Acceptance speech

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Carl Wunsch, awardee in the Climate Change and Environmental Sciences category (18th edition)

My thanks to the many colleagues who have said and written such nice things about me: nominators, the committee, the Foundation.

I'm representing the accomplishments of what is a necessarily global, international, scientific/engineering/technological effort that has spanned many decades and involving both individuals and numerous organizations including giant government agencies. To a great extent the efforts of these thousands of individuals and organizations were built upon basic science dating back hundreds of years. Much of what has happened over the past decades built upon the pioneering work of a few individuals beginning with Fourier and Tyndall in the 19th century, and whose efforts led to the insights of Arrhenius, Callendar and others in the early 20th centuries. By the middle to late 20th century, Revelle, Suess, Hansen and others recognized the huge threat of increasing atmospheric CO2.

About 1975, it became clear to much of the wider scientific community that continued additional CO2 would create a much more energetic atmosphere – one which, like an energized pendulum, would give rise to more extreme events, heat and cold waves, droughts and deluges, enormous rises in sea level, etc. to an extent beyond human experience. The possibilities of even more extreme events – a runaway greenhouse – were on the table.

For the oceanographic community, these warnings, which are based upon fundamental and well-understood physics and chemistry, raised extremely difficult issues. How much of the extra heat and CO2 being generated would be taken up by the ocean and where? Would they stay there? What parts of the ocean were going to become acidic to the detriment of the biosphere?

These and other questions were impossible to answer. Historically, and still true in the 1970s, the chief platform available to oceanographers was the ship. Travelling the ocean at less than 20km/hour, costing in modern terms

hundreds of thousands of euros/day, involving 30-60 scientists and crews, using instrumentation that was almost purely mechanical (vacuum tubes worked extremely poorly in the environment of a rolling, pitching, vibrating ship), it had taken 100 years to develop a sketchy knowledge of the global ocean. Speaking personally, it was a wonderful way to do science – so different from the everyday world of the office or laboratory – and one of the reasons I went into the field (a strong stomach and a tolerance for days of boredom helped). But many parts of the ocean (especially below about 1000m) had never been observed at all. Some had been visited just once, decades before. The state of the ocean, and whether and how it was changing, was unknown – the textbook picture and one used by climate modelers, was that of a stratified swamp – warm and salty layers on top of cold and fresher ones, moving sluggishly, not changing, and as depicted in beautiful atlases of temperature and other properties. The same issue applied to all of the oceanography sub-fields, physics, chemistry, biology, geology, geophysics.

What to do? To me, and a few others, it was obvious that the problem was a global one. Oceanographers had no organizations parallel to the meteorological agencies existing in most countries. But there had been a revolution both in the scientific understanding of turbulent fluid flows, in the technologies associated with measurements from space, and in the development of in situ instrumentation: possibly the first truly autonomous vehicles were those used in the sea. With an effort spanning several decades, and beginning with a few self-appointed individuals, we put in place a global observing system – one that incorporates the physics of temperature, salt, flow, chemistry including nutrients, oxygen, etc., and biology on all scales, thanks to thousands of scientists and engineers, universities, private and public laboratories, government and inter-governmental agencies, etc. To make sense of all of this previously unfamiliar data, we now have computer systems that properly combine our knowledge of the equations governing the fluid dynamics with the relevant chemistry and biology. It is these accomplishments recognized by the Award.

Some things are now clear: change is taking place everywhere in the ocean. But that change is radically different, depending upon the region. To understand the global implications, one must understand the different regions. Much of the change is taking place on time scales longer than a human lifetime, and will be a serious concern to our children, grandchildren, and generations to come. The systems must be sustained, and sustained globally. The observing system is still incomplete – much of the deep ocean, particularly, remains to this day almost unobserved.

I will close by repeating the warnings of our predecessors: observations confirm that climate change is real and is putting civilization and the wider environment at extremely serious risk. The challenge for all of us is to document and understand those risks, to prepare to meet them, and to be intolerant of the scientific and political stupidities that are vandalizing the world.

Thank you.