P7.10 ATMOSPHERE/OCEAN COUPLINGS THAT INFLUENCE GLOBAL CLIMATE

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1. INTRODUCTION

Inconsistencies between data and many climate models are precluding valuable insights. The worldwide ocean Conveyor has frequently been identified in the open literature as the reason for the end of ice ages. At first glance, this seems quite consistent with its reputed cycle time of 1,000-1,600 years (Albarede, 1997). However, many of the paleo-temperature records show large temperature shifts within a single decade (Adams, 1999).

In addition, several publications have postulated the Conveyor as a driver for decadal variations in Sahel rain fall, SOI/ENSO, El Ninos, North Atlantic sea-surface temperature, Azores High Pressure, Atlantic Trade Wind, Atlantic major hurricane activity, and global surface temperature change (Gray, 1997). A more responsive Conveyor is also hinted at by the dominant El-Nino cycles of 23, 50 and 90 years (Anderson, 1992).

ProCon is a computer code tuned to this faster Conveyor, which is able to predict English and Northern European weather 10 years into the future (Wilson A, 2001 and my website for predicting climate using a personal computer, http://www.srv.net/~wilson/PCClimate.html). This code clearly demonstrates an atmosphere-to-ocean coupling south of the Red Sea, and an ocean-to-atmosphere coupling in the East Pacific. Also hinted at is a coupling between the Conveyor and Asian monsoons, but more research is needed here.

2. ATMOSPHERE – TO - OCEAN COUPLING

At the heart of the ProCon code are the periodic masses of dense salt water forced out of the Red Sea over the Bab al Mandab Strait, where they mix with the arm of the Conveyor immediately outside the strait. These salt masses are created by the bi-annual monsoon winds. The summer monsoon winds act in opposition to the thermohaline flow, reducing outflow of highly saline waters. The winter monsoon wind blows in the opposite direction, encouraging outflow of the high-saline water masses. Theory would seem to indicate that only the winter monsoon would be identified by the code as a signal. However, when these salt signals were broken down by month, 2/3 did occur during winter monsoon, but not all (Wilson B, 2001). So, the theory must be reevaluated in light of this outlier data.

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3. OCEAN-TO-ATMOSPHERE COUPLING (10-YEAR LAG)

The ProCon code can also predict East Pacific Trade winds 10.3-years into the future (Figure 1, from Wilson B, 2001). The cause of these trade winds has been quite a controversy in the literature, but the very fact they can be predicted from a 10-year-old ocean signal, indicates the primal driver is ocean-borne.

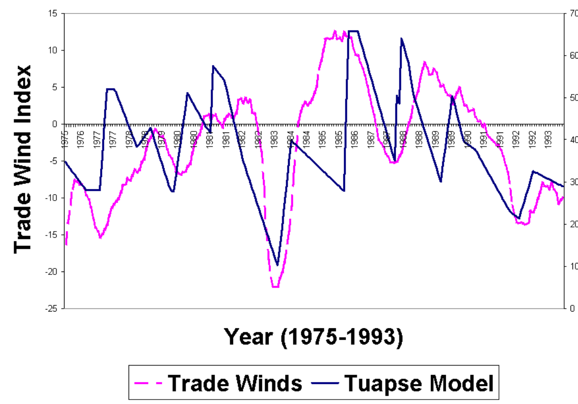

Figure 1: ProCon prediction of East Pacific trade winds based on data over 10 years old

This 10.3-year lag re-ignites another controversy: the cycle time of the Conveyor. Vallis (2000) details some of the background for the long-standing disagreement between data analysts and modelers. Specifically, many in the literature have pointed out discrepancies that would imply a faster Conveyor:

1. For the last 50 years, climatologists have tried unsuccessfully to find the missing carbon sink (Sarmiento, 1992). Models (using the "slow Conveyor" standard) had to increase CO_2 transport rates by four times in an attempt to balance global carbon data
2. New estimates of the Conveyor cycle show speeds an order of magnitude faster (Wilson A, 2001)
3. Startlingly fast, deep currents are being discovered throughout the Conveyor pathway, and constantly being explained away. For instance, the two-knot current running along the bottom of the Gulf of Mexico is assumed to be separate from the Conveyor (Nowlin 2001), though it runs the same route, where "half of the thermocline waters in the Caribbean Sea and the Gulf of Mexico are supplied by the two water masses formed in the South Atlantic and Indian Ocean" (Poole, 1999) and CFC-tracer studies show Conveyor water along that same path (Smethie, 1999). Other references also

cite deep fast currents associated with the Conveyor (Zenk, 2000)

4. An attempt to "reconcile the difference between theoretical and observed estimates of vertical mixing in the deep ocean by presenting a revised view of the thermohaline circulation, which allows the additional upwelling in the Southern Ocean...." (Webb, 2001) reduced the diapycnal (cross-density surface) mixing coefficient. This reduced the power losses of the Conveyor from 2.1 terawatts to 0.6 terawatts. This would also allow for a faster Conveyor.
5. According to Ferron (2000), "The deep meridional overturning circulation of the Indian Ocean still represents a dilemma to oceanographers." Estimates for the northward transport from hydrographic sections below 2000 m ranges up to 27 ± 10 Sv. "In contrast, GCMs only produce weak deep overturnings..."

The reason the issue of Conveyor speed is so important is that although the data has greater accuracy, the models have greater predictive capacity. The data is like a snapshot; the models, like a movie. With a model incorporating the faster Conveyor, the mystery of the 50-year lag in El Nino data may be solvable, in addition to finding the missing carbon sink, and another potential cause of global warming.

4. OCEAN – TO - ATMOSPHERE COUPLING (50-YEAR LAG)

It is satisfying to recognize that the 50-year-lag reported for El Nino's matches the 50-year half-cycle time for the Conveyor between the North Sea and the Indian Ocean (Wilson A, 2001). The discussion above on Trade Winds shows one way that the ocean can couple into the atmosphere. Now the question is, where does the 50-year-lag (Conveyor travel time between Indian Ocean and North Sea) couple to the atmosphere, in the North Sea, or the Indian Ocean?

On a purely theoretical basis, salt and heat are the only discernible signal that could be effective in the North Sea. The heat signal must be very small after 50 years, so this leaves the salt signal. A salt concentration in the North Sea might result in a slightly faster downwelling, but that hardly seems like a strong signal to the atmosphere and is just the opposite of an El Nino (a slow-down of the Conveyor).

However, the signal that might be brought into the Indian Ocean is much richer, since this water hasn't seen the atmosphere for 50 years. Theoretically, the signal may include sequestered CO_2 gas, chemically bound carbon from the ocean depths, nutrients capable of stirring immense burst of life at the upwelling, and the familiar salt signal.

If the Conveyor is indeed running 10 times faster, the CO_2 gas immediately released would be significantly higher than the CO_2 currently modeled. The nutrients would create a burgeoning of plant life first. However, for the small-celled plants, life cycle is very short, and with an abundance of animal life at the upwelling, another source of CO_2 releases would soon be manifest.

Hu (2000) claims that atmospheric CO_2 increases can create monsoons. This was posited in the context of a doubling of worldwide atmospheric CO_2 levels, but in the immediate vicinity of the upwelling, the atmosphere could easily reach such levels. Thus, a microclimate could be created that propagates monsoons in the area, implying another credible ocean/atmosphere link.

6. CONCLUSIONS

Rather than take years to properly reconcile the anomalous data readings with the models, the Indian Ocean upwelling modelers should merely increase the Conveyor speeds to values suggested by the data. Then, the crucial question of the Conveyor/monsoon coupling could be addressed.

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