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Urban Green Areas: Lots of Benefits, but some Drawbacks

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1 ABSTRACT

From the viewpoint of urban ecology, especially from the urban climatology, urban green areas have an important implication on the local climate. The aim of the applied, planning-oriented urban climatology is to create a synergy effect between the positive recreational use of these green spaces and its positive consequences on local climate and air quality. During the daytime hours the shadowing of the vegetation and the effect of evapotranspiration causes a smoother thermal diurnal course in comparison to the sealed up hyperthermic surroundings. Ideally, an urban park area should be composed of meadows with scattered bushes and a loose stock of the trees. This ensures a suitable shadowing for the people, but also a sufficient solar radiation during the daytime hours. By implication local cold air could be formed at night. This local cold air induces a cold air flow and an air change between the cooler urban green area and the heated, sealed vicinity with a verifiable cooling effect on the air temperature near the ground. The coverage of the cold air flow indeed correlates with the diameter of the urban green area. So a cross-linkage of many small green spaces could result in decreasing the effect of the urban heat island, but also increase people`s thermal comfort.

By the way, urban green areas could also induce a positive effect on the local urban air quality. But attention has to be paid to the assortment of the tree species. Some trees have the ability to affect the local air quality negatively. More or less all tree species are emitting biogenic volatile organic compounds (BVOC`s) in different concentration (e. g. isoprene and terpenes). These serve as precursors for the formation of tropospherical ozone near the ground. Especially within the urban green areas, which act as a resort for many people, wrong tree populations are contraindicated. Since this could lead to a significant exposure to noxious ozone. When many people visit an urban green space (clear and calm weather conditions with hot summery temperatures, low wind speed and a high solar radiation) the emission of BVOC`s is highest, and accordingly ozone concentration is high as well. Therefore, an analysis and assessment of the urban green area air quality could help to make a statement about the recreational effect of these areas in dependence of the leading vegetation and for that matter for the exposure to ozone. Both try to analyze the influence of the BVOC`s on the local formation of photo oxidation and furthermore the impact on the ozone near the ground. So using the calculation of short- and long-term air quality indices can describe the air hygienic situation. By the help of these the results can be used as a guidance of urban planning taking account of the influence of the biogenic emission as a function of the actual weather conditions.

2 SPHERES OF ACTIVITY FOR AN APPLIED URBAN CLIMATOLOGY

Due to the fact that urban areas represent a heterogeneous structure, which has been growing over a long time period, it is an obstacle to the applied climatology to create an adequate urban environment with ideally climatic and air quality conditions. Predominantly for the urban residents such an optimal urban environment was defined by Mayer (1989) called the “ideal urban climate”. But of course such an ideal urban climate could only be implemented and realized when new cities are being planned and the applied urban climatology is involved in this process right from the beginning. For already existing urban areas this is not feasible. Though the urban planning has the responsibility to come as close as possible to the ideal urban climate with the aid of selective measures. Hereby it is possible to create a so-called “tolerable urban climate” by minimizing the burdens und advances of the settings. In consideration of the demographic change and the recent exodus of German cities there can be no doubt that it is possible to use the knowledge of the applied climatology within the urban vacancies for future urban planning. The current phenomenon of the shrinking cities offers a lot of redundant areas, which are meaningfully from the viewpoint of the applied urban climatology to integrate them into the existing patterns of use. In this context different spheres of activity of the applied urban climatology are emphasized. Mainly urban green areas have the ability of a cooling effect. During day time an increased rate of evapotranspiration, intensified by the shading of the trees, caused a decrease of the air temperature. While night-time hours cold air masses were formed above the urban green and initiate the “urban park breeze” which carries these from the green area to the hyperthermic, densely sealed surroundings, also with a cooling effect for the air temperature. Depending on their size and design urban green spaces could have a significant influence on the air temperature and the climatic conditions of their nearby vicinity. Horbert (2000) postulated that urban green areas must have at least 50 ha to offer an obvious climatic effect. Nevertheless, also smaller ones do have a cooling effect and provide a reduction of the thermal load (Bongardt, 2006). Even the urban vegetation of an existing stock offers a great cooling potential, however, it is important to regard some facts: Basically, roadside vegetation contributes an improvement of the local climate and has the ability to percolate the air. Nevertheless, from the viewpoint of urban air quality not every tree is appropriated to be lined out along roadsides. The canopy of the trees must be taken into account. A tight and close leaf canopy could reduce the atmospheric changing and lead on to an accumulation of air pollutants. For roadside vegetation as well as for the vegetation of urban green spaces a second fact must be mentioned: Some tree species emit different amounts of volatile organic compounds (VOC`s; e. g. isoprene). These contribute as a precursor for the formation of near surface tropospheric ozone (O_3). Therefore it should be avoided to use such species along roadsides or within urban green areas (Benjamin & Winert, 1998). Now, especially within urban green areas it is important to take care of reducing the potential VOC-sources to minimize the formation of O_3, because this could lead to negative impacts for human health. In consequence during midsummer days urban green areas are magnets for lots of people searching for leisure, these days have also a great potential forming tropospheric O_3. Clear and calm weather conditions with high air temperature as well as high solar radiation are the basis for a high emission rate of biogenic volatile organic compounds, like isoprene. So it must be expected that for such conditions, combined with unfavorable planting, a photochemical pollution is enhanced. This results in an increasing concentration of near surface ozone with the possibility of some undesirable side effects to human health. For example some harmful secondary effects of ozone could be:

- penetrating the inferior respiratory tract,
- irritation of the respiratory tract, dyspnoea, tussis, headaches,
- decrease of the physical working capacity,
- increasing frequency of asthma attacks, and
- increasing frequency of allergic reactions (delicate reactions by 10-20 % of the people).

Characteristic risk groups are outdoor workers, athletes, asthmatics, small children and babies.

3 NEAR SURFACE OZONE AND BIOGENIC ISOPRENE

Carbon monoxide (CO), nitrogen monoxide (NO) and non-methane hydrocarbons (NMHC`s) are primary air pollutants. But there are also the secondary pollutants (e. g. nitrogen dioxide ($NO_2$) and ozone), which are formed by the emissions of the primary trace elements by diverse chemical reactions. Mainly, the corresponding precursors of $O_3$ are NO and the anthropogenic NMHC`s. Indeed, it should not be neglected that there are also some biogenic emissions, which have the ability to react with anthropogenic trace elements and form secondary air quality indicators. One of these is the biogenic hydrocarbon isoprene. It could form ozone due to its great capacity of reaction. Actually, in comparison to anthropogenic hydrocarbons, isoprene could already start a formation with O_3 less concentrated. That is why isoprene is one of the precursors which has to be taken seriously. The rate of emission is dependent on the meteorological conditions (air temperature and solar radiation) and how these affect the stock of vegetation (leaf temperature). The emission of isoprene is determined by the height of the air temperature and the intensity of the photosynthetic active radiation (PAR). This relation could be reconstructed by equation 1 (Guenther et al., 1991):

Eq. 1:

$$E_{isoprene} = Es_{isoprene}HCLT$$

E = rate of emission [μg g(dry weight)$^{-1}$ h^{-1}]

Es = standardized rate of emission [μg g(dry weight)$^{-1}$ h^{-1}]

H = correction term for air humidity

C = correction term for atmospheric CO_2 concentration

L = correction term for intensity of the solar radiation

T = correction term for leaf temperature

According to that, clear and calm weather conditions with a high solar radiation and high air temperature are best qualified for leading to a high emission rate of isoprene from the plants` leaves. So this means, that even for the days, when high concentration of ozone could already be expected, the amount of additional biogenic hydrocarbon, such as isoprene, may contribute to further formation of O_3, too. Especially within areas like urban parks, where at first sight high ozone levels are not estimated.

Down to the present day there is a number of publications which deal with the analysis of urban trees and their potential of forming near surface ozone along roadsides as well as within urban green areas (e. g. Young et al., 2009; Henninger, 2011). Since Taha (1996) the terms of „*low-*“ and „*high-emitter*“-plants are used. The consideration of these low- or high-emitting trees species could have a sustainable impact on the emission of biogenic hydrocarbons and thus on the formation of ozone.

4 ASSESSMENT OF AIR QUALITY

For an assessment of air quality within a distinct area there are different standards. However, some facts should be considered for an evaluation:

- a clearly defined purpose concerning the diverse trace elements,
- the type of land usage,
- the side effects of the analyzed air quality indicator on human health as well as on vegetation and materials,
- duration of exposition and
- the statistical distribution (e. g. exceedance probability).

Taking account of these it is achieveable to create a valuation system, which assesses the impact of each air pollutant in consideration of the temporal scale and in dependence of the actual type of land use.

4.1 Air quality valuation standards

Diverse summary indices could be used to present an assessment of the air quality situation within a certain area respectively different areas. The advantage of such indices is that not only the concentration of one substance will be assessed, but also the influence of several sources of emission. Referring to Mayer et al., 2002 two air quality indices should be distinguished:

- impact-dependent air quality indices and

impact-related air quality indices.

For this investigation and the assessment of the air quality situation the impact-related air quality index was chosen because for these belongings it is the more useful one. In contrast to the impact-dependent air quality index it is also possible to evaluate O_3 by the established guidelines of the EU for the air quality indicator. The calculation of this air quality index enables a temporal reference. It facilitates a direct relation to impairments to health, caused by corresponding substances, at a definite time of the day. One result of this is the opportunity to react correctly and within the right time. A further advantage of this valuation standard is the medical coverage. The daily air quality index (DAQ) is being calculated as shown in equation 2:

Eq. 2: $$DAQ = \left[\left(\frac{DAQ_{up} - DAQ_{low}}{C_{limit,up} - C_{limit,low}}\right) \times \left(C_{current} - C_{limit,low}\right)\right] + DAQ_{low}$$

- $C_{current}$ for O_3, highest 1-h-average mean value per day,
- $C_{limit,low}$ respectively $C_{limit,up}$ offers the specific range of concentration within the current concentration for the recurrent trace element,
- DAQ_{up} and DAQ_{low} offers the upper respectively lower DAQ index value of the appropriate range of concentration by what different indices are classified in Tab. 1.
- In consideration of a pay-as-use assessment of urban green areas according to Straßburger (2004) some specifics have to be attended:

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- the application frequency of the urban green area in dependence of the season and the meteorological conditions,
- the application frequency of the residents in dependence of the time of the day and
- the duration of stay within the park area.

Taking into account that the aim of this investigation is to analyze the formation of near surface ozone within urban green areas, it was ensured to determine the days during clear and calm weather conditions, with high air temperature and high solar radiation. Since these are the days promising the highest emission rate of isoprene and formation of O3 as well as the highest visitor frequency, most notably predominantly in the afternoon hours.

Tab. 1: Assignment of trace element dependent emissions into DAQ index value and DAQ index classification and their grades, exemplarily offered for ozone (modified by Mayer et al., 2002).

O_3 [$\mu g\ m^{-3}$]	Index value	Index classification	Grade
0-32	0.5-1.4	1	very good
33-64	1.5-2.4	2	good
65-119	2.5-3.4	3	satisfactory
120-179	3.5-4.4	4	adequately
180-239	4.5-5.4	5	poorly
$\geq$ 240	$\geq$ 5.5	6	awfully bad

5 INVESTIGATION AREA

Even if the focus of the investigation is on the formation process of near surface tropospheric ozone, it is inevitable to fulfill some criteria which involve the sealed and built-up surrounding areas beside the actual investigation area. The representativeness of urban green spaces und their reproducibility respectively the transferability of these results should hardly be given. Hence, the following facts must be attended:

- the question of comparability with an urban green area of the same size and structure within the urban area,
- the question of comparability with urban green spaces of a similar size and structure within other urban areas,
- the immediate vicinity to highly frequented streets to gauge potential sources of emission,
- the relevance and visitor frequency as an indicator for a nearby recreational area of the urban residents, and
- the question about the typical respectively characteristic urban park vegetation.

The so-called „Volkspark“ in the city of Kaiserslautern, Germany (49°14´ N., 7°53´ E.), was chosen to prove the measuring methodology. This urban green area is one of the most frequented recreational areas in Kaiserslautern and is used for leisure by the direct residents, but also by people from the outskirts. Many events act as attraction, but there are also many leisure-time possibilities within the area. With a size of approximately nine hectares the „Volkspark“ is coevally the biggest urban green space in the city. The park area is bounded by four-lane streets in the west and south. The green space can be divided into several types of land usage: lakes/ponds (4%), lawns (62 %), flowerbeds (4 %), bushes (11 %), forest area (3 %), diverse open spaces (1 %) and 11 % sealed areas. In reference to Sukopp & Wittig (1998), who postulated that generally all urban green spaces with more or less the same typical and characteristic park vegetation and also a comparable proportion as well as in varying degrees of similar emission structure display that the question of reproducibility and transferability to other urban green areas would be answered positively and could also be treated as a guidance for other urban park areas.

6 MEASURING METHODOLOGY

The air quality measurements as well as the climatological ones were made with a mobile laboratory. This methodology allows measuring the air quality and meteorology at one special type of land use, but also at different locations if necessary. That is a great advantage in comparison to stationary measurements. Initial measurements were taken 72 hours from 12 a.m. (10.07.2010) till 12 a.m. (12.07.2010). Due to the weather conditions this time period suited very good and offered a so-called "worst-case-scenario". An anticyclone above Germany catered several days of clear and calm weather condition with wind speed less than 1.5 m s-1, which provides a great potential to accumulate diverse trace elements. Midsummer air temperatures by at least 30°C and an accordingly high solar radiation by Q > 900 W m^{-2} offered a good basis for emitting the precursor isoprene and the formation of tropospheric ozone.

The aim of this measuring period was to determine the diurnal course of the different air pollutants` concentration in relation to the meteorological conditions within the urban green area. Thus it should be possible to prove the daily air quality and how it was influenced respectively dependent by different external influencing factors. Beside ozone carbon monoxide, carbon dioxide, nitrogen monoxide, nitrogen dioxide and aromatic hydrocarbons (benzene, toluene, ethylbenzol, m-, o-, p-xylene) were measured. The air quality indicators were determined by a suction device of the mobile laboratory 4 m above ground level. Additionally air temperature, air humidity, global and solar radiation were measured in 2 respectively 4 m a. g. l., wind speed and direction were determined in 10 m a. g. l. Though it is possible to display the results as a time line or in dependence of wind speed, it is more favorable in dependence of the wind direction. This enables an exact temporal allocation to the potential sources of emission of the specific air pollutants within and outside the urban park area.

The analysis of the biogenic emissions was limited to isoprene because the air quality of the investigation area should be exemplarily assessed by the ozone. So using this natural hydrocarbon as its precursor was the logical consequence. The determination of the isoprene was proved very complicated and the measuring methodology had to be adapted to the requirements of this investigation. Generally, the analysis of biogenic hydrocarbons ensued by turning a cuvette directly on the branches of the trees (Brüggemann & Schnitzler, 2008). For this investigation first of all a mapping of the vegetation of the area was done. In the process all spaces with potential isoprene emission sources species were particularly marked. Subsequently, a mobile measuring transect across the "Volkspark" was constructed. Measurements were taken every 30 minutes and the air sampling was done in 1.50 m a. g. l. with air-sampling tubes. The sampled gas was pumped through the tube filled with an appropriate reagent that absorbs the wanted biogenic hydrocarbon present in the air to form a complex. Then this complex is made to react with other chemicals to form a second colored complex. The intensity respectively the concentration could be read out some minutes later on a scale. With the aid of this semi-mobile measuring methodology isoprene could be detected directly and analyzed as well (Henninger 2011).

7 PERCEPTIONS

7.1 Theoretical estimation of the biogenic isoprene emission rate

Immediately after the mapping of the vegetation it was possible to calculate the theoretical rate of isoprene emission in dependence of the occurring species, considering an optimum of meteorological conditions. Indeed, it must be mentioned, that this estimation of biogenic emissions is afflicted with some uncertainties (e. g. phytomass, single or group trees, tanning). Nevertheless, the estimation should not be neglected because it creates an image of the pattern of emission that is very helpful for the ongoing analysis of the air quality situation within the investigation area.

The mapping resulted in typical park vegetation with a heterogeneous structure of single trees, groups of trees and small forest areas. Altogether within the „Volkspark" there are 701 individuals, combined with diverse species, whereas at least *Aceraceae*, *Betulaceae, Fagaceae*, *Malvaceae und Platanaceae* placed 79 % of the total stock. For measuring isoprene this was an advantage because the species of plane (*Platanaceae*), beech trees (*Fagaceae*) and lime tress (*Malvaceae*) are considered as potential emitters of isoprene. So in dependence of the meteorological conditions these tree locations could be assumed as biogenic isoprene sources. An assembly of the dominant groves is shown in Tab. 2. Additionally the specific rates of isoprene emissions are also offered. The highest rate of emission could be expected for planes (*Platanus acerifolia*) and oaks (*Quercus robur*) and had to be identified as „*high-emitter*" plants. Likewise the lime (*Tilia concardata*) and the birch (*Betula pendula*) must be counted as „*high-emitters*", too. Attention should be paid to the fact that at least plane and oak trees set 47 % of all species within the investigation area. The other individuals revealed values less than 2 µg g(dry weight)$^{-1}$ h^{-1} and must be referred as „*low-emitter*"-plants.

Now, it is possible to make a simple calculation of the total emission. For that purpose, the specific emission rate of isoprene [µg g(dry weight)$^{-1}$ h^{-1}] must be multiplied with the average biomass [g] of the respective species and the number of appropriate individuals. In reference to Benjamin & Winert (1998), but above all to Straßburger (2004), who also measured isoprene within a German urban park area („Grugapark", Essen; 51°28`N, 7°0`E), the average biomass was assumed a dry weight of leaves of 15 kg per tree. All in all this resulted in an biogenic isoprene emission rate of 6.8 g h^{-1} during the day time hours within the „Volkspark" in Kaiserslautern, in dependence of an optimal meteorological situation (Tab. 2). According to Straßburger (2004) a good comparison was given. The calculation of Straßburger offered an emission rate of 3 g h^{-1}, although the „Grugapark" reveals more than 1,000 individuals, but only a low density of "*high-emitter*" plants like *Fagaceae*.

Tab. 2: Assembly of the dominant groves within the „Volkspark" and their specific rates of isoprene emission plus the rate of emission per tree considering an average leaf mass of 15 kg per individual.

Scientific name	*Specific rate of isoprene emission [µg g(dry weight)$^{-1}$ h^{-1}]*	*Rate of isoprene emission per individual (15 kg) [µg h^{-1}]*	*Number of individuals*	*Rate of emission per species [mg h^{-1}]*
Acer campestre	*8*	*120*	*25*	*3*
Platanus acerifolia	*883*	*13,245*	*22*	*291.39*
Quercus robur	*1,405*	*21,075*	*310*	*6,533.25*
Tilius cordata	*26*	*390*	*72*	*28.08*
Betula pendula	*25*	*375*	*45*	*16.88*
Amount			***474***	***6,872.6***

7.2 Biogenic and anthropogenic hydrocarbons within the „Volkspark"

The mentioned measuring period revealed an excellent meteorological situation. Above all the solar radiation with a maximum of 979 W m^{-2}, a maximum air temperature of 36.9°C and an average wind speed of less than 1 m s^{-1} for all three days were very good conditions to form near surface tropospheric ozone within the green area. Due to the minor atmospheric exchange a long-range transport from outside the investigation area into it could be excluded.

As expected there was a temperature inversion above the park area in the early morning hours. During this time of the day and with the aid of the measured wind direction the influence of the morning rush-hour could be proved. CO, NO, NO_2 and benzene revealed an obvious maximum in their concentration. While forenoon an increasing solar radiation and a resolve of the inversion layer cater for a fast decrease of the traffic-induced pollutants. Noticeably, the concentration of isoprene was likewise high in the morning hours. This could be explained because isoprene's source could be anthropogenic as well as biogenic. So at this time the hydrocarbon was mainly caused by traffic. Approximately 90 % of the total reactivity related to the amount of both hydrocarbons omits to the isoprene source traffic. So it could be concluded that the rate of the anthropogenic isoprene reacted and urged the formation of near surface ozone. Indeed, the solar radiation in the morning hours was not strong enough to initiate an essential photochemical process to form ozone in high concentration.

Between noon and the afternoon hours there was no significant influence by traffic. Less concentration of anthropogenic air pollutants were measured. At this time of the day air temperature as well as solar radiation reached their maximum. So, with a slightly temporal offset, the near surface O_3 obtained its daily maximum around 5 p.m. as well. Owing an afternoon wind speed of less than 1 m s^{-1} and a wind direction from east a long-range transport as well as a transport from the nearby vicinity of the investigation area could be neglected. By implication this means that the existing and measured O_3 could only be formed within the urban park area. Analyzing the diurnal concentration of isoprene, this assumption was verified. A very good parallelism between the development of the increasing ozone concentration and the isoprene was visible. Whereas the concentration of the traffic-induced pollutants was regressive at this time of the day, it could be postulated that a majority of the isoprene was not induced from an anthropogenic source. The alleged optimal meteorological conditions leaded to an increasing rate of emission from the vegetation. So biogenic isoprene was able to be the current precursor to form near surface tropospheric ozone. This could be verified by the total reactivity of the hydrocarbons. In dependence of the total amount of all measured ones isoprene offered a rate of 30 %.

During the early evening hours the air quality situation turned again. Once more the rush-hour was detectable with increasing concentration of CO, NO, NO_2 and benzene. In the presence of NO the near surface O_3 was destroyed and its concentration was decreasing plainly within the investigation area. The evening hours offered almost completely the anthropogenic isoprene caused by traffic. Lower air temperature and missing solar radiation encouraged a slowdown of the isoprene emission. Comparable to the morning hours the rate of the biogenic isoprene was solely 4 %.

A calculation of the ozone output in dependence of the measuring period the detected anthropogenic and biogenic hydrocarbons displayed a remarkable authoritative statement, which could not be expected at the beginning of the measurements, but in conjunction with the nearly perfect environmental conditions it is at least no surprise. For the afternoon hours it was verifiable that 7 % of the near surface tropospheric ozone could be ascribed to the biogenic precursor isoprene. These results could be aligned with Straßburger (2004), who located a rate of 6 % biogenic isoprene within the ”Grugapark” in Essen.

7.3 Analysis of the short-time exposure

Additionally to the ozone concentration the already mentioned air pollutants NO, NO_2 and CO were determined at the same time. Their concentration peaks were measured in the morning and late afternoon hours. Due to a temporarily awkward wind direction the trace elements could be transported into the urban green area. This effect was additionally intensified by an inversion layer. Hence, the analysis of the data showed, that neither CO_2 nor the NO_x could be evaluated as a pollution to human health. At no time of the day they roughly reach their limit values for emission.

An entirely different result was offered for the near surface ozone concentration. Between 2 p.m. and 7 p.m. the so-called MIK-value (“maximum emission concentration”) for ozone (120 $\mu g\ m^{-3}$), defined by the German VDI and taken as a basis for the analysis, was exceeded eleven times (0.5-h-average-values). Also the limit values of emission for protecting human health of the Federal Emission Control Act (180 $\mu g\ m^{-3}$; 1-h-average-values; 33. BimSchV.) was passed twice in the late afternoon hours. Finally, the time period between noon and sundown, the time of the day with the highest air temperature and high solar radiation, could be signed as polluted by near surface ozone. This negative phenomenon is furthermore exacerbated due to the fact that the highest rate of emission was nearly congruent with the time of the day when potentially the highest visitor frequency was expected.

The above mentioned daily air quality index (DAQ) was calculated to give a statement for the impact-related air quality within the investigation area and its effect on human health. For an adequate validity of the calculation (s. Eq. 2) the daily maximum concentration of the 1-h-average values of the O_3 were considered. This procedure enabled a better and more precise assessment of the air quality situation because the diurnal course of the air pollutant could be reflected. Thus the hourly average value air quality index for the diurnal course of the near surface tropospheric ozone could be proven and is shown in fig. 1.

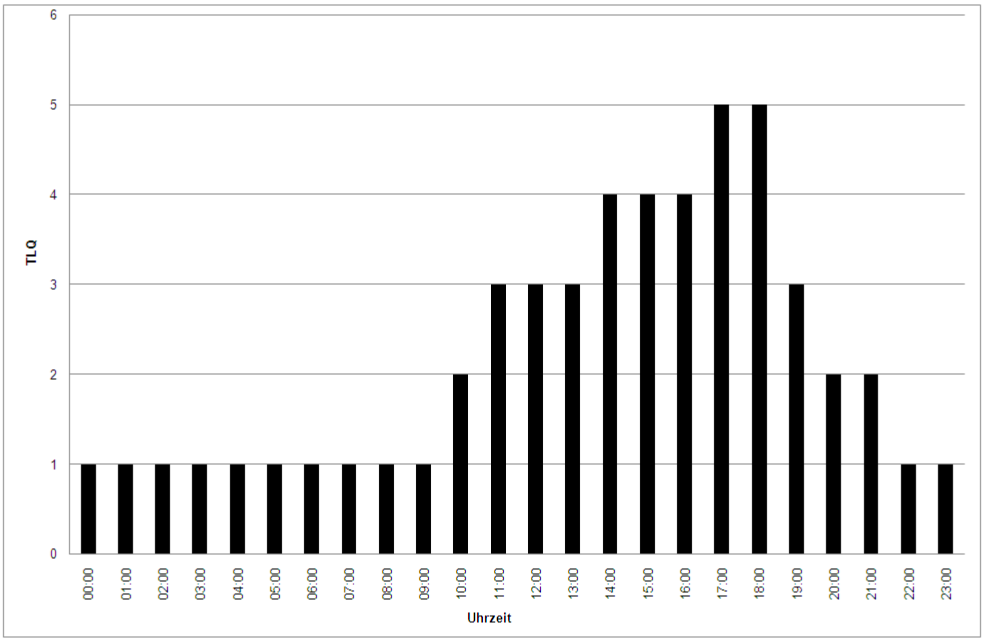

Fig.1: Mean diurnal course of the air quality classification based on 1-h-average mean values for the investigation area "Volkspark" within the city Kaiserslautern, Germany.

As a result of the calculation it could be demonstrated that during midsummer days (between noon and 7 p. m.) with clear and calm weather conditions, it must be expected that for this time of the day with the highest frequency of visitors near surface ozone is formed within the urban green space of Kaiserslautern. Due to this situation the calculated impact-related air quality index for the „Volkspark" is not better than „adequately (3.87), which shows the significant influence on the air quality of O_3 within this green area and allows conclusions on a feasible pollution of human organism.

8 CONCLUSION

Of course it is indisputable that urban green spaces have a positive impact on their nearby vicinity, but also for the residents. Though it does not matter, if it is a positive effect on the local climate or for recreational values. Even in midsummer people aspire enhanced within urban green spaces to use restful utilization of these. Nevertheless an awkward, particularely also thoughtless planting could lead to an accumulation of air pollutants. From the applied climatology's point of view it is necessary to think about planning new vegetation within urban parks. In comparison to a climatic adjusted construction all over the urban area, likewise for new plantings throughout the planning phase the predominantly planted species must be considered in the right way. The analysis of the air pollution situation within the "Volkspark" in the city of Kaiserslautern inevitably revealed that during clear and calm weather conditions biogenic precursors could be emitted by diverse plants. Less atmospheric exchange, high air temperature and solar radiation arrange it so that near surface ozone is formed. Due to the fact that this air quality indicator could be diluted or dispatched the accumulation of it leads to high concentration which obviously exceed the limiting values. This resulted in an air quality classification for the investigation area which was only adequate. Not least this is ascribed to a vegetation stock with a rate of more than 70 % so-called „*high-emitter*"-plants. So it could be calculated that a wrong proportion of species which emit higher or lower rates of biogenic hydrocarbons and the size of the green area lead to a location-based formation of near surface tropospheric ozone by 5 to 10 % caused by e. g. biogenic isoprene. Finally, it ends in a negative assessment of the recreational value of such an area in relation to the benefits which an urban green area should rather have. However, and this could also be proved, it is possible to react on this. Planning oriented recommendations for action could be given for optimizing the air quality situation. Ultimately it is frequently only the lack of knowledge that diverse species of the current vegetation stock of an urban park verifiably lead to an increase of the local near surface ozone concentration.

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