



# L'observation de la Terre à très haut facteur de compression

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[www.visioterra.fr](http://www.visioterra.fr)



# VisioTerra en quelques chiffres

- Crée en mai 2004
- 11 ingénieur(e)s
- C.A. 2023 : 820 K€
  - ESA ..... 50 %
  - TELESPAZIO ..... 22 %
  - AfEOS ..... 12 %
  - SERCO ..... 7 %
  - AGRECO ..... 6 %
  - CNES ..... 1 %
  - Cité des Sciences ..... 1 %

➤ <http://visioterra.fr>



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Cité Descartes  
Champs-sur-Marne  
France

The screenshot shows the VisioTerra website homepage. At the top, there's a navigation bar with links for VisioTerra, MISSIONS, SOLUTIONS, RÉFÉRENCES, ACTUALITÉS, VISIOTERRA, and CONTACTS. Below the navigation is a banner with the text "VtWeb" and "Le Monde à portée de mains". A sidebar on the left contains text about VisioTerra's missions and a link to "Accéder à leur VisioTerra". The main content area is divided into five sections: "Missions" (with a river map), "Solutions" (with a satellite image of land), "Références" (with a topographic map), "Actualités" (with a satellite image of a forest fire), and "Stories" (with three smaller images: a map of Marlborough Sounds, a map of New Zealand fires, and a map of Australia). The footer includes a copyright notice and a link to "VisioTerra Observatoire Climatique".





# Ingénierie en Observation de la Terre (O.T.) et éducation

janvier 1990



GAEL Consultant

mars 2004



1. Développement logiciel
2. Contrôle qualité
3. Production cartographique

mai 2004



VisioTerra

mars 1993



Université Paris-Est Marne-la-Vallée – [Site du Pr. Serge RIAZANOFF](#)

Professeur associé

1. Traitement d'images
2. Télédétection
3. Suivi des stagiaires

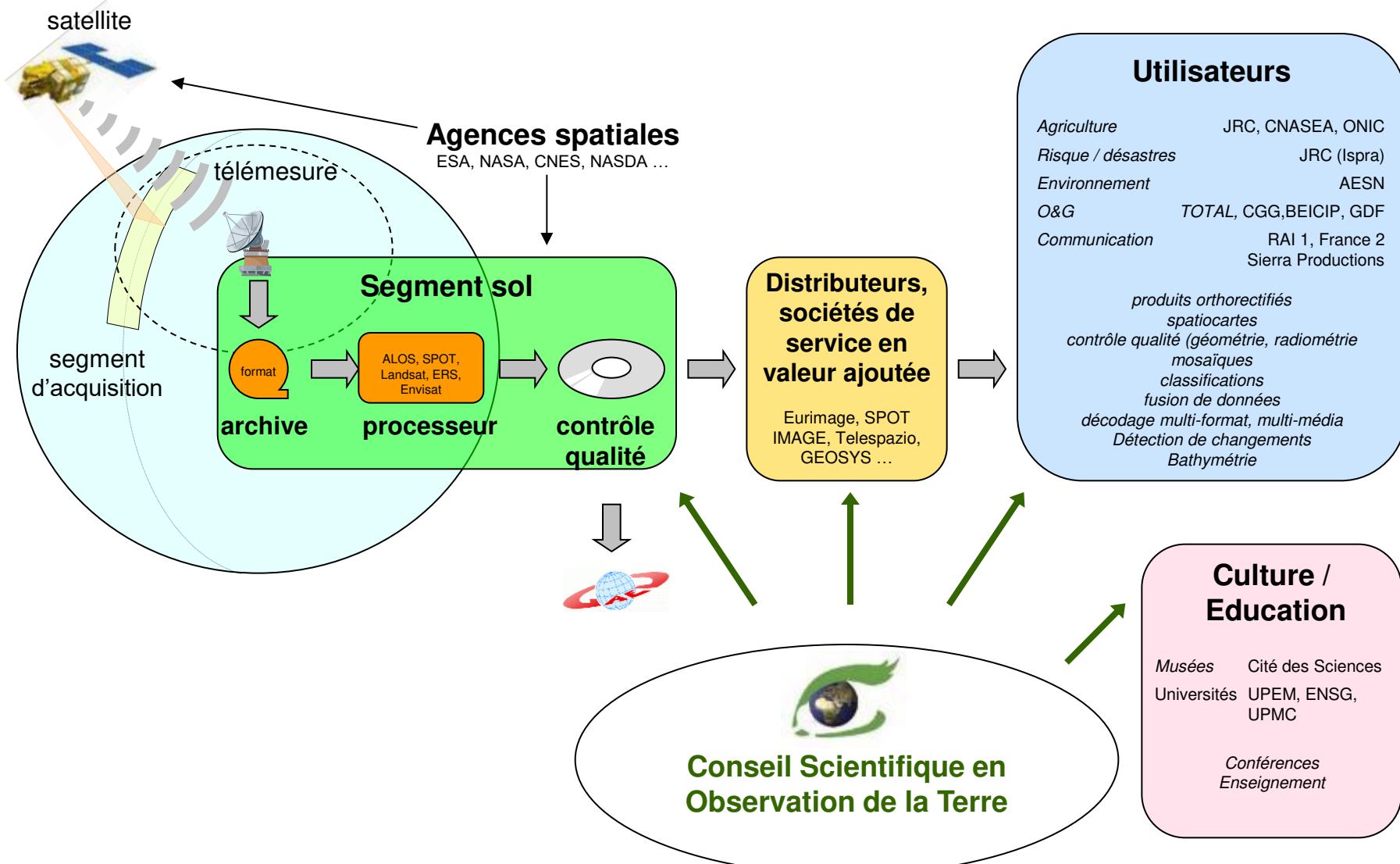
ENSG (Ecole de l'IGN)

Université Paris 7

Monde (Algérie, Maroc, Palestine, Douala, Kinshasa...)



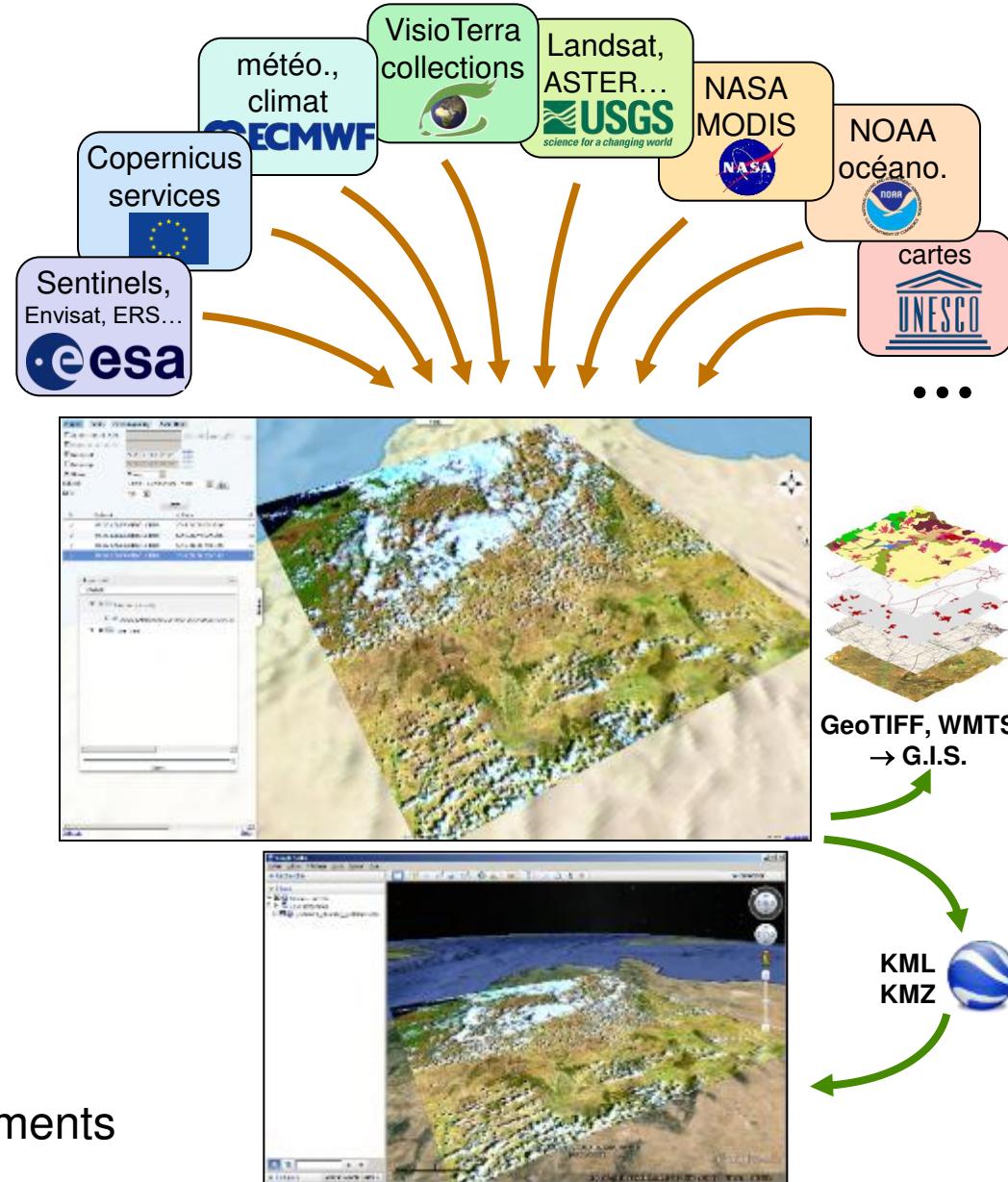
# Compétences de VisioTerra – Des satellites aux utilisateurs





# VtWeb – Concepts

- [www.visioterra.fr/?VtWeb](http://www.visioterra.fr/?VtWeb)
- données globales et gratuites
- fouille de données
- satellites / météo / ECV / Géol. / hydro./ alti./ LULC / populations...
- accès temps quasi-réel
- traitement automatique
  - pour le citoyen
    - style par défaut
    - styles prédéfinis
  - pour les scientifiques
    - ajustement des paramètres
    - vers une *P.O.F. toolbox*
- infrastructure(s) collaboratives(s)
- 2D webmapping / 3D globe virtuel
- dans l'aire d'intérêt
- archives pour analyser les changements
- services à valeur ajoutée,  
surveillance systématique, alarmes...

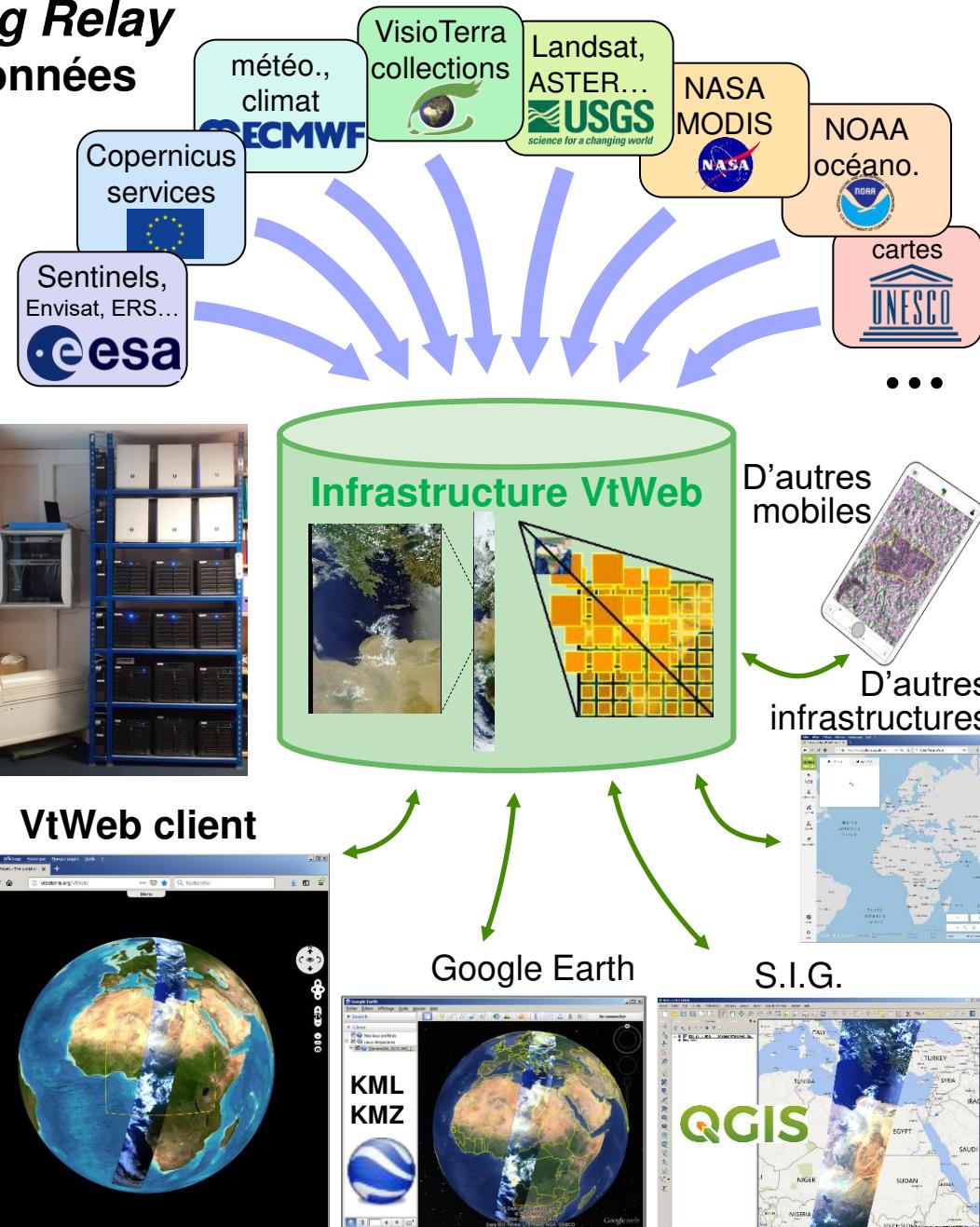
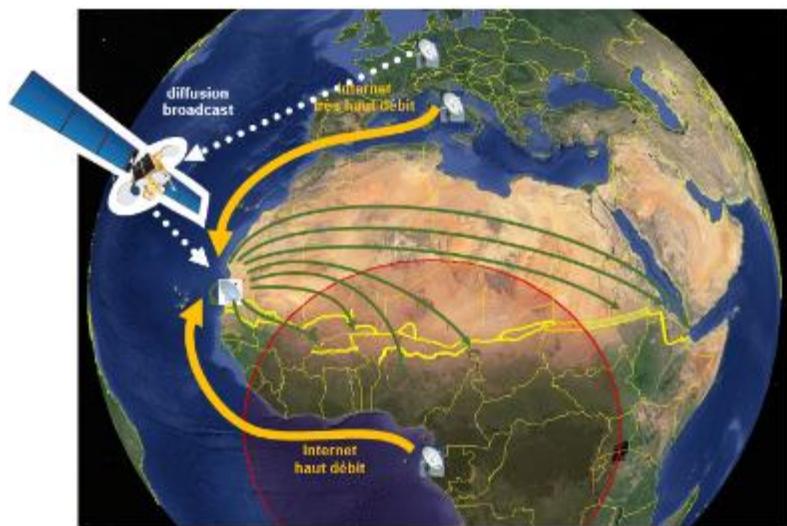




# VtWeb – Data Processing Relay

## Relais de traitement des données

- L'infrastructure VtWeb à VisioTerra :
  - 1 Po (1000 To) de disques
    - 50 To ASAR and ERS
    - 150 To MERIS
  - 1 Gb/s fibre optique symétrique
  - 6 serveurs
- solution DPR pour l'Afrique

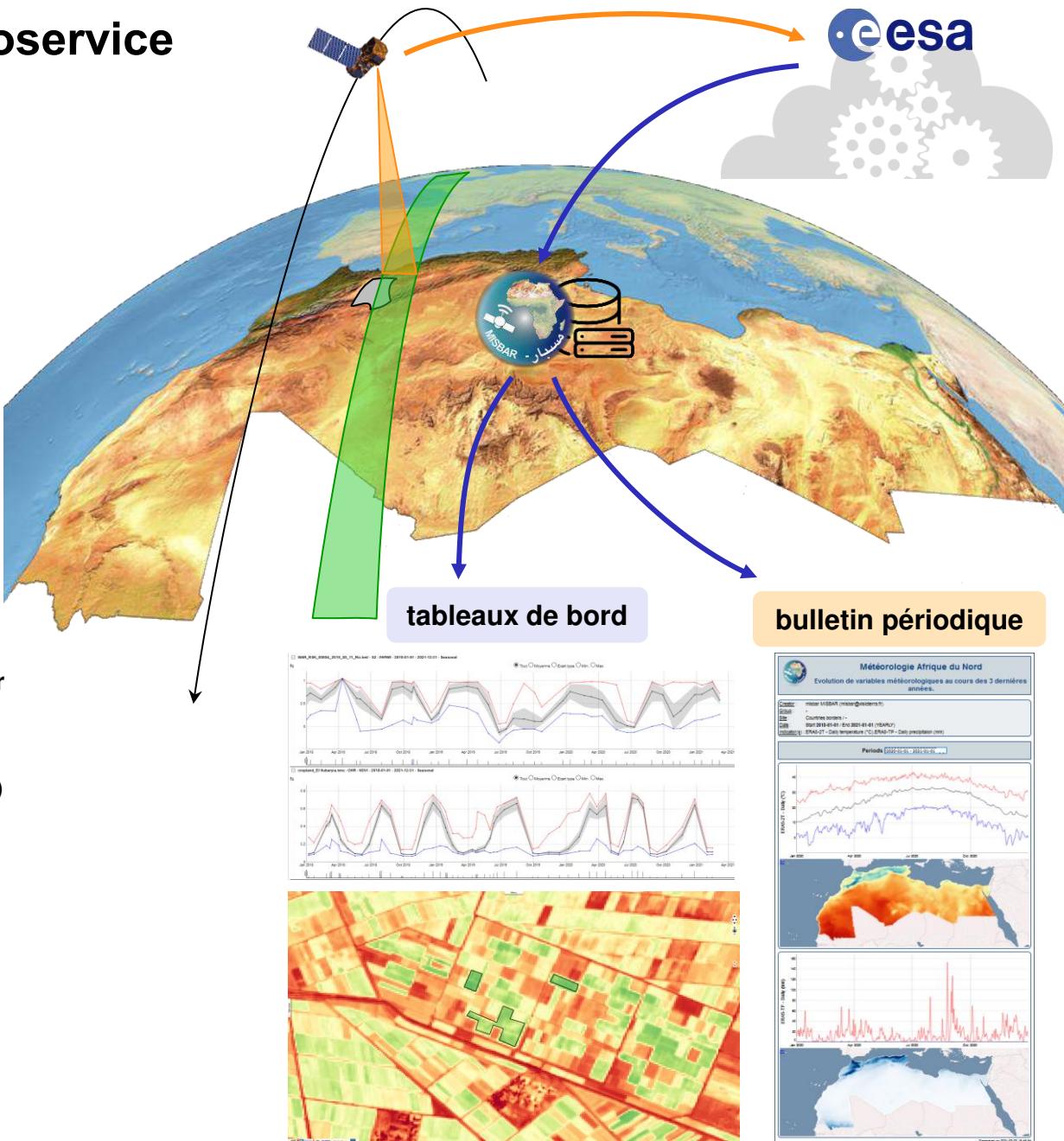




# Principe d'un géoservice

## ➤ Attributs d'un géoservice :

- Site
  - élémentaire
  - groupe
- Indicateur(s)
  - prédefini
  - programmé par l'utilisateur en POF-ML
- Période
  - mensuel
  - trimestriel
  - annuel...
- Alertes (option)
  - hors valeurs nominales
  - modérateur
  - liste de personnes à prévenir
- Tableaux de bord
  - agrégation spatiale (graphe)
  - agrégation temporelle (carte)
- Bulletins périodiques
  - modèle
  - visa
  - liste de distribution

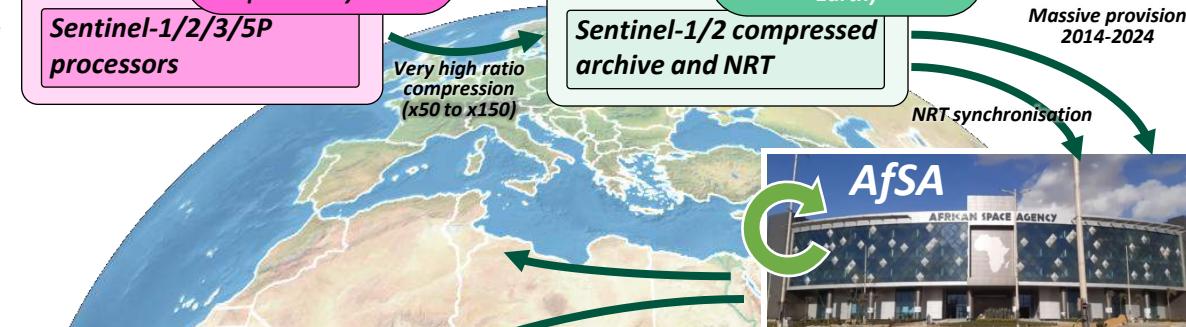
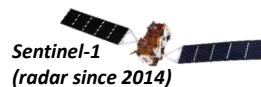


## ➤ Un géoservice est :

- automatisé
- contrôlé par son propriétaire
- une ressource qu'on peut partager

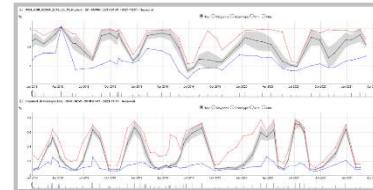
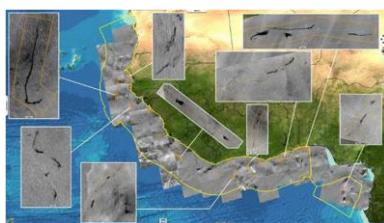


# Une solution pour l'Afrique



**Data & geoservices for:**

- **Monitoring**
- **Business**
- **Education**
- **Research**





# Summary

## ➤ Problem

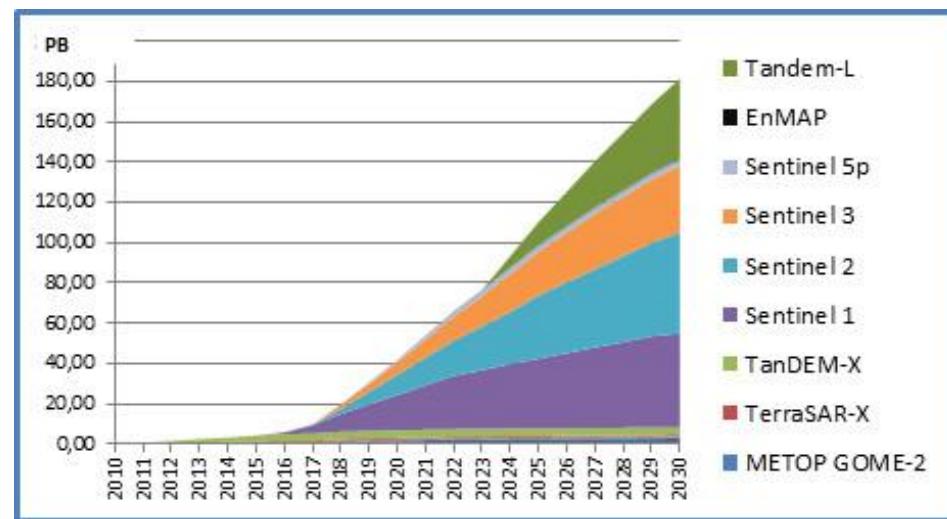
- Earth observation data, such as Sentinel (S1, S2, etc.) products, are extremely large, making storage costly and downloads slow, especially in regions with limited bandwidth or for scientists requiring large datasets.

## ➤ Solution

- A compression service that reduces product sizes by 100x, 250x while maintaining acceptable quality.
- This solution improves data accessibility, speeds up downloads, and optimizes resource management for constrained environments.

## ➤ Qualification

- To evaluate the performance of the proposed compression solution, both generic metrics (RMSE, PSNR, SSIM, LPIPS) and thematic metrics (classification degradation, k-means++...) are used.





# Discrete Cosine Transform (DCT)

## ➤ A Technique derived from the Fourier transform

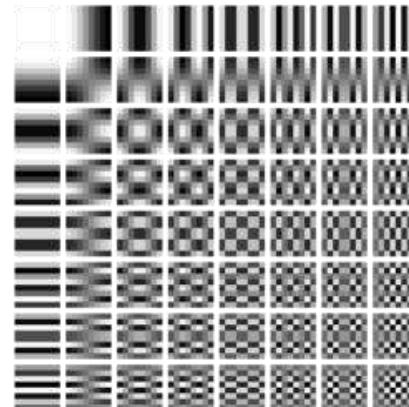
- The Discrete Cosine Transform (DCT) is a transformation similar to
- the Discrete Fourier Transform (DFT).  
The Fourier transform represents a function by the spectral density from which it originates, as an average of trigonometric functions of all frequencies.



## ➤ DCT for compression

- The DCT itself does not achieve compression, but rather prepares the image for compression.
- Once in the frequency domain, the image's high-frequency coefficients can be coarsely quantised so that many of them (>50%) can be truncated to zero.
- The coefficients can then be arranged so that the zeroes are clustered (zig-zag collection) and Run-Length Encoded.
- The remaining data is then compressed with Huffman coding.

***Visualization of the relationship between the time domain and the frequency domain of a function, based on its Fourier transform.***

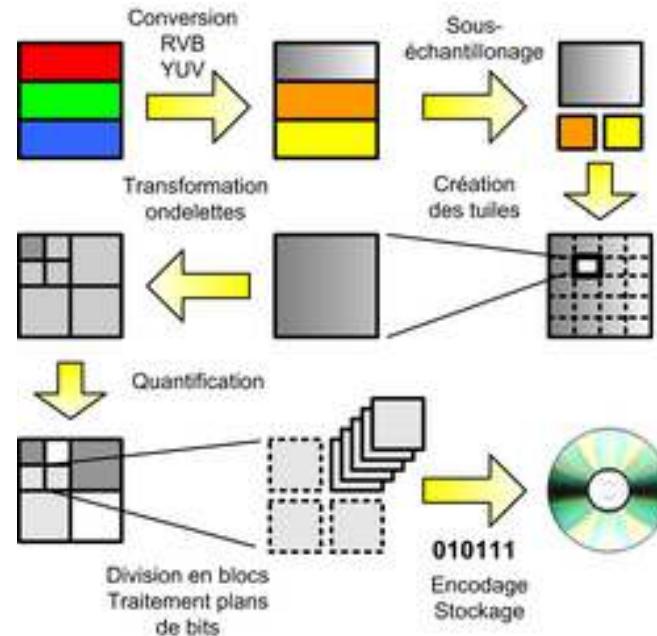


***DCT basis functions, showing different frequency components used to decompose the image into spatial frequencies.***



## ➤ Discrete Wavelet Transform (DWT): The basis of JPEG 2000

- Analyzes the image at multiple scales with a hierarchical decomposition.
- Divides the image into sub-bands: LL (low frequency), HL, LH, HH (high frequencies).
- Compression using Embedded Block Coding with Optimized Truncation (EBCOT).



**Main steps of JPEG2000 compression**



# AI for compression

## ➤ Traditional approach vs. Learned Image Compression (LIC)

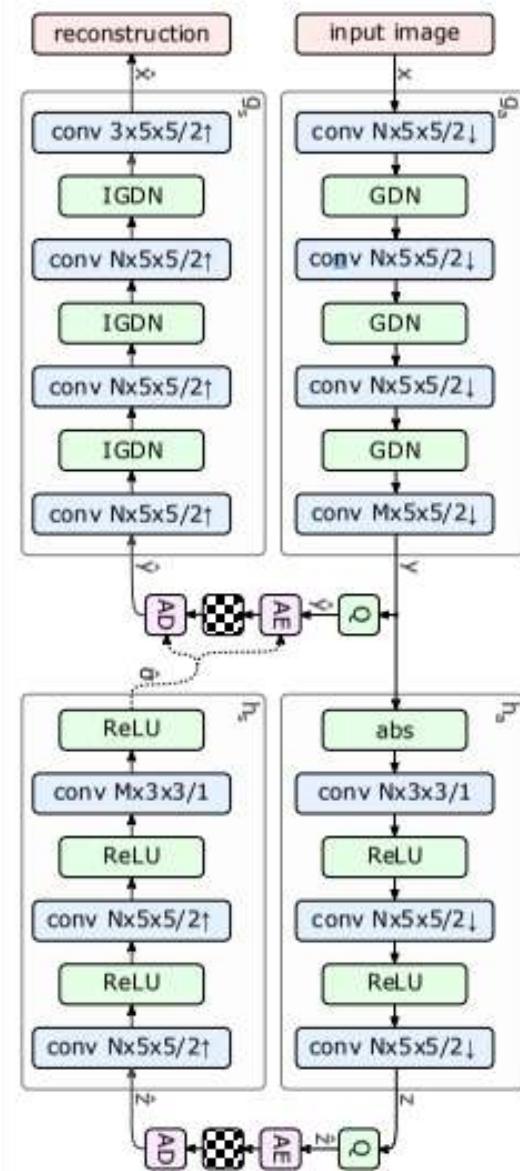
- Classical methods: JPEG, JPEG2000, BPG → based on fixed transformations (DCT, wavelets).
- LIC: Automatically learns the best representation using neural networks.

## ➤ Typical LIC model architecture

- Encoder: Converts the image into a compressible latent representation.
- Quantization: Discretizes latent values for compression.
- Entropic model: Predicts the distribution of latents for efficient coding.
- Decoder: Reconstructs the image from compressed data.

## ➤ Optimization

- Loss function combining:
  - Compression rate (minimizing latent entropy).
  - Reconstruction quality (e.g., MSE, SSIM, LPIPS).



**LIC model architecture**



**Merci de votre attention**  
*Thank you for your attention*

**Questions ?**



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