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Effect of background temperature on dew-point hygrometers during the calibration at low dew-points

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Accurate measurements on meteorological parameters such as temperature and water vapour are important for prediction of weather and climate change as well as safety issues. Radiosondes having a group of sensors are used to measure the upper-air environments up to about 35 km. The temperature of upper air goes down to –80 ^{o}C and thus the dew point (dp) of water vapour may go below –80 ^{o}Cdp. For the calibration of humidity sensors used for the measurement of upper-air, reference hygrometers that can reliably measure dew point down to –80 ^{o}Cdp or less is required. Hygrometers widely used for the dew point range are aluminum oxide and chilled mirror dew-point hygrometers. The background temperature may affect the dew point measured using those hygrometers because the dew point is so low that the adsorption/desorption properties of water vapour on any surfaces may vary depending the background temperature.

In this presentation, the effect of background temperature on the dew point measurement using aluminum oxide and chilled mirror dew-point hygrometers is investigated. First, the temperature of laboratory, pipe line, and/or sensors is varied and dew points measured by two different aluminum oxide hygrometers are investigated. In all cases, the dew point of hygrometers is increased as the temperature is elevated. The reason behind this observation is due to desorption of water from the inside of pipe line and/or sensor surroundings at elevated temperature that result in the increase of the absolute humidity. Moreover, the sensor itself shows a certain degree of temperature dependency in the sensing of humidity especially at low temperature. It also is found that chilled mirror dew-point hygrometer may indicate a higher dew point than the reference at high temperature because the cooling capability of mirror is decreased at high temperature. Our study will provide evidences for the incorporation of the temperature effect as one of the uncertainty factors in the standard calibration procedure for these dew point hygrometers.