Broadband radiation data in the Antarctic Peninsula and preliminary estimation of cloud cover from two different methods

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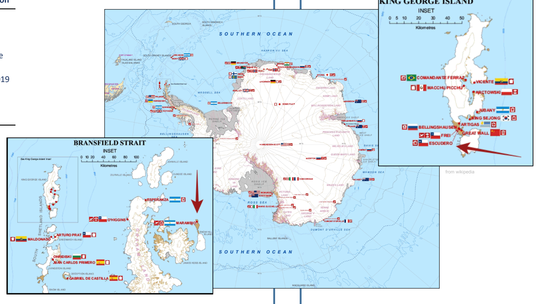
Intro The preliminary results presented here are part of the RadiCA (YOPP)[1] project, which aims at collecting and analysing broadband radiation data that will be used to derive cloud cover information in the Antarctic region. The project is carried out at Marambio station thanks to the collaboration of Argentinian Antarctic Institute researchers. The data from Professor Julio Escudero shown here were shared from American and Chilean researchers.

Marambio station

196 m a.s.l.
61° 14' 50.6'' S – 56°37'39.3''W
Argentina

Instruments	Radiation component	Data acquisition
SPN1 (DeltaT Devices)	Global shortwave downward (SWD)	every minute since 2 July 2019
	Diffuse shortwave (DIF)	
NR01 (Hukseflux)	Global shortwave downward (SWD)	
	Shortwave upward radiation (SWU)	
	Longwave downward radiation (LWD)	
	Longwave upward radiation (LWU)	





Professor Julio Escudero station

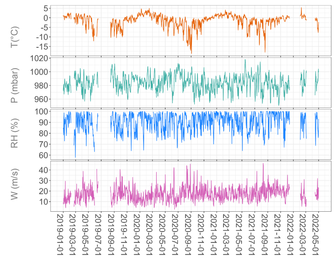
170 m a.s.l.
62° 12' 57'' S – 58°57'35'' W
Chile

instruments	Radiation components	Data acquisition
SMP21/22 (Kipp & Zonen)	Global shortwave downward (SWD)	every minute summers 2016 (SWD) 2017 (LWD) 2018 2022 years 2019 / 2021
SGR4 (Kipp & Zonen)	Longwave downwarradiation (LWD)	



Meteo

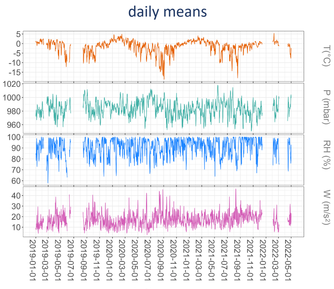
daily means



data by minute	min	max	mean sum	mean win
T	-34.3	15.6	-0.9	-14.6
P	918	991	963	970
RH	5	100	83	75
W	0	38	7	9

data by minute	min	max	mean sum	mean win
T	-20.6	7.7	1.2	-4.4
P	936	1020	983	988
RH	2	100	92	90
W	0	80	14.5	18

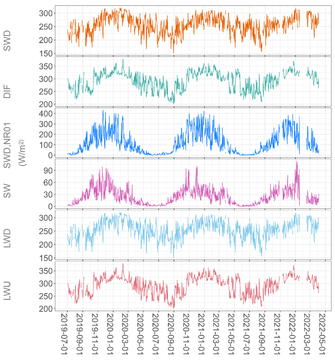
daily means



Radiation

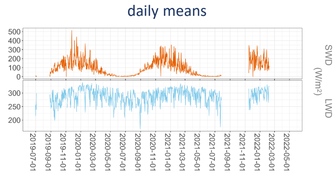
Quality Check[2] according to BSRN network[a]

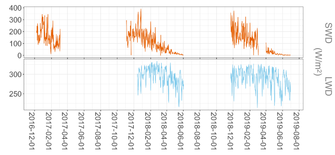
daily means



monthly mean on data by minute	Marambio						Escudero			
month	SWD SPN1	DIF	SWD NR01	SWU	LWD	LWU	12.2016 / 06.2019 SWD	12.2016 / 06.2019 LWD	07.2019 / 04.2022 SWD	07.2019 / 04.2022 LWD
1	203	128	205	34	290	327	162	303	151	309
2	158	94	161	27	288	325	122	297	124	303
3	95	60	93	22	271	306	72	300	74	297
4	49	35	47	13	251	236	32	291	30	291
5	21	18	15	4	251	290	12	274	10	285
6	16	15	3	2	241	265	3	279	4	281
7	19	17	9	4	232	264		234	7	271
8	40	31	13	32	225	246			28	269
9	93	59	98	27	237	275			81	271
10	166	95	168	44	249	286			143	281
11	225	127	233	42	268	320	189	288	185	291
12	264	145	261	49	278	328	195	295	192	296

daily means





Cloud cover estimation at Marambio

Long et al.(2006)[3]

Necessary input variables: SWD, DIF

I. *Identifies Clear Sky (CS) data* by checking if the variable or derived variable value is within lilmits
II. *Computes A and b constants for CS «days»**, from equation SWD or DIF = A cos(SZA) [b]
III. *Interpolation of A and b for all days*
IV. *Iteration* of the three steps above n until convergence
V. *Computation of fractional Sky cover (Scv)*

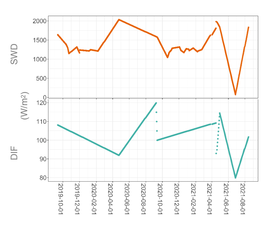
«APCADA»[b][4]

Necessary input variables: LWD, T_{air}, RH

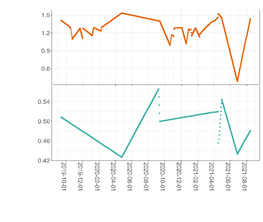
Necessary prior knowledge: clear sky measurements

I. *Computation of sky emittances* through variables and derived variables
II. *Computation of a constant k* through clear sky data only
III. *Computation of CSI (Clear Sky Index)*[c]

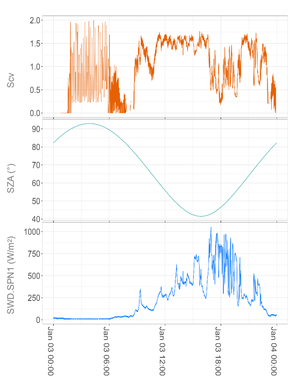
Interpolated A



Interpolated b

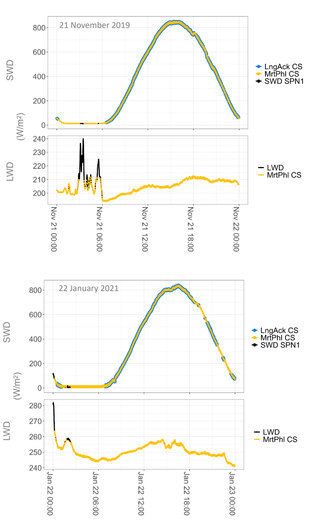


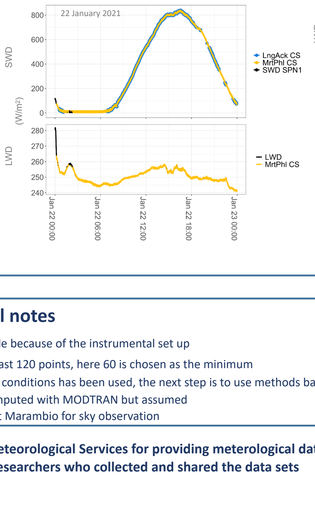
Example of Scv computation

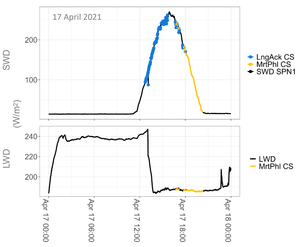


3 January 2021
Until 6:00, 2 < Scv < 15

Examples for comparison between algorithms







Technical notes

[a] Comparisons tests were not all possible because of the instrumental set up

* Original article defines a CS day as a day with at least 120 points, here 60 is chosen as the minimum

[b] Because of the lack of known clear days for Escudero station, an earlier algorithm for identifying sky conditions has been used, the next step is to use methods based on SWD alone to identify CS days

[c] emittance for dry atmosphere not computed with MODTRAN but assumed

Soon a webcam will be installed at Marambio for sky observation

Thanks and credit to the Argentinian and Chilean Meteorological Services for providing meterological data and to the Argentinian, American and Chilean researchers who collected and shared the data sets

References

[1] RadiCA – PNRA project
[2] Long and Shi, 2008: «An automated quality assessment and control algorithm for surface radiation measurements», Open Atm. Science J. Vol.2, most used QC in the BSRN network)
[3] Long et al. 2006: «Estimation of fractional sky cover from broadband shortwave radiometer measurements», J. Geophys. Res. Vol. 111
[4] Marty and Philipona, 2000: «The Clear Sky Index t o separate clear-sky from cloudy-sky situations in climate research», Geophys. Reas. Let., vol. 27