TOA Radiation Validation, Radiative Forcing, & AtmosphericAbsorption Estimation

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Satellite Data Sets

- **GOES-8 (See W. L. Smith presentation)**
  - 0.5 hour TOA SW albedo and LW OLR
  - 1° box centered on ARM SGP Central Facility
  - 0.5° gridded domain 32°N - 42°N; 90°W - 104°W

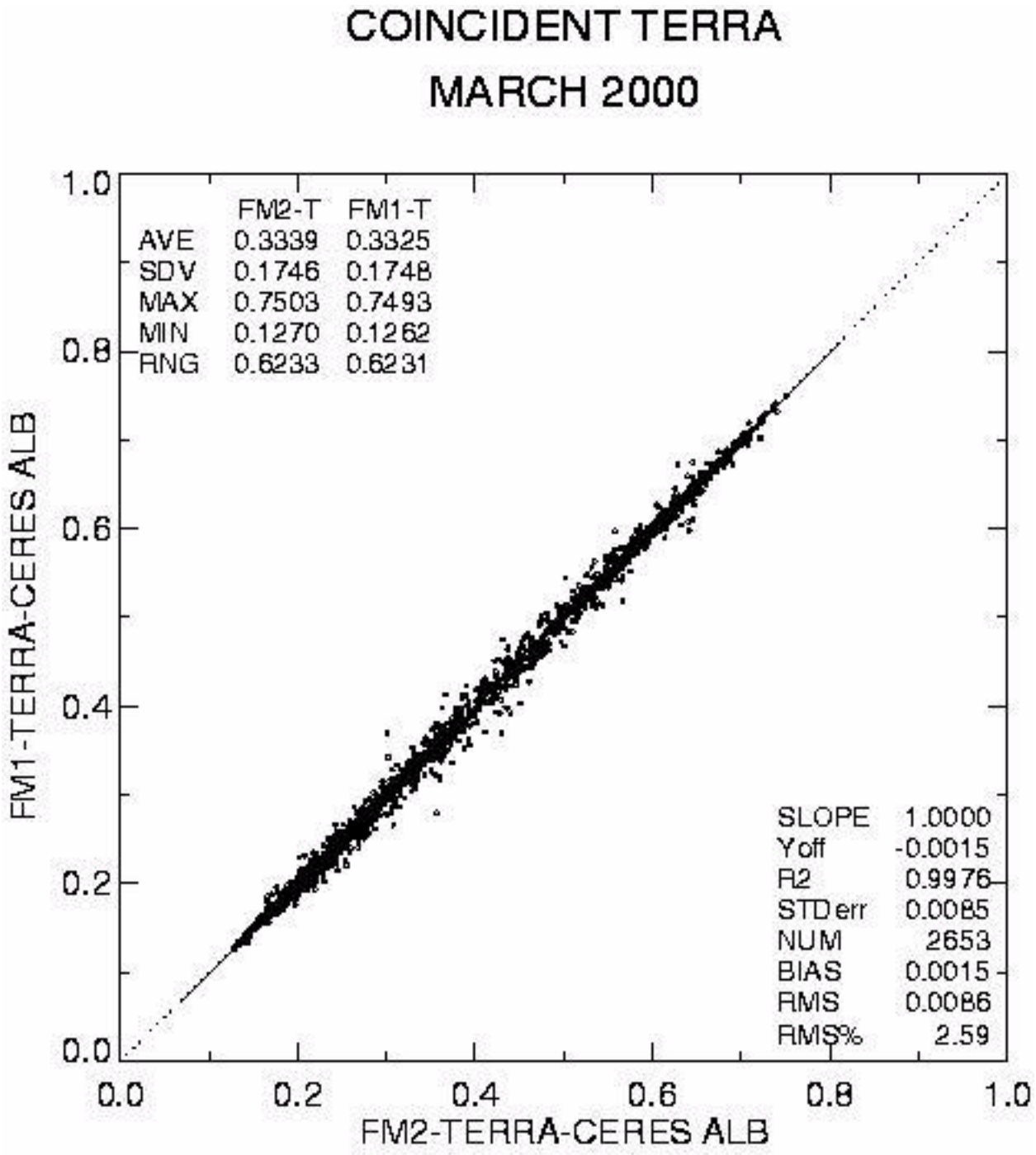
- **Visible-Infrared Scanner (VIRS)**
  - TRMM Orbital Characteristics
    - 35° Inclined Orbit, Precesses Through 24 Hours in 46 Days
  - VIRS: 0.65, 1.6, 3.75, 10.8, 11.9 μm, 2 km nadir resolution

- **CERES Broadband SW & LW Scanners**
  - TRMM, morning & late afternoon overpasses
  - Terra (FM1, FM2), 1030AM overpasses
  - 1° TOA albedo & OLR; SGP site & domain

Approach for Validation

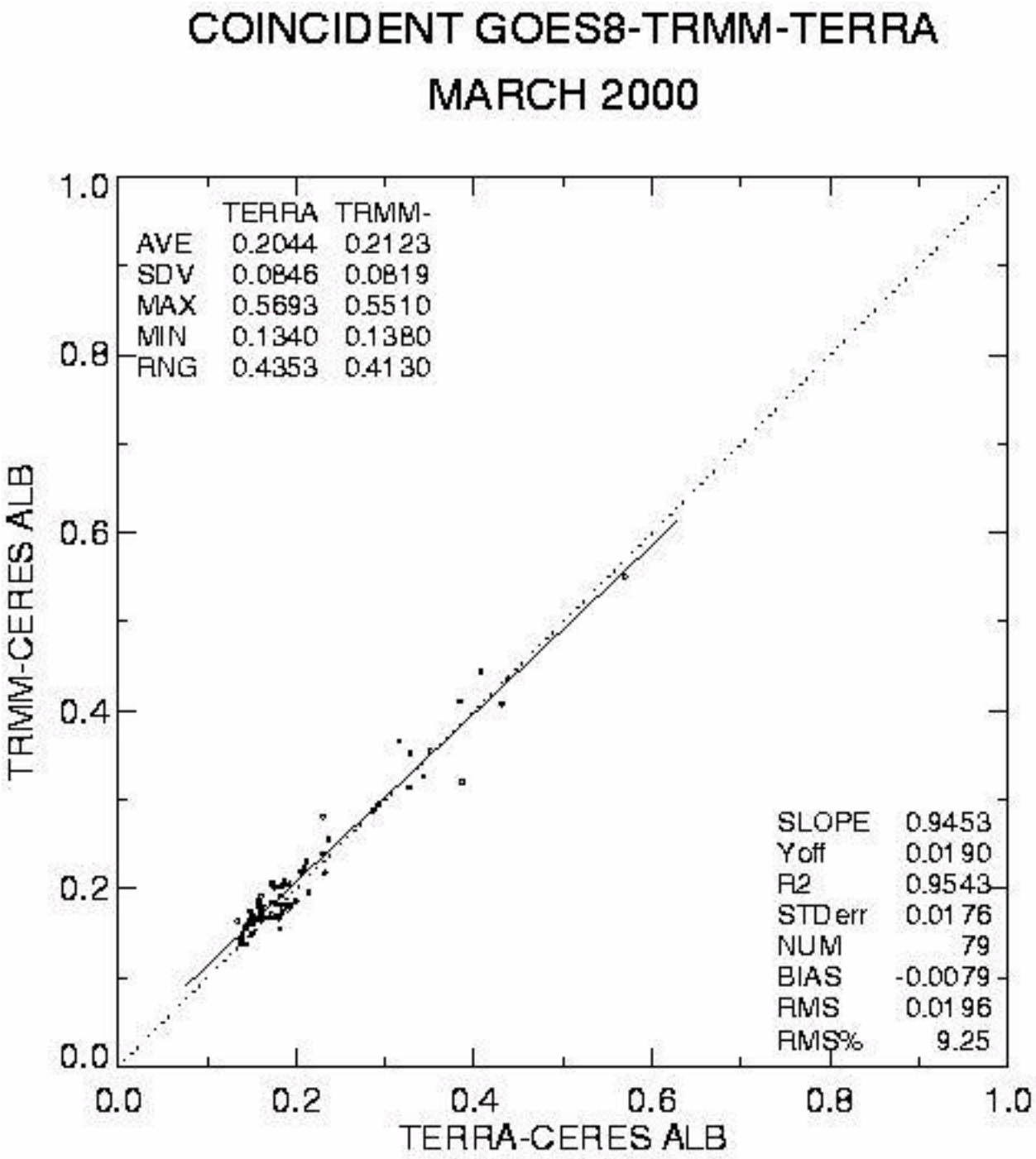
- **Compare CERES instruments to establish baseline expectations**
  - **CERES albedos over clear land average 6.5% less than those from ERBE**
- **Compare GOES-8 albedos with those fromvarious CERES data**
  - **different times of day and angular configurations**
- **Compare VIRS albedos computed with ERBE NB-BB conversion with coincident CERES**
  - **no angular differences**
- **Examine sources of discrepancy**

Terra CERES
FM1 vs FM2
All days



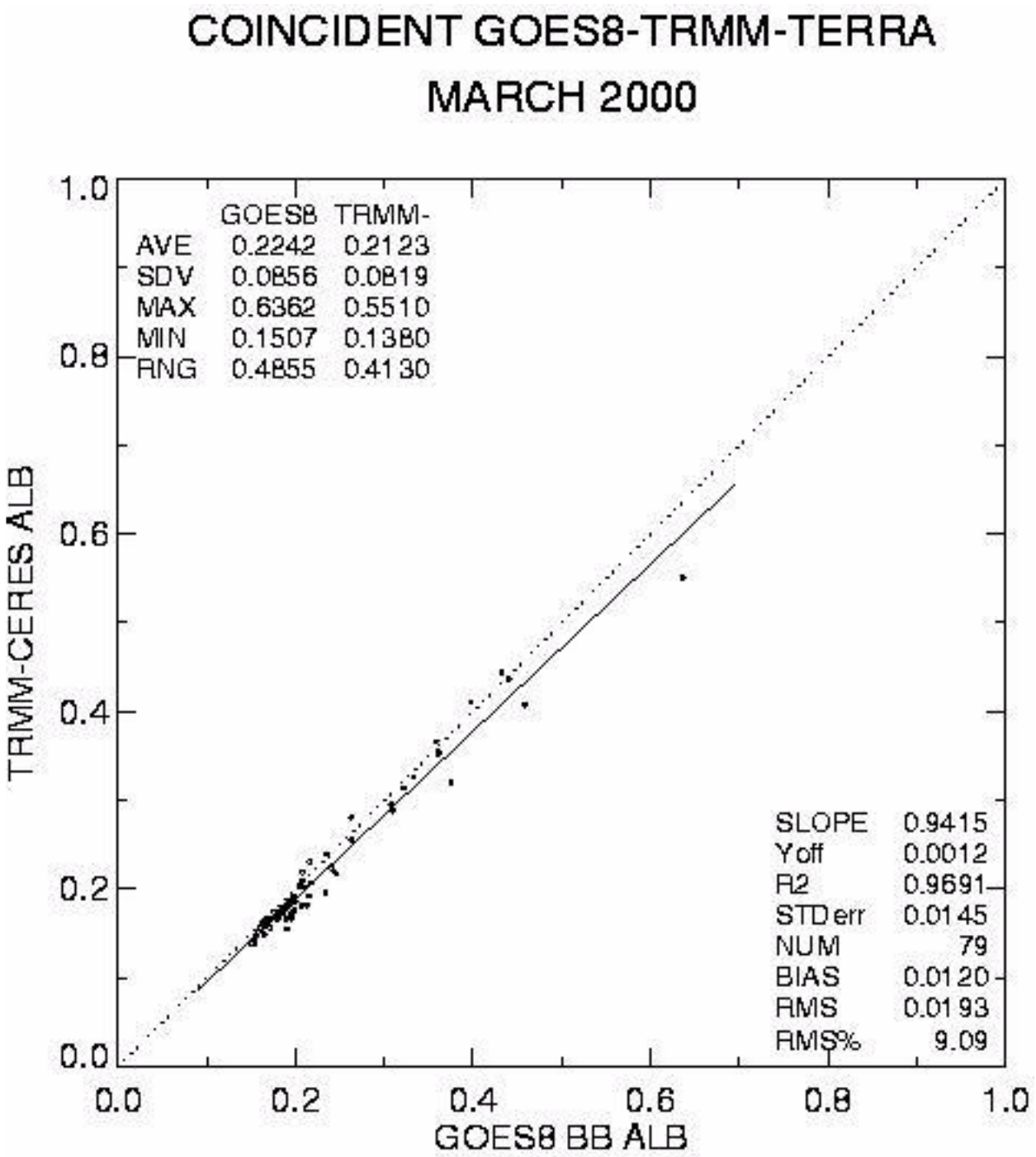
Terra CERES vs TRMM CERES

3-Way Match



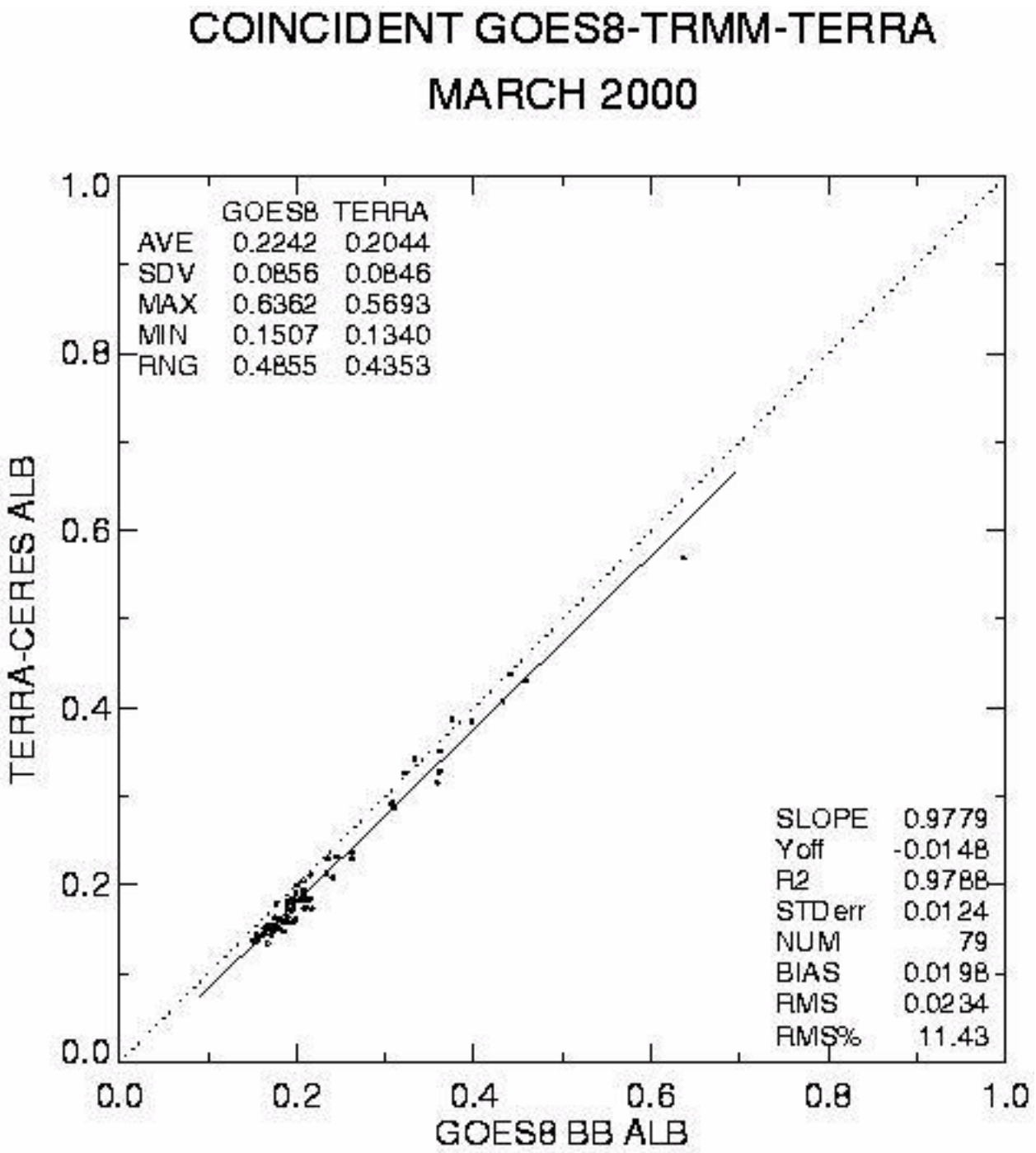
TRMM CERES
vs GOES BB

3-Way Match



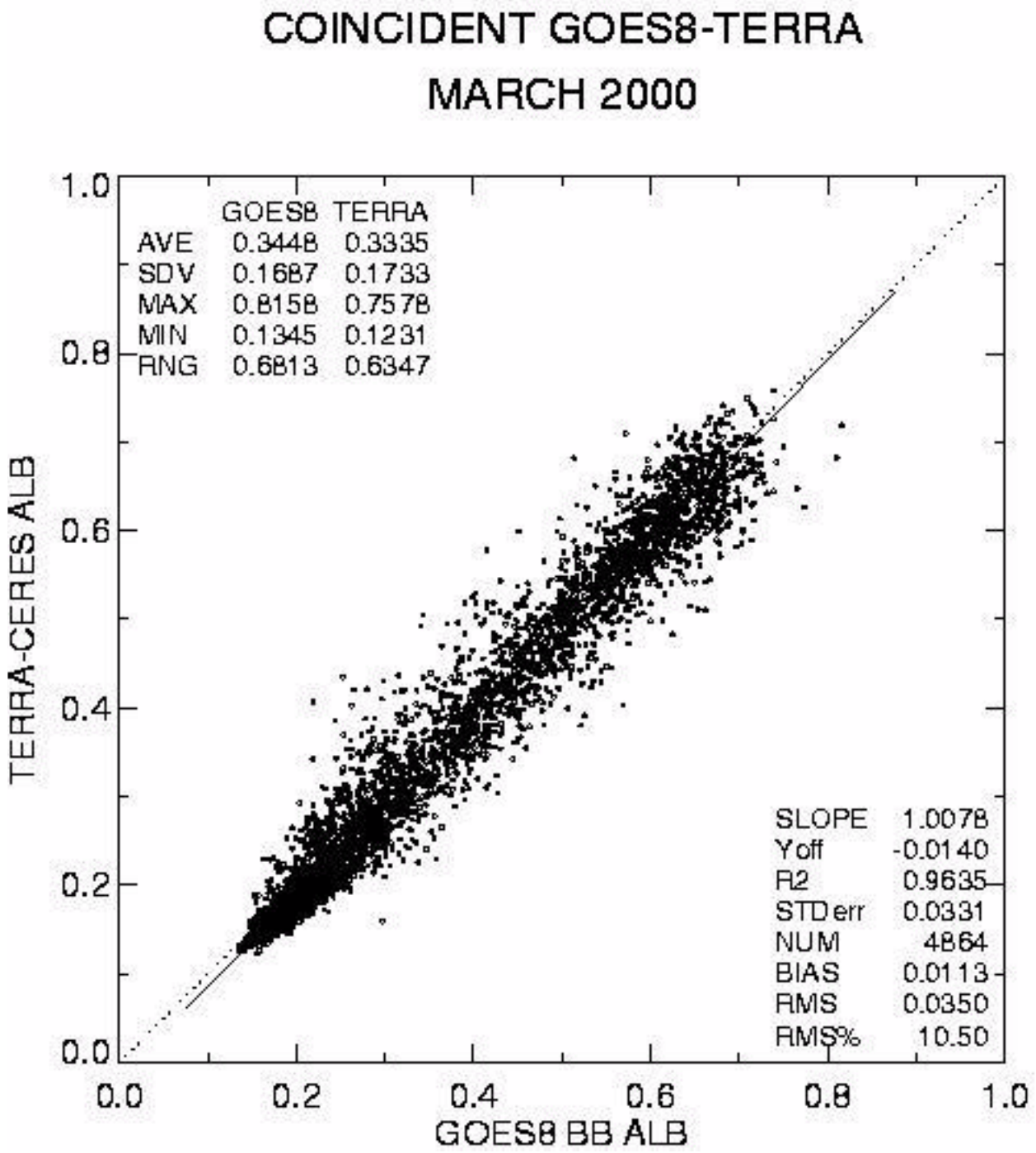
Terra CERES vs GOES BB

3-Way Match

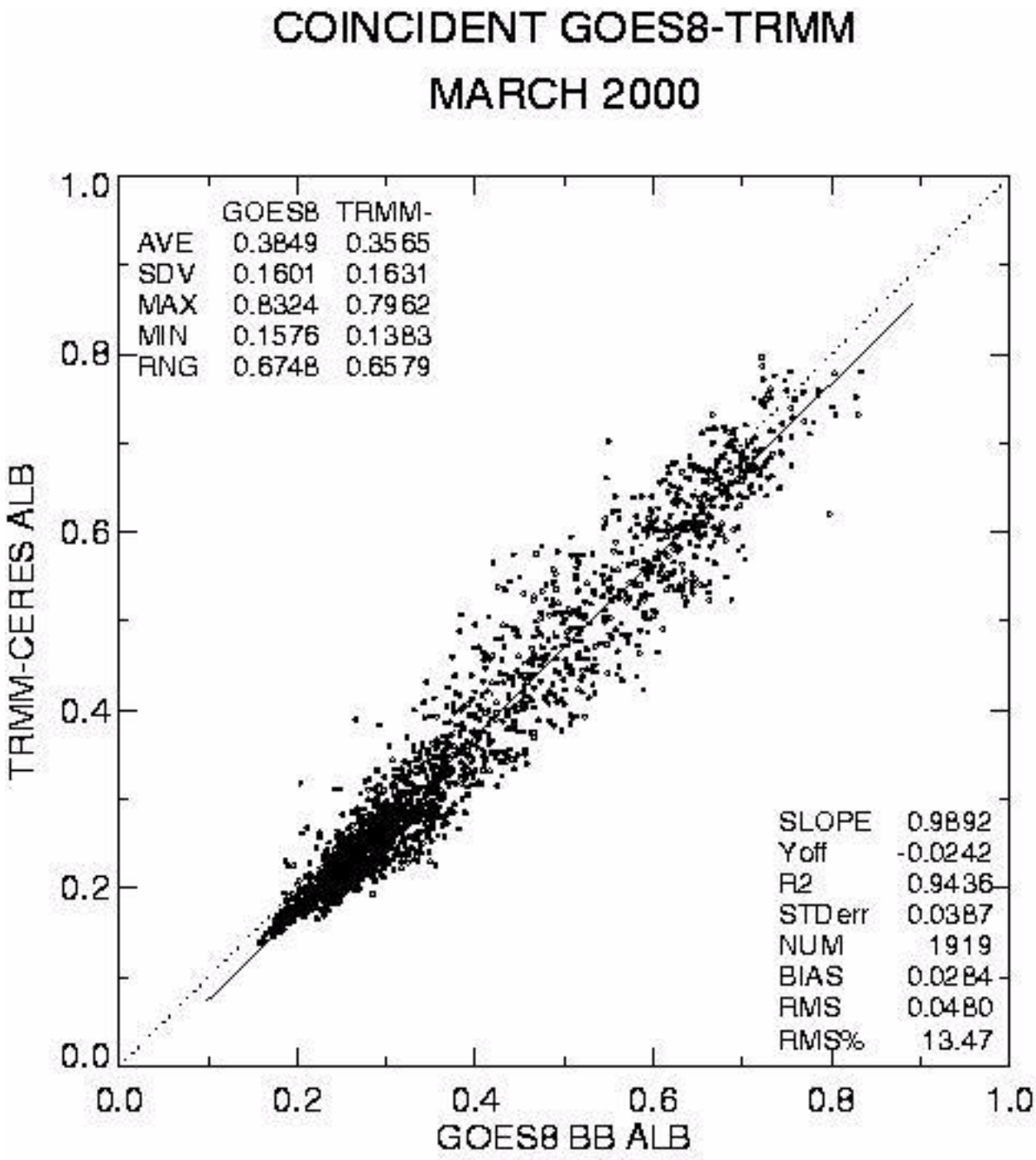


Terra CERES vs GOES BB

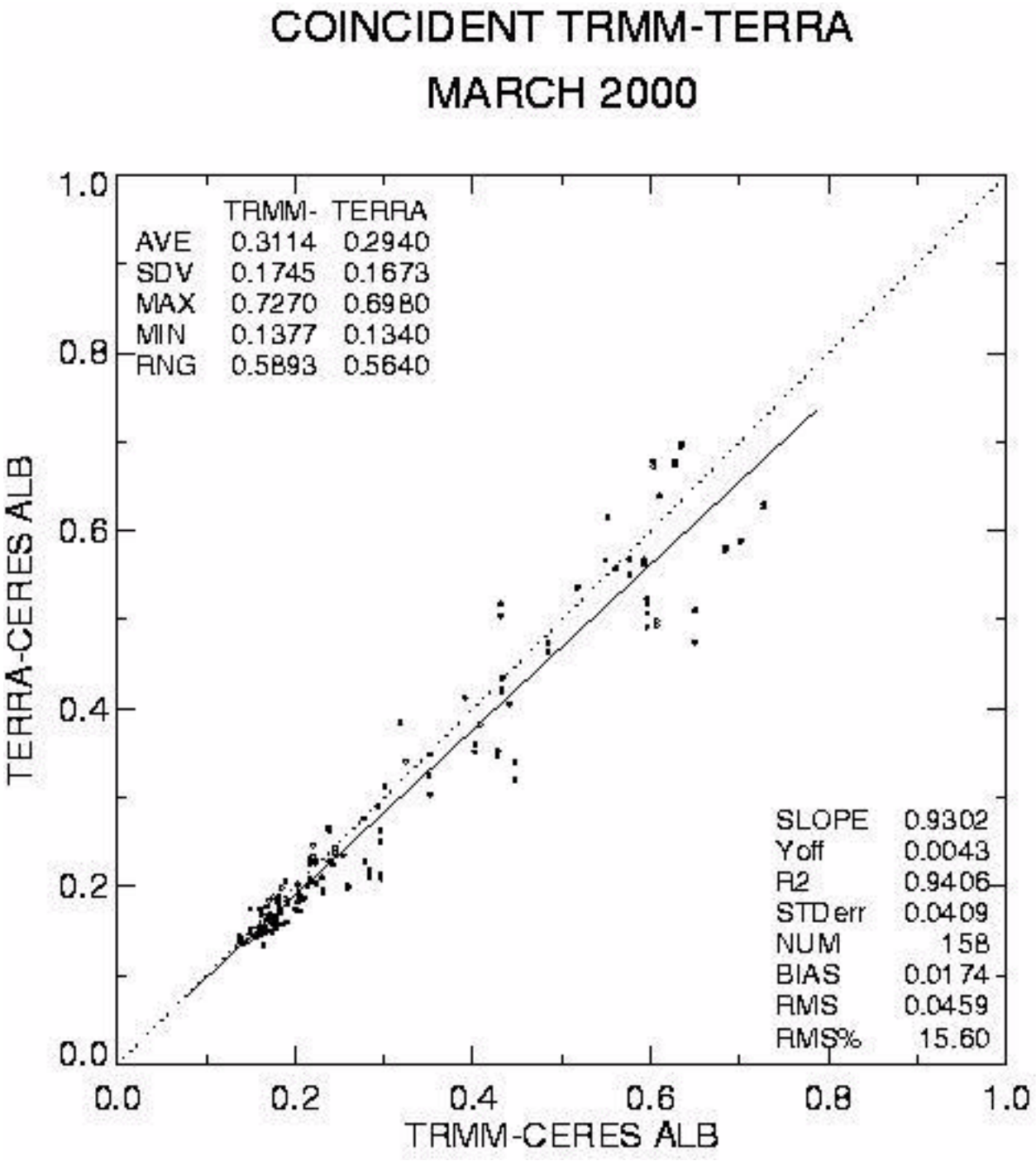
ALL DAYS



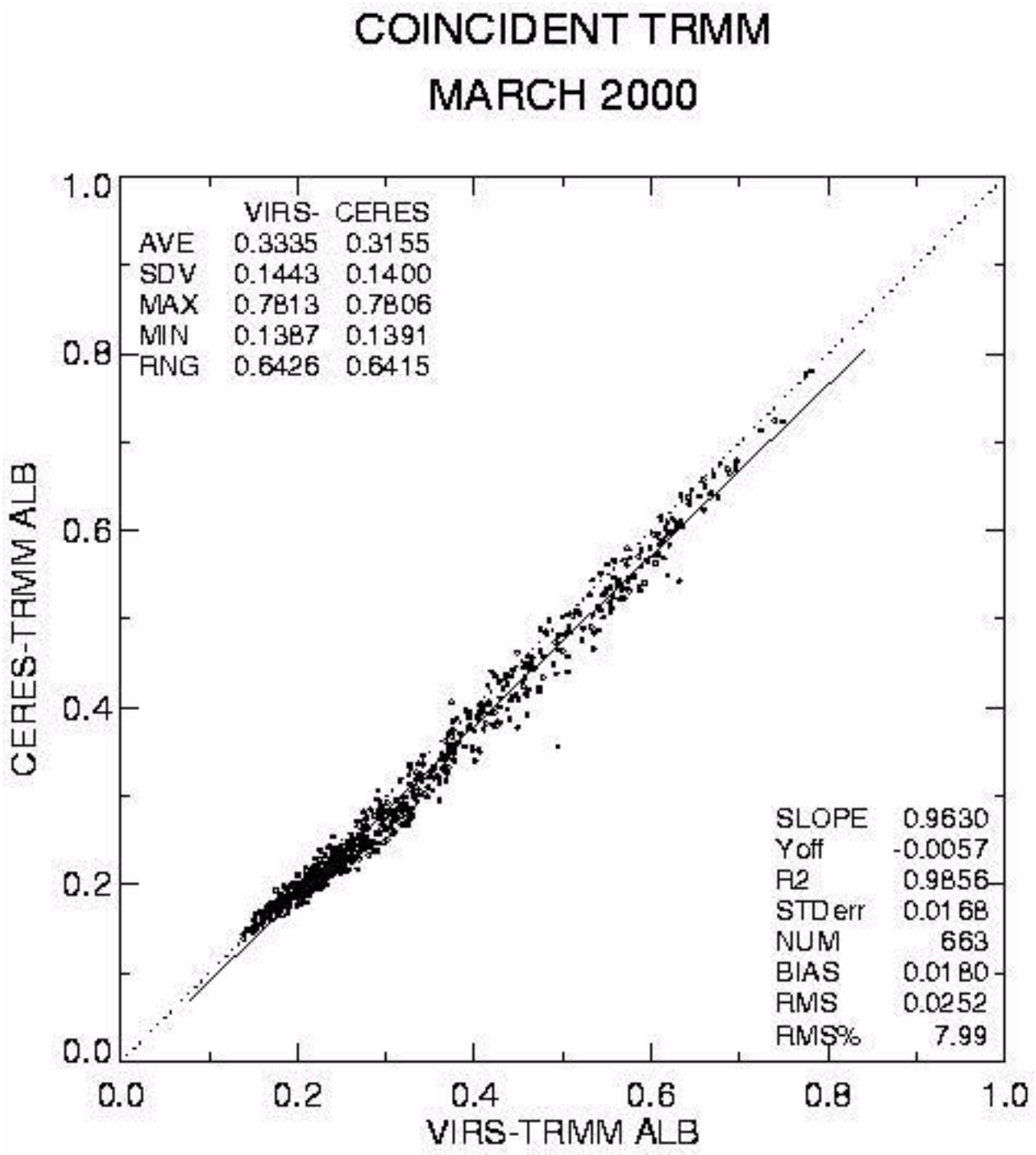
TRMM CERES
vs GOES BB
ALL DAYS



CERES TRMM
vs CERES Terra
ALL DAYS



APPLYING GOES NB-BB TO VIRS VIS CHANNEL



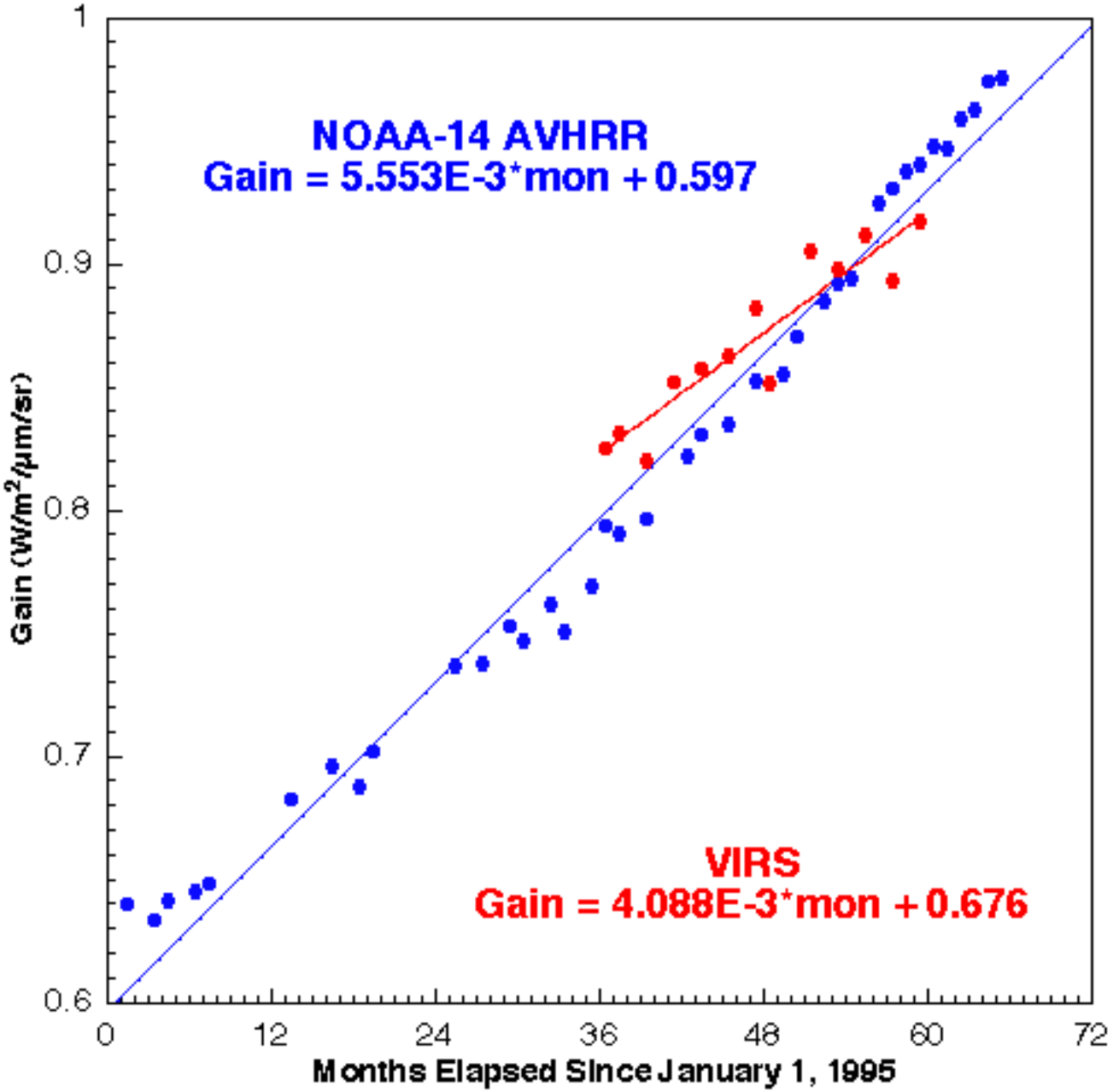
SUMMARY OF CERES VS NB-BB ALBEDOS

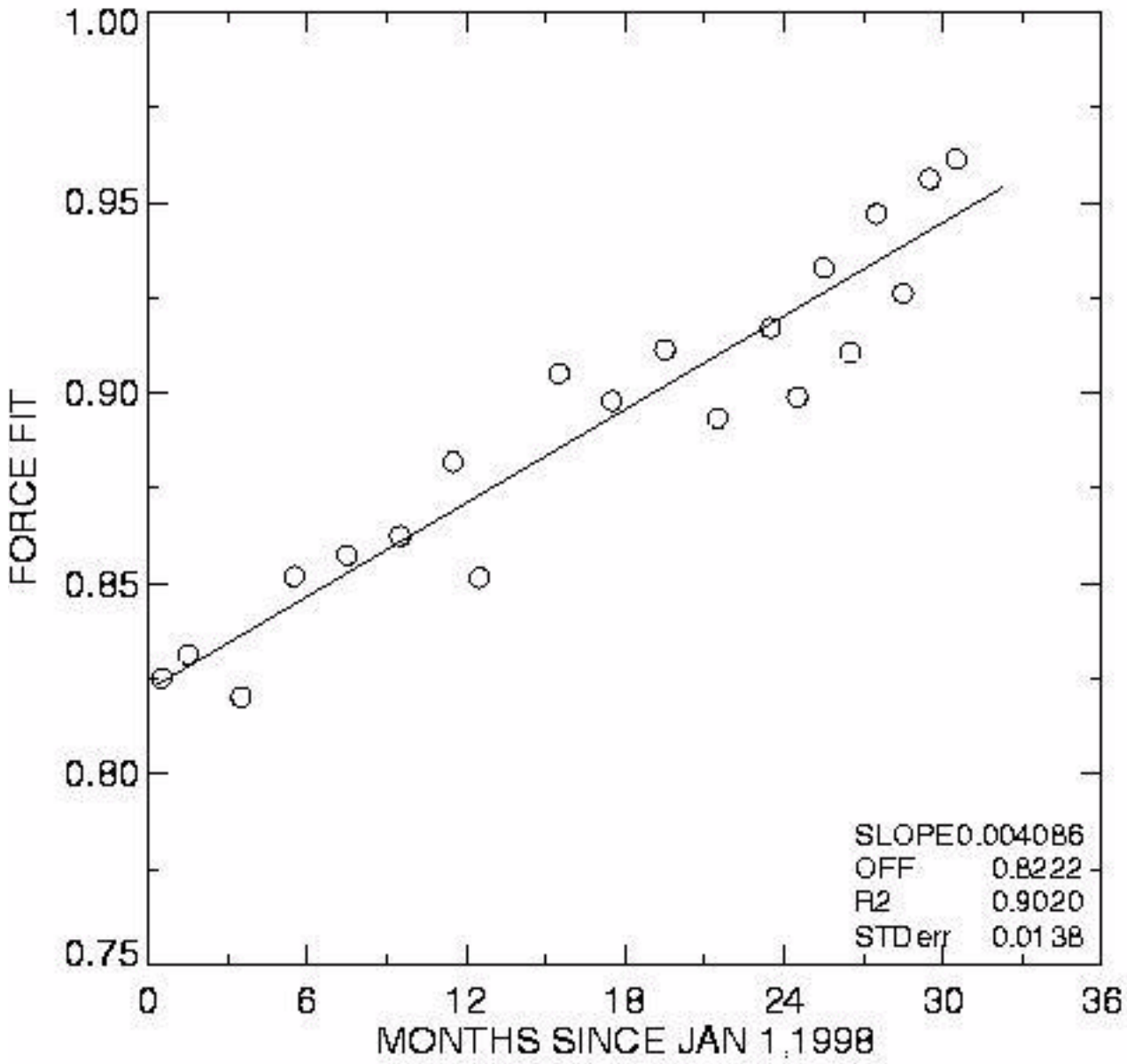
Instruments	bias	rms (%)
Terra FM2-FM1	0.0015	2.6
TRMM - Terra	0.0174	15.6
G8 - TRMM	0.0284	13.5
G8 - Terra	0.0113	10.5
G8 - TRMM (3 sat case)	0.0120	9.1
G8 - Terra (3 sat case)	0.0198	11.4
TRMM - Terra (3 sat case)	0.0079	9.3
VIRS - TRMM	0.0180	8.0

HISTORICAL BB COMPARISONS WITH GOES BB SW

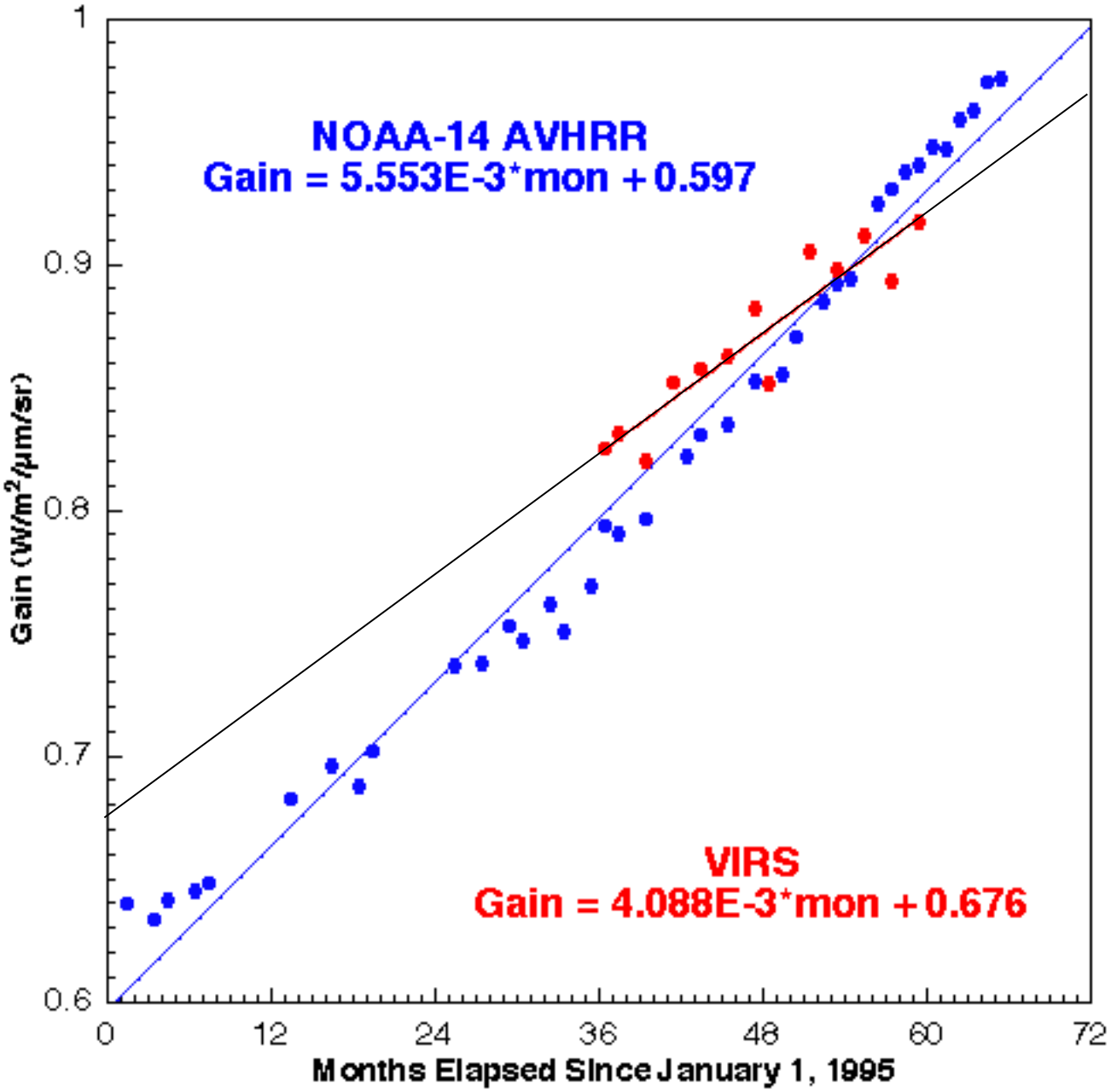
G7-SCARAB 1994	**-0.005**
G7-ERBE/WFOV 1994	**0.000**
G8-ERBE/WFOV 95-96	**-0.002**
G8-TSBR (ER2) 95	**0.012**
G8-CERES Terra 00	**0.0113**
G8-CERES TRMM 00	**0.0284**

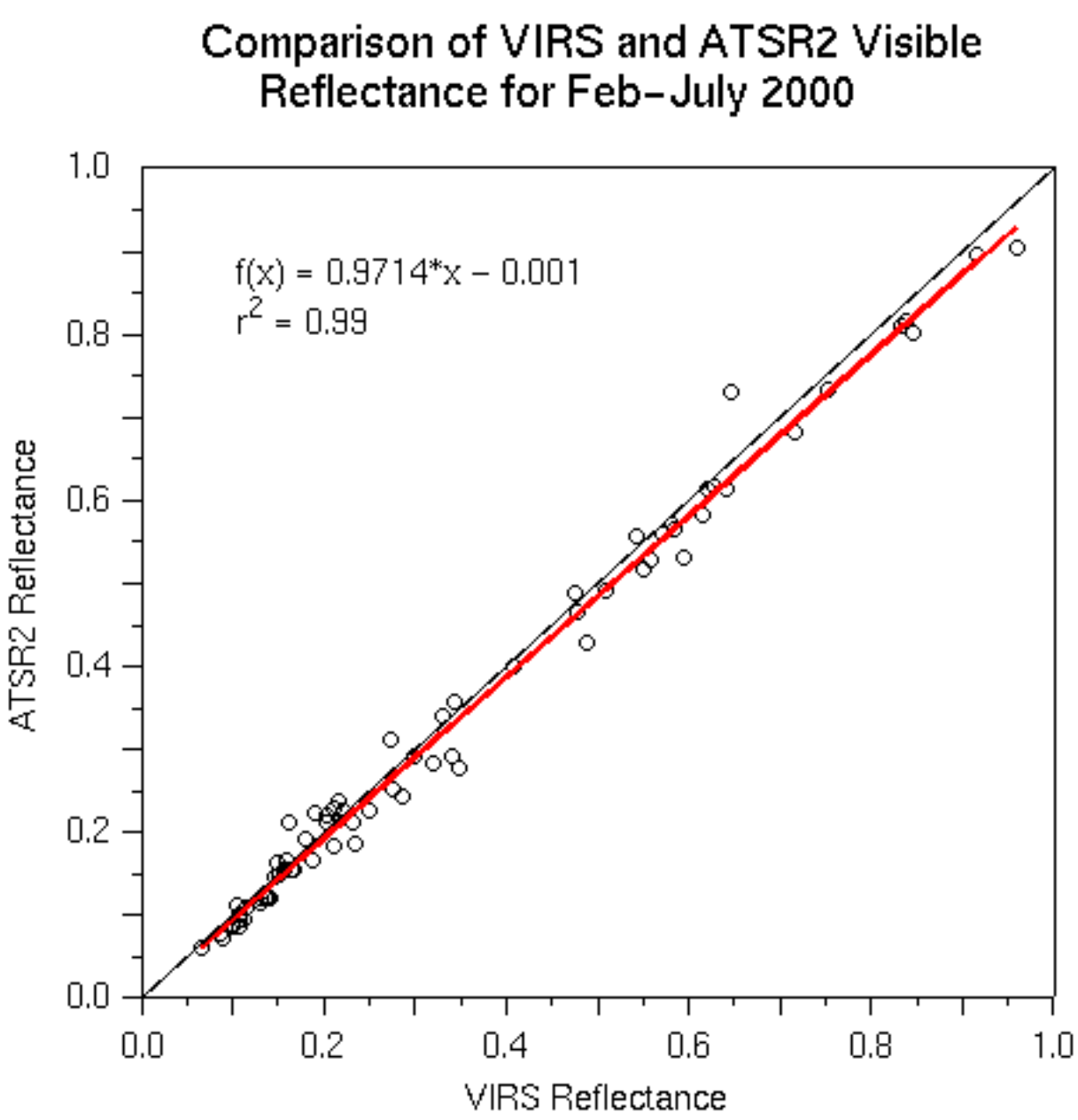
Comparison of GOES-8 Visible Gain Trend



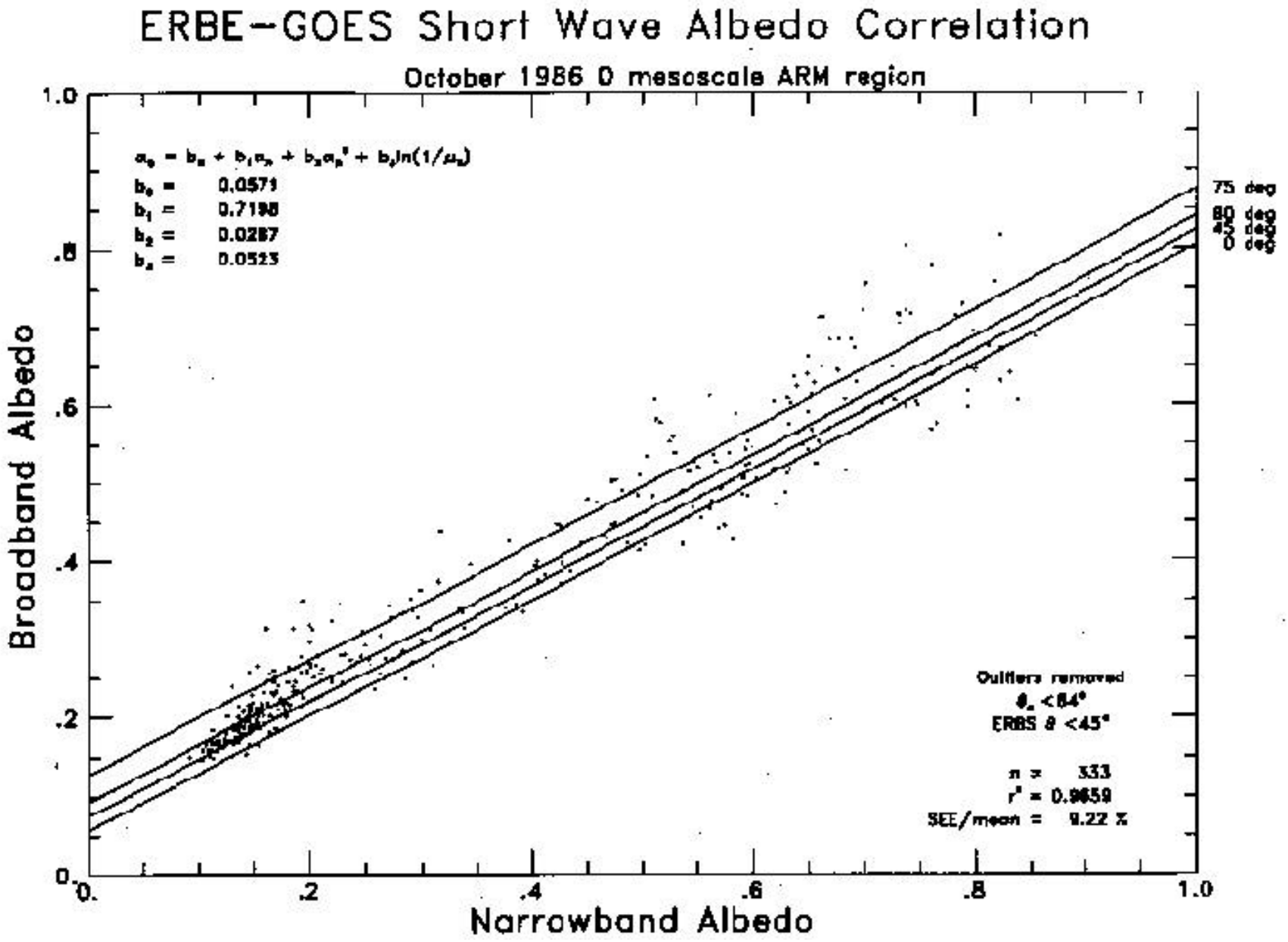

GOES-8 vs VIRS, 1998-2000
visible, 0.65um
FORCE FIT
1.00
0.95
0.90
0.85
0.80
0.75
0
6
12
18
24
30
36
MONTHS SINCE JAN 1,1998
SLOPE 0.004086
OFF 0.8222
R2 0.9020
STD err 0.0138

Comparison of GOES-8 Visible Gain Trend

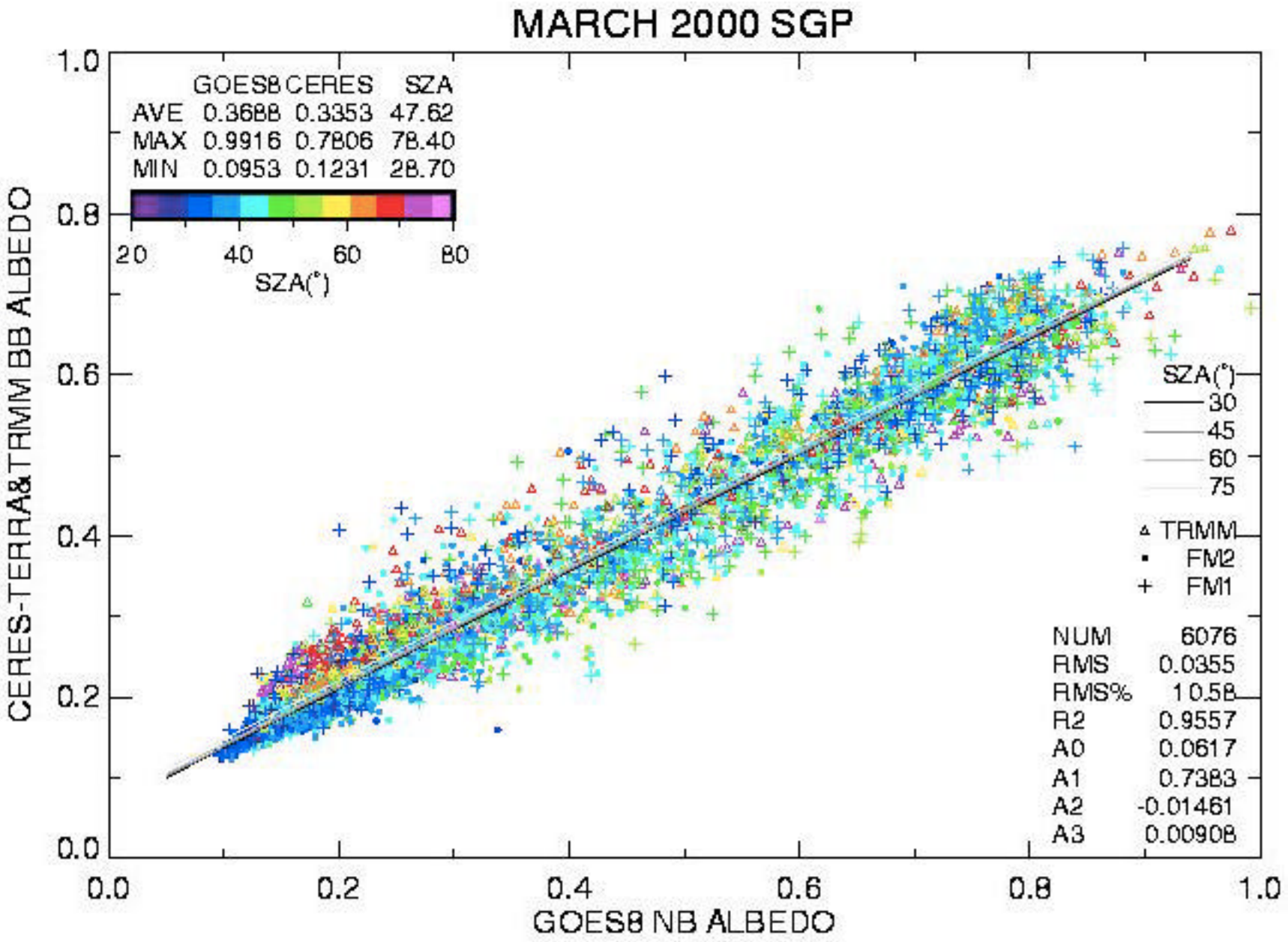



Comparison of VIRS and ATSR2 Visible Reflectance for Feb–July 2000
f(x) = 0.9714*x – 0.001
r2 = 0.99
ATSR2 Reflectance
VIRS Reflectance
0.0
0.2
0.4
0.6
0.8
1.0

ERBE-GOES NB-to-BB Conversion Function Used for ARM GOES



CERES-GOES NB-to-BB Conversion Function Using March 2000 VIRS NB Calibration for GOES-8 & All Terra and TRMM CERES Data



CONCLUDING REMARKS

- **GOES-8 ALBEDOS ~7% > CERES**
  - **Clear-sky expected to be different by 6%, but closer to 10%**
  - **Possible 4 - 5% difference due to NB calibration**
  - **Apparent lack of SZA dependence on NB-BB relationship**

    Explains difference in bias between Terra & TRMM

- **GOES-8 a valuable resource for BB albedo estimates**
  - **RMS errors no worse than those from BB instruments on two different satellites**
  - **At the mercy of 2 different calibrations**

    VIRS appears to be a more reasonable NB reference

Approach for Estimation of CRF & Absorption

- **Followed Methods of Cess et al. (1995)**
  - Calculated TOA and surface CRF using linear fits for clear sky

$$R = CRF_{TOA} / CRF_{SFC}$$

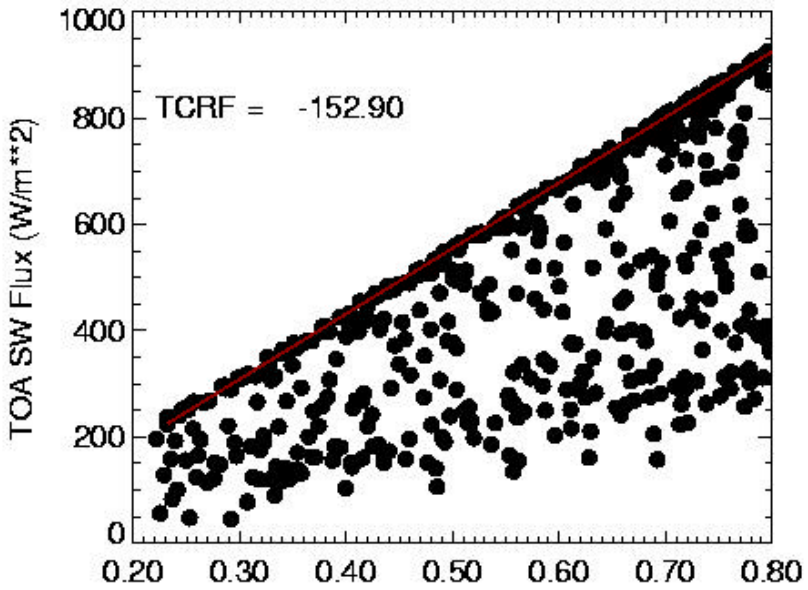
  - Computed mean rate of change of TOA albedo with transmission at the surface

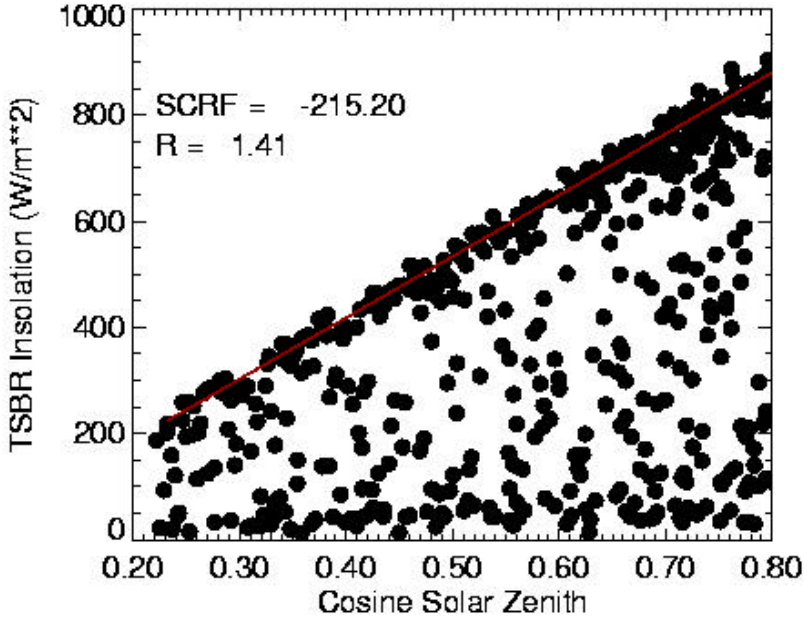
$$\beta = -(1 - \alpha_{SFC})\, CRF_{SFC} / CRF_{TOA}$$

  - Used variety of data combinations
    - **5 surface datasets**
    - **BB SW from GOES**
      entire period, flight times, CERES times
    - **BB SW from CERES**
      entire period, flight time

SURFACE DATA

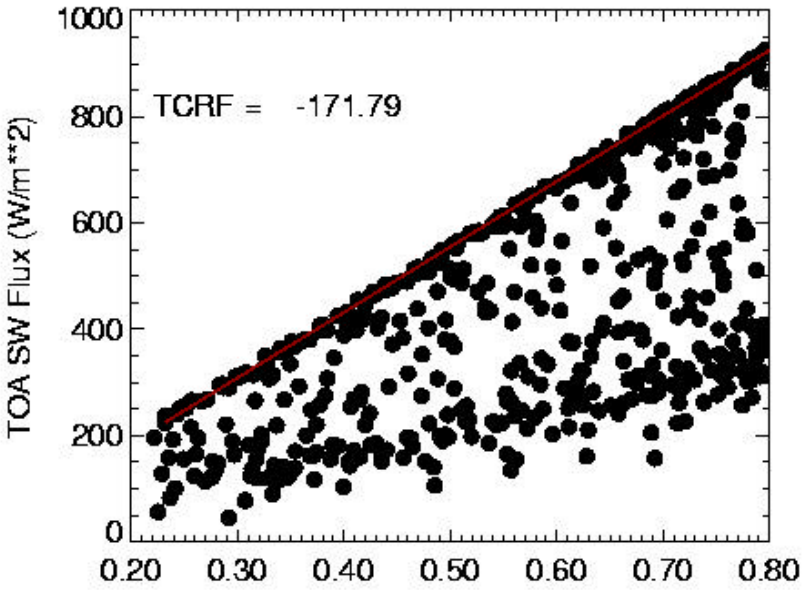
- **BSRN (I mean BSN) A1**
- **TSBR B1**
- **SIRS A1**
- **PSP (Haeffelin correction)**

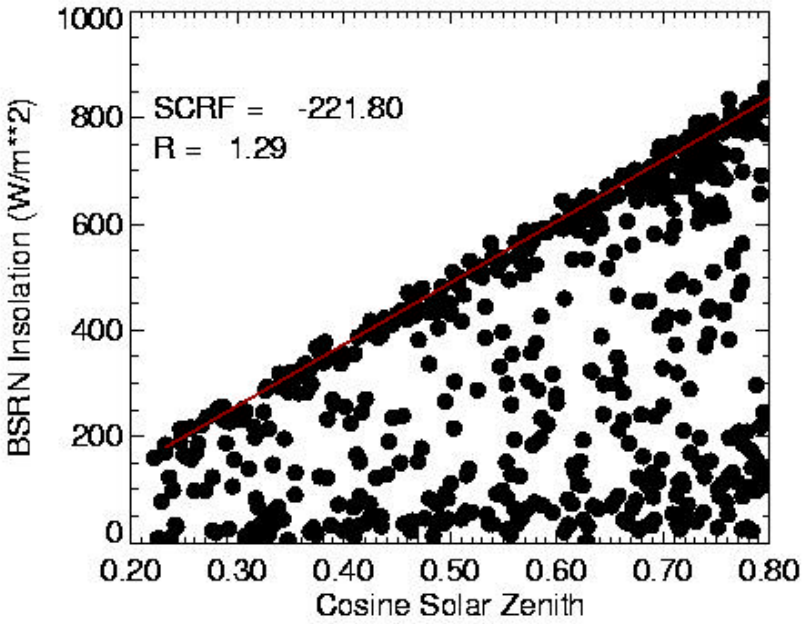




Determination of clear-sky TOA and SFC fluxes as a function of μ for GOES-8

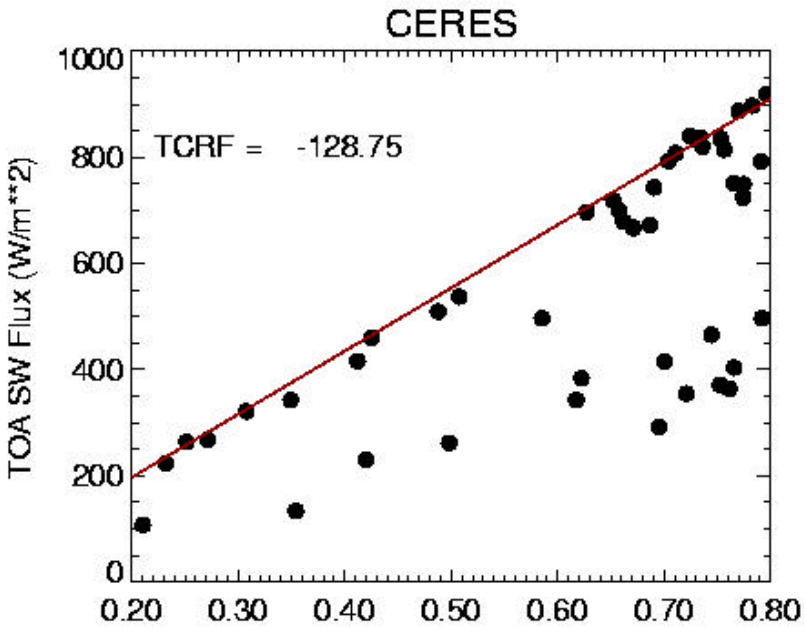
TSBR

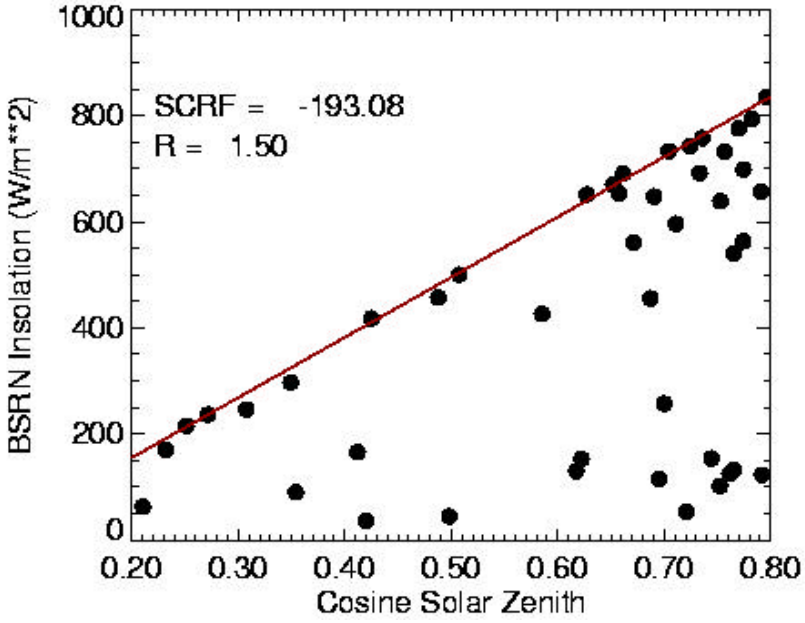




Determination of clear-sky TOA and SFC fluxes as a function of μ for GOES-8

BSRN



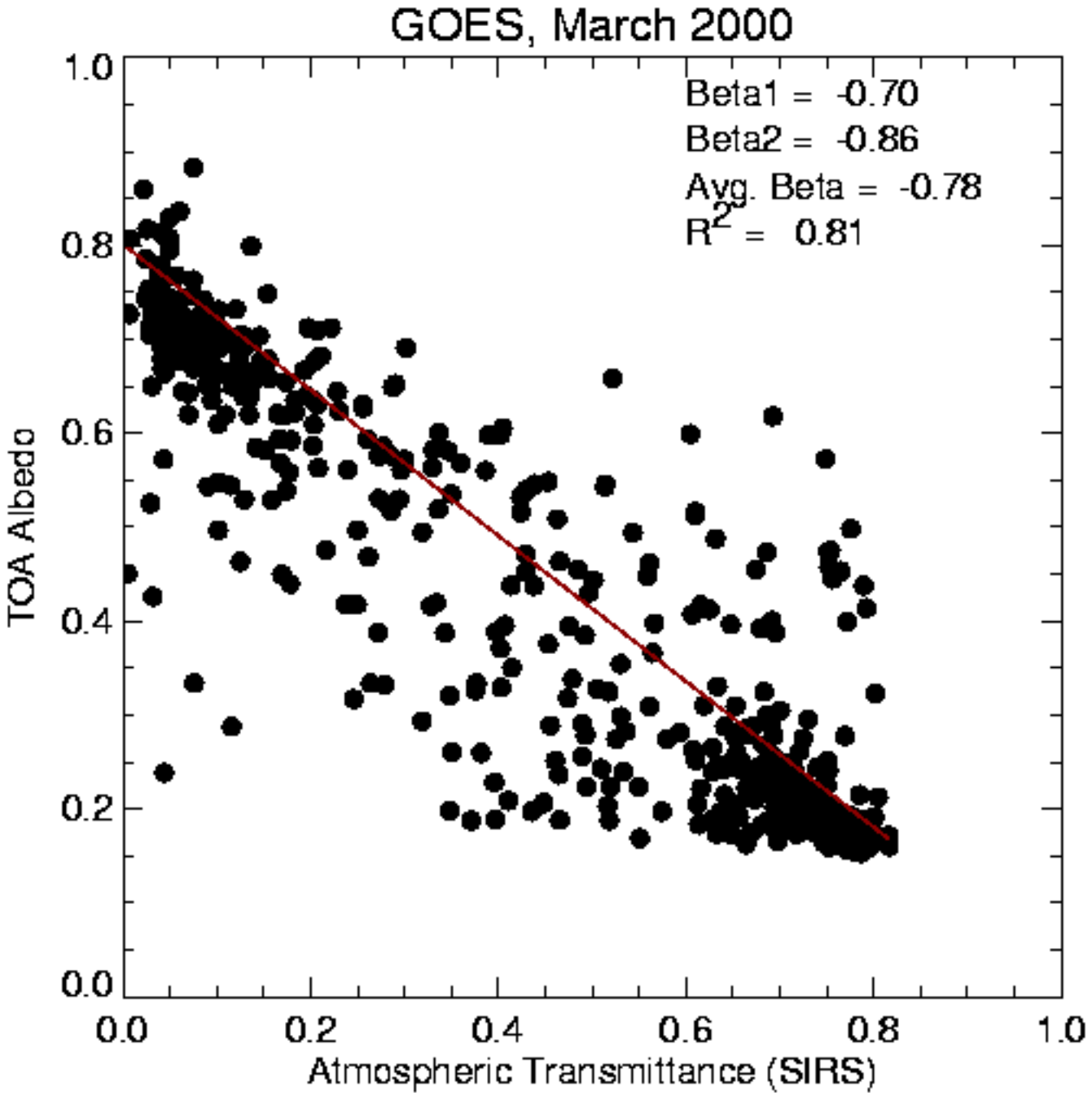


Determination of clear-sky TOA and SFC fluxes as a function of μ for CERES

BSRN

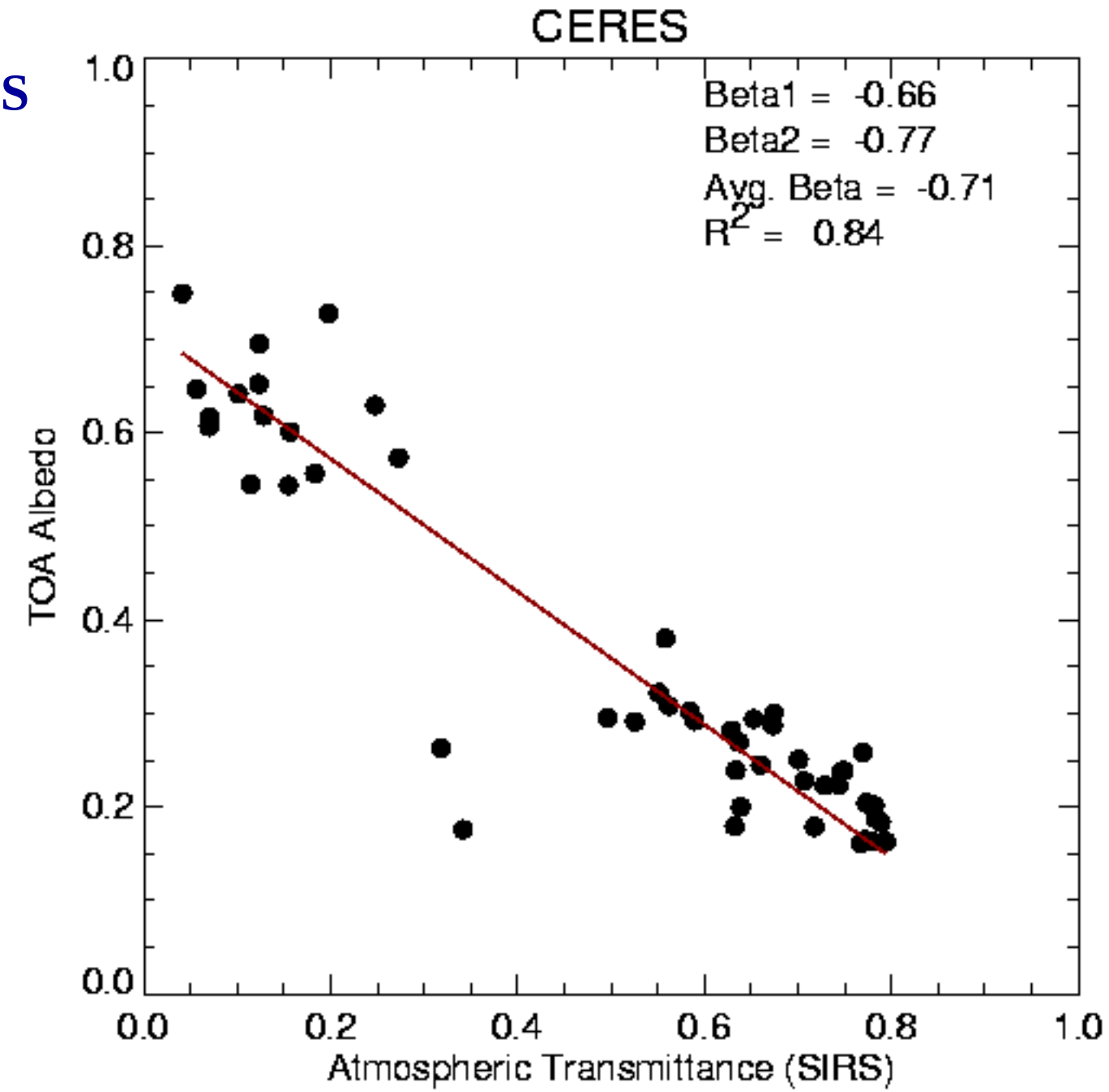
SIRS vs GOES

All days



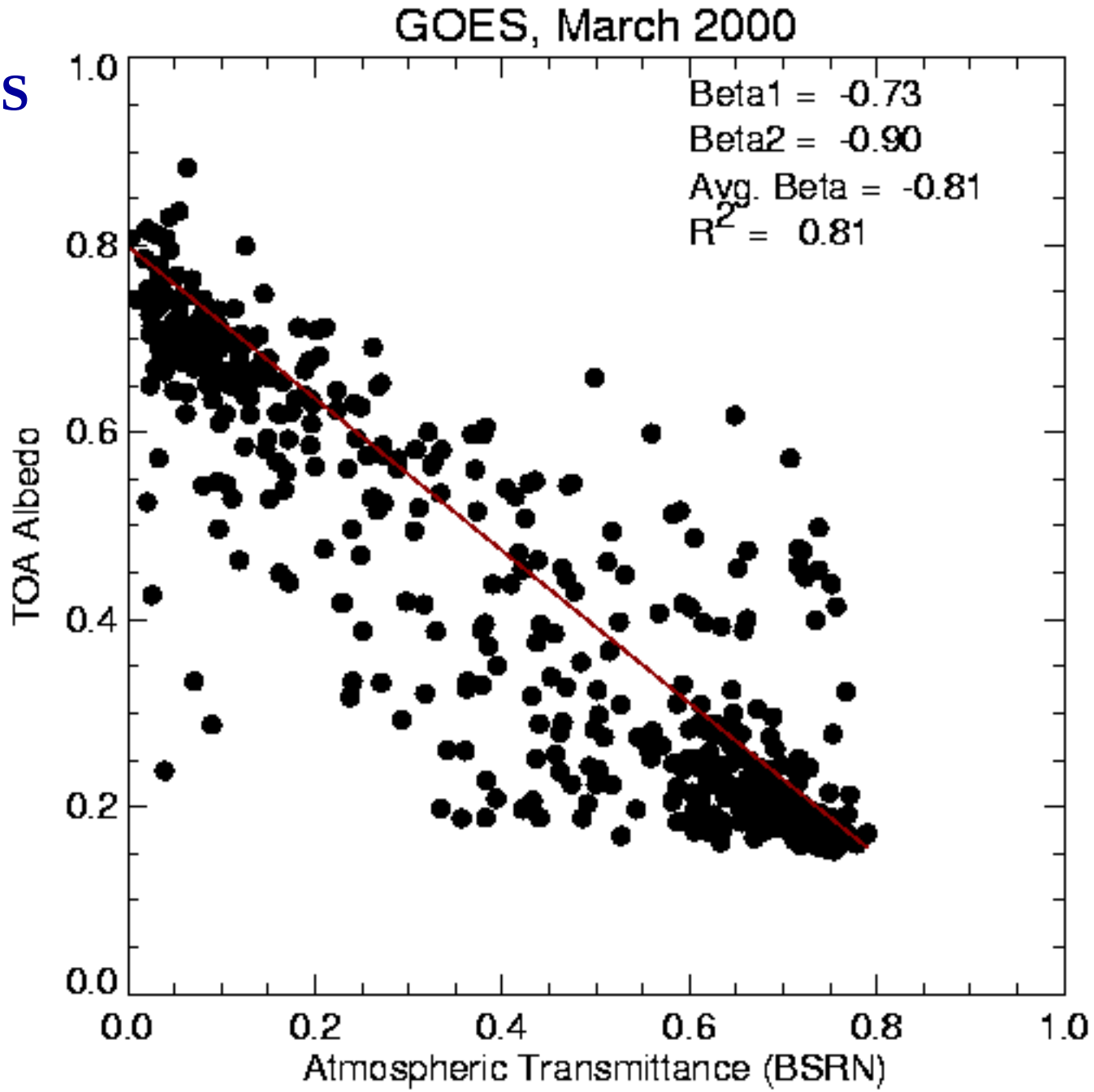
SIRS vs CERES

All days



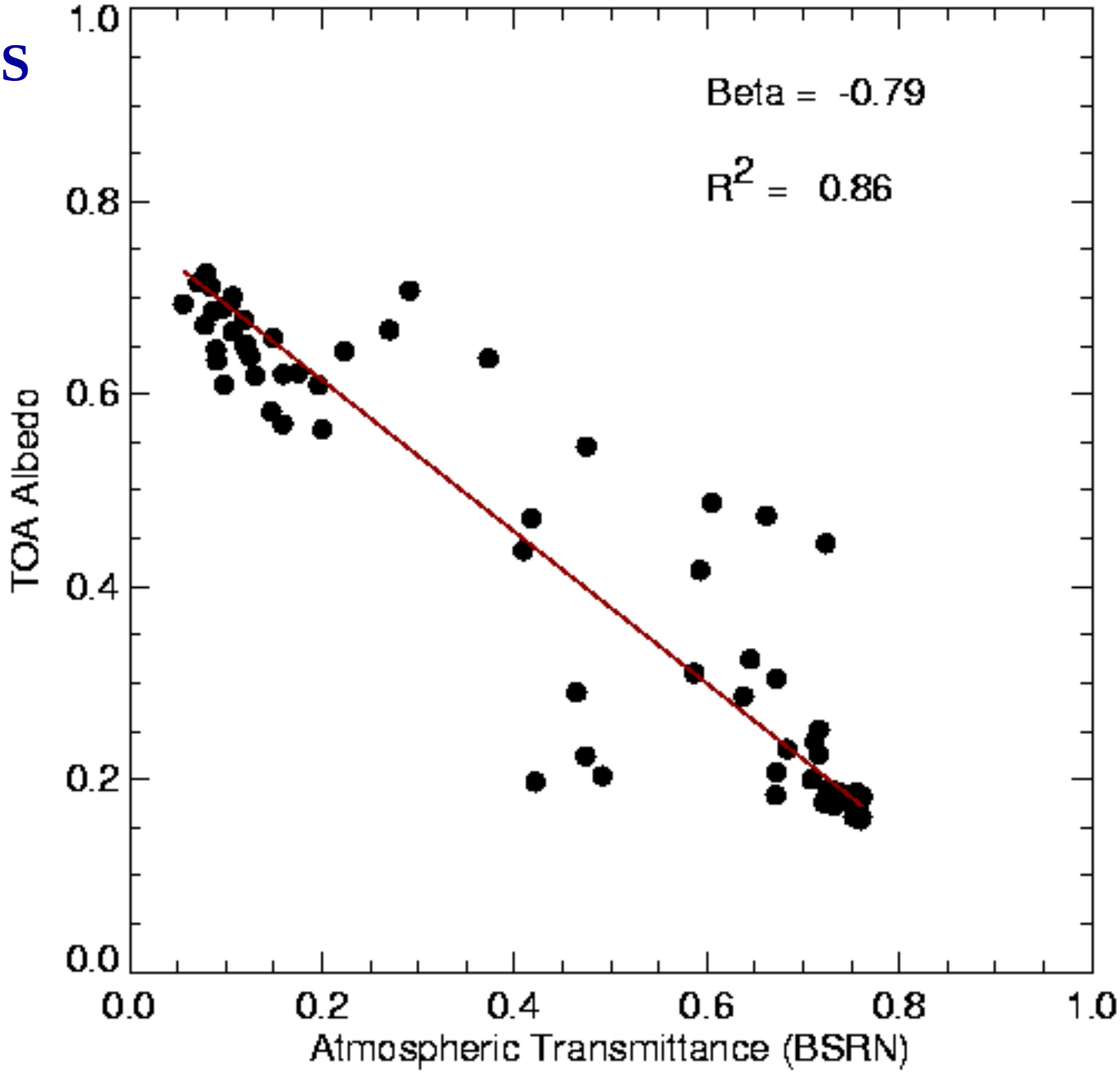
BSRN vs GOES

All days



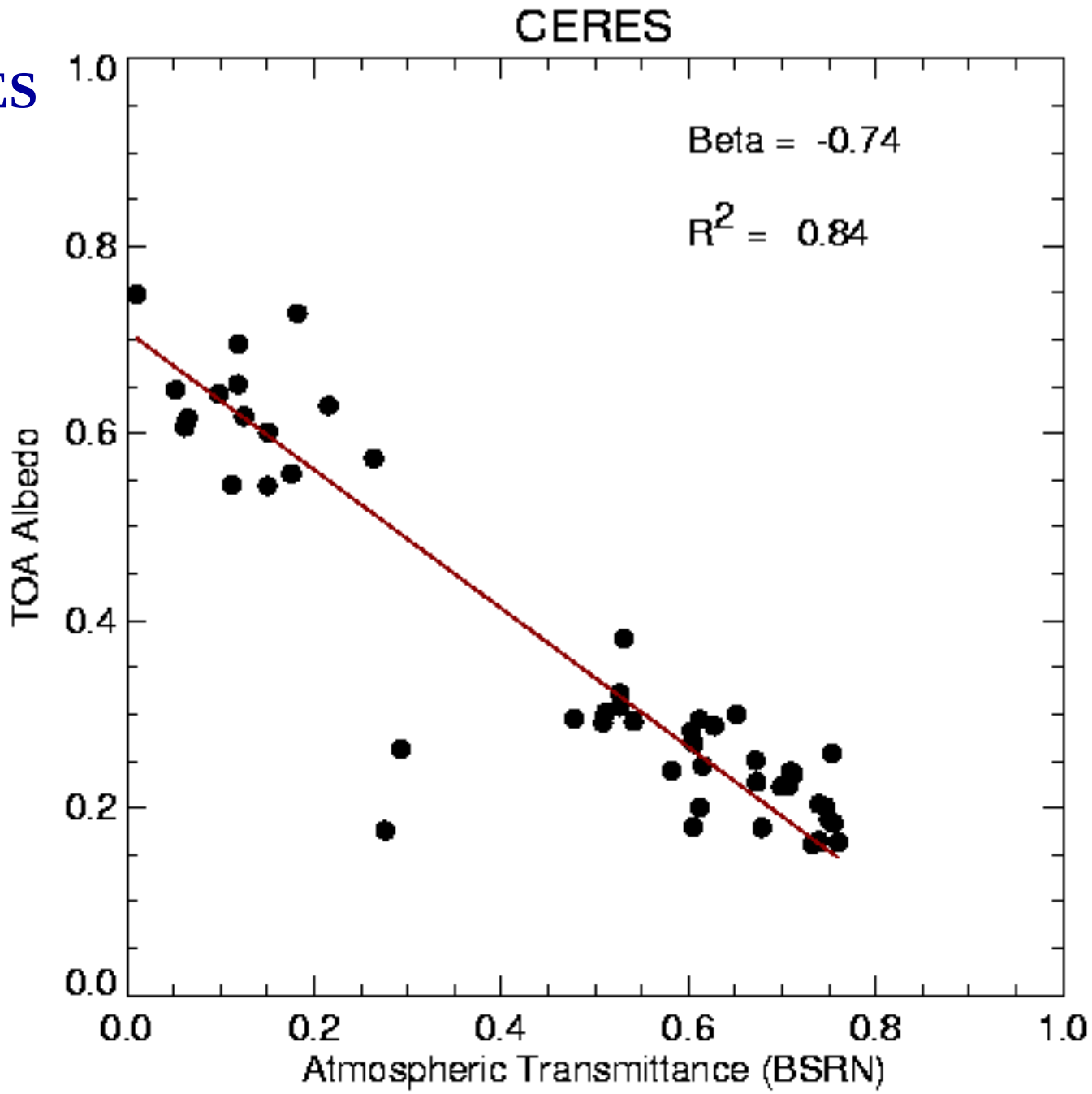
BSRN vs GOES

Flight days



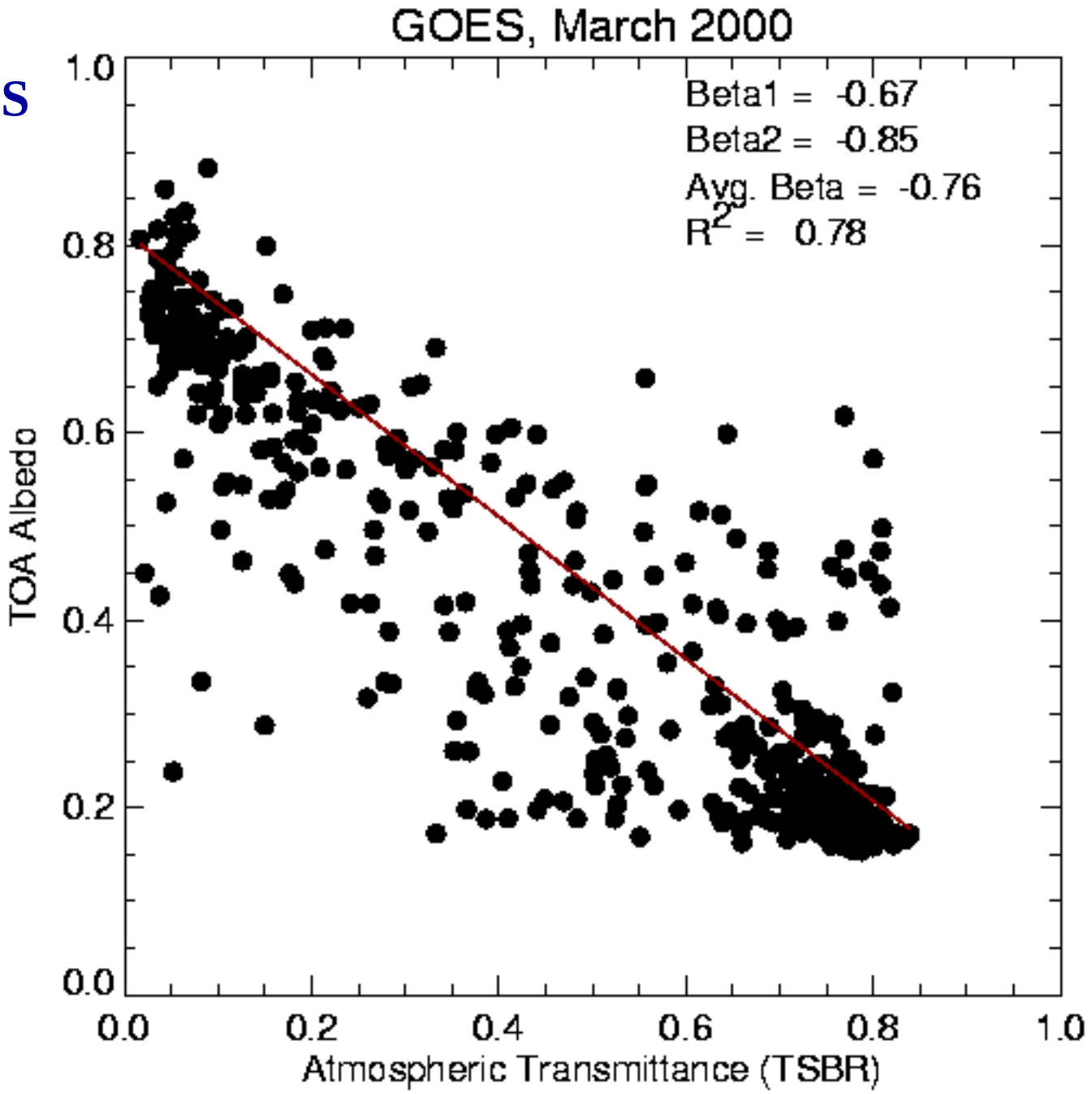
BSRN vs CERES

All days



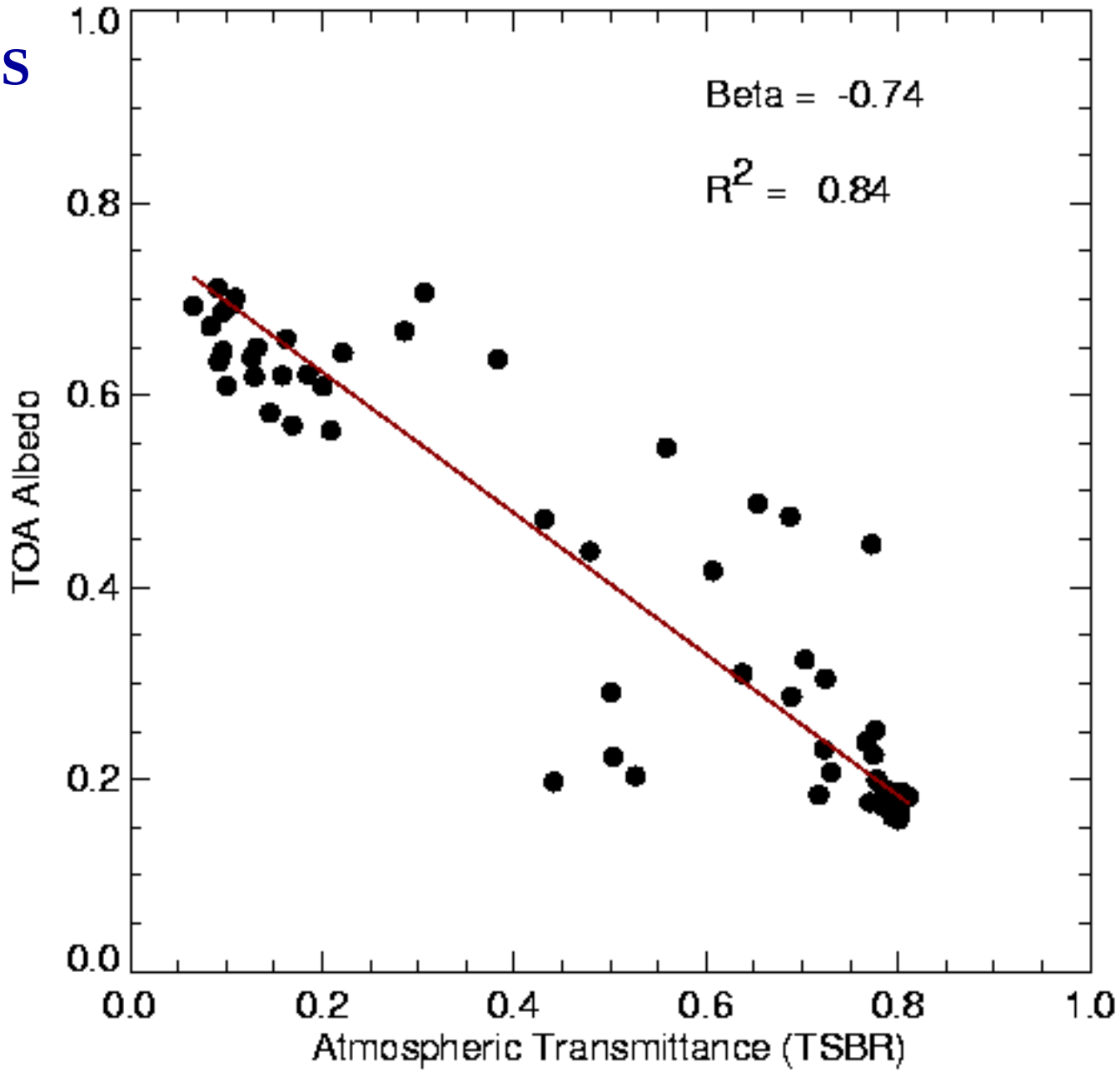
TSBR vs GOES

All days



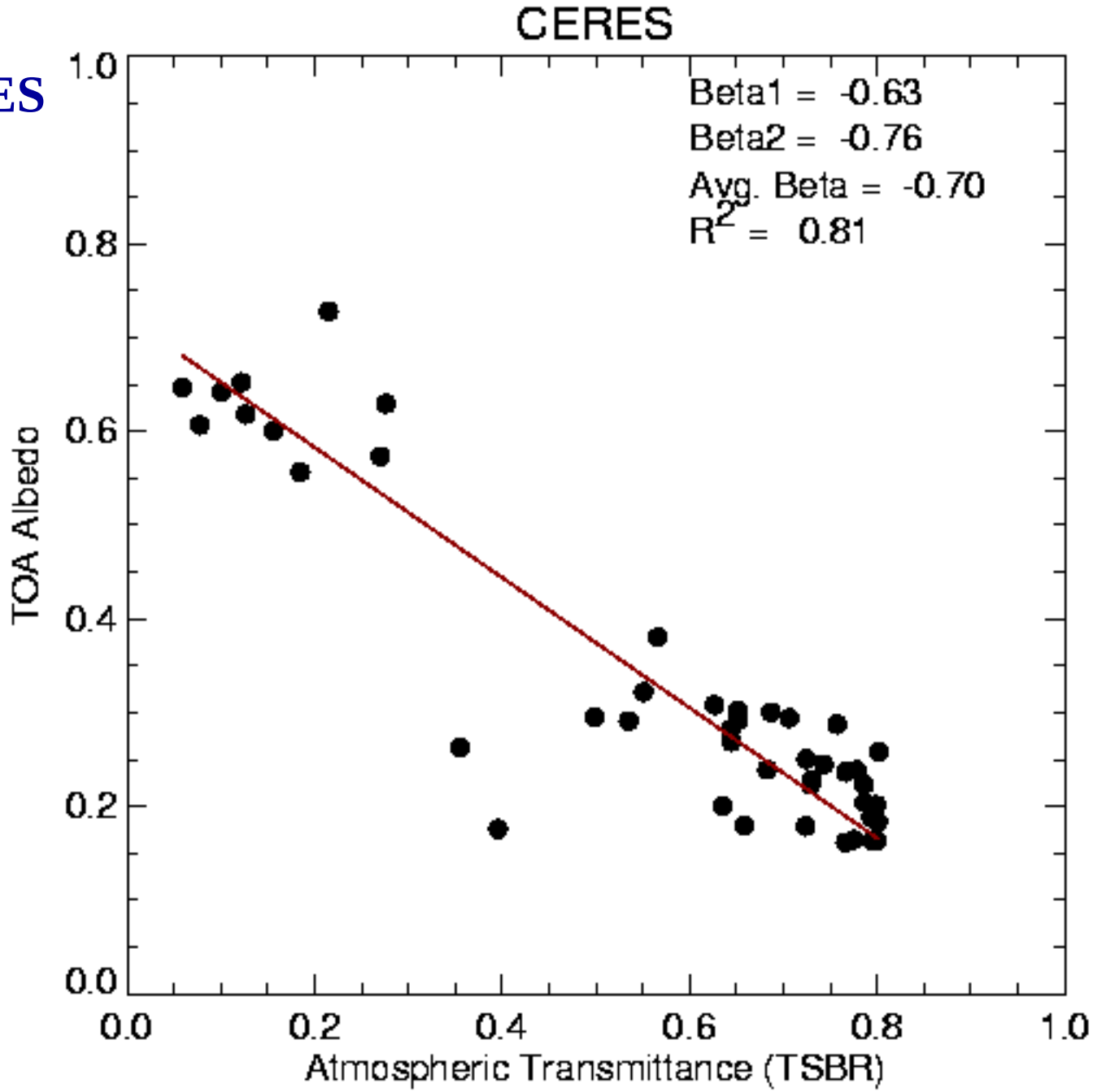
TSBR vs GOES

Flight days



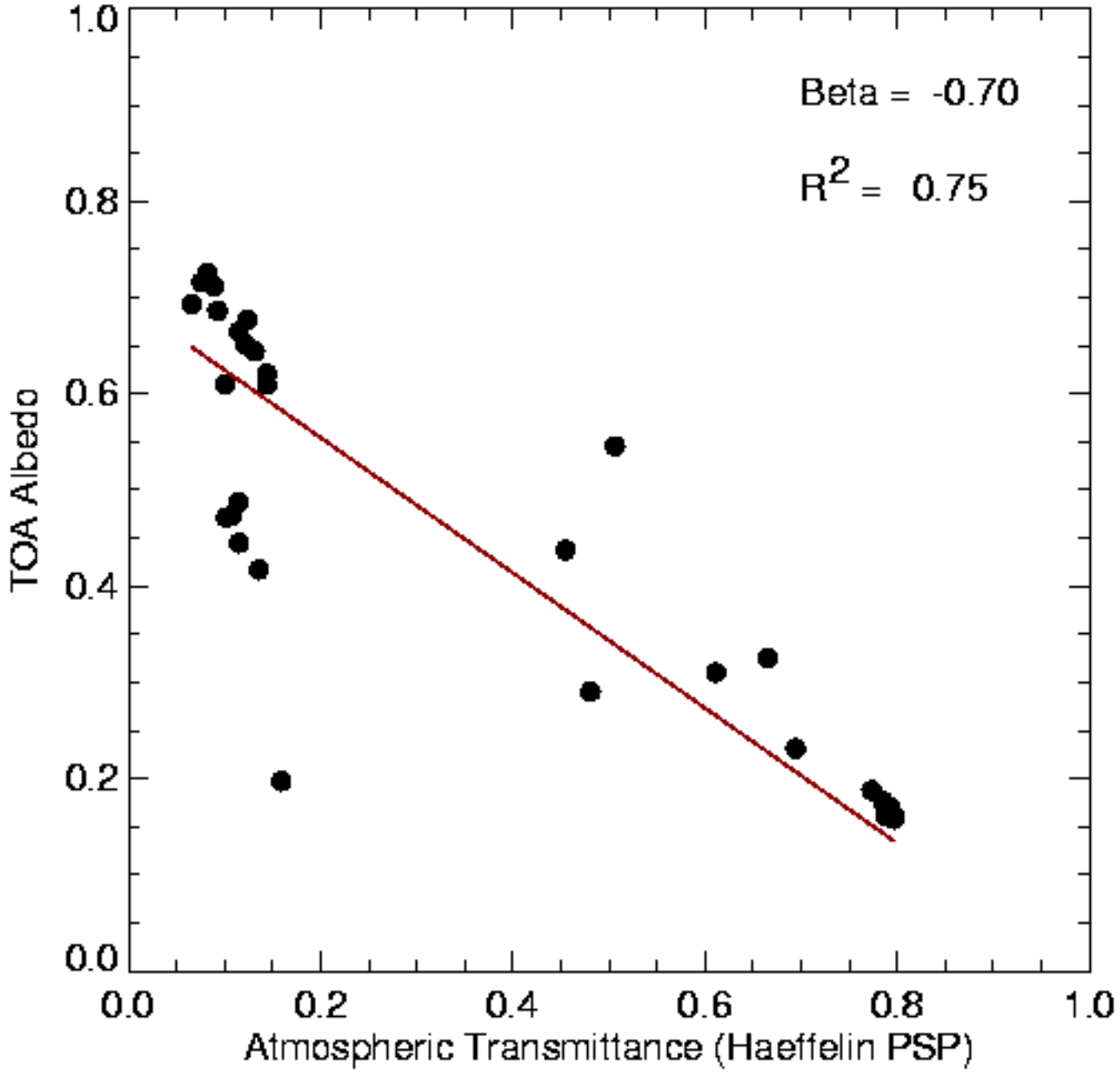
TSBR vs CERES

All days



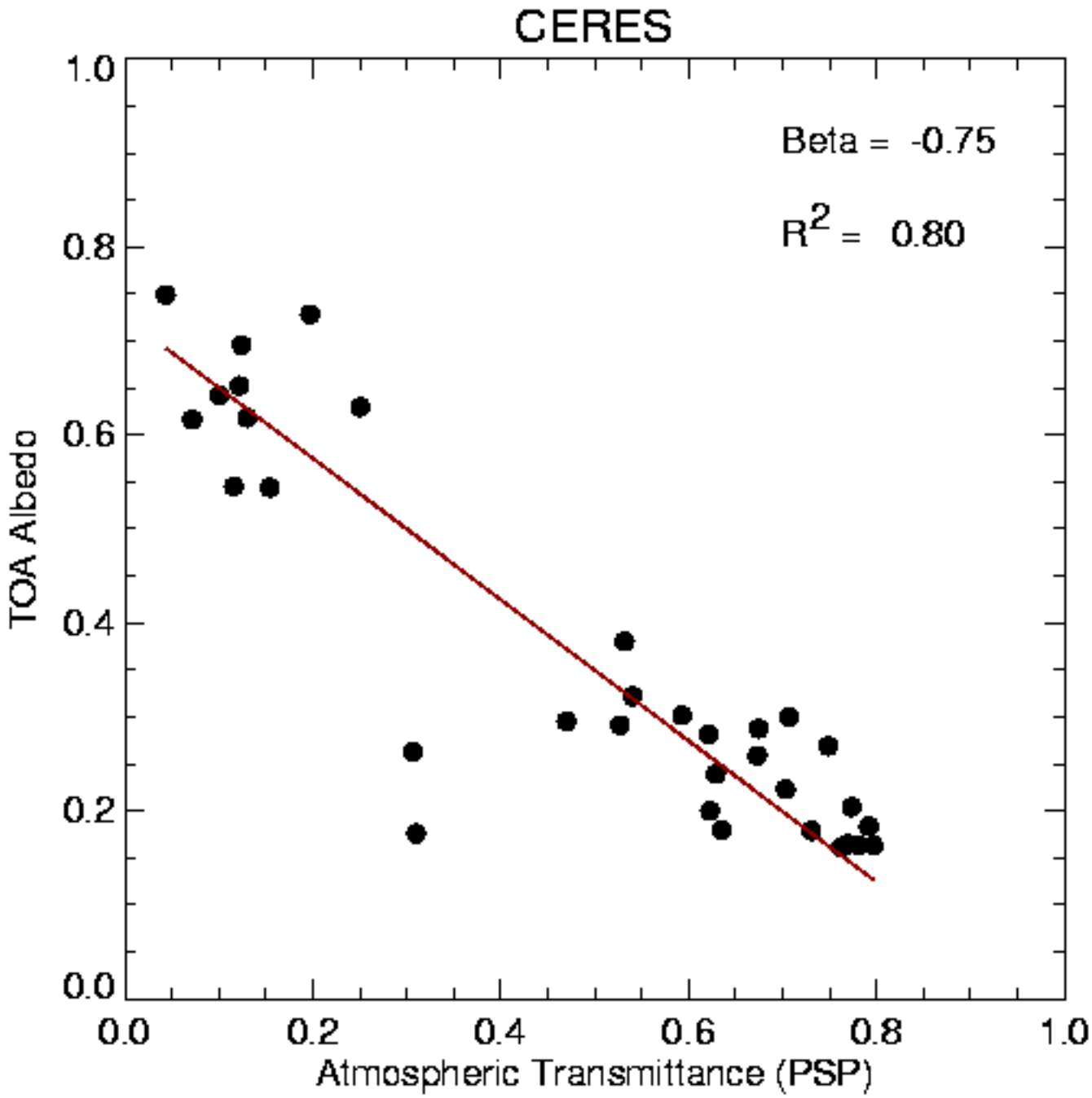
PSP vs GOES

Flight days



PSP vs CERES

All days



SUMMARY OF PRELIMINARY RESULTS

SFC	SAT	Sampling	$-\beta$	$-\beta_{mean}$
BSRN	GOES	All	0.73	0.80
	CERES	All	0.68	0.74
	GOES	Flight	0.73	0.79
PSP	GOES	All	0.73	0.79
	CERES	All	0.67	0.75
	GOES	Flight	0.60	0.70
TSBR	GOES	All	0.67	0.76
	CERES	All	0.63	0.76
	GOES	Flight	0.67	0.74
SIRS	GOES	All	0.70	0.78
	CERES	All	0.66	0.70
	GOES	Flight	0.70	0.75

CONCLUDING REMARKS

- **Slope method shows anomalous absorption if $\alpha = f(T)$ only**
  - **GOES -> 0.71**
  - **CERES -> 0.66**

- **Slope method shows no anomalous absorption if mean slope used**
  - **GOES -> 0.78**
  - **CERES -> 0.74**

- **BSRN consistently yields highest values of b**

- **Data will be reanalyzed with new GOES results, cleaned-up surface data, higher level results , and other instruments**

- **Mean slope approach ??**