



VGT4AFRICA Technical Note: ROI rounding

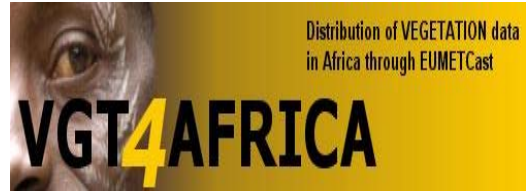


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1. General

1.1. *Scope*

To improve the usability of the products and to align the product ROIs to those already in use by the CILSS regional training center (AGHRYMET), it was proposed to round the ROIs (regions of interest) of the VGT4AFRICA products to integer degrees.

Before this ROI change can be made, we first wanted to evaluate the impact this ROI rounding has on the file size of the VGT4AFRICA products. Increased size will increase the time needed to download the products from the website, which is important for users with slow internet connections.

In this document, the results of the file size tests are presented.

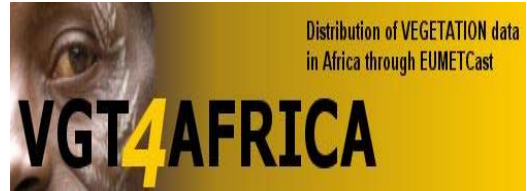
1.2. *Terms and abbreviations*

Terms	Description
Byte	Unit of binary data (8 bits).
KB	KiloByte. 1 KB = 1024 bytes
MB	MegaByte. 1 MB = 1024 KB.
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
ROI	Short for Region Of Interest. An ROI is a rectangular area on a map. For instance, a VGT image over Africa is said to have Africa as ROI.
SWB	Small Water Bodies
VGT	Short for Vegetation, the common name of 2 instruments aboard the SPOT4 and SPOT5 satellites.

1.3. *Impact of the tests*

If the conclusions based on this test indicate that the file size increase is small enough so that the ROI rounding can be done, then the following actions will be needed:

- change the ROI settings in the MySQL database of VITO's VGT4AFRICA processing system;
- reprocess the already created products and update the website accordingly;
- adapt the VGTEExtract pre-defined ROI settings and release the new VGTEExtract.



Please note that the products with Africa ROI, that are also distributed via EUMETCast, are not affected since they have always used a rounded ROI.

1.4. Revisions

Version	Revisions by	Description
1.0	VITO Tim Jacobs	Original document

1.5. Intended readers

This document is only intended for the VGT4AFRICA consortium only.

2. ROI rounding test

2.1. *Test description*

To conduct the test, a series of S10 NDVI, NDWI and SWB products were constructed with the rounded ROIs and their file sizes were compared to the sizes of the products currently made available (i.e. without the ROI rounding).

2.1.1. Test decades

For each product type tested, products were created for 5 decades, chosen based on data availability. The start dates of the chosen decades are as follows:

- for NDVI:
 - 2004-12-01
 - 2005-08-21
 - 2005-11-21
 - 2006-03-11
 - 2006-06-11
- for NDWI:
 - 2003-03-11
 - 2003-06-11
 - 2003-09-01
 - 2004-01-01
 - 2004-12-01
- for SWB:
 - 2004-07-01
 - 2004-08-01
 - 2004-09-21
 - 2004-11-01
 - 2004-12-01

2.1.2. ROI settings used

To assess the maximum file size increase (worst case scenario) incurred by ROI rounding, the minimum latitudes and longitudes of the ROI boundaries were rounded down to an integer degree and the maximum latitudes and longitudes were rounded up. The rounded ROI thus always fully includes the un-rounded ROI.

Please note that this rounding method does not necessarily correspond to the ROIs proposed by users (i.e. the CILSS ROIs from AGHRYMET). However, the actual file size increase incurred by using the user-proposed ROIs will be smaller than the results from this test.

An overview of the original ROI settings, the rounded ROI settings and the ROIs proposed by AGHRYMET is given in the following table. All latitudes and longitudes are given in decimal degrees.



ROI name	Original ROI settings		Rounded ROI settings		AGHRYMET	
	Long	Lat	Long	Lat	Long	Lat
Algeria	-8,67	18,96	-9	18	N/A	N/A
	11,98	37,09	12	38	N/A	N/A
Angola	11,68	-18,04	11	-19	N/A	N/A
	24,08	-4,37	25	-4	N/A	N/A
Benin	0,77	6,23	0	6	N/A	N/A
	3,85	12,42	4	13	N/A	N/A
Botswana	20	-26,91	20	-27	N/A	N/A
	29,36	-17,78	30	-17	N/A	N/A
Burkina Faso	-5,52	9,4	-6	9	-6,00	9,00
	2,41	15,08	3	16	3,00	16,00
Burundi	28,99	-4,47	28	-5	N/A	N/A
	30,85	-2,31	31	-2	N/A	N/A
Cameroun	8,49	1,65	8	1	N/A	N/A
	16,19	13,08	17	14	N/A	N/A
Cape Verde	-25,36	14,8	-26	14	-25,50	14,50
	-22,67	17,2	-22	18	-22,50	17,50
Central African Republic	14,42	2,22	14	2	N/A	N/A
	27,46	11,01	28	12	N/A	N/A
Chad	13,47	7,44	13	7	13,00	6,00
	24	23,45	24	24	25,00	24,00
Comoros	43,22	-13	43	-13	N/A	N/A
	45,24	-11,36	46	-11	N/A	N/A
Congo	11,21	-5,03	11	-6	N/A	N/A
	18,65	3,7	19	4	N/A	N/A
Democratic Republic Congo	12,21	-13,46	12	-14	N/A	N/A
	31,31	5,39	32	6	N/A	N/A
Djibouti	41,77	10,91	41	10	N/A	N/A
	43,42	12,72	44	13	N/A	N/A
Eastern Africa	26,2	-11,43	26	-12	N/A	N/A
	46,36	16,85	47	17	N/A	N/A
Egypt	24,7	21,73	24	21	N/A	N/A
	35,82	31,67	36	32	N/A	N/A
Equatorial Guinea	5,6	-1,46	5	-2	N/A	N/A
	11,34	3,79	12	4	N/A	N/A
Eritrea	36,44	12,36	36	12	N/A	N/A
	43,13	18	44	18	N/A	N/A
Ethiopia	33	3,4	33	3	N/A	N/A
	47,99	14,88	48	15	N/A	N/A
Gabon	8,7	-3,98	8	-4	N/A	N/A
	14,5	2,32	15	3	N/A	N/A
Gambia	-16,83	13,06	-17	13	-17,00	13,00
	-13,8	13,83	-13	14	-13,00	14,00
Ghana	-3,26	4,74	-4	4	N/A	N/A
	1,19	11,17	2	12	N/A	N/A
Guinea	-15,09	7,19	-16	7	N/A	N/A
	-7,64	12,68	-7	13	N/A	N/A
Guinea Bissau	-16,72	10,86	-17	10	-17,00	10,00
	-13,64	12,68	-13	13	-13,00	13,00
Ivory Coast	-8,6	4,36	-9	4	N/A	N/A
	-2,49	10,74	-2	11	N/A	N/A
Kenya	33,91	-4,68	33	-5	N/A	N/A
	41,9	4,63	42	5	N/A	N/A



Lesotho	27,03	-30,67	27	-31	N/A	N/A
	29,47	-28,57	30	-28		
Liberia	-11,49	4,35	-12	4	N/A	N/A
	-7,37	8,55	-7	9		
Libya	9,39	19,51	9	19	N/A	N/A
	25,15	33,17	26	34		
Madagascar	42,72	-25,61	42	-26	N/A	N/A
	50,48	-11,95	51	-11		
Malawi	32,67	-17,13	32	-18	N/A	N/A
	35,92	-9,37	36	-9		
Mali	-12,24	10,16	-13	10	-12,50	10,00
	4,24	25	5	25	5,50	25,00
Mauritania	-17,07	14,72	-18	14	-17,50	14,00
	-4,83	27,3	-4	28	-4,50	28,00
Mauritius	57,3	-20,53	57	-21	N/A	N/A
	57,8	-20	58	-20		
Morocco	-17,1	20,77	-18	20	N/A	N/A
	-0,99	35,93	0	36		
Mozambique	30,22	-26,87	30	-27	N/A	N/A
	40,84	-10,47	41	-10		
Namibia	11,72	-28,97	11	-29	N/A	N/A
	25,26	-16,96	26	-16		
Niger	0,17	11,7	0	11	0,00	11,00
	16	23,53	16	24	16,00	24,00
Nigeria	2,67	4,28	2	4	N/A	N/A
	14,68	13,89	15	14		
Principe	6,47	0,02	6	0	N/A	N/A
	7,47	1,7	8	2		
Reunion	55,22	-21,37	55	-22	N/A	N/A
	55,85	-20,86	56	-20		
Rwanda	28,86	-2,84	28	-3	N/A	N/A
	30,9	-1,05	31	-1		
Senegal	-17,54	12,31	-18	12	-18,00	12,00
	-11,36	16,69	-11	17	-11,00	17,00
Seychelles	55,37	-4,81	55	-5	N/A	N/A
	55,79	-4,28	56	-4		
Sierra Leone	-13,31	6,93	-14	6	N/A	N/A
	-10,28	10	-10	10		
Somalia	40,99	-1,66	40	-2	N/A	N/A
	51,41	11,99	52	12		
South-Africa	14,41	-34,84	14	-35	N/A	N/A
	32,9	-22,13	33	-22		
Southern Africa	8,11	-35	8	-35	N/A	N/A
	39,92	5,62	40	6		
Sudan	21,84	3,49	21	3	N/A	N/A
	38,58	23,15	39	24		
Swaziland	30,79	-27,32	30	-28	N/A	N/A
	32,14	-25,72	33	-25		
Tanzania	29,33	-11,75	29	-12	N/A	N/A
	40,44	-0,99	41	0		
Togo	-0,15	6,1	-1	6	N/A	N/A
	1,81	11,14	2	12		
Tunisia	7,52	30,24	7	30	N/A	N/A
	11,6	37,35	12	38		
Uganda	29,57	-1,48	29	-2	N/A	N/A
	35,04	4,21	36	5		



West Africa	-25,56	1,88	-26	1	-18,00	4,00
	16,22	36,18	17	37	25,00	28,00
Zambia	22	-18,08	22	-19	N/A	N/A
	33,71	-8,22	34	-8		
Zimbabwe	25,24	-22,42	25	-23	N/A	N/A
	33,06	-15,61	34	-15		

Please note that the ROIs from the table above cannot be compared simply “as is”. You have to take into account that:

- the rounded ROI settings fall exactly on the VGT grid (remember: pixel center coordinates), but this is not necessarily the case for the un-rounded values. If this is not the case, the system will calculate the ROI so that it encloses, as tightly as possible, the chosen ROI (so, the actual extracted ROI may be slightly larger than the ROI settings indicate).
- the VGT lat/long grid always uses pixel center coordinates, not pixel corner. The user may expect otherwise.
- the West Africa ROI is quite different from the CILSS ROI proposed by AGHRYMET.

2.1.3. Test approach

Estimating the number of pixels added by ROI rounding:

This is accomplished by taking the ROI settings from the MySQL database (as indicated in the above table), rounding them and then calculating the difference ([degree]) between the un-rounded and rounded value. Finally, this difference is multiplied by 112 ([pixels/degree]) to arrive at an estimation of the number of pixels added by the ROI rounding. Of course, this estimation is rounded up to an integer number of pixels.

Please note that the numbers calculated in this way are only a rough estimation. This calculation does not account for instance for the fact that the un-rounded ROI settings are not used “as is”, but rather remapped to the typical VGT lat/long grid.

However, these numbers do provide a first look at the reasons why the file size will increase and in which direction(s) the ROI grows by the rounding.

Creation of products with rounded ROI:

The normal procedure to create products includes the following steps:

- get ROI settings from MySQL database;
- remap those settings to the VGT grid, making sure that the ROI that is effectively extracted from the image of entire Africa is never smaller than the ROI settings indicate;
- apply the results in the ROI extraction;
- repeat the ROI extraction on all HDF bands in the product;
- finish the product by adding the metadata files (*LOG.TXT, *RIG.TXT) and by zipping everything into 1 file.

In the test, the only adjustment made to this procedure is the rounding of the ROI settings that are retrieved from the database. So, the rounded settings are subjected to the remapping, but the test results indicate that the remapping had no effect (the rounded ROI settings fall onto the VGT lat/long grid).

Calculation of file size increase:

After the creation of the products, the file sizes of the ZIP archives (both with and without the rounded ROI settings) were measured and inserted into Excel for further calculations and graphical results. These calculations included averaging the results over the 5 measured decades (but not over the product types or ROIs).

2.2. Test results

All results except those of section 2.2.1 were averaged over the 5 decades that were measured for each product type. These results are also only shown graphically here.

2.2.1. Estimating the number of pixels added by ROI rounding

ROI name	pixWest	pixEast	pixSouth	pixNorth
Algeria	37	3	108	102
Angola	77	104	108	42
Benin	87	17	26	65
Botswana	0	72	11	88
Burkina Faso	54	67	45	104
Burundi	111	17	60	35
Cameroun	55	91	73	104
Cape Verde	72	76	90	90
Central African Republic	48	61	25	111
Chad	53	0	50	62
Comoros	25	86	0	41
Congo	24	40	109	34
Democratic Republic				
Congo	24	78	61	69
Djibouti	87	65	102	32

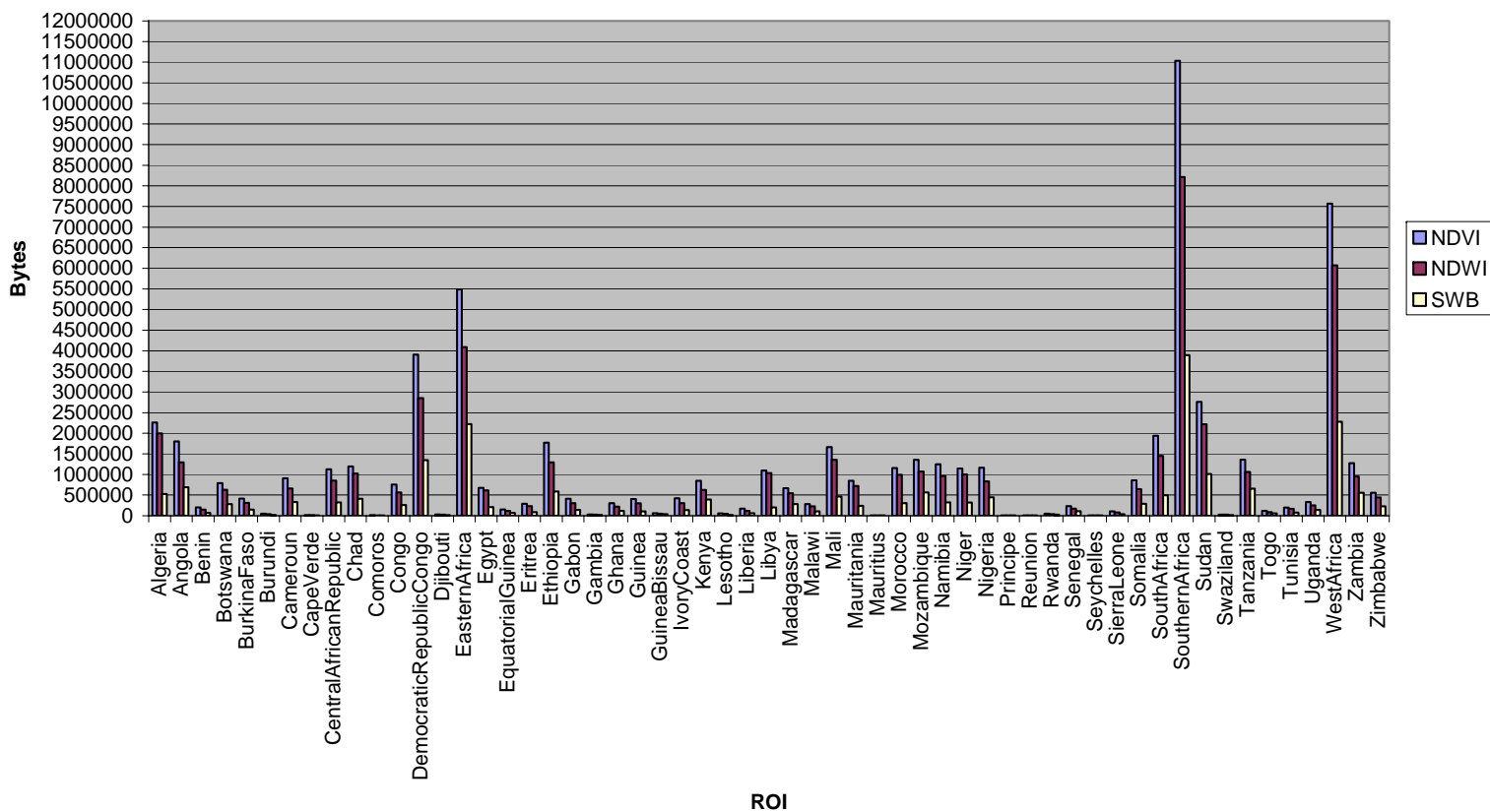


Eastern Africa	23	72	64	17
Egypt	79	21	82	37
Equatorial Guinea	68	74	61	24
Eritrea	50	98	41	0
Ethiopia	0	2	45	14
Gabon	79	56	3	77
Gambia	20	90	7	20
Ghana	83	91	83	93
Guinea	102	72	22	36
Guinea Bissau	32	72	97	36
Ivory Coast	45	55	41	30
Kenya	102	12	36	42
Lesotho	4	60	37	64
Liberia	58	42	40	51
Libya	44	96	58	93
Madagascar	81	59	44	107
Malawi	76	9	98	42
Mali	86	86	18	0
Mauritania	105	93	81	79
Mauritius	34	23	53	0
Morocco	101	111	87	8
Mozambique	25	18	15	53
Namibia	81	83	4	108
Niger	20	0	79	53
Nigeria	76	36	32	13
Principe	53	60	3	34
Reunion	25	17	71	97
Rwanda	97	12	18	6
Senegal	52	41	35	35
Seychelles	42	24	22	32
Sierra Leone	78	32	105	0
Somalia	111	67	39	2
South-Africa	46	12	18	15
Southern Africa	13	9	0	43
Sudan	95	48	55	96
Swaziland	89	97	77	81
Tanzania	37	63	28	111
Togo	96	22	12	97
Tunisia	59	45	27	73
Uganda	64	108	59	89
West Africa	50	88	99	92
Zambia	0	33	104	25
Zimbabwe	27	106	65	69

PixEast, pixWest, pixNorth, pixSouth are the estimated number of pixels added (by the ROI rounding) in the East, West, North and South of the original image respectively.

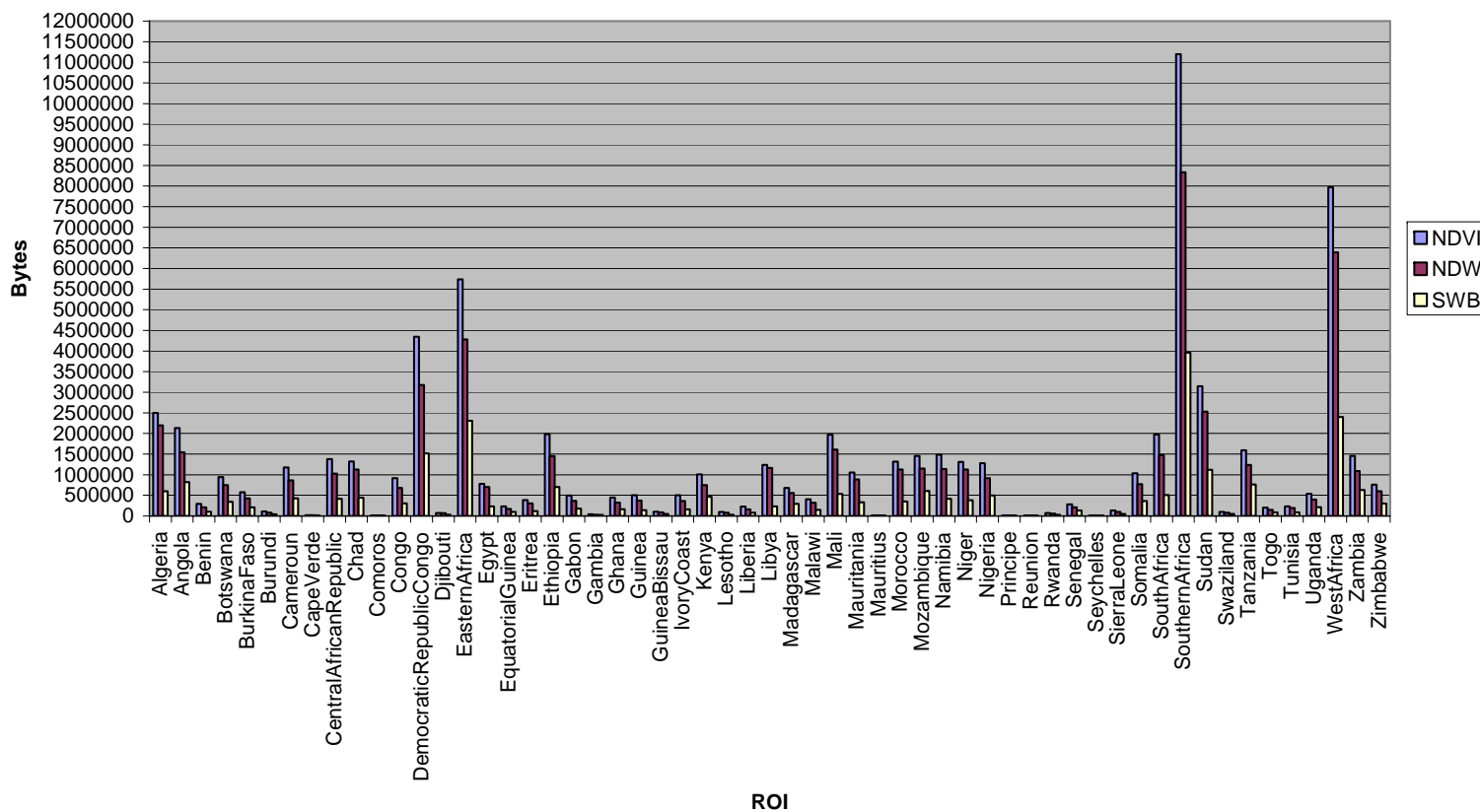
2.2.2. Average file size before and after ROI rounding

Average filesize before ROI rounding



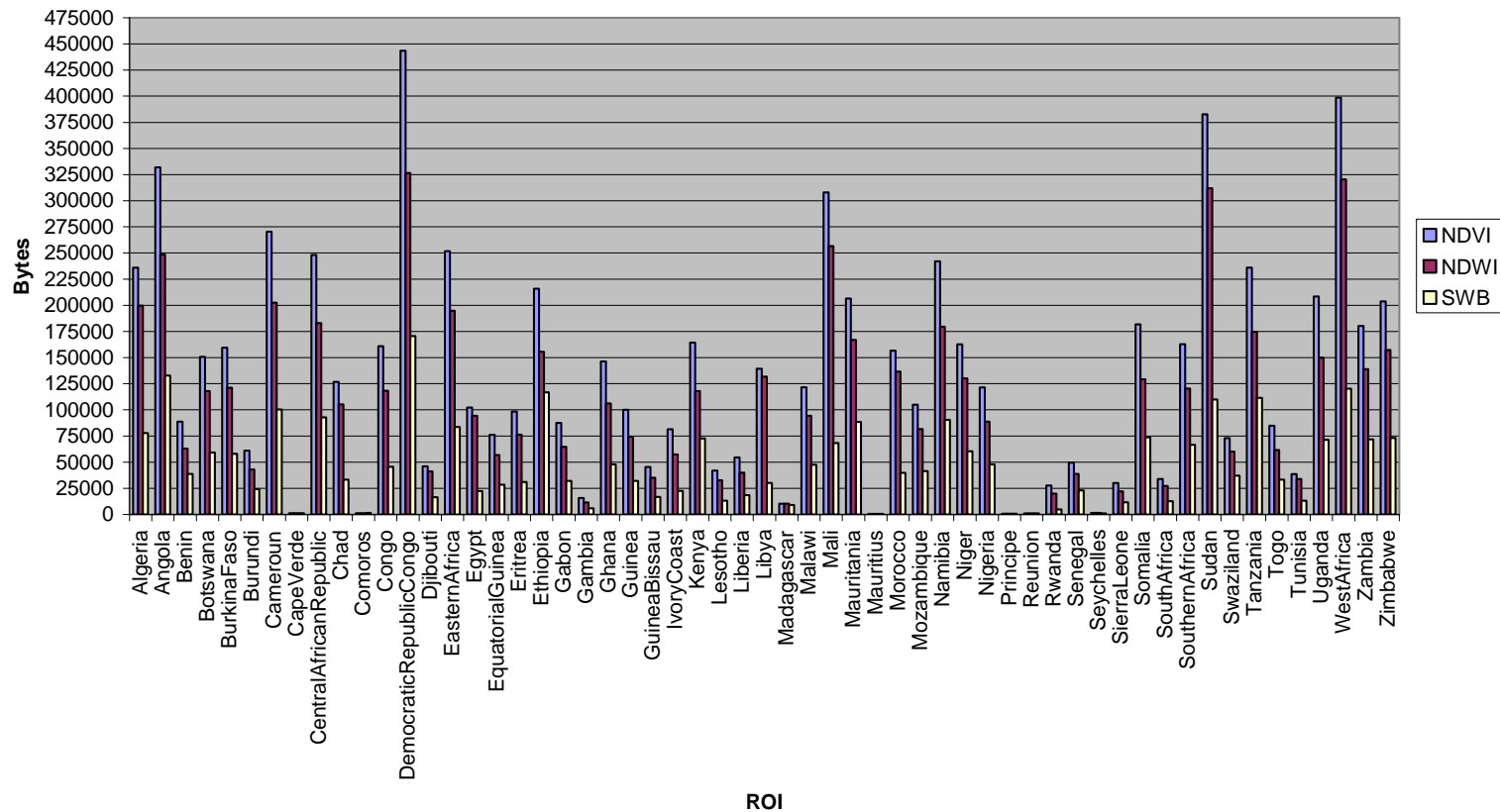


Average filesize after ROI rounding



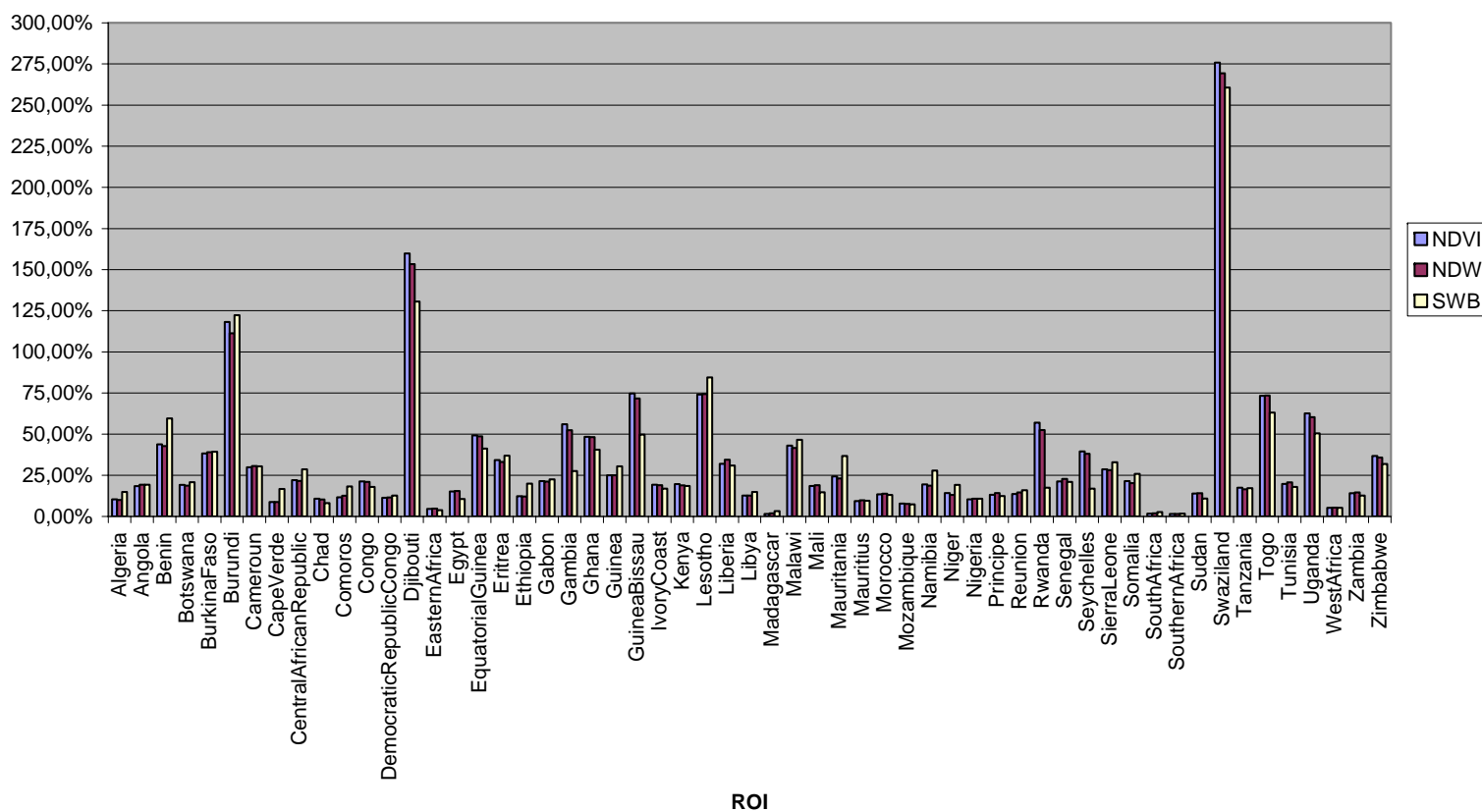
2.2.3. Average file size increase due to ROI rounding

Average file size increase

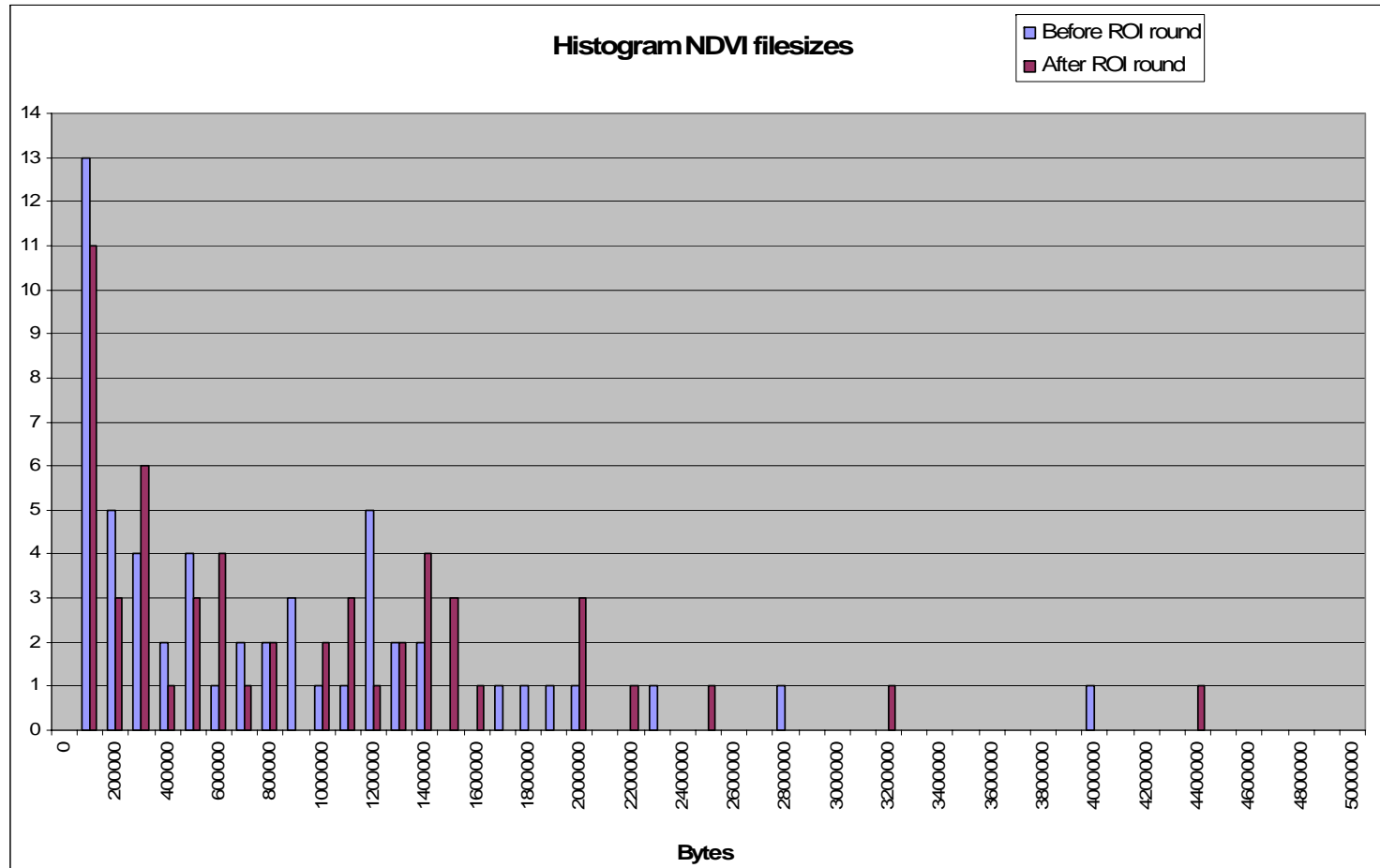


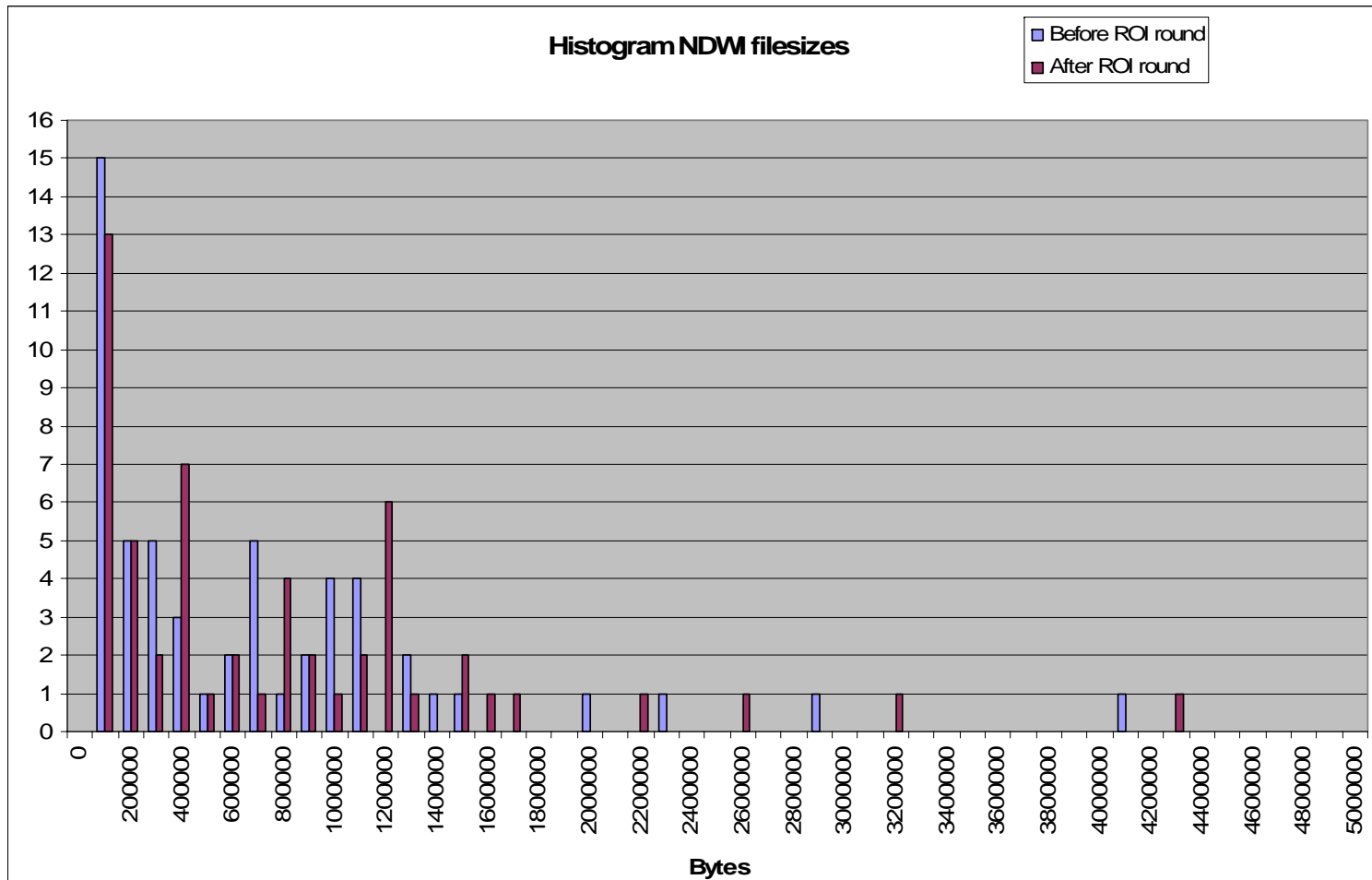
2.2.4. Average file size increase, as percentage of original size

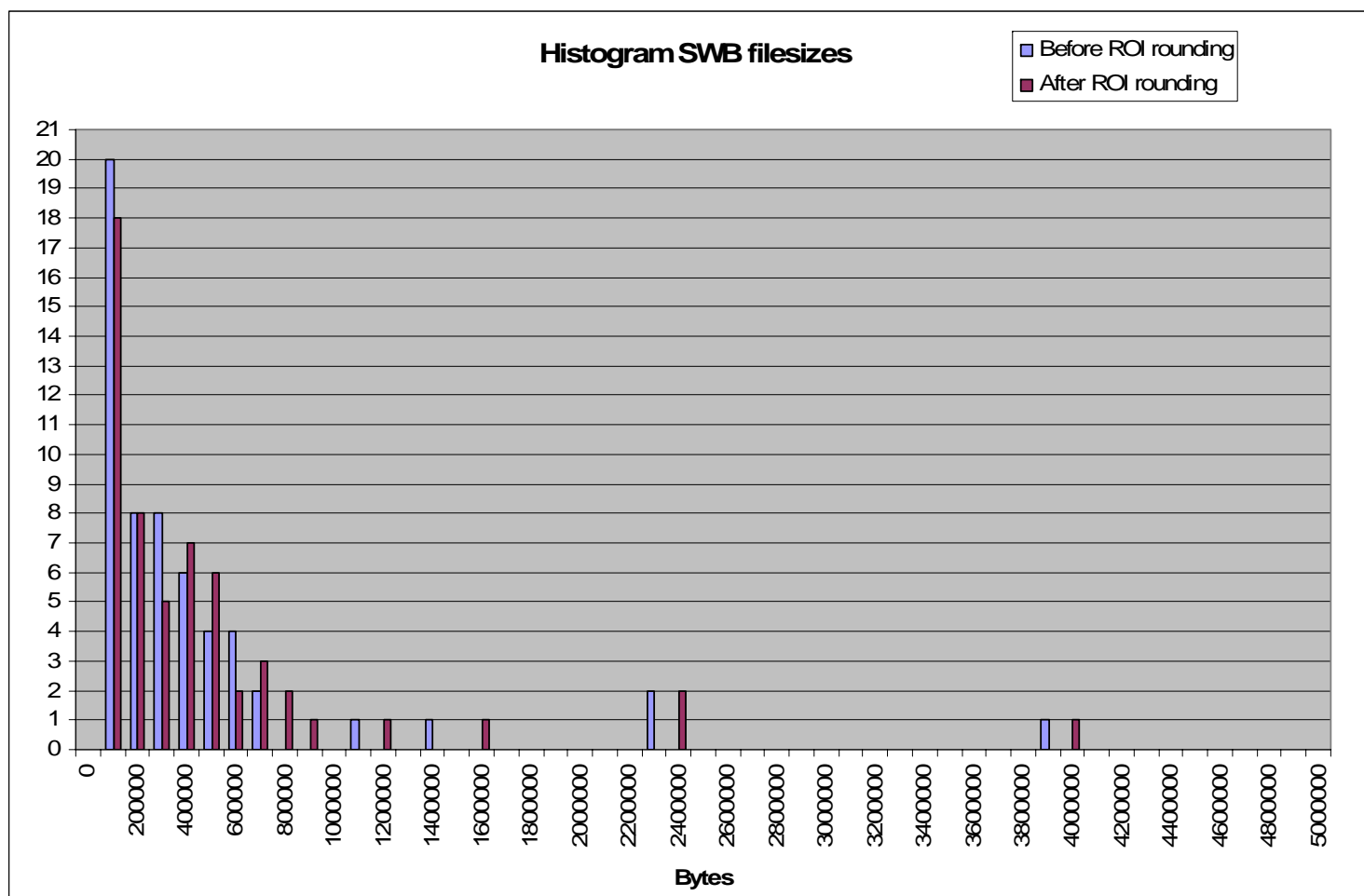
Average % file size increase



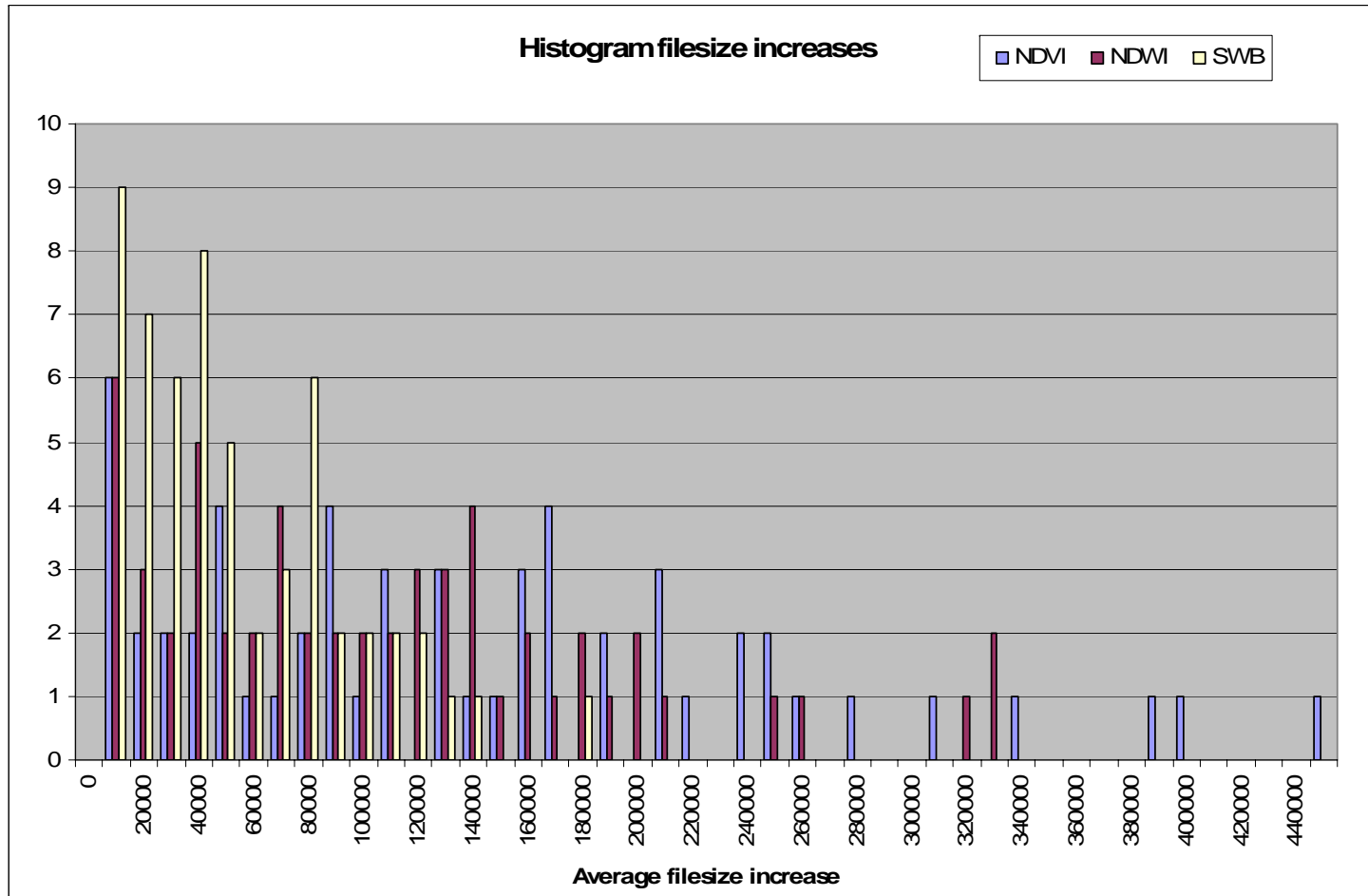
2.2.5. Histograms of file size



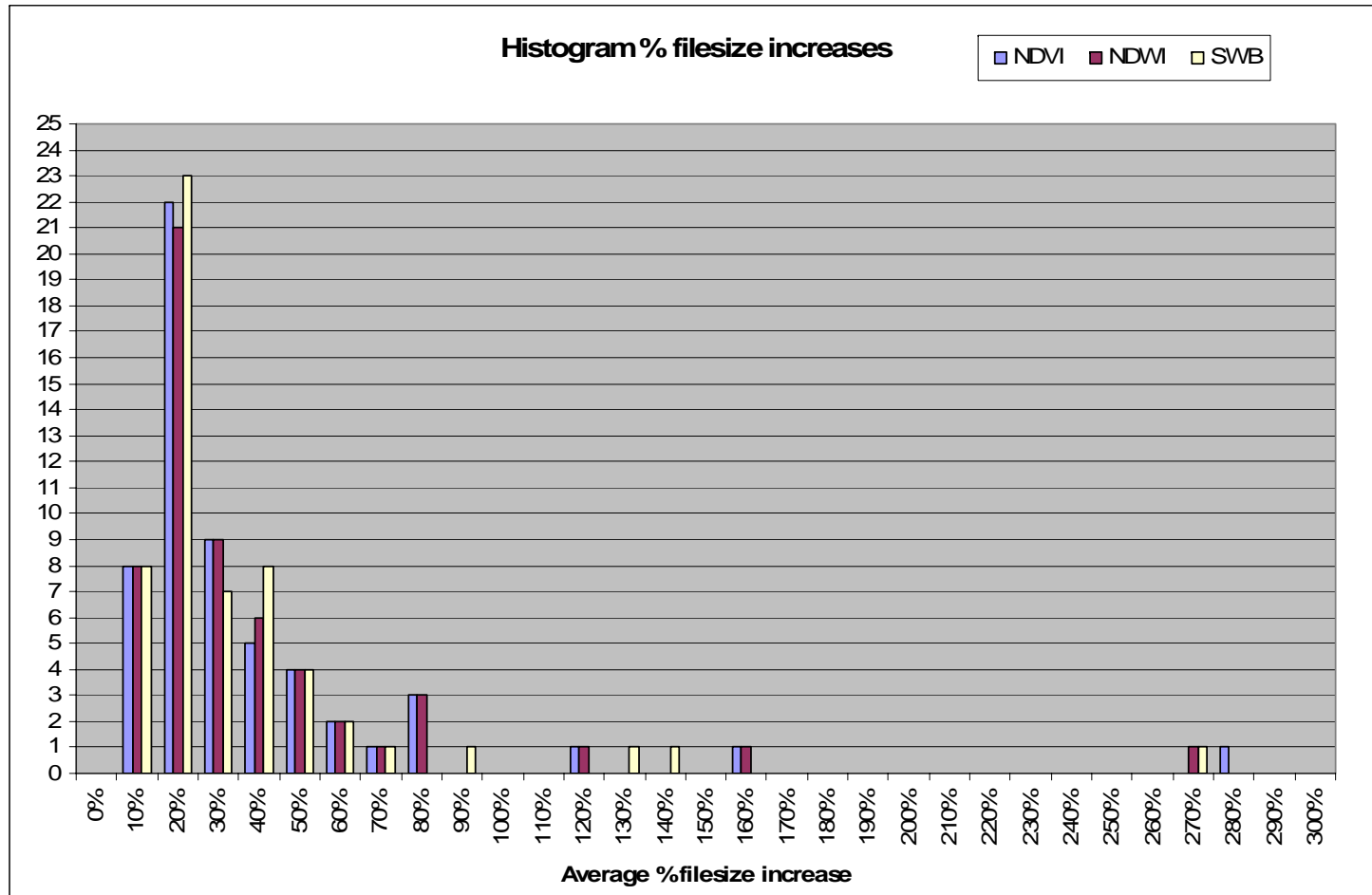




2.2.6. *Histogram of file size increase due to ROI rounding*



2.2.7. Histogram of file size increase, as percentage of original size





2.3. *Conclusions*

1. The estimated increase in number of pixels is on average 50-60 in each of the directions (N-E-S-W). Standard deviation is around 30-35. The maximum increase of 111 pixels is expected for some ROIs, while others show the minimum increase of 0 pixels as well.
2. As expected, file sizes generally increase by the ROI rounding. NDVI, NDWI and SWB products all increase in similar fashion.
3. File sizes vary strongly among ROIs, for each of the product types (high standard deviations).
4. The file size increase is maximum 0,5 MB and is highest for NDVI (0,45 MB) and lowest for SWB (0,17 MB) on average.
5. As percentage of the original size, the file sizes of Burundi, Djibouti and Swaziland increase the most. This can be explained by the large increase in number of pixels in one or more directions and by the fact that the original file sizes were already small, so a high percentage of increase is still a small increase in absolute size.
6. Maximum percentile file size increase can be as high as 275% or as low as 10% and is 30-35% on average (std. dev. around 40%).
7. Most NDVI product sizes are limited to < 2,1 MB, even after ROI rounding. Increases in NDVI sizes are mostly below 350 KB (mostly <90% of the original size).
8. Most NDWI product sizes are limited to < 1,7 MB, even after ROI rounding. NDWI increases are mostly below 280 KB (also <90% mostly).
9. Most SWB product sizes are limited to < 1,5 MB, even after ROI rounding. SWB increases are mostly limited to 150 KB (<110% mostly).

2.4. *Further testing*

No further testing is required.