Comparing CERES Measurements using ScaRaB-3

by

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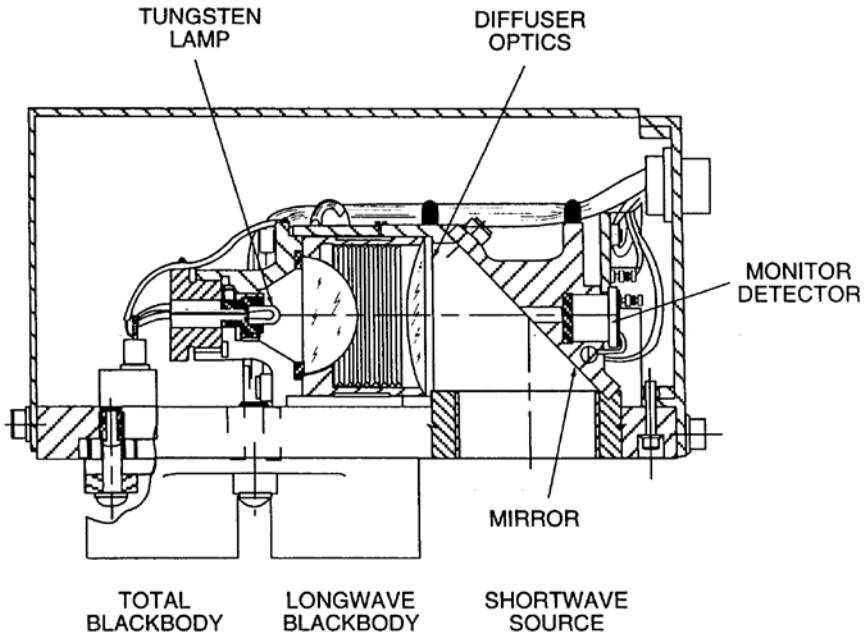
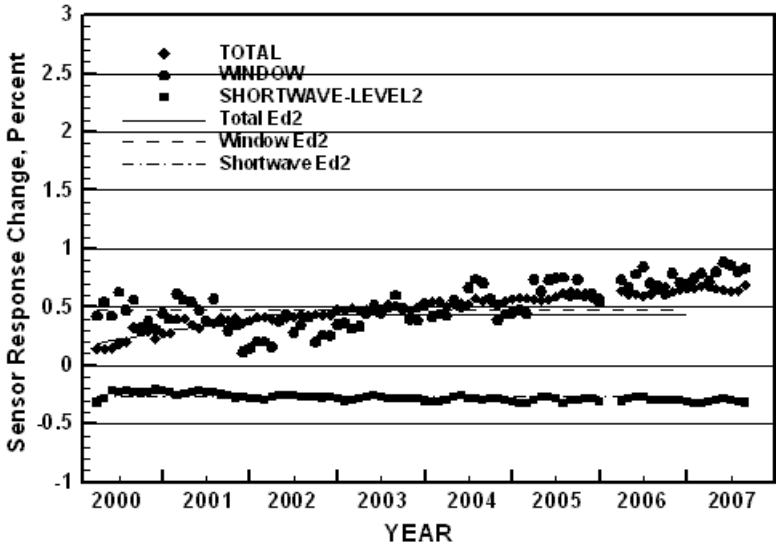
FM-5 Gives us a Unique Opportunity to Determine whether the Internal Black Bodies and Shortwave Internal Calibration Sources have changed.

The Earth Radiation Budget Climate Data Record is based on the Assumption that the IBBs and SWICSs have not changed during their Decade of Operation in Space.

Internal Calibration Module and On-orbit Calibration



Internal Calibration Module



In-Orbit Calibration using Internal Calibration Module

The ScaRaB-3 can be used as a Transfer Radiometer between the CERES FM-1, -2, -3, -4 and -5 to Address these Vital Questions

This will also give a Comparison of CERES with ScaRaB-3

Comparisons between ScaRaB and CERES Instruments

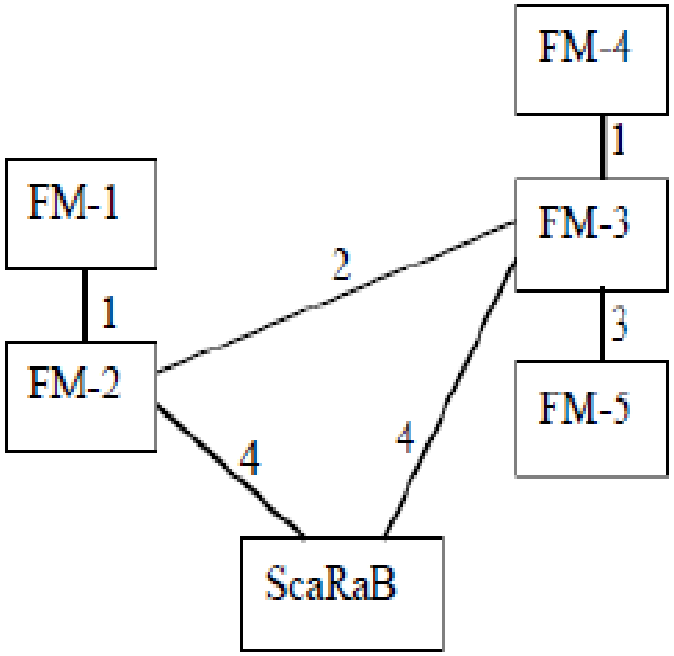


Figure 1: Comparisons between ScaRaB and CERES instruments. Numbers on lines for comparisons denote:
1. Both instruments on same spacecraft, 2 Special operations near 70° at solstice,
3. Comparisons during underpass, 4. Using ScaRaB as transfer radiometer.

ScaRaB will greatly enhance comparison opportunities

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Comparison of measurements from satellite radiation budget instruments

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Table 5. Shortwave Relative Flux Biases at TOA (Above Diagonal) and Standard Deviations (Below Diagonal), W m^{-2}

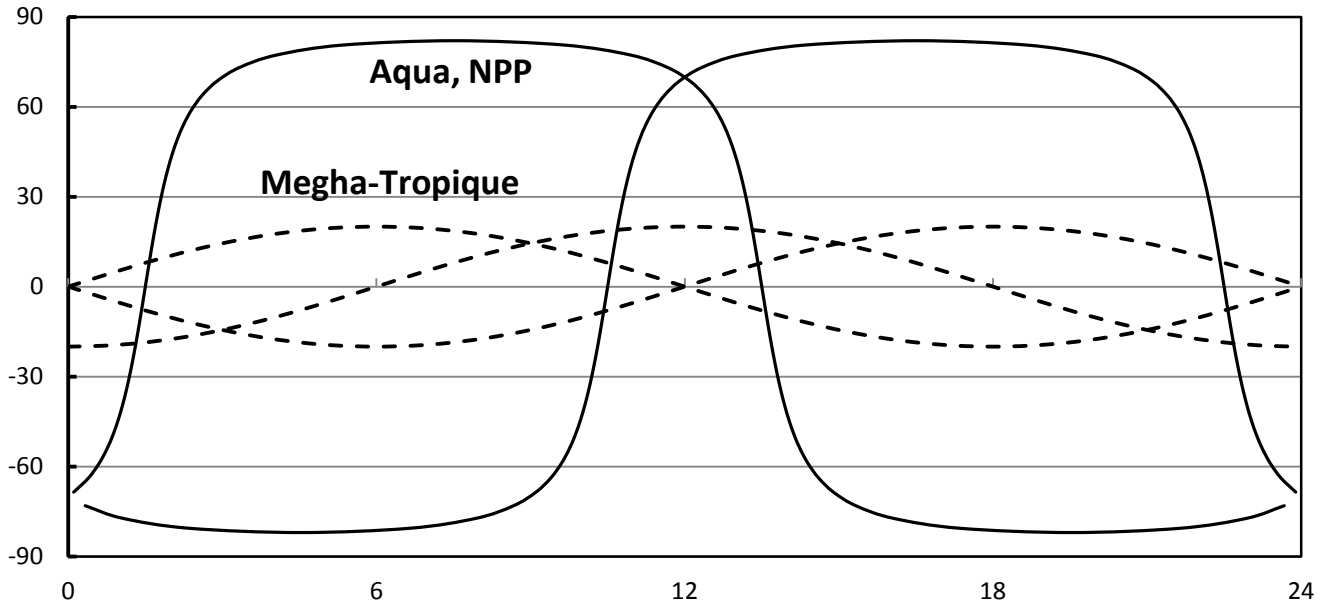
	ERBS Sc	ERBS NS	ScaRaB 1	CERES/TRMM	ScaRaB 2	CERES FM 1	CERES FM 2	CERES FM 3	CERES FM 4
ERBS Sc	-	**−5.9**	−5.0	−3.1	−6.6	−3.3	−2.9	−2.2	−2.3
ERBS NS	**0.3**	-	**0.9**	**2.8**	−0.7	2.6	3.0	3.7	3.6
ScaRaB 1	0.5	**0.4**	-	1.9	−1.6	1.7	2.1	2.8	2.7
CERES/TRMM	0.8	**0.7**	0.8	-	**−3.5**	**−0.2**	0.2	0.9	0.8
ScaRaB 2	1.6	1.6	1.6	**1.4**	-	3.3	3.7	4.4	4.3
CERES FM 1	1.0	0.9	1.0	**0.6**	1.5	-	**0.4**	1.1	**1.0**
CERES FM 2	1.1	1.1	1.2	0.8	1.6	**0.6**	-	0.7	0.6
CERES FM 3	1.0	0.9	1.0	0.6	1.5	0.2	0.6	-	**−0.1**
CERES FM 4	1.0	0.9	1.0	0.6	1.5	**0.1**	0.6	**0.2**	-

Table 8. Longwave at Night Relative Flux Biases at TOA (Above Diagonal) and Standard Deviations (Below Diagonal), W m^{-2}

	ERBS Sc	ERBS NS	ScaRaB 1	CERES/TRMM	ScaRaB 2	CERES FM 1	CERES FM 2	CERES FM 3	CERES FM 4
ERBS Sc	-	**1.5**	2.2	−0.5	1.1	−1.9	−1.1	−1.7	−1.7
ERBS NS	**0.1**	-	**0.7**	**−2.0**	−0.4	−3.4	−2.6	−3.2	−3.2
ScaRaB 1	0.2	**0.2**	-	−2.7	−1.1	−4.1	−3.3	−3.9	−3.9
CERES/TRMM	0.2	**0.2**	0.3	-	**1.6**	**−1.4**	−0.6	−1.2	−1.2
ScaRaB 2	0.3	0.3	0.3	**0.2**	-	−3.0	−2.2	−2.8	−2.8
CERES FM 1	0.2	0.2	0.3	**0.1**	0.2	-	**0.8**	0.2	**0.2**
CERES FM 2	0.3	0.3	0.4	0.2	0.3	**0.2**	-	−0.6	−0.6
CERES FM 3	0.2	0.2	0.3	0.1	0.2	0.0	0.6	-	0.0
CERES FM 4	0.2	0.2	0.3	0.1	0.2	**0.0**	0.2	**0.0**	-

ScaRaB 1 agreed very well with ERBE

Opportunities to Compare Earth Radiation Measurements

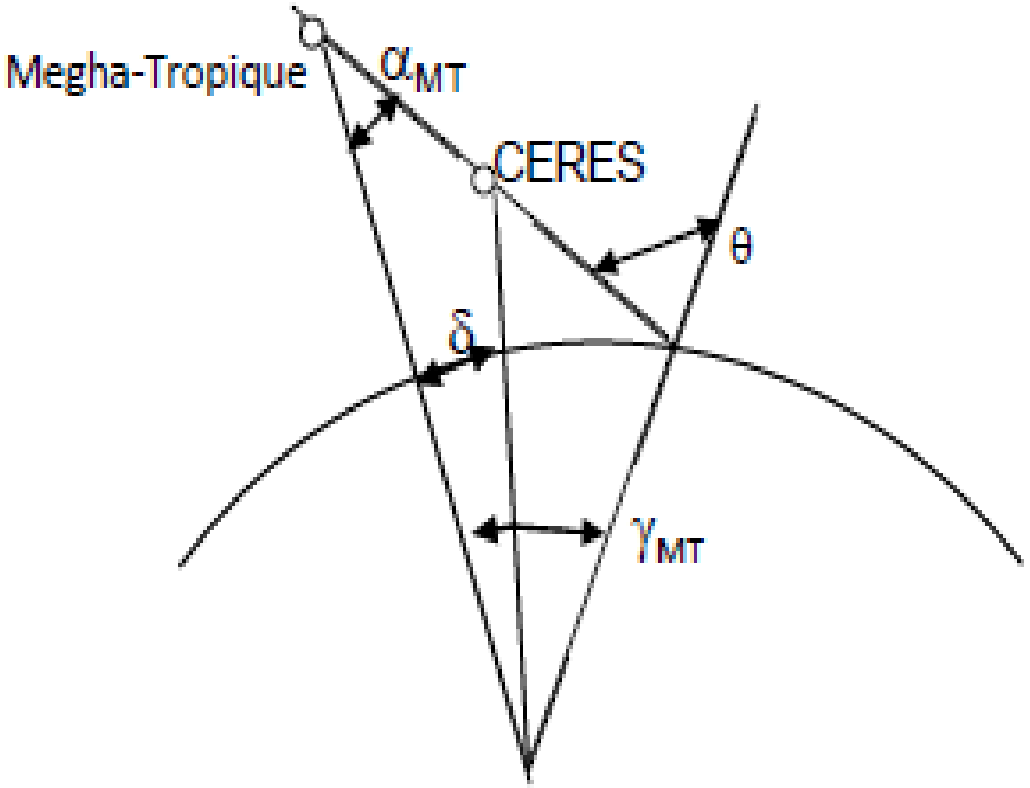


- The Megha-Tropique Orbit crosses the Terra orbit near 10:30 (High Sun) and near 23:30 for a night measurement.
- The Megha-Tropique Orbit crosses the Aqua and NPP orbits near 13:30 (High Sun) and near 01:30 for a night measurement

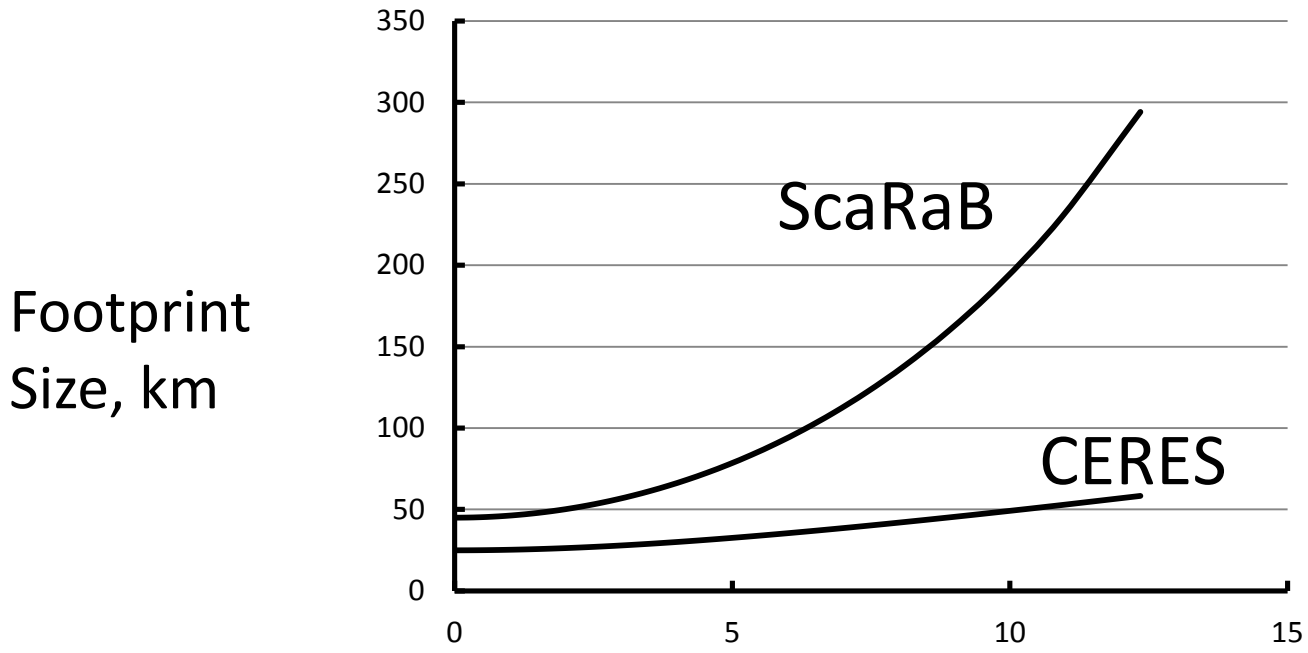
Special Operations of CERES Instruments to make Comparisons

- Near the Intersections of the Terra orbit with the Megha-Tropique orbit, FM-2 will be rotated in Azimuth so that its Scan Plane will be Coplanar with that of ScaRaB-3.
- FM-2 will operate in the Half-scan Mode so as to scan from Space view aft to Nadir and back, thus never looking in Ram Direction.
- FM-3 on Aqua and FM-5 on NPP will operate similarly.

View in Scan Plane



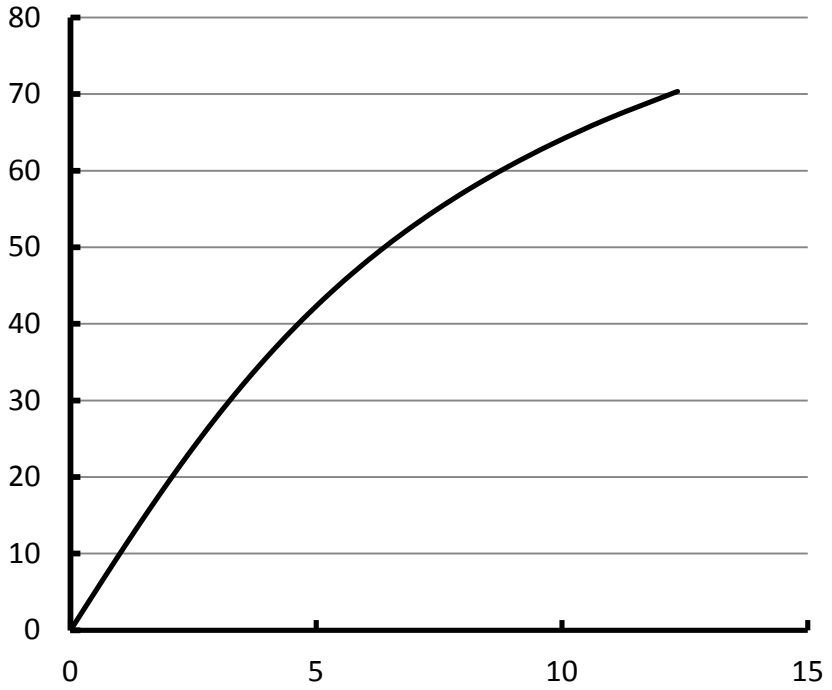
Footprint growth with Distance from CERES nadir point



6^{o} from CERES is limit due to footprint Growth

Increase of View Zenith Angle with Distance from CERES nadir Point

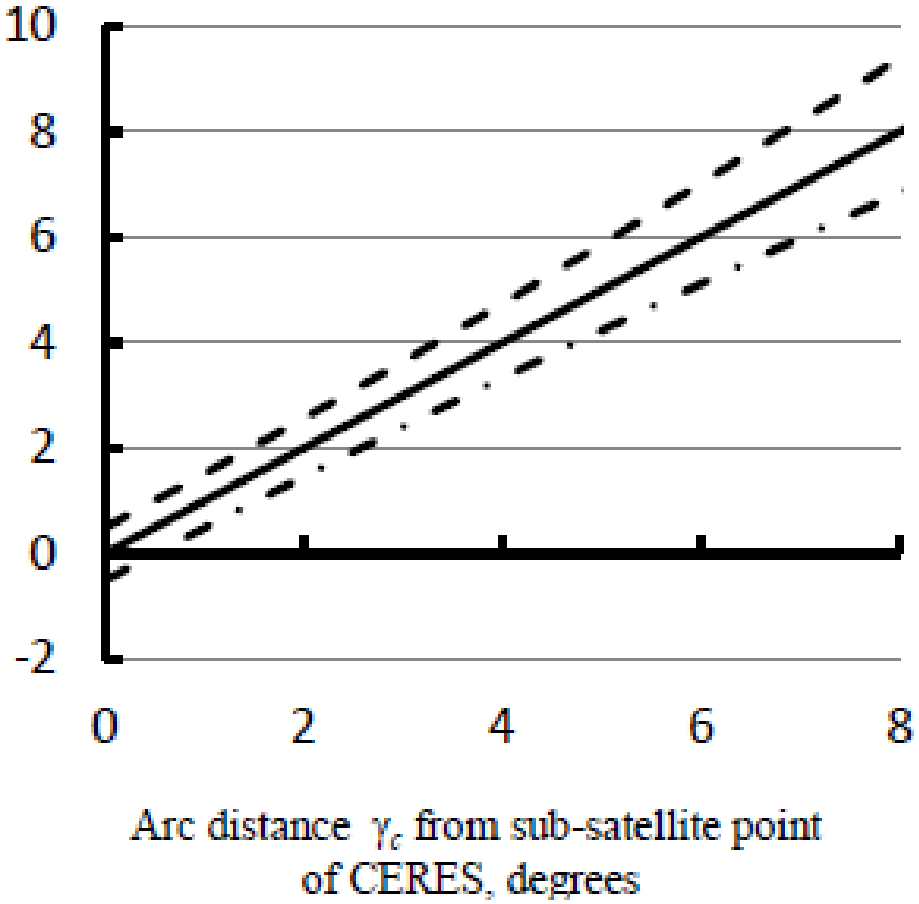
View Zenith Angle at Primary Scene, degrees



Arc distance from CERES nadir point, degrees

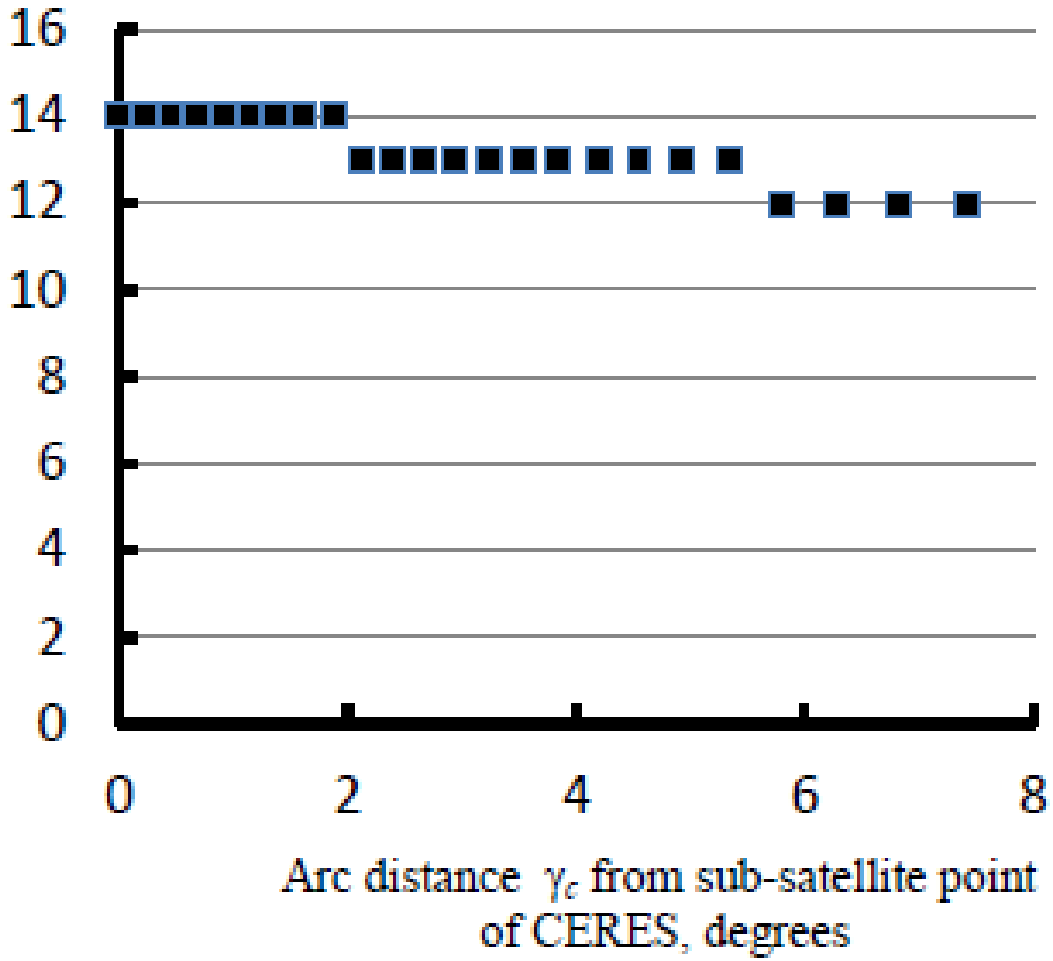
For 6^o from CERES, VZA is 45^o

Range of Distances from CERES Nadir matching Scene within 5° VZA

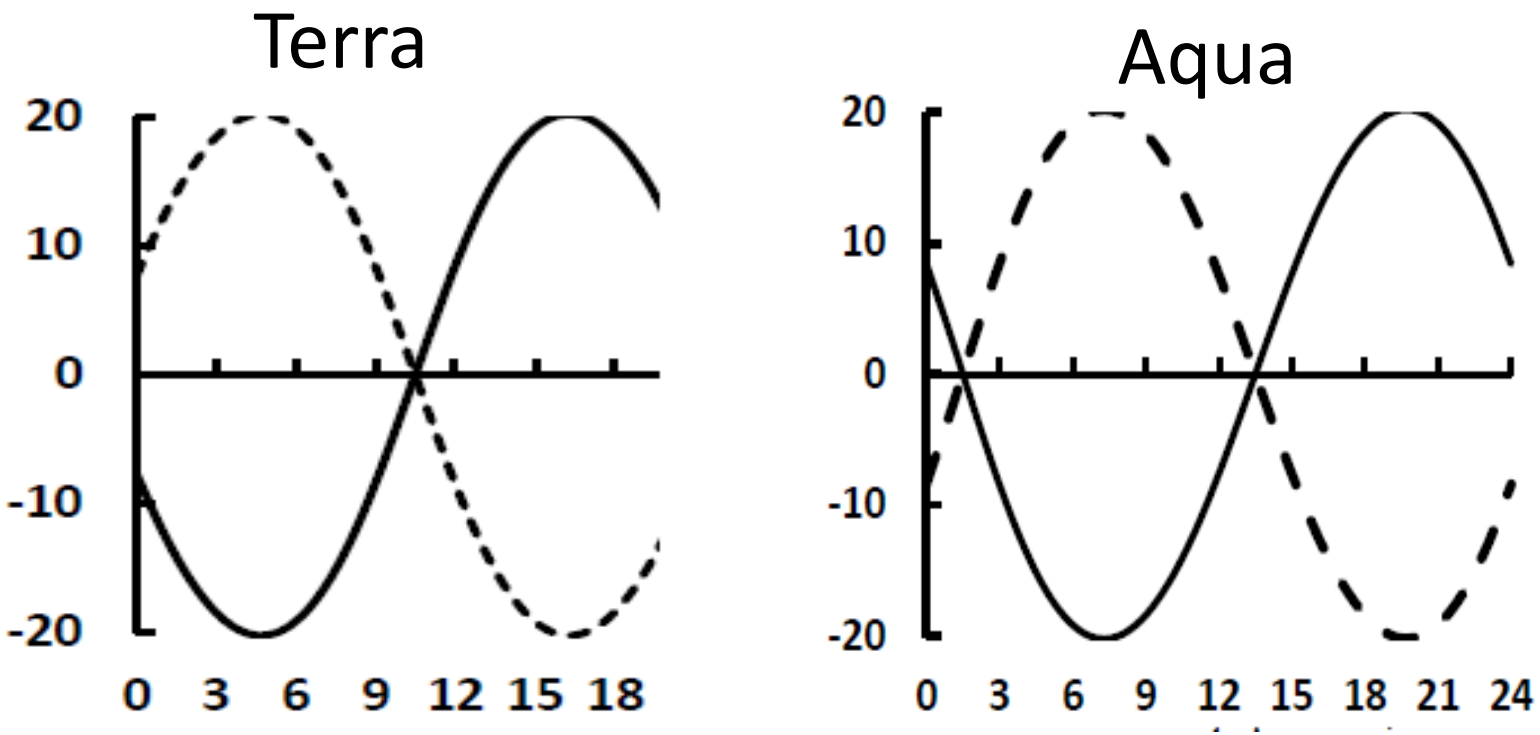


Data will cover one 1° region well.

Number of CERES Measurements with VZA within 5° of Primary Scene



Latitudes of Orbit Crossings with Megha-Tropique

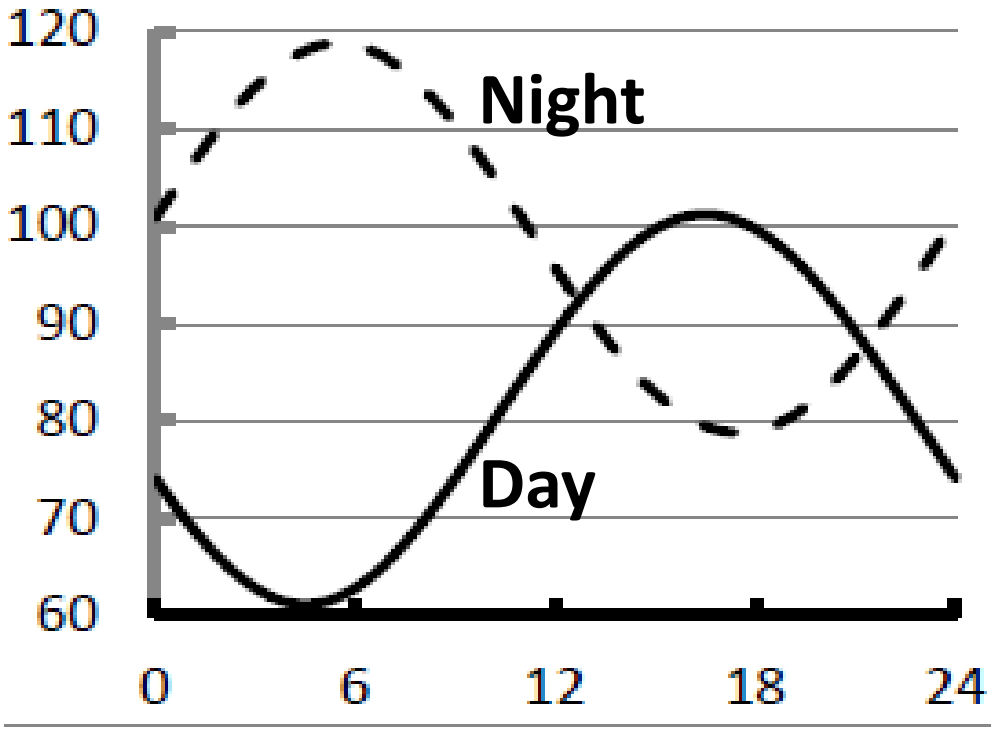


Local Solar time of Ascending Node of Megha-Tropique

Azimuth Rotation of CERES to Match ScaRaB Scan Plane

Terra

Azimuth rotation
Of CERES to match
ScaRaB Scan Plane



Local Solar time of Ascending Node of Megha-Tropique

Concluding Remarks

- The Geometry for Special Operations of CERES to compare with ScaRaB has been defined.
- Sampling Requirements must be defined.
- Special Operations of CERES began 17 April 2012