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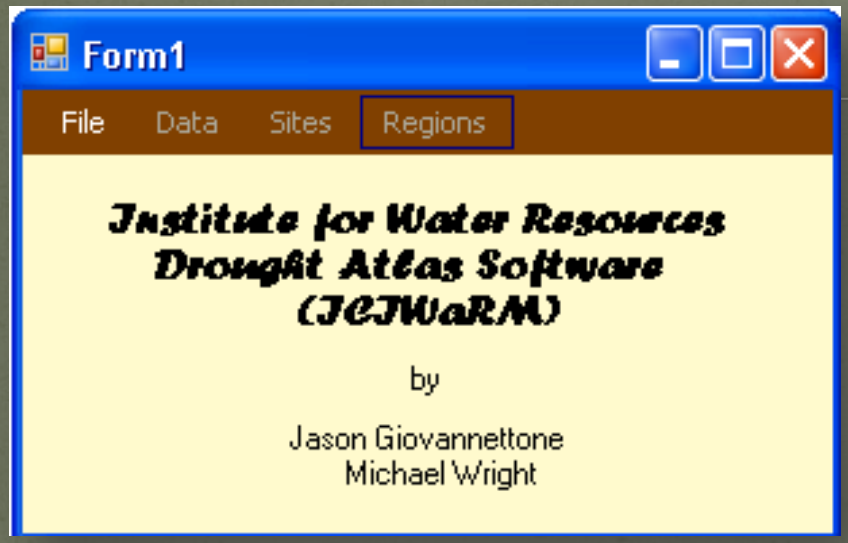
The ICI-WaRM Non-Proprietary Regional Frequency Analysis Tool Using the Method of L-Moments



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Objective

- Objective: Develop a free tool that uses available rainfall data to create rainfall frequency maps.
- Useful in arid & semi-arid regions.
- Many developing countries are located in dry regions.
- Maps assist in identifying areas vulnerable to climate change impacts on precipitation.
- Overall Result: Assist in long-range planning for arid developing countries where changes in rainfall due to climate change can be expected.

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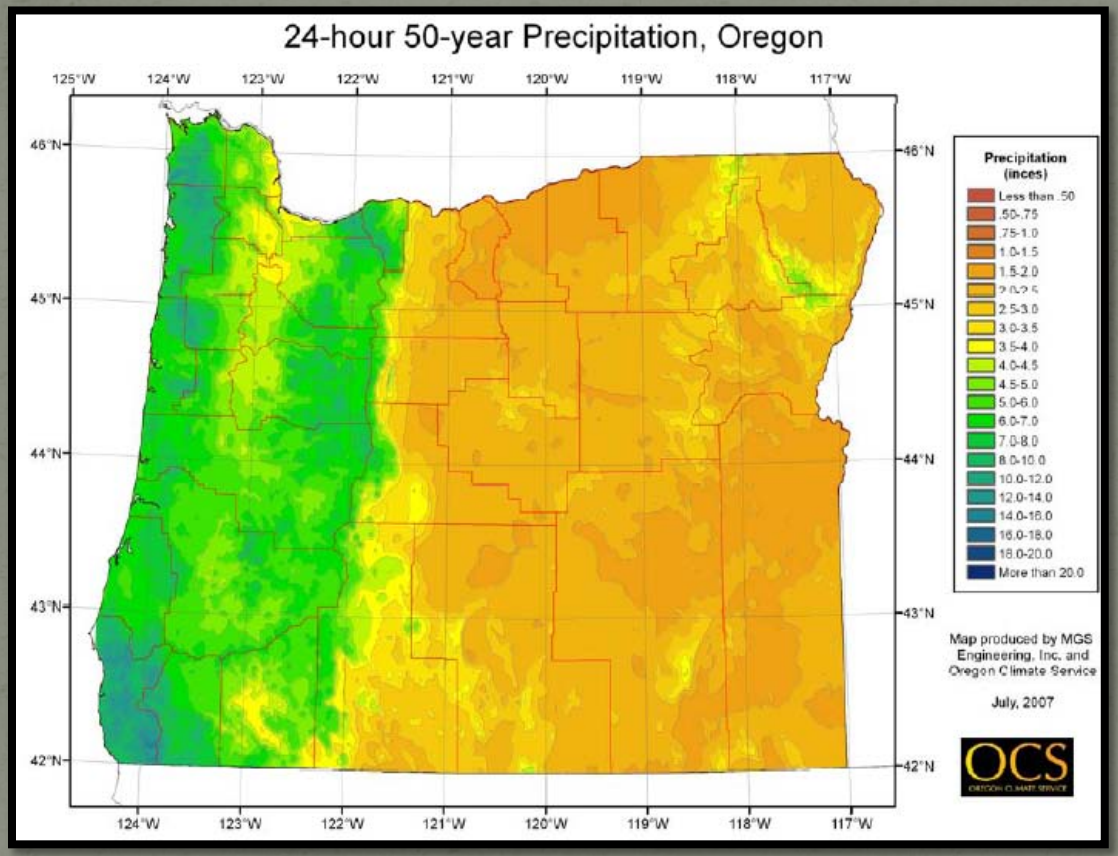
Rainfall Frequency Map



• Taken from Schafer et al. (2007). "Regional precipitation-frequency analysis and spatial mapping of 24-hour precipitation for Oregon," prepared by MGS Engineering Consultants, Inc. for the Oregon State Department of Transportation, 84 pp.

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ICIWaRM

- ICIWaRM: International Center for Integrated Water Resources Management.
- Category 2 UNESCO center headquartered at the Institute for Water Resources
- Consortium of universities, U.S. gov't agencies, & NGOs supporting UNESCO's IHP strategic program.
- Software supports ICIWaRM mission of aiding developing countries in water resources management & contributing to developing non-proprietary analytical tools.

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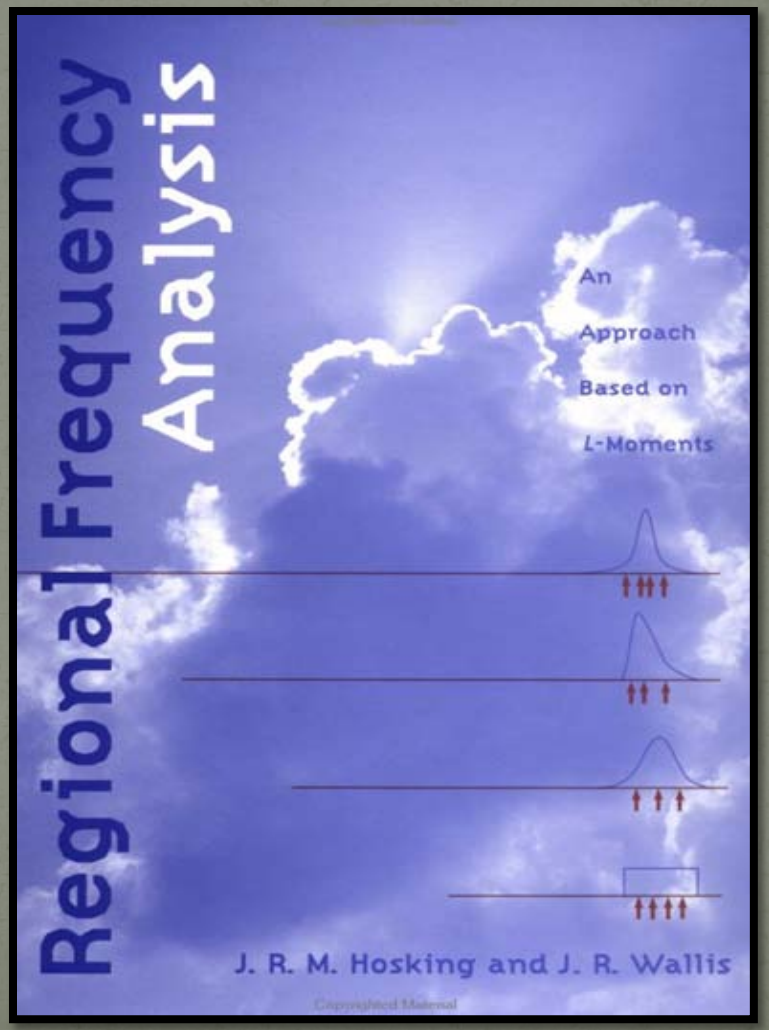
Definitions: L-Moments

- *L-moments* are the statistics used to determine the exact shape of the regional frequency.
- L-Mean, L-Coefficient of Variation, L-Skew, L-Kurtosis
- Developed by John Hosking & James Wallis



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Definitions: Regional Rainfall Frequency Analysis

- *Regional rainfall frequency analysis* is performed by grouping rainfall data from multiple sites with similar frequency distributions.
- Caution must be exercised in determining regions (e.g. Are sites only located on rivers?)

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Definitions: Drought Atlas

- A *drought* (rainfall frequency) *atlas* is a collection of maps/statistics that reveals the spatial distribution of storm intensities for particular frequencies.

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Input Data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Site ID	Latitude	Longitude	Elevation	Annual Mean Temperature	Annual Mean Precipitation	Mean Julian Day	Seasonality Index	Mean Precipitation (Winter)	Mean Precipitation (Spring)	Mean Precipitation (Summer)	Mean Precipitation (Autumn)	Other (1)	Other (2)	Other (3)	Eco-Regions/ Own Regions	Mean Precipitation (Selected Period)
2																	
3																	
4	8000900	11.13	-74.23	2			233.1929376	0.51710862								61308	200
5	8002200	10.45	-75.52	0			249.9389902	0.490782378								61401	200
6	8002800	10.9	-74.77	15			238.9474185	0.506581731								61308	200
7	8008401	8.12	-76.72	12			214.5577904	0.145107929								60137	200
8	8009100	7.02	-73.8	121			227.525528	0.197161636								60137	200
9	8009400	7.1	-73.2	1104			196.2399141	0.087765357								60136	200
10	8009704	7.6	-72.6	1272			284.5967965	0.117820307								60118	200
11	8009705	7.7	-72.7	1407			303.0542821	0.180009244								60118	200
12	8011202	5.9	-75.7	1496			212.4710466	0.150247982								60109	200
13	8011203	6.2	-75.6	1587			200.7289125	0.146755966								60136	200
14	8011206	6.22	-75.6	1528			209.863921	0.1428942								60136	200
15	8014902	5	-75.6	1295			184.9718123	0.020626232								60109	200
16	8014905	4.9	-75.1	2141			146.9336935	0.00797214								60136	200
17	8014911	4.98	-75.58	1463			228.3568478	0.018161971								60109	200
18	8021000	4.82	-75.8	1186			307.7957521	0.034361705								60109	200
19	8021100	4.5	-75.72	1302			15.41589255	0.073857596								60109	200
20	8021101	4.5	-75.6	2151			325.8450427	0.081081388								60109	200
21	8021400	4.43	-75.15	960			162.8213581	0.030195232								60221	200
22	8021900	4.28	-74.8	284			107.0949758	0.018964508								60221	200
23	8021904	4	-75	326			87.660313	0.062585756								60221	200
24	8021905	3.8	-75	326			344.8226573	0.122110602								60221	200
25	8021906	4.2	-74.9	330			129.0709464	0.036956398								60221	200
26	8021907	4	-75	326			90.82839864	0.016099452								60221	200
27	8021908	4.3	-74.4	1573			360.5458278	0.146726016								60136	200
28	8022200	4.7	-74.13	2550			354.2516696	0.037475064								60136	200
29	8024100	4.55	-70.92	184			186.0963571	0.392823215								60709	200
30	8025900	3.55	-76.38	962			52.00408303	0.080219823								60207	200
31	8025901	3.5	-76.3	991			43.36627263	0.09678166								60207	200
32	8025902	3.8	-76.5	1516			212.3094601	0.037714094								60145	200
33	8025903	3.5	-76.3	991			68.41840873	0.082110351								60207	200
34	8025905	3.4	-76.4	960			69.58678596	0.094160165								60207	200
35	8030800	2.47	-76.6	1737			357.7628545	0.255447306								60109	200
36	8030801	2.45	-76.58	1809			361.345847	0.223939096								60109	200
37	8031500	2.97	-75.3	425			3.958842076	0.258672108								60221	200
38	8031502	3.6	-75.1	322			360.6683265	0.168805494								60221	200
39	8031503	3.7	-75.5	869			356.3201274	0.106873071								60221	200
40	8033700	1.57	-78.68	17			109.0627878	0.255437627								60178	200
41	8034200	1.42	-77.27	1915			18.40327923	0.138653878								60145	200
42	8034204	1.27	-77.47	1873			5.236239721	0.118449082								60145	200
43	8037000	0.82	-77.63	2851			11.24676114	0.119242509								60145	200
44	8037001	1.2	-78	1368			19.64773785	0.104582121								60145	200

moxyrData | OtherData | Indices | Sheet2

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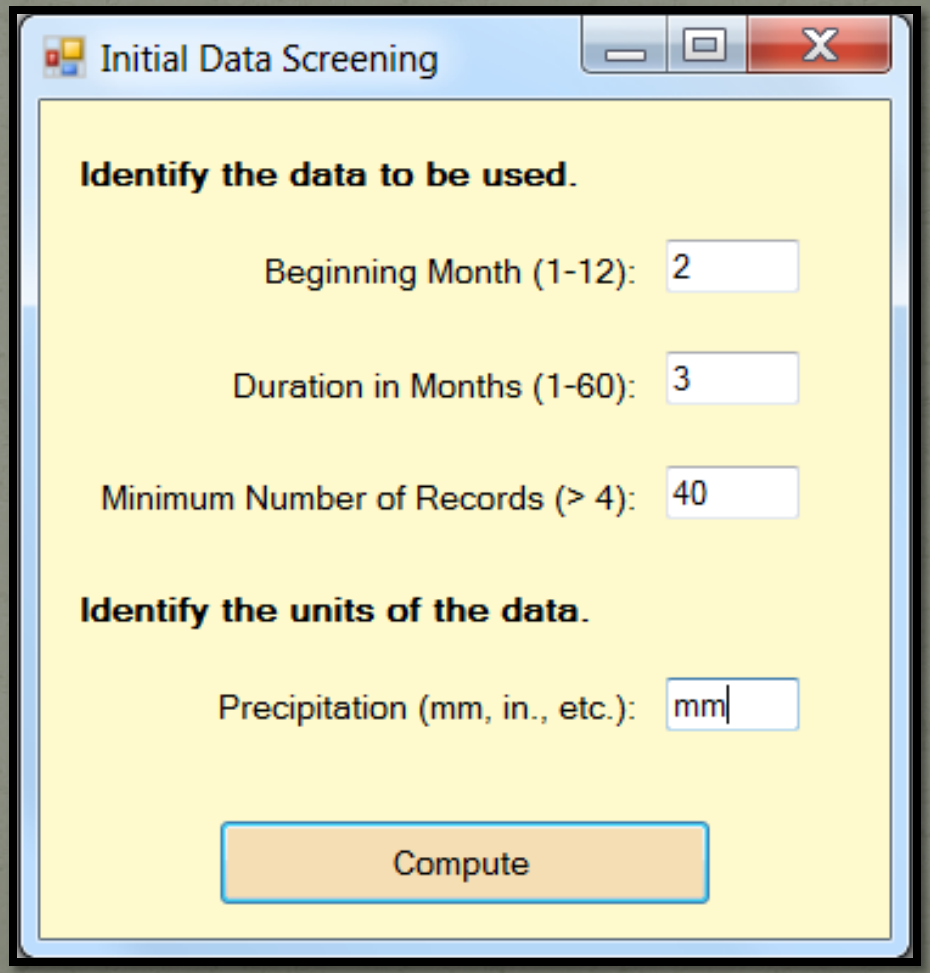
Choose Data

- Choose a period to analyze.
- Beginning month = February.
- Period duration = February – April.
- Each site requires 40 good periods of data to be used.



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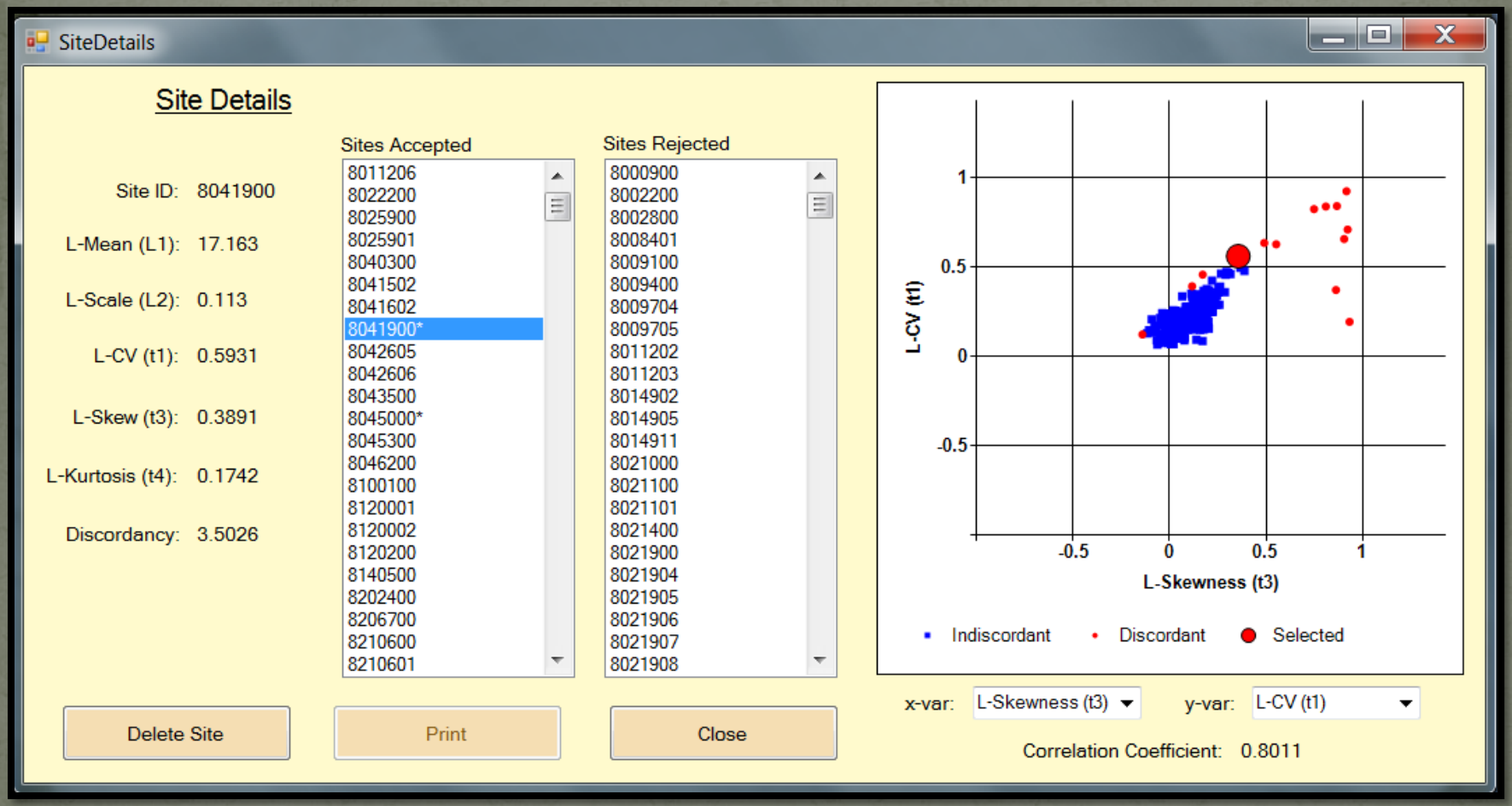
Discordancy



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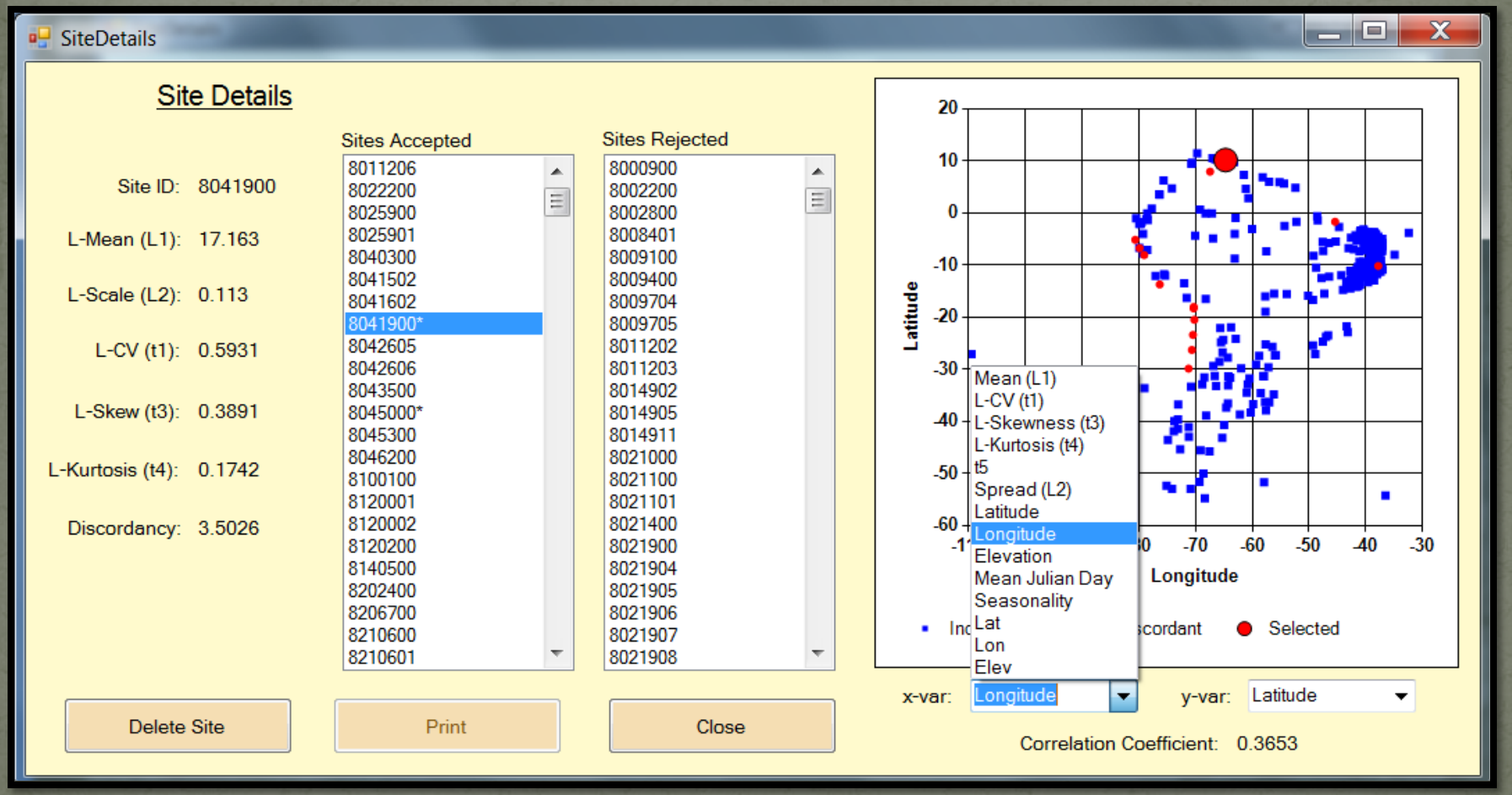
Locations of Discordancy



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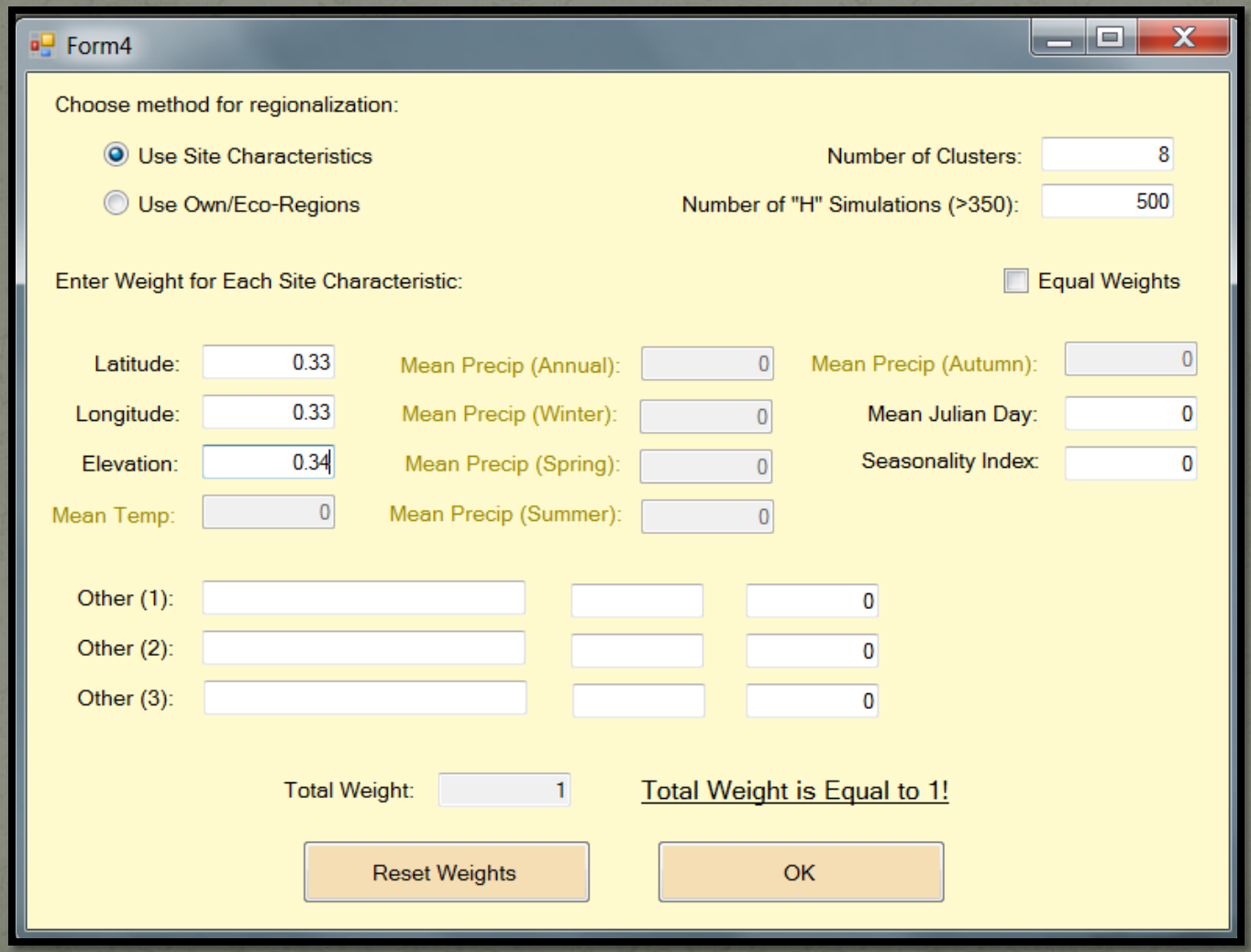
Regionalization



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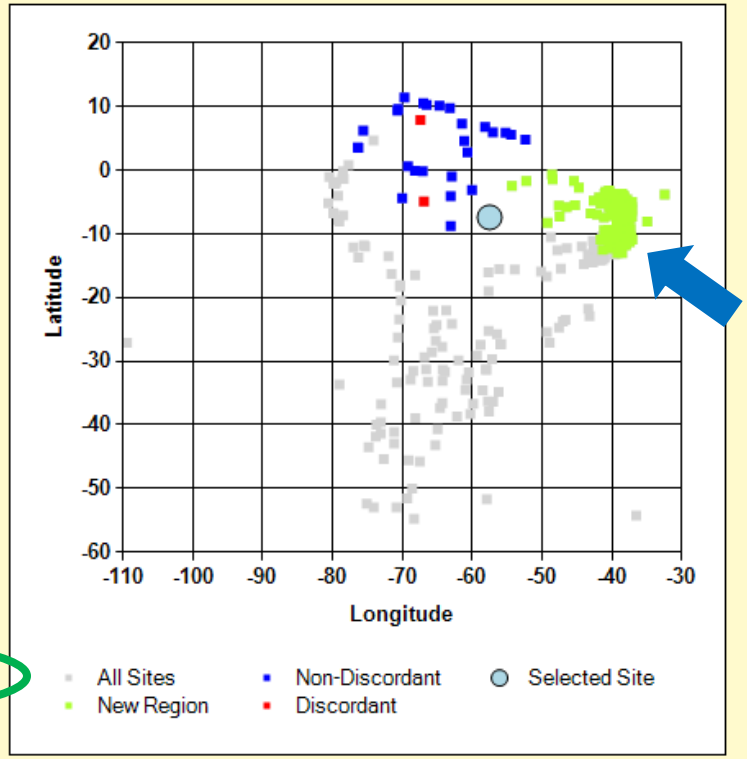
Region Details

Regionalization

Region #: 1 Site ID #: 8264001

Region Details		Site Details	
Number of Sites:	29	Site ID:	8264001
Regional L-Mean (L1):	480.0876	L-Mean (L1):	1051.6848
Regional L-Scale (L2):	92.4449	L-Scale (L2):	110.4404
Regional L-CV (t1):	0.2831	L-CV (t1):	0.105
Regional L-Skew (t3):	0.1371	L-Skew (t3):	0.0238
Regional L-Kurtosis (t4):	0.1258	L-Kurtosis (t4):	0.0761
Number of Discordant Sites:	2	Discordancy:	0.661
Homogeneity:	36.15	Move to Region #:	3



x-var: Longitude y-var: Latitude

Correlation Coefficient: -0.1085

Move Site | Print | Close

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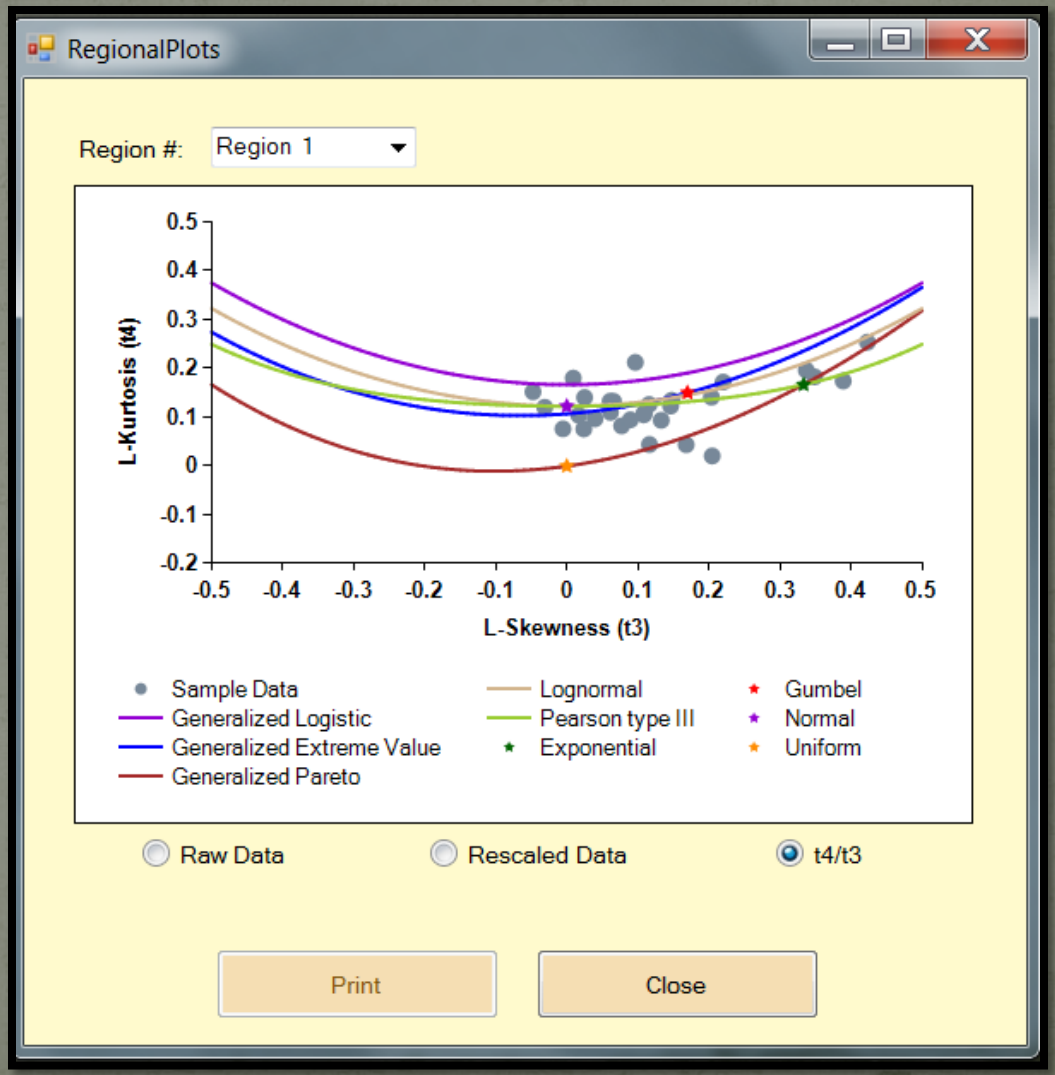
Frequency Distributions

- A graph of t4 vs. t3 gives an initial impression of which distribution may fit the data best.



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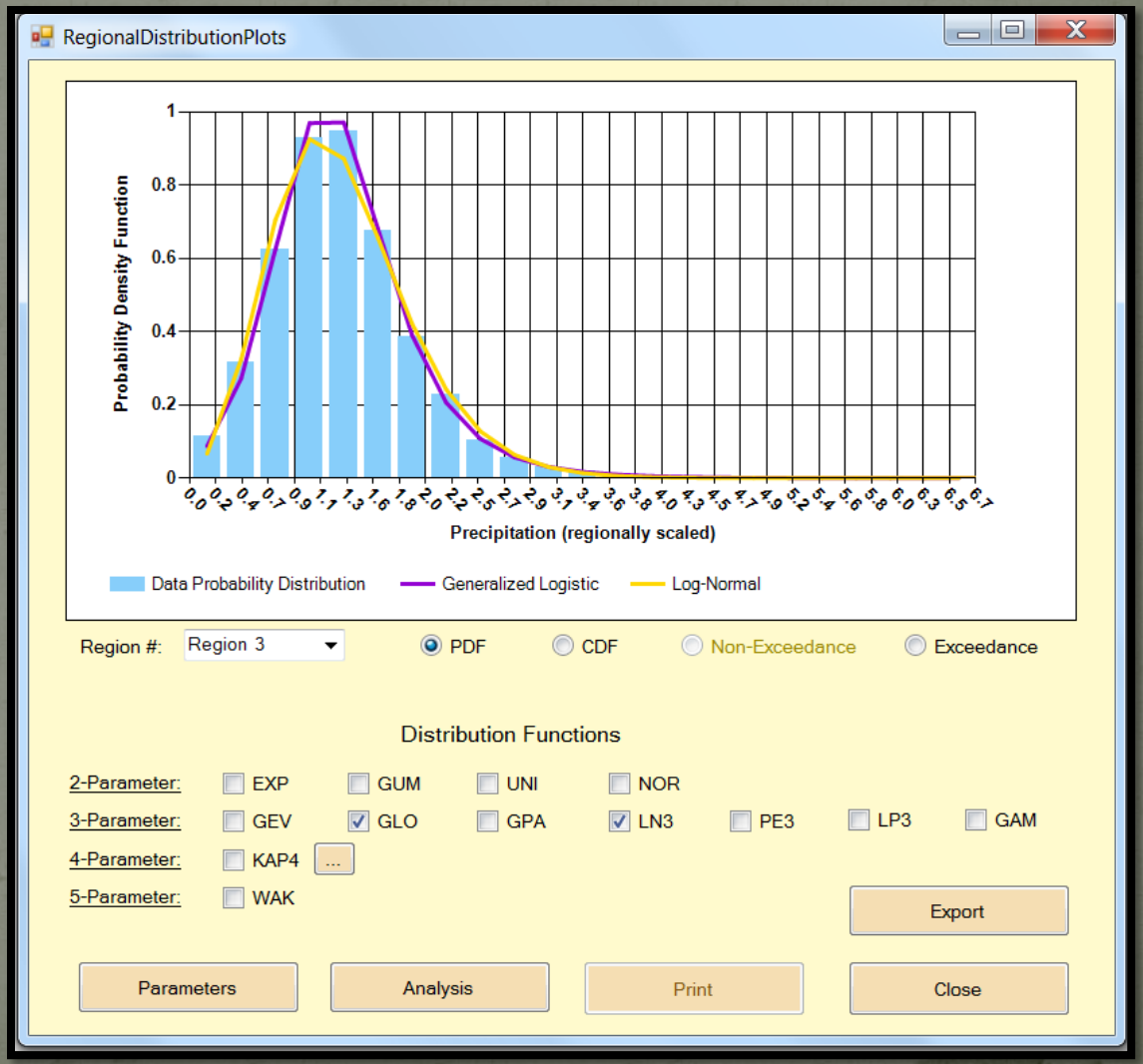
Fitting of Probability Density Functions (PDFs)

- The probability distribution function (PDF) for the region can be fit with up to 13 frequency distributions.



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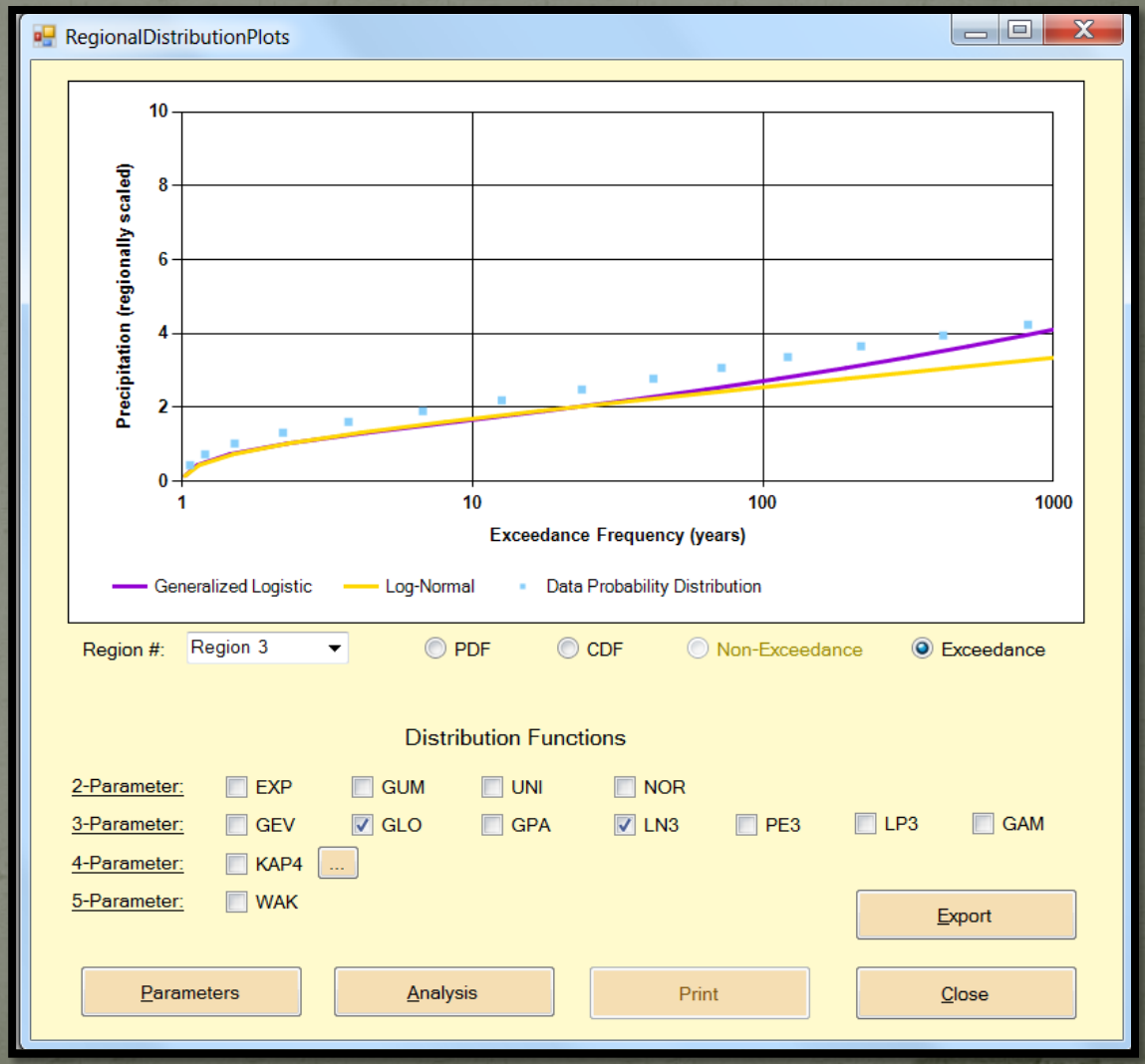
Frequency Distributions: Growth Curves

- The Cumulative Distribution Function (CDF) of the PDF is used to compute the Exceedance Curve. This curve gives the intensity of rain events with frequencies between 1 year up to 1000 years.



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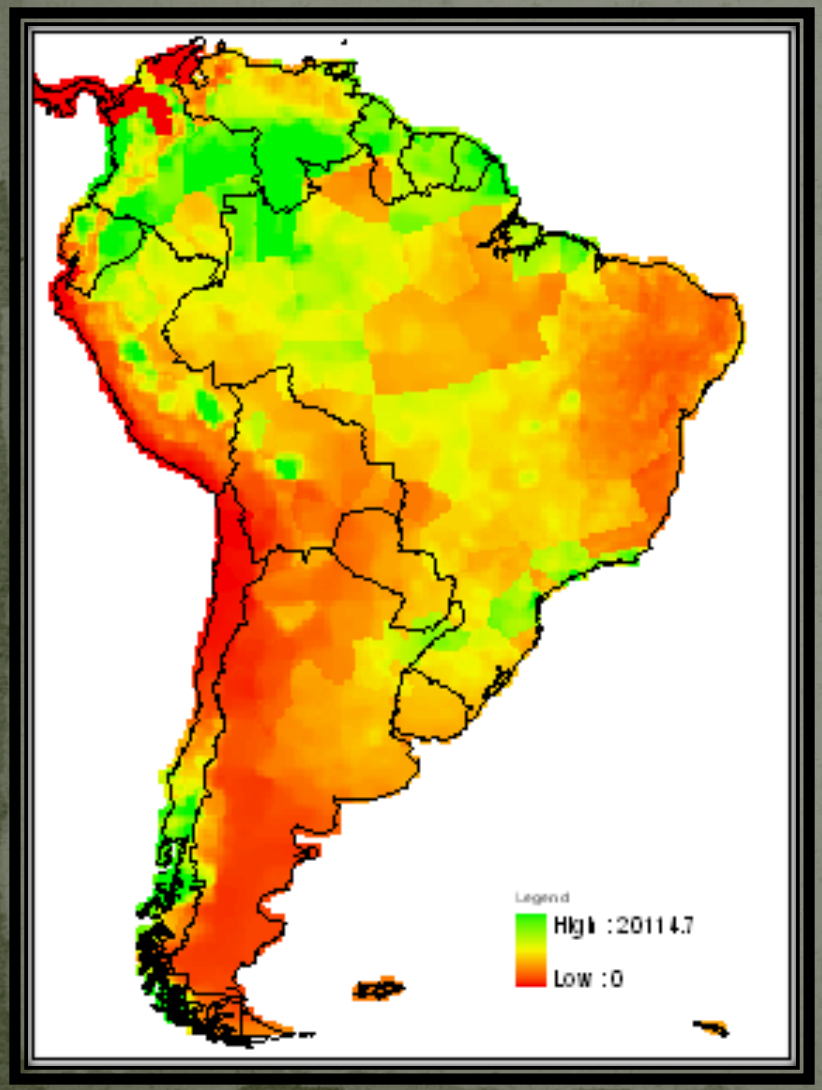
Preliminary LAC Drought Map



For droughts that occur every 20 years, how much total precipitation can be expected over 5 years?

- Source: NOAA's Global Hístorical Climatology Network
- As can be seen here, more data sites are needed to improve resolution and smoothness of contours.

THANK YOU