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Country-Level Climate Uncertainty for Risk Assessments: Volume 22 Appendix U – Historical Sea Ice Thickness

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Abstract

This report uses the CMIP5 series of climate model simulations to produce country-level uncertainty distributions for use in socioeconomic risk assessments of climate change impacts. It provides appropriate probability distributions, by month, for 169 countries and autonomous-areas on temperature, precipitation, maximum temperature, maximum wind speed, humidity, runoff, soil moisture and evaporation for the historical period (1976-2005), and for decadal time periods to 2100. It also provides historical and future distributions for the Arctic region on ice concentration, ice thickness, age of ice, and ice ridging in 15-degree longitude arc segments from the Arctic Circle to 80 degrees latitude, plus two polar semicircular regions from 80 to 90 degrees latitude. The uncertainty is meant to describe the lack of knowledge rather than imprecision in the physical simulation because the emphasis is on unfalsified risk and its use to determine potential socioeconomic impacts. The full report is contained in 27 volumes.

ACKNOWLEDGMENTS

The authors are grateful to Group 0150 for providing support in preparing this report and for appreciating the potential impact of climate change on international security and on Sandia's mission.

CONTENTS

FIGURES

TABLES

NOMENCLATURE

CMIP5	Coupled Model Intercomparison Project Phase 5
DOE	Department of Energy
SNL	Sandia National Laboratories
m	Meter
s	Second
da	Day
C	Degrees Centigrade
K	Degrees Kelvin
kg	Kilogram
yr	Year
m2	Square meters (area)
m3	Cubic meters (volume)

U.1. INTRODUCTION

This volume contains one of the appendices noted in Volume 1. Each appendix details the data for a single variable. The next section describes the basic information needed to interpret the data and then provides the actual data. The data for each variable are contained in separate report volumes as noted in the table below. **The report and all appendices are publicly available[1] and the data in EXCEL format are available upon request.[2]**

Volume	Appendix	Description	Unit of Measure	Time Period
1	-	Main Text	All	All
2	A	Near-Surface Air Temperature	K	Historical
3	B	Near-Surface Air Temperature	K	Forecast
4	C	Maximum Near-Surface Air Temperature	K	Historical
5	D	Maximum Near-Surface Air Temperature	K	Forecast
6	E	Minimum Near-Surface Air Temperature	K	Historical
7	F	Minimum Near-Surface Air Temperature	K	Forecast
8	G	Precipitation	m/day	Historical
9	H	Precipitation	m/day	Forecast
10	I	Evaporation	m/day	Historical
11	J	Evaporation	m/day	Forecast
12	K	Near-Surface Relative Humidity	% (monthly mean)	Historical
13	L	Near Surface Relative Humidity	% (monthly mean)	Forecast
14	M	Surface Runoff	m3/day	Historical
15	N	Surface Runoff	m3/day	Forecast
16	O	Soil Moisture (Upper Column)	m3/m3	Historical
17	P	Soil Moisture (Upper Column)	m3/m3	Forecast
18	Q	Maximum Near-Surface Wind Speed	m/day	Historical
19	R	Maximum Near-Surface Wind Speed	m/day	Forecast
20	S	Sea Ice Area Fraction	m2/m2	Historical
21	T	Sea Ice Area Fraction	m2/m2	Forecast
22	U	Sea Ice Thickness	M	Historical
23	V	Sea Ice Thickness	M	Forecast
24	W	Age of Sea Ice	day	Historical
25	X	Age of Sea Ice	day	Forecast
26	Y	Sea Ice Ridging Rate	(m2/day)/m2	Historical
27	Z	Sea Ice Ridging Rate	(m2/day)/m2	Forecast

Table 1: Report Volume to Variable-Data Mapping

[1] http://www.sandia.gov (https://cfwebprod.sandia.gov/cfdocs/CompResearch/templates/insert/pubs.cfm)
[2] Contact Dr. Thomas Lowry, Sandia National Laboratories, tslowry@sandia.gov.

U.2. ARCTIC SEA ICE THICKNESS

This appendix contains the uncertainty distribution information on Arctic Sea Ice Thickness for the historical period (CMIP5 output variable name: sit). The parametrization is for the Gamma distribution. Note that the parameters enable the calculation of the mean, median, and mode values, as well as of the exceedance-probability values. See the main text (Volume 1) for a further description of the variable, and on finding or using the appropriate data. The raw values from the models have been converted to have dimensions of m.

The pages that follow alphabetically cover each country or autonomous-area, with the distribution parameters for a time period, for a specific month. The table shows the centroid (average) year for the time period, should a user, for simulation purposes only, want to create linearly interpolated values between years. Interpolation requires both historical and forecast data for the years through 2015. The data maintain consistency across the historical and forecast time period to allow such interpolations. Although the change between years are closely approximated through linear interpolation, no claim is made here for the legitimacy of this usage for all purposes.

For forecast data, the values correspond to the average over the (typically) decadal period noted in Columns 6 and 7 of the data table below. For historical data, the values correspond to the average over the 30 year, 1976 to 2005, "historical period" segment from the CMIP5 model runs. Thirty years is typically the averaging time period used to describe the "normal" condition. Because, for example, conventional macroeconomic models do not generally include climate impacts, their results implicitly include the historical normal. Because climatic changes are relatively gradual during the historical period and the first decade of the forecast period, it is generally acceptable, for continuous-simulation purposes, to consider the average as representing a 1990 referent year.

The models used to calculate the distribution are compared in Chapter 2 of Volume 1. Essential information on the functional aspects of the probability distribution are shown on the next page.

Gamma Distribution: $Parameter1 = k, Parameter2 = \theta$

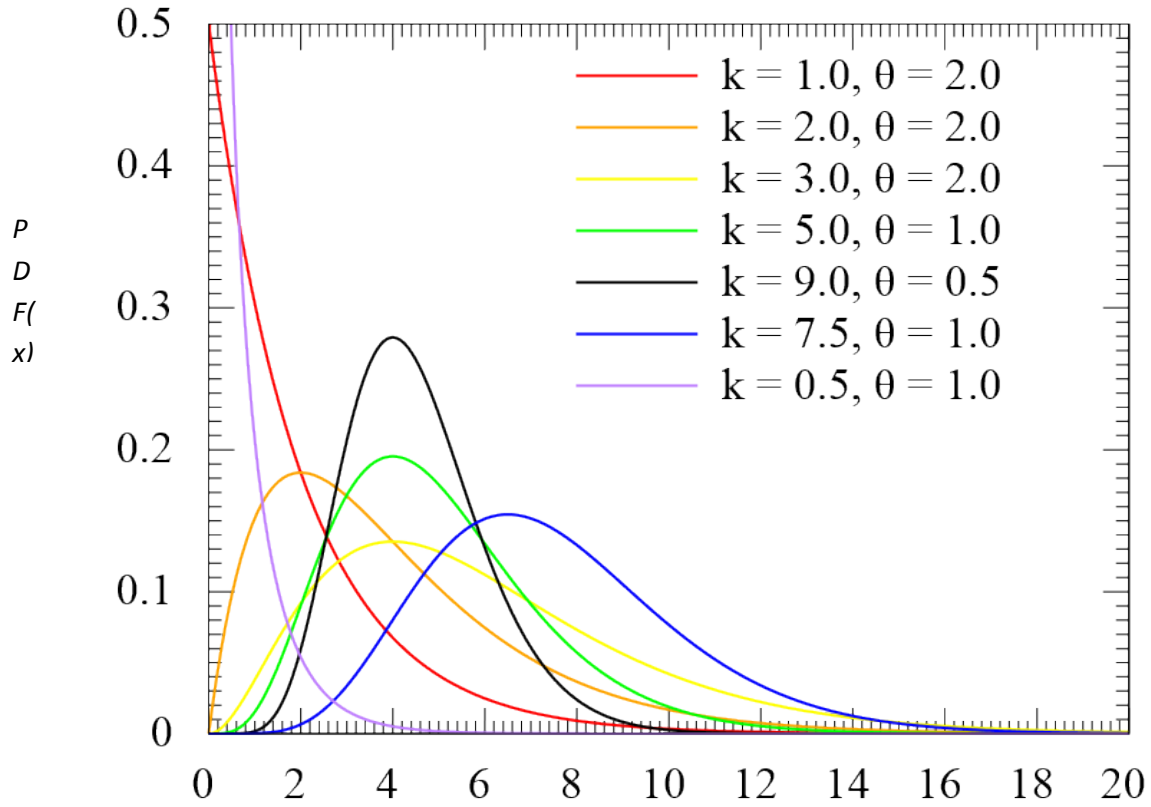

Figure 1: Gamma Distribution[3]

$$PDF(x) = \frac{1}{\Gamma(k) * \theta^k} * x^{k-1} * e^{-\frac{x}{\theta}}$$

$$CDF(x) = 1 - \Gamma\left(k, \frac{x}{\theta}\right)/\Gamma(k)$$

Where $\Gamma(\cdot)$ is the Gamma Function and $\Gamma(k,x/\theta)$ is the Incomplete Gamma Function

$$Mean = k\theta$$

$$Median \approx k\theta * \frac{3k - 0.8}{3k + 0.2} \quad k \geq 1$$

$$Median \approx \theta * (0.391424k^4 - 1.29095k^3 + 1.6553k^2 - 0.0257641k - 0.0367065)$$
$$0.3 \leq k \leq 1, \theta \ll 1.0$$

[3] The graphic comes from the Wikimedia commons. For more information, see the Wikipedia entry for the specified distribution in Volume 1, Chapter 5.

There is no closed-form solution for the median, but many mathematical packages have median calculators (e.g. MATLAB)

$Mode = (k-1) * \theta \;\; k \geq 1$
$Mode = 0 \;\; k < 1$

The shape of a Gamma distribution is quite flexible. Note that when k equals one, the gamma distribution becomes an exponential distribution.

The data columns of all the tables first include the country, then the type of distribution, the two parameters that define the distribution (as noted in the Chapter 5 of Volume 1), the standard error on the CDF estimate (the second order uncertainty), the beginning year of the data used to calculate the distribution, the last year of data used to calculate the distribution, the mid-year centroid, the month associated with the uncertainty distribution, and the short, CMIP5 variable name (noted in Table 3 of Volume 1).

As noted in the main text (Volume 1), the most legitimate use of the data is the comparison of a future sampled value to the historical mean or sampled value. The ratio of the forecasted and historical values minus 1 denotes the percentage change from historical values. This value most likely corresponds to the information needed to perform the impact analysis. Alternatively, but somewhat less meaningful, the difference between the numeric value of the forecast and historic values may be required for the impact analysis, for example, those associated with food production or water flow. For an example risk assessment see Backus et al. 2010.[4]

The Uncertainty Data begin on the next page.

[4] Backus, George A., Thomas S. Lowry, and Drake E. Warren. "The near-term risk of climate uncertainty among the US states." Climatic Change 116.3-4 (2013): 495-522. http://link.springer.com/article/10.1007/s10584-012-0511-8. See full report for the study at: http://prod.sandia.gov/techlib/access-control.cgi/2010/102052.pdf

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic0E15	Gamma	1.829E+00	2.500E-01	6.210E-02	1976	2005	1990	1	sit
Arctic0E15	Gamma	1.695E+00	2.897E-01	6.775E-02	1976	2005	1990	2	sit
Arctic0E15	Gamma	1.701E+00	3.150E-01	8.033E-02	1976	2005	1990	3	sit
Arctic0E15	Gamma	1.930E+00	3.154E-01	9.864E-02	1976	2005	1990	4	sit
Arctic0E15	Gamma	2.095E+00	3.263E-01	9.341E-02	1976	2005	1990	5	sit
Arctic0E15	Gamma	2.000E+00	3.378E-01	8.857E-02	1976	2005	1990	6	sit
Arctic0E15	Gamma	1.597E+00	3.753E-01	9.353E-02	1976	2005	1990	7	sit
Arctic0E15	Gamma	1.430E+00	3.539E-01	1.229E-01	1976	2005	1990	8	sit
Arctic0E15	Gamma	1.205E+00	3.425E-01	8.467E-02	1976	2005	1990	9	sit
Arctic0E15	Gamma	1.377E+00	2.788E-01	5.382E-02	1976	2005	1990	10	sit
Arctic0E15	Gamma	1.772E+00	2.284E-01	5.805E-02	1976	2005	1990	11	sit
Arctic0E15	Gamma	1.857E+00	2.305E-01	5.773E-02	1976	2005	1990	12	sit
Arctic0W15	Gamma	5.553E+00	1.713E-01	1.263E-01	1976	2005	1990	1	sit
Arctic0W15	Gamma	5.742E+00	1.700E-01	1.281E-01	1976	2005	1990	2	sit
Arctic0W15	Gamma	5.674E+00	1.771E-01	1.323E-01	1976	2005	1990	3	sit
Arctic0W15	Gamma	5.442E+00	2.020E-01	1.557E-01	1976	2005	1990	4	sit
Arctic0W15	Gamma	5.123E+00	2.333E-01	1.864E-01	1976	2005	1990	5	sit
Arctic0W15	Gamma	3.477E+00	3.222E-01	1.915E-01	1976	2005	1990	6	sit
Arctic0W15	Gamma	1.814E+00	4.969E-01	1.662E-01	1976	2005	1990	7	sit
Arctic0W15	Gamma	1.409E+00	5.709E-01	1.789E-01	1976	2005	1990	8	sit
Arctic0W15	Gamma	1.730E+00	4.318E-01	1.178E-01	1976	2005	1990	9	sit
Arctic0W15	Gamma	2.137E+00	3.520E-01	1.166E-01	1976	2005	1990	10	sit
Arctic0W15	Gamma	3.337E+00	2.534E-01	9.164E-02	1976	2005	1990	11	sit
Arctic0W15	Gamma	4.615E+00	1.996E-01	8.299E-02	1976	2005	1990	12	sit
Arctic105E120	Gamma	2.034E+01	8.593E-02	1.061E-01	1976	2005	1990	1	sit
Arctic105E120	Gamma	3.209E+01	5.906E-02	8.608E-02	1976	2005	1990	2	sit
Arctic105E120	Gamma	3.922E+01	5.160E-02	7.423E-02	1976	2005	1990	3	sit
Arctic105E120	Gamma	4.518E+01	4.776E-02	6.873E-02	1976	2005	1990	4	sit
Arctic105E120	Gamma	4.368E+01	5.198E-02	7.146E-02	1976	2005	1990	5	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic105E120	Gamma	2.773E+01	7.669E-02	1.025E-01	1976	2005	1990	6	sit
Arctic105E120	Gamma	7.835E+00	2.040E-01	1.074E-01	1976	2005	1990	7	sit
Arctic105E120	Gamma	3.062E+00	3.865E-01	1.046E-01	1976	2005	1990	8	sit
Arctic105E120	Gamma	2.599E+00	3.833E-01	1.120E-01	1976	2005	1990	9	sit
Arctic105E120	Gamma	3.266E+00	3.210E-01	1.434E-01	1976	2005	1990	10	sit
Arctic105E120	Gamma	6.119E+00	2.137E-01	1.529E-01	1976	2005	1990	11	sit
Arctic105E120	Gamma	1.081E+01	1.427E-01	1.337E-01	1976	2005	1990	12	sit
Arctic105W120	Gamma	2.084E+00	2.010E+00	7.542E-01	1976	2005	1990	1	sit
Arctic105W120	Gamma	2.431E+00	1.839E+00	7.625E-01	1976	2005	1990	2	sit
Arctic105W120	Gamma	2.716E+00	1.721E+00	7.741E-01	1976	2005	1990	3	sit
Arctic105W120	Gamma	2.892E+00	1.655E+00	7.834E-01	1976	2005	1990	4	sit
Arctic105W120	Gamma	2.975E+00	1.624E+00	7.885E-01	1976	2005	1990	5	sit
Arctic105W120	Gamma	2.699E+00	1.738E+00	7.781E-01	1976	2005	1990	6	sit
Arctic105W120	Gamma	1.719E+00	2.419E+00	6.267E-01	1976	2005	1990	7	sit
Arctic105W120	Gamma	1.091E+00	3.411E+00	5.368E-01	1976	2005	1990	8	sit
Arctic105W120	Gamma	1.000E+00	3.597E+00	5.404E-01	1976	2005	1990	9	sit
Arctic105W120	Gamma	1.143E+00	3.127E+00	5.652E-01	1976	2005	1990	10	sit
Arctic105W120	Gamma	1.418E+00	2.597E+00	6.611E-01	1976	2005	1990	11	sit
Arctic105W120	Gamma	1.727E+00	2.251E+00	7.239E-01	1976	2005	1990	12	sit
Arctic120E135	Gamma	1.330E+01	1.418E-01	1.848E-01	1976	2005	1990	1	sit
Arctic120E135	Gamma	2.110E+01	9.866E-02	1.421E-01	1976	2005	1990	2	sit
Arctic120E135	Gamma	2.908E+01	7.648E-02	1.217E-01	1976	2005	1990	3	sit
Arctic120E135	Gamma	3.421E+01	6.779E-02	1.207E-01	1976	2005	1990	4	sit
Arctic120E135	Gamma	3.031E+01	7.764E-02	1.458E-01	1976	2005	1990	5	sit
Arctic120E135	Gamma	1.652E+01	1.252E-01	1.845E-01	1976	2005	1990	6	sit
Arctic120E135	Gamma	4.863E+00	2.965E-01	2.043E-01	1976	2005	1990	7	sit
Arctic120E135	Gamma	2.168E+00	4.880E-01	1.453E-01	1976	2005	1990	8	sit
Arctic120E135	Gamma	2.011E+00	4.497E-01	1.400E-01	1976	2005	1990	9	sit
Arctic120E135	Gamma	2.724E+00	3.540E-01	1.867E-01	1976	2005	1990	10	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic120E135	Gamma	5.001E+00	2.569E-01	2.096E-01	1976	2005	1990	11	sit
Arctic120E135	Gamma	8.494E+00	1.879E-01	2.041E-01	1976	2005	1990	12	sit
Arctic120W135	Gamma	7.042E+00	3.145E-01	1.918E-01	1976	2005	1990	1	sit
Arctic120W135	Gamma	8.792E+00	2.899E-01	1.803E-01	1976	2005	1990	2	sit
Arctic120W135	Gamma	1.018E+01	2.763E-01	1.805E-01	1976	2005	1990	3	sit
Arctic120W135	Gamma	1.055E+01	2.793E-01	2.005E-01	1976	2005	1990	4	sit
Arctic120W135	Gamma	1.003E+01	2.885E-01	2.152E-01	1976	2005	1990	5	sit
Arctic120W135	Gamma	6.934E+00	3.679E-01	2.311E-01	1976	2005	1990	6	sit
Arctic120W135	Gamma	3.006E+00	6.693E-01	2.889E-01	1976	2005	1990	7	sit
Arctic120W135	Gamma	1.712E+00	1.028E+00	3.964E-01	1976	2005	1990	8	sit
Arctic120W135	Gamma	1.602E+00	1.042E+00	3.914E-01	1976	2005	1990	9	sit
Arctic120W135	Gamma	2.007E+00	7.764E-01	2.447E-01	1976	2005	1990	10	sit
Arctic120W135	Gamma	2.958E+00	5.612E-01	2.281E-01	1976	2005	1990	11	sit
Arctic120W135	Gamma	4.943E+00	3.829E-01	1.993E-01	1976	2005	1990	12	sit
Arctic135E150	Gamma	7.717E+00	2.973E-01	2.945E-01	1976	2005	1990	1	sit
Arctic135E150	Gamma	1.020E+01	2.503E-01	2.919E-01	1976	2005	1990	2	sit
Arctic135E150	Gamma	1.260E+01	2.165E-01	2.871E-01	1976	2005	1990	3	sit
Arctic135E150	Gamma	1.494E+01	1.889E-01	2.757E-01	1976	2005	1990	4	sit
Arctic135E150	Gamma	1.524E+01	1.849E-01	2.734E-01	1976	2005	1990	5	sit
Arctic135E150	Gamma	1.063E+01	2.314E-01	2.710E-01	1976	2005	1990	6	sit
Arctic135E150	Gamma	3.850E+00	4.688E-01	2.326E-01	1976	2005	1990	7	sit
Arctic135E150	Gamma	1.918E+00	7.276E-01	1.951E-01	1976	2005	1990	8	sit
Arctic135E150	Gamma	1.705E+00	7.398E-01	1.855E-01	1976	2005	1990	9	sit
Arctic135E150	Gamma	2.148E+00	5.923E-01	2.472E-01	1976	2005	1990	10	sit
Arctic135E150	Gamma	3.511E+00	4.526E-01	2.747E-01	1976	2005	1990	11	sit
Arctic135E150	Gamma	5.421E+00	3.585E-01	2.862E-01	1976	2005	1990	12	sit
Arctic135W150	Gamma	8.535E+00	2.515E-01	1.975E-01	1976	2005	1990	1	sit
Arctic135W150	Gamma	1.100E+01	2.201E-01	1.892E-01	1976	2005	1990	2	sit
Arctic135W150	Gamma	1.308E+01	2.024E-01	1.826E-01	1976	2005	1990	3	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic135W150	Gamma	1.432E+01	1.948E-01	1.915E-01	1976	2005	1990	4	sit
Arctic135W150	Gamma	1.353E+01	2.062E-01	2.061E-01	1976	2005	1990	5	sit
Arctic135W150	Gamma	8.051E+00	3.110E-01	2.420E-01	1976	2005	1990	6	sit
Arctic135W150	Gamma	3.108E+00	6.153E-01	2.928E-01	1976	2005	1990	7	sit
Arctic135W150	Gamma	1.718E+00	8.930E-01	3.581E-01	1976	2005	1990	8	sit
Arctic135W150	Gamma	1.653E+00	8.727E-01	3.677E-01	1976	2005	1990	9	sit
Arctic135W150	Gamma	2.093E+00	6.902E-01	2.871E-01	1976	2005	1990	10	sit
Arctic135W150	Gamma	3.376E+00	4.818E-01	2.699E-01	1976	2005	1990	11	sit
Arctic135W150	Gamma	5.763E+00	3.229E-01	2.213E-01	1976	2005	1990	12	sit
Arctic150E165	Gamma	6.405E+00	3.875E-01	2.759E-01	1976	2005	1990	1	sit
Arctic150E165	Gamma	8.174E+00	3.401E-01	2.851E-01	1976	2005	1990	2	sit
Arctic150E165	Gamma	9.702E+00	3.103E-01	2.918E-01	1976	2005	1990	3	sit
Arctic150E165	Gamma	1.185E+01	2.633E-01	2.574E-01	1976	2005	1990	4	sit
Arctic150E165	Gamma	1.306E+01	2.383E-01	2.395E-01	1976	2005	1990	5	sit
Arctic150E165	Gamma	9.400E+00	2.932E-01	2.206E-01	1976	2005	1990	6	sit
Arctic150E165	Gamma	3.470E+00	5.897E-01	2.097E-01	1976	2005	1990	7	sit
Arctic150E165	Gamma	1.762E+00	8.832E-01	1.901E-01	1976	2005	1990	8	sit
Arctic150E165	Gamma	1.588E+00	8.886E-01	1.827E-01	1976	2005	1990	9	sit
Arctic150E165	Gamma	1.904E+00	7.597E-01	1.897E-01	1976	2005	1990	10	sit
Arctic150E165	Gamma	3.066E+00	5.672E-01	2.263E-01	1976	2005	1990	11	sit
Arctic150E165	Gamma	4.662E+00	4.510E-01	2.548E-01	1976	2005	1990	12	sit
Arctic150W165	Gamma	9.525E+00	2.193E-01	1.505E-01	1976	2005	1990	1	sit
Arctic150W165	Gamma	1.218E+01	1.946E-01	1.569E-01	1976	2005	1990	2	sit
Arctic150W165	Gamma	1.423E+01	1.831E-01	1.768E-01	1976	2005	1990	3	sit
Arctic150W165	Gamma	1.564E+01	1.761E-01	1.743E-01	1976	2005	1990	4	sit
Arctic150W165	Gamma	1.556E+01	1.778E-01	1.810E-01	1976	2005	1990	5	sit
Arctic150W165	Gamma	9.735E+00	2.544E-01	2.382E-01	1976	2005	1990	6	sit
Arctic150W165	Gamma	3.471E+00	5.266E-01	3.148E-01	1976	2005	1990	7	sit
Arctic150W165	Gamma	1.867E+00	7.257E-01	3.503E-01	1976	2005	1990	8	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic150W165	Gamma	1.818E+00	6.802E-01	3.057E-01	1976	2005	1990	9	sit
Arctic150W165	Gamma	2.231E+00	5.698E-01	2.597E-01	1976	2005	1990	10	sit
Arctic150W165	Gamma	3.654E+00	4.033E-01	2.172E-01	1976	2005	1990	11	sit
Arctic150W165	Gamma	6.334E+00	2.791E-01	1.719E-01	1976	2005	1990	12	sit
Arctic15E30	Gamma	3.251E+00	2.508E-01	1.134E-01	1976	2005	1990	1	sit
Arctic15E30	Gamma	3.194E+00	2.736E-01	1.103E-01	1976	2005	1990	2	sit
Arctic15E30	Gamma	3.327E+00	2.756E-01	1.193E-01	1976	2005	1990	3	sit
Arctic15E30	Gamma	3.378E+00	2.827E-01	1.255E-01	1976	2005	1990	4	sit
Arctic15E30	Gamma	3.391E+00	2.870E-01	1.302E-01	1976	2005	1990	5	sit
Arctic15E30	Gamma	3.145E+00	2.814E-01	1.166E-01	1976	2005	1990	6	sit
Arctic15E30	Gamma	3.026E+00	2.333E-01	1.140E-01	1976	2005	1990	7	sit
Arctic15E30	Gamma	2.306E+00	2.646E-01	1.574E-01	1976	2005	1990	8	sit
Arctic15E30	Gamma	2.171E+00	2.649E-01	1.624E-01	1976	2005	1990	9	sit
Arctic15E30	Gamma	2.500E+00	2.059E-01	1.052E-01	1976	2005	1990	10	sit
Arctic15E30	Gamma	2.945E+00	2.029E-01	9.460E-02	1976	2005	1990	11	sit
Arctic15E30	Gamma	3.239E+00	2.237E-01	1.042E-01	1976	2005	1990	12	sit
Arctic15W30	Gamma	2.149E+00	1.111E+00	3.305E-01	1976	2005	1990	1	sit
Arctic15W30	Gamma	2.294E+00	1.086E+00	3.315E-01	1976	2005	1990	2	sit
Arctic15W30	Gamma	2.380E+00	1.062E+00	3.339E-01	1976	2005	1990	3	sit
Arctic15W30	Gamma	2.395E+00	1.041E+00	3.377E-01	1976	2005	1990	4	sit
Arctic15W30	Gamma	2.143E+00	1.119E+00	3.375E-01	1976	2005	1990	5	sit
Arctic15W30	Gamma	1.432E+00	1.473E+00	3.236E-01	1976	2005	1990	6	sit
Arctic15W30	Gamma	8.021E-01	2.151E+00	3.778E-01	1976	2005	1990	7	sit
Arctic15W30	Gamma	5.553E-01	3.698E+00	6.821E-01	1976	2005	1990	8	sit
Arctic15W30	Gamma	5.156E-01	5.002E+00	1.138E+00	1976	2005	1990	9	sit
Arctic15W30	Gamma	8.898E-01	1.970E+00	3.238E-01	1976	2005	1990	10	sit
Arctic15W30	Gamma	1.458E+00	1.323E+00	3.282E-01	1976	2005	1990	11	sit
Arctic15W30	Gamma	1.883E+00	1.160E+00	3.379E-01	1976	2005	1990	12	sit
Arctic165E180	Gamma	7.754E+00	2.980E-01	2.105E-01	1976	2005	1990	1	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic165E180	Gamma	9.767E+00	2.686E-01	2.195E-01	1976	2005	1990	2	sit
Arctic165E180	Gamma	1.122E+01	2.567E-01	2.301E-01	1976	2005	1990	3	sit
Arctic165E180	Gamma	1.292E+01	2.341E-01	2.148E-01	1976	2005	1990	4	sit
Arctic165E180	Gamma	1.460E+01	2.058E-01	1.977E-01	1976	2005	1990	5	sit
Arctic165E180	Gamma	1.106E+01	2.350E-01	2.031E-01	1976	2005	1990	6	sit
Arctic165E180	Gamma	3.706E+00	4.853E-01	1.865E-01	1976	2005	1990	7	sit
Arctic165E180	Gamma	1.747E+00	7.568E-01	1.646E-01	1976	2005	1990	8	sit
Arctic165E180	Gamma	1.524E+00	8.050E-01	1.689E-01	1976	2005	1990	9	sit
Arctic165E180	Gamma	1.843E+00	6.910E-01	1.855E-01	1976	2005	1990	10	sit
Arctic165E180	Gamma	3.164E+00	4.931E-01	2.086E-01	1976	2005	1990	11	sit
Arctic165E180	Gamma	5.336E+00	3.616E-01	2.122E-01	1976	2005	1990	12	sit
Arctic165W180	Gamma	1.049E+01	1.960E-01	1.507E-01	1976	2005	1990	1	sit
Arctic165W180	Gamma	1.327E+01	1.771E-01	1.441E-01	1976	2005	1990	2	sit
Arctic165W180	Gamma	1.552E+01	1.670E-01	1.408E-01	1976	2005	1990	3	sit
Arctic165W180	Gamma	1.750E+01	1.569E-01	1.422E-01	1976	2005	1990	4	sit
Arctic165W180	Gamma	1.901E+01	1.451E-01	1.453E-01	1976	2005	1990	5	sit
Arctic165W180	Gamma	1.366E+01	1.774E-01	1.490E-01	1976	2005	1990	6	sit
Arctic165W180	Gamma	4.475E+00	3.764E-01	2.286E-01	1976	2005	1990	7	sit
Arctic165W180	Gamma	2.116E+00	5.618E-01	2.354E-01	1976	2005	1990	8	sit
Arctic165W180	Gamma	1.888E+00	5.874E-01	2.314E-01	1976	2005	1990	9	sit
Arctic165W180	Gamma	2.406E+00	4.763E-01	2.121E-01	1976	2005	1990	10	sit
Arctic165W180	Gamma	3.922E+00	3.488E-01	1.818E-01	1976	2005	1990	11	sit
Arctic165W180	Gamma	6.898E+00	2.476E-01	1.587E-01	1976	2005	1990	12	sit
Arctic30E45	Gamma	3.557E+00	1.864E-01	9.605E-02	1976	2005	1990	1	sit
Arctic30E45	Gamma	2.978E+00	2.430E-01	1.243E-01	1976	2005	1990	2	sit
Arctic30E45	Gamma	2.824E+00	2.773E-01	1.437E-01	1976	2005	1990	3	sit
Arctic30E45	Gamma	2.971E+00	2.860E-01	1.553E-01	1976	2005	1990	4	sit
Arctic30E45	Gamma	3.219E+00	2.716E-01	1.381E-01	1976	2005	1990	5	sit
Arctic30E45	Gamma	3.237E+00	2.353E-01	9.229E-02	1976	2005	1990	6	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic30E45	Gamma	2.573E+00	2.298E-01	6.111E-02	1976	2005	1990	7	sit
Arctic30E45	Gamma	1.822E+00	2.837E-01	1.507E-01	1976	2005	1990	8	sit
Arctic30E45	Gamma	1.456E+00	3.298E-01	1.637E-01	1976	2005	1990	9	sit
Arctic30E45	Gamma	1.836E+00	2.411E-01	1.008E-01	1976	2005	1990	10	sit
Arctic30E45	Gamma	3.062E+00	1.646E-01	6.459E-02	1976	2005	1990	11	sit
Arctic30E45	Gamma	3.932E+00	1.482E-01	6.582E-02	1976	2005	1990	12	sit
Arctic30W45	Gamma	7.165E-02	1.136E+01	1.791E+00	1976	2005	1990	1	sit
Arctic30W45	Gamma	7.136E-02	1.236E+01	1.971E+00	1976	2005	1990	2	sit
Arctic30W45	Gamma	7.114E-02	1.320E+01	2.115E+00	1976	2005	1990	3	sit
Arctic30W45	Gamma	7.101E-02	1.373E+01	2.208E+00	1976	2005	1990	4	sit
Arctic30W45	Gamma	7.098E-02	1.386E+01	2.234E+00	1976	2005	1990	5	sit
Arctic30W45	Gamma	7.118E-02	1.306E+01	2.101E+00	1976	2005	1990	6	sit
Arctic30W45	Gamma	7.193E-02	1.044E+01	1.611E+00	1976	2005	1990	7	sit
Arctic30W45	Gamma	7.274E-02	8.172E+00	1.150E+00	1976	2005	1990	8	sit
Arctic30W45	Gamma	7.287E-02	7.823E+00	1.069E+00	1976	2005	1990	9	sit
Arctic30W45	Gamma	7.264E-02	8.390E+00	1.191E+00	1976	2005	1990	10	sit
Arctic30W45	Gamma	7.234E-02	9.240E+00	1.379E+00	1976	2005	1990	11	sit
Arctic30W45	Gamma	7.197E-02	1.032E+01	1.594E+00	1976	2005	1990	12	sit
Arctic45E60	Gamma	2.892E+00	3.144E-01	1.292E-01	1976	2005	1990	1	sit
Arctic45E60	Gamma	3.075E+00	3.375E-01	1.267E-01	1976	2005	1990	2	sit
Arctic45E60	Gamma	3.249E+00	3.495E-01	1.339E-01	1976	2005	1990	3	sit
Arctic45E60	Gamma	3.203E+00	3.729E-01	1.478E-01	1976	2005	1990	4	sit
Arctic45E60	Gamma	3.022E+00	3.929E-01	1.574E-01	1976	2005	1990	5	sit
Arctic45E60	Gamma	2.810E+00	3.643E-01	1.724E-01	1976	2005	1990	6	sit
Arctic45E60	Gamma	2.006E+00	3.794E-01	1.295E-01	1976	2005	1990	7	sit
Arctic45E60	Gamma	1.316E+00	4.928E-01	1.197E-01	1976	2005	1990	8	sit
Arctic45E60	Gamma	1.174E+00	5.138E-01	1.279E-01	1976	2005	1990	9	sit
Arctic45E60	Gamma	1.465E+00	3.495E-01	1.240E-01	1976	2005	1990	10	sit
Arctic45E60	Gamma	2.250E+00	2.546E-01	1.206E-01	1976	2005	1990	11	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic45E60	Gamma	2.736E+00	2.670E-01	1.159E-01	1976	2005	1990	12	sit
Arctic45W60	Gamma	8.139E+00	1.184E-01	7.372E-02	1976	2005	1990	1	sit
Arctic45W60	Gamma	1.008E+01	1.146E-01	7.926E-02	1976	2005	1990	2	sit
Arctic45W60	Gamma	1.200E+01	1.095E-01	1.020E-01	1976	2005	1990	3	sit
Arctic45W60	Gamma	1.181E+01	1.184E-01	1.335E-01	1976	2005	1990	4	sit
Arctic45W60	Gamma	8.483E+00	1.581E-01	1.339E-01	1976	2005	1990	5	sit
Arctic45W60	Gamma	4.011E+00	2.513E-01	1.416E-01	1976	2005	1990	6	sit
Arctic45W60	Gamma	1.233E+00	6.101E-01	1.703E-01	1976	2005	1990	7	sit
Arctic45W60	Gamma	5.799E-01	1.215E+00	2.400E-01	1976	2005	1990	8	sit
Arctic45W60	Gamma	2.478E-01	7.950E+00	1.048E+00	1976	2005	1990	9	sit
Arctic45W60	Gamma	3.375E-01	5.435E+00	1.152E+00	1976	2005	1990	10	sit
Arctic45W60	Gamma	1.963E+00	2.399E-01	6.626E-02	1976	2005	1990	11	sit
Arctic45W60	Gamma	5.013E+00	1.446E-01	7.185E-02	1976	2005	1990	12	sit
Arctic60E75	Gamma	3.364E+00	3.974E-01	2.939E-01	1976	2005	1990	1	sit
Arctic60E75	Gamma	4.035E+00	3.723E-01	2.819E-01	1976	2005	1990	2	sit
Arctic60E75	Gamma	4.689E+00	3.505E-01	2.740E-01	1976	2005	1990	3	sit
Arctic60E75	Gamma	5.089E+00	3.457E-01	2.730E-01	1976	2005	1990	4	sit
Arctic60E75	Gamma	4.751E+00	3.781E-01	2.957E-01	1976	2005	1990	5	sit
Arctic60E75	Gamma	3.264E+00	4.933E-01	3.612E-01	1976	2005	1990	6	sit
Arctic60E75	Gamma	1.785E+00	6.246E-01	2.486E-01	1976	2005	1990	7	sit
Arctic60E75	Gamma	1.219E+00	6.715E-01	2.188E-01	1976	2005	1990	8	sit
Arctic60E75	Gamma	1.029E+00	7.187E-01	2.378E-01	1976	2005	1990	9	sit
Arctic60E75	Gamma	1.165E+00	6.138E-01	2.606E-01	1976	2005	1990	10	sit
Arctic60E75	Gamma	1.735E+00	5.176E-01	2.890E-01	1976	2005	1990	11	sit
Arctic60E75	Gamma	2.530E+00	4.464E-01	3.071E-01	1976	2005	1990	12	sit
Arctic60W75	Gamma	9.341E-01	3.685E+00	1.916E+00	1976	2005	1990	1	sit
Arctic60W75	Gamma	1.034E+00	3.521E+00	1.973E+00	1976	2005	1990	2	sit
Arctic60W75	Gamma	1.109E+00	3.423E+00	2.008E+00	1976	2005	1990	3	sit
Arctic60W75	Gamma	1.140E+00	3.401E+00	2.013E+00	1976	2005	1990	4	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic60W75	Gamma	1.093E+00	3.506E+00	1.971E+00	1976	2005	1990	5	sit
Arctic60W75	Gamma	8.839E-01	3.960E+00	1.790E+00	1976	2005	1990	6	sit
Arctic60W75	Gamma	6.451E-01	4.599E+00	1.629E+00	1976	2005	1990	7	sit
Arctic60W75	Gamma	5.357E-01	8.415E+00	3.162E+00	1976	2005	1990	8	sit
Arctic60W75	Gamma	4.009E-01	1.797E+01	5.617E+00	1976	2005	1990	9	sit
Arctic60W75	Gamma	4.970E-01	5.863E+00	1.834E+00	1976	2005	1990	10	sit
Arctic60W75	Gamma	6.237E-01	4.633E+00	1.678E+00	1976	2005	1990	11	sit
Arctic60W75	Gamma	7.977E-01	3.996E+00	1.823E+00	1976	2005	1990	12	sit
Arctic75E90	Gamma	7.512E+00	1.865E-01	1.954E-01	1976	2005	1990	1	sit
Arctic75E90	Gamma	9.230E+00	1.700E-01	1.928E-01	1976	2005	1990	2	sit
Arctic75E90	Gamma	1.030E+01	1.661E-01	1.920E-01	1976	2005	1990	3	sit
Arctic75E90	Gamma	1.146E+01	1.602E-01	1.850E-01	1976	2005	1990	4	sit
Arctic75E90	Gamma	1.055E+01	1.759E-01	1.732E-01	1976	2005	1990	5	sit
Arctic75E90	Gamma	6.322E+00	2.546E-01	2.142E-01	1976	2005	1990	6	sit
Arctic75E90	Gamma	2.764E+00	3.865E-01	1.551E-01	1976	2005	1990	7	sit
Arctic75E90	Gamma	1.849E+00	4.273E-01	1.400E-01	1976	2005	1990	8	sit
Arctic75E90	Gamma	1.424E+00	4.656E-01	1.056E-01	1976	2005	1990	9	sit
Arctic75E90	Gamma	1.583E+00	3.993E-01	1.417E-01	1976	2005	1990	10	sit
Arctic75E90	Gamma	3.052E+00	2.949E-01	1.795E-01	1976	2005	1990	11	sit
Arctic75E90	Gamma	5.333E+00	2.207E-01	1.967E-01	1976	2005	1990	12	sit
Arctic75W90	Gamma	9.107E-01	5.870E+00	2.190E+00	1976	2005	1990	1	sit
Arctic75W90	Gamma	9.791E-01	5.637E+00	2.263E+00	1976	2005	1990	2	sit
Arctic75W90	Gamma	1.027E+00	5.497E+00	2.309E+00	1976	2005	1990	3	sit
Arctic75W90	Gamma	1.050E+00	5.435E+00	2.340E+00	1976	2005	1990	4	sit
Arctic75W90	Gamma	1.030E+00	5.521E+00	2.317E+00	1976	2005	1990	5	sit
Arctic75W90	Gamma	9.139E-01	6.001E+00	2.168E+00	1976	2005	1990	6	sit
Arctic75W90	Gamma	7.296E-01	6.877E+00	1.914E+00	1976	2005	1990	7	sit
Arctic75W90	Gamma	6.389E-01	7.834E+00	2.087E+00	1976	2005	1990	8	sit
Arctic75W90	Gamma	5.114E-01	1.079E+01	2.557E+00	1976	2005	1990	9	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
Arctic75W90	Gamma	6.134E-01	7.719E+00	1.806E+00	1976	2005	1990	10	sit
Arctic75W90	Gamma	7.336E-01	6.705E+00	1.963E+00	1976	2005	1990	11	sit
Arctic75W90	Gamma	8.274E-01	6.208E+00	2.095E+00	1976	2005	1990	12	sit
Arctic90E105	Gamma	1.693E+01	1.021E-01	9.215E-02	1976	2005	1990	1	sit
Arctic90E105	Gamma	2.120E+01	9.283E-02	1.206E-01	1976	2005	1990	2	sit
Arctic90E105	Gamma	2.135E+01	9.939E-02	1.348E-01	1976	2005	1990	3	sit
Arctic90E105	Gamma	2.173E+01	1.024E-01	1.400E-01	1976	2005	1990	4	sit
Arctic90E105	Gamma	2.197E+01	9.697E-02	1.454E-01	1976	2005	1990	5	sit
Arctic90E105	Gamma	1.670E+01	1.014E-01	1.188E-01	1976	2005	1990	6	sit
Arctic90E105	Gamma	5.315E+00	2.276E-01	1.232E-01	1976	2005	1990	7	sit
Arctic90E105	Gamma	2.353E+00	4.238E-01	9.541E-02	1976	2005	1990	8	sit
Arctic90E105	Gamma	2.377E+00	3.186E-01	1.042E-01	1976	2005	1990	9	sit
Arctic90E105	Gamma	3.360E+00	2.033E-01	6.601E-02	1976	2005	1990	10	sit
Arctic90E105	Gamma	6.318E+00	1.638E-01	1.040E-01	1976	2005	1990	11	sit
Arctic90E105	Gamma	1.145E+01	1.225E-01	1.058E-01	1976	2005	1990	12	sit
Arctic90W105	Gamma	1.291E+00	5.087E+00	1.668E+00	1976	2005	1990	1	sit
Arctic90W105	Gamma	1.414E+00	4.811E+00	1.716E+00	1976	2005	1990	2	sit
Arctic90W105	Gamma	1.509E+00	4.628E+00	1.757E+00	1976	2005	1990	3	sit
Arctic90W105	Gamma	1.569E+00	4.525E+00	1.794E+00	1976	2005	1990	4	sit
Arctic90W105	Gamma	1.591E+00	4.495E+00	1.806E+00	1976	2005	1990	5	sit
Arctic90W105	Gamma	1.539E+00	4.570E+00	1.774E+00	1976	2005	1990	6	sit
Arctic90W105	Gamma	1.209E+00	5.327E+00	1.603E+00	1976	2005	1990	7	sit
Arctic90W105	Gamma	9.061E-01	6.530E+00	1.434E+00	1976	2005	1990	8	sit
Arctic90W105	Gamma	7.640E-01	8.698E+00	1.685E+00	1976	2005	1990	9	sit
Arctic90W105	Gamma	8.878E-01	6.835E+00	1.464E+00	1976	2005	1990	10	sit
Arctic90W105	Gamma	1.038E+00	5.850E+00	1.540E+00	1976	2005	1990	11	sit
Arctic90W105	Gamma	1.153E+00	5.457E+00	1.608E+00	1976	2005	1990	12	sit
EastArctic80_90	Gamma	1.002E+01	2.221E-01	2.230E-01	1976	2005	1990	1	sit
EastArctic80_90	Gamma	1.296E+01	1.816E-01	2.085E-01	1976	2005	1990	2	sit

Country	Distribution	Parameter 1	Parameter 2	Std Error	Start Year	End Year	Mid-Year	Month	Variable
EastArctic80_90	Gamma	1.585E+01	1.563E-01	1.879E-01	1976	2005	1990	3	sit
EastArctic80_90	Gamma	1.759E+01	1.476E-01	1.810E-01	1976	2005	1990	4	sit
EastArctic80_90	Gamma	1.753E+01	1.516E-01	1.841E-01	1976	2005	1990	5	sit
EastArctic80_90	Gamma	1.348E+01	1.882E-01	2.152E-01	1976	2005	1990	6	sit
EastArctic80_90	Gamma	5.257E+00	3.962E-01	2.150E-01	1976	2005	1990	7	sit
EastArctic80_90	Gamma	2.482E+00	6.831E-01	2.362E-01	1976	2005	1990	8	sit
EastArctic80_90	Gamma	2.502E+00	6.407E-01	2.222E-01	1976	2005	1990	9	sit
EastArctic80_90	Gamma	3.420E+00	5.011E-01	2.199E-01	1976	2005	1990	10	sit
EastArctic80_90	Gamma	5.024E+00	3.755E-01	2.320E-01	1976	2005	1990	11	sit
EastArctic80_90	Gamma	7.179E+00	2.868E-01	2.369E-01	1976	2005	1990	12	sit
WestArctic80_90	Gamma	2.765E+00	1.409E+00	9.955E-01	1976	2005	1990	1	sit
WestArctic80_90	Gamma	2.953E+00	1.372E+00	1.037E+00	1976	2005	1990	2	sit
WestArctic80_90	Gamma	3.143E+00	1.336E+00	1.074E+00	1976	2005	1990	3	sit
WestArctic80_90	Gamma	3.293E+00	1.313E+00	1.100E+00	1976	2005	1990	4	sit
WestArctic80_90	Gamma	3.353E+00	1.306E+00	1.106E+00	1976	2005	1990	5	sit
WestArctic80_90	Gamma	3.253E+00	1.315E+00	1.056E+00	1976	2005	1990	6	sit
WestArctic80_90	Gamma	2.731E+00	1.402E+00	8.967E-01	1976	2005	1990	7	sit
WestArctic80_90	Gamma	2.165E+00	1.576E+00	7.945E-01	1976	2005	1990	8	sit
WestArctic80_90	Gamma	1.988E+00	1.677E+00	8.083E-01	1976	2005	1990	9	sit
WestArctic80_90	Gamma	2.144E+00	1.594E+00	8.253E-01	1976	2005	1990	10	sit
WestArctic80_90	Gamma	2.324E+00	1.533E+00	8.842E-01	1976	2005	1990	11	sit
WestArctic80_90	Gamma	2.535E+00	1.468E+00	9.457E-01	1976	2005	1990	12	sit

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