

Center

Data Analysis Service supported by the FAGS

SUNSPOT BULLETIN

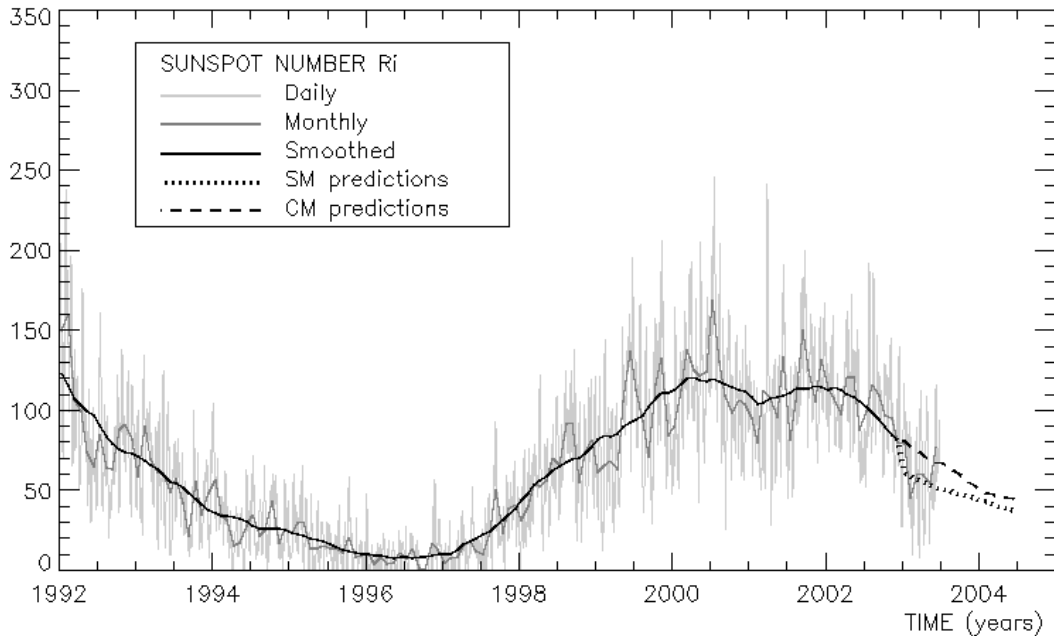
2003

n° 6

Provisional international and normalized hemispheric daily sunspot numbers for June 2003

computed at the *Observatoire Royal de Belgique* using observations from an international network with the *Locarno Specola Solare* as reference station.

Date	R' _I	R' _N	R' _S
1	42	21	21
2	38	27	11
3	40	29	11
4	47	37	10
5	59	50	9
6	86	69	17
7	98	75	23
8	101	76	25
9	111	80	31
10	111	61	50
11	116	62	54
12	115	51	64
13	96	38	58
14	81	30	51
15	63	28	35
16	57	16	41
17	56	22	34
18	68	29	39
19	76	25	51
20	74	28	46
21	62	21	41
22	61	27	34
23	66	40	26
24	68	44	24
25	76	57	19
26	82	63	19
27	93	73	20
28	93	70	23
29	94	73	21
30	92	75	17
Monthly mean	77.4	46.6	30.8
Cooperating stations	44	38	38



Predictions of the monthly smoothed Sunspot Number
 using the last provisional value, calculated for December 2002 : 82.0 ($\pm 5\%$)

	SM	CM		SM	CM		SM	CM
2003 Jan	78	81	2003 Jul	56	67	2004 Jan	48	50
Feb	71	78	Aug	54	65	Feb	47	49
Mar	64	75	Sep	53	62	Mar	46	48
Apr	62	72	Oct	51	59	Apr	44	47
May	60	70	Nov	50	56	May	43	46
Jun	58	68	Dec	49	53	Jun	42	45

SM : SIDC classical method : based on an interpolation of Waldmeier's standard curves; the estimated error ranges from 7% (first month) to 35% (last month)

CM : Combined method : the combined method is a regression technique coupling a dynamo-based estimator with Waldmeier's idea of standard curves, due to K. Denkmayr.

ref. : **K. Denkmayr, P. Cugnon**, 1997 : "About Sunspot Number Medium-Term Predictions", in "Solar-Terrestrial Prediction Workshop V", eds G. Heckman et al., Hiraiso Solar Terrestrial Research Center, Japan, 103

Brussels, July 1, 2003 10:00 UT

Reproduction permitted if source mentioned.
 Ed. Pierre Cugnon, avenue Circulaire, 3 B-1180 BRUXELLES - BELGIUM
 Fax 32-(0)2-373 02 24 Tel 32-(0)2-373 02 76
 e-mail : arille@oma.be, pierrec@oma.be
 ftp anonymous : omaftp.oma.be, directory dist/astro/sidcdata

S.I.D.C. SUMMARY OF THE URSIGRAMS

Date	R' _i	PPSI	600	2800	COS	SFI	XI	Ak	SEA
31	42	51	42	113	777	104	1/0	22	
1	42	29	43	112	789	3	5/0	23	
2	38	45	45	121	806	24	4/0	36	
3	40	64	42	115	823	3	0/0	29	
4	47	83	41	106	830	0	0/0	29	
5	59	85	41	114	835	2	0/0	12	
6	86	109	43	126	835	25	1/0	17	
7	98	145	46	133	832	4	0/0	29	
8	101	210	50	153	831	127	1/0	36	
9	111	215	50	158	830	25	2/1	27	
10	111	260	52	177	830	147	9/1	22	
11	116	277	51	193	829	38	8/1	13	
12	115	233	55	164	832	45	4/0	9	
13	96	161	54	151	838	12	3/0	10	
14	81	75	49	134	839	2	1/0	27	
15	63	42	51	129	839	1	0/1	21	
16	57	37	49	123	821	4	2/0	34	
17	56	41	46	122	810	12	1/0	38	
18	68	66	48	120	816	6	0/0	46	
19	76	58	49	123	811	0	0/0	16	
20	74	91	51	117	803	2	0/0	15	
21	62	60	94	115	800	3	0/0	24	
22	61	68	47	110	799	2	0/0	15	
23	66	75	51	114	798	2	0/0	21	
24	68	73	46	115	798	7	0/0	20	
25	76	91	46	116	805	1	0/0	21	
26	82	84	44	119	818	0	0/0	18	
27	93	77	49	124	821	0	0/0	33	
28	93	106	46	124	820	0	0/0	41	
29	94	117	46	127	826	3	0/0	28	
30	92	148	51	128	826	16	0/0	20	

R' _i : provisional international sunspot numbers from the S.I.D.C.
PPSI : prompt photometric sunspot index from the S.I.D.C. in 10⁻⁵ w/m² : the quantity to be subtracted from the mean solar constant to account for the sunspot contribution.
600 : 600 Mhz solar flux from the station at Humain (Belgium).
2800 : 2800 Mhz solar flux from Ottawa (origin : Ursigrams - UGEOI). The 10.7cm Flux data are a service of the National Research Council of Canada.
COS : thousands of the cosmic ray counts (origin : Ursigrams - UCOSE Terre Adélie).
SFI : From October 1992, Solar Flare Index from the S.I.D.C. (origin : Ursigrams – UGEOR, evaluation : 1 x Sn+10 x "1"+100 x ">1".
XI : X-flares index from the Ursigrams (M-flares/X-flares) (origin : Ursigrams – UGEOR, UGEOI).
Ak : geomagnetic index from Wingst, Germany (origin : Ursigrams).
SEA : sudden enhancements of atmospheric from Uccle & Humain (Royal Observatory, Belgium).

Note that due to problems of interferences saturating our receivers, no SEA could be detected this month.

SOLAR PHYSICS DEPARTMENT

UCCLE DAILY PROVISIONAL RELATIVE SUNSPOT NUMBERS FOR JUNE 2003

DATE	UT	NUMBER		RELATIVE SUNSPOT NUMBERS			PPSI 10-3 WM-2	QUAL	OBS	
		OF GROUPS	OF SPOTS	TOTAL	NORTH	SOUTH				CENTRAL
1	930	3	22	52	20	32	20	8.7	3	RV
2	815	3	17	47	33	14	31	16.2	3	OB
3	910	3	27	57	37	20	35	39.7	3	OB
4	815	5	24	74	48	26	27	73.9	2	OB
5	1045	4	17	57	46	11	11	73.6	3	OB
6	1030	6	58	118	96	22	54	82.8	3	OB
7	935	6	84	144	110	34	69	99.1	2	ST
8	1135	6	97	157	114	43	90	113.1	2	ST
9	745	6	116	176	124	52	125	118.8	2	ST
11	840	6	136	196	103	93	122	202.2	3	FC
12	700	7	121	191	82	109	93	200.8	3	OB
13	700	6	109	169	60	109	116	152.1	3	OB
14	1140	6	63	123	39	84	48	93.8	2	EV
15	1130	4	38	78	31	47	0	31.5	3	EV
16	810	5	27	77	14	63	0	34.4	3	OB
17	720	4	25	65	26	39	14	41.5	3	OB
18	1400	4	53	93	35	58	22	73.8	2	OB
20	815	4	34	74	16	58	58	74.0	2	DC
21	910	3	43	73	23	50	50	25.3	3	JY
22	1100	3	31	61	22	39	61	23.8	2	JY
23	720	5	41	91	49	42	60	36.7	3	OB
24	834	5	24	74	48	26	48	46.0	2	DC
25	1235	7	28	98	74	24	40	65.9	3	DC
26	1235	8	29	109	82	27	12	78.1	2	DC
27	900	9	27	117	93	24	40	70.6	1	DC
28	1100	9	29	119	88	31	67	99.8	3	OB
29	1015	8	32	112	92	20	47	91.5	3	OB

The relative mean sunspot number is 103.8.

NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS $U'=K'U$ FOR JUNE 2003

$$K' = 0.741 (*)$$

1	39	7	107	13	125	19	***	25	73
2	35	8	116	14	91	20	55	26	81
3	42	9	130	15	58	21	54	27	87
4	55	10	***	16	57	22	45	28	88
5	42	11	145	17	48	23	67	29	83
6	87	12	142	18	69	24	55	30	***

The normalised relative monthly mean sunspot number is 77.

(*) K' is the mean of the monthly K' for the last five years.

The Sun has been observed 27 days on 30 possible.

<http://sidc.oma.be>

MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

I. Solar Activity

In the course of this month we saw once again big variations in solar activity. The sun started the month with a high level of activity, culminating in very high activity on Jun 10-11 (17 M-flares and 2 X-flares were observed on these two days). Thereafter, activity gradually decreased and the solar activity level became low after June 17. An interesting observation to point out is that, although the sunspot number R_i was indeed the highest during the sun's most active days, solar activity was also high at the time that the daily sunspot number was *lowest* (in the beginning of the month). In the second half of the month, the daily sunspot number was relatively high, but solar activity was low.

The month started with a goodbye wave to the main player of the previous month: on June 1-2, Catania sunspot group 18 (NOAA 0365) rotated over the western solar limb. Before definitively disappearing, however, it still produced 4 more M-flares (the strongest one an M6.5), all visible above the limb. Almost diametrically opposed, the new dominant sunspot group, later numbered Catania 22 (NOAA 0375), announced its arrival, before becoming visible, by releasing several M-flares on June 1 and 2. Then followed a few less active days, with just weak C-flares on June 3, 4 and 5. Late on June 6, Catania 22 produced an M1.0 flare followed early on June 7 by a C8.5 flare from Catania number 28 (NOAA 0380), which was at the time situated behind the eastern limb. Again, this flare was observed above the solar limb by GOES/SXI. Another burst of activity happened on June 8 with several strong C-flares from Catania sunspot groups 22 and 28, followed by an M4.0 flare in Catania 28. The real firework started in earnest on June 9, with Catania 22 (NOAA 0375) as the prime actor. While this active region crossed the solar disk from just west of central meridian to beyond the west limb, it produced more than 30 M-flares and 3 X-flares! The group grew to more than 60 spots and covered about 0.1% of the solar disk at its maximal extent. Its largest event was an X1.7 flare on Jun 9. On Jun 11 the emission of NOAA 0375 was so strong that the X-ray flux recorded by GOES12 was above the M-level for the largest part of the day. As expected, when NOAA 0375 rotated behind the west limb on Jun 14, the X-ray background dropped back to a normal level.

Just when we thought that the firework was finished, a new X-class flare erupted late on the evening of June 15 at the other (eastern) limb of the Sun from the re-appearing sunspot group 18, now numbered Catania 37 (NOAA 0386). This group produced three more M-flares the following days, but then started to decay. Both the X-flare on June 15 and the final M6.8 flare on June 17 were accompanied by full halo CMEs. Although Catania 37 further developed a beta-gamma-delta configuration, its flaring activity was restricted to C-level after June 17. During the rest of the month, several more large sunspot groups appeared with beta-gamma magnetic configurations, but these produced only C-class flaring activity (e.g. Catania sunspot group 42, NOAA 0388) or remained remarkably quiet (e.g. sunspot group 41, NOAA 0387). An old acquaintance rotated into view on June 27: Catania sunspot group 22 returned as Catania 52 (NOAA 0397). But by that time, also this group was no longer capable of producing large flares, so despite a rather high Wolf number, solar activity remained low.

As regards proton fluxes, little happened this month. On June 1, the >10Mhz proton flux was still elevated (but below threshold), following an earlier proton event. During the fireworks from Catania 22, the Earth was obviously not magnetically connected to this active region, because – despite all the flaring firework – not the slightest enhancement of the proton flux was recorded by the NOAA GOES satellites. On June 18, a weak proton event occurred, although no major flare was observed that day. The >10MeV proton flux started to increase at approximately 9UT on June 18, and reached the event threshold at about 21UT. It peaked shortly after that and fell again below the threshold at about 9UT on June 19, returning to normal levels June 21.

II. Geomagnetic Activity

Geomagnetic conditions ranged between quiet and minor storm conditions this month, but were mostly at active levels. The main drivers of the geomagnetic perturbations were the quasi-continuous presence of large coronal holes on the sun, but the earth's magnetosphere was also hit by shocks fronts due to coronal mass ejections.

Coming down from the arrival of a CME shock front at the end of May, the solar wind speed decreased to just above 600km/s on June 1, but then the Earth entered a high speed solar wind stream from a large coronal hole. This pushed up the solar wind speed to about 800km/s by the end of June 2, causing minor storm conditions on June 2-4 (K-indices in Wingst up to 5). The coronal hole in question was large; mainly situated in the southern hemisphere, it spanned the latitude range from the southern pole up to the solar equator with some extensions farther into the northern hemisphere. On June 5, the solar wind speed decreased to about 450km/s, leading to a short period of quiet geomagnetic conditions on Jun 5-6, but the next day it rose again, reaching about 800km/s on June 7, as the Earth came under the influence of another equatorial extension of the coronal hole. The solar wind speed remained elevated for several days, and started gradually decreasing on June 10, going down to 400km/s by the end of June 12. In response, geomagnetic conditions were at active levels from June 6 (evening) to June 10, going down to quiet conditions on June 11-13.

A small coronal hole reached the central solar meridian early on June 11, becoming geo-effective on June 13 (evening). On top of that, on June 14, the ACE and GENESIS spacecraft recorded a shock in the solar wind. From June 14 onwards, this caused a new period of high solar wind speed (about 600km/s) and active geomagnetic conditions on June 14-15 (K-index in Wingst mostly 4, occasionally reaching 5). Geomagnetic activity increased to minor storm level on June 16-17. A shock was recorded by SOHO/CELIAS and ACE on June 18, at 04:45UT. The interplanetary magnetic field turned negative, further strengthening the minor geomagnetic storm (the K-index in Wingst reached 6). This disturbance was due to the CME associated with the X-flare of June 15 in Catania sunspot group 37 (NOAA 0386). Another shock was recorded on June 20 at about 08:00 UT, this time related to the M6.8 X-ray flare from the same sunspot group on June 17. On this occasion, the interplanetary magnetic field remained mostly northwards and there was no strong geomagnetic response. Geomagnetic conditions were therefore mostly quiet to active on June 19-26, while the solar wind speed remained elevated in the range 500-600 km/s.

On June 25, the leading edge of the large recurrent coronal hole mentioned at the start of this text again reached the central solar meridian so that from June 26 onwards the solar wind rose steadily to values near 800km/s late on June 28. After June 26, the IMF became mostly weakly southwards and minor geomagnetic storm conditions were reached on June 27 and especially June 28 (when the K-index in Wingst and Izmiran climbed to 6). On June 29-30, geomagnetic conditions returned to active.

III. Noticeable solar events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	RADIO	TYPE	600 (HMAIN)	Cat	NOAA	NOTE
01	0210	0303	0402	N11E89	M1.4		67	III/1			22	0375	at east limb
01	0700	0711	0723	N11E89	M1.0						22	0375	at east limb
01	1239	1250	1256	N09E89	M1.0						22	0375	EIT derived location
01	1643	1652	1659	S08W80	M1.4	SF					18	0365	
01	2058	2105	2110	N07E89	M1.0						22	0375	EIT derived location
02	0007	0022	0043	S06W90	M6.5	SF	620	II/3, III/1, IV/1			18	0365	
02	0812	0837	0852	S07W89	M3.9	SF	200	IV/1	0830, 0841		18	0365	
02	1313	1317	1322	S07W89	M1.0						18	0365	
02	1722	1733	1740	N10E70	M1.8	SF					22	0375	
06	2331	2338	2358	N13E17	M1.0	1F	110	II/1, III/2, CTM/1			22	0375	
08	1605	1611	1615	S19E62	M4.0	2N					28	0380	
09	1121	1128	1133	N11W29	M4.7	1N	46	II/1, V/3	1124		22	0375	
09	2131	2139	2143		X1.7		310	III/1, II/3, IV/1			22	0375	
09	2219	2231	2242		M1.4		250	III/2			22	0375	
10	0248	0254	0301	N13W41	M2.0	1N					22	0375	

10	0834	0837	0840	N12W44	M2.7	1N	110	III/2		0835	22	0375	
10	1055	1112	1115	N11W45	M5.1	2N	50	V/3			22	0375	
10	1244	1300	1317	N12W43	M2.2	1F					22	0375	
10	1408	1436	1442	N10W45	M2.2	SF					22	0375	
10	1620	1624	1627	N13W36	M1.0	SF	55	III/2		1621	22	0375	
10	1628	1630	1632		M3.9		37	III/3		1629	22	0375	
10	1808	1815	1826		M5.6						22	0375	
10	2204	2213	2221	N14W50	M1.0	2N					22	0375	
10	2319	0002	0012	N10W40	X1.3	2B	68	CTM/1			22	0375	
11	0301	0306	0313	N14W56	M1.8	SF					22	0375	
11	1028	1033	1035	N09W61	M1.1	SF					22	0375	
11	1051	1109	1132		M1.4			III/1			22	0375	
11	1309	1321	1337	N14W58	M2.7	1N		III/2			22	0375	
11	1437	1527	1547	N10W61	M3.7	SF	30				22	0375	
11	1621	1636	1650	N12W59	M4.5	1F	85			1627	22	0375	
11	1727	1743	1800	S16E23	M1.8	1F		III/3		1745	28	0380	
11	2001	2014	2027	N14W57	X1.6	1N	86	II/2, III/3			22	0375	
11	2141	2151	2210	N15W63	M2.9	SF		III/2			22	0375	
12	0104	0130	0152	N15W65	M7.3						22	0375	
12	1358	1403	1409	N10W65	M1.0	SF		III/2		1359	22	0375	
12	1706	1712	1716	N14W73	M1.1	SF				1710	22	0375	
12	2122	2127	2131		M2.6		130	III/1			22	0375	
13	0154	0204	0213		M3.1						22	0375	
13	0431	0437	0443	N15W78	M1.7	SF	130			0411, 0434 0438	22	0375	
13	0628	0645	0719	N14W81	M1.8	SF					22	0375	
14	0507	0609	0657	S06E89	M1.5		56	III/1					EIT derived location
15	2325	2356	0025	S07E80	X1.3	SF	860	III/3, II/2, IV/1			37	0386	Full halo CME
16	0244	0248	0251	S06E82	M1.0						37	0386	EIT derived location
16	1152	1200	1204	S12E83	M1.7	SF					37	0386	
17	2227	2255	2312		M6.8		2100	II/2, III/3, IV/1			37	0386	Full halo CM

loc: approximate heliographic location

Xray: X-ray flare class

op: optical flare class

10 cm: radio flux on 10 cm

type: type of radio-burst

600: peak UT time of 600 Mhz radio-bursts in Humain

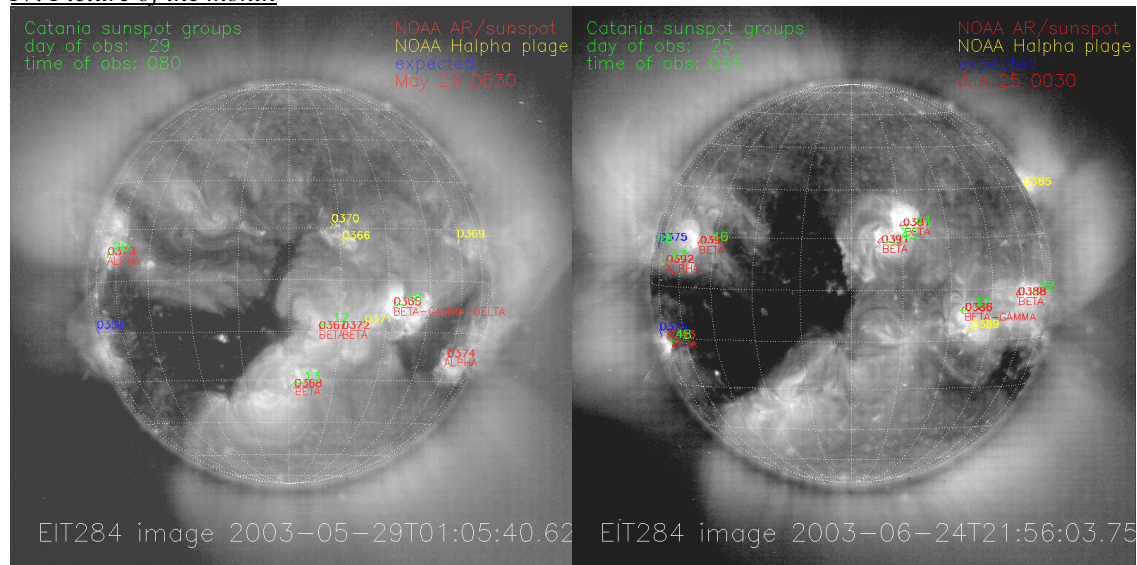
Cat: Catania sunspot group identification

NOAA: NOAA active region identification

p: proton event

CME: Coronal Mass Ejection.

IV. Picture of the month



The (in)constancy of the sun. These two ‘combimap’ images, giving sunspot group positions on the background of an EIT284 image, were made about 1 solar rotation apart: May 29 (left) and June 25 (right).

S I D C - News

2003 n° 2

SIDC DEFINITIVE INTERNATIONAL AND HEMISPHERIC SUNSPOT NUMBERS FOR 2003

Date	JANUARY			FEBRUARY			MARCH		
	Ri	Rn	Rs	Ri	Rn	Rs	Ri	Rn	Rs
1	31	8	23	40	7	33	48	14	34
2	27	7	20	43	0	43	59	19	40
3	66	14	52	36	0	36	57	24	33
4	65	8	57	35	0	35	80	40	40
5	68	8	60	50	11	39	65	39	26
6	86	18	68	68	14	54	63	39	24
7	90	15	75	82	23	59	79	49	30
8	108	10	98	87	31	56	66	35	31
9	109	8	101	93	32	61	89	45	44
10	117	10	107	73	22	51	71	30	41
11	117	12	105	73	27	46	69	38	31
12	104	9	95	71	29	42	56	35	21
13	94	0	94	59	25	34	45	34	11
14	94	22	72	45	22	23	58	33	25
15	84	25	59	31	31	0	63	33	30
16	84	32	52	20	20	0	62	29	33
17	81	36	45	10	10	0	41	14	27
18	77	38	39	20	20	0	43	14	29
19	87	45	42	33	33	0	39	11	28
20	93	51	42	44	37	7	29	8	21
21	68	34	34	46	37	9	23	0	23
22	86	34	52	34	26	8	8	0	8
23	70	24	46	28	28	0	27	14	13
24	76	22	54	28	28	0	33	25	8
25	59	14	45	32	22	10	52	37	15
26	72	12	60	30	21	9	70	50	20
27	85	21	64	43	10	33	81	54	27
28	85	22	63	34	11	23	91	56	35
29	84	14	70				112	58	54
30	62	13	49				112	57	55
31	41	10	31				102	49	53
MEAN :	79.7	19.2	60.5	46.0	20.6	25.4	61.1	31.7	29.4