Technical Workshop on Monitoring and Assessment of Sand and Dust Storms in the Marine Environment of ROPME Sea Area

REPORT OF THE WORKSHOP

INTRODUCTION

In accordance with Decision CM 16/7 of the Council-16, the Technical Workshop on Monitoring and Assessment of Sand and Dust Storms in the Marine Environment of ROPME Sea Area was held in Dubai, United Arab Emirates during 11-12 October 2015 in partnership with UNEP and NFP-UAE. The main objective of this important Workshop was to establish a Regional Monitoring Programme for the Assessment of the flux, fate and effect of dust fall in the marine environment of RSA.

ATTENDANCE

The Workshop was attended by the designated senior experts from ROPME Member States, international consultants, as well as the Professional Staff of ROPME Secretariat. The list of participants is attached as Annex I to this Report.

AGENDA ITEM 1: OPENING OF THE WORKSHOP

1.1 The Workshop was opened at 9:00 am on Sunday, 11 October 2015 with a welcome statement by Mr. Salim Akram, on behalf of the Ministry of Environment and Water (MOEW), UAE. He welcomed the participants in

the Workshop wishing to them a pleasant stay in Dubai. In his statement, Mr. Akram expressed the appreciation of the continuous exerted efforts by ROPME Secretariat towards the implementation of the Decisions of the Council-16 among which is the organization of this important Workshop on the impacts of dust storms on the marine environment of the ROPME Sea Area; a subject has never been studied before for the Region. This is although of the well known significant impacts of fallen dust on the marine quality and ecosystems in many regions subjected to this phenomenon. He ended the statement by hoping all the success to the Workshop in attaining its objective. The statement (in Arabic) is attached to this Report as Annex V.

1.2 On behalf of ROPME, Dr. Hassan Mohammadi, ROPME Coordinator, welcomed the participants and conveyed the warm greetings of H.E. Dr. Abdul Rahman Al-Awadi, Executive Secretary of ROPME. Dr. Mohammadi started his speech by outlining the occurrences of dust storms as a major environmental challenge in the ROPME Sea Area. He mentioned that no significant activities have been undertaken in the past five decades to mitigate the more frequent occurrence of dust storms and to protect the environment, but that environmental problems have exacerbated. The environmental problems in the Region include over extraction of ground waters in the entire Region, desertification, disturbance to top soil (related to war of 2003 over Iraq), agricultural activities and construction of numerous dams. Dr. Mohammadi concluded that the topic of dust storms is on high political agenda in the Region.

AGENDA ITEM 2: ORGANIZATION OF THE WORK

2.1 Election of Chairman and Rapporteur

The Workshop unanimously elected Mr. Salim Akram as Chairman and Dr. Zongbo Shi as Rapporteur of the Workshop.

2.2 Introduction of Participants

The participants introduced themselves to the Workshop by name,

affiliation and area of expertise.

AGENDA ITEM 3: ADOPTION OF THE AGENDA

3.1 The Workshop discussed and adopted the Provisional Agenda, which is attached as Annex II to this Report.

AGENDA ITEM 4: STATUS OF SAND AND DUST STORMS IN THE RSA

4.1 Mineral dust sources, properties and atmospheric processing

Dr. Shi firstly gave in his presentation an introduction on the mineral dust sources in the world and in the Middle East. Modelling results suggest that the ROPME Sea Area is the dustiest inhabited place in the world. Satellite studies also suggested that land use and climate change have led to a 40-50% increase in dust emissions in ROPME countries. This "new" dust (termed anthropogenic dust) may have different nutrient contents than other natural dust. Dr. Shi then described the morphology, size distribution, nutrient content, speciation, mineralogy and chemical composition of mineral dust from Asian and Sahara. However, there is no published data on bioavailable nutrient iron and phosphorus in dust from the Middle East. Finally, different atmospheric processes were described, including physical size sorting, uptake of sulphate and nitrate, mixing with anthropogenic emissions of fossil fuel combustion aerosols and acidic gases. These atmospheric processes may affect the properties of dust during atmospheric transport. One important aspect is that acidic gases such as SO_2 and NOx from fossil fuel combustion will increase atmospheric acidity, leading to conversion of insoluble iron and phosphorus to soluble iron and phosphorus. This can result in higher deposition flux of dissolved nutrients to the global ocean. The full presentation is attached to this Report in Annex-III.

The presentation followed by discussions focused on the difference between anthropogenic dust (dust that is produced related to land use and climate change) and anthropogenic particles (from fossil fuel combustion and industries).

4.2 Major dust storm trajectories effect on deposited dust characteristics in the ROPME Sea Area

Dr. Turki Al Said started his joint presentation with Dr. Ali Al-Dousari with an outline of past studies on dust conducted in the region including: Field environmental measurements in Bubiyan Island involving the monitoring of climatic conditions and movement of Aeolian sediments (sand & dust) (completed 2005); Dust fallout monitoring and analysis in Jahra City and surroundings (completed 2007); Monitoring and assessment of dust fallout and associated pollens (completed 2011). Kuwait has more dust storms than other countries in the Region. Major dust sources and the main trajectories at different seasons were identified. Dust collectors were deployed at a number of sites in Kuwait to collect dust fall samples. Deposition fluxes of dust were determined. Organic matter analysis showed that it is higher in the dust from the north and south of Kuwait. The mineralogy of dust particles has also been described. High Fe content was reported in dust from the Kuwaiti islands, which requires further investigation. Finally, Dr. Turki made a few recommendations to control dust emissions.

Discussions focused on the characteristics of spatial distribution of mineralogy and Fe in the fallen dust in Kuwait.

4.3 Air Quality part of our National Agenda 2021 in UAE

Mr. Fahad Hareb firstly introduced the Vision of UAE for 2021, with a particular focus on “Sustainable Environment and Infrastructure”. MOEW has also established Innovation Laboratories in 2014, and one is on air quality. Currently there are over 40 air quality monitoring stations in UAE. The air pollutants measured includes NOx, CO, SO_2 and ozone (used to calculate Air Quality Index). PM10 was also measured at these monitoring stations while PM2.5 and VOCs are measured in a few stations. Additional stations will be built this year and in the next year.

Air quality status in UAE was then described. NOx, CO, SO_2 and ozone were usually within the WHO guidelines. Research in UAE on dust deposition as well as remote sensing was briefly described. Dust fall was measured using a different type of dust collector from those used in

Kuwait by KISR. Data are being analyzed.

Discussions focused on the ambient air quality as well as the potential use of remote sensing for the proposed ROPME programme (e.g., ground truthing of satellite observations and for deciding on the timing of dust and water sampling during the foreseen impact assessment programme)

AGENDA ITEM 5: IMPACTS OF DUST STORMS ON THE MARINE ENVIRONMENT

5.1 Marine Biogeochemical Consequences of Atmospheric Inputs

Dr. Eric Achterberg explained in his first presentation why it is important to study the impact of dust deposition on ocean biogeochemistry and climate change. Dust could provide nutrients and toxins to the marine ecosystems, which affect ocean productivity, di-nitrogen fixation rates as well as ocean nutrient stoichiometry. All these can impact carbon uptake and thus indirectly affect the climate.

The presentation was then divided into three topics. The first topic is related to Dust supply to Tropical Atlantic Ocean. Research carried out at Cape Verde and cruises on nutrients were introduced. Results showed that dissolved Fe and Al in the surface ocean are much higher under the Saharan dust plume, clearly demonstrating the impact of dust. AMT17 Bioassay experiments with different combinations of nutrients revealed the nutrient limitation in N Atlantic Gyre (N and P limited) and S Atlantic Gyre (N limited). Bioassay with mineral dust showed that it stimulates plankton growth.

The second topic is on the Iceland volcanic ash fertilization of the sub-polar near Iceland in 2010. Volcanic ash fertilizes the low chlorophyll and high nutrient sub-polar Icelandic Basin and stimulates productivity and causes blooms. Enhanced dissolved Fe concentration in the surface ocean is accompanied by reduced N concentrations, as a result of

phytoplankton growth. But dissolved Fe is removed after ca. 1 month, suggesting that the impact on the ocean carbon uptake is relatively small.

The third topic is on Sensors for ocean measurements. A number of lab-on-ship sensors are developed which can measure the pH, pCO2 as well as ocean nano-nutrients.

Discussions focused on the potential impact of soluble materials and insoluble dust on the ROPME Sea Area, which receives extremely high dust inputs,

AGENDA ITEM 6: CURRENT MONITORING AND RESEARCH ACTIVITIES IN THE REGION

6.1 Assessment of sources and effect of mineral dust fluxes on biochemical processes in the northern ROPME Sea Area; challenges and Future plans

In his presentation, Dr. Turki described the Kuwaiti marine environment stressors including the build-up of salinity, rising of seawater temperature, less freshwater input, pollution, desalination plants, and annual dust storms. Oceanography group at KISR are working for a long time on understanding the mechanisms by which marine biogeochemical cycles controlling marine life and, in turn, how marine life controls biogeochemical cycles. KISR has 8 monitoring seawater stations for physical and chemical parameter measurements. Biochemical parameters including trace metals &nutrients, phytoplankton, zooplankton were determined during last two decade. Long-term seawater temperature and salinity, nutrients in the Kuwait bay was reported. Potential new experiments and new project ideas were also described. Trace metal and nutrients were presented which can be a base for relevant future experiments.

New joint project to be implemented soon by KISR with NIO India was also described. The aim is to enhance the understanding the effect of mineral dust on marine productivity. To this aim, KISR will estimate (a) the atmospheric deposition of mineral dust and its soluble fraction (inorganic leachable ions and nutrients), (b) the effect of mineral dust on marine biology and chemistry. Routine measurements will include monthly sampling of biogeochemical parameters such as dissolved oxygen, pH, nutrients, metals and chlorophyll-a. Seasonal measurements

will be carried out for dissolved inorganic carbon and alkalinity to understand the impact on the carbonate system. Fractional solubility (FracSol%) of an element from the dissolution of dust particles in seawater will also be measured to estimate the impact of the atmospheric particle flux on the dissolved stock (NIO, India). Dr. Turki stated that the Oceanographic group of KISR is keen to participate in the proposed ROPME programme.

Discussions focused on what caused the plankton blooms and the need to establish a network of long-term dust and water monitoring stations across the ROPME Sea Area in order to better quantify the dust impact on the marine biogeochemistry and ecosystems. There are indications that in the water near Bahrain nitrogen forms the proximal limiting factor for phytoplankton growth.

AGENDA ITEM 7: MONITORING PROGRAMME OF FALLEN DUST IMPACTS ON THE MARINE ENVIRONMENT OF THE ROPME SEA AREA

7.1 Dr. Eric Achterberg presented the prepared draft Concept Paper for this programme (Annex IV). The presentation included a summary of:

- Important questions to be answered in the programme
- Basic approach for the development of pilot study and subsequent long-term monitoring programme (BAISDS-2017)
- The main aim and objectives of the short-term pilot study
- Expected outcomes of the pilot study
- Potential contribution of this programme (and aim and objectives) to the 2016 cruise studies (4 season cruises)
- The aim and objectives of the baseline study
- Expected outcomes of the baseline study
- The aim and objectives of the long-term monitoring programme
- Expected outcomes of the long-term monitoring programme

The above components of the study have been discussed in details among participants. The discussions focused on the coordination of the dust studies with the 2016 cruises; strong support from Dr. Turki (Kuwait) to collect samples and conduct some culture studies from the cruises;

important to decide on the parameters to be analyzed but there is no need to specify natural and anthropogenic dust at the beginning; we will be able to distinguish them when the data are collected and data analysis can be done later.

AGENDA ITEM 8: IMPLEMENTATION PLAN FOR THE ASSESSMENT OF FALLEN DUST IN THE MARINE ENVIRONMENT OF THE RSA

8.1 In his followed presentation, Dr. Achterberg focused on the implementation plan for the proposed pilot programme which composed of the following elements:

a. Pilot Study

- Proposing three sampling sites (Dust and water) for two months
- Target analysis and modelling (total and soluble nutrients, total and soluble toxic elements, mineralogy, quantitative source apportionment, modelling of nutrient and trace metal deposition, AERONET optical depth; water chemistry, chlorophyll, modelling nutrients using ocean biogeochemical model, atmospheric pollutants, phytoplankton culture)
- Criteria and selection of suitable sampling sites
- Sampling protocol and sample types (follow GEOTRACES recommendations; use GEOTRACES reference materials, KANSO for nutrient references and Hansell reference material for dissolved organic carbon; TSP and Whatman41 and QMA filters; ocean trace metal sampling and analysis)
- Biological impact assessment of dust (Dust addition culture analysis; larger scale mesocosm experiment in the future)

b. Baseline experiment:

- Dust Sampling frequency: full seasonal cycle

- 6-8 sampling sites
- Dust Sampling time: 24 h usually
- Dust Sample storage: frozen to -20 degree Celsius
- Water sample collection: monthly
- Daily AOD measurements
- Sample bank
- Sample analysis and laboratories: one designated laboratory for baseline and pilot studies
- Data management and reporting
- Training needs
- Linkages with other ROPME activity programmes, National and International programmes
- Timeline of the programme

Details of the proposed programme and implementation plan are included in Annexes III and IV to this Report.

Discussions focused on the following topics:

- Survey of regional capacity and designation of the responsibilities
- Set up a questionnaire on Capacity of the Region
- Confirmation of willingness to participate in the programme:
  - Bahrain: need official invitation from ROPME
  - Iran: willing to participate but need ROPME to send official letter for Iran to decide on the actions; 180 ambient air monitoring stations; laboratories in coastal areas to participate in the pilot study
  - Iraq: 29 monitoring stations; Basra : 17 monitoring stations, some of which are close to the ROPME Sea Area
  - Kuwait - KISR: water and dust
  - Oman: willing to participate; about 11 monitoring stations
  - UAE: air monitoring; sampling

- Provided the Member States are ready then we should start with the baseline study without going to the pilot study.

AGENDA ITEM 9: FOLLOW-UP ACTIVITIES

9.1 The participants agreed on the following post meeting activities and time frame for their implementation:

- o Preparation of Draft Questionnaire by Drs. Achterberg and Shi: by the end of September 2015
- o The draft questionnaires sent to Member States representatives and ask for additional questions and comments: Iran (Dr. Shina Ansarihamedani), Iraq (Mr. Ahmed Ajrash), Kuwait (Dr. Turki Al-Said), Oman (Ms. Sana Ali Al-Jardani), and U.A.E. (Mr. Salim Akram)
- o The questionnaire to be finalized by ROPME Secretariat
- o The questionnaire to be sent along with an official invitation to Member States to participate in the programme: November 2015
- o Elaboration of a draft scientific programme by January 2016
- o Holding a technical workshop for scientists from the Region by March 2016 for the finalization and adoption of the scientific and implementation plan for the study
- o Designation of a scientific committee by April 2016, which will decide on pilot and baseline experiments.

AGENDA ITEM 10: OTHER MATTERS

10.1 No other matter was raised.

AGENDA ITEM 11: CONCLUSIONS AND RECOMMENDATIONS

11.1 Discussions were focused on the need of a pilot study and the possibility of merging pilot and baseline experiments. The final conclusions of the Workshop are:

- The Meeting approved the draft scientific programme prepared by Prof. Eric Achterberg, Dr. Zongbo Shi, and Prof. Hassan Awad
- Prof. Eric Achterberg, Dr. Zongbo Shi, and Prof. Award Hassan to draft a questionnaire
- Five participants from Member States were designated to review and finalize the draft questionnaire to be sent to Member States
- The finalized questionnaire will be sent to Member States within a month from 12th October 2015
- Prof. Achterberg and Dr. Shi will take the returned questionnaires into account to revise the scientific programme
- The scientific committee to meet in March 2016 (Provisional) to decide on the scientific programme (including the pilot and baseline measurements).

AGENDA ITEM 12:CLOSURE OF THE WORKSHOP

12.1 After the exchange of courtesies, the Meeting was declared closed at 17:00 hours on Monday, 14 September 2015.