

Urban Wind Design for the Citadel of Bonifacio



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Urban Climate
20th July 2015,
Toulouse, France**

URBALTERRE - Atelier Montlaur - Collectivité Territoriale de Corse - 29.09.2014

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1 - LOCATION AND DIAGNOSTIC

1 / Location and diagnostic

2 / Process

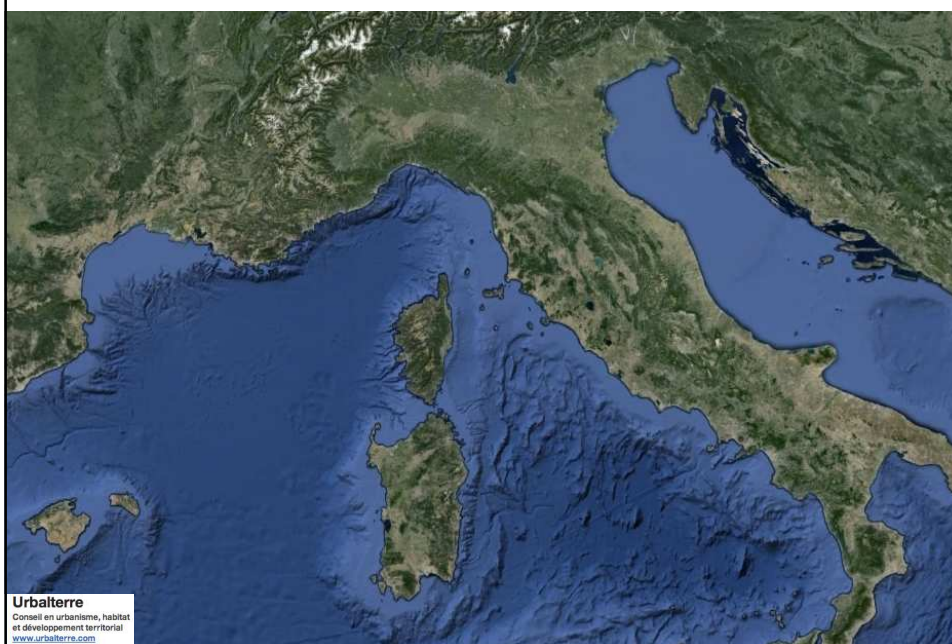
3 / Results

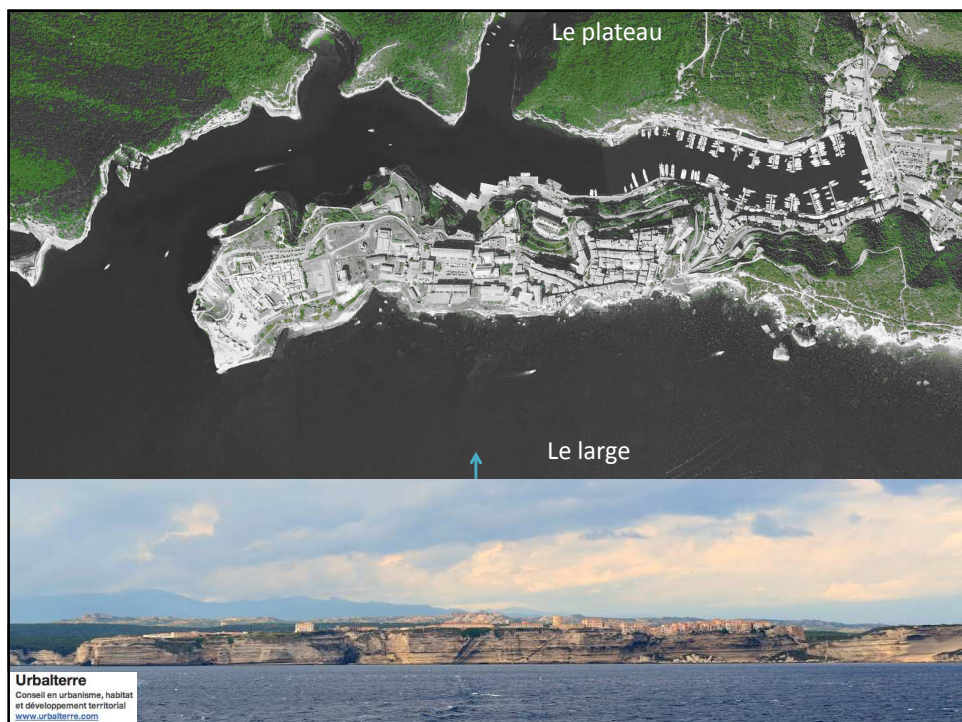
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The straight of Bonifacio, between Sardegna and Corsica



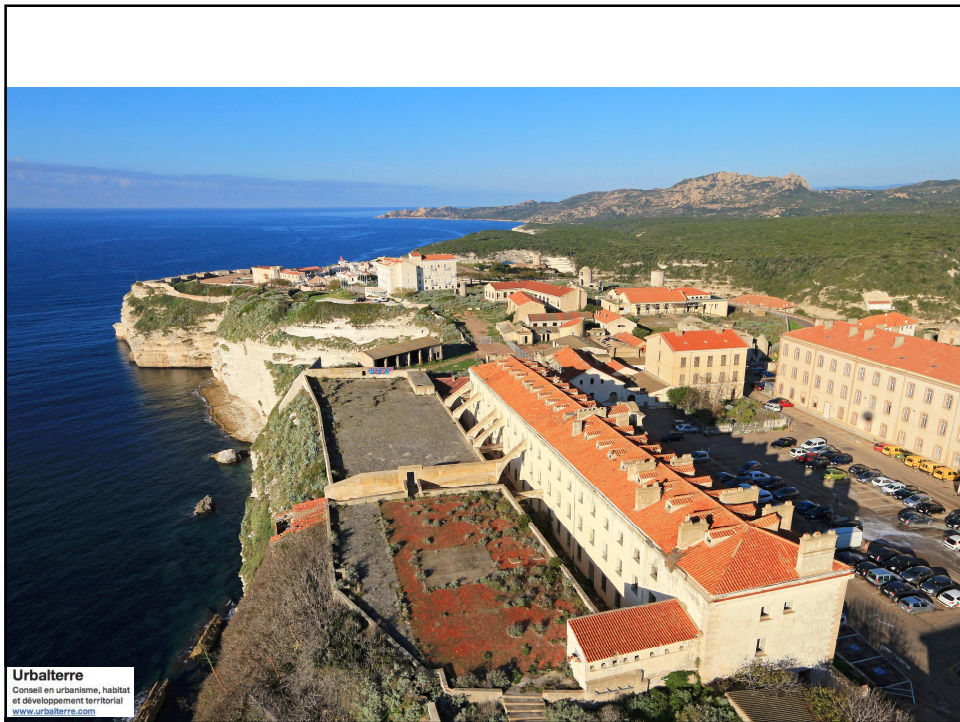




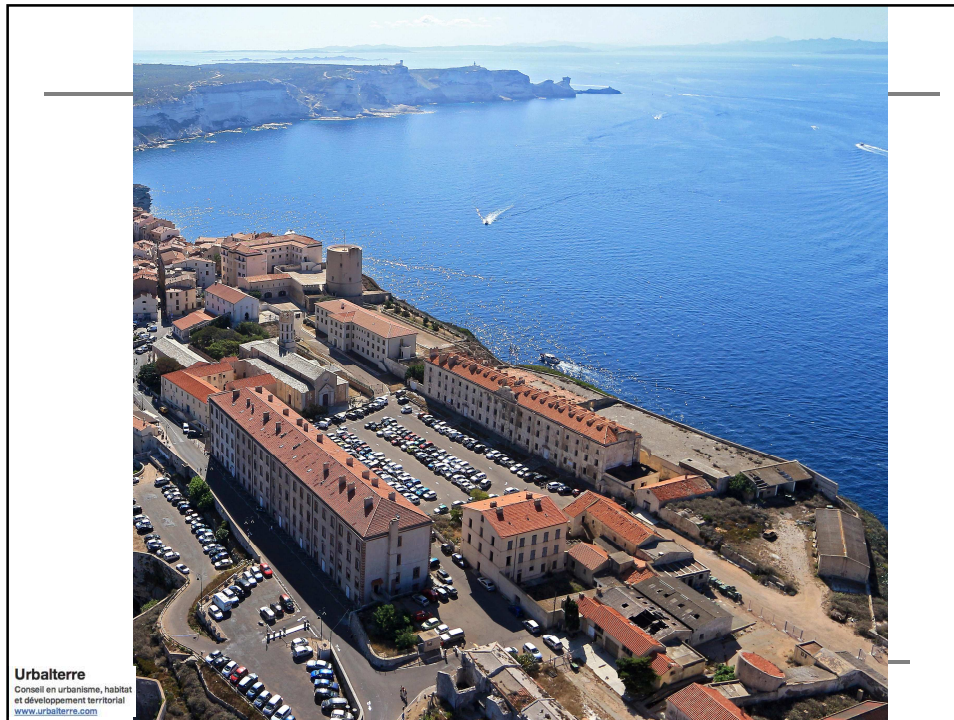
Up to the Cliff : The old town, the old military base and the cemetery

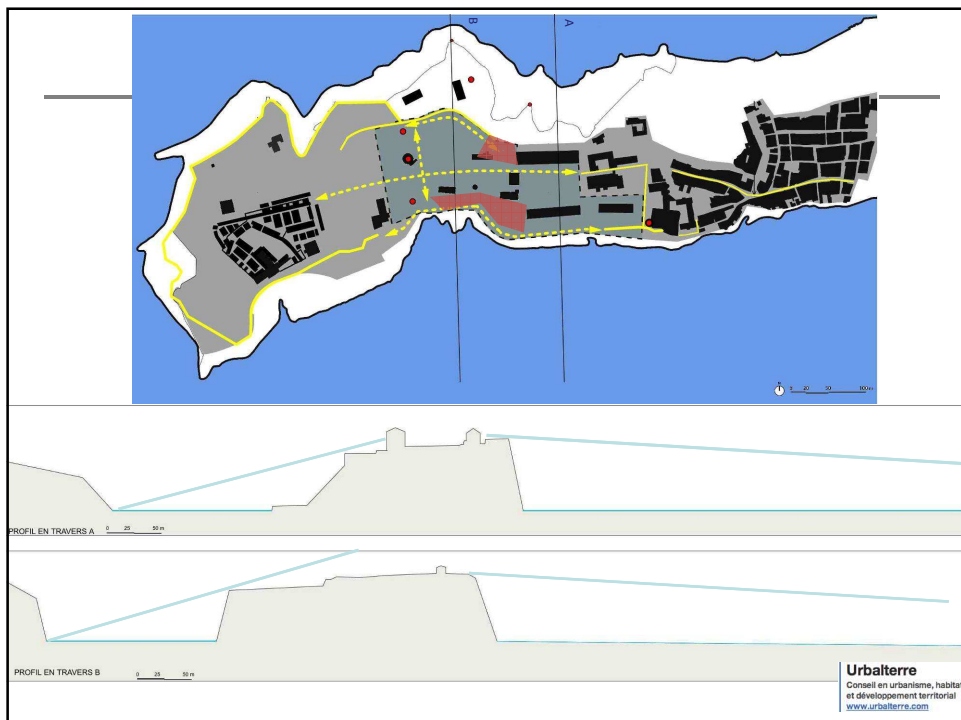


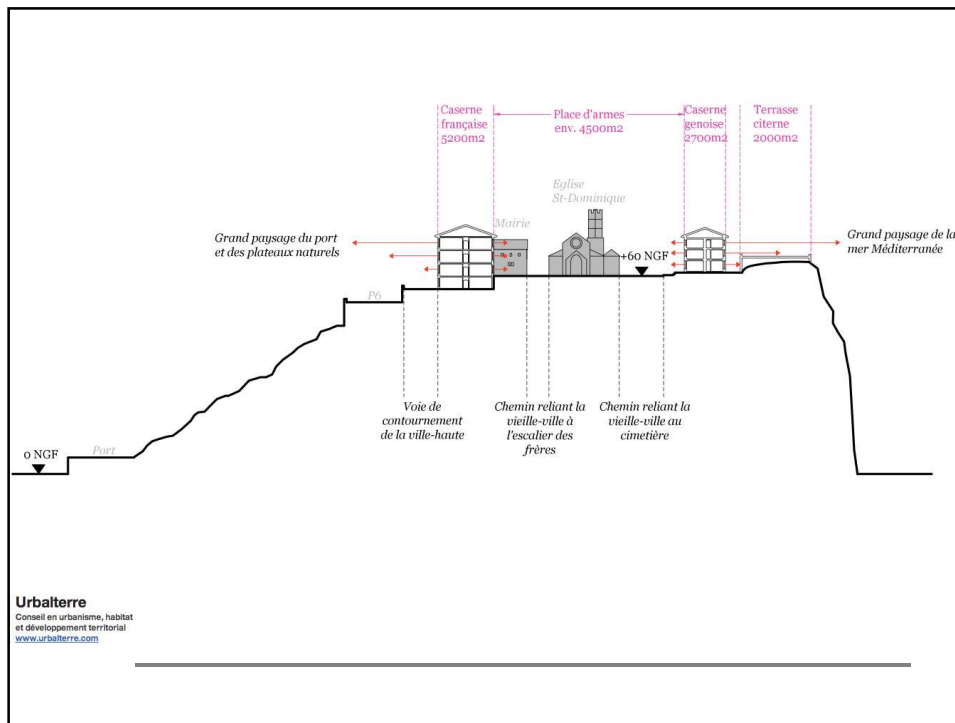
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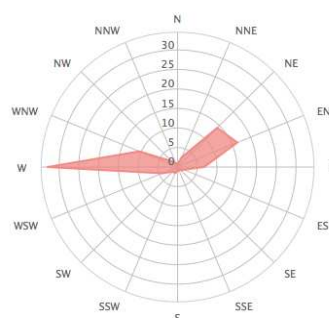




Bonifacio is called « fille du vent » - « daughter of the wind »

Mois	Jan	Fév	Mar	Avr	Mai	Jun	Jui	Aoû	Sep	Oct	Nov	Dec	An
	01	02	03	04	05	06	07	08	09	10	11	12	1-12
Direction du Vent dominant	>	>	>	>	>	>	>	>	>	>	>	>	>
Probabilité du vent >= 4 Beaufort (%)	51	53	61	65	53	53	54	40	51	60	59	54	54
Vitesse du vent (kts)	14	13	14	14	13	13	12	11	13	13	14	15	13
Température de l'air moyenne (°C)	11	10	13	15	18	21	25	26	22	19	15	12	17

Wind direction distribution in (%)
An



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© windfinder.com

Bonifacio is called « fille du vent » - « daughter of the wind »

Strong wind all the year long

→ More than 150 days per year, all seasons

High speed wind

→ More than 20 days par year with 100 km/h wind

→ Every year storms with winds up to 120 km/h until 200 km/h

Location « in the wind »

→ The citadel is face to the strongest wind from the sea

Around 2 millions tourists visit Bonifacio each year.

The project : museum, new hôtel, baby nursery, housing and activities

Wind is a stake of urban comfort and city branding.

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Most windy cities in the world...

Chicago (USA) → called « **Windy City** ». The wind is not very strong but is very cold in winter from the lake Michigan and threew the regular streets.

Wellington (NZ)→ Supposed to be the windiest city in the world, 2/3 days up to 4 Beaufort all the year long.

Punta Arenas (Chile) → **Windiest than Wellington**, and moreover is located « sous le vent »

Tarifa (Spain) → Close to Gibraltar, supposed to be the windiest in Europe, but less than Bonifacio.

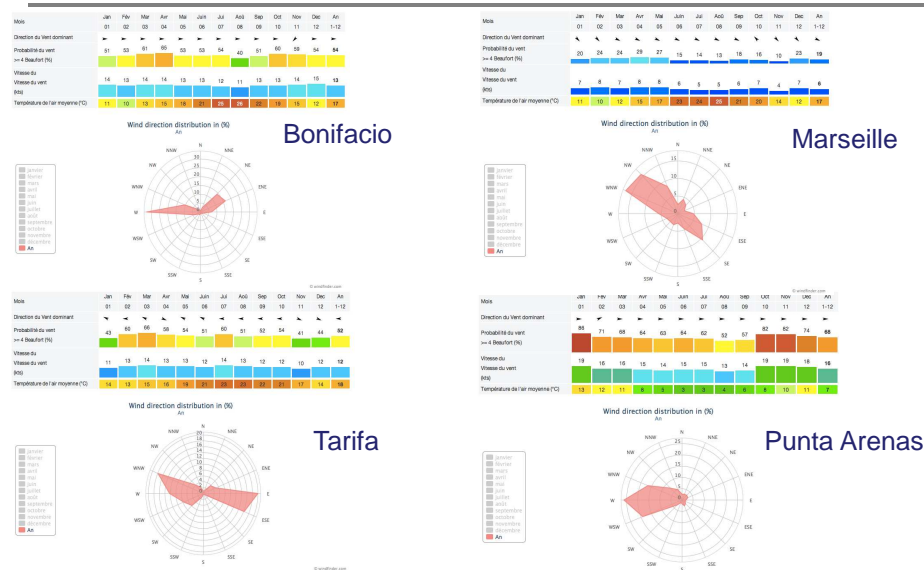
Essaouira (Marocco) → supposed to be the windiest in North Africa, but less than Bonifacio.

Karpathos (Greece) → As windiest as Punta Arenas 6 months in the year

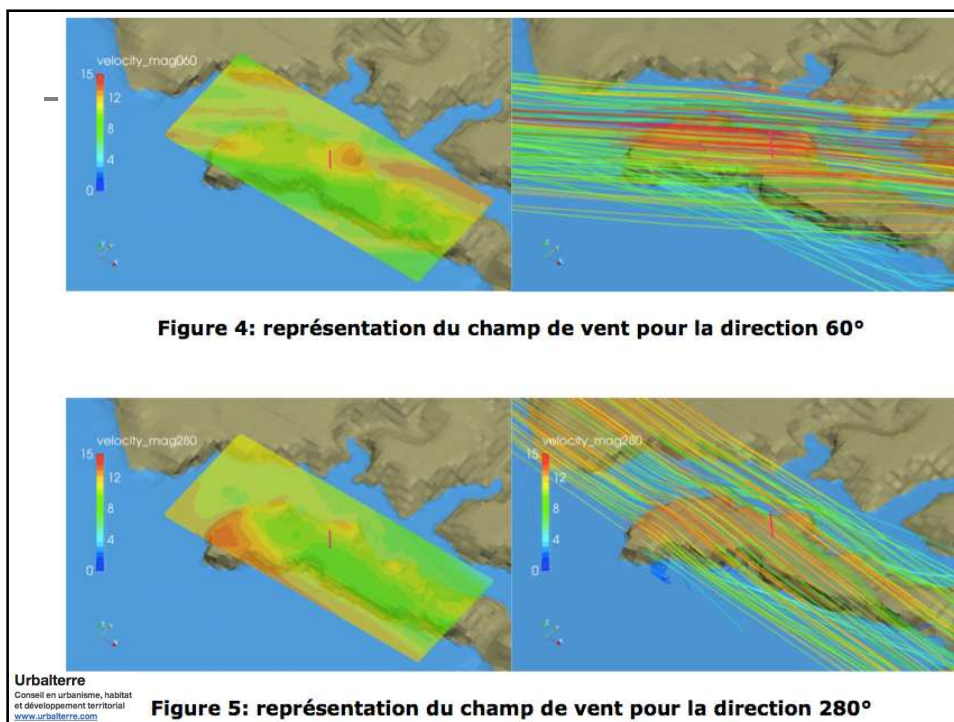
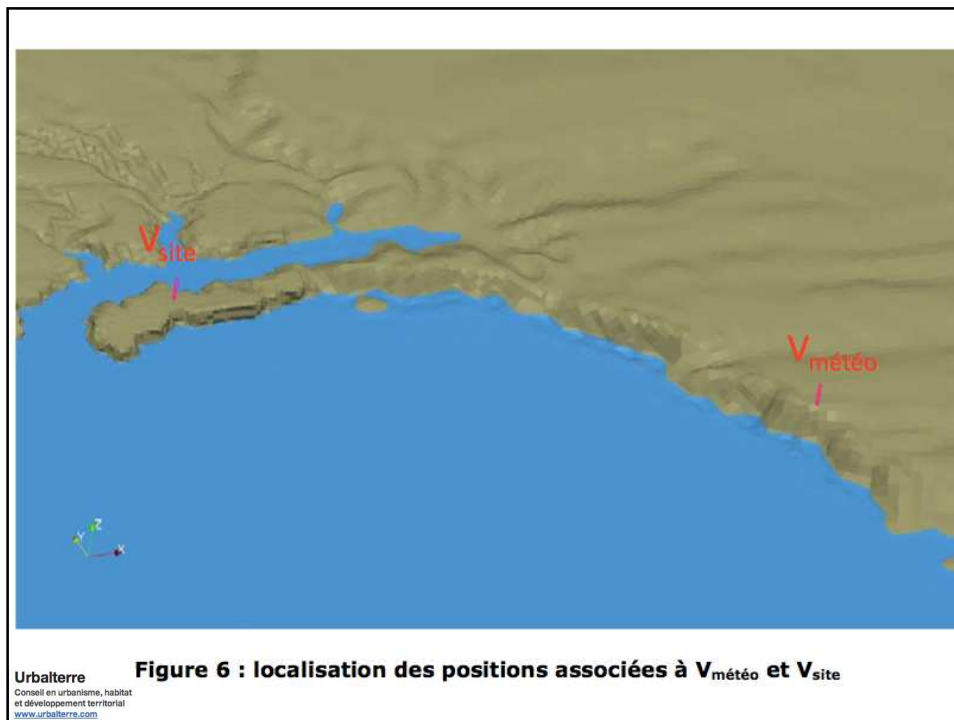
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Probably the windiest city in Europe and Mediterranean Region

Sources : www.windfinder.com www.infoclimat.fr



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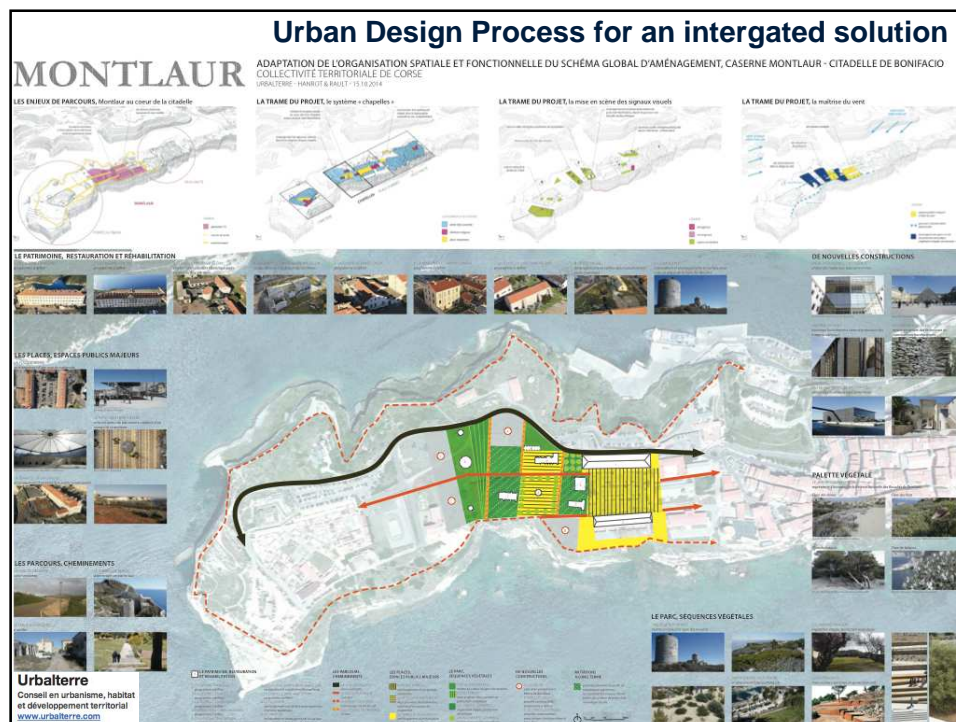


2 - PROCESSES

1 / Urban design methods

2 / Wind speed modelization

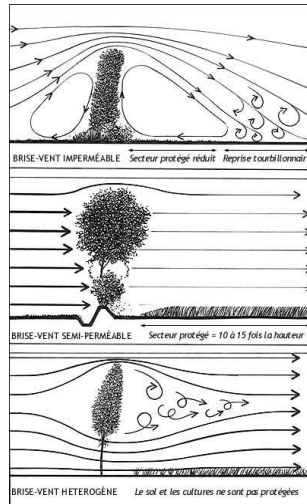
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An integrated solution to control wind effects

With skills from traditionnal building, farming and wind turbine industry :

➔ Oriented buildings back to the wind, fields protection, wind turbine location



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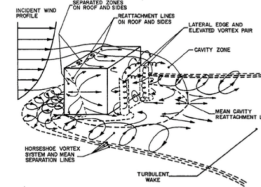
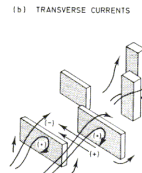
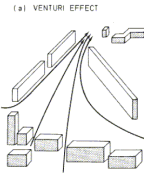


Figure 1. Sketch of flow distortions by a rectangular building (from Hosker 1979)

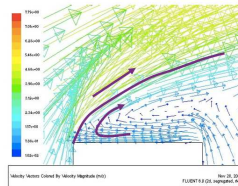


Figure 14: Wind flow around a building

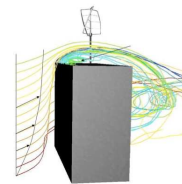
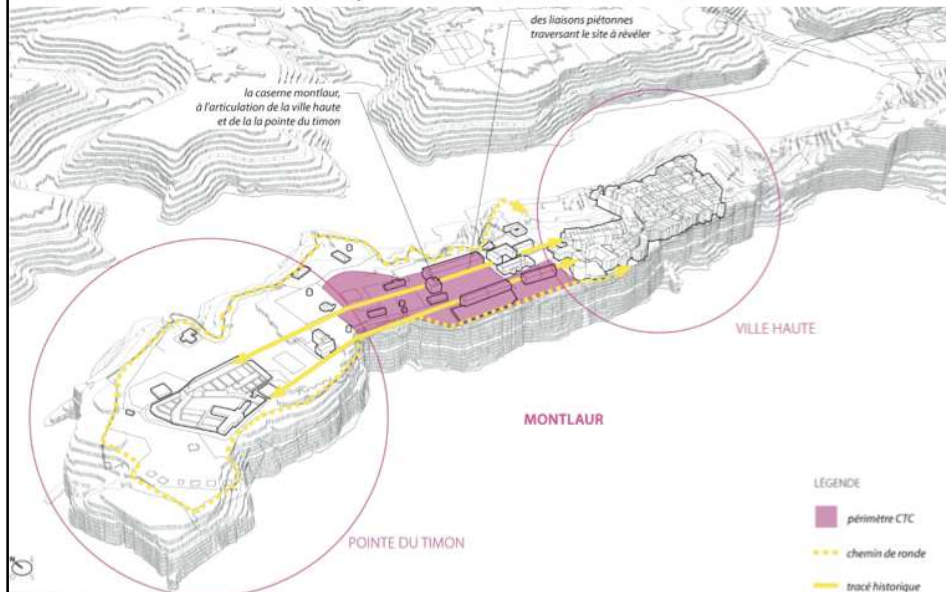
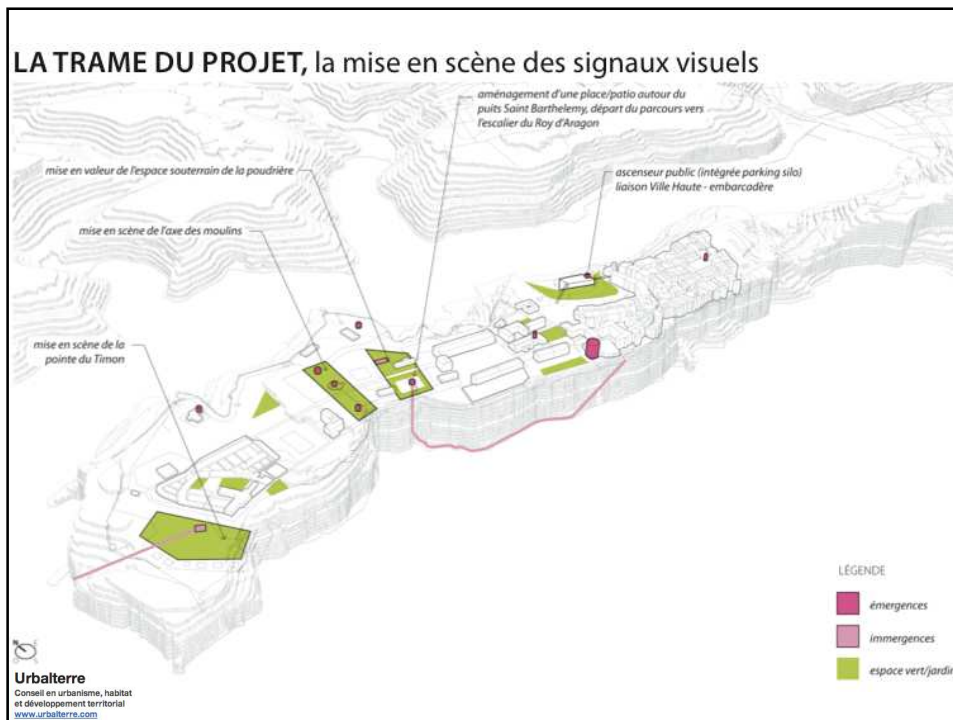
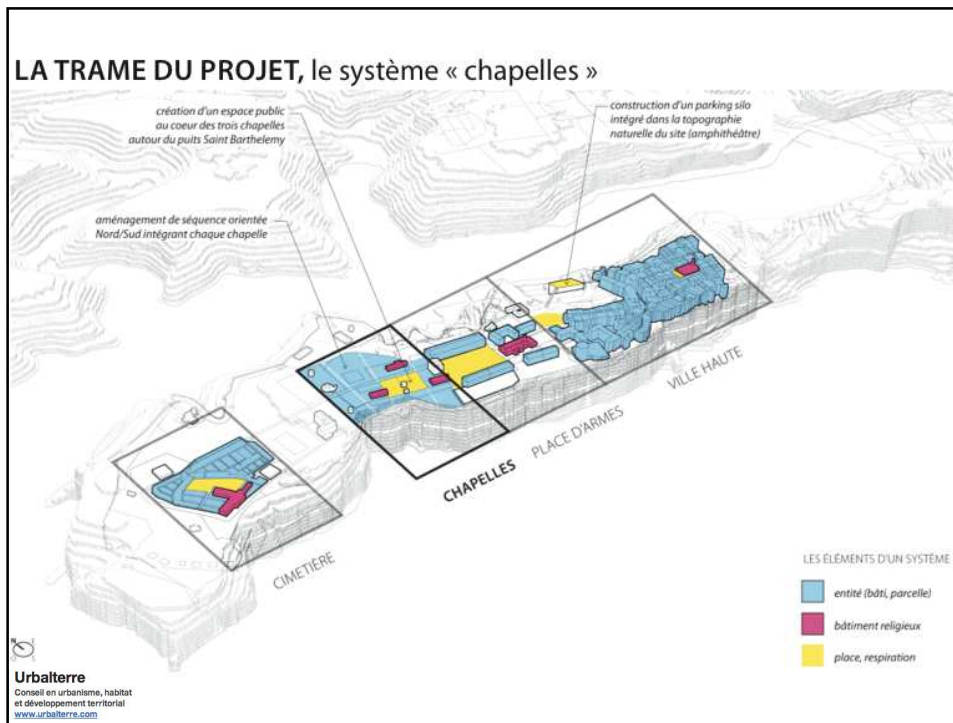


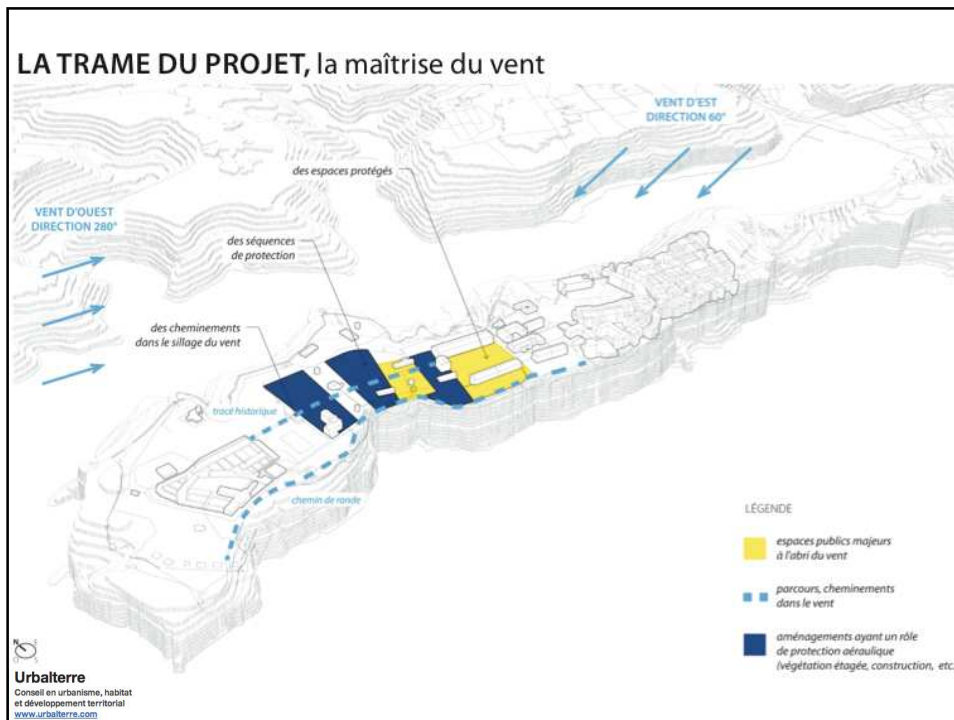
Figure 15: Placing a turbine on the roof

LES ENJEUX DE PARCOURS, Montlaur au cœur de la citadelle



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Wind study process

A study process combining two solutions :

- ➔ Computational Fluid Dynamics (CFD) modelization, with URBABIND
- ➔ Real turbine test on physical models, with CSTB Laboratory (Nantes, France)

An iterative process:

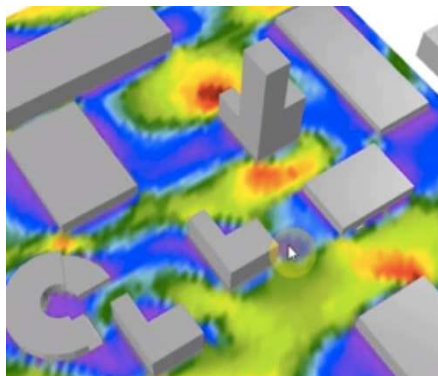
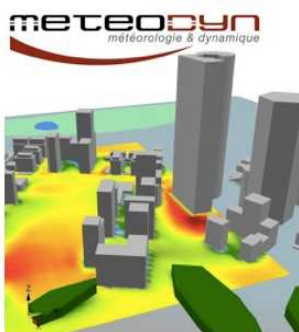
- ➔ From the test with the 2013 project, to the new URBALTERRE project
- ➔ With many CFD tests during the design, and two test with the turbine

UrbaWind

→ MeteoDyn en France, logiciel UrbaWind

Une évaluation précise des caractéristiques du vent...

- Vitesse moyenne et rafales de vent
- Direction du vent
- Intensité de la turbulence
- Coefficients de pression moyenne sur les bâtiments



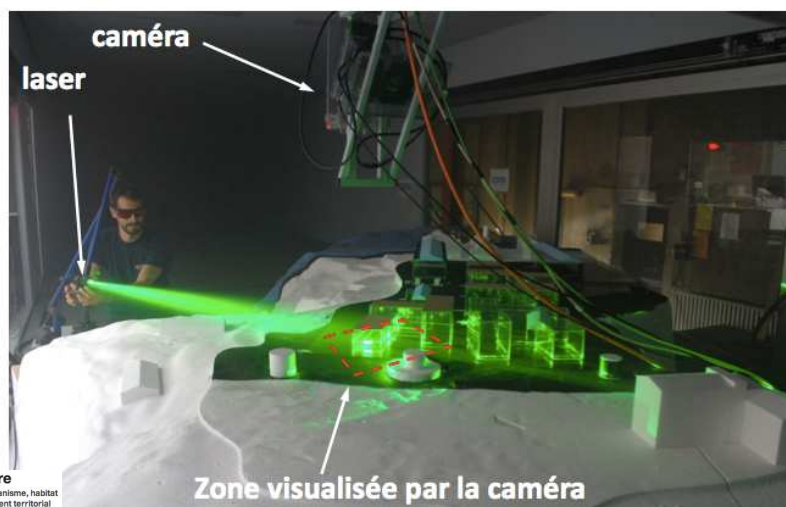
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Vélocimétrie par images de particules

CSTB
le futur en construction



- l'image couvre une zone de 20cm*20cm → il faut déplacer la caméra et le laser pour couvrir tout le site!
- mesure à 1.5cm du sol



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3 - RESULTS

1 / Diagnostic

2 / Process

3 / Results

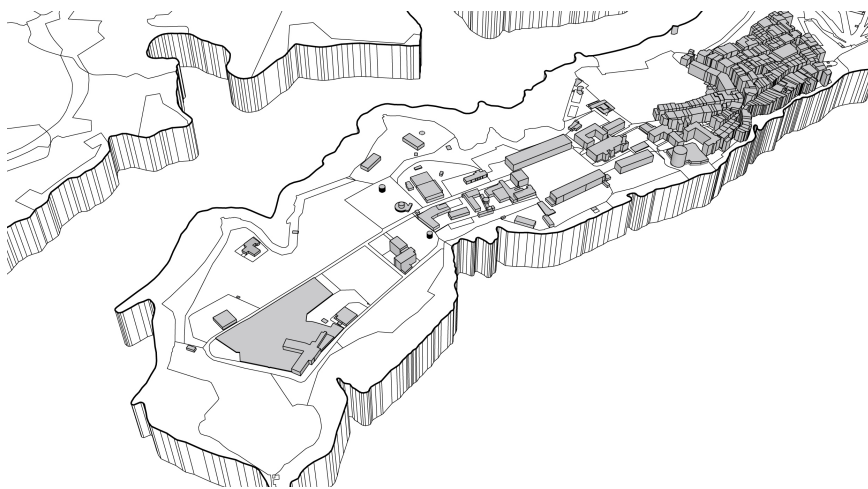
4 / Learnings

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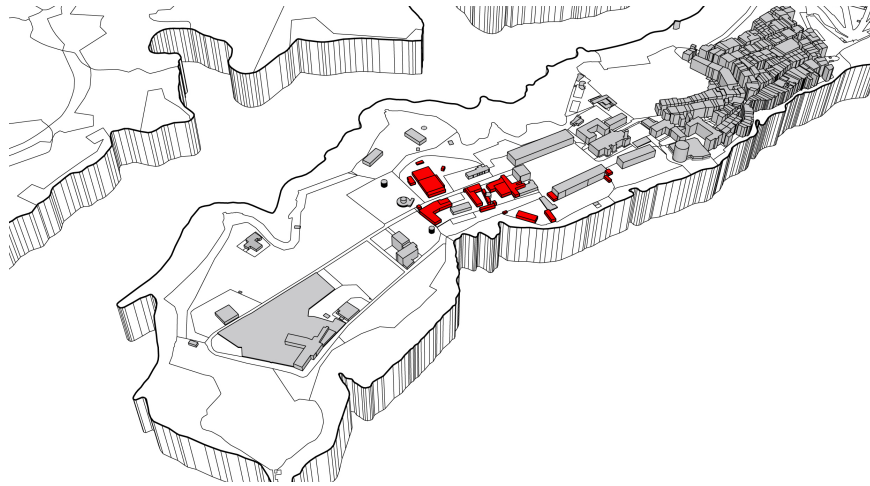
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Existing



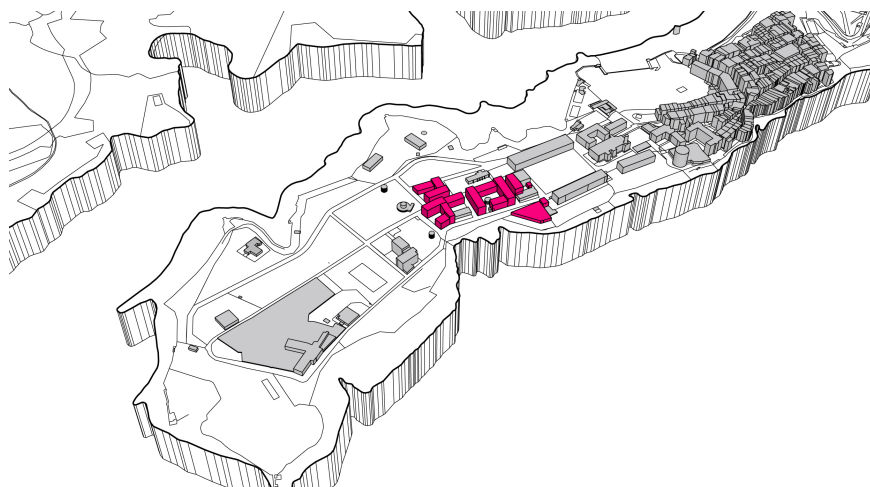
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Demolition (red)

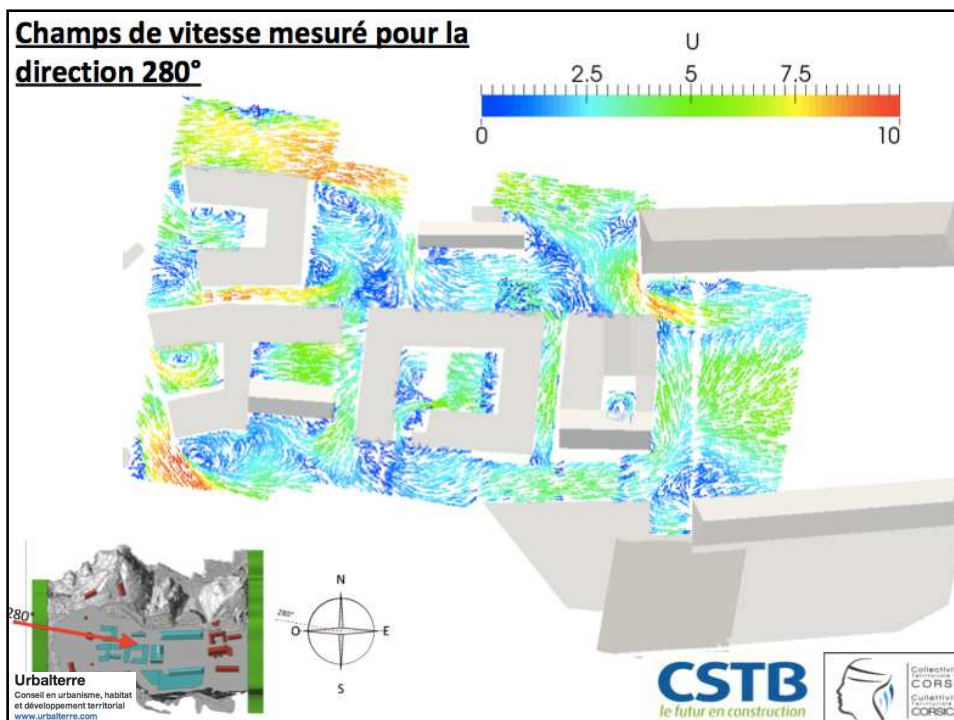
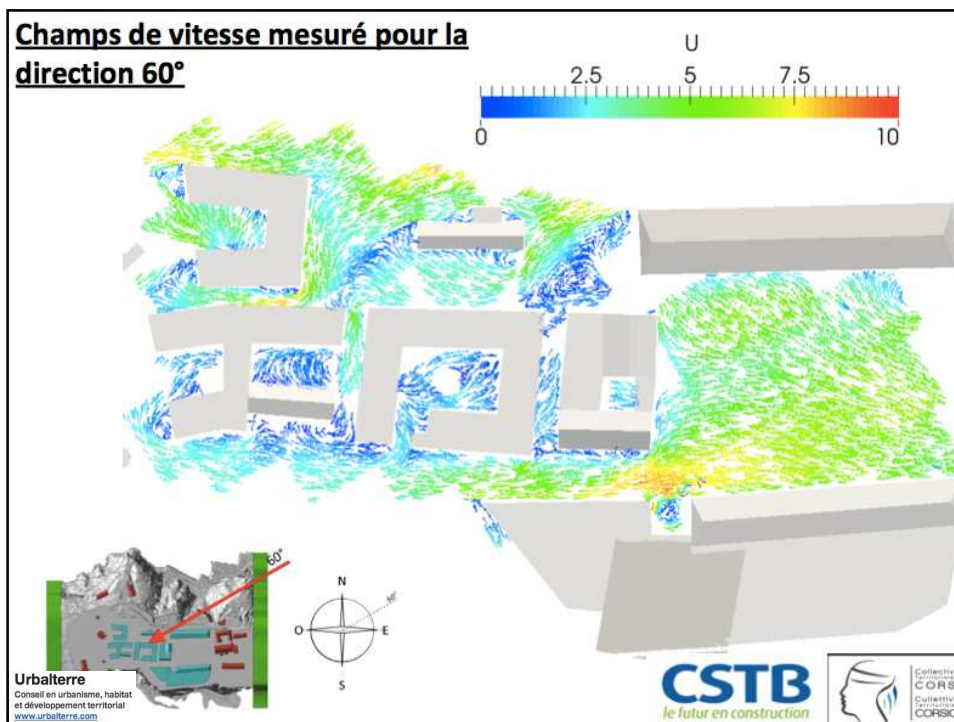


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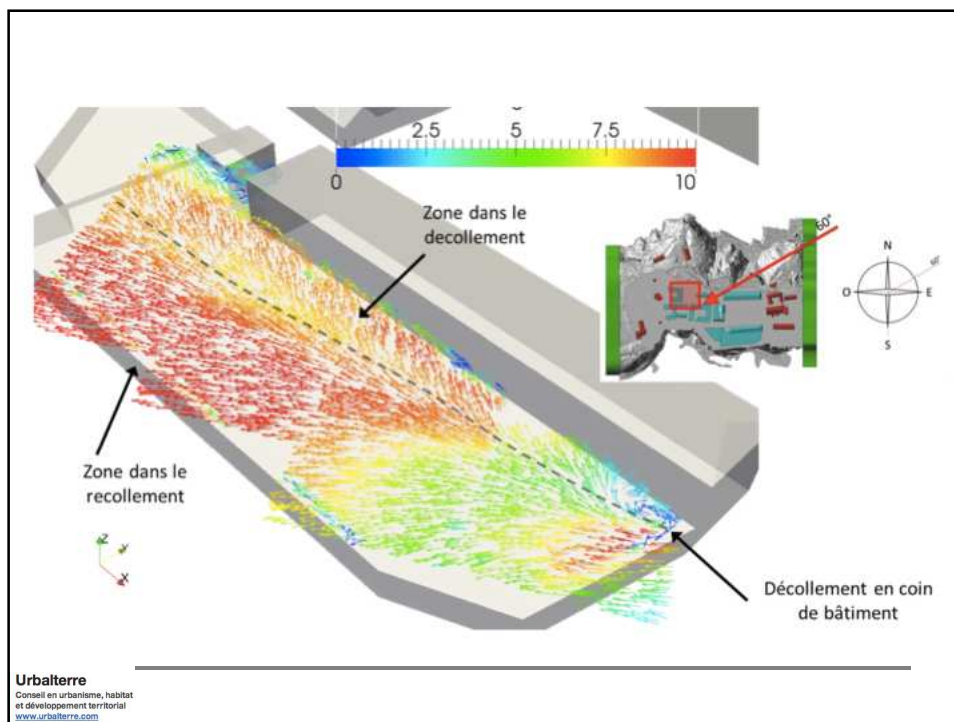
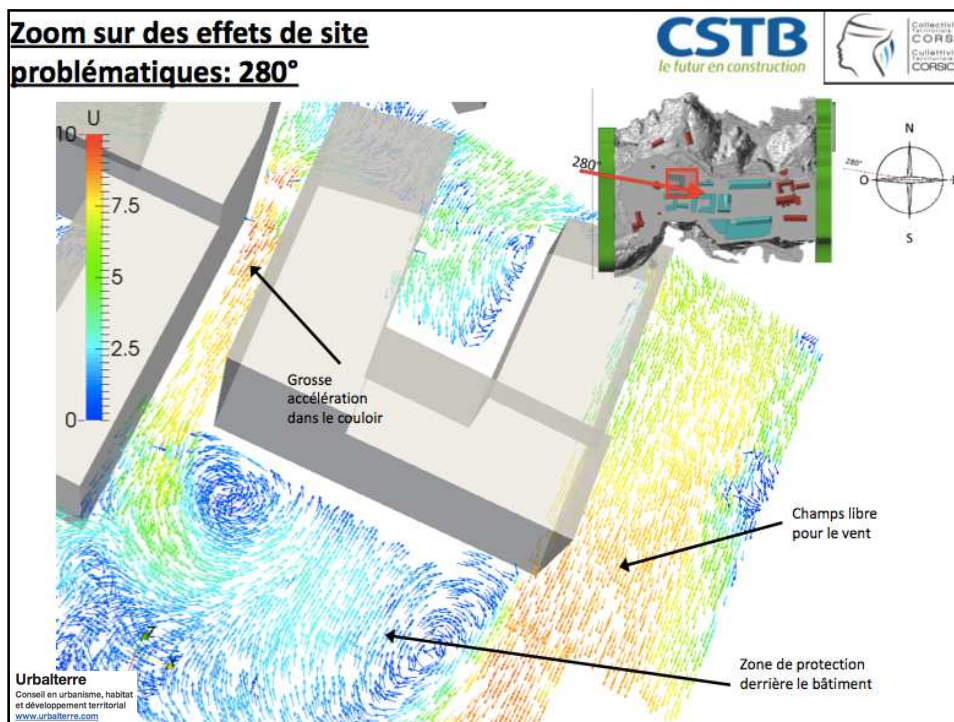
Former 2013's Project (pink)

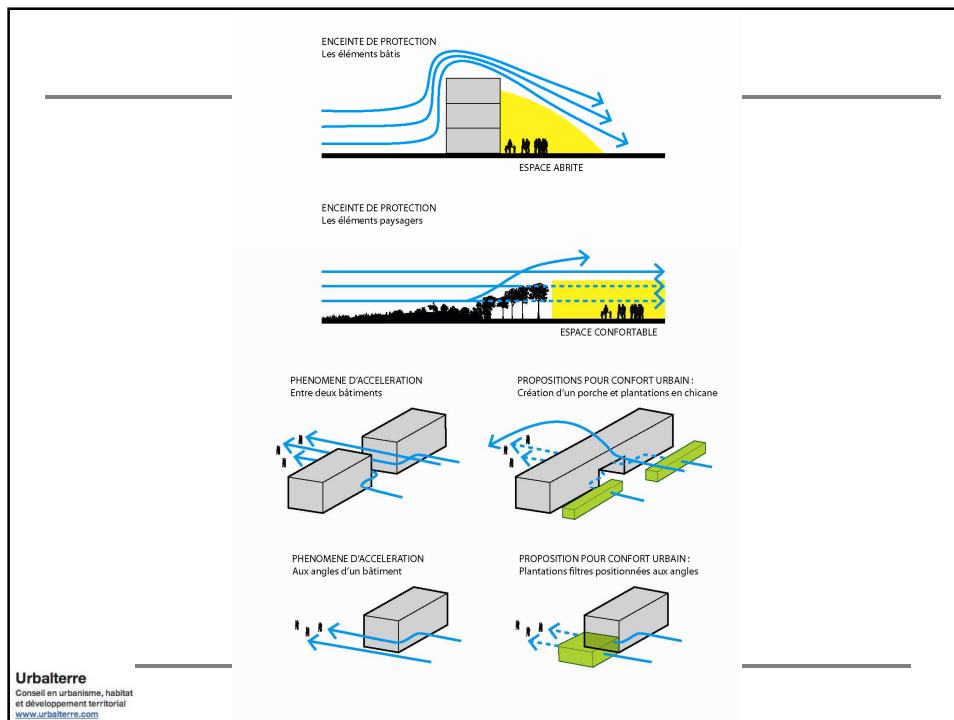
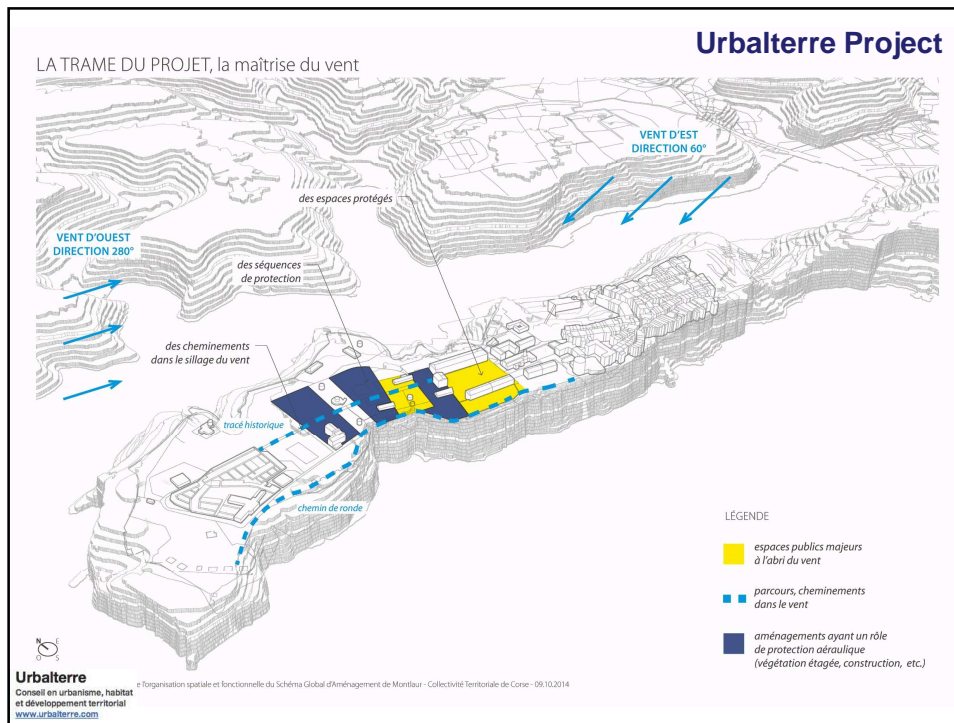


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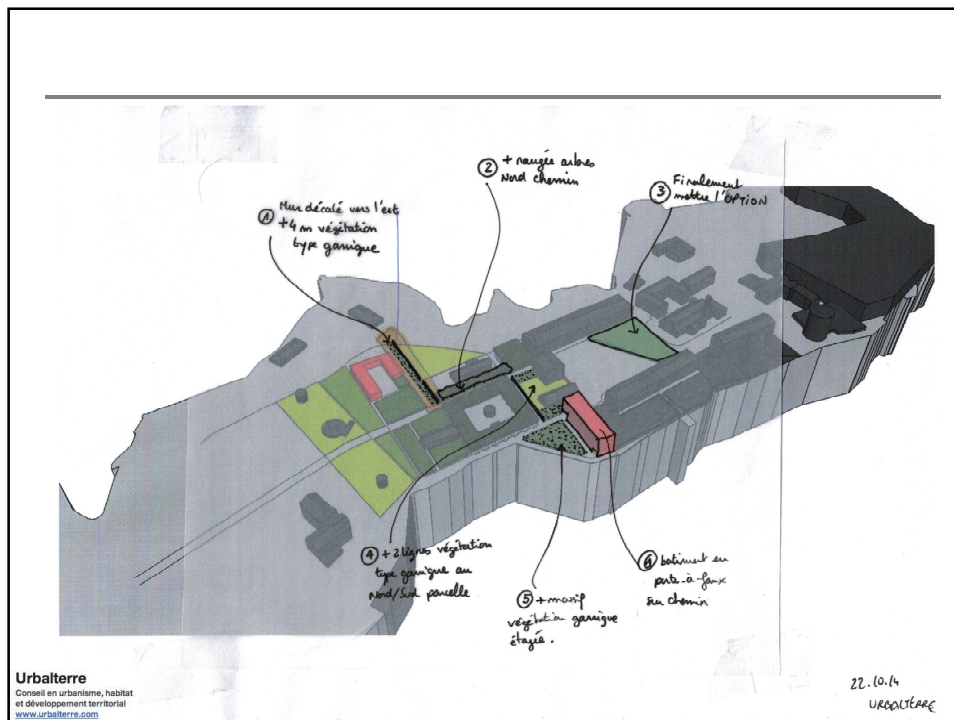
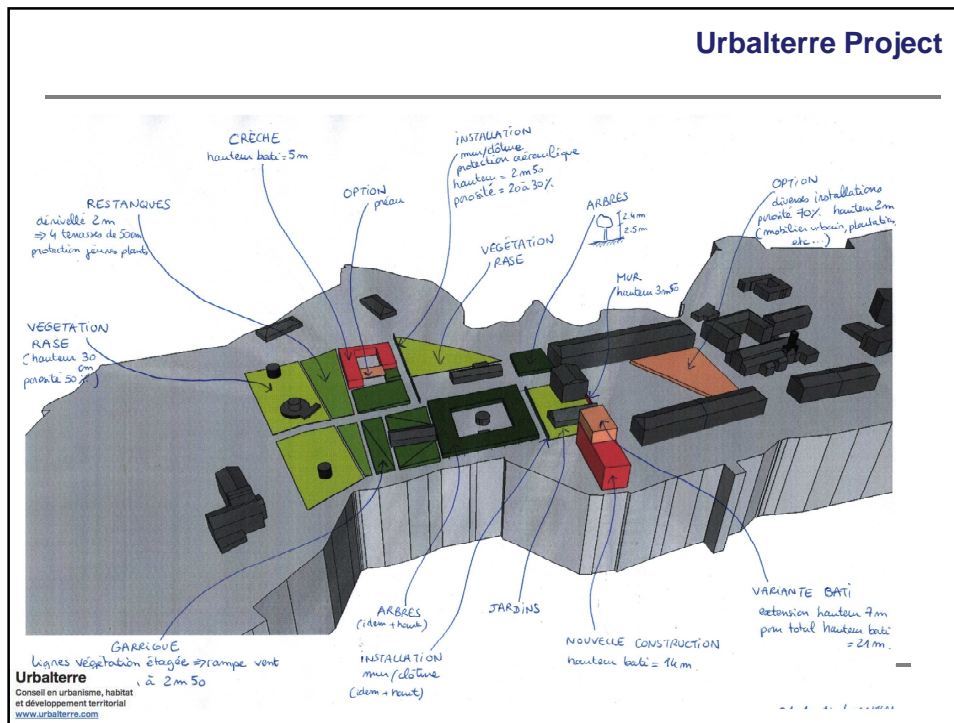


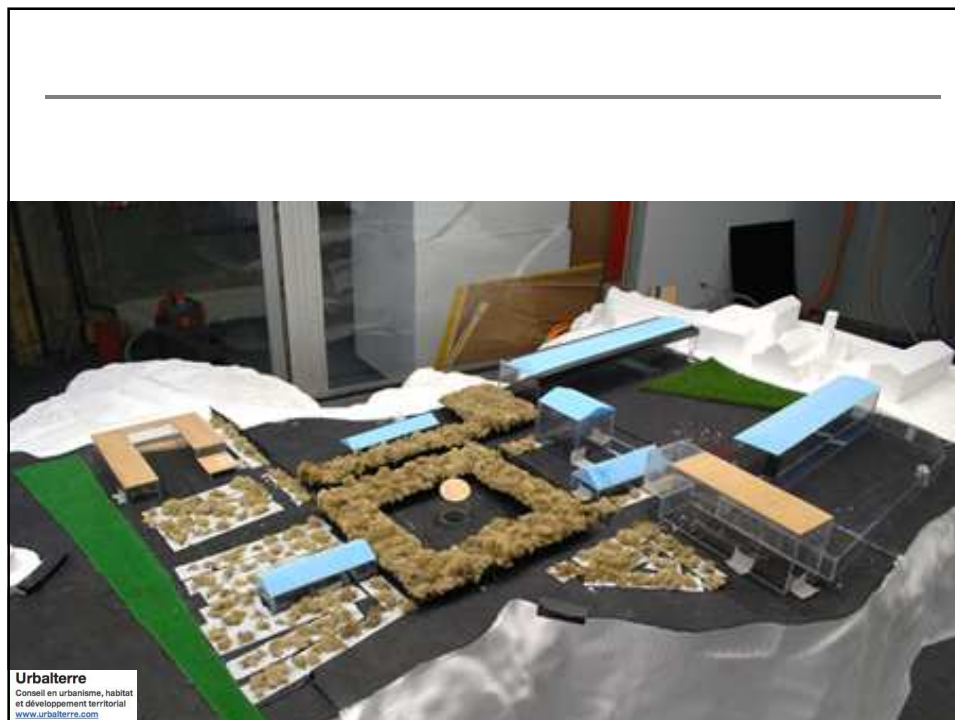
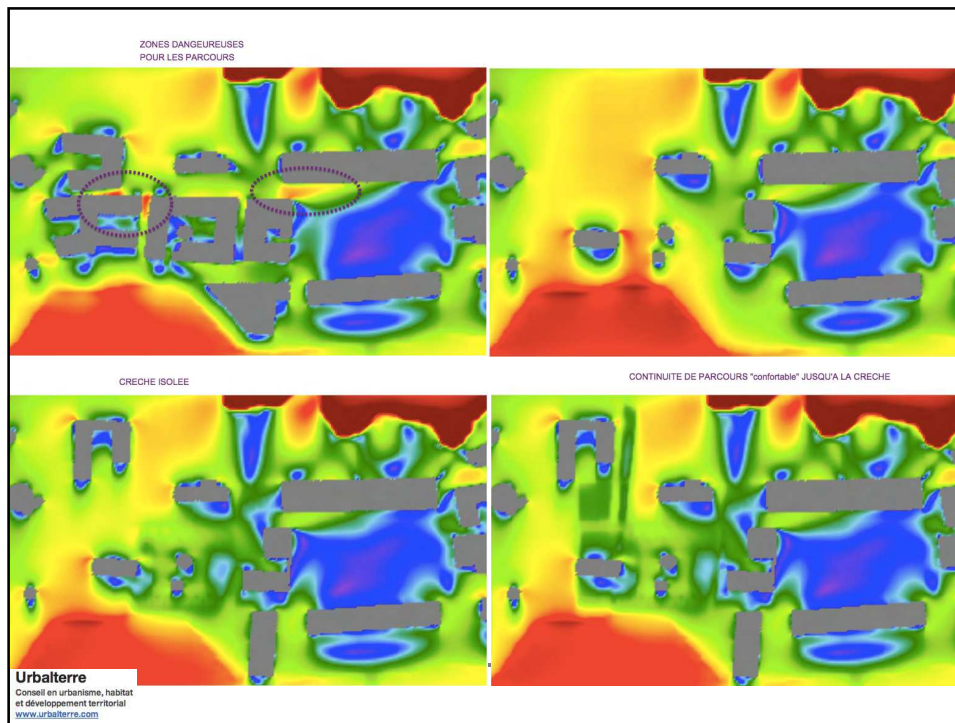
Zoom sur des effets de site problématiques: 280°

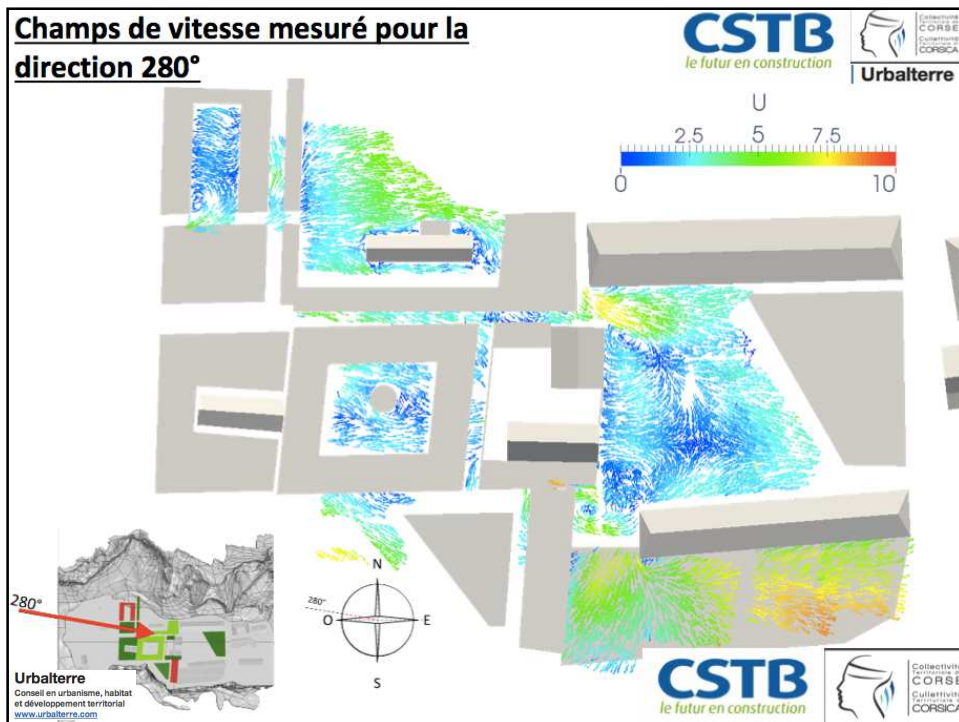
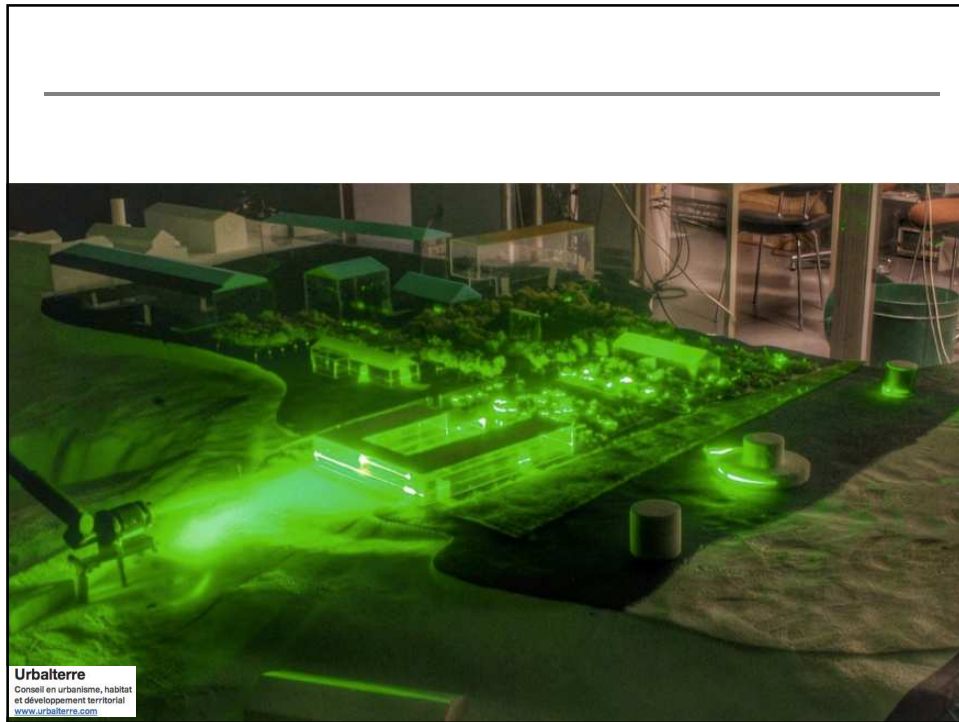


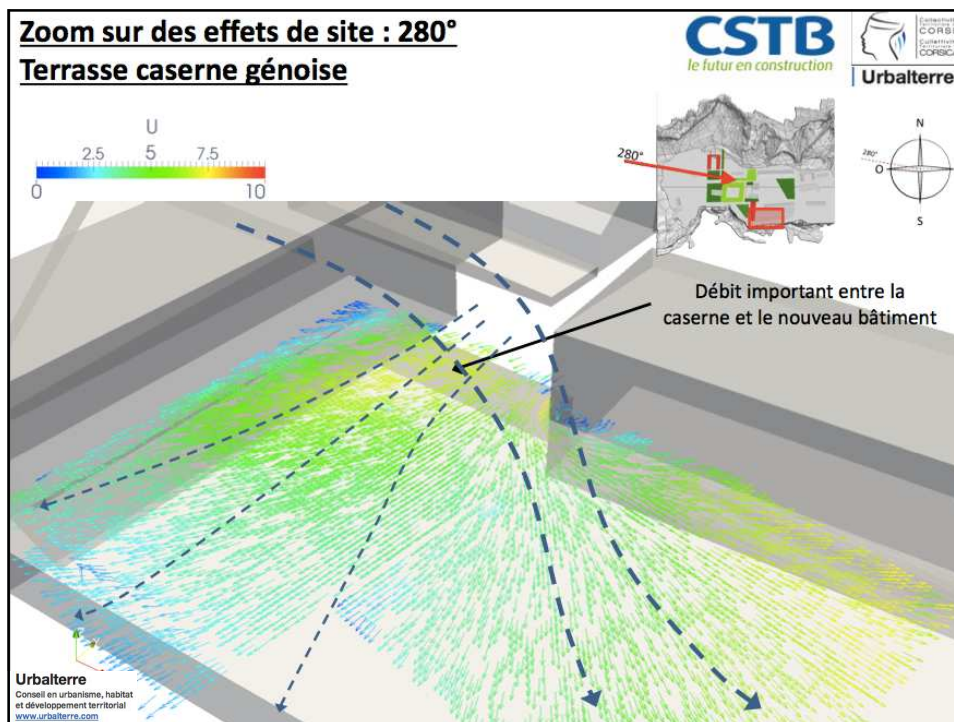


Urbalterre Project











4 - LEARNINGS

1 / Diagnostic

2 / Process

3 / Results

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DL Avocats
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CORSE
CORSICA



IGN
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5 - THANKS

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Marie-Pierre LABORDE, Marc-Antoine MONDOLONI – Corsica Local Government

Lionel GAUDIOT, Institut Géographique National
Stéphane SANQUER, Meteodyn

Jean-Charles ORSUCCI, Mayor of Bonifacio
Hélène PORTAFAX, City of Bonifacio





20th-24th July 2015
Toulouse France



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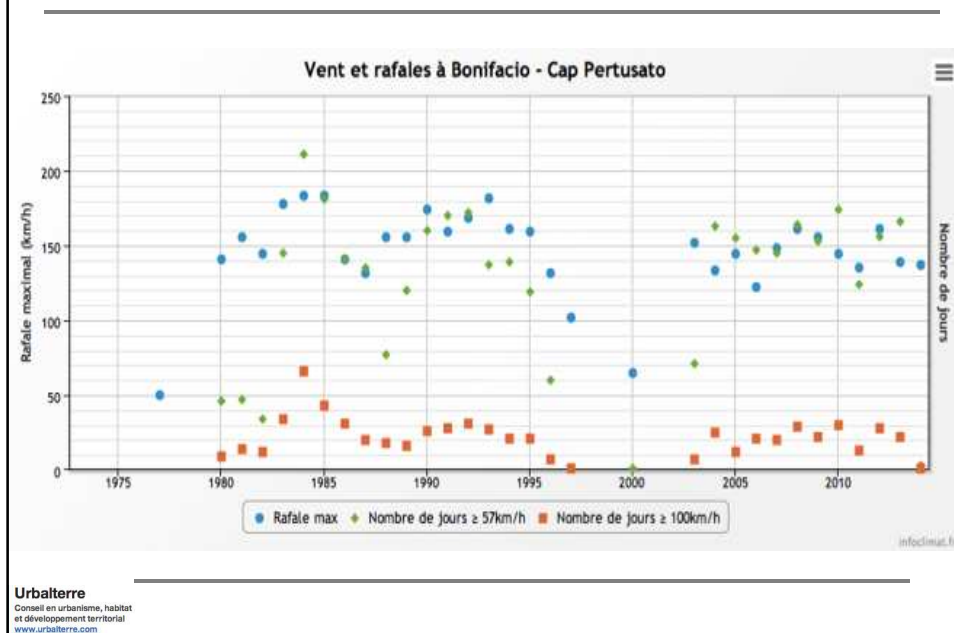


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Toulouse France





Wind condition comparison



Wind condition comparison

Station	Nombre de jours à plus de 57 km/h	Nombre de jours à plus de 100 km/h	Rafales maximales
Bonifacio – Pertusato	155	22 /an	144 km/h (moyenne) Dépasse 120km/h chaque année, jusqu'à 160 km/h
Ajaccio – Campo dell'Oro	20	3 sur 10 ans	Dépasse 100 km/h une année sur 8
Avignon	90	4 /an	+ de 100 km/h presque tous les ans
Marseille - Marignane	92	5 /an	+ de 100 km/h presque tous les ans

Bonifacio : Moyennes calculées sur les 10 dernières années

Ajaccio : Moyennes calculées sur les 10 dernières années

Avignon : moyennes calculées sur les 8 dernières années

Marignane : Moyennes calculées sur les 10 dernières années