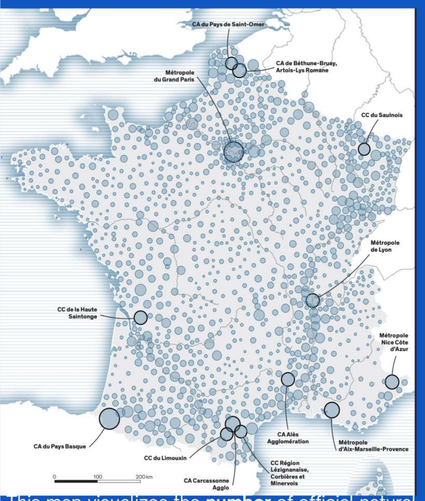
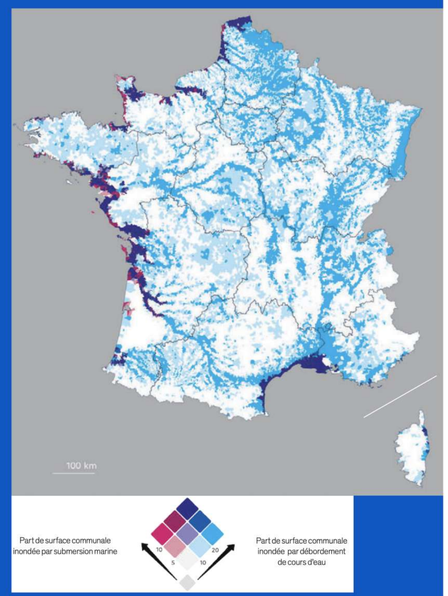
Cité Scolaire Bernard Palissy -- Saint Léonard de Noblat

CanSentinel : predict and prevent flooding

Flooding is France's top risk—two maps tell the story:





This map visualizes the **number** of official natural disaster declarations due to **flooding between 1982 and 2024**.

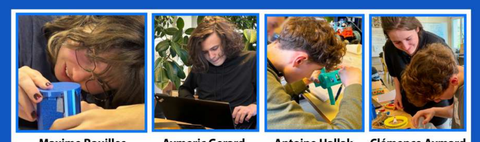
source : Gaspar database of the General Directorate for Risk Prevention (DGPR)

Flooding is the primary natural risk in metropolitan France and overseas territories. [1]

Crucially, due to climate change, surface runoff, river overflow, coastal submersion, and rising groundwater can combine and worsen each other's effects. Understanding their causes and origins is essential to predict, prevent, and manage these events.

and our Cansat can help !

Meet the Team :



Maxime Rouilles — Project Manager, Physical studies
Aymeric Gerard — Code design, Electronics
Antoine Hallak — Code design, Electronics
Clémence Aymard — 3D Design, Prototyping

EDF | ensil-ensci ÉCOLE D'INGÉNIEURS DE LIMOGES | RÉPUBLIQUE FRANÇAISE Liberté Égalité Fraternité | Cité scolaire Bernard Palissy Saint-Léonard-de-Noblat

mentors : Julien Py / Julien Péaud

Introduction

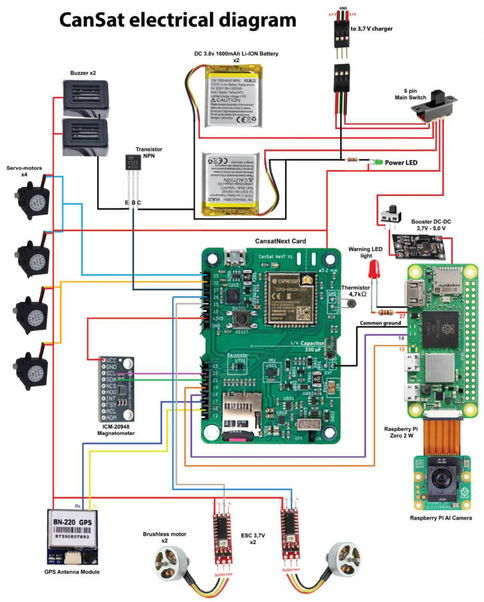
Flooding is a major concern in Limousin, sparking local legends like:

"If the Bort-les-Orgues dam breaks, Bordeaux will be underwater." To design a CanSat addressing this local risk, **we consulted EDF Hydro CENTRE to understand flood management.**

We also sought technical guidance from engineering students and professors **at ENSIL-ENSCI** in Limoges to ensure our project's relevance.

Research Question

How can a CanSat contribute to flood risk management by improving hazard forecasting (predicting storms, flash floods) and damage prevention (AI-assisted human detection in danger zones)?



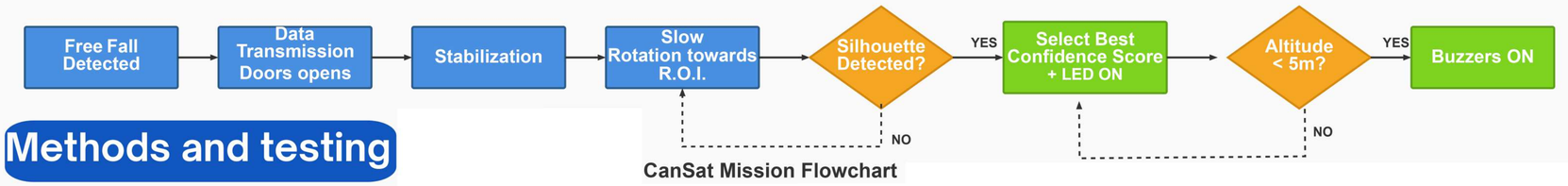
Conclusion

Limitations & Failure Risks

Our mission requires many conditions to align at the same time. Detection only works below ~10 m, GPS may not get a fix in time, and motor interference can disturb the magnetometer. The UART link has no error correction. **Building graceful degradation for each subsystem was a major challenge. We also found that our motors had unequal thrust, so we designed a dedicated calibration experiment** (see Methods).

Expected Results

Our CanSat will produce: annotated photos of detected persons, a GPS descent track shown on a map, and sensor graphs over time. **These will help us evaluate detection, navigation, flood risk and fallback behavior.** ENSIL feedback was integrated, but our resources limited the quality of the imaging sensor. With better optics, filters system and more sensors **this system could become a Cévenol flood-monitoring station as well as a dam safety equipement**

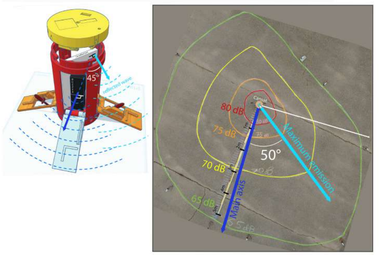


CanSat Mission Flowchart

Methods and testing

Imaging/AI: Pi Zero + 12.3MP IMX500 for AI detection[2] and target identification.
The camera performs relatively well, even in poor lighting**, as tested on our comrades, clearly too close to the dam.**

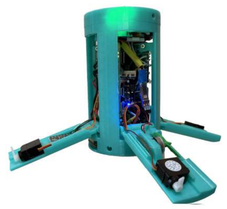
Recovery/Comms: Low-altitude buzzers testing : **65dB at 5 m**



Level	GPS	Mag.	Gyro	Behaviour
3	✅	✅	✅	Heading towards R.O.I. zone + person detection + full environemental data logging and imagery
2	❌	✅	✅	Magnetic North heading + person detection + full environemental data logging
1	❌	❌	✅	Spin braking + person detection + full environemental data logging and imagery
0	❌	❌	❌	Passive logging only: full environemental data logging and imagery

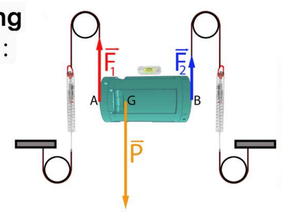
Degradation matrix : levels (3 to 0) ensuring continuous operation from active tracking to a passive fail-safe.

Meet our Cansat :
This year, we also **focused on improving the CanSat design.**



Stabilization tracking and NTC testing[3] :

Location of the center of gravity G

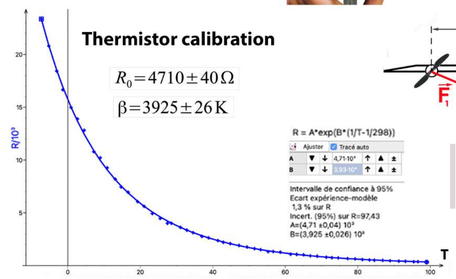


$$AG = \frac{AB}{1 + \frac{F_1}{F_2}}$$

$F_1 = 1{,}75\,N$; $F_2 = 1{,}20\,N$;

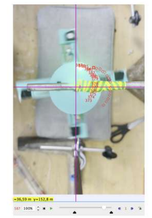
$AG = 4{,}7\,cm$

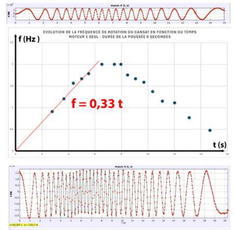
Thermistor calibration



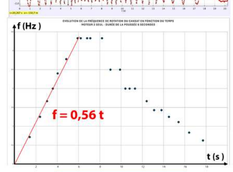
$$R_0 = 4710 \pm 40\,\Omega$$
$$\beta = 3925 \pm 26\,K$$

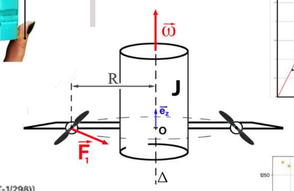
Evaluation of the compensation coefficient between motor thrust forces



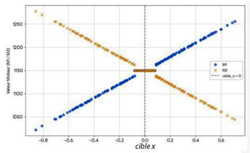


$$f = \frac{R\,F_1}{2\pi J_\Delta} \times t = k\,F_1 \times t$$



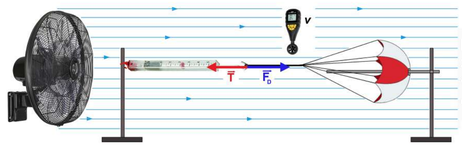


$$F_2 = \frac{0{,}56}{0{,}33} F_1 = 1{,}7\,F_1$$



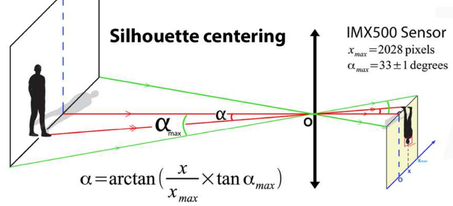
Velocity of M1 and M2 vs. R.O.I deviation along the x-axis.

Parachute



Preliminary parachute diameter calculations for a 300g CanSat at target descent velocity yield a value of 37.4 cm. This calculation assumes a drag coefficient (Cd) of 0.75. Wind tunnel testing is scheduled to refine this Cd value.

Silhouette centering



References

[1] https://www.ign.fr/publications-de-l-ign/institut/kiosque/publications/atlas_anthropocene/2025/Atlas-2025-risque-inondation.pdf
[2] https://developer.aitrios.sony-semicon.com/en/docs?tab=raspberry-pi-ai-camera
[3] https://github.com/netnspace/CanSatNeXT_library
[4]https://www.meteosuisse.admin.ch/portrait/meteosuisse-blog/fr/2023/06/temperaturedeclenchement.html