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Improving the Balloon-borne Ice Particle Imager (B-ICI)

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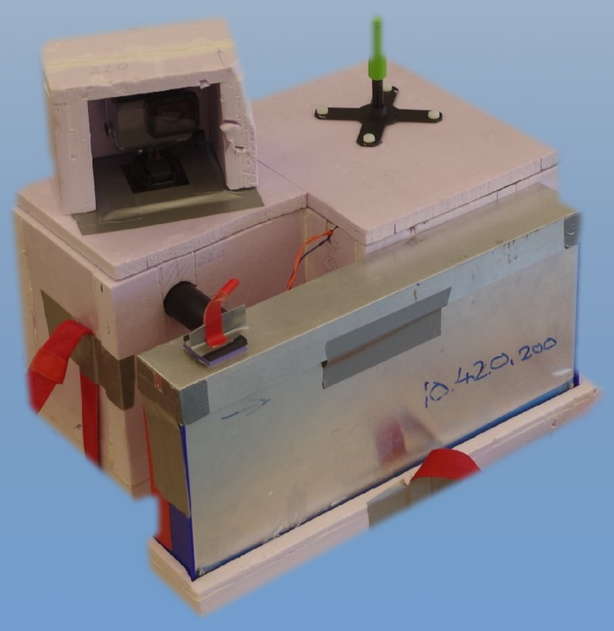
The radiative properties of the Earth's atmosphere are significantly influenced by various atmospheric constituents, including aerosols and clouds. Of these constituents, clouds play a particularly critical role in regulating the radiative balance of the atmosphere. To improve our understanding of this complex system, it is essential to develop improved models and conduct in-situ observations of cirrus clouds. Such efforts will enhance our ability to accurately quantify the contribution of cirrus clouds to the Earth's energy balance and improve our ability to predict future climate change.

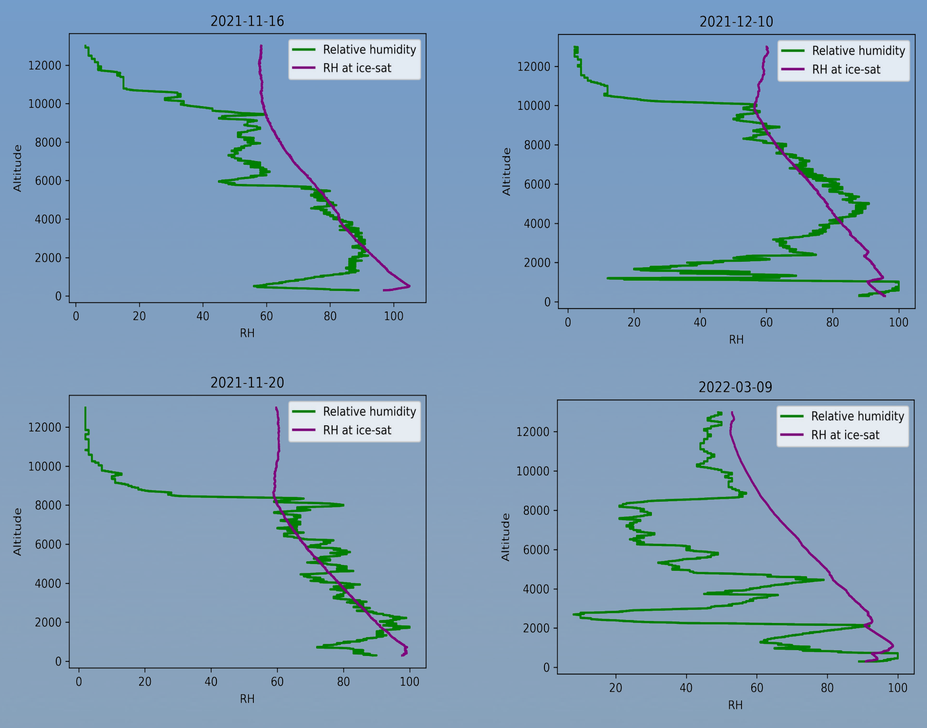
The instrument

For further improving current climate-modelling parameters, accurate parameterization of these clouds is required. From in-situ measurements, the size distribution of cirrus ice particles, their concentration and shape parameters can be determined. This can be achieved with the Balloon-borne Ice Cloud particle Imager (B-ICI). Campaigns done with the B-ICI and resulting parameterization have contributed to more accurate characterization of cirrus clouds.

The B-ICI is using a 4m long plastic tape to collect ice particles, that is continuously moving under a microscope lens to take high quality pictures of the crystals in the clouds. Measurements consists these images, pressure, temperature and humidity. Currently, the instrument is being tested with an additional OPC and partake measurements in Kiruna, North of Sweden.



Vertical profile



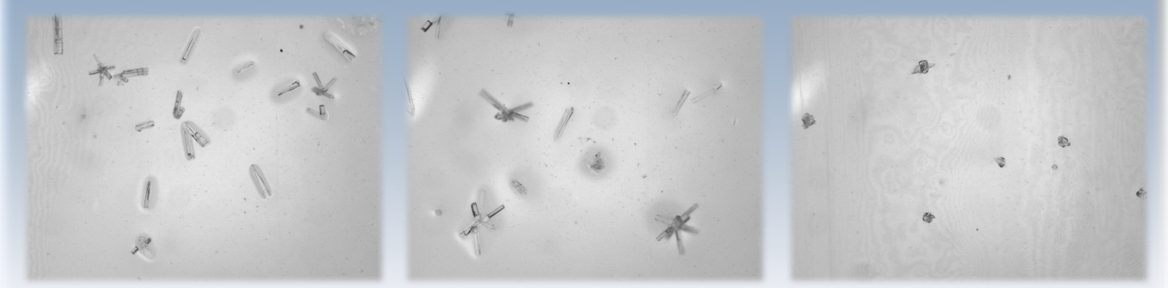
Relative humidity data compared to calculated ice saturation levels shows the altitude where ice clouds can be found during the flights.

Weight

The latest iteration of the instrument features a reduced tape-routing mechanism, resulting in a 60% reduction in the weight of the collector support frame. This weight reduction enables the incorporation of additional instruments and an increased battery capacity, allowing for longer flights.

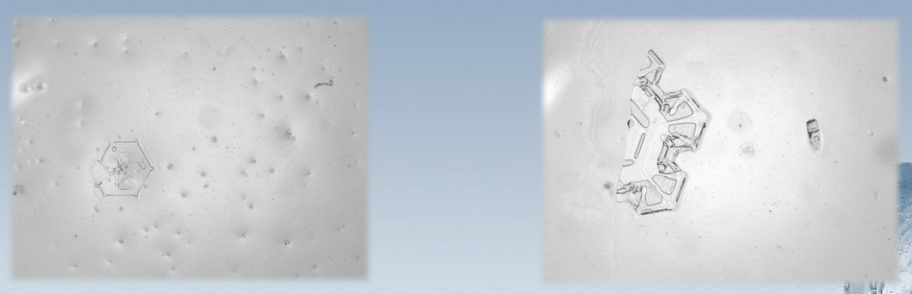
CCD images

The instrument is capable of capturing images of ice crystals collected from cirrus clouds. With a pixel size of 1.65 micrometers, particles that are 20 micrometers or larger can be distinguished and subsequently characterized for further analysis.



Secondary crystal deposition

The routing of the tape allowed mixed-phase crystals in lower altitude to deposit on the collection tape. This contamination can show up among cirrus-cloud particles resulting in outcome bias. This problem is addressed in the new version of the instrument.



Conclusion

This new version of the instrument is primarily improving image quality to enable easier and more automated image processing. Secondarily, changes in the design will reduce the weight of the instrument and simplify the method for sampling of ice particles. A more light-weight instrument allows to add other sensors. In particular, an optical particle counter to measure aerosol and small ice particles currently being tested with the B-ICI. This addition of an optical particle counter will result in more accurate size distributions in addition of providing complementary aerosol measurements.

References

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