point to the weather stations (example for Alachua, FL weather station).

### 2. Rainfall Pearson coefficient ($R^2$)

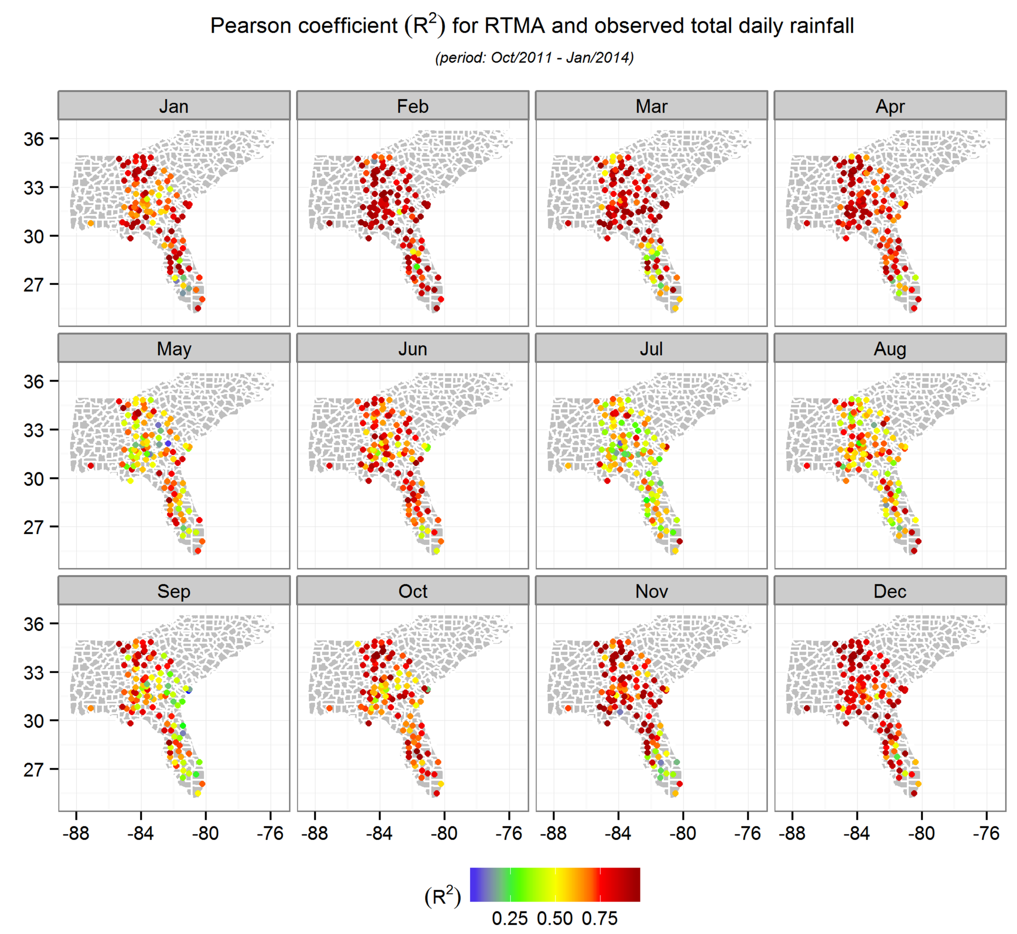


**Figure 2.** Monthly spatial distribution of Pearson coefficient in the study area for the weather stations.

### 3. Rainfall deviation statistics

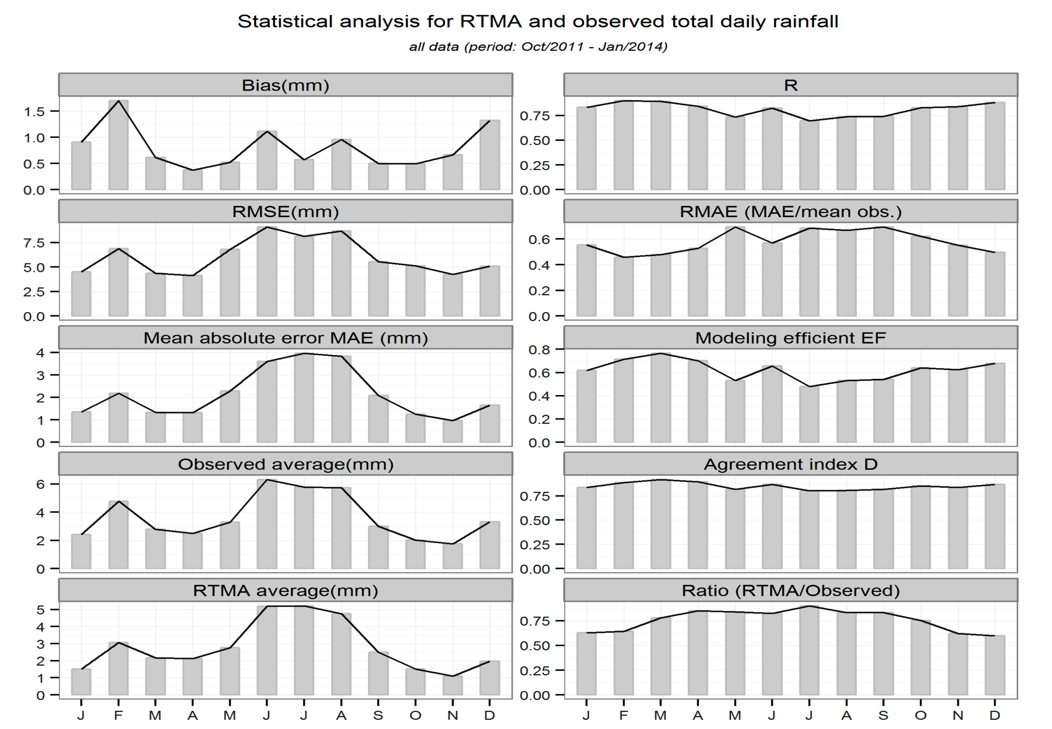


**Figure 3.** Monthly statistical evaluation of RTMA rainfall using all data from Florida and Georgia weather stations.

### 4. RTMA and observed hourly dew point temperature and air temperature

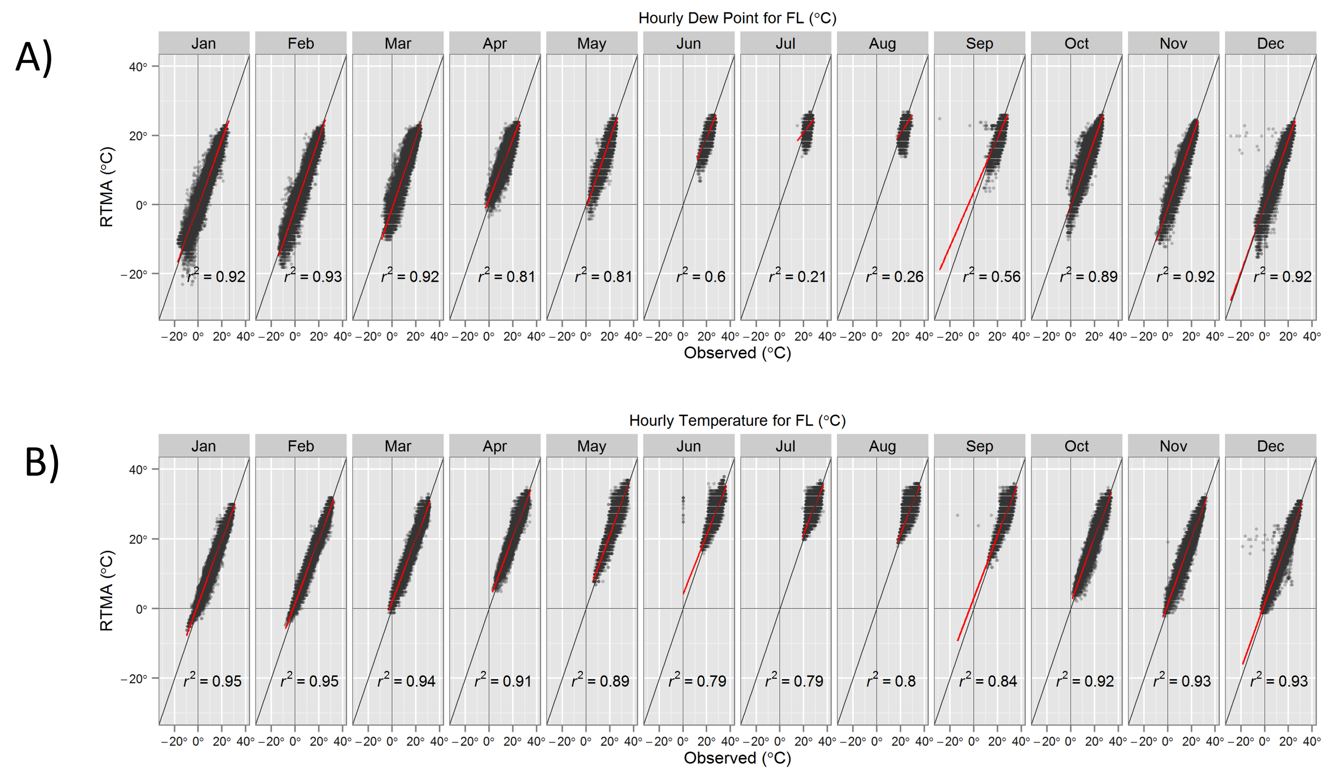


**Figure 4.** Monthly relationship between hourly RTMA and observed data for A) dew point temperature and B) 2-m air temperature.

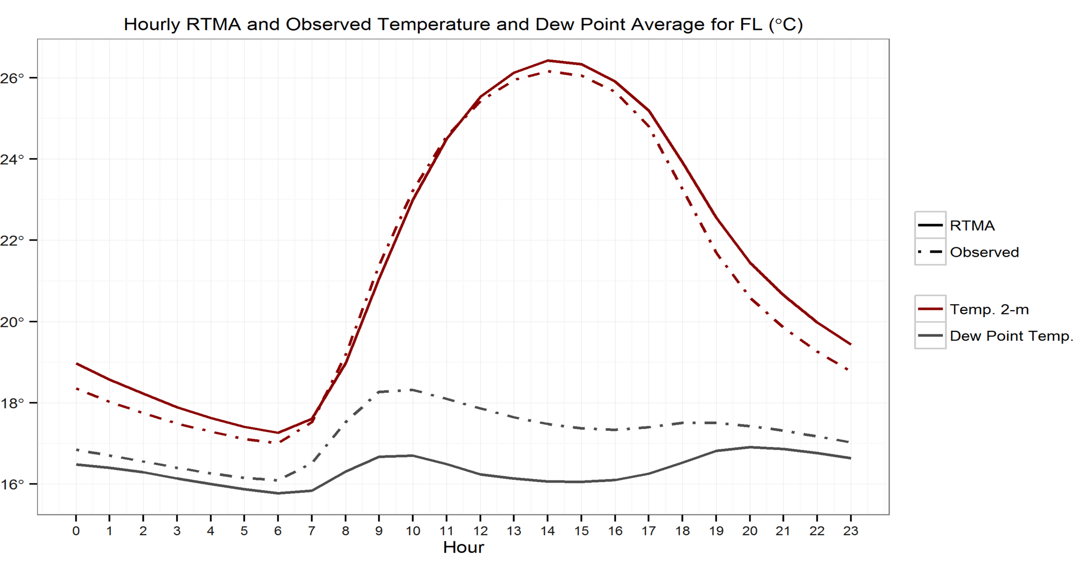


**Figure 5.** Average hourly profiles between RTMA and observed for 2-m air temperature and dew point temperature.

### 5. Maximum/minimum temperatures and wind speed general deviation statistics

**Table 1.** Statistical evaluation of RTMA for maximum, minimum temperatures and wind speed using all data from Florida and Georgia weather stations.

| | Tmax (°C) | Tmin (°C) | Wind speed (m/s) |
|---|---|---|---|
| **R** | 0.986 | 0.982 | 0.994 |
| **Bias** | 0.311 | -0.216 | -0.364 |
| **Ratio (RTMA/Observed)** | 0.987 | 1.015 | 1.052 |
| **RMSE** | 1.402 | 1.485 | 0.996 |
| **Mean absolute error MAE** | 1.109 | 1.048 | 0.750 |
| **RMAE (MAE/mean obs.)** | 0.047 | 0.074 | 0.106 |
| **Modeling efficient EF** | 0.970 | 0.963 | 0.987 |
| **Agreement index D** | 0.993 | 0.991 | 0.997 |
| **Observed average** | 23.626 | 14.211 | 7.055 |
| **RTMA average** | 23.315 | 14.427 | 7.418 |

## Conclusions

Although these results indicate an overall good agreement between observed and RTMA, the agreement varies depending on weather station location and season of the year. We observed better agreement in Georgia than in Florida and a decrease in data quality for rainfall during summer, for minimum temperature during winter, and for dew point temperature during daytime.

Even though there are potential limitations for using RTMA depending on the objective, overall, the level of agreement seems to be suitable for evapotranspiration calculation, irrigation scheduling, and for other agricultural applications.

## References and Acknowledgments


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Glahn, H. R., and D. P. Ruth, 2003: The new digital forecast database of the National Weather Service. Bull. Amer. Meteor. Soc., 84, 195–201.

Horel, J., and B. Colman, 2005: Real-time and retrospective mesoscale objective analyses. Bull. Amer. Meteor. Soc., 86, 1477–1480.



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