PROGRAMMA DI RICERCA CNR - Short Term Mobility 2016

Fruitore: Marina Baldi Qualifica: Ricercatore, Livello: III

Istituto di afferenza: CNR – Istituto di Biometeorologia

Istituzione ospitante: Laboratoire Atmosphères, Milieux, Observations Spatiales - LATMOS - Département TROPO of the Univ. Pierre et Marie Curie, Institut Pierre Simon Lapalce, Paris (F)

Analysis of the seasonal winds driven by the Saharan heat low using reanalysis and modeling output.

Final Scientific Report

The main goal of the project was the climatological analysis of the lower tropospheric and mid-tropospheric winds over North Africa and of the inertial and baroclinic instabilities generated by the African easterly jet which could enable to study the relationship between the heat low over Western Africa and the exiting position of perturbations crossing the Tropical Atlantic.

While at LATMOS an analysis of the lower tropospheric and mid-tropospheric winds over North Africa have been carried out based on ERA40 Reanalysis. This analysis has been complemented by using a simple analytical model in order to understand the roles played by different stressors on the development of baroclinic instabilities.

After a preliminary analysis of the summer circulation induced by the Saharan Heat Low (SHL) and by the Arabian Heat Low (AHL), performed using the ERA40 Reanalysis, the modelling part of the work consisted in the analysis of the shallow atmospheric circulation over North Africa done using a two layer Matsuno-Gill model system obtained by coupling a lower Rayleigh frictional layer with an upper almost frictionless layer. The dynamics are forced by prescribed diabatic sources generated by desert heat lows, and by airborne desert dust warming.

Model results show two Walker like atmospheric circulation cells, one driven by the SHL, and the other driven by the AHL. Because of large frictional losses the respective cyclones of the two cell stays in a close neighborhood of the respective low. While, because of small frictional losses, the AHL cell interacts with the SHL cell, a connection at 6000 km distance.

It results that there is a non-negligible contribution by AHL to the West African high and to the easterly jet, which reaches the middle of the Tropical Atlantic ocean. The presence of airborne dust does not change the shape of the Walker like cells, but simply strengthens the SHL cell.

The monsoonal subsidence is absent in the model, and it is introduced as a limiting factor for the Walker like cells. However, since this subsidence can strengthen the West African high, it needs to be included for a more complete analysis.

The importance of this study is due to the fact that these perturbations are directly affecting the generation of hurricanes forming off the west African coasts, on the Atlantic, and crossing the Tropical Atlantic reaching the Caribbean and North America. Therefore a better understanding of their formation and development assures a better evaluation of the conditions driving the hurricanes formation and their forecasting.

A manuscript entitled: “Some simple solutions for African easterly jet and Saharan winds – African winds driven by heat lows and desert dust warming” is presently under preparation to be submitted to an international peer reviewed scientific journal.

Firma del Fruitore

Rome, June 30th 2016