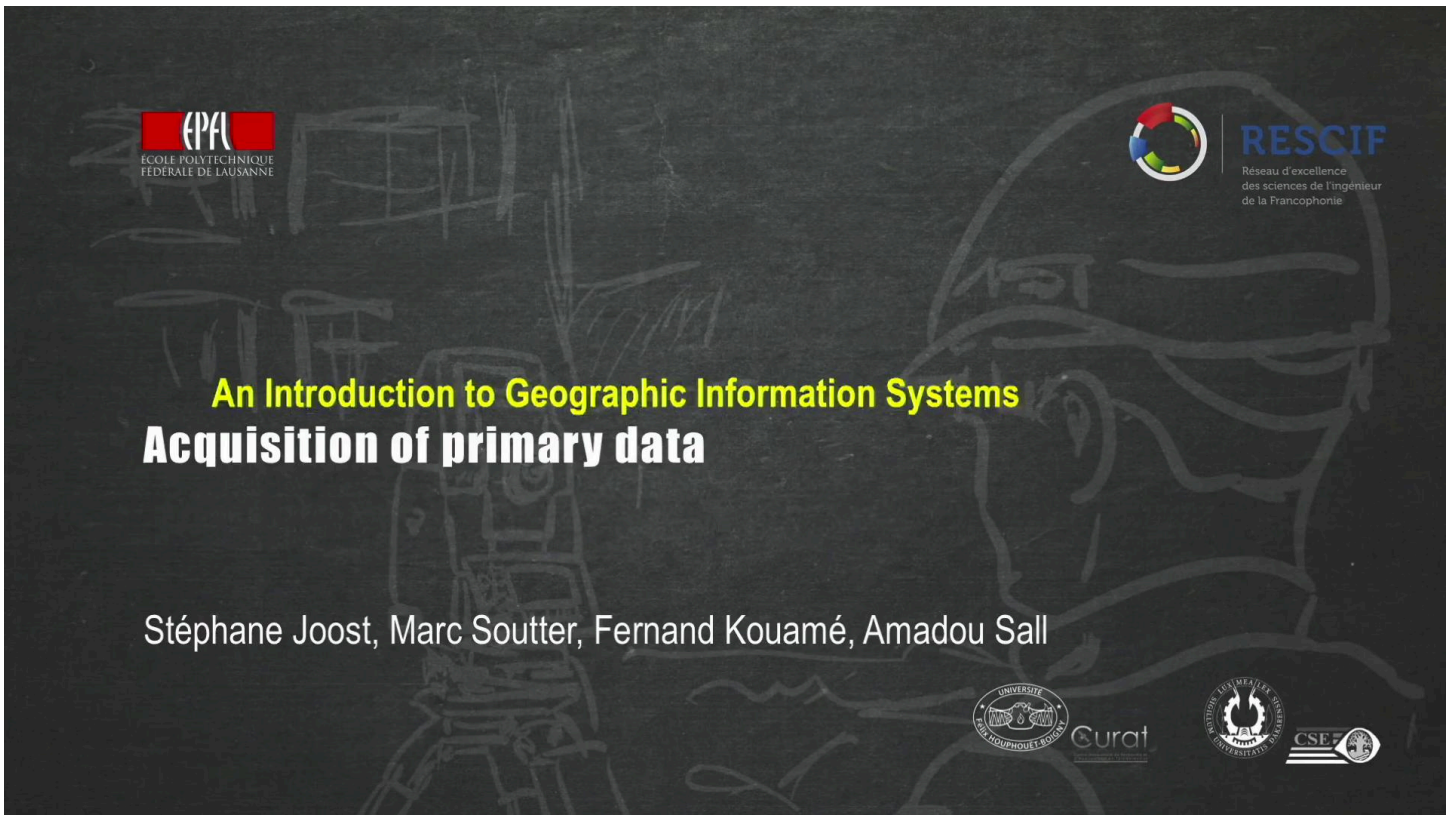

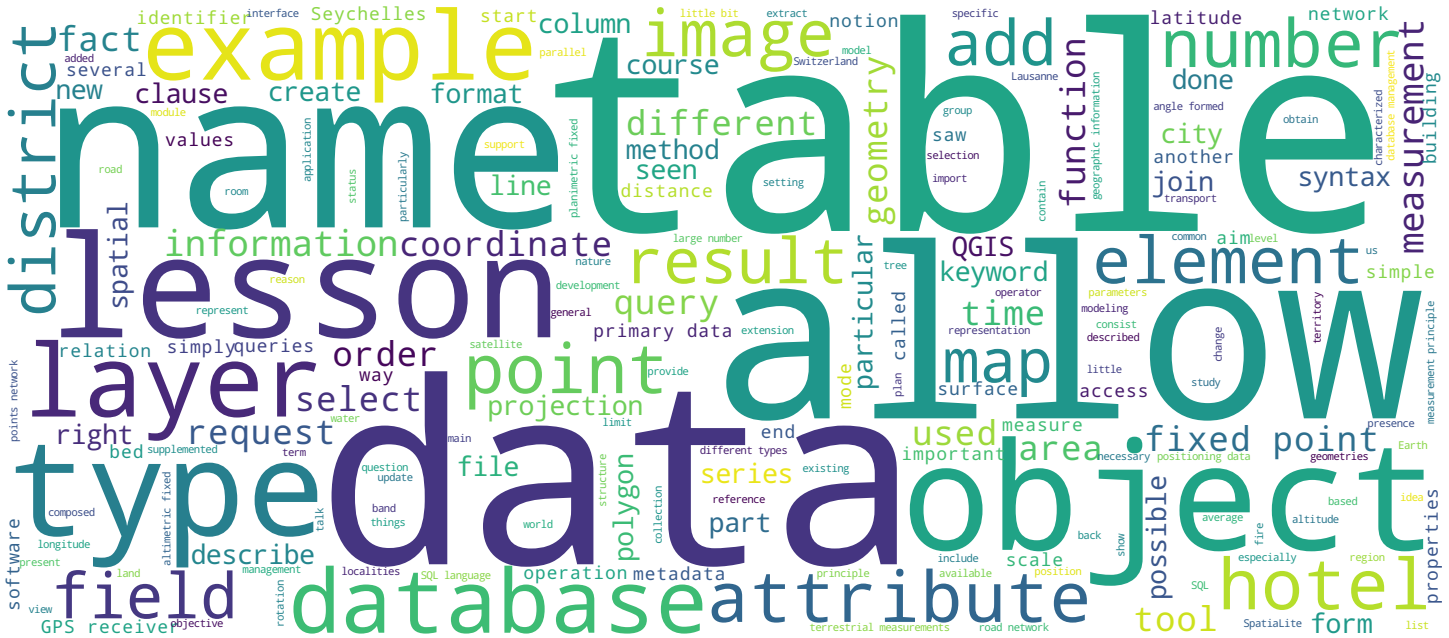

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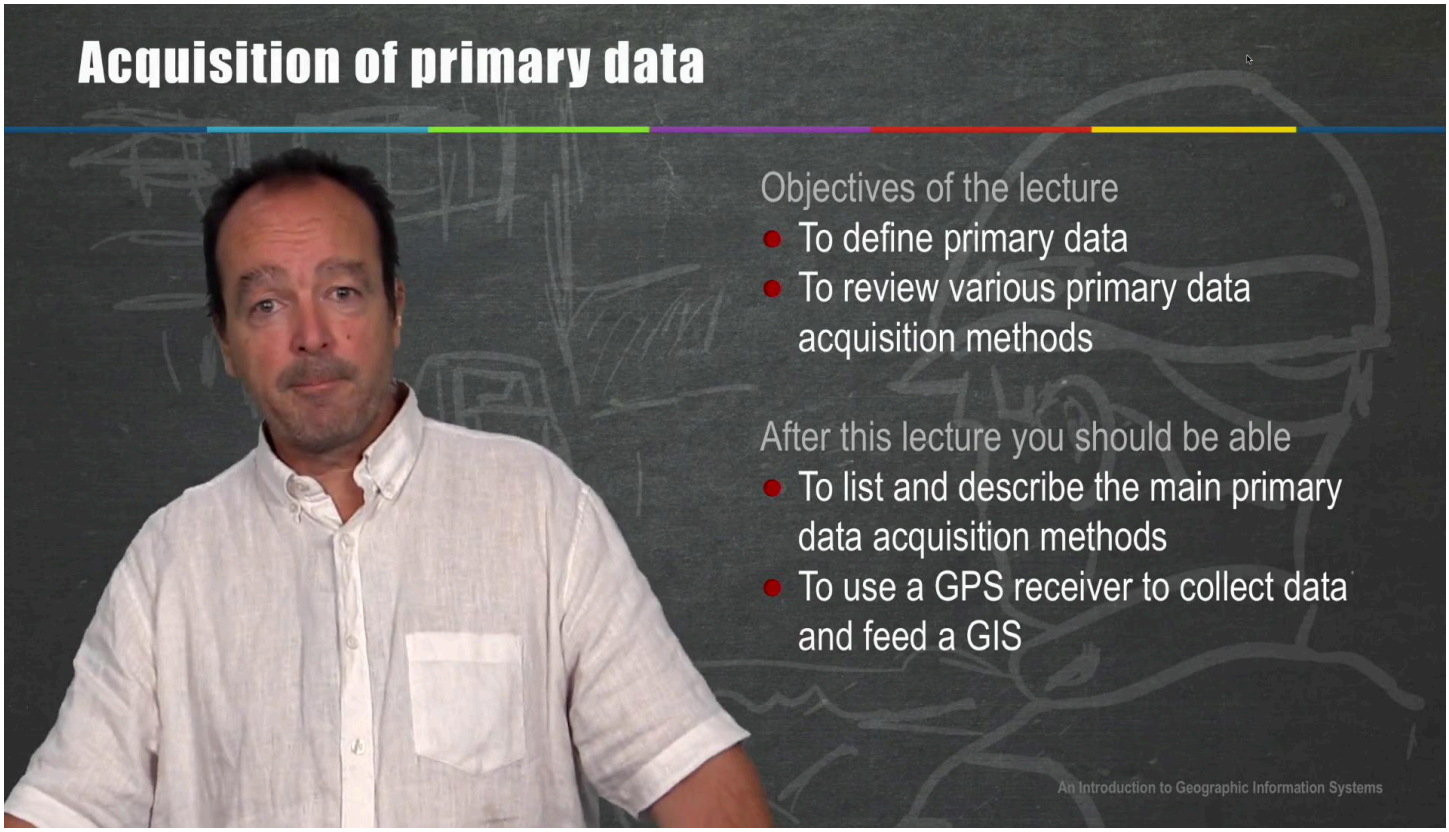


In the first part of this module, we reviewed the various aspects of the geographic space modeling. In the second part, which starts with this lesson we will see the different ways of acquiring information to describe and feed this model of geographical space. In this lesson, we will define what the primary data are and review various acquisition methods of these primary data. At the end of the lesson you should be able to describe these methods and you will have seen a little more in detail how to use a GPS receiver.

Notes

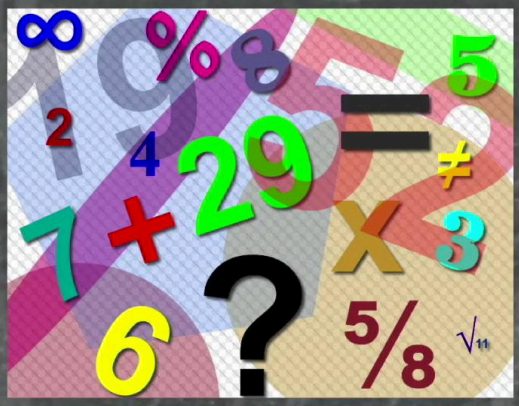
Summary

0m 22s

Notion of primary data

Origin

- Measured
  acquired by an instrument or an observation
- Derived
  resulting from a calculation, by combining primary information



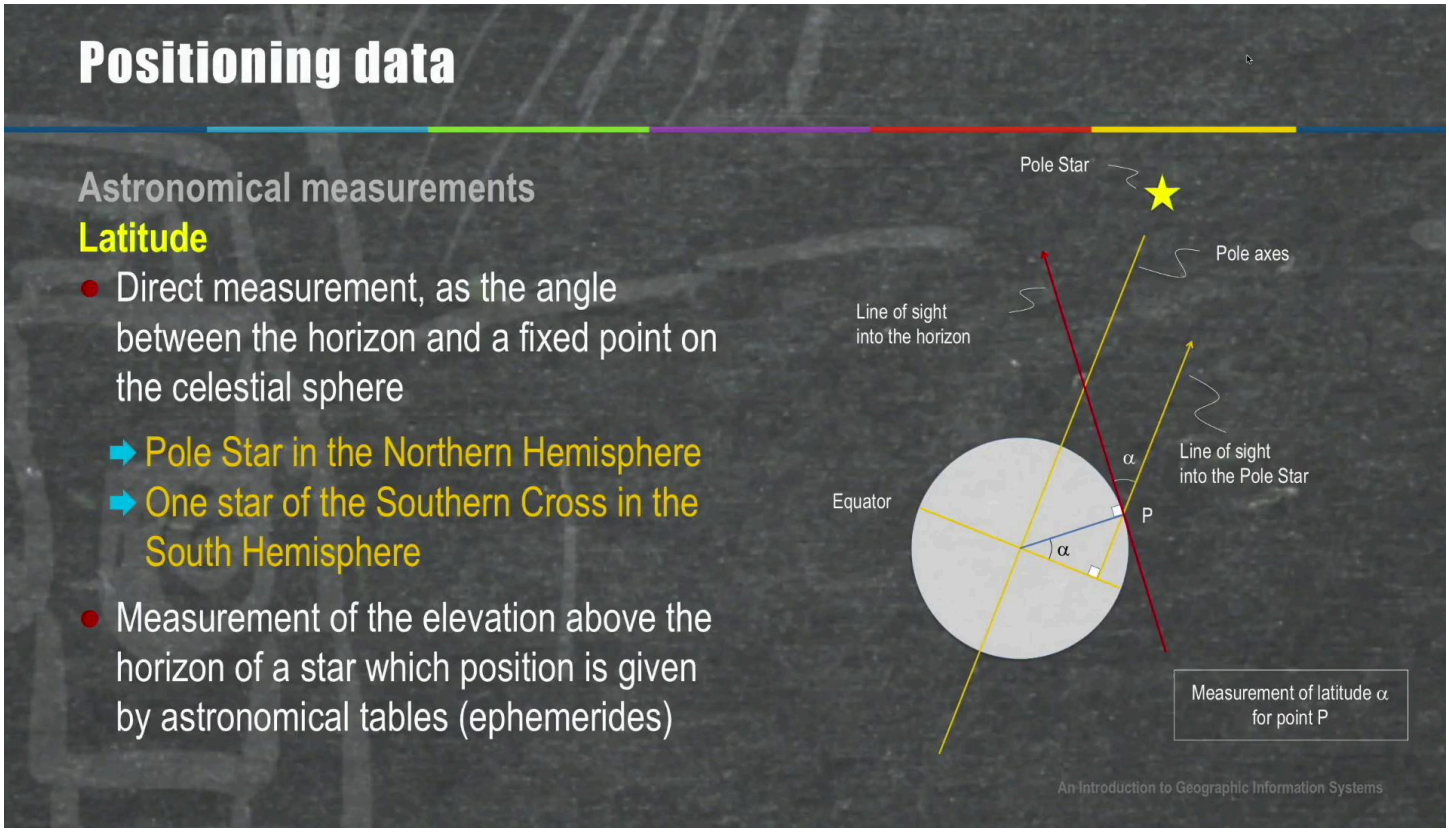
An Introduction to Geographic Information Systems

In this lesson, we will first come back to this primary data notion, to the definition of these primary data and then we will talk about the acquisition of positioning data with a small interlude to describe the use of a GPS receiver. And finally, we will talk a little bit about acquiring thematic data. We saw in a previous lesson dedicated to metadata that the different types of data can be distinguished based on their origin with measured data acquired by an instrument or by an observation, derived data that are coming from a calculation by the combination of primary information and interpreted data that are not measurable which are estimates from experts or opinions expressed by forum.

Notes

Summary

1m 02s

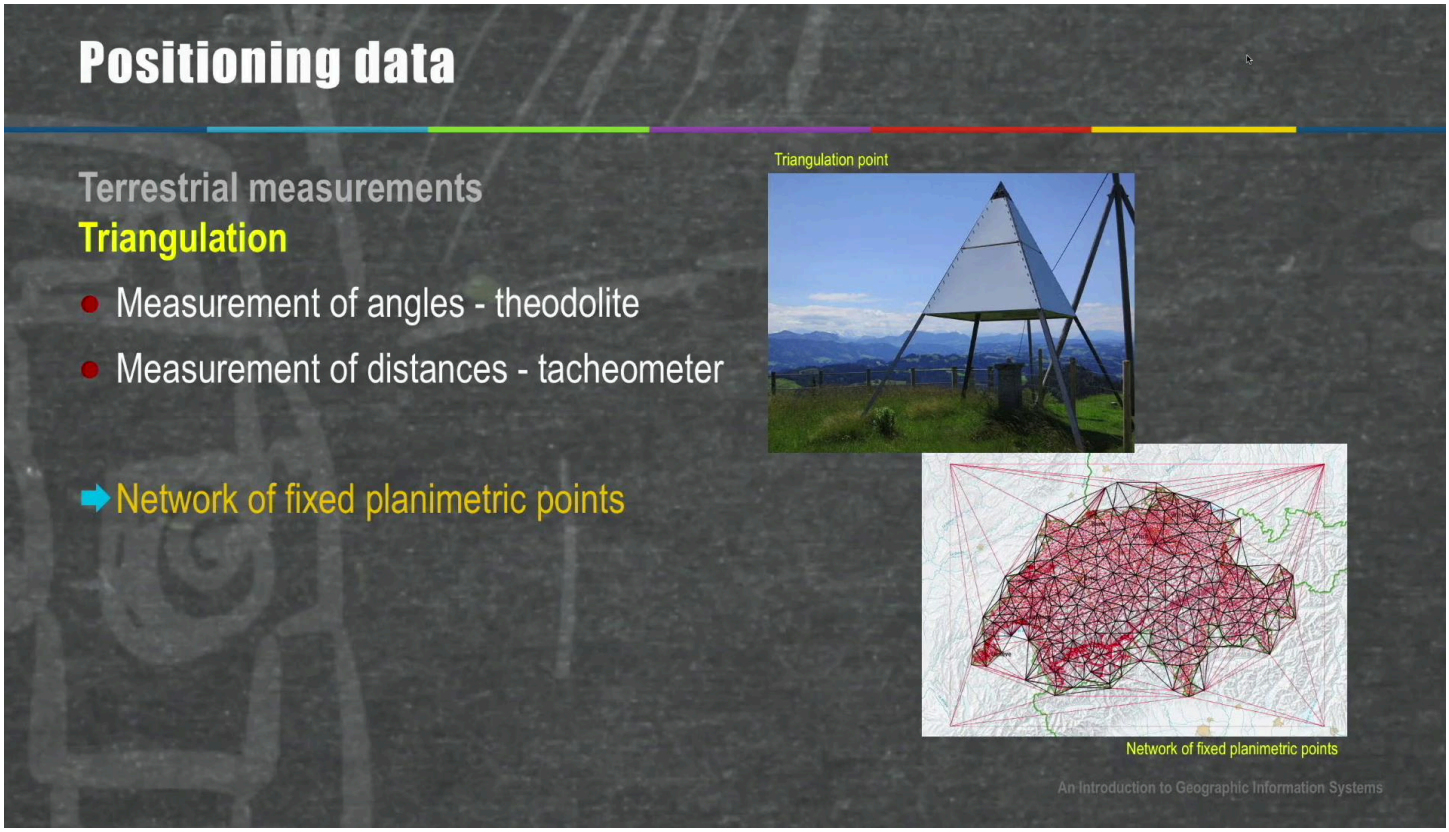


It is clear that the primary data concern the data measured either by a measurement instrument or from an observation. The positioning data, that is to say the location at the surface of the Earth so the latitude and longitude, are obtained initially by astronomical measurements. In the case of the latitude, it is a direct measurement of the angle formed by an aim on the horizon and by an aim towards a fixed point of the celestial vault. This fixed point corresponds to the pole star in the northern hemisphere the moon of the stars of the Southern Cross constellation in the southern hemisphere. We see in the figure that is here on the right that this aim on the North Star is actually parallel to the axis of rotation of the Earth and that the angle formed between this aim and the aim on the horizon corresponds in fact to the angle formed by the parallel of the latitude concerned with the equator which is by definition the latitude. The latitude can also be obtained by measuring the height of a star which position is known on the horizon. These positions are described by astronomical tables or ephemeris that one has to have on hand to make this measurement. The measurement of longitude is much more delicate due to the rotation of the Earth.

Notes

Summary

1m 55s

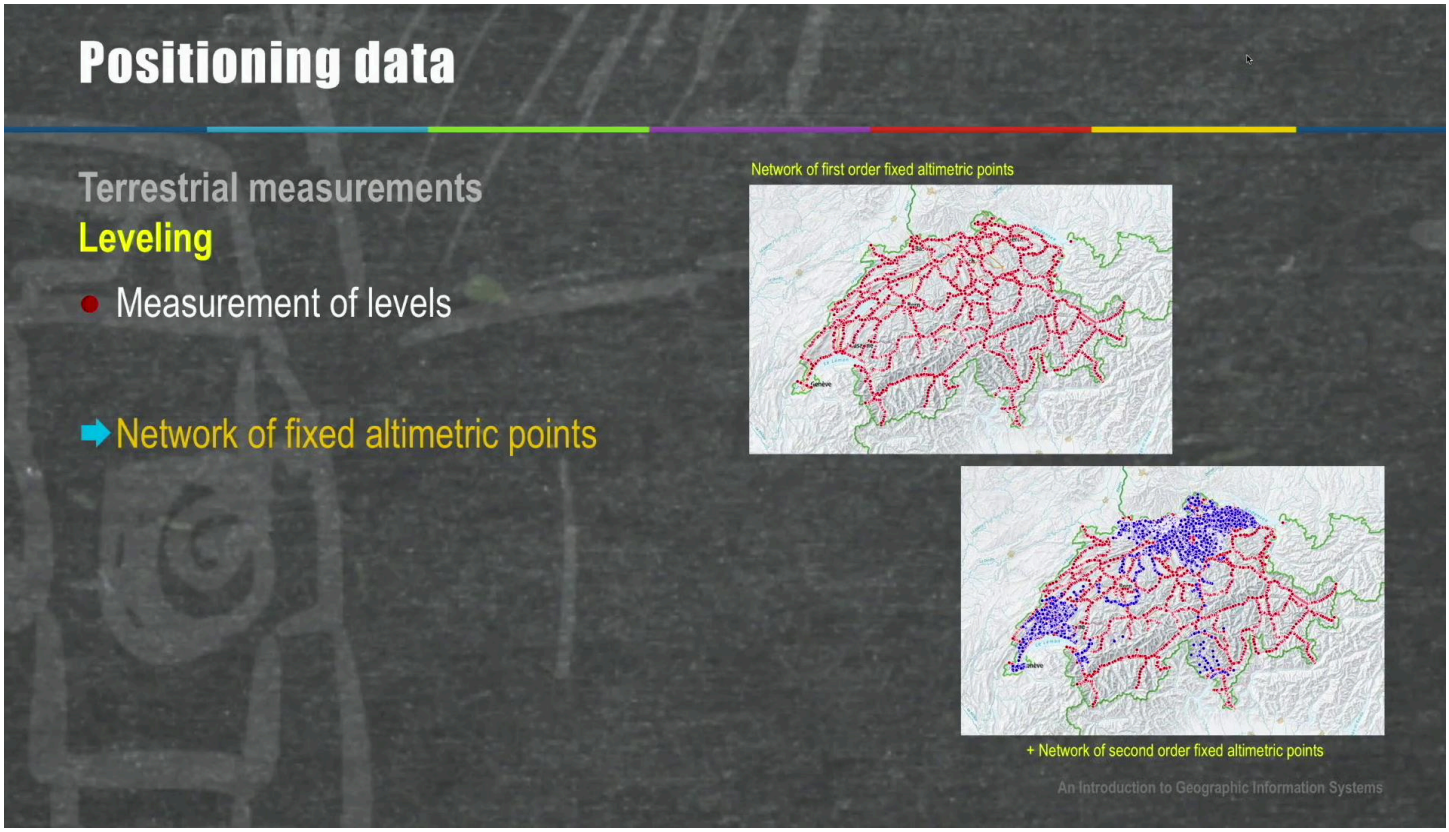


This has been one of the main challenges of the maritime navigation until the 18th century and that is why the maps that were available before this time were sometimes looking a bit quirky. In reality, in order to make this measure with some precision, we had to wait until the development of watchmaking and to have accurate clocks that allow to keep the time of a prime meridian in order to estimate the longitude by the difference of time with this prime meridian at the solar noon. The astronomical measurements not being always simple, they have been supplemented by terrestrial measurements, by triangulation, that count angle measurements done with a device called a "theodolite" and distance measurements using tacheometers. These allow to read the distance directly on a graduated scale from the measurement interval defined in the bezel of the aiming device. To be able to use these methods of terrestrial measurements, it is necessary to have a network of fixed points triangulation points, which coordinates are known and have been established and are regularly checked by astronomical methods.

Notes

Summary

3m 23s

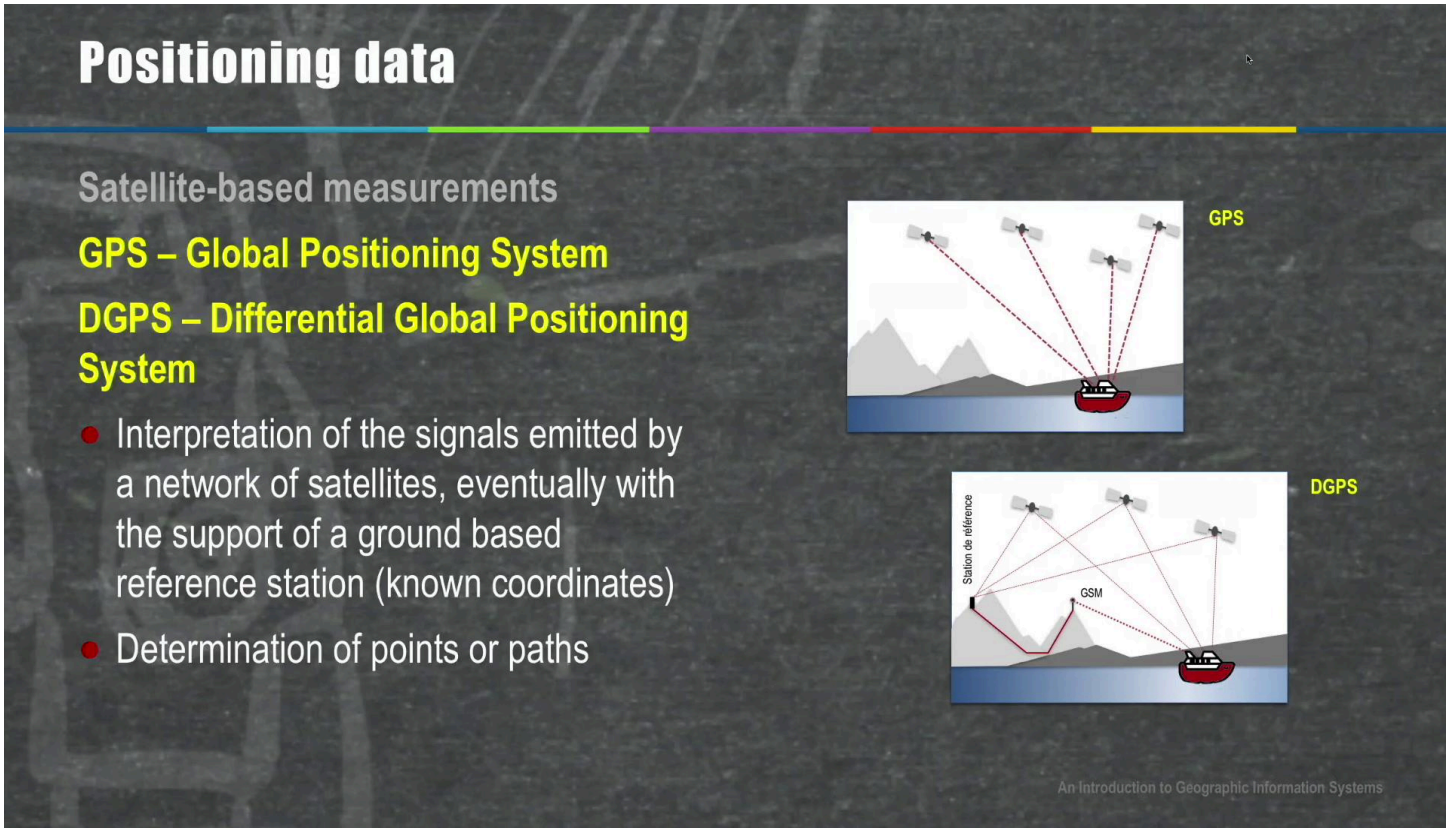


Such a network of planimetric fixed points exists in every country with, in the case of Switzerland, a first order network that here in the region of Lausanne is composed of about ten points supplemented by a much denser second order network. Triangulation methods are supplemented by levelling methods for the measuring, the height determination by level measurements. The equipment consists of sighting glasses sitting on a tripod and a graduated scale that an operator holds at a certain distance. And the altitudes are reported gradually by a horizontal vision rearward and forward. which allow then to do a compensation calculation and to get the altitude of the finishing point. In this case also, it is important to have a fixed points network to cling on to. That is why in all countries and especially in Switzerland, we have a network of altimetric fixed points of first order where we can guess the path that was followed in the valleys and a network of second order which densifies the information in specific areas. We see on these two figures that in the region of Lausanne, the first order altimetric fixed points network is slightly denser than the first order planimetric fixed points network was whilst the second order altimetric fixed points network is a little less dense, than the second order planimetric fixed point network.

Notes

Summary

4m 32s



The astronomical and terrestrial measurements methods which were mainly used until about twenty or thirty years ago are more and more often supplanted by satellite methods, the GPS, Global Positioning System, and the differential GPS that allow to obtain the coordinates of a point, so the positioning, from the signals emitted by a series of satellites which are specifically dedicated to this measure. The measurement principle is relatively simple since it is about interpreting the signals coming from a series of satellites possibly with the support of a ground reference station in the case of a differential system.

Notes

Summary

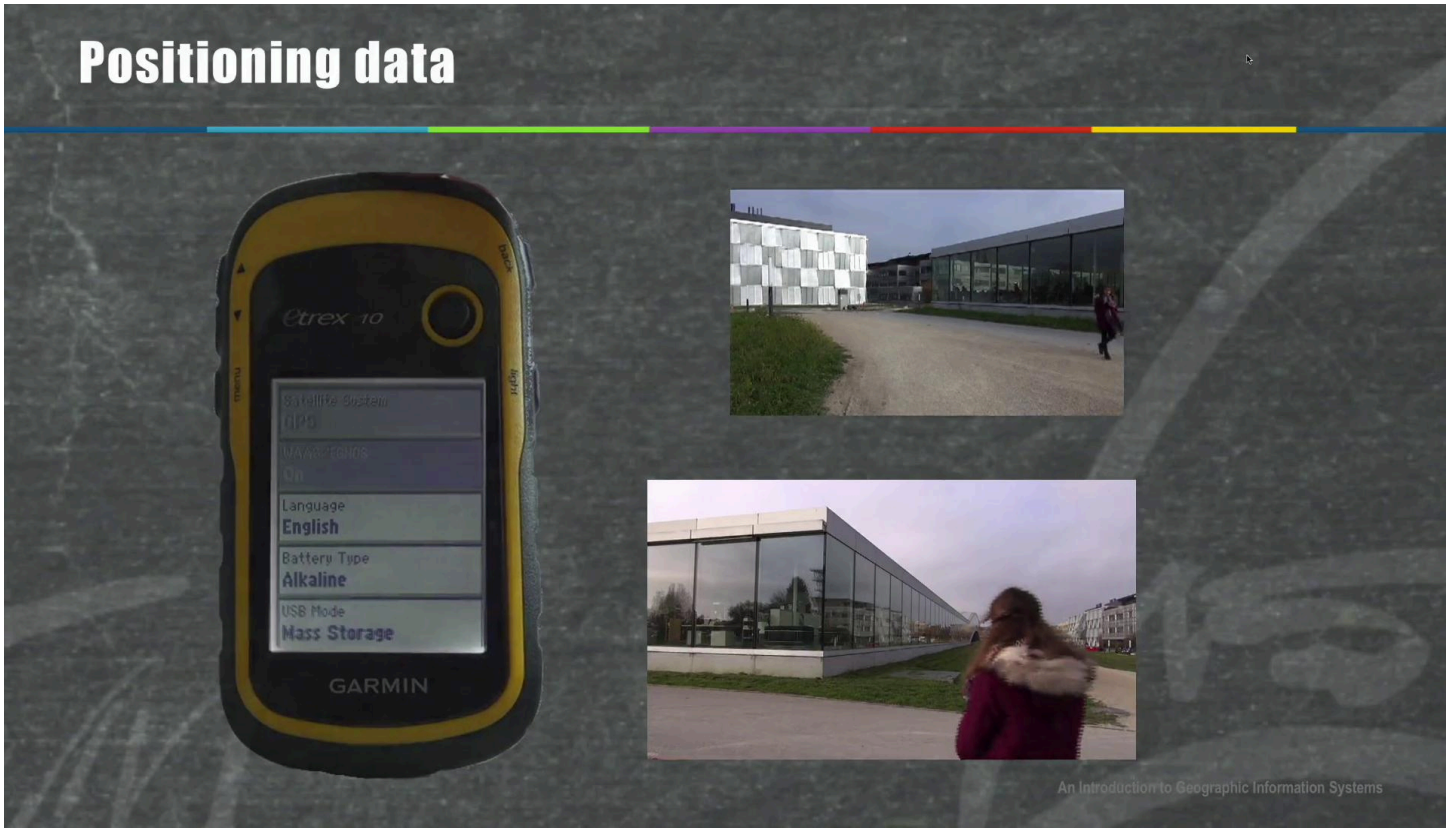
6m 01s

This measurement performed using commercially available receivers allows to determine points or paths. We will then perform a demonstration of the use of these satellite positioning methods and it is for this reason that I have the pleasure of welcoming in this lesson a surprise guest. Hello, my name is Margot and I will help Mark for this lesson. So I give you this precious instrument which is a satellite receiver and we will go and do these measurements. Thank you.

Notes

Summary

6m 50s



The home screen of the device appears as follows with a graphical menu which we can explore with the help of the button situated at the top on the right. By going down a few boxes, we can access the the camera settings and in these settings, the system settings, which allows to see that the GPS satellite system is active, as well as the geostationary navigation overlay service, WAAS in the US and EGNOS for the European Union.

Notes

Summary

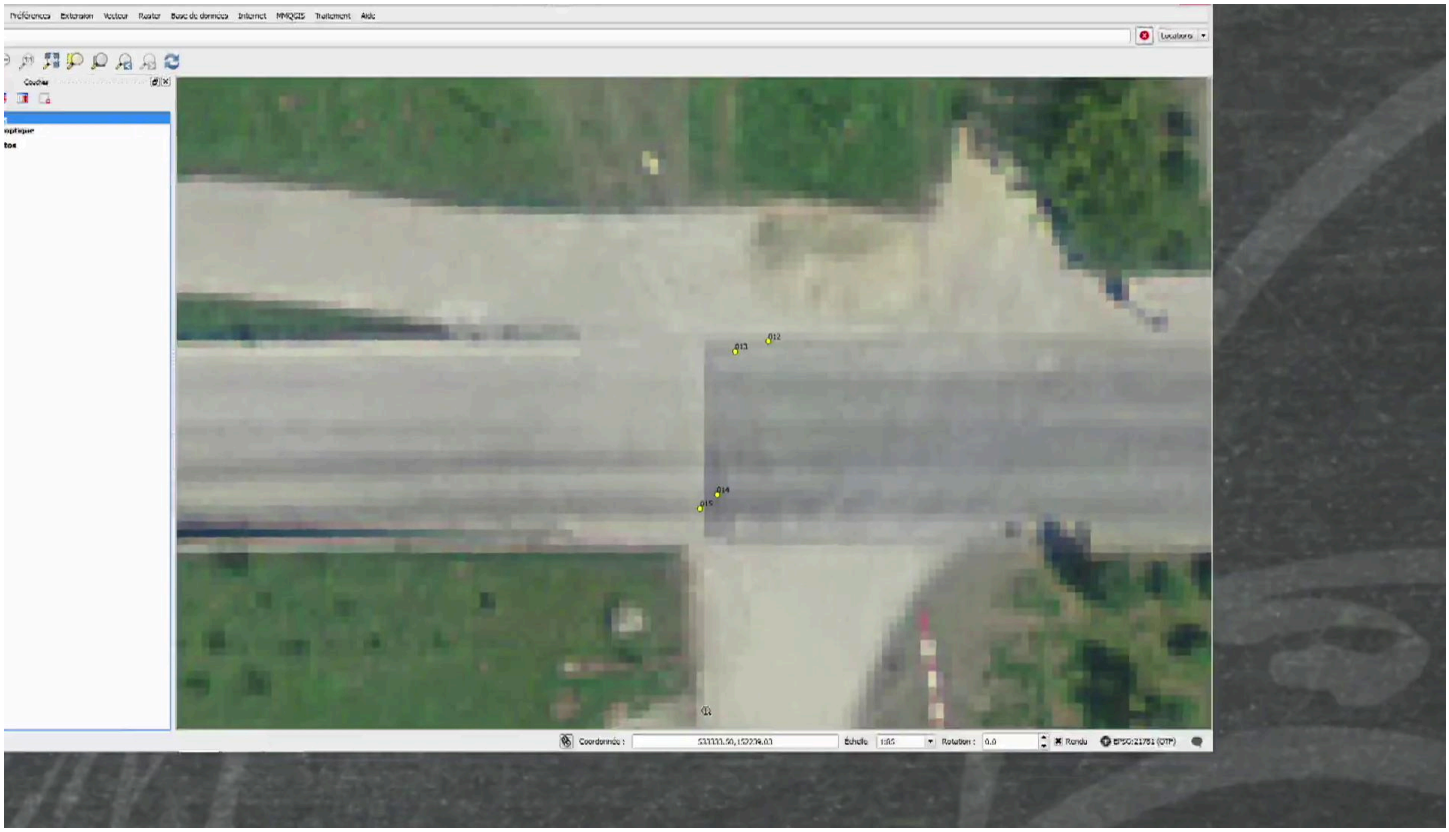
7m 26s

If we go back up a notch and we go down to the parameters that define the positioning format, we can see that the swiss projection system is the active system. Before doing the actual measurement, we have to make sure that the reception of the satellite signal is good. And for that, we have to go down to the "satellites" menu which shows that a large number of satellites are available, but that only two or three of them provide a relatively perceptible signal so a relatively low signal which is explained by the fact that this image was taken inside and not outside. To do the measurement, two possibilities: first, the "waypoint" menu. that can measure a point. We see that this point is characterized by its geographical coordinates in the swiss projection system and by its altitude. The determination of the coordinates of a point can also be done by an average of a large number of measures. This requires taking the ad hoc menu and create a new point and then wait for some time for the measurements to be done and for the confidence interval to become sufficiently good.

Notes

Summary

7m 57s

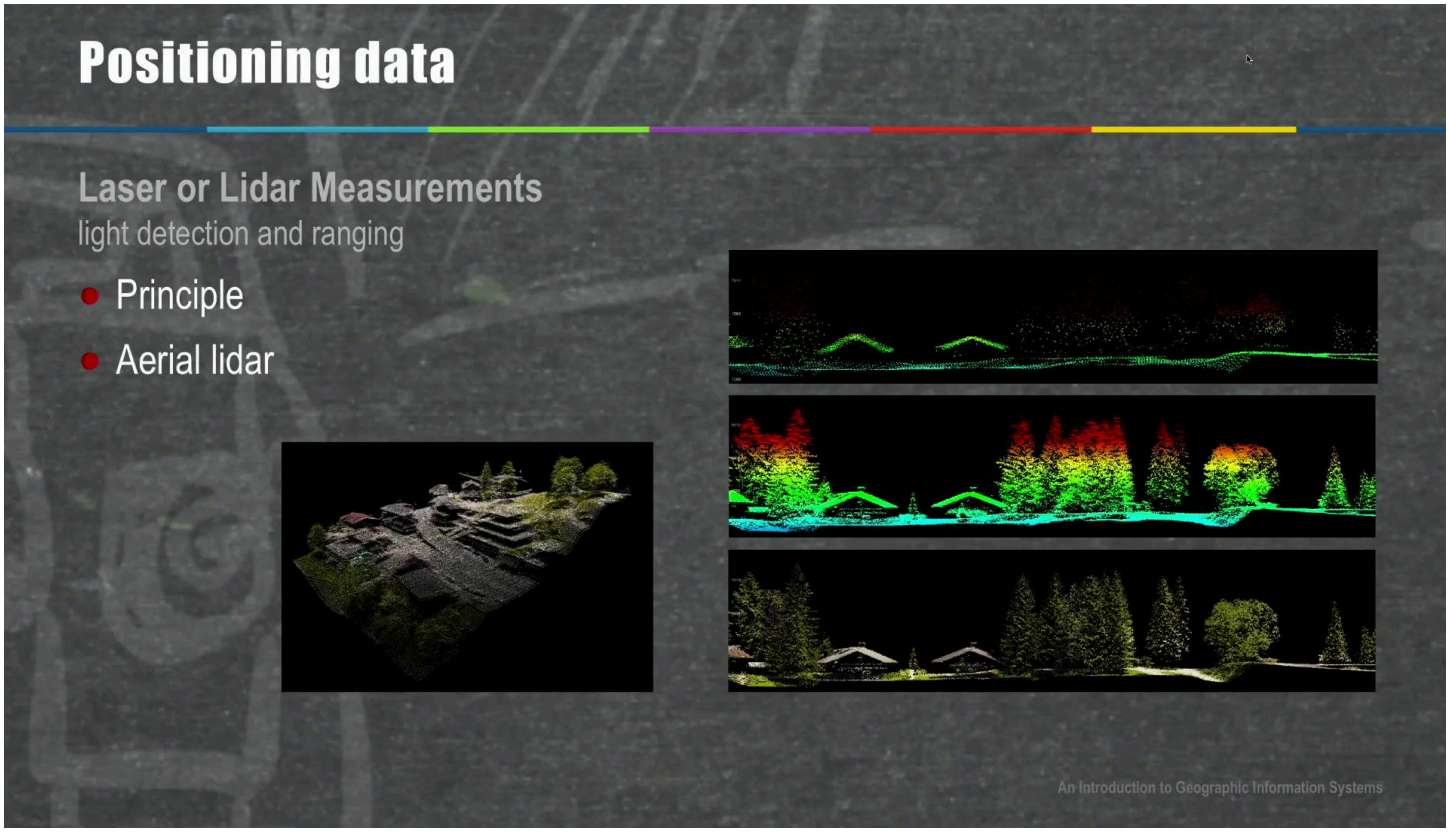


In general, the duration of the measurement is of one to two minutes. Back in the office, we can connect the GPS receiver to the computer and retrieve the measurement points. In this QGIS project, we have a synoptic map and the overlapping aerial photographs of the region of Lausanne. We remove the synoptic map and we will zoom on the Polytechnic School area and more specifically on the Rolex Learning Center sector around which we were taking our measurements. We decide to add a vector type layer and we see that in the file tree, there is the Garmin GPS receiver and in this receiver the GPX files and in particular the file of the points measured this day, 12th November. Among these points, we import the isolated points. And there they are, pretty much where we took the measurements. And we see that the corners of the building have been rather well represented. Going closer, we see that the two measuring points, once a simple measure and once an average measurement, are pretty close to each other. If we now go to the entrance of the underground car park where we tried to take more accurate measurements than the corners of the building, we see that both points of the measurements... We add a tag with the name of the point. So the points 12 and 14 are simple measurements 13 and 15 average measurements and the red crosses represent the points as vision.

Notes

Summary

9m 16s

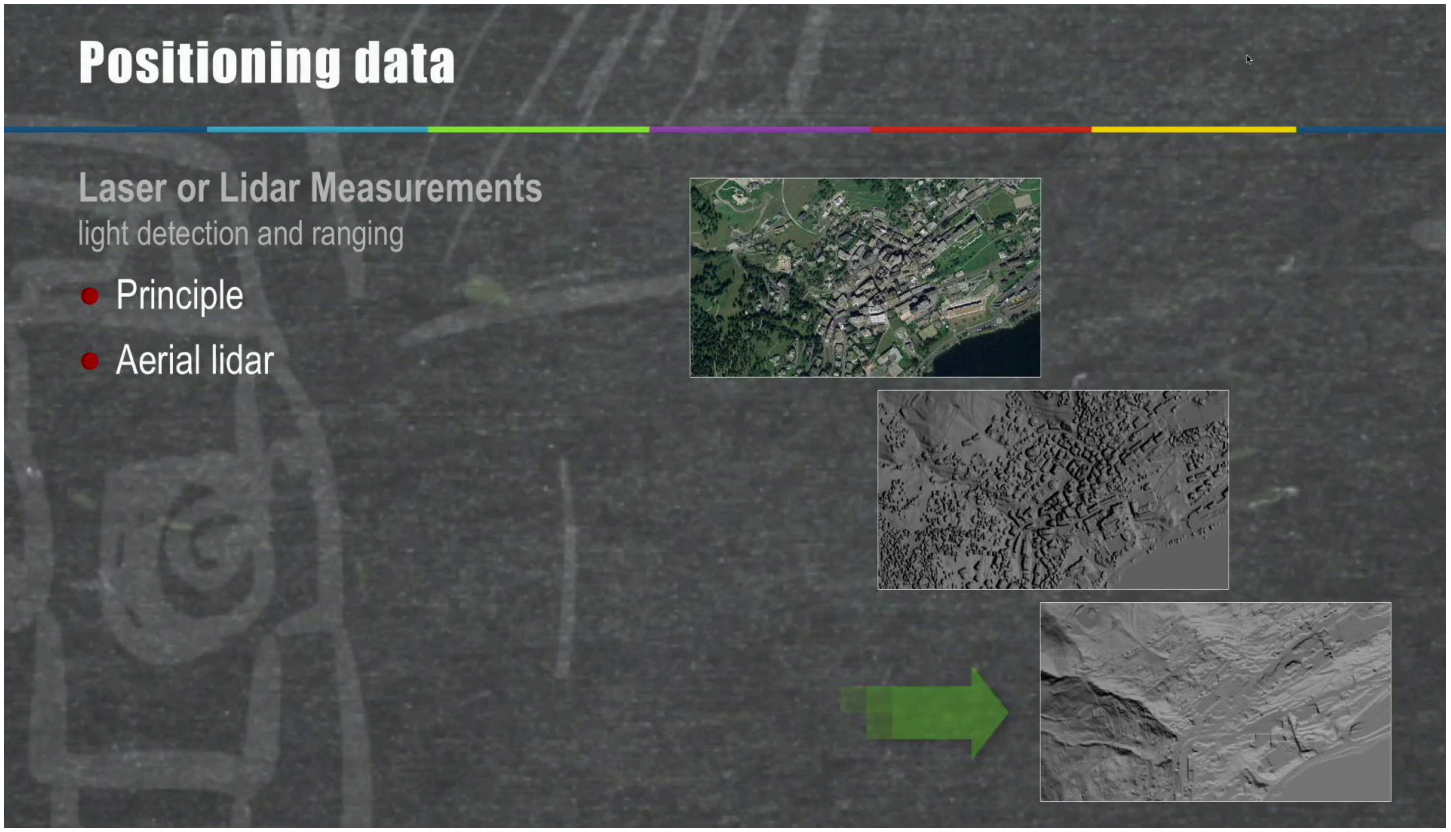


And we see that the measurement error is slightly lower in the case of average points. After this little interlude, back to the positioning data acquisition methods. with the measurements by laser or lidar for "light detection and ranging". The measurement principle is rather simple since we have a laser which emits a light beam. This beam interacts with the obstacles it encounters and sends a signal back which in turn is picked up by an optical system, filtered, detected and that actually allows to position the points intercepted in space. The application of this measurement principle is possible in systems taken on board in airplanes, this is called aerial lidar with the acquisition of three-dimensional point networks that allow to reconstruct afterwards the nature of what has been observed. The image on the right here shows the effect of the density of points since it is multiplied by 5 between the first image and the following two which are two variants of colorization of the same cloud of points.

Notes

Summary

11m 04s

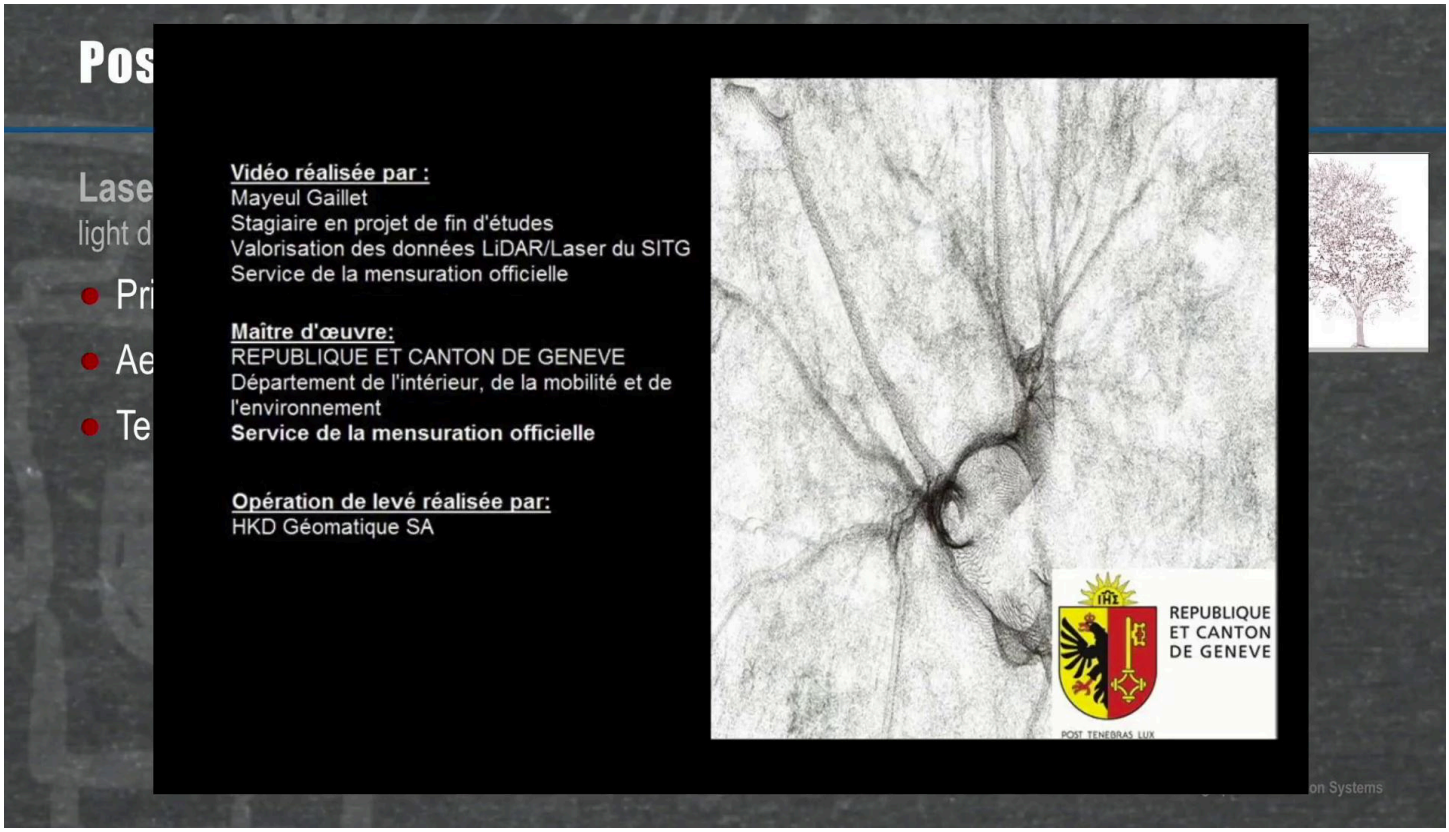


The data produced by lidar measurements here in the case of the Saint-Moritz region in the Grisons includes in fact the ground cover so the buildings and the trees and these basic data, these raw data have to be be processed using special algorithms that can erase this information to really get the digital model of the land.

Notes

Summary

12m 25s

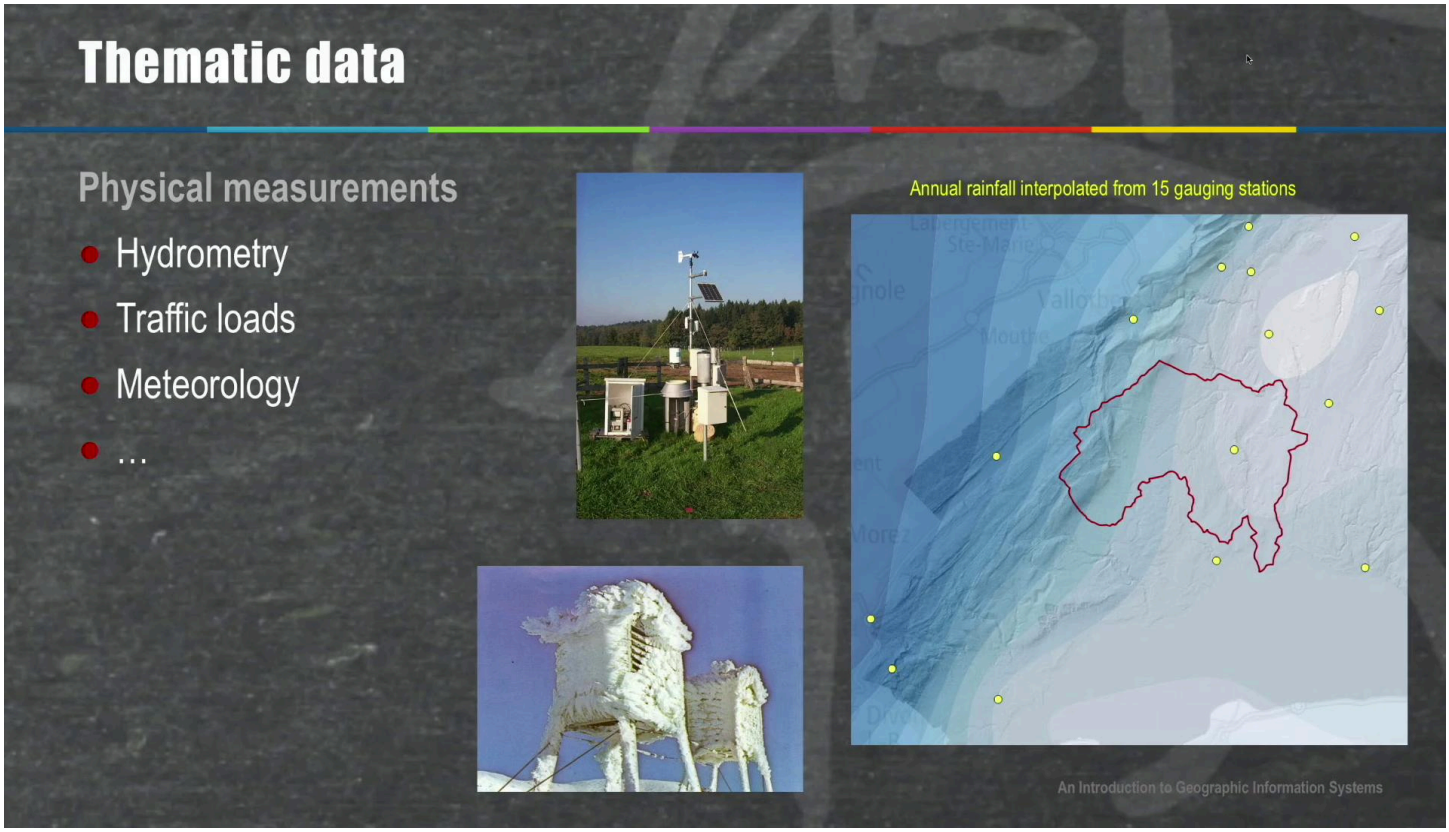


The lidar can also be used for terrestrial measurements with an example here of a crossroads reading in the city of Geneva where a cloud of point is extracted from the terrestrial lidar measurement which allows to represent the crossroads as it is and then to look around the crossroads and even here inside the tree that was measured.

Notes

Summary

12m 50s

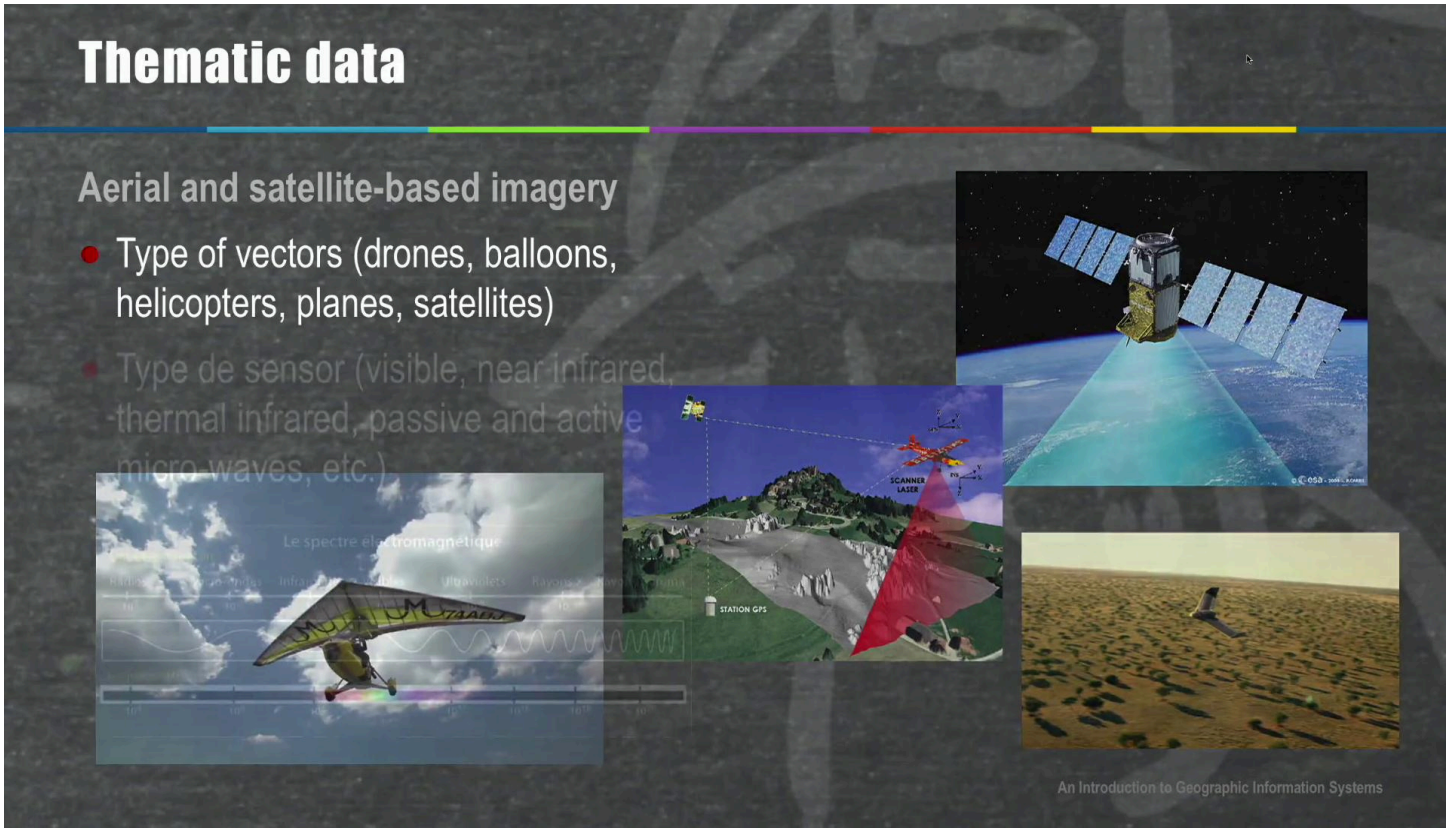


The thematic data can be acquired first from punctual physical measurements of various kinds such as the watercourse flow here so the hydrometry the traffic loads to describe a road network; the meteorology with climatic measurement stations which allow to make annual rainfall maps by interpolation.

Notes

Summary

13m 32s

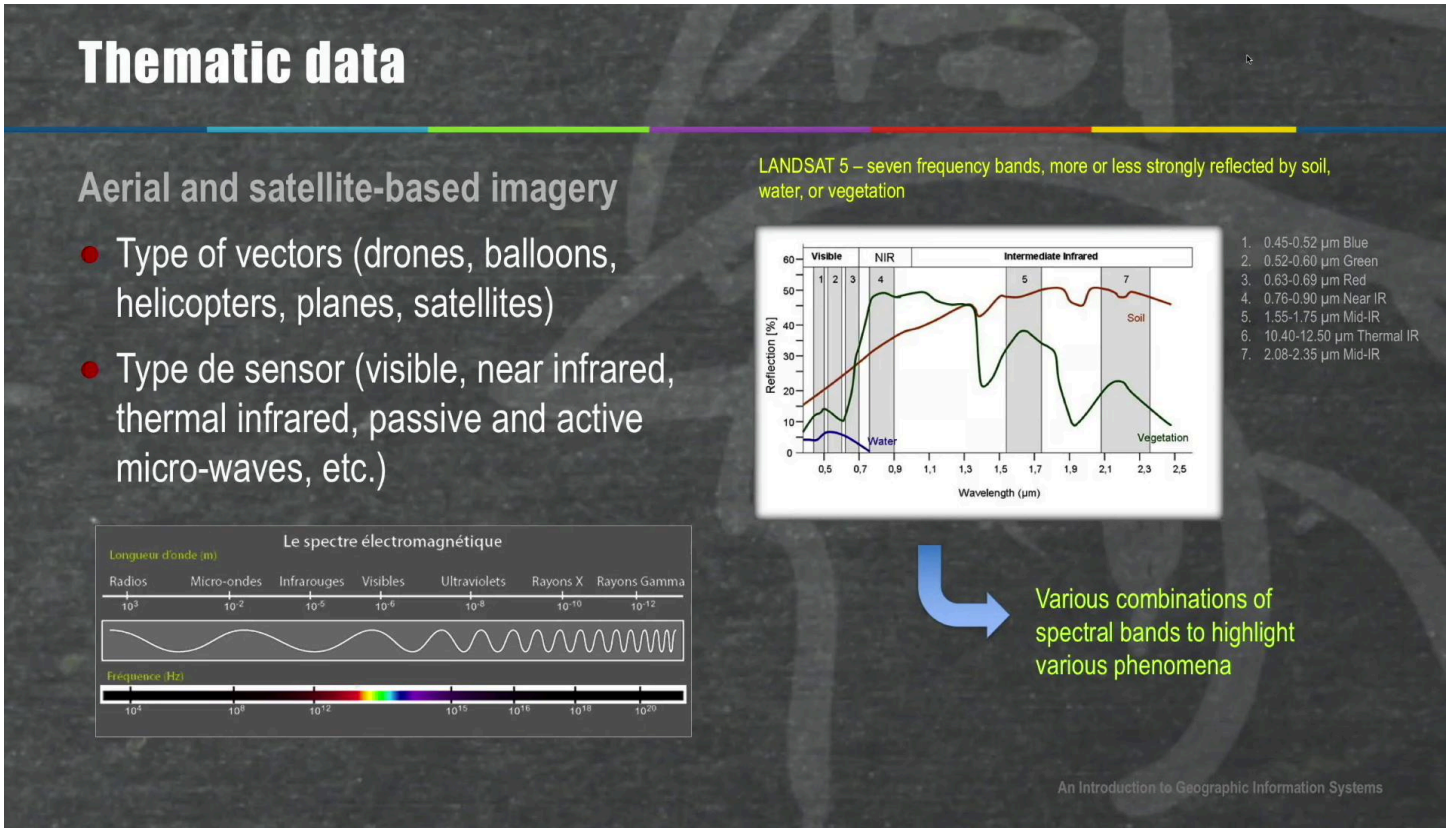


The punctual physical measurements are supplemented by aerial and satellite imagery which are characterized by the type of vector used: drones, helicopters, airplanes, etc. and the type of sensor used: visible, near infrared, thermal infrared, etc.

Notes

Summary

13m 57s

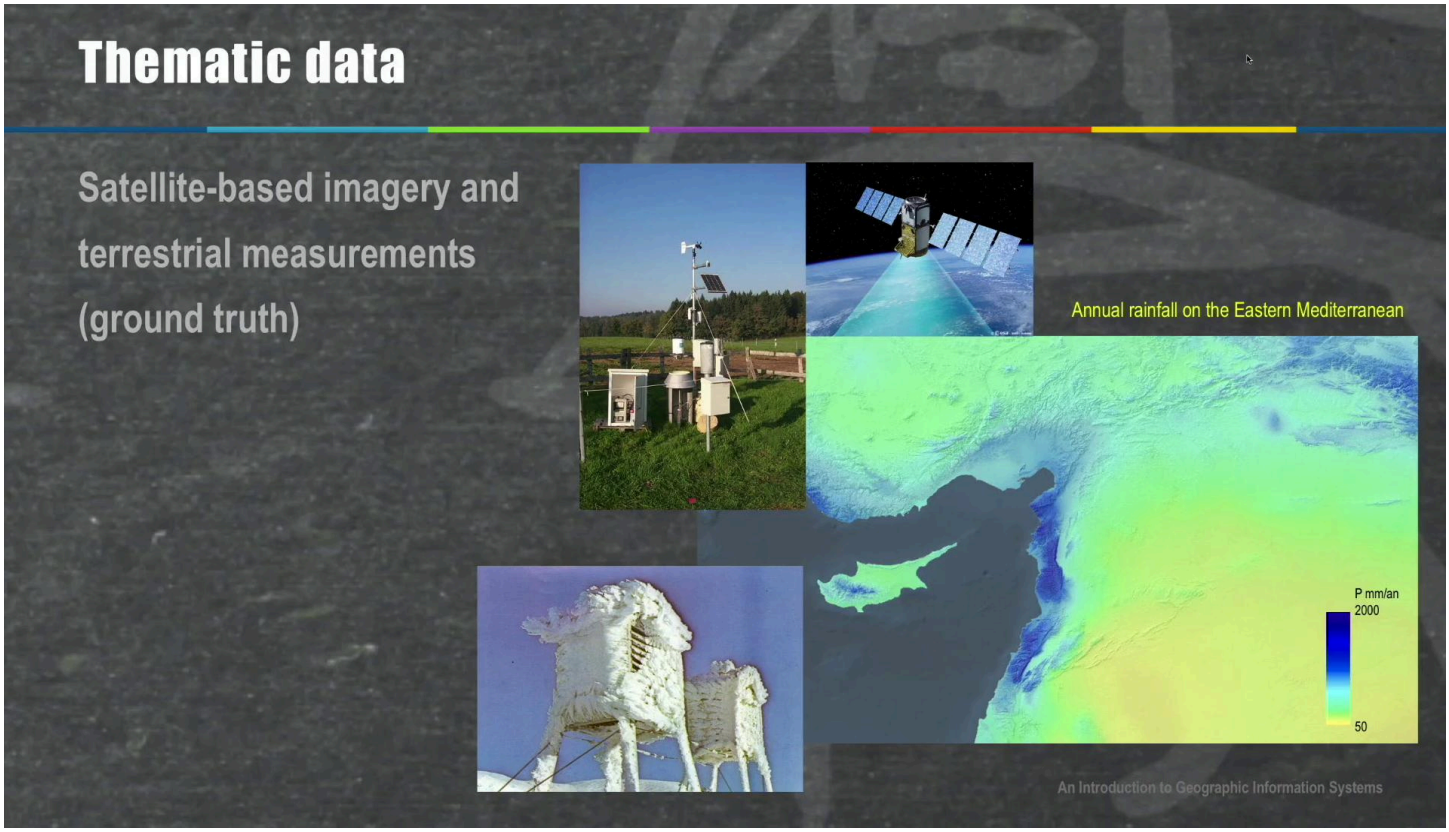


So these sensors measure different parts, different bands of the electromagnetic spectrum. In the case of the Landsat 5 satellite here on the right, we have seven frequency bands that are measured. And these frequency bands are interesting because they reflect more or less strongly depending on the nature of the substrate they meet, so we have spectral bands that are particularly sensitive to the presence of vegetation, the presence of water, etc. And these various combinations of spectral bands allow to highlight various phenomena.

Notes

Summary

14m 15s



Thus, an image whose red, green and blue channels are formed by the bands 3, 2, 1 of a Landsat image provide a visible image. A false color image with the bands 7, 5 and 3. An infrared image with the bands 4, 3 and 2 since the 4 is the near infrared and an image which highlights the presence of vegetation by combining the bands 7, 4 and 2. The thermal infrared bands are used to map sometimes to a very large scale and with a very good resolution the temperatures, here the average temperatures in January and in June 2015. The passive microwave sensors sometimes complemented by active radars allow to measure the soil moisture as is the case of the SMOS mission for the European Space Agency. Finally, satellite imagery and ground measurements are complementary to develop products like this annual rainfall map across the mediterranean East

Notes

Summary

14m 51s