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Ref. Request of WMO CIMO Expert Team on Developments in In-situ Technologies regarding radiosondes and environmental friendliness

Dear Dr. Warne,

Dr. Jarmo Hietanen, HMEI representative in the Expert Team on Developments in In-situ Technologies, brought to my attention your request to obtain information about "any efforts that have been made to make sondes more environmentally friendly, both successful and unsuccessful". In this document, I intend to bring to your attention Vaisala's related efforts.

Background

Radiosondes are used to obtain crucial information about the atmosphere for the purposes of weather forecasting, including public safety critical severe weather forecasting, medium range numerical weather prediction, as well as climatological and other atmospheric research. The societal value of radiosondes is significant in that they provide backbone data for numerical models (ref. Sixth WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction, Shanghai, China, 10-13 May 2016), including provisioning of reference data for weather satellite drift detection. Weather forecasters use radiosonde data to assess the atmospheric conditions and predict the likelihood of strong thunderstorms, for example. In these situations, sounding data provides information that is used as the basis for emergency management actions that help prevent loss of life and loss of property. The radiosonde data must be trustworthy so that the meteorologists can concentrate on their value-adding work rather than study peculiarities of sounding profiles in these high-stress situations. In addition to severe weather impact on land, radiosonde data is used to drive weather models and assist in forecasts that affect the safety of marine transport and aviation. This is especially important in the most challenging weather conditions that make these transportation systems prone to accidents.

Short summary of Vaisala efforts

By nature of the radiosonde observation system, some of the radiosondes remain in the nature after their use and are not recovered. The radiosonde flight train consists typically of a latex weather balloon, filled with hydrogen or helium, a parachute, a cord that separates the radiosonde from the weather balloon enough to ensure no detrimental impact from the balloon thermal wake to the measurement, and the radiosonde itself.

During the last 20 years, Vaisala has manufactured the following main radiosonde models: RS80, RS92 and RS41. Each new development has both improved the radiosonde's measurement performance and decreased the amount of material that remains in the nature from those soundings that are not recovered. Radiosondes do include markings according to European and international regulations that invite the finder to bring them to the proper recycling process for electric and electronic waste. The organizations operating radiosonde observing systems typically place stickers on the radiosondes that guide the recycling of the radiosonde after being found from the nature, according to the local regulations.

The following table summarizes the developments:

Sonde model	RS80-15G	RS92-SGPW	RS92-SGPD	RS41-SG (plastic cover version)	RS41-SG (EPS cover version)
Production year	1989-2008	2003-2011	2006-2017	2013-2018	2017-
Weight	330 g	311 g	280 g	109 g	80 g
Type of battery	Water activated CuCl based	Water activated CuCl based	Alkaline cell	Lithium cell	Lithium cell

***Table 1**. Characteristics of main radiosonde models of the last 20 years.*

In the table, the main radiosonde models during the last 20 years are listed with some of their characteristics that affect their environmental friendliness. The amount of plastic material is reduced from 66 g to 35 g (-47%) between the plastic cover and EPS cover versions of the RS41-SG radiosonde.

The RS41 third party environmental statement "Environmental Impacts of Vaisala Radiosondes" is attached. Vaisala hired an independent engineering company specialized in environmental footprint analysis to assess the RS41 and possible battery solutions for this radiosonde during its development. Based on this assessment, Vaisala chose the battery technology that provides the smallest environmental burden after use.

Starting January 2017, Vaisala has provided RS41 radiosondes with a default setting that leaves the radiosonde transmitter on after the actual meteorological observation is complete, in order to help the so called “radiosonde hunters” to recover the devices from the nature. While in some research campaigns it may be desirable to free the radiofrequency band immediately after balloon burst, typically in the middle stratosphere, in most cases there is no hurry in stopping the telemetry transmission. Furthermore, Vaisala RS41 radiosondes operate with digital telemetry modulation in order to minimize the occupied bandwidth, which gives more effective channels available for the radiosondes. Vaisala was active in updating the related harmonized standard EN 302 054.

Vaisala RS41 Radiosondes fulfill the European and international requirements related to the Reduction of Hazardous Substances (RoHS). Vaisala’s supply chain management policy and practices ensure that no so-called conflict minerals are used, according to the U.S. Dodd-Frank Act Section 1502.

Reliability of the radiosonde in the operational use is also important from the environmental point of view. If, for example, 15 percent of radiosondes launched fail to provide the observation report to the user, all the resources used and environmental impact of these 15 percent is made in vain. Vaisala RS41 radiosonde has proven to be extremely reliable in use and Vaisala’s warranty follow-up report more than 99% availability of good-quality data from Vaisala RS41 soundings.

Vaisala operates according to the Vaisala Group environmental policy that has been certified according to the ISO14000 Environmental Management System. Vaisala’s headquarters is certified Gold-level LEED building, and Vaisala Oyj, the location of manufacture of RS41 radiosondes, uses electricity 100% from renewable sources. In addition, all the waste generated in this site is recycled as material or recovered as energy in the waste treatment process.

***Picture 1**. Vaisala Headquarters building in Vantaa, Finland.*

Regarding the risks related to landing of the radiosondes from the observation altitudes to ground, Vaisala radiosondes are designed according to the principles for *light unmanned free balloons* as specified in ICAO Annex 2 Appendix 4. Vaisala always highly recommends the use of parachutes in radiosoundings in order to maximize safety and minimize any risk of damage caused by the descending radiosonde, irrespective of the weight of the radiosonde model. The new, improved cover solution introduced to RS41 radiosondes in June 2017, replaces the ABS plastic material in the radiosonde cover with EPS, which allows for more deformation in case the radiosonde hits something, thereby minimizing the falling impact related risks. As can be seen from Table 1, the reduction in radiosonde mass during the last 20 years is significant. Vaisala automatic sounding system AUTOSONDE allows radiosoundings with parachutes, either external or integrated inside the balloon.

Summary

We wish that this statement clarifies the continuous efforts that Vaisala has done and continues to do in making radiosondes environmentally as friendly as possible. One aspect of environmental friendliness is to make sure that each sounding provides the maximum value for the use of the data, because otherwise the related environmental load is caused with no reason.

Vaisala looks forward to interact with experts world-wide to maximize the value of radiosondes for the meteorological and climatological applications, as well as to look for ways to reduce the environmental impact of the radiosondes.

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