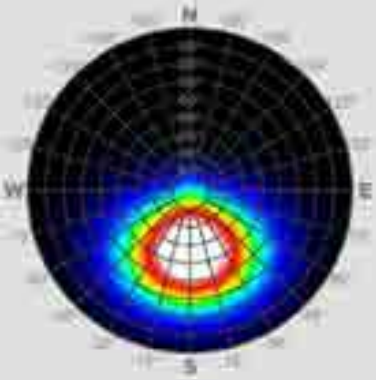
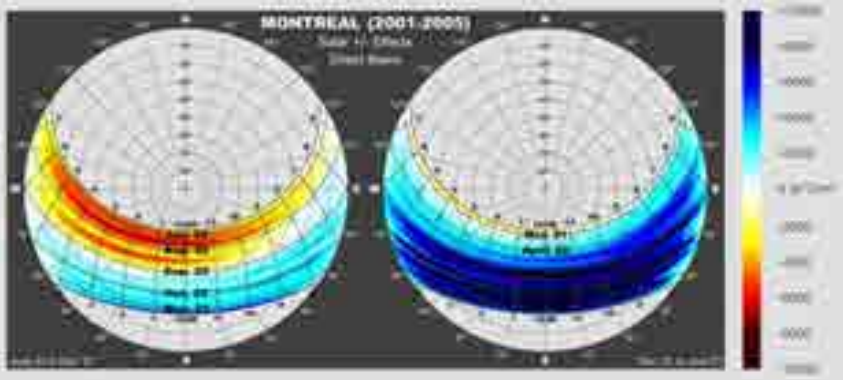
OFFICE
DE CONSULTATION PUBLIQUE
DE MONTRÉAL

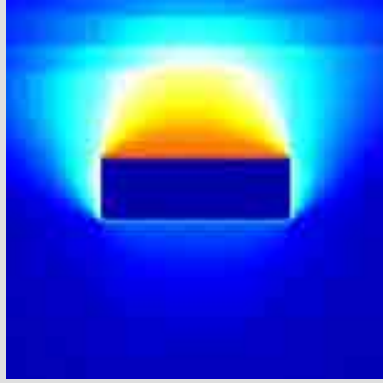
THE SUN AND THE CITY OF MONTRÉAL

September 4, 2013

MOJTABA SAMIMI

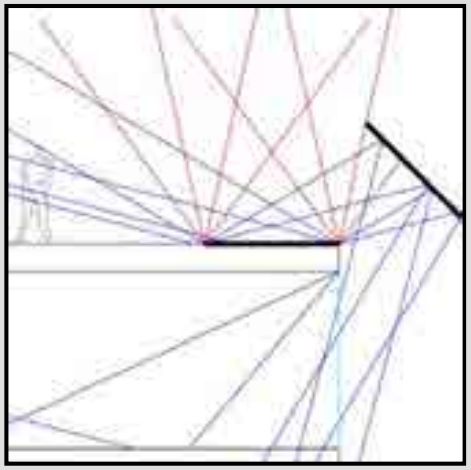


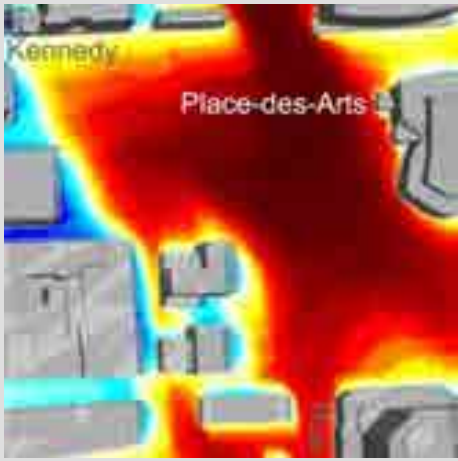




Objectives

- To demonstrate the remarkable effects of the Sun in complex climate of Montréal.
- To improve the quality of the city for the people using simple practical solutions.
- To advance the solar-climatic guidelines in different scale for future design.





— Introduction
— Method and Analysis
— Conclusion

Facts and Factors:

► Current and future challenges: Energy resources, Energy efficiency, Pollution, Heat island effect, Climate change, Global warming, etc.

► The role of climatic response of a city in providing health, comfort and safety for people inside and outside buildings.

► **Bold** effect of municipalities, urban planners, architects and landscape architects in the process of decision making and decision taking.

Problem Definition

— **Passive solutions**: to receive more from the Sun in cold times and to be protected in hot times (Comfort factors).

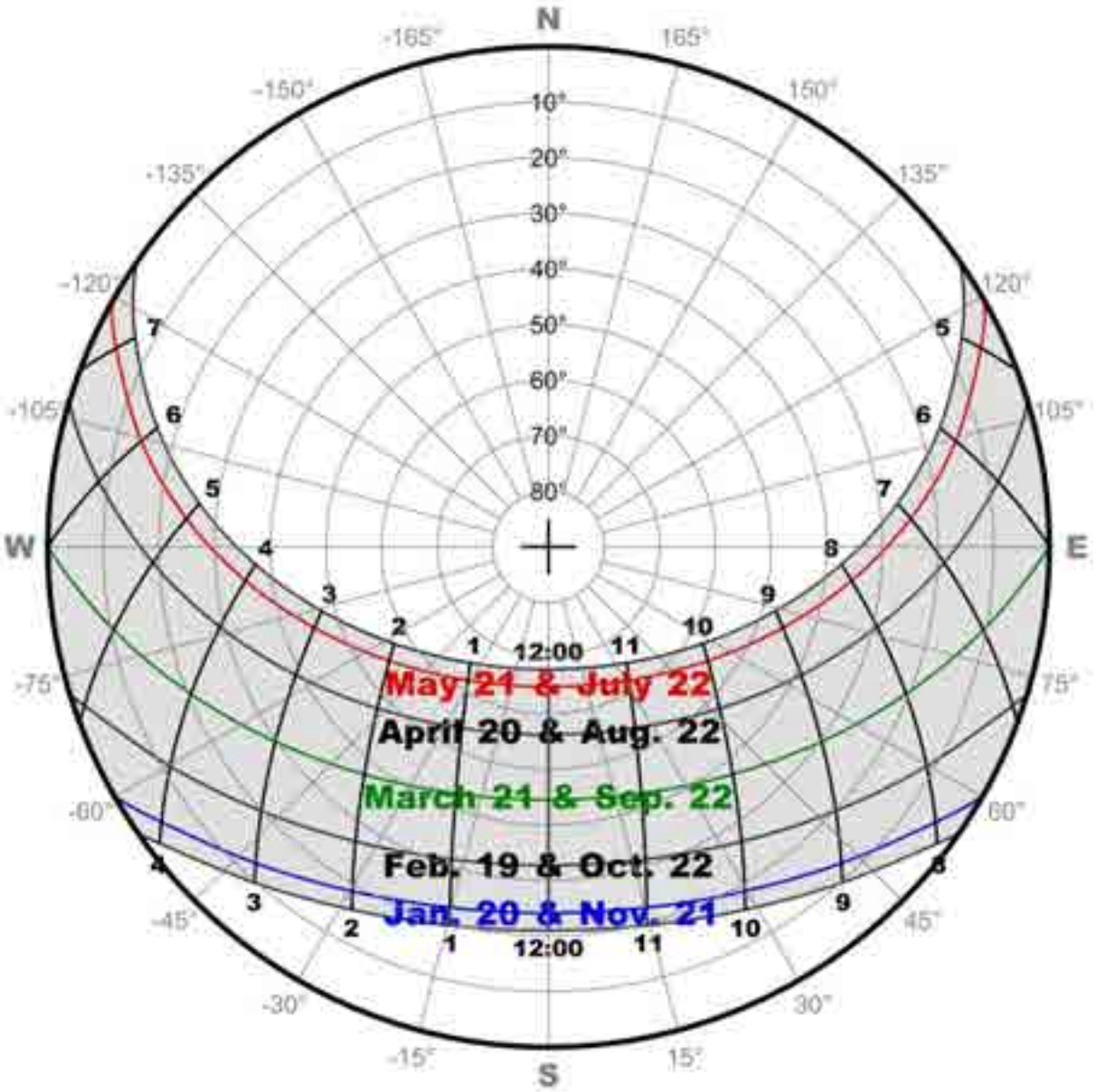
— **Active solutions**: to receive more from the pure and unlimited energy of the Sun (Energy efficiency).

► To put the active and the passive strategies into a dialectical relationship to fashion a culture of Solar-Climatic Vision that traverses the scales, like the sun itself, from human scale to the urban and territorial as well as global scale.

- Basics
- SOLARCHVISION Analysis

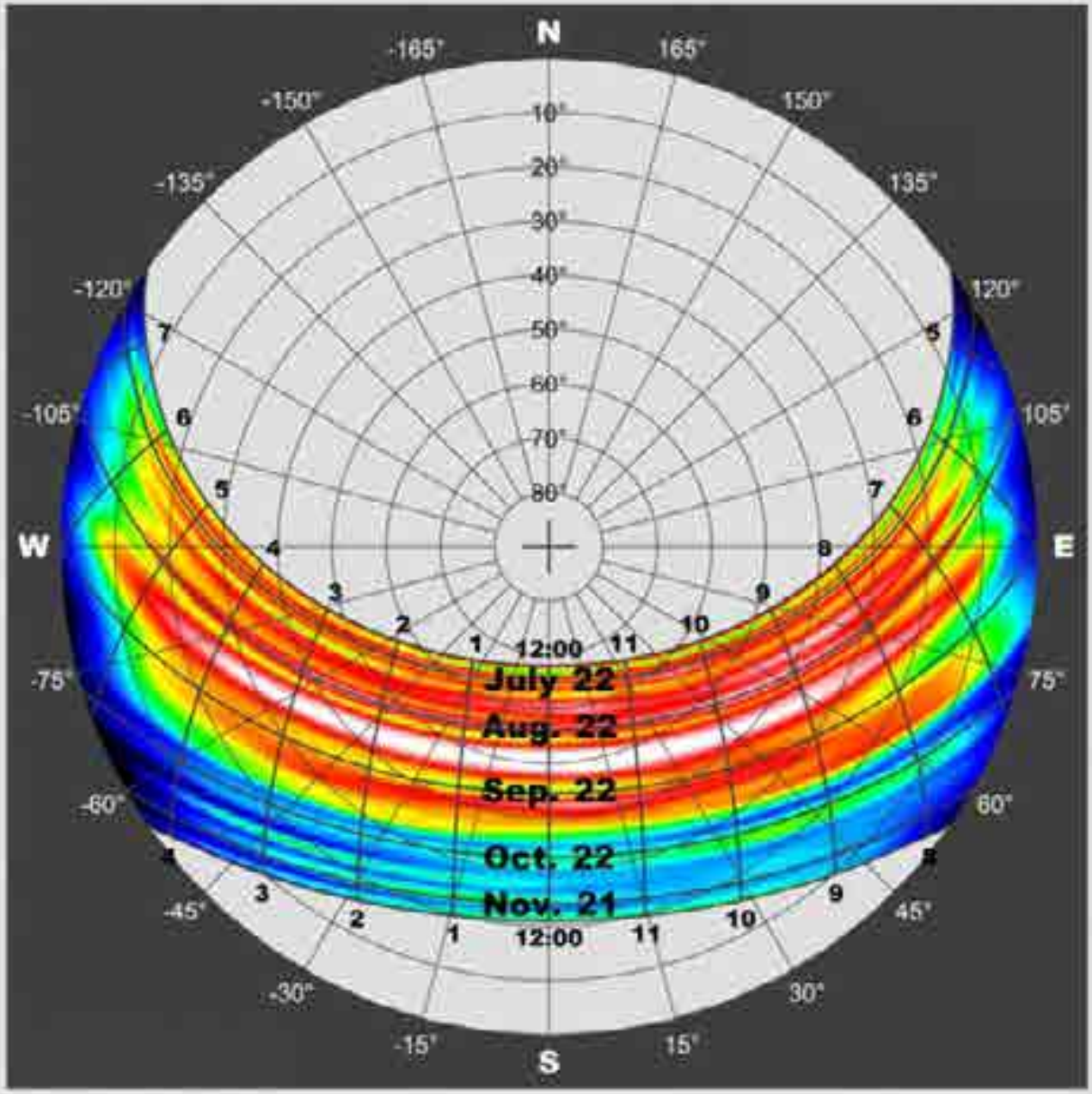
A new approach for solar-climatic analysis of indoor and outdoor spaces in different scales: human scale, building scale, urban scale, etc.

Montréal
Sun Path



Montréal Solar Radiation Direct Beam

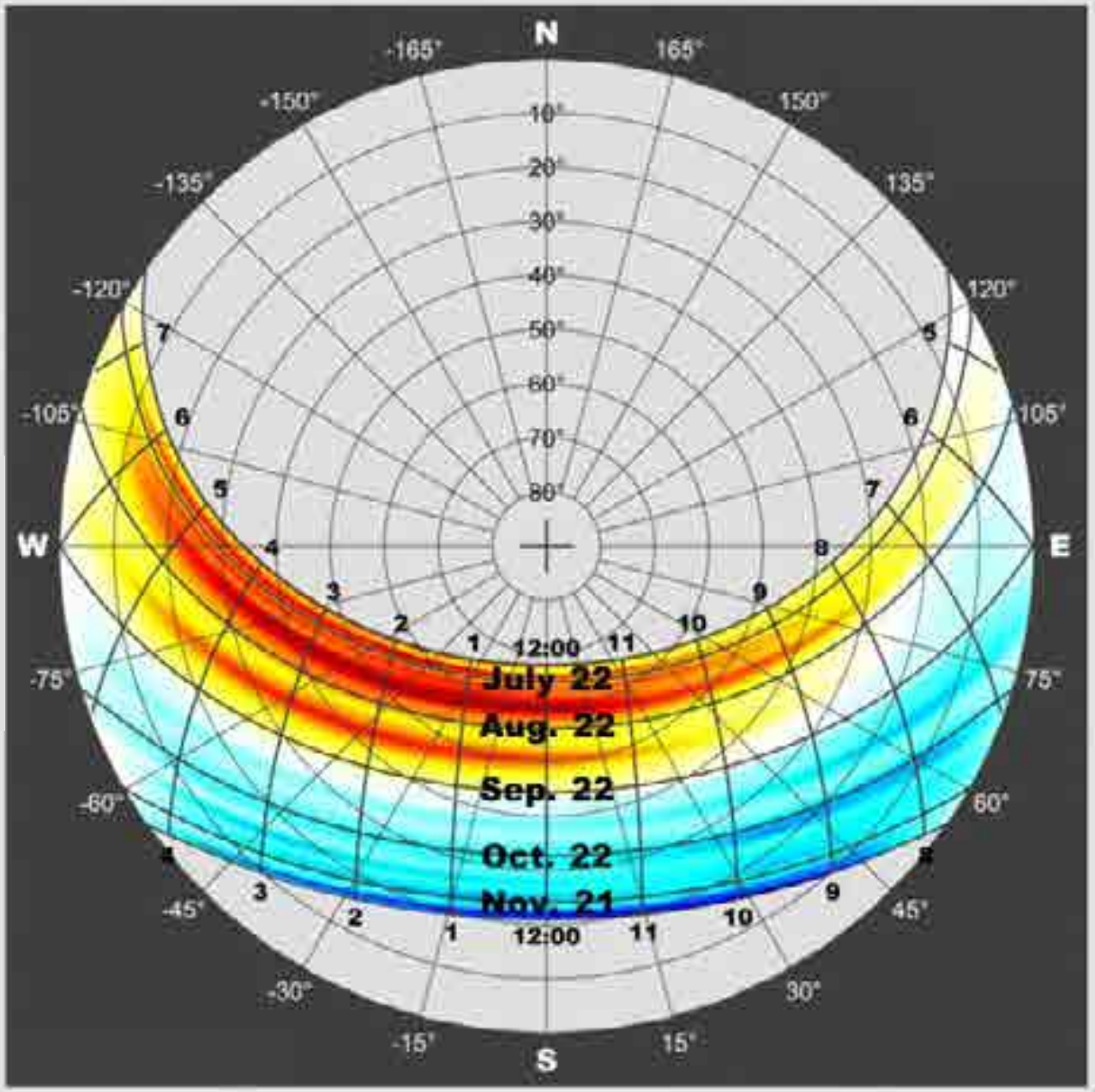
(2001 – 05)



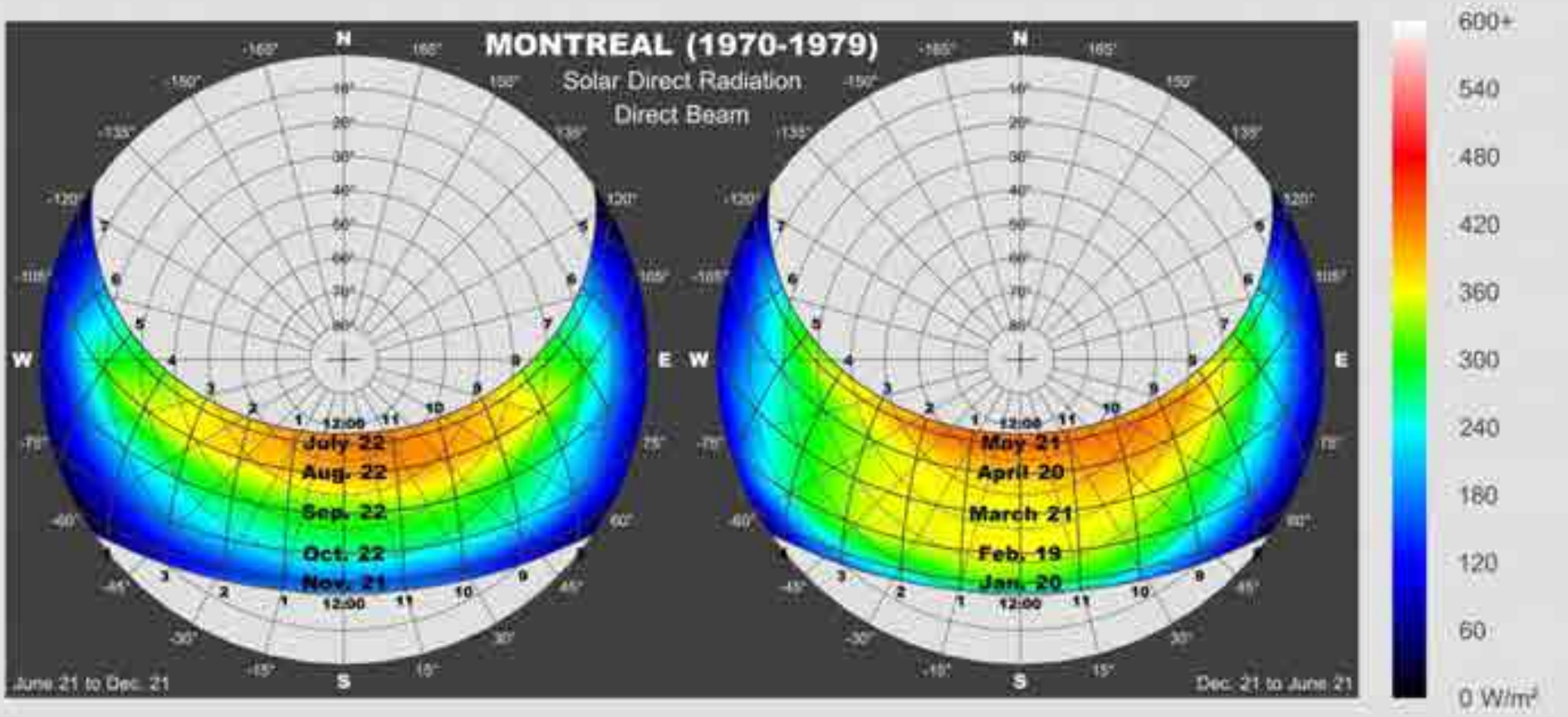
Montréal Solar +/- Effects Direct Beam

(2001 – 05)

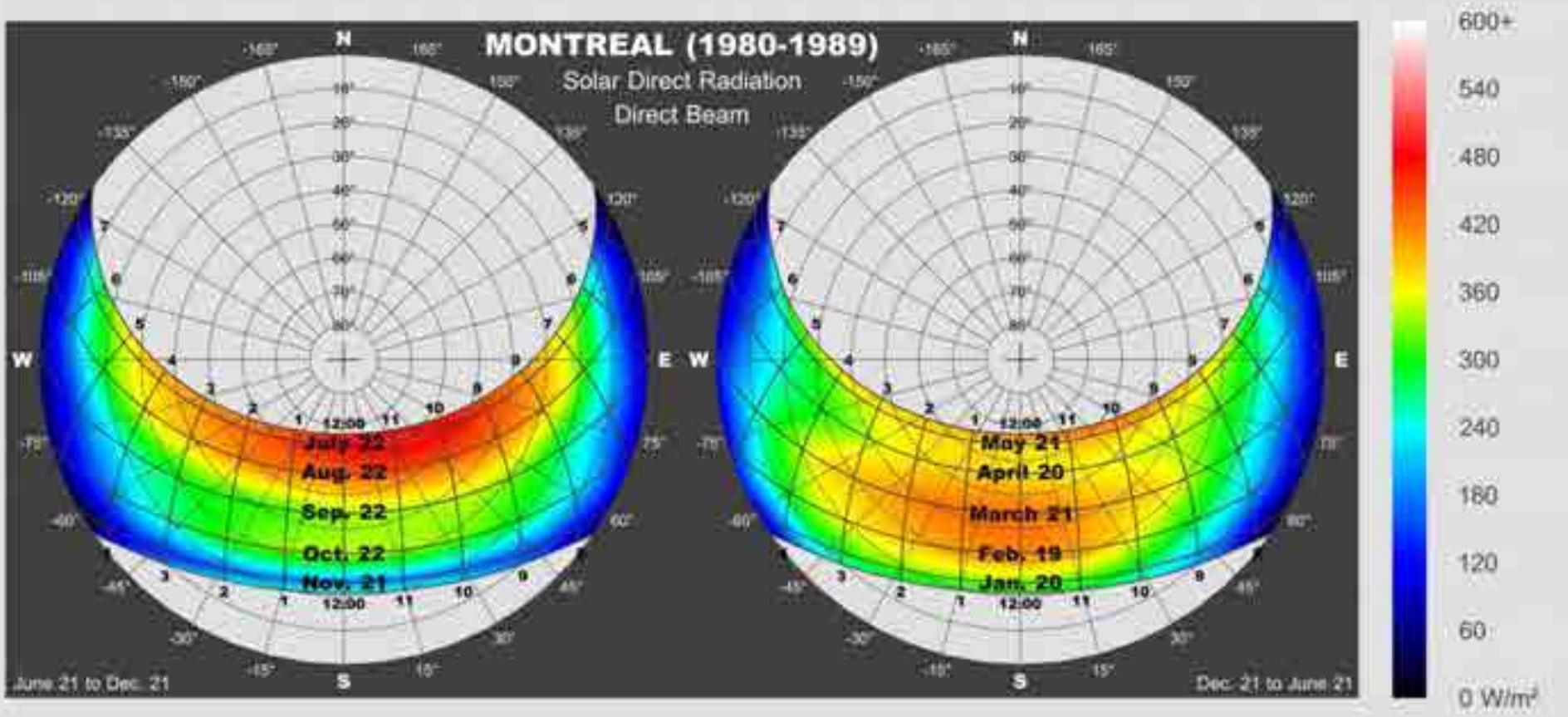
Le Corbusier drawing



Montréal
Pattern of Direct Solar Radiation: 70’s



Montréal
Pattern of Direct Solar Radiation: 80’s



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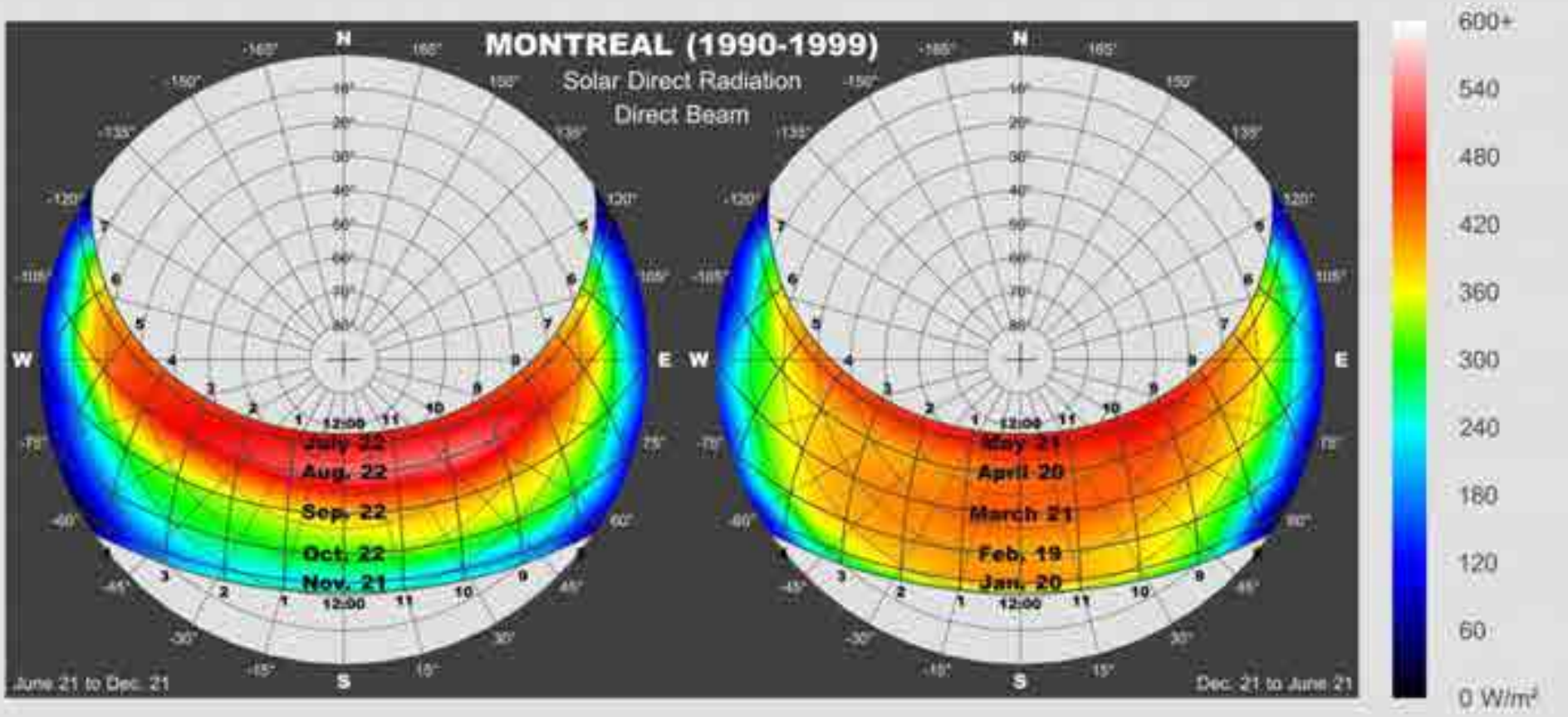
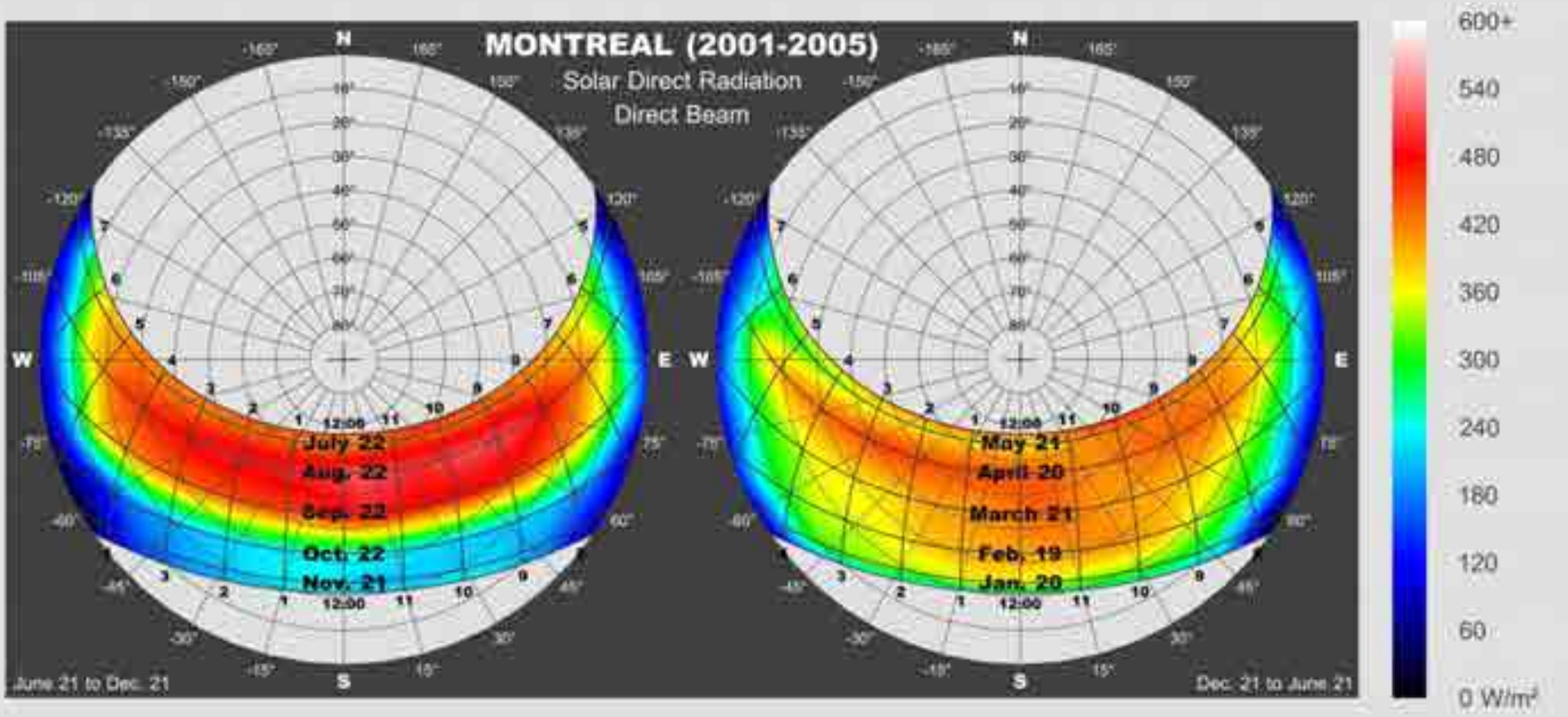
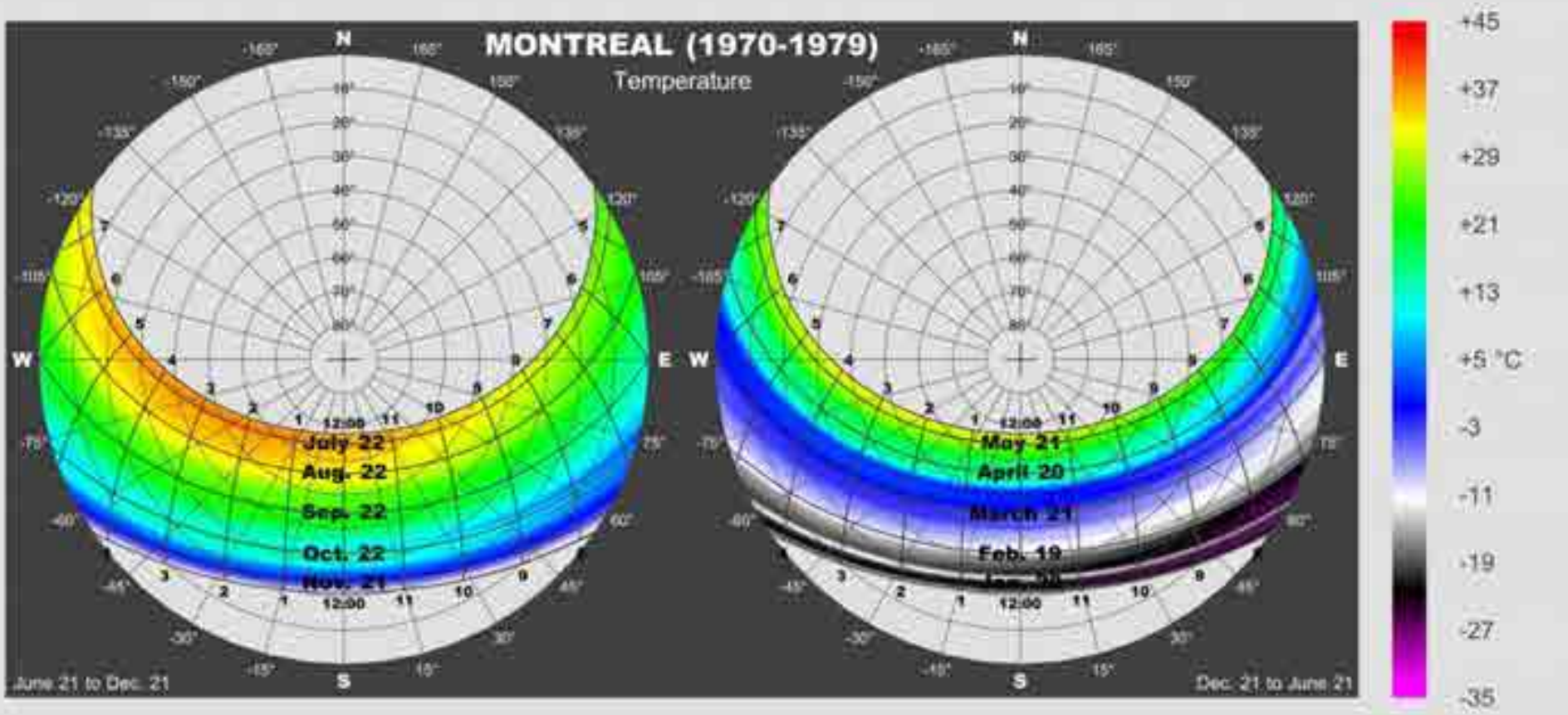


Montréal
Pattern of Direct Solar Radiation: 2000's



Montréal
Pattern of Air Temperature Radiation: 70’s



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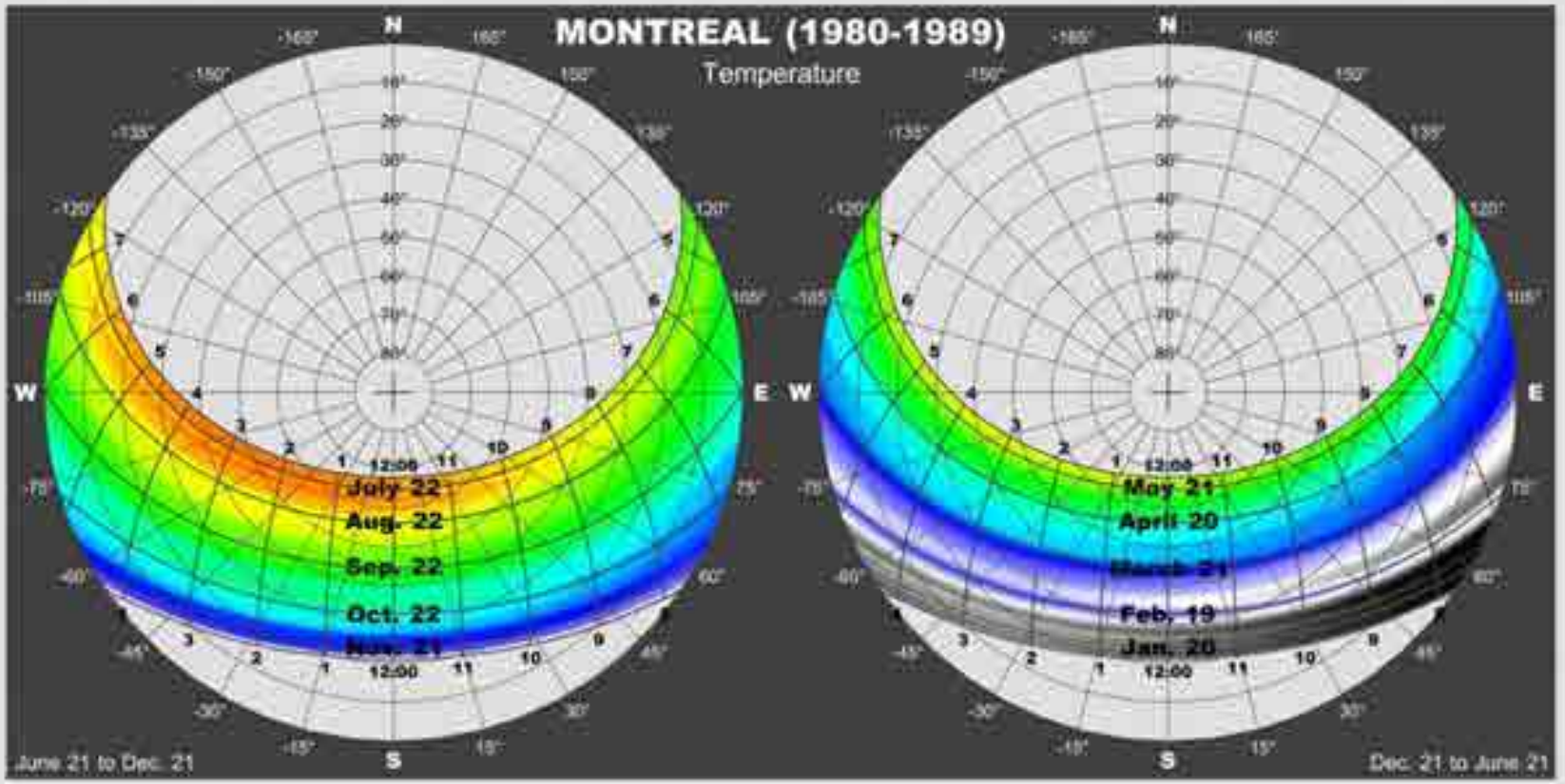

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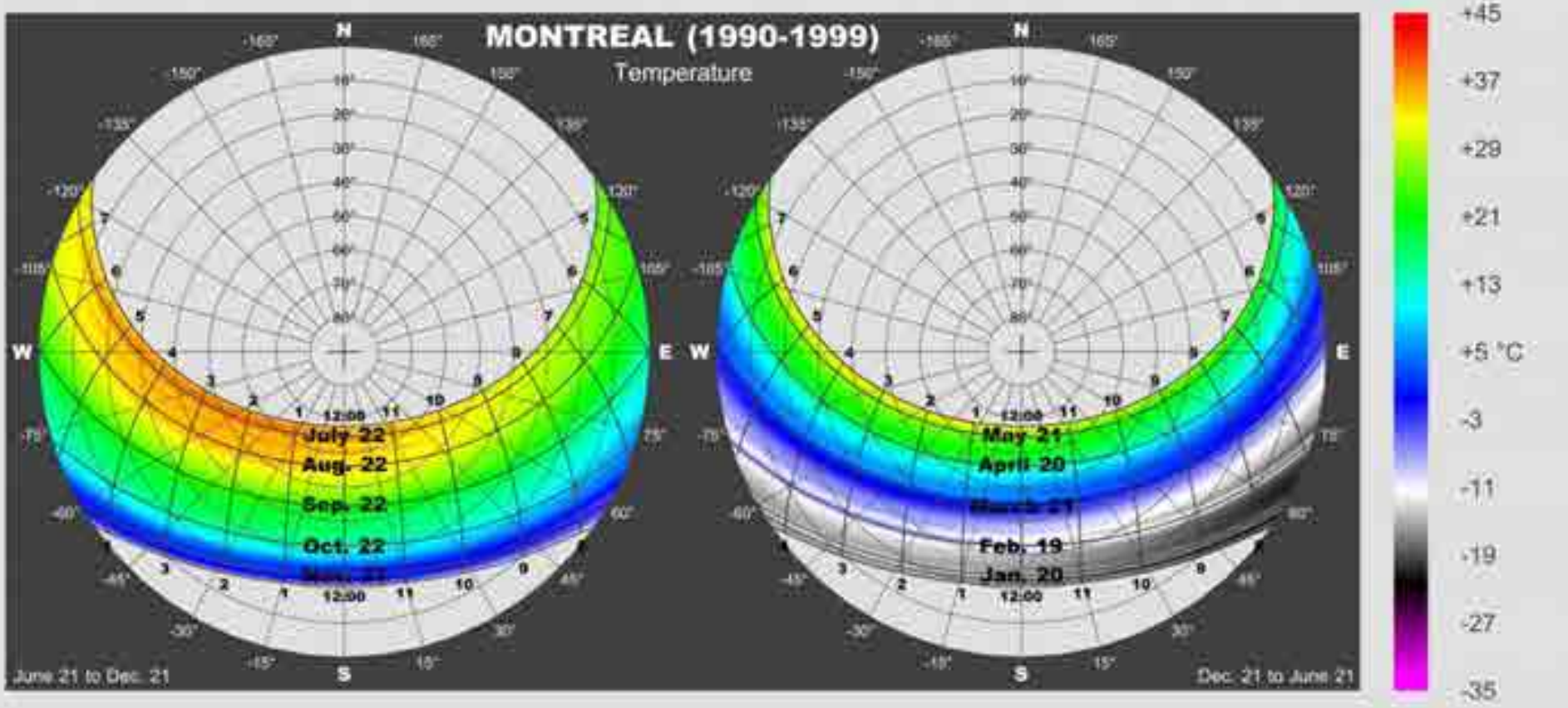
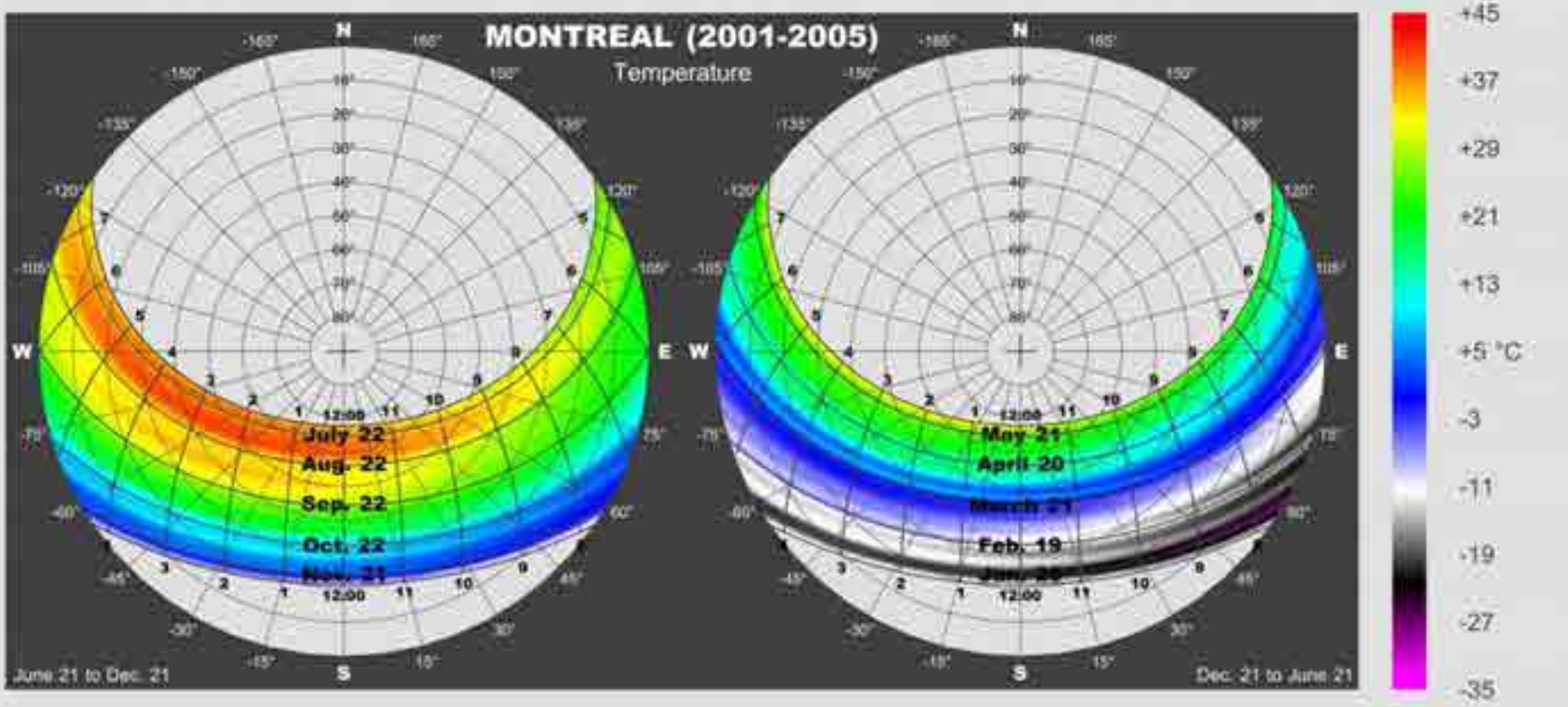
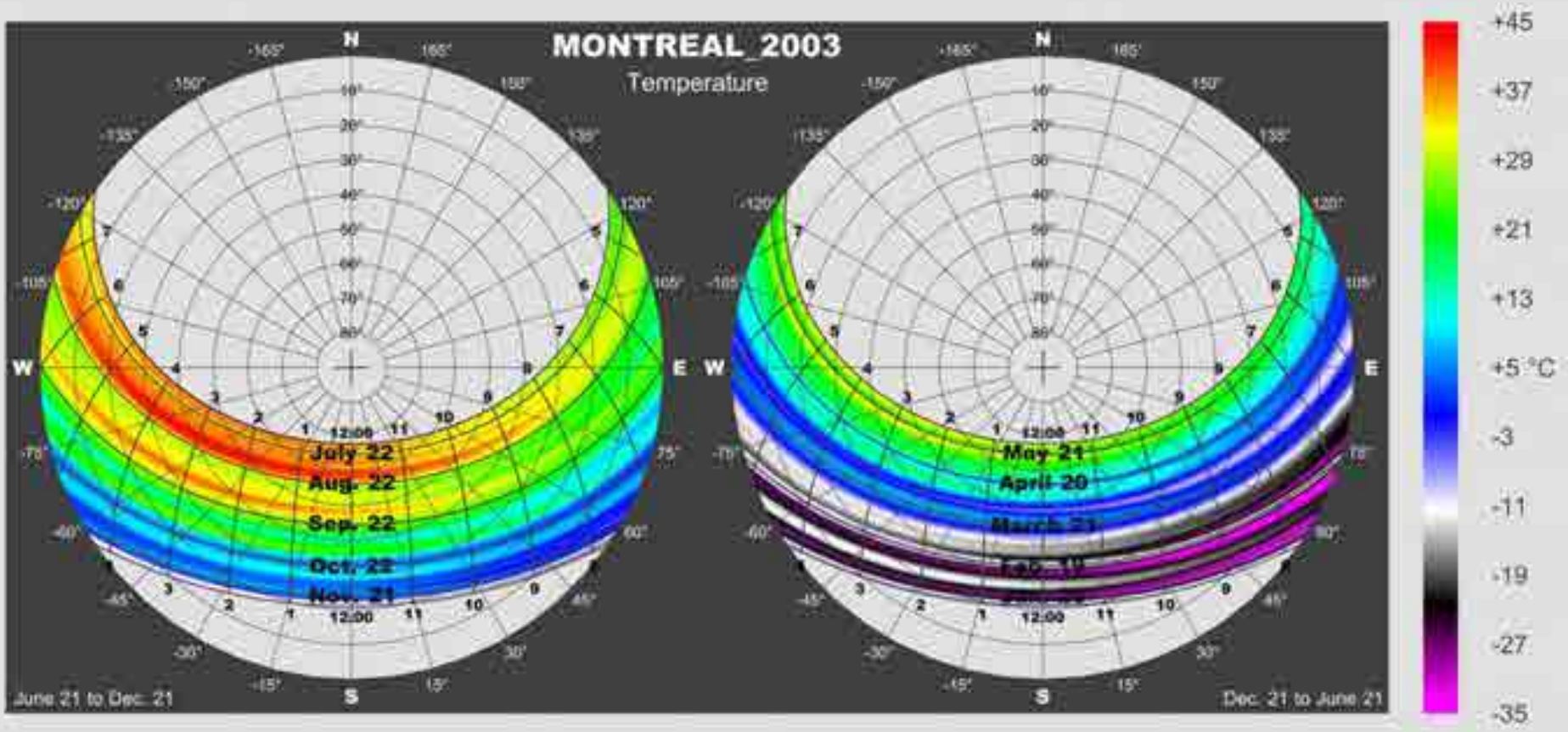


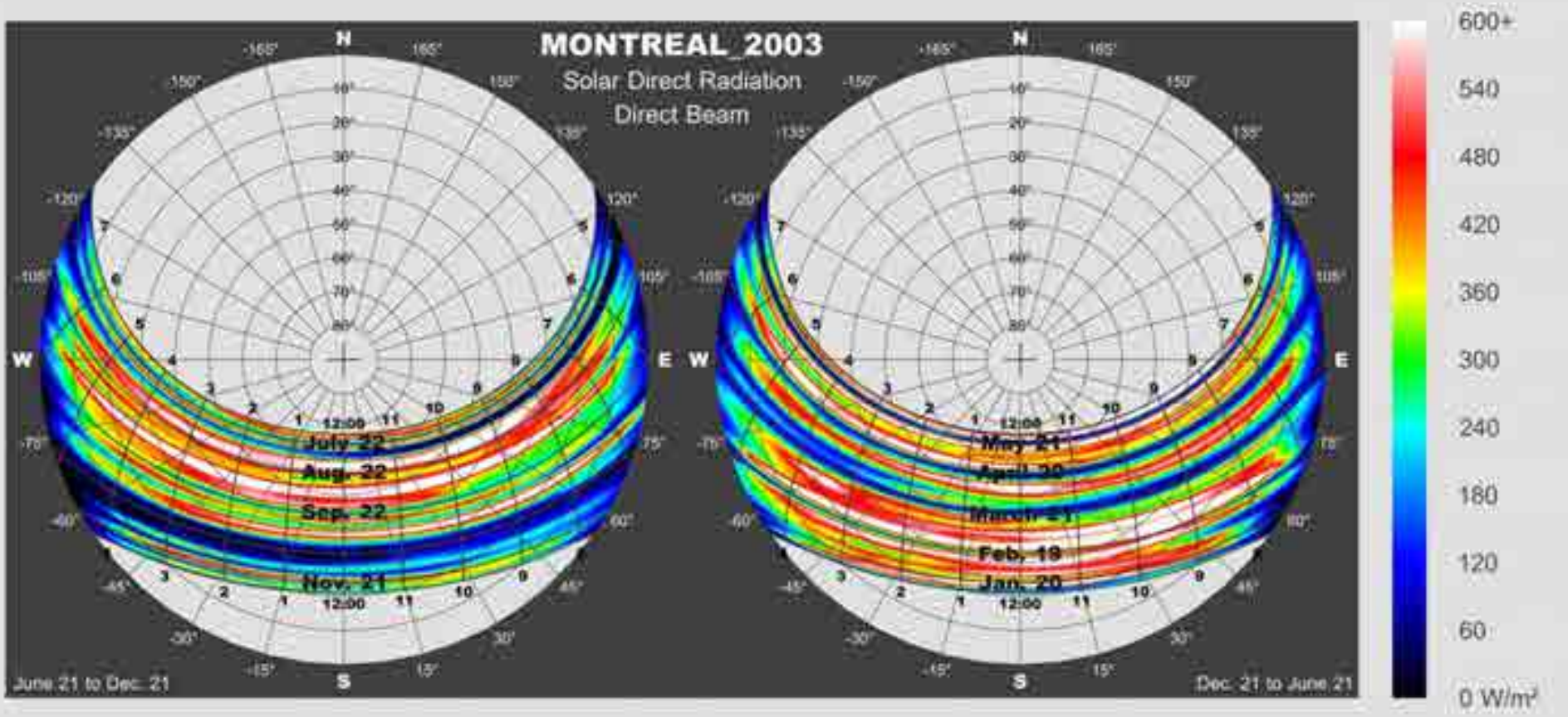
Montréal
Pattern of Air Temperature Radiation: 2000's



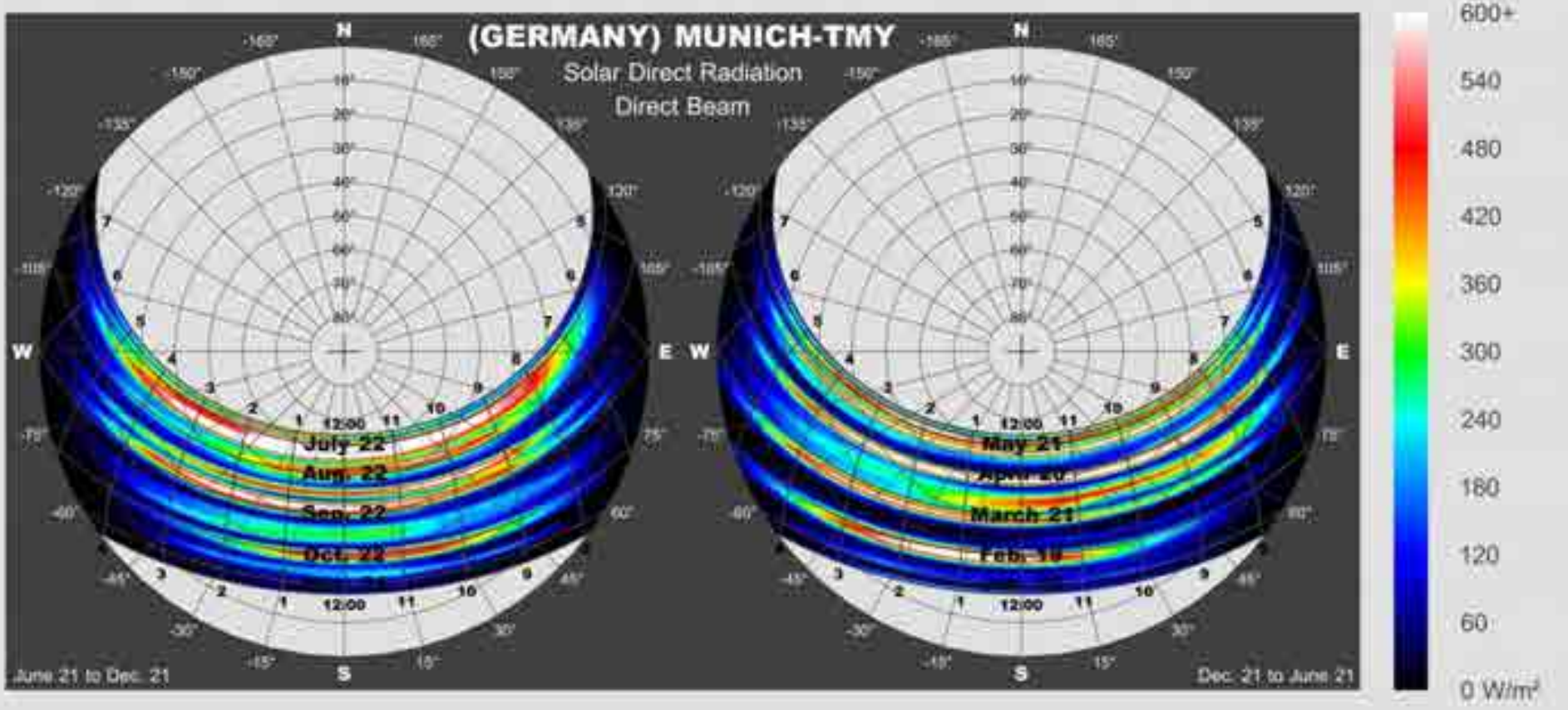
Montréal
Low and High Temperatures
in 2003 (a year with remarkable minimum and maximum temperatures)



Montréal
Solar Radiation Model
in 2003 (a year with remarkable minimum and maximum temperatures)

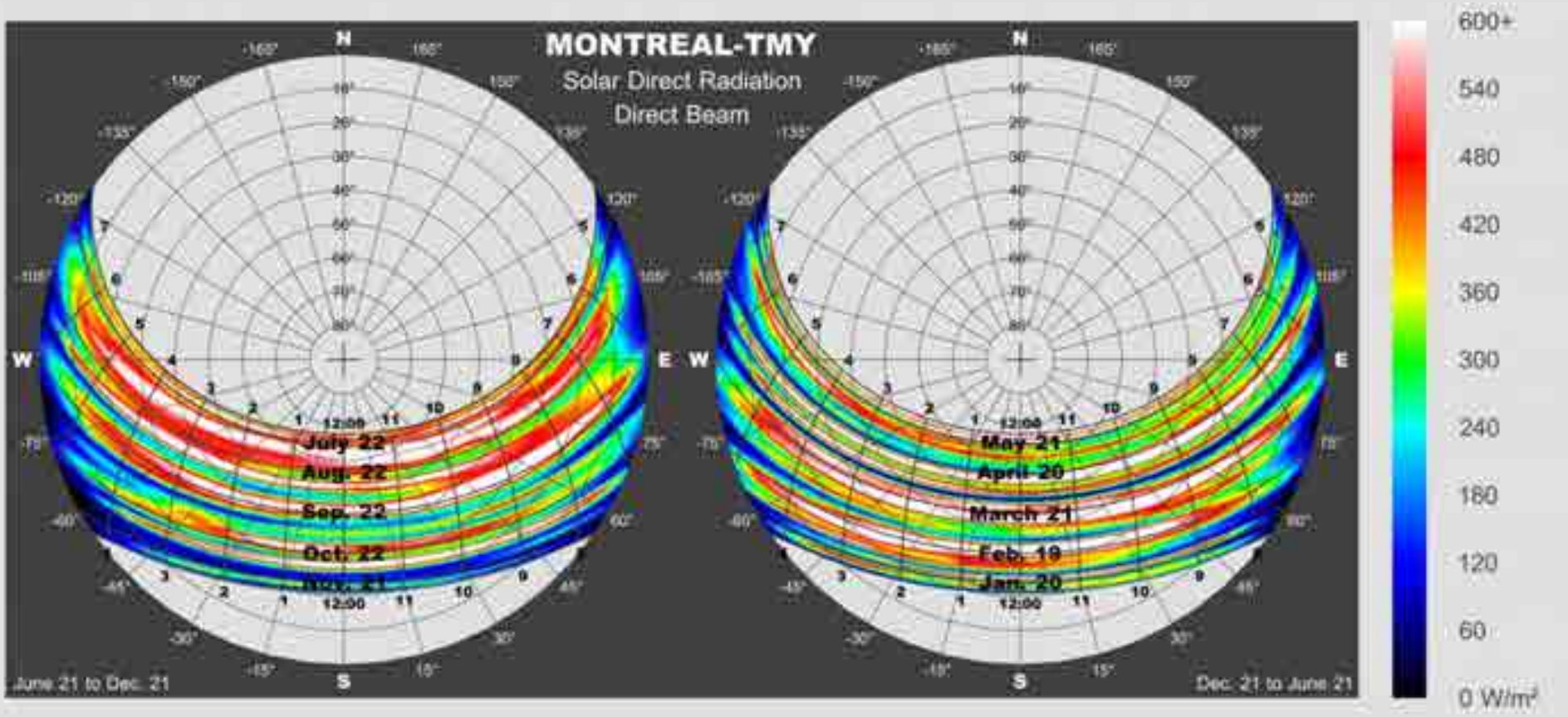


Munich
Solar Radiation Model
in Typical Meteorological Year – Data Source: US Department of Energy



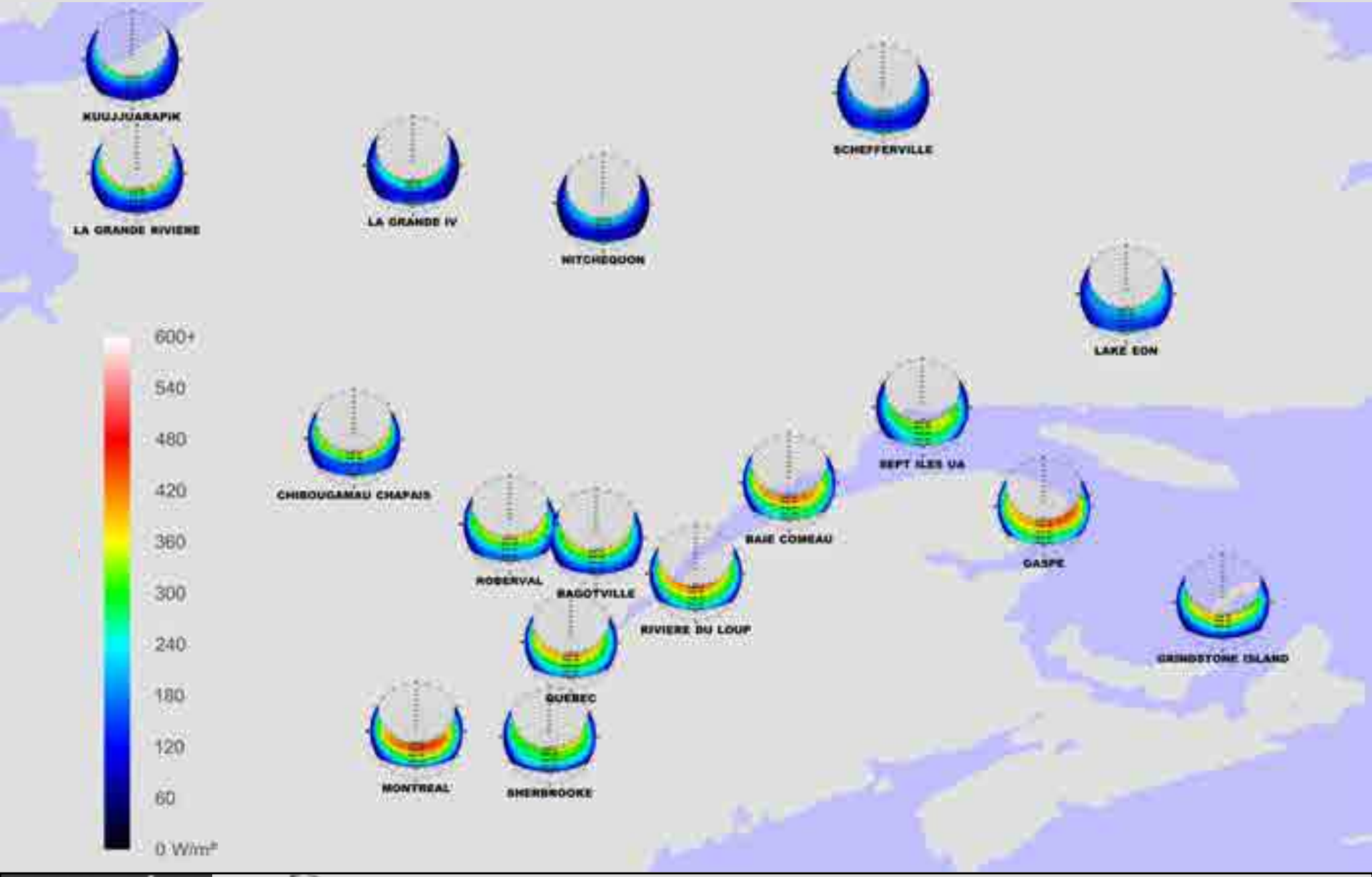
The sunniest city of Germany has much less in comparison with Montréal

Montréal
Solar Radiation Model
in Typical Meteorological Year – Data Source: US Department of Energy



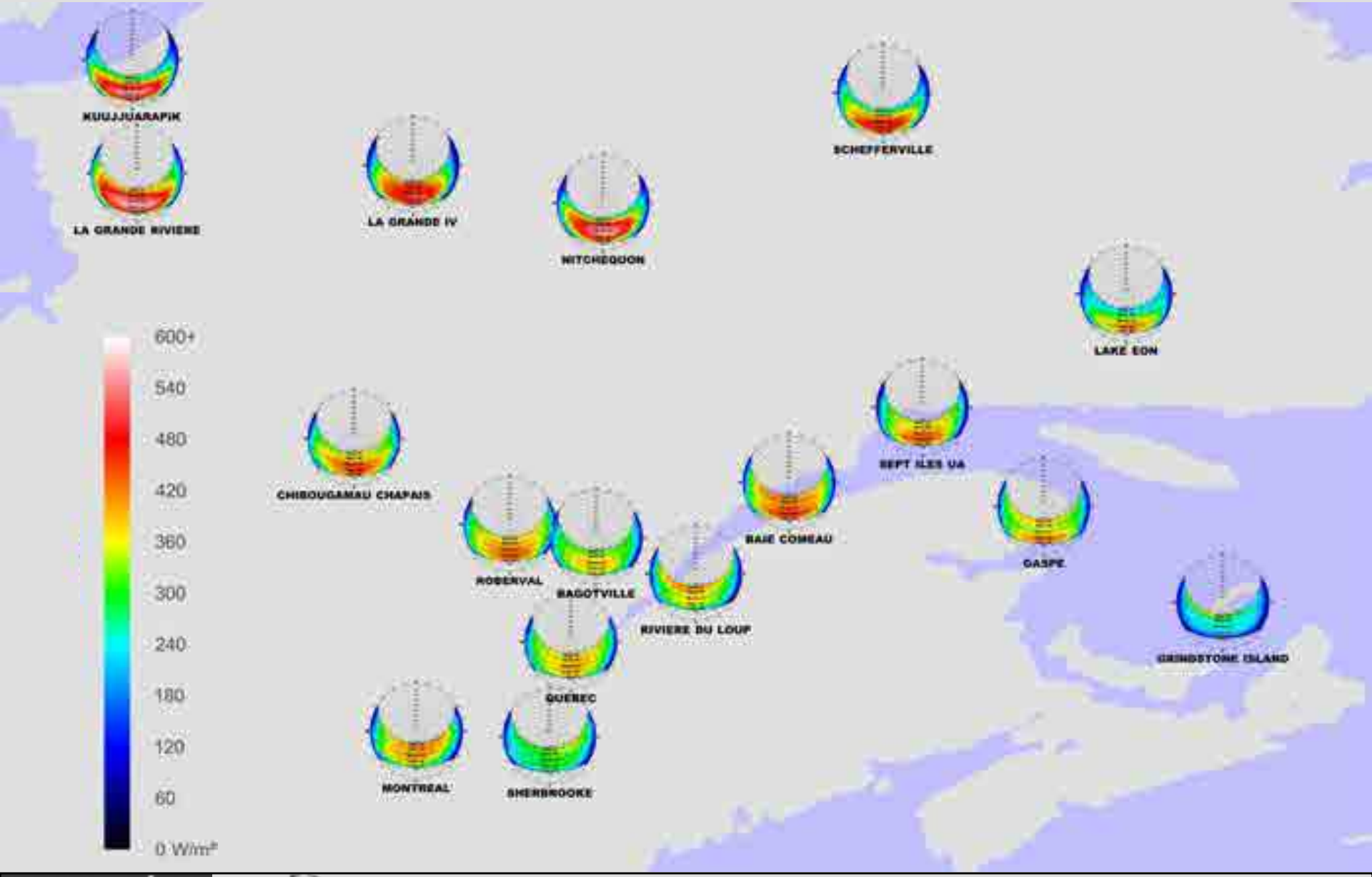
Normalization of Direct Beam Radiation (from June 21 to December 21) in Quebec - Canada

Data Source: Long Term Data (1953 – 2005), National Climate Data and Information Archive of Canada - CWEEDS files

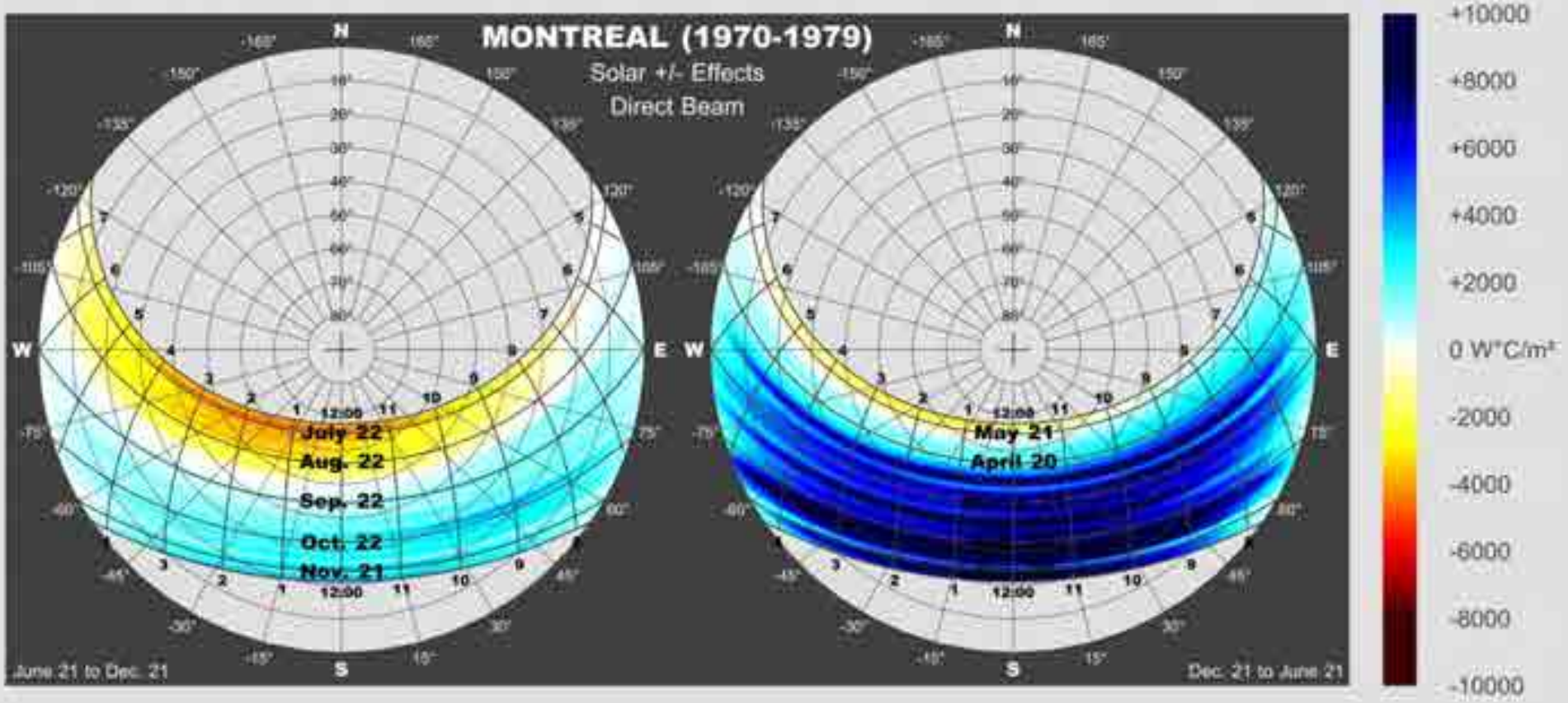


Normalization of Direct Beam Radiation (from December 21 to June 21) in Quebec - Canada

Data Source: Long Term Data (1953 – 2005), National Climate Data and Information Archive of Canada - CWEEDS files



Montréal
Change in Solar Positive and Negative Effects through Decades: 70’



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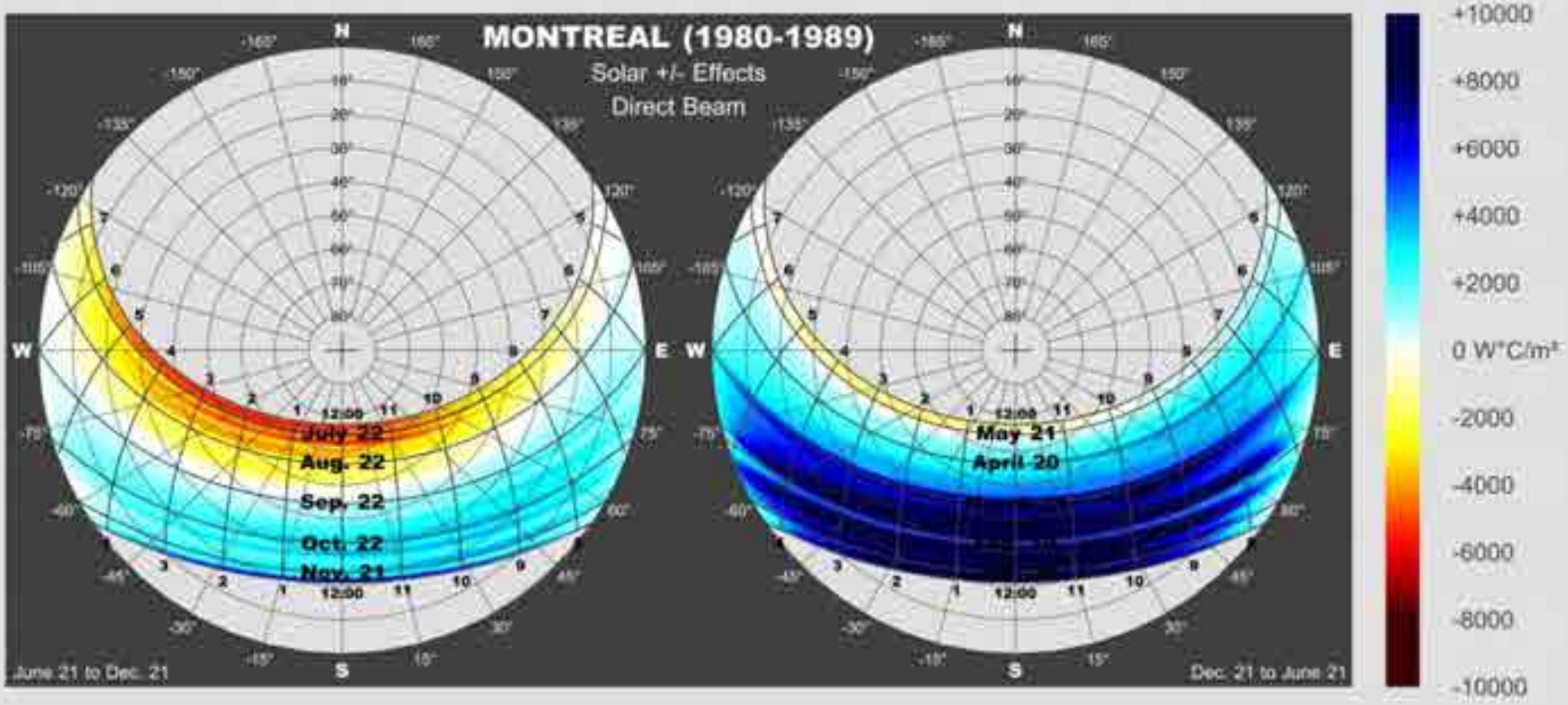

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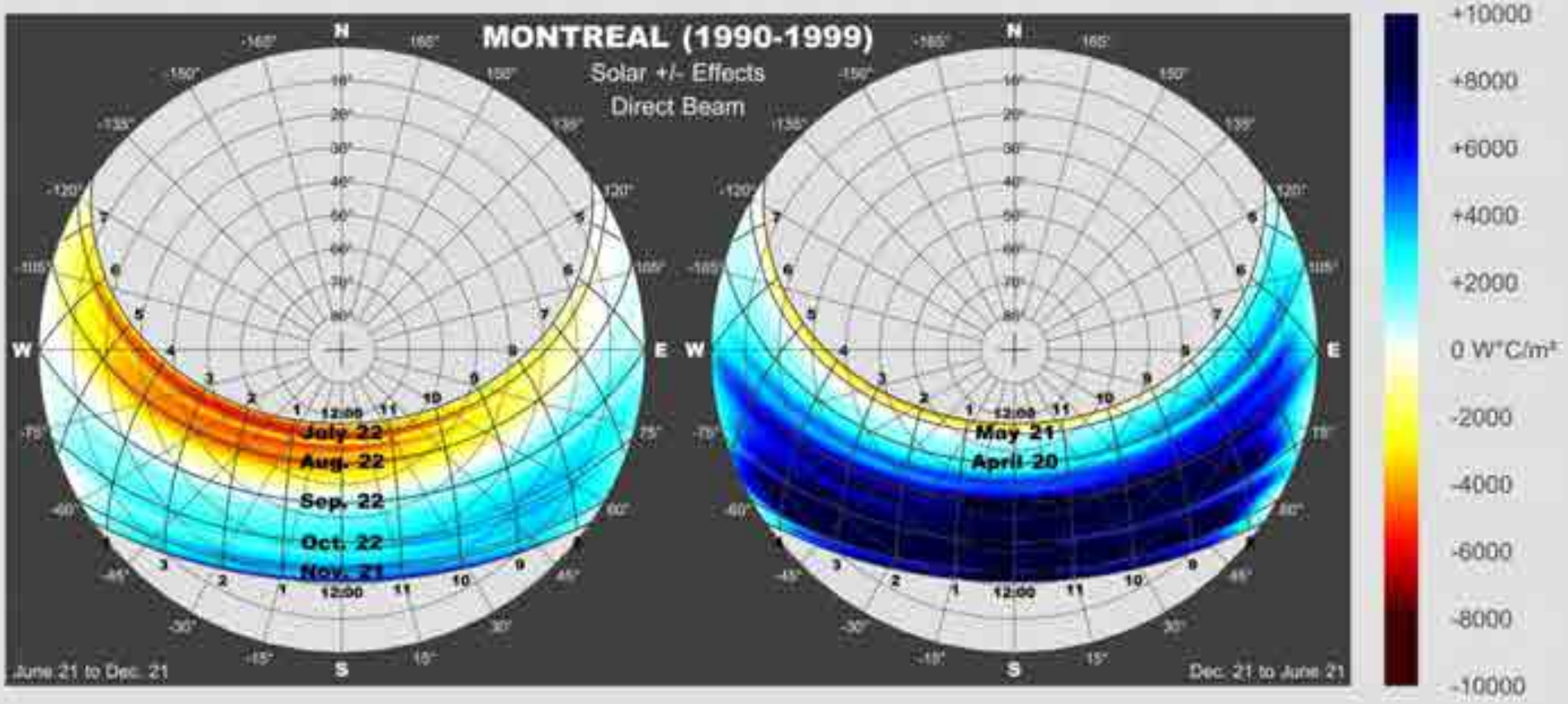

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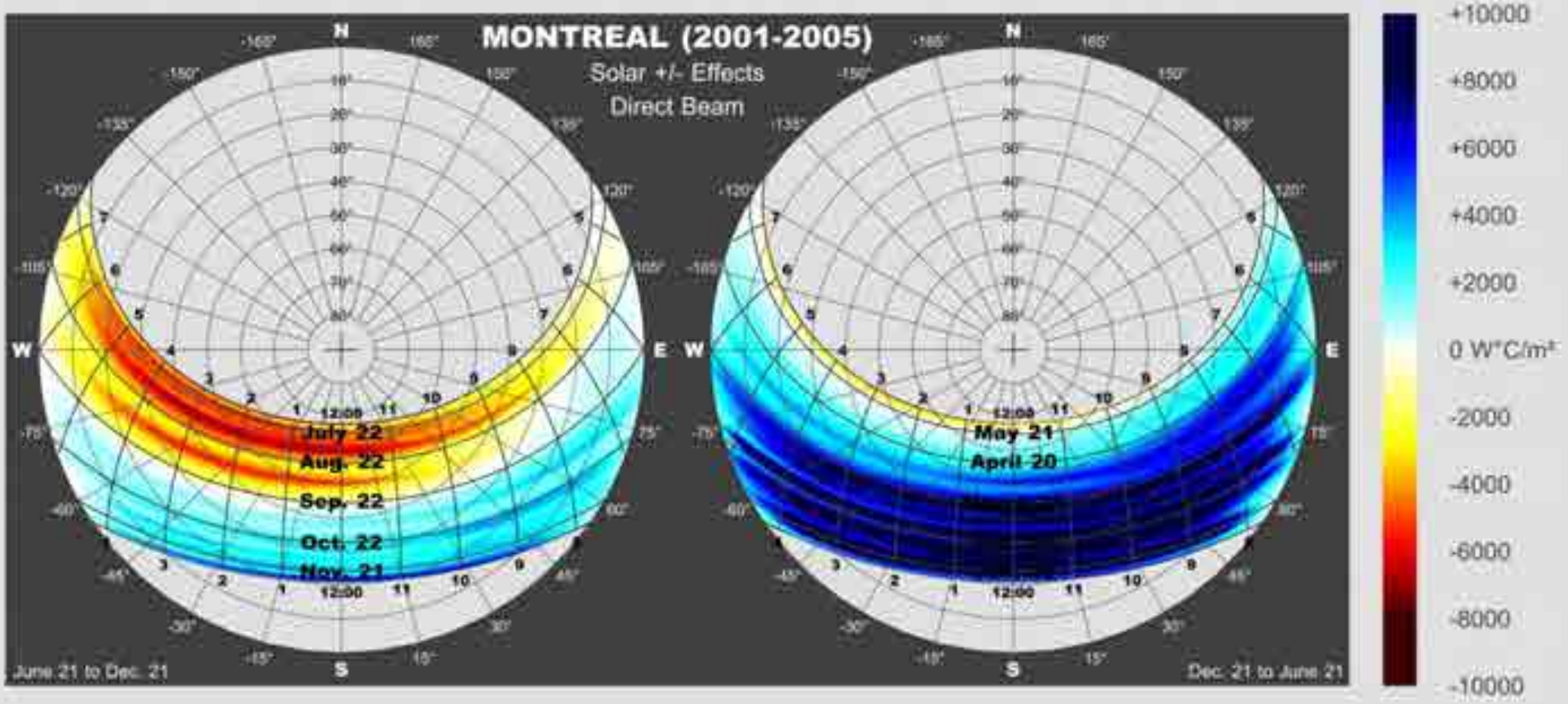
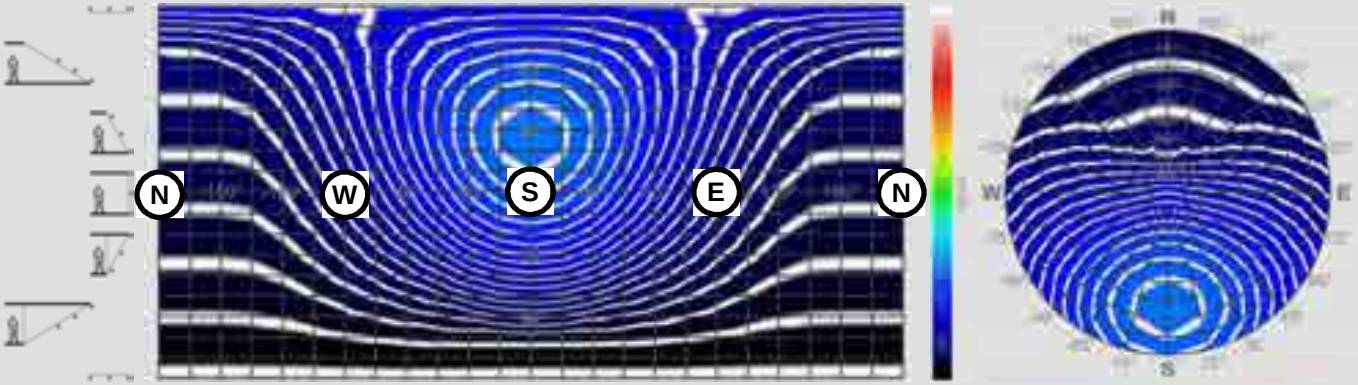
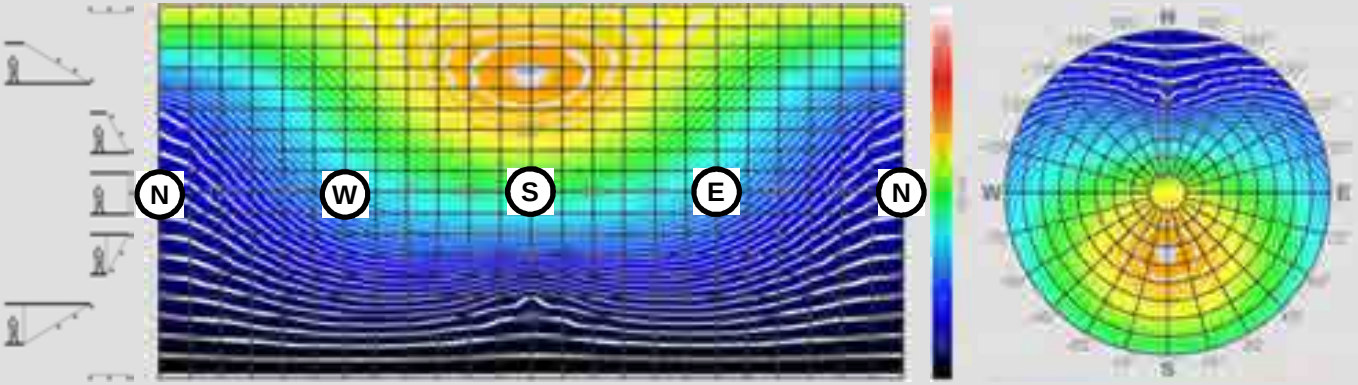


Montréal Total Daily Solar Radiation On Different Directions & Slopes

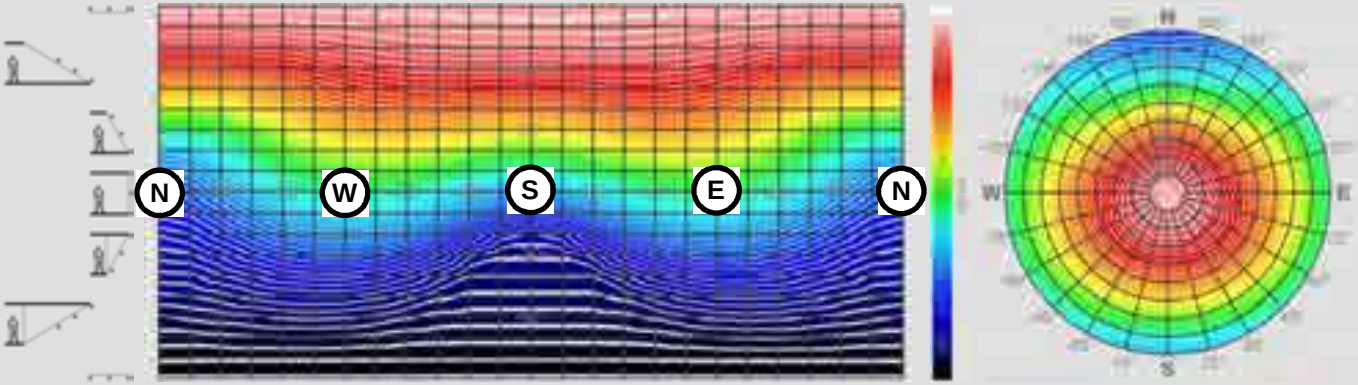
- December 21



- March 21

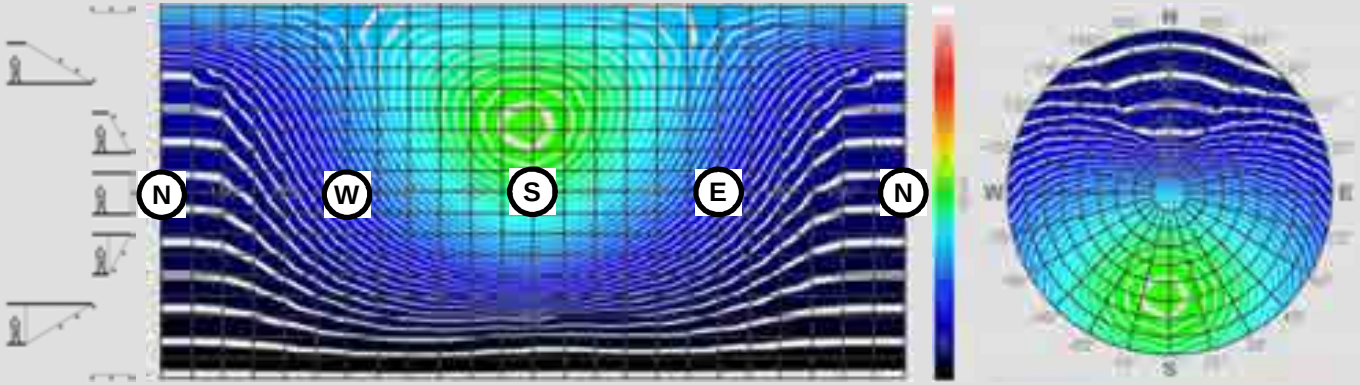


- June 21

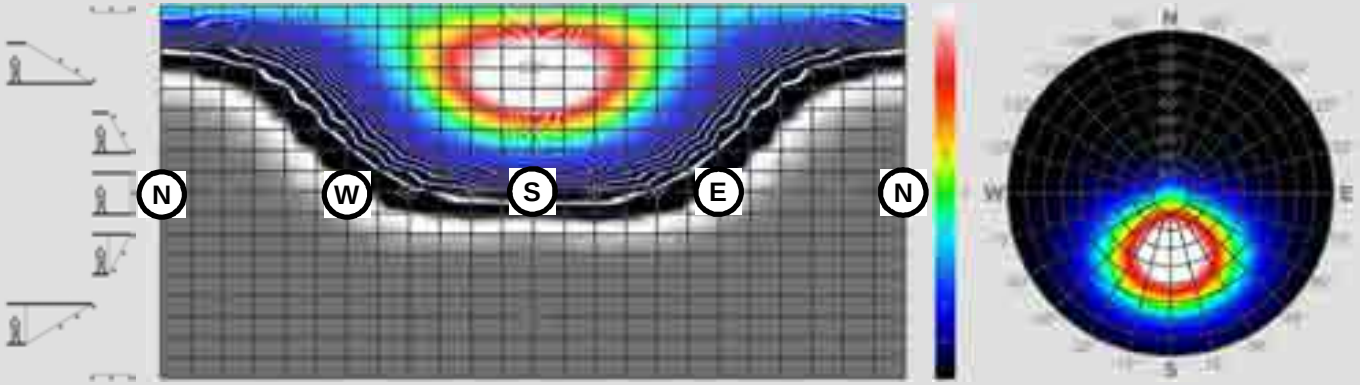


Montréal Yearly Diagrams for Different Directions & Slopes

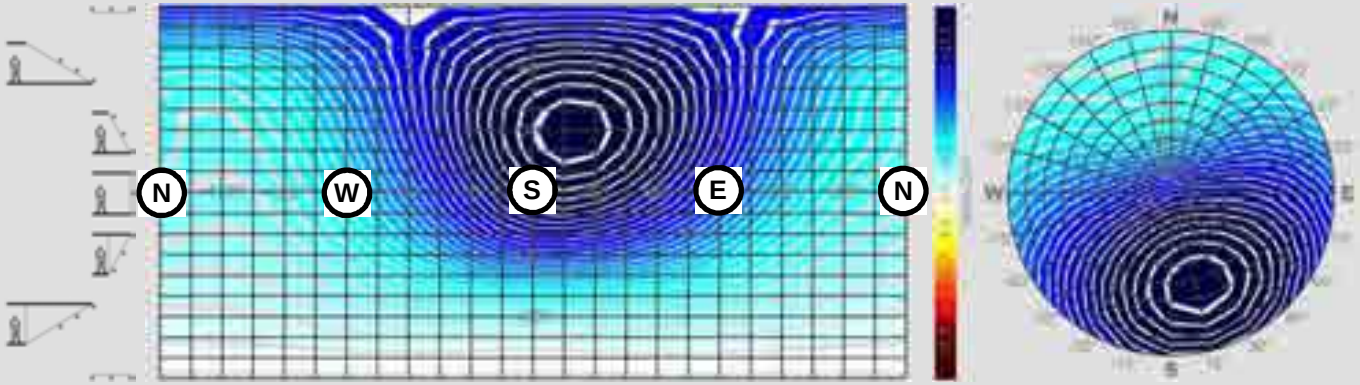
► Total
Solar Radiation



► Optimized
Active Analysis



► Optimized
Passive Analysis



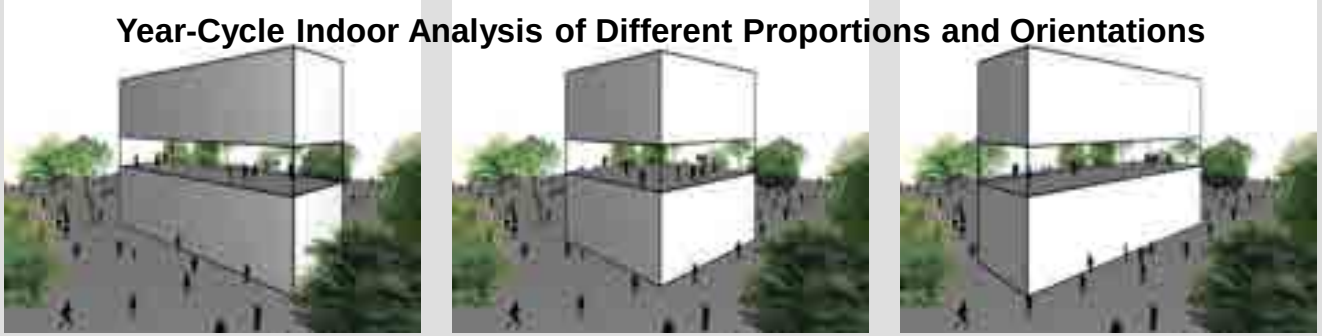
1. Solar-climatic Spatial Analysis for Montréal

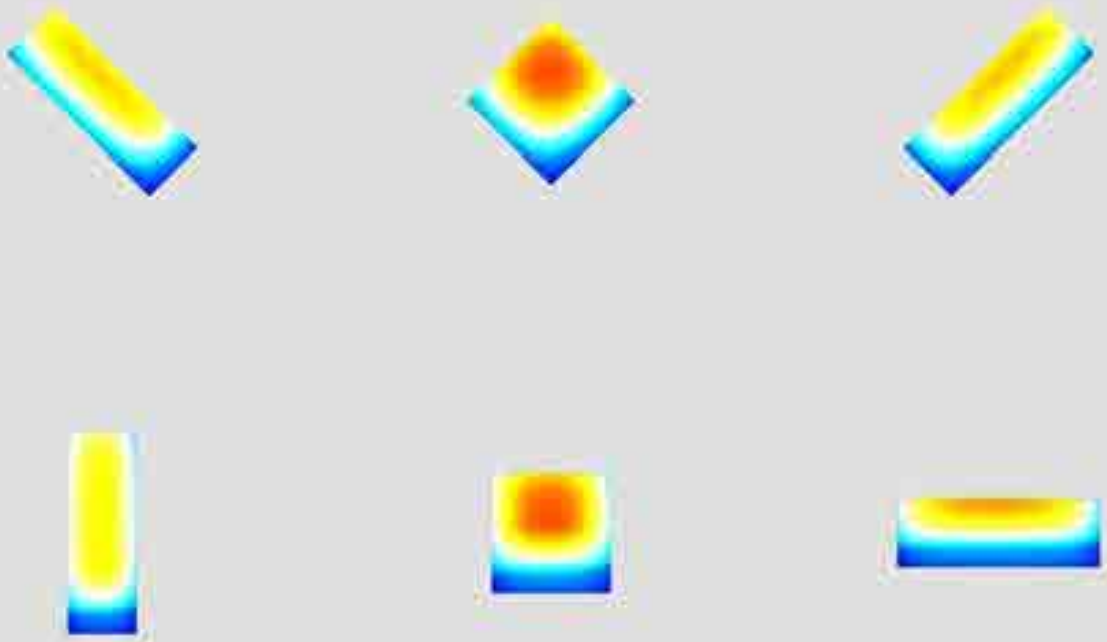
2. Montréal Case Studies

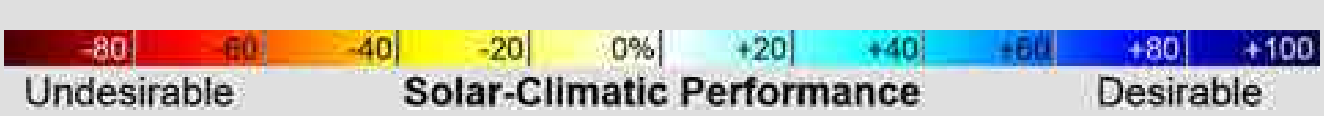
- ► Urban spaces: *Montréal Downtown (from Bell Center to Place-des-Arts).*
- ► Open spaces: *Mount Royal Chalet (Kondiaronk Belvedere).*
- ► Building spaces: *Fontaine School at Nuns' Island (OCPM open project).*

Montréal

Year-Cycle Indoor Analysis of Different Proportions and Orientations

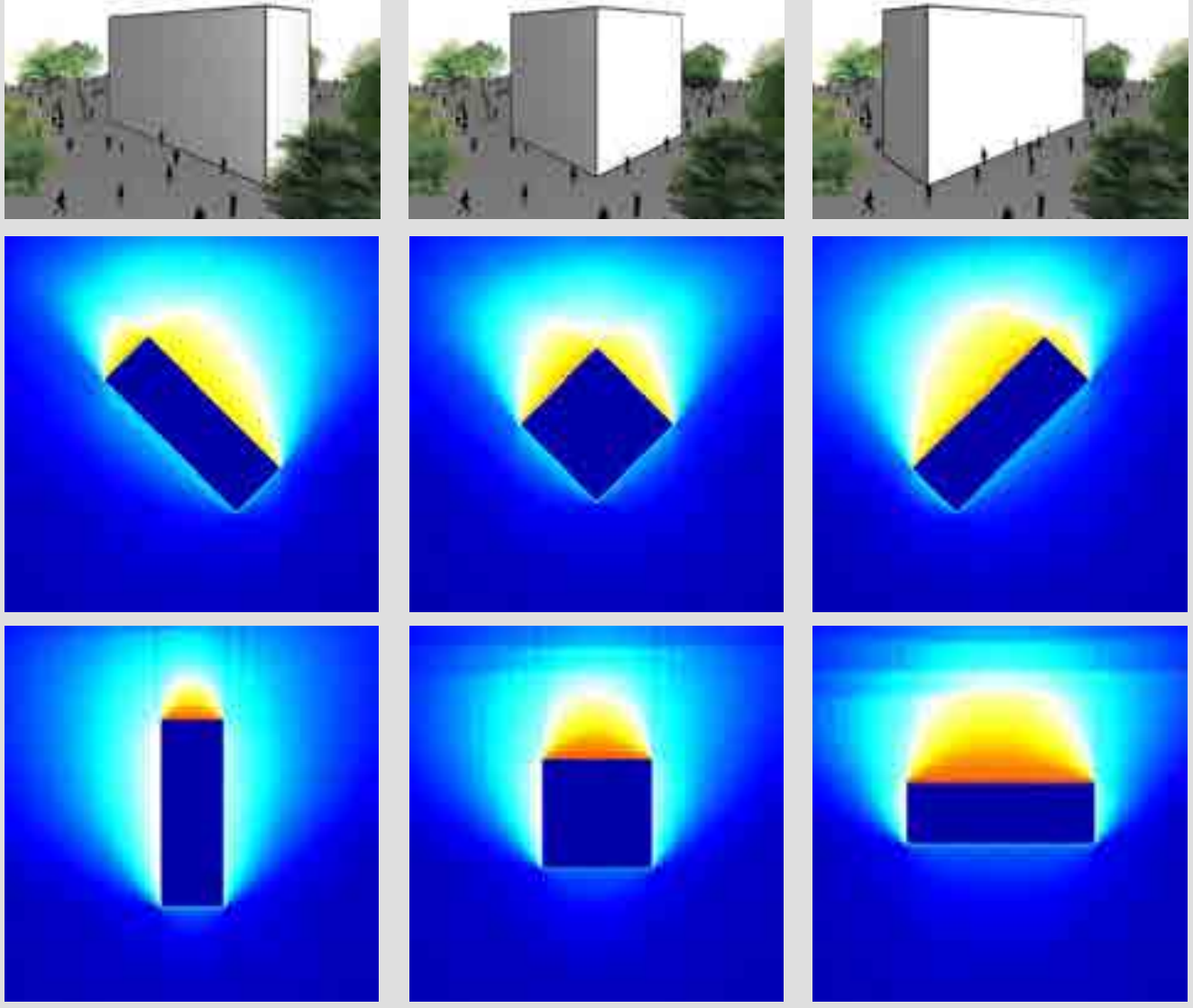






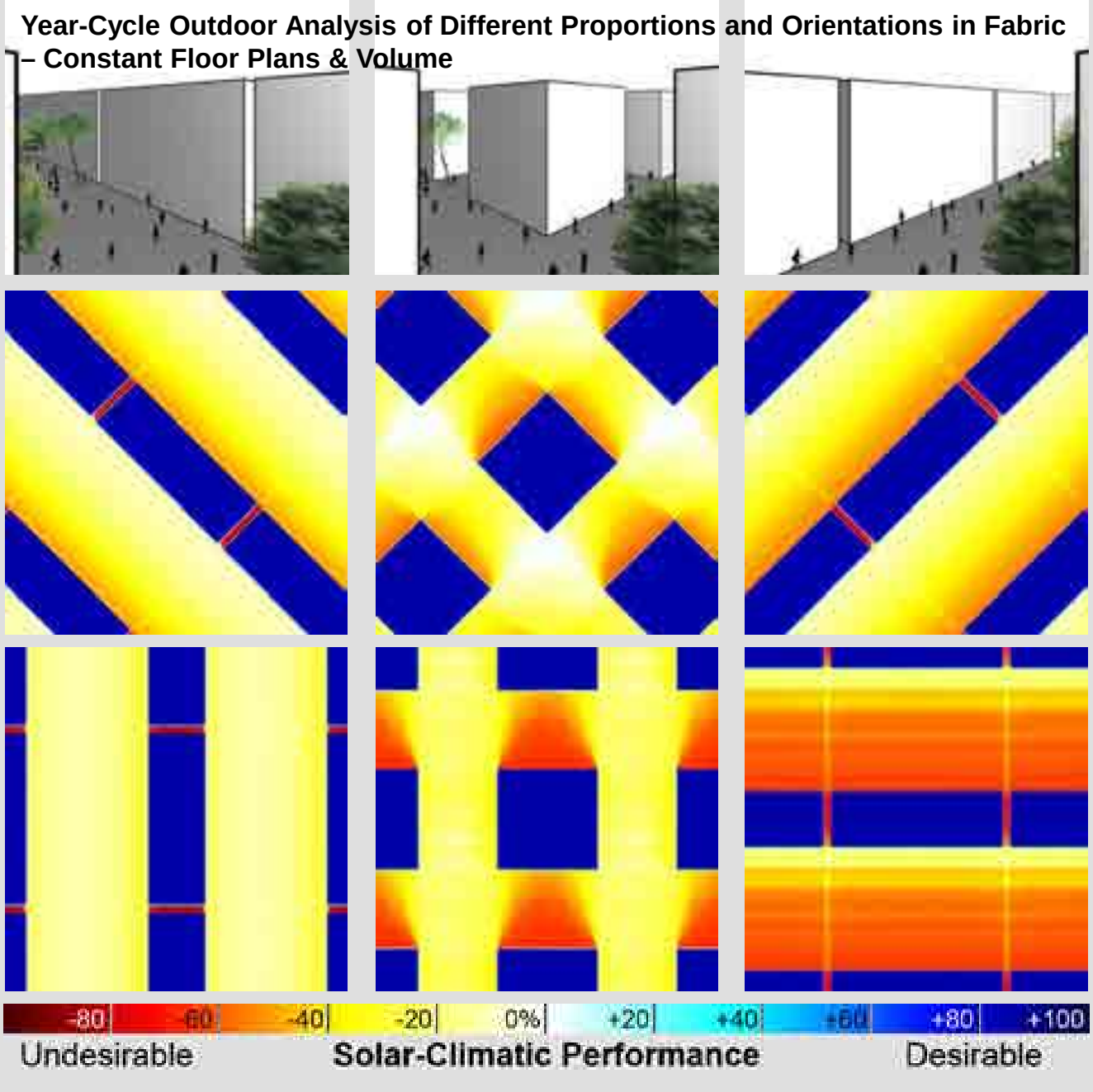
Montréal

Year-Cycle Outdoor Analysis of Different Proportions and Orientations – Constant Floor Plans & Volume



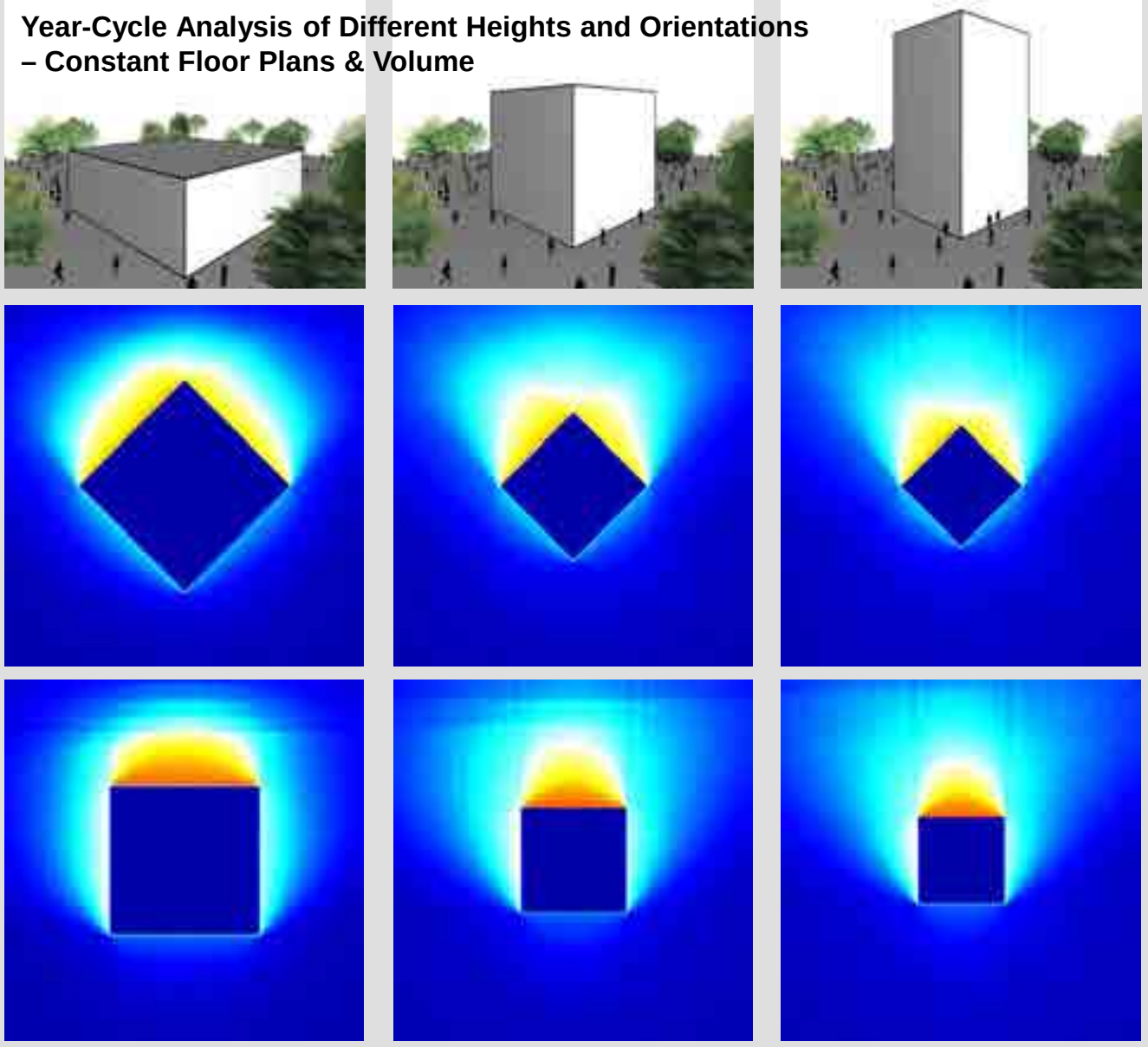
Montréal

Year-Cycle Outdoor Analysis of Different Proportions and Orientations in Fabric – Constant Floor Plans & Volume



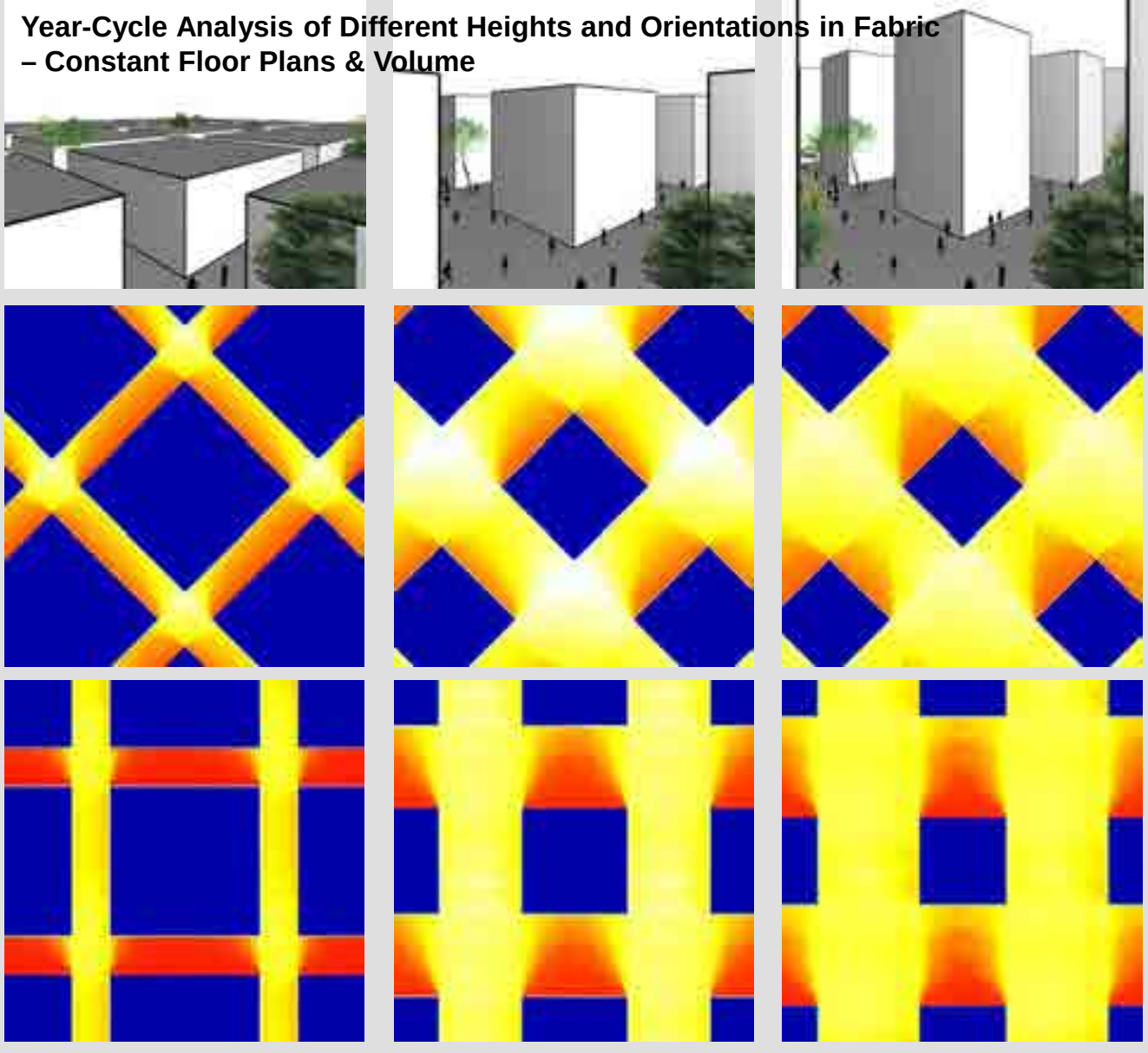
Montréal

Year-Cycle Analysis of Different Heights and Orientations – Constant Floor Plans & Volume



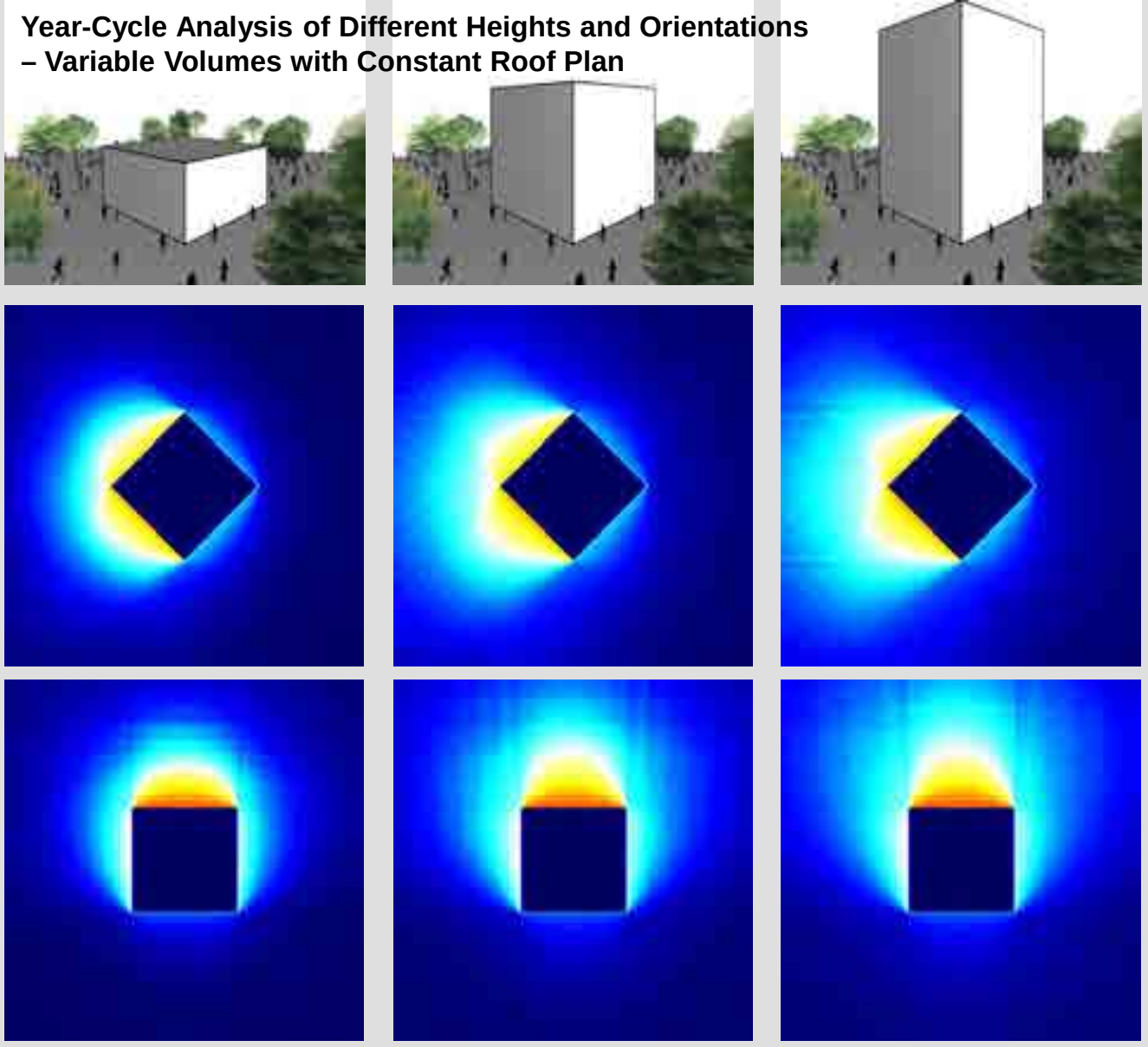
Montréal

Year-Cycle Analysis of Different Heights and Orientations in Fabric – Constant Floor Plans & Volume



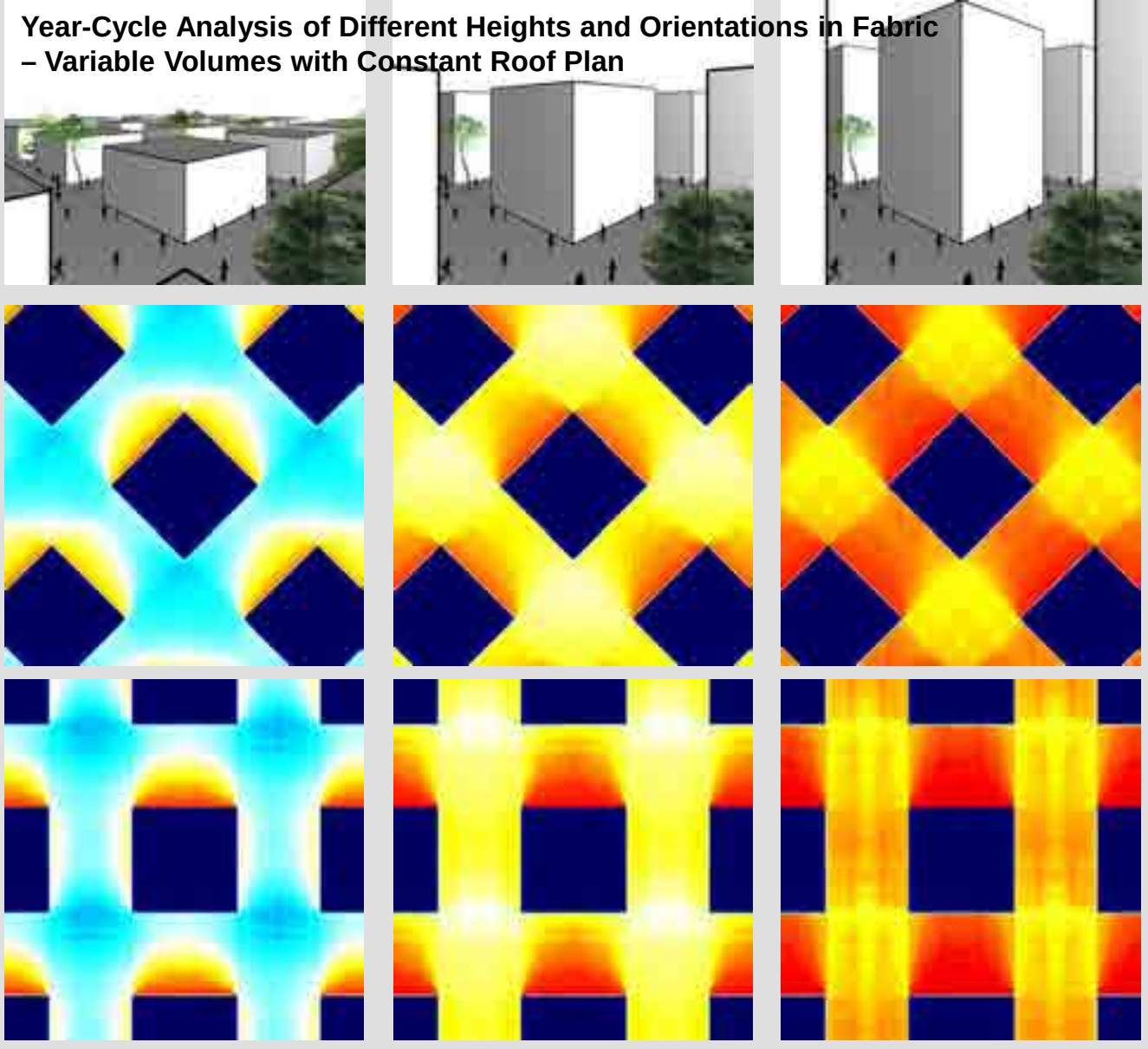
Montréal

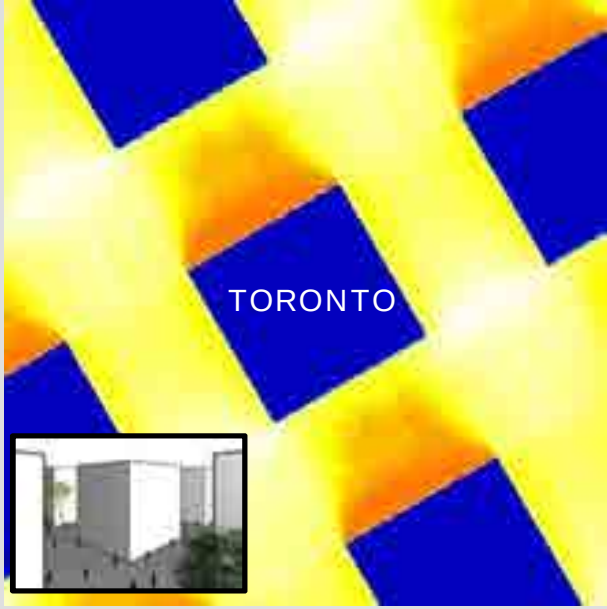
Year-Cycle Analysis of Different Heights and Orientations – Variable Volumes with Constant Roof Plan



Montréal

Year-Cycle Analysis of Different Heights and Orientations in Fabric – Variable Volumes with Constant Roof Plan



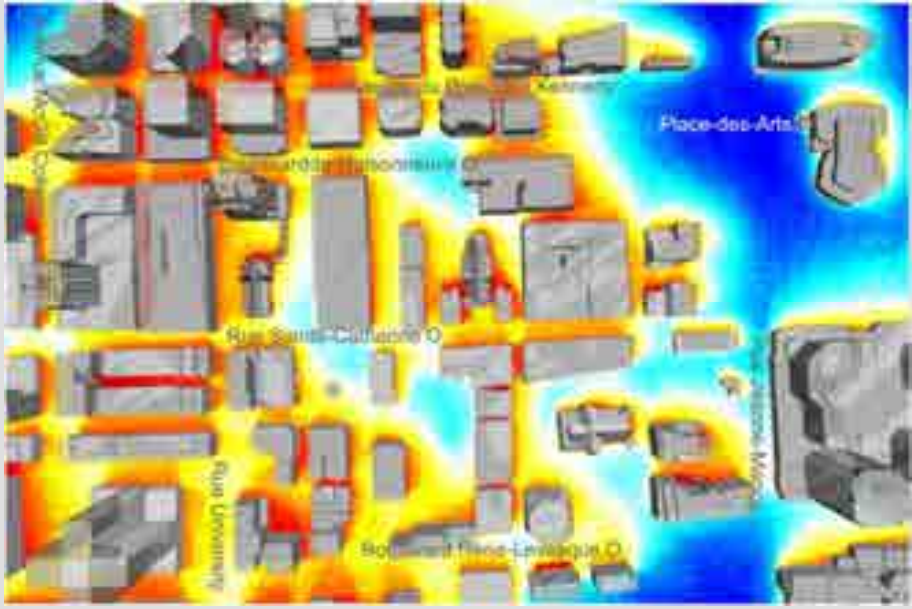


Comparison and Analysis of Different Urban Fabric the General Orientations in Toronto and Montréal Source: GoogleEarth

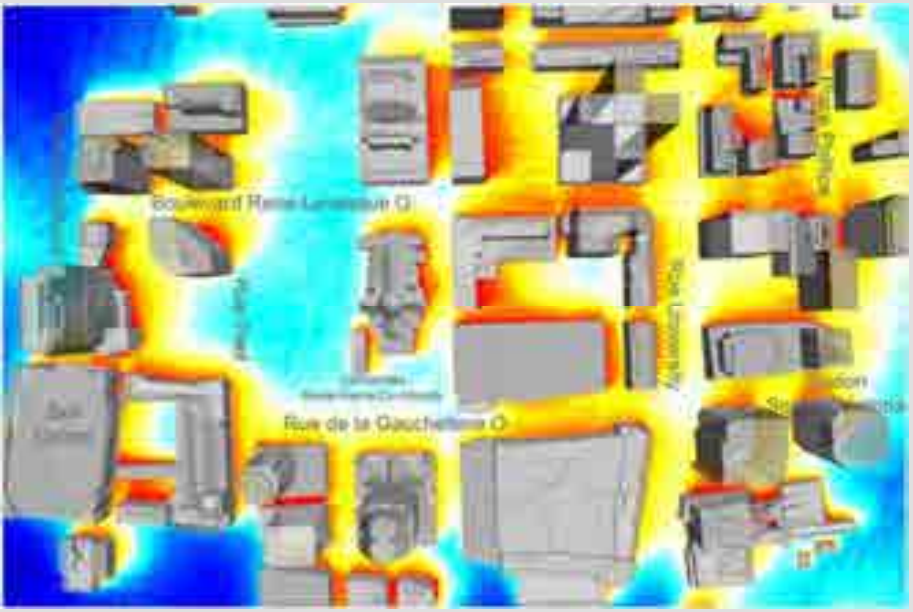

Avenue McGill College
Avenue du Président Kennedy
Place-des-Arts
Boulevard de Maisonneuve O.
Rue Sainte-Catherine O.
Rue Jeanne-Mance
Rue University
Boulevard René-Lévesque O.

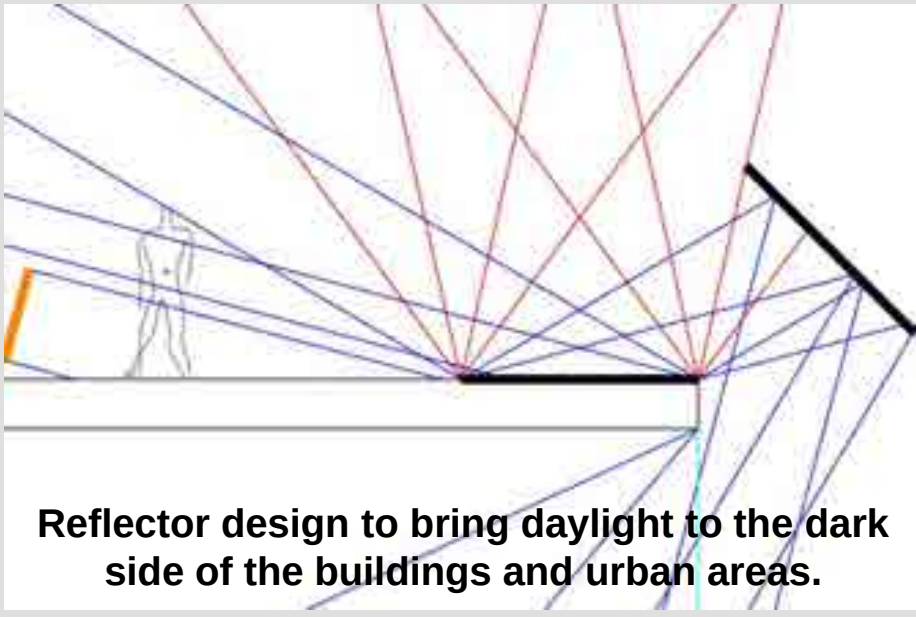

-80
-60
-40
-20
0%
+20
+40
+60
+80
+100
Undesirable
Solar-Climatic Performance
Desirable

Reflector design to increase performance of solar collectors and PVs (instaled almost vertical) to minimize snow and dust on the surface of the collector.

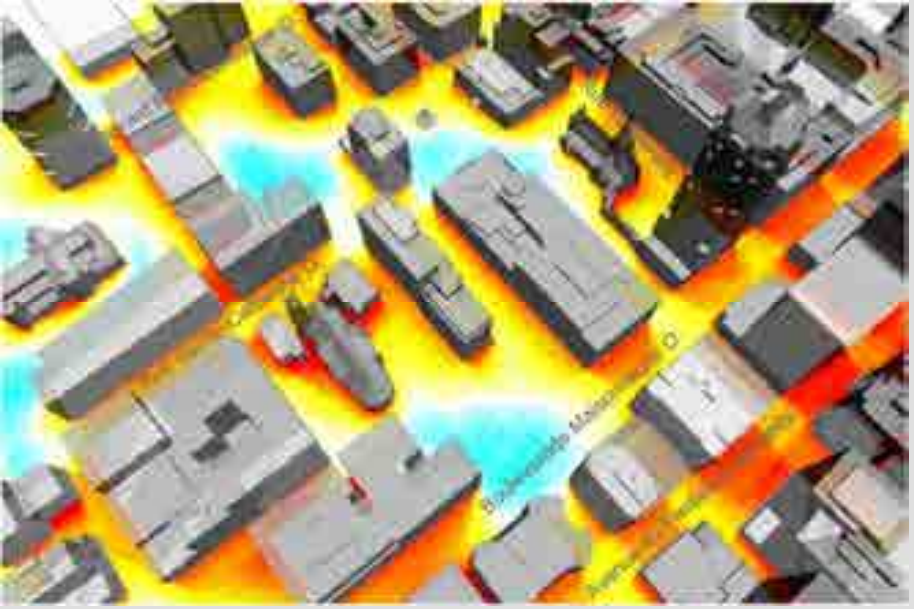


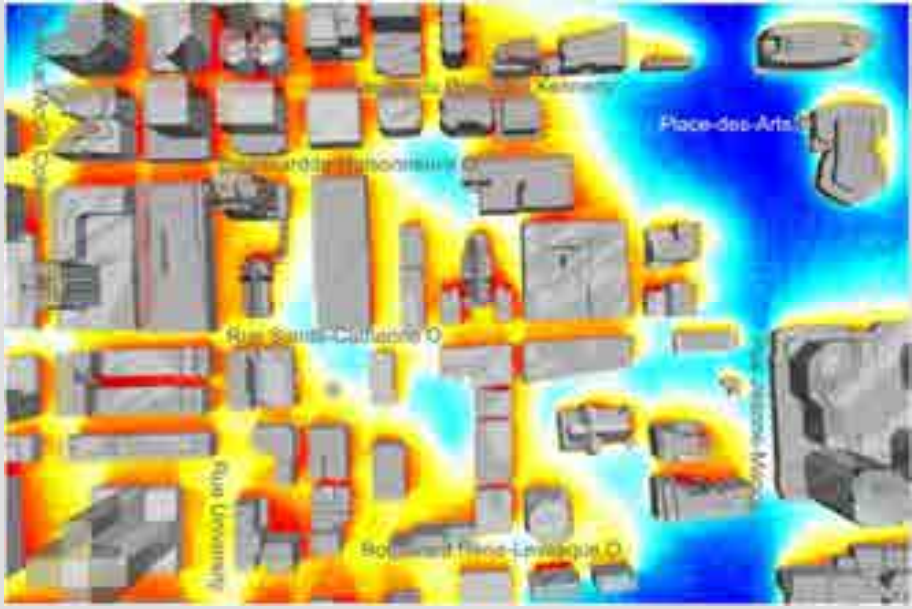
Year-Cycle Analysis



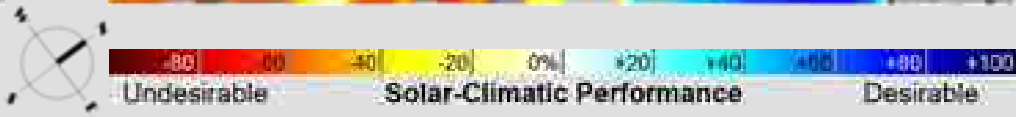


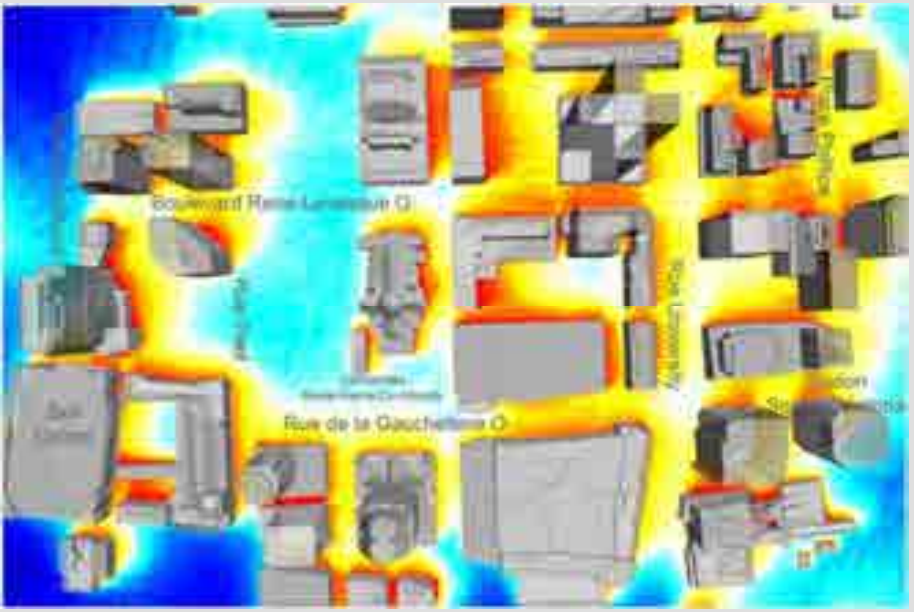
Reflector design to bring daylight to the dark side of the buildings and urban areas.

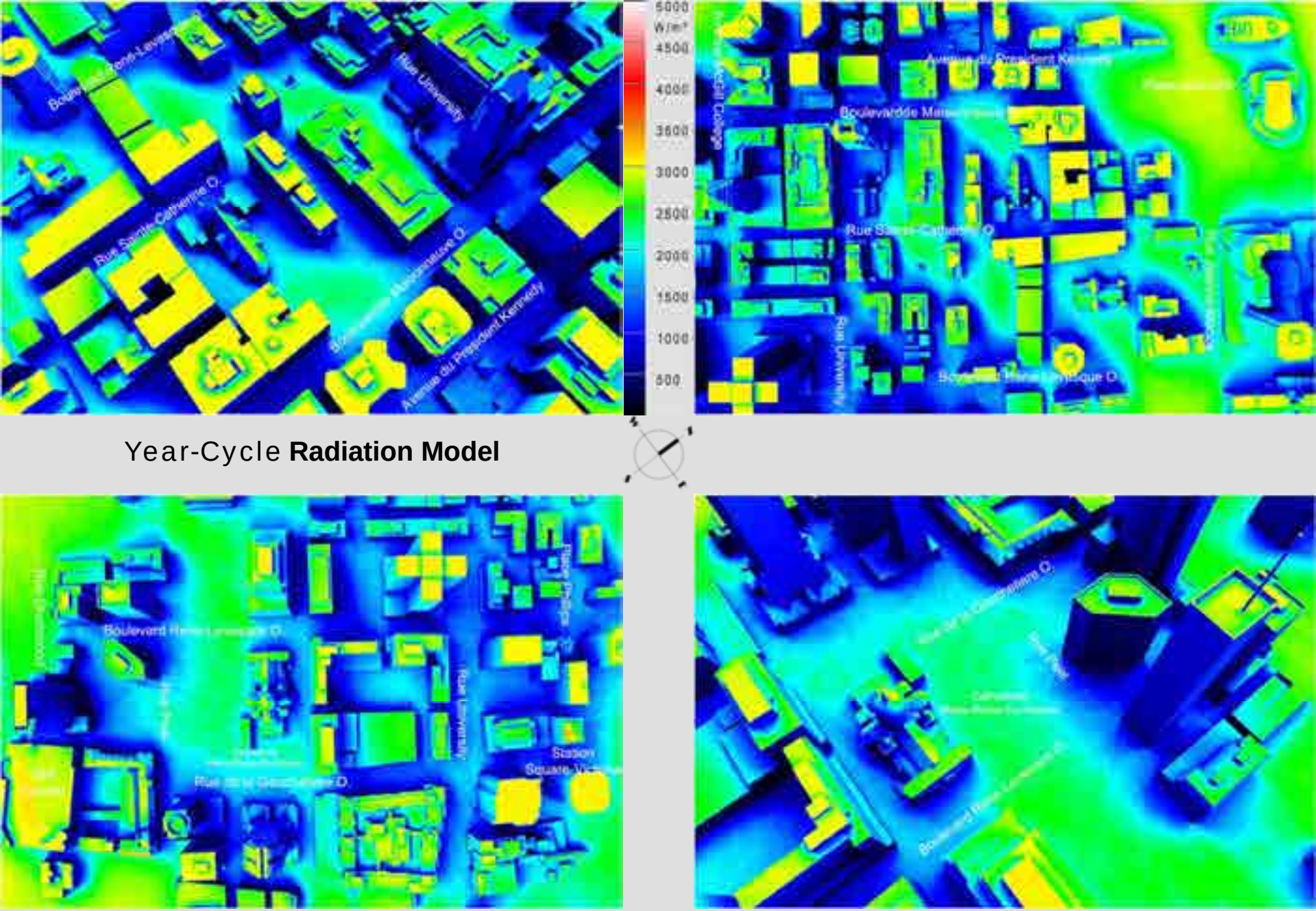




Year-Cycle Analysis

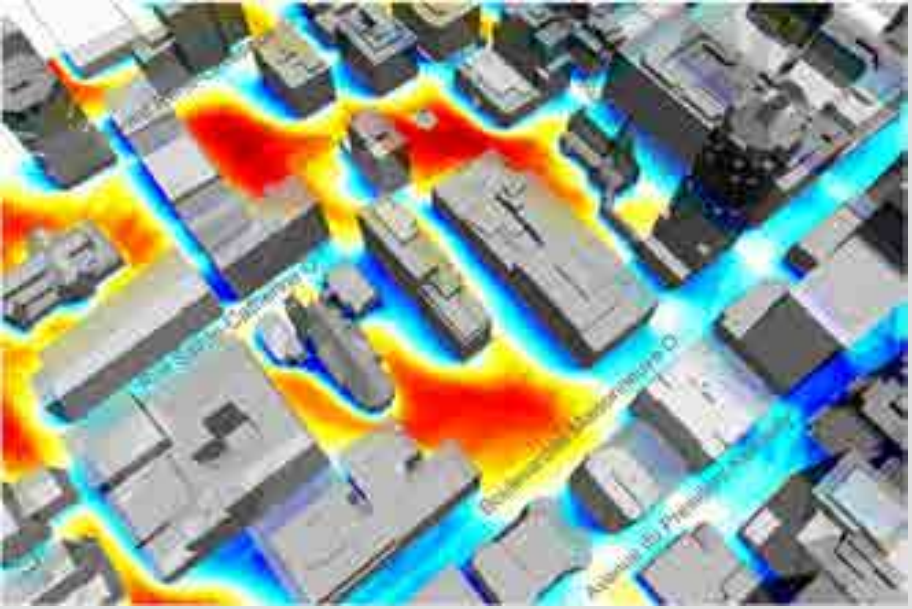


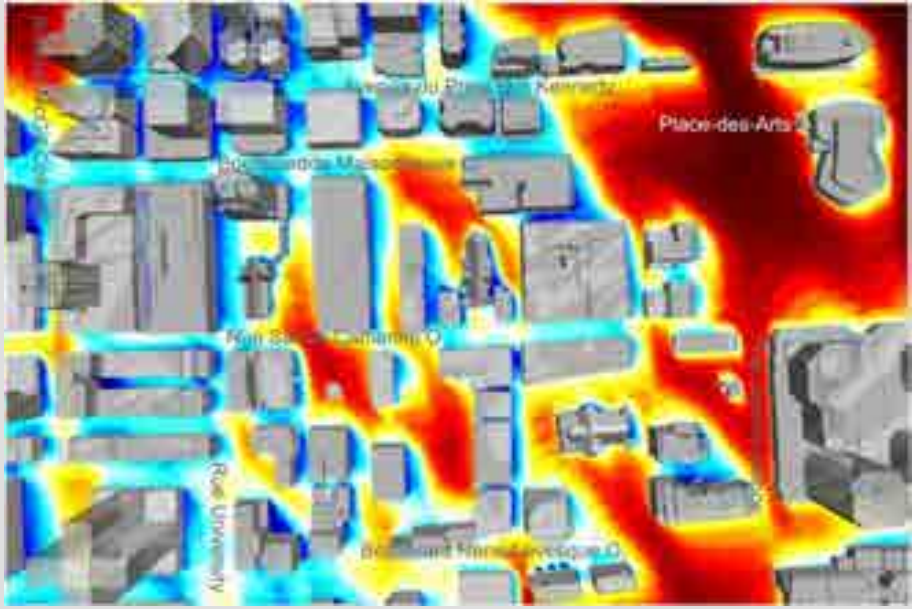




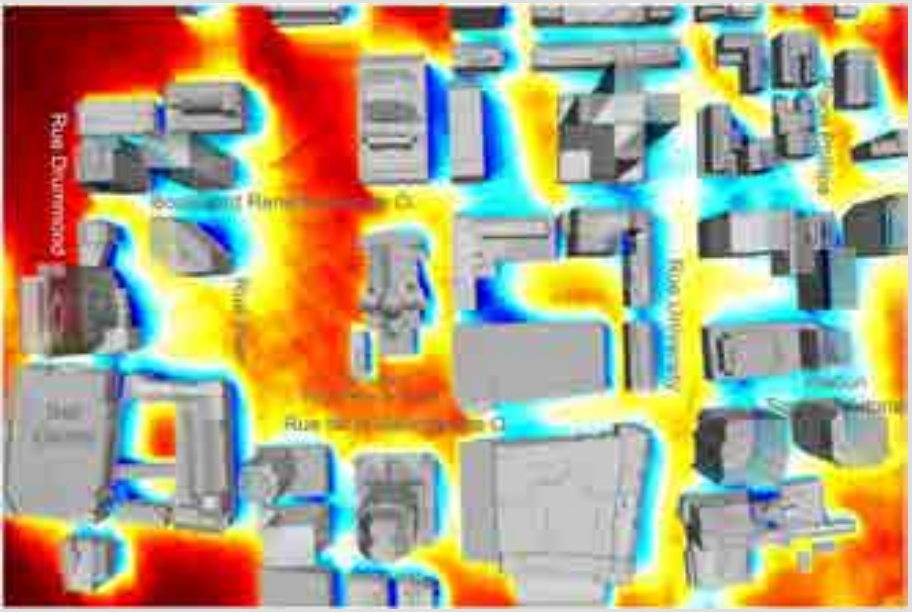
Year-Cycle **Radiation Model**

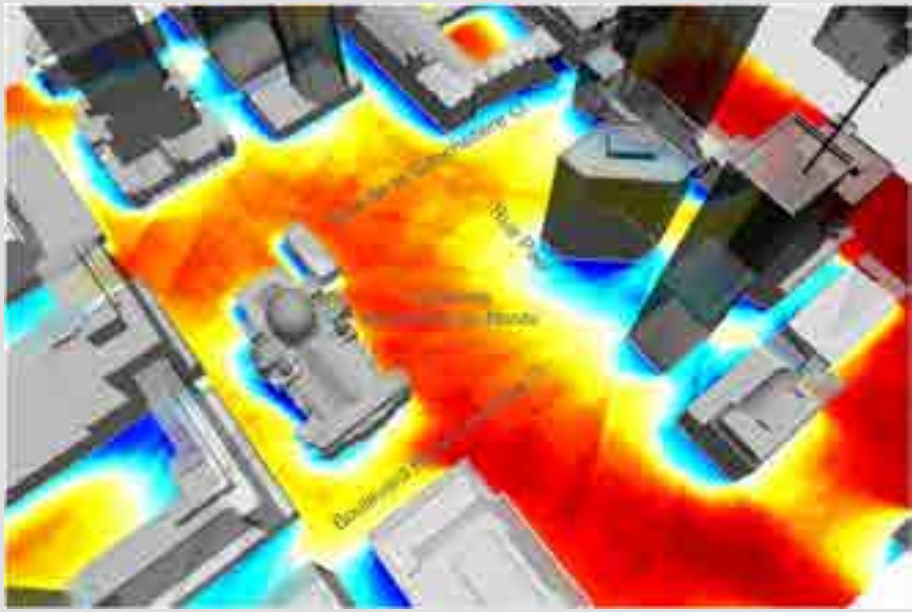
Summer **Radiation Model**

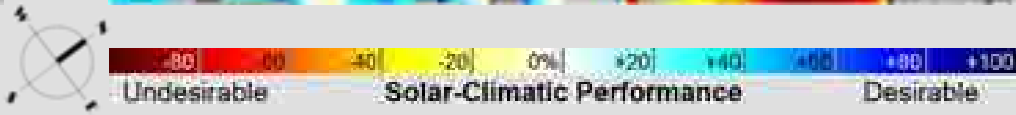




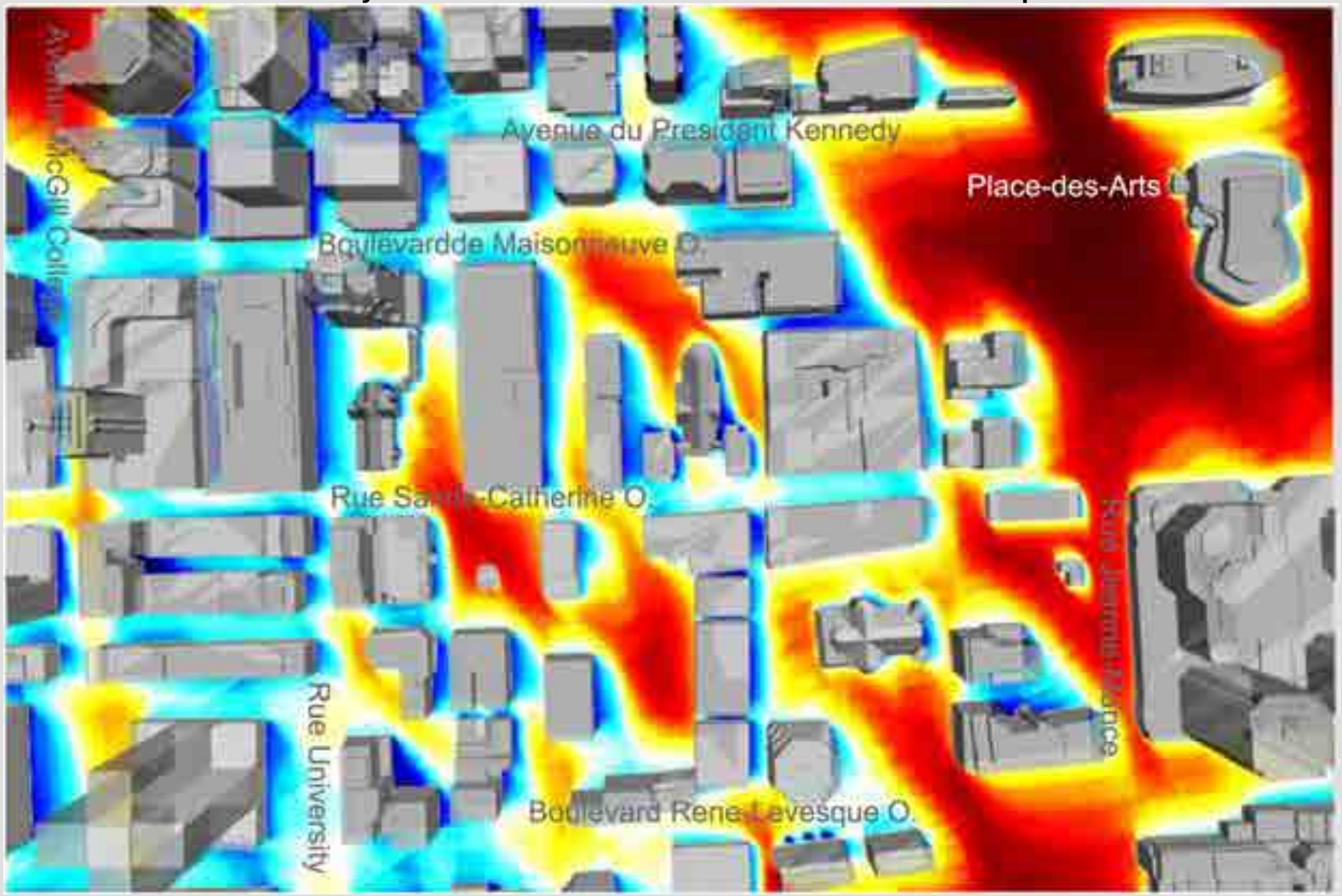
Summer **Analysis: from June 21 to Sep. 22**







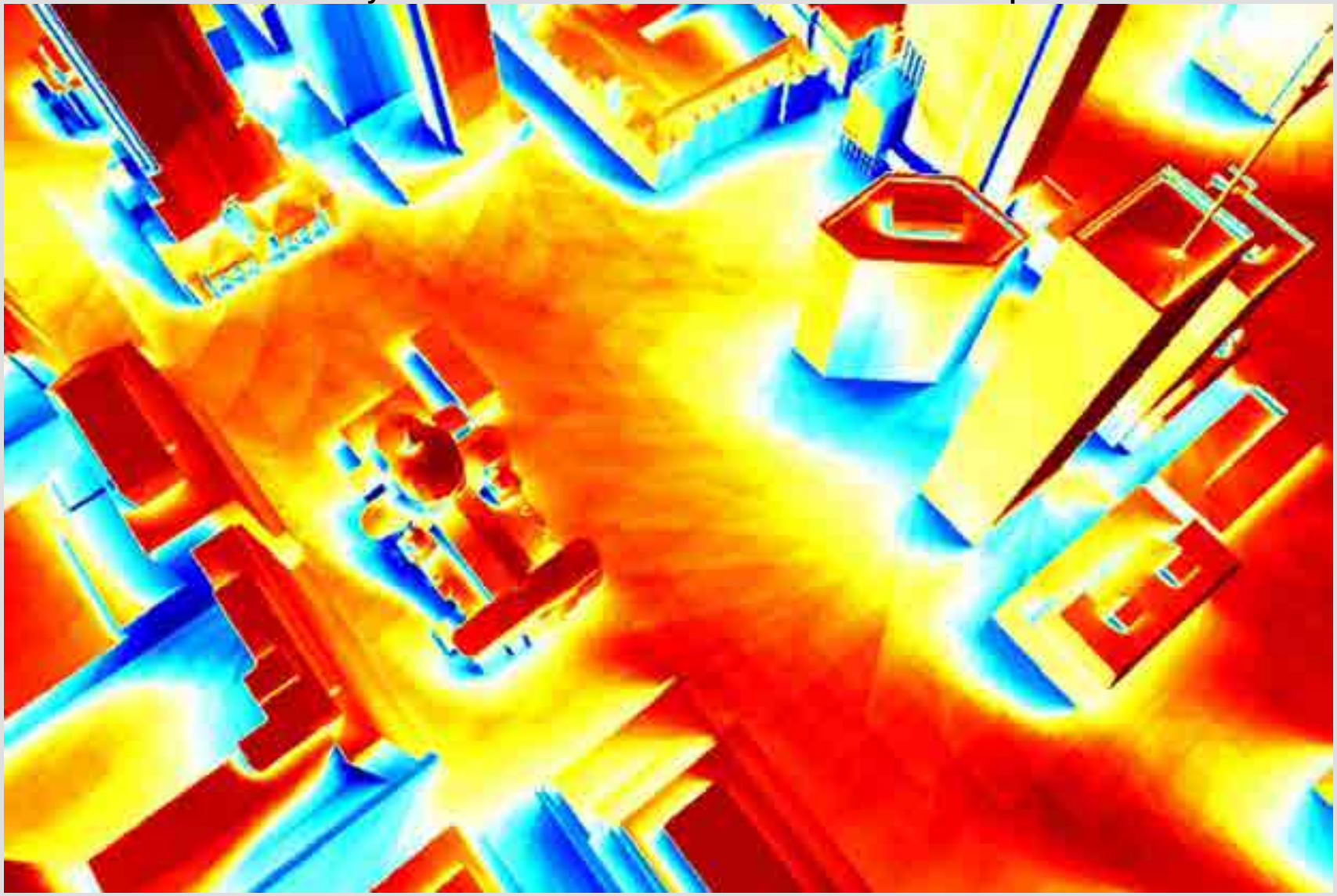
Summer **Analysis of Downtown Urban Fabric: : from June 21 to September 22**



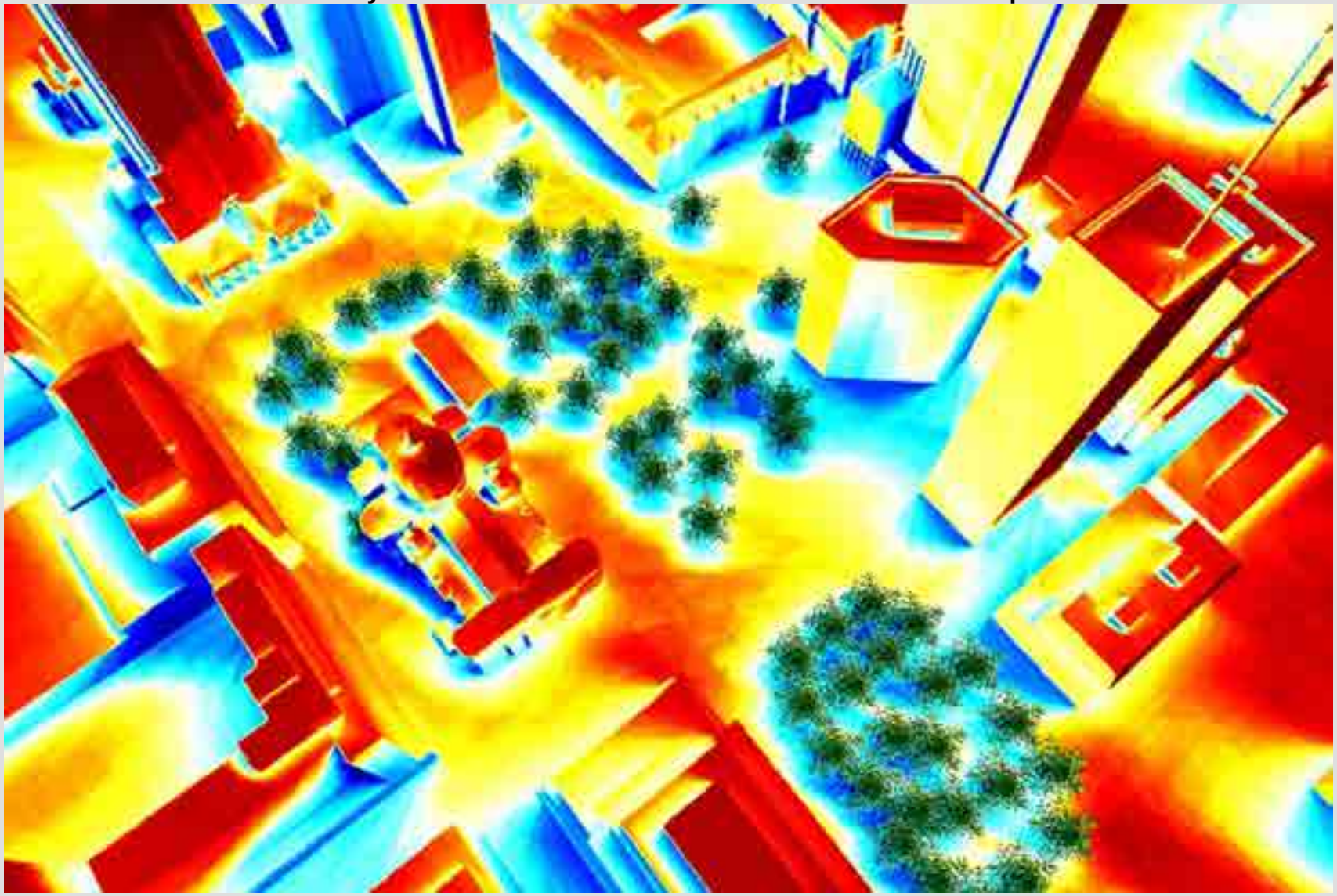
-80 -60 -40 -20 0% +20 +40 +60 +80 +100

Undesirable **Solar-Climatic Performance** Desirable

Summer **Analysis of Downtown Urban Fabric: from June 21 to September 22**



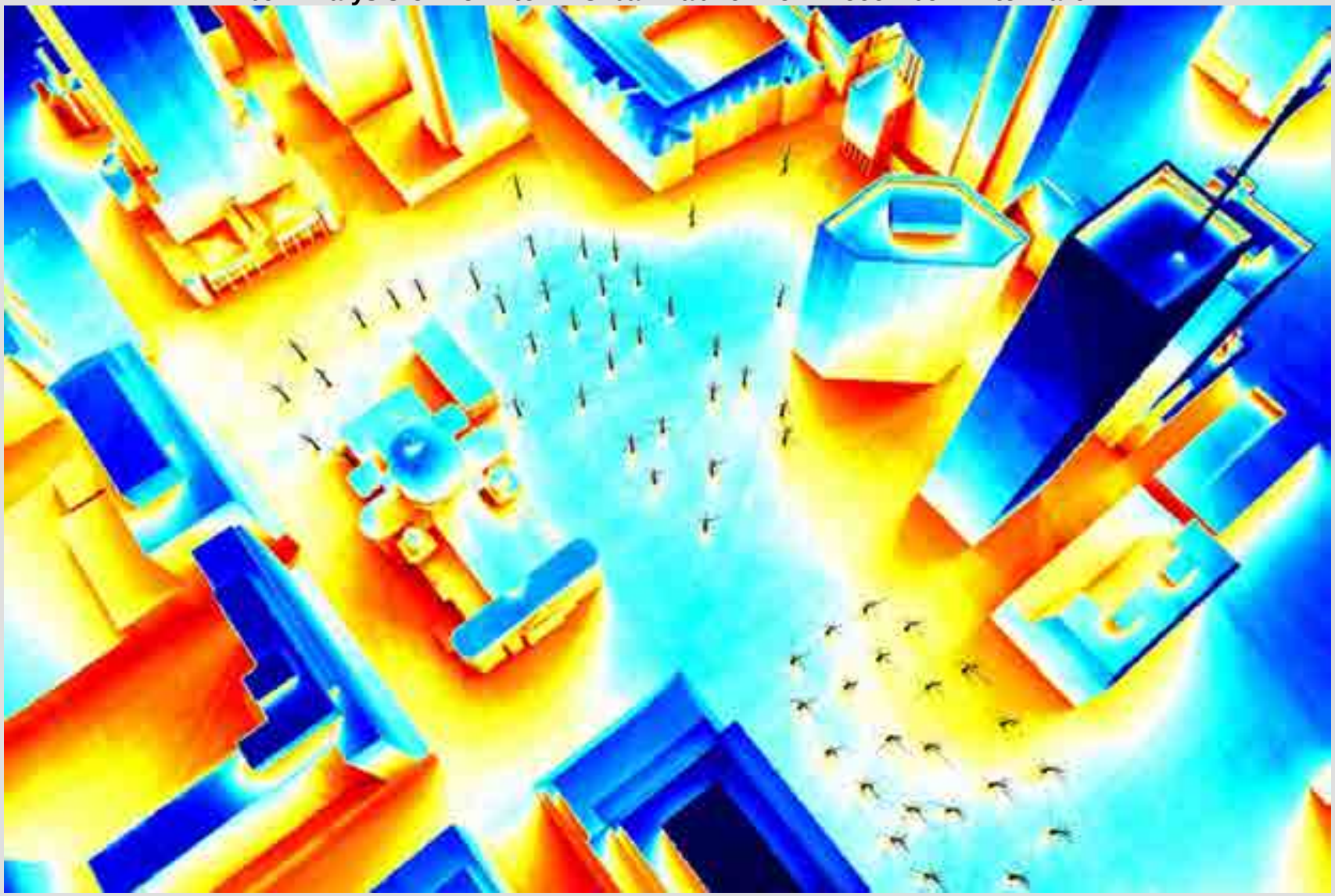
Summer **Analysis of Downtown Urban Fabric: from June 21 to September 22**



-80 -60 -40 -20 0% +20 +40 +60 +80 +100

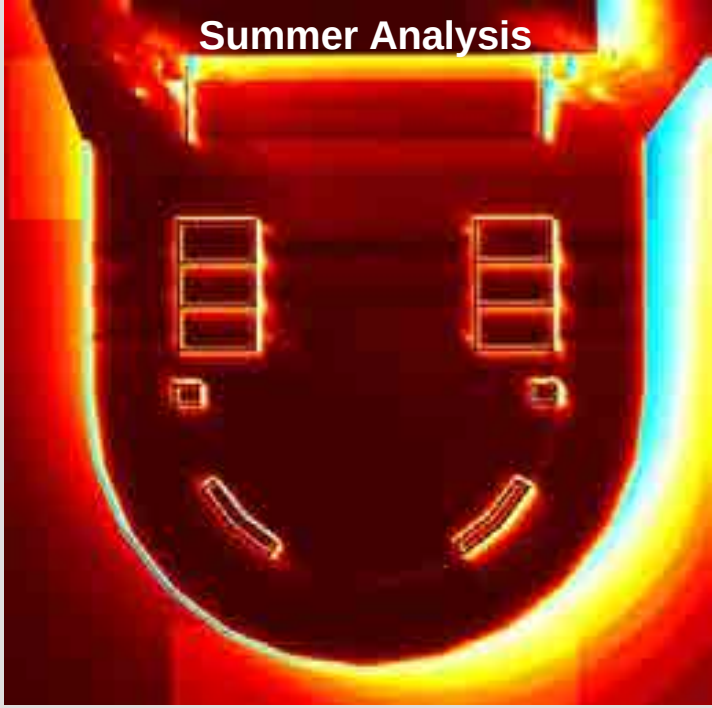
Undesirable **Solar-Climatic Performance** Desirable

Winter **Analysis of Downtown Urban Fabric: from December 21 to March 21**



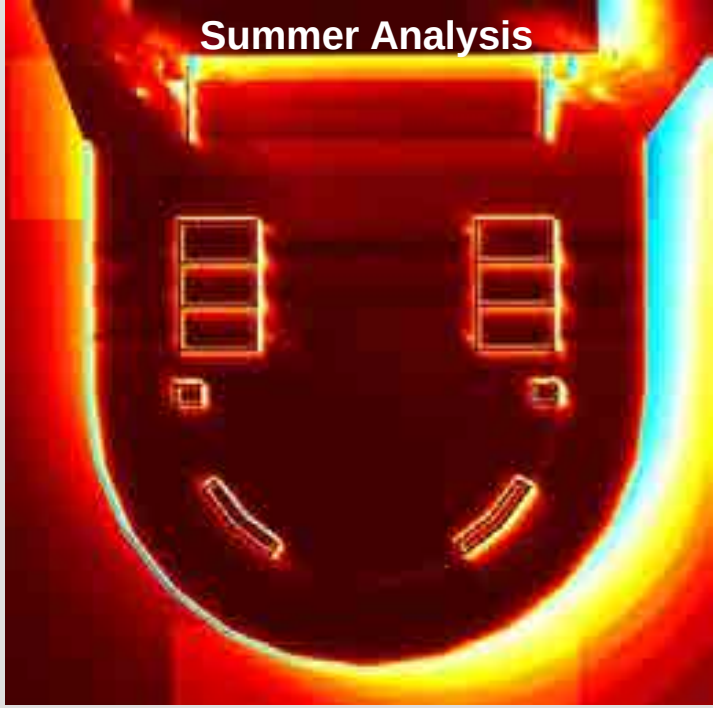
Mount Royal Chalet

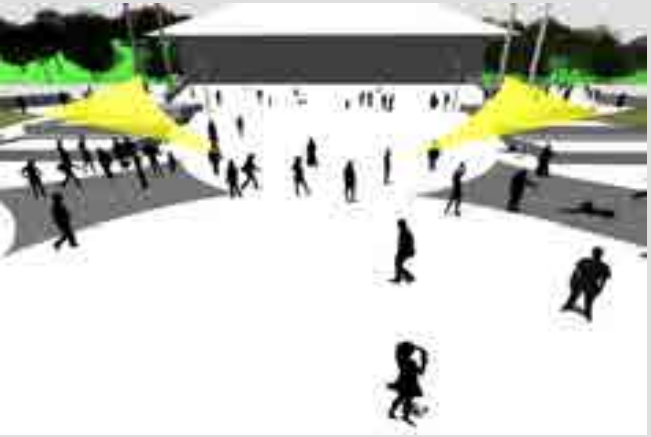
Image source: maps.google.ca

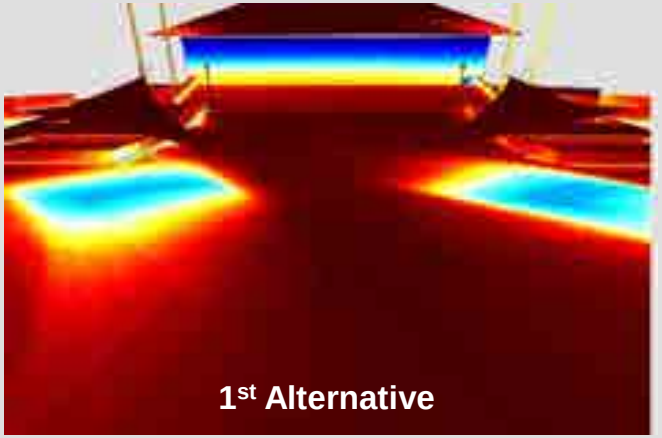


Mount Royal Chalet

Image source: maps.google.ca

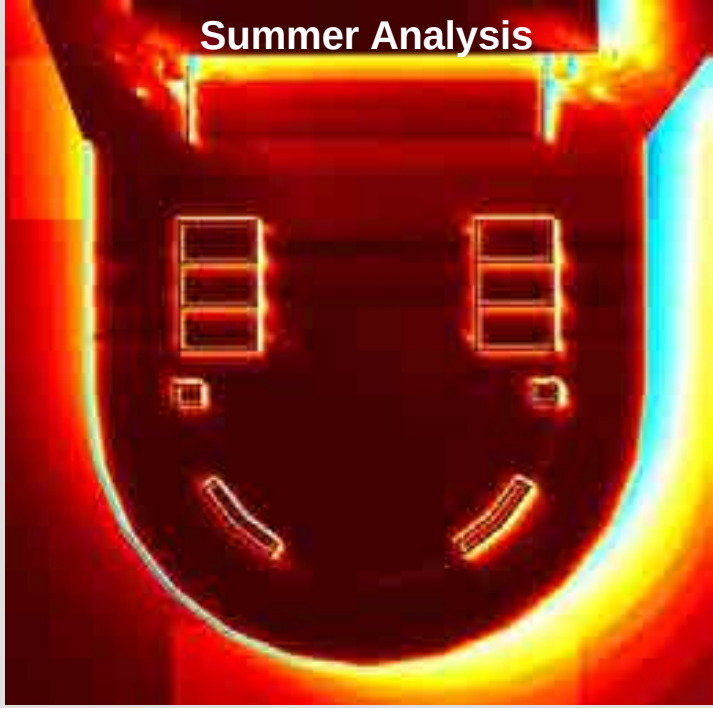


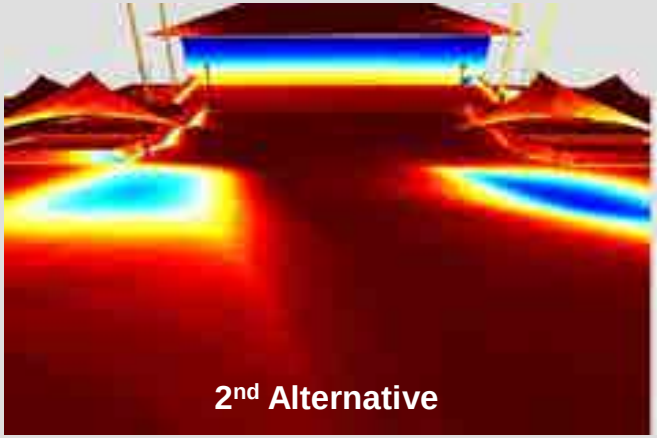


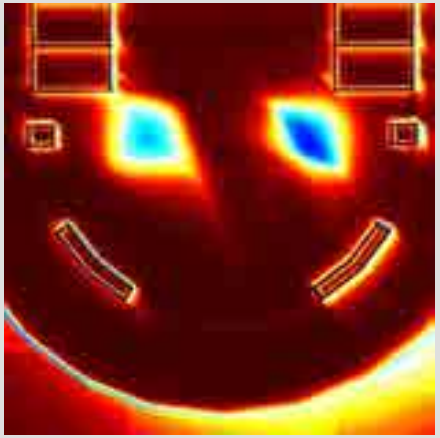


Mount Royal Chalet

Image source: maps.google.ca





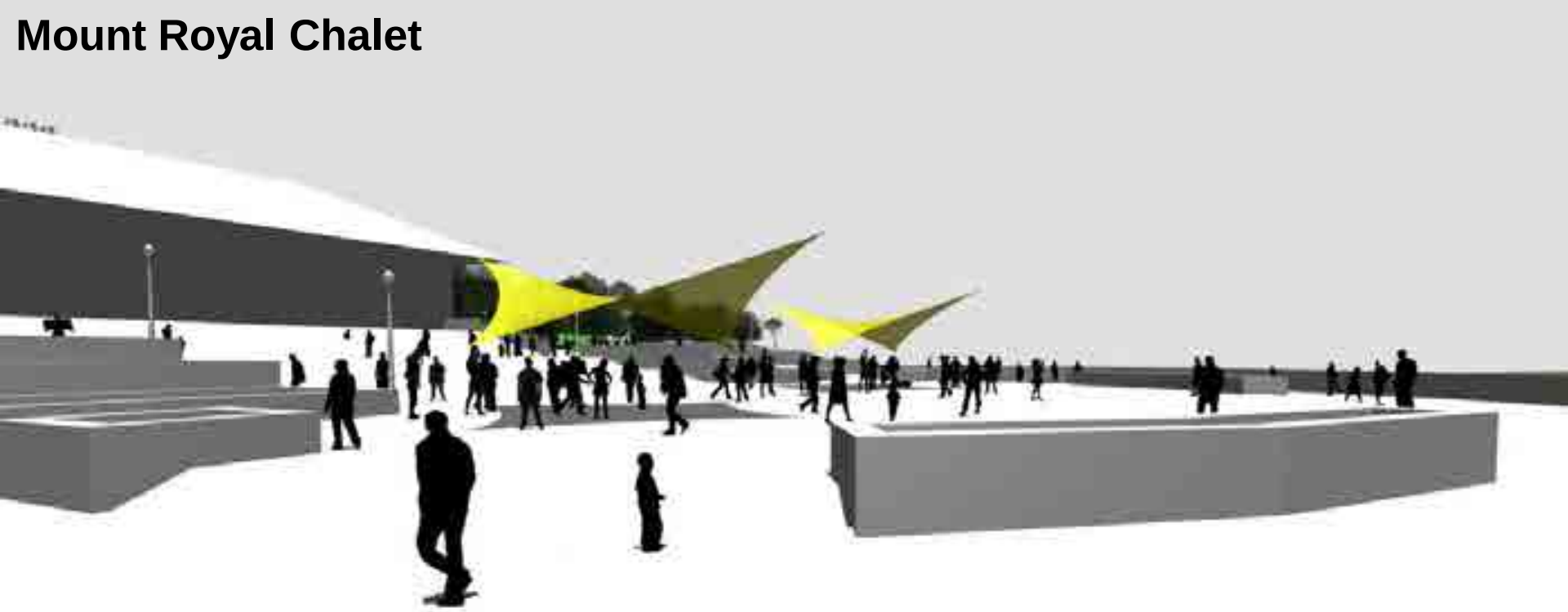


Mount Royal Chalet

Tensile structures can protect the visitors from the rain and the snow in several months of the year. In winter they also let desirable sun rays hit the ground. On the other side, in summer they protect visitors from the undesirable solar radiation during the day. Moreover attractive dynamic perspectives would be created from different points of the site and the city during the day and night.

2nd Alternative

Mount Royal Chalet



Tensile structures can protect the visitors from the rain and the snow in several months of the year. In winter they also let desirable sun rays hit the ground. On the other side, in summer they protect visitors from the undesirable solar radiation during the day. Moreover attractive dynamic perspectives would be created from different points of the site and the city during the day and night.

View from Mount Royal Chalet

1st Alternative

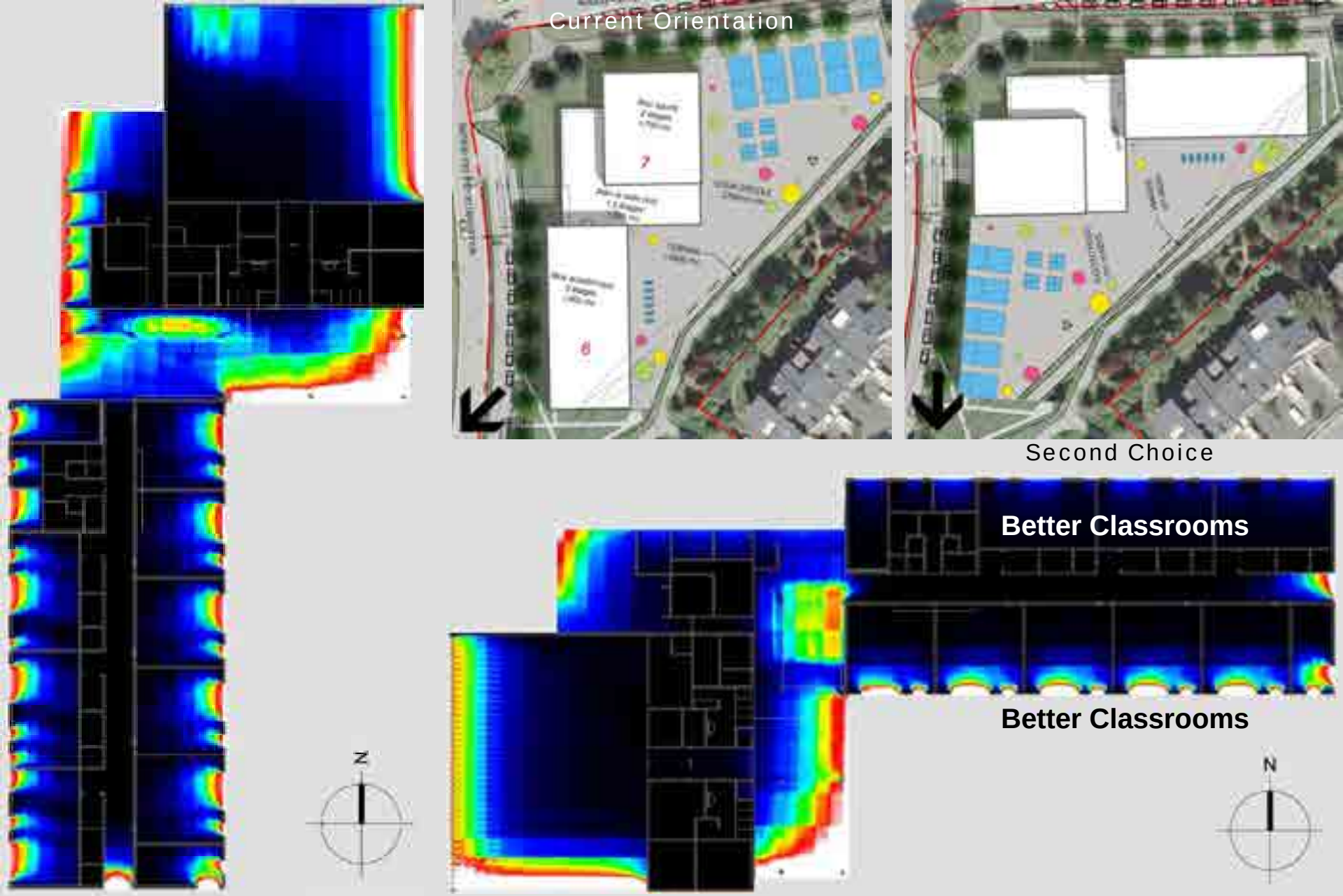
2nd Alternative

Fontaine School at Nuns' Island (OCPM open project).

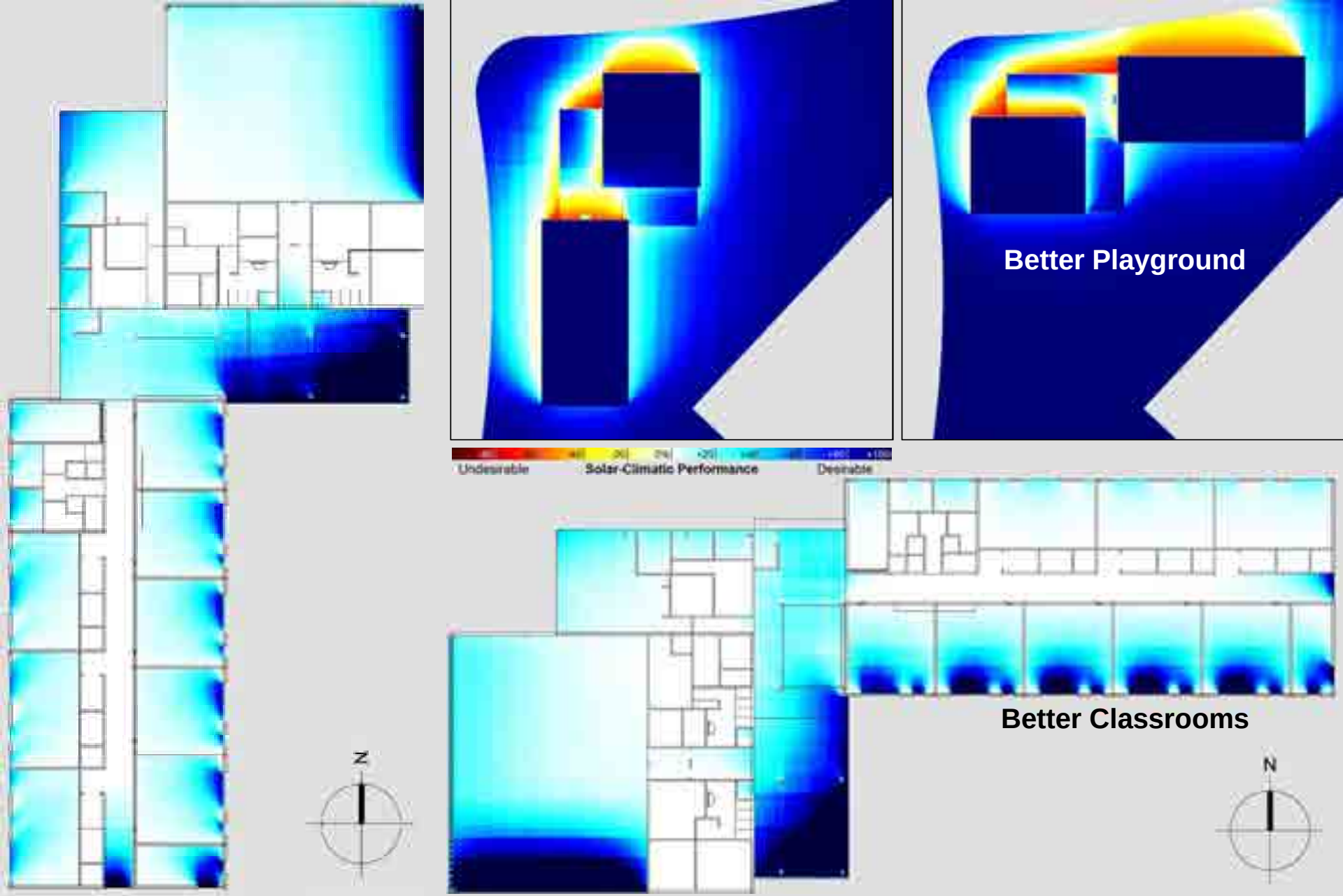
Current Orientation

Second Choice

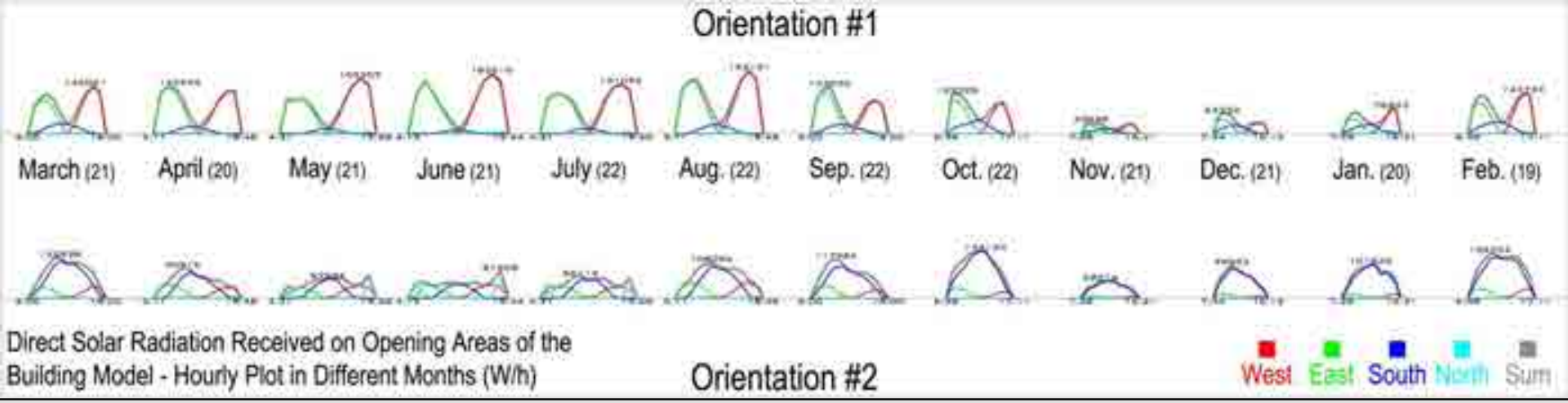
Fontaine School at Nuns' Island (OCPM open project).



Fontaine School at Nuns' Island (OCPM open project).



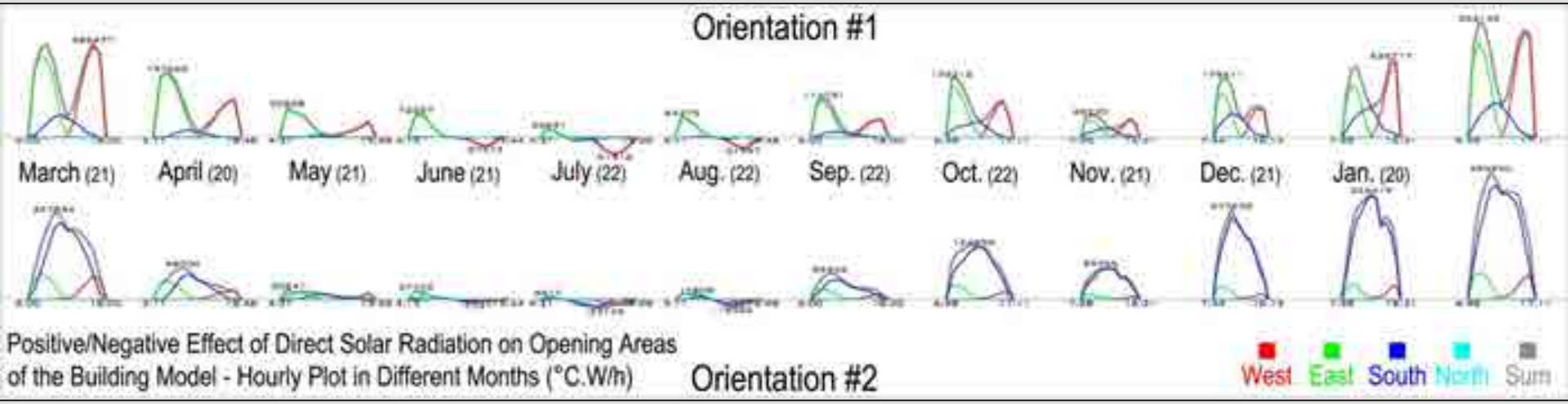
Fontaine School at Nuns' Island (OCPM open project).

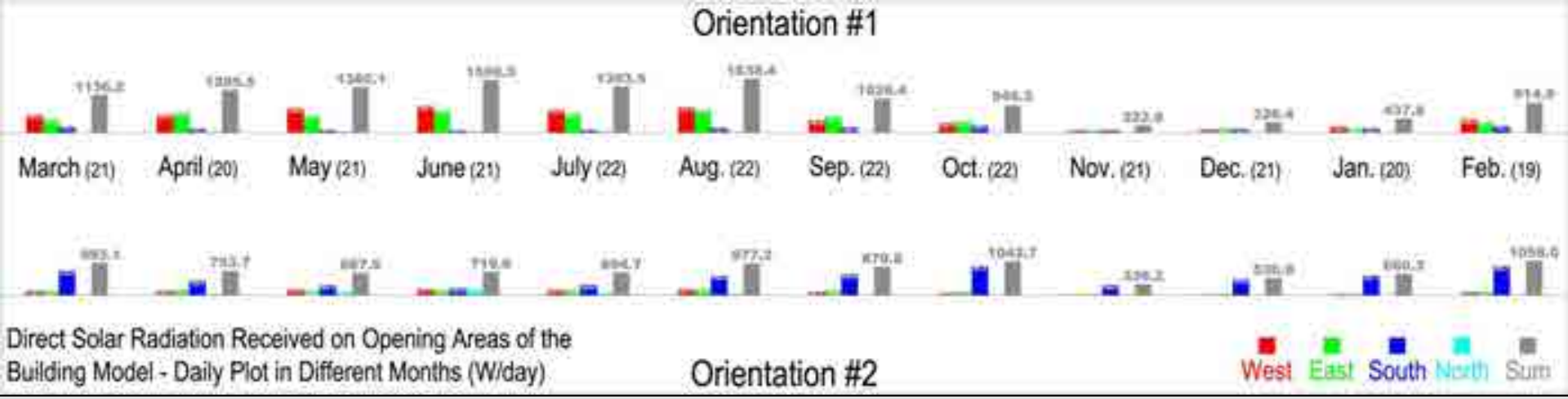


Active Analysis: Plot of Solar Radiation

Comparison of Hourly Plots on the Openings at Different Direction of two Choices

Passive Analysis: Plot of Solar +/- Effects

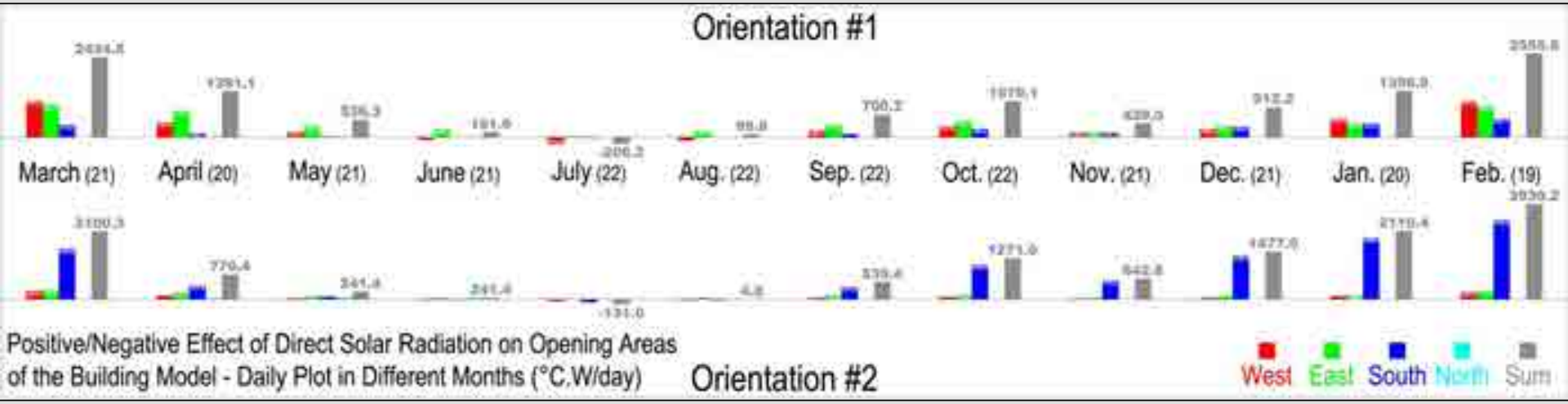


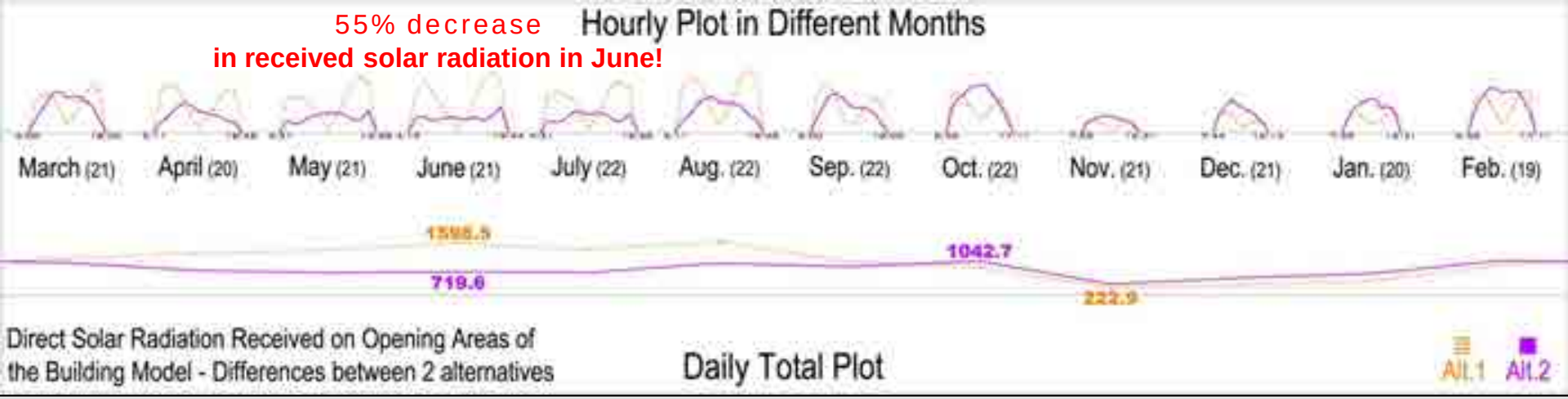


Active Analysis: Plot of Solar Radiation

Comparison of Daily Plots on the Openings at Different Direction of two Choices

Passive Analysis: Plot of Solar +/- Effects

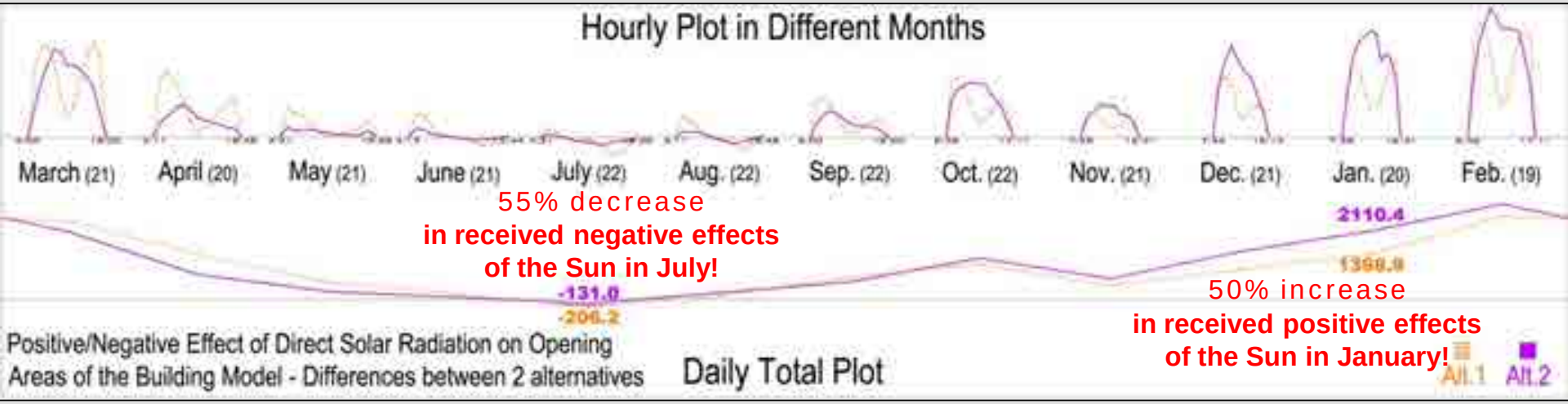




Active Analysis: Plot of Solar Radiation

Comparison of Total Daily Plots on the All Openings of two Choices of the School Project

Passive Analysis: Plot of Solar +/- Effects



Conclusion

- Necessity of basic researches and applied guidelines on solar-climatic planning.
- Necessity of solar-climatic analysis and design optimization

to improve comfort and energy efficiency
in different stages of design as well as different scales:
(urban planning, architectural design and landscape architecture)

Solar Radiation, Solar Effects
Climatic Response, Energy Efficiency,
Comfort, Health, Safety,
Global Warming, Heat Island Effect,
Human Scale, Building Scale, City Scale, Province Scale, Global Scale
Urban Planning, Architectural Design, Landscape Architecture,
Design Analysis, Form Finding, Performance Optimization,
Reflectors, Solar Collectors,
Shading Devices, Trees, Tensile Structures,
Benches, Bus Stops, Pedestrians, Public Spaces.

A 20-minute discussion may do something in **Montréal**, if

Merci Beaucoup
Les Montréalaises!

Special thanks to Kaveh Rashidzadeh for his intellectual assistance from Paris.

consider a look from the Sun!

References

► CWEEDS files (Canadian Weather Energy and Engineering Datasets) for different stations in Canada between 1953 and 2005.
► TMY-EPW files for different stations around the world from US Department of Energy.
► "SOLARCHVISION Studies on Young Cities Project" Book, SAMIMI M., NASROLLAHI F., TU-Berlin, 2013.
► "External and Internal Solar-Climatic Performance Analysis of Building Geometries using SOLARCHVISION" Paper, SAMIMI M., NILI M.Y., NASROLLAHI F., PARVIZSEDGHY L., VAHABI-MOGHADDAM D., CISBAT 2011, EPFL University, Lausanne, Switzerland.
► "A New Approach for Solar Analysis of Buildings" Paper, SAMIMI M., PARVIZSEDGHY L. & ADIB A., WORLDCOMP'08 –The 2008 International Conference on Software Engineering Research & Practice.
► www.solarchvision.com
► Website of Office de consultation publique de Montréal: www.ocpm.qc.ca