Comparison of cloud properties retrieved from MODIS, VIRS, and surface data at the ARM SGP site

X. Dong, University of North Dakota
P. Minnis, S. Sun-Mack, NASA LARC

Objectives

(1) Compare MODIS/VIRS results with surface data
(2) Compare LaRC and GSFC MODIS results with surface data

Significant contribution by Jay Mace and Yuying Zhang, University of Utah
Data Source

Time period: From Nov. 2000 to June 2001

Samples:

<table>
<thead>
<tr>
<th></th>
<th>Daytime</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>LaRC MODIS/Surface</td>
<td>69</td>
<td>66</td>
</tr>
<tr>
<td>LaRC VIRS</td>
<td>29</td>
<td>38</td>
</tr>
<tr>
<td>GSFC MODIS</td>
<td>12 stratus 9 cirrus,</td>
<td>No</td>
</tr>
</tbody>
</table>

Average: One hour for surface
30 km X 30 km for MODIS/VIRS

Location: DOE ARM SGP Site
Time Difference between VIRS and MODIS/Surface

(1) Surface cloud base and top heights, and microphysics are averaged over MODIS overpass SGP Site

(2) VIRS results are averaged near the MODIS overpass SGP site, may have 1~5 hours difference
What results do we expect to get from the cloud height comparison?
MODIS/VIRS daytime optically thin clouds at the ARM SGP Site ($\tau < 5$)
MODIS/VIRS daytime optically thick clouds at the ARM SGP Site ($\tau > 5$)
MODIS/VIRS nighttime optically thin clouds at the ARM SGP Site (τ<5)

- Cloud Heights (km) vs. Sample Number
- Stc/VIRS Height (km) vs. MODIS Cloud height (km)
- Cloud Temperatures (°K) vs. Sample Number
- Stc/VIRS Cloud Temp (°K) vs. MODIS Cloud Temp (°K)
MODIS/VIRS nighttime optically thick clouds at the ARM SGP Site (τ > 5)
MODIS/VIRS night stratus clouds at the ARM SGP Site

Effective radius (μm)

Sample Number

Surface=9.4
MODIS=7.8
VIRS=7.8/9.6(S)/8.4(M)

Corr(SFC, MODIS)=0.26
Corr(SFC, VIRS)=-0.37
Corr(MODIS, VIRS)=-0.54

Optical depth

Sample Number

Surface=25.7
MODIS=14.3
VIRS=8.4/29.7(S)/14.8(M)

Corr(SFC, MODIS)=0.80
Corr(SFC, VIRS)=-0.11
Corr(MODIS, VIRS)=0.38

LWP (g m⁻²)

Sample Number

Surface=151.8
MODIS=86.2
VIRS=46/177(S)/92(M)

Corr(SFC, MODIS)=0.74
Corr(SFC, VIRS)=-0.07
Corr(MODIS, VIRS)=0.25

LWP (MODIS/VIRS)

LWP (Surface)
MODIS/CERES daytime stratus clouds at the ARM SGP Site

Effective radius (µm)

Sample Number

Surface=9.6
CERES=8.2
MODIS=8.4

Effective radius (MODIS/CERES)

r_e (Surface)

Corr(SFC,MODIS)=0.044
Corr(CERES,MODIS)=0.27

Optical depth

Sample Number

Surface=34.8
CERES=35.2
MODIS=32.9

Optical depth (MODIS/CERES)

τ (Surface)

Corr(SFC,MODIS)=0.88
Corr(CERES,MODIS)=0.93

LWP (g m⁻²)

Sample Number

Surface=194
CERES=184
MODIS=199

LWP (MODIS/CERES)

LWP (Surface)

Corr(SFC,MODIS)=0.80
Corr(CERES,MODIS)=0.92
Compare LaRC and GSFC MODIS results with surface data.
Conclusions

1. LaRC MODIS Cloud effective height:
   Daytime: Reasonable with surface
   Nighttime: Much higher than surface

2. LaRC MODIS stratus cloud: Agree well with surface retrievals (daytime) with high correlations; smaller than surface retrievals (night) with low correlations

3. LaRC MODIS cirrus cloud: effective radius agree with surface, but optical depth and IWP are much larger than surface. High (day) and low (night) correlations.
Conclusion (cont)

4. LaRC VIRS Effective Height: Agree well with surface for day and overestimated for night, agree with MODIS for daytime lower than MODIS for night

5. LaRC VIRS stratus clouds: 50% (day) agree with or lower (night) than surface with low correlations. LaRC VIRS cirrus cloud: $r_e$ smaller, $\tau$ and IWP larger than surface with high correlations

6. GSFC MODIS stratus agree well with LaRC MODIS and surface results, and more work for cirrus clouds.
Thanks for your attention!