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TRACE Emission Heights Estimated from TRACE Limb Observations

M. Zhang

Beijing Astronomical Observatory, Chinese Academy of Sciences, China; National Astronomical Observatories, Chinese Academy of Sciences, China.

Abstract. While TRACE data have provided us much information of transition region and coronal structures, many TRACE data users would like to have a knowledge of emission heights of TRACE bands. By analyzing TRACE limb observations, we give an average estimation of emission heights of TRACE 171, 195 and 1216 bands for different features like quiet Sun regions, active regions and coronal holes. Average emission heights over the limb are also discussed. Previous equator-to-pole height variation is further confirmed by TRACE data when averaging on quiet Sun regions. If averaging for all fluxes, a reverse equator-to-pole height variation is shown.

1. Introduction

While TRACE data have provided us much information of transition region and coronal structures, many TRACE data users would like to have a knowledge of emission heights of TRACE bands. This knowledge can help us understand the different features detected by different TRACE bands. At the same time, it is usually found that at nearly all wavelengths there exist large differences in limb profile between the equator and the pole (Zhang, White and Kundu, 1998). It is interesting to check whether this difference exists for TRACE observations.

2. Observation, Background and Noise Detection

We analyzed the limb images detected with the TRACE telescope at 171, 195 and 1216 bands on 12 and 25 August 1999 respectively. For each day, 14 limb images are analyzed for each band.

To estimate the background level, we first find the median value of the flux f (in DN counts per exposure time per pixel) for each image in each band, and then find the median value of these median values of each band and use this value as the estimated background level of each band. Using this method, the background levels for this set of data are estimated at 5 DN for 171 and 195 bands respectively and 35 DN for 1216 band. Followed Aschwanden et al. (2000), the noise level for 171 and 195 bands are estimated as 3.5 DN with $f_{background} = 5DN$ respectively and the noise level for 1216 band is estimated as 17.7 DN with $f_{background} = 35DN$.

3. Average Formation Heights Calculation

For each image, 101 formation heights are calculated in 101 different directions, each one is separated by 0.2°. Along each direction, we first find the "outmost point" which is defined as that whose intensity itself and intensities of those points who are 3″ closer to the disk center than this point are all greater than $f_{background} + 3\sigma$. (This is to exclude selecting those "bad pixels" which may have high intensities in several pixels. Having high intensities in continuous 3″ may exclude most bad pixels and indicates a real emission.) Then we calculate the flux-weighted height from the WL limb to this point, and define this height as the average emission height in this direction.

4. Average Emission Heights For Different Features

Table.1 shows the found average emission heights of TRACE 171, 195 and 1216 bands by averaging in all directions. These values may give us a basic idea of typical emission heights of these TRACE bands.

Wavelength (Å)	Formation Heights		
	Active Regions	Quiet Sun Regions	Coronal Holes
171	60 ± 20	23 ± 4	21 ± 4
195	75 ± 17	41 ± 9	48 ± 5
1216	9 ± 7	6 ± 3	8 ± 4

5. Average Emission Heights Along the Limb

Figure 1 shows the emission heights of TRACE 171, 195 and 1216 bands along the limb by averaging for all fluxes. It shows a higher emission height near the equator than near the poles. X-axis is the longitudinal degree from $x = 0°$ (equator) to $x = 90°$ (poles). Y-axis is the average emission heights from the WL limb in arcsec, averaged every 10°.

Figure 2 shows the diagrams of the calculated emission heights of 171 band (in arcsec) against their 171 fluxes (in $log_{10}DN$) near the poles (±10°) (top) and near the equator (±10°) (bottom). Triangles show active regions, pluses show quiet Sun regions and squares show coronal holes. We can see that emissions from near the equator cover a wide range. When we average for all fluxes as above in Figure 1, the average emission height near the equator will be higher than that near poles. Only when averaging for the low end of fluxes, for example, averaging the flux lowest 50 points, the average emission height near the equator (18.4″) is lower than that near poles (23.2″), which is in agreement with previous pole-to-equator studies.

6. Summary

By analyzing TRACE limb observations, we find that:

1. Active regions, quiet Sun regions and coronal holes are formed at 60″, 23″ and 21″ above the WL limb respectively on average for 171 band. For 195 band, active regions, quiet Sun regions and coronal holes are found to be formed

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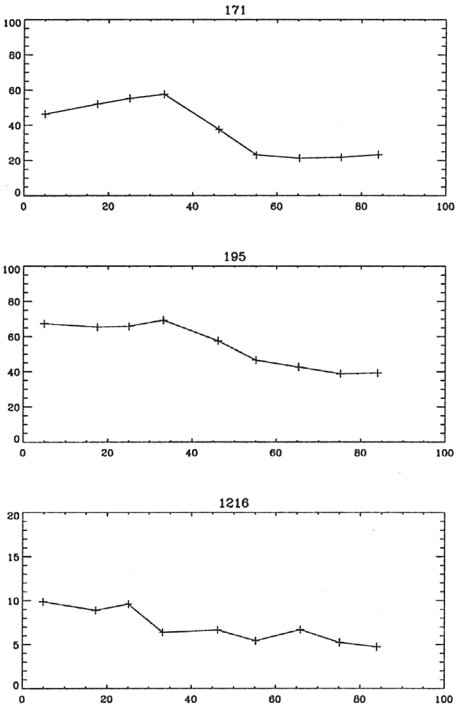

Figure 1. See text.

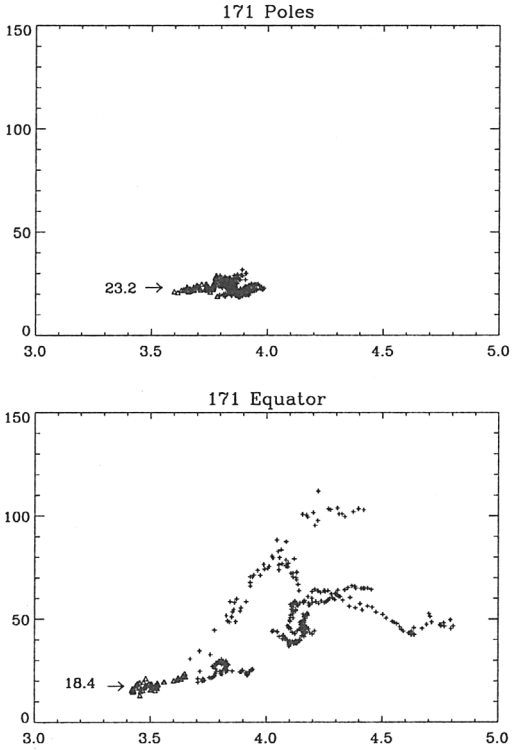

Figure 2. See text.

at 75″, 41″ and 48″ above the WL limb respectively on average. For 1216 band, active regions, quiet Sun regions and coronal holes are formed at 9″, 6″ and 8″ above the WL limb respectively on average.

2. Previous equator-to-pole height variation is further confirmed by TRACE 171 and 195 Å data when averaging at the low flux end. When averaging for all fluxes, a reverse equator-to-pole height variation is shown.

References

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