CPC Unified Gauge-based Analysis of Global Daily Precipitation

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CPC is Well-Known for Its Precipitation Products

- CPC Merged Analysis of Precipitation (CMAP)
- Higgins-Shi Gauge-based analysis of daily precipitation over US-MEX and Brazil
- Gauge-based analysis of global monthly precipitation analysis (PREC/L)
- Satellite-based precipitation estimates of CMORPH (CPC Morphing Technique)

A Project Launched to Create a Unified Suite of Precipitation Products

- **Problems with current CPC precipitation analyses**
  - Multiple precipitation analyses generated at CPC over the past ~20 years to satisfy various requirements
  - Do not take advantage of all available gauge and satellite data
  - Inconsistencies exist among the various CPC precipitation products
    - Differences in input data sources; and
    - Differences in objective analysis algorithms

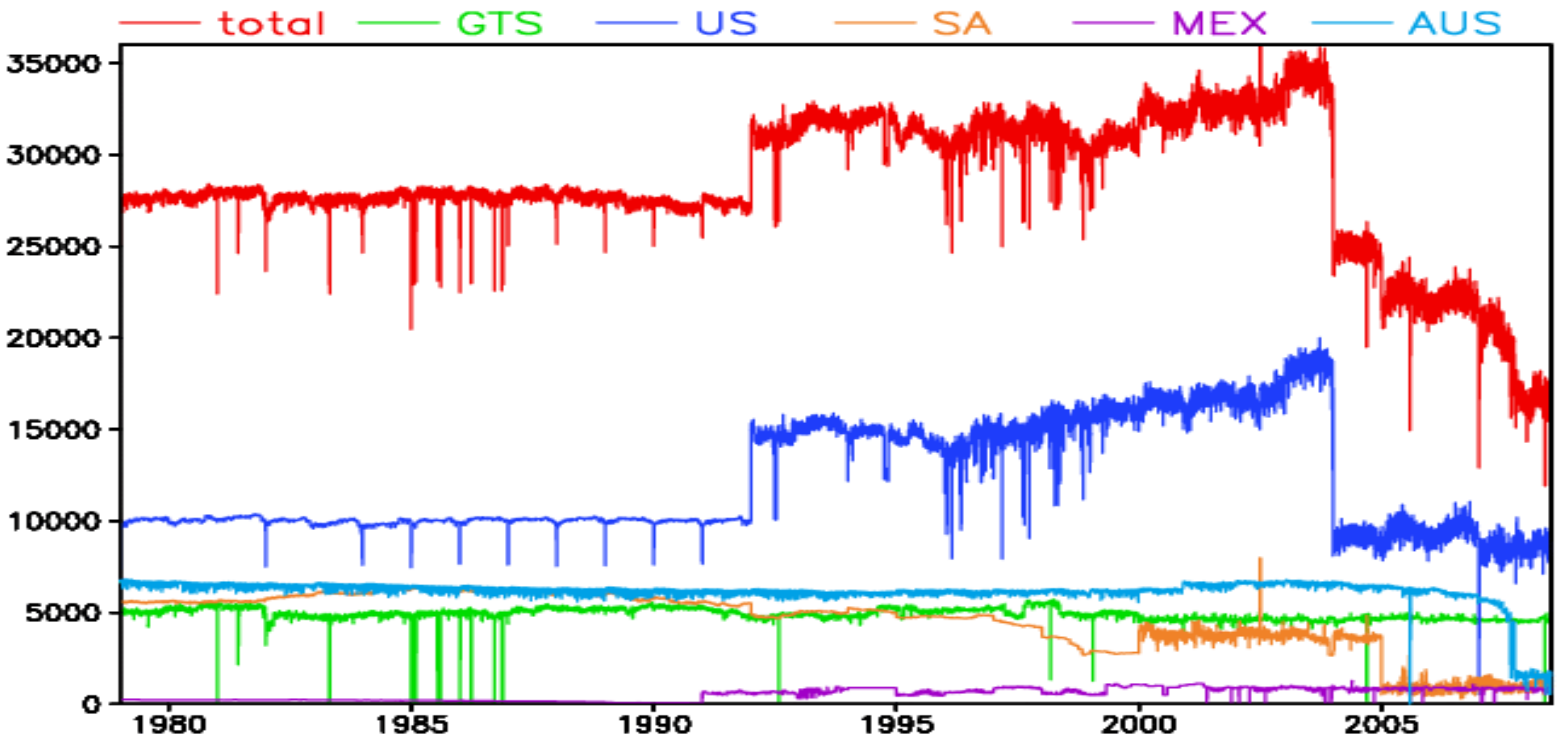
- **A project has been launched at CPC**
  - To unify the various CPC precipitation products by generating a suite of unified products of precipitation analysis
  - To improve quality and quantitative consistency

- **The first step of the project**
  - To construct a unified analysis of gauge-based daily precipitation over global land

Gauge-Based Analysis of Global Daily Precipitation

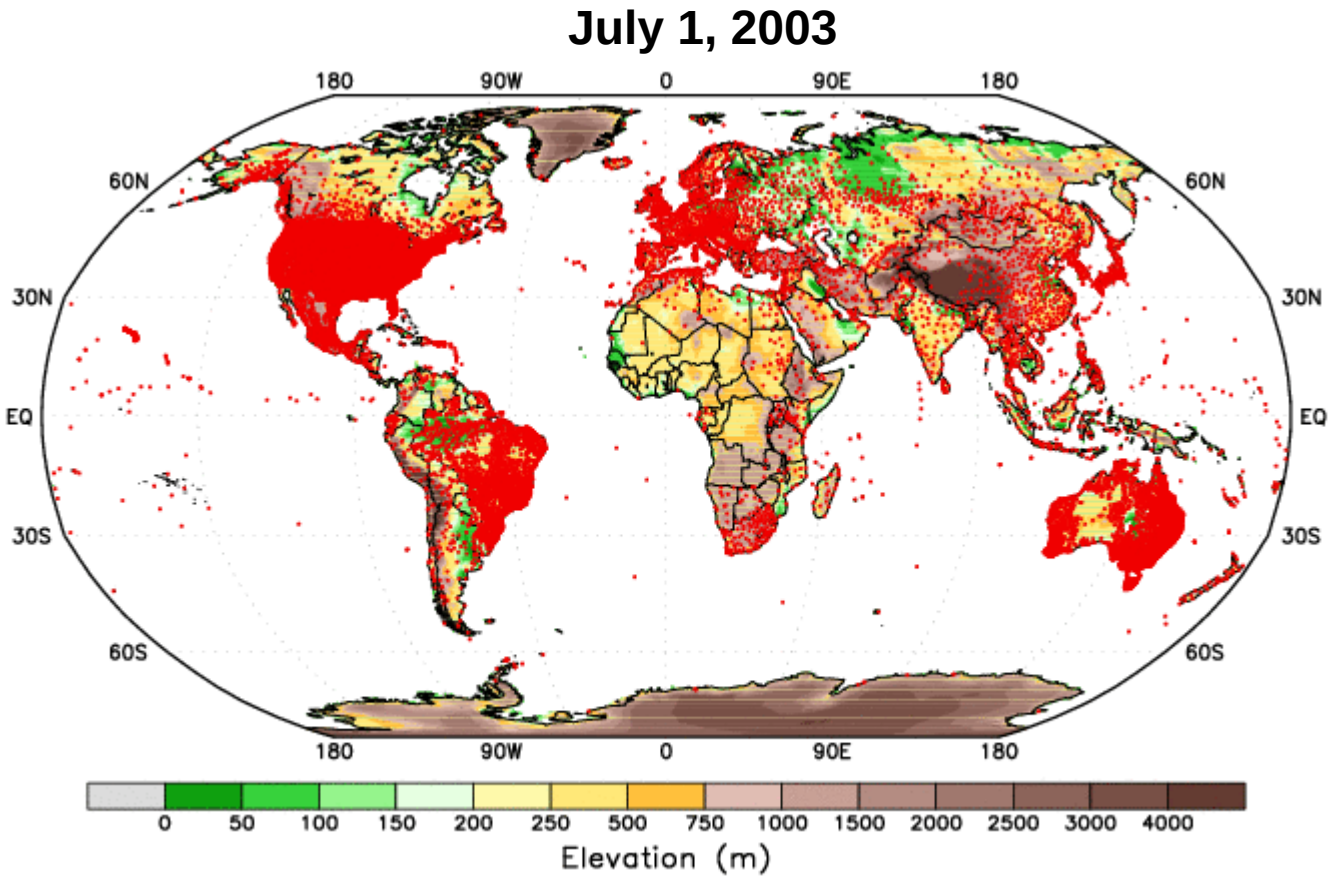
- QCed daily reports from >30,000 stations
- Optimal Interpolation (OI) with orographic consideration
- 0.5^{o}lat/lon grid over global land
- Daily fields from 1979 to present
- Real-time operations

Time Series of Available Reporting Stations



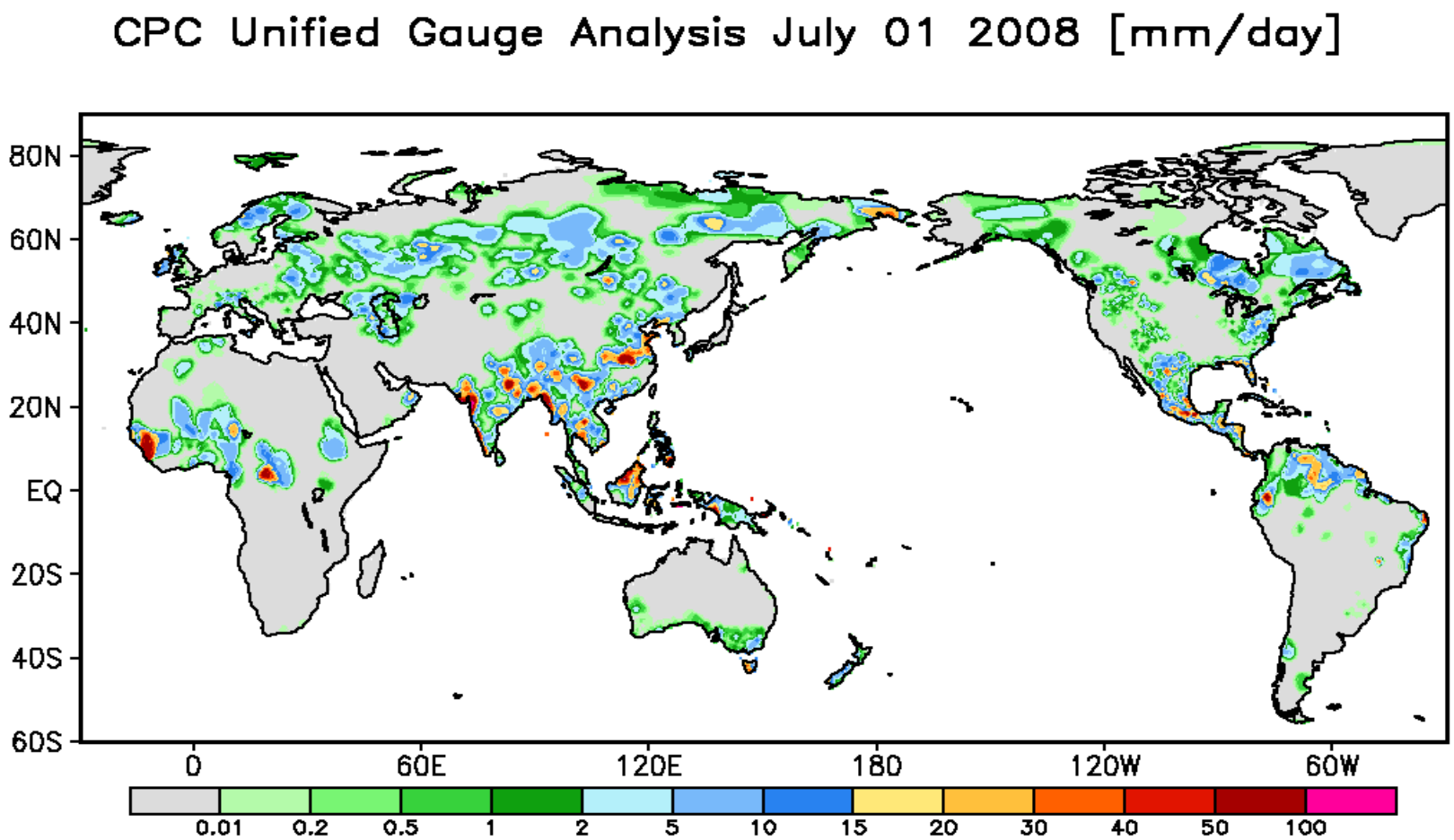
- Special CPC collections over US, Mexico, S. America, and Australia
- GTS gauge network elsewhere from ~5,000 stations
- Global daily reports available from ~17,000 stations at real time basis
- More than 30,000 stations in 1992-2004

Distribution of Reporting Stations



- Dense gauge networks from special CPC collections over US, Mexico, S. America, and Australia;
- GTS gauge network elsewhere
- Poor network over most of Africa continent, NE Europe, W China, central Australia, and the Amazon

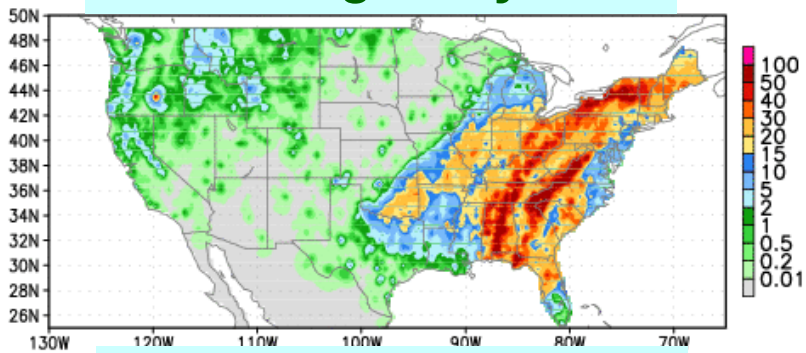
Example of Gauge-based Analysis



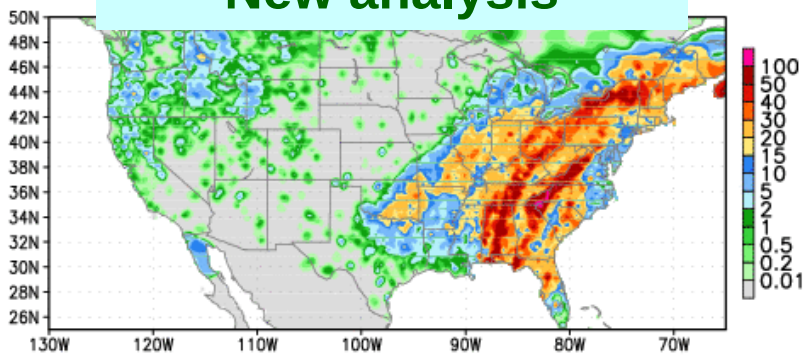
Comparison with Existing Analysis

- Comparison with CPC existing regional analysis over US for January 8, 1998
- Existing analysis is created using the Cressman method.
- The new analysis presents finer structure in better agreements with station data.

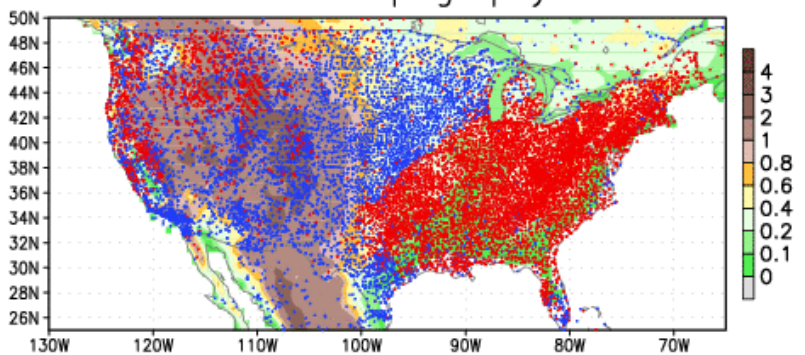
Existing analysis



New analysis



Stn & Topography



Cross-validation

- Withdraw 10% randomly selected station reports
- Define the analysis values at the withdrew stations using the remaining 90% reports
- Process 10 times
- Compare the original reports with the analysis values

Correlation & Bias at Different Sub-regions

	Cressman (existing)		OI (new)	
	Corr.	Bias (%)	Corr.	Bias (%)
Global	0.706	0.251	0.735	-0.349
U.S.	0.793	0.754	0.811	-0.467
Africa	0.364	3.316	0.377	-0.778

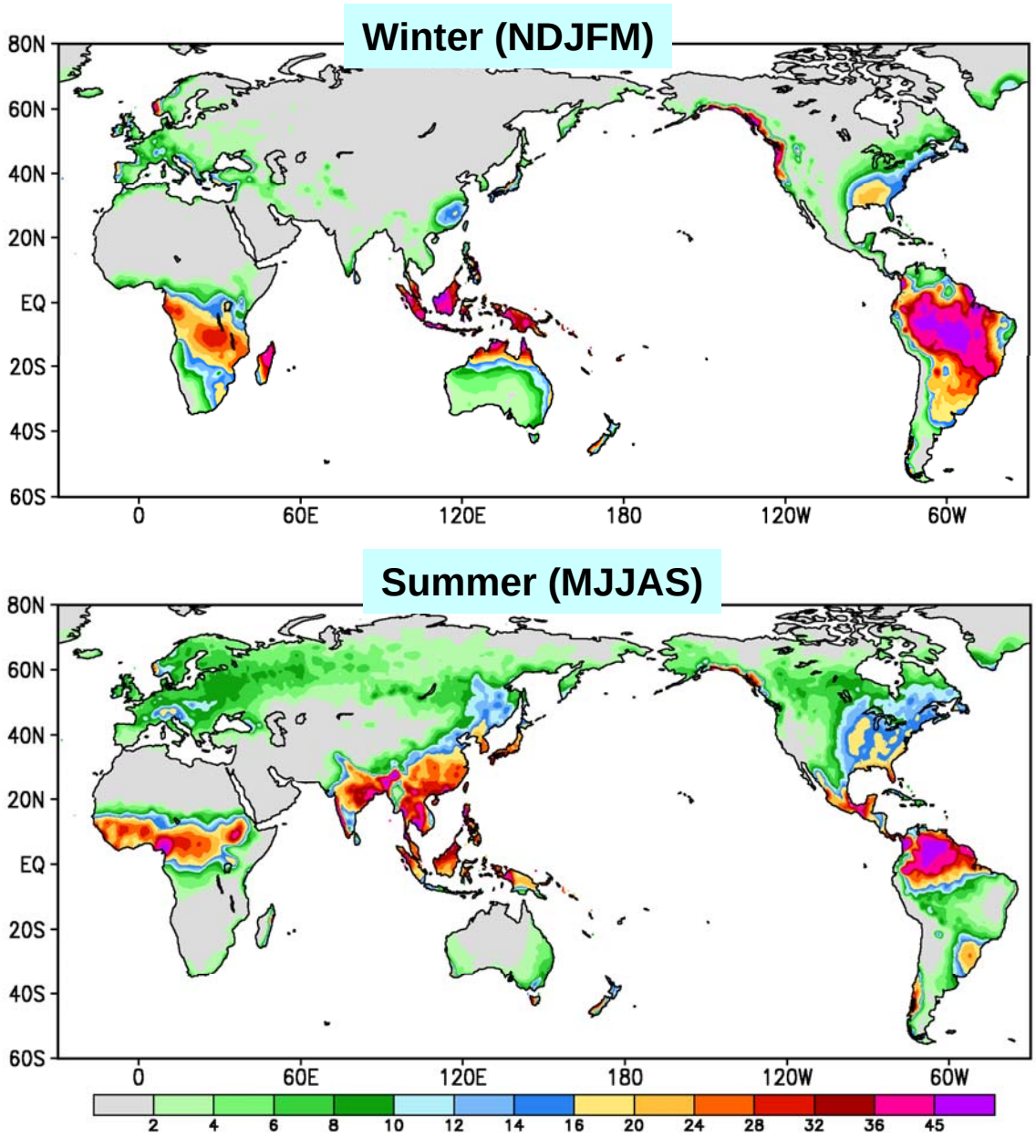
- All algorithms are capable to generate analysis with reasonable quality.
- The performance is the best over the US regions.
- The performance is relative poor over the Africa region.
- OI presents the higher correlation and smaller bias over most regions.

Application

Heavy Rain Frequency

- Average numbers of days with large rainfall in winter (NDJFM) and summer (MJJAS) from Jan1979 to July2008
- High heavy rain occurrence frequency over tropical convection zones, changes seasonally
- Heavy rain over NW coast and SE US, and E coast of China in winter
- Heavy rain over N Europe, SE Asia, and E and N of N. America in summer

Days with large rainfall value(10mm)

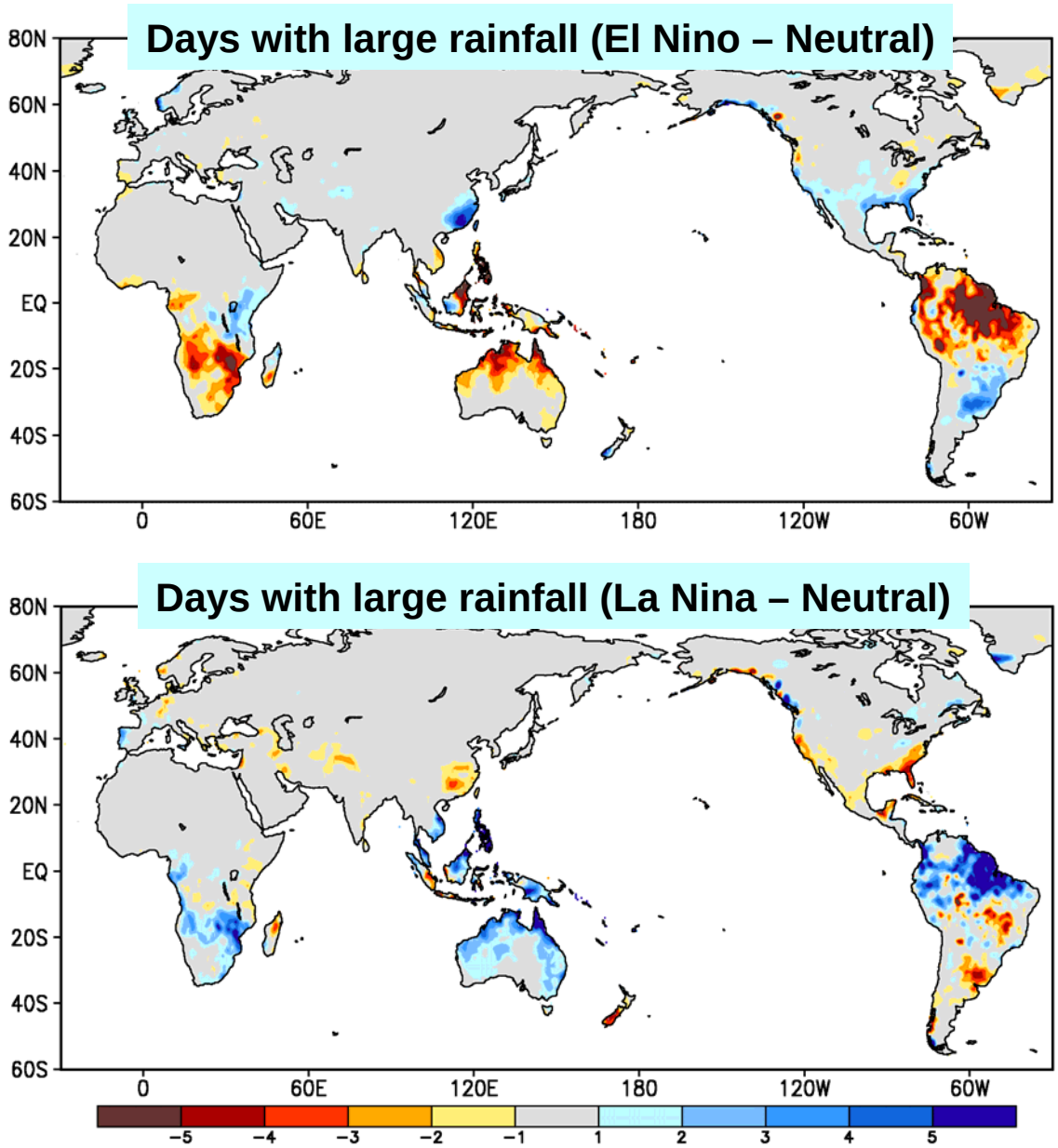


Application

Heavy Rain Frequency

- Differences of the numbers of days per winter season with large rainfall in El Nino years and Neutral years
- 14 Neutral/9 El Nino/7 La Nino years
- In El Nino years, more heavy rain events over the E. tropical Africa, E. coast China, W. and E. coast US, less heavy rain events over S. Africa, N. Australia, & N. of S. America

ENSO Impact on Winter Precipitation (NDJFM 1979-2007)

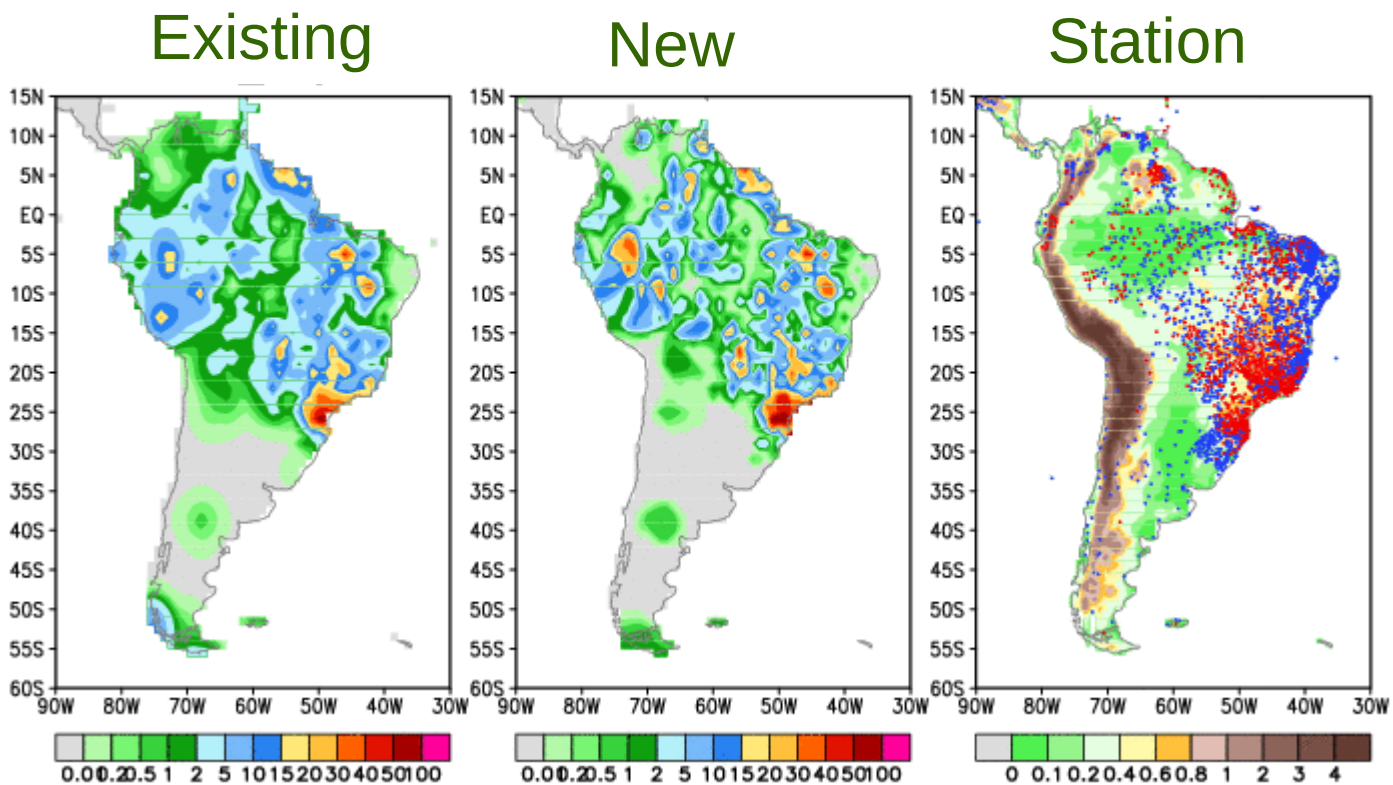


Summary

- Gauge-based analysis has been constructed by interpolating the QCed station data using the OI algorithm for an extended period from 1979 to present.
- The analysis is available at anonymous ftp site: ftp.cpc.ncep.noaa/gov/precip/CPC_UNI_PRCP
- The new grid analysis presents improved quality comparing to existing CPC analyses.
- The global daily precipitation analysis has many potential applications such as weather/climate monitoring, climate variability studies and model verifications.

Comparison with Existing Analyses

January 8, 1988



The existing analysis which is generated by the Cressman algorithm is smoother and presents large raining areas than the new analysis.

Cross-validation

- ~70% occurrence for no-rain;
- ~1% for 50mm heavy rain
- All analyses present lower frequencies for no-rain & strong rainfall events compared to gauge observations.
- Cressman analysis yields substantially reduced (inflated) frequencies for no-rain (light rain) events.

Histograms of Rainfall Intensity (PDF)