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Column: Arizona headed for drier conditions

By DR. DALE MEYER
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The effect of our changing climate on our water resources is an issue of significance to Arizona and the Prescott region. The Citizens Water Advocacy Group recently invited Dr. Michael Crimmins, associate professor in the Department of Soil, Water, and Environmental Science at the [University of Arizona](#), to speak to this issue. His presentation, "Climate Change and Arizona: Past, Present, and Future," can be viewed at <http://vimeo.com/25008129>.

Crimmins emphasized that Arizona's location in the atmosphere's subtropical Hadley circulation, where air warms and dries as it descends to the surface, makes it a strange and interesting spot in the Earth's climate. Weather records show temperatures have been rising in Arizona since the 1970s. The warmer temperatures have increased the atmosphere's already high demand for Arizona's surface moisture, making Arizona evaporation and transpiration rates among the highest in the world. When precipitation falls in Arizona, the atmosphere quickly wants it back.

Crimmins said the main conclusion of the reports published by the Intergovernmental Panel on Climate Change is that our atmosphere's greenhouse effect is responsible for the recent observed changes in our climate. This effect can be understood by considering what happens to the shortwave radiation from our sun as it passes, virtually unimpeded, through our atmosphere to the Earth's surface.

Ice and snow in the Earth's polar regions reflect much of the sun's radiation back into space, while the remainder of the Earth's surface absorbs most of the sun's radiation and converts it into heat energy. Longwave radiation from the warmed earth then excites CO₂ molecules in the atmosphere, which, in turn, emit energy back down to the Earth's surface. Because of this effect, atmospheric greenhouse gases, mainly CO₂, cause the atmosphere to serve as a warm blanket for the Earth's surface, making life on this planet possible. Without our atmosphere's greenhouse effect, the average temperature of our earth's surface would be about zero degrees Fahrenheit. The surprising fact is that even though our atmosphere's greenhouse gases, including CO₂, are only trace gases in the atmosphere, they are so incredibly efficient at absorbing longwave radiation from our Earth's surface that they serve to govern the surface temperature of our planet.

Since the beginning of the Industrial Age, the amount of CO₂ in our atmosphere has jumped dramatically. Climatological studies reveal strong correlations between the observed increases in atmospheric CO₂ and observed increases in the Earth's surface temperature. Mathematical reconstructions of these observed historical trends show that the Earth's observed temperature increases can only be explained by including stratospheric aerosols from volcanic eruptions and atmospheric CO₂ in these simulations.

The unavoidable conclusion of these studies is that our climate has entered an era where there is a deficit of heat energy leaving our planet, and that our planet will warm by as much as eight degrees by the end of this century.

Because of the very, very long "residence" times of CO2 in the atmosphere - many centuries - the Earth will continue to warm for the foreseeable future. Crimmins concluded by saying Arizona's new warmer and drier climate presents urgent and serious, but not insurmountable, challenges. Higher Arizona temperatures and higher associated evaporation and transpiration rates will mean: 1) less water for our aquifers and greater losses from our reservoirs; 2) faster drying of our soils following precipitation; 3) greater stress on our vegetation; 4) less precipitation falling as snow, with less snowpack for spring runoff, and even less water in summers for the recharge of our aquifers; 5) more water needed for landscaping; and 6) more extreme, and frequent, summer heat events, yet with freezes still possible in winter.

Climatological projections of Arizona precipitation have lower confidence. Yet, even with little or no change in Arizona precipitation, the projected increases in Arizona's temperatures and evaporation and transpiration rates will mean a drier Arizona with more frequent and intense droughts.

Our region's changing climate will make it more difficult to balance our demand for water with our supply and it will be more difficult to keep our surface waters flowing. These facts must be acknowledged and addressed as we try to achieve a sustainable water future.

State Rep. Karen Fann, R-Prescott, will discuss water and the 2011 legislative session when she speaks to CWAG on July 9. Please bring your water-related questions. Details are at cwagaz.org.

Submit your comments and questions to info@cwagaz.org.

Dr. Dale Meyer is a mostly retired meteorologist and is a former chair of the Citizens Water Advocacy Group's science and education committee.

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