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A thermal subtidal model for a well-mixed estuary based on field data

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In this meeting, we will present a predictive model for the spatio-temporal variability of the temperature in a well-mixed estuary: The Guadalquivir river estuary, which is located in SW Spain and flows into the northern Gulf of Cádiz (Atlantic Ocean). It is a convergent, relatively narrow, navigable and positive estuary normally subjected to low freshwater discharges mainly released from the Alcalá del Río head dam, located 110 km inland.

The tidally- and cross-sectionally averaged advection-diffusion equation for the thermal energy balance was integrated numerically by stretches defined by the moorings' locations. The model operates at the momentum-conveying part of the cross-section at subtidal scale, and is based on a data set from a comprehensive monitoring campaign carried out during 2008-2011 (Navarro et al., Ocean Dynamics 61 (6) 753-765, 2011). The thermal energy transport model is forced by radiative, atmospheric, tidal and fluvial data series. In particular, the time evolution of short and longwave radiation, and latent and sensible heat were obtained at different locations along channel (Pawlowicz et al. Eos Trans. AGU 82 (1), 2, 2001). Hindcast water surface temperature resulted in close agreement with observations in all locations, reaching a correlation higher than 0.99. The most important contributions to temperature variability, which exhibits evident subtidal and seasonal modulations, are radiation and advection. This is in agreement with recent results near the estuary mouth (García-Lafuente et al. Estuarine, Coastal and Shelf Science 111, 60-66, 2012). Results of the model indicate that water surface temperature along the main channel is weakly dependent on dispersion and freshwater discharges.

Sea water temperature is a crucial factor that affects density, oxygen solubility, nutrients distribution and plankton migrations. Thus, present and future works focus on investigating the primary and secondary production evolution along the Guadalquivir estuary using the thermal model as a biological tool.