BALLON2025

Berufsbildende Schule Donnersbergkreis

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Ziele des Projektes

Die konkrete Zielsetzung des Ballonprojektes bestanden darin, in der Stratosphäre mithilfe eines Ballons, mit entsprechenden Messinstrumenten bzw. Microcomputern und vorbereiteten Experimenten für die Umwelt relevante Daten zu gemessen. Allein diese Versuchsanordnung dokumentiert die Entsprechung zu dem ausgewählten horizontalen Ziel: Environment und fight against climate change.

Diese Messungen schärfen das Bewusstsein der Teilnehmer bezogen auf Umweltbelastungen. Absicht ist es durch dieses Bewusstsein auch den Kampf gegen den Klimawechsel zu unterstützen, entsprechend den Zielen civic engagement common values and participation. Wir gehen davon aus, dass unsere Teilnehmerinnen durch selbst gemachte Erfahrungen auf der Grundlage von selbst organisierten und durchgeführten Studien nicht nur privat, sondern z. B. auch in NGOs aktiv werden könnten. Die oben gemachten Beschreibungen machen also den Zusammenhang zwischen politischen Organen, Forschung und praktische Umsetzung im gesellschaftlichen Kontext deutlich.

So ist die Umsetzung theoretischen Wissens in die fachliche Praxis (Organisation des Ballon-Projektes, Unterricht in IT, Chemie, Biologie) im Kontext verschiedener Ausbildungen ein Beitrag zur Innovation der Berufsbildung.

Content

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Flight Information

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G-Preperation

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Ballon 2025 – Flight Information

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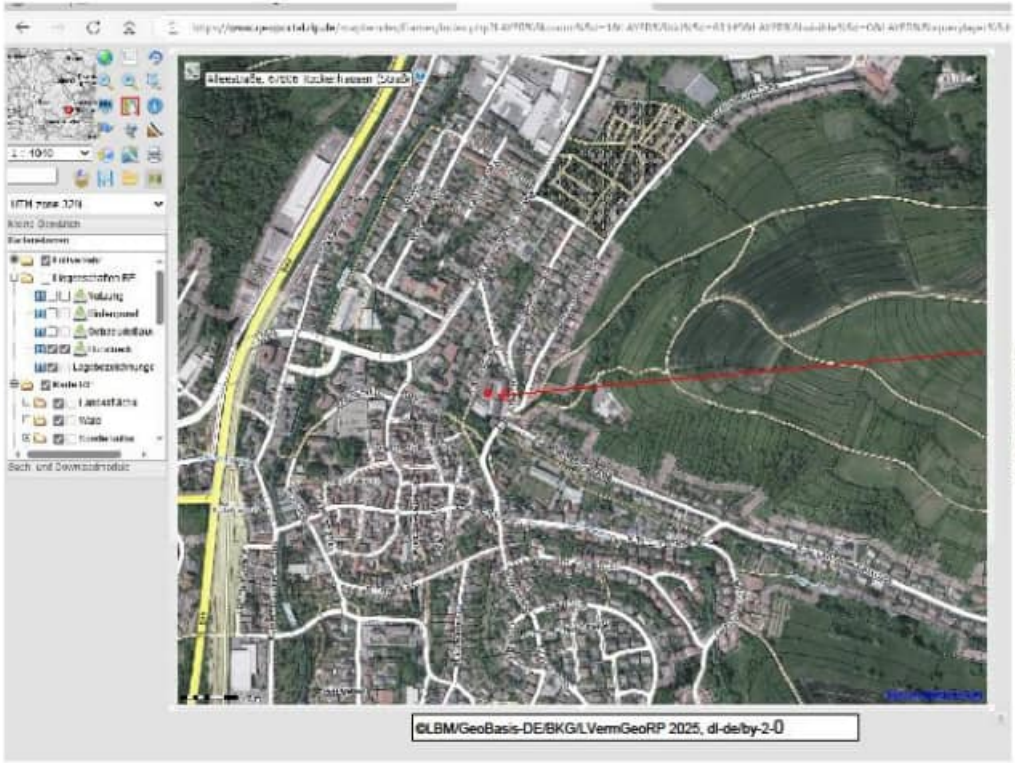
Anlage Einzelaufstiegserlaubnis Wetterballon



Aufstiegsstelle leichter unbemannter Freiballon
am 06.05.25 altern.
07.05.25
Koordinaten
49°37'50.276"N
7°49'24.908"E

Berufsbildende Schule
Donnersbergkreis

Einzelaufstiegserlaubnis durch Landrat Donnersbergkreis

Einzelaufstiegserlaubnis durch LFBA

Erasmus+

Zustimmung des Grundstückeigentümers zum Aufstieg eines unbemannten Freiballons (Wetterballon)

Im Rahmen eines Erasmus+ - Schulprojektes zu Umwelt- und Klimaschutz möchten die beteiligten Schulen

Lycée général et technologique Auguste Béhal (France)
6 Rue Paul Elvert, 62300 Lens, France (http://behalens.com)

Zespół Szkół Nr 1 im. Legionów Polskich (Poland)
ul. Warszawska 72, 26-900 Kozienice (www.zsp.edu.pl)

BBS Donnersbergkreis
Alleestr. 8, 67806 Rockenhausen (www.bbs-donn.de)

mit einem unbemannten Wetter-Ballon umweltrelevante Daten vom Erdboden bis in die Stratosphäre mittels geeigneter (Mikrocomputer gestützter) Messgeräte messen und vorbereitete Experimente durchführen.

Für den Aufstieg des Wetter-Ballons wurde eine entsprechende Haftpflichtversicherung abgeschlossen und zusammen mit der Genehmigung des Grundstückseigentümers wird eine entsprechende Aufstiegserlaubnis beim Landesbetrieb Mobilität Rheinland-Pfalz, Fachgruppe Luftverkehr, beantragt.

Startgelände:

Schulhof der BBS Donnersbergkreis
Standort Rockenhausen
Alleestr. 8
67806 Rockenhausen

Starttag/Startzeit:

07. oder 08. 05.2025

Dem Verfahren wird hiermit als Grundstückseigentümer in/Grundstückseigentümer abgestimmt.

Ort, Datum

Unterschrift

Rainer Guth (Landrat)

Name, Vorname in Druckbuchstaben

Bitte senden Sie diesen Antrag vollständig und unterschrieben an Landesbetrieb Mobilität Rheinland-Pfalz, Fachgruppe Luftverkehr, Gebäude 867C, 66482 Hahn-Flughafen oder per E-Mail an luftverkehr@lbm.rlp.de

LBM

Antrag auf Erteilung einer Einzelaufstiegserlaubnis für unbemannte Freiballone
(gemäß § 20 Abs. 1 Nr. 6 Luftverkehrs-Ordnung)

1. Angaben zum Antragsteller

a. Angaben bei natürlichen Personen/Einzelpersonen:

Name:		Vorname:
Straße und Hausnummer:	Postleitzahl:	Wohnort:
Telefon:	Telefax:	E-Mailadresse:

b. Angaben bei juristischen Personen/Vereinen

Name der juristischen Person/Vereins:		
Verteilungsberechtigte Personen:		
Name:	Vorname:	
Straße und Hausnummer:	Postleitzahl:	Ort des Sitzes:
Telefon:	Telefax:	E-Mailadresse:

Telefonische Erreichbarkeit und Name der verantwortlichen Person vor Ort bei Aufstieg Wetterballon:

2. Angaben zur Haftpflichtversicherung (§§ 37 Abs. 1a), 43 LuftVG i.V.m. §§ 101 ff. LuftVZO) Bitte den Versicherungsschein beifügen.

Name der Versicherung:	
Versicherungsnehmer:	
Versicherungsnummer:	
Deckungssumme:	
Vertragsdauer:	

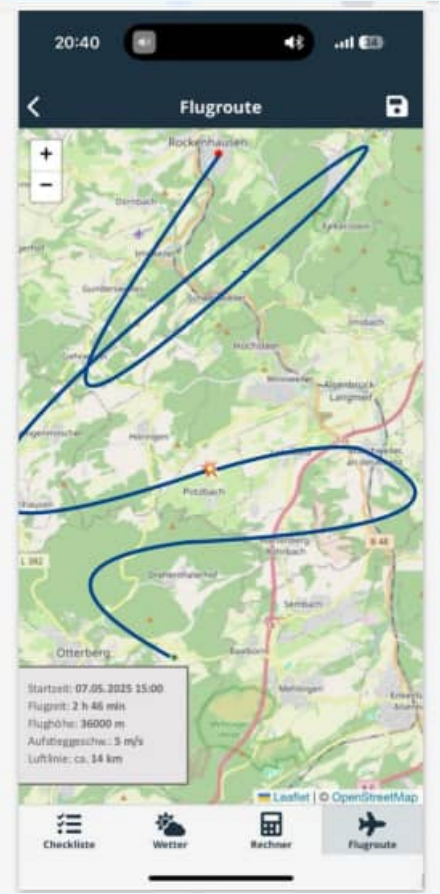
3. Angaben zum Freiballon (§§ 37 Abs. 1a), 43 LuftVG i.V.m. §§ 101 ff. LuftVZO)
Klassifizierung gemäß Ziffer 1.1. der Anlage 2 zum Anhang (SERA) der VO (EU) Nr. 923/2012:

☐ leicht ☐ mittel ☐ schwer

Bezeichnung:	Hersteller:
Gesamtmasse des Ballons:	Gesamtmasse des/der Paketes (Anhang):
Gesamtmasse inkl. Nutzlast:	Steigrate in Sekunden:
Gesamtlänge:	Sinkrate in Sekunden:
Material des Ballons:	Farbe des Gespanns:
Anzahl der Nutzlastpakete:	Beschreibung der Nutzlast:

LBM RP — O-FB 42 Antrag Einzelaufstiegserlaubnis Freiballon — Revision: 2, Datum: 06.2023, Seite: 1

Berufsbildende Schule Donnersbergkreis



Flugroute

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Who we are

- apprentices for electronics technicians at Adient Components
- school every 3 weeks
- job-related subjects

Obtaining the ascent permit

- location shouldn’t be near an airport, if possible
- permission from property owner is needed
- information summary for aviation authority
- flight insurance

STRATO FLIGHTS

Lieber Stratosphären-Abenteurer,

hiermit stellen wir dir deine eingegebenen Informationen übersichtlich zur Verfügung. Mit diesen Daten kannst du eine Anmeldung bei der Landesluftfahrtbehörde vornehmen. Die für dich zuständige Behörde findest du hier:

https://www.strato-flights.com/luftraum/luftfahrtbehoerden/

Vorhaben: Aufsteigen eines Wetterballons
Genehmigungsanschrift: Max Mustermann, Musterstraße 4, 11111 Musterstadt,
Koordinaten Aufstiegsort (Dezimal): 49.630675 N 7.623713 E
Koordinaten Aufstiegsort (Grad): 49°37'50.43"N 7°49'25.367"E
PLZ, Ort: 67806 Rockenhausen
Datum: 10.05.2024 - 10.05.2024
Uhrzeit: 13:00 - 14:00 (deutsche Zeit)
Gesamtlänge: 15 m
Flugdauer: 120 min
Farbe des Gespanns: weiß
Klassifizierung: Unbemannter Freiballon mit einer Gesamtmasse des Pakets von 2,7 kg ist in die „leichte Klasse“ einzuordnen
Material des Wetterballons: Naturkautschuk-Latex-Gemisch
Gesamtmasse ohne Nutzlast: 1,5 kg
Beschreibung der Nutzlast: GPS Tracker, Arduino Microcontroller
Anzahl der Nutzlastpakete: 1
Gesamtmasse mit Nutzlast: 2,7 kg
Flächendichte: 2,48 g/cm² (somit leichte Klasse)

Steigrate in Sekunden: 5 m/s
Sinkrate in Sekunden: 5 m/s
Fallschirmabsicherung: Ja
Sicherung/Verpackung der Nutzlast: Styroporbox und Fallschirm
Beschriftung vom GPS Gerät: GPS Tracker STRATOfinder
Füllung des Wetterballons: Helium
Reißfestigkeit der Schnur: 180 N
Maximale Flughöhe in Metern und Fuß (ft) über MSL: 36000 m (118080 ft)
Angabe des Zwecks: Temperaturmessung Druckmessung
Wird der Wetterballon die BRD verlassen?: Nein

Wir wünschen dir einen erfolgreichen Flug.

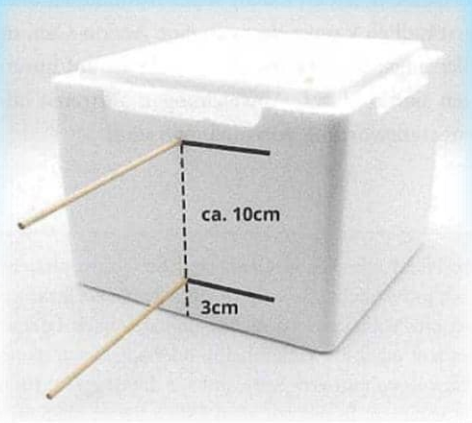
Beste Grüße
Dein Stratoflights-Team

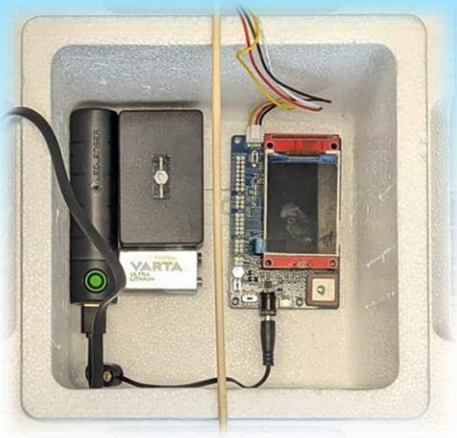
Making it fly

- gas needs to density lower than air
- possible gases to use
  - helium
  - ~~hydrogen~~ (too explosive)
- minimal volume of helium needed: 5250 liters

construction of payload

- GPS tracker, battery and powerbank are free to move if needed
- sticks need to go through the styrofoam box to attach wings

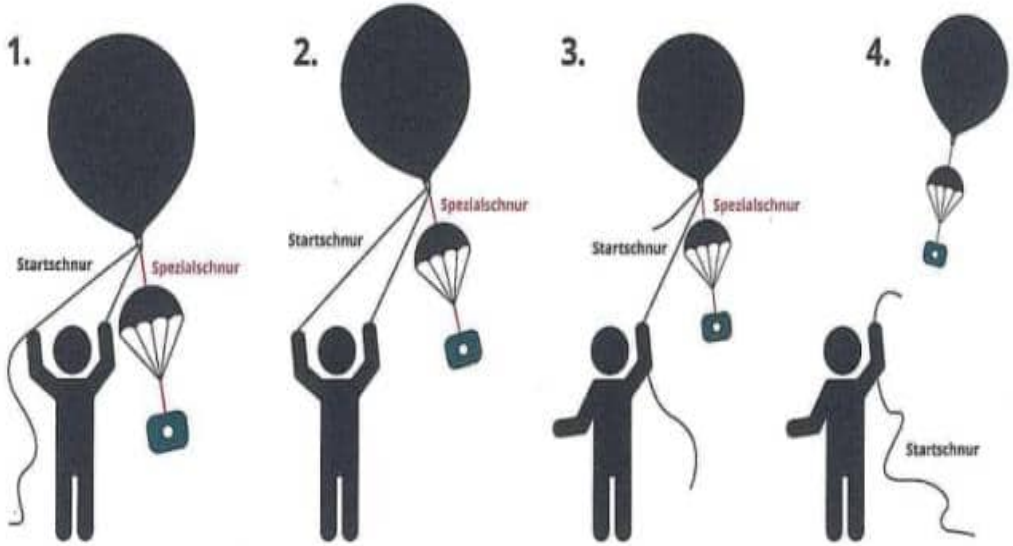




GPS tracker & flight prediction

- tracker is needed to find payload after the flight
- SIM card is inserted into tracker to send tracking data to app

how to start the ballon



- ballon should be lifted slowly to control when you start
- when ballon is lifted you can still reposition if starting point isn't optimal
- to start just let go of the string you're holding

ascent & descent

- while ascending temperature, pressure, coordinates and humidity is logged every 2 seconds
- ballon will burst at around 36000m due to pressure
- after the ballon burst the parachute will open and decelerate the descent

recovery of the payload

- recovery through the coordinates of the GPS tracker
- STRATOfinder can be added in STRATOflights APP
- coordinates from STRATOfinder can also be added in any app that can navigate to those coordinates

Android

iPhone

Because the information becomes a bit more complex from here on, you will also receive the information in your own language.

What is Geocaching?

Geocaching works like this:

Hiding a cache: A geocacher hides a cache in a specific location and enters the GPS coordinates of the hiding place into a geocaching database or website.

Finding the cache: Other geocachers use these coordinates to find the cache. There are different levels of difficulty depending on how well the cache is hidden and the challenges of the search.

Logging and trading: Finders sign the logbook and can also take small exchange items such as toys, coins or other small items or leave their own items.

Geocaching has a worldwide community and is a popular recreational activity that combines outdoor adventure, nature exploration and orientation.

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Co to jest geocaching?

Geocaching działa w następujący sposób:

Ukrywanie skrzynki: Geocacher ukrywa skrzynkę w określonym miejscu i wprowadza współrzędne GPS kryjówki do bazy danych lub strony internetowej geocachingu.

Znalezienie skrzynki: Inni geocacherzy używają tych współrzędnych do znalezienia skrzynki. Istnieją różne poziomy trudności, w zależności od tego, jak dobrze skrytka jest ukryta i jakie wyzwania pojawiają się podczas poszukiwań.

Rejestrowanie i wymiana: Znalazcy wpisują swoje nazwiska do dziennika i mogą również zabrać drobne przedmioty na wymianę, takie jak zabawki, monety lub inne drobne przedmioty, lub zostawić własne przedmioty. Geocaching ma społeczność na całym świecie i jest popularną formą spędzania wolnego czasu, która łączy przygodę na świeżym powietrzu, eksploracja i orientacja przyrodnicza.

Qu’est-ce que le géocaching ?

Le géocaching fonctionne comme ceci :

Cacher une cache : Un géocacheur cache une cache à un endroit spécifique et saisit les coordonnées GPS de la cachette dans une base de données ou un site Web de géocaching.

Trouver la cache : D'autres géocacheurs utilisent ces coordonnées pour trouver la cache. Il existe différents niveaux de difficulté, en fonction de la manière dont la cache est cachée et des défis rencontrés lors de la recherche.

Enregistrement et échange : les chercheurs entrent leur nom dans le journal de bord et peuvent également emporter de petits objets d'échange tels que des jouets, des pièces de monnaie ou d'autres petits objets ou laisser leurs propres objets derrière eux. Le géocaching a une communauté mondiale et est une activité de loisir populaire qui combine aventure en plein air, exploration et orientation de la nature.

How to find a Geocache?

Finding a geocache is an exciting treasure hunt that uses GPS coordinates and often small puzzles or clues. Here is a step-by-step guide on how to find a geocache:

1. Use geocache platforms
Go to a geocaching website or use a geocaching app (e.g. geocaching.com) to search for geocaches near you. You can filter by specific categories, difficulty levels and locations.

2. Navigate
Use a GPS device or smartphone app to navigate to the given coordinates. Be aware that you may not find the cache exactly at the specified point, as geocachers often add a little challenge and hide the cache in a secret location.

3. Find the geocache
Once you are at the specified coordinates or in the immediate vicinity, the real search begins. Geocaches can be anywhere: under trees, in rocks, in hollow branches or in other inconspicuous places. Sometimes there are additional clues on site that can help.

4. Make a logbook entry online
After finding the cache, you should log the find in the logbook and online.

Jak znaleźć skrzynkę geocache?

Znalezienie skrzynki to ekscytujące poszukiwanie skarbów, które wykorzystuje współrzędne GPS i często małe łamigłówki lub wskazówki. Oto przewodnik krok po kroku, jak znaleźć skrzynkę:

1. Korzystaj z platform do skrzynek
Przejdź do witryny poświęconej geocachingowi lub użyj aplikacji do geocachingu (np. geocaching.com), aby wyszukać skrzynki w Twojej okolicy. Możesz filtrować według określonych kategorii, poziomów trudności i lokalizacji.

2. Nawiguj
Użyj urządzenia GPS lub aplikacji na smartfonie, aby nawigować do określonych współrzędnych. Uważaj, aby nie znaleźć skrzynki dokładnie w określonym miejscu, ponieważ geocacherzy często dodają małe wyzwanie i ukrywają skrzynkę w tajnym miejscu.

3. Znajdź skrzynkę
Gdy znajdziesz się pod określonymi współrzędnymi lub w okolicy, rozpoczyna się właściwe wyszukiwanie. Geocache mogą znajdować się w dowolnym miejscu: pod drzewami, w skałach, w pustych gałęziach lub w innych niepozornych miejscach. Czasami na stronie znajdują się dodatkowe wskazówki, które mogą pomóc.

4. Dokonaj wpisu do dziennika online
Po odnalezieniu kesza należy zapisać znalezisko w dzienniku oraz w internecie.

Comment trouver une géocache ?

Trouver une géocache est une chasse au trésor passionnante qui utilise les coordonnées GPS et souvent de petites énigmes ou indices. Voici un guide étape par étape sur la façon de trouver une géocache :

1. Utilisez les plateformes de géocache
Accédez à un site Web de géocaching ou utilisez une application de géocaching (par exemple geocaching.com) pour rechercher des géocaches près de chez vous. Vous pouvez filtrer par catégories, niveaux de difficulté et emplacements spécifiques.

2. Naviguez
Utilisez un appareil GPS ou une application pour smartphone pour accéder aux coordonnées spécifiées. Attention, vous ne trouverez peut-être pas la cache exactement à l'endroit spécifié, car les géocacheurs ajoutent souvent un petit défi et cachent la cache dans un endroit secret.

3. Trouvez la cache
Lorsque vous êtes aux coordonnées spécifiées ou dans les environs, la recherche proprement dite commence. Les géocaches peuvent se trouver n'importe où : sous les arbres, dans les rochers, dans les branches creuses ou dans d'autres endroits discrets. Il existe parfois des conseils supplémentaires sur place qui peuvent vous aider.

4. Faire une entrée dans le journal de bord en ligne
Après avoir trouvé la cache, vous devez enregistrer la découverte dans le journal de bord et en ligne.

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The task will be for each group to look for a geocache on our trip to Lublin tomorrow.

Since the geocaching app distinguishes between premium (paid) and normal members, normal members do not see all geocaches.

You can search for any cache in Lublin and then let us know if you found it.

All we need is a photo of the location, ideally with the hidden container.

As an alternative to a random search, you can search for the cache suggested here using the coordinates and the clue.

Zadaniem każdej grupy będzie odnalezienie skrzynki na naszej jutrzejszej wycieczce do Lublina.

Ponieważ aplikacja geocaching rozróżnia członków premium (płatnych) i zwykłych, członkowie zwykli nie widzą wszystkich skrzynek.

Możesz wyszukać dowolną skrzynkę w Lublinie, a następnie dać nam znać, jeśli ją znalazłeś.

Jedyne, czego potrzebujemy, to zdjęcie lokalizacji, najlepiej z ukrytym pojemnikiem.

Alternatywnie do wyszukiwania losowego możesz wyszukać sugerowaną tutaj skrzynkę, korzystając ze współrzędnych i wskazówki.

La tâche sera pour chaque groupe de chercher une géocache lors de notre voyage à Lublin demain.

Étant donné que l'application de géocaching fait la différence entre les membres premium (payants) et les membres réguliers, les membres réguliers ne voient pas toutes les géocaches.

Vous pouvez rechercher n'importe quelle cache à Lublin et nous faire savoir si vous l'avez trouvée.

Tout ce dont nous avons besoin est une photo du lieu, idéalement avec le conteneur caché.

Comme alternative à la recherche aléatoire, vous pouvez rechercher la cache proposée ici à l'aide des coordonnées et de l'indice.

You can also search for a cache selected by us.

Możesz także wyszukać wybraną przez nas skrzynkę.

Vous pouvez également rechercher une cache que nous avons sélectionnée.

Sie können auch nach einem von uns ausgewählten Cache suchen.

Zamek Lubelski | Château de Lublin | Lubliner Schloss

N 51° 15.013 E 022° 34.296

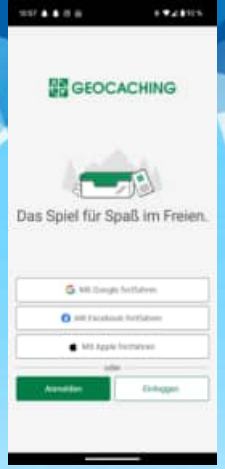
In der kostenlosen Geocaching-App Version 'missbrauchen' wir dazu einen beliebigen Cache um unsere Koordinaten zur Suche zu verwenden

In the free Geocaching app version we therefore 'misuse' any cache to use our coordinates for searching.

W bezpłatnej wersji aplikacji do geocachingu „nadużywamy” dowolnej skrzynki, aby używać naszych współrzędnych do wyszukiwania.

Dans la version gratuite de l'application de géocaching, nous « abusons » de n'importe quel cache pour utiliser nos coordonnées pour la recherche.

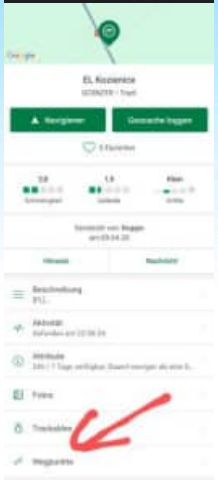
Install the app



log in/ register however you like

choose any cache you want

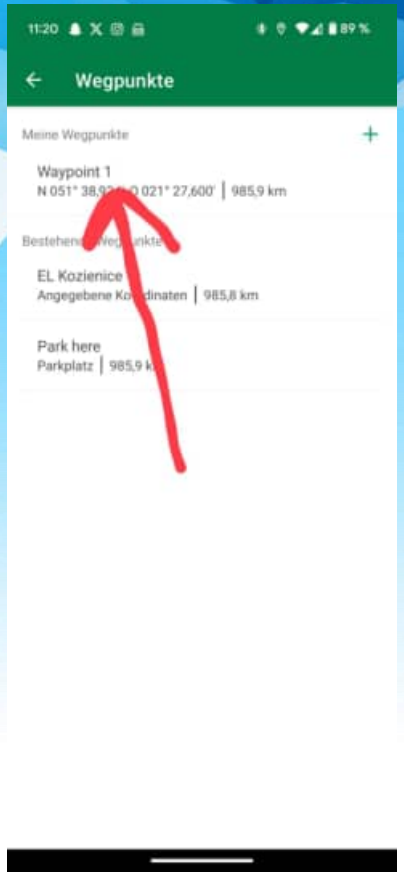
click on the cache to open the menu



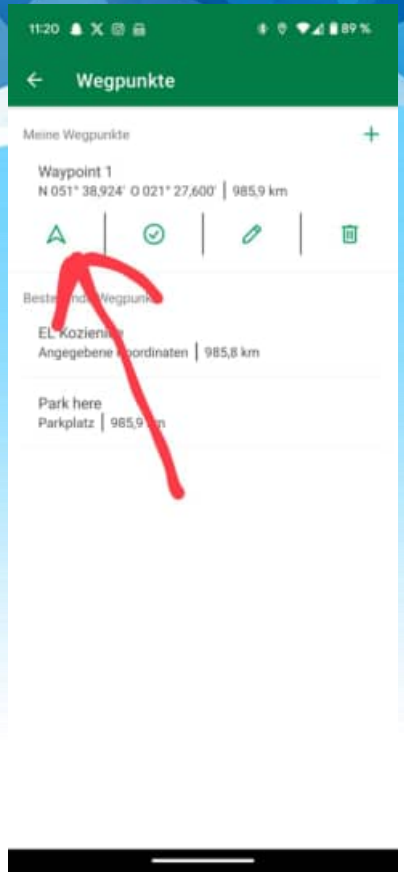
click on waypoint

add a waypoint

enter your coordinates and confirm the waypoint



click on waypoint to open menu



click on navigate

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O keszu:
Zamaskowana minipreforma PET, w środku tylko logbook. Poziom trudności wynika ze stopnia zmugolenia okolicy. Powodzenia!

À propos du cache :
Mini-préforme PET masquée, avec seulement un journal de bord à l'intérieur. Le niveau de difficulté dépend du degré de boue de la zone. Bonne chance!

Über den Cache:
Maskierter PET-Mini-Preform, nur ein Logbuch darin.
Der Schwierigkeitsgrad hängt vom Grad der Schlammbildung in der Gegend ab.
Viel Glück!

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Environmental Consciousness
Erasmus+
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N 51° 15.013 E 022° 34.296

Wir suchen einen sogenannten PETling. Machen Sie ein Foto davon. Möglicherweise ist der Container vor Ort nicht auffindbar, daher machen Sie bitte ein Foto vom vermuteten Standort. Im Petling liegt ein Streifen Holz. Dort kann der Fund auch dokumentiert werden.

We are looking for a so-called PETling. Take a photo of it. The container may not be found on site, so please take a photo of the suspected location. There is a strip of wood in the petling. The find can also be documented there.

Poszukujemy tzw. PETlinga. Zrób zdjęcie. Być może kontenera nie można odnaleźć na miejscu, wówczas prosimy o wykonanie zdjęcia podejrzanego miejsca. W petlingu znajduje się pas kłody. Znalezisko może być tam również udokumentowane.

Nous recherchons un soi-disant PETling. Prenez-en une photo. Peut-être que le conteneur ne peut pas être trouvé sur place, veuillez alors prendre une photo de l' emplacement suspecté. Il y a une bande de bûche dans le petling. La découverte peut également y être documentée.

Die Informationen zum von uns vorgeschlagenen Cache bekommen sie auch noch schriftlich.
Wenn ihr den Cache gefunden haben, dürft ihr euch auch gerne in das Logbuch eintragen.
Vielleicht findet ihr auch außerhalb dieses Projektes Spaß am Geochaching.

You will also receive written information about the cache we suggest.
If you have found the cache, you are welcome to sign the logbook. Perhaps you will also enjoy geocaching outside of this project.

Otrzymasz również pisemną informację o zaproponowanej przez nas skrytce.
Po odnalezieniu skrzynki możesz wpisać swoje imię i nazwisko do dziennika.
Być może geochaching spodoba ci się również poza tym projektem.

Vous recevrez également les informations sur la cache que nous vous avons suggérées par écrit.
Une fois que vous avez trouvé la cache, vous pouvez inscrire votre nom dans le journal de bord.
Peut-être que vous apprécierez également le géochaching en dehors de ce projet.

Trip to dwd weather park Offenbach

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Berufsbildende Schule Donnersbergkreis

Why to visit the to dwd weather park Offenbach

As part of our Erasmus+ project, in which we are preparing to launch a research probe with cameras, experiments, and measuring instruments into the stratosphere using a helium-filled weather balloon, we want to visit *Wetterpark Offenbach*. The 20,000 m² open-air park with its interactive stations will give us the opportunity to learn more about how weather and atmospheric phenomena are explained, measured, and observed in practice.

The visit is especially relevant for our project because meteorologists also use weather balloons to collect data high up in the atmosphere. Experiencing how professionals apply the same method that we are working with will help us to better understand the scientific background of our own experiment. It will allow us to see the direct link between our student project and established research practices, making our work more meaningful. At the same time, the visit will inspire us as an international team to continue exploring science together and to connect our hands-on experiences with the broader field of meteorology

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The first station contains many measuring instruments for different purposes.

1. Air temperature
2. Ground temperature
3. Humidity
4. Air pressure
5. Wind direction and –speed
6. Precipitation duration
7. Amount of precipitation
8. Cloud base
9. Visibility
10. Duration of sunshine
11. Type of precipitation
12. Air hygiene

The second station shows what happens when a lightning strikes a hardwood tree. You can see how the lightning passes through the tree.

The third station shows how the air movement occurs between warm and cold air.

The fourth station is about air pressure. The cube is designed to show how much air weights in this size.

The fifth station focuses on phenology, which examines the annual recurring growth and developmental phenomena of selected plants.

The sixth station is about the structure of the atmosphere and which layer has its function and how it influences the weather.

The seventh station is about the influence of trees on our climate and what they can filter.

The eight station is about the sun and how it influences our climate and the environment, as well is the position of the sun a part of this station. In the right picture, you can see a sundial that works based on the position of the sun.

The ninth station is about the weather and how it can show us the weather over different countries with the help of weather satellites.

That was our small trip to the dwd weather park in Offenbach.

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Chapter two
Measurement

P Charts-interpretation-keynote

P Analysis-Python3 chartgenerators

P-Micropython-experiments

P-Picobox-construcion-manual

P-Erasmus+ Ballon 2025 Measurment PPTX

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Erasmus+
„Strato-Ballon Measurement an Environmental Consciousness“
2024-1-DE02-KA210-VET-000243591

https://euballon.zslp.edu.pl/

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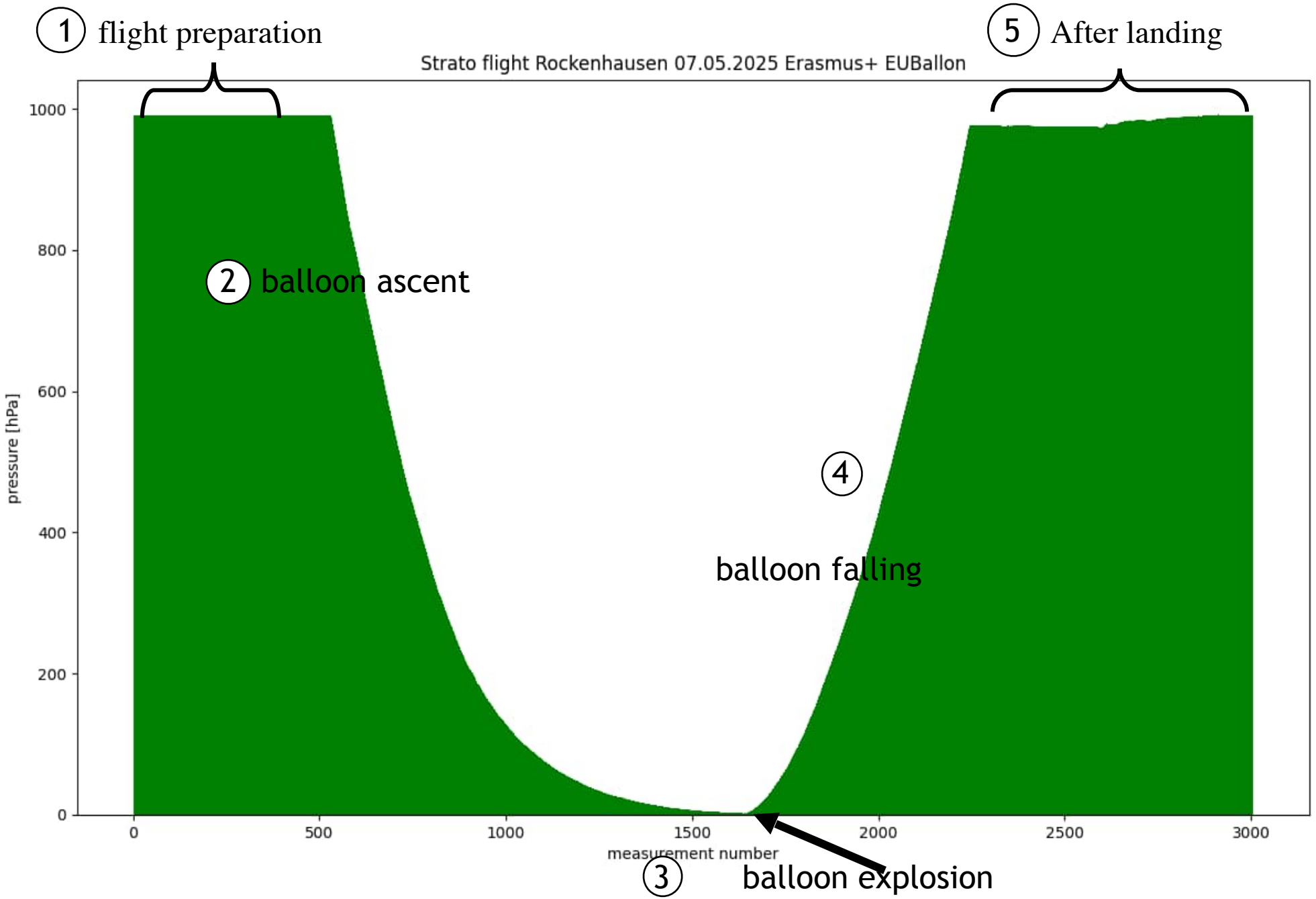
Interpretation of graphs generated from files recorded by our measurement system based on MicroPython and the Raspberry Pi Pico microcontroller during a stratospheric balloon flight in Rockenhausen on May 7, 2025


1 flight preparation
5 After landing
Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon
2 balloon ascent
4
balloon falling
3 balloon explosion
pressure [hPa]
measurement number
1000
800
600
400
200
0
0
500
1000
1500
2000
2500
3000

Balloon explosion:

The moment of explosion is clearly visible as a tipping point. The atmospheric pressure then reaches a minimum of 2.1 hPa – At this point, the balloon, which was expanding due to the decreasing external pressure, reaches the limit of its strength and bursts

This is a breakthrough moment of the mission – the balloon exploded, the ascent phase ended and the descent phase began on the parachute

At this point, the pressure was only

Descent of the balloon on a parachute:

A sudden increase in pressure – the air becomes increasingly denser with decreasing altitude

The rate of descent is faster than the rate of ascent, which can be seen from the steeper side

Time after landing:

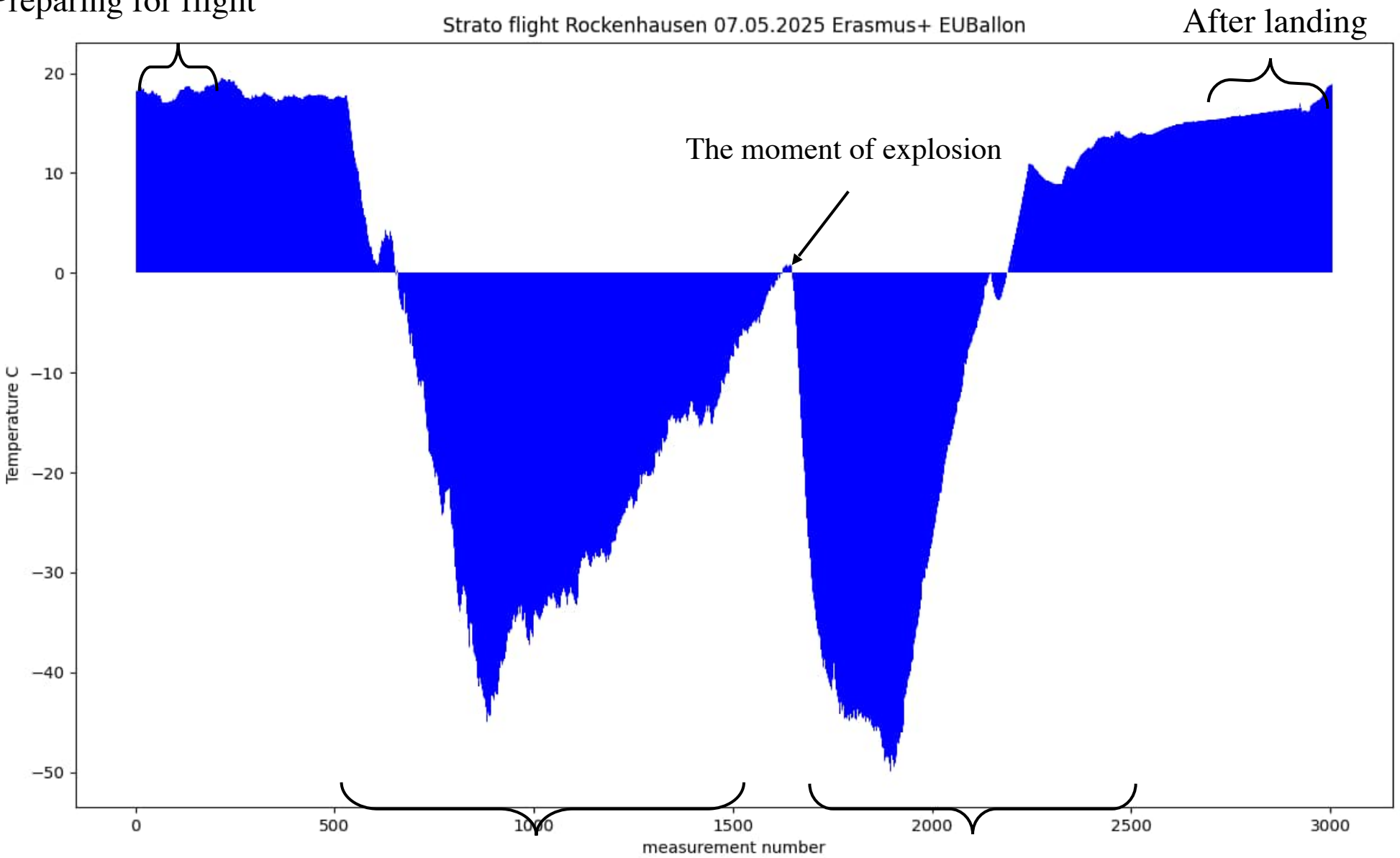
The pressure stabilizes at a level close to the atmospheric pressure at ground level (approx. 990 hPa)

A clear flattening and lack of sudden changes mean that the flight has come to an end

It can be seen from the graph that the process of falling on the parachute is faster than the ascent

The range of pressure changes proves that the balloon reached an altitude of 36,000 m

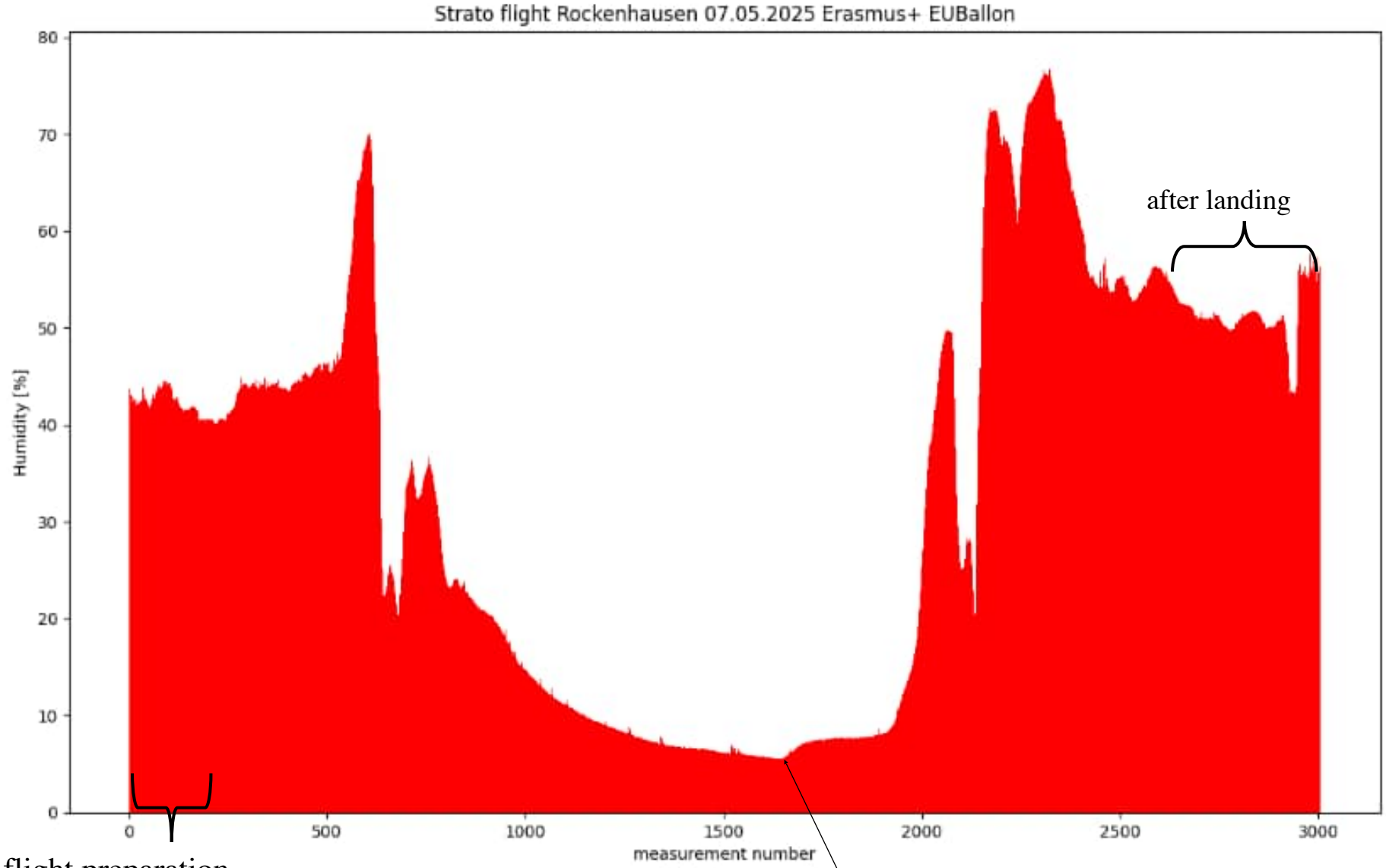
Preparing for flight



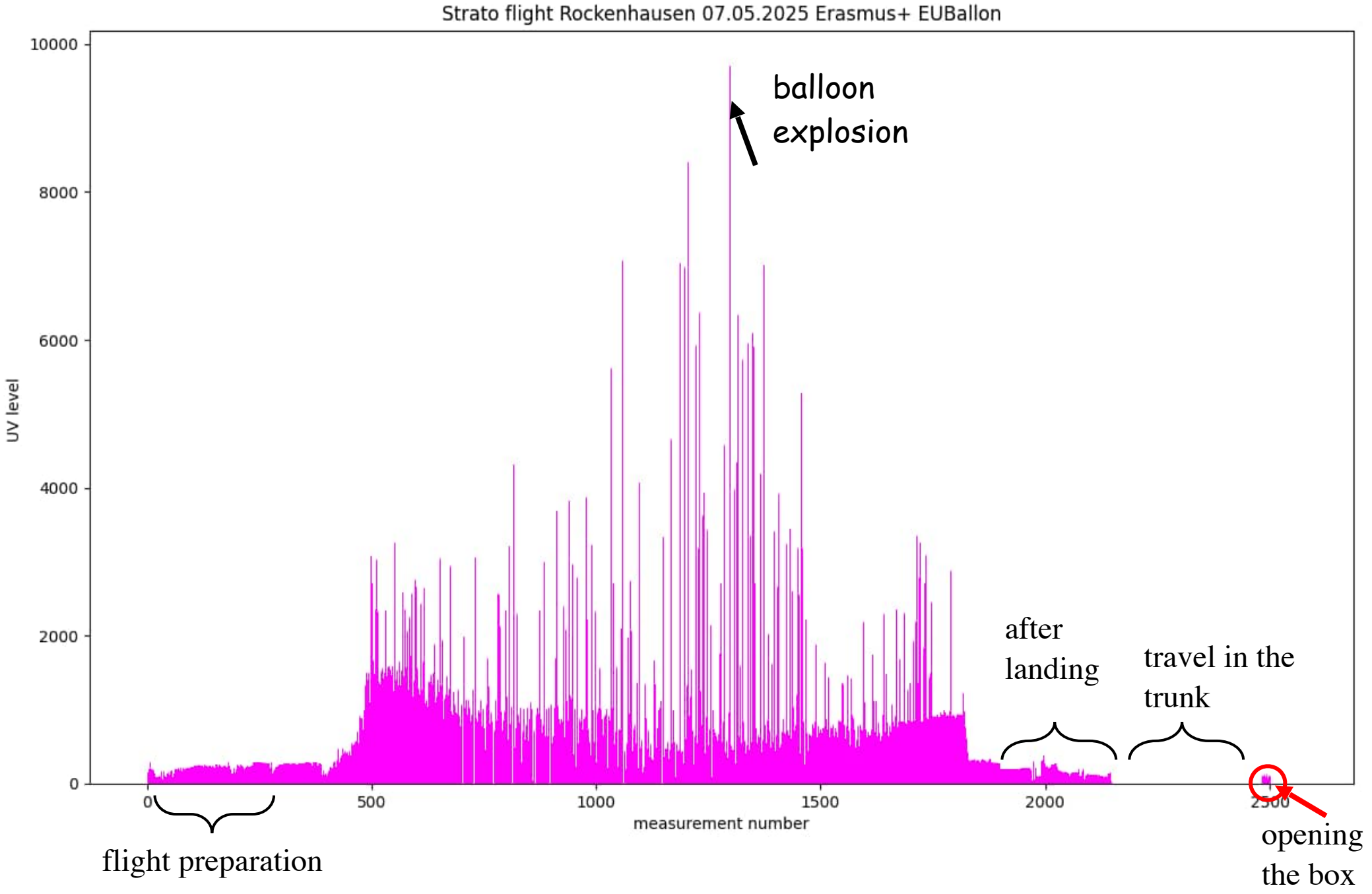
Ascension phase

Falling phase

At first, the temperature of the balloon was about 17 degrees Celsius, which was the same as the temperature on the ground. Then, as the balloon rose into the air, the temperature began to drop. When it reached about -45 degrees, it began to rise again. After reaching its maximum height, the balloon exploded, and the temperature was about 0. After the explosion, we can see an axis of symmetry on the graph and a repetition of the temperature changes. It began to decrease again, although you can see that when a balloon falls on a parachute, this process is faster It reached a minimum value of about -50 degrees. Then it rose until it reached the ground.


Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon
Humidity [%]
measurement number
0
10
20
30
40
50
60
70
80
0
500
1000
1500
2000
2500
3000
after landing
flight preparation
Explosion

The graph shows the changes in relative air humidity as a function of the measurement number, which corresponds to subsequent readings over time. In the initial phases of the measurements, the humidity is quite high, which means that the balloon took off in humid ground air, where low-level clouds could be present. In the middle part of the graph, the humidity drops below 10%, which means that the balloon entered a dry layer of the atmosphere. This is characteristic of the middle and upper troposphere, where the air is drier and there are few or no clouds. The final part of the graph shows the balloon's path after the explosion. The balloon reenters the humid layer of the atmosphere, where clouds are present again. The humidity graph shows a typical atmospheric distribution.


Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon
UV level
measurement number
balloon explosion
after landing
travel in the trunk
flight preparation
opening the box

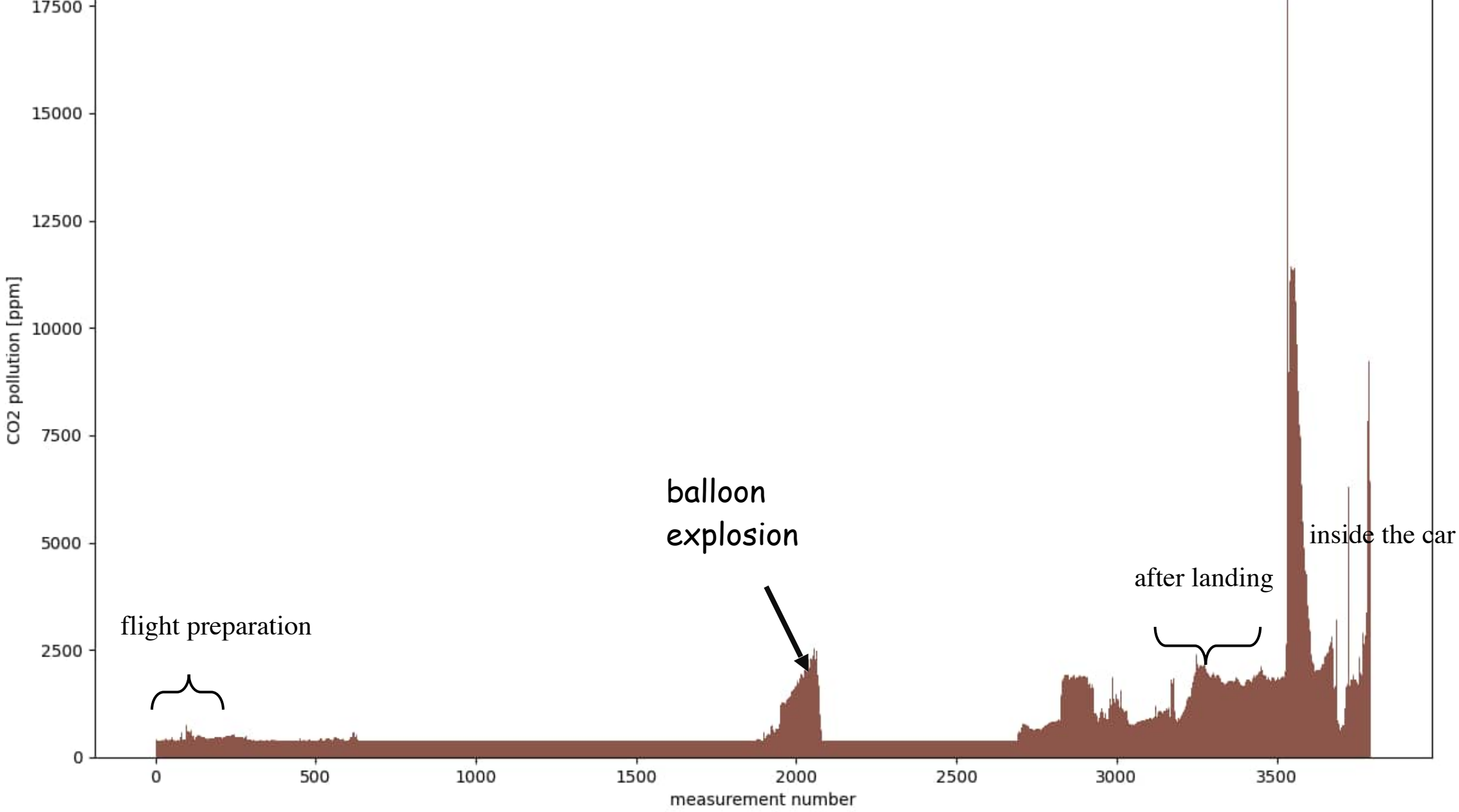
After rising above the cloud level, there is a rapid increase in UV intensity with increasing altitude. This is due to the thinner layer of the atmosphere at higher elevations blocking UV radiation less.

The maximum UV level means that the balloon has reached the stratosphere, where the atmosphere is so thin that the sensor registers very intense radiation.

This is further evidence that the balloon reached an altitude of about 36,000 m.

In the stratosphere, UV radiation reached a level of about 10,000, while before takeoff, when the balloon was on the school grounds, these levels were about 200-300.

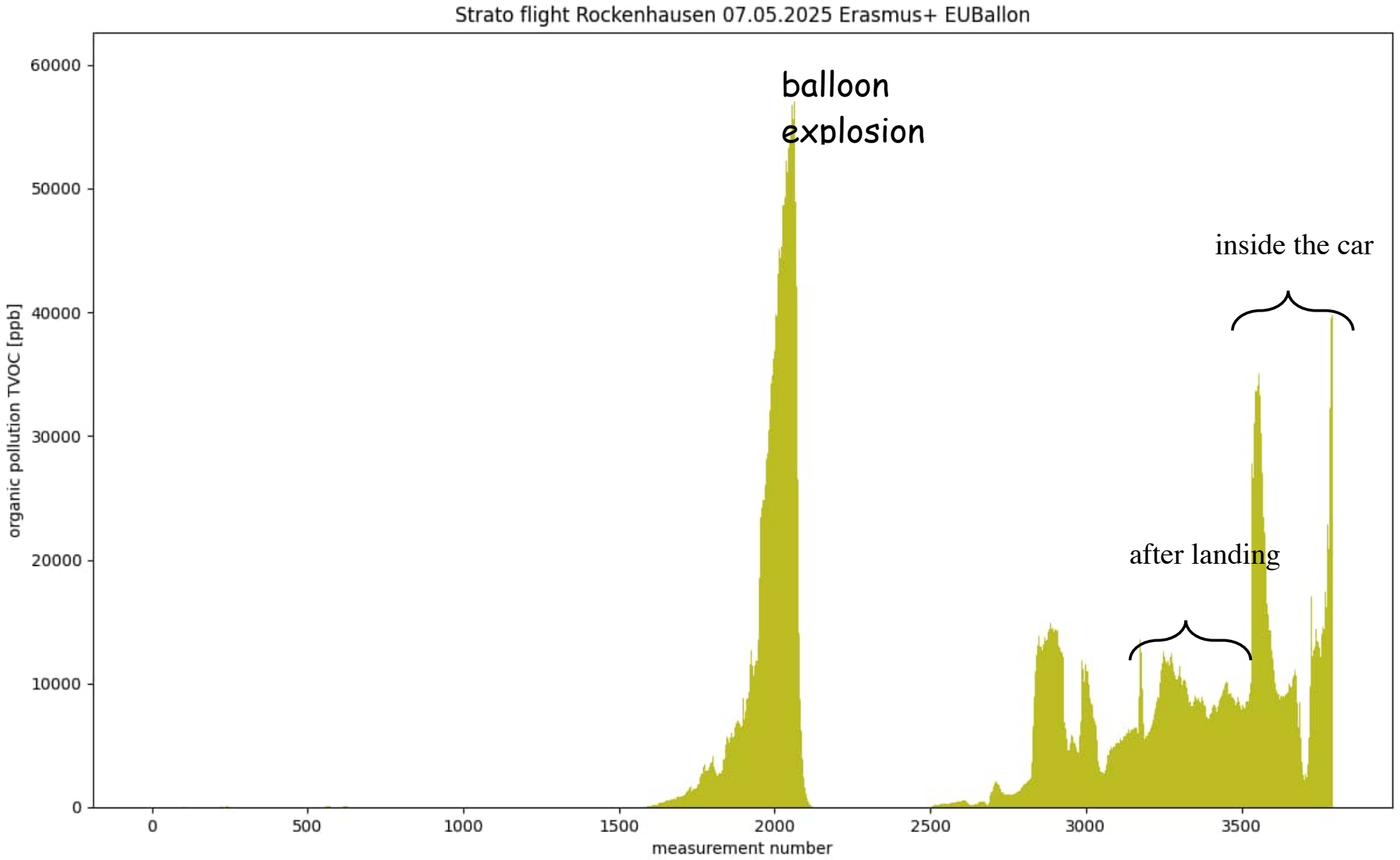
The UV sensor recorded the results correctly until the end. You can clearly see the UV levels close to zero during the journey in the trunk and you can clearly see the moment of carrying it from the car to the hotel.


CO2 pollution [ppm]
17500
15000
12500
10000
7500
5000
2500
0
0
500
1000
1500
2000
2500
3000
3500
measurement number
balloon
explosion
flight preparation
after landing
inside the car

High CO2 levels recorded at peak flight altitude.

After the balloon landed, clearly high CO2 readings. The balloon was found in a village with many cows and horses.

Also, during the balloon's journey in the car, the readings were relatively high
Extreme conditions in the stratosphere could have affected the sensor readings.

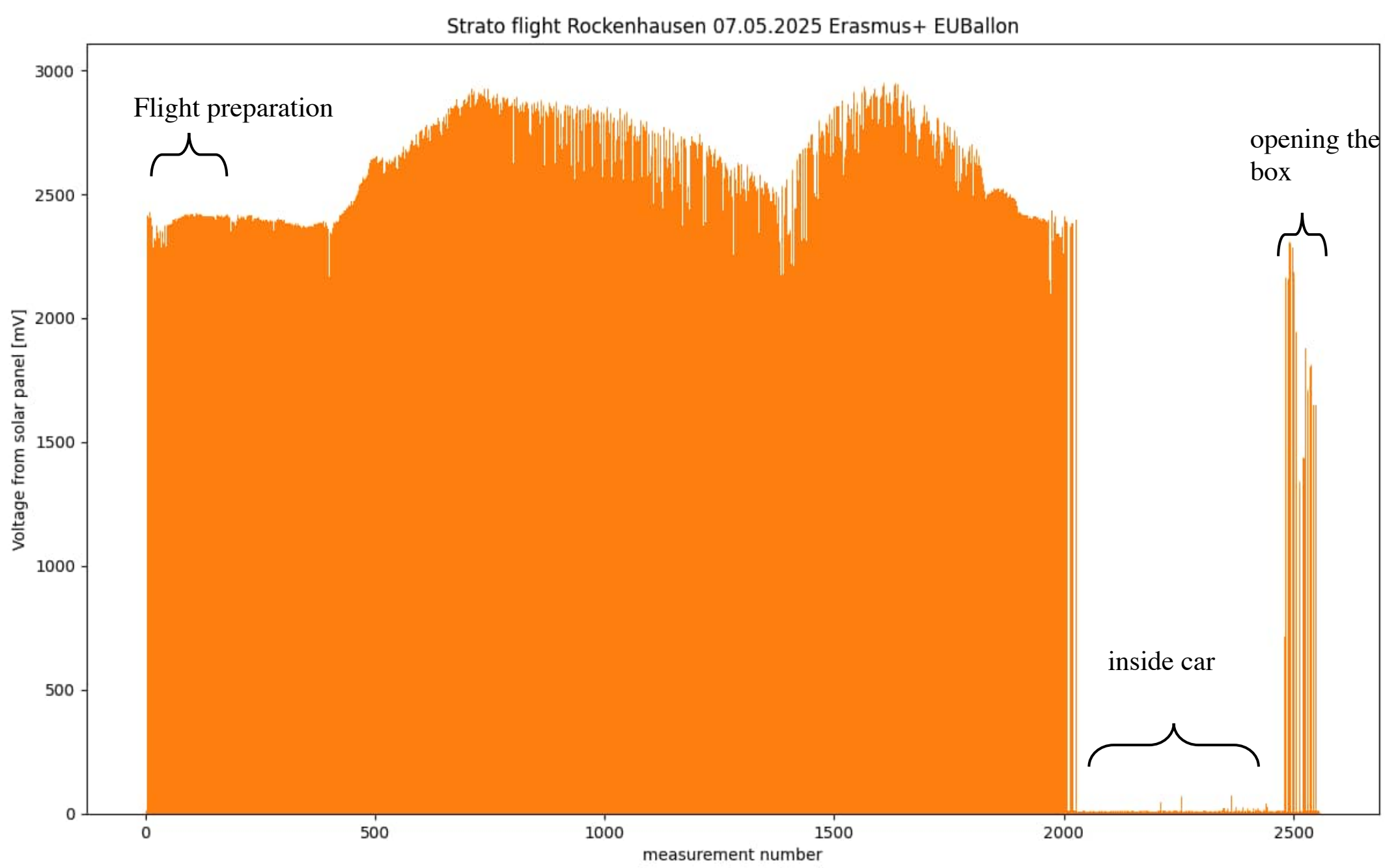

Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon
balloon explosion
inside the car
after landing
organic pollution TVOC [ppb]
measurement number
0
10000
20000
30000
40000
50000
60000
0
500
1000
1500
2000
2500
3000
3500

Extremely high levels of VOCs were recorded at peak altitude (over 50,000).

After the balloon landed, significantly high TVOC readings. The balloon was found in a village with many cows and horses.

In addition, during the balloon's journey by car on the highway, the readings were relatively high

Extreme conditions in the stratosphere could have affected the sensor readings.


Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon
Flight preparation
opening the box
inside car
Voltage from solar panel [mV]
measurement number
0
500
1000
1500
2000
2500
3000

The voltage level generated by the solar panel is in the range of 2200 mV to 2900 mV. The jaggedness of the graph is clearly visible, which means large voltage fluctuations. This is related to the change in the orientation of the balloon box (the angle of sunlight). The period of transporting the balloon box in the trunk of a car, when the voltage drops to practically zero, and the moment the box is brought to the hotel are also very clearly visible

Conclusion

The experiments performed confirmed the fact that the balloon reached the stratosphere, an altitude of 3600.

They provide a full picture of changes in air parameters with altitude

They provide evidence for the cause of the balloon bursting

They prove very high levels of UV radiation

They are evidence of relatively high levels of stratospheric pollution with volatile organic compounds

Based on the graphs, we can also see the speed of the balloon's ascent and descent

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Erasmus+
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2024-1-DE02-KA210-VET-000243591

Material for students and teachers allowing for the preparation of measuring equipment. Developed and used as part of the project implementation

https://euballon.zslp.edu.pl/

Analysis of measurement results taken during a stratospheric balloon flight. Recorded data and analysis methods.

Developed own automatic data analysis tools.

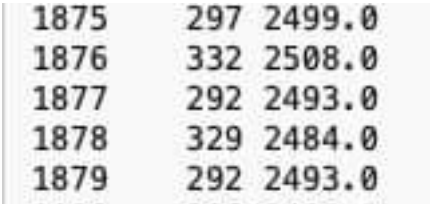
Analysis of measurement results taken during a stratospheric balloon flight. Recorded data and analysis methods.

Developed own automatic data analysis tools.

Below we present our tools made in Python, which allow for quick analysis saved in CSV text files during the flight. For the analysis, Python version 3 with the **numpy** (https://numpy.org/) and **mathplotlib** (https://matplotlib.org/) libraries installed is required.

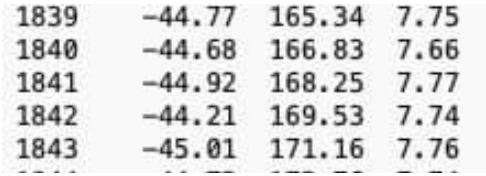
Shared MicroPython (see other our manuals) software from 3 Raspberry Pi Pico2 recorders used during flight creates CSV files named:

UVvolt.CSV (measuring the voltage from the solar panel, measuring the level of UV radiation)



1875	297	2499.0
1876	332	2508.0
1877	292	2493.0
1878	329	2484.0
1879	292	2493.0

presssuretemp.CSV (measuring the air pressure, temperature, humidity)



1839	-44.77	165.34	7.75
1840	-44.68	166.83	7.66
1841	-44.92	168.25	7.77
1842	-44.21	169.53	7.74
1843	-45.01	171.16	7.76

CO2TVOCresult.CSV (measuring CO2 and volatile organic compounds TVOC)

2010	1822	42537
2011	1885	43408
2012	1844	43129
2013	1815	42467
2014	1861	42850

In all data files, the **tab character** was used to separate table fields. All of these files can be imported into Excel, but the proposed solution is much easier, faster and more efficient, also due to several thousand records.

1)A. Measuring the level of UV radiation

Python 3 script (All blank lines and comment lines starting with the "#" character can be omitted)

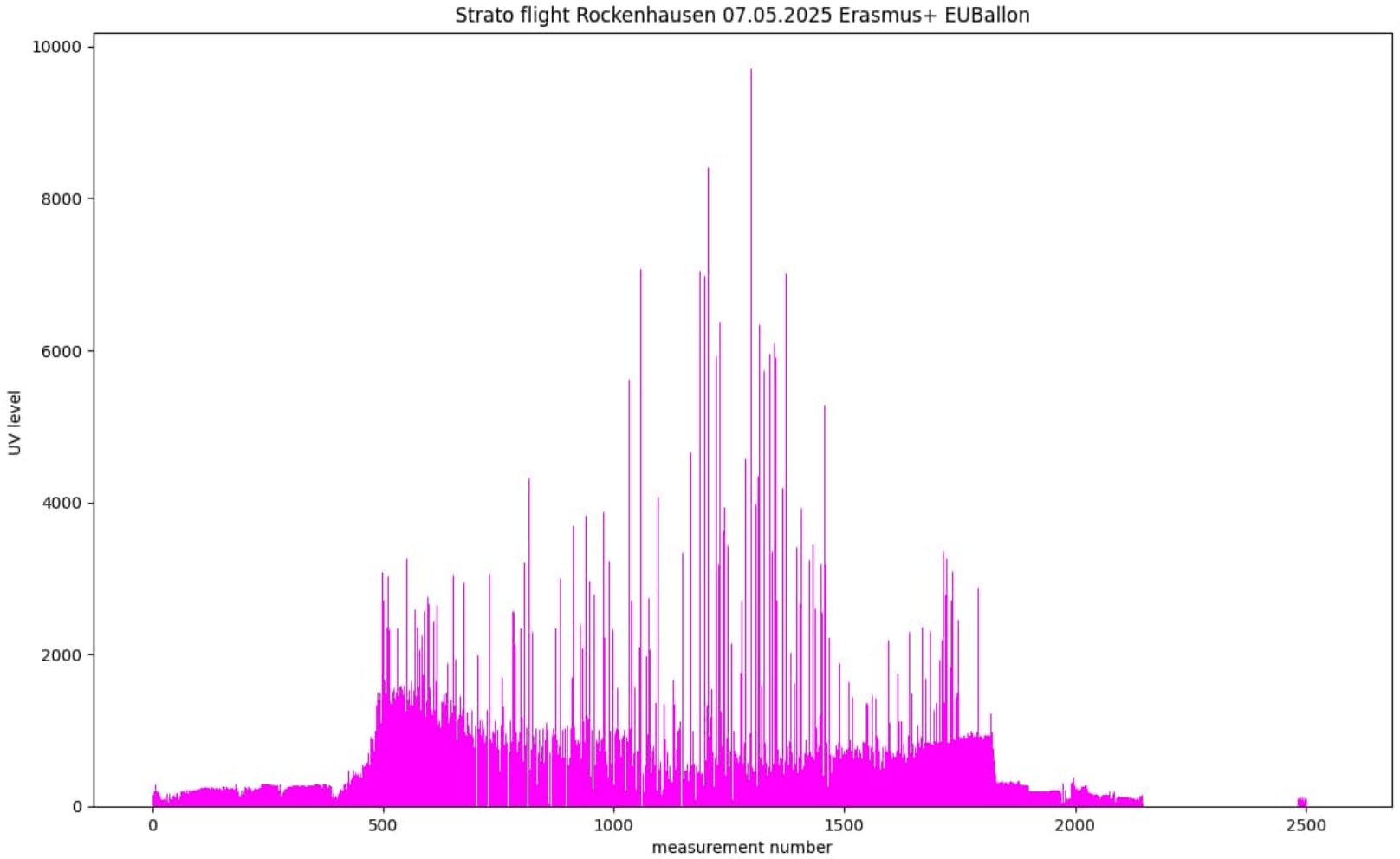
```
#library accepts only real numbers as data source
# data must also be represented in numeric form

import numpy as np
import matplotlib.pyplot as plt

# filename with results: UVvolt.CSV
No,uvlevel=np.loadtxt('UVvolt.CSV',unpack=True,usecols=(0,1),delimiter ='\t')
print(No, uvlevel)
#Allocate space and determine the layout of the figure
fig, ax = plt.subplots()
ax.set_xlabel('measurement number')
ax.set_ylabel('UV level ')
plt.title('Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon')
# plot  bar graph
plot = plt.bar(No, uvlevel,width=1.0,color='magenta')
# Display chart
plt.show()
```

Intuitively, you can change the chart title, axis descriptions, and chart color.
We share this Python3 script with the name: **UVlevel_analysis.py**
We assume that the CSV data file and the above script are in the same folder

Chart UV radiation- png file generated by Python 3 UVlevel_analysis.py with mathplotlib library based on data from CSV file: **UVvolt.CSV**



1) B. **Measuring the voltage from the solar panel**

Python 3 script (All blank lines and comment lines starting with the "#" character can be omitted)

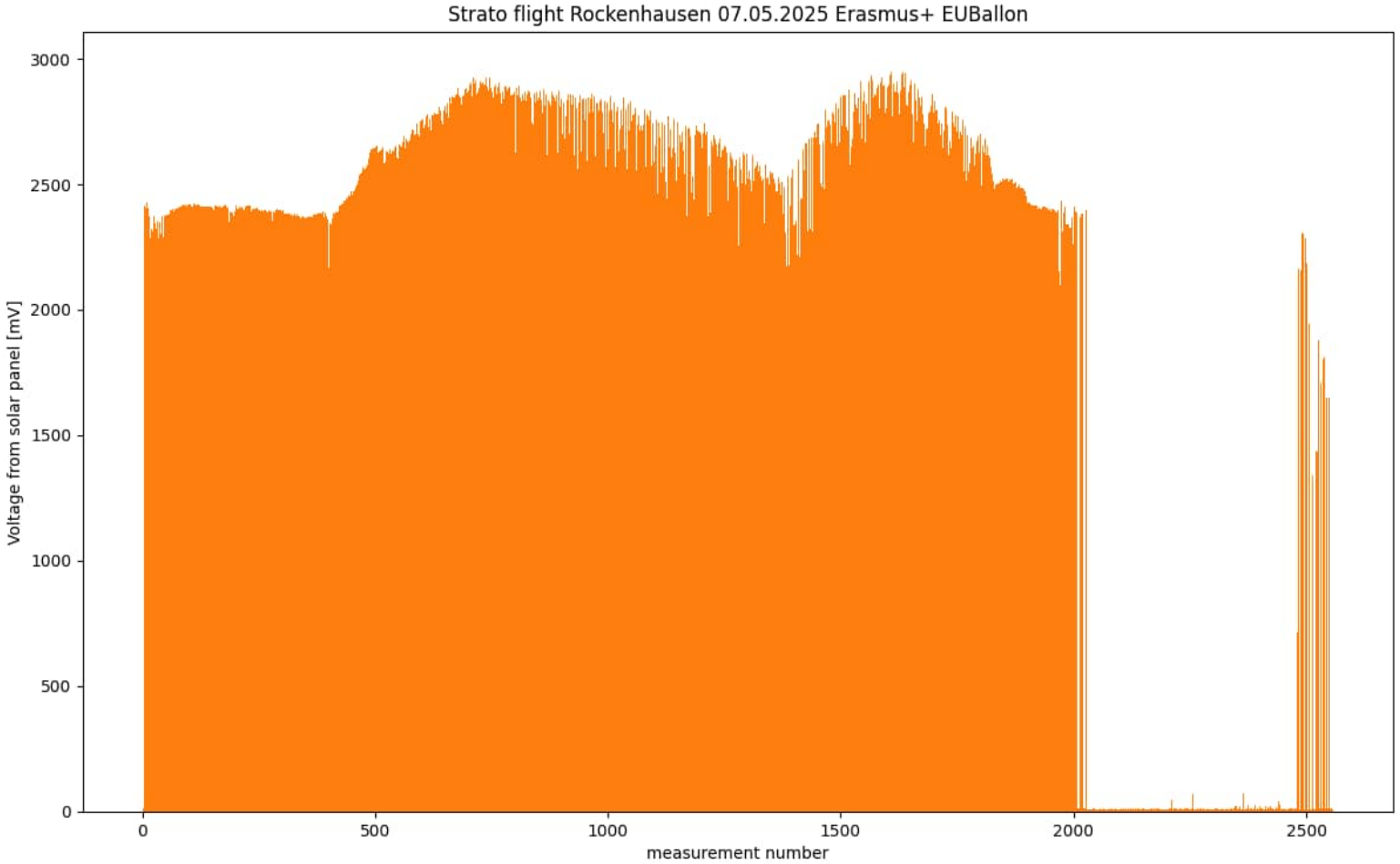
```
#library accepts only real numbers as data source
# data must also be represented in numeric form

import numpy as np
import matplotlib.pyplot as plt

# filename with results: UVvolt.CSV
No,voltage=np.loadtxt('UVvolt.CSV',unpack =True,usecols=(0,2),delimiter='\t')
print(No, voltage)
#Allocate space and determine the layout of the figure
fig, ax = plt.subplots()
ax.set_xlabel('measurement number')
ax.set_ylabel('Voltage from solar panel [mV]')
plt.title('Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon')
# plot  bar graph
plot = plt.bar(No, voltage,width=1.0,color="tab:orange")
# Display chart
plt.show()
```

Intuitively, You can change the chart title, axis descriptions, and chart color.
We share this Python3 script with the name: **solarpanelvoltage.py.**
We assume that the CSV data file and the above script are in the same folder.

Chart UV radiation- png file generated by Python 3 **solarpanelvoltage.py** with mathplotlib library based on data from CSV file: **UVvolt.CSV** recorded during flight.



2) **A. Measuring the air pressure**

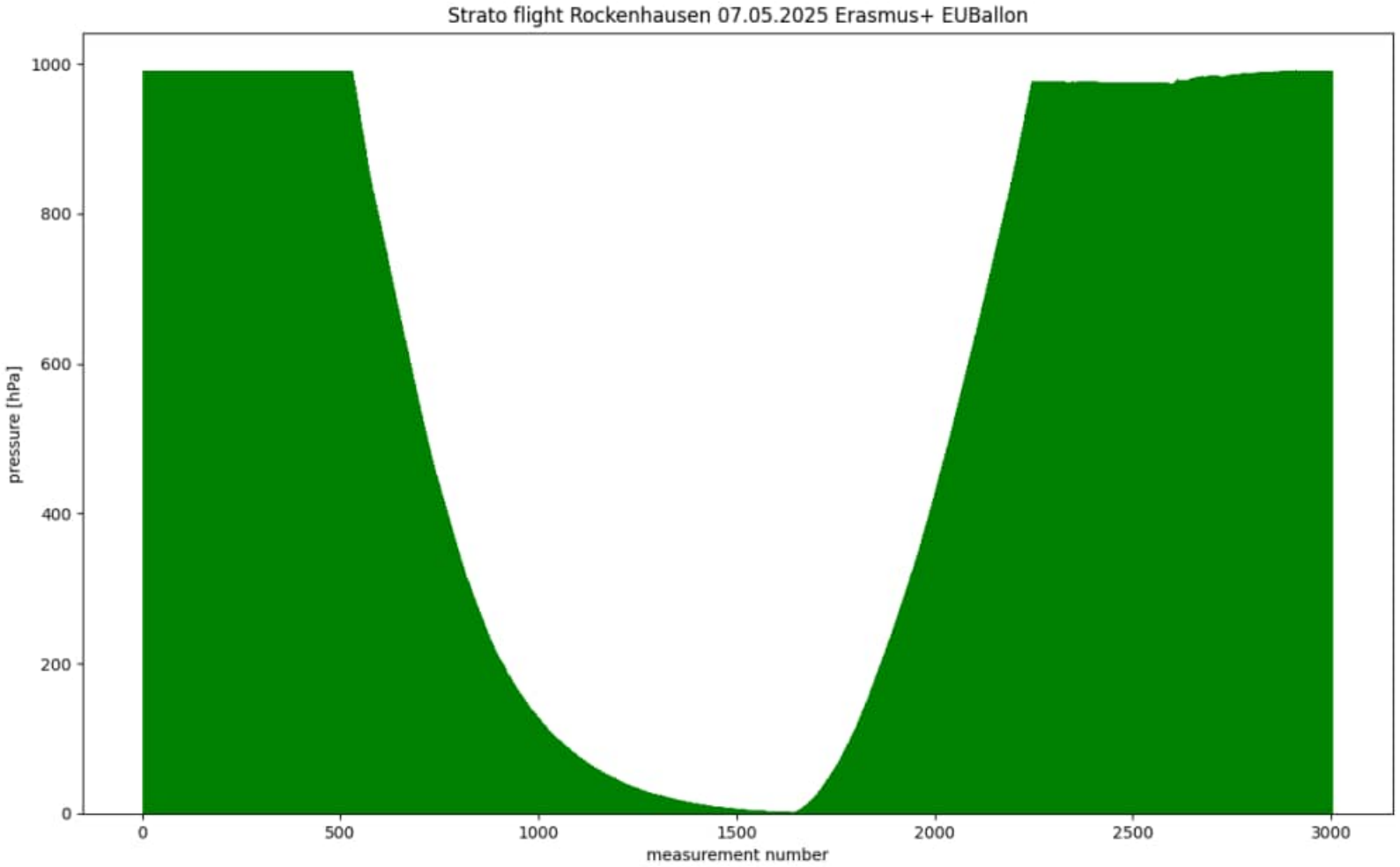
Python 3 script (All blank lines and comment lines starting with the "#" character can be omitted)

```
#library accepts only real numbers as data source
# data must also be represented in numeric form

import numpy as np
import matplotlib.pyplot as plt
# filename with results: presssuretemp.CSV
No,press=np.loadtxt('presssuretemp.CSV',unpack=True,usecols=(0,2),delimiter='\t')
print(No, press)
#Allocate space and determine the layout of the figure
fig, ax = plt.subplots()
ax.set_xlabel('measurement number')
ax.set_ylabel('pressure [hPa]')
plt.title('Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon')
# plot  bar graph
plot = plt.bar(No, press,width=1.0,color='green')
# Display chart
plt.show()
```

Intuitively, You can change the chart title, axis descriptions, and chart color.
We share this Python3 script with the name: **pressure_analysis.py.**
We assume that the CSV data file and the above script are in the same folder.

Chart Air pressure- png file generated by Python 3 **pressure_analysis.py** script with mathplotlib library based on data from CSV file: **presssuretemp.CSV** recorded during flight.



2) **B. Measuring the air temperature**

Python 3 script (All blank lines and comment lines starting with the "#" character can be omitted)

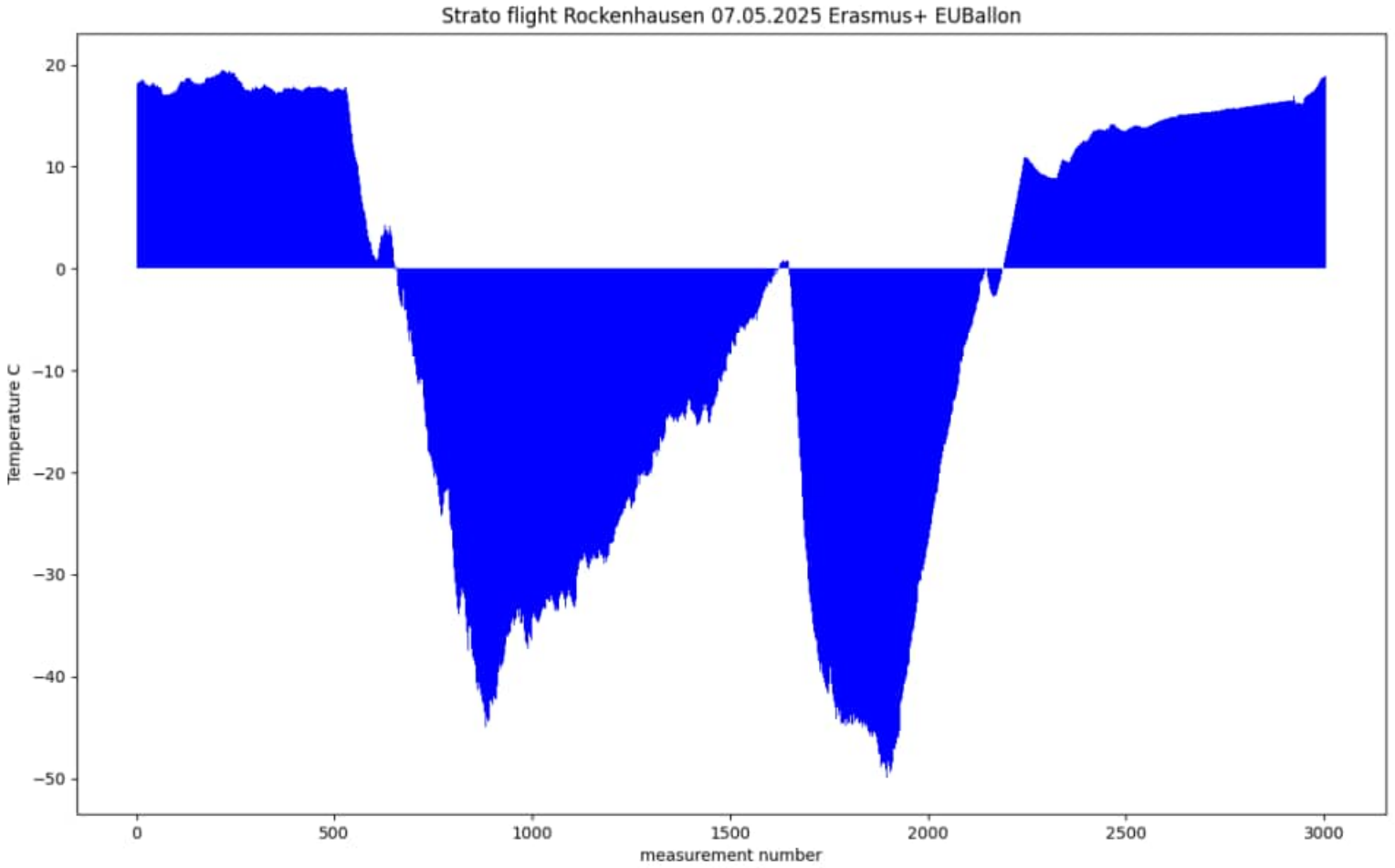
```
#library accepts only real numbers as data source
# data must also be represented in numeric form

import numpy as np
import matplotlib.pyplot as plt

# filename with results: presssuretemp.CSV
No,temp =np.loadtxt('presssuretemp.CSV', unpack =True,usecols = (0,1),delimiter ='\t')
print(No, temp)
#Allocate space and determine the layout of the figure
fig, ax = plt.subplots()
ax.set_xlabel('measurement number')
ax.set_ylabel('Temperature [C]')
plt.title('Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon')
# plot  bar graph
plot = plt.bar(No, temp,width=1.0,color='blue')
# Display chart
plt.show()
```

Intuitively, You can change the chart title, axis descriptions, and chart color.
We share this Python3 script with the name: **temp_analysis.py.**
We assume that the CSV data file and the above script are in the same folder.

Chart Air temperature- png file generated by Python 3 script **temp_analysis.py** with mathplotlib library based on data from CSV file: **presssuretemp.CSV** recorded during flight.



2) **C. Measuring the air humidity**

Python 3 script (All blank lines and comment lines starting with the "#" character can be omitted)

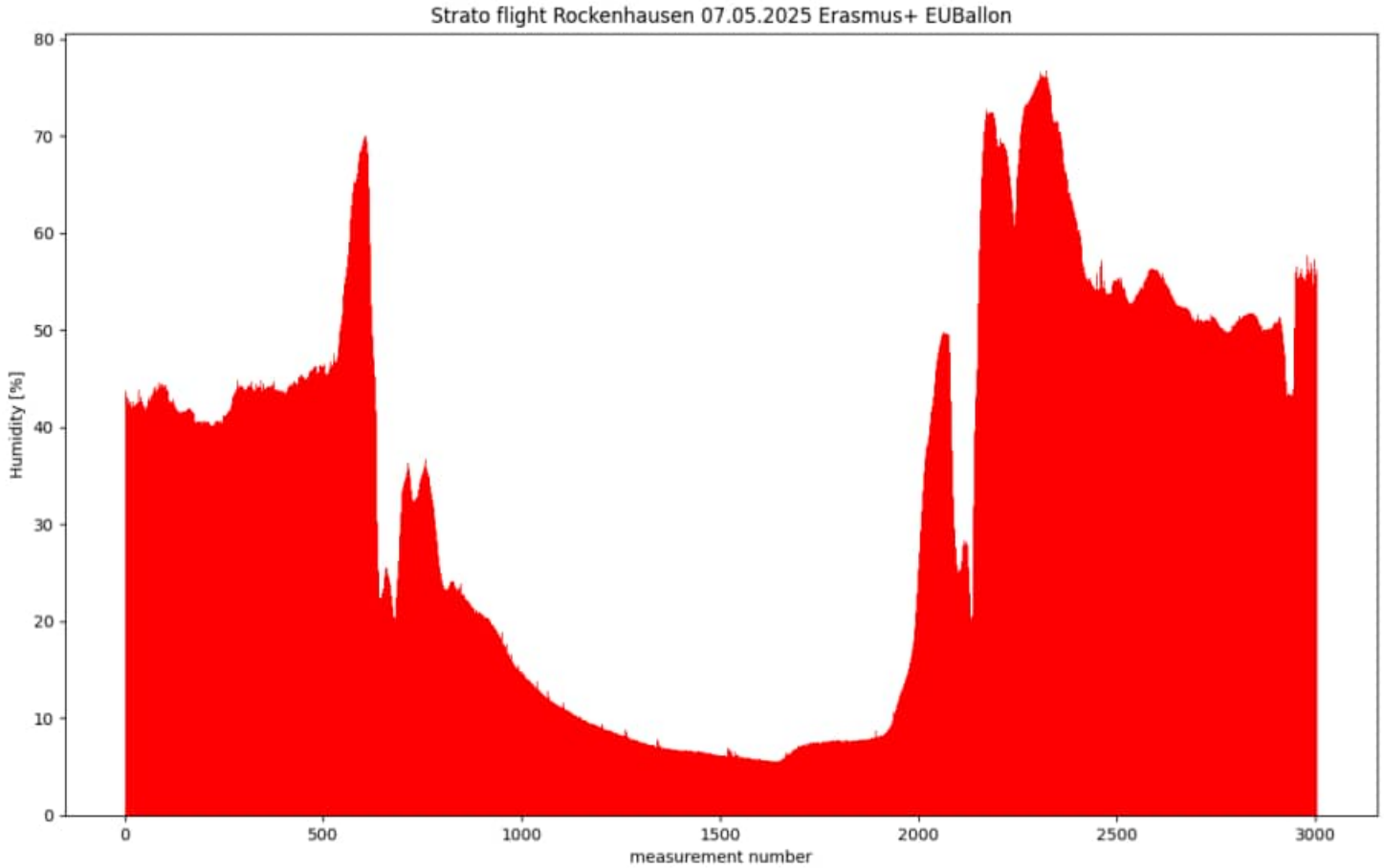
```
#library accepts only real numbers as data source
# data must also be represented in numeric form

import numpy as np
import matplotlib.pyplot as plt

# filename with results: presssuretemp.CSV
No,humid=np.loadtxt('presssuretemp.CSV',unpack=True, usecols=(0,3),delimiter ='\t')
print(No,humid)
#Allocate space and determine the layout of the figure
fig, ax = plt.subplots()
ax.set_xlabel('measurement number')
ax.set_ylabel('Humidity [%]')
plt.title('Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon')
# plot  bar graph
plot = plt.bar(No, humid,width=1.0,color='red')
# Display chart
plt.show()
```

Intuitively, You can change the chart title, axis descriptions, and chart color.
We share this Python3 script with the name: **humid_analysis.py.**
We assume that the CSV data file and the above script are in the same folder.

Chart Air humidity- png file generated by Python 3 script **humid_analysis.py** with mathplotlib library based on data from CSV file: **presssuretemp.CSV** recorded during flight.



3) **A. Measuring CO2**

Python 3 script (All blank lines and comment lines starting with the "#" character can be omitted)

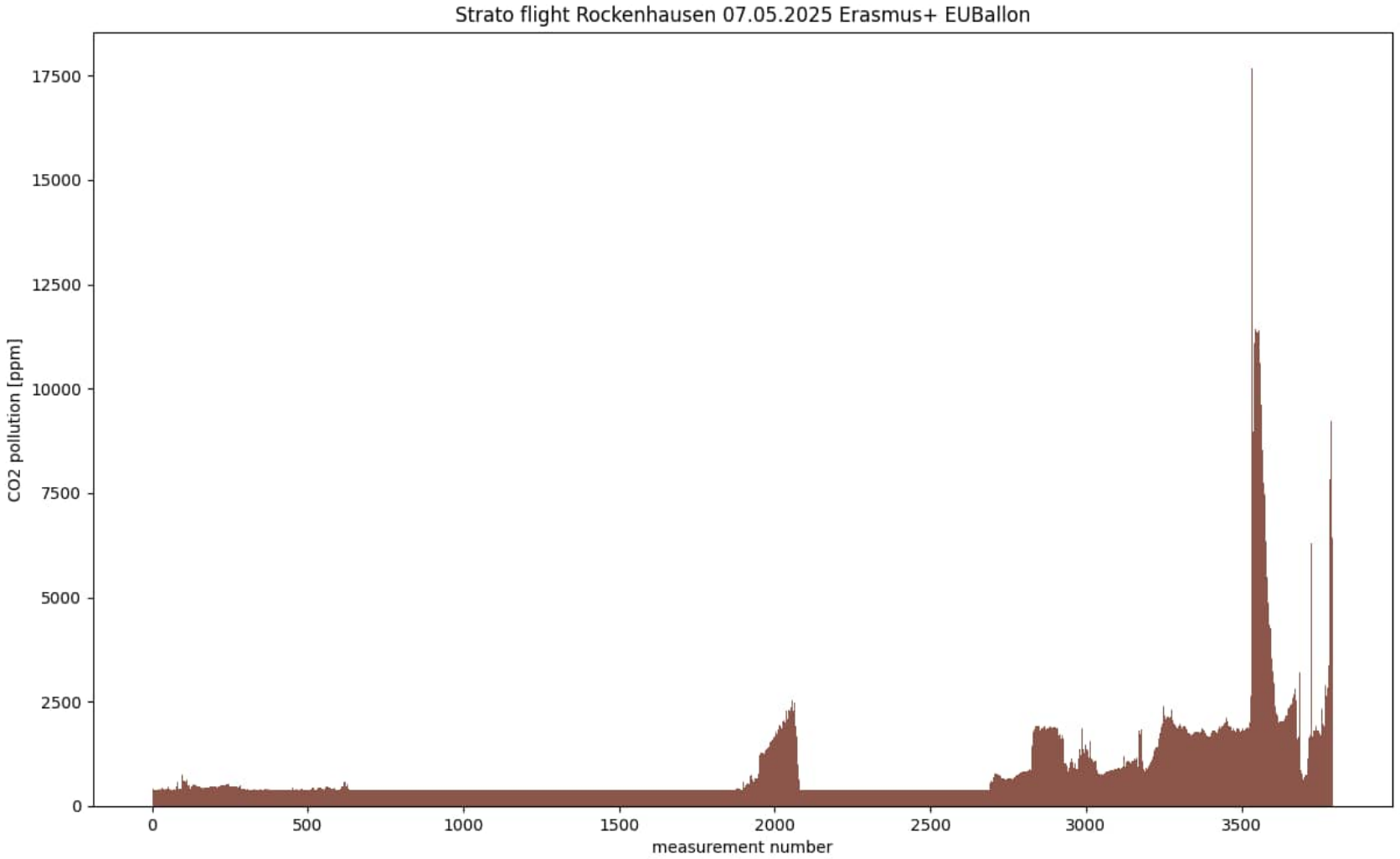
```
#library accepts only real numbers as data source
# data must also be represented in numeric form

import numpy as np
import matplotlib.pyplot as plt

# filename with results: CO2TVOCresult.CSV
No,co2 =np.loadtxt('CO2TVOCresult.CSV',unpack =True,usecols=(0,1),delimiter ='\t')
print(No,co2)
#Allocate space and determine the layout of the figure
fig, ax = plt.subplots()
ax.set_xlabel('measurement number')
ax.set_ylabel('CO2 pollution [ppm]')
plt.title('Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon')
# plot  bar graph
plot = plt.bar(No, co2,width=1.0,color="tab:brown")
# Display chart
plt.show()
```

Intuitively, You can change the chart title, axis descriptions, and chart color.
We share this Python3 script with the name: **co2ppm.py.**
We assume that the CSV data file and the above script are in the same folder.

Chart CO2 pollution- png file generated by Python 3 script **co2ppm.py.** with mathplotlib library based on data from CSV file: **CO2TVOCresult.CSV** recorded during flight.



3) B. Measuring volatile organic compounds TVOC

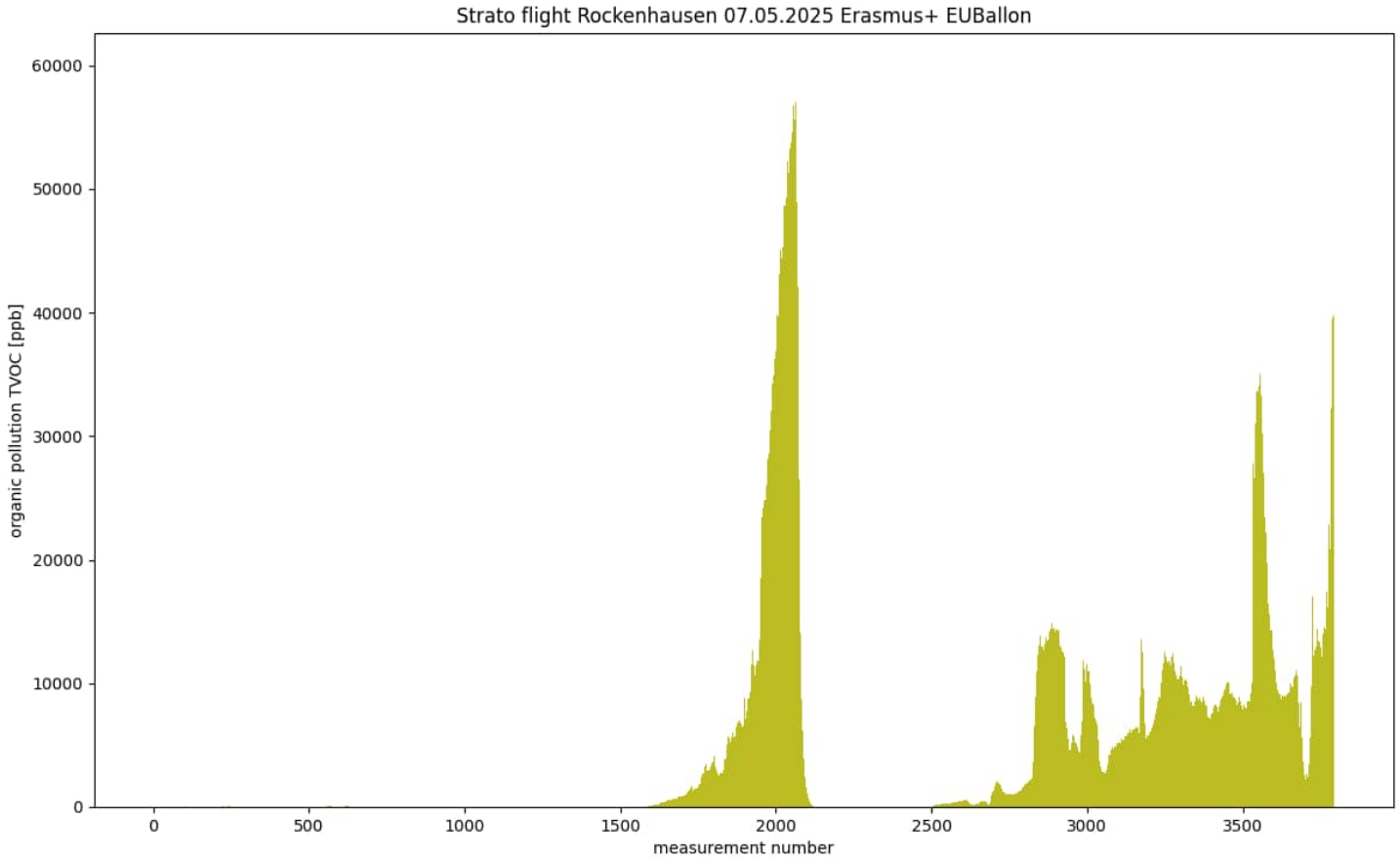
```
#library accepts only real numbers as data source
# data must also be represented in numeric form

import numpy as np
import matplotlib.pyplot as plt

# filename with results: CO2TVOCresult.CSV
No,tvoc=np.loadtxt('CO2TVOCresult.CSV',unpack=True,usecols=(0,2),delimiter ='\t')
print(No, tvoc)
#Allocate space and determine the layout of the figure
fig, ax = plt.subplots()
ax.set_xlabel('measurement number')
ax.set_ylabel('organic pollution TVOC [ppb]')
plt.title('Strato flight Rockenhausen 07.05.2025 Erasmus+ EUBallon')
# plot  bar graph
plot = plt.bar(No, tvoc,width=1.0,color="tab:olive")
# Display chart
plt.show()
```

Intuitively, You can change the chart title, axis descriptions, and chart color.
We share this Python3 script with the name: **tvocppb.py**
We assume that the CSV data file and the above script are in the same folder.

Chart CO2 pollution- png file generated by Python 3 script **tvocppb.py.** with mathplotlib library based on data from CSV file: **CO2TVOCresult.CSV** recorded during flight.



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Erasmus+
„Strato-Ballon Measurement an Environmental Consciousness“
2024-1-DE02-KA210-VET-000243591

Material for students and teachers allowing for the preparation of measuring equipment. Developed and used as part of the project implementation

https://euballon.zslp.edu.pl/

1)BME 280 Pressure, humidity and temperature sensor

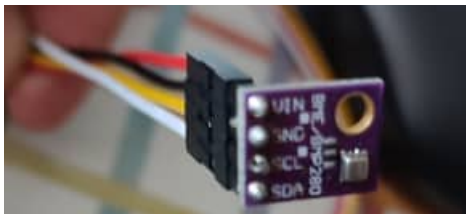
Experiment:
Measurement of atmospheric pressure, air temperature and air humidity

Required equipment:

-PicoBox (Raspberry Pi Pico 2 with 2.4" SSD1306 OLED screen)
-BME280 3.3V sensor
-Grove cable with female ends

Software:

MicroPython system installed on Pico in version 1.25 or newer,
Thonny Editor v.4 or newer,
MicroPython script presented below.



Wiring:

BME280 sensor pin	Grove cable colors
VCC	red
GND	black
SCL	yellow
SDA	white

Connect Grove cable plug to PicoBox socket GP6,GP7

MicroPython scripts for Raspberry Pi Pico
Simple version

The second line imports the BME280 sensor library.
The third line imports the sleep method from the module

```
1  from machine import I2C, Pin
2  from bme280 import BME280
3  from time import sleep
4  bus = I2C(1, scl=Pin(7), sda=Pin(6))
5  bme = BME280(i2c=bus, address=0x76)
6  print("temp. C, pressure [hPa],  humidity %")
7  while True:
8      #You can select which parameters are plotted by Plotter
9      print(bme.values[0],bme.values[1],bme.values[2])
10     #time between measurements (2 seconds)
11     sleep(2)
```

The fourth line defines the I2C bus to which we connect the sensor (GP6, GP7)
The fifth line creates the **bme** variable, which will contain the results of the temperature measurement (bme.values[0]), pressure (bme.values[1]) and humidity (bme.values[2])
The sleep method allows us to set the interval between measurements. In the presented example, sleep(2) is 2 seconds, but usually this interval should be longer, also due to the size of the recording file and the limited capacity of Pico memory

Version with logger and OLED SSD1306 screen

This version saves the measurement results in a CSV text file), which can be a source of data for further analysis, for example using Excel. In our case, we used Python with the MatPlotlib library installed
In line 8 You can set filename for data log, in our case this is **pressuretemp.CSV**
This file is open in mode "a"- append. If PicoBox will be restarted, then new lines are added to log file.

This part is executed only once

```
from machine import I2C, Pin
from bme280 import BME280
from time import sleep
import ssd1306

bus =I2C(1, scl=Pin(7),sda=Pin(6), freq=400000)
bme = BME280(i2c=bus, address=0x76)
file=open("presssuretemp.CSV","a")
file.write("Measurement EUBallon BME280 sensor \n")
file.write("No"+ "\t"+"temp.C"+"\t"+"pressure[hPa]"+"\t"+"hum.[%]"+"\n")
file.flush()
no=1
#oled screen resolution
WIDTH = 128
HEIGHT = 64
#Pinout for Raspberry Pi Pico-Oled screen and BME280 sensor
#connected to pin GP6(SDA) and GP7(SCL)
#both connected to the same BUS I2C
#variable oled assigned to oled screen
oled =ssd1306.SSD1306_I2C(WIDTH, HEIGHT,bus)
#clear screen
oled.fill(0)
oled.contrast(200)
print("temp. C, pressure [hPa],  humidity %")

```

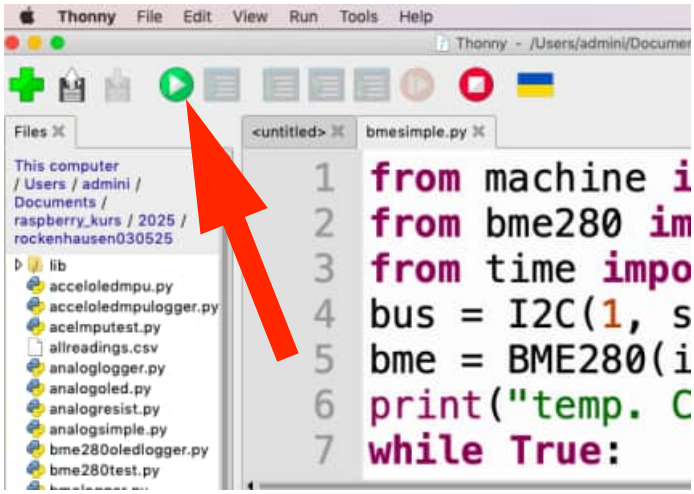
Infinite loop

```
while True:
    #You can select which parameters are plotted by Plotter
    print(bme.values[0],bme.values[1],bme.values[2])
    file.write(str(no)+ "\t"+str(bme.values[0])+"\t"\
    +bme.values[1]+"\t"+str(bme.values[2])+"\n")
    no=no+1
    #save to the file without closing file:
    file.flush()

    oled.text("EUballon",30,0)
    oled.text("Temp C:"+bme.values[0],0,15)
    oled.text("Press[hPa]:"+bme.values[1],0,30)
    oled.text("Hum.[%]:"+bme.values[2],0,45)
    #and now drawing above lines- must use show method!
    oled.show()
    #time between measurements (2 seconds)
    sleep(2)
    oled.fill(0)
```

If You want use this system without PC, than save the script on Pico with filname: **main.py**.

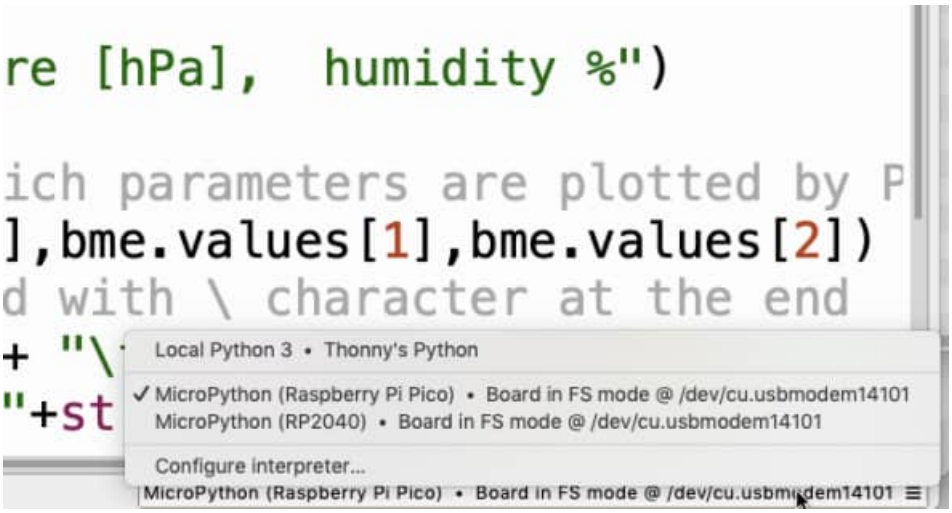
In this case Your script will be automatically executed when PicoBox is turned on.

Running the script in the Thonny environment



Before running the script, make sure you have selected the correct MicroPython interpreter.

In the lower right corner of the window, select "Micropython Raspberry Pi Pico"
If this interpreter does not appear, then the problem is that there is no connection between Pico and the computer, see below:



On our website we share our Python3 scripts which produces graphs using Matplotlib based on files with measurement results taken during a stratospheric balloon flight on May 7, 2025 in Rockenhausen

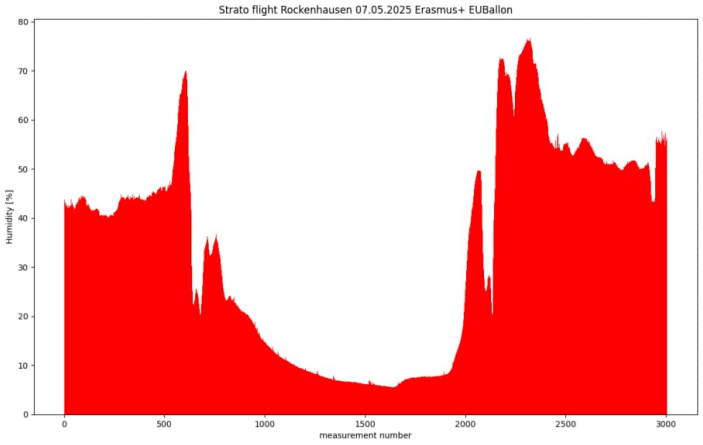
In a separate document we discuss these results in detail.

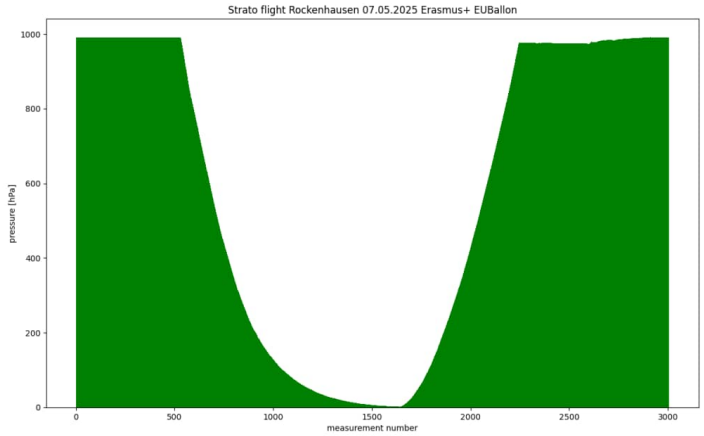
"Analysis of measurement results taken during a stratospheric balloon flight. Recorded data and analysis methods." We share also our

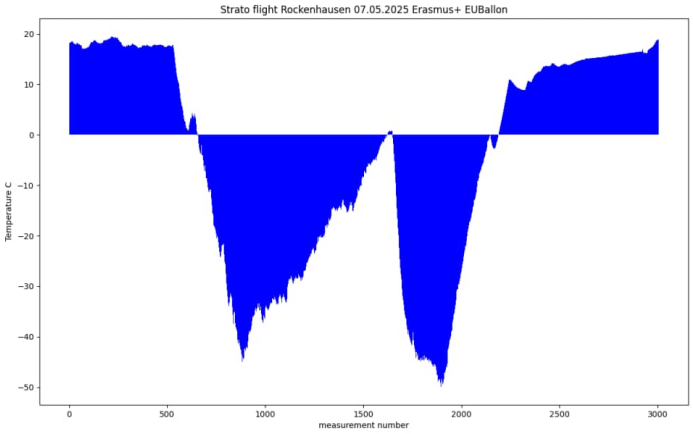
Below is a CSV file with measurement results made by Pico and BME280 using the presented script

1839	-44.77	165.34	7.75
1840	-44.68	166.83	7.66
1841	-44.92	168.25	7.77
1842	-44.21	169.53	7.74
1843	-45.01	171.16	7.76

Graphs generated by our own Python3 scripts based on CSV files saved in Pico







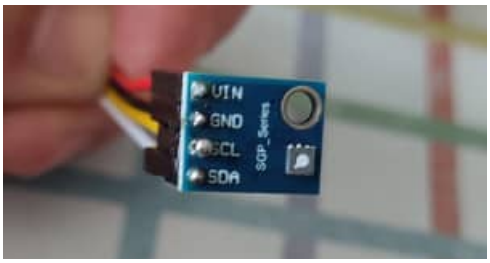
Our PicoBox with Raspberry Pi Pico 2 and BME280 sensor

2)SGP30 CO2 TVOC organic pollution

Experiment:
Testing the content of CO2 and volatile organic compounds in the air

Required equipment:
-PicoBox (Raspberry Pi Pico 2 with 2.4" SSD1306 OLED screen)
-SGP30 I2C 3.3V sensor
-Grove cable with female ends

Software:
MicroPython system installed on Pico in version 1.25 or newer,
Thonny Editor v.4 or newer,
MicroPython script presented below.



Wiring:

SGP30 sensor pin	Grove cable colors
VCC	red
GND	black
SCL	yellow
SDA	white

Connect Grove cable plug to PicoBox socket GP6,GP7

CO2 ppm (particle per milion)

TVOC ppb (particle per bilion)

Note: SGP30 sensor requires several minutes for initialization and is not ready to measure immediately

MIcroPython scripts for Raspberry Pi Pico

Simple version

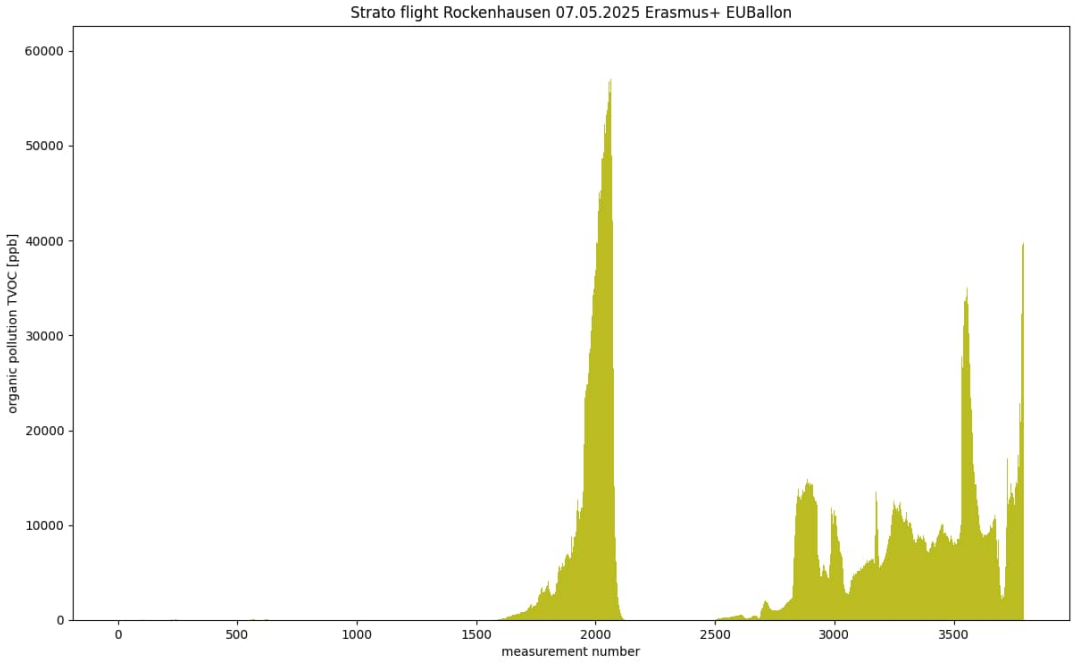
```
#Adafruit library for SGP30 CO2 and TVOC sensor
import adafruit_sgp30
from machine import I2C, Pin
from time import sleep

bus =I2C(1, scl=Pin(7),sda=Pin(6), freq=400000)
#SGP sensor connected to GP6(SDA Pin) and GP7(SCL Pin)
sgp = adafruit_sgp30.Adafruit_SGP30(bus)

while True:
    co2eq, tvoc = sgp.iaq_measure()
    if co2eq == 400:
        print("initializing mdodule, please wait!")
    else:
        while True:
            try:
                co2eq, tvoc = sgp.iaq_measure()
                print("CO2 concentration = %d ppm \t TVOC = %d ppb" % (co2eq, tvoc))
                #delay before next reading in seconds:
                sleep(0.5)
            except OSError as e:
                pass


```

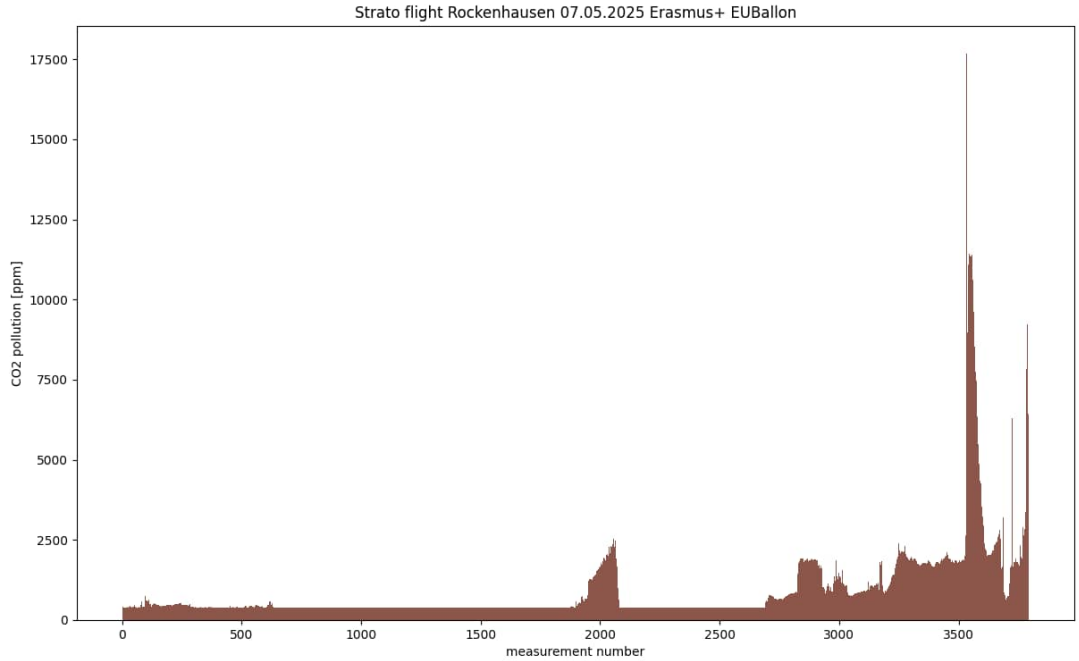
Version with OLED screen and data logger (result saved inside Raspberry Pi Pico)

```
#Adafruit library for SGP30 CO2 and TVOC sensor
#oled screen library:
import ssd1306
import adafruit_sgp30
from machine import I2C, Pin
from time import sleep
#screen resolution
WIDTH = 128
HEIGHT = 64

bus =I2C(1, scl=Pin(7),sda=Pin(6), freq=400000)
#SGP sensor and OLED screen connected to GP6(SDA Pin) and GP7(SCL Pin)
# variable sgp assigned to SGP30 sensor
sgp = adafruit_sgp30.Adafruit_SGP30(bus)
# variable oled assigned to OLED screen, initialisation
oled=ssd1306.SSD1306_I2C(WIDTH, HEIGHT,bus)
file=open("CO2TVOCresult.CSV","a")
file.write("Measurement EU-Ballon CO2 and TVOC sensor \n")
file.write("No"+ "\t"+"CO2"+"\t"+"TVOC"+"\n")
file.flush()
no=1
#clear screen:
oled.fill(0)
#maximum brightness contrast(255), usually more then 100
oled.contrast(200)
oled.text("EU-ballon",30,0)
oled.text("Air Quality",0,15)
oled.text("Measurement",0,30)
oled.show()
sleep(3)
```

```
oled.fill(0)
while True:
    co2eq, tvoc = sgp.iaq_measure()
    if co2eq == 400:
        print("initializing module, please wait!")
        oled.text("EUballon",30,0)
        oled.text("initializing...",0,15)
        oled.text("please wait!",0,30)
        oled.show()
        sleep(1)
        oled.fill(0)
    else:
        while True:
            try:
                co2eq, tvoc = sgp.iaq_measure()
                print("CO2 concentration = %d ppm \t TVOC = %d ppb" % (co2eq, tvoc))
                oled.text("EUballon",0,0)
                oled.text("org. pollution",0,15)
                oled.text("CO2 ppm:"+str(co2eq),0,30)
                oled.text("TVOC ppb:"+str(tvoc),0,42)
                oled.show()
                file.write(str(no)+"\t"+str(co2eq)+"\t"+str(tvoc)+"\n")
                no=no+1
                #save to the file without closing file:
                file.flush()
                #delay before next reading in seconds:
                sleep(1)
                oled.fill(0)
            except OSError as e:
                pass
```

Charts generated from a csv file with measurement data taken during a balloon flight in Rockenhausen on 07.05.2025



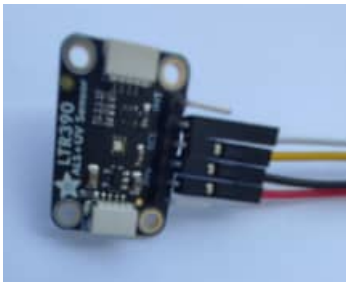


3)UV Ltr390 sensor simple version

Experiment:
UV radiation measurement

Required equipment:
-PicoBox (Raspberry Pi Pico 2 with 2.4" SSD1306 OLED screen)
-LTR390 UV Adafruit 3.3V sensor
-Grove cable with female ends

Software:
MicroPython system installed on Pico in version 1.25 or newer,
Thonny Editor v.4 or newer,
MicroPython script presented below.



Wiring:

LTR390 UV sensor pin	Grove cable colors
VCC	red
GND	black
SCL	yellow
SDA	white

Connect Grove cable plug to PicoBox socket GP6,GP7

Simple test

```
# UV LTR390 Adafruit sensor with library modified by Pawel Boryczka
# based on library from Waveshare (Pico Enviromental Sensor).
from time import sleep
from ltr390 import LTR390
from machine import Pin, I2C
i2c=I2C(1, scl=Pin(7), sda=Pin(6), freq=100000)

sensor = LTR390(i2c)
sleep(1)
while True:
    UVS = sensor.UVS()
    #print in consola
    print(" UVS:",UVS )
    sleep(1)
```

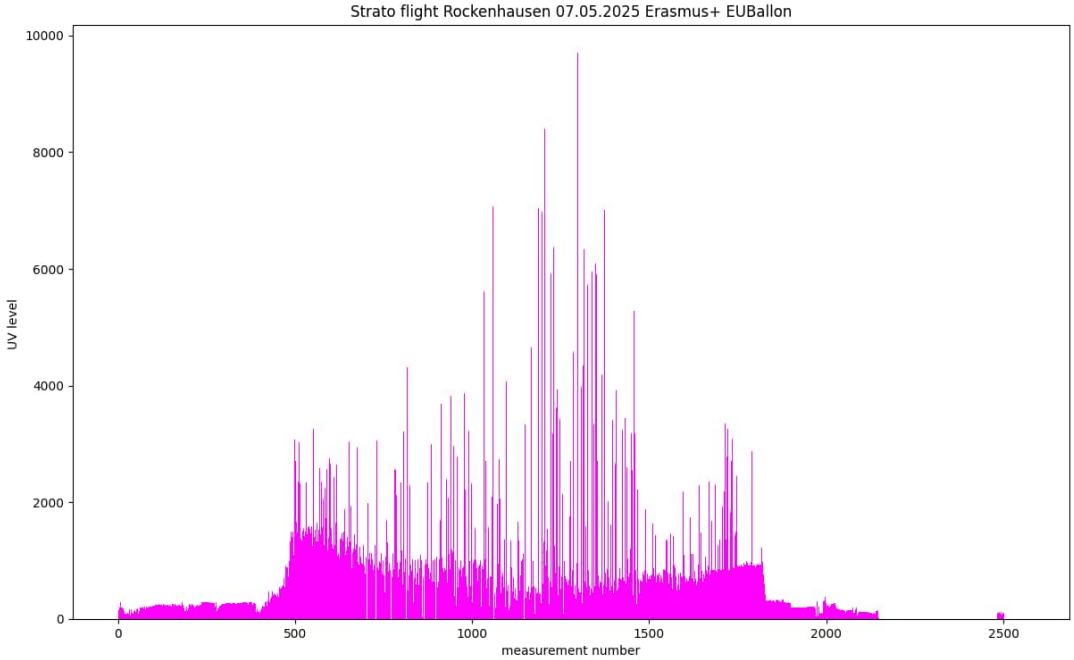
Version with OLED screen and logger

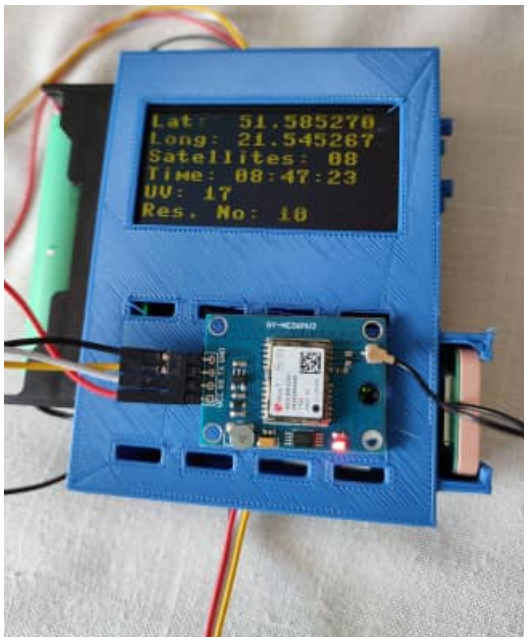
```
# UV LTR390 Adafruit sensor with library modified by Pawel Boryczka
# based on library fromWaveshare (Pico Enviromental Sensor).
from time import sleep
from ltr390 import LTR390
from machine import Pin, I2C
import ssd1306
#screen resolution
WIDTH = 128
HEIGHT = 64
#Pinout for Raspberry Pi Pico-Oled screen and LTR390
#I2C Screen and sensor connected to GP6(SDA) and GP7(SCL)
i2c=I2C(1, scl=Pin(7), sda=Pin(6), freq=400000)
oled =ssd1306.SSD1306_I2C(WIDTH, HEIGHT,i2c)
#clear screen:
oled.fill(0)
#maximum brightness contrast(255), usually more then 100
oled.contrast(250)
#variable assigned to LTR390
sensor = LTR390(i2c)
sleep(1)
file=open("UVreadings.CSV","a")
file.write("Measurement EUBallon UV LTR390 sensor \n")
file.write("No"+ "\t"+"result"+"\n")
file.flush()
no=1

```

infinite loop:

```
while True:
    UVS = sensor.UVS()
    #print in consola:
    print(" UVS:",UVS )
    oled.text("EU-ballon",30,0)
    oled.text("UV index:",0,16)
    oled.text(str(UVS),20,35)
    oled.text("No:"+str(no),0,50)
    oled.show()
    file.write(str(no)+ "\t"+str(UVS)+"\n")
    no=no+1
    #save to the file without closing file:
    file.flush()
    sleep(1)
    oled.fill(0)
```

Example of a graph generated based on data recorded in a file during a stratospheric balloon flight in Rockenhausen on May 7, 2025





4)Measuring the voltage from a 3V solar panel using an analog pin

Experiment:
solar panel voltage

Required equipment:
-PicoBox (Raspberry Pi Pico 2 with 2.4" SSD1306 OLED screen)
-solar panel 3V
-Grove cable with female ends

Software:
MicroPython system installed on Pico in version 1.25 or newer,
Thonny Editor v.4 or newer,
MicroPython script presented below.

Wiring:

```
while True:
    sensor_raw = analog_value.read_u16()
    print("raw:", sensor_raw)
    minivolt= sensor_raw/65535*3300
    oled.text("Analog sensor",0,0)
    oled.text("readings",0,15)
    oled.text("ADC level: "+str(sensor_raw),0,30)
    oled.text(str(round(minivolt,0))+" mV",0,45)
    oled.show()
    print("mV:", minivolt)
    sleep(2)
    oled.fill(0)
```

Solar panel 3V sensor pin	Grove cable colors
VCC	red
GND	black
not used	yellow
not used	white

Connect Grove cable plug to PicoBox socket GP27

Simple version

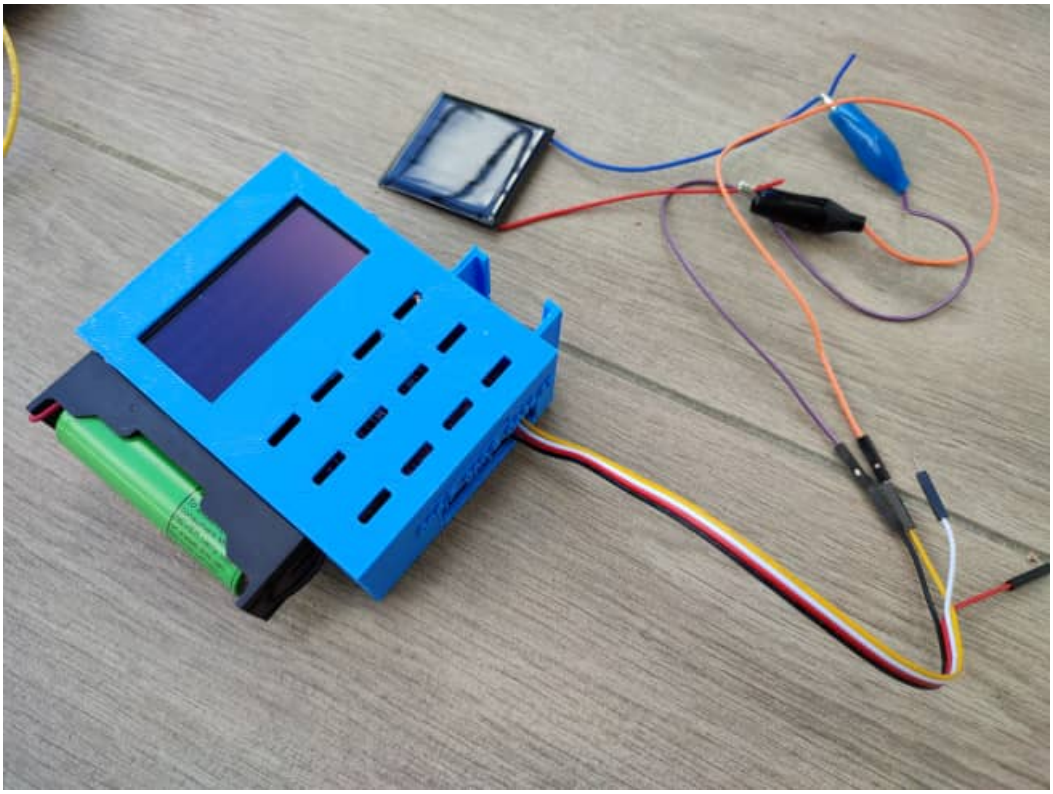
```
from time import sleep
from machine import ADC
#sensor signal pin (OUT) connected to GP27
analog_value = ADC(1)

while True:
    sensor_raw = analog_value.read_u16()
    print(sensor_raw)
    sleep(2)
    print("Voltage", sensor_raw/65535*3300, "mV")
```

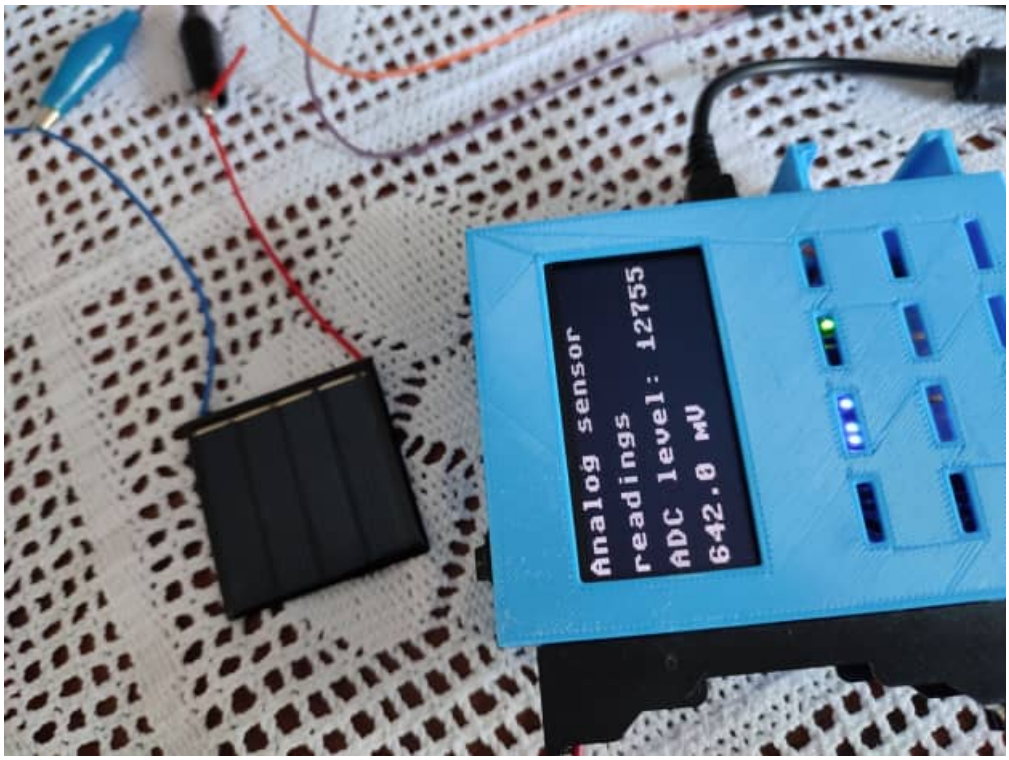
Version with OLED screen

```
from time import sleep
from machine import I2C, Pin, ADC
#oled screen library:
import ssd1306
#screen resolution
WIDTH = 128
HEIGHT = 64

#Pinout for Raspberry Pi Pico-Oled screen
#connected to pin SDA to GP6, pin SCL to GP7
#screen connected to BUS I2C

bus =I2C(1, scl=Pin(7),sda=Pin(6), freq=400000)
oled =ssd1306.SSD1306_I2C(WIDTH, HEIGHT,bus)
oled.fill(0)
#sensor signal pin (OUT) connected to GP27 analog Pin
analog_value = ADC(1)
oled.contrast(250)
```

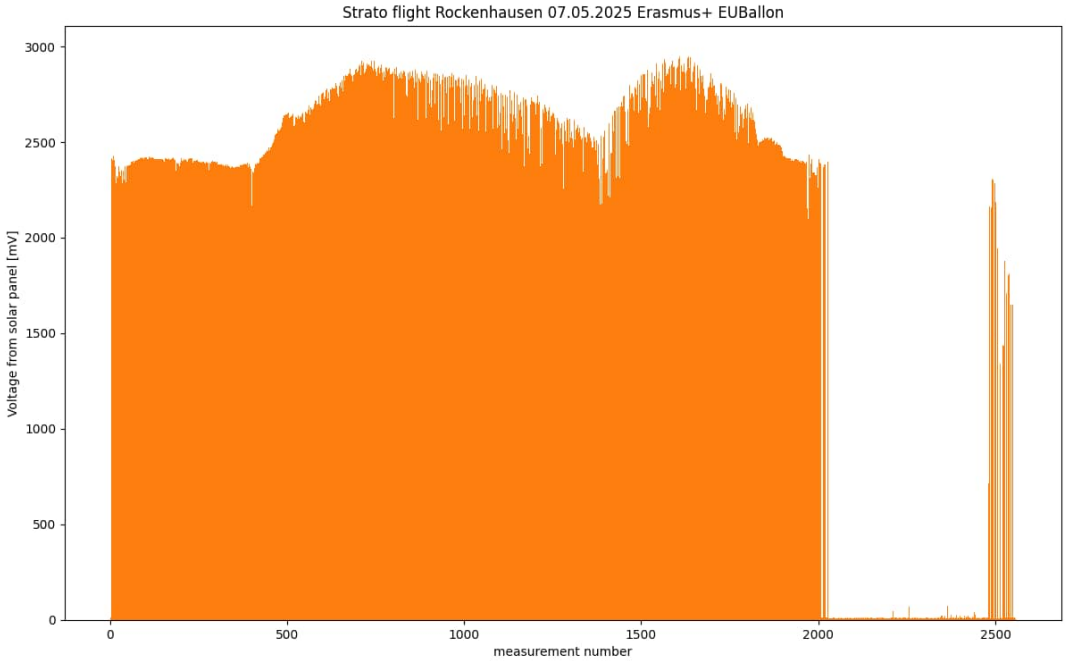
Data logger

```
from machine import  ADC
from time import sleep
analog_value=ADC(1)
file=open("readings.CSV","a")
file.write("Measurement EU-Ballon Analog sensor \n")
file.write("No"+ "\t"+"result"+"\n")
file.flush()
no=1
while True:
    result=analog_value.read_u16()
    file.write(str(no)+ "\t"+str(result)+"\n")
    #print in consola
    print(str(nr)+ "\t"+str(result))
    no=no+1
    #save to the file without closing file:
    file.flush()
    #measurement every 5 seconds:
    sleep(5)
```





Example of a chart generated based on data recorded in a file during a stratospheric balloon flight in Rockenhausen on May 7, 2025



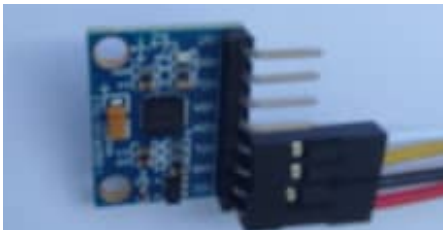
5)Accelerometer

MPU-6050
simple version
This example use library

https://github.com/harishragul/mpu6050-raspberry-pi-pico-library
sample.py is a sample code to find the raw values
Author of the used library: Harish Ragul

Required equipment:

-PicoBox (Raspberry Pi Pico 2 with 2.4" SSD1306 OLED screen)
-MPU-6050 accelerometer with thermometer (I2C 3.3V sensor)
-Grove cable with female ends



Software:

Micropython system installed on Pico in version 1.25 or newer,
Thonny Editor v.4 or newer,
MicroPython script presented below.

Wiring:

MPU-6050 sensor pin	Grove cable colors
VCC	red
GND	black
SCL	yellow
SDA	white

Connect Grove cable plug to PicoBox socket GP6,GP7

Simple version

```
#vector3d.py and imu.py inside lib folder
from imu import MPU6050
from time import sleep
from machine import Pin, I2C
import ssd1306
#MPU6050 connected to GP6, GP7
i2c = I2C(1, sda=Pin(6), scl=Pin(7), freq=400000)
imu = MPU6050(i2c)
#oled screen resolution
WIDTH = 128
HEIGHT = 64
oled=ssd1306.SSD1306_I2C(WIDTH, HEIGHT,i2c)
oled.fill(0)
oled.text("EUBallon ", 0, 0)
oled.text("Acceleration", 0, 15)
oled.text("Temperature ", 0, 30)
oled.text("Measurement ", 0, 40)
oled.text("Please wait.. ", 0, 50)
oled.show()
file=open("Accellog.CSV","a")
file.write("Measurement EU-Ballon MPU6050 sensor \n")
file.write("No"+ "\t"+"ax"+"\t"+"ay"+"\t"+"az"+"\t"+"temp C"+"\n")
file.flush()
no=1
sleep(2)
```

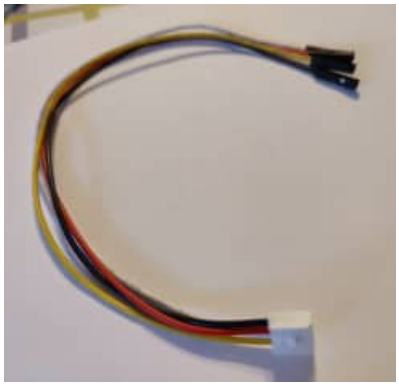
Version with OLED screen and logger

```
"""https://github.com/harishragul/mpu6050-raspberry-pi-pico-library
#sample.py is a sample code to find the raw values
# Author Harish Ragul"""
#vector3d.py and imu.py inside lib folder
from imu import MPU6050
from time import sleep
from machine import Pin, I2C
#MPU6050 connected to GP6, GP7
i2c = I2C(1, sda=Pin(6), scl=Pin(7), freq=400000)
imu = MPU6050(i2c)

while True:
    #Read Accelerometer raw value
    accX = round(imu.accel.x,2)
    accY = round(imu.accel.y,2)
    accZ = round(imu.accel.z,2)
    temp=round(imu.temperature,1)
    print(accX,"\t",accY,"\t",accZ,"\t", temp)
    sleep(0.2)
```

```
while True:
    #Read Accelerometer raw value
    accX = round(imu.accel.x,2)
    accY = round(imu.accel.y,2)
    accZ = round(imu.accel.z,2)
    temp=round(imu.temperature,1)
    print(accX,"\t",accY,"\t",accZ,"\t", temp)
    #long line splitted with \ character at the end
    file.write(str(no)+ "\t"+str(accX)+"\t"\
    +str(accY)+"\t"+str(accZ)+"\t"+str(temp)+"\n")
    #save to the file without closing file:
    file.flush()
    #time between measurements (2 seconds)
    oled.fill(0)
    oled.text("EU-Ballon logger", 0, 0)
    oled.text("AX:"+str(accX), 0, 10)
    oled.text("AY:"+str(accY), 0, 20)
    oled.text("AZ:"+str(accZ), 0, 30)
    oled.text("Temp:"+str(temp)+"C", 0, 40)
    oled.text("No:"+str(no), 0, 50)
    oled.show()
    no=no+1
    sleep(0.5)
```

Our equipment inside thermal box- preparation to ballon flight (07.05.2025)

Grove to female cable-for connection between sensors and Grove socket in PicoBox:



From the website https://euballon.zslp.edu.pl/downloads/ You can download our MicroPython scripts for Raspberry Pi Pico, libraries, our Python tools for data analysis and other materials.

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Erasmus+
„Strato-Ballon Measurement an Environmental Consciousness“
2024-1-DE02-KA210-VET-000243591

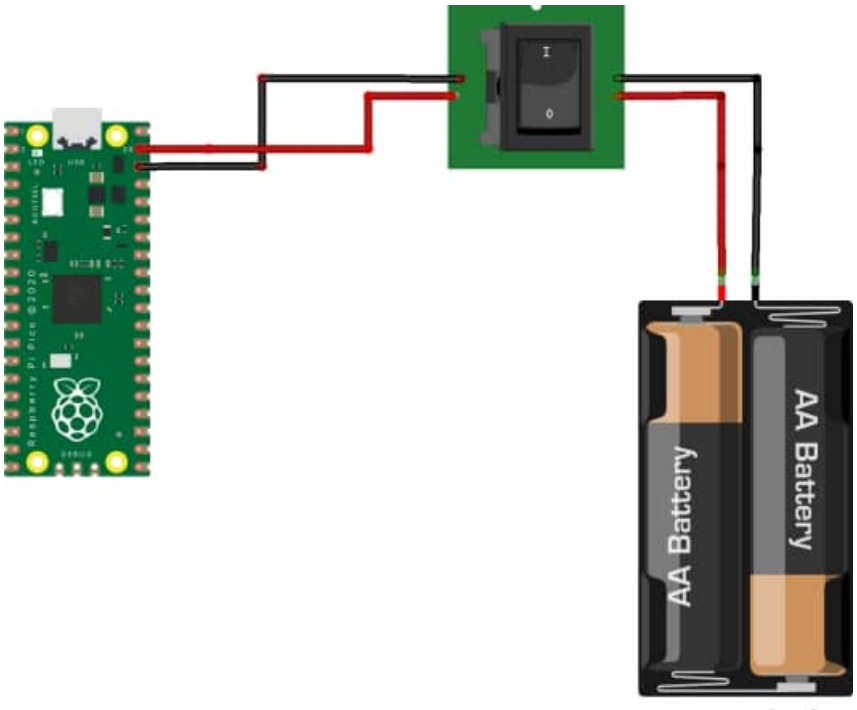
https://euballon.zslp.edu.pl/

Material for students and teachers allowing for the preparation of measuring equipment. Developed and used as part of the project implementation

PICOBOX

Information useful for constructing flight data recording devices (May be used in many other experiments, also in the field, including geospatial analysis)

Power switch/ battery schema



Raspberry Pin	Battery wire	remarks
VSYS	red (+)	The minimum recommended voltage for the VSYS pin on the Raspberry Pi Pico is 1.8V, and the maximum is 5.5V.
GND	black(ground)	You can select one from many pins with description "GND"

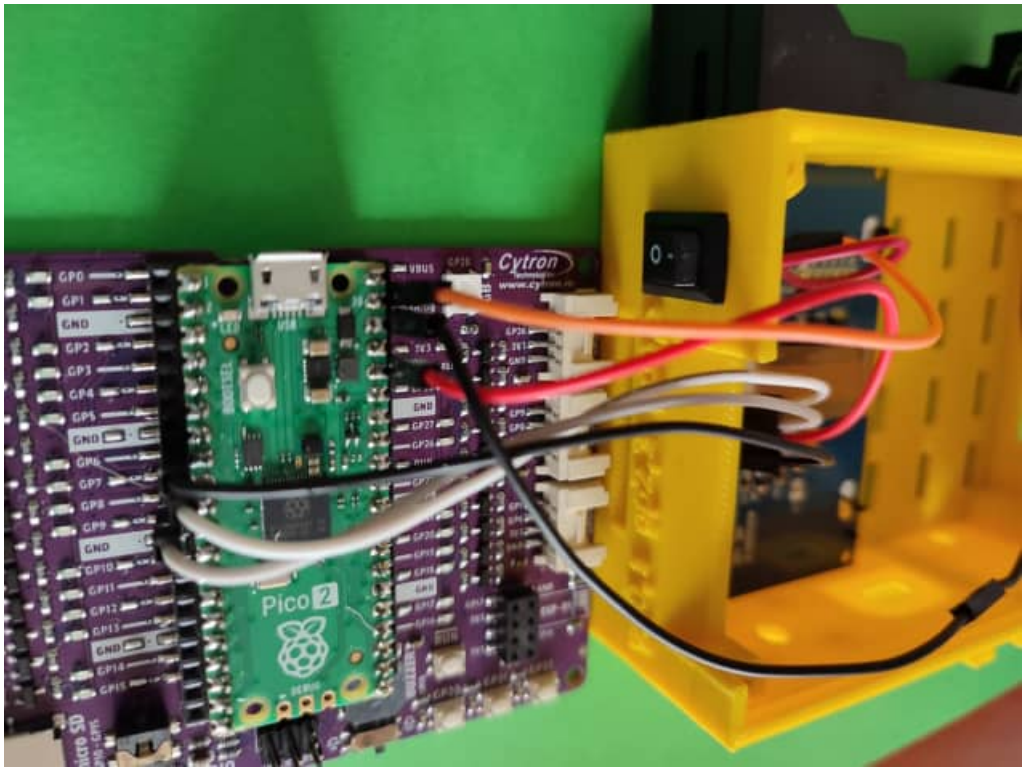
We use 1 acumulator/battery 18650 with single battery holder which offer from 3.7V to 4,2V (recommended). If you want to use a 18650 battery holder for 2 or more batteries, it can only be used battery holder with a parallel connection (then the voltage will not change). Battery holder with a series connection increase the voltage beyond the allowable norm (8.4V, 12.6V...).

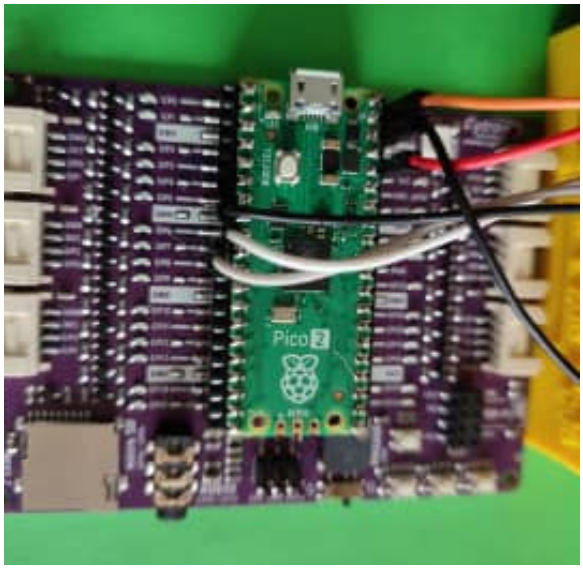
Warning! Make sure the battery 18650 does not drop below 2.5V, otherwise it may not be possible to charge it again.

This type of battery provides stable current for a long time. During our almost three-hour flight, 90% of the maximum charge remained

You can't connect the set of batteries which deliver max 5V.

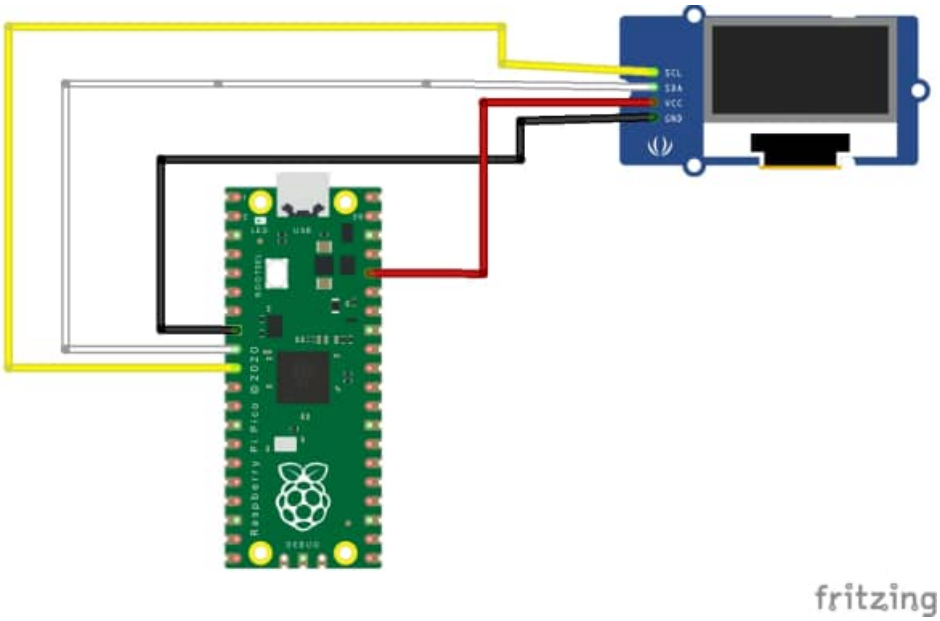
You must solder wires to power switch.





OLED screen SSD1306 I2C 2.4" connection

Raspberry Pico Pin	OLED SSD1306 PIN	wire color	remarks
3V3 Out	VCC	red	3.3 Volts (+)
GND	GND	black	You can select one from many pins with description "GND"
GP6	SDA	white	you can use different colour
GP7	SCK (SCL)	yellow	you can use different colour



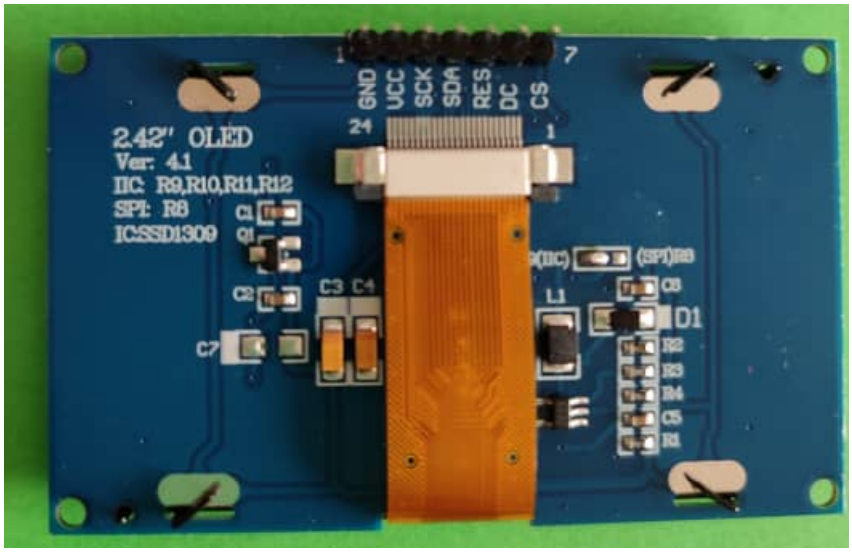
Colours: black, red, white and yellow is the standard for very popular Grove wires.

You can select different pins for I2C communication (GP6,GP7), but in this case You must modify our Python scripts.
See details: https://pico2.pinout.xyz/

In our case, we used RP2350 Pico 2 microcontrollers due to the space for recorded measurements and larger memory than Pico 1. Pico 1W and Pico 2W offer less space for saving data than Pico 2.

OLED SSD1306 2.4" screen

For I2C communication it is necessary to properly solder jumpers R9, R10, R11 and R12 Pins RES, DC, CS not used if we have I2C communication (these pins are used for SPI communication).



Parts:

Raspberry Pi Pico 2

https://botland.store/modules-and-kits-for-raspberry-pi-pico-2/25311-raspberry-pi-pico-2-rp2350-arm-cortex-m33-5056561803951.html

Docking station for Pico/Pico2 (Cytron Maker Pi Pico)

https://botland.store/raspberry-pi-pico-hat-extenders-findings/19297-maker-pi-pico-base-simplifying-pi-pico-for-beginners-5904422360917.html

OLED SSD1306 2.4"

https://sklep.msalamon.pl/produkt/wyswietlacz-oled-242-128x64px-bialy/

Power switch (14x10 mm)

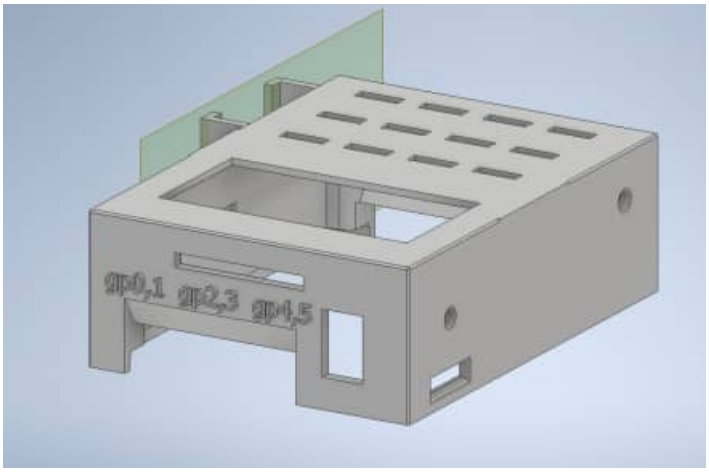
Battery holder for 18650 battery

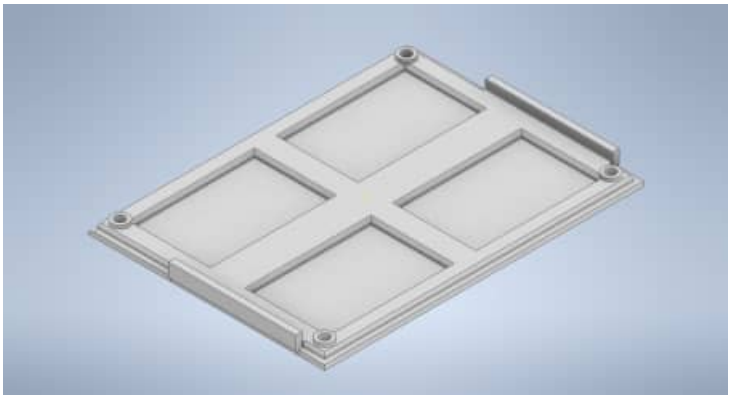
Battery 18650

Wires
https://botland.store/female-to-male-connecting-cables/19949-connecting-cables-female-male-justpi-10cm-40pcs-5904422328696.html

Note: instead of battery You can use PowerBank connected to USB socket, but many Powerbanks have low power consumption shutdown protection
3D Models for self print Box

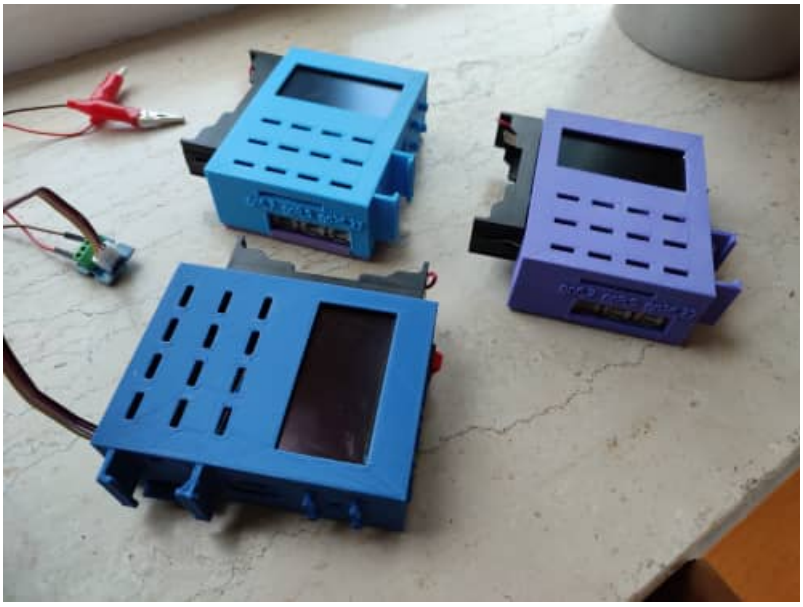
PicoBox 3D Models





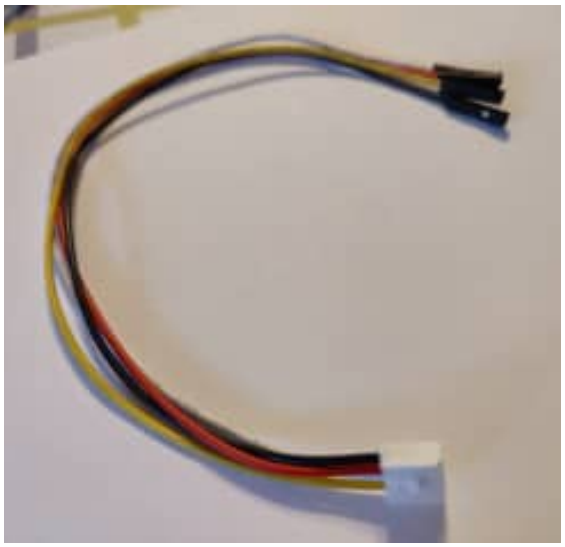
You can download our STL models from the website:

https://euballon.zslp.edu.pl
Our PicoBoxes after returning



Battery 18650 LI-Ion, Male -Female wires (10 cm), holder for 18650 battery

Grove to female cable for connection between PicoBox and sensors



Ready to start PicoBox powered by 18650 battery with switch

From the website https://euballon.zslp.edu.pl/downloads/ You can download our MicroPython scripts for Raspberry Pi Pico, libraries, our Python tools for data analysis and other materials.

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Ballon 2025 – Measurement DOC – by POL

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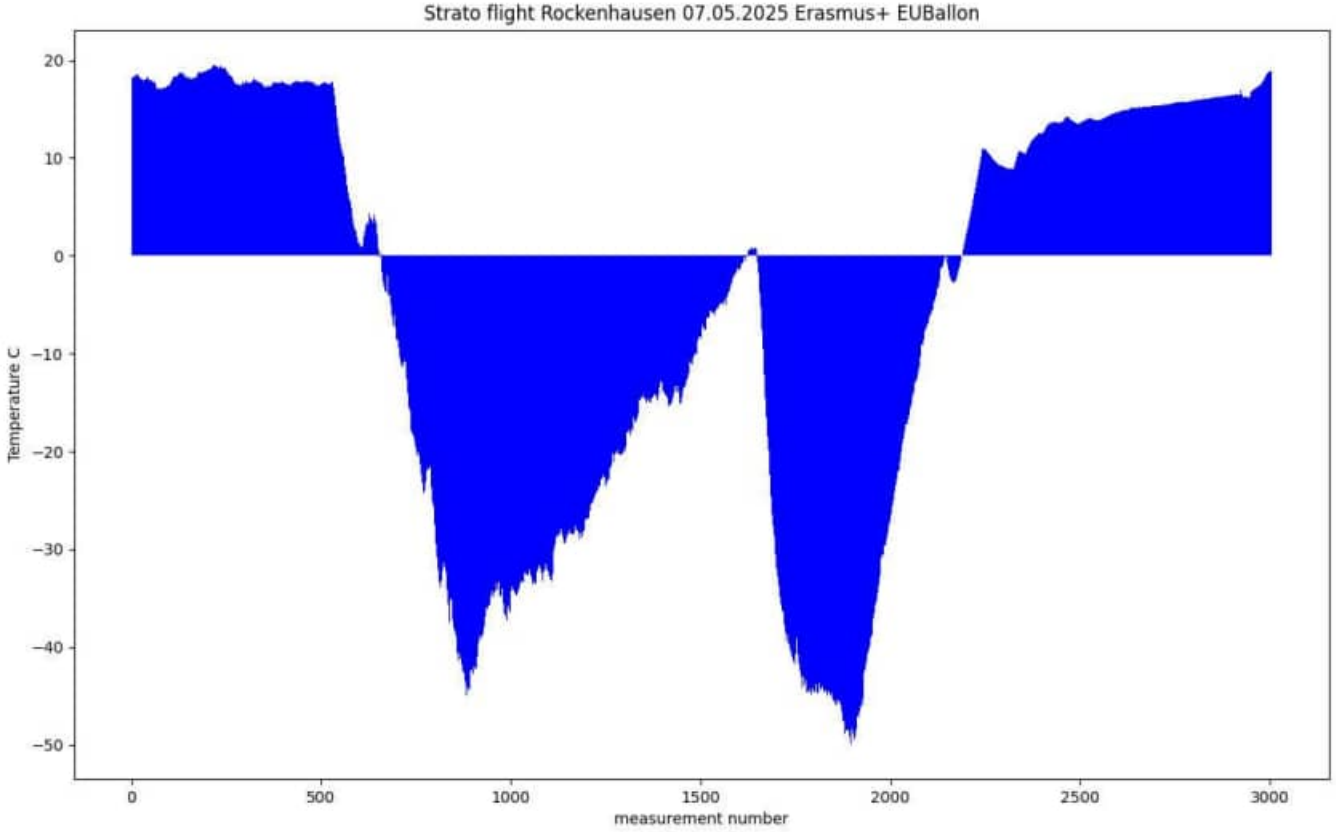
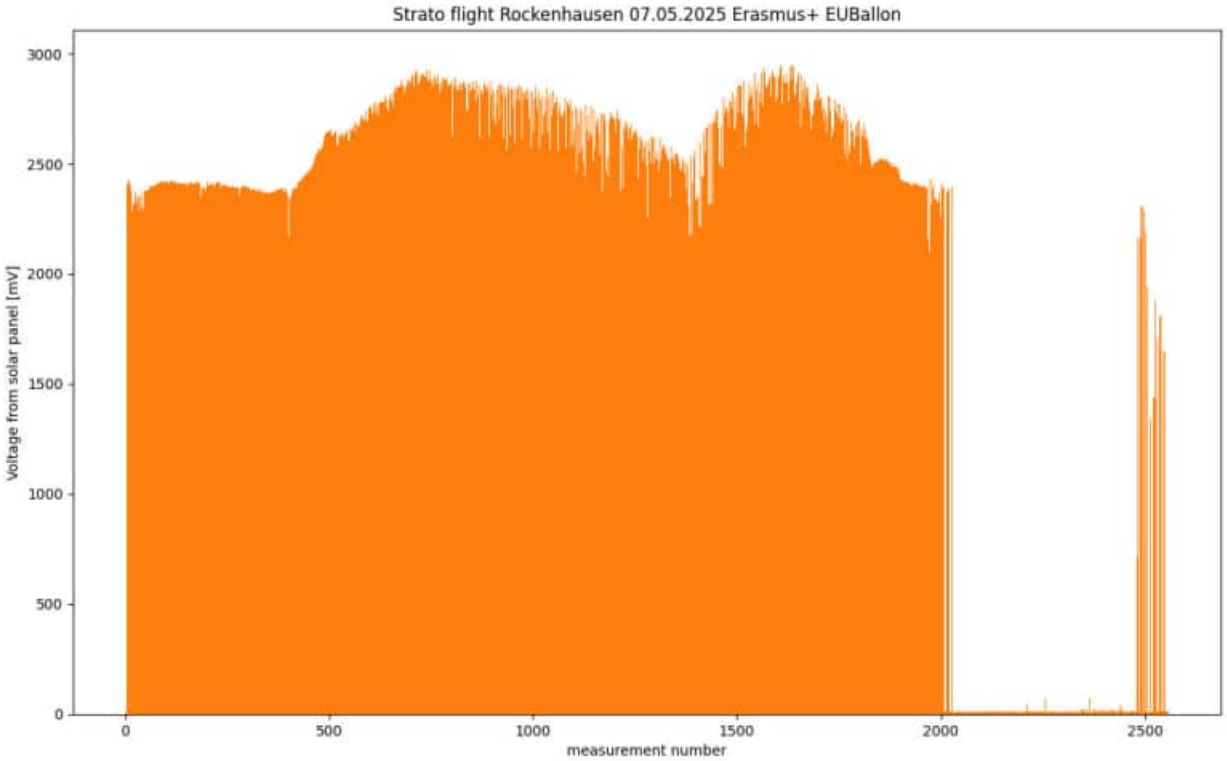
Charts generated from CSV files recorded by PICO in strato flights. For generation was used PYTHON LIBRARY MATHPLOTLIB an NUMPY LIBRARY.



Erasmus+ Berufsbildende Schul Donnersbergkrei Co-funded by the European Union



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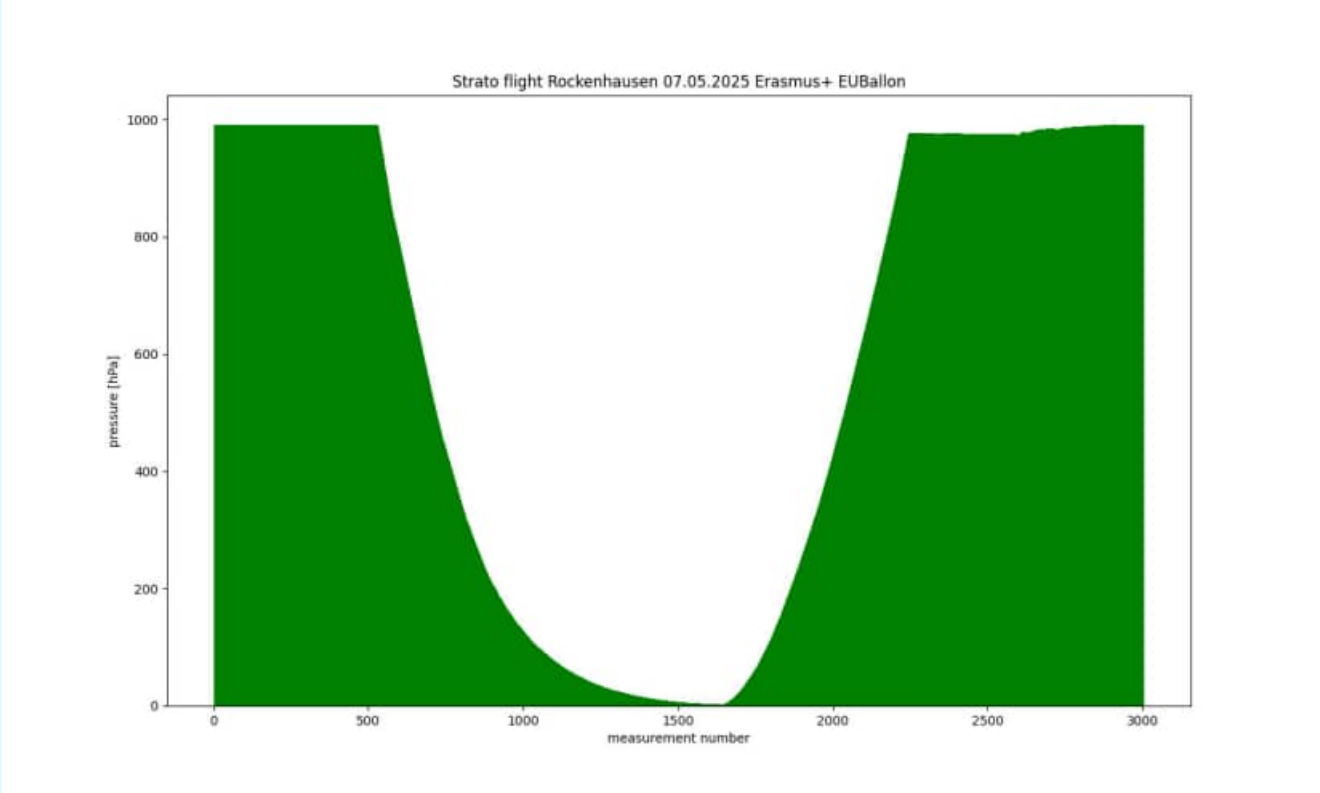
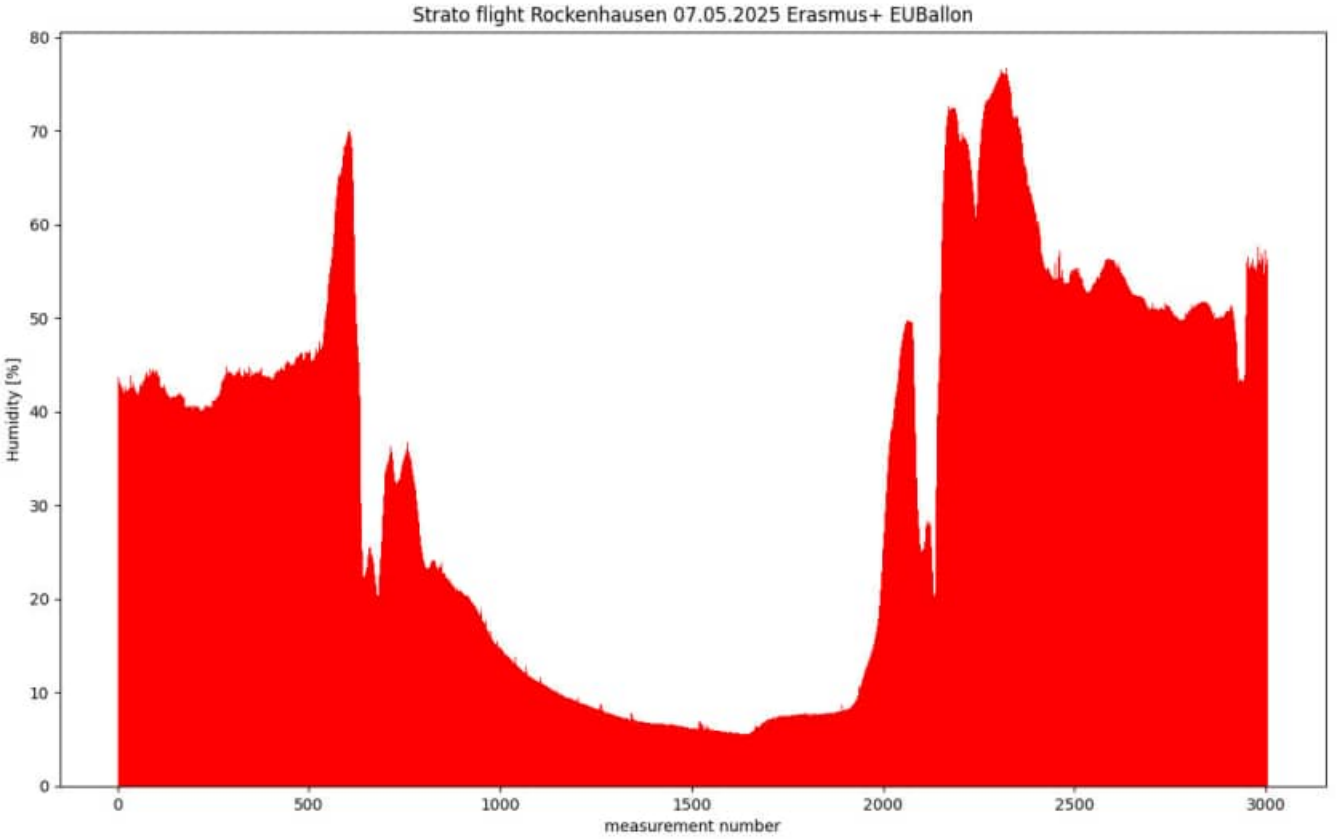




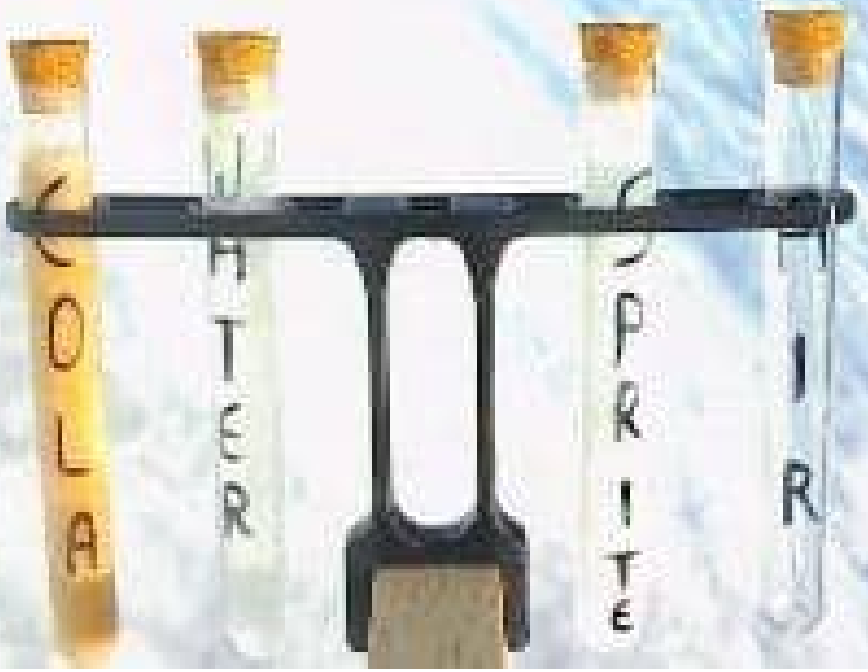
Chapter three

Experiments

F-Measurements and Results d ring the flight

F French erasmus Rock 5_5_ 25presentation

Measurements and Results during the flight



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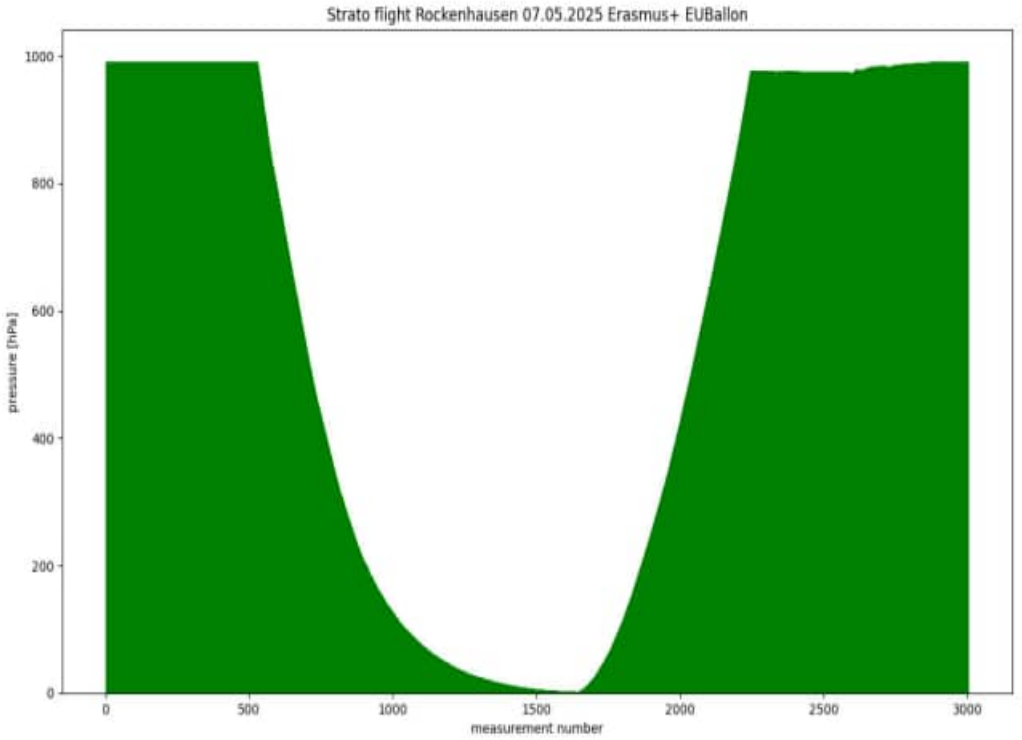
ATMOSPHERIC PRESSURE

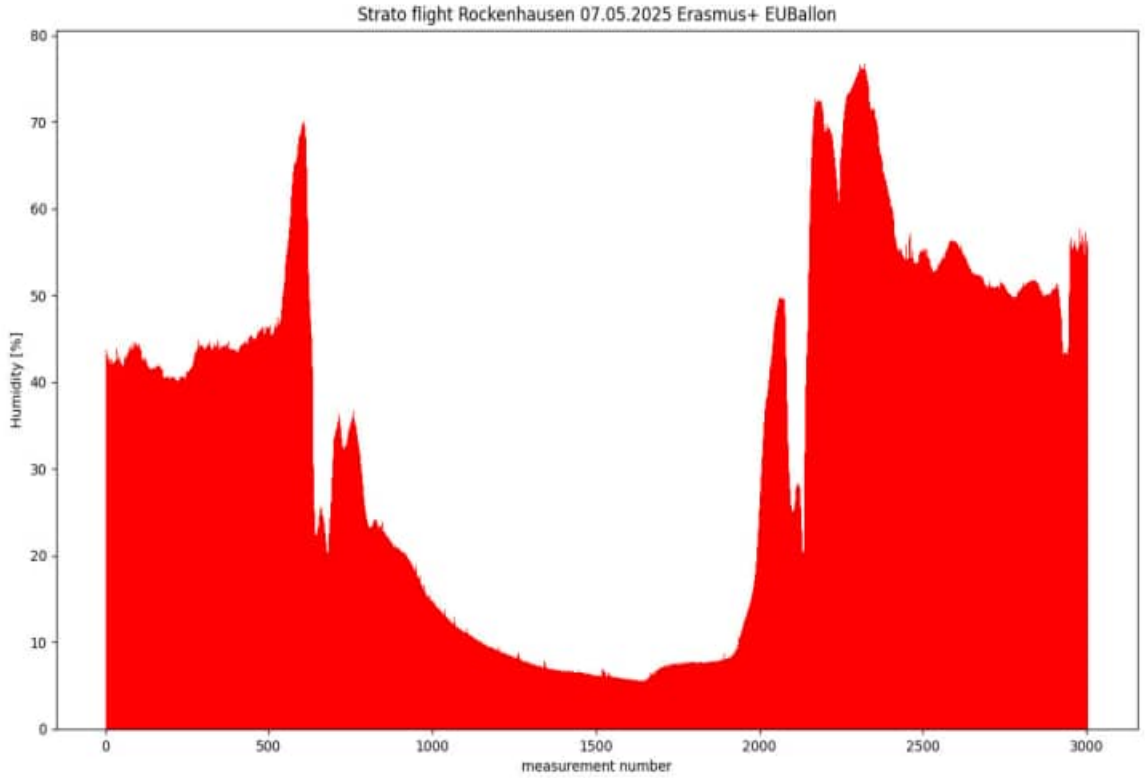


The measurements obtained show a significant decrease in atmospheric pressure during the Balloon's ascent, followed by a gradual increase during its descent.

These measurements show that the balloon indeed had an ascending and then descending phase, without any incident along the way.

Unfortunately, we were unable to record the Balloon's altitude due to lack of space in the box, but the pressure at very high altitudes is close to zero.

HUMIDITY LEVEL

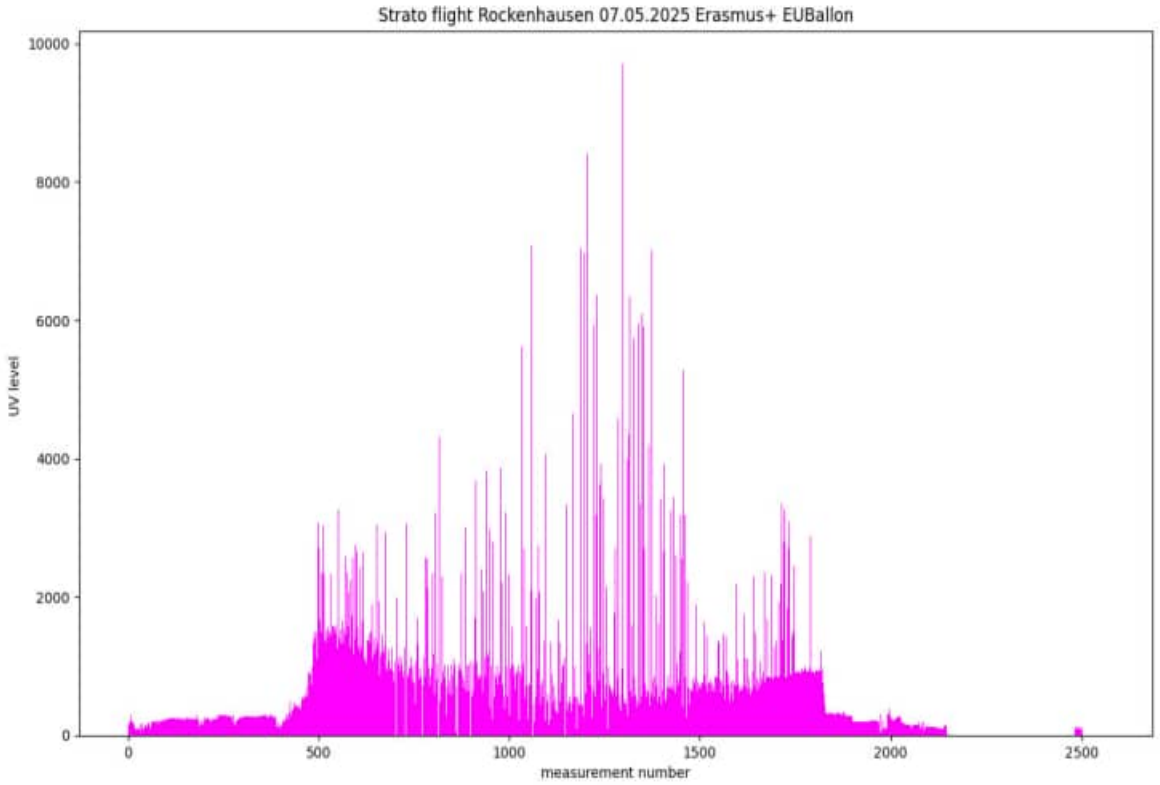


Humidity measurements during the flight show a decrease at high altitude (from 40% to 10%).

The two peaks obtained during the ascent and descent are due to the passage through clouds, since

the weather was very overcast that day.

UV LEVEL



Measurements of UV radiation levels show that they increase with altitude. This is an expected result, since the atmosphere filters UV rays.

We can generalize these results to other radiation, particularly that converted by solar panels into electricity.

Space-based solar panels would therefore be more efficient. The problem of transporting electricity to Earth remains to be solved...

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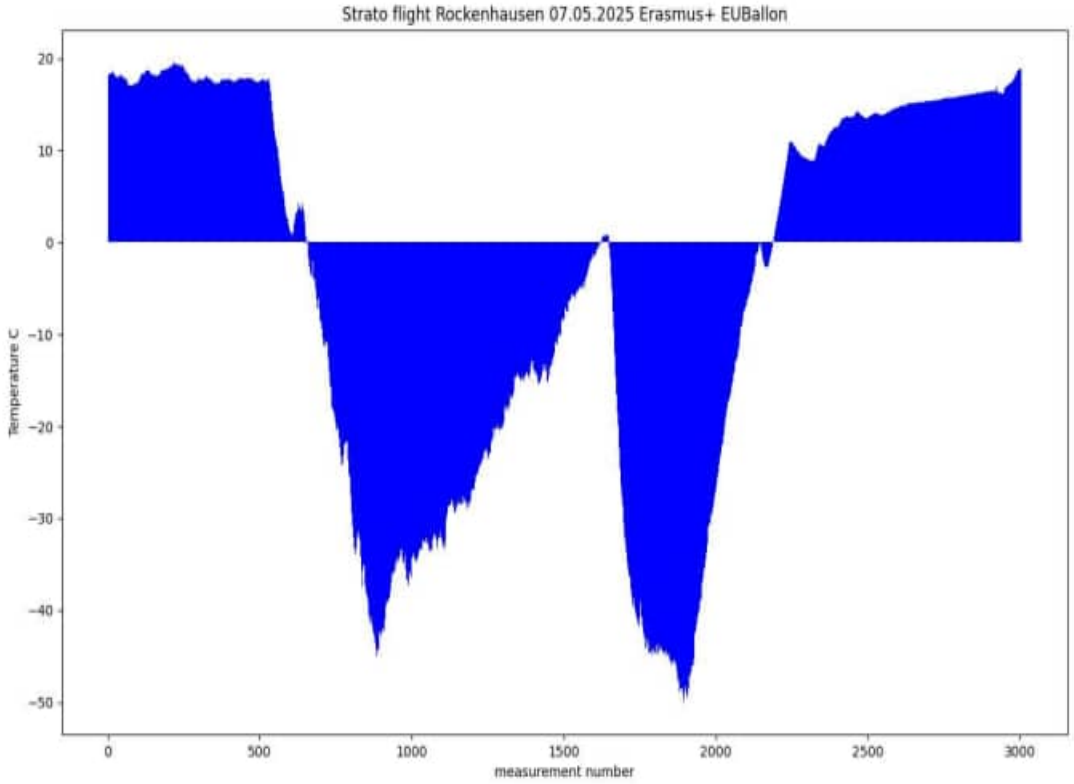
TEMPERATURE



The temperature curve shows a significant decrease, as we expected, since the temperature in the stratosphere reaches -50 degrees Celsius.

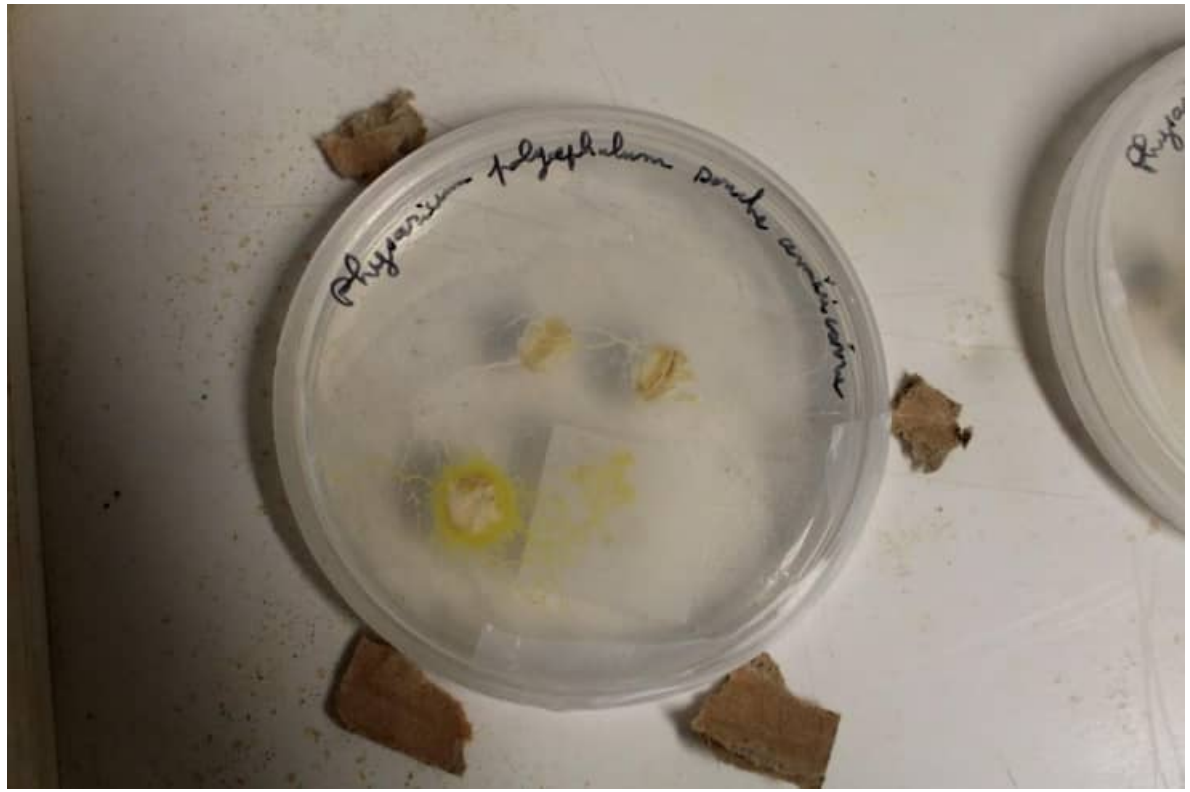
What caught our attention was the temperature increase during the flight (from -41 to +2 degrees Celsius!).

The hypothesis of a balloon descent was ruled out thanks to pressure measurements, which prove that the balloon had a constant ascent.

From this, we deduced that the balloon crossed a warmer layer at altitude during its ascent.

Is this due to global warming?

A LIFE ON BOARD: THE BLOB



Although microscopic, Physarum polycephalum plays an important ecological role : decomposition of organic matter, microbial regulation, ecological indicator.

We tested the resilience of this particular living being, wondering if it would withstand these extreme conditions.

Unfortunately, both specimens did not survive, either outside or inside the polystyrene box. We don't know if it was the temperature or the pressure, or a combination of the two, that killed it.

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Strato-Ballon Measurement

Environmental Consciousness

ERASMUS+
2025

CS-CHEMISTRY-BIOLOGY

Presented by :

Mr.Solarczyk and Ms.Oristil

Erasmu

Geo-engineering

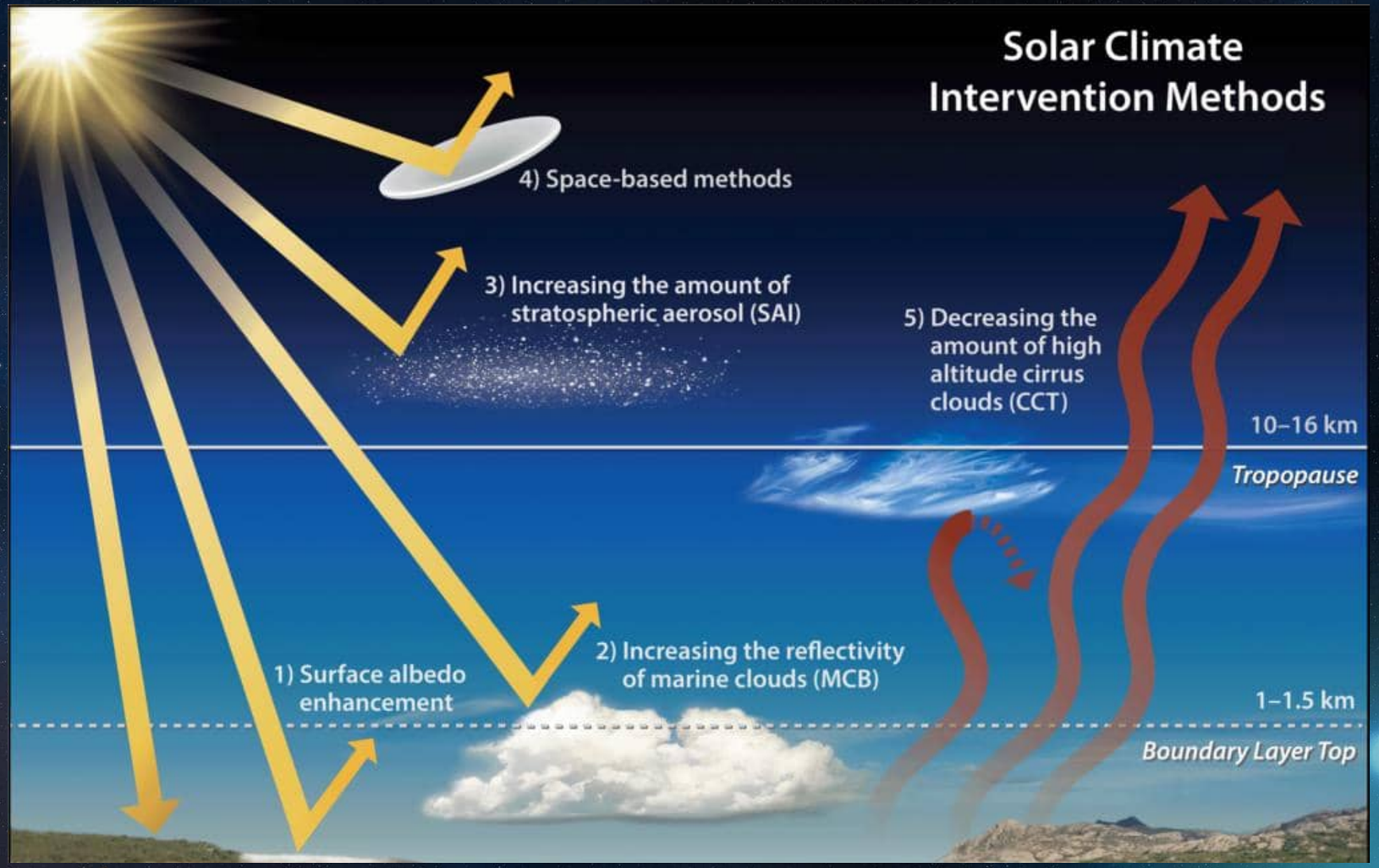
Large-scale manipulation of the environment to counteract climate change

In 1991, Mount Pinatubo in the Philippines erupted, releasing about 17 million tons of aerosols in the atmosphere

This led to a *decrease* in Northern Hemisphere average temperatures of 0.5–0.6 °C and a global *decrease* of about 0.4 °C.

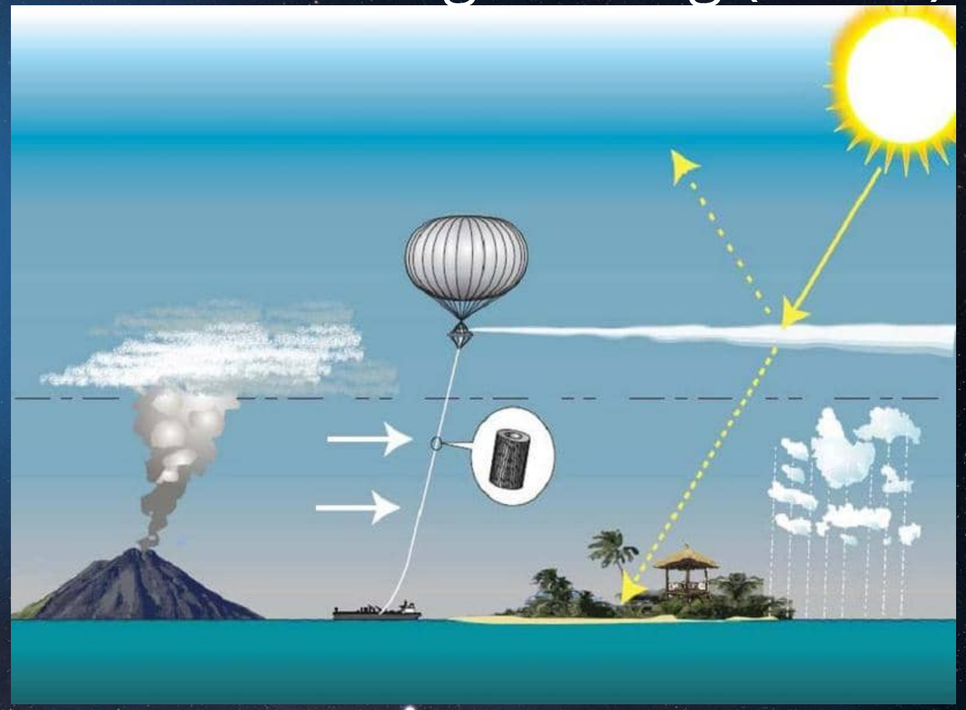
This is interesting.

Could we reduce global warming by putting aerosols in the stratosphere?



Could we reduce global warming by putting aerosols in the stratosphere?

Stratospheric Particle Injection for Climate Engineering (SPICE)



Coastal Atmospheric Aerosol Research and Engagement

THE LEMONADE EXPERIMENT

THE QUESTION

WHAT WILL HAPPEN FIRST ?

WILL THE LIMONADE FREEZE FIRST ?

O

R

WILL THE GAL ESCAPE FIRST ?

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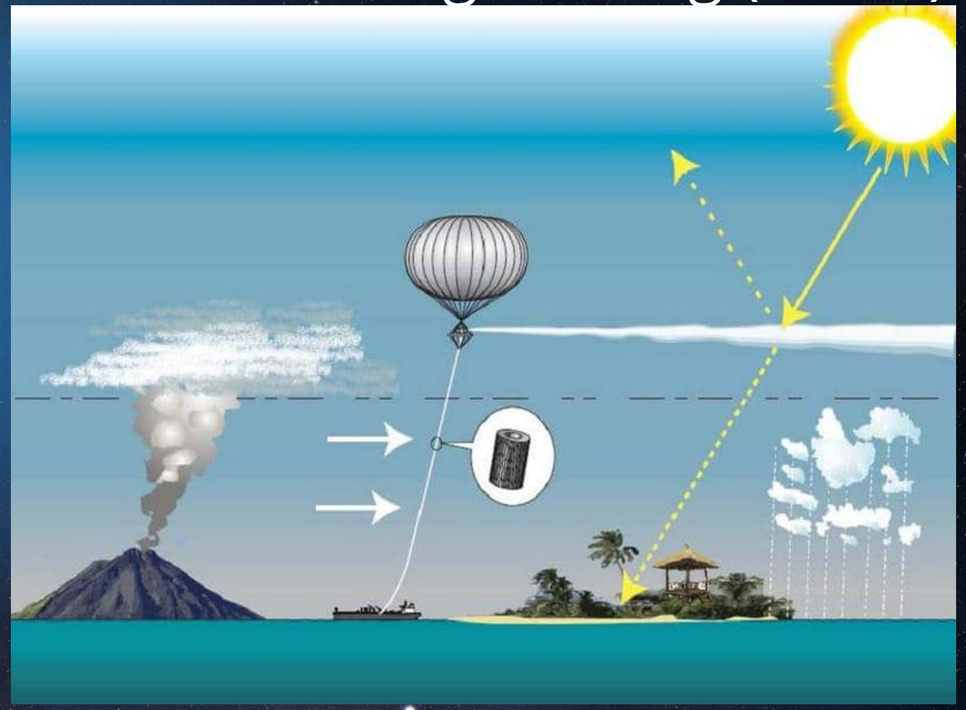
Could we reduce global warming by putting aerosols in the stratosphere?

Stratospheric Particle Injection for Climate Engineering (SPICE)



Coastal Atmospheric Aerosol Research and Engagement

HOWEVER...

Is it ethical?

Is it safe?

Will it really solve global warming?

Is it even possible?

Pollution in space

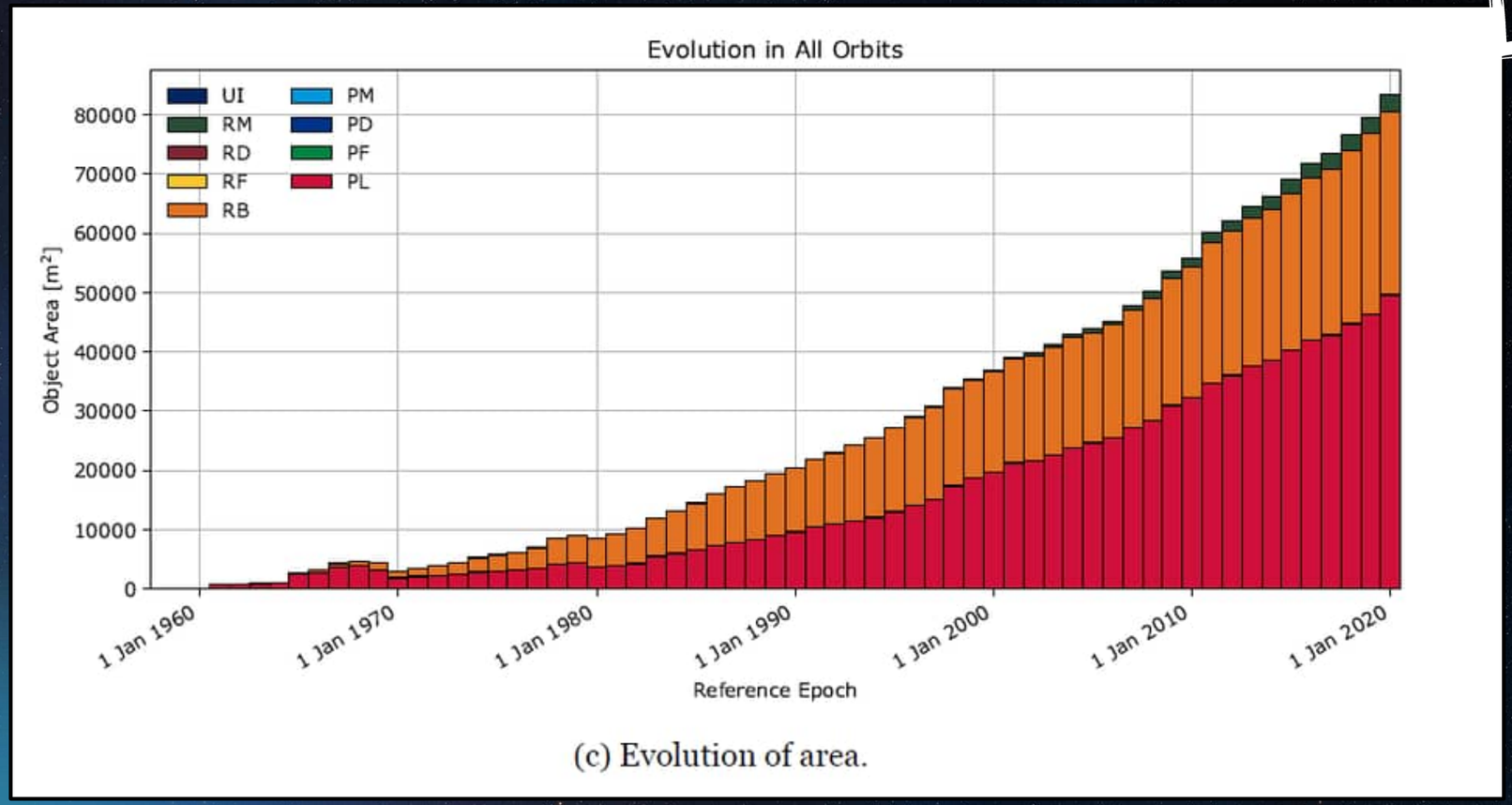
approximately 128 millions pieces of debris
that are larger than 1 mm

around 34,000 pieces of debris
over 10 cm in size

RM= OBJECT LINKED TO A LAUNCH

SATELLITES

RB = LAUNCHERS



(c) Evolution of area.


CSA
ASC

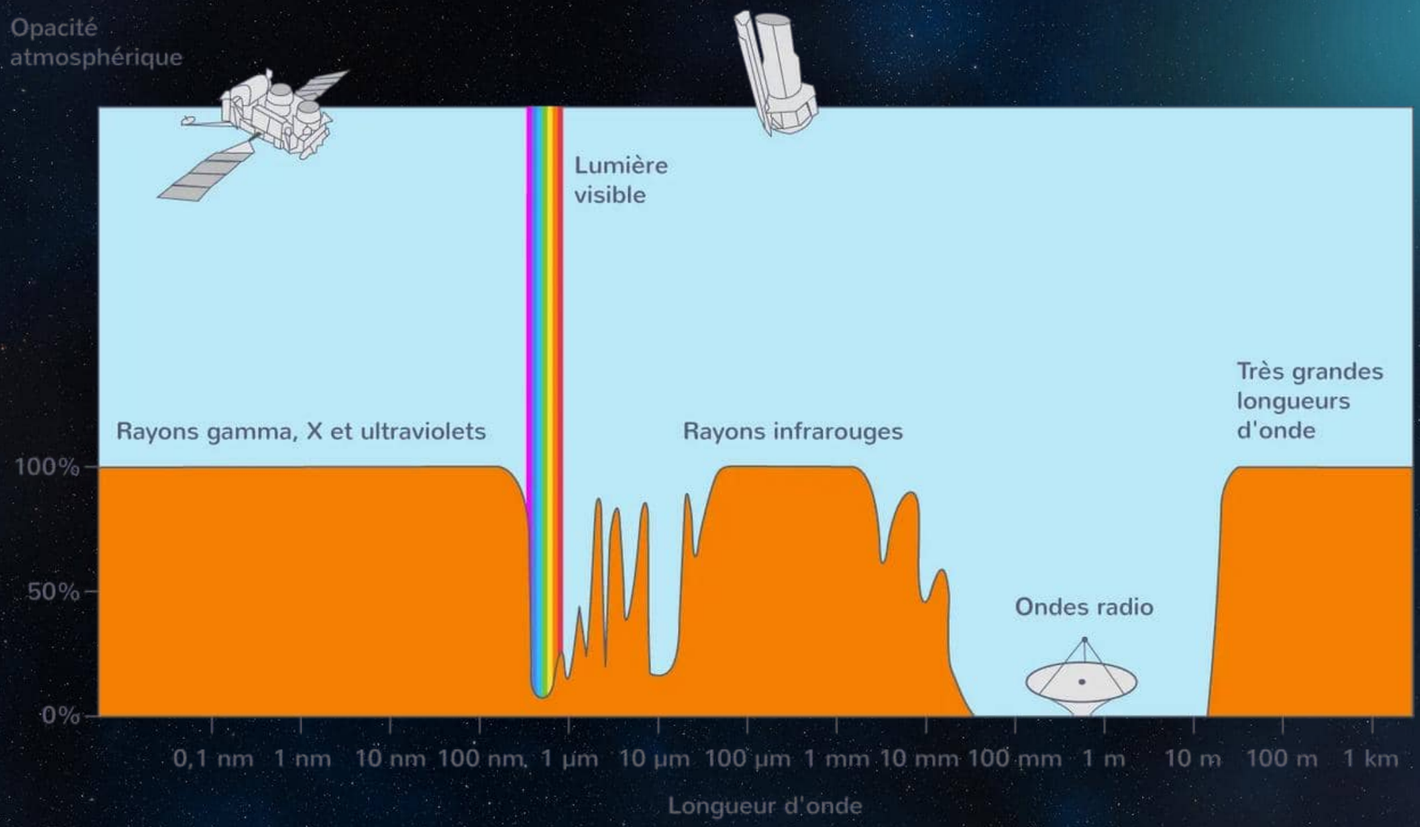
SPACE SOLAR PANNELS

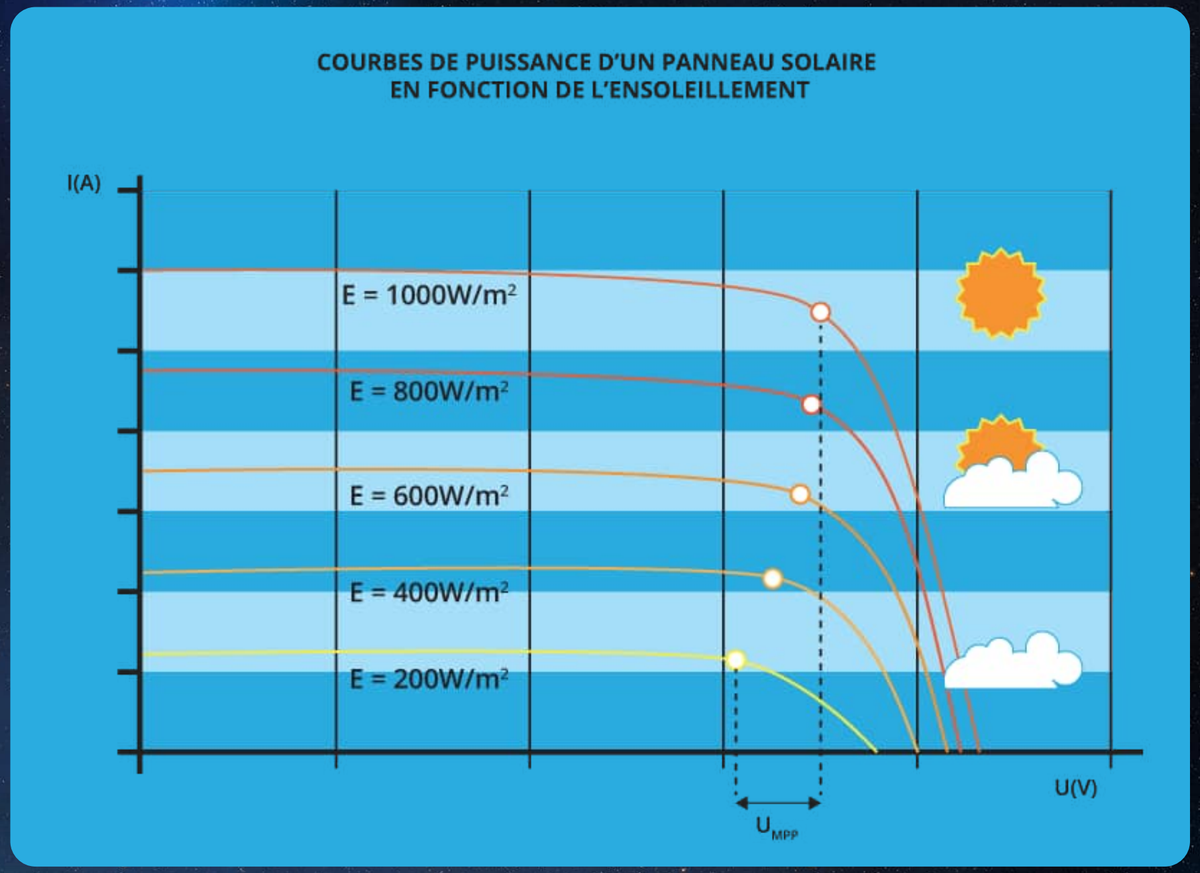

BECKMAN INSTITUTE

SOLAR PANELS OF MORE THAN 1 SQUARE KILOMETER

FARMS A HUNDRED TIMES BIGGER TAHN THE ISS

Energy transfered by micro-waves (between 30cm and 1m)





No obstacles, no clouds, no air

Better efficiency

The Greenhouse Effect

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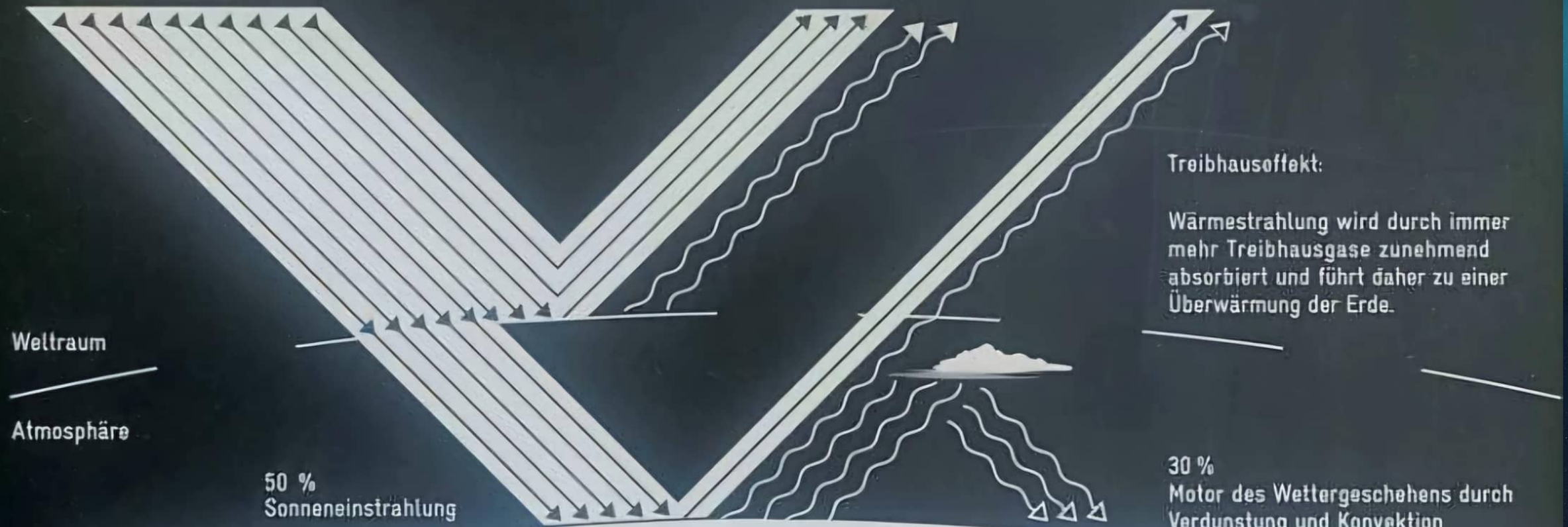


Wärmeabstrahlung der Erde:

Ein Großteil der abgestrahlten Wärmestrahlung wird durch die Wolken und die Treibhausgase am Entweichen in den Weltraum gehindert und als „Gegenstrahlung" wieder zur Erde reflektiert. Das ist auch der Grund, warum nachts bei bedecktem Himmel die Lufttemperatur nur wenig, bei wolkenlosem Himmel jedoch markant absinkt.

The greenhouse gases human activity.

Causes a rise of temperature

These gases absorbing part of the infrared rays emitted by the surface of the planet.

The greenhouse effect are mainly in troposphere, between 0 and 10-15 km altitude

Proportion of greenhouse gas contribution for each gas

- Water vapor: 60%
- Carbon dioxide: 26%
- Ozone: 8%
- Methane and nitrous oxide: 6%

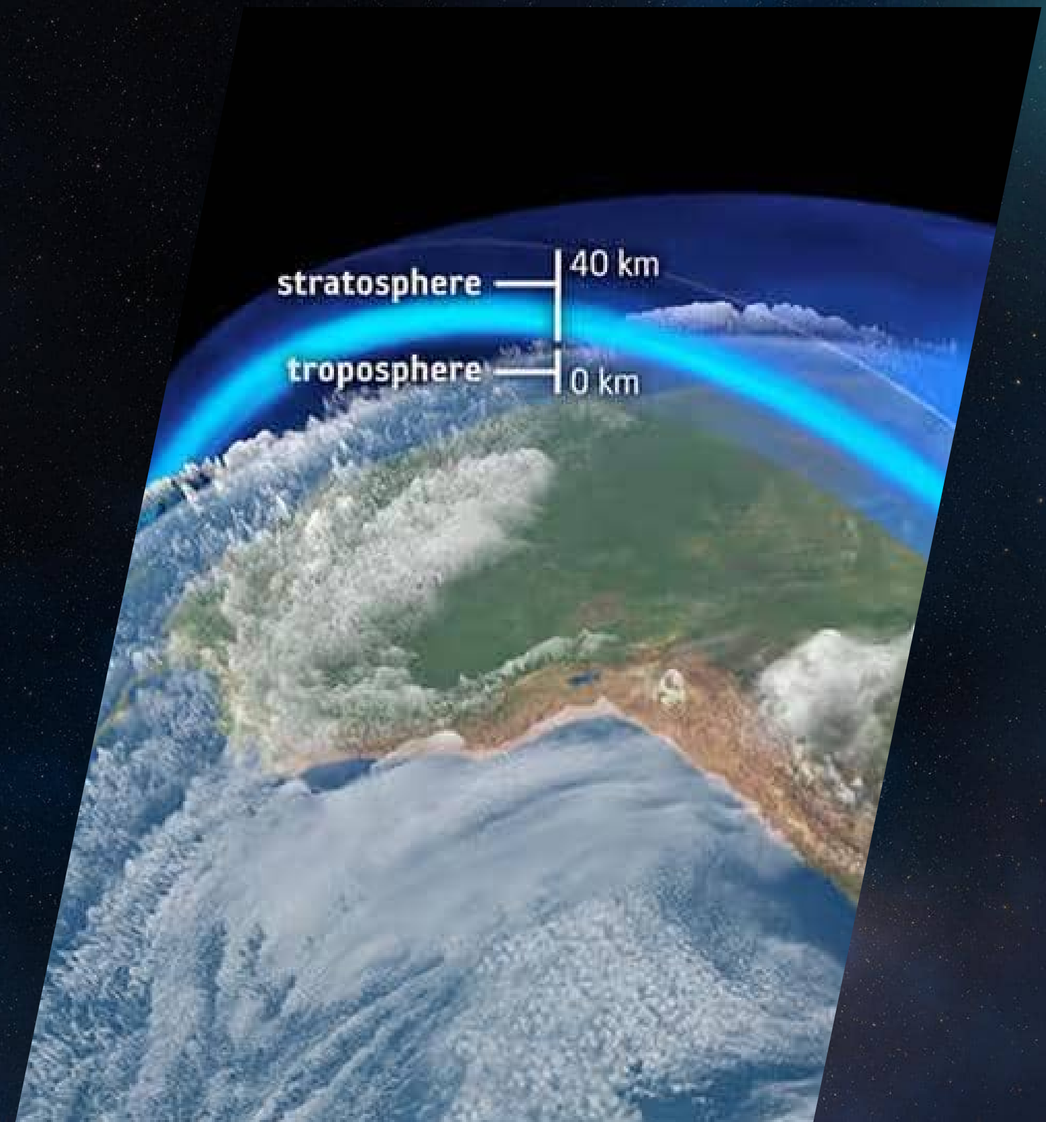
We were unable to find a greenhouse gas curve as a function of altitude, so we might be able to plot this curve using the measurements we will make during the experiment.

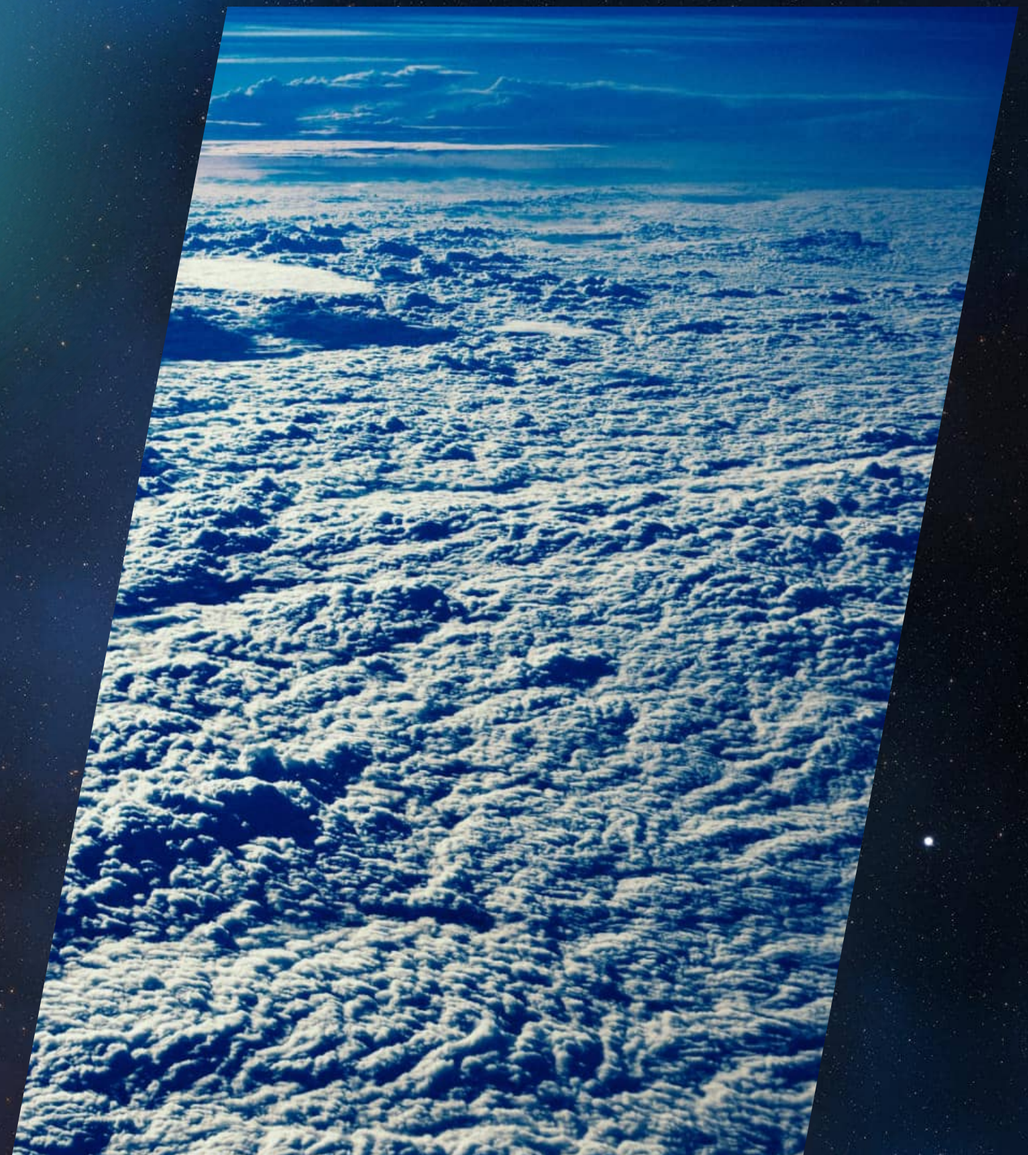
The increase in CO2 reduces frictional forces, which means that satellites have a longer lifespan.

The Ozone Layer

WHAT'S THE OZONE ?

- Ozone (O3): a gas composed of three oxygen atoms
- highly unstable, with oxidizing properties
- essential role: absorption of UV rays





WHAT ARE ITS PROPERTIES?

- Effectively absorbs UVC rays
- Present at an altitude of 25 km (0.0005% concentration)
- Protects the Earth despite its low quantity

WHERE IS IT ?

- Dispersed between 15 and 50 km altitude
- Low concentration but high efficiency

WHY DO WE NEED IT ?

- Magic UV Shield
- Essential for life: protects human health and ecosystems

DANGERS

- Human products (aerosols, refrigerators) = danger
- CFCs release chlorine, which destroys the ozone layer
- environmental impact

WHAT ARE THE SOLUTIONS

- 1985 Global Agreement: 196 countries committed
- CFC reduction = start of ozone layer healing
- 2 million cases of skin cancer prevented each year

At very high altitudes, in the **upper atmosphere**,
the ozone layer protects living organisms
by **absorbing** part of the **UV rays**.

But at **lower altitudes**, where we live and breathe,
it is a **pollutant**
that **irritates** the **eyes** and **respiratory system**,
and is **harmful to vegetation**.

Co-funded by
the European Union

Air pollution can cause **respiratory problems** such as :
asthma and bronchitis.

It can also **aggravate** :
cardiovascular disease and **shorten life** expectancy.

Children, the elderly and people with **pre-existing illnesses**
are particularly **vulnerable**.

Finally, it can also affect the **brain development of children**.

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Carbon monoxide

At least we are measuring CO2

CO

Co-funded by the European Union

The impact of CO on human health

Carbon monoxide is a very **dangerous gas** : you can't see or smell it.

But when you breathe it, it **takes the place** of **oxygen** in **red blood cells**.

World Health Organization

over the **long term,**
CO can cause :

- asthma,
- cardiovascular disease,
- chronic obstructive pulmonary disease
  (3 million deaths/year)
- premature death.

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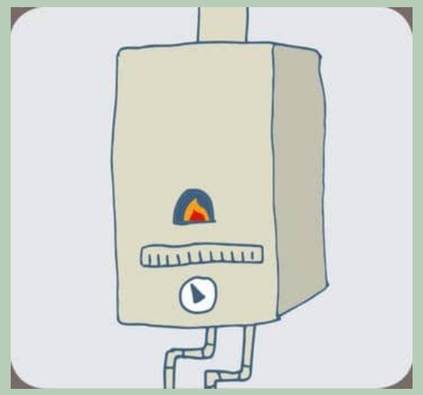
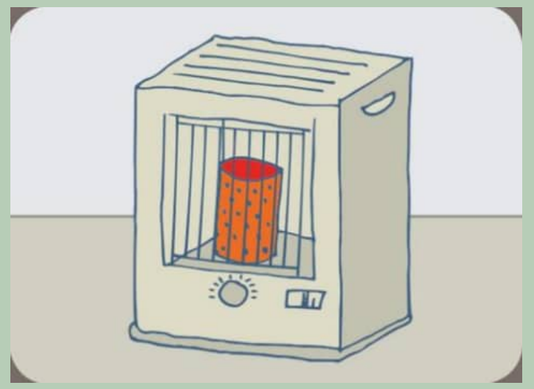
Where it comes from ?

This gas comes from **heating or cooking equipment**
that run on **gas**, **wood**, **coal**, **gasoline**, **fuel oil** or **ethanol**.
This gas does not come from electrical equipment.
These equipment can produce carbon monoxide when there are an **incomplet combustion** :

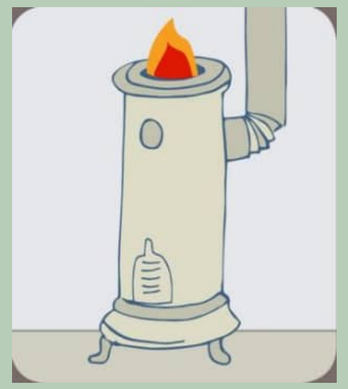
stove



boiler and water heater



non-electric auxiliary heating



fireplace

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It can also be found outside

The biggest **sources of carbon monoxide** in outdoor environments are **road traffic** with combustion vehicles and engines, power stations, **forest fires** and **residential heating**, especially wood-burning.

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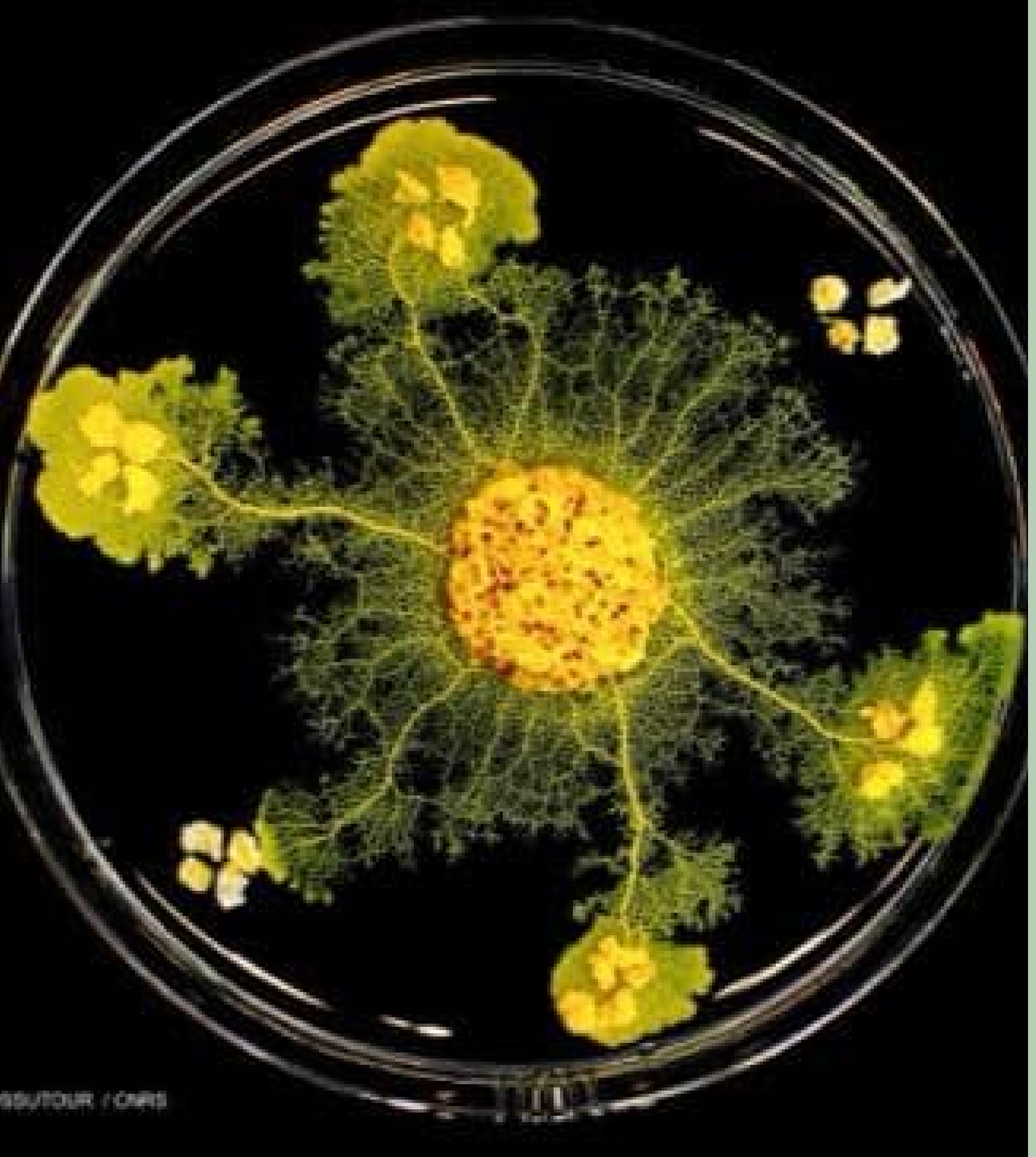

Reminder

- It’s a living creature in a shape of a yellow moss wich is living in the forest.
- It’ an unicellular but multinucleated organism.
- It has the capacity of movement, leaning, memorazing and regeneration.
- It is near-immortality.

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Role of the Blob in ecosystems

<u>Ecological indicator</u> :
Present in humid and forest environments,
it can be used to monitor soil quality
and the impact of climate change.

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Impact on the reservation of ecosystems

- By **better understanding** the interactions between these organisms and their environment, we can refine OUR **conservation strategies for forest and wetland ecosystems**.
- Because CO makes **rain acidic, attacking forests**

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Our conclusion

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Impact of air pollution

When **air pollution increases**, so do **illnesses**, and they get worse.

If **WE CHANGE** our behavior towards air pollution, there's **hope** for us all !!!

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So LET'S CHANGE our behavior to improve our QUALITY OF LIFE, our health and that of future generations !

YES WE CAN

!!!

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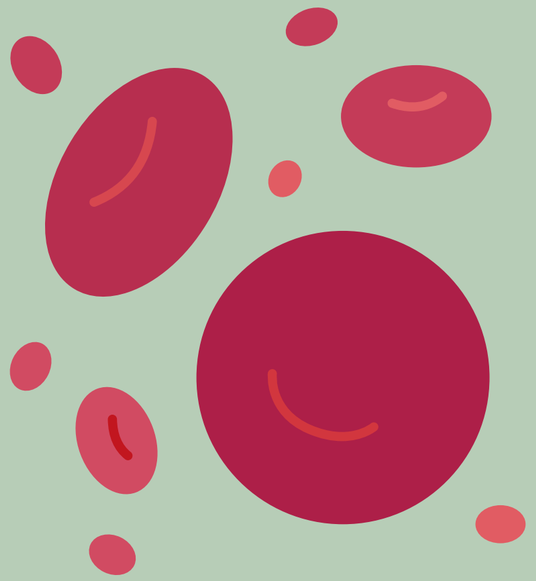
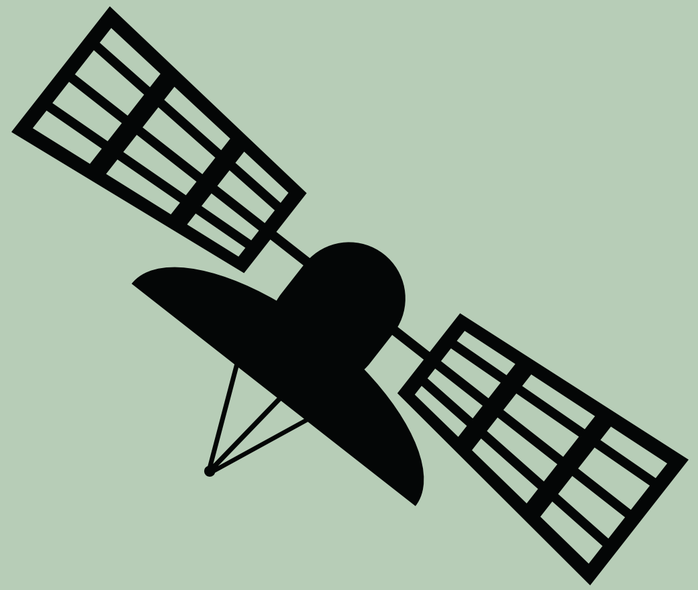
Please download kahoot for the quiz





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