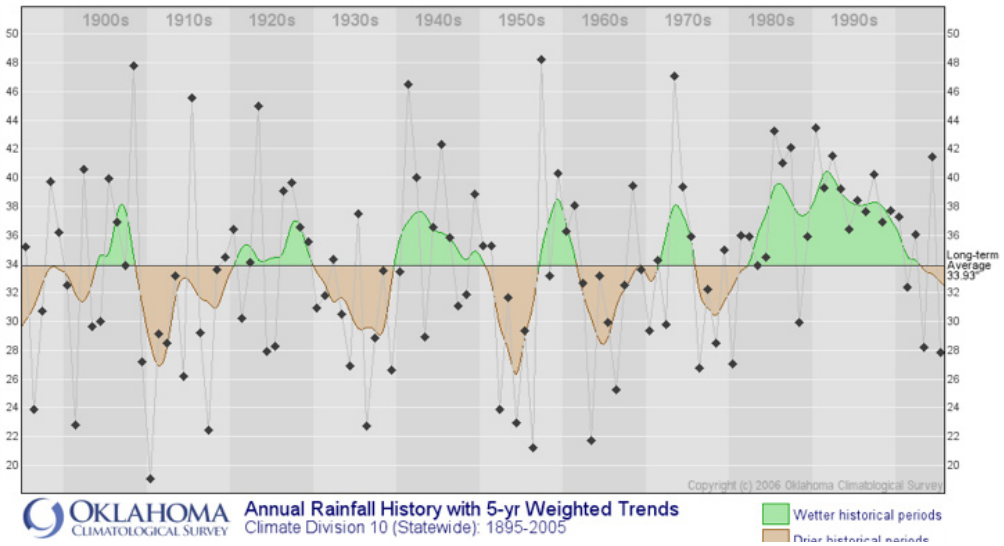
OKLAHOMA CLIMATOLOGICAL SURVEY

STATEMENT ON WEATHER MODIFICATION FROM CLOUD SEEDING

Oklahoma appears to be transitioning once again into a decadal-scale period of below-average precipitation. Measured precipitation during three of the last five years has been below the average of the past 111 years. In the past year, drought conditions across portions of the state have approached levels similar to the droughts of the 1930s or 1950s.



Among the proposed solutions to drought pursued in years past has been the use of cloud seeding in an attempt to increase precipitation. Cloud seedinag has proven controversial over two questions: (1) is precipitation actually increased, and (2) are the benefits worth the cost of the program? Based upon a review of cloud seeding studies in Oklahoma, we conclude that a targeted cloud seeding program may have merits, but further studies are needed to establish its effectiveness, appropriate operational considerations, and economic benefits. Furthermore, consideration should be given to longer-term activities that assess future needs and promote water conservation.

Previous studies conducted by the Oklahoma Climatological Survey (OCS) and others have demonstrated a response within clouds to seeding activities. A 1997-1998 study concluded that "in most cases, precipitation and increased cloud development are present after and downwind of the rainfall enhancement seeding activities." However, the study concluded that while there was a relationship, it could not be determined if changes in cloud structure were a direct result of cloud seeding; nor could it determine the magnitude of precipitation enhancements. The study did find that if precipitation could be increased at key times in crop development cycles, resultant yield increases would generate substantial increases in revenue to the local and state economies.

OCS recently completed a climatological evaluation of cloud seeding activities for 14 regions in Texas and Oklahoma. This study sought to extend previous studies by comparing areas of seeding activities to nearby areas where no seeding operations were conducted. Key findings include:

- Of the 14 regions studied, 7 showed an overall (total rainfall) increase when compared to nearby locations without cloud seeding, while 7 showed an overall decrease.
- Overall precipitation enhancement was generally marginal (less than 5% increase in total rainfall), although some programs consistently produce more rain than others.
- Due to large-scale favorable rainfall patterns, the likelihood of successful rainfall enhancement was greater during the months of May and September than it was during typically dry, intervening summer months.
- Oklahoma was among the regions showing a higher likelihood of increased rainfall when compared with neighboring regions, although southeastern Oklahoma responded more poorly than did southwestern or south-central Oklahoma, perhaps a result of minimal cloud seeding.
- Areas that showed an overall increase in precipitation also showed an increase in the total number of days with rainfall greater than established thresholds (e.g., 0.10 inch to 0.50 inch or greater).

Recommendations

Based upon these studies, OCS concludes that cloud seeding activities provide minimal relief to drought conditions. Oklahoma's approach has been to target all areas of the state over all months from May through September. This approach stretched limited resources too thin to allow confidence that the activities produced any significant positive benefit.

While results are mixed, cloud seeding efforts may have merit if performed within a more regimented structure. More seeding does not necessarily equate to more precipitation; rather, targeted opportunities suggest greater likelihood of significantly increasing precipitation. This includes targeting the times of year when programs operate, specifically May and September, with limited or no activity during summer and winter months.

OCS also encourages the continued evaluation of any ongoing cloud seeding activities. Evaluation provides valuable feedback on program operations that can improve the likelihood of success of current and future programs. Further, OCS recommends that a benefit-cost analysis be completed in advance of any new program to determine how much of an increase in precipitation is needed to produce economic benefits sufficient to offset program costs.

These studies were limited to examination of cloud characteristics and measured precipitation only. They do not include measurements of soil moisture – a critical factor for the growth of vegetation – or measurements of groundwater depth. Light precipitation may evaporate before entering the deeper layers of the soil or aquifers. However, a small increase in heavier precipitation events, which already saturate the soil, may generate additional runoff that could be captured in ponds, lakes, and reservoirs. Further studies should address changes to soil moisture and groundwater to increase confidence that cloud seeding activities will have the intended effects.

Other Options for Drought Management

OCS supports a host of other options available to government officials to help mitigate the effects of drought in Oklahoma. These options include better educating citizens regarding use of water resources, expanding groundwater depth monitoring statewide, providing information via OSU's Cooperative Extension Service to producers regarding drought-tolerant crop varieties when drought conditions are anticipated, and development of community-level plans and infrastructures for better management of water resources. OCS also endorses a review and update of the Oklahoma Comprehensive Water Plan, last updated in 1997. As we anticipate entering a significantly drier decade when compared to the past two decades, we must recognize that cloud seeding efforts likely cannot provide enough water to maintain current usage demands.

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