



Energy, Mines and Resources Canada / Énergie, Mines et Ressources Canada

THE NATIONAL ATLAS OF CANADA 5th EDITION

CANADA

**SOLAR RADIATION-
DECEMBER AND JUNE**

Produced by the Geographical Services Division, Survey and Mapping Branch, Energy, Mines and Resources Canada. Printed 1984.

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Scale 1:2 500 000 or 1 centimetre represents 125 kilometres
1:2 500 000 ou 1 centimètre représente 125 kilomètres

Latitude Central Canada (Toronto), Standard Meridian 49°W and 77°W
Modified Polyconic Projection, North of Latitude 80°

MEAN DAILY GLOBAL SOLAR RADIATION

Notes and Definitions

Solar Radiation: Energy transmitted from the sun in the form of electromagnetic waves. Global solar radiation includes radiation received at the earth's surface by direct incidence and radiation received after scattering or diffuse reflection by atmospheric gas molecules, water vapor, and dust particles. In addition to direct and diffuse radiation, global solar radiation on inclined surfaces includes the component of radiation reflected from ground surfaces.

Monthly Mean Daily Global Solar Radiation: The average of the daily global solar radiation values for the month. The months of June and December have been selected as the months with highest and lowest averages for daily values of global solar radiation incident on a horizontal surface.

The seasonal variation of solar radiation received at the earth's surface is influenced significantly by four factors: the declination of the sun, the length of day, cloudiness, and ground cover. In the northern hemisphere, the sun reaches its maximum declination of 23°26'30"N (Tropic of Cancer) at the summer solstice (June 20-22) and minimum declination of 23°26'30"S (Tropic of Capricorn) at the winter solstice (December 20-22). Solar radiation received on a horizontal surface varies accordingly, with values ranging from highest at the time of maximum declination to lowest at the time of minimum declination.

The changing declination of the sun in its annual apparent path between the tropics of Cancer and Capricorn is also responsible for the variation of day length throughout the year. The length of day in turn governs the amount of time available for the receipt of incoming radiation. Considerable seasonal variation in day length occurs. Most of the months of June and December when up to 24 hours of daylight or darkness occur. The mean limits of these extremes are indicated on the maps of June and December respectively.

As clouds above and reflect back to space a substantial proportion of incoming solar radiation, cloud cover and thickness are additional controls on the amount of radiation that reaches the earth's surface. Solar radiation on inclined surfaces is further modified by the reflectivity of the ground surface. Snow, for example, reflects more solar radiation than a dark surface. Global radiation on inclined surfaces is therefore augmented by its reflected component, and it is possible to convert surface to receive more global solar radiation in winter and in spring than in summer.

Monthly Mean Daily Global Solar Radiation Methodology: The standard deviation of the monthly mean daily global solar radiation—a measure of the inter-annual variation of monthly mean daily global solar radiation values.

Inclined Surfaces: Data for solar radiation incident on inclined surfaces have been derived from measured and simulated horizontal radiation data using a mathematical model. Inclined surfaces of 60° and 90° with a south orientation were assumed because of their relevance to solar energy applications. 60° was the angle applicable to active solar energy systems. Inclined radiation on solar energy systems, 60° and 90° are relevant to passive energy systems that use solar radiation directly.

Megajoule Per Square Metre ($\text{MJ}\cdot\text{m}^{-2}$): The standard metric unit of radiation measurement. One joule (J) is the amount of energy equivalent to the work done by a force of one newton ($\text{N}=\text{kg}\cdot\text{m}\cdot\text{s}^{-2}$) when the point at which the force is applied is displaced one metre in the direction of the force.

Polar Night: This period of continuous darkness during which the sun does not appear above the horizon within a 24-hour period. The darkness of polar night is reduced by twilight and by moonlight reflected by ice and snow.

Polar Day: For the purposes of these maps polar day is defined as the period of continuous daylight during which the sun does not sink below the horizon within a 24-hour period.

Observing Network: The solar radiation observing network operated by the Atmospheric Environment Service of Environment Canada included 24 climate stations in 1980-1981 with more than 10 years of record. In order to increase the information base, solar radiation data were simulated for 80 additional sites from a mathematical model.

Period of Record: Measured data are based on the recording period of 1950 to 1975; simulated data are based on the recording period of 1950 to 1980.

Radiation Availability: Adapt changes occur in the amount of solar radiation received on surfaces in mountainous regions as a result of significant variations of elevation, aspect and slope, over short distances. In areas of more regular terrain, however, of continuous bathymetric irregularities imposed by the uneven and often sparse distribution of observations, the density of the station network can be used as an index of radiation availability. A discontinuous line symbol is used over water bodies to indicate approximate values.

This map sheet was prepared in association with the Canadian Climate Centre, Atmospheric Environment Service, Environment Canada, Canadian Climate Centre. Additional research by S.A. Kelly and D.M. Chapman. Geographical Services Division, Survey and Mapping Branch, Energy, Mines and Resources Canada.

Cartography by Cartography and Topography, Geographical Services Division, Survey and Mapping Branch, Energy, Mines and Resources Canada.

Source: Canada, Environment Canada, Atmospheric Environment Service, 1982; Solar Radiation Observing Network, Canadian Climate Centre, 1980-1981; Volume 1, 1980-1981; Volume 2, 1982-1983; Volume 3, 1984-1985; Volume 4, 1986-1987; Volume 5, 1988-1989; Volume 6, 1990-1991; Volume 7, 1992-1993; Volume 8, 1994-1995; Volume 9, 1996-1997; Volume 10, 1998-1999; Volume 11, 2000-2001; Volume 12, 2002-2003; Volume 13, 2004-2005; Volume 14, 2006-2007; Volume 15, 2008-2009; Volume 16, 2010-2011; Volume 17, 2012-2013; Volume 18, 2014-2015; Volume 19, 2016-2017; Volume 20, 2018-2019; Volume 21, 2020-2021; Volume 22, 2022-2023; Volume 23, 2024-2025; Volume 24, 2026-2027; Volume 25, 2028-2029; Volume 26, 2030-2031; Volume 27, 2032-2033; Volume 28, 2034-2035; Volume 29, 2036-2037; Volume 30, 2038-2039; Volume 31, 2040-2041; Volume 32, 2042-2043; Volume 33, 2044-2045; Volume 34, 2046-2047; Volume 35, 2048-2049; Volume 36, 2050-2051; Volume 37, 2052-2053; Volume 38, 2054-2055; Volume 39, 2056-2057; Volume 40, 2058-2059; Volume 41, 2060-2061; Volume 42, 2062-2063; Volume 43, 2064-2065; Volume 44, 2066-2067; Volume 45, 2068-2069; Volume 46, 2070-2071; Volume 47, 2072-2073; Volume 48, 2074-2075; Volume 49, 2076-2077; Volume 50, 2078-2079; Volume 51, 2080-2081; Volume 52, 2082-2083; Volume 53, 2084-2085; Volume 54, 2086-2087; Volume 55, 2088-2089; Volume 56, 2090-2091; Volume 57, 2092-2093; Volume 58, 2094-2095; Volume 59, 2096-2097; Volume 60, 2098-2099; Volume 61, 2100-2101; Volume 62, 2102-2103; Volume 63, 2104-2105; Volume 64, 2106-2107; Volume 65, 2108-2109; Volume 66, 2110-2111; Volume 67, 2112-2113; Volume 68, 2114-2115; Volume 69, 2116-2117; Volume 70, 2118-2119; Volume 71, 2120-2121; Volume 72, 2122-2123; Volume 73, 2124-2125; Volume 74, 2126-2127; Volume 75, 2128-2129; Volume 76, 2130-2131; Volume 77, 2132-2133; Volume 78, 2134-2135; Volume 79, 2136-2137; Volume 80, 2138-2139; Volume 81, 2140-2141; Volume 82, 2142-2143; Volume 83, 2144-2145; Volume 84, 2146-2147; Volume 85, 2148-2149; Volume 86, 2150-2151; Volume 87, 2152-2153; Volume 88, 2154-2155; Volume 89, 2156-2157; Volume 90, 2158-2159; Volume 91, 2160-2161; Volume 92, 2162-2163; Volume 93, 2164-2165; Volume 94, 2166-2167; Volume 95, 2168-2169; Volume 96, 2170-2171; Volume 97, 2172-2173; Volume 98, 2174-2175; Volume 99, 2176-2177; Volume 100, 2178-2179; Volume 101, 2180-2181; Volume 102, 2182-2183; Volume 103, 2184-2185; Volume 104, 2186-2187; Volume 105, 2188-2189; Volume 106, 2190-2191; Volume 107, 2192-2193; Volume 108, 2194-2195; Volume 109, 2196-2197; Volume 110, 2198-2199; Volume 111, 2200-2201; Volume 112, 2202-2203; Volume 113, 2204-2205; Volume 114, 2206-2207; Volume 115, 2208-2209; Volume 116, 2210-2211; Volume 117, 2212-2213; Volume 118, 2214-2215; Volume 119, 2216-2217; Volume 120, 2218-2219; Volume 121, 2220-2221; Volume 122, 2222-2223; Volume 123, 2224-2225; Volume 124, 2226-2227; Volume 125, 2228-2229; Volume 126, 2230-2231; Volume 127, 2232-2233; Volume 128, 2234-2235; Volume 129, 2236-2237; Volume 130, 2238-2239; Volume 131, 2240-2241; Volume 132, 2242-2243; Volume 133, 2244-2245; Volume 134, 2246-2247; Volume 135, 2248-2249; Volume 136, 2250-2251; Volume 137, 2252-2253; Volume 138, 2254-2255; Volume 139, 2256-2257; Volume 140, 2258-2259; Volume 141, 2260-2261; Volume 142, 2262-2263; Volume 143, 2264-2265; Volume 144, 2266-2267; Volume 145, 2268-2269; Volume 146, 2270-2271; Volume 147, 2272-2273; Volume 148, 2274-2275; Volume 149, 2276-2277; Volume 150, 2278-2279; Volume 151, 2280-2281; Volume 152, 2282-2283; Volume 153, 2284-2285; Volume 154, 2286-2287; Volume 155, 2288-2289; Volume 156, 2290-2291; Volume 157, 2292-2293; Volume 158, 2294-2295; Volume 159, 2296-2297; Volume 160, 2298-2299; Volume 161, 2300-2301; Volume 162, 2302-2303; Volume 163, 2304-2305; Volume 164, 2306-2307; Volume 165, 2308-2309; Volume 166, 2310-2311; Volume 167, 2312-2313; Volume 168, 2314-2315; Volume 169, 2316-2317; Volume 170, 2318-2319; Volume 171, 2320-2321; Volume 172, 2322-2323; Volume 173, 2324-2325; Volume 174, 2326-2327; Volume 175, 2328-2329; Volume 176, 2330-2331; Volume 177, 2332-2333; Volume 178, 2334-2335; Volume 179, 2336-2337; Volume 180, 2338-2339; Volume 181, 2340-2341; Volume 182, 2342-2343; Volume 183, 2344-2345; Volume 184, 2346-2347; Volume 185, 2348-2349; Volume 186, 2350-2351; Volume 187, 2352-2353; Volume 188, 2354-2355; Volume 189, 2356-2357; Volume 190, 2358-2359; Volume 191, 2360-2361; Volume 192, 2362-2363; Volume 193, 2364-2365; Volume 194, 2366-2367; Volume 195, 2368-2369; Volume 196, 2370-2371; Volume 197, 2372-2373; Volume 198, 2374-2375; Volume 199, 2376-2377; Volume 200, 2378-2379; Volume 201, 2380-2381; Volume 202, 2382-2383; Volume 203, 2384-2385; Volume 204, 2386-2387; Volume 205, 2388-2389; Volume 206, 2390-2391; Volume 207, 2392-2393; Volume 208, 2394-2395; Volume 209, 2396-2397; Volume 210, 2398-2399; Volume 211, 2400-2401; Volume 212, 2402-2403; Volume 213, 2404-2405; Volume 214, 2406-2407; Volume 215, 2408-2409; Volume 216, 2410-2411; Volume 217, 2412-2413; Volume 218, 2414-2415; Volume 219, 2416-2417; Volume 220, 2418-2419; Volume 221, 2420-2421; Volume 222, 2422-2423; Volume 223, 2424-2425; Volume 224, 2426-2427; Volume 225, 2428-2429; Volume 226, 2430-2431; Volume 227, 2432-2433; Volume 228, 2434-2435; Volume 229, 2436-2437; Volume 230, 2438-2439; Volume 231, 2440-2441; Volume 232, 2442-2443; Volume 233, 2444-2445; Volume 234, 2446-2447; Volume 235, 2448-2449; Volume 236, 2450-2451; Volume 237, 2452-2453; Volume 238, 2454-2455; Volume 239, 2456-2457; Volume 240, 2458-2459; Volume 241, 2460-2461; Volume 242, 2462-2463; Volume 243, 2464-2465; Volume 244, 2466-2467; Volume 245, 2468-2469; Volume 246, 2470-2471; Volume 247, 2472-2473; Volume 248, 2474-2475; Volume 249, 2476-2477; Volume 250, 2478-2479; Volume 251, 2480-2481; Volume 252, 2482-2483; Volume 253, 2484-2485; Volume 254, 2486-2487; Volume 255, 2488-2489; Volume 256, 2490-2491; Volume 257, 2492-2493; Volume 258, 2494-2495; Volume 259, 2496-2497; Volume 260, 2498-2499; Volume 261, 2500-2501; Volume 262, 2502-2503; Volume 263, 2504-2505; Volume 264, 2506-2507; Volume 265, 2508-2509; Volume 266, 2510-2511; Volume 267, 2512-2513; Volume 268, 2514-2515; Volume 269, 2516-2517; Volume 270, 2518-2519; Volume 271, 2520-2521; Volume 272, 2522-2523; Volume 273, 2524-2525; Volume 274, 2526-2527; Volume 275, 2528-2529; Volume 276, 2530-2531; Volume 277, 2532-2533; Volume 278, 2534-2535; Volume 279, 2536-2537; Volume 280, 2538-2539; Volume 281, 2540-2541; Volume 282, 2542-2543; Volume 283, 2544-2545; Volume 284, 2546-2547; Volume 285, 2548-2549; Volume 286, 2550-2551; Volume 287, 2552-2553; Volume 288, 2554-2555; Volume 289, 2556-2557; Volume 290, 2558-2559; Volume 291, 2560-2561; Volume 292, 2562-2563; Volume 293, 2564-2565; Volume 294, 2566-2567; Volume 295, 2568-2569; Volume 296, 2570-2571; Volume 297, 2572-2573; Volume 298, 2574-2575; Volume 299, 2576-2577; Volume 300, 2578-2579; Volume 301, 2580-2581; Volume 302, 2582-2583; Volume 303, 2584-2585; Volume 304, 2586-2587; Volume 305, 2588-2589; Volume 306, 2590-2591; Volume 307, 2592-2593; Volume 308, 2594-2595; Volume 309, 2596-2597; Volume 310, 2598-2599; Volume 311, 2600-2601; Volume 312, 2602-2603; Volume 313, 2604-2605; Volume 314, 2606-2607; Volume 315, 2608-2609; Volume 316, 2610-2611; Volume 317, 2612-2613; Volume 318, 2614-2615; Volume 319, 2616-2617; Volume 320, 2618-2619; Volume 321, 2620-2621; Volume 322, 2622-2623; Volume 323, 2624-2625; Volume 324, 2626-2627; Volume 325, 2628-2629; Volume 326, 2630-2631; Volume 327, 2632-2633; Volume 328, 2634-2635; Volume 329, 2636-2637; Volume 330, 2638-2639; Volume 331, 2640-2641; Volume 332, 2642-2643; Volume 333, 2644-2645; Volume 334, 2646-2647; Volume 335, 2648-2649; Volume 336, 2650-2651; Volume 337, 2652-2653; Volume 338, 2654-2655; Volume 339, 2656-2657; Volume 340, 2658-2659; Volume 341, 2660-2661; Volume 342, 2662-2663; Volume 343, 2664-2665; Volume 344, 2666-2667; Volume 345, 2668-2669; Volume 346, 2670-2671; Volume 347, 2672-2673; Volume 348, 2674-2675; Volume 349, 2676-2677; Volume 350, 2678-2679; Volume 351, 2680-2681; Volume 352, 2682-2683; Volume 353, 2684-2685; Volume 354, 2686-2687; Volume 355, 2688-2689; Volume 356, 2690-2691; Volume 357, 2692-2693; Volume 358, 2694-2695; Volume 359, 2696-2697; Volume 360, 2698-2699; Volume 361, 2700-2701; Volume 362, 2702-2703; Volume 363, 2704-2705; Volume 364, 2706-2707; Volume 365, 2708-2709; Volume 366, 2710-2711; Volume 367, 2712-2713; Volume 368, 2714-2715; Volume 369, 2716-2717; Volume 370, 2718-2719; Volume 371, 2720-2721; Volume 372, 2722-2723; Volume 373, 2724-2725; Volume 374, 2726-2727; Volume 375, 2728-2729; Volume 376, 2730-2731; Volume 377, 2732-2733; Volume 378, 2734-2735; Volume 379, 2736-2737; Volume 380, 2738-2739; Volume 381, 2740-2741; Volume 382, 2742-2743; Volume 383, 2744-2745; Volume 384, 2746-2747; Volume 385, 2748-2749; Volume 386, 2750-2751; Volume 387, 2752-2753; Volume 388, 2754-2755; Volume 389, 2756-2757; Volume 390, 2758-2759; Volume 391, 2760-2761; Volume 392, 2762-2763; Volume 393, 2764-2765; Volume 394, 2766-2767; Volume 395, 2768-2769; Volume 396, 2770-2771; Volume 397, 2772-2773; Volume 398, 2774-2775; Volume 399, 2776-2777; Volume 400, 2778-2779; Volume 401, 2780-2781; Volume 402, 2782-2783; Volume 403, 2784-2785; Volume 404, 2786-2787; Volume 405, 2788-2789; Volume 406, 2790-2791; Volume 407, 2792-2793; Volume 408, 2794-2795; Volume 409, 2796-2797; Volume 410, 2798-2799; Volume 411, 2800-2801; Volume 412, 2802-2803; Volume 413, 2804-2805; Volume 414, 2806-2807; Volume 415, 2808-2809; Volume 416, 2810-2811; Volume 417, 2812-2813; Volume 418, 2814-2815; Volume 419, 2816-2817; Volume 420, 2818-2819; Volume 421, 2820-2821; Volume 422, 2822-2823; Volume 423, 2824-2825; Volume 424, 2826-2827; Volume 425, 2828-2829; Volume 426, 2830-2831; Volume 427, 2832-2833; Volume 428, 2834-2835; Volume 429, 2836-2837; Volume 430, 2838-2839; Volume 431, 2840-2841; Volume 432, 2842-2843; Volume 433, 2844-2845; Volume 434, 2846-2847; Volume 435, 2848-2849; Volume 436, 2850-2851; Volume 437, 2852-2853; Volume 438, 2854-2855; Volume 439, 2856-2857; Volume 440, 2858-2859; Volume 441, 2860-2861; Volume 442, 2862-2863; Volume 443, 2864-2865; Volume 444, 2866-2867; Volume 445, 2868-2869; Volume 446, 2870-2871; Volume 447, 2872-2873; Volume 448, 2874-2875; Volume 449, 2876-2877; Volume 450, 2878-2879; Volume 451, 2880-2881; Volume 452, 2882-2883; Volume 453, 2884-2885; Volume 454, 2886-2887; Volume 455, 2888-2889; Volume 456, 2890-2891; Volume 457, 2892-2893; Volume 458, 2894-2895; Volume 459, 2896-2897; Volume 460, 2898-2899; Volume 461, 2900-2901; Volume 462, 2902-2903; Volume 463, 2904-2905; Volume 464, 2906-2907; Volume 465, 2908-2909; Volume 466, 2910-2911; Volume 467, 2912-2913; Volume 468, 2914-2915; Volume 469, 2916-2917; Volume 470, 2918-2919; Volume 471, 2920-2921; Volume 472, 2922-2923; Volume 473, 2924-2925; Volume 474, 2926-2927; Volume 475, 2928-2929; Volume 476, 2930-2931; Volume 477, 2932-2933; Volume 478, 2934-2935; Volume 479, 2936-2937; Volume 480, 2938-2939; Volume 481, 2940-2941; Volume 482, 2942-2943; Volume 483, 2944-2945; Volume 484, 2946-2947; Volume 485, 2948-2949; Volume 486, 2950-2951; Volume 487, 2952-2953; Volume 488, 2954-2955; Volume 489, 2956-2957; Volume 490, 2958-2959; Volume 491, 2960-2961; Volume 492, 2962-2963; Volume 493, 2964-2965; Volume 494, 2966-2967; Volume 495, 2968-2969; Volume 496, 2970-2971; Volume 497, 2972-2973; Volume 498, 2974-2975; Volume 499, 2976-2977; Volume 500, 2978-2979; Volume 501, 2980-2981; Volume 502, 2982-2983; Volume 503, 2984-2985; Volume 504, 2986-2987; Volume 505, 2988-2989; Volume 506, 2990-2991; Volume 507, 2992-2993; Volume 508, 2994-2995; Volume 509, 2996-2997; Volume 510, 2998-2999; Volume 511, 3000-3001; Volume 512, 3002-3003; Volume 513, 3004-3005; Volume 514, 3006-3007; Volume 515, 3008-3009; Volume 516, 3010-3011; Volume 517, 3012-3013; Volume 518, 3014-3015; Volume 519, 3016-3017; Volume 520, 3018-3019; Volume 521, 3020-3021; Volume 522, 3022-3023; Volume 523, 3024-3025; Volume 524, 3026-3027; Volume 525, 3028-3029; Volume 526, 3030-3031; Volume 527, 3032-3033; Volume 528, 3034-3035; Volume 529, 3036-3037; Volume 530, 3038-3039; Volume 531, 3040-3041; Volume 532, 3042-3043; Volume 533, 3044-3045; Volume 534, 3046-3047; Volume 535, 3048-3049; Volume 536, 3050-3051; Volume 537, 3052-3053; Volume 538, 3054-3055; Volume 539, 3056-3057; Volume 540, 3058-3059; Volume 541, 3060-3061; Volume 542, 3062-3063; Volume 543, 3064-3065; Volume 544, 3066-3067; Volume 545, 3068-3069; Volume 546, 3070-3071; Volume 547, 3072-3073; Volume 548, 3074-3075; Volume 549, 3076-3077; Volume 550, 3078-3079; Volume 551, 3080-3081; Volume 552, 3082-3083; Volume 553, 3084-3085; Volume 554, 3086-3087; Volume 555, 3088-3089; Volume 556, 3090-3091; Volume 557, 3092-3093; Volume 558, 3094-3095; Volume 559, 3096-3097; Volume 560, 3098-3099; Volume 561, 3100-3101; Volume 562, 3102-3103; Volume 563, 3104-3105; Volume 564, 3106-3107; Volume 565, 3108-3109; Volume 566, 3110-3111; Volume 567, 3112-3113; Volume 568, 3114-3115; Volume 569, 3116-3117; Volume 570, 3118-3119; Volume 571, 3120-3121; Volume 572, 3122-3123; Volume 573, 3124-3125; Volume 574, 3126-3127; Volume 575, 3128-3129; Volume 576, 3130-3131; Volume 577, 3132-3133; Volume 578, 3134-3135; Volume 579, 3136-3137; Volume 580, 3138-3139; Volume 581, 3140-3141; Volume 582, 3142-3143; Volume 583, 3144-3145; Volume 584, 3146-3147; Volume 585, 3148-3149; Volume 586, 3150-3151; Volume 587, 3152-3153; Volume 588, 3154-3155; Volume 589, 3156-3157; Volume 590, 3158-3159; Volume 591, 3160-3161; Volume 59