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Abstract

An increase of temperature over Europe, both in terms of averages and extremes is expected within the current century. In order to consider **health impacts under warm conditions**, it is important to **take into account also the combined effect of temperature and humidity on the human body**. To this aim projections of a basic index – the **humidex** - representative of the perceived temperature, under different scenarios and periods, has been investigated in this study. A very low concomitance of observed extreme temperature events and extreme perceived temperature events is found over the present climate, reinforcing the importance to investigate not only future projections of temperature and humidity, but also the combination of the two fields. A set of **10-km resolution climate simulations**, provided within the **EURO-CORDEX** multi-model effort, **demonstrates ability in representing the intense and extreme events of perceived temperature** over the present climate (Fig.1) and to be eligible as a tool to quantify future changes in geographical patterns of exposed areas over Europe. Following the worst (RCP8.5) climate scenario, **an enlargement of the domain subject to dangerous conditions is expected since the middle of the current century**, reaching 60 degrees North when considering really extreme events (Fig. 2). The most significant increase of extreme events is found when comparing the 2066-2095 projections, to the 1966-2005 period: bearing in mind that changes in relative humidity may either amplify or offset the health effects of temperature extremes, **a less pronounced projected reduction of relative humidity in the north-eastern part of the European domain – due to an increase of specific humidity over the region (not shown) - makes north-eastern Europe the most prone region to an increase of intense to really extreme values of perceived temperature**.

Data and Methods

The **PERCEIVED TEMPERATURE** index is defined based on 2 meter air Temperature (TAS) and Relative Humidity (RH) as:
HUMIDEX = TAS + 5/9 x (e-10)
where:
 $e = \{6,112 \times 10^{(7.5 \times TAS / [237,7 + TAS])} \times RH / 100\}$

Five main **HUMIDEX** categories are defined to represent different level of **heat disease**:
I) **HUMIDEX** >= 45 **Really Dangerous**
II) 40 <= **HUMIDEX** < 45 **Huge Discomfort**
III) 35 <= **HUMIDEX** < 40 **Great Discomfort**
IV) 30 <= **HUMIDEX** < 35 **Some Discomfort**
V) **HUMIDEX** < 30 **No Discomfort**

Intense/Extreme/Really Extreme events (90th/99th/99.9th percentiles [90p/99p/99.9p]) are computed based on daily time series over the **HISTORICAL (1976-2005)** and **FUTURE (2066-2095)** period under the **CMIP5 RCP8.5** scenario (worst case in terms of emissions).

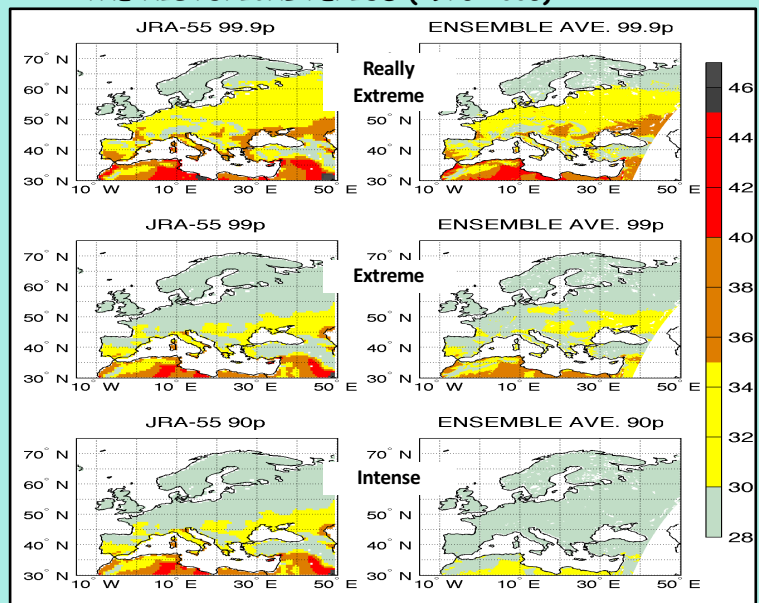
The analysis is based on **multi-model EURO-CORDEX** (Tab.1) results having a horizontal resolution of **about 10 km**

Model name	Driving GCM	Institute
SMHI-RCA4	CNRM-CM5	Swedish Meteorological and Hydrological Institute, Rossby Centre
KNMI-RACMO22E	ICHEC-EC-EARTH	Royal Netherlands Meteorological Institute
INERIS-WRF331F	IPSL-CM5A-MR	IPSL (Institut Pierre Simon Laplace) and INERIS (Institut National de l'Environnement industriel et des RISques)
CNRM-ALADIN53	CNRM-CM5	Centre National de Recherches Meteorologiques

Tab. 1 Involved EURO-CORDEX EUR-11 Regional Climate Models.

Fig.1 Intense (90p, lower panels), Extreme (99p, central panels) and Really Extreme (99.9, upper panels) **HUMIDEX** values over the **HISTORICAL** period (1976-2005) as represented by the **EURO-CORDEX** ensemble average (right panels) compared to observations (left panels). The five colors (gray/yellow/orange/red/brown) indicate No discomfort/ Some discomfort/ Great discomfort/ Huge discomfort/ Really dangerous conditions, respectively.

THE HISTORICAL PERIOD (1976:2005)



THE FUTURE PERIOD (RCP8.5 2066:2095)

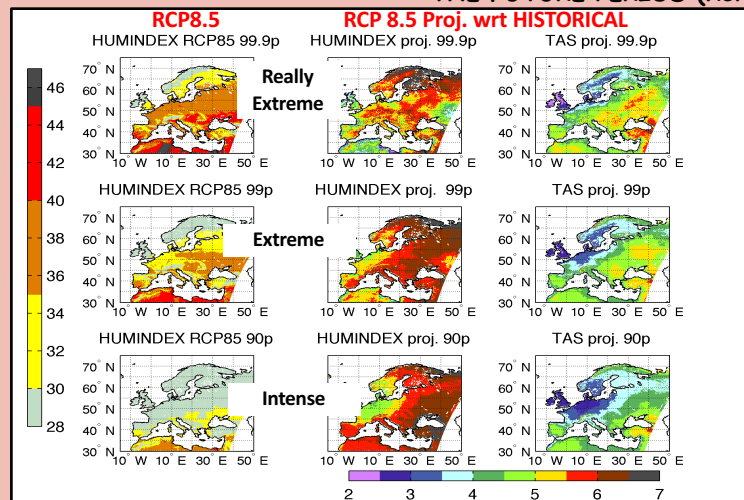


Fig. 2 Intense (90p, lower panels), Extreme (99p, central panels) and really extreme (99.9, upper panels) **HUMINDEXTAS** RCP85 far future (2066-2095) values (left panels) and **HUMINDEXTAS** increase (central panels) compared to **TAS** increase (right panels). Projections refer to the **HISTORICAL** period (1976-2005). Units are [°C].

CONCLUSIONS:

- EURO-CORDEX models in EUR11 config are able to represent perceived temperature extremes in the current climate
- Extreme Events of *Temperature* and Extreme Events of *perceived Temperature (HUMIDEX)* are not synchronous.
- projections of *perceived temperature* over north-eastern Europe are more pronounced than projections of *temperature (TAS)* only.

Ref: Scoccimarro E., P.G. Fogli, S. Gualdi, 2017:

The role of humidity in determining perceived temperature extremes scenarios in Europe. *Environmental Research Letters*. Doi: 10.1088/1748-9326/aa8cdd