LOW ALTITUDE ROCKETSONDE FOR REFRACTION INDEX DETERMINATION IN THE LITORAL ENVIRONMENT

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1. IRREGULAR REFRACTION AT LOW ALTITUDE

Electromagnetic sensors in the frequency range of over a few MHz are affected by the refractive effects of the atmosphere. The irregularities in the refractive conditions are caused by rapidly changing gradients of water vapor content and air temperature. Observing refractive conditions and taking corrective action may improve the performance of applications that depend upon on electromagnetic signal propagation.

Irregularities in refraction are common in the marine environment, especially close to shorelines, in various weather conditions in which different air masses are not greatly mixed, and where the evaporation from the sea surface causes sharp changes in the vertical profile of water vapor content.

2. ROCKETSONDE: LOW ALTITUDE PROFILING

Balloon-borne radiosondes have been used to measure the vertical profiles of temperature and relative humidity in the determination of refractive index profiles. However, the new low altitude Vaisala Rocketsonde and Vaisala Floatsonde are a more convenient way to perform the measurements on the ship deck. Radiosondes released from the deck of the ship do not give relevant readings of the free atmosphere until they have drifted away from the thermal fingerprint of the vessel itself. Consequently, the altitude of the first relevant measurement may be in the order of a hundred meters.

The Vaisala Rocketsonde is launched away from the vessel and carries its measuring payload away from vessel's thermal fingerprint. At apogee, an altitude of about 1 km, the rocket deploys its sonde payload which descends slowly by parachute, providing a profile of atmospheric temperature and relative humidity with good vertical resolution. From a practical operational point of view, launching the Rocketsonde from the ship deck is easier than filling and releasing a balloon-borne radiosonde.

The Rocketsonde PTU sensors are very accurate: they are the same as those used in the Vaisala RS90 and RS92 radiosonde families. However, the Rocketsonde is meant to be used without ground checking prior to launch, which compromises accuracy somewhat. Furthermore, equipment and application-specific error sources do exist, which makes the measurement performance of the Rocketsonde somewhat less than that of RS90 and RS92 radiosondes. Comparison flights with RS90 radiosonde confirm the accuracy given in Table 1, Rocketsonde Performance.

Parameter	
Altitude range	0 - ~1000 m
Resolution	3 m
Pressure accuracy	± 3 hPa
Temperature accuracy	± 1 ºC
RH accuracy	± 5 % RH

Table 1: Rocketsonde performance

3. FLOATSONDE: SEA SURFACE MEASUREMENTS

It is difficult to measure evaporation from the sea surface due to the random nature of the process. The Vaisala Floatsonde continuously measures sea surface temperature at a depth of 2 ... 5 cm below the sea surface, and air temperature and relative humidity 2 ... 10 cm above the sea surface.

A special Vaisala HUMICAP® sensor was developed for the Floatsonde which resists salt water contamination. During the development phase of the Floatsonde issues such as reproducibility of sounding, the effects of the sensor boom

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positioning, salt water immersion and solar radiation were taken into account.

The Vaisala Floatsonde can be considered a good prototype at this time. More performance tests are needed. The current performance characteristics have not been published yet. However, dual soundings have shown good measurement reproducibility.

4. SUMMARY

The Vaisala Rocketsonde and Vaisala Floatsonde are complementary products which provide the naval community with a new method of making high-resolution in-situ measurements of variations in air temperature, relative humidity and sea surface temperature in the littoral zones. In the study of refractive index, it is less important to achieve absolute measurement accuracy than it is to achieve vertical profiles with the correct shape and good vertical resolution.

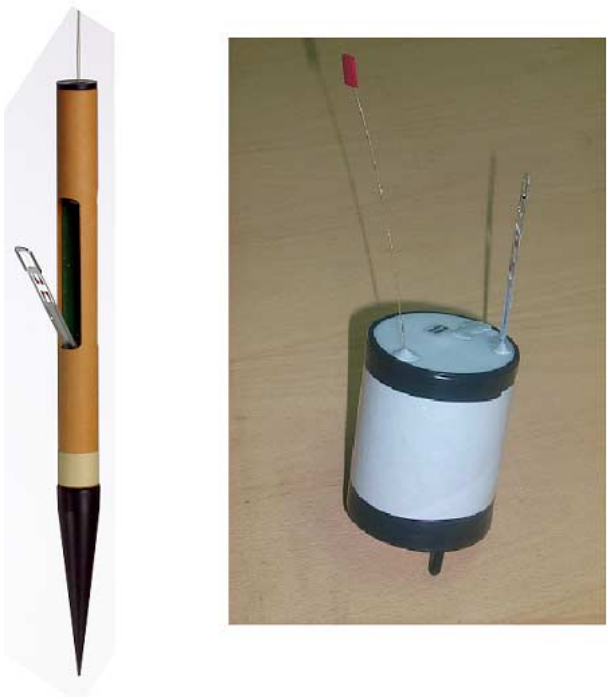

Figure 1 - Vaisala Rocketsonde payload (left) and Vaisala Floatsonde (right)

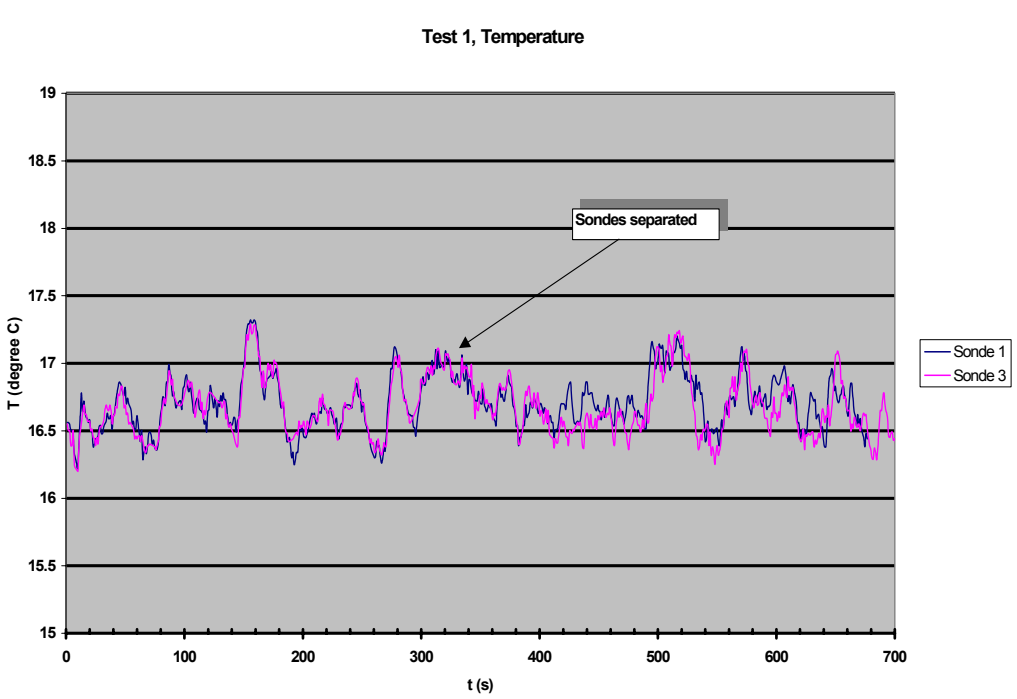

Figure 2 - Two Vaisala Floatsondes measuring air temperature

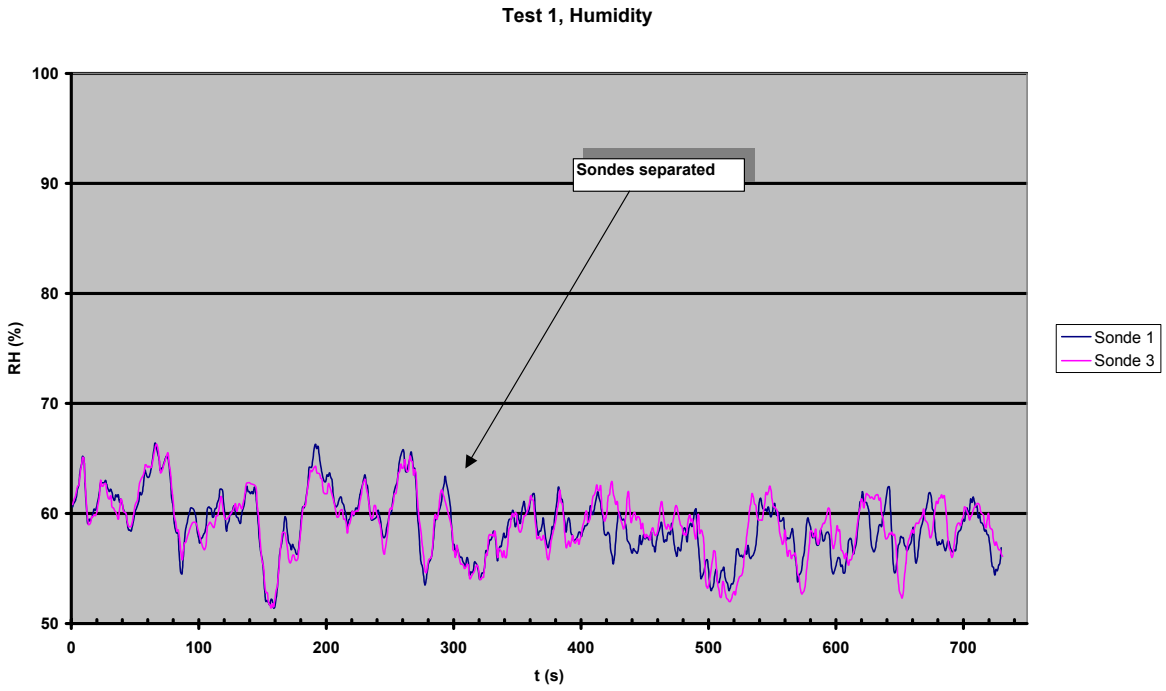

Figure 3 - Two Vaisala Floatsondes measuring relative humidity