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

THE NATIONAL ATLAS OF CANADA 5th EDITION

CANADA

SOLAR RADIATION- DECEMBER AND JUNE

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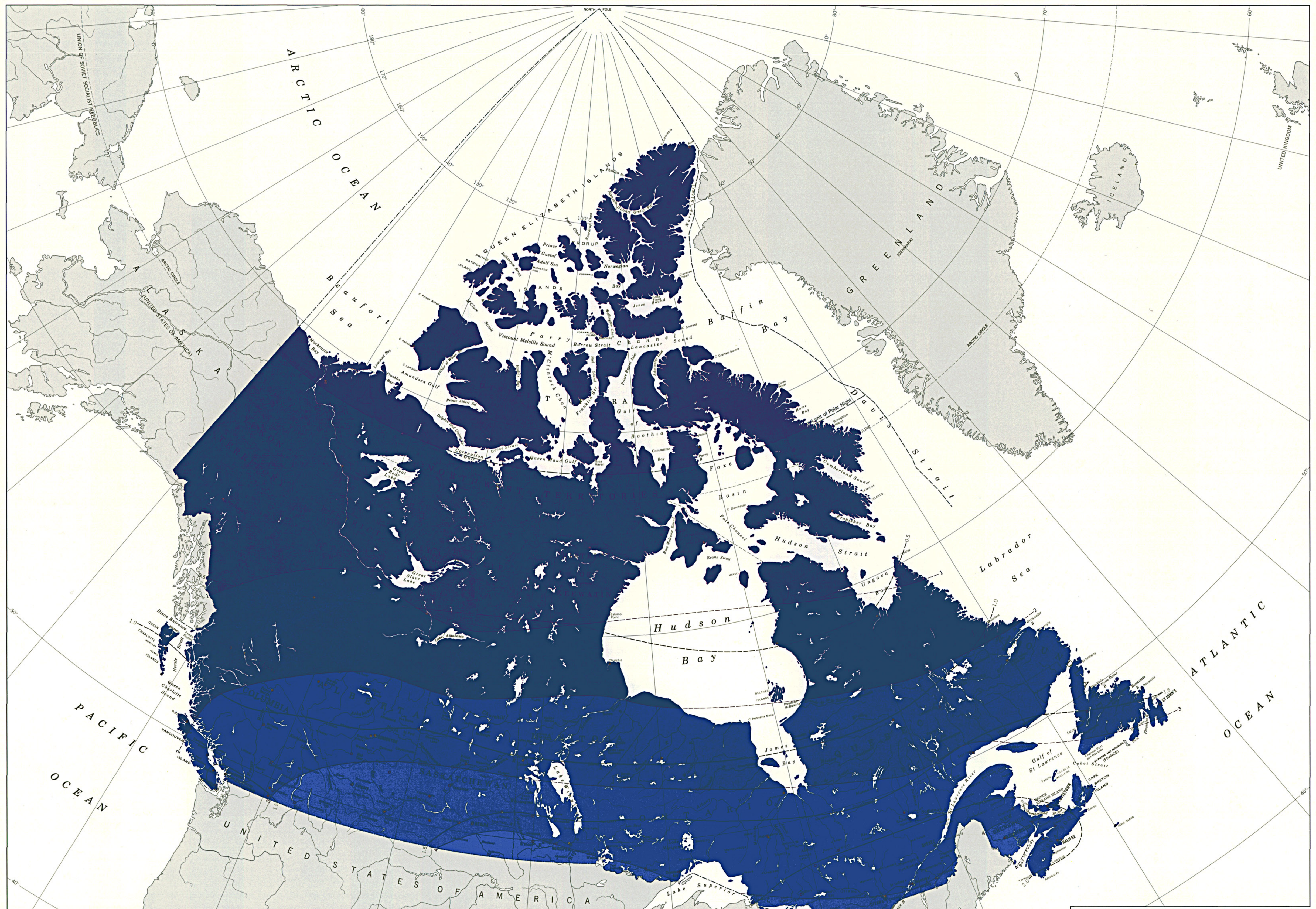
Scale 1:12 500 000 or 1 centimetre represents 125 kilometres

125 0 125 250 375 500 kilometres

Lambert Conformal Conic Projection, Standard Parallels 49°N and 77°N.
Modified Polyconic Projection, North of Latitude 80°.

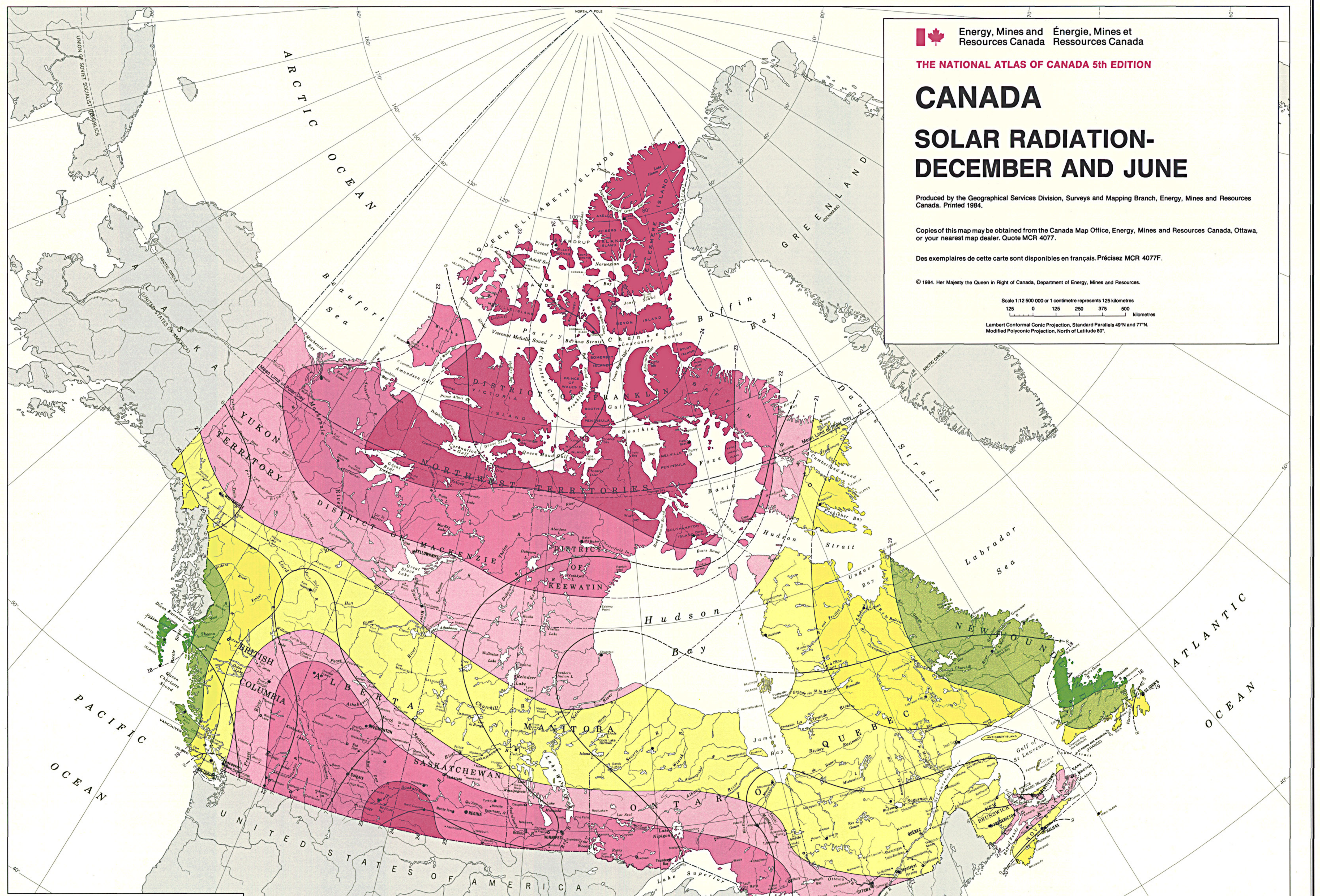


DECEMBER MEAN DAILY GLOBAL SOLAR RADIATION and VARIABILITY OF SOLAR RADIATION Incident on a Horizontal Surface

December Mean Daily Global Solar Radiation (MJ·m⁻²)

December Mean Daily Global Solar Radiation Variability (MJ·m⁻²)

Mean Limit of Polar Night



JUNE MEAN DAILY GLOBAL SOLAR RADIATION and VARIABILITY OF SOLAR RADIATION Incident on a Horizontal Surface

June Mean Daily Global Solar Radiation (MJ·m⁻²)

June Mean Daily Global Solar Radiation Variability (MJ·m⁻²)

Mean Limit of Polar Day

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 vapour, and dust particles. In addition to direct and diffuse radiation, global solar radiation on inclined sufaces 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 throughout* Canada, particularly in arctic regions. Extremes are reached in 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.

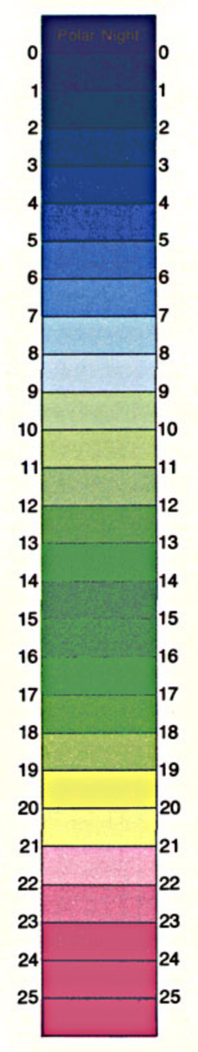
As clouds absorb and reflect back to space a substantial proportion of incoming solar radiation, cloud cover and thickness are additional controls on the amount of radiation that reaches the earth's surface.

Solar radiation on inclined surfaces is further modified by the reflectivity of the ground surface. Snow, for example, reflects more solar radiation than vegetated surfaces. Total radiation incident on inclined surfaces is therefore augmented by this reflected component, and it is possible for inclined surfaces to receive more global solar radiation in winter and in spring than in summer.

Monthly Mean Daily Global Solar Radiation Variability: 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 numerical model. Inclined surfaces of 60° and 90° with a south orientation were selected because of their relevance to solar energy applications. 60° data are applicable to active solar energy systems that convert solar radiation into other energy forms. 90° data are relevant to passive energy systems that use solar radiation directly.

MEGAJOULES PER SQUARE METRE ($MJ \cdot m^{-2}$)



CLIMATE STATION

- • Measured Data
- ∘ Simulated Data

Megajoule Per Square Metre ($MJ \cdot m^{-2}$): The standard metric unit of radiation measurement. One joule (10^{-6} megajoule) of radiant energy is equivalent to the work done by a force of one newton ($kg \cdot m \cdot s^{-2}$) when the point at which the force is applied is displaced one metre in the direction of the force.

Polar Night: The 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 54 climate stations in 1980 (30 with more than 10 years of record). In order to increase the information base, solar radiation data were simulated for 93 additional sites from a numerical model.

Period of Record: Measured data are based on the recording period of 1956 to 1978; simulated data are based on the recording period of 1952 to 1980.

Isoline Reliability: Abrupt 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, because of constraints on isarithmic interpolation imposed by the uneven and often sparse distribution of climate stations, the density of the station network can be used as an index of isoline reliability. 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. Specialist consultants/map authors were D.C. McKay and D.W. Phillips, Canadian Climate Centre. Additional research by S.A. Kelly and D.M. Chapman, Geographical Research, Geographical Services Division, Surveys and Mapping Branch, Energy, Mines and Resources Canada.

Cartography by Cartography and Toponymy, Geographical Services Division, Surveys and Mapping Branch, Energy, Mines and Resources Canada.

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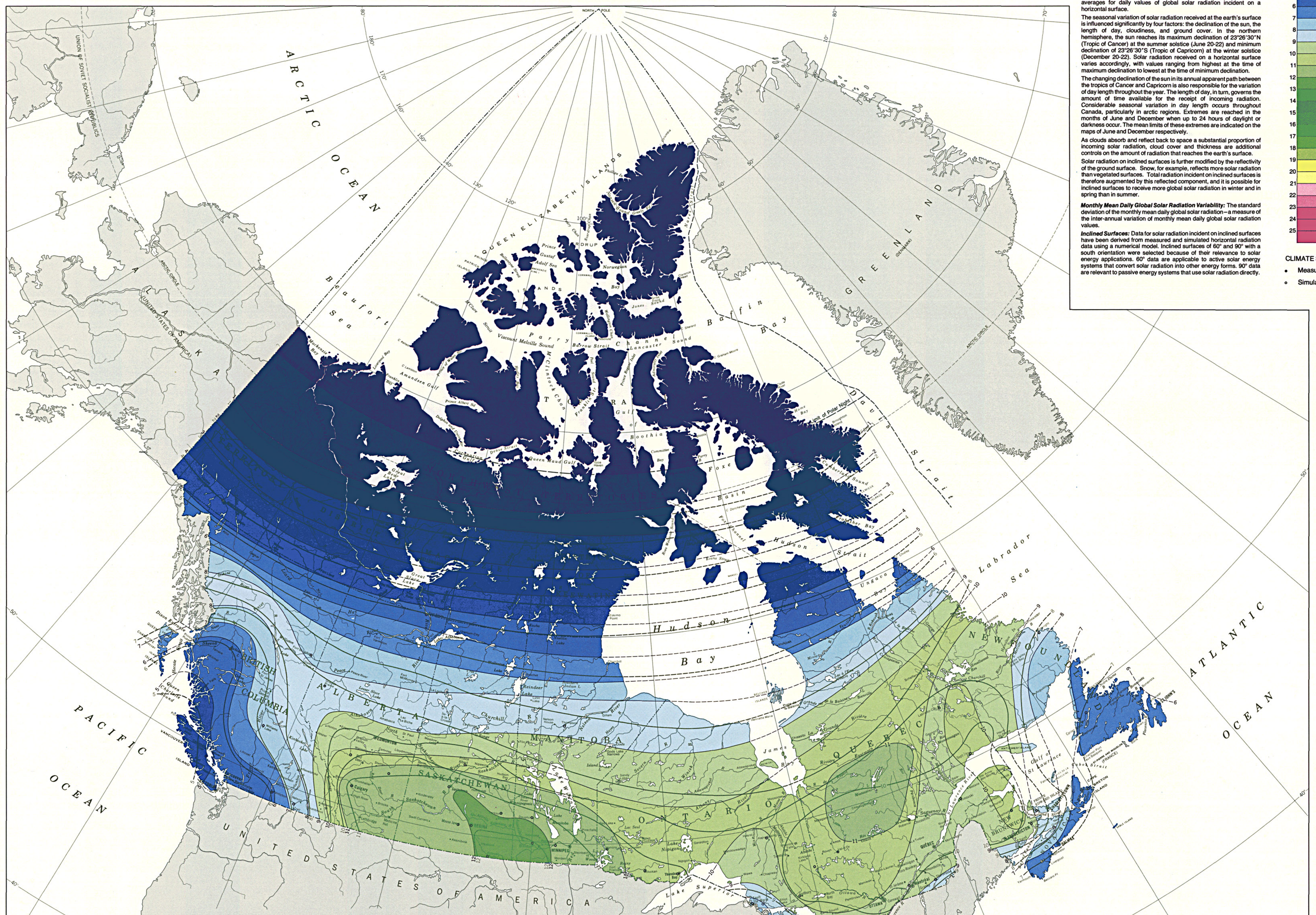


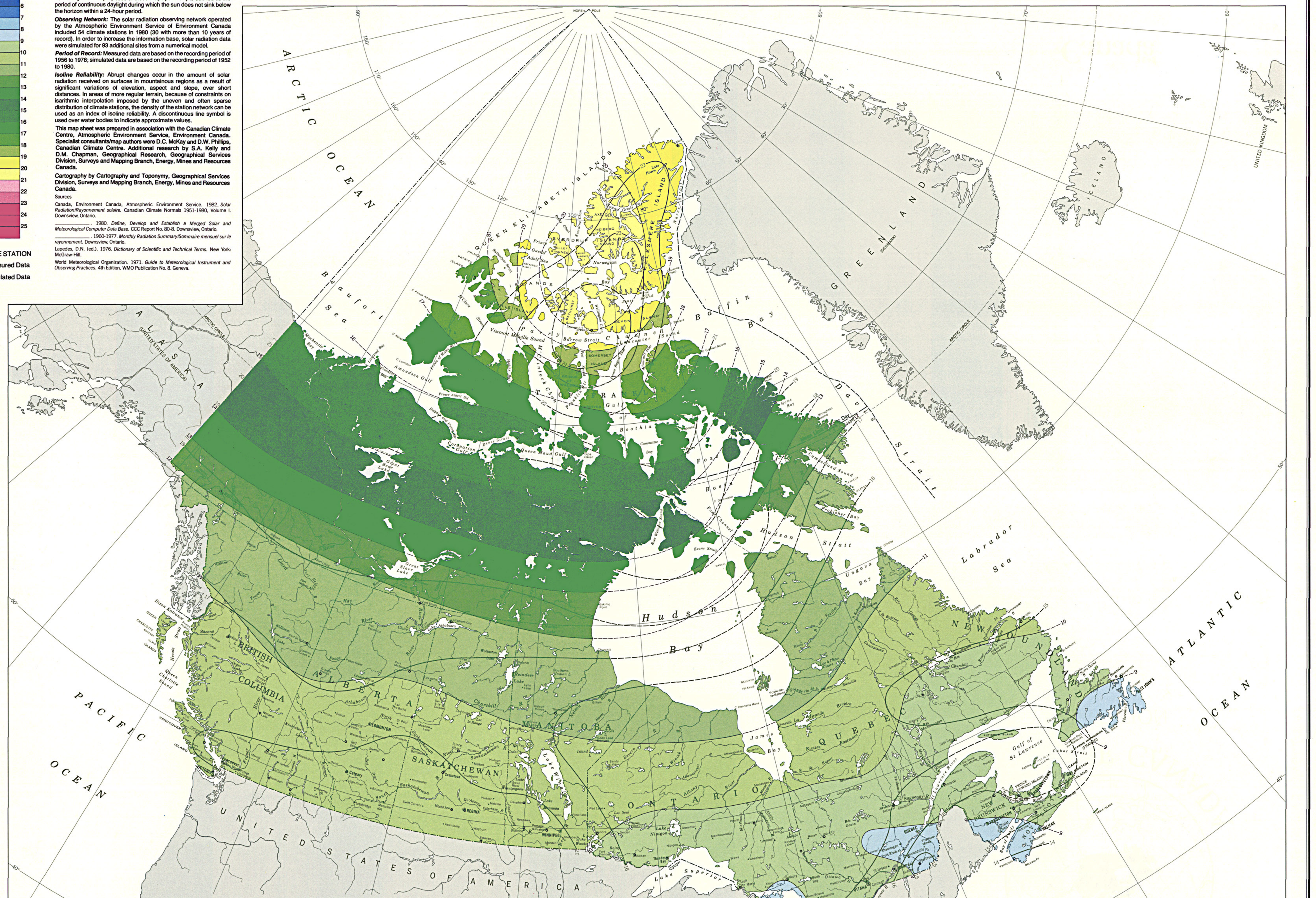
DECEMBER MEAN DAILY GLOBAL SOLAR RADIATION Incident on Inclined Surfaces of 90° and 60° with a South Orientation

DECEMBER MEAN DAILY GLOBAL SOLAR RADIATION ($MJ \cdot m^{-2}$):

90° Inclined Surface

60° Inclined Surface

Mean Limit of Polar Night



JUNE MEAN DAILY GLOBAL SOLAR RADIATION Incident on Inclined Surfaces of 90° and 60° with a South Orientation

JUNE MEAN DAILY GLOBAL SOLAR RADIATION ($MJ \cdot m^{-2}$):

90° Inclined Surface

60° Inclined Surface

Mean Limit of Polar Day