COASTAL RESTORATION, CLIMATE CHANGE, AND ENERGY

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QUESTION 10

CAN RESTORATION OF LOUISIANA'S MISSISSIPPI RIVER DELTA SUCCEED IN THE FACE OF SEVERE CLIMATE IMPACTS AND INCREASINGLY EXPENSIVE ENERGY?

Global climate change coupled with increasing energy costs pose significant threats to the ecological and social systems of Louisiana's coastal zone. In this section we review climate and energy issues and discuss their significance for Louisiana's coast.

OUR ANALYSIS

We performed an extensive survey of the latest research on climate change and energy trends. Like the vast majority of scientists, we accept that climate change is a reality and that mitigating its effects requires a swift and effective response. Similarly with energy costs and scarcity, we follow the mainstream view on peak oil and discuss its implications for coastal Louisiana.

WHAT THE SCIENCE SAYS

The mean global temperature increase in the 21st century is predicted to be as high as 6 degrees Celsius or about 10 degrees Fahrenheit. There is a strong scientific consensus that the rate of global sea level rise will accelerate as land based ice masses melt and the oceans expand due to heating. In 2007, the Intergovernmental Panel on Climate Change predicted that sea level rise will be about 40 centimeters by the end of the 21st century, with a range of uncertainty from 10 to 54 centimeters. More recent work suggests that this prediction may be too low and that sea level rise may be one meter or more by 2100. Sea level rise is especially worrisome in the Mississippi and other deltas, because it is augmented by high rates of subsidence, which can exceed 1 centimeter per year. Thus, if recent projections hold true, the effect of sea level rise plus subsidence may be as high as two meters by 2100 in much of the Mississippi River Delta.

It is now increasingly certain that the frequency of strong hurricanes will increase in the 21st century. Recent studies show that sea surface temperatures in the tropics increased by about 1 degree Celsius over the past half century. During the same period, total hurricane intensity increased by about 80 percent. Other studies have found an increase in the number of category 4 and 5 storms over the past several decades and have linked those increases to higher sea surface temperatures. Some have argued that these increases are not linked to climate change but to decadal cycles in tropical storm activity. Regardless of the reason, it appears likely that the future will bring stronger hurricanes, which will complicate Louisiana's coastal restoration and flood protection efforts.

Although no single weather event or flood can be attributed solely to climate change, the flood of 2011 is consistent with climate projections. The intense storms that delivered so much precipitation up river were created when warm air masses off a warming Gulf hit colder continental air masses. Precipitation is generally expected to increase in higher latitudes due to a wetter atmosphere, making floods like those in 2011 more common.

Climate change is not the only global trend with implications for Louisiana. Energy costs increased by a factor of five in the last decade, and similar increases are likely in the future. Considerable amounts of information have been published in the scientific literature on this subject, primarily by petroleum geologists with long experience in oil exploration and production. These scientists predict a peaking of total world oil production soon, perhaps within a decade. This is expected to usher in an era in which demand will consistently exceed supply. The price of energy can therefore be expected to increase significantly, under even the most optimistic scenarios.

The combined forces of climate change and energy cost increases will pose serious challenges to Louisiana's flood control and navigation systems. Higher water and increasing storms will make these systems more vulnerable to flood damage. At the same time, a flood control system based on levees is extremely energy intensive; costs for levee operation and maintenance will likely become progressively more expensive in coming decades as energy costs increase.

Given all of these factors, it may be impossible to protect some of Louisiana's coastal residents where they currently live. The loss of wetlands due to climate change may also make employment based on wetland estuaries less sustainable. This information should be clearly and honestly presented to coastal residents and others so that fully informed decisions can be made.

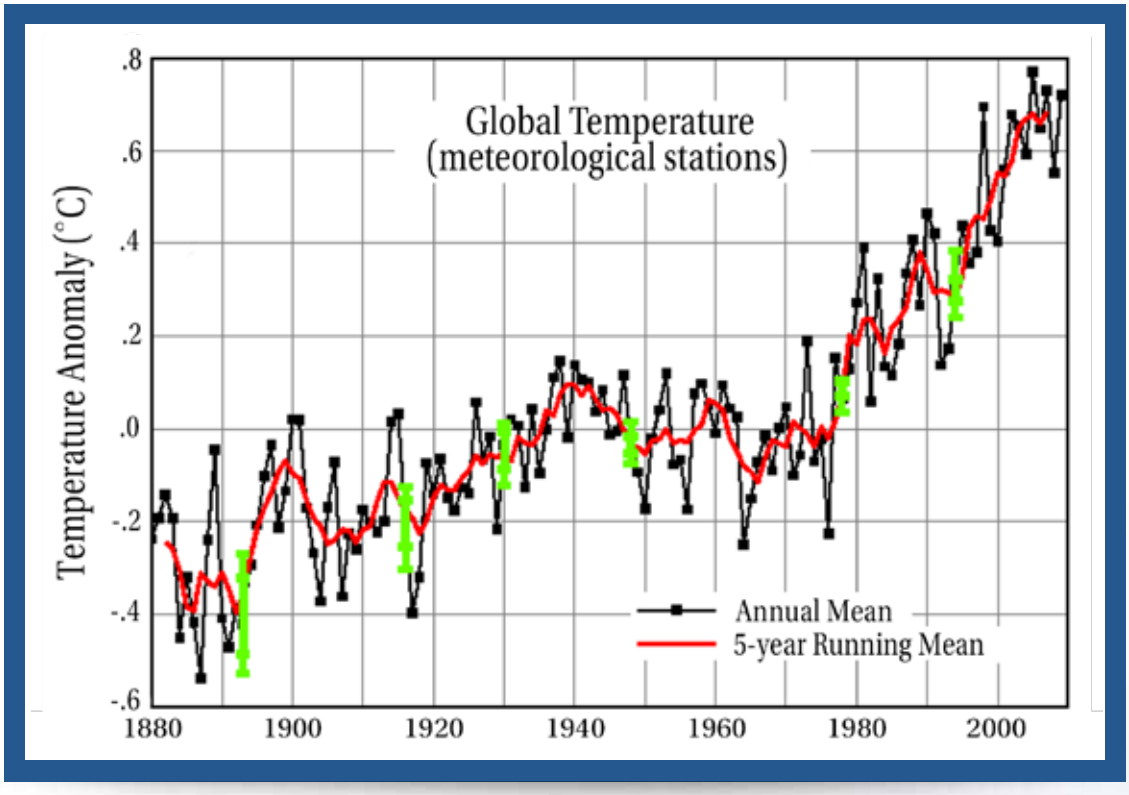

Figure 1: History of global mean surface air temperature, from the NASA Goddard Institute for Space Studies. The scale shows how much warmer or cooler the world was than the average temperature from 1951 to 1980. Recent warming is clear but with high year to year variability. The green vertical lines show data variability for the indicated time periods. Other research groups have produced similar plots. The figure is modified from Figure 1a in Hansen, J., Mki. Sato, R. Ruedy, K. Lo, D.W. Lea, and M. Medina-Elizade, 2006: Global Temperature Change. Proc. Natl. Acad. Sci., 103, 14288-14293, doi:10.1073/pnas.0606291103.).

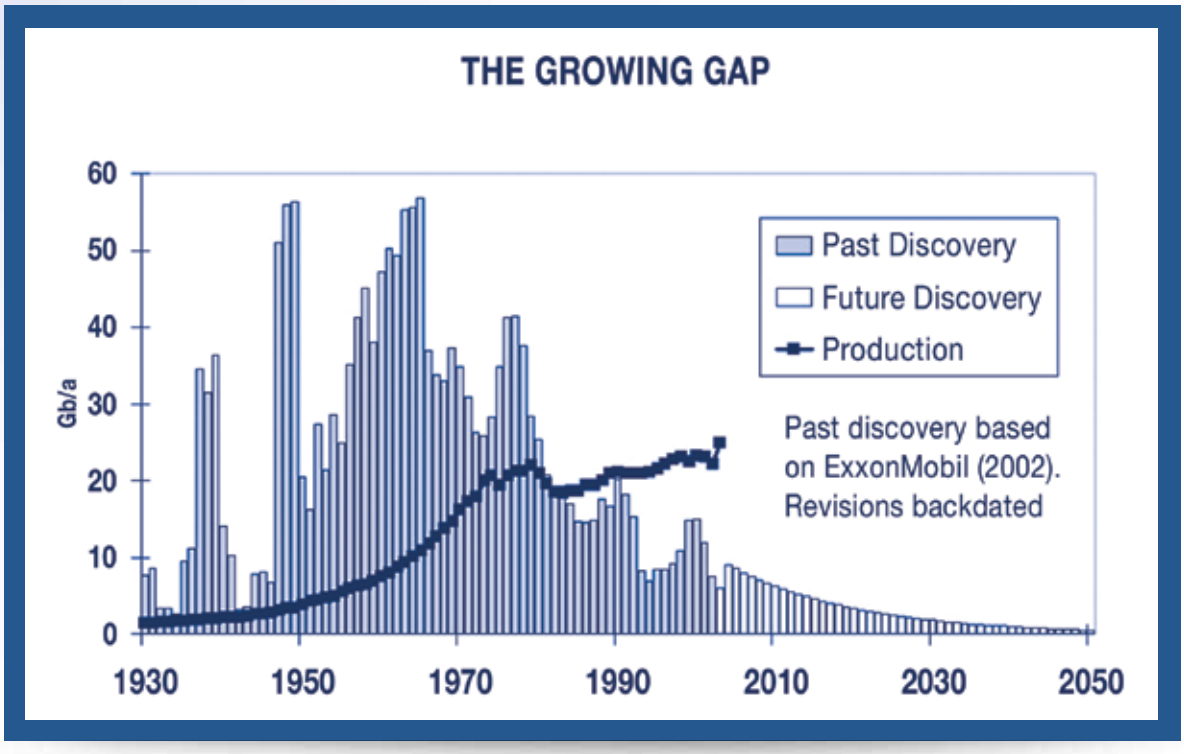

Figure 2: The rate at which oil is discovered globally has been dropping for decades and is projected to drop off even more precipitously in future years. The rate of oil supply and demand can be expected to widen. Data courtesy of Colin Campbell.

These trends are sobering, but the past need not be a prologue to the future. Deltaic systems are extremely sensitive to sediment supply, which is largely under human control in the Mississippi River Valley. We can use new and reengineered river diversions with the Atchafalaya/Wax Lake Deltas, and the Bonnet Carré Spillway as prototypes for a new generation of improved sediment diversions. Using the increased amount of sediment brought into coastal Louisiana by the projected uptick in river floods, these diversions offer the possibility of offsetting some of Louisiana's land loss.

IMPLICATIONS FOR POLICY MAKERS

Climate trends and energy costs indicate that current management of the Mississippi River and its delta will lead to cascading failures in navigation, flood protection, and wetland restoration. If this risk is quickly recognized and addressed, however, a sustainable trajectory can be achieved that will lead to a less ecologically destructive scheme for river management. This new approach will improve the long term economic viability of deep draft navigation, storm protection, and the economy of south Louisiana. Using the river in this way will have the additional benefit of building more coastal land to offset projected land losses.

- Accelerated sea level rise and stronger hurricanes will increase threats to jetties and other exposed channel infrastructure at the river mouth. Flood protection levees throughout the Mississippi River Delta will also face greater risk from storm damage.
- Projected climate change argues for an aggressive restoration program. This approach requires a commitment to a series of very large diversions that would need to be constructed soon. It will be critical to design these diversions to convey as much sediment as possible. This will allow marshes with strong soils to be formed before sea level rise and storms further damage the coastal ecosystem.
- Design of these diversions should factor in other already observed climate change effects in the Mississippi River watershed, including alternating severe floods and droughts.
- Projects should be devised that require as little fossil energy for operation and maintenance as possible so that performance is not hampered by energy scarcity or cost in the future.
- Planning horizons dictate that these large diversion projects begin implementation soon. The rationale for doing so should take into account that structural protection measures will continue to depreciate with time, requiring more operation and maintenance costs, particularly given rising sea levels. River diversions, on the other hand, have the potential to appreciate with time, having larger up front costs but reduced long term operation and maintenance.