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Oceanographic Research Towers In European Waters

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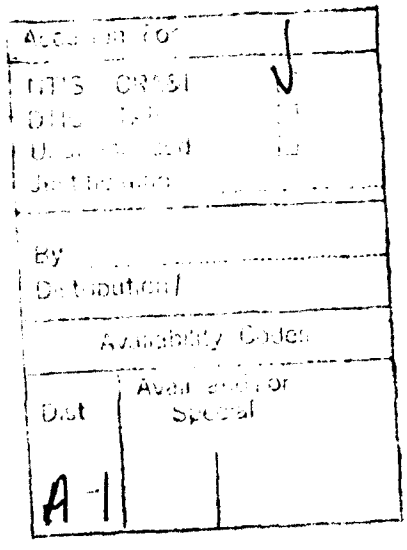

Oceanographic Research Towers In European Waters

by Hans Dolezalek, formerly a liaison scientist with the Office of Naval Research European Office in the areas of remote sensing and atmospheric electricity. Dr. Dolezalek is presently with the Office of Naval Research in Arlington, Virginia.

INTRODUCTION

Tower or Floating Platform?

Field experiments conducted to obtain, by in-situ measurements (the term "in-situ measurements" is used in contrast to remote sensing or remote measuring, but including measurements by in-situ instruments which may be remotely controlled and/or the results of which are telemetered), scientific data for the various disciplines of oceanography and maritime meteorology, suffer from the fact that the measuring instrument disturbs the natural parameters to be measured, especially if these measurements require the presence of man. In the atmosphere and at sea, it is more difficult than on land to apply instruments and their support as if they were part of the natural environment, and man is always alien in these environments. An exception are some types of experiments in ocean engineering, for which this difficulty arises only in a much reduced form or not at all.

An additional difficulty is caused by the possibility that the measurement of one oceanic parameter may be disturbed by other parameters' action on the instrument and/or its support, unless this action can be controlled or measured with a sufficient reliability and accuracy and thereby accounted for. Such accounting, however, has its own error sources and the resulting error bars must be incorporated into the accuracy determination of the measurement. An obvious example is the movement of a floating instrument carrier caused by the waves not only at the immediate measuring locality but along the whole size of the carrier. This difficulty can occur in a specific way if there are two or more locally separated measuring points in or on the water whose results have to be related to each other; it is difficult or may be impossible to find a common coordinate system.

Difficulties indicated in the preceding paragraph may be modified and maybe reduced by the use of bottom-fixed structures in the ocean, e.g. measuring poles or research towers. It is true, this is a compromise because the presence of such structures usually increases the difficulties mentioned in the first paragraph, above. To counteract this in part, measuring instruments may be lowered into the water from tower-mounted cranes reaching far out over the water; or may be supported by separate bottom-mounted structures of relatively small cross sections, far enough away from the tower. The needed length of a crane-outreach or the needed distance from the tower for a separate instrument placement depend on many and variable natural parameters, the type of desired measurement and the required accuracy. In some cases, model experiments in tanks or wind-tunnels have been made to provide data for such calculations. Still, in many cases oceanographers considering the use of poles, masts, towers or other carriers, will feel that estimations — based on well-reasoned experience — will suffice to determine the means to reduce these disturbances.

Advantages of Research Towers

- Solid, common coordinate-system for the three-dimensional location of all measurements.
- Possibility to use heavy and bulky instruments with high power requirements.
- Possibility to use many instruments at the same site or a site close-by and simultaneously.
- More precise and/or reliable adjustment of instruments to measure certain parameters of small extension (in one, two or three dimensions).

The presence of the responsible scientists makes it possible:

- to immediately react on unexpected results or other events
- to determine, in real time, the active measuring periods depending on weather etc. and on parallel measurements
- to make quick repairs if necessary
- to save money because potentially expensive automatic devices are not needed;
- to be alert to unexpected natural events
- to educate the scientists by direct observation of parameter-instrument response etc.
- to evaluate some results while the experiment is running, and
- to make adjustments.

One obvious disadvantage is the fact that — at least in European waters — all towers are located in shallow water. Deep sea towers are an option but more expensive.

Factors for the Selection of a Particular Tower

- Location (near-shore — off-shore)
- Water depth
- Nature and topography of bottom
- Magnitude and frequency of occurrence of desired as well as of undesired natural events, such as wave height; currents; internal waves; tides; water clarity, salinity, temperature; existence of biological systems; air temperature; winds; other weather parameters, etc.
- Accommodation of instruments, support, power, availability of computer facilities, transport to and from tower
- Availability of routine measurements of marginal parameters and the possibility to incorporate them into own measurements by hand or by electronic means
- Accommodation and sustenance of persons, transport, acceptable solution for waste disposal
- Costs of using the tower including transport.

Not all of these factors could be included in this list of European Towers.

Contents of this list of European Towers

The listed research towers or platforms and combination of pier and towers are fully dedicated to research, on a permanent basis. Not included are: temporary setups, anchored ships, and oil towers temporarily used for research. Also not included are the research installations on high rocks at the shore as they exist or existed near Stad in Norway and on the Crimea peninsula. An attempt has been made to include all towers or platforms which correspond to the above conditions, and at present, we do not know of any other.

Unfortunately, one of the very best towers cannot be sustained anymore: the FORSCHUNGS-PLATTFORM NORDSEE will be dismantled because of high cost of operation.

The list presented in this document consists of answers to a questionnaire sent to the administrators of the various towers; in some cases with added information derived from personal visits to the towers. The questions are the same for all towers so comparisons can easily be made.

On several towers additional material is available, such as pictures, detailed technical descriptions etc. If interested, inquire with:

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NORTH SEA — THE NETHERLANDS*

Name, Location, and Water Depth

Name

- MEETPOST NOORDWIJK
  - Owned by: Rijkswaterstaat (the Dutch Department of Public Works)

Location

- South-Western North Sea, 9 Km from the Dutch coast off of the seaside resort of Noordwijk
  - Geographic coordinates: 52° 16' 25.9" N
    4° 17' 45.2" E

Water Depth

- The mean waterdepth at the site is 18 meters; an appropriate value for the tidal amplitude is 2 m.

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*Authors of this report D. van Halsema, J.A.M. Goosens, and C.H. Huijgens refer to Acknowledgements at the end of this section.

Administration, Persons of Contact, and Access

Administration

- Rijkswaterstaat directie Noordzee, Postbus (P.O. Box) 5807, NL-2280-HV Rijswijk, The Netherlands; TEL: +31 (70) 394-9500

Persons of Contact

- Director
  - Rijkswaterstaat directie Noordzee, Postbus 5807, NL-2280-HV Rijswijk, The Netherlands; Tel: +31 (70) 394-9500; FAX: +31 (70) 390-0691
- Staff of Institute
  - Director Maritime Technology
    - Mr. R. van der Poel
    - J.A.M. Goossens (platform manager)
    - J. van der Horn (platform manager)
    - C.H. Huijgens (offshore manager)
      - Rijkswaterstaat directie Noordzee, Postbus 5807, NL-2280-HV Rijswijk, The Netherlands; TEL: +31 (70) 394-9500; FAX: +31 (70) 390-0691
- Royal Netherlands Meteorological Institute
  - Dr. W.A. Oost
    - KNMI, Postbus 201, NL-3730-AE de Bilt, The Netherlands; TEL: +31 (30) 20-6557; FAX: +31 (30) 21-0407; TELEX: 47096; OMNET: KNMI

Access

- The platform can be accessed either by boat or by helicopter. By boat, the usual access is through the port of Scheveningen where the owner of the platform (Rijkswaterstaat)_ has her own loading station "wal-accomodatie", TEL: +31 (70) 355-4948. Access by boat is only possible during weather conditions with low sea states ($H1/3 < 1$ m). Travel time depends on the tide, approximately 1.25 hours. By helicopter the platform can be reached from either airport Schiphol, near Amsterdam or from Zestienhoven near Rotterdam. Rijkswaterstaat has special contracts with the Airspeed Company in Rotterdam. Flying time is approximately 10-15 minutes, the helicopter can carry 8 persons. Schiphol International Airport can be reached with many international airlines. It has a railway station with connections to all major cities in The Netherlands. To go to Scheveningen Harbor from there, take a train to Den Haag (The Hague) or Rijswijk (27 minutes or slightly more). From there transport to the harbor of Scheveningen is most easily done by taxicab. Connections to Zestienhoven: by train to Rotterdam (from Schiphol about 45 minutes, from Den Haag about 17 minutes), from there by bus or taxi to the airport Zestienhoven.
- The Noordwijk tower has a wireless telephone connection [+31 (06) 5270-4506].

Description of the Platform

Introduction and Utilization

The platform "Meetpost Noordwijk" is operated by the North Sea Directorate of The Netherlands Public Works Department (Rijkswaterstaat). Constructed as a commercial television broadcasting station, it is situated in the North Sea at eight kilometers off the coast near Noordwijk. The platform came into operation in 1975 after being renovated and adapted or its present dual purpose:

- a fully automated hydro-meteo measuring station of the North-Sea Measuring Network
- a research and test facility for investigations which require the marine environment as an essential condition.

With respect to the latter, the platform offers the following facilities:

- manned or unmanned operation; accommodation is available for 19 people
- testing of instruments and measuring methods at real sea conditions; for this purpose the platform is equipped with upliftable sensor piles, which enable the user to mount or replace sensors without diving work
- data collection for scientific research; a data acquisition system can be used to gather data
  - a direct data link transmits data to shore for both processing and data storage purposes
  - using the telecommanding system it is possible to control experiments from shore and to get status data available
- execution of tests of a various nature, including underwater tests on a specially-built sub-surface platform.

Platform facilities are available to the Dutch government, research institutes and (offshore) industries.

General Structure

Six steel pillars (diameter 0.8 m) in a rectangle of 9 × 16 meter carry the platform. The pillars are slightly slanted toward the center line of the platform. At 73 cm above and 8.4 m and 17.6 m below the mean sea level (MSL), the pillars are connected to each other by horizontal pipes. Furthermore the pillars are interconnected by diagonally mounted pipes. There are 14 surface penetrating pipes. At the SW and NW edge of the platform two sensor carrying poles are mounted. These poles are mounted close to the SW and NE pillars of the platform.

Boats usually moor at the western side of the platform. Via a small platform at 1.9 m above MSL personnel can access the tower. Stainless steel stairs lead to the first deck (11.6 m above MSL). Halfway up to the first deck there is a small grid platform.

The first, lower deck at 11.6 m above MSL contains 4 cabins of 2 × 3.5 m which can accommodate 2 persons each, a toilet and shower, a large workshop (7.5 × 4.5 m), a slightly smaller measuring room (5 × 4.5 m), an engine room and a storage room which accommodates the electrical machinery and water and oil tanks. The workshop and measuring room can both be used during experiments to operate equipment. A walkway of about 1.5 meter wide goes all the way around the platform. From this walkway the so-called 'remote sensing' platform can be reached. This platform protrudes from

the North-Western side of the tower. It is approximately 5 × 2.5 meters large at the west side and 3.5 × 1.5 at the norther side, mounted at 15 m above MSL. This platform is fully dedicated to experiments. The meteorological boom operated by the Royal Netherlands Meteorological Institute can be serviced from this platform.

The second, upper deck can be reached from the first deck by means of two staircases. It contains 6 more cabins, two of which are reserved for personnel, furthermore a shower and a toilet. Also at this level the kitchen, recreation room/mess and platform manager office can be found as well as the receiving and transmitting station of the meteorological sensors and buoys. Around half of the northern and southern side and the whole eastern side a broad walkway exists. At the northern side a small 'bridge' protrudes about 6 meters from the platform. From the walkway on the second deck the helicopter landing pad can be reached. At the southern side of this top deck a standard meteo tower with the wind sensors is mounted, height above MSL: 29 m.

The platform has a number of cranes available for loading/unloading of equipment. The large crane is mounted on the top deck at the southern side. It can lift weights up to 1000 Kg. Another crane at the first deck, south, can lift weights up to 4000 Kg.

Under the sea surface, there is an additional platform at a depth of about 10 m under MSL.

Permanent or Semipermanent Instrumentation

The MPN platform is one of the standard measuring points in the North Sea monitoring network as employed by Rijkwaterstaat. It carries a meteorological station providing information on wind speed and direction, air pressure, humidity. waveheight, wave frequency, tide. The meteo station is regularly calibrated. In the neighborhood of the platform quite often pitch and roll buoys are employed, providing directional wave information. On special request, acoustic current speed and direction sensors can be mounted on one of the legs of the platform. As mentioned above, The Netherlands Meteorological Institute employs a special boom, protruding 18 m at the western side of the platform. The length of the boom permits measurement of wind flux with minimal flow distortion by the platform itself. Detailed theoretical and wind tunnel studies have been carried out to estimate the flow distortion by the platform. Information on this is available at the KNMI (Dr. Oost). This boom can be equipped with all kinds of sensors, though the maximum weight is limited. It can be serviced quite easily from the remote sensing platform.

Climatology

Air

- Prevailing winds are from 180 to 270°
- mean wind velocity — 7 m/s (11 knots)
  - highest daily average in 1990 — 21 m/s on 26-2-90

Temperature

- January — 5.9, March — 8.7, June — 14.9, September — 14.7, December — 5.1°C

Precipitation

- January — 62, March — 19, June — 30, September — 43, December - 51 hours.

Water

- **Statistics** 10 yearly average (1977-1987) probability: H1/3 > 0.6m: 70%; H1/3 > 1.0 m: 40%; H1/3 > 2.1 m: 10%. Extreme observation: h1/3 = 6 m.

Bottom

- The bottom around the platform is sandy with some elevations in the form of underwater dunes, with crests of arount 5 meters. Close to the platform (10 km) is an area where many radar-imaging bottom topography experiments have been executed.

  More detailed climatology upon request at Rijkswaterstaat.

Utilization of the Platform

Normally the platform is not inhabited. Service visits are made once every two weeks. The platform has been used for several remote sensing and acoustic oceanographic experiments over the pst 15 years. Utilization of the platform for oceanographic field experiments by researchers from outside is encouraged.

The future life time of the platform is envisioned to be at least 10 additional years (estimate, dated March 1991).

Additional Information

Detailed descriptions with pictures, floor plans, elevation plans, etc. are available.

There exists also another research facility near the coast of The Netherlands: a one-leg (monopod) tower near the town of Hoeck van Holland, close to the approaches to Rotterdam harbor, at 510 59.5' N and 30 16' E, 55 km off the coast, in about 32 m water depth. Access by helicopter or boat. The deck contains a measurement room, an electric power room, a workshop, and a kitchen, all of them 5 × 5 meters; but no accomodations; it is not designed for prolonged manned use. The pile has a diameter of 3.5 m, and the deck is about 19 m above sea level, waves expected to about 15 m.

Acknowledgements

The text of this description has been written by D. van Halsema of the Physics and Electronics Laboratory TNO, and J.A.M. Goosens and C.H. Huijgens of the Rijkswaterstaat, directorate Noordzee; and slightly edited by Hans Dolezalek. I am grateful for their contributions to this collection of European Research Towers.

References

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de Loor, G.P. and P. Hoogeboom: "Radar backscatter measurements from platform Noordwijk in the North Sea." IEEE, Journal of Oceanographic Engineering, OE-7:1:15-20, 1982.

Smith, S.D., K.B. Katsaros, W.A. Oost and P.G. Mestayer: "Two major experiments in the Humidity Exchange Over the Sea Program." Bulletin of the American Meteorological Society, 71:(2):161-172, 1990.

NORTH SEA — FEDERAL REPUBLIC OF GERMANY

Name, Location, and Water Depth

Name

- Forschungsplattform Nordsee [(FPN) Research Platform "North-Sea"]

Location

- German Bight in the North Sea, 74 Km northwest (320° true north) from the island of Helgoland, about 80 Km west from the island of Sylt. No closer land.
  - Geographic coordinates: 54° 42' 5.8" N
    7° 10' 9.2" E

Water Depth

- 30 m water depth at the platform site.

Administration, Persons of Contact, Access

Administration

- Owner: Federal Republic of Germany (FRG) represented by
  - Bundesminister für Forschung und Technologie (Federal Minister of Research and Technolgy)
- Operator: RF Reedereigemeinschaft Forschungsschiffahrt GmbH, August Bebel Allee 1, D-W/2800 Bremen 41; Telephone: +49 (0421) 23-806-01; Telex: 246062 rfor d
- Contact for Use of Platform
  - General — Bundesministerium für Forschung und Technologie (Federal Ministry for Research and Technolgy); Postfach (P.O.Box) 20 02 40, Heinemannstraße 2, D-W/5300 Bonn 2; Telephone: +49 (0228) 59-1; Telefax: +49 (0228) 503-105; Telex: 885674
  - If underwater acoustics research is intended — Forschungsanstalt der Bundeswehr für Wasserschall und Geophysik/FWG (Research Institution of the Armed Forces for Water-Acoustics and Geophysics), Klausdorfer Weg 2-24, D-W/2300 Kiel 14; Telephone: +49 (0431) 7204-106; Telefax: +49 (0431) 7204-150; Telex: 299855 bw d

- If intended research is defense-related, contact also — Bundesministerium der Verteidigung (Federal Ministry of Defense), RüT III 3, Postfach 1328, D-W/5300 Bonn 1; Telephone: +49 (0228) 12-4279 or 6855, Telefax: +49 (0228) 12-6480 or 6770; Telex: 886575 bw d

Persons of Contact

- In BMFT (FMRT): Dr. Stöffler, Referat 525
  - Telephone: +49 (0228) 59-3542
- In FWG: Prof. Dr. Peter Wille, Director FWG
  - Telephone: +49 (0431) 7204-100
  - or Wiss. Dir. Stepputat
  - Telephone: +49 (0431) 7204-106.
- In BMVg (FMoD): Ministerialrat Hans Hirsch
  - Telephone: +49 (0228) 12-4279
  - or Oberamtsrat Peter Wittenbeck
  - Telephone: +49 (0228) 12-6855

Access

- Normally by helicopter. The helicopter platform on the uppermost deck of the FPN can accommodate helicopters of up to ten metric tons. For groups up to 4 persons usual flight is from Hamburg airport Fuhlsbüttel (special building) by the company Wasserthal GmbH Helicopter Service (Schierenberg 17, D-W/2000 Hamburg 17, telephone +49 (040) 644-5982, 644-8081), cost at present about DM5,500 round trip. For somewhat larger groups up to 9 persons from Mariensiel near Wilhelmshaven by Wiking Helicopter Service, cost DM9,000 round trip.
- The FPN is located close to several military exercise areas on and over the North Sea which must not be overflown without special permission (to be applied for several months in advance and through channels).
- There is telephone, telefax, etc. connection with FPN (via radio).

Description of the Platform

General Structure, Standing Crew

The platform is a four-legged tower (with a fifth, oblique leg added later to support the heavy acoustic transponders) of a square of about 26 × 26 m; totally about 65 m height, of which about 30 m are under water. It stands on a hollow but water-filled reinforced concrete shell which rests on the flat, sandy bottom. The four legs (steel pipes, 1.42 m diameter) are supported by two oblique legs each below and also above water, which supporting legs are connected to the main leg at about 4,5 m above water. The upper legs are steel pipes of 1.016 m diameter. The water surface is penetrated by 12 legs plus the "acoustic transmitter leg" and its support, together 14. In a depth of about 13 m, the legs are connected by horizontal pipes, and additional supports. The steel pipes are corrosion protected by a thick (up to ½ mm) coating "Tenaxon" with special addition in the water surface range; and an active cathode protection facility. For safety observations, the platform is fitted with special sensors.

The uppermost deck, at 33.5 m above water, is the octagonal helicopter deck with about 20 m diameter. At 27.5 m above water is the upper open deck, and between it at the height of 20 m are two fully enclosed decks, both with an open catwalk all around them. Additional smaller decks and catwalks are in various heights, above 27.5 and below 20 m, the lowest at about 10 m above water just around a leg. Along the legs are ladders down to the water, but they are not intended for normal access and do not have platforms.

The two enclosed decks contain seven bedrooms for the crew and seven bedrooms for scientists and engineers, each with toilet and shower, capable of accommodating one or two persons. There are seven laboratories, workshops for mechanical, electrical, electronic work, radar room, offices, a mess room, a recreation room, a kitchen; there is an open shaft in the center, toilets, water, sea-water and fuel storage, a large sewage tank with treatment, a neutralizer tank for wet-lab chemicals; heating, air-conditioning and hot-water systems, and three large cranes at the three corners of the open upper deck which are not occupied by the helipad.

An instrument mast, reaching up to 47 m above water, the watch tower and antennae are located on the upper deck; also a double-drum winch (5 metric ton) with an A-frame crane for 8 metric ton, for lowering instruments into the sea through the large central shaft.

The platform is always manned by a crew of nine persons: 1 manager, 1 electronic engineer, 1 machinist, 1 electrician, 1 diesel mechanic, 2 watchstanders (radio and visual), 1 cook, 1 steward.

For emergencies there is a tight escape capsule accommodating 28 persons. This is the limit number for people allowed on FPN at any one time, unless a helicopter is there, able to carry the others.

Every two or three weeks, a supply ship brings fresh water and fuel etc., and carries away waste. Care is taken not to contaminate the sea water around the platform. With fully loaded storage facilities, the platform is self-contained for 70 days.

More information on the general structure, some figures and pictures, and detailed climatic information are contained in an appendix to the present document which is available in limited numbers but not over electronic mail, including telefax.

Permanent Instrumentation

The platform is powered by main and auxiliary diesel engines and generators, providing three-phase 220/380 V, 50 Hz current; 440 V 60 Hz, 254 V 60 Hz, and 115 V 60 Hz, 220/380 V 400 Hz, and 24 V dc, but not all kinds in all laboratories. Total potential power generation is $(4 \times 170) + 75 + 60 = 815$ KVA.

Meteorological and oceanographic data are constantly measured, computer-analyzed and digitally stored when appropriate: air temperature, relative humidity, wind speed and direction, atmospheric opacity, rainfall, water temperature, sea state, salinity, chemical content of sea water, water currents, sediment transport, plankton counts, chemical pollution in shellfish, wave height, water mark, ambient noise, transmission loss, reverberation.

A unique feature is a sophisticated underwater-acoustic system, including transmitters and receivers in the frequency band 500 Hz to 10 KHz mounted on a carriage which can be moved from 5 m above

bottom to the surface and out of it to the top of the platform along a special leg (added after the platform had been built) at the west side, inclined 60°, and a long-line near bottom receiving array for 10 Hz to 15 KHz at a distance of 10.4 Km, hard wired to the platform. For more information on the acoustic facilities see the appendix.

Climatology

General

- A special feature of this platform, compared to others, is the occurrence of very high winds and high waves (up to 18 m observed in recent years) but also an almost completely flat sea, and all states in between.

Air

- Directions for the highest winds are northwest and southwest. During some summers, long periods with east winds may occur, bringing an almost flat sea surface. Average air temperature: January 0°C, July 15°C; minimum January -1.5°C, July 12°C; maximum Jan 8°C, July 18°C. Fog: February 10%, May 5%, Aug/Sep 2%. In winter about 50% of time have 6/8 or more, and 15% have less than 2/8 cloudcover; in summer its 40% resp. 8%.

Water

- A feature of special value for some experiments is the possibility of very high sea states occurring at the platform: waves of nearly 20 m height have been measured at the platform at one or two occasions since its construction in 1976. On the other hand, there is hardly a month during which at least a few days with a nearly flat surface are not observed; several programs aiming at high sea state were disappointing because even in October/November the very-high sea states do not occur every year. The average frequency of low waves (sign.height less than 50 cm) is less than 10% in October through January, about 25% in April to August; the average frequency of high waves (sign.height more than 3.5 m) is about 10% in October to January and almost nil throughout the remainder of the year (values of 1978-1985).

Bottom

- Flat, fine sand, some stones.

Diving

- Frequently necessary to mount instruments on the bottom, to inspect the underwater parts of the platform, to inspect the acoustic range etc.; no specific problems involved.

Ship-traffic (near-by)

- There are no routine ship-tracks near the platform; the general traffic is far away, not even visible from the platform. Military exercise areas almost surround the site of the platform, a fact which keeps commercial traffic away. The area is not a frequent fishing ground.

History and Utilization of the Platform

The platform was built in two parts at the shore, towed to the site, and assembled there in 1974-1975, operation began 1976. Annual maintenance costs are now in the order of 4.5 Million DM, 70% borne by the Federal Ministry of Research and Technology, 30% by the Federal Ministry of Defense.

Several experiments are run all the time; additional experiments are welcome, early planning, at least one year in advance, is requested. The most important user has always been the Research Institute of the German Armed Forces on Water-Acoustics and Geophysics (FWG) in Kiel.

Present plans are to dismantle the platform in 1993 because of the high maintenance cost; structurally it probably could last much longer. Efforts are under way to save it. There have been some cracks in the concrete foundation, it is not yet known whether they are of critical importance or not.

Acknowledgements

I am grateful to the Director of FWG, Prof. Peter Wille, and to LWissDir Dr. Hartard, WissDir. Dr. Stepputat, WissOR Wendel for providing actual material for this report; to WissOR Peter Lobemeier for giving me over the years much information on it and now providing ample information about the climate at the platform (all the former are at FWG); and to the FMoD for inviting me several times in the last years to visit the platform.

References

Salzmann, H., St.Knabe, W.-D. Longree, P. Burmeister, W. Jennrich, U. Meins, J. Vieregge, W. Kirchhoff and H. Victor: "Meß- und Erprobungsplattform, im deutschen Nordseeschelf; Measuring and testing platform in the German North Sea Shelf" (in German and in English); Meerestechnik, Marine Technology 6:5:161-170,1975.

Victor, H., W. Kirchhoff, und H.Salzmann: "Forschungsplattform 'Nordsee'; Meßstation und Erprobungsstation." GKSS & IMS, Geesthacht & Hamburg 1975, 27pp.

ADRIATIC SEA — ITALY

Name, Location, and Water Depth

Name

- PIATTAFORMA OCEANOGRAFICA < < Acqua Alta > >
  - CNR — Consiglio Nazionale delle Ricerche

Location

- Northern Adriatic Sea, 15 Km SE of Lido di Venezia, 80 Km West of the nearest point of the Yugoslavian coast.
  - Geographic coordinates: 45° 18' 50" N
    12° 30' 30" N

Water Depth

- 16 m

Administration, Persons of Contact, and Access

Administration

- Istituto (formerly Laboratorio) per lo Studio della Dinamica delle Grandi Masse [also written Istituto Studio Dinamica Grandi Masse (ISDGM)], San Polo 1364, I-30125 Venezia, Italy

Persons of Contact

- Director of the Institute
  - Dr. Gianfranco Dallaporta; Tel: +39 (41) 5216-811 or 816; FAX: +39 (41) 5216-871; TELEX: 410095; Telegram address: SANPOLOLAB
- Institute Staff, among others
  - Ing. Luigi Cavaleri; Tel: +39 (41) 5216-810; FAX: +39 (41) 5216-871; TELEX: 410095
    - He wrote description of Platform [3] and papers based on, or related to, measurements done there [1,2,4,5,6,7]
  - Silvestro ("Toni") Curiotto; Tel: +39 (41) 5216-814; FAX: +39 (41) 5216-871; TELEX: 410095;
    - With Cavaleri, he wrote paper on instruments on platform [6], and accompanied author to the Platform on 22 May 1990.
  - Dr. Stefano Zecchetto; Tel: +39 (41) 5216-848; FAX: +39 (41) 5216-871; TELEX: 410095
    - He works on radar sensing of ocean surface, scatterometer, altimeter, in part done or to be done at Platform. For essential related papers see references [8-12].

Access

- The Administration is located in the Palazzo Papadopoli which is situated in the San Polo quarter of Venezia, on the western bank of the Canal Grande, between the mouths of Rio di Meloni and Rio della Madonetta. It has a gate to the Canal Grande. From there a motor boat goes to the Platform under the Ponte dell'Accademia, via the Bacino di San Marco, across the Laguna di Venezia and through the Porto di Lido or the Porto di Malamocco into the open Adriatic Sea and straight south-east to the Platform. Travel time depends on the type of boat, approximately one hour. There is no possibility for helicopter landing on the Platform.
- The Marco Polo Airport (VCE) with scheduled international traffic is on the northern shore of the Laguna, connection to Venezia (Marco Polo) by water bus (about every two hours, transit time one hour) or water taxi (much quicker); or by shuttle bus (one for each flight) or by public bus No. 5 to the Piazzale Roma (car terminal in Venezia), south of the railroad station. There is also an airfield at the northern end of the Lido di Venezia island near the Porto di Lido.
- Telephone connection to the Platform is by radio, there is no cable.

Description of the Platform

General Structure

Four steel pillars, 66 cm diameter, in a square of 5 × 5 meters, are driven 22 m into the ground, slightly slanting to the center of the square. The four pillars are closely directed to the four cardinal points. At about 3 m above the water, and at 3, 10 and 16 meters below the surface, they are connected to each other by horizontal steel pipes with 22 cm diameter. Pipes of the same type are going in A-form from the centers of the above-water horizontal connectors down to the main pillars, connecting to them under the water surface. That means that there are 12 surface-penetrating pipes. In the centers of the north-western and the south-western sides, additional structures go into the water; they carry ladders, and close to the water surface, small platforms for access from the boat (another access possibility is via a rope-ladder, to be lowered to the deck of the boat from a bridge higher up on the Platform). These (altogether 14) surface-penetrating structures constitute some obstacles against the free flowing of currents and waves and provide disturbances for the wind. The effect on waves and currents is, according to Cavaleri [7], somewhat attenuated by the thick covering of the pillars with mussels, providing an absorbing sponge.

From the upper end of the slightly slanted pillars, four vertical pipes go up to carry the four decks of the Platform. The lowest deck, about 4 m above the water, has a fully transparent grid surface. The next deck, about 7 m above the water, carries a housing with a workshop and the two electricity generators of 12 KW each (cannot be operated at the same time), an extra walk-in housing for the storage batteries, and the fuel tank, to be replenished about once a month be a ship.

- At this level, a special platform (about four meters wide) protrudes for seven meters out over the sea, in a south-easterly direction. It provides mounting points for instruments into the sea from above at a significant distance from the structure, and into the main wind directions (see below for these). A light man-carrying frame under this protruding platform going down for about 4 m, allows servicing of instruments hanging from the platform.

The next higher deck has a cabin with three rooms: a living and sleeping room, a kitchen, and a fully equipped bathroom. Three people can live permanently on board; if desired, two more people could be accommodated. As with the other decks, a walk-way goes around the cabin on the outside.

The uppermost or fourth deck carries the fresh water and seawater tanks (the latter one for the toilet, there is no sewage treatment or storage on board), a number of masts for instruments, and space is also provided for additional instrumentation. A small crane or hoist is protruding from this deck towards the south-west. A photovoltaic generator of about 1 square meter provides electricity for automatic instruments.

Permanent or Semipermanent Instrumentation

- The uppermost deck carries a series of antennae and of meteorological instruments.
- Two vertical pipes go down into the water, serving as parts for two fast-response shallow-water tide gauges, see Cavaleri and Curiotto [6]. Its results can be interrogated from the coast by radio.
- From the outer rim of the special protruding platform, an instrumental system for detailed wind-wave studies is going down into the w ter, see Cavaleri [7]. The instrument carrier is a light cart

gliding up and down along vertical wires which are kept tight by a heavy cast iron ballast (2.5 ton weight) anchoring at the sea bottom. Several electromagnetic current meters and pressure transducers are supported by this cart. Parallel to these two vertical wires is a wave-staff which also can be move vertically. This system provides directional wave spectra, the quoted reference [7] also presents some results.

- Three pressure sensors are going down into the water at the north, south, and east steel pillars form the Platform to allow the monitoring of the directional wave spectrum of long waves. The system operates automatically, becoming active whenever a certain minimum level is exceeded and then measuring during a given period.

Calibration Experiment for ERS-1 Altimeter

At the time of this writing, preparations are being made for a participation in the calibration campaign for the altimeter to be mounted on the upcoming ESA-Satellite ERS-1. On the uppermost deck, mountings for a scatterometer, PRARE station, radiometer, and stereoscopic picture system of the sea surface are in preparation.

Climatology

Air

- The site of the Platform is characterized by the occurrence of two main wind systems:
  1. the "Bora" blows from the north-east over a fetch of about 100 Km, for periods of on-to-three days duration, particularly during the winter months, but occasionally present throughout the year
  2. the "Scirocco" blows from the south-east (fetch over 700 Km) for periods of one to two days from November to April.

  Extreme wind velocities are 50 knots. The range of average air temperatures goes from -5 to +30°C; averaged extreme temperatures are -10 and +35°C (the Cabin on the Platform is equipped with an air-conditioner). Precipitation and fog occurrence are 5 percent and 1 percent of the time. High humidity is frequent in summer.

Water

- Extreme known wave height at Platform is 9 m and those estimated at 11 meters. The latter had destroyed the lowest two decks including the power generators. As far as it is know, this happened only once during the life time of the Platform (constructed in 1970). Statistics of the wave height (height period) and direction is available for the last ten years. The most frequent storms are from the north-east, the most frequent waves are from the south-east (including sea-breeze during the summer). It must be expected that the water is polluted because of the industry in Mestre and the wastes from Venezia (no treatment known).

Diving

- Personnel of the ISDGM have frequently dived into the water at the Platform to mount or secure (etc.) instruments. Sharks have been reported once when a 5-meter shark shook the Platform (pictures available).

Bottom

- The sea bottom around the Platform is flat. No dunes or significant ripples are known. The material of the bottom is sand and mud.

Ship-Traffic

- Scheduled ship-traffic from Menezia passes the Platform usually at distances greater than 0.5 Km. Fishery as well as pleasure-boat traffic comes frequently close, maybe directly to the Platforms, although access is prohibited.

Utilization of the Platform

Usually, the Platform is inhabited by two or three persons. It serves as an automated data acquisition center for most of the time.

The following meteorological or oceanographic data are routinely collected and either stored or interrogated from the coast: wind direction and velocity tide level, wave height and direction.

The Platform has been used for the conduct of oceanographic field experiments for average periods of 50 days in each of the last ten years. It is expected that this number may increase in the coming years.

Utilization of the Platform for oceanographic field experiments by researchers from outside the ISDGM is encouraged, particularly when ISDGM staff is involved.

At present (May 1990), the future life time of the Platform is envisioned to be ten additional years.

Acknowledgements

I am especially grateful to Dr. Gianfranco Dallaporta for the permission to visit the tower, provision of transport and very welcome other support. Silvestro ("Toni") Curiotto spent much time and effort, first going with us to the tower and then correcting this report and providing many useful additional data; I shall always remember with gratitude and joy his cheerful way of dealing with us.

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BLACK SEA — UKRAINA

Name, Location, and Water Depth

Name

- SCIENTIFIC RESEARCH PLATFORM
  - of the Marine Experimental Test Area of the Experimental Department of Marine Hydrophysical Institute of the Ukrainian SSR Academy of Sciences, abbreviated META EO MHI AS UkSSR.

Location

- Northern Black Sea, 1 km South of Katsiveli on the Southern Crimea Peninsula
  - Geographic coordinates: 44° 24' 5" N
    34° 00' E

Water Depth

- 30 m water depth at platform site

Administration, Persons of Contact, and Access

Administration

- Marine Hydrophysical Institute, Academy of Sciences of the Ukrainian SSR (MHI AS UkSSR, 2, Kapitanskya Str., 335000 Sevastopol, the Commonwealth of Independent States (CIS)

Persons of Contact

- Director of the Institute and Others
  - Prof. Valery N. Eremeyev; Tel: +7 (0690) 52-04-52; TELEX: 187115 SWSWO SU Hydrophys; Telegram: SEVASTOPOL OKEAN
  - Dr. Vladimir V. Efimov; Tel: +7 (0690) 52-50-46; TELEX: 187115 SWSWO SU Hydrophys
    - Responsible for scientific marine operations of the MGI, author of papers based on, or related to, measurements conducted on the Platform (see list of references).
  - Nikolay I. Spichak; Tel: +7 (0600) 77-33-04; TELEX: 187115 SWSWO SU Hydrophys
    - Responsible for marine operation in META
  - Dr. Yuriy P. Solov'yov; Tel: +7 (0690) 52-04-51; TELEX: 187115 SWSWO SU Hydrophys
    - Domain of research: investigations of the fields of surface wind waves, author of papers based on, or related to, measurements conducted on the Platform (see list of references).
  - Dr. Alexander V. Babanin; Tel: +7 (0690) 52-04-51; TELEX: 187115 SWSWO SU Hydrophys
    - Domain of research: surface wind waves and other properties of wave fields, author of papers based on, or related to, measurements conducted on the Platform (see list of references).

Access

The administration occupies a building located on Cape Khrustalniy near the outlet from the Sevastopol bay.

The experimental department of the Institute is situated in Katsiveli on the shore of the Blue Bay 50 kilometers off Sevastopol on the Crimea's South Coast. The Platform is mounted on the shelf about one kilometer off the coast.

Bus service exists between Sevastopol and Katsiveli; the travel time is approximately 1 hour. There are two moorings at the Marine Experimental Site of MH1 AS UkSSR from which motor boats go to the Platform, the travel time is nearly 10 minutes. The Platform does not feature a helicopter pad.

The International airport in Simpheropol is situated in the center of the Crimean peninsula. Flying time from Moscow is 2 hours. Transfer from the airport to Sevastopol (at the South-West Crimean Coast) by buses which take approximately 2 hours. Railway riding time from Moscow to Sevastopol about 24 hours, railway from Simpheropol to Sevastopol about two hours.

There is telephone connection with the Platform.

Description of the Platform

General Structure

The Platform represents a 17 × 17 meter tower supported by 4 iron 80 cm diameter pillars mounted in sand bottom. The main working deck is situated at a 12 meter height above sea level. The pillars are connected to each other by horizontal steel pipes 40 cm in diameter at 5 and 25 meters below the sea surface. These horizontal pipes are connected by diagonal pipes to each other and to the vertical pillars above and below sea surface level. At the northern part of the Platform there is a boat-mooring area and a gangway to the main deck. At 3.5 meter height, there is an auxiliary grating deck.

The Platform is supplied with water through a pipeline from the land. Power supply and phone communication is effected through cables from the coast.

Power specifications are 50 kW, 50 Hz, 380 V. There is a transfo ıer on the Platform providing scientific and other equipment with 220 V and 36 V power.

For lifting loads from boats to the main and auxiliary decks there is a winch with 2000 Kg carrying capacity situated at the northern side of the Platform.

There are some stationary and moving protruding platforms and other devices at the south side of the Platform. They provide mounting points for oceanographic instruments lowered into the sea at a significant distance from the tower in the open sea direction.

These platforms protrude from 3 to 8 meters out over the sea.

The main deck has a cabin with living and sleeping rooms, laboratories, a kitchen, a sitting-room, a bathroom, and a toilet. Simultaneously, 16 scientists can live on the Platform. There are three dispatch cabins of 12 square meters each (dispatcher is on Platform constantly), five laboratories of 12 square meters each, one 18 square meter kitchen, and a 20 square meter sitting room. A walk-way goes around the cabin on the outside. Refer to section on "Additional Research Facilities at the Site" below for other existing, prepared, and planned facilities at this site.

Permanent Instrumentation

The main deck carries a number of meteorological and other permanent measuring and recording instruments:

- water temperature on the surface at 5, 20, 15, 20, and 25 meters and at the bottom every 3 hours
- air temperature
- wind speed and direction (anemometer is mounted on the mast four meters above the Platform's roof)
- velocity and direction of currents at 4 m and 20 m levels below sea surface every 15 minutes
- waves (5 minute records made every 3 hours)
- humidity
- atmospheric pressure.

Additional Research Facilities at the Site

There is a research mast to the South of the Platform (directed toward the open sea). It is situated 40 m off the Platform, hard mounted at the bottom. The mast protrudes by five meters above the sea surface. The Mast is served by boat, it is not powered and has no wired connection with the platform. However, cable connection and powering could be easily provided.

The Institute bought a floating Platform which is now being established and will be moored (about at about the end of 1991) five kilometers to the South (in the open sea) from the stationary Platform at 100 meters water depth. It has six hollow pillars on a raft foundation floating 8.5 m below the sea surface. The main deck is located 8 m above the water with cabins and laboratories with 100 square meters area. There will be power generators, tanks for fresh water and fuel on it. Access is by boat. More information will be available at a later time.

West of the platform, one more tower is being mounted. It will be like the one described above and will have westward protruding platforms and devices. A walk-way will connect it with the existing platform.

Climatology

Air

- Strong and durable eastern winds predominate at the site of the platform. The most rare wind direction is the seaward southerly one. Another kind of winds are powerful Northern gusts which may occur in any season. In this case waves fetches are some hundreds of meters and conditions of rapid wave generation take place.
- Extreme wind velocities are about 45 m/s. Average air temperatures range from 120 to +30°C; general average temperature is 14°C.

Water

The largest known wave height at the platform is estimated to be 6-7 meters. As far as is known, this happened only once during the life time of the platform (constructed 1982). The most frequent storms are from the East. Swell in the Black Sea is rather weak in contrast to the ocean. Mean

water temperature goes from +5 to +25°C.

Bottom

- The sea bottom around the platform is flat and is lightly sloping towards the open sea. It is covered by fine sand.

Diving

- Personnel on the platform have frequently dived into the water to mount or secure instruments. There are no sharks or any submarine works conducted at the Marine Experimental Site.

Ship-Traffic

- Regular ship-route between Sevastopol and Yalta passes at about 0.5 km off the Platform.

Utilization of the Platform

The platform is usually inhabited by groups of investigators from April to November. Meteorological and oceanographic data are routinely collected in automatic and semi-automatic regime during the whole year. Utilization of the platform for oceanographic field experiments by researchers from other institutions is welcomed.

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I am grateful for Dr. Victor Shrira of the P.P. Shirshov Institute of Oceanology of the Academy of Sciences of the former U.S.S.R. in Moskva for offering his assistance and then finding and convincing a colleague near the platform to compile the information and to write the report. This was done by Dr. Alexander Babanin (see above). He also provided additional information by telex. I know that it required much work, and I am grateful for the excellent way in which he did it.

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BLACK SEA — BULGARIA

Oceanographic Research Station (administration, laboratories, research pier, and two offshore towers).

Name, Location, and Water Depth

Name

- Research Station "SHKORPILOVZI", Institute of Oceanology, Bulgarian Academy of Sciences (IO, BAS-Varna).

Location

- Western Black Sea, 50 km to the south of the Town of Varna, 1.5 km from the village of Shkorpilovzi.
  - Geographic coordinates: 42° 57' 40" N
    27° 57' 50" E

Water Depth

- Pier: from the shore out to water depth of 5 m
- Towers: one at 11 m depth; second at 18 m depth.

Administration, Persons of Contact, Access

Administration

- Institute of Oceanology, Bulgarian Academy of Sciences, P.O. Box 152, 9000 Varna Bulgaria

Persons of Contact

- Prof. Zdravko Belberov (Director); Tel: (359) 52 77 20 38; FAX: (359) 52 77 42 56; TELEX: (865) 77 237 BAN IO BG; or
- Dr. Christo Slabakov; same details as above; or
- Dr. Veliko Dachev; Tel: (359) 77 23 92; same FAX and TELEX as above.

Access

- The administration for the laboratory facilities of the Institute of Oceanology is located in the Asparoukhovo residential district of Varna, about 200 m from the shore. The airport in Varna has scheduled international traffic part of the year, and has daily flights to and from Sofia. The airport, located 10 km west of the city has bus service to Varna every 30 minutes.
- The research station "Shkorpilovzi" is located at the shore, 50 km south of Varna. Once a day a bus goes from Varna to the village of Shkorpilovzi, and back. The institute of Oceanology regularly shuttles from Varna to the research station.

- The towers can be accessed by small boat, only when the weather is calm. Access to the pier is from the shore.

Description of the Research Station "Shkorpilovzi"

General Structures

The Research Station includes a laboratory, a pier, and two offshore towers. The laboratory has two floors, and is located 150 m from the shore. The facility includes a laboratory for grain size analysis, an automated data acquisition system (GAMAK type), eight bedrooms (with WC and bath in each), a seminar hall seating 40, kitchen, dining room for 20, repair shop, and diving locker with compressor. The station is supplied with electricity, and also has a backup power generator.

The Research Pier is 250 m long, extending perpendicular to shore to a depth of 5 m. The supports are 1.2m diameter concrete piles set over 10 m. The pier is 6.4 m wide, and the upper deck is 7.25 m above sea level. At every 20 m there are adjustable vertical rails on which instruments can be mounted. During storms, control or replacement of gauges is possible. At the end of the pier there is a 15 m high mast, permitting meteorological measurements at different heights.

The 11 m Tower: This tower consists of four cased, reinforced concrete foundations connected by a supporting horizontal framework and an upper steel structure constructed of 300 mm diameter pipes. At 6 m above sea level, there is a 6 m × 6 m working platform. Various extensions from the platform permit a variety of instrument mountings.

The 18 m Tower: This tower is made of three 25 ton reinforced concrete foundations connected by a triangular supporting truss of 300 mm diameter steel pipes, and a vertical steel casing of 400 m diameter. It has two working platforms: 1.2 m × 2.0 m at 6.5 m above sea level, and 1.5 m × 3.0 m at 5.0 m above sea level. There is also an underwater platform, 1.2m × 2.0 m at 2.5 m below sea level.

Permanent Instrumentation

- Permanent measurements are carried out daily at the station, including water and air temperature, humidity, wind speed and direction, sea level variation, also waves (during storms).

Diving

- Divers from the Institute can mount or secure instruments to the pier, offshore tower, or on the seabed.

Climatology

Air

- The site is dominated by NNE winds in Winter (December through April), with a 100 to 500 km fetch and duration from one to three days. Extreme wind speeds are about 35 m/sec. During the summer, sea breeze dominates, with an onshore speed of 4 m/sec during the day, and from 2-3 m/sec offshore at night. Average air temperatures range from -2°C to 23°C, and the absolute

minimum and maximum are -25°C and 37.2°C respectively.

Water

- The extreme wave height measured during the life of the Research Station (built in 1977) is 6 m. The most frequent storms are from the North and Northeast. Mean water temperature ranges from 2°C to 25°C. In the area of the facilities the water is clear; it serves as a national background station for monitoring the Bulgarian sector of the Black Sea.

Bottom

- The sea bottom along the pier and around the towers is flat, composed of medium-grained quartzo-feldspathic sand. It slopes gently seaward, and generally lacks ripples.

Ship Traffic

- Regular shipping between Varna and Bourgas passes more than 3 km offshore of the facilities.

Use of the Research Station

Since its construction in 1977, the station has been used for field experiments focusing on:

- rough turbulent atmospheric boundary layer over the ocean
- hydro- and sediment-dynamic processes in the coastal zone
- momentum flux from winds into the wave field
- suspension and transport of sediments
- dynamics of underwater morphology
- structure and turbulence of the upper ocean
- dispersion of passive contaminants, etc.

Use of the research station for International oceanographic field experiments and personnel training is encouraged.

Acknowledgements

We are grateful to Prof Belberov who has spent a large effort in several exchanges of letters and FAXs to compile and transfer the information in the way we needed it.

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Note: The following references are available on request to the administration of the station.

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The author of this report discusses methods used to obtain "in-situ" measurements for scientific data in the various disciplines of oceanography and maritime meteorology. The author also points out the advantages of "research towers" and factors in the selection of a particular tower. Included in the report is a list of research towers which does not include temporary setups, anchored ships, oil towers temporarily used for research, and research installations on high rocks at the shore as they exist or existed near Stad in Norway and on the Crimea peninsula.

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