Geophysical Research Abstracts
Vol. 14, EGU2012-5932, 2012
EGU General Assembly 2012

To What Extent Do Atmospheric Modes Of Variability Determine Mediterranean Sea Surface Heat Exchange?

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In recent years, a significant amount of research has been directed towards understanding the impacts of various modes of atmospheric variability on heat exchange in the Mediterranean Sea. However, not all of these modes are independent and this has led to some uncertainty regarding which modes are most important for the heat budget of the basin and its sub-basins. In this paper, a range of modes and their relative dependencies will be considered, and a clear picture of their impacts on the heat exchange developed. In particular, the influence of the first four independent modes of atmospheric variability in the North Atlantic / Europe region will be assessed using a.) observation based indices of these modes from the NOAA Climate Prediction Centre (CPC) and b.) two reanalysis (NCEP/NCAR and ARPERA) surface flux datasets for the period 1958 onwards. The modes considered are the North Atlantic Oscillation (NAO), East Atlantic pattern (EA), Scandinavian pattern (SCAN) and East Atlantic / West Russian pattern (EA/WR). The relative influence of these modes on the mean heat budget of the full Mediterranean basin and the eastern and western sub-basins will be discussed. The NAO, has a surprisingly small impact on the full basin winter mean heat budget, < 5 Wm-2. In contrast, the EA mode has a major effect, of order 25 Wm-2, with similar impacts on both the eastern and western Mediterranean. The EA/WR mode plays a significant role but, in contrast to the EA mode, it generates a dipole in the heat exchange with an approximately equal and opposite signal of about 15 Wm-2 on the eastern and western sub-basins. The findings obtained with the four independent modes will be discussed in the context of other ‘modes’ advanced in the literature, in particular the North Caspian Pattern and Mediterranean Index. To conclude, a clearer picture of how the atmosphere controls the heat exchange in the Mediterranean basin considering all modes will be presented.