The book of abstracts

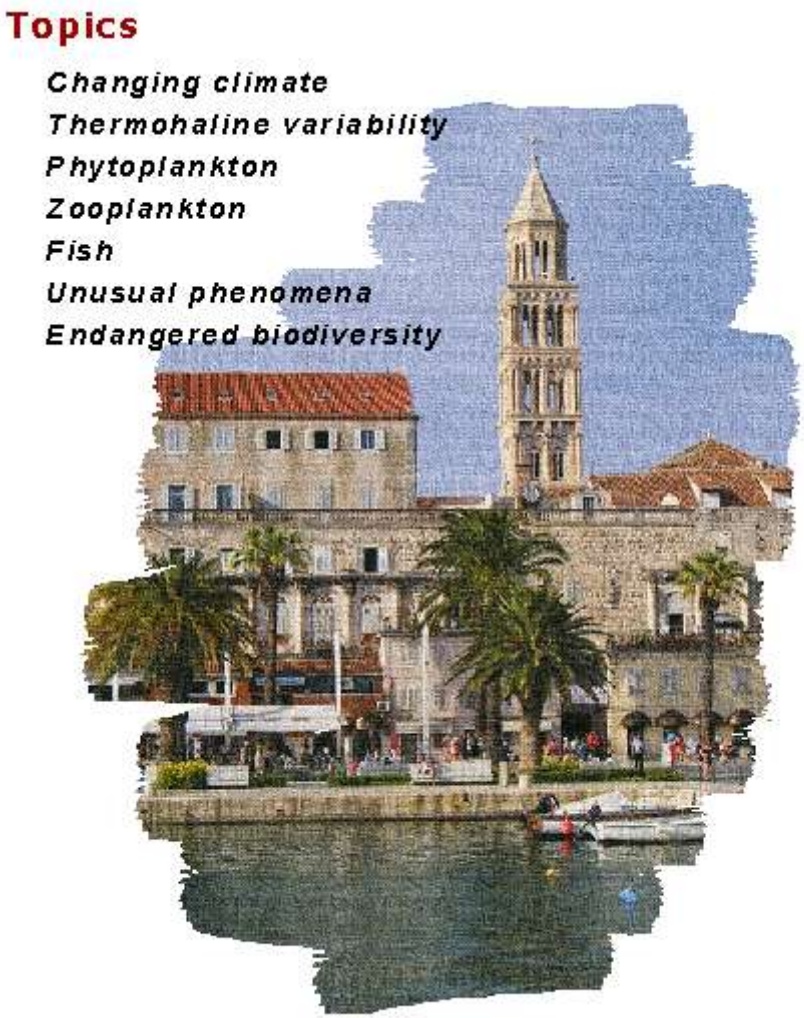
from the meeting

Climate and Ecosystem

held at the

Institute of Oceanography and Fisheries, Split (Croatia)

25 November 2011



Organizing committee

M.Morović, I.Marasović, B.Grbec, J.Dulčić, G.Beg Paklar, F.Matić, Ž.Kovač, A.Marušić

Scientific committee

prof dr Ivona Marasović, prof dr Branka Grbec, dr Krešo Pandžić, prof dr Ivica Vilibić, dr Živana Ninčević, dr Mira Morović

Programme

9:00-9:15 Registration

9:15-9:20 Prof Dr Ivona Marasović, Welcome of the Director of the Institute

9:20-9:30 Mira Morović
About the project "Cooscillations of the atmosphere and the sea of importance for the Adriatic ecosystem" its goals and achievements.

Meeting presentations

9:30-9:50 Branka IVANČAN-PICEK, Kristian HORVATH, Nataša STRELEC MAHOVIĆ,
Mechanisms producing heavy precipitation event in the southern Adriatic area

9:50-10:10 Kristian HORVATH, Alica BAJIĆ, and Stjepan IVATEK-ŠAHDAN, Dynamical downscaling of wind speed in complex terrain prone to bora-type flows

10:10-10:30 Mirta PATARČIĆ, Ivan GÜTTLER, Lidija SRNEC, Čedo BRANKOVIĆ, Extreme climatic events over Europe in regcm simulations of present and future climate

10:30-10:50 Gordana BEG PAKLAR and Mirko ORLIĆ,
Response of the Adriatic Sea to the meteorological forcing under the present-day and future climatic conditions

10:50-11: 20 Coffee break

11:20-11.40 Branka GRBEC, Mira MOROVIĆ, Frano MATIĆ, Alica BAJIĆ, Stjepan IVATEK-ŠAHDAN, Ante ŽULJEVIĆ,
Unusual and long lasting atmospheric conditions over the Adriatic Sea and its influence on thermohaline variability

11.40-12:00 Frano MATIĆ, Branka GRBEC, Mira MOROVIĆ,
Atmospheric tele-connection pattern related to termohaline conditions in Adriatic Sea

12:00-12:20 Ivica VILIBIĆ, Jadranka ŠEPIĆ, Nicolas PROUST,
Observational evidence of a weakening of thermohaline circulation in the Adriatic Sea

12:20-12:40 Mira MOROVIĆ, Branka GRBEC, Živana NINČEVIĆ, Olja VIDJAK, Natalija BOJANIĆ; Frano MATIĆ, Žarko KOVAČ,
The Adriatic Sea ecosystem and tele-connection patterns

12:40-13:00 M. KRŽELJ, A. RUSSO, M. BASTIANINI, G. SOCAL, F. GRILLI, M. RAVAIOLI, N. VRGOČ,
Long-Term Variations Detected in the Adriatic Sea

13:00-13:20 Goran LONČAR, Marin PALADIN and Vladimir ANDROČEC,
Influence of Sea Level Rise and River Mirna Discharge Decrease on Salt Water Intrusion

13:20-13:30 Short break for photographing

13:30-14:00 Drafting conclusions of the meeting, information for publishing in Acta Adriatica.

*names of presenters are underlined

Mechanisms producing heavy precipitation event in the southern Adriatic area

Branka IVANČAN-PICEK, Kristian HORVATH,

Nataša STRELEC MAHOVIĆ

Croatia Meteorological and Hydrological Service Grič 3, 10000 Zagreb

picek@cirus.dhz.hr

Abstract

Extreme precipitation event occurred in the morning hours on 22 November 2010 over Dubrovnik, Croatia and the surrounding area of the southern Dinaric Alps mountain range. The event caused severe flash floods, landslides, interruption of traffic and electricity as well as other infrastructural damage.

The mechanisms responsible for the formation of convection have been analyzed though synoptic measurements, satellite data and convection-resolving numerical experiments performed with the WRF model. The numerical simulations highlighted the essential role of southerly low-level jet stream (LLJS) in the transport of warm and moist air towards the affected area. In addition, numerical sensitivity experiments shaded light on the role of the complex orography of the southern Dinaric Alps on the initialization and development of convection over the target area.

Dynamical downscaling of wind speed in complex terrain prone to bora-type flows

Kristian HORVATH, Alica BAJIĆ, and Stjepan IVATEK-ŠAHDAN

Croatia Meteorological and Hydrological Service Grič 3, 10000 Zagreb

kristian.horvath@cirus.dhz.hr

Abstract

In complex terrain the global model reanalysis, forecast or climate data needs to be downscaled to provide information for regional interpretation. Dynamical downscaling was performed with the use of ALADIN model for the entire Adriatic area, driven by the ERA-40 reanalysis for a 10-yr period. Complimentary statistical and spectral verification, performed on measurement stations in different climate regions of Croatia, suggested that downscaling was successful. The main improvement of the dynamical downscaling is found for stronger cross-mountain flows (e.g., bora) and for diurnal circulations. Due to underestimation of energy of sub-diurnal motions, further improvement of wind resource assessment in complex terrain may be achieved through the use of higher resolution numerical modeling.

Extreme climatic events over Europe in RegCM simulations of present and future climate

Mirta PATARČIĆ, Ivan GÜTTLER, Lidija SRNEC,

Čedo BRANKOVIĆ

Meteorological and Hydrological Service (DHMZ) 10000 Zagreb, Grič 3, Croatia

mirta.patarcic@cirus.dhz.hr

Abstract

The Regional climate model (RegCM) is used to simulate present (P0: 1961-1990) and future (P1: 2011-2040) climate over Europe. Simulations are carried out for three ensemble members defined by the global coupled climate model ECHAM5-MPIOM. Future climate projection is done under the IPCC A2 emission scenario. Analysis of RegCM results is focused on the following 2m temperature (T2m) and precipitation indices of extremes: cold (warm) nights and cold (warm) days, moderate wet days, very wet days and the largest number of consecutive dry days. Cold nights and cold days show decreasing trends in both periods, while warm nights and warm days have mostly increasing trend. Most of the trends based on T2m extremes are significant in summer, while in winter trends are significant only in P1 over the Mediterranean region. For precipitation extremes, significant is only increasing trend of the largest number of consecutive dry days in summer during P0 in the northern part of the domain.

Response of the Adriatic Sea to the meteorological forcing under the present-day and future climatic conditions

Gordana BEG PAKLAR* and Mirko ORLIĆ**

*Institute of Oceanography and Fisheries, Split, Croatia

**Andrija Mohorovčić Geophysical Institute, Department of Geophysics, Faculty of Science, University of Zagreb, Croatia

beg@izor.hr

Abstract

The Princeton Ocean Model (POM) was used to simulate the effect of four selected wind episodes on the Adriatic Sea dynamics. Two bora and two sirocco episodes were selected as the strongest and longest wind episodes over the Adriatic from the results of two numerical experiments obtained by a coupled ocean–atmosphere model ECHAM4. The first – control experiment – was run for the period 1970–1999 and represents the present climate, whereas the second – scenario experiment – was run for the period 2060–2089 and represents the future climate corresponding to effective CO_2 doubling. The surface meteorological fields from the ECHAM4 model with approximately 1.125 degrees spatial and six hours time resolution were used to calculate the wind stress and heat flux fields in order to force the ocean model.

Two groups of experiments were run with the POM model. The first group of four experiments was initialised with the results of almost three–year–long simulations, which precede the selected wind episodes, whereas the other four experiments were started from the state of rest and with the climatological temperature and salinity fields.

Analysis of the numerical model results revealed many problems with the three–year–long simulations probably related to the used curvilinear grid and radiation condition applied at the southern open boundary.

Current and temperature fields obtained in the bora control and scenario experiments show no essential difference between these two experiments. Sea surface salinities in the bora scenario experiment are somewhat lower than in the bora control experiment, which can be ascribed to

the longer duration of the bora scenario episode. Differences between effects of the control and scenario sirocco events arise from their different duration. Longer duration of the sirocco scenario event induces stronger mixing, which affects temperature and salinity fields. Moreover, it supports prolonged rising of sea level.

Unusual and long lasting atmospheric conditions over the Adriatic Sea and its influence on thermohaline variability

Branka GRBEC*, Mira MOROVIĆ*, Frano MATIĆ*, Alica BAJIĆ**, Stjepan IVATEK-ŠAHDAN**, Ante ŽULJEVIĆ*

* Institute of Oceanography and Fisheries Setaliste I. Mestrovica 63, 21000 Split, Croatia

** Croatia Meteorological and Hydrological Service Grič 3, 10000 Zagreb

grbec@izor.hr

Abstract

The results of statistical analysis of long lasting extreme weather conditions prevailing over the Mediterranean since 1960 were used to highlight significant thermohaline changes of the Middle Adriatic Sea. The interannual thermohaline fluctuations were investigated based on long term series of measurements over the Palagruža Sill (Split-Gargano transect), the area characteristic for the thermohaline conditions in the Middle Adriatic. During this period several extreme long lasting coupled atmosphere-ocean conditions were extracted and analyzed from the episodes of strong bora event during winter 1987 and 2002, hot summers 2003 and 2006, unusually warm winter 2007, extremely cold and windy autumn 2007, and last unusual prolonged warm summer 2011. All these atmospheric conditions significantly influenced thermohaline properties on the Palagruža Sill. Since 1960s the mean heat wave intensity, heat wave length and heat wave frequency across the Eastern Mediterranean significantly increased (Kuglitsch, et al., 2010), and during winter and even autumn periods of cold weather intensified. Adriatic Sea has been the main source of dense water masses for the Eastern Mediterranean, and it seems that long lasting extreme atmospheric conditions can change the previously established pattern of formations and spreading of the Adriatic dense water. Consequences of such as extreme thermohaline condition on biota might be significant. Unusual reduction of invasive green algae Caulerpa taxifolia settlements in Stari Grad (Hvar Island) was reported after extremely cold autumn 2007.

Atmospheric teleconnection pattern related to termohaline conditions in Adriatic Sea

Frano MATIĆ, Branka GRBEC, Mira MOROVIĆ

Institute of Oceanography and Fisheries Setaliste I. Mestrovica 63, 21000 Split, Croatia

fmatic@izor.hr

Abstract

Principal component analysis applied on long term (1963 - 2004) summer termohaline data along Palagruža sill distinguishes intermediary sea layer as layer representative for analyzing termohaline condition in the Adriatic Sea caused by atmospheric teleconnection pattern's variability. Analysis of temperature and salinity of intermediate layer revealed the three climate regimes (first until 1986, second from 1987 to 1998, third from 1999). All regimes are significant at 0.01 level according to Student's t-test. Until 1986 the fluctuations of termohaline data of intermediate layer were within expected climate range. Temperature of intermediate layer in the second climate regime was characterized with lower temperatures for more than two standard deviations in comparison with previous regime. Such thermohaline conditions took place until 1998, when the second shift occurred. After this shift the temperature abruptly increased, i.e. turned to the values close to those before the first shift. These changes in the marine environment are consequences of atmospheric changes over the area wider than the Mediterranean. Atmospheric teleconnection patterns during winter modified surface air pressure fields in zonal (AO, NAO) and meridional (EAWR) directions, causing different wind field types over the Adriatic Sea. Bura types associated with zonal and meridional pressure gradients govern the differences in evaporation over the two convection zone in Adriatic Sea and modify thermohaline regimes. Periods before and after the two shifts are characterized by rather strong exchange through the Otranto strait, while in the period between the shifts the EMT was crucial for lower exchange between the Adriatic Sea and the Mediterranean, as a consequence of changed wind pattern in the Ionian Sea as well as over the Adriatic Sea.

Observational evidence of a weakening of thermohaline circulation in the Adriatic Sea

Ivica VILIBIĆ, Jadranka ŠEPIĆ, Nicolas PROUST

Institute of Oceanography and Fisheries Setaliste I. Mestrovica 63, 21000 Split, Croatia

vilibic@izor.hr

Abstract

We provide observational evidence for the weakening of the Adriatic-Ionian thermohaline cell (AITHC), one of the three cells which drive the deep Mediterranean thermohaline circulation. The AITHC weakening is detected from long-term temperature, salinity and dissolved oxygen trends estimated from data measured between 1952 and 2010 along the Palagruža Sill, Adriatic Sea. The weakening of the AITHC is supported by a substantial decrease of the deep water formation (detectable from decrease in dissolved oxygen content, warming, and increase of salinity in deep waters) and by consequent advection of less saline and warmer Levantine Intermediate Water towards the northeastern Adriatic. Further weakening of the AITHC may have noteworthy impact on deep aquatic systems, and should therefore be monitored and assessed regularly.

The Adriatic Sea ecosystem and tele-connection patterns

Mira MOROVIĆ, Branka GRBEC, Živana NINČEVIĆ,

Olja VIDJAK, Natalija BOJANIĆ, Frano MATIĆ, Žarko KOVAČ

Institute of Oceanography and Fisheries Setaliste I. Mestrovica 63, 21000 Split, Croatia

morovic@izor.hr

Abstract

Northern hemisphere large scale tele-connection patterns impact the ecosystem changes of the Mediterranean Sea, thus the changes in these features highly affect oceanographic properties of the Adriatic Sea as well. The influence of mechanisms that control the climatic changes was studied analyzing correspondence with tele-connection indices, the set of most important proxies of the North hemisphere climate, like NAO, AO, SCA, EA and EAWR.

Analyzed thermohaline, biological and optical data in the Middle Adriatic indicate that the Adriatic Sea has undergone significant variations during the last decades. The changes in the ecosystem sometimes coincided with the changes in the local atmosphere, while in some periods direct links were not obvious.

The analysis of abrupt changes, duration and timing of changed regimes were tested with STARS method. The analyses were performed on seasonal time scales.

The Secchi disc data, 60 year record also helped in understanding the ecosystem variability.

Long-Term Variations Detected in the Adriatic Sea

M. KRŽELJ[1], A. RUSSO[2,4], M. BASTIANINI[3], G. SOCAL[3], F. GRILLI[4], M. RAVAIOLI[5], N. VRGOČ[6]

[1] Center of Marine Studies, University of Split, Livanjska 5/III, 21000 Split, Croatia

[2] Università Politecnica delle Marche, Dip. Scienze della Vita e dell'Ambiente, 60131 Ancona, Italy

[3] Consiglio Nazionale delle Ricerche, Istituto di Scienze Marine, 30122 Venice, Italy

[4] Consiglio Nazionale delle Ricerche, Istituto di Scienze Marine, 60122 Ancona, Italy

[5] Consiglio Nazionale delle Ricerche, Istituto di Scienze Marine, 40129 Bologna, Italy

[6] Institute of Oceanography and Fisheries, Šetalište Ivana Meštrovića 63, 21000 Split, Croatia

maja.krzelj@unist.hr

Abstract

Environmental changes and anthropogenic disturbance can cause variations in marine ecosystems. It is deduced that ongoing changes could have a stronger and faster effect on small and enclosed seas than other seas and oceans. Research in long-term ecological changes in the Adriatic basin, based on analysis of historical data, was carried on, with the aim to contribute to a better understanding of vulnerabilities and ongoing changes. In order to do that, different datasets have been analyzed, considering in the same time the complexity of available data and interconnections between different parameters. Obtained results show that the northern Adriatic Sea has been influenced by a general warming of air temperature, together with changes in precipitation pattern and a varying of Po river runoff, variations of thermohaline and biogeochemical properties in the northern Adriatic, which in turn drive marine ecosystems changes.

Influence of Sea Level Rise and River Mirna Discharge Decrease on Salt Water Intrusion

Goran LONČAR, Marin PALADIN and Vladimir ANDROČEC

Water Research Department, Faculty of Civil Engineering, University of Zagreb Savska 16, 10000 Zagreb, Croatia

goran.loncar@grad.hr

Abstract

The paper presents the numerical analysis of saline wedge intrusion into the river Mirna in the conditions of years 2007/2008 and 2019/2020. 3D numerical model covers the area of Novigrad Bay, resolving the transient fields of sea currents, temperature and salinity in the unsteady conditions of Mirna freshwater inflow. For the atmosphere forcing, model use the data sets from Aladin model results. Analysis related to the future hypothetic condition in the years of 2019/2020 are based on the same boundary conditions in terms of the sea temperature/salinity distribution at the model open boundary and atmosphere forcing at the air-sea interface. The influence of the climate changes are taken into account through the increase of mean sea level (+1.2 cm) and the decrease in mean annual discharge of the Mirna (reduced by 14%) in relation to 2007/2008 situation. The results of the analysis indicate increased upstream salt water intrusion in 2020 for about 1 km in comparison to 2008.