RECOMMENDATIONS BASED UPON DANUM VALLEY AUDIT/TWINNING REPORT 2018

Necessary and critical recommendations had been given by Professor Dr. Alfred Wiedensohler and Dr. Thomas Tuch in the audit/twinning report 2018 for the Danum Valley Global Atmospheric Watch (GAW) Station, Malaysia. Giving due reference to these recommendations, remedial actions are being undertaken by the Malaysian Meteorological Department. The order in which the remedial actions being undertaken have been detailed follows the order of the potential issues as given in the "SUMMARY" section of the audit/twinning report mentioned above.

1. Arrangements are being made to send the whole Multi Angle Absorption Photometer (MAAP) setup to the manufacturer (Thermo Fisher Scientific, USA) to be diagnosed and repaired. We expect the MAAP to be delivered to the manufacturer within the 4th week of March

2. The Tapered Element Oscillating Microbalance (TEOM) for measuring PM10 particles had been sent form the Danum Valley GAW station to the Malaysian Meteorological Department headquarters for diagnostic and repair processes. The local agents for Thermo Fisher Scientific have volunteered to have a look at the equipment and perform the necessary diagnostic and repair works. We hope to settle these processes within the first week of April.

3. The manufacturer for the Integrating Nephelometer had been informed of the potential issue. Arrangements are being undertaken to send only the light housing assay to the manufacturer, Ecotech Pty Ltd, Melbourne, Australia for purposes of diagnostics and repair. We expect the equipment to be delivered to the manufacturer within the 3rd week of March.

4. We are about to initiate the procedures for procurement of a new adsorption dryer (Boge DAZ 5 – 2). Depending on the pricing of the unit, procurement of a new adsorption dryer can involvement a period from two months up to six months. These extended periods are due to the necessity to conform to financial

regulations stipulated for government procurement processes and the additional period required by the local agent to deliver the equipment.

5. A replacement 64bit workstation (Windows 10 Pro as the operating system) has already been identified and will be sent to the Danum Valley GAW station in June 2018, subject to the planned completion of the first phase of electrical works to be carried out at the GAW station. The first phase of the electrical works to be carried out involves improvement of lightning protection at the Danum Valley GAW station.

6. Two phases of electrical infrastructure works have been planned to be carried out, if possible by the end of this year.

I. The first phase involves a complete rewiring of the GAW station and substantial upgrades to the lightning protection system. The District Public Works Department had been appointed as the agency to carry out the rewiring and lightning protection works mentioned above. We expect this first phase to be completed sometime in June or July.

II. The second phase of the electrical works is much more elaborate and includes procurement of two new power generators to replace the old ones, procurement of an additional underground medium voltage electrical cable to complement the existing underground medium voltage electrical cable and to add another set of step – up and step – down transformers to complement the existing ones. These measures are meant to provide a stable and adequate power supply for the GAW station with consideration for potential addition of new instruments. The second phase also involves reinstallation of a new UPS system. Given the extensiveness of this second phase of electrical works, this phase falls under the purview of the State Public Works Department, and there is a possibility of the completion of this phase extending to next year.

7. The LoFlo CO_2 analyzer had been replaced with a Picarro G2401 greenhouse gas analyzer on January this year. Continuous measurements of CO_2, CH_4, CO and H_2O are being carried out with the Picarro presently. The inlet is placed at a height of 100 metres. Simultaneously CO_2 measurements are also being undertaken using a LiCor-840 CO_2 analyzer with the respective inlet being placed at a height of 60 metres.

8. As with the other affected instrumentations, the Precision Filter Radiometer (PFR) to measure AOD had also been affected by lightning events. We had sent it to the World Radiation Centre (WRC) at Davos to be repaired. Nevertheless the instrument appears to be beyond repairs. The Malaysian Meteorological Department plans to revisit procurement of this instrumentation once proper lightning and a stable power supply had been established.

9. The charging unit and a 5 volt converter on the Automatic Weather Station are suspected to be faulty. We expect to have both these components replaced within the next two to three weeks, using replacement components delivered from the headquarters.

10. Finally, the Integrating Nephelometer and MAAP data for 2013, 2014, 2015 and 2016 will be submitted via EBAS within the coming May.

We will keep Dr. Thomas Tuch informed with regard to progressive developments on the Integrating Nephelometer, MAAP, TEOM, adsorption dryer, new data workstation and lightning protection upgrade. The overall priority is to get the rewiring and lightning protection upgrade done prior to reinstalling the repaired instrumentation at the Danum Valley GAW station. We expect most of the major works to be settled by the first quarter of 2019. Therefore we would like to suggest a potential visit by Dr. Thomas Tuch on either April or May of 2019, as to enable optimization of aerosol observation operations at the Danum Valley GAW station.