Grasvelden & Klimaat Biodiversiteit

# WP2 Klimaat en Temperatuur

- Literatuurstudie 2020

# Wat hebben we in 2020 gedaan en wat zijn de resultaten

- Literatuurstudie
  - Q1 Wat is het verkoelend effect van gras ten opzichte van andere oppervlakten,
  - Q1.2 en hoe verschilt het verkoelend effect van grasvelden zonder bomen en of struiken
  - Q2 Wat is de invloed van beheer op verkoelend effect van grasvegetaties
  - Q3 Welke link is er tussen verkoelend effect met fysieke eigenschappen van grassoorten
  - Q4 Hoe veranderd het toepassen van hittetolerante soorten het verkoelend effect
- *Onderzoeksvragen vastgesteld op basis van onderzoeksplan en aanvullende enquête voorjaar 2020*

# Literatuurstudie – zoektermen in CAB abstracts

**Stad (1)**

Stad, bewoond, stedelijk, centrum, bebouwd, bebouwing

+ Engelse en Duitse synoniemen

**EN**

**Oppervlakten (1)**

Bomen, asfalt, beton, stoep, verharding, struik

+ Engelse en Duitse synoniemen

**EN**

**Gebruik (1)**

Grasveld, gazon, grasperk, veld, grasmat, sportveld, stadion, voetbal, park, recreatie, speelplaats, tuin, hof, plantsoen, golfbaan, green, tee, fairway, rough, berm, talud, strook

+ Engelse en Duitse synoniemen

**EN**

**Hitte (1)**

Hitte, heet, hittestress, hoge temperatuur, hittegolf, klimaatextremen, urban heat island effect, verdamping, transpiratie, evapotranspiratie, vapor pressure deficit, verkoeling, temperatuur demping, latent, park cool island

+ Engelse en Duitse synoniemen

**Soorten (2)**

Engels raaigras, Veldbeemdgras , Rietzwenkgras, Roodzwenkgras , Struisgras, Hardzwenkgras, Gewoon schapegras, Ruwe smele, Fakkelgras, Fijnbladig schapegras, Westerwolds raaigras

+ Engelse en Duitse synoniemen, en Latijnse namen

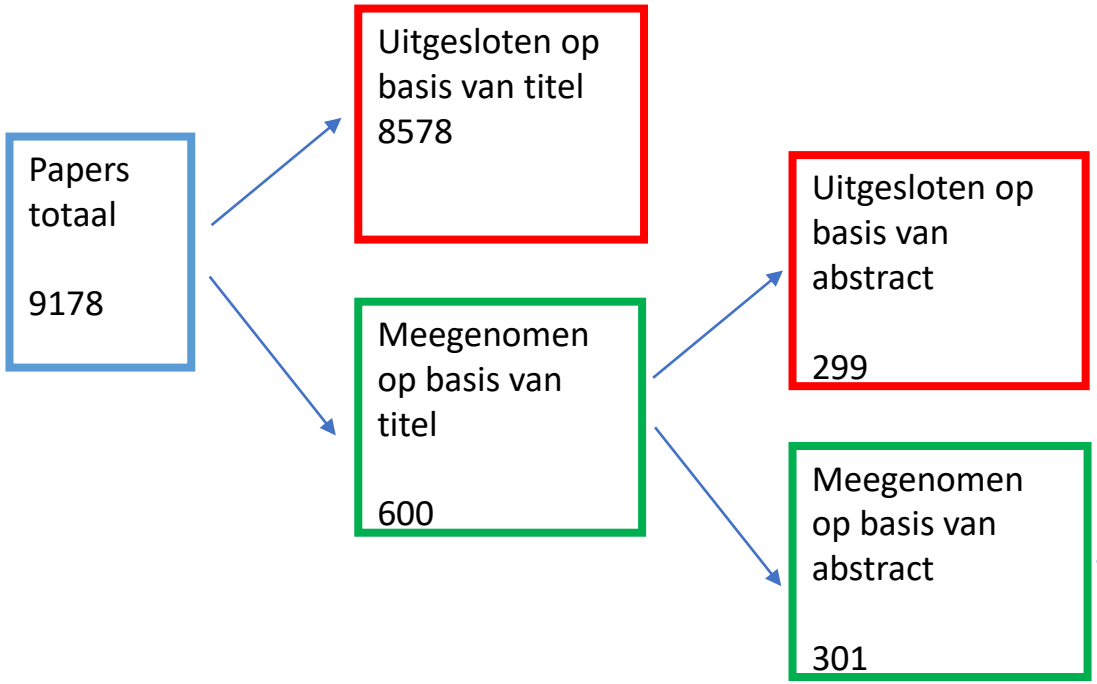
**EN**

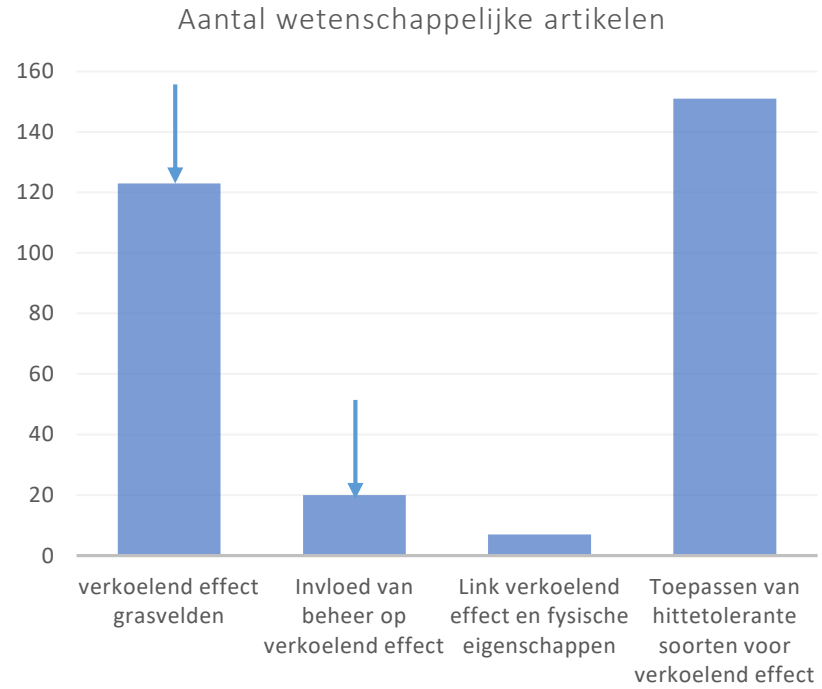
**Hitte (2)**

Hitte, heet, hittestress, hoge temperatuur, hittegolf, klimaatextremen, urban heat island effect, verdamping, transpiratie, evapotranspiratie, vapor pressure deficit, verkoeling, temperatuur demping, latent, park cool island

+ Engelse en Duitse synoniemen

# Literatuurstudie - screening

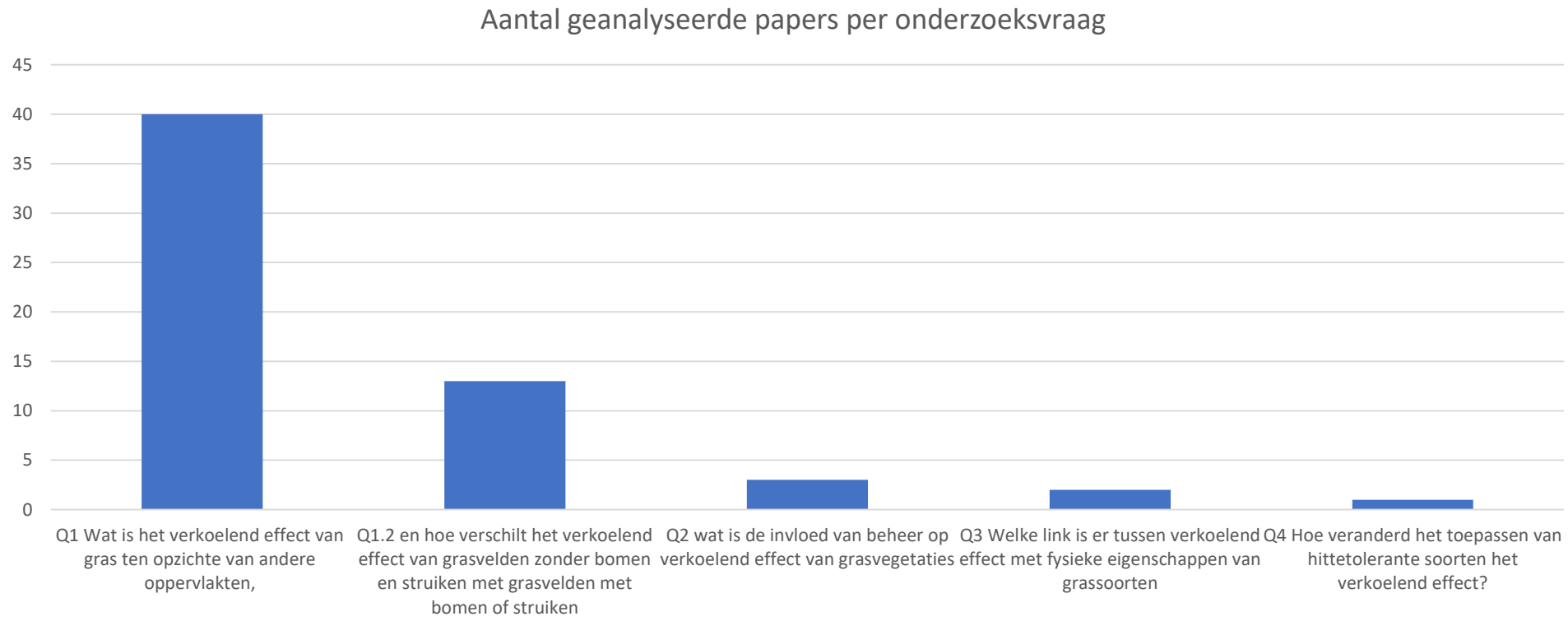



**Criteria**

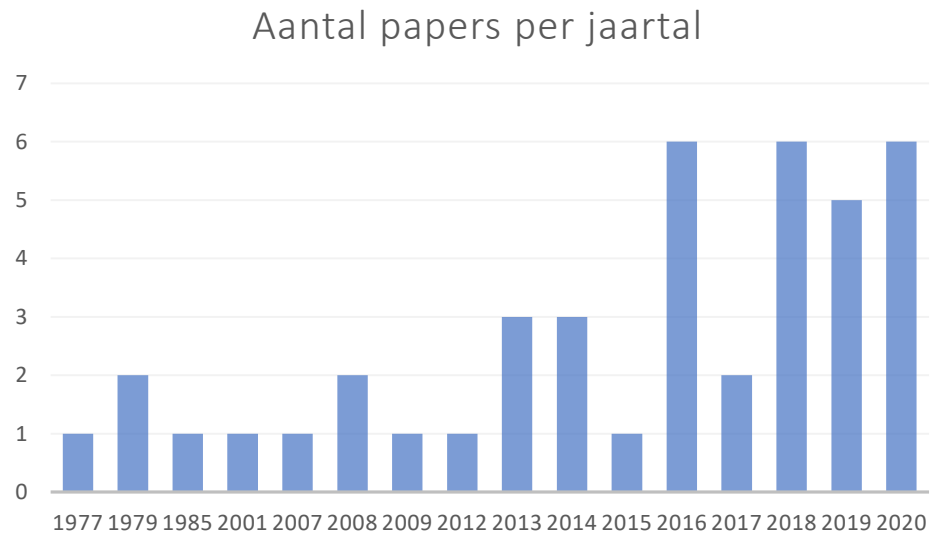
- Engelse, Duitse, Nederlandse taal
- Na 1975 (2000)
- Geen voedergrassen

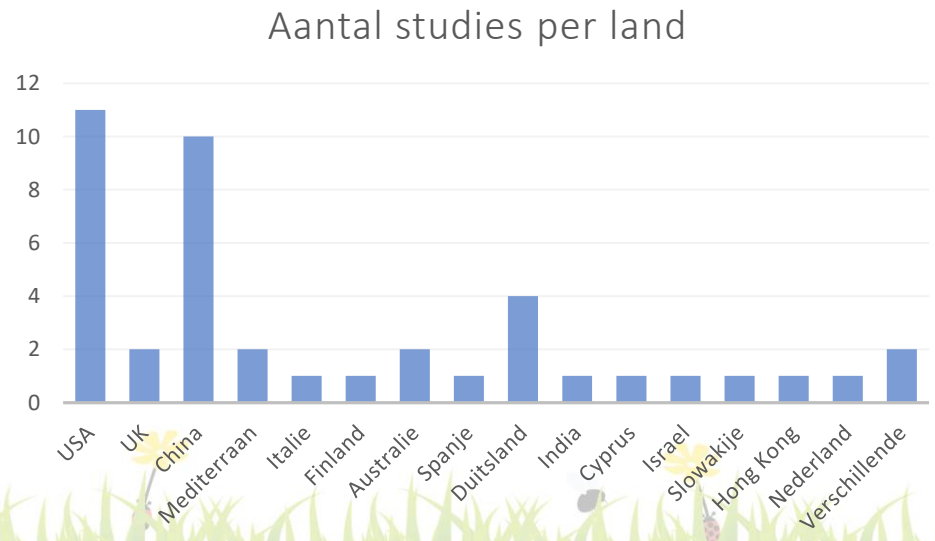
# Literatuurstudie - extractie

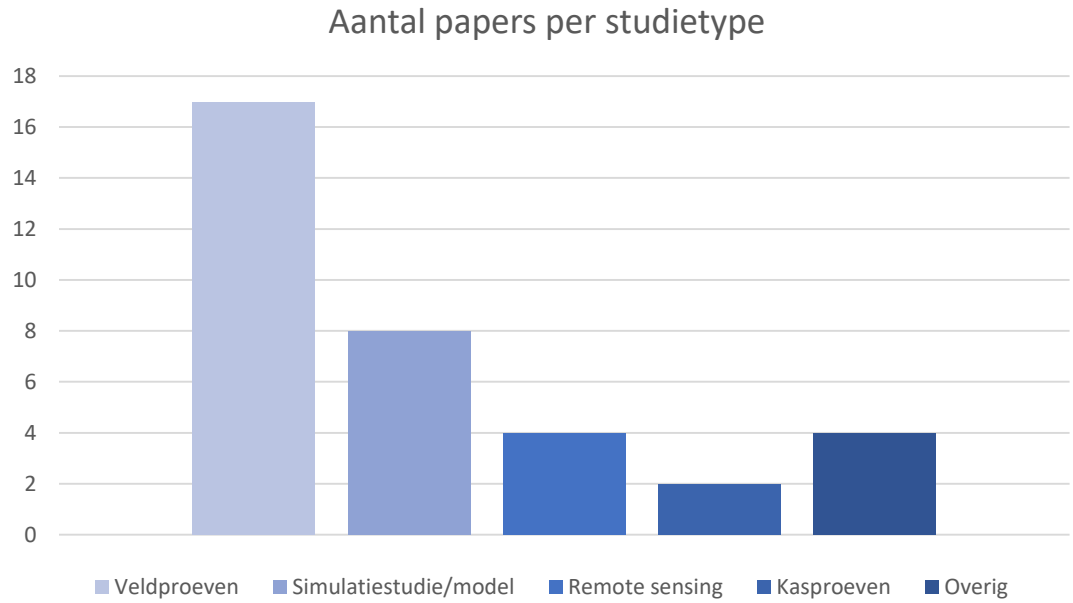



- Onderzoeksvormen die in de geanalyseerde papers bestaan grotendeels uit:
  - Metingen - zowel in het veld als in gecontroleerde omgeving. Zowel oppervlaktetemperatuur als luchttemperatuur en relatieve  luchtvochtigheid
  - Remote sensing – temperatuurverschillen over tijd op basis van satellietbeelden
  - Modelstudies – met name ENVI-met
  - Literatuurstudies – o.a. gecombineerde datasets uit verschillende papers

# Literatuurstudie - Spreiding in jaartal en herkomst



# Literatuurstudie – samenvatting Q1

Conclusies verkoelend effect grasvegetaties

- Verkoelend effect is te relateren aan:
  - De toestand van het gras: kort/verdroogd gras - minder verkoelend effect
  - De klimatologische omstandigheden (vochtbeschikbaarheid)
  - Het type gras
- Meeste studies vrij grof ingezet (weinig onderscheid grasvegetaties, niet kijkend naar vochtbeschikbaarheid lucht/bodem)
- Bijna geen Nederlandse studies

Vragen

- Wat is de invloed van schaduwwerking op verkoelend effect
- Hoe reageert grasvegetatie op verschillende beheersmaatregelen, welke soorten zijn het meest interessant om te onderzoeken in het kader van toekomstige veranderingen in klimaat zoals drogere lucht (in de toekomst krijgt Nederland een droger, meer continentaal klimaat – *KNMI 2020*)

# Literatuurstudie – samenvatting Q1.2

Conclusies verkoelend effect ten opzichte van verharding en bomen

- Verkoelend effect ten opzichte van kunstgras/beton:
  - Grote verschillen in met name oppervlaktetemperatuur en fysiologisch equivalente temperatuur tussen natuurgrassen en verschillende typen kunstgras
  - Irrigatie geeft bij kunstgras slechts enkele tientallen minuten verkoeling. Bij natuurgras is het effect langer (verdamping-evapotranspiratie)
  - Oppervlakken zoals beton worden niet alleen veel warmer, de warmte blijft ook in de avond uren langer hangen

- Verkoelend effect ten opzichte van bomen
  - Combinatie bomen, struiken en gras - grootste verkoelend effect.
  - Bomen/struiken overdag groter verkoelend effect, grasvelden in de avond en nacht groter verkoelend effect.
  - Het verkoelend effect van grasvelden dringt minder diep door (tot ca 10 meter) tot in het bebouwde gebied dan groenzones met gras en bomen (tot ca 60 meter).
  - Irrigatie van grasvelden draagt bij aan het verkoelend effect

# Literatuurstudie – samenvatting Q1.2

Vragen

- Wat is de invloed van bomen/schaduw op ‘prestaties’ verkoelend effect van grassen, en nemen bomen water weg dat anders gebruikt wordt door grassen?
- In hoeverre belemmert het vervangen van echt gras door kunstgras het verkoelend effect
- Hoe lang houdt het verkoelende effect van irrigeren van grasvelden aan
- Welke soorten gaan het beste om met droogte in de lucht (in de toekomst krijgt Nederland een droger, meer continentaal klimaat – *KNMI 2020*)

# Samenvattend

- Met name veel recente studies (v.a. 2010) over UHI en rol stedelijk groen
- Veel studies in USA en China
- Weinig studies in Nederland/Nederlands klimaat
- Weinig informatie relatie grasvegetatie en invloed beheermaatregelen
- Weinig verdieping/focus op verschillende typen grasvegetatie (*gras=gras*)
- Veel informatie over gecombineerd verkoelend effect bomen en grassen
- Weinig informatie over wisselwerking bomen en grassen

# Main messages literatuur studie

| Author | Year | Main message |
|---|---|---|
| O'Neil | 1979 | The caibrated consumptive use coefficients for the Blaney-Criddle and SCS formula's for estimating evapotranspiration in production grasses, differed considerably from the current experiments. Measured values from the current experiment are higher. |
| Feldhake | 1985 | The evapotranspiration and canopy temperature for grass preconditioned to different shading levels are equal to grass preconditioned to full PAR when testing under full PAR |
| Bell | 1999 | No significant variation was found between plots receiving morning shade and afternoon shade or between plots in 80% and 100% shade |
| Sifers | 2001 | There were significant differences in root depth and root biomass between the different cultivars |
| Thomas | 1977 | Later cutting reduced leaf extension rates and leaf lengths in later seasons. Leaf appearance rates were reduced for only about 1 month after cutting |
| Yu | 2020 | more attention should be paid to quantify the contributions of local background climate and landscape characteristics to the cooling effect (threshold-size) of blue-green space |
| Yao | 2020 | Urban green space, especially forest contributes significantly to mitigating UHI in an urban block. UHI is mitigated most in summer months |
| Su | 2020 | vegetation cooling is generally stronger during the daytime periods, in warm seasons, at low latitude zones, for forest lands and at leaf growth stage, while vegetation warming usually occurs in the opposite contex |
| Grilo | 2020 | green spaces with reduced areas can regulate microclimate, alleviating temperature by 1–3 °C and increasing moisture by 2–8%, on average. Green spaceswith a higher density of trees were more efficient in delivering the cooling effect. Green spaces influenced temperature and relative humidity up to 60 m away from the parks' limits. |
| Gatto | 2020 | In summer, for both locations thermal comfort is improved by presence of green space. This accounts for both grass and tree vegetation. |
| Zhang | 2019 | An increase of park tree coverage and a decrease of sky view factor could reduce evening air temperature by around 2 °C and 2.5 °C respectively |
| Wang | 2019 | Increase in tree density and Leaf Area Index (LAI) significantly decreases land surface temperature and Park Cool Island effect |
| Sodoudi | 2018 | The spatial configuration and the vegetation type of green areas are both affecting the efficiency of the green areas' cooling effect. Most cooling in the afternoon and by big trees |
| Chandramathy | 2018 | Higher land surface temperature in built up areas compared to different types of green cover. |
| Amani-Beni | 2018 | Grass irrigation management can have a positive effect on cooling effect of grass surfaces, irrigated grass can have similar cooling effects with small water bodies |
| Amani-Beni | 2018 | Urban park's cluster trees with short ground vegetation generated higher cooling effect than single trees, grass and waterbodies |
| Fung | 2017 | Woodland strip has a stronger cooling effect and creates more thermally comfortable environments than Rough and concrete plots |

# Main messages literatuur studie II

| | | |
|---|---|---|
| Vahmani | 2016 | Transforming lawns to drought-tolerant vegetation resulted in daytime warming of up to 1.9°C, largely due to decreases in irrigation that shifted surface energy partitioning toward higher sensible and lower latent heatflux. During nighttime, however, adopting drought-tolerant vegetation caused mean cooling of 3.2°C, due to changes in soil thermodynamic properties and heat exchange dynamics between the surface and subsurface |
| Lee | 2016 | On a hot summer day, averaged over 10-16CET, trees over grassland lead to a mitigation effect up to 2.7K for Ta, 39.1K for Tmrt and 17.4K for PET. In comparison, the effect of grasslands can be up to 3.4K for Ta, 7.5K for Tmrt and 4.9K for PET |
| Yan-Dong | 2015 | as the percent tree cover increased by 10 %, the air temperature decreased by 0.26 °C during daytime, while as the percent lawn cover increased by 10 %, the air temperature decreased by 0.56 °C during nighttime |
| Litvak | 2014 | Shading of turfgrass by trees decreases total evapotranspiration, as turfgrass evapotranspiration is highly sensitive to radiation. Turf with trees total evapotranspiration is lower than evapotranspiration of only turf. |
| Shashua-Bar | 2009 | Grasses reduce radiant loads, while differences in air temperature are small compaired to trees |
| Kong | 2014 | UCI intensity was affected by areas of forest vegetation and its spatial arrangements, as well as by the composition of the cool island and its neighboring thermal environment |
| Kereszteso va | 2013 | Remarkable differences between different surface composition and cooling effect have been observed |
| Armson | 2012 | Grass reduced maximum surface temperatures by up to 24 ◦C, similar to model predictions, while tree shade reduced them by up to 19 ◦C. In contrast, surface composition had little effect upon globe temperatures, whereas shading reduced them by up to 5–7 ◦C. These results show that both grass and trees can effectively cool surfaces and so can provide regional cooling, helping reduce the urban heat island in hot weather. In contrast grass has little effect upon local air or globe temperatures, so should have little effect on human comfort, whereas tree shade can provide effective local cooling |
| Yu | 2018 | High relative humidity restricts cooling by urban green vegetation.Increased wind speed enhances the tree-covered cooling effect while weakening the grass-covered UGVs' in Mediterranian Climate cities.  in order to achieve the most effective cooling with the smallest sized tree-covered UGV |
| Wang | 2018 | a park area threshold of 1.34 to 17 hectares provides the best PCI effect, that park shape (perimeter/area), Leaf Area Index (LAI), density, tree cover, water cover, and impervious surface cover have significant correlation with PCI development |
| Balling | 2008 | Greater sensitivity to atmospheric conditions occurred in land use situations with large lots, many pools, a high proportion of irrigated mesic landscaping, and a high proportion of high-income residents |
| Connors | 2013 | proportional area of grass explains much of the variation in mesic temperatures |
| Jenrette | 2007 | significant potential air and surface temperature reductions between representative and proposed vegetation scenarios: 1) a Park Cool Island effect that extended to non-vegetated surfaces; 2) a net cooling of air underneath or around canopied vegetation ranging from 0.9 °C to 1.9 °C during the warmest time of the day; and 3) potential reductions in surface temperatures from 0.8 °C to 8.4 °C in areas underneath or around vegetation |
| Declet-Barreto | 2013 | increasing vegetation in parks can mitigate local effects of the UHI by creating localized PCIs where extreme temperatures are lowered, sometimes significantly |
| Sinclair | 2008 | cool-season grass Festuca arundinacea growth does not decrease, but increases with higher temperatures (18,5 - 27 degrees), with stable VPD (1,2 kPa). With stable T and increasing VPD growth rates decline. Growth appears to in response to a maximum transpiration rate. When temperatures are higher in future, but VPD remains equal, growth rates can be stimulated rather than decreased in temperate climate zones. |
| Aram | 2019 | the highest cooling effect distance and cooling effect intensity are for large urban parks with an area of more than 10 ha; however, in addition to the area, the natural elements and qualities of the urban green spaces, as well as climate characteristics, highly inform the urban green space cooling effect |
| Jim | 2016 | Intense incoming shortwave and longwave radiation absorbed readily by Artificial Turf materials raised turf surface temperature to 70.2C and substrate 69.3C, in comparison with <40C at Natural Turf |
| Klemm | 2015 | 10% tree crown cover within a street canyon lowered street averaged Tmrt about 1K. In contrast, our results did not show an influence of street greenery on street averaged T. both physical and psychological aspects of thermal comfort have to be considered in urban design processes |