



Compiled by J.S. Clayton and I.B. Marshall, Canada, Department of Agriculture, 1972.

THE SOIL CLIMATES OF CANADA

Many classification systems of climate emphasize the aerial biosphere and are based on direct interpretation of air temperatures and precipitation distributions together with probabilities of variable weather conditions. These factors do not account for the climate of the total plant environment, in which interaction takes place between the aerial climate associated with surface plant growth, and the soil climate relating to subaerial growth, root development, soil structure and the environment of the soil microflora and fauna. Soil climate responds to changes in aerial climate but these responses are affected in time and degree by the water content, depth, surface cover, landscape position, and man's manipulation of the soil.

The two maps on this sheet, one dealing with soil temperature, the other with soil moisture, together provide information for the delineation and designation of soil climates in Canada. The soil climates indicated for Canada are included within an overall classification for Canada and the United States, that is, the classification is continental in scope. It is based on the recognition of temperature and moisture conditions in the soil. The overall classification is outlined below. Five major temperature classes, Arctic, Subarctic, Cryoboreal, Boreal and Mesic are recognized in Canada. Moisture subclasses are recognized on the basis of stated periods of saturation for the Aquic Regime and on calculations of increasing intensity and degree of moisture deficits during the growing season for the Moist Unsaturated Regime.

SOIL TEMPERATURE CLASSES

- 1 ARCTIC**
*EXTREMELY COLD. Mean annual soil temperature less than 20°F. Cold to very cool summer. Mean summer soil temperature less than 41°F. Regions in this class have continuous permafrost usually within a depth of 3 feet (1 metre).
**No significant growing season. Less than 15 days over 41°F. No warm thermal period over 59°F.
 - 2 SUBARCTIC**
*VERY COLD. Mean annual soil temperature 20° to 36°F. Moderately cool summer. Mean summer soil temperature 41° to 47°F. Regions in this class have sporadic permafrost. Some profiles do not have permafrost within a depth of 3 feet. Alpine soils are included in this class.
**Short growing season. Less than 120 days over 41°F. Less than 1000 degree days over 59°F. No warm thermal period over 59°F.
 - 3 CRYOBOREAL¹**
*COLD TO MODERATELY COLD. Mean annual soil temperature 36° - 47°F. Mild summer. Mean summer soil temperature 47° to 59°F. Regions in this class have no permafrost but the soil is frozen annually.
**Moderately short to moderately long growing season. 120-220 days over 41°F. 1000 - 2250 degree days over 41°F. An insignificant or very short warm thermal period. 0-60 days over 59°F. Less than 60 degree days over 59°F.
 - 3.1 COLD CRYOBOREAL¹**
*No (or insignificant) warm thermal period over 59°F.
**Moderately short growing season. 1000 to 2000 degree days over 41°F.
 - 3.2 MODERATELY COLD CRYOBOREAL¹**
*Usually an insignificant warm thermal period over 59°F.
**Moderately short to moderately long growing season. 2000 - 2250 degree days over 41°F.
 - 4 BOREAL²**
*COOL TO MODERATELY COOL. Mean annual soil temperature 41° to 47°F. Mild to moderately warm summer. Mean summer soil temperature 59° to 65°F.
**Moderately short to moderately long growing season. 170-220 days over 41°F. 2250-3100 degree days over 41°F. Significant very short to short warm thermal period. More than 60 days over 59°F. 60 - 400 degree days over 59°F.
 - 4.1 COOL BOREAL²**
*Very short to short warm thermal period over 59°F.
**Moderately short to moderately long growing season. 2250 - 2500 degree days over 41°F.
 - 4.2 MODERATELY COOL BOREAL²**
*Short warm thermal period over 59°F.
**Moderately long growing season. 2500 - 3100 degree days over 41°F.
 - 5 MESIC³**
*MILD TO MODERATELY WARM. Mean annual soil temperature 47° - 59°F. Moderately warm to warm summer. Mean summer soil temperature 59° - 72°F.
**Moderately long to nearly continuous growing season. 200-365 days over 41°F. 3100 - 5000 degree days over 41°F. Short to moderately short warm thermal period. Less than 160 days over 59°F. 300-1200 degree days over 59°F.
 - 5.1 MILD MESIC³**
*Short warm thermal period over 59°F.
**Moderately long growing season. 3100 - 4000 degree days over 41°F.
 - 5.2 MODERATELY WARM MESIC³**
*Moderately short warm thermal period over 59°F.
**Moderately long to continuous growing season. 4000 to 5000 degree days over 41°F.
 - 6 THERMIC (Does not occur in Canada)**
*MODERATELY WARM TO WARM. Mean annual soil temperature 59° - 72°F.
 - 7 HYPERTHERMIC (Does not occur in Canada)**
*VERY WARM TO HOT. Mean annual soil temperature over 72°F.
- ¹ In Canada the CRYOBOREAL class is separated into COLD CRYOBOREAL (3.1) and MODERATELY COLD CRYOBOREAL (3.2).
² In Canada the BOREAL class is separated into COOL BOREAL (4.1) and MODERATELY COOL BOREAL (4.2).
³ In Canada the MESIC class is separated into MILD MESIC (5.1) and MODERATELY WARM MESIC (5.2). Because of scale limitation the two classes are combined as MILD MESIC on the map.

SOIL MOISTURE REGIMES AND SUBCLASSES

- AQUIC REGIME**
Soil is saturated for significant periods of the growing season.
- Peraquic**
Soil saturated for very long periods of the year (Greater than 300 days). Ground water level at or within capillary reach of the surface. (Because of scale limitation Peraquic is included with Aquic on the map).
- Aquic**
Soil saturated for moderately long periods of the year (120-300 days).
- Subaquic**
Soil saturated for short periods of the year (less than 120 days).
- MOIST UNSATURATED REGIME**
Varying periods and intensities of water deficits during the growing season.
- Perhumid**
*Soil moist all year, seldom dry.
**No significant water deficit in the growing season. Water deficits 0 to 1". Climatic Moisture Index over 84.
- Humid**
*Soil not dry in any part as long as 90 consecutive days in most years.
**Very slight water deficit in the growing season. Water deficits 1 to 2.5". Climatic Moisture Index 74 to 84.
- Subhumid**
*Soil is dry in some parts when soil temperature is greater than 41°F in some years.
**Significant water deficit in the growing season. Water deficits 2.5 to 5.0". Climatic Moisture Index 59 to 73.
- Semiarid**
*Soil dry in some parts when soil temperature is greater than 41°F in most years.
**Moderately severe water deficit in the growing season. Water deficit 5.0 to 7.5". Climatic Moisture Index 46 to 58.
- Subarid**
*Soil dry in some or all parts most of the time when the soil temperature is greater than 41°F. Some periods as long as 90 consecutive days when the soil is moist.
**Severe water deficit in the growing season. Water deficit 7.5 to 15" in Boreal and Cryoboreal classes. 7.5 to 20" in Mesic or warmer classes. Climatic Moisture Index 25 to 45.
- Arid¹**
*Soil dry in some or all parts most of the time when the soil temperature is greater than 41°F. No period as long as 90 consecutive days when soil is moist.
**Very severe water deficit in the growing season. Water deficits more than 15" in Boreal classes and more than 20" in Mesic or warmer classes. Climatic Moisture Index less than 25.
- Xeric¹**
*Soil dry in all parts 45 consecutive days or more within the four month period (July to October) following the summer solstice, in more than 6 years out of 10.
**Soil moist in all parts for 45 consecutive days or more within the four month period (January to April) following the winter solstice, in more than 6 years out of 10.
- ¹ These regimes are not believed to occur extensively in Canada but may be found in local areas of microclimate.

*Primary Classifier
**Secondary Classifier

For each Soil Temperature Class and each Soil Moisture Subclass there are primary classifiers in accordance with criteria established for the FAO/UNESCO Soil Climate Map of North America. The secondary classifiers are in accordance with criteria established for the Soil Climate Map of Canada (Canada Department of Agriculture, 1973).

DEFINITIONS

- MEAN ANNUAL SOIL TEMPERATURE**
- mean average temperature of the soil recorded for the 12 months of the year at a depth of 50 cm (19 11/16").
- MEAN SUMMER SOIL TEMPERATURE**
- mean average temperature of the soil recorded for the months of June, July and August at a depth of 50 cm (19 11/16").
- PERMAFROST**
- thermal condition of earth materials such as soil and rock when their temperature remains below 32°F continuously for a number of years.
- GROWING SEASON**
- period with soil temperatures over 41°F at a depth of 50 cm.
- WATER DEFICIT**
- the additional amount of water required by a crop during the growing season to meet consumptive need for water not readily available from the soil.
- CLIMATIC MOISTURE INDEX**
- expresses the growing season precipitation as a percentage of the potential water used by annual crops, when water is readily available from the soil.
- $$CMI = \frac{P}{P + SM + IR} \times 100$$
- P = observed growing season precipitation.
SM = water stored in the soil at the beginning of the growing season, readily available to crops.
IR = irrigation requirement or water deficit for growing season.
CMI = Climatic Moisture Index.
- DEGREE DAYS**
- the difference between the mean daily temperature and a selected standard temperature, accumulated daily over a period of time, such as the growing season.

