SYSTEM OF WEATHER COMFORT FORECASTING FOR EUROPEAN RUSSIA

Svetlana V. Tkachuk

[1]Hydrometeorological Research Centre of Russian Federation
[2]A.M. Obukhov Institute of Atmospheric Physics (RAS)

E-mail: tkachukzn@gmail.com

This work provides information about the system of the weather comfort forecasting through biometeorological indexes, which is being held in the Russian Hydrometeorological centre of the operational test. It is shown that the evaluation of comfort in different areas should take into account geographic location and specific features of the climate. It is explains the differences in the selection of indicators for the weather of the northern and southern regions of European Russia. Particular attention is devotes to influence the meteorological parameters such as air temperature, humidity and wind speed on human health. Shows the results of modeling some bioclimatic indexes with application the different versions of the mesoscale model WRF (Weather Research and Forecast) for some areas such as Moscow (spatial resolution 2x2 km), the Caucasus region (spatial resolution 9x9 km), Murmansk region (5x5 km) and the whole European territory of Russia (20x20km) for the for the abnormally hot conditions of summer 2010 and for cold days in winter 2010, 2011.

Fields of basic meteorological elements, which are calculated on the basis of the indices, obtained by using mesoscale model WRF-ARW (Weather Research Forecasting, USA)

Region	WRF-ARW version	Spatial resolution
Murmansk area	polar	5 x 5 km
European territory of Russia; Caucasus region	«normal»	10 x 10 km
Administrative districts of Moscow	urban	2 x 2 km

One of the most widely used formula for determining the heat stress - Apparent temperature (proposed Missenard,1955):

$$ET = t - 0{,}4(t-10)(1 - f/100)$$

Where t – air temperature (°C), f- relative humidity (%)

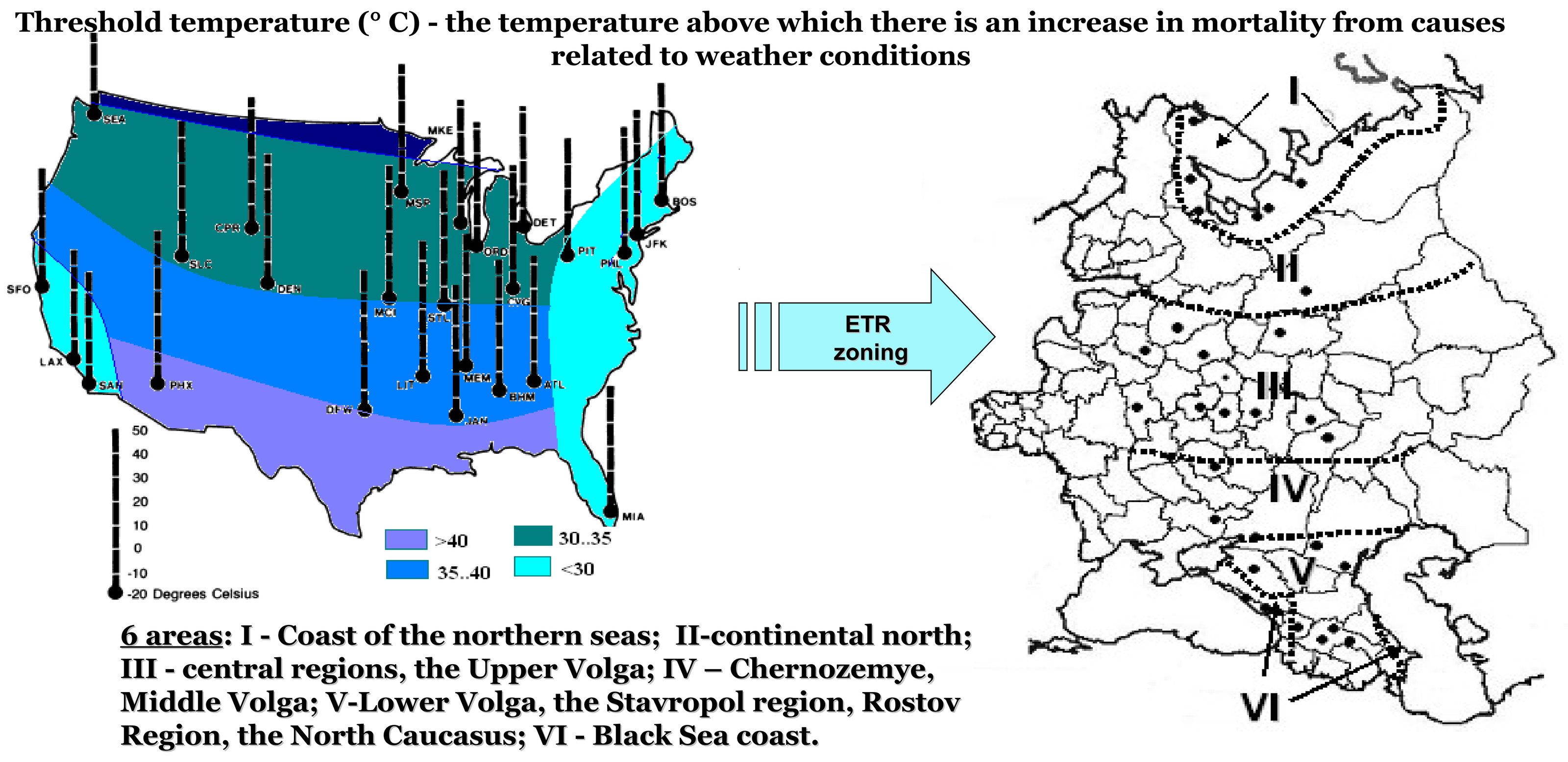
In national practice the calculation of the overall effect of air temperature, humidity and wind speed, the so-called equivalent-effective temperature, is calculated using the formula proposed by Aizenshtadt (1987):

$$EET = t[1 - 0{,}003 * F] - 0{,}385V^{0{,}59}[(36{,}6 - t) + 0{,}622(V-1)] + [(0{,}0015V + 0.008)(36{,}6 - t) - 0{,}0167]F$$

Where t – air temperature (°C), F=100 -f , f- relative humidity (%), V – wind speed (m/s)

Zoning of the European territory of Russia in the degree of comfort

Threshold temperature (° C) - the temperature above which there is an increase in mortality from causes related to weather conditions



6 areas: I - Coast of the northern seas; II-continental north; III - central regions, the Upper Volga; IV – Chernozemye, Middle Volga; V-Lower Volga, the Stavropol region, Rostov Region, the North Caucasus; VI - Black Sea coast.

Regional features EET values for different regions of the European territory (°)

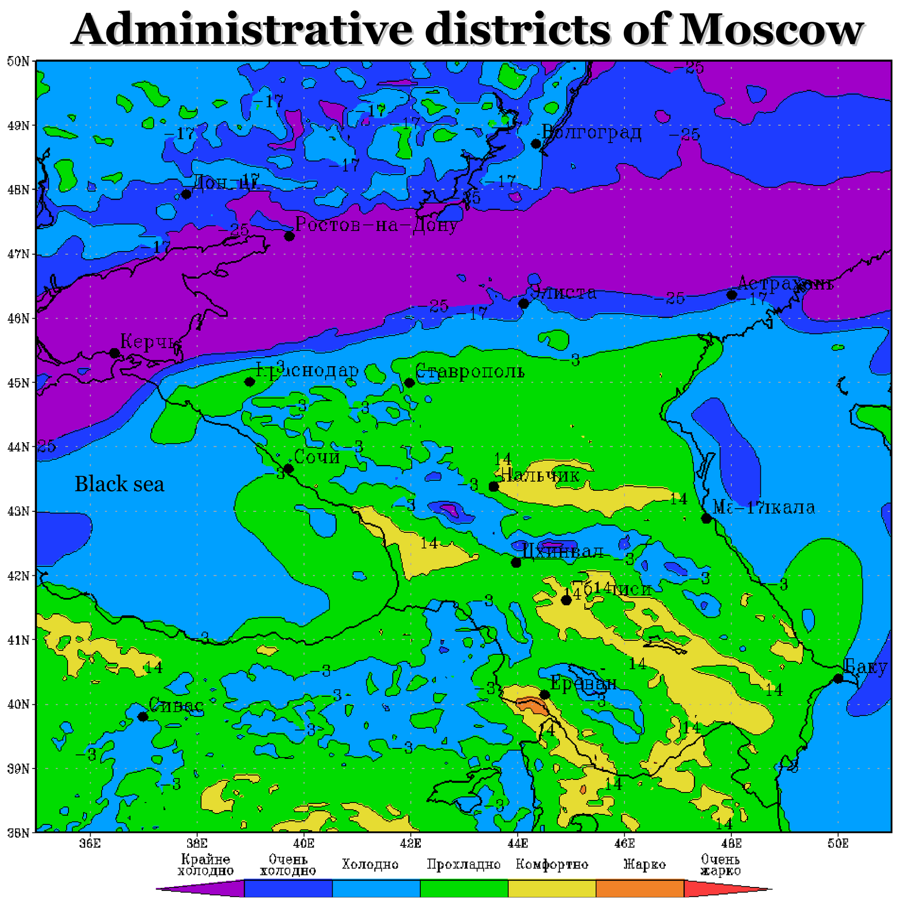
Region	Extremely cold	Very cold	Cold	Cool	Comfort	Hot	Very cold
I	<–15	–14… –5	–4…4	5….11	12..16	17…23	>23
II	<–25	–24.. –13	–12…0	0….14	15..19	20…24	>25
III	<–21	–20.. –11	–10…0	0….17	18..24	25…30	>31
IV	<–16	–15… –6	–5…4	5….20	21..29	30…35	>36
V	<–10	–9… –2	–1…6	7….21	22..30	31…40	>41
VI	<–8	–7….2	1…9	10…19	20..24	25…30	>31

Very hot
Hot
Comfort
Cool
Cold
Very cold
Extremely cold

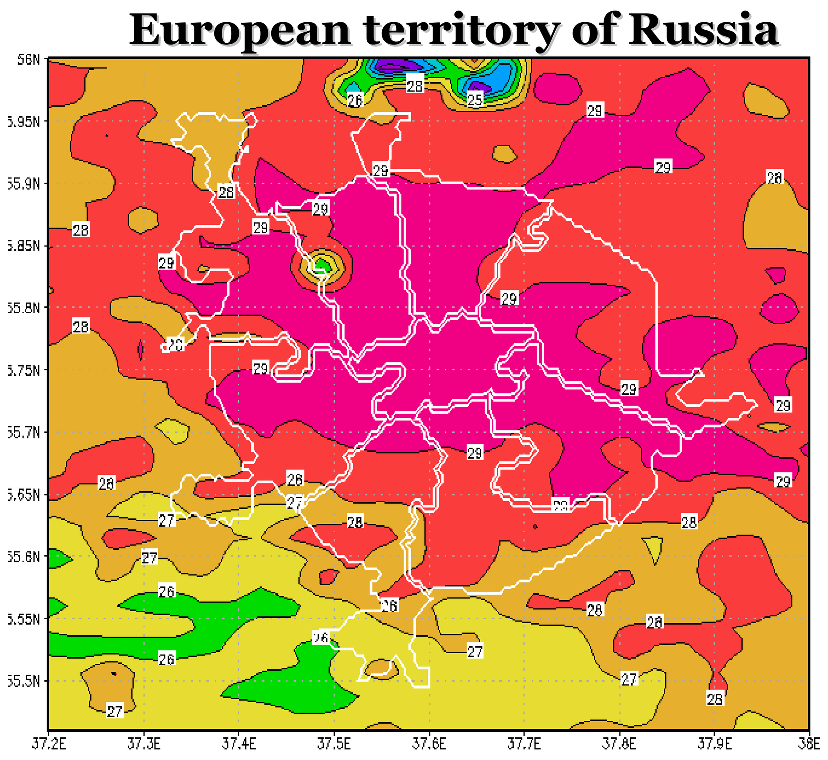
Regional features ET values for different regions of the European territory (°)

Region	Extremely cold	Very cold	Cold	Cool	Comfort	Hot	Very cold
I	<-13	-12..-3	-2..2	3..9	10..14	15..21	>21
II	<-26	-25..-14	-13..-1	0..13	14..18	19..23	>24
III	<-22	-21..-12	-11..0	0..16	17..23	24..29	>30
IV	<-17	-16..-7	-6..3	4..19	20..28	29..34	>35
V	<-12	-11..-4	-3..4	5..19	20..28	29..38	>39
VI	<-10	-9..0	1..7	8..17	18..22	23..28	>30

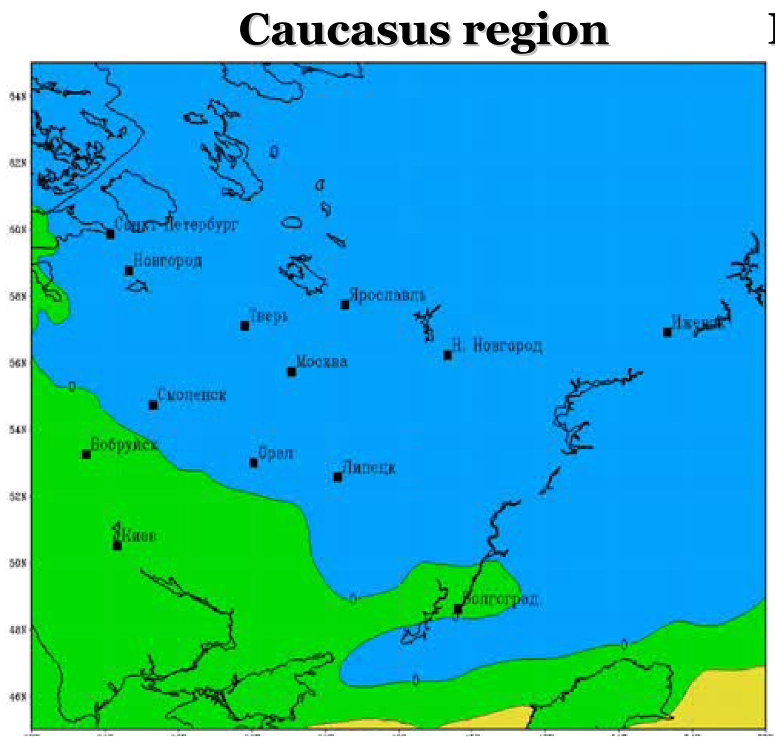
Administrative districts of Moscow



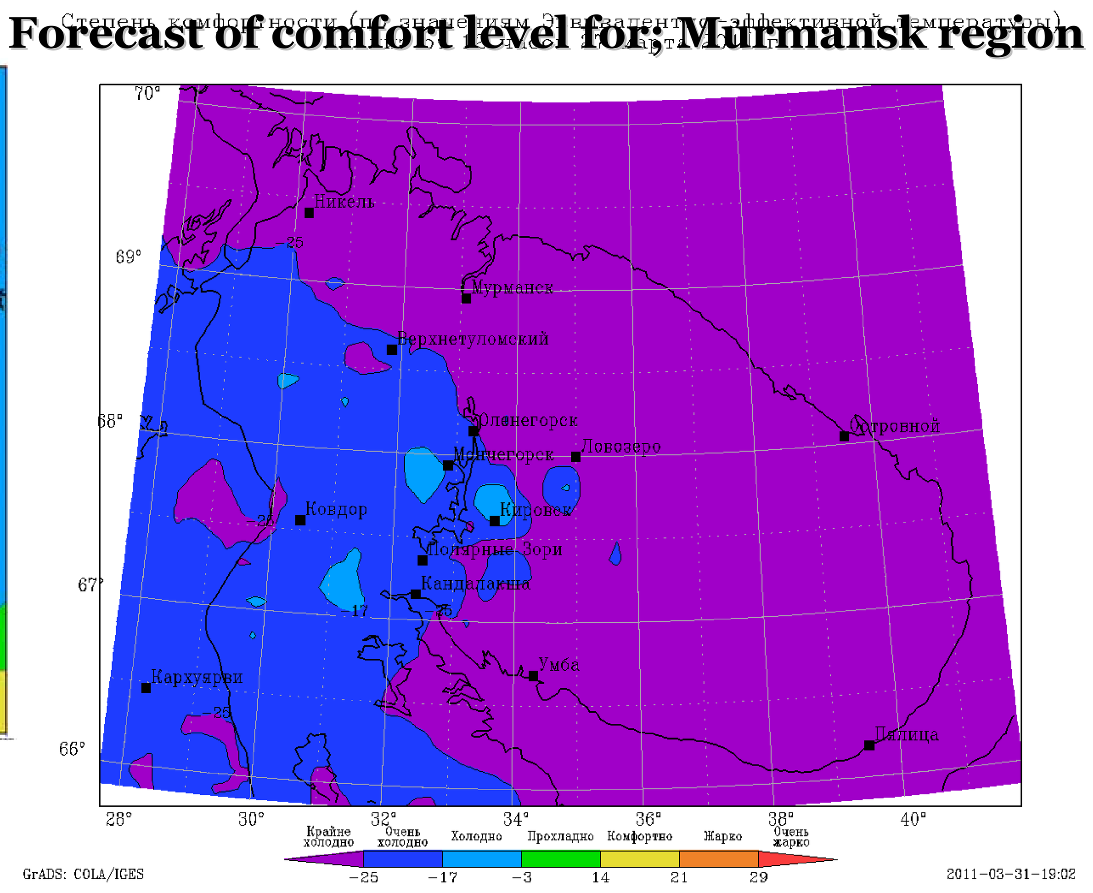
European territory of Russia



Caucasus region



Forecast of comfort level for Murmansk region



The Heat Stress Index and its application

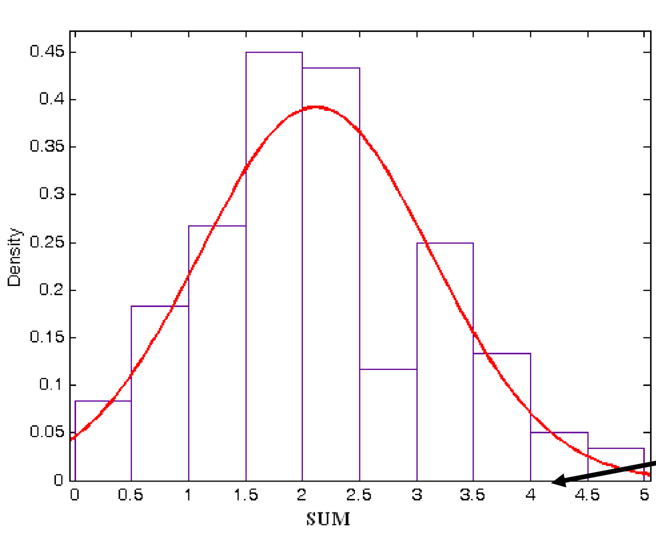
Sum = At max +At min + CDD + Cons Day+ (1-CC mean)

Moscow weather variables and their corresponding daily percentile values for 28 Jul 2010

Variables:

- Maximum and Minimum Apparent Temperature, best simple measure of combined thermal and moisture stress on human body.
- Mean Cloud Cover, a 95 degree day with cloud cover is less stressful than the same conditions if it is clear (average hourly cloud cover from 10AM to 6PM).
- Cooling Degree Hours, used to evaluate the impact of a cooling afternoon thunderstorm (sum of hourly degrees over 65 degrees apparent temperature for 24 hour period).
- Consecutive Day Count, since the same oppressive weather for several consecutive days increases human health risks (day counted when mean daily apparent temperature is at least 1 standard deviation above the mean).

Variable	Data	Persentage
AT_MAX	42.2 °C	0.990
AT_MIN	32.2 °C	0.999
CDD	178 °C	0.92
CCMEAN	3.46	0.44
Cons_day	1	0.81
	SUM	4.29



HSI value ranges from 0 to 10.

9.6 - 10.0 EXTREME
9.0 - 9.5 HIGH
7.0 - 8.9 MODERATE
4.0 - 6.9 LOW
0.0 – 3.0 NONE

4.29 represents the 95th percentile

Advantages of the Heat Stress Index:

Easily understandable by the general public and decision-makers

- Yields *relative* weather stress through time and space
- Considers much more than temperature and humidity
- Can be easily applied to population weights
- Is being used by the National Weather Service as guidance to call excessive heat warnings and advisories

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