The Early History of COADS

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We all learn at an early age that the first and most essential step in answering a question is to understand what the question is—and then, all too often we see that obvious principle violated.

In laboratory science we can often formulate the question ourselves and design experiments to test possible answers. For geophysical systems nature defines the behavior we seek to understand and we learn what that behavior is by observing nature. We must, also, test our hypotheses against this observed behavior. This is not as neat as a laboratory experiment but is unavoidable.

The problem of understanding climate change is further exacerbated by the long time scale. We have no choice but to look backward in time because we cannot afford to wait for the future to unfold.

When we look backward in time we find the observational record frustratingly incomplete. We have satellite records for only a couple of decades and very incomplete radiosonde coverage for about four decades. To document longer term behavior we have only surface observations and for reasonable spatial coverage of this water planet they must include data from the ocean domain.

I ran squarely into this limitation when I began to study climate change in the mid-1960s. My general approach was to look at the global system as a whole, considering first its most energetic parts and asking:

> What factors force the motion?
> Do they exhibit variation in time?
> What physical processes are related to these variations?
> Can they be described quantitatively?
> What observational tests can be designed to evaluate concepts of how the machine works?

One of the strongest thermal forcing feature of the global system is Antarctica and the most steady energetic dynamical feature is the southern hemisphere westerlies, so an early effort was to look at the time variability of the Antarctic heat sink and the wind field. The record for the ocean area seemed to be a blank wall and in the effort to find such data I visited the U.S. Navy's then Fleet Numerical Weather Center (FNWC) at Monterey, California.

FNWC was already struggling with the problem of compiling historical marine observations and in working with NOAA, NSF and WMO to organize international efforts. Taivo Levastu was the project officer and Paul Wolff, the Center Director, was pushing hard for progress. I think they deserve recognition for helping to generate the international effort to digitize the surface ocean record.

When I came to NOAA in 1974 1 again tried to access this record. I found that an enormous effort had been invested by the international community in recovering and digitizing the marine data but it was not in a useable form for global studies.

The data collection effort really had started with Matthew Maury in the 1840s. In the 1930s Willard McDonald of the U.S. Weather Bureau initiated the first large-scale comprehensive marine climatic data base, resulting in publication of an atlas (McDonald, 1938). This was followed by Navy-supported work in Asheville, North Carolina led by Harold Crutcher, Norman Canfield, Dick Davis, Robert Quayle, and Joe Elms spanning the years from the 1950s to the early 1980s. The resulting "Atlas" data set of about 50 million observations on about 300 magnetic tapes formed the foundation for COADS.

Another major source of data eventually used in COADS consisted of observations from the Historical Sea Surface Temperature (HSST) Data Project, undertaken in the early 1970s and coordinated in the U.S. by Rob Quayle. In an effort to assure better data quality, only those marine reports containing SST observations taken by a bucket were to be included in the project. Unfortunately, the HSST data contained some gaps, as exchanges with all countries were not completed for some years and even then not all weather elements were included in the HSST data format.

Then in 1973 funding in Asheville for routine data entry and quality control of surface marine observations was cut by the Navy (about half of the data were already being received in digital form via telecommunications).

From ERL I tried to encourage NCDC and their parent EDIS (Environmental Data and Information Service) to push this important work but year after year in the 1970s their budget requests were given too low priority to be funded. Finally, in 1980, I went to Tom Potter, who was then heading EDIS, and proposed that we undertake the effort in concert, without funding, and without commitment to deadlines. Tom agreed and NCDC was given a green light.

Ralph Slutz, Scott Woodruff, and Sandy Lubker were the primary ERL and CIRES participants and it soon became clear that a huge amount of computer time would be needed, more than could be extracted from ERL's CDC Cyber. The Director of NCAR, Bill Hess, agreed to provide this computer resource during the test phase of their new Cray supercomputer, before it was fully allocated to other users. Roy Jenne became the NCAR project supervisor, and Dennis Joseph and other staff members of NCAR's Data Support Section were instrumental in getting the job done. Pete Steurer and Joe Elms became vigorously involved from NCDC.

We did not know at the time what an enormous task it would be to find and correct all the errors from various sources present in the many data sets that were collected nor did we fully anticipate all the other pitfalls. The work is still in progress a decade later and there are still many improvements to be made. I believe that this work deserves high priority for the reasons outlined above: only nature can define the behavior we seek to understand; we must look backward in time to define this behavior. Only the surface marine record provides the spatial and temporal extent that can help understand climate behavior; this record is the Rosetta Stone for interpreting the longer proxy records that can be extracted from countless other sources.

Reference

McDonald, W.F., 1938: *Atlas of Climatic Charts of the Oceans.* U.S. Weather Bureau, No. 1247.