TERRA FORMA

TERRA FORMA – 2021-2029



Our places of living = complex system



Our places of living = complex system

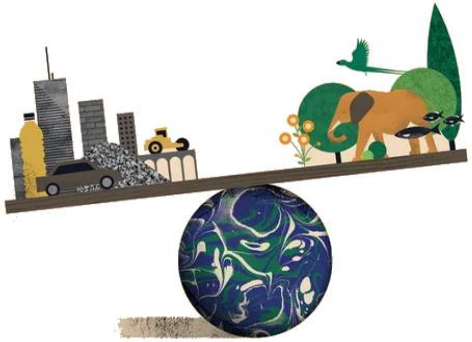


An ecosystem is a volume with hotspots and hot moments

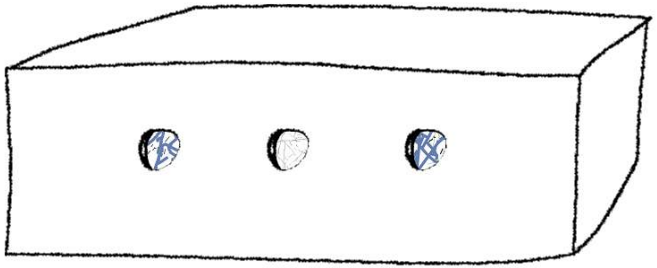


Strong interactions between water, gaz, matter … and living

Our places of living = complex system

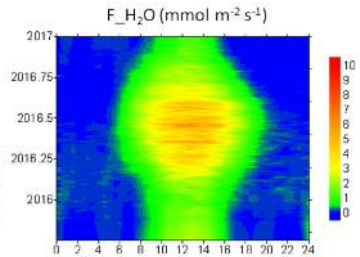


Scientific American, December 9, 2020

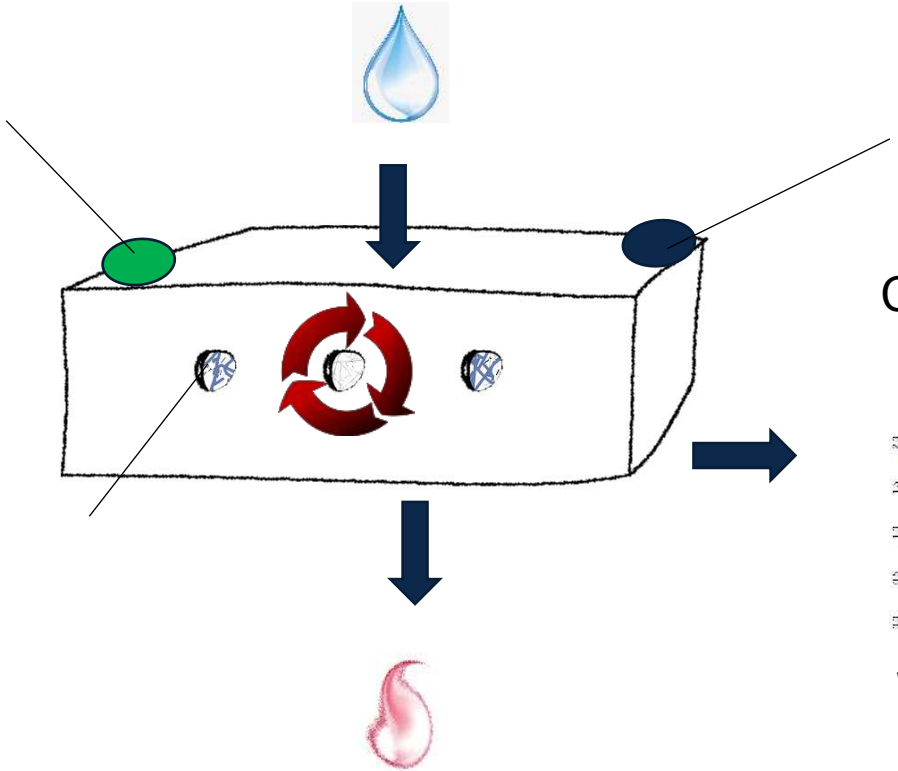


The habitable Earth is inside

Our places of living = complex system
How to track emerging signals ?



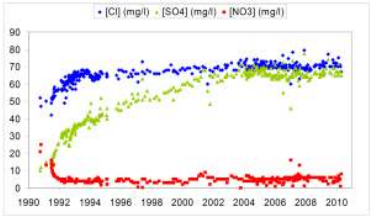
Evapotranspiration

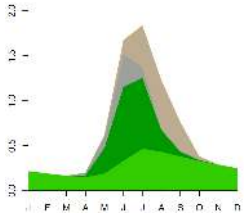




Cyanobacteria blooms

Water quality





Water quantity

TERRA FORMA
Re-questionning instrumental needs

Existing Research Infrastructures

DATA TERRA
eosc

OZCAR
Zones Ateliers
eLTER
LabEx DRIIHM
ILICO

Big Scientific questions

Solubiod
OneWater Eau Bien Commun
FORESTT
FairCarboN
PROGRAMME PRIORITAIRE DE RECHERCHE OCEAN & CLIMAT
FRANCE PROGRAMME DE RECHERCHE VILLE DURABLE
PREZODE
Bridges
TRACCS
Outremer

Same challenge for public

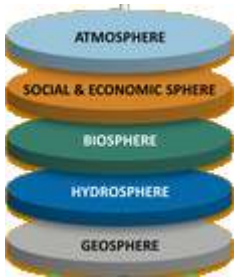
GREC SUD
Les Parcs nationaux de France
G.A.G.T
OFB
eau du Grand Lyon
LORIENT
EDF
UNESCO
FABLAB





Needs

Value Chain



TERRA FORMA

Context of evolution of research infrastructures to handle new research questions

Augment observation systems for habitability challenges

Define the scope of new technologies and approaches (IoT, low-tech, open, ...)

Instrumentation

RTCE

Information and engineering sciences

TERRA FORMA

TERRA FORMA : a standard platform une plateforme standardisée pour les enjeux de territoires

Propose a new paradigm for in-situ (operational) observation strategies

- Augment existing observatories
  - New sensors adapted to our needs
  - Data infrastructures handling highly distributed heterogeneous sensor networks
  - « social » infrastructure with participatory science
- Sustain operational data production
  - Data pipelines for ingestion and processing
  - OGC-based data standardisation
- Professionnal practice transformation and harmonization to ttransform research (quality, **open science/hardware**, FAIR principles) and interactions with non-academic partners

19 part.

dont 3 organismes de recherche,
15 universités et 1 entreprise

~160

45 labos

78 FTE « enviroment »
60 FTE « technology »
7 CNRS institutes out of 10

9.6 M€

Total cost 39.5 M€

cnrs INRAE IRD MINES ParisTech IPGP + Univ.

TERRA FORMA

TF : A platform of sensors
24 research products

Usual variables for aquatic ecosystems (température, E conductivity, Active radiation, turbidity, Chlorophyll, O_2)



~ 10 000 €
robust, proprietary

Industrial systems and reglementary operations (large scale)



~ 300 €
Open source, reproductible, réparable
community-based, adaptable

local / territorial monitoring
(research, watch, alert)

TF : A platform of sensors
24 research products

Compartiment	Produit de recherche
Air	AURORA
Air	CamHSP
Air	POPCORN
Biodiv	Audioanalyzer
Biodiv	Audio-logger
Biodiv	Biomove
Biodiv	E-Cage
Biodiv	Ecoeye-mini
Biodiv	Entomoscope
Biodiv	GPS LoRA
Eau	Biosampler
Eau	HydroScannR
Eau	Lab on a chip
Eau	MILS-CO2
Eau	MILS-N2O
Eau	MIMS miniRUEDI
Eau	Sonde CO4
Eau	Sonde MOD
Eau	Sonde MP
Eau	THOE Smart
Eau	TRACESENSE
Sol	CFGS
Sol	Hymenet
Sol	SQWA-SIP

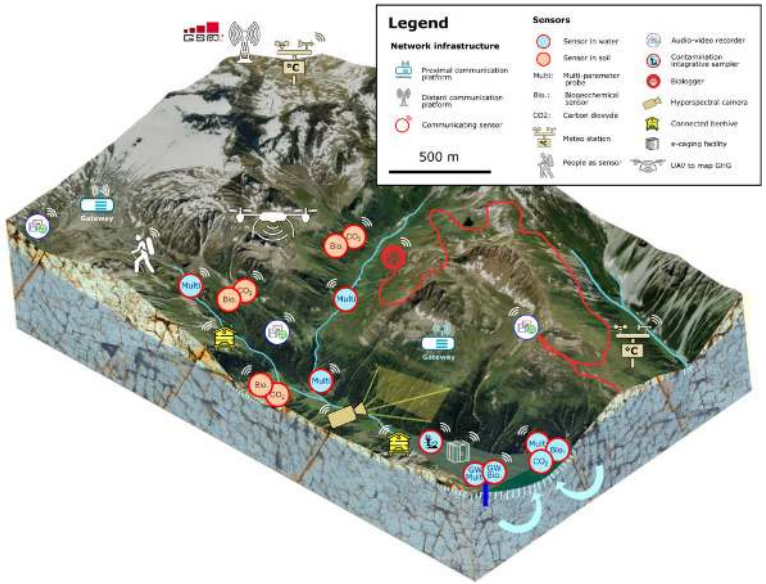




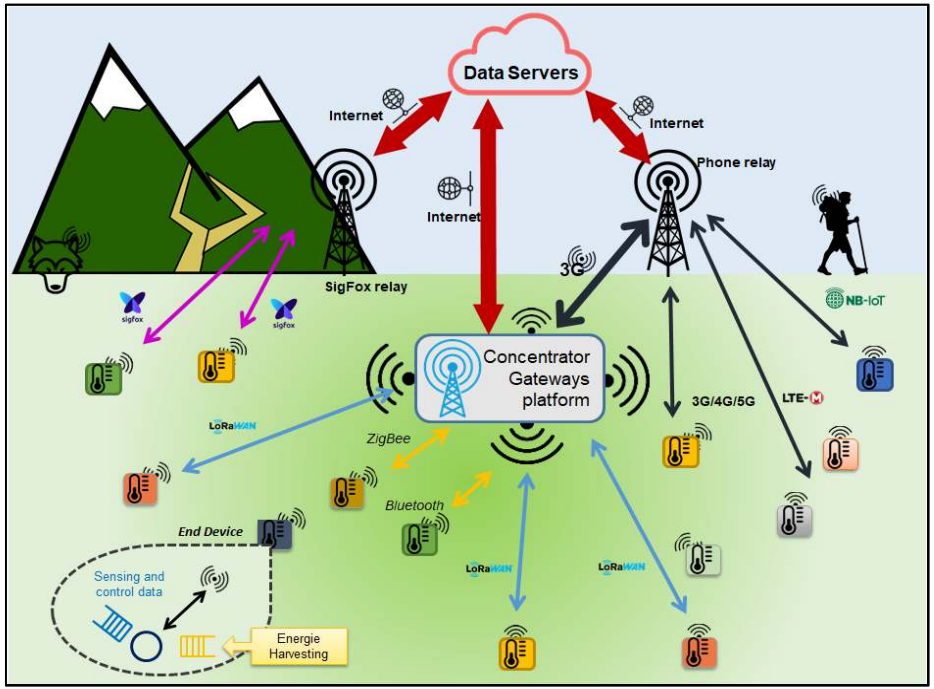
Catalogue of instruments - Version 1 en FR et EN - https://terra-forma-web.osug.fr/Catalogue-des-instruments

- Rising TRL from 4 to 7 with an infrastructure of sites with strategy (test, fail and improve). Interdiscplinarity as a vector for innovation.
- Focus on transformational impact : e.g. cost reduction by a factor 20, size reduction ...

TF : A platform of services
5 services



Highly distributed sensor networks
Low data rate
Renewable energy sources



IoT-based services on sensor - data value chain

TF : A platform of services
5 services

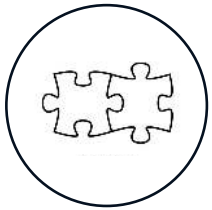
Sites



Operations and assistance

Dev. Edge Computing

IoT



LoRaWAN (Chirpstack)

Dev multi-protocol

Fluxes

SaaS



NodeRED as a Service

Decoding and enrichmentt

Standards

Data

SaaS



Files

Elastic Suite

PostgreSQL

Données

SaaS PaaS



API S3

SensorThings Portal

Jupyter Lab

Deployment @sites

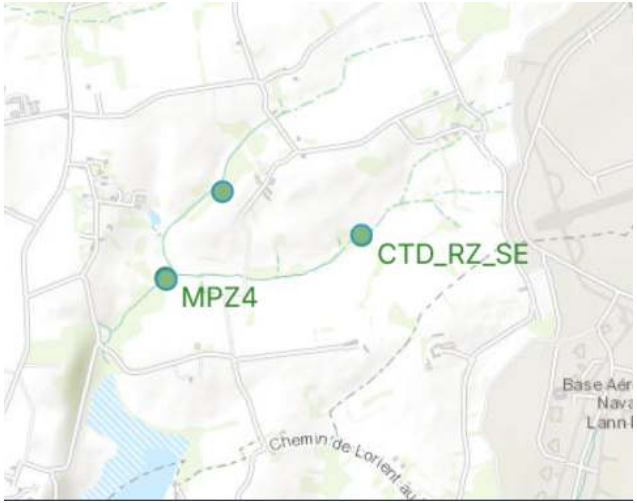
Collect @PULSE*

Ingestion @CEBA*

Exploitation @CEBA*

TF : A platform of services
5 services

https://data.ceba.uca.fr/public-dashboards/5baab3e3963443959461bfe9bfcb25ed?from=now-40d&to=now&timezone=browser





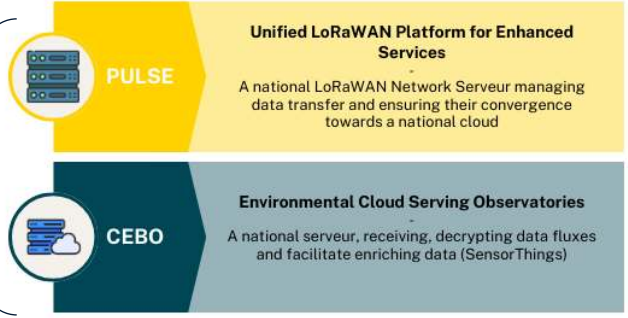
TF : A platform of services
5 services

INSTRUMENTATION –
design & duplication



Adapt with a library of existing (open) solutions

DATA FLUXES –
transmission & enrichment



Plug your sensor & observe

Produce documented data

EXPERIMENTATION –
instruments &
partnership



Share « Big » insturments with expertise

Support participatory sciences with metrological practices

TERRA FORMA

TF : A platform of sites
28 sites

	Sites
1	Bassin versant de l'Orgeval / ORACLE / ZAS
2	Domaine de Belval-Bois-des-Dames / ZARG
3	Forêt de la Massane
4	Hāmani fenua
5	Plateforme de Recherche de Crépieux-Charmy
6	Station les Nouragues
7	Tournière de Frasne
8	Valescure / OHMCV
9	ZACAM
10	Zone Humide de Rophin / ZATU
11	Bassin Versant Rivière du Sud et Embouchures / ZATA
12	GISFI et Liecoscope
13	Ruisseaux forestiers lorrasin de tete de bassin / ZAM
14	Marais Poitevein
15	Galabre / SNO Draix-Bleone
16	SNO Tourbière - La Guette
17	SNO Tourbière - Landemarais
18	SNO Tourbière - Bernadouze
19	SNO OHMCV - Olivier de Serre
20	SNO OHMCV - Mont-Lozère
21	SNO HYBAM - Site Belém (estuaire amazone)
22	SNO HYBAM - Station Rurrenabaque
23	SNO HYBAM - Station San Regis
24	SNO HYBAM - Station Manacapuru
25	ZA Environnementale Urbaine
26	ZA Hwangue



Lautaret-Oisans



Auradé



Guidel-Ploemeur







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Laboratoires impliqués : CARRTEL, CEBC, CEFE, Centre de Géosciences, CERFE, CESBIO, Chrono-environnement, CRAL, CReSTIC, DT-INSU, Dynafor, ECOBIO, EVS, GET, GR, GSMA, HABITER, IGE, IM2NP, IPAG, IPGP, IRISA, IRIT, ISM, ISTO, ITES, Jardin du Lautaret, LAAS, LCA, LECA, LEFE, LEMAR, LHYGES, LIG, LIRMM, LMGE, LPC, LRGP, LIS, OMP, OSUG, RiverLy, SAS, SEBIO, SETE, Subatech.

Tutelles et partenaires non académiques : CNRS : INSU, INEE, INSIS, IN2P3, INP, INS2I, INSHS, INSB. **Autres organismes de recherche** : IRD, INRAE, IPGP. **Ecole d'ingénieur** : Mines ParisTech. **Universités** : Grenoble, Savoie-Mont-Blanc, Toulouse et Toulouse INP, Rennes, Clermont-Auvergne, Montpellier, Reims, Toulon, Franche Comté, Orléans, Strasbourg, Aix Marseille, Le Havre Normandie. **PME** : Extralab

Soutiens : CNES, OFB, BRGM, Agence de l'eau Loire Bretagne, Réseau RECOTOX, l'observatoire du sol vivant, Institut Carnot Eau & Environnement, Groupes Régionaux des experts du climat, Régions, Offices régionales de la biodiversité, Fondation François Sommer

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terra-forma.cnrs.fr

anr agence nationale de la recherche

INVESTIR L'AVENIR

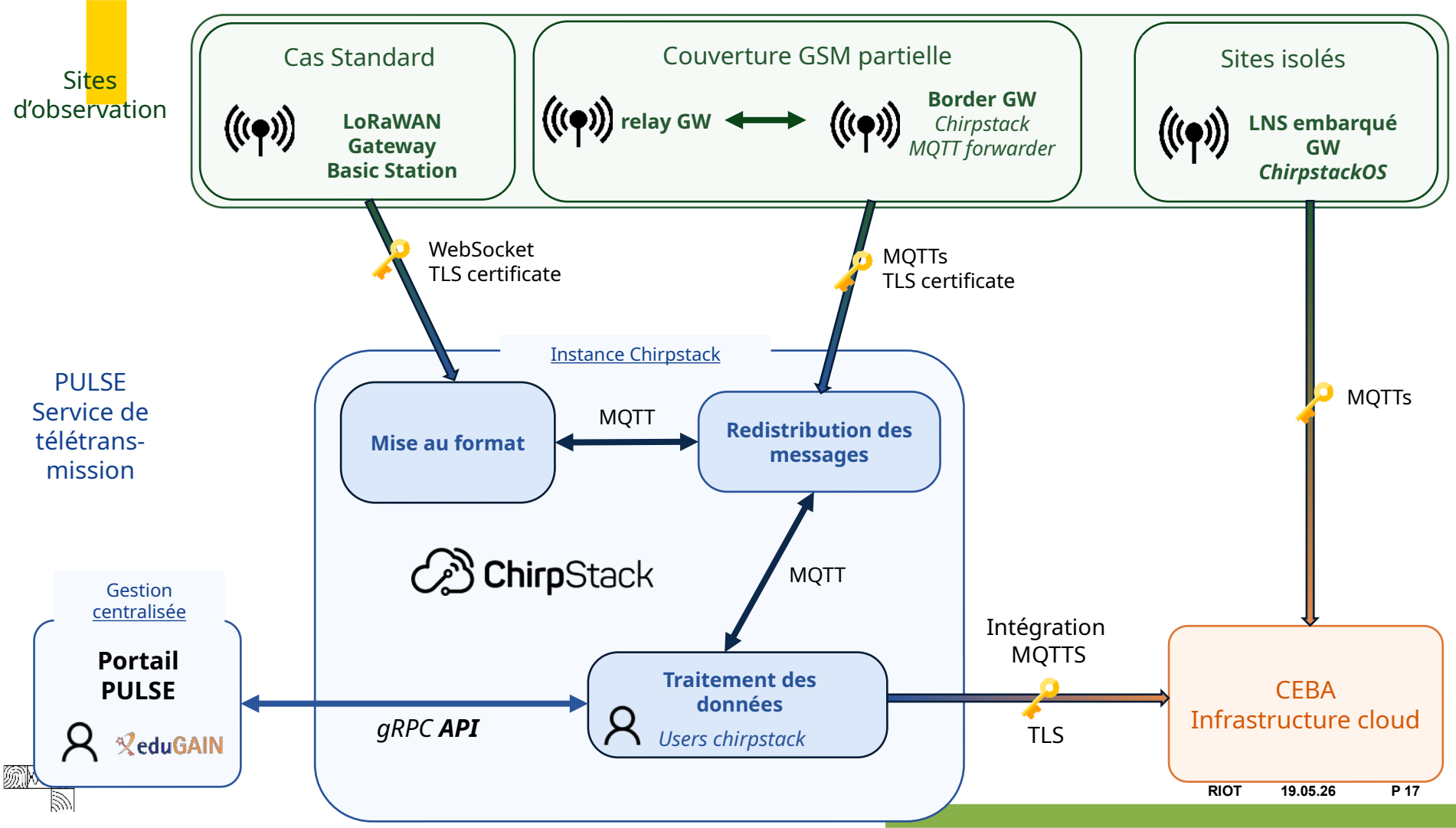
ANR-21-ESRE-0014

TERRA FORMA

cnrs

OZCAR

ZA Zones Ateliers LTSER FRANCE


Sites d'observation
Cas Standard
LoRaWAN Gateway Basic Station
Couverture GSM partielle
relay GW
Border GW
Chirpstack
MQTT forwarder
Sites isolés
LNS embarqué GW
ChirpstackOS
WebSocket TLS certificate
MQTTs TLS certificate
MQTTs
PULSE Service de télétrans-mission
Instance Chirpstack
Mise au format
MQTT
Redistribution des messages
ChirpStack
MQTT
Gestion centralisée
Portail PULSE
eduGAIN
gRPC API
Traitement des données
Users chirpstack
Intégration MQTTS
TLS
CEBA Infrastructure cloud

Terrain





Métadonnées

Flux

Thésaurus THEIA

Vocabulaire : variables, capteurs, contexte

Voc. Variables, contexte

Portail SensorThings

Point d'entrée principal
Déclaration des déploiements : site, capteur, variable

DevEUI

PULSE
Gestion de la télétransmission, remontée des données d'observation

Vocabulaire capteur

Référence

Enrichissement

CEBA
Gestion des flux, enrichissement, curation, qualification, outils métiers, visualisation, mise à disposition

Catalogue instruments existants

Spécifications, constru…, REX …



Base de données capteurs in-situ

Capteur déclaré

Opérations : Données manuelles

Contexte - > qualité

Flux qualifié et



Fiche de vie capteur

Suivi, statut, contrôle, étalonnage

SI / entrepôts
Moissonnage, données FAIR

Données
Métadonnées
Contexte / contrôle
API
En développement

FORMA