

ATMOSPHERIC CORRECTIONS FOR TIMS ESTIMATED EMITTANCE

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Figure 1 shows the estimated temperature of the average of 500 lines of TIMS data of the Pacific Ocean, from flight line 94, collected on September 30, 1988, at 1931 GMT. In Figure 1A, with no atmospheric corrections, estimated temperature decreases away from nadir (the center of the scan line). In Figure 1B, a LOWTRAN modeled correction (Kneizys, *et al.*, 1985), using local radiosonde data and instrument scan angle information, results in reversed limb darkening effects for most bands, and does not adequately correct all bands to the same temperature. The atmosphere tends to re-radiate energy at the wavelengths at which it most absorbs, and thus the overall difference between corrected and uncorrected temperatures is approximately 4^o C, despite the average LOWTRAN calculated transmittance of only 60% between 8.1 and 11.6 μm . An alternative approach to atmospheric correction is a black body normalization. This is done by calculating a normalization factor for each pixel position and wavelength, which when applied to Figure 1A, results in a single calculated temperature, as would be expected for a gray body with near uniform emittance.

The black body adjustment is based on the atmospheric conditions over the sea. Figure 2 shows the ground elevation profile along the remaining 3520 scan lines (approximately 10 km) of flight line 94, up the slopes of Kilauea, determined from aircraft pressure and laser altimeter data. This flight line includes a large amount of vegetation that is clearly discernible on the radiance image, being much cooler than the surrounding rocks. For each of the 3520 scan lines, pixels were classified as vegetation or "other" (see Figure 3). A moving average of 51 lines was applied to the composite vegetation emittance (Warner and Levandowski, 1990) for each scan line, to reduce noise (Figure 4). Assuming vegetation to be like water, and to act as gray body with an emittance of 0.986 across the spectrum, Figure 4A shows that the LOWTRAN induced artifacts are severe, and other than for the 0.9.9 μm channel, not significantly different from applying no corrections at all. As expected, with increasing elevation atmospheric effects are slightly reduced (Figure 4B), because moisture tends to be concentrated in the lowermost part of the atmosphere. The black body adjustment (Figure 4C) is highly robust, and even at elevations nearly 600 meters above the sea, remains an alternative procedure for use in calculating emittance.

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Estimated Sea Temperature

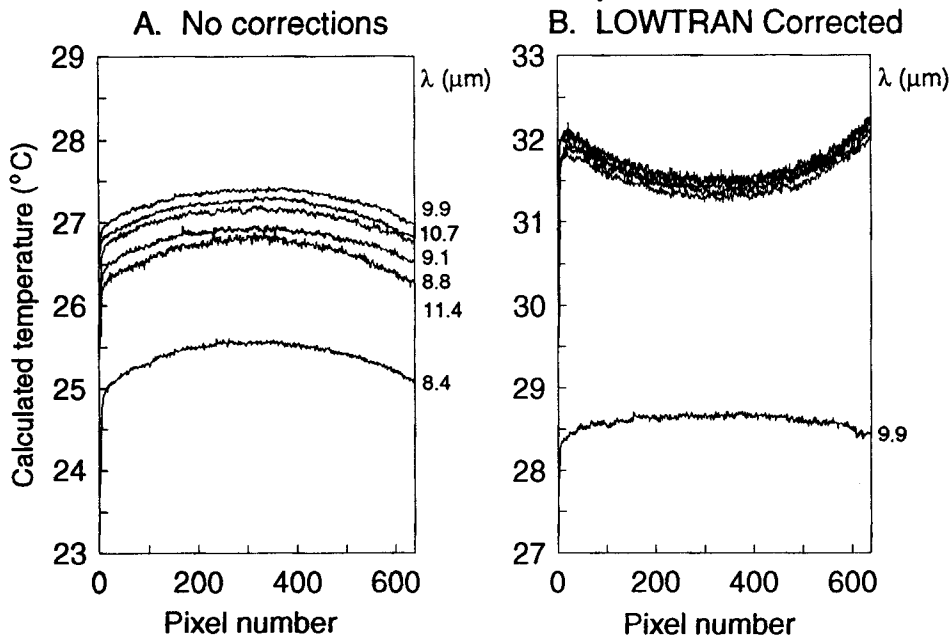


Figure 1. Radiance data from the average of 500 lines of TIMS data of the Pacific Ocean, converted to estimated black body temperatures. A. Temperatures estimated with no atmospheric corrections. B. Temperatures estimated using LOWTRAN modelled atmospheric parameters.

Ground Elevation

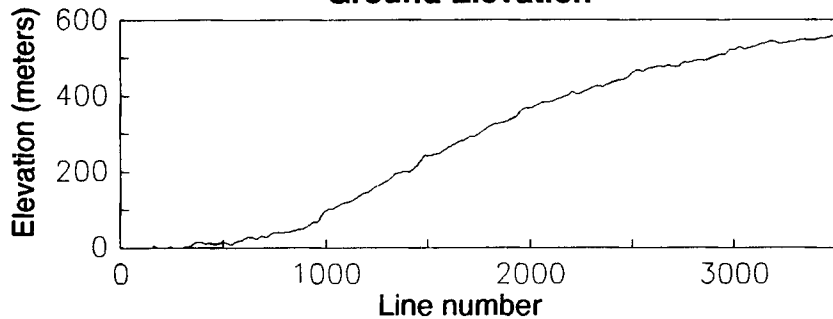


Figure 2. Nadir ground elevation for part of TIMS flightline 94, estimated from laser and pressure altimeter data.

Number of pixels per scan line classified as vegetation

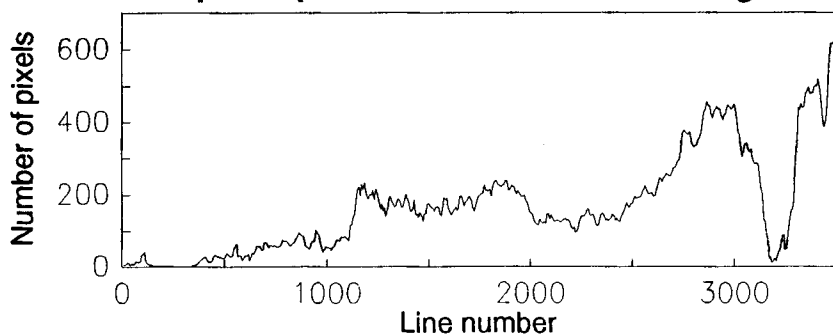


Figure 3. Number of pixels in each scan line classified as vegetation.

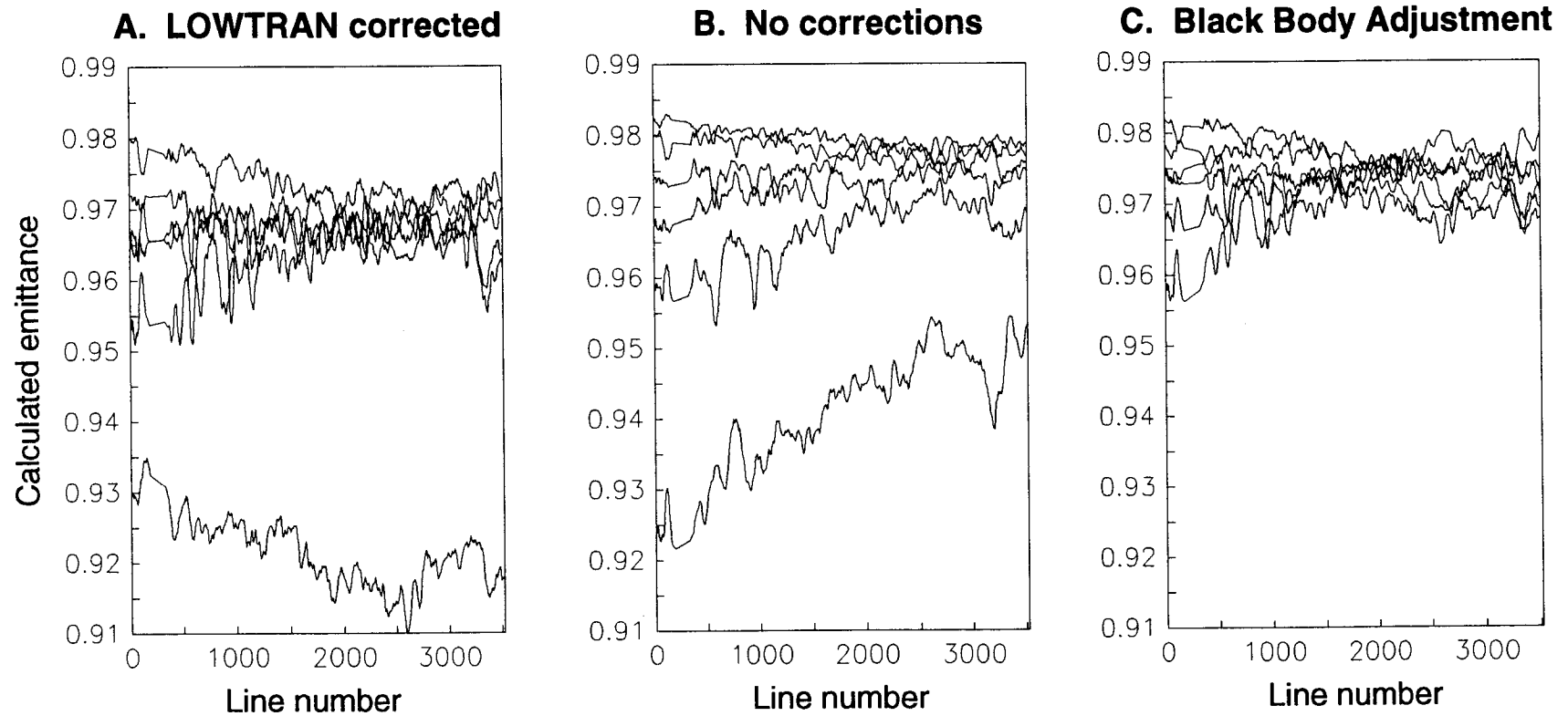


Figure 4. Calculated six band emittance for vegetation versus scan line number. Ground elevation increases with increasing line number (see Figure 2.) A. Lowtran corrected (Lowermost curve is $9.9\ \mu\text{m}$). B. No corrections applied. (Lowermost curve is $8.4\ \mu\text{m}$.) C. Black body adjustment.