



Universität Augsburg
Medizinische Fakultät

Compound heat and ozone pollution events relevant for human health

EGU21 session NH10.4

'Compound weather and climate events'

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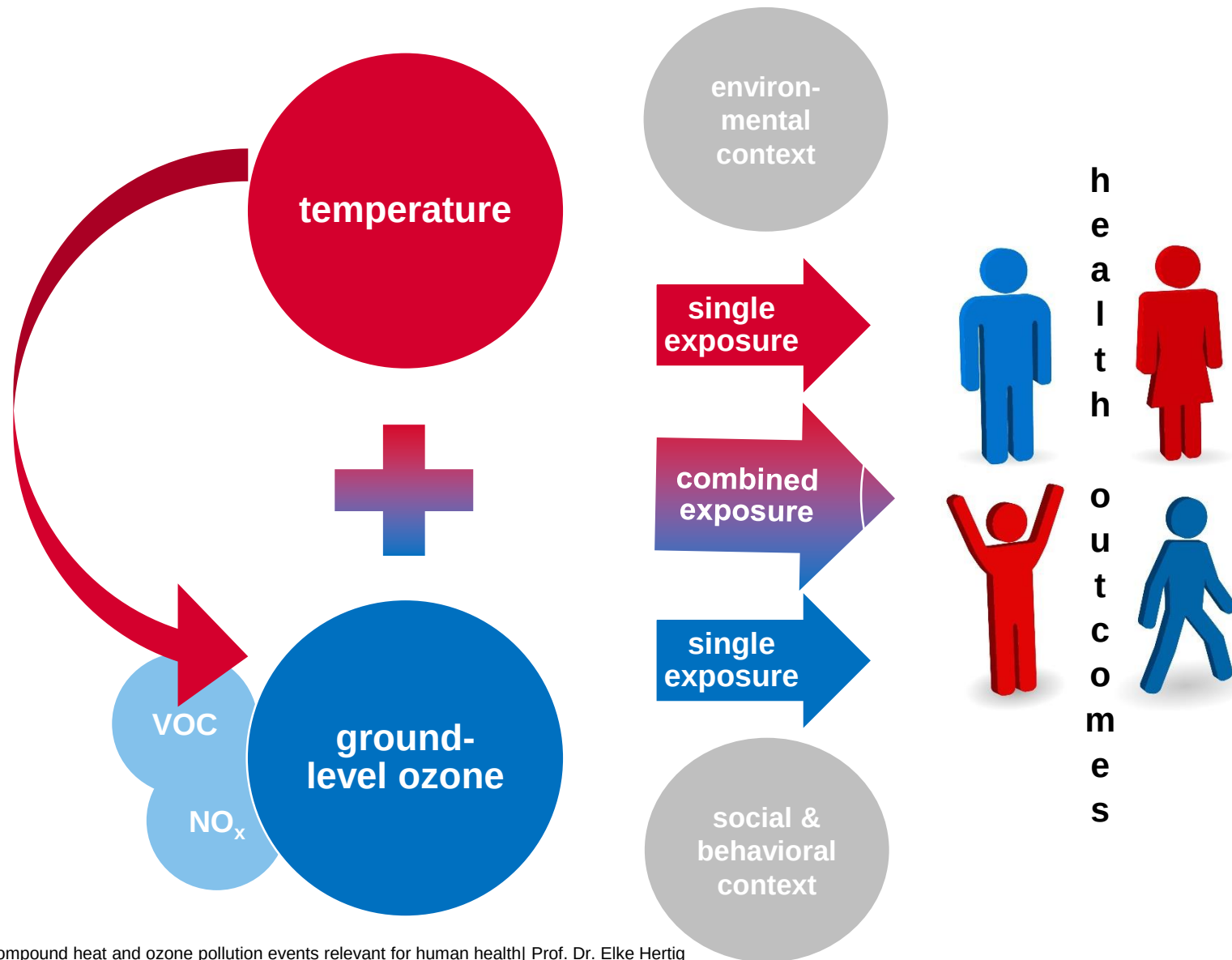
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Relationships of temperature, ozone and health



- Due to the physical relationships between temperature and ozone and their frequent co-occurrence it makes sense to regard both exposures together
- The environmental context (e.g. living surrounding, inner-city versus suburban) and social & behavioral contexts (e.g. outdoor activities, knowledge of exposure) modify the overall exposure

Exposure-response association $O_3_{\max}$ – myocardial infarction frequencies

Cumulative exposure-response association
daily maximum 1-hour O_3 concentrations -
MI frequencies for Augsburg, April -
September

Reference value: $18 \mu\text{g}/\text{m}^3$

Grey signature: 95%- confidence interval

Vertical lines:

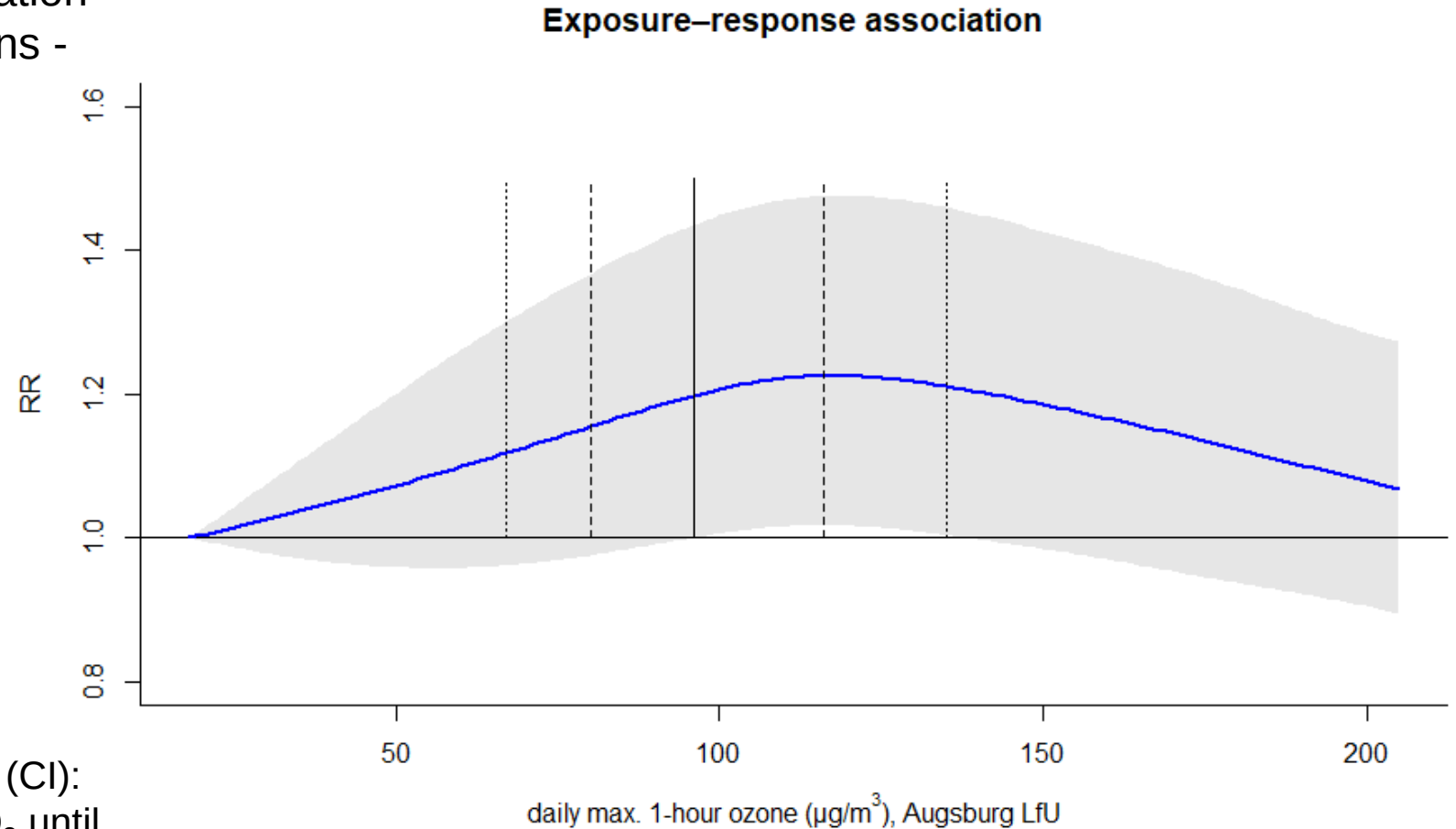
50%- (solid),

25%-, 75%- (dashed),

10%-, 90%- (dotted) percentiles

Hertig et al. (Atmos. Environ. 2019)

Linear RR: 3.41% (95% confidence interval (CI):
[1.33%, 5.53%]) per $10 \mu\text{g}/\text{m}^3$ increase in O_3 until
cut-off at 75%- percentile.



Association of heat and ozone pollution waves with mortality

Total number of wave days (n_wave days), number of excess deaths per 100,000 inhabitants (n_excess deaths), excess deaths per wave day (excess deaths/day) in the time period April–September 2003-2017

	O3max90 all	Tmax90 all	O3max90 with Tmax90	O3max90 without Tmax90	Tmax90 without O3max90	O3min90 all	Tmin90 all
Bavaria							
n_wave days	554	475	249	350	315	446	641
n_excess deaths	668	613	420	320	264	279	468
excess deaths/day	1.21	1.29	1.69	0.91	0.84	0.63	0.73
Portugal							
n_wave days	554	387	142	449	344	419	377
n_excess deaths	264	378	197	182	206	120	353
excess deaths/day	0.48	0.98	1.39	0.40	0.60	0.29	0.94

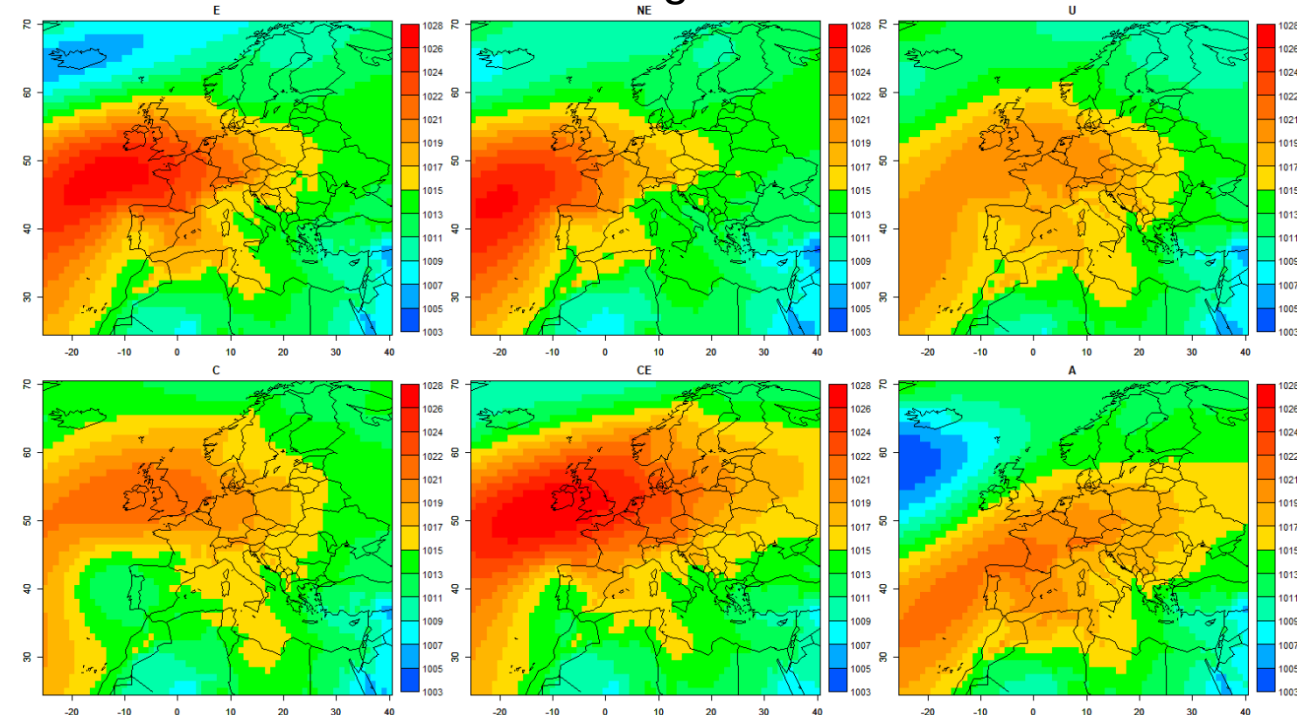
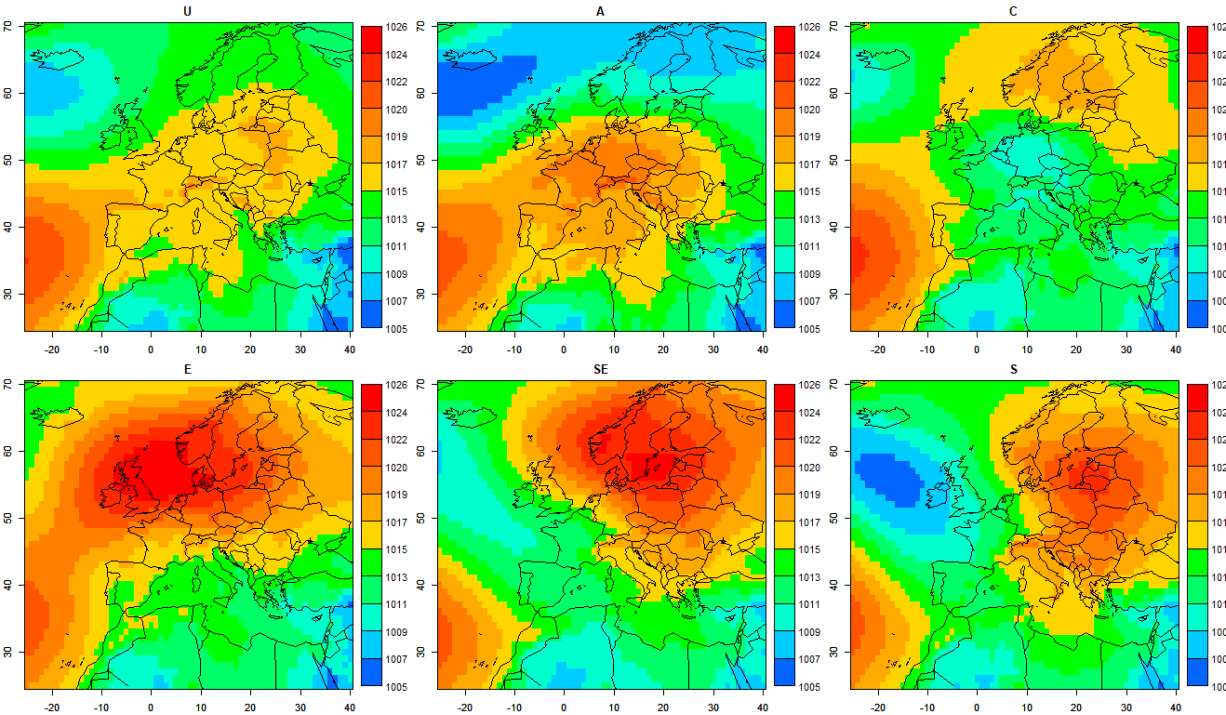
Weather types relevant for ozone and heat waves in Bavaria (left) and Portugal (right)

Shown is the mean sea level pressure in hPa

Hertig et al. (Atmosphere 2020)

Bavaria

Portugal



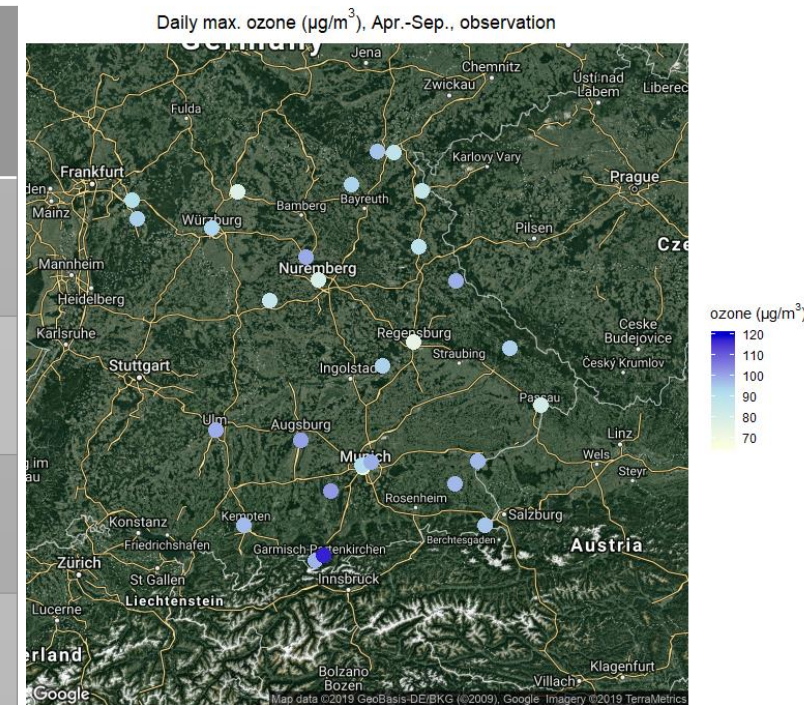
U: “Unclassified” weather type (mean relative frequency across all heat-ozone wave types: 27.6%)
A: Anticyclonic (17.5%), C: Cyclonic (7.3%)
E: East (4.4%), SE: Southeast (4.3%), S: South (3.9%).

E: East (mean relative frequency across all heat-ozone wave types: 24.4%), NE: Northeast (15.2%),
U: “unclassified” weather type (15%), C: Cyclonic (7.8%),
CE: Cyclonic East (6.7%), A: Anticyclonic (5.7%)

Frequency of exceedance 2081-2100 and change relative to 1986-2005 in Bavaria

Projected frequency of exceedance (% of days) April to September in scenario period 2081-2100 and change compared to historical period 1986-2005 (numbers in brackets).

Station characteristics	Number of stations	$T_{\max} > 30^{\circ}\text{C}$	$\text{O}_3 \text{ max} > 100 \mu\text{g}/\text{m}^3$	$T_{\max} > 30^{\circ}\text{C} \ \& \ \text{O}_3 \text{ max} > 100 \mu\text{g}/\text{m}^3$
Urban traffic	5	31.2 (+25.1)	40.9 (+23.6)	27.5 (+22.4)
Urban background	6	29.8 (+23.5)	56.8 (+22.1)	29.3 (+23.1)
Suburban background	10	28.3 (+22.8)	62.3 (+21.7)	28.2 (+22.8)
Rural peri-urban background	3	26.9 (+22.2)	62.7 (+20.6)	26.8 (+22.1)
Rural regional background	4	28.0 (+23.3)	69.4 (+21.8)	28.0 (+23.3)



**Hertig (Air quality,
Atmosphere & Health 2020)**

Hertig, E., Russo, A., Trigo, R. (2020): Heat and ozone pollution waves in Central and South Europe- characteristics, weather types, and association with mortality. Atmosphere. doi: 10.3390/atmos11121271

Jahn, S., Hertig, E. (2020): Modeling and projecting health-relevant combined ozone and temperature events in present and future Central European climate. Air Quality, Atmosphere and Health. <https://doi.org/10.1007/s11869-020-00961-0>

Hertig, E. (2020): Health-relevant ground-level ozone and temperature events under future climate change using the example of Bavaria, Southern Germany. Air Quality, Atmosphere and Health. DOI: <https://doi.org/10.1007/s11869-020-00811-z>

Hertig, E., Schneider, A., Peters, A., von Scheidt, W., Kuch, B., Meisinger, Ch. (2019): Association of ground-level ozone, meteorological factors and weather types with daily myocardial infarction frequencies in Augsburg, Southern Germany. Atmos. Environment. DOI: 10.1016/j.atmosenv.2019.116975



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