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program of the National Conference on Micrometeorology of the American Meteorological Society, October 13-16, 1964, Salt Lake City, Utah

Tuesday Morning,
October 13, 9 a.m.

Instrumentation

Chairman: Paul E. Carlson, Dugway Proving Ground, Dugway, Utah.

The use of a sweeping-boom mechanism in a study of low-level radiation flux divergence.
Harry L. Hamilton, Jr., University of Wisconsin, Madison, Wis. (20 min)

A portable mechanism which is capable of continuously moving one sensor, or an array of sensors, vertically through a three-meter layer has been constructed. The device is designed so that the movement of the sensors is uniform, at selected rates (between 1 and 1/3 sweep per min), and the cycling is automatic.

Sensors for micrometeorological studies which have been used thus far include: thermocouples, to measure temperature profiles across an air/water interface; shielded flux-plate radiometers, to measure infrared radiation profiles; wet- and dry-bulb thermocouples plus radiometers, to study low-level radiation flux divergence.

The temperature measurements, taken on Lake Mendota, reveal an apparent discontinuity at the air/water interface when advection occurs. The radiometers indicate a flux divergence in the air adjacent to the lake occasionally approaching 0.01 ly min^{-1} per meter. Simultaneous measurements of temperature, vapor pressure, and radiation flux show agreement between measured flux divergence and flux divergence computed by the Funk method. Divergences capable of producing cooling rates of 10C hr^{-1} are common.

Tuesday Afternoon,
October 13, 1:30 p.m.

Evaporation

Chairman: Eugene L. Peck, Supervising Hydrologist, Water Supply Forecast Unit, U. S. Weather Bureau, Salt Lake City, Utah.

Micrometeorological studies of interactions at an air-water interface. Arlin Super, University of Wisconsin, Madison, Wis. (15 min)

Case studies of air mass modification in the lowest 3 m above Lake Mendota (41 km^2 surface area) with the aid of a specially instrumented pontoon boat, are discussed. Measurements include wind speed, air temperature and wet-bulb temperature at five levels above the air-water interface, and water temperature. Vertical profile structure is studied as a function of several kilometers of horizontal fetch by making runs across the lake into the mean wind. Simultaneous measurements at a fixed tower on the lake serve as a reference to estimate local changes. Budgets based on horizontal and vertical mean-motion transports of momentum, sensible heat, and latent heat and eddy transfer are calculated and graphed. Especially interesting conditions prevail on summer days; when the air flow is from rough and heated land to the smooth water surface with changes to inversion, wind speed increases first, and decreases after about 2 km of fetch.

Measurements of currents in the upper 150 cm of Lake Mendota reveal the existence of "spiral flow" and occasionally indicate a possible inertial oscillation. Positive divergence of about 10^{-4} sec^{-1} generally exists in the 0-10 cm water layer at sufficient distance from the shore.

Wednesday Morning,
October 14, 8:30 a.m.

General Session

Chairman: E. Arlo Richardson, U. S. Weather Bureau, Salt Lake City, Utah.

Thermal-response studies under semi-controlled conditions in the field. John C. Turner,
University of Wisconsin, Madison, Wis. (15 min)

Methods and results are described of a study to test the working under field conditions of tau's 2-medium model, dealing with the partitioning of sensible heat between atmosphere and underlying medium. The external variables of the theory are surface roughness, friction velocity and period of a harmonic forcing function as represented by net radiation. In terms of variables, the theory attempts to predict the amplitudes and phase constants of surface temperature, as well as that of sensible heat fluxes in both media.

In practical experiments, surface roughness and period of the forcing function (using a sun-shade) have been varied by artificial means over one or more orders of magnitude. For simplicity, two essentially non-evaporating surfaces have been used in seasonal phases of the study: lake ice and sheet concrete. Temperature gradient and heat flux sensors for the media and for the lowest few centimeters of the atmosphere are described. The results reported deal mainly with amplitudes of surface temperature and the sensible heat fluxes in relation to wide ranges of the three variables mentioned above.

The potential of the method as a tool to determine "in situ" values of the significant parameters before and after large-scale surface treatment (as, for example, proposed by J. and Tarmy, *J. appl. Meteor.*, 2, p. 557, in a paper entitled "The use of asphalt coating to increase rainfall") will also be discussed.

Micrometeorology and aerodynamics of sand-dune migration. Heinz H. Lettau and C. R. Stearns, University of Wisconsin, Madison, Wis. (15 min)

One interesting aspect of wind action is dune formation and migration. The classical form of barchans (crescent-shaped sand dunes) occurs in great perfection and large numbers in the pampas of Southern Peru. Classical theory predicts that dune-celerity times crest-height is constant. The physical meaning of this constant in terms of effective surface-stress and conditions from classic theory due to shape factors, as well as interrelationships between crest-height and sand-density, will be discussed, based on data reported in the literature.

During July 1964, a University of Wisconsin team is scheduled to obtain micrometeorological wind and temperature profile data in the Pampa de Islay, near La Joya, Peru, in connection with measurements of surface-energy budgets, sand-discharged over the crest-line of barchans of various sizes, detailed determinations of dune-shape and the aerodynamics of air-flow over obstacles. Tentative results of these field measurements will be discussed.

Thursday Morning,
October 15, 9 a.m.

Atmospheric Turbulence I

Chairman: Prof. S.-K. Kao, University of Utah, Salt Lake City, Utah.

Physical-statistical turbulence theory. (Invited paper.) Heinz H. Lettau, University of Wisconsin, Madison, Wis. (30 min).

A new hypothesis is presented which interrelates the vectors of eddy velocity (\mathbf{V}') and mean flow ($\bar{\mathbf{V}}$) in the following form:

$$\mathbf{V}' = \mathbf{r}' \times [\nabla \times \bar{\mathbf{V}}] - \bar{\mathbf{V}} \cdot (\nabla \cdot \mathbf{r}')$$

where \mathbf{r}' is a formally defined eddy displacement vector ($\bar{\mathbf{r}} = 0$). The above is essentially a three-dimensional vorticity-transfer hypothesis which expresses not only "preservation" along eddy trajectories (as in G. I. Taylor's one-dimensional model) but "adaption" due to entrainment and mixing, and also accounts for non-gradient type diffusion.

Shear-flow turbulence near solid walls is satisfactorily described by letting $\nabla \cdot \mathbf{r}' = 0$. This results in Prandtl's form of the friction force, the logarithmic wind profile of the surface-layer, and a rigorous formulation of the transversal eddy length-scale as well as Karman's similarity principle. Free turbulence, and turbulence in zero-shear zones is characterized by $\nabla \cdot \mathbf{r}' \neq 0$. This results in a longitudinal eddy length-scale, and explains the Gaussian distribution of mean velocity in free jets, as well as the exponential wind profile within roughness elements, as in plant communities, and eddy diffusion across the center of ducts.

The decisive advantage of the new hypothesis is that the previously only "phenomenologically" defined characteristics of turbulent transfer (such as Prandtl's mixing length, Karman's constant, or Reichardt's momentum-transfer length) are rigorously derived as co-variances involving eddy displacement vector components. Implications of the new hypothesis concerning micrometeorology as well as turbulent engineering flow will be discussed.

Thursday Afternoon,
October 15, 1:30 p.m.

Atmospheric Turbulence II

Chairman: Prof. Hans A. Panofsky, Pennsylvania State University, University Park, Pa.
Dynamic structure of the atmospheric boundary layer over a forest. Warren B. Johnson, Jr., University of Wisconsin, Madison, Wis. (15 min)

Results are presented by an analysis of almost 200 detailed wind profiles up to 2000 m over the extended forest region in northeastern Wisconsin, obtained by tracking pilot balloons with two theodolites. Estimates of surface geostrophic winds and thermal winds are obtained by least-squares fitting of surface-pressure data and upper air temperatures reported by the radiosonde network.

A polynomial-fitting process was applied to each observed wind profile. After allowance is made for local (time) changes in the wind velocities, the geostrophic-departure method is used to compute boundary-layer parameters (such as surface stress, geostrophic drag coefficient, and

energy dissipation) from mean wind profiles. The dependence of these parameters upon roughness and stability of the lower layers is investigated.

A constant thermal wind is introduced into H. H. Lettau's barotropic, adiabatic, wind solution. The resulting baroclinic model is compared with the observations for various regimes.

Several of the wind profiles were obtained by pilot balloons with artificially-roughened surfaces in the manner described by J. R. Scoggins (*J. geophys. Res.*, 1964). Wind profiles from alternate ascents of roughened and unmodified balloons are illustrated.