Database management for the analysis of crop conditions in Afghanistan

A practical tutorial using the internet, AgrometShell, Windisp, Excel and Word

Peter Hoefsloot
Rabah Lekhal
Fahim Zaheer

OSRO/AFG/309/USA

Kabul, Afghanistan, July 29, 2004

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1 Introduction

Food security is one of the top priorities of the Afghani government. FAO supports this effort by producing crop condition reports based on local information. The government as well as many embassies, NGO's, UN agencies have shown keen interest in these reports being produced. Combined with other sources of information (demographic, socio-economic etc…) crop monitoring information gives a clear picture of the status of the growing season.

Producing crop monitoring reports is a rather technical task. Data sources have to be retrieved and combined. It needs a specialist in agrometeorology who should at the same time have a good understanding of data structures, software and methods as well as the needs of readers of his reports.

This tutorial takes a very practical approach and is especially created for the Afghan crop monitoring unit that resides under the Ministry of Agriculture. The approach is "lots of graphical information and a limited amount of text".

This manual uses several software packages of which AgrometShell (AMS) and Windisp are the most important. These software packages are free of charge and can be downloaded form the FAO website. AMS contains the weather database for the purpose of crop monitoring in Afghanistan. Windisp is used for image display and analysis. Microsoft Excel and Microsoft Word are used to manipulate data and produce reports respectively. AMS stores its data in an Access database. This Access database can be opened by Access version 2000 or higher. In this way powerful reporting and querying possibilities can be applied to the AMS database.

Some good advice: Keep your data well-organized in AMS and keep the amount of data in spreadsheets to an absolute minimum. Even station-based based crop-yield data can be stored inside AMS. AMS is completely open. You can use any analysis tool in combination with AMS. Import all your weather and crop related information into AMS and enter new data directly into AMS. It is good practice to make regular backups of your data.

I would like to thank the Afghani crop forecasting unit under the direction of Mr. Rabah Lekhal and Mr. Fahim Zaheer for a useful and indeed very pleasant time in emerging Afghanistan.

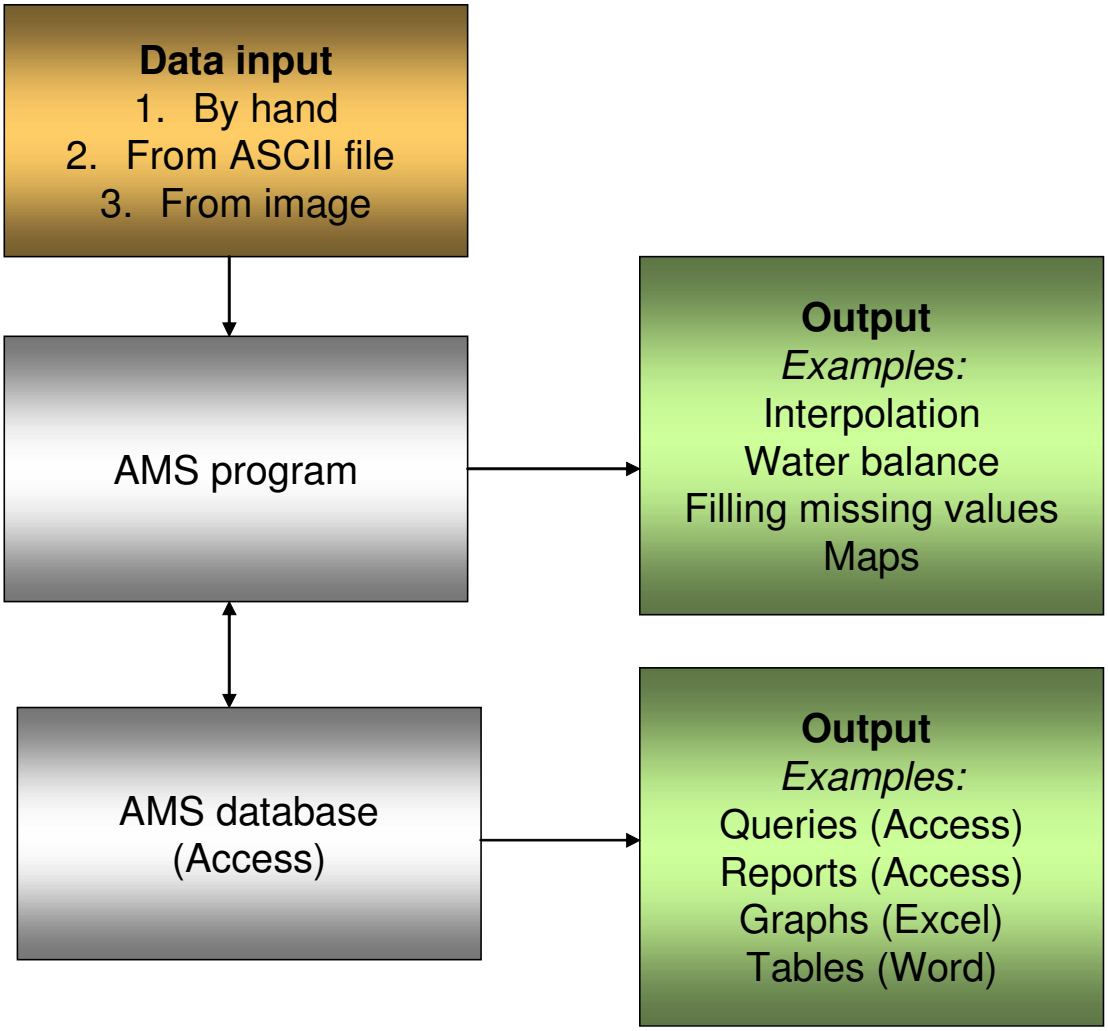
Peter Hoefsloot (peter.hoefsloot@wxs.nl; do not hesitate to mail!)
Kabul July 28, 2004

1.1 The use of the AMS software and database.

In general terms software can be defined as a tool with which certain input is converted in useful output. For AMS this is valid too.

The basic principles are as follows:

- **Input** is exclusively done through the AMS program. Technically it would be possible to enter data directly into the Access database. However, doing so will most probably result in problems. The database has a certain structure (see last chapter in this manual) that is easily damaged.
- The AMS program helps you to create all sorts of **output** related to crop monitoring.
- On top of that you have the full functionality of Access to create **special output**. As long as your activities in Access do not change the database it is a both powerful and safe way to generate queries, reports etc.



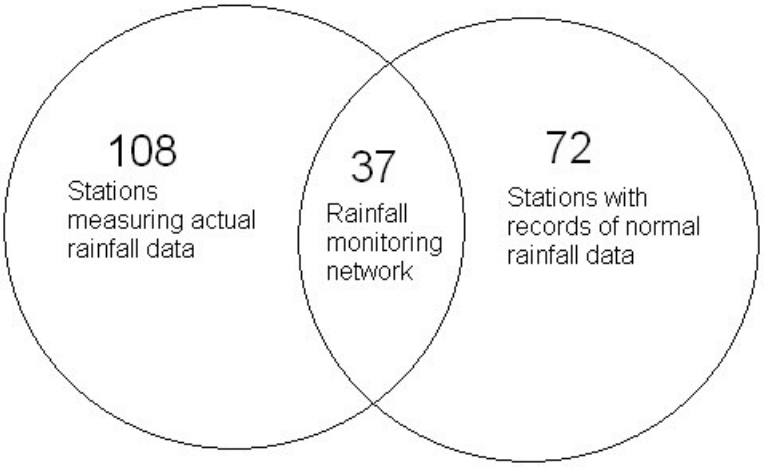
2 The monitoring networks.

Crop conditions are usually monitored on the basis of station information. We should therefore establish a "station network" or "monitoring network"..

2.1 The rainfall monitoring network.

The "rainfall monitoring network" in Afghanistan contains all the stations for which actual and normal rainfall are available.

At the moment *actual data* are gathered from 108 stations. *Normal data* are available for 72 stations. Unfortunately the 72 stations are not a subset of the 108 stations as is explained in the following graph:



For crop monitoring purposes normal data are needed. Therefore the rainfall network will start with 37 stations. The Ministry of Agriculture will make a strong effort to install raingauges in the 72 – 37 = 35 stations that do have normal rainfall data but currently do not have an operational rain gauge.

The spelling of station names differs strongly from dataset to dataset we found. Therefore, from the onset, great care is taken to produce a list with standardized names of stations. For all 37 stations the following attributes are available:

1. ID
2. Name
3. Longitude
4. Latitude
5. Altitude
6. Province (Kabul, Bamyan etc..). Afghanistan has 32 provinces.
7. Region (North, North-East etc..). Afghanistan has 7 agricultural regions

2.2 The crop monitoring network.

To monitor crops in a water balance model, the following data are needed in addition to normal and actual rainfall:

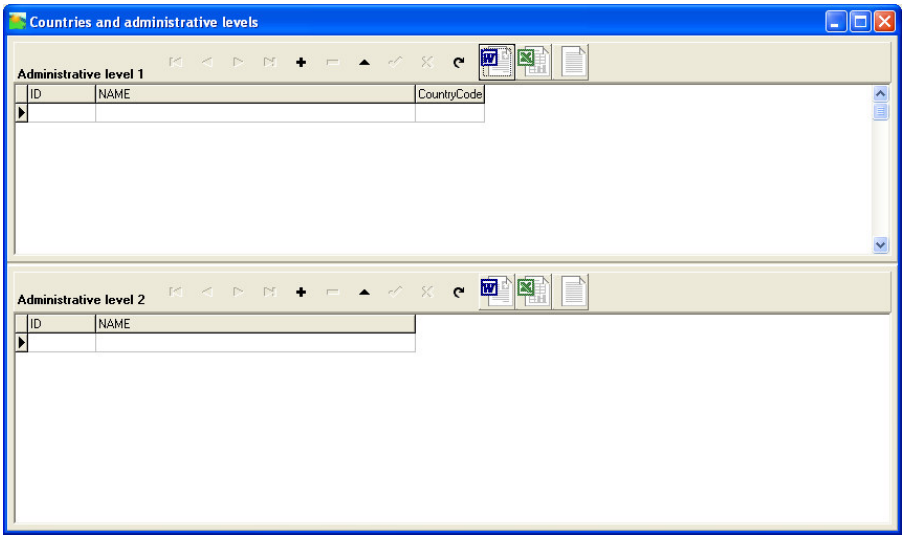
1. PET (Potential evapotranspiration)
2. Crops (which crops are planted and where they can be found)
3. Planting dates for crops (PLD)
4. Cycle length for all the crops (CYC)
5. Water Holding Capacity (WHC) of the soil.
6. Percentage Effective Rainfall (EFR)
7. Pre-season Crop coefficient (usually around 0.15)
8. Irrigation data including bund height (when applicable).

At this moment, of the 37 stations in the rainfall list, 2 stations can not provide these data. This reduces the number of stations available for water balance calculations to 35. This list is called the "Crop monitoring network".

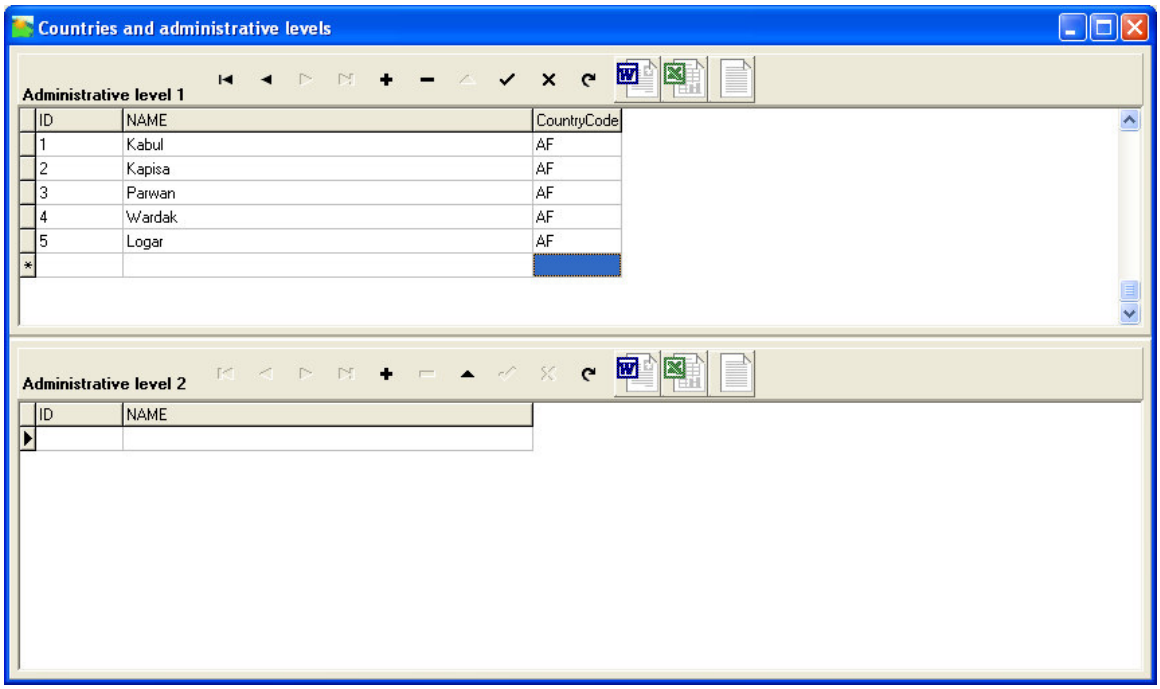
2.3 Setting up the monitoring networks in AMS

2.3.1 Entering administrative area's

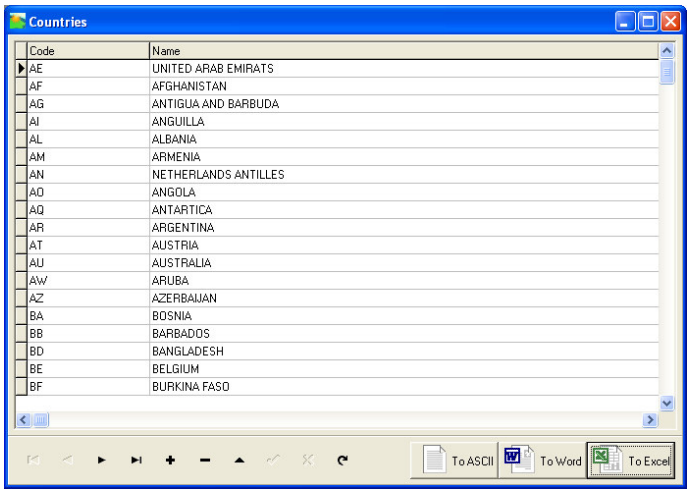
Afghanistan is divided into 32 provinces. A further break-down into districts is existent, but is ignored for the moment. Therefore we will only fill the first administrative level. To achieve this, start AMS. Open the menu item "*Database – Manage Stations*". Press the "*Administrative Levels*" – button at the top of the screen. The following screen will appear:



The window is divided in two parts. The top part enables you to enter administrative level 1 (Provinces), the bottom part represents administrative level 2 (Districts). As the administrative level 2 is (for now) ignored in Afghanistan, the bottom part of the window is left empty. At the top part we start filling the window with the names of the Provinces:



The first column represents a unique ID for the province. In Afghanistan a simple number starting at 1 is chosen. The second column represents the name of the Province. The third column represents the country code (AF for Afghanistan). In case you would not know the code for Afghanistan, you can search for a country code using the "*Database-Configure-Countries*" option of AMS. This option shows the countries and their respective codes:

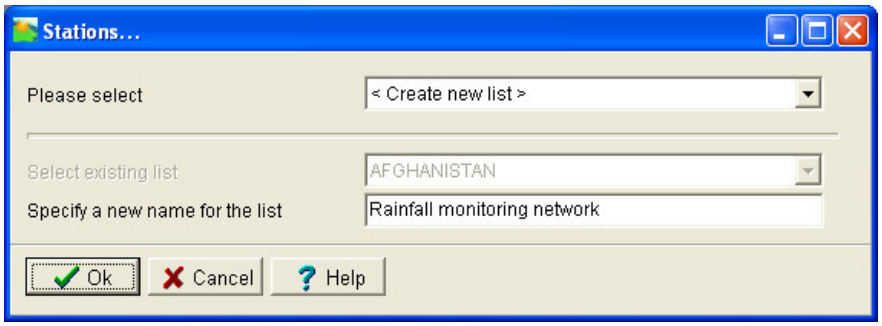


2.3.2 Setting up the station list.

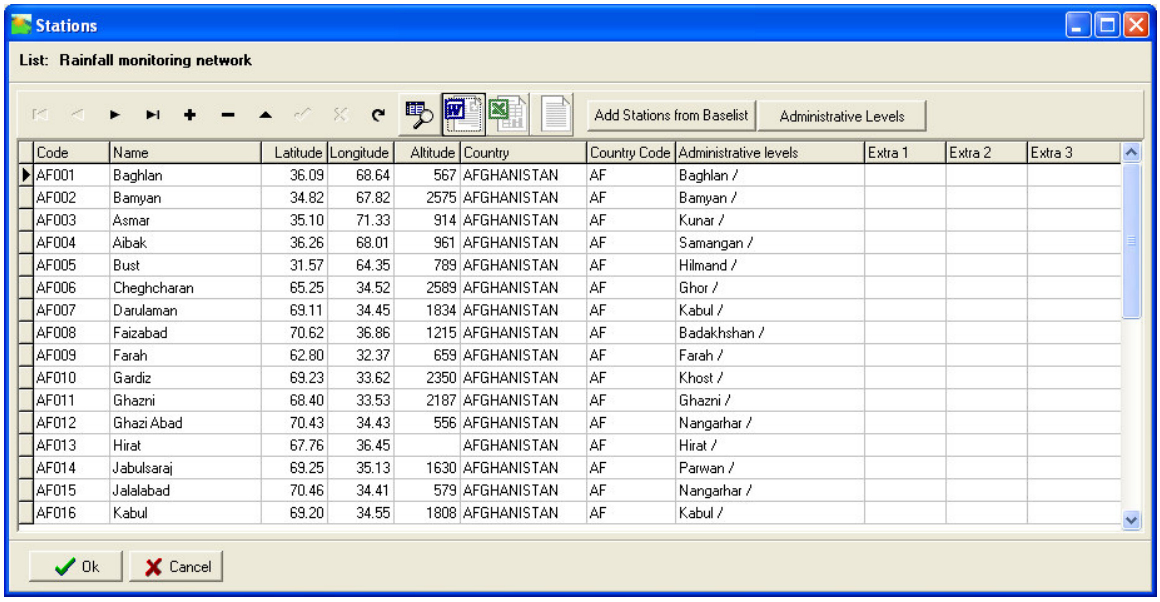
In this step we will start setting up the "rainfall monitoring network" list. Perform the following steps:

- Activate the "*Database – Manage Station Lists*" function.

- Select <Create new list>
- Specify the name for the new list : "Rainfall monitoring network"



Press OK. You will get a window in which to enter the names of the new stations and all the attributes. In the first column the code of the station is specified. This code is AF001 for the station Baghlan. The second column specifies the station name. The third column specifies the latitude, the fourth the longitude, the fifth the altitude. The next three columns enable the user to specify the country and the administrative levels from "pick lists". After entering all the stations the screen should look like this:



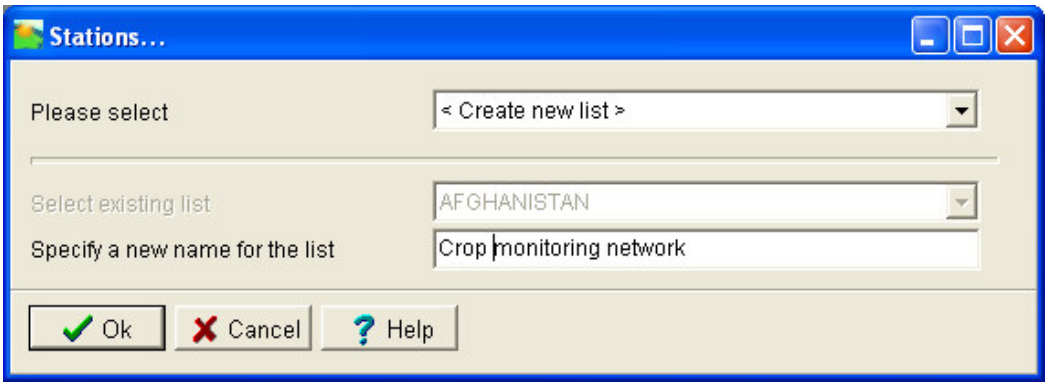
Code	Name	Latitude	Longitude	Altitude	Country	Country Code	Administrative levels	Extra 1	Extra 2	Extra 3
AF001	Baghlan	36.09	68.64	567	AFGHANISTAN	AF	Baghlan /			
AF002	Bamyan	34.82	67.82	2575	AFGHANISTAN	AF	Bamyan /			
AF003	Asmar	35.10	71.33	914	AFGHANISTAN	AF	Kunar /			
AF004	Aibak	36.26	68.01	961	AFGHANISTAN	AF	Samangan /			
AF005	Bust	31.57	64.35	789	AFGHANISTAN	AF	Hilmand /			
AF006	Cheghcharan	65.25	34.52	2589	AFGHANISTAN	AF	Ghor /			
AF007	Darulaman	69.11	34.45	1834	AFGHANISTAN	AF	Kabul /			
AF008	Faizabad	70.62	36.86	1215	AFGHANISTAN	AF	Badakhshan /			
AF009	Farah	62.80	32.37	659	AFGHANISTAN	AF	Farah /			
AF010	Gardiz	69.23	33.62	2350	AFGHANISTAN	AF	Khost /			
AF011	Ghazni	68.40	33.53	2187	AFGHANISTAN	AF	Ghazni /			
AF012	Ghazi Abad	70.43	34.43	556	AFGHANISTAN	AF	Nangarhar /			
AF013	Hirat	67.76	36.45		AFGHANISTAN	AF	Hirat /			
AF014	Jabulsaraj	69.25	35.13	1630	AFGHANISTAN	AF	Parwan /			
AF015	Jalalabad	70.46	34.41	579	AFGHANISTAN	AF	Nangarhar /			
AF016	Kabul	69.20	34.55	1808	AFGHANISTAN	AF	Kabul /			

Automatically all stations are saved in the so-called "base list".

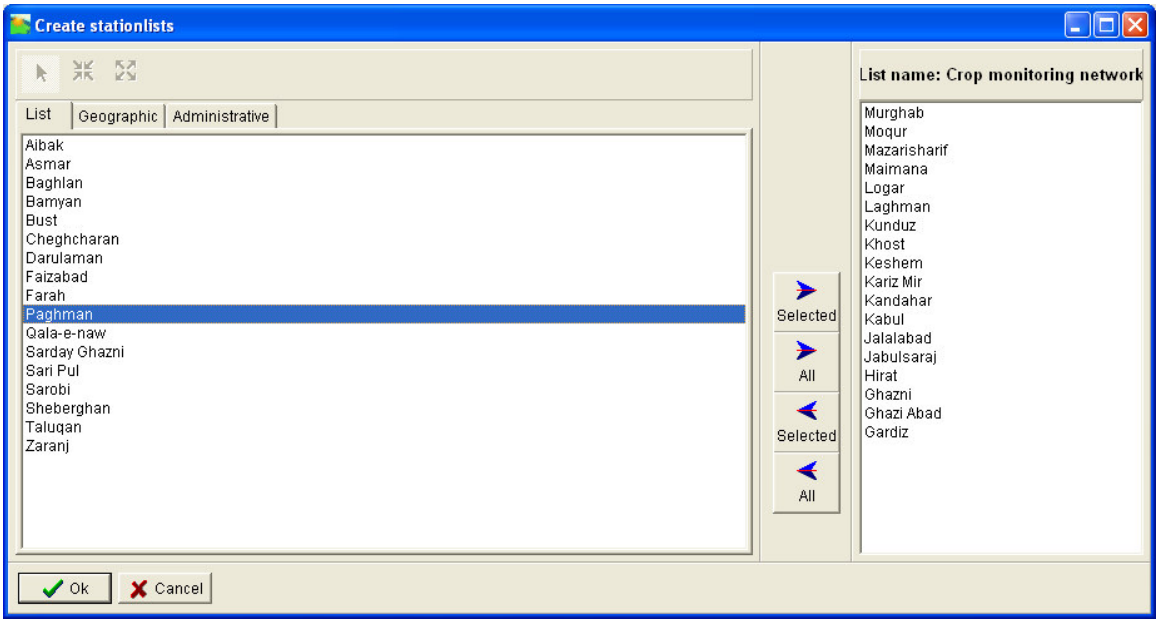
2.4 Setting up an additional list (e.g. a "Crop monitoring network").

Stations from the "base list" can be used to set up an additional list such as the "crop monitoring network". In fact, the "crop monitoring network" is a sub-set of the "rainfall monitoring network". We will create the crop monitoring network list as follows:

Activate the "*Database – Manage Station Lists*" function. Create another list:



Give it the name "Crop monitoring network" and press OK. Then press the button "*Add stations from base list*". Move stations to the new list by selecting them on the left side and adding them to the right side using the buttons in the middle. Finally the screen should finally look somewhat like the following screendump.



As many lists as you need can be implemented this way. Adding new stations to a list will have these stations saved in the "Base list". This will enable later re-use in other lists.

3 Entering weather data

3.1 Importing datasets from spreadsheets and ASCII files.

When setting up a crop monitoring project, data from many sources have to be included in the database. This can be done by re-typing the information from the source document into the AMS database. However, this is subject to errors and takes a lot of time to complete. Therefore data can best be imported.

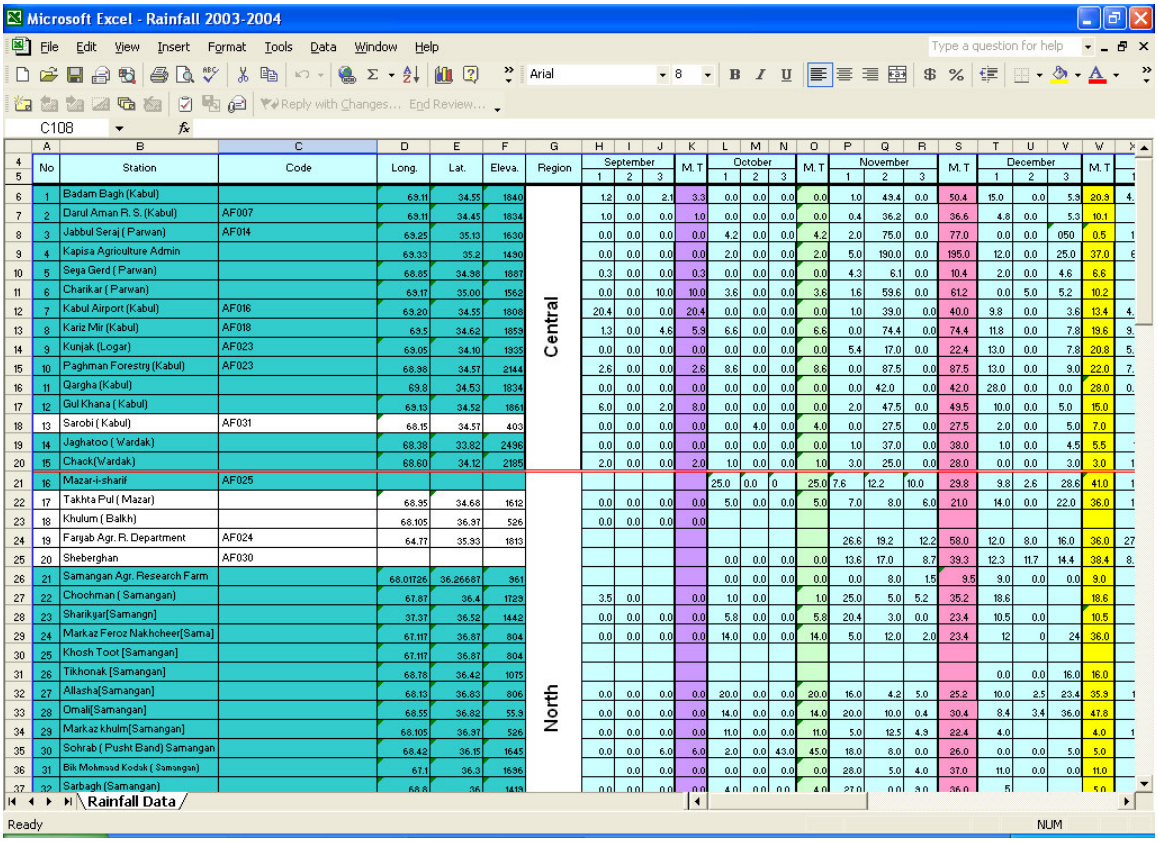
AMS can import all ASCII data, as long as the data are organized in columns and rows. In Afghanistan, many datasets are stored in Excel files that can easily be converted into ASCII and subsequently imported into AMS. This section will deal with the import of those files.

Data can only be imported into AMS if the file to import contains a column that can be matched with a corresponding AMS station list. Linkage can be provided through the station code or through the station name. As previously explained, in Afghanistan station names are not usable for the connection between AMS and data in other files. The only possibility is connecting AMS and the ASCII files by station code.

3.1.1 Inspecting and changing the spreadsheet

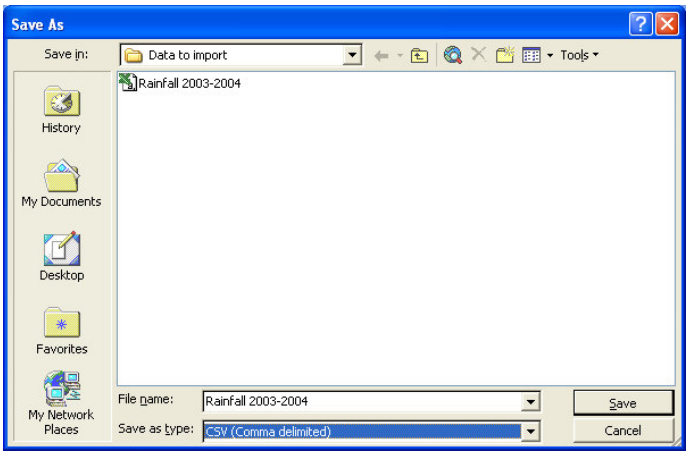
AMS can import data as long as it is in ASCII format. That means that Excel data can only be imported if it is saved into ASCII files, or more precise "comma separated value" files (*.csv).

As an example we will import rainfall data for the years 2003-2004. First we inspect the spreadsheet (see below). We will take out all columns and lines that do not represent data.

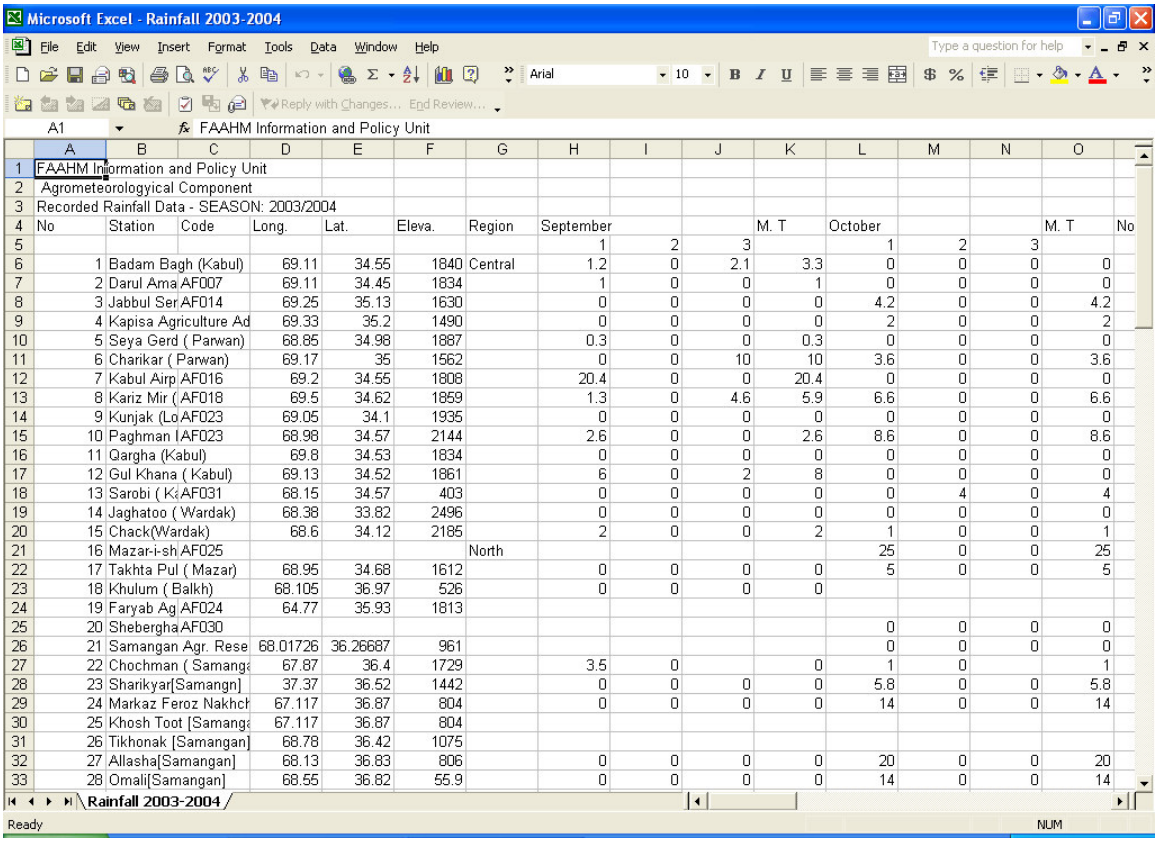


As outlined before, the data will be identified by station code. Therefore an extra column is added to the spreadsheet. This Column C represents the station code. This code is entered by hand and should correspond to the station code used in AMS (see previous chapters).

The next step is to save the spreadsheet in CSV format. We do so by using the "*file-save as*" command in Excel and save the file as CSV file.



Now close the XLS file in Excel and open the CSV file (again in Excel). You will notice that all the formatting (colors etc..) has disappeared:



Microsoft Excel - Rainfall 2003-2004

File Edit View Insert Format Tools Data Window Help

A1 FAAHM Information and Policy Unit

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	FAAHM Information and Policy Unit														
2	Agrometeorologyical Component														
3	Recorded Rainfall Data - SEASON: 2003/2004														
4	No	Station	Code	Long.	Lat.	Eleva.	Region	September			M. T	October			M. T
5								1	2	3		1	2	3	
6	1	Badam Bagh (Kabul)		69.11	34.55	1840	Central	1.2	0	2.1	3.3	0	0	0	0
7	2	Darul Ama	AF007	69.11	34.45	1834		1	0	0	1	0	0	0	0
8	3	Jabbul Ser	AF014	69.25	35.13	1630		0	0	0	0	4.2	0	0	4.2
9	4	Kapisa Agriculture Ad		69.33	35.2	1490		0	0	0	0	2	0	0	2
10	5	Seya Gerd (Parwan)		68.85	34.98	1887		0.3	0	0	0.3	0	0	0	0
11	6	Charikar (Parwan)		69.17	35	1562		0	0	10	10	3.6	0	0	3.6
12	7	Kabul Airp	AF016	69.2	34.55	1808		20.4	0	0	20.4	0	0	0	0
13	8	Kariz Mir (	AF018	69.5	34.62	1859		1.3	0	4.6	5.9	6.6	0	0	6.6
14	9	Kunjak (Lo	AF023	69.05	34.1	1935		0	0	0	0	0	0	0	0
15	10	Paghman I	AF023	68.98	34.57	2144		2.6	0	0	2.6	8.6	0	0	8.6
16	11	Qargha (Kabul)		69.8	34.53	1834		0	0	0	0	0	0	0	0
17	12	Gul Khana (Kabul)		69.13	34.52	1861		6	0	2	8	0	0	0	0
18	13	Sarobi (Ka	AF031	68.15	34.57	403		0	0	0	0	0	4	0	4
19	14	Jaghatoo (Wardak)		68.38	33.82	2496		0	0	0	0	0	0	0	0
20	15	Chack(Wardak)		68.6	34.12	2185		2	0	0	2	1	0	0	1
21	16	Mazar-i-sh	AF025				North					25	0	0	25
22	17	Takhta Pul (Mazar)		68.95	34.68	1612		0	0	0	0	5	0	0	5
23	18	Khulum (Balkh)		68.105	36.97	526		0	0	0	0				
24	19	Faryab Ag	AF024	64.77	35.93	1813									
25	20	Shebergha	AF030									0	0	0	0
26	21	Samangan Agr. Rese		68.01726	36.26687	961						0	0	0	0
27	22	Chochman (Samang		67.87	36.4	1729		3.5	0		0	1	0		1
28	23	Sharikyar[Samangn]		37.37	36.52	1442		0	0	0	0	5.8	0	0	5.8
29	24	Markaz Feroz Nakhch		67.117	36.87	804		0	0	0	0	14	0	0	14
30	25	Khosh Toot [Samang		67.117	36.87	804									
31	26	Tikhonak [Samangan]		68.78	36.42	1075									
32	27	Allasha[Samangan]		68.13	36.83	806		0	0	0	0	20	0	0	20
33	28	Omali[Samangan]		68.55	36.82	55.9		0	0	0	0	14	0	0	14

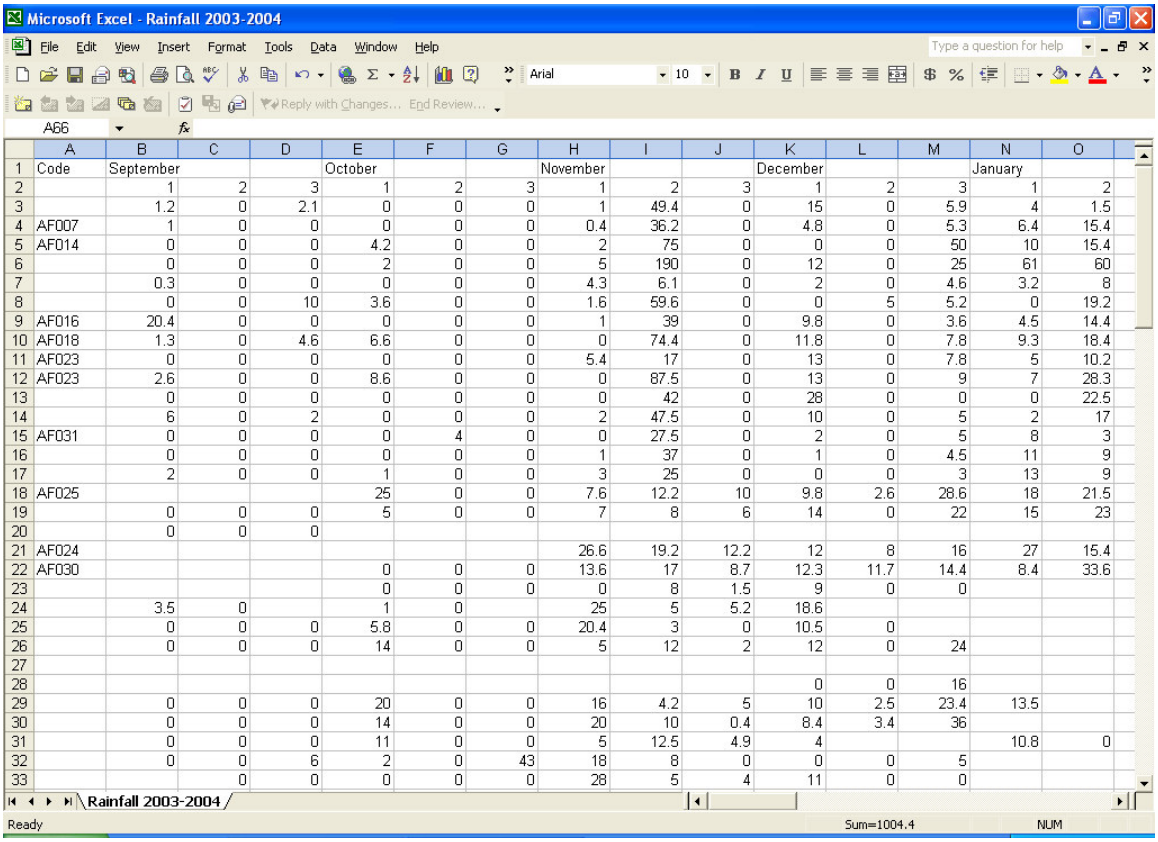
Rainfall 2003-2004

Ready NUM

To import into AMS we only need the station code and the dekadal rainfall data. The rest of the information will be removed. Strictly spoken this step is not necessary, but importing is easier when we do so.

The following columns are deleted: A, B, D, E, F, G. We also take out columns K, O etc… because they contain monthly data. In the middle of the spreadsheet we found header lines and removed them as well. At the end of the spreadsheet we found totals and we removed those as well…

In the end we have the following solid block of data:



Microsoft Excel - Rainfall 2003-2004

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Code	September			October			November			December			January	
2		1	2	3	1	2	3	1	2	3	1	2	3	1	2
3		1.2	0	2.1	0	0	0	1	49.4	0	15	0	5.9	4	1.5
4	AF007	1	0	0	0	0	0	0.4	36.2	0	4.8	0	5.3	6.4	15.4
5	AF014	0	0	0	4.2	0	0	2	75	0	0	0	50	10	15.4
6		0	0	0	2	0	0	5	190	0	12	0	25	61	60
7		0.3	0	0	0	0	0	4.3	6.1	0	2	0	4.6	3.2	8
8		0	0	10	3.6	0	0	1.6	59.6	0	0	5	5.2	0	19.2
9	AF016	20.4	0	0	0	0	0	1	39	0	9.8	0	3.6	4.5	14.4
10	AF018	1.3	0	4.6	6.6	0	0	0	74.4	0	11.8	0	7.8	9.3	18.4
11	AF023	0	0	0	0	0	0	5.4	17	0	13	0	7.8	5	10.2
12	AF023	2.6	0	0	8.6	0	0	0	87.5	0	13	0	9	7	28.3
13		0	0	0	0	0	0	0	42	0	28	0	0	0	22.5
14		6	0	2	0	0	0	2	47.5	0	10	0	5	2	17
15	AF031	0	0	0	0	4	0	0	27.5	0	2	0	5	8	3
16		0	0	0	0	0	0	1	37	0	1	0	4.5	11	9
17		2	0	0	1	0	0	3	25	0	0	0	3	13	9
18	AF025				25	0	0	7.6	12.2	10	9.8	2.6	28.6	18	21.5
19		0	0	0	5	0	0	7	8	6	14	0	22	15	23
20		0	0	0											
21	AF024							26.6	19.2	12.2	12	8	16	27	15.4
22	AF030				0	0	0	13.6	17	8.7	12.3	11.7	14.4	8.4	33.6
23					0	0	0	0	8	1.5	9	0	0		
24		3.5	0		1	0		25	5	5.2	18.6				
25		0	0	0	5.8	0	0	20.4	3	0	10.5	0			
26		0	0	0	14	0	0	5	12	2	12	0	24		
27															
28											0	0	16		
29		0	0	0	20	0	0	16	4.2	5	10	2.5	23.4	13.5	
30		0	0	0	14	0	0	20	10	0.4	8.4	3.4	36		
31		0	0	0	11	0	0	5	12.5	4.9	4			10.8	0
32		0	0	6	2	0	43	18	8	0	0	0	5		
33			0	0	0	0	0	28	5	4	11	0	0		

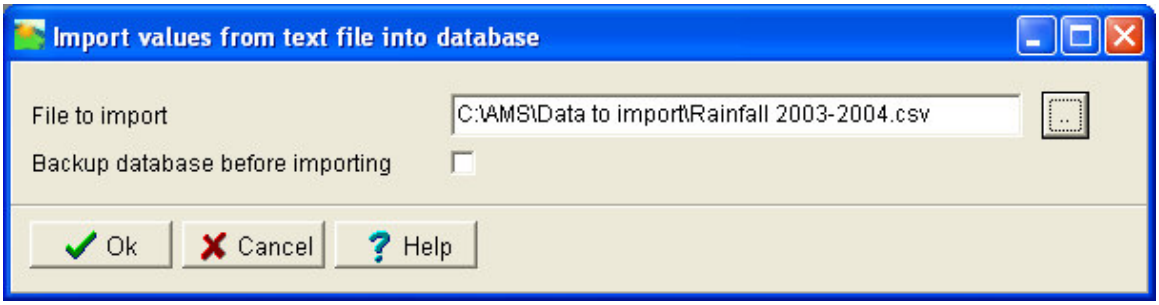
Rainfall 2003-2004

Ready Sum=1004.4 NUM

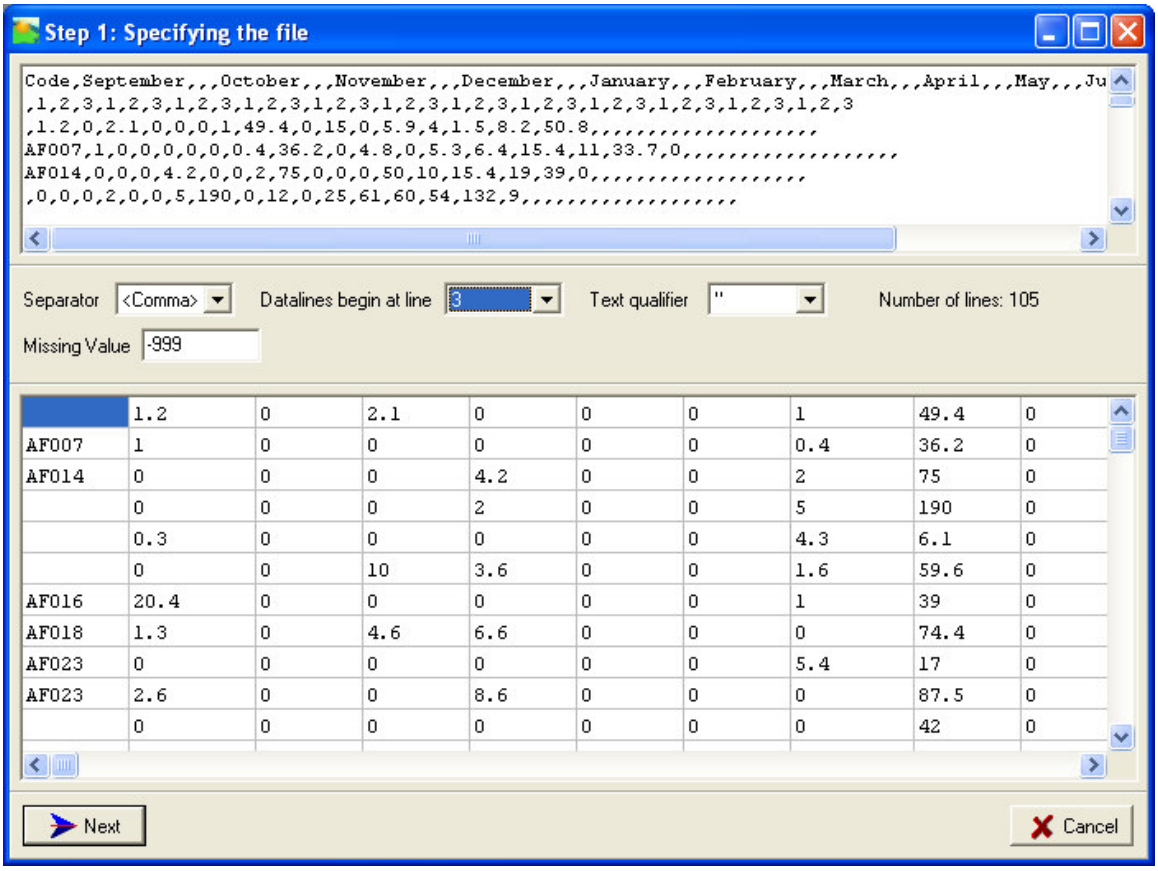
Save this file to CSV format again and exit Excel.

3.1.2 Importing the data into AMS

Start AMS and activate the "*Database-Import-From ASCII file*" option. Specify the name of the CSV file you just created.

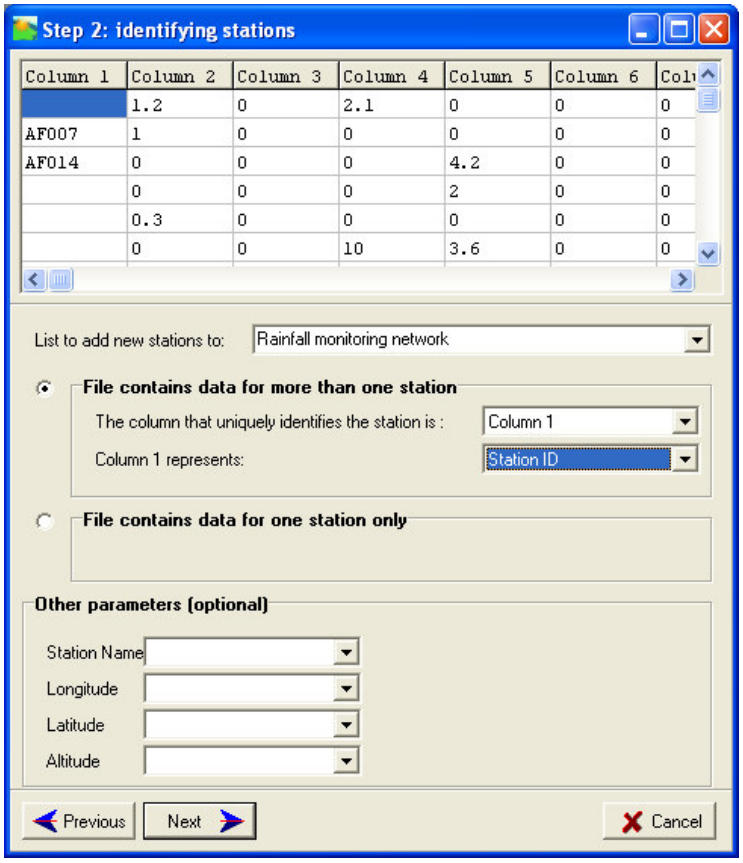


You will be presented the next screen. The top of the screen displays the ASCII file, the bottom part will change according to the settings you make in the middle. In this case the data lines start at line 3 and the delimiter is a comma.

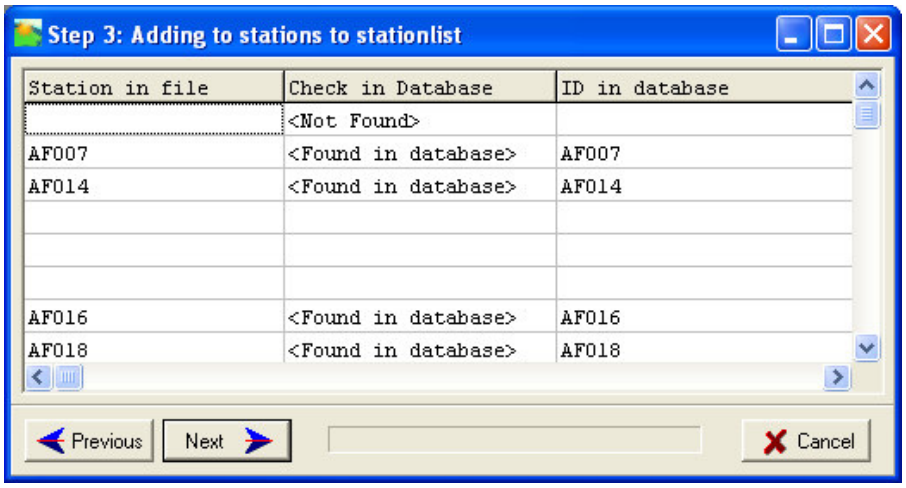


Press "*Next*"….

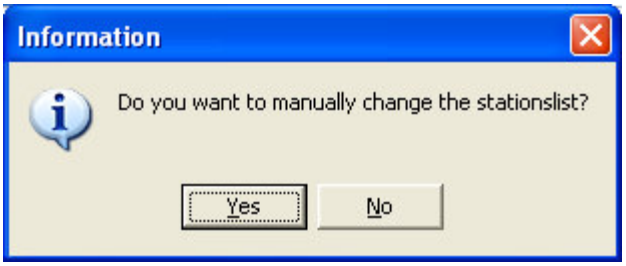
With the following screen you help AMS to find the column that uniquely identifies the station. In this case it is column1. This column represents the station ID. Any new stations would be added to the "Rainfall monitoring network". In this case however, we have put in codes for stations already present in AMS, therefore no new stations will added. In the stationlist (previous chapter) we have entered station name, longitude, latitude and altitude. Therefore we will ignore these fields here:



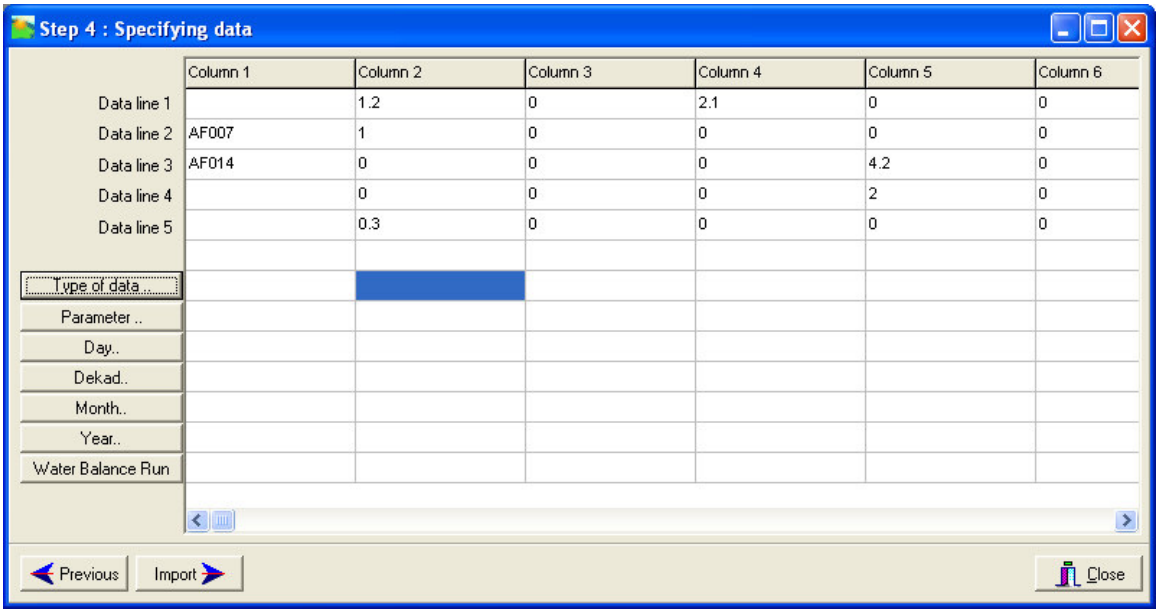
Press Next…. AMS now checks the file line by line for valid station codes. All stations have been found (except for the empty line, which will be ignored later).



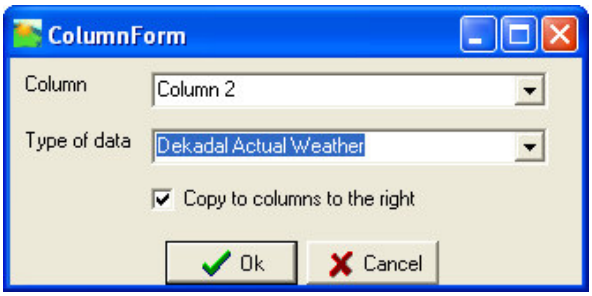
Press Next.... The following screen enables you to change the station list. This is only useful in case new stations were added. This is not the case, so we press "*No*".



You now get to the data definition screen in which to specify exactly what the columns in the file represent:

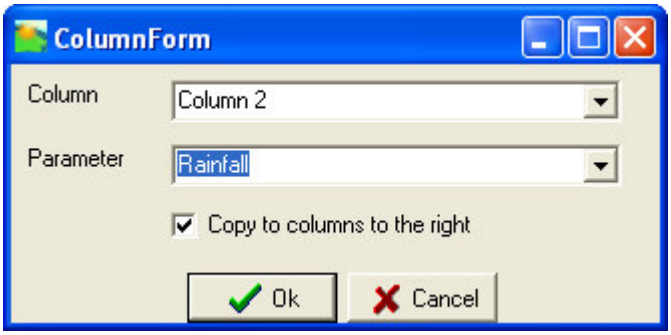


First you specify type of data. Place your cursor in column 2 (the first data column) behind the "*Type of data*" button. Now, Press the "*Type of data*" button:

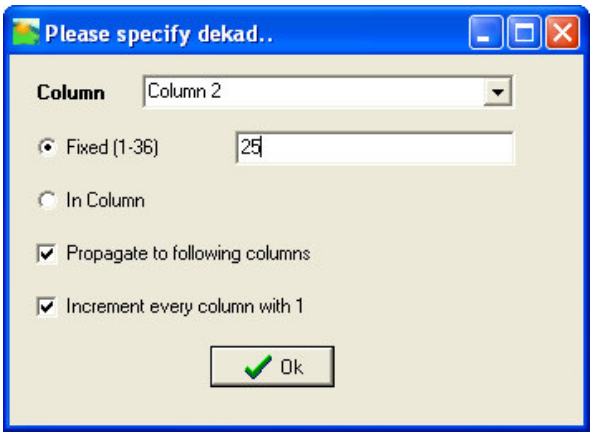


The type of data is "*Dekadal Actual Weather*" and the following columns contain the same type of data (therefore the "*Copy to columns to the right*" checkbox is checked).

Press the "*Parameter*" button and specify "*Rainfall*":



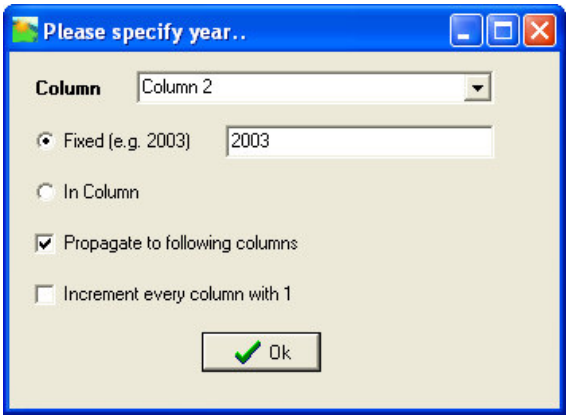
The data are dekadal, so we ignore the "*Day*" button. We press the Dekad button. The first column represents the first dekad of September. This is dekad number 25 in the year. Every next column represents the next dekad in the year, so we set the options as follows:



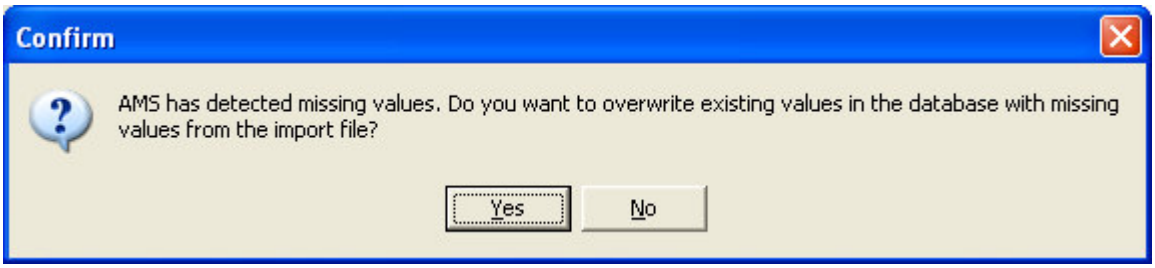
Column 2 – 13 represent data for 2003. With column 14 the year 2004 starts. Therefore we start afresh assigning 1 to the dekad of column 14, 2 to column 15 etc…

We ignore the "*Month*" button.

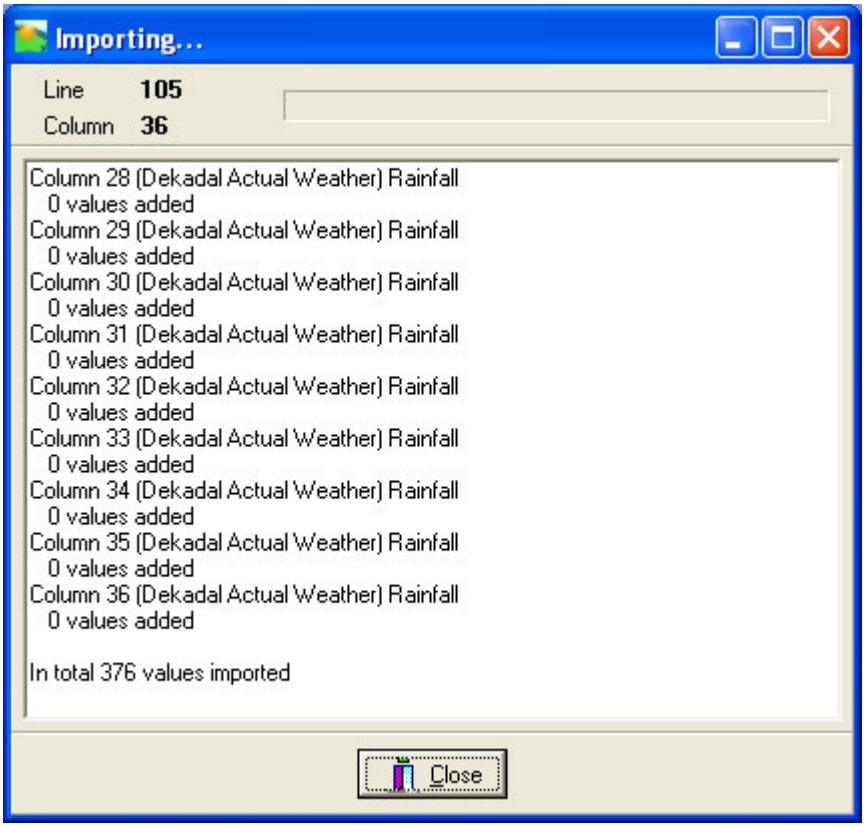
We specify the year "*2003*" for column 2 to 13 and the year "*2004*" for columns 14 to 36:



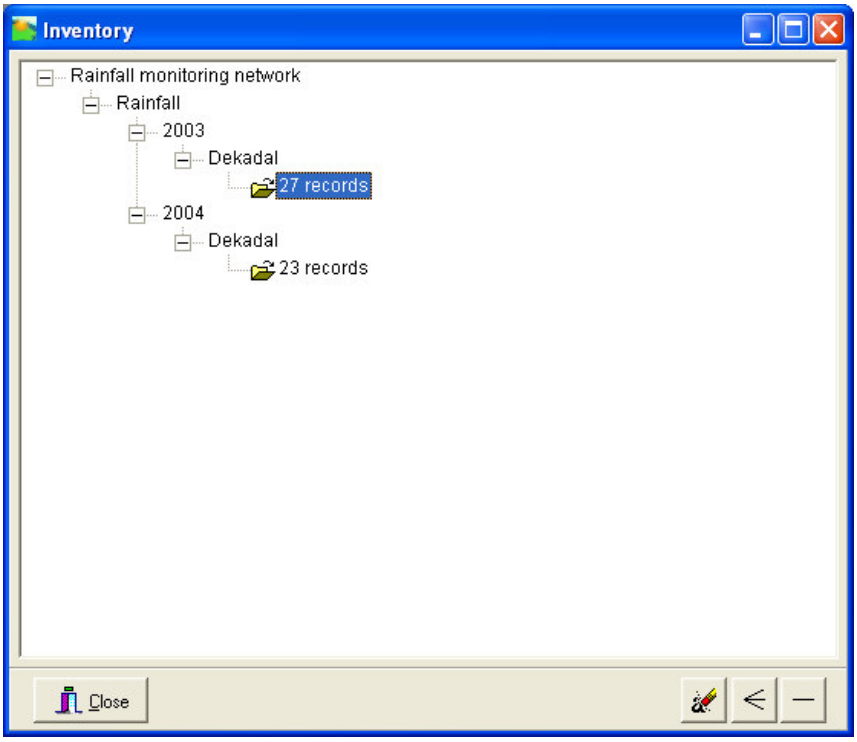
Press. OK. We ignore the Water Balance button. Press Next and ….. the data are imported! In case of missing data you get the following message:



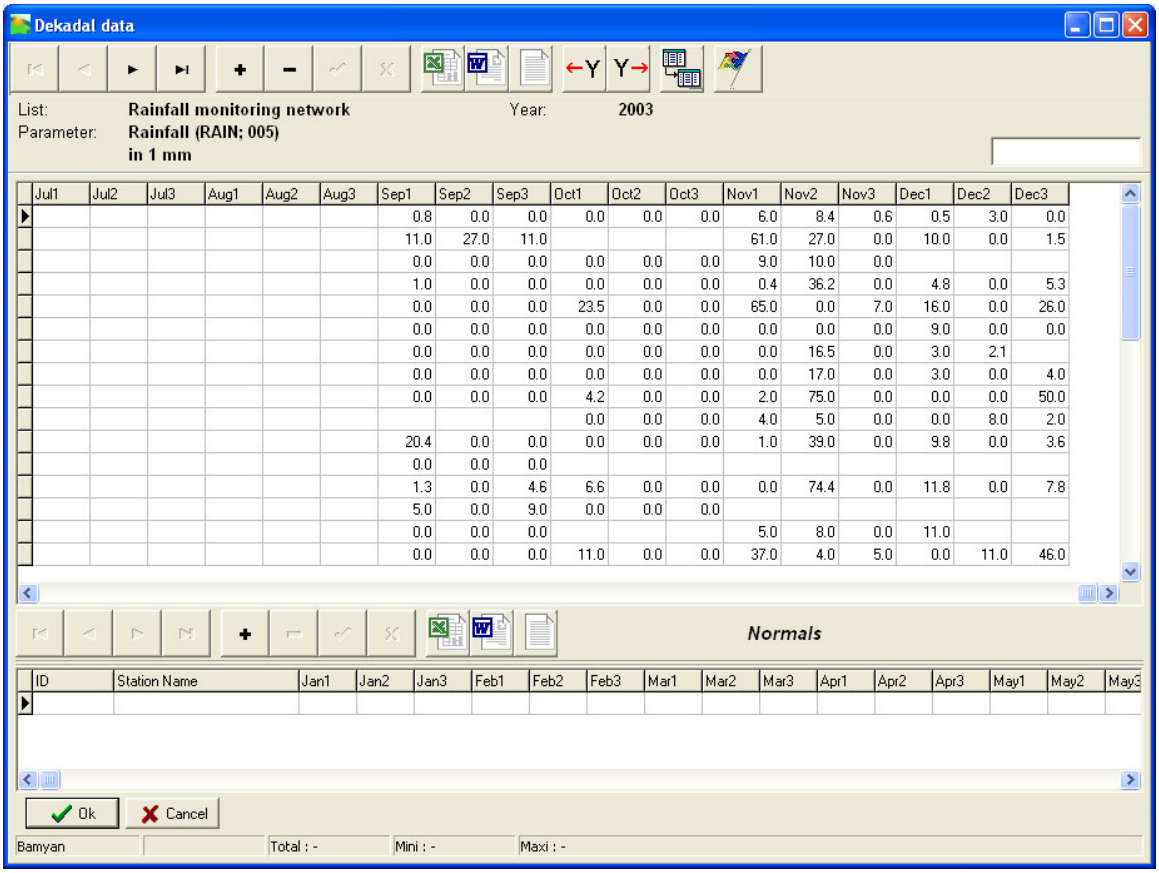
Answer "*No*" to prevent existing values from being overwritten by missing values. Press next and the data are being imported:



Check whether all data are in the database by checking the "*Database – Data inventory*" function.



Double-click "*27 records*" item to see the data in an input form:



What on earth is a record?

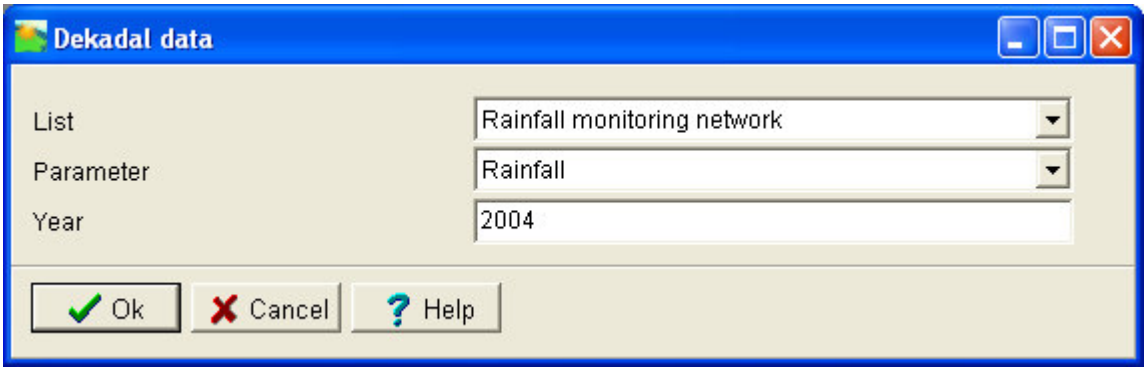
Answer: a record is a single line of data in a database

3.2 Entering data directly into AMS

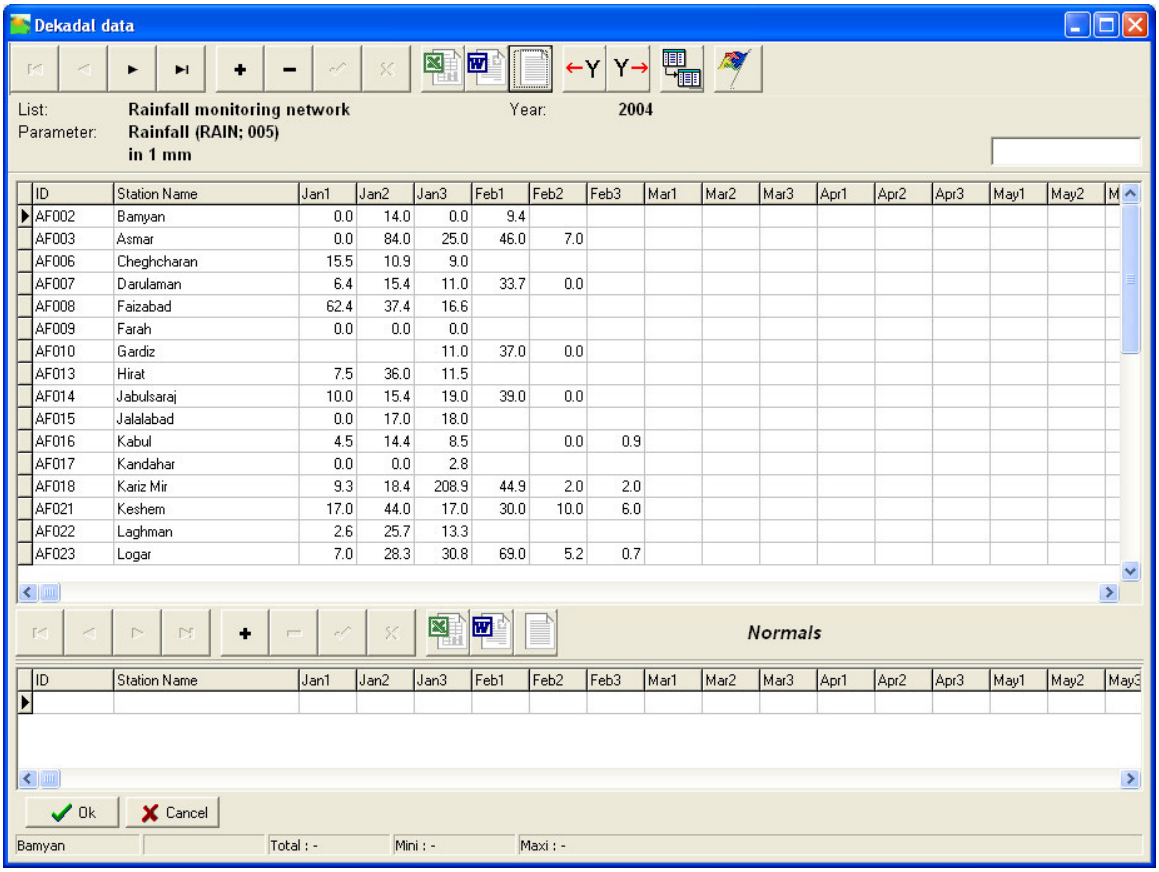
AMS can store daily, dekadal and monthly values. All values are stored independently in the database. As expected, monthly data can be calculated from dekadal and dekadal data can be calculated from daily values. Also, dekadal estimates can be created from monthly values. As an example we will enter dekadal rainfall data and create monthly data from them.

3.2.1 Entering dekadal rainfall data

Start the "*Database – Manage Weather Data – Dekad*" function. Specify the list for which you want to enter then data, the parameter and the year:



Press "*Ok*". The following screen is presented. In this screen you can enter new data. Simply move to the right cell in the input screen and start typing. AMS uses the dot as decimal separator. In this window two types of data can be entered. The top window provides access to **actual** data, the bottom window provides access to **normal** data.

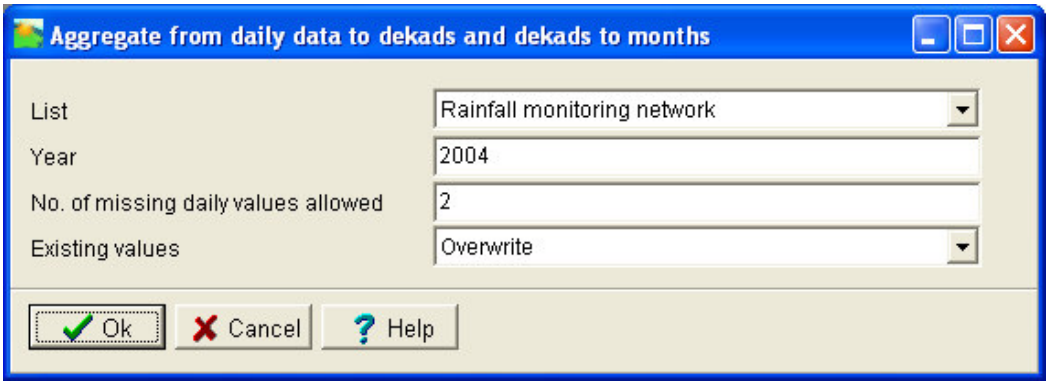


The two button-bars give full navigational functionality:

Button	Meaning
⏮	Move to first line
◀	Move to previous line
▶	Move to next line
⏭	Move to last line
✚	Add a record for a station
━	Delete a record
✓	Save the changes when editing a record
✗	Cancel the changes when editing a record

3.2.2 Calculating monthly rainfall from dekadal rainfall.

Let us calculate the monthly rainfall based on the dekadal rainfall we just added. For this purpose we will use the Database-Calculate-Aggregate function:



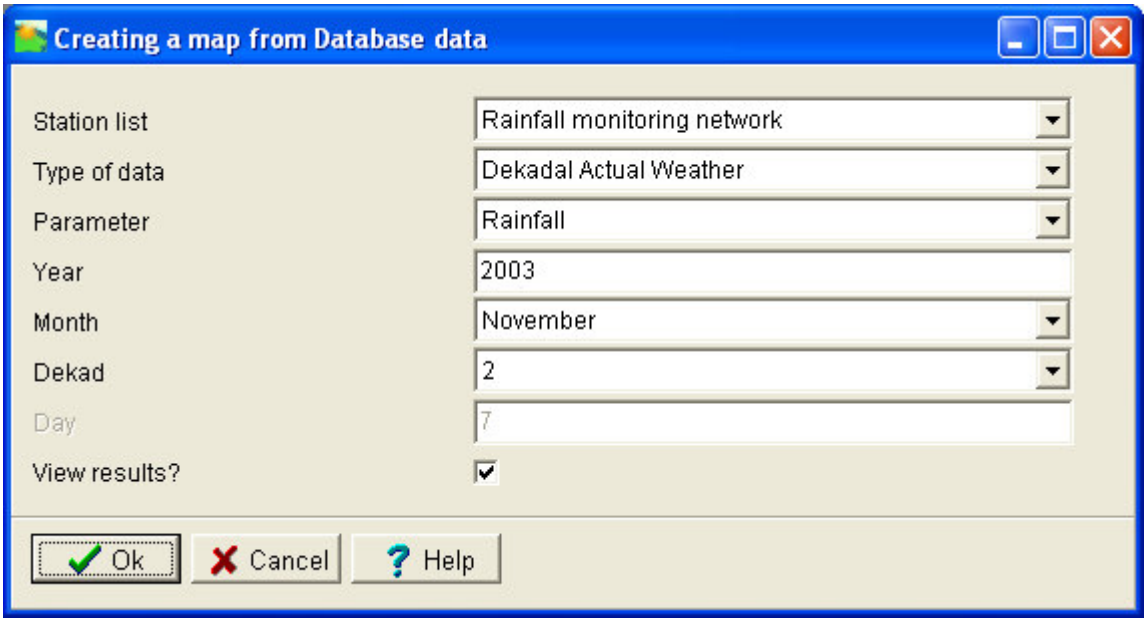
Press OK. Check whether the data have been calculated with the "*Database-Inventory*" function.

4 Displaying data in simple way.

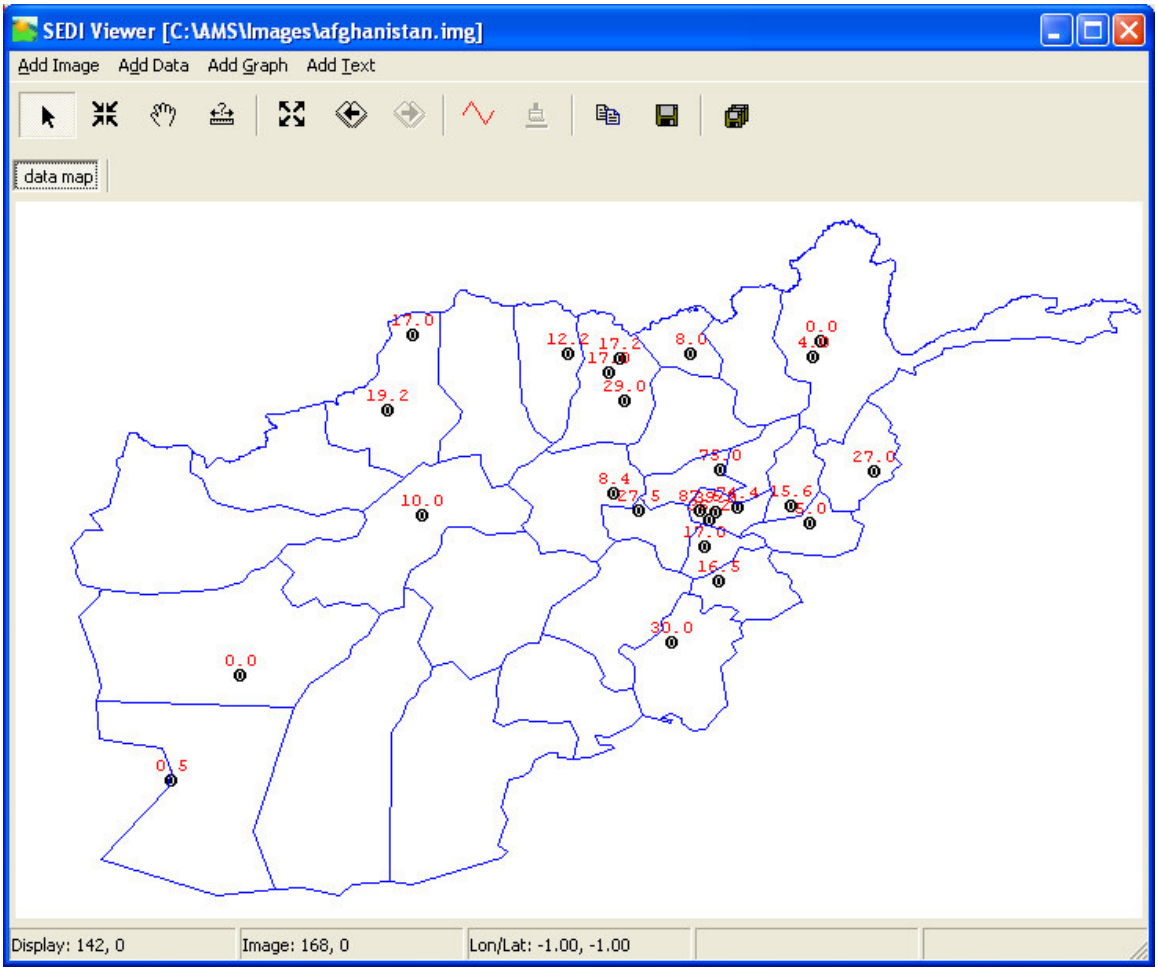
You can display data in several ways. These display functions are added for quick reference and easy analysis of the data.

4.1 Mapping data in AMS

First we will look at the mapping possibilities of AMS. Start the "*Database-Map*" function. As an example enter the following settings.



Press OK and a map will be displayed:



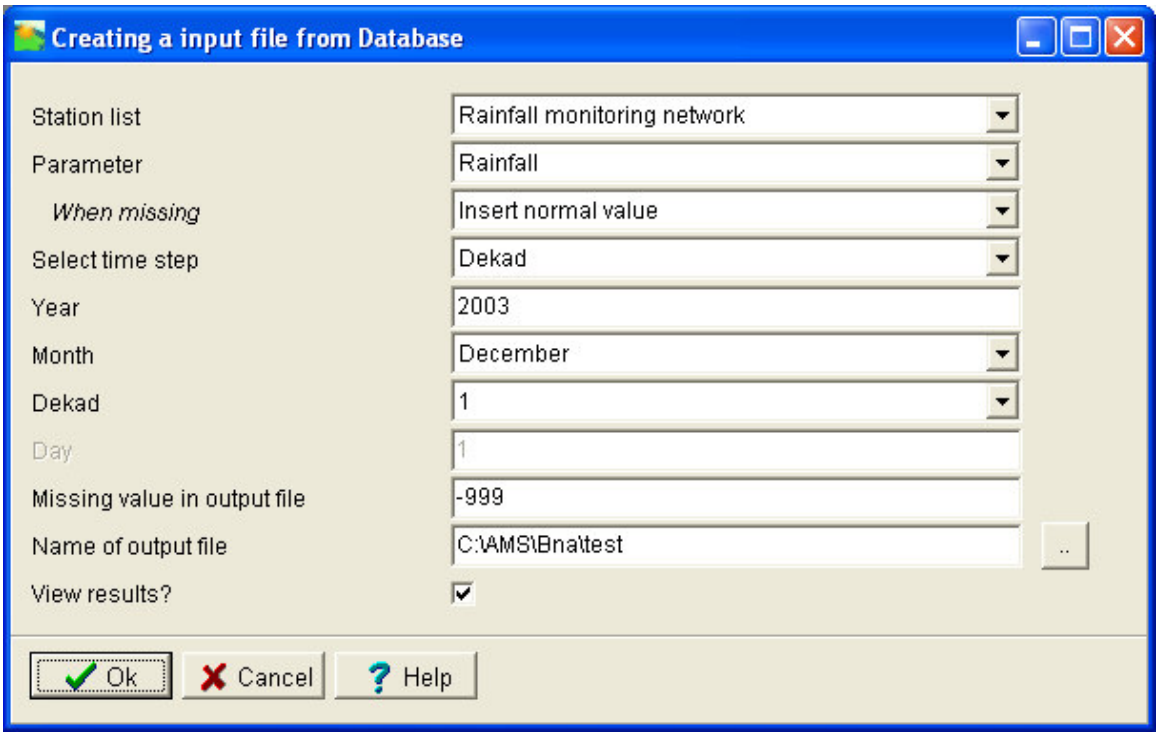
The toolbar provides the following functionality:

Button	Meaning
	Cursor
	Zoom in
	Pan
	Measure distance between two points
	Zoom out
	Previous view
	Load another boundary file
	Copy to clipboard (e.g. to copy image to Word)
	Save image a bitmap
	Save the set of displayed files

4.2 Mapping data in WinDisp

We will map the same data in Windisp. Windisp enables you to improve the lay-out. When inserting a map into a bulletin, Windisp is the preferred application to prepare your images for presentations.

First export the data to BNA format using AMS. Use the "*Interpolate – Make input file – Database*" function. As an example take the following settings:



Be sure to tick the "*View results?*" option. Press Ok. In this example, the directory "*c:\ams\bna*" will contain two output files. The file with the extension "*bna*" is the one we need.

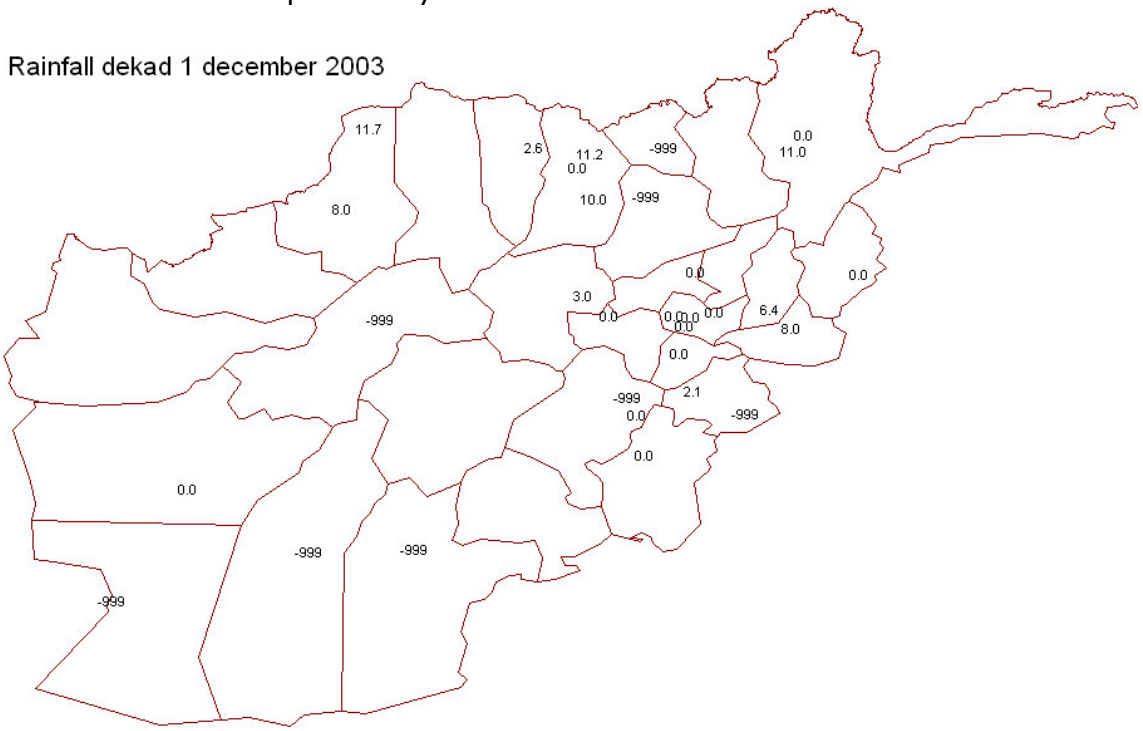
Perform the following steps:

- Open Windisp
- Use the function "*File-Open-Map*" to display a background map (e.g. afgad1.bna).
- Use the function "*Draw-Labels*" with the "bna"-file we just created.

You should now see a map of Afghanistan with superimposed the rainfall data.

- Annotation can be added. E.g. Rainfall dekad 1 December 2003 using the "*Draw text*" function.
- You can copy your work to the clipboard with the Edit-Copy function. In Windisp Draw a window that covers the part of the screen you want to copy.

- Paste the map into any Word document with CTRL-V.



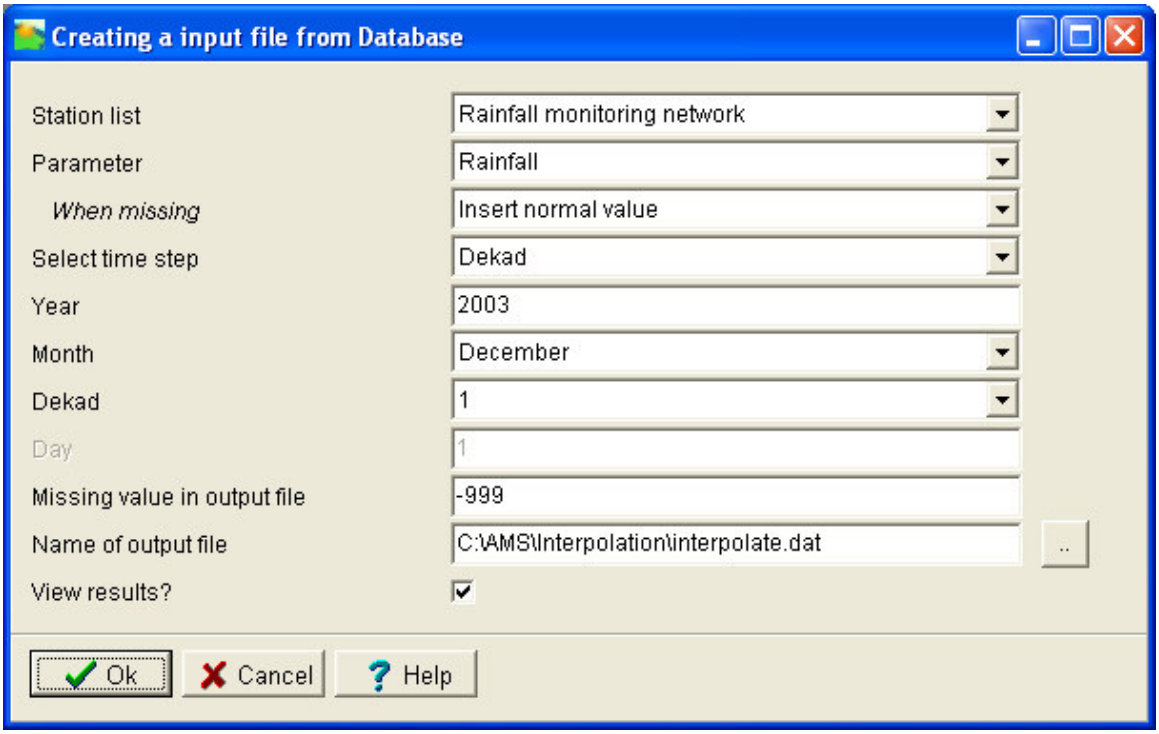
5 Interpolation

Why interpolation? Well, the answer is simple. We are not only interested in what happens at the station level, we want an estimate of what happens in between! We have to convert our data from the world of tables to the world of images.

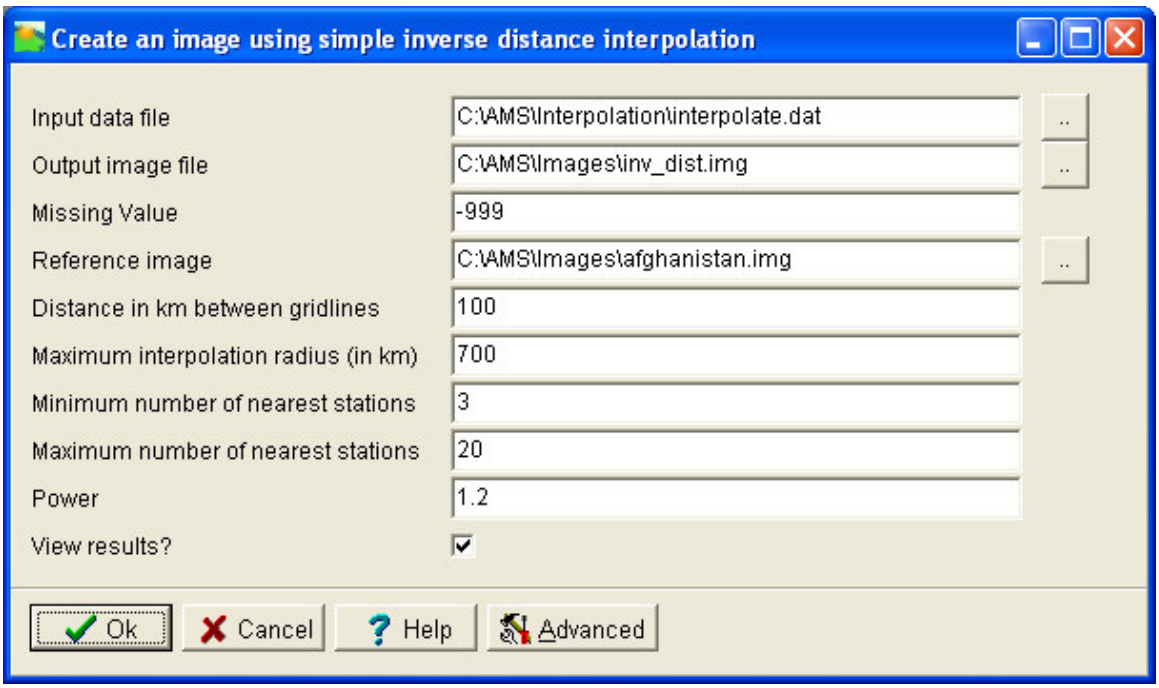
The first example is simple and sometimes leaves much to be desired. The second example is more advanced and should produce better results.

5.1 Start simple: using the inverse distance interpolation method

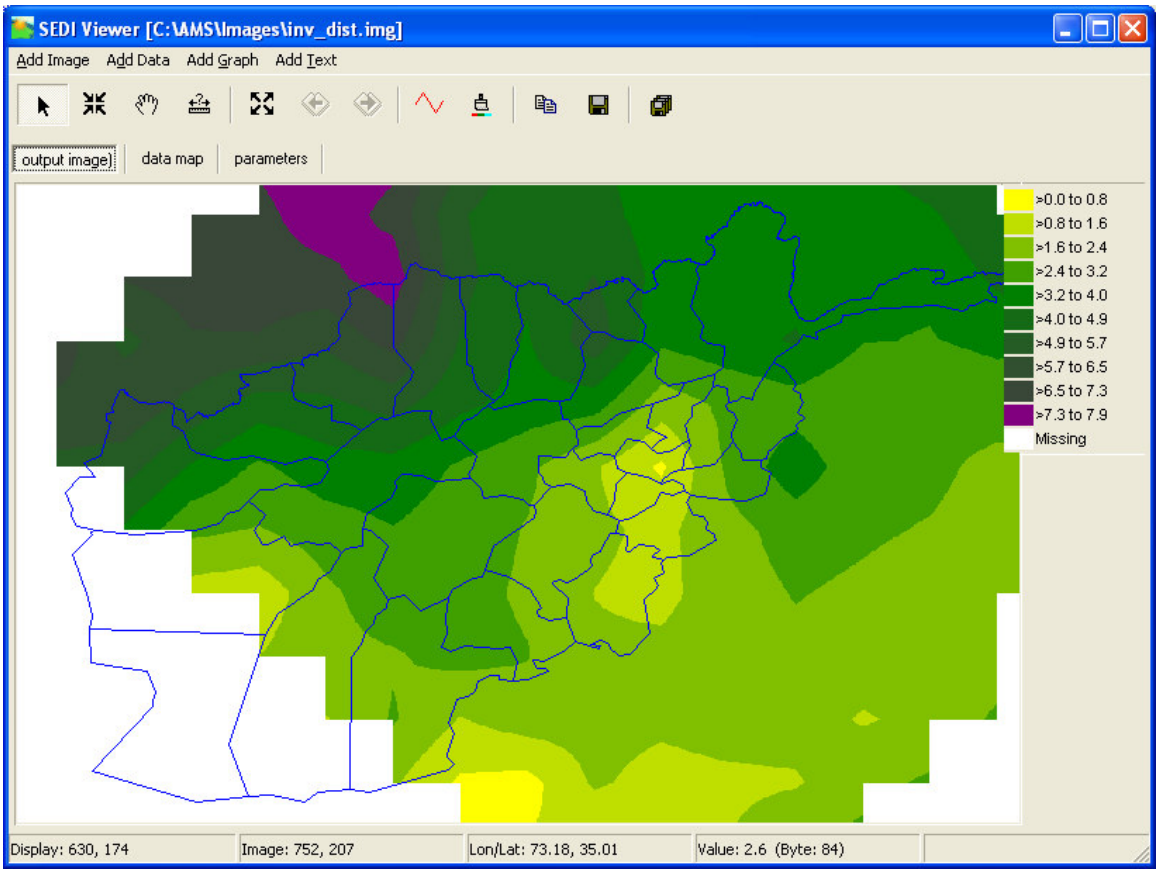
First export the data to CSV format using AMS. As an example use the "*Interpolate – Make input file – Database*" function with the following settings:



The results will be shown in the AMS viewer. We close this viewer and use the "*Interpolate – Inverse distance*" function to create an image. Use the following settings as an example:



The following image will be the result:

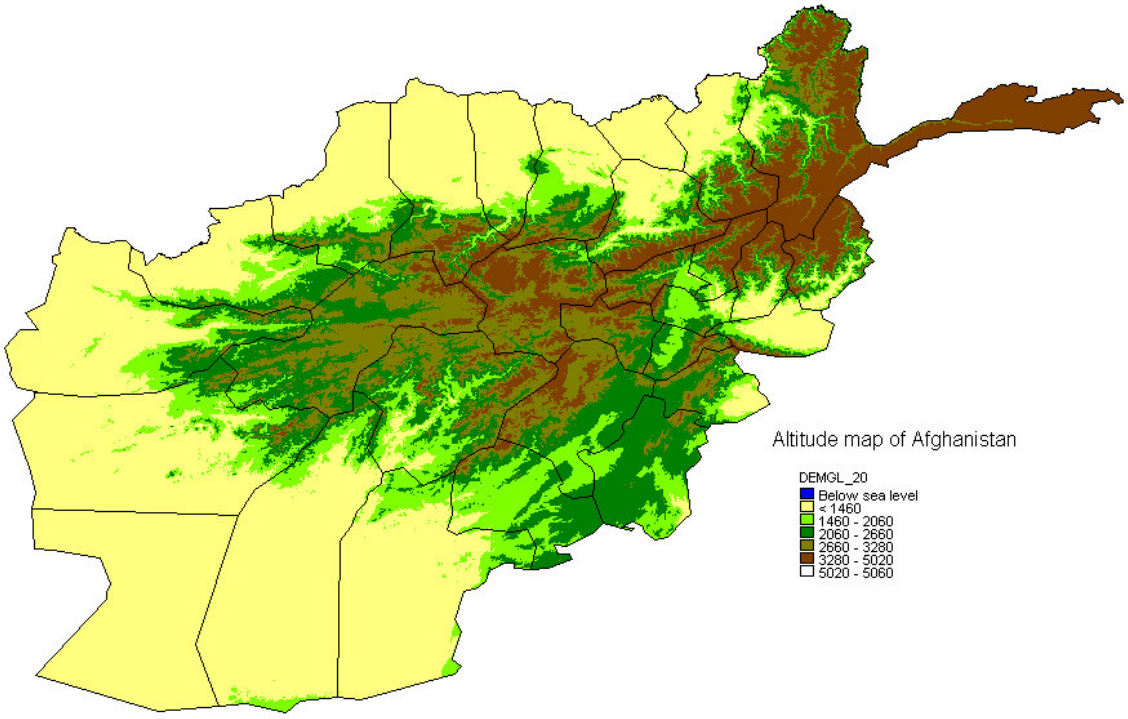


We might use the copy to clipboard functionality () at this stage to paste the map to Microsoft Word.

Try to re-do the previous exercise with different settings. Notice the difference in the resulting images. Exercising with the settings is the best way to understand them.

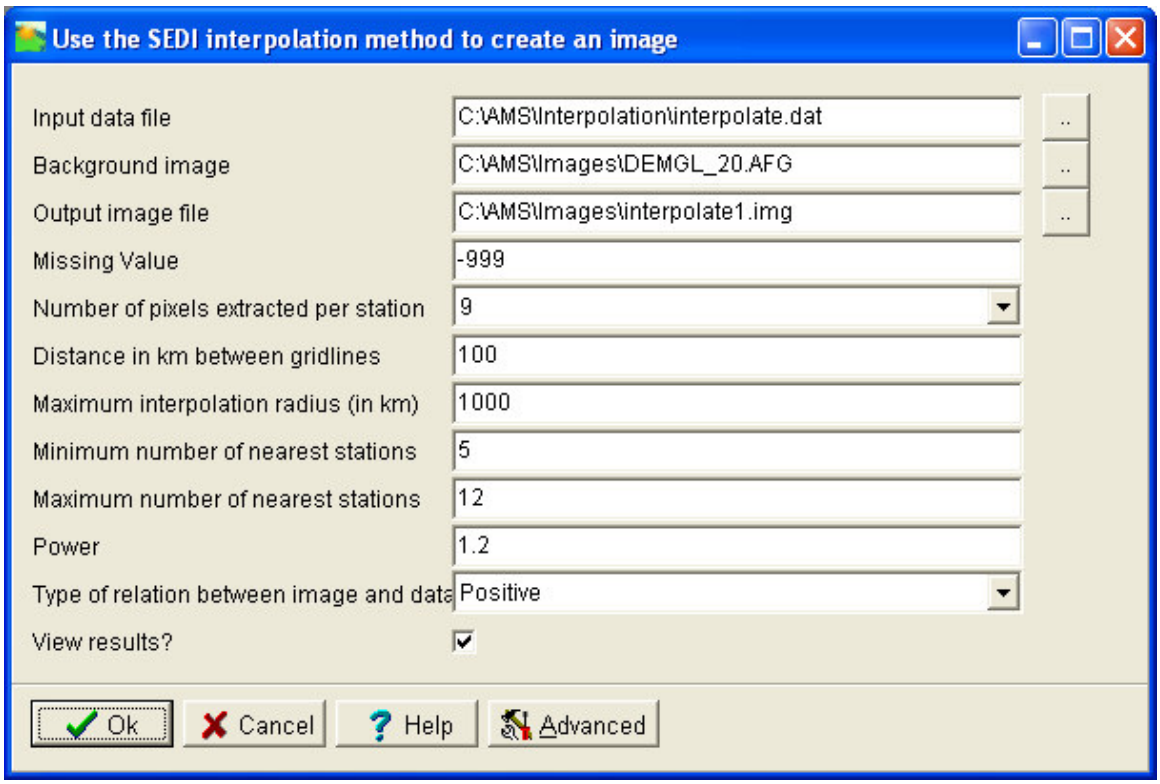
5.2 Making an image using altitude as background image.

In general, rainfall amounts are higher with higher altitudes. We can use this knowledge to produce better rainfall maps. For Afghanistan we have an altitude image. The name of this image is DemGL_20.afg. The image can be displayed in Windisp using the File – Open – Image function.

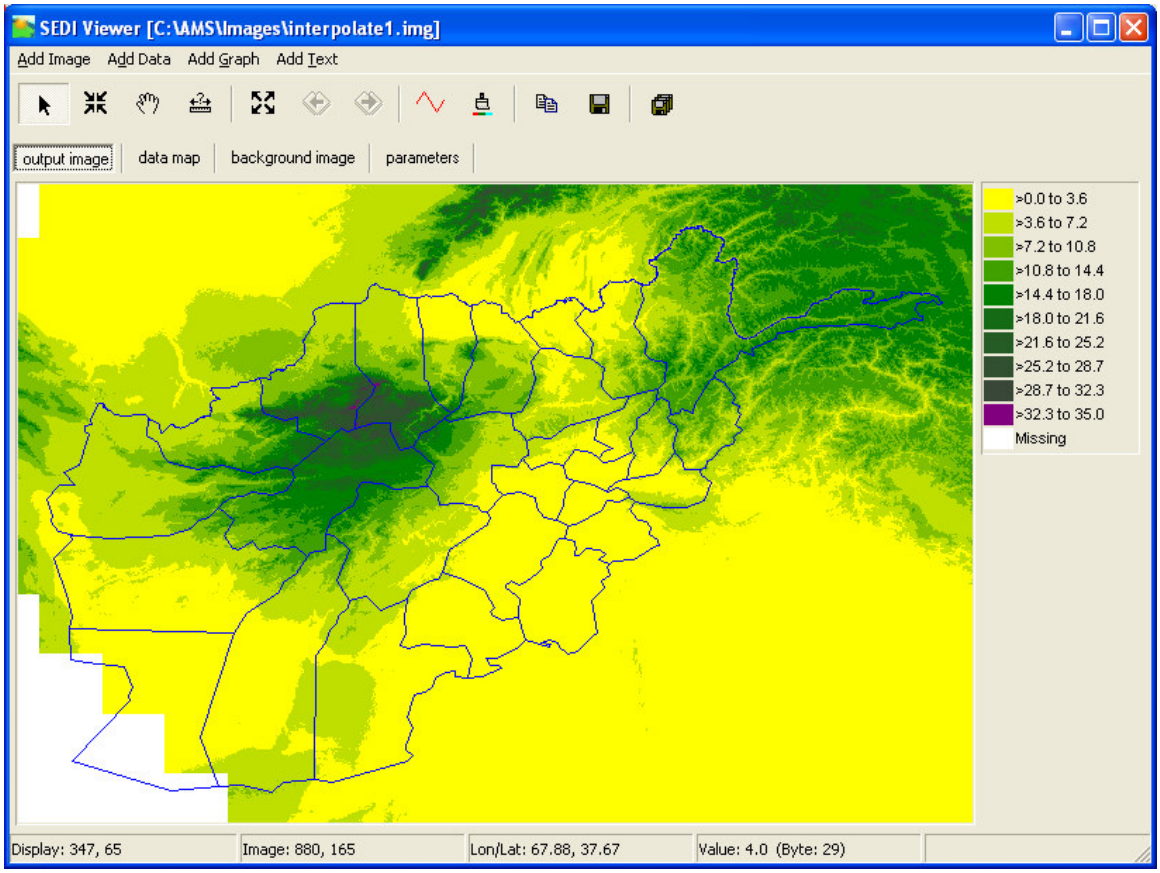


In this example we use the altitude map to interpolate rainfall for a particular dekad using the "*SEDI – inverse distance*" method. First we export the data from the database to an ASCII file in exactly the same way as we did in the previous paragraph.. The file contains rainfall for the first dekad of December 2003.

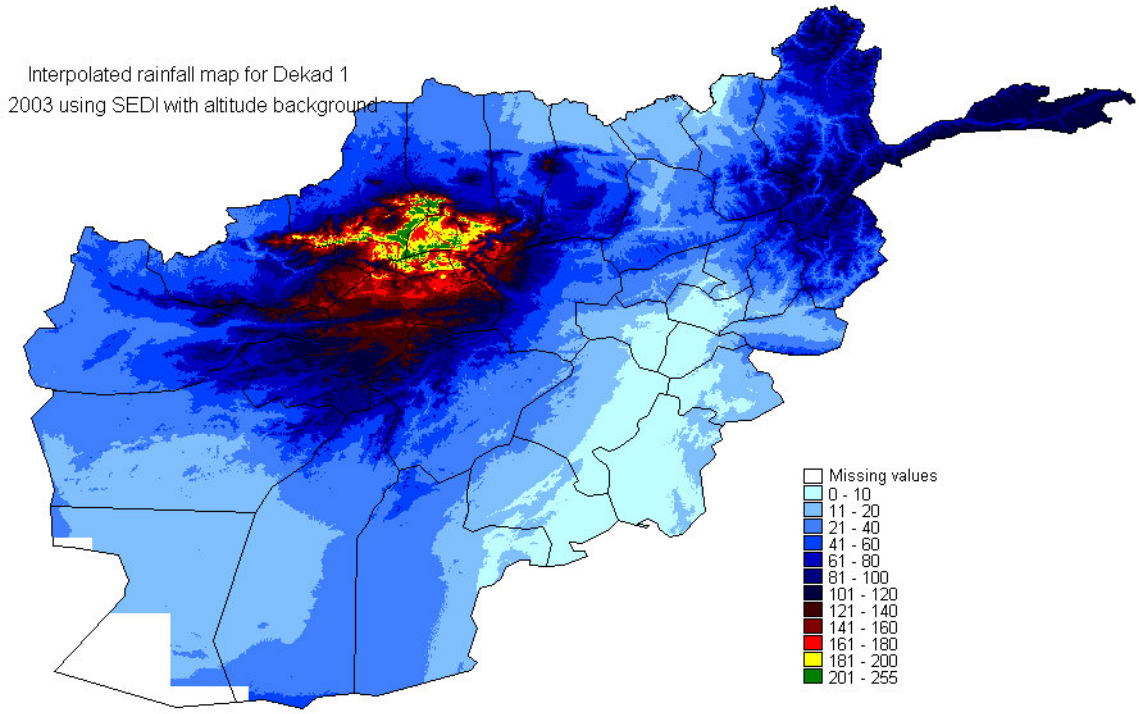
Start the "*Interpolate – SEDI – Inverse distance*" function. Fill the screen according to your needs (it is probably best to accept most defaults and refine later).



Press OK. AMS now displays interpolated rainfall for the first dekad of December 2003:



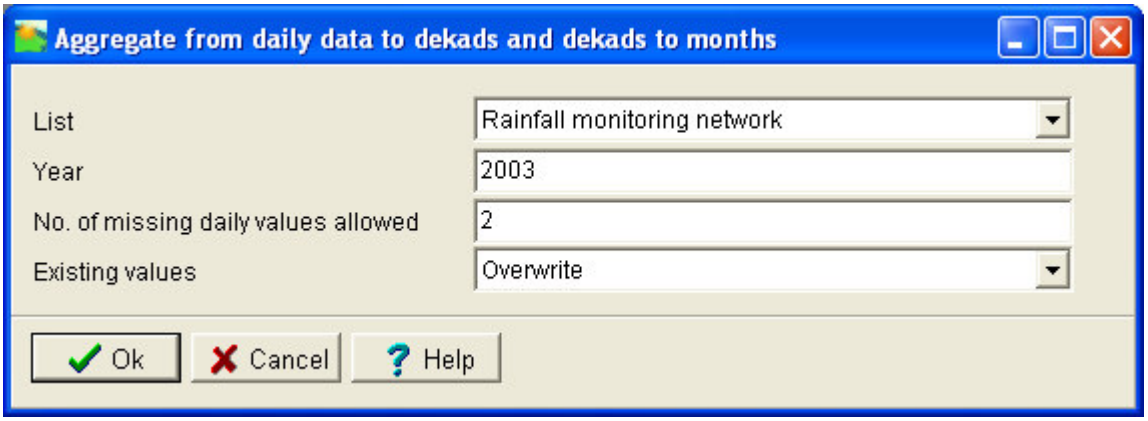
The details of all settings will not be explained here. The created image is compatible with Windisp. Therefore we can load it into Windisp and create a nice input for a bulletin like the one below:



5.3 Making an interpolated image with data for a whole season.

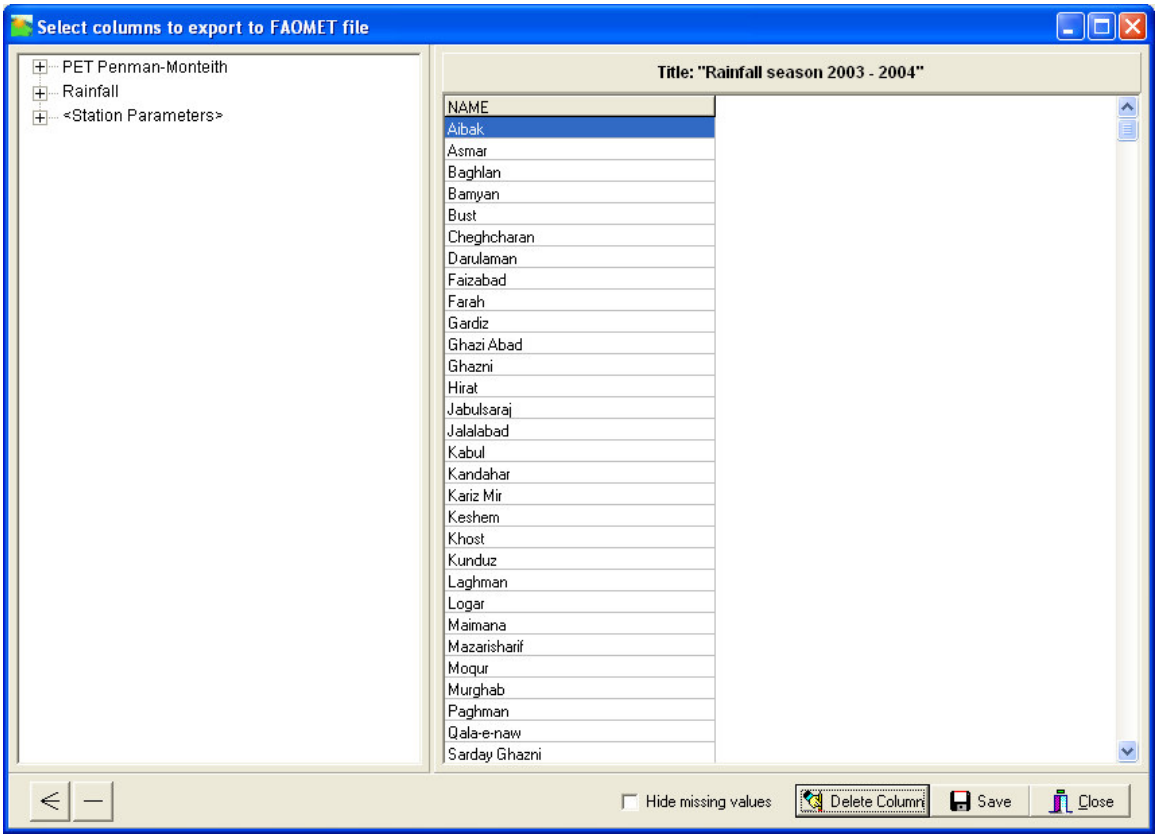
The AMS option we used previously to make the input data file for the SEDI image ("*Interpolate – Make input file – Database*") will not provide accumulated rainfall for a whole season. To have less work in Excel we first aggregate the dekadal values to monthly using the AMS function "*Database – Calculate - Aggregate*".

First we do this for 2003 and then again for 2004.

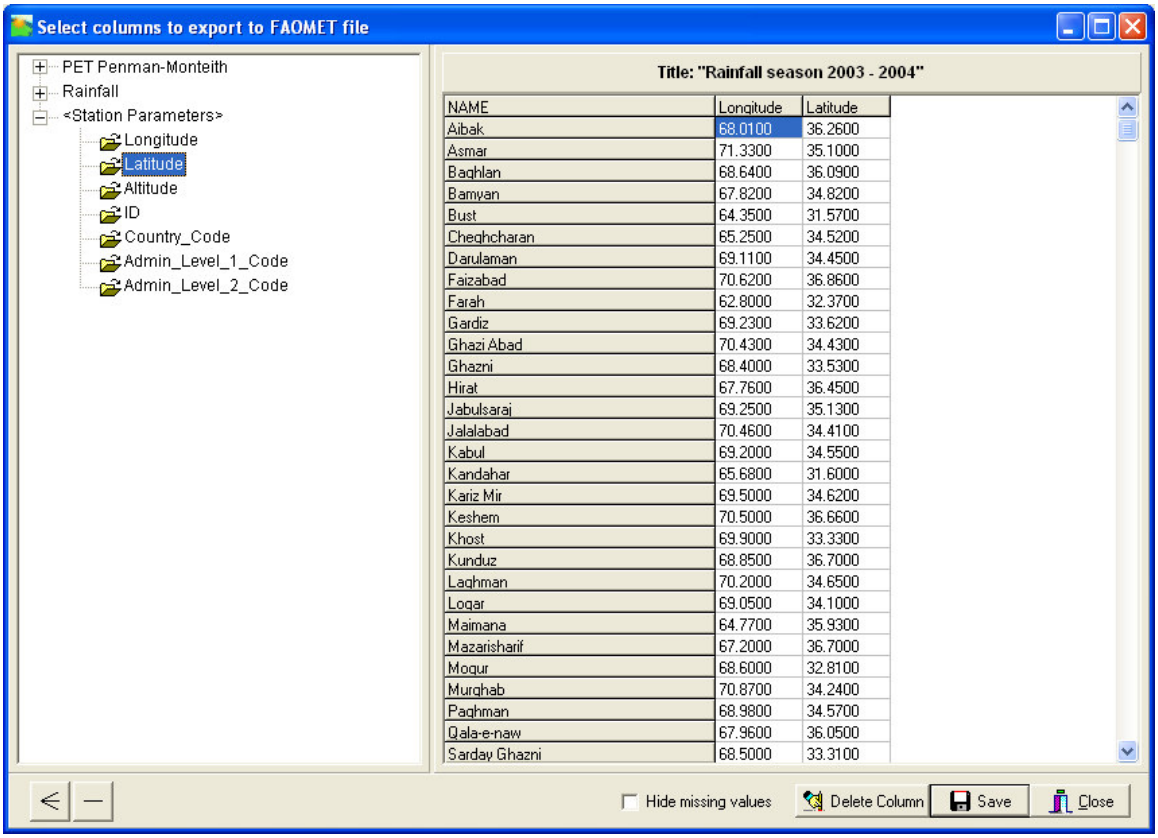


To make such a SEDI input file we need Excel.

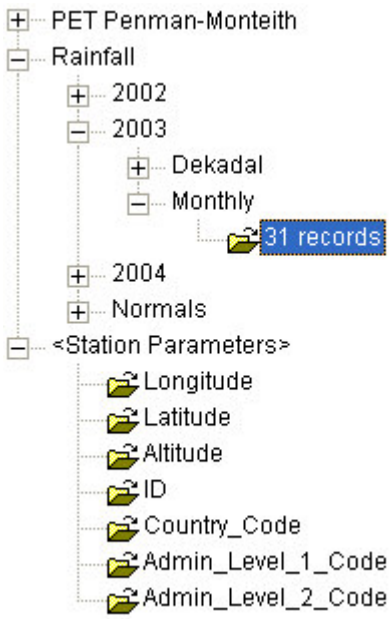
First we export the data from AMS to ASCII using the "*Tools-Make input file from database*" function. This ASCII file will be imported into Excel. We will export columns for all monthly rainfall values from September 2003 up to January 2004. We see the following screen:



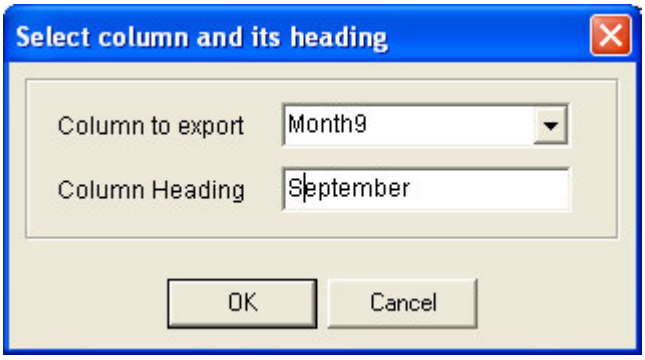
First we have to add the longitude and the latitude. Double click on "*Station parameters*" and add longitude and latitude:



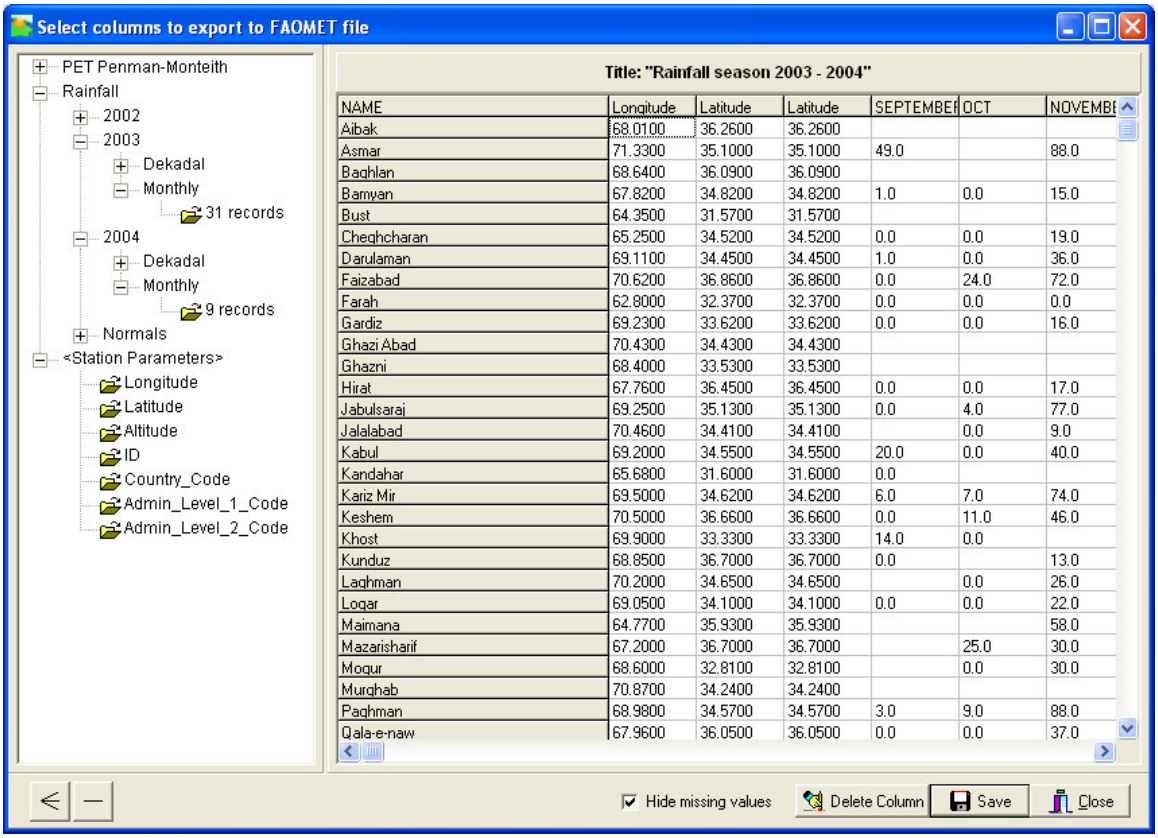
Now add rainfall data for all the months in the season. First double-click the right part of the tree on the left side:



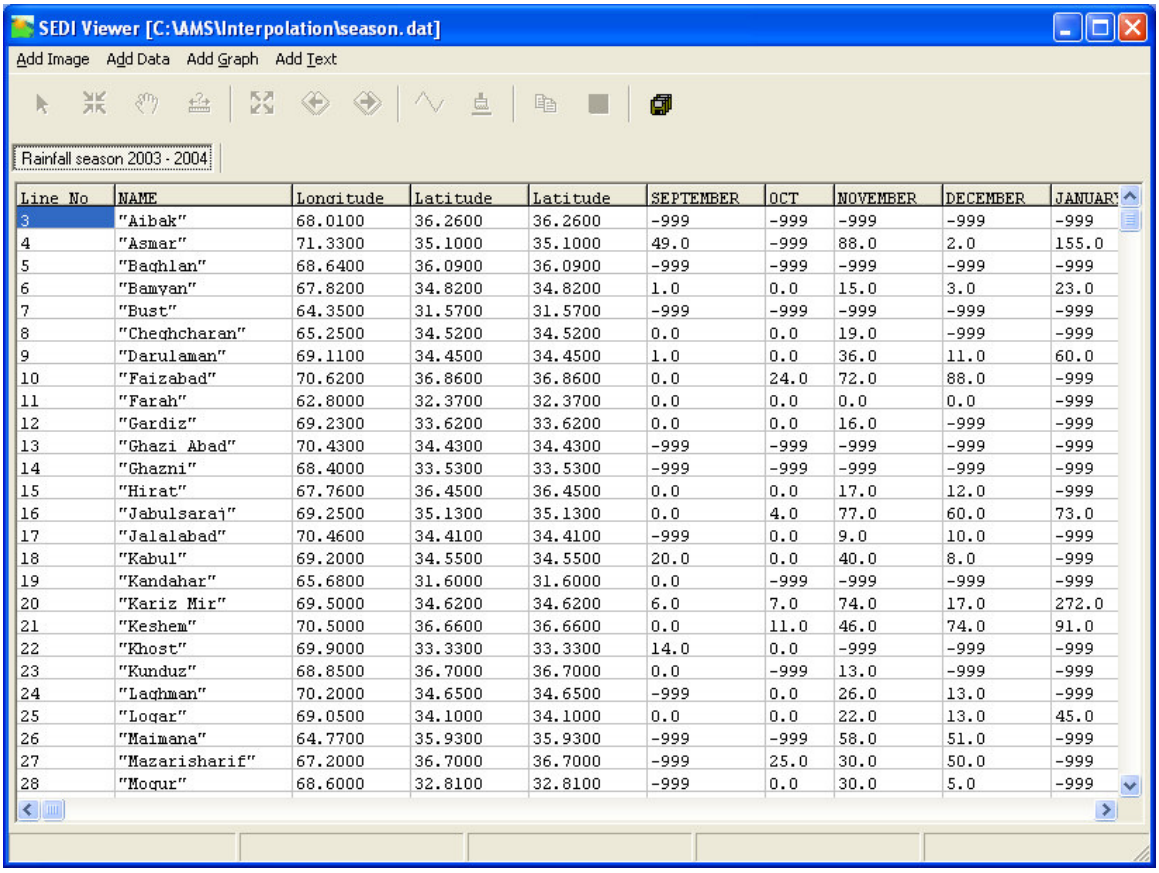
Then specify which month column to add and which appropriate title to use as a heading:



In the same way we add all 5 monthly columns for 2003 and 2004 until we have the following screen:

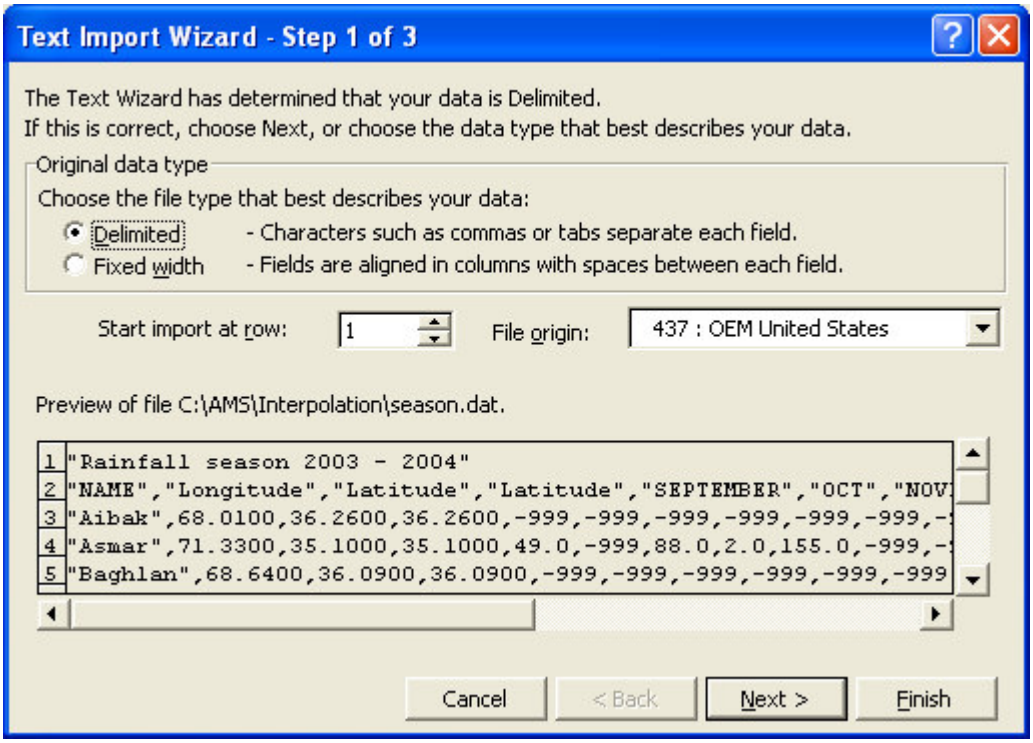


Press "*Save*" and the output file is shown in the AMS viewer:

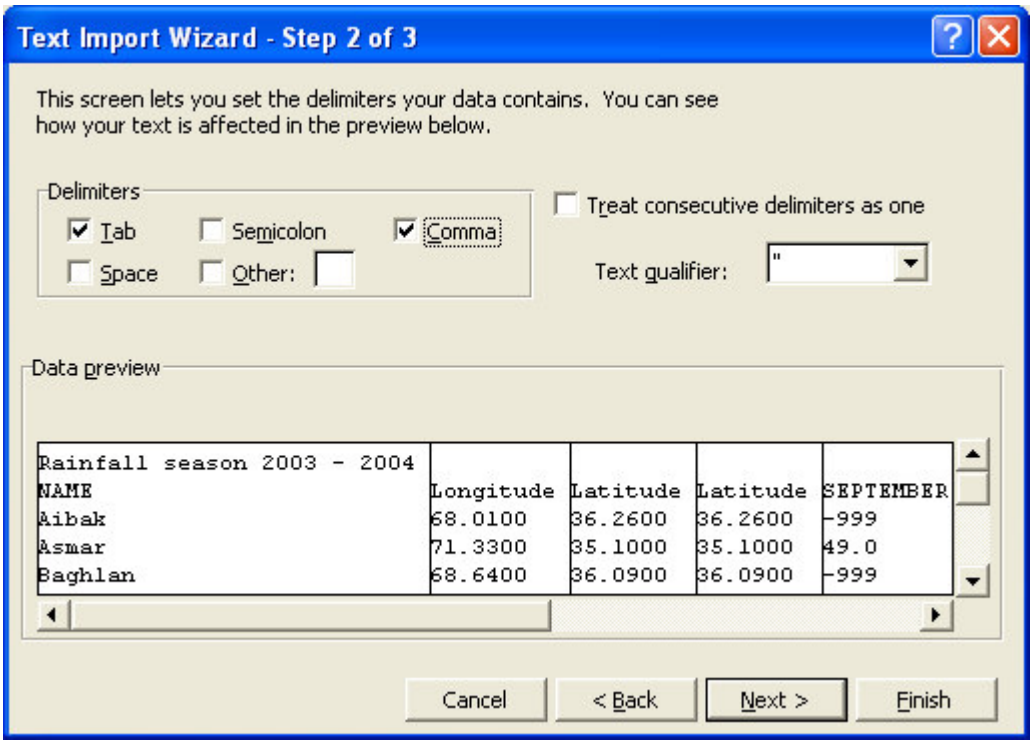


Line No	NAME	Longitude	Latitude	Latitude	SEPTEMBER	OCT	NOVEMBER	DECEMBER	JANUAR
3	"Aibak"	68.0100	36.2600	36.2600	-999	-999	-999	-999	-999
4	"Asmar"	71.3300	35.1000	35.1000	49.0	-999	88.0	2.0	155.0
5	"Baghlan"	68.6400	36.0900	36.0900	-999	-999	-999	-999	-999
6	"Bamyan"	67.8200	34.8200	34.8200	1.0	0.0	15.0	3.0	23.0
7	"Bust"	64.3500	31.5700	31.5700	-999	-999	-999	-999	-999
8	"Cheghcharan"	65.2500	34.5200	34.5200	0.0	0.0	19.0	-999	-999
9	"Darulaman"	69.1100	34.4500	34.4500	1.0	0.0	36.0	11.0	60.0
10	"Faizabad"	70.6200	36.8600	36.8600	0.0	24.0	72.0	88.0	-999
11	"Farah"	62.8000	32.3700	32.3700	0.0	0.0	0.0	0.0	-999
12	"Gardiz"	69.2300	33.6200	33.6200	0.0	0.0	16.0	-999	-999
13	"Ghazi Abad"	70.4300	34.4300	34.4300	-999	-999	-999	-999	-999
14	"Ghazni"	68.4000	33.5300	33.5300	-999	-999	-999	-999	-999
15	"Hirat"	67.7600	36.4500	36.4500	0.0	0.0	17.0	12.0	-999
16	"Jabulsaraj"	69.2500	35.1300	35.1300	0.0	4.0	77.0	60.0	73.0
17	"Jalalabad"	70.4600	34.4100	34.4100	-999	0.0	9.0	10.0	-999
18	"Kabul"	69.2000	34.5500	34.5500	20.0	0.0	40.0	8.0	-999
19	"Kandahar"	65.6800	31.6000	31.6000	0.0	-999	-999	-999	-999
20	"Kariz Mir"	69.5000	34.6200	34.6200	6.0	7.0	74.0	17.0	272.0
21	"Keshem"	70.5000	36.6600	36.6600	0.0	11.0	46.0	74.0	91.0
22	"Khost"	69.9000	33.3300	33.3300	14.0	0.0	-999	-999	-999
23	"Kunduz"	68.8500	36.7000	36.7000	0.0	-999	13.0	-999	-999
24	"Laghman"	70.2000	34.6500	34.6500	-999	0.0	26.0	13.0	-999
25	"Logar"	69.0500	34.1000	34.1000	0.0	0.0	22.0	13.0	45.0
26	"Maimana"	64.7700	35.9300	35.9300	-999	-999	58.0	51.0	-999
27	"Mazarisharif"	67.2000	36.7000	36.7000	-999	25.0	30.0	50.0	-999
28	"Mogur"	68.6000	32.8100	32.8100	-999	0.0	30.0	5.0	-999

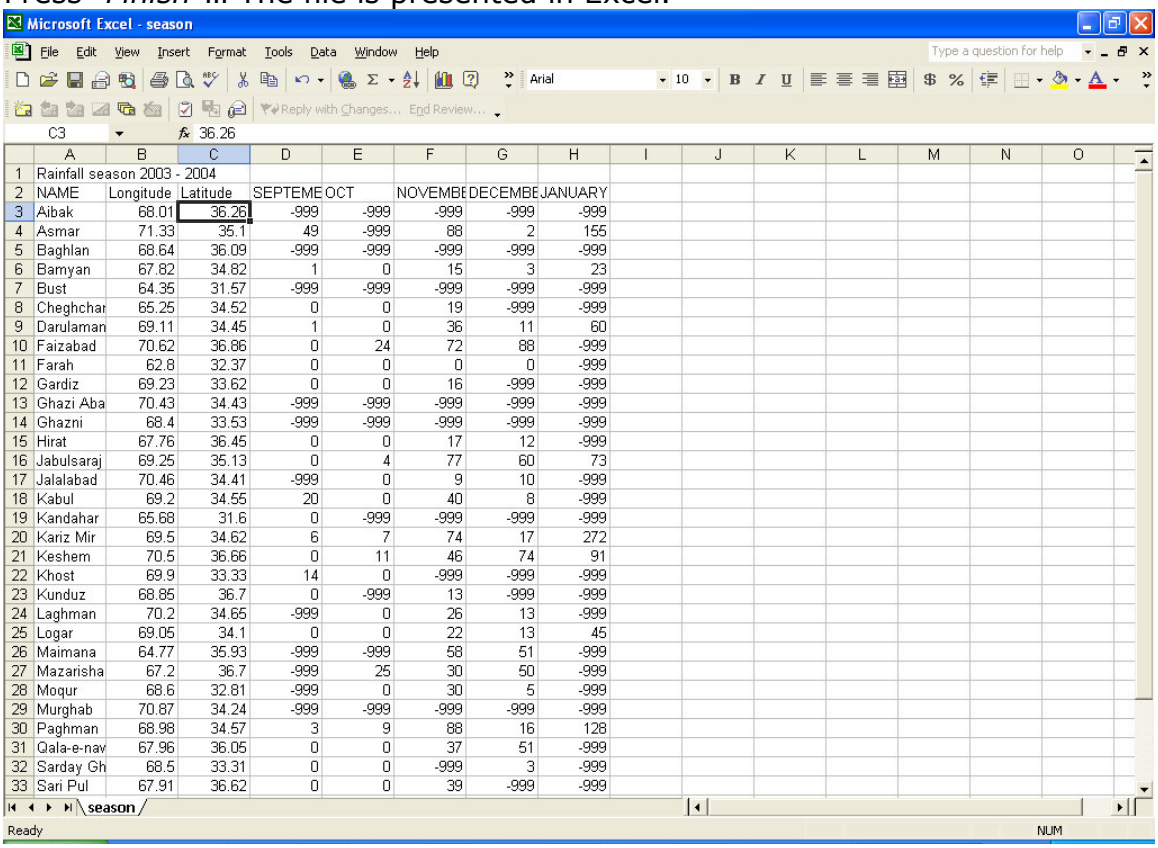
Exit AMS and open Excel with the file we just produced. In Excel use "*File-Open*". The following screen is presented:



Press "*Next*". Specify "*Comma*"



Press "*Finish*"… The file is presented in Excel.

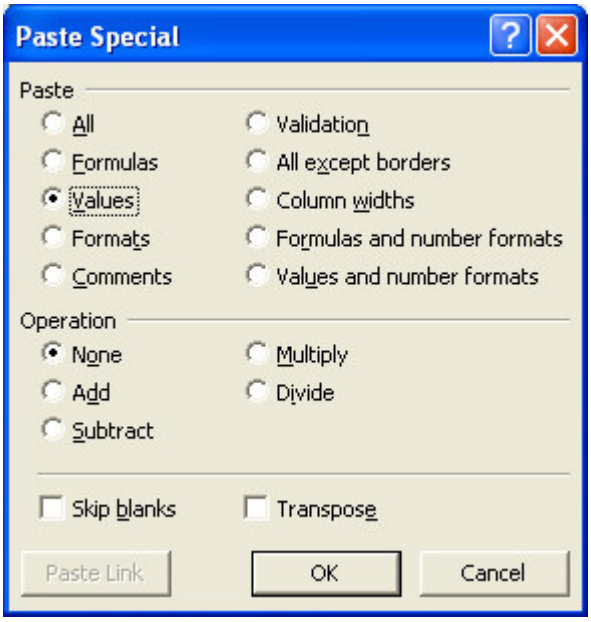


	A	B	C	D	E	F	G	H
1	Rainfall season 2003 - 2004							
2	NAME	Longitude	Latitude	SEPTEME	OCT	NOVEMBE	DECEMBE	JANUARY
3	Aibak	68.01	36.26	-999	-999	-999	-999	-999
4	Asmar	71.33	35.1	49	-999	88	2	155
5	Baghlan	68.64	36.09	-999	-999	-999	-999	-999
6	Bamyan	67.82	34.82	1	0	15	3	23
7	Bust	64.35	31.57	-999	-999	-999	-999	-999
8	Cheghchar	65.25	34.52	0	0	19	-999	-999
9	Darulaman	69.11	34.45	1	0	36	11	60
10	Faizabad	70.62	36.86	0	24	72	88	-999
11	Farah	62.8	32.37	0	0	0	0	-999
12	Gardiz	69.23	33.62	0	0	16	-999	-999
13	Ghazi Aba	70.43	34.43	-999	-999	-999	-999	-999
14	Ghazni	68.4	33.53	-999	-999	-999	-999	-999
15	Hirat	67.76	36.45	0	0	17	12	-999
16	Jabulsaraj	69.25	35.13	0	4	77	60	73
17	Jalalabad	70.46	34.41	-999	0	9	10	-999
18	Kabul	69.2	34.55	20	0	40	8	-999
19	Kandahar	65.68	31.6	0	-999	-999	-999	-999
20	Kariz Mir	69.5	34.62	6	7	74	17	272
21	Keshem	70.5	36.66	0	11	46	74	91
22	Khost	69.9	33.33	14	0	-999	-999	-999
23	Kunduz	68.85	36.7	0	-999	13	-999	-999
24	Laghman	70.2	34.65	-999	0	26	13	-999
25	Logar	69.05	34.1	0	0	22	13	45
26	Maimana	64.77	35.93	-999	-999	58	51	-999
27	Mazarisha	67.2	36.7	-999	25	30	50	-999
28	Moqur	68.6	32.81	-999	0	30	5	-999
29	Murghab	70.87	34.24	-999	-999	-999	-999	-999
30	Paghman	68.98	34.57	3	9	88	16	128
31	Qala-e-nav	67.96	36.05	0	0	37	51	-999
32	Sarday Gh	68.5	33.31	0	0	-999	3	-999
33	Sari Pul	67.91	36.62	0	0	39	-999	-999

First remove all stations with missing values (we cannot calculate totals for those). Create a new column at the end of the data range and calculate the totals. The following file should remain.

	A	B	C	D	E	F	G	H	I
1	Rainfall season 2003 - 2004								
2	NAME	Longitude	Latitude	SEPTEME	OCT	NOVEMBE	DECEMBE	JANUARY	Total
3	Asmar	71.33	35.1	49	0	88	2	155	294
4	Bamyan	67.82	34.82	1	0	15	3	23	42
5	Darulaman	69.11	34.45	1	0	36	11	60	108
6	Jabulsaraj	69.25	35.13	0	4	77	60	73	214
7	Kariz Mir	69.5	34.62	6	7	74	17	272	376
8	Keshem	70.5	36.66	0	11	46	74	91	222
9	Logar	69.05	34.1	0	0	22	13	45	80
10	Paghman	68.98	34.57	3	9	88	16	128	244
11	Sarobi	68.15	34.57	0	4	28	13	35	80

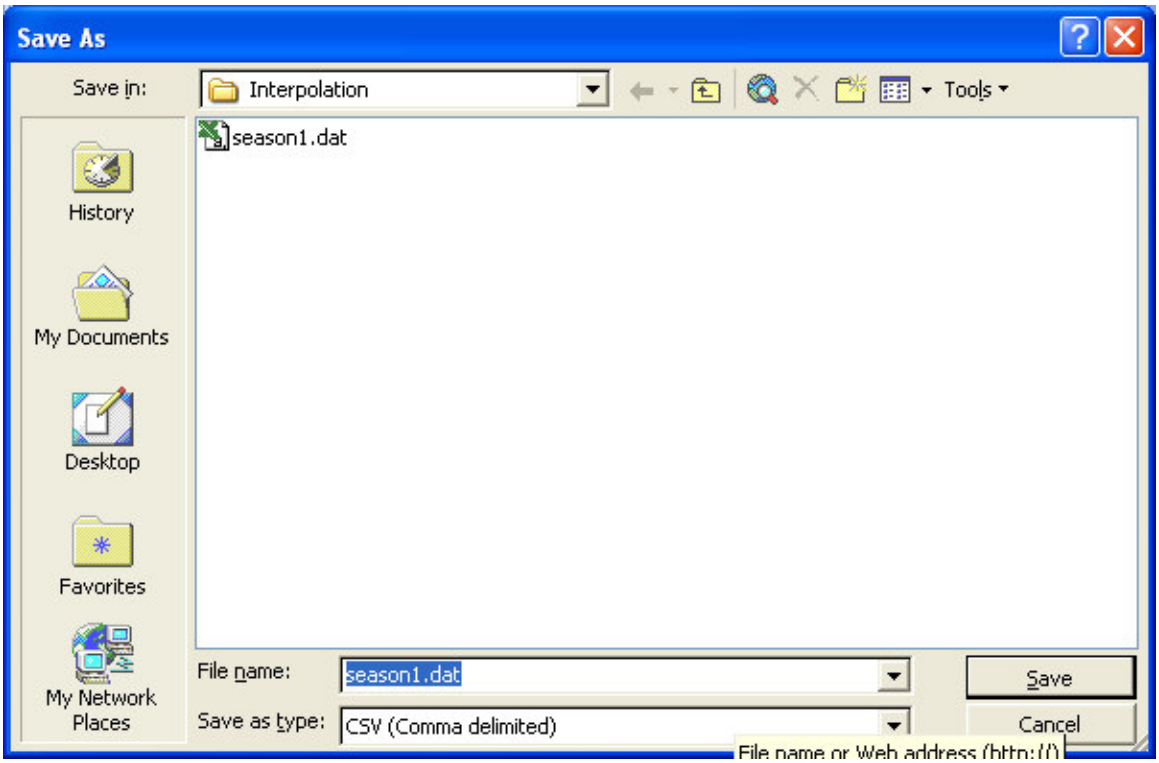
Finally we remove some columns, because we no longer need them. Beware: Column I contains formulas, not values. Column I would fail if we would remove column D-G. Therefore first make values in column I. Do this by selecting column I and press Ctrl-C. Then go to the menu-item "*Edit-Paste Special*" and set the settings as follows:



Now remove the name column and the monthly data columns as well as the title until we have the following structure:

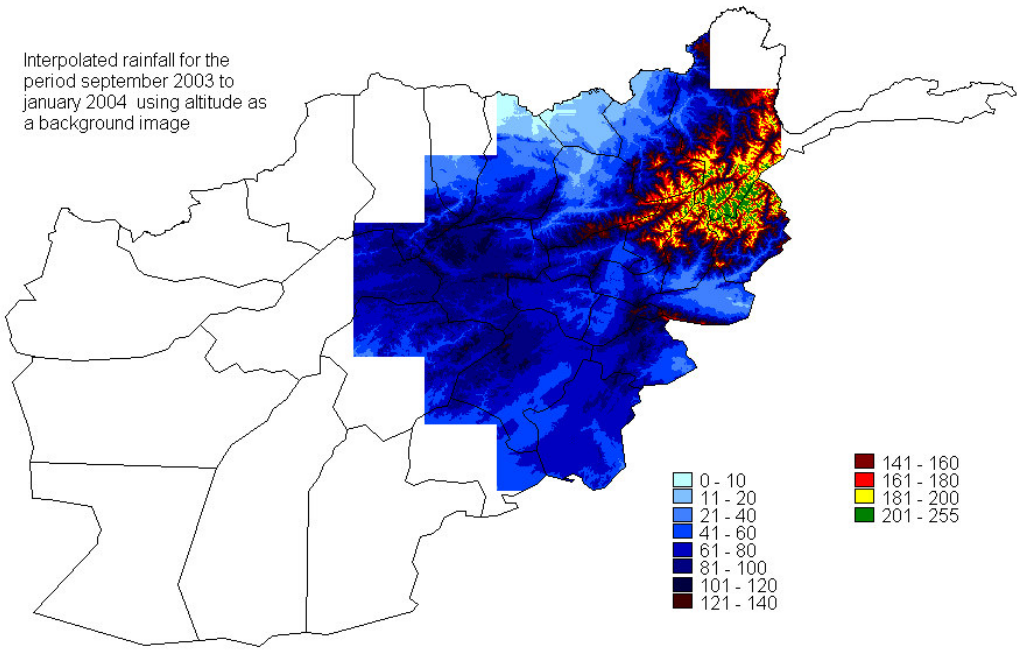
	A	B	C
1	71.33	35.1	294
2	67.82	34.82	42
3	69.11	34.45	108
4	69.25	35.13	214
5	69.5	34.62	376
6	70.5	36.66	222
7	69.05	34.1	80
8	68.98	34.57	244
9	68.15	34.57	80

Column A now represents the longitude, B the latitude and C the seasonal total. Save this worksheet to a comma delimited CSV file using "*File-Save as*" with the following settings:



The input file for the interpolation is now ready. Please proceed in the same way as the previous paragraph.

Due to the lack of data, estimates are not produced for a large part of the country. The final map produced looks like this:

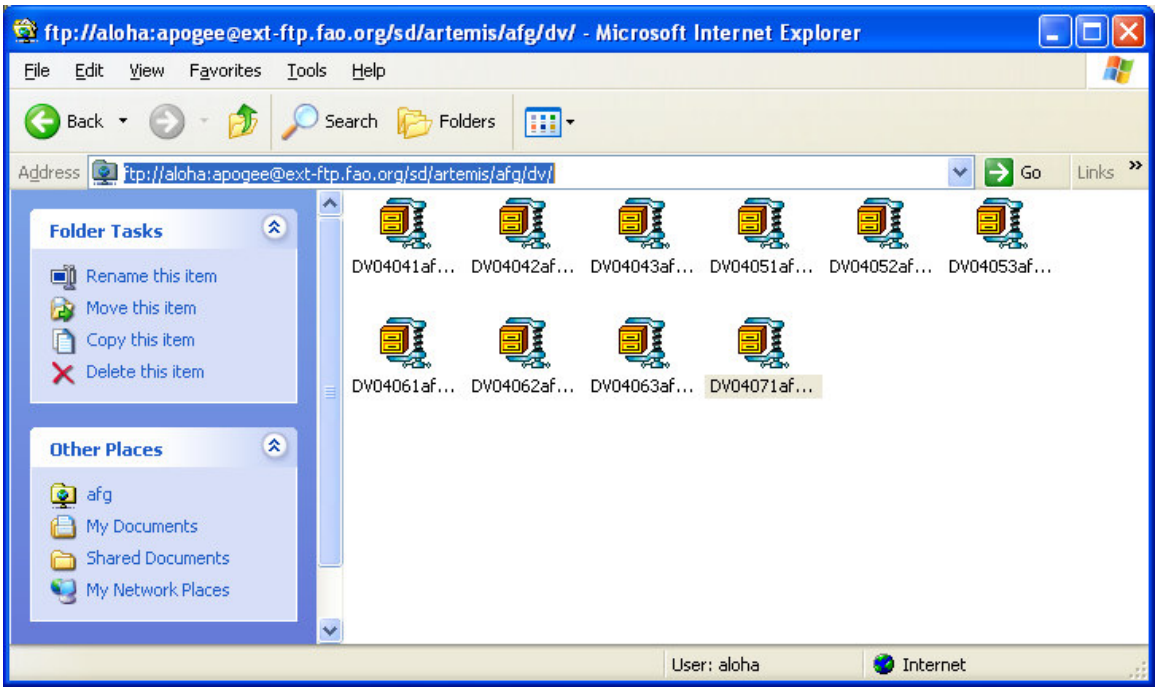

Interpolated rainfall for the period september 2003 to january 2004 using altitude as a background image
0 - 10
11 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 120
121 - 140
141 - 160
161 - 180
181 - 200
201 - 255

6 Using satellite and weather model data for Afghansitan

6.1 Dekadal NDVI

NDVI can be obtained free of charge from the FAO website. Go to your webbrowser and move to : ftp://aloha:apogee@ext-ftp.fao.org/sd/artemis/afg/dv/

You see the following screen:

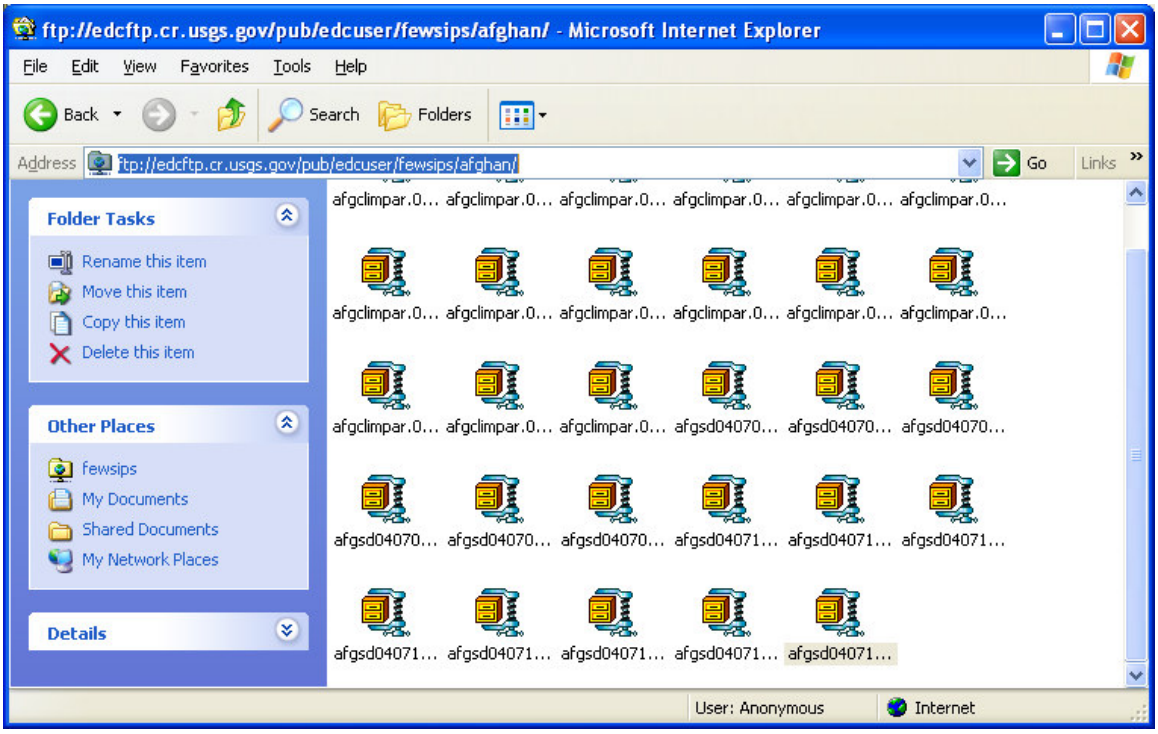


The naming convention of these files is simple. DV stands for NDVI. The rest represents the year, the month and the dekad. So the zip file DV04042.afg contains the NDVI image for the second dekad of april 2004. Click on the files to download them to your own computer. Subsequently unzip them….

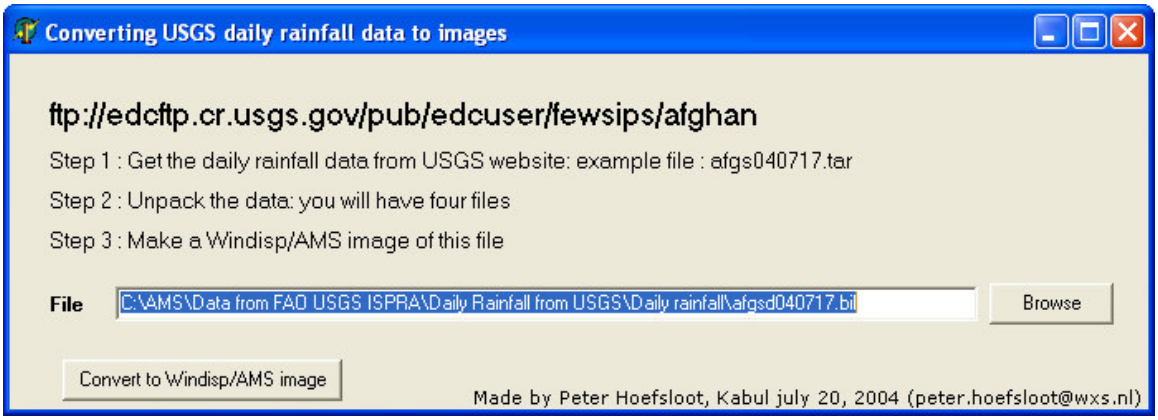
6.2 Daily rainfall estimates from USGS

In general terms one should always prefer ground measurements above estimates derived from satellites. However, sometimes using estimates is the only way to complete our dataset. USGS produces 6-hour estimates of several parameters and offers them for download under this FTP address:

ftp://edcftp.cr.usgs.gov/pub/edcuser/fewsips/afghan/



A special program converts the USGA rainfall estimates to Windisp images. The program is called "*USGSDailyRainfall.exe*".



The program expects a BIL file as input and creates a Windisp / AMS image.

6.3 Data from ISPRA

ISPRA provides the project with ECMWF (European Weather Forecast Model) data. Among other parameters they provide rainfall and PET estimates. These can easily be converted into an image following the instructions below.

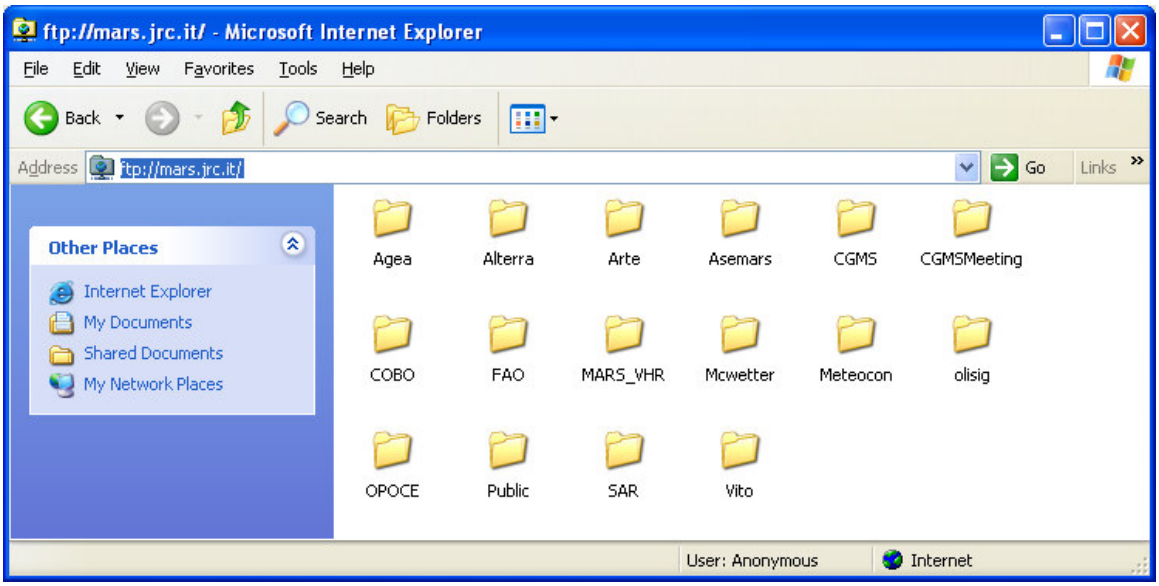
The filenaming convention is as follows:
meteo_<decade>_<month>_<year>.csv
where decade = dekade of the month (1,2,3)

Col	Parameter Description	Param	Unit
F	Minimum Temperature (of the 10 days period)	tmin10	°C
G	Maximum Temperature (of the 10 days period)	tmax10	°C
H	Cumulated mean Temperature (for the 10 days period)	tsum10	°C
I	Mean Temperature (for the 10 days period)	tmean10	°C
J	Precipitation (cumulated for the 10 days period)	rain10	mm
K	Potential Evapo-Transpiration (cumulated for the 10 days period)	pet10	mm
L	Climatic water balance (cumulated for the 10 days period)	cwb10	mm
M	Global Radiation1(cumulated for the 10 days period)	rg10	KJ/m2

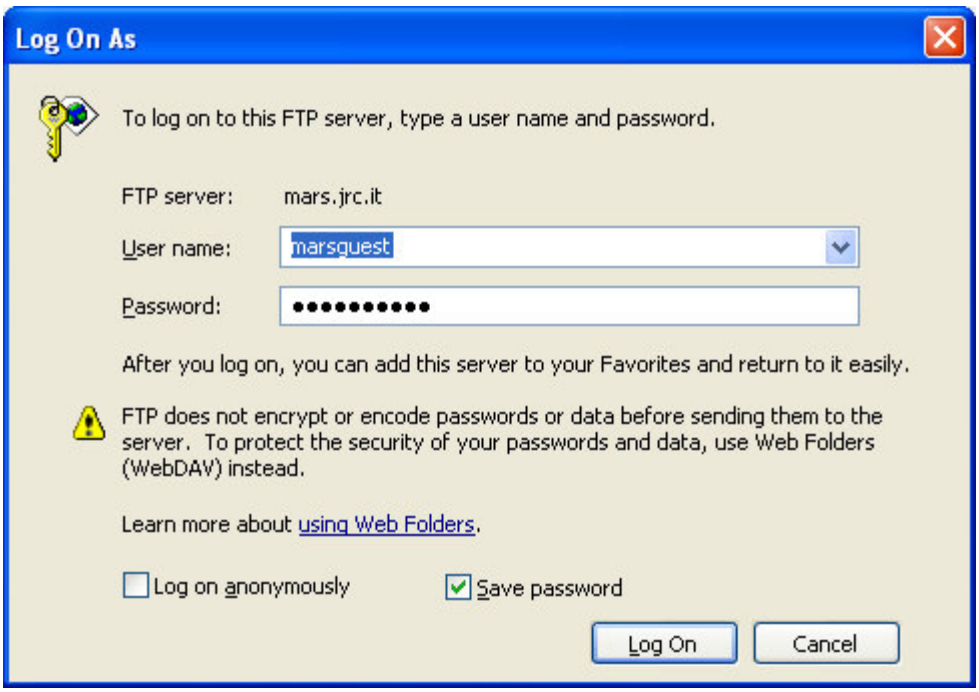
The first step is to download the data from the ISPRA FTP site. In your browser enter:

ftp://mars.jrc.it/ .

You now see:



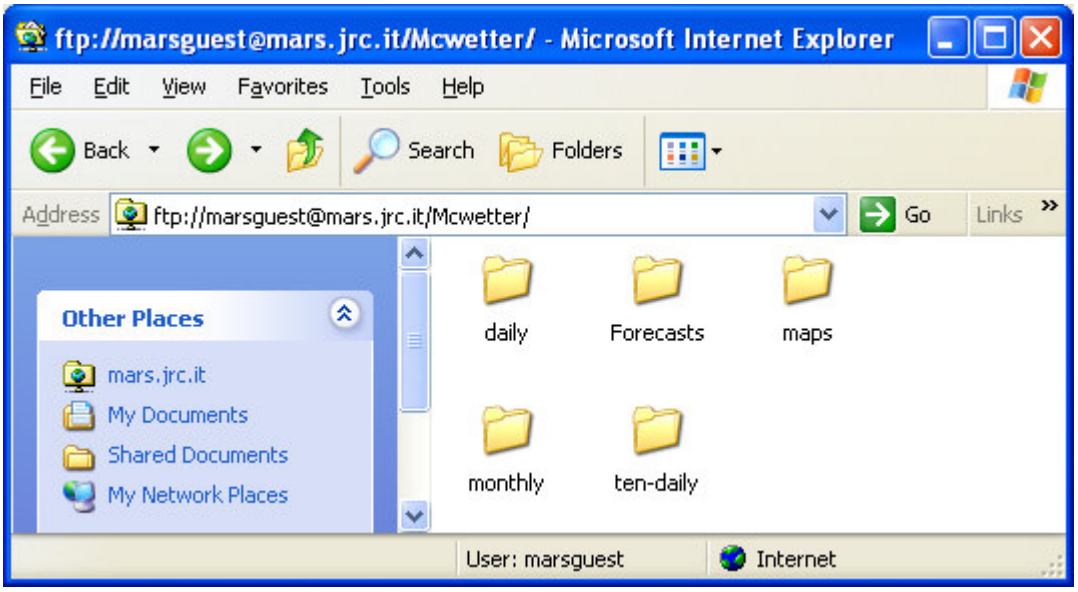
Press the right mouse button and select "*Login as…*": You will see:



Fill this screen with the following data:

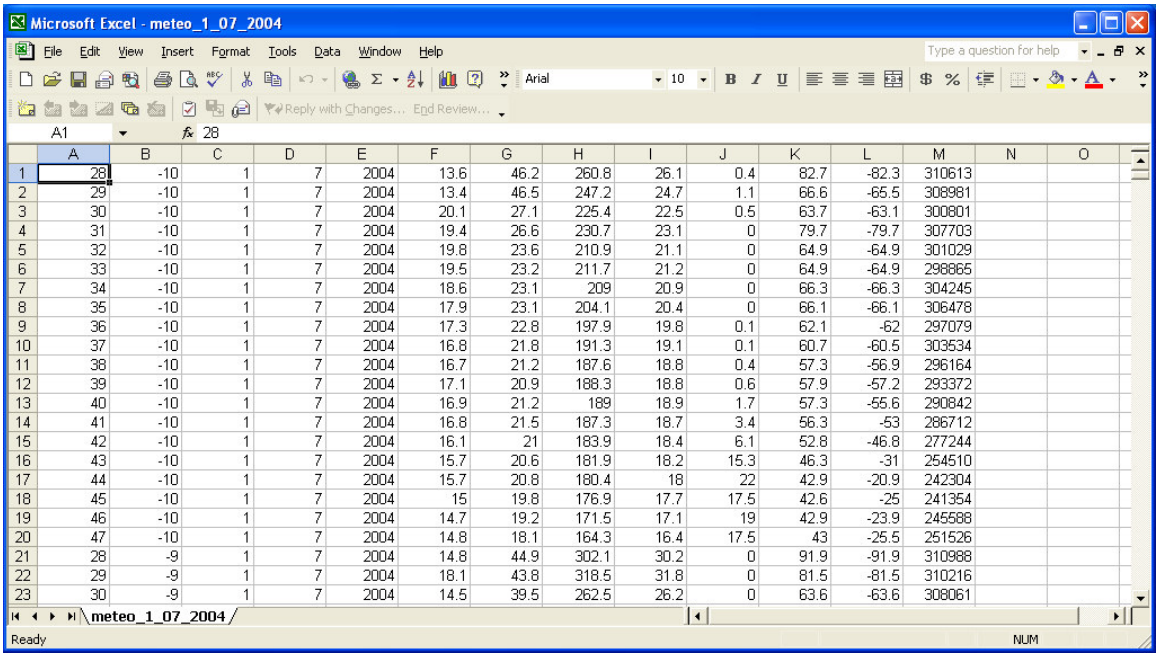
- Username : marsguest
- Password : mars4guest

Now you can enter the Mcwetter directory. Go to the 10-day products and download the file for the specific dekad you want to have.



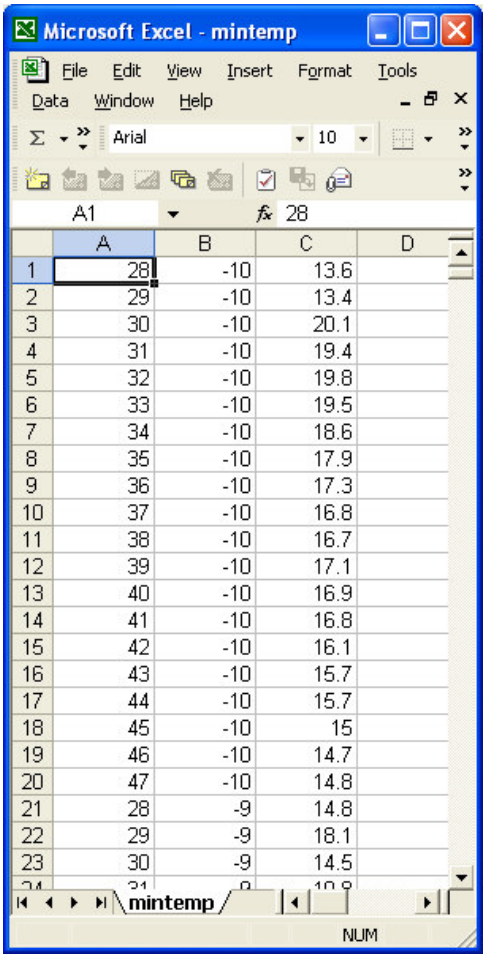
The next steps explain how to convert the downloaded CSV file to AMS / Windisp images:

Open the downloaded file in Excel. You see:



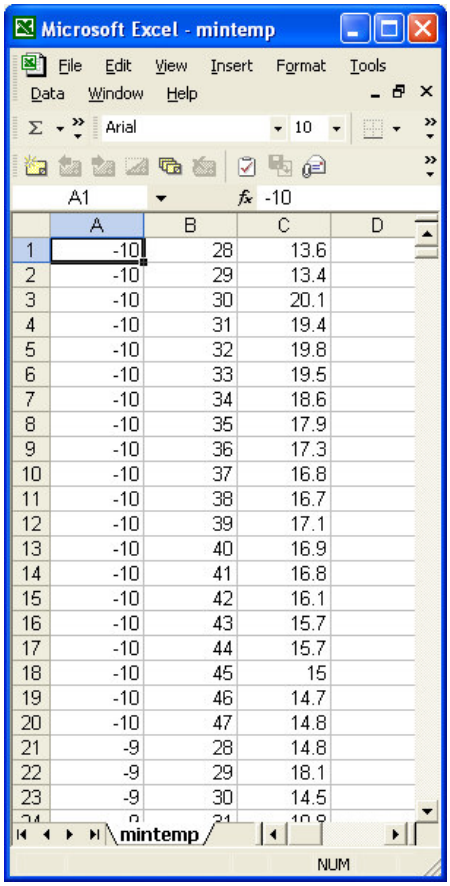
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	28	-10	1	7	2004	13.6	46.2	260.8	26.1	0.4	82.7	-82.3	310613		
2	29	-10	1	7	2004	13.4	46.5	247.2	24.7	1.1	66.6	-65.5	308981		
3	30	-10	1	7	2004	20.1	27.1	225.4	22.5	0.5	63.7	-63.1	300801		
4	31	-10	1	7	2004	19.4	26.6	230.7	23.1	0	79.7	-79.7	307703		
5	32	-10	1	7	2004	19.8	23.6	210.9	21.1	0	64.9	-64.9	301029		
6	33	-10	1	7	2004	19.5	23.2	211.7	21.2	0	64.9	-64.9	298865		
7	34	-10	1	7	2004	18.6	23.1	209	20.9	0	66.3	-66.3	304245		
8	35	-10	1	7	2004	17.9	23.1	204.1	20.4	0	66.1	-66.1	306478		
9	36	-10	1	7	2004	17.3	22.8	197.9	19.8	0.1	62.1	-62	297079		
10	37	-10	1	7	2004	16.8	21.8	191.3	19.1	0.1	60.7	-60.5	303534		
11	38	-10	1	7	2004	16.7	21.2	187.6	18.8	0.4	57.3	-56.9	296164		
12	39	-10	1	7	2004	17.1	20.9	188.3	18.8	0.6	57.9	-57.2	293372		
13	40	-10	1	7	2004	16.9	21.2	189	18.9	1.7	57.3	-55.6	290842		
14	41	-10	1	7	2004	16.8	21.5	187.3	18.7	3.4	56.3	-53	286712		
15	42	-10	1	7	2004	16.1	21	183.9	18.4	6.1	52.8	-46.8	277244		
16	43	-10	1	7	2004	15.7	20.6	181.9	18.2	15.3	46.3	-31	254510		
17	44	-10	1	7	2004	15.7	20.8	180.4	18	22	42.9	-20.9	242304		
18	45	-10	1	7	2004	15	19.8	176.9	17.7	17.5	42.6	-25	241354		
19	46	-10	1	7	2004	14.7	19.2	171.5	17.1	19	42.9	-23.9	245588		
20	47	-10	1	7	2004	14.8	18.1	164.3	16.4	17.5	43	-25.5	251526		
21	28	-9	1	7	2004	14.8	44.9	302.1	30.2	0	91.9	-91.9	310988		
22	29	-9	1	7	2004	18.1	43.8	318.5	31.8	0	81.5	-81.5	310216		
23	30	-9	1	7	2004	14.5	39.5	262.5	26.2	0	63.6	-63.6	308061		

To create an image we need just three columns. The first two columns (A and B) are always necessary. From columns C, D and E we can see that the data are for the first dekad of july 2004. If we want to make an image of the minimum temperature we keep column F and delete all other columns.



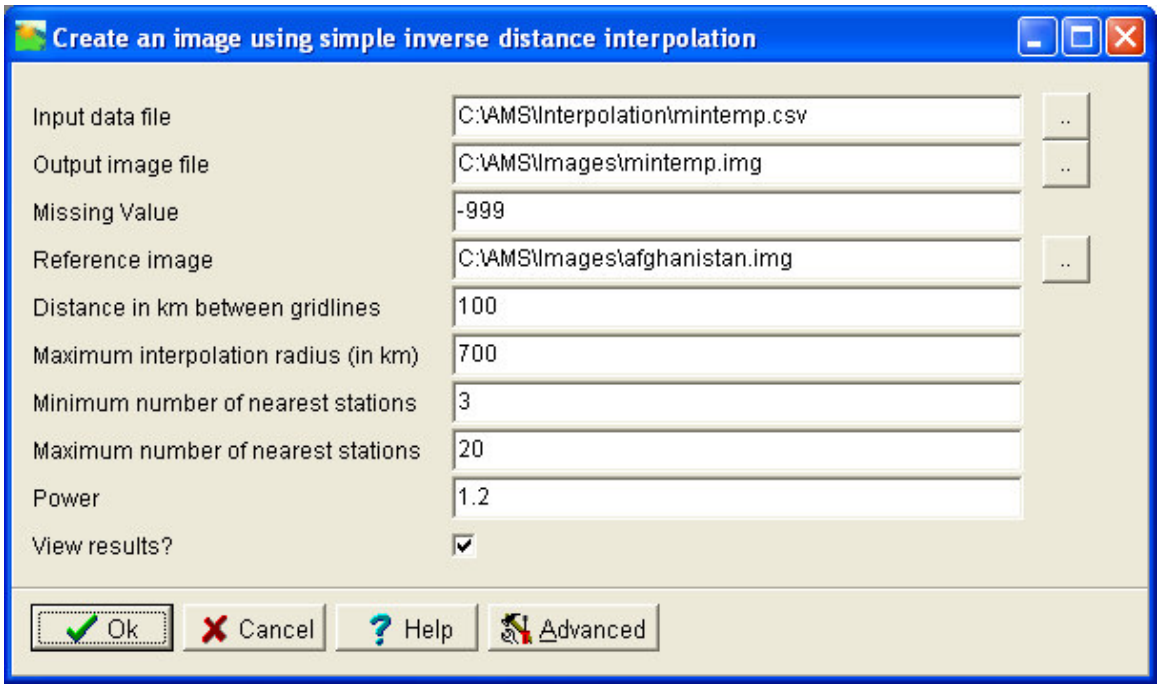
	A	B	C	D
1	28	-10	13.6	
2	29	-10	13.4	
3	30	-10	20.1	
4	31	-10	19.4	
5	32	-10	19.8	
6	33	-10	19.5	
7	34	-10	18.6	
8	35	-10	17.9	
9	36	-10	17.3	
10	37	-10	16.8	
11	38	-10	16.7	
12	39	-10	17.1	
13	40	-10	16.9	
14	41	-10	16.8	
15	42	-10	16.1	
16	43	-10	15.7	
17	44	-10	15.7	
18	45	-10	15	
19	46	-10	14.7	
20	47	-10	14.8	
21	28	-9	14.8	
22	29	-9	18.1	
23	30	-9	14.5	

The longitude and latitude have to be swapped to make the interpolation work. In the end your file looks like this:

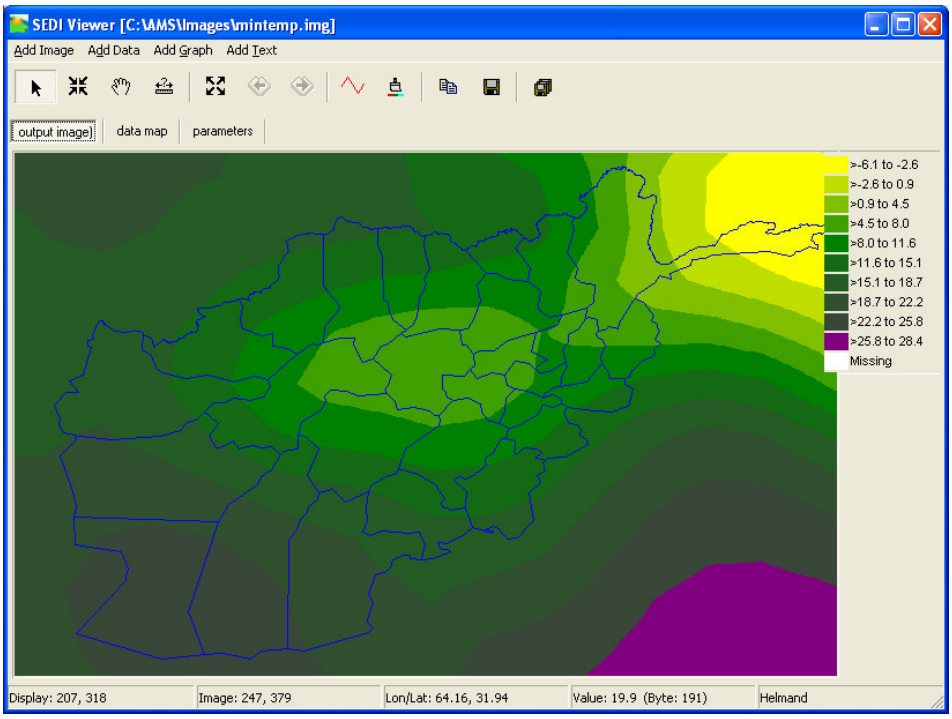


	A	B	C	D
1	-10	28	13.6	
2	-10	29	13.4	
3	-10	30	20.1	
4	-10	31	19.4	
5	-10	32	19.8	
6	-10	33	19.5	
7	-10	34	18.6	
8	-10	35	17.9	
9	-10	36	17.3	
10	-10	37	16.8	
11	-10	38	16.7	
12	-10	39	17.1	
13	-10	40	16.9	
14	-10	41	16.8	
15	-10	42	16.1	
16	-10	43	15.7	
17	-10	44	15.7	
18	-10	45	15	
19	-10	46	14.7	
20	-10	47	14.8	
21	-9	28	14.8	
22	-9	29	18.1	
23	-9	30	14.5	

Save the file under another name in CSV format (do not overwrite the original!). Now go to AMS and activate the "*Interpolation – Inverse distance*" function. Fill the screen as follows:

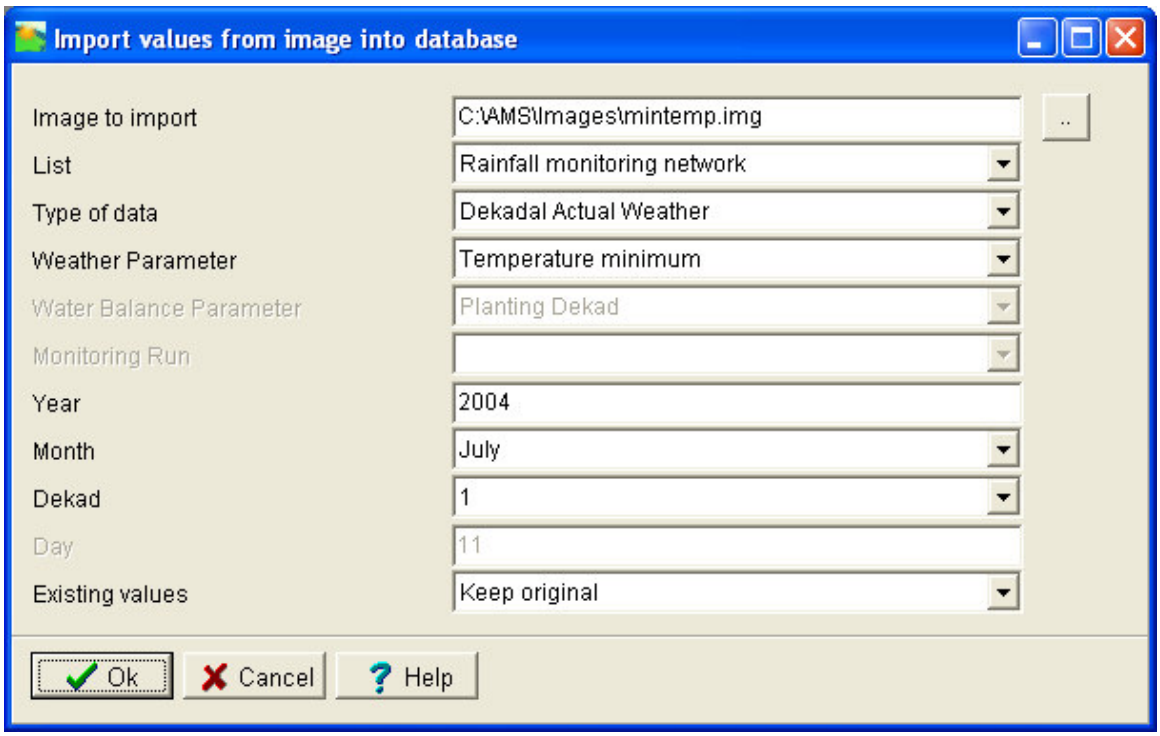


Finally our minimum temperature map for the first dekad of July 2004 looks like this:

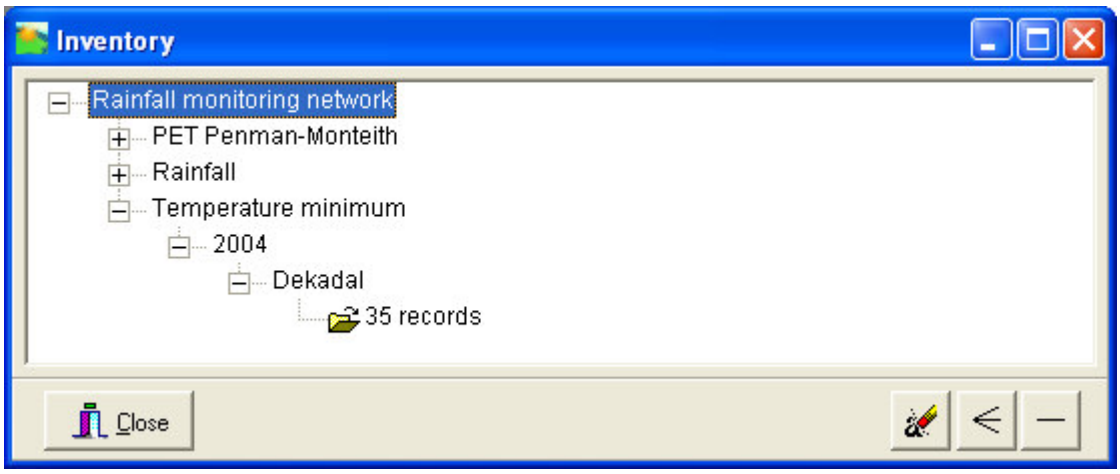


You might want to load these estimates into the AMS database for all stations of a certain list. An estimate is sometimes better than no value at all. Be sure not to overwrite measured values! Take the following steps:

In AMS activate the "*Database – Import – From Image*" function. Fill the screen as follows:



Press OK. The data are now imported. To check this, go to the "*Database-Inventory*" function:

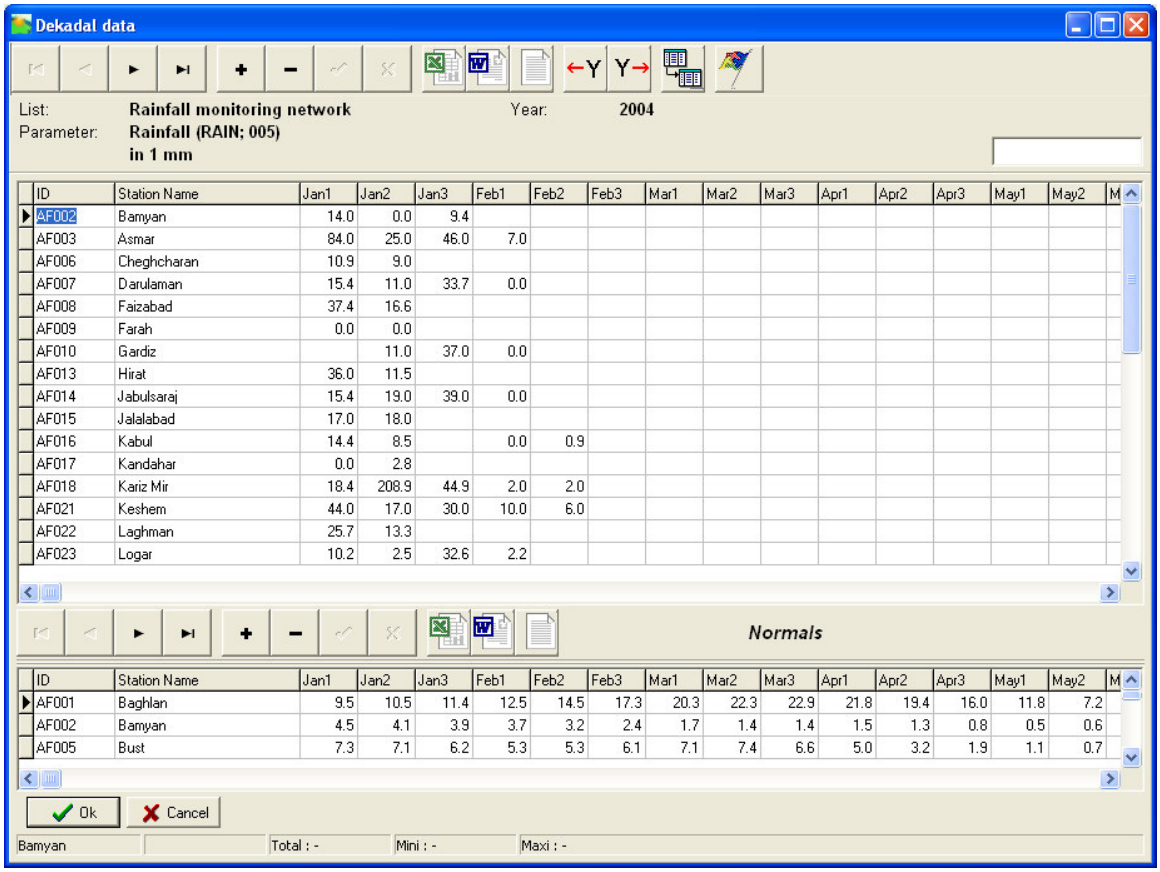


7 Filling data gaps

Data gaps are very common in Afghanistan. This is due to a many different reasons and it would not occur, had the world been perfect! Fortunately there are a number of ways to fill data gaps. In paragraph 6.3 a method is mentioned using ECMWF data from ISPRA. The missing data are simply replaced by the ECMWF estimates. In this chapter we look at two ways that might produce better results.

7.1 Using inverse distance to replace missing data by estimates

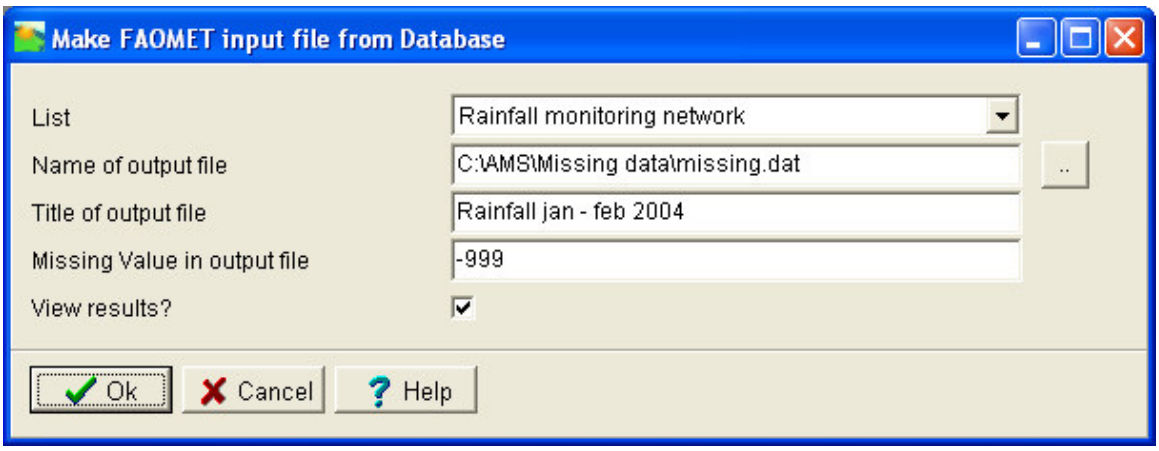
Let us take an example. For the January and February 2004, our rainfall network has many data gaps:



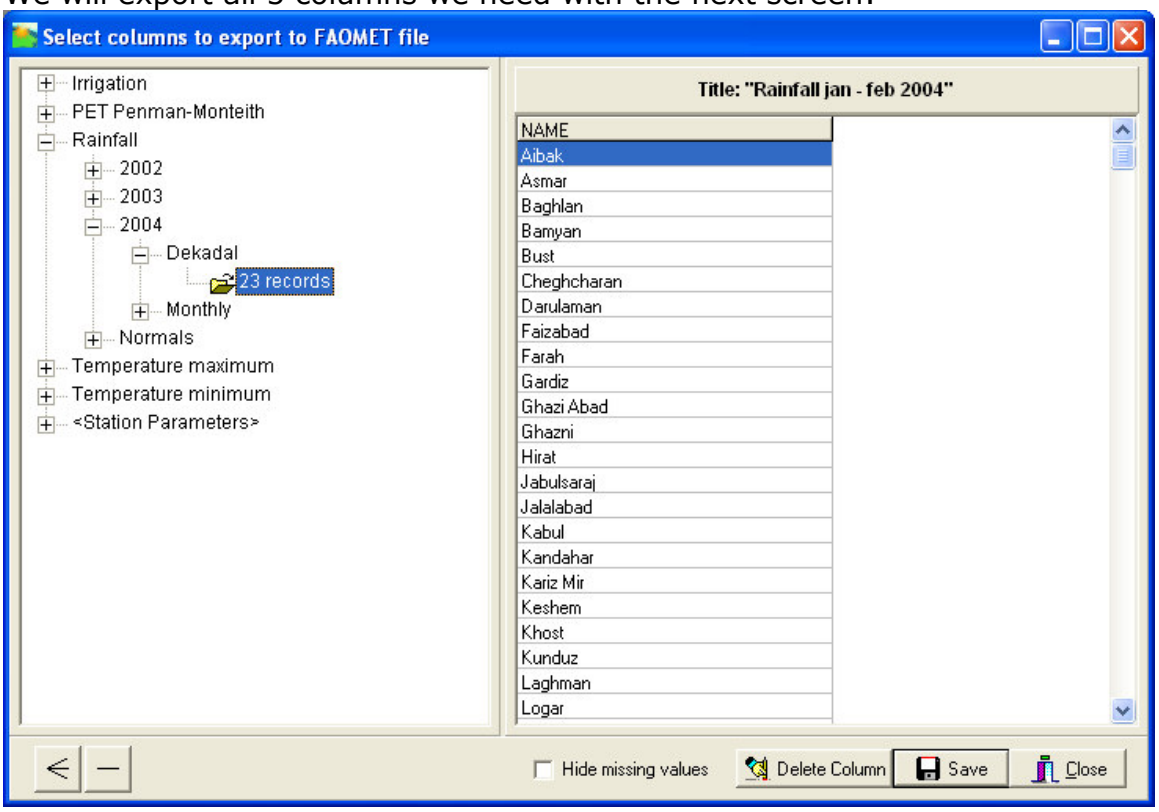
ID	Station Name	Jan1	Jan2	Jan3	Feb1	Feb2	Feb3	Mar1	Mar2	Mar3	Apr1	Apr2	Apr3	May1	May2
AF002	Bamyan	14.0	0.0	9.4											
AF003	Asmar	84.0	25.0	46.0	7.0										
AF006	Cheghcharan	10.9	9.0												
AF007	Darulaman	15.4	11.0	33.7	0.0										
AF008	Faizabad	37.4	16.6												
AF009	Farah	0.0	0.0												
AF010	Gardiz		11.0	37.0	0.0										
AF013	Hirat	36.0	11.5												
AF014	Jabulsaraj	15.4	19.0	39.0	0.0										
AF015	Jalalabad	17.0	18.0												
AF016	Kabul	14.4	8.5		0.0	0.9									
AF017	Kandahar	0.0	2.8												
AF018	Kariz Mir	18.4	208.9	44.9	2.0	2.0									
AF021	Keshem	44.0	17.0	30.0	10.0	6.0									
AF022	Laghman	25.7	13.3												
AF023	Logar	10.2	2.5	32.6	2.2										

ID	Station Name	Jan1	Jan2	Jan3	Feb1	Feb2	Feb3	Mar1	Mar2	Mar3	Apr1	Apr2	Apr3	May1	May2
AF001	Baghlan	9.5	10.5	11.4	12.5	14.5	17.3	20.3	22.3	22.9	21.8	19.4	16.0	11.8	7.2
AF002	Bamyan	4.5	4.1	3.9	3.7	3.2	2.4	1.7	1.4	1.4	1.5	1.3	0.8	0.5	0.6
AF005	Bust	7.3	7.1	6.2	5.3	5.3	6.1	7.1	7.4	6.6	5.0	3.2	1.9	1.1	0.7

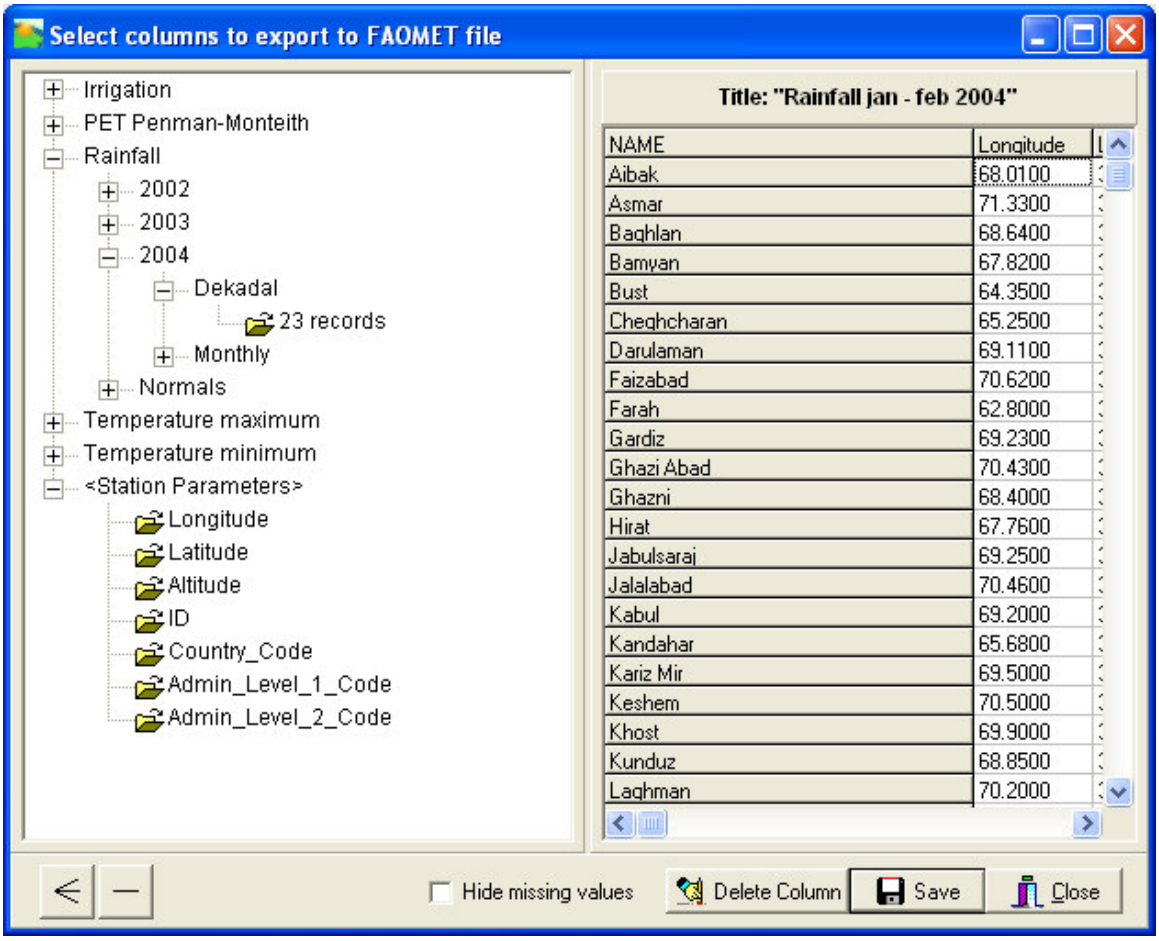
We will use the function "*Tools - Interpolate to replace missing data*". First we have to export the data from the database. Later we will re-import the data.



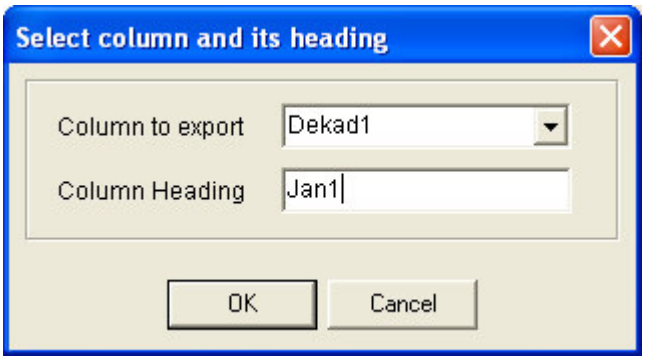
We will export all 5 columns we need with the next screen:



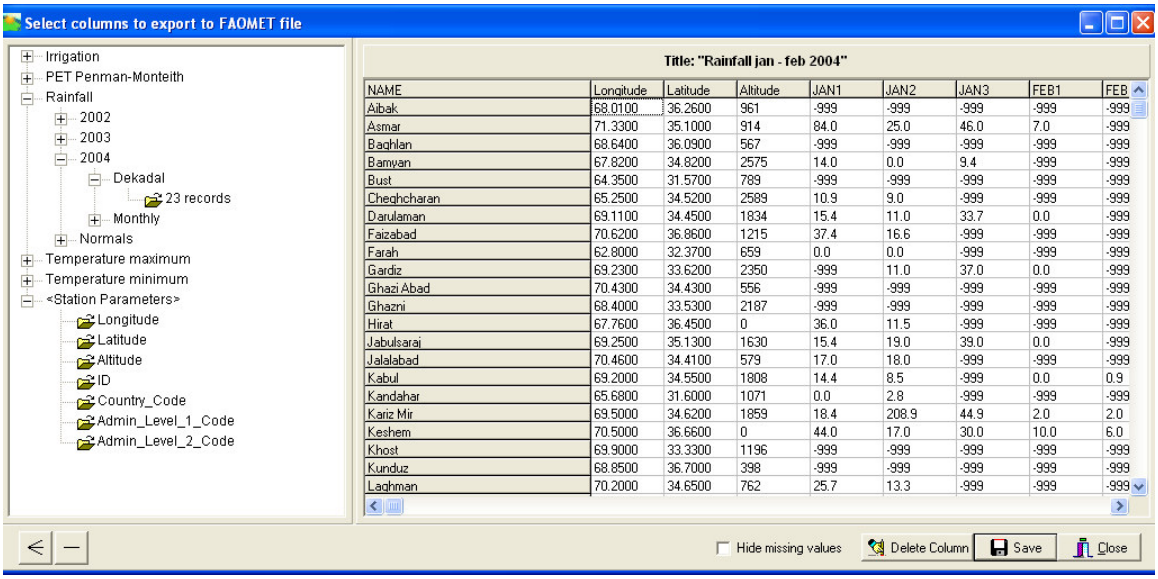
First add the column longitude, then latitude, then altitude.



Subsequently add the five data columns. Double click the "*23 records"* item You get the following screen. For the first dekad of January fill the screen accordingly:

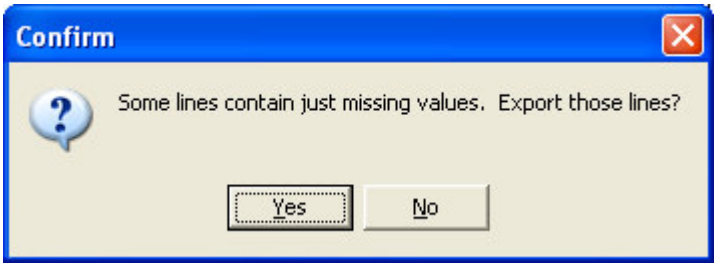


In the end your screen should look like this:

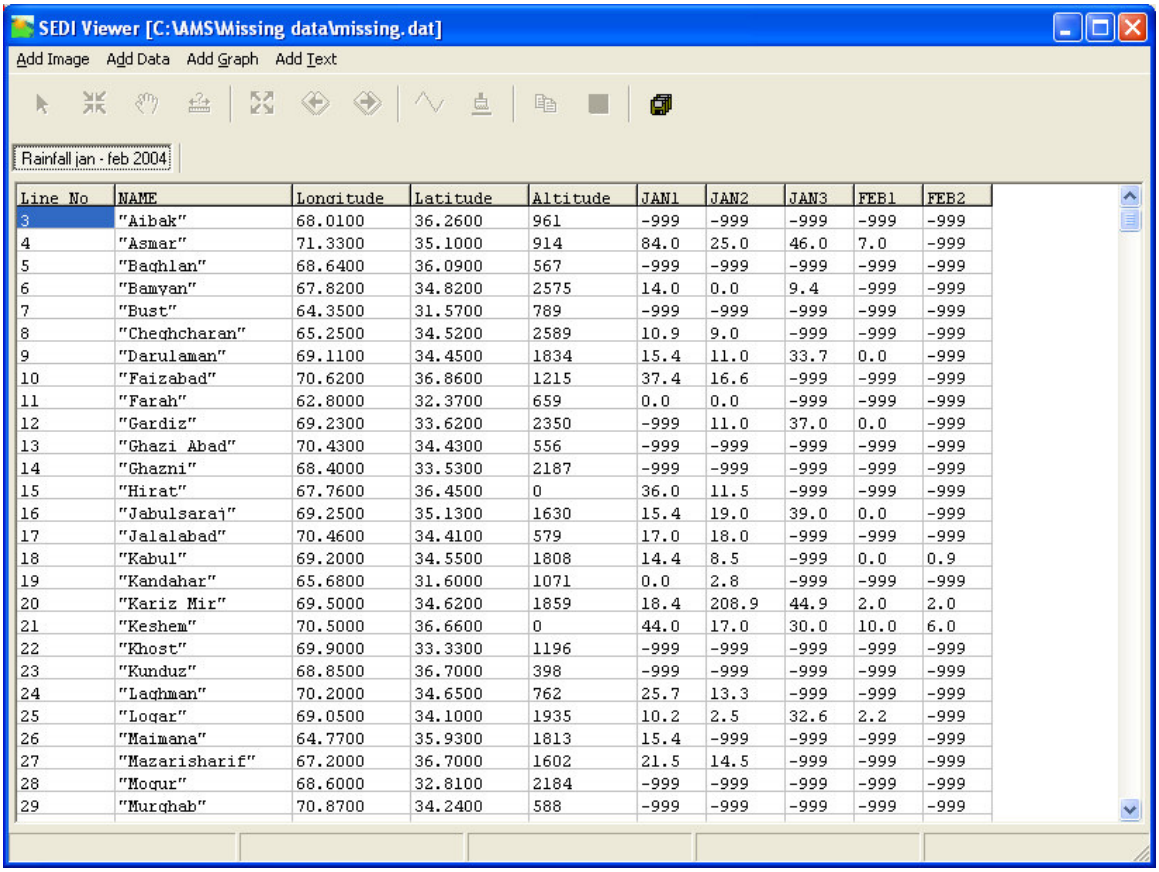


NAME	Longitude	Latitude	Altitude	JAN1	JAN2	JAN3	FEB1	FEB
Aibak	68.0100	36.2600	961	-999	-999	-999	-999	-999
Asmar	71.3300	35.1000	914	84.0	25.0	46.0	7.0	-999
Baghlan	68.6400	36.0900	567	-999	-999	-999	-999	-999
Bamyan	67.8200	34.8200	2575	14.0	0.0	9.4	-999	-999
Bust	64.3500	31.5700	789	-999	-999	-999	-999	-999
Cheghcharan	65.2500	34.5200	2589	10.9	9.0	-999	-999	-999
Darulaman	69.1100	34.4500	1834	15.4	11.0	33.7	0.0	-999
Faizabad	70.6200	36.8600	1215	37.4	16.6	-999	-999	-999
Farah	62.8000	32.3700	659	0.0	0.0	-999	-999	-999
Gardiz	69.2300	33.6200	2350	-999	11.0	37.0	0.0	-999
Ghazi Abad	70.4300	34.4300	556	-999	-999	-999	-999	-999
Ghazni	68.4000	33.5300	2187	-999	-999	-999	-999	-999
Hirat	67.7600	36.4500	0	36.0	11.5	-999	-999	-999
Jabulsaraj	69.2500	35.1300	1630	15.4	19.0	39.0	0.0	-999
Jalalabad	70.4600	34.4100	579	17.0	18.0	-999	-999	-999
Kabul	69.2000	34.5500	1808	14.4	8.5	-999	0.0	0.9
Kandahar	65.6800	31.6000	1071	0.0	2.8	-999	-999	-999
Kariz Mir	69.5000	34.6200	1859	18.4	208.9	44.9	2.0	2.0
Keshem	70.5000	36.6600	0	44.0	17.0	30.0	10.0	6.0
Khost	69.9000	33.3300	1196	-999	-999	-999	-999	-999
Kunduz	68.8500	36.7000	398	-999	-999	-999	-999	-999
Laghman	70.2000	34.6500	762	25.7	13.3	-999	-999	-999

Press the "*Save*" button. Probably you will get the following message:

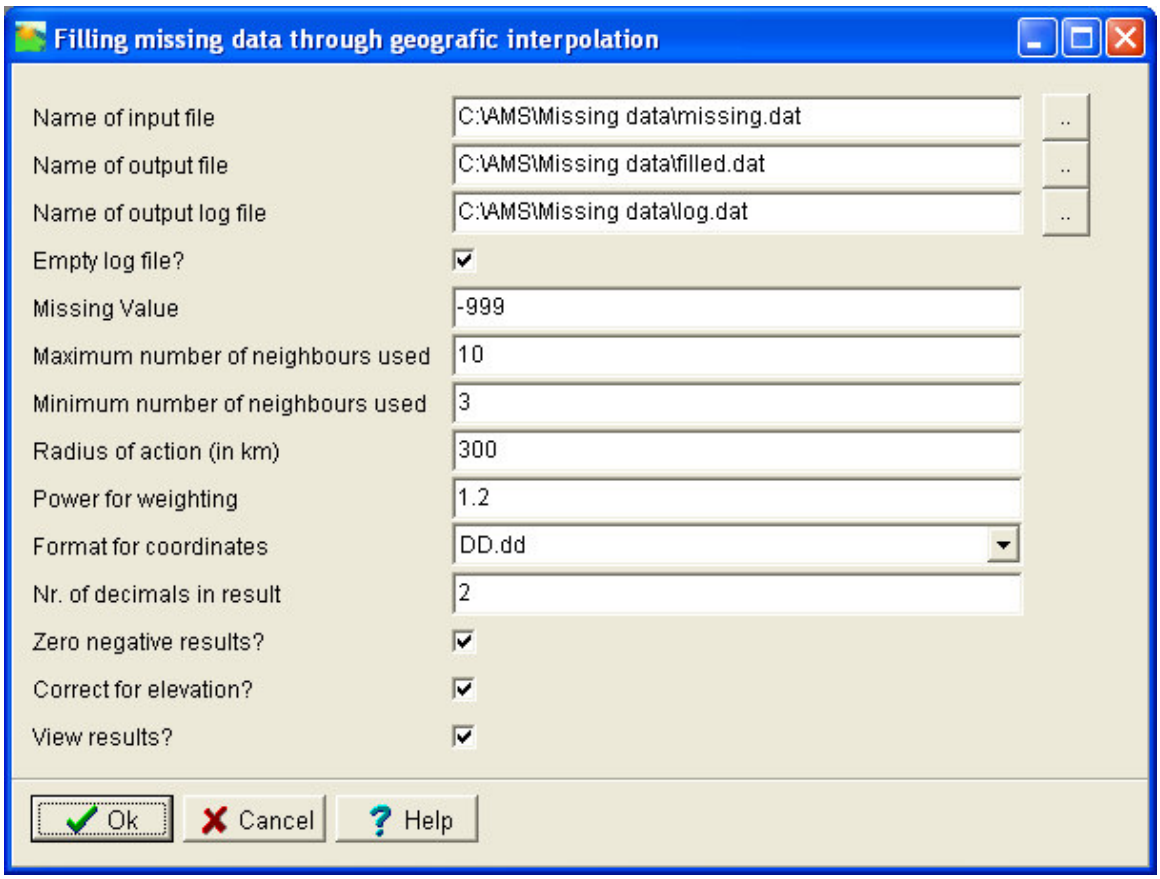


Press Yes, because we want to fill all gaps. The exported file is shown in the viewer. Notice "*-999*" where data gaps occur.

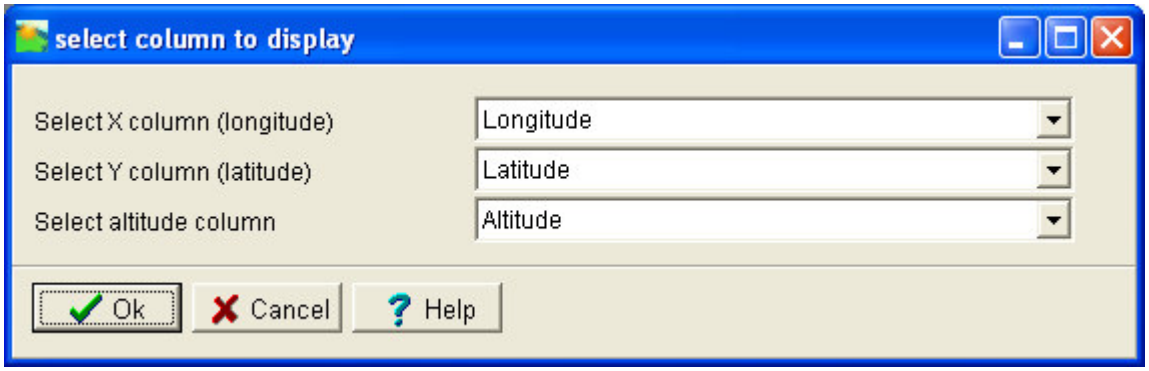


Line_No	NAME	Longitude	Latitude	Altitude	JAN1	JAN2	JAN3	FEB1	FEB2
3	"Aibak"	68.0100	36.2600	961	-999	-999	-999	-999	-999
4	"Asmar"	71.3300	35.1000	914	84.0	25.0	46.0	7.0	-999
5	"Baghlan"	68.6400	36.0900	567	-999	-999	-999	-999	-999
6	"Bamyan"	67.8200	34.8200	2575	14.0	0.0	9.4	-999	-999
7	"Bust"	64.3500	31.5700	789	-999	-999	-999	-999	-999
8	"Cheghcharan"	65.2500	34.5200	2589	10.9	9.0	-999	-999	-999
9	"Darulaman"	69.1100	34.4500	1834	15.4	11.0	33.7	0.0	-999
10	"Faizabad"	70.6200	36.8600	1215	37.4	16.6	-999	-999	-999
11	"Farah"	62.8000	32.3700	659	0.0	0.0	-999	-999	-999
12	"Gardiz"	69.2300	33.6200	2350	-999	11.0	37.0	0.0	-999
13	"Ghazi Abad"	70.4300	34.4300	556	-999	-999	-999	-999	-999
14	"Ghazni"	68.4000	33.5300	2187	-999	-999	-999	-999	-999
15	"Hirat"	67.7600	36.4500	0	36.0	11.5	-999	-999	-999
16	"Jabulsaraj"	69.2500	35.1300	1630	15.4	19.0	39.0	0.0	-999
17	"Jalalabad"	70.4600	34.4100	579	17.0	18.0	-999	-999	-999
18	"Kabul"	69.2000	34.5500	1808	14.4	8.5	-999	0.0	0.9
19	"Kandahar"	65.6800	31.6000	1071	0.0	2.8	-999	-999	-999
20	"Kariz Mir"	69.5000	34.6200	1859	18.4	208.9	44.9	2.0	2.0
21	"Keshem"	70.5000	36.6600	0	44.0	17.0	30.0	10.0	6.0
22	"Khost"	69.9000	33.3300	1196	-999	-999	-999	-999	-999
23	"Kunduz"	68.8500	36.7000	398	-999	-999	-999	-999	-999
24	"Laghman"	70.2000	34.6500	762	25.7	13.3	-999	-999	-999
25	"Logar"	69.0500	34.1000	1935	10.2	2.5	32.6	2.2	-999
26	"Maimana"	64.7700	35.9300	1813	15.4	-999	-999	-999	-999
27	"Mazarisharif"	67.2000	36.7000	1602	21.5	14.5	-999	-999	-999
28	"Mogur"	68.6000	32.8100	2184	-999	-999	-999	-999	-999
29	"Murghab"	70.8700	34.2400	588	-999	-999	-999	-999	-999

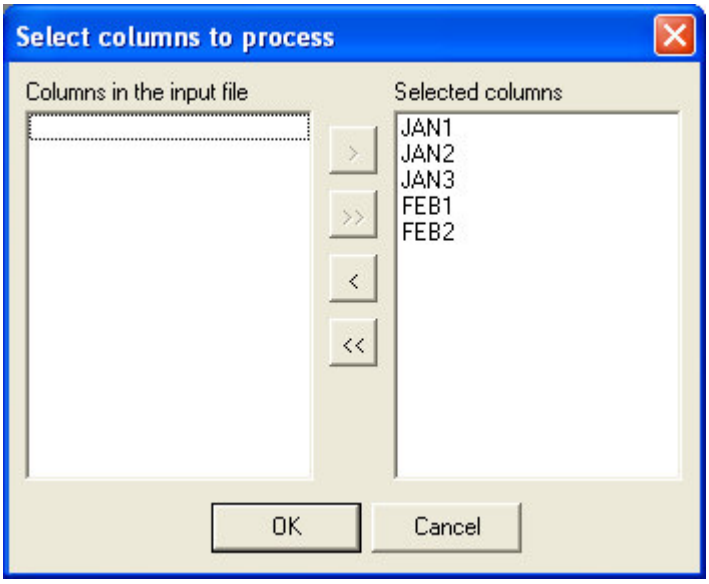
Now activate the "*Tools - Interpolate to replace missing data*" function. Set the options as follows:



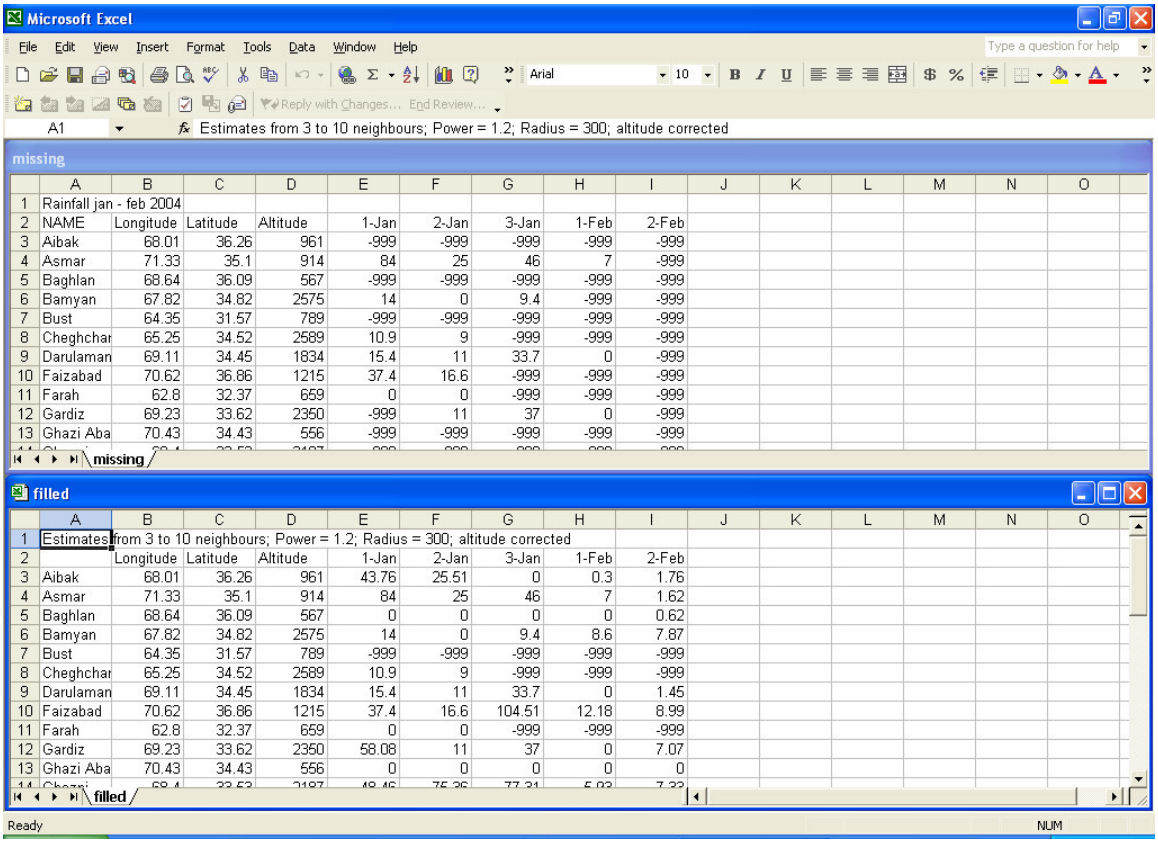
Press Ok and a new window is presented. Specify the longitude, latitude and altitude accordingly.



Select all columns (we want to interpolate for missing data in all columns):

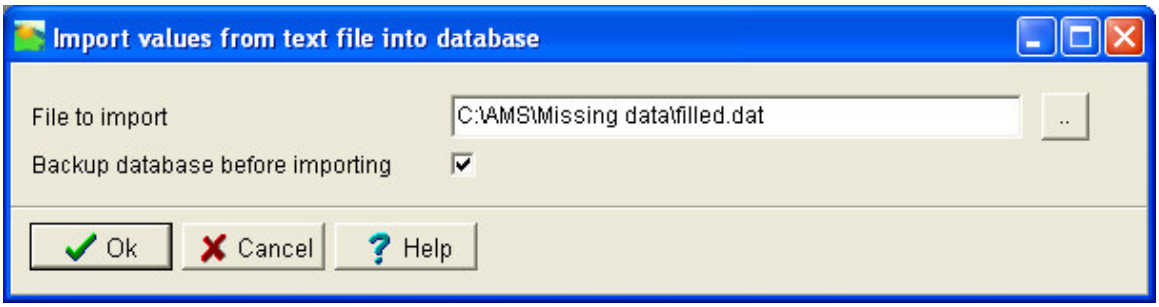


After pressing OK the interpolation is done and missing data are filled. We can compare both files in Excel to see the result:

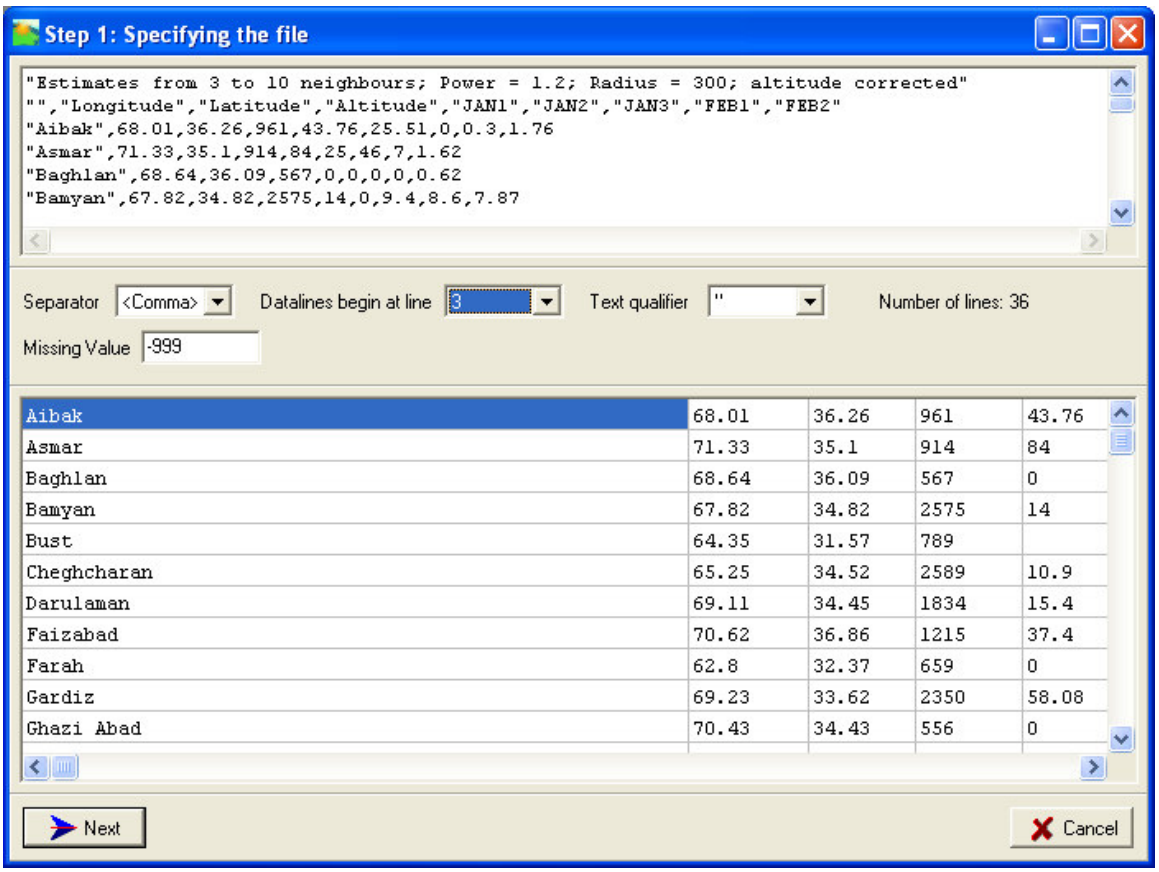


The bottom file has many data gaps filled. Some gaps are not filled because the settings prevent AMS from doing so. For example, by setting the action radius higher we would fill more gaps.

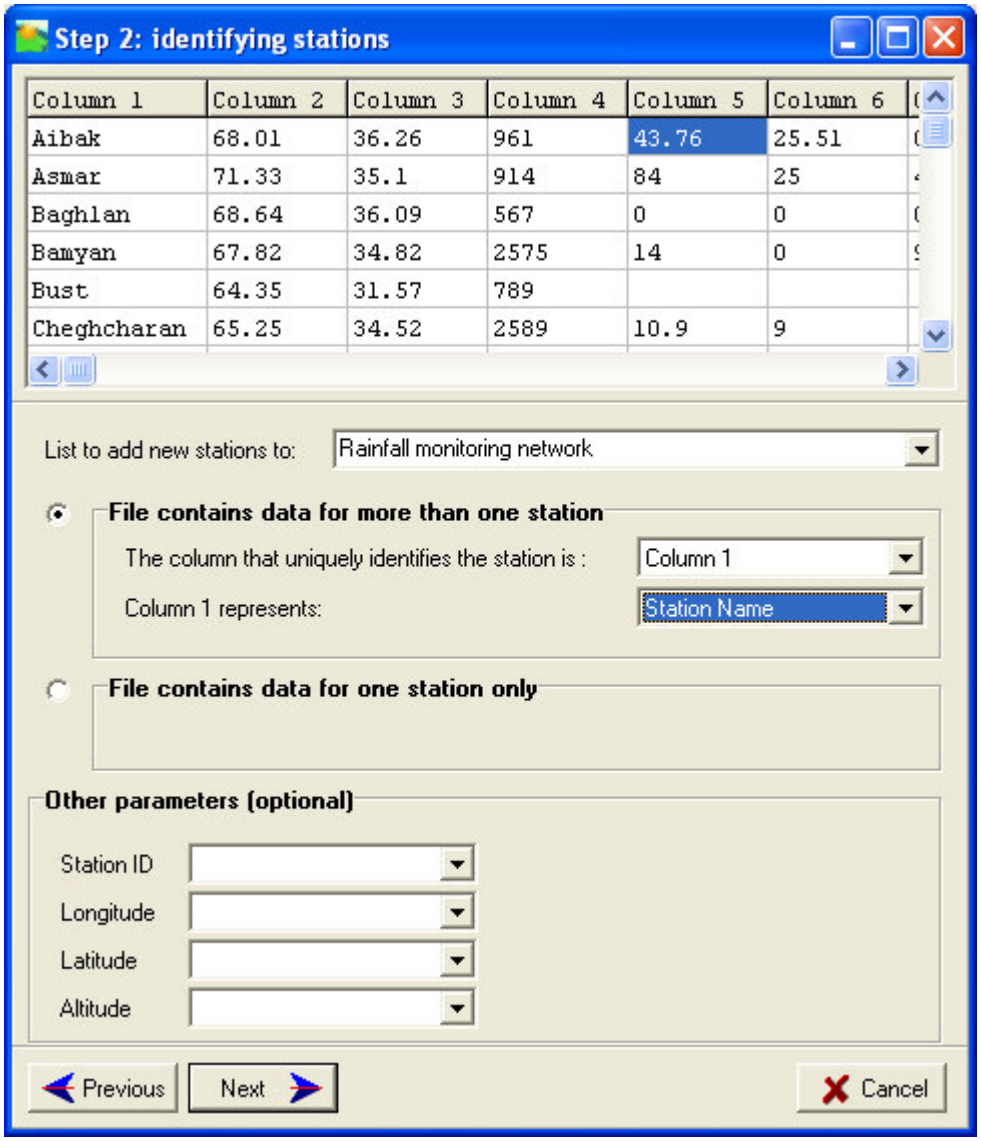
Now we are going to re-import the data again. Activate the "*Database – Import – from ASCII file*" function. Specify the file you just created:



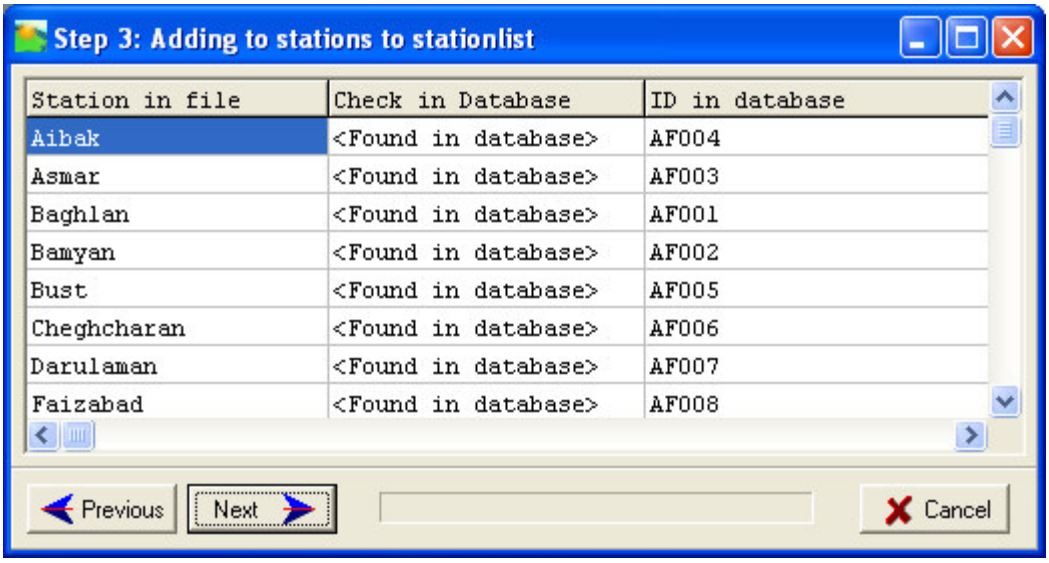
Press OK. Specify the following settings:



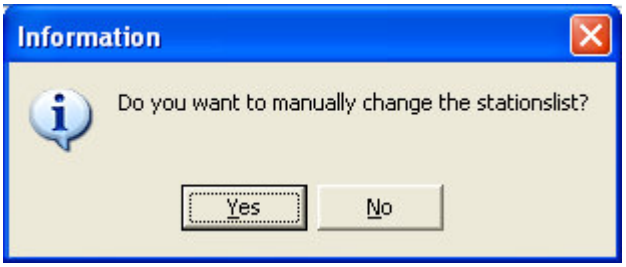
Specify "*Name*" as identifier….



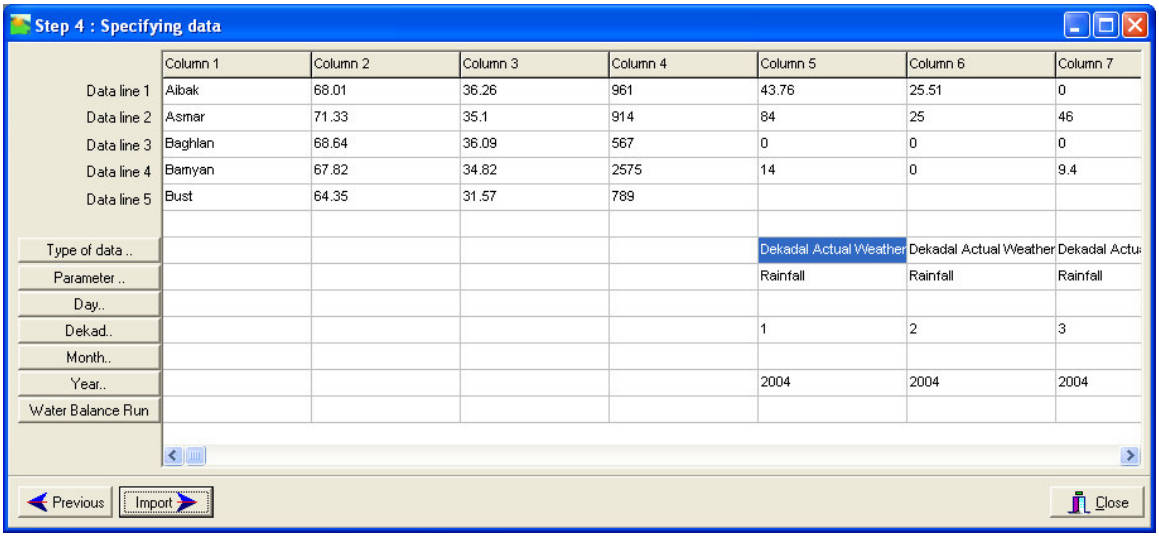
As expected all stations are found (we exported them earlier):



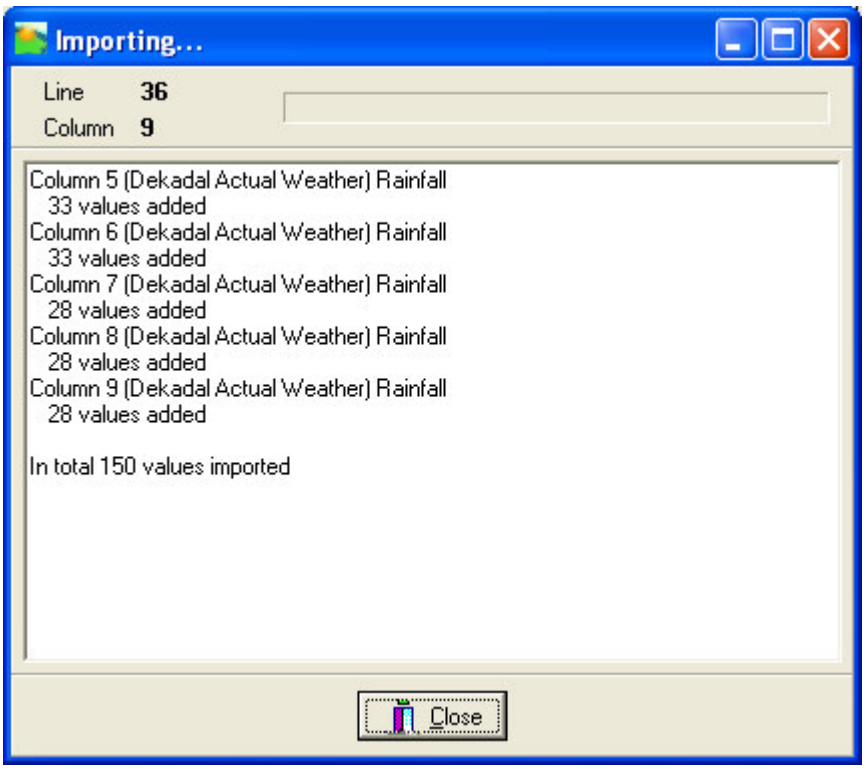
Press Next…



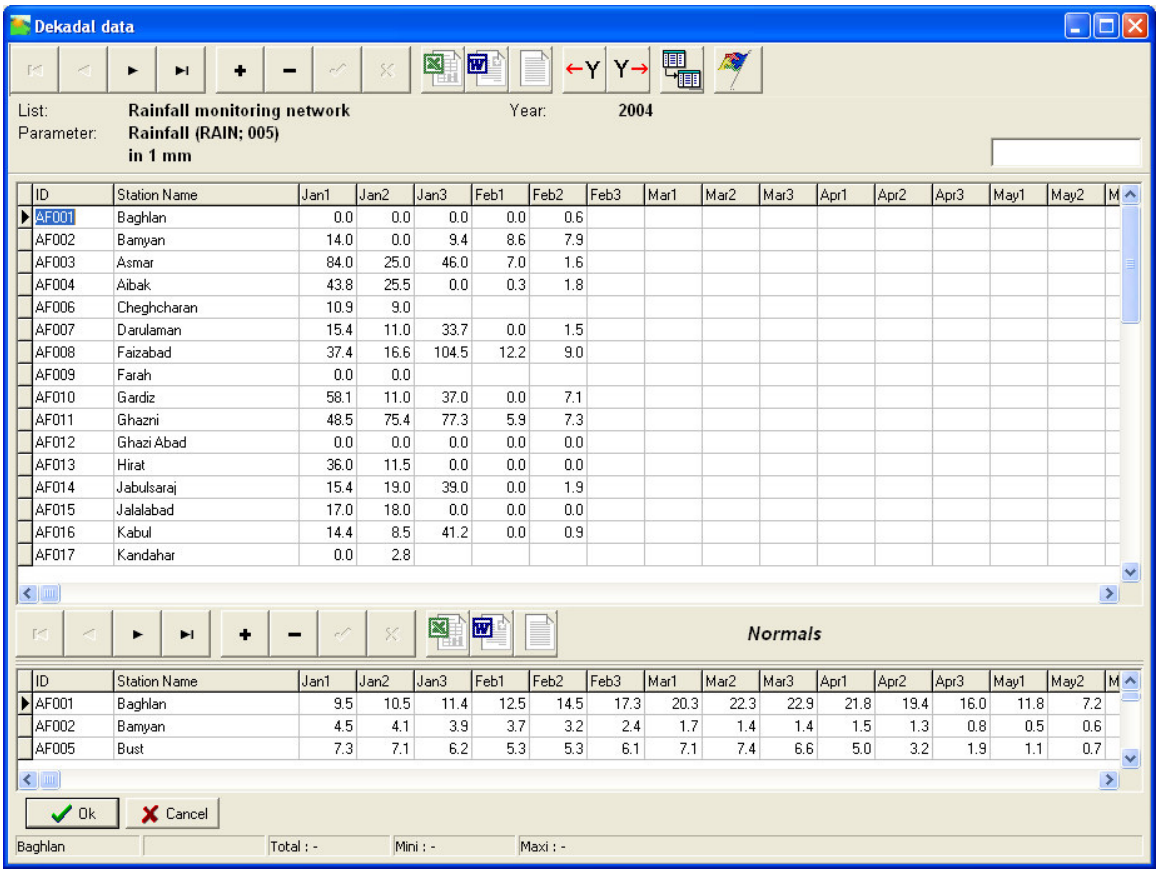
Press No (no new stations in the file). Fill the screen accordingly.



Press Import….



Check the data inventory to see the changes in the database:



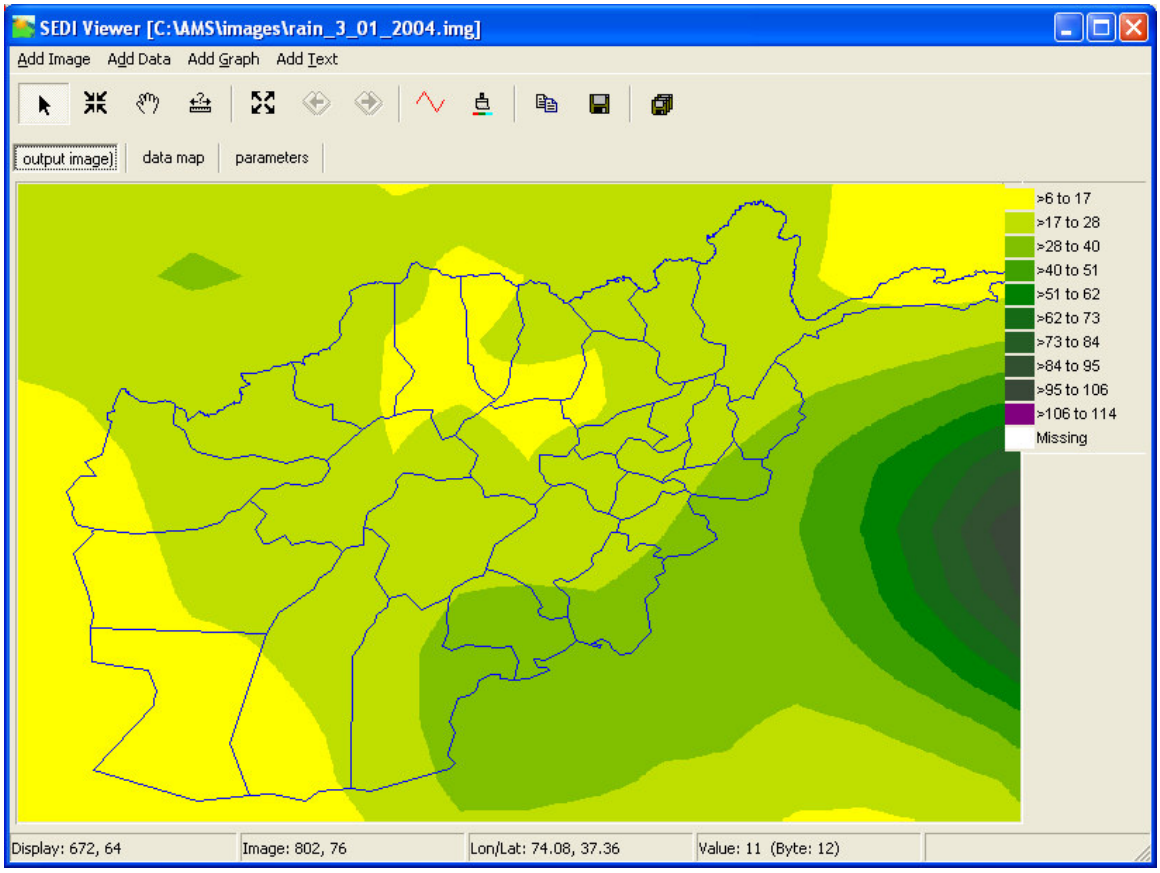
7.2 Filling gaps with ECMWF estimates and measured data

This method method has to be applied dekad by dekad. We will take rainfall for the third dekad of January 2004 and interpolate the data with the aid of data from ISPRA.

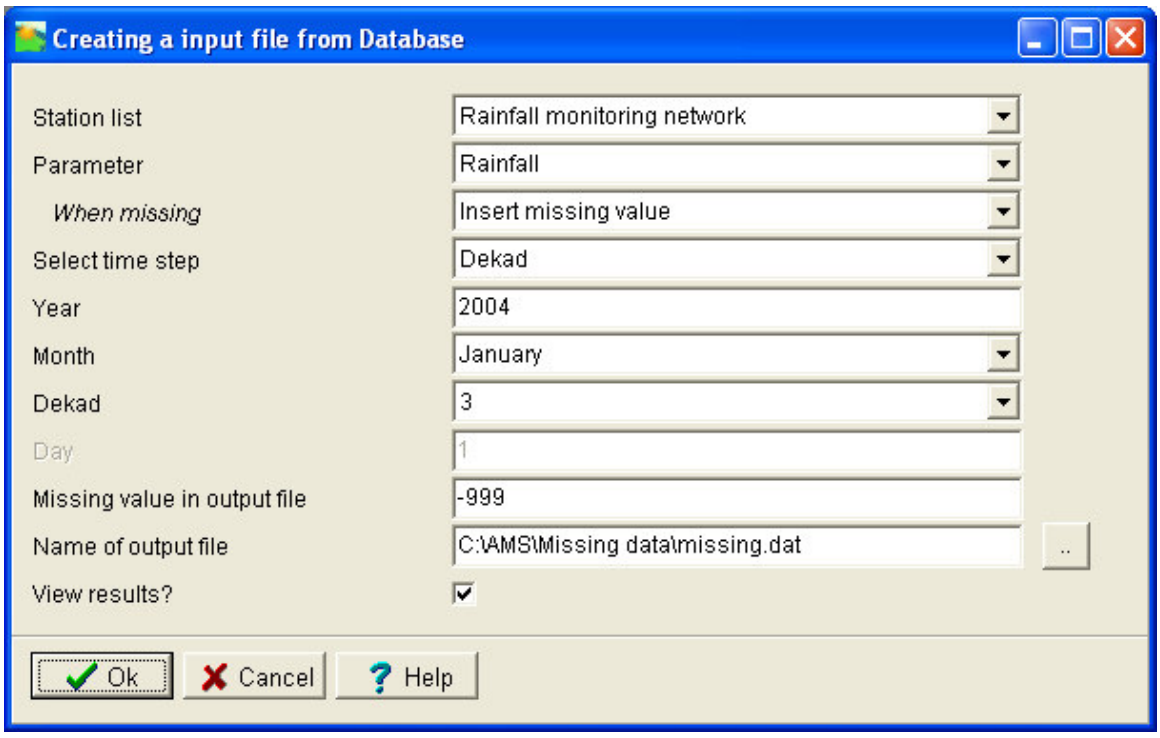
Paragraph 6.3 has explained how we can fill gaps with ECMWF data from ISPRA. Now we go a bit further (and more accurate) by using both sources of rainfall data (rainguages at neighbouring stations **and** ECMWF data) to produce better estimates.

Re-do the paragraph 6.3 with rainfall for the third dekad of January 2004 (column J), but do not yet import the data into the database.

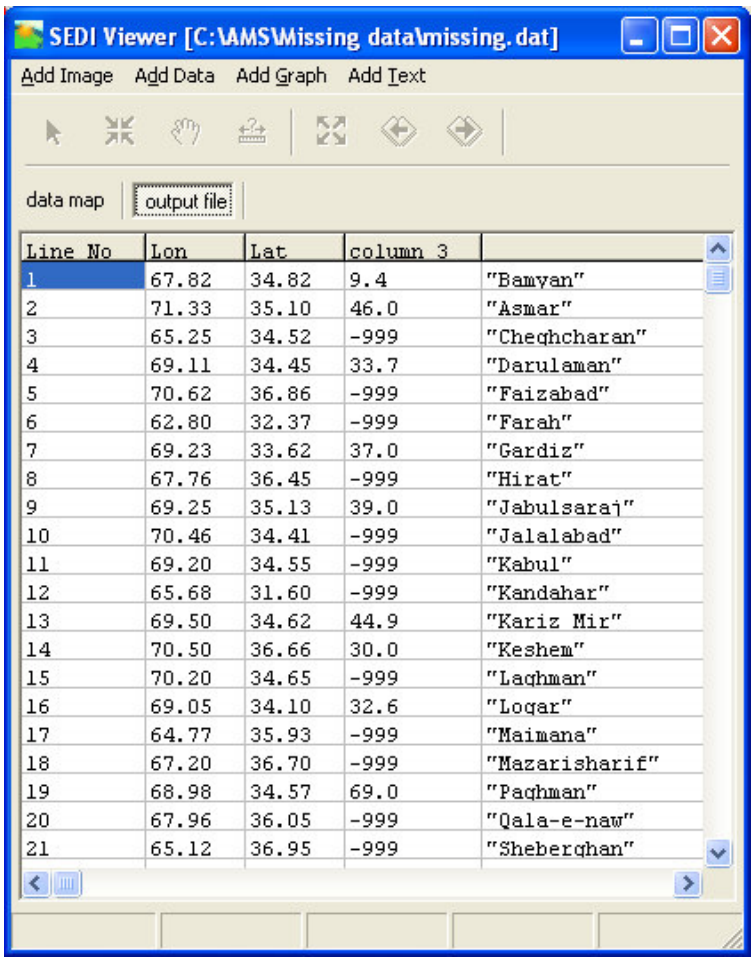
You should get the following estimated rainfall image for the third dekad of January 2004.:



Then export the measured rainfall data from the database with the "*Interpolate – Make input file – Database*" function:

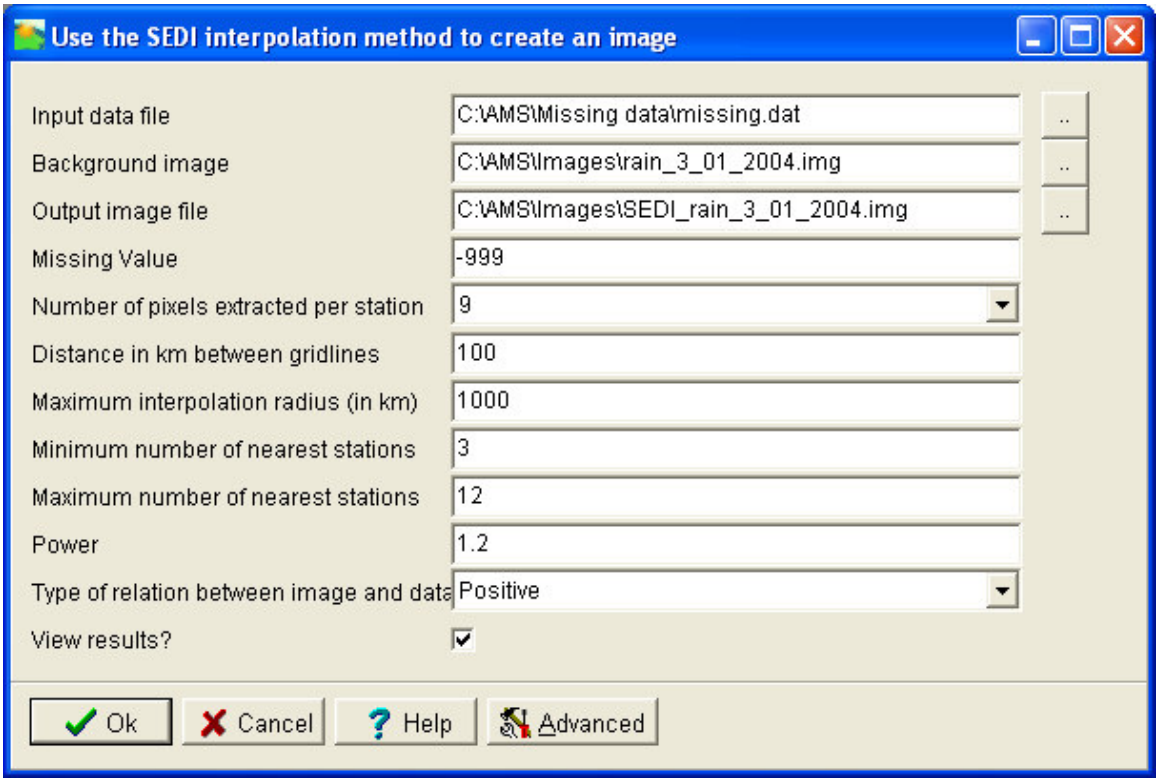


The following file is produced:

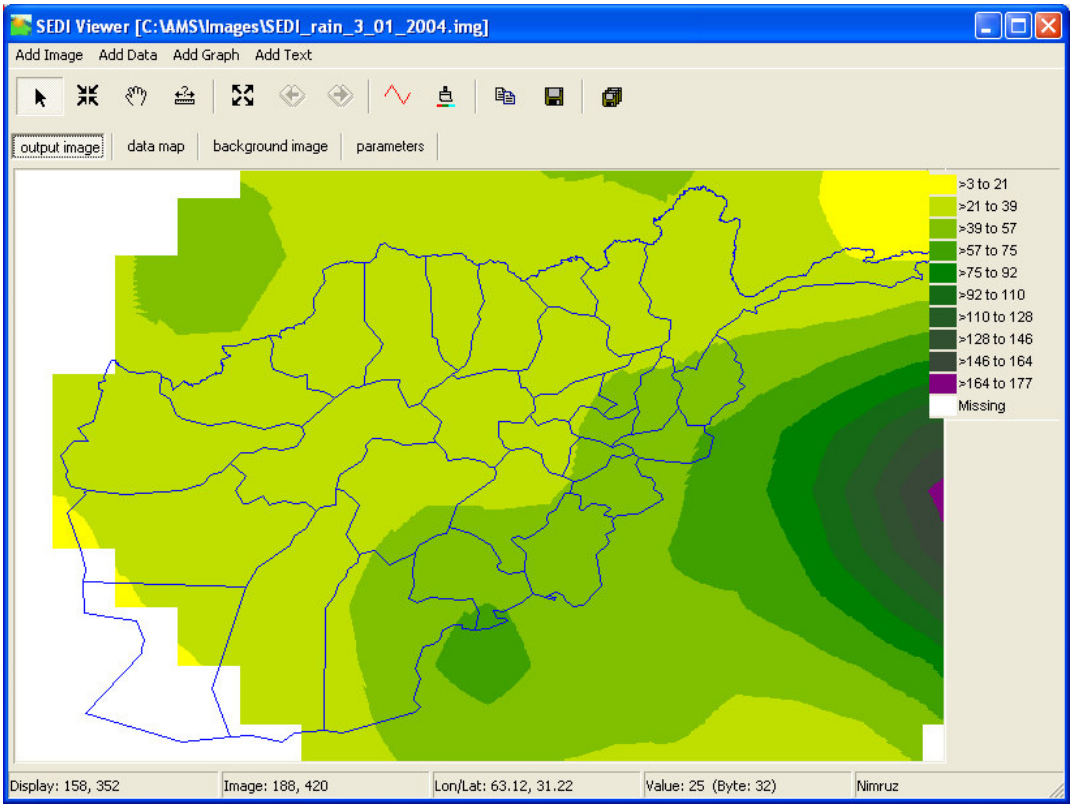


Line_No	Lon	Lat	column_3	
1	67.82	34.82	9.4	"Bamyan"
2	71.33	35.10	46.0	"Asmar"
3	65.25	34.52	-999	"Cheghcharan"
4	69.11	34.45	33.7	"Darulaman"
5	70.62	36.86	-999	"Faizabad"
6	62.80	32.37	-999	"Farah"
7	69.23	33.62	37.0	"Gardiz"
8	67.76	36.45	-999	"Hirat"
9	69.25	35.13	39.0	"Jabulsaraj"
10	70.46	34.41	-999	"Jalalabad"
11	69.20	34.55	-999	"Kabul"
12	65.68	31.60	-999	"Kandahar"
13	69.50	34.62	44.9	"Kariz Mir"
14	70.50	36.66	30.0	"Keshem"
15	70.20	34.65	-999	"Laghman"
16	69.05	34.10	32.6	"Logar"
17	64.77	35.93	-999	"Maimana"
18	67.20	36.70	-999	"Mazarisharif"
19	68.98	34.57	69.0	"Paghman"
20	67.96	36.05	-999	"Qala-e-naw"
21	65.12	36.95	-999	"Sheberghan"

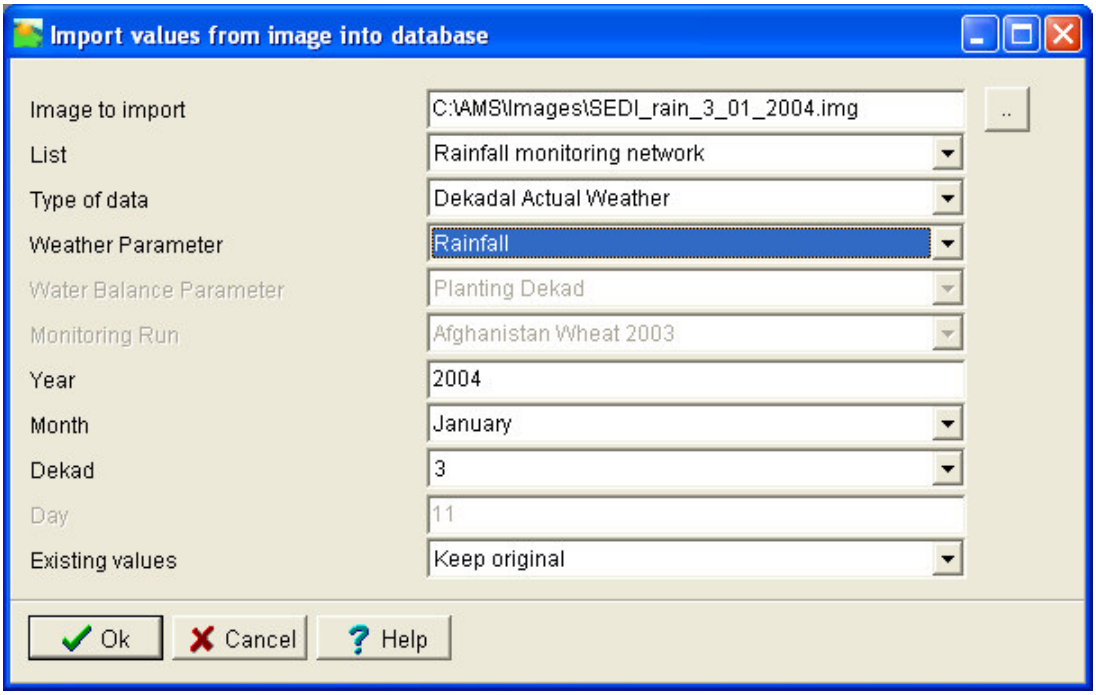
Use this image in a SEDI interpolation ("*Interpolation – SEDI – Inverse Distance*") with the measured data:



The following SEDI estimated image is produced:



Use this image to extract data to the database with the "*Database – Import – From Image*" function:



Check the data with the "*Data inventory*" function.

8 The water balance

In early warning for food security we need an understanding of the condition of crops. Crops are dependent on water, and water is scars in many developing countries. Especially in semi-arid countries water is the most important factor determining crop yield.

FAO has developed a simple method based on a water balance calculation scheme that will help you determine whether crops have enough water to achieve a projected yield. The outcome of a water balance calculation is an index that roughly represents the percentage of needed water the plant has received during its cycle. In semi-arid areas this index is closely related to yield, presuming no other limiting factor is in place (such as crop diseases).

Besides the index many other useful parameters are calculated from the water balance. Very informative are:

- Actual evapotranspiration. In a number of cases yield is more closely related to actual evapotranspiration than to the WSI index.
- Water storage in the soil
- Water excess and shortage

This manual will not provide details concerning the background of the water balance calculation. You can find a manual on the FAO website. The water balance model is usually run on a dekadal (10-day) basis, although running it on a daily basis is possible. This will also be the time-step we will assume for the following section.

Calculating the water balance with AMS is a station based activity. Afterwards, the outcome of the calculations can easily be converted into images and aggregated by province/district to compare to yield data.

8.1 Data availability check

For the calculation of the water balance you need the following information:

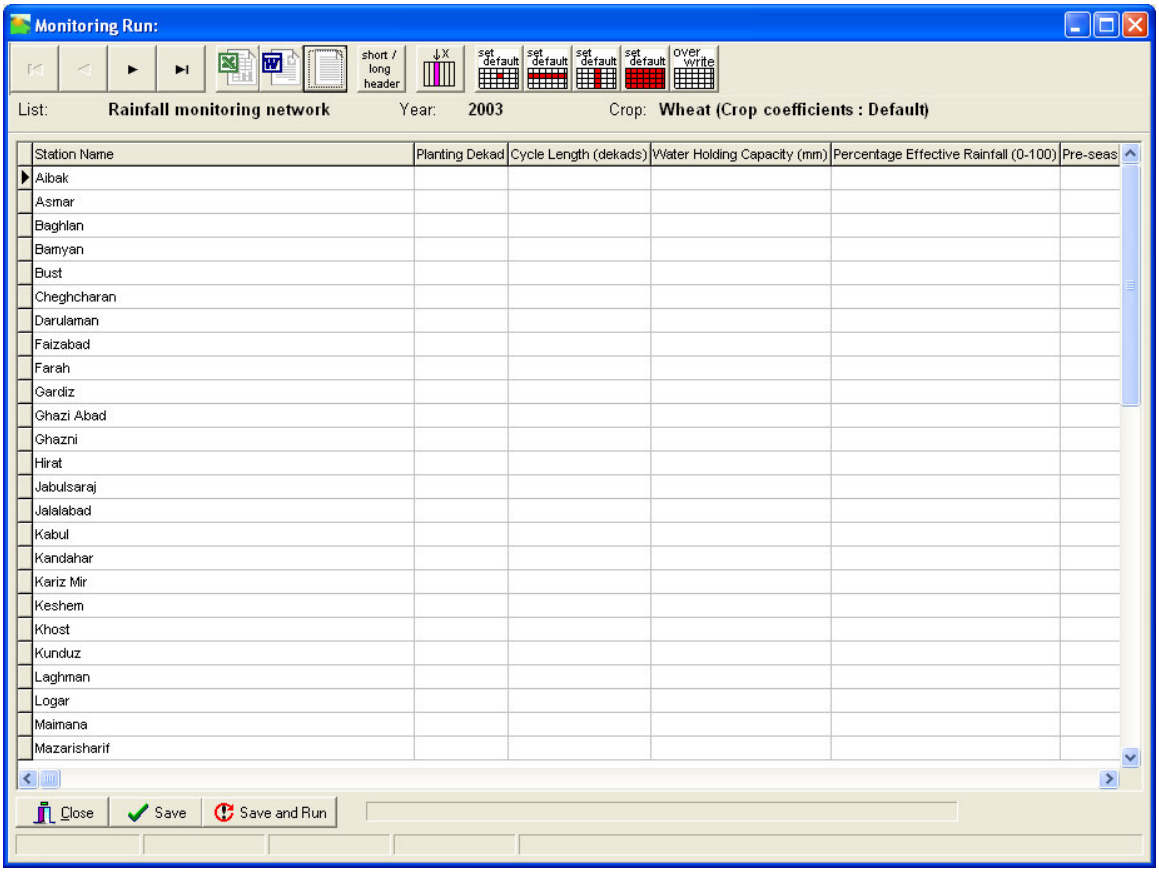
1. **Dekadal Actual Rainfall**
2. **Dekadal Normal Rainfall**
3. **Dekadal actual PET**. PET can be calculated from temperature, windspeed, humidity and other parameters that are only available from full-blown weather stations. Often actual PET data are not available. In that case normal PET data can be used with little damage to the accuracy of the water balance method.
4. **Dekadal normal PET.**
5. **Crops.** Which crops are grown? Each crop has its own crop coefficients.
6. **Planting dekads**. In which dekad planting occurred?
7. **Cycle length** of the crops grown.
8. **Water Holding Capacity** of the soil**.**

9. **Percentage Effective Rainfall.** This parameter is non-essential and is usually kept at 100%
10. **Pre-season crop coefficient.** This is the "*crop*" coefficient related to bare soil.
11. **Irrigation amounts.** This setting is very important for use in Afghanistan as half of the crops are irrigated.

8.2 Preparing a water balance

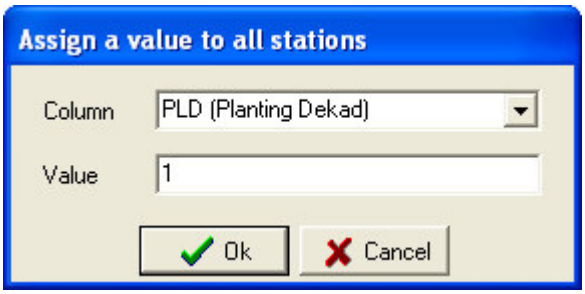
After checking the availability of data for Afghanistan we can prepare a water balance. Activate the "*Water Balance – Monitoring Run – New*" function. The following window is shown:

We specify a new name for the run. We choose "*Afghanistan Wheat 2003*". We will use the rainfall monitoring network in 2003 as a basis for the weather data. The selected crop is wheat. This crop is cultivated in almost all districts of Afghanistan, partly supplied with water trough irrigation. In the following screen you can enter all the data needed for the water balance. The rainfall and PET are entered elsewhere (see previous chapters).



Let us set up an "over-simplified" example and assign the same values to all stations. We will refine the water balance later. Put the cursor in the planting dekad column and press the following button:

We will assign the value of 1 to the planting dekad. This means that we assume that the wheat crop is planted in the first dekad of January for all stations in the list.

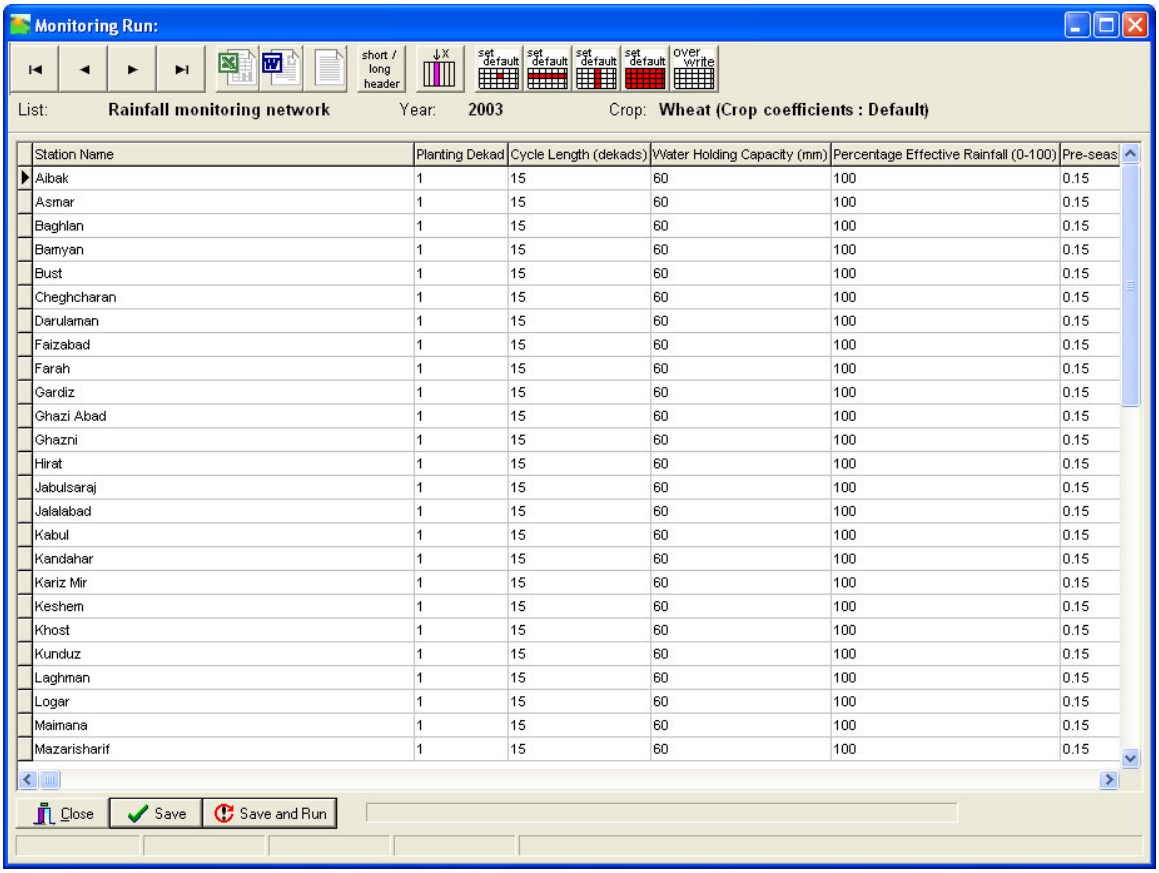


Press Ok. The planting dekad column is filled with the value 1. Do the same for the following columns. We assign the following values to the next columns:

- Cycle length : 15 dekads

- ❖ Water Holding Capacity of the soil : 60 mm
- ❖ Percentage effective rainfall : 100 %
- ❖ Pre-season Kcr : 0.15
- ❖ Irrigation application : 0 (this means NO irrigation)
- ❖ Irrigation bund height : 0

In the end the window is filled as follows:

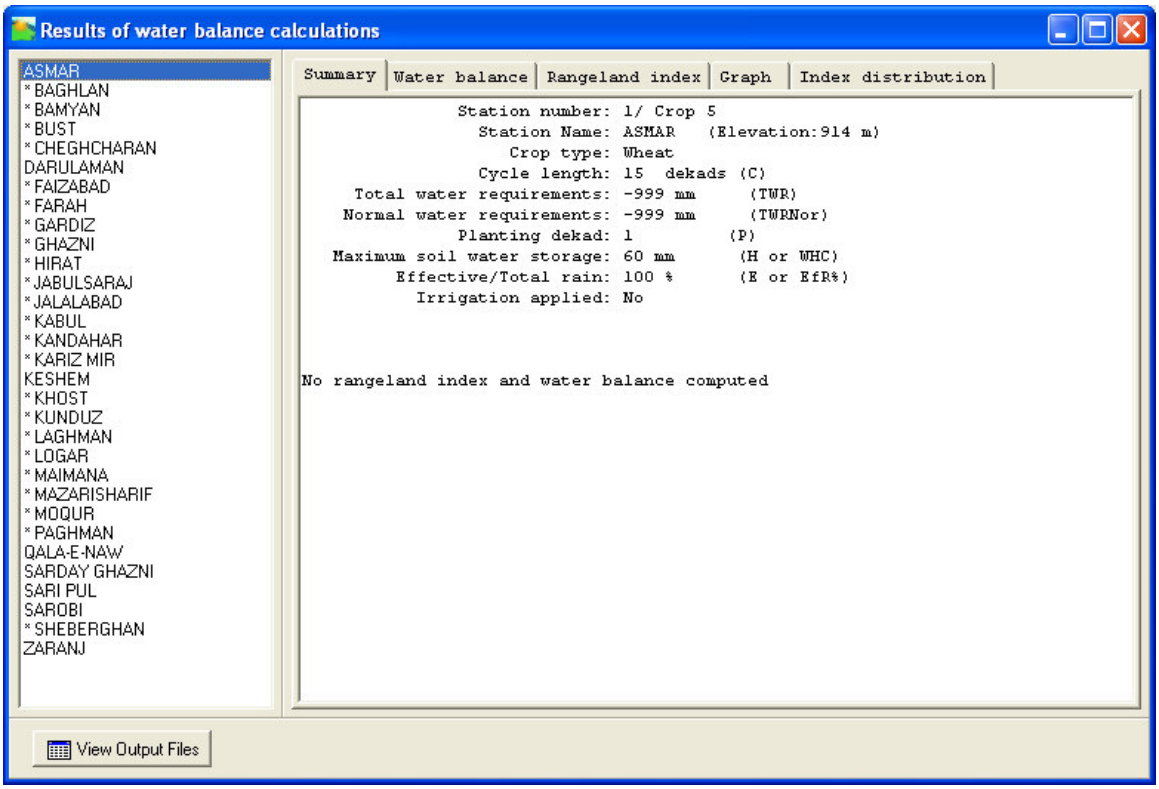


Station Name	Planting Dekad	Cycle Length (dekads)	Water Holding Capacity (mm)	Percentage Effective Rainfall (0-100)	Pre-seas
Aibak	1	15	60	100	0.15
Asmar	1	15	60	100	0.15
Baghlan	1	15	60	100	0.15
Bamyan	1	15	60	100	0.15
Bust	1	15	60	100	0.15
Cheghcharan	1	15	60	100	0.15
Darulaman	1	15	60	100	0.15
Faizabad	1	15	60	100	0.15
Farah	1	15	60	100	0.15
Gardiz	1	15	60	100	0.15
Ghazi Abad	1	15	60	100	0.15
Ghazni	1	15	60	100	0.15
Hirat	1	15	60	100	0.15
Jabulsaraj	1	15	60	100	0.15
Jalalabad	1	15	60	100	0.15
Kabul	1	15	60	100	0.15
Kandahar	1	15	60	100	0.15
Kariz Mir	1	15	60	100	0.15
Keshem	1	15	60	100	0.15
Khost	1	15	60	100	0.15
Kunduz	1	15	60	100	0.15
Laghman	1	15	60	100	0.15
Logar	1	15	60	100	0.15
Maimana	1	15	60	100	0.15
Mazarisharif	1	15	60	100	0.15

8.3 Running the Water balance

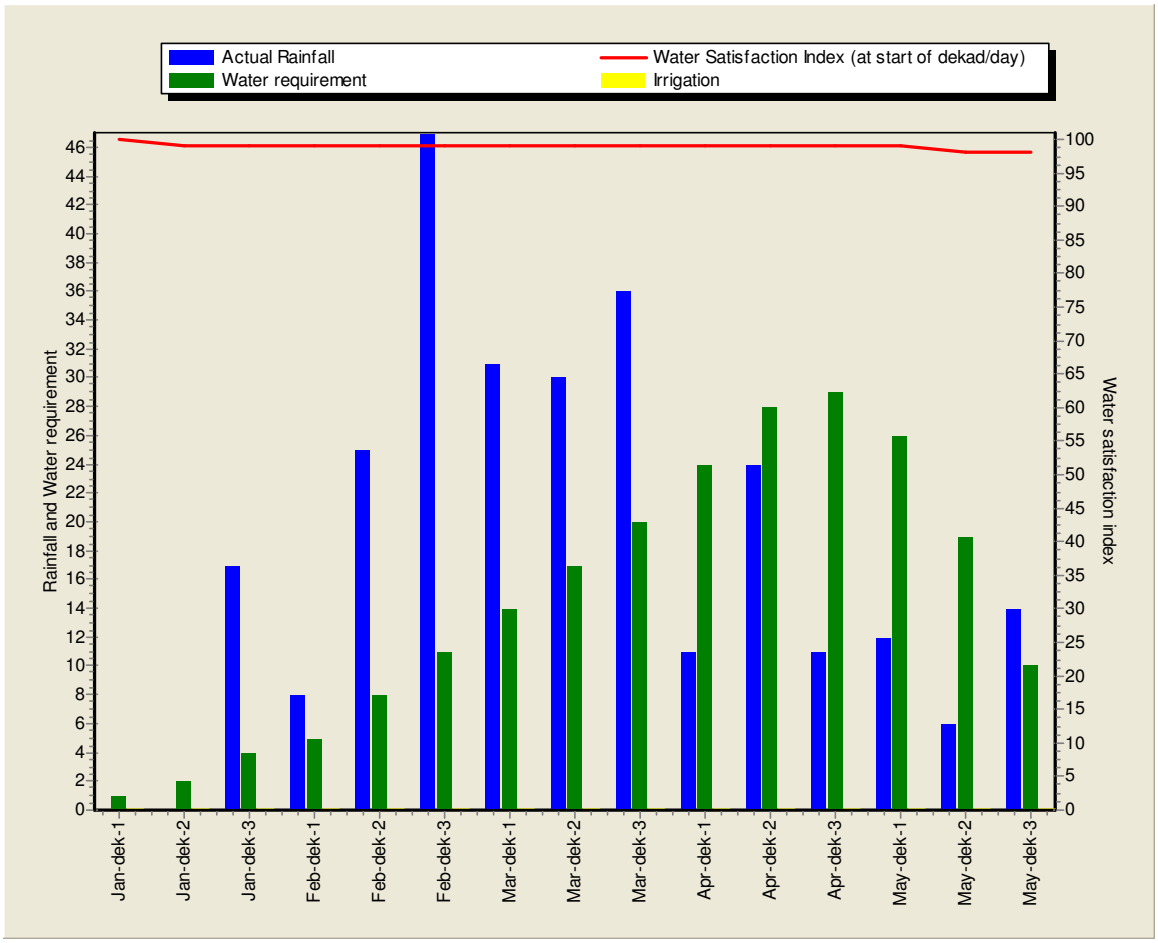
Press the "*Save and Run*" button. Fill the resulting screen as follows:

Press OK and the water balance is calculated. After some calculations we see:



The left side of the screen gives the name of the stations. The stations Asmar is selected. For this station, the calculations could not be finished, due to lack of weather data. Stations for which a water balance is successfully calculated have a "*" in front of the name.

Inspect the water balance graph for Baghlan:



The table with the calculations is written under the "*Water Balance"* Tab:

DATE	NOR	ACT	WRK	IRR	PET	KCR	WR	AvW	SW	S/D	INDEX
Jan-dek-1	10	0	0	0	5	0.12	1	-1	0	-1	100
Jan-dek-2	10	0	0	0	4	0.46	2	-2	0	-2	99
Jan-dek-3	11	17	17	0	5	0.74	4	13	13	0	99
Feb-dek-1	12	8	8	0	6	0.87	5	3	16	0	99
Feb-dek-2	14	25	25	0	8	1.01	8	17	33	0	99
Feb-dek-3	17	47	47	0	10	1.07	11	36	60	9	99
Mar-dek-1	20	31	31	0	13	1.07	14	17	60	17	99
Mar-dek-2	22	30	30	0	16	1.07	17	13	60	13	99
Mar-dek-3	23	36	36	0	19	1.07	20	16	60	16	99
Apr-dek-1	22	11	11	0	22	1.07	24	-13	47	0	99
Apr-dek-2	19	24	24	0	26	1.07	28	-4	43	0	99
Apr-dek-3	16	11	11	0	31	0.92	29	-18	25	0	99
May-dek-1	12	12	12	0	38	0.68	26	-14	11	0	99
May-dek-2	7	6	6	0	44	0.44	19	-13	0	-2	98
May-dek-3	3	14	14	0	48	0.20	10	4	4	0	98

Phase	ETAt	Surplus	Deficit
Initial	0	0	-3
Vegetative	17	0	0
Flowering	114	55	0
Ripening	82	0	-2

Surplus: 55mm (WEXt) Deficit: 5mm (WDEFt)
ETAt: 213mm % data avail:100% (%AVAIL)
Norm.index: 100% (INDXn)

8.4 Refining the water Balance

We have just completed a very simple Water Balance calculation. We have assigned the same values to the water balance parameters for all stations. In this paragraph we will discuss the possibilities to make the water balance calculation more realistic.

8.4.1 Filling Data gaps

First of all we have to try to fill gaps in the data. In the previous chapter we have seen that we do not have enough ground data for Asmar. In the following order we should try to do the following:

- Try again to get the data from the station and enter them in AMS. Measured values are always best.
- If you lack rainfall or PET data, extract the data from the 10-day data provided by ISPRA. Rainfall is in column J. PET is in column K.

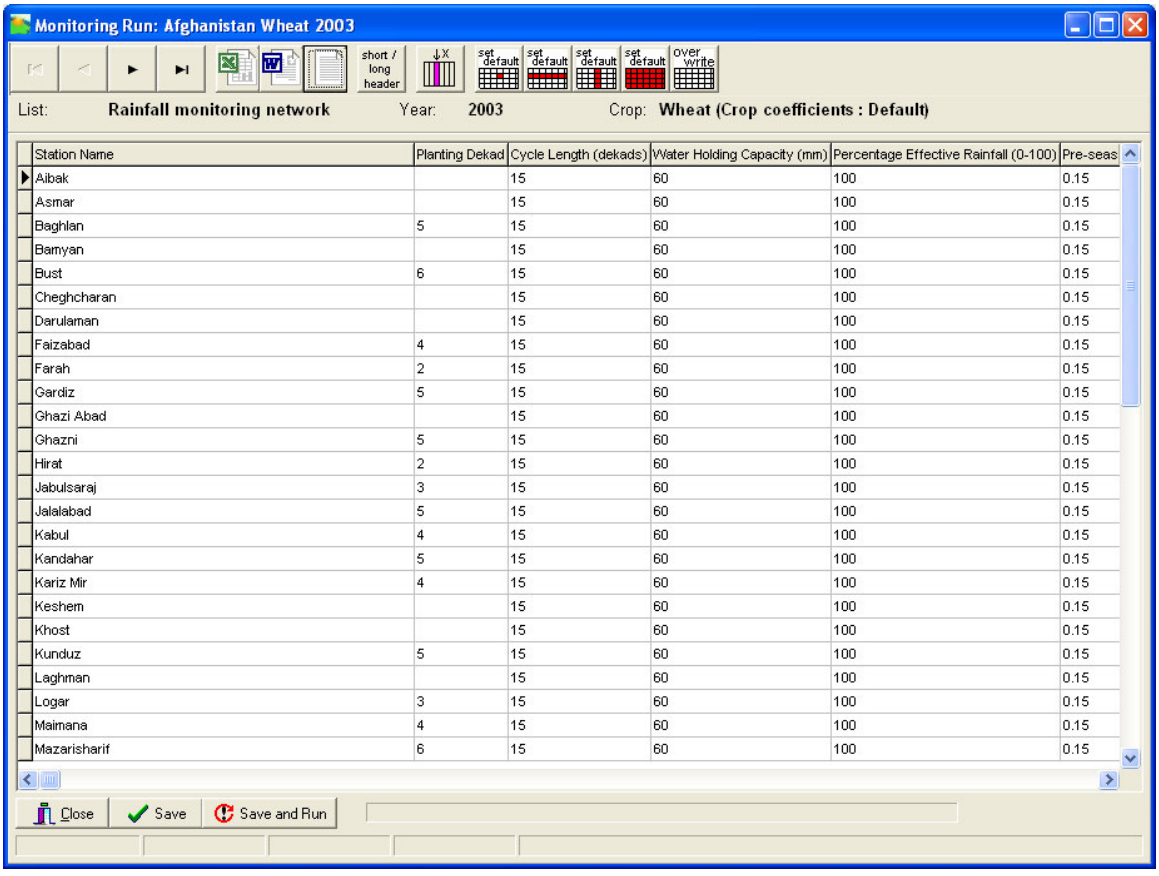
Col	Parameter Description	Param	Unit
J	Precipitation (Rainfall cumulated for the 10 days period)	rain10	mm
K	Potential Evapo-Transpiration (cumulated for the 10 days period)	pet10	Mm

  Please note that these data should always be second choice! Therefore never overwrite ground data. Furthermore, mark the data with "E" for "estimate". Should ground data come in at a later stage, replace the satellite data with ground data in AMS.
- If you cannot achieve any of the above solutions, you can use the function "*Tools – Interpolate for missing data*" to interpolate for missing data.
- Another method is by creating an image using one of the interpolation techniques (see "*Interpolation*" menu) and extracting values from this image into the database (function "*Database – Import – From image*"). This has previously been described.

8.4.2 Calculate planting dates

Measured values are always the best data around. So if you have planting dates for Afghanistan you should enter them. However a good approximation of planting dates can be figured out with rainfall records. Planting usually occurs as a result of rainfall exceeding a certain amount. We can let AMS calculate the planting dates for us, based on this simple algorithm. Activate the "*Water Balance – Monitoring Run – Calculate planting dekads – Based on Rainfall Threshold*" function. We will assume that planting occurs when 20 millimeters of rainfall have been exceeded.

Press OK. Notice that the planting dekads van changed from 1 into other dekads. Whenever the 20 mm rainfall threshold between January 1 and July 31 is not exceeded, the planting date is made "*missing value*"



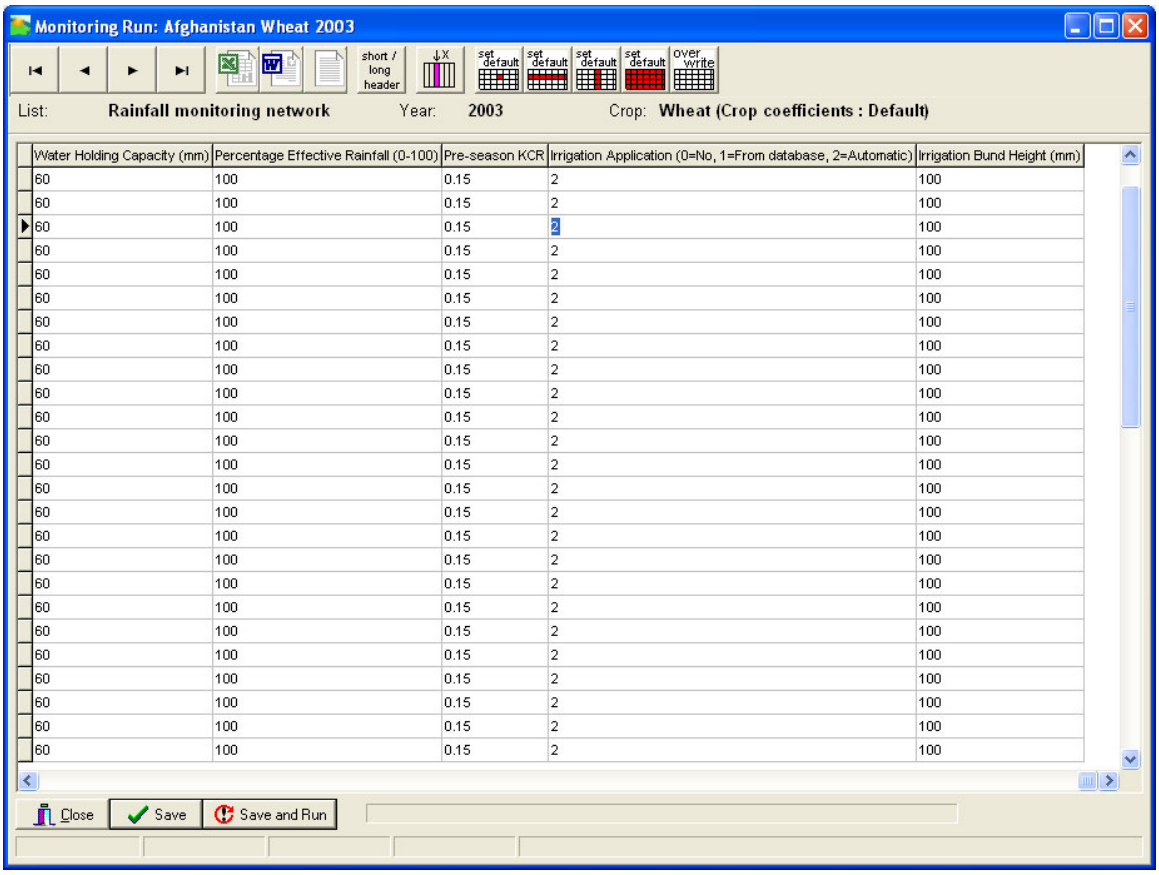
Station Name	Planting Dekad	Cycle Length (dekads)	Water Holding Capacity (mm)	Percentage Effective Rainfall (0-100)	Pre-seas
Aibak		15	60	100	0.15
Asmar		15	60	100	0.15
Baghlan	5	15	60	100	0.15
Bamyan		15	60	100	0.15
Bust	6	15	60	100	0.15
Cheghcharan		15	60	100	0.15
Darulaman		15	60	100	0.15
Faizabad	4	15	60	100	0.15
Farah	2	15	60	100	0.15
Gardiz	5	15	60	100	0.15
Ghazi Abad		15	60	100	0.15
Ghazni	5	15	60	100	0.15
Hirat	2	15	60	100	0.15
Jabulsaraj	3	15	60	100	0.15
Jalalabad	5	15	60	100	0.15
Kabul	4	15	60	100	0.15
Kandahar	5	15	60	100	0.15
Kariz Mir	4	15	60	100	0.15
Keshem		15	60	100	0.15
Khost		15	60	100	0.15
Kunduz	5	15	60	100	0.15
Laghman		15	60	100	0.15
Logar	3	15	60	100	0.15
Maimana	4	15	60	100	0.15
Mazarisharif	6	15	60	100	0.15

"*Save and Run*" the Water balance to see the results.

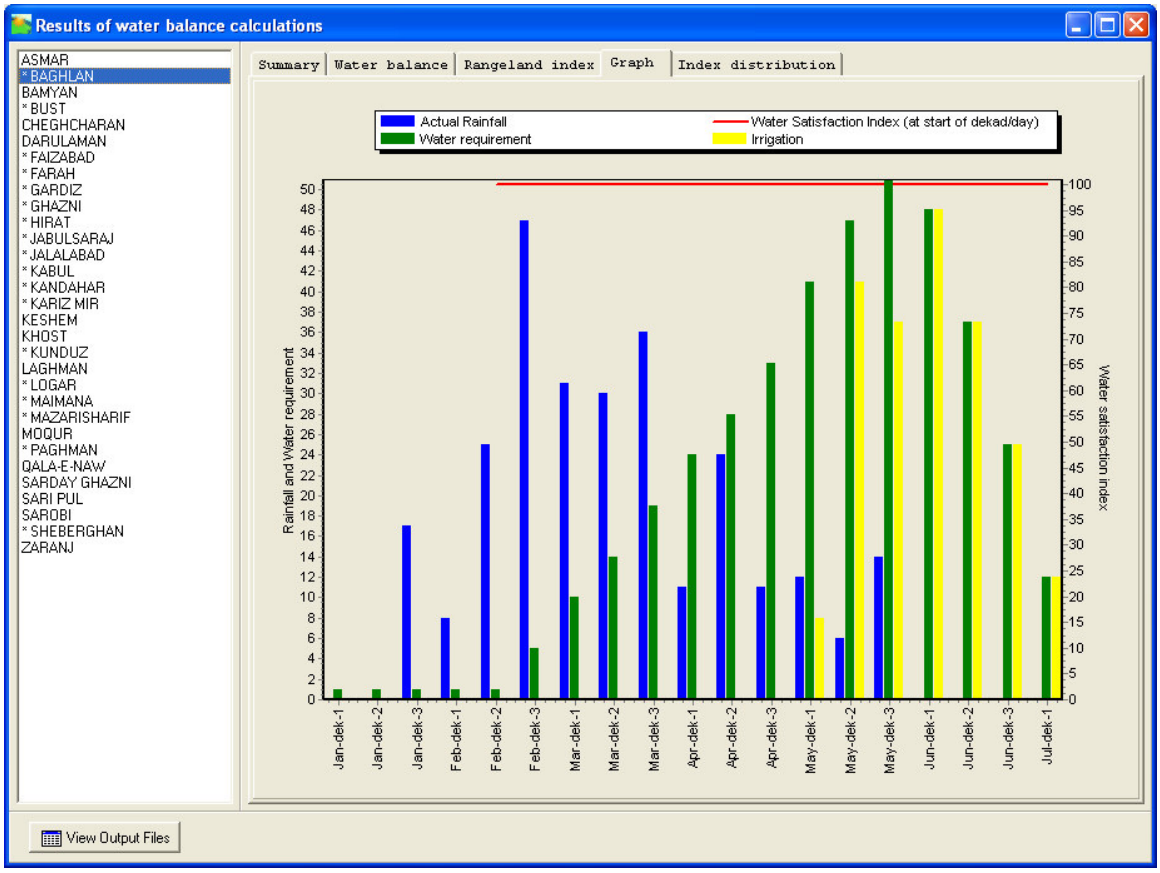
8.4.3 Adding Irrigation

In Afghanistan, irrigation is applied to roughly 50 % of the cropped area. In many places a crop would never reach maturity without irrigation. AMS gives the user the possibility to add irrigation to a crop at a certain station. AMS provides two methods of irrigation:

Automatic irrigation.
This type of irrigation will ensure that the crop will never experience water stress. Therefore the final index will always be 100. This type of calculation is useful as it calculates the actual evapotranspiration without water stress. This parameter is closely related to crop yield. Furtermore it also tells you how much water the crop uses to mature. On this knowledge irrigation amounts can be based. Automatic irrigation can be switched on by entering a "2" in the "*Irrigation Application"* field of the Water Balance.

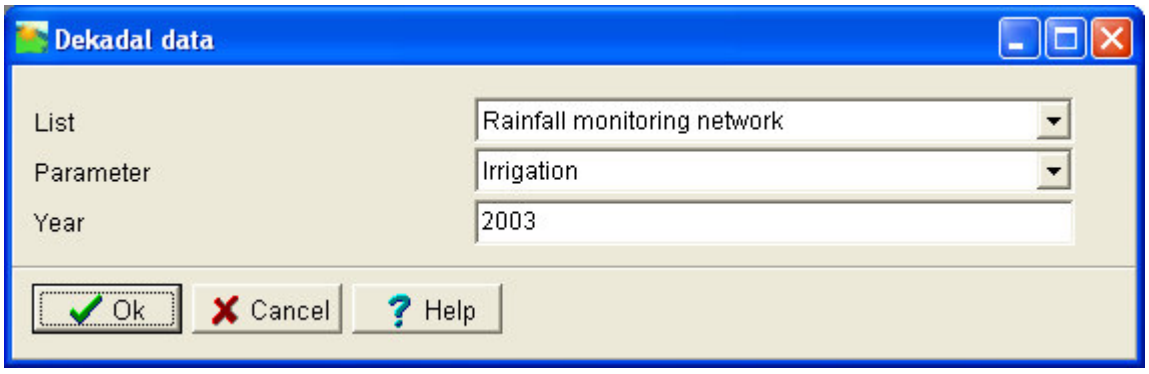


"*Save and Run*" the water balance to see the result. Yellow bars in the graph indicate the application of automatic irrigation.

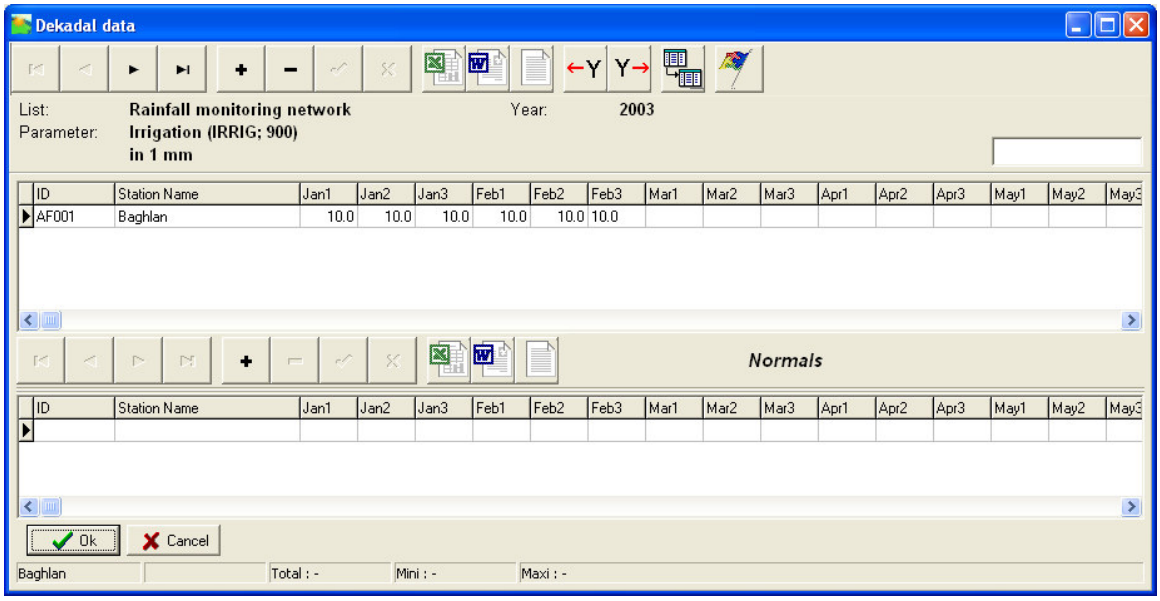


Manual irrigation.
In this case the irrigation is applied manually for each station. In AMS irrigation is considered a meteorological parameter that can be entered using the weather parameter input screens.

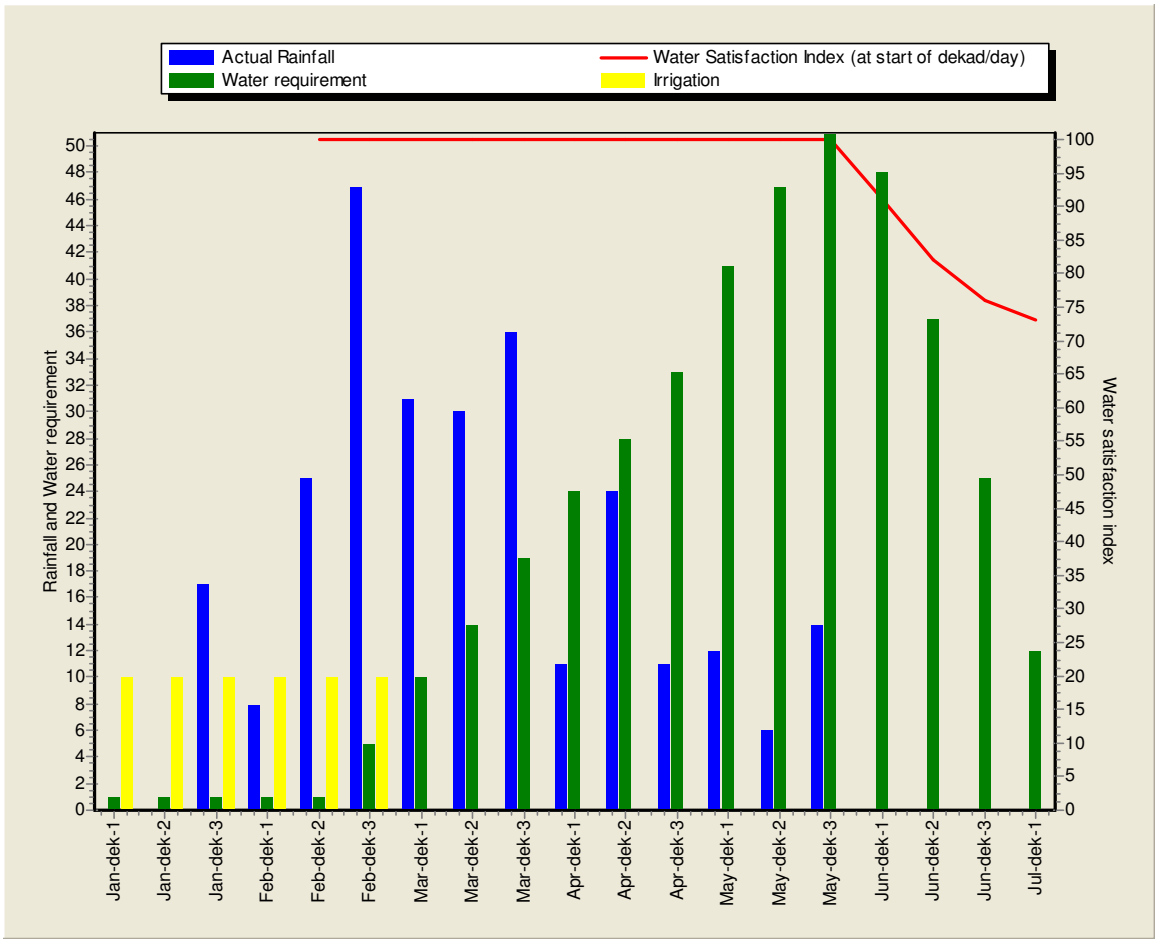
Enter dekadal irrigation amounts in the following way:
Go to the option : "*Database – Manage Weather Data - Dekad*". Specify for example the following settings:



Press Ok. Enter the irrigation amounts in the same way as you would enter rainfall.



Press OK, Activate the "*Water Balance – Monitoring Run - Edit*" option and change the "*Irrigation Application"* field of the Water Balance sheet to 1. By pressing "*Save and Run*" we calculate the water balance with these amounts of irrigation. The viewer will show the following results:



Notice the yellow bars on the left side of the screen.

8.5 From Water Balance results to yields

For Afghanistan the following steps should be taken to run the water balance as part of a crop forecasting activity:

As a separate preparing activity we calculate the water balances for every year in history for which we have sufficient data, calculate the index and establish a relationship between the index and the yield data obtained from the crop assessment missions and the National Statistical Office.

Then for the running season we do the following:

1. For every station in the network, establish the crops to be monitored. In Afghanistan the crops are wheat, rice and perhaps maize and barley.
2. For every station in the network establish early, average and late planting dates and corresponding cycle lengths.
3. Make separate monitoring runs for 2 crops and 3 planting dates, so in this case 6 runs.
4. Throughout the season re-calculate the water balance whenever new data are received. The water balance always calculates the predicted final index.
5. Report on crop monitoring in the dekadal bulletin in a non-technical way.

9 How to analyze data that have a different geographical format

Basically data come to crop forecasting officers in three different ways:

1. As **point data** (usually by stations). E.G. Rainfall data and other parameters (temperatures etc..) reach Kabul is this way from the field stations. The data from ISPRA are in tabular form as well…
2. By **province** or **district** (technically called polygon data)**.** Yield data are an example of this type of data.
3. By **image** (technically called raster or grid data). As an example: we have images for NDVI, we have an altitude image, we have created images with AMS (e.g. SEDI)

Now, you can only analyze and integrate datasets if the data are in same geographical format. So, if you want to analyze your data, select one of the three basic formats described above. The following paragraphs are an overview of these three data formats and how to get the data from other formats into the right geographic format.

9.1 Analyzing information on station level

Station data are easy to work with. You enter the in AMS and you can use AMS, Windisp and Excel to analyze the data. You can present the station data on a map using Windisp, AMS or ArcView. The disadvantage of working with station data is the lack of overview. There is no approximation of the parameters for areas in between the stations. However, you could work with station data as long as the analysis takes place and convert the station data into images for presentation of the results and an estimation of "what happens" in between the stations.

If you have **data by province or district** you can convert them into point data as follows:

1. Assign values to districts and provinces. Make an image of the province/districts data with the AMS function "*Tools – Assign Image Values Within Boundaries*"
2. Extract values for your stations into the database with the AMS function "*Database – Import - From image*". If the parameter does not exist in the database, you will have to define a new parameter in AMS using the "*Database – Configure – Parameter Definitions*" function.
3. If you want to do an analysis in Excel, export the data using the AMS function "*Tools – Make input file from database*" or the "*Database – Report*" function.

If you have data **by image** you essentially do the same:

1. Take the image and extract values for your stations into the database with the AMS function using the function "*Database – Import - From image*". Again, if the parameter does not exist in the database, you will have to define a new parameter in AMS.
2. If you want to do an analysis in Excel, export the data using the AMS function "*Tools – Make input file from database*" or the "*Database – Report*" function.

9.2 Analyzing information on province/district level (area averaging)

For the analysis of this type of data you use AMS, Windisp and Excel. ArcView is another possibility. ArcView essentially uses this type of information (polygonal). So, if you plan to work with ArcView this is probably the preferred geographical format to bring your data in.

If you have **station data** and you have to aggregate them to provinces and districts, you do the following:

1. Make an image of the point data using any of the functions in the AMS "*Interpolate*" menu. You might want to use "*Interpolate – Inverse distance*" or (if you have a background field related to the parameter) you can use the SEDI functions.
2. Extract average values for the districts by using the Windisp function Process – Stats – Average. This will create an ASCII file with averaged values for your parameter by district/province.
3. Now you can use your data in Excel next to other data on province district level. If you are an expert in ArcView you might join the ASCII table to an ArcView shape file.

If you have **images** you essentially do this**:**

1. Extract average values for the districts by using the Windisp function Process – Stats – Average. This will create an ASCII file with averaged values for your parameter by district/province.

9.3 Analyzing information on image level

Analyzing information on this level has the advantage that all your (intermediate) products are highly graphical and show a country-wide picture. A disadvantage is that the information uses more hard disk space. However, the affordable huge hard disks of today make this disadvantage less important.

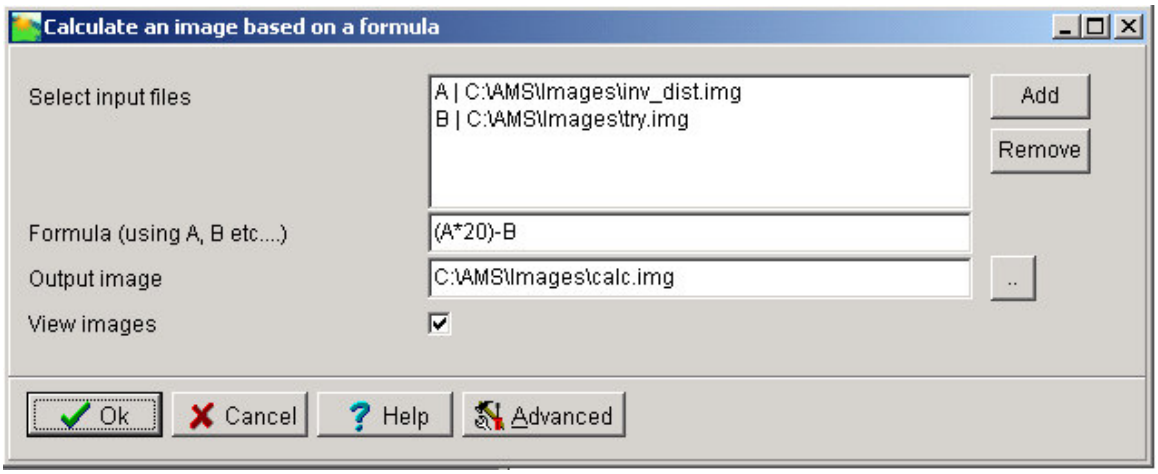
If you have **station data** you can make images in just 1 step:

1. Make an image of the point data using any of the functions in the AMS "*Interpolate*" menu. You might want to use "*Interpolate – Inverse distance*" or (if you have a background field related to the parameter) you can use the SEDI functions.

If you have **data by province or district** you can convert them into images with just one step:

1. Assign values to districts and provinces. Make an image of the province/districts data with the AMS function "*Tools – Assign Image Values Within Boundaries*"

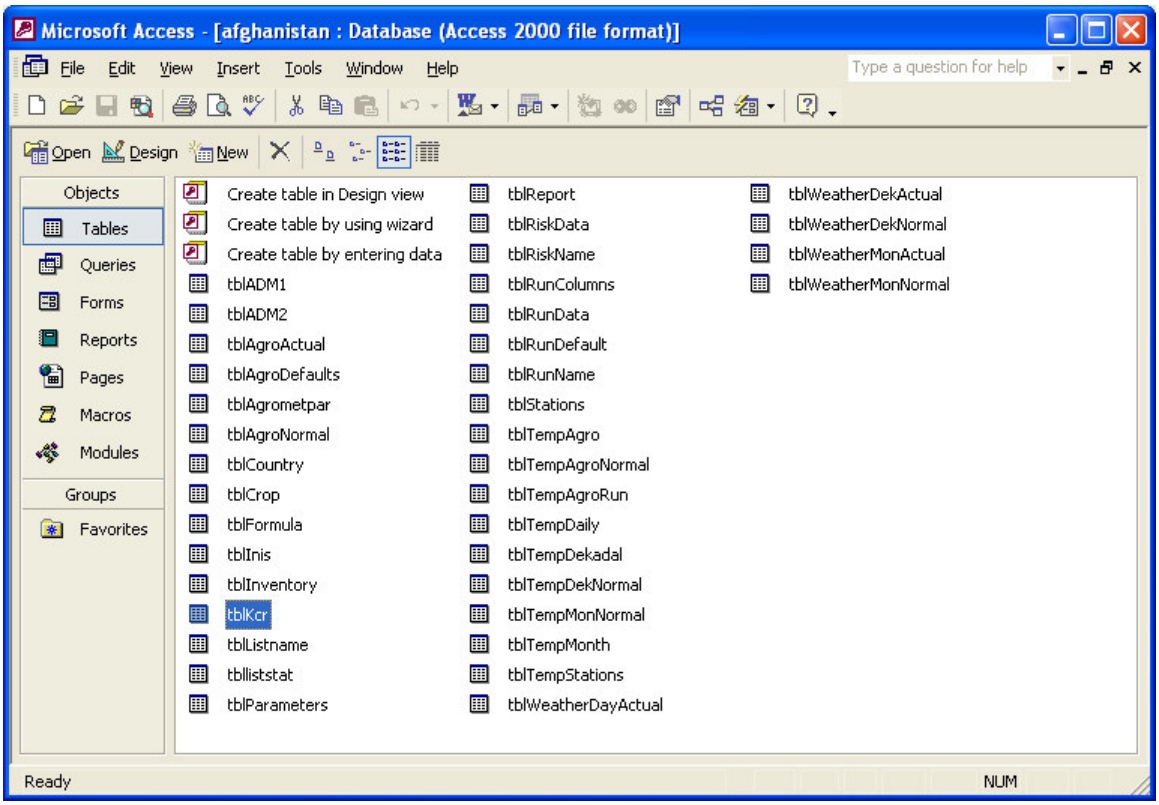
Working with images is not restricted to display only. Images can be subjected to adding, substracting and every possible other mathematical operation using the "*Tools – Image calculations with formula*" function:



10 Using Access with the AMS database

AMS stores all its data in the Access database that is underlying the program. AMS will enter and retrieve the data to this database for its own use. As a normal AMS user you do not need any knowledge about Access. But if you have some knowledge new ways of using the information

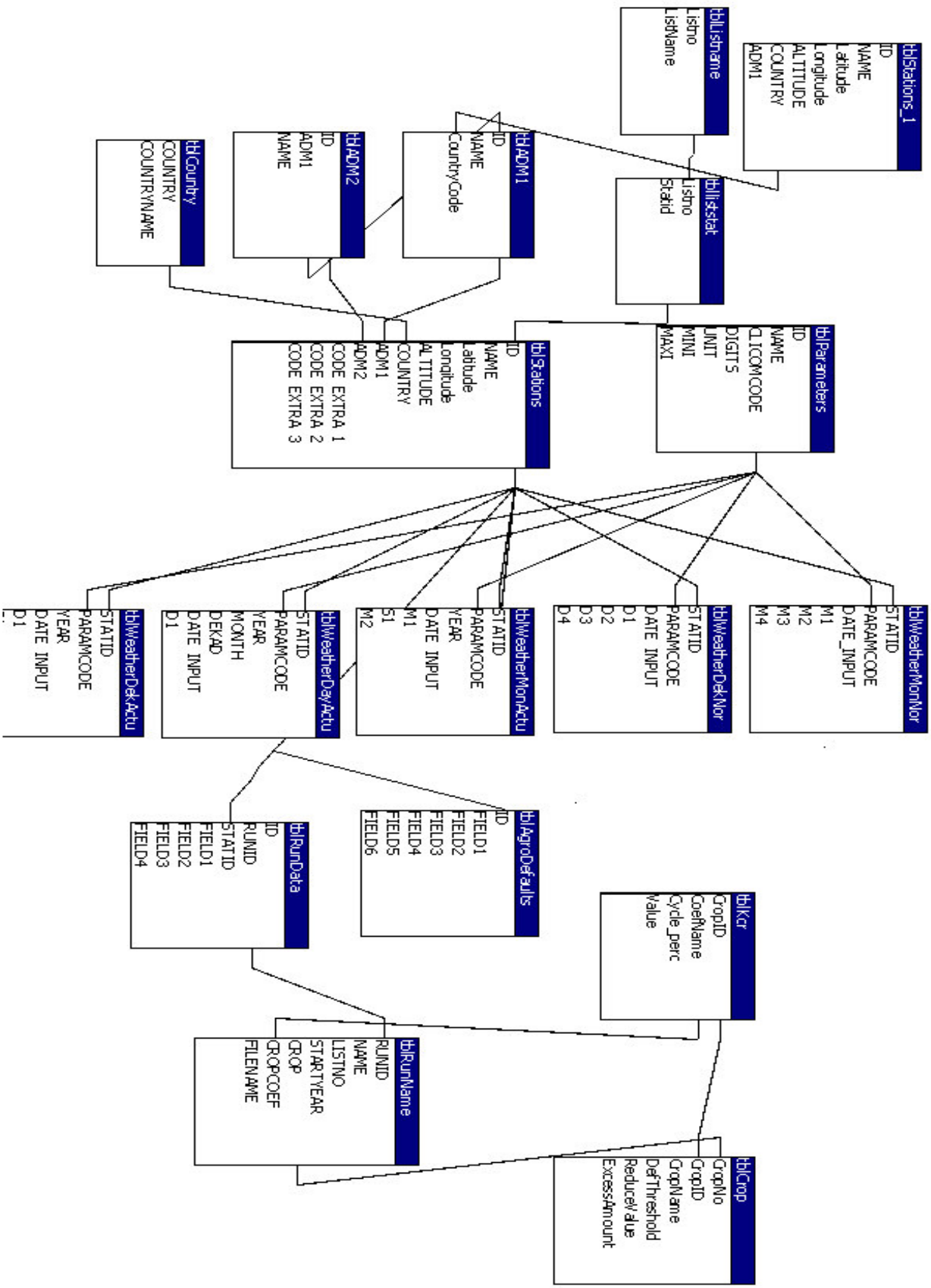
Simply double-click database file in the database directory to see the database in Access.. You will see the following:



This manual will not explain the use of Microsoft Access to you, but a few examples will be given.

10.1 The datamodel

First of all you need to understand the AMS datamodel. It is printed on the next page.

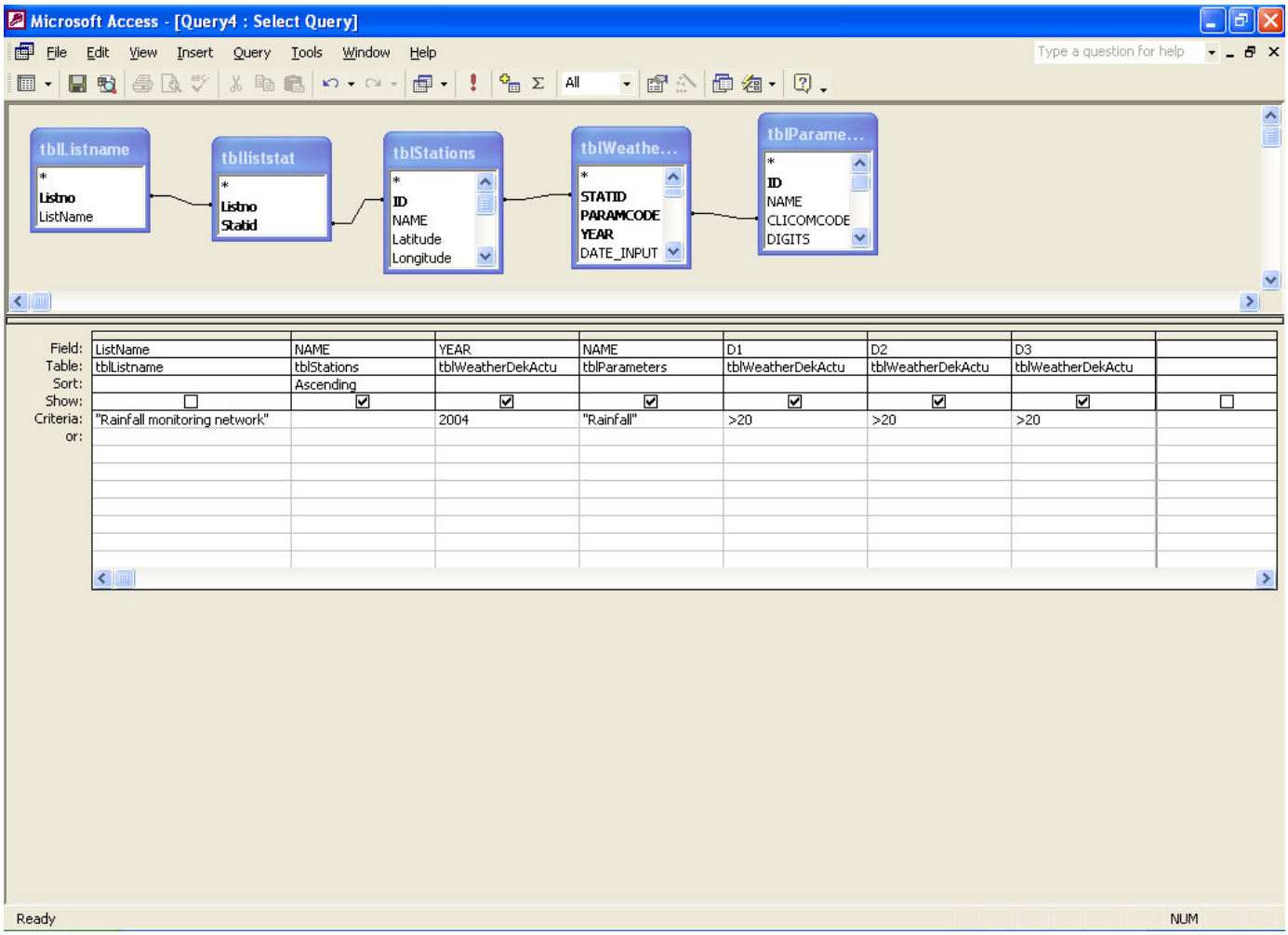

tblStations_1
ID
NAME
Latitude
Longitude
ALTITUDE
COUNTRY
ADM1
tblListname
Listno
ListName
tblliststat
Listno
Statid
tblADM1
ID
NAME
CountryCode
tblADM2
ID
ADM1
NAME
tblCountry
COUNTRY
COUNTRYNAME
tblStations
ID
NAME
Latitude
Longitude
ALTITUDE
COUNTRY
ADM1
ADM2
CODE EXTRA 1
CODE EXTRA 2
CODE EXTRA 3
tblParameters
ID
NAME
CLICOMCODE
DIGITS
UNIT
MINI
MAXI
tblWeatherMonNor
STATID
PARAMCODE
DATE_INPUT
M1
M2
M3
M4
tblWeatherDekNor
STATID
PARAMCODE
DATE INPUT
D1
D2
D3
D4
tblWeatherMonActu
STATID
PARAMCODE
YEAR
DATE INPUT
M1
S1
M2
tblWeatherDayActu
STATID
PARAMCODE
YEAR
MONTH
DEKAD
DATE INPUT
D1
tblWeatherDekActu
STATID
PARAMCODE
YEAR
DATE INPUT
D1
tblAgroDefaults
ID
FIELD1
FIELD2
FIELD3
FIELD4
FIELD5
FIELD6
tblRunData
ID
RUNID
STATID
FIELD1
FIELD2
FIELD3
FIELD4
tblKcr
CropID
CoefName
Cycle_perc
Value
tblRunName
RUNID
NAME
LISTNO
STARTYEAR
CROP
CROPCOEF
FILENAME
tblCrop
CropNo
CropID
CropName
DefThreshold
ReduceValue
ExcessAmount

The full functionality of Microsoft Access (including reports and queries) is now under you fingertips.

10.2 Queries and reports

You can make queries easily in the following way:

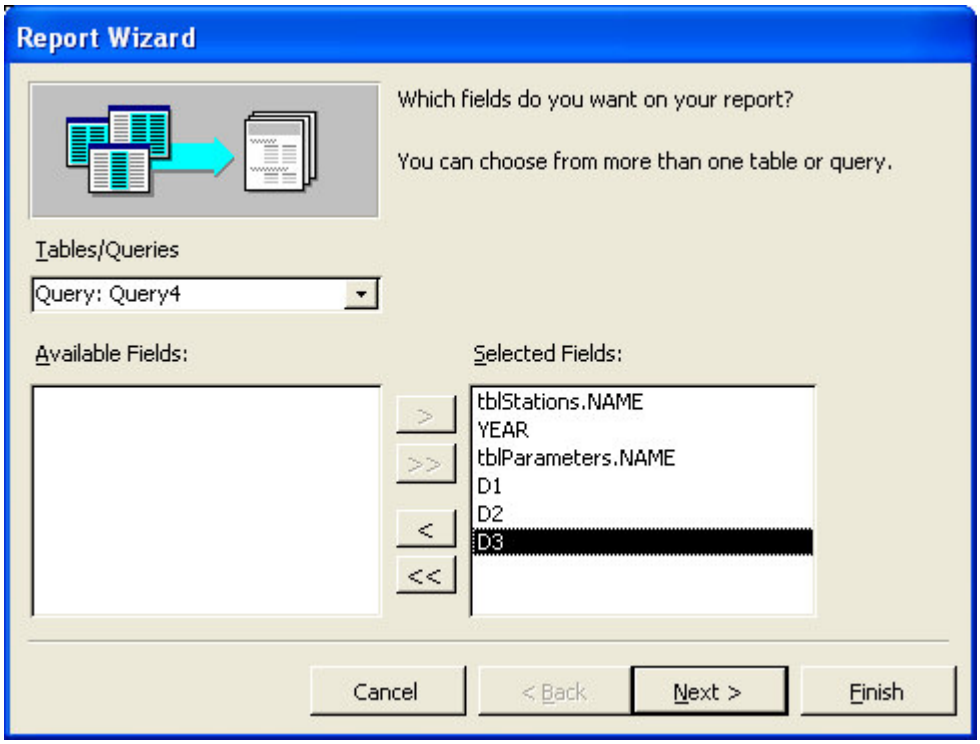
Press Queries. We will make a query that will show us all stations of the Rainfall monitoring network that have rainfall exceeding 20 millimeters every dekad in the month of January 2004.



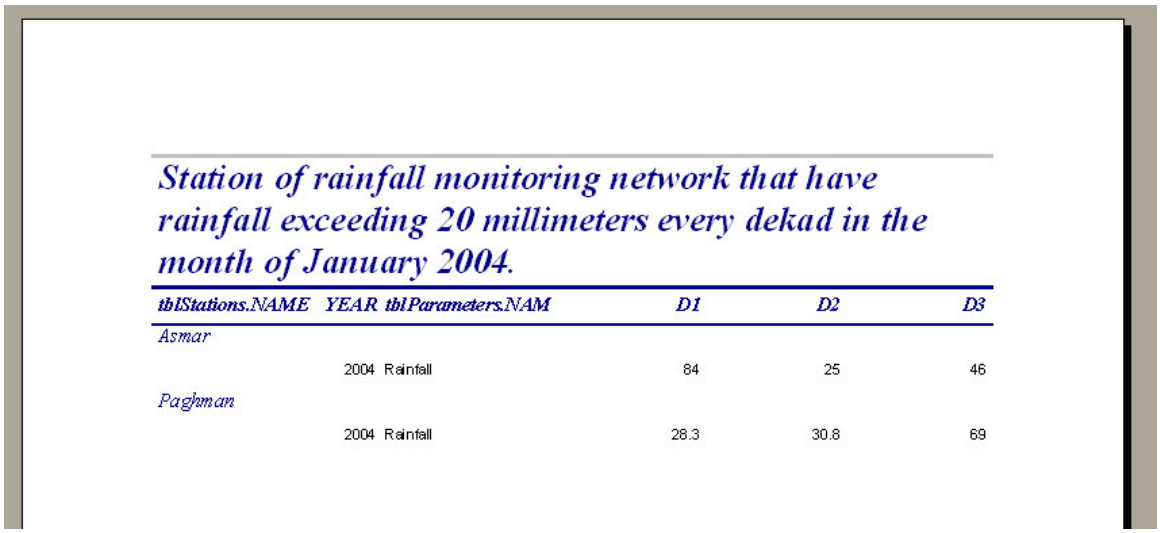
The result is :

	tblStations.NAME	YEAR	tblParameters.NAME	D1	D2	D3
▶	Asmar	2004	Rainfall	84	25	46
	Paghman	2004	Rainfall	28.3	30.8	69

From this result we can make a report. First save the (Query4). Then we activate the report wizard and specify all columns:



Press "*Finish*" and the results are shown:



Station of rainfall monitoring network that have rainfall exceeding 20 millimeters every dekad in the month of January 2004.

tblStations.NAME	YEAR	tblParameters.NAM	D1	D2	D3
Asmar					
	2004	Rainfall	84	25	46
Paghman					
	2004	Rainfall	28.3	30.8	69