

## A REPORT ON GLOBAL CHANGE ACTIVITIES IN TURKEY

*Emin Özsoy\* and H. Nüzhet Dalfes†*

*\*Institute of Marine Sciences,  
Middle East Technical University,  
PK 28 Erdemli, İ çel, 33731 Turkey*

*†Istanbul Technical University,  
Department of Geology  
80626 Istanbul, Turkey*

### Climate Studies in Turkey

Activities directly related to Global Change Programs around the world are limited in Turkey. A National Committee of IGBP or other previous programs directly addressing the problems are not in existence. However, sufficient infrastructure exists, national working groups on different aspects of climate problems has recently been established with initiatives from various individuals and governmental bodies, and related researches are being carried out at some research units of universities.

The establishment of a National Committee for IGBP seems to be both essential and timely. There are a number of possible candidates for research oriented members of such a Committee. However, the only prerequisite for such organization seems to be the generation of some interest in government and research organisations, and to obtain sufficient funding for its activities.

The organisation responsible for collecting climatic data is the General Directorate of Meteorology (the weather service of Turkey, hereafter referred as DMI), which is a governmental organisation established in early 1930's, and operating a number of stations which make meteorological observations. This organization is also a member of the European Center for Medium Range Weather Forecasts (ECMWF), Reading, England.

After half a century of mostly descriptive work conducted within the geography community, climate studies in Turkey seems to be gaining a new momentum with the formal institution of a "National Climate Program" (UIP) in June 1992 following UNCED in Rio. The DMI

is the lead agency responsible for the Program. ÜİP, at the present, has no earmarked funds and can be at best described as a coordination rather than funding effort. It consists at the moment of five working groups:

- o Climate Change
- o Climatology of Turkey
- o Climate Data
- o Agricultural Climatology
- o Air Pollution

Out of these five working groups, the only one able to generate some interest within the relevant research communities is the Working Group on Climate Change (WGCC). It has been operative since late summer 1992 and consists of researchers from various government agencies and universities. It is chaired by one of the authors (HND) and its tasks are modeled after the IPCC:

- o to construct with the help of data and model output analyses climate change scenarios at regional, national and local scales;
- o to assess possible impacts of such changes on natural and managed ecosystems, water resources and consequently on various socioeconomic activities;
- o to analyze national policy options regarding the mitigation of impacts and reduction of net greenhouse gas emission contributions for Turkey.

The above list's order also reflects the priorities of WGCC. Currently two major teams in Turkey are conducting climate data and model diagnostic studies for the ultimate aim of designing consistent climate change scenarios for Turkey and its region.

The first team at İTU, lead by one of us (HND) is focusing at the moment in two areas:

- o developing and applying techniques for the detection and discrimination of urban heat island effects and inhomogeneities in station records;
- o assessing various general circulation models included in the IPCC archive as to their performance in simulating regional-scale sea level pressure, surface temperature and precipitation long-term mean and interannual variability climatologies.

The second team lead by M. Türkeş is within the Research Section of DMİ and has been working on:

- o building thoroughly quality controlled data bases for station surface temperature and precipitation data;
- o assessing long-term trends and variability of various climate parameters for Turkey.

Building well checked and continuous climate record data bases for Turkey and its region is of primeval importance to both teams. DMI and various other government agencies have been operating climate station networks since late 1920's, but their records are beginning to be used only recently for comprehensive climate studies, thus transfer to computer media is just starting and problems regarding the unequal quality of data are just beginning to pop up.

The WGCC of UIP is facing some high priority tasks besides the above described list. It is to provide technical support for Turkish diplomacy in international forums. Turkey did not sign the Framework Convention on Climate Change (FCCC), objecting to her inclusion in Annexes I and II. This decision was taken as a result of rapid inter-agency assessment and consultation process just prior to Rio Conference. Two and a half year after UNCED, this decision is being questioned and efforts for a policy reassessment are underway.

Within this context, the WGCC took as a very high priority task to prepare the "National Communication" for Turkey. Such a document is required from all signatories of FCCC, and although Turkey is not among them, it is believed it will be very useful in arguing the Turkish case against its inclusion in Annexes I and II. The document is being prepared by an ad hoc subgroup including besides DMI and İTÜ teams, researchers from the Ministries of Energy and Environment, State Statistics Institute and Electrical Power Production and Distribution Company among others.

The report will start with a brief description of the natural and socioeconomic features of the country and will include sections with detailed greenhouse source and sink inventories for Turkey (organized following IPCC guidelines) and current energy production and conservation policies.

### **Outlook for a General Assessment of Regional Climate Processes**

Turkey is a passageway between major continents of Europe, Africa and Asia, and between large regional bodies of water, as well as between various ecosystems and socio-economic systems. For example, the region is a pathway of migratory species of birds and fish, and the origin for a number of faunal and floral species that were then transported to nearby and distant continents.

Toxic waste dumping, usage of chemicals, and rapid changes in land use patterns and in utilization of marine resources are occurring at a very high rate.

Water resources are also a major problem in the region. All of these problems, and their interaction with climate variability have a high potential for making the region have a high priority from a global change perspective. The detailed study of the implied climate processes necessitates multidisciplinary long term studies.

## **Oceanographic Processes of Global Change Relevance in the Eastern Mediterranean**

The particular setting of the Mediterranean Sea, as a temperate semi-enclosed sea located between land masses with great contrasts of climate, makes it predisposed to climatic interactions occurring via air-sea fluxes and modulated by the circulation, mixed-layer dynamics, and deep and intermediate depth convection. Impacts on biological components (including human concerns such as productivity, drought, *etc.*) in this environment deserve further study from a global change perspective.

In the Eastern Mediterranean, the circulation is composed of a series of interacting gyres, jets and eddies, modulating the interaction of the ocean with the atmosphere. Major interannual changes in the circulation occur, especially following exceptionally strong winters leading to deep and intermediate water formation. The patterns and modes of seasonal circulation modulate the strong interannual climatic changes. Deep water formation occurs selectively at intervals of several years, leading to changes in circulation. Similarly, the formation of the Levantine Intermediate water varies in volume over periods of several years. More interestingly, the periods of deep and intermediate formations in a massive scale coincide with strong mixing events in the other regions surrounding Turkey, i.e. the Marmara Sea, and the Black Sea. Furthermore, basic climatic variables, either in the ocean or the atmosphere do not reveal why this should be so. The relation between mixing events, circulation changes and atmospheric variables have a subtle yet important structure.

Since mixing events of extraordinary strength seem to be recurrent on time scales of several years; variability on these scales essentially implies strong coupling between the ocean and the atmosphere and important roles played by the internal dynamics of the sea, which can only be understood by the pooling of long-term data and continued studies.

Some other regions such as the Black Sea are threatened by rapid changes in their chemical and biological structure, driven by changes in the nutrient regimes of major rivers discharging into the basin, which modify the food web, force some marine species to extinction as a result of eutrophication and an almost total collapse of the marine ecosystem. The changes in the Black Sea and the neighboring Marmara Sea are on the scales of ecological disaster, having produced major changes in the nutrient concentrations at the surface layers, and concomitant increases in diatom and dinoflagellate blooms that are out of proportion when compared to the earlier decades.

The Black Sea circulation has much faster scales as compared to the Eastern Mediterranean, and important processes of shelf - open sea interaction that are responsible for redistributing nutrients and other transports of the buoyancy and wind driven flows.

Both the Black Sea and the Marmara Sea have deep / intermediate water renewal mechanisms driven by dense water inflows and the intrusive boundary driven flows representing a major mechanism of the evolution of their upper layers. It is those processes that determine the mixing and carbondioxide absorbing properties of the surficial layers.

The seasonally modulated interannual changes in either the river runoff or the atmospheric flux components are quite large in the Black Sea. For example, the fresh water inflow can change by more than a factor of 3 due to these changes. There are close correlations between the freshwater influxes and basin sea level even at the interannual time scales, as well as seasonal time scales, as a result of the nonlinear controls exerted by the Bosphorus exchange flows.

Furthermore, both the Black Sea and the Eastern Mediterranean, and the Marmara Sea have their water masses, and their geochemical structures strongly influenced by paleoclimate, and may thus serve as models to understand such processes.