Update on VAMOS EXTREMES WG Activities and Plans

Siegfried Schubert and Iracema Cavalcanti (cochairs)

14th Session of the VAMOS panel
Miami, Florida, USA
25-26 March 2011

Extremes Working Group

- **The overall focus is on improving our understanding of the mechanisms and predictability of warm season extremes over the Americas**
  - Develop atlas of warm-season extremes over the Americas
  - Evaluation of existing and planned simulations
  - New model runs to address mechanisms and predictability of extremes

Alexander (Sasha) Gershunov, Scripps, UCSD, USA
Alice Grimm, Federal University of Paraná, Brazil
Brant Liebmann: CIRES/University of Colorado, USA/SA
Charles Jones: ICESS/UCSB-USA/Brazil/SA
Dave Gochis, ESSL/NCAR, USA
Hugo Berbery: UMD, USA
Hugo Hidalgo: Universidad de Costa Rica, Costa Rica
Jae Schemm: CPC/NOAA, USA
Kingtse Mo; CPC/NOAA –USA
Leila Vespoli De Carvalho: ICESS/UCSB-USA/SA
Matilde Rusticucci, FCEN–Universidad de Buenos Aires, Argentina
Olga Penalba, University of Buenos Aires, Argentina
Paulo Sergio Lucio, University of Rio Grande do Norte, Brazil
Tereza Cavazos, Dept. of Physical Oceanography, CICESE,
Tim LaRow, COAPS/FSU, USA
Viatcheslav (Slava) Kharin, Canadian Centre for Climate Modelling and Analysis, Canada
Xuebin Zhang, Environment Canad

Overview

- **Update on Atlas**
  - Main developer: Young-Kwon Lim (NASA/GMAO)
  - http://gmao.gsfc.nasa.gov/research/subseasonal/atlas/Extremes.html
- **Next steps**
- **Summary of WCRP Drought workshop**

Characterizing extremes for the recent past over the Americas

This webpage displays the rainfall and temperature characteristics for the last three decades over the Americas. Geographical distribution and time series of the values displayed on this webpage are climatology (seasonal & daily), rainfall frequency, temporal variation of the monthly precipitation in terms of the Standardized Precipitation Index (SPI), return values of extreme-related quantities from daily precipitation, and temperature extreme indices. The SPI is presented here to give an indication of what the precipitation amount is in relation to normal, and whether the individual locations experience wet/drought condition. Return values have been calculated for the daily maximum precipitation, the number of heavy rainfall events, the number of rainy days, and the consecutive dry days per season based on the Generalized Extreme Value (GEV) distribution. Please click the following list to be better informed about the concept of these values and the process of calculation.

Note: Please be aware that this atlas is a beta version. The atlas is still evolving as we learn more about the quality of the data and continue to add additional extreme parameters. We point out in particular that there are substantial regional difference in the quality of the reanalysis products with parts of South America showing considerably less (compare with North America) agreement in the precipitation and surface temperature fields among the reanalysis products and compared with observations (to the extent those are available). Please click Readmefirst for more information.

1. Mean fields
- 1.1 Seasonal climatology (Precipitation)
  - MERRA CFSR CPC (US&Mexico) CPC (SA) CDC (SA)
- 1.2 Seasonal climatology (Temperature)
  - MERRA (T mean, T max, T min) CFSR (T mean, T max, T min)
- 1.3 Daily precipitation climatology
- 1.4 Daily rainfall frequency

Basic climatologies

2. Precipitation extreme indices
- 2.1 The Number of Extreme Rain Days (Prcp. amount > 90% percentile) Maps
- 2.2 Maximum Length of Wet Spell (Max. number of consecutive rainy days (rain >= 1mm)) Maps
- 2.3 Maximum Length of Dry Spell (Max. number of consecutive dry days (rain < 1mm)) Maps

Precipitation extremes

3. Standardized Precipitation Index (SPI)
- 3.1 SPI maps
- 3.2 SPI time series
- 3.3 SPI plots for each season
  - MAM JJA SON DJF

SPI time series and maps

4. Generalized Extreme Value (GEV) and Return values
- 4.1 Return value maps
- 4.2 Return value maps in ENSO phases
  - El Niño years La Niña years Difference (El Niño - La Niña)

Precipitation return values based on GEV fits, including impact of ENSO

5. Temperature extreme indices
- 5.1 The Number of Warm Extreme Days (Tmax >= 90% percentile) Maps
- 5.2 The Number of Warm Extreme Days time series
- 5.3 The number of Cold Extreme Days (Tmin =< 10% percentile) Maps
- 5.4 The Number of Cold Extreme Days time series
- 5.5 Warm Spell Duration Index (WSDI) time series
- 5.6 Cold Spell Duration Index (CSDI) time series
- 5.7 The Number of Warm Extreme Nights (Tmin >= 90% percentile) Maps
- 5.8 The Number of Warm Extreme Nights time series

Various temperature extremes - latest

Datasets used:
1. Modern Era Retrospective-analysis for Research and Applications (MERRA) (1979-2009) from NASA/GSFC/GMAO (0.667x0.5 degree resolution)
2. The Climate Forecast System Reanalysis (CFSR) (1979-2009) from NOAA/NCEP (T382(~0.3125 degree Resolution))
3. NOAA/NCEP/CPC gridded observation (1.0 degree resolution)
   - 3.1 North America (US and Mexico) (1979-2009)
   - 3.2 South America (1978-2007)
4. NOAA/CDC (Liebmann et al. 2005) gridded observation over South America (1979-2005) (2.5 degree resolution)

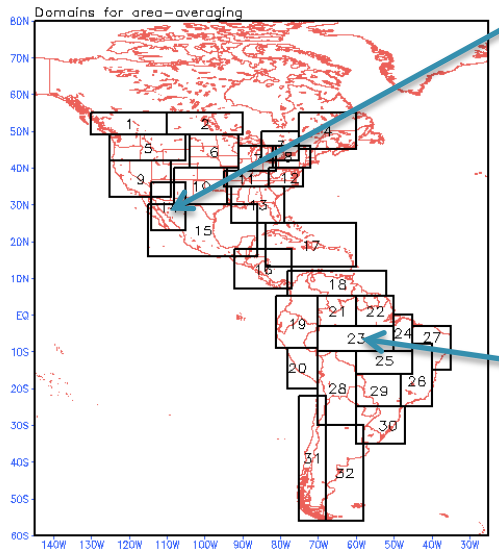
Data sets: MERRA, CFSR, gridded station obs (CPC, CDC)

Climatology – Annual Cycle of Daily Precipitation

Daily precipitation amount climatology (1979-2009) (domain averaged)

Daily precipitation climatology [mm/day] Domains for area-averaging (Click here--)		
1. SW Canada	2. SC Canada	3. SE Ontario (Toronto & near Great lakes)
4. SE Canada (Quebec(Montreal))	5. US (WA, OR, ID, MT, WY)	6. US (ND, SD, NE, MN, IA)
7. US (WI, IL, IN, MI, OH)	8. US (PA, NY, NJ, CT, MA, RI, NH, VT, ME)	9. US (CA, NV, UT, AZ)
10. US (CO, NM, KS, OK, TX)	11. US (MO, AR, KY, TN)	12. US (WV, VA, MD, DC, DE, NC)
13. US (LA, MS, AL, FL, GA, SC)	14. North American Monsoon (NAM)	15. Mexico
16. C America (Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Panama)	17. Caribbean isand countries	18. N Colombia, Venezuela, Tri.&Tobago, N Guyana
19. Ecuador, S Colombia, N Peru	20. S Peru	21. NW Amazon (NW Brazil), S Venezuela
22. NE Amazon (N Brazil), S Guyana, Suriname, French Guiana	23. Amazon (W Brazil)	24. Amazon (NE Brazil)
25. C Brazil	26. SE Brazil	27. E Brazil
28. Bolivia, N Argentina	29. Paraguay, S Brazil	30. Uruguay, SE Brazil
31. Chile, W Argentina (Andes)	32. E Argentina	

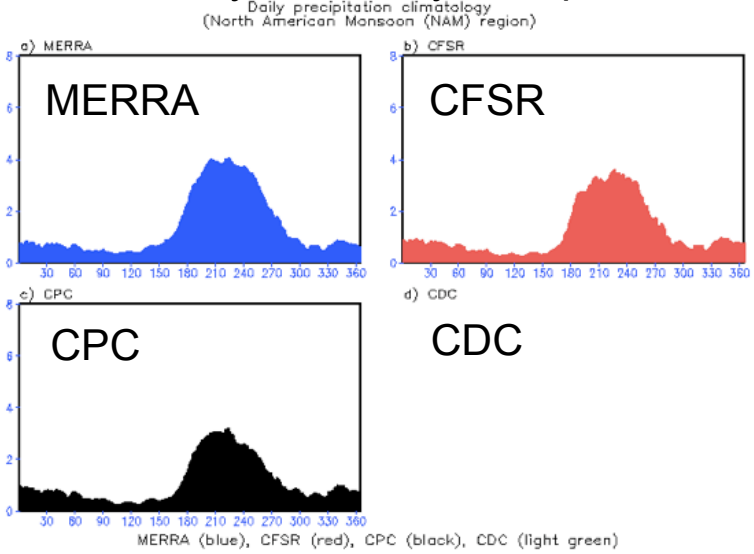
Choice of Regions



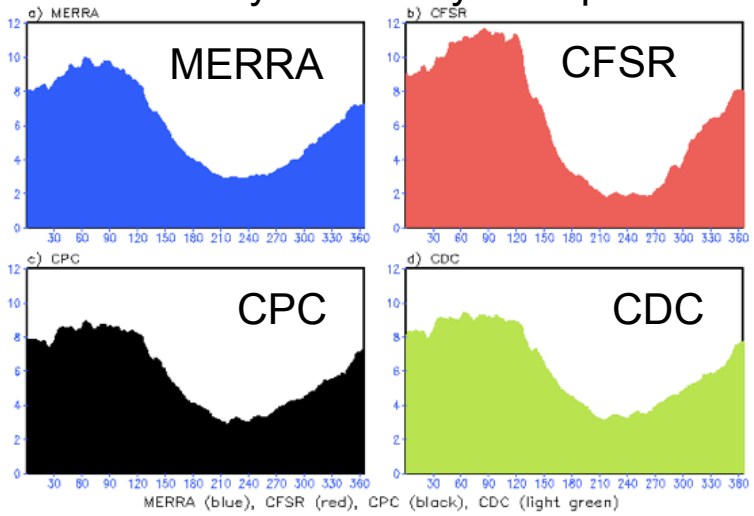
NAM

W. Brazil

Annual Cycle of daily Precipitation

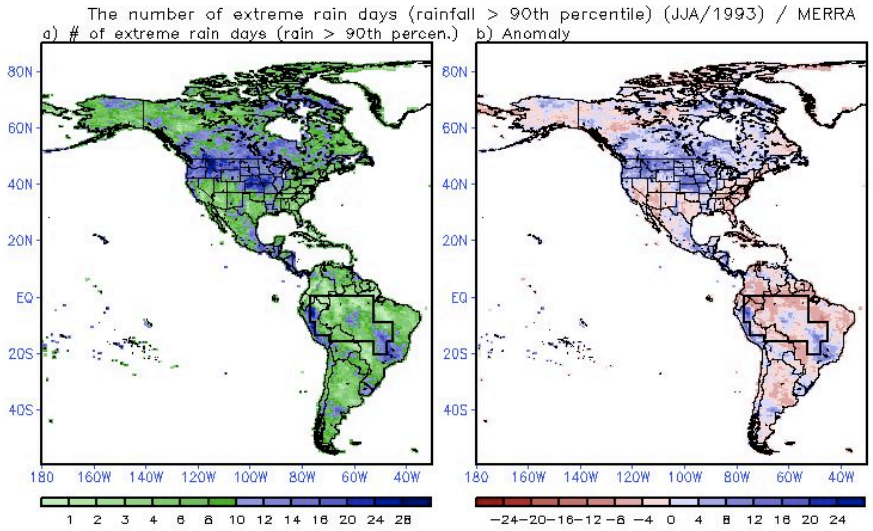


Annual Cycle of daily Precipitation



The Number of Extreme Rain Days (90th percentile) maps

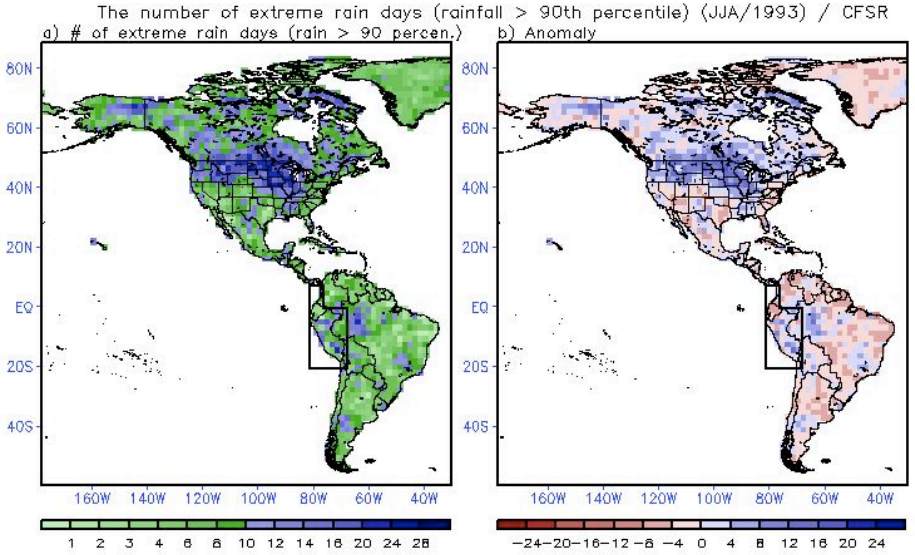
JJA 1993:MERRA



Total

Anomaly

JJA 1993:CFSR



Total

Anomaly

Standardized Precipitation Index (SPI)

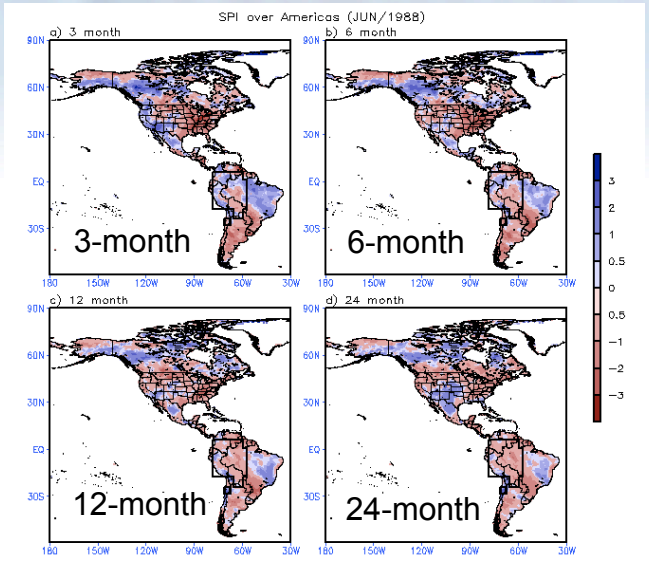
Standardized Precipitation Index time series over 1981-2009

Note: Part of South America where the reanalysis is very low correlated (MERRA CFSR) with the observational CPC precipitation show some inconsistency with the observational SPI time series. Please be sure to check **Domains for area-averaging** (Domains) before looking at the SPI time series

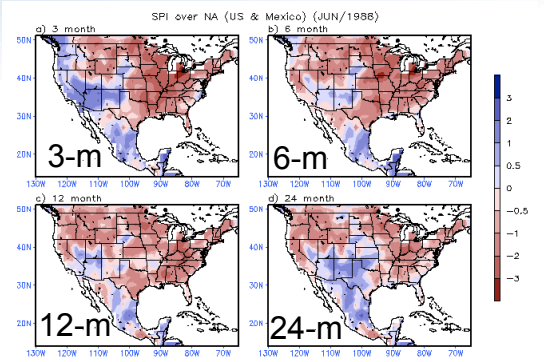
1. SW Canada 3 mon, 6 mon, 12 mon, 24 mon.	2. SC Canada 3 mon, 6 mon, 12 mon, 24 mon.	3. SE Ontario (Toronto & near Great lakes) 3 mon, 6 mon, 12 mon, 24 mon.
4. SE Canada (Quebec(Montreal)) 3 mon, 6 mon, 12 mon, 24 mon.	5. US (WA, OR, ID, MT, WY) 3 mon, 6 mon, 12 mon, 24 mon.	6. US (ND, SD, NE, MN, IA) 3 mon, 6 mon, 12 mon, 24 mon.
7. US (WI, IL, IN, MI, OH) 3 mon, 6 mon, 12 mon, 24 mon.	8. US (PA, NY, NJ, CT, MA, RI, NH, VT, ME) 3 mon, 6 mon, 12 mon, 24 mon.	9. US (CA, NV, UT, AZ) 3 mon, 6 mon, 12 mon, 24 mon.
10. US (CO, NM, KS, OK, TX) 3 mon, 6 mon, 12 mon, 24 mon.	11. US (MO, AR, KY, TN) 3 mon, 6 mon, 12 mon, 24 mon.	12. US (WV, VA, MD, DC, DE, NC) 3 mon, 6 mon, 12 mon, 24 mon.
13. US (LA, MS, AL, FL, GA, SC) 3 mon, 6 mon, 12 mon, 24 mon.	14. North American Monsoon (NAM) 3 mon, 6 mon, 12 mon, 24 mon.	15. Mexico 3 mon, 6 mon, 12 mon, 24 mon.
16. C America (Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Panama) 3 mon, 6 mon, 12 mon, 24 mon.	17. Caribbean island countires 3 mon, 6 mon, 12 mon, 24 mon.	18. N Colombia, Venezuela, Trl.&Tobago, N Guyana 3 mon, 6 mon, 12 mon, 24 mon.
19. Ecuador, S Colombia, N Peru 3 mon, 6 mon, 12 mon, 24 mon.	20. S Peru 3 mon, 6 mon, 12 mon, 24 mon.	21. NW Amazon (NW Brazil), S Venezuela 3 mon, 6 mon, 12 mon, 24 mon.
22. NE Amazon (N Brazil), S Guyana, Suriname, French Guiana 3 mon, 6 mon, 12 mon, 24 mon.	23. Amazon (W Brazil) 3 mon, 6 mon, 12 mon, 24 mon.	24. Amazon (NE Brazil) 3 mon, 6 mon, 12 mon, 24 mon.
25. C Brazil 3 mon, 6 mon, 12 mon, 24 mon.	26. SE Brazil 3 mon, 6 mon, 12 mon, 24 mon.	27. E Brazil 3 mon, 6 mon, 12 mon, 24 mon.
28. Bolivia, N Argentina 3 mon, 6 mon, 12 mon, 24 mon.	29. Paraguay, S Brazil 3 mon, 6 mon, 12 mon, 24 mon.	30. Uruguay, SE Brazil 3 mon, 6 mon, 12 mon, 24 mon.
31. Chile, W Argentina (Andes) 3 mon, 6 mon, 12 mon, 24 mon.	32. E Argentina 3 mon, 6 mon, 12 mon, 24 mon.	

SPI June 1988

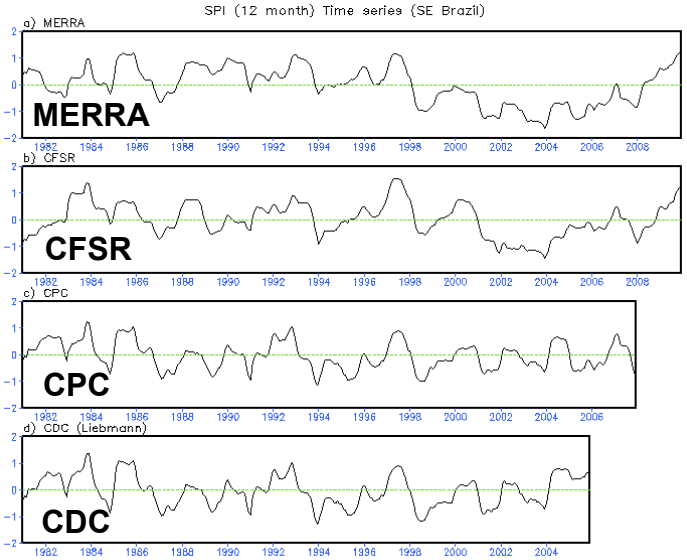
MERRA



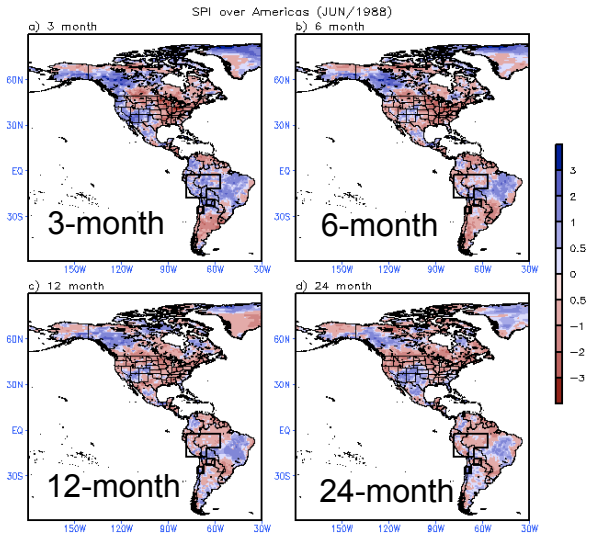
CPC



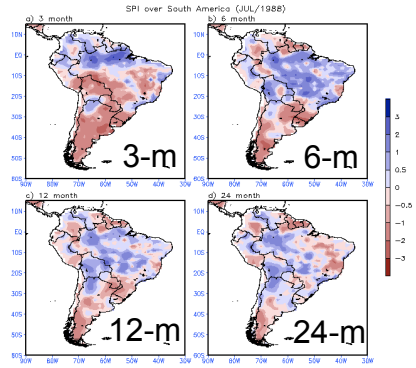
SPI 12 month – SE Brazil



CFSR



CDC



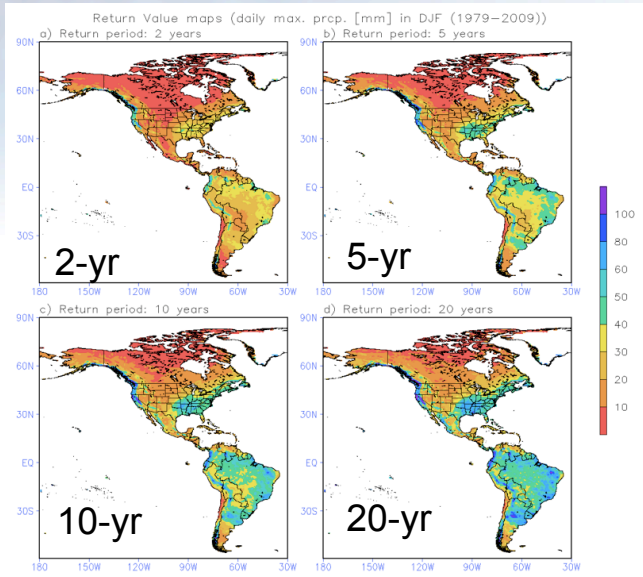
Return Values Based on Fit to GEV Distributions

Return Value maps based on Generalized Extreme Value (GEV) Distribution

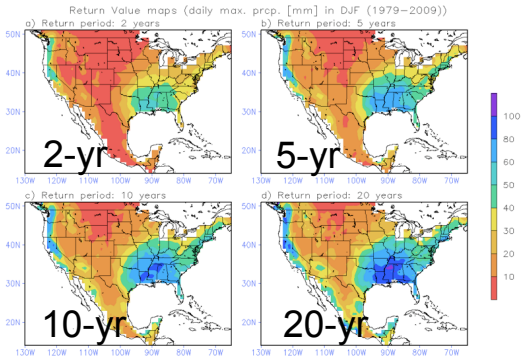
Return value (with N year return level) is defined as a value which is expected to be equaled or exceeded on average once every N years. Therefore, conceptual basis on the calculation of return value is inverting the probability distribution function of a sample of extremes. Calculation details including GEV distribution fitting is available at GEV and RV calculation. In this work, return values were calculated for 2-, 5-, 10-, and 20-yr return period, for the four extreme value-related quantities in each season. From the return value maps, we can find out the anticipated return values for the amount of heavy rainfall, the number of heavy rainfall days, the number of rainy days, and maximum consecutive dry days for a given return period. Please be advised that the return values for the maximum daily precipitation tend to be overestimated by CFSR, while they are underestimated by MERRA, compared with return values calculated from gridded observation (NCEP/CPC). We suggest that overestimation by CFSR might be associated with longer tail of the PDF curves that were shown in section 3.1. Please also note that the datasets used for return value calculation are gridded ones that were averaged over a grid box. Therefore, return values calculated here could be lower than return values calculated from local station data.

	Return Value maps based on Generalized Extreme Value distribution			
	MAM	JJA	SON	DJF
daily maximum precipitation	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA
the number of heavy rain days (>10mm/day)	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA
the number of rainy days (>1mm/day)	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA
maximum consecutive dry days	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA	MERRA CFSR CPC-US,MX CPC-SA CDC-SA

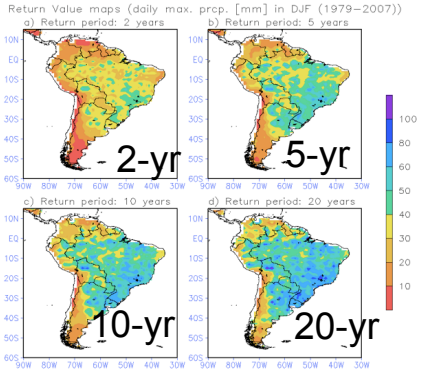
MERRA



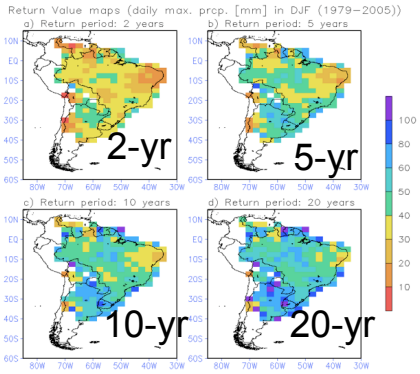
CPC



CPC



CDC



Next Steps

- Continue updating Atlas (adding new observations, extremes parameters, continue evaluation/validation)
- Hope to establish atlas based on station observations
  - http://eca.knmi.nl/ (European Climate Assessment & Dataset (ECA&D) project)
  - Implemented by ECA&D, we provide the observations for the Americas
- Begin adding model results (initially from GMAO)
  - ½ degree global AMIP simulations for 1979-present
  - selected years at 10km
- Science (take advantage of atlas, observations and model runs)
- Propose new model runs – e.g., case studies
- Special Session on Extremes at AGU

Extremes Atlas: Based on Station Data

- Developed at KNMI for Europe
  - European Climate Assessment and Data (ECA&D)
  - http://eca.knmi.nl
- Recently ported to focus on Indonesia
  - Southeast Asian Climate Assessment and Data (SACA&D)
  - http://saca-bmkg.knmi.nl/rcc/
- Propose porting to focus on the Americas region
  - Americas Climate Assessment and Data (ACA&D)
  - Porting done by KNMI (cost: 3 person-months + approx. $5K for computer)
  - We would be responsible for providing and updating the data and a mirror-site
  - Have verbal agreement (contact: Gerard van der Schrier schrier@knmi.nl)

Update on WCRP DIG Drought Workshop (Barcelona)

- 2-4 March 2011 (plus 5 March follow-on meeting)
- About 140 attendees from all over the world
- All presentations are available at:
  - http://drought.wcrp-climate.org/workshop/index.html
- Hope to finalize drought white paper in coming months
- Key Action Items from workshop:
  - Develop a drought catalog that provides a summary of our current understanding of the causes of drought world-wide. E.g., a map that summarizes in each location the important time scales (e.g., subseasonal, seasonal, decadal, centennial) and mechanisms (e.g. ENSO, PDO, land feedbacks, global warming) with links to relevant publications
  - Define case studies and carry out coordinated (at the WCRP level) analysis of the mechanisms, predictability and prediction skill - here we will choose cases that have a high profile and strong links to user needs.
  - Define and develop an experimental drought early warning system (DEWS) that takes advantage of our current capabilities in drought prediction and monitoring (with links to the NIDIS drought portal and other national drought monitoring activities).