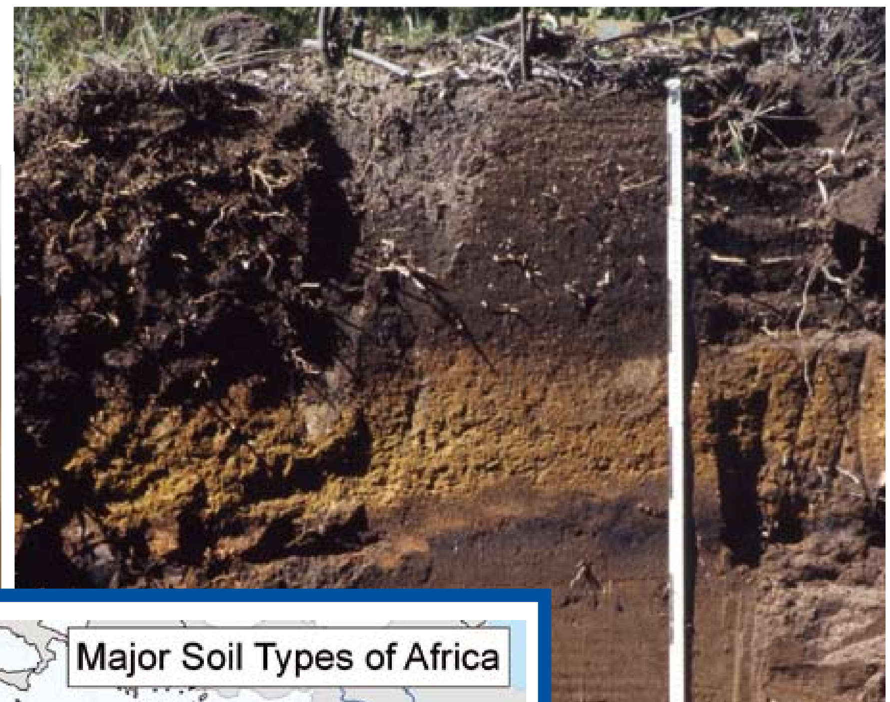
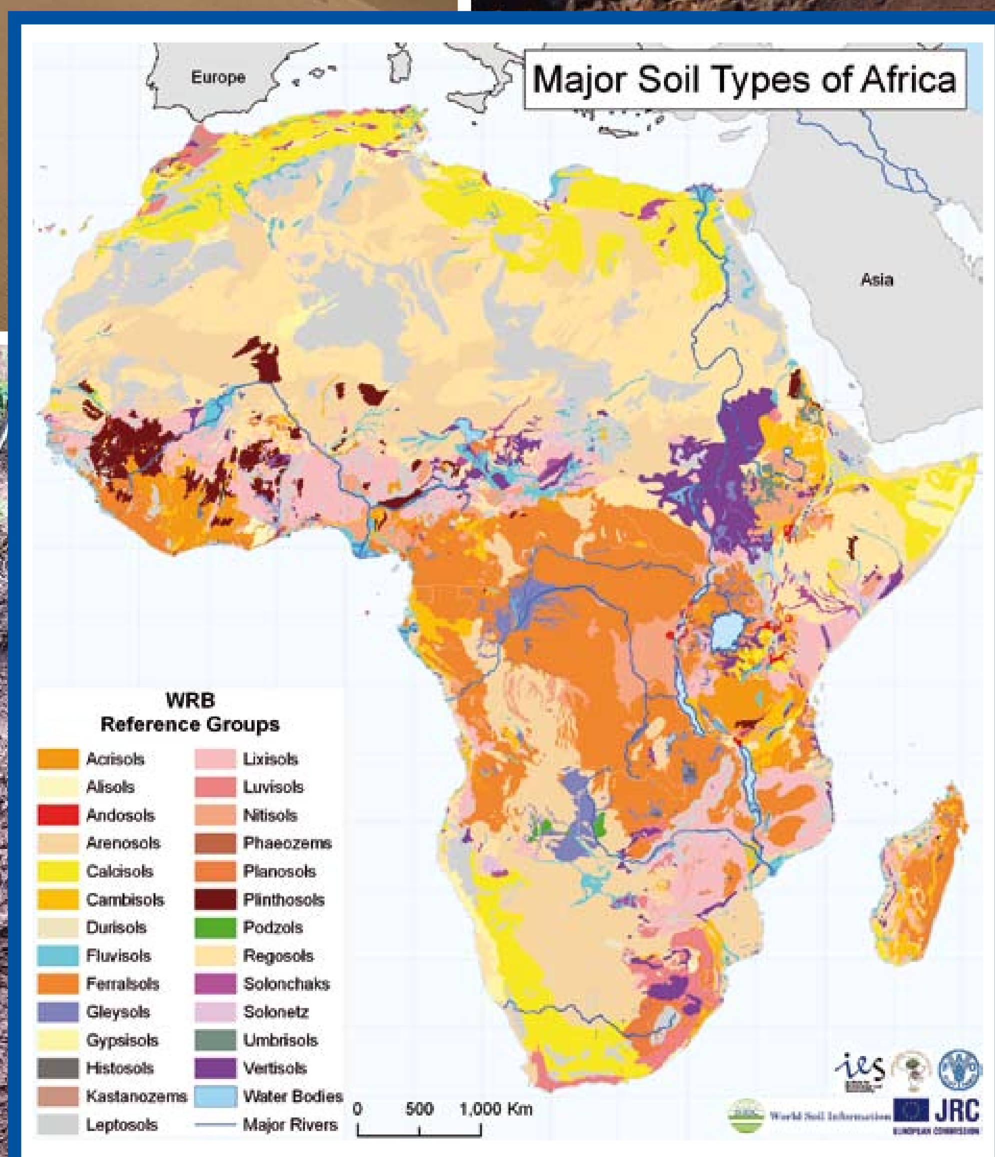
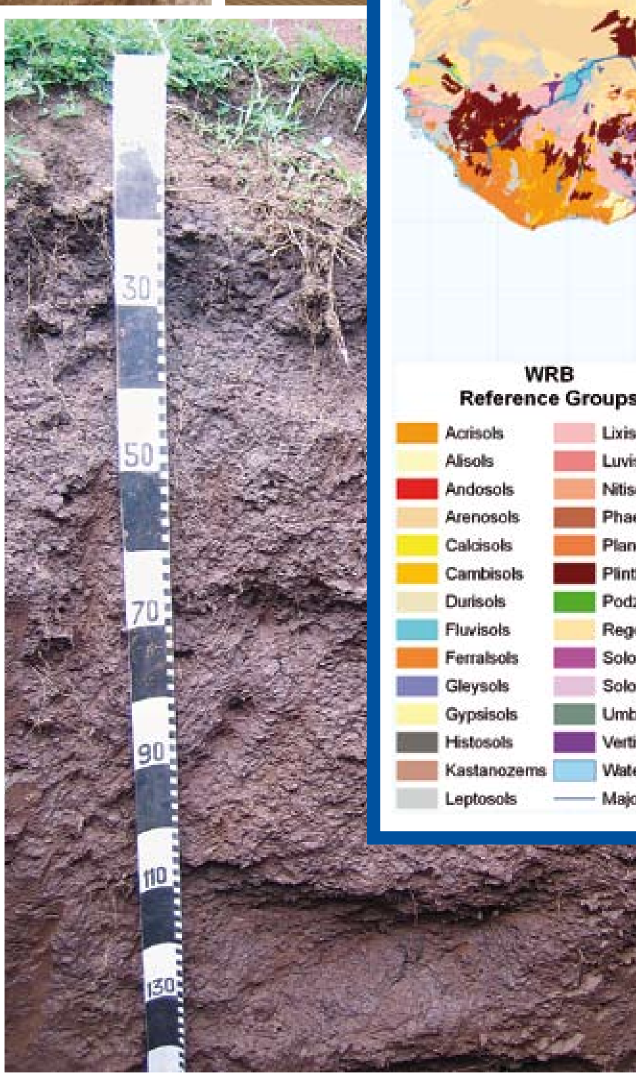
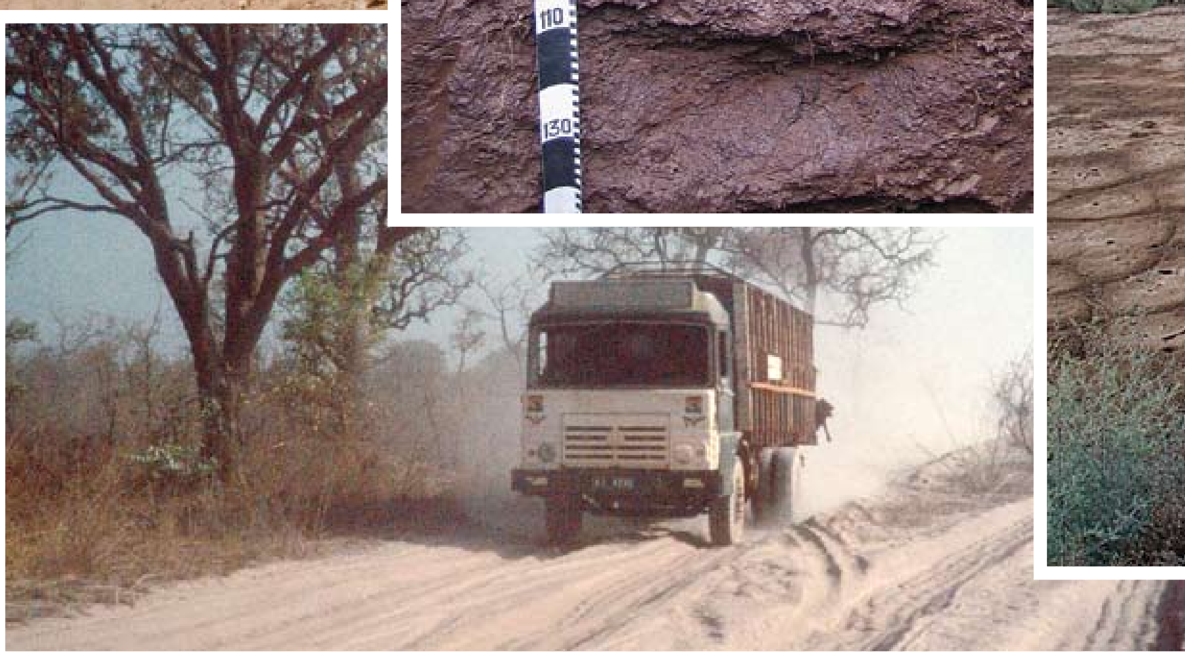
African Soil 2010

Supporting the sustainable use of natural resources









ISRIC World Soil Information

FAO FIAT PANIS

Africa Soil Science Society ASSS

JRC
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Soil in Africa

Soil is one of the fundamental components for supporting life on the planet.

Plants and crops are dependent on soil for the supply of water, nutrients and as a medium for growing.

Soil stores, filters, buffers and transforms substances that are introduced into the environment. This capability is crucial in producing and protecting water supplies and for regulating greenhouse gas emissions.

Soil is a provider of raw materials.

Soil is also an important habitat and gene pool – in excess of 5 tonnes of live organisms can exist in a hectare of arable soil.

Soil is a fundamental component of our landscape and cultural heritage

Half-moon shaped pits in Burkina Faso are dug in nutritionally-poor soil and filled with organic-rich material to support the growth of crops. The hard surface crust is used to keep irrigation water within the pit. This is a good example of how local knowledge can be used to successfully utilize the soil.

This calendar and the related Soil Atlas of Africa is an initiative of the Joint Research Centre of the European Commission, The Food and Agricultural Organization of the United Nations, the African Soil Science Society and ISRIC – World Soil Information. The calendar aims to bring African soil to the attention of everyone who deals with this natural, non-renewable resource that is vital for food and fibre production and sustainable development of the environment.

The African environment is diverse, ranging from deserts and seasonally dry regions in the north and the south to tropical rainforests in west and central Africa; from coastal lowlands with mangroves in the west to high mountain ranges in the east. Large parts of Africa, especially in the south and the west consist of plateaus with soils that are millions of years old. Once degraded, soil resources are not renewed easily.

The soil names and terminology used in the calendar are those of the World Reference Base for Soil Resources 2006, a cooperative effort of the Food and Agricultural Organization of the United Nations, ISRIC-World Soil Information and the International Union for Soil Sciences to arrive at a common language for describing soils.

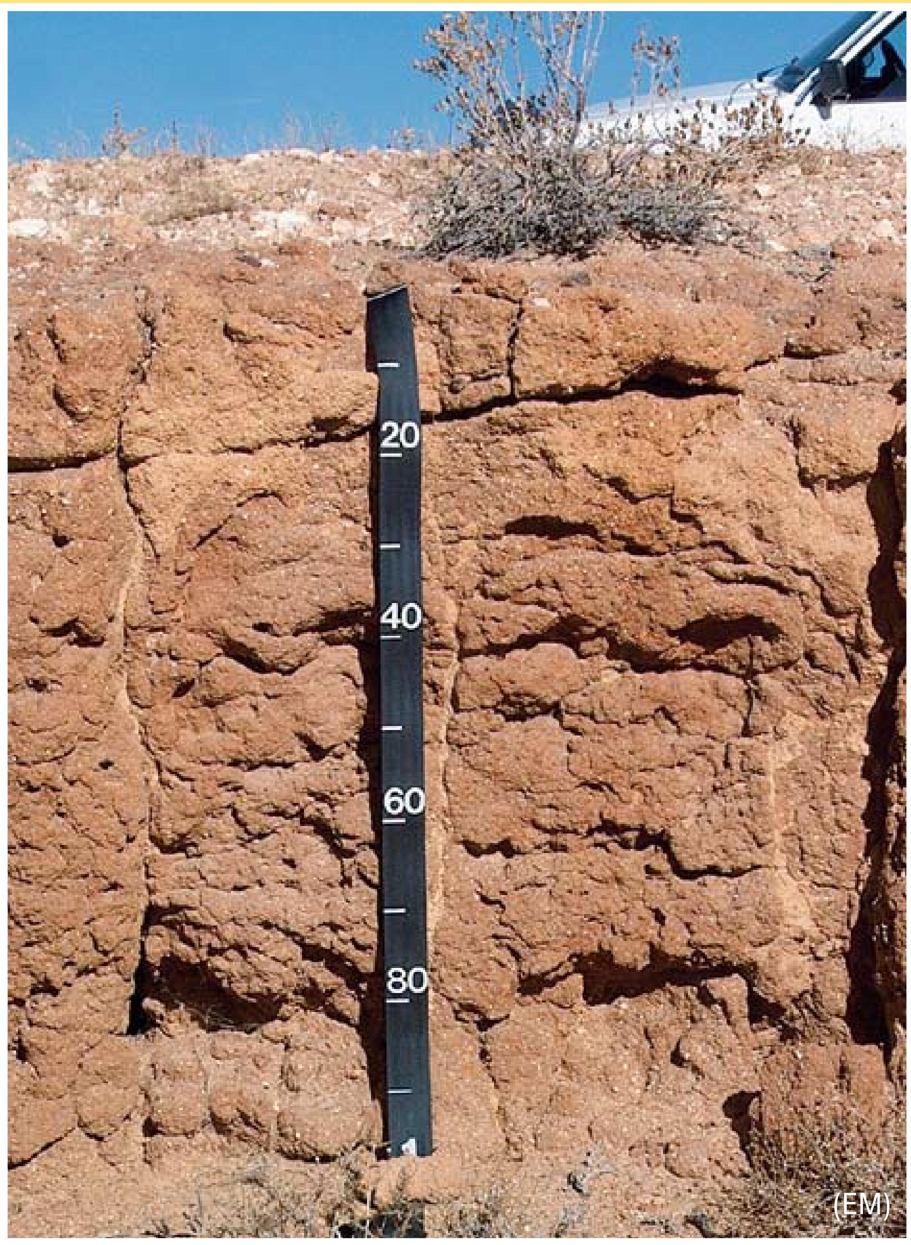
This calendar highlights the diversity and richness of soil in Africa and may help the reader to understand better the characteristics and potential of various soil types in this part of the world.

Soil characteristics change significantly with depth. Colour differences identify soil horizons reflecting variations in the distribution of diverse materials. In the example belowe from Tanzania, a dark-coloured surface horizon containing high levels of decaying vegetation overlays a much redder horizon where clay associated with iron has accumulated. Below that, a whitish layer represents the disintegrating rock from which this soil has formed, the so-called parent material. This type of soil is referred to as a Haplic Luvisol (Chromic). (EM)

Gypsisols

(from Greek *gypsos*, meaning gypsum)

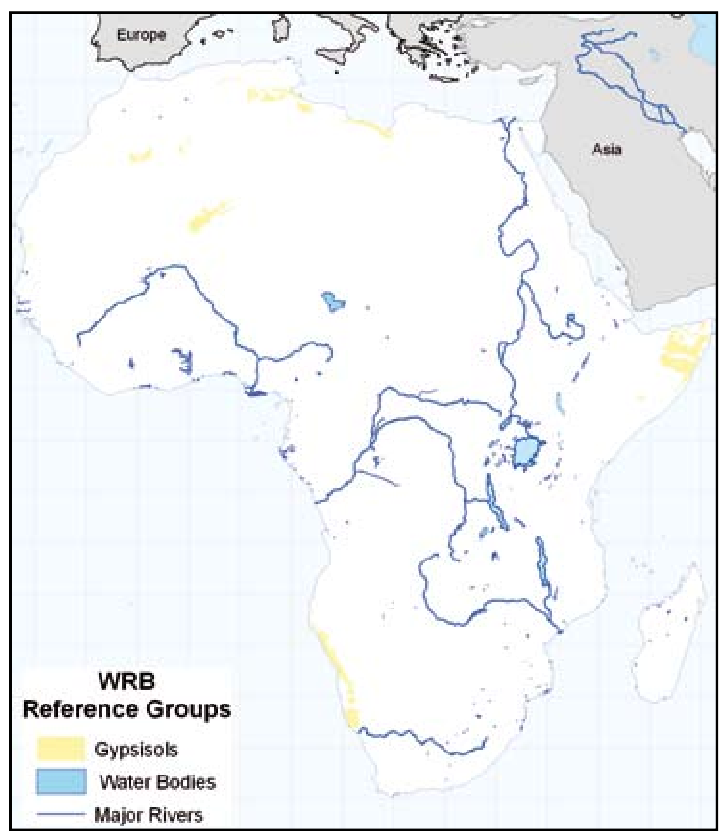
January 2010



The picture shows the desolate Namib Desert where Gypsisols are one of the dominant soil types. Gypsum is easily dissolved when scarce rain water enters into the soil. The dissolution gypsum crystals creates many cavities in the soil. When a stone is dropped on the surface, a hollow sound can often be heard.

Soils having a layer with five percent or more gypsum, one percent of which is at least visibly redeposited (secondary or pedogenetic) gypsum. This layer can be soft (gypsic horizon) or hardened (petrogypsic horizon). If a clay-enriched subsurface horizon is present, this horizon must also contain gypsum or calcium carbonate.

The above example from Namibia shows the irregular face of the soil profile, caused by the needle-shaped gypsum crystals, as well as a number of cavities resulting from the dissolution of the gypsum. Gypsisols occur in the driest parts of semi-arid regions where annual evapotranspiration exceeds greatly the precipitation, and where a source of sulphate is present to form gypsum ($CaSO_4 \cdot 2H_2O$).

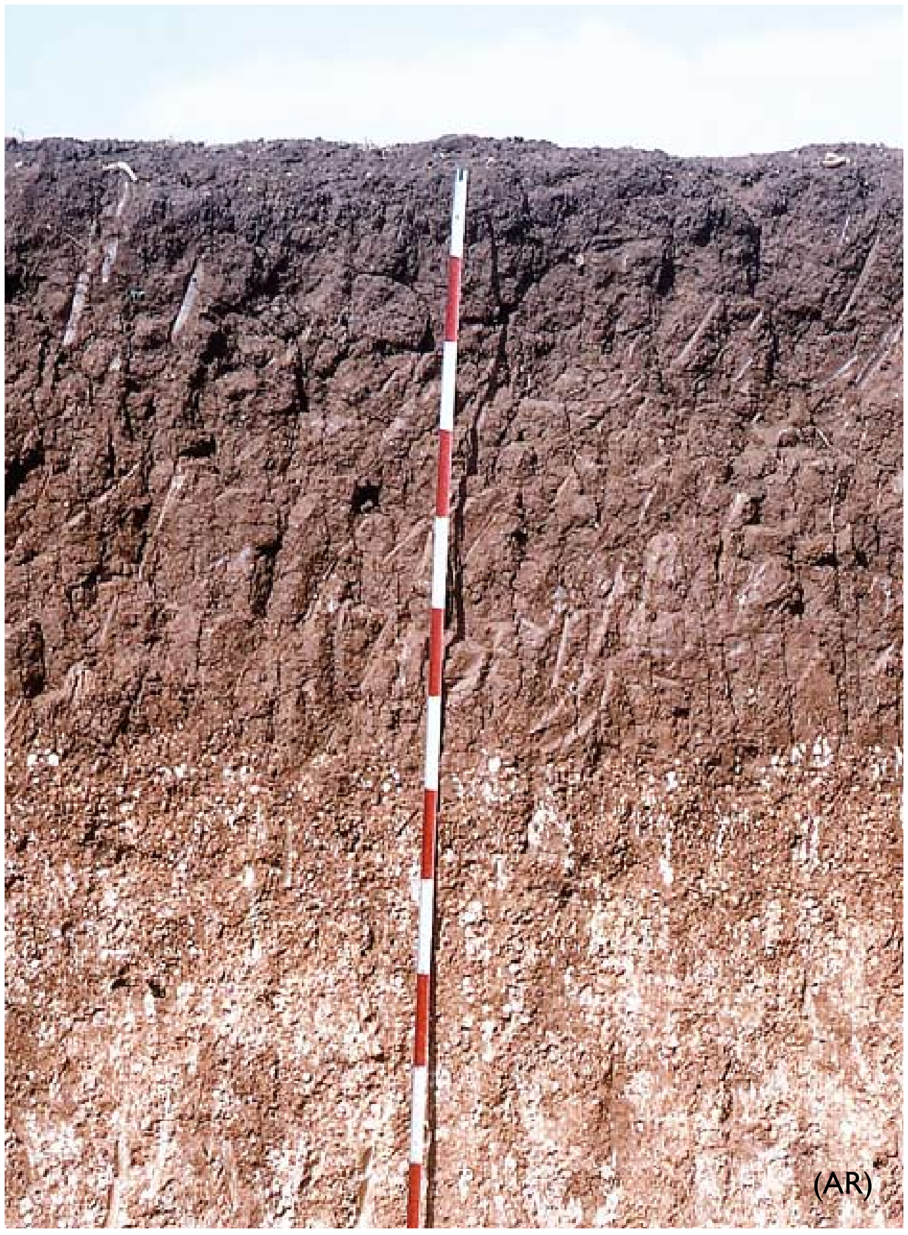


Location of areas where Gypsisols are dominant (i.e. > 50% of the mapping unit). Gypsisols cover around 1% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Kastanozems

(from Latin *castaneo*, and Russian *kashtan*, meaning chestnut, and *zemlja*, for earth or land)



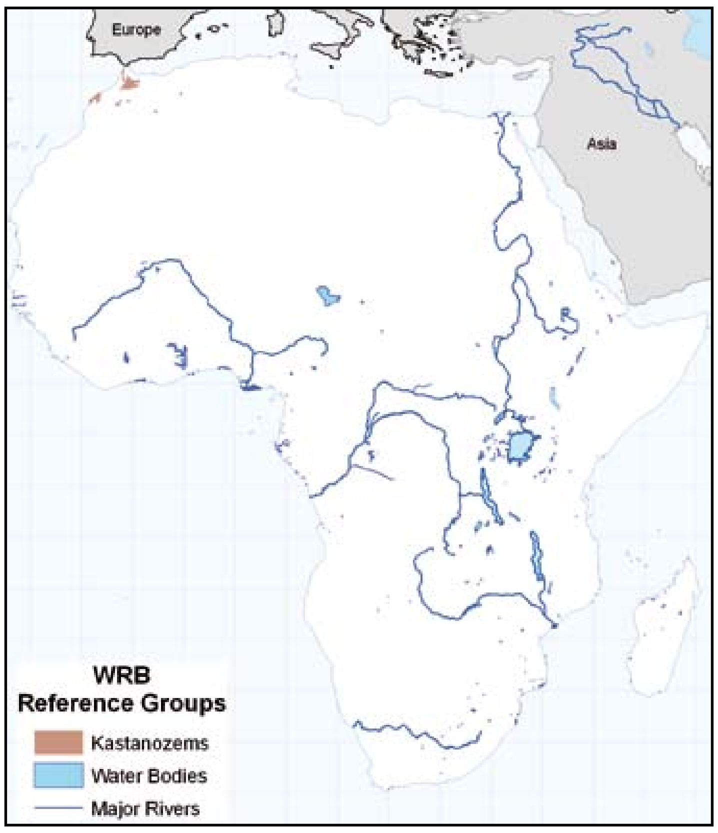
(AR)

Soils having a deep, dark coloured surface layer with a significant accumulation of organic matter and high base saturation (mollic horizon), and accumulation of secondary calcium carbonate within 50 cm from the lower limit of the mollic horizon. Kastanozems grade into Calcisols, which are extensive in the drier parts of Africa, when the darker surface horizon becomes lighter coloured due to lower input of organic matter. In the above example from Morocco, the dark coloured surface horizon overlies a well-structured, chestnut brown subsoil; below 70 cm, calcium carbonate has accumulated mainly in the form of nodules. Kastanozems occur mainly in the dry grasslands of the world. In Africa, their occurrence is mainly limited to the Mediterranean region.

February 2010

(AR)

This picture shows a Kastanozem area in Northern Morocco which is highly valued as agricultural land. The main source of the high organic matter content of Kastanozems is the abundant grass vegetation.



Location of areas where Kastanozems occur in Africa. Kastanozems cover around 0.1% of the continent and are of local importance only.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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15	16	17	18	19	20	21
22	23	24	25	26	27	28

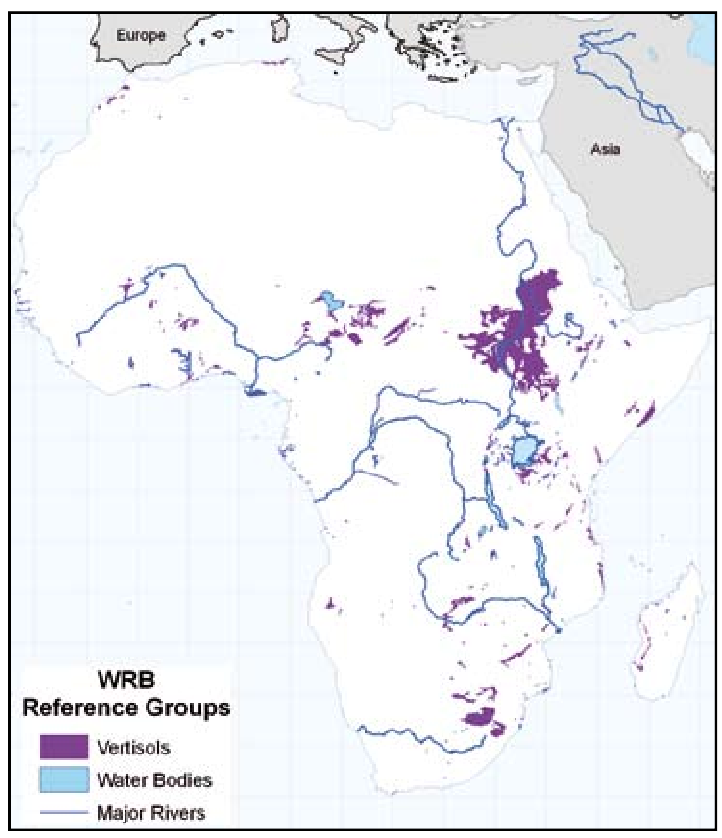
Vertisols

(from Latin *vertere*, meaning to turn)

March 2010

Dry or rainfed farming on a Vertisol with surface cracking near Gezirah, Sudan.

Soils having a clayey subsurface layer with polished and grooved ped surfaces (*slickensides*) or wedge-shaped or parallelepiped structural aggregates (*vertic horizon*) within 100 cm from the soil surface.
Vertisols have thirty percent or more clay between the soil surface and the vertic horizon. In addition, Vertisols exhibit wide cracks which open and close periodically upon drying and wetting.
In the Sudanese Vertisol above, the calcium carbonate-rich subsoil (the whitish substrate) is pushed upwards through the expansion and contraction of the clay minerals in the soil, leading to an irregularly shaped surface (*gilgai*).
Vertisols occur dominantly in level landscapes under climates with a pronounced dry season. Vast areas occur in northeastern Africa (Sudan, Ethiopia) and southern Africa (Zambia, Zimbabwe and South Africa).



Location of areas where Vertisols are the dominant soil. Vertisols cover around 4% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Andosols

(from Japanese *an*, meaning black, and *do*, meaning soil)


(ISRIC)

Andosols form from volcanic ash, pumice, cinder and related parent materials. Many Andosols have a thick, dark topsoil as a result of the fixing of organic substances by aluminium that is released from volcanic minerals upon weathering.

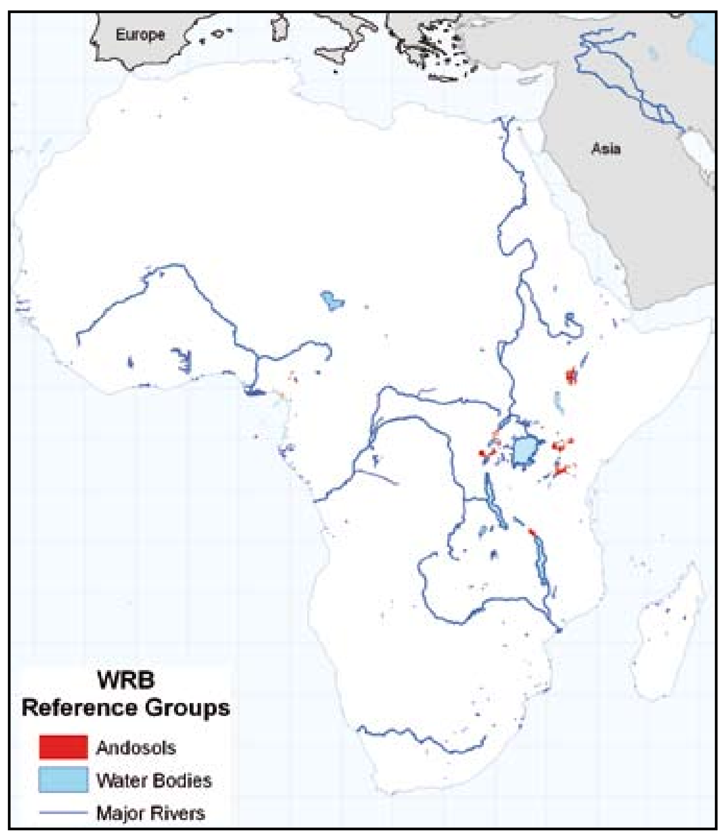
This profile from Kenya shows clear layering as a result of intermittent eruptions. Evidence of soil formation can be observed in the upper part of the soil (between 10 and 40 cm) where the accumulation of organic matter subsequent mixing has taken place. The difference in colour can be partly attributed to the weathering of iron-rich minerals (the reddish colours) and partly to the origin of the eruptive material.

Andosols are highly productive soils but suffer from phosphate fixation due to a high amount of iron in the soil.

April 2010


(ISRIC)

The snow-covered summit of Mount Kenya, an extinct volcano north of Nairobi.



Location of areas where Andosols are the dominant soil. Andosols cover around 0.2% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

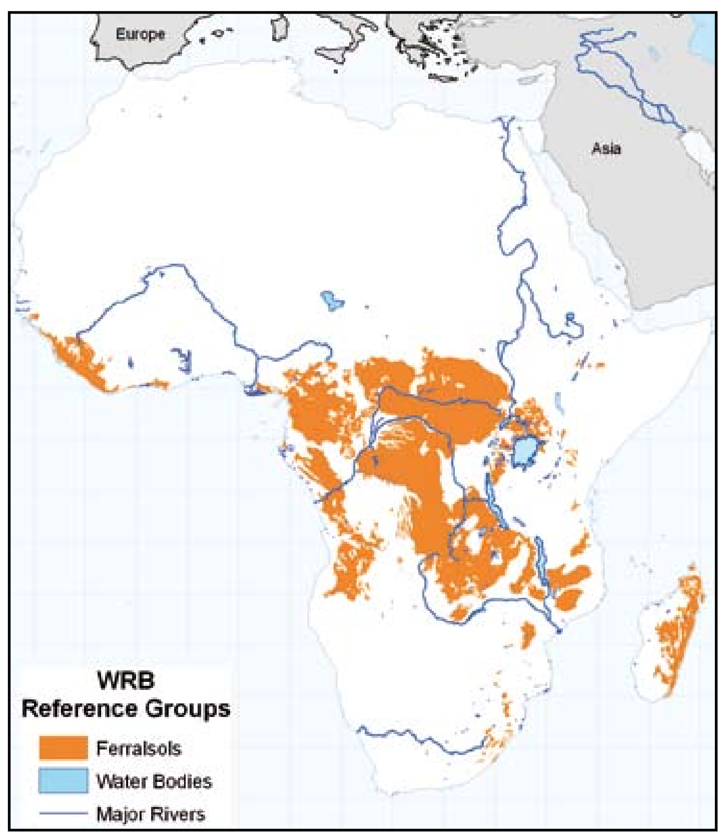
Ferralsols

(from Latin *ferrum*, iron, and *aluminium*)

Ferralsols are deep, intensely weathered soils with diffuse or gradual horizon boundaries which are according to some, at least partly attributed to termites. The "ferralic" subsurface horizon, reddish or yellowish in colour and without conspicuous mottles, has typically weak macro-structure and strong micro-aggregated soil structure ("pseudo-silt" and "pseudo-sand"), and friable consistence.
This profile from Ghana shows a clear plough layer up to a depth of 30 cm. The large cavities in the plough layer are termite chambers.
The mottled horizon below 120 cm is plinthite, a material that hardens irreversibly upon repeated exposure to air and sunlight.
Ferralsols in Africa occur almost exclusively in the humid central part of the continental shield, in regions not affected by intensive folding or glacial action during recent geological periods.

May 2010

Termites colonize soils in the tropics by building up large hills and excavating deep burrows to fetch water and clay. The above photograph shows termites in action.



Ferralsols are relatively common in Africa and are often associated with Acrisols. They cover around 16% of the continent.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

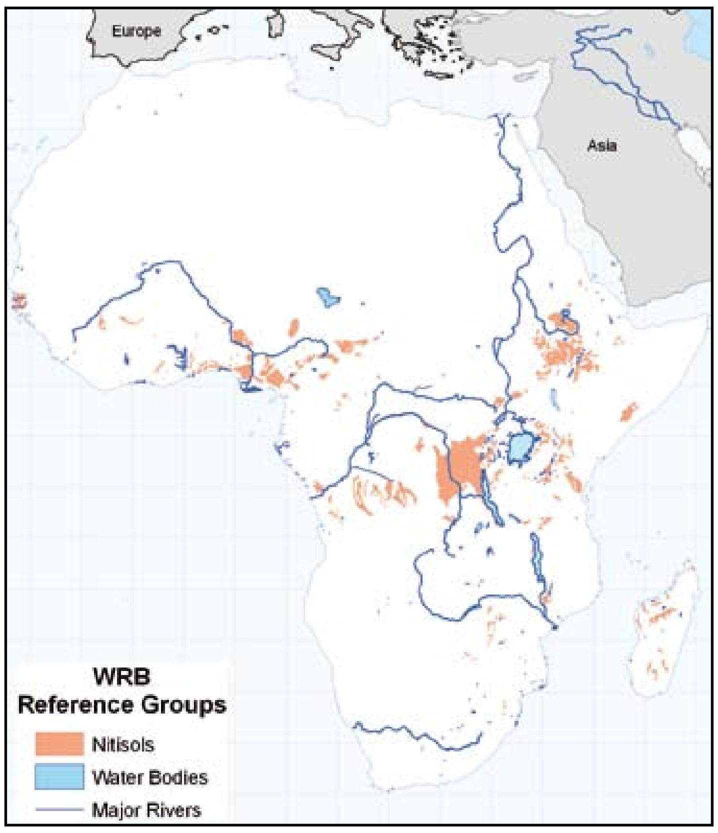
Nitisols

(from Latin, *nitidus,* meaning shiny)

June 2010

Nitisols are much sought after by farmers because of their high productivity despite their high phosphate-fixing capacity which renders phosphate unavailable to plants. They are excellent soils for growing coffee and many other crops.

Dusky red or dark red coloured soils having a clayey subsurface horizon that is deeply stretched and has nutty or polyhedric blocky structure elements with shiny ped faces. Reticular manganese segregation on ped faces is common in the lower parts of the "nitic" subsurface horizon. The soil above from Ethiopia, developed in finely textured weathering products of basalt, clearly shows the nutty structure typical for the nitic horizon. The horizon boundaries are typically gradual and diffuse.
Nitisols are mainly developed in highly weathered products of intermediate to basic igneous parent rock. More than half of all Nitisols are found in tropical Africa, notably in the highlands (> 1000 m) of Ethiopia, Kenya, Congo and Cameroon.



Location of areas where Nitisols are the dominant soil. Nitisols cover around 4% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	1	2	3	4	5	6
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14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

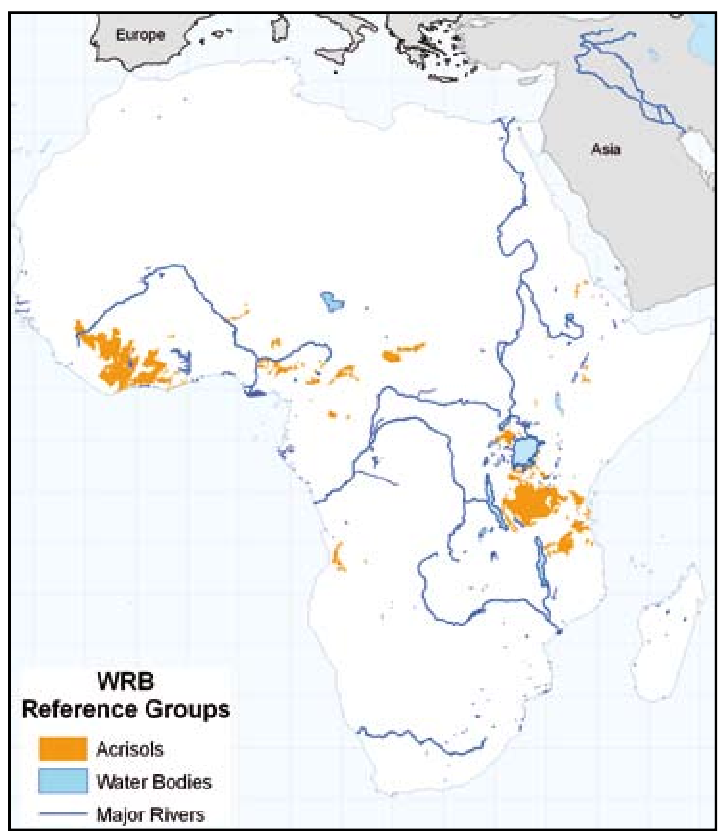
Acrisols

(from Latin *acer*, very acid).

Soils having a subsurface horizon with a distinctly higher clay content (argic horizon) than the overlying horizon. They have a low nutrient retention and a low base saturation (total amount of Ca, Mg, K and Na with respect to the cation exchange capacity).
The photograph shows the upper, yellowish coloured part has lost clay that has been leached down and redeposited in the lower, reddish coloured part. The round pale spots are filled animal burrows (krotovinas).
Acrisols are fairly susceptible to erosion and compaction due to their poorly developed soil structure. Many Acrisols become hard when dry, which makes cultivation difficult with conventional African farm implements like the hoe.
Acrisols occur dominantly in the wetter parts of the tropics and subtropics as well as the warm temperate regions in relatively young landscapes.

July 2010

Because of the low inherent fertility of Acrisols, many African farmers use slash-and-burn techniques to release nutrients from the vegetation and to counteract weeds. This practice is only sustainable when fallow periods are sufficiently long.



Location of areas where Acrisols are the dominant soil. Acrisols cover around 3% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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12	13	14	15	16	17	18
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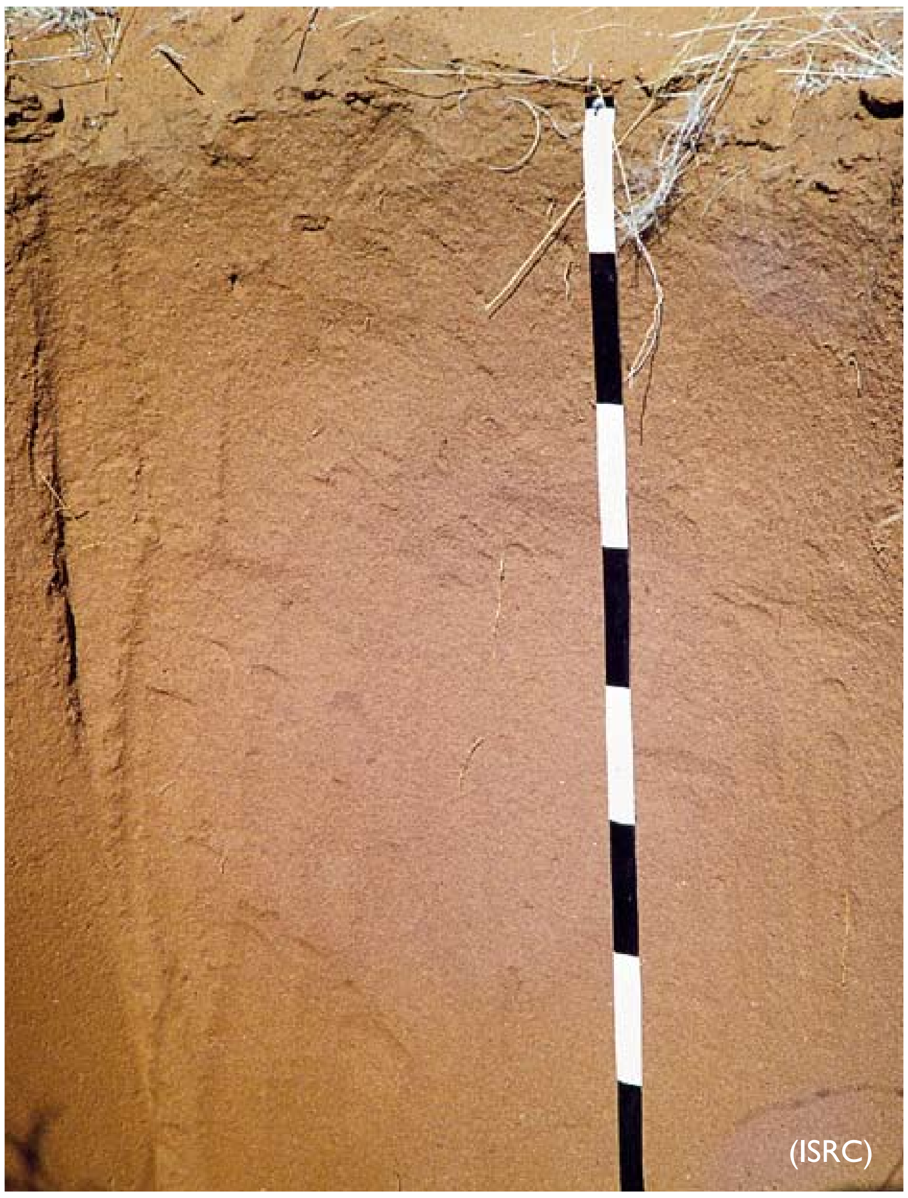
Arenosols

(from Latin, *arena*, meaning sand)

August 2010



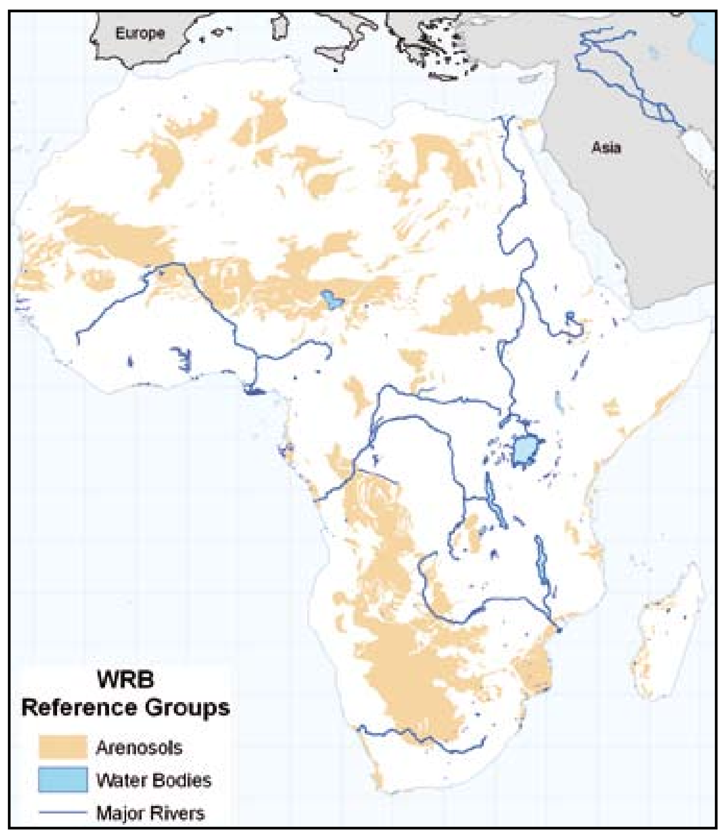
(ISRC)

(EM)

The photograph above shows part of a dune complex in Namibia containing some of the highest sand dunes on Earth, over 350 meters high.

Soils with a loamy sand or coarser texture either to a depth of at least 100 cm from the soil surface, or to a contrasting layer between 50 and 100 cm from the soil surface. They contain less than 40 percent (by volume) rock fragments or other coarse fragments within that depth. The profile shows a featureless Arenosol in a Namibian dune the redcolour is due to very thin iron coatings around the individual sand grains. Arenosols are much sought after by small farmers because they are easy to work. They do, however, suffer from moisture deficiency; irrigation is often needed to overcome drought periods. Nutrient supply is typically low.

Arenosols occur over large areas of Africa; the largest extent on Earth is found in southern Africa: *the Kalahari sands.*



Location of areas where Arenosols are the dominant soil. Arenosols cover around 18% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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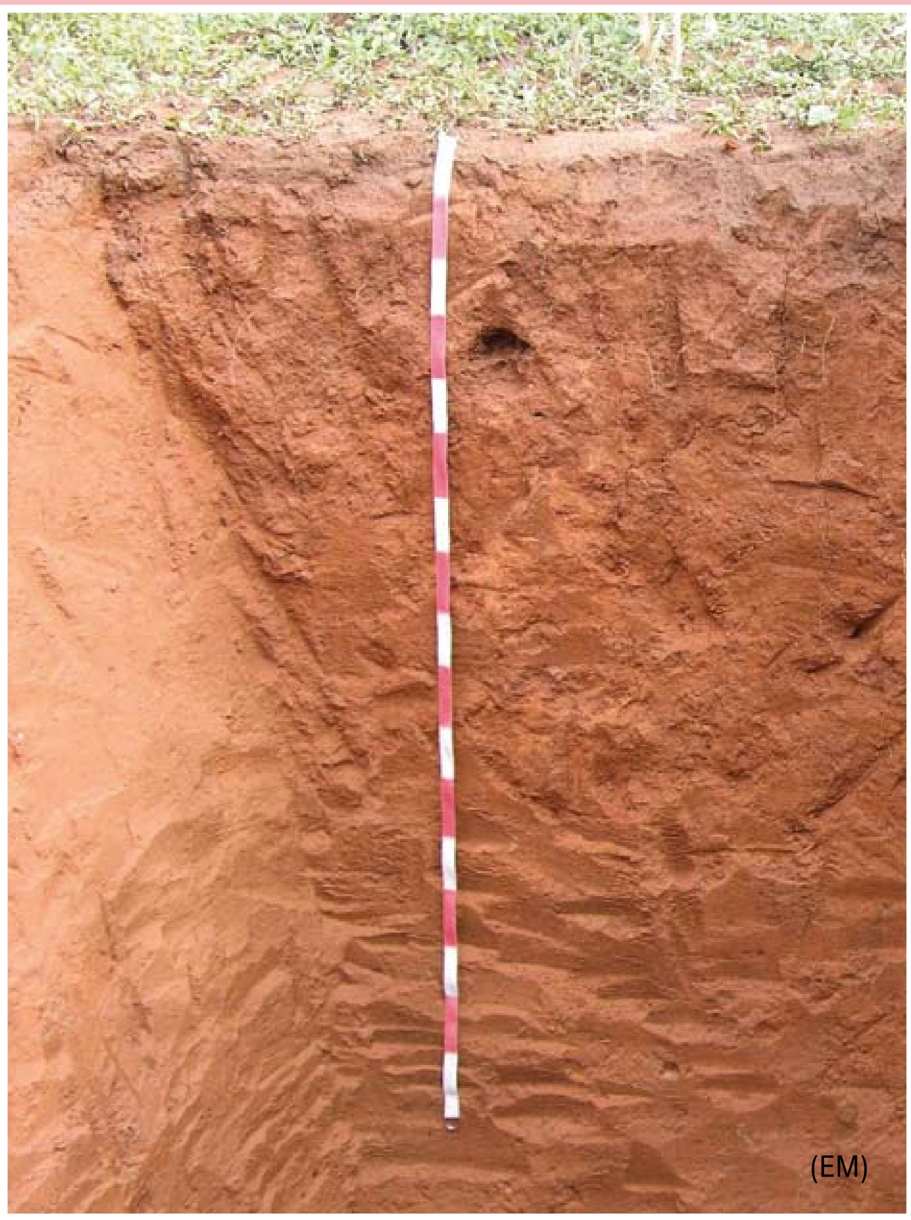
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Lixisols

(from Latin *lixivia*, meaning washed-out substances)

September 2010

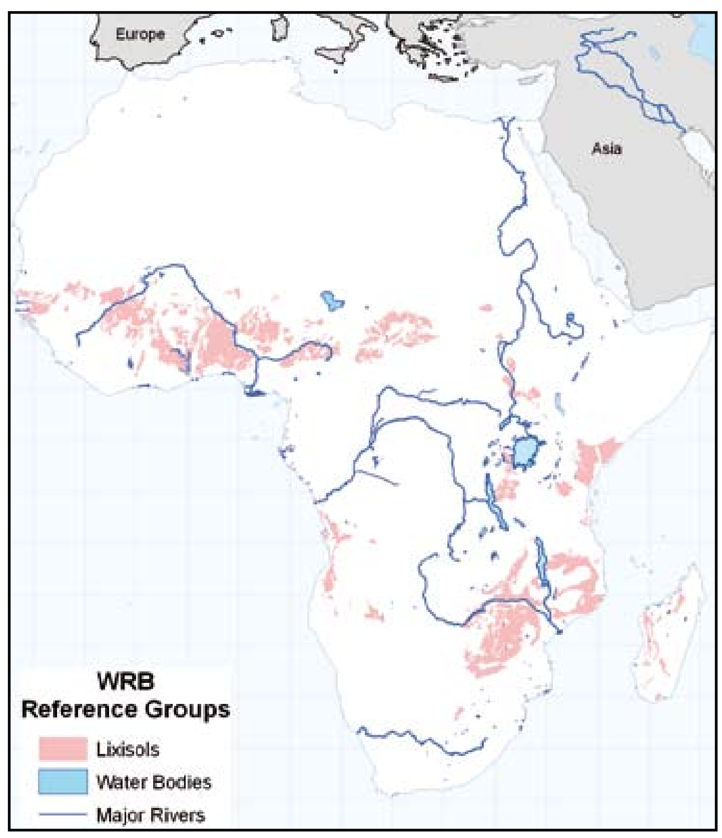


Soils having a subsurface horizon with distinctly higher clay content (argic horizon) than the overlying horizon. They have a low nutrient retention and a high base saturation (total amount of Ca, Mg, K and Na with respect to the cation exchange capacity).

Like Acrisols, they are fairly susceptible to erosion and compaction because of their poorly developed soil structure. The photograph above shows a Lixisol from Ghana with a cultivated shallow topsoil.

Lixisols occur dominantly in the drier parts of the tropics and subtropics. Their high base status is partly due to low leaching, and partly from inputs of airborne dust from adjacent desert regions.

Ridging is a common practice on Lixisols to concentrate the soil's fertility in the rooting zone of the crop. The photograph above shows a ridged field in northern Ghana after harvest of the sorghum; the ridges remain intact during the entire cropping season.



Location of areas where Lixisols are the dominant soil. Lixisols cover around 7% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Plinthosols

(from Greek *plinthos*, meaning brick)

October 2010

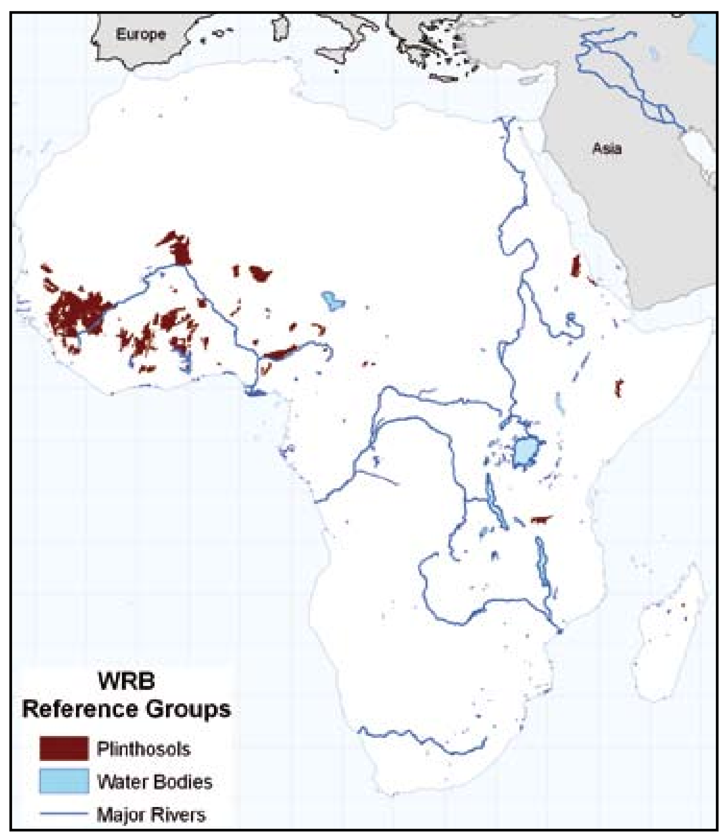
Soils having either a hardened layer of accumulated iron (hydr) oxides (petroplinthic horizon), or a strongly mottled layer with iron (hydr) oxides that hardens irreversibly (plinthic horizon) upon exposure to the air and sunlight.

The photograph above shows a Plinthosol practically from Kenya. An indurated hard layer covers the subsoil that predominantly consists of weakly cemented large iron nodules (buck shot) which can be mined.

Plinthosols occur mainly in the moist tropical regions in low-lying positions where iron from adjacent uplands soils is accumulating. When hardened layers become exposed, they are highly resistant to erosion and become eventually the higher parts of the landscape.

This phenomenon, known as landscape inversion, is widespread in West Africa.

Plinthosols provide one of the main sources for construction material in Africa. The material is used to harden road surfaces and airstrips, and, when soft, it can be cut into blocks that are used to construct buildings. The photograph above shows Nigerian women mining the nodular material for surfacing the floor of their huts.



Location of areas where Plinthosols are the dominant soil. Plinthosols cover around 2% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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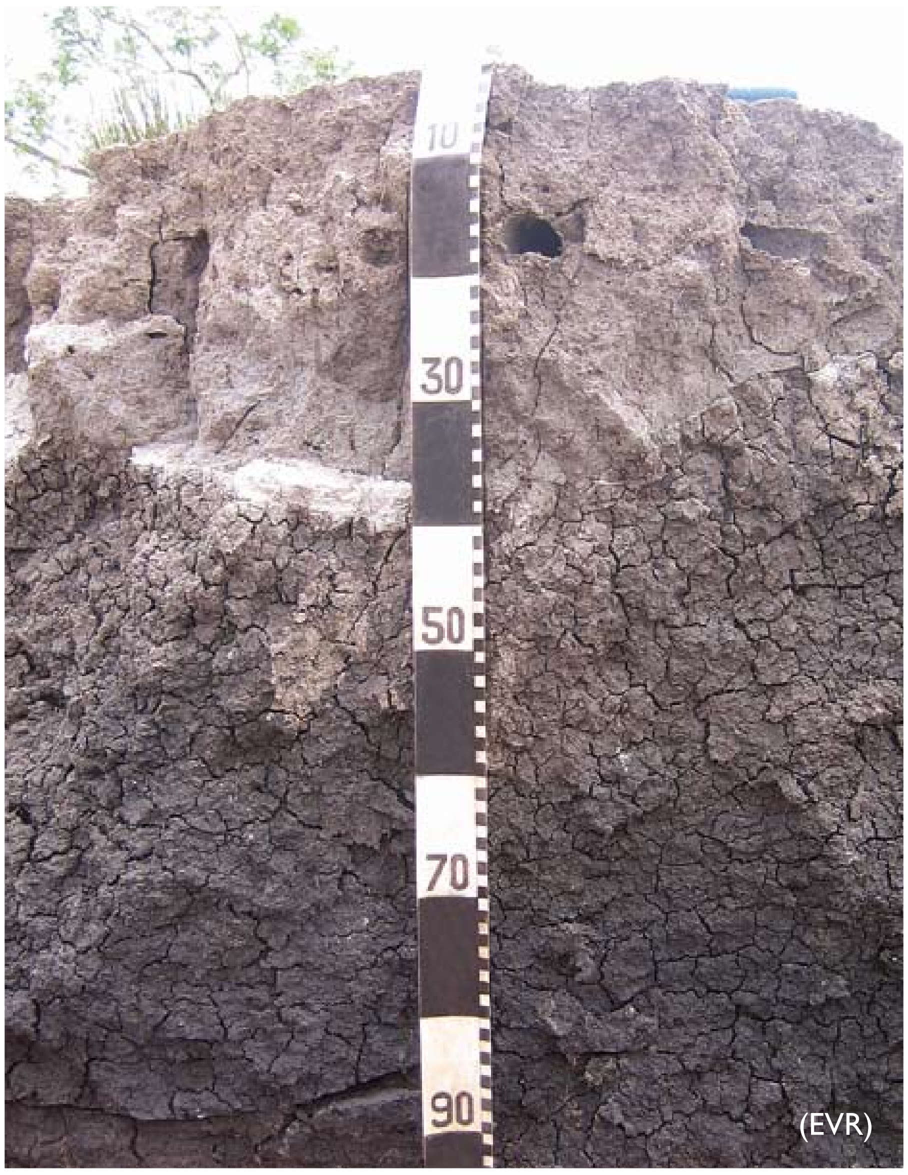
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Planosols

(from Latin *planus*, meaning flat)



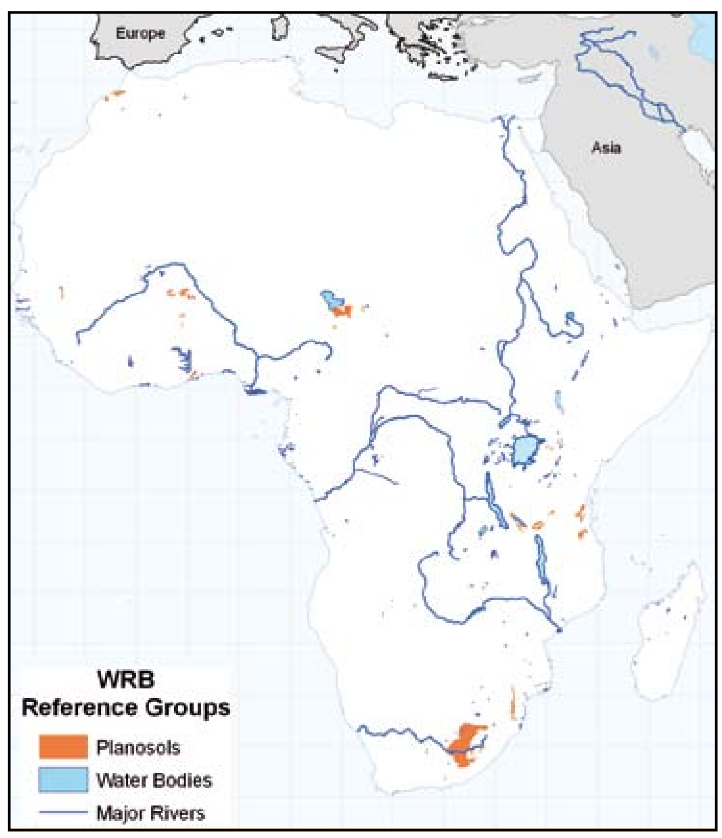
Soils having an abrupt textural change within 100 cm from the soil surface, associated with stagnic properties (waterlogging) above or below that boundary.

This profile from Ethiopia shows a typical Planosol with a thick, structureless topsoil. At about a depth of 40 cm, there is an abrupt textural change; evidence of the stagnating conditions can be seen as yellowish brown mottles at the bottom of the profile. According to some researchers, the texture contrast of Planosols can be explained by clay decomposition in the upper part of acid, seasonally wet soils. In this process, termed ferrolysis, clay minerals are destroyed in a sequence of repetitive cycles, each cycle involving a reduction and an oxidation phase.

Planosols occur in level landscapes throughout the world and are often associated with broad river valleys. During the rainy season, water can stagnate on the impermeable soil layer for a significant period of time.

November 2010

A truck driving over a temporary road on a terrace of the Volta River in Ghana creates huge dust clouds. This is due to the lack of cohesion between the particles in the topsoil.



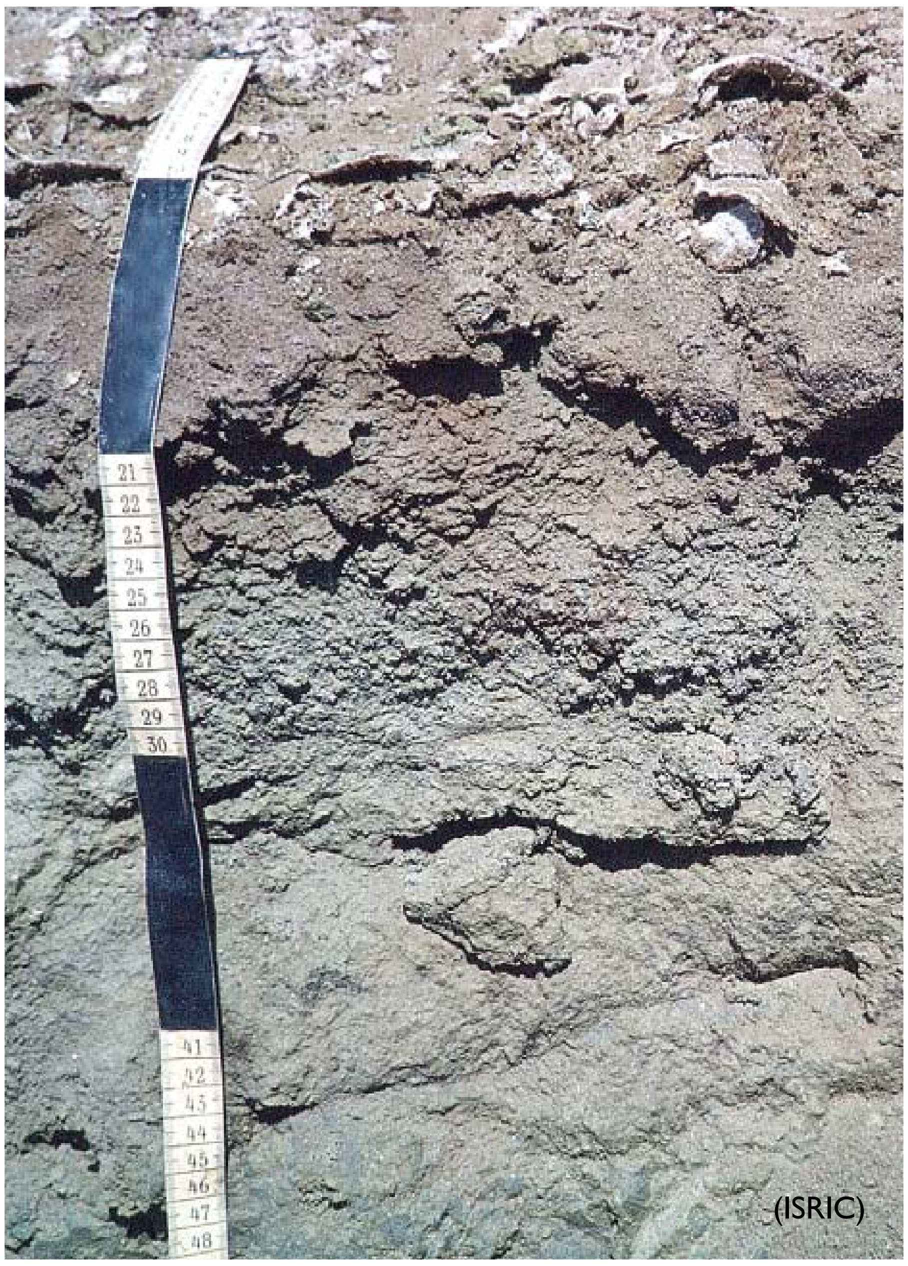
Location of areas where Planosols are the dominant soil. Planosols cover around 1% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Solonchaks

(from Russian *sol*, meaning salt)

December 2010

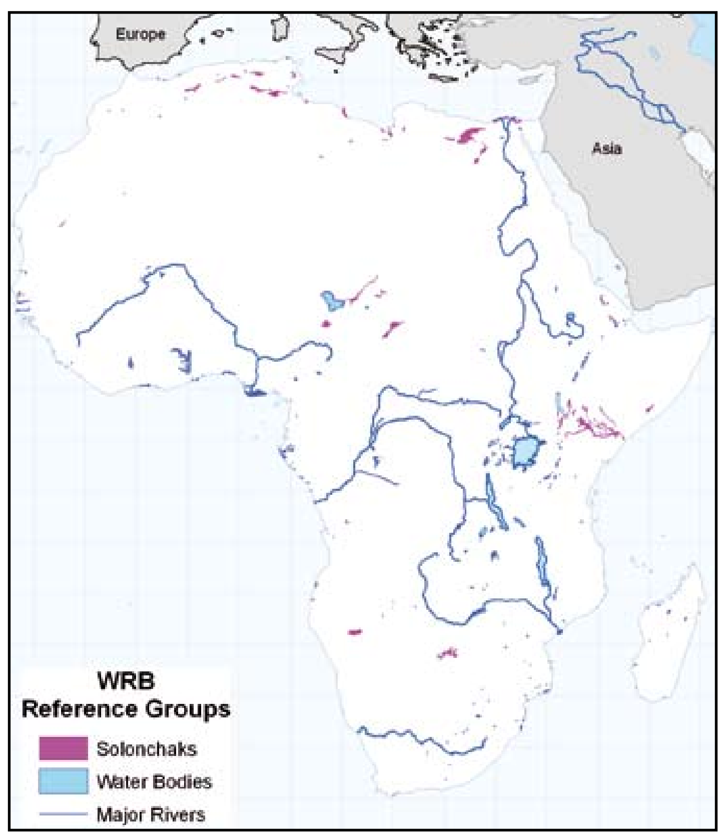


The above landscape shows Solonchaks under natural vegetation in Namibia. High salt content in the bare sports prevents the growth of even salt-tolerant plants.

Solonchaks are soils with high salinity. Water evaporating from the soil leaves the dissolved salts behind, often creating a salt crust at the surface. The example above comes from Kenya. Salt efflorescence can be seen at the surface as white spots. Usually, Solonchaks do not show much profile differentiation in terms of distinct layers.

Management requires washing out the salts or the use of salt-tolerant crop varieties when the salinity is not too high. Solonchaks, however, can best be left under natural vegetation as the costs of amelioration can be prohibitive.

Solonchaks occur mainly in level areas where saline groundwater comes close to the surface or where the soil itself contains salts (e.g. in old marine deposits).



Location of areas where Solonchaks are the dominant soil. Solonchaks cover around 1% of Africa.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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6	7	8 World Soil Day	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Soil Atlas of Africa

To raise awareness of the general public, policy makers and other scientists of the global perspective and importance of soil in Africa, particularly, in the context of the sustainable use of natural resources, the European Commission's Joint Research Centre (located in Ispra, Italy) has collaborated with soil scientists from Africa and Europe to produce the first ever SOIL ATLAS OF AFRICA. The atlas links the theme of soil with rural development and, at the same time, supports the goals of the EU Thematic Strategy for Soil Protection in conserving a threatened natural resource that is vital to human existence.

The atlas illustrates the diversity of soil from the humid tropics to the arid deserts through a series of maps supported by explanatory texts, high quality photographs and descriptive graphics. The atlas illustrates the variation of soil in Africa and from an African perspective. Supporting texts describe the major soil types, together with their principal characteristics and the main soil forming processes; special attention is given to the relationship between land use and soil condition.

For more details and how to obtain a copy, please see *http://eusoils.jrc.it/library/maps/africa_atlas/index.html*

Distribution of major soil types in Africa.

The map shows the dominant Reference Soil Groups according to the WRB classification and correlation system for Africa. The map is the updated output of the African part of the Digital Soil Map of the World produced by the Food and Agricultural Organization of the United Nations (FAO).

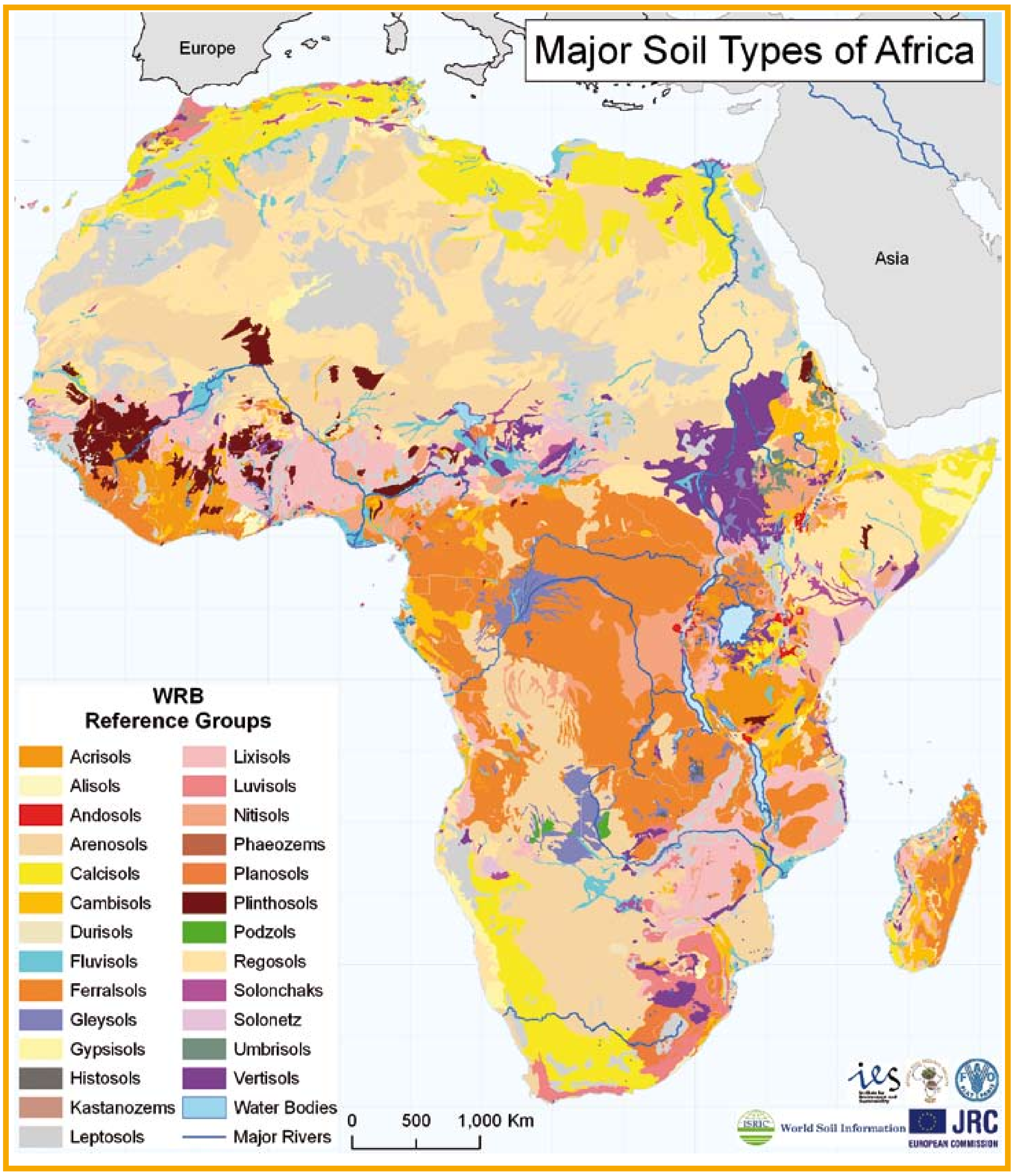
The map clearly shows the zonal arrangement of soils in Africa. The central, wetter part is dominated by Ferralsols, depicted in brown-orange. They are associated with Acrisols (orange-brown). Towards drier parts, Lixisols start to appear (pale pink). In West Africa large areas of Plinthosols occur (dark brown), mainly as hardened surface layers or cuirasses. The desert regions in the north and the south are dominated by Calcisols (bright yellow), Leptosols (shallow soils depicted in grey), Regosols (pale rose), Arenosols (brownish yellow) and Gypsisols (pale yellow). Very locally, especially in southern Africa, Durisols (pinkish grey) occur.

The dark purple colour on the map, mainly in Sudan and Ethiopia, indicate Vertisols whereas the bright red colours depict the dominance of Andosols, mostly associated with the African Rift valley. This is also where most of Africa's Nitisols are found (dark rose). In the Mediterranean region pale brown and brown colours indicate areas of, respectively, Kastanozems and Phaeozems.

Gleysols (dark blue) and Fluvisols (bright blue) are found throughout the map, the latter associated with Africa's river systems and deltas. Solonchaks (purple) and Solonetz (light purple) are mainly associated with coastal plains.

Alisols (very pale yellow), Cambisols (orange), Histosols (dark grey), Luvisols (dark pink), Planosols (dark orange), Podzols (green) and Umbrisols (dark green) are scattered over the map and can be locally important.

In urbanized areas and near large mines, Technosols (highly disturbed soils) may occur. However, most of these areas will be too small to be visible on the map.



Map based on WRB2006 interpretation of the FAO Digital Soil Map of the World (FAO, 1985)

Soil is our life-support system. It delivers food and fresh water; recycles wastes, etc. Decision makers need good baseline information about soils – for planning, reducing land degradation, investment and management. The African Soil Science Society (ASSS) is a network of national societies that aims to consolidate and promote knowledge on African soils by strengthening the capacity of expertise of African soil scientists (training process), lobbying towards political institutions in Africa (Africa Union) for a better consideration of soil aspects by decision makers, and ensuring widespread diffusion of soil-related information to both specialists and the general public (awareness raising) through the ASSS website and ASSS regular activities.

JRC
EUROPEAN COMMISSION

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies.

As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.
The JRC consists of seven different institutes, each with its own focus of expertise, on five separate sites around Europe. The Institutional and Scientific relations provides coordination and serves as a link between the institutes and the policymakers.

http://www.jrc.ec.europa.eu/

Located in Ispra (Italy), the Institute for Environment and Sustainability is one of the seven institutes that constitute the Joint Research Centre of the European Commission.

ies
Institute for Environment and Sustainability

In line with the JRC mission, the aim of IES is to provide scientific and technical support to European Union strategies for the protection of the environment contributing to a sustainable development. IES works in close collaboration with official laboratories, research centres and industries of the EU's Member States, creating a bridge between the EU's policies and the European citizen. The combination of complementary expertise in the fields of experimental sciences, modelling and remote sensing puts the IES in a strong position to contribute to the implementation of the European Research Area and to the achievement of a sustainable environment.

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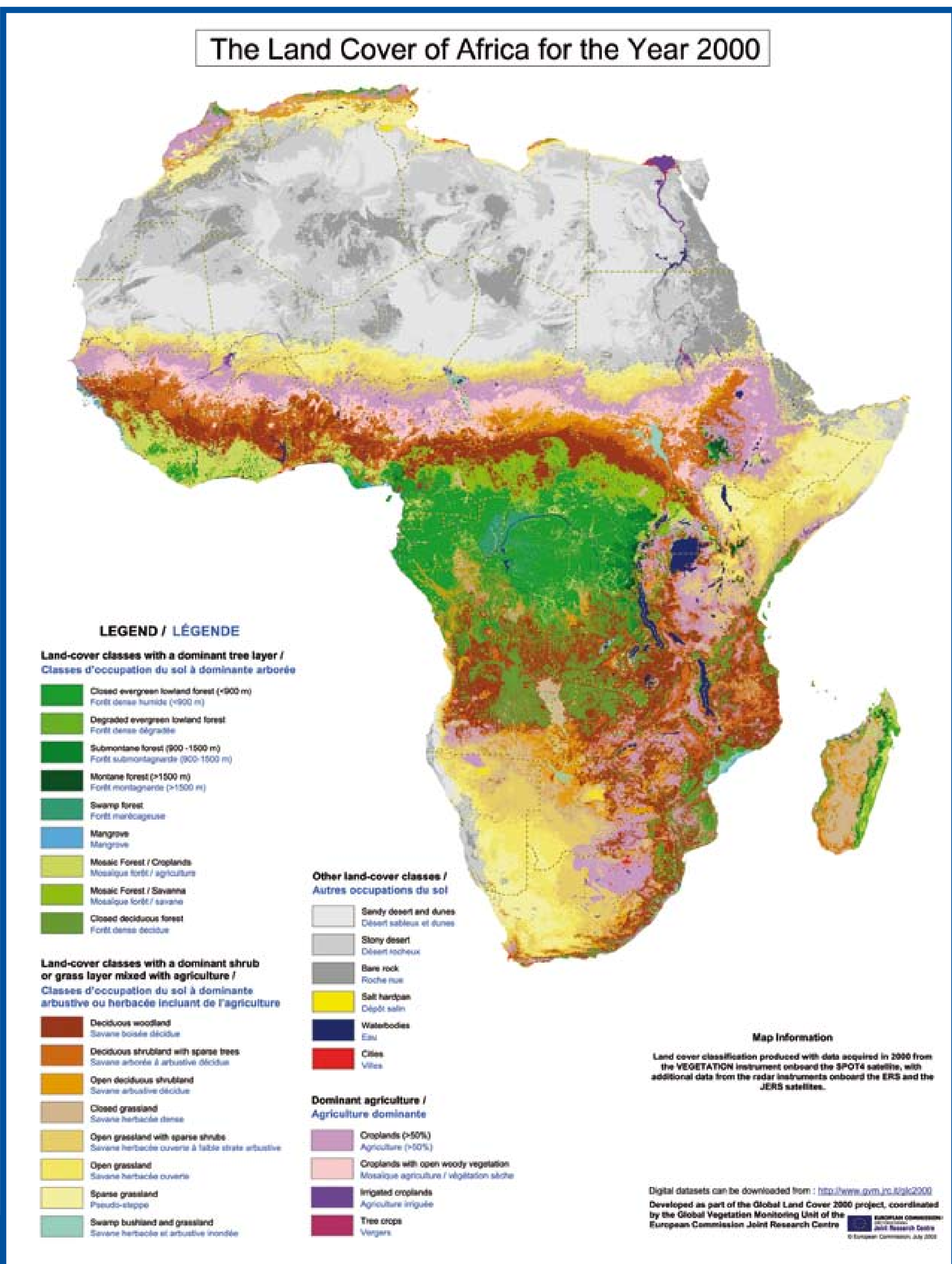
ACP Observatory for Sustainable Development

Driven by and responding to the needs of the European Commission Services and African, Caribbean and Pacific (ACP) Countries and Regions, the Joint Research Centre is building the observation, monitoring, modelling and analytical capacity of the ACP Observatory for Sustainable Development. The Observatory provides scientific information, diagnostics and scenario building to the service of development policies (EC, Member States, beneficiary countries and regions, donor community) for information sharing, increased co-operation and co-ordination of response strategies.
Information on soil, their properties and characteristics, is an integral part of any initiative towards the sustainable use of natural resources. The activities described in this calendar will contribute to JRC's ACP Observatory programme. **http://acpobservatory.jrc.ec.europa.eu**



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Further information and a high resolution image of the poster to the left can be obtained from http://www-tem.jrc.it/glc2000/