

In presenting his results the speaker first discussed the radiation quantities, giving emphasis to the significance of the snow cover on the sea-ice in maintaining its high shortwave albedo. He emphasised also the great importance of radiation as an energy transfer process within the sea-ice, and quoted experimental extinction coefficients for snow and ice. The diurnal temperature wave at a depth of 30 cm was synthesised from a sinusoidal temperature wave of appropriate phase and the radiation curve. The heat flux at 30 cm within the ice was shown to be related to ice growth, the phase delay (which depends on the frequency of the heat flux waves and the ice thickness) being generally four or five days. Development of a heat budget for the sea-ice cover was then discussed and illustrated, and the accuracy of the assessment indicated.

The speaker then considered supra-surface aspects - transfer processes in the atmosphere. Temperature profiles over the sea-ice were found to be closely isothermal - with a tendency to slight inversion conditions in winter and slight lapse conditions in spring (data were available for the period June to November). A logarithmic temperature profile was assumed. From the wind profiles a roughness parameter of 0.013 cm was found for snow covered sea-ice and was related to the micro-structure of the surface. Due to the slight diurnal variation of elements Richardson's numbers were computed on a daily mean basis without incurring significant error. Heat exchange coefficients were calculated after Hoinkes and Untersteiner (1952) and used as the basis for computations of the eddy heat flux. Due to the lack of adequate instrumentation for profile measurements for the determination of latent heat fluxes in the polar regions and the unreliability of glaciological methods under the windy conditions experienced at Mawson, this component of the energy budget could not be computed for the upper sea-ice surface. The latent heat contribution to the energy balance at the ice/water interface was simply calculated by considering the amount of ice accretion or ablation.

In conclusion Mr. Weller set up the complete energy budget for the upper and lower surfaces of the sea-ice, with the latent heat flux as a remainder term for the upper surface and the eddy flux as the remainder term for the lower surface. He then made a comparison of his results with corresponding assessments for the open ocean, showing that the total energy supplied to the atmosphere from ice-covered regions is only of the order of one-seventh that available from the ice-free ocean.

In the ensuing discussion, Dr. C.H.B. Priestley enquired whether any relationship between roughness parameter and wind speed had been looked for, or found. Mr. Weller replied that he could detect no significant variation with wind. Dr. U. Radok commented that a slight correlation had been found at Byrd Base.

Mr. J.C. Langford asked the speaker to comment on the effect of the heat flux upward through the sea-ice on the surface air temperature distribution around the hemisphere, and suggested that the strong thermal gradient even in winter might be concentrated near the Antarctic coastline proper.

A discussion of the temperature distribution as shown in one of the introductory slides followed and Mr. H.R. Phillpot (who had produced the mean isotherm charts shown) commented on their derivation. In turn he asked Mr. Weller if he could account for the existence of apparently lower surface air temperatures well seaward of the coastline than on the coast itself, as found for example by a temporary station on an island seaward from Mirny. Mr. Weller, Dr. U. Radok and other members of the audience speculated on the problem but no general agreement was reached.

J.W.Z.

12 September 1967

CONVECTIVE PROCESSES IN TROPICAL DISTURBANCES

By H. Riehl

Professor Riehl, who is at present Head of the Department of Meteorology at Colorado State University, described work recently completed at Imperial College, London, in collaboration with R. Pearce. In summary, in their own words:-

"The cold-core structure of waves in the easterlies, frequently observed, can be

explained as the accumulative result of many meso-scale downdrafts initiated through evaporation from falling rain. Thus it is suggested that processes on the convective scale can influence the large-scale structure of tropical disturbances.

In consequence of the downdrafts, air with equivalent potential temperature 10°K lower than elsewhere appears in the main convergence zones at the surface. This represents a strong deterrent against hurricane formation. The low energy values, represented mainly by low dew-points, develop along relative trajectories of the surface wind field in spite of maxima of evaporation from below. This demonstrates that the energy transfer from the sea does not determine the magnitude or even the sign of changes in surface heat content. A numerical model for incorporating the meso-scale downdrafts in computations based on synoptic-scale grids is developed.

To illustrate the synoptic background of the proposed model the speaker showed a number of slides describing the three dimensional structure, and moisture and temperature anomaly patterns, through a Caribbean Tropical Disturbance. He then suggested qualitatively the role of meso-scale downdrafts in determining the structure of tropical systems and followed this with a brief mathematical description of the proposed model.

In the subsequent discussion Mr. R.H. Clarke asked whether the vertical humidity distribution should not be a parameter in the model. The speaker replied that the equations could be broken into separate moisture and heat budgets. Dr. G.B. Tucker pointed to the difficulties which would be encountered in divergence assessment over the Indian Ocean and wondered whether satellite data might help. Professor Riehl replied that in the study he had described, divergence had been measured by kinematic methods. High tropospheric cirrus shields would frequently obscure the lower tropospheric features which would provide the basis for satellite assessments of divergence.

Mr. K.T. Morley questioned the validity of ignoring horizontal mixing at the 'boundary' in the proposed model and Mr. J.C. Langford suggested the importance of radiation processes. Dr. D. Sargent asked the speaker for comment on the nature of doughnut-shaped cloud systems in the tropics observed by the ATS Satellite, but Professor Riehl said he had not yet seen these and could advance no explanation.

Note: Professor Riehl indicated that a report on the investigation which he had outlined to the Colloquium would be submitted for publication in the near future.

J.W.Z.

21 September 1967

MOUNTAIN AIRFLOW-LEE WAVES

By C.E. Wallington

Mr. Wallington introduced the subject of his talk with photographs of lee wave clouds over various parts of the earth. He then outlined how lee waves were first noticed visually and then later by glider and powered aircraft pilots.

Conditions that appear necessary for lee waves to occur were then stated as:-

- (i) There is usually a layer of air in the lower troposphere whose stability is greater than the air above or below it.
- (ii) The wind speed at geostrophic level is greater than about 15 knots.
- (iii) The wind is approximately constant to the stable layer.

Scorer's natural wave length of an air stream was mentioned and special reference made to the two-layer airstream of two different natural wave lengths. It was pointed out that in such an air stream a composite wave length would be anticipated.

An interesting analogue was drawn between coil springs of varying toughness and the air flow over mountains. By substituting a tough spring for the stable air where the restoring force on a perturbation is greatest and a weak spring for unstable air, it was noticed that lee wave type oscillations occurred with a tough spring between two weak springs; but with uniform springs waves did not occur.