Ocean Pipes:

Is OTEC a “Silver Bullet” for Climate Change?

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Various types of “Ocean Pipes” have been proposed for upwelling for fertilization, mariculture, CO_2 sequestration and lowering of sea surface temperatures for coral reef protection and hurricane mitigation (Lovelock and Rapley, 2007). Though upwelled ocean water generally has all the carbon it needs to promote phytoplankton growth so that little new carbon is required from the atmosphere, some fraction of the enhanced productivity is expected to be sequestered in the deep ocean. Upwelling in low nitrate, low chlorophyll regions may be particularly effective (Karl and Letelier, 2007). Mechanisms to induce upwelling include wave driven pumps with flexible hoses and one-way valves (Kithil, 2006), and rigid pipes employing the Bernoulli effect in the vertical decay zone of the surface waves (Kenyon, 2007). These have been shown to work though some of the upwelled dense fluid will sink again unless mixing is vigorous. The salt fountain of Stommel et al, (1956) uses the unstable distribution of salt and heat exchange through the pipe wall to produce a permanent change in the buoyancy of upwelled water, so re-sinking is not an issue. Simple salt fountains tend to be slow (Maruyama et al, 2004; Zhang et al, 2006) though proper design changes should greatly enhance the flow rate (Golmen and Cushman-Roisin, 1992). In addition, Ocean Thermal Energy Conversion (OTEC,) plants that draw on the temperature difference between tropical surface waters to generate energy (Avery and Wu, 1994) also show significant promise for upwelling. Because they draw up large volumes of cold water, they can produce substantial zero carbon emissions energy (perhaps all of societal needs), cooling for air conditioning and coral reef protection, lowering of SST in hurricane zones, and upwelling for mariculture and carbon sequestration. Finally, since OTEC enhances vertical mixing in the tropical thermocline, it should serve to enhance and stabilize the thermohaline circulation of the ocean if deployed on a large-enough scale. By shifting more of the meridional heat flux to the ocean, a decrease in atmospheric storminess could result. Interest in OTEC plants has been revived in response to the increasing cost of energy, and the substantial side benefits listed above must be explored as new plants are brought on-line. OTEC is one green energy source that could indeed be a “silver bullet” for the climate change problem.

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