EJP SOIL
European Joint Programme

Towards climate-smart sustainable management of agricultural soils

Summer School

Course N° 1: Soil Management for Sustainable Agriculture

UNIVERSITÀ
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Soil classification system: USDA Soil Taxonomy

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Why do we need to classify soil?

Why do we need to classify?

Classification and identification are important because they **allow us to better understand relationships and connections between things**

In Biology….

Classification of organism is defined as the system of arrangements of organisms into different groups and sub-groups on the basis of their similarities, differences and relationships.

Need of classification

1. It helps scientist to give names to different organism on the basis similarities found in organism.

2. Helps identification of unknown species.

3. It helps to understand different interrelations among different organisms.

4. It also helps to compare and study the evolution of organisms according to their hierarchy.

"It is necessary to classify because it helps in the identification of living organisms as well as in understanding the diversity of living organisms."

Classification ⇄ Diversity

Scientists classify for a reason, and this reason becomes part of the design of the classification system. For example, scientists may use identifying and classifying when trying to understand and protect an endangered species.

Classification also helps scientists to communicate clearly with each other

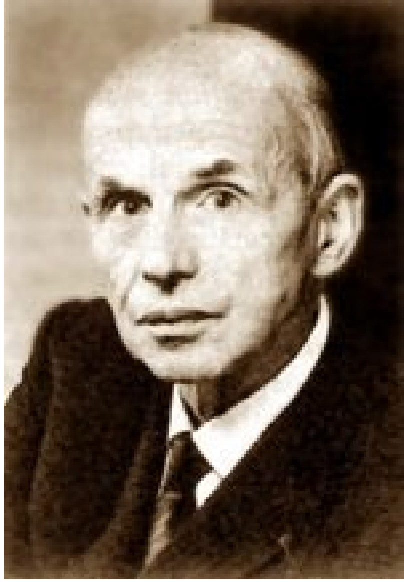
«*Nomina sunt consequentia rerum*» ***words are consequences of facts***

Justinian I

Why do we need to classify soil?

Dokuchaiev

Soils are independent natural bodies, each with a unique morphology resulting from a unique combination of climate, living matter, parent materials, relief, and age of landforms.



Hans Jenny

$$\mathbf{S = f\,(cl,\ o,\ r,\ p,\ t,\ \ldots)}$$

Classifications are contrivances made by humans to suit their purposes.

They are not themselves truths that can be discovered.

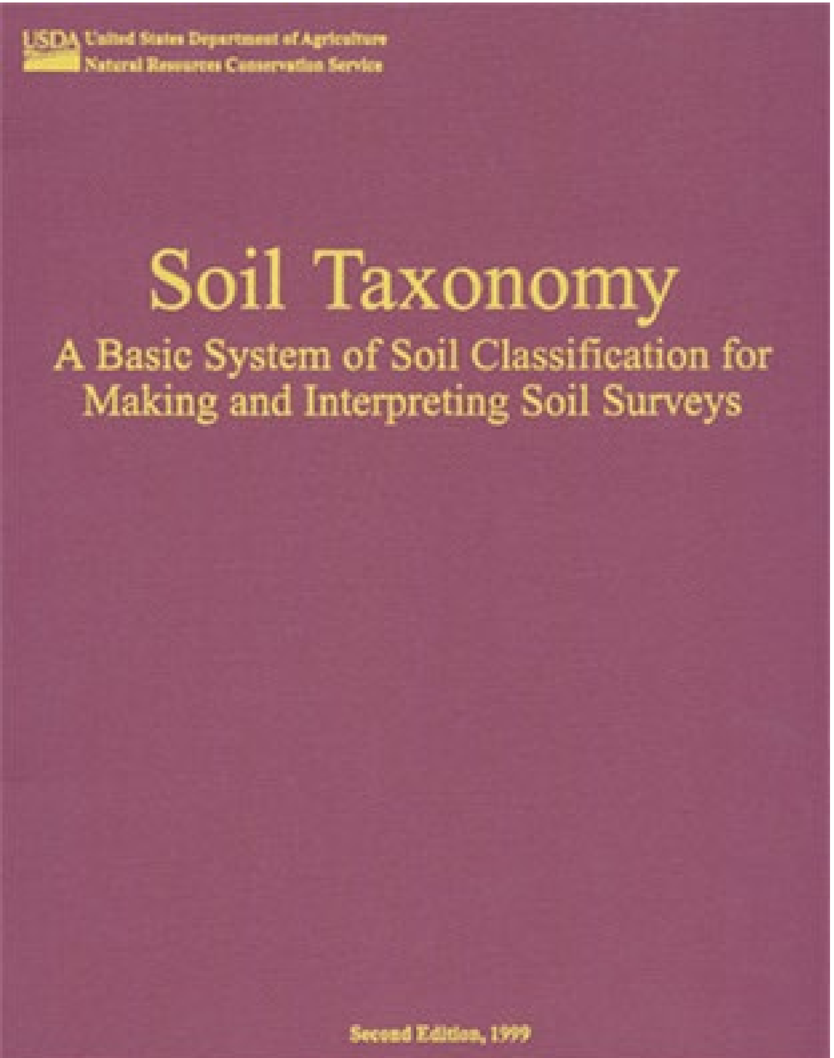
A perfect classification would have no drawbacks when used for the purpose intended. Each distinctly different purpose, to be served best, demands a different classification.

Classification vs. Taxonomy

Taxonomy is a narrower term than classification.

Classification includes taxonomy, but it also includes the grouping of soils according to limitations that affect specific practical purposes.

Taxonomy is the part of classification that is concerned primarily with relationships…..
…..a system, a framework, a tool, a set of rules… for classifying (process).



USDA – SOIL TAXONOMY

(United States Department of Agriculture)

1938 – 1951: collecting information

1960: start working

1960 - 1977: Approximations

1977: 1st Edition

1999: 2nd Edition

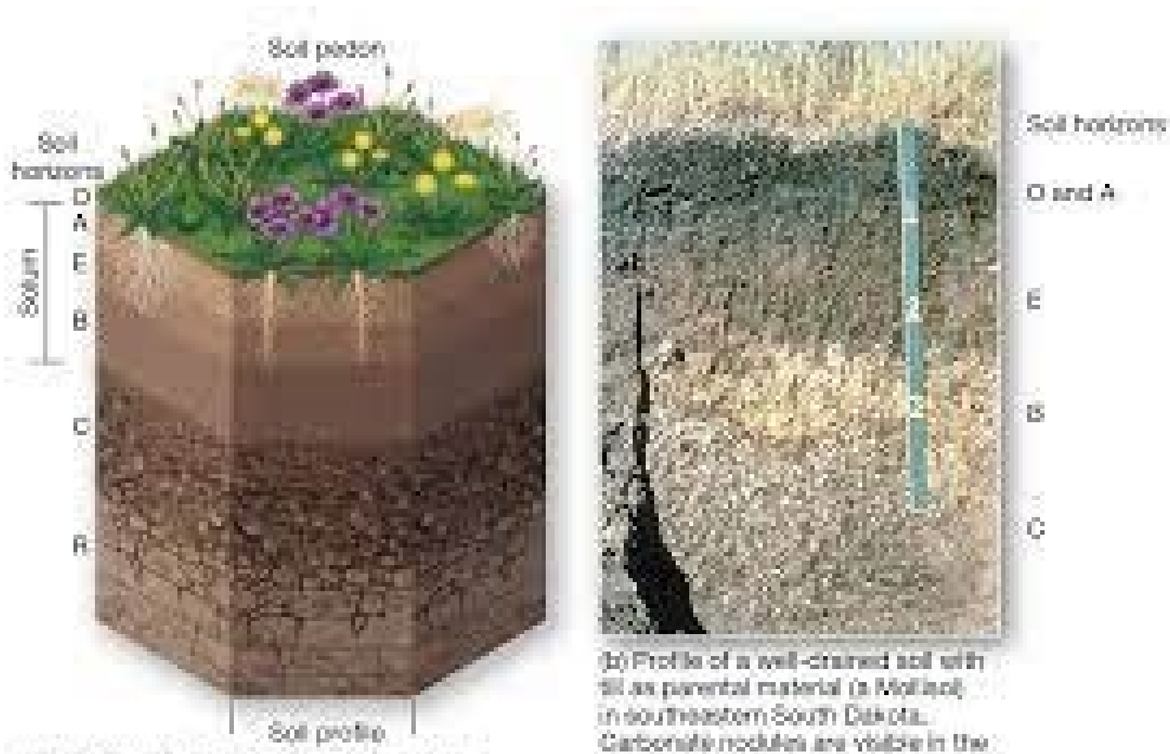
The Pedon

To determine the nature of a soil, we must study its horizons. This study requires pits or some means of extracting samples of material from the surface to the base of the soil.

In fact, few soil properties can be determined from the surface. The visible and tactile properties of samples can be studied in the field.

Other properties of a soil must be learned by studies of samples in an appropriate place, usually a laboratory.

In other words, we learn about most of the properties of a soil by studying samples extracted to represent a **sampling unit**, not by study of the whole soil body that is classified.



(a) An idealized soil profile within a pedon.

(b) Profile of a well-drained soil with till as parental material (a Mollisol) in southeastern South Dakota. Carbonate nodules are visible in the lower B and upper C horizons.

The 8 Attributes of Soil Taxonomy

Principles…foundation…constitution…

1. The definition of each taxon carries as nearly as possible the same meaning to each user.
Definitions in soil taxonomy are **operational**.
Properties for classifying soils must be visible and measurable (values). (not hypothetical, neither generical)

Only by operational definitions can competent pedologists with diverse backgrounds arrive at the same classification of the same kind of soil.

The 8 Attributes of Soil Taxonomy

2. Soil taxonomy is a multicategoric system.

Taxa must be grouped on some rational basis into progressively smaller numbers of classes of higher categories in a manner that permits the mind to grasp the concepts and relationships of all taxa.

Many taxa are needed in the lower categories because many properties are important to the use of a soil.

The 8 Attributes of Soil Taxonomy

3. Taxa represent real bodies of soil that are known to occupy geographic areas.

Pedologists are concerned with mapping real bodies of soil, and a classification related to these real bodies facilitates the mapping.

The 8 Attributes of Soil Taxonomy

4. Differentiae are soil properties that can be observed in the field or that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines.
Some of the most important properties of the soil are chemical properties, and soil taxonomy uses criteria in some taxa based on laboratory measurements.

Classifications from suppositions or from properties non concerning the soil are misleading!!..**the object to classify is Soil.**

The 8 Attributes of Soil Taxonomy

4. If there are no data about important soil properties, it is probably best to defer classifying a soil until some knowledge of its important properties is available.

A classification that is based on extremely limited knowledge of an object has little utility.

The 8 Attributes of Soil Taxonomy

5. Soil taxonomy is capable of modification to accommodate new knowledge with a minimum of disturbance.
Taxa can be added or combined in any category without disturbance of the rest of the system at the same or a higher categorical level. If the highest category includes a number of taxa defined by a variety of properties, the number can be increased or decreased by combining or subdividing taxa whenever experience convinces us that this is advisable.

Open and Flexible

but not discretional…rules and borders must be respected!

The 8 Attributes of Soil Taxonomy

6. Insofar as possible, the diagnostic horizons and features should be those below the part of the soil affected by human activities.
Deeper horizons have more importance than surface ones, which could be easily modified by human activities (directly or indirectly).

i.e. changes produced by a single or repeated plowing; truncation by erosion; modifications by wildfire; etc.

The 8 Attributes of Soil Taxonomy

7. Soil taxonomy is capable of providing taxa for all soils on a landscape.

Soils form a continuum. The continuum is broken into a reasonable number of segments that have limited and defined ranges in properties so that quantitative interpretations of soil behaviour can be made.

Breaking the continuum

The 8 Attributes of Soil Taxonomy

8. Soil taxonomy provides for all soils that are known, wherever they may be around the world.

International classification system

Soil Taxonomy

1. A connotative naming system that enables those users familiar with the nomenclature to remember selected properties of soils.
2. A means for understanding the relationships among soils within a given area and in different areas.
3. A means of communicating concepts of soils and soil properties.
4. A means of projecting experience with soils from one area to another.
5. Names that can be used as reference terms to identify soil map unit components.

Soil Taxonomy.pdf (24.45 MB)

Errata Sheet for Soil Taxonomy (8.24 KB)

Differentiae

soil-forming factors

↓

soil-forming processes

↓

diagnostic horizons, properties, materials

↓

soil taxonomic system

Distinction between Mineral Soils and Organic Soils

Definition of Mineral Soils

Mineral soils are soils that have *either* of the following:

1. Mineral soil materials that meet *one or more* of the following:

   a. Overlie cindery, fragmental, or pumiceous materials and/or have voids[2] that are filled with 10 percent or less organic materials *and* directly below these materials have either a densic, lithic, or paralithic contact; *or*

   b. When added with underlying cindery, fragmental, or pumiceous materials, total more than 10 cm between the soil surface and a depth of 50 cm; *or*

   c. Constitute more than one-third of the total thickness of the soil to a densic, lithic, or paralithic contact or have a total thickness of more than 10 cm; *or*

   d. If they are saturated with water for 30 days or more per year in normal years (or are artificially drained) and have organic materials with an upper boundary within 40 cm of the soil surface, have a total thickness of *either*:

      (1) Less than 60 cm if three-fourths or more of their volume consists of moss fibers or if their bulk density, moist, is less than 0.1 g/cm^3; *or*

      (2) Less than 40 cm if they consist either of sapric or hemic materials, or of fibric materials with less than three-fourths (by volume) moss fibers and a bulk density, moist, of 0.1 g/cm^3 or more; *or*

2. More than 20 percent, by volume, mineral soil materials from the soil surface to a depth of 50 cm or to a glacic layer or a densic, lithic, or paralithic contact, whichever is shallowest; *and*

Definition of Organic Soils

Organic soils have organic soil materials that:

1. Do not have andic soil properties in 60 percent or more of the thickness between the soil surface and either a depth of 60 cm or a densic, lithic, or paralithic contact or duripan if shallower; *and*

2. Meet *one or more* of the following:

   a. Overlie cindery, fragmental, or pumiceous materials and/or fill their interstices[2] *and* directly below these materials have a densic, lithic, or paralithic contact; *or*

   b. When added with the underlying cindery, fragmental, or pumiceous materials, total 40 cm or more between the soil surface and a depth of 50 cm; *or*

   c. Constitute two-thirds or more of the total thickness of the soil to a densic, lithic, or paralithic contact *and* have no mineral horizons or have mineral horizons with a total thickness of 10 cm or less; *or*

   d. Are saturated with water for 30 days or more per year in normal years (or are artificially drained), have an upper boundary within 40 cm of the soil surface, and have a total thickness of *either*:

      (1) 60 cm or more if three-fourths or more of their volume consists of moss fibers or if their bulk density, moist, is less than 0.1 g/cm^3; *or*

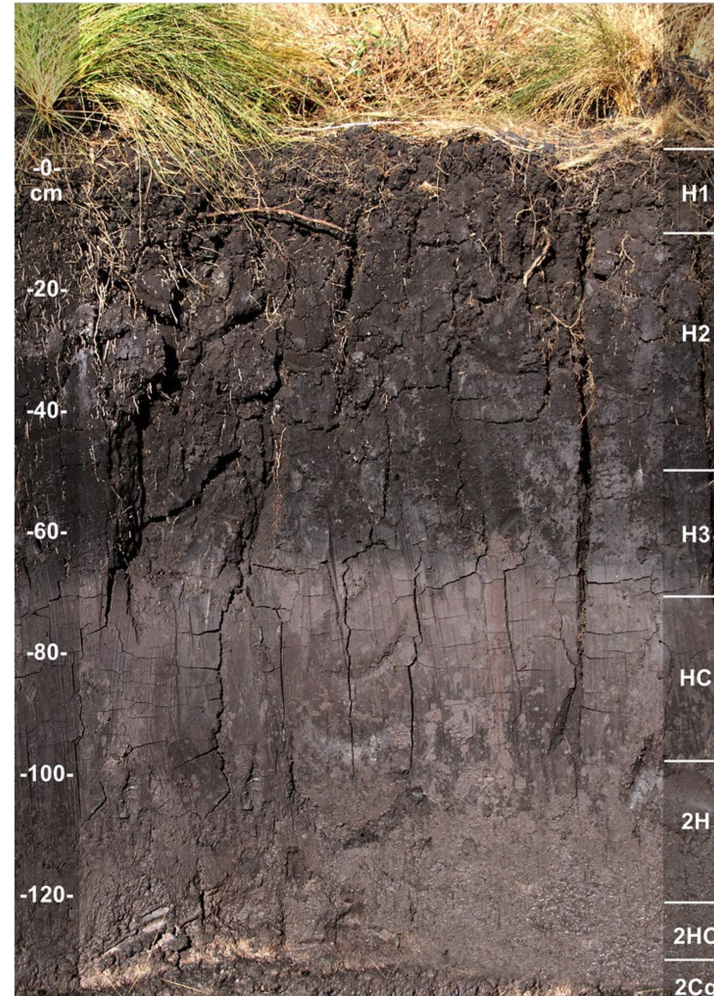
      (2) 40 cm or more if they consist either of sapric or hemic materials, or of fibric materials with less than three-fourths (by volume) moss fibers and a bulk density, moist, of 0.1 g/cm^3 or more; *or*

   e. Are 80 percent or more, by volume, from the soil surface to a depth of 50 cm or to a glacic layer or a densic, lithic, or paralithic contact, whichever is shallowest.

It is a general rule that a soil is classified as an organic soil (Histosol) if more than half of the upper 80 cm (32 in) of the soil is organic or if organic soil material of any thickne[illegible] on rock or on fragmental material having interstices filled with organic materials.

Mineral Soil

Organic Soil



Differentiae

Diagnostic

Horizons, Characteristics, Properties, Materials, Soil Moisture Regimes, Soil Temperature Regimes.

Differentiae

Diagnostic Horizons

Diagnostic Surface Horizons: **Epipedon**

The epipedon (*Gr. epi, over, upon, and pedon, soil*) is a horizon that forms at or near the surface and in which most of the rock structure has been destroyed. It is darkened by organic matter or shows evidence of eluviation, or both.

Differentiae

Diagnostic Horizons

Diagnostic Surface Horizons: **Epipedon**

The epipedon (Gr. *epi*, over, upon, and *pedon*, soil) is a horizon that forms at or near the surface and in which most of the rock structure has been destroyed. It is darkened by organic matter or shows evidence of eluviation, or both.

Differentiae

Diagnostic Horizons

Diagnostic Surface Horizons: **Epipedon (8)**

Mollic, Antrhopic, Umbric, Ochric,

Plaggen, Histic, Folistic, Melanic.

Anthropic Epipedon

The anthropic epipedon has the same limits as the mollic epipedon in color, structure, and organic-carbon content. It formed during long-continued use of the soil by humans, either as a place of residence or as a site for growing irrigated crops. In the former case, disposal of bones and shells has supplied calcium and phosphorus and the level of phosphorus in the epipedon is too high for a mollic epipedon. Such epipedons occur in the humid parts of Europe, the United States, and South America and probably in other parts of the world, mostly in kitchen middens. The high level of phosphorus in the anthropic epipedons is not everywhere accompanied by a base saturation of 50 percent or more, but it is accompanied by a relatively high base saturation if compared with the adjacent soils.

In arid regions some long-irrigated soils have an epipedon that is like the mollic epipedon in most chemical and physical properties. The properties of the epipedon in these areas are clearly the consequence of irrigation by humans. Such an epipedon is grouped with the anthropic epipedons, which developed under human habitation. If not irrigated, such an epipedon is dry in all its parts for more than 9 months in normal years. Additional data about anthropic epipedons from several parts of the world may permit future improvements in this definition.

Required Characteristics

In summary, the anthropic epipedon shows some evidence of disturbance by human activity and meets all of the requirements for a mollic epipedon, except for *one or both* of the following:

1. 1,500 milligrams per kilogram or more P_2O_5 soluble in 1 percent citric acid and a regular decrease in P_2O_5 to a depth of 125 cm; *or*

2. If the soil is not irrigated, all parts of the epipedon are dry for 9 months or more in normal years.

Melanic Epipedon

The melanic epipedon is a thick, dark colored (commonly black) horizon at or near the soil surface (photo 5). It has high concentrations of organic carbon, generally associated with short-range-order minerals or aluminum-humus complexes. The intense dark colors are attributed to the accumulation of organic matter from which "Type A" humic acids are extracted. This organic matter is thought to result from large amounts of root residues supplied by a gramineous vegetation and can be distinguished from organic matter formed under forest vegetation by the melanic index.

The suite of secondary minerals generally is dominated by allophane, an density and a high anion a

Required Ch

Differentiae

Diagnostic Horizons

Diagnostic Subsurface Horizons: **Endopedon**

The epipedon (Gr. *endo*, inside, and *pedon*, soil)

The horizons described in this section form below the surface of the soil, although in some areas they form directly below a layer of leaf litter. They may be exposed at the surface by truncation of the soil. Some of these horizons are generally regarded as B horizons, some are considered B horizons by many but not all pedologists, and others are generally regarded as parts of the A horizon.

Differentiae

Diagnostic Horizons

Diagnostic Suburface Horizons: **Endopedon (19)**

Agric, Albic, Argillic, Calcic, Cambic, Duripan, Fragipan, Glossic, Gypsic, Kandic, Natric, Ortstein, Oxic, Petrocalcic, Petrogypsic, Placic, Salic, Sombric, Spodic.

Calcic Horizon

Natric Horizon

Petrocalcic Horizon

Spodic Horizon

Argillic Horizon

Differentiae

Other Diagnostic Soil Characteristics

Abrupt Textural Change, Albic Materials, Andic Soil Properties, Anhydrous Conditions, Coefficient of Linear Extensibility (COLE), Durinodes, Fragic Soil Properties, Identifiable Secondary Carbonates, Interfingering of Albic Materials, Lamellae, Lithologic Discontinuities, *n* Value, Petroferric Contact, Plinthite, Resistant Minerals, Slickensides, Spodic Materials, Weatherable Minerals…. Humilluvic Material, Limnic Materials, Fibers…...Permafrost, Gelic Materials, Lithic Contact….etc.

Differentiae

Soil Moisture Regimes

The term "*soil moisture regime*" refers to the presence or absence either of ground water or of water held at a tension of less than 1500 kPa* in the soil or in specific horizons during periods of the year.

The most important of the soil interpretations are the potentials for growing different plants and the cultural practices required to grow them.

"Normal year"

**Permanent wilting point*

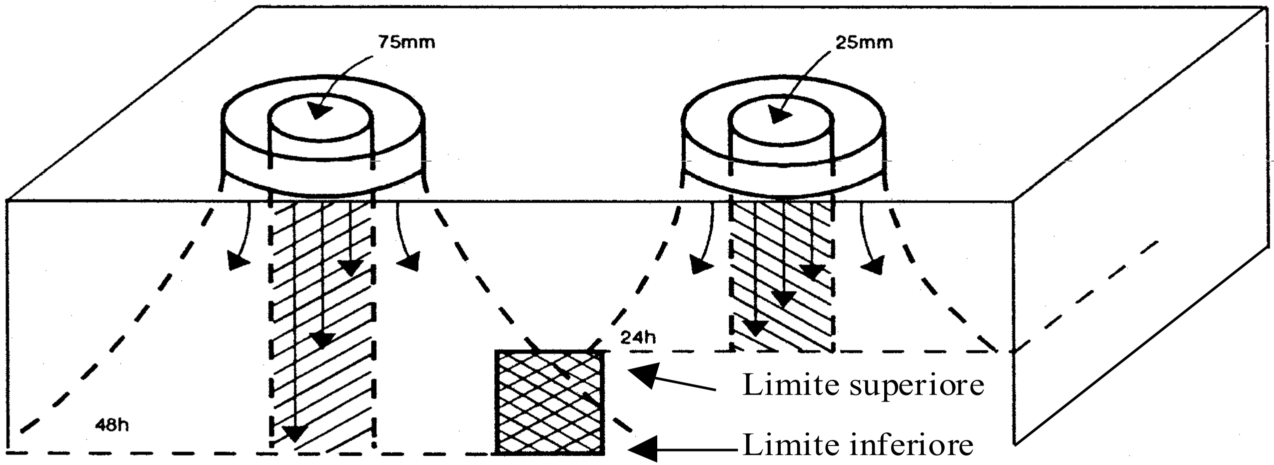
Soil Moisture Control Section

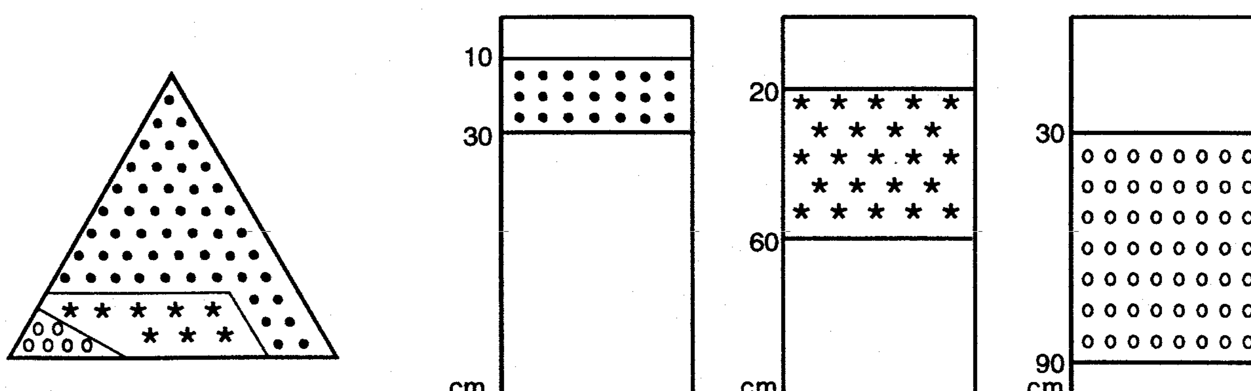
The intent in defining the soil moisture control section is to facilitate estimation of soil moisture regimes from climatic data. The upper boundary of this control section is the depth to which a dry (tension of more than 1500 kPa, but not air-dry).

soil will be moistened by 2.5 cm of water within 24 hours. The lower boundary is the depth to which a dry soil will be moistened by 7.5 cm of water within 48 hours. These depths do not include the depth of moistening along any cracks or animal burrows that are open to the surface.

Normal year

Soil Moisture Control Section





Differentiae

Classes of Soil Moisture Regimes

Aquic (L. *aqua*, water)
Aridic or Torric (L. *aridus*, dry, and L. *torridus*, hot and dry)
Udic (L. *udus*, humid)
Ustic (L. *ustus*, burnt; implying dryness)
Xeric (Gr. *xeros*, dry)

Differentiae

Classes of Soil Moisture Regimes

Xeric moisture regime.—The xeric (Gr. xeros, dry) moisture regime is the typical moisture regime in areas of Mediterranean climates, where winters are moist and cool and summers are warm and dry. The moisture, which falls during the winter, when potential evapotranspiration is at a minimum, is particularly effective for leaching. In areas of a xeric moisture regime, the soil moisture control section, in normal years, is dry in all parts for 45 or more consecutive days in the 4 months following the summer solstice and moist in all parts for 45 or more consecutive days in the 4 months following the winter solstice. Also, in normal years, the moisture control section is moist in some part for more than half of the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is higher than 6 °C or for 90 or more consecutive days when the soil temperature at a depth of 50 cm is higher than 8 °C. The mean annual soil temperature is lower than 22 °C, and the mean summer and mean winter soil temperatures differ by 6 °C or more either at a depth of 50 cm from the soil surface or at a densic, lithic, or paralithic contact if shallower.

Differentiae

Soil Temperature Regimes

The temperature of a soil is one of its important properties. Within limits, temperature controls the possibilities for plant growth and for soil formation.

Mean Annual Soil Temperature

Estimation:

Tm soil = Tm air + 1

Tm soil in summer = Tm air in summer – 0,6

Tm soil in winter = [Tm soil – (Tm soil in summer – Tm soil)]

Differentiae

Classes of Soil Temperature Regimes

Cryic (Gr. *kryos*, coldness; meaning very cold soils).—Soils in this temperature regime have a mean annual temperature lower than 8 °C but do not have permafrost.

Frigid.—A soil with a frigid temperature regime is warmer in summer than a soil with a cryic regime, but its mean annual temperature is lower than 8 °C and the difference between mean summer (June, July, and August) and mean winter (December, January, and February) soil temperatures is more than 6 °C.

Mesic.—The mean annual soil temperature is 8 °C or higher but lower than 15 °C, and the difference between mean summer and mean winter soil temperatures is more than 6 °C

Differentiae

Classes of Soil Temperature Regimes

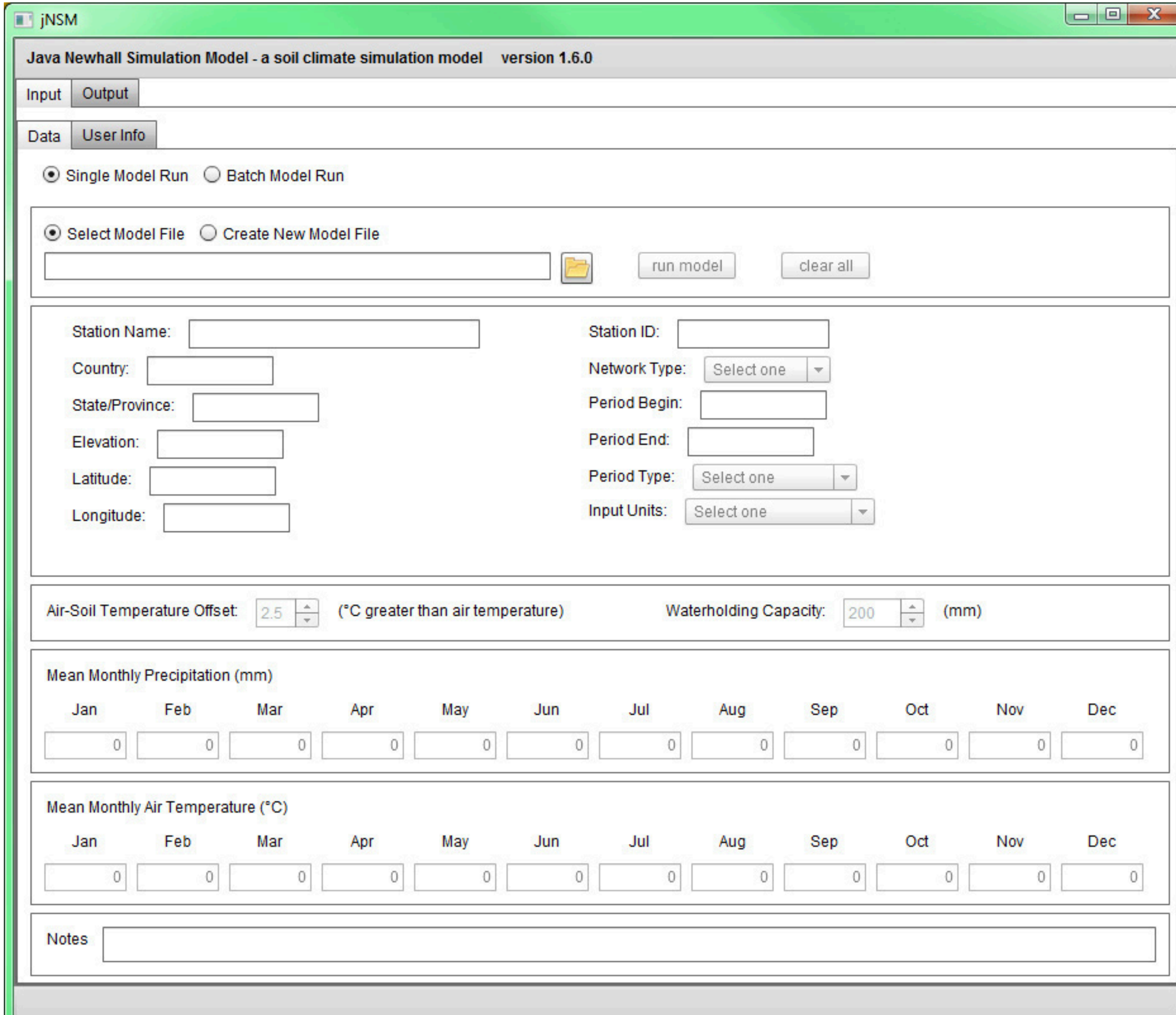
Thermic.—The mean annual soil temperature is 15 °C or higher but lower than 22 °C, and the difference between mean summer and mean winter soil temperatures is more than 6 °C.

Hyperthermic.—The mean annual soil temperature is 22 °C or higher, and the difference between mean summer and mean winter soil temperatures is more than 6 °C.

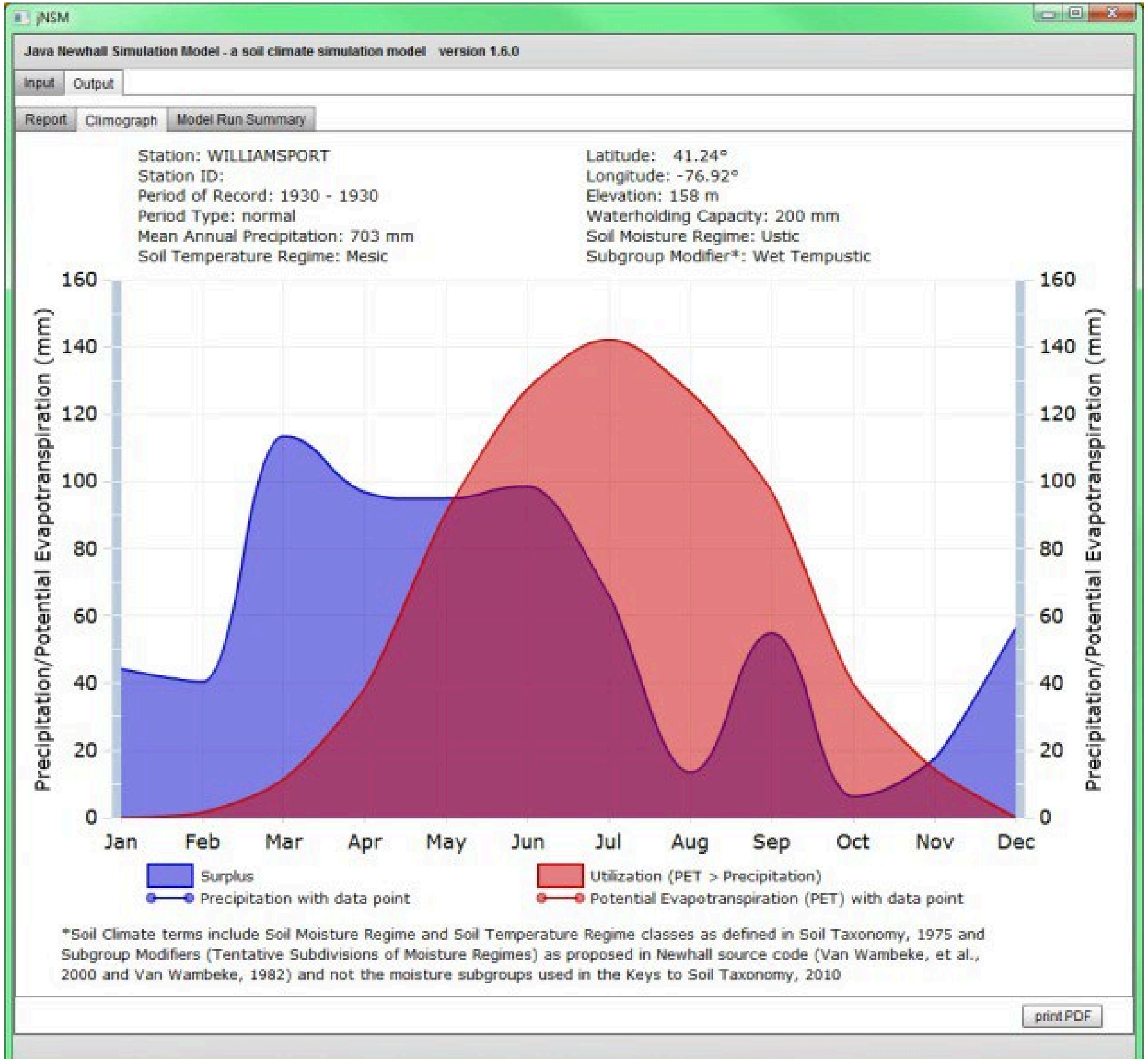
If the name of a soil temperature regime has the prefix **iso**, the mean summer and mean winter soil temperatures differ by less than 6 °C.

Isofrigid, Isomesic, Isothermic, Isohyperthermic

Newhall Simulation Model



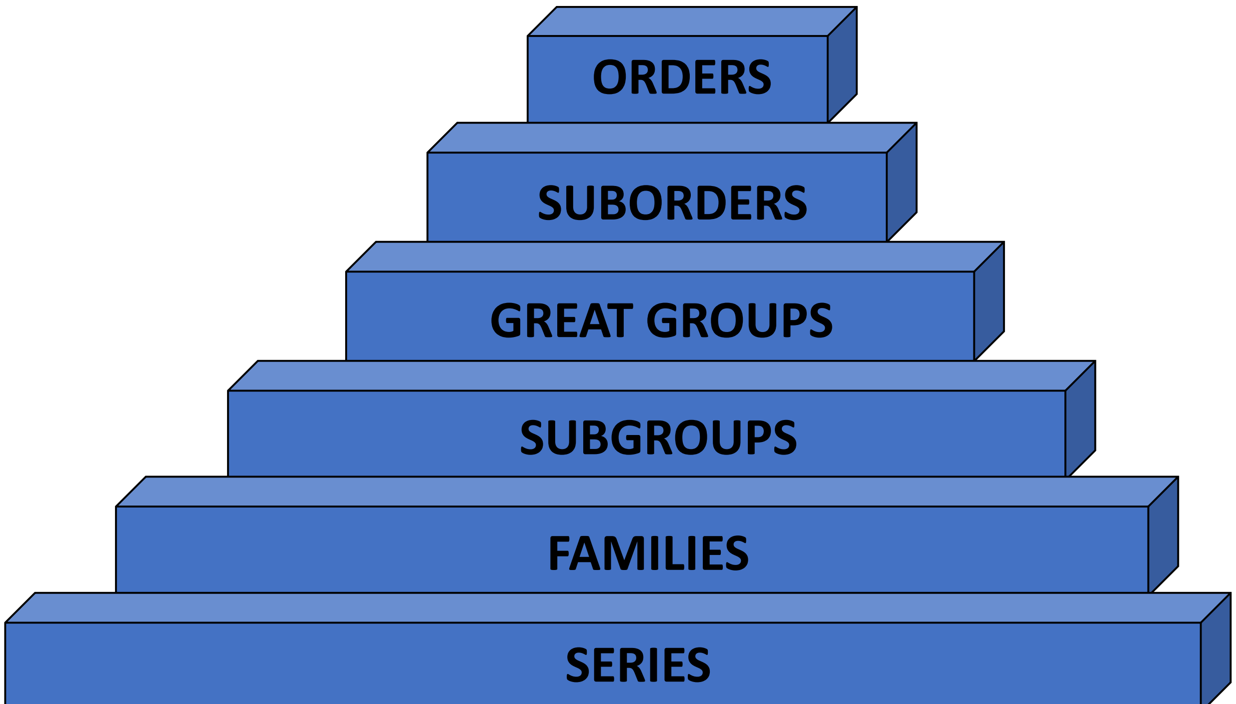
Newhall Simulation Model



SOIL TAXONOMY

Categories of Soil Taxonomy

Hierarchical system



SOIL TAXONOMY

ORDERS: 12

SUBORDERS: 64

GREAT GROUPS: ~ 300

SUBGROUPS: ~ 2,400

FAMILIES: > 5,000

SERIES: > 22,000

The Twelve USDA Soil Orders

Entisols	Ultisols	Spodosols
Inceptisols	Gelisols	Histosols
Mollisols	Vertisols	Andisols
Alfisols	Aridisols	Oxisols

The Twelve USDA Soil Orders

Alfisol

Andisol

Ardisol

Entisol

Gelisol

Histisol

Inceptisol

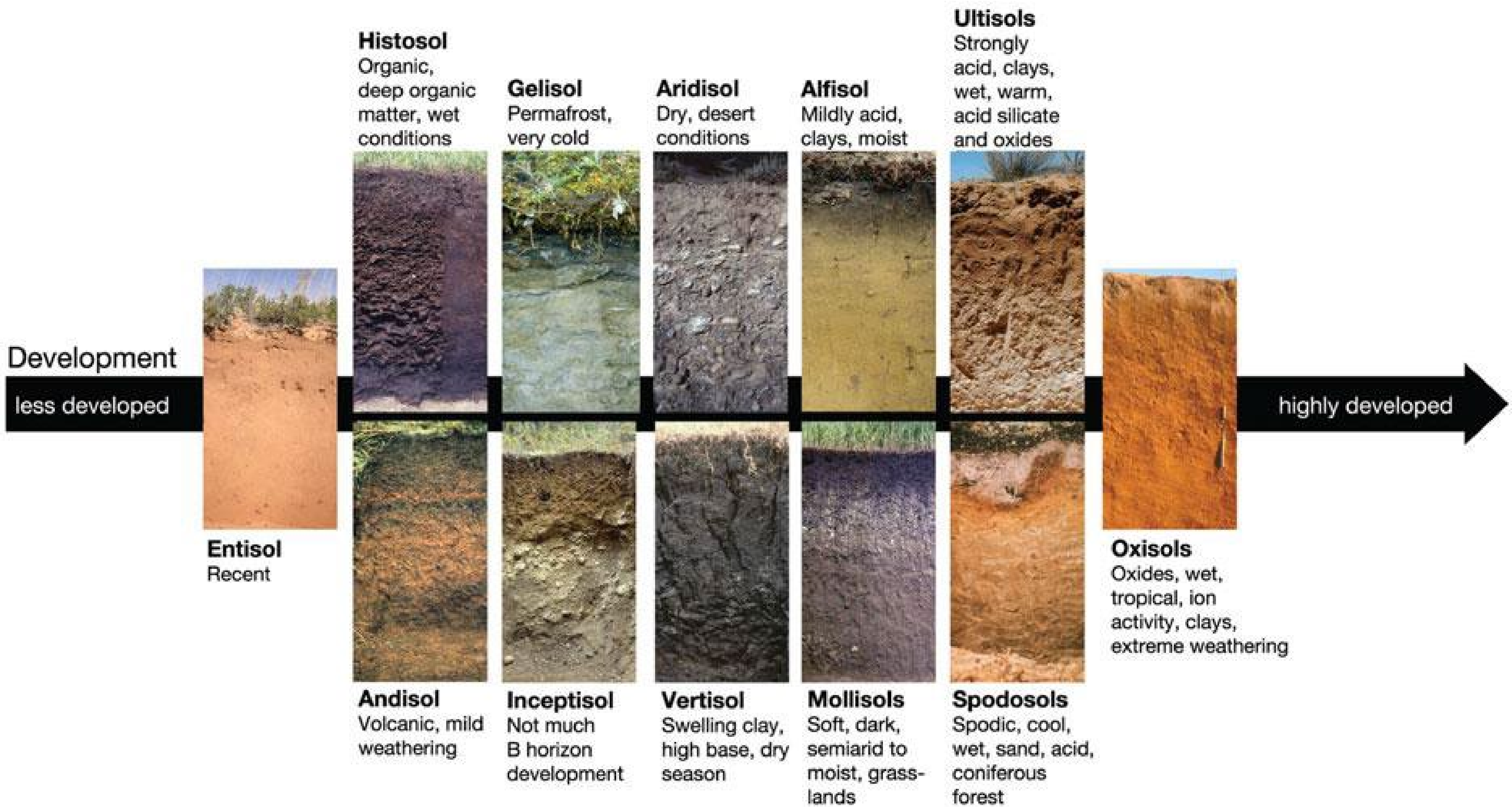
Mollisol

Oxisol

Spodosol

Ultisol

Vertisol



Development
less developed
highly developed
Entisol
Recent
Histosol
Organic, deep organic matter, wet conditions
Andisol
Volcanic, mild weathering
Gelisol
Permafrost, very cold
Inceptisol
Not much B horizon development
Aridisol
Dry, desert conditions
Vertisol
Swelling clay, high base, dry season
Alfisol
Mildly acid, clays, moist
Mollisols
Soft, dark, semiarid to moist, grass-lands
Ultisols
Strongly acid, clays, wet, warm, acid silicate and oxides
Spodosols
Spodic, cool, wet, sand, acid, coniferous forest
Oxisols
Oxides, wet, tropical, ion activity, clays, extreme weathering

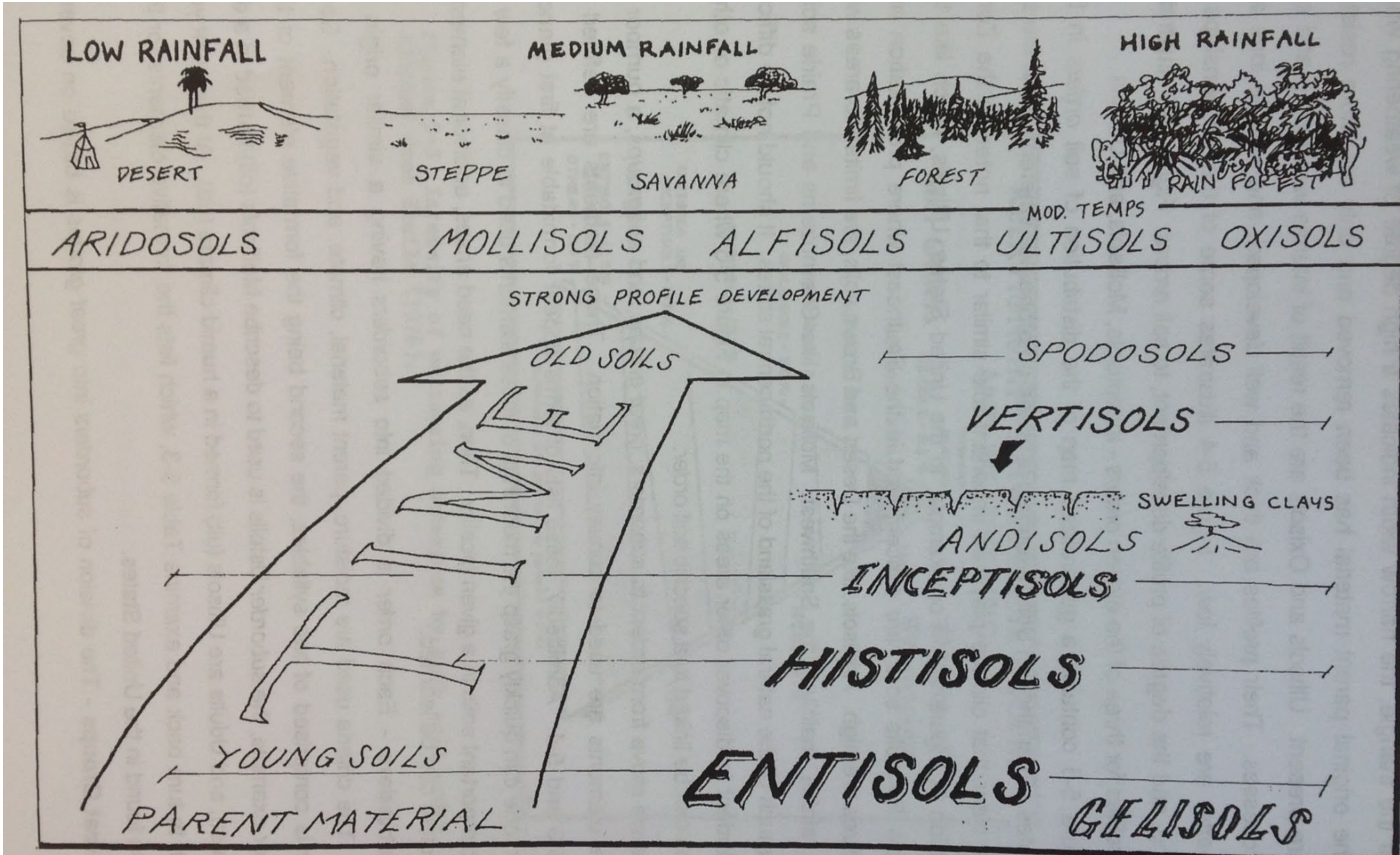


Figure 5-4 Some relationships of soil orders to rainfall, time, and other factors.

NOMENCLATURE

The nomenclature of soil taxonomy is based on the following premises:

- Each taxon requires a name if it is to be used in speech; a good name is short, easy to pronounce, and distinctive in meaning;
- a name is connotative, that is, capable of mnemonic attachment to the concept of the thing itself;
- it is useful if the name of a taxon indicates its position in the classification, if similarities in important properties are reflected by similarities in names, if the mnemonic attachments hold in many languages, and if the name fits into many languages without translation.

The name of each taxon above the category of series indicates its class in all categories of which it is a member.

The name of a soil series indicates only the category of series. Thus, a series name may be recognized as a series, but it does not indicate the order, suborder, great group, subgroup, or family.

Formative Elements in Names of Soil Orders

Name of order	Formative element in name	Derivation of formative element	Pronunciation of formative element
Alfisols	Alf	Meaningless syllable	Pedalfer.
Andisols	And	Modified from ando	Ando.
Aridisols	Id	L. *aridus*, dry	Arid.
Entisols	Ent	Meaningless syllable	Recent.
Gelisols	El	L. *gelare*, to freeze	Jell.
Histosols	Ist	Gr. *histos*, tissue	Histology.
Inceptisols	Ept	L. *inceptum*, beginning	Inception.
Mollisols	Oll	L. *mollis*, soft	Mollify.
Oxisols	Ox	F. *oxide*, oxide	Oxide.
Spodosols	Od	Gr. *spodos*, wood ash	Odd.
Ultisols	Ult	L. *ultimus*, last	Ultimate.
Vertisols	Ert	L. *verto*, turn	Invert.

Suborders

The names of suborders have exactly two syllables. The first syllable connotes something about the diagnostic properties of the soils. The second is the formative element from the name of the order.

28 formative elements are used with the 12 formative elements from names of the orders to make the names of 64 suborders.

The suborder of Entisols that has aquic conditions throughout is called **Aquents** (L. ***aqua***, water, plus ***ent*** from Entisol). The formative element *aqu* is used with this meaning in 9 of the 12 orders.
The suborder of Entisols that consists of very young sediments is called **Fluvents** (L. ***fluvius***, river, plus ***ent*** from Entisol).

Formative Elements in Names of Suborders

Formative element	Derivation	Connotation
Alb	L. *albus*, white	Presence of an albic horizon.
Anthr	Modified from Gr. *anthropos*, human	Modified by humans.
Aqu	L. *aqua*, water	Aquic conditions.
Ar	L. *arare*, to plow	Mixed horizon.
Arg	Modified from argillic horizon; L. *argilla*, white clay	Presence of an argillic horizon.
Calc	L. *calcis*, lime	Presence of a calcic horizon.
Camb	L. *cambiare*, to exchange	Presence of a cambic horizon.
Cry	Gr. *kryos*, icy cold	Cold.
Dur	L. *durus*, hard	Presence of a duripan.
Fibr	L. *fibra*, fiber	Least decomposed stage.
Fluv	L. *fluvius*, river	Flood plain.
Fol	L. *folia*, leaves	Mass of leaves.
Gyps	L. *gypsum*, gypsum	Presence of a gypsic horizon.
Hem	Gr. *hemi*, half	Intermediate stage of decomposition.
Hist	Gr. *histos*, tissue	Presence of organic materials.
Hum	L. *humus*, earth	Presence of organic matter.
Orth	Gr. *orthos*, true	The common ones.
Per	L. *per*, throughout in time	Perudic moisture regime.
Psamm	Gr. *psammos*, sand	Sandy texture.
Rend	Modified from Rendzina	High carbonate content.
Sal	L. base of *sal*, salt	Presence of a salic horizon.
Sapr	Gr. *saprose*, rotten	Most decomposed stage.
Torr	L. *torridus*, hot and dry	Torric moisture regime.
Turb	L. *turbidus*, disturbed	Presence of cryoturbation.
Ud	L. *udus*, humid	Udic moisture regime.
Ust	L. *ustus*, burnt	Ustic moisture regime.
Vitr	L. *vitrum*, glass	Presence of glass.
Xer	Gr. *xeros*, dry	Xeric moisture regime.

Great Groups

The name of a great group consists of the name of a suborder and a prefix that consists of one or two formative elements suggesting something about the diagnostic properties.
The names of great groups, therefore, have three or four syllables and end with the name of a suborder.

Fluvents that have a cryic temperature regime are called **Cryofluvents** (Gr. ***kryos***, icy cold, plus ***fluvent***).

Fluvents that have a torric moisture regime are called **Torrifluvents** (L. ***torridus***, hot and dry).

Formative Elements in Names of Great Groups

Formative element	Derivation	Connotation
Acr	Modified from Gr. *arkos*, at the end	Extreme weathering.
Al	Modified from aluminum	High aluminum, low iron.
Alb	L. *albus*, white	Presence of an albic horizon.
Anhy	Gr. *anydros*, waterless	Very dry.
Anthr	Modified from Gr. *anthropos*, human	An anthropic epipedon.
Aqu	L. *aqua*, water	Aquic conditions.
Argi	Modified from argillic horizon; L. *argilla*, white clay	Presence of an argillic horizon.
Calci, calc	L. *calcis*, lime	A calcic horizon.
Cry	Gr. *kryos*, icy cold	Cold.
Dur	L. *durus*, hard	A duripan.
Dystr, dys	Modified from Gr. *dys*, ill; dystrophic, infertile	Low base saturation.
Endo	Gr. *endon*, *endo*, within	Implying a ground water table.
Epi	Gr. *epi*, on, above	Implying a perched water table.
Eutr	Modified from Gr. *eu*, good; eutrophic, fertile	High base saturation.
Ferr	L. *ferrum*, iron	Presence of iron.
Fibr	L. *fibra*, fiber	Least decomposed stage.
Fluv	L. *fluvius*, river	Flood plain.
Fol	L. *folia*, leaf	Mass of leaves.
Fragi	Modified from L. *fragilis*, brittle	Presence of a fragipan.
Fragloss	Compound of fra(g) and gloss	See the formative elements "frag" and "gloss."
Fulv	L. *fulvus*, dull brownish yellow	Dark brown color, presence of organic carbon.
Glac	L. *glacialis*, icy	Ice lenses or wedges.
Gyps	L. *gypsum*, gypsum	Presence of a gypsic horizon.
Gloss	Gr. *glossa*, tongue	Presence of a glossic horizon.
Hal	Gr. *hals*, salt	Salty.
Hapl	Gr. *haplous*, simple	Minimum horizon development.
Hem	Gr. *hemi*, half	Intermediate stage of decompos
Hist	Gr. *histos*, tissue	Presence of organic materials.
Hum	L. *humus*, earth	Presence of organic matter.

Subgroups

The name of a subgroup consists of the name of a great group modified by one or more adjectives.
In some instances, the adjective **Typic** represents what is thought to typify the great group. In other instances, Typic subgroups simply do not have any of the characteristics used to define the other subgroups in a great group. Each Typic subgroup has, in clearly expressed form, all the diagnostic properties of the order, suborder, and great group to which it belongs.
Typic subgroups also have no additional properties indicating a transition to another great group. A Typic subgroup is not necessarily the most extensive subgroup of a great group.

Subgroups

Intergrade subgroups are those that belong to one great group but have some properties of another order, suborder, or great group. They are named by use of the adjectival form of the name of the appropriate taxon as a modifier of the great group name. Thus, the *Torrifluvents* that have some of the properties of *Vertisols* or the properties closely associated with Vertisols are called ***Vertic Torrifluvents.***

Subgroups

Extragrade subgroups are those that have important properties that are not representative of the great group but that do not indicate transitions to any other known kind of soil. They are named by modifying the great group name with an adjective that connotes something about the nature of the aberrant properties. Thus, a **Cryorthent** that has bedrock that is at least strongly cemented within 50 cm of the mineral soil surface is called a **Lithic Cryorthent** (lithic, Gr. ***lithos***, stone).

Adjectives in Names of Extragrades and Their Meaning

Adjective	Derivation	Connotation
Abruptic	L. *abruptus*, torn off	Abrupt textural change.
Aeric[1]	Gr. *aerios*, air	Aeration.
Albic	L. *albus*, white	Presence of an albic horizon.
Alic	Modified from aluminum	High Al^{3+} status.
Anionic	Gr. *anion*	Positively charged colloid.
Anthraquic	Modified from Gr. *anthropos*, human, and L. *aqua*, water	Controlled flooding.
Anthropic	Modified from Gr. *anthropos*, human	An anthropic epipedon.
Arenic	L. *arena*, sand	Sandy material between 50 and 100 cm thick.
Calcic	L. *calis*, lime	Presence of a calcic horizon.
Chromic	Gr. *chroma*, color	High chroma.
Cumulic	L. *cumulus*, heap	Thickened epipedon.
Durinodic	L. *durus*, hard	Presence of durinodes.
Eutric	Modified from Gr. *eu*, good; eutrophic, fertile	High base status.
Fragic	Modified from L. *fragilis*, brittle	Presence of fragic properties.
Glacic	L. *glacialis*, icy	Presence of ice lenses or wedges.
Glossic	Gr. *glossa*, tongue	Tongued horizon boundaries.
Grossarenic	L. *grossus*, thick, and L. *arena*, sand	Thick sandy layer.
Gypsic	L. *gypsum*, gypsum	Presence of a gypsic horizon.
Halic	Gr. *hals*, salt	Salty.
Humic	L. *humus*, earth	Presence of organic matter.

Families

The names of families are polynomial.
Each consists of the name of a subgroup and descriptive terms, generally three or more, that indicate the **particle-size class** (or combinations thereof if strongly contrasting), the **mineralogy** (26 classes), the **cation-exchange activity** (4 classes), the **calcareous and reaction class** (4 classes), the **temperature** (8 classes), and, in a few families, depth of the soil (3 classes), rupture resistance (2 classes), and classes of coatings and classes of cracks (3 classes). The names of most families have three to five descriptive terms that modify the subgroup name.

Families

An example:

family of **fine-loamy** (particle-size class), **mixed** (mineralogy), **superactive** (cation-exchange activity), **calcareous** (calcareous and reaction), **mesic** (soil temperature) **Typic Torrifluvents**.

Typic Torrifluvents, fine-loamy, mixed, superactive, calcareous, mesic.

NOTE. Redundancy in the names of families should be avoided. Particle-size class and temperature classes should not be used in the family name if they are specified above the family level.

Series

The names of series as a rule are abstract place names. The name generally is taken from a place near the one where the series was first recognized. It may be the name of a town, a county, or some local feature.

Order	Suborder	Great Group	Subgroup	Family	Series
Entisols	Fluvents	Torrifluvents	Typic Torrifluvents ...	Fine-loamy, mixed, superactive, calcareous, mesic.	Jocity, Youngston.

Examples

Typic Xerofluvent

Chromic Calcixerert

Lithic Petrocalcid

A name is connotative, that is, capable of mnemonic attachment to the concept of the thing itself. It's remind the properties, then how we can use and manage soil.

«Nomina sunt consequentia rerum» ***name are consequences of facts***

Justinian I

TYPIC

XEROFLUVENT

LITHIC

XERORTHENT

PETROCALCIC

PALEXERALF

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

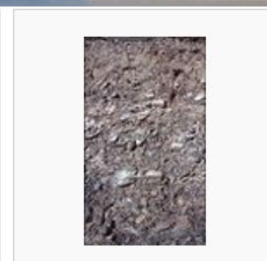
Keys to Soil Taxonomy

Twelfth Edition, 2014

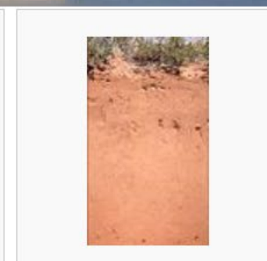
Dichotomous Key

Alfisol

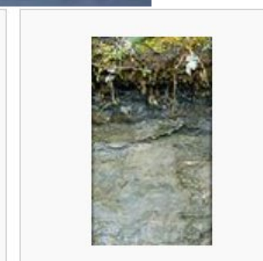
Andisol



Ardisol

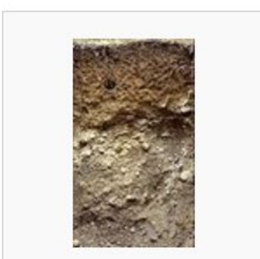


Entisol



Gelisol

Histisol



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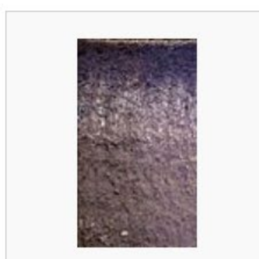

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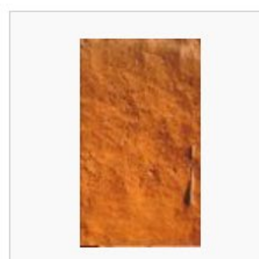
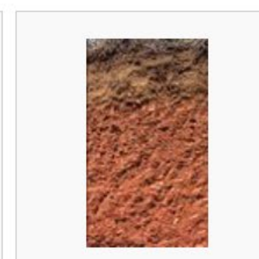


Oxisol

Spodosol



Ultisol

Vertisol