

# Artificial rain & cloud growth: a new Brazilian process

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This project shows the development of a new process to provoke Artificial Localized Rains with remarkable intensity, by seeding size controlled water droplets from aircrafts on clouds previously selected by meteorological radar. This radar needs to be modified and calibrated for this special operation. The seeded droplet is similar to that ones of nature use to produce rains. The radar helps in the process by tracking clouds that are in conditions to cause rains over the desired area, for example, a hydrographic basin from a group of rivers or lakes to supply a city or a hydroelectric power plant; a reforested area or even an agricultural area. The radar helps in determining the cloud's position height, volume, trajectory, speed and water content. These parameters are important for the seeder airplane to find the cloud above the area where the artificial rain is necessary. In the past the experiments that did not work out in warm clouds, they were based on seeding Silver Iodide vapors that act as agglutinants or Sodium Chloride that acts as humectants, while in our process we act seeding just pure drinking water, in form of collector droplets of controlled size.

Sabesp, the biggest Brazilian Water Supply Company, localized in Sao Paulo city, verified in 2003 that we have produced 31% of rain precipitation, in a period of 4.5 months, during the worst drought period season in the last 70 years (accordingly to its Hydrology Department). In the rain and cloud growths operations they were verified with close and similar clouds according to radar information and only in the seeded clouds occurred growth and precipitation.

Technical flight and operational information: the Size Controlled Collecting Water Droplet is seeded with a  $60\mu\text{m}$  to  $90\mu\text{m}$  diameter according to the cloud's condition; the diameters of the droplets are measured before by laser equipments. The cloud's typical vertical speed during the seeding operation varies from 2 to 5 m/sec in cumulus clouds; 10 m/sec in Cumulus Congestus Clouds and 0.1 m/sec in thick Stratiform Clouds. The typical height of the cloud during the application is from 2.5 km to 4 km in Cumulus Clouds, and the pilot is asked to leave the cloud when and if it reaches an 8 km height but generally, at this time, the cloud is still producing rain. We have completed 236 flight missions and we produced, artificially, 188 rains. In some cases, it was possible to produce 3 to 6 rains in different convective clouds in one flight only.

The Meteorological radar must be reset, modified and tuned for higher sensibility, to track clouds with about  $2\text{ g/m}^3$  of liquid water contents without rain. Sabesp receives

all flight information with date, time and rain photos, GPS trajectography, and the modified radar images. Meteorologists follow the raining images through the radar and direct from Sabesp Hydrologists using ground pluviometers measured before and after the rain. Sabesp's Hydrology Department analyzes the produced water measured in the pluviometers net, the river's volume increase and the water level at the reservoir. Sabesp's Hydrologists, and CIRAM (Hydro meteorologists in Sta. Catarina State), followed our process and attested our technology. We describe in this paper the methodology, data registrations, results with included photos and discussions of many applications in Brazil territory of making artificial rains using only drink water onboard aircrafts.