

UVirginiaTech

# Evaluating weather observations and the CFSR as inputs for hydrologic modeling in the Hawaiian Islands

Kim Falinski, Dan Auerbach, Kirsten Oleson, Zachary M. Easton, Daniel R. Fuka

## UH at Manoa, EPA, Virginia Tech, The Nature Conservancy



This material is based on work supported by the NSF under Grant No. 1343802





# Summary

What is GHCN and CFSR Review of Past Results

- Cont. US & Ethiopia
- Ethiopia
- Puerto Rico
- This study: Hawai'i, USA



# What is GHCN-Daily

#### 75000 stations

Wirginia Tech

- 180 countries and territories
- Max and Min temperature, total daily precipitation, snowfall, and snow depth
- ~ Two thirds of the stations precipitation only.
- Record length and period vary by station less than year to 175+ years.



# Short Term Forecasts

Often times correlate better with electrical load for cities better than weather station data.

- Every 6 hours
- Cover the entire world

Existing long term archives of past forecasts for model improvement



# **Basic Concept**

# CFSR is a 6 hour Global Forecasting System 1979 – today

The error of using a weather station will converge with the error of weather forecast as weather station

#### UVirginiaTech



#### **Biological Systems Engineering**





# **Continental USA and Ethiopia**

SWAT is used as a calibrated response function:

## flow=SWAT(wx,a)

Nearby GHCN WX Stations CFSR Interpolated to center of basin Optimize flow with R DEoptim





\*-CFSR at center of watershed, O-WX guage data, X-CFSR interpolated to WX guage location



#### Andreas Cr., Palm Springs, CA NSE for CFSR and Weather Gage



While CFSR is best, second closest station is better than closest. This weather station appears to report at 4pm local time. ToC issue? Still lower confidence though.

\*-CFSR at center of watershed, O-WX guage data, X-CFSR interpolated to WX guage location

# Continental USA & Ethiopia

Name	Location	CFSR	Closest Met <sup>1</sup>	Closest Met	Best Met <sup>2</sup>	Best Met
		Center	Weather	Distance	Weather	Distance
Town Br.	Hobart, NY, USA	.63	NA	NA	.52	NA
Gumera	Bahir Dar, Ethiopia	.71	NA	NA	.68	NA
Andreas Cr.	Palm Springs, CA, USA	.71	.36	9km	.67	9km
Tesuque Cr.	Santa Fe, NM, USA	.49	.08	15km	.34	45km
Cross R.	Cross R., NY, USA	.67	.63	15km	.63	15km

Closest meteorological station to the center of the watershed.

<sup>2</sup> Best performing meteorological station weather, or combination of weather stations in the case of Town Brook and Gumera.

UVirginiaTech



# Ethiopia Study 2, Dile and Srinivasan

Traditional SWAT modeling project, monthly

- Initialize using Ethiopia MOWR WX Stns.
- Initialize using Closest Gridded CFSR

Un-Calibrated

	Con W	ventional Teather	<b>CFSR Weather</b>		
Rivers	NSE	PBIAS	NSE	PBIAS	
Gilgel Abay	0.87	11.05	0.79	-3.83	
Gumera	0.84	9.99	0.75	15.09	
Rib	-0.58	-115.69	-0.90	-110.67	
Megech	0.49	-29.08	-1.91	-131.88	



# **Puerto Rico**

Tropical, Montane, Island Extremely Data Rich SWAT is used as a calibrated response function:

#### flow=SWAT(wx,a)

Nearby GHCN WX Stations CFSR Interpolated to center of basin Optimize flow against WX with R DEoptim











# Hawaii

# Most Exciting Hydrology EVER!

#### **Two Islands**

- Kauai older soils
- Hawaii/Big Island newest soils

## SWAT used as calibrated response function:

## flow=SWAT(wx,a)

#### **Nearby GHCN WX Stations**

### CFSR Interpolated to center of basin

## Optimize flow against WX with R DEoptim

# Weather Station by Distance



0.6

0.2

Unvent the Future



Watershed Science and Engineering



# Hawai'i Summary

Closest weather is not best 8 out of 14 times Newer, high Ksat soils have flashy'er response

Convergence is ~30-45km



# **Current Distance Convergence**

Location	Distance
Continental USA: NY, NM, CA	~10km
Ethiopia, Upper BNB	~30km
Tropical Montane Gulf	25-30km
Hawaii Tropical Young	30-45km



# Discussion

Closest weather station is not always your best weather station CFSR is NOT a competing product Quick minute worst case scenario Fallback for ungaged basins 15 minute first look





# **Concluding Remark**

There are many many places with really good weather data to force watershed models...

This project is trying to provide easy to access, continuous, representative weather data for the other 90% of the world