Validation of GOES-8 Derived Cloud Properties Over the Southeastern Pacific

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Outline

- Introduction
- Cloud Property Retrieval
  - VISST/SIST Methodology
  - Required Inputs
- Sample Cloud Properties
  - Hourly
    - Pixel Level, Gridded
  - Monthly
    - Gridded
- Validation
  - Tc, Zc, τ, r_e, LWP
- Conclusions
- Future Work

Introduction

- **Why do we need satellite cloud products?**
  - Very important climatic region
    - ITCZ
    - Stratocumulus region
    - Southern hemispheric storm track
  - Region is vast and in-situ measurements are limited
  - Satellite cloud products are the only way to get near continuous coverage of the entire region

- **Why do we need validation?**
  - Without validation satellite products are suspect
  - Provides means for correcting and proving algorithms

Methodology

- **Visible Infrared Solar-Infrared Split Window Technique (VISST)**
  - Daytime
  - 0.65, 3.9, 10.8, 12.0 µm channels
  - Utilizes parameterization of theoretical radiance calculations for 7 water and 9 ice crystal size distributions
  - Retrieves cloud optical properties by matching calculations to observations

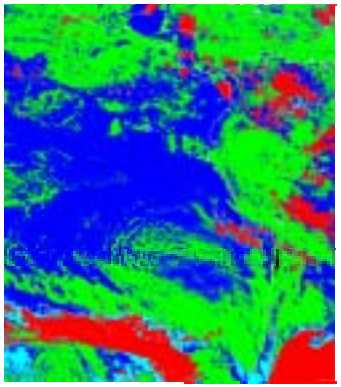
- **Solar-Infrared Infrared Split Window Technique (SIST)**
  - Night
  - 3.9, 10.8, 12.0 µm channels
  - Minimum error, iterative regression method
  - Retrieves cloud optical properties by matching calculations to observations

Required Inputs

- Soundings from model runs or in-situ measurements
- Surface characterization from IGBP 10 minute map
- Uses CERES cloud mask algorithm
- Clear sky reflectances from CERES & GOES-based ocean model
- Narrowband to Broadband flux conversion functions from GOES-ERBE
- Satellite data (GOES-8, GOES-10) 4-km pixel resolution

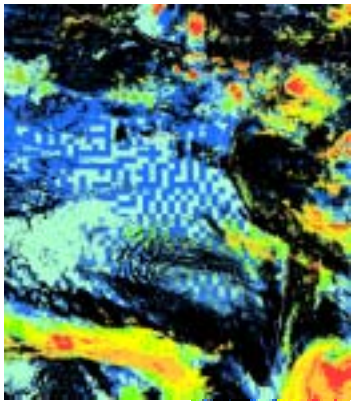
Sample Products - Hourly Pixel Level (11/01/99 , 14:45 UTC)

Cloud Mask



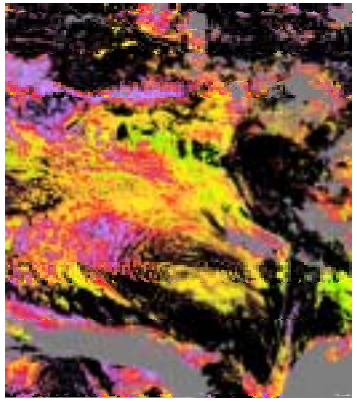
Ice
Water
SLW
No Ret
Clear

Cloud Height



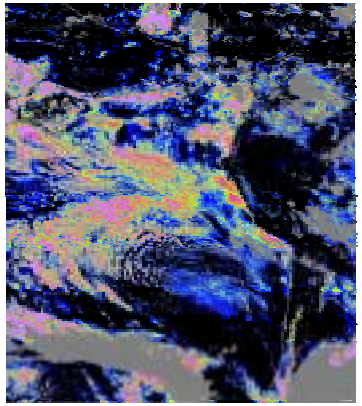
0 2 4 6 8 10 12 14
Cloud Height (km)

Effective Droplet Radius



0 4 8 12 16 20
Effective Droplet Radius (um)

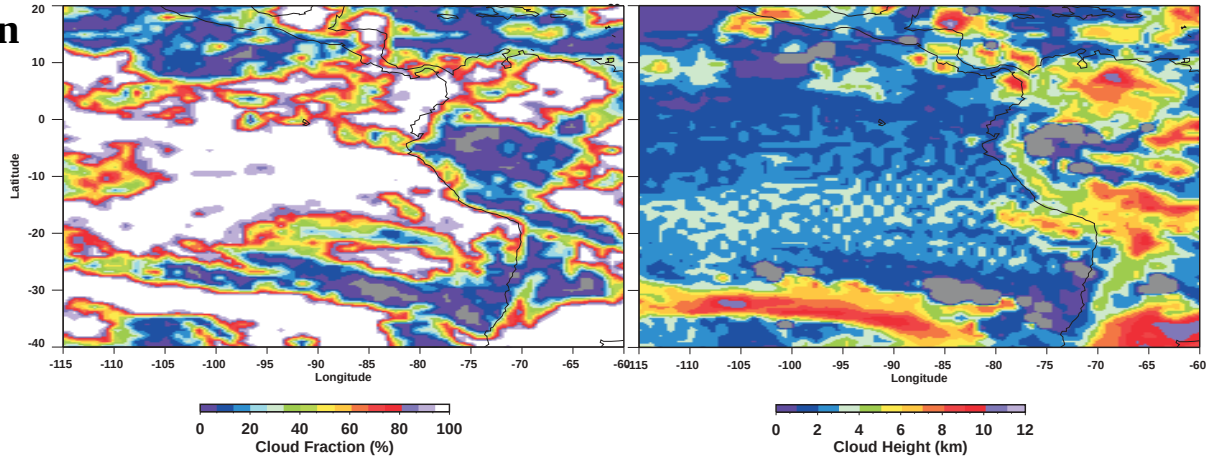
Liquid Water Path



0 50 100 150 200 250
Liquid Water Path (g/m2)

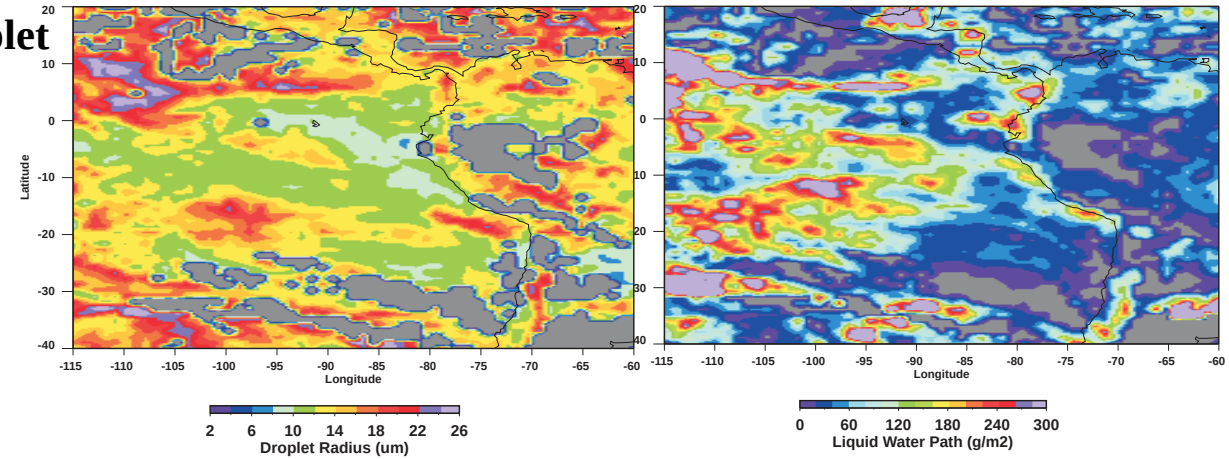
Sample Products - Hourly Gridded (11/01/99, 14:45 UTC)

Cloud Fraction



Cloud Height

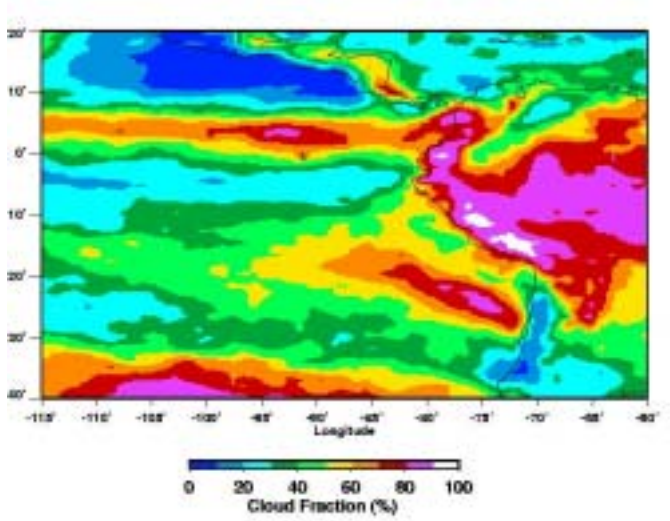
Effective Droplet Radius



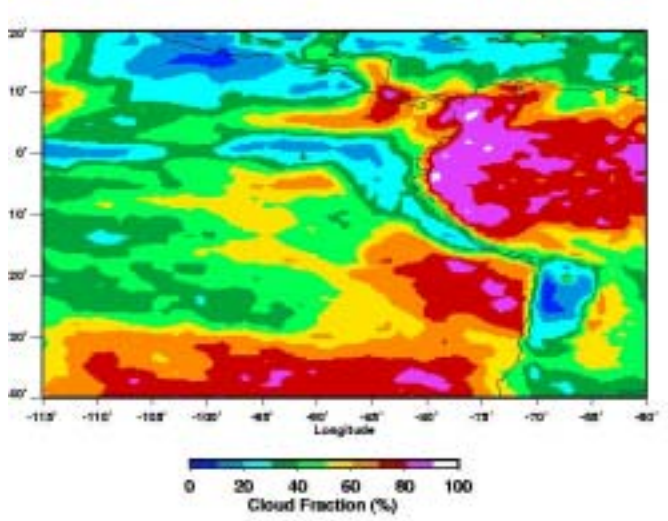
Liquid Water Path

Monthly Gridded Cloud Fractions (1°)

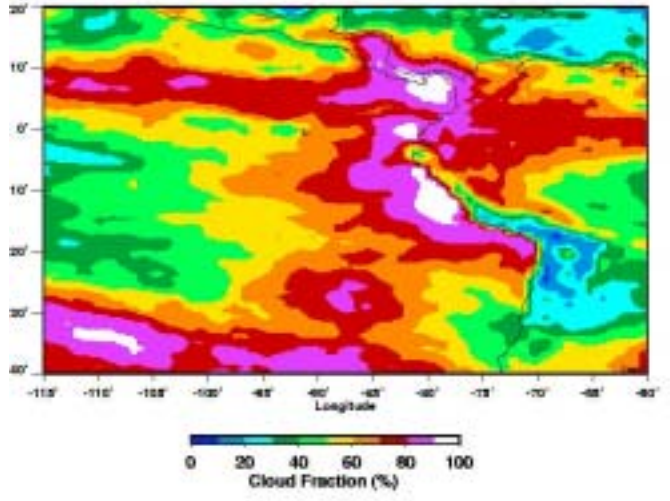
Jan



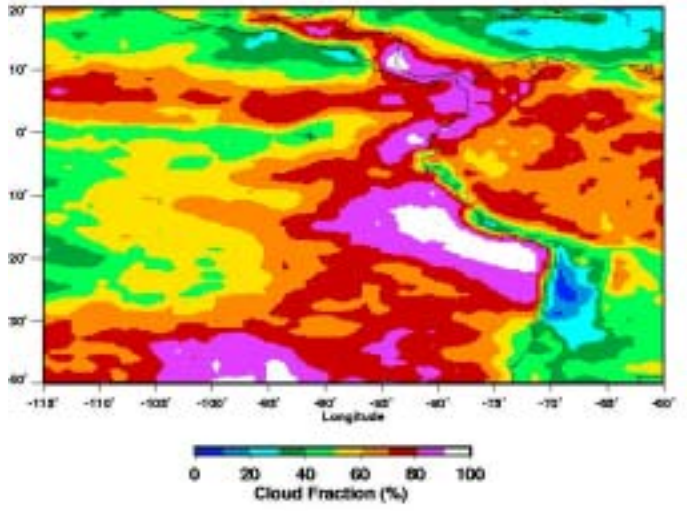
April



July



Oct



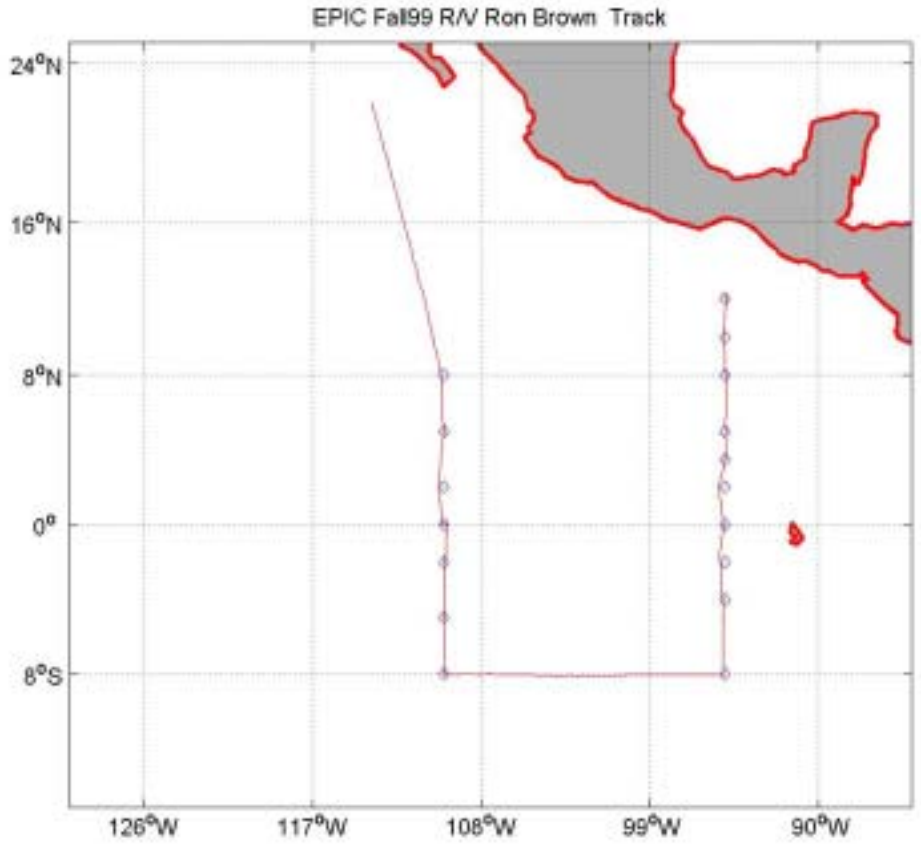
Validation

- VISST/SIST
  - Analysis for a 1° box centered on the ship
  - Solar zenith angle restricted to 82° or less
  - Cloud limited to a single phase in most cases
  - Appropriate properties adjusted by cloud fraction

- Fall 2000
  - 20 minute average centered on satellite image time
- Fall 2001
  - 60 minute average centered on image time
  - 20 minute average centered on satellite image time (Cloud Height)

Fall 1999

Ron Brown Track - Fall 1999



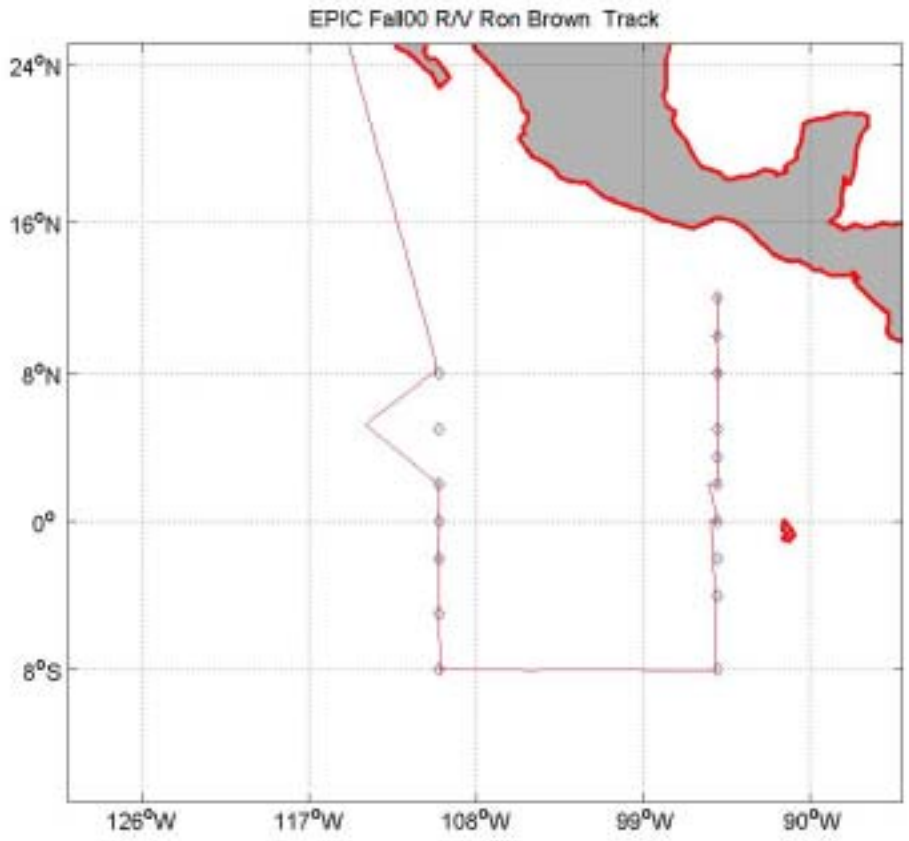
Comparison of Satellite and Ceilometer Cloud Fraction (Fall 1999 Cruise)

	VISST				
Ceilometer	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**
0-20	19	1	5	0	0
20-40	4	1	1	0	0
40-60	0	0	1	0	0
60-80	0	0	1	0	0
80-100	0	1	1	1	12

Cmean = 39.7%, Vmean = 36.8%, StDev = 19%

Fall 2000

Ron Brown Track - Fall 2000

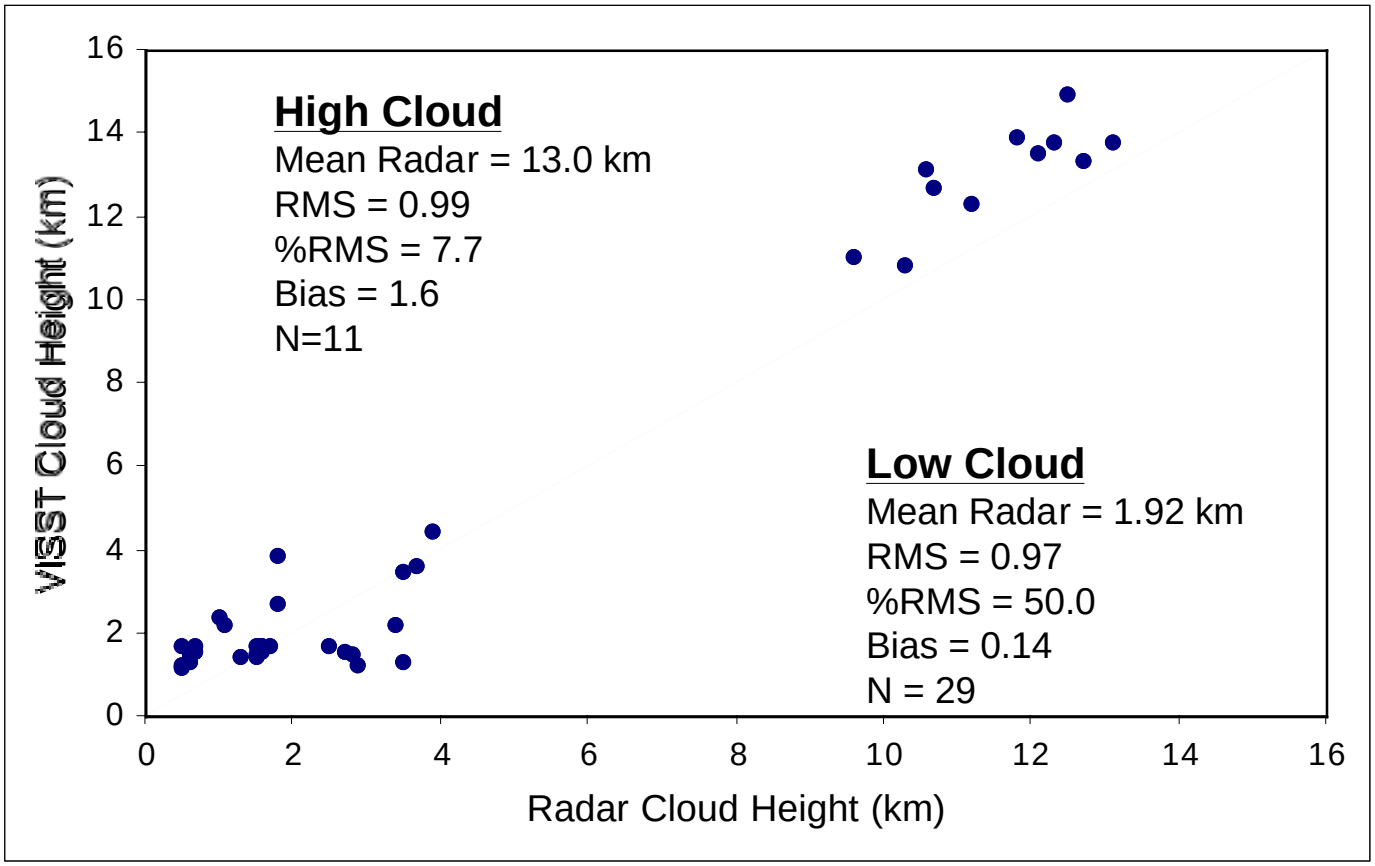


Comparison of Satellite and Ceilometer Cloud Fraction (Fall 2000 Cruise)

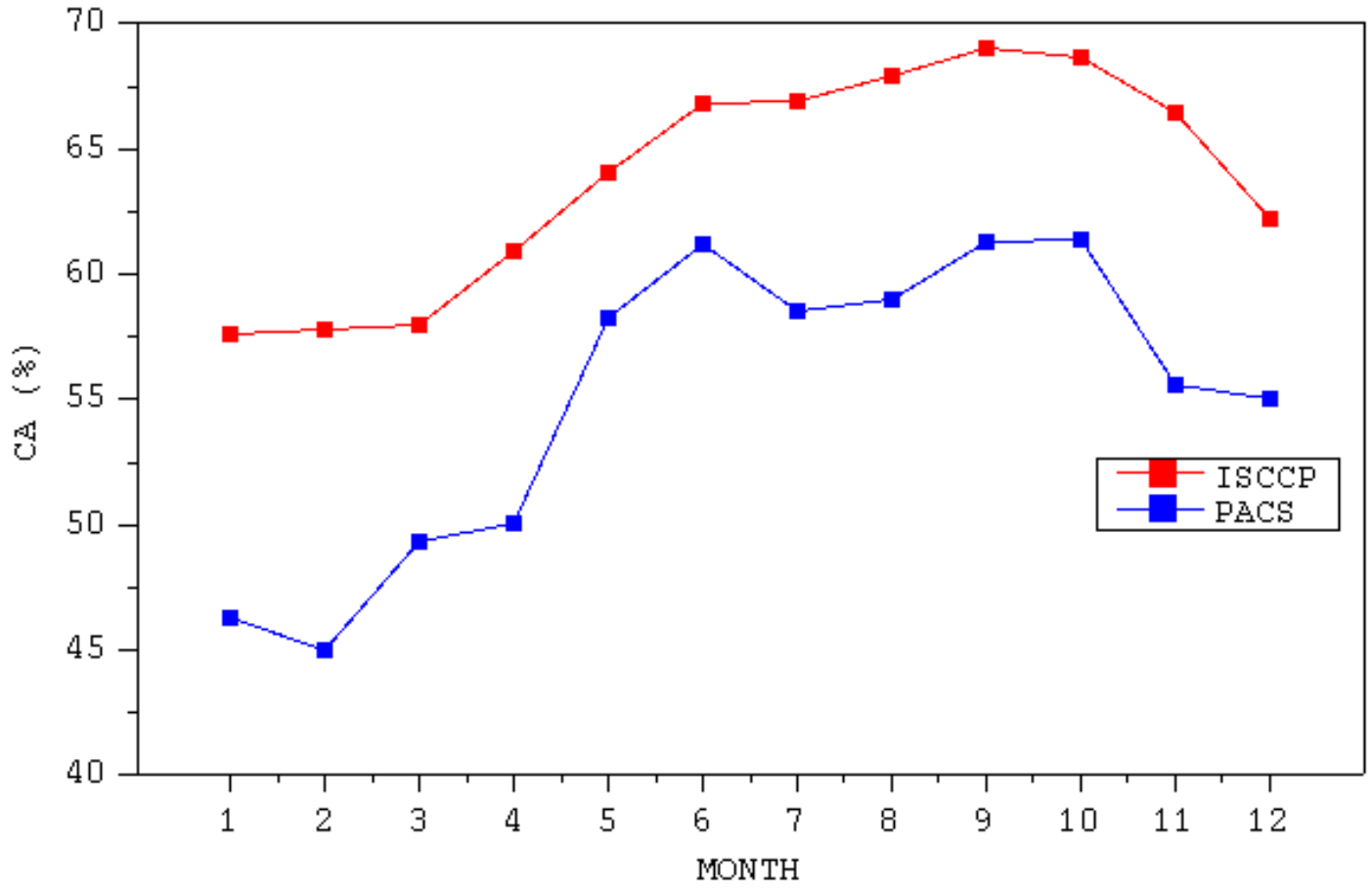
	VISST				
Ceilometer	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**
0-20	20	5	3	0	0
20-40	1	1	2	2	0
40-60	2	3	3	1	3
60-80	0	1	1	2	3
80-100	2	3	2	2	47

Cmean = 64.3%, Vmean = 60.4%, StDev = 24%

Comparison of Radar and VISST Derived Cloud Heights (Fall 2000)

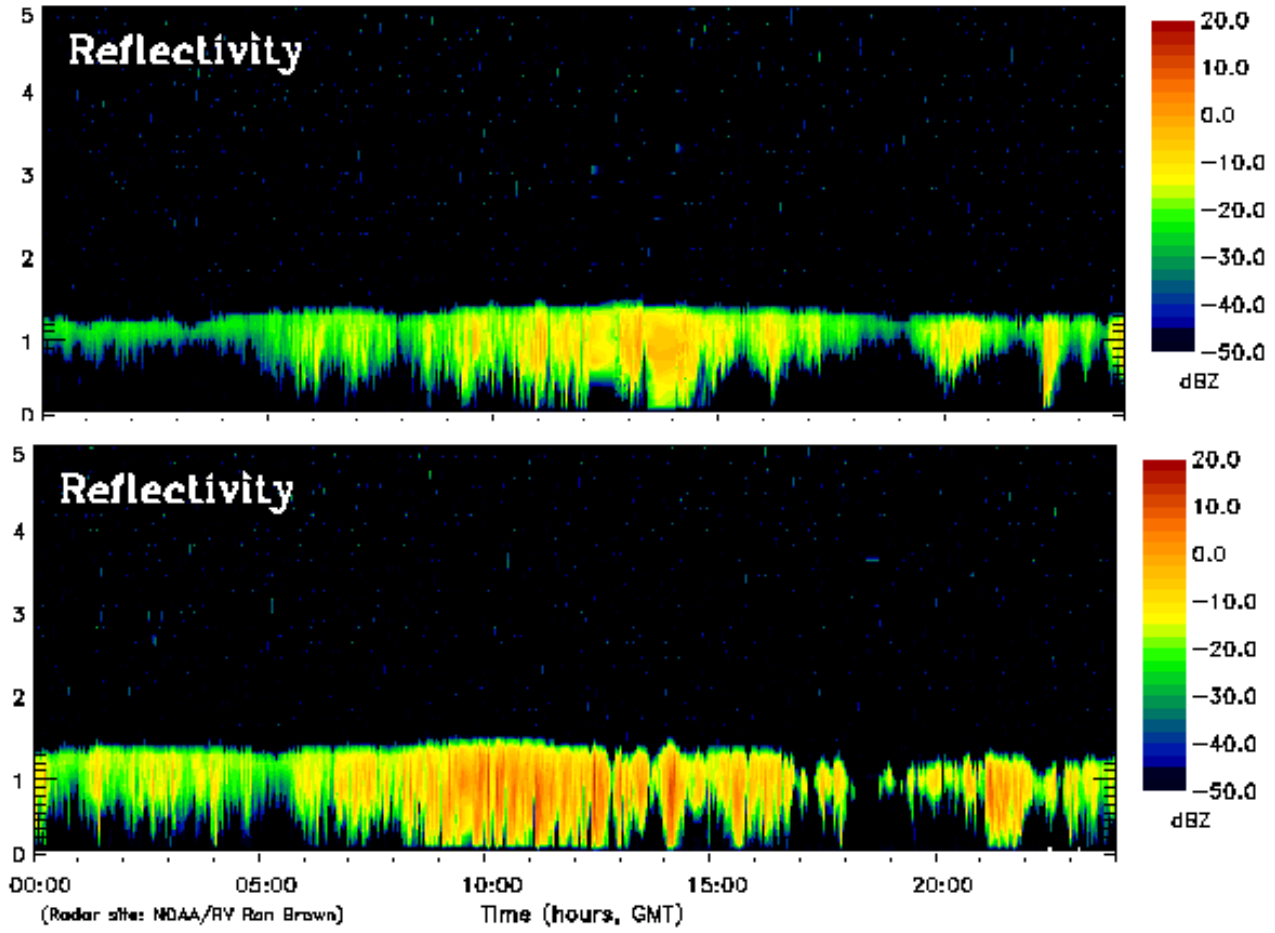


Comparison of VISST and ISCCP (83-98) Mean Cloud Amount

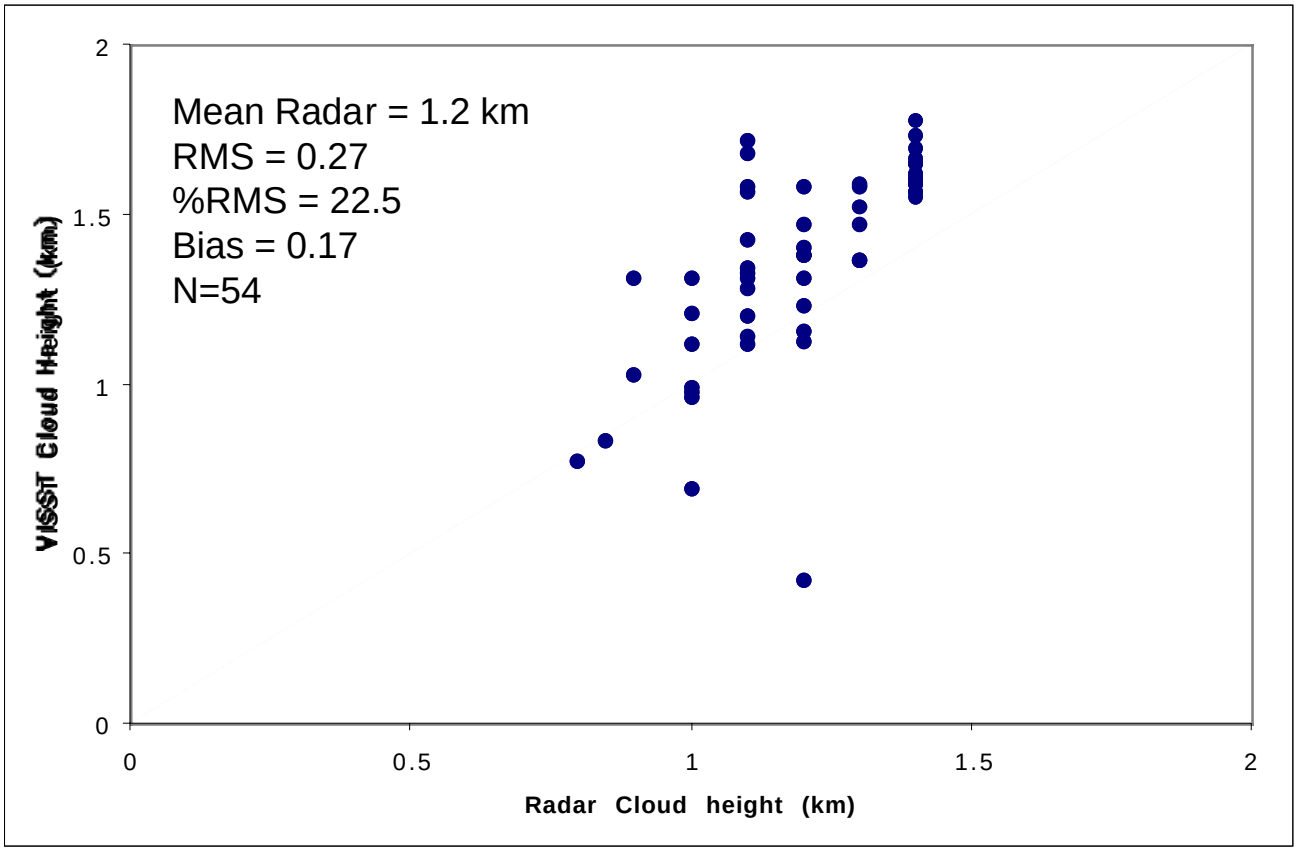


Fall 2001

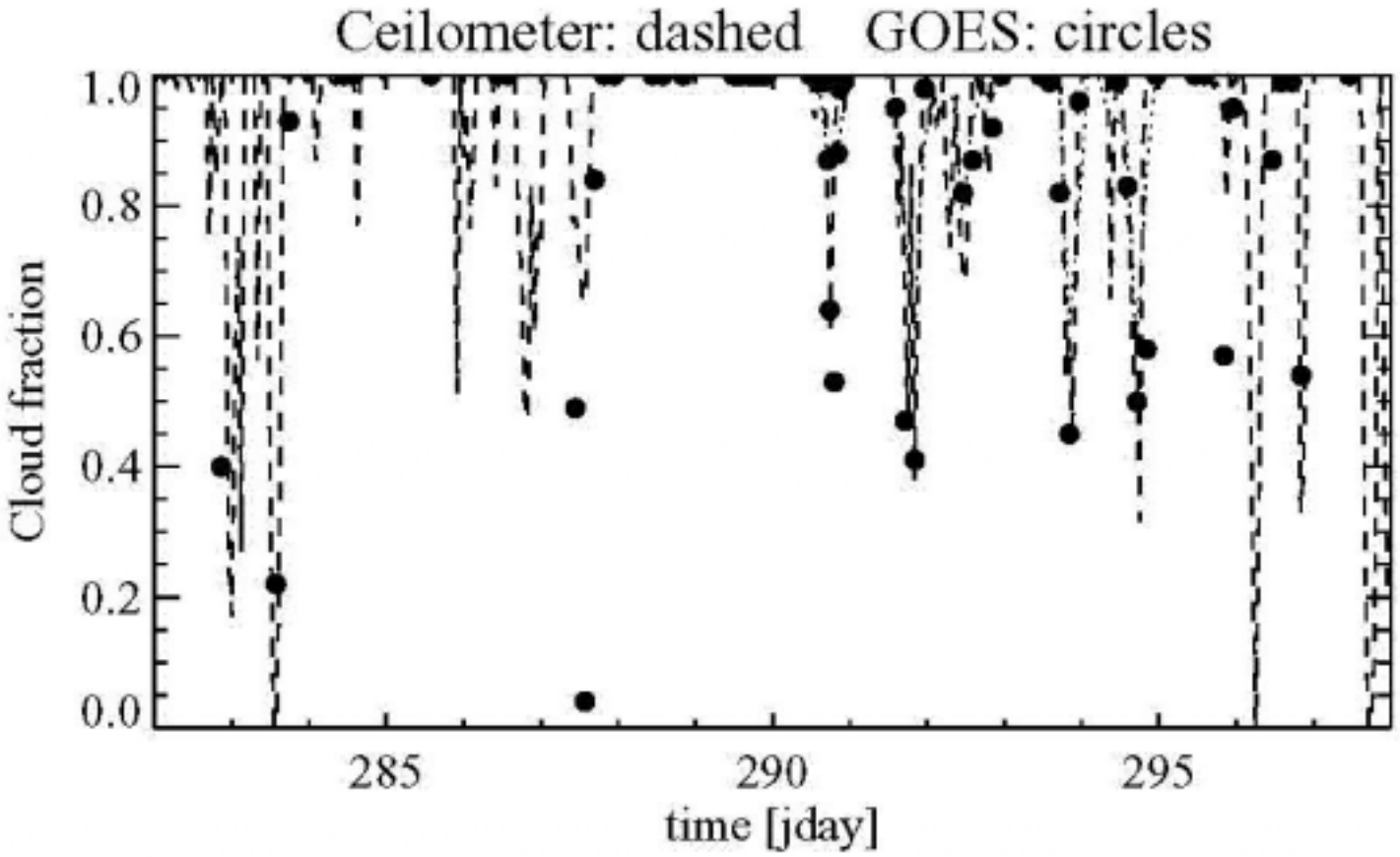
Cloud Radar Images from Days 289 and 290



Cloud Height Comparison



Cloud Fraction Timeline

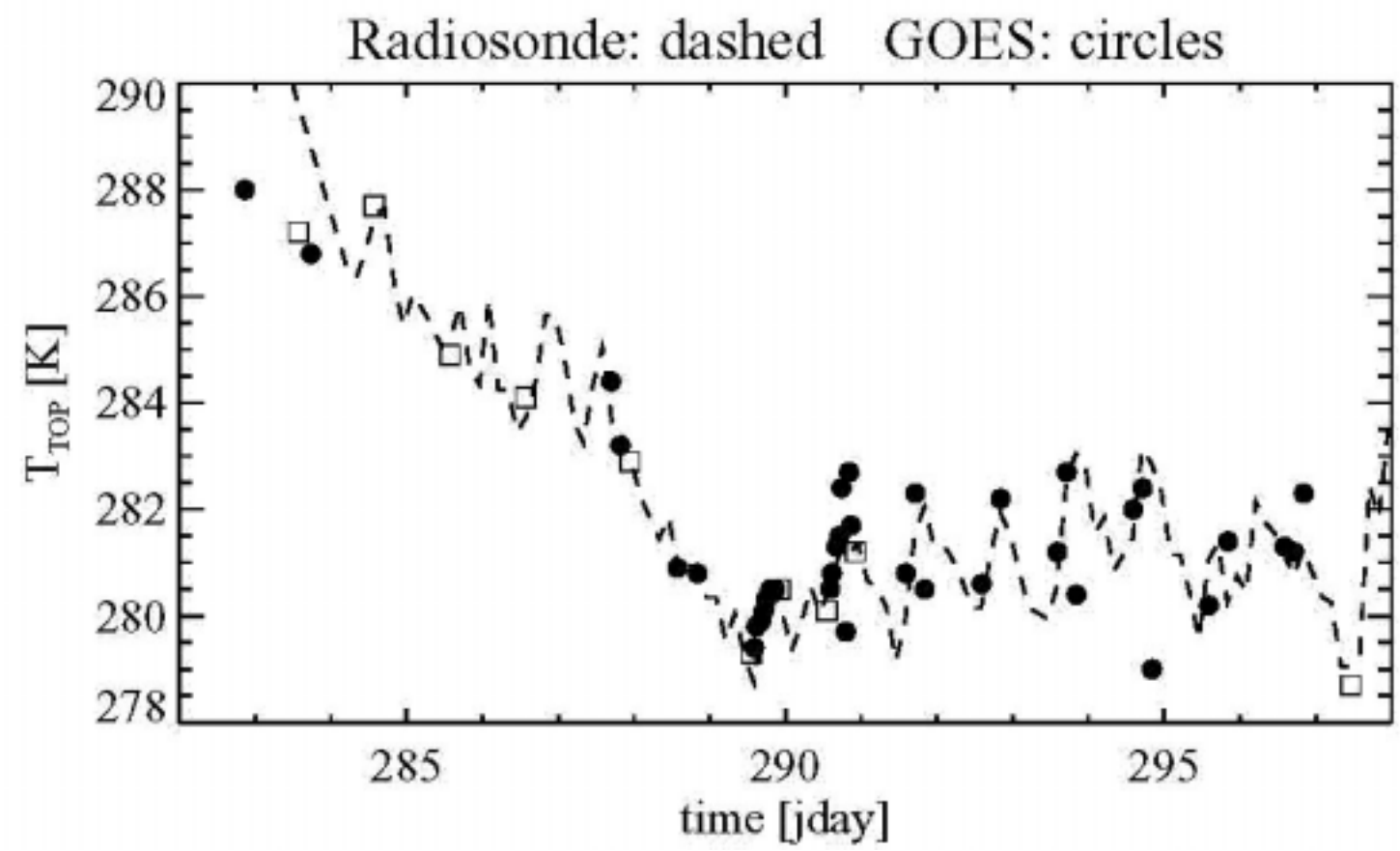


Cloud Fraction Comparison

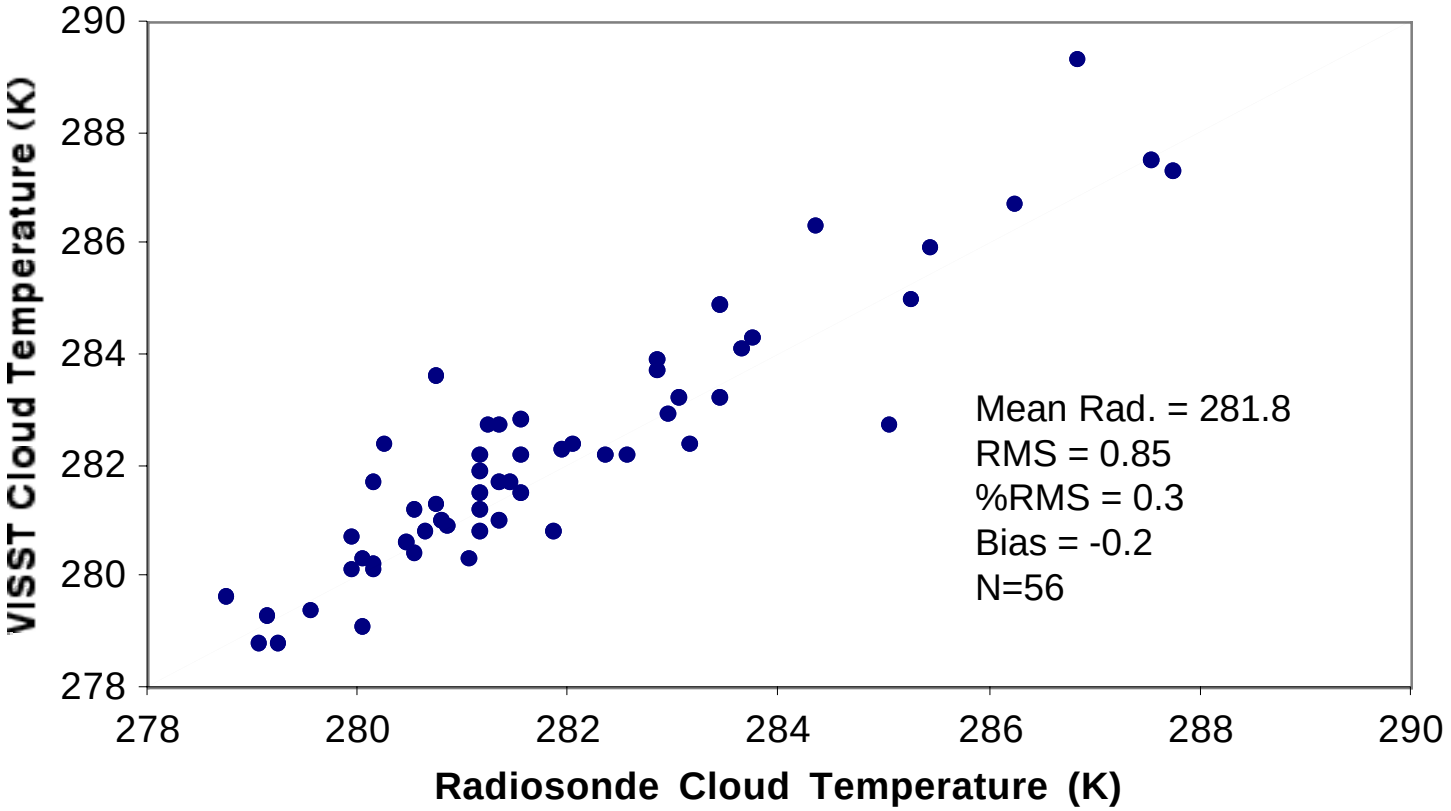
	VISST				
Ceilometer	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**
0-20	1	0	0	0	0
20-40	0	0	0	0	0
40-60	0	2	2	0	0
60-80	0	0	2	2	2
80-100	0	0	3	3	60

Cmean = 92.6%, Vmean = 84.3%, StDev =12%

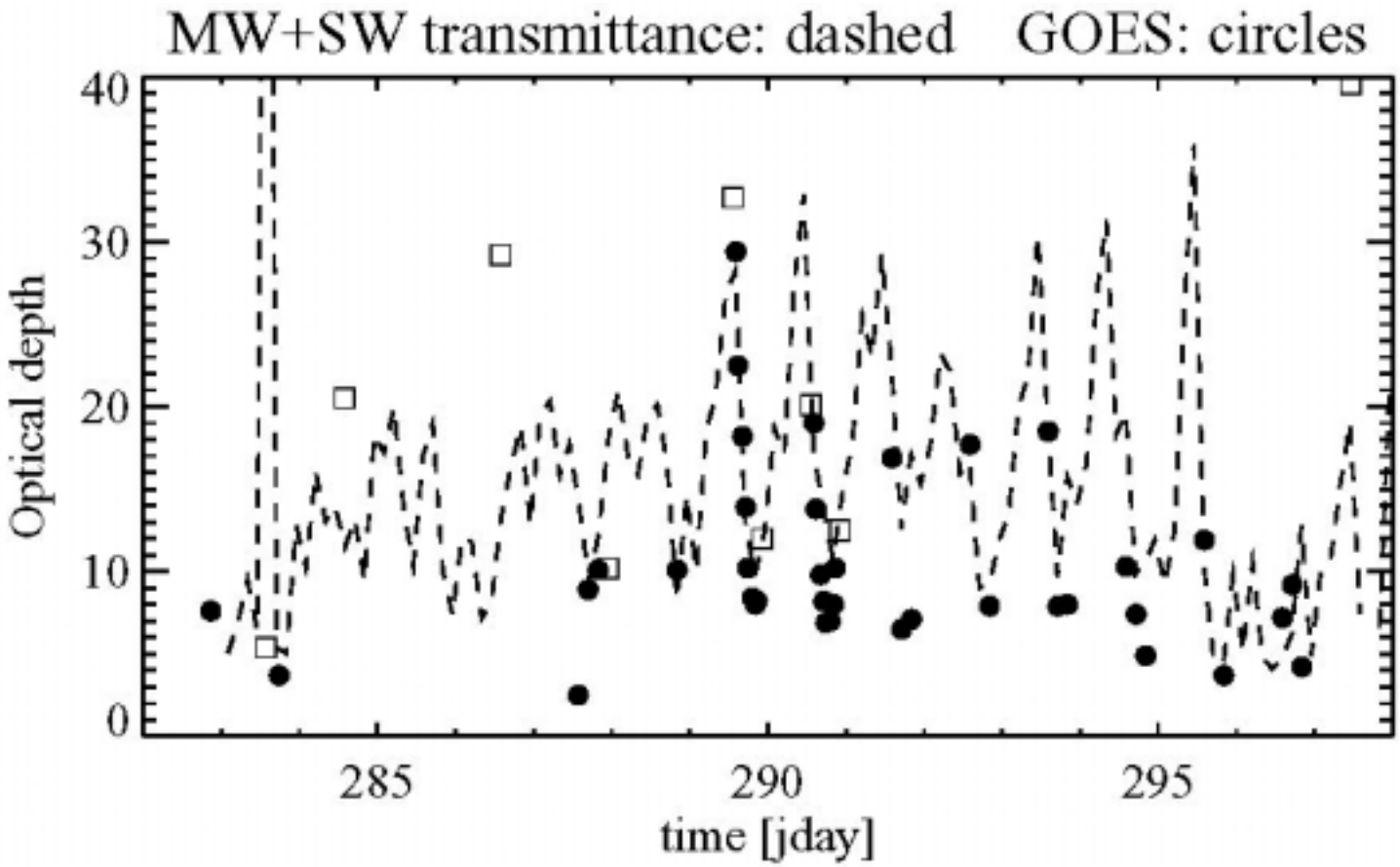
Cloud Temperature Timeline



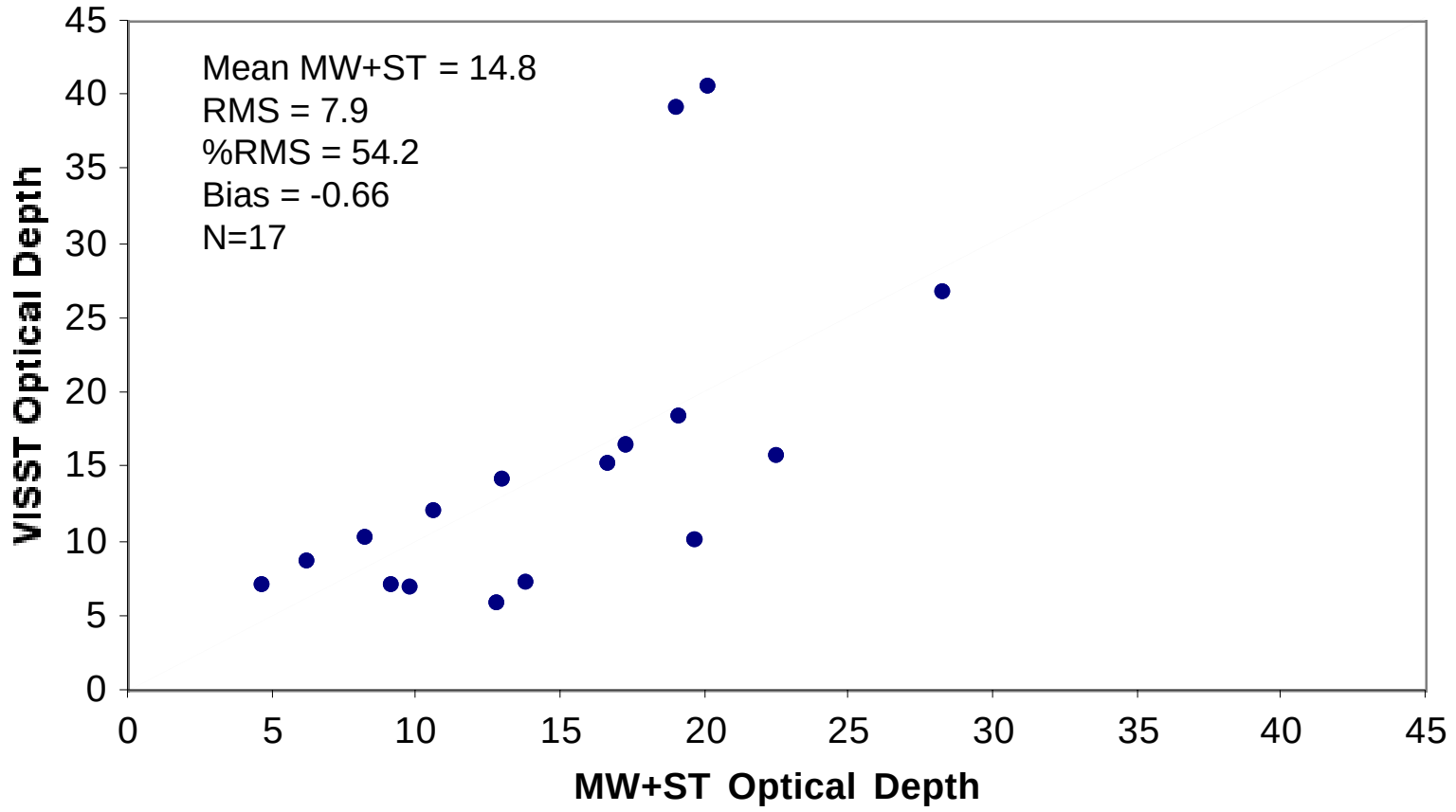
Cloud Temperature Comparison



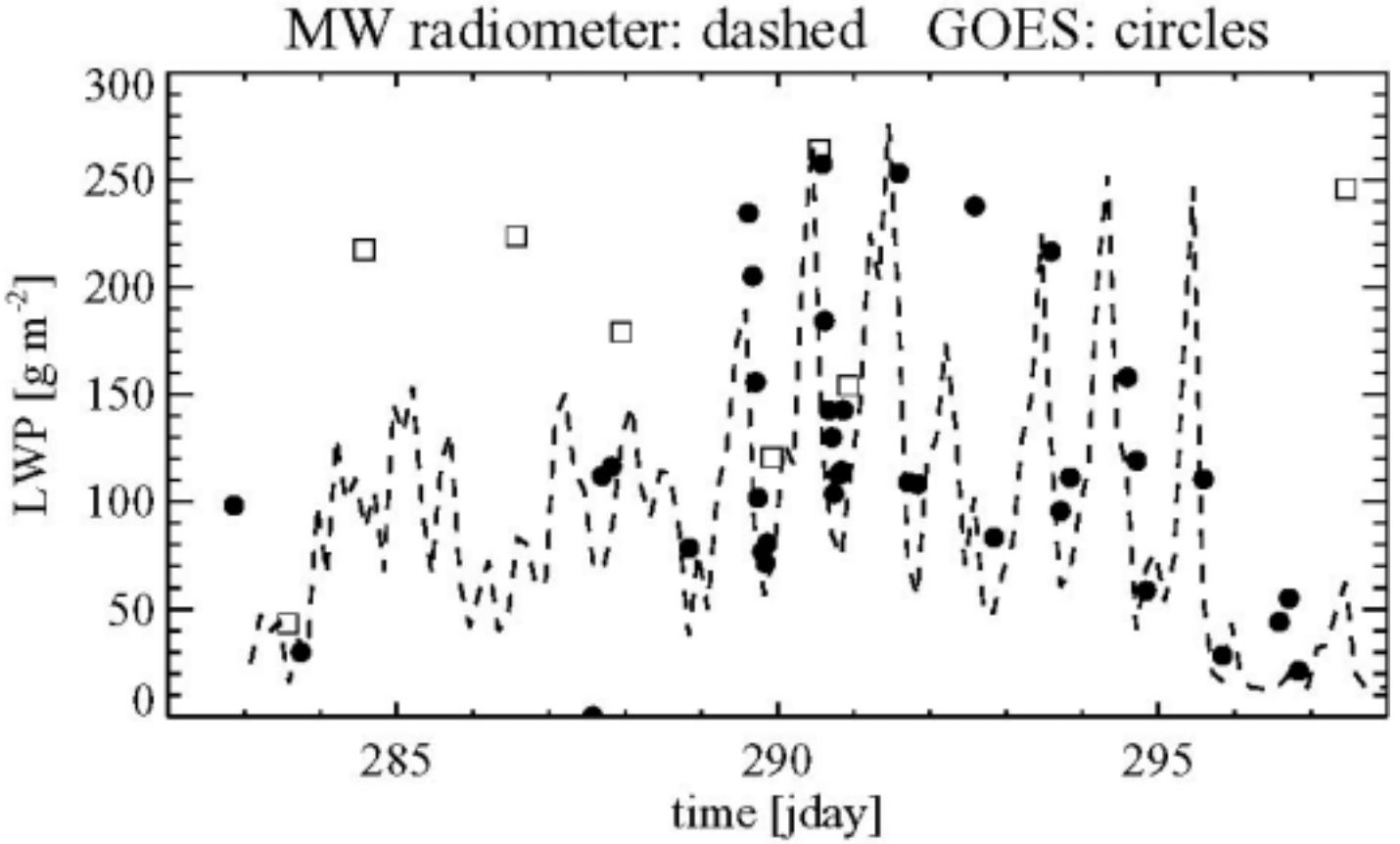
Optical Depth Timeline



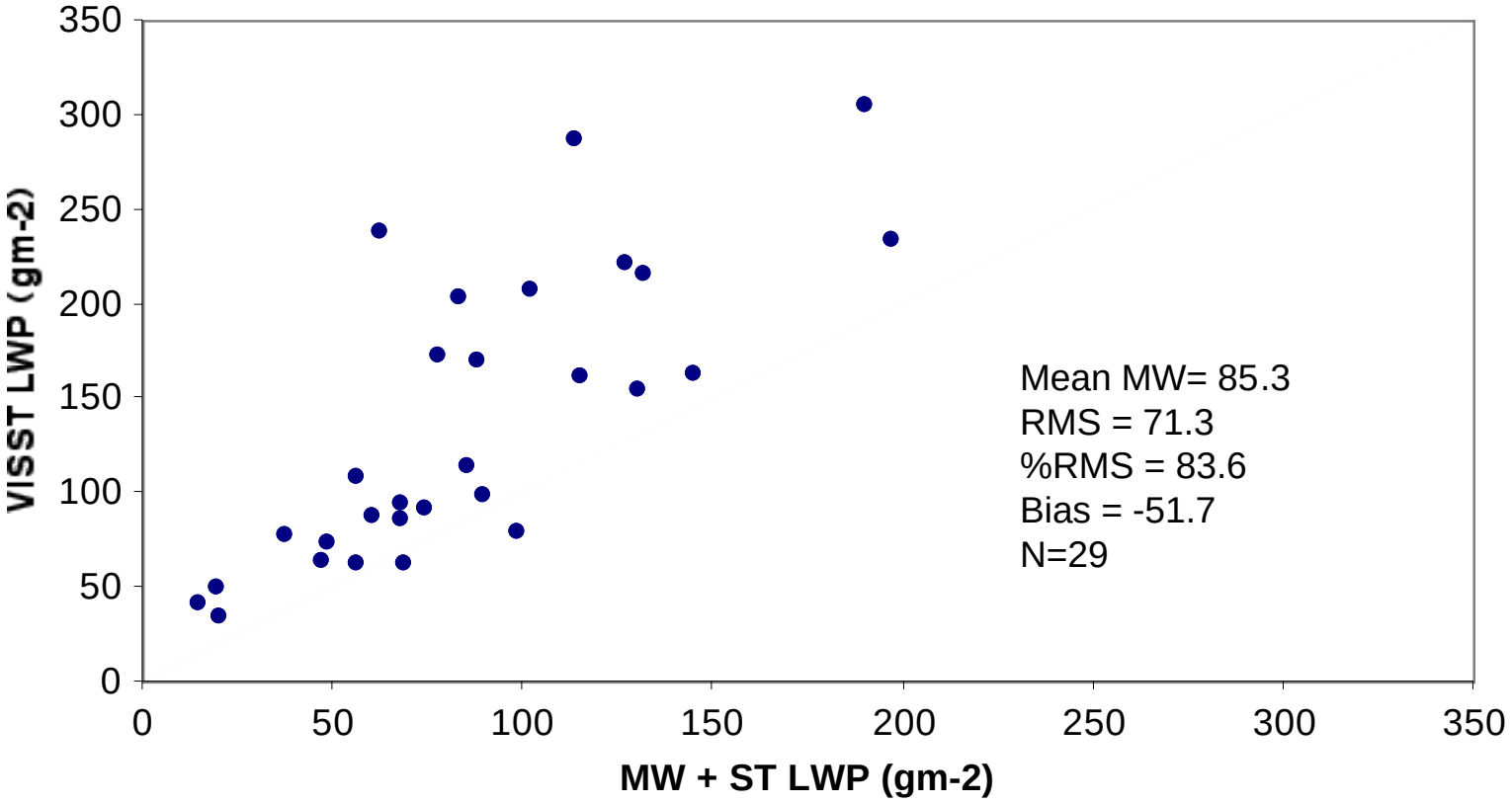
Optical Depth Comparison



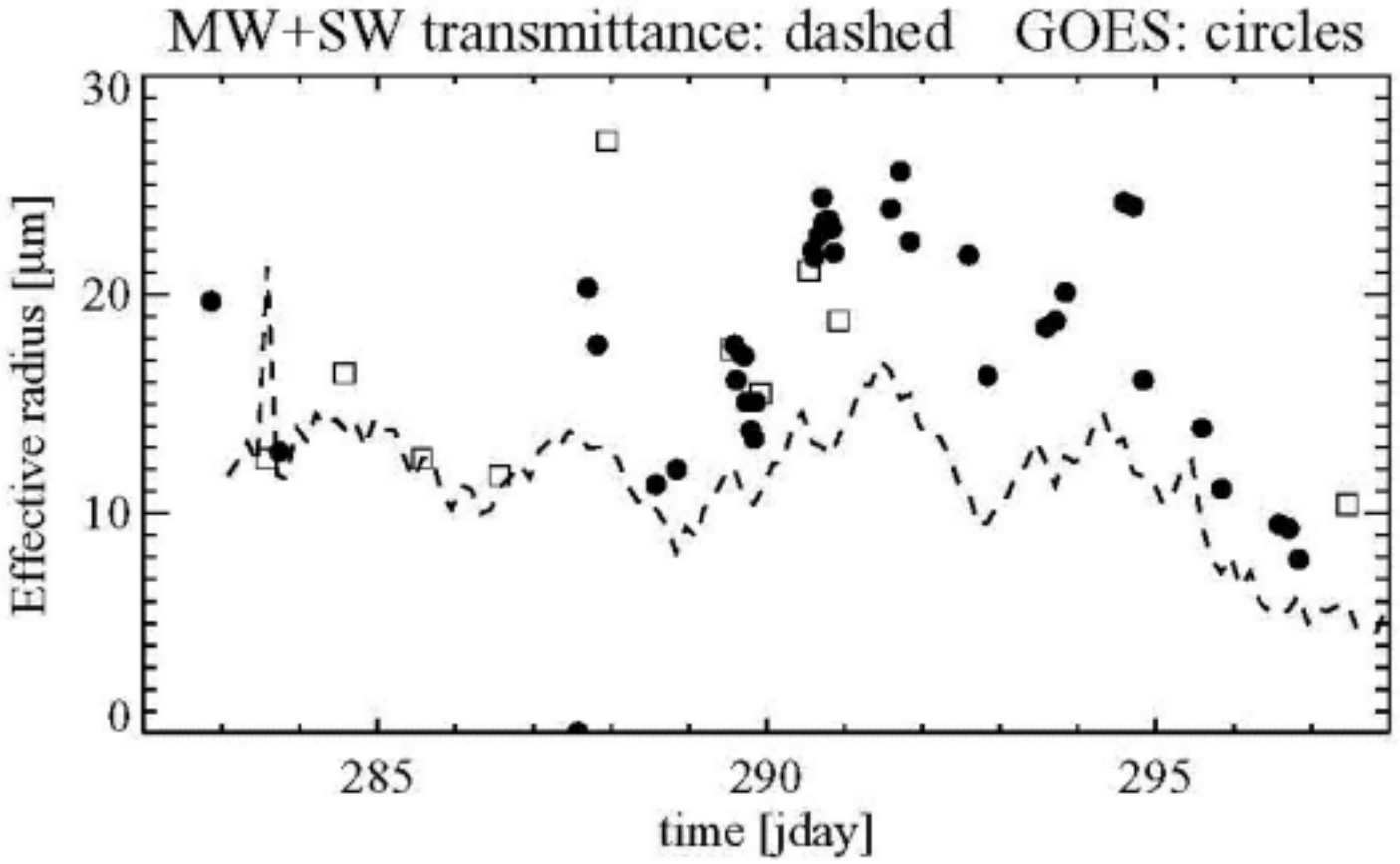
LWP Timeline



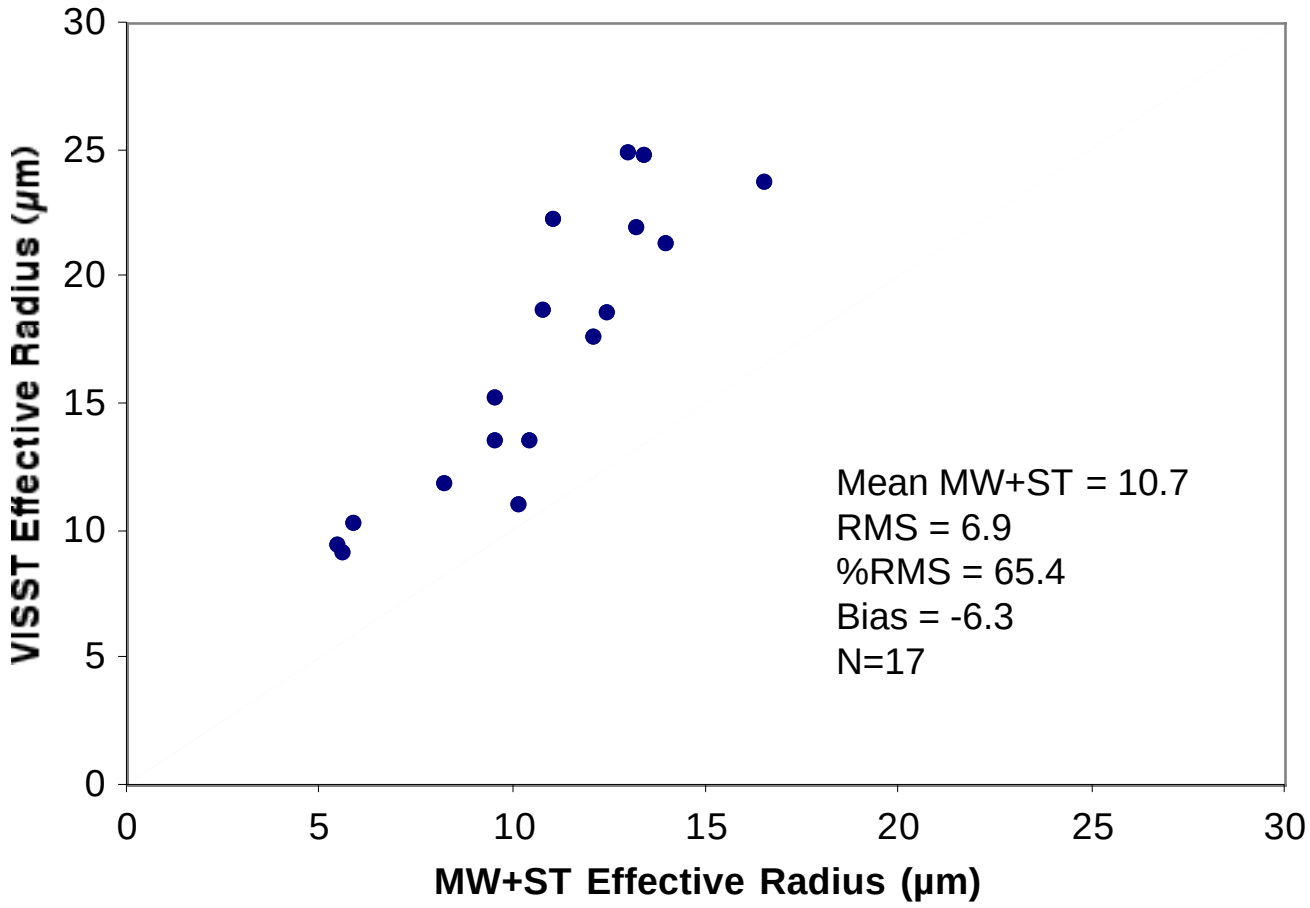
Liquid Water Path Comparison



Effective Radius Timeline



Effective Droplet Radius Comparison



Conclusions

- Cloud amounts in good agreement, need to explore cases of poor agreement
- Cloud heights are as good as we can expect, some issues with overlap
- Diurnal cycles for all parameters show good agreement
- Magnitude of re differences in question

Future Work

- Explore cases of bad agreement for cloud amount
- Compare nocturnal cloud amount and heights
- Examine re differences more closely
- Evaluate microwave LWP using different techniques and compare with SSMI and TMI (on TRMM)
- Compare TOA albedos from VISST and surface with CERES instrument on TERRA
- Compute average lapse rate for each cruise to determine if a change in cloud height determination method is needed
- Continue producing products for the domain, implement improvements from comparisons

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