

**MEMORANDUM FOR** The Record

**FROM** Changyong Cao, NOAA/NESDIS/STAR/SMCD/SPB  
Ping Jing, I.M. Systems Group

**SUBJECT** NOAA-N' HIRS (H308) Spectral Response Functions

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The spectral response functions (SRFs) of the 19 infrared channels of HIRS/H308 for NOAA-N' have been generated based on the optical piece part spectral response of this instrument. The following files are attached:

1. H308srf.txt: the SRFs in ASCII with the same format as those for previous instruments, i.e.,  

Channel number	# of data points			
wavenumber	filter transmittance	sys. w/o filter	total sys.	normalized total sys.
....				
2. H308cwnbc.txt: an ASCII file that contains the center wavenumber (CWN), half power bandwidth, and band correction coefficients
3. H308SRF\_MEMO.pdf: a memo about the H308 spectral response functions (this file)
4. H308srf.pdf: the spectral response functions in graphic format
5. H308srffcompare.pdf: graphic comparison of SRFs with those from previous instruments

Table 1. NOAA-N/HIRS/H308 center wavenumbers and band correction coefficients

channel	center wavenumber	half power bandwidth	band correction coefficients		T <sub>min</sub> (K)	T <sub>max</sub> (K)
	(cm <sup>-1</sup> )	(cm <sup>-1</sup> )	b	c		
1	669.33	3.73	0.001311	0.99999	210	280
2	680.31	10.18	0.007803	0.99996	200	265
3	688.85	14.48	0.018599	0.99991	195	240
4	702.65	14.64	0.018578	0.99992	190	250
5	715.80	13.96	0.018657	0.99992	185	265
6	733.39	17.05	0.019877	0.99991	180	280
7	749.12	17.36	0.020736	0.99991	180	290
8	899.46	34.63	0.065019	0.99977	180	330
9	1028.14	22.55	0.038021	0.99988	190	270
10	802.32	15.10	0.016169	0.99994	180	290
11	1362.20	39.29	0.075651	0.99981	180	290
12	1531.04	51.52	0.104860	0.99976	180	260
13	2185.02	20.47	0.016756	0.99997	180	300
14	2213.95	21.55	0.017841	0.99997	180	290
15	2232.65	21.03	0.016995	0.99997	180	280
16	2246.86	21.66	0.017311	0.99997	185	260
17	2420.81	30.96	0.032879	0.99995	190	280
18	2518.41	32.23	0.045757	0.99993	195	340
19	2661.92	101.52	0.276520	0.99962	220	340

Note: 1)  $T_{\min}$  and  $T_{\max}$  are the minimum and maximum temperatures used in generating the band correction coefficients.

2) HIRS level 1b data users can use the following procedure to convert the Earth scene radiance  $R$  into brightness temperature  $T$  (Weinreb, et al, 1981, NOAA Technical Report NESS 85):

$$T^* = \frac{c_2 \nu}{\ln(c_1 \nu^3 / R + 1)}$$

$$T = (T^* - b) / c$$

In which:  $R$  = scene radiance ( $\text{mW}/[\text{m}^2 \text{sr cm}^{-1}]$ )  
 $T^*$  = effective temperature (K)  
 $c_1 = 1.1910427\text{E-}5 \text{ mW}/(\text{m}^2 \text{sr cm}^{-4})$   
 $c_2 = 1.4387752 \text{ (K cm)}$   
 $\nu$  = center wavenumber ( $\text{cm}^{-1}$ )  
 $T$  = scene brightness temperature (K)  
 $b, c$  = band correction coefficients in Table 1

3) The H308 SRFs are generated with the same software used for generating the SRFs for the previous HIRS instruments. In processing the SRFs, the long ‘tails’ of the H308 SRFs are removed. The left cut-off point on the SRF curve is set to be where the first zero SRF value appears as the wavenumber decreases from the center wavenumber (CWN); the right cut-off point is where the first zero SRF value appears as the wavenumber increases from the CWN. Although the ‘tails’ are necessary for the instrument developers to prove that there is no out-of-band response, they need to be removed here so that they will not cause unwanted noise in the application of the SRFs. The removal of the ‘tails’ did not affect the calculation of the CWN.

Table 2. Comparison between the CWN in Table 1 (i.e., STAR CWN) and the vender’s CWN (i.e., ITT CWN)

Channel	ITT CWN ( $\text{cm}^{-1}$ )	STAR CWN ( $\text{cm}^{-1}$ )	STAR – ITT ( $\text{cm}^{-1}$ )
1	669.3266	669.3271	0.0005
2	680.3105	680.3109	0.0004
3	688.8486	688.8489	0.0003
4	702.6446	702.6451	0.0005
5	715.8041	715.8044	0.0003
6	733.3941	733.3939	-0.0002
7	749.1197	749.1194	-0.0003
8	899.4601	899.4609	0.0008
9	1028.1413	1028.1410	-0.0003
10	802.3161	802.3161	0.0000
11	1362.1982	1362.1990	0.0008
12	1531.0426	1531.0399	-0.0027
13	2185.0203	2185.0168	-0.0035
14	2213.9519	2213.9480	-0.0039
15	2232.6572	2232.6538	-0.0034
16	2246.8682	2246.8628	-0.0054
17	2420.8093	2420.8069	-0.0024
18	2518.4117	2518.4131	0.0014
19	2661.9768	2661.9199	-0.0569

4) There are two different definitions of CWN: area CWN and moment CWN. The moment CWN is used here for consistency with the calculations of CWN for previous HIRS instruments. Although our moment CWN matches well the vendor's (as shown in Table 2), the area CWN is found to be different (difference up to  $0.4 \text{ cm}^{-1}$ ). However, this discrepancy should not affect the users since the area CWN is not used.

The moment center is defined as:

$$\nu_{Moment} = \frac{\int_0^{\infty} \Phi_{\nu} \cdot \nu \cdot d\nu}{\int_0^{\infty} \Phi_{\nu} \cdot d\nu}, \text{ in which } \nu \text{ is wavenumber and } \Phi_{\nu} \text{ is spectral response as a function of wavenumber.}$$

For additional information about the NOAA-N HIRS (H308) spectral response functions, please contact us at: [changyong.cao@noaa.gov](mailto:changyong.cao@noaa.gov), or phone (301) 763-8136  $\times$  196.