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GRUAN site inventory

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Summary and Purpose of Document

This document provides a brief overview of the diverse observing capabilities at the current GRUAN sites in relation to priority one climate variables.

GRUAN site inventory

GRUAN sites possess diverse observing capabilities for climate variables ranked as priority one. The information presented here has been collected through a dedicated questionnaire, site reports, as well as through previous presentations. It reflects only a part of the current observing capabilities at the sites, which are relevant to the priority one essential climate variables as defined in GCOS 112. The analysis of the site survey focuses on measurement capabilities for upper air temperature and water vapor. Profiling and total column instruments were considered as well as in situ sounding instruments and remote sensing instruments. Key to obtaining reference observations of priority one climate variables will be the ability to establish and to verify measurement uncertainties for all observations, which is a particularly difficult challenge in the upper troposphere. Metadata completeness, change management, and commitment to long-term measurements are also factors that contribute to obtaining long term reference measurements, but were not considered in this survey. The concept of traceability was included in this survey and is expressed in the need for surface reference observations, which will be needed to connect the remote and in situ observations to the chain of traceability. The capability for redundant observations of a climate variable through for example in situ and remote sensing techniques or through multiple in situ techniques is considered key in the verification of established measurement uncertainties. All sites have some capability for redundant observations; however, only some of the stations currently have capabilities for stratospheric water vapor.

Routine sounding capabilities

Operational radiosondes are launched at least twice daily at 11 sites, including 2 sites that launch operational radiosondes 4 times daily. One site launches operational sondes once per day, two sites launch once per week and one site can launch at a frequency that is determined by the available funding.

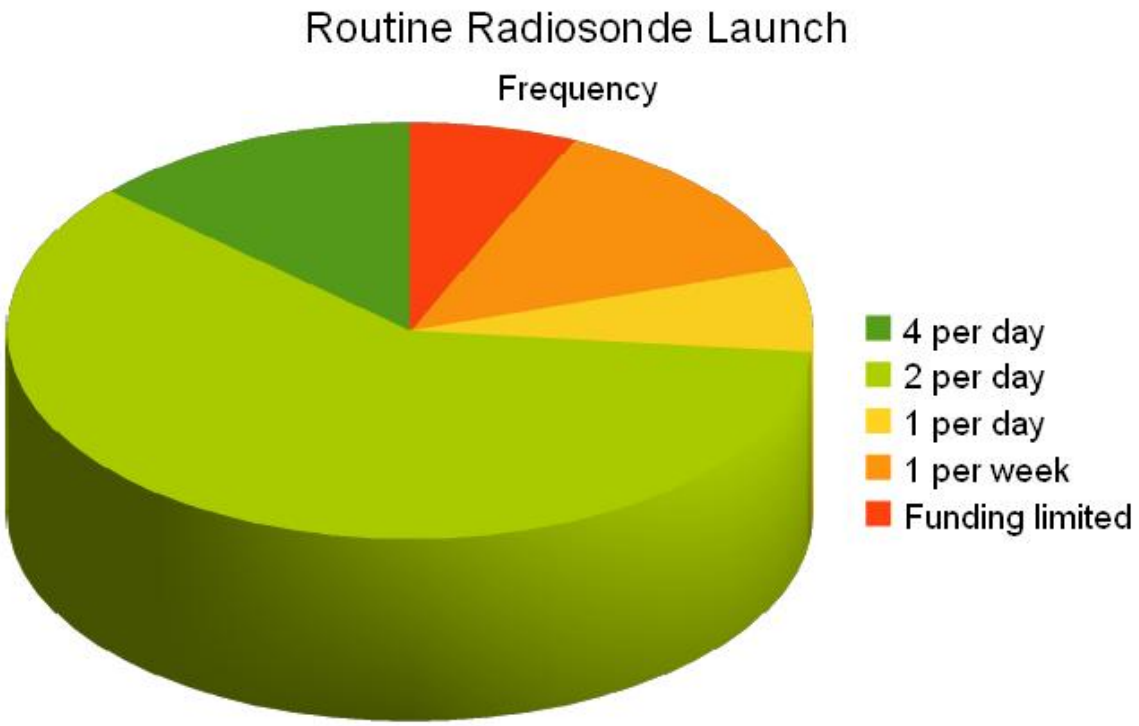

Figure 1: Distribution of launch frequency for operational radiosondes

The operational radiosondes models launched at the different sites are the Vaisala RS92, which is being used at 11 sites; the Meteolabor SRS-400, launched at one site; the Intermet Imet 1, launched at one site; and the Shanghai Changwang GTS1, which is also launched at one site.

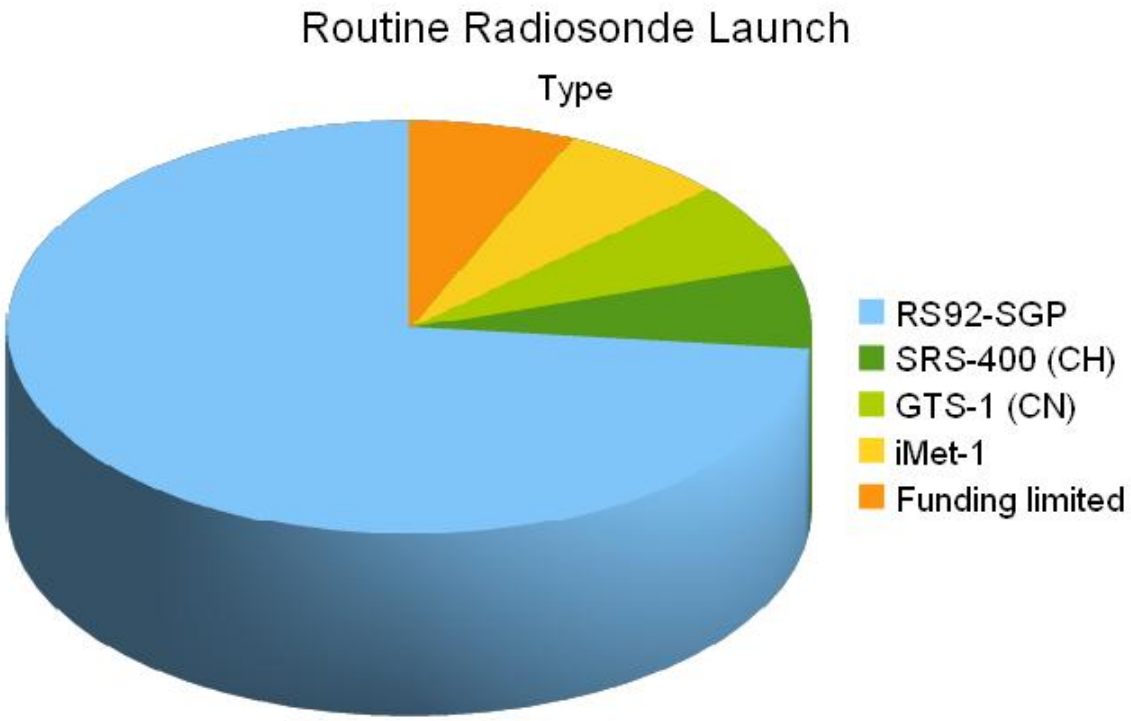

Figure 2 Distribution of radiosonde model used for operational radiosonde launches

Of the sites, which do not launch Vaisala RS92 radiosondes operationally, all but one site have the capability to launch Vaisala RS92 sondes or are in the process of acquiring that capability. The radiosonde model most commonly used across the network is the Vaisala RS92.

Remote sensing capabilities

Remote sensing capabilities are strong at most sites, with a large spectrum of different instrumentation across the network. Common to nearly all sites are GPS integrated (total column) precipitable water vapor (IPW). Raman lidars are being operated at 6 sites, microwave radiometers at 9 sites, FTIR radiometers at 7 sites and sun photometers at 4 sites. Among other instrumentation relevant for the accurate determination of priority one variables may be ceilometers, which are operated at 9 sites, cloud radars at 8 sites, aerosol lidars at 5 sites, and wind profilers at 5 sites. Remote sensing instrumentation is supplied by a larger number of manufacturers compared to radiosonde instrumentation and is not separated between different suppliers.

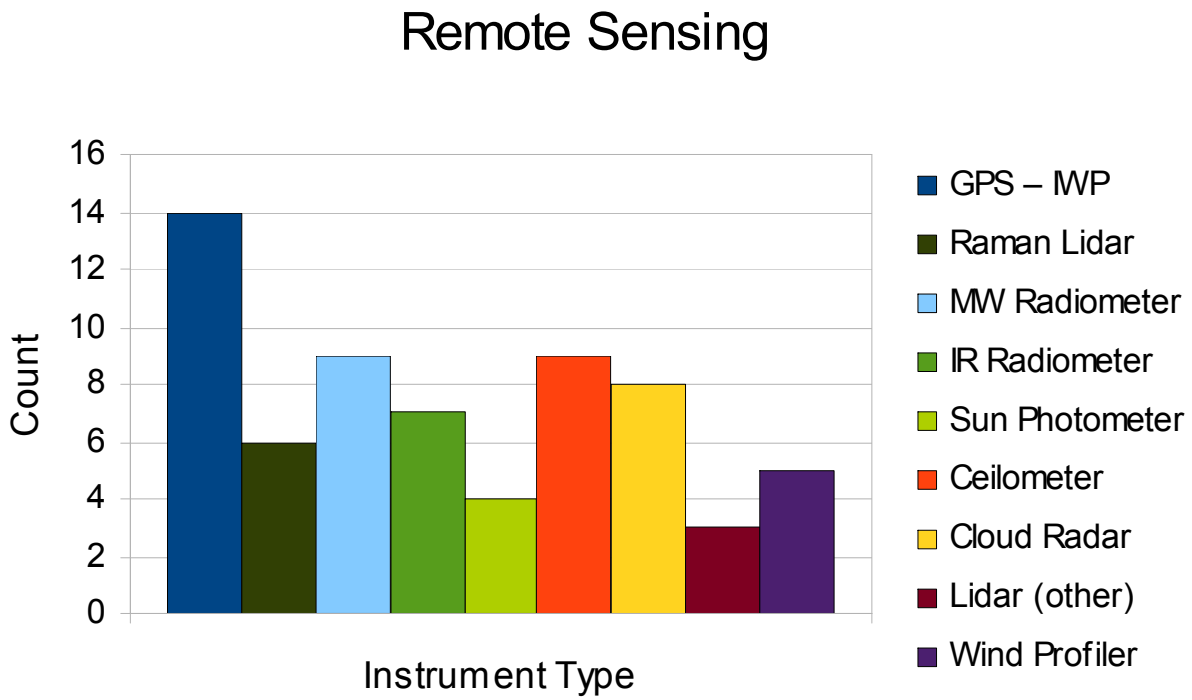

Figure 3 Frequency of remote sensing capabilities across the network.

IPW can be determined at all sites through a large number of in situ and remote sensing instrumentation. Profiling of water vapor through remote sensing techniques is limited to microwave radiometers for lower tropospheric water vapor and raman lidars for lower to mid latitude upper tropospheric water vapor. No stations employs remote sensing for measurements of lower to mid stratospheric water vapor.

Scientific reference capabilities for in situ water vapor profiling

Scientific instrumentation with reference capabilities for in situ water vapor profiling is distinguished from operational radiosondes, because of the increased cost and increased operational demand for these systems. Currently 5 sites launch instrumentation capable of measuring stratospheric water vapor on a routine schedule, which varies between roughly twice monthly and once per month. The instruments used for these observations are the Cryogenic Frostpoint Hygrometer (CFH) used at 2 sites, the NOAA Frostpoint Hygrometer (FPH), also used at 2 sites, and the Fluorescent Lyman Alpha Stratospheric Hygrometer for Balloon (FLASH-B) used at one site. Two sites currently have the capability to launch multiple reference sondes. Out of these 5 sites, three also launch operational radiosondes at least twice daily.

Surface reference observations

All stations operate reference observations for surface pressure, surface temperature, and surface humidity at or near the launch or remote sensing site or are in the process of establishing this capability.