Plinius Conference Abstracts
Vol. 13, Plinius13-86, 2011
13th Plinius Conference on Mediterranean Storms

A modification for sea evaporation estimates based on changes in stratification in the contact layer

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Evaporation from sea surface plays a key role in the ocean-atmosphere energy exchanges, and is a primary source for moisture to the atmosphere. Both energy and moisture are drivers for storms and marine circulation. However, up to date direct measurements of evaporation over the sea are extremely occasional, without much impact on weather or oceanographic analyses. Traditionally evaporation has been estimated by means of bulk aerodynamic formulas involving specific humidity, wind speed, and sea surface temperature (SST). All of these quantities are widely observed in most coastal stations, as well as in ships or buoys, and can also be derived from remote sensors in satellites. One of the basic assumptions of the bulk formulas is that air in contact with the sea surface will collect as much moisture as required to reach saturation at sea surface temperature. However, these formulas do not consider the renewal of the air after taking the moisture from the sea. That is, the ability of this air to move away – upwards - exporting the water out of the contact layer. Otherwise, a barrier over the sea surface will form, preventing moisture export.

In this communication we introduce a correction in the bulk formulas through a stability criterion that accounts for these alternative situations. The estimates of evaporation are thus lower when the contact layer is stratified. Therefore, overall estimates of evaporation are reduced as well as the latent heat extraction from the sea which would revert to higher SST.

The preliminary results in some scenarios, using semi hourly meteorological and SST data, show overall daily reductions (up to a 60%) of the evaporation estimates over the estimates using the typical bulk formulae. We also used this correction to estimate its impact on the SST upon a regional configuration of the NEMO-OPA oceanic model, implemented over the eastern North-Atlantic Ocean. The overall response of the SST to this correction is almost negligible but slightly more realistic in terms of RMS error. In particular, in the coastal upwelling areas new SST estimates do not reach values as low as those without correction. These results should raise awareness in the numerical modelling community that the cold SSTs simulated in the upwelling regions may not come only from the upwelling dynamics but from an unrealistic evaporation regime.