

WeaGETS:

**A daily stochastic weather generator for
preserving low-frequency of climate
variability**

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MPO 524 - Applied Data Analysis

Spring 2013 Term Project

Professor Brian Mapes

Outline

☁ What is a daily stochastic weather generator?

⚡ Motivations

💧 Application to modeling and climate change

☁ What is WeaGETS?

⚡ Weather Generator École de Technologie Supérieure
(WeaGETS)

☁ My own results

<http://www.mathworks.com/matlabcentral/fileexchange/29136-stochastic-weather-generator-weagets>

What is a daily stochastic weather generator?

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A daily stochastic weather generator for preserving low-frequency of climate variability

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1. Introduction

A stochastic weather generator is a computer algorithm that uses existing meteorological records to produce a long series of synthetic daily weather data. The statistical properties of the generated data are expected to be similar to those of the actual data for a specified site. Unlike historical weather records, which may have missing data, the weather generator output provides a complete record for any desired period of time, thus enhancing the use of continuous hydrologic models (Kevin et al., 2005). Moreover, it can be used to generate daily weather data for ungauged areas through spatial interpolation of model parameters from adjacent

gauged sites (Baffault et al., 1996). An important application of weather generators involves them serving as computationally inexpensive tools to produce multiple-year climate change scenarios at the daily time scale, which are used to assess the impact of future climate change (Semenov and Barrow, 1997; Wilks, 1992, 1999; Pruski and Nearing, 2002; Zhang et al., 2004; Zhang, 2005; Zhang and Liu, 2005; Minville et al., 2008). Model parameters of the weather generator can be readily manipulated to simulate arbitrary changes in mean and variance quantities for sensitivity analysis, or be deliberately modified to mimic changes in mean and variance as predicted by global climate models (GCMs) for impact assessment. Over the years, several weather generators have been developed, such as the Weather Generator (WGEN) (Richardson, 1981; Richardson and Wright, 1984), USCLIMATE (Hanson et al., 1994), Climate Generator (CLIGEN) (Nicks et al., 1995), Climate

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What is WeaGETS?

- ☁ Weather Generator École de Technologie Supérieure (WeaGETS) is a Matlab-based versatile stochastic daily weather generator (WeaGETS) for producing time series of unlimited length for daily precipitation at a specific weather station site, plus maximum and minimum temperatures.
- ☁ WeaGETS can be used in climate change studies as a downscaling tool by perturbing the parameters to account for expected changes in precipitation and temperature.

What is WeaGETS?

- ☁ First, second and third-order Markov models are provided to generate precipitation occurrence.
- ☁ Exponential and gamma distributions are available to produce daily precipitation quantity.
- ☁ Precipitation generating parameters have options to be smoothed using Fourier harmonics.
- ☁ A spectral correction approach is included to correct the well-known underestimation of monthly and inter-annual variability associated with weather generators.

What is WeaGETS?

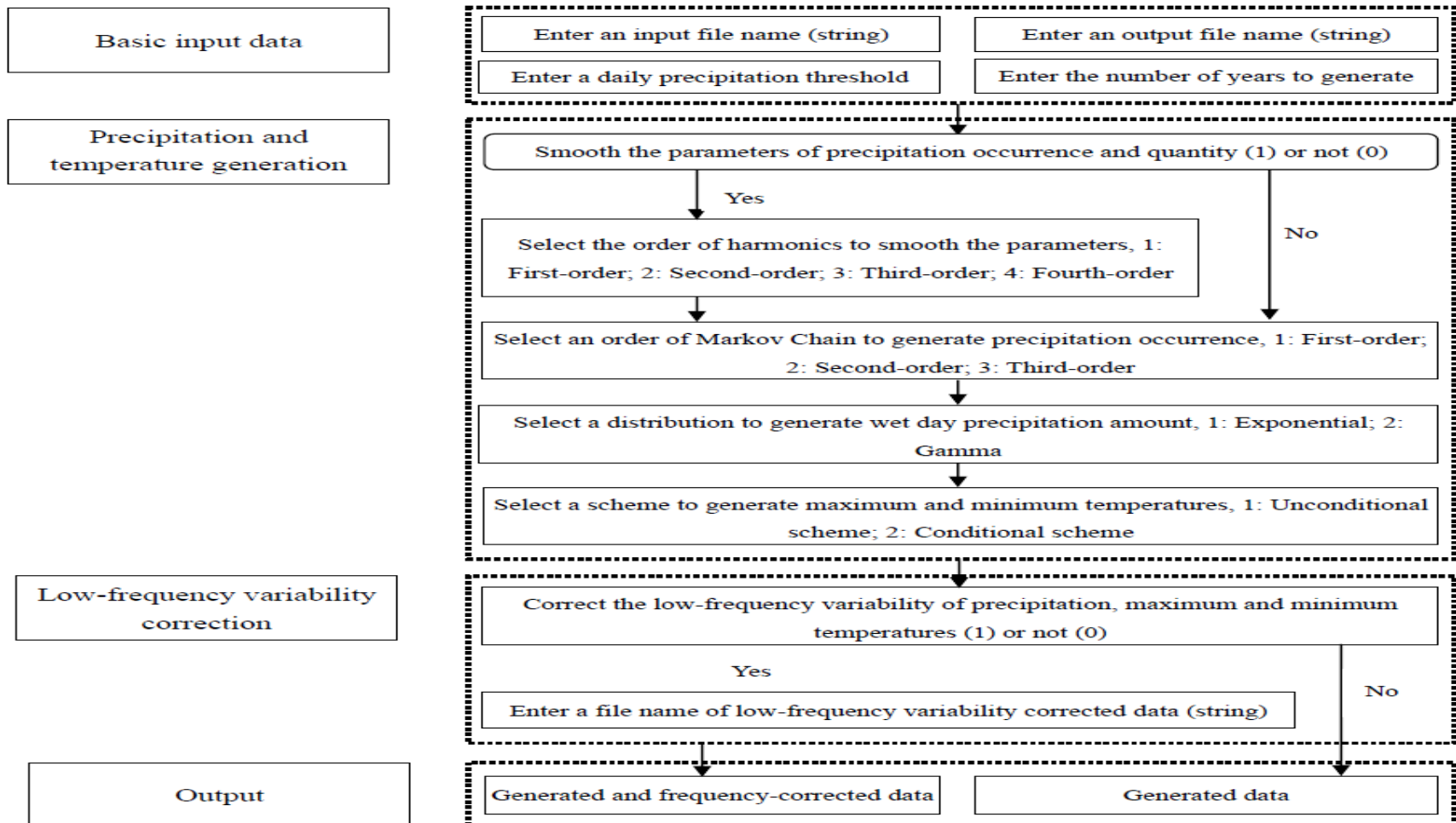


Fig. 1. Structure chart of the WeaGETS stochastic weather generator

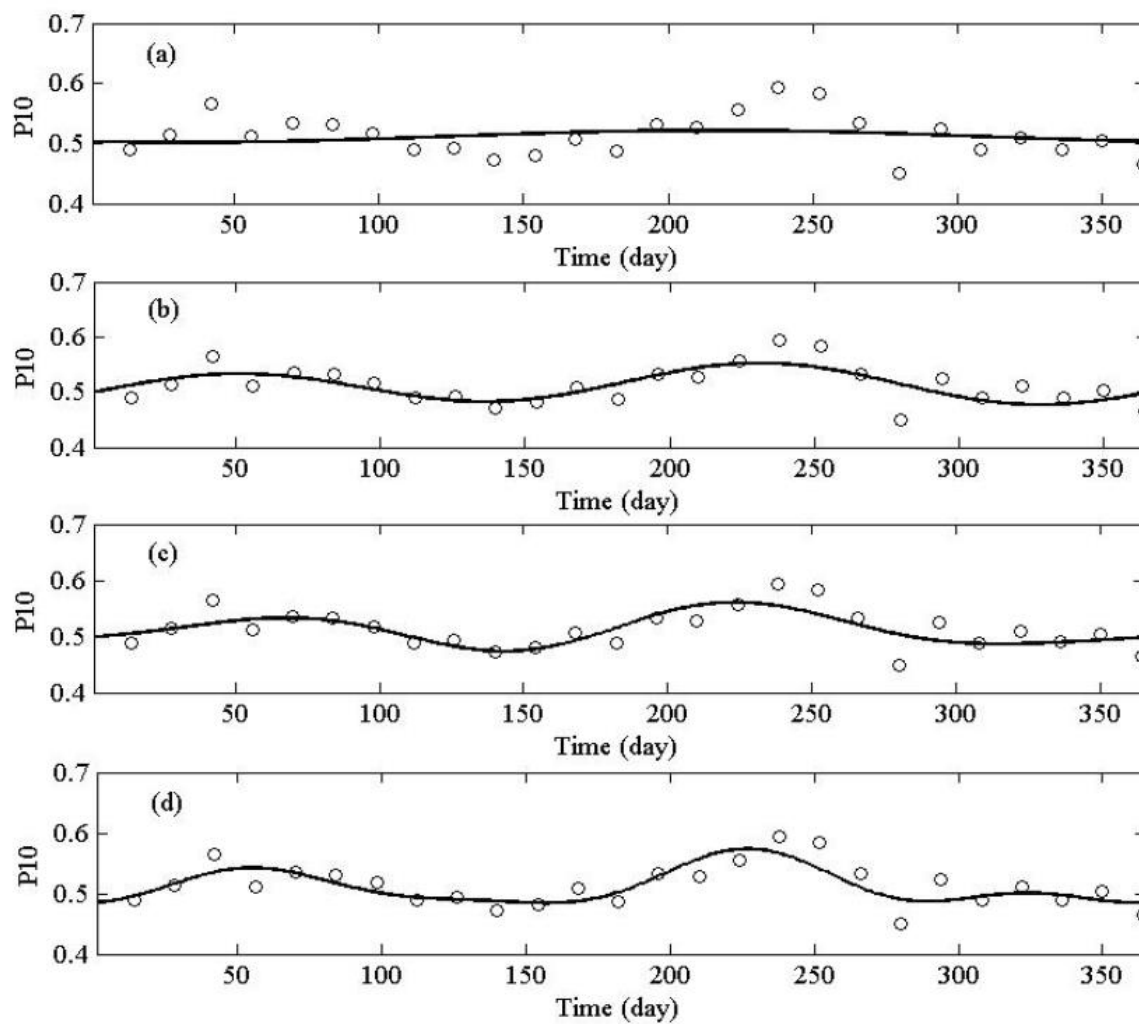
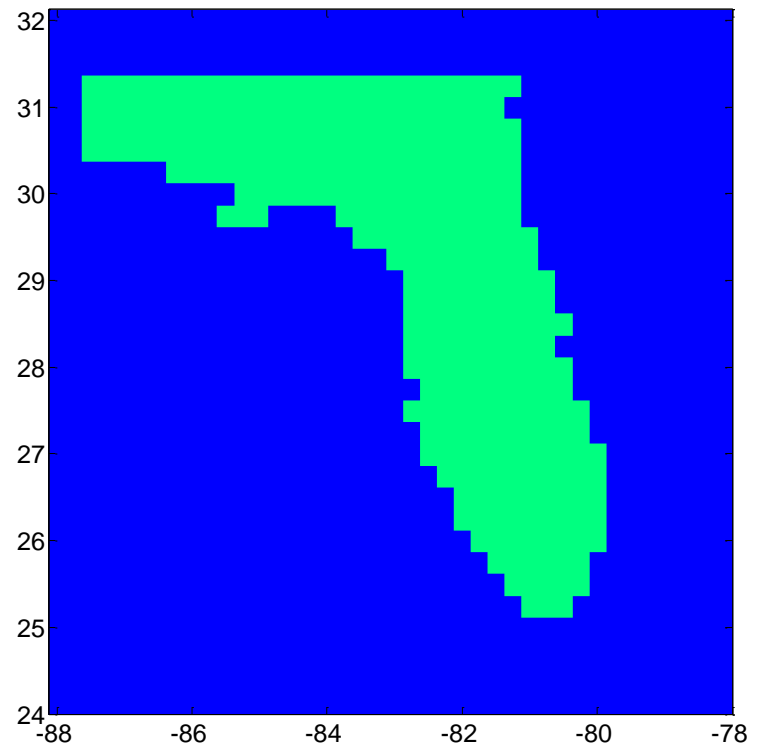


Fig. 2. A dry day following a wet day (P10) calculated at a two-week scale and smoothed by first-order (a), second-order (b), third-order (c) and fourth-order (d) Fourier harmonics.

My Data

☁️ National Oceanic and
Atmospheric
Administration (NOAA)
Climate Prediction
Center (CPC) $0.25^\circ \times$
 0.25° Daily U.S.
UNIFIED Precipitation
Version 1 (1951-2000)
rain-gauge-based
precipitation




```
>> RUN_weaGETS
```

```
*****START*****
```

```
*****basic input*****
```

```
Enter an input filename (string):'CPCprecip_1951_2000.mat'
```

```
Enter an output filename (string):'500FakeYearsOfPrecip.mat'
```

```
Enter a daily precipitation threshold:0.1
```

```
Enter the number of years to generate:500
```

```
*****precipitation and temperatures generation*****
```

```
Smooth the parameters of precipitation occurrence and quantity (1) or do not smooth (0):1
```

```
Select an order of harmonics to smooth the parameters,1: First order;2: Second order;3: Third order or 4: Fourth order:2
```

```
Select an order of Markov Chain to generate precipitation occurrence,1: First order; 2: Second order or 3: Third order:3
```

```
Select a distribution to generate wet day precipitation amount,1: Exponential or 2: Gamma:2
```

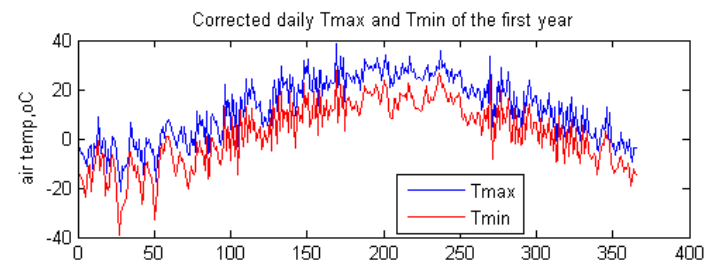
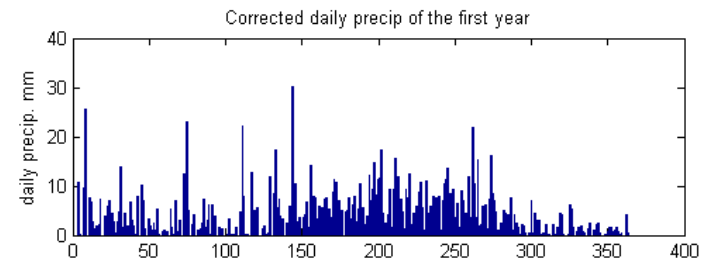
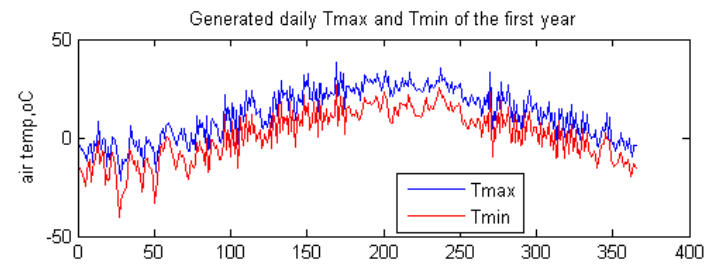
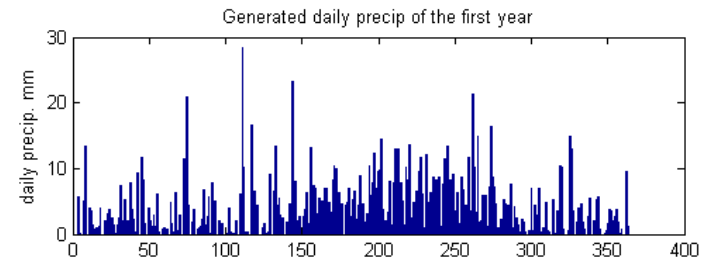
```
Select a scheme to generate maximum and minimum temperatures,1: Unconditional or 2: Conditional:2
```

```
*****low-frequency variability correction*****
```

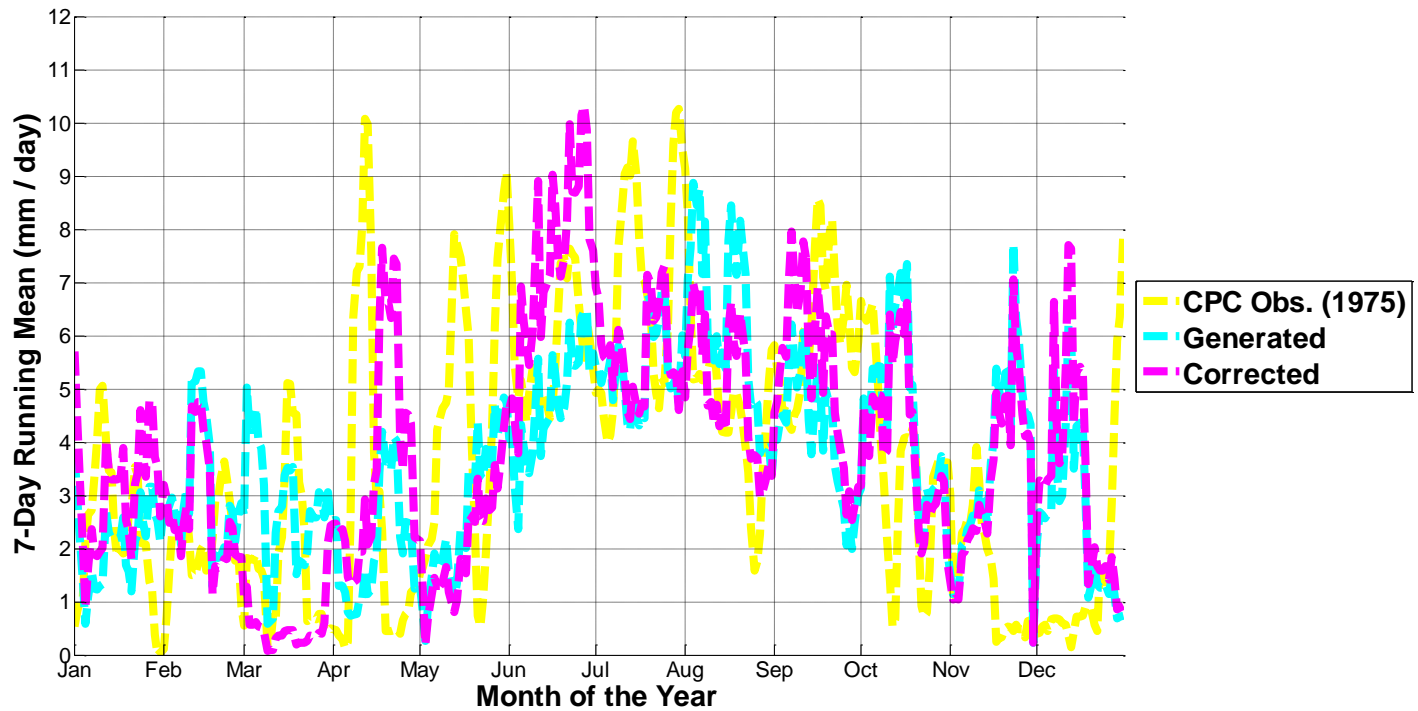
```
Correct the low-frequency variability of precipitation and maximum and minimum temperatures (1) or do not correct (0):1
```

```
Enter a filename of low-frequency variability corrected data (string):'500FakeYearsOfPrecipCorrected.mat'
```

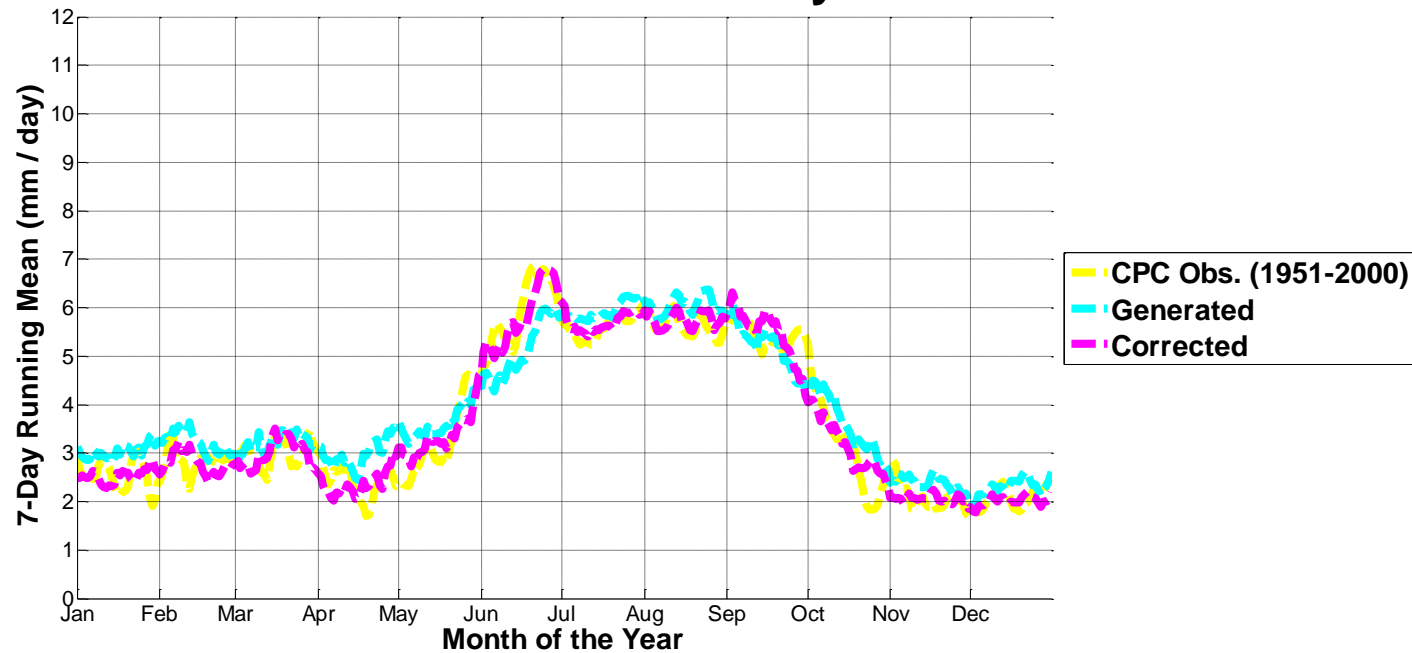
```
*****END*****
```



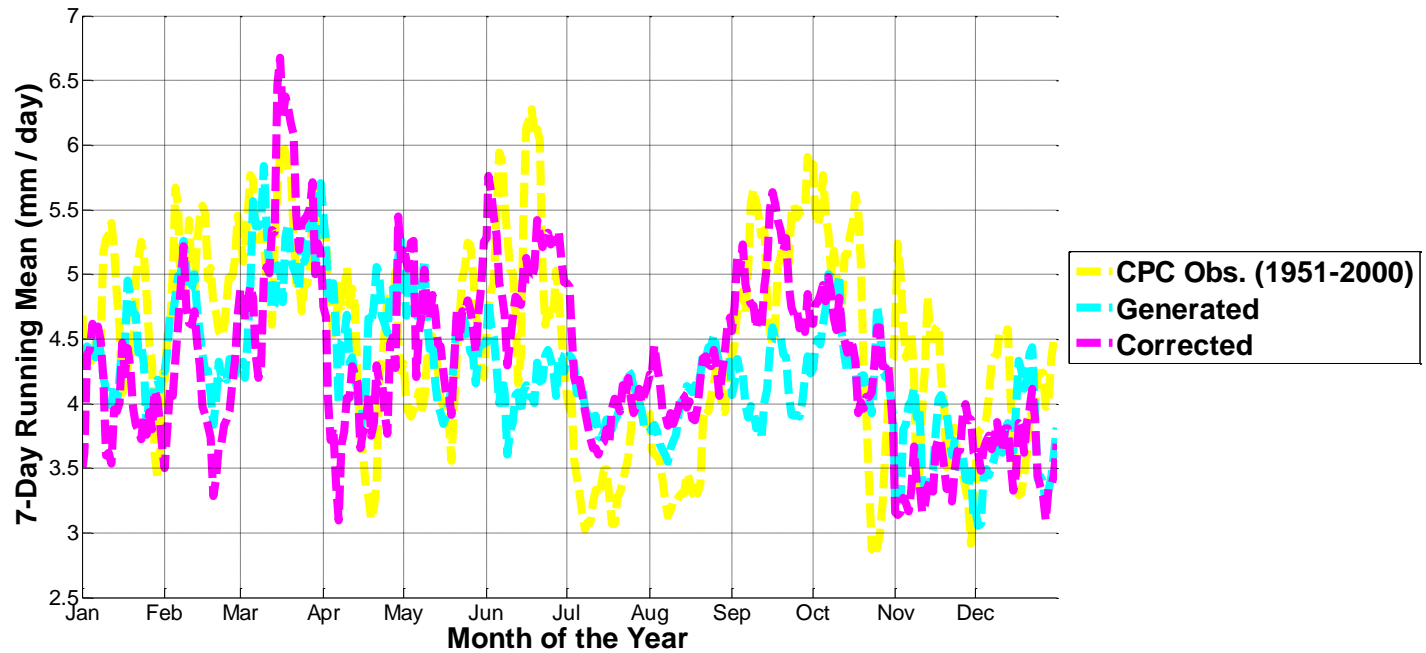
Florida Rainfall Whole State - 25th Year



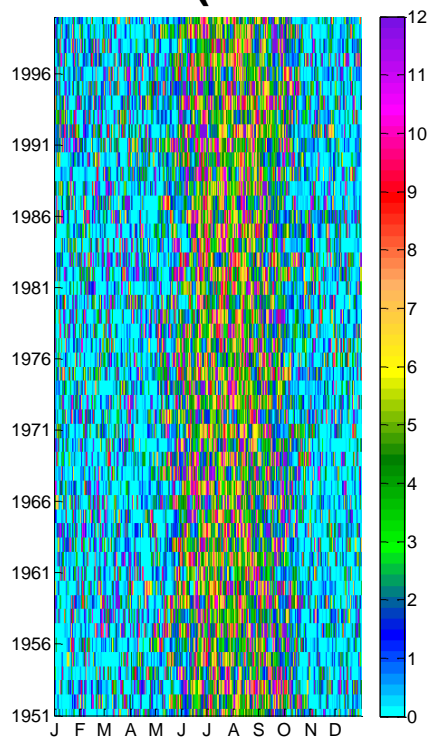
Florida Rainfall Whole State 50-Year Mean Seasonal Cycle



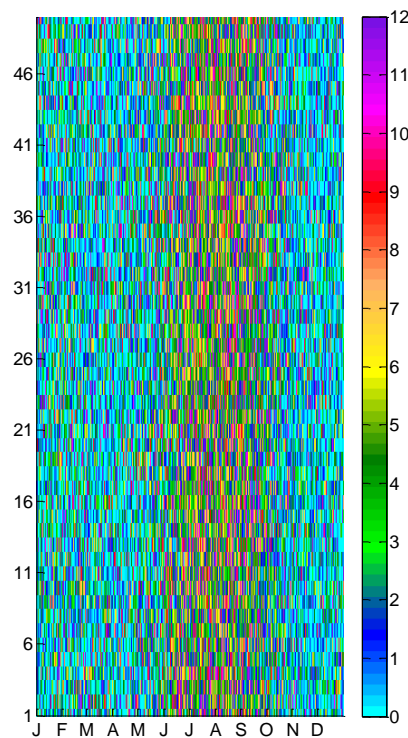
Florida Rainfall Whole State 50-Year Standard Deviation



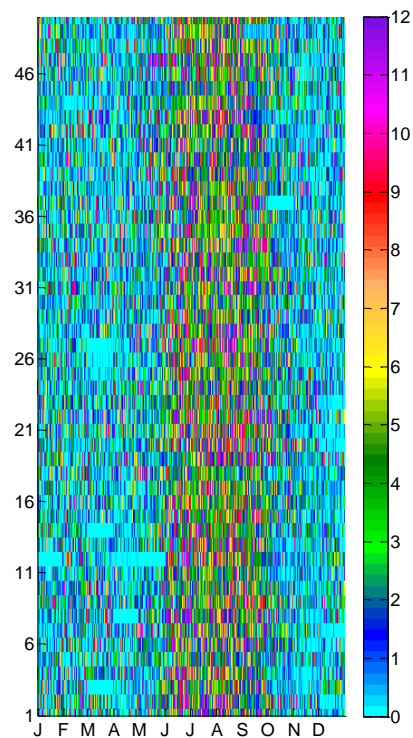
CPC Obs. (1951-2000)



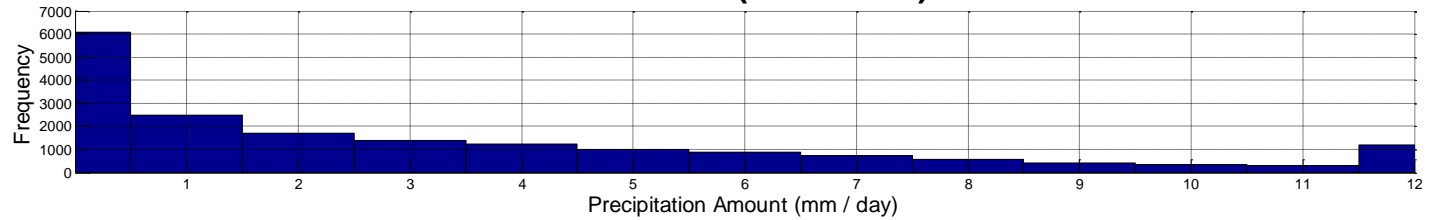
Generated



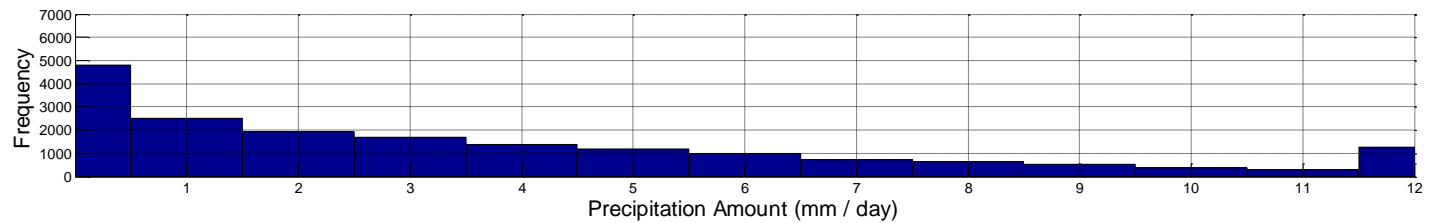
Corrected



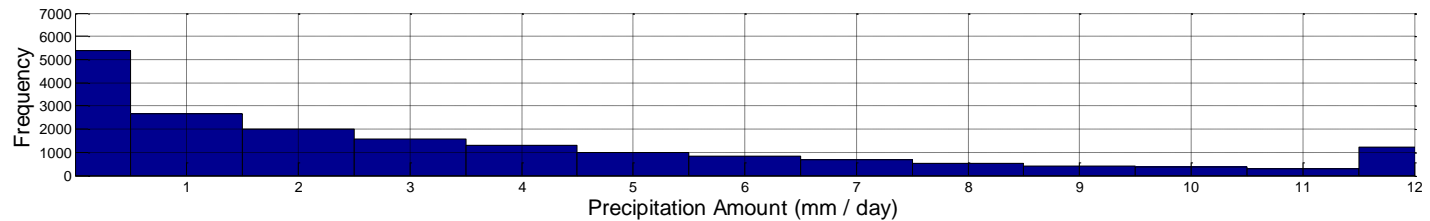
CPC Obs. (1951-2000)



First Generated 50 Years



First Correted 50 Years





Thank you everybody!!!

Any question???