

Criteria and recommendations for capturing and presenting soil profile images in order to create a database of soil images

Criterios y recomendaciones para la toma de imágenes de perfiles de suelos para crear una base de datos de imágenes

Crítérios e recomendações para captação de imagens do solo a fim de criar uma base de dados de imagens

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ABSTRACT

This work aims to improve the skills of soil scientists in taking photographs of soil profiles for teaching and publishing scientific works. The authors have compiled a set of instructions, recommendations and tips that cover the process from the photographic capture to the selection of an appropriate file format to store or publish a picture, through to editing and post-processing the images. The main topics covered in this paper concern the physical position of the camera when shooting soil profiles, the basic adjustments of the camera, the basic retouching actions, and a list of tips and errors to be avoided.

RESUMEN

El objetivo de este trabajo es mejorar las habilidades de los científicos de suelos en la toma de imágenes de suelos para la docencia y la publicación de trabajos científicos. Los autores han compilado un conjunto de instrucciones, recomendaciones y consejos a partir de su experiencia, que van desde la captura de imágenes a la selección de un formato de archivo apropiado para almacenar o publicar una imagen, pasando por la edición y el post-procesado de las imágenes. Los aspectos principales incluidos en este trabajo se refieren a la posición física de la cámara cuando se dispara para tomar un perfil de suelo, el ajuste básico de la cámara, las acciones básicas de retoque y una lista de recomendaciones y errores que deben evitarse.

RESUMO

O objetivo deste trabalho é contribuir para melhorar as capacidades dos cientistas do solo na captação de imagens dos solos para utilização no ensino e publicação em artigos científicos. Os autores compilaram um conjunto de instruções, recomendações e conselhos com base na sua experiência, que vão desde a captação de imagens para a seleção de um formato de ficheiro adequado para armazenar ou publicar uma imagem, incluindo a edição e pós-processamento das imagens. Os principais aspectos incluídos neste documento referem-se à posição física da câmara quando se dispara para fotografar um perfil do solo, o ajustamento básico da câmara, as ações básicas de retoque e uma lista de recomendações e erros que devem ser evitados.

1. Introduction

Soil scientists often take photographs of the soils they work with in the field. Images must be taken not only to accurately record and display the main features of the soil, but also record the main features of the landscape to which it belongs, the soil forming factors, the land use and management, the processes and risks of soil degradation. There are a variety of details that may form the subject of an image (Porta et al. 2014).

It is usually not easy to re-photograph soil profiles: this would involve having to travel to distant areas of study and, in most cases, having to re-open a pit, with the resulting consumption of time and financial resources. It is therefore important to emphasize the importance of taking good source images, even if this requires further recommendations as identified in this work.

It is thus necessary to provide specific criteria for taking good images in order to avoid unsatisfactory issues when seeking to use the stored images in teaching, a public presentation or in a quality scientific publication. When the purpose of the images is the creation or extension of a database of soil images, it is imperative to follow strict rules regarding the quality of the images. Therefore, the main aim of the authors has been to make a set of techniques and advice available to teachers and researchers in order to ensure the quality and usefulness of the soil images.

Advances in camera hardware and the implementation of image processing software have caused previous works to become obsolete. This is the reason for the present work, which derives from the experience of the authors of many years of trial and error, and incorporates the techniques currently available.

Although the recommendation of basic equipment for taking and managing pictures is not the purpose of the authors, some considerations may be helpful in this regard.

- Camera, lenses and accessories. A digital single lens reflex (DSLR) certainly offers a versatility that can hardly be found in other types of cameras. DSLR allow mounting of a wide variety of lenses, covering a high range of focal distances and luminosity, which facilitates its use in virtually any type of photographic shot of the soil and its environment. They also allow storing files in raw format, manufacturer-specific formats that facilitate the preservation of the color information more accurately than other formats. The most useful lenses for field work are usually short focal lenses, which allow the capture of images with a wide viewing angle, suitable for taking pictures of soil profiles and the soil forming environment. Due to the recommendation of working with small apertures, discussed in section 3, it is not particularly necessary to invest in lenses of high luminosity. Concerning accessories, a tripod to stabilize the camera, lens hoods to prevent flare and polarizing filters for landscape pictures are the most useful.
- Image management software. *Adobe Photoshop®* is with no doubt the most complete software for cataloging, tagging, post-processing and retouching. In addition to the comprehensive manual delivered by that company, there are a lot of tutorials on the internet (at the time of writing of this work, the query "photoshop tips" on Google generated more than 92 million results). Its software license could be considered expensive, but the online

KEY WORDS

Database, camera, photography, image editing, post-processing, soil profile

PALABRAS

CLAVE

Base de datos, cámara, fotografía, edición de imágenes, post-procesado, perfil edáfico

PALAVRAS-

CHAVE

Base de dados, câmara, fotografia, edição de imagens, pós-processamento, perfil pedológico

store offers discounts of almost 80% for the educational community. The free software *Gimp* is one of the most powerful for general use in image editing. However, its use is sometimes complex and the technical support is limited. *Adobe® Lightroom* is also a powerful software tool with which to complete the entire workflow, from importing images to print or web publishing. *Aperture*, *Sagelight* and *Paint Shop Pro* are also programs that offer good performance for photo editing.

2. Resolution, Image Size and Color Management

The size required for a given image, specified as individual dots or pixels, depends on the quality and size in which it will be printed. To print high-quality images, a print density of 300 dots per inch (dpi) is common. This means that if an image is to be printed at a size of, for example, 18 x 24 cm (and considering that 1 inch corresponds to 2.54 cm), the number of pixels (px) required to form the image along its width and length will be, respectively:

$$18 \text{ cm} \times 300 \text{ dpi}^{-1} \times (1 \text{ cm} / 2.54 \text{ inch}) \\ = 2126 \text{ dots} = 2126 \text{ pixel}$$

$$24 \text{ cm} \times 300 \text{ dpi}^{-1} \times (1 \text{ cm} / 2.54 \text{ inch}) \\ = 2835 \text{ dots} = 2835 \text{ pixel}$$

This means that the image will contain $2126 \times 2835 = 6,027,210$ pixels, i.e. 6.03 Mpx. At present this is a very common value, even surpassed, by most digital cameras. However, when an image should be included in a screen presentation, its size does not need to exceed the resolution of the screen or the projector, which is usually around 1024×768 px.

However, in order to acquire as much information as possible, it can be very useful to capture the image at the maximum size allowed by the

camera. It must be kept in mind that some post-processing techniques, such as cropping and alignment can cause the loss of a more or less noticeable portion of the image at the edges. Large images can be reduced by almost any photo editing program, although in this case it is advisable to keep a copy of the original image, and save the reduced image in a new file.

Color management is a key element to consider throughout the process from digital capture to printing or web publishing. Most digital capture devices, cameras or scanners are RGB devices. This means that the color of the images is generated by combining three color layers (Red, Green and Blue). For each dot or pixel of the image, each one of the three layers records the intensity of the corresponding color on a scale ranging from 0 to 255 (when the image is recorded at 24 bits per pixel, 8 bits per each layer of color) or even on a broader scale. It is important to note that the color information that is recorded for each pixel is a value on a relative scale, not a precise definition of the captured color. Because different devices such as cameras, scanners, computers, screens and printers each have their own particular tonal properties, the result is that when the same image is transferred from one device to another (e.g. from the camera to the computer and then to a printer) the color information is "translated" by each device if a standard and precise color definition does not exist. This result is that the printed image may end up showing an appearance (brightness, color, contrast...) that is very different from the scene where the image was taken. It is a similar effect to that can be seen in a TV shop, where each brand offers different looking images.

The standard to define the color management system was established at the time by the International Color Consortium (ICC, www.color.org). The ICC identified a number of color spaces, essentially a catalog or palette. The color spaces define, among others, the red (255/0/0), the green (0/255/0) and the blue (0/0/255), the basic elements for coding the color in the RGB system, so that the color, for example, 255/200/0 is always the same color, regardless of the device

which is managing the image. Keeping the same color space along the entire workflow ensures that color changes when the image is transferred from one device to another are minimal. Each of these devices (camera, monitor, printer...) should have a file called an ICC profile, which contains the color information data associated with the device. These files are then used by the color management module of the computer (Colour Matching Module, CMM, in Windows, and Colorsync in Macintosh) to compensate for the peculiarities of the use of color of each device and then to minimize their differences.

To ensure that the color management system will function properly it is necessary for the image files to contain the color profile with which they have been captured or edited, and the editing software needs to be able to preserve the color profile and embed it in the new files. Only then can it be ensured that when we send a picture for publishing it can be reproduced with its original colors.

3. The position and the basic adjustments of the camera

An inadequate position of the camera in front of the soil profile can be the origin of two problems related to the perspective and the depth of field.

Regarding perspective, if the camera is placed in the upper or in the lower edges of the soil profile, the image will be vertically distorted. This effect is more remarkable the deeper is the profile. Although this issue can be partially corrected during post-processing, the only way to avoid this is to place the camera back parallel to the profile and, for the reasons set forth below, in its central part.

Depth of field (dof) is the distance in front of and

behind the point of focus in which the existing objects in the scene appear reasonably sharp in the photograph. The dof is reduced when:

- (i) long focal lengths are used (when we "approach" to the subject using the camera zoom),
- (ii) a large aperture (small f/ number) is selected, or when
- (iii) the subject on which we focus is close to the lens

When the camera is placed inside the pit, the small distance between the device and the profile dramatically reduces the dof, which can cause the central part of the profile appears sharp, but not the bottom and higher edge. To increase the dof in this case it may be advisable to minimize the focal length and to select a small aperture (Figure 1). This adjustment increases the exposure time, and thus increases the risk of taking blurred images. Therefore, the use of a tripod or a flash may be necessary in this case.

When using automatic cameras, without manual control of the shooting adjustments, the automatic scene modes (ASM) can be useful to control the capture to some extent. The ASM are fundamentally combinations of sensitivity, aperture and exposure time, which are effective for capturing particular types of scenes. Although each camera may have a set of particular ASM, some of them are relatively common and can be useful for taking soil profile pictures:

- Landscape / night landscape. This ASM is designed to increase the dof by closing the aperture as much as possible. In many cameras, the software assumes that the camera is hand held, and therefore, the closure of the diaphragm is limited in order to avoid large exposure times involving risk of camera shake. Additionally, this ASM usually reduces the sensitivity of the sensor to avoid granulation and noise. The night version of this ASM usually assumes that the camera is stabilized by a fastening system and, therefore, allows greater closure of the diaphragm. This ASM is useful for taking pictures of the whole profile, in addition to the uses for which it was designed.

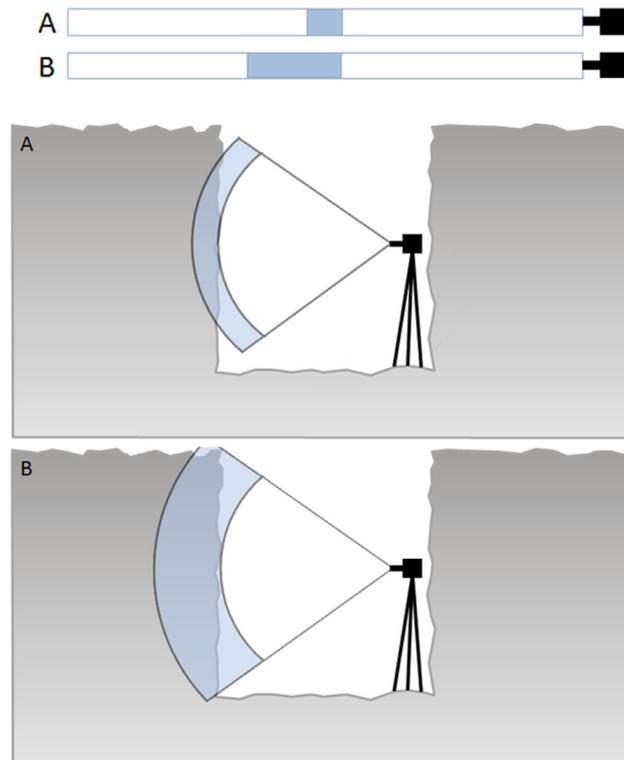


Figure 1. The depth of field (dof) is the space between the nearest and the farthest distance from the camera where the elements of the scene are captured reasonably sharp. In the figure, the dof has been highlighted as the shady area. In the case **A**, with a shallow depth of field, the central part of the profile appears sharper (within the shaded area), but not the edges of the profile. In the case **B**, with a greater dof, the entire soil profile could be placed within the sharp area. © Oriol Ortiz.

- Portrait / night portrait. This ASM aims to selectively focus on well-defined objects and to isolate them from the blurred background. The diaphragm is usually opened to blur the background by reducing the depth of field, and selective focus is used to draw attention to the subject. In the night mode, the camera is supposed to be fixed on a tripod, so no risk of camera shake is considered. This ASM is useful for imaging of medium-sized objects that can be found within the profile.
- Snowy landscape. This ASM increases the exposure time to correct the underexposure that occurs when capturing images of bright objects, which is discussed below. It is particularly useful when taking pictures of soils with high amounts of carbonate, gypsum or kaolinite.

- Macro. This ASM is a complement of the change in the arrangement of the objective lenses when small objects very close to the lens must be focused. Given the small size of the objects to capture and their proximity to the camera, the dof is increased by closing the aperture as far as possible, while avoiding use of the flash.

Light meters, whether hand or embedded in the cameras, are calibrated to generate halftone images, neither too dark nor too light. However, the soils are sometimes very bright or very dark. In these cases, the exposure parameters suggested the light meter may be biased to produce halftones (Figure 2):

- Bright soils appear darker, and
- Dark soils appear brighter

To avoid this error in the exposure, it may be useful to measure the light on a halftone object located above the soil profile. Cards with a density of 18% gray are sold in photo shops for this purpose. Alternatively, it can also be useful to measure the light on the surface of the hand against the profile, or on the vegetation close to the pit. When these alternative measurements are not feasible, it may be satisfactory to underexpose by 2 or 3 steps the exposure suggested by the light meter for dark soils, and to overexpose by 2 or 3 steps for bright soils. If dark and bright layers occur simultaneously within a soil profile, the general

advice is to expose for the darker areas. In this case, if precise light measurement is not feasible, an under-exposition by 1 or 2 steps can be useful.

A particular type of soil image is that taken for stereoscopic viewing. To study the soil profile using a stereoscope in order to get the feeling of the volumes, two pictures of the soil profile must be taken at the same distance of the profile, but from separate locations about one meter apart. As in all cases, the images must be taken before describing the profile and after an adequate preparation of the profile.

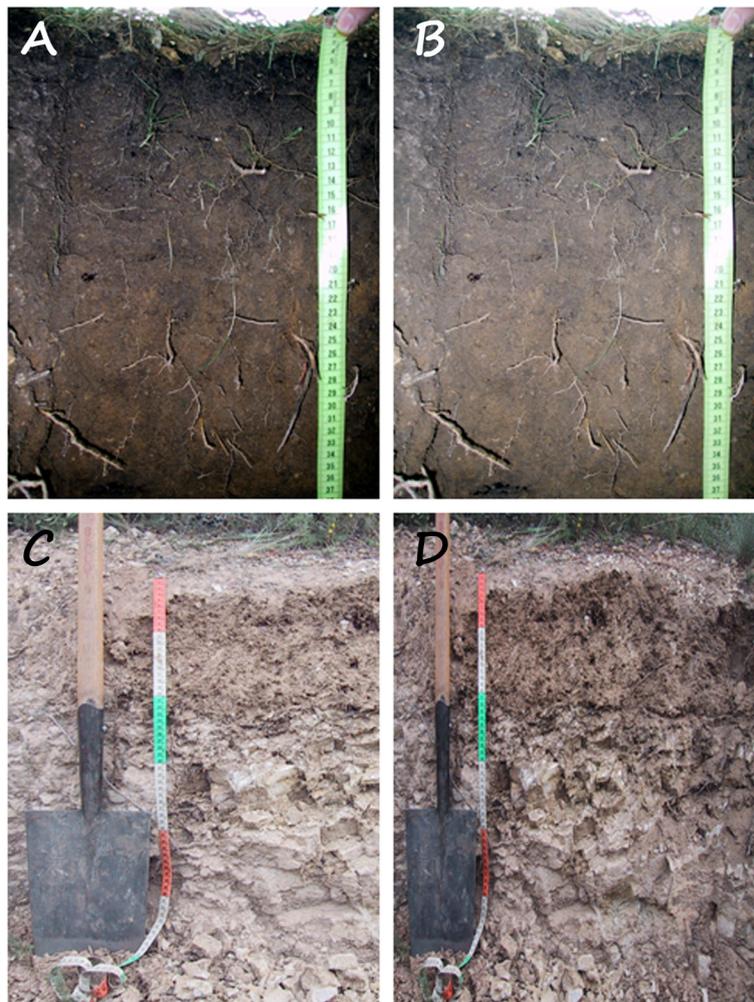


Figure 2. Original scene from a dark soil (A) and the resulting image after an automatic exposure (B). Original scene of a bright soil (C) and the resulting image after an automatic exposure (D). © Oriol Ortiz.

4. Composition

An image composed by only a few elements is often more informative and powerful than an image composed of many elements. This can be summarized by the old rule that says "less is more". When taking soil images, a series of several images describing the profile as a whole, the land use, the landscape features or some details of the soil is generally better than a single picture that attempts to show this variety and diversity of information.

Each photo must have a clearly identifiable subject, but only one subject. When trying to graphically describe two different features of the soil, taking two images is usually the best option. Note that the subject of the image must be some particular aspect or attribute of the soil or its environment. The subject should never be the shovel, or the tape, or the knife, or a coin. These objects can be useful and effective references, but generally should be at an edge of the image.

5. Photo retouching

The scientific photography should carefully reflect reality, although this does not exclude the possibility or the need to retouch photos, which in the visual arts is called post-production. In this paper, we use the term "retouch" to indicate all actions to correct defects or errors in the shot, which will be carried out in order to recover from the image all that was observed within the scene. Therefore, the term "retouch" is not used here to refer to the manipulation of the image with the purpose of changing the reality, or suggesting another reality. It should be noted also that some types of adjustments, such as tuning of color or sharpness are common steps done by some digital cameras prior to recording the image in jpg format.

The most common types of photography adjustments in soil photography are listed below. Some of these retouches are displayed in a workflow shown in [Figure 3](#).

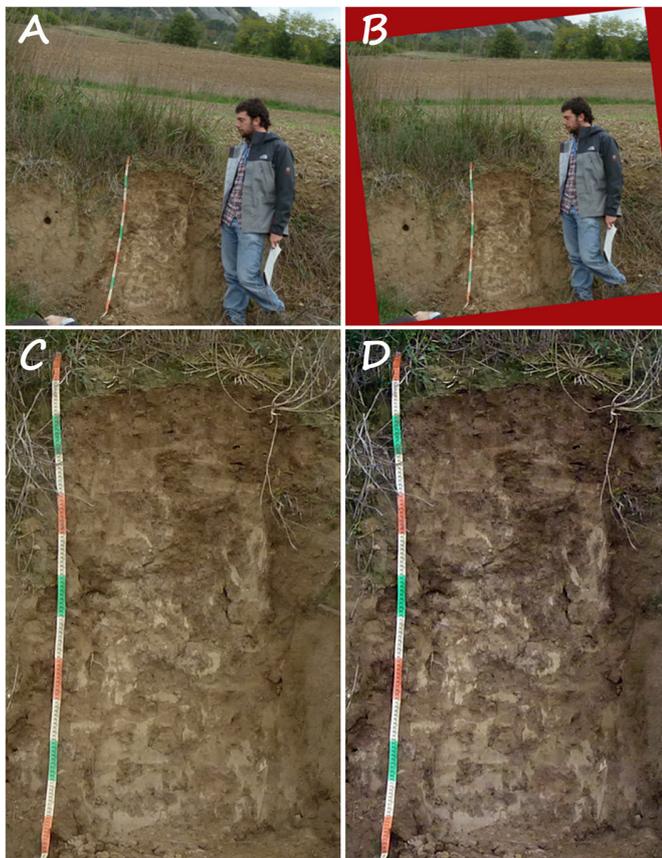


Figure 3. The original image (A) was aligned to recover the flat soil surface (B). Then, the portion containing the soil profile was cropped (C) and the tones of the final image (D) were adjusted. © Oriol Ortiz.

6. Most common mistakes and defects that should be avoided

- Image cropping and alignment
- Adjustment of curves or levels (tone retouching)
- Adjustment of white balance and color temperature and saturation (color adjustment)
- Contrast retouching

During the photo retouching special attention should be paid to the measuring tape, which is usually much more reflective, and therefore brighter, than the materials of the soil profile. Many images show unreadable tapes that should have been selectively corrected by adjusting levels or curves in the affected area.

Although many general and useful tips could be provided here to improve the capture of soil images, the following list shows only the advice that has proved most useful based on the experience of the authors, and that can be implemented practically at no additional charge.

- Frequent use of photographic equipment helps the user become familiar with it, and to remember the functions of the controls and to avoid repeating the same mistakes over again.
- It is better to work without haste. It can be a unique image, and the time required to avoid mistakes is a real need. If you get a good picture, it can be a lifelong image, a picture for teaching, or a picture to publish.
- If you can choose, you should to orient the pit so that backlighting and shadows are avoided. Depending on the expected time spent working in the field, you may have to consider the changing position of the sun throughout the day.
- The contrast between light and shadow tends to be much more remarkable in photographs than in the original scene. Try to avoid areas of high contrast between light and shadow. Cloudy days offer great opportunities to take pictures without shadows ([Figure 4](#)).

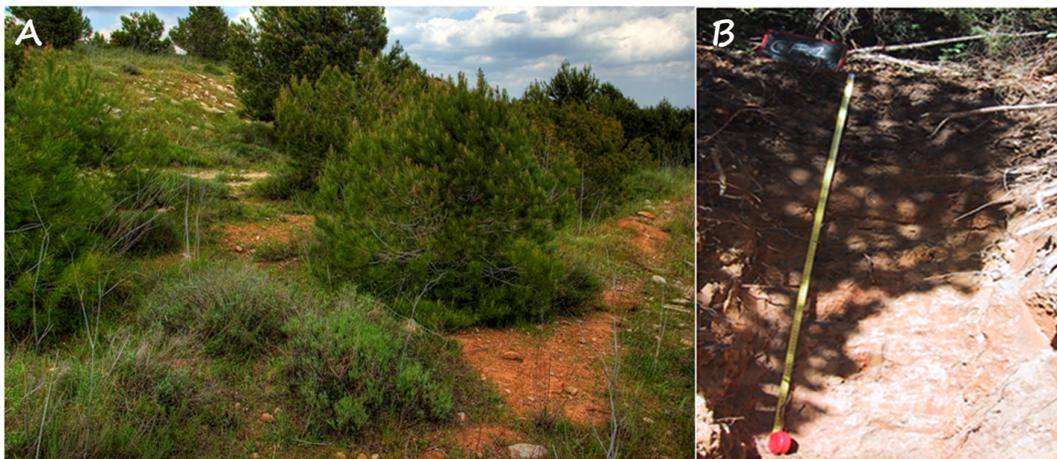


Figure 4. Cloudy days offer great opportunities with virtually no shadows (**A**). Conversely, sunny days can cause huge contrast between the shadows and the highlights (**B**). © Oriol Ortiz.

- The soil profile should be free of remains of the excavation and of other items that may be distracting.
- The soil profile must be adequately prepared prior to the image capture:
 - Some features are easier to observe and identify some days after the excavation, such as color, saline efflorescences, soil structure, clay coatings or accumulations of carbonates.
 - The traces of the digging tools must be removed (Figure 5) with a brush or a knife, as if shaving the profile. However, please note that some features of the structure could be revealed by the pattern of shadows and highlights, which should be preserved in the image.
 - The vertical surface of the soil profile should be leveled to avoid shadows and parasitic features.
- If the profile is located on a side road, the vegetation must be removed and the profile must be conditioned to improve the observation of its attributes.
- Avoid contaminating a soil layer with materials coming from another layer.
- Spraying water on the soil profile helps to homogenize the colors and highlights the differences between layers.
- Photographs of the environment should be taken (Figure 6) to describe:
 - The soil forming factors and the position of the soil within the soil landscape.
 - The characteristics of the environmental functions of the soil (the natural vegetation, the soil use...).
 - The existing or predictable soil degradation processes.



Figure 5. The soil profile should be carefully prepared to be free of marks of the excavator or other artifacts which may distract or hinder the observation of what is intended to show. © Jaume Porta.



Figure 6. A composite image is very useful for understanding the relationships between the soil and the landscape.
© Carmen Arbelo.

• Pictures of the relevant details of the soil must be also taken. In particular:

- Soil layers and their limits.
- Spots and mottling.
- The coarse elements.
- Soil structure and aggregates.
- Cracks and fissures.
- Accumulations and cementation.
- Clay skins.
- Appearance and development of the roots.
- Features caused by the biological activity.

• Do not forget the tripod. A good camera stabilization is equally or more important than having a good camera. In addition, a stabilized camera makes it easier to concentrate on composition and settings.

• A particular attention should be paid to the background. An homogeneous or out of focus background helps to concentrate the eye on the essential elements of the image (Figure 7).

• When a sharp background cannot be avoided, such as when photographing items are put on a card, care should be taken to use a clean and non-distracting background. The same consideration should be taken into account when holding any soil component in the hands.

• Look through the center of the viewfinder, and also through the edges to avoid including unwanted image elements.

• Consider the possibility of taking pictures another day if the light or the conditions are not appropriate.

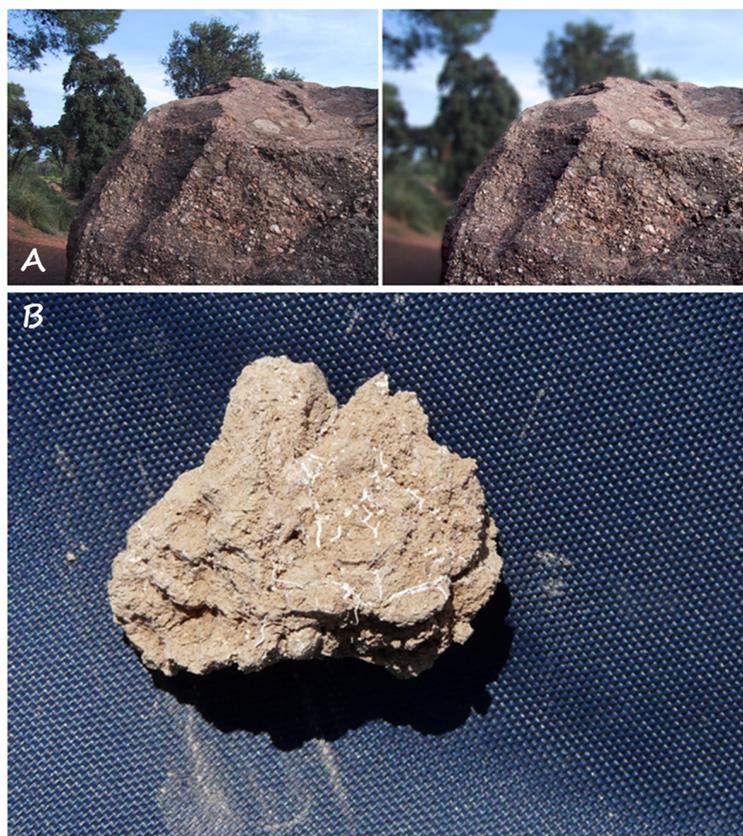


Figure 7. The picture shows the soil parent material (A): the image on the right was taken with a small aperture to keep the background out of focus. When a sharp background could not be avoided (B), it must be clean and not distracting. © Oriol Ortiz (left) and Jaume Porta (right). © Oriol Ortiz (A) and Jaume Porta (B).

7. Special techniques: panoramic photography and HDR compositions

The panoramic photography is a composition of multiple frames of a single scene which cannot be captured in a single image. While shooting for a panoramic composition, all individual images must be taken with the same exposure settings (aperture and shutter speed), focal length and focus point setting. The best way to proceed in this case is:

- (i) Fix the adjustments of the exposition (aperture and shutter speed) for the overall scene,
- (ii) Select a focal length useful to capture all the frames (short focal length works well here, because of the increase in the dof),
- (iii) Focus on the main subject of the image, or at the distance that facilitates the focus on all the essential elements of the image, and
- (iv) Disable the autofocus.

The images should overlap by about one third of their surface area in order to facilitate the combination of the individual images. Special attention should also be given to photographing every portion of the scene. To do this, it is useful to take photos in a systematic way as proposed in **Figure 8**. Briefly, we draw an imaginary horizontal line across the scene (red line in the example). Then we take a first series of photos (green frames, in the example) with their lower edges just above the red line and overlapping on a third at each side. Then we take a second set of photos (orange frames, in the example) centered on the red line, and with the same overlapping scheme. Finally, we take a third series of overlapping photos (blue in the example) with their upper edges just above the red line. If the whole scene cannot be photographed with these three sets of images, it can be divided with two imaginary lines, taking five series of images.

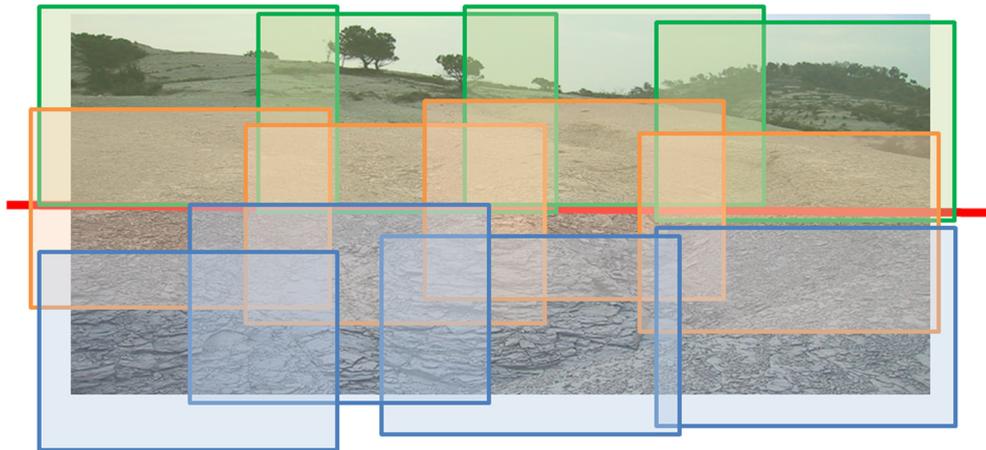


Figure 8. Suggested pattern to capture individual frames to be used to compose a panoramic picture.
© Oriol Ortiz.

There are a variety of programs that can combine the single frames to get the final panorama. The authors have successfully used the Microsoft® ICE (Microsoft Corporation, 2011), which is free and very easy to use, and can save the panoramic composition in tiff format.

The range between shadows and bright light in the scene can sometimes be greater than the range of tones that the sensor of the camera can capture. In this case, it is difficult to prevent some portions of the image appearing black or white in the picture, with no detail. The HDR images (High Dynamic Range) consist mainly of combinations of images taken from a single scene but with

different exposure values, in order to capture the entire tonal range (Figure 9). The number of individual photographs needed to obtain an HDR image will depend on the overall tonal range of the scene, and usually ranges from three to five. When shooting to create an HDR image it is essential to fix the camera on a tripod, to ensure a perfect alignment of all elements when the images are combined. The popularization of this technique in recent years has facilitated the emergence on the market of many programs that can create these images, and at very reasonable prices. The adjustments of the HDR imaging should be carefully selected to avoid creating overcooked images with artificial tones and colors.



Figure 9. Workflow for creating an HDR image. (A) The view of the scene reveals the existence of strongly lit and dark areas. In addition, as in the wheat field, these areas may appear highly mixed, making zone-based post-processing difficult. (B) 5 images were taken: 2 underexposed images (by -1 and -2 steps), one image exposed as suggested by the lightmeter, and 2 overexposed images (by +1 and +2 steps). All these images contain elements that are over- and underexposed. (C) The HDR image reflects the wide tonal range of the scene by combining elements of the 5 images. (D) The final image was then slightly adjusted to level the horizon and fine tune the tones. © Oriol Ortiz.

8. Appendix 1. File formats

There are now a great variety of file formats to store digital images, designed to meet specific needs regarding the color of the images, the compression of the files, the preservation of the

quality of the images, etc. The most widely used at present, with a brief description of the format and some additional indications are shown in **Table 1**.

Table 1. The most commonly used graphic formats to store and work with digital pictures. The compilation of this table was made from information taken from the specifications of different imaging programs, as well from San (2004-2009) and Rutter (1998-2013)

File format	Brief description	Comments
TIFF	A very flexible format. The files can be saved with or without compression, and this may result in a loss of quality (JPEG and ZIP compression) or not (LZW compression).	One of the most used formats for color photographs and diagrams. Not supported by most web browsers. Suitable for high quality images and for post-processing in several cycles (no quality is lost during the saving).
PNG	Compressed files without loss of quality.	Supported only by recent browsers. It will probably replace the GIF format in the future (except animated gif). Very useful for graphics of uniform colors and well-defined edges. Also to display images on the web without quality losses.
GIF	Files with indexed colors, only 256. Uses the LZW compression.	Supported by all web browsers. Quality loss occurs only at the first saving, so it holds up well along the post-processing steps. Useful for images of 256 colors or less, such as vector or statistical graphics.
JPG	Relatively flexible format that allows the user to choose from a wide range of compression values, although there is always quality loss.	Supported by all web browsers. It is the most used format by compact and bridge cameras. The images can be compressed to a high degree, but the quality loss is then quite visible. Not suitable for post-processing by steps, since a loss of quality occurs at every saving step. Useful for final copies to be sent by email or post to the web.
RAW	Only available on some digital cameras, like DSLR. Generates compressed files without loss of quality, but they are not standardized formats and their specifications depend on each manufacturer.	Very useful for storing images on the memory card, as it saves space without losing quality. Not recommended for long term photo storage or for the creation of a photographic archive.
BMP	Uncompressed file format only available to Windows® based systems.	Not supported by web browsers.
PSD, PSP, ...	Specific formats of some photo editing programs, designed to exploit the potential of the software. Not standardized.	Useful as work files, although it is advisable to keep the final versions of the images in a more widely accepted format.
EPS	PostScript file which can, but not necessarily, include a raster thumbnail.	It can preserve some of the image metadata.

9. Appendix 2.

What are the requirements of the SJSS and other scientific journals?

The following is only a summary of the general recommendations issued by some publishing groups, shown here as a reference. Only those relevant aspects related to photos have been selected, and no vector graphics and statistical printouts have been considered. Readers are encouraged to review the specific requirements of the journal to which they intend to send a work. Similarly, we recommend that a set of quality criteria be defined when work based on or supported by a photographic archive is to be carried out.

Spanish Journal of Soil Science:

- File formats: tif, bmp, gif, eps and jpg.
- Resolution: 300 dpi.
- Image size: depending on the size to be printed.

Elsevier (Elsevier, 2013):

- File formats: tif, jpg and eps (RGB of 24 bits).
- Resolution: 300 dpi.
- Image size: from 1063 to 2244 pixels to be printed from 90 to 190 mm.
- Image retouching:
 - Only accepted to clarify information.
 - No features or attributes can be enhanced, obscured, moved, removed or added.
 - Adjustments of brightness, contrast and white balance are only accepted if these do not conflict with the above two points.
 - Non-linear adjustments, such as changes in gamma settings, should be described in the figure caption.

Springer (Springer, 2013):

- File formats: tif.
- Resolution: 300 dpi.

Wiley (Wiley, 2013):

- File formats: eps, pdf and tif (CMYK for images to be printed, RGB for web color images, and grayscale for monochrome images). LZW compression.
- Resolution: 300 dpi.
- Images files should not contain layers or transparent objects.

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