HEAT WAVES IN THE MEDITERRANEAN REGION: ANALYSIS AND MODEL RESULTS

Marina Baldi, Massimiliano Pasqui, Francesco Cesarone, Giovanna De Chiara*
Institute of Biometeorology - CNR, Rome, Italy
*Corresponding Author: m.baldi@ibimet.cnr.it

Using the Regional Atmospheric Modelling System (RAMS) and the NCEP-NCAR reanalysis, Baldi et al. (2004) have demonstrated that a latitudinal northward shift of the West African monsoon is related to observed SST anomalies in the Gulf of Guinea. In an idealized simulation, Baldi et al. (2004) perturbed the climatological SST in the first half of the summer, specifically in May-June, introducing a colder dipole in the Gulf of Guinea which in turn favoured a deeper inland northward penetration of the oceanic moisture, while warm SSTAs, in the second half of the summer, provided additional moisture which enhanced the strength of the monsoon, which, through its thermodynamics and the dynamics, resulted in stronger subsidence over the Mediterranean Sea. Figure 1 shows the effect of colder SST in the Guinea Gulf on the Geopotential height at 500hPa, simulated by RAMS, obtained forcing the whole system by introducing a cold SST anomaly.

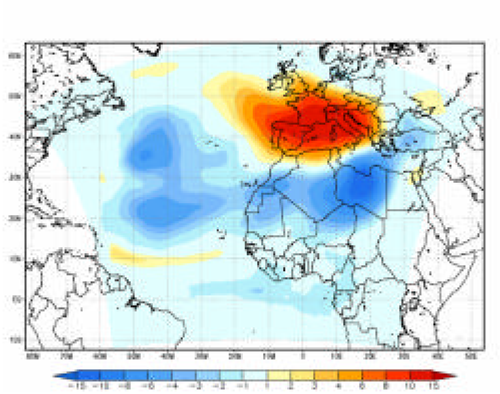

Figure 1: Effects of cold June SSTAs in the Gulf of New Guinea on the Geopotential Height at 500 mb in August (RAMS sensitivity run).

The simulation, started on April 1st 2003, lasted until end of September 2003, in order to capture the main features of the exceptionally long heat wave of summer 2003. The domain extends from central Europe to the Gulf of Guinea and, longitudinally, it includes the Atlantic Ocean, the whole Mediterranean Basin and it extends eastward to the Balkans. The SST has been updated weekly during the whole period, while a monthly average is used for the soil moisture. Results of the simulation, in terms of Geopotential field at 850 and 500 hPa and the air Temperature at 850 hPa are well reproducing the corresponding maps obtained from the NCEP/NCAR reanalysis. In particular, the use of weekly SST, instead of monthly mean, increases the performance of the model in reproducing the weather patterns.

As first shown by model results, a key role is certainly played by a positive feedback on the temperatures, by a low convective rainfall activity, and by the large soil moisture deficits, accrued in the region due to an exceptionally early and warm spring, which may have intensified most of the subsequent summer heat waves. Moreover the use of weekly versus monthly SST in the whole domain indeed improved the performance of the model, as well as more accurate soil moisture data at finer resolution can certainly do (results under investigation).

The Guinea Gulf SST, and, thus, the West African Monsoon, contribute significantly to the hot episodes triggering, and to the inter-annual variability of the central-western Mediterranean summer climate (Baldi et al., 2004).

The analysis performed and the simulation results are a major starting point for a better understanding of the physical mechanisms yielding to such severe events, and will improve the forecast of these phenomenon (expected to occur more frequently in the course of the 21st century, as suggested by regional climate scenarios, see Beniston, 2004), as needed for an efficient early warning systems. In particular, through numerical simulations, it is possible to distinguish the role played by each of the different physical processes (soil moisture depletion, positive feedback on summer temperatures, and lack of convective rainfall) characterizing severe episodes such as the summer 2003.