

Evaluation of insemination clouds with the Generators to the ground by the radar data

By

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ABSTRACT

The national weather modification program time, known as "Al Ghait" by his late Majesty King Hassan II may God glorify him, started in 1984 as a contribution to the search for solutions to water resources problems related to both the pressure of an ever stronger demand than climate hazards.

During the first phase of testing, evaluation of program interventions were made on the basis of a control area which was well chosen to compare the rainfall collected in this area with those in the intervention area. Thus, the effectiveness of interventions is well quantified.

In recent years, the program "Al Ghait" expanded its operations whether by land, using generators to the ground, or air through two King Air 200 and Alpha Jet, evaluation s' was very difficult using conventional methods.

In this study, we try to use the weather radar network data management of the National Meteorology (DMN), to evaluate program interventions. Indeed, it wants to follow a cloud clusters during its movement and determine the various changes in the amount of precipitation, which will take place before and after planting.

Initially, it will be limited to interventions by land including on websites linked generators in the center El Hajeb. For this, once the intervention area is limited, we will determine the area before intervention and after the intervention area. We use the data from the radar of Fes, which is the nearest radar in the region to monitor and assess the impact of interventions this by comparing the reflectivity of the areas before and after planting.

The choice of situations to study, will be determined by the history of interventions in the two years 2011 and 2012, in addition to meteorological studies will be made for limited primarily to situations where the flow is from west or northwest so that cloud clusters, which concern the area defined after generators, must pass through the area before generating or at least the area of generators.

Towards the end of this study, it is apparent that the results are very encouraging. Indeed, it was found that the cumulative rainfall in the cloud is more important after seeding.

INTRODUCTION

Cloud seeding is a form of weather modification which involves pouring various aerosols into clouds to increase the condensation of liquid water on available water vapor and thus increase or decrease the number and size of droplets there. The spill is done through which vectors can be either aircraft directly sow the cloud at the base or at the top, or generators that sow from the ground through the ascending currents.

The weather National artificial modification Program called "Al Ghait" by His Majesty King Hassan II, started in 1984 to contribute to finding solutions to water resources problems, which affected the Morocco during the 90s because of successive years of drought.

After a first phase of tests over five years when the program was conducted in cooperation with US experts, research and applications have been going to Morocco Weather with the assistance of the Royal Gendarmerie and Royal Air Forces. Other ministries such as the Ministries of the Interior, Agriculture and Energy, are contributing.

From 2005 the program has been generalized in the north of the country by increasing the number of ground sites (Beni Mellal, Azilal and El Hajeb) and air intervention by Alpha jet.

LOGISTICS AND EQUIPMENTS OF THE PROGRAM «AL GHAIT»

Ground Generators: are installed in the high mountains for delivering microscopic particles of silver iodide into the atmosphere where ascending currents carry to the clouds.

King Air 100: it is a laboratory plane with multiple sensors allowing it to collect data from takeoff. It is equipped with cartridges to seed warm and cold clouds; it is generally used in seeding inside the clouds, and their bases. It is also equipped with several sensors that measure different microphysical parameters.

Alpha Jet aircraft: Featuring pyrotechnic cartridges launchers for seeding cumulus clouds with their tops.



Fig. 1 : Ground Generators, King Air 100 and Alpha Jet aircraft.

GOAL

This study aims to prepare the environment of working for the statistical evaluation of the cloud's in-semination with the ground generators on the province of El Hajeb by radar data.

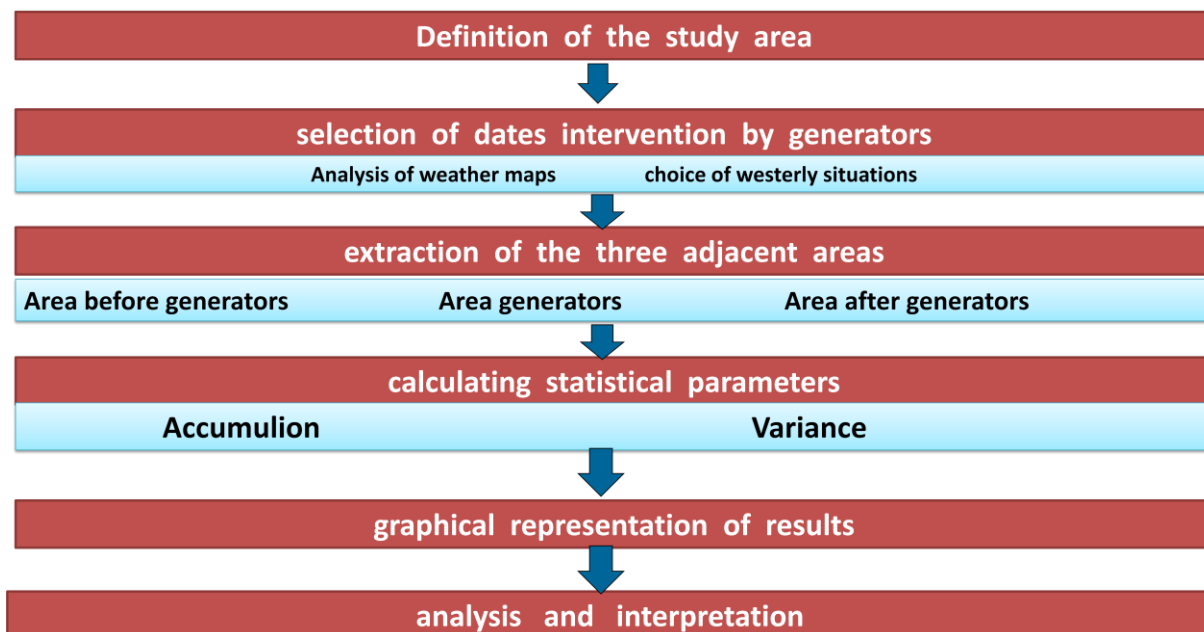
DATA PREPARATION

First of all it was necessary to determine the dates of in-semination operations and their durations, then analyze the maps corresponding weather situations for each operation to determine the direction of the flow and moisture field to clearly define the movement clouds.

The situations which constitute the clouds passing above the generators are generally westerly situations; therefore, the choice was cover only those situations. Thereafter recovering the radar data from these situations after setting the coordinates of the study area.

The data that will be the raw material for this study are the reflectivity measured by the Doppler radar installed in Fes.

METHOD OF WORKING



RESULTS AND DISCUSSION

The study was focused on a set of situations that interventions « Al Ghait » program were made, we chose to treat only the situations of western sector.

For each situation, the combination will be presented and variance of rainfall deduced from radar reflectivity, after analyzing the meteorological situation.

Weather situation of 27 January 2012:

Before examining the results obtained by the radar data (reflectivity), analysis of weather maps will have an overview of the time during the period of sowing.

➤ **Analysis of cumulative rainfall**

The rain intensity is deduced from the measurement of reflectivity using

$$Z-R \text{ relationship : } Z=aR^b$$

a and b empirical constants (a=200 and b=16.6 for stratiform rain).

The cumulative corresponds to the integral over 8 minutes flow of precipitation derived from the measurement of radar reflectivity.

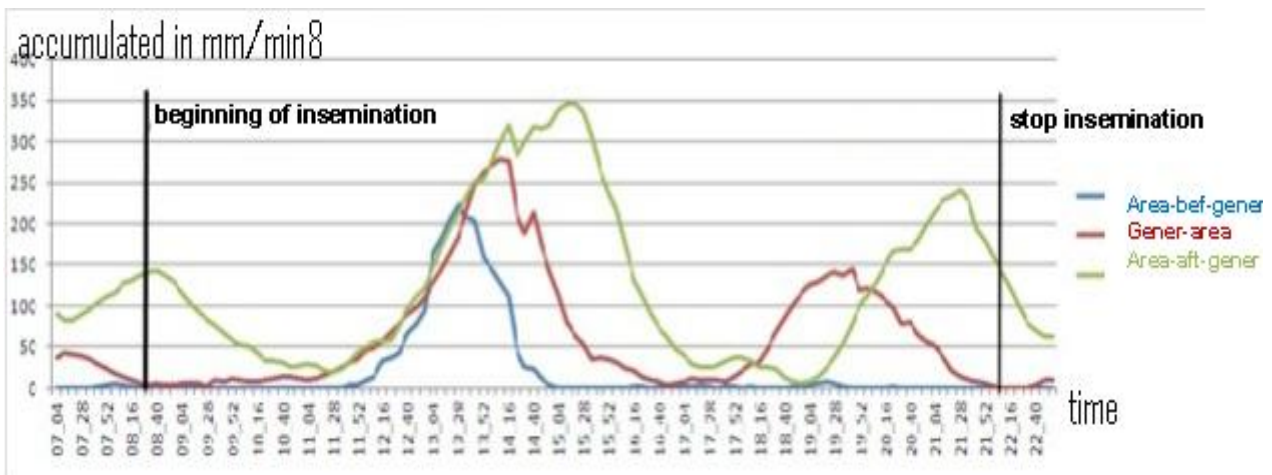


Fig. 2: Evolution of the cumulative rainfall in the three study areas for the weather situation of January 27, 2012.

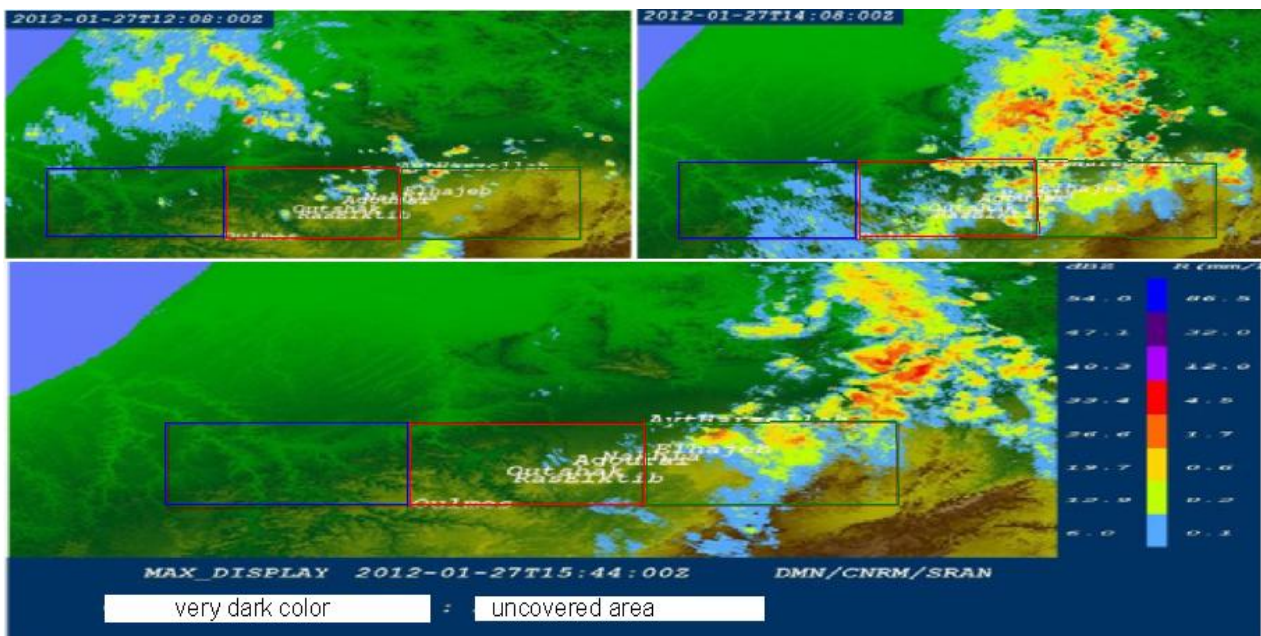


Fig. 3: Radar Images of January 27, 2012 at 7:12 p.m, 8:56 p.m, 2:08 p.m on El Hajeb area.

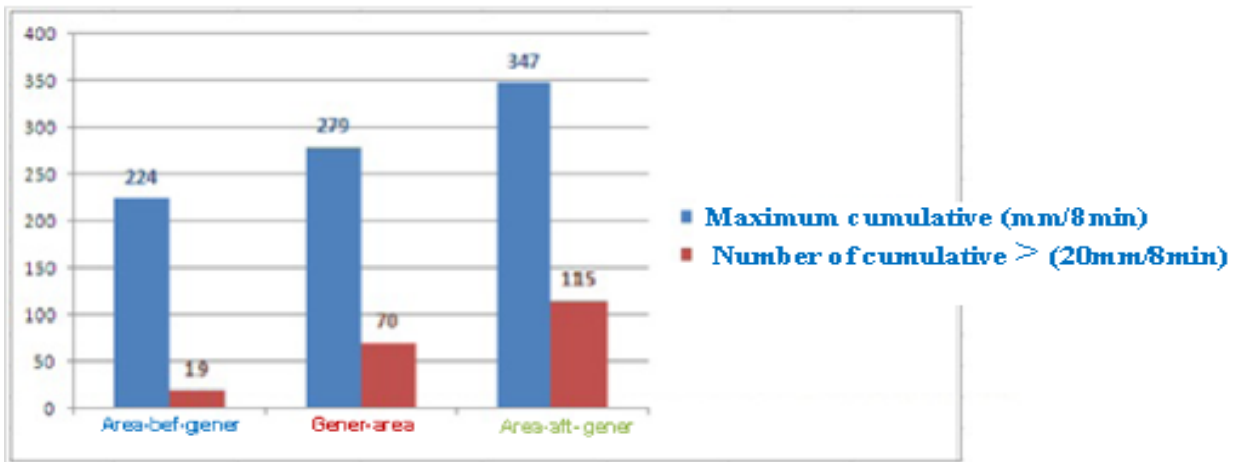


Fig. 4: Maximum cumulative and the occurrence cumulative higher to 20 mm / 8min in the three study areas during the situation of January 27, 2012.

➤ **Analysis of variance**

Variance can inform us about the variability of the size and density of particles within a cloud, indeed it is the variance calculated on all containers pixels of cloud particles.

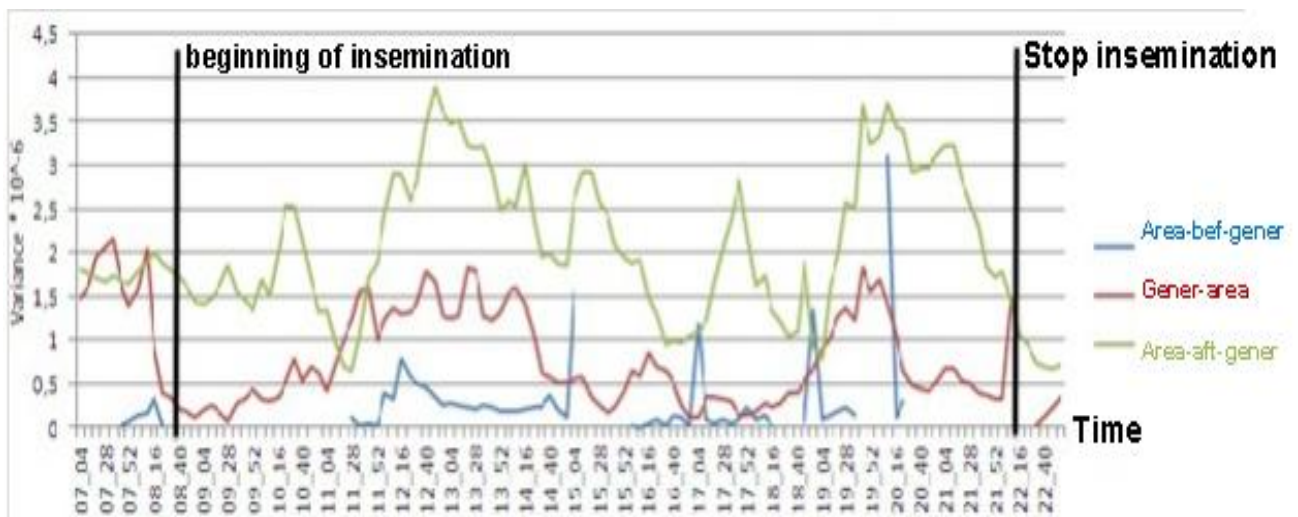


Fig. 5: Evolution of the variance of the cloud particles in the three study areas during the situation of 27 January 2012.

➤ In conclusion of this situation, the evolution of the rainfall's quantity deduced from radar reflectivity, presents:

- The largest peaks in the area after generators as before, the difference between these peaks seen on the graph is explained by the fact that the cloud clusters have concerned firstly the front region and the generating area to reach the area after.
- The continuity of precipitation over time is greater in the area according to the two areas that generators and the one before.

CONCLUSION

The results are very encouraging. Indeed, it was found that the cumulative rainfall in the cloud is more important after seeding.

Also, it was observed that the lifetime of the cloud cells after insemination is longer.

These results are derived from a very limited sampling of inseminated weather situations. However, extensive and thorough study should be conducted over a long period on this area of intervention. So you have to think to focus on tracking changes in certain cells seeded cloud and some not, evolving in the same weather conditions, using a air vector.

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