GMS ENHANCEMENT

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Note: Much of the following has been taken directly from the GMS Enhancement Manual.

Enhancement is a technique whereby the arrangement of the various grey shades that make up a GMS picture is changed in such a way that the contrasts between certain key features of the cloud, sea or land surfaces become more discernable. No new information is gained, but because identification of some of the data is made easier, interpretation can be more objective.

Both visible and infrared pictures may be enhanced. The visible satellite pictures are based on reflected sunlight measurements obtained when the earth's surface and clouds visible to the satellite are illuminated by the sun. Enhancement is achieved by adjusting the albedo values to increase contrasts in the grey shades. The infrared satellite pictures depend on the equivalent black body temperature of the radiating surface. Enhancement of infrared imagery increases the contrast between adjacent features which have small temperature gradients. This process is particularly useful for fog/stratus situations, identifying thunderstorm tops, areas of warmer (or colder) sea surface temperatures, coastlines and terrain features.

To achieve an enhanced product the incoming high resolution analogue signal transmitted via the satellite is converted to digital format by the processing computer. The digital components of the input signal can then be assigned different values if required, prior to output to produce enhancements.

Digitally each picture element (pixel) of the input or output signal takes a value of either 0, 1, 2, 3, ... 126, 127 level counts, which eventually register a particular shade of grey on the facsimile image. The facsimile equipment in current use in Australia is capable of resolving 32 shades of grey for high resolution sectors, so that each grey step will correspond to a unit of 4 digital signal counts. For a standard (unenhanced) imagery the count levels are arranged so that the darkest shade (black) corresponds to counts 0-3, the next lightest shade to counts 4-7, etc., with the lightest shade (white) corresponding to counts 124-127.

THE AUSTRALIAN GMS MEDIUM DATA UTILIZATION STATION (MDUS) computer allows the relationship between input and output count values to be adjusted according to varying user specification. This relationship can easily be identified from the structure of the grey shade scale (grey wedge) that appears at the top of every transmitted picture. If the input/output relation is linear one-to-one, the grey wedge will show an even progression of lighter shades, starting with black on the left and progressing gradually through to white on the right. Any other form of input/output will result in quite a different grey wedge. The effect of enhancement therefore, is to introduce large shading contrasts between adjoining elements in certain parts of the grey wedge, instead of the subtle changes that are present in standard (unenhanced) imagery. When temperature gradients are small and it is difficult to recognise significant cloud (e.g. thunderstorm tops), enhancement increases the contrast between such features and their background.

In practice enhancement is simply achieved by entering pairs of co-ordinates that specify the input/output relationship via a keyboard display unit and then instructing the compute to output an image based on this configuration. An enhancement can be identified by up to 12 pairs of input/output co-ordinates to define that specific enhancement.

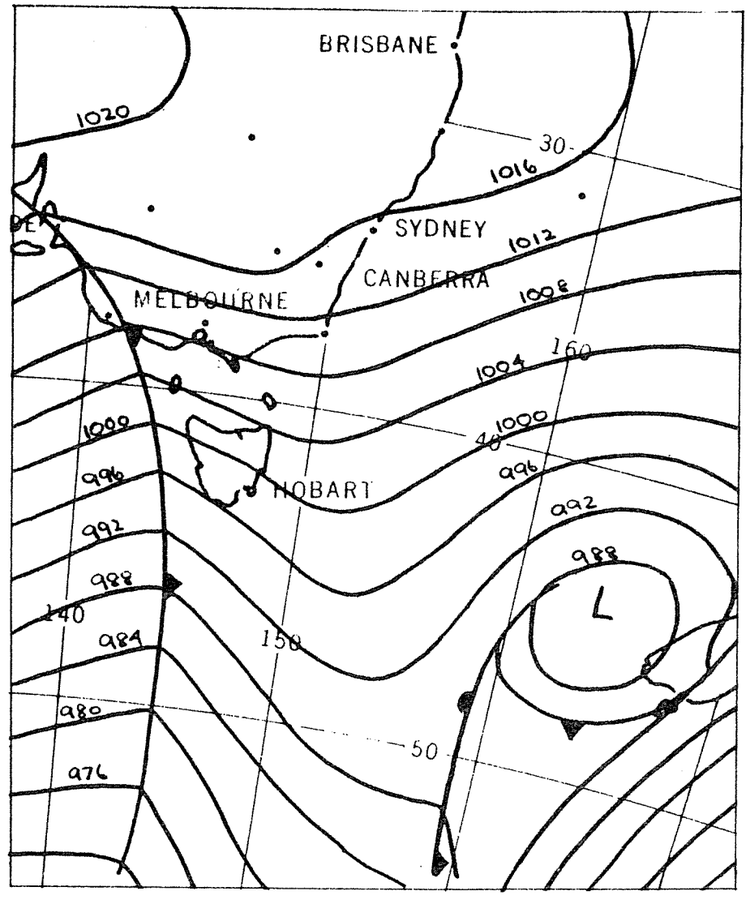


Fig 1. MSL pressure (mb) analysis for 2100 GMT 18 September 1980 over southeastern Australia and adjacent waters.

Example

To illustrate some of the aforementioned points, the situation of 2100 GMT 18 September 1980 is examined.

Fig. 1 is the MSL pressure analysis over southeastern Australia and adjacent waters for that time. It depicts a cold front approaching Tasmania, a west-southwesterly stream over the Tasman Sea, and a complex frontal zone associated with a depression near the South Island of New Zealand.

Fig. 2 illustrates graphically the slight enhancement used routinely to give the optimum grey scale. Count values as input are plotted on the horizontal axis and modified count values are plotted on the vertical axis. (An equivalent black body temperature scale is included along the input axis for reference).

Fig. 3 presents the infrared imagery for the situation of 18 September, enhanced on the basis of the input/output co-ordinates illustrated in Fig. 2. Features of interest are:

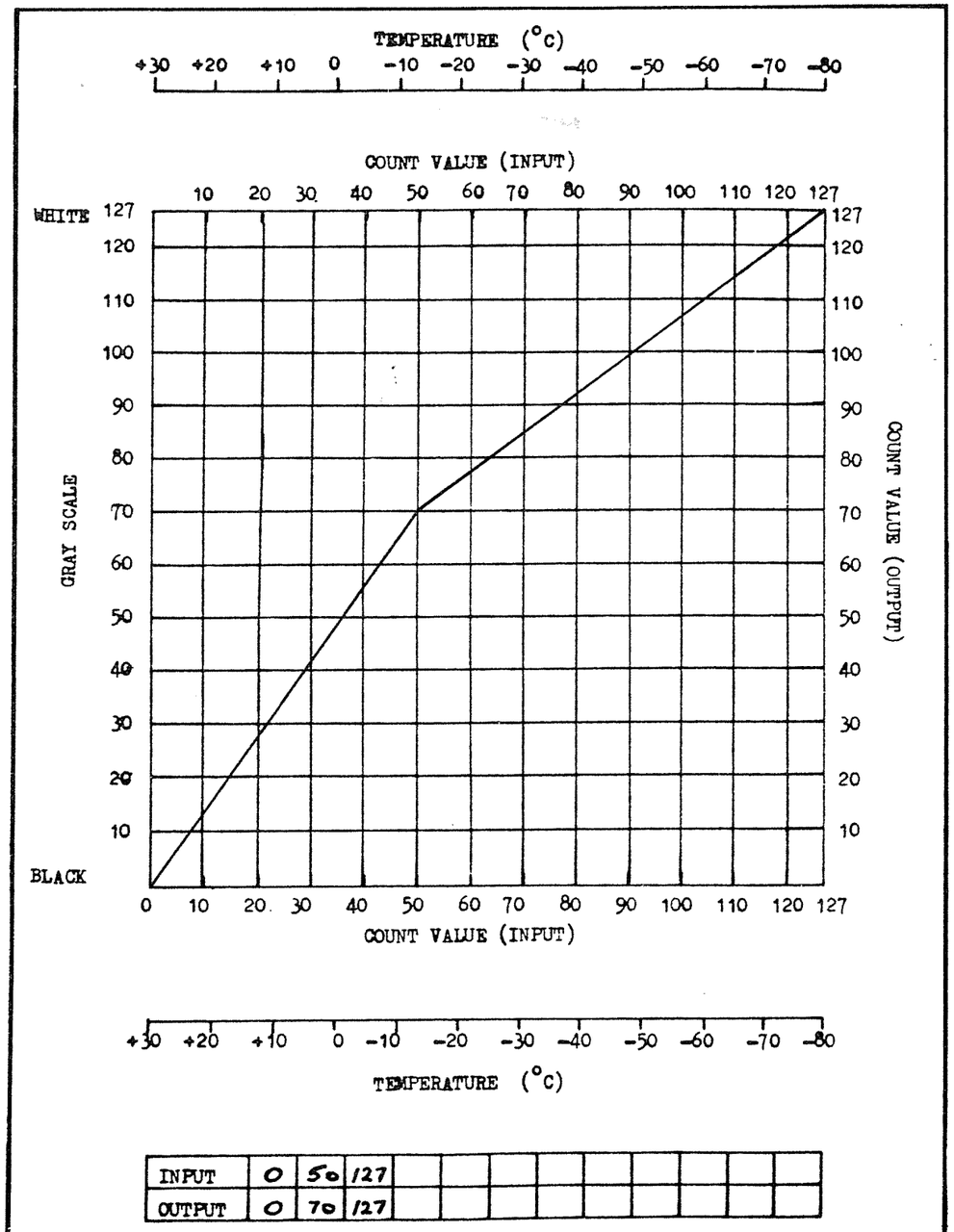
(1) the area of low cloud on the northern side of the Victorian ranges; and

(2) the two frontal zones.

In order to define these features in greater detail than that given in Fig. 3, the more complex enhancement illustrated graphically in Fig. 4 is used. Fig. 5 presents the infrared imagery associated with this enhancement. It may be seen that:

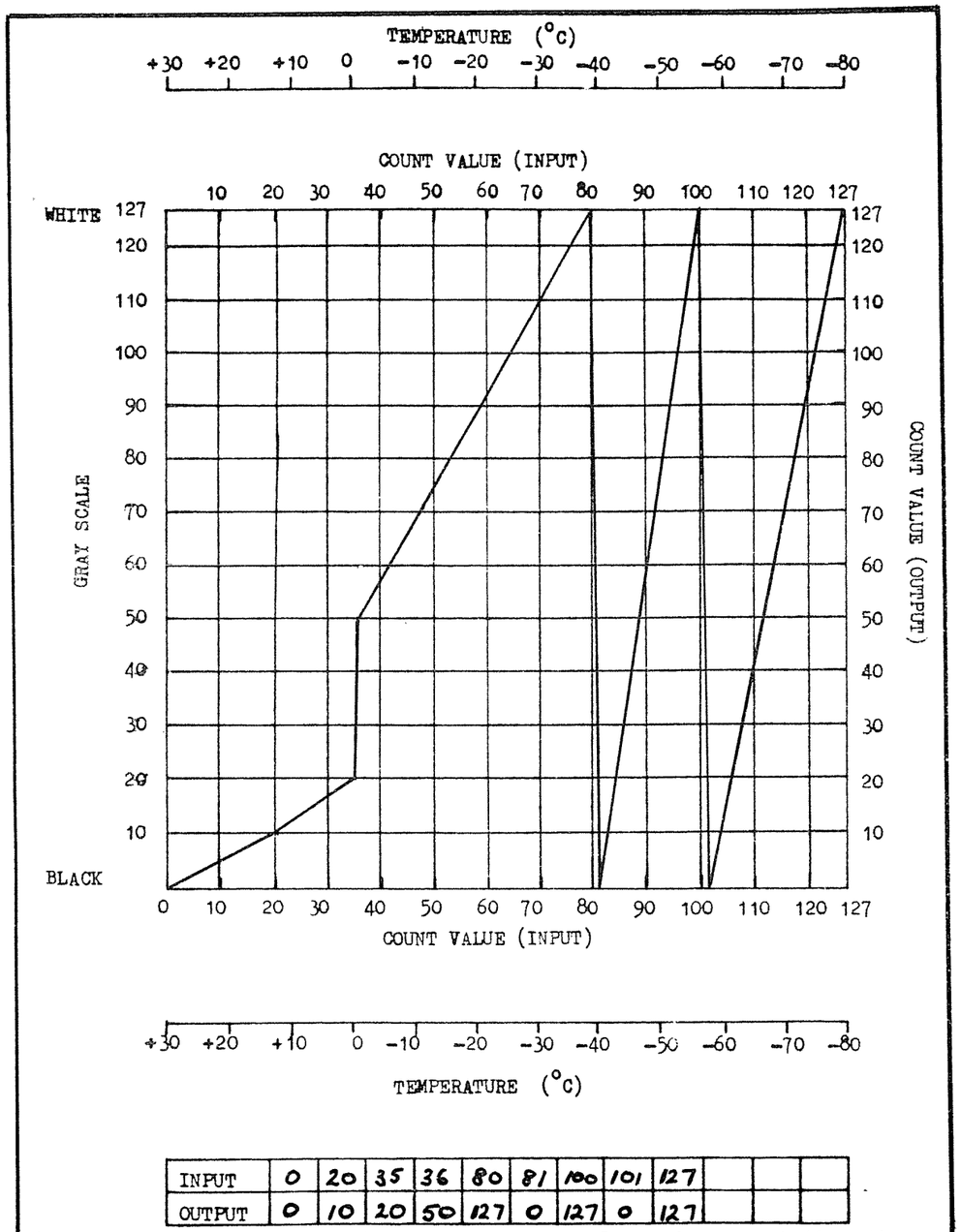
(1) The area of cloud on the northern side of the Victorian ranges has been made more easily identifiable by increasing the grey shade contrast between +ve and -ve blackbody temperatures. As a result the land appears considerably darker than the cloud; and

(2) The structure of the middle and high cloud associated with the frontal zones has been made apparent by inserting darker shades at black body temperatures of approximately -40^{0}C and also at approximately -60^{0}C.



INPUT	0	50	127									
OUTPUT	0	70	127									

Fig 2. Graphical illustration of the slight enhancement used routinely to give the optimum grey scale.



INPUT	0	20	35	36	80	81	100	101	127			
OUTPUT	0	10	20	50	127	0	127	0	127			

Fig 4. Graphical illustration of a more complex enhancement than that given in Fig 2.

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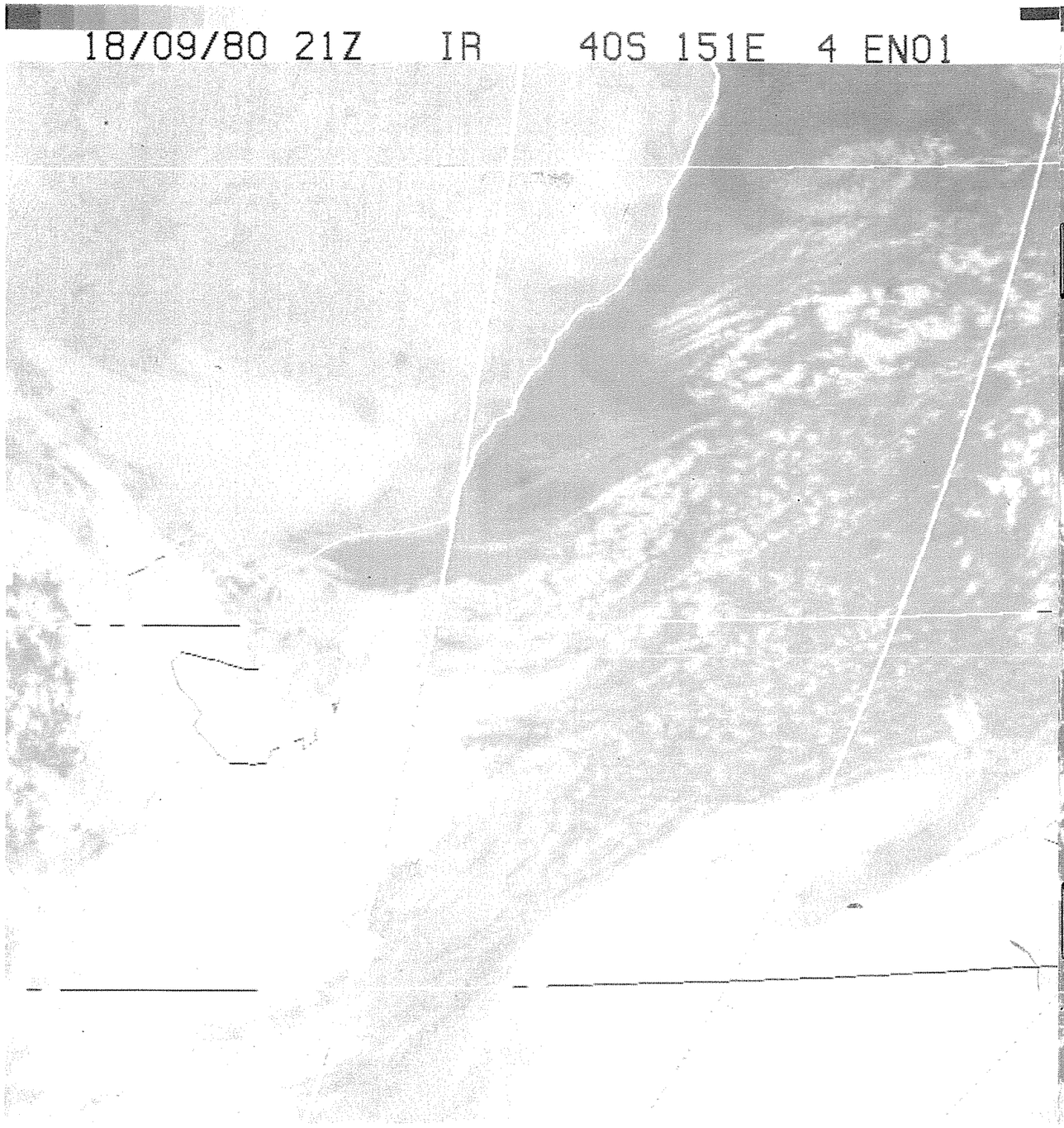

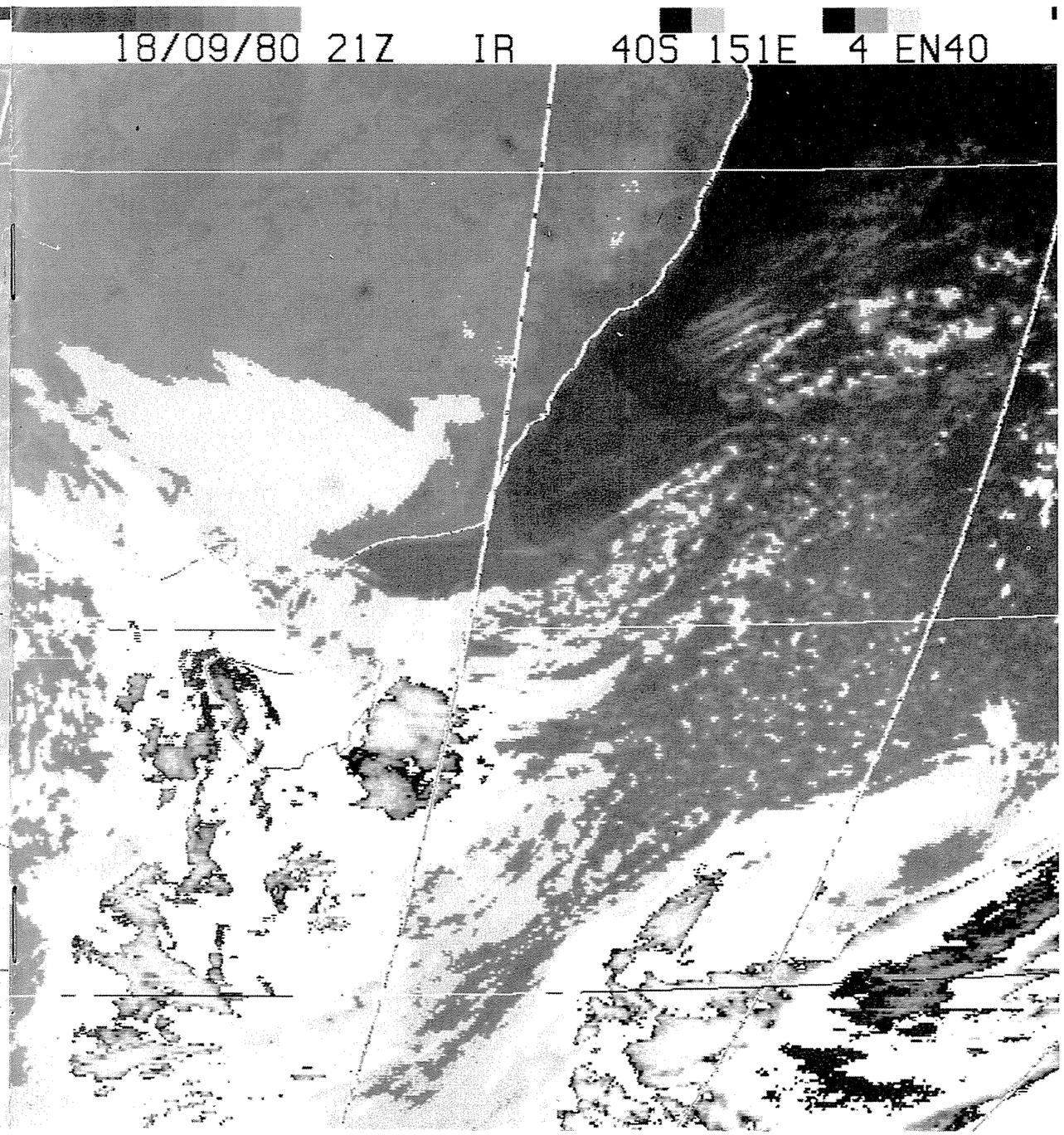

Fig 5 (front cover photograph). Infrared imagery for 2100 GMT 18 September 1980, over southeastern Australia and adjacent waters, enhanced on the basis of the input/output coordinates illustrated in Fig 4.

Fig 3 (above). Infrared imagery for 2100 GMT 18 September 1980, over southeastern Australia and adjacent waters, enhanced on the basis of the input/output coordinates illustrated in Fig 2.

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