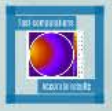
The modelling of Skyglow: the experiences of the light pollution research group from the Slovak Academy of Sciences

2016 SSL TECHNOLOGY DEVELOPMENT WORKSHOP



The modelling of skyglow: the experiences of the light pollution research group from the Slovak Academy of Sciences

2016 SSL TECHNOLOGY DEVELOPMENT WORKSHOP

Solano Lamphar HA, Kocifaj M
ICA. Slovak academy of sciences
National Council of Science and Technology CONACYT
Department of experimental physics, Faculty of Mathematics Physics and Informatics, Comenius University in Bratislava
hsolano@institutomora.edu.mx

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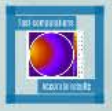
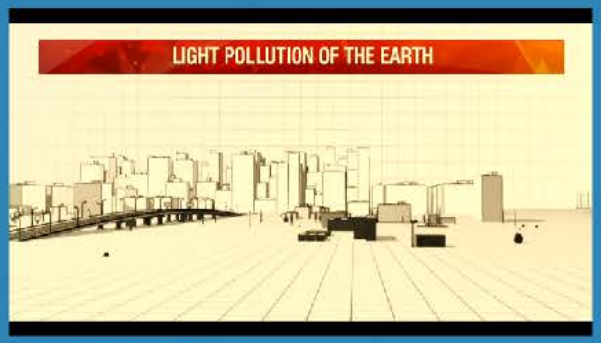
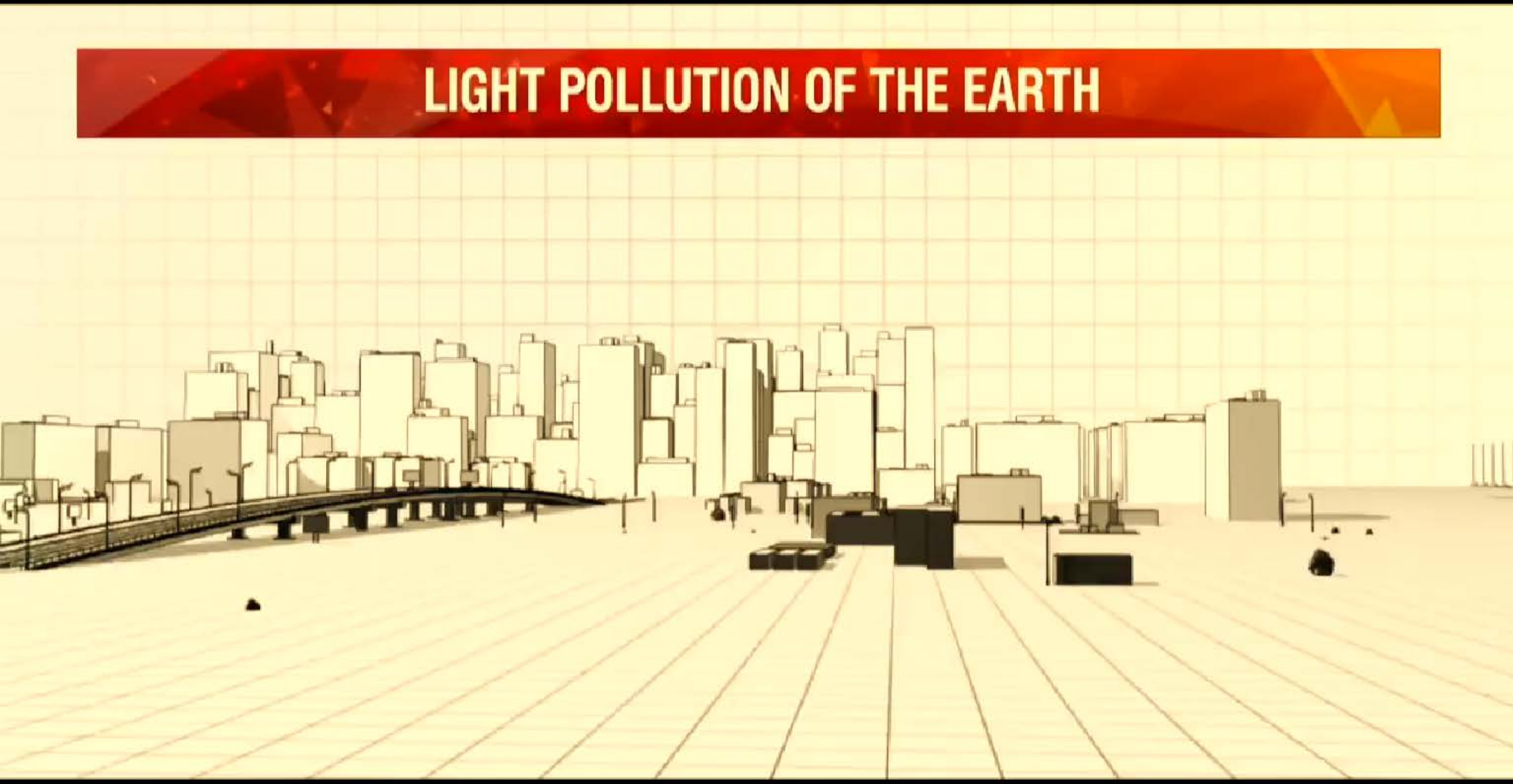


CONTENTS

What is light pollution?



LIGHT POLLUTION OF THE EARTH



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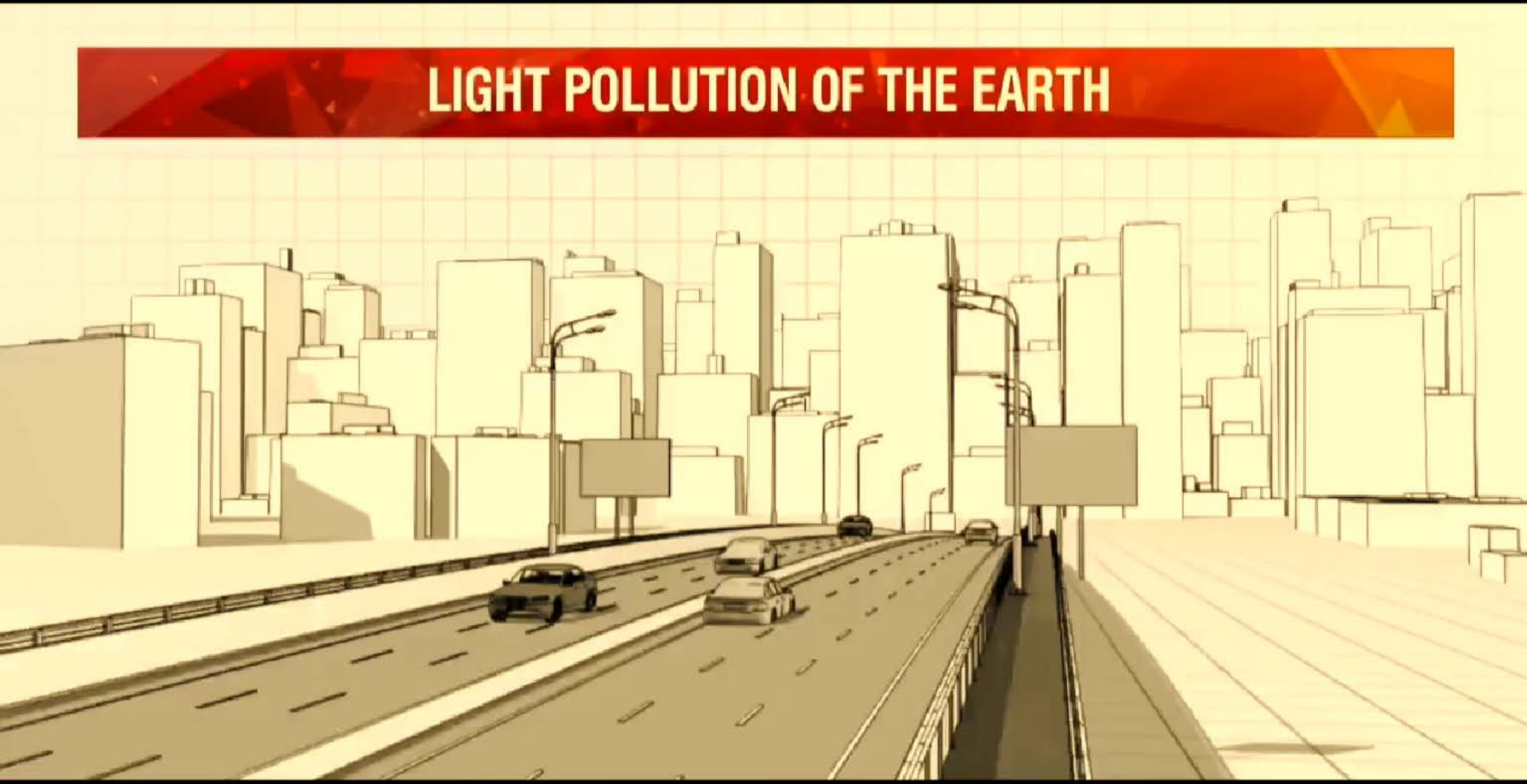

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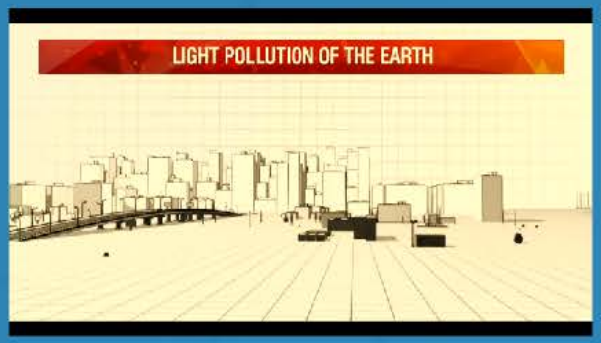
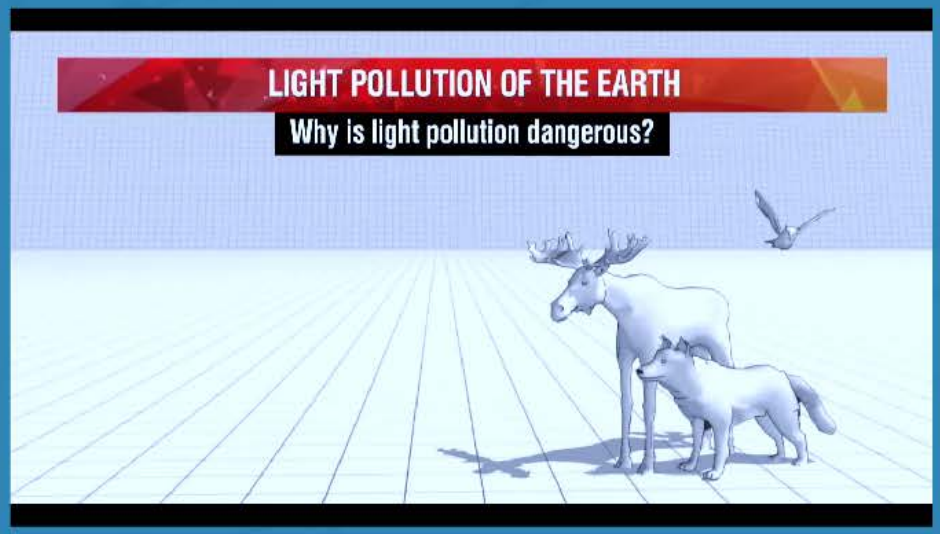
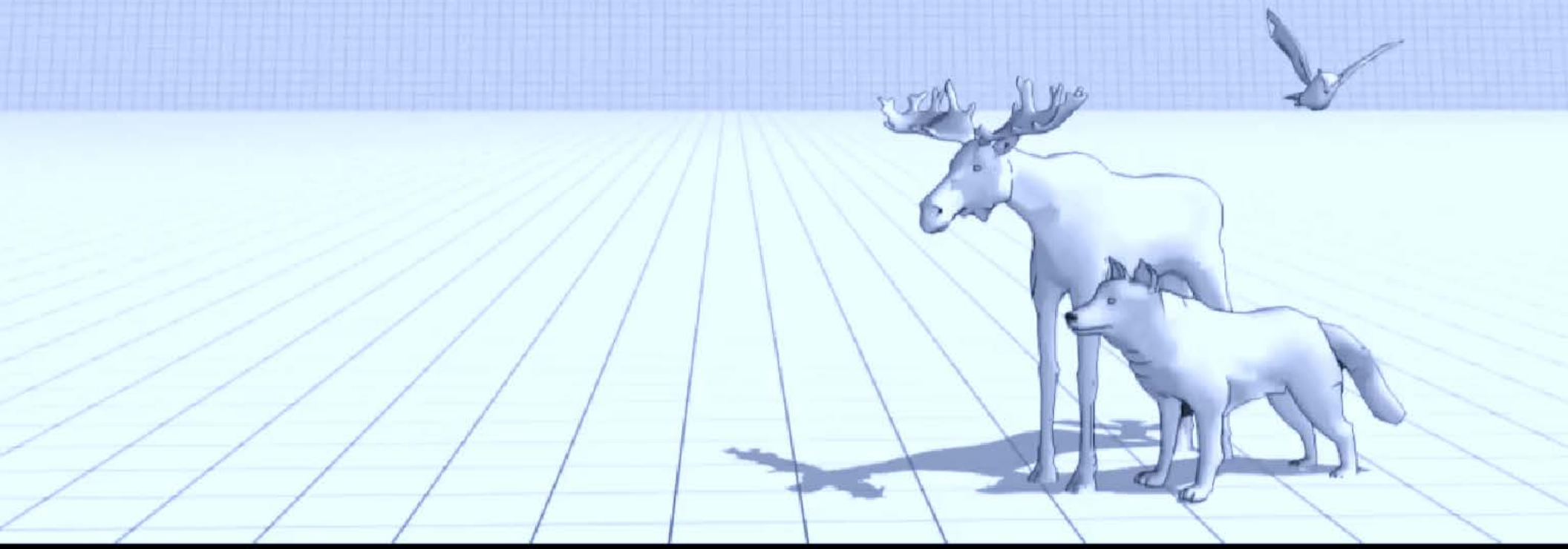


Effects of light pollution



LIGHT POLLUTION OF THE EARTH

Why is light pollution dangerous?



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Why is light pollution dangerous?

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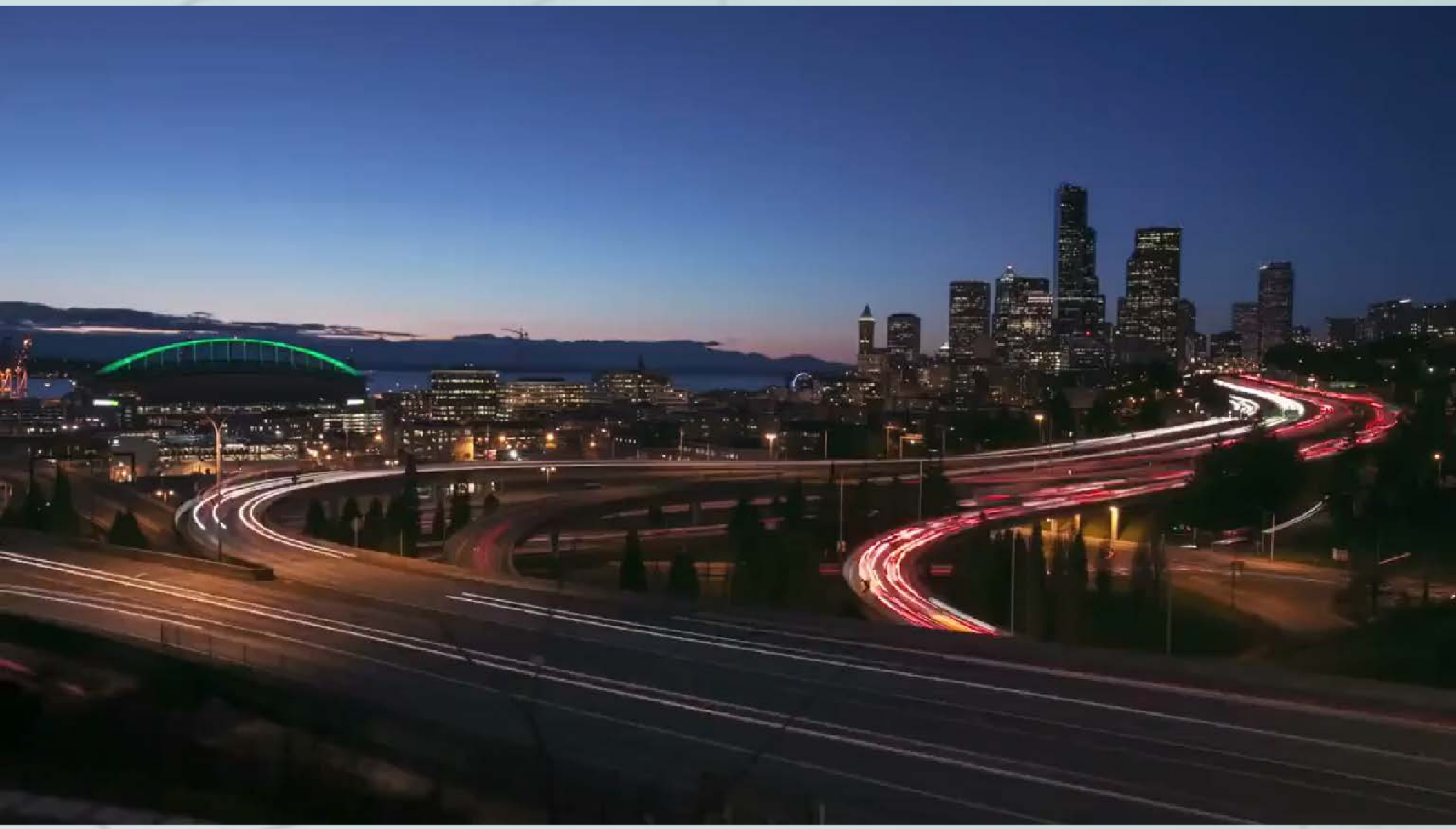
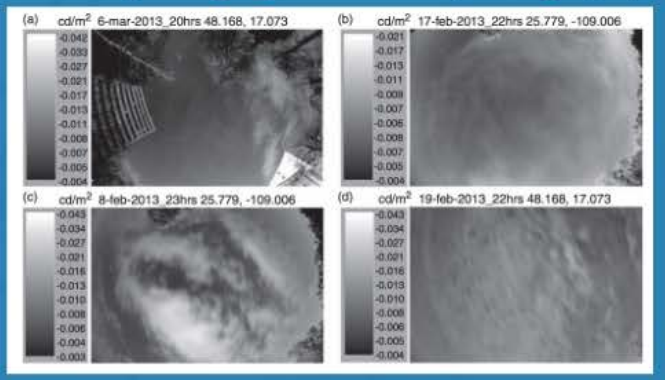


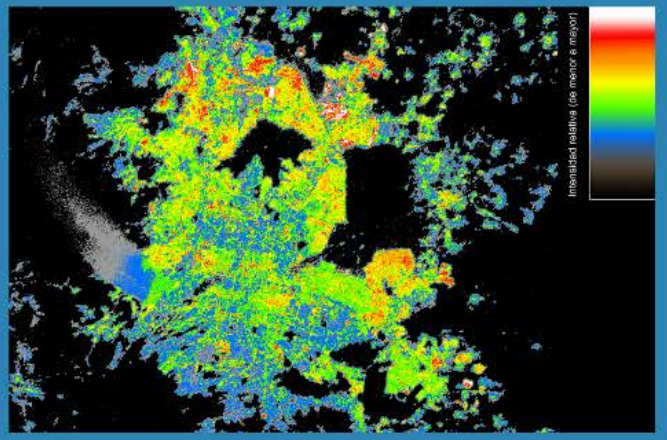
The study of SKYGLOW

Measuring skyglow is challenging given the different complex environments and metrics to describe it are in constant development.

Innovative techniques
such as all-sky imaging and aerial photography



International Space Station
and satellite imagery




JAPAN

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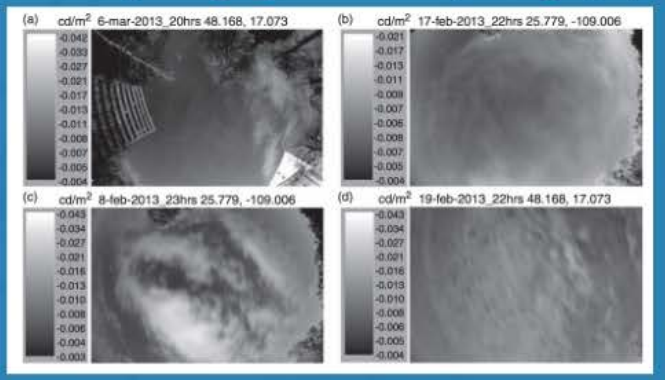

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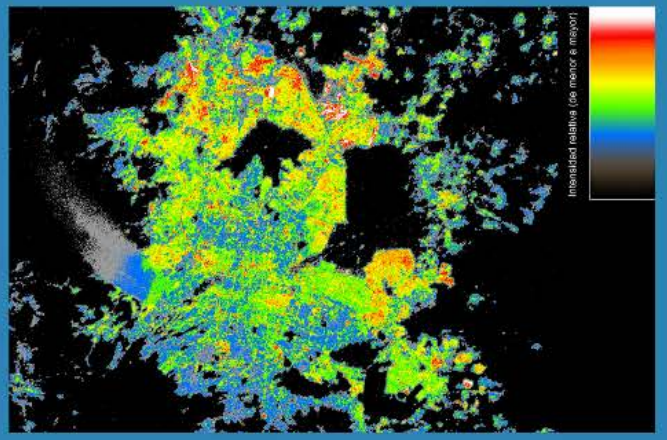

Modelling skyglow

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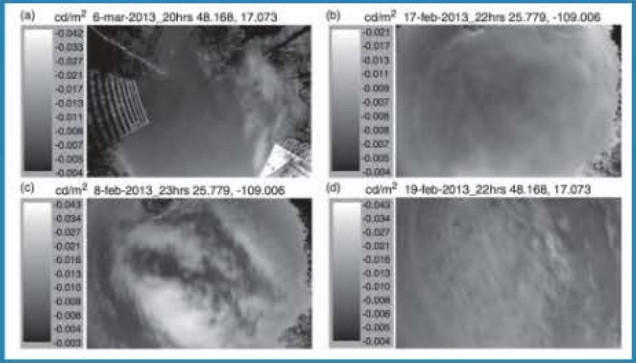

International Space Station
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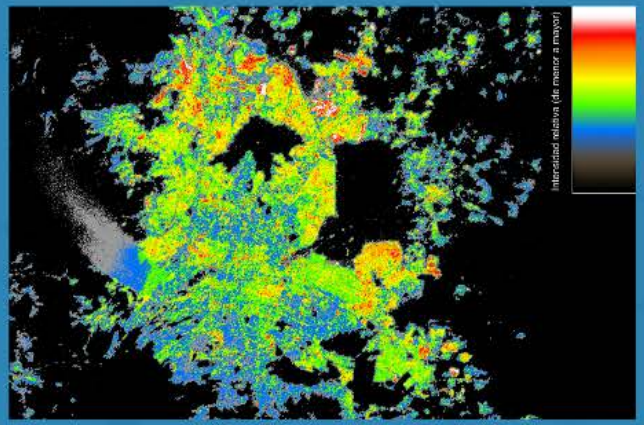
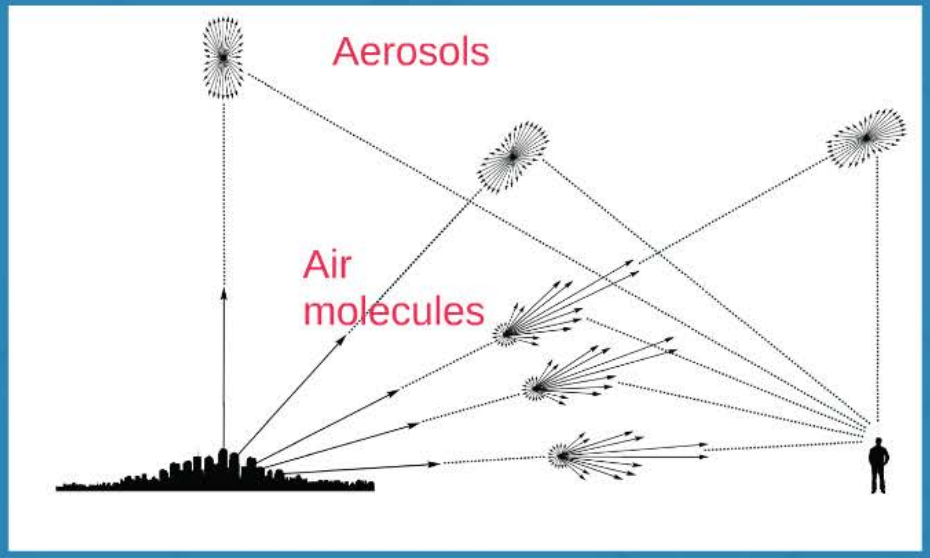


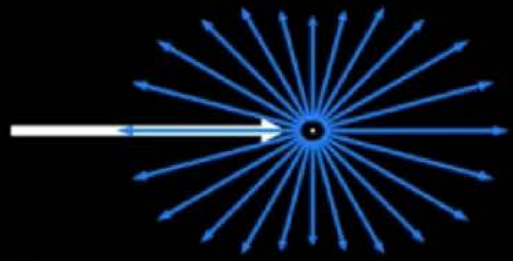
Modelling the skyglow in a diverse nocturnal atmosphere is a non-trivial problem that is theoretically and experimentally difficult to solve, due to both the complexity of radiative transfer methods and measuring devices.

The atmosphere is a heterogeneous media; its physical and optical characteristics are altered by its constituents.



Rayleigh scattering

Mie theory is used to simulate light scatter by aerosols.



Rayleigh scattering is used to simulate scatter through molecules.

tiny particle

less than 1/10 of wavelength

Rayleigh scattering

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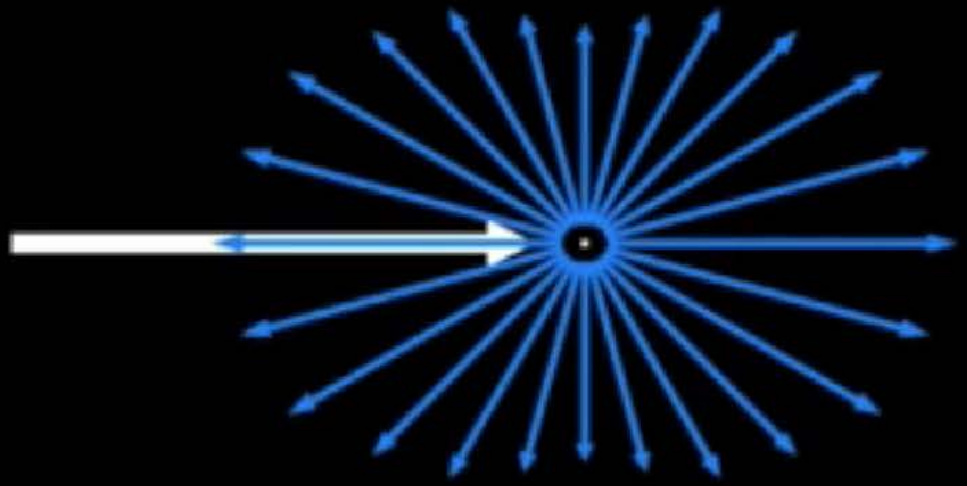

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tiny particle

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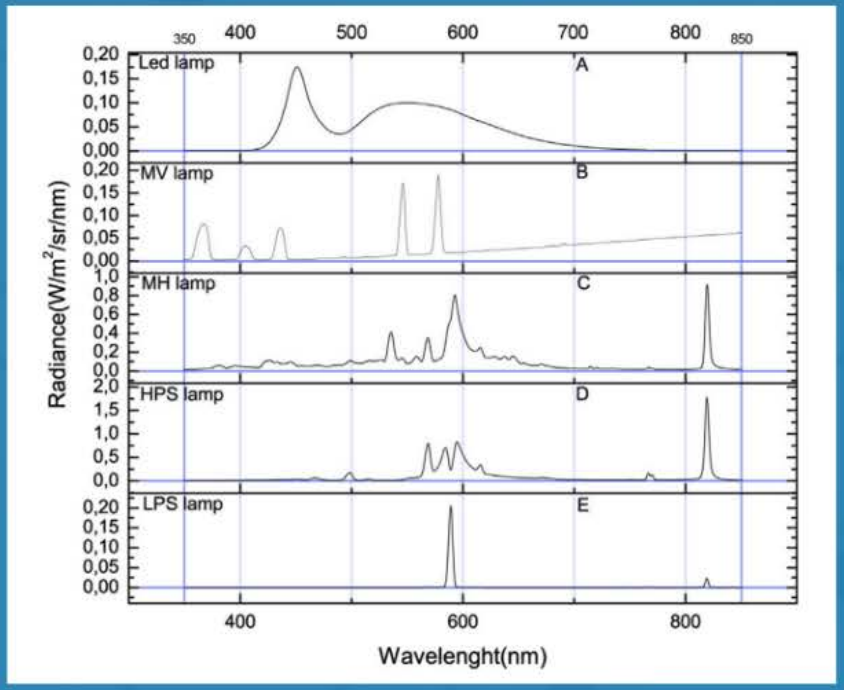
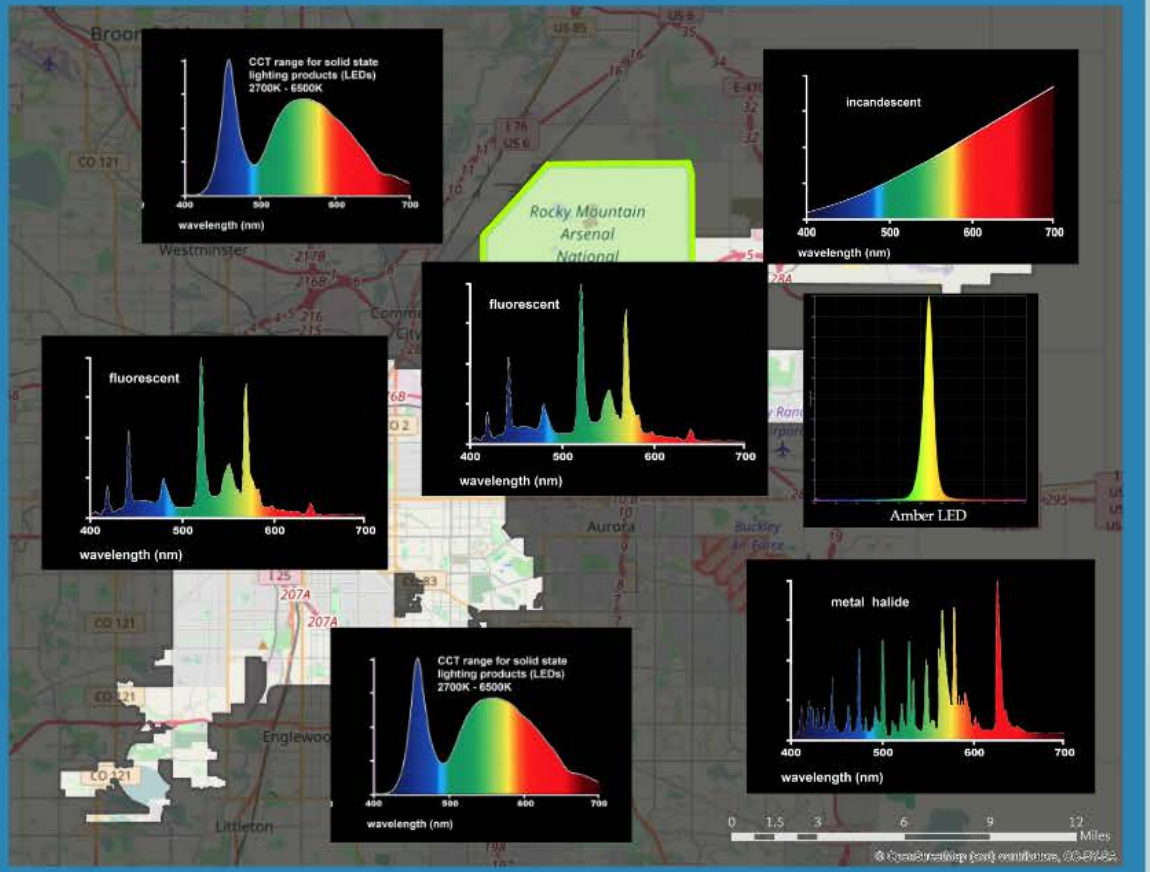
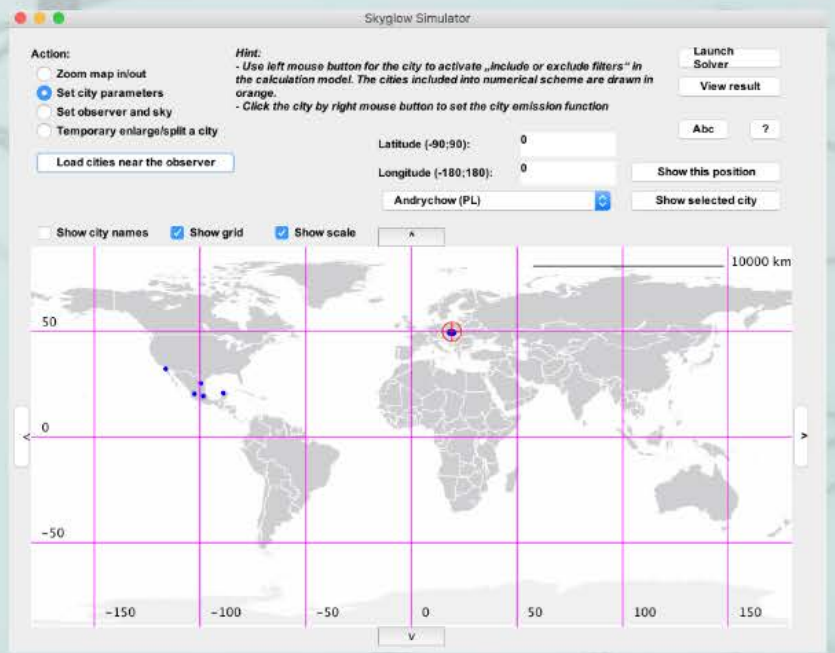
As well, the spectral power distribution of ground-based light sources is dissimilar, making the issue more challenging.

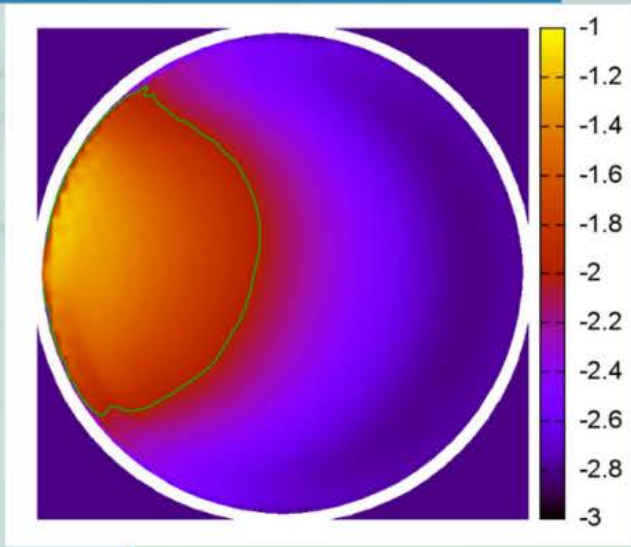




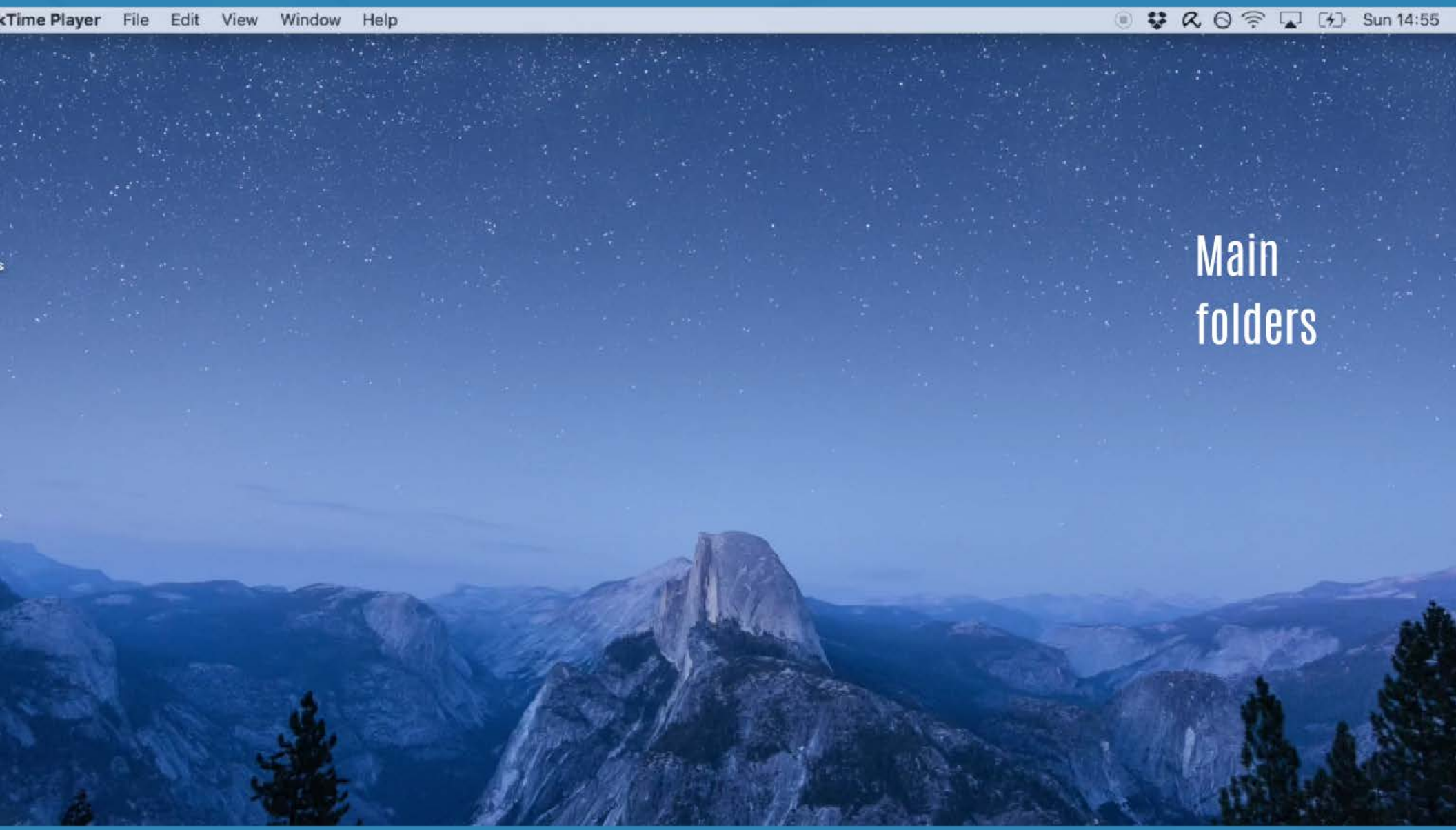


Skyglow simulator

Fast computations



Accurate results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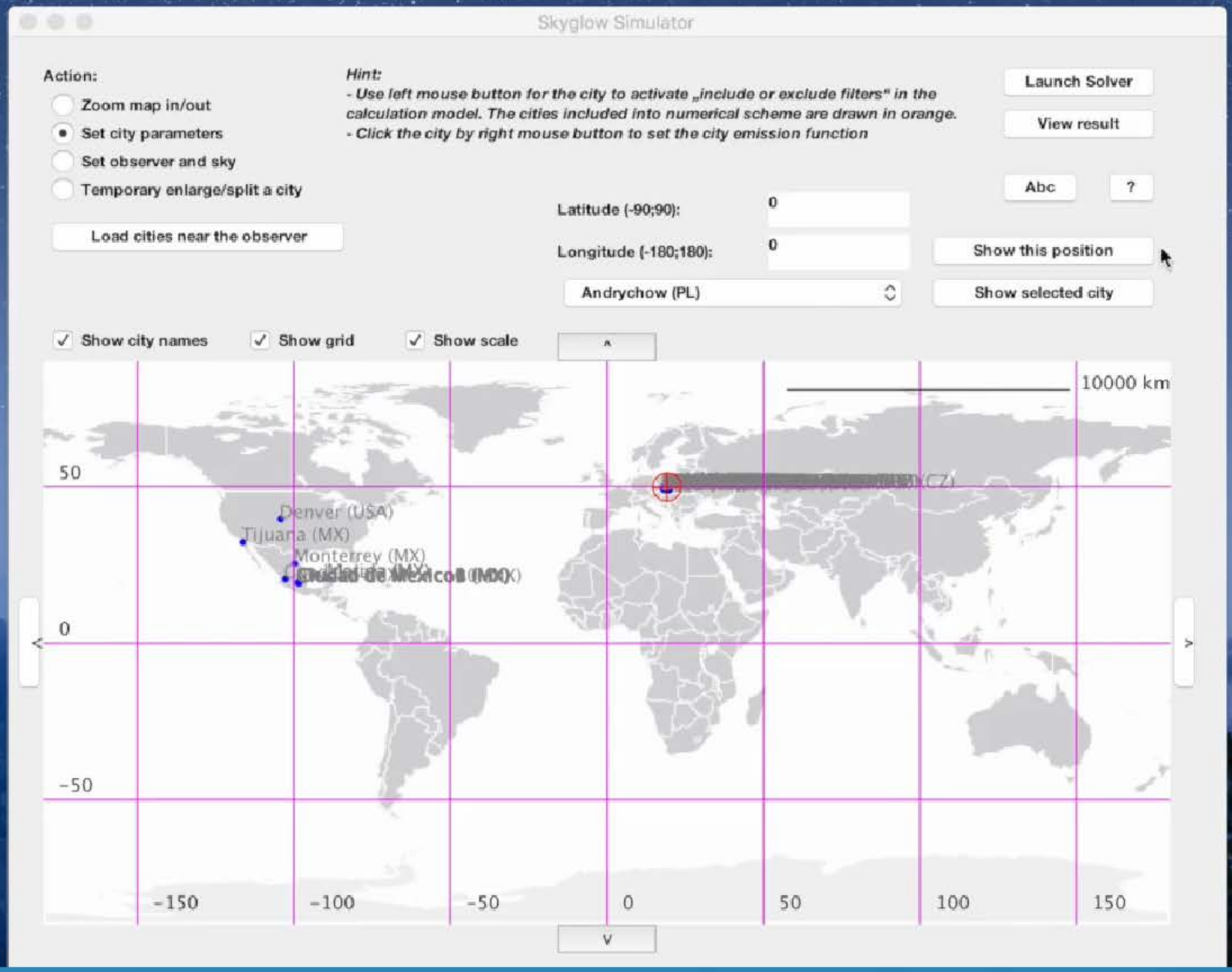
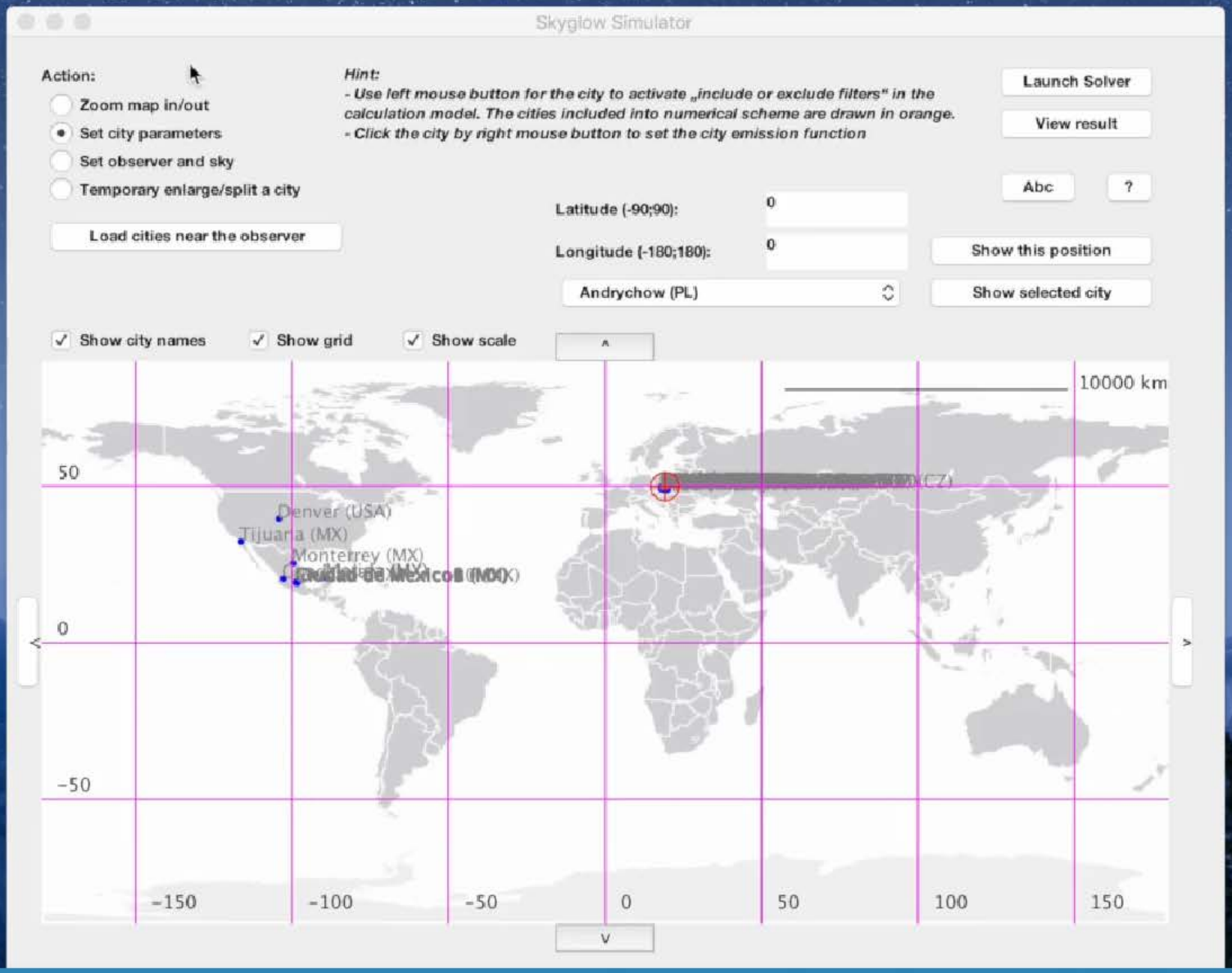
Main
folders

Type of font


Skyglow Simulator
Action:
Zoom map in/out
Set city parameters
Set observer and sky
Temporary enlarge/split a city
Load cities near the observer
Hint:
- Use left mouse button for the city to activate „include or exclude filters" in the calculation model. The cities included into numerical scheme are drawn in orange.
- Click the city by right mouse button to set the city emission function
Launch Solver
View result
Abc
?
Latitude (-90;90):
0
Longitude (-180;180):
0
Show this position
Andrychow (PL)
Show selected city
Show city names
Show grid
Show scale
10000 km
50
0
-50
Denver (USA)
Tijuana (MX)
Monterrey (MX)
-150
-100
-50
0
50
100
150


Skyglow Simulator

Zooming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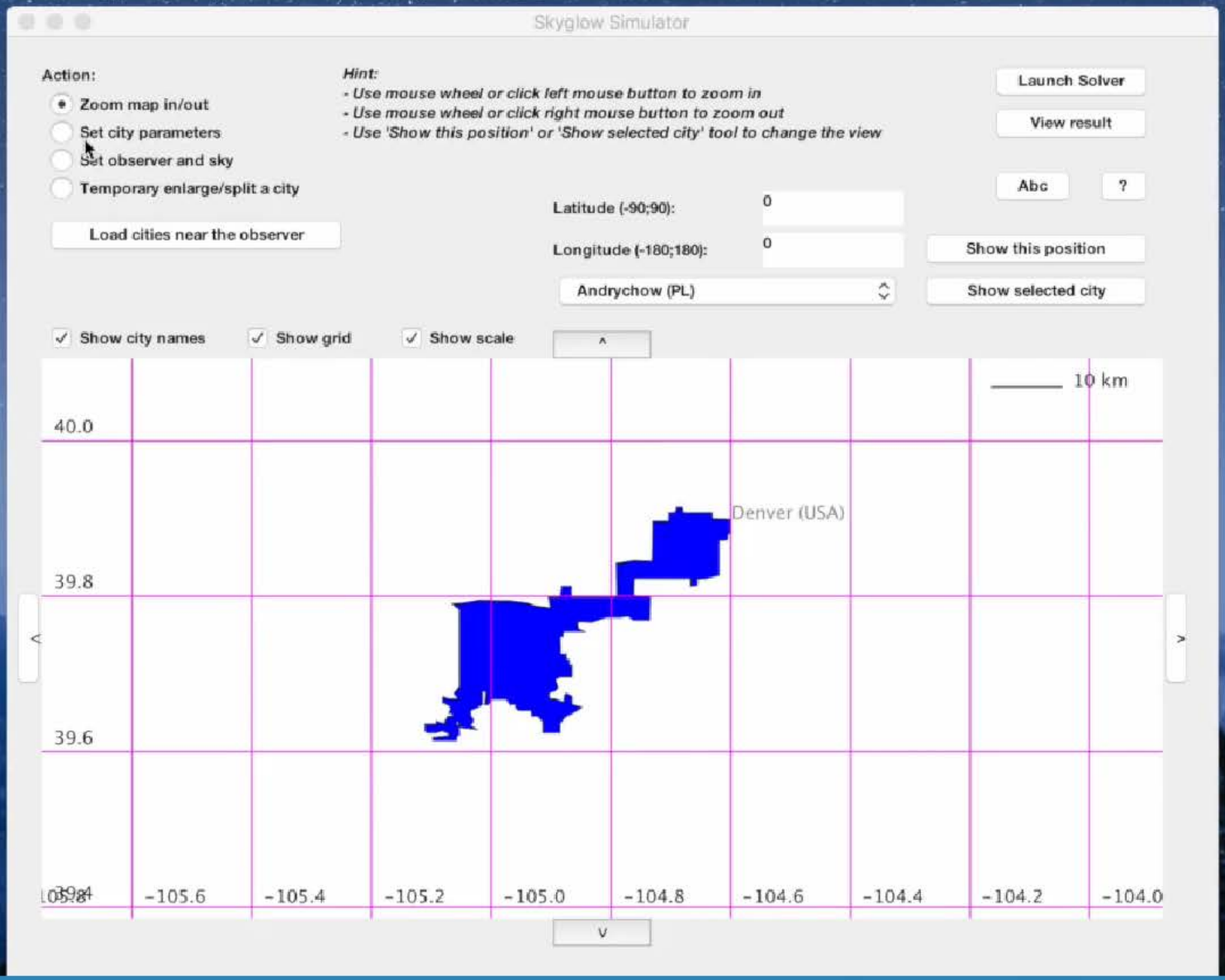
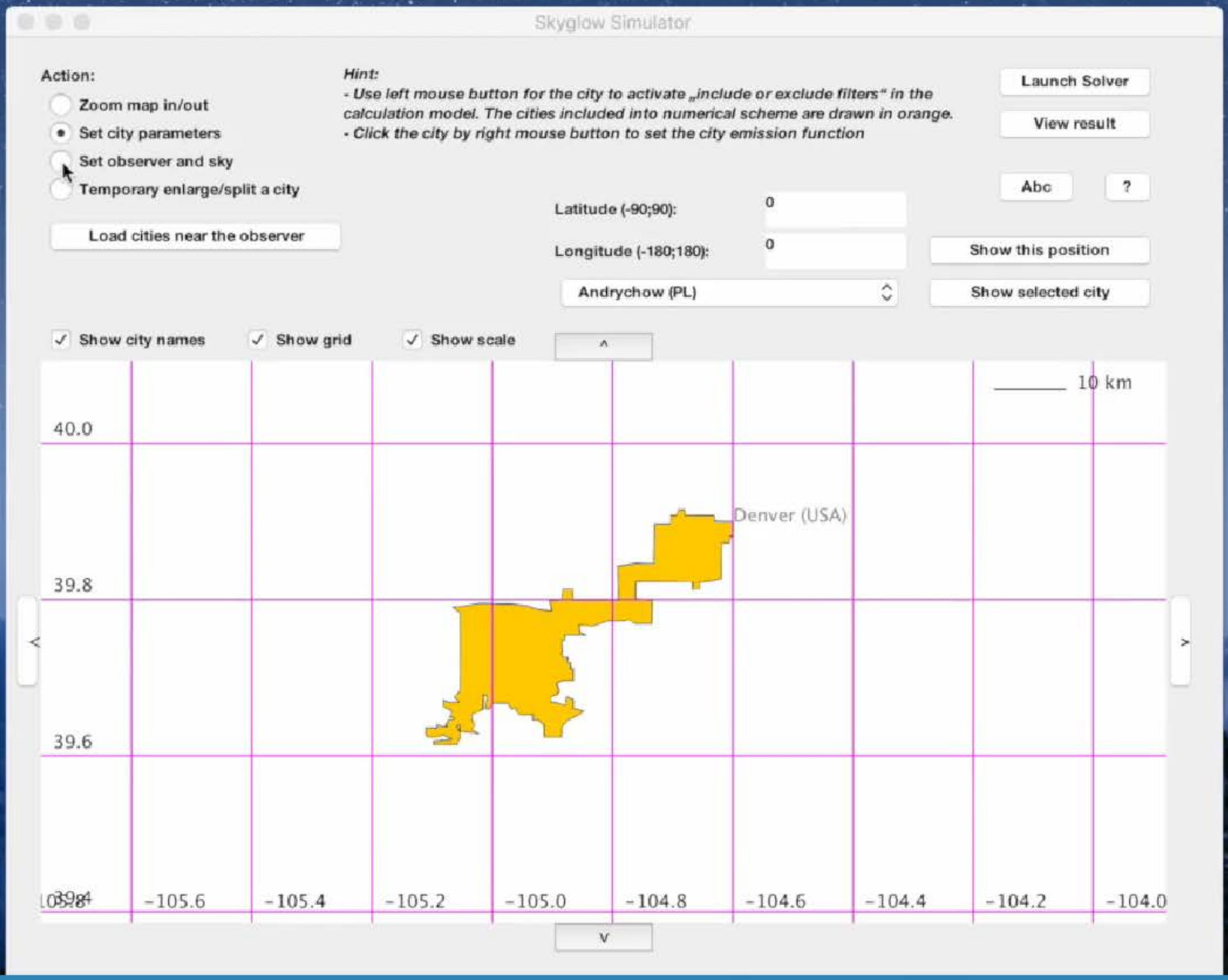
100
150

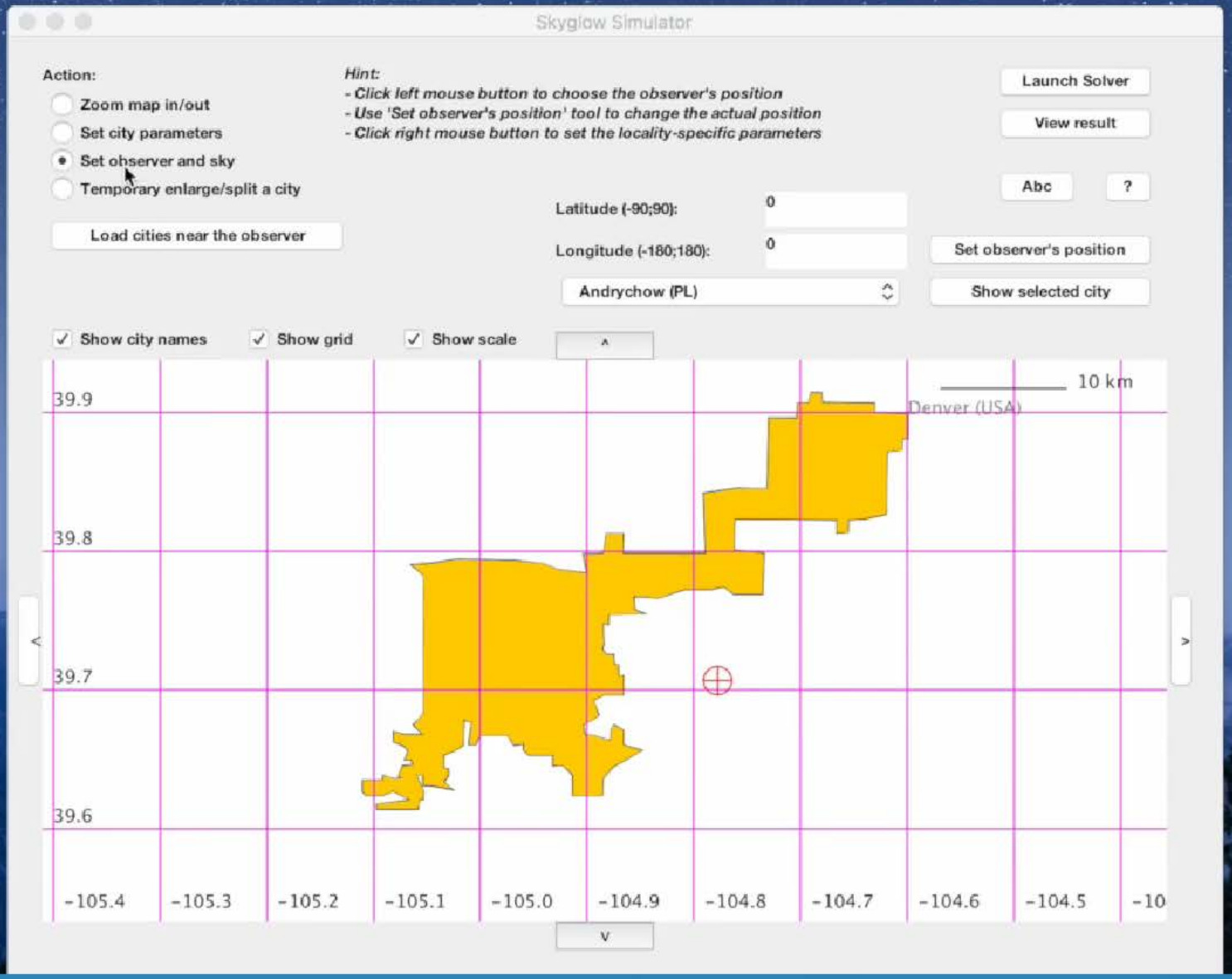
Setting the city parameters

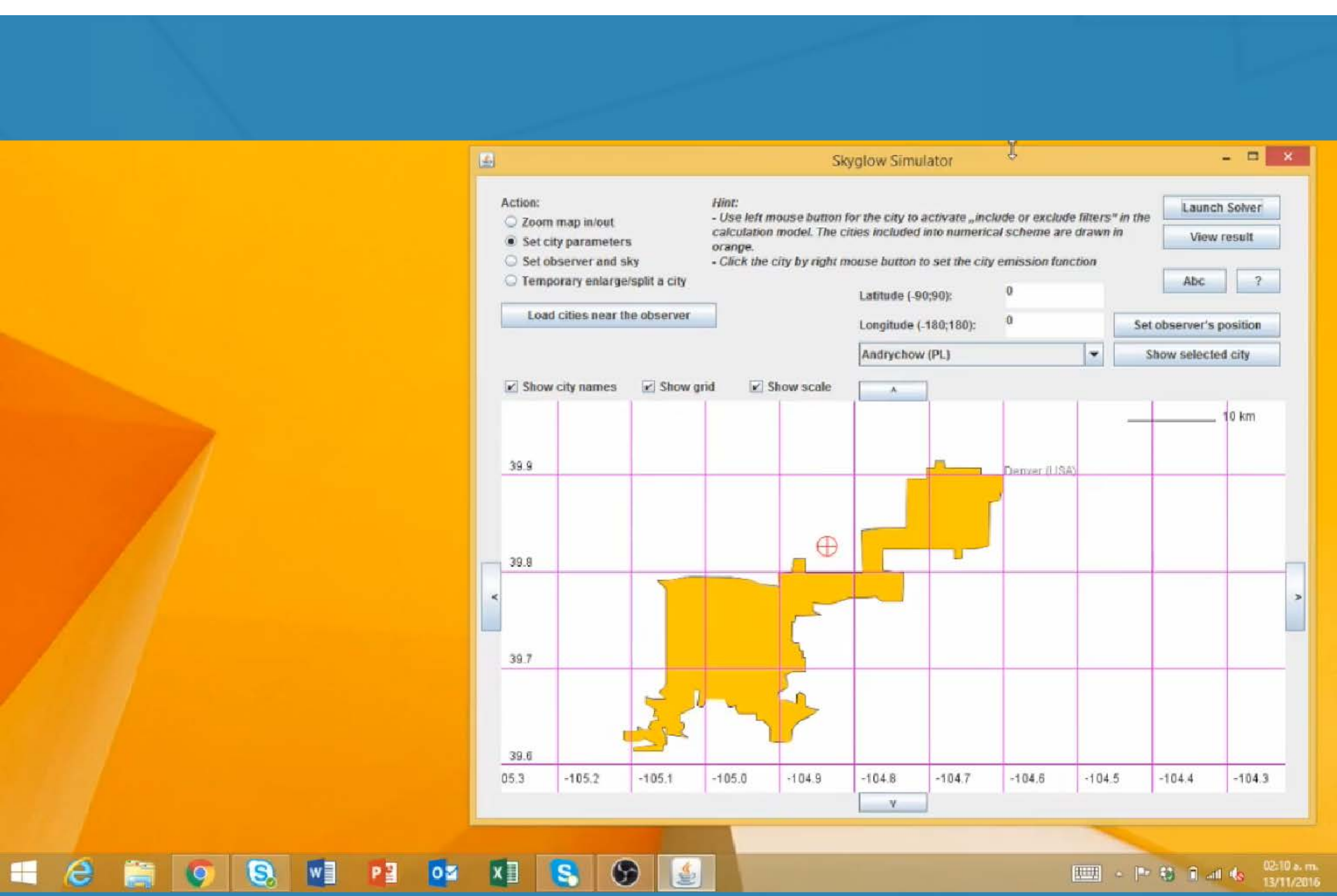


Setting the atmosperic parameters and the observer



Dividing a city

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View result
Abc
?
Load cities near the observer
Latitude (-90;90):
0
Longitude (-180;180):
0
Set observer's position
Andrychow (PL)
Show selected city
Show city names
Show grid
Show scale
10 km
Denver (USA)
39.9
39.8
39.7
39.6
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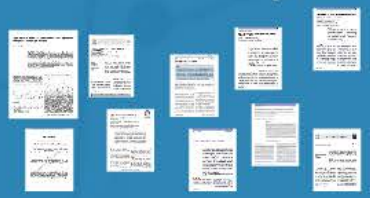
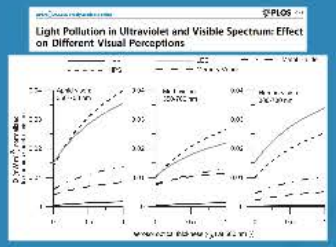
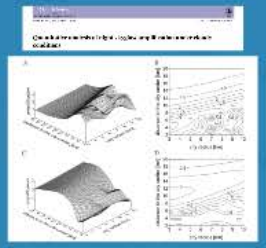
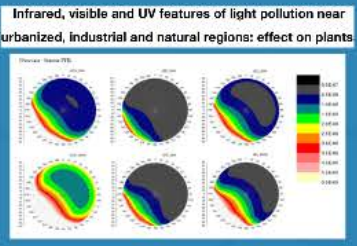
DIFFERENT TESTS

Publications in different journals









Publications in different journals


Light-pollution model for cloudy and cloudless night skies with ground-based light sources


Journal of Quantitative Spectroscopy & Radiative Transfer


Light Pollution in Ultraviolet and Visible Spectrum: Effect on Different Visual Perceptions


Skyglow: a retrieval of the approximate radiant intensity function of ground-based light sources


On the relation between zenith sky brightness and horizontal illuminance


Retrieval of Garstang's emission function from all-sky camera images


Urban artificial light emission function determined experimentally using night sky images


Urban night-sky luminance due to different cloud types: A numerical experiment


Quantitative analysis of night skyglow amplification under cloudy conditions

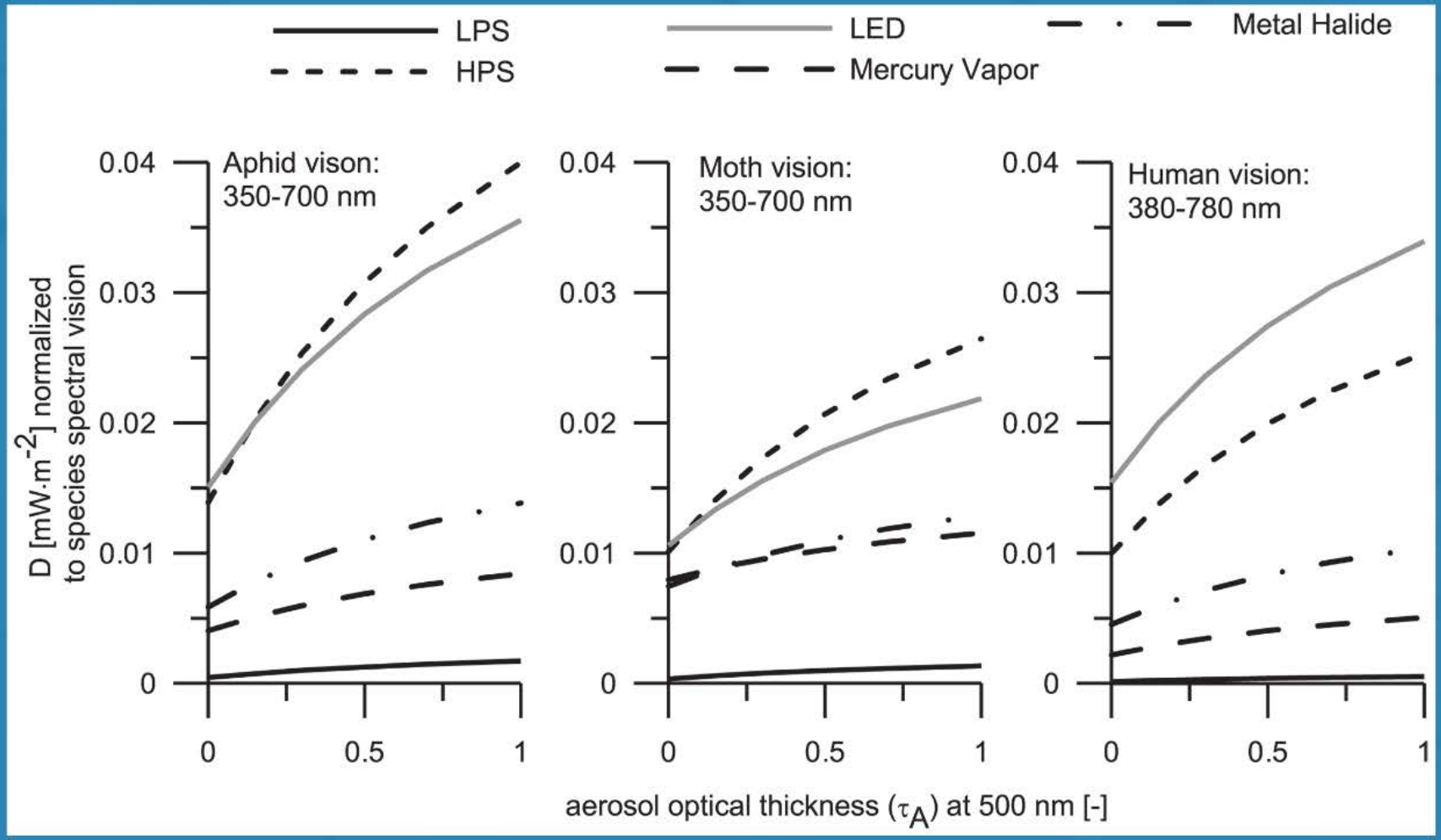

Journal of Environmental Management

Skyglow effects in UV and visible spectra: Reflective fluxes

OPEN ACCESS Freely available online

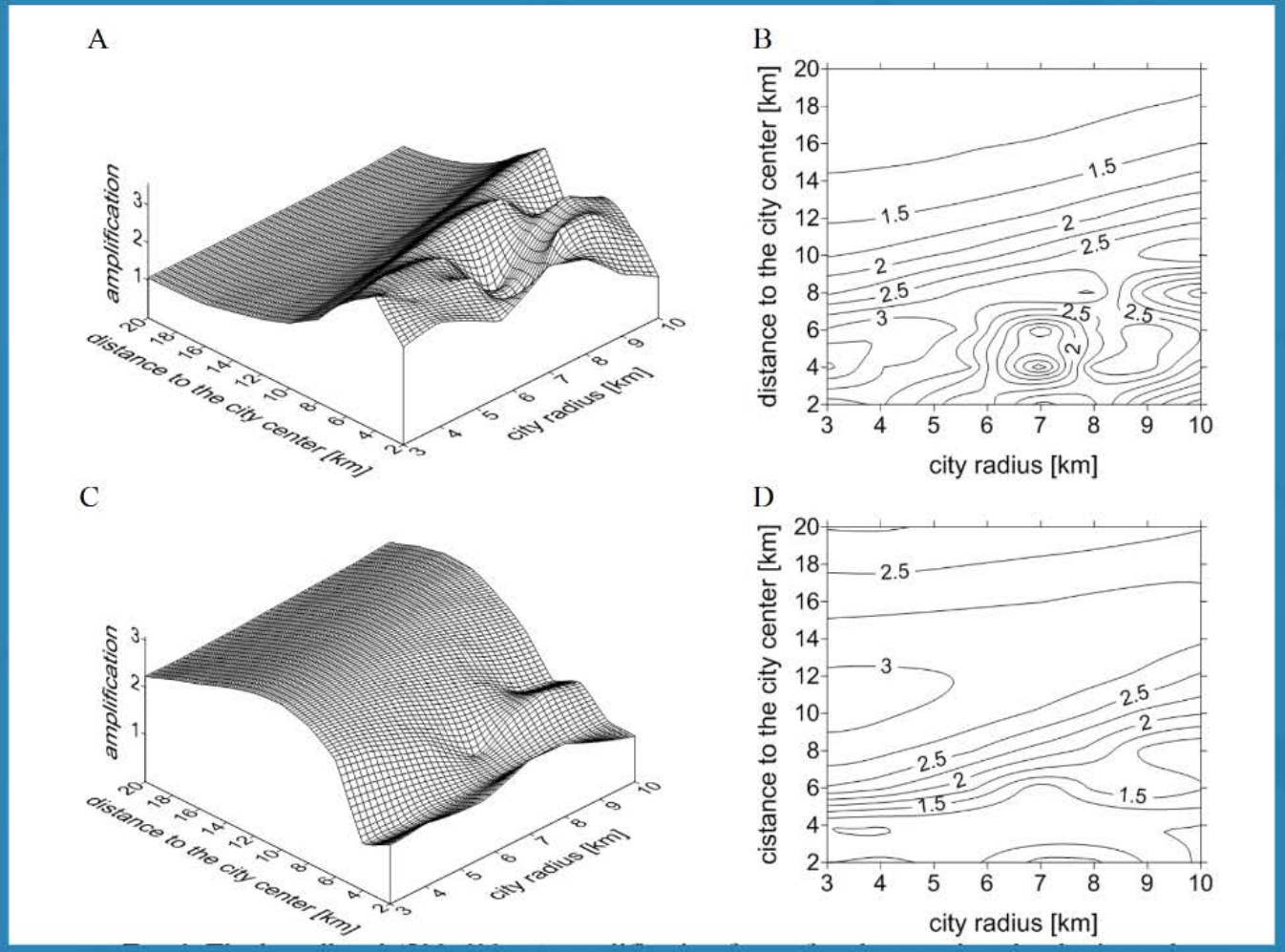
PLOS | ONE

Light Pollution in Ultraviolet and Visible Spectrum: Effect on Different Visual Perceptions

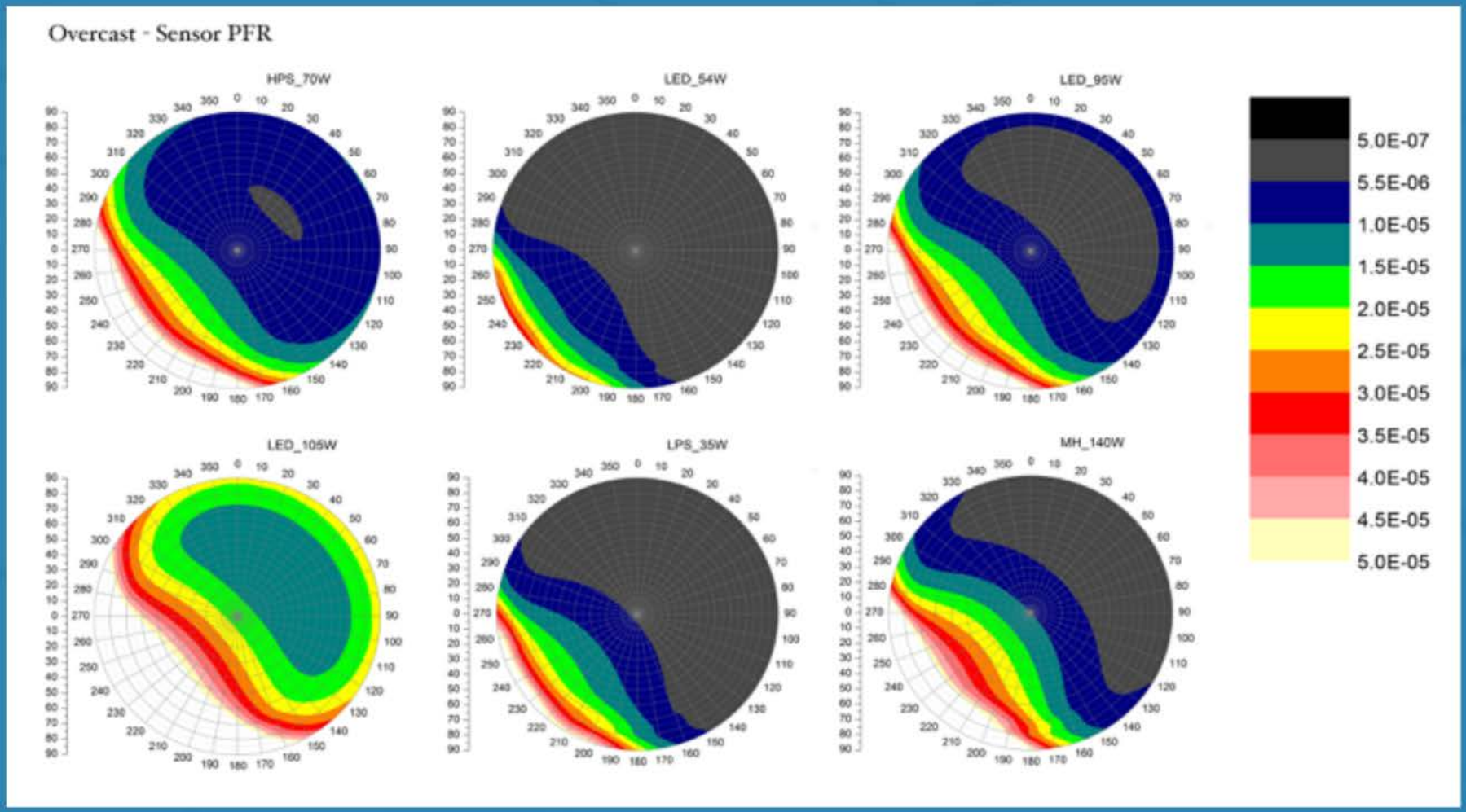


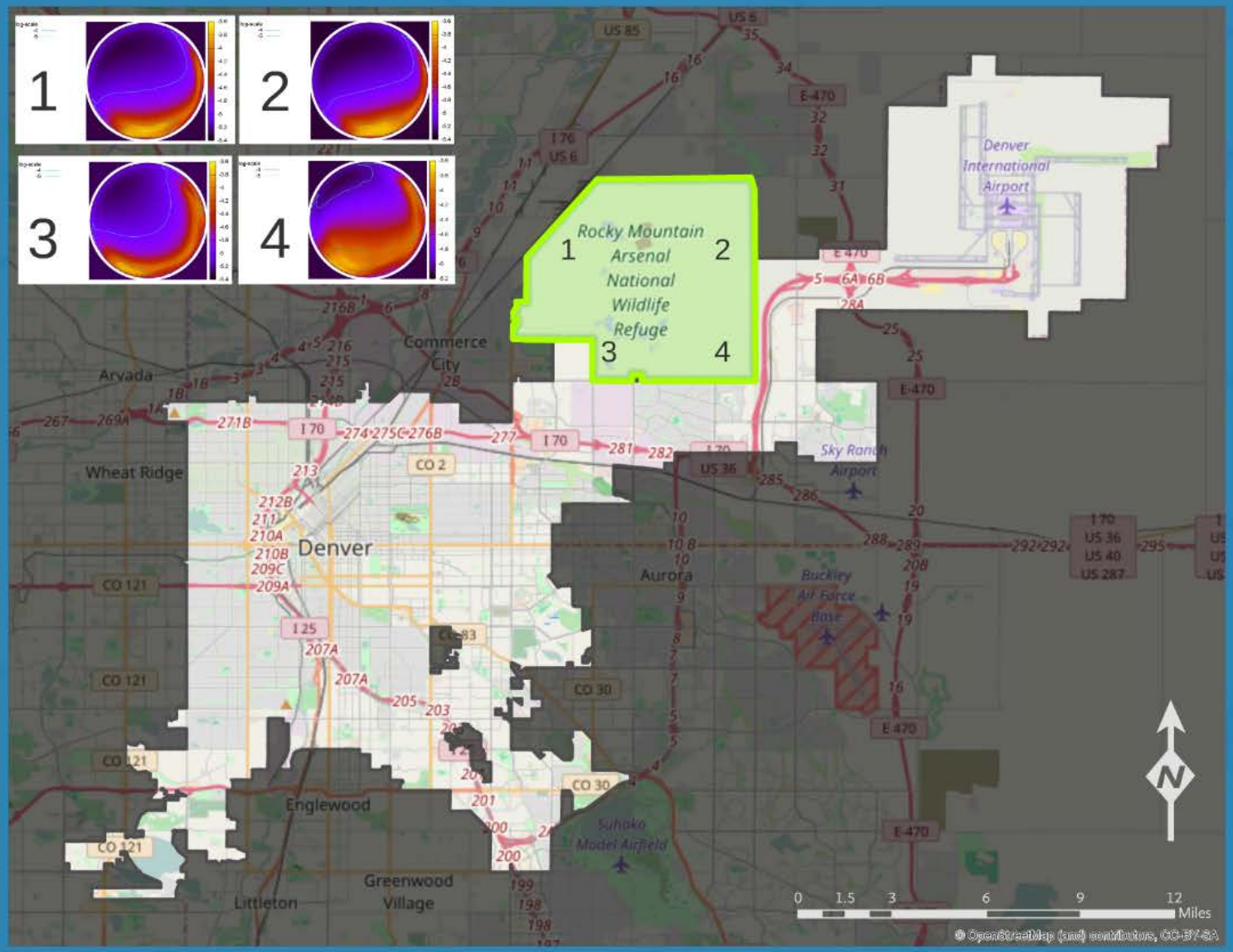
Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY
MNRAS **443,** 3665–3674 (2014) doi:10.1093/mnras/stu1301

Quantitative analysis of night skyglow amplification under cloudy conditions



Infrared, visible and UV features of light pollution near urbanized, industrial and natural regions: effect on plants

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Commerce City
Arvada
Wheat Ridge
Denver
Aurora
Englewood
Littleton
Greenwood Village
Sky Ranch Airport
Buckley Air Force Base
Sunako Model Airfield
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I 25
CO 2
CO 121
CO 30
E-470
US 85
US 6
US 36
US 40
US 287
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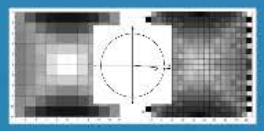
Miles
© OpenStreetMap (and) contributors, CC-BY-SA

OPTIMIZATIONS

Optimization

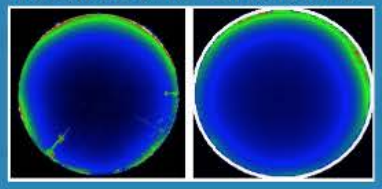
- Discretization
- Comparisons to other models
- Comparisons to reality



The effect of cutting intervals

Altitude, scattering angle, and atmospheric characteristics.

Measurements Simulations

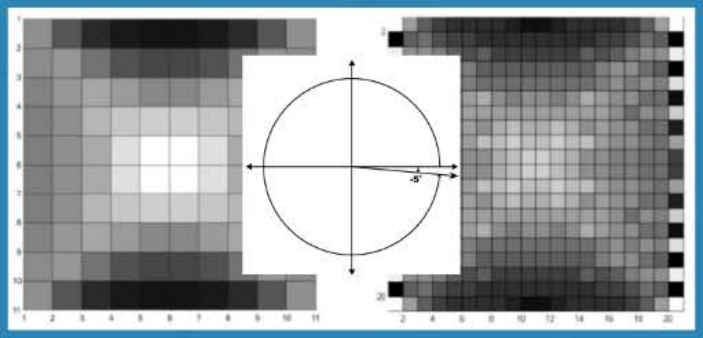


Future scopes

Different emission functions for other kinds of fixtures.
The methodology to retrieve the emission function has been developed.
Merge the data with VIIRS database.
Non spherical particles.

Optimization

- Discretization
- Comparisons to other models
- Comparisons to reality



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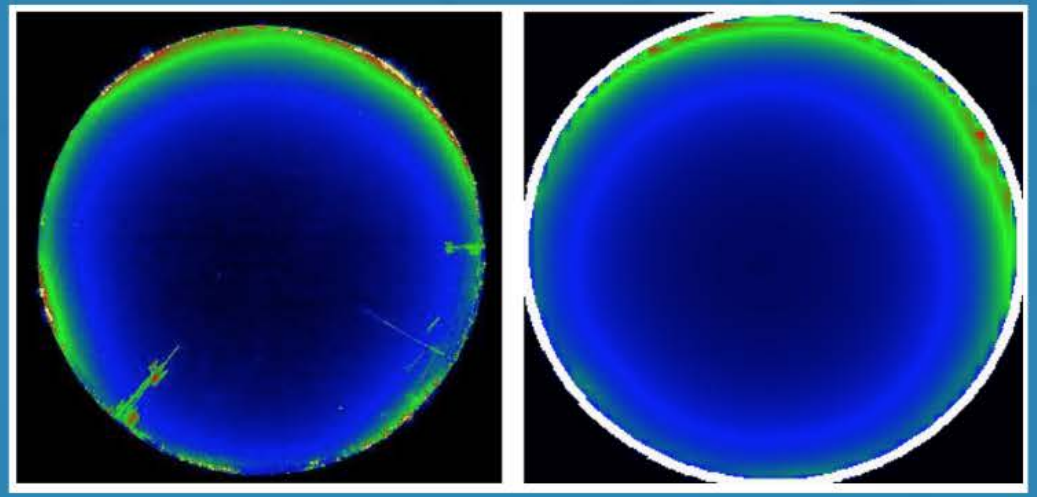

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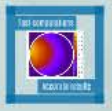

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National Council of Science and Technology CONACYT
Department of experimental physics, Faculty of Mathematics Physics and Informatics, Comenius University in Bratislava
hsolano@institutomora.edu.mx