PICES IX Japan/East Sea cruise

Vyacheslav B. Lobanov
Pacific Oceanological Institute
43 Baltiyskaya Street,
Vladivostok,
Russia. 690041
e-mail: pacific@online.marine.su

Dr. Vyacheslav (Slava) B. Lobanov is the Deputy Director of the V.I. Il'ichev Pacific Oceanological Institute of the Far Eastern Branch of the Russian Academy of Sciences. His scientific interest is in physical oceanography, and he is currently working on projects related with mesoscale eddies in the Japan/East Sea. Dr. Lobanov joined the PICES community in 1993 at the Nemuro workshop on Subarctic Circulation when he was involved in Working Group 1's activity. He was appointed as a member of the Physical Oceanography and Climate Committee (POC) in 1995 and elected as the POC Chairman at the PICES Seventh Annual Meeting in 1998. He also served as a Co-Chairman for the Okhotsk Sea workshops in Vladivostok (1995) and Nemuro (1998).

Hakodate City is located on the Tsugaru Strait and stands on the way from Vladivostok, Russia, to the North Pacific. When we go on scientific cruises we usually see the lights of Hakodate about one and a half days after departure. This is roughly the same time that you need to get to Hakodate from Russia by airplane, after making connecting flights across Japan. That is why when we heard that the Ninth Annual Meeting of PICES was going to be in Hakodate, our first idea was to go by ship. Even a research vessel of a small size could bring 10-15 marine scientists who might contribute to the meeting as presenters and participants. This would be a good chance to bring more Russian scientists, who usually have no funds to travel abroad, to a PICES meeting. At the same time, the V.I. Il'ychev Pacific Oceanological Institute (POI) had planned a cruise to the northern Japan Sea in the fall to conduct hydrographic and ecosystem studies under the new Russian federal program "World Ocean" and Naval International Cooperative Program (NICOP). A continuation of this cruise might have a port call at Hakodate.

The integration of these two objectives, with partial support from PICES, resulted in cruise No. 30 of R/V *Professor Gagarinskiy*. We called it the PICES Cruise because we were going to the PICES Annual Meeting, and we were planning to implement multi-disciplinary observations in the PICES area for a comprehensive study of the northern Japan/East Sea ecosystem structure and dynamics, consistent with the PICES scientific strategy.

The R/V *Professor Gagarinskiy* belongs to the Far Eastern Branch of the Russian Academy of Sciences. She is not large and economical 56 m in length and has 1100-ton tonnage. She is quite stable and allows work even in a rough sea (Fig. 1). The cruise was organized by POI with the participation of the Far Eastern Hydrometeorological Institute (FERHRI), TINRO-center, Institute of Marine Biology and Pacific Institute of Bioorganic Chemistry. Unfortunately we did not manage to have an international research team because of a lack of time for the necessary bureaucratic procedures related with EEZ.

Fig. 1 Working in the Tatar Strait (20 m/s wind): Sergey Sagalaev, Pavel Tishchenko and Olga Vereshchagina taking water samples at the last station of the leg.

The general idea of the scientific program is to study mesoscale water dynamics in the northwestern Japan/East Sea and its influence on the ecosystem. Extensive field observations implemented in the 1990s under CREAMS and ONR/JES programs revealed many findings in the circulation pattern of the basin. One of these findings is the high energy

and importance of mesoscale processes related to long-lived anticyclonic eddies over the deep central part of the sea (Japan Basin), and the strong topographic influence on water flow at the continental slope and bottom rise areas. The fall season is characterized by intense upwelling events along the Primorye coast of Russia. However the ecosystem impacts of these phenomena have never been studied in detail. The mesoscale structure of the Primorye (Liman) Current is expected to influence the composition and distribution of phytoplankton species at the shelf area, including the distribution of toxic species cysts about which we still have very poor knowledge. Our study was focused on the following major topics:

- ecosystem of isolated mesoscale eddy over the Japan Basin;
- structure of Liman Current ecosystem and its evolution during Primorye upwelling;
- biogeochemical processes at Primorye continental slope; and
- distribution and composition of the harmful algal (dinoflagellates cysts) and water quality along Russian shelf.

Observations included CTD measurements with water sampling for standard chemical parameters with nutrients, carbonate, chlorophyll and phytoplankton analyses, Jeddy net sampling for zooplankton and underway echosounder measurements. Because of limited funds, we had no sampling of higher trophic levels this time, with the exception of sampling and analyses of squid (Dr. Yuriy Zuenko). We also took samples of bottom sediments at coastal area to identify harmful algal cysts (Dr. Tatiana Orlova) and check environmental quality by biological testing (Drs. Dmitry Aminin and Irina Agafonova). To trace mesoscale structures we used NOAA satellite infrared images provided by the Inter-institute Center for Satellite Monitoring, Vladivostok (Drs. Anatoliy Aleksanin and Emil Herbeck), received just prior to the cruise and updated in Hakodate through the internet.

The cruise began just off the Vladivostok harbor on October 12, 2000, and ended at the same place on November 4 (Fig. 2). A few sections were observed repeatedly within the 2-3 week interval, which should allow us to see the ecosystem dynamics as a response to rapid changes of hydrographic structure in the fall season. A prominent upwelling event along the southern Primorye coast occurred after October 18, when we finished the first leg of the cruise (Fig.3). Rapid cooling and convective mixing of the 20-30 m surface layer also contributed to a change in the thermohaline structure. When we returned to the section off Preobrazhenie on October 31, we found that SST had declined to 3-7°C from 13-14°C on October 14 (Fig. 4). This also increased the salinity of the upper layer. Results of the upwelling are also seen at subsurface and intermediate depths. Water of the open sea, with lower temperature and higher salinity, had shifted close to the slope, replacing and displacing the offshore warm and fresh water of the Primorye Current. Slope water of 200-300 m came up to the shelf bringing higher nitrate concentration.

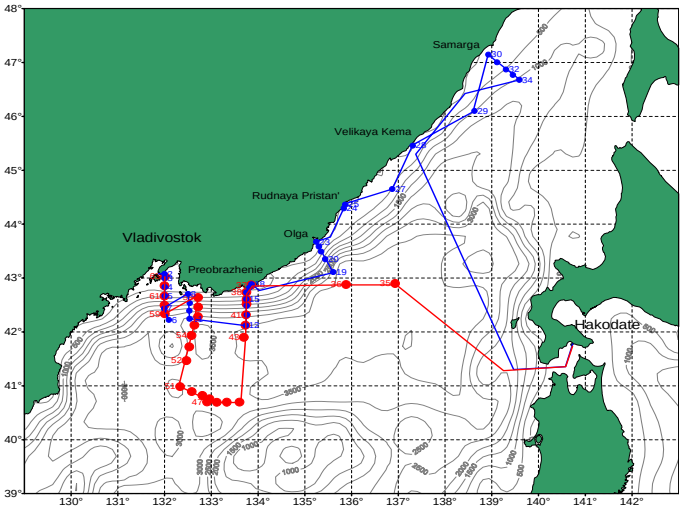

Fig. 2 Route of the cruise.

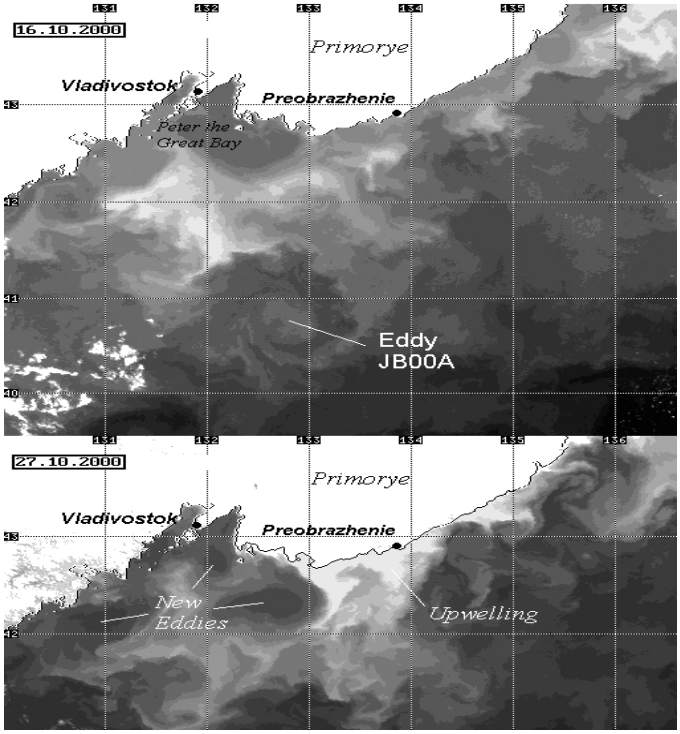

Fig. 3 Satellite images of study area showing upwelling event off Primorye coast and mesoscale anticyclonic eddies. Dark shades correspond to warm water areas, light shades are cold water, white areas are clouds.

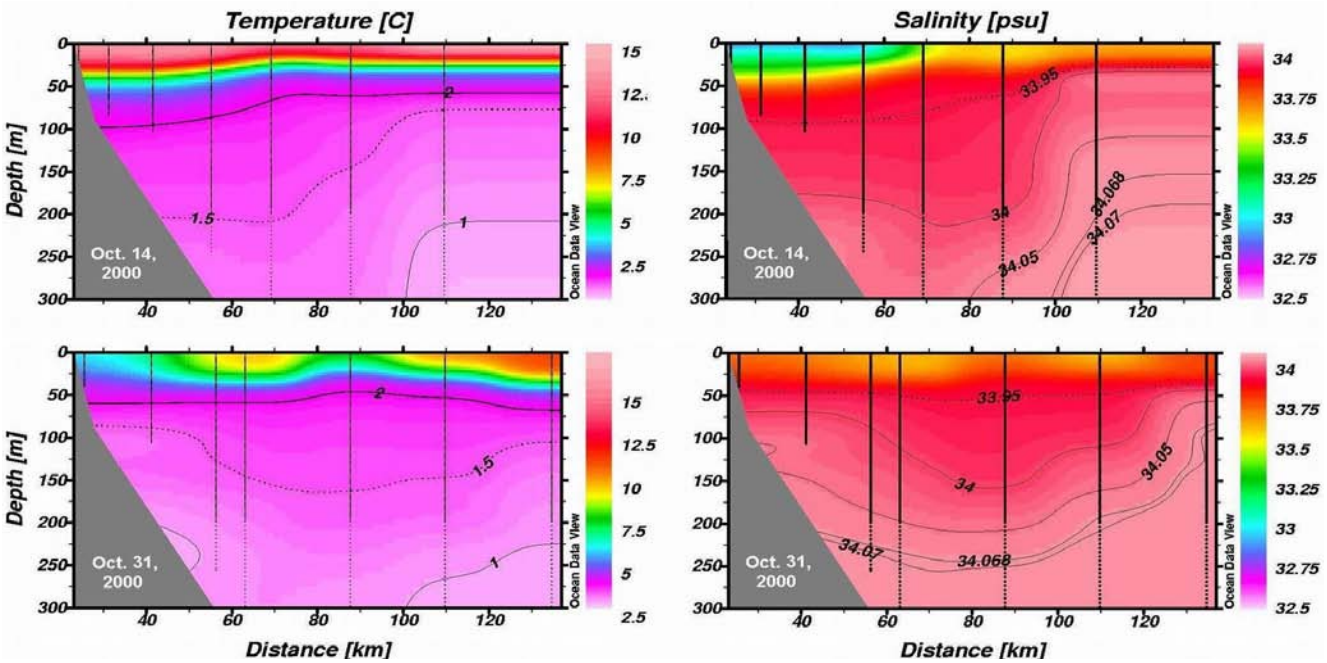

Fig. 4 Thermohaline changes at the section off Preobrazhenie during upwelling event and fall cooling.

At the same time, the horizontal structure of the Primorye Current system was noticeably changed (Fig. 3). A new anticyclonic eddy of 15-40 miles in diameter and intrusions of cold water were formed off Peter the Great Bay and along the slope off eastern Primorye.

Another objective of our cruise was to sample the anticyclonic eddy JB00A located over the southern part of the deep Japan Basin (Fig.3). The eddy was traced by satellite data from its formation in January 2000, southwest off Peter the Great Bay, and sampled on our previous cruises in March and July this year.

Recent hydrographic observations we made in cooperation with Drs. Lynne Talley (SIO), Yuri Volkov (FERHRI) and Steve Riser (UW), confirmed that these eddies travel from west to east, transporting water of lower salinity at intermediate depths and penetrating down to the bottom layer. Convergence and mixing in the upper layer as well as filamentation and streamer intrusions in the eddies should have a significant influence on the behavior of biological species. At the time of our most recent observations, the eddy had a weak signature at the surface but it was evident at depth (Fig. 5), keeping extremely cold and fresh water (0.25°C, 33.96 psu) trapped in its core at 260-380 m. A subsurface layer of high salinity was developed at the eddy center at 50-100 m providing a double-picnocline structure. These are some of the preliminary hydrographic results. After the completion of hydrochemical and biological analyses, we will understand the ecosystem response to mesoscale water processes.

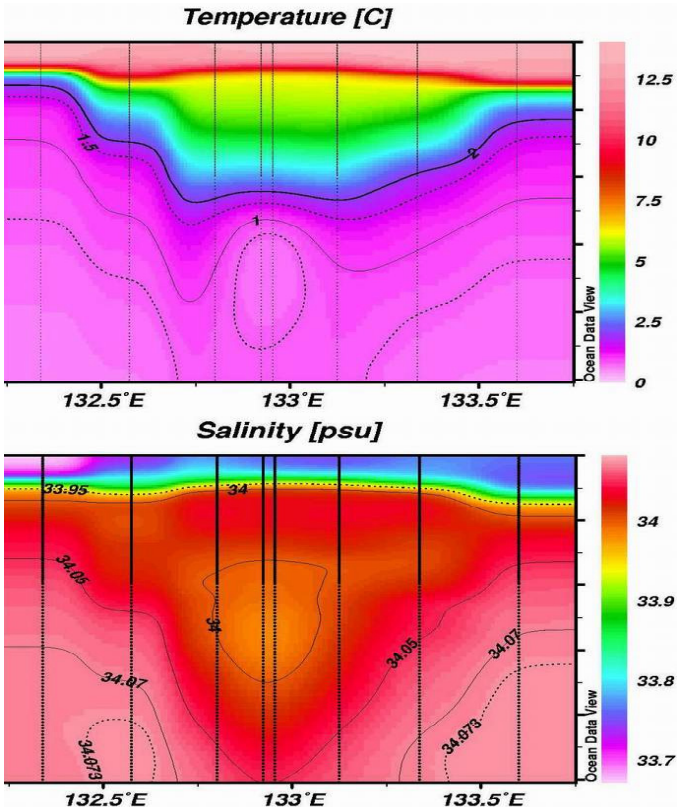

Fig. 5 Temperature and salinity section across the anticyclonic eddy over the Japan Basin (JB00A).

Coming back to the initial idea of the cruise, of bringing more and new people to the PICES meeting, we can say that it was successful. Most of the research group contributed to the PICES symposia and discussions. One of the researchers on board, Dr. Anatoliy Salyuk, received the Best Presentation Award for his talk at the topic session (Fig. 6). It was also good to relax in Hakodate in the middle of the cruise. We greatly appreciate the warm hospitality and kind arrangements of the Mayor of Hakodate City, all the staff of the Local Organizing Committee, and Dr. Yasunori Sakurai.

Thanks to Anatoliy Aleksanin for the satellite images, Sergei Sagalaev for the cruise scheme, Anatoliy Salyuk for the hydrographic sections, Pavel Tishchenko, Vladimir Ponomarev, Anatoliy Obzhirov, Yuri Zuenko, Lynne Talley, Steve Riser, Mikhail Danchenkov and Alexandr Nikitin for collaboration, inspiration and support in the organization of the cruise. Special thanks to Alexander Bychkov and Pat Livingston for support from PICES. Photos by V. Lobanov.

Fig. 6 Dr. Anatoliy Salyuk (right) reporting at the seminar on the ship after he received the PICES Best Presentation Award for the POC Committee.

(cont. from page 30)

Because PMEL's focus of research has been on the Bering Sea ecosystem during the past ten years, those portions of the theme page that deal with the Bering Sea are particularly well developed. Starting in the twenty-first century, the research focus is expected to shift to the North Pacific Ocean, and the theme page will see consequent development for that region. Presently the theme page averages about 80,000 "hits" each month. This number will increase as the larger North Pacific research community begins accessing the site.

To contribute information or to request subscription service to news postings, notify the site director at: *bering@pmel.noaa.gov*.

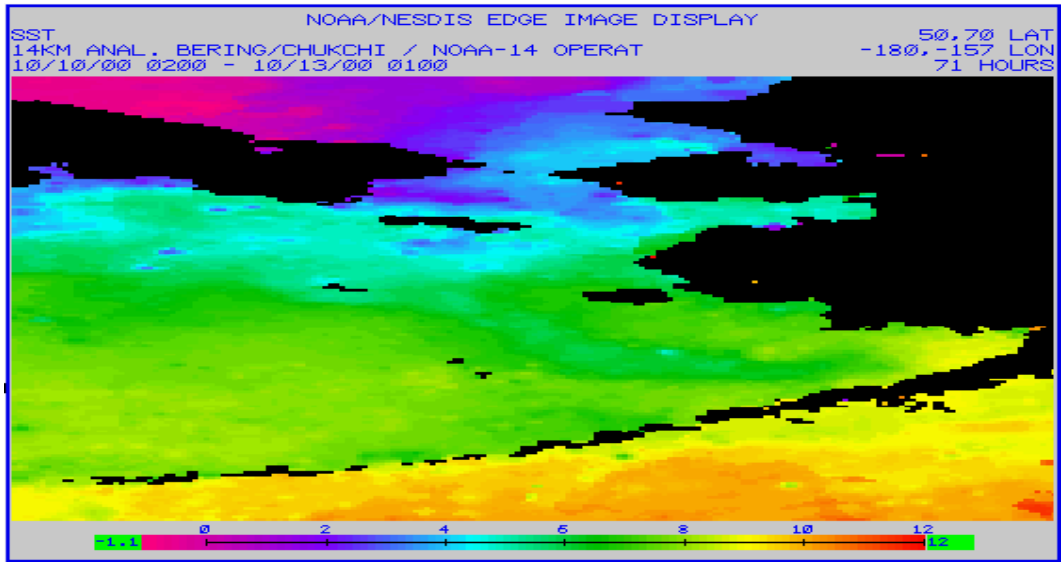

Fig. 2 Satellite-derived, sea-surface-temperature images such as this NOAA/NESDIS image from October 13 2000, are available for the Berng Sea and North Pacific Ocean from the theme page.