Global short wave solar radiation monitoring system GLOB

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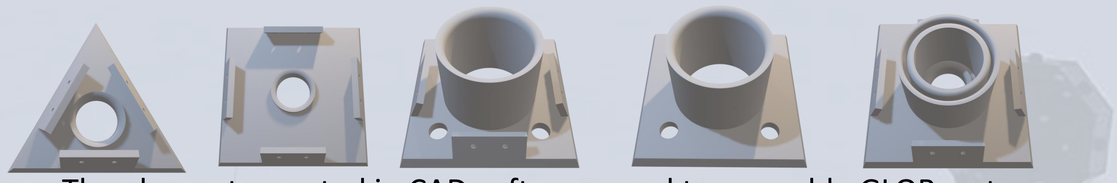
The Arctic region presents numerous challenges for human presence, ranging from constructing on thawing permafrost to ensuring adequate food supplies. However, one of the most pressing challenges revolves around energy sources, encompassing both heat and electricity supply. Arctic settlements are typically considered off-grid systems, necessitating the development of systems of locally generated energy that are both reliable and sustainable.

The goal of GLOB is to measure solar irradiation on as many as possible array planes to verify recorded values with modeled. Due to technical and costs limitations a sphere with 26 faces called rhombicuboctahedron has been pointed as most suitable for this project.

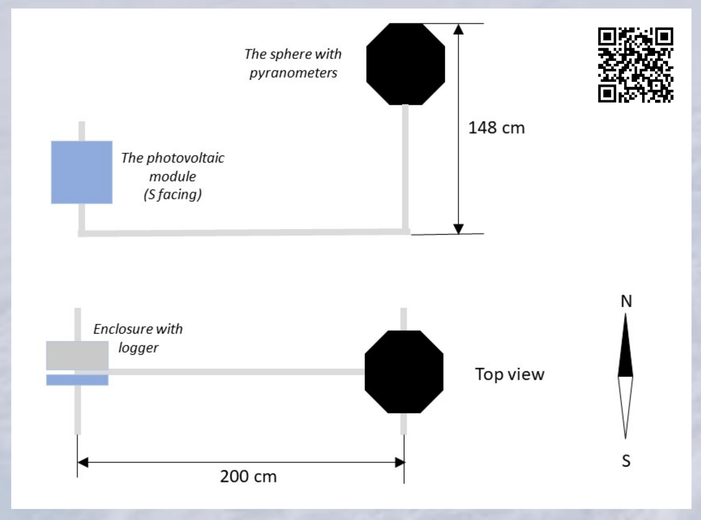
SENSORS AND OTHER ELECTRONIC COMPONENTS

Following components has been used to build complete system: 26 self-powered silicon-cell pyranometers type SP110, 1 temperature probe 107 manufactured by Campbell Sci., CR1000x logger, AM16/32B Multiplexer, CELL215 LTE modem, 7 Ah 12V battery, solar charging regulator, 20W photovoltaic module.

The rhombicuboctahedron is a polyhedron comprised of 8 triangles and 18 squares. For this project, elements with edges measuring 10 cm for both squares and triangles have been constructed. The bottom-facing square element isn't utilized for irradiation data collection. This is because a stainless steel pipe has been employed as a support leg, passing through the bottom square and reaching the top face, which is horizontally oriented. All components required for building the rhombicuboctahedron have been meticulously designed using CAD software, and the corresponding files compatible with most 3D printers have been attached for your convenience.

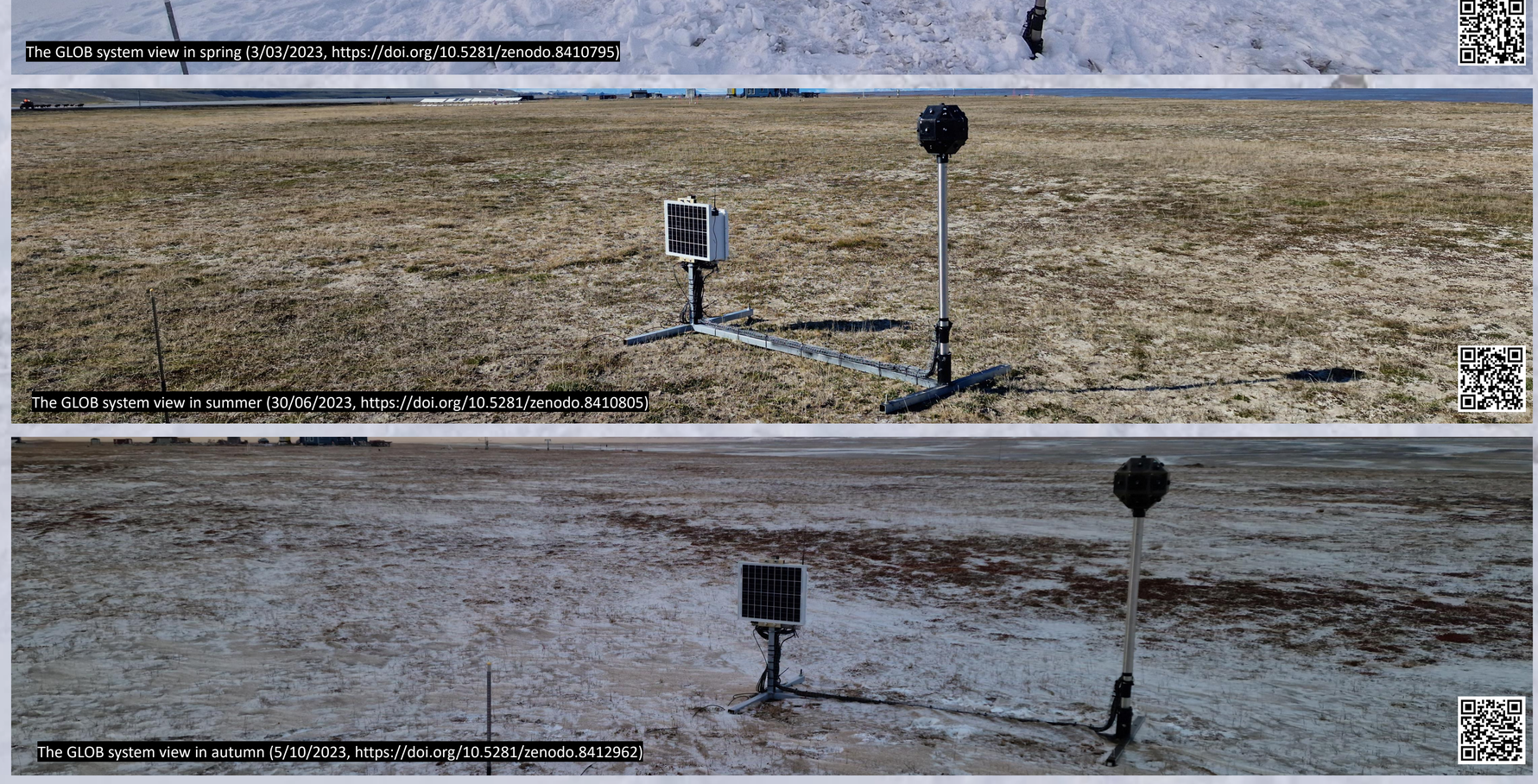


The elements created in CAD software used to assemble GLOB system

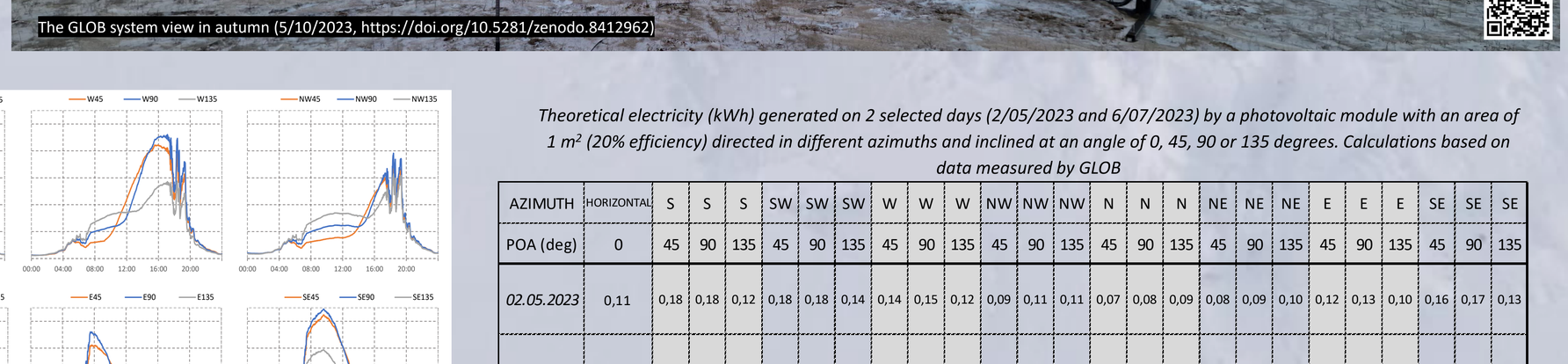


Sketch of the GLOB system (https://doi.org/10.5281/zenodo.8411391)

Location of the GLOB system (https://toposvalbard.npolar.no/)



The GLOB system view in spring (3/03/2023, https://doi.org/10.5281/zenodo.8410795)



The GLOB system view in summer (30/06/2023, https://doi.org/10.5281/zenodo.8410805)

The GLOB system view in autumn (5/10/2023, https://doi.org/10.5281/zenodo.8412962)

*Daily cycle of shortwave radiation (in W*m-2) received on various arrays planes, measured on May 2, 2023 by the GLOB system*

Theoretical electricity (kWh) generated on 2 selected days (2/05/2023 and 6/07/2023) by a photovoltaic module with an area of 1 m² (20% efficiency) directed in different azimuths and inclined at an angle of 0, 45, 90 or 135 degrees. Calculations based on data measured by GLOB

AZIMUTH	HORIZONTAL	S	S	S	SW	SW	SW	W	W	W	NW	NW	NW	N	N	N	NE	NE	NE	E	E	E	SE	SE	SE
POA (deg)	0	45	90	135	45	90	135	45	90	135	45	90	135	45	90	135	45	90	135	45	90	135	45	90	135
02.05.2023	0,11	0,18	0,18	0,12	0,18	0,18	0,14	0,14	0,15	0,12	0,09	0,11	0,11	0,07	0,08	0,09	0,08	0,09	0,10	0,12	0,13	0,10	0,16	0,17	0,13
06.07.2023	0,17	0,19	0,15	0,06	0,18	0,15	0,09	0,18	0,15	0,08	0,16	0,15	0,11	0,15	0,15	0,09	0,16	0,15	0,12	0,18	0,15	0,08	0,18	0,16	0,09

Scan QR code to see the full technical description of the system

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SVALBARDS MILJØVERNFOND

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