Regional SST diurnal warming from SEVIRI

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Title: Regional SST diurnal warming from SEVIRI

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Abstract: Diurnal warming of the upper ocean layer typically occurs under clear skies when the wind is low and the solar heating high. This diurnal signal has been extensively studied as it poses challenges for validating and calibrating satellite sensors, merging SST time series, oceanic and atmospheric modelling. As heat is significantly trapped close to the surface, the diurnal signal's maximum amplitude is best captured by radiometers. The availability of infra-red retrievals from a geostationary orbit allows the hourly monitoring of the diurnal SST evolution. SEVIRI SSTs from 2006 to 2011 were used in this study to i) construct a foundation temperature field (SST_{found}) representative of well mixed conditions and to ii) quantify the day-time warming signal at different regions. In order to construct a representative SST_{found} sensitivity tests were performed using multi versus single day averages of night time SSTs of different quality flags. It was found that the bias against a single day validation field consisting of the last pre-dawn, quality 5 SST ranged from -0.1 to 0.1 K and the standard deviation was mostly between 0.2 and 0.3 K. Using a single day composite of night-time (local time 00-04), quality 3-5 SST, the day-time (from 08-20 local time) anomalies, δSST, were estimated as quality 5 SST_{day}- SST_{found}. It was shown that δSST exceeding 1K are found in the enclosed basins such as the Mediterranean, Black, Baltic and Arabian Seas but also in the coastal areas of western Africa and Madagascar as well as in the central North and South Atlantic (Figure 1, left panel). Such occurrences coincided well with concurrent low winds and high surface heat fluxes from ECMWF (Figure 1, right panel). A regional analysis of the diurnal warming characteristics in terms of the mean daily cycle, the annual distribution of warming exceeding various thresholds and the local time of occurrence was performed for 8 domains. These were categorised in 2 mid-latitude domains in the north and south Atlantic, 3 sub-Tropical domains, 1 domain in the Tropics and 2 domains covering the Mediterranean and Black Sea and the Baltic and North Sea. Consistent patterns identified in all domains included the seasonal spring and summer signal, a peak of occurrences in the early afternoon between 13 and 16 local time, the early morning cooling and the residual warm layer of the mean daily cycle. Differences between domains were noted in the amount of identified warming exceeding different thresholds, the width of the annual distributions indicating the occurrence of warming throughout the year or only during some months, the peak local time of occurrence shifting earlier or later depending on the domain, the occurrence or not of warming at certain periods of the day, the peak mean amplitude and rate of warming and cooling (Figure 2). For a detailed description of the study, see the manuscript from Karagali and Høyer, *Characterisation and quantification of regional diurnal SST cycles from SEVIRI*, in Ocean Sciences Discussion, 11, 1093-1128, 2014.

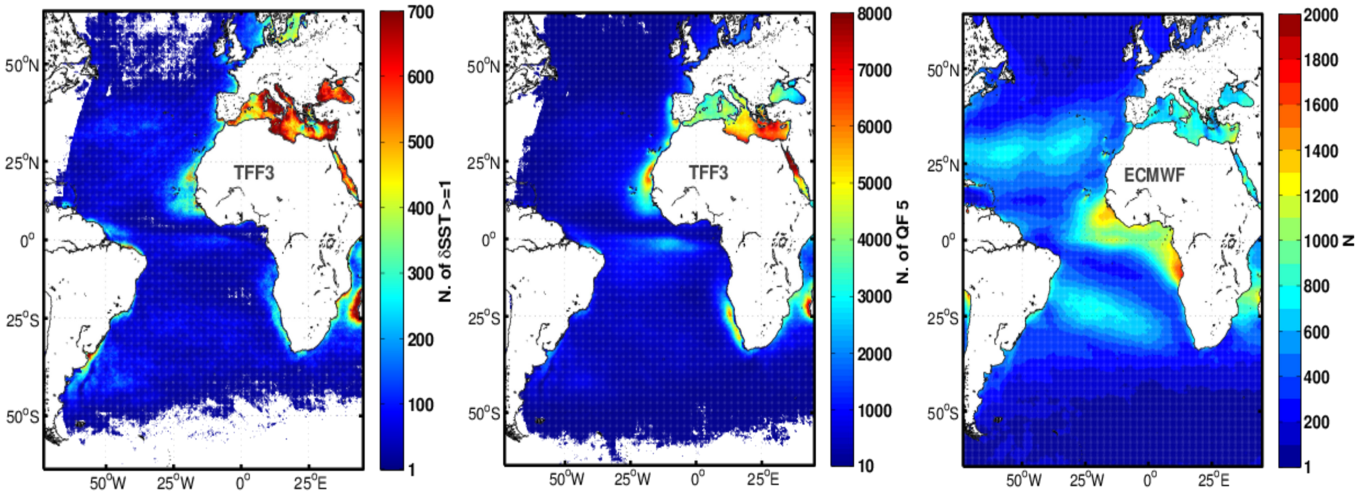

Figure 1: Number of cases for δSST greater or equal to 1 K (left), quality 5 day-time SST (middle) during 2006-2011 and simultaneous low wind (less than 6 m/s) and high surface heat flux (more than 400 W/m^2) cases (ECMWF, 2009-2011).

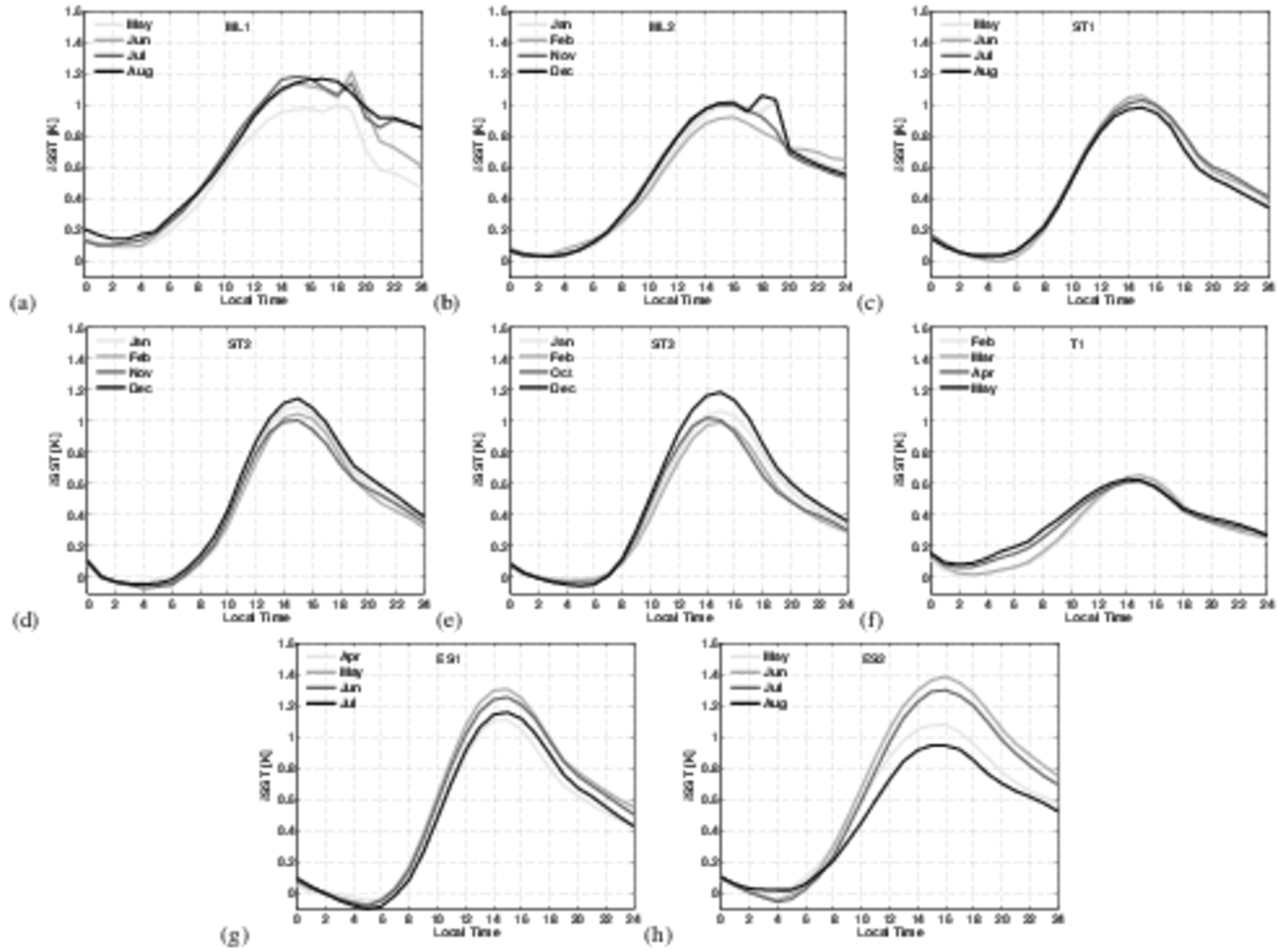

Figure 2: The monthly averaged daily cycle at 8 different domains of the SEVIRI disk, for the months with the peak amplitude. The daily cycles are based on grid cells that show warming exceeding 0.5 K at least once during the day.