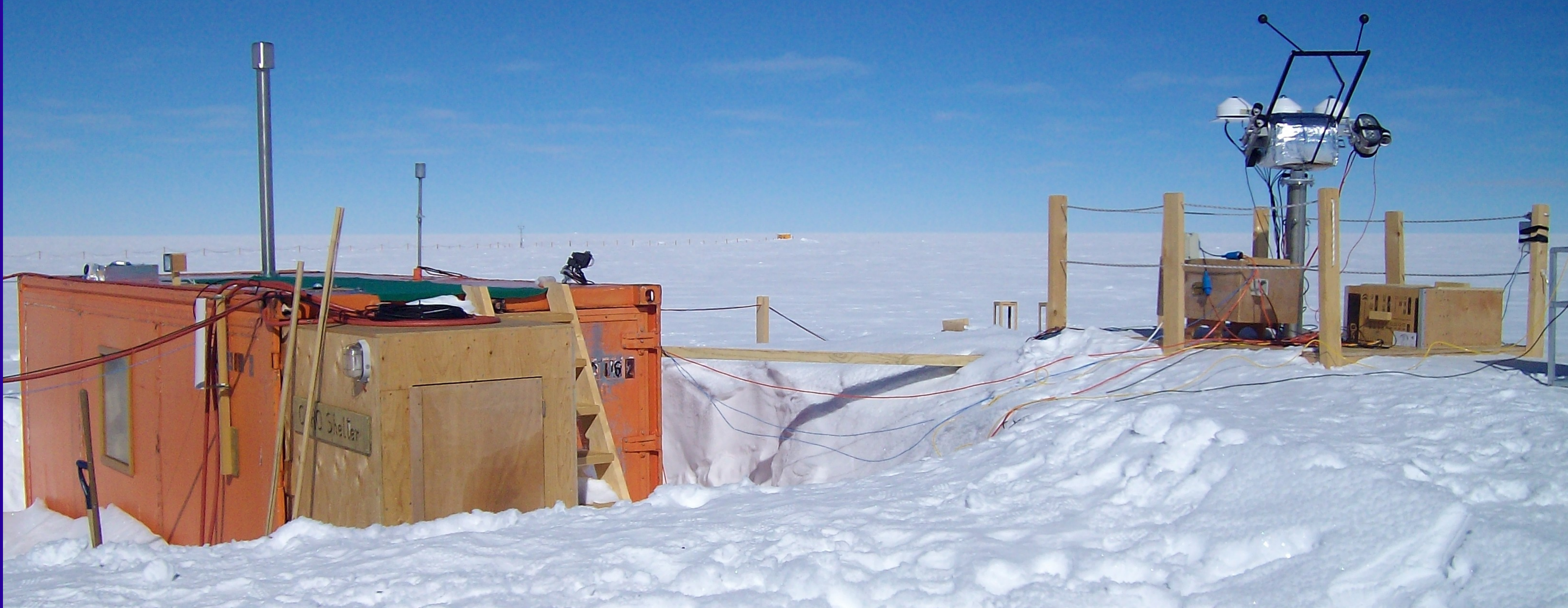
BSRN measurements at Concordia

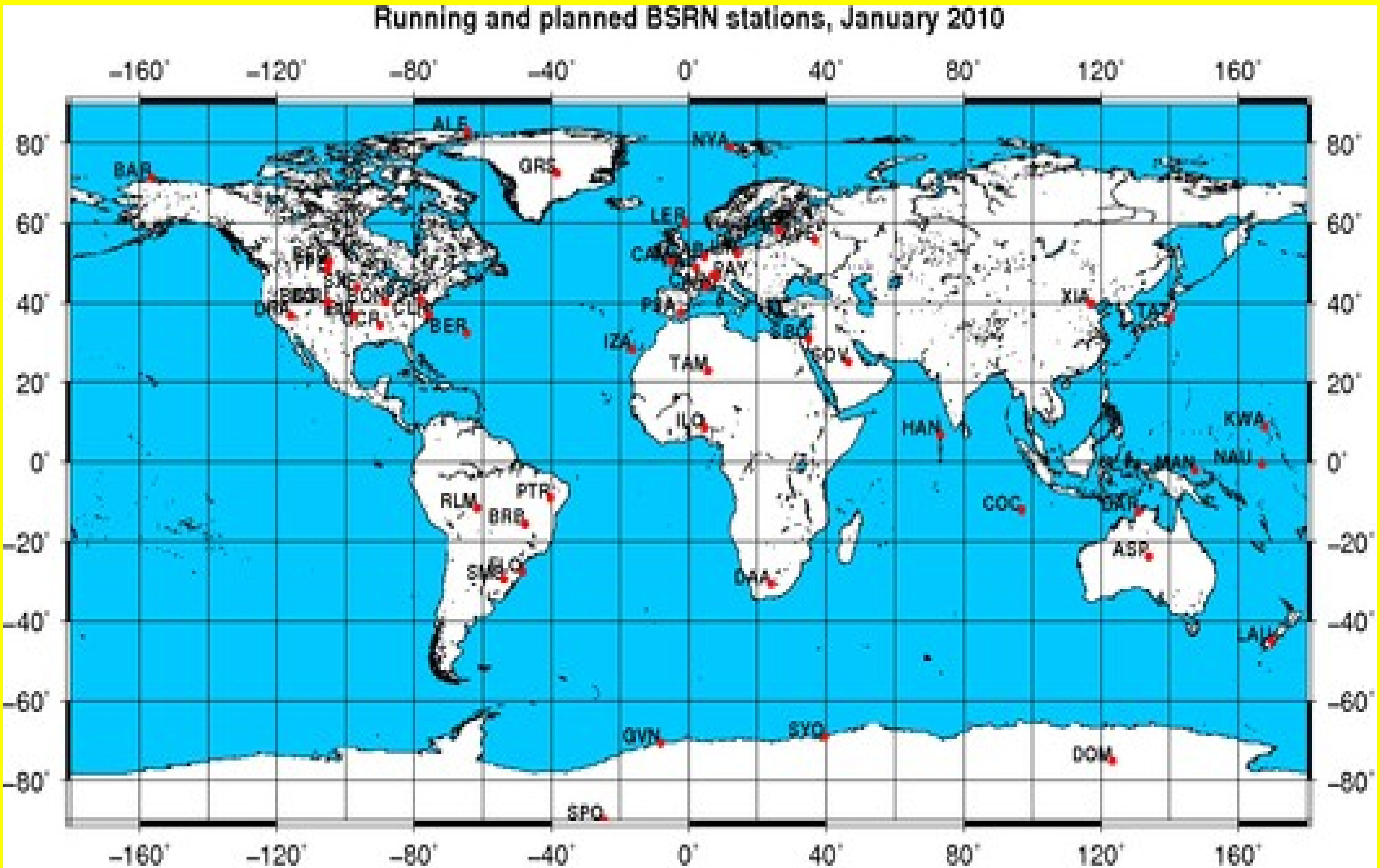
M. Busetto , C. Lanconelli , M. Mazzola , A. Lupi, B. Petkov and V. Vitale



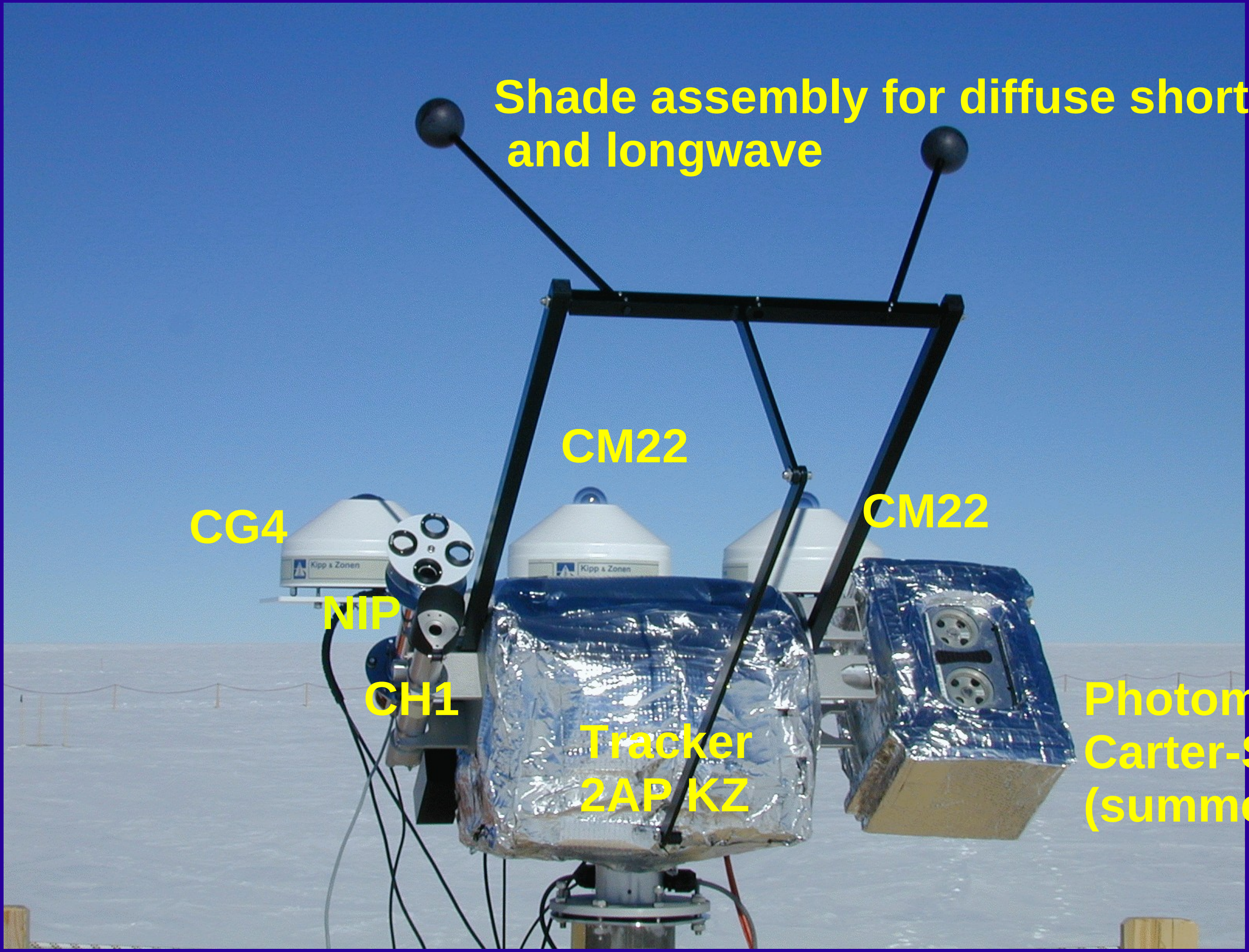
Institute of Atmospheric Science and Climate
National Research Council
Bologna (Italy)

CONCORDIASI workshop – 20-21 March, Toulouse (France)

BASELINE SURFACE RADIATION NETWORK



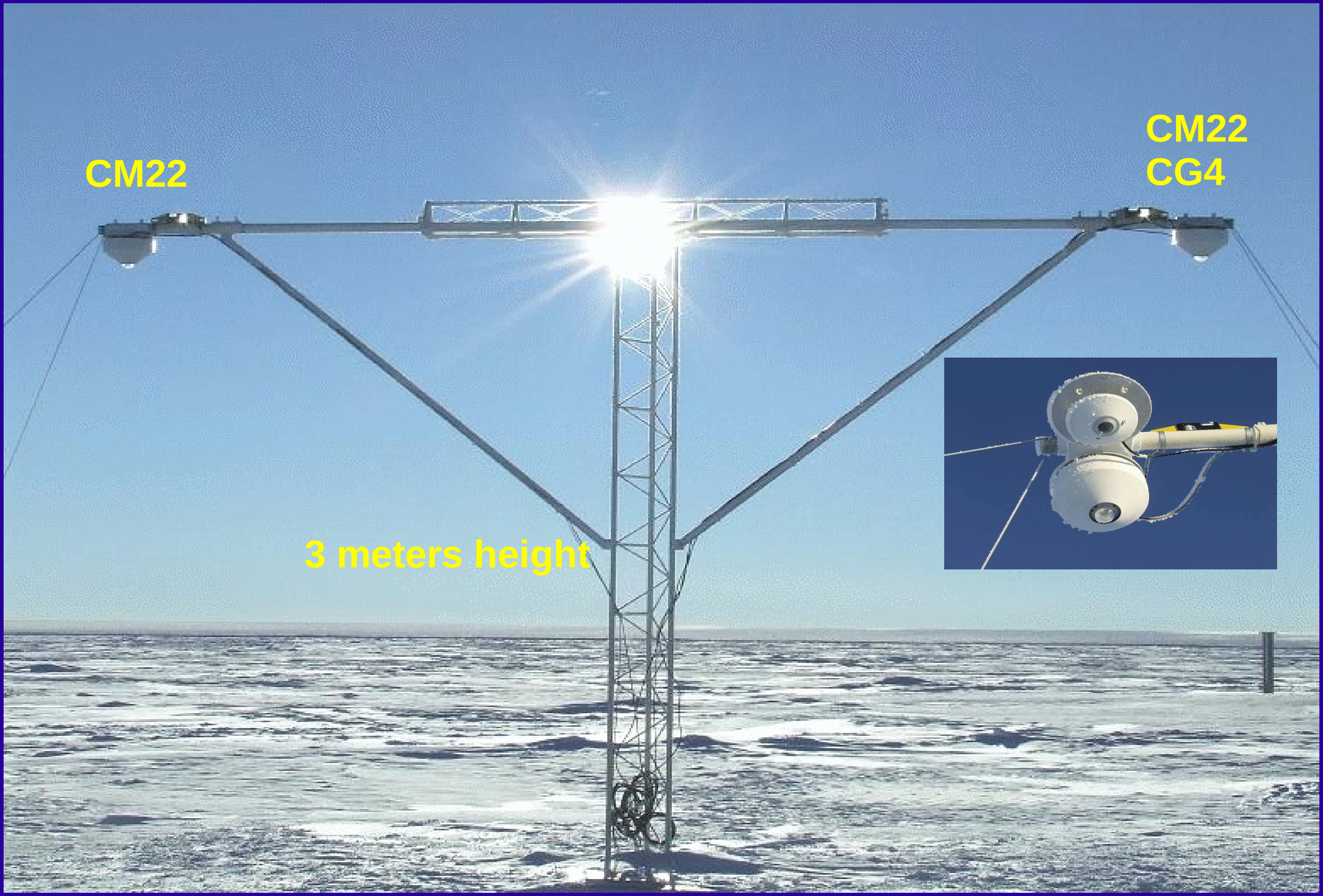
Measurements of downwelling radiation: BSRN site



SINCE 2006

Direct short-wave (CH1,NIP) Global short-wave (CM22) Diffuse short-wave (CM22) long-wave (CG4). During some summer campaign also photometric measurements

Measurements of upwelling radiation: ALBEDO rack

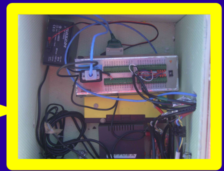


SINCE 2007

Short-wave (CM22), long-wave (CG4) and snow temperature at two depths (pt100)

Measurements chain

CR10X

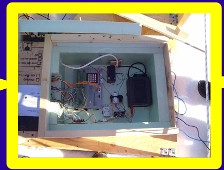


MODEM

1 min data
(mean, st. dev.,
max, min)

Data every 1 sec

RS232

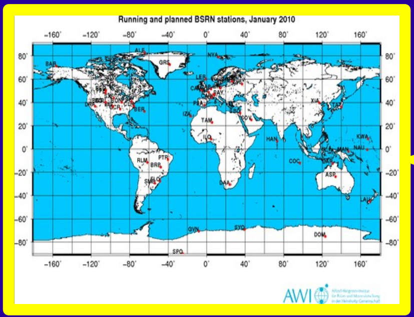


CR23X

Raw data

WIRELESS
OPTICAL
FIBER

Daily



WWW.BSRN.AWI.DE

Monthly

FTP

At present only
downwelling

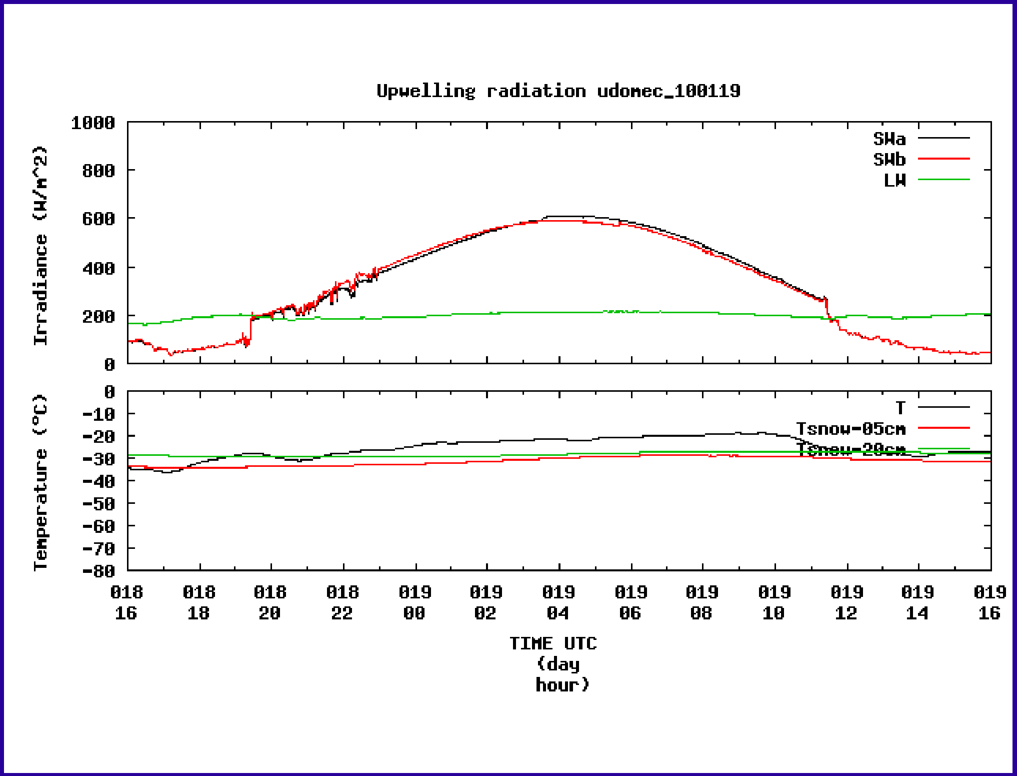
Daily

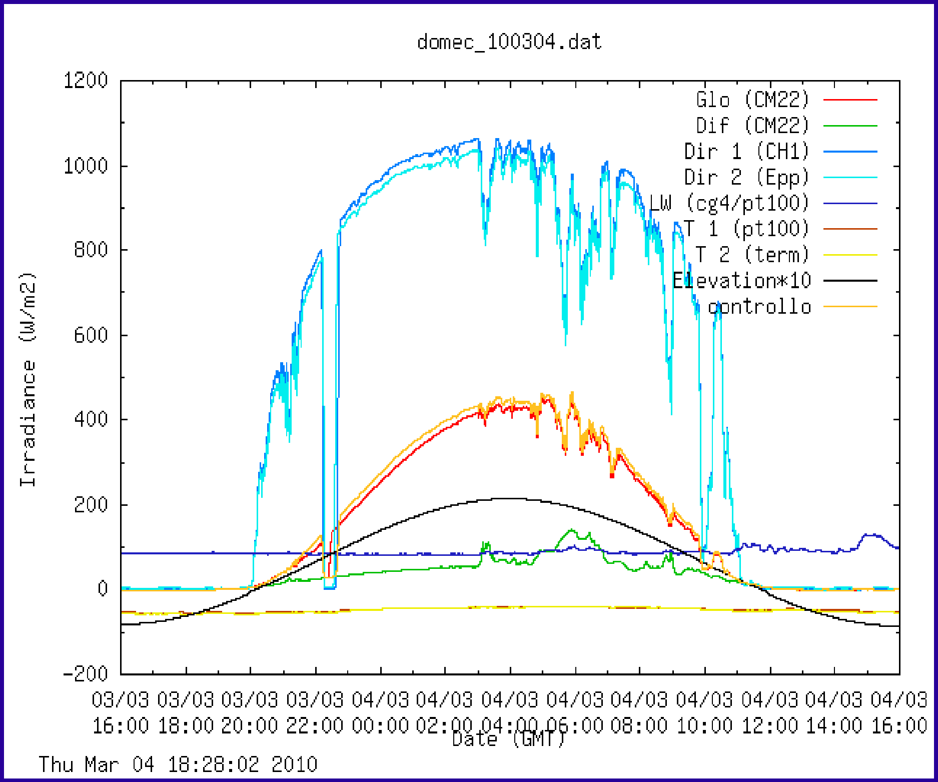
E-MAIL

First visual check made on the Concordia PC (made on raw data)

Make a daily graph that can be seen by the operator at Dome C to check measurement quality.

These graphs can see also form Concordia intranet to give at the scientific crew some visual information about the daily radiation regime at Dome C





Correction made on 1-min data (at ISAC)

Pyranometers : $F_{SW} = S\ R(T)\ R(\cos SZA)\ (V - V_0)$

Pyrheliometers : $F_{SW} = S\ R(T)\ (V - V_0)$

Pygeometerss : $F_{LW} = S\ R(T)\ V$

F is the IRRADIANCE
V is the MEASURED SIGNAL
S is the RADIOMETER SENSITIVITY
R(T) is the TEMPERATURE CORRECTION
R(cos SZA) is the COSINE CORRECTION
V_0 is the NIGHT OFFSET

OFFSET CORRECTION :

more important for diffuse radiation because of its lower value

Pyranometers about -2 W/m2 (depending on the thermal incoming radiation)
Pyreliometers less then instrument accurancy (no correction)
Pyrgeometers don't need offset correction

COSINE CORRECTION :

more important for global radiation

Pyranometers correction between -1.5 and 1.5 W/m2
Pyreliometers don't need cosine correction
Pyrgeometers don't need cosine correction

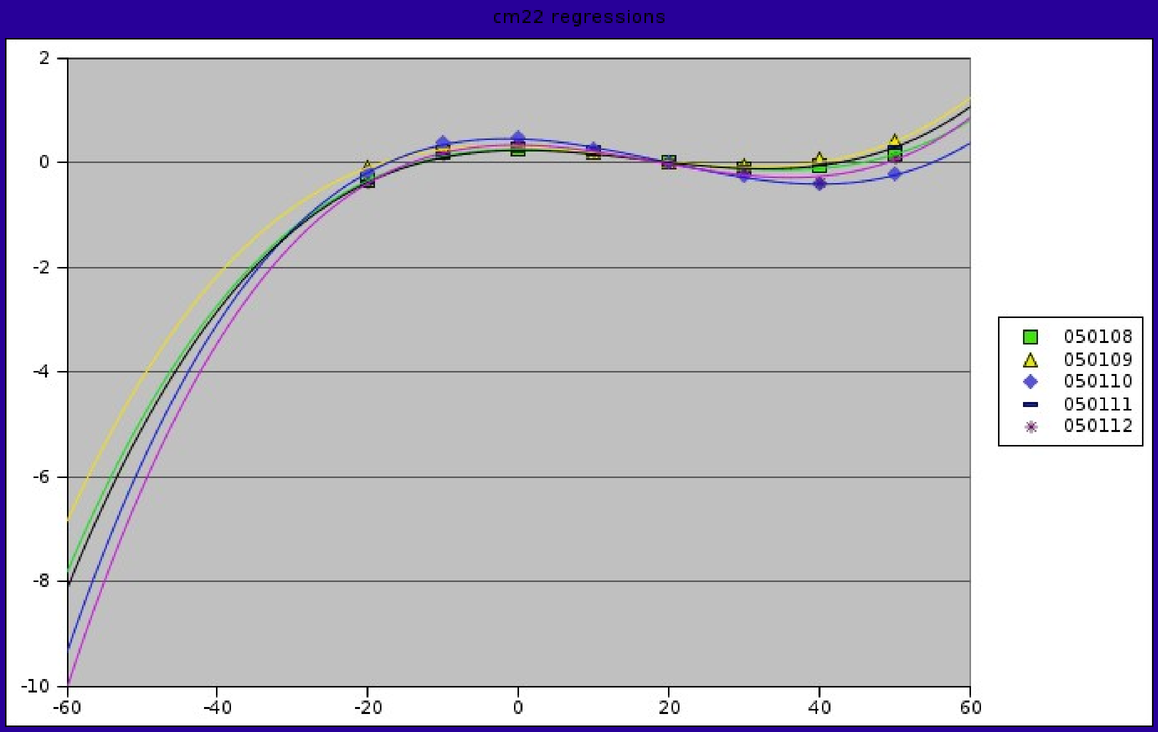
TEMPERATURE CORRECTION

Problem:
The sensitivity correction due to temperature is given by the manufacturer only until -20 °C and the temperature range at Dome C is from -80 °C to -25 °C

TEMPERATURE CORRECTION

Su et al., J. Atmos. Oceanic Technol, 2008

dependency of the instrumental sensitivity from temperature: third degree polynomial extrapolation of manufacturer sensitivity curve (pyranometers and pyreliometers)



At -60 °C sensitivity correction of 10%

This method seems better then keeping the correction constant below -20 °C

BSRN quality check

Absolut values

	PPL [W/m^2]		ERL [W/m^2]	
	Min	Max	Min	Max
Global	-4	$1.5 S_a \mu_0^{1.2} + 100$	-2	$1.2 S_a \mu_0^{1.2} + 50$
Diffuse	-4	$0.95 S_a \mu_0^{1.2} + 50$	-2	$0.75 S_a \mu_0^{1.2} + 30$
Direct	-4	S_a	-2	$0.95 S_a \mu_0^{0.2} + 10$
Longwave	40	700	60	500

Compared quantities

	SZA < 75°	93° > SZA > 75°
Ratio of Global over Sum [g/(D+d)]	$0.92 < \frac{g}{(D+d)} < 1.08$	$0.85 < \frac{g}{(D+d)} < 1.15$
Diffuse Ratio [d/g]	$\frac{d}{g} < 1.05$	$\frac{d}{g} < 1.10$
Longwave to Air Temperature comparison	$0.4 \sigma T_{air}^4 < LW < \sigma T_{air}^4 + 25$	

Automatically eliminated from dataset to be submitted:

out of PPL limit

out of ERL limits and respective AQ

measured during tracker return (‘round midnight) for direct and diffuse

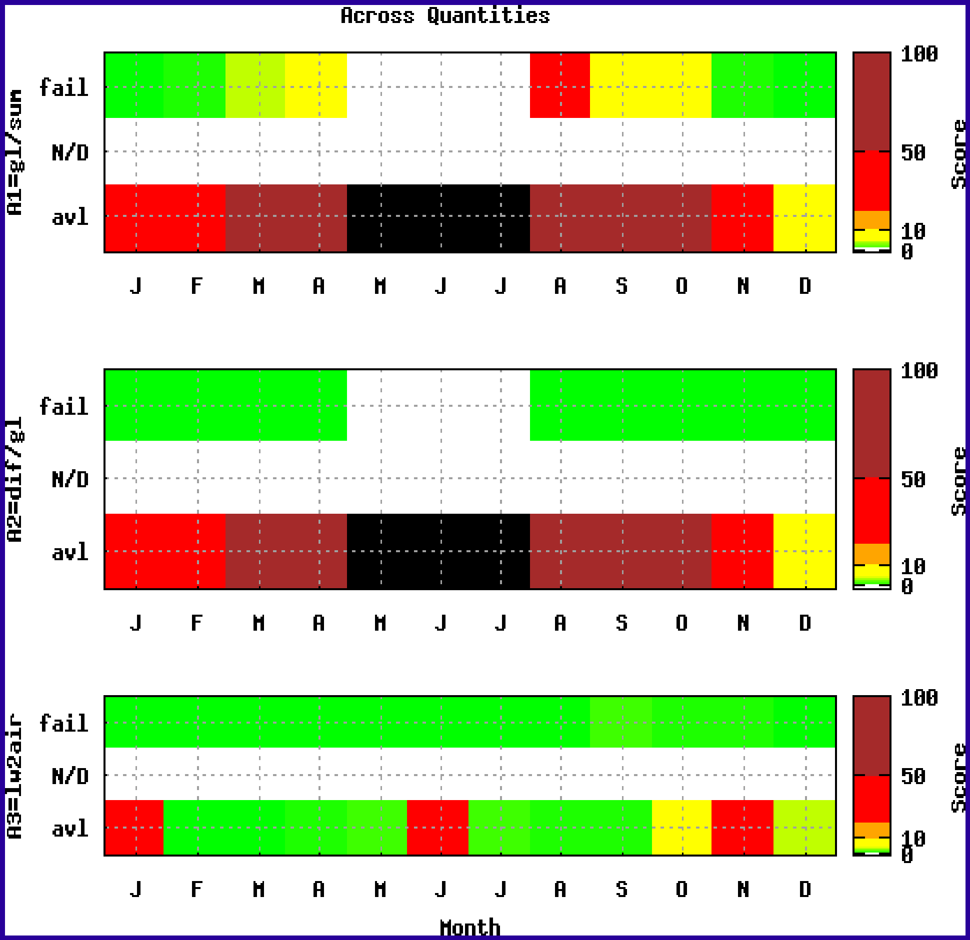
out of AQ and only one quantity (gl, dr, df) dramatically change

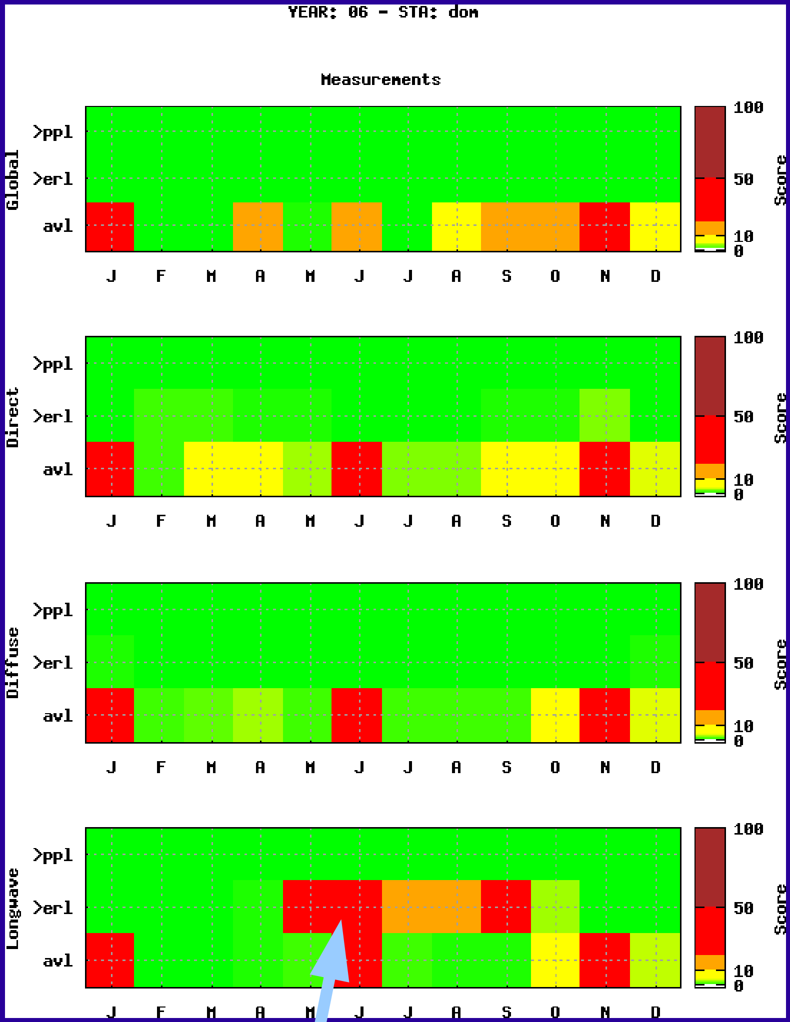
during polar night if diffuse, direct or global are higher than offset

Last check.......VISUAL CHECK

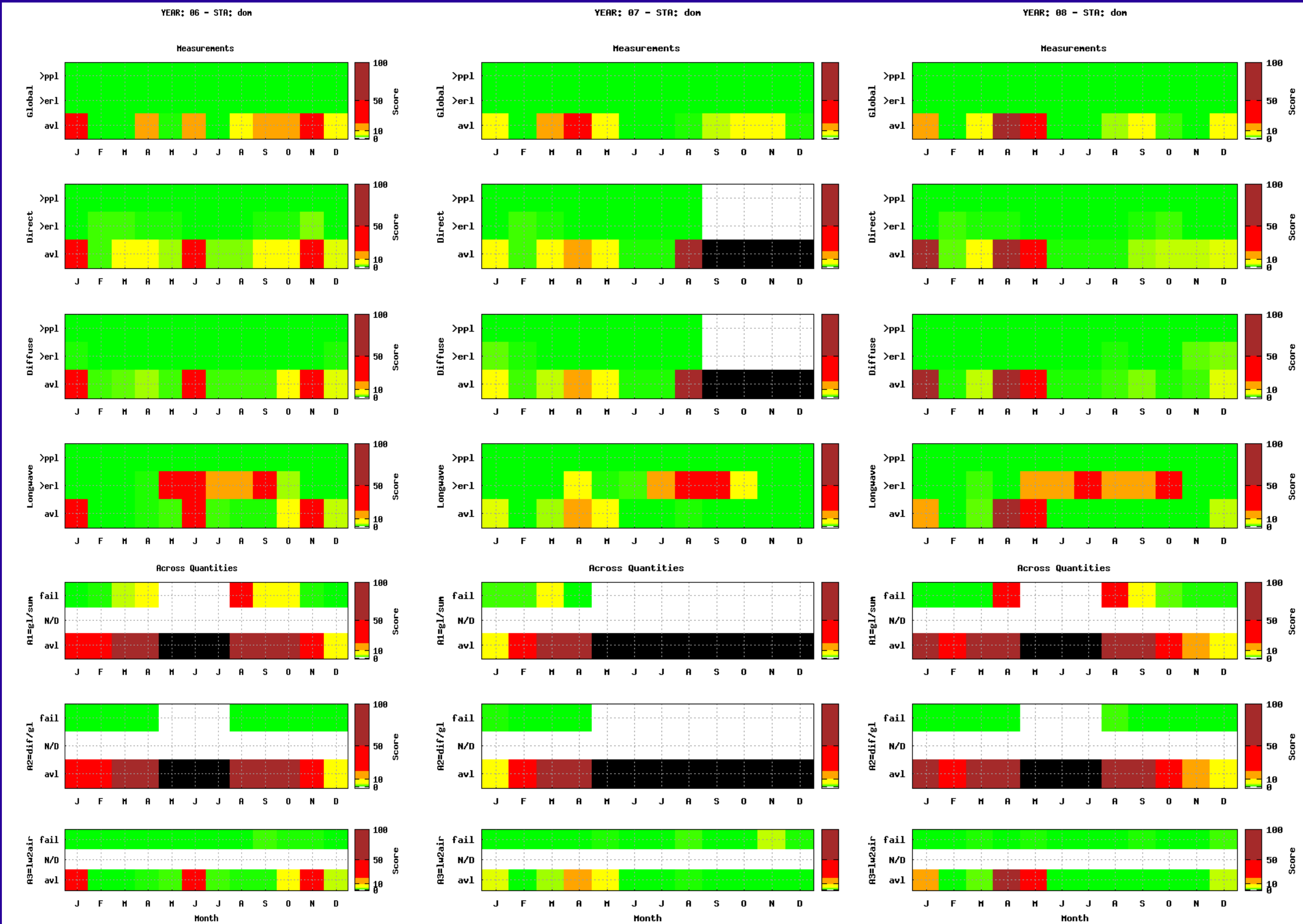
Ready to submit to BSRN archive WWW.BSRN.AWI.DE

Quality of Dome C data





Probably the lower ERL for LW is too low !!


YEAR: 06 - STA: dom
YEAR: 07 - STA: dom
YEAR: 08 - STA: dom
Measurements
Global
Direct
Diffuse
Longwave
>ppl
>erl
avl
Across Quantities
A1=gl/sum
A2=dif/gl
A3=lw2air
fail
N/D
J F M A M J J A S O N D
Month
Score
100
50
10
0

Other radiation measurements (not BSRN) : UV radiation

November 2007 installation of UV-RAD radiometer :

UV spectral measurements in the range 300-400 nm

ozone content and UV flux

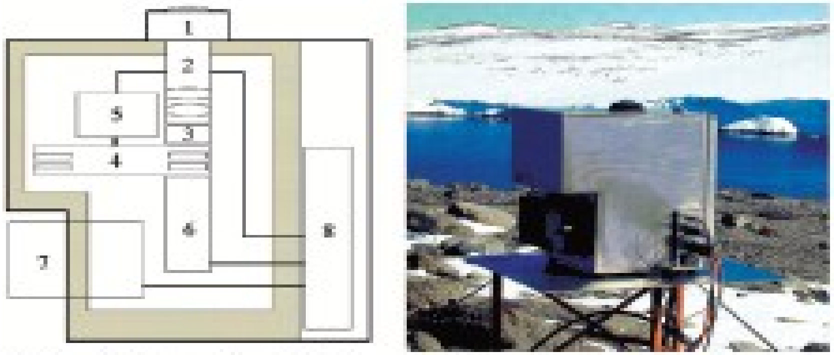


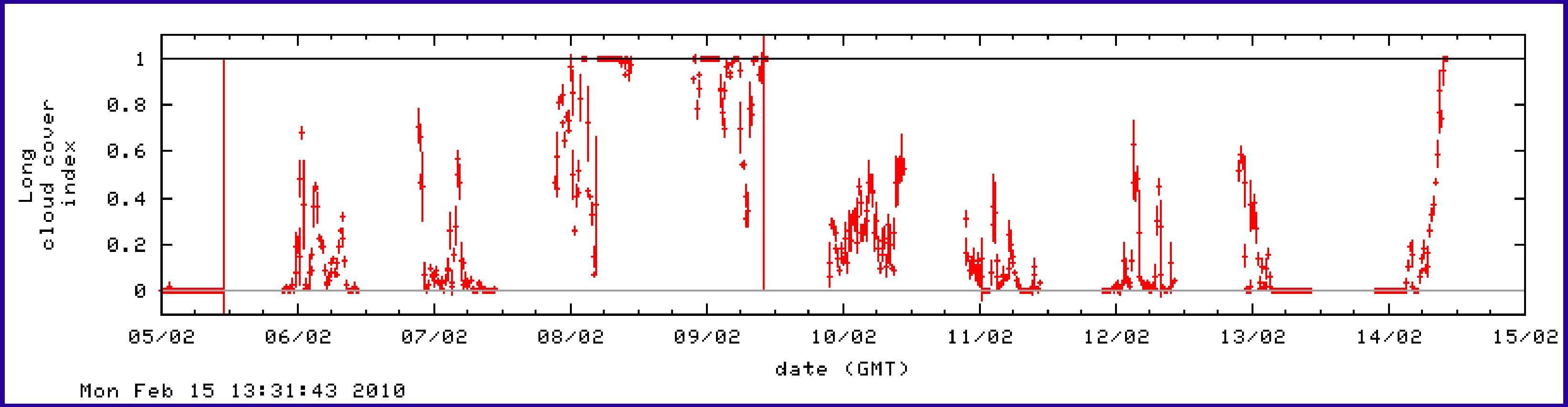
Fig. 1. (Color online) Left, schematic diagram of the UV-RAD with its main components: 1, hemispherical diffuser; 2, entrance optics with field stopper and collimating system (consisting of two lenses); 3, UV–VIS passband with a pair of colored glass filters (see also Fig. 3 below); 4, filter wheel; 5, synchronous motor rotating the filter wheel; 6, photomultiplier; 7, thermoelectric (Peltier) heat pump; 8, recording and controlling electronics. Right, photograph of the instrument during a measurement test in Antarctica. The radiometer is 310 mm × 300 mm × 370 mm in size, with an overall weight of 12 kg.

DOWNELLING FLUXES CLIMATOLOGY

	gl [MJ/m^2]			Lw [MJ/m^2]		
	2006	2007	2008	2006	2007	2008
1	1021	1057	1053	274	282	291
2	689	671	674	235	236	200
3	286	291	230	229	264	217
4	50	17	96	213	199	220
5	0.5	0.4	0.1	187	239	206
6	0.0	0.0	0.0	179	209	197
7	0.1	0.2	0.3	199	187	191
8	5.5	13.5	13	179	189	230
9	157	150	157	196	180	214
10	469	454	507	203	227	174
11	1016	944	927	211	218	268
12	1208	1158	1189	247	284	284

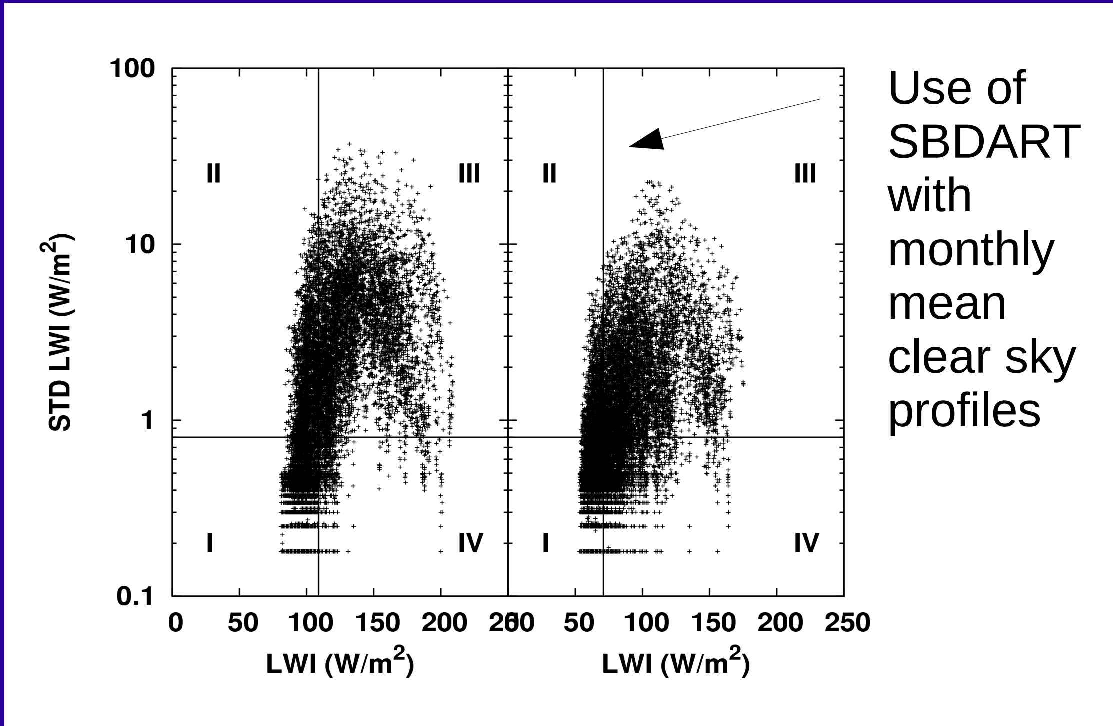
CLOUDS DETECTION

In sunny months (Jan, Feb, Oct, Nov, Dec) :
use of LONG (JGR 2000) SHORT-WAVE



Clear sky index

Always : use of Town (J. of Clim. 2007) LONG-WAVE



Percentage of clear-sky:

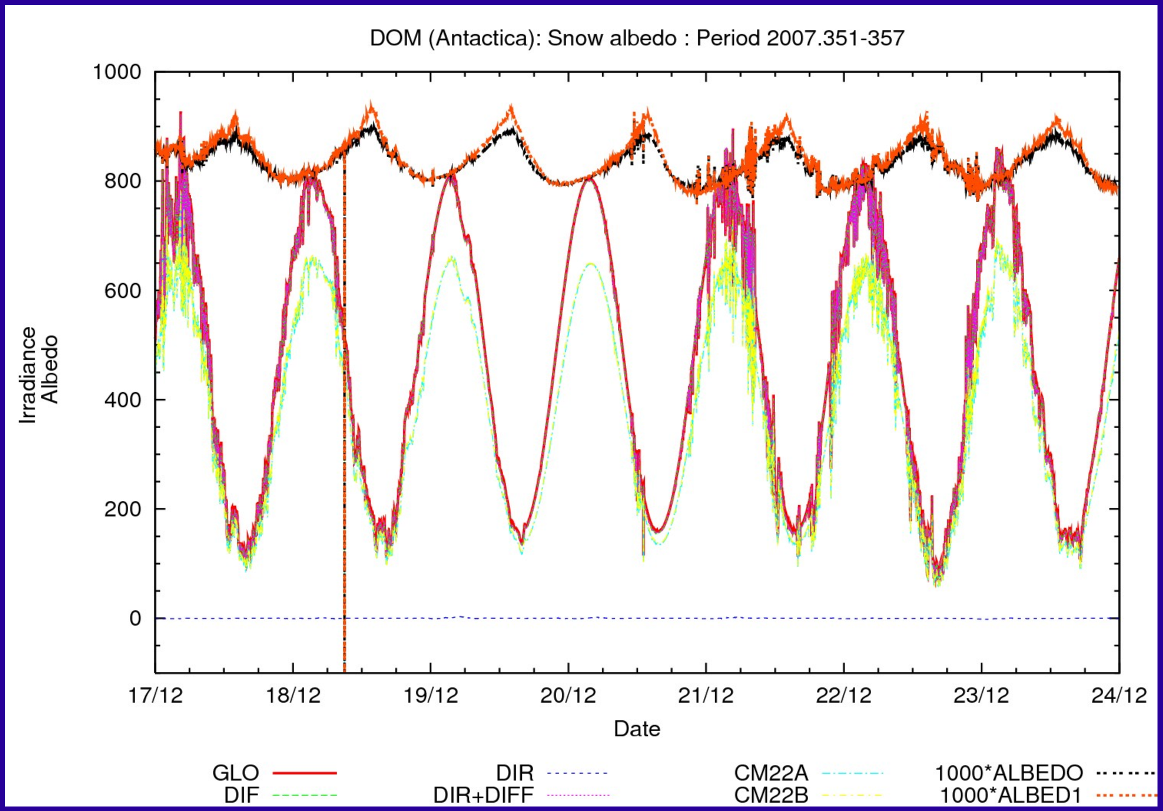
Jan 57%, Feb 68%, Mar 43%

Apr 49%, May 32%, Jun 57%

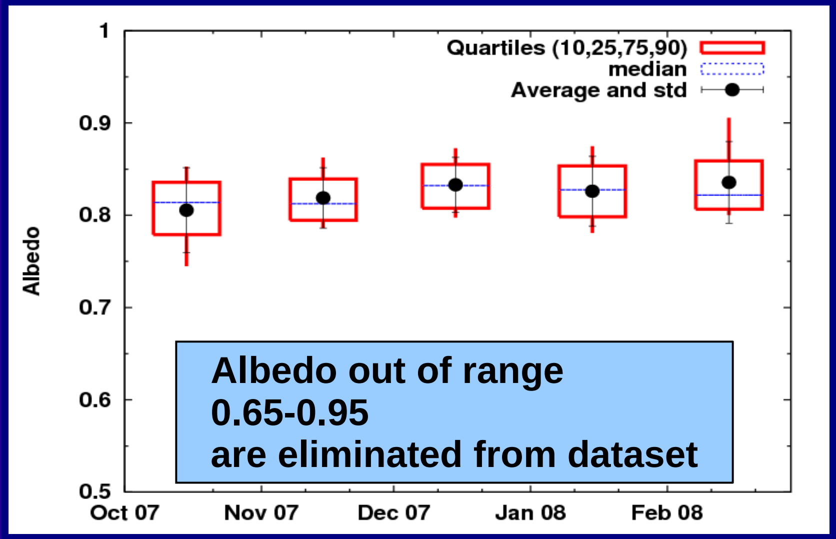
Jul 49%, Aug 42%, Sep 44%

Oct 53%, Nov 38%, Dec 62%

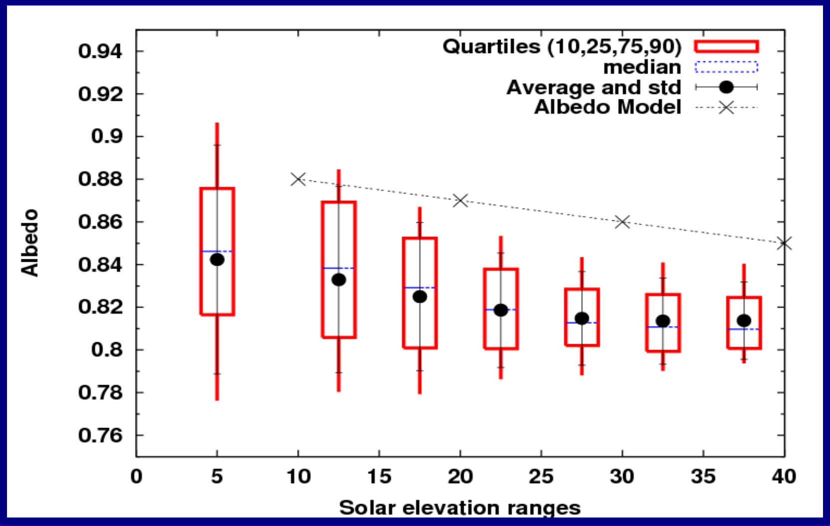
ALBEDO



Statistic



Monthly statistic

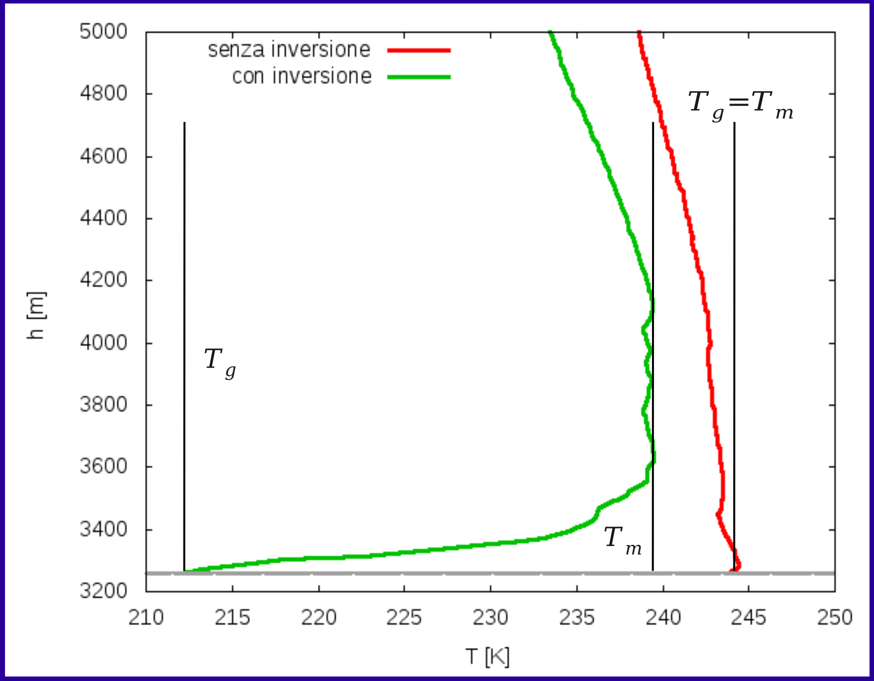


Solar elevation effects

Time pattern of snow albedo:
the minimum is not at local noon

due to a slope in snow surface??

Parameterization of emissivity



From radiosounding: Presence of surface-based temperature inversion

it's better define the emissivity as function of T max

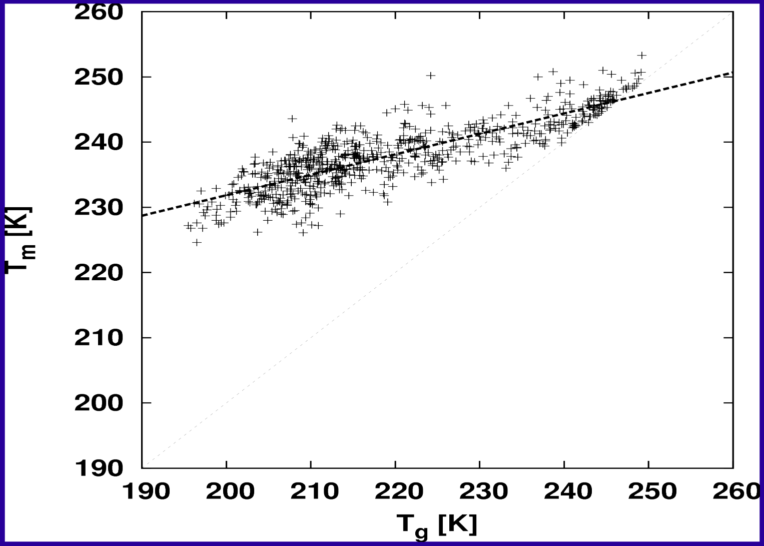
$$\epsilon^m = LWI_{cls} / (\sigma T_m^4)$$

To calculate LWI using only ground temperature both in case of inversion and not inversion

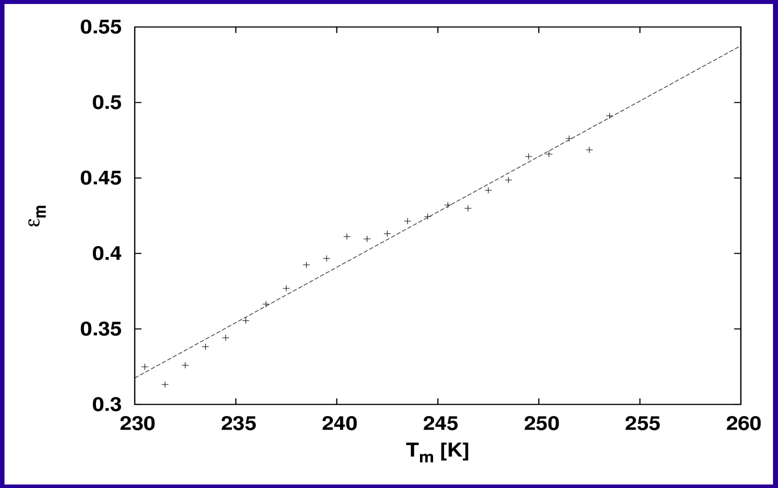
$$LWI_{cls} = \epsilon_{cls} \sigma T_g^4$$

We can rewrite the definition of emissivity such as:

$$\varepsilon_{cls} = \varepsilon^m \left(\frac{T_m}{T_g} \right)^4$$

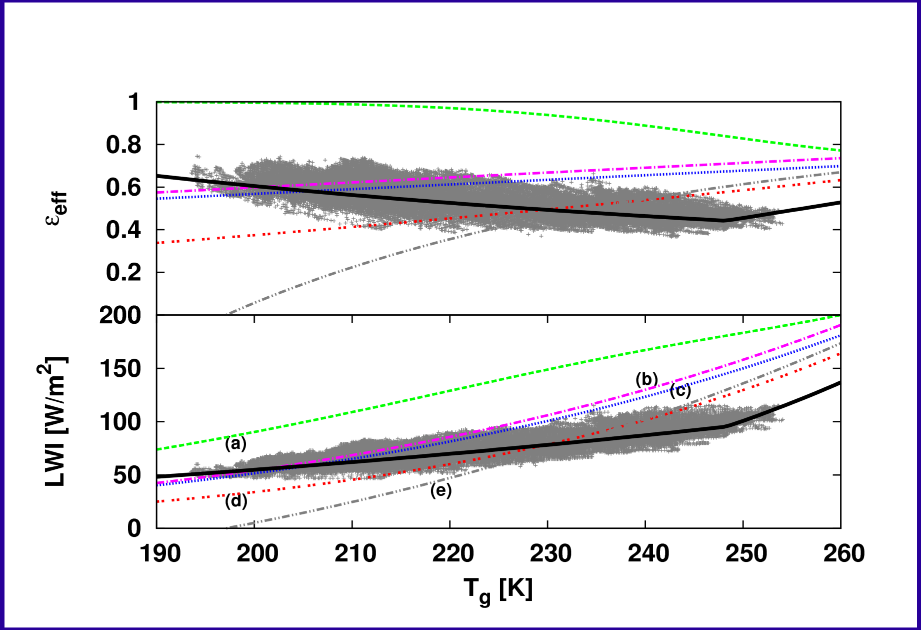


From radiosounding :
T max is in linear relationship
w.r.t T ground



ε ^{m} is in linear relationship w.r.t T max

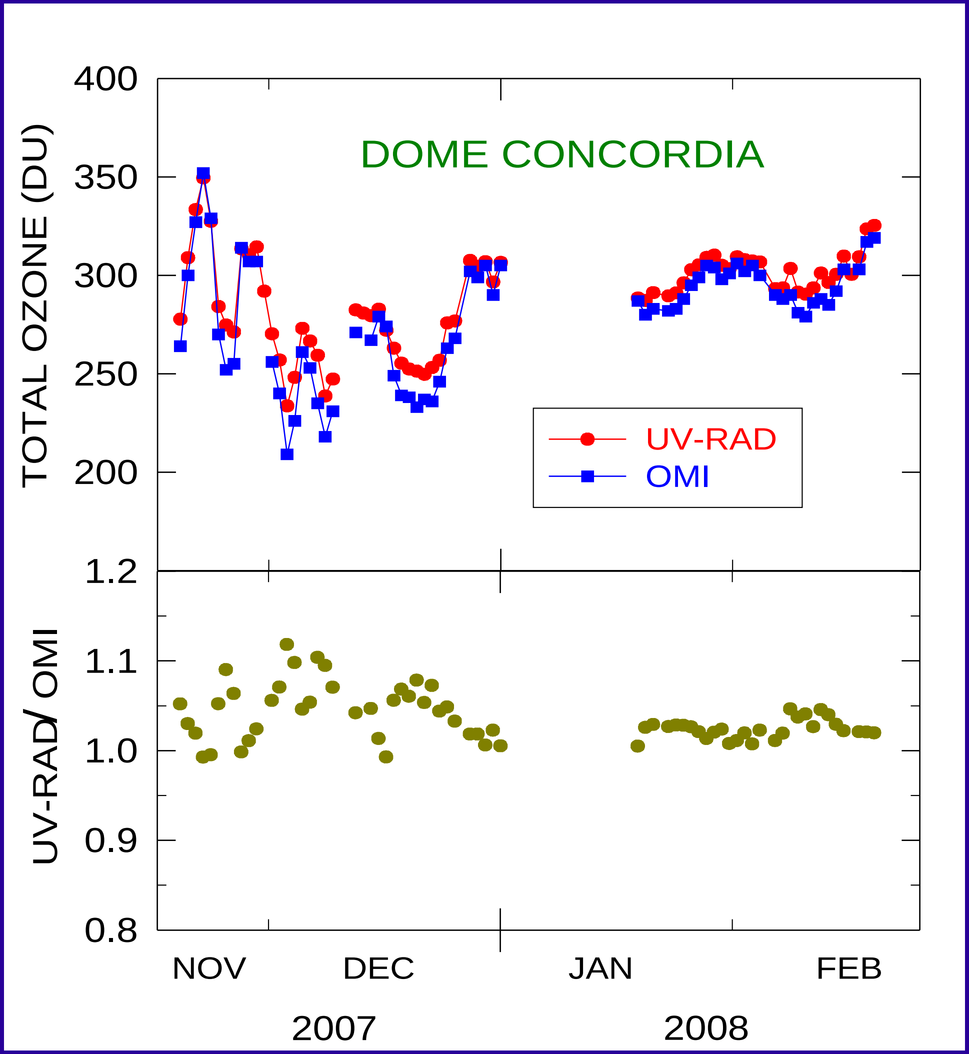
We can evaluate the emissivity
only knowing T ground (easy to measure)

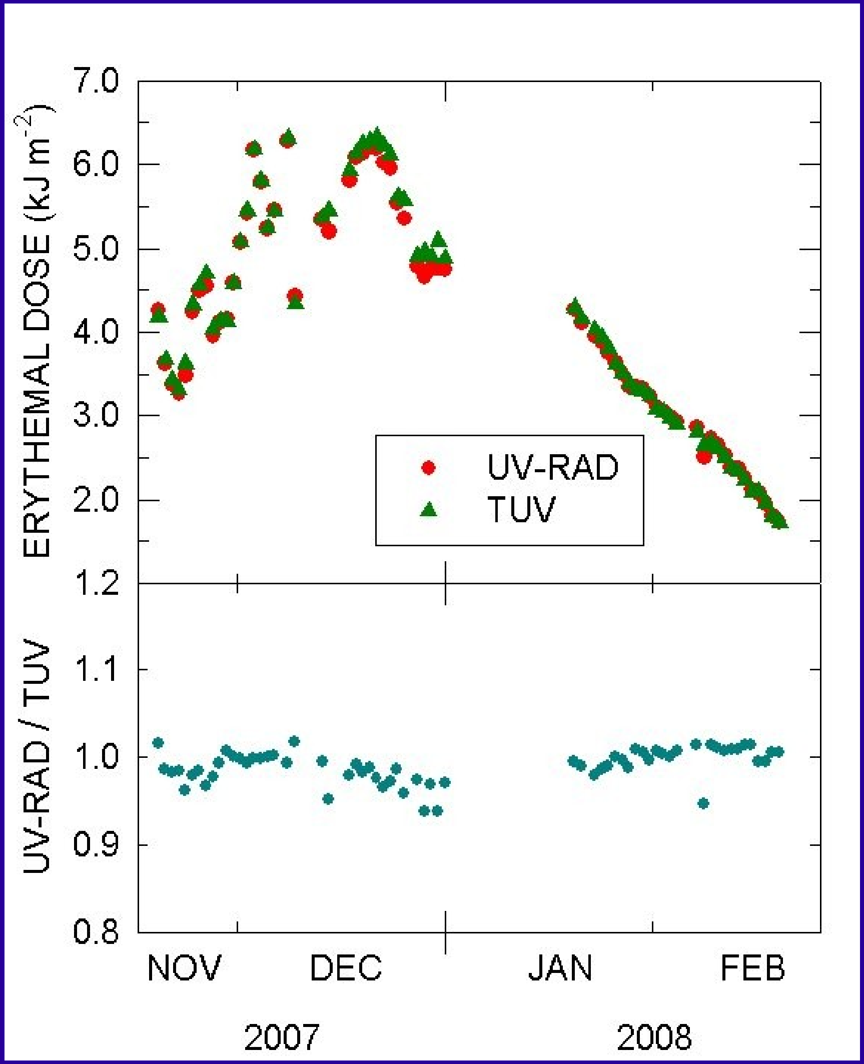


In the temperature range
of Dome C this method works
better then other
parameterizations

UV measurements: total ozone amount and erythemal dose

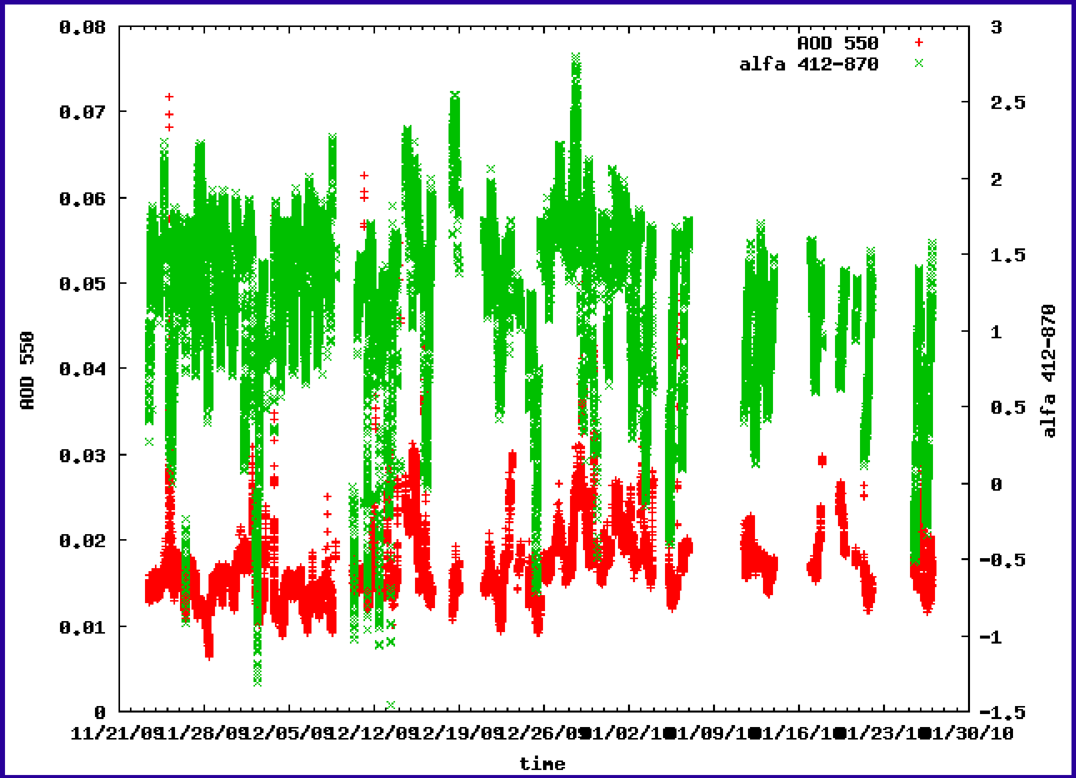
Dome C total ozone amount, retrieved from UV-RAD for summer 2007-2008, and from OMI satellite.
UV-RAD overestimated OMI by about 3%



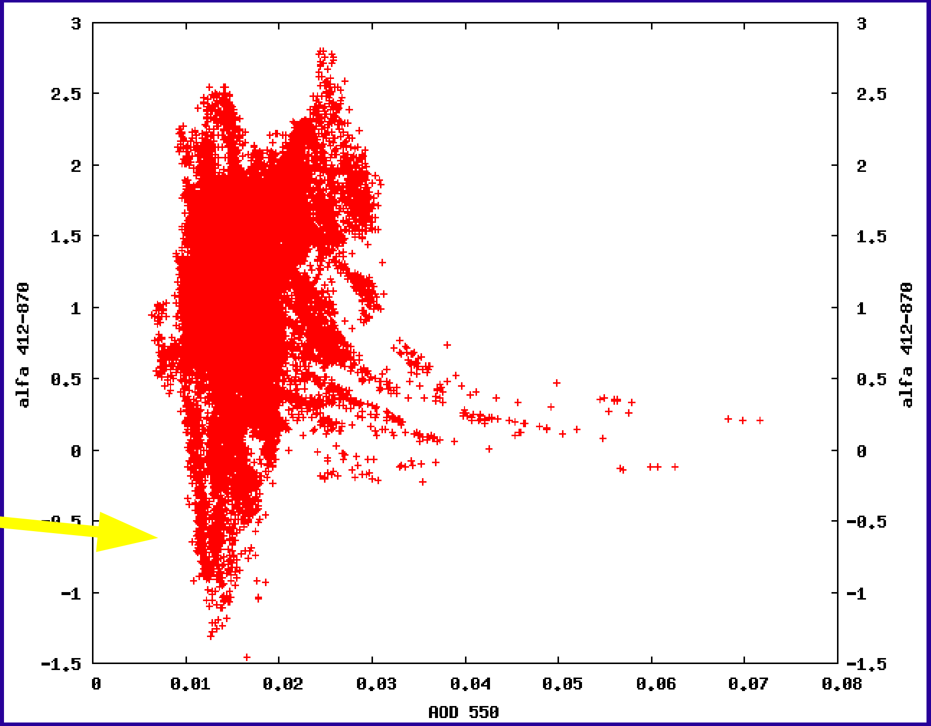


Erythemal daily dose measured by UV-RAD at Dome C during 2007-2008 austral summer and corresponding values computed by radiative transfer model (TUV).

Preliminary analysis AOD and alpha values – summer 2009-2010



Clear sky cases



Negative alpha values due to too low AOD values

GRAZIE