MAY 1985

OKLAHOMA water news

MONTHLY NEWSLETTER OF THE OKLAHOMA WATER RESOURCES BOARD

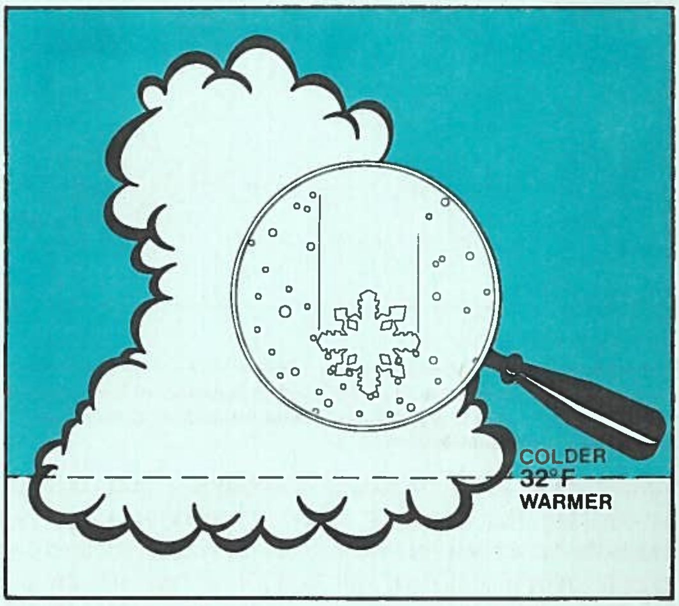
Board Studies Cloud Seeding to Supplement Water Supply

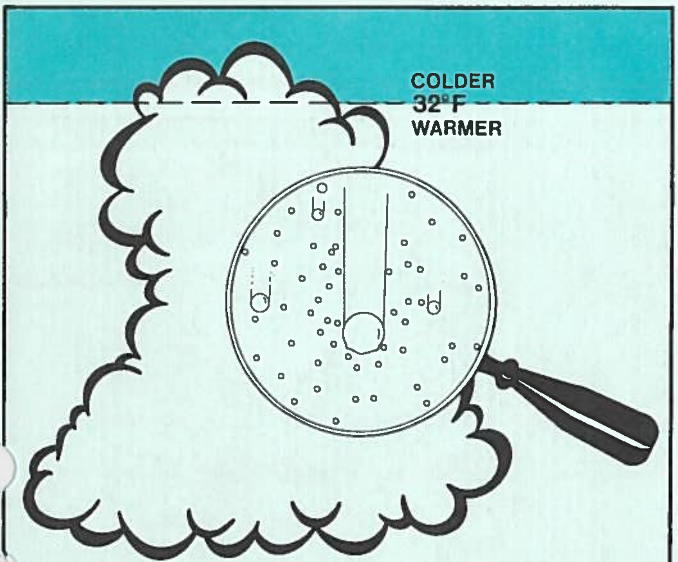
Too often, farmers and ranchers watch promising green crops and grasslands burn to brown stubble under a hot, cloudless sky. In towns and rural water districts, officials struggle through the summer months, desperately juggling drought-stricken water supplies to meet the hot weather demand.

Droughts and dry spells suck away Oklahoma's water with tragic regularity, but now, perhaps, there is a remedy in a scientific, long-term program of weather modification — or cloud seeding. With the backing of the Bureau of Reclamation, the OWRB recently finished a strategy for the seeding of warm weather cumulus clouds. Proponents point out that cloud seeding has the potential for producing almost immediate results and perhaps increasing rainfall at times critical to crop development.

Weather modification cannot replace the development of new water sources, but rather, work in harmony with ground water recharge, conservation and all other means for augmenting the state's water supplies. It has the further advantages of being more affordable and lying closer at hand.

The ice phase process occurs in clouds or regions of a cloud where the temperature is colder than 32 degrees Fahrenheit. Ice crystals grow by merging with frozen or supercooled droplets, then melt into rain on their trip to earth.





Rain is formed by coalescence in warm clouds with temperatures of 32 degrees Fahrenheit or higher. A raindrop is the result of the merging by collision of a million or more tiny cloud drops until the drop is heavy enough to fall to the ground.

In two years of studies in cooperation with the OU Department of Meteorology, Oklahoma Climatological Survey, National Severe Storms Laboratory and the National Weather Service, Board meteorologists discovered that new technology now makes it possible to modify the weather more accurately and in a greater variety of ways than ever before.

Although little of it is visible as clouds at any given time, millions of tons of water always are present in the atmosphere over the earth in the form of vapor, ice particles and liquid droplets. Cumulus clouds form when bubbles of buoyant air rise from summer heated land surfaces, or are lifted by low-pressure disturbances. Some of these cumuli form and fade quickly or produce only light and scattered showers of a few hours' duration. However, if they were seeded, these same cumuli could

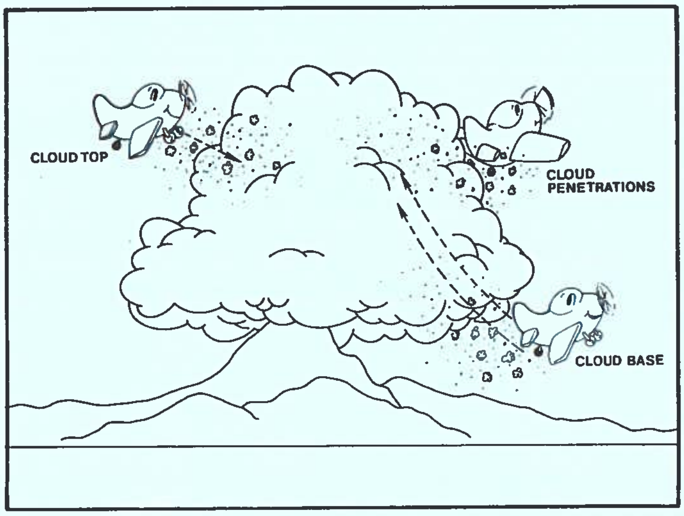
Continued on page 2

Cloud Seeding, continued from page 1

possibly deliver significant rainfall.

As the air is lifted to higher, colder regions, the water vapor present in the air condenses around microscopic particles called cloud condensation nuclei (CCN). Just as water vapor is always present in the air, so too are the particles of dust, smoke, salt, soil and other materials upon which condensation begins. Similar particles which create ice at colder temperatures are called ice-forming nuclei (IFN). Cloud droplets freeze on contact with the IFN, or ice crystals form directly from water vapor. A cloud is made of billions of cloud droplets or ice crystals, and often both.

The formation of a cloud depends on enough water vapor in the air; some means of cooling (a cloud updraft or cool weather front, for instance); and enough aerosol particles to serve as nuclei upon which condensation can begin. When and how much it rains depends on the vertical and horizontal dimensions of the clouds, the duration of cloud life, the sizes and concentrations of cloud droplets and/or ice particles and the strength of the cloud updraft.



Specially instrumented aircraft are used to dispense an ideal number of CCN or IFN into a promising cumulus formation at cloud top or cloud base or by penetration.

Precipitation forms by two basic processes — coalescence, which occurs in "warm" clouds with temperatures of 32 degrees Fahrenheit or more; and ice phase, which occurs in clouds colder than 32 degrees. Coalescence is the merging by collision of a million or more cloud drops, a process made more efficient if there are enough large nuclei available to collect some drops large enough and heavy enough to fall.

The sizes, types and concentrations of nuclei available in the atmosphere make a critical difference in forming clouds and producing rain. Since oversize nuclei are abundant as salt crystals over oceanic regions, rain can form and fall well within the lifetime of the clouds. Such is not the case, however, over inland regions where smaller, more abundant nuclei breed only medium-sized clouds which usually dissipate before the coalescence can initiate rain. Providing large artificial "seeds" such as urea particles can accelerate the warm rain process. Similarly, silver iodide or dry ice seeding can create the additional ice crystals critical in producing rain from a cold cloud.

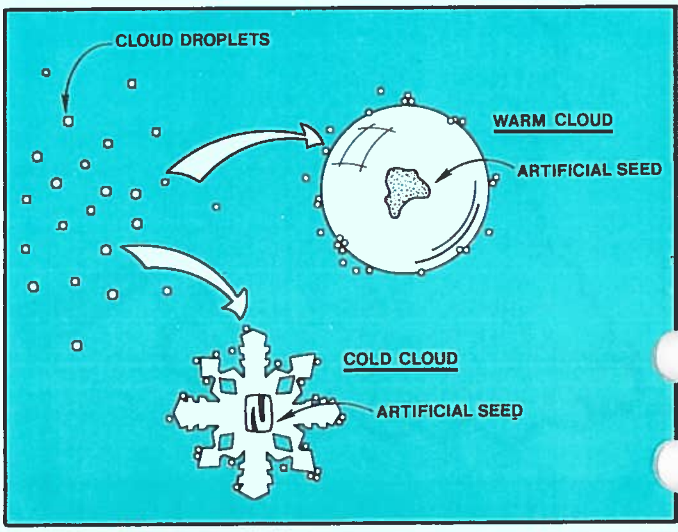
Silver iodide and dry ice are effective seeding agents when the cloud temperature is 32 degrees Fahrenheit or colder and introduction of such materials into a supercooled cloud causes the liquid droplets to freeze. With millions of repetitions of this freezing action, a great amount of heat is produced. This heat of fusion makes the cloud more buoyant, thrusting it higher, helping it grow larger and enabling it to produce more rain for a longer period than it would have without seeding. The ice crystals formed in the cloud grow by merging with frozen or supercooled droplets until they are heavy enough to fall, melting into raindrops on their fall to earth.

On the basis of credible field experiments, water resources board planners believe normal precipitation can be increased 10 percent or more by a carefully planned cloud seeding program. This is not to say that planners could increase normal rainfall by 10 percent when the state is locked into a pattern of drought. Rather, if the state is receiving only 25 percent of normal precipitation, a 10 percent increase would yield only 2.5 percent more water.

Among the means developed for the delivery of cloud seeding materials are ground generators located upwind of the target area, or aircraft flying above cloud tops, below cloud bases or passing through the clouds. When promising cumuli form, all other climatological conditions appear favorable, and radar confirms that there is no severe weather, Oklahoma's cloud seeding plan could be implemented.

In perfecting Oklahoma's cloud seeding strategy, OWRB planners had the advantage of learning from the successes and failures of other projects in the region and throughout the nation. While some credible programs died solely for want of funding, others failed because they could not demonstrate clear evidence of success.

To accrue tangible evidence of success, Board meteorologists have included a strong evaluation component in Oklahoma's cloud seeding plan. On the basis of other such projects in the nation, planners know that any serious



Weather modification scientists know that precipitation efficiency can be increased by seeding promising cumuli with artificial nuclei such as silver iodide, dry ice, urea or water vapor.

cloud seeding effort needs the time and means to measure its effectiveness. Some projects which might have proven valid, had they been well evaluated and allowed to run their course, had been abandoned prematurely.

The research upon which Oklahoma's plan is constructed shows that man can, indeed, turn certain types of weather to his advantage and that the technology is available to enhance the chances for warm-weather rainfall. Oklahoma has at its disposal unique scientific groups to provide the expertise and resources vital to a state program of weather modification.

Although the plan is completed that perhaps could ameliorate the losses to drought of Oklahoma farmers and stockmen, it appears doubtful that funding for its implementation soon will be forthcoming from state, federal or private sources. And in the meanwhile, Oklahoma cities, towns and rural water districts may continue to pay drought's costs in the coin of diminished water supplies and stressed water systems.

mainstream

Conference on Environmental Quality June 7-8

National and state perspectives on resource management will be keynote topics of Dr. Oliver Houck of Tulane University and Dr. Robert Sandmeyer of Oklahoma State University at the Oklahoma Conference on Environmental Quality June 7 and 8 in Oklahoma City. According to Conference Coordinator Mary Schooley of the Department of Pollution Control, the meeting will be concerned with managing the state's air, land and water resources.

A Friday morning panel on Air Quality will discuss management, auto emission regulation, lung disease, the rules and regulations process and acid rain. Luncheon speakers will be Gov. George Nigh and Congressman Mike Synar. Land Management will be the topic of a post-luncheon discussion on agricultural lands, soil conservation, coal and mineral extraction, oil and gas economy and ecology, and reclamation.

Friday afternoon panelists on water quantity and quality will survey the resource and discuss water user laws, ground water resources and citizens' concerns regarding management.

Saturday's session will include a 9 a.m. panel on Land Management and the Disposal of Wastes with discussions of Oklahoma's options, site suitability and geologic criteria, industries' responsibilities and citizens' concerns. Later, panelists on Water Quality Management will direct their discussions to the state's role in regulation, scenic rivers, legal issues, the Garber-Wellington ground water basin, monitoring and enforcement, citizens' views on water quality and conservation.

Advance registration for two days costs $15; $5 for Friday only. On conference day, registration will cost $20. For further information on registration, call Mary Schooley at (405) 271-4677.

ACTIVE CONSERVATION STORAGE IN SELECTED OKLAHOMA LAKES AND RESERVOIRS AS OF APRIL 30, 1985

PLANNING REGION LAKE/RESERVOIR	CONSERVATION STORAGE (AF)	PERCENT OF CAPACITY
SOUTHEAST		
Atoka	124,100	100.0
Broken Bow	918,100	100.0
Pine Creek	77,700	100.0
Hugo	157,600	100.0
CENTRAL		
Thunderbird	105,925	100.0
Hefner	77,200	100.0
Overholser	15,900	100.0
Draper	84,900	84.9
SOUTH CENTRAL		
Arbuckle	62,571	100.0
Texoma	2,637,700	100.0
Waurika	203,100	100.0
SOUTHWEST		
Altus	29,950	22.5
Fort Cobb	70,267	89.5
Foss	146,932	60.2[2]
Tom Steed	67,467	76.0
EAST CENTRAL		
Eufaula	2,329,700	100.0
Tenkiller	627,500	100.0
Wister	27,100	100.0
Sardis	302,500	100.0
NORTHEAST		
Eucha	79,567	100.0
Grand	1,491,800	100.0
Oologah	544,240	100.0
Hulah	30,594	100.0
Fort Gibson	365,200	100.0
Heyburn	6,600	100.0
Birch	19,200	100.0
Hudson	200,300	100.0
Spavinaw	30,000	100.0
Copan	43,400	100.0
Skiatook	—	—[1]
NORTH CENTRAL		
Kaw	428,600	100.0
Keystone	616,000	100.0
NORTHWEST		
Canton	94,500	80.9
Optima	3,000	—[1]
Fort Supply	13,900	100.0
Great Salt Plains	31,400	100.0
STATE TOTALS	**12,064,513[3]**	**95.5[3]**

1. In initial filling stage
2. Temporarily lowered for maintenance
3. Conservation storage for Lake Optima not included in state total

Data courtesy of U.S. Army Corps of Engineers, Bureau of Reclamation, Oklahoma City Water Resources Department, and City of Tulsa Water Superintendent's Office.

Hotel accommodations are available at the Lincoln Plaza at special conference rates of $35 per single; $45 per double room. For information on accommodations or to make room reservations, call 1-800-522-8034 by May 23.

Continued on page 4

Industrial Water Management Program Set

The Oklahoma Water Resources Board and the OSU School of Industrial Engineering and Management invite industry representatives to a day-long workshop on Industrial Water Management in Tulsa June 4. The program is aimed at helping industries reduce monthly water costs by reducing water use.

Spokesmen for the program point out that they have conducted eight water audits of Oklahoma industries, saving over 76 million gallons of water or about $50,000 per year. Additionally, they have identified more than $139,000 in energy savings from better management of boiler, cooling tower and pumping systems. The program will include case studies describing water management opportunities and instructions on how to conduct a water audit of any industry.

The Industrial Water Management Workshop will be held at the Doubletree Inn at 6120 South Yale in Tulsa from 9 a.m. to 4 p.m. on June 4. Although the program is free, there is a $15 charge to cover the costs of lunch, breaks and workshop materials. Advance registration or general information is available by calling (405) 624-5146. For technical information, call Dr. Wayne Turner or Dr. Rick Webb at (405) 624-6055.

To register by mail, send check, purchase order number, Visa/Mastercard number with names of participants to Oklahoma State University, Engineering Extension, 512 Engineering North Building, Stillwater, Oklahoma 74078.

Pilot Study Shows Irrigation Savings

Marshmallow-sized gypsum blocks embedded in the soil of the root zone of plants in irrigated fields are helping California farmers schedule irrigation more efficiently. According to INFORM, a non-profit research organization that conducted the tests, gypsum blocks with embedded electrodes attached to insulated copper wires to the surface measured soil moisture at approximately 12, 24, 36 and 48-inch depths. For most field crops, one station (four or more blocks) is required for each 10 to 15 acres, depending on soil types and irrigation equipment.

Blocks for INFORM's testing cost four dollars each; auger and hammer for installing them, about $100; impedance meter, $200 and batteries for the season, five dollars.

Pilot tests were conducted by scheduling irrigations using gypsum blocks in half a corn, alfalfa or tomato acreage, conventional means in the other half. Early studies showed water and dollar savings of 14 to 27 percent per acre. Increased yields indicated that lighter waterings in the test areas were beneficial.

A report on study findings is available for $3.50 by writing to INFORM, 381 Park Avenue South, New York, N.Y., 10016. To order, request "Saving Water from the Ground UP: A Pilot Study of Irrigation Scheduling on Four California Fields."

APRIL CROP AND WEATHER SUMMARY

Warm weather and rainfall accelerated growth of wheat, oats, barley, row crops, hay and forage throughout the state. Small grains made rapid growth, advancing to 20 percent headed. Row crops made good headway, with half of the corn acreage planted and a third of it up-to-stand. Cotton planting increased in the west, and farmers began planting all major row crops except peanuts. Pastures, ranges and livestock remain in good condition.

Temperatures were near normal during the last week of April, ranging from one degree below normal in the Panhandle and west central area to three degrees above normal in the northeast. Precipitation totals for the last week of April ranged from 1.34 inches in the Panhandle to 3.64 inches in the southeast.

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