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THE ENVIRONMENTALLY FRIENDLY RADIOSONDES

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| **Summary and purpose of document**This document provides overview of the possibilities how to make currently produced radiosondes more environmentally friendly.  |

**Action proposed**

The Meeting is invited to take notice of the findings reported in this document and to decide whether the recommendations are appropriate.

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Appendix: N/A

***Introduction***

**“Environmentally friendly (also eco-friendly, nature friendly, and green) are terms that refer to objects that people buy (called *goods*), services,** [**laws**](https://simple.wikipedia.org/wiki/Law)**, and rules that either do not harm the** [**environment**](https://simple.wikipedia.org/wiki/Environment) **or do very little harm to it.» ("nature-friendly". Webster's New Millennium Dictionary of English, Preview Edition (v 0.9.7). Lexico Publishing Group, LLC.)**

About 620,000 radiosondes are launched worldwide annually. The radiosonde is a disposable device is carried aloft by balloon and retiring for long distances from the point of release. After reaching a certain height, the balloon is bursts and the radiosonde falls to the ground. All radiosondes with balloons remnants remain usually on the ground and thus create a problem of environmental pollution.

***Radiosonde Components***

*Radiosonde Housing*

The main component of the radiosonde is a plastic or of expanded polystyrene housing, the size depends of type and manufacturer of a radiosonde. The housing includes itself all radiosonde electronic and battery pack to power the radiosonde during the flight.

*Radiosonde Electronics*

A basic radiosonde design usually comprises three main parts as follows:

(a) The sensors plus references;

(b) An electronic transducer, converting the output of the sensors and references into electrical signals;

(c) The radio transmitter.

The b and c parts usually designed in a one printed circuit board with electronic components. The PCB and all electronic components made from nondegradeable materials

*Battery Pack*

Radiosonde batteries should be of sufficient capacity to power the radiosonde for the required flight time in all atmospheric conditions. For radiosonde ascents to 5 hPa, radiosonde batteries should be of sufficient capacity to supply the required currents for up to three hours, given that the radiosonde launch may often be delayed and that flight times may be as long as two hours. Three hours of operation would be required if descent data from the radiosonde were to be used. Batteries should be as light as practicable and should have a long storage life. They should also be environmentally safe following use. Many modern radiosondes can tolerate significant changes in output voltage during flight. Two types of batteries are in common use, the dry-cell type and water-activated batteries. The dry-cell batteries may be lithium or alkaline.

*Balloon and Parachute*

Radiosondes are carried aloft by balloons. The best basic materials for extensible balloons are high-quality natural rubber latex and a synthetic latex based upon polychloroprene. Both materials may be compounded with various additives to improve their storage life, strength and performance at low temperatures both during storage and during flight, and to resist ozone and ultraviolet radiation. Balloons manufactured from synthetic latex incorporate a plasticizer to resist the stiffening or freezing of the film at the low temperatures encountered near and above the tropopause.

In order to reduce the risk of damage caused by a falling sounding instrument, it is usual practice to attach a simple type of parachute. For instruments weighing up to 2 kg, a parachute made from waterproof paper or plastic film

***Possibilities to make the environmentally friendly radiosonde, Recommendations***

It is a very difficult question how to make a radiosonde more environmentally friendly. The main issues are materials for radiosonde producing. Almost all radiosondes parts are made from non-degradable materials, so after falls down to the earth surface they remains there as a garbage.

The dimensions and weight of the radiosondes sometimes are not small and they may do a harm in case of contact with people and animals during a falling down.

*So in this case is a recommendation to reduce the dimensions and weights as small as possible.*

The batteries, used in radiosondes are also difficult to name environmentally friendly. Almost all batteries inevitably contain a number of either toxic or corrosive chemicals.

Balloons made from natural latex are biodegradable but they biodegrade at a much slower rate than other substances. Synthetic rubber is made from petroleum. This latter substance is natural, as is latex, but rubber producers put the petroleum through a process known as polymerization. This process creates long chains of molecules called polymers. These polymers are designed to resist weathering. They do not break down anywhere nearly as fast as natural latex.

*In this case the natural latex balloons are preferable for radiosonde observations.*

There are biodegradable plastics for now, but only Meisei have tried to make a radiosonde housing from such materials. The result of this is not very good enough. The reason may be that such plastics are not suitable for using in radiosonde observation conditions.

*The only recommendation can be made is the manufacturers should attempt to make a radiosonde housing from biodegradable plastics.*

***Experience in this area***

GRAW have plans to replace to replace the polystyrene with a more eco-friendly version. But he had no further details.

Korean technology (JinYang Industries) are replacing their RSG-20A weighing 180 g  (link) with an RSG-40A weighing 38 g, a weight reduction by a factor 4.5. Their new model, has a Green Technology product certification (what is that?) and is consistent with EU ROHS regulations.

MeteoModem - The environmental friendliness of the radio sonde is considered in the design, but it may not affect the quality of the measurements. The new M10GPSonde is smaller (less weight, 150 g including batteries) than the previous sonde.

Also Modem switched from lithium to alkaline batteries (4 pcs 1.5V alkaline battery pack).

Modem expects that within 5-10 years another, more environmentally friendly, material for the housing of the sonde will become available.

Vaisala admits that all parts of the radio sonde (balloon, strings, sonde itself) contain non-bio degradable material and/or material that can be harmful to animals. They considered/tested other materials in the past decades, but none were considered suitable.

The only achievement is that the RS41 is lighter (109 g for RS41-SG and 113 g for RS41-SGP) compared to the RS92.

There have been recent test by Vaisala in Australia with RS41-SG series without the outer plastic shell, thus reducing the overall weight and material used. Around 30 were flew in a trial and survived the flight, and were tracked to the ground. Analysis of the data is underway and plans are in place to identify fallen sondes and monitor their decade in the field.

It is noted that the RS41 uses 2 pcs AA-size Lithium batteries, but the RS92 had versions with lithium (RS92-SGPL) and alkaline batteries (RS92-SGPD, RS92-SGPA).

Meisei had/tested a RS in bio-degradable housing, but results were not satisfactory.