II. Man Reshapes the Water Cycle: A Galactic Perspective

Categories of Interaction With the Water Cycle

by Benjamin Deniston

Preface

The future of water depends upon a new understanding of the global water cycle as driven by solar and galactic processes, and a new commitment for man to improve his management of the system from these higher levels.

The vast majority of current water management exists within one particular category of interaction with the water cycle: the utilization and management of the water that has fallen to the ground, making itself available in the form of lakes, rivers, and groundwater stores. But managing water as it makes its way across the land and back into the ocean is only the end-phase of a larger water cycle.

Surface and ground water come from the precipitation of only a fraction of the larger store of atmospheric water vapor filling the world's skies. On average globally, about 90% of water evaporated from the oceans never makes its way onto land, instead precipitating back into the oceans, and there is, on average, ten times more fresh water flowing from the oceans into the atmosphere than there is flowing from rivers back into the ocean.[1]

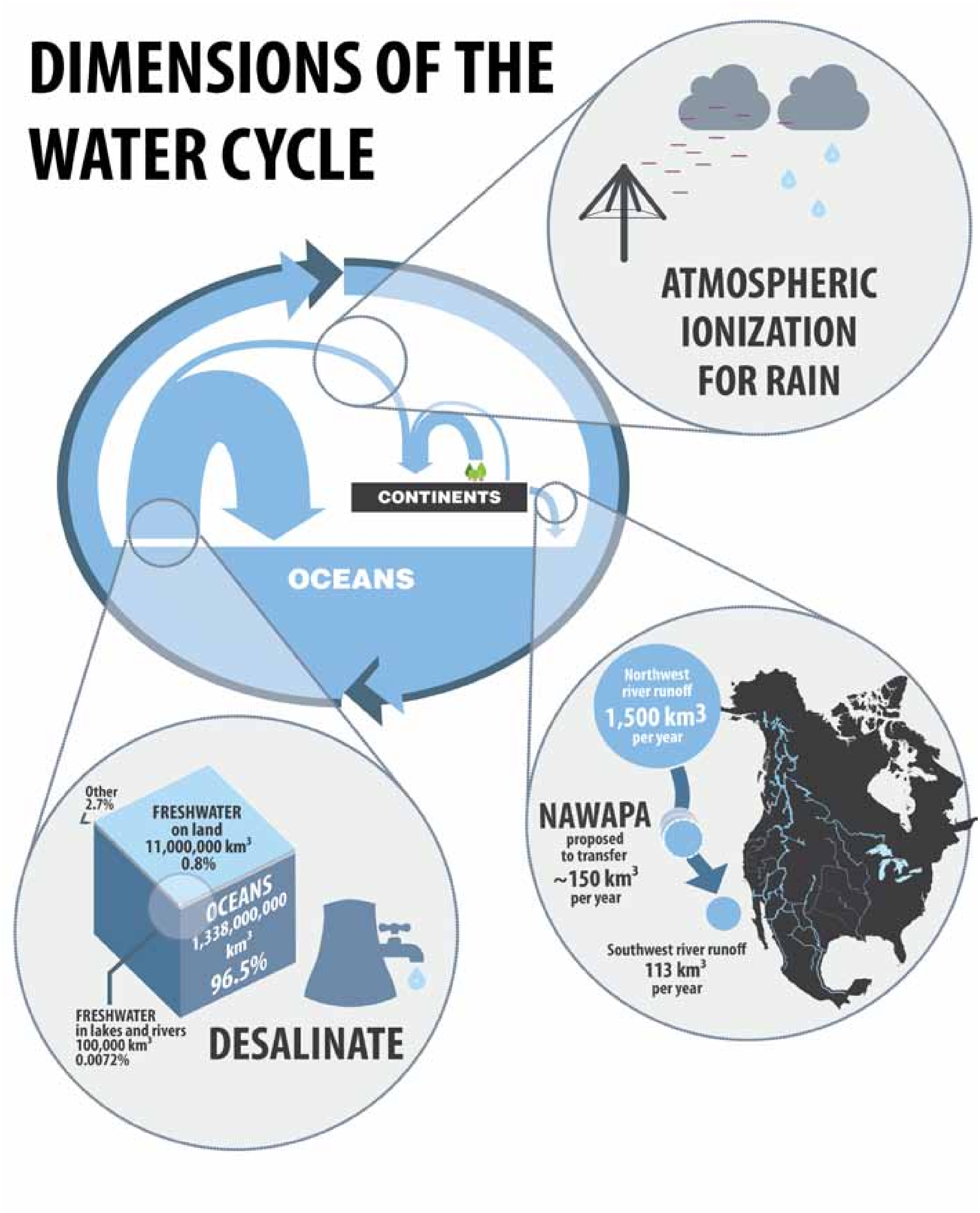
The ocean itself is an essentially endless source of water, containing 97% of all the water on Earth, and well over 300,000 times more water than all the world uses in a year.

There is nothing preventing mankind from developing, expanding, and augmenting the global water cycle from these higher levels.

For California and the western United States, this means going beyond the management of the snowpack, rivers, groundwater, and related systems of the region. Providing water for the West now starts with the North Pacific ocean as a whole, managing its relationship with North America.

As the "westerly" winds carry the moisture of the Pa-

1. Estimates of current global water distribution and water flows used throughout this report are taken from the study, "Estimates of the Global Water Budget and Its Annual Cycle Using Observational and Model Data," by Kevin Trenberth et al., from the National Center for Atmospheric Research in Boulder, Colorado; published in the *Journal of Hydrometeorology*, Volume 8, 2007. This does not include the recent discoveries of large aquifers beneath the oceans, and even larger amounts of water in mineral formations deep within the Earth's crust.



DIMENSIONS OF THE WATER CYCLE
ATMOSPHERIC IONIZATION FOR RAIN
CONTINENTS
OCEANS
Other 2.7%
FRESHWATER on land 11,000,000 km³ 0.8%
OCEANS 1,338,000,000 km³ 96.5%
FRESHWATER in lakes and rivers 100,000 km³ 0.0072%
DESALINATE
Northwest river runoff 1,500 km3 per year
NAWAPA proposed to transfer ~150 km³ per year
Southwest river runoff 113 km³ per year

cific Ocean from the west to the east, the vast majority of the atmospheric moisture delivered to western North America is unfairly concentrated in the northwest, where much of it returns to the ocean rather rapidly. A first-order approach to addressing the southwestern water crisis, is to extend the geographic length and time of the surface component of this cycle by a grand water transfer project to bring a portion of this available freshwater throughout the southwest, before returning it to the ocean. The design for the North American Water and Power Alliance still stands as the most developed proposal for this aspect of a new era of managing the interaction of the Pacific Ocean and the North American continent.

But this is only the last component of the cycle (managing surface flows). We must also go to the first component, the source of the water for the land: the oceans. Desalination technologies exist, allowing mankind to supersede a dependence upon the natural process of evaporation and precipitation, by generating his own sources of freshwater directly from the oceans. While this is being done in small scales around the world, the higher levels of power per capita and per square kilometer provided by a nuclear economy and a fusion driver program will enable a major leap in the volume of desalination. Along the coast of California we can create small freshwater rivers, flowing from the ocean onto the land, under our direction. This goes beyond simply managing the existing distribution of freshwater deposited by the natural water cycle, expressing a qualitatively different category of interaction, *increasing the total freshwater cycle of the entire continent*, rather than simply managing what is there.

A third point of intervention into the cycle is the connection between these first and last components, the atmospheric moisture flows. This has the advantage of putting the Sun's already accomplished work to greater effect. The Sun expends a vast amount of energy evaporating and desalinating ocean water, creating conditions where incredible volumes of freshwater flow throughout the sky, over huge distances, waiting to find the particular conditions which trigger condensation and precipitation. So-called atmospheric rivers, carrying flows of moisture through the sky comparable to the flow of the Mississippi River, are not uncommon. Unfortunately, on a global average, only 10% of the atmospheric moisture provided from the oceans ever makes it onto land. However, numerous trials have already demonstrated that certain ground-based ionization systems can be used to modulate the atmospheric conditions involved in determining when and where the atmospheric moisture condenses and precipitates. Though it is not clear exactly how much new water such systems can provide for California, this technology *can* increase rainfall in desired regions, and should be immediately deployed along the California coast.

Each of these three approaches—surface water transfer, desalination of ocean water, and atmospheric moisture control—represents a qualitatively different interaction with the water cycle, but they must be developed as interacting and interdependent components of a single program of action for California and the southwest. The survival of the population of this region depends upon the development of a higher-order management of the Pacific Ocean–North American water cycle as a whole, in all its aspects.

In what follows we will elaborate each of these three categories, their potentials and interactions, and applications to the specific crisis facing the United States.