Quality Control System for Daily Precipitation Reports from GTS

Project technique reports Draft Oct. 2006

http://ams.confex.com/ams/88Annual/techprogram/paper_131381.htm

Questions concerning the document and system process shall be address to

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Objective

- The object of this project is to develop and implement an automatic system to objectively perform quality control for the daily precipitation reports on a real-time basis.Establish an automatic system to perform objective QC for GTS daily precipitation reports globally on a real time basis;

ISSUES:

- The “0” values;
- The extremes and large values;

Introduction

- Daily precipitation reports from gauge stations provide ground true observations and have many applications in real time monitoring and assessments, verification of official climate forecasts, and diagnostic studies of climate variability.
- At the Climate Prediction Center/NCEP/NOAA, daily precipitation reports are received from Global Telecommunication System on a near real-time basis.
- There are, however, quality problems with daily precipitation reports. General problems include missing reports values assigned wrongly as ‘0’ or others, wrong values due to typo or incorrect transmission, and different definitions of starting and ending times for a day.

ISSUES:

  - The “0” values;
  - The extremes and large values;

Approaches

- The GTS global QC system adopts the basic techniques (e.g. buddy check, and climatology standard deviation check) developed by Higgins and Shi in the operational QC system for Unified US gauge data set.
- It takes advantage of the satellite estimates and other additional information (such as GFS forecasts) based the characteristics of the GTS quality problems.
- It, finally, provides users with information of the degrees of the suspiciousness of the suspicious observations.

Data

- Daily climatology probability

  -- calculated from daily GTS obs 1977-2003 at gauge stations;

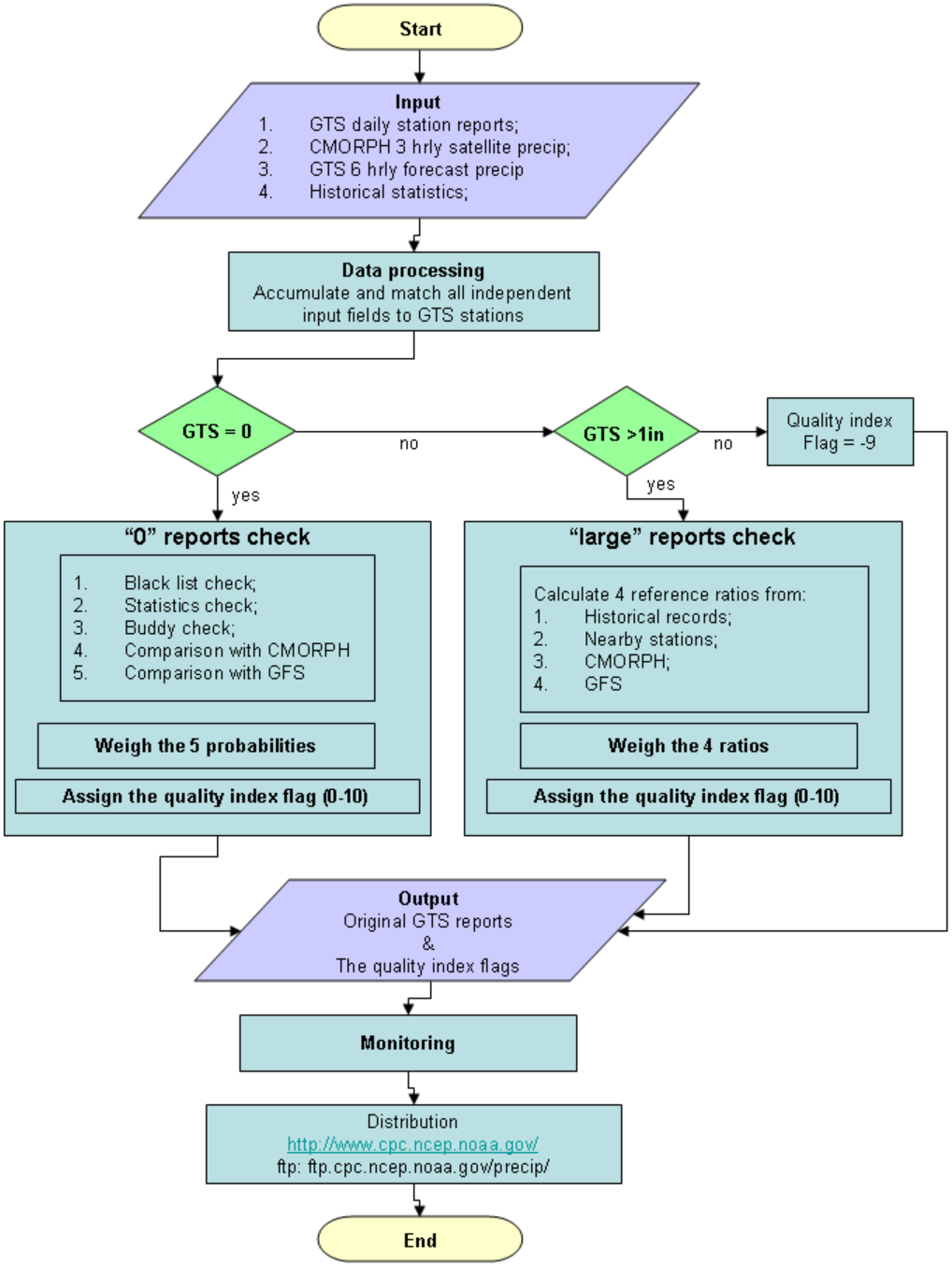
- Daily CMORPH (satellite precip estimates)

  -- accumulated from 3 hourly 0.25^{o} lat/lon field at the grid nearest to the GTS station;

- Daily GFS FCST

  -- accumulated from 3 hourly 1^{o} lat/lon 00Z GFS at the grid nearest to the GTS station;

GTS QC Process Flow



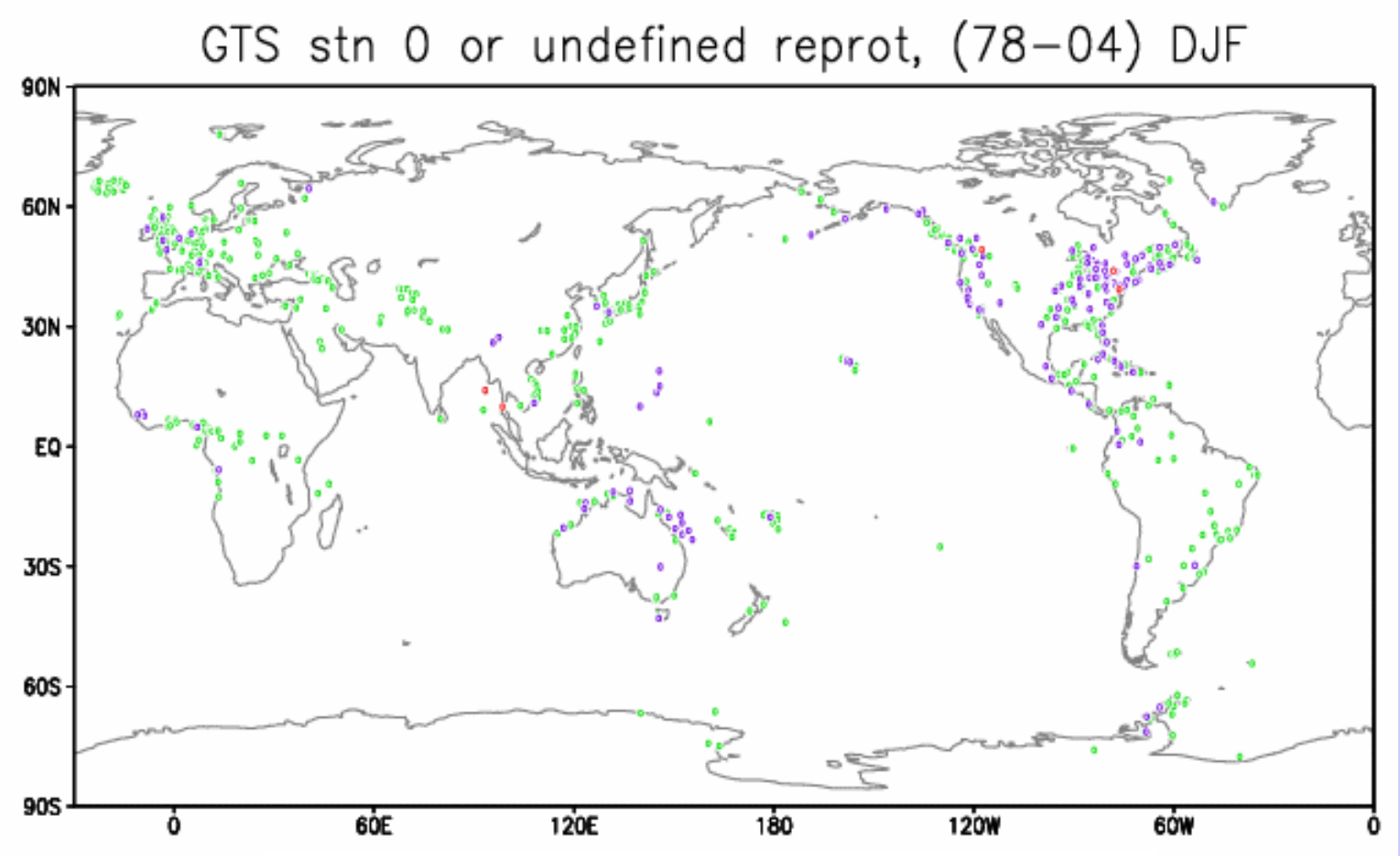
To check the quality of GTS “0” reports

- Weighting the probabilities from the following independent examinations:
  - Black list check (history);
  - Buddy check;
  - Comparing with CMORPH;
  - Comparing with GFS forecast;

1. Black List Check

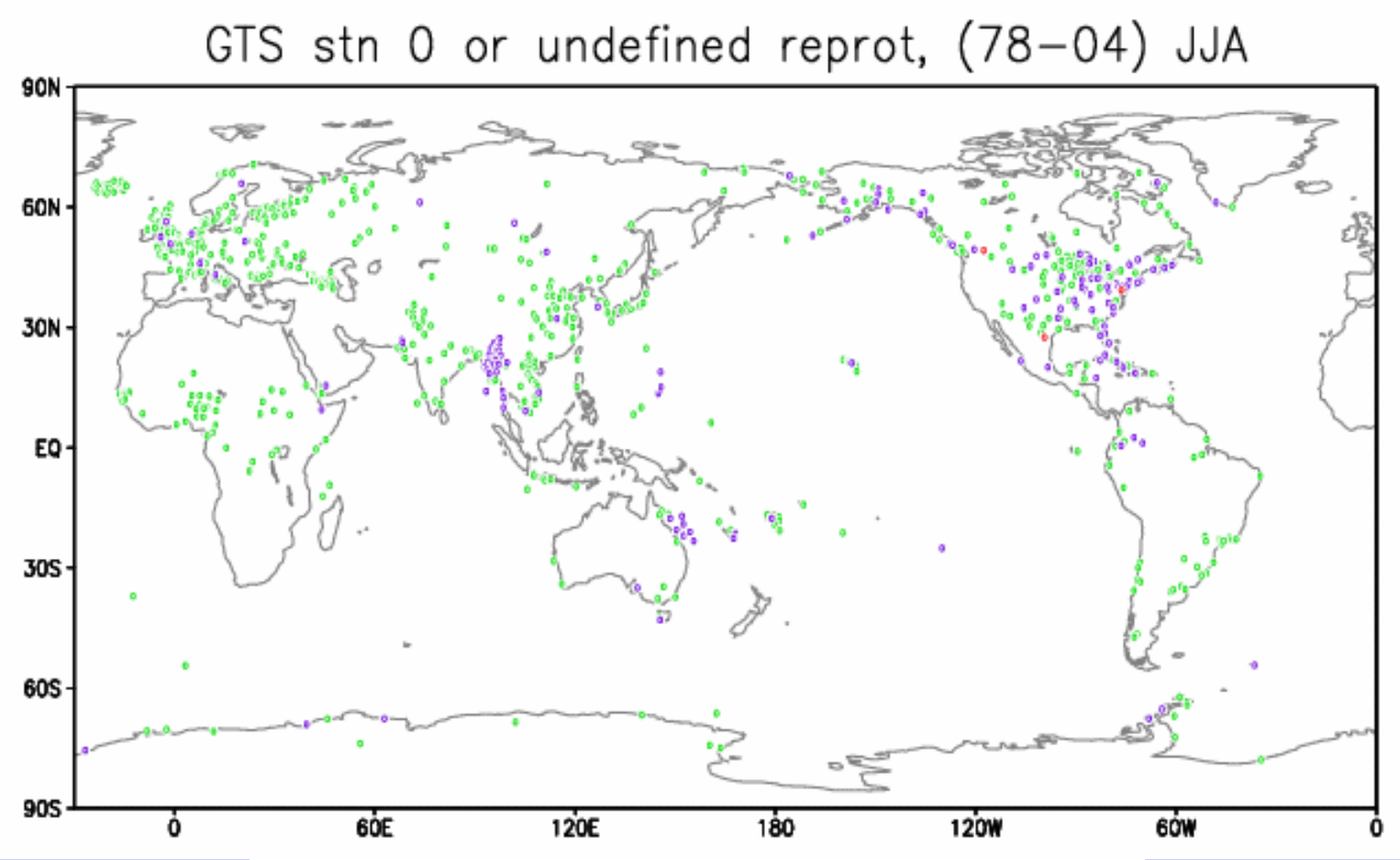
- Construct a list of stations
  - For each season (DJF,MAM,JJA, & SON) of GTS daily data from 1978 to 2004,
  - The station reports “0” or undefined reports (at least one “0” report) during entire season; and
  - The seasonal climatology from PREC/L > 1mm/day;

Location of stations in the black list (DJF)



- >= 5 seasons, 633 stations
- >=10 seasons, 152 stations
- >=20 seasons, 5 stations

Location of stations in the black list (JJA)



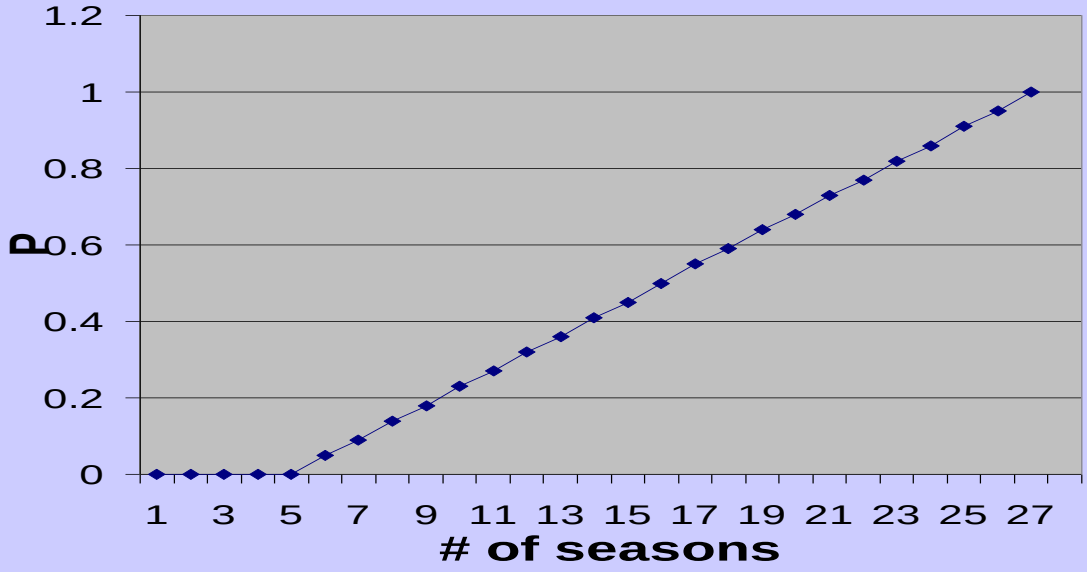
- >= 5 seasons, 808 stations
- >=10 seasons, 149 stations
- >=20 seasons, 3 stations

1. Black List Check (cont.)

The probability to toss out "0" report:

$$P = \begin{cases} 1; & N = 27; \\ 0.0; & N = 1,\cdots,5; \\ (N-5)/22; & N = 6,\cdots,26; \end{cases}$$

N – the number of seasons with "0" or undefined reports

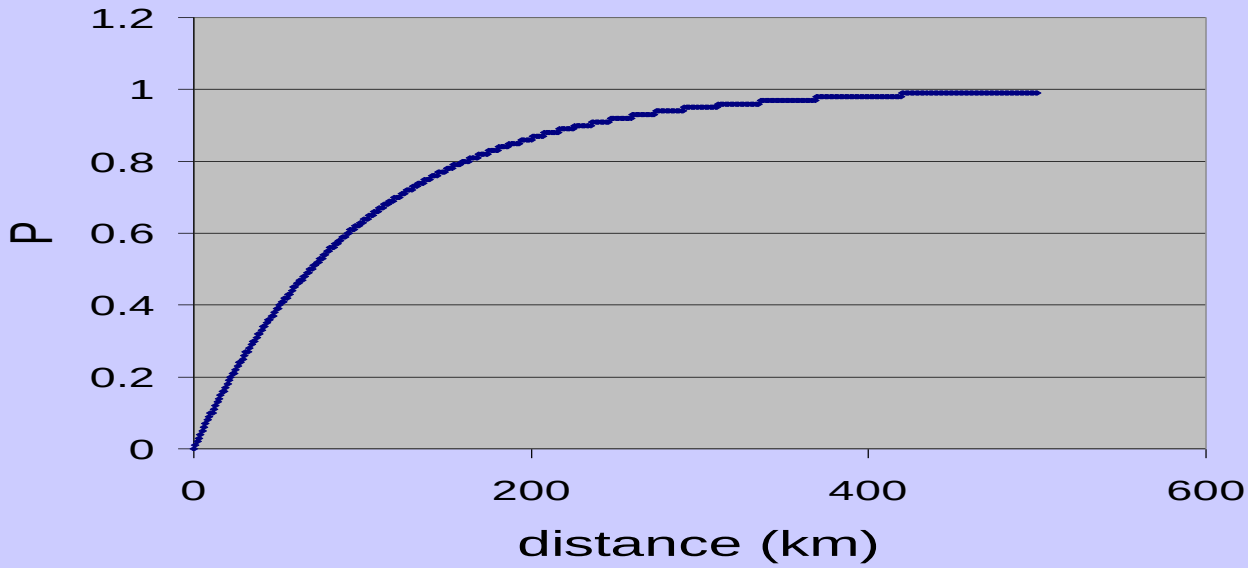


2. Buddy Check

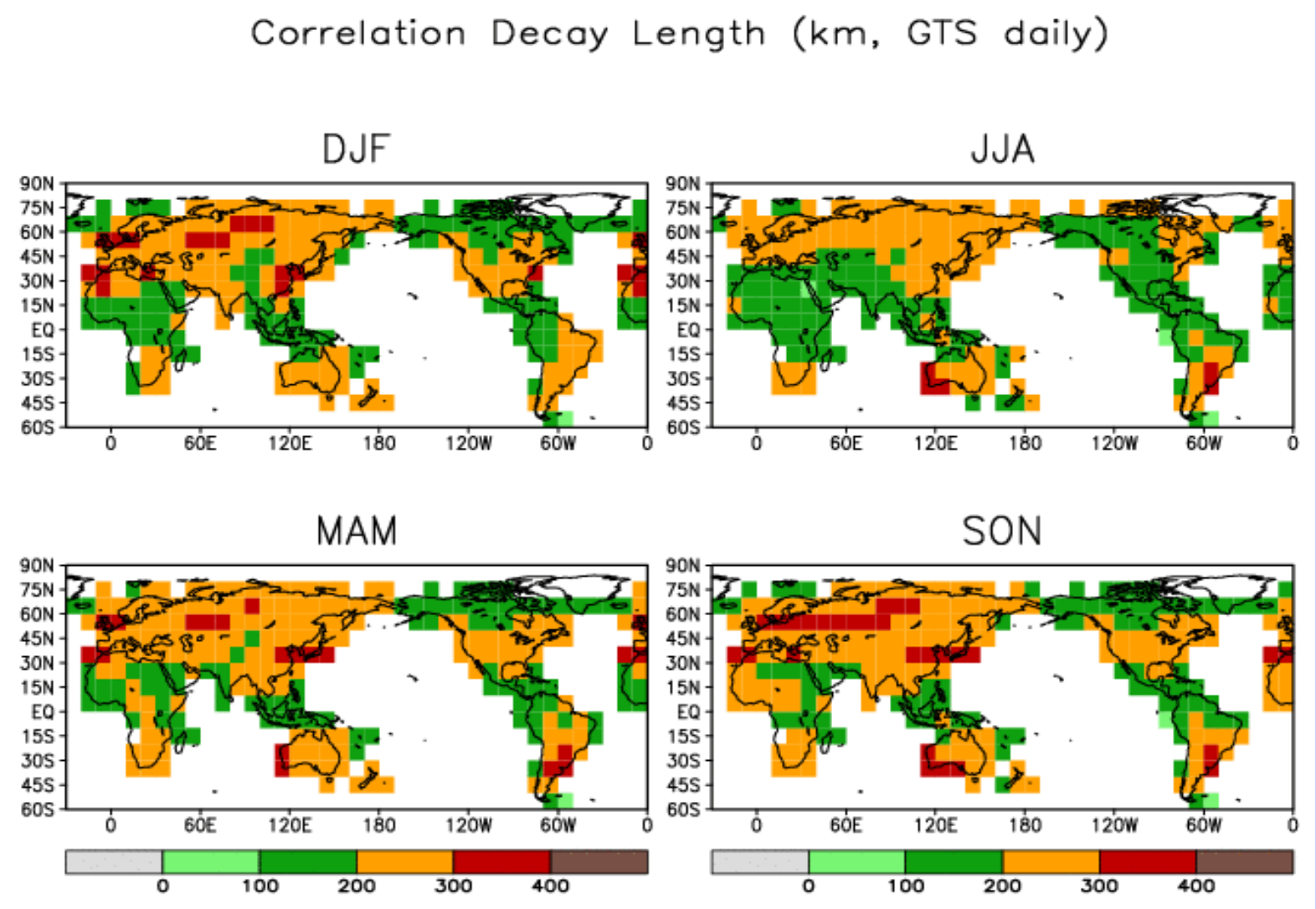
- To find out the nearest “0” station;
- The probability to toss out “0” report:

$$P = 1.0 - e^{-d/\lambda}$$

d – the distance between the target and the nearest station with “0” report;
λ – the correlation decay length of daily precip; &regional and seasonal dependent;

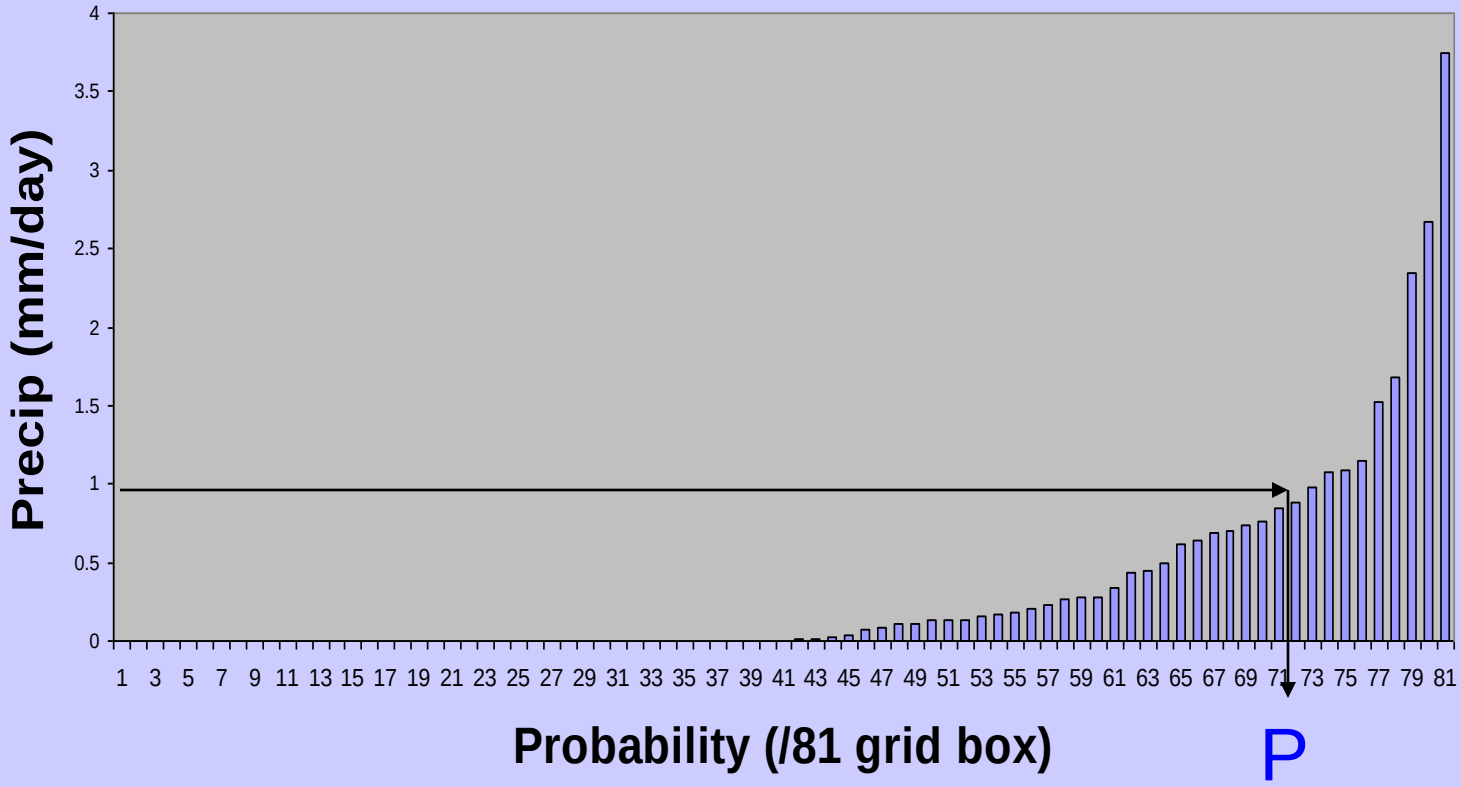


Seasonal and spatial variation of the correlation decay length for daily precipitation



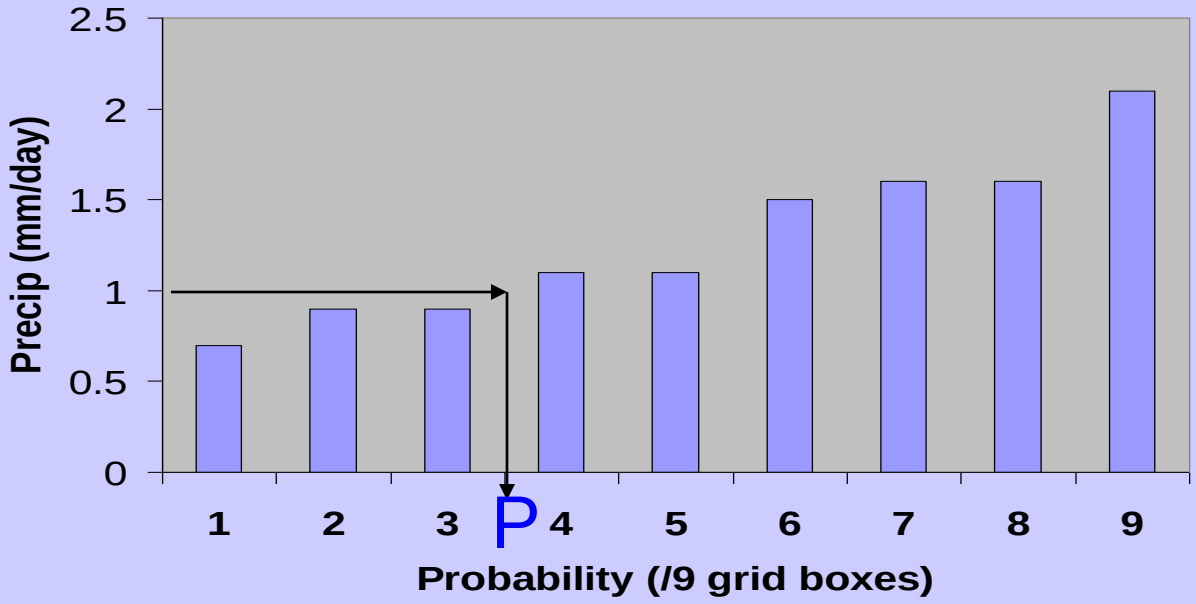
3. Comparing with CMORPH

To find out the probability (P) of no zero value precip (> 1mm/day) among the nearest 9x9 grid box values from CMORPH.



4. Comparing with GFS Forecast

To find out the probability (P) of no zero value precip (> 1mm/day) among the nearest 3x3 grid box values from GFS forecast.



Summary of the total probability

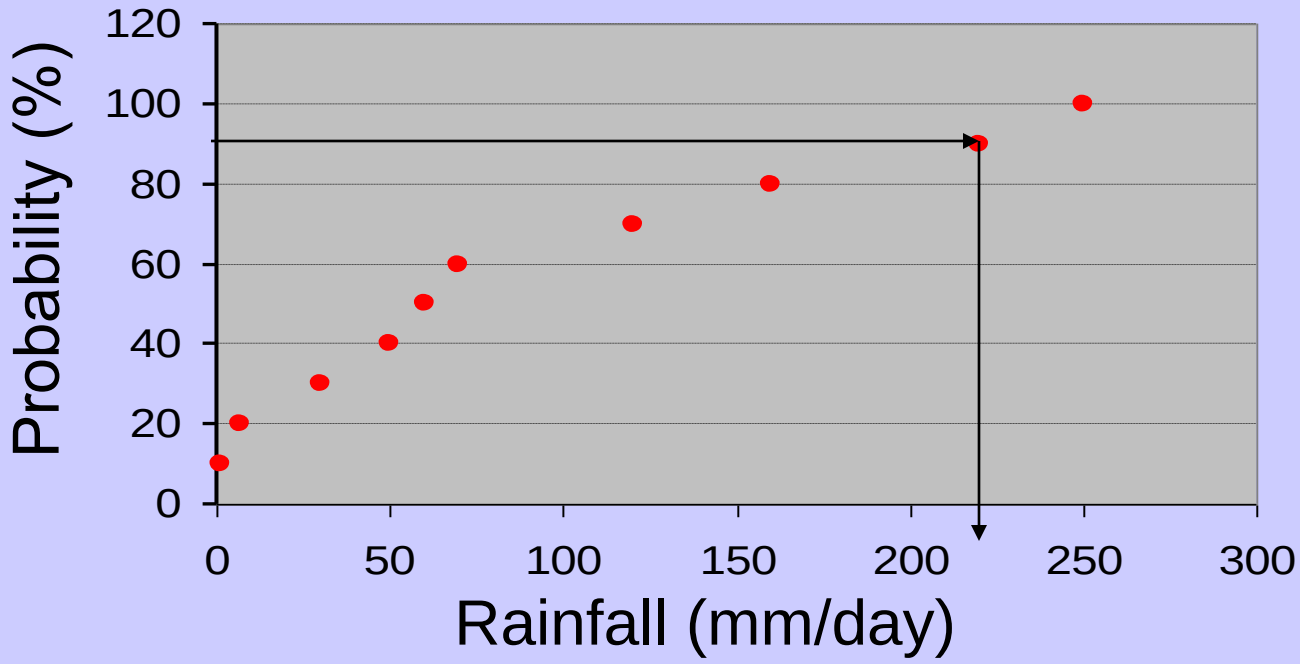
- The final risk level (0-10) of the suspicious “0” report is determined by weighting the no zero probabilities obtained from above 4 steps.
- The weight for CMORPH and GFS FCST are defined based on their quality and vary with season and location

To check the extremes and large values

- Weighting the ratios of the suspicious obs to the rainfall values at 90% accumulated probabilities in each data sets;
  - Neighboring stations (buddy check);
  - Climatology;
  - CMORPH;
  - GFS forecast;

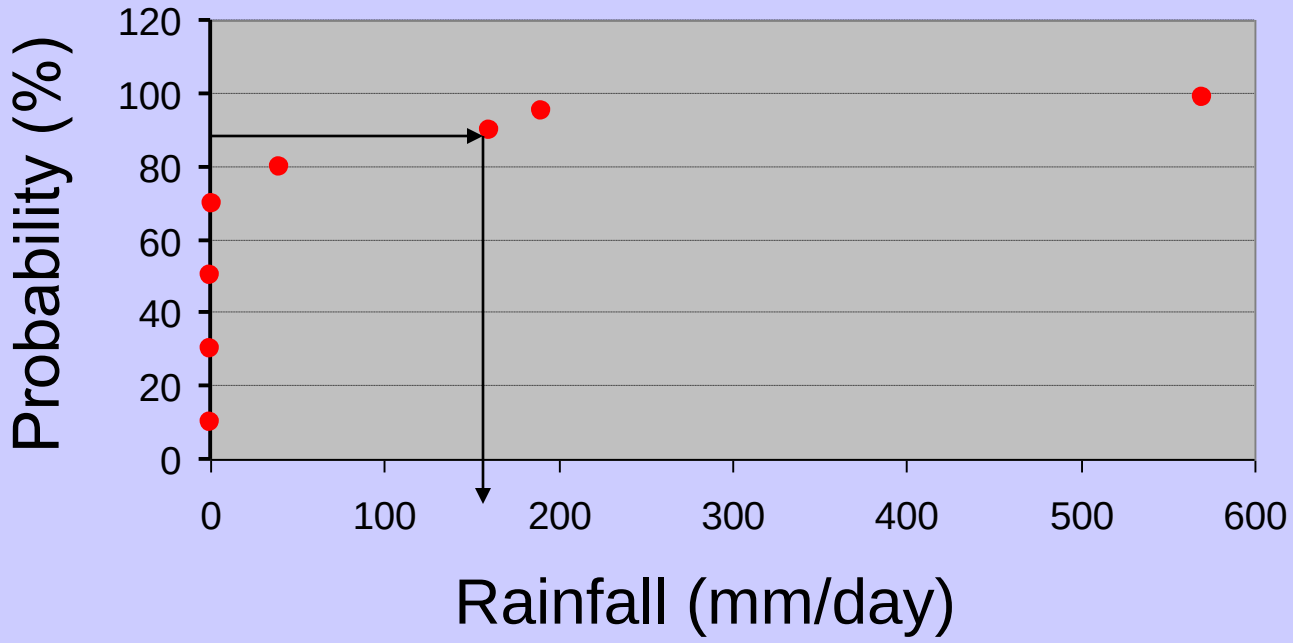
1. Buddy Check

- Neighboring stations:
  - Within the radius of 200 km;
- Ratio = obs/rain(90%)



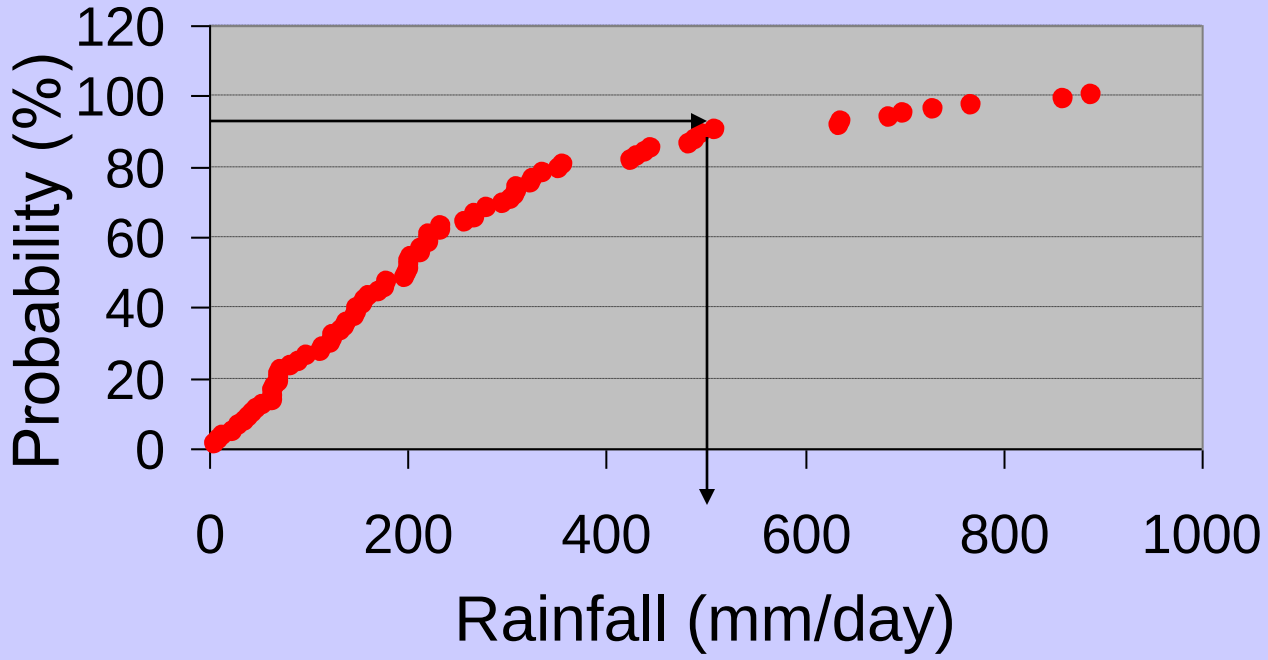
2. Climatology Check

- Daily climatology probability at obs stations;
- Ratio = obs/rain(90%)



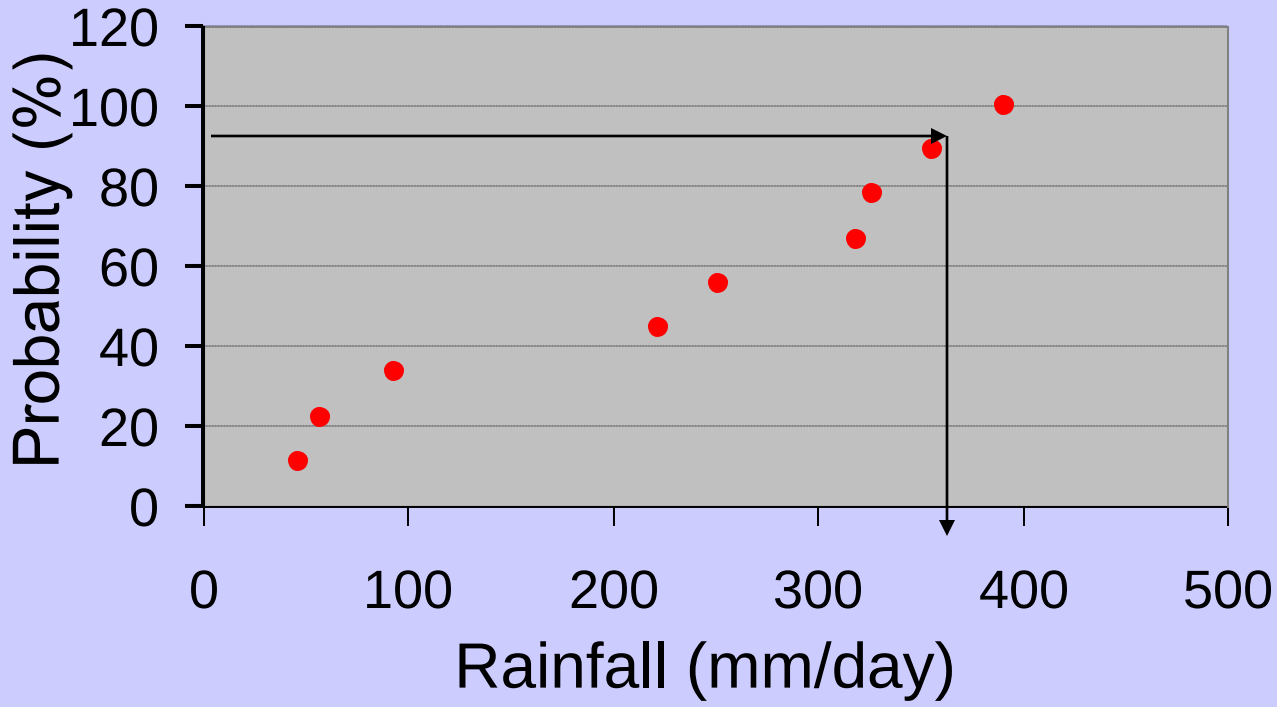
3. CMORPH Check

- Rainfall values from CMORPH 9x9 (0.25 deg) grid boxes;
- Ratio = obs/rain(90%)



4. GFS Forecast Check

- Rainfall values from GFS Forecast 3x3 (1 deg) grid boxes;
- Ratio = obs/rain(90%)



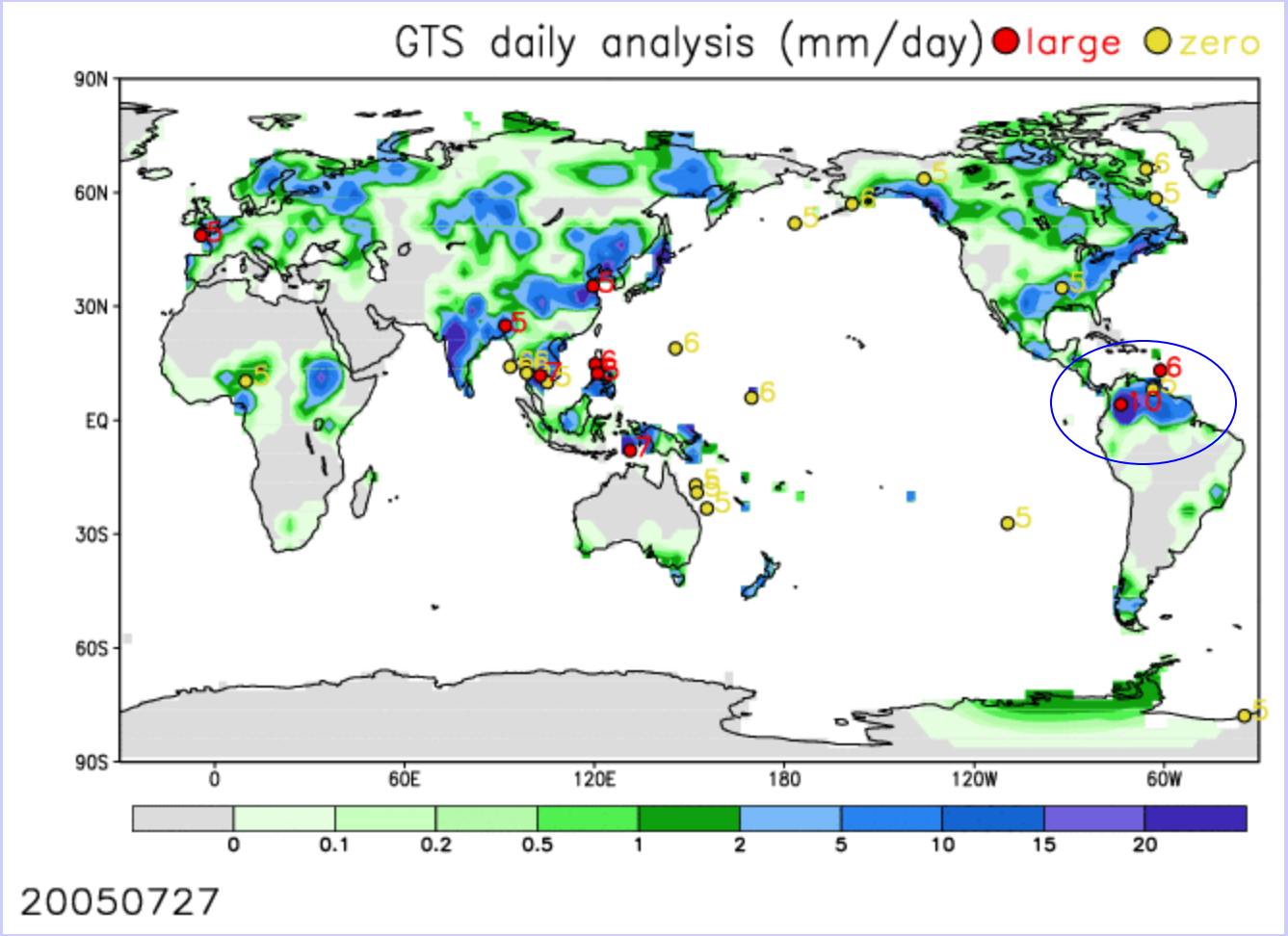
The total suspiciousness of large value obs

- Weighting the ratios obtained from the above 4 independent steps;
- The weightings for CMORPH and GFS Forecast depend on their quality and same as used in “0” value QC.
- For the cases with small value of climatology and large values of CMORPH and GFS Forecast, the weight for Climatology check are reduced.
- The final risk level is defined from 0 – 10 based on the total weighted ratio. The larger the ratio is, the higher the risk level of the obs.

Results

- The QC system has been tested for JJA 2005.
- The results are compared with that from regional US and S. America QC system.
- The daily analysis field with QC is compared with that without QC.
- The followings are some selected examples.

July 27, 2005


GTS daily analysis (mm/day) large zero
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
0
0.1
0.2
0.5
1
2
5
10
15
20
20050727

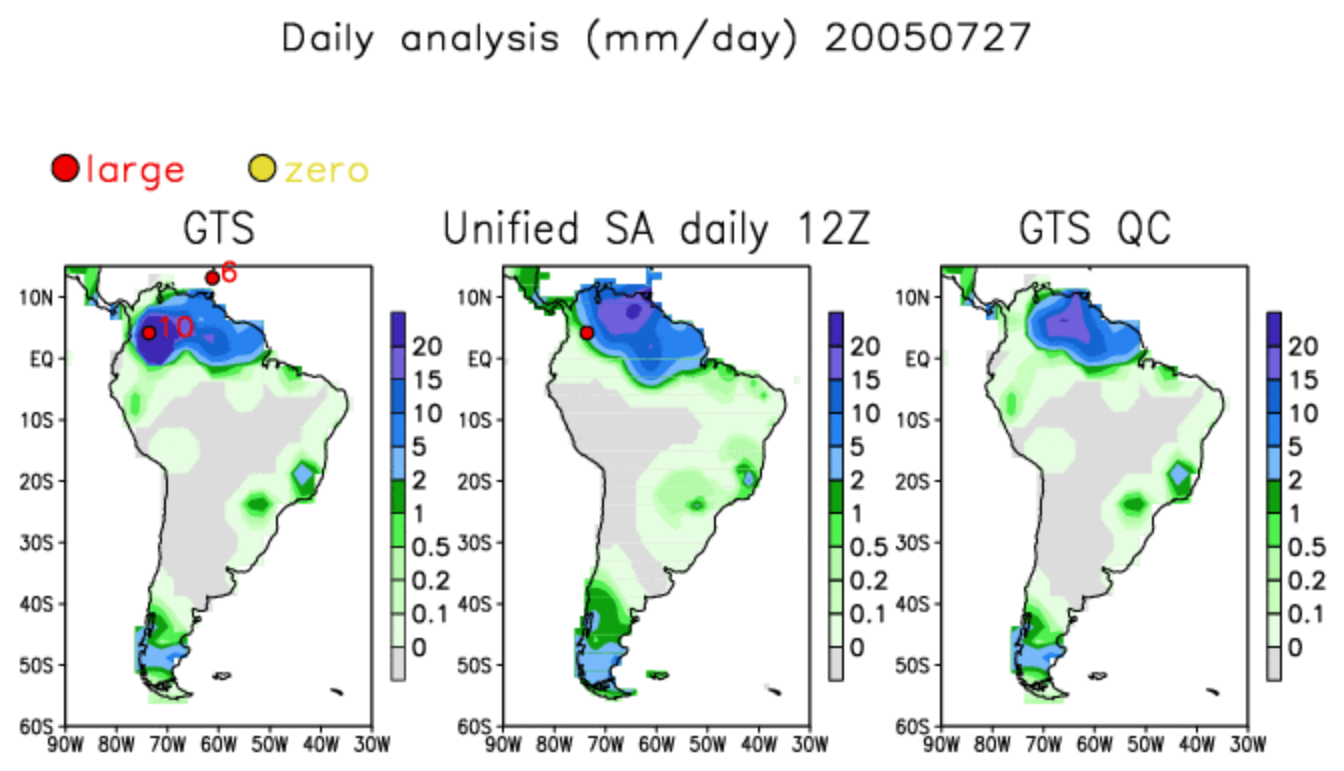
July 27, 2005
List of stations with risk level >= 5

	WMO#	LAT	LON	rain(0.1mm/day)	Risk level
1	1404	48.68	-4.33	540	5
2	6279	24.9	91.88	696	5
3	7487	11.77	102.88	1707	7
4	7966	35.38	119.53	462	5
5	11119	13.13	-61.2	640	6
6	11166	4.17	-73.62	3623	10
7	13643	-7.98	131.3	880	7
8	13668	14.8	120.27	1197	6
9	13688	12.35	121.03	917	5

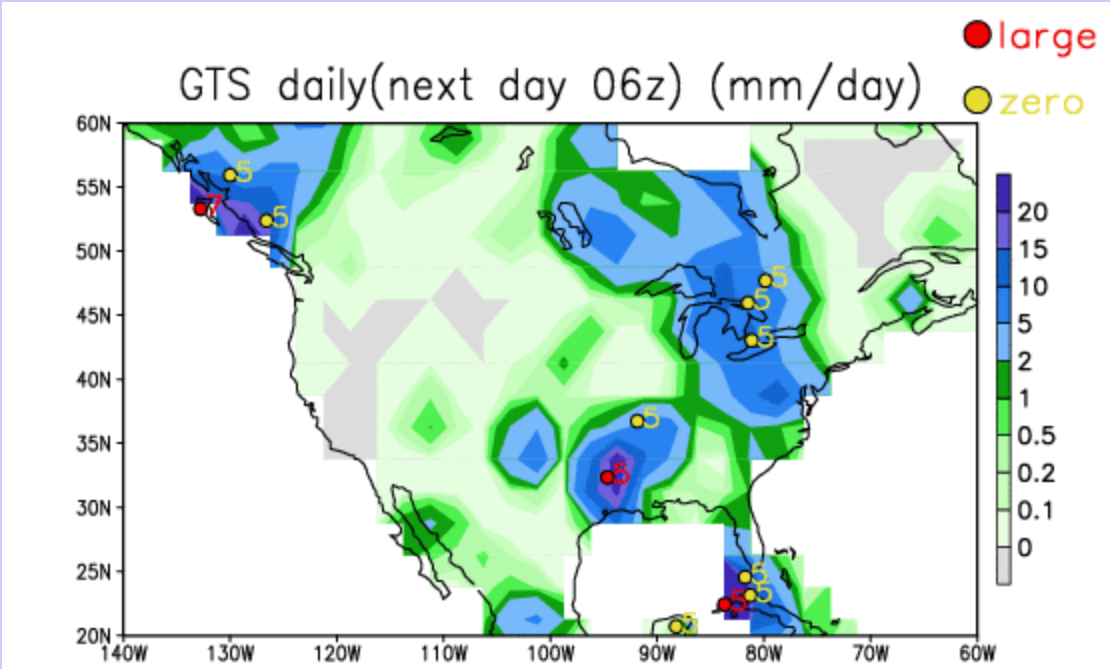
July 27, 2005
List of stations with risk level >= 5

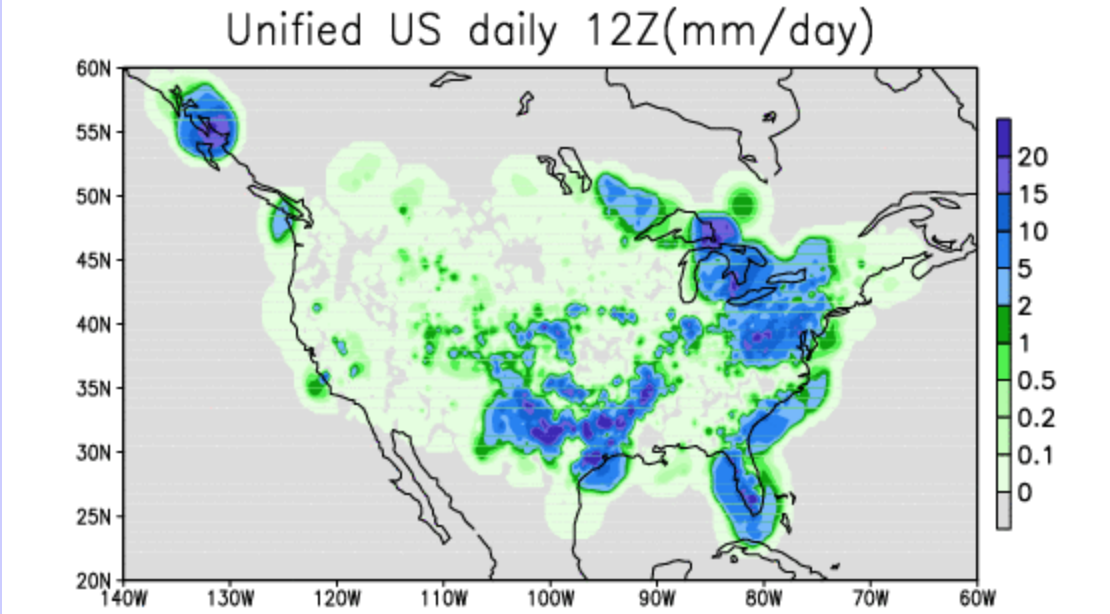
	WMO#	LAT	LON	Rain(0.1mm/day)	Risk level	
1	7429	14.1	98.22	0	6	
2	7430	14.12	93.37	0	6	
3	7431	12.43	98.6	0	5	
4	7565	10	105.1	0	5	
5	9181	10.28	9.82	0	5	
6	9786	56.95	-158.6	0	6	
7	9809	51.88	-176.7	0	5	
8	10204	58.33	-62.58	0	5	
9	10224	66.14	-65.71	0	6	
10	10345	63.61	-135.9	0	5	
11	10462	34.83	-92.25	0	5	
12	11212	8.15	-63.55	0	5	
13	11790	-27.2	-109.4	0	5	
14	12084	-77.9	-34.62	0	5	
15	12240	18.9	145.6	0	6	
16	12282	5.92	169.7	0	6	
17	12846	-17.1	152	0	5	
18	12847	-19.1	152.4	0	5	
19	12918	-23.3	155.5	0	5	

July 27, 2005 in the region of SA



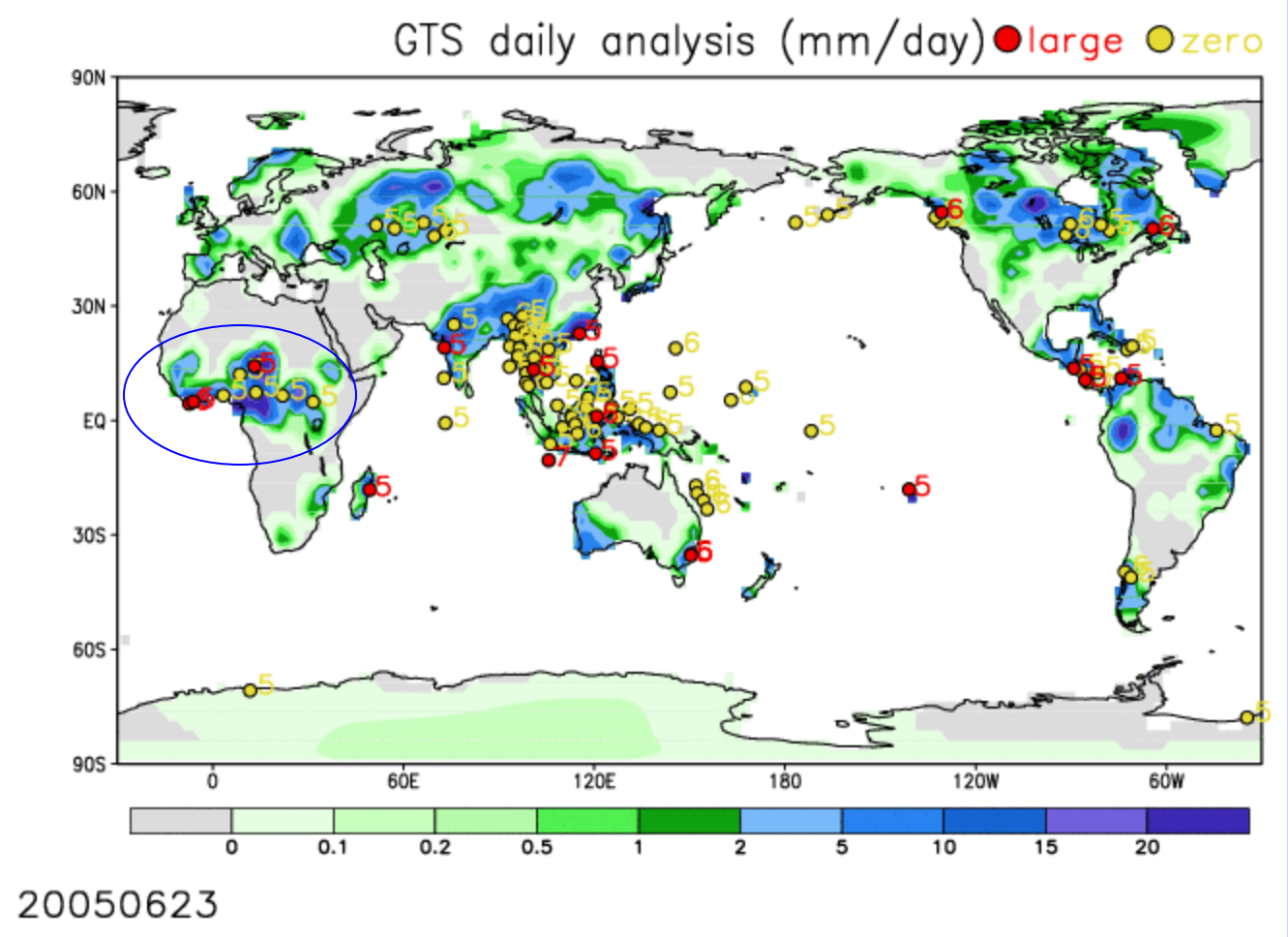
Aug. 28 2005



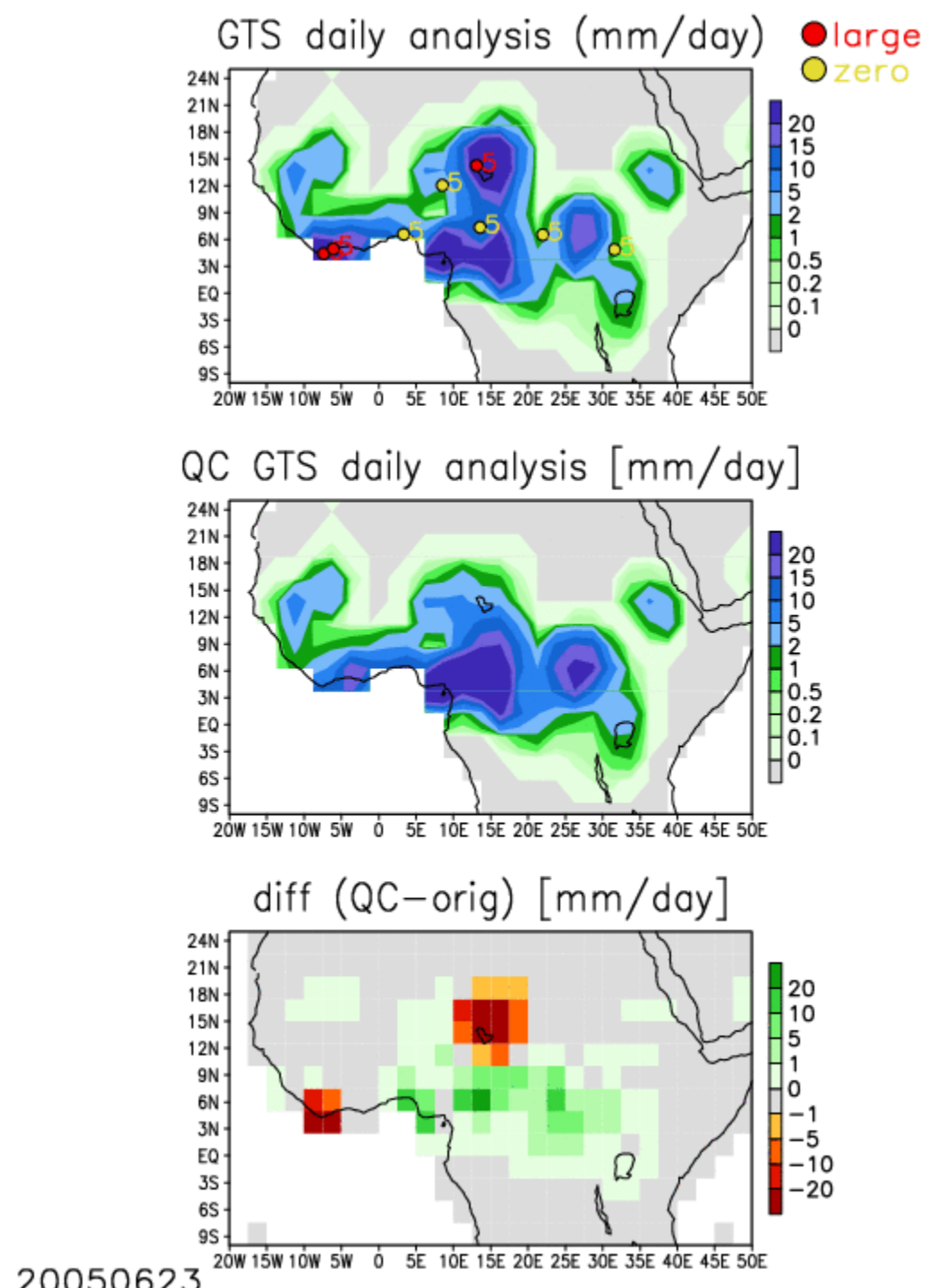


20050828

June 23, 2005


GTS daily analysis (mm/day) large zero
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
0
0.1
0.2
0.5
1
2
5
10
15
20
20050623

June 23 2005


GTS daily analysis (mm/day)
large
zero
QC GTS daily analysis [mm/day]
diff (QC−orig) [mm/day]
20050623

Summary

- A new QC system has been established for global GTS daily precip obs.
- The system outputs suspiciousness levels of suspicious “0” and large value reports.
- The suspiciousness levels are based on the weighted probability from independent comparisons with neighborhood, climatology, satellite estimates and GFS forecast.
- The system has been tested for JJA 2005, and results were compared with that from US and SA regional QC.