On the determination of spectral optical characteristics of the earth atmosphere

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Spectral optical characteristics of the earth atmosphere are used and can be used for the physical state analysis of the atmosphere and right accounting of radiation extinction in carring out of environmental remote sensing, determination of the composition and properties of aerosols and solar energy absolute spectrophotometric measurements as well as for the selection of the optimum conditions of solar energetic installations work and an evaluation of the atmosphere pollution in the different regions of the globe.

Hence, the purpose of this paper is to review results of the earths atmosphere spectral optical characteristics for the above mentioned problems on Mongolian territory, located in continental conditions of climate, comparatively on high altitudes above sea level.

This paper contains three parts of these kinds of studies carried out by research workers of the Research Centre for Geophysics of the Mongolian Academy of Sciences and National University of Mongolia (RCG MAS NUM) during last few years.

1.Direct solar and near solar aureole radiation measurements in the observation square of the RCG MAS NUM at Ulaanbaatar ($\varphi = 47^0\ 50'$, $\lambda = 106^0\ 55'$, h = 1330 metres above sea level), in scientific expeditions at khobd ($\varphi = 48^0\ 01'$, $\lambda = 91^0\ 04'$, h =1480 metres above sea level), at Tsogt ($\varphi = 45^0\ 20'$, $\lambda = 96^0\ 39'$, h =2300 metres above sea level), Bayantoroi ($\varphi = 44^0\ 56'$, $\lambda = 96^0 37'$, h = 1147 metres above sea level), Prykhubsgul ($\varphi = 51^0\ 39'$, $\lambda = 100^0 38'$, h = 1800 metres above sea level) with the aid of aureole photometers with combinations of glassfilters JZS-12 and SS-14, KS-15 and JZS-19. at the optical stability days. has been performed.

Using data obtained by us we have determined the values of the earth atmosphere spectral transparency coefficient graphycally by Bouguer's methods.

The results obtained in this work are compared with analogous data for Moscow and Pryhybsgul, which has been presented in Table 1

Stability of the atmosphere was evaluated by the values of relative aureole.

$\mu = F / F\ m(z)$

We used important controling criterion, in which mean square deviation of μ, corresponding with different locations of the sun is not exceeding 10%.

Let us examine as an example, we consider in Fig.1 construction of Bougeur's lines at that day, in which the above mentioned criterion has been carried out.

2.Direct solar radiation measurements on different height of the sun were conducted by Feisner actinometer with interference filters on 353, 373, 400, 455, 552, 684, 745, 798, 848, 944, 1001 nm in the observation square of the RCG MAS NUM at Ulaanbaatar in past years.

On the basis of Bouguer's law and using our experimental data, the values of the spectral coefficient of atmosphere transparency have been determined.

Fig.2 shows results of determination of P_2 in Ulaanbaatar on October, 9, 1992.

Some values of atmosphere spectral transparency coefficient on solar radiation measurement data in 1992-1993 are given in Table 2. Dependence of the atmosphere spectral transparency coefficient on wavelengths turned out a values in limits corresponding of theoretical calculation.

Applying measured data on solar radiation, we calculated the values of the atmosphere optical thickness τ, which are presented in Table 3.

3.Direct solar radiation measurements in spectral regions $\lambda < 510$ nm, 510-650 nm, 380-710nm, $\lambda > 710$ nm conducted with the aid of thermoelectric actinometer AT-50 with the filters BS-8, JS-18, KS-15 and KS-19.

Using the values of solar radiation in above mentioned regions of spectrum on a extrernal boundary of the atmosphere, we determined the values of the atmosphere optical thickness in intervals of sun elevation: 5-10^0, 10.1-15^0 , 15.1-20 ^{0}, 20.1-25^0 , ..., 60.1-65 ^{0}, which are given in Table 4. One can see from Table 4, the atmosphere optical thickness in the spectral region 380-710 nm are varied in limit 0.30-0.60 and is observed almost monthly a tendency of growth with the increasing of the sun's elevation. The values of the atmosphere optical thickness in this region of spectrum in summer months - are increased.

The values of optical thickness in the spectral region λ<510 nm are varied in limit 0.42-0.91 and predomiпants the values 0.62-0.85.

The values of optical thickness in the region of spectrum 510-650 nm, corresponding to maximum of solar spectrum are comparatively small and predominants 0.12-0.22.

The values of optical thickness in infrared region of spectrum are varied in limit 0.12-0.18 in winter months and predominants 0.18-0.30 in summer months. Moreover in some cases the value of optical thickness reaches to 0.35. Such a difference of optical thickness is observed during a year, than other regions of spectrum. This peculiarity is expained by the spectral region λ>710 nm contains main bands of water vapour absorbtion and water vapour content in the atmosphere in winter season is less than in the summer season.

Values of the atmosphere optical thickness in depending on sun elevation at Ulaanbaatar has generally a growth tendency. It is apparent that motion in the city and the daily variation of air pollution in the city has been connected.

Conclusion

On the basis of the data obtained by us, we have the following conclusion:

-Direct solar radiation and near-solar aureole flux measurements will make it possible to determine the atmosphere optical properties at the observational time with a high degree of accuracy.

-Mean values of the earth atmosphere spectral transparency coefficients determined by us can be used for different practical calculations.

Table 1. Comparative data of atmosphere spectral transparency for some sites of Mongolia and Russia

Sites	Red filter	Green filter	Blue filter
-North region of Lake Hyb-sugul	0.910	0.860	0.784
-Ulaanbaatar	0.864	0.801	0.756
-Khobd	0.891	0.842	0.778
-Bayantoroi	0.866	0.812	0.775
-Tsogt	0.877	0.818	0.781
-Mondi (Sayan observatory)	0.882	0.823	0.767
-Kuchino near Moscow	0.870	0.790	-
-Listvennichnoye (south Baikal)	0.842	0.790	0.736

Table 2.Some values of the atmosphere spectral transparency coefficient on the data Feisner actinometer measurements.

1992

	λ,nm									
Date	353	373	400	455	552	684	745	798	848	944
X.9	0.584	0.614	0.664	0.722	0.787	0.829	0.831	0.841	0.798	0.901
X.10	0.533	0.572	0.634	0.698	0.795	0.816	0.825	0.849	0.834	0.861
X.14	0.501	0.541	0.598	0.663	0.747	0.766	0.789	0.815	0.799	0.866
	0.526	0.601	0.634	0.714	0.785	0.803	0.837	0.851	0.805	0.879
X.18				0.665	0.727	0.704	0.718	0.724	0.741	0.783
				0.677	0.774	0.780	0.794	0.821	0.884	0.875
P_2	0.536	0.582	0.632	0.695	0.778	0.799	0.815	0.835	0.824	0.880
δ	0.035	0.032	0.028	0.025	0.019	0.026	0.022	0.026	0.037	0.017

Table 3. Determination of atmosphere optical thickness τ on Feisner actinometer measurement data

	λ,nm									
Date	353	373	400	455	552	684	745	798	848	944
X.9	0.537	0.487	0.409	0.325	0.239	0.187	0.184	0.172	0.227	0.104
X.10	0.628	0.558	0.454	0.359	0.229	0.203	0.192	0.163	0.180	0.105
X.14	0.690	0.614	0.514	0.411	0.292	0.267	0.239	0.205	0.233	0.143
X.14.	0.641	0.509	0.454	0.336	0.242	0.218	0.177	0.160	0.217	0.128
X.18				0.407	0.318	0.350	0.330	0.322	0.299	0.244
X.18				0.389	0.256	0.248	0.230	0.197	0.122	0.110
τ_λ	0.624	0.542	0.458	0.364	0.252	0.225	0.204	0.179	0.196	0.127
τ_λ	0.024	0.062	0.128	0.194	0.192	0.185	0.174	0.159	0.131	0.117

	λ,nm									
Date	353	373	400	455	552	684	745	798	848	944
IY.27	0.774	0.762	0.823	0.879	0.881	0.904	0.920	0.938	0.894	0.966
Y.8	0.588	0.562	0.648	0.778	0.794	0.839	0.843	0.867	0.824	0.887
Y.13	0.507	0.597	0.623	0.767	0.791	0.822	0.845	0.855	0.813	0.910
Y.16	0.766	0.631	0.661	0.816	0.865	0.714	0.878	0.896	0.807	0.951
YI.1	0.494	0.419	0.616	0.776	0.794	0.855	0.875	0.889	0.773	0.844
YI.5	0.631	0.615	0.670	0.788	0.736	0.848	0.832	0.864	0.776	0.851
YI.6	0.375	0.398	0.526	0.656	0.723	0.773	0.770	0.727		0.763
YI.23		0.581		0.815	0.799	0.827	0.861	0.656		0.822
YП.16	0.523	0.637	0.638	0.804	0.742	0.875	0.881	0.884	0.791	0.912
YШ.3	0.775	0.583	0.721	0.686	0.830	0.918	0.918	0.910		0.803
YШ.26	0.431	0.532	0.608		0.832	0.873	0.868		0.792	0.893
YШ.26	0.541	0.738	0.631	0.744	0.713	0.690	0.811	0.813		
YШ.27	0.375	0.631	0.673	0.775	0.813	0.749	0.885	0.926	0.794	0.882
IX.7	0.640	0.604	0.765	0.702	0.717	0.758	0.650	0.681	0.825	0.823
IX.24	0.469	0.525	0.620	0.804	0.841	0.861	0.845	0.881		
X.3	0.490	0.523	0.651	0.794	0.651	0.852	0.878	0.923	0.813	0.912
X.23	0.531	0.680		0.698	0.916	0.916	0.873	0.885	0.819	0.869
X.15	0.537	0.580	0.677	0.851	0.843	0.904	0.920	0.923	0.912	
X.16	0.544	0.618	0.674	0.790	0.856	0.924	0.918	0.912		0.934
X.18	0.667	0.666	0.776	0.794	0.872	0.889	0.901	0.881	0.938	0.957
X.19	0.580	0.626	0.557	0.650	0.740	0.759	0.828	0.776	0.698	0.738
P_2	0.562	0.596	0.661	0.768	0.793	0.836	0.857	0.854	0.818	0.873

Table 4

Spectral optical thickness of the earth atmosphere

	n		Q	D	S	S_1	S_2	S_3	S_4
			January						
5-10	2	m	134	47	453	89	23	332	76
		σ	21	12	187	55	13	117	47
10-15	8	m	171	60	574	127	28	404	113
		σ	8	7	19	4	3	11	5
15-20	33	m	261	78	693	175	51	465	142
		σ	5	3	15	3	1	11	3
20-25	26	m	336	87	750	204	67	487	164
		σ	12	5	23	8	2	13	7
			February						
10-15	9	m	195	66	611	167	47	410	122
		σ	11	5	26	7	5	2	6
15-20	23	m	273	87	657	170	62	437	133
		σ	13	3	20	6	3	13	4
20-25	44	m	351	97	716	198	72	461	153
		σ	11	3	14	5	2	8	4
25-30	39	m	440	119	766	218	84	487	163
		σ	19	4	23	7	3	15	6
30-35	19	m	460	122	762	230	85	477	173
		σ	16	8	23	8	1	15	8
35-40	1	m	818	93	1.033	356	141	604	253
		σ							
			March						
10-15	5	m	159	73	464	94	33	254	81
		σ	20	8	60	14	4	58	14
15-20	18	m	282	90	632	163	54	436	127
		σ	18	4	34	10	2	24	9
20-25	22	m	354	116	629	171	55	422	139
		σ	16	5	28	8	2	19	8
25-30	33	m	482	118	744	213	82	466	215
		σ	28	3	25	9	1	20	14
30-35	46	m	554	148	773	228	87	494	172
		σ	21	4	20	6	2	13	5
35-40	49	m	607	150	789	243	97	496	175
		σ	20	4	16	6	1	10	5
40-45	36	m	640	164	774	239	105	474	172
		σ	20	6	19	7	3	12	4
45-50		m	743	121	914	290	156	571	208
		σ	131	1	55	21	10	42	13

	n		Q	D	S	S_1	S_2	S_3	S_4
					April				
10-15	4	m	109	55	368	80	28	270	66
		σ							
15-20	10	m	212	89	501	127	36	356	105
		σ	9	5	4	7	1	21	6
20-25	22	m	291	92	607	167	60	408	127
		σ	14	2	20	7	2	13	5
25-30	9	m	369	102	671	191	87	426	150
		σ	5	1	1	3	3	6	1
30-35		m	467	119	712	219	86	460	161
		σ	16	3	16	6	2	11	4
35-40	23	m	503	137	726	230	103	454	162
		σ	4	4	9	3	2	6	2
40-45	37	m	581	144	747	243	113	457	165
		σ	1	4	7	3	1	4	2
45-50	40	m	652	152	790	268	110	479	185
		σ	6	4	8	4	2	5	3
50-55	29	m	761	148	835	263	129	501	176
		σ	26	5	11	6	1	7	8
55-60	3	m	877	149	927	320	150	560	215
		σ	109	8	25	6	5	27	11
					May				
10-15	3	m	161	57	499	125	36	374	95
		σ	60	8	117	37	21	82	15
15-20	13	m	265	69	620	192	61	412	142
		σ	27	2	32	17	7	15	8
20-25	9	m	272	90	588	193	57	381	133
		σ	14	0.3	16	3	1	14	5
25-30	26	m	404	96	702	228	79	458	173
		σ	16	1	18	7	3	6	4
30-35	15	m	437	103	712	227	78	467	171
		σ	15	4	19	7	3	12	6
35-40	33	m	534	108	759	265	100	474	183
		σ	18	3	14	7	2	9	4

	n		Q	D	S	S_1	S_2	S_3	S_4
40-45	24	m	582	123	780	263	104	487	188
		σ	17	4	14	5	2	8	4
45-50	30	m	646	126	764	264	101	476	196
		σ	11	2	10	4	2	6	4
50-55	26	m	726	126	830	287	116	510	206
		σ	23	4	9	4	2	6	2
55-60	37	m	778	125	857	299	125	520	215
		σ	21	3	8	3	2	5	3
60-65	16	m	807	122	858	306	143	475	207
		σ	26	6	10	3	1	16	3
					June				
5-10	2	m	112	48	409	106	43	276	77
		σ							
10-15	4	m	356	71	620	183	55	424	147
		σ	99	1	99	41	12	56	31
15-20	4	m	243	78	574	178	62	383	132
		σ							
20-25	25	m	326	87	663	220	74	330	160
		σ	11	3	19	7	2	39	5
25-30	5	m	394	120	667	217	87	435	157
		σ							
30-35	30	m	470	91	754	264	96	475	189
		σ	16	2	16	6	3	9	4
35-40	0	m							
		σ							
40-45	31	m	580	99	795	288	108	482	209
		σ	5	4	14	6	2	7	3
45-50	0	m							
		σ							
50-55	28	m	531	108	852	316	126	510	219
		σ	33	4	14	6	3	8	3
55-60	22	m	787	148	793	328	125	453	220
		σ	80	2	24	14	1	21	2
60-65	27	m	673	125	850	319	132	503	216
		σ	55	4	12	5	0.01	8	2
65-70	2	m	815	125	833	314	132	491	208
		σ							

	n		Q	D	S	S_1	S_2	S_3	S_4
			July						
5-10	**4**	m	137	52	434	131	24	308	106
		σ	26	4	26	7	2	22	9
10-15	**8**	m	190	57	544	163	39	379	132
		σ	14	2	22	7	2	16	6
15-20	**15**	m	283	93	626	211	66	407	156
		σ	14	2	25	14	5	12	7
20-25	**12**	m	302	84	627	210	73	393	182
		σ	9	4	24	4	8	12	9
25-30	**11**	m	477	114	765	256	82	464	184
		σ	28	3	33	10	8	13	6
30-35	**15**	m	465	97	732	262	96	455	186
		σ	17	5	17	6	1	12	5
35-40	**13**	m	572	116	743	274	105	453	184
		σ	19	5	21	7	7	11	5
40-45	**12**	m	640	133	755	278	109	439	193
		σ	25	7	15	6	2	9	3
45-50	**22**	m	688	130	778	293	125	465	202
		σ	21	3	9	5	4	7	3
50-55	**20**	m	752	117	792	300	121	477	208
		σ	39	6	16	4	3	14	3
55-60	**25**	m	870	152	843	321	132	494	210
		σ	29	4	9	5	2	7	10
60-65	**25**	m	560	139	810	239	128	478	206
		σ	65	4	14	27	1	8	5
			August						
5-10		m	49	20	364	121	6	217	82
		σ							
10-15		m	102	41	436	126	23	314	107
		σ							
15-20	**7**	m	234	63	616	195	59	406	152
		σ	7	3	11	6	3	4	5
20-25	**6**	m	269	66	652	208	57	435	165
		σ	12	5	22	13	2	13	7
25-30	**6**	m	352	79	713	238	90	452	178
		σ	8	5	9	4	2	4	3

	n		Q	D	S	S_1	S_2	S_3	S_4
30-35	**15**	m	477	96	761	269	97	477	189
		σ	22	3	15	7	3	11	4
35-40	**31**	m	536	93	810	295	113	490	201
		σ	7	1	7	2	1	3	0.5
40-45	**14**	m	585	105	804	297	118	486	189
		σ	15	3	12	4	4	8	10
45-50	**28**	m	675	112	825	300	122	494	211
		σ	13	3	10	2	2	6	1
50-55	**24**	m	718	113	728	282	116	468	194
		σ	12	2	2	4	2	1	4
55-60	**36**	m	770	110	812	317	134	492	216
		σ	9	1	1	2	1	2	1
60-65	**9**	m	876	181	837	323	127	494	206
		σ	26	11	4	3	1	2	1
					September				
5-10	**2**	m	135	45	531	167	17	354	120
		σ							
10-15	**6**	m	170	47	600	170	44	407	139
		σ	9	1	20	9	6	7	9
15-20	**16**	m	297	73	706	207	61	466	150
		σ	12	2	19	6	2	10	2
20-25	**16**	m	323	74	718	225	76	460	161
		σ	4	2	4	1	2	3	7
25-30	**22**	m	414	91	765	251	88	484	183
		σ	9	3	4	2	2	1	1
30-35	**15**	m	491	92	792	267	95	490	192
		σ	20	1	15	2	1	12	4
35-40	**32**	m	575	106	830	285	116	501	195
		σ	13	2	8	2	2	5	1
40-45	**32**	m	697	122	828	290	120	488	191
		σ	23	2	3	2	3	1	3
45-50	**19**	m	745	164	859	302	121	516	193
		σ	29	18	2	1	4	1	9
50-55	**1**	m	710	108	962	341	162	556	228
		σ							

	n		Q	D	S	S1	S2	S3	S4
			October						
10-15	**2**	m	202	56	638	169	60	423	130
		σ	37	6	28	23	20	0	7
15-20	**5**	m	308	69	752	245	83	466	176
		σ	36	2	55	18	14	33	8
20-25	**10**	m	362	44	817	250	84	525	189
		σ	10	10	24	8	4	13	6
25-30	**17**	m	522	90	878	277	107	541	212
		σ	20	0.1	16	4	3	8	5
30-35	**19**	m	563	110	855	279	117	528	188
		σ	23	1	11	5	5	3	2
35-40	**8**	m	688	107	896	301	122	531	216
		σ	55	1	32	11	6	18	7
			November						
5-10	**5**	m	52	39	251	56	30	183	25
		σ							
10-15	**16**	m	217	55	546	129	30	383	110
		σ	5	1	17	5	1	12	4
15-20	**33**	m	235	70	660	181	50	437	139
		σ	4	1	6	4	1	4	2
20-25	**34**	m	321	82	710	202	72	454	153
		σ	5	1	5	2	1	3	1
25-30	**11**	m	374	82	744	233	79	456	173
		σ	3	3	5	5	4	3	1
			December						
15-20	**4**	m	236	100	544	124	28	382	113
		σ							

Table 4

Spectral optical thickness of the earth atmosphere

	n		P_2	τ_1	τ_2	τ_3	τ_4
					January		
5-10	2	m	0.76	0.36	0.49	0.14	0.25
		σ	0.1	0.13	0.12	0.1	0.13
10-15	8	m	0.79	0.36	0.59	0.13	0.19
		σ	0.02	0.02	0.05	0.01	0.02
15-20	33	m	0.8	0.38	0.61	0.13	0.18
		σ	0.01	0.01	0.01	0.01	0.01
20-25	26	m	0.8	0.41	0.63	0.15	0.17
		σ	0.01	0.02	0.01	0.01	0.02
					February		
10-15	9	m	0.79	0.31	0.51	0.14	0.15
		σ	0.02	0.02	0.03	0.01	0.01
15-20	23	m	0.77	0.4	0.58	0.16	0.22
		σ	0.01	0.01	0.01	0.01	0.01
20-25	44	m	0.78	0.44	0.63	0.17	0.22
		σ	0.01	0.01	0.01	0.01	0.01
25-30	39	m	0.78	0.47	0.67	0.18	0.22
		σ	0.01	0.02	0.01	0.02	0.02
30-35	19	m	0.77	0.5	0.76	0.21	0.21
		σ	0.01	0.02	0.01	0 .02	0.03
35-40	1	m	0.85	0.29	0.52	0.09	0.001
		σ					
					March		
10-15	5	m	0.71	0.5	0.66	0.2	0.24
		σ	0.03	0.1	0.11	0.04	0.06
15-20	18	m	0.77	0.42	0.6	0.16	0.21
		σ	0.01	0.02	0.02	0.02	0.02
20-25	22	m	0.73	0.47	0.68	0.204	0.24
		σ	0.01	0.02	0.01	0.02	0.02
25-30	33	m	0.77	0.48	0.71	0.18	0.19
		σ	0.01	0.02	0.02	0.02	0.02
30-35	46	m	0.76	0.53	0.66	0.21	0.23
		σ	0.01	0.02	0.01	0.01	0.02
35-40	49	m	0.76	0.54	0.77	0.22	0.21
		σ	0.01	0.02	0.01	0.01	0.02
40-45	36	m	0.73	0.61	0.81	0.28	0.27
		σ	0.01	0.02	0.01	0.02	0.02
45-50		m	0.81	0.5	0.73	0.15	0.15
		σ	0.01	0.05	0.04	0.05	0.04

	n		P_2	τ_1	τ_2	τ_3	τ_4
					April		
10-15	**4**	m	0.72	0.36	0.45	0.17	0.24
		σ					
15-20	**10**	m	0.72	0.44	0.64	0.2	0.26
		σ	0.02	0.02	0.02	0.02	0.02
20-25	**22**	m	0.74	0.46	0.65	0.2	0.26
		σ	0.01	0.01	0.01	0.01	0.01
25-30	**9**	m	0.76	0.49	0.61	0.22	0.23
		σ	0.01	0.01	0	0.01	0.01
30-35		m	0.74	0.52	0.73	0.23	0.24
		σ	0.01	0.01	0.02	0.02	0.02
35-40	**23**	m	0.73	0.56	0.73	0.27	0.28
		σ	0.01	0.01	0.01	0.01	0.01
40-45	**37**	m	0.73	0.6	0.77	0.31	0.34
		σ	0.01	0.02	0.01	0.01	0
45-50	**40**	m	0.77	0.57	0.83	0.28	0.23
		σ	0.06	0.01	0.01	0.01	0.01
50-55	**29**	m	0.75	0.56	0.75	0.26	0.19
		σ	0.01	0.02	0.02	0.01	0.02
55-60	**3**	m	0.76	0.51	0.5	0.23	0.2
		σ	0.01	0.01	0.2	0.03	0.03
					May		
10-15	**3**	m	0.77	0.3	0.47	0.13	0.18
		σ	0.04	0.04	0.09	0.03	0.03
15-20	**13**	m	0.76	0.34	0.53	0.16	0.17
		σ	0.01	0.02	0.02	0.01	0.01
20-25	**9**	m	0.73	0.4	0.64	0.22	0.23
		σ	0.01	0.01	0.01	0.01	0.01
25-30	**26**	m	0.76	0.44	0.69	0.2	0.2
		σ	0.01	0.01	0.02	0.01	0.01
30-35	**15**	m	0.75	0.4	0.78	0.21	0.2
		σ	0.01	0.04	0.02	0.01	0.02
35-40	**33**	m	0.76	0.55	0.76	0.24	0.2
		σ	0.01	0.01	0.02	0.01	0.01

	n		P_2	τ_1	τ_2	τ_3	τ_4
40-45	**24**	**m**	0.75	0.53	0.79	0.24	0.21
		σ	0.01	0.01	0.02	0.01	0.01
45-50	**30**	**m**	0.73	0.59	0.9	0.29	0.22
		σ	0.01	0.01	0.02	0.01	0.01
50-55	**26**	**m**	0.76	0.56	0.86	0.26	0.17
		σ	0.01	0.01	0.02	0.01	0.01
55-60	**37**	**m**	0.77	0.56	0.86	0.26	0.15
		σ	0.01	0.01	0.01	0.01	0.02
60-65	**16**	**m**	0.76	0.57	0.78	0.28	0.2
		σ	0.01	0.01	0.01	0.01	0.01
					June		
5-10	**2**	**m**	0.74	0.31	0.42	0.17	0.21
		σ					
10-15	**4**	**m**	0.76	0.38	0.61	0.16	0.17
		σ	0.03	0.03	0.01	0.03	0.06
15-20	**4**	**m**	0.73	0.44	0.6	0.21	0.23
		σ					
20-25	**25**	**m**	0.76	0.39	0.6	0.2	0.18
		σ	0.01	0.01	0.01	0.01	0.01
25-30	**5**	**m**	0.72	0.5	0.69	0.24	0.24
		σ					
30-35	**30**	**m**	0.76	0.43	0.69	0.22	0.19
		σ	0.01	0.01	0.01	0.01	0.01
35-40	**0**	**m**					
		σ					
40-45	**31**	**m**	0.76	0.45	0.73	0.23	0.15
		σ	0.01	0.01	0.01	0.01	0.01
45-50	**0**	**m**					
		σ					
50-55	**28**	**m**	0.79	0.49	0.79	0.15	0.12
		σ	0.01	0.01	0.02	0.02	0.01
55-60	**22**	**m**	0.76	0.52	0.85	0.32	0.1
		σ	0.01	0.003	0.002	0.01	0.03
60-65	**27**	**m**	0.76	0.55	0.86	0.31	0.16
		σ	0.01	0.01	0.01	0.01	0.01
65-70	**2**	**m**	0.77	0.57	0.87	0.33	0.18
		σ					

	n		P_2	τ_1	τ_2	τ_3	τ_4
					July		
5-10	4	m	0.71	0.32	0.56	0.18	0.19
		σ	0.002	0.02	0.08	0.01	0.001
10-15	8	m	0.754	0.33	0.58	0.24	0.24
		σ	0.01	0.02	0.03	0.04	0.03
15-20	15	m	0.74	0.38	0.59	0.19	0.19
		σ	0.01	0.02	0.03	0.01	0.01
20-25	12	m	0.73	0.4	0.65	0.22	0.19
		σ	0.01	0.01	0.02	0.01	0.01
25-30	11	m	0.75	0.42	0.65	0.21	0.22
		σ	0.01	0.02	0.03	0.01	0.05
30-35	15	m	0.76	0.44	0.68	0.24	0.17
		σ	0.01	0.02	0.02	0.02	0.02
35-40	13	m	0.71	0.5	0.8	0.29	0.21
		σ	0.01	0.02	0.04	0.02	0.02
40-45	12	m	0.73	0.51	0.79	0.3	0.19
		σ	0.01	0.01	0.01	0.01	0.01
45-50	22	m	0.72	0.51	0.79	0.32	0.17
		σ	0.01	0.01	0.03	0.01	0.01
50-55	20	m	0.72	0.54	0.84	0.3	0.16
		σ	0.01	0.01	0.02	0.01	0.01
55-60	25	m	0.73	0.52	0.82	0.29	0.14
		σ	0.01	0.01	0.01	0.02	0.01
60-65	25	m	0.72	0.56	0.83	0.33	0.19
		σ	0	0.02	0.01	0.01	0.03
				August			
5-10		m	0.71	0.15	0.17	0.11	0.11
		σ					
10-15		m	0.79	0.27	0.48	0.14	0.15
		σ					
15-20	7	m	0.79	0.29	0.46	0.15	0.13
		σ	0.01	0.02	0.02	0.01	0.01
20-25	6	m	0.77	0.33	0.56	0.15	0.14
		σ	0.01	0.04	0.04	0.02	0.02
25-30	6	m	0.78	0.38	0.57	0.19	0.15
		σ	0.01	0.01	0.02	0.01	0.01

	n		P_2	τ_1	τ_2	τ_3	τ_4
30-35	15	m	0.74	0.41	0.67	0.21	0.15
		σ	0.01	0.01	0.02	0.01	0.01
35-40	31	m	0.76	0.4	0.64	0.18	0.13
		σ	0.002	0.01	0.01	0.01	0.002
40-45	14	m	0.77	0.45	0.66	0.25	0.13
		σ	0.01	0.01	0.01	0.01	0.003
45-50	28	m	0.76	0.47	0.73	0.26	0.13
		σ	0.001	0.01	0.02	0.01	0.003
50-55	24	m	0.73	0.57	0.91	0.34	0.29
		σ	0.01	0.01	0.03	0.01	0.02
55-60	36	m	0.74	0.5	0.77	0.29	0.13
		σ	0.01	0.01	0.01	0.01	0.002
60-65	9	m	0.72	0.5	0.86	0.3	0.18
		σ	0.01	0.01	0.01	0	0.01
					September		
5-10	2	m	0.8	0.23	0.53	0.12	1.94
		σ					
10-15	6	m	0.8	0.3	0.52	0.14	0.15
		σ	0.002	0.03	0.03	0	0.01
15-20	16	m	0.79	0.33	0.56	0.13	0.24
		σ	0.01	0.01	0.02	0.01	0.02
20-25	16	m	0.78	0.39	0.62	0.17	0.23
		σ	0.01	0.01	0.02	0.01	0.03
25-30	22	m	0.78	0.4	0.64	0.18	0.15
		σ	0.01	0.01	0.01	0.01	0.01
30-35	15	m	0.78	0.43	0.67	0.2	0.13
		σ	0.01	0.01	0.01	0.01	0.01
35-40	32	m	0.78	0.44	0.68	0.22	0.18
		σ	0.01	0.01	0.01	0.01	0.01
40-45	32	m	0.76	0.48	0.72	0.26	0.22
		σ	0.01	0.01	0.02	0.01	0.02
45-50	19	m	0.78	0.48	0.77	0.23	0.24
		σ	0.01	0.01	0.02	0.01	0.04
50-55	1	m	0.8	0.41	0.58	0.19	0.08
		σ					