Geophysical Research Abstracts
Vol. 13, EGU2011-11340, 2011
EGU General Assembly 2011

The Mediterranean Sea surface Heat Budget: from the observed estimates to the atmosphere-land surface-river-ocean regional modelling

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Considering the Mediterranean Sea surface Heat Budget (MSHB) multi-year mean, the Mediterranean basin loses heat by its surface with an excess of the net Long-Wave radiation, Sensible Heat flux and Latent Heat flux over the incoming net Short-Wave radiation. This surface budget is balanced by the net Gibraltar strait Heat Transport and the variation of the Mediterranean Sea total Thermal Heat Content. The MSHB partly drives the Mediterranean Sea surface temperature, its feedback to the regional climate and its impact on the characteristics of the deep water masses. The assessment of the MSHB becomes consequently a tipping point of the observation, modelling and understanding of the regional Mediterranean climate system. The complex regional physical characteristics of the Mediterranean basin (orography, complex coast line, strong land-sea contrast, air-sea coupling, regional winds, cloud-radiation interaction and aerosol-radiation interaction) strongly influence the various components of the MSHB and make this estimation task even more complicated.

State-of-the-art observation datasets over the period 1989-2001 are assessed for the different components of the MSHB using in-situ data and satellite products to reach a best estimate that full-fills the closure hypothesis. We specially take care about the spatial coverage, the land-sea mask and the resolution of each dataset during the computation. We then use these best observed estimates to evaluate the available reanalysis (ERA40, ERAInterim, NCEP), the Mediterranean-dedicated downscaling or correction of reanalysis (ARPERA, FP6-ENSEMBLES, Pettenuzzo et al. 2010) and a new generation of Mediterranean-dedicated regional climate models called Regional Climate System Models (RCSM). RCSMs include all the components of the physical climate system with high-frequency coupling between the atmosphere, the land surface, the river and the ocean. Mainly developed in the framewok of the European project CIRCE, these RCSMs are the modelling basis of the starting HyMeX and Med-CORDEX initiative. Four models are analysed coming from ENEA, MPI, IPSL/LMDZ and Meteo-France/CNRM. The major quality and drawbacks of the RCSMs with respect to the MSHB representation are analysed as well as pathways to model improvement. The spatial and temporal variability of the terms of the MSHB is finally studied.