ILWIS 2.1 for Windows

The Integrated Land and Water Information System

Beginner's Guide

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ITC
The International Institute for Aerospace Survey and Earth Sciences, Enschede, is the largest institute for international higher education in the Netherlands. Its main objective is to assist developing countries in human resources development in aerospace surveys, Remote Sensing applications, the establishment of geoinformation systems and the management of geoinformation. To this end, ITC concentrates on three activities: education/training, research and advisory services. In-house expertise covers an extensive range of disciplines in the above fields.

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Contents

Preface

ILWIS is an acronym for the Integrated Land and Water Information System. It is a Geographic Information System (GIS) with image processing capabilities. ILWIS has been developed by the International Institute for Aerospace Survey and Earth Sciences (ITC), Enschede, The Netherlands. For more than a decade, since 1985, the software has undergone major improvements. The last of which includes the change from DOS to the MS-Windows environment. The release of ILWIS for Windows marks a new era in the development of the software.
As a GIS package, ILWIS allows you to input, manage, analyze and present geographical data. From the data you can generate information on the spatial and temporal patterns and processes on the earth surface.

The ILWIS media

The ILWIS Beginner's Guide is part of the documentation for ILWIS 2.1. The full documentation includes:

- ILWIS Installation Guide. Instructions for setting up ILWIS and guidelines for setting up hardware, such as digitizers and printers;
- ILWIS Beginner's Guide. A first look at ILWIS, introducing the basic concepts, some essential ILWIS techniques and the main operations included with ILWIS;
- ILWIS User's Guide. Training in the skills you need to work with ILWIS. It provides numerous exercises to practice GIS techniques and Image Processing operations;
- ILWIS Applications Guide. Advanced procedures to work with ILWIS, providing 25 case studies for various research disciplines;
- ILWIS Reference Guide. Detailed description of the functionality of ILWIS including its window types, the objects, the operations, etc., illustrated with tips and examples.

Besides these Guides, extensive on-line and context-sensitive Help is available in the program.

The ILWIS Beginner's Guide: Main objectives

The ILWIS Beginner's Guide is especially designed for new ILWIS users. It contains simple GIS and Image Processing exercises introducing you to the software.
It is intended for those who want to get a first impression of ILWIS 2.1. Those persons who want to learn how to work with ILWIS 2.1, and how ILWIS is used in

basic GIS and Image Processing operations are referred to the ILWIS User's Guide.

Structure of the ILWIS Beginner's Guide

The ILWIS Beginner's Guide consists of 5 chapters.

- Chapter one, ILWIS Main window, explains the way to start up ILWIS and the functions of the Main window;
- Chapter two, Visualization, shows how to display maps, tables and graphs;
- Chapter three, Retrieval of information, explains how you can retrieve information using the mouse or through the pixel information window;
- Chapter four, Operations, gives some examples of operations applied on maps and tables;
- Chapter five, Annotation, shows how to create some annotations (title, text, north arrow etc.).

The data set

All data files required for the exercises in the ILWIS Beginner's Guide are included on the CD-ROM, which also contains the software, and the data for the User's Guide and the Applications Guide. The files can be found in the directory d:\bgnguide (where d is the drive letter of the CD-ROM drive).

During the installation of ILWIS you can install the data files on your harddisk, normally in the directory c:\ilwis21\data.

! If you did not install the data files during the installation of ILWIS, you should still do so, before continuing. See the ILWIS Installation Guide on how to install data files. You can also use the Windows File Manager to copy the data files from the CD-ROM to your harddisk.

The subdirectory of c:\ilwis21\data will be the working directory for the exercises of the ILWIS Beginner's Guide.

! When you want to repeat the exercises of the Beginner's Guide, we recommend that you copy the original data files from the CD-ROM, or use the ILWIS Installation program, so that you always start with the original files, and not with files which may be altered.

Conventions used in the ILWIS Beginner's Guide

This manual is formatted in such a way that the specific actions dealing with the software are separated from the accompanying text.

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- This is an *exercise box*. You can follow the instructions step by step.
- Words in *Times New Roman 10 Italics* are *keywords*.
- Formulas that you should type are shown in `Courier New 10`.
  For example: `Mapc = Mapa + Mapb`
- All information that should be supplied by the user is also shown in `Courier New 10`, as well as all the names of objects (maps, tables, columns, etc.)
  For example: `Geology`.
- The names of operations, dialog boxes and the options in dialog boxes are shown in Arial 10.
  For example: Display Options - Raster Map.

! This is a *tip-box*. It is used to give tips.

The ILWIS Beginner's Guide was made on computers with SVGA display (with a resolution of 1024 by 768 pixels, and 256 colors). If you are working on a screen with a lower resolution, some of the pictures in the book may look slightly different from the ones displayed on the screen. This is even more so when you work in VGA mode (640 by 480 pixels, and 16 colors); the display of some of the maps and images may be confusing. We therefore recommend you to have at least a resolution that allows you to display 256 colors.

The ILWIS Beginner's Guide was prepared with ILWIS running under Microsoft Windows 3.1, with the Windows default color scheme, so all ILWIS windows shown in this book are in the Windows 3.1 fashion.

Chapter 1

ILWIS Main window

When you start ILWIS, the first thing you will see after the opening screen, is the Main window (see Figure 1.1).

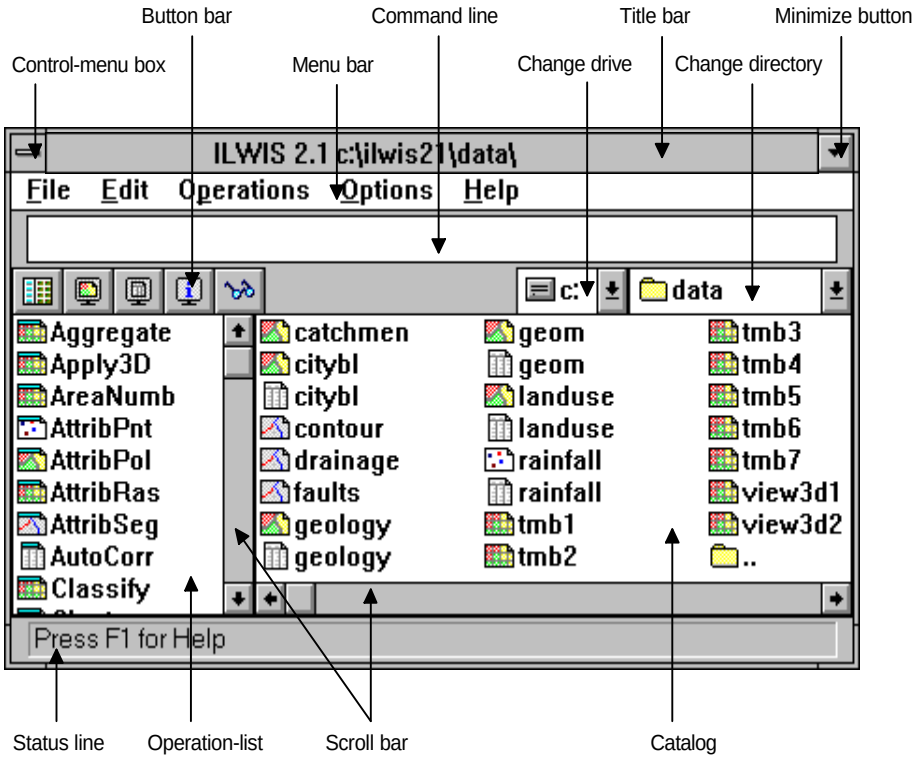

Figure 1.1 The ILWIS Main window (in Windows 3.1).

From this window you can start all operations and select all data. On the left, there is a list of GIS and image processing operations and other tools, called the *Operation-list*.

☞

- Use the vertical scroll bar next to the Operation-list to see more operations.
- Place the mouse pointer at one of the Operations in the Operation-list, for example Show.

You will see a short description of the operation on the status line at the bottom of the Main window.

☞

- Press the right mouse button on any operation and select Help to get a short explanation of the operation.

To be able to continue with this chapter you need to have direct access to the ILWIS Demo Data set. This means that your current drive and working directory (C:\ILWIS21\DATA) have to be the ones that contain the ILWIS Demo Data set. In case you are not in the right working directory you will need to change this.

To change the current drive and working directory, you can use the navigator:


to change drive,


to change directory.

☞

- To change the working drive, click the Change Drive icon and select the drive which contains the ILWIS Demo Data set.
- To change the working directory, click the Change Directory icon and select the directory which contains the ILWIS Demo Data set.

Now you should be able to directly access the Demo Data.

On the right part of the Main window, maps, tables and other objects in the working directory are displayed, each with its own icon. This part of the Main window is called the *Catalog*.

In the Catalog the following icons are used for data objects:


for raster maps (for example `tmb1`),


for polygon maps (for example `landuse`),


for segment maps (for example `contour`),


for point maps (for example `rainfall`),


for tables (for example `rainfall`).

☞

- Place your mouse pointer at a map or table in the Catalog, for example on polygon map `landuse`. A description will appear on the status line.
- Press the right mouse button on a map to get a *context-sensitive menu*.

The context-sensitive menu shows operations which can be applied on the selected object.

At the top of the Main window, you see the *menu bar*, the *command line*, and a *button bar*. The menu bar, can among others, be used to select all operations, to change the contents of the Catalog and to access the Help menu. The command line can be used to type commands or calculations. The button bar provides short cuts for certain menu commands.

The *button bar* contains the following buttons:

Hide/Show Operation-list button: to hide or show the Operation-list in the Main window,

Show Map button: to open a raster, segment, polygon or a point map or any other object in a new window,

Show Table button: to open a table in a new table window,

Show Pixel Information button: to open the Pixel Information window,

Customize Catalog button: to select the object types to be shown in the Catalog.

In ILWIS an action can be performed in different ways.
To start an operation, you can:
- double-click an operation in the Operation-list, or
- use the Operations menu in the Main window, or
- select the data in the Catalog you want to perform an operation on, and press the right mouse button to get a context-sensitive menu, or
- use the command line and type a command.

For example, there are several methods to open a map:
- double-click a map in the Catalog, or
- press the right mouse button on a map in the Catalog and select Open from the context-sensitive menu, or
- click the Show Map Button in the button bar, or
- double-click Show in the Operation-list, and select a map, or
- choose Visualization, Show Map from the Operations menu, or
- type `Open` *`Mapname.ext`* on the command line.

Chapter 2

Visualization

A map is displayed in a map window and a table is displayed in a table window. To move a window, place the mouse pointer at a title bar, press and hold down the left mouse button while you move the mouse. A window can be resized by dragging a window border.

2.1 Display maps

The way maps are displayed in ILWIS for Windows is controlled by the user. Before a map is displayed, a dialog box will be presented. In this dialog box you are prompted to answer some questions about the display of the map in the map window.
The easiest way to open a map is to double-click it in the Catalog (press the left mouse button twice in rapid succession).

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- Double-click raster map `tmb1` in the Catalog.

The Display Options - Raster Map dialog box is presented.

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- Accept the defaults by clicking the OK button or pressing <Enter>.

A map window is opened displaying `tmb1`(Figure 2.1 shows part of this image). This raster map is band 1 of a Thematic Mapper satellite image. The brightness of the pixels corresponds with the reflectance of light on the earth surface. On the status line at the bottom of the map window you can see the column and row numbers and the XY-coordinates of the place of your mouse pointer when it is located in the map window.

☞

- Press the left mouse button in the map window.

You will see the reflectance value of the pixel at the location of the mouse pointer.

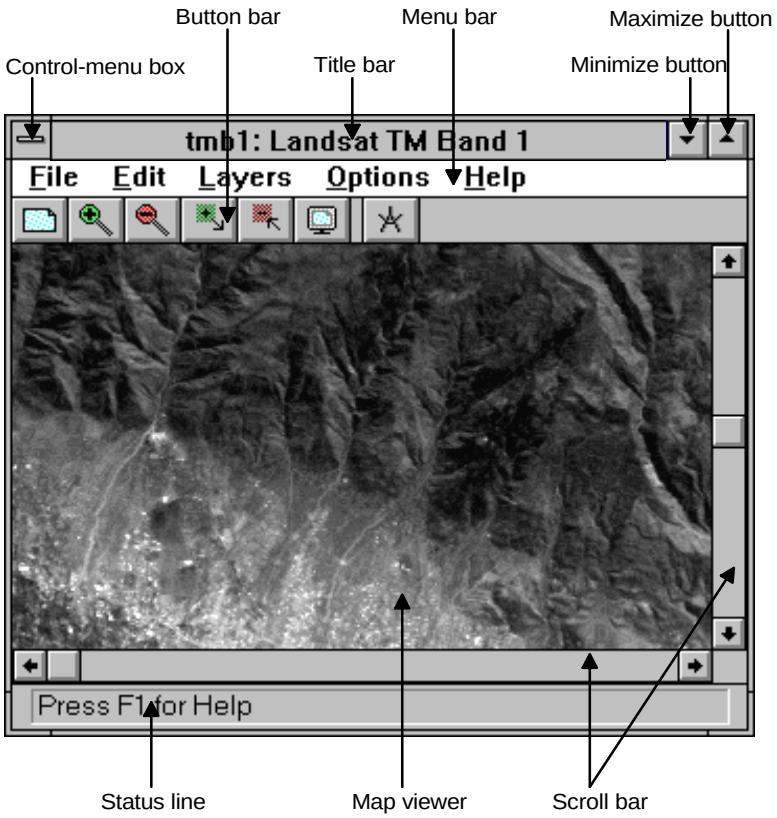

Figure 2.1 Example of an ILWIS map window.

You can *zoom*, *resize the window* and interactively *measure distances and angles* using the buttons in the button bar of the map window (see Figure 2.1). The status line gives brief information on the effect of a button when you move the mouse pointer over the buttons in the button bar. By using the scroll bars, you can scroll through the image.

☞

- Click the Zoom In button. Then drag an area with the left mouse button to define the zooming area.
  Zoom in a couple of times to see the *pixels* in the map as little blocks.
- Click the Measure Distance button, press and hold down the left mouse button while you move the mouse. The distance between the two points is displayed. When you release the left mouse button both the distance and angle between the two points are displayed.
- Click the Entire Map button to get the map back to its original size.

The image tmb1 can also be displayed in other colors.

☞

- Press the right mouse button in the map window and select the layer 1 map tmb1.

The Display Options - Raster Map dialog box is presented again.

☞

- Select representation pseudo instead of the default gray in the Display Options dialog box and click OK.

The map is displayed using blue colors for low values, green for intermediate values and red for high values. Try also some other representations, for example inverse or colorstp10. Finally change the representation to gray again.

To compare raster map tmb1 with other images you can open raster map tmb2.

☞

- Double-click raster map tmb2 in the Catalog. Accept the default display options.
- Drag the map window by the title bar to another place on the screen to be able to see both maps.
- Place the mouse pointer in either of the map windows and press the left mouse button to get the reflectance values. You can easily switch between the map windows.
- Close tmb2 by choosing Exit from the File menu.

Instead of opening a new map window to display another raster map, you may also use drag and drop to change the contents of a map window.

If a drag and drop is allowed, you see the icon of the map that you drag, e.g.  .
If a drag and drop is not allowed, you see the  icon.

☞

- Select raster map tmb4 in the Catalog, drag it to the existing map window of tmb1 and drop it on raster map tmb1.

All other types of maps can also be opened in a map window.

☞

- Place the mouse pointer on polygon map `landuse`, press the right mouse button to get the context-sensitive menu.
- Select Open.
- Accept the default display options and click OK.
- Press the left mouse button in the map window to get information.

For each unit in the map you will see the name of land use class. The information you get depends on the *domain* of a map. In this case the domain consists of the names of the land use classes. The domain type of this map is class.

A *domain* is a new concept in ILWIS for Windows, it is a user-defined collection of possible class names, ID's or values that may occur in a map or in a column of a table (also see User's Guide and the on-line Help). For a satellite image like `tmb4`, values are in the range of 0 to 255, which are called the reflectance values.

☞

- Close the polygon map `landuse` by double-clicking the Control-menu box. The Control-menu box is located in the upper left corner of a map window.

2.2 Display a 3D view of the Cochabamba area

For an impression of the Cochabamba area, open the 3D views prepared from images and a height model.

☞

- Double-click raster maps `view3D1` and `view3D2`, accept default display options, zoom in, zoom out and scroll through the area.

2.3 Display multiple layers

Until now, you have displayed raster maps and a polygon map in separate windows. In the next exercise, you will display different maps in one map window by adding segment, polygon and point maps as *layers*.

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- Drag segment map `contour` which contains contour lines of the area and drop it in the existing map window of `tmb4`.
- In the Display Options - Segment Map dialog box, select Single Color and select a bright color, like yellow, to obtain a good contrast with the dark colors of the satellite image.
- Click OK.

The segments are drawn as a layer on top of the raster map `tmb4`.

☞

- Press the right mouse button in the map window.

On the context-sensitive menu, below the horizontal line, you will see the two layers in the map window, the raster map `tmb4` and the segment map with contour lines. Let's also add polygon map `landuse`.

☞

- Open the Layers menu in the map window, choose Add Data Layer, Polygon Map and select the polygon map `landuse`.
- Click OK in the Add Polygon Map dialog box.
- In the Display Options dialog box select Boundaries Only. Select a color for the boundaries and click OK.

The boundaries of the polygon map `landuse` are drawn as another layer in the same map window.

☞

- Press the left mouse button in the map window and you will get information on the land use classes.

Instead of the land use classes you might want to see the reflectance values of the raster map `tmb4`. You can change the behavior and the order of layers in a map window in the Layer Management dialog box.

☞

- Press the right mouse button in the map window and select Layer Management. The Layer Management dialog box is opened (Fig 2.2)

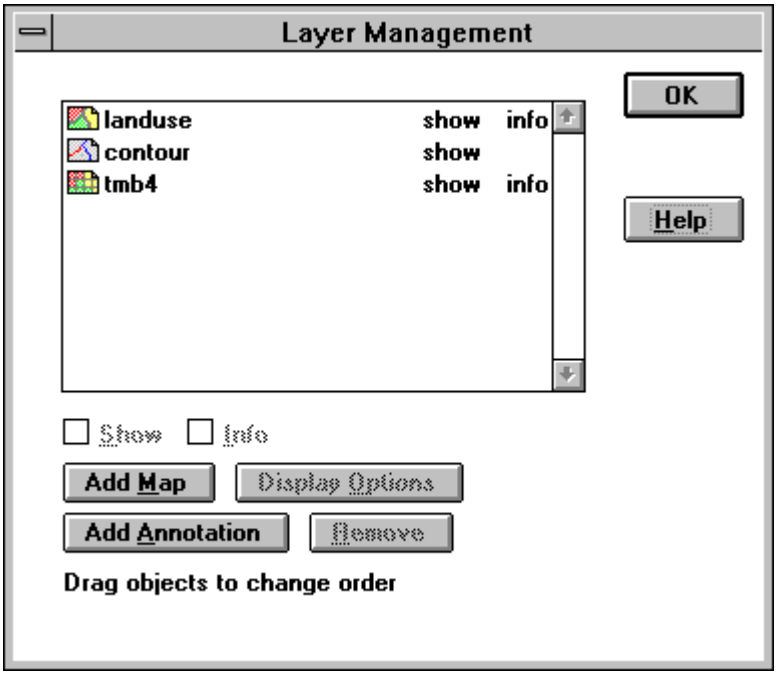

Figure 2.2 The Layer Management dialog box.

In this dialog box, all layers in the map window are listed. You can select layers by clicking them. A selected layer appears highlighted.

For the selected layer, you can select or clear the Info check box to indicate whether you want information of the specified layer when you click the left mouse button in the map.

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- Select polygon map `landuse` in the Layer Management dialog box and clear the Info check box. No cross is visible in the check box now.
- Click OK.
- Press the left mouse button in the map window and move through the map, you will get the reflectance values.

The point map `rainfall` with rainfall stations can also be added as another layer.

☞

- Drag point map `rainfall` from the Catalog and drop it in the map window.
- In the Display Options dialog box, choose Text and choose Text Color `Cyan`; this means you will get the names of the rainfall stations in cyan next to their location in the map window.
- Click the Symbol button and in the Symbol dialog box, select Size 6 and select for the Color `Cyan`, then click OK.
- Click OK in Display Options dialog box.

The points are drawn as a new layer.

☞

- Place the mouse pointer at a rainfall station and press the left mouse button in the map window. You will get the name of the rainfall station.

Now you have a map window with four layers: raster map `tmb4`, segment map `contour`, polygon map `landuse` and point map `rainfall`. The Layer Management dialog box can be used to add or remove layers. To change the order of the layers, use drag and drop in the Layer Management dialog box.

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- Press the right mouse button in the map window to see which layers are displayed in the map window.

You can save the contents of a map window as a *map view*. A map view saves a set of layers and the way you displayed them.

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- Open the File menu in the map window and choose Save View As.
- Type `view` for the map view name, press Tab on the keyboard, and type `view` for the title. Then click OK.
- Close the map window by double-clicking the Control-menu box.

In the Catalog you will see the map view named `view` with its icon.

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- In the Catalog, press the right mouse button on the map `view`.
- Select Open from the context-sensitive menu.

A map window is opened showing all layers that were previously displayed in the map window.

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- Close the map window.

2.4 Display by attribute

If a map has an attribute table, you might want to see the map displayed by one of its attributes.

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- Display raster map `tmb4` by double-clicking it in the Catalog.
- Accept the default display options and click OK.

In this new map window, let's display the polygon map named `citybl` with cityblocks by the attribute `landuse`.

☞

- Drag the polygon map `citybl` from the Catalog to the map window of `tmb4`.
- In the Display Options dialog box, select the Attribute check box and choose `LandUse`.
- Specify Boundary Width `0`.
- Select Representation and select `cityluse`.
- Click OK.

In the map window, the polygons are displayed by their attribute `landuse` using the colors of representation `cityluse`. A representation comprises colors, patterns, line widths, symbols and symbol sizes used to graphically represent data.

☞

- Zoom in on the cityblocks.
- Press the left mouse button on one of the cityblocks.

You will see the number of the cityblock (its ID) and the land use information. Move the mouse pointer through the cityblocks to see their land use information.

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- Close the map window.

You can also display a point map by their attribute values in proportional symbols. For example, you can display the rainfall values of January for each rainfall station by a proportional symbol.

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- Open raster map `tmb1` and accept the defaults in the Display Options dialog box.
- Drag the point map `rainfall` from the Catalog into this map window.

The Display Options - Point Map dialog box is opened.

☞

- Select the Attribute check box and select column `January`. This column contains rainfall values for the month of January. Values can be displayed proportionally.
- Click the Symbol button.
- Select the Stretch check box.

The minimum and maximum value of column `January` are displayed. Now you can give a symbol size in screen pixels to the minimum and the maximum values.

☞

- Type `5` for the minimum and `20` for the maximum size.
- Select a color, then click OK.
- Click OK in Display Options dialog box.

The point map with proportional symbols for the rainfall in January is displayed.

2.5 Display tables and graphs

Tables can be displayed in a similar way as maps. In the Catalog you can find several tables. Let's take a look at the attribute table rainfall you used before.

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- Open table `rainfall` by double-clicking it in the Catalog.

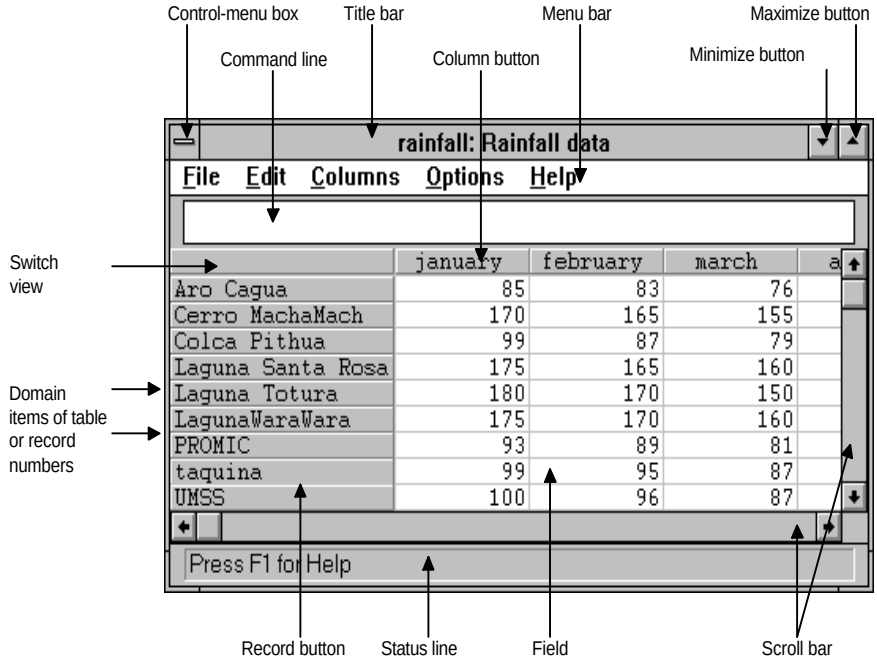

Figure 2.3 Example of an ILWIS table window.

The table is shown in a table window. The rainfall values per month at each station are displayed. Tables consist of records and columns, a menu bar and a command line. By using the scroll bars you can see the other columns and records. There are two ways to view the data of a table: *Table View* and *Record View*.

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- Open the Options menu and select Record View to see the contents of the table record by record.
- Use the >, >>, < and << buttons to go to next or previous records.
- To go back to Table View, open the Options menu again and choose Table View. You can also click the Switch View button.

The data of a column of a table can also be displayed as a graph.

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- Open the Options menu and select Show Graph.

The Graph dialog box is opened. In this dialog box you can select the columns you want to use for the graph.

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- Select `rainfall value` for the x-axis and the column `January` for the y-axis.
- Click OK.

The Edit Graph dialog box is displayed. You can select a graph type and a display color (see User's Guide).

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- Accept the defaults and click OK.

The result is a bar graph in red with the amount of rainfall in January on the vertical axis and the rainfall stations on the horizontal axis.

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- Close all opened windows by opening the File menu of the ILWIS Main window and select Close All.

Chapter 3

Retrieval of information

There are several ways to retrieve information from maps and their attribute tables.

One way to retrieve information from a map is to use the left mouse button in the map window. In this way you will get a value (for example reflectance values of a satellite image), a class name (for example land use classes) or an ID (for example the name of a rainfall station) of a map. By selecting or clearing the Info check box, per layer in the Layer Management dialog box, you can customize the information you will get. How to use the left mouse button is explained in chapter 2.

3.1 Retrieval of information by double-clicking in a map window

The polygon map `landuse` and the point map `rainfall` are linked to the attribute tables `landuse` respectively `rainfall`. You can see this in the Properties dialog boxes of the maps.

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- Press the right mouse button on polygon map `landuse` to get the context-sensitive menu.
- Select Properties.

The Polygon Map - Properties dialog box is opened. You will see that there is an attribute table named `landuse` linked to the polygon map `landuse`.

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- Click Cancel.

The attribute information stored in this attribute table can be accessed by double-clicking in the map.

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- Open the map view `view` created in chapter 2.
- Press the right mouse button in the map window; the context-sensitive menu appears.
- Select Double-Click Action.

In this dialog box you can specify what should happen if you double-click with the left mouse button in the map window. This short cut can be used in three ways. The default is Edit Attribute. The other options are Edit Representation and Execute Action (see ILWIS on-line Help).

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- Click OK.

Now you have to make sure that the Info check box of the layers of interest is activated otherwise you will get no information about them.

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- Press the right mouse button again.
- This time select Layer Management.
- Select the `landuse` map and make sure that the Info check box is selected.
- Click OK.
- Move through the map and double-click.

Depending on where you double-click, you get information on the land use or the rainfall values per month. Besides viewing the attributes, you can also edit them in the Edit Attribute window. The attribute table will be updated immediately.

☞

- Close the Edit Attribute window by double-clicking its Control-menu box.

3.2 Retrieval of information with the Pixel Information window

The *Pixel Information window* is used to interactively inspect coordinates, class names, IDs or pixel values in one or more maps and attribute values of map-related tables.

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- Click the Pixel Info button in the button bar of the Main window or double-click the Pixel Info item in the Operation-list.

The ILWIS Pixel Information window is opened (Fig. 3.1). First of all this window shows information about the mouse pointer position in a map window.

☞

- Move the mouse pointer in the map window to see the XY-coordinates.

Further you can drag and drop maps from the Catalog into the Pixel Information window to obtain information stored in the different maps at the same location.

☞

- Drag and drop polygon map `landuse` from the Catalog into the Pixel Information window.
- Also drag and drop segment map `contour`, raster map `tmb4` and point map `rainfall` into the Pixel Information window.
- Again, move the mouse pointer in the map window.

Now you get information which is stored in the land use map, the contour map, the satellite image and the rainfall map. The link between the information is the location.

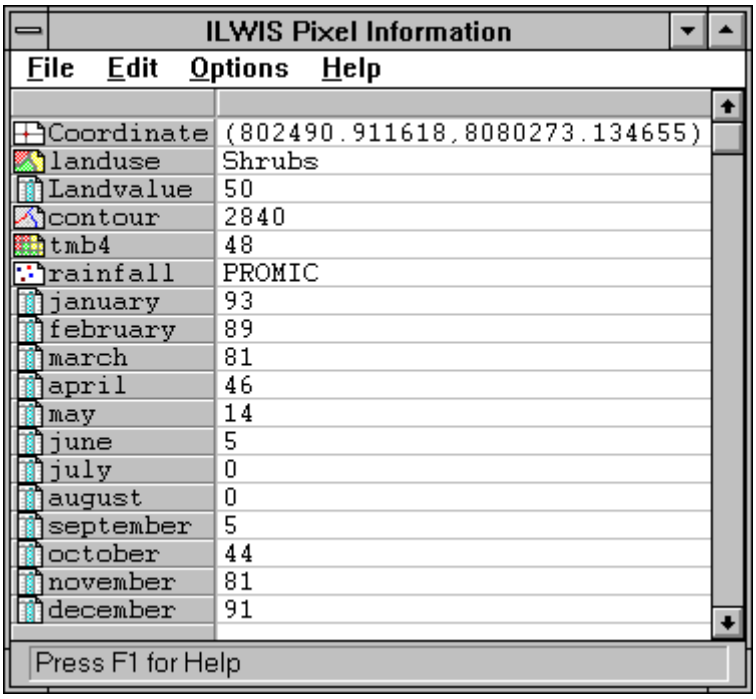

Figure 3.1 Example of the ILWIS Pixel Information window.

The data in the Pixel Information window can be customized.

☞

- Open the Options menu of the Pixel Information window and select Customize.

The Customize Pixel Info dialog box is displayed. In this dialog box you can select which information you want to see in the Pixel Information window.

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- Deselect the maps or columns in which you are not interested by clicking them. Only the highlighted maps and columns will be shown in the Pixel Information window.
- Click OK.

The customized Pixel Information window is shown.

☞

- Close all windows.

Chapter 4

Operations

The left part of the Main window is called the Operation-list. An overview of all ILWIS operations is given in the list. By using the scroll bar you can go up or down through the list. By pressing the right mouse button on an operation, you can choose Run or Help. Run opens the dialog box, Help gives a short explanation of the operation. Double-clicking an operation opens its dialog box.

This chapter will familiarize you with different ways of accessing operations. Some operations will be described which can be performed on the ILWIS demonstration data.

4.1 Basic statistics - creating histograms

Let's calculate the histogram of `tmb1`. This histogram shows the frequency distribution of pixel values in satellite image `tmb1`.

☞

- Scroll through the Operation-list until the Histogram operation is visible.
- Drag raster map `tmb1` from the Catalog and drop it on the Histogram operation in the Operation-list.

The Calculate Histogram dialog box is presented.

☞

- Click OK.

The histogram of `tmb1` is displayed in a table window. This data can also be displayed as a graph.

☞

- From the Options menu, select Show Graph.
- Select `image value` for the x-axis and `npix` for the y-axis.
- Click OK.
- Accept the defaults in the Edit Graph dialog box and click OK.

The graph is displayed with the default layout.

☞

- Close the graph window.
- Close the table window.

Besides calculating histograms of images or other raster maps, you can also calculate histograms of point, segment and polygon maps. As an example, we will calculate the histogram of the polygon map `landuse`.

☞

- Press the right mouse button on polygon map `landuse` in the Catalog to display the context-sensitive menu.
- Choose Statistics and Histogram.
- Click OK in the dialog box.

A table window is opened showing the number of polygons and the total perimeter and area of the polygons, by land use class. This data can also be displayed as a graph.

☞

- From the Options menu, select Show Graph.
- Select `landuse value` for the x-axis and `area` for the y-axis.
- Click OK.
- Accept the defaults in the Edit Graph dialog box and click OK.

A graph of the area per land use class is displayed.

☞

- Close the graph window and the table window.

4.2 Applying a filter

In ILWIS there is a set of pre-defined filters that you can apply on raster maps. You can also create your own filters. Let's apply an enhancement filter on raster map `tmb1`. This filter improves the visibility of linear features, for example roads and coast-lines.

☞

- Press the right mouse button on raster map `tmb1` in the Catalog.
- Select Image Processing and Filter from the context-sensitive menu.

The Filtering dialog box is opened. In this dialog box you can select the filter to be applied: you can choose a pre-defined filter or create one yourself.

☞

- Make sure the Filter Type is `Linear`. This is the default.
- Select `edgesenh` filter in the Filter Name list box.
- Type `tmb1edg` in the Output Raster Map text box.
- Make sure that the Show check box is cleared. No cross is then visible.

If the Show check box is cleared, the map is not shown immediately; only the map *definition* is stored. If the Show check box is selected, the output map will be calculated and displayed immediately.

☞

- Accept the defaults and click OK.

In the Catalog your raster map `tmb1edg` appeared. The *definition* of the map can be viewed in the properties of the map.

☞

- Place the mouse pointer at raster map `tmb1edg` and press the right mouse button.
- Select Properties.

In the Raster Map Properties dialog box, the definition of the map is shown: `MapFilter (tmb1.mpr,edgesenh.fil).` If you want to display the map, it has to be calculated first. This is done by clicking the Calculate button in this dialog box. You can also close this dialog box and double-click the map `tmb1edg`; then the map will be automatically calculated and displayed.

☞

- Click Cancel to close the Raster Map Properties dialog box.

Let's now compare the original map `tmb1` with the output map `tmb1edg`.

☞

- Double-click raster map `tmb1`.
- Accept the default display options and click OK.
- Double-click raster map `tmb1edg`.

ILWIS starts calculating this map.

☞

- Accept the display options and click OK.

Place the two map windows next to each others to see both maps totally. The result of the filtering is a better visibility of linear features in raster map tmb1edg. If the filtered image does not seem sharper then the unfiltered one, zoom in on a comparable area in both maps.

☞

- Close both map windows.

4.3 Create a color composite

Spectral information from satellite images can be visualized by combining three individual bands into one image. One band is displayed in shades of red, one in shades of green and one in shades of blue. Putting three bands together in one color composite can give a better visual impression of reality, rather than displaying one band at a time. There are three types of color composites: natural color composites, pseudo natural color composites and false color composites.

- Natural color composites are made of the green, blue and red part of the spectrum. This results in an image with realistic colors.
- A pseudo color composite is created with other parts of the spectrum, but the result has natural looking colors.
- In false color composites the colors in the image are not the same as in reality. For example healthy vegetation is red and urban areas are blue.

Let's make a false color composite of three Landsat Thematic Mapper bands.

☞

- Scroll through the Operation-list until the ColorComp operation is visible.
- Double-click the ColorComp operation.

The Color Composite dialog box is opened. In this dialog box you can choose which raster maps you want to use. You can click the Help button if you want more information about the creation of color composites.

☞

- Drag the dialog box next to the Catalog.
- Drag the `tmb4` map from the Catalog and drop it in the Red Band box.
- Then drag `tmb3` to the Green Band box and `tmb2` to the Blue Band box.
- Type for Output Raster Map name `tmb432`.
- Click the Show check box to immediately calculate and display the color composite.
- Type as a Description `Color composite of tmb4, tmb3 and tmb2`.
- Accept the other defaults and click OK.

The Display Options - Raster Map dialog box is opened.

☞

- Accept the default display options and click OK.

The color composite `tmb432` is displayed. The colors are false colors. For example, you can see the vegetation in red and the urban areas in blue.

☞

- Close the map window.

4.4 Calculating a Normalized Difference Vegetation Index (NDVI)

Map Calculation is a powerful tool in ILWIS for Windows. It is used for the execution of most spatial analysis functions and modeling operations. MapCalc enables the user to perform queries and overlays.

The Normalized Difference Vegetation Index (NDVI) is a measurement for the presence and condition of green vegetation. The function uses two satellite bands; one containing the red reflectance values and another containing the infra-red reflectance values. Raster map `tmb3` in the ILWIS Demo data set contains the red reflectance values and `tmb4` contains the infra-red values. To calculate the NDVI you have to use these two images.

☞

- Double-click the MapCalc operation in the Operation-list.
- Type the following formula in the Expression text box:
  `(tmb4 - tmb3) / (tmb4 + tmb3)`
- Type `ndvitm34` in the Output Raster Map text box.
- Select the Show text box and click the Defaults button.

ILWIS determines the value range, precision and domain type.

☞

- Click OK.
- In the Display Options dialog box, select Representation `pseudo` instead of the default `gray` and click OK.

The image ndvitm34 is displayed. The values range from -1 to 0.7.
- Vegetated areas will generally yield values close to one because of their relatively high near-infrared reflectance and low visible reflectance.
- In contrast, water, clouds and snow have larger visible reflectance than near-infrared reflectance. Thus, these features yield negative index values.
- Rock and bare soil areas have similar reflectance's in the two bands and result in vegetation indices near zero.

Instead of typing the complete expression it is also possible to use the function NDVI (red band, near infra red band). The NDVI is one of the many pre-defined functions in MapCalc.

Let's now use the Map Calculation operation to create a map of areas with a high vegetation index. These are the relatively highly vegetated areas. Let's assume that areas with an NDVI larger than 0.1, are highly vegetated. To get a map with these areas we use an IFF-statement.

☞

- Double-click the MapCalc operation in the Operation-list.
- Type the following formula in the Expression text box: `IFF((ndvitm34>0.1),1,0)`
- Type `highveg` in the Output Raster Map text box.
- Select the Show check box and click the Defaults button.
- Click OK.
- In the Display Options dialog box select for Representation `pseudo` and click OK.

The map `highveg` is displayed. The vegetated areas have value 1 and the other areas have value 0.

☞

- Close both map windows.

4.5 Table Calculation

Table calculation is the ILWIS application you can use for calculating with columns of a table. In the next example we will calculate the periodic rainfall for every three months using the rainfall table.

☞

- Double-click the attribute table `rainfall` in the Catalog.

Table calculation expressions can be typed on the command line of the table window. To get the periodic rainfall values you have to add the values of the three months and put it in a new column.

☞

- Type the following expression on the command line:

  `janfebmar=january+february+march`

- Press Enter.

The Column Properties dialog box of your new column is opened.

☞

- Click OK.
- In the table window, scroll to the right with the horizontal scroll bar.

The last column is the one you just made. You can see the added values of January, February and March.

☞

- Close the table window.

4.6 Cross

The Demo Data set includes a polygon map `geology`. This map shows the geology in the Cochabamba area. There is also a map which shows the land use in the area (`landuse`). Let's try to see on which geological units what type of land use is found. This can be done with the Cross operation. The Cross operation needs two raster maps as input. At this stage, both the `geology` and the `landuse` maps are polygon maps, so you first need to rasterize them.

☞

- Press the right mouse button on polygon map `geology` and choose Polygon to Raster from the context-sensitive menu.
- In the dialog box select GeoReference `cochabam`.
- Click OK.

The raster map `geology` appeared in the Catalog. The same has to be done with polygon map `landuse`.

☞

- Press the right mouse button on polygon map `landuse` and choose Polygon to Raster from the context-sensitive menu.
- In the dialog box select GeoReference `cochabam`.
- Click OK.

Although the maps are not calculated yet, only their *definition* is stored, you can use them in the cross calculation as if they are already calculated.

☞

- Double-click Cross in the Operation-list.
- Select `geology` as 1st Map.
- Select `landuse` as 2nd Map.
- Type `geolland` in the Output Table text box.
- Select the Show check box.
- Select the Output Map check box and type `geolland`.
- Click OK.

ILWIS starts rasterizing both maps and calculating a cross table and a cross map.

After the calculation, the *cross table* `geolland` appears. In this table each geological unit with its land use is displayed. The number of pixels and areas of each combination is also stored in the cross table.

☞

- Maximize the table window to see the number of pixels and the area of crossed units.
- Click the Restore button  when finished.

Further, a *cross map* geolland is calculated which contains the same combinations as in the cross table.

☞

- To display the cross map, double-click raster map `geolland`.

The Display Options dialog box is opened.

☞

- Select `7`, `15`, or `31` colors to display the map.
- Click OK.

Raster map `geolland` is displayed. The two maps `geology` and `landuse` are overlaid. This creates areas with specific combinations of geology and land use. Displaying the map in 31 colors allows for a better distinction between the different units.

With the left mouse button, click in the map window to get information on the geology and the land use.

You can also open the Pixel Information window and drag the polygon maps `geology, landuse` and `geom` into it. This will give you even more information.

☞

- Close the map and table window.

Chapter 5

Annotation

To present maps it is useful to add annotation like a map title, a scale and a legend. This chapter will give some examples of basic annotation. The polygon map `geology` will be used as a basis. The result can be printed on paper.

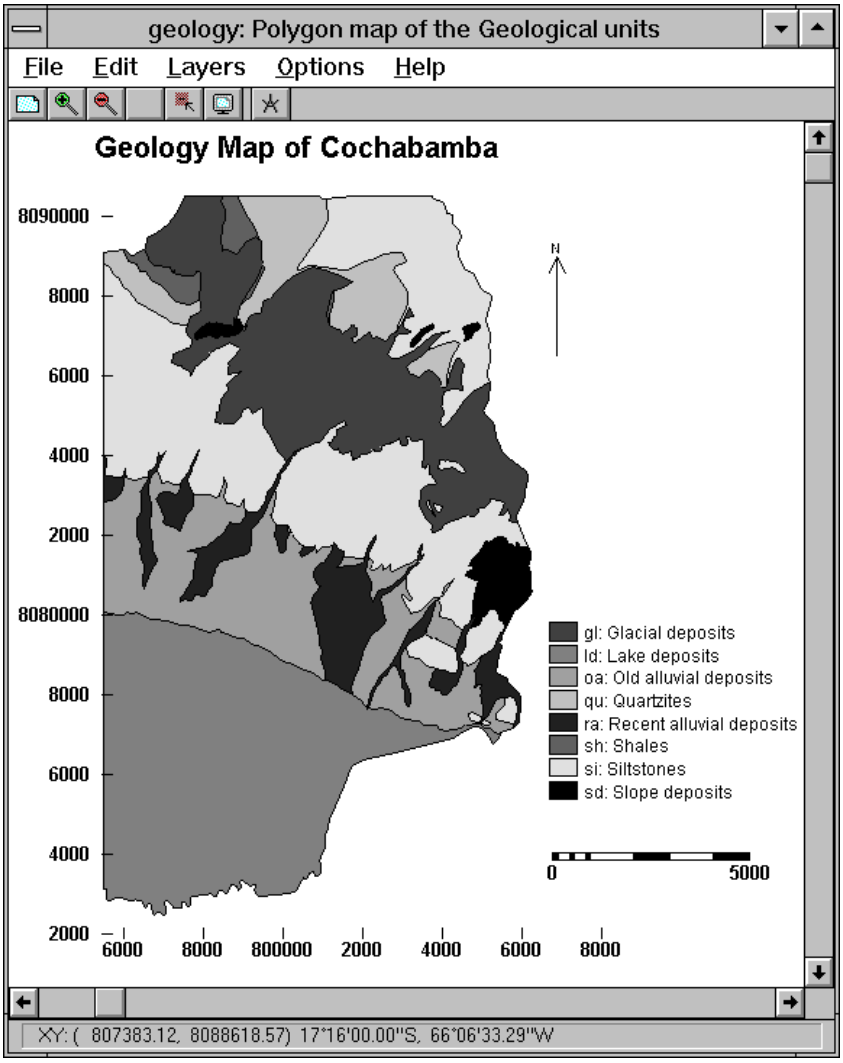

Figure 5.1 The polygon map Geology with annotation.

☞

- Double-click polygon map `geology`.
- Accept the defaults display options and click OK.

You will add annotation as layers to the map window. First, you will created some extra space around the map.

☞

- Open the Options menu and select Extend Window and Extend by Percentage.
- Click in the text boxes and type the following percentages: `10`, `10`, `20`, `55` and click OK. Use the Tab key to go to the next text box.

The map window is resized.

Now, let's add a title.

☞

- If the Enlarge button is available in the button bar, click this button to enlarge the map window.
- From the Layers menu, select Add Annotation and Text.
- Remove the current text in the Display Options-Text dialog box and type `Geology Map of Cochabamba`.
- Accept other default options and click OK.

The annotation editor is opened: it shows the map `Geology` and at this moment the text `Geology Map of Cochabamba` appears in the center of the map window.

The text is selected when it is surrounded by a selection box. The corners of the selection box are little black handles. The font size can be changed by dragging these handles. As you can see the title is already selected.

☞

- Drag the title to the top of the map window like in Figure 5.1.
- You can enlarge the title by dragging one of the size handles of the title.

In this way all text can be added. You can also change the font, size, and the color of text.

Let's now add a legend and a north arrow. The legend is created automatically from the domain of the map and the representation used by the domain.

☞

- Click the Legend button in the button bar of the Annotation Editor.

The Display Options-Legend dialog box is opened. By default all classes are selected.

☞

- Accept the defaults and click OK.
- Drag the legend to the lower right corner to make it fit better in the map.
- To add a north arrow, click the North Arrow button in the button bar.

The Display Options - North Arrow dialog box is opened.

☞

- Accept the defaults and click OK.
- Drag the north arrow to the upper right corner of the map window.
- Resize the north arrow by dragging its size handles.

Finally let's add a scale bar and a grid to the map.

☞

- Click the Scale bar button in the button bar.
- In the dialog box, clear the check box Text 1: ...
- Click OK.
- Drag the scale bar to the bottom of the map window.

☞

- To display the grid, click the Grid button in the button bar.
- Type `2000.0` as the Grid Distance.
- Clear the Draw Border check box.
- Clear the Grid Lines check box.
- Select Outside Map.
- Click OK.

Reposition the Legend and Scale Bar if necessary.

The result is a map with different layers of annotation. The order of these layers can be changed in the Layer Management dialog box.

The contents of this map window can be saved as a *map view*.

☞

- Open the File menu and select Save View As to save the map window as a map view.
- Type `GeolView` for Map View Name.
- Click OK.

To print the map, you need to leave the Annotation editor and return to the map window.

☞

- Open the File menu and select Exit Editor to exit the Annotation Editor and to return to the map window.

Make sure that your printer is installed. To check to which printer you are currently connected or to install a printer, you can select Printer Setup from the File menu.

☞

- Open the File menu and select Print.
- Accept the defaults Current window and Fit on Page.
- Click OK to print.

The map is printed.

You have now finished the Beginner's Guide. To further improve your ILWIS skills, you can continue with the User's Guide.

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