Bioecology
Module: Soil Science

Lecture 11.
Soil geography

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Chronology of the highlights related to soil geography development

Chronology	Socities and authors	Contributions
Antecedents: From 3.500 a. Chr. n. to s. XVII	Fertile Crescent (Western Asia, the Nile Valley and Nile Delta), Mexico and, Hindustan and East China Religious congregation and Arabian civilization	First activities related to soils and agricultural practices Tillage and ploughing with animals, irrigation by gravity and soil conservation
s. XVIII-XIX	J.G. Wallerius, Rieule, T. de Saussure, J. von Liebig and J.B. Boussingault	Biochemical soil properties such as organic matter, color, mineralogy and biodiversity
1837	Philipp Carl Sprengel	First book strictly about soil science ("Die Bodenkunde")
1893	Emil Ramman	Classified soils into two general groups (residual and alluvial). Developed the first scientific diagrams of soil profiles.
1860-1907	Eugene Woldemar Hilgard	Soil as an independent body and the influence of climatic parameters on pedogenesis

Chronology of the highlights related to soil geography development

Chronology	Socities and authors	Contributions
1877-1878	Vasily Vasili'evich Dokuchaev	Developing the first scientific classification of soils such as Chernozem soil profile, methods for soil mapping, and establishing the foundation for the study of both soil genesis and soil geography
1906-1910	Konstantin Dmitrievich Glinka	Detected important factors that conditioned pedogenesis
1926-1927	K.D. Glinka and C.F. Marbut	Create the first complete soil classification, characterized by six groups and 23 sub-types.
1937-1938	Herrmann Stremme	First international soil map of Europe
1950	CISRO	It implemented the use of aerial photography in its first soil classification in Australia
1956-1998	P. Duchaufour	Genetic soil classification and land use planning

Chronology of the highlights related to soil geography development

Chronology	Socities and authors	Contributions
1952 and 1953	W.L. Kubiëna	Evolutionary process of soils interpreted through their pedo-morphological characteristics
1961	Hans Jenny	Five soil-forming factors into a state factor equation to explain the geographic distribution of soils
1979-2012	Van Zuidam, van Zuidam-Cancelado, Verstappen and A. Zinck	Soil geographic databases, soil geomorphology and geopedology
1980	Ewart A. FitzPatrick	Genetic classifications trying to find the most accurate explanation of soil distribution over the landscape and using a coordinate system with specific typologies

MAIN REGULARITIES OF SOIL GEOGRAPHY

The formation (genesis) of any soil is the result of a complex interaction of factors of soil formation. Since certain patterns are observed in the distribution of factors on the earth's surface, naturally, they are reflected in the distribution of soils.

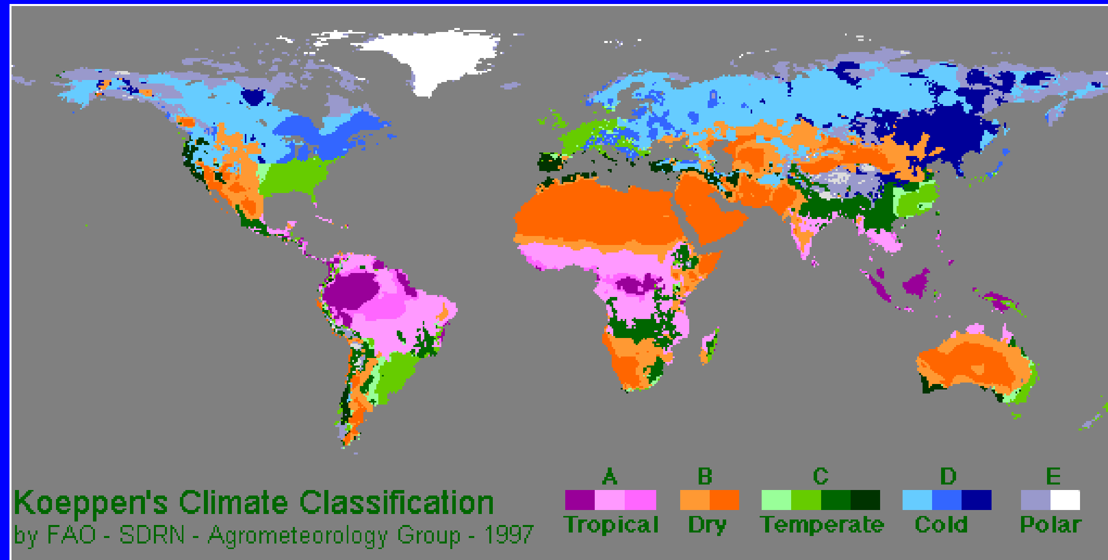
The main laws in soil geography:

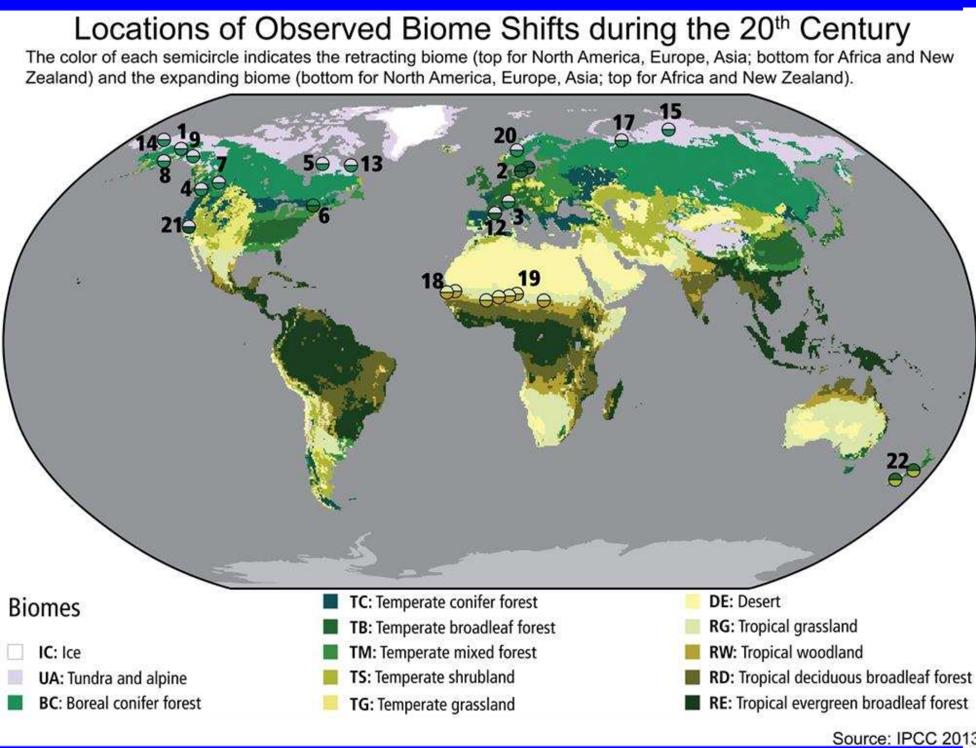
- ✓ the law of latitudinal (horizontal) soil zonality,
- ✓ the law of vertical soil zonality,
- ✓ the law of soil faciess,
- ✓ the law of similar topographic series.

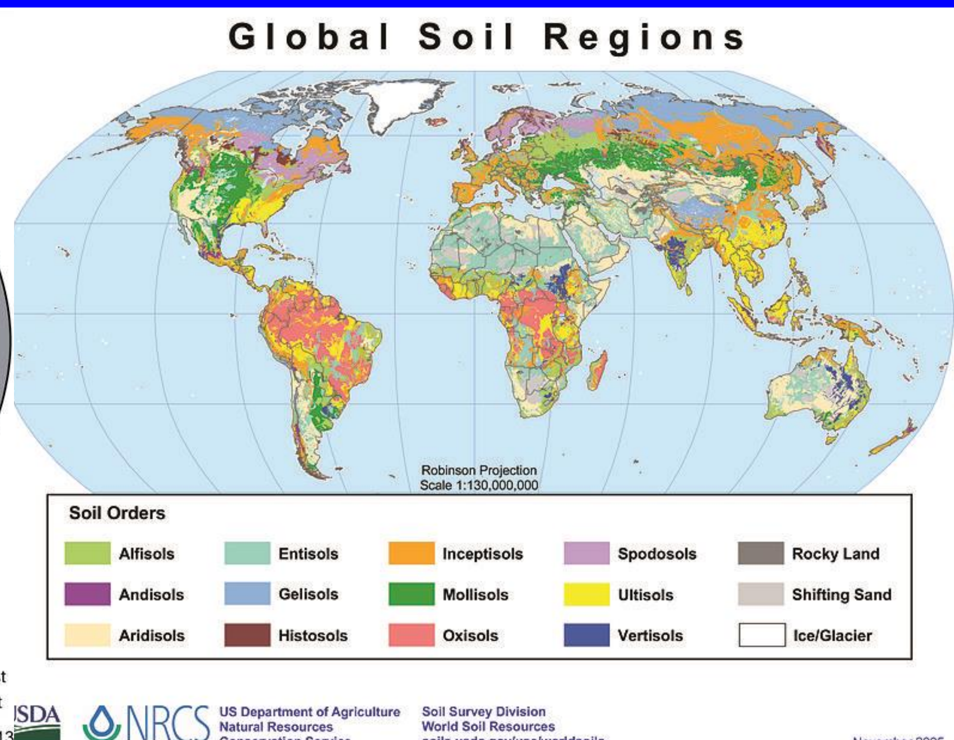
MAIN REGULARITIES OF SOIL GEOGRAPHY

The law of horizontal (latitudinal) soil zonality (V.V. Dokuchaev): since the most important soil formers (climate, vegetation and wildlife) regularly change in latitudinal direction from north to south, the main (zonal) soil types should successively replace each other, located on the earth's surface in latitudinal bands (zones). The presence on the land area of the globe successively replacing each other soil-bioclimatic (thermal) belts, characterized by the similarity of natural conditions and soil cover, due to the generality of radiation and thermal indicators. When moving from north to south within the Northern Hemisphere, five belts are distinguished: polar, boreal, subboreal, subtropical and tropical. Similar belts can be distinguished in the southern hemisphere.

The most distinctly latitudinal soil zones are separated on vast plain areas within continents. On the territory of the continents adjacent to the oceanic and marine basins, such a sequence in the change of latitudinal soil zones is disturbed due to the complicating influence of humid air masses flowing from vast bodies of water to changes in soil formation conditions (climate, vegetation and soil).


Koeppen's Climate Classification
by FAO - SDRN - Agrometeorology Group - 1997
A
Tropical
B
Dry
C
Temperate
D
Cold
E
Polar


Locations of Observed Biome Shifts during the 20th Century
The color of each semicircle indicates the retracting biome (top for North America, Europe, Asia; bottom for Africa and New Zealand) and the expanding biome (bottom for North America, Europe, Asia; top for Africa and New Zealand).
Biomes
IC: Ice
UA: Tundra and alpine
BC: Boreal conifer forest
TC: Temperate conifer forest
TB: Temperate broadleaf forest
TM: Temperate mixed forest
TS: Temperate shrubland
TG: Temperate grassland
DE: Desert
RG: Tropical grassland
RW: Tropical woodland
RD: Tropical deciduous broadleaf forest
RE: Tropical evergreen broadleaf forest
Source: IPCC 2013

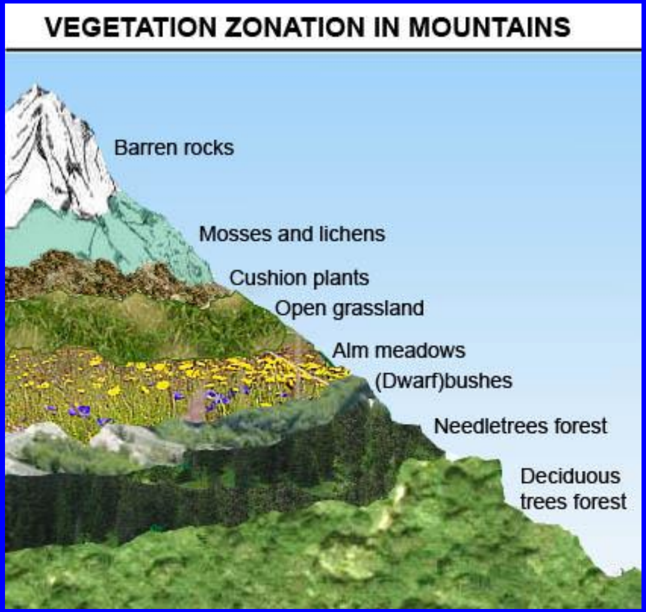

Global Soil Regions
Robinson Projection
Scale 1:130,000,000
Soil Orders
Alfisols
Entisols
Inceptisols
Spodosols
Rocky Land
Andisols
Gelisols
Mollisols
Ultisols
Shifting Sand
Aridisols
Histosols
Oxisols
Vertisols
Ice/Glacier
NRCS
US Department of Agriculture
Natural Resources
Conservation Service
Soil Survey Division
World Soil Resources
soils.usda.gov/use/worldsoils
November 2005

MAIN REGULARITIES OF SOIL GEOGRAPHY

The ***law of vertical soil zonality*** states that in the conditions of mountainous terrain regular sequential changes in climate, vegetation and soil occur due to changes in the absolute height of the terrain. As the mountains rise from their foot to their tops, the air temperature drops by an average of 0.5°C per 100 m of absolute altitude, which leads to a change in the amount of precipitation and, as a result, changes in vegetation and soil. These changes are manifested in the formation of vertical plant-climatic and soil belts (vertical zones). In general, the successive change of zones is similar to their change in the plain areas when moving from south to north.

Such a general scheme of successive change of vertical soil zones can be complicated and disturbed due to the peculiarities of the mountain relief (abrupt change of absolute heights, steepness and exposure of slopes, types of macrorelief - plateau, intermountain depressions, variety of slopes, etc.) and frequent change of soil-forming rocks.

The specific composition of the soil vertical zones is determined by the position of the mountainous country in the system of latitudinal zones and the absolute heights of its relief.



MAIN REGULARITIES OF SOIL GEOGRAPHY

The ***law of soil facies*** is that the soil cover in individual meridional parts of thermal belts and zones may change significantly due to climate change under the influence of thermodynamic atmospheric processes. These changes are due to the proximity or remoteness of specific parts of the belt or zone from the sea and ocean basins, as well as the influence of mountain systems, etc. They manifest themselves in the form of an increase or weakening of atmospheric moisture and a continental climate. Such changes affect vegetation and the manifestation of soil-forming processes.

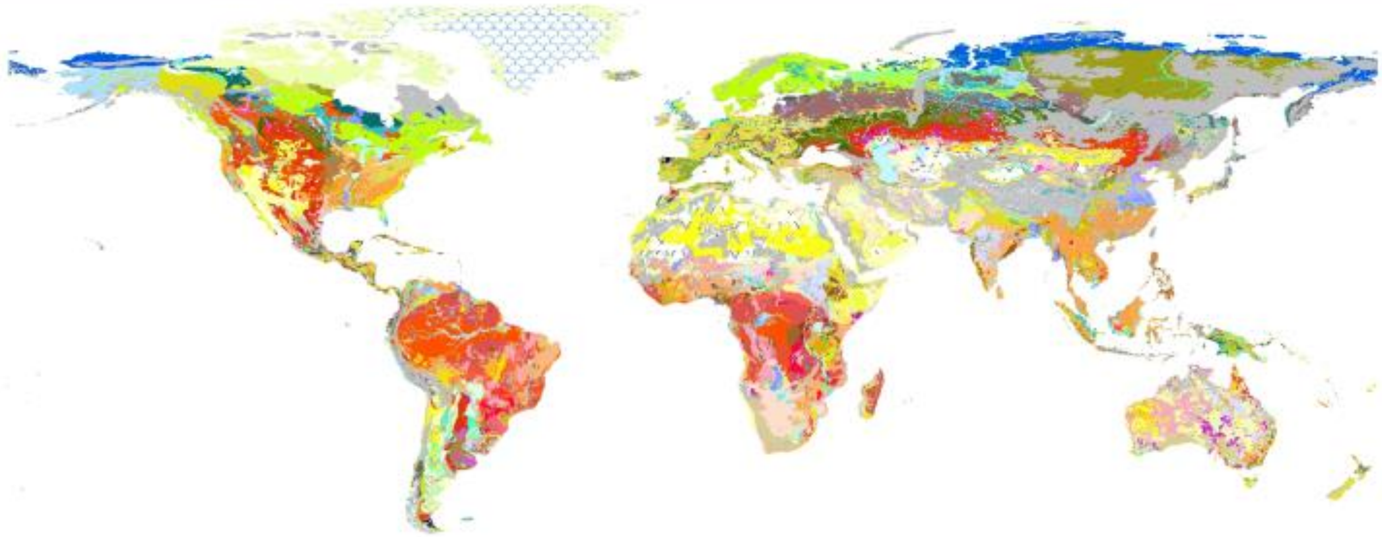
The facial peculiarities of the soil cover are often expressed in the differentiation of the soil according to the temperature regime (warm, moderate, cold, non-freezing, freezing, long-term freezing soils, etc.), occurring differences in the structure of the profile (thickness of humus horizons, etc.) and the properties of the zonal soil type or subtype, and sometimes the appearance of new types in this facies.

MAIN REGULARITIES OF SOIL GEOGRAPHY

The ***law of similar topographic series***: in any zone, the distribution of soils on relief elements has a similar character: on elevated elements there are soils that are genetically independent (automorphic), which are characterized by the removal of mobile soil formation products and the accumulation of slow-moving;

Generically subordinate soils (semi-hydromorphic and hydromorphic) with accumulation of mobile soil-formation products brought from the surface and inside the soil drains from watersheds and slopes. Transitional soils are deposited on the slope relief elements, in which, as they approach the negative forms of the relief, accumulation of mobile substances increases.

Digital Soil Map of the World



Legend

- A -ACRISOLS
- Af-Ferric Acrisols
- Ag-Gleyic Acrisols
- Ah-Humic Acrisols
- Ao- Orthic Acrisols
- Ap-Plinthis Acrisols
- B- CAMBISOLS
- Bc- Chromic Cambisols
- Bd- Dystric Cambisols
- Be- Eutric Cambisols
- Bf- Ferralic Cambisols
- Bg- Gleyic Cambisols
- Bh- Humic Cambisols
- Bk- Calcic Cambisols
- Bv- Vertic Cambisols
- Bx- Gelic Cambisols
- E- RENDZINAS
- C- CHERNOZEMS
- Cg- Glossic Chernozems
- Ch- Haplic Chernozems
- Ck- Calcic Chernozems
- Cl- Luvic Chernozems
- D- PODZOLUVISOLS
- Dd - Dystric Podzoluvisols
- De- Eutric Podzoluvisols
- Dg- Gleyic Podzoluvisols
- F-FERRALSOLS
- Fa- Acric Ferrlsols
- Fh-Humic Ferralsols
- Fo-Orthic Ferralsols
- Fp - Plinthic Ferralsols
- Fr-Rhodic Ferralsols
- Fx- Xanthic Ferralsols
- G-GLEYSOLS
- Gc- Calcaric Gleysols
- Gd- Dystric Gleysols
- Ge- Eutric Gleysols
- Gh- Humic Gleysols
- Gm- Mollic Gleysols
- Gp- Plinthic Gleysols
- Gx- Gelic Gleysols
- H- PHAEOZEMS
- Hc- Calcaric Phaeozems
- Hg- Gleyic Phaeozems
- Hh- Haplic Phaeozems
- Hl- Luvic Phaeozems
- I- Lithosols
- J- FLUVISOLS
- Jc- Calcaric Fluvisols
- Jd- Dystric Fluvisols
- Je - Eutric Fluvisols
- Jt- Thionic Fluvisols
- K- KASTAZNOZEMS
- Kh- Haplic Kastanozems
- Kk- Calcic Kastanozems
- Kl- Luvic Kastanozems
- L- LUVISOLS
- La- Albic Luvisols
- Lc- Chromic Luvisols
- Lf- Ferric Luvisols
- Lg- Gleyic Luvisols
- Lk- Calcic Luvisols
- Lo- Orthic Luvisols
- Lp- Plinthic Luvisols
- Lv - Vertic Luvisols
- M- GREYZEMS
- Mg- Gleyic Greyzems
- Mo- Orthic Greyzems
- N- NITOSOLS
- Nd- Distric Nitosols
- Ne- Eutric Nitosols
- Nh- Humic Nitosols
- O- HISTOSOLS
- Od- Dystric Histosols
- Oe- Eutric Histosols
- Ox- Gelic Histosols
- P- PODZOLS
- Pf- Ferric Podzols
- Pg- Gleyic Podzols
- Ph- Humic Podzols
- Pl- Leptic Podzols
- Po- Orthic Podzols
- Pp- Placic Podzols
- Q- ARENOSOLS
- Qa- Albic Arenosols
- Qc-Cambic Arenosols
- Qf- Ferralic Arenosols
- Ql- Luvic Arenosols
- R- REGOSOLS
- Rc- Calcaric Regosols
- Rd- Dystric Regosols
- Re- Eutric Regosols
- Rx- Gelic Regosols
- S- SOLONETZ
- Sg- Gleyic Solonetz
- Sm- Mollic Solonetz
- So- Orthic Solonetz
- T-ANDOSOLS
- Th- Humic Andosols
- Tm- Mollic Andosols
- To-Ochric Andosols
- Tv- Vitric Andosols
- U- RANKERS
- V- VERTSOLS
- Vc- Chromic Vertisols
- Vp- Pellic Vertisols
- W- PLANOSOLS
- Wd- Dystric Planosols
- We- Eutric Planosols
- Wh-Humic Planosols
- Wm- Mollic Planosols
- Ws- Solodic Planosols
- Wx- Gelic Planosols
- X- XEROSOLS
- Xh- Haplic Xerosols
- Xk- Calcic Xerosols
- Xl- Luvic Xerosols
- Xy- Gypsic Xerosols
- Y-YERMOSOLS
- Yh- Haplic Yermosols
- Yk- Calcic Yermosols
- Yl- Luvic Yermosols
- Yt- Takyric Yermosols
- Yy- Gypsic Yermosols
- Z- SOLONCHAKS
- Zg- Gleyic Solonchaks
- Zm- Mollic Solonchaks
- Zo- Orthic Solonchaks
- Zt- Takyric Solonchaks
- Water Bodies (WA)
- Water bodies (WA)
- Glaciers (GL)
- Salt flats (ST)
- Rock debris (RK)
- Dunes/Shifting sand (DS)
- No data (ND)

Thank you for attention!