

Storm surge modeling at RSMC La Réunion

September 9, 2008



September 15, 2008



USGS

6th session
training course of tropical cyclones
(28 oct. – 5 nov. 2013)



METEO FRANCE
Toujours un temps d'avance



Presentation Plan

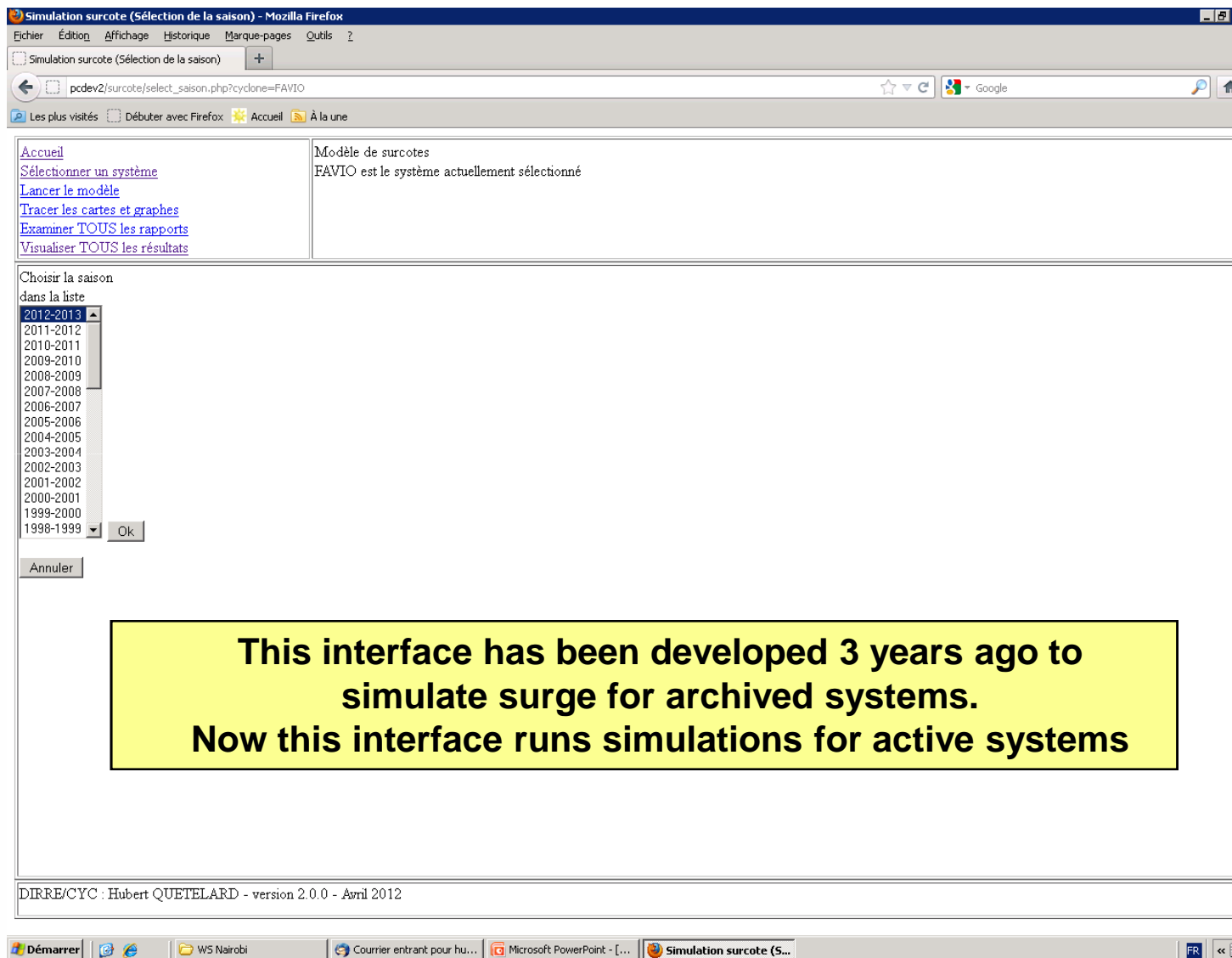
1. Interface to launch and display the surge model products associated to a RSMC forecast track
2. The "Cyclone surge atlas " Project and the surge forecast tool



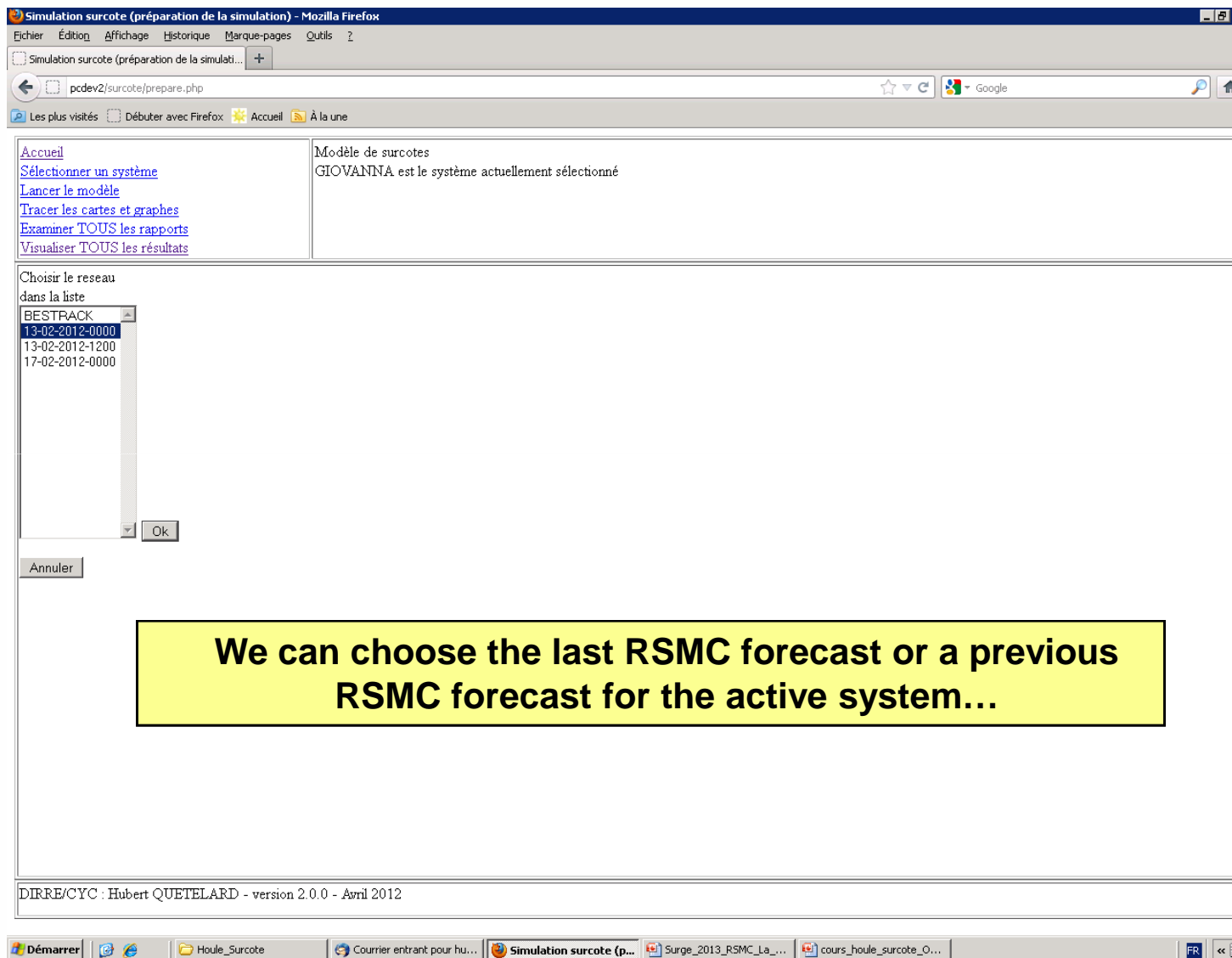
Presentation Plan

- 1. Interface to launch and display the surge model products associated to a RSMC forecast track**
2. The "Cyclone surge atlas " Project and the surge forecast tool

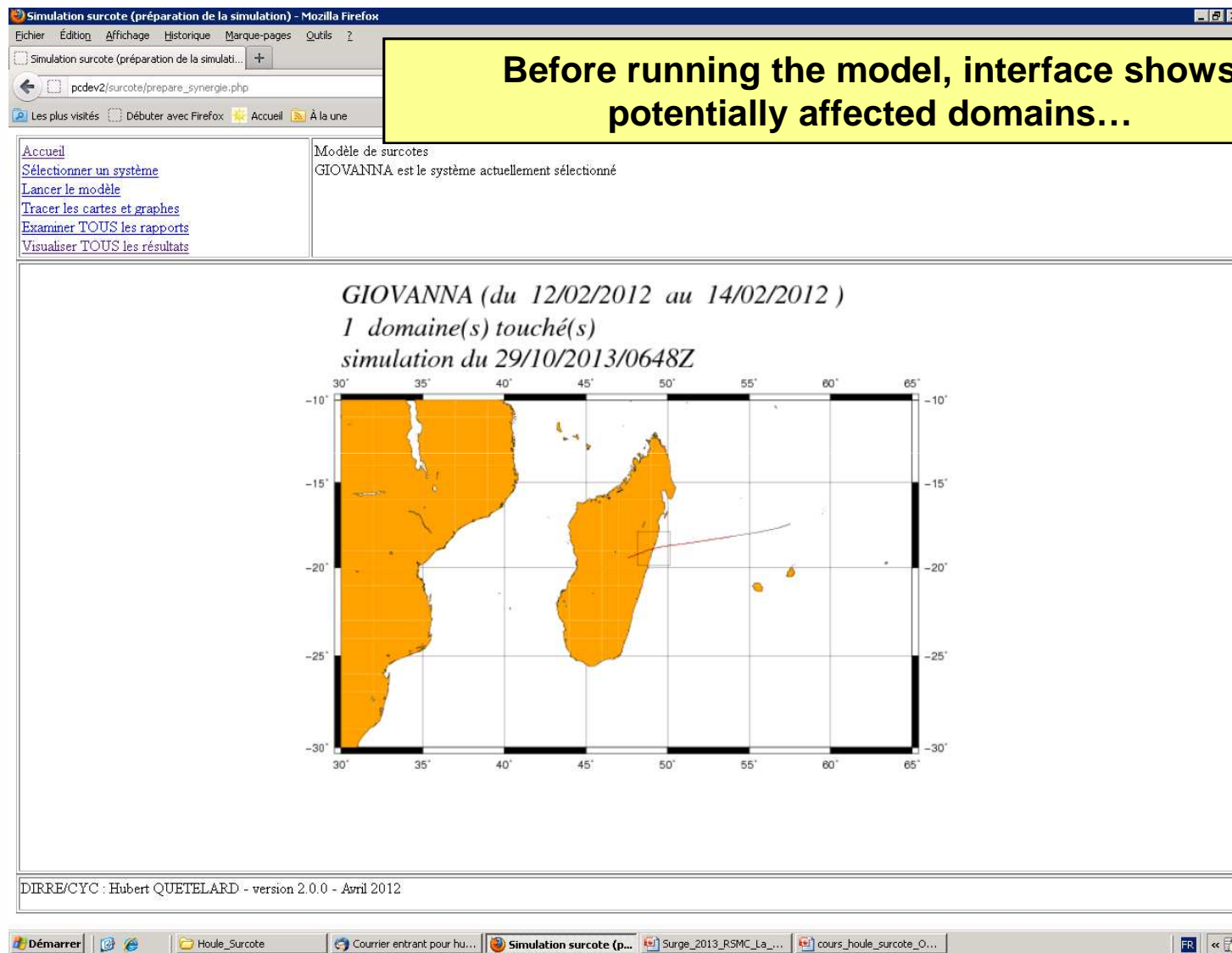
1 – Interface to launch the model



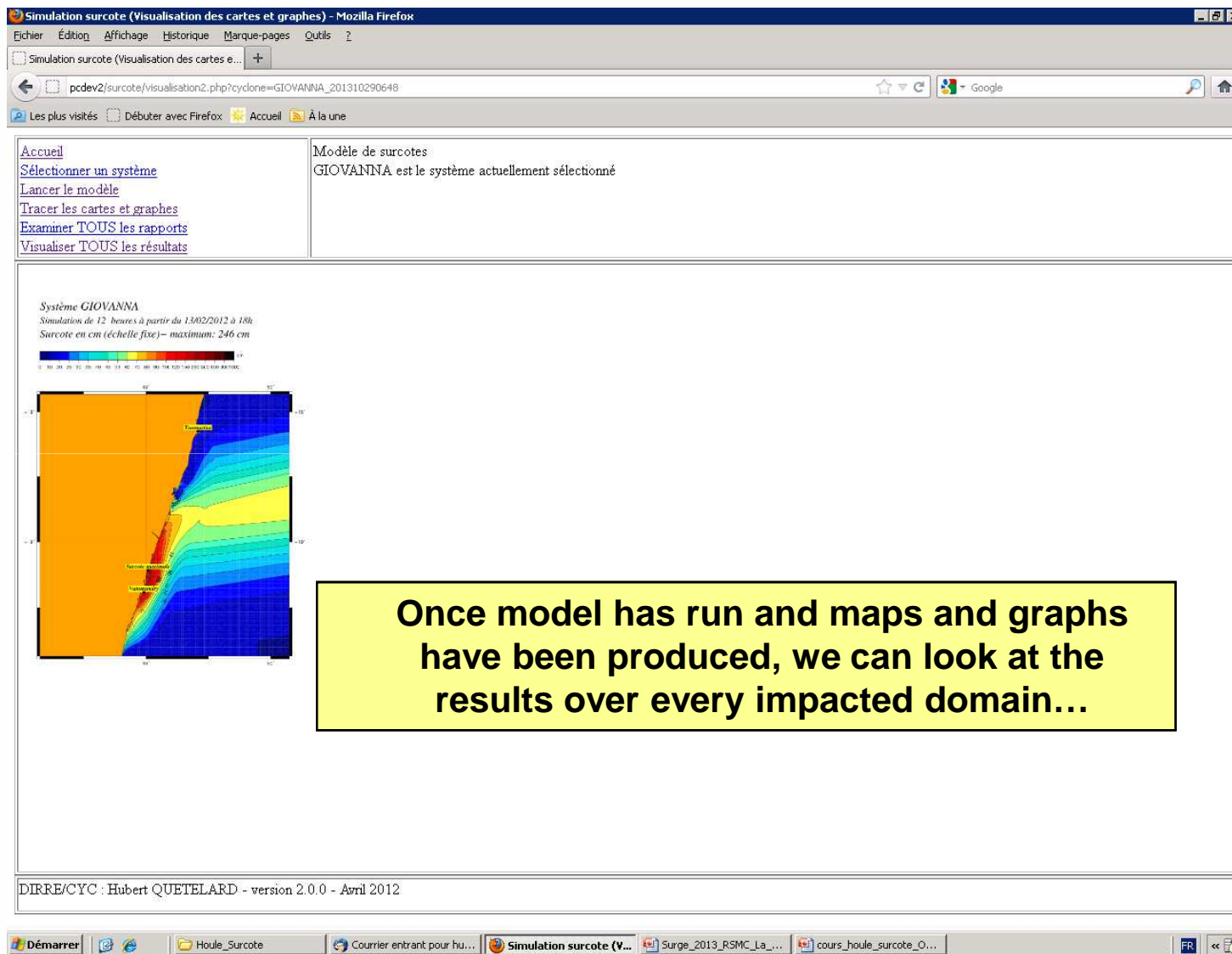
1 – Interface to run the model



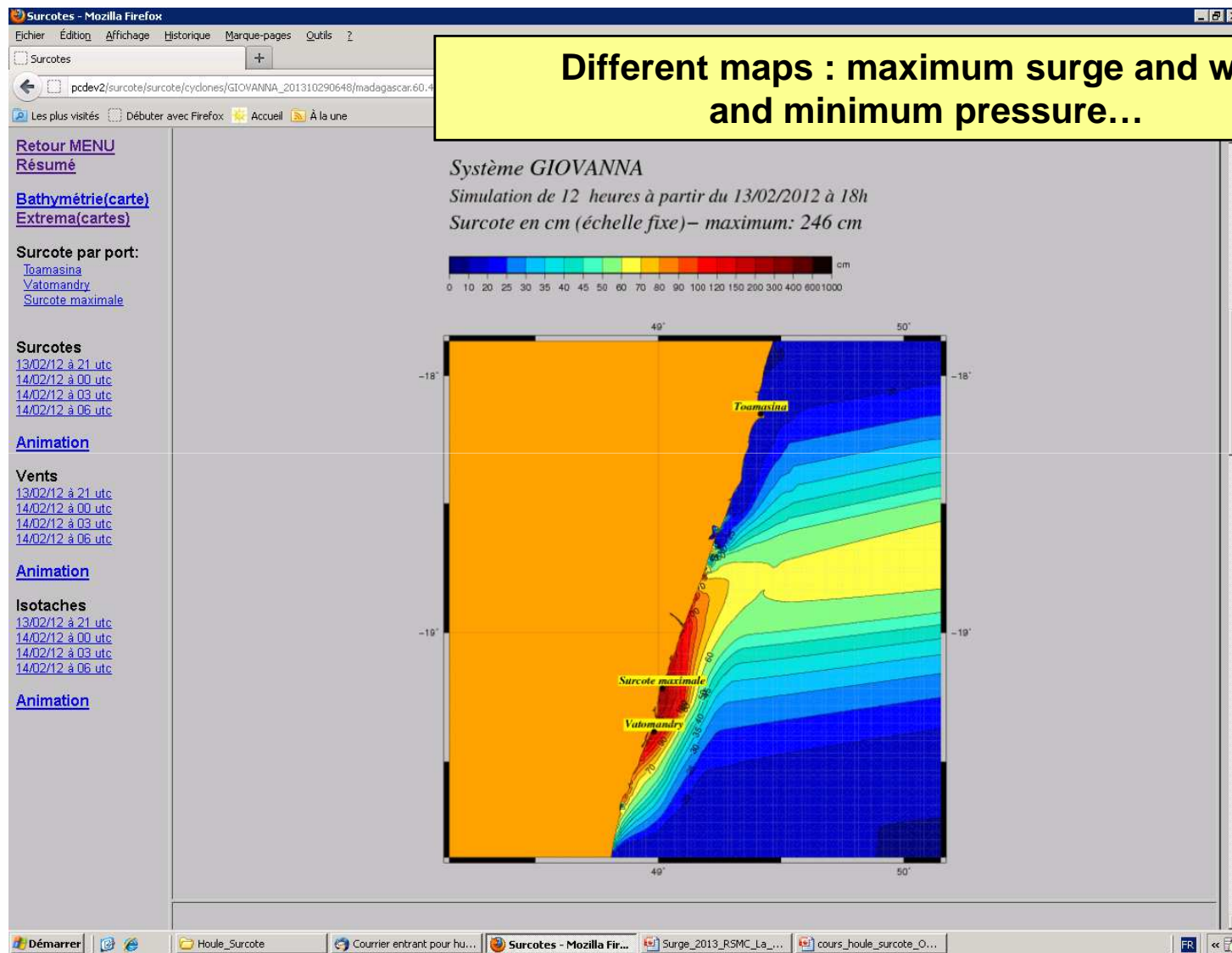
1 – Interface (GIOVANNA, 13/02/12 at 00Z forecast)



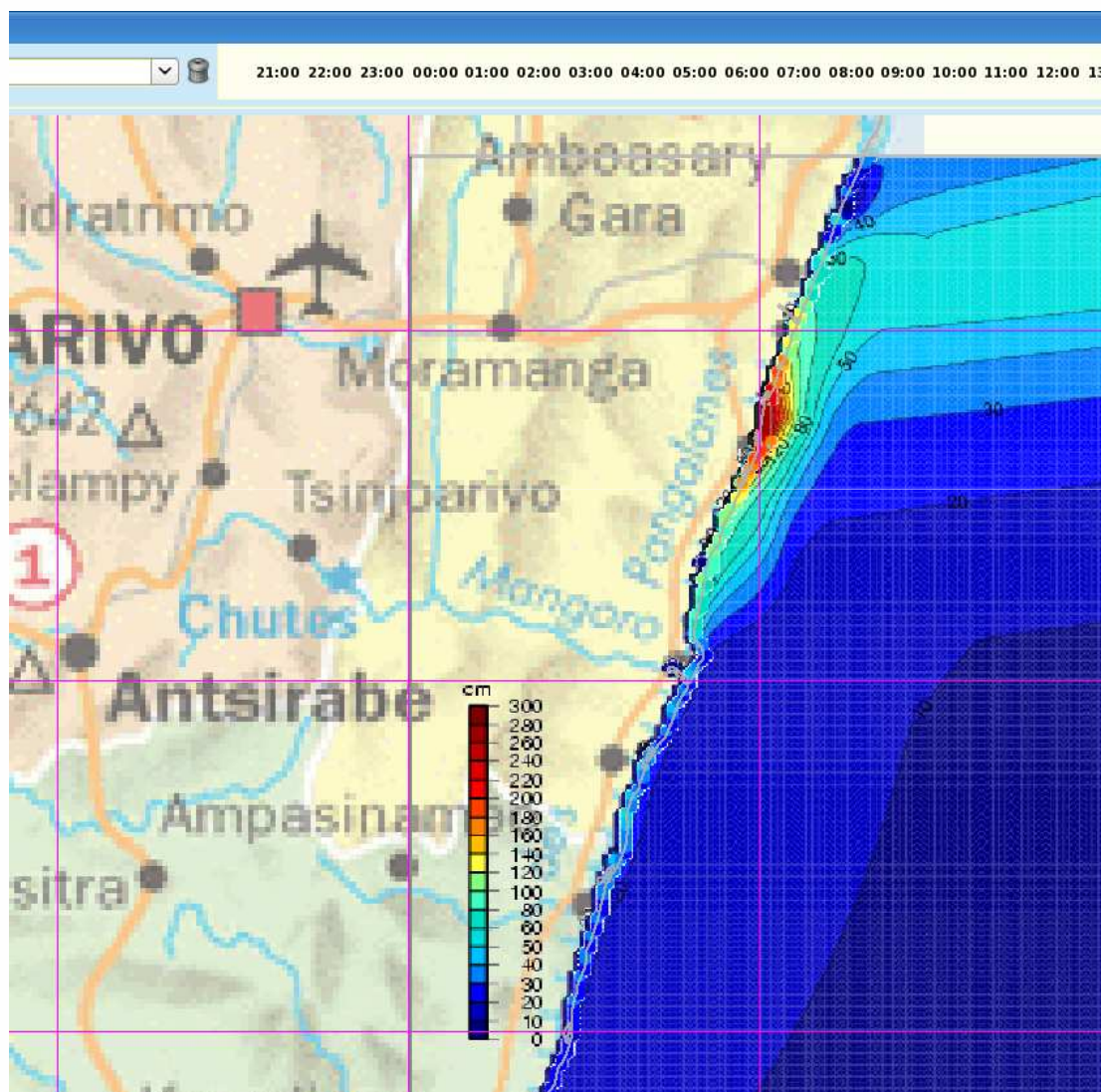
1 – Interface (GIOVANNA, 13/02/12 at 00Z forecast)



1 – Interface (GIOVANNA, 13/02/12 at 00Z forecast)

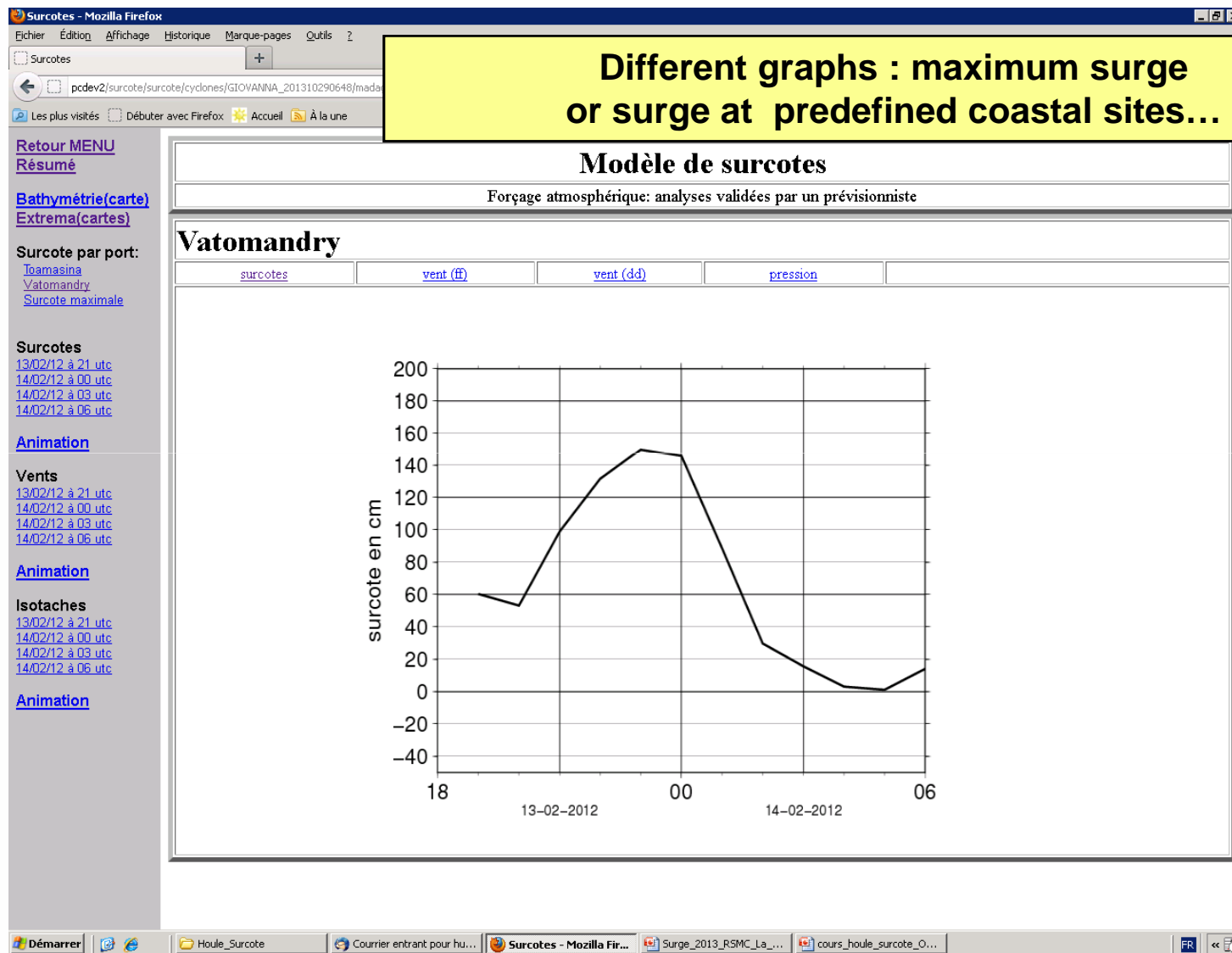


1 – Interface (GIOVANNA, 13/02/12 at 00Z forecast)



Maps are displayed in
SYNERGIE-CYCLONE as
different layers...

1 – Interface (GIOVANNA, 13/02/12 at 00Z forecast)





1 – Interface to launch and display model

- Remarks:
 - This interface is perfectible but at least exists, and is very easy to use to run the model at real time forecast ...
 - ...**but model runs just for a single deterministic forecast !**
Several errors and inaccuracies exist regarding track, intensity, storm speed, size
 - To improve surge forecast, « cyclone surge atlas for south-west Indian ocean basin » project uses a statistical approach



Presentation Plan

1. Interface to launch and display the surge model products associated to a RSMC forecast track
- 2. The "Cyclone surge atlas " Project and the surge forecast tool**



2 – Cyclone surge atlas

- Two purposes for the project;
 1. Produces a digital cyclone surge atlas associated to the coastal areas of the south-west Indian ocean basin
 2. Develops a web interface to provide surge risk probabilities maps in association to a RSMC forecast track



2 – Cyclone surge atlas

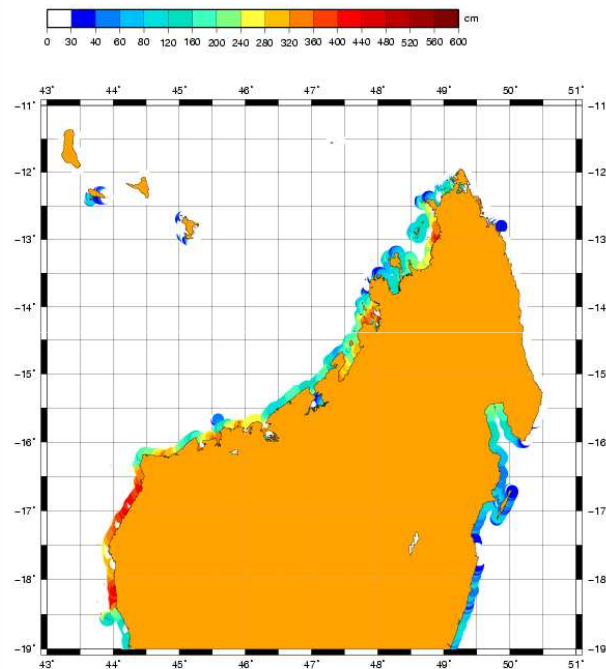
- These two purposes require the existence of a Meteo-France model simulations database. These simulations are generated with varying parameters of the cyclone;
 - Landfall point on the coast
 - Track (impact angle relative to the coast)
 - Intensity (maximum wind)
 - Size and structure
 - Speed of the movement

2 – Atlas (wind sensibility tests for Madagascar)

Simulation vent constant de 100 kt

Rotation complete sur 24 heures

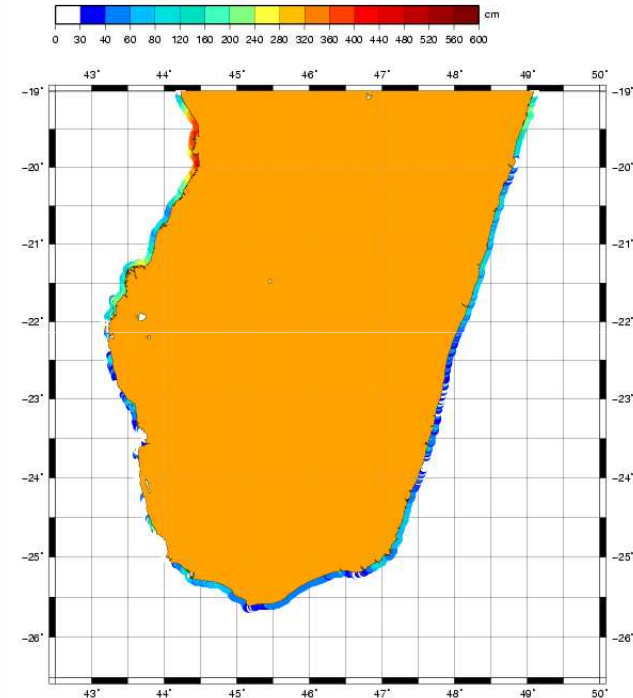
Domaine: Madagascar_Nord



Simulation vent constant de 100 kt

Rotation complete sur 24 heures

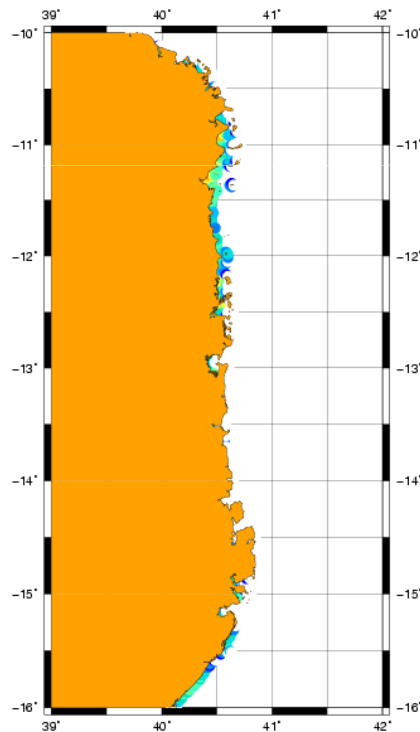
Domaine: Madagascar_Sud



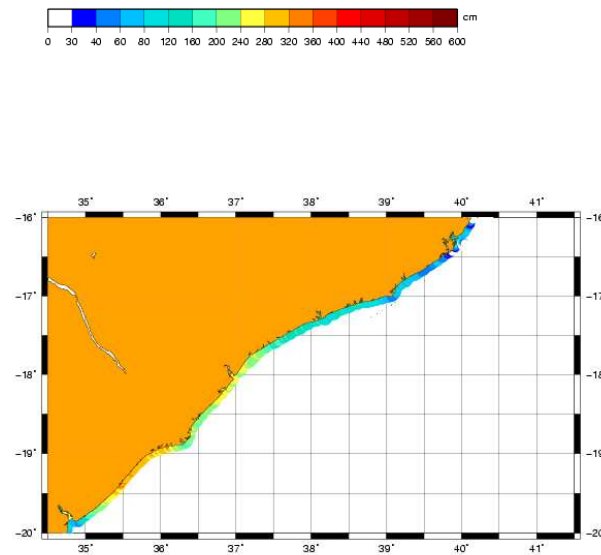
To reduce the number of simulations, (total duration limited at 3000/4000 hours on NEC calculator of Météo-France), constant wind tests have been produced to determine particularly sensible areas (1 minute bathymetry)

2 – Atlas (wind sensibility tests for Mozambique)

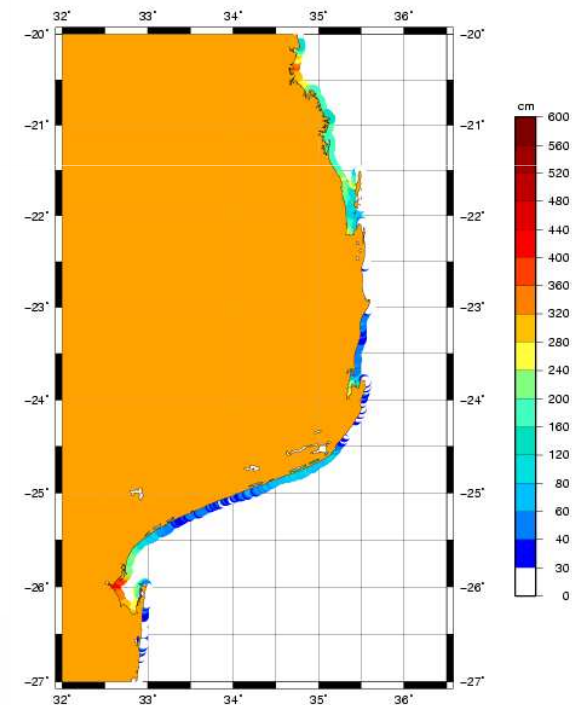
*Simulation vent constant de 100 kt
Rotation complete sur 24 heures
Domaine: Mozambique_Nord*



*Simulation vent constant de 100 kt
Rotation complete sur 24 heures
Domaine: Mozambique_Centre*

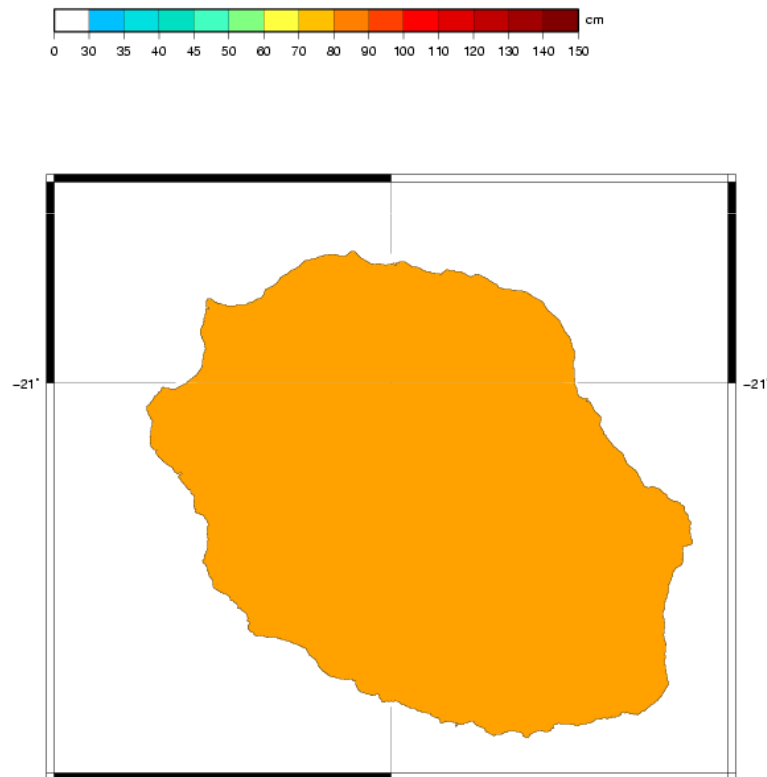


*Simulation vent constant de 100 kt
Rotation complete sur 24 heures
Domaine: Mozambique_Sud*

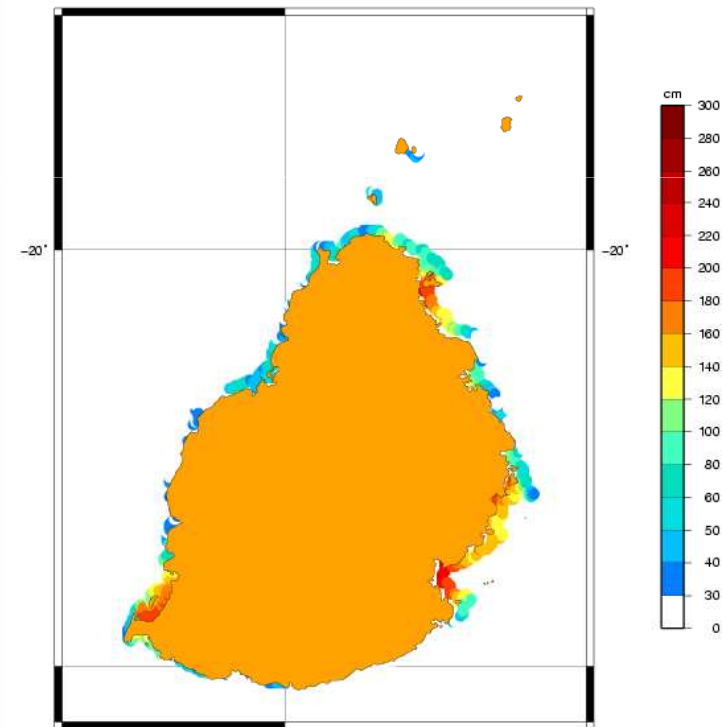


2 – Atlas (wind sensibility tests for Mauritius and Reunion)

*Simulation vent constant de 100 kt
Rotation complete sur 24 heures
Domaine: Reunion*



*Simulation vent constant de 100 kt
Rotation complete sur 24 heures
Domaine: Maurice*

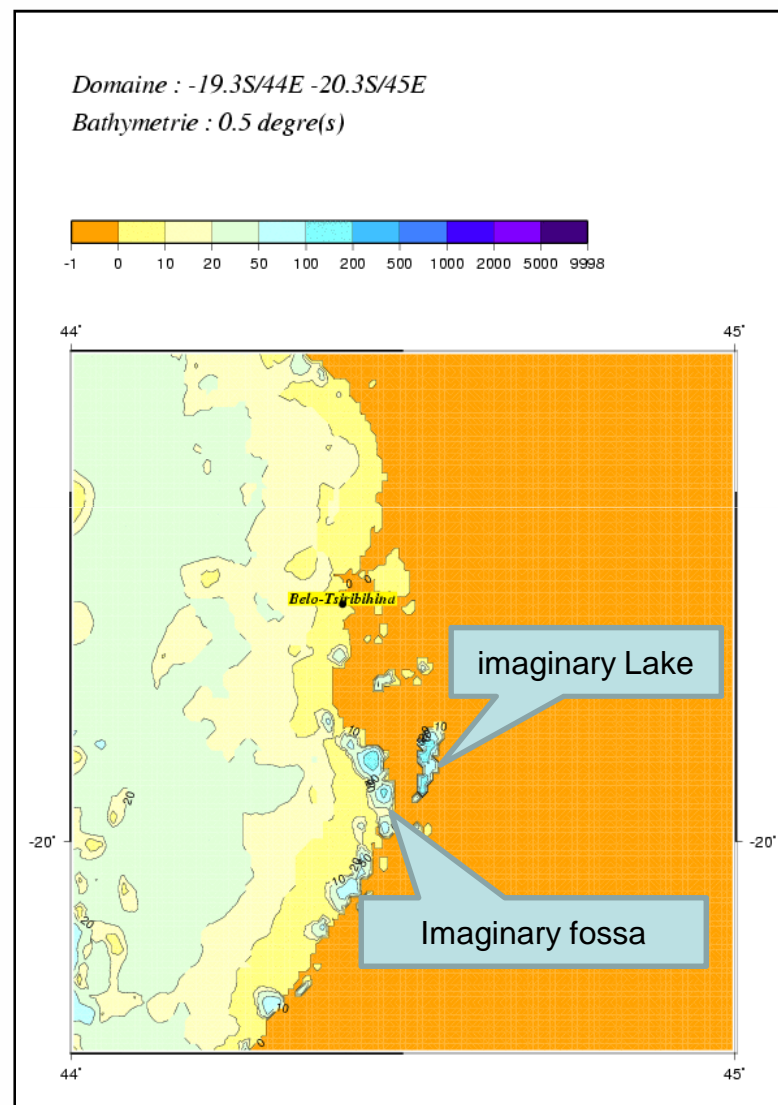
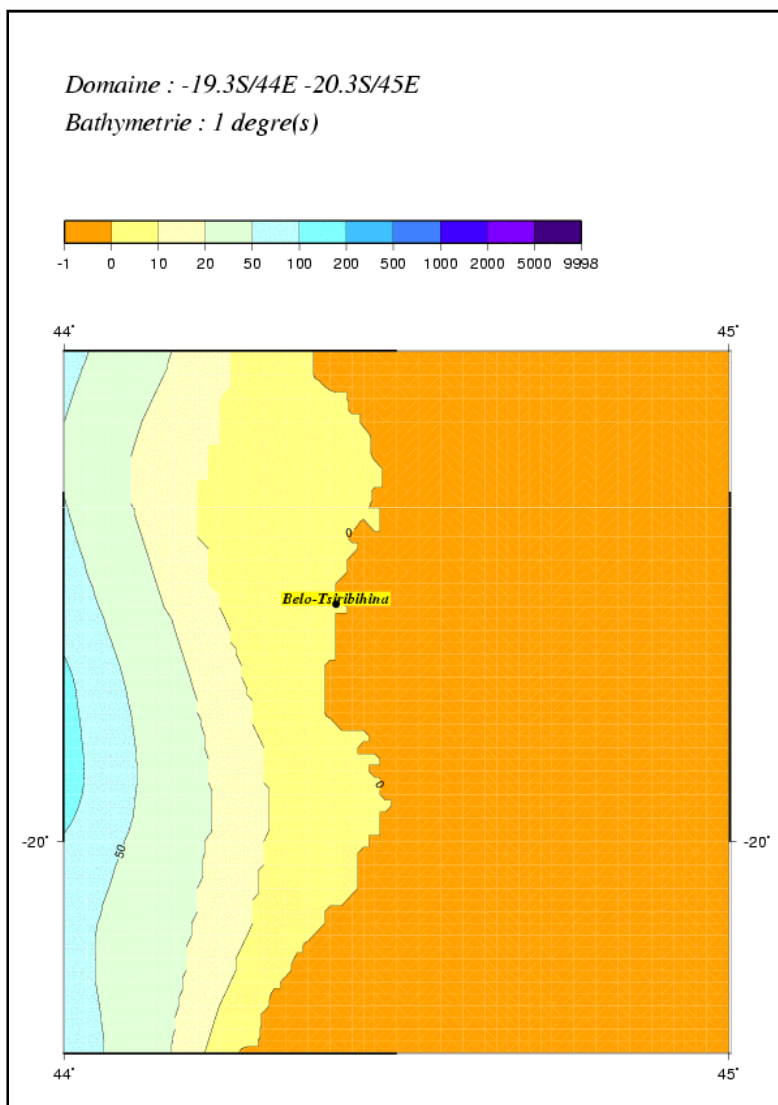




2 – Atlas (selection and control of bathymetry)

- Various bathymetries are available to run the model;
 - 5 NM ETOPO (NOAA)
 - 1 NM ETOPO (NOAA)
 - 1 NM GEBCO
 - 0.5 NM GEBCO
 - 0.12 NM Bathymetry established by PREVI/MAR Meteo-France service for Islands: Réunion, Mauritius and Mayotte

2 – Atlas (30'' bathymetry not reliable)

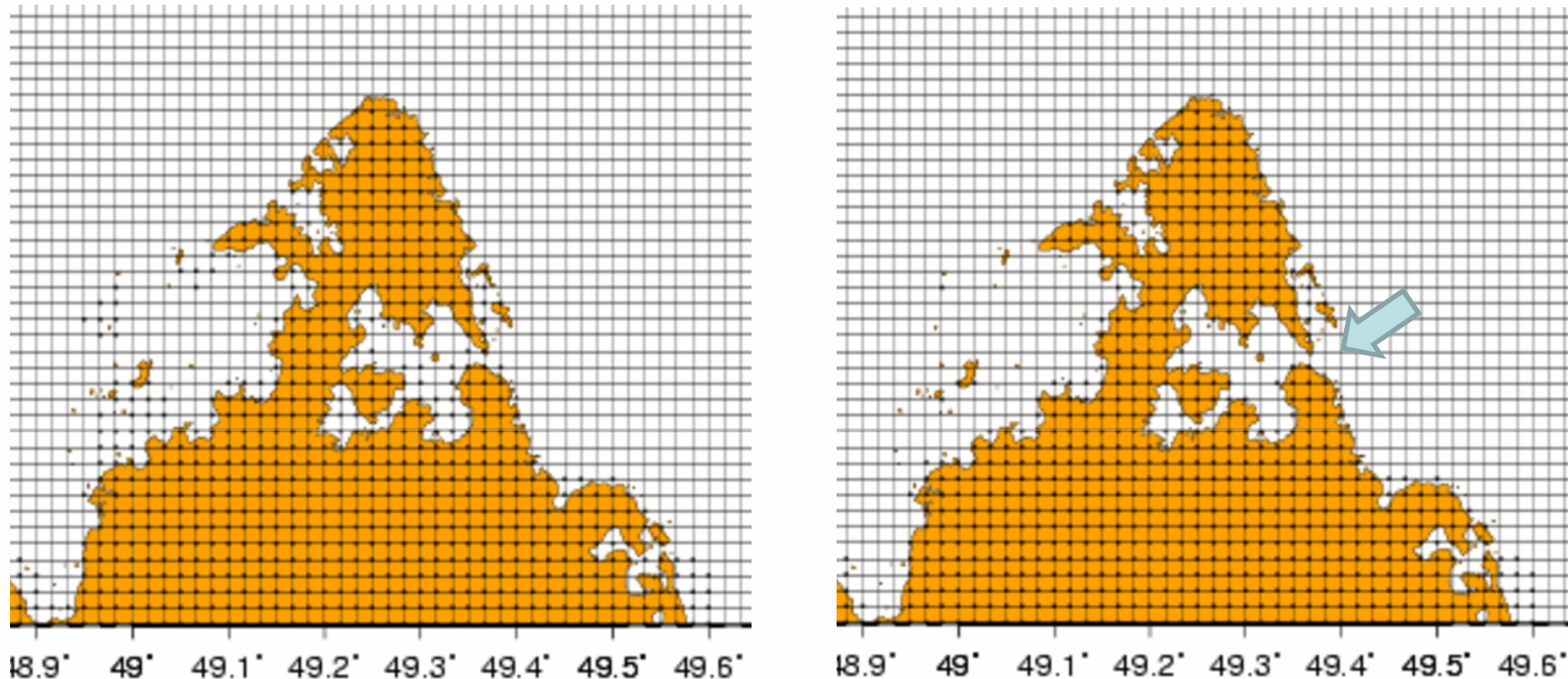




2 – Atlas (selection and control of bathymetry)

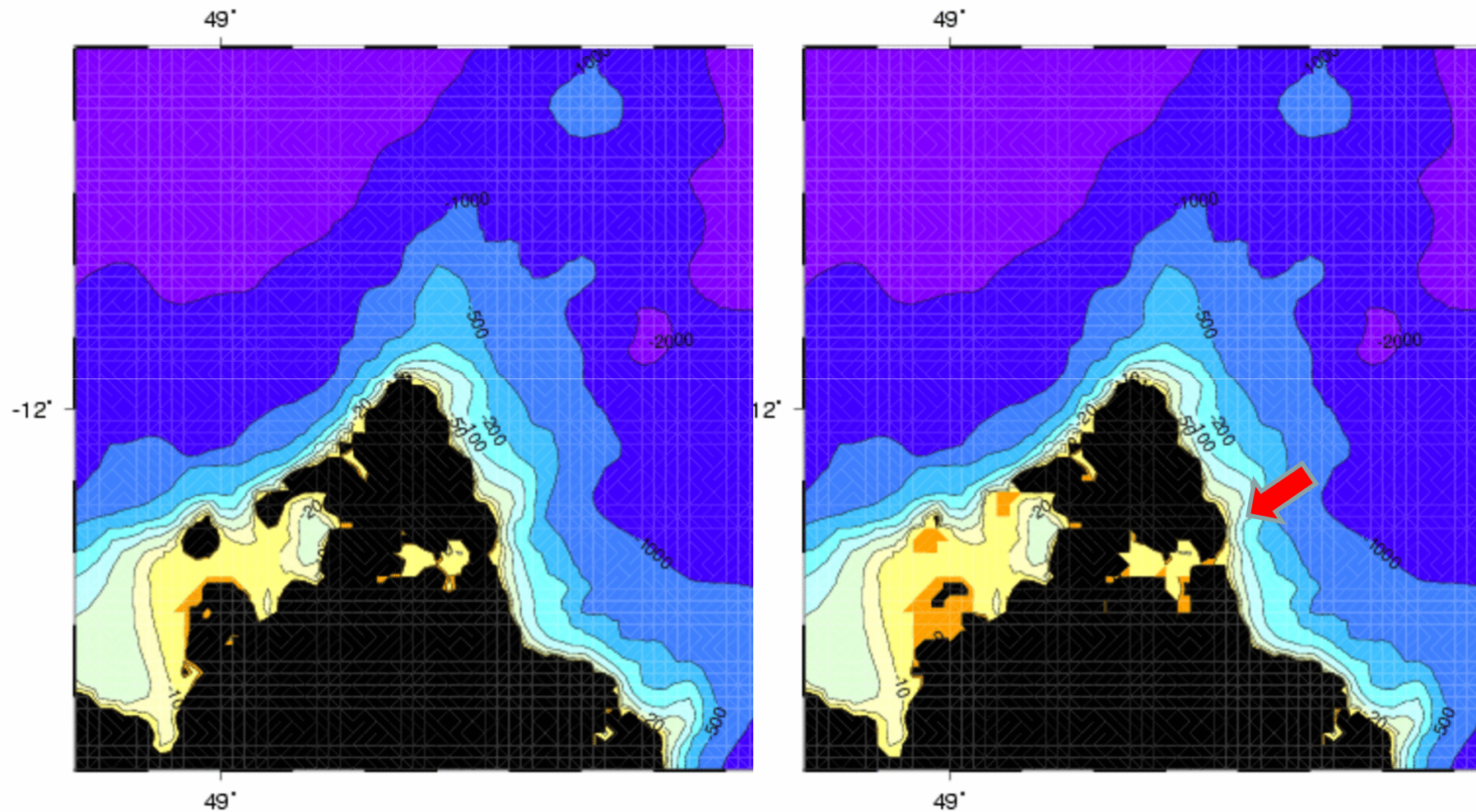
- A detailed control of bathymetry has shown that 30s GEBCO is not reliable because there are many errors within coastal areas
- We will use 1 minute bathymetry and this one has been verified also, especially:
 - For the coastline, by checking that a land point of bathymetry is inland and a sea point is oversea ! (verification according to GMT and GOOGLE Earth)
 - For important bays, to confirm that they are effectively open in bathymetry (propagation of surge currents)

2 – Atlas (selection and control of bathymetry)



On the left, picture shows land point of bathymetry before correction and on the right, picture presents land point after.
For example, it may be noted « opening » of Diego-Suarez Bay (blue arrow)

2 – Atlas (selection and control of bathymetry)

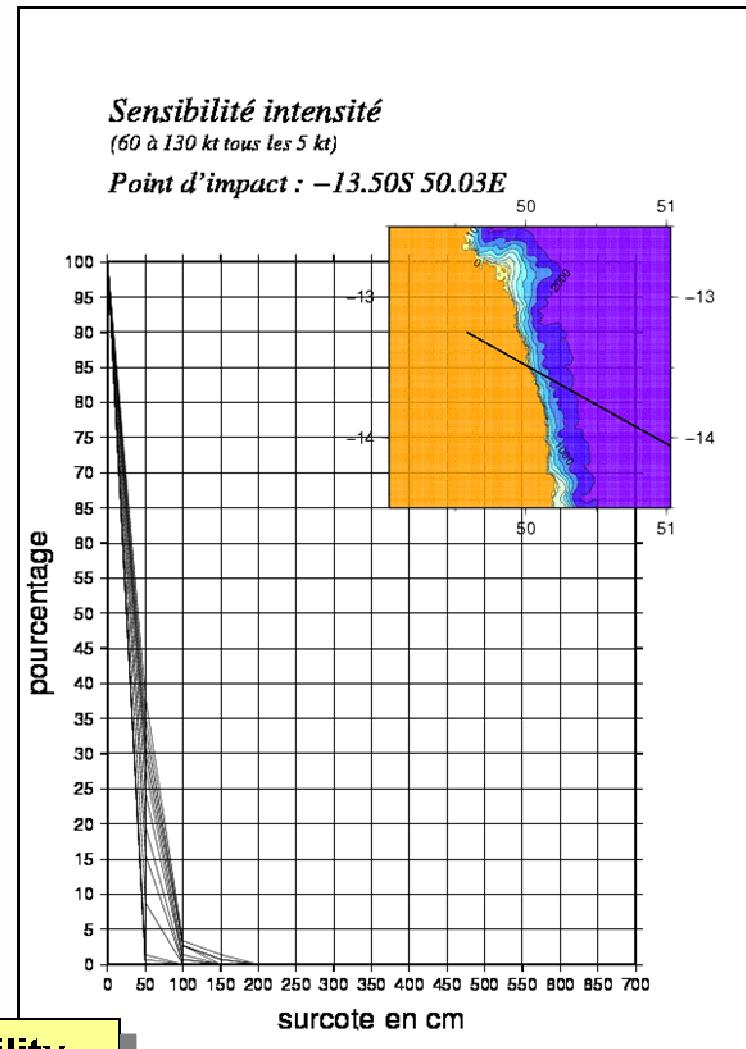
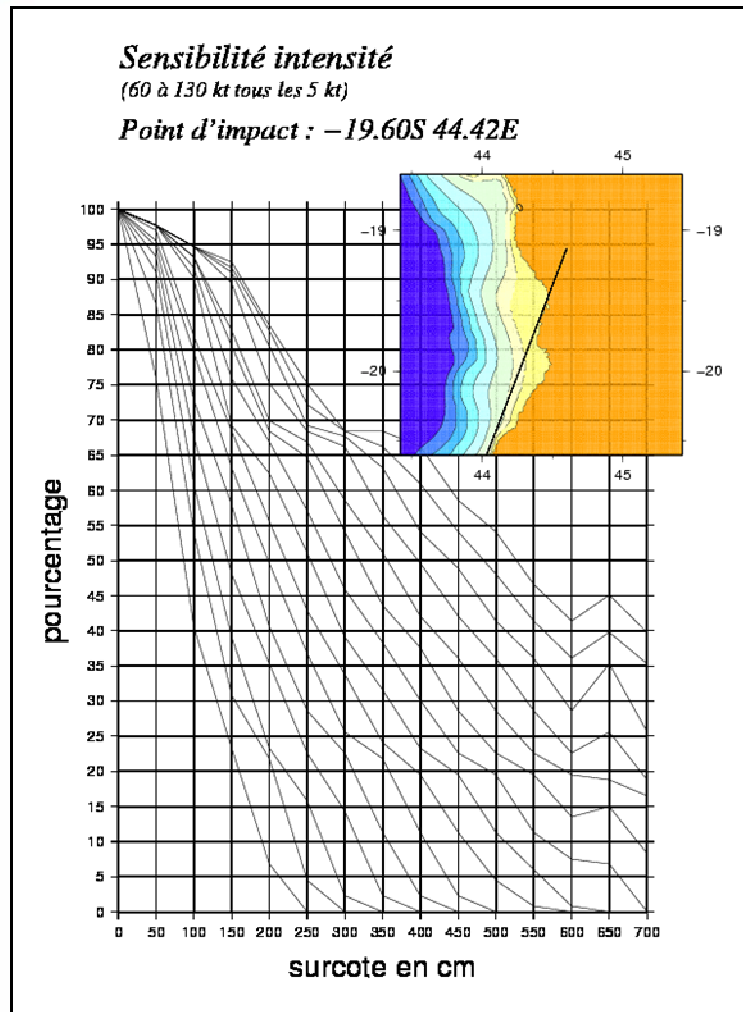




2 – Atlas (sensitivity tests for different parameters)

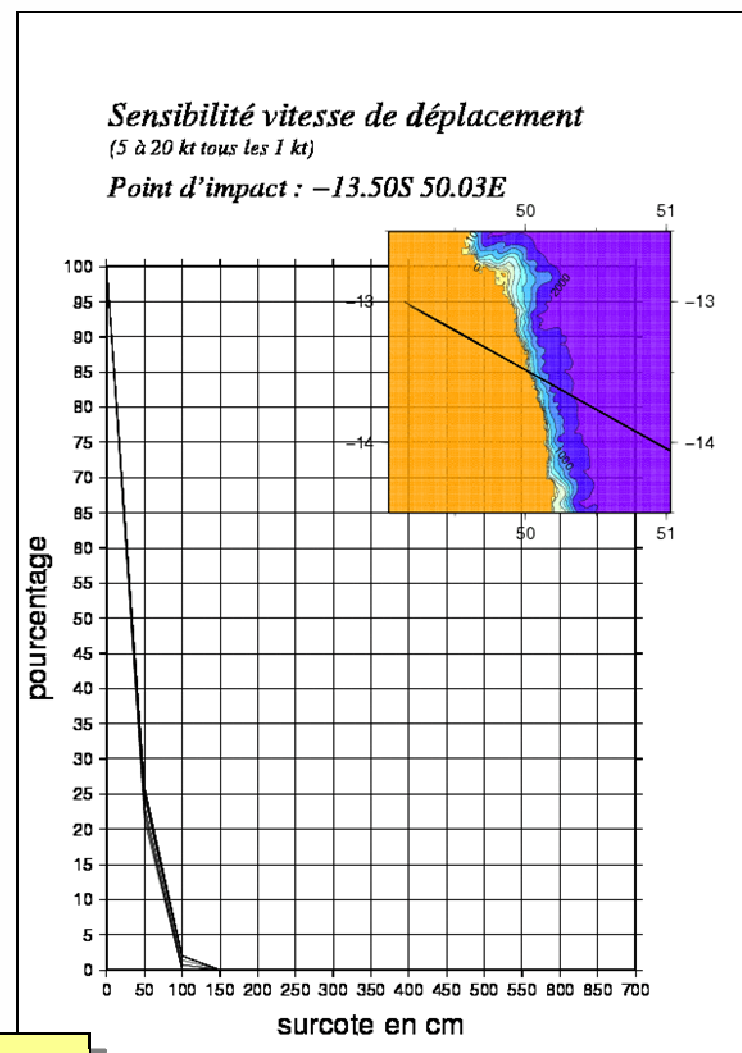
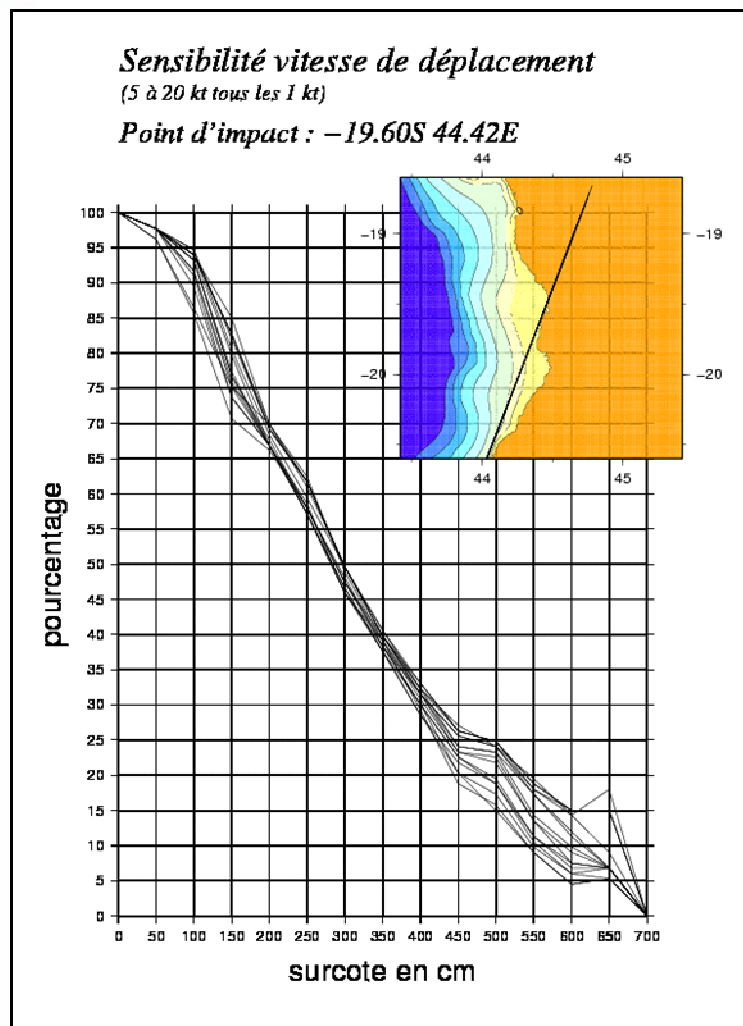
- Tests have been made to check surge sensibility in relation to the parameters of a cyclone :
 - Impact angle on the coast
 - Maximum wind intensity
 - Central pressure
 - Radius maximum wind
 - Movement speed
- These tests have helped to define intervals at which parameters might vary to obtain relevant samples and simultaneously stay within the duration limits available for calculations

2 – Atlas (example for wind sensibility)



On the left, continental shelft > high sensibility
On the right, abrupt coast > low sensibility

2 – Atlas (ex: speed of movement sensibility)



On the left and the right, > low sensibility

2 – Cyclone surge Atlas (simulations)

About 450 domains (size $2^\circ \times 2^\circ$) have been defined on all coastal areas of South-West Indian ocean. They correspond to a point every 8 nautical miles on the coasts... This point is the central point of domain.





2 – Cyclone surge Atlas (simulations)

- **8640 simulations was expected for each domain :**
 - **Impact angle on the coast (20° to 360°, step 20°)**
 - **Maximum wind intensity (60kt to 130kt, step 10kt)**
 - **Central pressure (-15hPa to +15hPa, step 15hPa)**
 - **Radius maximum wind (5 to 25 NM, step 5 NM)**
 - **Movement speed (5 to 20kt, step 5kt)**
- **But « unrealistic » simulations (inland track on Madagascar and Mozambique) did not run. So the number of simulations per domain is sensibly less large**



2 – Cyclone surge atlas

- Simulations are completed. Atlas should be available in 2014 probably on the RSMC web site (QGIS server with POSTGIS database on a server of DIRRE)
- Forecast helper tool (web interface for RSMC senior forecasters) is practically finished. It will be operational for the 2013-2014 season



2 – Cyclone surge atlas

FIN