Update on UW MODIS Activities

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Quarterly Activities Report for Jan - Mar 1992
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NEAR TERM OBJECTIVES

Algorithm Definition. Using the MAS/FIRE data from Nov-Dec 1991, investigate the algorithms for specifying cloud parameters. Determine the appropriate adjustments for signal noise, spatial resolution, and temporal resolution. Study situations of single layer thin cloud, mixed layers of ice and water cloud, over land, over ocean. From the MAS investigations, infer the best MODIS algorithms within the next year.

Reconfigure MAS. The MAS (MODIS Airborne Simulator) will be configured to its full capability for cloud investigations in April and engineering checkout will proceed in May. UW will assist in the instrument evaluation to confirm stable performance for ASTEX.

TASK PROGRESS

MAS Instrument Performance Evaluation. After reconfiguration of the MAS instrument to 1991 specifications, several test flights were evaluated jointly by UW, GSFC and Ames to assess instrument performance. It was found that noise in the six thermal channels (3.75, 4.5, 4.65, 8.8, 10.95, 11.95 microns) was in the .5 to 1.5 C range over uniform scene in the Gulf of Mexico (rms was 1.7, 0.6, 0.8, 0.3, 0.4, 0.7 C respectively). Calibration with an ice bucket revealed biases in the range of .1 to 1.3 C (measured minus truth were 1.0, 1.3, 1.3, .7, .1, .4 C respectively without benefit of complete spectral response data or correction for residual atmospheric absorption); confidence in inflight calibration appears to be justified. However initial processing has revealed that the blackbody counts of the MAS must be smoothed for several scan lines (eg. nine lines) to reduce the effects of single sample noise in the calibration (which reveals itself as striping in the image). Inflight gain (radiance per count) changes of 10 to 20% were recorded as the instrument temperature dropped from 240 K to 230 K inflight; this made dynamic range adjustments somewhat hit or miss (corrective measures are under discussion).. Overall the instrument performance was excellent, given the short amount of preparation time; this is reported in a MAS/FIRE Quick Look Engineering Report prepared by GSFC and UW.

MAS FIRE Flights and Data Processing. Thirteen MAS flights from 12 Nov to 6 Dec during FIRE were flown. UW and GSFC provided onsite support to assist with flight planning and quick data analysis. A data book has been compiled that includes flight tracks, pilot debriefings, MAS settings, radiometric gains, and noise evaluation. Initial processing of MAS data is proceeding at UW. After modifying code for processing MAMS instrument data, MAS data has been successfully loaded, calibrated, and displayed for qualitative and quantitative analysis on the McIDAS. A transmittance regression model has been developed for the infrared spectral channels of the MAS (1991 configuration). The model will be used to simulate atmospheric transmittances for MAS channels using radiosonde data. The data from the 5 Dec flight over Coffeyville, Kansas is receiving initial attention because of the varying thin cirrus over the ground network and the data from the 16 Nov test is being used to characterize the calibration accuracy (see above).

Thin Cirrus Algorithm Development. The algorithm for detection of thin ice cirrus with the 8.6, 11 and 12 micron channels of MODIS has been investigated with MAS/FIRE data from 5 December 1991. Single sample noise necessitated averaging to about 250 meter resolution (25 fields of view). Ice cloud and water cloud show markedly different slopes in plots of temperature differences 8-11 versus 11-12. Several examples will be presented at the team meeting. Algorithm thresholds for thin cirrus detection are under investigation.

Shortwave CO2 Investigations. The shortwave CO2 slicing cloud height and emissivity estimation was attempted with the MAS/FIRE data of 5 December 1992. Adjustment of the forward calculation was necessary to compare measured and calculated radiances for scenes with thin cirrus; the shortwave determinations of cloud parameters are very sensitive to corrections for reflected solar radiation. Reasonable heights were determined for effective cloud amounts less than .25. Nonetheless, it appears that the shortwave CO2 calculations are best used as a supplement to the longwave CO2 calculations at night.

ANTICIPATED ACTIVITIES DURING THE NEXT QUARTER

Processing MAS/FIRE Data. At least five days have been identified as worthy of case study. The UW team will be processing the MAS data from these days. Additionally we will find the collocated HIS (High resolution Interferometer Sounder) data, intercalibrate the two instruments, and study the spectral sensitivity of the cloud parameter algorithms.

Testing New MAS Configuration. The MAS will be reconfigured to its full cloud investigation capability (only a limited version was ready for FIRE). UW will assist with the engineering checkout flights and the analysis of the data.

Algorithm Definition. An initial version of the operational MODIS cloud parameter code will be drafted and documentation will be contemplated.

PROBLEMS/CORRECTIVE ACTIONS

We are currently ignorant of any problems. All seems to be going fine.

PUBLICATIONS

King, M. D., Y. J. Kaufman, W. P. Menzel, and D. Tanre, 1992: Remote Sensing of Cloud, Aerosol and Water Vapor Properties from the Moderate Resolution Imaging Spectrometer (MODIS). IEEE Trans. and Geoscience and Remote Sensing, 30, 2-27.

Menzel, W. P., D. P. Wylie, and K. I. Strabala, 1992: Seasonal and Diurnal Changes in Cirrus Clouds as seen in Four Years of Observations with the VAS. J. Appl. Meteor., Vol. 31, No. 4, 370-385.

MAS Instrument Performance

Noise in the six thermal channels
over uniform scene in the Gulf of Mexico

microns	rms deg C
3.75	1.7
4.5	0.6
4.65	0.8
8.8	0.3
10.95	0.4
11.95	0.7

Biases (measured minus truth) in the six thermal channels
from ice bucket calibration

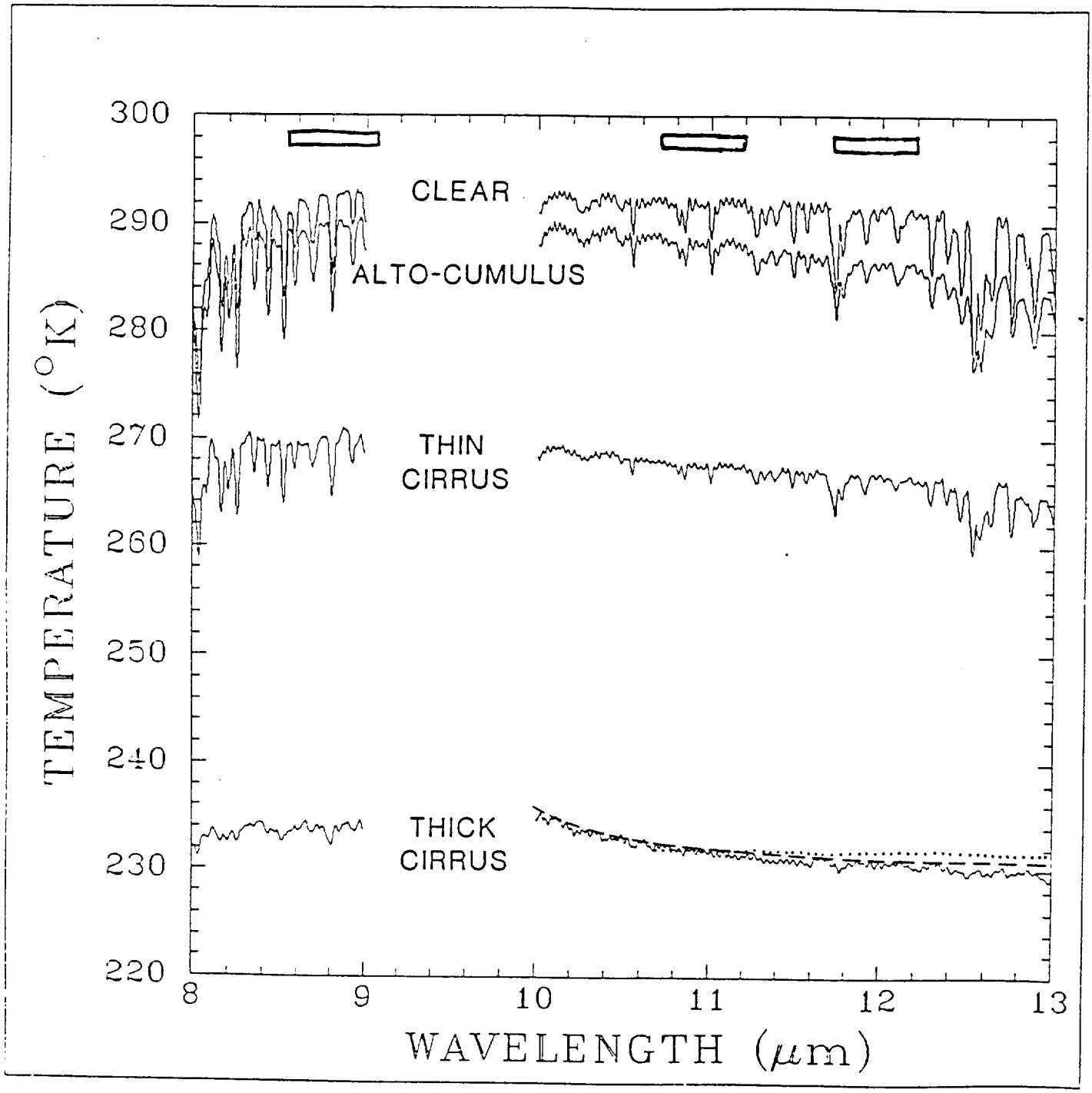
microns	diff deg C
3.75	1.0
4.5	1.3
4.65	1.3
8.8	0.7
10.95	0.1
11.95	0.4

Typical Inflight gain (radiance per count)

microns	dr/dc (mW/m2/ster/cm-1/count)
3.75	6.6 E-3
4.5	2.3 E-2
4.65	1.7 E-2
8.8	.30
10.95	.50
11.95	.45

Changes of 10 to 20% were recorded as instrument temperature dropped from 240 K to 230 K inflight; this made dynamic range adjustments somewhat hit or miss

Overall the instrument performance was excellent, given the short amount of preparation time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280
270
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250
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230
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TEMPERATURE (°K)
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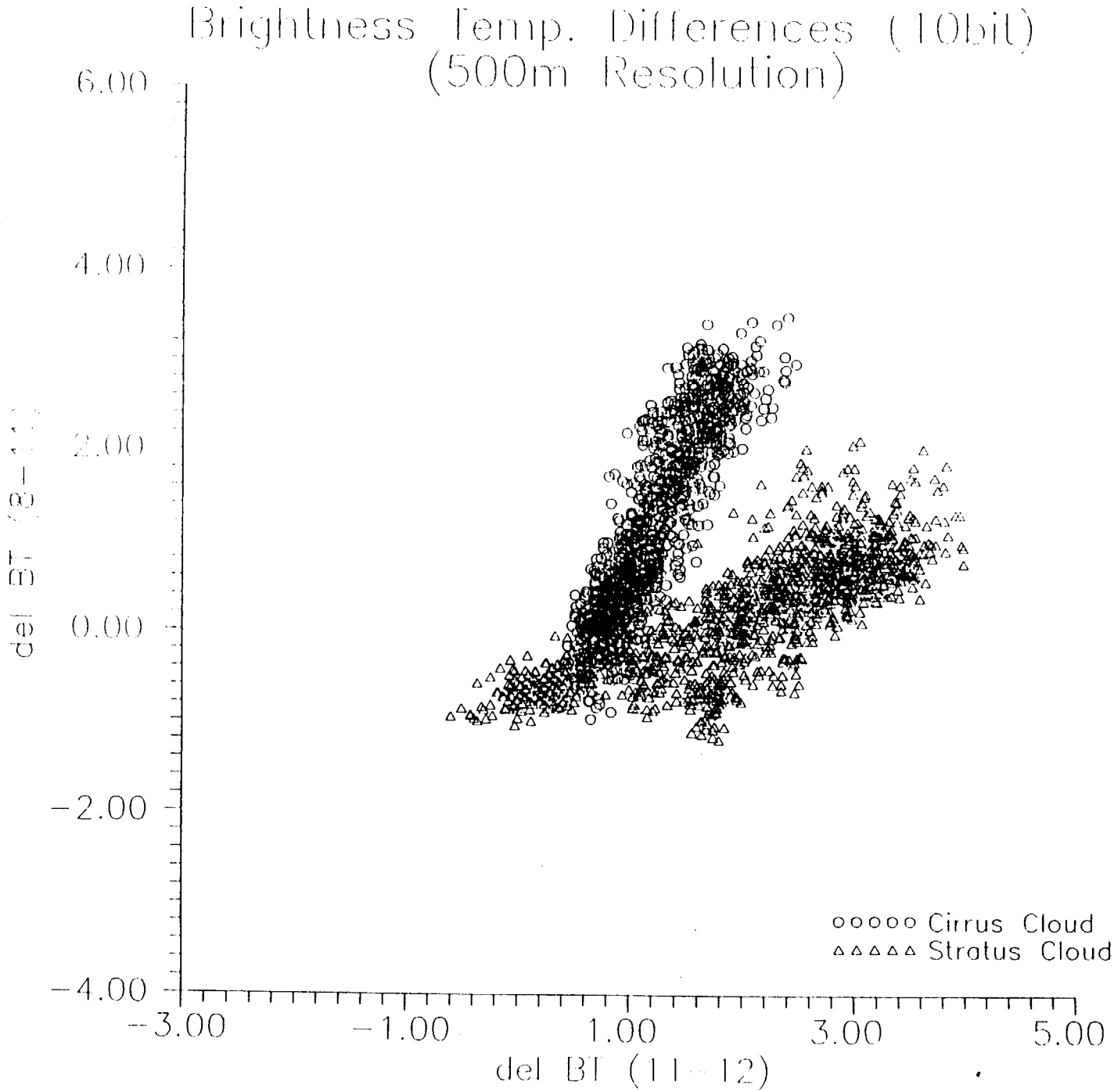
ALTO-CUMULUS
THIN
CIRRUS
THICK
CIRRUS
8
9
10
11
12
13
WAVELENGTH (μm)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(500m Resolution)
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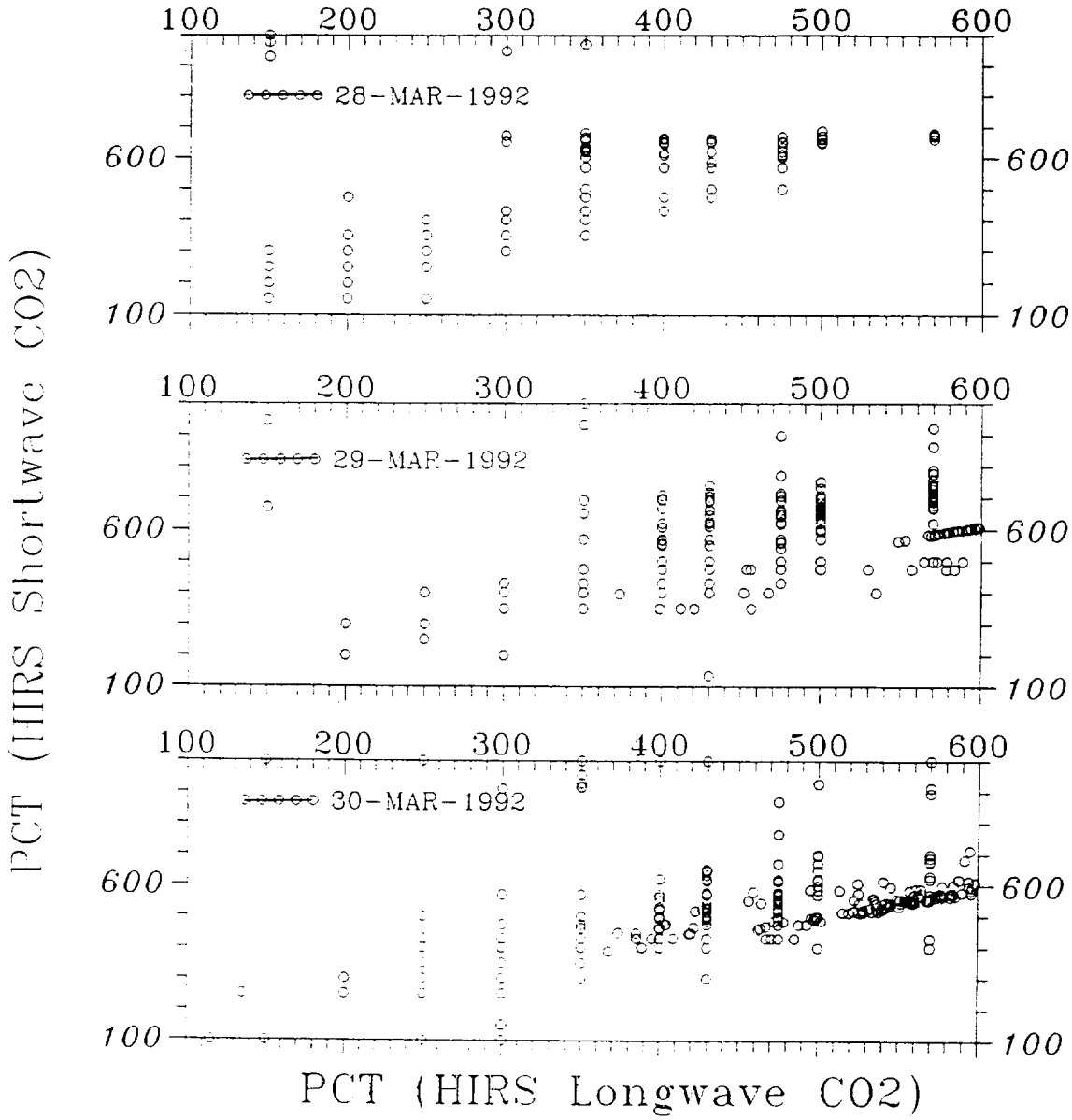
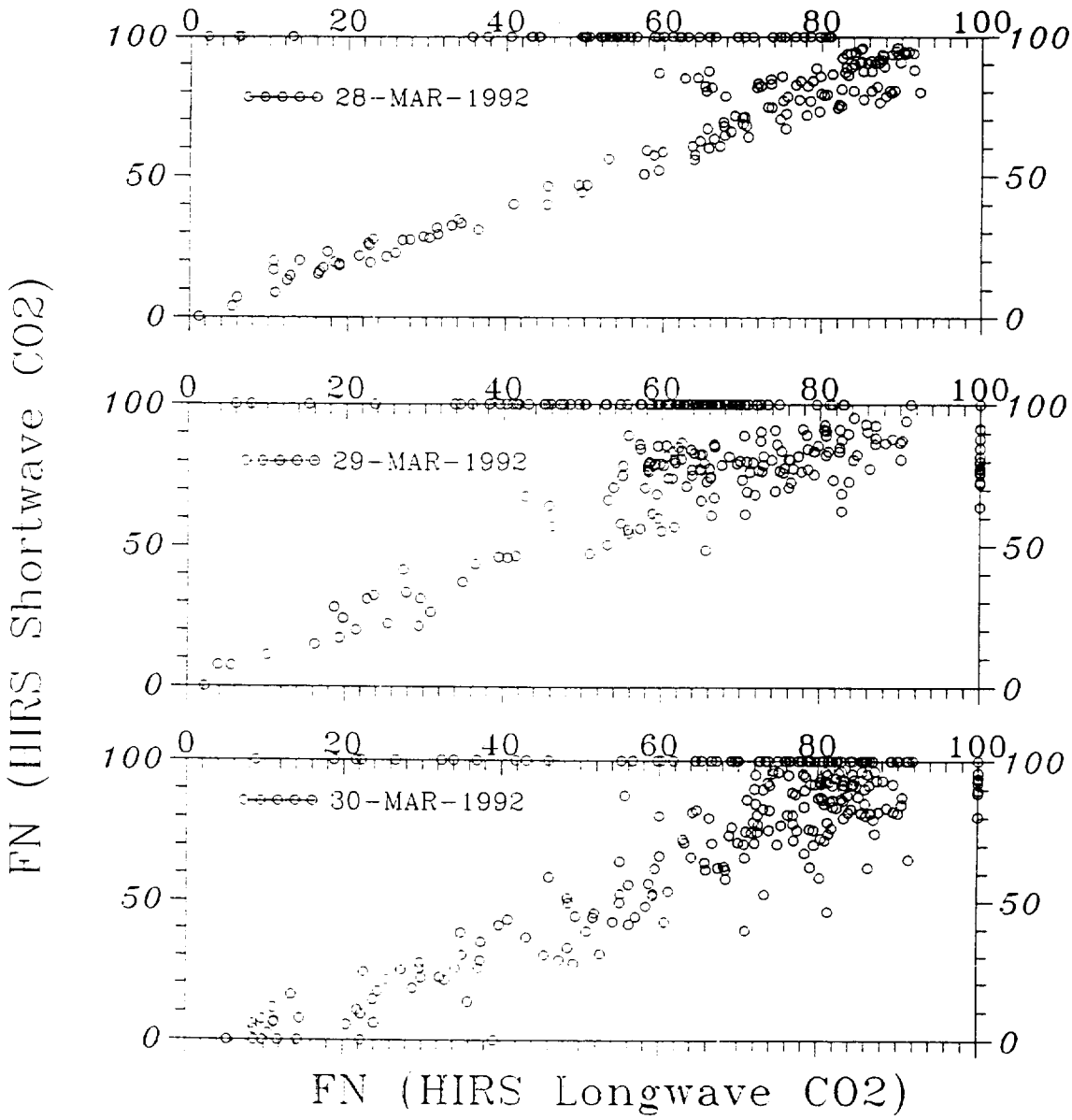
4.00
2.00
0.00
−2.00
−4.00
−3.00
−1.00
1.00
3.00
5.00
del BT (11−12)
ooooo Cirrus Cloud
ΔΔΔΔΔ Stratus Cloud

899 Cloud top heights comparison between
HIRS longwave and shortwave CO2 channels.
Constriants: HIRS longwave PCT < 600 mb



899 Cloud Fraction Emissivity (FN) comparison between
HIRS longwave and shortwave CO2 channels.
Constriants: HIRS longwave PCT < 600 mb



Algorithm Development

Cloud Top Pressure (Pc)
Cloud Effective Emissivity (NE)

approach:	longwave CO2 slicing
	shortwave nighttime enhancement
algorithm:	tested with VAS and HIRS
	awaiting longwave MAS data
s/w:	written
del to SDST:	3Q93

Cloud Top Temperature

approach:	use Pc and guess profile
algorithm:	tested
s/w:	written
del to SDST:	3Q93

Cloud Emissivity

approach:	infer from slope of CO2 versus IRW radainces
	use higher resolution visible data to get N
algorithm:	initial testing with HIRS and AVHRR
s/w:	needs more work
del to SDST:	1Q94

Cloud Phase

approach:	temp diff of 8-11 versus 11-12;
	slope gives phase
algorithm:	successful testing with MAS/FIRE data
	threshold for cloud detection to be investigated
s/w:	straightforward to finalize
del to SDST:	1Q94

Cloud Particle Size

approach:	temp diff of 8-11 versus 11-12;
	models will indicate particle size
algorithm:	not determined
s/w:	not ready
del to SDST:	1Q95 ?