THALES
Building a future we can all trust

Comment valoriser les données massives satellites et météo pour répondre aux enjeux de risques environnementaux ?

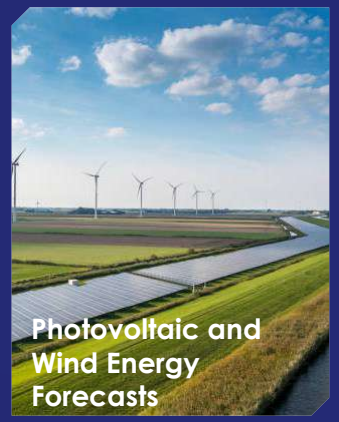
11 juin 2026

Thales Services Numériques

www.thalesgroup.com

Agile solution for the integration, management, and efficient use of combined weather and environmental data

> Accelerate the development and optimisation of environmental risk management applications by combining machine learning, weather data, and satellite observations



DHEMETER

Data **H**ub for **E**nvironmental and **METE**orological **R**esources

https://github.com/thalesgroup/dhemeter

Why DHEMETER?
Key challenges in environmental data management

> Access & Variety

- Wide range of data needed: meteorological, oceanographic, hydrological, and spatial (multi-sensor)
- Diversity of data providers and formats

> Data retrieval challenges

- Complexity of registration, authentication, and retrieval procedures
- Questions about retrieving specific data and crafting queries

> Management of multi-source retrieval

- Needs for concatenation with spatial/temporal interpolations
- Selection of study areas
- Use of a common storage format

Data Hub for Environmental and METEorological Resources

A **data aggregation** service centred around **physical synchronisation** and file **format standardisation** for **observation** (**satellite and in-situ**) and **forecast weather data**

INPUT DATA

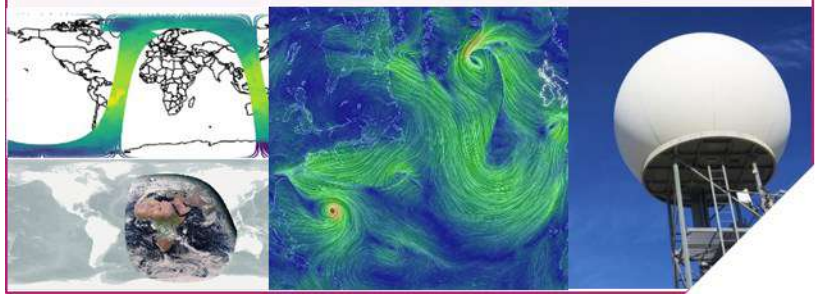
Weather Products
More than 10 international data sources

Satellite observation

In-situ observation

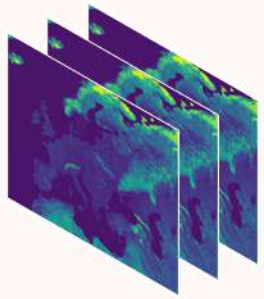
Forecast & Re-analysis (historical data)

EUMETSAT · Copernicus · ECMWF · DWD · NOAA · METEO FRANCE



PROCESSING

- Complete Workflows
  - **Data source selection**
  - **Variables selection**
  - **Data sources' combination**

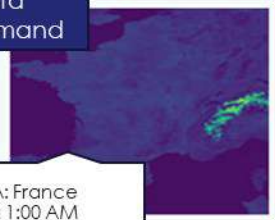


OPTIONNAL

- **Geographical focus**
- **Data tailoring**
  - **Customized interpolation**
  - **Dynamic Downscaling Method**

WRF Weather Research & Forecasting

Data on-demand

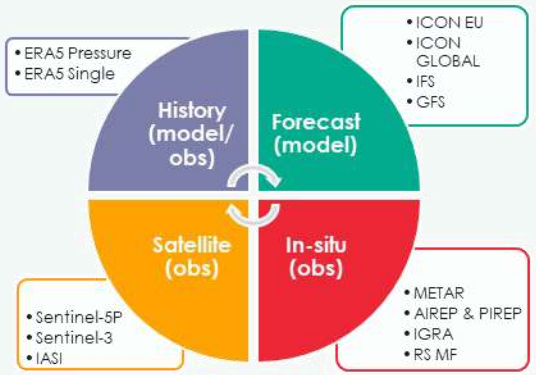


AREA: France
TIME: 1:00 AM
RESOLUTION: 0.25°

OUTPUT

- Weather Products with :
  - Physical **Synchronisation**
  - File format **Standardisation**
- 1 API for >10 data sources

netCDF



API integration for end-users

OPTIONNAL

- **Adaptation of the output format to visualisation needs**

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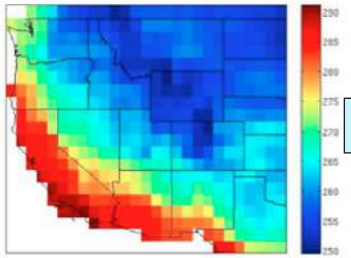
High resolution zoom

- Global Weather data:
  - GFS
  - IFS
  - ICON EU

Initial meteorological forecast
Spatial $\sim 2\ km$ – temporal $\sim 1h$

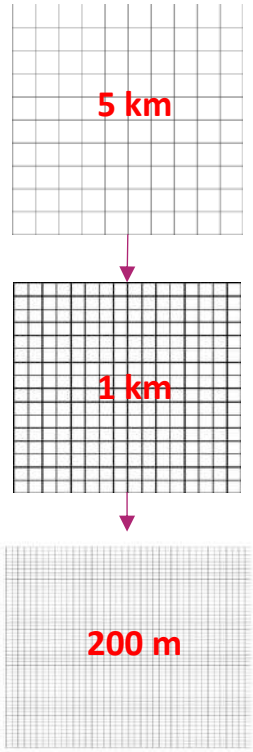


netCDF

INPUT

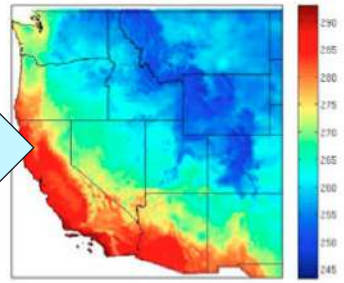
Dynamical downscaling

WRF Weather Research & Forecasting



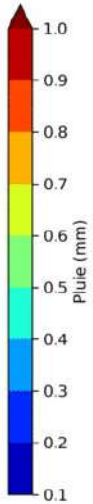
OUTPUT

Final resolution
Spatial $\sim 200\ m$ – temporal $\sim 10\ min$



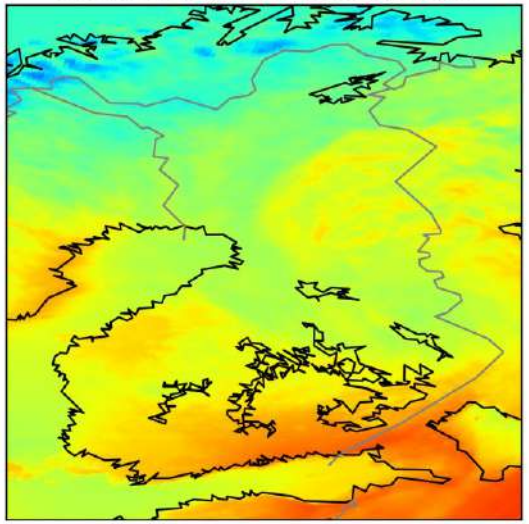
netCDF

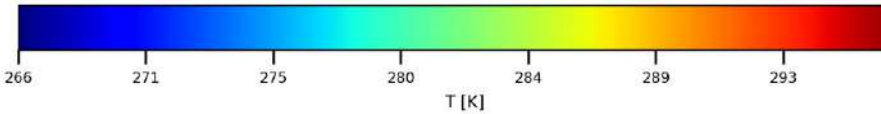
Precip between 11 and 12 Jan 2016



WRF: Examples of meteorological modelling

Temperature every hour from 9:00a.m. on 2021-06-15 in **Finland**





DHEMETER : la data météo au service du climat et de la protection des sociétés

Automatiser, fiabiliser et valoriser la météo locale

> Rôle de DHEMETER

- Un **agrégateur de données météo** qui joue le rôle **de chef d'orchestre** entre :
  - prévisions **globales**,
  - **données d'observation** (satellites, terrain, capteurs in situ)
- Objectif : transformer un flux hétérogène de données en décisions opérationnelles

> Ce que fait concrètement la solution

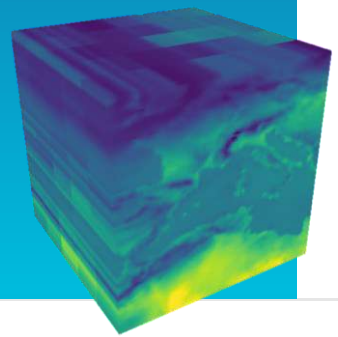
- **Automatise** la chaîne de traitement de bout en bout (du global au local)
- Intègre une **validation** systématique : comparaison aux mesures terrain, métriques de performance, …
- Fournit des données via des **API standardisées**, prêtes à intégrer dans les systèmes métiers des clients
- Se déploie en **Cloud**, selon les besoins

> Pour les utilisateurs

- Réduction des coûts opérationnels grâce à l'automatisation,
- Intégration facilitée dans les systèmes d'aide à la décision

Key Points

- Single API
- Uniform request format
- No limit on variables per request
- Aggregate the most relevant multi-source variables into a single, easily exploitable file
- Ensure maximum data availability
- Adjust spatial grids for better coherence
- Perform spatial interpolations for coherent data
- Select data based on space and time
- Obtain a global overview of the data



How to use it?

Accelerated ingestion

- **Uniform output:** standardised output format for easy integration into applications and visualisation tools

Rapid integration of functionalities

Customisable post-processing steps

- Adjust spatial projections
- Efficient data storage and retrieval

Based on cloud technologies

- Docker: Containerisation technology
- Kubernetes: Orchestration platform
- Object Storage (S3): Scalable storage solution

Microservice Architecture: modular and scalable architecture

➢ **Software quality: maintainability, extensibility, interoperability**

From data needs to operational impact

> Key needs

- Accurate, up-to-date environmental data aggregated across sources
- Harmonisation across Earth, atmosphere and surface observations
- Advanced risk modelling from proprietary and open data

> Operational expectations

- Centralised, automated pipelines to speed acquisition, processing and delivery
- Simple, secure access (single sign-on, API keys, ready-made queries)
- Scalable common data store
- Flexibility and frugality

Use cases

> Cutting-edge AI-based solutions that integrate satellite observations and weather data

> Applicable to any area in the world

Flexible algORIthm for the monitoring of Air pollution based on artificial intelligence and satellite observations

SCO SPACE FOR CLIMATE OBSERVATORY

- Identification of high-risk areas for wildfires
- High-resolution prediction of fire development and Chemical composition of the smoke

- Flood risk forecasting through early, reliable and local detections
- Mapping of the flood extent

- Renewable energy
- Anticipation of Photovoltaic and Wind Energy Forecasts

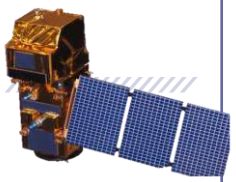
- High-resolution wind forecasting
- Fog Forecasting

Our solution: FLexible algORIthm for the monitoring of Air pollution

An **innovative** statistical approach based on **artificial intelligence** coupled with **satellite data**, facilitating application to **different regions of the globe and to any air pollutants & GHGs**

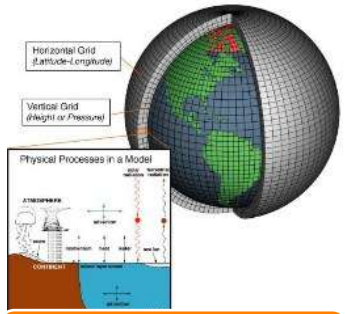
Input data

- Meteorological data
- Satellite observations



Artificial Intelligence

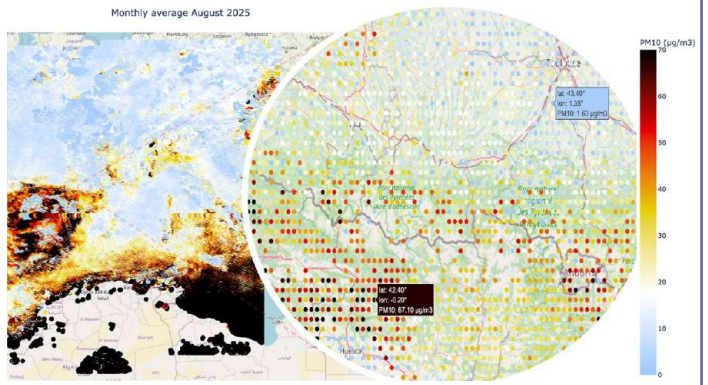
Machine Learning/Surrogate Model



Surrogate Model

Output map of air pollution

- Regular (daily) production of **pollutant maps at ground level** at satellite resolution
- Tool able to **support decision- and policy makers**



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Présentation du projet FLORIA

> Contexte

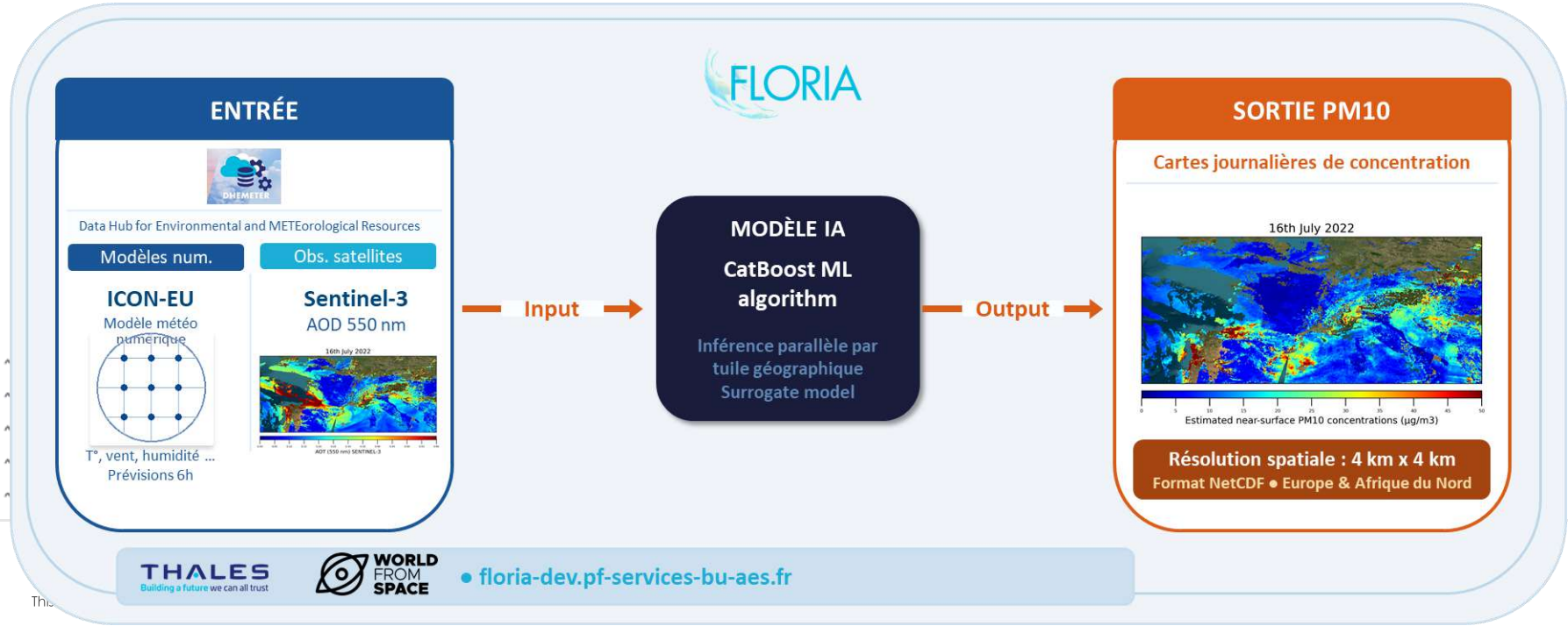
- Les PM10 (<10 µm) sont un indicateur clé de la qualité de l'air. Les modèles numériques (chimie-transport) sont efficaces mais coûteux en calcul.

> Projet SCO FLORIA

- Fév. 2025 – mars 2026 — Label SCO mars 2024
- Zone : Europe + Rép. Tchèque (Prague, Brno, Pilsen)

> Approche innovante

- Surrogate model IA couplé aux observations satellite (Copernicus/Sentinel-3)
- Cartes PM10 journalières à la résolution satellite (4 km) sur l'Europe
- Zones peu instrumentées couvertes



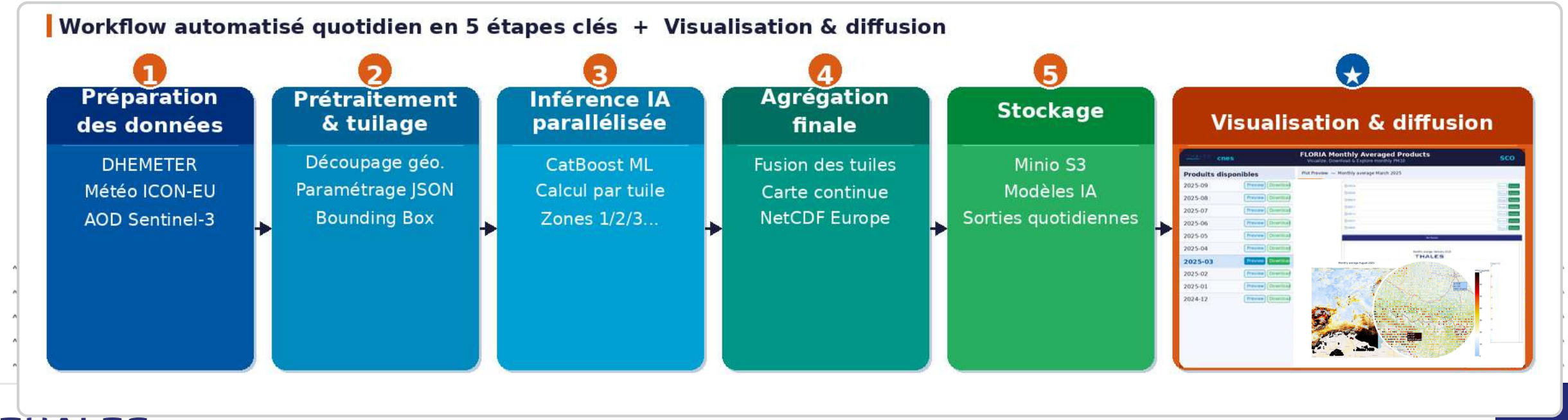
FLORIA : industrialisation de la solution

> Workflow automatisé quotidien

- Préparation des données via DHEMETER (récupération, agrégation météo & agrégation satellitaire)
- Prétraitement et tuilage (découpage géographique)
- Inférence IA parallélisée (calcul par tuile)
- Agrégation finale (fusion des résultats en une carte continue NetCDF)
- Stockage

> Visualisation & diffusion

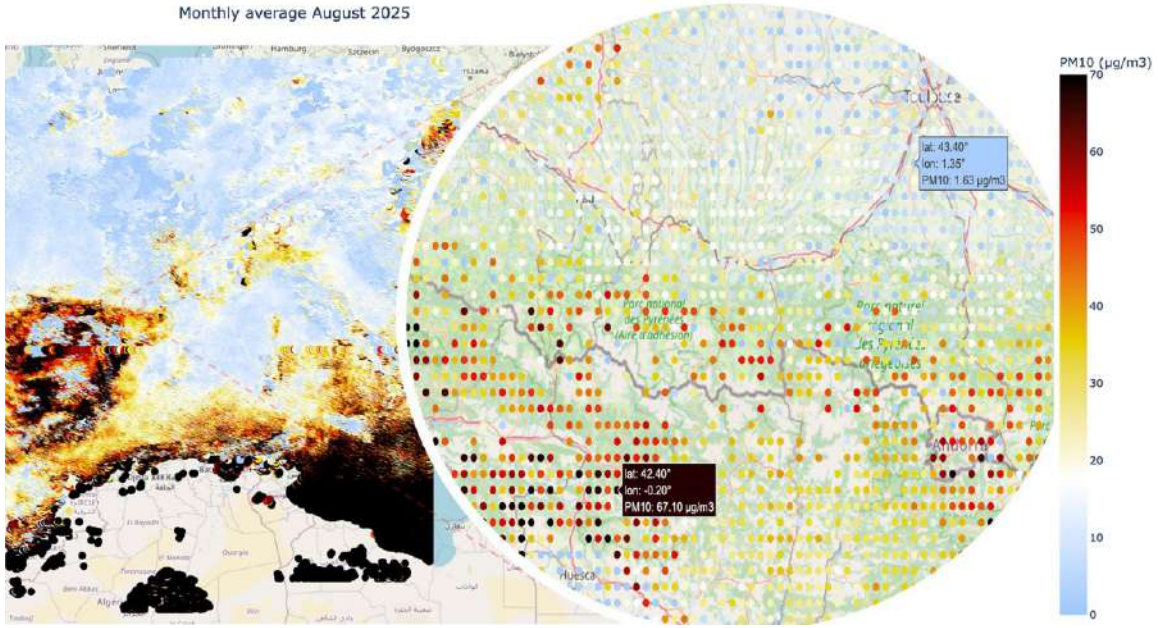
- Service web Flask : https://floria-dev.pf-services-bu-aes.fr/
- Fonctionnalités :
  - visualisation cartes mensuelles (Preview),
  - exploration (Zoom/Dézoom),
  - téléchargement des cartes (Download)



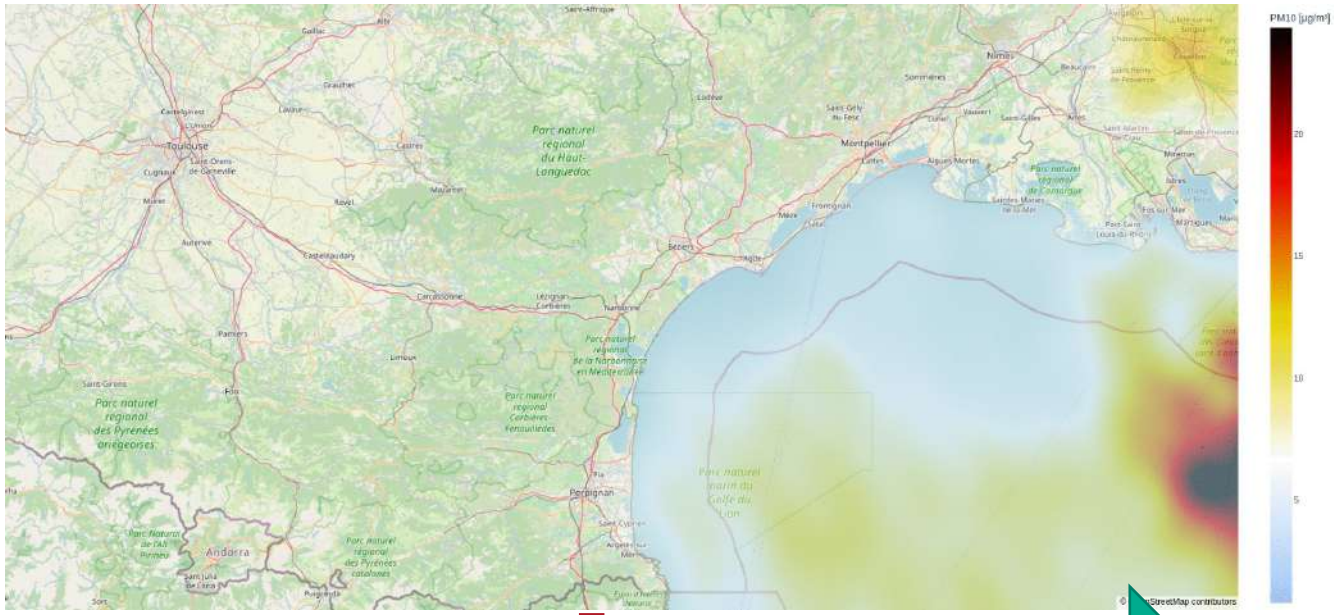
A real-world example: the 2025 forest fires in France

> Daily and monthly production of fine particles (PM10) using daily measurements taken by satellite (Sentinel-3) over a month

- Open maps : GCP-hosted platform for visualizing PM10 map

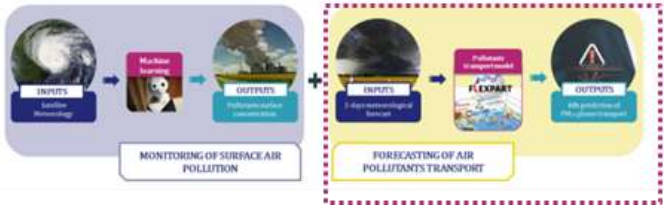


- Use Case : Wildfire Aude August 2025



August 3rd → 5th August Wildfire → 10th August

Estimation of pollutant plume dispersion



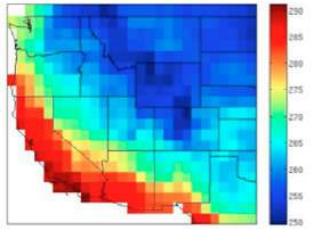
FLORIA

DHEMETER

Satellite measurement of Pollutants from the Top of the Atmosphere + Weather Data

- Weather :
  - GFS
  - ICON EU
- Sat :
  - S3 SYN / S5P

Input Weather Forecast:
Spatial 7 km – temporal 1h



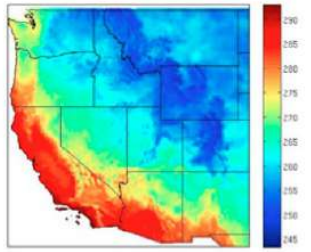
INPUT

Dynamical downscaling

WRF Weather Research & Forecasting

OUTPUT

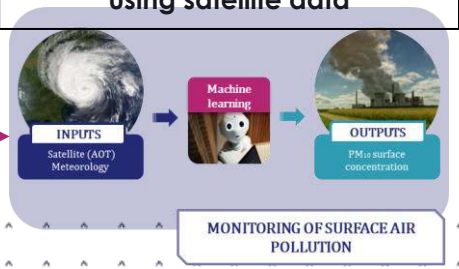
Output Weather Forecast:
High scalable resolution depending on the users need



INPUT

Near-real time Estimation using an AI Model

Mapping surface pollution sources using satellite data



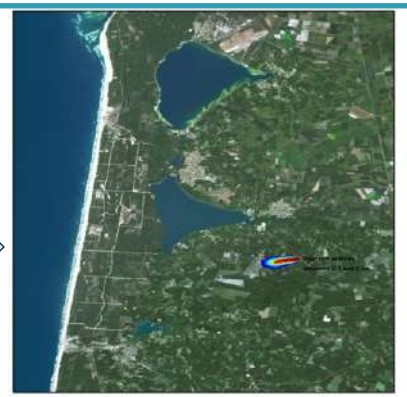
Automatic Hotspots detection & extraction

INPUT

Atmospheric dispersion model

OUTPUT

48 Hours Forecast
Forecast of pollutants dispersion



PM10 index

Spatial resolution: 200 m

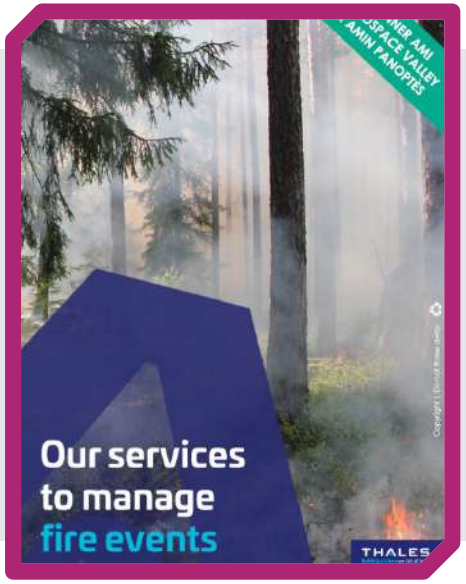
cnes CENTRE NATIONAL D'ÉTUDES SPATIALES
INERIS maîtriser le risque pour un développement durable
Rte
lisa Laboratoire Inter-Universitaire des Systèmes Atmosphériques

Use cases

> Cutting-edge AI-based solutions that integrate satellite observations and weather data

> Applicable to any area in the world

Flexible algORIthm for the monitoring of Air pollution based on artificial intelligence and satellite observations



- Identification of high-risk areas for wildfires
- High-resolution prediction of fire development and Chemical composition of the smoke

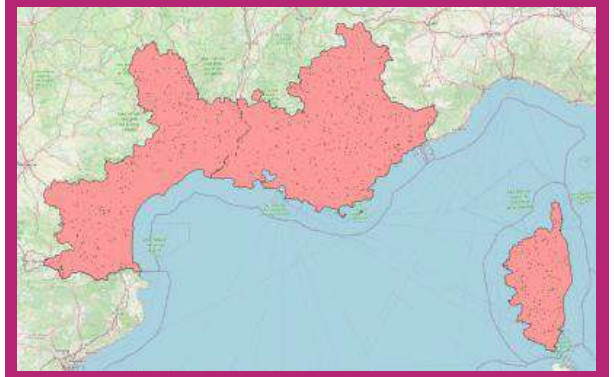
- Flood risk forecasting through early, reliable and local detections
- Mapping of the flood extent

- Renewable energy
- Anticipation of Photovoltaic and Wind Energy Forecasts

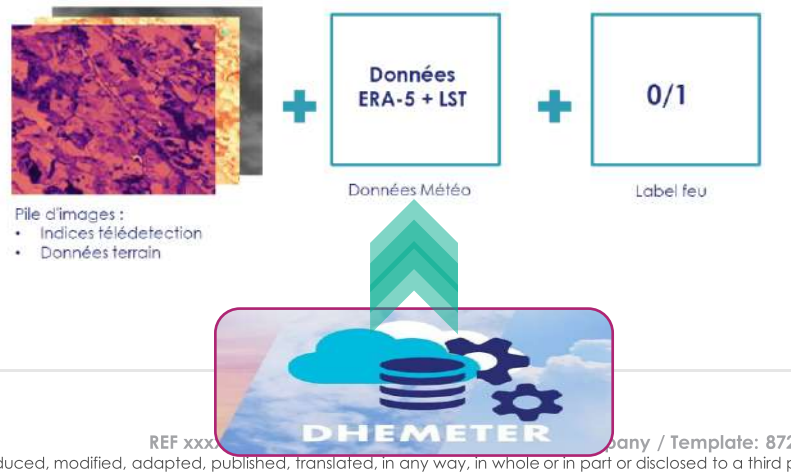
- High-resolution wind forecasting
- Fog Forecasting

Wildfire favorable conditions detection

Study area:
Mediterranean region
(Prometheus zone)



Innovative Approach:
Hybridation of data used to build a training database



Data Production by Automation:
For each fire/non-fire event

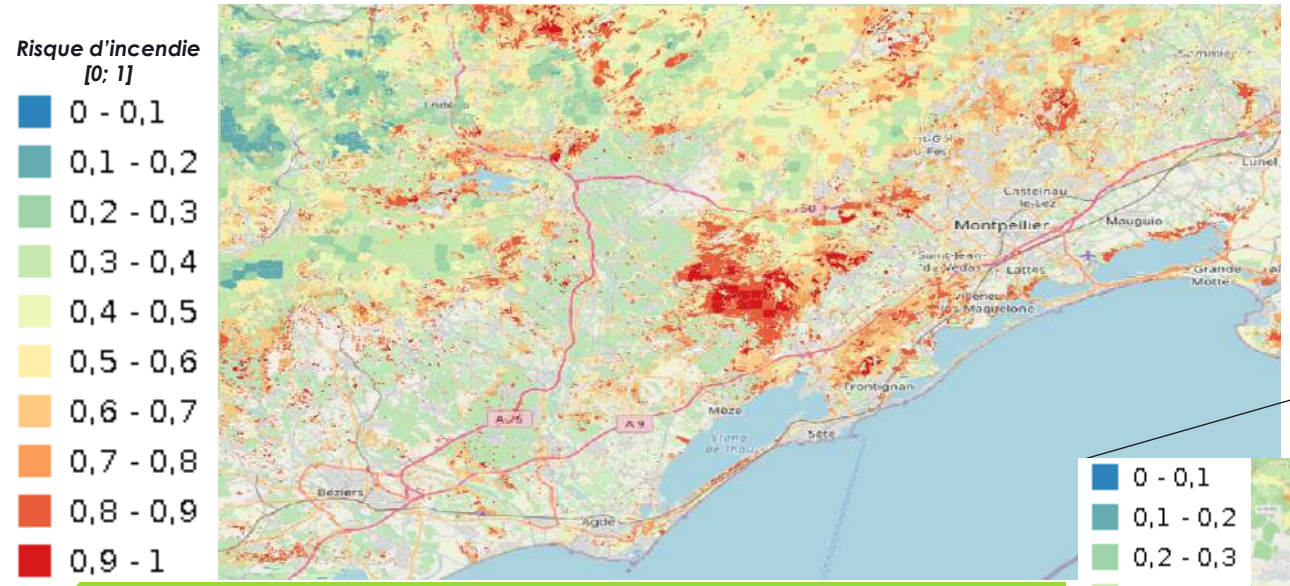
Risk map from D-0 to D+5: Fire risk prediction from 27/05/2024 to 01/06/2024 in an area south of the Alpilles (84))

Expérimentation SDIS 34 : été 2025

> Service de prévision journalière de risque de départ de feu à J0 et J+1

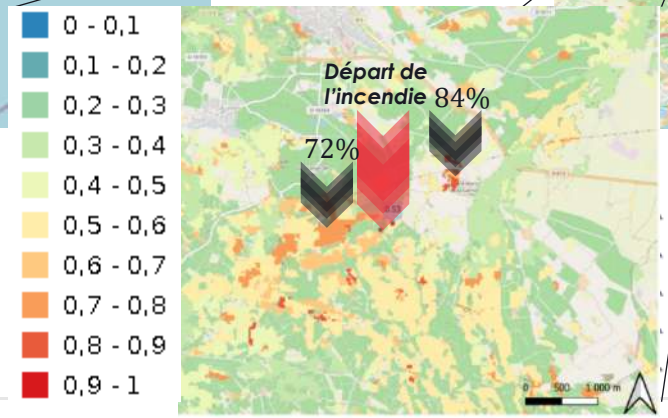
> Exemples

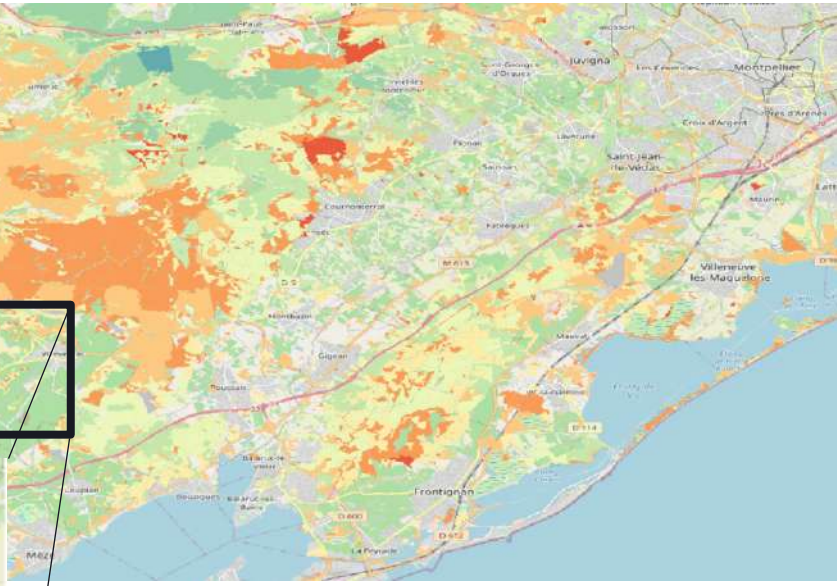
- Risques de départ de feu dans l'Hérault durant la période du vaste incendie sur l'Aude le **9 août 2025**



- Aligné avec la "Météo des forêts", en apportant une **résolution plus fine** : *Très bonne **complémentarité** avec les indicateurs de **Météo-France** pour **cibler** les zones à surveiller*
- Bonne prise en compte des **phénomènes météo clés (vent, …)**
- **Valeur ajoutée** décisive des **données satellites** (granularité spatiale, actualisation fréquente)

- Départ de **l'incendie de Montagnac dans l'Hérault** le **8 juillet 2025**



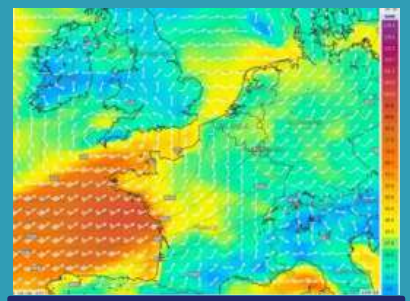


- **Validation** des résultats de prévision par les pompiers du **SDIS 34** dans un cadre **opérationnel**
  - ***Conditions météo & sol propices au départ de feu***

Fire Spread Forecasting Model: WRF-FIRE

High-resolution Forecast of the Fire's Spread

Meteorological data



Input Data: Low Resolution

Dynamical downscaling

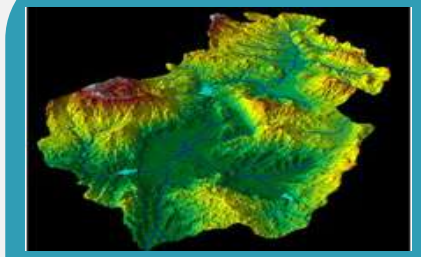
Output Data: High Resolution

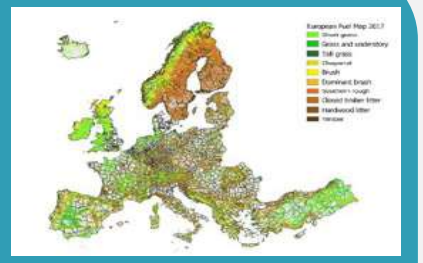
Weather Forecasts

DHEMETER

Satellite products + Weather Data

- **Weather :**
  - GFS
  - ICON EU





Digital Elevation Model (provided by Land Copernicus)

Fuel Type Database (provided by EFFIS)

20 m resolution

400 m resolution

Geographical data

INPUTS

Coupled fire-atmosphere Model

Open-source

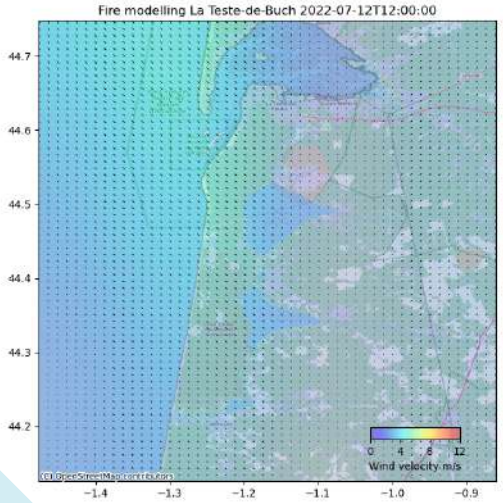
WRF-Fire

Simulation:

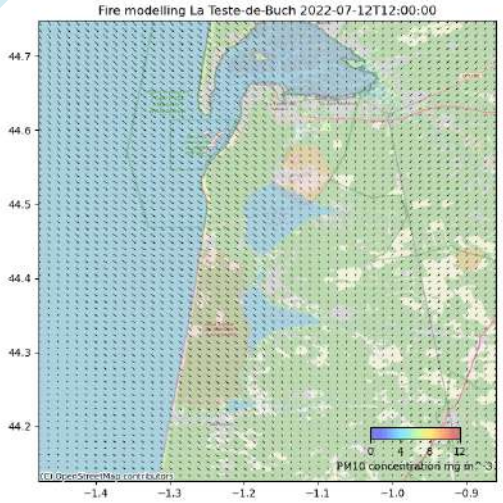
- **Burning** and **burnt** Zones
- **Spread rate** of the fire's front
- **Flame Heights** and **emitted radiation**
- **Intensity** and **smoke plume's height**
- **Chemical variables**: CO concentration, fine particles

OUTPUTS

Burnt area and wind speed



PM 10



Use cases

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Flexible algORIthm for the monitoring of Air pollution based on artificial intelligence and satellite observations

- Identification of high-risk areas for wildfires
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- Mapping of the flood extent

Landslides prediction and monitoring

- High-resolution wind forecasting
- Fog Forecasting

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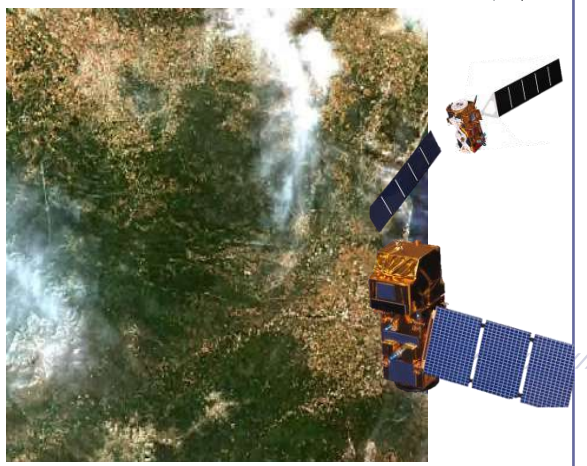
Our solution: A more reliable and automated forecast system

An **innovative** approach combining ***in-situ*** **& satellites imagery data** and artificial intelligence for **reliable and local** forecasts of **flood events**

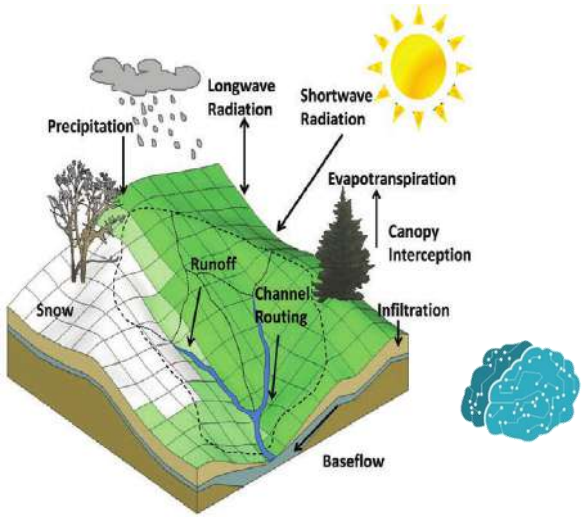
Input data

- Meteorological data
- Satellite observations
- In situ observations



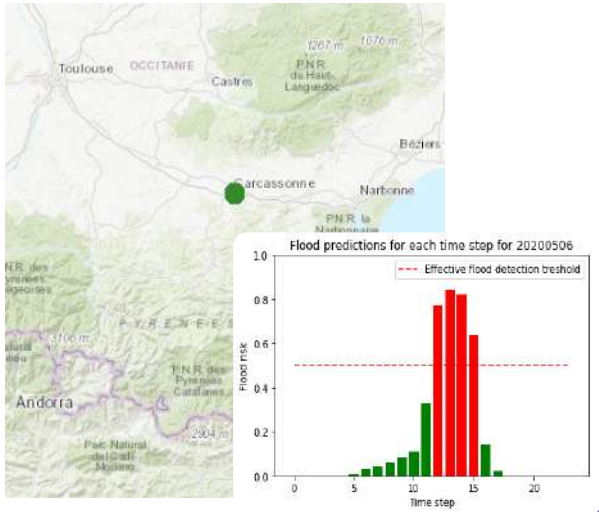
Combination

- Hydrologic modelling & Machine Learning



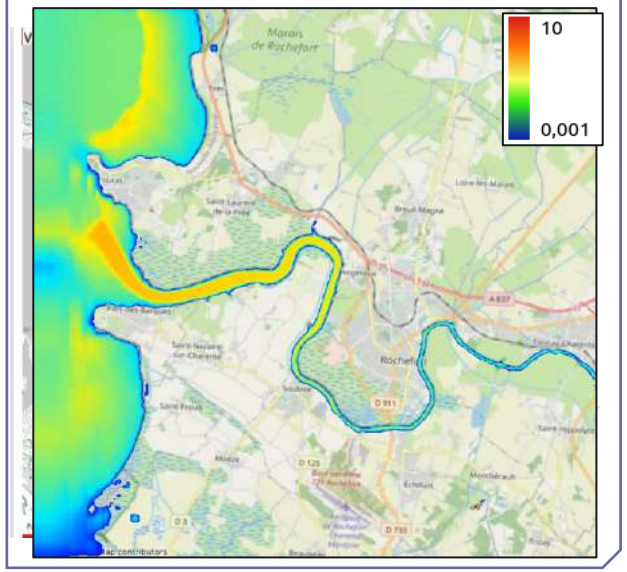
Output forecast

- 5-day forecast of flood risk index
- Hourly time step
- Reliability > 90%



Mapping

- Extent of flooding
- Flood scenarios



DHEMETER

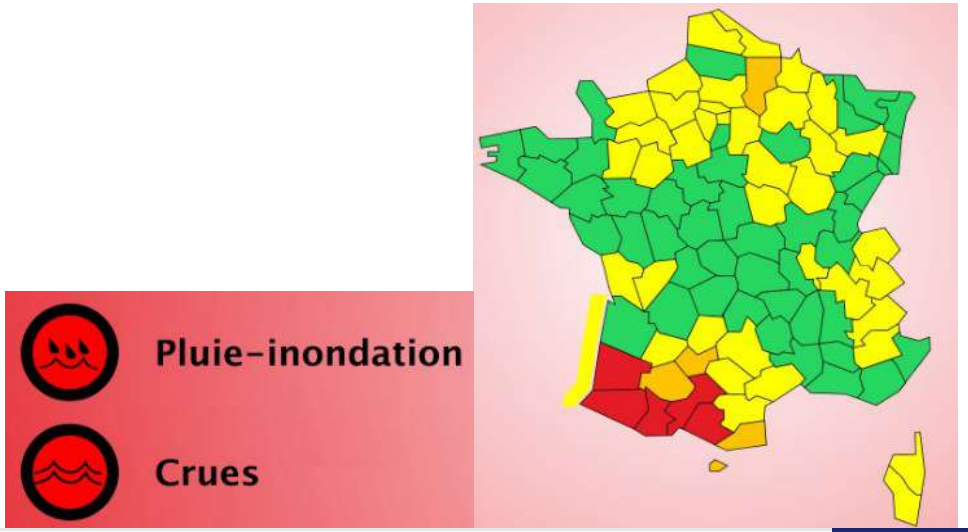
Demonstration under real conditions

11/01/2022 event on the **Aude basin**

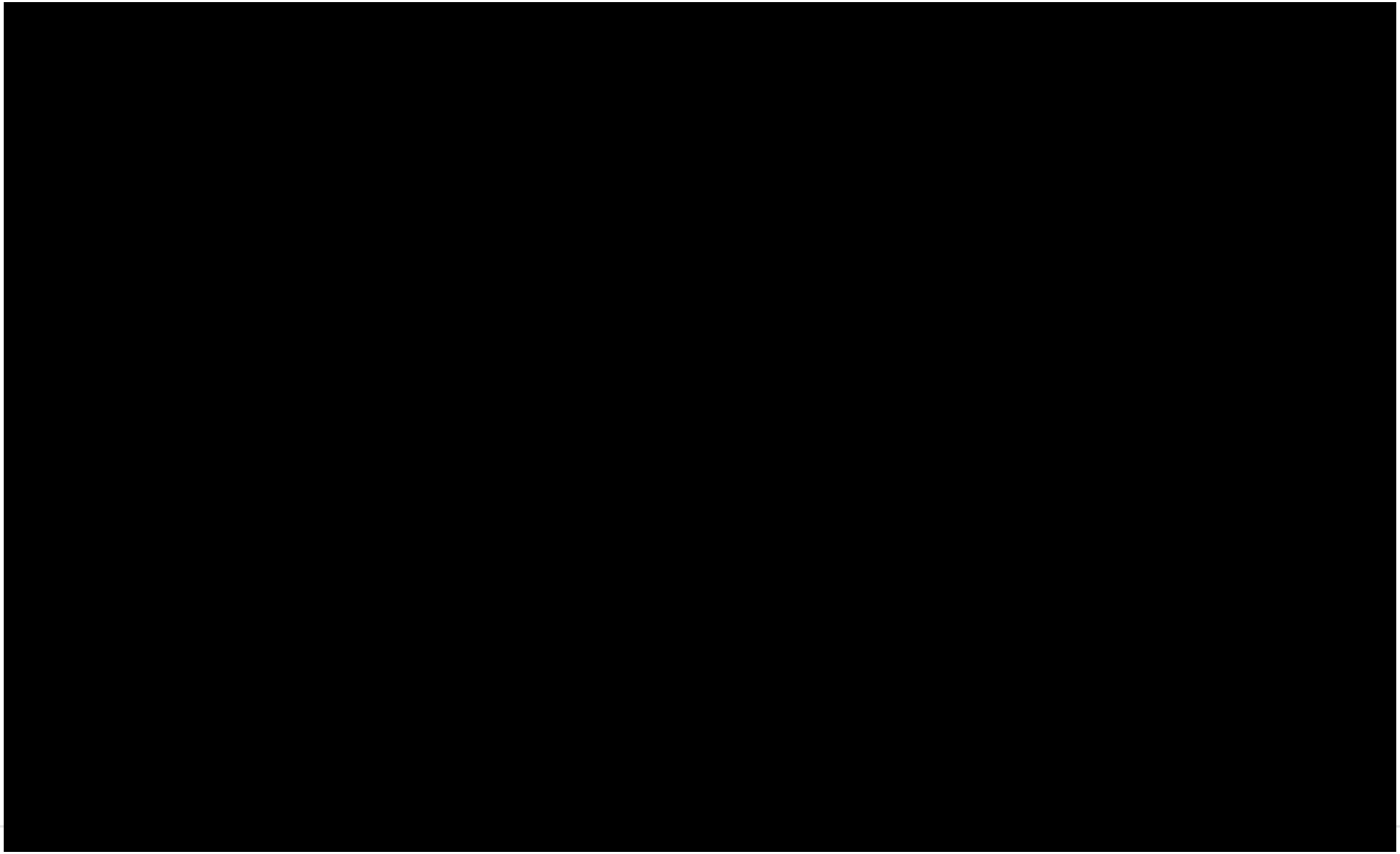
- Real conditions:
  - Flood dates not recorded in the training database
  - Use of **weather forecasts** available between **January 6 and 12, 2022**

- Event detection:
  - **4 days in advance**
  - **Decreased uncertainties** with each iteration
  - **Accurate estimation** of magnitude

- **User-friendly design and visualisation of combination of occurrence probability and magnitude of the event**



Demonstration under real conditions (11/01/2022 event)



Hydrodynamic model Basilisk

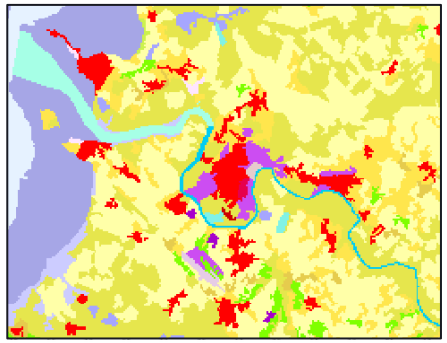
> Boundary conditions

- NEMO Model from Copernicus Marine Service
- Streamflow time series from Hydroportail or from Flood4Kast
- Rainfall from meteorological model

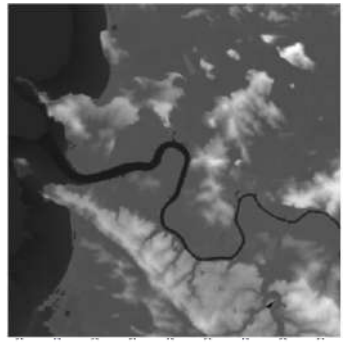
> Digital Terrain Model

- Bathymetry + topography

> Land cover



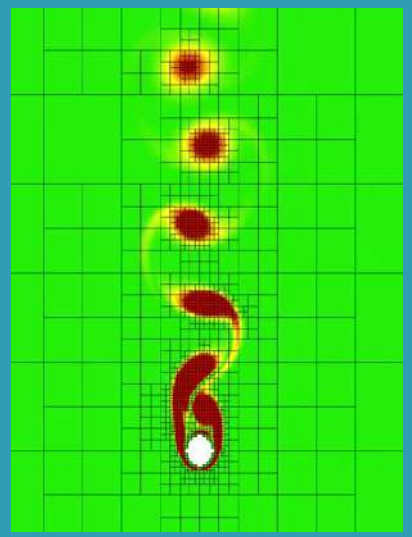
Corine Landcover



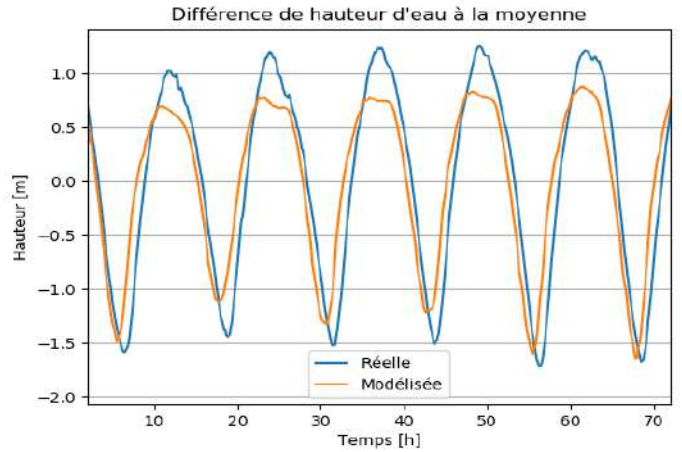
IGN and SHOM DTM Model

Basilisk CFD model
Saint-Venant equations solved
Adaptive and automatic mesh
Fully configurable

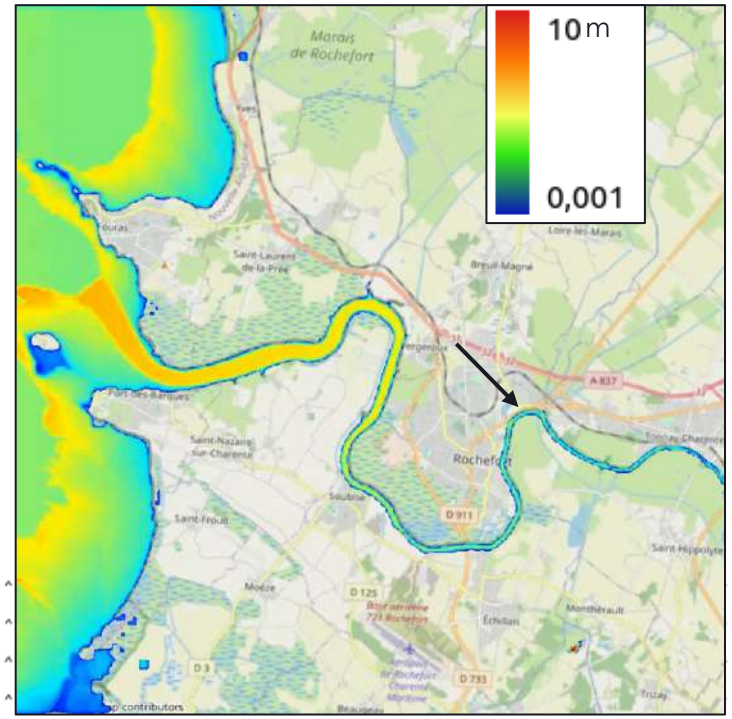
INPUTS



OUTPUTS



Nash-SutCliffe Efficiency = 0.82



Water height (m)