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Jérémy Bernard (1), Pascal Kéravec (3,5), Benjamin Morille (2,3), Marjorie Musy (3,4), Isabelle Calmet (3,5), and Erwan Bocher (1)

(1) CNRS, Lab-STICC Laboratory UMR 6285, 56000 Vannes, France, (2) CNRS, Centre de Recherche Nantais Architectures Urbanités, UMR 1563, École Nationale Sup ´erieure d'Architecture de Nantes - Nantes, France, (3) CNRS, Institut de Recherche en Sciences et Techniques de la Ville, FR 2488, École Centrale de Nantes, 44000 Nantes, France, (4) Cerema Ouest - Nantes, France, (5) CNRS, Laboratoire de Recherche en Hydrodynamique, Énergétique et Environnement Atmosphérique, UMR 6598, École Centrale de Nantes - Nantes, France

The air temperature measurement in outdoor spaces is very sensible to solar radiation and wind speed. In most of the cases, shelters are used to protect the air temperature sensors. However, the temperature difference between two sensors located in a same outdoor environment but within a different shelter may reach several degrees Celsius under certain meteorological conditions. The objective of this contribution is to propose a semi-empirical model to characterize the error of air temperature measurement induced by a shelter under given meteorological conditions.

First, an energy balance is applied to a simplified shelter shape. The temperature difference between the air inside and outside the shelter is then isolated in the equation. Several assumptions are proposed in order to obtain an analytical solution of this error term. At the end of the day, the predictive equation of the error is a function of the shelter dimensions and thermal characteristics as well as four meteorological variables: the wind speed, outdoor air temperature, heating rate of the outdoor air temperature and global radiation.

In order to verify the consistency of the predictive equation of the error, it is transformed into a semi-empirical model. The shelter dimensions and thermal characteristics information are gathered under constants that are estimated using a dataset containing shelter error and meteorological conditions along time. The data used come from a shelter comparison campaign performed by the World Meteorological Organization (WMO) in Ghardaïa (Algeria) during one year between 2008 and 2009. Eighteen shelters were equipped with the same temperature sensor in order to identify their performances in extreme meteorological conditions (desert). Seventy percent of this data are used for model calibration whereas the remaining thirty percent are used for model evaluation.

Results show that the physical meaning of the model is respected: a large shelter limits its overheating but slightly delays the outdoor air temperature signal. The ability of the semi-empirical model to predict a shelter temperature error is then evaluated and compared to existing empirical models.Its performance is higher than the one of the existing models for certain shelters but not all of them.