

Summary of Comparisons Between SNPP VIIRS and Calipso/PATMOS-X Cloud Properties and Progress in Addressing the Discrepancies

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NOAA STAR JPSS 2014 Annual Science
Team Meeting, May 12-16, 2014
NCWCP, College Park, MD

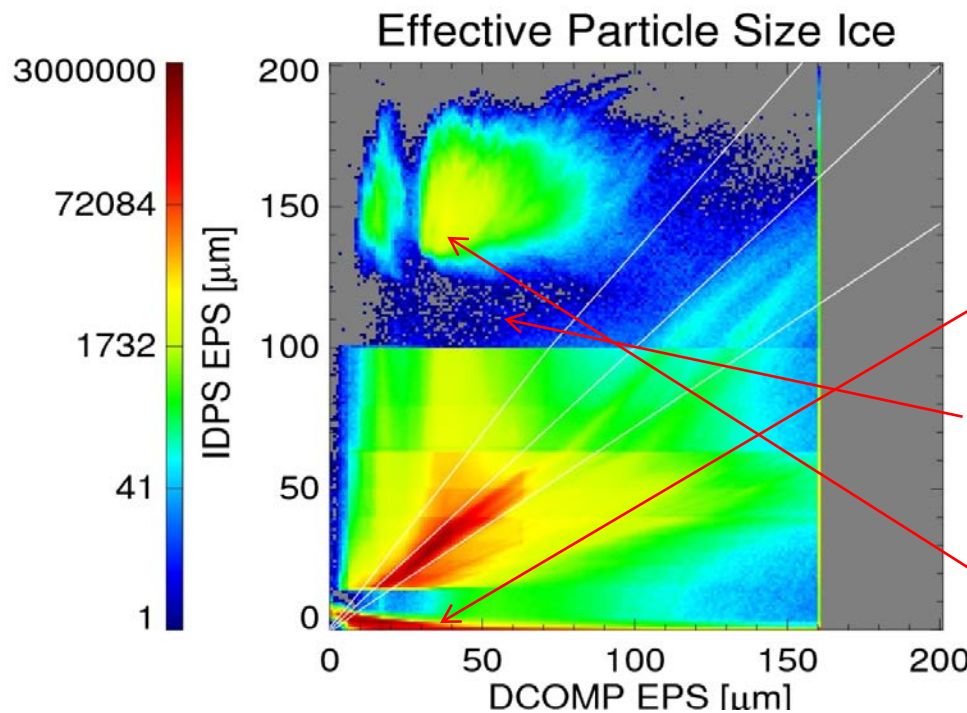
Eric Wong

- Description of the 2 major issues affecting performance of IDPS Cloud Properties Products
- Work completed in addressing the day COT/EPS retrieval discrepancies issue
- Progress in addressing the ice cloud low bias issue
- Concluding Remarks

Provisional Effective Particle Size Ice Phase – Discrepancy Issue Identified Below

Requirements:

- Precision & Accuracy: 28% for Ice (or 1 μm whichever larger)



58.6% of pixels meets the specs.
(similar to Beta Analysis)

Distinctive disagreement features in
scatterplot density plot:

(belong to un-converged pixels)

- Pattern of very low EPS values

- Density gap between 5 μm and 15 μm

- High EPS values where DCOMP has
values between 40 and 80 μm .

(belong to un-converged pixels)

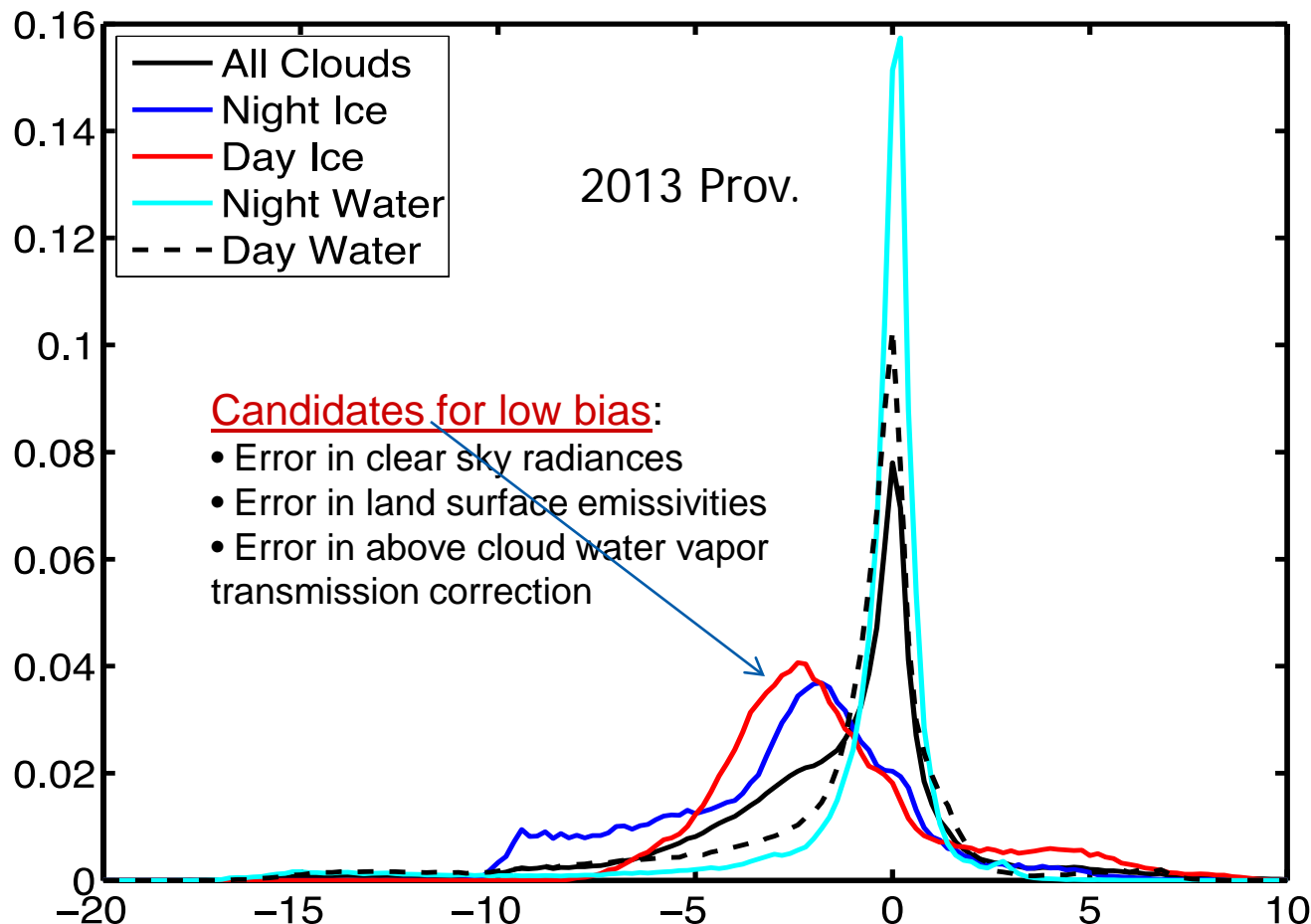
- Issue remains: the wide scatter in comparison

- Hints: scatter points mainly land pixels; un-converged data mostly are land pixels

- Leading candidate for discrepancies – differences in land surface albedos used

Global CALIPSO/CALIOP Cloud Top Height Evaluation of the VIIRS IP CTH – Low Bias Issue Identified

Results at Provisional Presentation (before low cloud inversion logic)



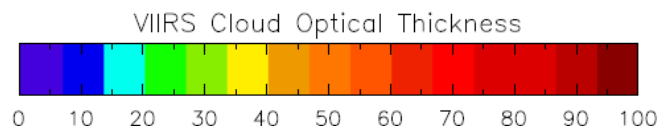
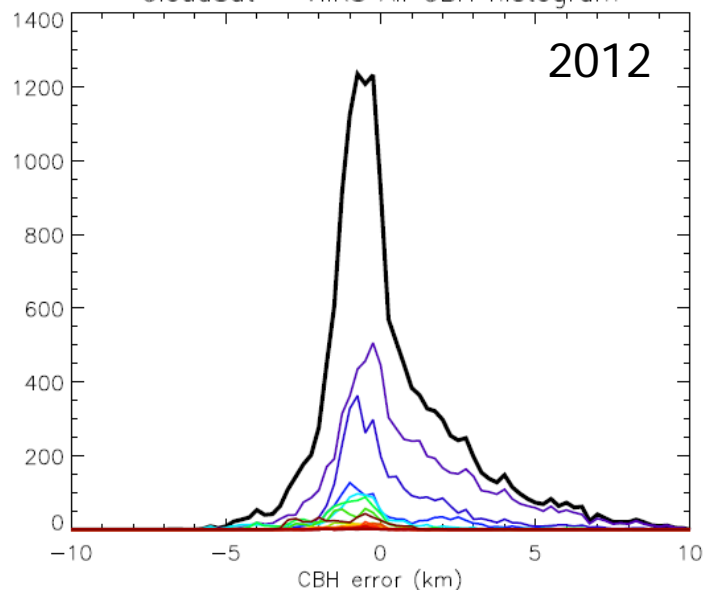
- 4 months of collocated CALIOP (lidar) comparisons with the VIIRS IP CTH product
- 20 minute maximum time separation
- Poles (>60deg lat) excluded.
- **Results show positive bias for water clouds has been largely removed.**
- **High cloud bias remains.**

CBH Statistics When CTH Is “within spec”

Average error: 0.5 km
Standard deviation of error: 2.2 km
Median error value: -0.1 km
RMSE: 2.3 km
Percentage of pixels with CBH within 250 m of CloudSat: 14.6%

r^2 value: 0.551
N: 14689

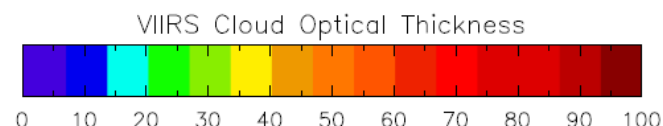
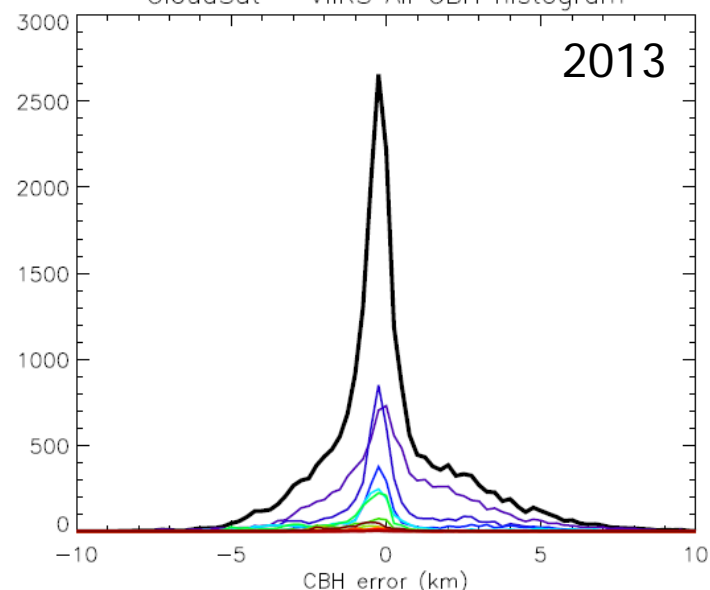
CloudSat - VIIRS All CBH histogram



Average error: 0.2 km
Standard deviation of error: 2.1 km
Median error value: -0.1 km
RMSE: 2.1 km
Percentage of pixels with CBH within 250 m of CloudSat: 22.9%

r^2 value: 0.595
N: 21307

CloudSat - VIIRS All CBH histogram



VIIRS CBH biased high relative to CloudSat

Candidates for improvement:

- Improvement in CTH from upstream CTH will improve CBH performance
- A DR submitted to investigate performance due to LWC of different cloud types

Assessment Of The Impact Of Land Surface Albedo On COT/EPS Performance

Diagnosis:

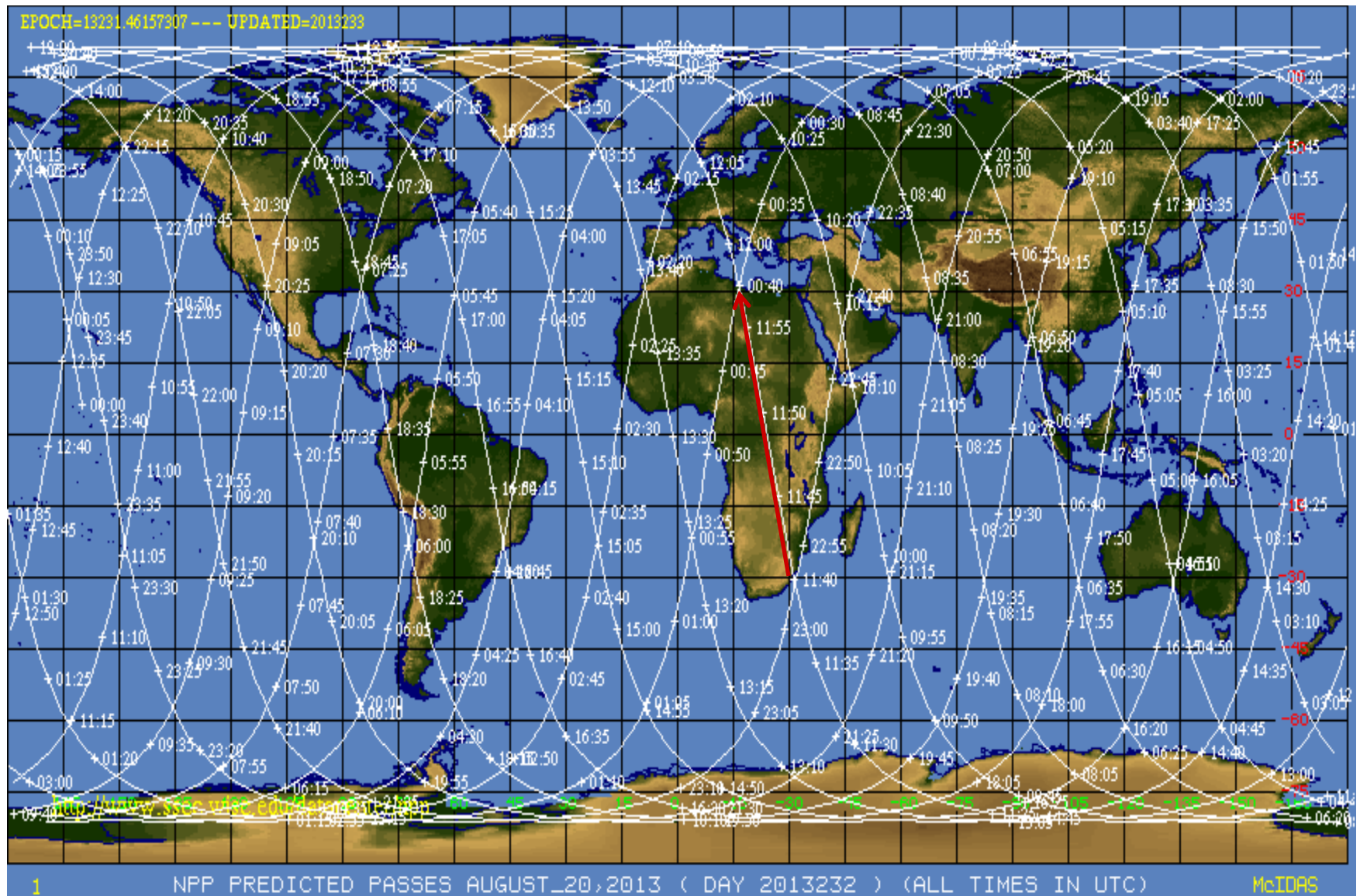
- Current NPP COP algorithms use a static database for land surface albedos
- There are only 3 land surface type in database: desert, land and forest - one single value is used to represent each land type
- Land surface albedos are highly non-uniform

Expected outcome

- Constant land surface albedo introduces large error in COT/EPS for thin and semi-transparent clouds

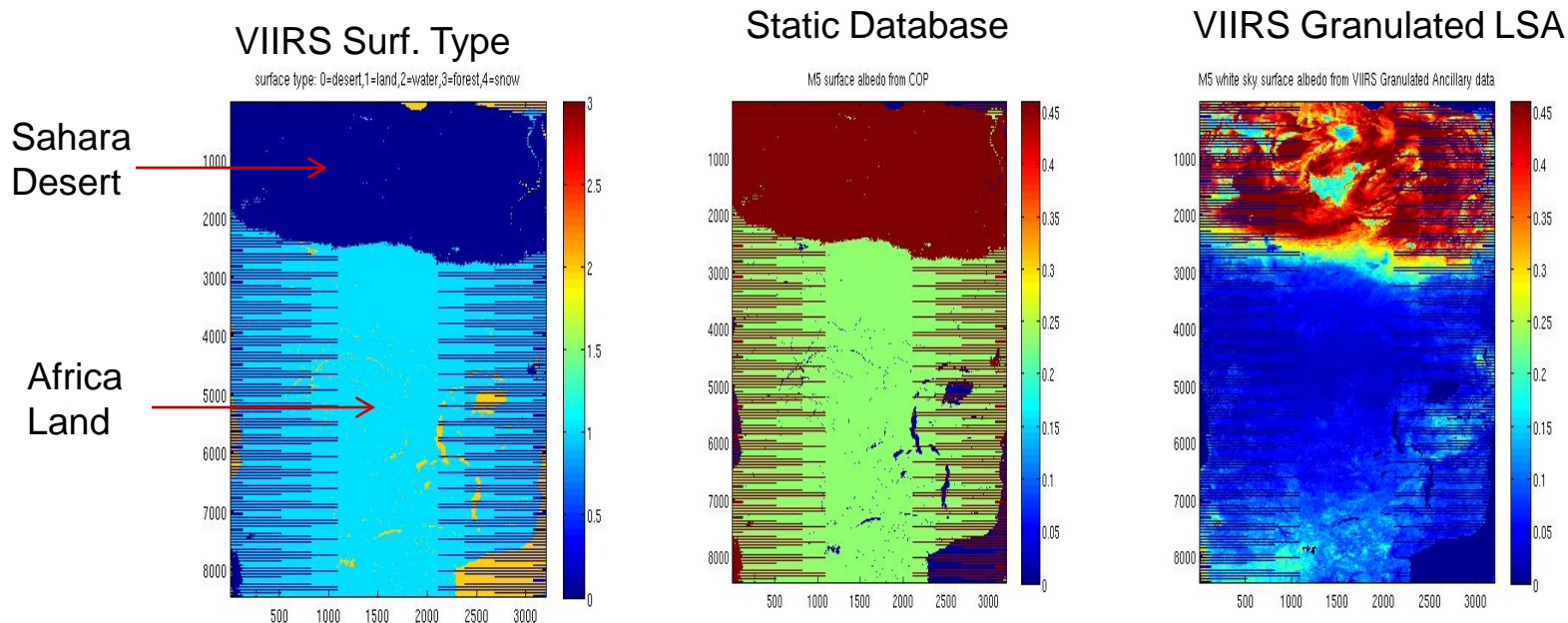
Method for assessing the land surface albedo effects on COT/EPS Retrievals

- IDPS VIIRS Operational System generates Granulated Land Surface Albedo based on years of MCD43C1 white sky land surface albedo product (years of data since 2002)
- Replace Static Database with input of VIIRS Granulated Land Surface Albedo files
- Assess improvement by comparing with CLAVRX-PATMOS COT/EPS

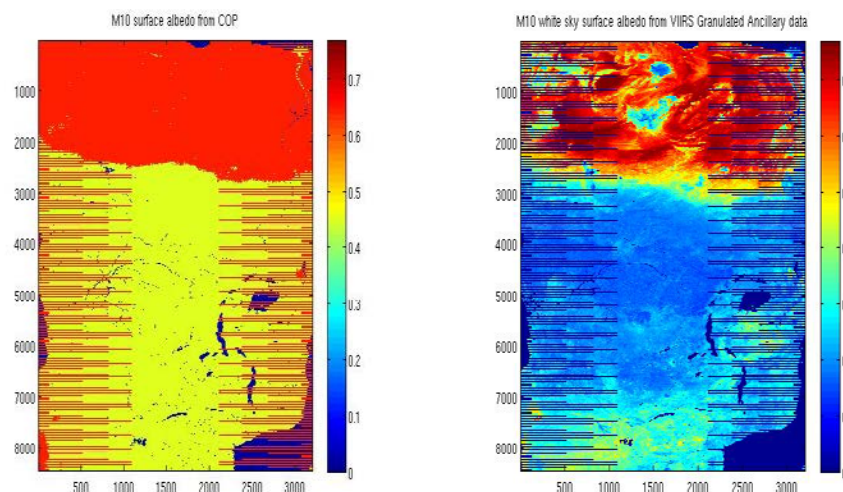


Region selected for testing and assessing effect of
land surface albedo on COT/EPS performance

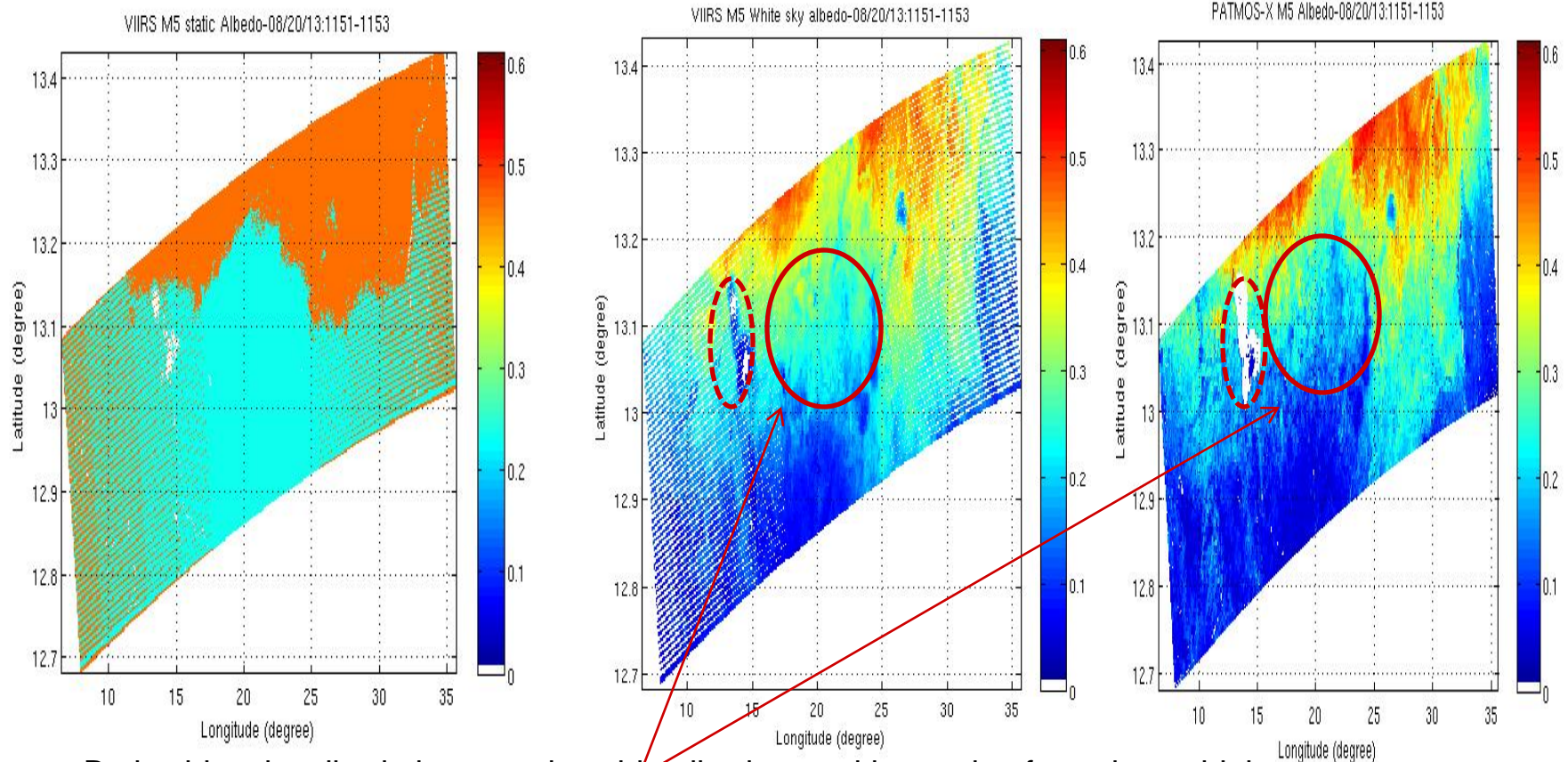
Comparison of Land Surface Albedo Between COP Static Database and VIIRS Granulated Products – Scene Of Africa 08/20/13, 11:41-11:57



- Significant differences between static database and white sky albedo values
- Albedo values are highly non-uniform under the same land type
- Albedo value differences within the land type exceed 50%
- Albedo value differences within the desert type can also vary greatly

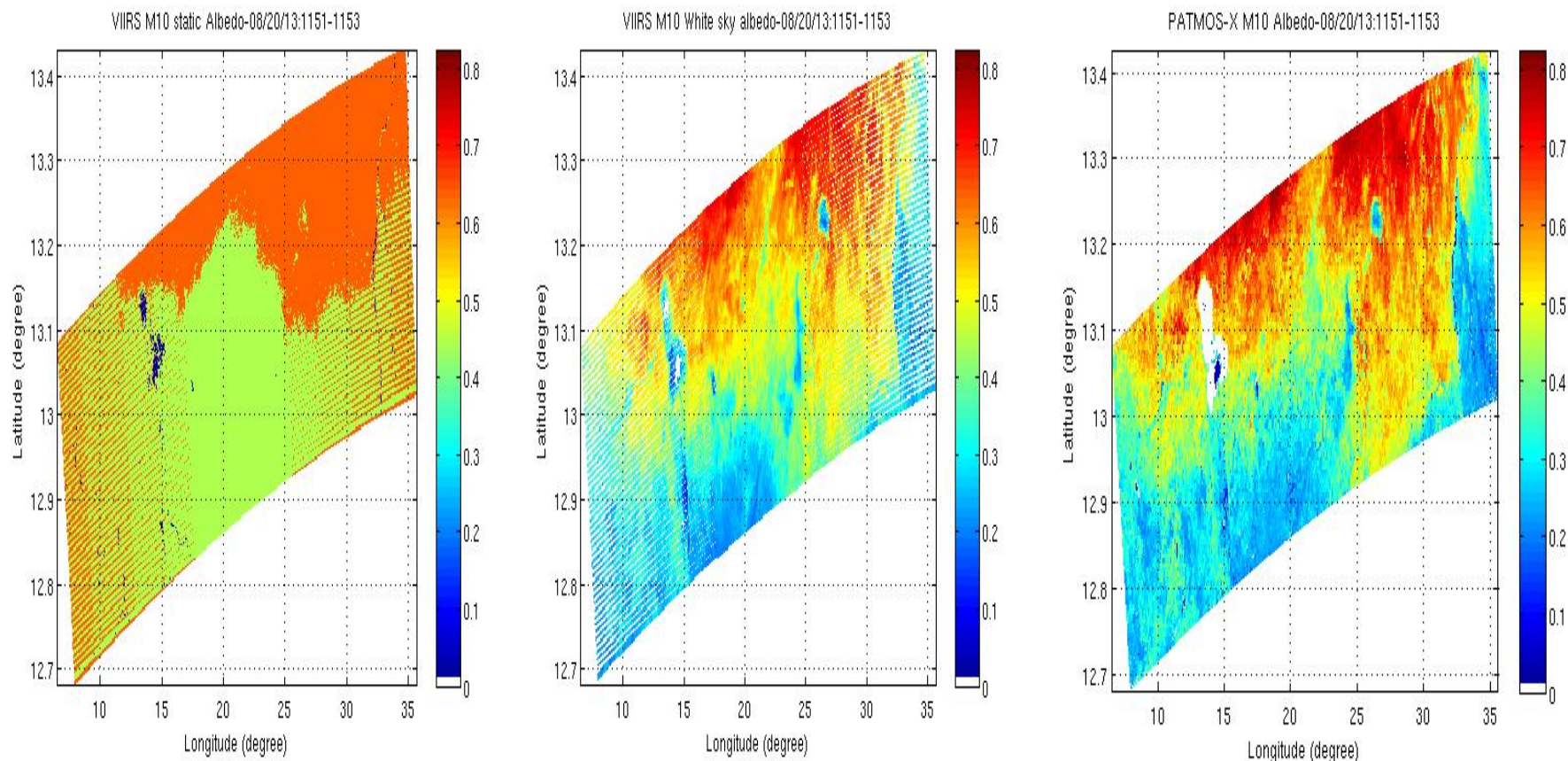


Comparison of M5 Surface Albedo Between VIIRS Granulated White sky Albedo And PATMOS-X Based On MODIS Moody Dataset



- Both white sky albedo images show big albedo transition region from desert high to land low values, while static database shows a jump
- While the 2 sources of white sky albedo look similar there are regions of significant difference
- Such differences will undoubtedly contribute to differences in COT/EPS retrievals

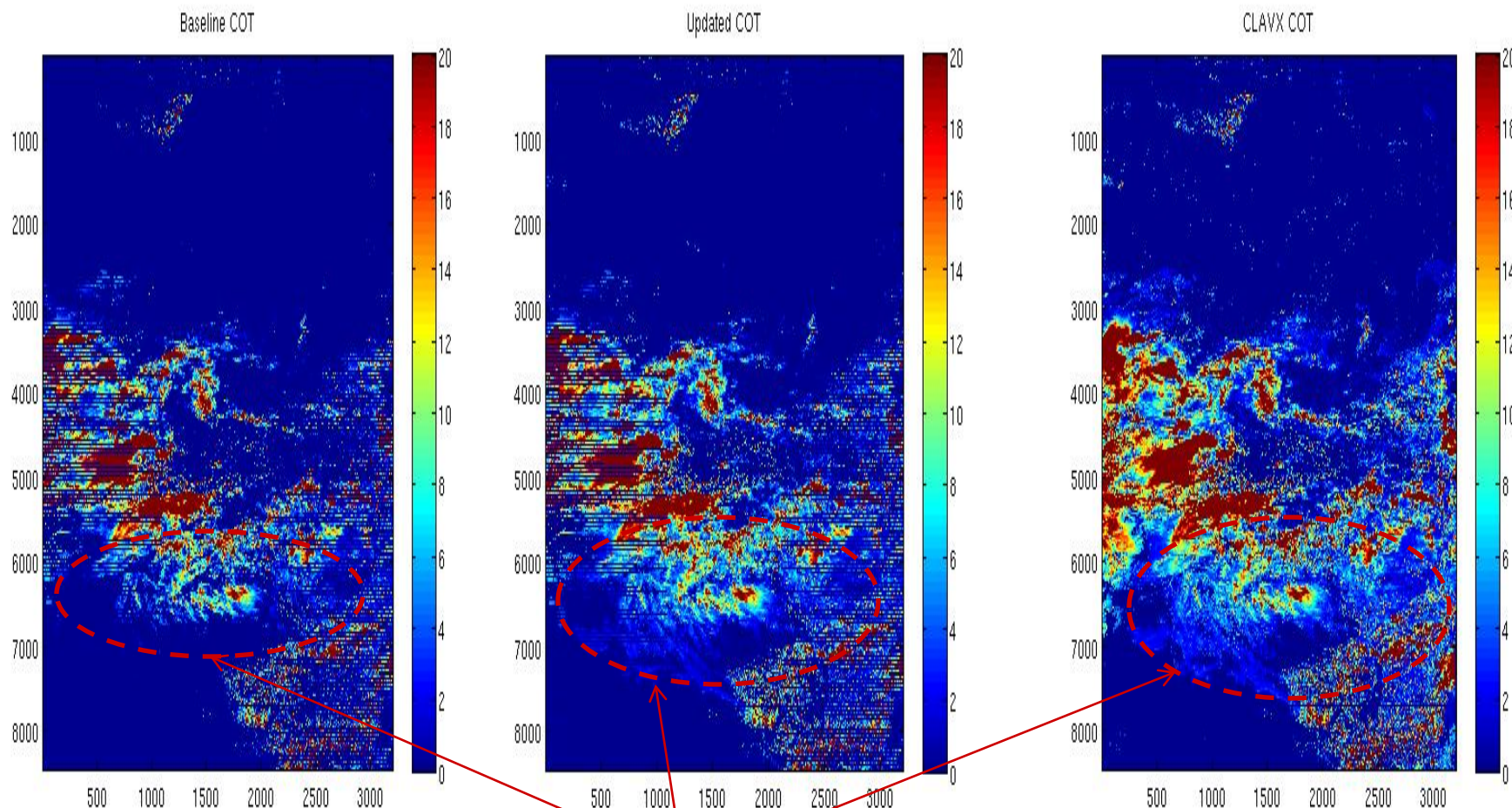
Comparison of M10 Surface Albedo Between VIIRS Granulated White sky Albedo And PATMOS-X Based On MODIS Moody Dataset



Similar behaviors as shown in the previous slide on M5 albedo comparison

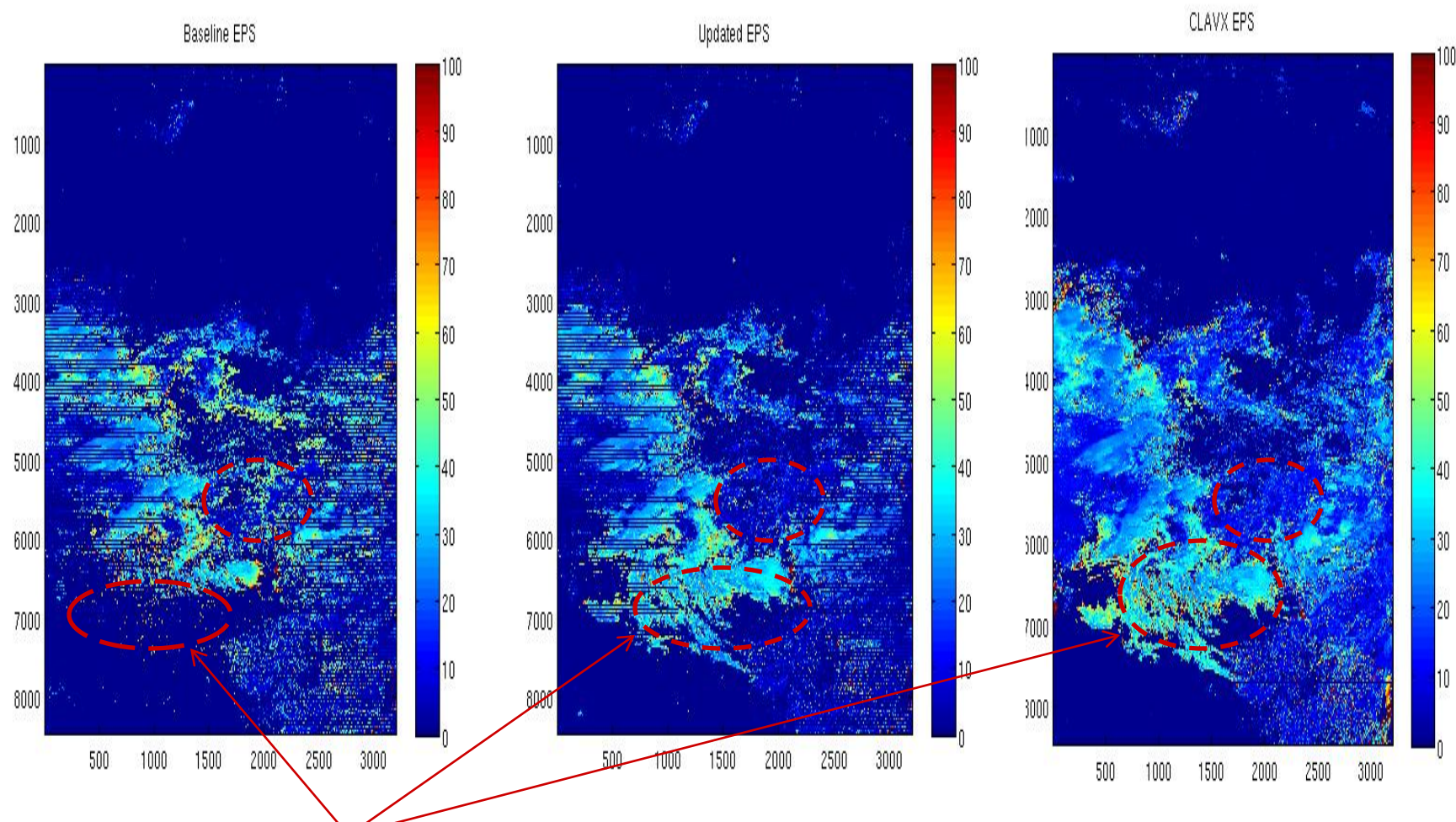
Comparison of Cloud Optical Thickness Between Baseline, Updated VIIRS COP And CLAVRX – Scene Of Africa

08/20/13, 11:41-11:57



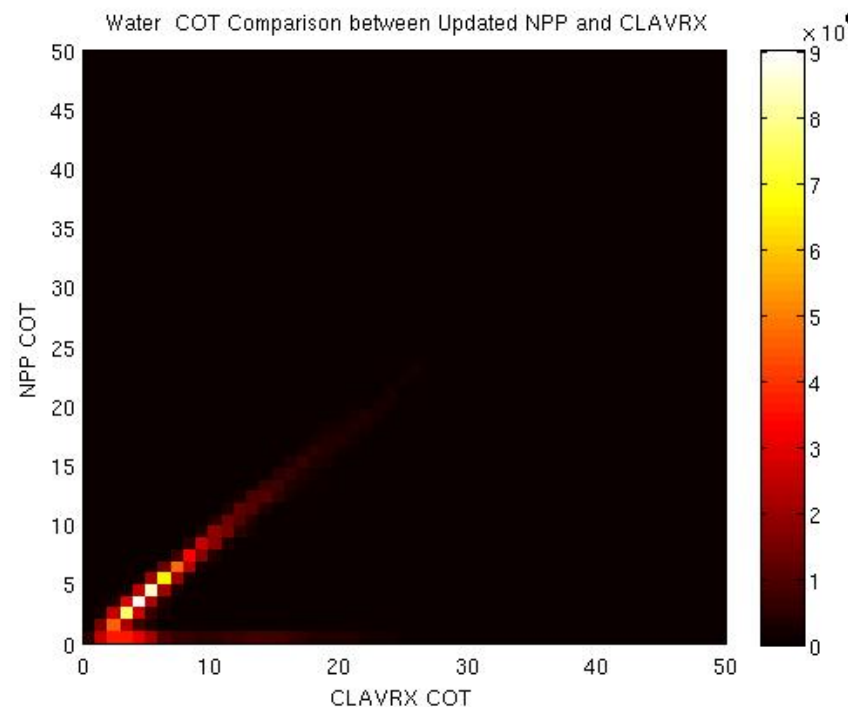
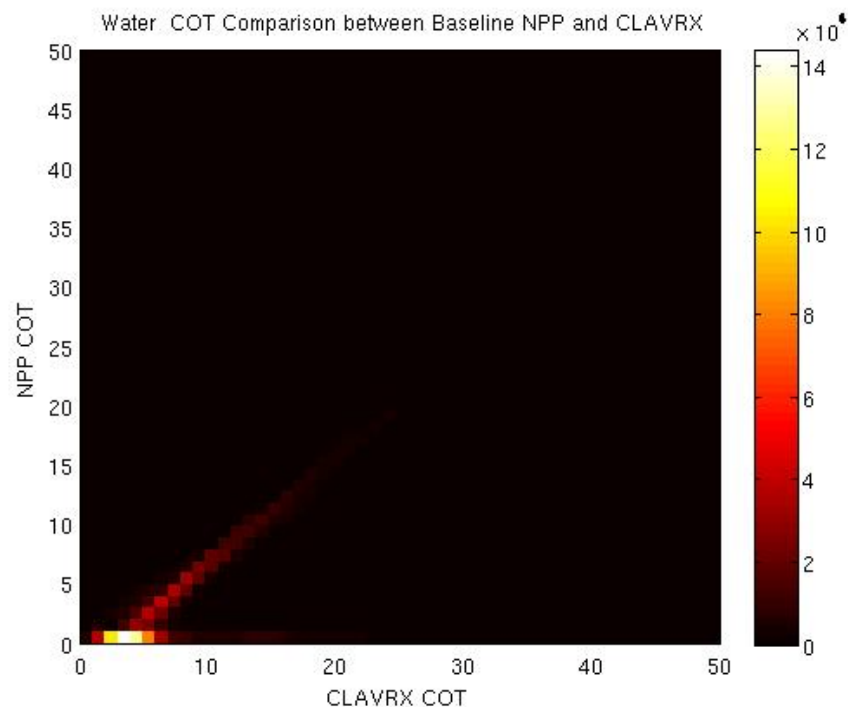
- Updated COT image looks much closer to that of PATMOS-X
- Updated COT has more converged retrievals than that of Baseline

Comparison of Cloud Effective Particle Size Between Baseline, Updated VIIRS COP and CLAVRX – Scene of Africa 08/20/13, 11:41-11:57



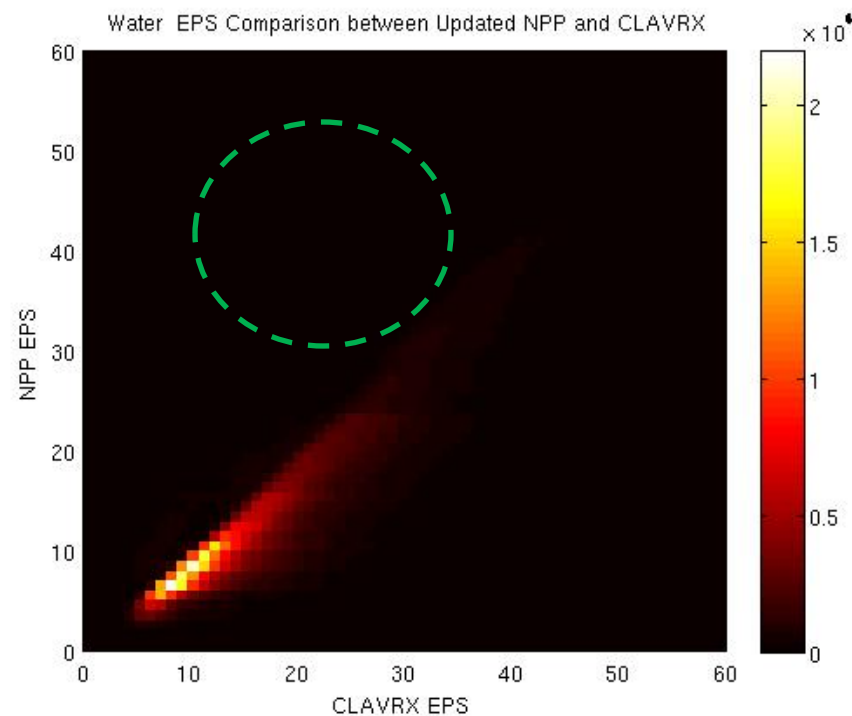
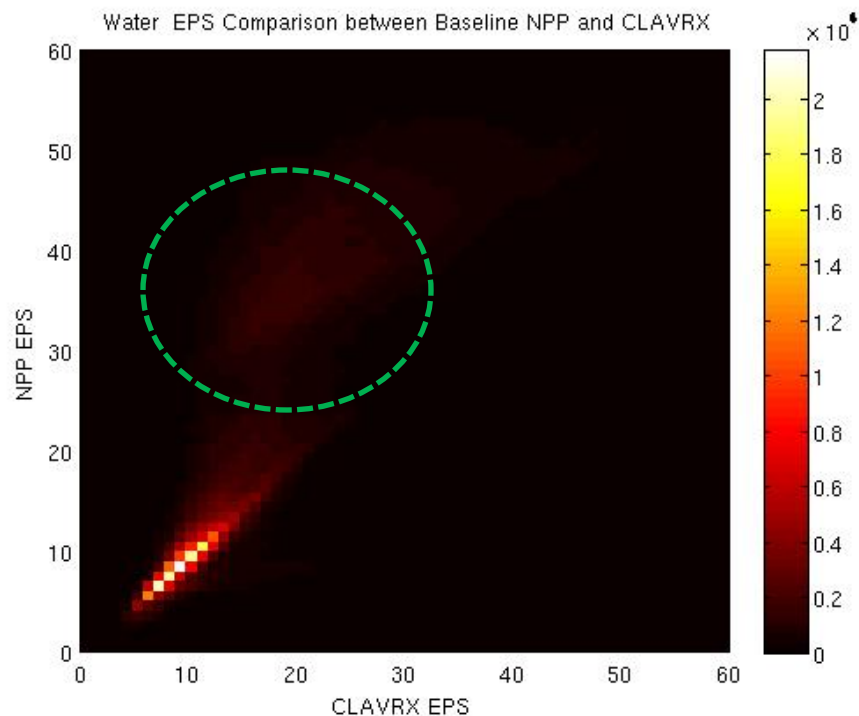
- Updated EPS shows noticeable improvement in these 2 regions
- Updated VIIRS EPS are smoother at cloud edge than in PATMOS-X

Statistics On The Comparison Of Water Cloud COT Between Baseline, Updated VIIRS COP and CLAVRX – Scene Of Africa 08/20/13, 11:41-11:57



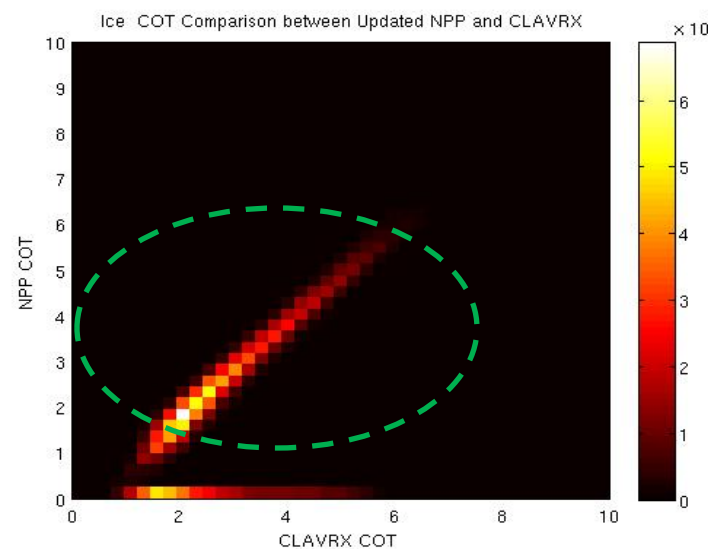
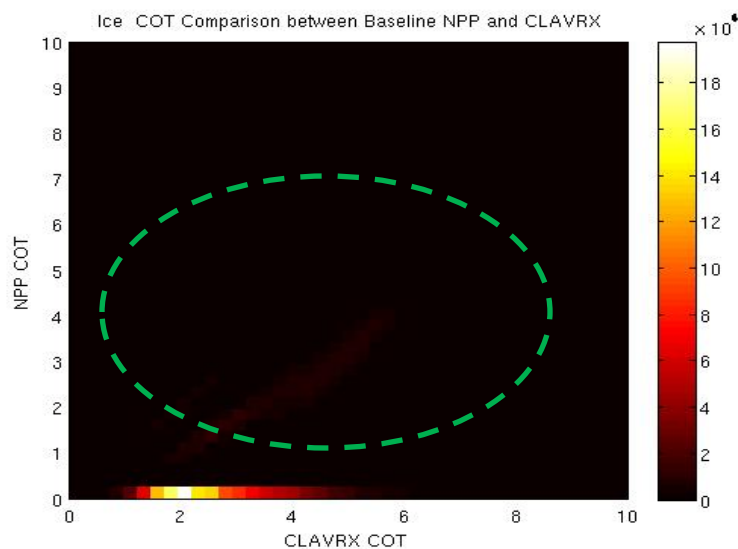
- Updated COT shows better performance than Baseline
- Updated COT has significantly less number of optically thin clouds predicted than in the Baseline
- Discrepancies between Updated and PATMOS-X are unavoidable due to differences in surface albedo values, particularly for optically thin clouds

Statistics On The Comparison of Water Cloud EPS Between Baseline, Updated VIIRS COP and CLAVRX – Scene of Africa 08/20/13, 11:41-11:57



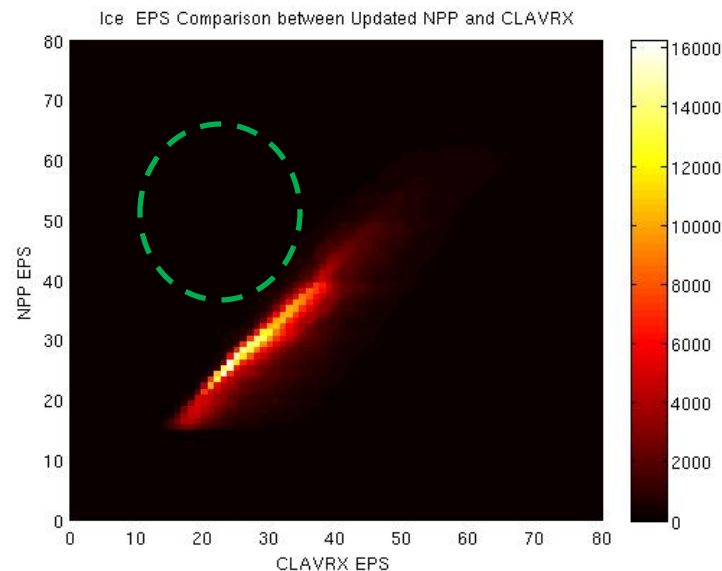
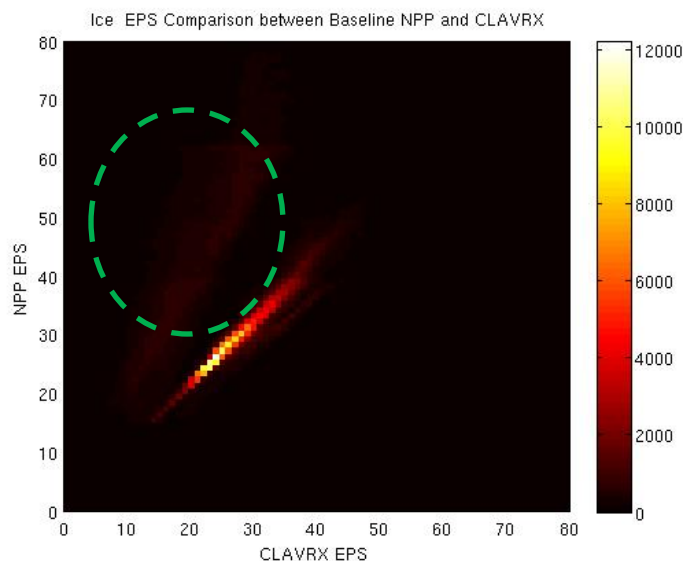
- Updated EPS shows better performance
- Large number of off diagonal pixels are no longer in the Updated retrievals

Statistics On The Comparison of Ice Cloud COT Between Baseline, Updated VIIRS COP and CLAVRX – Scene Of Africa 08/20/13, 11:41-11:57



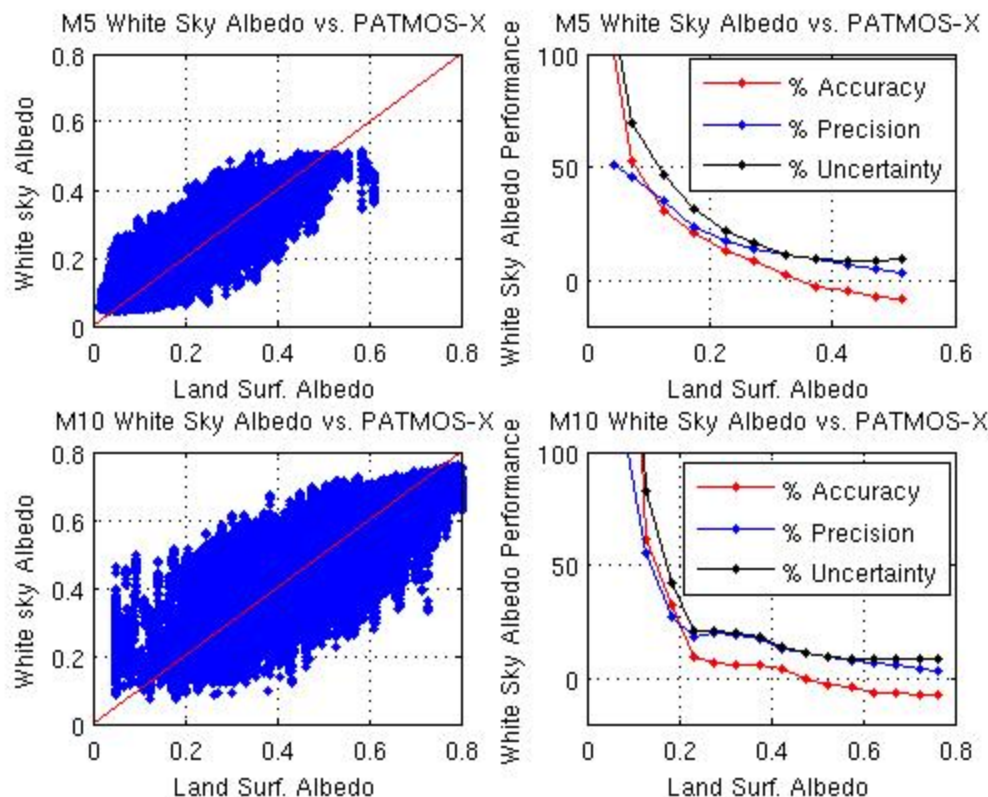
- Updated COT shows better performance than Baseline
- Updated COT has significantly less number of optically thin clouds predicted than in the Baseline
- Discrepancies between Updated and PATMOS-X are unavoidable due to differences in surface albedo values, particularly for usually optically thin ice clouds

Statistics On The Comparison of Ice Cloud EPS Between Baseline, Updated VIIRS COP and CLAVRX – Scene of Africa 08/20/13, 11:41-11:57



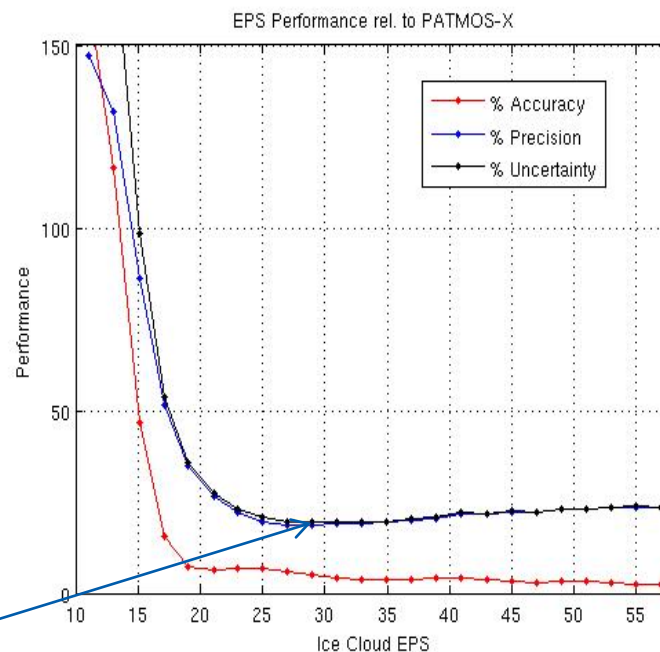
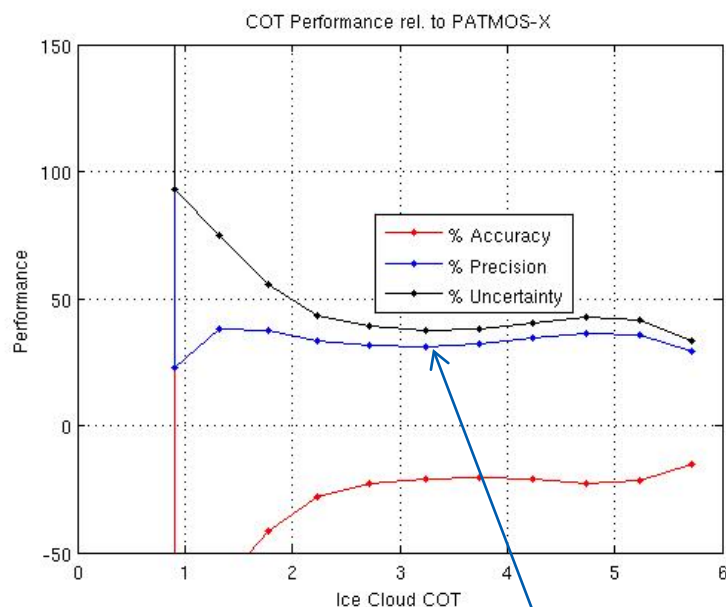
- Updated EPS shows better performance
- Large number of off diagonal pixels are no longer in the Updated retrievals

Statistics Of VIIRS Granulated And PATMOS-X Land Surface Albedo



- Precision error dominates the overall uncertainty
- This albedo precision error will translate into precision errors in COT/EPS performance statistics

Statistics of IDPS COT/EPS Performance Relative To PATMOS-X, Due To Differences In Land Surface Albedo



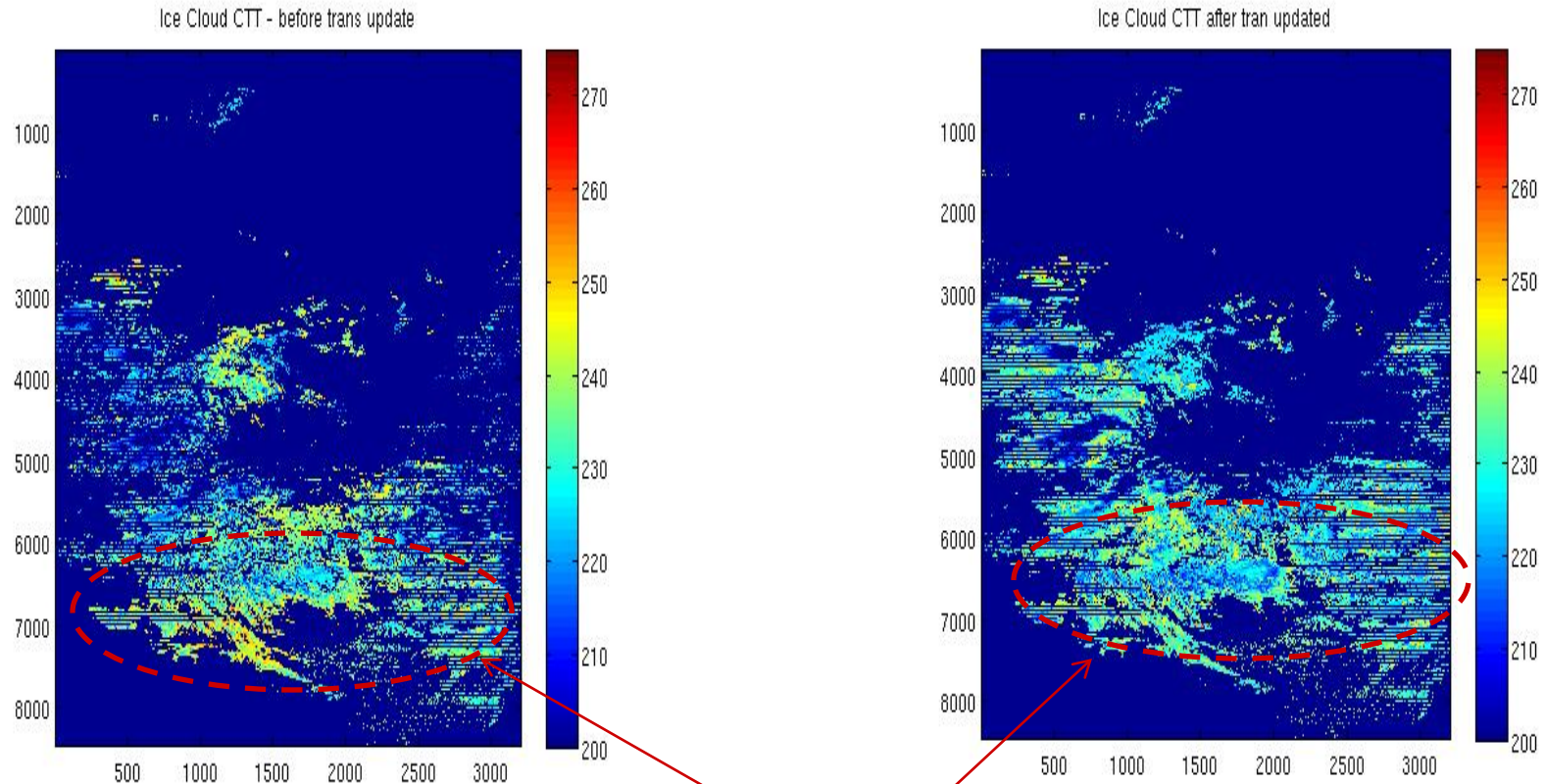
- Precision error dominates the overall uncertainty in COT/EPS performance
- These COT/EPS precision errors are direct results of precision errors in albedo noted above

Focus Areas Contributing To The Low Bias In Ice Cloud Top Height



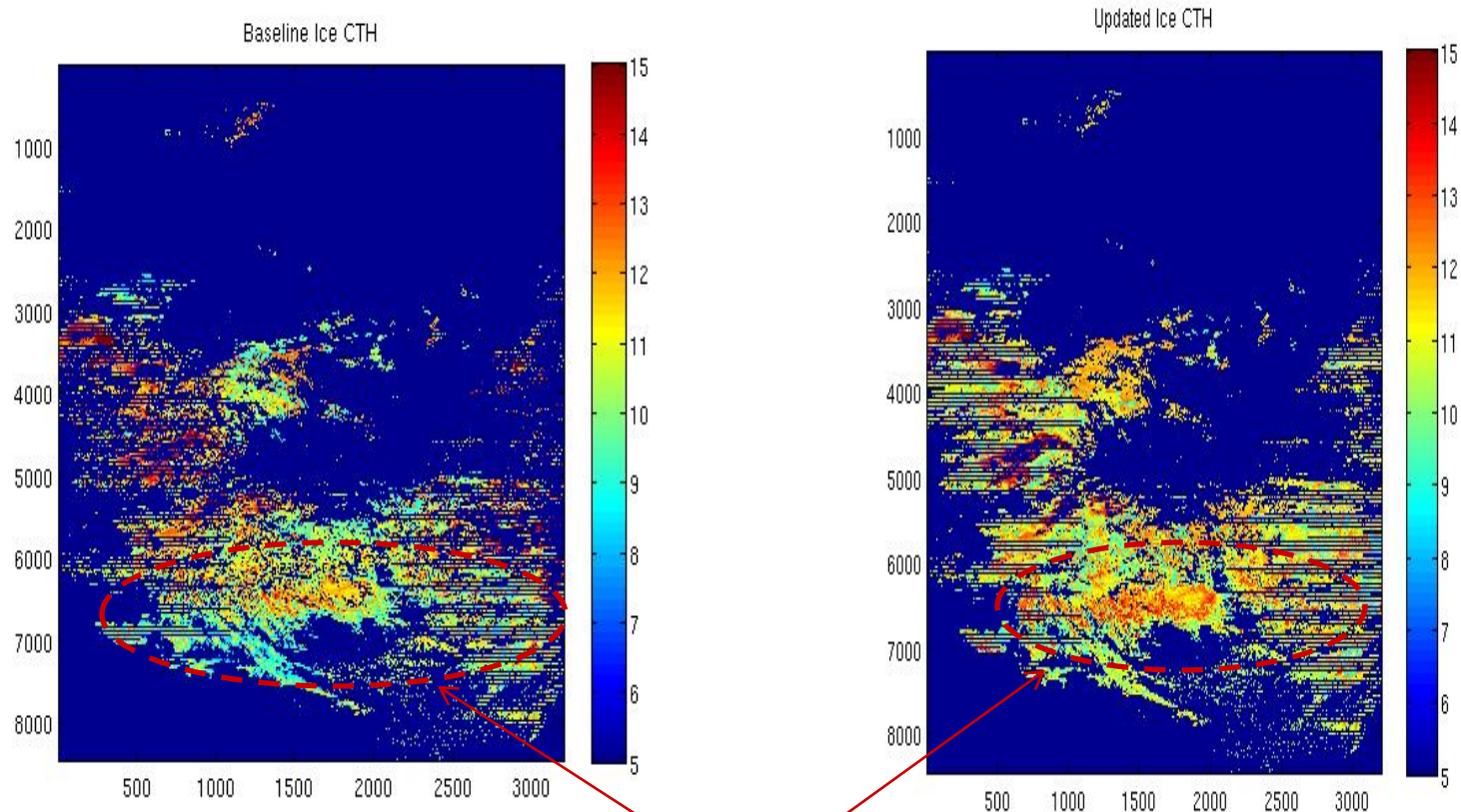
- Error in clear sky radiances due to Non-VIIRS RSR used in Pfaast RTM – DR to be submitted to correct for the discrepancies
- Error in land surface emissivities – to be investigated along with the above
- Error in the above cloud water vapor transmission effect – Correcting an error in transmission effect for ice clouds, preliminary results were obtained and presented here

Comparison In Ice Cloud CTT Between the Baseline and COP Code Updated To Remove Error In Above Cloud Transmission Correction – Scene Of Africa, 08/20/13 11:41-11:57



- After code update ice cloud CTT is noticeably colder thus raising CTH
- Removing the error in transmission correction will reduce the low CTH bias seen in Calipso data comparisons

Comparison In Ice Cloud CTH Between the Baseline and COP Code Updated To Remove Error In Above Cloud Transmission Correction – Scene Of Africa, 08/20/13 11:41-11:57



Correcting the transmission error raised the CTH,
therefore reducing the low bias

Summary

- 2 major issues derived from the Provisional Cloud Properties Review are discussed here : (1) Discrepancies in COT/EPS comparisons; (2) low bias in ice cloud CTH
- Approached are identified to address these 2 major issues affecting the performance of the cloud properties products
- From preliminary results it was found that the discrepancies in COT/EPS are caused by the differences in land surface albedo used between the VIIRS and PATMOS-X code
- The COT/EPS issue can be completely resolved once the VIIRS COP code is updated with the Granulated surface albedo
- For the reduction of the low bias in ice cloud CTH 3 candidates: errors in clear sky radiance derived from MODIS Pfaast RTM, surface emissivities and above cloud transmission were identified
- With preliminary testing results it was demonstrated that correction to the above cloud transmission error reduces the low bias
- With updates to Pfaast and perhaps including surface emissivities the ice cloud CTH low bias issue will be completely resolved

Conclusion

- With completion of these 2 DR updates to COP it is expected all IDPS cloud properties products will meet the JPSS L1RD requirements, thus advancing the products to Validated stage1 Maturity

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