



New Energy Balance, New Atmospheric Circulation and New Water Cycle in Western Mediterranean



Prof. Dr. Mohammed Said KARROUK
Hassan II University of Casablanca, FLSH Ben M'Sick, Geography, Climatology, LCEAT, CEREC, Climate & Development Program (ClimDev Morocco),
Chair, National Committee of Future Earth, Casablanca, Morocco, E-Mail. CEREC@univh2m.ac.ma & ClimDev.Morocco@GMail.Com

The "New Planetary Climate"

Cumulating ocean-atmospheric thermal energy caused by global warming has resulted in the reversal of the energy balance towards the poles (Fig. 1). This situation is characterized by a new ocean-continental thermal distribution: over the ocean, the balance is more in excess than in the mainland, if not the opposite when the balance is negative inland (Fig. 2).

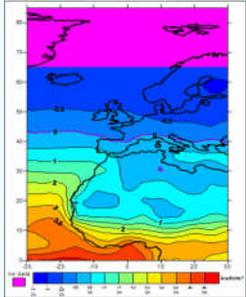


Fig. 01: Reversal Energy in the North Atlantic (December "1983-2005" SSE / NASA)

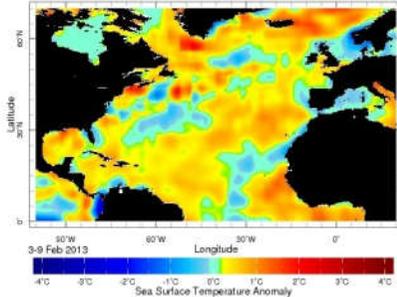


Fig. 02: Pushed pole ward ocean energy (NOAA / NCEP)

Thanks to satellite observation and daily monitoring of meteorological conditions for more than ten years, we have observed that the positive balance has shifted more towards the poles, mainly in the northern hemisphere (Fig. 3). Subtropical anticyclones are strengthened and have extended to high latitudes, especially over the Atlantic and Pacific oceans. This situation creates global peaks strengthened in winter periods, and imposes on cosmic cold the deep advection toward the south under the form of planetary valleys "Polar Vortex" (Fig. 4).

This situation imposes on the jet stream a pronounced ripple and installs a Meridian Atmospheric Circulation (MAC) in winter, which brings the warm tropical air masses to reach the Arctic Circle, and cold polar air masses to reach North Africa and Florida.

The Meridian Atmospheric Circulation (MAC) in Northern Hemisphere

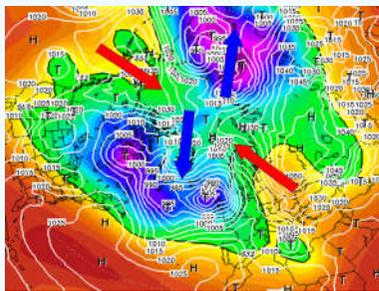


Fig. 03: Situation of February 1, 2014 (ECMWF / Wetterzentrale)

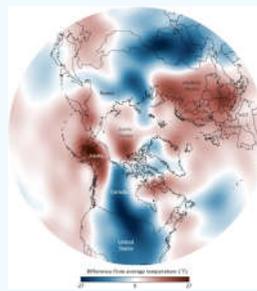


Fig. 04: Air temperatures (1000 hPa) for January 5-7, 2014, compared to the 1981-2010 average. (NOAA / NCEP)

This situation creates unusual atmospheric events, characterized by hydrothermal "extreme" conditions: excessive heat at high latitudes, accompanied by heavy rains and floods, as well as cold at low latitudes and the appearance of snow in the Sahara !

The populations are profoundly influenced by the new phenomena. The socioeconomic infrastructures can no longer assume their basic functions and man when unprotected is weak and hence the advanced vulnerability of all the regions especially those belonging to poor and developing countries.

Characteristics of the "New Climate"



Fig. 05: New! Reduced snow in Alaska, January 25, 2014 (NASA / MODIS)

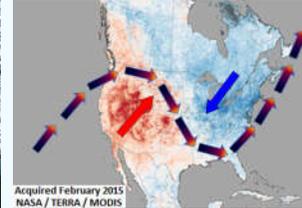


Fig. 06: Going Hot and Cold in February 2015 in North America

The thrust of the tropical heat to very high latitudes induced a rapid melting of polar ice. The case of Alaska in January 2014 is representative in this regard; when the cold winter sets in to the pole, the polar space is invaded by the tropical heat of the Atlantic and Pacific side (Fig. 5). The situation has resulted in an increase of heat in Alaska, and the advection of cosmic cold over the continents, mainly in eastern Canada and the United States of America (Fig. 6).

Since the end of last century, qualified meteorological events of "exceptional" causing floods have not ceased to occur in Morocco and elsewhere, with a recurrence increasingly high, prompting to wonder about the "new" Mode hydrothermal functioning of climate inducing torrential rains, as well as its effect on the environment and societies.

The latest event is the disaster of November 2014 flooding in southern Morocco, which is due especially to the non usual rains return (Fig. 7).

Weather conditions were marked by enhanced Meridian Atmospheric Circulation (MAC), characterized by persistent high temperatures during the autumn period in Morocco, mainly south of the Atlas, combined by the intrusion of a cold drop in the beginning of the event on 11.17.2014, and straightforward installation of a planetary valley across the Moroccan coast on 11.24.2014, which has evolved into storm (Xandra) in which depression has reached the surprising value of 975 hPa on 11.28.2014.

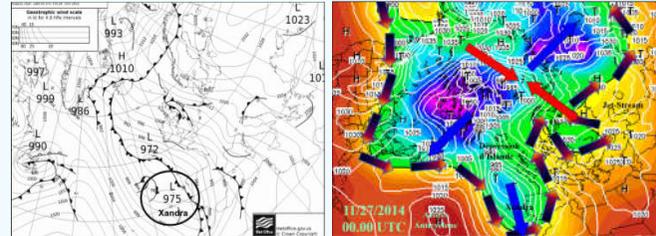


Fig. 07: November 28, 2014 Storm Xandra in the Western Mediterranean (Met Office & Wetterzentrale)

Human and material damage caused by this flood are impressive: people died, roads, bridges and crops have been destroyed, overwhelmed dams. It has been a catastrophe.

This event and others like it (Mohammedia 2002, Tangier 2008, Gharb 2009-2010, Casablanca 2010), must be considered as references for the simulation of future situations, and integration into development plans on future (Fig. 8).

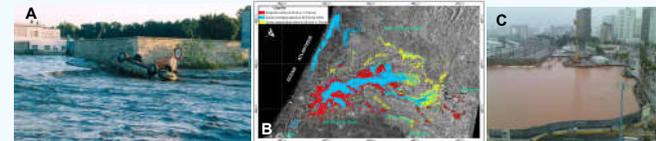


Fig. 08: The floods in the Mohammedia (A), Gharb (B) & Casablanca (C): Morocco

New Impacts of "New Climate"

The new "New Climate" extreme effects have emerged in recent years. It is the impact of MAC and the Polar Vortex. Over the North Atlantic, Polar Vortex could cause a negative anomaly of atmospheric pressure, causing a violent movement of the wind, which creates giant waves that reach the sea coast. The situation of January 6, 2014 is revealing in this respect (Fig. 09 & 10).

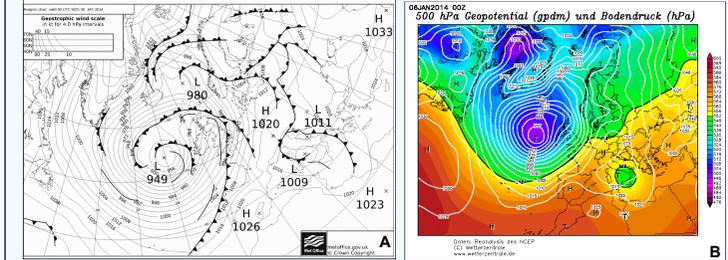


Fig. 09: January 06, 2014 The Polar Vortex in North Atlantic, Europe and North America (A: Met Office & B: Wetterzentrale / NCEP)



Fig. 10: January 06, 2014 Giant Waves in France (A) and Morocco (B)

The Northeast Atlantic coast in recent years knows new implications of MAC. It induces tropical storms to the Northeast Atlantic and located in the Azores basin. The example of Xynthia (2010), Gordon (2006 & 2012), Nadine (2012) and Alex (2016) is revealing in this regard (Fig. 11 & 12).



Fig. 11: September 30, 2012 Tropical Storm Nadine in the Northeast Atlantic (NASA / MODIS)



Fig. 12: January 14, 2016, a Hurricane Alex in the Northeast Atlantic (NASA / MODIS)

References

*Karrouk, M.S. 2020: Floods and Droughts Management: The Extreme Event and its Human and Physical Impacts. American Meteorological Society's 34th Conference on Hydrology, 100th Annual Meeting, American Meteorological Society (AMS), Boston, MA.
*Karrouk, M.S. 2019: The Shift of the Atmospheric Circulation Patterns and Its Impacts on Western Mediterranean. In: Zhang Z., Khelifi N., Mezghani A., Heggy E. (eds) Patterns and Mechanisms of Climate, Paleoclimate and Paleoenvironmental Changes from Low-Latitude Regions. CAJG 2018. Advances in Science, Technology & Innovation (IEREK Interdisciplinary Series for Sustainable Development), Springer, Cham. DOI https://doi.org/10.1007/978-3-030-01599-2_25. Publisher Name Springer, Cham, eBook Packages, Earth and Environmental Science. Publisher: Springer International Publishing, Copyright Holder: Springer Nature Switzerland AG.
*Karrouk, M.S. 2019: The impact of the "New Climate" warmed on the "New Water Cycle" in the Maghreb », American Geophysical Union Fall Meeting (AGU), San Francisco, CA.
*Kennedy C. and R. Lindsey 2014: How is the polar vortex related to the Arctic Oscillation? NOAA, January 20, 2014.
*Lindsey R. 2014: Polar vortex brings cold here and there, but not everywhere. NOAA, January 10, 2014.