SOIL GEOGRAPHICAL DATABASE OF TURKEY AT A SCALE 1:1.000.000

4th APPROXIMATION

by

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PREFACE

The soil geographical database of Turkey at 1:1 million scale is prepared in the context of the ESB network initiative (Version 4) primarily seeking to extend the EU soil database to the countries of the Southern Mediterranean Basin as well as build up a common understanding and nomenclature of soils (within the soil region concept) and strong contacts for future mutual detailed soil/environment your studies. Further studies under preparation by the ESB/WRB network members would necessitate the preparation of soil maps with larger scales (1:500.000, 1:25.000).

The first meeting in Bari organized by the CIHEAM's efforts with the resolution for the completion of the 1:1M soil maps by all member was followed by the second meeting in Beirut bearing the ultimate discussions of the completion of the maps. The preparation of a follow up project, based on the maps produced as well as information complied since decade in the region on soil degradation/desertification, was decided

The task of preparation was conferred to Dr. S. Kapur later to proceed and finalized with leading inputs by Drs. C. Bogliotti and P. Steduto.

The ESB together with the CIHEAM are kindly acknowledged for the organization of the meeting as well as their inputs the follow up project to be pursued for further soil degradation studies.

Introduction

The late Prof. Dr Kerim Ö. Çağlar pioneered in Turkey in the early 1950's modern research in soil science and soil survey, which was summarised in his study on "Turkish Soils". The work contained a schematic soil colour map showing 11 soil classes, which included among others, the dry and Chestnut Dark Yellowish Soils, the Mediterranean – Aegean and South East Anatolian zone of Red Soils, the North Eastern Anatolia and Eastern Black Sea Region with Black Soils (Çağlar, 1958).

Oakes (1958) undertook another soil survey work, which yielded to a soil map of 1:800.000 scale. This reconnaissance survey, which was accomplished in a relatively short period of time, was based on the geologic and topographic maps of the country comprising also soil analyses for selected Great Soil Groups. The author classified the Turkish soils according to Baldwin et al's (1938) Soil Classification System with mapping units showing soil phases such as slope, stoniness, drainage and salinity.

In the early 1960's, the task of classifying and mapping soils in Turkey, to be accomplished at a more detailed level than in the past, was conveyed to the former General Directorate of Soil and Water (GDSW) or the present General Directorate of Rural Services (GDRS). These studies were meant to be part of the small-scale reconnaissance soil map of Europe, which was prepared from 1966 to 1971 using 1:25,000 scaled topographic maps. For more detailed work on land use planning, the Great Groups established according to Baldwin et al (1938) system, together with selected phases, were used for provincial (1:100,000) as well as basin mapping purposes (1:200,000). The initial use of the earlier versions of Soil Taxonomy (Soil Survey Staff, 1975) was accomplished by de Meester (1970) and Boxem and Wielemaker (1972) on the Konya Plain (Central Anatolia) and the Küçük Menderes Valley (Western Anatolia). The GDRS and Universities accomplished numerous soil surveys throughout the country from the 1970's until the present (Dinç, 1970, Dinç, 1974, Dinç et al. 1990, 1991a, 1991b)

The recently prepared 1:1 M ESB/WRB map of the Turkey is a 4th approximation which is a compilation of the previous maps and studies undertaken in the past (Dinç and Şenol, 1998). However, partial refinement is still required by additional profile descriptions, especially from the northeast Acrisols of Black Sea region, the Andosols of eastern Anatolia and Kastanozems of the higher elevations, in spite of the field trips of 1996-2001 led by Profs. U. Dinç (pioneer of the remotely sensing studies and their soil applications to surveys in Turkey), S. Kapur and S. Şenol, Drs. O. Dinç and E. Akça incorporating the recent soil mapping studies accomplished by the University of Çukurova in central, south and eastern Anatolia as well as many spot sites throughout the country.

MATERIALS USED

This work is undertaken according to the "Instructions Guide for Elaboration of Soil geographical Database of Euro-Mediterranean Countries at 1:1.000.000, Version 4". For the preparation of Soil Map of Turkey:

a. 1/1.000.000 Geology Maps
b. 1/800.000 Soil Map of Oakes (1958)
c. 1/1.000.000 Erosion Map of Turkey
d. 1/ 4.000.000 Slope Map of Turkey
e. 1/100.000 County Soil Maps
f. 1/200.000 Basin Soil Maps
g. 1/25.000 Southeastern Anatolia Irrigation Project Area Soil Maps

h. University projects

TOPOGRAPHY AND CLIMATE

A. Topography

The climate, vegetation, population, economic life and particularly soils of Turkey are highly affected by the diverse topography of the country. Major causes of this diversity are due to the tectonic movements of the recent geologic periods and accumulation of volcanic products, which have created an elevated mass with an average altitude of 1132m. Thus, plains of 0 to 250m altitude cover only one tenth of the country, whereas places higher than 800m cover two third and half of the country is higher than 1000m (Izbirak, 1975; Dinç et al. 1997) (Figure 1). Most mountain ranges extend from west to east and great ranges appear in forms of arches. Among these, are the ranges in northern, eastern, western and southern Anatolia. The Taurus Mountains in the south set a good example of this sort. The highlands and basins among them have formed similar geomorphologic features.

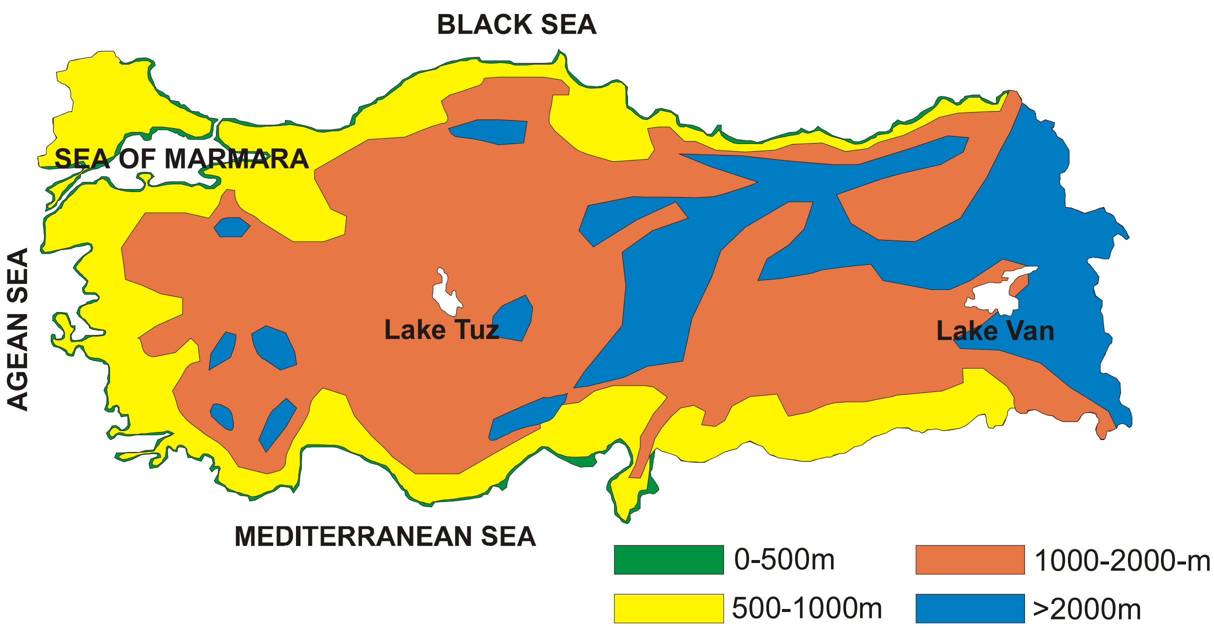

Figure 1. Elevation of Turkey (modified from Izbirak, 1975; Darkot and de Agostini, 1980)

B. Climate

Turkey is under the influence of two rather contrasting climatic types, namely the temperate climate with a year round precipitation and the Mediterranean with dry summers.

However, 15 subdivisions of the two main climatic types have been established by Izbirak (1975) due to the effect of topography on climate (Figure 2).

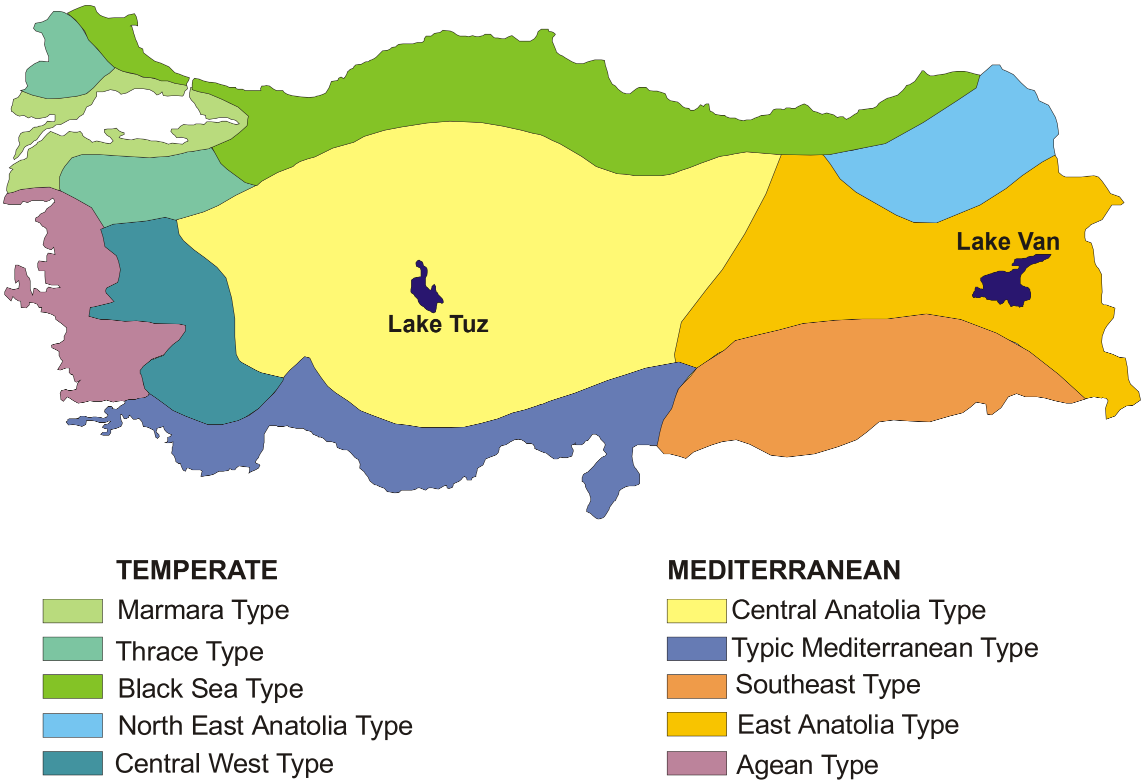

Figure 2. Climatic Regions (modified from Izbirak, 1975; Darkot and de Agostini, 1980, SMD, 2001)

Precipitation

The highest rates of precipitation are received at the seaside slopes of the coastal mountains (Figure 3), where the annual precipitation varies from 700 to 2500mm. The eastern Black Sea region is a good example for this exceeding 2400mm in a period of 170 days (State Meteorological Directorate "SMD", 2001). Precipitation increases as humid west and northwest winds penetrate the land in accordance with mountains parallel to or perpendicular to the coastline. Towards inland precipitation decreases to an annual 600mm. Farther interior to the east and central part of the country, which is only behind the high (2000-3000m) coastal mountain ranges the annual precipitation drops to about 450mm and to 360mm in Ankara. Similar trends prevail in the Mediterranean region with precipitation being 1300mm on the coast, and increasing to 2000 at the higher slopes. On the contrary the inland annual precipitation rates vary from 600mm to 450mm. The precipitation of coastal and inland parts of the country are mostly as rainfall whereas higher plateaus and ranges are subjected to snowfall.

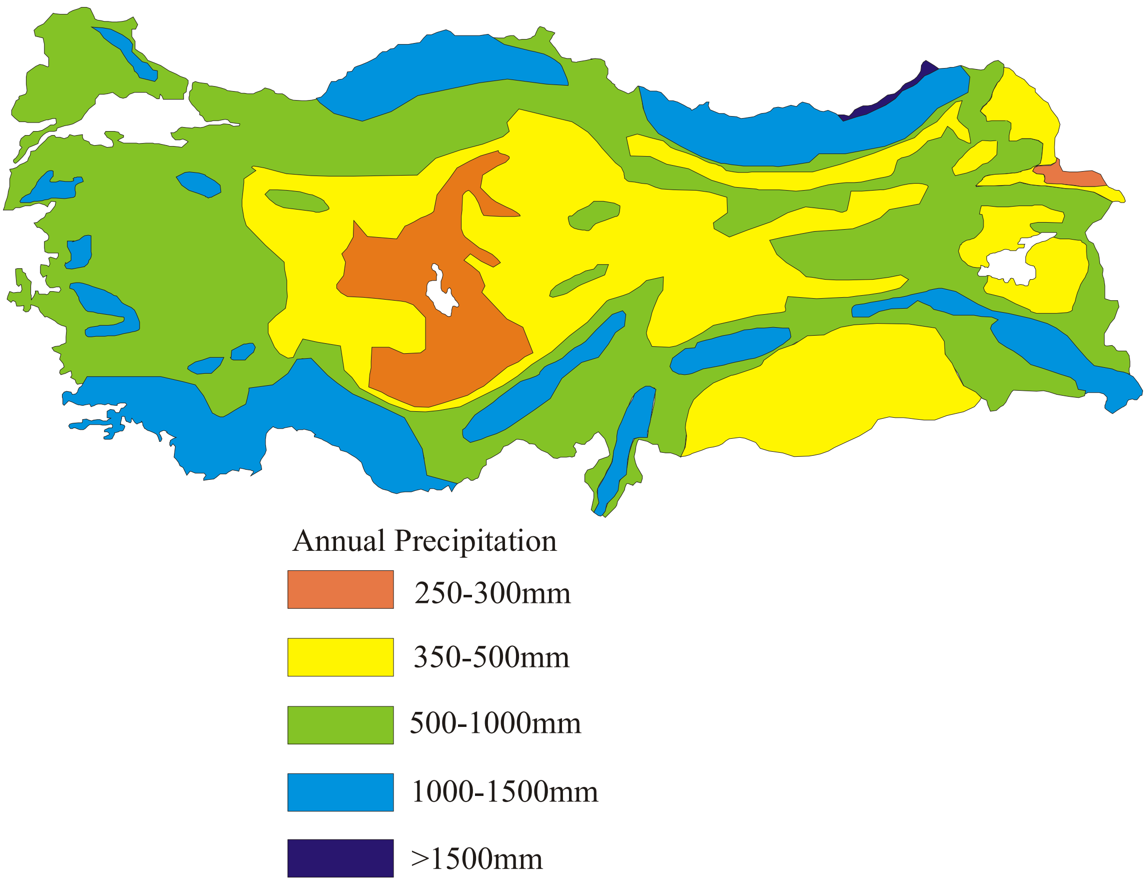

Figure 3. Distribution of Annual Precipitation (modified from Izbirak, 1975; Darkot and de Agostini, 1980; SMD, 2001)

Temperature

The average January temperatures of the country are higher than 10°C along the Mediterranean coasts decreasing to 5°C on the Aegean, Black Sea and southern parts along the eastern Mediterranean coast and along the Syrian border. The immediate inland average temperatures, surrounding the coast, further decrease to 0°C in January. The central part of the country varies from –5°C to 0°C. The coldest part of the country with January average temperatures of –10°C to –5°C and –15°C to –10°C is eastern Anatolia with patches bordering Central Anatolia with the west, north and south (Figure 4).

The average July temperatures are more than 30°C in the southeast and the south. Along the river valleys of the Aegean region (western Turkey) the temperature varies from 25°C to 30°C. The inland temperature is 20°C to 25°C in the central and northwestern parts and 15°C to 20°C along the deep valleys of the main tectonic belts of the country, namely along the Black Sea coast and eastern Turkey. Patches of 10 to 15°C and relatively lower temperatures prevail on the highlands scattered along the southern slopes of the Black Sea ranges (the Pontids) and in the south on the southern higher slopes (1500-2500m) of the Taurus Mountains (The Taurids) (Figure 5).

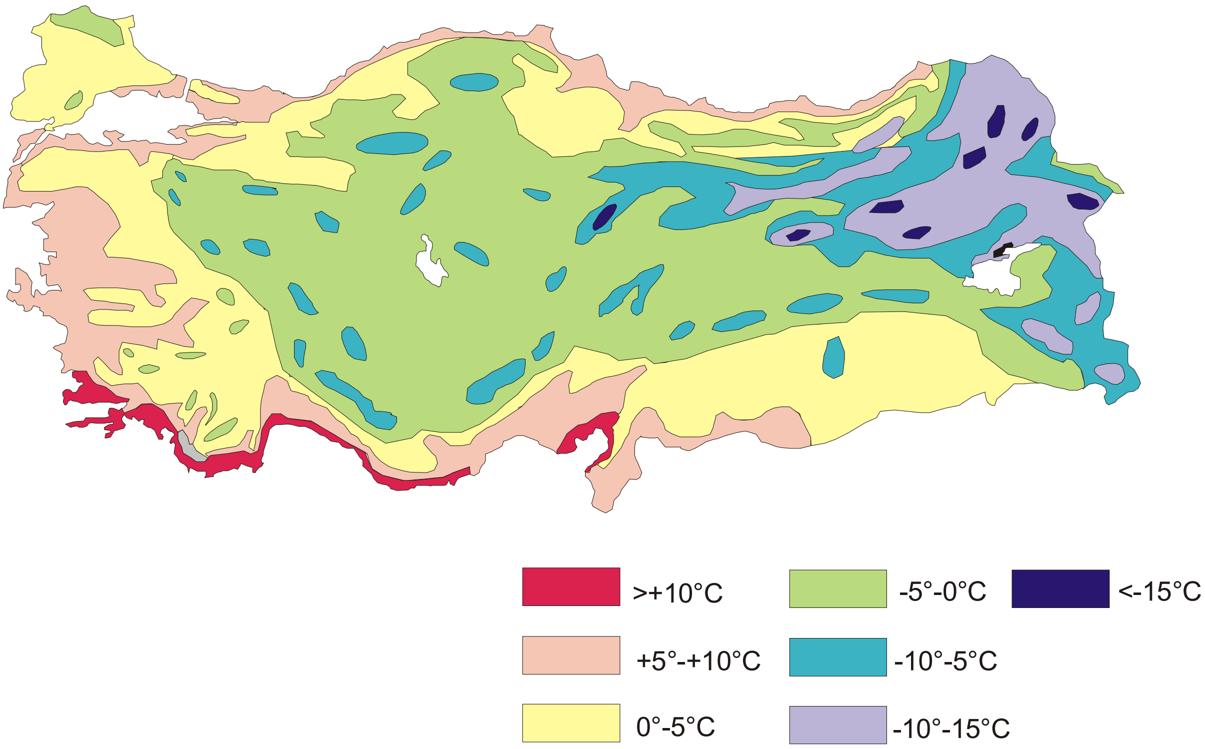

Figure 4. Distribution of January Temperatures (modified from Izbirak, 1975; Darkot and de Agostini, 1980; SMD, 2001)

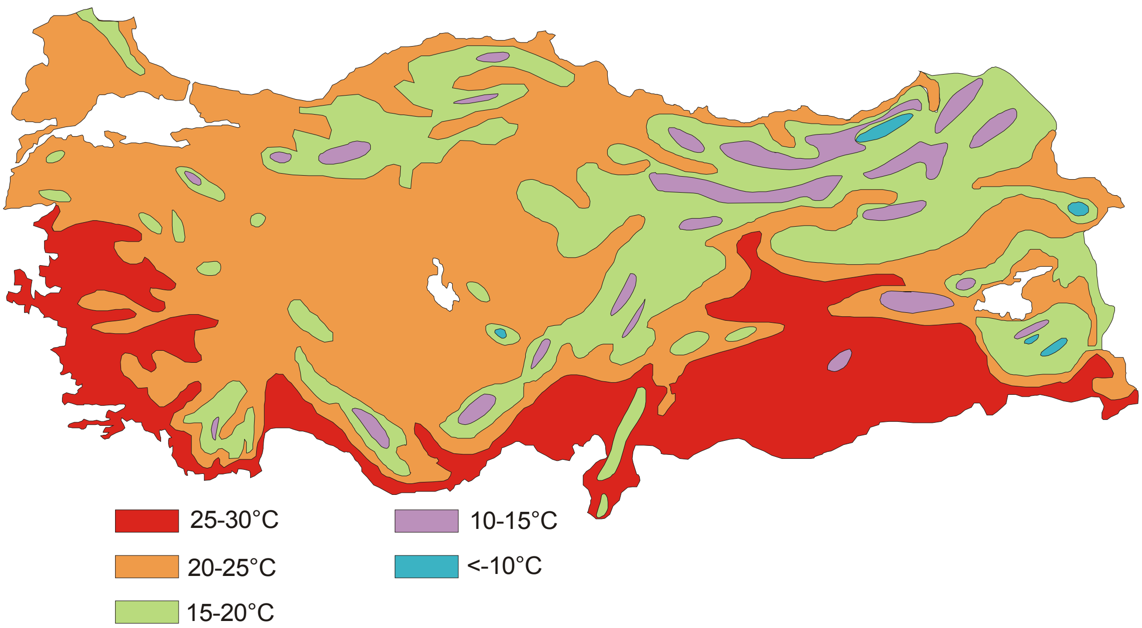

Figure 5. Distribution of June Temperatures (modified from Izbirak, 1975; Darkot and de Agostini, 1980; SMD, 2001)

SOIL MAPPING UNITS (SMUs)- SOIL ASSOCIATIONS

The country comprises 32 soil associations i.e. SMU's each with two to three STU's and a few with one (Table 1). The Leptosols are the dominant soils followed by the Calcisols, Fluvisols, Cambisols, Vertisols, Kastonozems, Regosols, Arenosols and Acrisols.

Table 1. Distribution of Soil Mapping Units

SMU	Distribution (%)
Umbric Leptosol/Dystric Cambisol	2.286
Mollic Fluvisol/Eutric Vertisol	0.224
Calcaric Fluvisol/Vertic Cambisol/Calcic Vertisol	7.019
Calcaric Regosol/Calcaric Cambisol	0.066
Mollic Leptosol/Petric Calcisol/Calcic Vertisol	2.475
Mollic Leptosol/Lithic Leptosol	17.736
Lithic Leptosol/Chromic Luvisol	1.424
Salic Fluvisol/Eutric Vertisol	0.138
Haplic Calcisol/Mollic Leptosol	1.363
Luvic Calcisol/Eutric Leptosol	0.959
Lithic Leptosol	7.094
Calcic Vertisol/Calcaric Fluvisol	0.203
Rendzic Leptosol/Haplic Cambisol/Luvic Kastanozem	7.588
Haplic Andosol	0.173
Haplic Arenosol	0.180
Haplic Kastanozem/Haplic Cambisol	3.376
Eutric Vertisol/Vertic Cambisol	1.119
Dystric Leptosol/Haplic Kastanozem	0.036
Haplic Acrisol/Eutric Cambisol	2.224
Haplic Calcisol/Vertic Cambisol	6.027
Calcic Vertisol/Petric Calcisol/Luvic Calcisol	1.286
Calcaric Cambisol/Eutric Leptosol	9.468
Mollic Leptosol/Vertic Cambisol	0.201
Mollic Leptosol/Haplic Cambisol/Haplic Andosol	0.625
Vertic Cambisol	0.630
Eutric Cambisol	0.010
Eutric Leptosol/Hapic Cambisol/Eutric Vertisol	3.780
Luvic Calcisol/Calcic Vertisol	0.615
Luvic Calcisol/Petric Calcisol/Calcic Vertisol	3.102
Luvic Calcisol/Petric Calcisol	0.629
Luvic Calcisol/Haplic Calcisol	16.405
Eutric Fluvisol	0.191
Water Bodies	1.337
Marsh	0.012

LEPTOSOLS

The abundance of Leptosols is the outcome of the vigorous Anatolian tectonic activities since the Miocene (Neotectonics) resulting to the development of steep slopes and their inevitable consequence causing mass transportation of soils and continuous destruction of the landscape (Erol, 1981).

The Dystric Leptosols associated with the Haplic Kastanozems overlying calcareous, sedimentary and igneous rocks occupy the northeastern parts of the country, which is temperate to cold with 8°C to 15°C annual temperature and rainfall varying from 350 to 1400mm annually. Other Leptosols are associated with Cambisols and Andosols and Vertisols in the eastern part of Turkey overlying volcanic rocks as well as metamorphic along strips of grabens with basins occupied by large areas of Vertisols and Fluvisols.

Lithic Leptosols of the west associate with Chromic Luvisols which are the carbonate leached Red Mediterranean Soils with high contents of kaolinite, thus being at an advanced stage of weathering i.e the typical Terra Rossa of Manchini (1966) described for the Mediterranean which are dominantly developed at relatively higher altitudes (500-1000m) with annual rainfall of 500-1000mm and on hard crystalline limestones throughout the country especially on the slopes of the Taurus Mountains located at the south. The Lithic and Mollic Leptosols may also be included into the Terra Rossa theme or the Mediterranean Red Soils developed on Oligo-Miocene limestones -karstic land- with annual rainfall varying from 400-1500mm and annual temperature from 14° to 18°C. Rendzic Leptosols (Rendzinas) together with the Haplic Cambisols and Luvic Kastanozems overlie various ages of soft and crystalline limestones interlayered with numerous sediments on the west and northwestern parts of the country (Dinç et al. 1997).

The Mollic Leptosol, Petric Calcisol and their geomorphologically lower most versions the Calcic Vertisol association is the Red to Reddish Brown Mediterranean Soils developed on colluvial materials overlying the abundant grabens of southeastern Anatolia. This area is under the development of the huge southeastern Anatolian irrigation project seeking to irrigate 1.7 million ha of land.

CALCISOLS

Calcisols are the next dominant soils of Turkey taking place in the drier parts of the country, particularly developed on ancient lake basins and mudflow deposits developing to tectonically induced terraces of the Quaternary (Dinç et al. 1991c).

Luvic and Petric Calcisols associating with Calcic Vertisols in the south-southeast and central part of the country represent the soils of similar tectonic areas of the northern part of the Arabian shield. The Luvic and Petric Calcisols are the well-defined calcretes -massive caliches- of Vogt (1984) and Kapur et al (1998) and the k-horizon of Gile et al (1966) developed during the Pleistocene and Holocene climatic fluctuations (pluvials). The Luvic Calcisols are the widespread soils mostly comprising weathered or intact column horizons (term coined by Kapur et al. 1987, describing leached carbonate rich solutions in soil later to crystallize in vertical cracks as infill of clay sediments/soils of Tertiary and Quaternary ages) rich in palygorskite (Verrechia and Le Coustumer. 1996) and palygorskite-calcite nodules (Kapur et al. 1987) distributed throughout the north and southern parts of the Mediterranean Basin. The soils of this association located at the center and south of the country developed from transported mudflow materials of Tertiary clays maturing to calcretes whereas the Red Mediterranean Soils of the western part have developed on travertines. Haplic Calcisols of central Anatolia associating with Cambisols have developed on lacustrine clayey deposits of the ancient Lake Konya shrunk to its present conditions the Tuz Lake. Annual rainfall of this area varies from 200 to 400 mm with mean annual temperature of 8°C to 12°C. The Luvic Calcisol/Haplic Cambisols covers a large area of the land area of Turkey (Table 1) with variable parent materials marine limestones, lake deposits and volcanic rocks. Climate varies from Mediterranean to mild aridic and frigid in eastern Turkey with annual rainfall varying from 200 to 800mm. Calcisols of southeastern Turkey associating with Leptosols have also developed on calcareous rocks, hard limestones and fluvial with residual redeposited materials (Dinç et al. 1997).

FLUVISOLS

The Fluvisol association ie the widely distributed SMU's throughout Turkey along river valleys and lake basins are not determined in southeastern Turkey –the northern part of the Arabian Shield- which is covered by the materials transported following Neotectonic activities. Thus, the widespread Calcaric Fluvisols associating with Vertic Cambisols and Calcaric Vertisols are a good example for catenary sequential continuum encountered in countries with vigorous and frequent tectonic movements causing formation of prominent topographic/geomorphologic features/soils that are subjected to a long history of exploitation since the Neolithic.

CAMBISOLS

Cambisol associations, the soils of the slightly more temperate areas than the typical Mediterranean, associating with Leptosols and Kastanozems, are frequently located at the northern fringes of the Calcisols, which embrace the coastal areas of the north and south Mediterranean Basin. The higher annual precipitations than the Mediterranean 500-1000mm and lower average annual temperatures of 13°C to 15°C reveal the milder and more temperate character of the Cambisols than the typical Mediterranean Calcisols (Dinç et al. 1997).

VERTISOLS

The Calcic Vertisols with less prominent cracking features and gilgai due to the coarse calcite and palygorskite contents have developed from the transported Petric Calcisols ie the Quaternary mudflow surfaces designated as the "glacis" ie the colluvials (Dinç et al. 1991a; Kapur et al. 1990, 1991, 1993). Alluvial deposits transported by the ancient and modern courses of the rivers in the central and south part of the country are also the agents responsible for the formation of Calcic Vertisols. The Eutric Vertisols in the northwestern parts are similar to the Vertisols found elsewhere in the Balkans transported from volcanic areas/massifs with very well defined cracking features and gilgai due to the less CO_3 and coarse clay contents (Dinç et al. 1986; Kapur et al. 1987; Dinç et al. 1997).

ACRISOLS

One of the minor soil groups of Turkey are the Acrisols (Haplic) (Table 1) associating to Eutric Cambisols overlying volcanic and metamorphic parent materials with the highest annual rainfall in the area (1500-2000mm) and annual average temperatures of 12°C to 15°C, (northeast Black Sea coastal) needs detailed filed trials and description of new profiles for the ultimate differentiation from Podzols to Acrisols (Dinç et al. 1997). Unfortunately, the Haplic Acrisol STU of the 4th approximation of the Turkish Soil Map is the least studied area by the GDRS and University of Çukurova, who have used previously accomplished survey reports and data produced by the Universities of Ankara and Atatürk to complete the map of this part of the country.

REGOSOLS

The Calcaric Regosol and Calcaric Cambisol association covers a small part of the country (Table 1) and is located at a similar climate as the Lithic Leptosol/Chromic Luvisol association of the Mediterranean Region (Dinç et al. 1997).

ARENOSOLS

The Haplic Arenosol association represents the coastal sand dunes being on the ancient and/or present courses of the large rivers of Anatolia intergrading to the coastal beach sands of the Mediterranean covering a relatively small part of the country (Dinç et al. 1978; Dinç et al. 1997, Akça, 2001).

ANDOSOLS

The Haplic Andosol STU has been recently defined in eastern Turkey and previously at the northeast, south and western parts of the country (Kapur et al. 1980; Dinç et al. 1997).

The use of especially the major class levels of the parent materials 3000 and 3300 of Version 4.0 of the ESB/WRB has provided more inside in the development of a more geologically oriented concept for the designation of Andosols that have developed on or in pyroclastic rocks (tephra).

SUGGESTIONS ON THE USE OF SOIL GEOGRAPHICAL DATABASE OF EURO-MEDITERRANEAN COUNTRIES VERSION 4.0 FOR SOILS OF TURKEY

1. The presently produced map is the 4th approximation of the Soils of Turkey at the 1:1 M level. The earlier 3 approximations have evolved following recent ground truthing field trips to most parts of the country. The areas still needing to be better understood are the east Black Sea coast Acrisol/Cambisol SMU and some SMU's south of this one. Field trips to be accomplished soon will enable the authors to map the region mentioned above with higher confidence at a newer version of the soil map.
2. Greenhouse production is a developing sector on appropriate as swell as inappropriate land ie on marginally located but productive soils and on the contrary on level land with soils of lower quality. The allocation of the appropriate land for greenhouses raises an important issue for future sustainability discussions requiring urgent solution.
3. Calcretes and column horizons should be incorporated to the parent material as redeposited clay (5722) or as colluvial deposit (5821). Thus, Red to Reddish Brown soils of the Mediterranean climate, developing in or on these calcretes with or without an underlying column horizon should be considered as the Petric Calcisols as similarly stated by Driessen and Dudal (1991). However, a distinction should be made to better define the development of calcretes, which may be accepted as petrocalcic horizons at certain occasions as in Soil Taxonomy (Soil Survey Staff, 1999) and as stated by

Kapur et al. (1993) in the discussions of development of Quaternary calcretes and petrocalcic horizons from calcic horizons in arid regions. The classical petrocalcic horizon does not meet the thickness and geomorphic setting (terrace) as well as the mode of development (as mudflow) of the calcretes (Erol, 1984; Kapur et al. 1998).

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