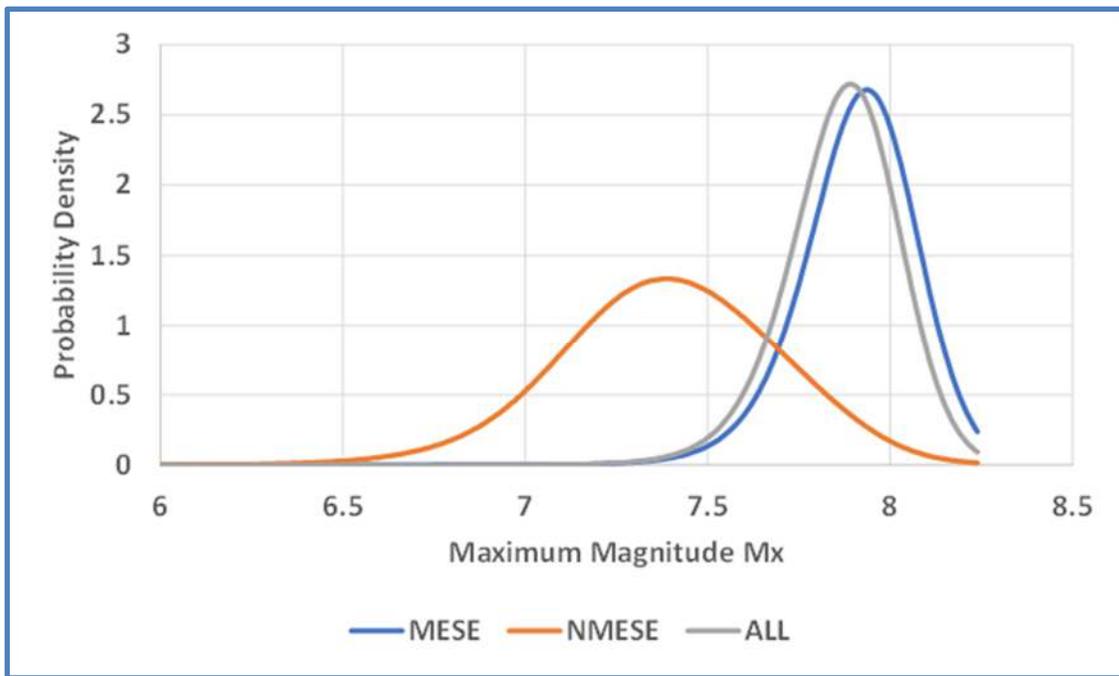


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**Investigation of Maximum Earthquake Magnitudes in Stable Continental Regions**



Report to: USGS

Author: Gabriel R. Toro, Senior Principal Engineer  
Lettis Consultants International, Inc.  
1000 Burnett Avenue, Suite 350  
Concord, CA 94520  
Ph. 650-995-7347, e-mail [toro@lettisci.com](mailto:toro@lettisci.com)  
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## ABSTRACT

The Bayesian approach introduced by Cornell in 1994 and recently used by the CEUS-SSC study (USNRC et al., 2012) with an updated database is the most widely used approach for the estimation of maximum magnitude ( $M_{max}$ ) for distributed-seismicity seismic source zones in stable continental regions (SCRs). The main advantage of this approach is that it takes advantage of both worldwide data and local data from the source-zone of interest and combines these in a rigorous manner.

The conventional  $M_{max}$  approach calculates the prior distribution of  $M_{max}$  for seismic domains with a particular geologic history by calculating the distribution of  $M_{max,obs}$  for these domains, and then shifting that distribution in a deterministic manner using a median value of the difference  $M_{max} - M_{max,obs}$ . To make this approach more stable, pooling of the domains is used. This study investigated an alternative approach in which the uncertainty in  $M_{max,obs}|M_{max}$  in each domain is explicitly considered. Two different algorithms were implemented for these calculations. Results indicate that the resulting prior distributions of  $M_{max}$  have higher means and much lower standard deviations than were previously obtained in the CEUS-SSC study. The implication is that much of the observed scatter in  $M_{max,obs}$  is due to the uncertainty in the distribution of  $M_{max,obs}|M_{max}$ , and not to domain-to-domain variation in  $M_{max}$  or to statistical uncertainty.

The two algorithms yield very similar results, and Monte Carlo simulations indicate that the two algorithms are essentially unbiased. Because the resulting prior distributions are very narrow, the effect of Bayesian updating (which combines the information from the worldwide data set with the information about the specific source zone of interest) becomes negligible for most source zones with the same geologic history.



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## APPENDICES

Appendix A. Data

## 1.0 BACKGROUND AND PURPOSE

The Bayesian approach introduced by Cornell (see Johnston et al., 1994) and recently used by the CEUS-SSC study (USNRC et al., 2012) with an updated database is the most widely used approach for the estimation of maximum magnitude ( $M_{max}$ ) for distributed-seismicity seismic sources in stable continental regions (SCRs). the Central and Easter United States (CEUS, USNRC et al., 2012) and elsewhere. Specifically, the Bayesian approach has been used in the Central and Easter United States (CEUS, USNRC et al., 2012), in the GSHAP model for Central, North, and Northwest Europe (Grunthal et al., 1999), by several expert teams in Swiss PEGASOS study (Coppersmith et al., 2009; Renault et al., 2010), and in South Africa (Bommer et al., 2015). The main advantage of this approach is that it takes advantage of both worldwide data and local data from the source-zone of interest and combines these in a rigorous manner. Other approaches for the determination of  $M_{max}$  exist and are described in Wheeler (2009). The application of the Bayesian approach to a specific source zone is illustrated in Figure 1 below. The purpose of this research is to improve the estimation of the prior distribution of  $M_{max}$  shown in Figure 1a.

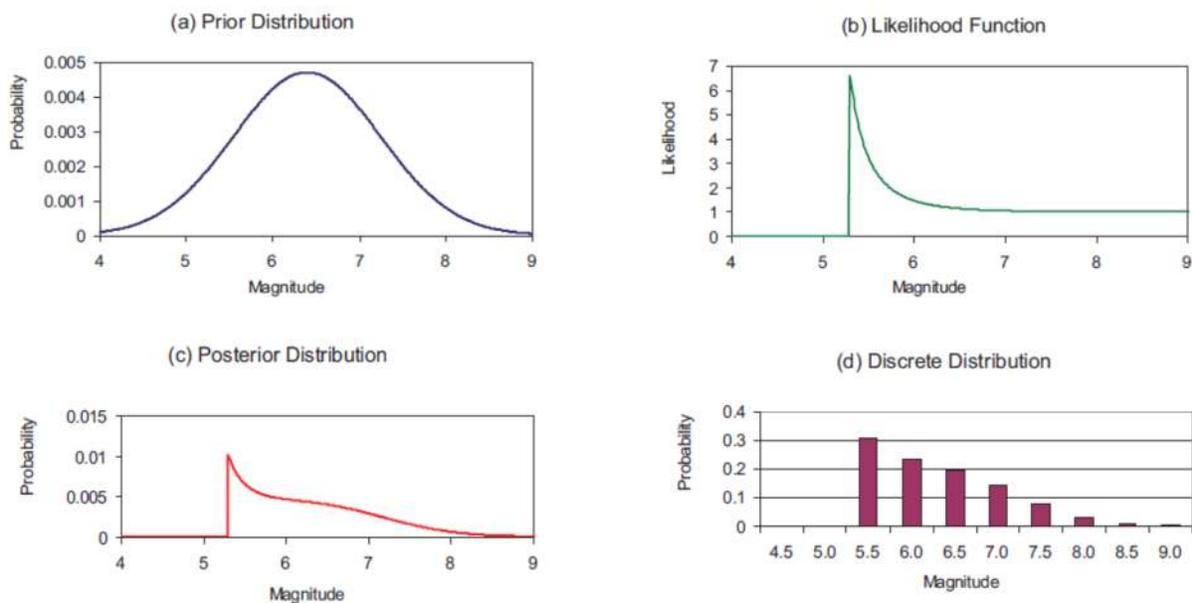


Figure 1. Illustration of the Bayesian  $M_{max}$  approach. (a) prior distribution based on the  $M_{max,obs}$  values of many SCR domains with characteristics similar to the source zone of interest, (b) likelihood function based on observed seismicity within source zone of interest, (c) posterior distribution (i.e., the product of the prior and the likelihood, normalized so it integrates to unity), and (d) discretized posterior distribution for use in PSHA. Source: USNRC et al. (2012).

For the estimation of the prior distributions of  $M_{max}$ , the worldwide stable continental region (SCR)  $M_{max}$  database developed by Johnston et al. (1994) and updated by the CEUS-SSC study divides the earth's SCR crust into 255 crustal domains, characterizes each domain in terms of

type (extended or non-extended crust), age, age of most recent extension, stress state, and orientation of major domain structures with respect to current tectonic stress directions. For each domain, the database indicates the values of observed  $M_{max}$  (called  $M_{max,obs}$ ) and number of  $M > 4.5$  earthquakes in each domain. The purpose of this characterization is to investigate which characteristics affect  $M_{max,obs}$  (and, by implication,  $M_{max}$ ). Further details on these data are provided in the Data section below.

The current  $M_{max}$  approach, as implemented in Johnston et al (1994) and NUREG et al. (2012), calculates the distribution of  $M_{max,obs}$  in several sets of pooled SCR domains (called “superdomains”) and then obtains the distribution of  $M_{max}$  by shifting that distribution using a relation between the median value of  $M_{max,obs}$  and  $M_{max}$  (this step is called the bias correction step; see Figure 2). After investigating alternative partitions of the data set of superdomains according to their characteristics, the only statistically significant partition identified by the CEUS-SSC study was between extended superdomains of Mesozoic and younger ages (designated MESE), and the older extended and non-extended superdomains formed the second group (designated NMESE). In addition, the CEUS-SSC study also calculated the  $M_{max}$  distribution the entire set of superdomains (designated ALL). The resulting mean and standard deviation of  $M_{max}$  are shown in Table 1.

Table 1. CEUS-SSC Superdomain Categories and  $M_{max}$  Distribution Parameters

Superdomain Category	mean	Standard Deviation
MESE	7.35	0.75
NMESE	6.70	0.61
ALL	7.20	0.64

This approach for the calculation of the  $M_{max}$  prior does not account for the uncertainty in the bias adjustment (i.e., uncertainty in the quantity  $M_{max} - M_{max,obs}$ , which may also be thought of as the distribution of the unknown  $M_{max}$  given  $M_{max,obs}$ ) for each superdomain. This is especially important for those superdomains with fewer earthquakes. The significance of this uncertainty is shown by the fractile curves in Figure 2. To make the earthquake counts large enough for the bias correction to be finite, the approach also forces the analyst to pool the domains in ways that may obscure important differences between domains.

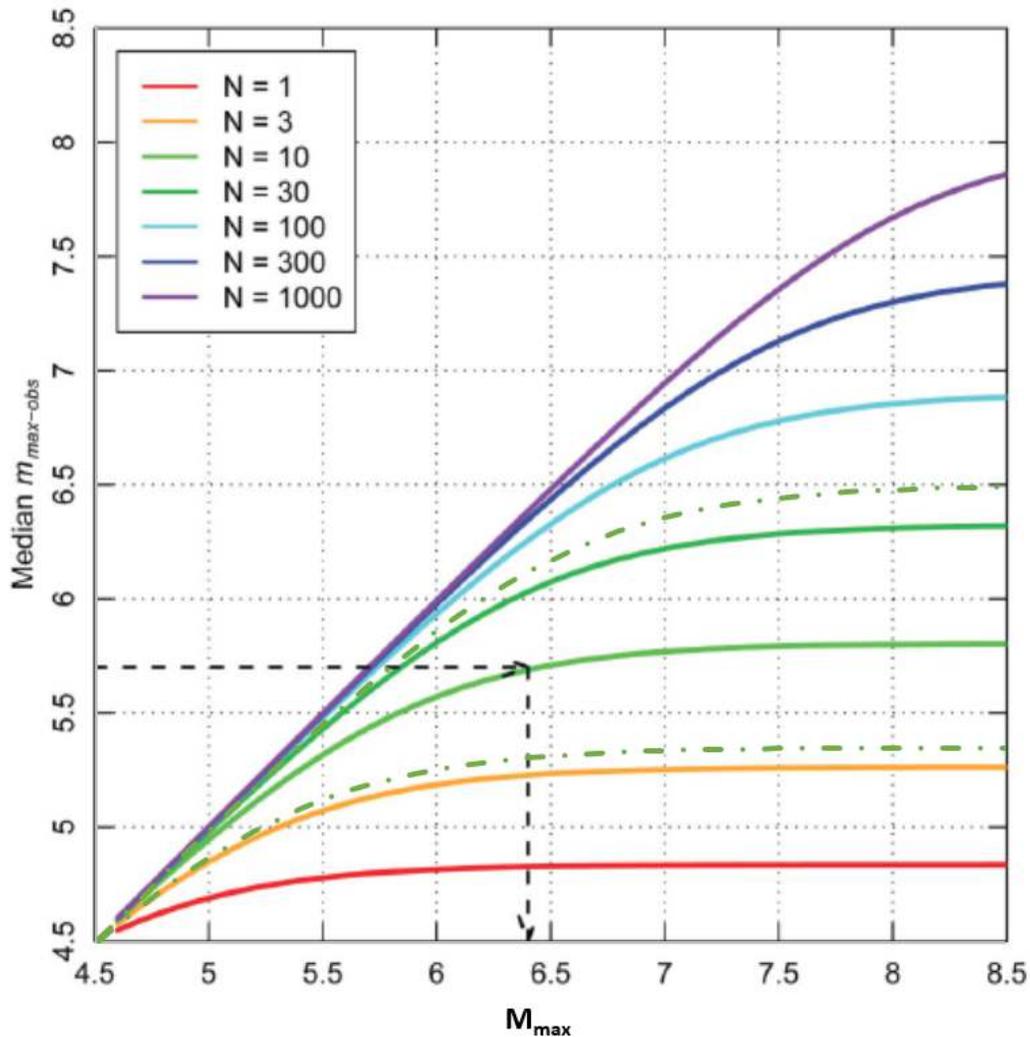


Figure 2. Median values of the median  $M_{max,obs}$  as a function of  $M_{max}$  and  $N$ , the number of  $M > 4.5$  earthquakes in a domain, and the associated uncertainty around that median. Black dashed lines show bias correction for  $M_{max,obs} = 5.7$  and 10 earthquakes. Green dot-dash lines show the associated 0.15- and 0.85- fractile values of  $M_{max,obs}$  (also for 10 earthquakes). The epistemic uncertainty represented by the spread between the dot-dash curves is not taken into account in the CEUS-SSC approach for the bias correction. Modified from USNRC et al., (2012).

The effect of this uncertainty in  $M_{max} - M_{max,obs}$  was recently investigated by Vanneste et al. (2016), who proposed the hypothesis that all SCR seismic sources have the same  $M_{max}$  value (equal to the maximum  $M_{max,obs}$ ), and that all the observed uncertainty in  $M_{max,obs}$  can be explained by the broad uncertainty in  $M_{max}$  given  $M_{max,obs}$ . They performed Montecarlo simulations of synthetic catalogs using and  $M_{max}$  of 7.9 and published SCR recurrence and completeness data, obtaining distributions of  $M_{max,obs}$  that are similar to those that have been observed.

The objective of this project is to investigate the effect of uncertainty in the distribution of  $M_{max}$  given  $M_{max,obs}$  (written as  $M_{max}|M_{max,obs}$ ) on the calculation of the prior distribution of  $M_{max}$ , to obtain a more robust estimation of  $M_{max}$  and its epistemic uncertainty in the CEUS and other SCRs.

This project does not consider approaches that use only the historical earthquakes within an individual source (e.g., Kijko, 2004).

## 2.0 DATA

Johnston et al. (1994) divided the earth's stable crust into 255 SCR crustal domains on the basis of characteristics such as crustal extension, crustal age, age of major deformation, state of stress, and orientation of predominant structural grain relative to stress. The reader is referred to this reference for the rationale behind these definitions and for the description and detailed characteristics of these 255 domains. In addition, they generated a catalog of historical and instrumental SCR earthquakes, which includes the assignment of each earthquake to a specific domain, the best-estimate magnitude of the earthquake, and the uncertainty in that magnitude (measured by a standard deviation). These standard deviations range from essentially zero for well investigated recent earthquakes to 0.7 for some historical earthquakes. All magnitudes in this report are moment magnitudes (**M**), but the boldface will be omitted throughout this report.

This data set was later updated by the CEUS-SSC study, which extended the catalog to December of 2008, converted all magnitudes to expected magnitude  $E[M]$  (see EPRI et al. 2012 for details on this conversion), and re-calculated the  $M_{max,obs}$  for each domain. The updated database is contained in tables K-1 (catalog) and K-2 (domain characteristics, number of earthquakes with magnitude above 4.5  $N_{4.5}$ , and  $M_{max,obs}$ ) of EPRI et al. (2012). These tables are reproduced, with additional columns, as Tables A-1 and A-2 in Appendix A of this report.

This project updated the CEUS-SSC earthquake catalog of  $M > 4.5$  earthquakes to an end date of December 16, 2020 using magnitudes, locations, and depths from the CMT catalog. A few earthquakes with coordinates within an SCR domain but with depths greater than or equal to 45 km were excluded as non-crustal. In addition, earthquakes that were identified visually as aftershocks were removed. In total, 191  $M \geq 4.5$  earthquakes were added, with the largest magnitude being **M** 6.7.

Using this information, this project re-calculated the  $M_{max,obs}$  values and  $N_{4.5}$  for all domains. Tables with the updated data are reproduced as Tables A-4 and A-5 in Appendix A of this report.

This report uses both the CEUS-SSC and updated data sets in the sections that follow. The rationale for using both sets is that results obtained with the CEUS-SSC data set are more directly comparable with the CEUS-SSC report for the sake of testing the methodology.

### 3.0 METHODOLOGY

This section describes the formulation of the problem of estimating the parameters (mean and standard deviation) of the prior distribution of Mmax for a particular set of SCR domains, with certain characteristics (age, age of most recent extension, stress state, etc.), using Mmax,obs in each domain. Many of the same assumptions made in the CEUS-SSC study are also made in this report. For the sake of compactness in the equations, Mmax will be further abbreviated to Mx and Mmax,obs to Mx,obs in this section.

#### 3.1 DIRECT INTEGRATION APPROACH

The objective of the analysis is to estimate the parameters  $\bar{m}$  and  $\sigma$  of the prior distribution of Mx, and their associated uncertainty. If one had observed Mx directly in each domain, one could relate those values to the desired parameters by constructing and maximizing the corresponding likelihood function<sup>1</sup>. Under the assumption that this prior distribution is normal (following CEUS-SSC), the likelihood function of these two parameters takes the well-known form:

$$\ell_{\bar{m},\sigma}(\bar{m},\sigma|M_{x,1},M_{x,2},\dots) = \prod_i \frac{1}{\sqrt{2\pi}\sigma} \exp\left[-\frac{1}{2}\left(\frac{M_{x,i}-\bar{m}}{\sigma}\right)^2\right] \quad (1)$$

where the product extends over the selected set of domains and  $M_{x,i}$  is the maximum magnitude in domain  $i$ . In this case, the maximum-likelihood solution for parameters  $\bar{m}$  and  $\sigma$  corresponds to the solution one would obtain using the method of moments.

Because we do not actually observe  $M_{x,i}$  (but only observe  $M_{x,obs,i} \leq M_{x,i}$ ), we need to consider the relationship between these two quantities in each domain. This relationship is given by the likelihood function of  $M_{x,i} | M_{x,obs,i}$ , which takes the form

$$\ell_{M_{x,i}}(m_x|M_{x,obs,i},n_i) = \begin{cases} c_i(1 - 10^{-b(m_x-4.5)})^{-n_i} & M_{x,obs,i} < m_x < M_{xx} \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

where  $c_i$  is a normalizing constant (so that the function integrates to unity),  $b$  is the Gutenberg-Richter  $b$  value of domain  $I$  (which is taken as 0.95, following the CEUS-SSC project),  $n_i$  is the number of earthquakes above **M** 4.5 in domain  $I$  (denoted  $N_{4.5}$  earlier in this report but written as

<sup>1</sup> In the Cornell and CEUS-SSC Mmax formulation, likelihood functions are used only to modify the prior distribution for a specific source zone. Here, the likelihood functions for all domains are introduced earlier and used to calculate the prior distribution itself.

$n_i$  in this section for the sake of brevity), and  $M_{xx}$  is the maximum possible  $M_{max}$ , which is set to 8.25 following the CEUS-SSC project ( $M_{xx}$  must be specified in order for the likelihood to have a finite integral). The rationale for  $M_{xx}$  of 8.25 is that this is the largest crustal earthquake recorded outside subduction zones.

The shape of this likelihood function is shown in Figure 1b. This shape may have a sharp peak above  $M_{x,obs,i}$  and then flatten, as shown in Figure 1b, or it may be nearly flat. This shape depends on the “missing count”  $n_i 10^{-b(M_{x,obs,i}-4.5)}$  (i.e., the expected count of earthquakes above  $M_{x,obs,i}$  if  $M_x$  is taken as equal to infinity). If the missing count is much greater than 1, the sharp peak in the likelihood function indicates that the data favor values of  $M_{x,i}$  slightly above  $M_{x,obs,i}$ . If the missing count is smaller than 1, the flat shape of the likelihood function indicates that the data contain little information about  $M_{x,i}$ , other than the fact that it must be greater than  $M_{x,obs,i}$ .

The likelihood function in Eq. 2 is constructed by assuming an exponential magnitude distribution between 4.5 and  $M_x$  with a known  $b$  value. If one represents epistemic uncertainty in the  $b$  value with a normal distribution, one obtains the magnitude distribution first derived by Campbell (1982), which involves Gamma functions instead of exponentials. Campbell’s magnitude distribution could also be used to construct the likelihood for  $M_x | M_{x,obs}$ . Because Campbell’s magnitude distribution has broader tails, the resulting likelihood would be more informative about  $M_x$  because the missing counts would be larger. This approach is not pursued in this report, although its implementation would not be too different from the implementation presented here.

There is additional uncertainty in the likelihood function for  $M_{x,i}$  because the observed magnitude  $M_{x,obs,i}$  is also uncertain. The magnitudes in the SCR catalog are themselves uncertain, particularly for historical earthquakes. The CEUS-SSC project accounted for this uncertainty by randomizing all magnitudes in the catalog, re-calculating  $M_{x,obs}$  for each domain, re-calculating the mean and standard deviation of  $M_{x,obs}$  for the domain categories, and applying the bias corrections.

For the purposes of this project, it is more convenient to account for the uncertainty in  $M_{x,obs,i}$  analytically, by integrating the likelihood of Eq. 2 with the distribution of  $M_{x,obs}$  in domain  $i$ , which depends on the magnitudes and uncertainties of all earthquakes within domain  $i$  that are contained in the catalog (not just the one with the largest observed  $E[M]$ ). One accounts for this by integrating over the distribution of  $M_{x,obs}$  in the domain, i.e.,

$$\ell_{M_{x,i}}(m_x | cat_i) = \check{c}_i \int_0^{M_{xx}} \ell_{M_{x,i}}(m_x | m, n_i) f_{M_{x,obs,i}}(m | cat_i) dm \quad (3)$$

where  $\tilde{c}_i$  is a new normalizing constant. We use the symbol  $\ell_{M_{x,i}}(m_x|cat_i)$  to distinguish this quantity from the quantity in Eq. 2 and to indicate that this quantity depends on all the earthquakes in the catalog that are contained within domain  $i$ .

The density function  $f_{M_{x,obs,i}}(m|cat_i)$  required for Eq. 3 can be calculated using the well-known result that the cumulative distribution function (CDF) of the maximum of several independent random variables is the product of their respective CDFs. So, the CDF of  $M_{x,obs}$  for a domain is the product of the CDF's of all the uncertain magnitudes for all catalog events in that domain. For this calculation, it is assumed that the uncertainty in the individual event magnitudes follows a normal distribution, as was done by the CEUS-SSC study.

The standard approach for problems with un-observed data from the likelihood function of the desired parameters is to remove the unobserved  $M_{x,i}$  by integrating over all their possible values (while taking into account their distribution, which is given by the normalized likelihood in Eq. 3). The result is a likelihood function that depends only on the observed data (through the magnitudes in the catalog), i.e.;

$$\ell_{\bar{m},\sigma}(\bar{m},\sigma|cat_1,n_1,cat_2,n_2,cat_3,n_2,\dots) = \prod_i \left\{ \int_{4.5}^{M_{xx}} \frac{1}{\sqrt{2\pi}\sigma} \exp\left[-\frac{1}{2}\left(\frac{m_x - \bar{m}}{\sigma}\right)^2\right] \ell_{M_{x,i}}(m_x|cat_i,n_i) dm_x \right\} \quad (4)$$

In principle, the normal density in the above equation should be normalized so that it integrates to unity after removing the distribution tails below 4.5 and above  $M_{xx} = 8.25$ , particularly the latter. We choose not to normalize it to maintain consistency with Eq. 1, which corresponds to the method of moments and is consistent with the CEUS-SSC approach. This choice reduces sensitivity to the choice of  $M_{xx}$  and effectively down-weights  $\bar{m}$ - $\sigma$  combinations in which  $\bar{m}$  approaches  $M_{xx}$  and  $\sigma$  is comparable to the distance between the two.

Because there are only two unknown parameters (namely  $\bar{m}, \sigma$ ) in the above equation, it is possible to calculate the likelihood function in Eq. 4 for a 2-D grid of  $\bar{m}, \sigma$ . The resulting grid of likelihood values is then used to determine the maximum-likelihood estimate  $\bar{m}$  and  $\sigma$  (i.e., the coordinates of the grid point with the highest likelihood), and for further calculations to incorporate the effect of uncertainty in these parameters. This report used discretized  $\bar{m}$  from 4.505 to 8.245 magnitude units, with a spacing of 0.01, and  $\sigma$  from 0.1125 to 2.4875 magnitude units, with a spacing of 0.025. All numerical integrations used a spacing of 0.01 magnitude units.

In addition to the maximum-likelihood estimates of  $\bar{m}$  and  $\sigma$ , it is important to consider their statistical uncertainty and the resulting uncertainty in the distribution of  $M_x$ . This uncertainty includes not only the uncertainty due to the limited number of domains being used, but also from

the fact that the  $M_{x,i}, i=1,2,\dots$  were not observed directly (but were observed “with noise” through  $M_{x,obs,i}$ ). Thus, the final step in the analysis is to obtain total uncertainty in the  $M_x$  distribution as the weighted sum of the distributions of  $M_x$  associated with all possible combinations of  $\bar{m}$  and  $\sigma$ , as follows:

$$f_{M_x}(m) = \int \int c \ell_{\bar{m},\sigma}(\bar{m},\sigma|data) \frac{1}{\sqrt{2\pi}\sigma} \exp\left[-\frac{1}{2}\left(\frac{m-\bar{m}}{\sigma}\right)^2\right] d\bar{m} d\sigma \quad (5)$$

where  $\ell_{\bar{m},\sigma}(\bar{m},\sigma|data)$  is the likelihood calculated in Eq. 4 but written with a more compact notation, and  $c$  is a normalizing constant so that this likelihood integrates to unity. The resulting distribution is the prior Mmax distribution that one should use in the Bayesian approach illustrated in Eq. 1.

Results in the next section will be presented in terms of both the maximum-likelihood (ML) and predictive mean and standard deviations of the prior distribution. The distinction between the ML and predictive standard deviations is a subtle one. The ML standard deviation represents the most-likely value of the domain- to-domain variation in  $M_x$ , while the predictive standard deviation also includes the effect of the statistical uncertainty in  $\bar{m}$  and  $\sigma$ . If one had many more domains and/or a much longer catalog for each domain, the two standard deviations would become identical but may remain finite (they would both tend to zero if the hypothesis of Vanneste et al., 2016 is correct).

### 3.2 EXPECTATION-MAXIMIZATION (EM) APPROACH

An alternative to the direct integration approach described above is the EM algorithm (Dempster et al., 1977). The calculation of Mmax is a classic example where the EM algorithm is useful: the likelihood function of the desired parameters would be very simple (i.e., Eq. 1) if the  $M_{x,i}$  (vector  $\mathbf{X}$  in the usual EM notation, as introduced by Dempster et al., 1977) were known, but becomes complicated when one incorporates the complex relationship between the observed  $M_{x,obs,i}$  (vector  $\mathbf{Y}$  in the usual EM notation) and the un-observed  $M_{x,i}$  (or  $\mathbf{X}$ ). The EM algorithm for this problem is implemented using the following steps:

1. Define initial values (corresponding to iteration counter  $k=0$ ) of the prior-distribution parameters  $\bar{m}$  and  $\sigma$  of the selected seismic domains; call them  $\bar{m}^{(k)}$  and  $\sigma^{(k)}$  (vector  $\boldsymbol{\theta}^{(0)}$  in the usual EM notation) and use them for the next step.
2. E (or Expectation) step: Calculate the conditional distribution of  $\mathbf{X}|\mathbf{Y}, \boldsymbol{\theta}^{(k)}$  and use this distribution to calculate the expected value of the “complete-data” log-likelihood (i.e., the

logarithm of Eq. 1). In this problem, the distribution  $f_{M_{x,i}|M_{x,obs,i},\bar{m}^{(k)},\sigma^{(k)}}$  is obtained using Bayes' Theorem as

$$f_{M_{x,i}|M_{x,obs,i},\bar{m}^{(k)},\sigma^{(k)}}(m_{x,i}|M_{x,obs,i},\bar{m}^{(k)},\sigma^{(k)}) = c f_{M_{x,obs,i}|M_{x,i}}(M_{x,obs,i}|m_{x,i}) \times \frac{1}{\sqrt{2\pi}\sigma^{(k)}} \exp\left[-\frac{1}{2}\left(\frac{m_{x,i}-\bar{m}^{(k)}}{\sigma^{(k)}}\right)^2\right] \quad (6)$$

where  $f_{M_{x,obs,i}|M_{x,i}}(M_{x,obs,i}|m_{x,i})$  is the same as the likelihood function of  $M_{x,i}$  calculated in Eq. 3, and  $c$  is a new normalizing constant. For the purpose of these calculations, it is useful to discretize the range of possible  $m_x$  values and convert the above density function for each domain  $i$  into discrete weights  $w_{i,1}^{(k)}, w_{i,2}^{(k)}, \dots$  that add to unity<sup>2</sup>. Using these, one can write the expected value of the complete-data log-likelihood as

$$E\left\{\ln[\ell_{M,\sigma}(\bar{m},\sigma)]^{(k)}\right\} = -D\ln\sigma - \frac{1}{2\sigma^2} \sum_{i=1}^D \sum_j w_{i,j}^{(k)} (m_{x,j} - \bar{m})^2 \quad (7)$$

where  $D$  is the number of domains considered, the first summation (indexed by  $i$ ) extends over these domains, and the second summation (indexed by  $j$ ) extends over the discretization of  $m_x$ .

3. M (or maximization) step: determine the new values  $\bar{m}^{(k+1)}$  and  $\sigma^{(k+1)}$  that maximize the expected log-likelihood in Eq. 7. In this case, the maximization process involves calculating the first derivatives of Eq. 7 with respect to  $\bar{m}$  and  $\sigma$ , making those derivatives equal to 0, and solving for  $\bar{m}$  and  $\sigma$ .
4. Repeat steps 2 and 3, using the new estimates of  $\bar{m}$  and  $\sigma$ , until the process converges. Dempster et al. (1997) have shown that the EM iteration process converges to the ML values of the parameter vector  $\Theta$ .

Finally, the statistical uncertainty in the final estimates of  $\bar{m}$  and  $\sigma$  can be calculated using the procedure described by Louis (1982).

<sup>2</sup> Notice that we are discretizing the sample space for the EM algorithm, while we discretized both the parameter space and the sample space for the direct integration algorithm.

## 4.0 RESULTS

### 4.1 RESULTS USING CEUS-SSC DATA SET

The reason for retaining the original CEUS-SSC data set is to make the results obtained with the methodology in Section 2 directly comparable with the CEUS-SSC results, for the sake of comparing the two methodologies.

#### 4.1.1 Direct Integration

Results for the direct integration were obtained for the same three domain categories used by the CEUS-SSC project. Table 2 lists the domains in the MESE and NMESE domains that have non-zero values of  $n$  (those with zero values contribute nothing to the estimation of  $M_x$ ). The last column ( $M_{x,obs,max}$  refers to the maximum  $M_{x,obs}$  among all the domains in a category). Further details on these domains are contained in Johnston et al. (1994) and in Appendix A.

Table 2. List of domains in each CEUS-SSC domain category

Domain Category	Domains	$M_{x,obs,max}$
MESE	1 2 4 6 11 15 16 21 23 26 30 32 33 34 35 46 53 54 59 65 70 71 75 76 80 85 90 91 105 114 115 116 117 118 119 120 125 126 127 132 137 144 148 170 183 184 188 189 193 194 195 197 198 199 201 208 213 214 215 217 218 221 227 228 247 248 249 250 254	7.9
NMESE	3 5 7 8 9 10 12 13 14 17 18 19 27 28 31 41 42 47 49 51 52 56 58 60 61 63 64 66 67 68 72 73 74 77 78 79 81 82 83 84 89 92 93 95 98 99 100 106 107 108 109 110 111 112 113 122 123 128 129 130 131 133 134 135 136 138 139 140 141 146 147 149 152 154 156 157 158 159 160 161 166 167 168 169 171 173 175 177 179 181 182 185 186 187 190 192 196 200 202 222 223 224 225 226 229 230 231 235 236 237 238 239 241 242 244 246 251 253 255	7.3

For the direct integration calculations, the magnitude range was discretized from 4.5 to 8.25, using a spacing of 0.01 magnitude units. The joint likelihood function in Eq. 4 was calculated for all  $\bar{m}$  values in that same discretization, and for  $\sigma$  values from 0.1 to 2.5 magnitude units, with a spacing of 0.025 magnitude units.

Figures 3 and 4 depict the likelihood functions of  $M_x$  for the MESE and NMESE domains, without and with the effect of uncertainty in  $M_{x,obs}$  in each domain (i.e., Eqs. 2 and 3 respectively). The top figures illustrate the strong influence of the “missing count” in some source zones, particularly for NMESE. The bottom figures illustrate the strong effect of uncertainty in  $M_{x,obs}$ , which tends to smooth out the left portion of the likelihood functions. Note also that the likelihood functions for domains with high  $M_{x,obs}$  tend to be higher as a result of normalization.

Figures 5 through 7 show the joint likelihood function of the  $M_x$  distribution parameters  $\bar{m}$  and  $\sigma$  for the MESE, NMESE, and ALL domains (see Eq. 4). This joint likelihood function is much broader for NMESE than for MESE and ALL (this may be due in part to edge effects associated with  $M_{xx} = 8.25$ , which has a strong effect on some of the likelihoods in Figure 4). In all cases, the point of maximum likelihood is associated with  $\bar{m}$  nearly equal to the maximum observed magnitude in all domains within that category, and  $\sigma=0.1$  magnitude units (the lowest value in the discretization), which is essentially 0 for practical purposes. Tests with a finer discretization of  $\sigma$  yielded even smaller values of  $\sigma$ , but the same overall shape of the joint likelihood.

Figure 8 shows the predictive distributions for the three CEUS-SSC domain categories, obtained using Eq. 5. As anticipated from Figures 5 through 7, the predictive distribution for NMESE is much broader than those for MESE and ALL. Finally, Table 3 lists the maximum-likelihood (ML) and predictive-distribution parameters for the three domain categories.

These results show that the direct integration approach yields maximum-likelihood values of  $\bar{m}$  in the vicinity of the highest  $M_{x,obs}$  and very small maximum-likelihood values of  $\sigma$  (essentially zero). This is generally consistent with the hypothesis by Vanneste et al. (2016) that the observed scatter in  $M_{x,obs}$  may be due to the variability in  $M_{x,obs}$  given  $M_x$  and not necessarily to domain-to-domain variability in  $M_x$ . On the other hand, Figure 6 shows that values of  $\sigma$  as high as 0.3 may be admissible for the NMESE domain category.

The higher standard deviation of the predictive distribution is a consequence of statistical uncertainty, which arises from the limited number of domains in each category and to the uncertainty in  $M_x|M_{x,obs}$ .

An important question is whether the partition of the domains between MESE and NMESE is justified. This question can be investigated by calculating the Akaike Information Criterion or AIC (Akaike, 1974), which balances the goodness of fit between model and data (as measured by the maximum value of the likelihood) and the number of free model parameters. For sample sizes of approximately 40 or more observations, the AIC is given by the expression

$$AIC = -2 \ln(\ell) + 2K \quad (8)$$

Where  $\ell$  is the value of the likelihood at the maximum-likelihood point and  $K$  is the number of free distribution parameters. In this case,  $\sigma$  is not counted as a parameter because its value is essentially 0 and because it was constrained by the discretization. Low values of the AIC are preferred, and the normalized  $\exp(-AIC/2)$  values of competing models are sometimes used as logic-tree weights (Burnham and Anderson, 2002). The resulting AIC values are -517.9 for MESE, -854.0 for NMESE (for a combined AIC of -1371.9), versus an AIC of -1371.0 for the ALL model. Therefore the model with the MESE/NMESE partition is slightly better in terms of AIC than the

ALL model. Note that AIC comparisons depend on the difference between AIC values, not on their ratio. Regarding AIC-based weights, the partitioned MESE/NMESE model would get a weight of 0.6, while the model with no partition gets 0.4. This is not too different from the findings of the CEUS-SSC study, which found that the probability that the two populations have different means is slightly greater than 0.5.

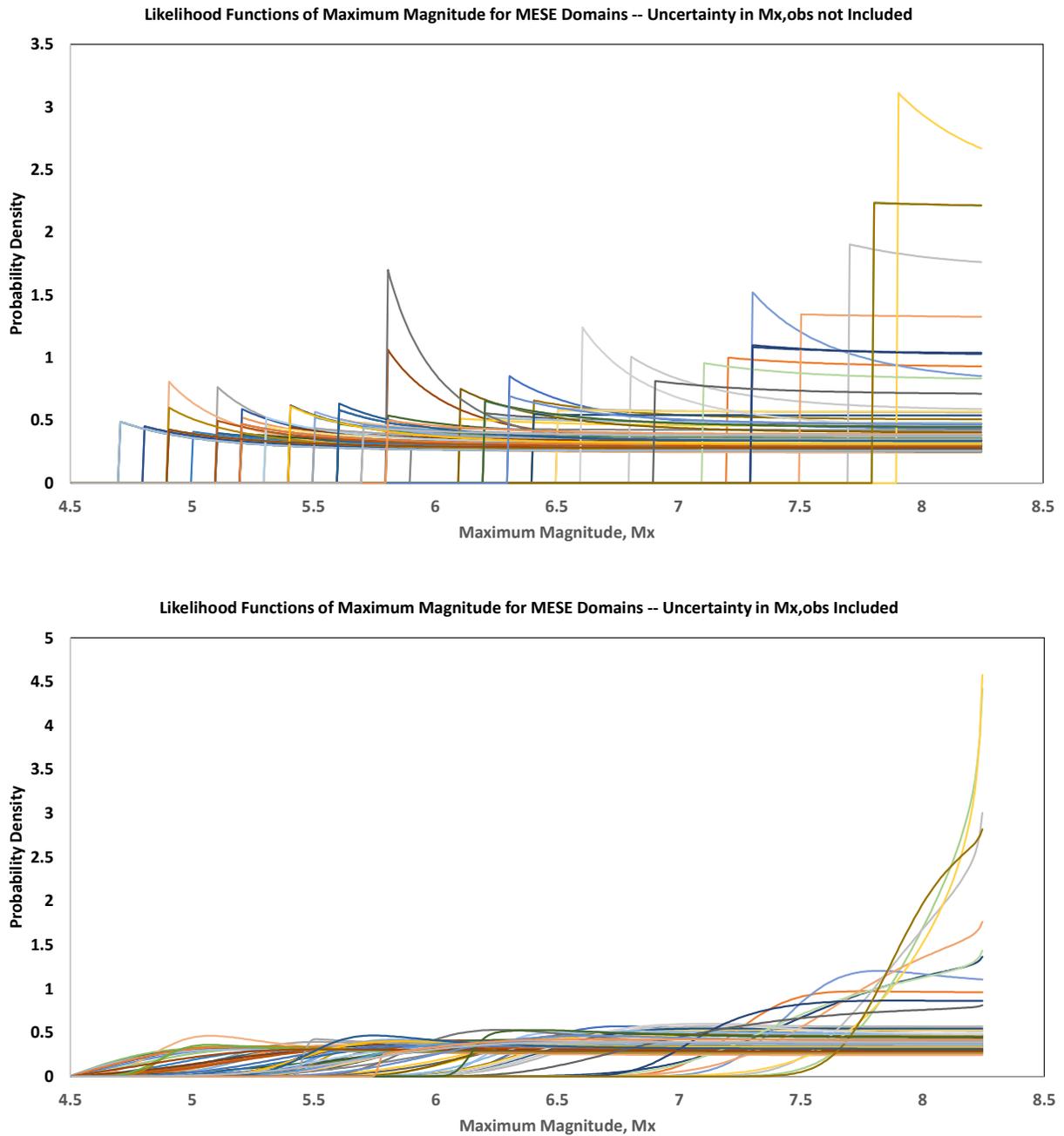


Figure 3. Normalized likelihood functions of  $M_x$  for MESE domains (with original data), not including (top) and including (bottom) the effect of uncertainty in  $M_{x,obs}$ .

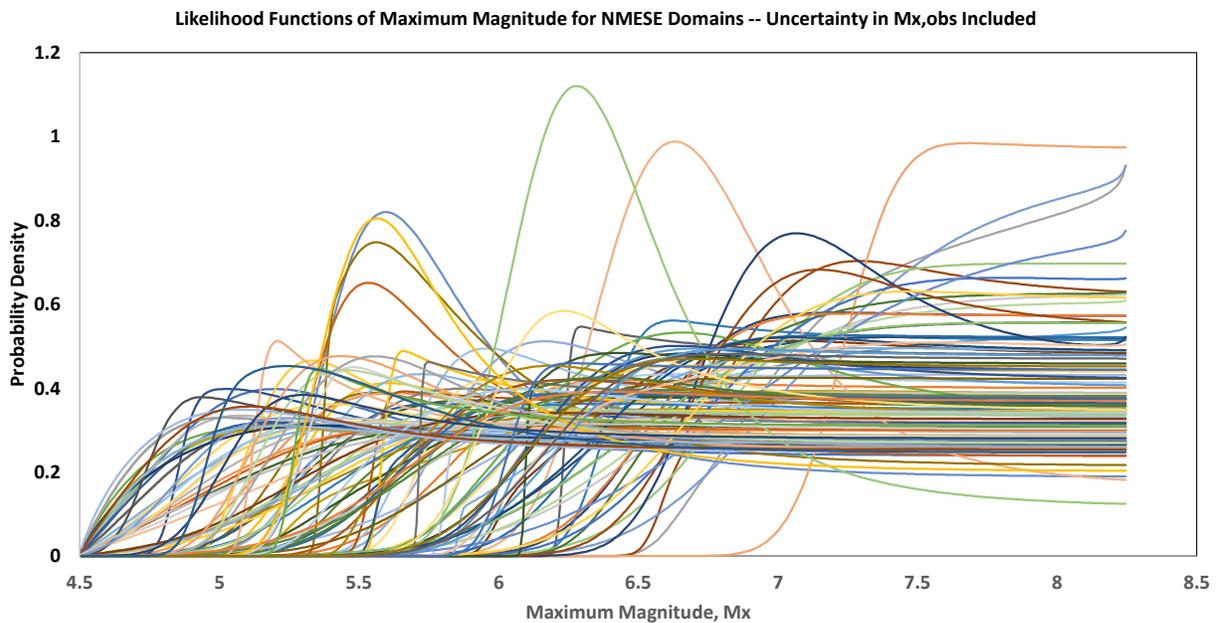
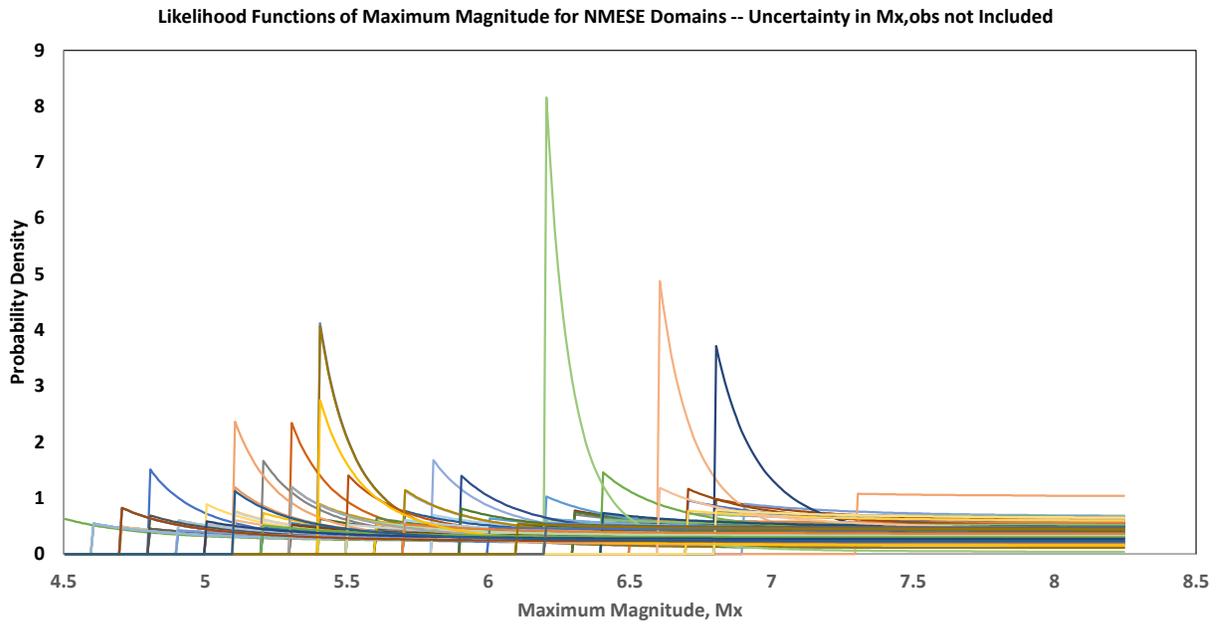


Figure 4. Normalized likelihood functions of  $M_x$  for NMESE domains (with original data), not including (top) and including (bottom) the effect of uncertainty in  $M_{x,obs}$ .

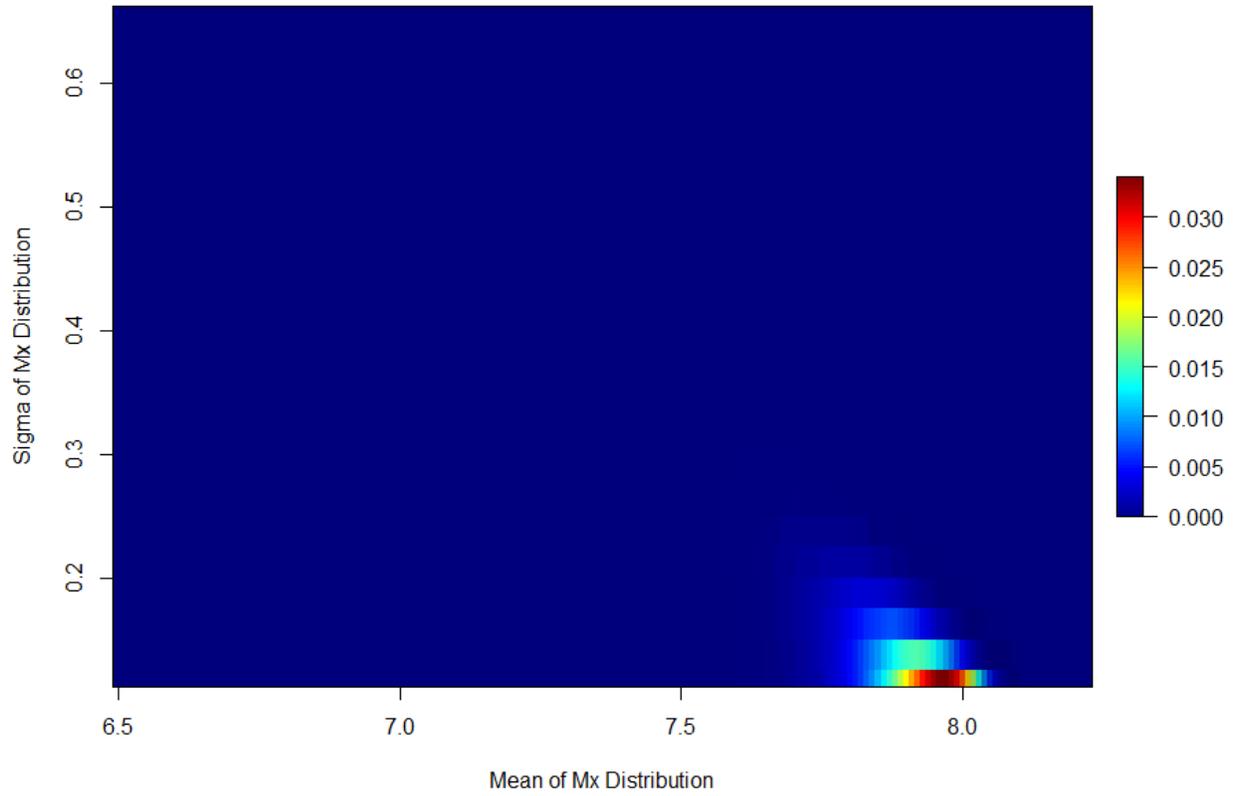


Figure 5. Joint likelihood function of the mean and standard deviation of the maximum-magnitude distribution of the MESE domains (using original data).

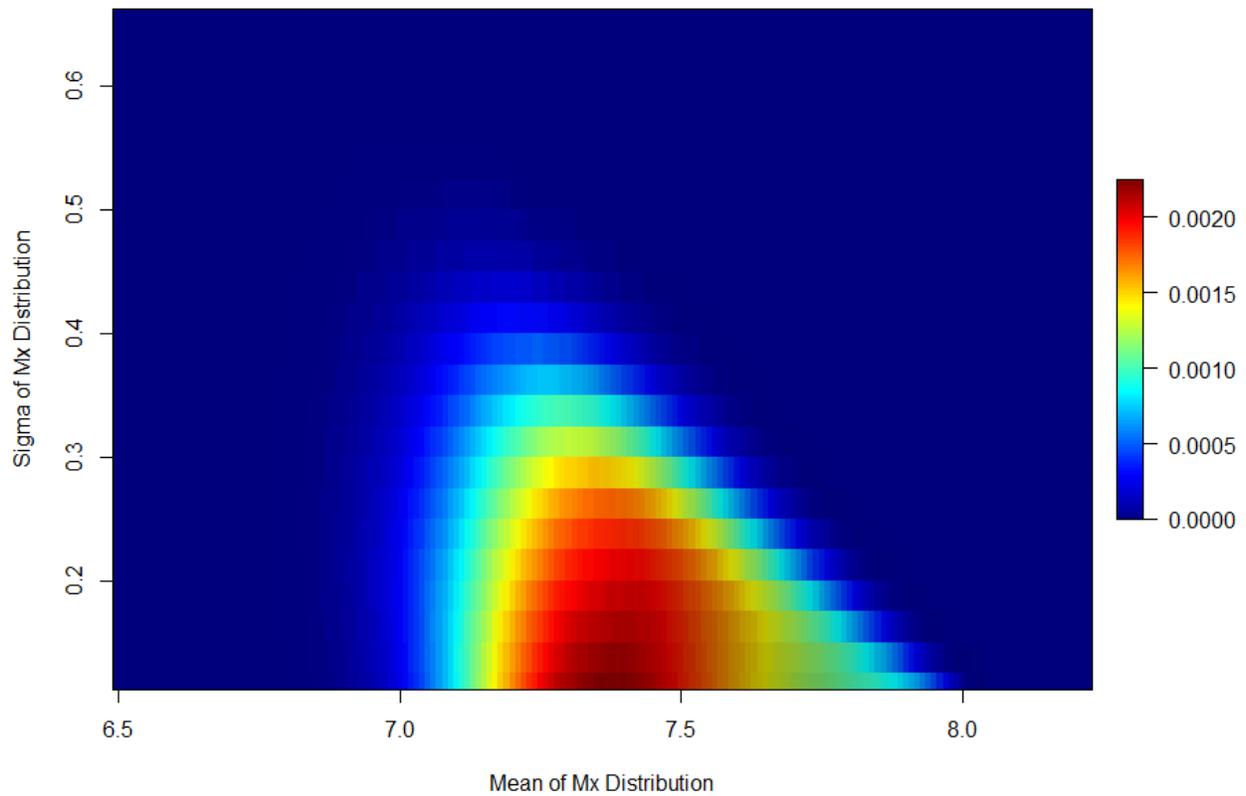


Figure 6. Joint likelihood function of the mean and standard deviation of the maximum-magnitude distribution of the NMESE domains (using original data).

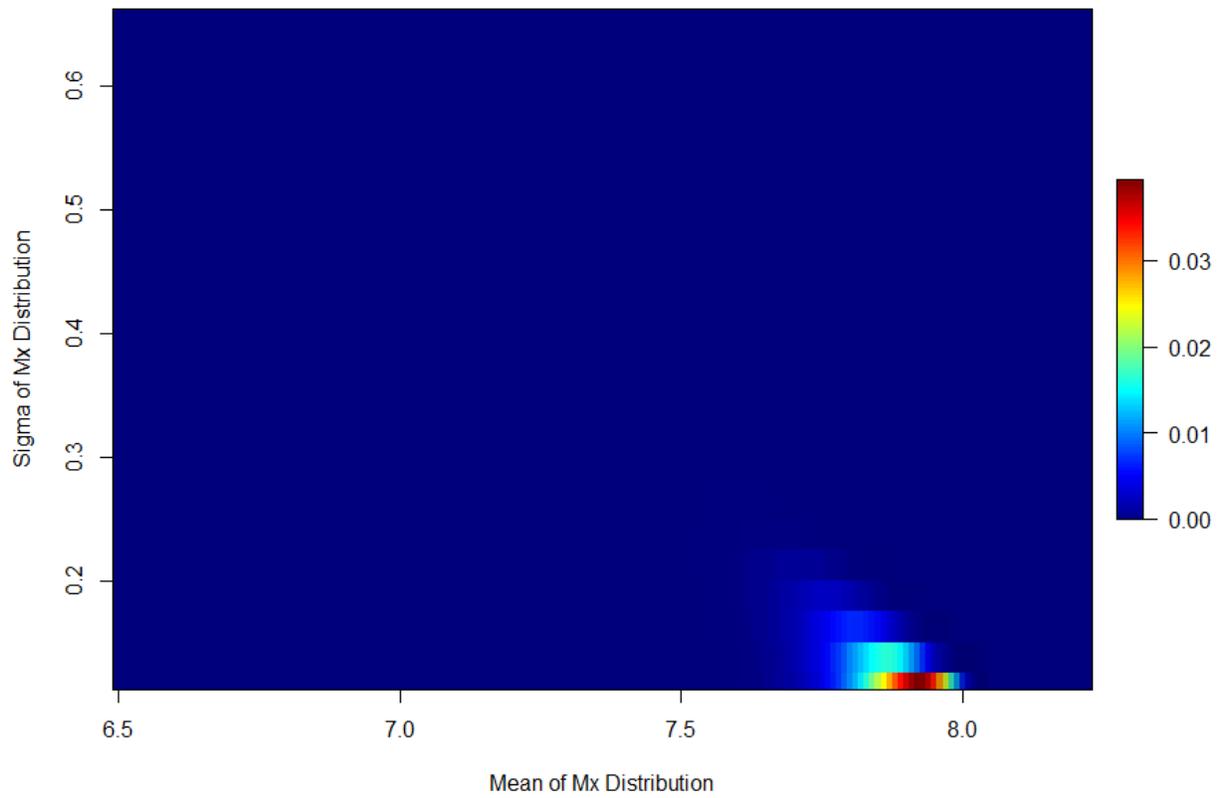


Figure 7. Joint likelihood function of the mean and standard deviation of the maximum-magnitude distribution of all domains combined (using original data).

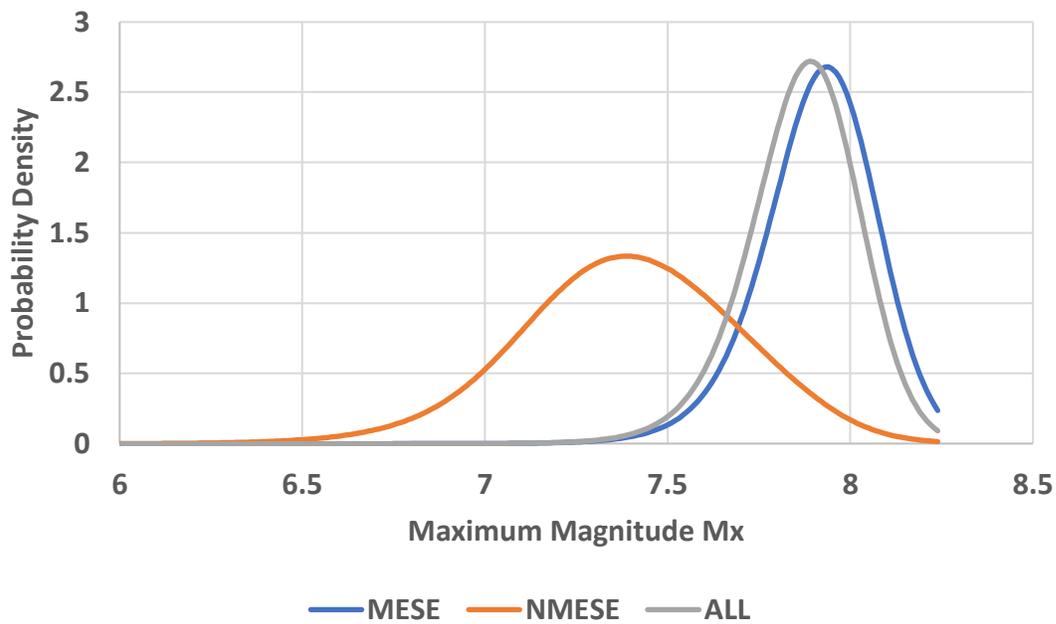


Figure 8. Predictive distributions of Mx for the CEUS domain categories obtained using direct integration.

Table 3. Summary of distribution parameters obtained using direct integration and the original data set (values from CEUS-SSC project shown for reference)

CEUS-SSC Domain Category	CEUS-SSC Project		Direct Integration			
	mean	Sigma	ML mean	ML sigma	Mean of Predictive Distribution	Sigma of Predictive Distribution
MESE	7.35	0.75	7.98	0.11	7.91	0.16
NMESE	6.70	0.61	7.36	0.11	7.39	0.30
ALL	7.20	0.64	7.93	0.11	7.87	0.15

### 4.1.2 EM Algorithm

Results for the EM algorithm were also obtained for the same three domain categories used by the CEUS-SSC project. Only the ML estimates of the mean and standard deviation of the distribution of  $M_x$  were obtained. The statistical uncertainty in these two values may be obtained using the approach described by Louis (1982) and then used to construct an approximate predictive distribution of  $M_x$ , but this was not done in this project.

For the implementation of the EM algorithm, the magnitude range was discretized from 4.5 to 8.25, using a step size of 0.01 magnitude units, as was done in Section 4.1.1 for the calculation of the likelihoods of  $M_x$ . Unlike Section 4.1.1, there is no need to discretize the parameter space of the ML mean and  $\sigma$ , so that the algorithmic lower limit for  $\sigma$  is the discretization step of 0.01.

Table 4 lists the estimates of the ML mean and  $\sigma$  obtained using the EM algorithm for the same three CEUS-SSC domain categories. Comparing the ML means to the corresponding ML means in Table 2, one observes that the values are the same for NMESE, but higher by 0.2 magnitude units for MESE and ALL. The reason for this difference is not clear, but it may be that the end effects related to truncation at M 8.25 affect the two approaches differently.

Table 4. Results from application of the EM algorithm using the original data set.

CEUS-SSC Domain Category	CEUS-SSC Project		EM Algorithm	
	mean	sigma	ML mean	ML sigma
MESE	7.35	0.75	8.18	0.02
NMESE	6.70	0.61	7.36	0.10
ALL	7.20	0.64	8.13	0.04

### 4.1.3 Monte Carlo Simulation with Direct Integration and EM Algorithm

The purpose of these simulations is to further investigate the possible bias of the direct integration and EM approaches. To this effect, we generate 100 synthetic earthquake catalogs with prescribed distributions of  $M_x$ , determine the ML parameters of the distribution of  $M_x$  for each synthetic catalog using the direct integration and EM approaches, and then compare the distributions obtained to the prescribed distributions.

The steps for generating the synthetic catalog are as follows:

- Step 1. Simulate the value of  $M_x$  for each domain by drawing from a prescribed distribution of  $M_x$ . We consider the distributions obtained by the CEUS-SSC study for the various domain categories (odd-numbered cases in Table 4), as well as the ML estimates of the distribution parameters obtained for the same categories in Section 4.1.1 using direct

integration (see Table 3 above; even-numbered cases). In all cases, we simulate the  $M_x$  distributions as normal and truncated at magnitudes 4.5 and 8.25.

- Step 2. Simulate the best-estimate magnitude for each event in each domain using an exponential distribution between 4.5 and the domain's simulated  $M_x$ , using a b value of 0.95. The number of events in each domain is the value of  $N_{>4.5}$  in Table A-2 (called  $n$  in Section 3), rounded to the nearest integer.
- Step 3. Simulate the standard deviation in each simulated magnitude. Use a normal distribution with values based on the statistics observed in Table A-1 (mean value of 0.30 magnitude units, standard deviation of 0.12 magnitude units, truncated at 0.01 and 0.70 magnitude units<sup>3</sup>). Adjust the magnitudes from step 2 for the effect of the standard deviation by calculating expected magnitudes ( $E[M]$ ) using Eq. 5.2.1-4 of CEUS-SSC.

Thus, each synthetic catalog has similar characteristics as the real catalog in terms of number of domains, number of events in each domain, and uncertainty in magnitude. The only difference with the real catalog is that the analyst prescribes the distribution of  $M_x$  for each set of 100 synthetic catalogs.

Results for all simulations and the direct integration approach are shown in Table 4. There are two sets of results for each domain category; i.e., for prescribed distributions of  $M_x$  based on CEUS-SSC study and for prescribed distributions based on the direct-integration results obtained in Section 4.1.1. Results for each set of simulations include the following summary statistics:

- The mean of ML means, which represents the simulation-based central estimate of the mean  $M_x$ . These values can be compared to the prescribed mean  $M_x$  values used as inputs in the simulations for the domain category under consideration.
- The simulation-to-simulation standard deviation of the ML means, which represents an empirical (i.e., simulation-based) measure of the standard deviation of the  $M_x$  distribution that arises from the limited number of earthquakes in the catalog and the limitations of  $M_{x,obs}$  as a measure of  $M_x$ . For the simulations based on the direct-integration parameters, these values (cases 2, 4, and 6; shown in bold in Table 4) can be compared to the standard deviation of the corresponding predictive distribution<sup>4</sup>. These standard deviations, if divided by  $\sqrt{100} = 10$  yield the standard error in the means calculated in the previous column (i.e., yielding values of 0.04 magnitude units or less), indicating that 100 simulations are sufficient to obtain a stable estimate of the ML mean.
- The rms of ML standard deviations, which represents the simulation-based central estimate of the ML standard deviation of  $M_x$ . These values can be compared to the

<sup>3</sup> The magnitude uncertainties in the catalog data of Table A-1 have a very slight correlation with magnitude, but this correlation was ignored.

<sup>4</sup> For the CEUS-SSC results, it is impossible to know how much the reported standard deviations represent the domain-to-domain variability in  $M_x$  within a domain category (which correspond to the ML standard deviation in Section 4.1.1) and how much represents statistical uncertainty.

prescribed standard deviations of  $M_x$  used as input to the simulation for the domain category under consideration.

- The standard deviation of the ML standard deviations, which can also be used to calculate the corresponding standard errors, also yielding very low values.

The absolute value of the bias in the mean is 0.2 magnitude units or less. The mean bias for the six cases considered is -0.02 magnitude units. Also, there is a weak negative correlation between the bias and the postulated mean  $M_x$ .

Although this bias is not zero as one would desire, it is small enough compared to the difference between the CEUS-SSC based prescribed distributions and those based on Section 4.1.1. In other words, if the true distribution of  $M_x$  for MESE and NMESE had mean values of 7.35 and 6.70, respectively, the direct integration approach would have produced comparable values.

Comparing the standard deviation of the ML means (cases 2, 6, and 6; shown in bold in Table 4) to the predictive standard deviations in Table 3 indicate that the predictive standard deviations obtained using direct integration are accurate to within 0.05 magnitude units.

For the cases that were simulated using the CEUS-SSC parameters, with greater standard deviations than obtained in Section 4.1.1 (i.e., odd-numbered cases in Table 4), both the standard deviation of the ML means and the rms of the ML standard deviations are lower than the prescribed standard deviations used to generate the catalogs. This result underscores the difficulty of determining how much of the observed variability in  $M_{x,obs}$  is due to domain-to-domain variability in  $M_x$  and how much to the broad (i.e., uninformative) distribution of  $M_x|M_{x,obs}$ . In the CEUS-SSC study, the observed variability in  $M_{x,obs}$  for each superdomain category was interpreted as epistemic uncertainty in  $M_x$ .

For the cases that were simulated using the results from Section 4.1.1, the rms of the ML standard deviations is small and agrees with the prescribed values.

The overall conclusion from these simulations is that the direct integration approach yields estimates of the distribution of  $M_x$  that are consistent with the underlying distributions, especially when those distributions are not excessively broad.

Table 6 shows results obtained using the same simulated catalogs but using the EM algorithm. In this case, there is no EM-based estimate of the predictive standard deviation, but one can compare the mean of the ML means to the prescribed means and the rms's of the ML standard deviations to the prescribed standard deviations. The absolute value of the bias in the mean is 0.18 magnitude units or less. As was the case with direct integration, the rms of the EM standard deviations under-estimates the prescribed standard deviation of  $M_x$  is based on the CEUS-SSC results, and is accurate when the standard deviations obtained in Section 4.1.1 are used.

Overall, the results in this Section show that both the direct integration and EM approaches produce essentially unbiased estimates of the underlying distributions of  $M_x$ . The one exception is when the prescribed standard deviation of  $M_x$  has an excessively large standard deviation.

Table 5. Results from Monte Carlo simulations with the direct integration approach. Odd-numbered cases use the CEUS-SSC values; even-numbered cases use values obtained in Section 4.1.1 by direct integration.

Case No.	CEUS-SSC Domain Category	Mmax Distribution used to Simulate Domain Mmax		Summary Statistics from 100 Simulated Catalogs			
		mean	sigma	mean of ML means	sigma of ML means	rms of ML sigmas	sigma of ML sigmas
1	MESE	7.35	0.75	7.45	0.38	0.18	0.09
2	MESE	7.98	0.11	7.78	<b>0.23</b>	0.12	0.03
3	NMESE	6.70	0.61	6.89	0.23	0.29	0.13
4	NMESE	7.36	0.11	7.51	<b>0.26</b>	0.12	0.03
5	ALL	7.20	0.64	7.40	0.31	0.19	0.08
6	ALL	7.93	0.11	7.84	<b>0.13</b>	0.12	0.02

Table 6. Results from Monte Carlo simulations with the EM algorithm. Odd-numbered cases use the CEUS-SSC values; even-numbered cases use values obtained in Section 4.1.1 by direct integration.

Case No.	CEUS-SSC Domain Category	Mmax Distribution used to Simulate Domain Mmax		Summary Statistics from 100 Simulated Catalogs			
		mean	sigma	mean of ML means	sigma of ML means	rms of ML sigmas	sigma of ML sigmas
1	MESE	7.35	0.75	7.46	0.42	0.19	0.11
2	MESE	7.98	0.11	7.88	0.31	0.09	0.05
3	NMESE	6.7	0.61	6.87	0.18	0.3	0.12
4	NMESE	7.36	0.11	7.53	0.29	0.12	0.04
5	ALL	7.2	0.64	7.38	0.31	0.21	0.09
6	ALL	7.93	0.11	7.95	0.20	0.08	0.04

## 4.2 RESULTS USING UPDATED DATA SET

The direct integration and EM calculations documented in Sections 4.1.1 and 4.1.2 were repeated with the updated catalog, obtaining the results in Tables 7 and 8. These results are very similar to those obtained earlier using the CEUS-SSC data set. In all cases, differences in the means and standard deviations are 0.03 magnitude units or less.

Table 7. Summary of distribution parameters obtained using direct integration and the updated data set

CEUS-SSC Domain Category	CEUS-SSC Project		Direct Integration			
	mean	sigma	ML mean	ML sigma	Predictive mean	Predictive sigma
MESE	7.35	0.75	7.97	0.11	7.91	0.16
NMESE	6.70	0.61	7.34	0.11	7.37	0.30
ALL	7.20	0.64	7.93	0.11	7.86	0.16

Table 8. Summary of distribution parameters obtained using direct integration and the updated data set

CEUS-SSC Domain Category	CEUS-SSC Project		EM Algorithm	
	mean	sigma	ML mean	ML sigma
MESE	7.35	0.75	8.18	0.02
NMESE	6.70	0.61	7.33	0.11
ALL	7.20	0.64	8.13	0.04

## 5.0 CONCLUSIONS AND DISCUSSION

The results presented here confirm the hypotheses by Vanneste et al. (2016) that narrow distributions of  $M_{max}$  with mean values near the overall maximum observed magnitude ( $M_{max,obs,max}$ ) are consistent with the observed distribution of maximum magnitudes in the catalog of large SCR earthquakes. As a corollary, the observed broad distributions of  $M_{max,obs}$  are a consequence of the large uncertainty in  $M_{max,obs}$  given  $M_{max}$  in the individual domains, not necessarily of domain-to-domain variability in  $M_{max}$ .

The predictive distributions of  $M_{max}$  for MESE and NMESE sources obtained here, which would serve as prior distributions in Cornell's approach, have smaller standard deviations than the priors

obtained by the CEUS-SSC study (i.e., 0.16 and 0.3 magnitude units vs. 0.75 and 0.61 magnitude units, respectively). As a result, the Bayesian update step of multiplying the prior  $M_{max}$  distribution by the likelihood associated with the source zone under consideration will have negligible effects for all source zones except for those with  $M_{max,obs}$  close to the mean  $M_{max}$ . Recalling Figure 1, if the prior distribution (panel a) is narrow and has a mean value greater than  $M_{max,obs}$ , then the product of the prior and the likelihood (i.e., panel a  $\times$  panel b) will be approximately equal to the prior after normalization.

These results also show that the MESE/NMESE partition proposed by the CEUS-SSC study is slightly more statistically significant than no partition. For MESE and for all domains combined, one important factor affecting the results presented here is the effect of the truncation at magnitude 8.25, as can be seen from the likelihood functions in Figure 3. Figures 3 and 4 also show that uncertainty in the  $M_{max,obs}$  of large historical earthquakes has an important effect on the resulting likelihood functions and on the resulting distributions of  $M_{max}$ .

The results presented here suggest that the direct integration and EM approaches implemented for the calculation of prior  $M_{max}$  distributions are robust and essentially unbiased. Both approaches yield essentially identical results, and Monte Carlo simulations indicate that these approaches reproduce the prescribed distributions of  $M_{max}$  (except in cases where the prescribed distribution is too broad). On the other hand, the prior distributions obtained here are substantially different from those obtained in previous studies and the methods employed here have not been applied to these problems in the past, so it may not be prudent to adopt these distributions immediately without further review and confirmation.

The results from this study underscore the limitations of purely statistical approaches for the estimation of  $M_{max}$  using data from the historical catalog of large earthquakes, even when data from all SCRs are pooled into a few domain categories. Therefore, it is important for the earthquake research community to investigate alternative approaches for the estimation of  $M_{max}$ , including (a) geologic/geomorphic approaches that determine the largest earthquakes that may have been concealed in the landscape (with consideration of the associated uncertainties); (b) physical approaches that consider the maximum dimensions of ruptures; and (c) geodetic approaches that investigate the relationship between maximum magnitude and regional strains.

It is useful to compare the  $M_{max}$  distributions obtained here with the distributions in current use. The mean  $M_{max}$  for MESE source zones is 0.56 magnitude units greater than the CEUS-SSC mean value and 0.51 magnitude units greater than the USGS National Seismic Hazard Map (NSHMP; Petersen et al., 2014) mean value. For NMESE source zones, the means obtained here are 0.69 and 0.29 magnitude units greater, respectively. The implications of these increased mean values on the results from Probabilistic Seismic Hazard Analysis (PSHA) cannot be quantified immediately, but it is anticipated that the low-frequency hazard will have moderate increase and the high-frequency hazard a small increase. The reason these effects are not larger is that large earthquakes are infrequent. The effect of the reduced standard deviations is difficult to estimate but is expected to be minor.

To utilize the results obtained here in a PSHA, one would have two logic-tree branches, with the weights calculated earlier. The first branch would correspond to the case where the source zones in MESE and NMESE domains have distinct distributions (with a weight of 0.6), and a second branch where all SCR source zones have the same Mmax distribution (corresponding to the ALL results; with a weight of 0.4).

## 6.0 ACKNOWLEDGMENTS

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## 7.0 REFERENCES

- Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer, New York.
- Akaike, H. (1974). "A New Look at the Statistical Model Identification." *IEEE Trans. Auton. Contr.*, 19, 716-723.
- Bommer, J.J., Coppersmith, K.J., Coppersmith, R.T., Hanson, K.L., Mangongolo, A., Neveling, J., Rathje, E.M., Rodriguez-Marek, A., Scherbaum, F., Shelembe, R. and Stafford, P.J., 2015. A SSHAC level 3 probabilistic seismic hazard analysis for a new-build nuclear site in South Africa. *Earthquake Spectra*, 31(2), pp.661-698.
- Campbell, K. W. 1982. "Bayesian analysis of extreme earthquake occurrences. Part I. Probabilistic hazard model." *Bull. Seismol. Soc. Am.* 72(5): 1689-1705.
- Coppersmith, K.J., Youngs, R.R. and Sprecher, C., 2009. Methodology and main results of seismic source characterization for the PEGASOS Project, Switzerland. *Swiss Journal of Geosciences*, 102(1), pp.91-105.
- Dempster, A. N. Laird, and D. Rubin. Maximum likelihood estimation from incomplete data via the EM algorithm (1977). *Journal of the Royal Statistical Society B*, 39:1–38.
- Grünthal, G., Bosse, C., Sellami, S., Mayer-Rosa, D. and Giardini, D., 1999. Compilation of the GSHAP regional seismic hazard for Europe, Africa and the Middle East. *Annali Di Geofisica*, Vol.. 42, N. 6, December.
- Louis, T. A. (1982). Finding the Observed Information Matrix when Using the EM Algorithm. *Journal of the Royal Statistical Society B*, 44:226-233.
- Johnston, A.C., Coppersmith, K.J., Kanter, L.R., and Cornell, C.A.,(1994). The Earthquakes of Stable Continental Regions: Final Report Submitted to Electric Power Research Institute (EPRI): TR-102261, 5-volume report prepared for Electric Power Research Institute, Palo Alto, California.

- Kijko, A., (2004). Estimation of the maximum earthquake magnitude,  $m_{max}$ : Pure and Applied Geophysics, v. 161, pp. 1-27.
- Petersen, M.D., Moschetti, M.D., Powers, P.M. Mueller, C.S. Haller, K.M., Frankel, A.D., Zeng, Y., Rezaeian, Harmsen, S.C., Boyd, O.S., Field, N., Chen, R., Rukstales, K.S., Luco, N., Wheeler, R.L., Williams, R.A. and Olsen, A.H. (2014). Documentation for the 2014 Update of the United States National Seismic Hazard Maps: USGS Open-File Report 2014-1091, 243 pp.
- Renault, P., Heuberger, S. and Abrahamson, N.A., 2010, August. PEGASOS Refinement Project: An improved PSHA for Swiss nuclear power plants. In Proceedings of 14ECEE—European Conference of Earthquake Engineering.
- USNRC, EPRI, DOE (2012). Central and Eastern United States Seismic Source Characterization for Nuclear Facilities, NRC Report NUREG-2115, EPRI Report 1021097, 6 Volumes.
- Vanneste, K., Vleminckx, B., Stein, S. and Camelbeeck, T., 2016. Could  $M_{max}$  Be the Same for All Stable Continental Regions?. Seismological Research Letters, 87(5), pp.1214-1223.
- Wheeler, R.L. (2009). Methods of  $M_{max}$  Estimation East of the Rocky Mountains: U.S. Geological Survey Open-File Report 2009-1018, 44 pp.

# Appendix A

## Data



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Table A-1 (SCR catalog) is the same as Tables K-1 of the CEUS-SSC report. Table A-2 (SCR domain characteristics) is the same as Table K-2 of the CEUS-SSC report, except that two unused columns are not shown, and a column is added with domain names. Table A-3 lists the abbreviations used in Tables A-2 and A5. Table A-4 (updates to SCR catalog) shows the 2009-2020 SCR earthquakes compiled by this project, using the same format as Table A-1. Table A-5 shows the updated domain characteristics.

These data are available on-line (<http://dx.doi.org/10.13140/RG.2.2.36083.40480>).

Table A-1. CEUS-SSC SCR Earthquake Catalog

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
495	3	31	0	0	0	37.5	121.5	5.22	0.44	133
827	0	0	0	0	0	51.1	12.8	5.25	0.5	192
973	9	0	0	0	0	32.2	46.3	5.53	0.5	81
999	10	0	0	0	0	31.8	119.9	5.25	0.5	132
1058	12	8	0	0	0	34.3	44.7	5.62	0.47	81
1062	2	8	0	0	0	49	12	5.81	0.5	192
1067	11	0	0	0	0	23.6	116.5	6.12	0.32	125
1068	3	18	0	0	0	28.7	36.75	6.9	0.47	81
1088	5	12	0	0	0	51.1	13.1	5.25	0.5	192
1112	0	0	0	0	0	48.417	8.833	5.81	0.5	195
1128	0	0	0	0	0	47.483	7.567	5.81	0.5	195
1130	2	27	0	0	0	33.6	45.7	6.09	0.47	81
1185	4	15	0	0	0	53.22	-0.5	5.53	0.5	187
1194	3	0	0	0	0	32	44.3	4.67	0.44	81
1247	2	20	0	0	0	52	-6	5.28	0.32	197
1275	9	11	0	0	0	51	-2.5	5.49	0.44	196
1279	9	2	0	0	0	49	8	5.81	0.5	195
1344	0	0	0	0	0	38.9	-8.85	5.96	0.5	199
1346	0	0	0	0	0	50.8	12.2	5.39	0.5	192
1366	5	24	0	0	0	50.8	12.2	5.25	0.5	192
1382	5	21	0	0	0	51.5	2.5	5.41	0.44	187
1407	11	0	0	0	0	31.2	112.6	5.25	0.5	130
1430	0	0	0	0	0	32.2	46.4	5.48	0.47	81
1445	2	14	0	0	0	50	6.3	5.81	0.5	196
1445	12	12	0	0	0	24.5	117.6	5.65	0.44	125
1457	0	0	0	0	0	31.9	46.9	5.7	0.47	81
1477	8	6	0	0	0	45.8	3	5.51	0.32	195
1490	3	1	0	0	0	45.85	3.1	5.85	0.32	195
1523	8	14	0	0	0	29.9	121.7	5.25	0.5	125
1528	3	12	0	0	0	39.7	-8.9	5.25	0.5	199
1531	1	26	0	0	0	38.95	-9	7.04	0.54	199
1548	9	13	0	0	0	38	121	6.1	0.32	133
1553	8	17	0	0	0	51.583	13	5.39	0.5	192

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1556	1	0	0	0	0	29.4	113.1	5.15	0.32	130
1558	6	0	0	0	0	23.4	111.5	4.81	0.32	129
1568	0	0	0	0	0	41.5	-72.5	5.25	0.5	218
1574	0	0	0	0	0	27.6	119.1	5.25	0.5	125
1574	0	0	0	0	0	41.5	-72.5	5.25	0.5	218
1574	8	19	0	0	0	26.1	119.3	5.83	0.32	125
1575	2	26	0	0	0	53	-1.5	4.9	0.44	187
1580	4	6	0	0	0	50.9	1.7	6.67	0.32	187
1584	0	0	0	0	0	41.5	-72.5	5.25	0.5	218
1585	3	6	0	0	0	31.2	117.7	5.28	0.32	130
1592	0	0	0	0	0	41.5	-72.6	5.25	0.5	222
1600	9	29	0	0	0	23.5	117	6.84	0.32	125
1604	12	29	0	0	0	25	119.5	7.65	0.32	127
1605	7	13	0	0	0	19.9	110.5	7.47	0.32	126
1611	9	9	0	0	0	21.5	111.3	5.25	0.5	129
1615	0	0	0	0	0	5.1	-1.3	5.81	0.5	100
1618	2	18	0	0	0	16.7	-3.2	5.37	0.44	99
1618	5	26	0	0	0	18.9	72.9	6.41	0.51	106
1624	2	10	0	0	0	32.4	119.5	5.73	0.32	132
1624	9	1	0	0	0	31.2	121.4	4.65	0.32	132
1624	10	0	0	0	0	33.2	107.5	5.25	0.5	131
1626	5	14	0	0	0	66	35.5	5.27	0.44	173
1631	8	14	0	0	0	29.3	111.7	6.38	0.32	130
1635	10	26	0	0	0	33.2	107.5	5.25	0.5	131
1636	0	0	0	0	0	33.1	107	5.25	0.5	131
1636	12	18	0	0	0	5.1	-2.2	6.19	0.32	100
1638	6	11	0	0	0	42.5	-69	5.81	0.5	218
1641	11	26	0	0	0	23.6	116.5	5.47	0.44	125
1651	2	15	0	0	0	26.2	116.6	5.16	0.32	125
1655	3	29	0	0	0	48.5	9.067	5.25	0.5	195
1657	2	15	0	0	0	47.1	0.6	5.53	0.5	196
1661	2	10	0	0	0	45.5	-73	5.25	0.5	227
1663	2	5	0	0	0	47.6	-70.1	6.72	0.52	227
1668	7	25	0	0	0	34.3	118.5	7.87	0.32	132
1679	12	16	0	0	0	31.4	119.5	4.98	0.5	132

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1682	5	12	0	0	0	47.9	6.5	6.55	0.32	195
1690	10	7	0	0	0	53	-3	4.77	0.44	185
1692	9	18	0	0	0	50.7	4.333	5.08	0.32	187
1710	4	16	0	0	0	27.8	111.3	5.25	0.5	129
1711	10	6	0	0	0	47.06	0.03	5.93	0.32	196
1720	7	15	0	0	0	28.53	77.2	6.11	0.5	113
1727	7	19	0	0	0	51.5	-3.5	5.09	0.32	196
1727	11	10	0	0	0	42.8	-70.8	4.77	0.32	218
1728	8	3	0	0	0	48.3	7.8	5.55	0.32	195
1732	9	16	0	0	0	45.5	-73.6	6.25	0.32	227
1736	4	30	0	0	0	56.18	-3.77	4.98	0.5	186
1737	12	19	0	0	0	40.8	-74	5.25	0.5	218
1743	6	29	0	0	0	30.7	118.4	4.76	0.32	130
1751	12	19	0	0	0	41	-7	5.53	0.5	200
1752	3	27	0	0	0	40.65	-8.55	5.53	0.5	199
1755	11	18	0	0	0	42.7	-70.3	6.1	0.26	218
1755	12	26	0	0	0	50.8	6.333	5.5	0.32	195
1759	12	22	0	0	0	57.7	11.1	5.1	0.32	177
1764	6	4	0	0	0	24	88	5.81	0.5	118
1764	8	17	0	0	0	17.9	73.7	4.65	0.44	106
1769	11	14	0	0	0	57.46	-4.22	4.69	0.44	185
1772	2	18	0	0	0	68.7	33.3	4.66	0.44	171
1772	6	0	0	0	0	44.37	4.82	5.35	0.32	195
1775	9	8	0	0	0	51.6	-4	5.01	0.32	196
1775	12	30	0	0	0	49.17	-0.4	5.28	0.32	196
1780	0	0	0	0	0	58.5	121	5.08	0.44	147
1782	4	30	0	0	0	26.2	111.7	4.91	0.32	129
1785	1	2	0	0	0	42.3	-71.1	5.25	0.5	218
1786	8	11	0	0	0	54.53	-3.68	4.98	0.5	185
1788	0	0	0	0	0	7.6	1.7	5.74	0.44	92
1791	4	8	0	0	0	24.5	117.7	5.25	0.5	125
1791	12	6	0	0	0	47.4	-70.5	5.5	0.48	226
1795	5	20	0	0	0	9.3	-13.4	4.78	0.32	105
1798	5	23	0	0	0	57.9	56.8	4.76	0.44	166
1799	1	25	0	0	0	46.95	-2	5.91	0.32	196

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1803	9	1	0	0	0	27.5	77.7	6.65	0.44	113
1804	5	5	0	0	0	53.3	104	5.41	0.44	149
1806	1	11	0	0	0	25.3	115.7	5.71	0.44	125
1808	8	8	0	0	0	-5.7	-37.7	4.58	0.32	56
1809	12	4	0	0	0	-34	18.4	5.53	0.5	59
1811	6	2	0	0	0	-34	18.4	5.25	0.5	59
1812	2	7	0	0	0	36.5	-89.6	7.8	0.17	228
1816	8	13	0	0	0	57.45	-4.17	4.71	0.32	185
1816	9	9	0	0	0	45.5	-73.6	5.25	0.5	227
1817	3	18	0	0	0	42.25	-2.1	5.24	0.32	201
1817	5	22	0	0	0	44.72	-67.5	4.69	0.32	222
1818	1	0	0	0	0	12.1	-12.4	5.85	0.32	100
1819	6	16	0	0	0	23.6	69.6	7.79	0.32	114
1819	8	31	0	0	0	66.7	15.5	6.38	0.32	179
1819	9	14	0	0	0	26.5	107.2	5.25	0.32	130
1820	0	0	0	0	0	-4.5	11.6	6.35	0.44	74
1822	4	3	0	0	0	24	89	5.25	0.5	118
1823	2	9	0	0	0	7	80	5.25	0.5	107
1824	0	0	0	0	0	-8	-39	5.81	0.5	56
1827	5	0	0	0	0	57.9	108.8	6.4	0.44	149
1827	9	24	0	0	0	31.57	74.35	6.11	0.5	113
1828	7	8	0	0	0	22.6	88.4	5.25	0.5	118
1828	8	22	0	0	0	13	75	5.25	0.5	106
1829	12	1	0	0	0	53.8	82.4	4.95	0.44	156
1831	5	8	0	0	0	47.3	-70.5	5.25	0.5	227
1833	10	4	0	0	0	27	85	6.41	0.51	112
1833	10	18	0	0	0	27	84	5.81	0.5	112
1834	9	3	0	0	0	61	6	5.15	0.32	179
1838	6	9	0	0	0	38.5	-89	5.12	0.48	230
1841	4	3	0	0	0	56.9	8	4.64	0.32	190
1842	5	21	0	0	0	25	87	5.25	0.5	111
1843	1	5	0	0	0	35.5	-90.5	6	0.17	228
1843	3	31	0	0	0	15.2	76.9	5.29	0.32	106
1845	6	19	0	0	0	23.78	68.83	5.53	0.5	114
1845	8	6	0	0	0	22.7	88.4	5.25	0.5	118

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1846	0	0	0	0	0	31.6	106	5.22	0.44	131
1846	5	27	0	0	0	23	80	5.25	0.5	111
1846	7	29	0	0	0	50.2	7.7	4.55	0.32	195
1848	4	26	0	0	0	24.4	72.7	5.48	0.44	113
1850	1	18	0	0	0	58.5	121	5.55	0.44	147
1852	4	29	0	0	0	36.7	-82	5.21	0.26	224
1852	11	9	0	0	0	53.23	-4.12	4.99	0.32	185
1853	4	1	0	0	0	49.27	-1.82	4.72	0.32	196
1854	11	24	0	0	0	29.1	107.1	5.25	0.5	131
1855	2	8	0	0	0	46	-64.5	4.9	0.32	221
1855	12	11	0	0	0	39.1	121.6	5.25	0.5	133
1856	6	10	0	0	0	29.7	108.8	4.79	0.32	130
1856	12	25	0	0	0	21.15	72.9	5.12	0.5	115
1857	10	8	0	0	0	38.7	-89.2	5.13	0.32	230
1858	11	11	0	0	0	38.2	-9	7.09	0.32	199
1859	11	21	0	0	0	-40.7	145.2	4.73	0.32	26
1860	0	0	0	0	0	45.97	-94.82	4.98	0.5	236
1860	10	17	0	0	0	47.5	-70.1	6.08	0.48	227
1861	2	16	0	0	0	22.6	88.4	5.25	0.5	118
1861	7	13	0	0	0	45.4	-75.4	4.71	0.48	227
1861	7	19	0	0	0	39.1	121.7	5.81	0.5	133
1861	8	31	0	0	0	36.2	-81.2	5.63	0.26	223
1862	7	10	0	0	0	7	0.4	6.75	0.32	92
1863	10	6	0	0	0	51.97	-2.88	4.89	0.32	187
1863	11	18	0	0	0	21.8	75.3	5.53	0.5	120
1864	4	29	0	0	0	22.3	72.8	4.98	0.5	115
1864	12	7	0	0	0	33.3	45.9	5.91	0.47	81
1865	5	7	0	0	0	59.5	4.8	4.92	0.32	179
1865	8	17	0	0	0	36	-89.5	5.21	0.32	228
1866	3	9	0	0	0	63.3	6.7	5.75	0.32	183
1866	5	23	0	0	0	25	87	5.67	0.5	111
1866	9	14	0	0	0	46.8	1.2	4.98	0.32	196
1867	4	24	0	0	0	39.17	-96.3	5.08	0.15	235
1867	12	18	0	0	0	44.7	-75.2	4.4	0.15	226
1868	6	18	0	0	0	-32.8	151.6	4.64	0.32	27

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1868	9	30	0	0	0	24	85	5.25	0.5	111
1869	10	22	0	0	0	45	-67.5	5.47	0.32	222
1870	10	20	0	0	0	47.4	-70.5	6.55	0.48	226
1872	3	6	0	0	0	50.86	12.28	4.9	0.32	192
1872	4	14	0	0	0	5.5	-0.4	5.06	0.44	92
1873	7	19	0	0	0	44.48	4.72	5.2	0.32	195
1873	12	15	0	0	0	-26.8	127.2	6.04	0.7	9
1875	6	18	0	0	0	40.2	-84	4.6	0.32	235
1875	8	17	0	0	0	50.3	24.2	4.86	0.44	167
1875	12	12	0	0	0	31.57	74.35	5.53	0.5	113
1875	12	23	0	0	0	37.8	-78	4.77	0.32	218
1877	11	4	0	0	0	44.5	-74	4.71	0.32	226
1877	11	15	0	0	0	41	-97	5.05	0.32	255
1878	1	28	0	0	0	49.8	-0.3	4.78	0.32	196
1878	8	26	0	0	0	50.9	6.4	4.94	0.32	195
1879	2	11	0	0	0	6.5	-3.3	5.56	0.32	100
1880	2	3	0	0	0	-43	146.4	4.62	0.32	26
1880	11	28	0	0	0	56.4	-7.3	4.88	0.32	184
1882	1	0	0	0	0	8.6	81.2	5.81	0.5	107
1882	3	15	0	0	0	54.7	83.2	5.24	0.44	156
1882	10	22	0	0	0	35.9	-95.1	5.58	0.32	231
1883	8	0	0	0	0	30	9.5	4.93	0.44	89
1883	8	28	0	0	0	-25.5	151.7	5.12	0.32	28
1884	4	22	0	0	0	51.83	0.92	4.8	0.32	187
1884	7	13	0	0	0	-40.5	148.5	5.66	0.32	26
1884	8	10	0	0	0	40.6	-74	4.79	0.32	218
1885	1	5	0	0	0	-26.5	116.3	6.5	0.7	7
1885	5	12	0	0	0	-39.9	148.9	5.96	0.32	26
1885	7	2	0	0	0	-39	146	4.92	0.44	26
1885	7	14	0	0	0	24	90	5.25	0.5	118
1886	9	1	0	0	0	32.9	-80	6.9	0.17	218
1886	10	25	0	0	0	61.6	5.9	5.01	0.32	179
1886	11	29	0	0	0	-34.75	148.8	4.79	0.32	27
1888	8	23	0	0	0	50	134	5.53	0.5	139
1889	0	0	0	0	0	6.8	-6.7	5.09	0.44	100

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1889	5	30	0	0	0	49.5	-0.5	4.77	0.32	196
1891	9	27	0	0	0	38.25	-88.5	5.52	0.32	230
1892	1	26	0	0	0	-40.4	149.5	6.35	0.32	26
1892	5	15	0	0	0	60.6	4.4	5.4	0.32	194
1892	8	18	0	0	0	51.6	-5.2	4.77	0.32	196
1893	11	2	0	0	0	51.6	-4.6	4.58	0.32	196
1893	11	27	0	0	0	45.5	-73.3	5.12	0.48	227
1894	7	23	0	0	0	68.5	13	5.84	0.32	183
1895	2	5	0	0	0	63.5	5	5.47	0.32	183
1895	8	8	0	0	0	57	133	6.19	0.44	147
1895	8	30	0	0	0	23.5	116.3	5.67	0.5	125
1895	10	31	0	0	0	37	-89.4	6	0.17	230
1896	9	2	0	0	0	50.3	2.88	4.87	0.32	196
1896	12	17	0	0	0	52.02	-2.69	4.75	0.32	187
1897	3	23	0	0	0	45.5	-73.6	4.59	0.48	227
1897	5	10	0	0	0	-37.33	139.75	6.16	0.32	23
1897	5	31	0	0	0	37.3	-80.7	5.91	0.32	224
1897	6	22	0	0	0	19.4	84.9	5.12	0.5	108
1897	8	25	0	0	0	62.5	55	4.86	0.44	168
1900	2	8	0	0	0	10.75	76.75	5.66	0.32	106
1901	1	10	0	0	0	50.5	16.1	4.67	0.32	192
1902	4	10	0	0	0	64.3	27.6	4.81	0.44	173
1902	9	19	0	0	0	-35	137.4	5.38	0.32	19
1902	11	4	0	0	0	38.9	-5.6	5.43	0.44	200
1903	1	14	0	0	0	24	70	5.53	0.5	114
1903	4	6	0	0	0	-38.43	142.53	4.5	0.37	23
1903	6	4	0	0	0	0	26	6.3	0.37	78
1903	6	19	0	0	0	53.05	-4.38	4.58	0.32	185
1903	7	14	0	0	0	-38.43	142.53	4.58	0.32	23
1903	8	9	0	0	0	38.3	-9	6	0.32	199
1903	11	4	0	0	0	36.9	-89.3	4.97	0.32	228
1904	2	13	0	0	0	56.4	73	5.26	0.44	158
1904	3	21	0	0	0	45	-67.2	5.73	0.32	222
1904	4	9	0	0	0	-37	147.1	4.5	0.44	27
1904	10	23	0	0	0	59	10.5	5.87	0.37	177

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1905	7	18	0	0	0	-10.2	-40.4	4.67	0.32	47
1905	8	22	0	0	0	36.8	-89.6	4.95	0.32	228
1906	1	8	0	0	0	39.2	-96.5	4.91	0.32	235
1906	3	27	0	0	0	24.5	118.5	6.04	0.37	125
1906	6	27	0	0	0	52.64	-4	4.87	0.32	185
1906	11	19	0	0	0	-19.1	111.8	7.2	0.19	2
1906	11	20	0	0	0	6.5	0.3	5.09	0.32	92
1907	1	14	0	0	0	65.5	11	5.32	0.37	183
1908	0	0	0	0	0	7.7	-7.8	5.8	0.32	100
1908	4	2	0	0	0	3	25.5	6.3	0.37	73
1909	4	23	0	0	0	38.95	-8.82	6.4	0.37	199
1909	5	16	0	0	0	50	-104	5.72	0.32	237
1909	5	26	0	0	0	41.75	-88.3	5.15	0.48	230
1909	8	5	0	0	0	-22.2	29	5.01	0.32	66
1909	9	27	0	0	0	39.5	-87.4	4.73	0.32	230
1910	1	8	0	0	0	35	122	6.5	0.19	132
1910	5	30	0	0	0	10	27	5.8	0.37	84
1910	10	21	0	0	0	-30.5	24.7	5.26	0.32	63
1910	12	4	0	0	0	-10	140	6.8	0.25	13
1911	3	26	0	0	0	3.1	11	5.79	0.37	73
1911	8	6	0	0	0	53.5	127.1	4.92	0.44	136
1911	11	16	0	0	0	48.22	9.05	6.17	0.25	192
1912	2	20	0	0	0	-29.45	25.06	6.04	0.25	63
1912	4	13	0	0	0	78.9	108	5.12	0.37	170
1912	6	12	0	0	0	32.9	-80	4.5	0.48	218
1912	11	6	0	0	0	42.9	-2.7	5.25	0.5	198
1913	1	1	0	0	0	34.7	-81.7	4.54	0.32	218
1913	4	3	0	0	0	32.2	119.5	5.22	0.37	132
1913	7	19	0	0	0	64	8	5.15	0.37	183
1913	8	4	0	0	0	61.3	5.2	4.95	0.37	179
1913	10	9	0	0	0	3.8	12.3	4.9	0.32	84
1913	10	27	0	0	0	41.67	-8.72	4.7	0.32	199
1913	12	18	0	0	0	-20	147	5.12	0.37	27
1914	2	10	0	0	0	46	-75	5.1	0.48	226
1914	4	13	0	0	0	53.8	81.5	5.06	0.37	156

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1914	5	18	0	0	0	31.35	15.25	5.35	0.37	90
1914	5	24	0	0	0	-10	15	6.15	0.25	72
1914	6	7	0	0	0	73	119	5.37	0.37	146
1914	8	17	0	0	0	57	59.4	5.24	0.44	159
1914	9	25	0	0	0	39	-8.82	4.91	0.32	199
1915	6	2	0	0	0	48.9	11.4	4.68	0.32	192
1915	10	10	0	0	0	48.8	11.6	4.84	0.32	192
1916	2	21	0	0	0	35.5	-82.5	5.13	0.32	223
1916	10	18	0	0	0	33.5	-86.2	4.98	0.32	224
1916	12	3	0	0	0	43.7	-7.5	5.25	0.5	198
1917	1	21	0	0	0	-3	10	5.63	0.37	76
1917	4	9	0	0	0	38.1	-90.2	4.86	0.32	229
1917	4	17	0	0	0	18	84	4.66	0.45	117
1917	7	30	0	0	0	28	104	6.5	0.25	131
1918	2	13	0	0	0	23.54	117.243	7.42	0.19	125
1918	6	6	0	0	0	-23.5	152.5	5.8	0.25	32
1919	4	21	0	0	0	22	72	5.25	0.5	113
1919	6	1	0	0	0	27.074	123.315	7.5	0.25	127
1919	6	1	0	0	0	-18	-56	4.75	0.44	49
1919	10	31	0	0	0	-27	31.5	6.5	0.47	64
1919	10	31	0	0	0	24	116.5	5.33	0.45	125
1920	2	8	0	0	0	-35	111	6.15	0.25	6
1920	5	29	0	0	0	25.1	120.5	5.13	0.47	127
1920	11	26	0	0	0	42.4	-8.6	4.97	0.37	199
1921	5	30	0	0	0	-35	145	4.95	0.37	27
1921	9	16	0	0	0	3.8	16.3	4.84	0.32	84
1921	12	1	0	0	0	33.7	122	6.4	0.37	132
1922	1	19	0	0	0	-7	143	7.29	0.37	16
1922	1	27	0	0	0	-22.17	-47.04	4.78	0.32	49
1922	4	7	0	0	0	23.5	119	5.71	0.37	127
1922	4	10	0	0	0	-39.14	144.85	5.11	0.37	26
1922	4	13	0	0	0	60	-110	5.11	0.37	239
1922	5	20	0	0	0	24.7	116.5	4.79	0.44	125
1922	7	26	0	0	0	70	-70	5.12	0.37	248
1922	8	14	0	0	0	52.069	130.539	6.72	0.52	139

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1923	10	15	0	0	0	48.5	122.5	4.98	0.5	135
1923	12	8	0	0	0	32	127.5	5.71	0.37	127
1924	3	1	0	0	0	-41.6	145	4.52	0.32	26
1924	5	27	0	0	0	62	135.5	5.34	0.37	147
1924	7	25	0	0	0	72.5	16	5.09	0.37	183
1924	9	30	0	0	0	47.6	-69.7	4.69	0.16	222
1924	10	17	0	0	0	60	-118	5.08	0.37	241
1925	2	1	0	0	0	49.16	-5.22	5.04	0.32	197
1925	2	7	0	0	0	48	105	5.3	0.37	136
1925	2	18	0	0	0	69	145	4.97	0.37	141
1925	3	1	0	0	0	47.76	-69.84	6.18	0.29	227
1925	4	27	0	0	0	38.3	-87.6	4.87	0.32	229
1925	7	30	0	0	0	35.4	-101.3	5.24	0.32	231
1925	9	24	0	0	0	25.51	55.38	5.88	0.37	81
1925	11	6	0	0	0	26.5	81.5	4.52	0.45	112
1925	12	18	0	0	0	-33	151.6	4.56	0.32	27
1926	2	28	0	0	0	38.58	-7.9	5.28	0.32	200
1926	3	10	0	0	0	66.5	-130	4.55	0.45	241
1926	6	13	0	0	0	20	116.5	4.78	0.45	127
1926	6	29	0	0	0	27	121	5.06	0.44	127
1926	7	30	0	0	0	49.22	-1.82	4.98	0.32	196
1926	8	18	0	0	0	65.8	28.5	4.76	0.44	173
1926	9	19	0	0	0	57.3	67	5.3	0.44	158
1926	9	29	0	0	0	48	122.7	4.98	0.5	135
1926	12	14	0	0	0	-12	121	6.26	0.25	1
1926	12	31	0	0	0	25	77.5	4.47	0.45	112
1927	1	24	0	0	0	59.9	1.8	5.57	0.32	188
1927	2	3	0	0	0	33.5	121	6.6	0.25	132
1927	5	7	0	0	0	35.7	-90.6	4.84	0.32	228
1927	6	2	0	0	0	23.5	81	6.4	0.25	119
1928	4	5	0	0	0	9.8	-13.3	4.51	0.32	105
1929	2	8	0	0	0	24.9	119.9	4.47	0.45	127
1929	4	11	0	0	0	25	77.5	5.39	0.5	112
1929	7	26	0	0	0	-2.5	24.5	5.5	0.37	73
1929	8	12	0	0	0	42.91	-78.402	4.72	0.2	226

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1929	8	16	0	0	0	-16.99	120.66	6.26	0.25	1
1929	10	24	0	0	0	22	118	6.57	0.25	127
1929	11	18	0	0	0	44.691	-56.006	6.97	0.31	218
1929	12	28	0	0	0	-39.69	149.45	5.42	0.37	26
1930	1	3	0	0	0	32.2	119.4	5.04	0.44	132
1930	1	9	0	0	0	47.62	-2.88	5.1	0.37	196
1930	4	3	0	0	0	32.5	43.7	5.2	0.37	81
1930	6	25	0	0	0	25	77.5	4.45	0.45	112
1930	7	5	0	0	0	37.6	-4.6	5.21	0.37	200
1930	9	23	0	0	0	27.5	106	5.15	0.37	130
1931	1	8	0	0	0	47.63	-70.17	4.89	0.37	226
1931	4	20	0	0	0	43.4	-73.7	4.58	0.32	224
1931	5	1	0	0	0	3	27	5.21	0.37	73
1931	6	7	0	0	0	54.1	1.5	5.7	0.32	194
1931	6	29	0	0	0	48.5	123.5	4.98	0.37	135
1931	7	1	0	0	0	30	109	4.44	0.45	130
1931	9	17	0	0	0	50.1	127	5	0.44	138
1931	9	20	0	0	0	40.4	-84.21	4.58	0.48	235
1931	9	21	0	0	0	19.421	113.158	6.73	0.25	127
1931	12	17	0	0	0	34.1	-89.9	4.71	0.32	225
1932	6	21	0	0	0	16.7	111.8	5.31	0.37	127
1932	8	14	0	0	0	62.8	154.6	4.97	0.37	140
1932	8	22	0	0	0	36.1	121.6	6.26	0.25	132
1932	11	20	0	0	0	51.71	5.61	4.97	0.37	195
1932	12	31	0	0	0	-28.5	32.75	6.61	0.25	63
1933	2	8	0	0	0	48.8	8.2	4.71	0.37	195
1933	7	14	0	0	0	42.9	56.5	5.33	0.37	160
1933	12	2	0	0	0	-51.5	-44	6.49	0.25	35
1934	5	12	0	0	0	44.43	4.82	4.75	0.32	195
1934	5	21	0	0	0	25	118.2	5.47	0.37	125
1934	11	12	0	0	0	38	-8.5	5.15	0.37	199
1934	11	18	0	0	0	-34.8	149.2	4.99	0.32	27
1935	3	1	0	0	0	40.35	-96.15	4.5	0.32	235
1935	3	21	0	0	0	24.2	89.5	6.08	0.25	118
1935	4	12	0	0	0	-25.5	151.67	5.14	0.37	28

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1935	4	18	0	0	0	70.5	-73	5.38	0.37	248
1935	4	19	0	0	0	31.243	15.3	6.62	0.31	90
1935	6	27	0	0	0	48.1	9.5	5.44	0.32	192
1935	7	17	0	0	0	66.05	8.1	5.26	0.37	183
1935	7	20	0	0	0	21	72.4	4.98	0.5	115
1935	11	1	0	0	0	46.885	-79.004	6.06	0.2	226
1935	12	30	0	0	0	48.6	8.2	4.91	0.37	195
1936	1	12	0	0	0	-27	31	4.82	0.32	64
1936	1	16	0	0	0	-29.8	25.3	5.3	0.32	63
1936	4	1	0	0	0	22.5	109.4	6.24	0.32	129
1936	4	26	0	0	0	28.733	103.497	6.72	0.52	131
1936	6	13	0	0	0	32.75	22.5	5.79	0.37	90
1936	6	20	0	0	0	42.4	-9.8	5.56	0.37	199
1937	1	24	0	0	0	56	130	4.76	0.58	147
1937	3	9	0	0	0	40.47	-84.28	5.11	0.32	235
1937	10	28	0	0	0	-26.1	136.5	5.35	0.37	12
1937	12	20	0	0	0	-25.4	136.5	5.55	0.37	12
1938	1	26	0	0	0	33.12	45.87	5.63	0.37	81
1938	3	11	0	0	0	61.7	4.2	4.75	0.37	183
1938	3	14	0	0	0	21.68	75.2	6.26	0.25	106
1938	3	24	0	0	0	-35.5	146	4.97	0.37	27
1938	4	17	0	0	0	-25.5	137.2	5.84	0.25	5
1938	6	11	0	0	0	50.78	3.58	5.28	0.37	187
1938	7	23	0	0	0	22.4	71.8	4.93	0.37	113
1938	9	10	0	0	0	7.7	79.2	5.56	0.37	117
1938	10	16	0	0	0	43.25	-3.62	5.3	0.25	198
1939	1	20	0	0	0	31.03	15.84	5.7	0.37	90
1939	1	23	0	0	0	31.69	16.06	5.95	0.37	90
1939	2	2	0	0	0	31.8	16.8	5.21	0.37	90
1939	3	26	0	0	0	-32	138	5.79	0.37	21
1939	6	22	0	0	0	5.18	-0.13	6.35	0.24	91
1939	6	28	0	0	0	-29	-49	6.08	0.32	46
1939	8	18	0	0	0	6.2	-0.3	5.25	0.37	100
1939	10	19	0	0	0	48.016	-69.734	5.02	0.36	227
1940	1	19	0	0	0	42.7	121.3	5.89	0.37	137

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1940	2	27	0	0	0	8.3	-60.8	5.78	0.25	52
1940	5	24	0	0	0	51.467	11.792	4.85	0.37	192
1940	5	29	0	0	0	67	-135	6.21	0.25	241
1940	6	23	0	0	0	74.7	-14	5.7	0.37	254
1940	10	31	0	0	0	22.5	70.4	5.71	0.37	113
1940	11	10	0	0	0	-24	30.2	5.16	0.32	65
1940	12	24	0	0	0	43.908	-71.283	5.13	0.47	222
1941	3	4	0	0	0	30.75	15.75	5.17	0.37	90
1941	4	29	0	0	0	-26.791	116.197	6.78	0.25	7
1941	5	4	0	0	0	-26.3	136.9	5.9	0.37	12
1941	5	5	0	0	0	46.5	126.9	6.22	0.25	137
1941	6	27	0	0	0	-25.95	137.34	6.49	0.25	12
1941	9	21	0	0	0	25.1	115.6	5.02	0.32	125
1942	2	14	0	0	0	-29.5	136	4.97	0.37	19
1942	7	8	0	0	0	43.5	121.9	5.71	0.37	137
1943	5	28	0	0	0	48.2	9	5.2	0.37	192
1943	7	16	0	0	0	33	21.5	5.28	0.37	90
1943	11	7	0	0	0	21.6	119.3	4.72	0.45	127
1944	4	9	0	0	0	49.92	-67.43	4.44	0.13	226
1944	6	23	0	0	0	49.42	-67.75	4.79	0.37	226
1944	7	17	0	0	0	35.91	42.55	6.21	0.58	81
1944	9	5	0	0	0	44.958	-74.723	5.71	0.19	226
1944	12	19	0	0	0	39.7	124.3	6.73	0.25	133
1945	9	12	0	0	0	2.5	15.6	5.92	0.27	84
1945	11	8	0	0	0	83	-15	6.16	0.25	251
1946	4	19	0	0	0	-33.5	114.5	4.5	0.7	6
1946	9	14	0	0	0	-40.2	149	5.56	0.37	26
1948	1	21	0	0	0	-31.11	-57.27	4.87	0.32	42
1948	5	23	0	0	0	37.2	121.8	5.71	0.37	133
1948	8	6	0	0	0	-37.36	139.68	5.24	0.37	23
1948	9	26	0	0	0	80.7	99.6	4.97	0.37	170
1949	1	14	0	0	0	33.2	121	5.39	0.37	132
1949	3	10	0	0	0	-34.74	149.2	5.04	0.37	27
1949	5	2	0	0	0	-30.9	116.4	4.6	0.37	7
1949	9	17	0	0	0	3.83	-51.84	5.11	0.32	52

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1950	4	14	0	0	0	48	-75.7	4.59	0.37	226
1950	9	30	0	0	0	-30.5	18	4.36	0.45	60
1950	10	28	0	0	0	52.3	79.3	4.56	0.37	157
1951	1	1	0	0	0	47.7	109.9	5.69	0.37	136
1951	3	10	0	0	0	38.18	-3.82	5.47	0.32	200
1951	3	14	0	0	0	50.633	6.717	5.49	0.37	195
1951	4	8	0	0	0	18.5	70.8	4.69	0.45	116
1951	4	19	0	0	0	-19.2	28.8	4.41	0.45	67
1951	4	22	0	0	0	76	-73	5.32	0.37	248
1951	5	28	0	0	0	31.8	27	5.18	0.37	90
1951	6	27	0	0	0	45	-57	4.59	0.37	218
1951	9	17	0	0	0	-18.5	23	5.12	0.5	61
1952	1	28	0	0	0	-32.9	20.5	4.98	0.5	58
1952	3	19	0	0	0	39	125.5	6.2	0.37	133
1952	4	9	0	0	0	35.525	-97.85	5.29	0.12	231
1952	4	20	0	0	0	-69.9	157.7	4.6	0.45	208
1952	5	10	0	0	0	-18	22.5	5.25	0.5	61
1952	6	9	0	0	0	-27.5	18.6	5.25	0.5	60
1952	6	24	0	0	0	-25.5	152.8	4.81	0.37	32
1952	9	7	0	0	0	-34.8	149.3	4.66	0.37	27
1952	10	11	0	0	0	-19.3	23.4	5.02	0.45	61
1952	10	14	0	0	0	48.02	-69.78	4.54	0.32	227
1953	2	22	0	0	0	50.917	10	5.09	0.37	192
1953	4	2	0	0	0	-18	27	5.53	0.5	67
1953	5	1	0	0	0	-29	17	5.53	0.5	61
1953	9	28	0	0	0	41.13	-1.58	5.09	0.37	201
1954	2	28	0	0	0	-34.93	138.69	5.09	0.32	21
1954	7	7	0	0	0	59.8	4.8	4.64	0.37	179
1954	8	18	0	0	0	-19.5	23.5	5.25	0.5	61
1954	8	28	0	0	0	45.17	-56.87	4.79	0.37	218
1954	9	19	0	0	0	-28.5	148.6	4.74	0.37	27
1954	10	16	0	0	0	44.83	-56.8	4.86	0.37	218
1954	11	26	0	0	0	-18	13	4.98	0.5	61
1955	1	31	0	0	0	-12.42	-57.3	6.12	0.37	52
1955	3	30	0	0	0	22.4	118.7	4.78	0.37	127

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1955	5	26	0	0	0	25.5	105	4.56	0.37	130
1955	6	3	0	0	0	61.9	4.15	5.12	0.37	183
1955	8	23	0	0	0	31.31	71.38	5.56	0.37	113
1955	11	27	0	0	0	-18	25	5.25	0.5	61
1956	1	29	0	0	0	61.5	131.4	4.72	0.37	147
1956	4	9	0	0	0	49	130.5	4.88	0.37	139
1956	6	3	0	0	0	79.5	-118.5	5.77	0.37	250
1956	6	5	0	0	0	56.8	-58.9	4.67	0.37	247
1956	6	29	0	0	0	-5	22	5.02	0.37	73
1956	7	21	0	0	0	23.3	70	5.96	0.17	114
1956	10	10	0	0	0	28.2	77.7	6.05	0.37	113
1956	10	13	0	0	0	48.5	122	4.98	0.44	135
1957	1	4	0	0	0	7.42	-12.52	5.2	0.44	105
1957	2	11	0	0	0	52.86	-1.15	4.66	0.37	187
1957	4	13	0	0	0	-30.18	26.91	5.56	0.37	60
1957	4	16	0	0	0	-9.5	-67	4.92	0.44	51
1957	8	9	0	0	0	62.3	132	4.59	0.37	147
1957	8	25	0	0	0	22	80	4.9	0.37	111
1958	1	1	0	0	0	-42.2	146.1	4.79	0.37	26
1958	1	23	0	0	0	65.19	6.91	5.42	0.37	183
1958	3	2	0	0	0	67	144	4.69	0.37	141
1958	5	14	0	0	0	47.092	-76.818	4.17	0.16	226
1958	5	17	0	0	0	31.81	11.28	5.25	0.37	89
1958	7	8	0	0	0	50.833	10.117	5.15	0.37	192
1958	8	6	0	0	0	59.61	5.94	4.78	0.37	179
1958	9	25	0	0	0	22.5	109.5	4.7	0.32	129
1959	1	2	0	0	0	47.99	-3.99	5.35	0.37	196
1959	1	30	0	0	0	61	-78.5	4.46	0.25	237
1959	3	10	0	0	0	-15.31	30.16	5.31	0.37	68
1959	4	14	0	0	0	-14.55	22.11	5.16	0.37	61
1959	5	18	0	0	0	-36.218	148.64	4.61	0.37	27
1959	5	21	0	0	0	-31.4	139	4.64	0.37	21
1959	8	12	0	0	0	-14.96	26.54	5.86	0.37	70
1959	10	12	0	0	0	15.68	80.07	5.15	0.37	117
1959	10	21	0	0	0	65	-87	4.84	0.37	239

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1959	11	2	0	0	0	-33.36	135.98	4.64	0.37	19
1959	12	31	0	0	0	43.5	111	4.73	0.37	135
1960	5	12	0	0	0	-9	-72.5	4.92	0.47	51
1960	7	15	0	0	0	-14.15	21.85	4.91	0.37	72
1960	8	26	0	0	0	-11	123.9	5.4	0.37	1
1960	8	27	0	0	0	28.59	76.72	4.7	0.32	113
1960	9	6	0	0	0	64.7	-86.4	4.98	0.37	239
1960	10	19	0	0	0	-21	149.3	4.49	0.32	32
1960	11	5	0	0	0	24	108.5	4.87	0.32	129
1960	12	24	0	0	0	-38.88	143.59	4.79	0.37	23
1961	3	7	0	0	0	30.28	111.2	4.75	0.32	130
1961	5	16	0	0	0	-30.85	147.27	4.61	0.37	27
1961	5	21	0	0	0	-34.547	150.503	5.08	0.37	27
1961	6	12	0	0	0	21.6	106.02	5.53	0.32	130
1961	6	18	0	0	0	-20.1	119.3	4.88	0.37	9
1961	8	23	0	0	0	-18.5	119	4.79	0.37	2
1961	12	28	0	0	0	-28.12	141.57	4.5	0.37	27
1962	3	8	0	0	0	3.73	28.99	5.67	0.37	83
1962	3	18	0	0	0	23.72	114.67	6	0.14	125
1962	4	20	0	0	0	24.3	106	4.65	0.32	130
1962	12	15	0	0	0	67.36	13.9	4.73	0.37	179
1962	12	26	0	0	0	39.3	-10.6	5.33	0.32	199
1963	1	18	0	0	0	-32.25	117.17	4.64	0.32	7
1963	2	21	0	0	0	32.6	21	5.71	0.37	90
1963	3	3	0	0	0	36.7	-90	4.62	0.14	230
1963	3	8	0	0	0	76.6	-94.33	5.18	0.37	248
1963	3	14	0	0	0	-25.7	137.4	4.75	0.37	5
1963	4	9	0	0	0	22.5	85.8	4.8	0.7	109
1963	5	8	0	0	0	21.7	84.9	5.1	0.37	109
1963	6	21	0	0	0	47.91	130.61	5.62	0.37	139
1963	6	22	0	0	0	53.1	121.4	5.27	0.37	136
1963	7	13	0	0	0	24.77	70.26	5.61	0.37	113
1963	8	15	0	0	0	56	134.5	4.59	0.37	147
1963	9	4	0	0	0	71.234	-72.998	6.14	0.05	248
1963	9	6	0	0	0	36.47	130.76	5.8	0.05	127

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1963	9	23	0	0	0	-16.58	28.46	5.65	0.17	67
1963	10	7	0	0	0	42.9	110.5	5.35	0.37	135
1963	12	14	0	0	0	-2.3	-61.01	5.21	0.2	53
1963	12	26	0	0	0	76.53	23.46	4.62	0.45	169
1964	1	8	0	0	0	46.23	-77.53	3.74	0.12	226
1964	2	13	0	0	0	-18.06	-56.69	5.3	0.25	49
1964	3	23	0	0	0	-17.71	123.16	5.26	0.37	11
1964	3	28	0	0	0	42.997	-101.798	4.84	0.32	255
1964	4	15	0	0	0	21.6	88.07	5.25	0.25	118
1964	5	12	0	0	0	-11	126	4.83	0.25	1
1964	6	19	0	0	0	2.55	-59.3	4.56	0.25	52
1964	7	12	0	0	0	53.8	81.4	4.79	0.25	156
1964	7	14	0	0	0	57.03	7.2	4.71	0.25	189
1964	8	10	0	0	0	9.15	-62.02	5.35	0.25	52
1964	9	23	0	0	0	23.73	114.68	4.74	0.32	125
1965	1	25	0	0	0	-31.93	138.49	4.73	0.25	21
1965	2	15	0	0	0	53.65	81.53	5.2	0.25	156
1965	3	2	0	0	0	-30.52	138.22	5.2	0.25	21
1965	3	14	0	0	0	-31.95	138.57	4.93	0.37	21
1965	3	18	0	0	0	-40.29	149.59	4.5	0.37	26
1965	3	26	0	0	0	24.18	69.56	4.75	0.25	114
1965	5	18	0	0	0	-17.6	49.91	5.38	0.14	71
1965	5	19	0	0	0	-25	112.5	5.09	0.25	4
1965	6	3	0	0	0	-28.084	150.217	4.49	0.32	28
1965	8	15	0	0	0	2.71	-60.24	4.96	0.25	52
1965	8	28	0	0	0	-32.23	138.1	4.69	0.25	21
1965	9	10	0	0	0	-18.1	122.2	4.6	0.37	11
1965	9	14	0	0	0	-38.68	144.24	4.94	0.25	23
1965	10	13	0	0	0	71.1	-20	4.83	0.25	254
1965	10	21	0	0	0	37.5	-91	4.61	0.08	230
1966	1	1	0	0	0	42.8	-78.2	4.26	0.08	226
1966	3	22	0	0	0	64.75	-88	4.69	0.37	239
1966	3	26	0	0	0	-18.54	26.39	5.06	0.25	67
1966	4	5	0	0	0	-16.45	28.68	4.71	0.25	67
1966	5	3	0	0	0	-37.042	147.168	4.4	0.17	27

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1966	5	27	0	0	0	24.46	68.69	4.96	0.25	113
1966	6	18	0	0	0	-29.52	29.37	4.92	0.25	60
1966	6	23	0	0	0	-14.17	22.03	4.96	0.25	61
1966	8	15	0	0	0	28.67	78.93	5.51	0.25	113
1966	9	26	0	0	0	22.3	117.9	4.88	0.25	127
1966	10	2	0	0	0	43.83	125.12	4.6	0.25	137
1966	10	9	0	0	0	12.63	30.75	5.64	0.37	82
1966	10	12	0	0	0	-11.94	121.77	5.58	0.25	1
1966	11	13	0	0	0	-23.97	111.67	5.1	0.25	4
1966	12	3	0	0	0	-8.8	135.5	4.55	0.25	13
1967	3	20	0	0	0	35.89	44.08	5.01	0.25	81
1967	3	27	0	0	0	15.6	80.1	5.2	0.25	117
1967	4	20	0	0	0	-16.64	28.26	5.14	0.37	67
1967	4	25	0	0	0	18.26	73.3	4.31	0.45	106
1967	6	4	0	0	0	33.6	-90.9	4.29	0.08	225
1967	6	13	0	0	0	42.9	-78.2	4.07	0.08	226
1967	6	21	0	0	0	48.7	122	4.63	0.25	135
1967	8	9	0	0	0	39.9	-104.7	4.79	0.15	255
1967	8	21	0	0	0	57.06	4.92	4.67	0.25	194
1967	10	14	0	0	0	-3.32	38.19	5.16	0.14	79
1967	12	10	0	0	0	17.39	73.774	6.27	0.14	106
1967	12	30	0	0	0	20.4	118.2	4.92	0.25	127
1968	1	12	0	0	0	-33.7	25.2	5.01	0.25	59
1968	4	1	0	0	0	25.1	117.6	4.89	0.32	125
1968	5	15	0	0	0	-15.92	26.099	5.7	0.25	61
1968	6	13	0	0	0	23.2	105.2	4.5	0.7	130
1968	7	6	0	0	0	-6.351	133.831	5.64	0.25	16
1968	10	14	0	0	0	-31.522	116.978	6.57	0.08	7
1968	11	9	0	0	0	37.96	-88.46	5.32	0.06	230
1968	12	2	0	0	0	-14.104	23.779	5.47	0.27	61
1968	12	15	0	0	0	-13.47	26.6	4.83	0.25	61
1968	12	31	0	0	0	-31.04	149.26	4.67	0.37	27
1969	4	13	0	0	0	17.838	80.68	5.72	0.1	110
1969	6	17	0	0	0	-25.26	116.73	5.25	0.37	7
1969	6	20	0	0	0	-38.47	146.3	4.79	0.37	26

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1969	7	25	0	0	0	21.611	111.803	5.71	0.17	129
1969	8	30	0	0	0	-26.77	26.8	4.9	0.25	63
1969	9	9	0	0	0	-2.602	24.744	5.1	0.25	73
1969	9	11	0	0	0	-33.41	21.8	4.89	0.37	58
1969	9	29	0	0	0	-33.191	19.335	6.38	0.1	58
1969	9	29	0	0	0	65.1	6.5	4.75	0.25	183
1969	10	24	0	0	0	24.76	72.54	5.01	0.25	113
1969	11	20	0	0	0	37.4	-81	4.5	0.14	224
1969	12	17	0	0	0	18.11	110.55	4.79	0.25	127
1970	1	22	0	0	0	48.328	9.094	4.52	0.25	192
1970	2	8	0	0	0	-27.4	125.073	4.33	0.45	3
1970	2	13	0	0	0	24.603	68.617	4.88	0.25	113
1970	3	8	0	0	0	55	-116.6	4.75	0.25	242
1970	3	10	0	0	0	-31.093	116.513	5.46	0.25	7
1970	3	23	0	0	0	21.7	73	5.37	0.1	115
1970	3	24	0	0	0	-22.053	126.666	6.03	0.08	9
1970	4	14	0	0	0	-33.17	19.47	5.69	0.2	58
1970	6	15	0	0	0	-25.97	28.18	4.55	0.37	63
1970	7	25	0	0	0	25.711	88.496	5.06	0.25	112
1970	8	22	0	0	0	-26.36	27.38	4.52	0.37	63
1970	8	29	0	0	0	51.1	135.1	5.3	0.25	139
1970	10	14	0	0	0	31.226	74.34	5.1	0.25	113
1970	10	31	0	0	0	-26.78	26.85	4.62	0.37	63
1970	11	19	0	0	0	-22.19	30.73	4.78	0.37	66
1970	12	2	0	0	0	68.5	-67.55	5.06	0.15	248
1971	2	22	0	0	0	-18.425	26.474	4.87	0.25	67
1971	7	6	0	0	0	-38.423	145.113	4.45	0.32	26
1971	7	26	0	0	0	-31.37	138.76	4.5	0.37	21
1971	8	16	0	0	0	28.879	103.673	5.4	0.25	131
1971	10	2	0	0	0	64.4	-86.5	4.68	0.05	239
1971	11	26	0	0	0	79.438	-17.766	5.06	0.25	253
1971	12	7	0	0	0	55.082	-54.352	5.52	0.15	247
1972	1	15	0	0	0	57.5	121.1	4.63	0.25	147
1972	1	21	0	0	0	71.84	-74.96	4.56	0.15	248
1972	2	3	0	0	0	33.31	-80.58	4.31	0.15	218

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1972	2	25	0	0	0	-34.22	147.47	4.5	0.37	27
1972	4	5	0	0	0	23	118.3	4.85	0.37	127
1972	4	14	0	0	0	40.1	122.5	4.45	0.25	133
1972	4	18	0	0	0	-31.58	138.62	4.87	0.32	21
1972	8	9	0	0	0	56.9	127.7	5.15	0.19	147
1972	8	28	0	0	0	-24.992	136.326	5.28	0.1	5
1972	9	2	0	0	0	31.39	16.09	5.53	0.19	90
1972	9	7	0	0	0	45.99	-1.5	5.01	0.25	196
1972	9	30	0	0	0	79.88	-107.72	4.49	0.25	250
1972	10	21	0	0	0	-24.88	115.55	4.71	0.37	3
1972	10	24	0	0	0	-21.8	-40.5	4.83	0.25	46
1972	12	18	0	0	0	-16.7	28.1	5.57	0.17	67
1972	12	27	0	0	0	76.759	-107.093	6.1	0.3	249
1973	3	9	0	0	0	-34.14	150.29	5.06	0.19	27
1973	3	11	0	0	0	-21.96	127.44	4.34	0.45	13
1973	6	15	0	0	0	45.3	-70.9	4.48	0.08	222
1973	12	15	0	0	0	74.2	147.1	4.86	0.25	144
1974	2	1	0	0	0	-17.882	26.05	4.65	0.37	61
1974	3	17	0	0	0	13.32	30.88	4.8	0.25	82
1974	4	3	0	0	0	38.6	-88.1	4.29	0.15	230
1974	4	22	0	0	0	31.6	119.1	5.31	0.1	132
1974	5	10	0	0	0	28.181	103.994	6.8	0.25	131
1974	8	1	0	0	0	-16.652	28.004	4.96	0.25	67
1974	9	4	0	0	0	33.103	13.411	5.68	0.1	90
1974	9	23	0	0	0	-0.296	12.758	5.98	0.05	73
1974	9	27	0	0	0	2.646	-71.355	5.9	0.19	52
1974	10	8	0	0	0	60.6	118.5	4.75	0.25	148
1974	10	15	0	0	0	-70.55	161.3	4.75	0.25	208
1974	11	17	0	0	0	-22	126.53	4.94	0.25	9
1974	12	24	0	0	0	-21.81	153.21	4.59	0.37	32
1975	3	6	0	0	0	-17.08	126.38	4.91	0.32	14
1975	3	8	0	0	0	79.82	-94.07	5.03	0.19	249
1975	4	15	0	0	0	9.42	-61.47	5.27	0.19	52
1975	6	23	0	0	0	50.592	9.859	4.57	0.32	195
1975	6	30	0	0	0	71.44	-71.19	4.75	0.25	248

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1975	7	24	0	0	0	-21.09	120.47	4.49	0.37	10
1975	9	2	0	0	0	32.83	121.83	4.93	0.19	132
1975	10	3	0	0	0	-22.21	126.58	4.95	0.25	9
1975	10	6	0	0	0	44.71	-57.07	5.06	0.14	218
1976	1	18	0	0	0	77.816	18.466	5.98	0.19	181
1976	1	22	0	0	0	8.8	-60.3	4.32	0.45	52
1976	2	19	0	0	0	66.41	-135.28	4.94	0.19	241
1976	3	12	0	0	0	-0.487	12.624	5.06	0.25	73
1976	3	25	0	0	0	35.59	-90.48	4.62	0.08	228
1976	5	15	0	0	0	4.461	19.348	5.43	0.14	84
1976	6	4	0	0	0	24.575	68.41	5.23	0.19	113
1976	6	23	0	0	0	21.415	88.79	5.06	0.25	118
1976	7	1	0	0	0	-29.559	25.112	5.74	0.1	63
1976	8	28	0	0	0	43.88	114.17	4.45	0.25	135
1976	10	6	0	0	0	35.296	124.297	5.32	0.19	132
1976	12	8	0	0	0	-27.91	26.71	5.1	0.25	63
1977	3	24	0	0	0	51.48	16.05	4.64	0.19	192
1977	4	6	0	0	0	61.605	2.466	4.67	0.25	188
1977	8	2	0	0	0	-0.1	-50	4.67	0.25	54
1977	10	19	0	0	0	23.229	107.594	5.06	0.19	130
1978	1	10	0	0	0	3.51	-73.64	4.88	0.25	51
1978	2	5	0	0	0	78.24	-107.33	5.08	0.14	249
1978	5	1	0	0	0	-23.64	115.59	4.76	0.32	3
1978	5	6	0	0	0	-19.55	126.56	4.89	0.37	11
1978	6	16	0	0	0	33.01	-100.72	4.49	0.1	231
1978	9	3	0	0	0	48.283	9.033	5.04	0.17	192
1978	11	28	0	0	0	-23.34	152.52	4.94	0.25	32
1978	12	9	0	0	0	23.951	26.353	5.11	0.19	82
1979	2	6	0	0	0	48.9	116.8	5.02	0.19	136
1979	2	12	0	0	0	-17.34	-63.63	4.92	0.25	51
1979	4	23	0	0	0	-16.616	120.163	6.12	0.08	1
1979	5	21	0	0	0	31.08	110.5	4.92	0.25	130
1979	6	2	0	0	0	-30.818	117.105	6.08	0.05	7
1979	6	27	0	0	0	70.03	-96.48	4.96	0.14	239
1979	7	9	0	0	0	31.45	119.25	5.44	0.08	132

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1979	7	14	0	0	0	-18.42	122.82	5.03	0.14	9
1979	8	19	0	0	0	47.672	-69.901	4.72	0.12	227
1979	12	26	0	0	0	54.903	-2.683	4.5	0.25	185
1980	1	7	0	0	0	40.26	125.11	5.09	0.17	133
1980	2	10	0	0	0	48.9	122.02	5.04	0.17	135
1980	3	6	0	0	0	-6.17	-71.16	4.83	0.25	51
1980	7	27	0	0	0	38.18	-83.94	5.01	0.13	226
1980	9	2	0	0	0	17.179	73.707	5.49	0.19	106
1980	11	12	0	0	0	-8.04	-50.14	4.79	0.25	52
1980	11	20	0	0	0	-4.3	-38.4	5.19	0.08	56
1981	3	3	0	0	0	31.39	73.216	4.98	0.19	113
1981	4	25	0	0	0	48.93	121.952	5.02	0.19	135
1981	6	16	0	0	0	-38.913	144.262	4.81	0.37	23
1981	6	18	0	0	0	-10.328	135.476	4.94	0.25	13
1981	8	18	0	0	0	65.67	-90.5	4.6	0.25	239
1981	9	3	0	0	0	69.62	13.68	4.75	0.25	183
1981	11	18	0	0	0	-2.282	22.813	5.53	0.14	73
1981	11	21	0	0	0	79.52	-108.11	4.7	0.19	249
1981	12	15	0	0	0	-65.74	133.6	4.75	0.25	213
1982	1	9	0	0	0	46.98	-66.66	5.47	0.05	222
1982	2	13	0	0	0	-22.096	126.643	4.74	0.25	9
1982	2	14	0	0	0	38.27	125.68	5.17	0.15	132
1982	2	28	0	0	0	37.04	129.6	4.83	0.25	127
1982	4	8	0	0	0	-24.8	-58.1	4.96	0.19	41
1982	4	13	0	0	0	-27.926	26.783	4.88	0.25	63
1982	5	1	0	0	0	31.583	71.41	5.31	0.19	113
1982	6	28	0	0	0	50.733	7.804	4.51	0.37	195
1982	7	29	0	0	0	60.118	2.151	4.79	0.25	188
1982	10	27	0	0	0	23.951	106.049	5.19	0.14	130
1982	11	3	0	0	0	-20.53	120.48	4.69	0.37	9
1982	11	4	0	0	0	-80.79	36.9	4.52	0.25	202
1982	11	21	0	0	0	-37.205	146.956	4.6	0.15	27
1983	1	26	0	0	0	-30.73	117.13	4.96	0.25	7
1983	2	8	0	0	0	-26.26	-59.89	4.88	0.25	41
1983	3	8	0	0	0	59.74	5.38	3.28	0.32	179

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1983	8	5	0	0	0	-3.59	-62.17	5.39	0.19	52
1983	9	20	0	0	0	-68.87	122.1	4.45	0.25	202
1983	10	7	0	0	0	43.938	-74.258	4.84	0.05	226
1983	11	8	0	0	0	50.63	5.5	4.68	0.2	187
1983	12	22	0	0	0	11.863	-13.512	6.21	0.12	105
1983	12	25	0	0	0	-5.09	-73.42	5.1	0.19	51
1983	12	29	0	0	0	-30.79	138.4	4.62	0.37	21
1984	3	16	0	0	0	-14.95	123.38	4.64	0.25	14
1984	5	19	0	0	0	-67.43	113	4.91	0.17	202
1984	5	21	0	0	0	32.694	121.513	6.06	0.1	132
1984	7	19	0	0	0	52.958	-4.398	4.95	0.19	185
1984	8	31	0	0	0	-10.698	126.349	4.5	0.7	1
1984	9	8	0	0	0	44.24	-106.019	4.9	0.14	238
1984	10	26	0	0	0	-16.465	28.667	5.29	0.14	67
1984	11	29	0	0	0	-11.614	123.952	4.84	0.25	1
1985	3	13	0	0	0	-15.45	121.853	4.83	0.37	1
1985	4	12	0	0	0	-23.94	-60.55	5.09	0.14	41
1985	4	19	0	0	0	-10.552	124.403	5.05	0.25	1
1985	5	26	0	0	0	37.84	-4.69	4.96	0.19	200
1985	7	23	0	0	0	-19.14	126.77	4.64	0.25	13
1985	7	28	0	0	0	-32.51	122.22	5.13	0.19	8
1985	10	4	0	0	0	-18.304	48.433	5.53	0.14	71
1985	10	23	0	0	0	-11.109	125.159	5.77	0.1	1
1985	12	21	0	0	0	50.14	12.44	4.65	0.32	193
1986	1	2	0	0	0	-34.484	112.098	5.56	0.19	6
1986	1	31	0	0	0	41.65	-81.162	4.65	0.2	226
1986	2	5	0	0	0	62.68	5.05	4.69	0.1	183
1986	2	10	0	0	0	-27.944	26.735	4.88	0.25	63
1986	3	30	0	0	0	-26.31	132.741	5.76	0.05	9
1986	4	20	0	0	0	57.4	-59.6	5.07	0.2	247
1986	7	18	0	0	0	-16.356	28.502	5.19	0.14	67
1986	8	1	0	0	0	73.031	56.726	4.68	0.19	156
1986	8	15	0	0	0	48.638	126.621	4.95	0.14	137
1986	10	5	0	0	0	-30.546	28.737	5.33	0.14	60
1986	10	22	0	0	0	22.42	118.79	5.01	0.19	127

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1986	11	30	0	0	0	-5.5	-35.75	5.08	0.14	56
1987	1	9	0	0	0	-20.11	133.636	5.4	0.14	13
1987	1	26	0	0	0	6.373	12.453	4.89	0.14	85
1987	2	17	0	0	0	33.69	120.66	5.1	0.19	132
1987	3	5	0	0	0	52.48	132.64	5.04	0.19	136
1987	4	18	0	0	0	22.346	79.259	4.79	0.25	111
1987	6	10	0	0	0	38.713	-87.954	4.95	0.08	230
1987	8	2	0	0	0	24.924	115.608	4.99	0.1	125
1987	9	5	0	0	0	22.5	118.73	4.98	0.19	127
1987	12	13	0	0	0	74.46	-93.71	5.35	0.14	248
1987	12	22	0	0	0	-36.11	141.54	4.75	0.19	31
1988	1	3	0	0	0	-14.31	25.4	4.52	0.25	61
1988	1	5	0	0	0	-26.807	26.64	4.92	0.25	63
1988	1	7	0	0	0	0.56	18.43	4.71	0.25	73
1988	1	22	0	0	0	-19.896	133.856	6.56	0.05	13
1988	1	28	0	0	0	32.33	21.2	5.3	0.25	90
1988	1	28	0	0	0	48	-65.58	3.55	0.06	222
1988	1	31	0	0	0	67.81	10.2	4.67	0.25	183
1988	2	6	0	0	0	-16.679	124.663	5.09	0.14	13
1988	3	10	0	0	0	-17.2	13.4	4.52	0.25	61
1988	3	26	0	0	0	33.2	13.34	5.2	0.37	90
1988	6	15	0	0	0	-31.51	126.51	4.88	0.25	19
1988	6	26	0	0	0	-36.27	-52.73	5	0.19	46
1988	8	8	0	0	0	63.673	2.397	5.53	0.17	183
1988	9	6	0	0	0	61.33	47.98	4.85	0.25	167
1988	9	12	0	0	0	-26.89	26.65	4.6	0.25	63
1988	9	30	0	0	0	-20.08	133.84	5.25	0.25	13
1988	11	10	0	0	0	21.2	108.57	4.6	0.25	129
1988	11	25	0	0	0	48.056	-71.28	5.84	0.08	226
1988	12	31	0	0	0	-26.88	26.64	4.8	0.25	63
1989	1	4	0	0	0	-7.486	133.25	4.67	0.25	1
1989	1	12	0	0	0	40.42	122.66	4.83	0.25	133
1989	1	23	0	0	0	61.949	4.504	5.12	0.1	183
1989	1	25	0	0	0	-27.96	26.72	5.14	0.19	63
1989	1	29	0	0	0	59.45	5.9	4.75	0.25	179

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1989	3	10	0	0	0	-5.81	-35.56	5.17	0.19	56
1989	3	13	0	0	0	50.72	9.91	5.22	0.19	195
1989	3	16	0	0	0	-16.927	-65.005	5.22	0.14	51
1989	3	16	0	0	0	59.93	-69.66	4.97	0.17	239
1989	3	23	0	0	0	-11.148	123.737	4.75	0.25	1
1989	3	26	0	0	0	-5.05	-37.6	4.7	0.25	56
1989	4	7	0	0	0	-12.516	122.161	5.1	0.25	1
1989	4	8	0	0	0	39.45	-8.92	4.89	0.19	199
1989	5	14	0	0	0	50.87	51.4	4.52	0.25	161
1989	5	28	0	0	0	-25.07	130.78	5.57	0.19	12
1989	6	5	0	0	0	-11.97	14.59	4.96	0.25	72
1989	6	12	0	0	0	21.829	89.754	5.76	0.08	118
1989	6	18	0	0	0	-12.449	121.52	5.2	0.14	1
1989	6	29	0	0	0	51.44	16.07	4.55	0.25	192
1989	7	18	0	0	0	76.865	12.972	4.88	0.19	182
1989	9	29	0	0	0	-30.6	28.7	4.82	0.19	60
1989	10	13	0	0	0	-17.59	122.4	5.47	0.14	11
1989	10	25	0	0	0	57.519	118.811	5.38	0.16	147
1989	10	28	0	0	0	51.6	16.01	4.67	0.25	192
1989	11	20	0	0	0	29.882	106.804	5.14	0.19	131
1989	11	25	0	0	0	23.72	114.52	5.4	0.27	125
1989	12	10	0	0	0	24.81	70.89	4.67	0.25	113
1989	12	25	0	0	0	60.045	-73.538	6.03	0.08	236
1989	12	27	0	0	0	-32.94	151.56	5.28	0.27	27
1990	1	17	0	0	0	-31.68	116.99	5.1	0.25	7
1990	2	7	0	0	0	-26.8301	26.6818	4.5	0.37	63
1990	2	9	0	0	0	31.72	121.03	4.92	0.19	132
1990	2	12	0	0	0	-31.22	-48.9	5.15	0.19	46
1990	2	14	0	0	0	-26.29	27.43	4.5	0.25	63
1990	2	20	0	0	0	32.5564	44.2181	4.6	0.25	81
1990	3	3	0	0	0	-26.9543	26.72	4.9	0.37	63
1990	3	13	0	0	0	-4.03	39.93	5.49	0.14	80
1990	4	2	0	0	0	52.32	-3	4.65	0.25	185
1990	5	20	0	0	0	5.121	32.145	7.22	0.15	82
1990	5	25	0	0	0	8.259	32.9262	4.7	0.25	82

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1990	5	28	0	0	0	55.15	58.63	4.6	0.25	159
1990	6	9	0	0	0	75.12	113.1	4.75	0.25	152
1990	6	24	0	0	0	-17.6407	27.7695	4.5	0.25	67
1990	7	18	0	0	0	-26.8569	26.6248	4.6	0.25	63
1990	7	28	0	0	0	74.8794	-79.9866	4.5	0.37	248
1990	9	20	0	0	0	4.2221	9.0551	4.5	0.37	85
1990	9	26	0	0	0	-28.014	26.727	4.97	0.14	63
1990	10	19	0	0	0	46.4373	-75.5759	4.53	0.2	226
1990	10	24	0	0	0	73.3597	54.6741	5.1	0.47	156
1990	11	11	0	0	0	33.94	12.04	5.15	0.14	90
1990	11	29	0	0	0	78.4481	-108.49	4.7	0.25	249
1990	12	6	0	0	0	-26.35	27.31	4.5	0.25	63
1990	12	31	0	0	0	47.7018	-72.6666	4.16	0.15	226
1991	1	13	0	0	0	65.628	-37.5123	4.6	0.25	239
1991	1	24	0	0	0	-13.1283	23.1763	4.8	0.25	61
1991	2	4	0	0	0	60.9412	-43.3441	4.9	0.25	244
1991	2	12	0	0	0	71.4432	-75.0874	5	0.37	248
1991	2	27	0	0	0	25.6762	103.9086	4.8	0.25	130
1991	4	19	0	0	0	-4.006	-39.7315	4.7	0.25	56
1991	4	26	0	0	0	20.8118	89.6729	4.7	0.25	118
1991	5	10	0	0	0	-17.3484	24.982	4.7	0.25	61
1991	6	10	0	0	0	-26.8689	26.7138	4.7	0.25	63
1991	6	19	0	0	0	-20.0685	133.9655	5.1	0.25	13
1991	9	10	0	0	0	24.1675	68.6842	4.9	0.25	114
1991	9	30	0	0	0	43.0932	112.5325	4.8	0.25	134
1991	11	3	0	0	0	-26.8912	26.6395	4.9	0.37	63
1991	11	3	0	0	0	28.3437	104.0239	4.5	0.37	131
1991	11	8	0	0	0	26.28	70.58	5.36	0.14	113
1992	1	2	0	0	0	32.3641	-102.967	4.66	0.16	231
1992	1	4	0	0	0	66.84	-94.46	5.37	0.17	239
1992	1	22	0	0	0	35.3276	121.09	5.02	0.1	132
1992	3	7	0	0	0	-26.4414	27.3387	4.9	0.25	63
1992	4	13	0	0	0	51.16	5.82	5.31	0.1	195
1992	4	17	0	0	0	-20.0236	133.7528	4.6	0.25	13
1992	6	6	0	0	0	-27.9762	26.7805	5	0.37	63

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1992	6	12	0	0	0	44.2414	116.2393	4.6	0.37	135
1992	6	13	0	0	0	-23.8616	130.0962	5	0.25	12
1992	7	1	0	0	0	-19.0302	111.8556	4.5	0.25	2
1992	7	9	0	0	0	20.98	89.96	5.3	0.25	118
1992	7	9	0	0	0	-5.5221	137.9927	4.7	0.25	16
1992	7	15	0	0	0	-22.4264	126.5028	4.9	0.25	9
1992	8	31	0	0	0	43.93	106.92	5.33	0.14	135
1992	9	2	0	0	0	45.5822	117.9208	4.7	0.25	135
1992	9	18	0	0	0	21.286	117.6981	5.1	0.47	127
1992	9	29	0	0	0	34.501	14.4913	5.1	0.37	90
1992	9	30	0	0	0	-11.349	134.5335	5.26	0.17	17
1992	10	23	0	0	0	31.35	-4.33	5.55	0.04	95
1992	11	3	0	0	0	35.3446	123.2905	4.57	0.1	132
1992	11	8	0	0	0	61.9791	2.6797	4.5	0.37	183
1992	11	28	0	0	0	-26.9957	26.5164	4.6	0.37	63
1992	12	23	0	0	0	-23.8258	17.3111	4.8	0.25	61
1993	2	4	0	0	0	-7.9448	134.1146	4.8	0.37	13
1993	2	8	0	0	0	-8.8653	133.8904	4.8	0.37	13
1993	2	20	0	0	0	-7.7297	22.3845	4.6	0.25	73
1993	2	21	0	0	0	-20.1311	133.733	5	0.37	13
1993	2	23	0	0	0	-26.3566	27.3881	4.5	0.37	63
1993	3	13	0	0	0	71.211	-71.8438	4.9	0.25	248
1993	3	28	0	0	0	32.9404	123.7381	5	0.25	128
1993	5	5	0	0	0	30.0425	108.2326	4.5	0.37	131
1993	5	16	0	0	0	23.1388	86.8324	4.5	0.25	111
1993	6	2	0	0	0	28.91	47.5708	4.6	0.37	81
1993	6	15	0	0	0	79.7807	-16.6234	4.5	0.25	253
1993	6	30	0	0	0	51.4914	16.0949	4.5	0.25	192
1993	7	18	0	0	0	17.9312	-93.1846	4.5	0.25	215
1993	8	1	0	0	0	15.4	31.67	5.49	0.13	82
1993	8	10	0	0	0	83.03	-27.92	5.56	0.14	251
1993	8	18	0	0	0	-26.9049	26.6872	4.6	0.25	63
1993	8	24	0	0	0	20.6973	71.4408	5.1	0.37	116
1993	8	28	0	0	0	17.2402	73.7331	5.1	0.25	106
1993	8	29	0	0	0	-26.3489	27.3139	5.2	0.47	63

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1993	9	3	0	0	0	19.8473	-13.0178	4.6	0.25	98
1993	9	9	0	0	0	32.2394	20.3859	4.8	0.25	90
1993	9	13	0	0	0	66.3237	5.8379	4.8	0.47	183
1993	9	29	0	0	0	18.077	76.486	6.2	0.37	106
1993	10	13	0	0	0	28.6253	103.3757	4.8	0.25	131
1993	11	1	0	0	0	51.625	16.0294	4.6	0.37	192
1993	12	6	0	0	0	6.8278	78.3202	5.3	0.25	117
1993	12	18	0	0	0	-11.8274	133.8567	4.8	0.37	13
1993	12	20	0	0	0	-26.9098	26.7103	4.7	0.25	63
1993	12	30	0	0	0	38.1635	122.7901	4.6	0.25	133
1994	2	6	0	0	0	3.5021	27.5524	5	0.37	73
1994	2	8	0	0	0	-19.9992	133.5254	5.1	0.25	13
1994	2	11	0	0	0	64.9006	-52.0772	4.6	0.37	246
1994	3	2	0	0	0	26.32	118.64	4.8	0.25	125
1994	5	5	0	0	0	51.648	133.3765	4.9	0.25	139
1994	5	10	0	0	0	-26.8869	26.7634	4.7	0.25	63
1994	6	4	0	0	0	49.0688	129.811	4.5	0.37	139
1994	7	25	0	0	0	34.97	124.43	5.14	0.16	132
1994	8	1	0	0	0	47.994	67.5271	5	0.25	158
1994	8	6	0	0	0	-32.9377	151.1628	5	0.25	27
1994	8	31	0	0	0	25.8963	78.6269	4.8	0.25	112
1994	10	2	0	0	0	-26.4123	27.4682	4.7	0.25	63
1994	10	30	0	0	0	-28.0213	26.7184	5.3	0.25	63
1994	11	30	0	0	0	-30.6245	137.608	4.9	0.25	21
1994	12	29	0	0	0	29.09	103.85	5.12	0.12	131
1995	1	5	0	0	0	59.6137	56.6197	4.9	0.25	166
1995	1	10	0	0	0	20.4195	109.4385	5.53	0.04	126
1995	1	15	0	0	0	20.69	109.8	5	0.25	126
1995	2	10	0	0	0	-26.8338	26.669	4.8	0.37	63
1995	2	25	0	0	0	24.3716	118.6643	5	0.25	127
1995	2	27	0	0	0	-2.9306	39.9749	4.8	0.25	80
1995	3	8	0	0	0	82.3577	-71.7175	5	0.25	249
1995	3	12	0	0	0	17.3784	73.9096	4.6	0.25	106
1995	4	14	0	0	0	30.2885	-103.319	5.64	0.05	226
1995	4	28	0	0	0	-6.2142	-73.2034	4.6	0.25	51

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1995	6	3	0	0	0	47.138	-76.2833	3.28	0.17	226
1995	6	14	0	0	0	-20.149	133.7148	4.8	0.37	13
1995	6	21	0	0	0	21.7637	85.286	4.5	0.47	109
1995	7	4	0	0	0	79.9971	94.8377	5	0.37	154
1995	7	24	0	0	0	38.0329	124.285	5.1	0.25	133
1995	8	25	0	0	0	-23.7538	112.1831	4.6	0.25	4
1995	9	22	0	0	0	1.0903	19.3548	5.24	0.22	73
1995	10	20	0	0	0	61.5656	116.4441	4.8	0.25	149
1995	10	28	0	0	0	-26.3378	27.5454	4.7	0.25	63
1995	10	30	0	0	0	-49.6603	-42.775	4.6	0.25	35
1995	11	14	0	0	0	68.41	51.61	4.8	0.25	168
1995	11	25	0	0	0	-26.9224	26.6805	4.8	0.37	63
1995	11	29	0	0	0	42.9189	-7.2295	5	0.25	200
1995	12	5	0	0	0	57.6977	107.0928	4.7	0.25	149
1995	12	17	0	0	0	-27.9673	26.6594	4.5	0.25	63
1996	1	14	0	0	0	51.5986	16.1205	4.5	0.37	192
1996	1	15	0	0	0	52.9635	83.7387	4.5	0.25	156
1996	2	7	0	0	0	27.4584	106.5679	4.7	0.25	130
1996	2	28	0	0	0	29.0782	104.7045	5.2	0.25	131
1996	3	29	0	0	0	82.8988	-43.6804	5	0.25	251
1996	6	9	0	0	0	-34.1658	135.8155	4.5	0.25	19
1996	6	15	0	0	0	51.5675	16.2235	5.2	0.37	192
1996	6	26	0	0	0	-18.3579	48.4751	4.98	0.5	71
1996	7	22	0	0	0	44.2	-105.68	4.6	0.37	238
1996	8	13	0	0	0	-30.0363	143.5507	4.9	0.25	27
1996	9	8	0	0	0	-4.4521	-76.7274	4.6	0.37	51
1996	9	11	0	0	0	51.4666	11.7071	4.8	0.37	192
1996	9	16	0	0	0	-26.857	26.7031	4.5	0.25	63
1996	9	25	0	0	0	-37.7783	146.258	4.7	0.25	27
1996	10	30	0	0	0	32.4343	20.5326	4.7	0.25	90
1996	11	9	0	0	0	31.6311	123.3463	5.59	0.03	128
1996	12	11	0	0	0	-27.8959	26.729	4.7	0.25	63
1996	12	13	0	0	0	37.1873	128.7499	5	0.25	128
1997	1	23	0	0	0	17.1421	76.6916	4.7	0.25	106
1997	2	10	0	0	0	-26.933	26.7087	5	0.37	63

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1997	3	5	0	0	0	-33.7067	138.9698	4.8	0.25	21
1997	5	2	0	0	0	28.94	122.77	4.5	0.25	125
1997	5	21	0	0	0	23.062	80.088	5.81	0.02	111
1997	5	21	0	0	0	42.85	-7.1535	5.33	0.15	200
1997	6	15	0	0	0	23.98	89.91	4.6	0.37	118
1997	7	21	0	0	0	-26.8706	26.7773	4.7	0.25	63
1997	7	27	0	0	0	33.5481	122.2349	5.1	0.68	132
1997	7	29	0	0	0	-27.9521	26.6442	5.1	0.37	63
1997	8	10	0	0	0	-16.154	124.338	6.24	0.02	14
1997	8	13	0	0	0	29.4139	105.6148	4.9	0.25	131
1997	9	11	0	0	0	-3.6376	-76.9265	4.9	0.37	51
1997	9	11	0	0	0	-31.4593	117.5452	4.6	0.37	7
1997	9	22	0	0	0	54.7642	19.6155	4.7	0.37	175
1997	9	25	0	0	0	-26.372	27.3481	4.7	0.25	63
1997	10	3	0	0	0	-22.7886	147.1643	4.6	0.37	27
1997	10	11	0	0	0	-10.6132	24.6701	4.8	0.25	77
1997	10	24	0	0	0	31.1933	-87.1997	4.88	0.1	217
1997	11	6	0	0	0	46.7275	-71.3546	4.41	0.12	222
1997	12	6	0	0	0	64.904	-88.0878	5.2	0.25	239
1997	12	11	0	0	0	-26.8974	26.6575	4.5	0.25	63
1998	3	3	0	0	0	-3.7548	-77.322	4.6	0.37	51
1998	3	5	0	0	0	0.8049	17.3948	4.98	0.21	73
1998	3	10	0	0	0	-11.745	-56.9634	5.2	0.25	52
1998	3	29	0	0	0	-12.3957	139.2206	5.1	0.25	13
1998	4	12	0	0	0	-12.4435	25.5442	4.8	0.37	61
1998	4	16	0	0	0	25.0379	107.9586	4.7	0.25	129
1998	4	16	0	0	0	25.2458	108.2534	4.5	0.25	129
1998	5	11	0	0	0	27.0812	71.7594	4.8	0.25	113
1998	5	28	0	0	0	31.4459	27.6426	5.5	0.03	90
1998	6	3	0	0	0	29.15	103.19	4.6	0.25	131
1998	7	13	0	0	0	-27.9098	26.8024	4.5	0.25	63
1998	8	29	0	0	0	43.445	109.0753	4.8	0.25	135
1998	9	24	0	0	0	46.3059	106.3265	5.56	0.03	136
1998	9	25	0	0	0	41.4444	-80.3388	4.55	0.17	226
1998	10	14	0	0	0	60.6616	-44.0581	4.99	0.15	244

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
1998	11	2	0	0	0	-19.8618	113.8855	4.5	0.37	2
1998	11	5	0	0	0	27.0812	71.7594	4.8	0.25	113
1998	11	17	0	0	0	-26.8668	26.6823	4.5	0.25	63
1998	12	1	0	0	0	26.385	103.938	4.9	0.37	130
1998	12	5	0	0	0	-26.2962	27.5215	4.6	0.25	63
1998	12	22	0	0	0	79.9756	-90.6722	4.8	0.25	249
1999	1	1	0	0	0	80.003	-111.51	5	0.24	250
1999	1	5	0	0	0	4.239	44.062	5.6	0.37	79
1999	1	18	0	0	0	33.408	-87.258	4.7	0.25	224
1999	1	25	0	0	0	43.67	-105.094	4.5	0.37	238
1999	1	27	0	0	0	-22.221	16.291	5.1	0.37	61
1999	1	29	0	0	0	2.12	45.721	5.4	0.25	80
1999	1	29	0	0	0	44.648	115.721	5	0.25	135
1999	2	10	0	0	0	32.944	15.277	4.7	0.25	90
1999	2	14	0	0	0	-19.27	21.256	4.6	0.37	61
1999	3	9	0	0	0	-10.8895	128.7734	5.5	0.25	1
1999	4	15	0	0	0	-20.124	134.061	4.7	0.25	13
1999	4	22	0	0	0	-27.939	26.675	5.3	0.25	63
1999	7	18	0	0	0	-6.3221	141.8213	4.8	0.37	16
1999	8	6	0	0	0	-8.543	21.517	4.5	0.25	72
1999	8	17	0	0	0	29.406	105.607	4.8	0.47	131
1999	8	17	0	0	0	67.813	34.498	4.5	0.47	171
1999	8	28	0	0	0	22.915	89.795	4.8	0.25	118
1999	12	7	0	0	0	75.588	-121.197	4.9	0.25	249
1999	12	30	0	0	0	43.735	-105.137	4.9	0.37	238
2000	1	1	0	0	0	46.875	-78.756	4.62	0.11	226
2000	2	8	0	0	0	-26.438	27.474	4.5	0.25	63
2000	3	12	0	0	0	17.244	73.707	4.87	0.28	106
2000	4	11	0	0	0	51.418	16.043	4.7	0.25	192
2000	7	13	0	0	0	-26.383	27.537	4.7	0.25	63
2000	8	13	0	0	0	21.212	71.105	4.7	0.25	113
2000	9	5	0	0	0	17.332	73.79	5.17	0.15	106
2000	9	5	0	0	0	1.029	25.835	4.5	0.2	78
2000	10	11	0	0	0	-20.065	112.905	4.93	0.27	2
2000	11	8	0	0	0	77.042	-77.829	6	0.25	248

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2000	12	8	0	0	0	59.749	1.924	4.9	0.25	188
2000	12	23	0	0	0	-7.832	135.889	6	0.47	13
2001	1	22	0	0	0	65.879	-52.497	4.7	0.25	246
2001	1	24	0	0	0	-26.742	26.844	4.8	0.37	63
2001	1	26	0	0	0	23.442	70.31	7.6	0.25	114
2001	2	3	0	0	0	-16.906	28.542	4.9	0.25	67
2001	2	28	0	0	0	18.1	-87.9	5.4	0.25	214
2001	3	18	0	0	0	-14.4643	137.0496	5.6	0.37	13
2001	4	5	0	0	0	-15.5248	122.6804	5.3	0.37	13
2001	4	9	0	0	0	43.783	-105.109	4.8	0.37	238
2001	4	12	0	0	0	60.3706	64.5696	5.7	0.37	159
2001	4	14	0	0	0	56.04	-119.583	5.27	0.04	242
2001	4	17	0	0	0	-6.196	22.71	4.7	0.25	73
2001	4	21	0	0	0	46.2	-105.4	5.3	0.25	238
2001	5	2	0	0	0	49.91	130.15	5	0.37	139
2001	5	5	0	0	0	18	-90.6	5.3	0.25	214
2001	5	20	0	0	0	42.806	-7.612	4.7	0.37	200
2001	6	12	0	0	0	22.24	83.918	4.8	0.25	110
2001	6	23	0	0	0	29.325	105.563	4.8	0.25	131
2001	6	25	0	0	0	35.1035	43.4952	5.6	0.25	81
2001	6	26	0	0	0	-26.34	27.487	4.5	0.25	63
2001	6	27	0	0	0	-12.1	-63.7	5.2	0.25	51
2001	7	12	0	0	0	21.2717	70.8706	4.6	0.25	113
2001	7	13	0	0	0	18.1502	78.8564	5.1	0.37	106
2001	7	16	0	0	0	75.5434	-23.5549	5.5	0.25	253
2001	7	25	0	0	0	33.4073	118.8967	4.5	0.25	132
2001	7	25	0	0	0	-12.663	-59.8357	4.5	0.25	52
2001	7	26	0	0	0	30.6635	21.6633	4.8	0.25	90
2001	7	26	0	0	0	48.5692	0.6203	4.8	0.25	196
2001	7	31	0	0	0	80.6	-80.3	5.4	0.25	249
2001	7	31	0	0	0	-9.2026	-70.0348	5.1	0.25	51
2001	7	31	0	0	0	-26.896	26.737	4.8	0.25	63
2001	8	5	0	0	0	-9.2812	137.2033	5	0.25	13
2001	8	5	0	0	0	-6.3181	137.017	4.8	0.25	13
2001	8	9	0	0	0	-26.543	150.3748	4.9	0.25	28

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2001	8	13	0	0	0	-8.4663	138.0104	5.2	0.37	13
2001	8	14	0	0	0	76.658	-107.228	5.2	0.25	249
2001	8	16	0	0	0	12.4503	107.3692	4.6	0.25	123
2001	8	18	0	0	0	63.3427	-106.173	5	0.25	239
2001	8	19	0	0	0	-13.365	119.5607	4.8	0.25	1
2001	8	20	0	0	0	-25.585	133.2451	4.9	0.25	9
2001	8	20	0	0	0	-17.426	129.9737	4.8	0.25	13
2001	8	23	0	0	0	-17.344	140.6926	5.6	0.25	18
2001	8	25	0	0	0	36.2641	125.3343	5	0.25	132
2001	8	26	0	0	0	76.3339	-20.322	6.1	0.25	253
2001	8	26	0	0	0	-14.256	123.8186	5	0.25	1
2001	8	30	0	0	0	28.274	19.4471	5	0.25	90
2001	8	30	0	0	0	19.0558	31.2686	4.9	0.25	82
2001	9	2	0	0	0	-6.7649	10.4997	5.1	0.25	76
2001	9	2	0	0	0	37.673	129.78	4.9	0.25	127
2001	9	5	0	0	0	75.1661	-106.182	5.1	0.25	249
2001	9	5	0	0	0	77.984	-114.673	4.7	0.25	249
2001	9	5	0	0	0	37.109	-104.528	4.42	0.1	255
2001	9	7	0	0	0	28.1113	15.1375	4.9	0.25	89
2001	9	7	0	0	0	29.7381	123.8315	4.6	0.25	127
2001	9	10	0	0	0	29.8725	104.5288	4.8	0.25	131
2001	9	11	0	0	0	18.5	-92.2	5.7	0.25	215
2001	9	13	0	0	0	27.9811	20.8813	5.7	0.25	90
2001	9	14	0	0	0	-40.278	149.7071	5.2	0.25	26
2001	9	14	0	0	0	-20.019	133.804	5	0.25	13
2001	9	15	0	0	0	19.7238	-91.9038	4.7	0.25	214
2001	9	16	0	0	0	32.6497	19.2837	5.5	0.25	90
2001	9	17	0	0	0	23.0733	117.7519	5	0.25	127
2001	9	17	0	0	0	45.3943	113.7827	4.7	0.25	135
2001	9	21	0	0	0	51.508	15.924	4.6	0.25	192
2001	9	22	0	0	0	34.3917	6.15	4.8	0.25	93
2001	9	22	0	0	0	-14.177	124.448	4.5	0.25	14
2001	9	23	0	0	0	18.3224	32.8639	4.9	0.25	82
2001	9	25	0	0	0	11.984	80.225	5.2	0.25	117
2001	9	25	0	0	0	31.7297	29.0631	5.1	0.25	90

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2001	9	26	0	0	0	-13.243	147.2773	5.2	0.25	34
2001	9	26	0	0	0	-34.763	151.8227	5.1	0.25	30
2001	9	26	0	0	0	25.8207	22.8831	5	0.25	89
2001	9	28	0	0	0	-32.995	120.9596	5.2	0.25	8
2001	9	28	0	0	0	-30.399	117.319	4.9	0.25	8
2001	9	28	0	0	0	38.0842	126.5439	4.5	0.25	132
2001	9	30	0	0	0	-12.991	126.7785	5.1	0.25	15
2001	10	1	0	0	0	68.8555	-127.699	4.8	0.25	241
2001	10	2	0	0	0	-16.542	129.5569	4.9	0.25	13
2001	10	2	0	0	0	27.5382	118.6441	4.8	0.25	125
2001	10	3	0	0	0	-6.9671	137.0515	6.2	0.25	13
2001	10	8	0	0	0	34.8007	121.2051	5	0.25	132
2001	10	8	0	0	0	-6.2523	137.4915	4.8	0.25	13
2001	10	9	0	0	0	21.7104	-92.8017	5.1	0.25	214
2001	10	16	0	0	0	47.4945	112.7612	5	0.25	136
2001	10	16	0	0	0	26.8645	49.1077	4.8	0.25	81
2001	10	17	0	0	0	-10.052	133.2564	4.6	0.25	17
2001	10	19	0	0	0	-7.941	12.104	5.3	0.25	76
2001	10	19	0	0	0	-33.712	120.628	5.1	0.25	8
2001	10	20	0	0	0	-31.605	147.4204	4.8	0.25	27
2001	10	21	0	0	0	-13.734	122.9126	4.5	0.25	1
2001	10	23	0	0	0	27.8303	18.7848	4.7	0.25	89
2001	10	24	0	0	0	-9.0099	133.5067	4.5	0.25	13
2001	10	25	0	0	0	29.1506	122.51	4.7	0.25	125
2001	10	28	0	0	0	27.2492	70.5076	4.8	0.25	113
2001	10	29	0	0	0	-19.293	115.2423	4.8	0.25	2
2001	10	30	0	0	0	19.1093	19.1265	4.7	0.25	89
2001	11	1	0	0	0	23.513	55.6403	4.6	0.25	81
2001	11	2	0	0	0	23.7152	49.4	5.2	0.25	81
2001	11	2	0	0	0	27.658	19.7634	4.8	0.25	90
2001	11	2	0	0	0	-16.8054	134.754	4.5	0.25	13
2001	11	4	0	0	0	26.8836	21.4003	5.3	0.25	89
2001	11	4	0	0	0	25.3812	47.0527	4.9	0.25	81
2001	11	4	0	0	0	9.4009	4.7531	4.7	0.25	89
2001	11	5	0	0	0	-15.767	126.3471	5.1	0.25	14

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2001	11	7	0	0	0	20.8091	74.3352	4.8	0.37	106
2001	11	7	0	0	0	43.775	-105.215	4.7	0.37	238
2001	11	7	0	0	0	24.3326	70.5843	4.6	0.37	113
2001	11	10	0	0	0	-12.809	12.6848	5	0.25	75
2001	11	14	0	0	0	7.8137	105.9438	6.5	0.25	122
2001	11	14	0	0	0	-22.876	151.377	4.8	0.25	32
2001	11	16	0	0	0	31.84	43.2838	4.7	0.25	81
2001	11	17	0	0	0	27.5644	49.4508	4.7	0.25	81
2001	11	18	0	0	0	32.7764	42.6509	4.5	0.25	81
2001	11	19	0	0	0	23.0845	72.7343	4.9	0.25	115
2001	11	19	0	0	0	-26.675	150.897	4.7	0.25	28
2001	11	20	0	0	0	26.1886	19.0605	4.8	0.25	89
2001	11	20	0	0	0	-19.373	128.96	4.8	0.25	13
2001	11	20	0	0	0	-17.96	135.7664	4.8	0.25	13
2001	11	21	0	0	0	-16.784	152.113	4.9	0.25	34
2001	11	21	0	0	0	33.1923	123.9614	4.5	0.25	132
2001	11	23	0	0	0	-16.497	121.1809	4.8	0.25	1
2001	11	23	0	0	0	24.5701	71.1103	4.6	0.25	113
2001	11	25	0	0	0	22.594	52.9846	5	0.25	81
2001	11	26	0	0	0	30.993	18.9136	5.6	0.25	90
2001	11	26	0	0	0	50.1921	16.3672	5	0.25	192
2001	11	26	0	0	0	28.8118	20.472	4.9	0.25	90
2001	12	13	0	0	0	31.157	110.781	4.8	0.25	130
2002	1	7	0	0	0	69.11	-95.87	4.7	0.25	239
2002	1	8	0	0	0	-29.268	24.112	4.7	0.37	63
2002	2	20	0	0	0	51.561	16.082	4.8	0.25	192
2002	2	28	0	0	0	-27.982	26.789	4.8	0.25	63
2002	3	5	0	0	0	-11.779	24.762	5.1	0.25	61
2002	3	5	0	0	0	-30.52	117.18	4.8	0.25	7
2002	3	21	0	0	0	-26.496	27.346	4.6	0.25	63
2002	3	23	0	0	0	-26.877	26.574	4.8	0.25	63
2002	4	16	0	0	0	40.705	128.67	4.6	0.37	133
2002	4	19	0	0	0	-23.306	26.115	4.5	0.25	66
2002	4	20	0	0	0	44.513	-73.699	4.91	0.18	227
2002	4	30	0	0	0	29.459	105.647	4.8	0.37	131

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2002	5	31	0	0	0	30.293	104.219	4.6	0.25	131
2002	6	13	0	0	0	-20.76	113.752	4.5	0.37	2
2002	6	15	0	0	0	-42.223	147.37	4.7	0.25	26
2002	6	18	0	0	0	38.069	-87.68	4.48	0.1	230
2002	7	12	0	0	0	-26.412	29.015	4.7	0.25	63
2002	7	22	0	0	0	50.889	6.103	4.8	0.25	195
2002	7	23	0	0	0	35.571	122.181	4.9	0.25	132
2002	8	10	0	0	0	35.353	123.252	4.5	0.25	132
2002	9	22	0	0	0	52.52	-2.15	4.8	0.25	187
2002	10	3	0	0	0	31.695	73.704	4.6	0.25	113
2002	10	8	0	0	0	-25.409	115.888	4.6	0.37	3
2002	10	20	0	0	0	44.621	117.371	4.6	0.25	135
2002	12	8	0	0	0	50.91	124.726	4.5	0.25	135
2003	1	23	0	0	0	41.541	-6.005	4.5	0.37	200
2003	2	22	0	0	0	48.342	6.57	4.78	0.31	195
2003	3	22	0	0	0	35.056	124.411	5.1	0.37	132
2003	3	22	0	0	0	48.21	9	4.7	0.37	192
2003	3	23	0	0	0	-13.763	14.273	4.8	0.25	72
2003	3	30	0	0	0	37.573	123.821	4.7	0.25	132
2003	4	29	0	0	0	34.494	-85.629	4.57	0.1	224
2003	5	24	0	0	0	6.498	-65.147	4.5	0.25	52
2003	6	4	0	0	0	75.154	16.726	4.8	0.25	181
2003	6	18	0	0	0	72.07	15.525	4.5	0.25	183
2003	7	4	0	0	0	76.372	23.282	5.4	0.25	169
2003	7	19	0	0	0	-26.425	27.333	4.6	0.25	63
2003	8	4	0	0	0	65.989	5.477	4.8	0.25	183
2003	8	10	0	0	0	27.216	75.739	4.5	0.37	113
2003	8	11	0	0	0	-18.436	147.114	4.8	0.25	33
2003	8	16	0	0	0	43.77	119.643	5.42	0.04	137
2003	10	5	0	0	0	51.517	16.201	4.8	0.25	192
2004	2	6	21	29	21.4	-4.5	137.31	4.87	0.08	16
2004	2	11	9	30	39	-22.51	130.17	4.85	0.13	5
2004	3	24	1	53	49.4	45.38	118.15	5.37	0.02	135
2004	5	29	10	14	28.4	36.66	129.95	5.1	0.03	127
2004	7	10	8	56	20.5	-8.72	130.57	4.81	0.08	1

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2004	8	10	10	26	14.7	27.16	103.78	5.35	0.02	130
2004	9	21	13	32	30.8	54.79	20.11	4.74	0.09	175
2004	10	16	10	4	38	33.56	45.63	4.79	0.18	81
2004	12	5	1	52	37.2	48.03	8.04	4.73	0.15	195
2005	1	22	10	48	45.7	-10.76	124.19	5.15	0.07	1
2005	2	22	23	14	17.8	-65.64	133.54	5.46	0.02	213
2005	3	14	9	43	49.1	17.1	73.79	4.91	0.07	106
2005	7	18	2	6	53.8	-10.33	124.72	5.47	0.05	1
2005	7	20	21	54	5.7	43.04	109.04	5.21	0.02	135
2005	7	25	15	43	41.1	46.86	124.88	5.01	0.03	137
2005	8	5	14	14	48	26.46	103.19	5.26	0.03	130
2005	8	10	22	8	22.6	36.9	-104.79	4.93	0.07	255
2005	9	19	3	27	53.2	49.72	120.93	4.46	0.24	135
2005	11	8	7	54	39	10.12	108.26	5.33	0.03	122
2005	11	10	19	29	54.1	57.48	120.63	5.86	0.01	147
2005	11	26	0	49	37.7	29.66	115.71	5.2	0.03	130
2006	2	15	1	46	4.1	-9.63	126.57	4.74	0.18	1
2006	3	7	18	20	46.1	23.72	70.77	5.48	0.01	114
2006	3	10	7	50	14.4	32.62	73.51	4.96	0.08	113
2006	3	31	12	23	17.9	44.65	124.08	4.76	0.06	137
2006	4	6	17	59	16.4	23.25	70.35	5.56	0.02	114
2006	6	8	16	29	13.3	4.88	-51.96	5.07	0.03	52
2006	8	25	5	51	44.4	28	104.31	5.04	0.08	131
2006	11	17	9	25	21.4	-4.7	138.27	5.08	0.09	16
2007	1	7	1	50	53.8	62.08	1.22	4.85	0.07	184
2007	1	20	11	56	53.7	37.65	128.43	4.76	0.06	132
2007	7	9	15	58	22.3	34.1	6.89	4.85	0.05	93
2007	11	4	20	35	37.3	-67.27	111.53	5.72	0.01	202
2007	11	6	9	38	5.8	21.04	70.49	5.13	0.04	113
2007	11	28	15	16	8.5	10.02	108.28	5.2	0.03	122
2007	12	23	12	56	13	-4.08	39.45	4.9	0.05	80
2008	2	21	2	46	17.9	77.02	19.28	6.1	0.01	181
2008	3	6	12	19	16.4	-24.92	-64.29	4.97	0.05	41
2008	4	18	9	36	59.1	38.49	-87.86	5.3	0.09	229
2008	4	20	7	30	44.3	-3.66	25.97	5.27	0.03	72

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2008	4	26	13	14	52.2	50.71	51.8	5.13	0.04	161
2008	6	10	6	5	4.7	49.07	122.47	4.96	0.06	135
2008	8	15	15	52	50.8	82.23	-18.58	4.78	0.05	239
2008	10	7	10	0	48.1	79.77	-116.02	5.77	0.01	250
2008	12	16	5	20	1.5	55.55	13.76	4.3	0.11	177

Table A-2. SCR Domain Characteristics from CEUS-SSC study (see Table A-3 for notation).

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N ≥ 4.5
1	Scott-Browse	E	MZ	CZ	C	F	542655	6.3	35.4
2	Exmouth	E	MZ	CZ	C	NF	383752	7.2	29.4
3	Gascoyne_Pateroso	NE	PC	PC	C	UK	369232	4.8	4
4	Canarvan	E	MZ	MZ	C	UK	420994	5.1	4
5	Alice Springs	NE	PC	PC	C	NF	279587	5.8	4
6	Naturaliste	E	MZ	MZ	C	UK	115589	6.2	3.3
7	Yilgarn West	NE	PC	PC	C	NF	237858	6.7	20.3
8	Yilgarn East	NE	PC	PC	C	NF	501577	5.2	4.6
9	Musgrave-Fraser	NE	PC	PC	C	UK	853794	6	12.5
10	Pilbara	NE	PC	PC	C	UK	192642	4.5	1
11	Fitzroy	E	MZ	CZ	C	F	118809	5.5	4
12	Amadeus	E	PC	PZ	C	NF	200768	6.5	7.2
13	North Australia	NE	PC	PC	C	UK	2010402	6.8	81.2
14	Kimberley	NE	PC	PC	C	UK	197610	6.2	6.8
15	Bonaparte	E	PZ	MZ	C	UK	140443	5.1	1
16	New Guinea Margi	E	MZ	CZ	C	UK	310194	7.3	23.3
17	Money Shoal	E	PZ	PZ	C	UK	27315	5.3	3
18	Northeast Orogen	NE	PC	PC	C	NF	645753	5.6	1
19	Gawler	NE	PC	PC	C	UK	838499	5.4	5.2
20	Great Australian	E	MZ	MZ	C	UK	430647	0	0
21	Adelaide	E	PC	CZ	C	NF	109798	5.8	21.6
22	Batten	E	PC	PC	C	F	31132	0	0
23	Otway	E	MZ	MZ	C	F	91577	6.2	7.1
24	Bass	E	MZ	CZ	C	UK	21214	0	0
25	Gippsland	E	MZ	CZ	C	NF	38206	0	0
26	Tasmania	E	MZ	CZ	C	NF	578458	6.4	16.9
27	Thomson-Lachlan	NE	PZ	PZ	C	UK	1732818	5.4	26.2
28	New England	NE	PZ	PZ	C	F	320334	5.1	6.2
29	Gympie	NE	MZ	MZ	C	F	33900	0	0
30	Sydney Offshore	E	MZ	MZ	C	NF	64704	5.1	1
31	Kanmantoo	NE	PZ	PZ	C	UK	203355	4.7	1
32	Marion	E	MZ	MZ	C	UK	465267	5.8	6
33	Queensland Towns	E	MZ	CZ	C	UK	130520	4.8	1

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N $\geq$ 4.5
34	Coral	E	CZ	CZ	C	UK	330468	5.2	2.6
35	Malvinas	E	MZ	MZ	C	UK	1174158	6.5	4.3
36	Valdes	NE	PC	PC	C	UK	88752	0	0
37	Patagonia East	NE	PZ	PZ	C	UK	854067	0	0
38	Patagonia West	NE	PZ	PZ	C	UK	136385	0	0
39	Colorado	E	MZ	MZ	C	F	90689	0	0
40	Pampas	NE	PZ	PZ	C	UK	239608	0	0
41	Chaco	NE	PC	PC	C	UK	923063	5.1	4
42	Rio De La Plata	NE	PC	PC	C	F	509261	4.9	1
43	Salado	E	MZ	MZ	C	NF	73005	0	0
44	Don Feliciano	NE	PC	PC	C	NF	286827	0	0
45	Riberia	NE	PC	PC	C	NF	718524	0	0
46	Janeiro	E	MZ	MZ	C	F	784433	6.1	4.2
47	Sao Francisco	NE	PC	PC	C	UK	941052	4.7	1
48	Uruacuano	NE	PC	PC	C	UK	324268	0	0
49	Paraguay-Araguai	NE	PC	PC	C	UK	860086	5.3	3
50	Verde	NE	PC	PC	C	UK	229524	0	0
51	Rondonian	NE	PC	PC	C	NF	2130122	5.3	15.1
52	Guyana-Guapore	NE	PC	PC	C	UK	4715337	6.3	22.2
53	Amazonas	E	PZ	CZ	C	NF	281647	5.3	1
54	Belem	E	MZ	MZ	C	NF	680267	4.7	1
55	Sao Luis	NE	PC	PC	C	UK	90225	0	0
56	Borborema	NE	PC	PC	C	F	1052751	5.4	8.4
57	Takuta	E	MZ	MZ	C	NF	17869	0	0
58	Cape Belt	NE	PZ	PZ	C	F	141370	6.4	10.2
59	Cape Town	E	MZ	MZ	C	UK	392983	5.2	3.3
60	Namaqua-Natal	NE	PC	PC	E	UK	577400	5.6	7.5
61	Damara_Lufilia	NE	PC	PC	E	NF	1197397	5.8	33.2
62	Namiba Coast	E	MZ	MZ	C	F	527118	0	0
63	Kaapval	NE	PC	PC	E	NF	480297	6.6	368
64	Pongola	E	PC	PC	E	UK	22629	6.5	2
65	Soutpansberg	E	PC	MZ	E	UK	46793	5.2	1
66	Limpopo	NE	PC	PC	E	UK	295236	5	3.9
67	Zimbabwe-Namibia	NE	PC	PC	E	F	655453	5.7	19
68	Zambezi	NE	PC	PC	E	F	60012	5.3	1

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N ≥ 4.5
69	Irumia	NE	PC	PC	E	NF	11451	0	0
70	Karoo	E	MZ	MZ	E	NF	28193	5.9	1
71	Madagascar	E	MZ	MZ	E	NF	701414	5.6	4.1
72	Angola	NE	PC	PC	C	F	1004603	6.2	13.6
73	Congo	NE	PC	PC	C	UK	1985264	6.3	28.7
74	West Congo	NE	PC	PC	C	NF	132886	6.4	1
75	Sao Braz	E	MZ	MZ	U	UK	80902	5	1
76	Gabon	E	MZ	MZ	U	UK	372829	5.6	3
77	Kibara South	NE	PC	PC	U	UK	49528	4.8	1
78	Kibara North	NE	PC	PC	U	UK	45208	6.3	4.8
79	Ogaden	NE	PC	PC	E	F	803876	5.6	2
80	Somali Margin	E	MZ	MZ	E	NF	492873	5.5	4.9
81	Saudi	NE	PC	PC	C	NF	2971006	6.9	55.2
82	Nile	NE	PC	PC	C	NF	2034295	7.3	18.7
83	Nile West	NE	PC	PC	C	UK	244105	5.7	1
84	Central Africa	NE	PC	PC	C	NF	2323466	6.1	6
85	Cameroun	E	CZ	CZ	C	NF	355539	4.9	2.9
86	Benue	E	MZ	MZ	U	UK	187366	0	0
87	Poli	E	MZ	MZ	U	UK	81856	0	0
88	Chad	E	MZ	MZ	U	UK	57545	0	0
89	Hoggar	NE	PC	PC	C	NF	3890522	5.3	9.3
90	Sirte	E	MZ	MZ	C	NF	960298	6.8	86.9
91	Niger	E	MZ	MZ	C	NF	175410	6.5	1
92	Dahomey-Pharusia	NE	PC	PC	C	UK	689805	6.8	4
93	Wargla	NE	PC	PC	C	UK	421251	4.9	2
94	Ourgarta	NE	PC	PC	U	UK	176032	0	0
95	Anti-Atlas	NE	PZ	PZ	C	UK	164906	5.5	1
96	Tindouf	NE	PC	PC	U	UK	306656	0	0
97	Reguibat	NE	PC	PC	U	UK	396208	0	0
98	Taoudenni	NE	PC	PC	U	UK	1128104	4.6	1
99	Gourma	E	PC	PC	U	UK	429359	5.4	1
100	Guinea	NE	PC	PC	C	UK	1374935	6.2	7
101	Ivory Coast	E	MZ	MZ	U	UK	188729	0	0
102	Bove	NE	PZ	PZ	U	UK	14966	0	0
103	Belmorja	NE	PZ	PZ	C	UK	19779	0	0

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N $\geq$ 4.5
104	Mauritania	NE	PZ	PZ	U	UK	150047	0	0
105	Dakar	E	MZ	MZ	E	F	1272700	6.2	4
106	Dravidia	NE	PC	PC	C	NF	781860	6.3	26.3
107	Ceylon	NE	PC	PC	C	UK	79382	5.5	2
108	Eastern Ghats	NE	PC	PC	C	NF	155035	4.7	1
109	Singhbhum Nuclea	NE	PC	PC	C	UK	41141	5.1	3.9
110	Bhandara-Singhbh	NE	PC	PC	C	UK	142062	5.7	2.3
111	Satpura	NE	PC	PC	C	NF	178946	5.8	11.8
112	Bundelkhad	NE	PC	PC	C	UK	504375	6.2	9
113	Aravalli	NE	PC	PC	C	F	810970	6.7	71.7
114	Kutch	E	MZ	MZ	C	NF	76406	7.8	31
115	Cambay	E	MZ	CZ	C	NF	39598	5.4	5
116	Bombay Offshore	E	MZ	CZ	C	UK	248085	5.4	2
117	Cauvery	E	MZ	MZ	C	F	326551	5.6	6
118	Bengal	E	MZ	CZ	C	F	243283	6.1	20.9
119	Mahanadi-Damodar	E	PZ	MZ	C	NF	65847	6.4	1
120	Narmada-Son	E	MZ	CZ	C	NF	55041	5.2	1
121	Godavari	E	PZ	MZ	C	NF	61324	0	0
122	Cardamome	NE	PZ	PZ	C	UK	310144	6.5	5.1
123	Kontum-Khorat	NE	PC	PC	C	UK	377393	4.6	1
124	Annamit	NE	PZ	PZ	C	UK	178223	0	0
125	Wuyi Shan	E	MZ	MZ	C	NF	383113	7.3	307.5
126	Qiongzhou	E	CZ	CZ	C	NF	64880	7.5	12.1
127	China Seas	E	CZ	CZ	C	NF	1258535	7.7	124.2
128	Fukien-Reinan	NE	MZ	MZ	C	NF	201788	5.6	4.5
129	Huanan Crystalli	NE	MZ	MZ	C	NF	603996	6.2	42
130	Huanan Fold Belt	NE	MZ	MZ	C	UK	682979	6.4	91.6
131	Szechuan	NE	PC	PC	C	UK	261381	6.8	454.8
132	Yellow Sea	E	CZ	CZ	C	NF	495752	7.9	501.6
133	Dongbei	NE	PC	PC	C	F	312369	6.7	107.7
134	Chifeng	NE	PZ	PZ	C	F	127045	4.8	1
135	Inner Mongolia	NE	PZ	PZ	C	F	712893	5.4	26
136	Hinggan	NE	PZ	PZ	C	F	641577	5.7	11.8
137	Songliao	E	MZ	MZ	C	NF	333684	6.2	15.7

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N ≥ 4.5
138	Yichun	NE	MZ	MZ	C	UK	152897	5	1
139	Bureya	NE	PZ	PZ	C	UK	173986	6.8	20.4
140	Omolon	NE	PC	PC	U	UK	229180	5	1
141	Alazeya	NE	MZ	MZ	U	UK	204323	5	2
142	Anyuy-Oloy	NE	MZ	MZ	U	UK	234618	0	0
143	Verkhoyansk Nort	NE	MZ	MZ	U	UK	160531	0	0
144	New Siberian Isl	E	MZ	MZ	U	UK	499042	4.9	1
145	Lomonosov	E	CZ	CZ	U	UK	151400	0	0
146	Olenyek	NE	PC	PC	U	UK	296773	5.4	1
147	Aldan	NE	PC	PC	U	UK	750750	6.2	14.5
148	Viluy	E	PC	MZ	U	UK	200729	4.8	1
149	Agara-Anabar	NE	PC	PC	U	UK	2249521	6.4	10.8
150	Udzha	E	PC	PC	U	UK	72411	0	0
151	Yenisey	NE	PC	PC	U	UK	202499	0	0
152	Kheta	NE	PZ	PZ	U	UK	436997	5.2	1
153	Starokadomskogo	NE	PC	PC	U	UK	312722	0	0
154	Pinner	NE	PZ	PZ	U	UK	155264	5	1
155	Obsky	E	MZ	MZ	U	UK	1083894	0	0
156	Tomsk-Tazovsky	NE	PZ	PZ	C	UK	1206616	5.2	9.8
157	Kazakh Margin	NE	PZ	PZ	U	UK	178540	4.6	1
158	Kazakhstan	NE	PZ	PZ	U	UK	1145766	5.3	3.4
159	Ural	NE	PZ	PZ	U	UK	1334133	5.7	5.3
160	Beyneu	NE	PC	PC	U	UK	209438	5.3	1
161	Caspian Depressi	E	PZ	PZ	U	UK	561624	5.1	2.9
162	Donetz	E	PZ	PZ	C	NF	276360	0	0
163	Kursk	NE	PC	PC	U	UK	561495	0	0
164	Ukraine	NE	PC	PC	C	F	371000	0	0
165	Pachelma	E	PC	PC	U	UK	54556	0	0
166	Tatar-Russia	NE	PC	PC	U	UK	1276933	4.9	2
167	Trans-Russia	E	PC	PC	C	NF	182051	4.9	2
168	Timan	E	PC	PZ	U	UK	525509	4.9	2
169	Barents	NE	PC	PC	E	UK	1166510	5.4	2
170	Franz Josef Rim	E	CZ	CZ	U	UK	141010	5.1	2
171	Kola	NE	PC	PC	C	F	241485	4.7	2
172	Lapland-White Se	NE	PC	PC	C	UK	96452	0	0

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N $\geq$ 4.5
173	Svecokarelia	NE	PC	PC	C	F	821894	5.3	3
174	Bothnia	NE	PC	PC	C	F	76920	0	0
175	Svecofennia	NE	PC	PC	C	F	1056504	4.8	2
176	Varmland	NE	PC	PC	C	F	76985	0	0
177	Dalsland	NE	PC	PC	C	F	174915	5.9	2
178	Oslo	E	PZ	MZ	C	NF	26218	0	0
179	Norway	NE	PZ	PZ	C	NF	342539	6.4	26.6
180	Hammerfest	E	MZ	MZ	C	NF	274830	0	0
181	Svalbard	NE	PZ	PZ	C	UK	109385	6.1	4.4
182	Spitsbergen	NE	PZ	PZ	U	UK	35620	4.9	1
183	Voring	E	MZ	CZ	C	NF	411360	5.8	33.5
184	Rockall	E	MZ	CZ	C	UK	734600	4.9	2
185	Britain	NE	PZ	PZ	C	NF	399518	5.1	10
186	Midland Valley	E	PZ	PZ	C	NF	66123	4.6	1
187	London-Brabant	NE	PC	PC	C	UK	123709	6.7	31.9
188	Viking	E	MZ	MZ	C	NF	150936	5.6	6
189	Horn	E	MZ	MZ	C	NF	15655	4.7	1
190	Denmark	NE	PZ	PZ	C	UK	186309	4.6	1
191	Polish Trough	E	PZ	CZ	C	F	101917	0	0
192	Bohemia	NE	PZ	PZ	C	F	360973	6.2	223.4
193	Eger	E	CZ	CZ	C	NF	11175	4.7	1
194	North Sea	E	MZ	CZ	C	F	163623	5.7	3.5
195	Rhine	E	CZ	CZ	C	NF	265266	6.6	104
196	Armorica	NE	PZ	PZ	C	UK	540395	5.9	34.5
197	Biscay North	E	MZ	MZ	C	F	423541	5.3	2
198	Biscay South	E	MZ	MZ	E	NF	57097	5.3	3
199	Galicia	E	MZ	MZ	C	NF	180858	7.1	45
200	Iberia	NE	PZ	PZ	C	F	288764	5.5	15.8
201	Celtiberia	E	MZ	CZ	C	F	156373	5.2	2
202	Amundsen-Scott	NE	PC	PC	C	UK	7263353	5.7	3.1
203	Sor Rondane	NE	PC	PC	U	UK	1028169	0	0
204	Napier	NE	PC	PC	U	UK	79414	0	0
205	Menzies	NE	PC	PC	U	UK	152545	0	0
206	Vestfold	NE	PC	PC	U	UK	4175	0	0
207	George V	E	MZ	CZ	U	UK	1250511	0	0

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N $\geq$ 4.5
208	Transantarctic	E	CZ	CZ	U	UK	606087	5.2	2
209	Jutulstraumen	E	MZ	MZ	U	UK	14821	0	0
210	Lambert	E	MZ	MZ	U	UK	122104	0	0
211	Queen Maud	E	MZ	MZ	U	UK	346880	0	0
212	Enderby	E	MZ	MZ	U	UK	177314	0	0
213	Wilkes	E	MZ	MZ	U	UK	900281	5.5	2
214	Yucatan	E	MZ	MZ	C	F	523819	5.4	4.9
215	Campeche	E	MZ	MZ	C	F	89292	5.7	2.9
216	Gulf Coast	E	MZ	MZ	E	UK	1150114	0	0
217	Suwanee-Blake	E	MZ	MZ	C	NF	501647	4.9	1
218	Eastern Seaboard	E	MZ	MZ	C	F	1023295	7.3	35.1
219	Grand Banks	E	MZ	MZ	C	UK	498363	0	0
220	Newfoundland	NE	PZ	PZ	C	NF	339302	0	0
221	Magdalen	E	PZ	MZ	C	F	176827	4.9	1
222	Acadia	NE	PZ	PZ	C	NF	395328	5.7	19.4
223	Piedmont	NE	PZ	PZ	C	NF	141177	5.2	2
224	Valley and Ridge	NE	PZ	PZ	C	NF	252674	5.9	17.9
225	Ouachita	NE	PZ	PZ	C	UK	272762	4.7	2
226	Grenville	NE	PC	PC	C	NF	1297437	6.6	96.5
227	St. Lawrence-Ott	E	PZ	MZ	C	NF	136629	6.9	27
228	Reelsfoot	E	MZ	CZ	C	NF	20987	7.8	17.5
229	Cottage Grove-Ro	E	PZ	PZ	C	F	82782	5.5	4.1
230	Granite-Rhyolite	NE	PC	PC	C	UK	498443	6.8	30.2
231	Granite-Rhyolite	NE	PC	PC	C	UK	540467	5.7	7.7
232	Oklahoma Aulacog	E	PZ	PZ	C	NF	27481	0	0
233	Penocean	NE	PC	PC	C	UK	272794	0	0
234	Minnesota River	NE	PC	PC	C	F	130527	0	0
235	Keweenawan	E	PC	PC	C	NF	325388	5.5	6.5
236	Superior	NE	PC	PC	C	F	2195241	6	2
237	Trans-Hudson	NE	PC	PC	C	UK	1344617	5.7	5.3
238	Wyoming	NE	PC	PC	C	F	373331	5.3	9.3
239	Rae-Hearn	NE	PC	PC	C	UK	3882973	5.4	20.6
240	Slave	NE	PC	PC	C	UK	483039	0	0
241	Wopmay-Bear	NE	PC	PC	C	NF	1067319	6.2	7
242	Thelon-Taltson	NE	PC	PC	C	F	550542	5.2	2.5

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N $\geq$ 4.5
243	Kiglapait	NE	PC	PC	C	UK	73011	0	0
244	Ketilidian	NE	PC	PC	C	UK	96381	5	2.3
245	Gardar	NE	PC	PC	U	UK	18765	0	0
246	Nain	NE	PC	PC	C	UK	296714	4.7	2
247	Labrador Sea	E	MZ	MZ	C	NF	235667	5.6	7.2
248	Baffin	E	CZ	CZ	E	NF	1651160	6.2	16.1
249	Queen Elizabeth	E	MZ	MZ	C	NF	649859	6.3	20.6
250	Canada Basin	E	MZ	MZ	C	NF	259139	5.8	4.3
251	Peary	NE	PZ	PZ	C	UK	189322	6.2	5
252	Greenland Caledo	NE	PZ	PZ	U	UK	194188	0	0
253	Scoresby	E	PZ	PZ	U	UK	170849	6.1	6.4
254	Greenland Sea	E	MZ	CZ	C	UK	350276	5.7	2
255	Central Plains	NE	PC	PC	C	UK	601885	5.1	5.9

Table A-3. Notations used in Tables A-2 and A-5

Type Domain type

- E – Extended crust
- NE – Non-extended crust (crustal age domain)

Age Domain age assigned in Johnston et al. (1994)

- CZ – Cenozoic
- MZ – Mesozoic
- PZ – Paleozoic
- PC – PreCambrian

MRE Age Age of most recent extension. For Type NE domains, this equals Age

- CZ – Cenozoic
- MZ – Mesozoic
- PZ – Paleozoic
- PC – PreCambrian

Stress: Crustal Stress State in Domain

- C – Compressive
- E – Extensive
- U – Unknown

SS\_Ang: Classification of angle between maximum horizontal stress vector and strike of major domain structures with respect to reactivation

- F – Favorable orientation
- NF – Unfavorable orientation
- UK – Unknown

Area:

Area of domain in km

Note: SDNT and SDNC columns in CEUS-SSC Table K-2 are not reproduced here because they are not used in this report.



Table A-4. Catalog of SCR Earthquakes from 1/1/2009 to 12/31/2020.

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2009	1	26	21	30	38	57.48	120.67	5.43	0.1	147
2009	4	9	1	46	58	26.99	70.64	5.16	0.1	113
2009	4	15	6	54	53	80.57	-108.63	5.04	0.1	250
2009	5	26	22	27	34	21.66	119.47	4.99	0.1	127
2009	6	29	18	3	50	31.31	104.15	5.29	0.1	131
2009	6	30	7	22	21	31.37	104.2	4.96	0.1	131
2009	7	7	19	11	46	75.33	-72.49	6.06	0.1	248
2009	7	18	20	32	30	35.9	43.19	5.09	0.1	81
2009	11	14	13	3	34	17.1	73.74	4.79	0.1	106
2009	11	27	16	4	4	31.13	103.9	4.97	0.1	131
2009	12	12	11	51	25	17.02	73.74	4.87	0.1	106
2009	12	29	11	8	54	32.56	15.04	5.01	0.1	90
2010	2	3	0	29	30	-8.63	130.65	5.02	0.1	1
2010	4	12	7	57	22	77.01	19.61	4.96	0.1	169
2010	6	5	1	20	0	5.06	-72.38	4.87	0.1	52
2010	6	23	17	41	41	45.97	-75.58	5.2	0.1	226
2010	9	10	17	24	16	23.29	90.74	5.1	0.1	118
2010	12	9	23	17	33	31.48	70.62	5.42	0.1	113
2011	1	26	7	24	31	9.96	108.22	5.01	0.1	122
2011	2	28	5	0	50	35.38	-92.37	4.84	0.1	225
2011	4	16	5	31	18	-20.08	147.77	5.17	0.1	28
2011	4	17	18	41	18	-19.85	113.49	5.32	0.1	2
2011	7	21	13	55	53	-15.89	26.07	4.99	0.1	61
2011	8	22	23	30	19	37.08	-104.65	4.91	0.1	255
2011	8	23	5	46	18	37.12	-104.59	5.38	0.1	255
2011	8	23	17	51	4	37.91	-77.93	5.76	0.1	218
2011	10	14	6	10	14	54.17	123.77	6.06	0.1	136
2011	10	20	12	24	41	29.05	-98.01	4.78	0.1	216
2011	10	20	17	18	37	20.98	70.44	5.13	0.1	113
2011	11	5	7	12	45	35.61	-96.67	5.03	0.1	231
2011	11	6	3	53	10	35.61	-96.72	5.74	0.1	231
2011	11	8	2	46	57	35.5	-96.78	5.07	0.1	231
2011	12	4	18	53	3	-5.37	140.4	5.17	0.1	16

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2011	12	5	19	10	0	-21.49	114.42	5.27	0.1	2
2012	3	5	6	50	37	34.96	44.14	5.2	0.1	81
2012	3	23	9	25	14	-26.11	132.08	5.33	0.1	9
2012	3	24	4	43	51	-20.19	14.46	4.98	0.1	61
2012	5	5	1	57	11	35.04	44.04	4.82	0.1	81
2012	5	17	8	12	1	32.08	-94.46	4.91	0.1	216
2012	6	18	5	11	32	47.96	130.58	4.78	0.1	139
2012	6	19	10	53	29	-38.28	146.24	5.01	0.1	26
2012	6	19	20	14	5	23.52	70.24	5.17	0.1	114
2012	7	3	5	3	40	33.91	14.71	4.79	0.1	90
2012	7	20	12	11	52	33.08	119.49	5.01	0.1	132
2012	9	7	3	19	42	27.47	104.12	5.6	0.1	130
2012	9	7	4	16	30	27.47	104.19	5.33	0.1	130
2012	10	25	20	49	35	-5.84	-76.16	5.25	0.1	51
2012	12	8	19	0	7	-7.4	144.01	4.83	0.1	16
2013	2	14	13	13	53	67.65	142.51	6.7	0.1	141
2013	2	14	16	52	15	-4.41	135.39	5.41	0.1	16
2013	2	19	2	47	1	27.17	103.16	4.97	0.1	130
2013	2	19	14	17	42	31.18	105.26	5.09	0.1	131
2013	2	22	9	31	55	67.71	142.56	4.92	0.1	141
2013	3	5	8	33	53	67.7	142.44	5.15	0.1	141
2013	4	11	23	2	53	60.89	-43.79	4.64	0.1	244
2013	4	19	17	51	41	-12.01	121.71	5.86	0.1	1
2013	4	20	0	2	47	30.22	103.12	6.64	0.1	131
2013	4	20	23	21	29	35.21	124.45	4.85	0.1	132
2013	4	22	9	11	56	42.9	122.32	5.02	0.1	137
2013	4	24	22	10	30	28.46	104.83	4.75	0.1	131
2013	5	17	13	43	23	45.8	-76.41	4.76	0.1	226
2013	5	17	22	2	25	37.67	124.54	4.96	0.1	132
2013	6	9	14	22	15	-26	132.09	5.47	0.1	9
2013	7	22	15	8	50	51.53	131.95	4.82	0.1	139
2013	8	14	5	15	51	67.63	142.79	4.86	0.1	141
2013	10	14	3	18	60	27.95	102.94	4.92	0.1	131
2013	10	31	3	3	34	44.75	124.02	5.25	0.1	137
2013	10	31	3	10	6	44.63	124.04	4.98	0.1	137

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2013	11	22	6	51	25	34.28	45.31	5.7	0.1	81
2013	11	22	8	18	51	44.73	124.05	5	0.1	137
2013	11	22	22	4	25	44.65	124.06	5.28	0.1	137
2013	12	7	18	10	24	35.63	-97.35	4.77	0.1	231
2013	12	16	5	4	54	31.04	110.36	4.97	0.1	130
2014	1	4	19	34	25	56.84	129.57	5.39	0.1	147
2014	1	9	20	57	43	23.38	-80.64	5.06	0.1	216
2014	3	31	19	48	36	36.96	124.34	4.87	0.1	132
2014	4	4	22	40	35	28.18	103.69	4.91	0.1	131
2014	5	8	22	51	15	26.2	68.39	5.03	0.1	113
2014	5	29	5	7	33	70.86	140.17	4.89	0.1	143
2014	7	29	8	20	14	31.45	105.3	5.07	0.1	131
2014	8	3	8	30	13	27.06	103.5	6.18	0.1	130
2014	8	5	10	22	34	-26.83	26.79	5.51	0.1	63
2014	8	16	15	50	58	57.55	120.71	4.95	0.1	147
2014	8	16	22	7	59	28.06	103.67	5.13	0.1	131
2014	8	22	20	6	4	33.67	45.51	4.98	0.1	81
2014	8	25	22	54	45	67.79	142.61	4.98	0.1	141
2014	10	1	1	23	29	28.31	102.87	5.26	0.1	131
2014	11	9	4	42	40	76.7	-96.97	4.73	0.1	248
2014	11	12	21	40	0	37.38	-97.6	5.02	0.1	231
2015	1	14	5	21	38	29.2	103.37	4.92	0.1	131
2015	2	6	21	1	7	28.33	105	4.79	0.1	131
2015	2	12	2	11	41	72.03	-75.31	4.88	0.1	248
2015	2	15	15	57	10	-25.09	151.42	5	0.1	28
2015	3	9	9	59	43	25.26	103.3	4.81	0.1	130
2015	4	27	5	34	31	26.18	53.59	4.81	0.1	81
2015	7	27	18	12	15	36.14	-97.52	4.86	0.1	231
2015	9	25	6	10	24	32.69	46.31	5.15	0.1	81
2015	10	23	0	27	39	29.49	70.33	5.65	0.1	113
2015	11	19	7	42	12	36.76	-98.34	4.86	0.1	231
2015	11	28	10	59	11	3.83	-71.21	4.86	0.1	52
2015	11	30	9	49	12	36.91	-97.88	4.94	0.1	231
2015	12	4	13	27	6	57.56	120.78	4.83	0.1	147
2016	1	7	4	27	57	36.66	-98.62	4.81	0.1	231

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2016	2	13	17	7	6	36.64	-98.64	5.18	0.1	231
2016	3	29	10	32	7	77.82	20.96	5.2	0.1	169
2016	5	10	9	44	38	-16.26	118.79	4.93	0.1	1
2016	5	20	18	14	4	-25.61	129.94	6.07	0.1	9
2016	6	14	22	9	28	-4.63	138	5.25	0.1	16
2016	7	5	11	33	3	35.56	129.77	4.92	0.1	127
2016	7	8	9	40	50	-32.47	122.45	5.13	0.1	8
2016	7	31	9	18	13	24.1	111.62	4.88	0.1	129
2016	8	7	8	15	5	47.06	37.59	4.65	0.1	163
2016	8	18	4	30	8	-19.76	148.79	5.73	0.1	32
2016	9	3	12	2	44	36.54	-96.86	5.78	0.1	231
2016	9	12	10	44	33	35.78	129.14	5.13	0.1	127
2016	9	12	11	32	55	35.79	129.12	5.54	0.1	127
2016	10	9	12	48	26	62.39	2.38	4.84	0.1	183
2016	11	7	1	44	24	36.16	-96.73	5.06	0.1	231
2016	11	18	7	42	24	34.71	6.15	5.32	0.1	93
2016	12	12	2	31	8	53.85	125.64	4.78	0.1	136
2016	12	27	0	17	33	29.41	105.85	4.76	0.1	131
2017	1	8	23	47	14	74.44	-92.06	6.12	0.1	248
2017	1	9	17	55	35	74.53	-92.11	5.06	0.1	248
2017	1	11	22	6	58	-20.11	46.74	5.66	0.1	71
2017	1	27	18	46	36	28.15	104.86	4.92	0.1	131
2017	2	8	11	11	42	27	103.54	5.08	0.1	130
2017	2	20	7	45	10	-5.31	-74.98	5.13	0.1	51
2017	3	12	12	21	23	27.02	103.55	4.82	0.1	130
2017	4	3	17	40	18	-22.54	25.21	6.53	0.1	67
2017	4	18	17	49	55	-2.77	-75.37	5.97	0.1	51
2017	5	4	5	40	22	28.27	104.97	4.98	0.1	131
2017	5	31	13	59	12	77.14	15.42	4.75	0.1	182
2017	6	30	13	33	44	59	1.9	4.79	0.1	188
2017	7	22	23	13	36	45.25	124.69	5	0.1	137
2017	8	6	4	21	50	-19.09	127.95	4.84	0.1	13
2017	9	15	23	13	14	67.69	143	4.88	0.1	141
2017	11	15	5	29	32	36.13	129.21	5.52	0.1	127
2017	11	20	15	23	42	32.87	46.26	5	0.1	81

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2017	11	23	9	43	34	29.36	108.06	4.89	0.1	130
2017	12	22	8	0	13	65.65	-133.78	5.07	0.1	241
2018	1	11	6	59	30	33.71	45.57	5.58	0.1	81
2018	1	11	7	14	16	33.68	45.59	5.45	0.1	81
2018	1	11	7	21	43	33.77	45.56	5.34	0.1	81
2018	1	11	8	0	39	33.64	45.59	5.32	0.1	81
2018	1	19	22	17	55	33.81	45.47	5.02	0.1	81
2018	2	10	20	3	3	36.15	129.26	4.77	0.1	127
2018	2	28	3	30	36	-6.34	142.3	5.23	0.1	16
2018	3	17	9	23	48	-9.95	127.01	4.87	0.1	1
2018	4	7	12	16	3	36.42	-97.46	4.77	0.1	231
2018	4	9	10	22	20	36.23	-97.52	4.81	0.1	231
2018	5	27	17	50	52	45.26	124.65	5.3	0.1	137
2018	8	28	7	8	11	-10.82	124.14	6.21	0.1	1
2018	8	28	7	13	32	-10.85	124.4	5.81	0.1	1
2018	8	28	11	55	45	-10.84	124.24	5.04	0.1	1
2018	8	31	21	53	35	-10.84	124.32	5.05	0.1	1
2018	9	4	22	58	19	54.83	58.08	5.05	0.1	159
2018	9	16	4	56	25	-34.2	116.87	5.29	0.1	7
2018	11	8	21	7	1	-34.39	116.81	5.16	0.1	9
2018	11	25	23	57	25	23.35	118.52	5.82	0.1	127
2018	12	16	4	46	9	28.2	105.09	5.32	0.1	131
2018	12	16	14	26	19	-23.27	112.53	5.91	0.1	4
2019	1	3	0	48	8	28.21	104.95	4.99	0.1	131
2019	1	6	13	41	59	34.06	45.47	5.76	0.1	81
2019	1	8	10	0	10	-4.62	-74.06	5.17	0.1	51
2019	2	23	16	34	10	-21.53	-62.95	5.03	0.1	41
2019	2	25	5	15	59	29.55	104.64	4.74	0.1	131
2019	3	24	16	21	15	-3.14	38.3	4.81	0.1	79
2019	4	1	10	7	23	33.62	45.62	5.28	0.1	81
2019	4	1	10	16	14	33.58	45.55	4.88	0.1	81
2019	5	15	19	31	43	57.51	120.5	4.77	0.1	147
2019	5	15	20	33	33	28.09	103.65	4.83	0.1	131
2019	5	17	22	24	52	45.24	124.68	5.06	0.1	137
2019	5	30	2	26	52	-21.29	132.03	4.95	0.1	13

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	E[M]	sigma M	Domain No.
2019	6	17	14	55	44	28.38	104.95	5.76	0.1	131
2019	6	17	15	36	2	28.4	104.93	5.12	0.1	131
2019	6	17	23	34	34	28.45	104.93	4.8	0.1	131
2019	6	22	8	50	24	39.33	-99.42	4.63	0.1	255
2019	6	22	14	29	56	28.42	104.89	5.25	0.1	131
2019	7	4	2	17	58	28.42	104.86	5.16	0.1	131
2019	7	14	5	39	23	-18.15	120.29	6.7	0.1	9
2019	8	1	1	22	17	-19.82	133.76	5.1	0.1	13
2019	9	7	22	42	14	29.55	104.89	5.1	0.1	131
2019	10	12	14	55	23	22.15	110.52	4.74	0.1	129
2019	10	17	16	58	28	-46.51	-68.89	4.88	0.1	37
2019	11	11	10	52	46	44.63	4.76	4.94	0.1	195
2019	11	25	1	18	22	22.88	106.68	5.03	0.1	130
2019	11	27	23	49	52	22.94	106.75	4.76	0.1	130
2019	12	18	0	14	6	29.52	104.86	4.98	0.1	131
2019	12	26	10	36	37	30.88	113.4	4.79	0.1	130
2020	8	9	12	7	37	36.53	-81.1	5.22	0.1	223
2020	10	3	13	22	47	69.34	-30.05	5.31	0.1	252

Table A-5. Updated SCR Domain Characteristics (see Table A-3 for explanations)

Domain No.	Domain Name	Type	Age	MRE Age	Stress	SS_Ang	Area	Mmax_obs	N ≥ 4.5
1	Scott-Browse	E	MZ	CZ	C	F	542655	6.3	35.4
2	Exmouth	E	MZ	CZ	C	NF	383752	7.2	29.4
3	Gascoyne_Pateroso	NE	PC	PC	C	UK	369232	4.8	4
4	Canarvan	E	MZ	MZ	C	UK	420994	5.1	4
5	Alice Springs	NE	PC	PC	C	NF	279587	5.8	4
6	Naturaliste	E	MZ	MZ	C	UK	115589	6.2	3.3
7	Yilgarn West	NE	PC	PC	C	NF	237858	6.7	20.3
8	Yilgarn East	NE	PC	PC	C	NF	501577	5.2	4.6
9	Musgrave-Fraser	NE	PC	PC	C	UK	853794	6	12.5
10	Pilbara	NE	PC	PC	C	UK	192642	4.5	1
11	Fitzroy	E	MZ	CZ	C	F	118809	5.5	4
12	Amadeus	E	PC	PZ	C	NF	200768	6.5	7.2
13	North Australia	NE	PC	PC	C	UK	2010402	6.8	81.2
14	Kimberley	NE	PC	PC	C	UK	197610	6.2	6.8
15	Bonaparte	E	PZ	MZ	C	UK	140443	5.1	1
16	New Guinea Margi	E	MZ	CZ	C	UK	310194	7.3	23.3
17	Money Shoal	E	PZ	PZ	C	UK	27315	5.3	3
18	Northeast Orogen	NE	PC	PC	C	NF	645753	5.6	1
19	Gawler	NE	PC	PC	C	UK	838499	5.4	5.2
20	Great Australian	E	MZ	MZ	C	UK	430647	0	0
21	Adelaide	E	PC	CZ	C	NF	109798	5.8	21.6
22	Batten	E	PC	PC	C	F	31132	0	0
23	Otway	E	MZ	MZ	C	F	91577	6.2	7.1
24	Bass	E	MZ	CZ	C	UK	21214	0	0
25	Gippsland	E	MZ	CZ	C	NF	38206	0	0
26	Tasmania	E	MZ	CZ	C	NF	578458	6.4	16.9
27	Thomson-Lachlan	NE	PZ	PZ	C	UK	1732818	5.4	26.2
28	New England	NE	PZ	PZ	C	F	320334	5.1	6.2
29	Gympie	NE	MZ	MZ	C	F	33900	0	0
30	Sydney Offshore	E	MZ	MZ	C	NF	64704	5.1	1
31	Kanmantoo	NE	PZ	PZ	C	UK	203355	4.7	1
32	Marion	E	MZ	MZ	C	UK	465267	5.8	6
33	Queensland Towns	E	MZ	CZ	C	UK	130520	4.8	1

34	Coral	E	CZ	CZ	C	UK	330468	5.2	2.6
35	Malvinas	E	MZ	MZ	C	UK	1174158	6.5	4.3
36	Valdes	NE	PC	PC	C	UK	88752	0	0
37	Patagonia East	NE	PZ	PZ	C	UK	854067	0	0
38	Patagonia West	NE	PZ	PZ	C	UK	136385	0	0
39	Colorado	E	MZ	MZ	C	F	90689	0	0
40	Pampas	NE	PZ	PZ	C	UK	239608	0	0
41	Chaco	NE	PC	PC	C	UK	923063	5.1	4
42	Rio De La Plata	NE	PC	PC	C	F	509261	4.9	1
43	Salado	E	MZ	MZ	C	NF	73005	0	0
44	Don Feliciano	NE	PC	PC	C	NF	286827	0	0
45	Riberia	NE	PC	PC	C	NF	718524	0	0
46	Janeiro	E	MZ	MZ	C	F	784433	6.1	4.2
47	Sao Francisco	NE	PC	PC	C	UK	941052	4.7	1
48	Uruacuano	NE	PC	PC	C	UK	324268	0	0
49	Paraguay-Araguai	NE	PC	PC	C	UK	860086	5.3	3
50	Verde	NE	PC	PC	C	UK	229524	0	0
51	Rondonian	NE	PC	PC	C	NF	2130122	5.3	15.1
52	Guyana-Guapore	NE	PC	PC	C	UK	4715337	6.3	22.2
53	Amazonas	E	PZ	CZ	C	NF	281647	5.3	1
54	Belem	E	MZ	MZ	C	NF	680267	4.7	1
55	Sao Luis	NE	PC	PC	C	UK	90225	0	0
56	Borborema	NE	PC	PC	C	F	1052751	5.4	8.4
57	Takuta	E	MZ	MZ	C	NF	17869	0	0
58	Cape Belt	NE	PZ	PZ	C	F	141370	6.4	10.2
59	Cape Town	E	MZ	MZ	C	UK	392983	5.2	3.3
60	Namaqua-Natal	NE	PC	PC	E	UK	577400	5.6	7.5
61	Damara_Lufilia	NE	PC	PC	E	NF	1197397	5.8	33.2
62	Namiba Coast	E	MZ	MZ	C	F	527118	0	0
63	Kaapval	NE	PC	PC	E	NF	480297	6.6	368
64	Pongola	E	PC	PC	E	UK	22629	6.5	2
65	Soutpansberg	E	PC	MZ	E	UK	46793	5.2	1
66	Limpopo	NE	PC	PC	E	UK	295236	5	3.9
67	Zimbabwe-Namibia	NE	PC	PC	E	F	655453	5.7	19
68	Zambezi	NE	PC	PC	E	F	60012	5.3	1
69	Irumia	NE	PC	PC	E	NF	11451	0	0

70	Karoo	E	MZ	MZ	E	NF	28193	5.9	1
71	Madagascar	E	MZ	MZ	E	NF	701414	5.6	4.1
72	Angola	NE	PC	PC	C	F	1004603	6.2	13.6
73	Congo	NE	PC	PC	C	UK	1985264	6.3	28.7
74	West Congo	NE	PC	PC	C	NF	132886	6.4	1
75	Sao Braz	E	MZ	MZ	U	UK	80902	5	1
76	Gabon	E	MZ	MZ	U	UK	372829	5.6	3
77	Kibara South	NE	PC	PC	U	UK	49528	4.8	1
78	Kibara North	NE	PC	PC	U	UK	45208	6.3	4.8
79	Ogaden	NE	PC	PC	E	F	803876	5.6	2
80	Somali Margin	E	MZ	MZ	E	NF	492873	5.5	4.9
81	Saudi	NE	PC	PC	C	NF	2971006	6.9	55.2
82	Nile	NE	PC	PC	C	NF	2034295	7.3	18.7
83	Nile West	NE	PC	PC	C	UK	244105	5.7	1
84	Central Africa	NE	PC	PC	C	NF	2323466	6.1	6
85	Cameroun	E	CZ	CZ	C	NF	355539	4.9	2.9
86	Benue	E	MZ	MZ	U	UK	187366	0	0
87	Poli	E	MZ	MZ	U	UK	81856	0	0
88	Chad	E	MZ	MZ	U	UK	57545	0	0
89	Hoggar	NE	PC	PC	C	NF	3890522	5.3	9.3
90	Sirte	E	MZ	MZ	C	NF	960298	6.8	86.9
91	Niger	E	MZ	MZ	C	NF	175410	6.5	1
92	Dahomey-Pharusia	NE	PC	PC	C	UK	689805	6.8	4
93	Wargla	NE	PC	PC	C	UK	421251	4.9	2
94	Ourgarta	NE	PC	PC	U	UK	176032	0	0
95	Anti-Atlas	NE	PZ	PZ	C	UK	164906	5.5	1
96	Tindouf	NE	PC	PC	U	UK	306656	0	0
97	Reguibat	NE	PC	PC	U	UK	396208	0	0
98	Taoudenni	NE	PC	PC	U	UK	1128104	4.6	1
99	Gourma	E	PC	PC	U	UK	429359	5.4	1
100	Guinea	NE	PC	PC	C	UK	1374935	6.2	7
101	Ivory Coast	E	MZ	MZ	U	UK	188729	0	0
102	Bove	NE	PZ	PZ	U	UK	14966	0	0
103	Belmorja	NE	PZ	PZ	C	UK	19779	0	0
104	Mauritania	NE	PZ	PZ	U	UK	150047	0	0
105	Dakar	E	MZ	MZ	E	F	1272700	6.2	4

106	Dravidia	NE	PC	PC	C	NF	781860	6.3	26.3
107	Ceylon	NE	PC	PC	C	UK	79382	5.5	2
108	Eastern Ghats	NE	PC	PC	C	NF	155035	4.7	1
109	Singhbhum Nuclea	NE	PC	PC	C	UK	41141	5.1	3.9
110	Bhandara-Singhbh	NE	PC	PC	C	UK	142062	5.7	2.3
111	Satpura	NE	PC	PC	C	NF	178946	5.8	11.8
112	Bundelkhad	NE	PC	PC	C	UK	504375	6.2	9
113	Aravalli	NE	PC	PC	C	F	810970	6.7	71.7
114	Kutch	E	MZ	MZ	C	NF	76406	7.8	31
115	Cambay	E	MZ	CZ	C	NF	39598	5.4	5
116	Bombay Offshore	E	MZ	CZ	C	UK	248085	5.4	2
117	Cauvery	E	MZ	MZ	C	F	326551	5.6	6
118	Bengal	E	MZ	CZ	C	F	243283	6.1	20.9
119	Mahanadi-Damodar	E	PZ	MZ	C	NF	65847	6.4	1
120	Narmada-Son	E	MZ	CZ	C	NF	55041	5.2	1
121	Godavari	E	PZ	MZ	C	NF	61324	0	0
122	Cardamome	NE	PZ	PZ	C	UK	310144	6.5	5.1
123	Kontum-Khorat	NE	PC	PC	C	UK	377393	4.6	1
124	Annamit	NE	PZ	PZ	C	UK	178223	0	0
125	Wuyi Shan	E	MZ	MZ	C	NF	383113	7.3	307.5
126	Qiongzhou	E	CZ	CZ	C	NF	64880	7.5	12.1
127	China Seas	E	CZ	CZ	C	NF	1258535	7.7	124.2
128	Fukien-Reinan	NE	MZ	MZ	C	NF	201788	5.6	4.5
129	Huanan Crystalli	NE	MZ	MZ	C	NF	603996	6.2	42
130	Huanan Fold Belt	NE	MZ	MZ	C	UK	682979	6.4	91.6
131	Szechuan	NE	PC	PC	C	UK	261381	6.8	454.8
132	Yellow Sea	E	CZ	CZ	C	NF	495752	7.9	501.6
133	Dongbei	NE	PC	PC	C	F	312369	6.7	107.7
134	Chifeng	NE	PZ	PZ	C	F	127045	4.8	1
135	Inner Mongolia	NE	PZ	PZ	C	F	712893	5.4	26
136	Hinggan	NE	PZ	PZ	C	F	641577	5.7	11.8
137	Songliao	E	MZ	MZ	C	NF	333684	6.2	15.7
138	Yichun	NE	MZ	MZ	C	UK	152897	5	1
139	Bureya	NE	PZ	PZ	C	UK	173986	6.8	20.4
140	Omolon	NE	PC	PC	U	UK	229180	5	1
141	Alazeya	NE	MZ	MZ	U	UK	204323	5	2

142	Anyuy-Oloy	NE	MZ	MZ	U	UK	234618	0	0
143	Verkhoyansk Nort	NE	MZ	MZ	U	UK	160531	0	0
144	New Siberian Isl	E	MZ	MZ	U	UK	499042	4.9	1
145	Lomonosov	E	CZ	CZ	U	UK	151400	0	0
146	Olenyek	NE	PC	PC	U	UK	296773	5.4	1
147	Aldan	NE	PC	PC	U	UK	750750	6.2	14.5
148	Viluy	E	PC	MZ	U	UK	200729	4.8	1
149	Agara-Anabar	NE	PC	PC	U	UK	2249521	6.4	10.8
150	Udzha	E	PC	PC	U	UK	72411	0	0
151	Yenisey	NE	PC	PC	U	UK	202499	0	0
152	Kheta	NE	PZ	PZ	U	UK	436997	5.2	1
153	Starokadomskogo	NE	PC	PC	U	UK	312722	0	0
154	Pinner	NE	PZ	PZ	U	UK	155264	5	1
155	Obsky	E	MZ	MZ	U	UK	1083894	0	0
156	Tomsk-Tazovsky	NE	PZ	PZ	C	UK	1206616	5.2	9.8
157	Kazakh Margin	NE	PZ	PZ	U	UK	178540	4.6	1
158	Kazakhstan	NE	PZ	PZ	U	UK	1145766	5.3	3.4
159	Ural	NE	PZ	PZ	U	UK	1334133	5.7	5.3
160	Beyneu	NE	PC	PC	U	UK	209438	5.3	1
161	Caspian Depressi	E	PZ	PZ	U	UK	561624	5.1	2.9
162	Donetz	E	PZ	PZ	C	NF	276360	0	0
163	Kursk	NE	PC	PC	U	UK	561495	0	0
164	Ukraine	NE	PC	PC	C	F	371000	0	0
165	Pachelma	E	PC	PC	U	UK	54556	0	0
166	Tatar-Russia	NE	PC	PC	U	UK	1276933	4.9	2
167	Trans-Russia	E	PC	PC	C	NF	182051	4.9	2
168	Timan	E	PC	PZ	U	UK	525509	4.9	2
169	Barents	NE	PC	PC	E	UK	1166510	5.4	2
170	Franz Josef Rim	E	CZ	CZ	U	UK	141010	5.1	2
171	Kola	NE	PC	PC	C	F	241485	4.7	2
172	Lapland-White Se	NE	PC	PC	C	UK	96452	0	0
173	Svecokarelia	NE	PC	PC	C	F	821894	5.3	3
174	Bothnia	NE	PC	PC	C	F	76920	0	0
175	Svecofennia	NE	PC	PC	C	F	1056504	4.8	2
176	Varmland	NE	PC	PC	C	F	76985	0	0
177	Dalsland	NE	PC	PC	C	F	174915	5.9	2

178	Oslo	E	PZ	MZ	C	NF	26218	0	0
179	Norway	NE	PZ	PZ	C	NF	342539	6.4	26.6
180	Hammerfest	E	MZ	MZ	C	NF	274830	0	0
181	Svalbard	NE	PZ	PZ	C	UK	109385	6.1	4.4
182	Spitsbergen	NE	PZ	PZ	U	UK	35620	4.9	1
183	Voring	E	MZ	CZ	C	NF	411360	5.8	33.5
184	Rockall	E	MZ	CZ	C	UK	734600	4.9	2
185	Britain	NE	PZ	PZ	C	NF	399518	5.1	10
186	Midland Valley	E	PZ	PZ	C	NF	66123	4.6	1
187	London-Brabant	NE	PC	PC	C	UK	123709	6.7	31.9
188	Viking	E	MZ	MZ	C	NF	150936	5.6	6
189	Horn	E	MZ	MZ	C	NF	15655	4.7	1
190	Denmark	NE	PZ	PZ	C	UK	186309	4.6	1
191	Polish Trough	E	PZ	CZ	C	F	101917	0	0
192	Bohemia	NE	PZ	PZ	C	F	360973	6.2	223.4
193	Eger	E	CZ	CZ	C	NF	11175	4.7	1
194	North Sea	E	MZ	CZ	C	F	163623	5.7	3.5
195	Rhine	E	CZ	CZ	C	NF	265266	6.6	104
196	Armorica	NE	PZ	PZ	C	UK	540395	5.9	34.5
197	Biscay North	E	MZ	MZ	C	F	423541	5.3	2
198	Biscay South	E	MZ	MZ	E	NF	57097	5.3	3
199	Galicia	E	MZ	MZ	C	NF	180858	7.1	45
200	Iberia	NE	PZ	PZ	C	F	288764	5.5	15.8
201	Celtiberia	E	MZ	CZ	C	F	156373	5.2	2
202	Amundsen-Scott	NE	PC	PC	C	UK	7263353	5.7	3.1
203	Sor Rondane	NE	PC	PC	U	UK	1028169	0	0
204	Napier	NE	PC	PC	U	UK	79414	0	0
205	Menzies	NE	PC	PC	U	UK	152545	0	0
206	Vestfold	NE	PC	PC	U	UK	4175	0	0
207	George V	E	MZ	CZ	U	UK	1250511	0	0
208	Transantarctic	E	CZ	CZ	U	UK	606087	5.2	2
209	Jutulstraumen	E	MZ	MZ	U	UK	14821	0	0
210	Lambert	E	MZ	MZ	U	UK	122104	0	0
211	Queen Maud	E	MZ	MZ	U	UK	346880	0	0
212	Enderby	E	MZ	MZ	U	UK	177314	0	0
213	Wilkes	E	MZ	MZ	U	UK	900281	5.5	2



214	Yucatan	E	MZ	MZ	C	F	523819	5.4	4.9
215	Campeche	E	MZ	MZ	C	F	89292	5.7	2.9
216	Gulf Coast	E	MZ	MZ	E	UK	1150114	0	0
217	Suwanee-Blake	E	MZ	MZ	C	NF	501647	4.9	1
218	Eastern Seaboard	E	MZ	MZ	C	F	1023295	7.3	35.1
219	Grand Banks	E	MZ	MZ	C	UK	498363	0	0
220	Newfoundland	NE	PZ	PZ	C	NF	339302	0	0
221	Magdalen	E	PZ	MZ	C	F	176827	4.9	1
222	Acadia	NE	PZ	PZ	C	NF	395328	5.7	19.4
223	Piedmont	NE	PZ	PZ	C	NF	141177	5.2	2
224	Valley and Ridge	NE	PZ	PZ	C	NF	252674	5.9	17.9
225	Ouachita	NE	PZ	PZ	C	UK	272762	4.7	2
226	Grenville	NE	PC	PC	C	NF	1297437	6.6	96.5
227	St. Lawrence-Ott	E	PZ	MZ	C	NF	136629	6.9	27
228	Reelsfoot	E	MZ	CZ	C	NF	20987	7.8	17.5
229	Cottage Grove-Ro	E	PZ	PZ	C	F	82782	5.5	4.1
230	Granite-Rhyolite	NE	PC	PC	C	UK	498443	6.8	30.2
231	Granite-Rhyolite	NE	PC	PC	C	UK	540467	5.7	7.7
232	Oklahoma Aulacog	E	PZ	PZ	C	NF	27481	0	0
233	Penokean	NE	PC	PC	C	UK	272794	0	0
234	Minnesota River	NE	PC	PC	C	F	130527	0	0
235	Keweenawan	E	PC	PC	C	NF	325388	5.5	6.5
236	Superior	NE	PC	PC	C	F	2195241	6	2
237	Trans-Hudson	NE	PC	PC	C	UK	1344617	5.7	5.3
238	Wyoming	NE	PC	PC	C	F	373331	5.3	9.3
239	Rae-Hearn	NE	PC	PC	C	UK	3882973	5.4	20.6
240	Slave	NE	PC	PC	C	UK	483039	0	0
241	Wopmay-Bear	NE	PC	PC	C	NF	1067319	6.2	7
242	Thelon-Taltson	NE	PC	PC	C	F	550542	5.2	2.5
243	Kiglapait	NE	PC	PC	C	UK	73011	0	0
244	Ketilidian	NE	PC	PC	C	UK	96381	5	2.3
245	Gardar	NE	PC	PC	U	UK	18765	0	0
246	Nain	NE	PC	PC	C	UK	296714	4.7	2
247	Labrador Sea	E	MZ	MZ	C	NF	235667	5.6	7.2
248	Baffin	E	CZ	CZ	E	NF	1651160	6.2	16.1
249	Queen Elizabeth	E	MZ	MZ	C	NF	649859	6.3	20.6



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250	Canada Basin	E	MZ	MZ	C	NF	259139	5.8	4.3
251	Peary	NE	PZ	PZ	C	UK	189322	6.2	5
252	Greenland Caledo	NE	PZ	PZ	U	UK	194188	0	0
253	Scoresby	E	PZ	PZ	U	UK	170849	6.1	6.4
254	Greenland Sea	E	MZ	CZ	C	UK	350276	5.7	2
255	Central Plains	NE	PC	PC	C	UK	601885	5.1	5.9