

UNIVERSITY OF BELGRADE – TECHNICAL FACULTY BOR



International
Scientific and
Professional Meeting

"ECOLOGICAL TRUTH"

PROCEEDINGS

Eco-Ist'12

Edited by
ZORAN S. MARKOVIĆ

2012

UNIVERSITY OF BELGRADE – TECHNICAL FACULTY BOR



**International Scientific and
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ZORAN S. MARKOVIC

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TABLE OF CONTENTS

PLENARY LECTURE

- Dragan Bogdanovic, C. Dolicanin, D. Randjelovic, Z. Milosevic, Z. Dolicanin*
AN EVALUATION OF HEALTH EFFECTS OF PRECIPITATION USING
REGRESSION AND ONE-WAY ANALYSIS OF VARIANCE..... 1
- Florian Kongoli, E. Z. O'Brien, S. Llubani, I. McBow*
ECOLOGY AND SUSTAINABILITY IN 21ST CENTURY: MYTHS AND REALITY..... 9

PROTECTION AND PRESERVATION OF NATURAL RESOURCES

- Stevan M. Stankovic*
HYDROGRAPHY OF NATIONAL PARK DURMITOR..... 10
- Mihajlo Stankovic*
NEW SPECIES OF FLORA AND FAUNA IN SNR ZASAVICA
BETWEEN 1997.TH - OF 2011 17
- Ljiljana Brasanac-Bosanac, T. Cirkovic-Mitrovic, V. Popovic*
IMPORTANCE OF IMPLEMENTATION OF ADAPTIVE FOREST
MANAGEMENT IN SERBIA..... 24
- Martin Bobinac, S. Andrasev*
STAND STRUCTURE AND CARBON STOCK IN AN UNMANAGED
BEECH STAND ON FRUSKA GORA..... 31
- Orhideja Strbac*
FOREST WILDFIRES IN VRSAC MOUNTAINS..... 38
- Djordja Stojicic, M. Ocokoljic, D. Obratov-Petkovic, N. Stojanovic*
INFLUENCE OF CHANGED CLIMATE CONDITIONS ON ADAPTABILITY AND
VITALITY OF *Ficus carica* L. SPECIES ON GREEN SPACES IN BELGRADE..... 42
- Djordja Stojicic, M. Ocokoljic, D. Obratov-Petkovic, D. Skocajic*
EFFECT OF AGE AND SITE ON THE YIELD AND VIABILITY
OF EMPRESS TREE SEEDS..... 48
- Isidora Simovic, M. Ocokoljic, D. Obratov-Petkovic, D. Vilotic*
VITALITY ANALYSIS OF NORWAY MAPLE (*Acer platanoides* L.)
IN PARKWAYS OF BELGRADE..... 55
- Isidora Simovic, M. Ocokoljic, D. Obratov-Petkovic, D. Vilotic*
DISTRIBUTION OF *Acer* L. GENUS IN VEGETATION OF SERBIA..... 60

<i>Vladan Popovic, I. Bjelanovic, T. Cirkovic-Mitrovic, Lj. Brasanac-Bosanac, A. Lucic, D. Jokanovic</i> STATE OF QUERCUS ROBUR FORESTS IN NATURAL MONUMENT "ROGOT".....	65
<i>Ivan Bjelanovic, M. Perovic, V. Popovic</i> MAIN CHARACTERISTICS OF <i>Chamaecyparis lawsoniana</i> (MURR.) PARL. AND ITS USAGE IN PLANTATIONS ON MONTANE BEECH FOREST SITES.....	70
<i>Bojan D. Petrovic, N. Petrovic, M. Vujcic, A. Sabovljevic, M. Sabovljevic</i> BIOTECHNOLOGY IN BRYOPHYTE PROTECTION.....	77
<i>Milica Miljkovic, V. Randjelovic, N. Randjelovic</i> THE BOULDER VEGETATION OF MILJKOVACKA GORGE VALLEY.....	84
<i>Miodrag Velojic</i> THE WATERFALLS OF STARA PLANINA MOUNTAIN AND THEIR PROTECTION.....	91
<i>Branko Stajic, M. Vuckovic, M. Koprivica, S. Andrasev, B. Matovic, G.Vucetic</i> TREE-SIZE DIVERSITY AND TREE SPECIES DOMINANCE AS THE ELEMENTS OF MIXED BEACH SPATIAL STANDS STRUCTURE.....	98
<i>Branko Stajic, M. Vuckovic, G.Vucetic, S. Andrasev</i> DIAMETER GROWTH AND INCREMENT OF ARTIFICIALLY ESTABLISHED BLACK LOCUST IN S. N. R. DELIBLATO SANDS.....	105
<i>Gerassimos Arapis, E. Evergetis, D. Mavrogiorgos, F. Pavlides</i> RESTORATION INTERVENTIONS IN THE FIRE AFFLICTED FORESTS OF MOUNTAIN ATTAVIROS, A PROTECTED AREA ON THE ISLAND OF RHODES – GREECE.....	112
<i>Goran Sekulic, J. Petrovic</i> VALORISATION OF BRZANSKO MORAVIŠTE FROM THE ASPECT OF ORNITHOFAUNA.....	127
TECHNOLOGIES, WASTES RECYCLING AND THE ENVIRONMENT	
<i>Ana A. Cuculovic, R. Cuculovic, D. Veselinovic</i> ACTIVITY LEVELS OF ¹³⁷ Cs, ⁴⁰ K, ²²⁶ Ra AND ²³² Th IN MOSSES FROM THE TERRITORY SOKOBANJA AND BANJA JOŠANICA.....	135
<i>Vladimir D. Zivanovic, M. B.Tosic, S. R.Grujic, J. D. Nikolic, S. D.Matijasevic, S. N. Zildzovic, S.V.Zdrale</i> APPLICATION OF WASTE GLASS AND MG-SLAG FOR PRODUCTION OF GLASS MATRIX COMPOSITE.....	141
<i>Emmanuel Ayuk Tataw</i> TECHNOLOGIES, WASTE RECYCLING AND THE ENVIRONMENT TURNING WASTE INTO WEALTH.....	147

<i>Ivan Krstic, M. Stanisavljevic, V. Lazarevic</i> SYSTEMATIZATION AND SUGGESTION OF TREATMENT OF ELECTROPLATING PROCESSES POLLUTER.....	151
<i>Snezana Urosevic, R. Nikolic, A. Fedajev, B. Pejic</i> COLLECTION AND RECYCLING OF ELECTRONIC AND ELECTRICAL WASTE IN SERBIA.....	159
<i>Samir Nuric, A. Nuric, M.Jukan, J.Jamakovic</i> OPTIONS FOR RECLAMATION OF DEGRADED AREAS AT THE PIT MINE.....	166
<i>Adila Nuric, S. Nuric</i> STABILITY ASSESSMENT FOR EMBANKMENTS AT PIT MINE CUBRIC.....	174
<i>Vladimir Jovanovic, Z. Sekulic, S. Mihajlovic, B. Ivosevic, M. Petrov, D. Radulovic</i> INVESTIGATION OF DISSOLUTION OF LIMESTONE BRIQUETTES FROM DOBRILOVICI DEPOSIT IN WATER.....	183
<i>Zivko Sekulic, S. Mihajlovic, B. Ivosevic, V. Jovanovic, M. Djokanovic</i> THE CHOICE OF FLOCCULANTS FOR SEDIMENTATION OF SLUDGE FROM "BOKSIT MILICI" SEPARATION.....	187
<i>Silvana Dimitrijevic, M. Rajcic-Vujasinovic, R. Jancic-Hajneman, D. Trifunovic, J. Bajat, V. Trujic, S. Alagic</i> NON-CYANIDE ELECTROLYTES FOR GOLD PLATING – A REVIEW OF RECENT DEVELOPMENTS.....	194
<i>Jelena Kiurski, I. Oros, S. Adamovic, L. Comic</i> THE COMPOSITION OF SHEET-FED OFFSET PRINTING INKS.....	200
<i>Tatjana Apostolovski-Trujic, J. Petrovic</i> SULFUR DIOXIDE EMISSIONS FROM MAJOR STATIONARY SOURCES IN THE COPPER SMELTER BOR.....	206
<i>Mirjana Rajcic-Vujasinovic, D. Vujasinovic, V. Grekulovic</i> COPPER AND COPPER ALLOYS IN CATALYSIS OF REACTIONS ELIMINATING GREENHOUSE GASES.....	211
<i>Mirad Delic, A. Nuric, S. Nuric, V. Radulovic</i> REHABILITATION OF THE LANDFILL OPEN "DUBRAVE" PIT MINE.....	216
<i>Darko Ljubic, M. Stamenovic, J. Petrovic, J. N. Shera, O. Jovanovic, M. Nujkic</i> BIODEGRADABLE PACKAGING FROM POLYETHYLENE AND LIFE-CYCLE ASSESSMENT	221
<i>Dominik Brkic, J. Petrovic, I. Dimic, M. Stamenovic, S. Putic</i> INFLUENCE OF THE PROCESSING OF POLYMER COMPOSITE MATERIALS ON THE ENVIRONMENT AND SOCIETY.....	229

<i>Ivana Dimic, J. Petrovic, M. Stamenovic, M. Rakin, S. Putic</i> POSSIBILITIES OF USAGE MECHANICAL PROPERTIES OF POLYMER COMPOSITE MATERIALS USING DIFFERENT RECYCLING METHODS.....	234
<i>Jelena Petrovic, M. Stamenovic, D. Ljubic, O Jovanovic, I. Dimic, D. Brkic</i> WASTE MANAGEMENT IN THE MUNICIPALITY OF SREMSKA MITROVICA.....	241
<i>Zoran Grdic, G. Toplicic-Curcic, N. Ristic, I. Despotovic</i> INFLUENCE OF ADDITION OF RECYCLED RUBBER TO CONCRETE ON ITS PHYSICAL-MECHANICAL PROPERTIES.....	248
<i>Dragana Randjelovic, I. Pacic, D. Randjelovic, T. Marjanovic</i> PUBLIC PARTICIPATION IN THE PROJECT OF RECONSTRUCTION AND BUILDING A NEW SMELTER AND SULFURIC ACID PLANT IN RTB BOR.....	255
<i>Sonja Stefanov, R. Biocanin</i> MODELING OF POLLUTANTS AT THE LANDFILL WASTE.....	264
<i>Dejan V. Antic, G. D. Bogdanovic, M. M. Antonijevic, V. Stankovic</i> REMOVAL OF COPPER IONS FROM ACID MINE DRAINAGE USING ANTHRACITE COAL.....	272
<i>Grozdanka D. Bogdanovic, Z. S. Markovic, M. Z. Trumic, D. V. Antic, M. S. Trumic, B. Milivojevic</i> SEDIMENTATION OF SUSPENDED PARTICLES FROM THE OILY INDUSTRIAL WASTE WATER.....	280
<i>Zoran Markovic, G. Bogdanovic, D. Antic, Z. Stirbanovic, B. Sokolovic</i> SOME ENVIRONMENTAL PROBLEMS BY USING XANTHATES IN FLOTATION.....	286

SOIL AND WATER CONSERVATION ENGINEERING

<i>Maja Todorovic Izquierdo, T. Todorovic</i> BIOLOGICAL REINFORCEMENTS AS A FACTOR OF SUSTAINABLE SLOPE STABILITY - CASE STUDY OF THE ZVEZDARA PARK FOREST IN BELGRADE.....	290
<i>Tea Spasojevic-Santic, G. Drazic, Z. Radojevic</i> PHYTOREMEDIATION OF SOILS CONTAMINATED WITH HEAVY METALS.....	299
<i>Branislav Jerinkic, B. Starcevic</i> REPORT ON THE USE OF ENZYMATIC BACTERIAL PRODUCTS FOR THE BIOREMEDIATION OF SOILS POLLUTED BY ORGANIC SUBSTANCES.....	306
<i>Branislav Jerinkic, B. Starcevic, P. Brignoli, S. Ansfferi</i> THE QUALITY IMPROVEMENT OF WATER USED FOR IRRIGATION PURPOSES THANKS TO THE APPLICATION OF ENZYMATIC BACTERIAL PROMOTERS.....	311
<i>Dubravka Perovic, T. Spasojevic-Santic</i> BIOREMEDIATION AND INDOOR AIR QUALITY.....	315

<i>Sonja Braunovic, M. Ratknic</i> STADY OF RAIN EROSIVITY IN BELGRADE REGION.....	321
<i>Ljiljana Trumbulovic-Bujic, Z. Acimovic-Pavlovic, Lj. Andric</i> PROBLEMS OF SOIL EROSION.....	329
<i>Vladimir Pavicevic, M. Stamenovic, I. Stankovic</i> VELIKI BACKI KANAL PROJECT.....	335
<i>Marina Stamenovic, D. Brkic, O. Jovanovic, J. Petrovic, V. Pavicevic</i> SUGGESTION OF SOLUTION FOR REMEDIATION OF THE LANDFILL IN KUCEVO..	343
<i>Ivana Mladenovic-Ranisavljevic, Lj. Takic, N. Zivkovic, M. Vukovic, Z. Damjanovic</i> LONG-TERM CHANGES IN TEN WATER QUALITY PARAMETERS OF THE DANUBE IN SERBIA.....	350

ENERGY EFFICIENCY, ENVIRONMENT AND CLIMATE

<i>Radoje Cvejic, R. Cvejic, M. Stevic</i> PROJECT FOR ECOLOGICAL MODERNISATION OF THERMOENERGETIC BLOCKS AND FACILITIES.....	356
---	-----

NUTRITION AND HEALTH

<i>Konstansa Lazarevic, D. Stojanovic, M. Ilic</i> DIETARY INTAKE OF PROTEINS AND RISK FOR GASTRIC CANCER.....	364
---	-----

AGRICULTURE: AGRIBUSINESS, AGROENGINEERING AND ORGANIC FOOD PRODUCTION

<i>Marija Mihajlovic, M. Grubisic, M. Stojanovic, Z. Lopacic, J. Milojkovic, M. Petrovic</i> EFFICIENCY OF ZEOLITE ENRICHED NATURAL PHOSPHATE FERTILIZER – A VEGETATION TRIAL WITH MAIZE.....	368
<i>Mirko Grubisic, Lj. Boskovic-Rakocevic, M. Mihajlovic, M. Stojanovic, Z. Lopacic, J. Milojkovic</i> EFFICIENCY OF ZEOLITE AND APATITE FOR THE REMEDIATE OF RADIONUCLIDES AND TOXIC METALS FROM THE SOIL.....	373

URBAN ECOLOGY

<i>Biljana Maluckov, V. Tasic, C. Maluckov</i> THE INFLUENCE OF THE LOW-FREQUENT ELECTROMAGNETIC RADIATION ON HUMANS HEALTH.....	380
--	-----

<i>Visa Tasic, B. Maluckov, R. Kovacevic, M. Jovasevic-Stojanovic, M. Zivkovic</i> FIELD COMPARISON OF CONTINUOUS PARTICULATE MATTER MONITORS FOR MEASUREMENT OF AMBIENT AEROSOLS.....	386
<i>Nadezda Stojanovic, M. Mesicek, M. Ocokoljic, D. Stojicic, S. Matic</i> PLAN AND PROGRAM DEVELOPMENT OF MANAGING URBAN GREEN SPACES.	392
<i>Nadezda Stojanovic, M. Mesicek, N. Anastasijevic, V. Anastasijevic, S. Matic</i> TREE FUNCTIONALITY <i>Quercus rubra</i> L. USED IN GREENING OF PRIMARY SCHOOL "MILOS CRNJANSKI" IN BELGRADE.....	399
<i>Nevenka Galecic, D. Skocajic, D. Vujicic, A. Tutundzic, N. Stojanovic, S. Matic</i> CONSTRUCTION AND CONSTRUCTIVE ELEMENTS OF A PATH IN LANDSCAPE DESIGN.....	406
<i>Nevenka Galecic, A. Tutundzic, D. Vujicic, D. Skocajic, N. Stojanovic, S. Matic</i> TECHNICAL POSSIBILITIES OF APPLYING WOODY PLANTS IN DESIGNING ROOF GARDENS.....	413
<i>Dragana Cavlovic, M. Celic, D. Obratov-Petkovic</i> DENDROFLORA IN CENTRAL BELGRADE AREA, AS A KEY ROLE TO ITS SUSTAINABILITY.....	420
<i>Ana Gacic, M. Glavendekic, I. Blagojevic, J. Cukanovic, E. Mladenovic</i> PLANT MATERIAL IN HORTICULTURE THERAPY.....	426
<i>Ana Gacic, M. Glavendekic, I. Blagojevic, E. Mladenovic, J. Cukanovic</i> APPLICATION OF HORTICULTURE THERAPY IN BOTANICAL GARDENS.....	434
<i>Jelena Petrovic, M. Stamenovic, O. Jovanovic, D. Brkic, D. Radosavljevic</i> THE ANALYSIS OF NEGATIVE TRAFFIC INFLUENCE ON THE ENVIRONMENT AND SOCIETY IN BELGRADE.....	442
<i>Sinisa Andrasev, M. Bobinac, S. Roncevic, M. Vuckovic, B. Stajic</i> THE STRUCTURE OF POPLAR TREES IN URBAN GREEN AREAS OF NOVI SAD.....	449
<i>Aleksandar Vukanovic</i> RELATIONSHIP TO THE CITIZENS TREBINJA ENVIRONMENTAL PROTECTION.....	457
<i>Ljiljana Stosic, Lj. Blagojevic, S. Milutinovic, K. Lazarevic</i> MONITORING OF PHOTOCHEMICAL SMOG IN NIS BETWEEN 2001-2010.....	464
<i>Dragana Rakovic, J. Petrovic, N. Stavretovic, O. Kosanin</i> STATE AND RECOMMENDATIONS FOR IMPROVING THE GRASS PITCHES OF RED STAR BELGRADE FC AND PARTIZAN FC.....	468
<i>Nenad Stavretović, J. Petrović</i> BRIEF HISTORY AND SIGNIFICANCE OF THE PRODUCTION OF GRASS CARPETS..	476

ECOLOGICAL MANAGEMENT (LOW, ECONOMY AND STANDARDIZATION)

Tatjana Lukic, B. Tubic, M. Pisaric
ENVIRONMENTAL IMPACT ASSESSMENT ACROSS BORDERS..... 482

Pasqua L'Abbate
EVOLUTION OF THE ANALYSIS OF INPUT/OUTPUT IN PHYSICAL UNITS..... 489

Radmilo Nikolic, A. Fedajev, S. Urosevic, I. Svrkota
ECOLOGY AND PRICE POLITICS..... 497

Marius Nicolae Miculescu, C. Miculescu, A. Bratu
COST-BENEFIT ANALYSIS, EFFECTIVE TOOL SUPPORT
OF SUSTAINABLE PROGRESS..... 503

Milos Stevic, R. Cvejic
OVERVIEW OF CURRENT TRENDS AND CHALLENGES IN THE MODERN WORLD
OF INTERNET, WEB APPLICATIONS AND SERVICES. ADVANTAGES AND
CHALLENGES OF BUSINESS AND COMMUNICATION..... 511

ENVIRONMENTAL IMPACT ASSESSMENT

Miodrag Miljkovic, R. Stanojlovic, J. Sokolovic
POSSIBILITY OF ACCIDENT OCCURRENCE AND ENDANGER OF ENVIRONMENT.. 518

ECOLOGICAL ETHICS AND ECOLOGICAL EDUCATION

Milica Andevski, M. Vidakovic, L. Murserovic
EDUCATION FOR SUSTAINABLE DEVELOPMENT OR ECOLOGICAL EDUCATION.. 528

Darko Radosavljevic, I. Stojkovic, V. Pavicevic
THE ROLE OF THE PERMANENT EDUCATION IN THE PROTECTION
OF THE ENVIRONMENT..... 535

Tibor Halasi, D. Lalosevic, S. Kalamkovic, R. Halasi, M. Miklos
BEGINNINGS OF ACADEMIC TEACHING OF ECOLOGY IN SERBIA..... 540

ECO TOURISM AND SUSTAINABLE DEVELOPMENT

Dragica Stojanovic, B. Ilic, D. Mihajlovic
ENVIRONMENTAL MANAGEMENT IN THE FUNCTION OF
SUSTAINABLE TOURISM DEVELOPMENT..... 549

Danijela Vukoicic, J. Dragojlovic, M. Nikolic, F. Bacevic, N. Bacevic
OPPORTUNITIES FOR TOURISM DEVELOPMENT AND ENVIRONMENTAL
PROTECTION OF RADAN MOUNTAIN..... 556

Cipriana Sava
ENDURO- TOURISM, CYCLO-TOURISM AND THEIR EFFECTS
ON THE ENVIRONMENT..... 563

Dina Maria Lut, M. Ogarlaci
MANAGEMENT OF PROTECTED AREAS IN CARAŞ-SEVERIN COUNTY,
IN THE CONTEXT OF ECOTOURISM DEVELOPEMENT.....569

PREVENTIVE MEDICINE AND ECOLOGY

Suzana Milutinovic, Lj. Stosic, D. Bogdanovic
AIR POLLUTION AS A RISK FACTOR FOR CHRONIC OBSTRUCTIVE
PULMONARY DISEASE..... 576

Biljana Kalicanin, D. Velimirovic, S. Naumovic
THE INFLUENCE OF PACKAGING MATERIAL ON THE CONTENT OF TOXIC
METALS IN THE BEVERAGE OF TEA FUNGUS KOMBUCHA582

Natasa Gojkovic-Bukvic, N. Bukvic
MULTIDISCIPLINARY APPROACH TO CREATE FRENLY ENVIRONMENT:
SCIENCEFICTION OR SCIENCEFRONTLINE..... 589

Liljana Sokolova, S. Dejanovic-Djukic, D. Djokic, N. Djokic, Z. Trivic
MENTAL HEALTH AND ENVIRONMENT, FACTORS WHICH DETERMINE OBESITY 598

STUDENTS PAPERS

Jasmina Jaksic
POSSIBLE ENHANCEMENT CONCEPT MANAGEMENT
PLAN OF NATIONAL PARK "DJERDAP"..... 603

Tamara Premovic, J. Premovic
NATURAL MINERAL WATERS AND THEIR IMPACT ON HEALTH..... 611

Jelena Premovic, Lj. Arsic, S. Vujovic
ECOTOURISM IN CONTEXT OF ENVIRONMENTAL PROTECTION.....619

Milica Samardzic
QUALITY OF WATER IN THE RIVER NISAVA BASIN..... 625

Sandra M. Pejic, S. Urosevic, D. Miljkovic
AIR POLLUTION INFLUENCE ON HUMAN HEALTH IN BOR AND ZAJECAR
DURING THE PERIOD SINCE YEAR 2007 UNTIL YEAR 2010..... 631

<i>Bozidar Rancic, N. Rancic</i> THE INFLUENCE OF WIND ENERGY ON ENVIRONMENT.....	637
<i>Ana Milovanovic, Milos Kirov, Milos Petrovic</i> THE IMPACT OF COAL PRODUCTION IN RB "KOLUBARA" ON THE ENVIRONMENT.....	641
<i>Milica Djordjevic, V. Nikolic, M. Katalinic</i> METALLURGY AND ITS IMPACT ON THE ENVIRONMENT IN SERBIA.....	642
<i>Milena Katalinic, M. Djordjevic, V. Nikolic</i> SOURCES OF POLLUTION IN THE MUNICIPALITY OF BOR.....	643
AUTORS' INDEX.....	645



AN EVALUATION OF HEALTH EFFECTS OF PRECIPITATION USING REGRESSION AND ONE-WAY ANALYSIS OF VARIANCE

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ABSTRACT

We investigated relations between the amount of precipitation and daily hospital admissions for cardiovascular diseases in the City of Niš during the 2001 to 2010 period. There were variations in the number of cardiovascular disease related hospital admissions in relation to the amount of rainfall, but they were not statistically significant. Hospital admissions were the most frequent when the amount of snowfall in the period up to 4 days before admission to hospital care was greater than 10 cm, and statistically significant differences were confirmed for Lag 2 in relation to the days with no snowfall ($p=0.02$) and to the days when the amount of snowfall was up to 5 cm ($p=0.04$).

Key words: weather, precipitation, hospital admissions, regression, analysis of variance

INTRODUCTION

Interest in the impact of weather on human health is increasing, especially in the light of potential climate changes [1,2]. Most investigations have focused on the effect of temperature on health through a time series approaches or focusing on extreme events (heat waves, cold spells) using episode analysis. Recently, studies on the effect of high temperatures on morbidity provided evidence of an increase in emergency hospital admissions for specific causes [3]. Schwartz et al. reported an effect of heat on cause-specific admissions within a few days after exposure and a short-term displacement of the events (harvesting effect) [4]. Smaller amount of studies have investigated adverse health effects of humidity, atmospheric pressure, precipitation, wind speed, wind direction, total cloud cover, solar radiation and visibility [2].

Health effects of precipitation

Most of the studies to date that have investigated the health effects of precipitation concentrated on the impact of snow. They demonstrated that heavy snowfall is associated with a significant increase of deaths and hospital admissions for

stroke and myocardial infarction. Adverse health effects showed a large increase for a three- to eight-day period after the snowfall. This increase is most likely a function of after-snowfall activities (snow shovelling, difficult movement). The risk is more significant in males than in females, probably because they are more exposed to snow-related physical activities [5].

Rainfall appears to have a limited impact on health. Kalkstein [6] has shown that a significant decline in mortality is experienced the day after summer rainfall, and the assumed mechanism of influence is an indirect effect of high summer temperature decrease. Precipitation and temperature also influence the decrease of time people spend outside, and the length of exposure to out-door air pollution.

Regression analysis

The goal of regression analysis is to model the expected value of a dependent variable y in terms of the value of an independent variable (or vector of independent variables) x . In simple linear regression, the model $y = \alpha + \beta x$ is used, where for each unit increase in the value of x , the conditional expectation of y increases by β units. However, in time series studies that estimate associations between day-to-day variations in weather variable values and day-to-day variations in adverse health outcomes, that type of linear relationship model cannot be used. One widely used approach for such an analysis involves a semi-parametric Poisson regression with polynomial, splined or smoothed dependent-independent variable functions to assess the relations between daily mortality or morbidity counts, weather variables and confounders (seasonality, long term trends, other weather variables and air pollution) [7].

Semi-parametric regression models are usually fitted using Akaike information criterion (AIC). Polynomial, splined and smoothed exposure-response curves are estimated to visually assess the shape of the relations between adverse health events and weather variables but it is often difficult to interpret the individual coefficients in a semi-parametric regression fit.

In some studies, instead of using an exposure-response curves function, authors used linear terms to represent low and high values. It is a way to obtain quantitative effect estimates of those values on adverse health events according to the logistic regression model. Low values were those below the 10th centile and high values were those above the 90th centile [8].

In other studies authors simply compared adverse health event counts between months or seasons with different weather variable levels [9].

One-way analysis of variance

One-way analysis of variance (one-way ANOVA) is a statistical method used to compare means of two or more samples using the F distribution. The ANOVA tests the null hypothesis that samples in two or more groups are drawn from the same population. To do this, two estimates are made of the population variance. The ANOVA produces an F statistic, the ratio of the variance calculated among the means to the variance within the samples. If the group means are drawn from the same population, the variance