

Cloud-Moving System to Regulate Climate

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Abstract: Here we introduce a design of a cost-effective cloud-moving system (CMS) in sky to tune the distribution of water resource in large scale and then regulate the climate on Earth. With it, the extreme weathers, such as drought and flood, could be relieved.

The distribution of water/rain on the Earth surface is extremely uneven. Some places are prone to floods while some places droughts. Land water can be used equitably through projects such as China's south-to-north water diversion project.^[1] However, use of water resources in air is mainly limited to artificial rainfall,^[2] which usually occurs with a high cost and low efficiency. Taking full advantage of water resources in atmosphere and controlling regional selective precipitation of water are significant matters which can tune or improve the living environment of human beings, but very challenging. Here we propose a feasible idea that distribution of water vapor in air could be reconstructed by moving clouds directly in long distance from areas of excessive rain to arid areas through certain driving forces, thus achieving a homogenous even distribution of water vapor or cloud and then a selective raining. We plan to use relatively cheap hot air balloons^[3] along with light, soft plastic tubes with diameters in meters to move the cloud from one area to another purposely. The movement of clouds is driven by fans holden by multiple hot air balloons to build a long (could be up tens or hundreds of kilometers) controllable paths through the clouds. In the following, we will introduce the significance, necessity, process and feasibility of this project in detail.

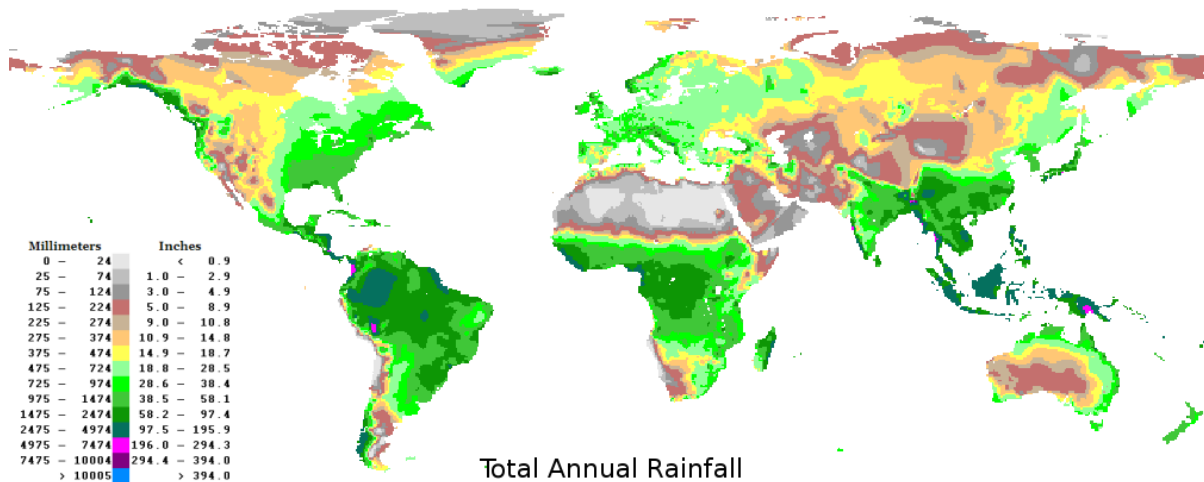


Fig. 1. The total annual rainfall on Earth.^[4]



Fig. 2 The uneven rainfall leads to extreme weather of droughts (left) or floods (right). Cited from *Los Angeles Times* and *The guardian Nigeria*.

1. The significance and necessity

The distribution of rain water is extremely uneven in the whole world as shown in the following Fig. 1. Such uneven distribution of rainfall can lead to frequent occurrence of some extreme climate. In China, for example, rainfall is usually more in the south and less in the north, more in the east and less in the west, causing some extreme weather, such as floods and droughts (Fig. 2). Such extreme weather then further leads to many other disasters, such as wild fire and starvation. Therefore, in order to maintain or

create more livable places on earth, it is very urgent for people to achieve the tuning of the regional distribution of rainfall artificially to keep the balance of precipitation.

At present, the utilization of water resources in air is only at the level of artificial rainfall. Artificial rainfall refers to a process of precipitation formation by supplementing artificially some necessary conditions for the formation of precipitation via promoting the rapid condensation of cloud drops into raindrops falling to the ground. Generally, artificial precipitation can play a role only when natural clouds have precipitation or are close to precipitation. In China, a few years ago, a huge project named as TianHe Project was proposed to make rain fall in Yellow River basin based on a water transfer model in atmosphere.^[5] Its purpose is to master the water vapor migration rules through monitoring the distribution and moving of water vapor in atmosphere, and then carry out precisely artificial intervention to achieve precipitation, so as to solve the shortage of surface water resources in the northern region and the uneven distribution of water resource. The essence of TianHe project is still artificial rainfall. While it has been known that the difficulty of this project is mainly that how to achieve the cross-regional water vapor transportation.^[6] It is generally believed that the cross-regional water vapor transportation goes beyond human ability to make rain fall in the Yellow River basin instead of the Yangtze river basin. Moreover, TianHe project also needs collaboration with satellite, rocket, and so on, making such artificial rainfall very expensive.

2. Process and Feasibility

About 80% of water resources in air are concentrated in the thickness of 2 km of atmosphere above the ground^[7] as shown in Fig. 3a. Effective development and utilization of air water resources is an effective way to alleviate the shortage of water resources on ground. Water resources in the atmosphere are usually converted and circulated with ground surface water resources by means of precipitation,^[8] which is closely related to clouds. A piece of cloud for precipitation is generally warm and humid. As the air gets cool, water vapor begins to form condensation nuclei and gradually becomes a cloud by aggregation. Cumulonimbus clouds^[9] contain abundant water resources and are the most likely clouds to produce rain.

Cumulonimbus clouds are usually quite large. A cumulonimbus cloud is a single unit of precipitation in a heavy rain area. Although each unit ranges from 1 km to 20 km horizontally, they can form a rain band between 100 km and 200 km wide. But at the same time, cumulonimbus clouds belong to the lower cloud family, and are usually 2500 meters above the ground. Some of them may be less than 1000 meters' high. If we can move the cumulonimbus cloud before it produces rain, either by moving it to a dry area or by introducing a fixed surface reservoir, we then can achieve a rational distribution and usage of rain in large area. Human intervention can effectively avoid regional floods and droughts, which will be a milestone in man's conquest of nature.

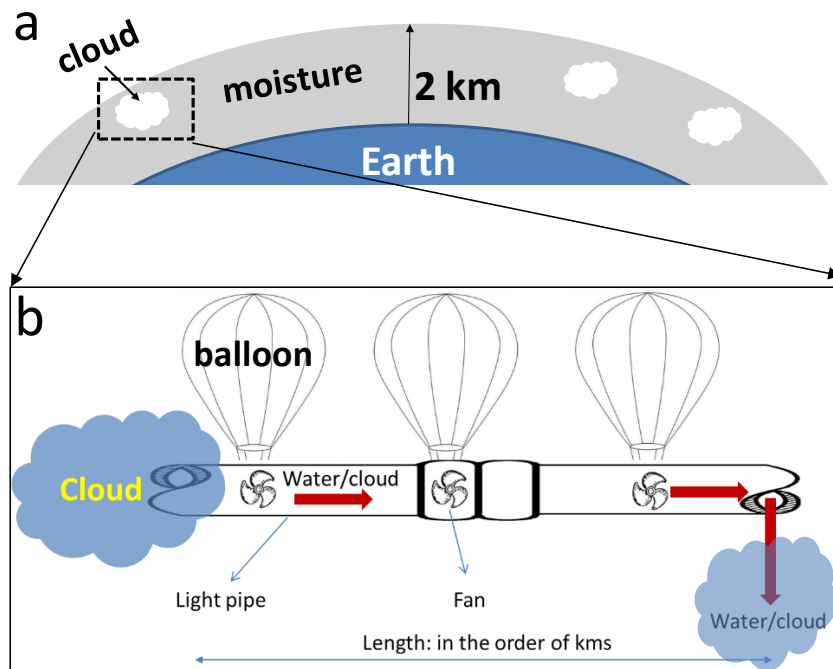


Fig. 3 (a) Scheme to show the distribution of moisture in the form of clouds in sky within 2 kms above the ground. (b) Schematic diagram for the fixed cloud-moving system (CMS), through which the water can be collected to a reservoir.

For this purpose, therefore, we propose a relatively cheap way to achieve cross-regional water vapor transportation in air to realize a controllable utilization of air water resources. The process diagram is shown in Fig. 3b. In this process, cheap hot-air balloons are adopted to elevate light pipe at certain height

(usually < 2 kms) in the sky. Blowing machines are installed dispersedly in the pipe with length in tens of kilometers. One end of the pipe is inserted into a piece of cloud. Turning on blowing machines, such long pipe then can work as an elastic channel to deliver the cloud to any direction in long distance to somewhere else in the sky, the land underneath such sky is very dry. In this way, a piece of cloud in the sky can be removed on purpose to anywhere you want in long distance with relatively low cost. Such cloud moving system (CMS) in sky could be very light if lightweight materials could be used to fabricate its main parts, such as the pipe, the blowing machines. The whole cost of such system could be relatively low since it is recyclable for many times. Since it can fly freely in sky at controllable height, it can move and work at any locations. The local governments can rent such CMS for use from others, such as Companies if their areas are in flood or drought.

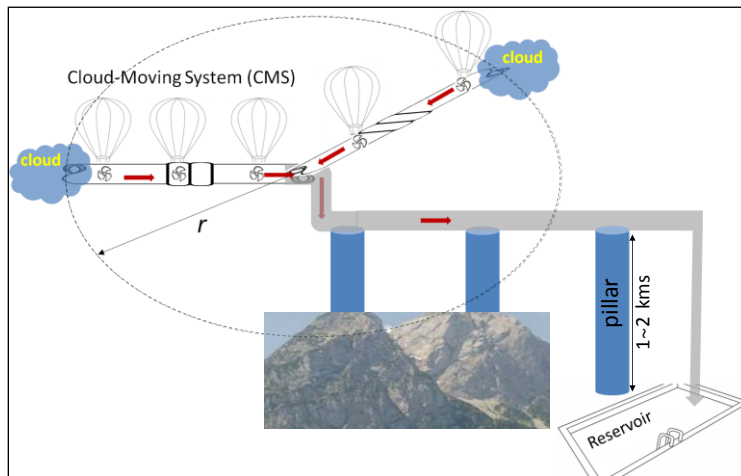


Fig. 4 Schematic diagram for the fixed cloud-moving system, through which the water can be collected and stored in a reservoir.

Besides the movable working model shown in Fig. 3, we also propose a fixed working model as shown in Fig. 4. In this model, the CMS could rotate 360° freely on the plane, then the cloud in the circle area with diameter of $2r$ could be collected via the CMS and stored in a reservoir in the form of liquid water. Such water in the reservoir can be used rationally at any time when needed. To build such fixed CMS, we need some pillars with height in $1\sim 2$ kms to support the fixed concrete pipe to deliver water from

cumulonimbus clouds. If the pillars can be built on top of mountains/hills or skyscrapers, then the pillars could be much shorter to save the building cost of the system. In such fixed working model, based on the height of cumulonimbus clouds, we can adjust the height of the balloon flexibly to collect the water vapor at different height.

3. Conclusion

In all, clouds in sky have no boundary and show complex physical motions, traditionally, it is difficult for us to change the distribution or movement of clouds. While with the help of the CMS presented here, we can completely control the movement and distribution of clouds and make full use of water resources in the sky in large area. Compared with other big projects proposed by others,, such as the TianHe Project, the project presented here is ahead of its time, but it is feasible technically and economically. The idea is expected to advance the development of water usage in air and solve in part some of the planet's extreme weather problems. It will benefit all the creatures on Earth and help its sustainability.

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