SW Time Interpolation :
Correction with climatological diurnal albedo variation,
Application to ScaRaB and March 2000 CERES/TERRA data
Inter-annual comparisons.

M Viollier, C. Standfuss
P. Raberanto, and R. Kandel

Laboratoire de Meteorologie Dynamique
Ecole Polytechnique 91128 Palaiseau Cedex (France)
tel: 33(0)169334757 fax: 33(0)169333049
email :viollier@lmd.polytechnique.fr

CERES/TERRA data we have used : ES9 product, March 2000

CER_ES9_Terra-FM1_Beta_015013.200003

read with adjusted version of ES9_readhdfv1.c

containing :

ES9 Regional Instantaneous Means (or Hourbox Averages) :
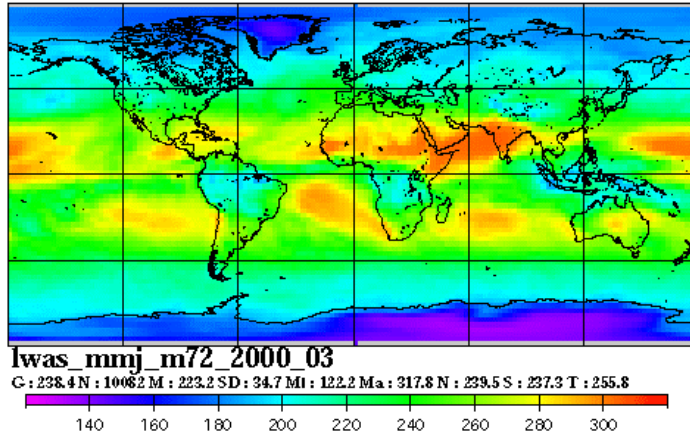
> from which we have applied the ScaRaB 'ERBE-type' software
> and the new 'climatological' method',
>
> and we have compared to the DAAC computation of
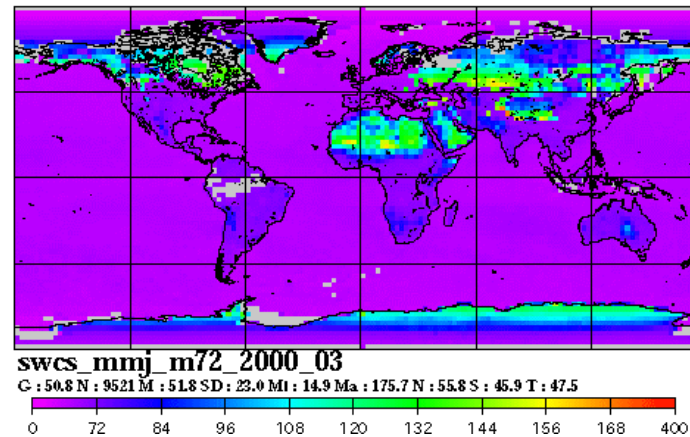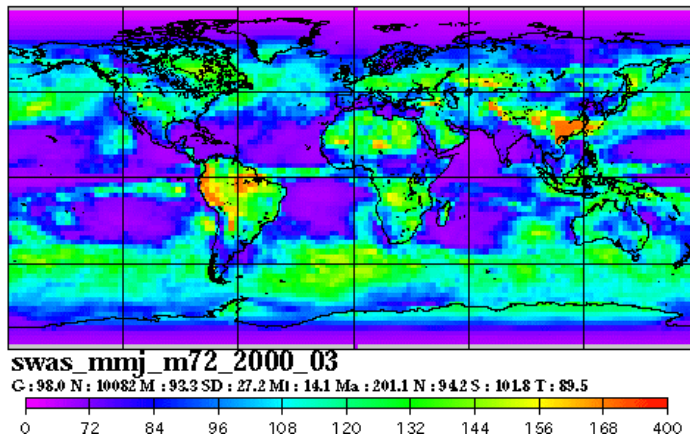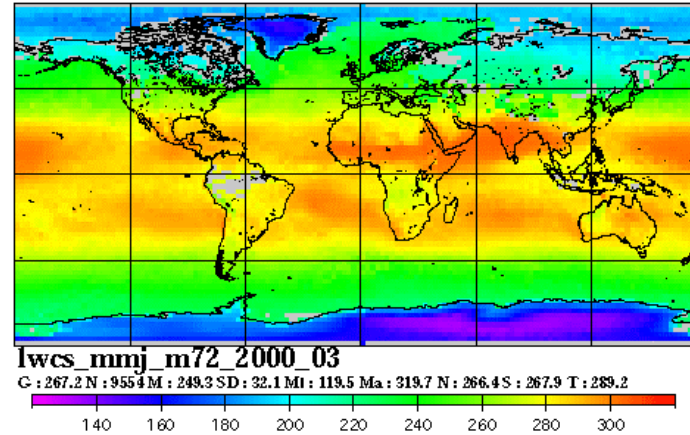
ES9 Regional Monthly Means (or Monthly 'Day', Total-sky Averages)

LMD Display of CER_ES9_Terra-FM1_Beta_015013.200003 CERES/Terra March 2000

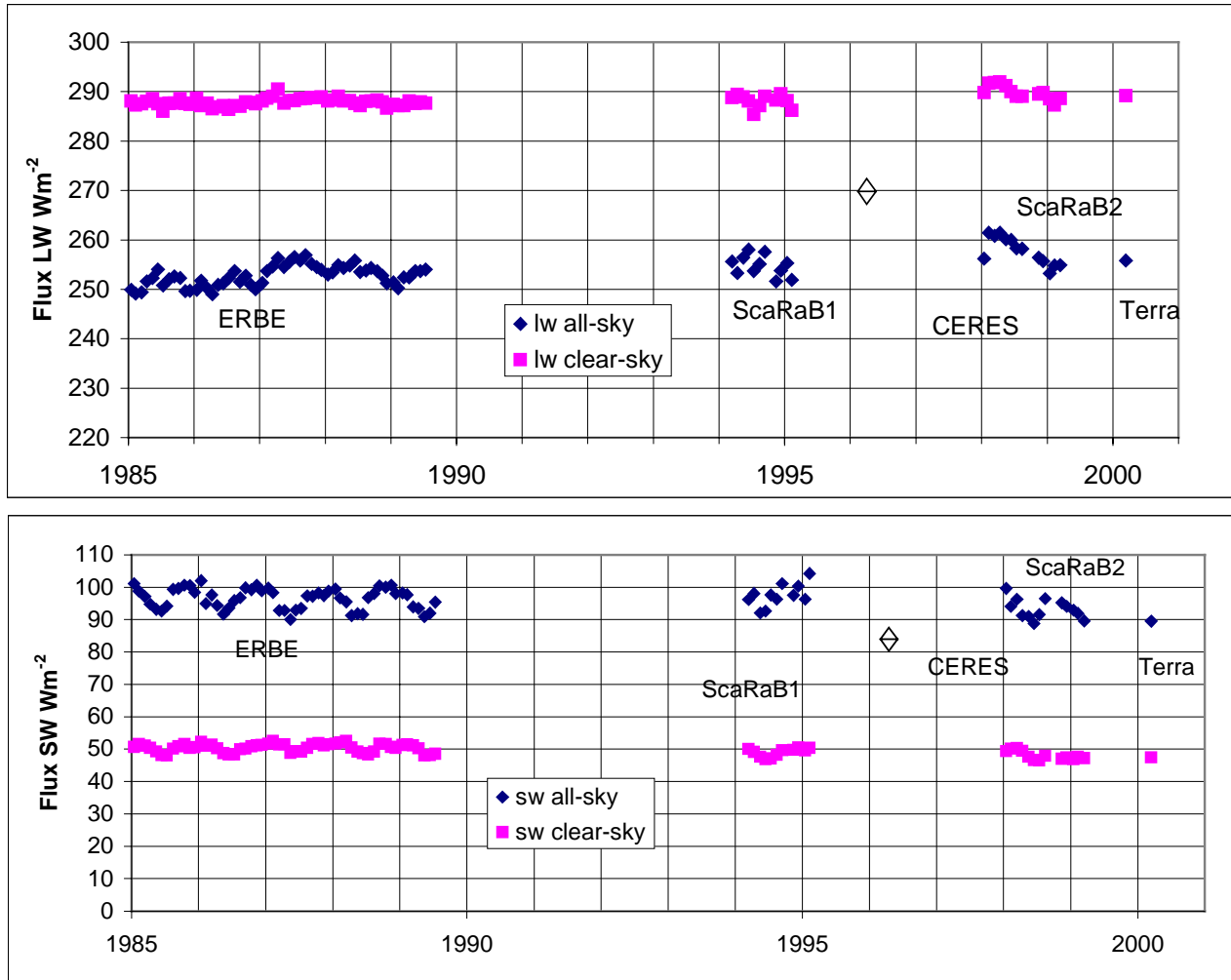**LW and RSW Total Sky**

LW and RSW Clear Sky

lwas_mmj_m72_2000_03
G : 238.4 N : 10082 M : 223.2 SD : 34.7 Mi : 122.2 Ma : 317.8 N : 239.5 S : 237.3 T : 255.8

140   160   180   200   220   240   260   280   300

lwcs_mmj_m72_2000_03
G : 267.2 N : 9554 M : 249.3 SD : 32.1 Mi : 119.5 Ma : 319.7 N : 266.4 S : 267.9 T : 289.2

140   160   180   200   220   240   260   280   300

swas_mmj_m72_2000_03
G : 98.0 N : 10082 M : 93.3 SD : 27.2 Mi : 14.1 Ma : 201.1 N : 94.2 S : 101.8 T : 89.5

0   72   84   96   108   120   132   144   156   168   400

swcs_mmj_m72_2000_03
G : 50.8 N : 9521 M : 51.8 SD : 23.0 Mi : 14.9 Ma : 175.7 N : 55.8 S : 45.9 T : 47.5

0   72   84   96   108   120   132   144   156   168   400

22nd CERES Science Team Meeting in Huntsville- September 2000- LMD/CNRS

Time Series of Tropical Means (20°S-20°N)

22nd CERES Science Team Meeting in Huntsville- September 2000- LMD/CNRS

Time Series of Tropical Means (20°S-20°N) - Month = March   ($W.m^{-2}$)

		swas	swcs	lwas	lwcs
ERBE	1985	97,1	51	249,4	287,5
ERBE	1986	97,6	51,4	250,2	287,7
ERBE	1987	92,8	51,4	254,6	289
ERBE	1988	95,5	52,5	254,9	289
ERBE	1989	93,9	51,1	252,4	287,2
ScaRaB1	1994	96,2	50	255,6	288,8
CERES-trmm	1998	96,3	50,3	260,8	291,8
ScaRaB2	1999	89,6	47,2	254,9	288,6
CERES-terra	2000	89,5	47,5	255,8	289,2

Longwave : ScaRaB1 and 2, and CERES-Terra are close to each other ,
lower by 5 $W.m^{-2}$ from CERES-TRMM, higher by 5 W.m-2 from ERBE

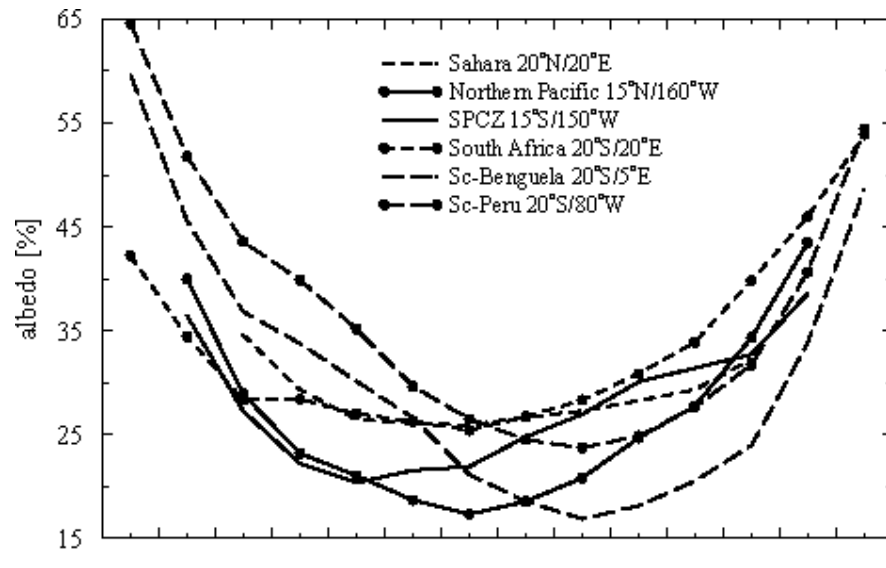Shortwave : CERES-Terra confirms low value found by ScaRaB 2 :
$\cong$ -5 Wm^{-2} (all-sky), -2.5 Wm^{-2} (clear-sky) :

change in tropical cloudiness or common experimental artifact ?
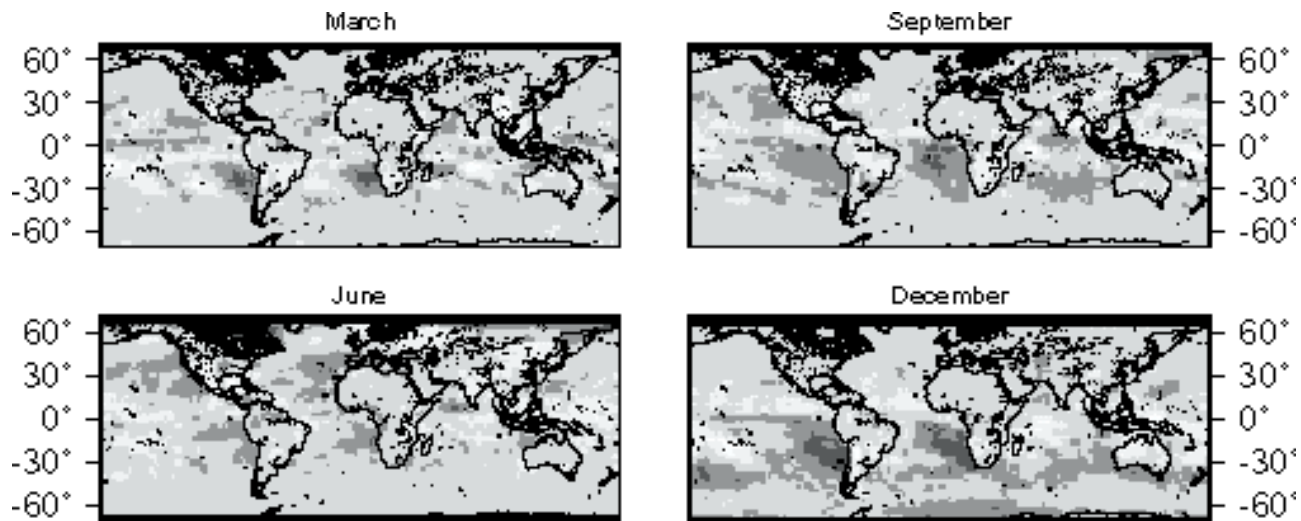
(Uncertainty estimation $\cong$ +/- 2 Wm^{-2})

'Climatological' Diurnal Interpolation/Extrapolation Procedure (CDIEP)

For each month, a mean hourly albedo is first computed from 5 years of ERBS data.

Climatological diurnal albedo cycles for 6 selected regions and the month of December.

**Relative asymmetry parameter (reflected solar solar before noon / full day)**

of the 'climatological albedo' for equinox and solstice months.

The new method then uses this hourly albedo instead of the ERBE directional albedo to extrapolate the SW flux from the observation to each local hour.

However the extrapolation may take on unrealistic values when the observed albedo deviates strongly from the 'climatological' albedo.

To avoid this problem, the ERBE DIEP and the 'climatological' extrapolation are first applied concurrently.

Separately for each hour, the middle value of the 'ERBE' flux, the 'climatologically' extrapolated flux and the climatological means then is chosen.
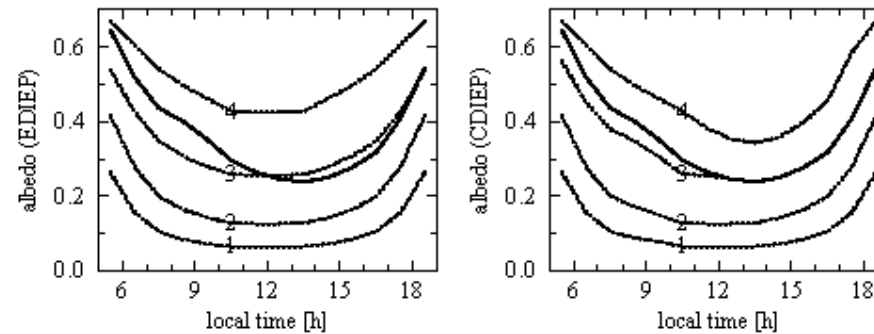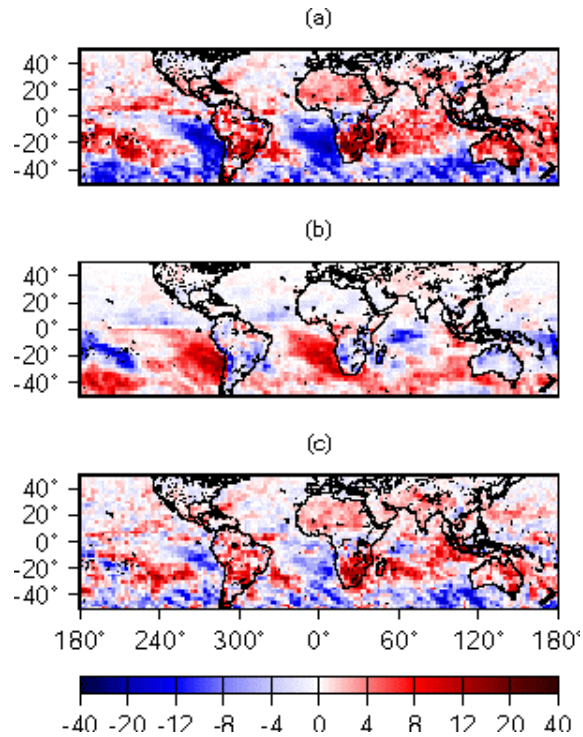

Example for diurnal extrapolation of the planetary albedo, indicated by dotted lines, for four fictitious observations at 10:30h local time (1, 2, 3, 4) using EDIEP (left) and CDIEP (right) for a given RDAC represented by a solid bold line.

Application to ERBE December 1986

Validation of CDIEP applied to NOAA-9 observations (December 1986) by regional monthly means of the reflected short-wave flux [Wm^{-2}]. Top: Initial error $M_9 - M_{90E}$;
centre: correction obtained by CDIEP $M_{9cli} - M_9$;
**bottom: remaining error $M_{9cli} - M_{90E}$.**

22nd CERES Science Team Meeting in Huntsville- September 2000- LMD/CNRS
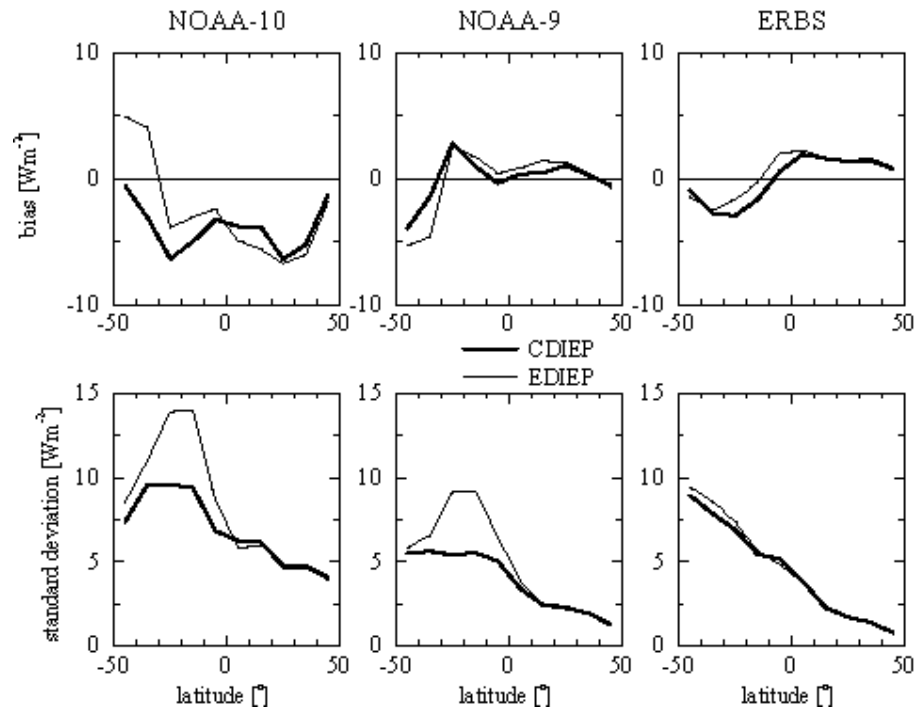
Validation results for CDIEP, averaged between 50°N and 50°S, for December 1986 in [Wm^{-2}]. Δ_i **: Bias,** σ_i **:**

standard deviation of single-satellite monthly regional means of DIEP i from 3-satellite monthly regional

means, $\hat{\sigma}^2 = \left(\sigma^2_{CDIEP} + \Delta^2_{CDIEP}\right) / \left(\sigma^2_{EDIEP} + \Delta^2_{EDIEP}\right)$ **: ratio of mean square errors (CDIEP/EDIEP, dimensionless).**

22nd CERES Science Team Meeting in Huntsville- September 2000- LMD/CNRS

	EDIEP		CDIEP		
	Δ_{EDIEP}	σ_{EDIEP}	Δ_{CDIEP}	σ_{CDIEP}	$\hat{\sigma}^2$
NOAA-9	+0.01	6.18	+0.10	4.47	**0.52**
NOAA-10	-2.79	9.66	-4.01	7.39	**0.70**
ERBS	+0.48	5.57	-0.02	5.40	**0.93**

The efficiency of the new method is satisfactory by accounting for coherent diurnal variations of cloudiness if present, and by reproducing the results obtained by the ERBE-type processing elsewhere.

APPLICATION TO ScaRaB1 : **Difference of ScaRaB monthly mean RSR calculated by CDIEP and EDIEP for a selection of four months in [Wm^{-2}].**
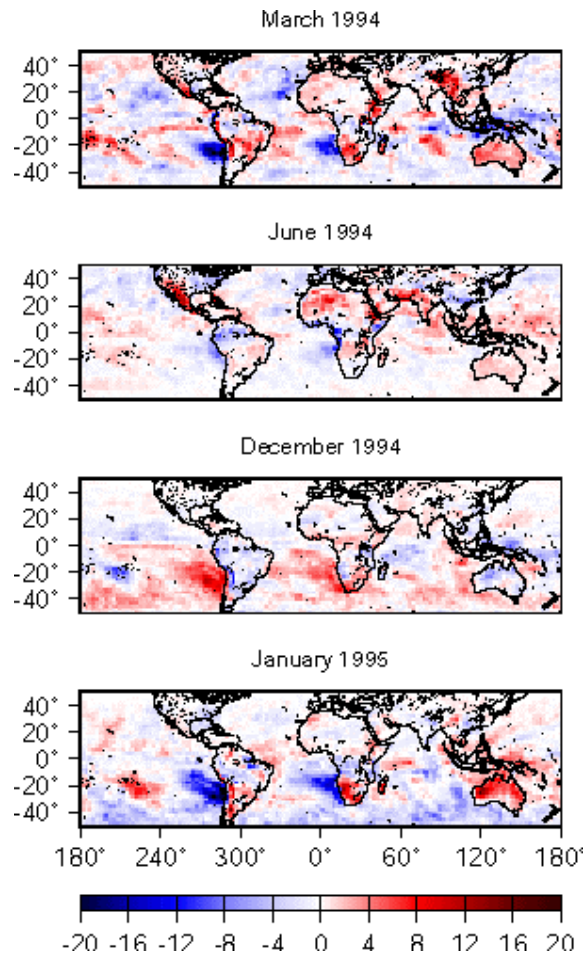
APPLICATION TO ScaRaB1 :
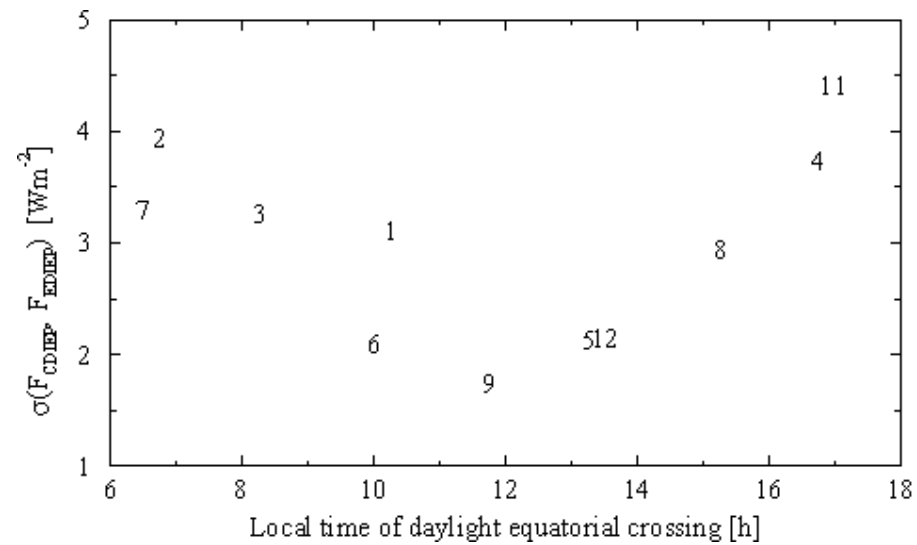
Standard deviation between regional monthly means (50°N to 50°S) obtained by CDIEP and EDIEP as a function of the local time of the daylight equatorial crossing in the middle of the month in Wm^{-2}. Numbers indicate the month between March 1994 and February 1995.
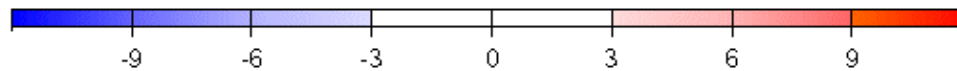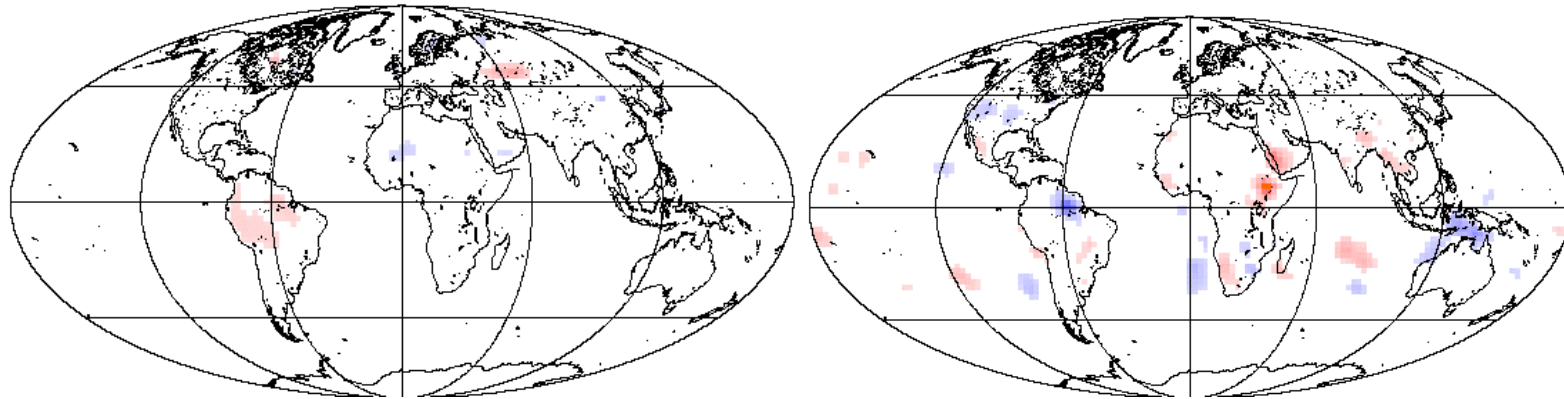
APPLICATION TO March 2000 CERES-TERRA (preliminary) :

Differences between our ERBE-type computation and ES9   Differences between 'clim albedo approach' and ERBE-type

Remaining errors = change in land ADM, difference, in time definition, ...?   Corrections are small (observations close to noon, 10:30)
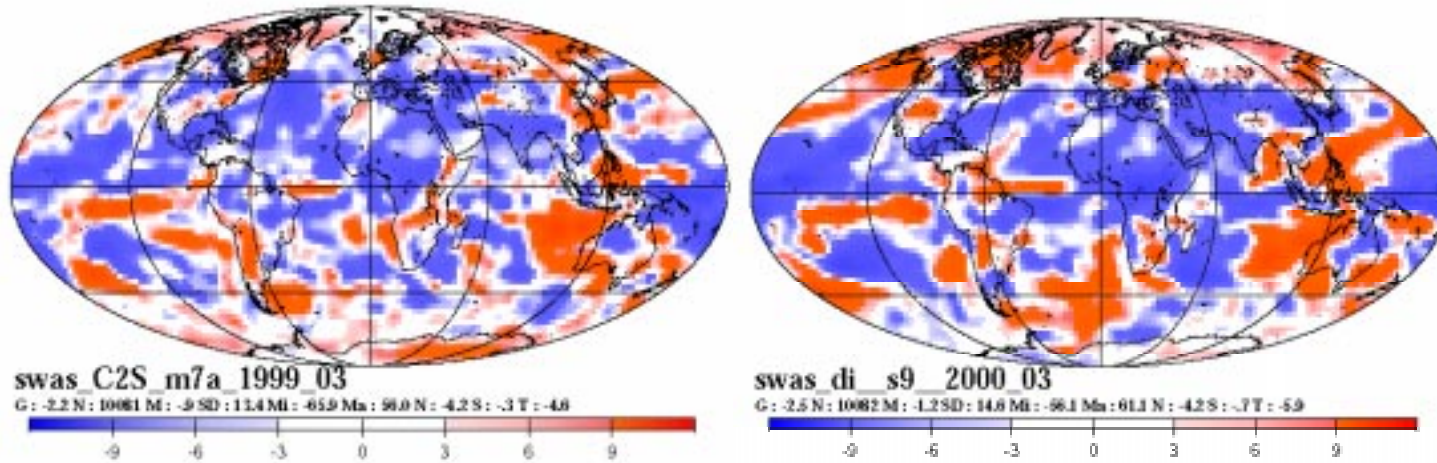

Wm^{-2}

	Global	Tropical
EDIEP -ES9	**0.1**	**0.2**
CDIEP-EDIEP	**0.0**	**0.2**

22nd CERES Science Team Meeting in Huntsville- September 2000- LMD/CNRS

Month : MARCH
With the same color scale : differences between ScaRaB 1999 (left) and CERES (2000)
and the 5-year ERBE average

swas_C2S_m7a_1999_03
G : -2.2 N : 10081 M : -.9 SD : 13.4 Mi : -65.9 Ma : 56.0 N : -4.2 S : -.3 T : -4.6

swas_di_s9_2000_03
G : -2.5 N : 10082 M : -1.2 SD : 14.6 Mi : -56.1 Ma : 61.1 N : -4.2 S : -.7 T : -5.9

Wm^{-2}

	Global	Tropical
1999	-2.2	-4.6
2000	-2.5	-4.9

(Uncertainty estimation $\cong$ +/- 2 Wm^{-2})

22nd CERES Science Team Meeting in Huntsville- September 2000- LMD/CNRS

Conclusion

1 March 2000 CERES confirms the low values of the RSW found in 1999 by ScaRaB 2

2 LMD ERBE-type computations on CERES/Terra data agree with DAAC distribution,
confirming consistency between ScaRaB, ERBE, and CERES inter-comparisons

3 A new method, with diurnal corrections based on 'climatological' albedo, has been applied to ScaRaB and CERES-Terra.
Corrections for CERES-Terra are shown to be < 10 Wm^{-2} (observations close to noon, 10:30)
The impact on global and tropical means are negligible.
.... to check with CERES-GEO computations.