✓ RADIATIONAL COOLING OF AIR PARCELS FOLLOWING THE EFFLUENT
OF PHOEBUS 1B EP-IV, FEBRUARY 24, 1967

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An updated radiational cooling model predicted diabatic results consistent with airplane measurements of plume height. The computer model produced diabatic cooling results which were in approximate agreement with results derived from previous hand calculations.

Prior to 1970, the authors have computed radiational cooling through the use of the Elsasser diagram.⁽¹⁾ Since these computations were time consuming, a computer program was developed by Scott.⁽²⁾

Computed values of radiational cooling in a partially cloudy atmosphere were then utilized in a diabatic trajectory analysis of the effluent released from a Phoebus 1B reactor test. Comparisons between the measured effluent path and the computed path suggested that the values of radiational cooling incorporated into the trajectory analysis were erroneous. The radiation computer program was reevaluated and improved. New dia-

batic trajectories, utilizing data from the updated radiational model, were then constructed and found to be in close agreement with the observed trajectories of the effluent.⁽¹⁾

Table 1 presents the cumulative radiational cooling effects in the cloudy atmosphere along the effluent's path. The initially predicted values (OLD) of radiative change showed a cumulative heating while the actual plume was observed to be cooling. The updated values of radiational cooling were found to be consistent with previously obtained values from an Elsasser diagram, thus lending further support for the accuracy of the present numerical model.

TABLE 1. Cumulative Cooling with Clouds

February	Elsasser	Scott		Derived	Sky Cover for the Plume
		Updated	Old	Measurements $\Delta\theta^*$	
	$^{\circ}\text{C}$	$^{\circ}\text{C}$	$^{\circ}\text{C}$	$^{\circ}\text{C}$	
23 22Z-24 12Z	-0.4	-0.4	+0.5	-0.5	overcast
24 12Z-25 00Z	-0.7	-0.8	+1.0	-1.2	overcast
25 00Z-25 12Z	-1.1	-1.5	+1.2	-1.7	clear to overcast
25 12Z-26 00Z	-1.4	-2.5	No		clear to overcast
26 00Z-26 12Z	-2.0	-3.5	data		clear to overcast

*Averaged from aircraft measurements.

In general, the radiational model yielded higher cooling rates than the hand calculations on an Elsasser diagram for times greater than $H + 21:30$ hours, and thus enabled the centerline of the predicted plume path⁽¹⁾ to be lowered to an altitude near where the actual plume was measured. Aircraft measurements indicated a "hot spot"⁽³⁾ at $H + 32$ hours with the potential temperature (θ) of the plume approximately $1/2$ °C cooler than the θ predicted for the center of plume by the diabatic trajectory. However, there is no indication that the aircraft actually measured the center of the plume since a vertical temperature and concentration sounding was not taken at this time.

To summarize, the updated numerical model appears to describe accurately the radiational cooling in a cloudy atmosphere and will thus enable its incorporation into a real time diabatic trajectory analysis scheme.

REFERENCES

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X PROJECT BOMEX STUDIES OF ATMOSPHERIC AND OCEANIC MIXING AND AIR-SEA INTERCHANGE USING RADIOACTIVE TRACERS

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The activities of cosmogenic ^7Be and several bomb-produced radionuclides were measured in air, seawater, and rain samples during the Barbados Oceanographic and Meteorological Experiment (BOMEX). Because

of its relatively short 53 day half-life, ^7Be was confined primarily to the top 50 meters of the sea, so its inventory in the sea could be determined from samples collected between the surface and 100 meters. The inventories of ^7Be and the other radionuclides in the sea varied by a factor of about 2.5 during BOMEX, with

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