MODIS NEAR-IR WATER VAPOR ALGORITHM

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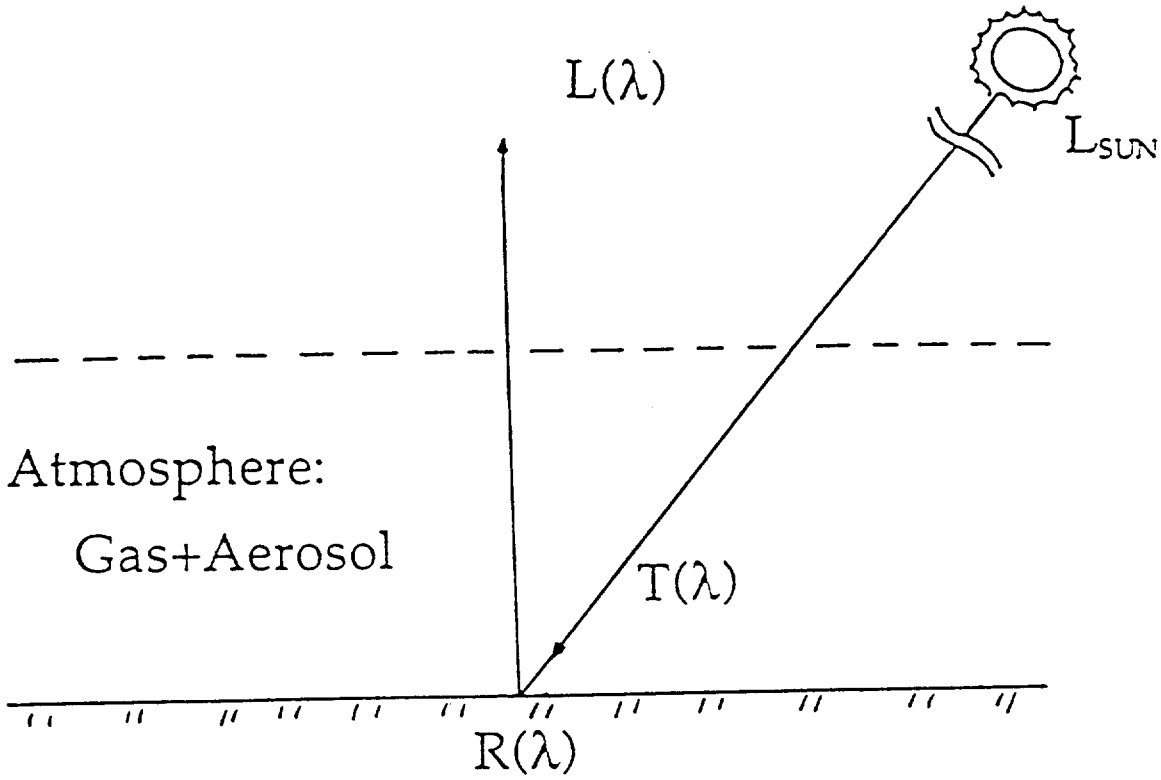


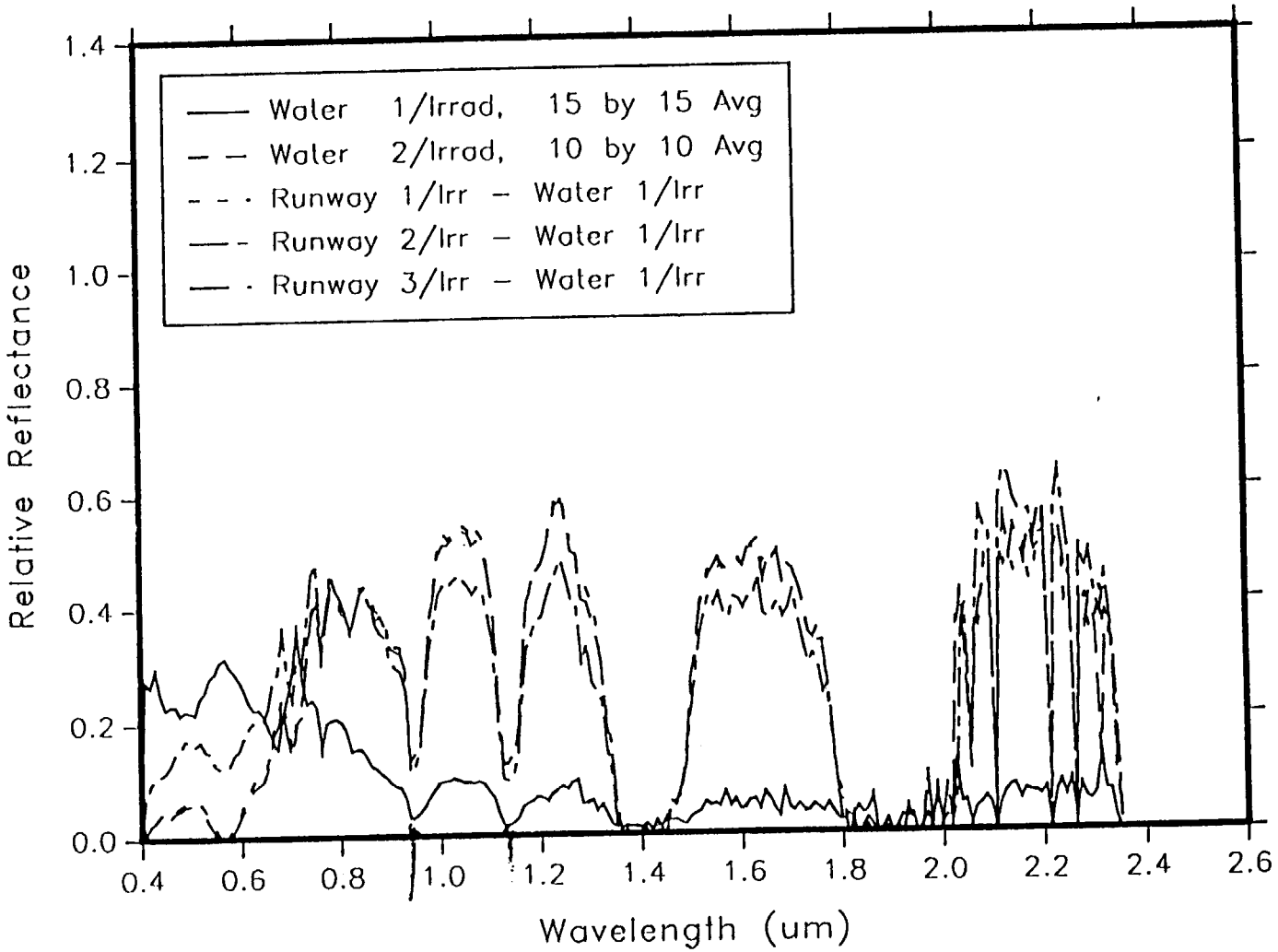
- Radiance received by satellite

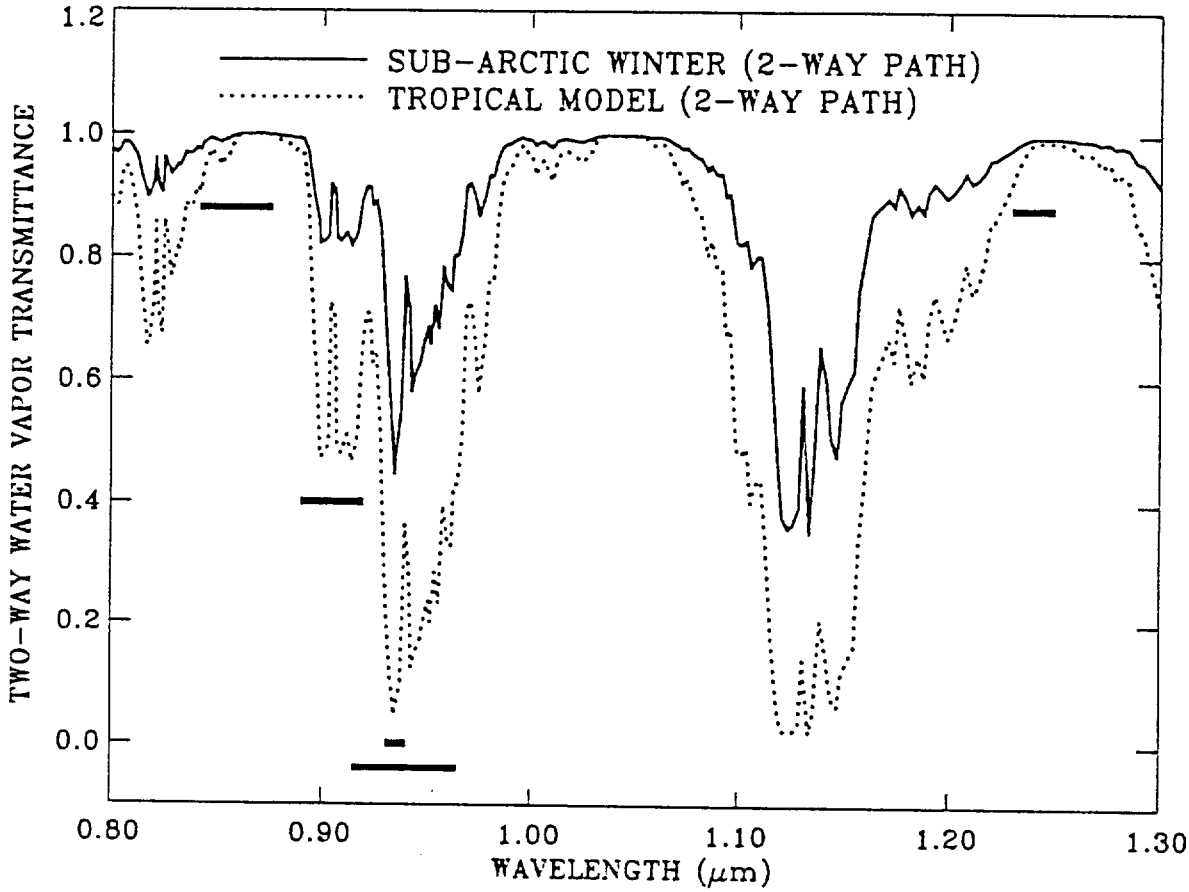
$$L(\lambda) = L_{SUN}(\lambda)\, T(\lambda)\, R(\lambda) + L_{PATH}(\lambda)$$
$$= L_{DIRECT}(\lambda) + L_{PATH}(\lambda)$$

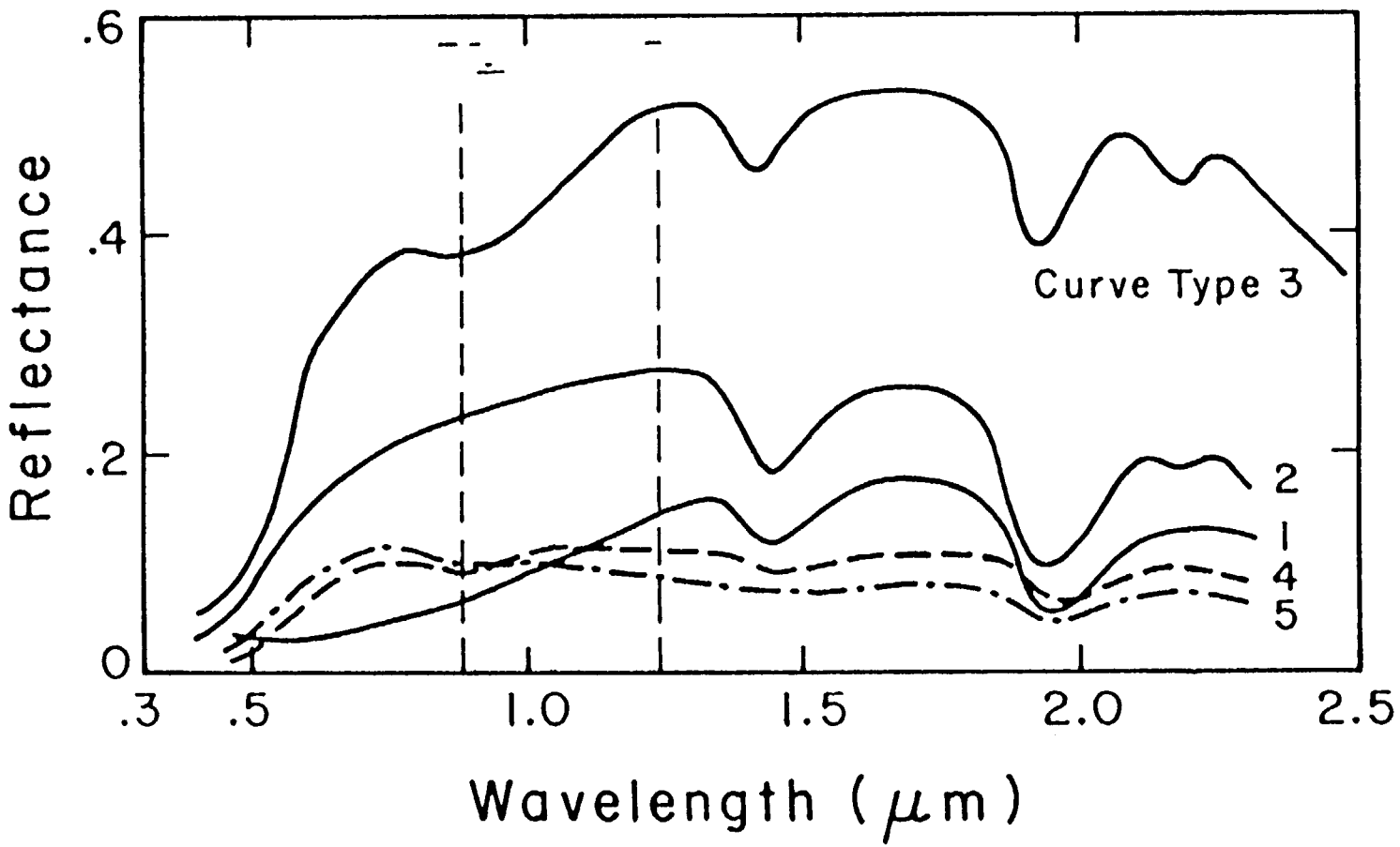
  - λ = wavelength
  - $L(\lambda)$ = radiance at satellite
  - L_{SUN} = solar radiance above atmosphere
  - $T(\lambda)$ = atmospheric transmittance
  - $R(\lambda)$ = surface reflectance
  - $L_{PATH}(\lambda)$ = path radiance, small at 1 μm

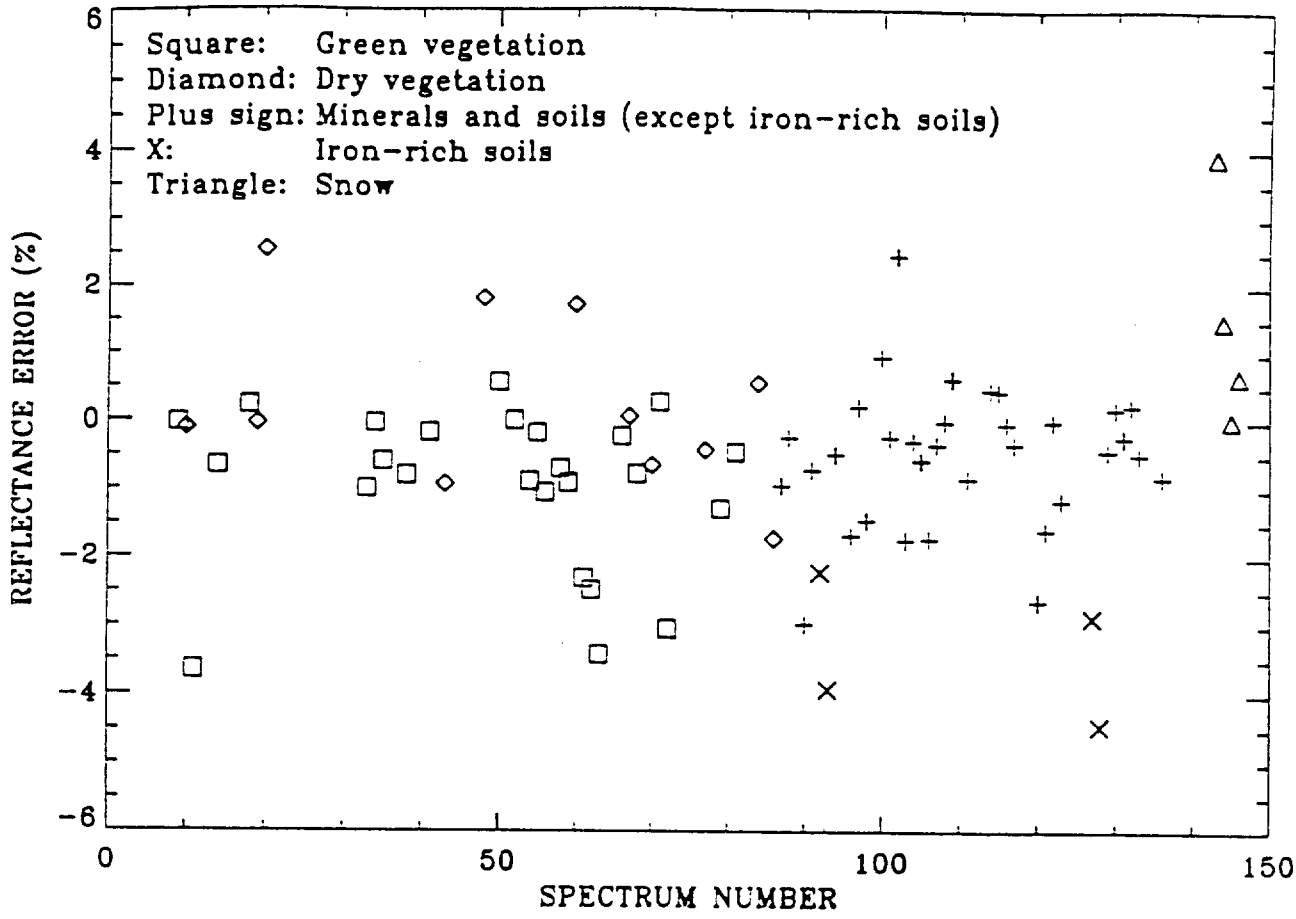
- Clear days, $\lambda > 0.8\mu m$, $L_{PATH}(\lambda) \sim 10\% L_{DIRECT}(\lambda)$
  If $L_{PATH}(\lambda)$ not modeled, ~10% error in $R(\lambda)$

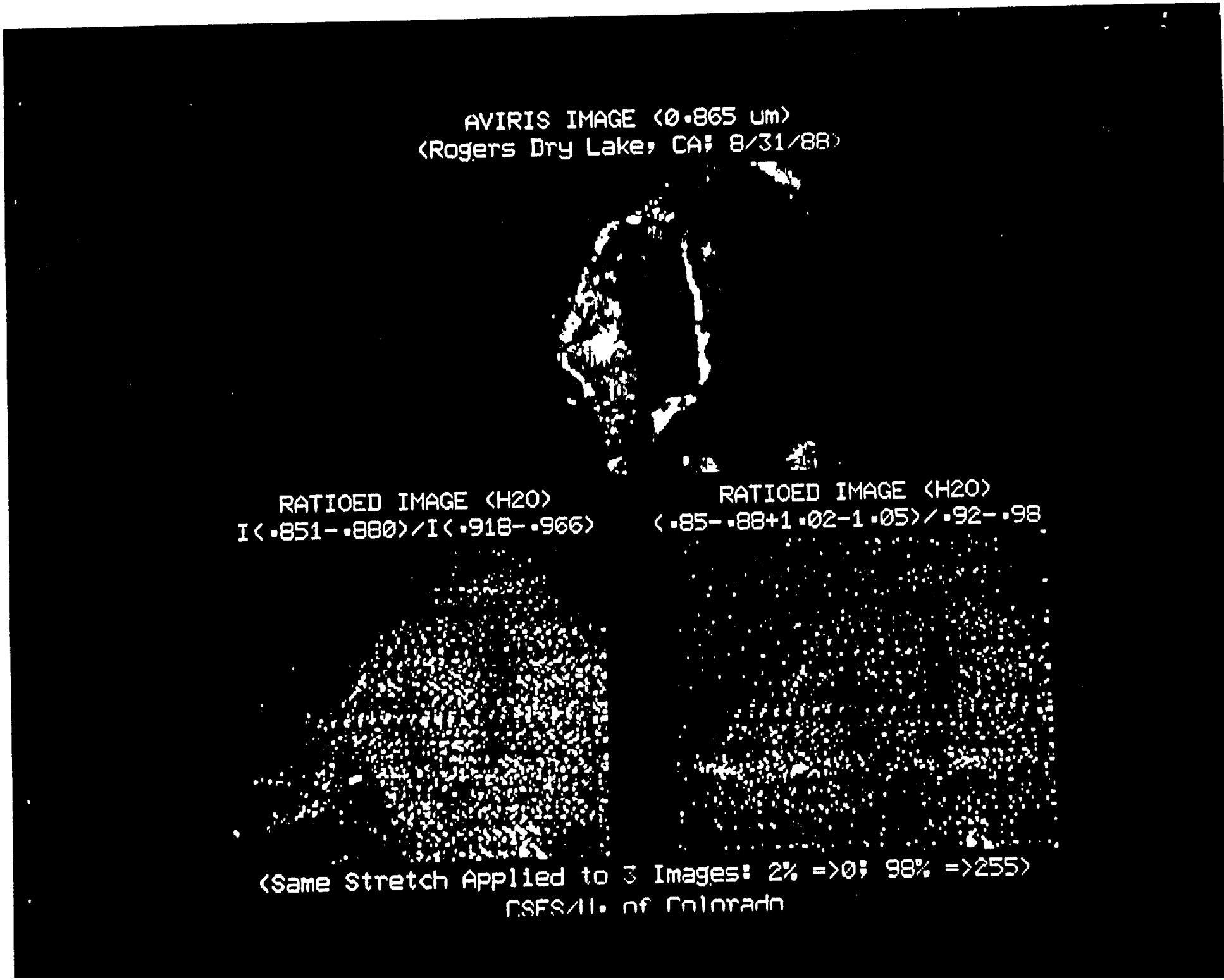
Relative Reflectance V.S. Wavelength




SUB-ARCTIC WINTER (2-WAY PATH)
TROPICAL MODEL (2-WAY PATH)
TWO-WAY WATER VAPOR TRANSMITTANCE
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.80
0.90
1.00
1.10
1.20
1.30
WAVELENGTH (μm)


.6
.4
.2
0
Reflectance
.3
.5
1.0
1.5
2.0
2.5
Wavelength (μm)
Curve Type 3
2
1
4
5


Square: Green vegetation
Diamond: Dry vegetation
Plus sign: Minerals and soils (except iron-rich soils)
X: Iron-rich soils
Triangle: Snow
REFLECTANCE ERROR (%)
6
4
2
0
-2
-4
-6
0
50
100
150
SPECTRUM NUMBER


AVIRIS IMAGE (0.865 um)
(Rogers Dry Lake, CA; 8/31/88)
RATIOED IMAGE (H2O)
I(.851-.880)/I(.918-.966)
RATIOED IMAGE (H2O)
(.85-.88+1.02-1.05)/.92-.98
(Same Stretch Applied to 3 Images: 2% =>0; 98% =>255)
CSES/U. of Colorado

ERROR ANALYSIS & CONCLUSIONS

Sensitivity:

1% error in channel ratio results in about 2.5% error in water vapor retrievals

Error source	Water vapor error
Surface reflectance	5.5%
1% error in sensor radiometric calibration	3.0%
5 nm shift in bandpass (0.94- & 0.905-μm Chs.)	1.5%
Pixel registration (for 5-km product, scene dependent)	~3%
Temperature & moisture profiles	4.0%
Haze effect	2-6%