Physical oceanography in Croatia, Yugoslavia, 1987-1991.

Report to the International Union of Geodesy and Geophysics, presented at the XXth General Assembly, Vienna, Austria, 11-24 August 1991*

Physical oceanographic studies in Croatia (Yugoslavia) during the preceding four years have been mainly performed in the following institutions:

- Institute of Oceanography and Fisheries, Split,
- Hydrographic Institute of the Navy, Split,
- Andrija Mohorovičić Geophysical Institute, Faculty of Science, University of Zagreb,
- Center for Marine Research, Ruđer Bošković Institute, Zagreb and Rovinj.

Current and hydrographic data were collected by several research vessels (*Andrija Mohorovičić, Bios, Vila Velebita* and others) in the open and coastal Adriatic, in the framework of different national and international programs. Sea level was continuously registered at nine tide-gauge stations. Wind waves were measured at three stations. Activities were oriented towards studies of the open Adriatic dynamics, as well as towards investigations of the shelf area and small semi-enclosed basins distributed along the coast.

Large-scale dynamics has been studied using long-term sea level and atmospheric pressure data (Lascaratos and Gačić, 1990). High coherence at the time scales of synoptic disturbances and atmospheric planetary waves has been evidenced over the larger portion of the Eastern Mediterranean (Adriatic, Ionian and Aegean Seas). Year-to-year variations in some oceanographic and meteorological variables have been studied for three locations along the eastern Adriatic coast. It has been shown that long-term changes of sea level are mainly generated by steric effects and/or by heat advection within the sea (Kovačević et al, 1990). Recent climatic variations and possible implications of predicted changes on the Mediterranean and Adriatic circulation have been assessed (Gačić et al, 1988; Lascaratos et al, 1990). It was shown that bottom topography influences residual current pattern (Zore-Armanda and Bone, 1987). Moreover, it was documented that the residual circulation pattern influences to a large extent distribution of chemical and biological properties of sea water (Faganeli et al, 1989). A comprehensive set of physical and chemical data, collected in the Adriatic from 1971 through 1983, has been presented and analysed (Zore-Armanda et al, 1991).

Residual circulation of the North Adriatic was found to be under the strong bora wind influence, which produces transient two-gyre system of the basin's dimensions. A

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* This brief report was written on personal invitation to Dr. Mira Zore-Armanda from Dr. Robert E. Stevenson, Secretary-General, International Association for the Physical Sciences of the Ocean (IAPSO) of the International Union of Geodesy and Geophysics (IUGG). It seemingly remained the only such report presented by the Croatian or any other Yugoslav scientist to the XXth General Assembly of the IUGG. It is to be hoped that National Committee for IUGG will be activated in the near future, and that all the national geodetic and geophysical activities will be reported at the forthcoming meetings. This would conform to the practice of most member states of the IUGG. Ed.

thermal front position is variable depending on the bora wind forcing (Zore-Armanda and Gačić, 1987). Three-dimensional numerical modeling confirmed that the bora wind blowing above the North Adriatic induces cyclonic gyre (Kuzmić and Orlić, 1987; Bone, 1987; Kuzmić 1989). The current system is capable of advecting highly-productive Po influenced waters from the river mouth in an offshore direction – a phenomenon which may be observed from space (Kuzmić, 1991; Sturm et al, 1991). In the warmer part of the year the bora wind also generates inertia-period oscillations manifesting themselves not only in the current field but in the pycnocline variability as well (Orlić, 1987). Besides the wind-induced dynamics, long-term variability of the Adriatic shelf was also considered. In particular, seasonal and interannual salinity variations have been analysed in some detail for the North Adriatic area (Orlić, 1989).

Pattern of the water exchange between a semi-enclosed by and the adjacent water body was studied in the Kašel Bay (Gačić et al., 1987). The vertical pattern of the current response to the local wind forcing can be described in terms of the first baroclinic mode. Horizontal distribution of salinity and temperature in the Kaštela Bay and its dependence on seasonal heating, freshwater inflow and evaporation was also studied (Kovačević and Gačić, 1990). Interaction between the »red tide« development and some oceanographic and meteorological variables was investigated (Marasović et al, 1991). Moreover, a method for the determination of absolute geostrophic velocities was developed and applied to the Rijeka Bay (Limić and Orlić, 1987). High-frequency oscillations were detected in the Krka Estuary, and were interpreted in terms of internal waves coupled to the surface seiches of the basin (Orlić et al., 1991).

Selected references

Bone, M. (1987): On topographic and wind vorticity effects in bora driven circulation in the North Adriatic. Geofizika **4**, 129-135.

Faganeli, J., Gačić, M., Malej, A. and N. Smodlaka (1989): Pelagic organic matter in the Adriatic Sea in relation to winter hydrographic conditions. J. Plankton Res. **11**, 1129-1141.

Gačić, M., Dadić, V., Krstulović, N., Marasović, I., Morović, M., Pucher-Petković, T. and N. Sviličić (1987): Near-shore transport processes induced by the wind. Estuarine Coastal Shelf Sci. **24**, 35-46.

Gačić, M., Lascaratos, A. and T. S. Hopkins (1988): Implications of climatic changes on oceanographic characteristic in the Mediterranean. Meeting of the Task Team on Implications of Climatic Changes in the Mediterranean, Split, in press.

Kovačević, V., Gačić, M., and B. Grbec (1990): Interannual variability of the air-sea interaction along the eastern Adriatic coast. Rapp. Comm. int. Mer Médit. **32/1**, 185.

Kovačević, V. and M. Gačić (1990): Seasonal variability of sea temperature and salinity in the Kaštela Bay (in Croatian, with English summary). Vijesti Pom. met. centra **36**, 30-43.

Kuzmić, M. and M. Orlić (1987): Wind-induced vertical shearing – ALPEX/MEDALPEX data and modelling exercise. Ann. Geophysicae **5B**, 103-112.

Kuzmić, M. (1989): A numerical study of wind-induced motions in shallow coastal seas: model and basic experiments. Appl. Math. Modelling **13**, 178-191.

Kuzmić, M. (1991): Exploring the effects of bura over the Northern Adriatic – CZCS imagery and a mathematical model prediction. Int. J. Remote Sensing **12**, 207-214.

Lascaratos, A. and M. Gačić (1990): Low-frequency sea level variability in the northeastern Mediterranean. J. Phys. Oceanogr. **20**, 522-533.

Lascaratos, A., Gačić, M. and T. Oguz (1990): Climatic variability in the Northeastern Mediterranean and Black Sea. Rapp. Comm. int. Mer Médit. **32/1**, 186.

Limić, N. and M. Orlić (1987): A method for the determination of absolute geostrophic velocities in the sea. Tellus **A39**, 82-94.

Marasović, I., Gačić, M., Kovačević, V., Krstulović, N., Kušpilić, G., Pucher-Petković, T., Odžak, N. and M. Šolić (1991): Development of the red tide in the Kaštela Bay (Adriatic Sea). Mar. Chem. **32**, 375-385.

Orlić, M. (1987): Oscillations of the inertia period on the Adriatic Sea shelf. Cont. Shelf Res. **7**, 577-598.

Orlić, M. (1989): Salinity of the North Adriatic – a fresh look at some old data. Boll. oceanol. teor. appl. **7**, 219-228.

Orlić, M., Ferenčak, M., Gržetić Z., Limić, N., Pasarić, Z. and A. Smirčić (1991): High-frequency oscillations observed in the Krka Estuary. Mar. Chem. **32**, 137-151.

Sturm, B., Kuzmić, M. and M. Orlić (1991): Two types of CZCS-derived patterns in the Adriatic Sea – some image evaluations and oceanographic interpretations. Second Conference on Oceans from Space, Venice, in press.

Zore-Armanda, M. and M. Bone (1987): The effect of bottom topography on the current system of the open Adriatic Sea. Boll. oceanol. teor. appl. **5**, 3-18.

Zore-Armanda, M. and M. Gačić (1987): Effects of bura on the circulation in the North Adriatic. Ann. Geophysicae **5B**, 93-102.

Zore-Armanda, M., Bone, M., Dadić, V., Morović, M., Ratković, D., Stojanoski, L. and I. Vukadin (1991): Hydrographic properties of the Adriatic Sea in the period from 1971 through 1983. Acta Adriat. **32/1**, 1-547.

Mira Zore-Armanda

Earthquake risk reduction network in the Balkan region

2nd Task Group 3 meeting, Zagreb, 20–24 May, 1991.

The Task Group 3 (Correlation of Macroseismic Intensity with Acceleration and other Parameters of Strong Ground Motion) was established within the framework of scientific activities that were approved at the meeting of the »Permanent Coordinating Committee for Earthquake Risk Reduction in the Balkan Region« held in Paris in 1985. The first Task Group 3 meeting was held in Zagreb, 7–9 February, 1989, and the second one was held in Zagreb too, 20–24 May, 1991. At the second meeting five countries were represented: Albania, Bulgaria, Romania, Turkey and Yugoslavia.

At the opening of the meeting the participants were welcomed by the Minister of science, technology and informatics of the Republic of Croatia Professor Osman Muftić.

The national experts presented and discussed thoroughly the reports on the activities within the Task Group 3. The Greek national report was received after the meeting and is included in the report of the meeting.

Representatives of Albania, Romania and Turkey brought the tapes/diskettes containing available strong motion data from their countries and submitted them to the convener. It was concluded that each country participating in the TG 3 activities will send additional available strong ground motion records to the TG 3 convener. Data will be systematized and one set of all data will be distributed on diskettes to each of the national representatives in TG 3. All the participants stressed the necessity to create