

We are losing the night

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Summary

With the growing up awareness by men towards environmental problems, concerning fields of study has increased, there has been a passage from a general attention to the environment to specific focused studies. Lately a new sensibility towards a new kind of pollution is born: lighting pollution.

At the beginning in this study the main features of this phenomenon will be examined, then even its negative incidence on the green house effect and on the world economy. Will be examined the main national economic benefits due to a lighting pollution decrease.

Introduction

We know that the firmament is a source of inspiration for all the humanity, we know, as well, that the observation of stars, crepuscular phenomena and aurora borealis represents one of the main element for the scientific culture. Heaven is the other half of the landscape, is the opened window from which the human mind light enters, is the aim of the research of the meteorologists and of the astronomers.

Anyway, faster than we think, we're losing the sensibility and the chance of observing the nightly sky, simply because we are losing the night! The Earth is not slackening the rotation but is the dark of the nightly hours that is becoming more luminous because of a new kind of pollution: the “luminous” one.

Rightly the Italian scientific divulgator Piero Angela affirms that, unlike other elements, the sky the more is lightened, the less can be seen. It has its own light: that of the stars, of the two Kordylewsky clouds and of the photochemical processes which occurs in the ionosphere (zodiacal light, Gegenschein, auroras, airglow...). Every other kind of artificial light (civil, military, public, private, industrial, railway storehouse), if wrongly designed, constitutes a form of pollution.

Light pollution

The light pollution consists in a breaking of the natural balance day/night or light/dark due to an inadequate lighting, in other words in the extreme and not calibrated emission of lighting beams from artificial and wrongly designed source: street-lamps, lighthouse towers, neon signs, globes, lanterns... The main effect is the creation of a luminous vault above every human and industrial settlement, with a consequent obscuring action of the night vision of the sky. Just think that the light produced in a night, today, by a little town, is the same of that diffused by a middle-sized nation of the past century! Paradoxally man is creating a "daily-night". This situation gets better going out the cities, but even in the opened fields there's a luminous vault that, mixing with the atmospheric pollution, erases the sky visual.

So the most expert meteorologist cannot observe that night phenomena as rare as fascinating such as the pearly clouds, the night-lighting clouds, the auroras and the selenic (lunar) photometeor.

Light pollution must not be linked to a modern phenomenon dues only to the electricity diffusion, in fact in 1873 J. A. C. Charles (famous for having formulated the homonymous law) coming back from his nightly ascensions on the first montgolfiers where he made physic experiments, noted the dazzles emitted by the modest lights of the urban settlement.

A diligent reader, anyway, has even to consider the "reflection factor", that is the polluting light reflection by clouds, industrial smokes (an industrial district could increase the phenomenon by the 60-70% [4, 34]), motes, mists and by lithometeors mists and thick fog; this exponentially increases the polluting phenomenon. Certainly the observative astronomy, based on the totally night obscurity, couldn't be born in this conditions. Nor Luke Howard (author of the first scientific classification of clouds, December 1802) could have recognized the real colors of clouds at dusk.

Now, with an almost daily night, enormous negative effects are determined in a scientific point of view: great astronomic observatories are placed in the few still dark areas belonging to not yet energetically and economically developed countries, such as Cile, Perù and Canarian Isles. This implies heavy budgets for universities and for other research institutes, which have to pay very expensive managements, transfer maintenances and long missions for researchers.

The effects on the human being are cultural: the photometeors caused by moonlight are semi-unknown phenomena, even if they're not so rare; constellations only are on school books, just think about the night which followed the last great earthquake which involved Los Angeles there were so many phone calls in California, blocking call centers, in order to know what in the heaven happened. What actually happened is that the momentaneous black out in many city areas and the partial destruction of many lights plants had shown the people that starry sky that the most had never seen.

The "Commissione Nazionale Inquinamento Luminoso (C.N.I.L.)" (National Light Pollution Commission) of the "Unione Astrofili Italiani (U. A. I.)" (Italian Amateur Astronomers Union) underlines how the nocturne illumination damages the surrounding ecosystem changing, for example, chlorophyllian photosynthesis cycle, which could be modified by artificial light sources; this modification can lead to an alteration of the oxygen and carbonic anhydride emissions in the troposphere by flora of our Biosphere, with climatic consequence and, as we'll see later, with incidence on greenhouse effect.

Examples on birds migrations deceived by city lights are known and a strange case happened in Kaktovik in which some bears have destroyed some street lamps because they disturbed their sleep. The night light seems to slow down the brain production of melatonin, with physical and psychological negative consequences on individual brains. In the 80's, the International Astronomical Union stood up against this problem and founds the International Dark-Sky Association (I.D.A.), which, with the "Società Astronomica Italiana (S.A.It.)", is throwing out some initiatives. In 1988 the "Unione Astrofili Italiani" founds the National Light Pollution Commission (C.N.I.L.). In 2000-2001 regional laws against light pollution are approved in the following Italian regions: Piemonte, Lombardia, Toscana, Veneto, Val d'Aosta and Lazio. Nationally the n. 751 law is blocked in Parliament (2000).

Greenhouse effect

Artificial light alters the chlorophyllian photosynthesis, and so even the oxygen-anhydride ratio coming from a natural process; anyway, even if the meteorologic observatory of Mauna Loa (Hawaii, U.S.A.) records the carbonic anhydride variations due partially to absorption by plants, mathematic models for evaluating the entity of such alterations.

Instead we can consider how much the carbonic anhydride could be reduced in the industrial process in a serious politic against this kind of pollution.

Making lighting installations not polluting mean reducing combustion the 35% to produce electricity, this involves a reduction of carbon of the 35% and of hydrogenous of the 14%. Considering equivalent stechiometrical values (1 Kg is equivalent to 3,66 Kg of carbonic anhydride and 2,667 Kg of oxygen), we can obtain that almost 1,4 tons of carbonic anhydride isn't emitted in the atmosphere and almost 1,5 tons of oxygen isn't burnt.

Extrapolating these valutations from all population of the Earth carbonic anhydride has a lowering of 75 million of tons in a year!

Robert M. White (U.S. Weather Bureau director) declares that about 58% of the greenhouse effect cause is due to energy use and production. Considering that light pollution constitutes about the 35% of the electricity production, deduce that such phenomenon has an incidence on the greenhouse effect like about the 20%.

Measuring

Technically light pollution could be measured with "middle emission ratio" (R%) estimated as the ratio between total flood emitted towards the sky (direct and by reflection on the round and on the other surfaces) and total flood emitted from artificial source: it changes from 29% for small countries to 30% for big cities. Two methods for R% metric exist (conceived by ing. Carlo Rossi, U.A.I.): the "magnitude method" and the "luminous lost flood method". With the first one the luminous flood lost from a city in an undirected way, but some mistakes of estimations can occur due for the 100% to the way of subdivision of the sample territory; with the second one instead it's possible calculating the middle ratio of emission, this last one is more precise, with mistakes equal to 10%, because it is based on technical characteristics and on luminous sources.

Economy Implication

Mr.Stefano Torre, a city councilman of Piacenza, underlines that it's not so hard to prevail administrators to change their outer lighting attitude when you talk about saving money. Often, to set budget, council administration always suggests improving local taxes. The energetic/economy saving reached removing pointless lights could bring to citizen a city impost lightening.

The example of Catania, which has changed part of its own lighting park, of Civitavecchia (Rome), and of Frosinone (Rome) that have approved a specific city law is very important. Usually interventions plans for each town should be prepared by specific Technical Offices for the practice adoption and fulfillment, but it's not always possible because some towns

don't have either financial resources or they need technical support, due to specificity and novelty of the subject.

In 1999, I realized a research about this theme: "Ecological problems and development" from which come out nationally economical advantages due to a luminous pollution falling.

The conclusion of this analysis are:

- The saving of 464.645 tons of fuel in a year;
- The energetic billing was lower than 50 Euro millions;
- 1.400.000 tons of carbon dioxide was not emitted in the atmosphere;
- 1.500.000 tons of oxygen not burnt;
- 10 Euro millions saved by the society producing electricity, and so less bill for the citizens;
- 200/300 Euro millions saved by the towns and by the citizens, due to the reduction of the luminous flow to the sky;
- Further saving of about 10 millions of Euros due to the use of lamps with more luminous efficiency;
- Focused funds can bring to these positive results: plant uniformity, optimization of the warehouse goods with fewer maintenance costs and the reduction of the construction costs of the illumination plants.

Conclusion

The world rising population, from 2,5 billion of people on the Earth in 1950 to 10,8 billion in 2150, according to an average estimate (prof. Golini, "Population Division of the Department of Economic Affairs at the UN Secretariat", 1998), and the technical improvement in the planet underdeveloped areas is totally changing the societies settlement and it's definitely damaging the biosphere equilibrium.

What will happen to the Earth development when the underdeveloped population will grow up and will feel our same needs? It's impossible to find an answer, but it's possible to analyze more or less realistic scenery. In order to avoid future ecological and energetic crisis it's important to enforce appropriate laws in every single nation; little individual expedient to save energy is important because it could bring good effects to the entire biosphere.

Pointing in a good way a lamp seems not much, as the damage made by every single person, but adding this to 5 billion it becomes an ecologic bomb. So, not only scientific community, but all society is called to review its relation-ship with environment by a new forma mentis which promotes critic and active behaving towards its habitat.

A wide sensitivity towards the complex relationship between biosphere and the human activities is required, which could be able to distinguish which resource to transmit from those to consume, and which could be able to emphasize the inherited environment resource in order to create new dynamics of production, in a sustainable development view.

See more on Web

- Ing. Carlo Rossi <http://www.astrosolare.it>
- Cielo Buio <http://www.vialattea.net/cielobuio/>
- C.N.I.L. http://www.uai.it/com_lum/index.htm
- International Dark-Sky Association <http://www.darksky.org>
- International Mailing list <http://www.celfosc.org/mag6/>
- Prof. Pierantonio Cinzano <http://www.inquinamentoluminoso.it/>
- U.A.I. <http://www.uai.it>