



Expertises Scientifiques & Technologiques

Modélisation Bactériologie Baignade

Emmanuel SOYEUX

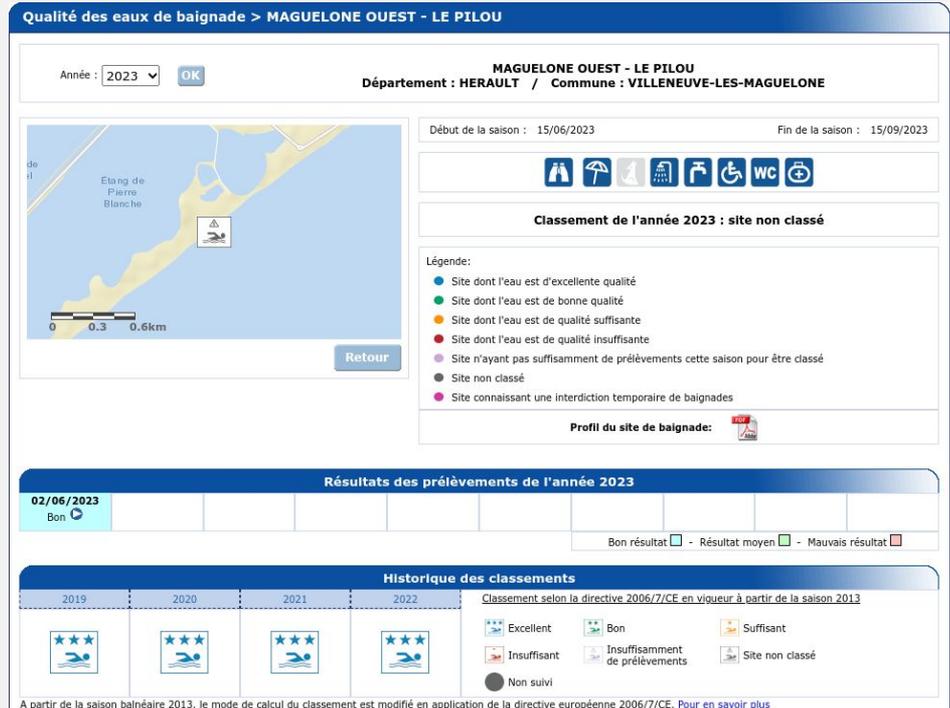
Plage ≠ Baignade

En France, l'eau des sites de baignade est contrôlée au minimum une fois par mois par les services de l'Etat (Prélèvement ARS et analyse par laboratoire agréé) :

Escherichia coli et entérocoques intestinaux dont la présence indique une contamination d'origine fécale

A distinguer :

- Classement sur 4 ans
- Qualité à un instant t



A partir de la saison balnéaire 2013, le mode de calcul du classement est modifié en application de la directive européenne 2006/7/CE. [Pour en savoir plus](#)

Plage ≠ Baignade

Le Maire peut fermer la baignade :

- dangerosité (drapeaux)
- qualité de l'eau

Qualification d'un prélèvement	<i>Escherichia coli</i> (UFC/100mL)	Entérocoques intestinaux (UFC/100mL)
Bon	≤ 100	≤ 100
Moyen	> 100 et ≤ 1000	> 100 et ≤ 370
Mauvais	> 1000	> 370

Analyse par méthodes miniaturisées (NPP)

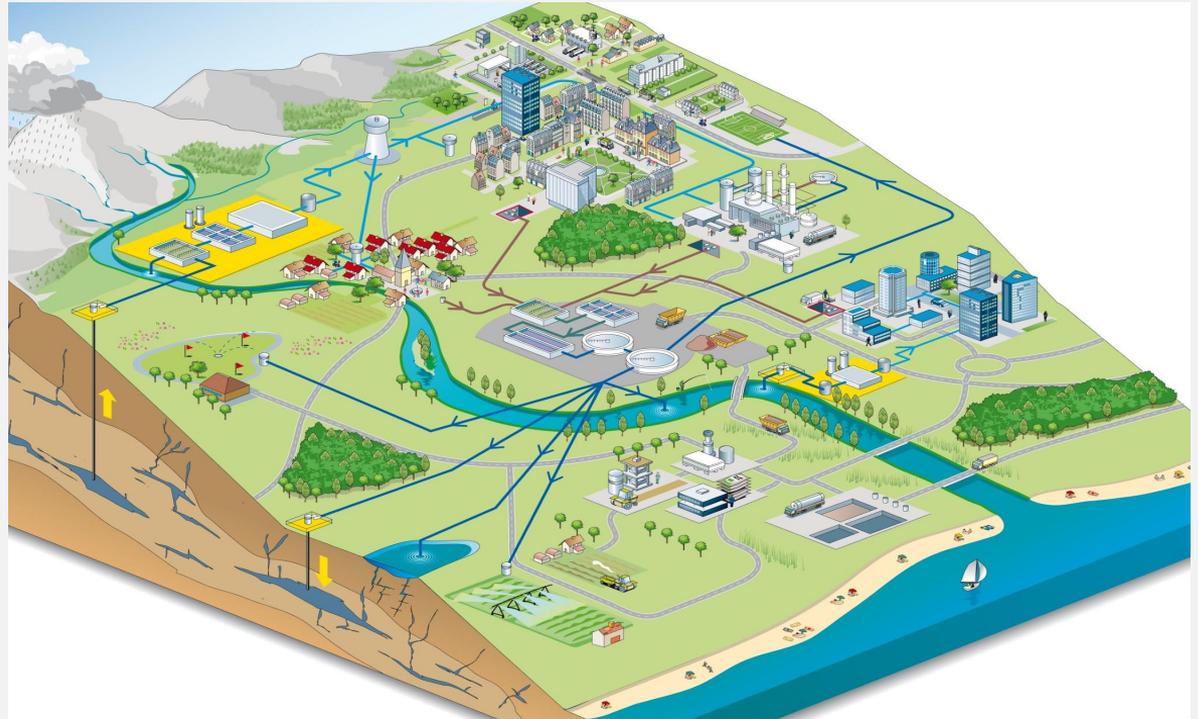
Délai d'obtention du résultat : 48 heures !

On connaît **mercredi** la qualité **microbiologique** de l'eau prélevée à un instant t le **lundi** !



Pour une gestion active des eaux de baignade

- Méthodes d'**analyses rapides** de l'eau : jours → heures
- Conjuguées avec des approches de prévision par **modélisation** numérique : anticiper et prélever au bon (plus mauvais !) moment



Modélisation : l'approche simple

- Pluie
- Vent
- Marée

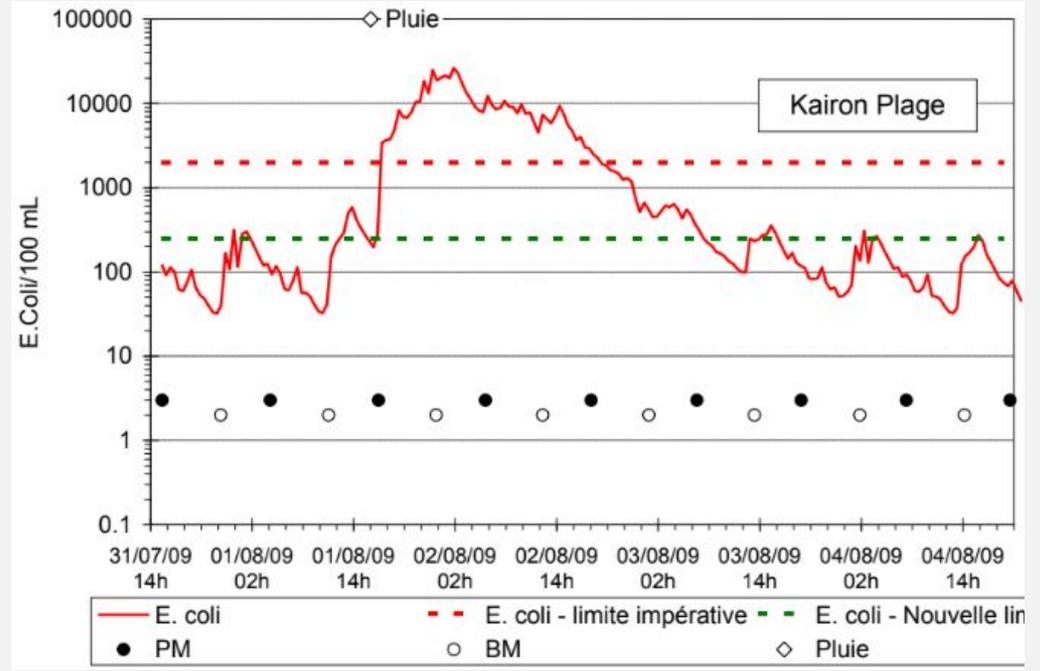
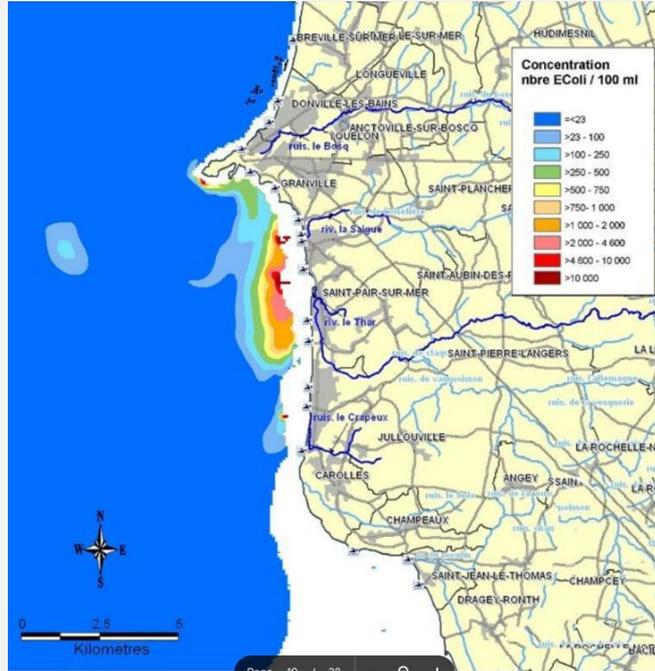
Une centaine de scénarios modélisés à l'avance

The screenshot displays the SAERS v1.04 software interface, which is used for modeling scenarios. The interface is divided into several sections:

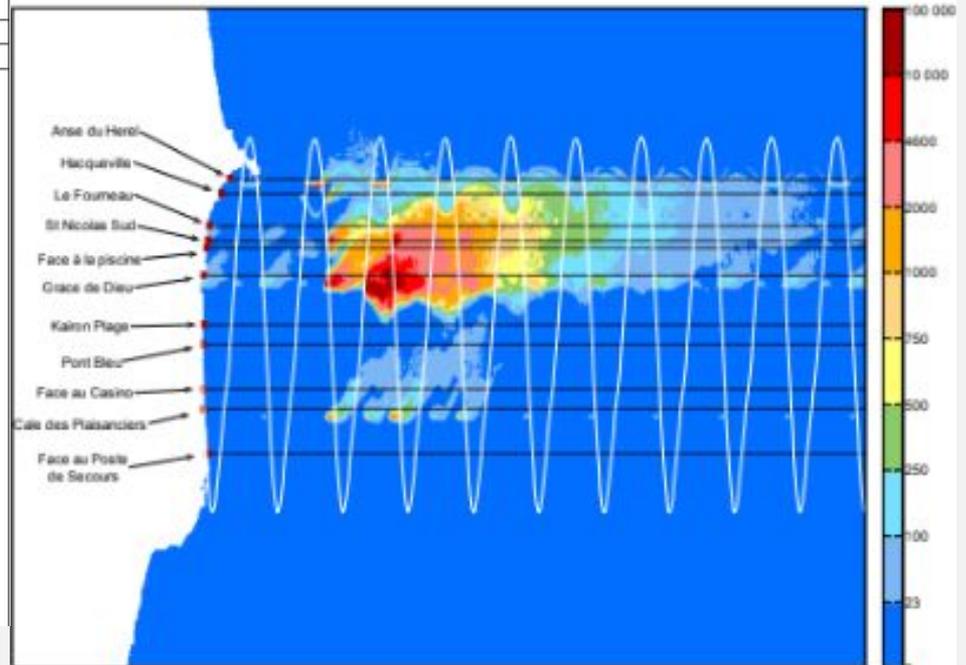
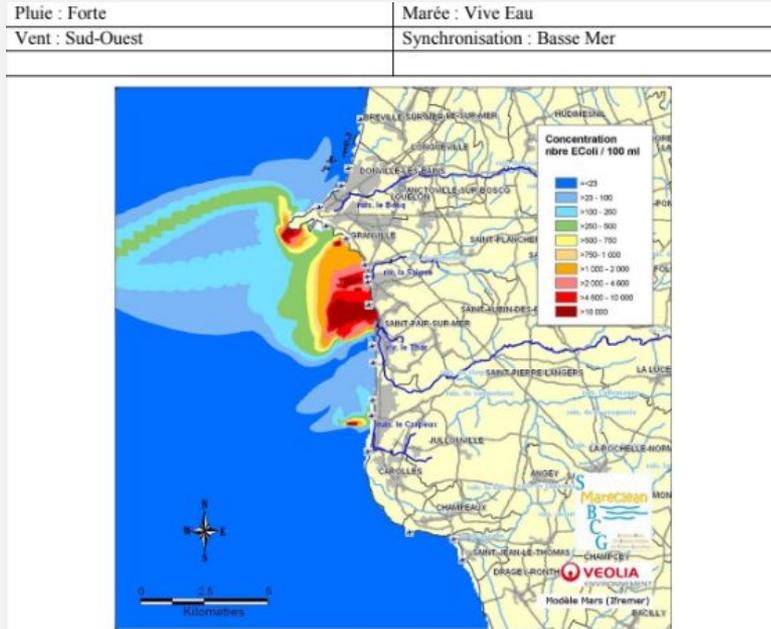
- 1 - Intervention opérateur**: Fields for Nom (TEST), Prénom (Test), Date (01/08/2009), and Heure (12:19). There are also fields for Prochaine Pleine Mer à, Prochaine Basse Mer à, and Coefficient de Marée.
- 2 - Situation des dernières 36h**: Radio buttons for Pluie (selected), Rejet de temps sec, and Absence de rejet. Below this is the MareClean logo.
- 3 - Vent annoncé**: Radio buttons for Vent non significatif (inférieur à 5 m/s), Vent de direction Sud-Ouest, Vent de direction Nord-Ouest, and Vent tournant de Sud-Ouest à Nord-Ouest.
- 4 - Pluie la plus forte (dernières 36h)**: Fields for Intensité maximale sur 1h (à titre indicatif), Valeur (mm), Date, Heure début, and Heure fin. Below this is the section for Durée de la pluie, with fields for Date début, Heure début, Date fin, and Heure fin, and a field for Cumul global (mm).
- 5 - Rejet temps sec**: Radio buttons for Rejet Bosc, Rejet Hacqueville, Rejet Saigue, and Rejet Thor.
- 6 - Période de rejet de temps sec**: Fields for Date début, Heure début, Date fin, and Heure fin.
- 7 - Exécution**: Buttons for Sauvegarder et déterminer le scénario and Effacer formulaire.

At the bottom right, there is a button labeled "Charger données ...".

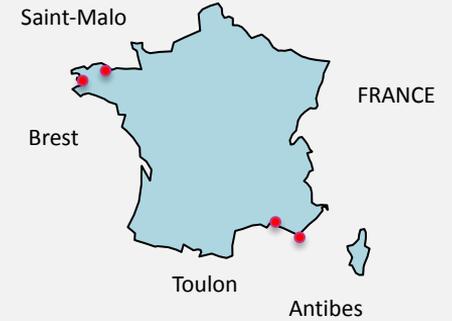
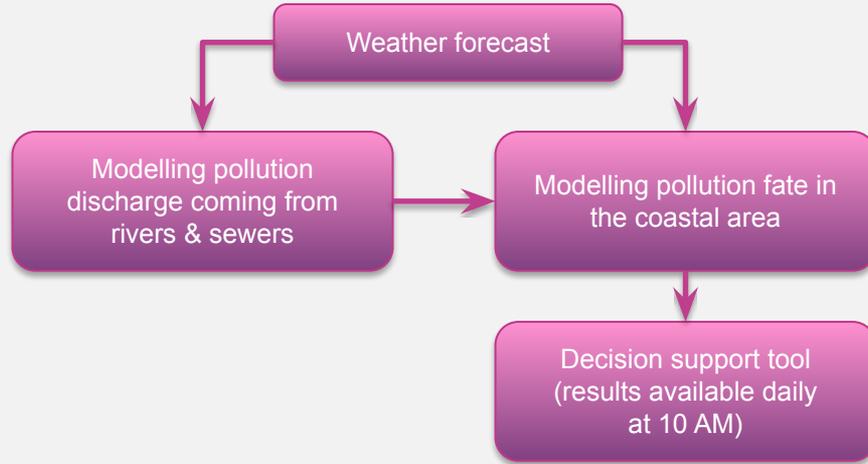
Modélisation : l'approche simple (suite)



Modélisation : l'approche simple (fin)



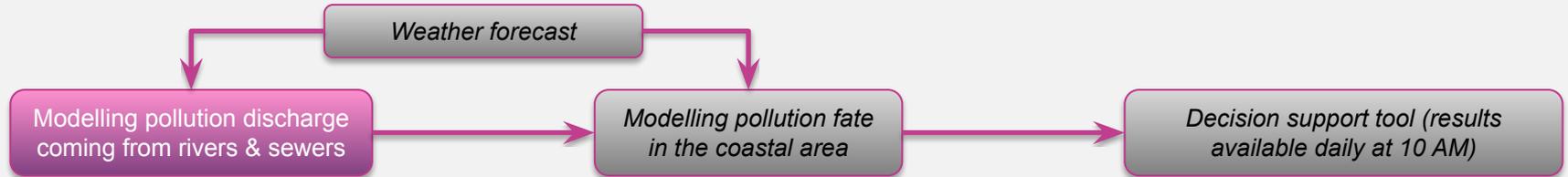
Modélisation : l'approche plus compliquée



	Today													Tomorrow										
	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	00:00	01:00	02:00	03:00	04:00	05:00
Le Ponteil	Low Risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Fort Carré	Low Risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Garoupe Ouest	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
La Salis	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
La Gravette	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Fontonne Ouest	Medium risk	Medium risk	Low Risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Fontonne Est	No risk	No risk	No risk	Low Risk	Low Risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk								
Marineland	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk

No risk ■ Low Risk ■ Medium risk ■ High risk ■

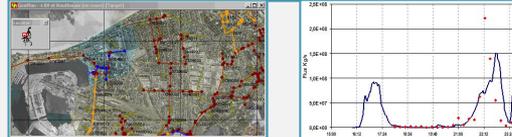
Modélisation : l'approche plus compliquée - Etape 1



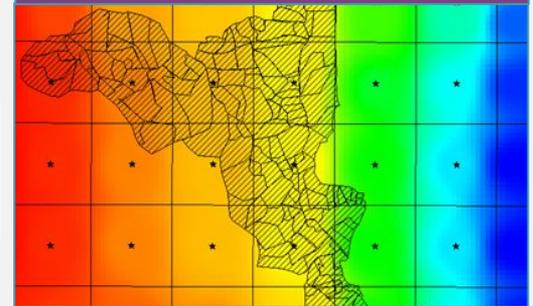
Monitoring flow & sampling [bacteria]
in rivers & sewers



Calibration & validation of the model
(flows then fluxes) using InfoWorks® CS
(Innovyze)



Automation of model forecast using
local rainfall forecast



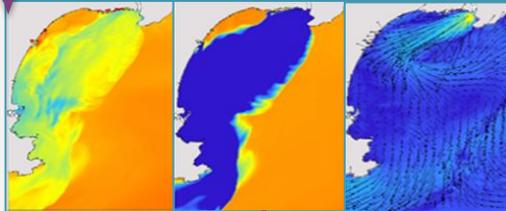
Modélisation : l'approche plus compliquée - Etape 2



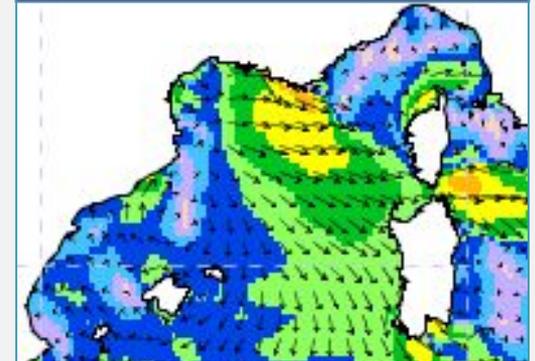
Monitoring salinity & sampling [bacteria]



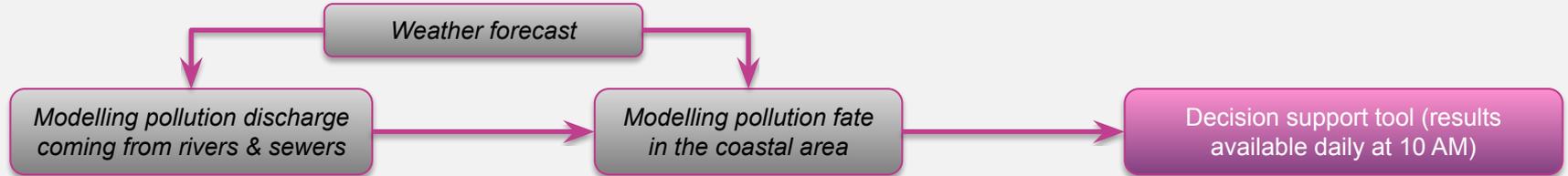
Calibration & validation of the model (temperature, salinity, current then [bacteria on beaches]) using MARS software (Ifremer)



Automation of model forecast using wind forecast & forecasted bacteria fluxes from rivers & sewers



Modélisation : l'approche plus compliquée - Etape 3

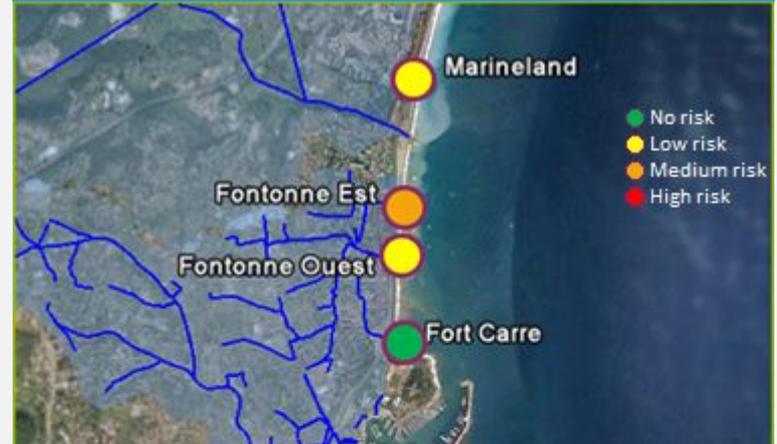


Hourly evolution of water quality for each beach (E. coli)

	Today													Tomorrow											
	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	00:00	01:00	02:00	03:00	04:00	05:00	06:00
Le Ponteil	Low Risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Fort Carré	Low Risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Garoupe Ouest	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
La Salis	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
La Gravette	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Fontonne Ouest	Medium risk	Low Risk	Low Risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk										
Fontonne Est	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk
Marineland	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk	No risk

No risk ■ Low Risk ■ Medium risk ■ High risk ■

Map of beaches water quality today (E. coli)



Conclusion

- L'approche compliquée de modélisation est restée à l'état de prototype
- L'approche simple de modélisation a été utilisée de manière opérationnelle pendant plusieurs années et est tombée en désuétude
- Les analyses rapides de l'eau ont précédé et ont survécu aux approches de modélisation