HOW TO CHANGE OR TRANSFORM A COORDINATE SYSTEM INTO A MAP LAYER? THE ANSWER IS IN ARCMAP

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ABSTRACT

The application of new technologies to agricultural activity, associated with the Global Positioning System, generates high amount of georeferenced information. Thus, we are often confronted with different assignments of coordinate systems. The transformation of data from one source of information into the data coordinate system from another source is a prior and fundamental step to any analysis of georeferenced information.

This study aims to know and understand the transformation process of geographical coordinates into rectangular ones and vice versa, as well as the transformation between different coordinate systems, through the ArcMap software tools because it is a question often asked by students and others who try to use the Geographic Information Systems tools.

Keywords: georeferenced information, transformation coordinate systems, precision agriculture

RESUMO

A aplicação das novas tecnologias à atividade agrícola, associada aos Sistemas de Posicionamento Global, gera elevada quantidade de informação georreferenciada. Deste modo, somos muitas vezes confrontados com atribuições distintas de sistemas de coordenadas. A transformação dos dados provenientes de uma das fontes de informação no sistema de coordenadas dos dados provenientes de outra fonte é uma etapa prévia e fundamental para qualquer análise de informação georreferenciada.

Este trabalho tem como objetivo conhecer e entender o processo de transformação de coordenadas geográficas em retangulares e vice-versa, bem como a transformação entre sistemas de coordenadas distintos, através das ferramentas do software ArcMap por ser uma questão colocada frequentemente por alunos e outros utilizadores que tentam utilizar as ferramentas Sistemas de Informação Geográfica.

Palavras-chave: informação georreferenciada, transformação do sistema de coordenadas, agricultura de precisão

INTRODUCTION

The GPS (Global Positioning System) has a large area of applications whether on land, air or sea. In agriculture, the GPS in combination with geographic information systems (GIS) have been decisive to the development and implementation of precision farming system.

The access to global positioning technology allows to georeference the position of a given agricultural machine with a metric or submetric accuracy, depending on the type of GPS system used. Thus, the survey of georeferenced data makes it possible to control some production factors in an environmentally friendly way.

The global positioning system (GPS) receivers, used to locate and navigate agricultural vehicles within a field have become the most common sensors in precision agriculture (Adamchuk, 2005/2006). In this context, new technologies have made it possible to stop thinking about the agricultural parcel as a unit of homogeneous treatment to consider the parcel as a heterogeneous unit that varies in space. The characterization

of the spatial variability of soil is only possible through the use of technologies that, combined with global positioning systems (GPS), allow to obtain, in an easy and economical way, a dense information on soil properties, as for instance the pH (e.g. Schirrmann et al.), electrical conductivity (e.g. Corwin and LESCH., 2005; Amin et al., 2004) and productivity (e.g. DIKER et al., 2004; Miao et al., 2006), which can then be correlated with more expensive soil attributes (Chig et al., 2010).

The accuracy GPS receivers allow to determinate geographic coordinates (latitude and longitude) and the high accuracy GPS allows measurement of altitude (elevation). In this way it is possible to calculate relevant parameters (e. g. slope (Cox et al., 2003); flow direction (Marques da Silva and Silva, 2008)) to the terrain that influence the agriculture production (Adamchuk et al., 2004).

The acquisition of geo-referenced information allows, not only the identification of the spatial variability of the agricultural parcel, but also, site-specific management zones, with the application of fertilizers and pesticides as inputs only where they are needed, and when they are needed, contributing in the long term to the sustainability of agricultural production (Lowenberg and Bongiovanni, 2004).

Nevertheless, this management requires work with multiple layers of georeferenced information in order to develop the prescription maps successfully. The integration of data from different sources of information requires that data be processed or obtained in the same geographical referencing system.

However, some users have difficulties in entering georeferenced data into a geographic information system and in displaying them in a coordinated and appropriate projection system. In this paper, we demonstrate a set of illustrative steps of this process using maize yield data.

MATERIALS, METHODS AND PROCEDURES

This study was conducted using data collected from a single agricultural field, in Fronteira (Lat: +39.09307; Long: -7.611332), the Alentejo region of southern Portugal.

The considered yield year was 2002 and maize was sown in late April/early May and harvested in September/October. A CLAAS Lexion 450 combine harvester was used, equipped with a combine electronic board information system (CEBIS), providing

instantaneous yield and grain moisture data, with less than 5% error. The combine harvester was equipped with: a 4.5m cutting header; a differential GPS Pilot; a grain mass flow sensor (through the impact force of grain hitting a plate) and a grain moisture sensor (by sensing the dielectric properties of the harvested grain), both near the top of the clean grain elevator. All these sensors were produced by CLAAS, Harsewinkel, Germany. The data were imported and manipulated in Microsoft Office Excel.

The SPSS® software (IBM SPSS Statistics, 2009) was used in the yield spatial data exploratory analysis to check the presence of global outliers and normality.

The yield data were analyzed using the software ArcGIS^{TM} (ESRI, 2009) which was used for the transformation of the coordinate system.

Creation of georeferenced shape

Production data from GPS CLAAS Lexion 450 combine harvester in geographic coordinate system (GWS84) and decimal degrees were imported into a Microsoft Excel File (Figure 1).

	A	B	C	D	E	F	G
1	LONG_CONV	LAT_CONV	MAIZE	TIME	SPEED	DATE	MOISTURE
2	-7,619366	39,087835	2,538	143625,0	5,00	28.09.02	26,50
3	-7,619366	39,087765	6,176	143630,0	5,10	28.09.02	26,50
4	-7,619366	39,087695	1,341	143635,0	5,10	28.09.02	26,50
5	-7,619366	39,087635	3,385	143640,0	5,20	28.09.02	26,50
6	-7,619356	39,087545	6,270	143646,0	5,30	28.09.02	26,50
7	-7,619356	39,087465	1,422	143651,0	5,00	28.09.02	26,50
8	-7,619356	39,087395	0,529	143656,0	4,60	28.09.02	26,50
9	-7,619336	39,087325	6,097	143701,0	4,60	28.09.02	26,50
10	-7,619336	39,087265	9,202	143706,0	4,00	28.09.02	26,50

Figure 1. Excel table data.

The excel file data were added to ArcGis: ArcMap 9.3. Figures 2 and 3 show the necessary steps to transform the geographic coordinate system into a projected coordinate system.
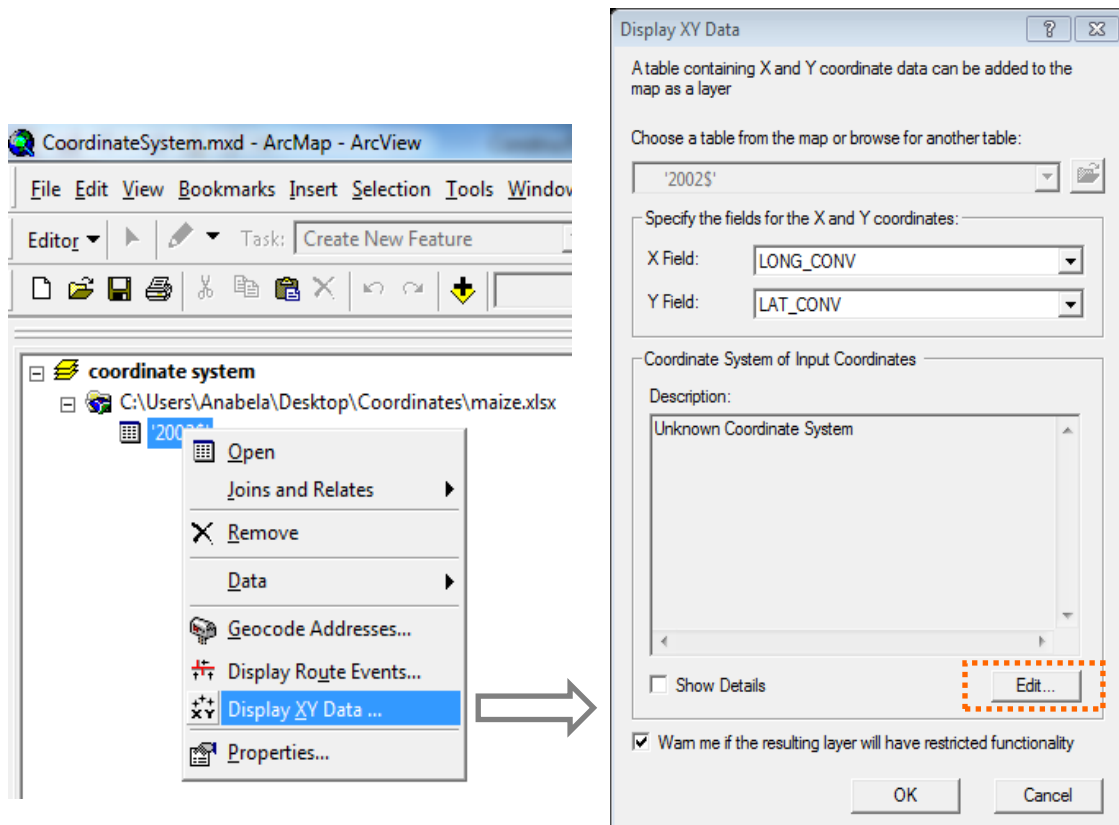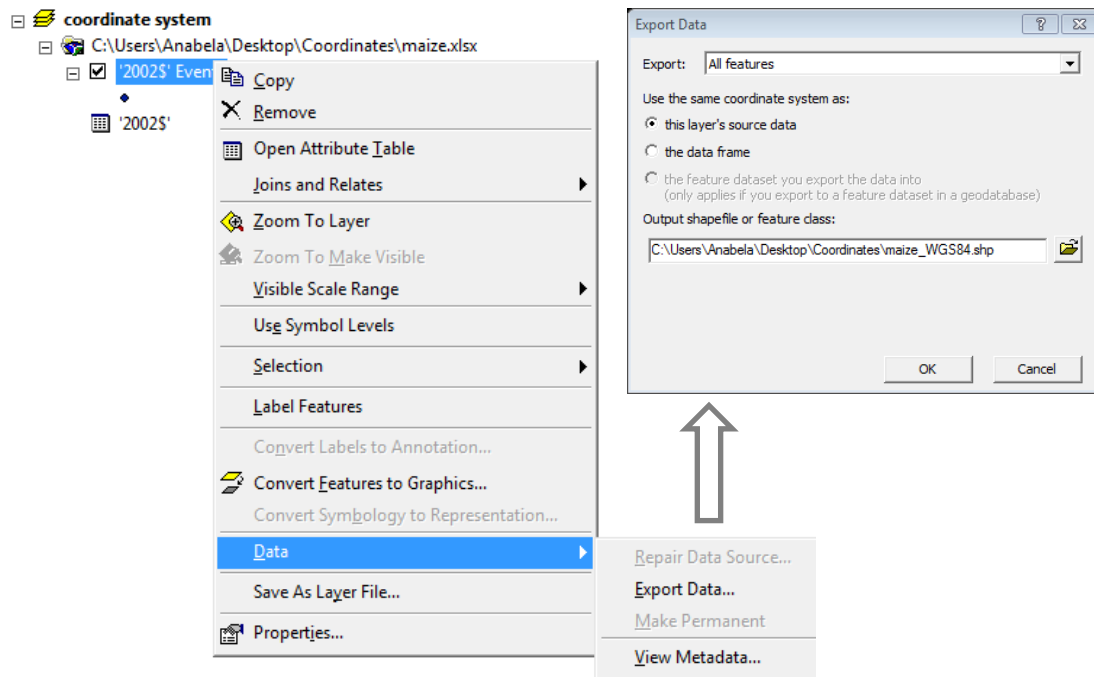
Figure 2. Access to coordinate system.
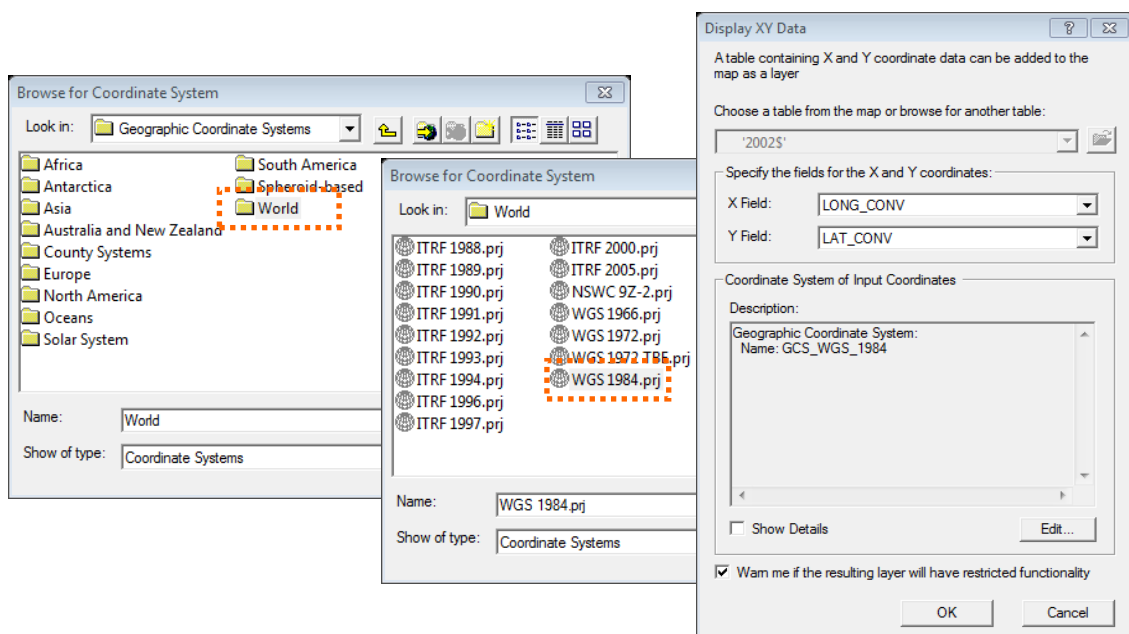
Figure 3. Allocation of the coordinate system.

After allocating the coordinate system you need to transform the data into shapefile. In secondary menu select Data and Export Data (Figure 4).

Figure 4. Data export in the chosen coordinate system.

Geographic data transformation

The earth as a sphere or a spheroid and its three-dimensional surface must be projected to create a flat map sheet.

In ArcToolBox select Data Management Tools and Projections and Transformations.

Choose the coordinate system in which you will work, according to the coordinate system where the remaining layers of the project work are.
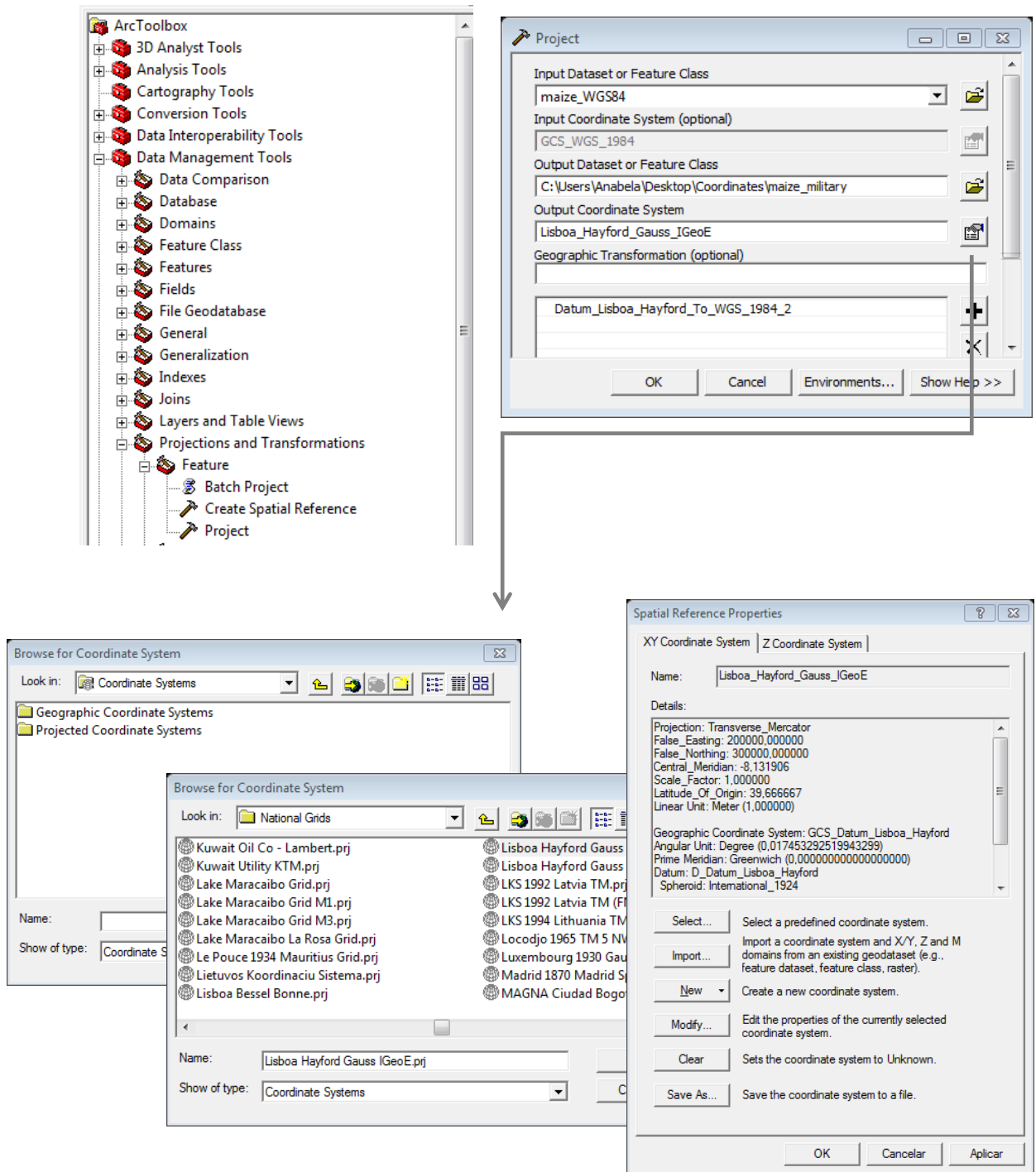
Figure 5. ArcToolbox and transformation of data into projected coordinate system.

RESULTS AND DISCUSSION

From a brief set of steps available in Arcgis 9.3 tools, geographical coordinates of data, obtained by a GPS receiver, were transformed into a common projected coordinate system. We can see the maize yield data in GWS84 system (Figure 6 (a)) and maize

yield data in Hayford Gauss Lisbon IGeoE system (Figure 6 (b)), the same used in the remaining working layers.
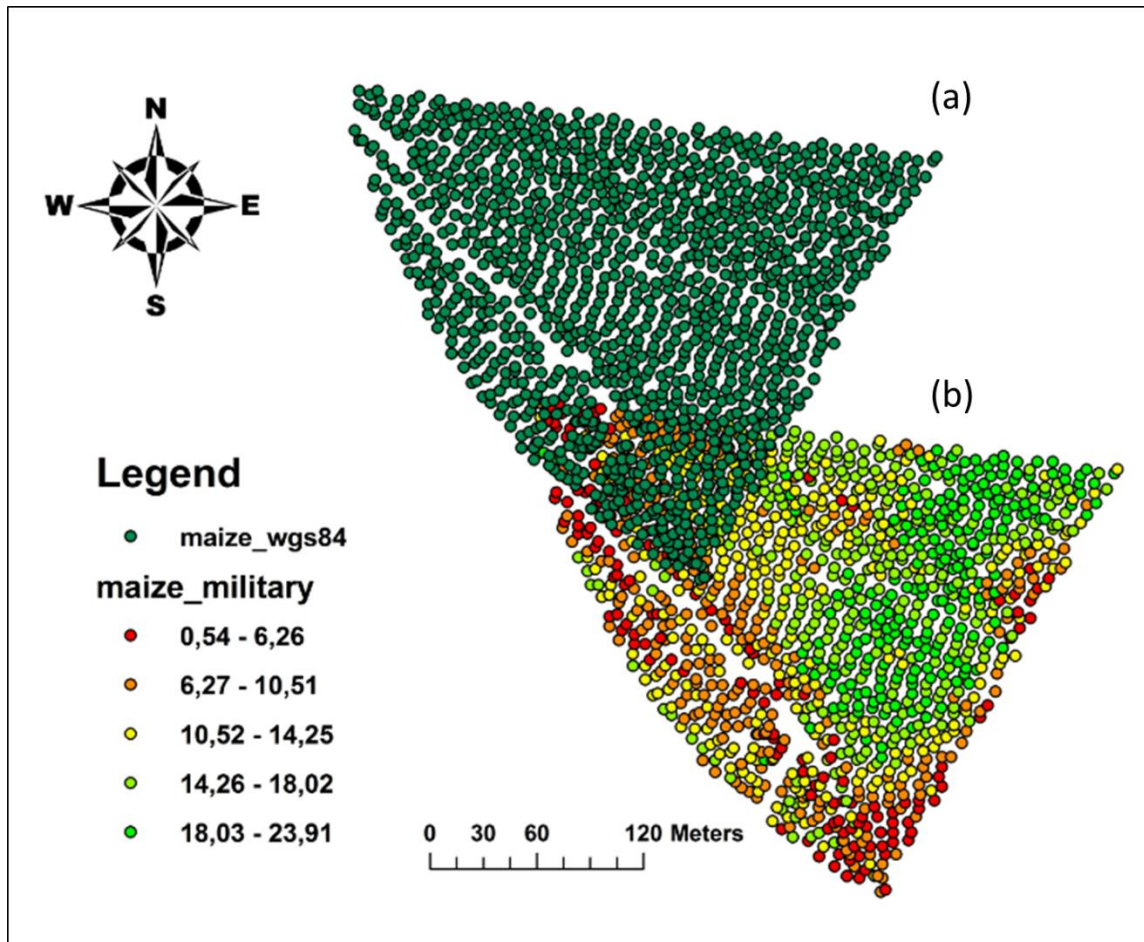
**Figure 7. Maize Yield data shapefiles with a different coordinate system:
(a) WGS84; (b) Hayford Gauss Lisbon IGeoE**

CONCLUSIONS

Currently geographic information tools are useful in many areas of knowledge being essential in precision agriculture.

The procedure makes it possible: (i) to distribute spatially the points of yield maize in the correct position; (ii) to transform the original geographic coordinate system into another coordinate system project within a common geographic framework.

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