and Gloersen (1977) support the notion that the Lambert Glacier interior basin is an area of exceptionally low accumulation. The brightness temperature is, however, a complex function of temperature and snow-crystal structure, and might equally be explained by the different crystal structures in the snow-pack in areas subject to wind glazing. For example, at many sites where there is glaze, we find a very high percentage of depth hoar, probably resulting from restricted vapour transfer within the snow-pack.

Remote sensing is increasingly providing valuable new data over vast areas of Antarctica but considerable care must be exercised in interpreting these data. Landsat imagery cannot be definitively interpreted merely in terms of observed shade differences, particularly when there are no supporting ground-truth data and, while we believe that our interpretation of the imagery from the Lambert Glacier basin is more plausible than that given by McIntyre, both more ground-truth data and quantitative assessment of the Landsat digital signal by spectral classification are needed. The pitfalls associated with interpretation of Landsat imagery by shade differences alone have been previously illustrated for this region of Antarctica; Southard and MacDonald (1974) claimed that the blue-ice areas seen around Komsomol'skiy Peak (Fig. 1) were mountains.

Until new hard data on accumulation rates are obtained from within the interior of the Lambert Glacier basin, we see no justification for revising the accumulation-rate distribution given by Allison (1979). We plan to conduct oversnow traverses within the basin from about 1988. Even accounting for the reduced area of the basin, we estimate that the interior Lambert Glacier basin remains significantly out of balance, with a mass input of approximately 50 GT a^{-1} and an outflow of only 30 GT a^{-1}.

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SIR,

Reply to "On re-assessment of the mass balance of the Lambert Glacier drainage basin, Antarctica"

I have read with interest the letter by Allison and others (1985) regarding my interpretation of tonal variations in Landsat multispectral scanner (MSS) imagery over the Antarctic ice sheet.

Concerning their comments on accumulation rates in Lambert Glacier's interior drainage basin, I should like to make two observations which support my contention of a lower value for net mass input. First, Allison and others claim that the probable strong katabatic winds of the area in question "can redistribute snow but do not result in significant net ablation at the very low temperatures of these inland areas". This statement contradicts measurements made at Mizuho Station (Fujii and Kusunoki, 1982), where surface lowering by sublimation of approximately 54 kg m^{-2} a^{-1} was recorded by two independent methods. These measurements were made across a variety of surface types including hard glaze as discussed by Allison and others. The mean annual surface temperature at Mizuho Station is approximately $-33\,^{\circ}$C (Fujii, 1979) and compares with an interpolated value of $-40\,^{\circ}$C in that part of the Lambert Glacier drainage basin under discussion (McIntyre, in press). I must therefore conclude that significant net ablation could well occur, even towards the ice-sheet interior, and hence result in a reduction in estimated mean accumulation rates from 55 kg m^{-2} a^{-1} (Allison, 1979) to 36 kg m^{-2} a^{-1} (McIntyre, 1985).

Secondly, the complex relationship between emissivity and structure of snow and ice surfaces is such that brightness temperatures could, indeed, be affected by differences in surface character, as pointed out by Allison and others. The measurements made by Zwally and Gloersen (1977), however, demonstrated unexpectedly low values across the entire interior drainage basin of Lambert Glacier and hence extend far beyond the area of blue ice or glazed surface under discussion. Some other basin-wide parameter, such as anomalously low accumulation rates, may offer an alternative interpretation.

Allison and others rightly observe that incorrect interpretation of remotely sensed data can occur without sufficient ground truth. This may be particularly true for sources such as Landsat photographic products. The relative brightness values, or grey scales, of different images may not be comparable, because they are uncorrected for differences in maximum and minimum measurable radiances; these vary both between Landsat satellites and for different calibrations of the same satellite (Dowdeswell and McIntyre, in press).

I would therefore suggest that the present uncertainty as to the cause of tonal variations seen in Landsat data over the Antarctic ice sheet could be resolved by converting digital MSS data into physical values in the form of radiances (Robinove, 1982). This may enable definition of spectral response patterns for different snow and ice types and hence automatic identification and absolute intercomparison within and between Landsat scenes. Although this procedure is not a necessary precursor to the valuable mapping programmes being carried out with Landsat data (for instance, Swithinbank and Lucchitta, in press), it would provide the basis for the absolute comparison of spectral signatures and the quantitative identification of ice-sheet surface characteristics. Of course, such investigations cannot operate entirely in isolation and I look forward to the results of the field work proposed by Allison and others for 1988.

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