Geophysical Research Abstracts
Vol. 16, EGU2014-6478, 2014
EGU General Assembly 2014

Impacts of Atmospheric Modes of Variability on Air-Sea Heat Exchange in the Red Sea

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The potential impacts on Red Sea surface heat exchange of various major modes of atmospheric variability are investigated using the NASA Modern Era Retrospective Analysis for Research and Applications (MERRA) atmospheric reanalysis and the Objectively Analyzed Air–Sea Flux dataset (OAFlux) merged satellite+reanalysis dataset. The mode impacts on surface net heat flux are quantified by calculating the heat flux anomaly that corresponds to a unit positive value of each index for each grid point. The seasonal effects of the atmospheric forcing are investigated considering two and four typical seasons of a calendar year. Considering two seasons, the impacts are strongest during the winter-centered part of the year (October to March) mainly over the northern sub-basin. The North Atlantic Oscillation (NAO), the East Atlantic - West Russia Pattern (EAWR), and the Indian Monsoon Index (IMI) have the greatest effects. They generate negative anomalies (by definition additional ocean heat loss) of 7-12 W/m2 in the northern Red Sea basin mean net heat flux for a unit positive value of the mode index. During the summer (April to September), the signal is smaller and the East Atlantic (EA) and Multivariate ENSO Index (MEI) modes have the strongest impact which is now located in the southern Red Sea (sub-basin anomalies of 4 W/m2 for unit positive mode index, negative for EA and positive for MEI). Results obtained by analysis carried out on the traditional four-season basis reveal that indices impact peaks during the typical boreal winter (DJF) with average anomalies of 12-18 W/m2 to be found in the northern part. It is noteworthy that during the winter, the EAWR generates negative anomalies around 30 W/m2 over the most of the central Red Sea. During the spring (MAM), summer (JJA) and autumn (SON) the anomalies are considerably lower, especially during the spring when the mode impacts are negligible. Atmospheric modes have a stronger effect on air-sea heat flux over the northern half of the Red Sea during the winter and autumn while the southern half experiences higher effects during the summer. Atmospheric forcing associated with the indices behavior is also discussed. In comparison with the neighboring eastern Mediterranean Sea, the mode impacts on the northern Red Sea during the autumn and winter, though producing in general weaker heat flux anomalies, show quite similar effects.