



Session 3E1

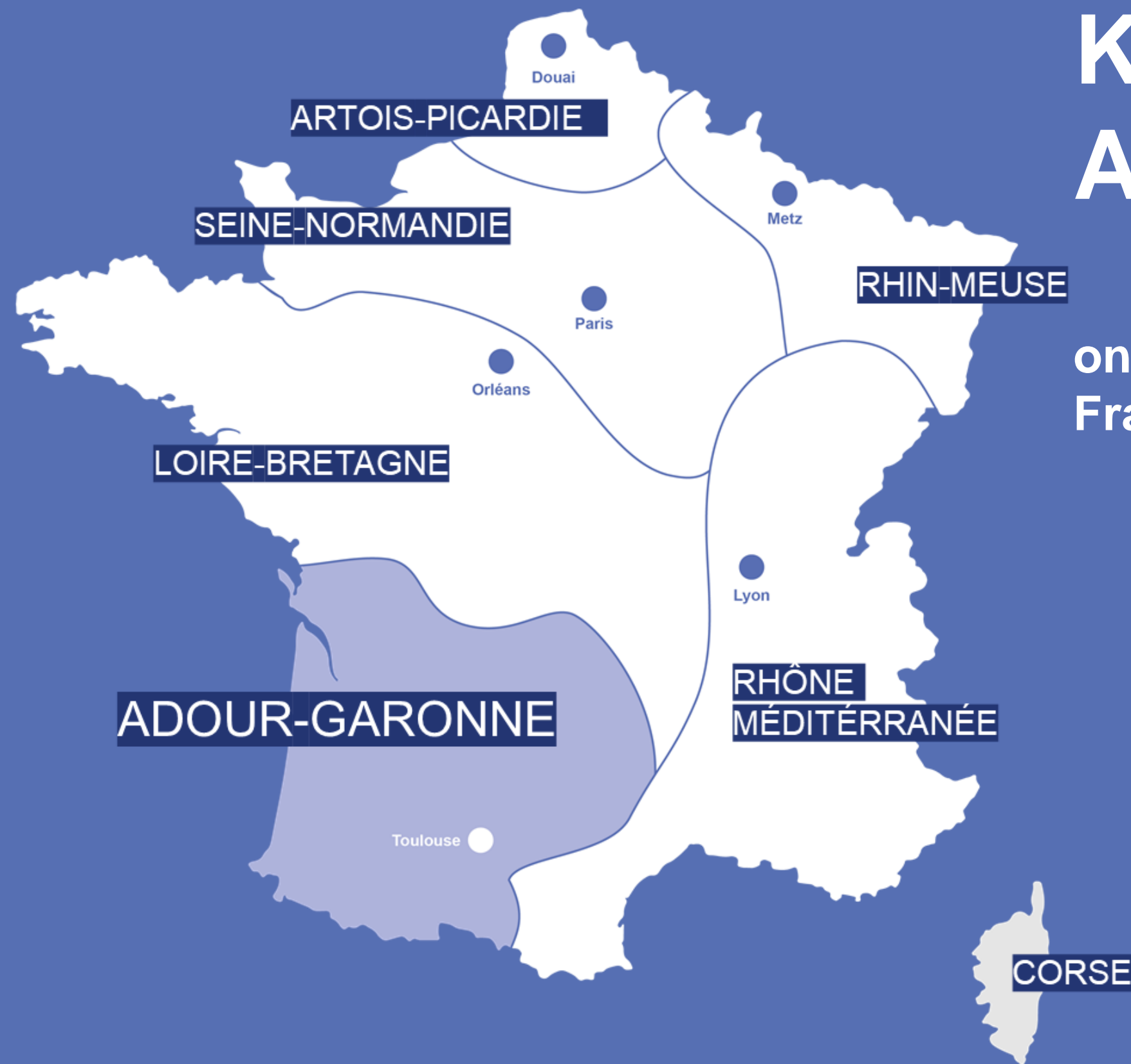
“Satellites and water resources management : towards a revolution ?”

Mr. **Guillaume CHOISY**

Director General
of Water Agency Adour-Garonne

9th World Water Forum (Dakar 2022)

Key figures of the basin Adour-Garonne



one of the 7 metropolitan watersheds, 1/5th of France's surface

Adour-Garonne Water agency : Key figures

Surface : 115 000 km²

260 staff in Adour Garonne (5 spots) ●

2 natural water reserves
(the Pyrénées and the Massif Central)

120,000 km waterways

Waters all flow to the Atlantic ocean

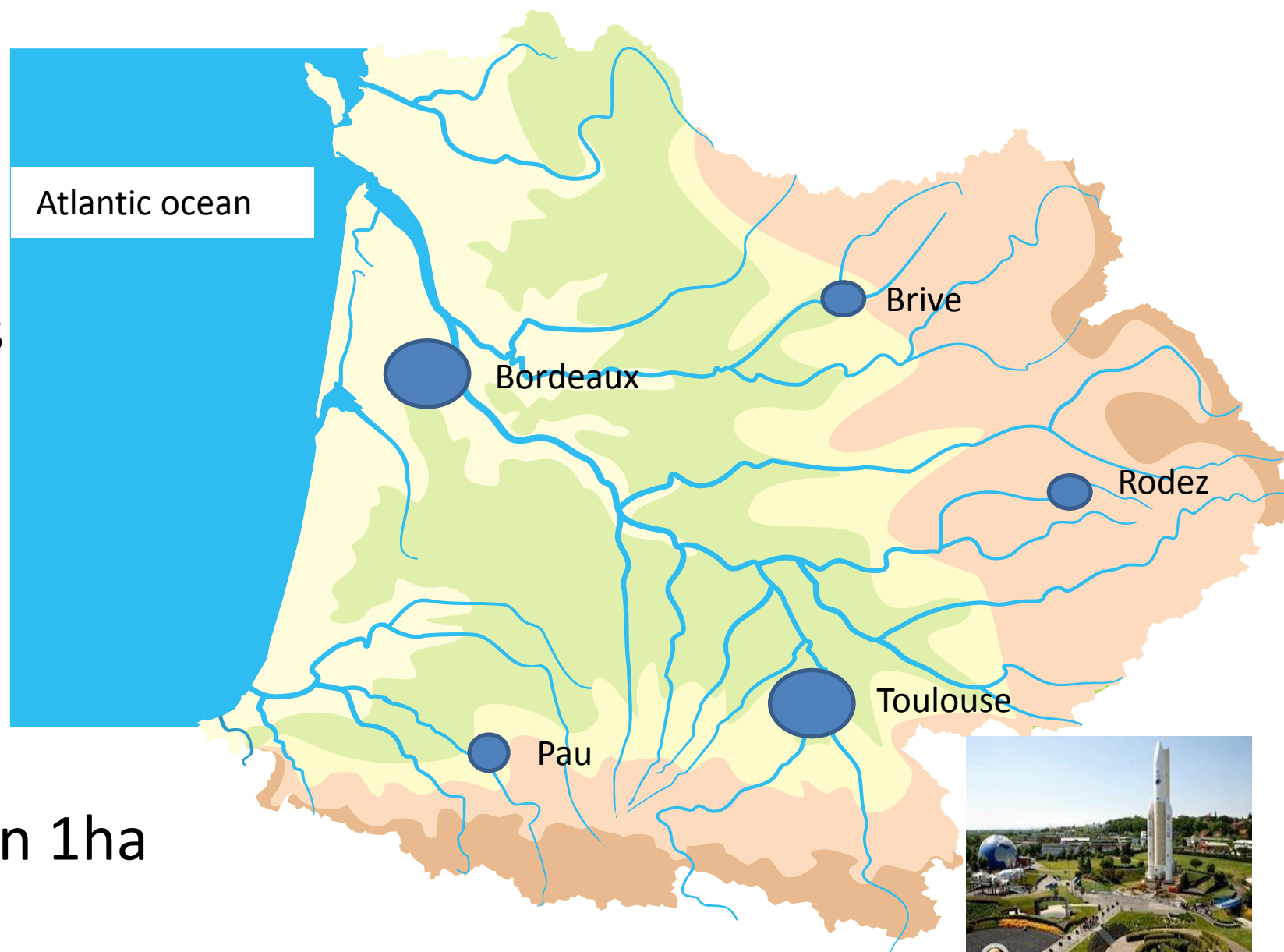
3 estuaries

650 km of coastline

6,870 lakes of more than 1ha

250,000 ha of wetlands

144 Groundwater water bodies



2 major cities, 0.5M inhabitants.
4500 villages of less than
500 inhabitants

inhabitants

7,6 M Adour-Garonne (+ 50 000/an)



Adour-Garonne Water Agency

A transversal approach

- contribute to the achievement of good ecological status of all waters in the basin ;
- seeks a balance between water resources and uses.



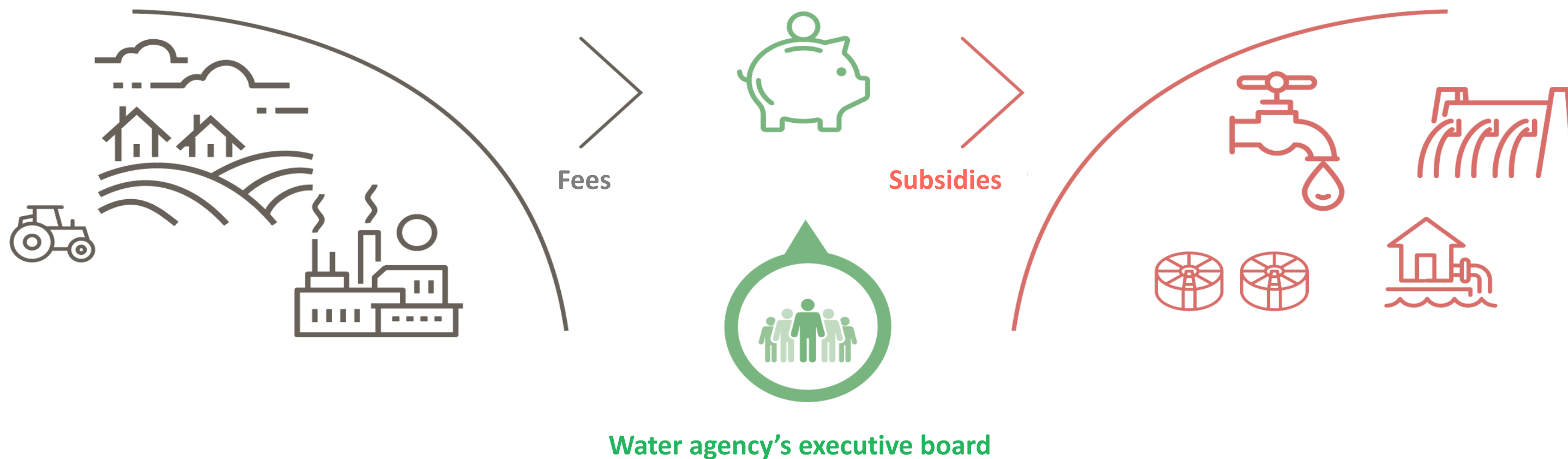
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Égalité
Fraternité*

eau
GRAND SUD-OUEST
AGENCE DE L'EAU ADOUR-GARONNE

Adour-Garonne Water-Agency

A solidarity approach

Solidarity system of redistribution of fees collected on water uses in the form of financial support for projects in favor of water resources: "water pays for water"

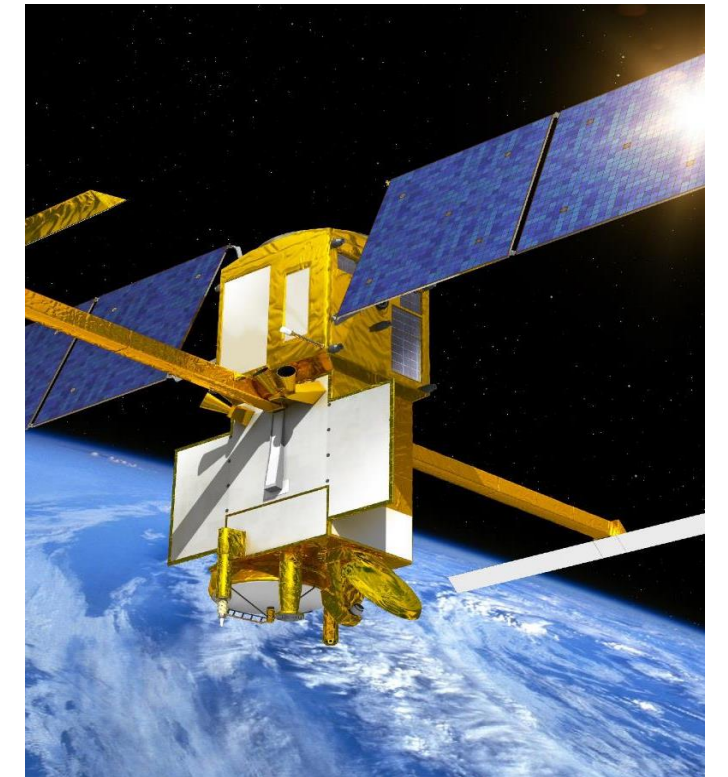
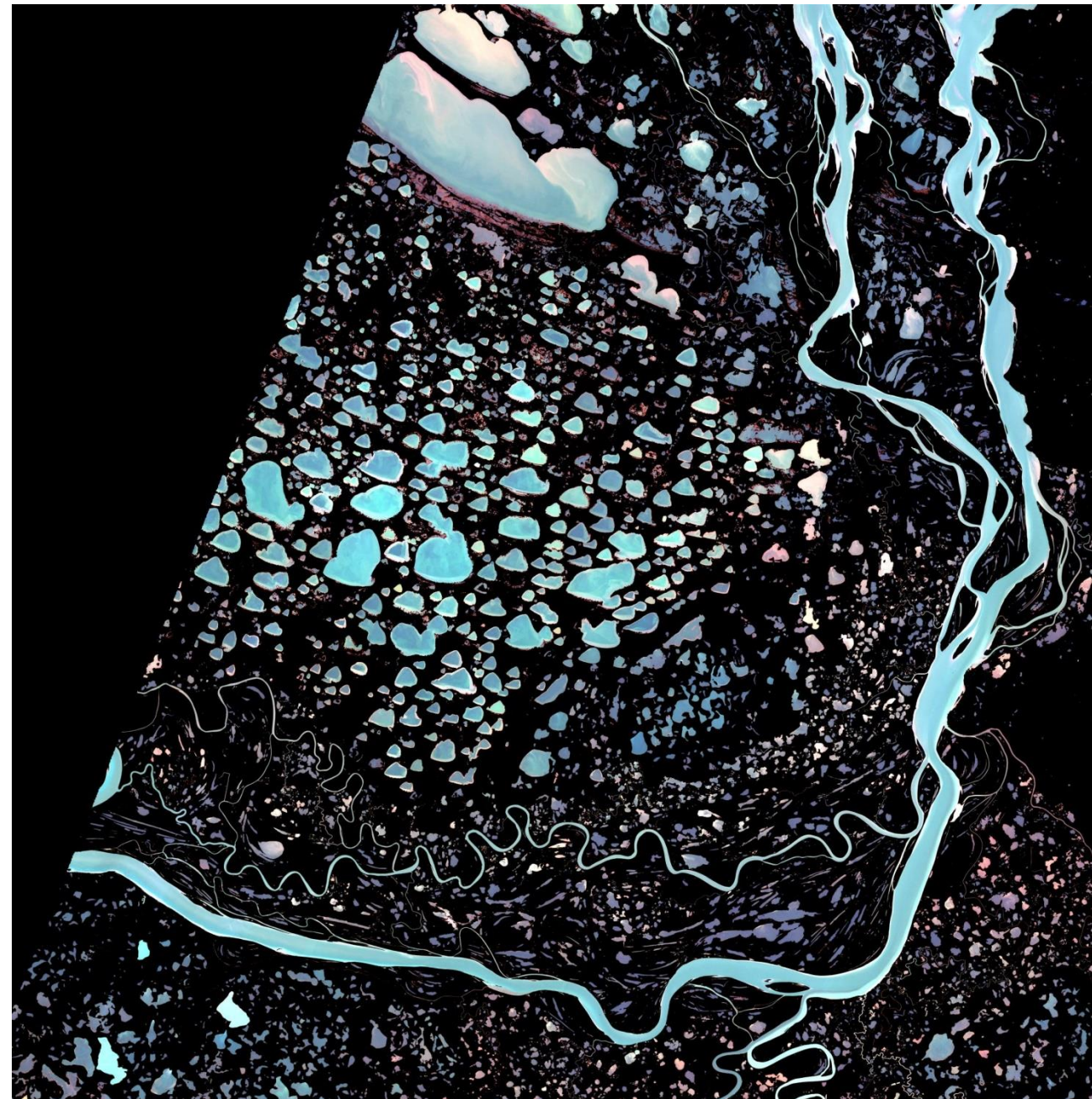


244

M€ average subsidies per year,
since 2016

What are the knowledge gaps of the hydrological state for the Adour-Garonne basin ?

Quantity and Quality



Climate change and its impacts in the South-West of France

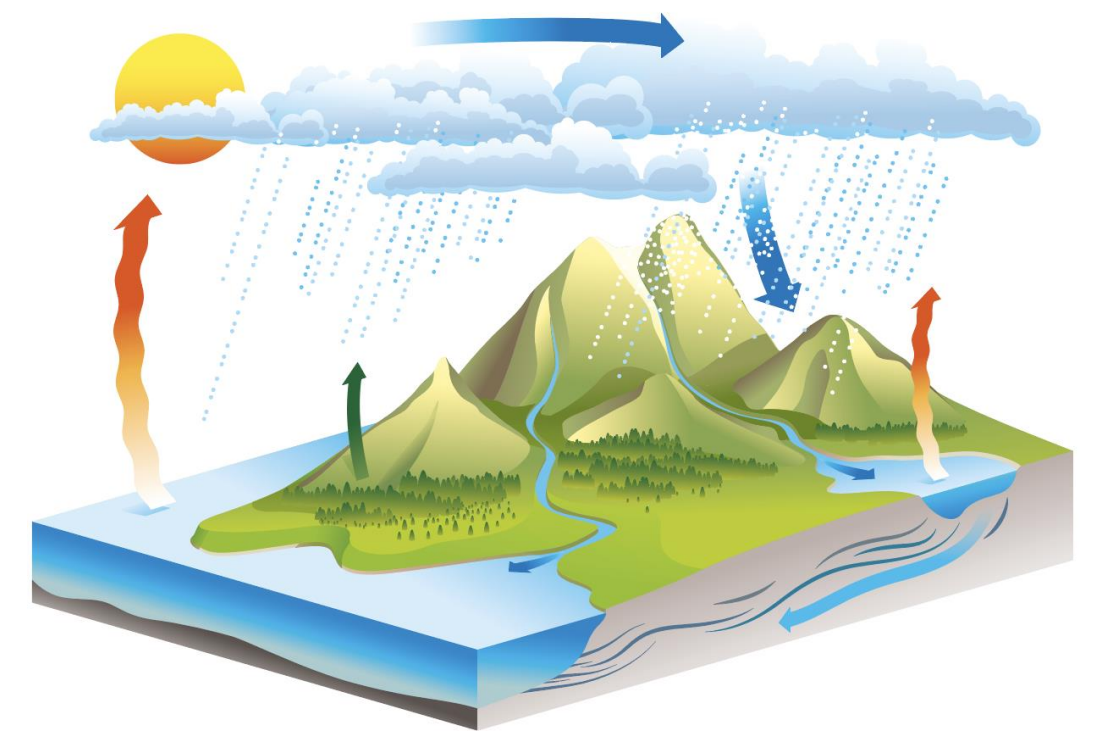
Adour-Garonne basin in **quantitative** terms :
A generous water supply but significant demands...

600 mm to **2,000** mm/year average rainfall

90 billion of m³/year of rainfall (but 60% is lost by evapotranspiration)

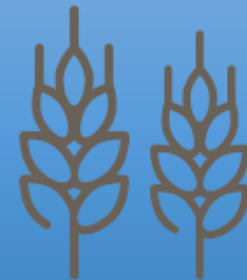
35 billion of m³/year natural flows in rivers but marked low water levels (summer)

2 billion of m³/year of water withdrawn on average per year currently, of which :



34 % over the year

23 % Low water



43 % over the year

65 % Low water



23 % over the year

12 % Low water

Major hydrological impacts

<https://www.eau-grandsudouest.fr/usages-enjeux-eau/changement-climatique>

More frequent extreme weather events : torrential rains

-35% à -60%



Snowpack

+10% à +30%



Evapotranspiration



-20% à -40%



Reduced river flows



Low water earlier, thougher and longer

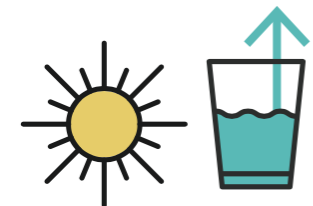
Reduced **groundwater** recharge

Temperature increase

+ 2°C

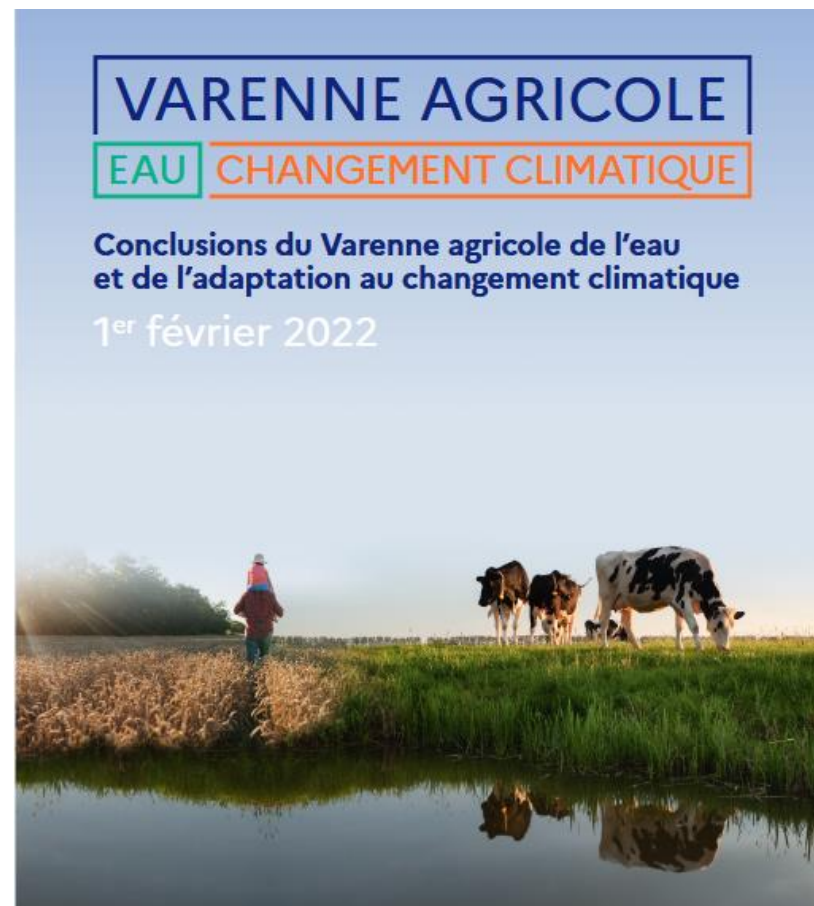


**+1°C → +1,6%
D'EAU POTABLE
consommée**



What are the needs in terms of knowledge of the hydrological state for the Adour-Garonne basin ?

Most urgent need : quantity



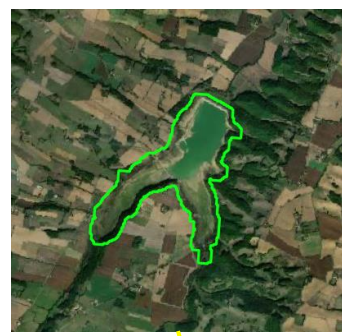
*Put in place by the President of the French Republic and organized by the Ministry of Agriculture and the Ministry of Ecological the Varenne Agricultural Water and Adaptation to Climate Change : **aims to give meaning and perspectives to the French agricultural project in a context of climate change.***

The most urgent need is to **know the water stocks in the different compartments** (soil, basement, reservoirs, soil drought ...)

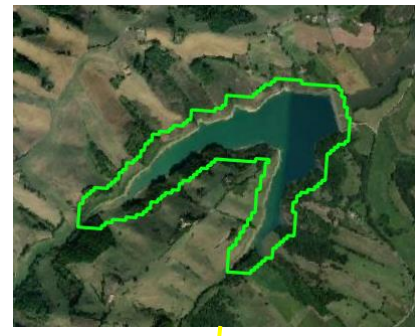
Towards real-time satellite monitoring of dam water stocks in France



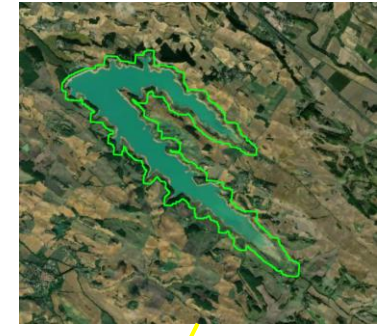
Astarac
S = 180 ha
V = 10 Millions m3



Aussoue
S = 43 ha
V = 3 Millions m3



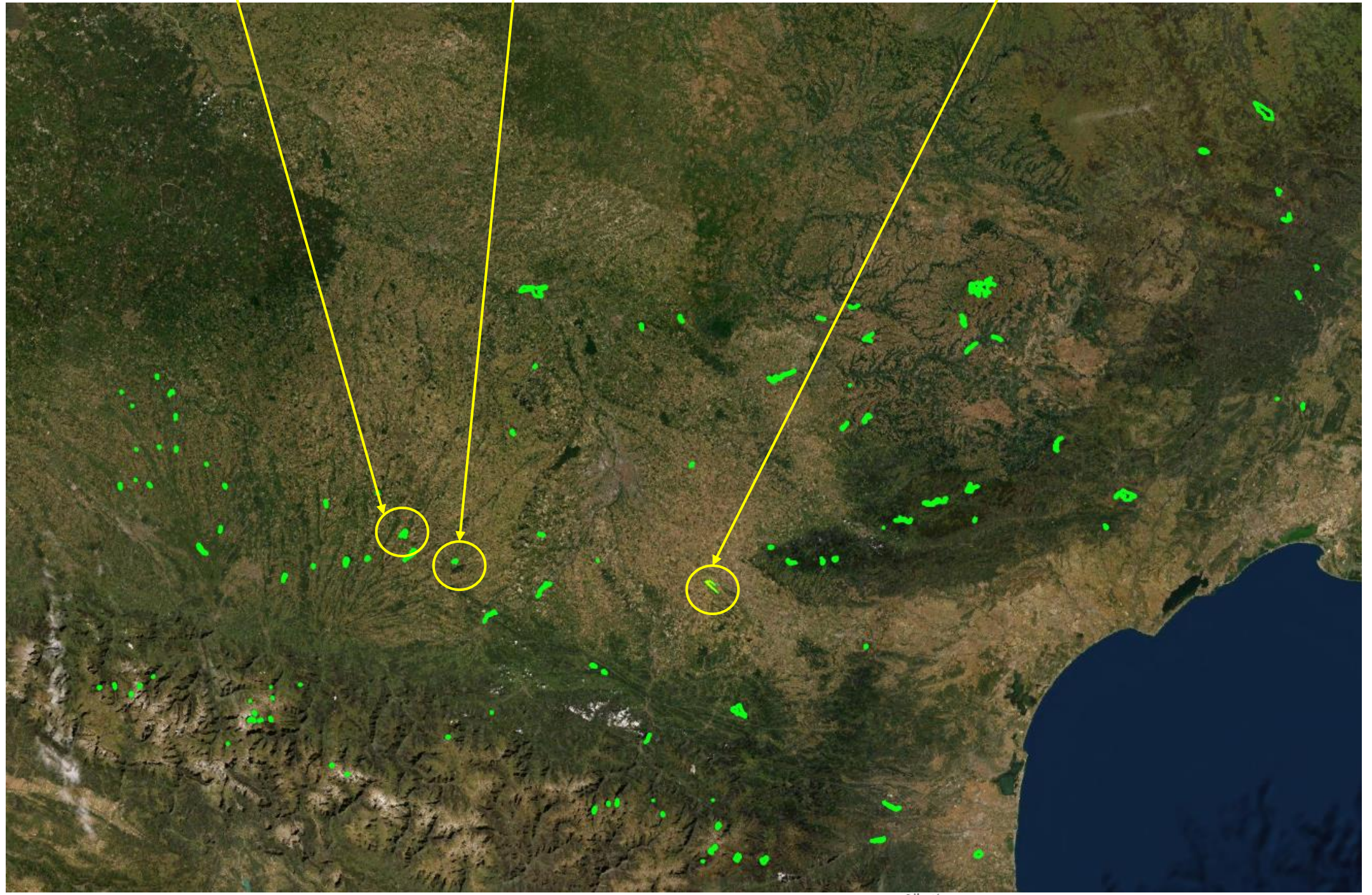
Guanguise
S = 400 ha
V = 45 Millions m3



Volume monitoring for **93 dams**:
78 - Occitanie
15 – Nouvelle Aquitaine

Conclusions:
Uncertainty < 15% volume rate

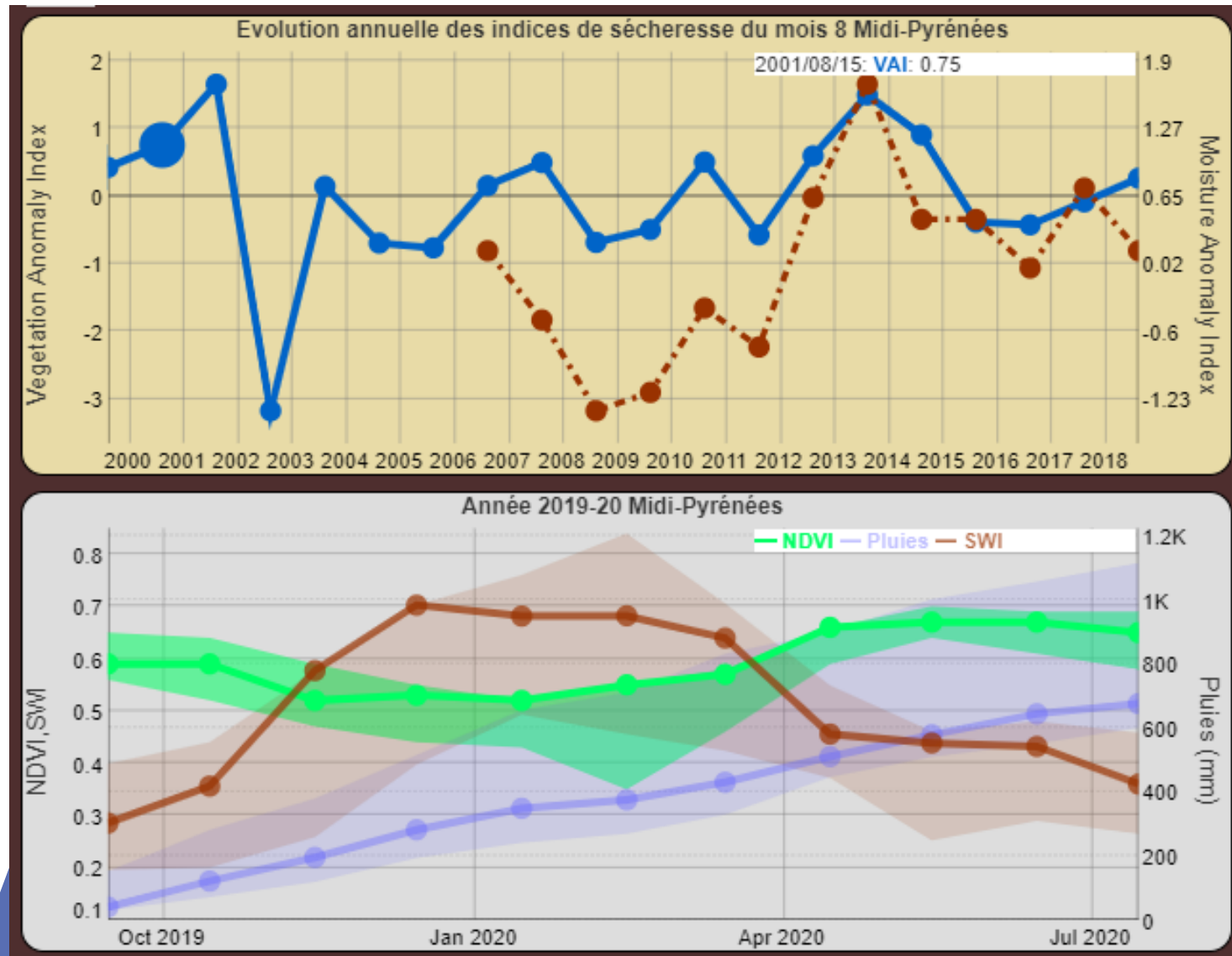
Next Project :
10k water bodies volume monitoring (>1ha)



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Satellite monitoring to forecast droughts and forward planning crop rotation



Satellite imagery gives efficient information on water content of soil.

For instance, the French Drought Index developed by CESBIO is a precious tool in supporting decision-making for sustainable water resources management :

- *It can be used by economic operators, farmers and states to predict and anticipate forecoming droughts.*
- *It is an additional indicator to available information used by the Prefect to limit or suspend water uses.*

What about the needs in terms **of quality** of the hydrological state for the Adour-Garonne basin ?



What are the knowledge gaps of the hydrological state for the Adour-Garonne basin ?

Quality

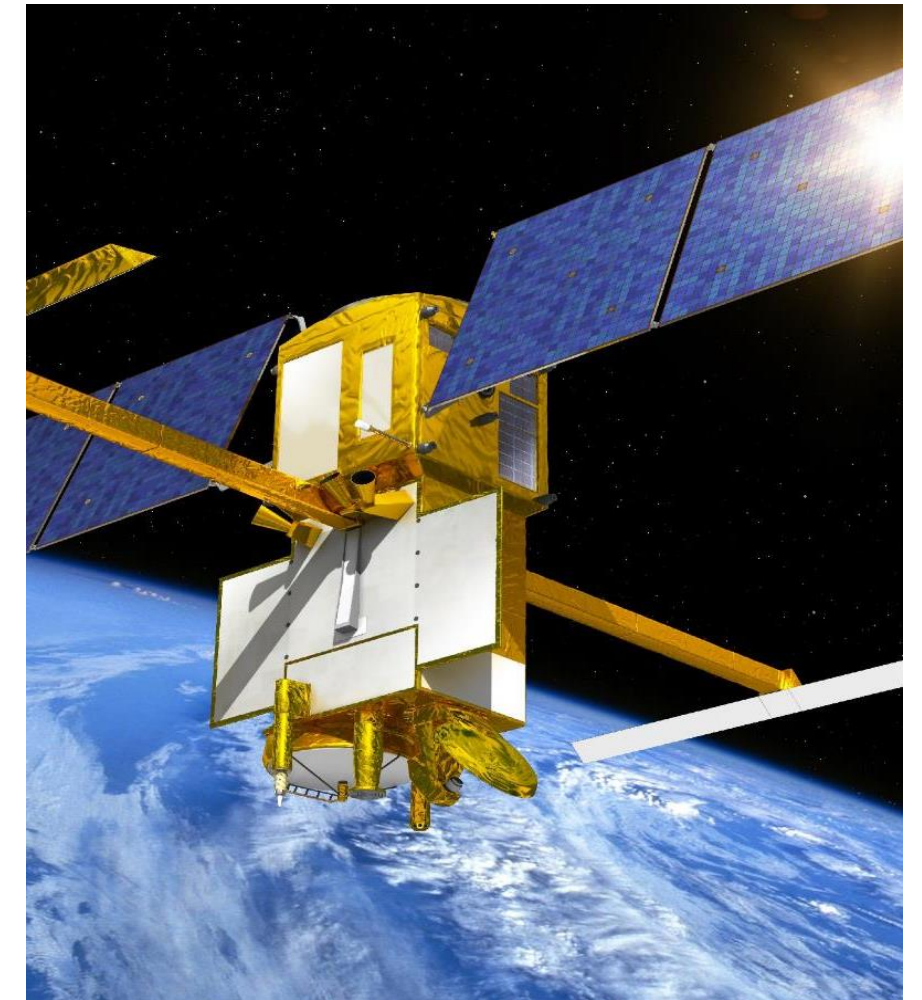
Water Agencies spend more than **200 M€ every year** on quality monitoring to obtain **20 M data per year**.

They use this data to define water quality state as demanded by the Water Framework Directive (2000).

Can satellite imagery contribute to this surveillance and how ?



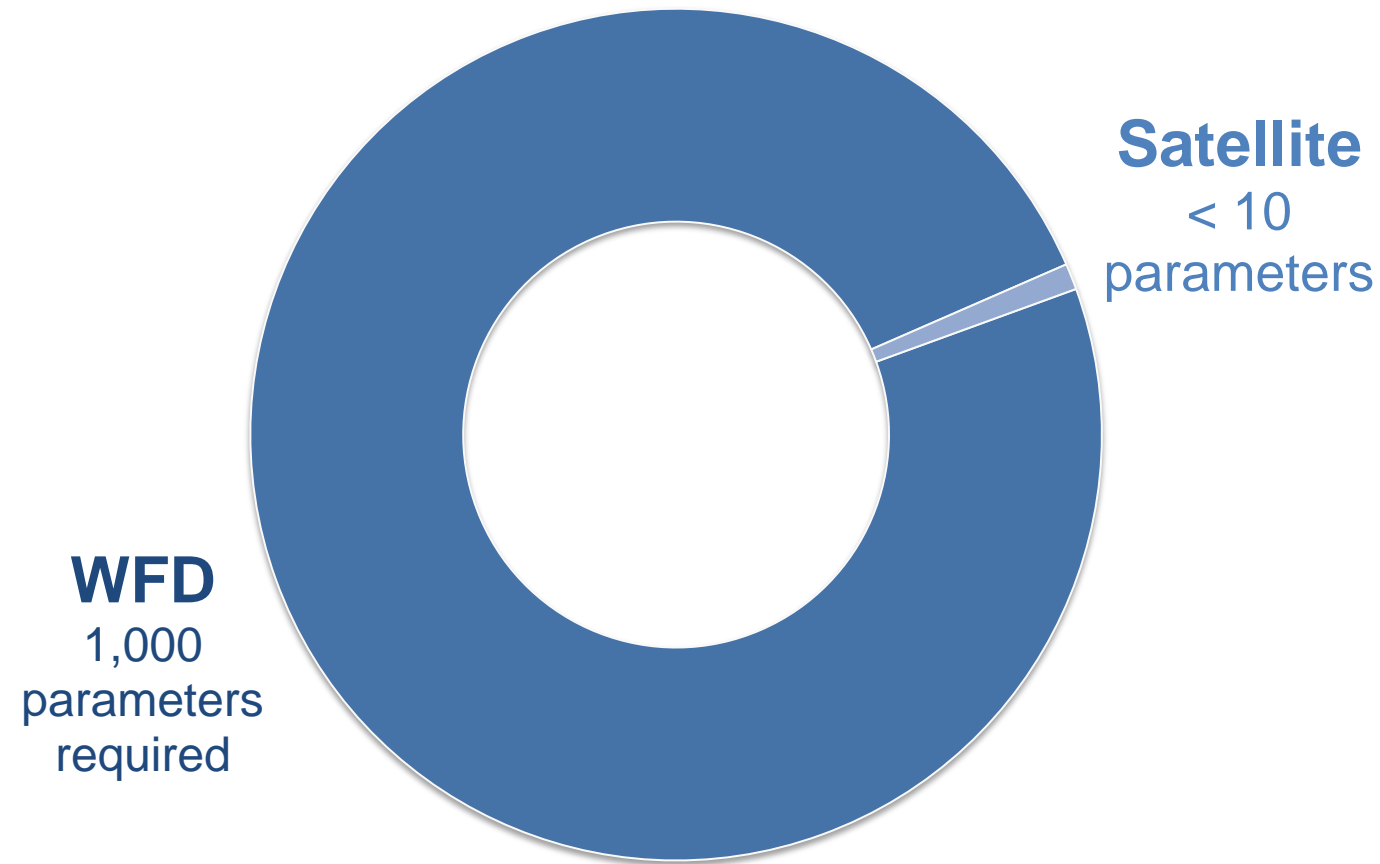
The goal of the WFD : To restore the chemical, biological and physical quality of each water bodies by 2027 (rivers, lakes, underground waters and coastal waters).



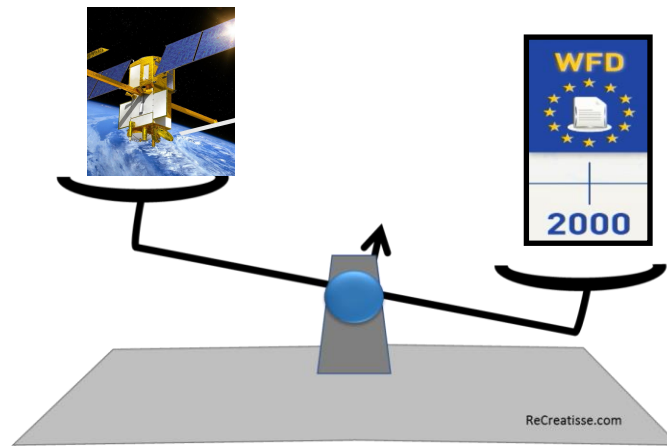
A significant challenge !

Today, satellite imagery acquires 10 parameters while the monitoring of the ecological and chemical state of the environment relies on 1 000 parameters.

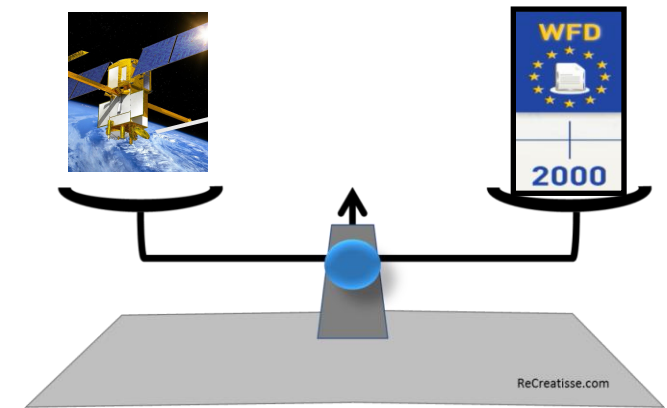
Ecological state :



Harmful algal blooms (HAB)
Chlorophyll-a (microg/L)
Turbidity (FNU)
Surface water temperature (°C)
Dissolved organic material (cDOM) (mg/L)
Suspended particulate matter (MES – SPM) (mg/L)



2022



Realistic future ??

The Agency's current satellite imagery uses :

In the situational analysis to :

- assess agricultural pressure,
- improve our river quality estimation model where

we can not monitor

(50% of our river water bodies modeled, 1 300 river water bodies)



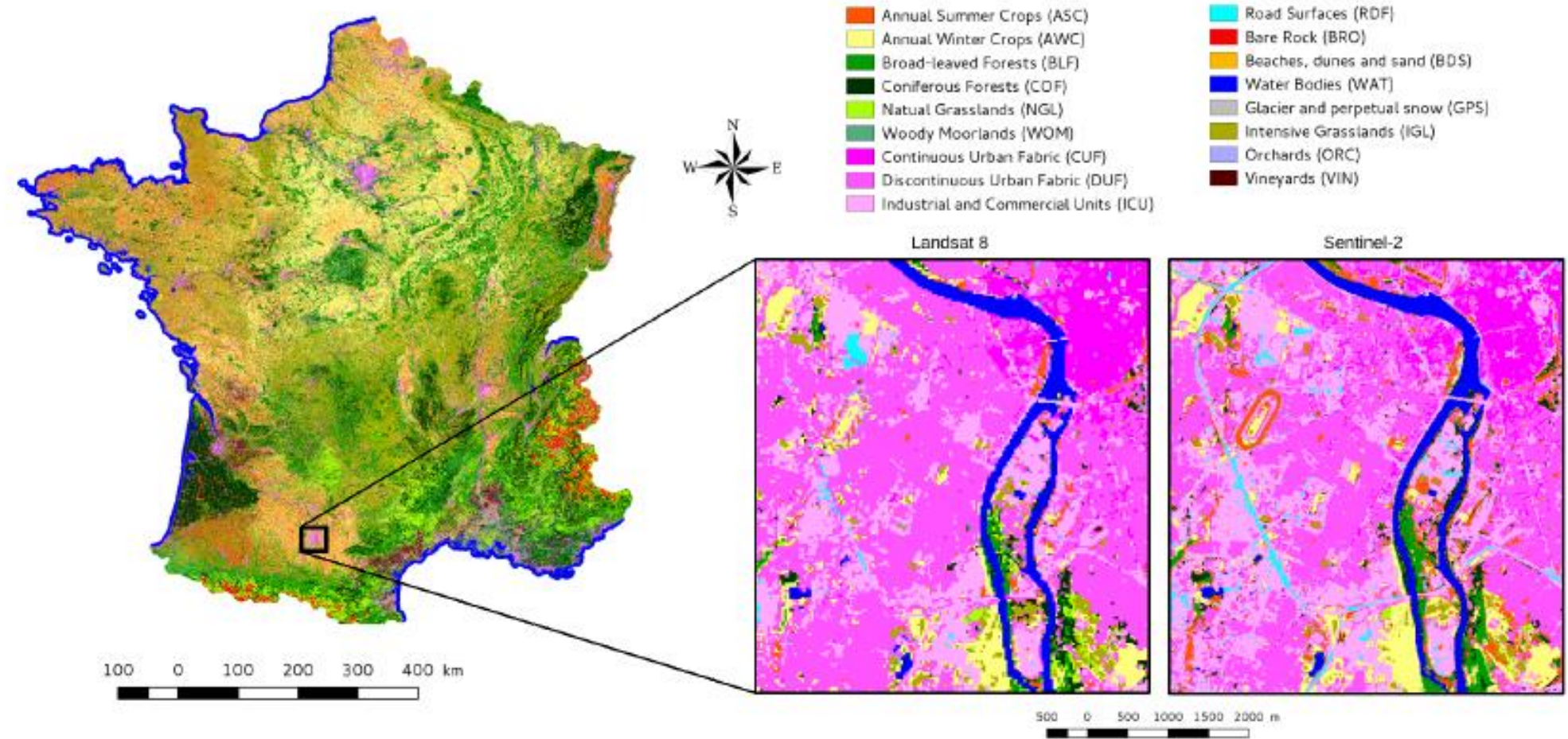
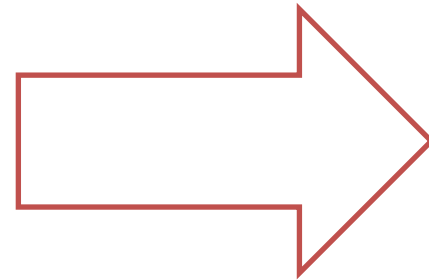
Context

Produit Couverture Sol OSO – France

Iota2



Logiciel libre:
Cesbio/CNES



Pole de données

- Résolution 10m
- Fréquence de production **actuellement** annuelle
- Actuellement 23 classes (distinction de cultures)

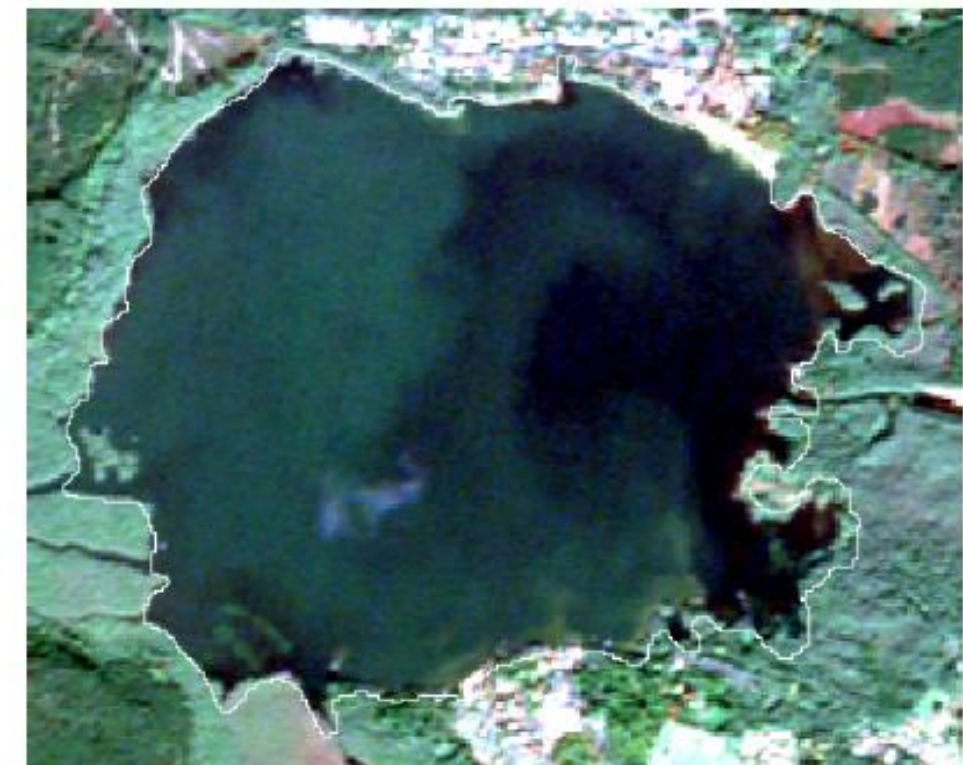
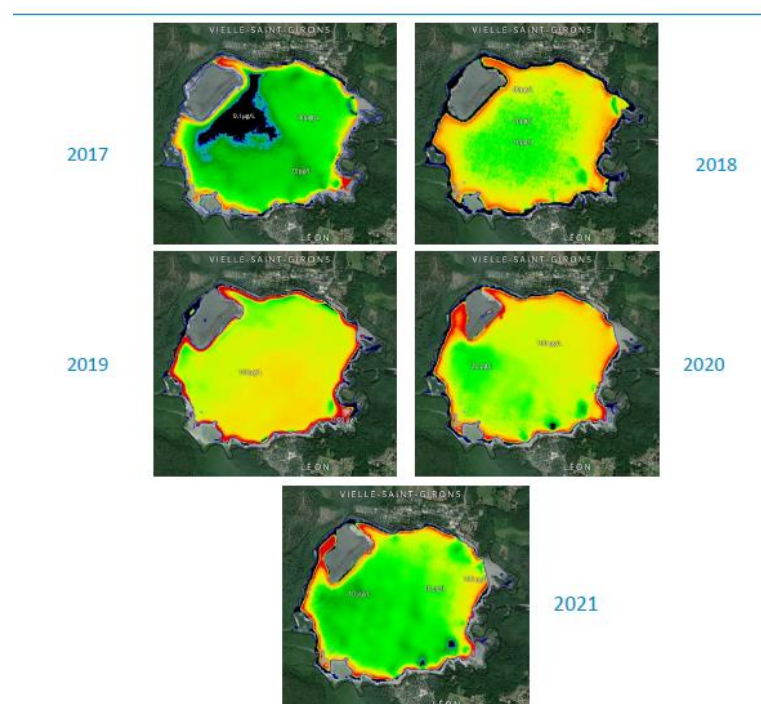
RÉPUBLIQUE

The Agency's current satellite imagery uses :

Local scale application :

- monitoring of cyanobacteria development on Léon in Landes

In 2020 : Beaches closure in summer season



Context :

Estuaries are high natural turbidity area (**Turbidity Maximum Zone**) which have a significant impact on the sedimentary budget, biogeochemical process and ecosystem biological quality (O²).

Question :

What is the real potential of spacial imagery to improve turbidity dynamics knowledge and in particular Turbidity Maximum Zone issues ?

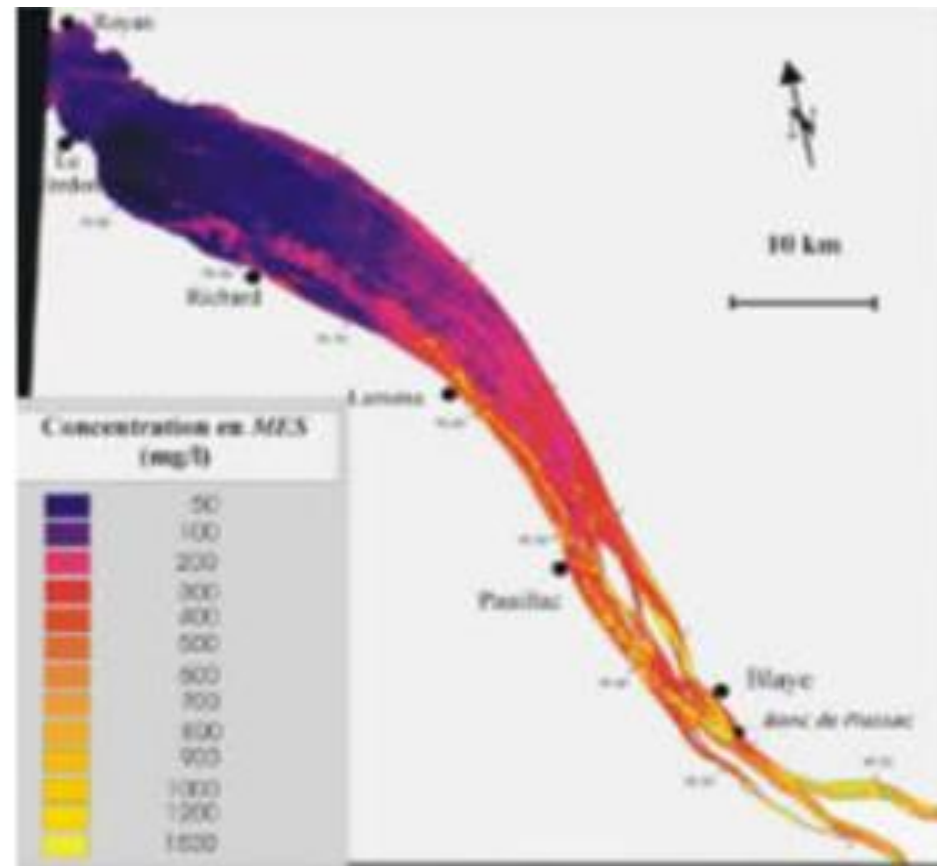
Stakes :

- Only european estuary with 8 migrating species left,
- In climate change context, better understand the Turbidity Maximum Zone (TMZ) dynamics that seems to travel upstream

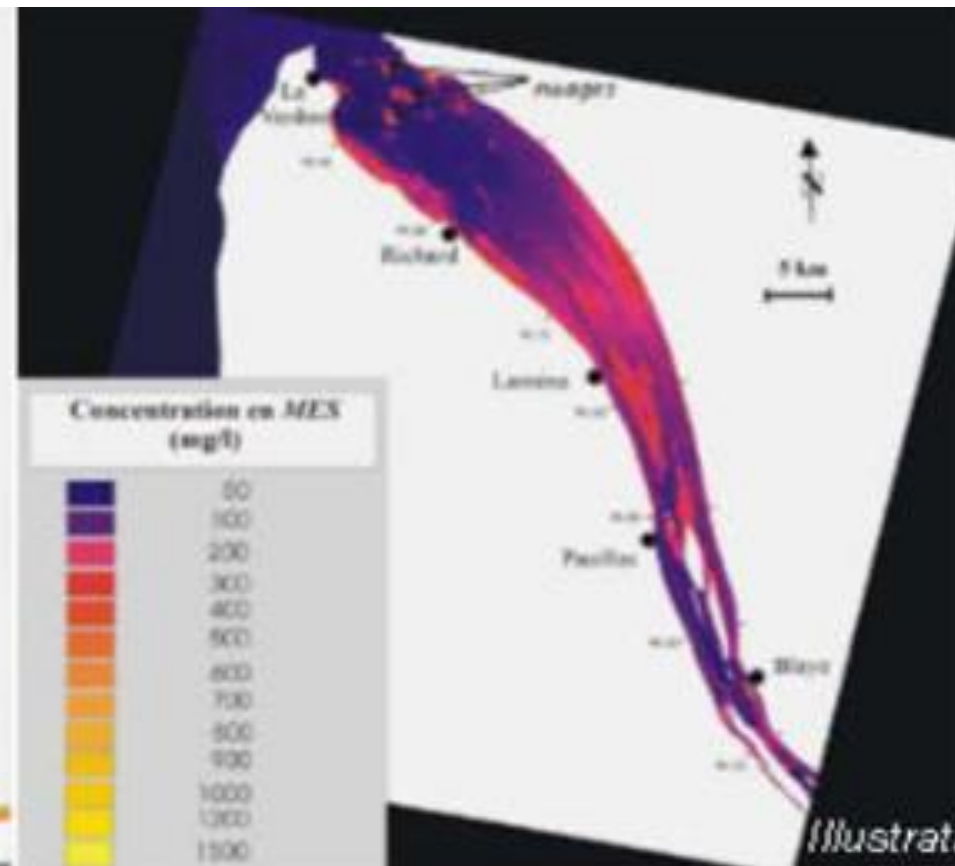


Flows

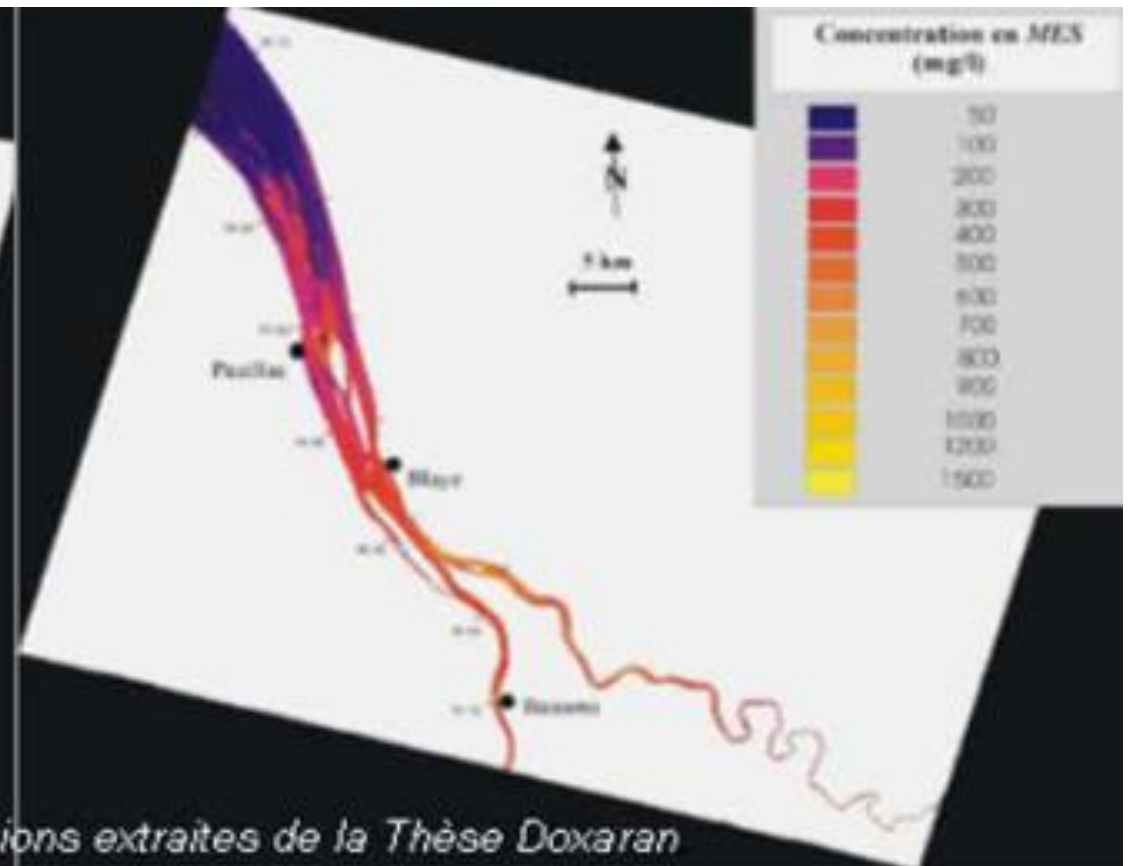
Average



Flood



Low water



Illustrations extraites de la Thèse Doxaran

Extrait : Virginie Lafont and coll. XIII èmes Journées Nationales Génie Côtier – Génie Civil / Dunkerque, 2-4 juillet 2014

RIVERCOLOR : chaîne de traitement des séries temporelles LANDSAT, SPOT et MODIS dédiée à la cartographie des matières en suspension en zone estuarienne



The Water Agency Adour-garonne and the CNES are preparing also the future



During the 'Calval' phase **SWOT** (launch of satellite scheduled for Q4 2022), will observe 2 'swaths' every day for 90 days.

This data represents **a unique opportunity** and dedicated technical work is under discussion between the Agency and CNES to work on the quality and quantity aspects.

