On-board Calibration Trend of ASTER/TIR

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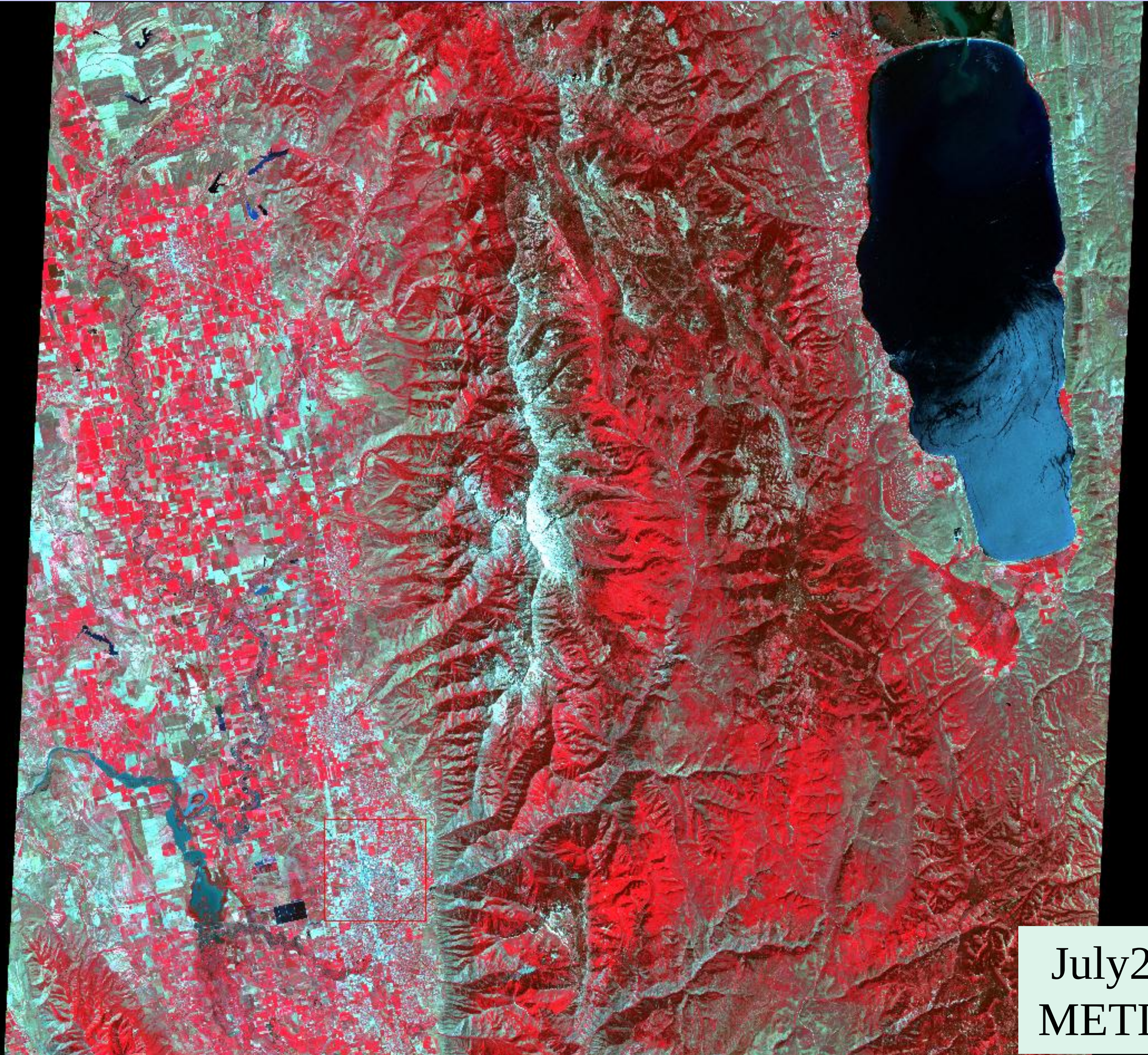
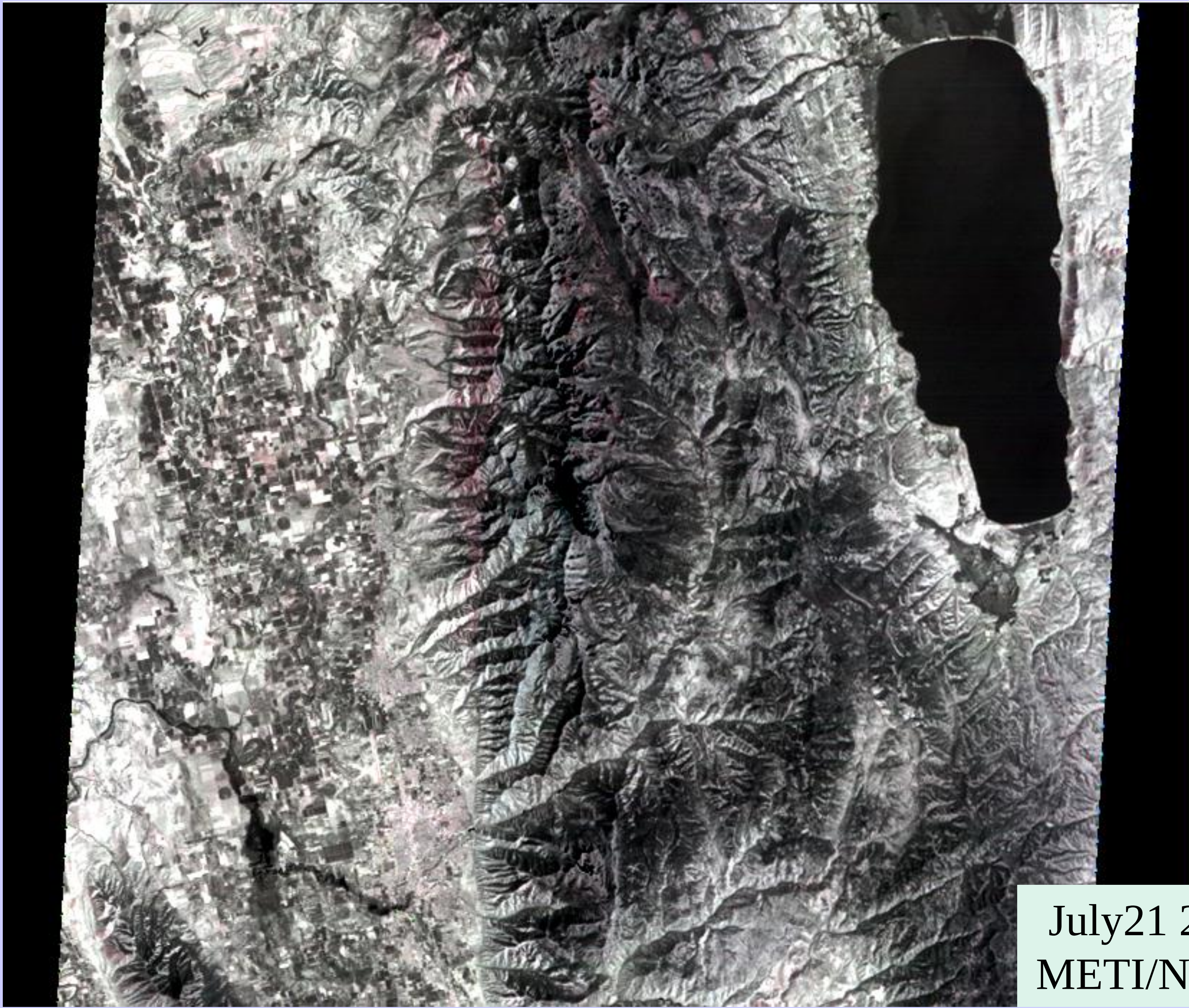
Contents

ASTER Bands

Band	Radiometer	Center wavelength (μm)	Uncertainty *k*=1
1	VNIR	0.56	4 %
2		0.66	
3		0.81	
4	SWIR	1.65	4 %
5		2.165	
6		2.205	
7		2.265	
8		2.33	
9		2.395	
10	TIR	8.3	3 K (200 K – 240 K) 2 K (240 K – 270 K) 1 K (270 K – 340 K) 2 K (340 K – 370 K)
11		8.65	
12		9.1	
13		10.6	
14		11.3	

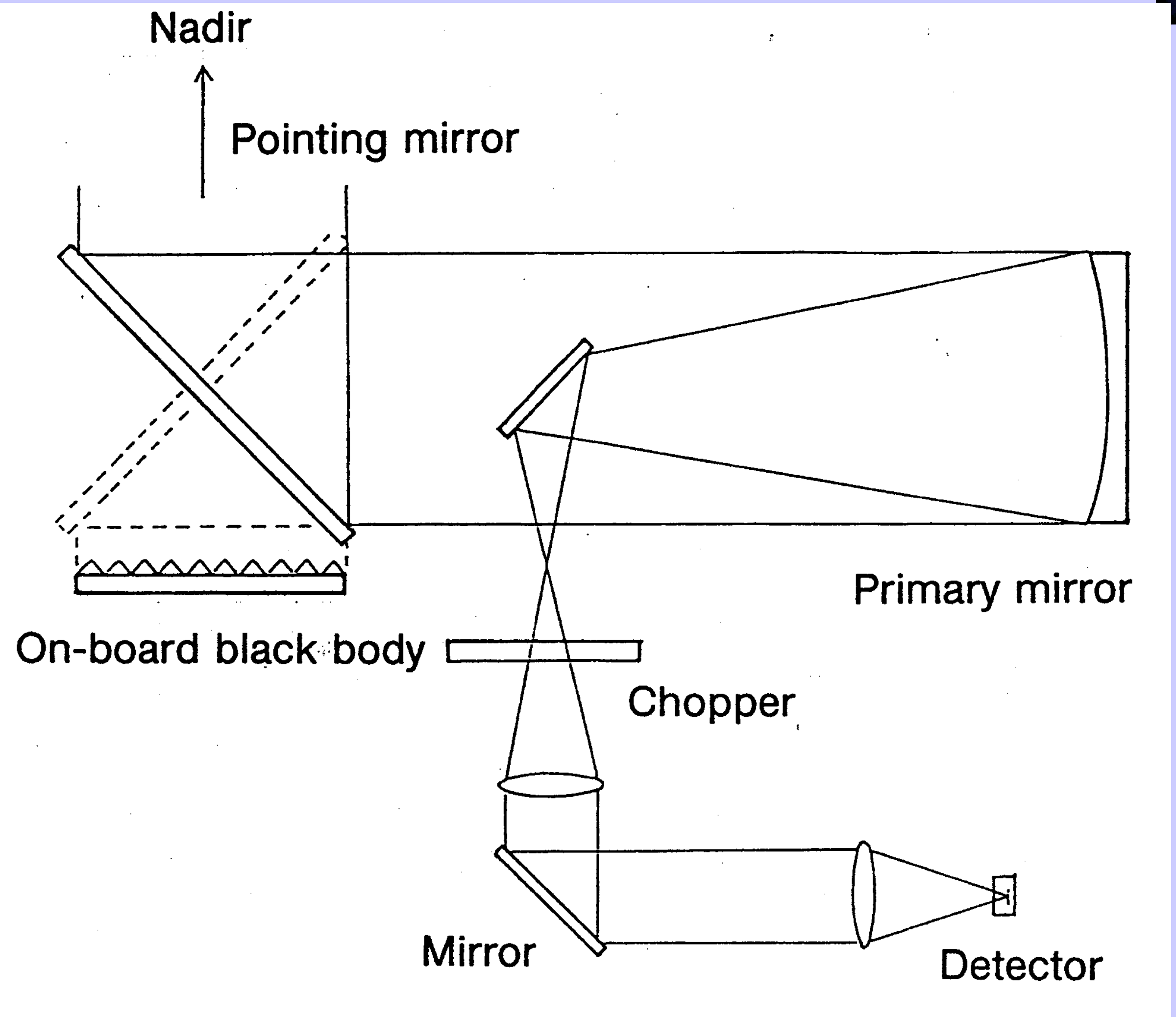


July21 2011
METI/NASA



July21 2011
METI/NASA

ASTER/TIR optics



LTC and STC

- Short Term Calibration (STC)

Start of every observation sequence

Blackbody temperature: 270 K

Offset is corrected

- Long Term Calibration (LTC)

Once every 49 days

Blackbody temperature is changed from 270 K to 340 K

The Gain and Offset of each detector are corrected

TIR RCC

- $L = C_0 + C_1 * \mathrm{DN} + C_2 * \mathrm{DN}^2$

L: Radiance

C_2:Nonlinear term:
  kept fixed

C_1:Linear term:
  determined by the Long Term Calibration (LTC)

C_0:Offset term:
  determined by the Short Term Calibration (STC)

$$C_0 = L - C_1 * \mathrm{DN} - C_2 * \mathrm{DN}^2$$

TIR RCC C_1

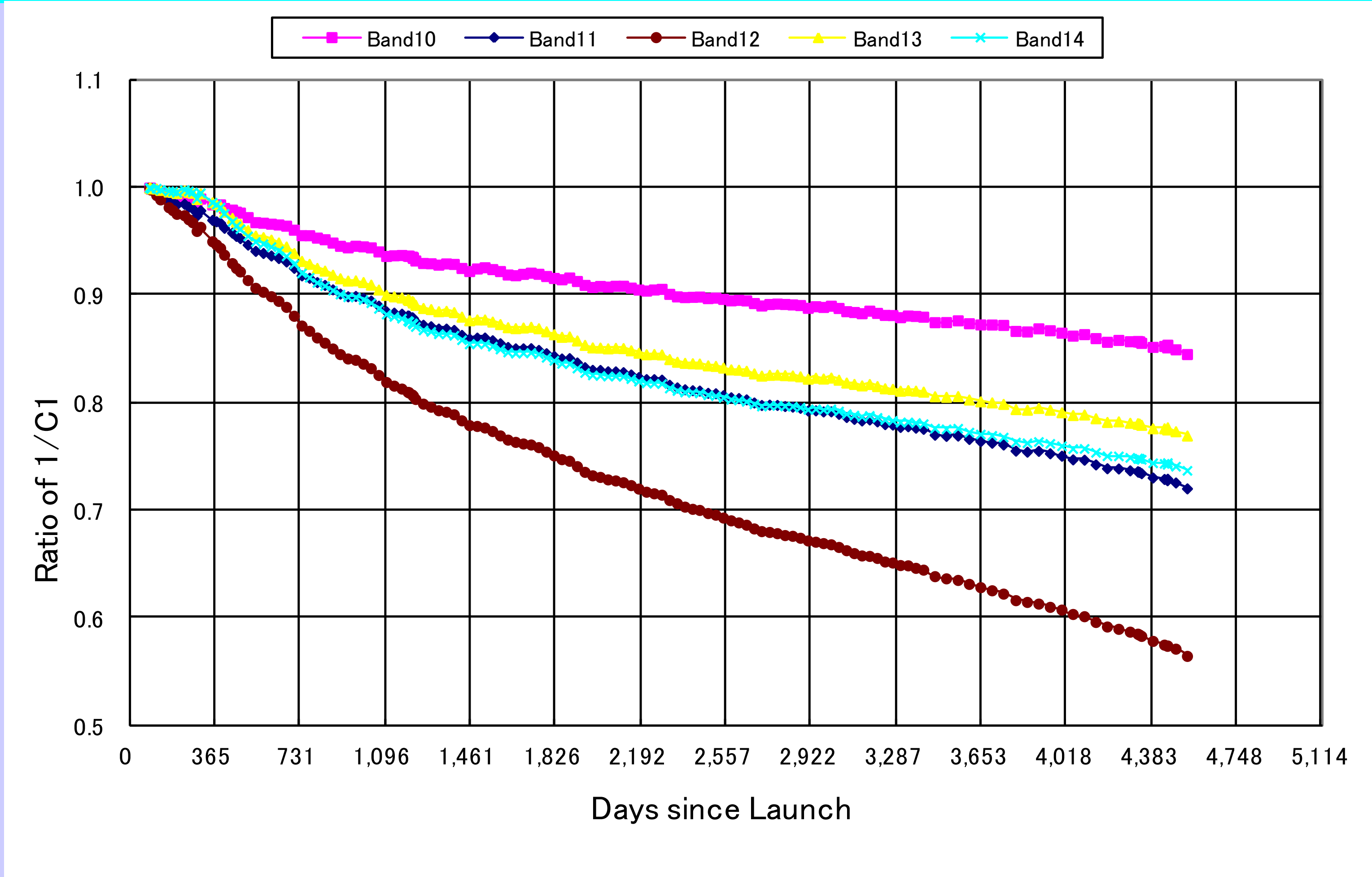
For days from October 20, 2000

(after 304 days since launch)

Express C_1 with an exponential function

$$C_1 = 1/\{b \exp(-a^* t) + c\}$$

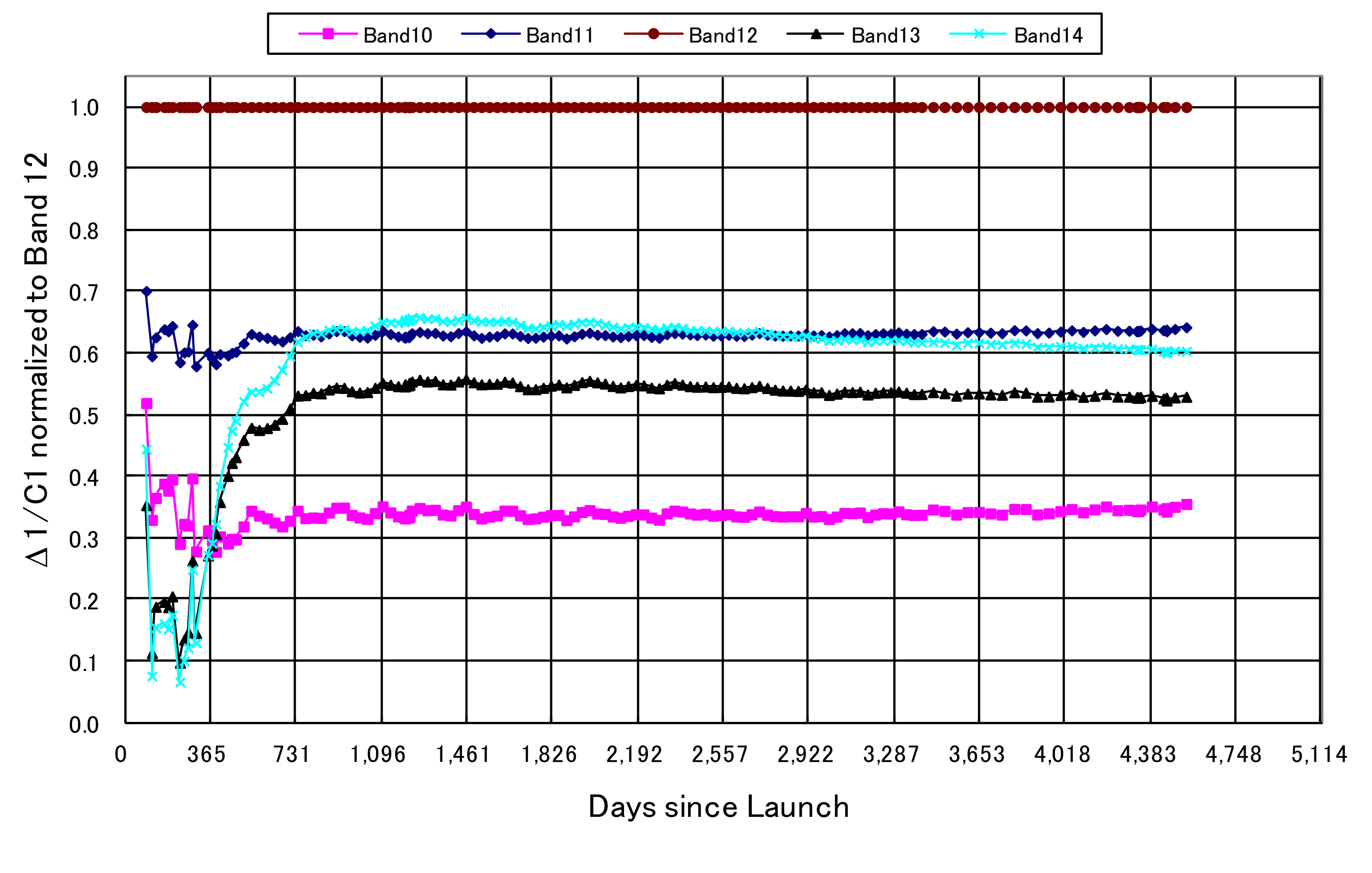
TIR $1/C_1$


Band10
Band11
Band12
Band13
Band14
Ratio of 1/C1
Days since Launch
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0
365
731
1,096
1,461
1,826
2,192
2,557
2,922
3,287
3,653
4,018
4,383
4,748
5,114

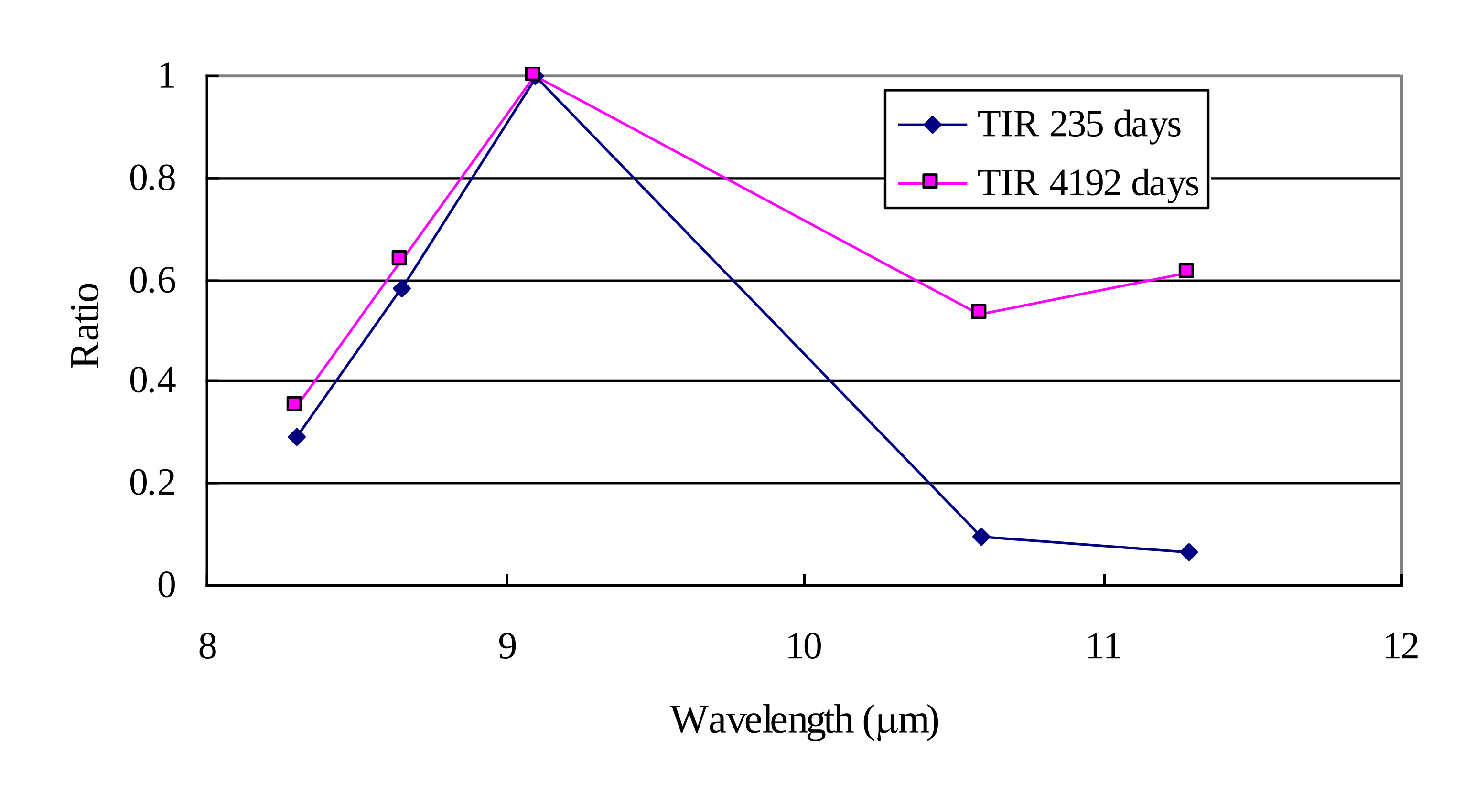
TIR Spectra

- TIR Spectra History
- TIR Spectra
- Hydrazine
- Silicone

TIR Spectra History



TIR Spectra



1
0.8
0.6
0.4
0.2
0
Ratio
8
9
10
11
12
Wavelength (μm)
TIR 235 days
TIR 4192 days

Possible cause of degradation

- Contamination by fuel

Hydrazine or its impurity

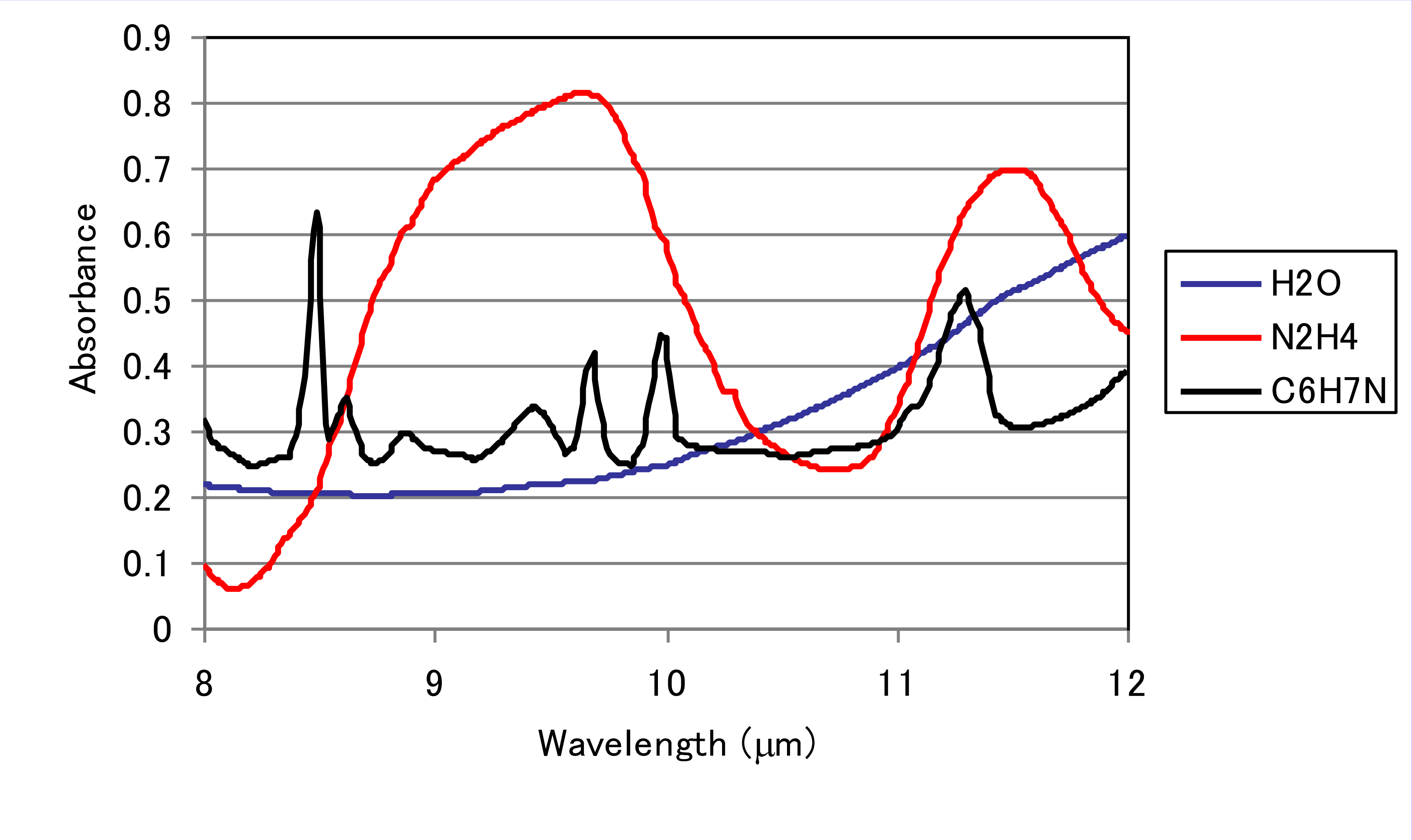
- Outgas from Silicone

Siloxane

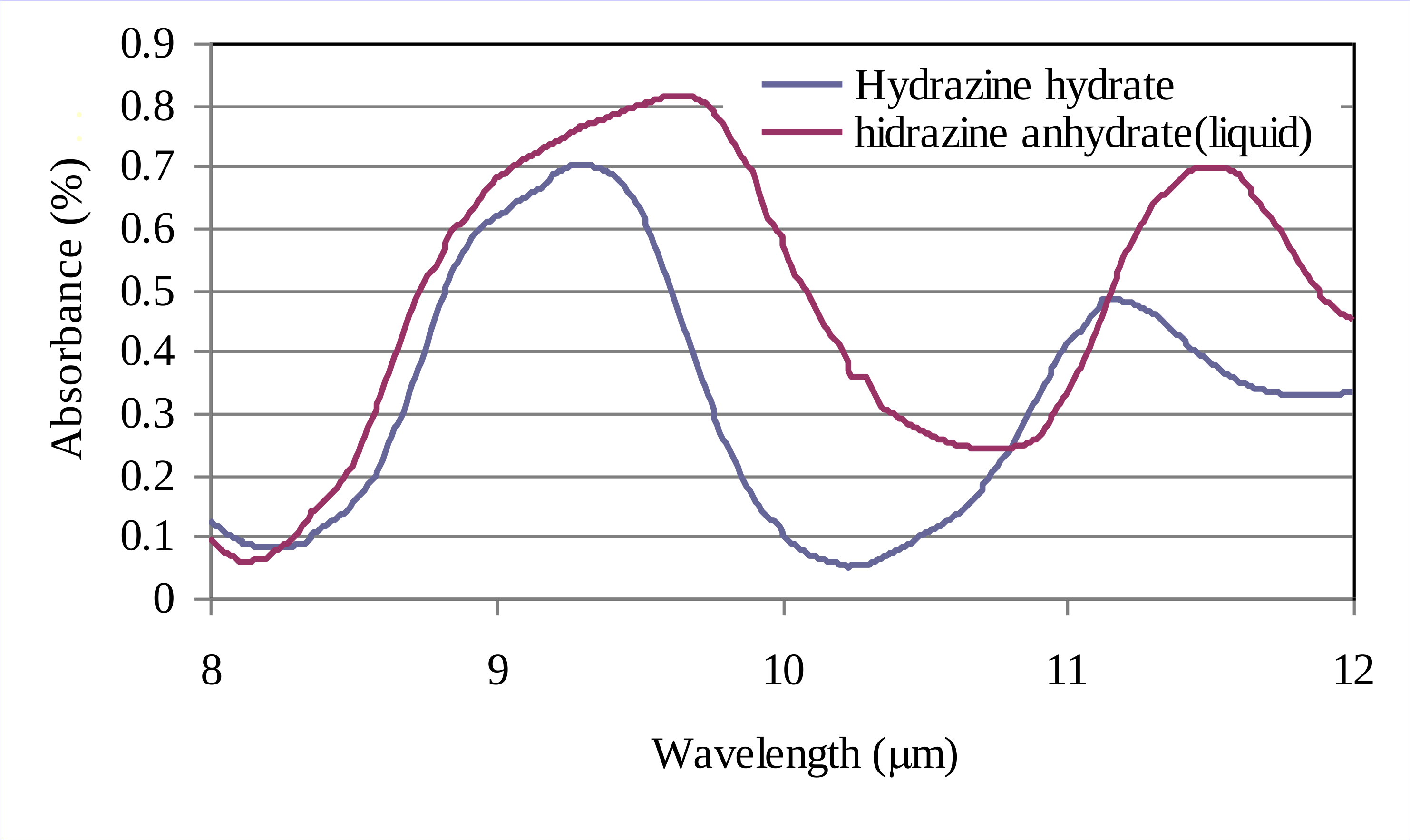
Exhausted components from hydrazine fuel

Species	Mole Fraction	Condensation Temperature (K)
NH_3	0.10-0.77	106
H_2	0.02-0.59	5
N_2	0.20-0.32	25
N_2H_4	0.004-0.05	162
H_2O	<0.03	166
C_6H_7N	<0.002	178
CO_2	<0.0002	83
Others	<0.00007	

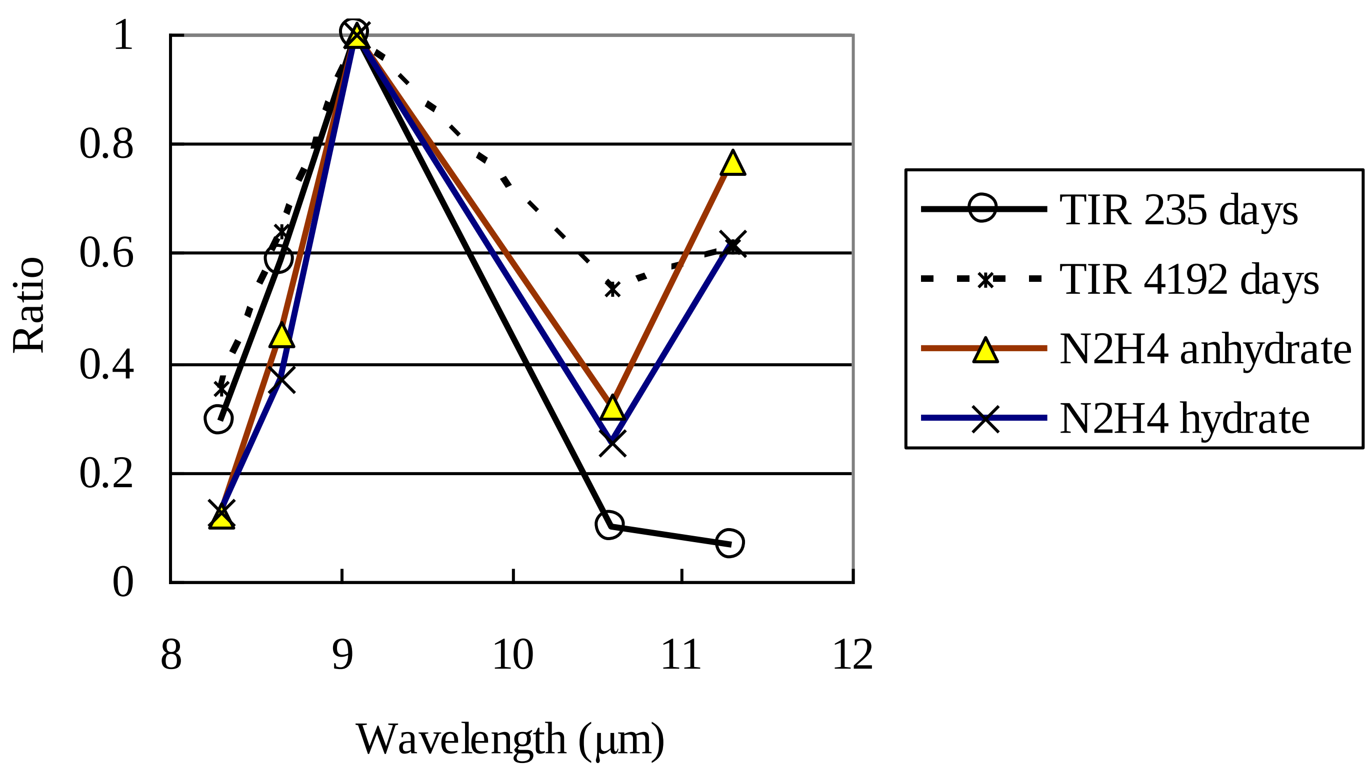
Infrared spectra of water, hydrazine and aniline



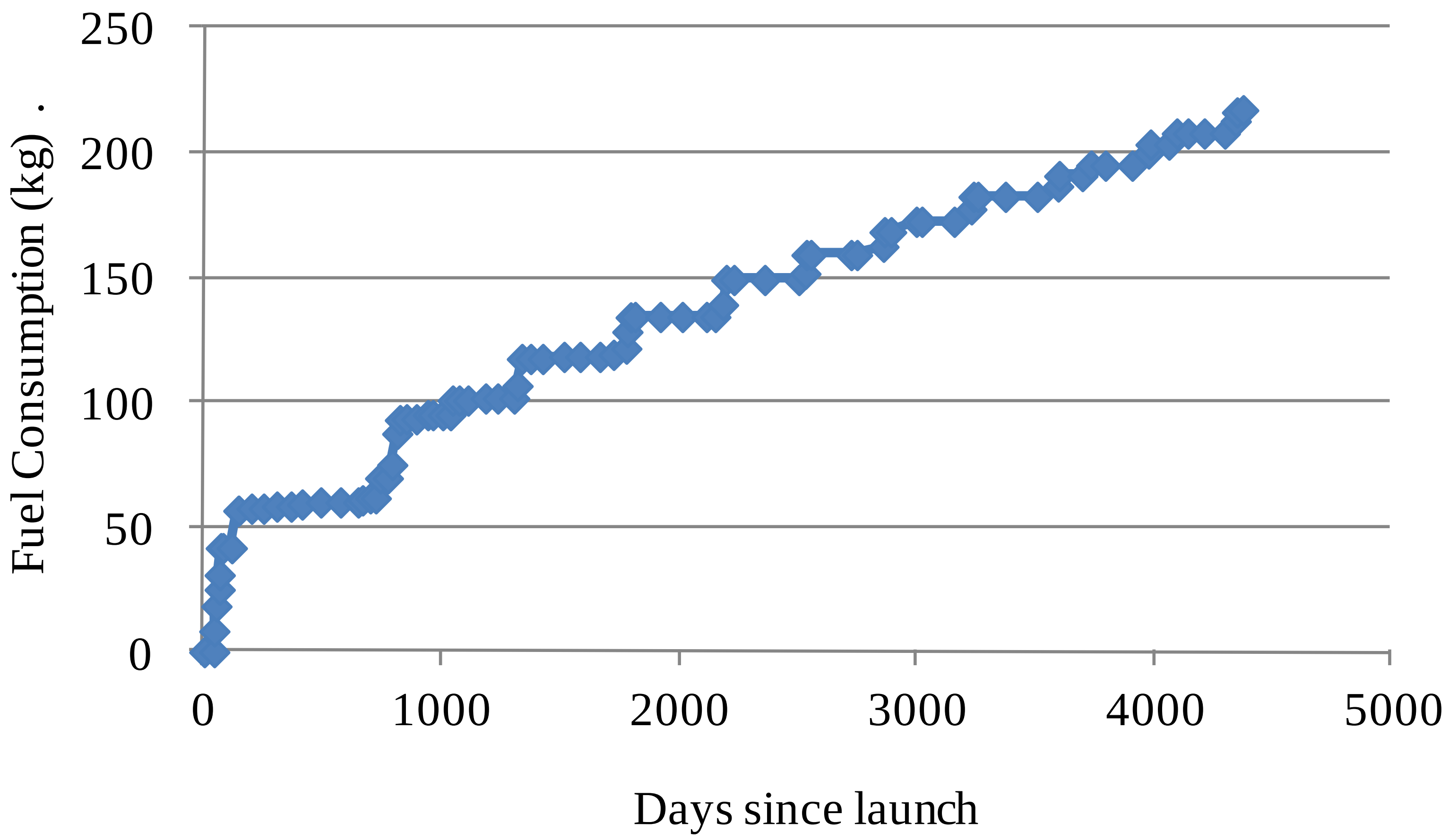
Hydrazine Spectra



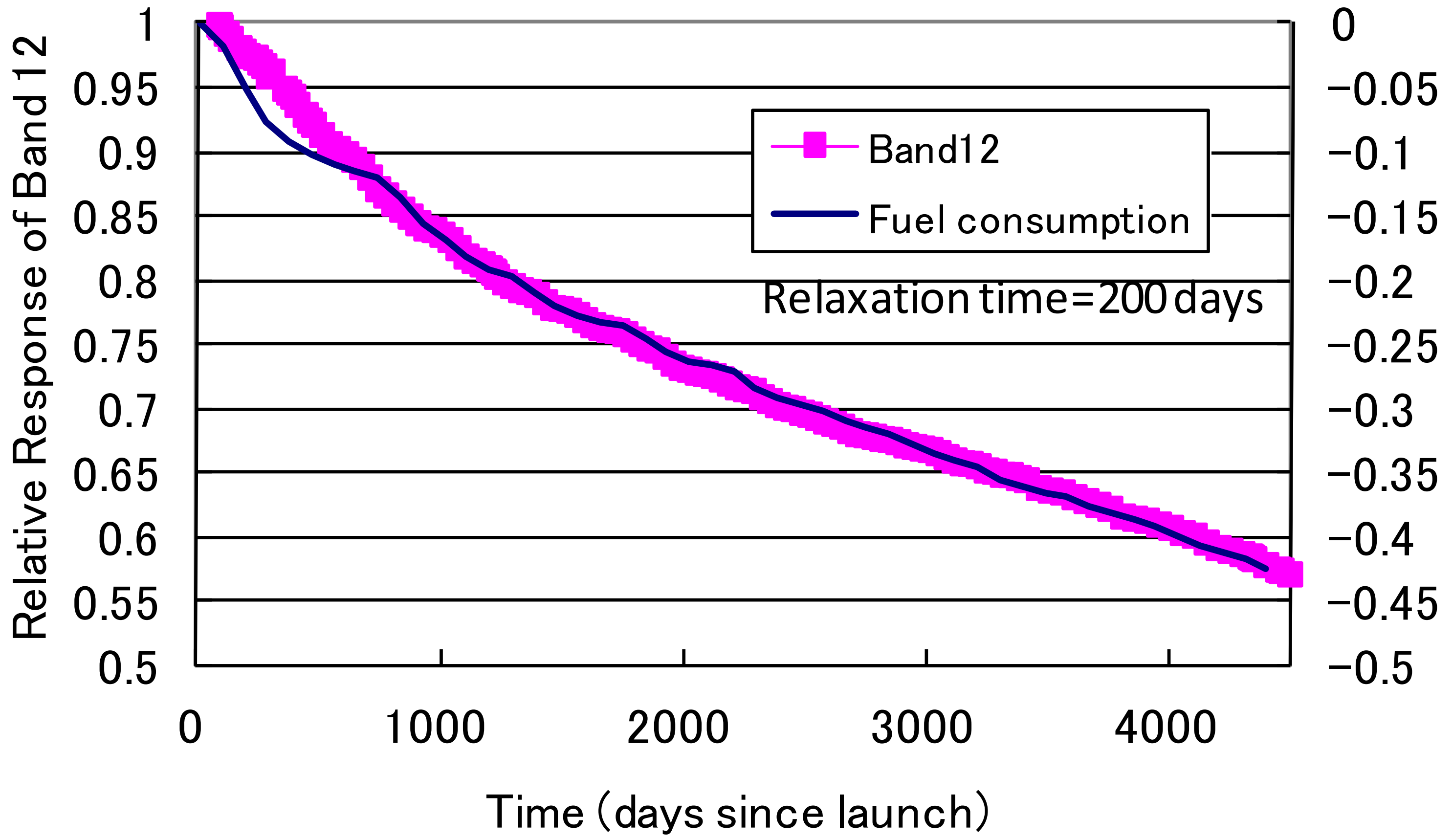
TIR Band-Averaged Hydrazine Spectra and TIR degradation



Hydrazine Fuel Consumption



Hydrazine Fuel Consumption and TIR Degradation



Hydrazine film thickness estimate from infrared absorbance

Film Thickness	Absorb-ance	Notes
2 to 4 μm	69.6 %	Hydrazine from paper
1 to 1.9 μm	43.5 %	Hydrazine thieckness
0.3 to 0.7 μm		For Pointing mirror

In case of hydrazine, the thickness was estimated as 0.5μm at the Pointing mirror.

Inclination Adjustment Maneuver (IAM) in Fiscal Year 2011

	Date	Cal before	IAM	Cal after	Beta angle
IAM#29	19 October 2011	4:10:55 to 10:02:52	14:57:23 to 15:29:38	15:43:09 to 21:35:06	19.9 °
IAM#30	26 October 2011	4:17:47 to 10:09:44	15:03:36 To 15:36:35	15:50:00 To 21:41:57	19.9 °
IAM#31	23 February 2012	5:06:56 to 10:58:53	15:53:16 to 16:35:24	16:39:05 to 22:31:02	26.7 °

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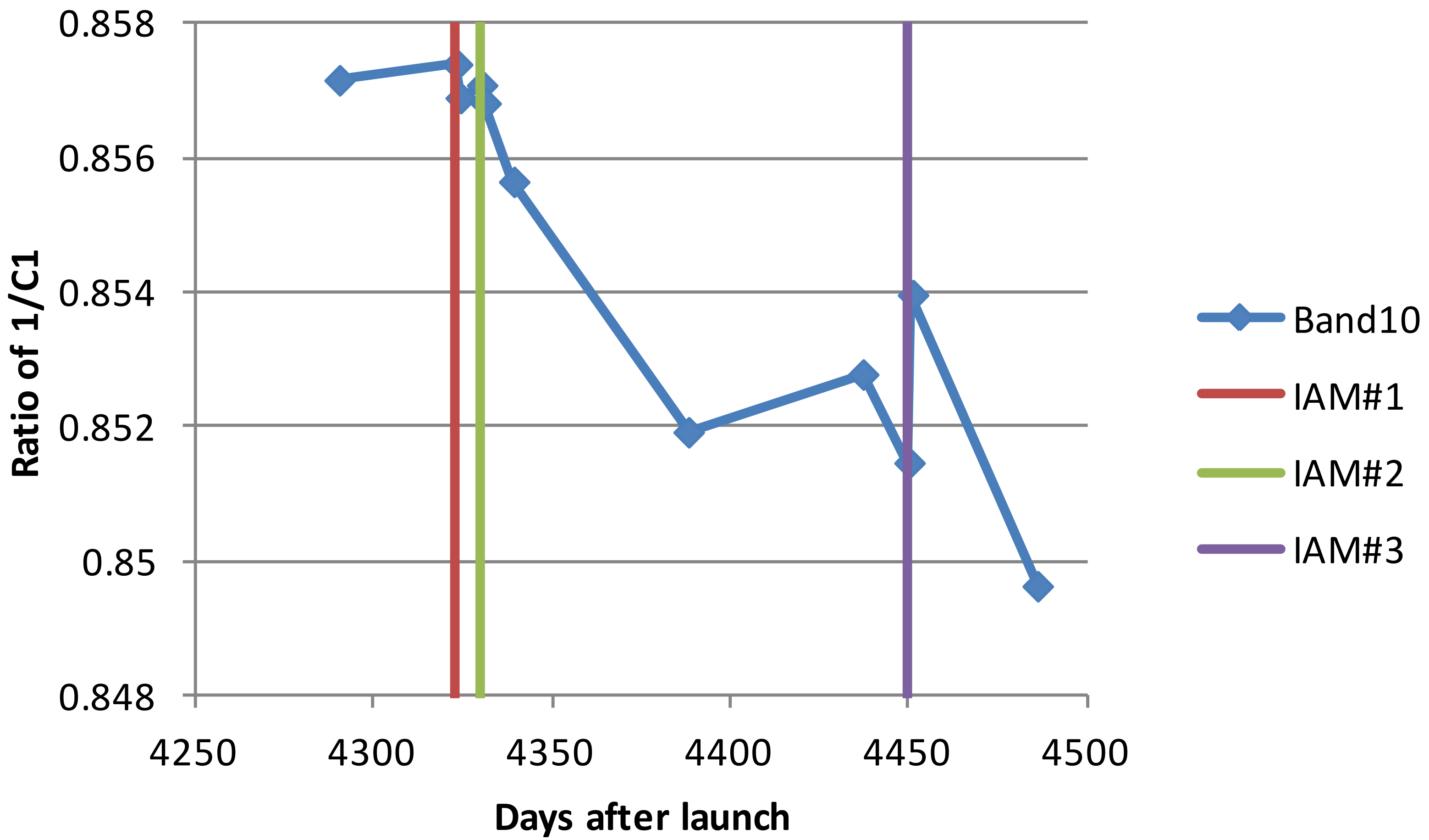
1/C1 Band 10



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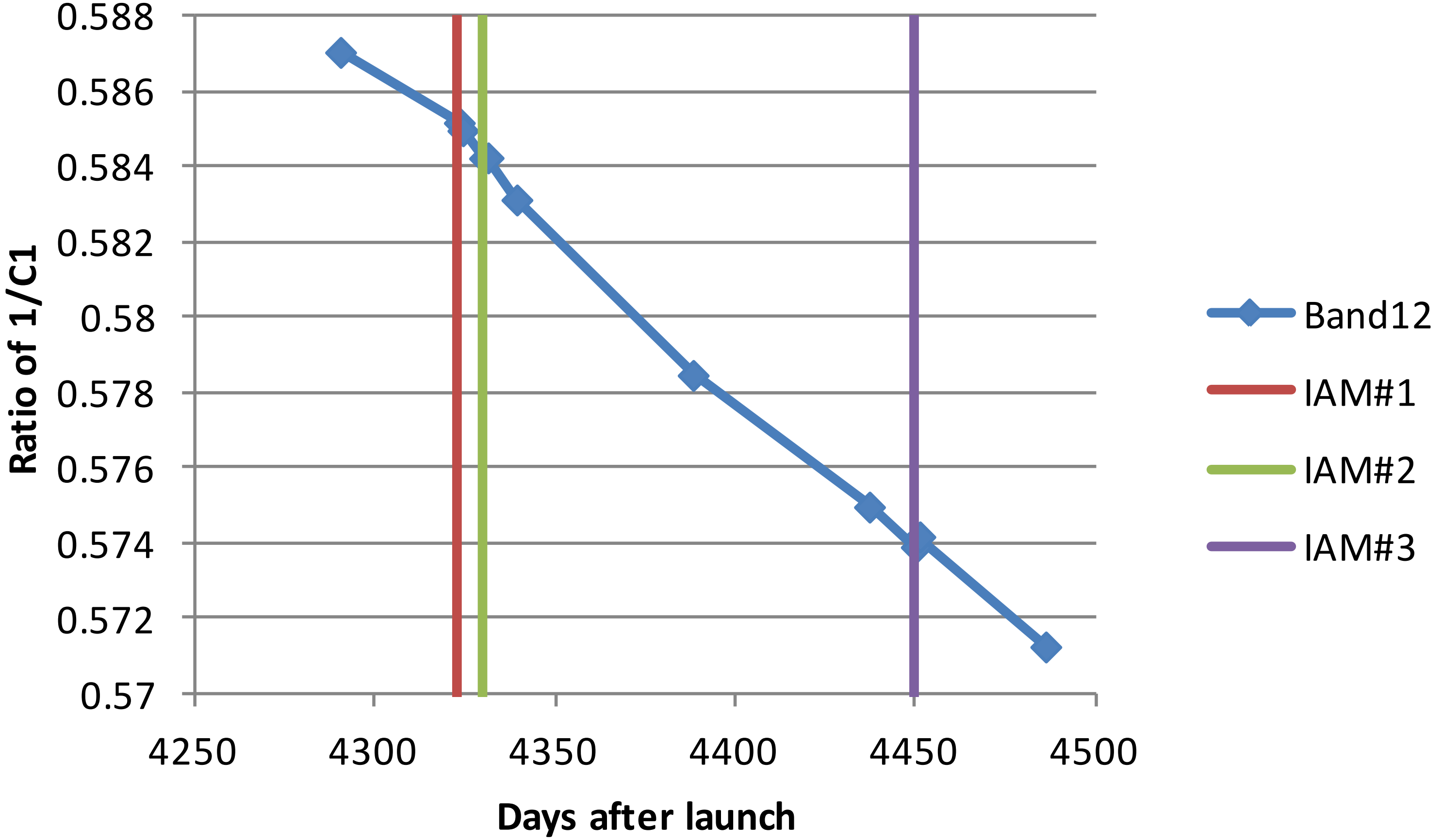
1/C1 Band 12



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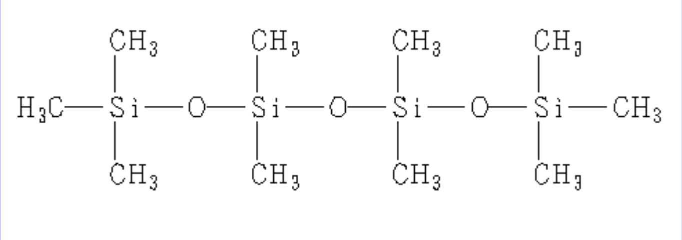
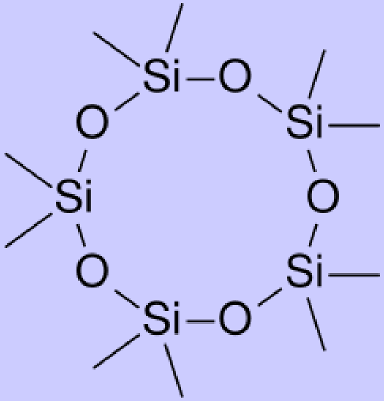
Silicone

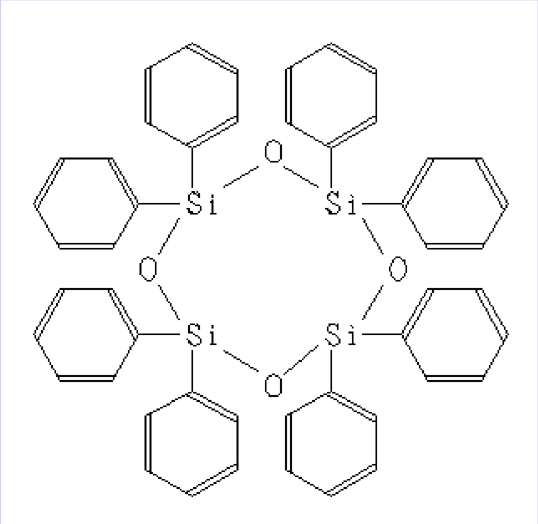
decamethyl
Tetrasiloxane
$C_{10}H_{30}O_3Si_4$



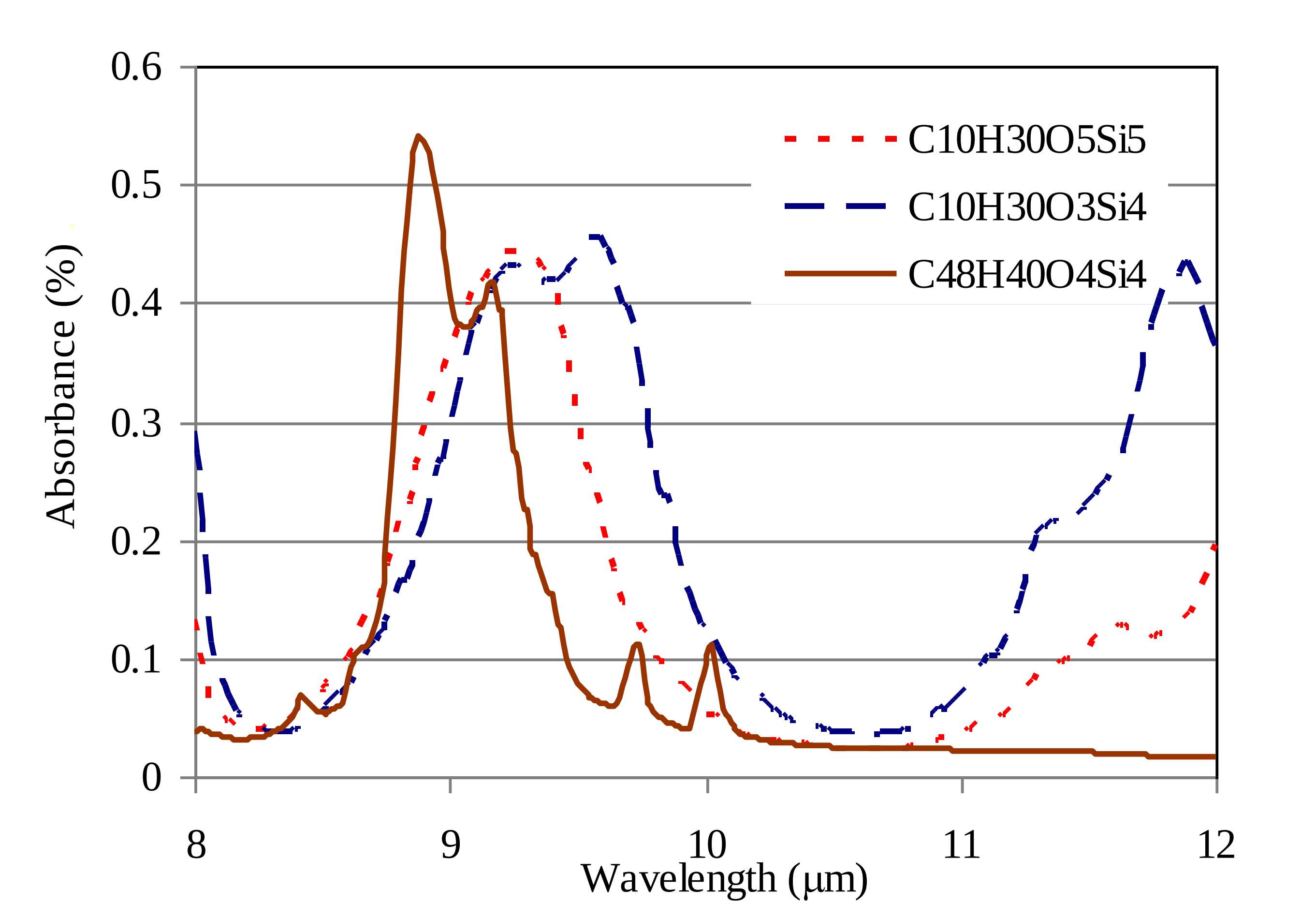
Decamethyl
cyclopentasiloxane
$C_{10}H_{30}O_5Si_5$



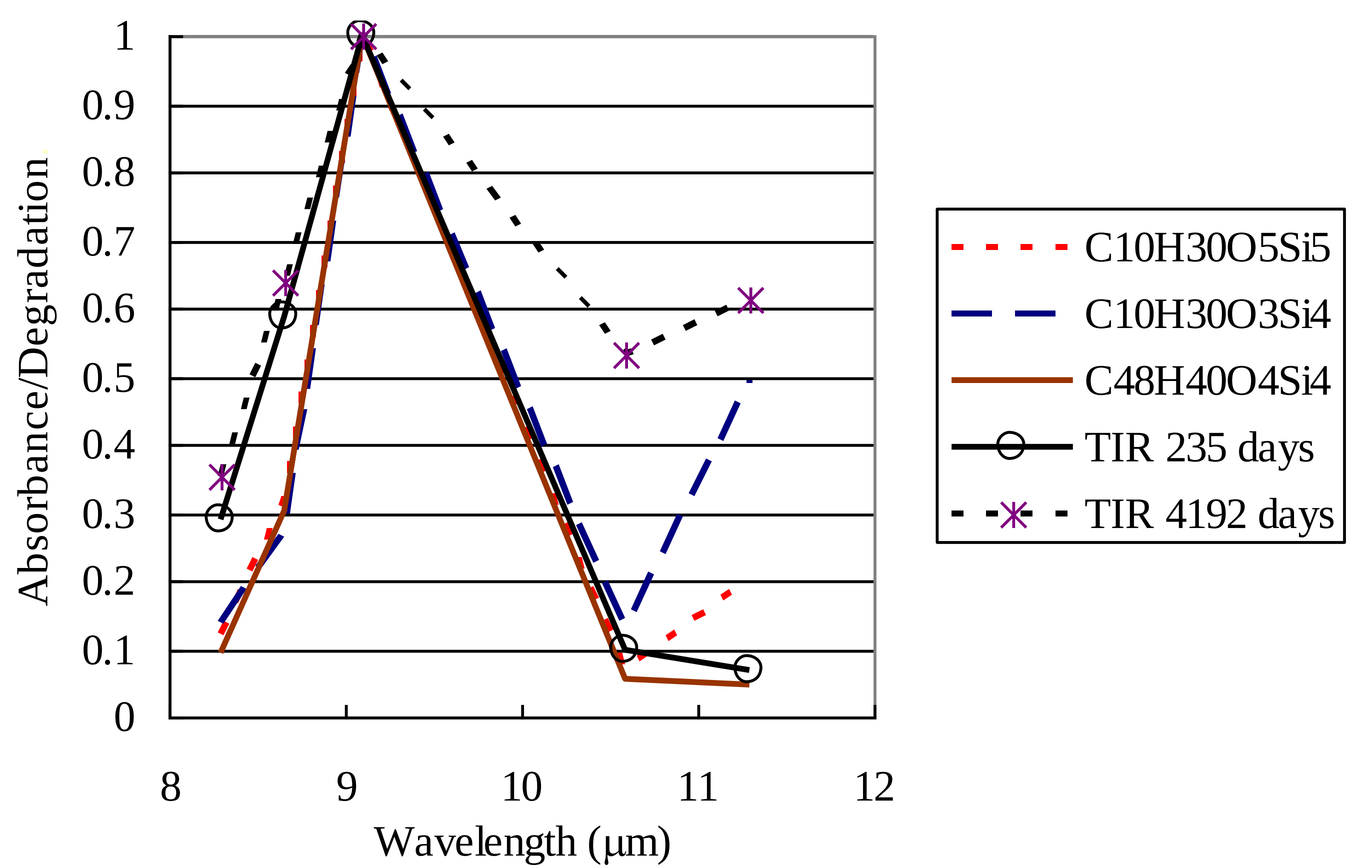
Octaphenyl
cyclotetrasiloxane
$C_{48}H_{40}O_4Si_4$



Siloxane Spectra



TIR Band-Averaged Siloxane Spectra and TIR degradation



Conclusions

The ASTER VNIR and TIR have been working for twelve and half years in space.

The degradation of output signal is about 43 % at the TIR Band 12.

From the degradation spectra of the TIR five bands two possible causes were discussed.

Hydrazine absorption spectra is similar to the TIR degradation spectra but LTC just before and after IAM showed almost no difference.

Outgases from silicones might be the first contaminant.

An experiment of the silicone outgas test at JAXA is planned and starts soon.

Thank you for listening!