

# The Flash Flood Guidance System for Central America (CAFFG) and very short Range Forecasting

Rosario Alfaro  
Instituto Meteorológico Nacional  
Costa Rica  
[ralfaro@imn.ac.cr](mailto:ralfaro@imn.ac.cr)

# The CAFFG system

- **Developed by the Hydrological Research Center, San Diego, CA**
- **Implemented for Central America in summer 2004. Runs in a server of the Instituto Meteorológico Nacional of Costa Rica.**
- **The input data are precipitation estimates of the Hydro-Estimator (HE) algorithm which was implemented in 2002 in another server at IMN too.**

# The CAFFG system (cont.)

- **Consists of three components: a) the soil moisture model (Georgakakos and Smith 2001), b) the threshold runoff model (Carpenter et al. 1999) and c) the Flash Flood Guidance model (Georgakakos 2004).**
- **The system relies on very short range precipitation forecasts (with lead times between 1 and 6h) which are the only human intervention of the system.**
- **Using the software ArcView and layers of rivers, towns and frequent flooding zones, the CAFFG final results show basins with Flooding or Imminent Flooding in red, with Possible Flooding in yellow and with no risk of Flooding in green.**

## Validation in Central America in 2004

- As a first attempt of using forecasts in the rainy season 2004, persistence and the experience of meteorological forecasters of the region were used to produce QPFs, however, it was hard to confirm the results obtained. Therefore, the final results of this validation only includes extreme cases in which flooding were reported. Instead of using QPFs, the precipitation estimates of the HE were used.
- It was hard to confirm the hours in which flooding occurred for all cases.

# Initial Evaluation Table, 2004

Country	Cases	<b>FIR</b>	<b>FINR</b>	<b>NFIR</b>
GU	2	2		
CR	4	4		
ES	15	10	5	
PA	1	1		
HO	6	1	4	1
BE	0			
NI	0			
<b>Tot</b>	<b>28</b>	<b>18</b>	<b>9</b>	<b>1</b>
<b>Tot%</b>	<b>100</b>	<b>64</b>	<b>32</b>	<b>4</b>

**FIR**=Flooding  
Indicated and  
Reported

**FINR**=Flooding  
Indicated and Not  
Reported

**NFIR**=No Flood.  
Indicated but  
Reported

# Working operationally with the CAFFG in 2005

- A version of the WSETA model runs in a server in Costa Rica since 2005. Then, short range quantitative precipitation forecasts of this model at 10 km resolution with mostly 6h lead times were used for the rainy season 2005
- As an additional information, it was also used the general pattern of the GFS precipitation forecasts on the web and the judge of the forecasters according to the current situation to obtained the final forecasts.

## Summary of daily cases until September 30, 2005

	According to HE				According to reports			
Days	F	PF	NRF	Tot	H	FA	M	Tot
31	191	21	27	239	43	182	14	239
%	80	9	11	100	18	76	6	100

	According to Eta				According to reports			
Days	F	PF	NRF	Tot	H	FA	M	Tot
22	7	82	81	170	106	45	19	170
%	4	48	48	100	62	27	11	100

F = Flooding, PF = Possible Flooding, NRF = No risk of Flooding  
H = Hit, FA = False Alarm, M = miss

# Results of extreme cases from 092105 to 110405

Days	According to HE				According to reports			
	F	PF	NRF	Tot	H	FA	M	Tot
45	109	25	19	153	77	55	21	239
%	71	16	13	100	50	36	14	100

18

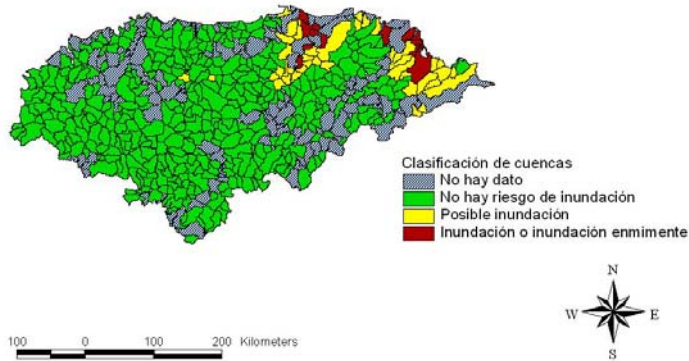
76

6

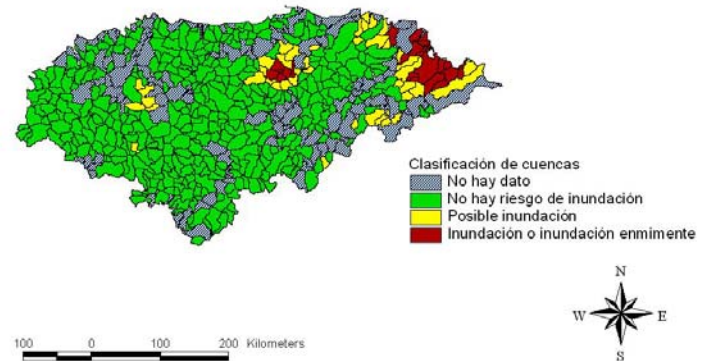
H = Hits, FA = False Alarm, M = miss

# Honduras, Beta Hurricane, Oct 30, 2005

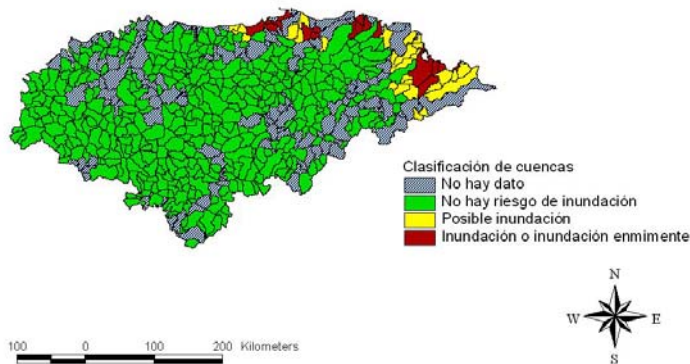
Evaluación del riesgo de inundación para el 301005, válido a las 00Z, usando la lluvia del satélite de las 18 a las 00Z



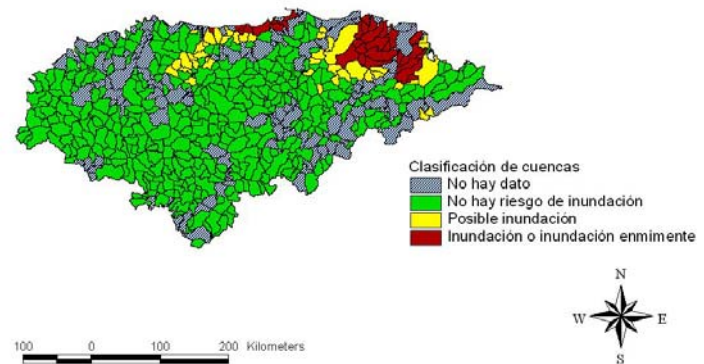
Evaluación del riesgo de inundación para el 301005, válido a las 06Z, usando la lluvia del satélite de las 00 a las 06Z



Evaluación del riesgo de inundación para el 301005, válido a las 12Z, usando la lluvia del satélite de las 06 a las 12Z

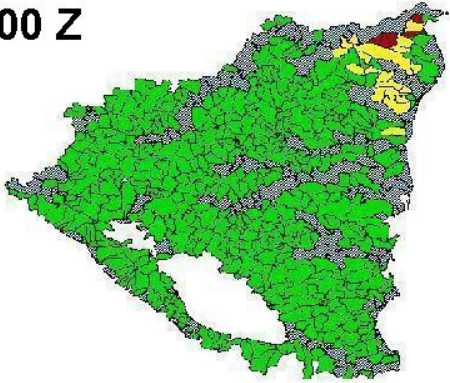


Evaluación del riesgo de inundación para el 301005, válido a las 18Z, usando la lluvia del satélite de las 12 a las 18Z

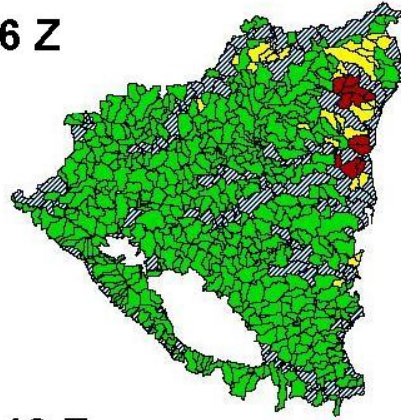


# Beta Hurricane Nicaragua

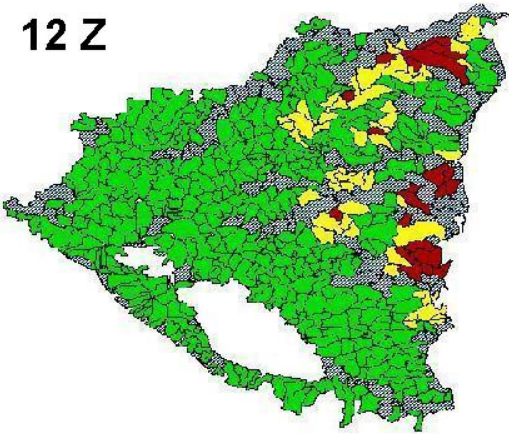
00 Z



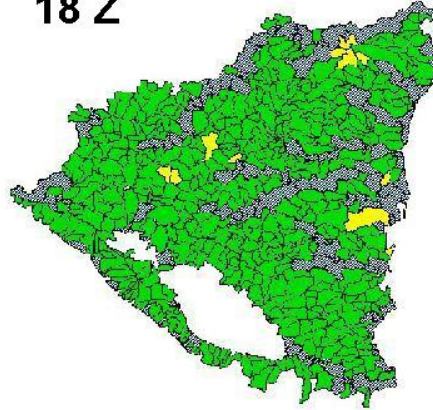
06 Z







12 Z



18 Z



Clasificación de cuencas

-  No hay dato
-  No hay riesgo de inundación
-  Posible inundación
-  Inundación o inundación enmimente

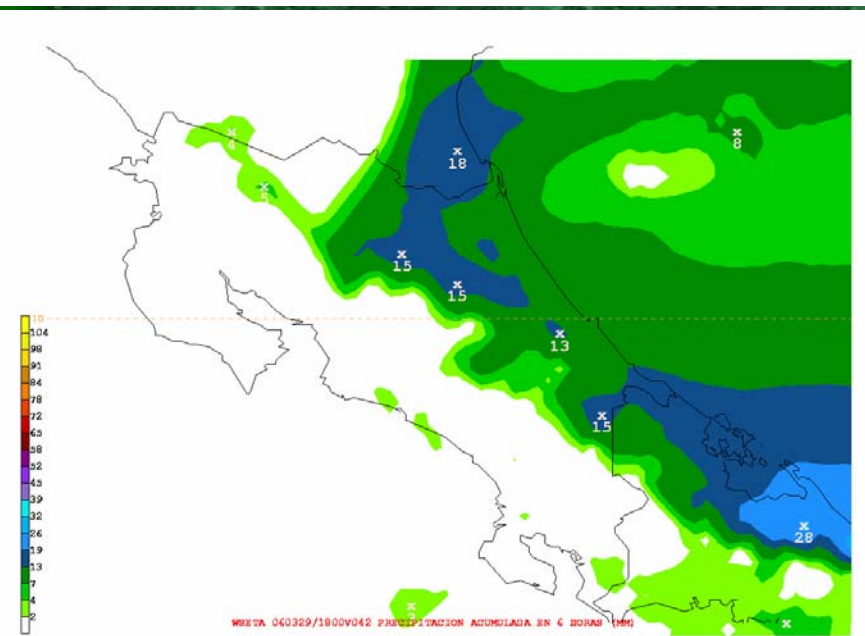
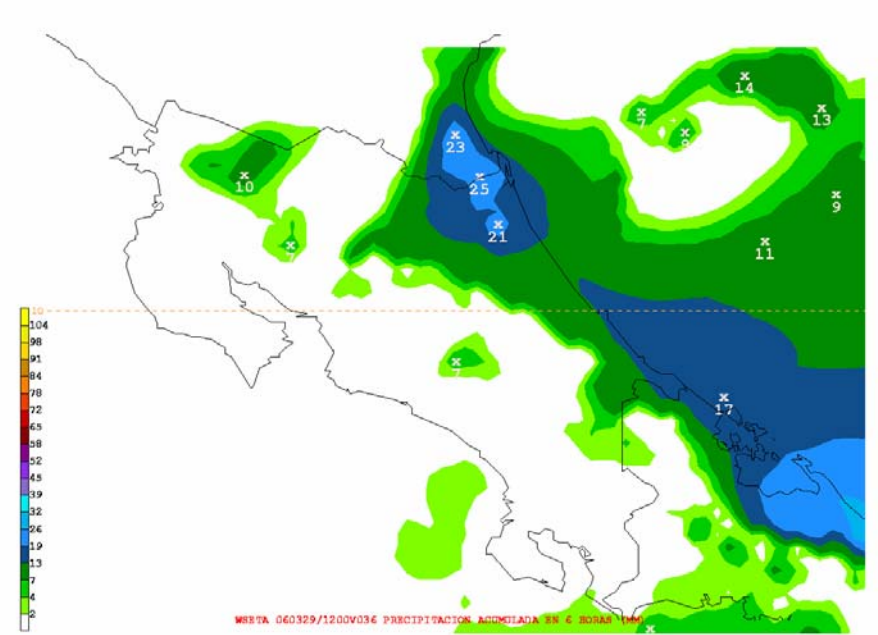
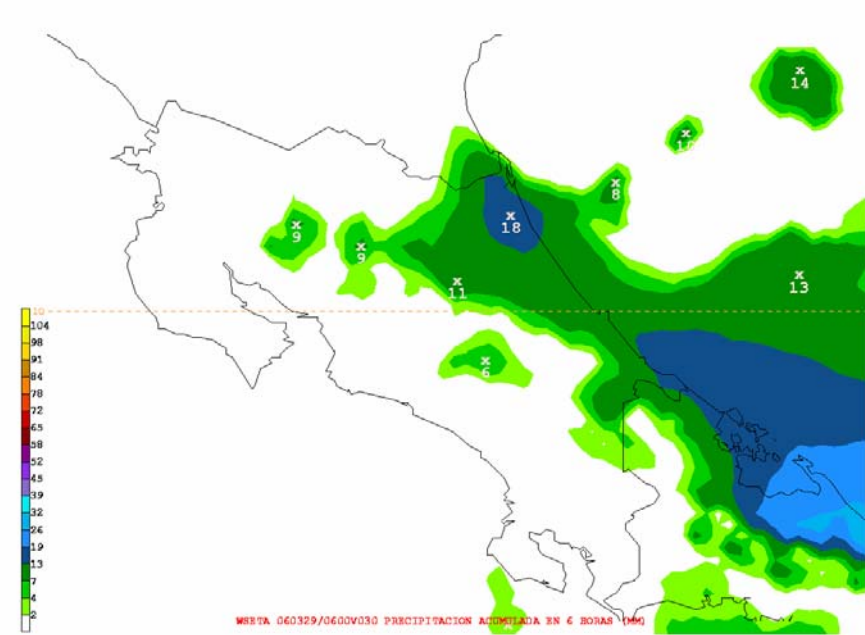
Oct 30, 2005

## Some observations

- The system works reasonably well, which can be observed when the HE is used, however the soil moisture content depends on satellite precipitation estimates **from the HE**, which are very poor for the winter months for two reasons: underestimation of the rain because of warm-topped clouds (warmer than  $-60^{\circ}\text{C}$ ) or mislocation of the rain due to the strong vertical wind shear during these months.
- Very important floodings occur in the Caribbean basin of Costa Rica during the winter months. Therefore, some other alternative precipitation estimates are needed for these months.

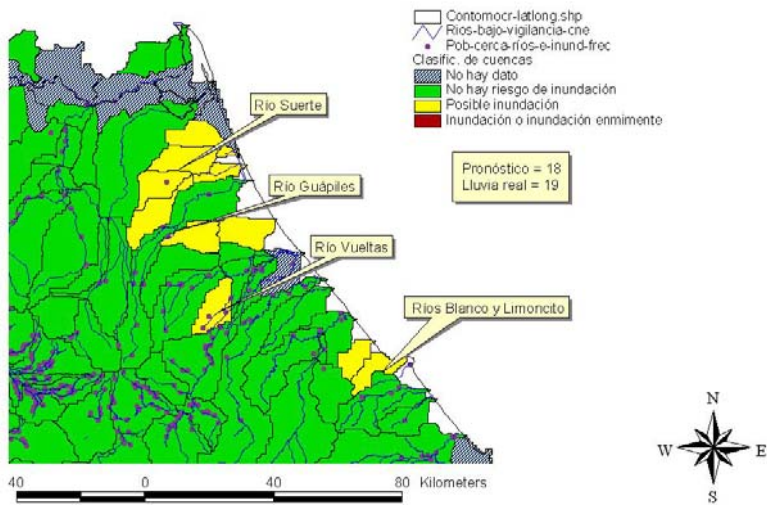
## Some observations

- QPFs are needed to work operationally with the system issuing warnings and alerts. The use of NWP precipitation forecasts of the WSETA model on a daily basis hardly shows the possibility of Flooding or Imminent Flooding because of the forecast precipitation amounts. However, in the presence of continuous rain for more than one day, the use of these forecasts has been a useful tool to determine regions in risk of flooding, especially for the winter months in the Caribbean Basin of Costa Rica. The following example show what is mentioned above.

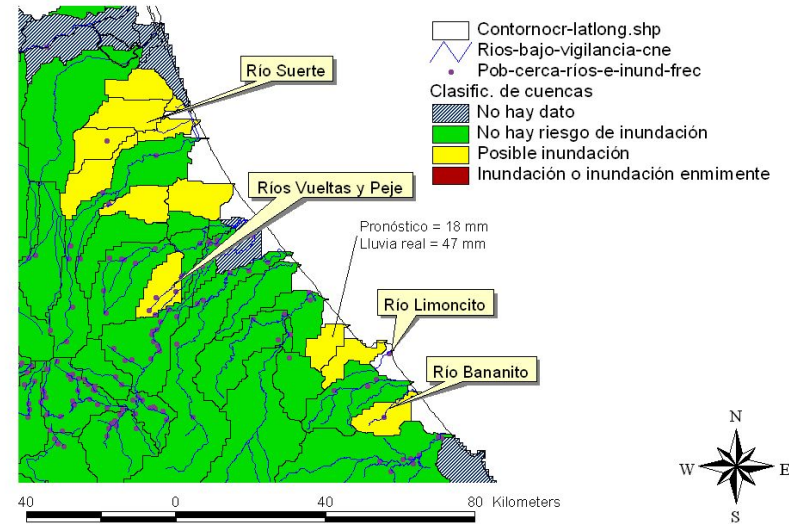


6 h forecasts: 0-6, 6-12  
12-18 Z on 03-29-06

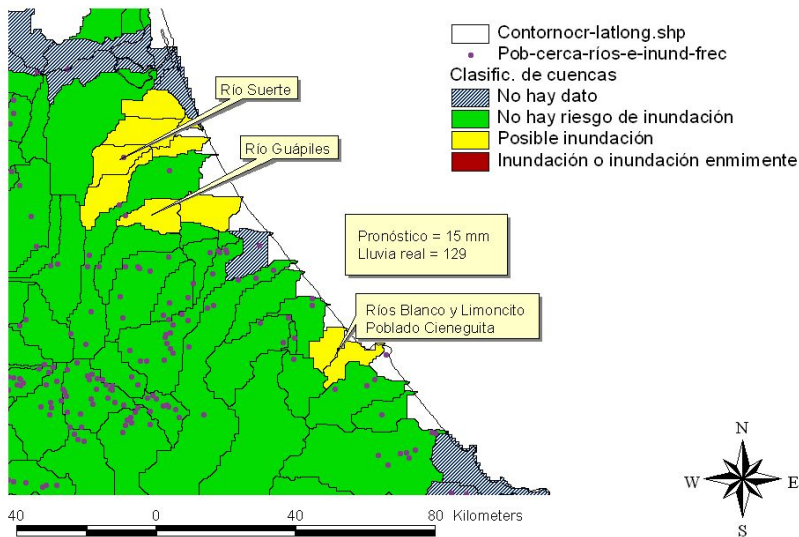
Evaluación del riesgo de inundación para el 290306 a las 06 Z, usando los pronósticos cuantitativos del modelo WSETA con la corrida del 280306 a las 00z



Evaluación del riesgo de inundación para el 290306 a las 12 Z, usando los pronósticos cuantitativos del modelo WSETA



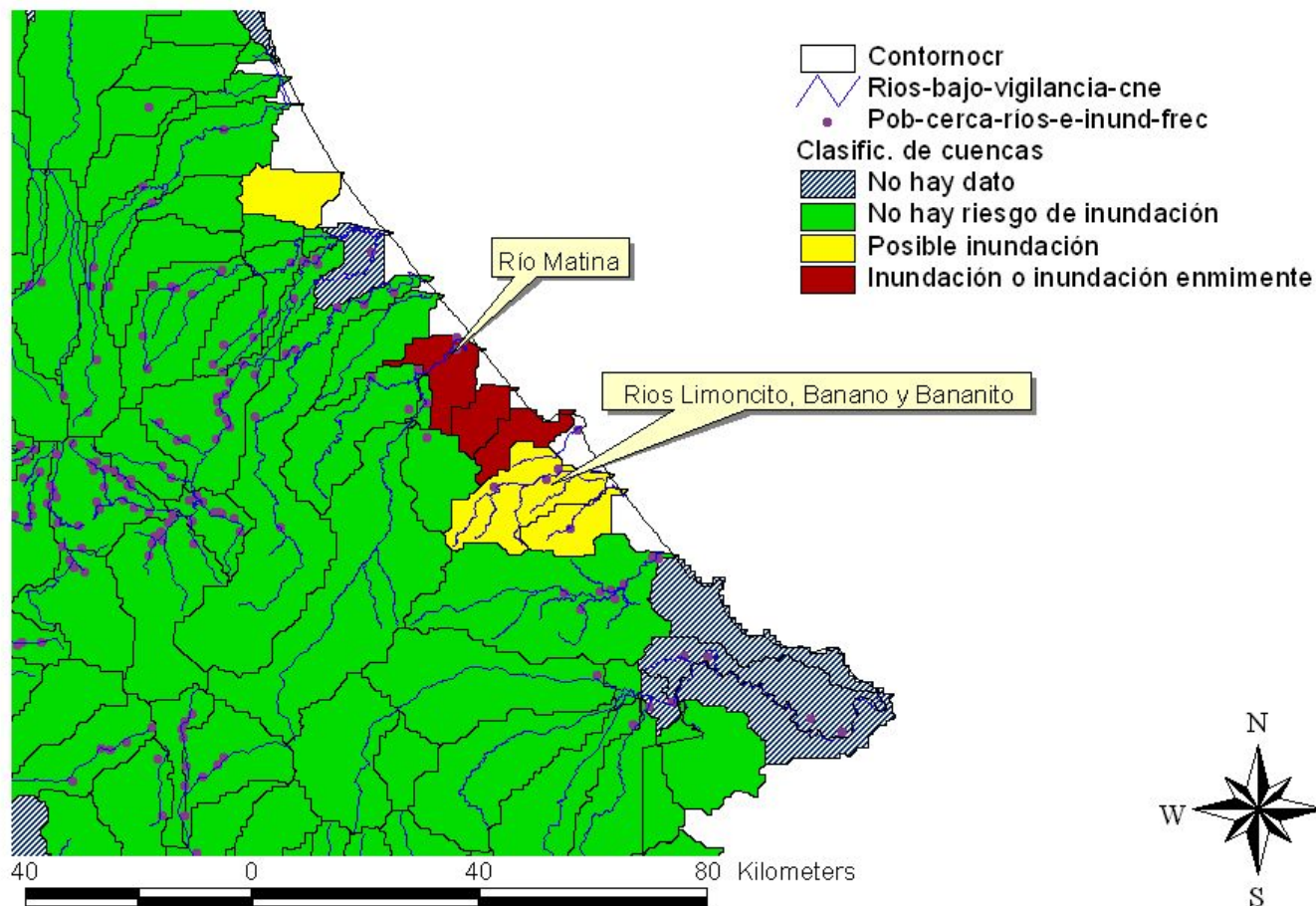
Evaluación del riesgo de inundación para el 290306 a las 18 Z, usando los pronósticos cuantitativos del modelo WSETA con la corrida del 280306 a las 00z



Final products using  
the 6 h forecasts

# Final product with the HE pp estimates

Evaluación del riesgo de inundación para el 290306 a las 18 Z, usando la lluvia estimada con el satélite



# Advantages of the use of WSETA short range forecasts

- For the winter months, these forecasts can give a good idea about the increase of precipitation for the period of time in which the forecast is valid.
- WSETA QPFs are more objective than the QPFs used before with the system.

## Future work

- Better precipitation estimates need to be used for the winter months to improve the CAFFG soil moisture estimates.
- Changes in the meteorological station network will be done in order to help the verification process and the sytem improvement.
- To decrease the False Alarms: a) the CAFFG precipitation thresholds need to be compared with real precipitation values, b) The Arcview layer of Frequent flooding zones used to issue warnings need to be updated.

## Future work

- Some other QPFs at higher resolution from other models as MM5 and WRF could be investigated.
- Automated assimilation of the QPFs will improve the timeliness of the warning and alerts. External help is needed for this.
- Personnel from the other Central American countries will be trained to use the system operationally.
- The exchange of similar experiences in some other countries is very valuable for us and is one of the main reasons of our participation in this symposium.

**FIN**

**MUCHAS GRACIAS**