Using the Google Gapminder motion chart gadget to visualise long-term chloride-to-sulphate ratios in South African rivers

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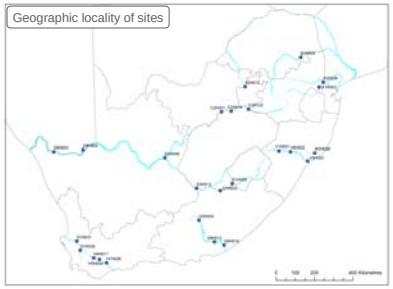
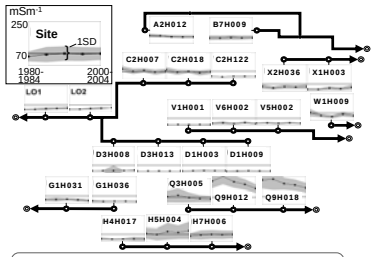
Geographic locality of sites





Van Niekerk, H., Silberbauer, M., and Hohls, B. 2008. Monitoring programme revision highlights long-term salinity changes in selected South African rivers and the value of comprehensive long-term data sets. Environmental Monitoring and Assessment. http://dx.doi.org/10.1007/s10661-008-0407-2.

Aims

Investigate the long-term changes in South African rivers of the ratios of ions expressed as annual means.

Test the Motion Chart gadget developed to do Gapminder analysis as demonstrated by Hans Rosling in his 2007 presentation at **TED** (Technology, Entertainment, Design - http://www.ted.com).

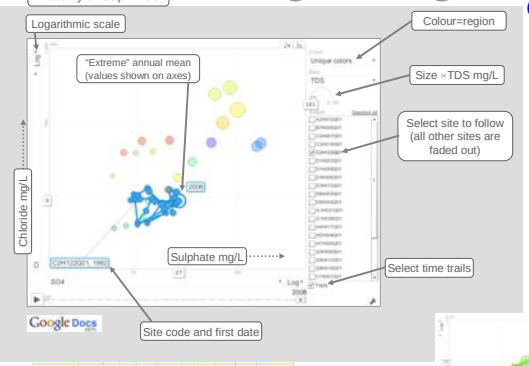
Method

Extract water quality data from the WMS database and flow data from the Hydstra database. Calculate annual means and transfer to a Google Docs spreadsheet (http://spreadsheets.google.com) with the columns: Site, Year, Variable1, Variable2, etc. Insert a Motion Chart and set the range to include all data. Assign the variables as shown in the annotated "Anatomy of Gapminder" screenshot below.

Results

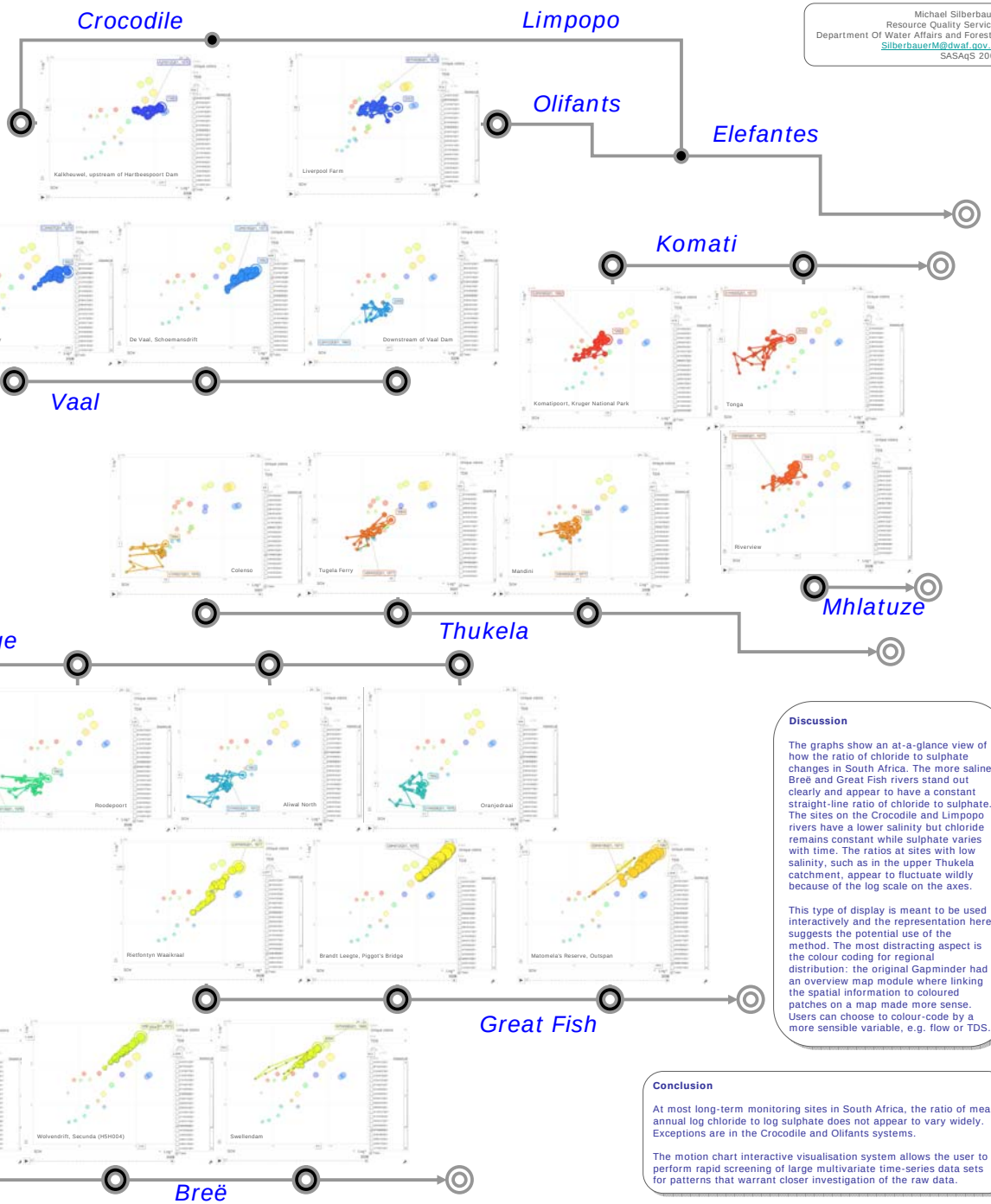
The technology is essentially interactive, and the schematic map on the right shows just one possible combination of $\log_{10}$ Cl against $\log_{10}$ SO_4 with time trails, for each site where long-term data were available.

Anatomy of Gapminder



Raw data (total 790 records)

A2H012Q01	1992	37	56	410	10.9	15	55	74	114	167
A2H012Q01	1993	42	52	402	10.9	13	52	68	106	138
A2H012Q01	1994	45	53	425	10.8	15	50	69	121	150
A2H012Q01	1995	41	51	398	10.2	14	47	68	107	259
A2H012Q01	1996	50	60	459	8.4	19	49	73	140	210
A2H012Q01	1997	43	57	392	9.1	14	49	67	141	447
A2H012Q01	1998	43	57	392	9.1	14	49	71	131	521
A2H012Q01	1999	40	59	421	9.0	17	53	71	120	244
A2H012Q01	2000	46	53	417	7.5	18	41	58	140	271
A2H012Q01	2001	40	51	397	8.4	19	42	55	131	485
A2H012Q01	2002	38	51	395	9.5	16	46	62	123	282
A2H012Q01	2003	38	61	407	10.5	14	53	53	128	137
A2H012Q01	2004	39	57	392	9.3	14	49	51	123	178
A2H012Q01	2005	40	54	394	10.0	14	49	48	128	225
A2H012Q01	2006	45	56	410	9.3	15	46	51	134	318
A2H012Q01	2007	36	59	389	9.9	14	54	47	118	438
A2H012Q01	2008	41	54	402	8.2	15	48	56	127	386
B7H009Q01	1979	31	55	410	2.9	27	46	21	185	259
B7H009Q01	1980	29	45	354	2.4	23	41	20	157	1107
B7H009Q01	1981	28	41	349	2.1	24	38	20	160	1242
B7H009Q01	1982	28	57	414	2.8	28	51	22	185	224
B7H009Q01	1983	32	55	381	3.2	24	44	22	165	461
B7H009Q01	1984	27	73	408	2.5	26	55	33	154	287
B7H009Q01	1985	27	67	417	2.8	30	53	25	173	318
B7H009Q01	1986	25	49	366	2.4	27	42	20	163	211
B7H009Q01	1987	27	40	351	2.1	24	38	18	164	584
B7H009Q01	1988	26	44	358	2.1	25	40	22	162	505
B7H009Q01	1989	27	43	373	2.6	25	40	19	176	490
B7H009Q01	1990	31	72	452	3.0	29	56	43	177	559
B7H009Q01	1991	26	50	343	2.8	22	42	37	133	1254
B7H009Q01	1992	33	90	508	3.7	34	67	48	189	80
B7H009Q01	1993	28	61	421	3.1	28	52	32	177	195
B7H009Q01	1994	28	48	381	3.1	23	45	30	166	251
B7H009Q01	1995	29	55	423	3.8	27	48	30	187	289
B7H009Q01	1996	29	48	341	3.7	21	37	44	127	2160
B7H009Q01	1997	33	37	368	2.2	23	37	43	139	1218



Discussion

The graphs show an at-a-glance view of how the ratio of chloride to sulphate changes in South Africa. The more saline Breë and Great Fish rivers stand out clearly and appear to have a constant straight-line ratio of chloride to sulphate. The sites on the Crocodile and Limpopo rivers have a lower salinity but chloride remains constant while sulphate varies with time. The ratios at sites with low salinity, such as in the upper Thukela catchment, appear to fluctuate wildly because of the log scale on the axes.

This type of display is meant to be used interactively and the representation here suggests the potential use of the method. The most distracting aspect is the colour coding for regional distribution: the original Gapminder had an overview map module where linking the spatial information to coloured patches on a map made more sense. Users can choose to colour-code by a more sensible variable, e.g. flow or TDS.

Conclusion

At most long-term monitoring sites in South Africa, the ratio of mean annual log chloride to log sulphate does not appear to vary widely. Exceptions are in the Crocodile and Olifants systems.

The motion chart interactive visualisation system allows the user to perform rapid screening of large multivariate time-series data sets for patterns that warrant closer investigation of the raw data.