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Space Administration

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California Institute of Technology
Pasadena, California

*Atmospheric Infrared Sounder*

# Characterization and Validation of Cloud-Cleared Radiances

E.F. Fishbein

# 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**

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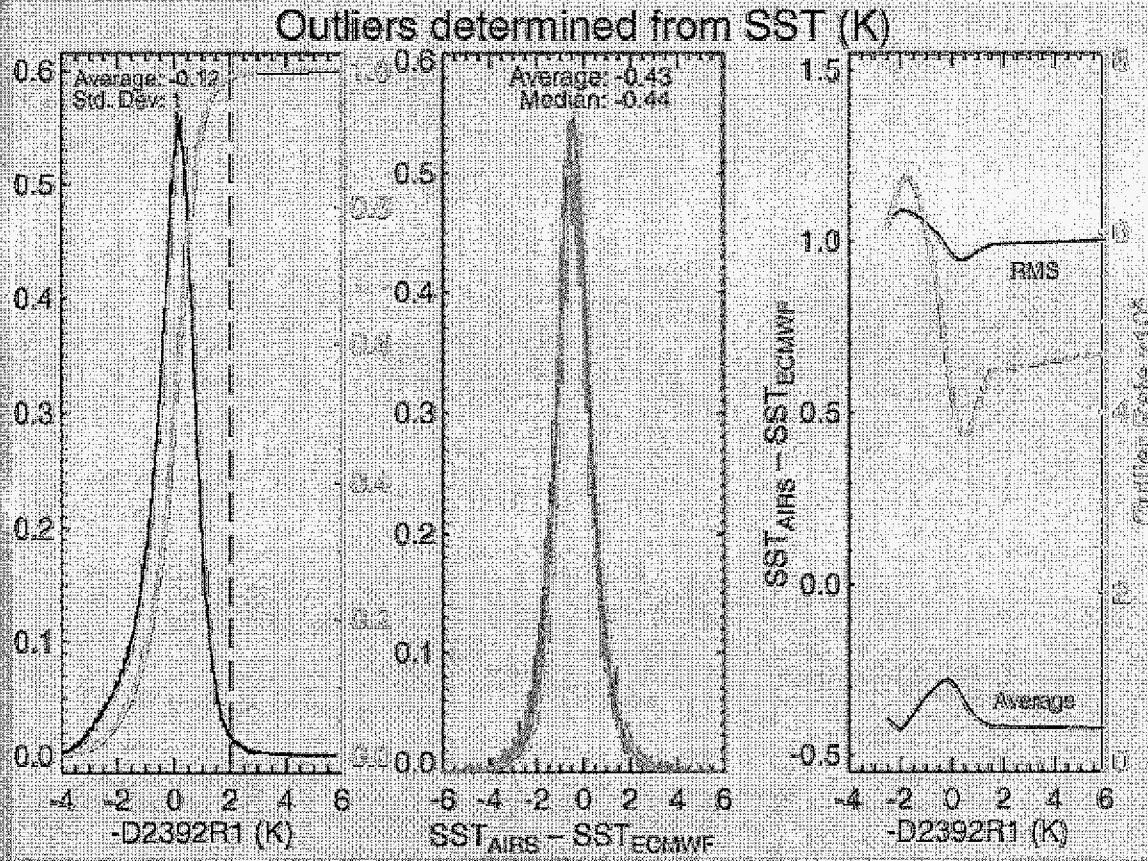
# Version 3.5 SST Inter-comparisons Outlier Rate

- 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



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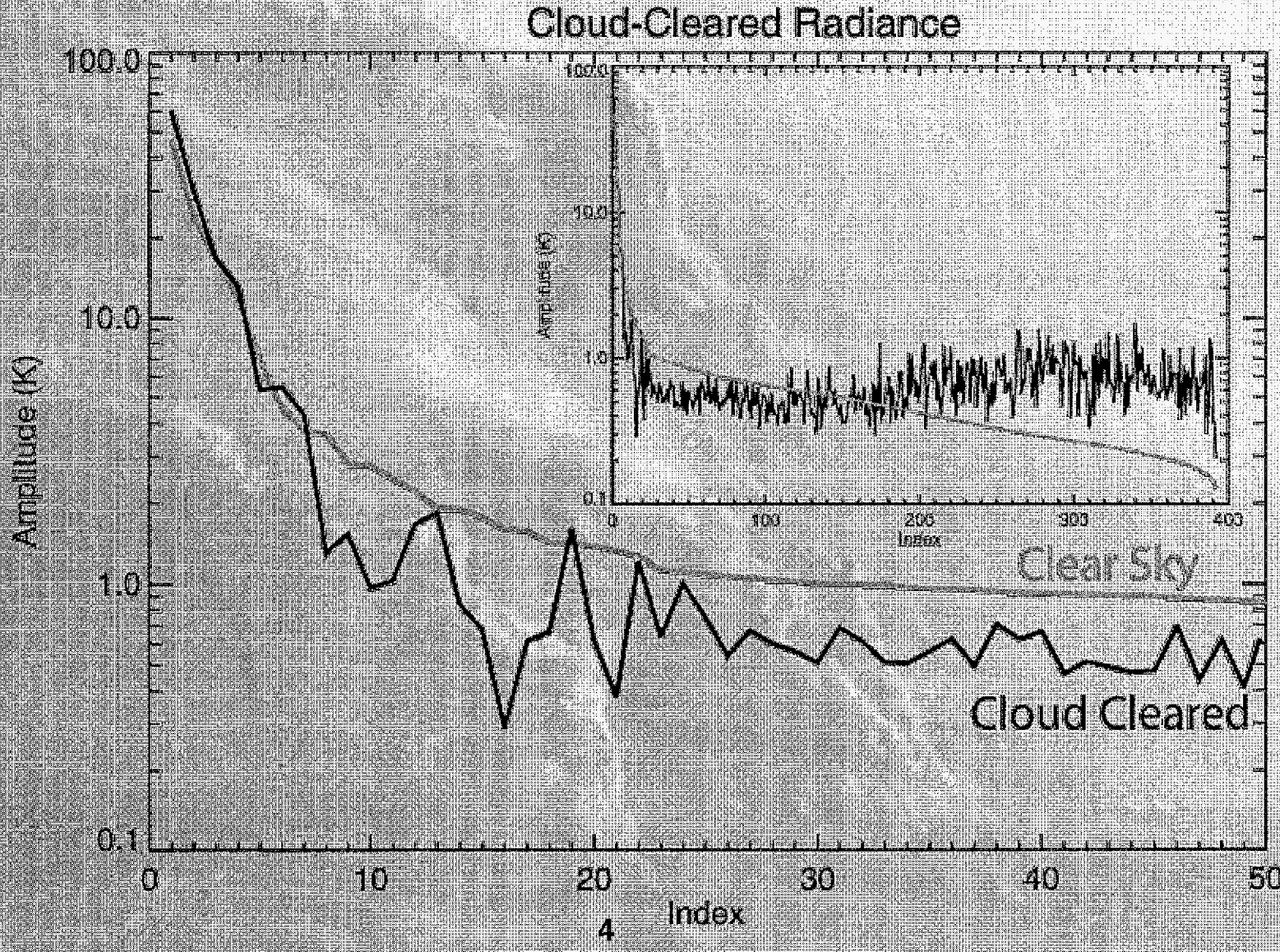
# Version 3.5
# Clear versus Cloud-Cleared Eigenvalues



# 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

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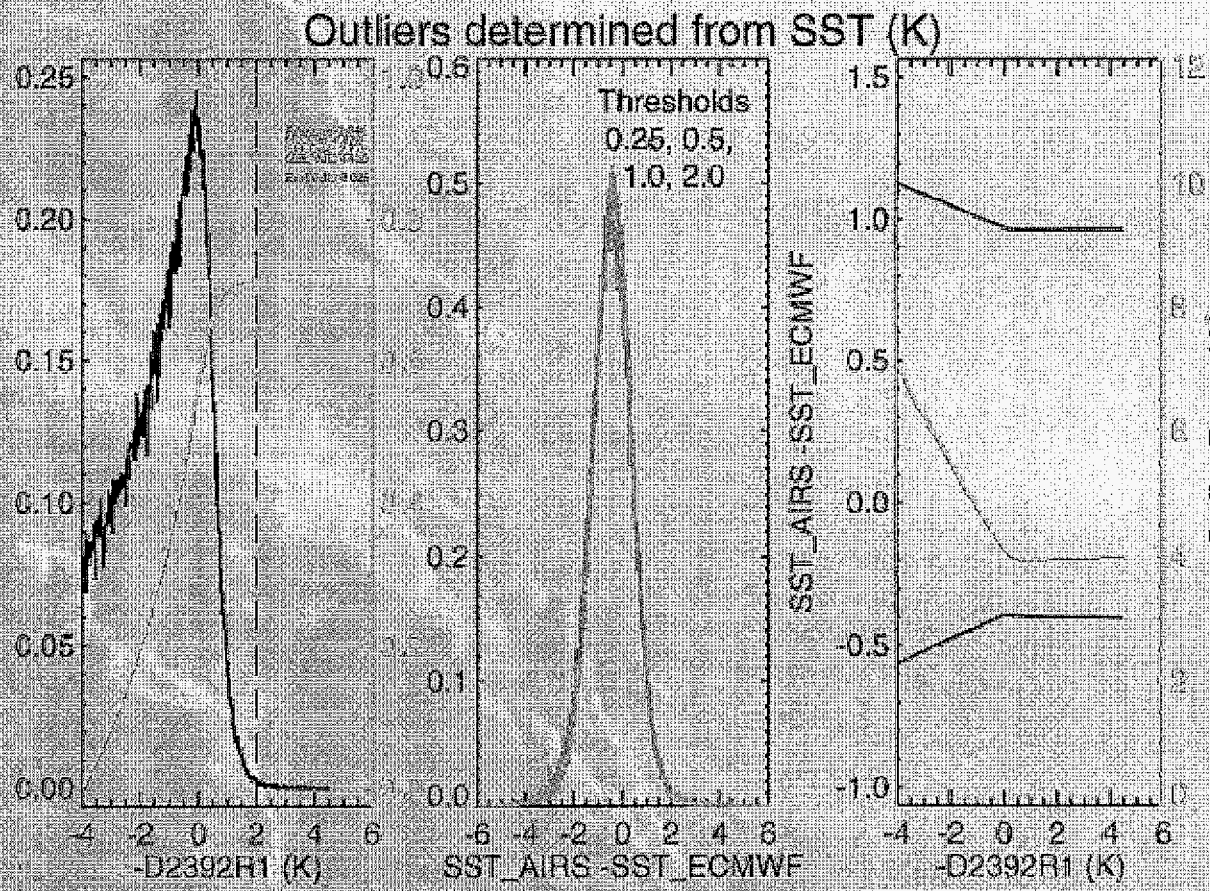
LW / SW SST Difference

# 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



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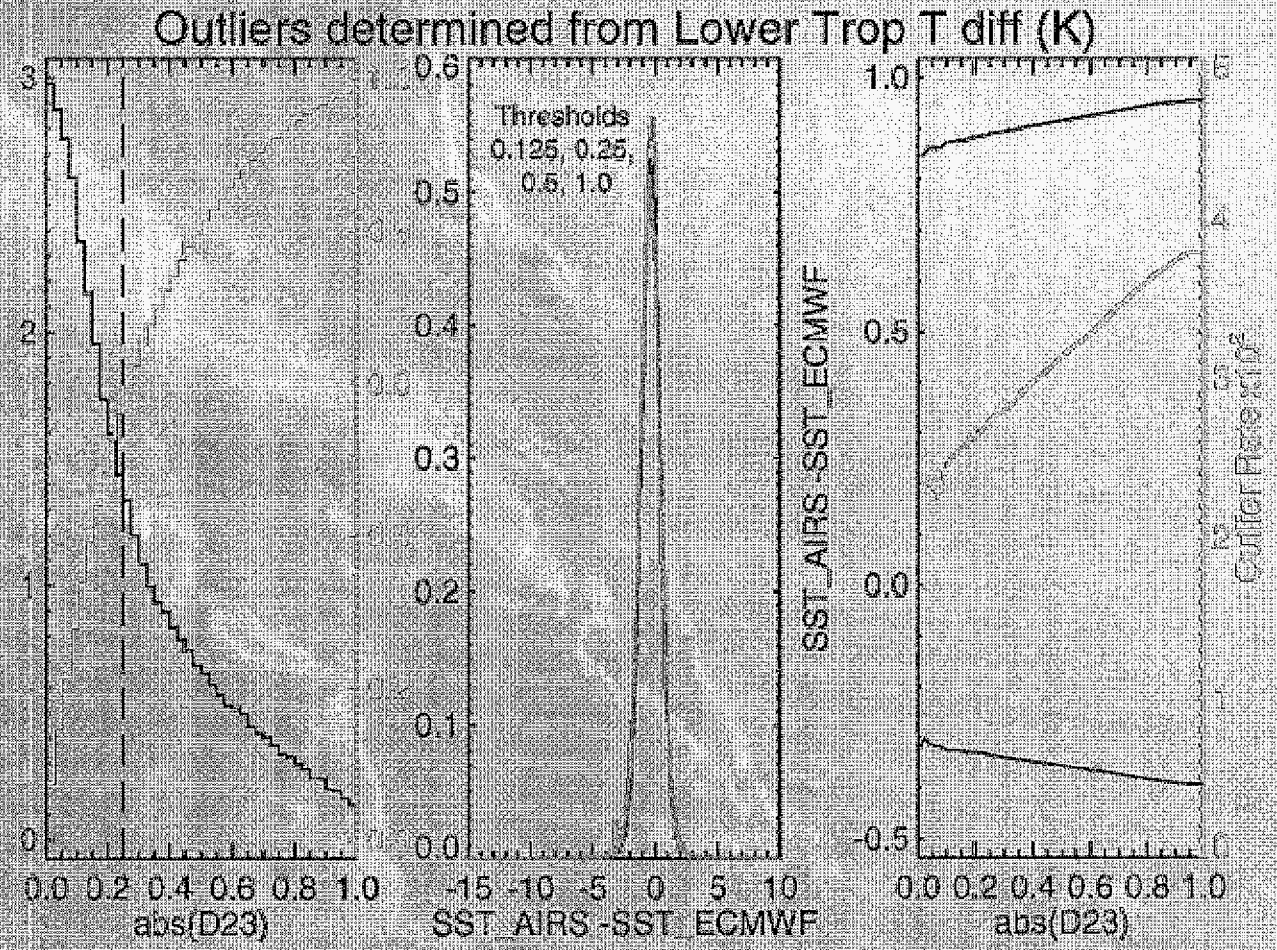
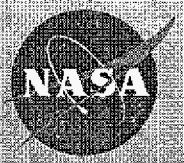
# Version 4.0 SST Inter-comparisons Outlier Rate

## LW Thin Cirrus Test

### 1231 / 943 $cm^{-1}$

- Possibly more skill
- Outlier rate decreasing with tightening





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# Version 4.0
# Clear versus Cloud-Cleared Eigenvalues

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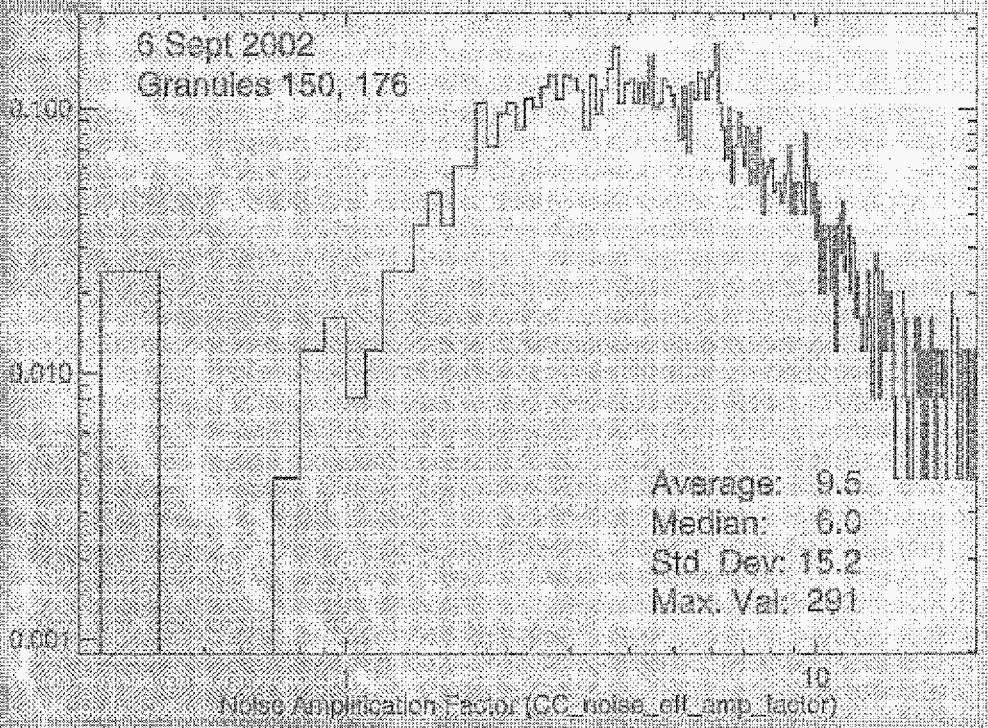
# Noise Amplification

- 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



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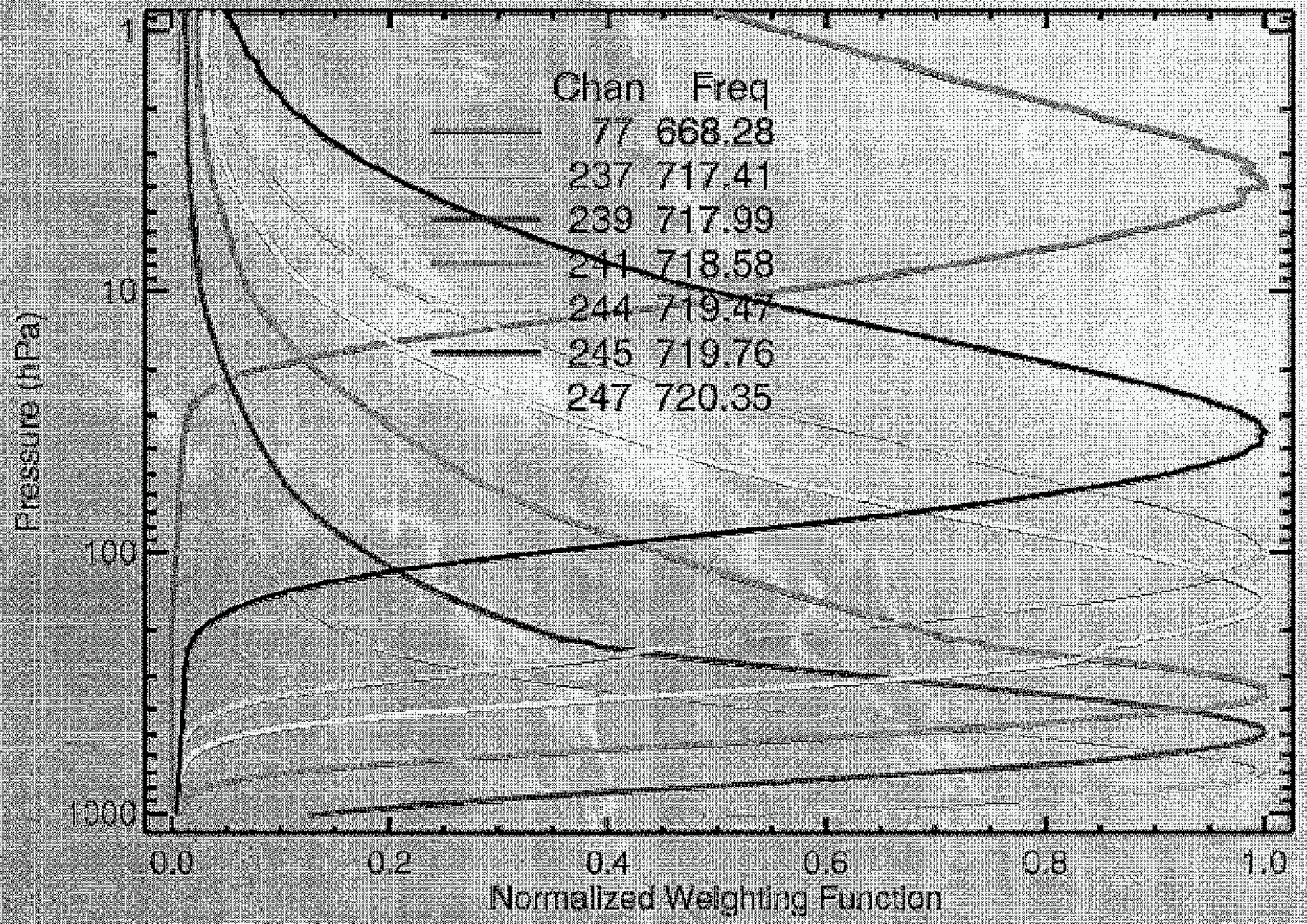
# Weighting Function Through Cloud Layers



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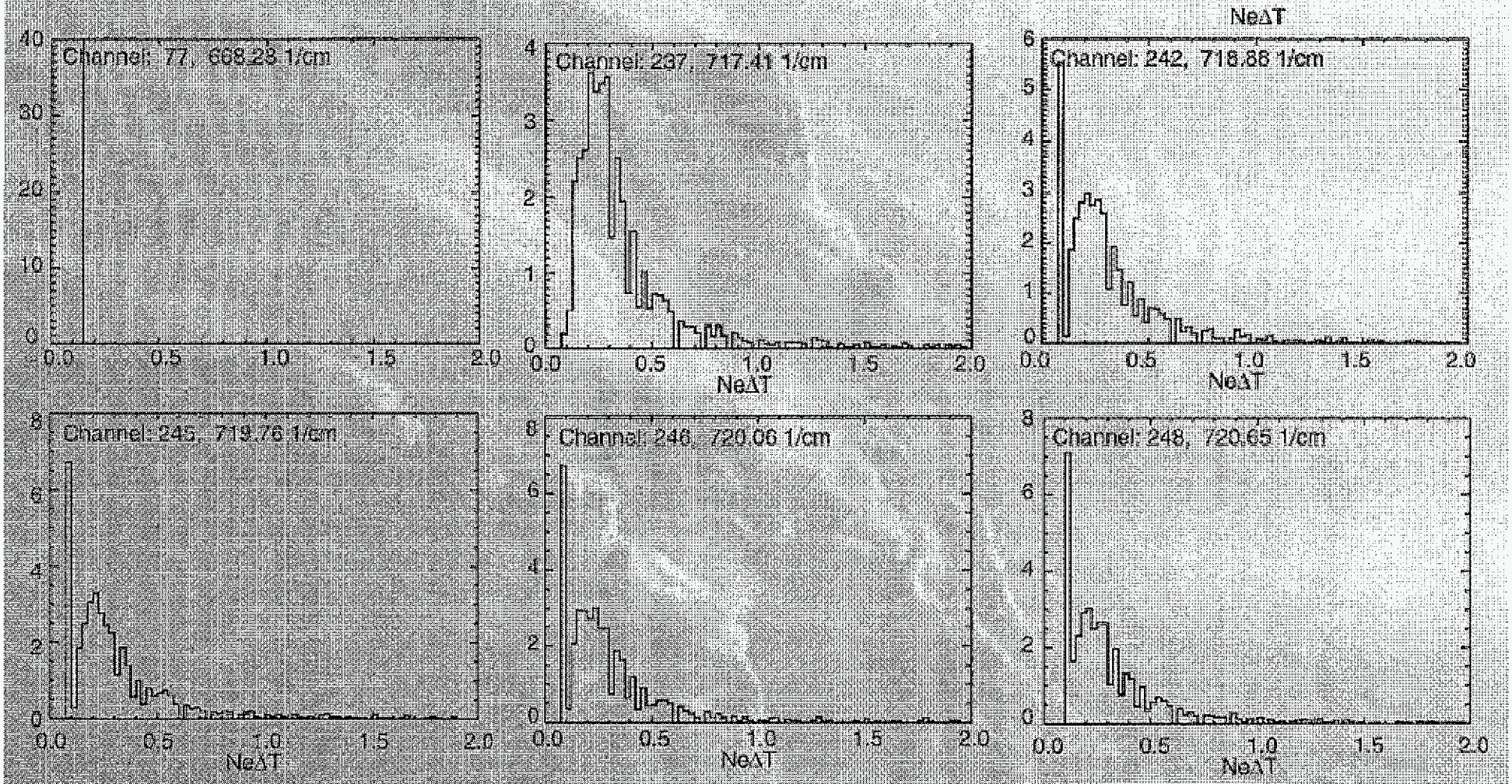
# Height –Dependence of Noise Amplification



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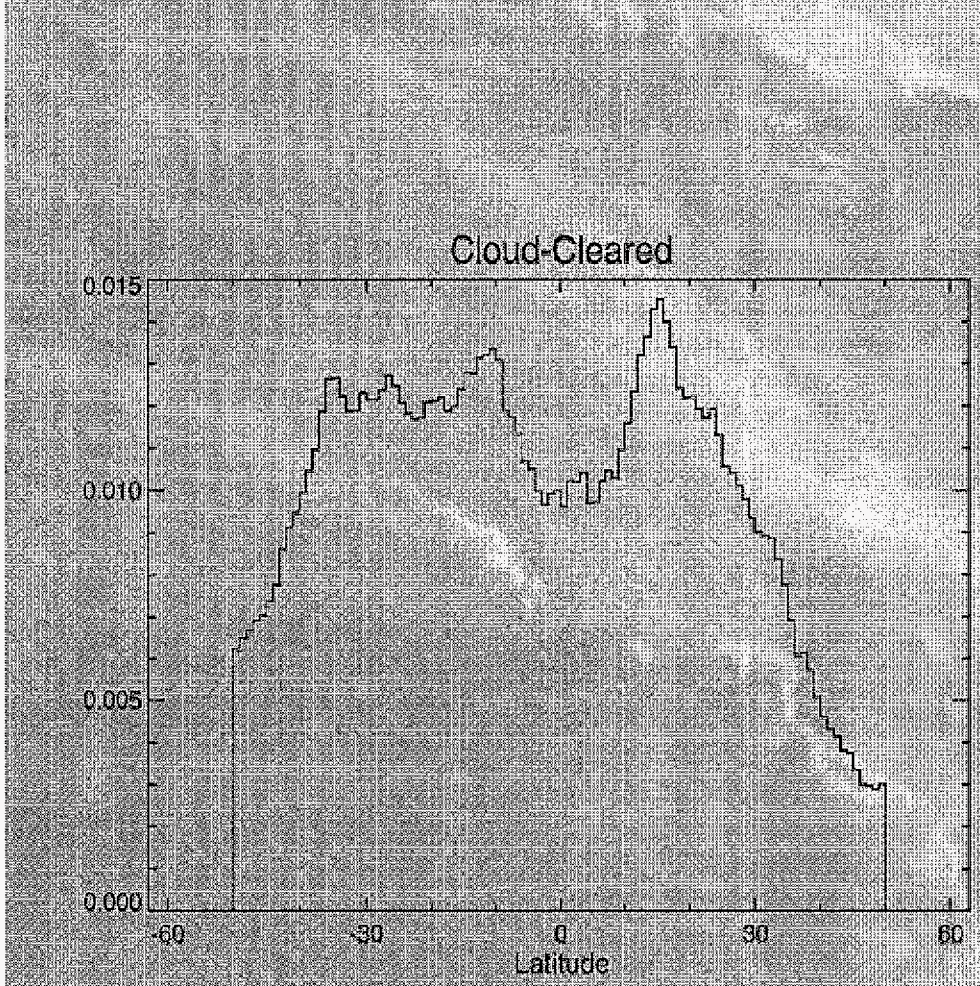
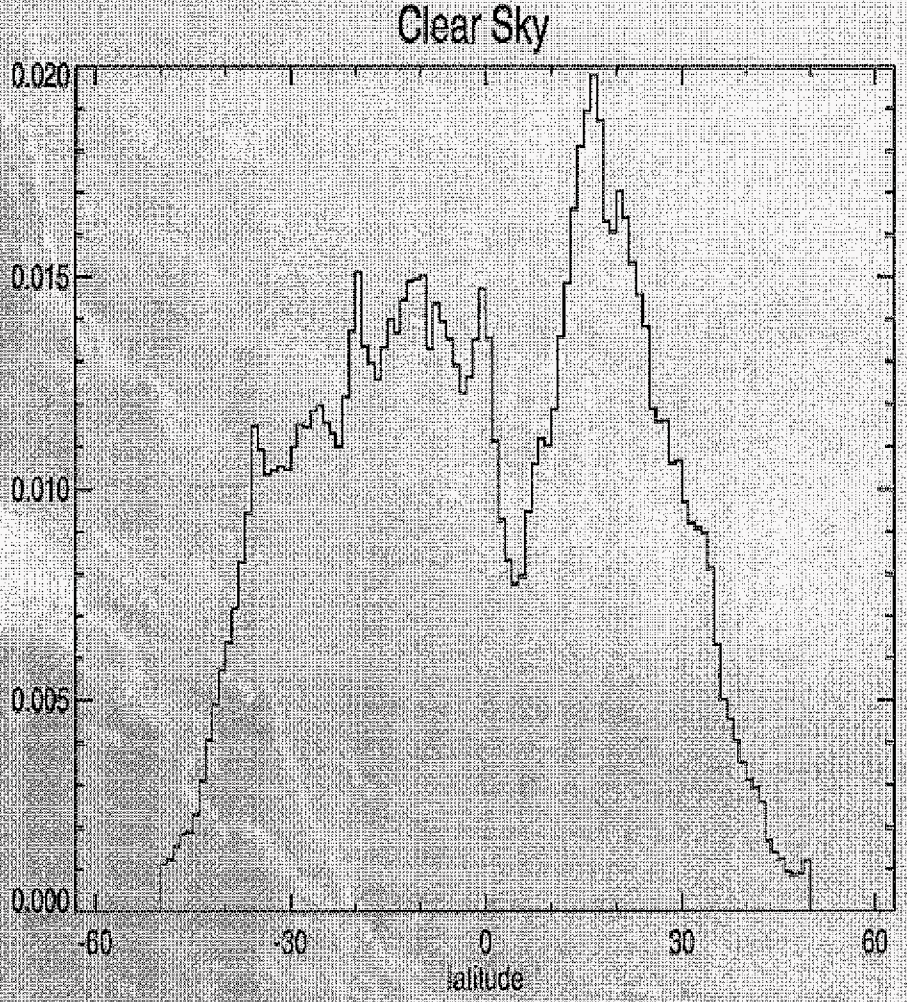
# Latitude Sampling



# Conclusions

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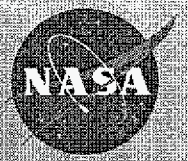

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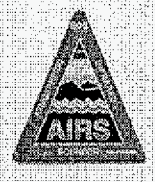


# Supplemental Slides

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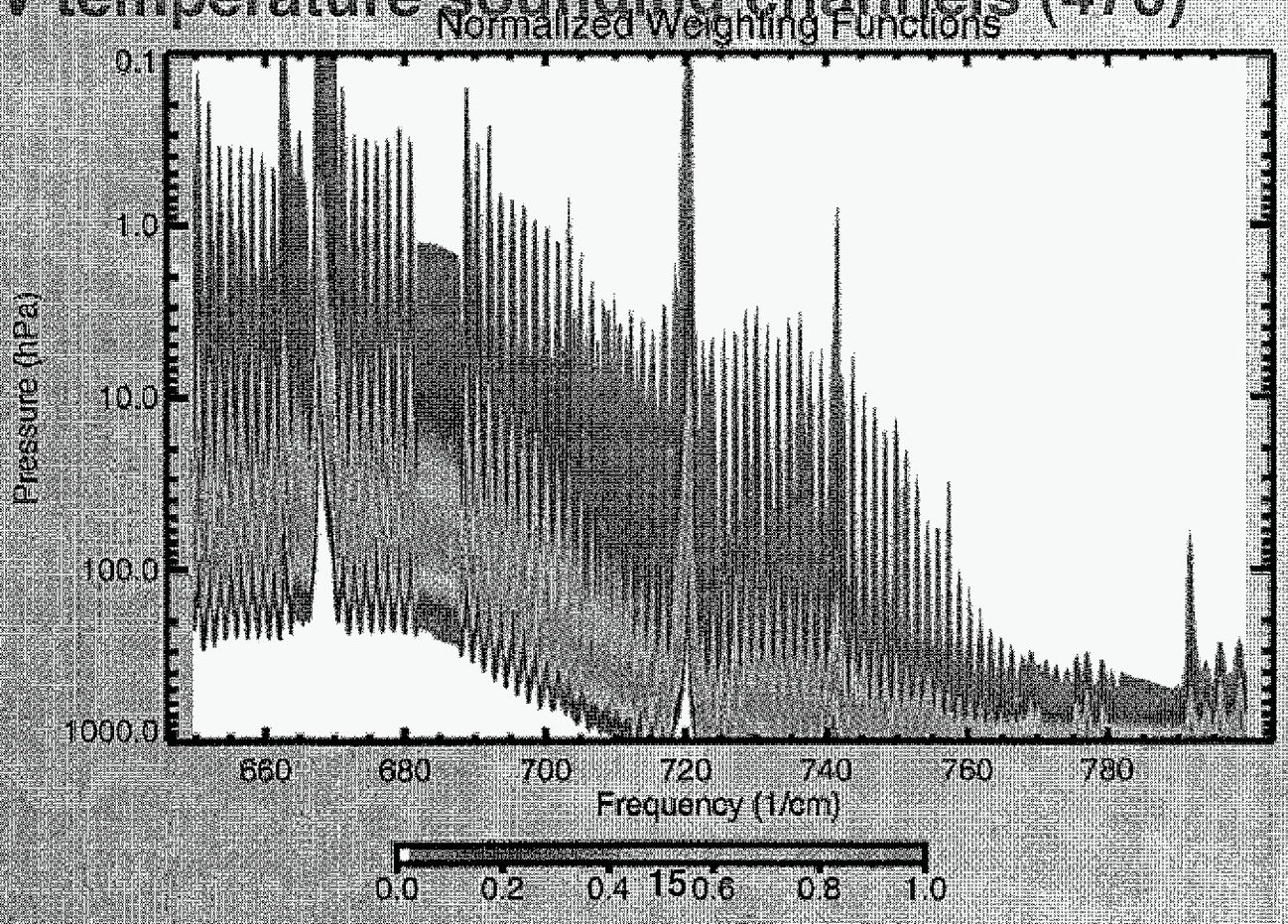
# Empirical Orthogonal Functions Data

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



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# Clear Scene Prescription

| Name | Description | Location | Time of Day | Default Condition |
|---|---|---|---|---|
| SST1231r5 | SST from LW channels using a split window | Ocean | Day/Night | |
| SST2392r1 | SST from SW channels using lapse rate extrapolation | Ocen | Day/Night | |
| d2392r1 | Difference of SST from LW and SW channels, SST1231r5-SST2392r1 | Ocean | Day/Night | > -2K |
| dd12g5 | SST LW/SW difference with glint correction | Ocean | Day | abs < 0.5K |
| d12 | SST LW/SW difference w/o glint correction | Ocean | Night | abs < 0.25K |
| d23 | LW Thin cirrus and silicate dust predictor | Ocean | Day/Night | abs < 0.25K |
| d34 | LW Thin cirrus predictor | Ocean | Day/Night | abs < 0.5K |
| lrt | SW lapse rate | Tropical Ocean | Day/Night | > 3.5K |
| g5n | SW sun glint detector | Ocean | Day | < 3 |
| spatial_coh 11 um | Std Deviation in LW predicted SST | Everywhere | Day/Night | < 0.5 |