Characterization and Validation of Cloud-Cleared Radiances

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Outline

- Version 3.5 Status
  - ECMWF – AIRS inter-comparisons
    - Dependence on cloud discriminants
    - SST outlier rates (2K threshold)
  - Radiance Covariance
    - Clear – versus cloud-cleared

- Version 4.0
  - ECMWF – AIRS inter-comparisons
  - Radiance Covariance
  - Outlier rates and empirical Q/A
Version 3.5
SST Inter-comparisons
Outlier Rate

- Discriminant smaller than clear threshold (density of discriminant)
- Density of SST differences are independent of discriminant
- Precision (bias) and accuracy of SST independent of discriminant

Cloud-clearing is working to reliability of discriminant
Version 3.5
Clear versus Cloud-Cleared Eigenvalues

Cloud-Cleared Radiance

Amplitude (K)

Clear Sky
Cloud Cleared

Index
Version 3.5 Conclusions

- Application of cloud-contamination test
  - *Most of CC radiances past test*
- Assessment of quality based on impact on retrieved products
  - *Outlier rate not dependent on clear test*
    - Suggests outliers do not arise from errors in CC radiances
- **Statistical Characteristics**
  - *Small differences in most significant eigenvectors*
    - Larger more varied ensemble of states
  - *Larger eigenvalues at least significant*
    - Evidence for noise amplification
Version 4.0
SST Inter-comparisons
Outlier Rate

- Same as Version 3.4
- Discriminant smaller than clear threshold
- Density of SST differences independent of discr.
- Precision (bias) and accuracy of SST are independent of discr.
  - Decreases with discr
  - Outlier rate increases
- Cloud-clearing is working to reliability of discriminant
Version 4.0
SST Inter-comparisons
Outlier Rate

LW Thin Cirrus Test
1231 / 943 cm⁻¹

- Possibly more skill
- Outlier rate decreasing with tightening

Outliers determined from Lower Trop T diff (K)
Version 4.0
Clear versus Cloud-Cleared Eigenvalues
Noise Amplification

- Increase in radiance noise by cloud clearing
- Applicable to surface sensing channels
- 9 clear footprints has NaF of 1/3

- Concern about amplification of systematic errors
Weighting Function Through Cloud Layers

Channel Frequency
77 668.28
237 717.41
239 719.99
241 718.58
244 719.47
245 719.76
247 720.35
Height – Dependence of Noise Amplification
Latitude Sampling

Atmospheric Infrared Sounder

Cloud-Cleared

Clear Sky
Conclusions

- Application of cloud-contamination test
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  - Outlier rate not dependent on clear test
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Supplemental Slides
Empirical Orthogonal Functions
Data

- Train on 826,340 identified clear spectra (11 Focus Days)
- LW temperature sounding channels (470)

![Normalized Weighting Functions](image-url)
### Clear Scene Prescription

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Location</th>
<th>Time of Day</th>
<th>Default Condition</th>
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<tbody>
<tr>
<td>SST1231r5</td>
<td>SST from LW channels using a split window</td>
<td>Ocean</td>
<td>Day/Night</td>
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<tr>
<td>SST2392r1</td>
<td>SST from SW channels using lapse rate extrapolation</td>
<td>Ocean</td>
<td>Day/Night</td>
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<td>Difference of SST from LW and SW channels, SST1231r5 - SST2392r1</td>
<td>Ocean</td>
<td>Day/Night</td>
<td>&gt; -2K</td>
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<td>SST LW/SW difference with glint correction</td>
<td>Ocean</td>
<td>Day</td>
<td>abs &lt; 0.5K</td>
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<td>Ocean</td>
<td>Night</td>
<td>abs &lt; 0.25K</td>
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<td>d23</td>
<td>LW Thin cirrus and silicate dust predictor</td>
<td>Ocean</td>
<td>Day/Night</td>
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<td>SW lapse rate</td>
<td>Tropical Ocean</td>
<td>Day/Night</td>
<td>&gt; 3.5K</td>
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<tr>
<td>g5n</td>
<td>SW sun glint detector</td>
<td>Ocean</td>
<td>Day</td>
<td>&lt; 3</td>
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<td>spatial_coh 11 um</td>
<td>Std Deviation in LW predicted SST</td>
<td>Everywhere</td>
<td>Day/Night</td>
<td>&lt; 0.5</td>
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