

Since the creation of Orstom activities (early forties) on the African continent, hydrologists studied a specific hydrology and managed more than 1,500 measurement stations on a region going West/East, from Senegal to Sudan and North/South, from Mali to Democratic Republic of Congo, roughly 7 million of square kilometers. This region includes two major rivers in the world: the Congo (second in the measured discharge) and the Niger (whose basin crosses 8 countries). This region experiencing severe decrease in rainfall in the early seventies, modelling was planned to estimate the impact of the variation of rainfall on water resources at the level of the region.

For this, researchers of HydroSciences Montpellier chose to model the rainfall/discharge relationship. The unit of this study is the area drained at a given measuring point on a river. Among all the stations managed in the data base, the researches selected the stations fulfilling two conditions: the drained basin had to measure at least the surface area of one cell of the model (i.e. around 3,000 square kilometers) and have been observed during at least 20 years in order to calibrate the model.

356 stations were selected and their drainage area were drawn.

Automatic delineation of the basins: recipe

Take a digital elevation model (also called DEM), place the points of the measurement stations on a map.

Ingredients:

"Clip" (or in other words, "cut") the DEM at the dimensions of "your area."

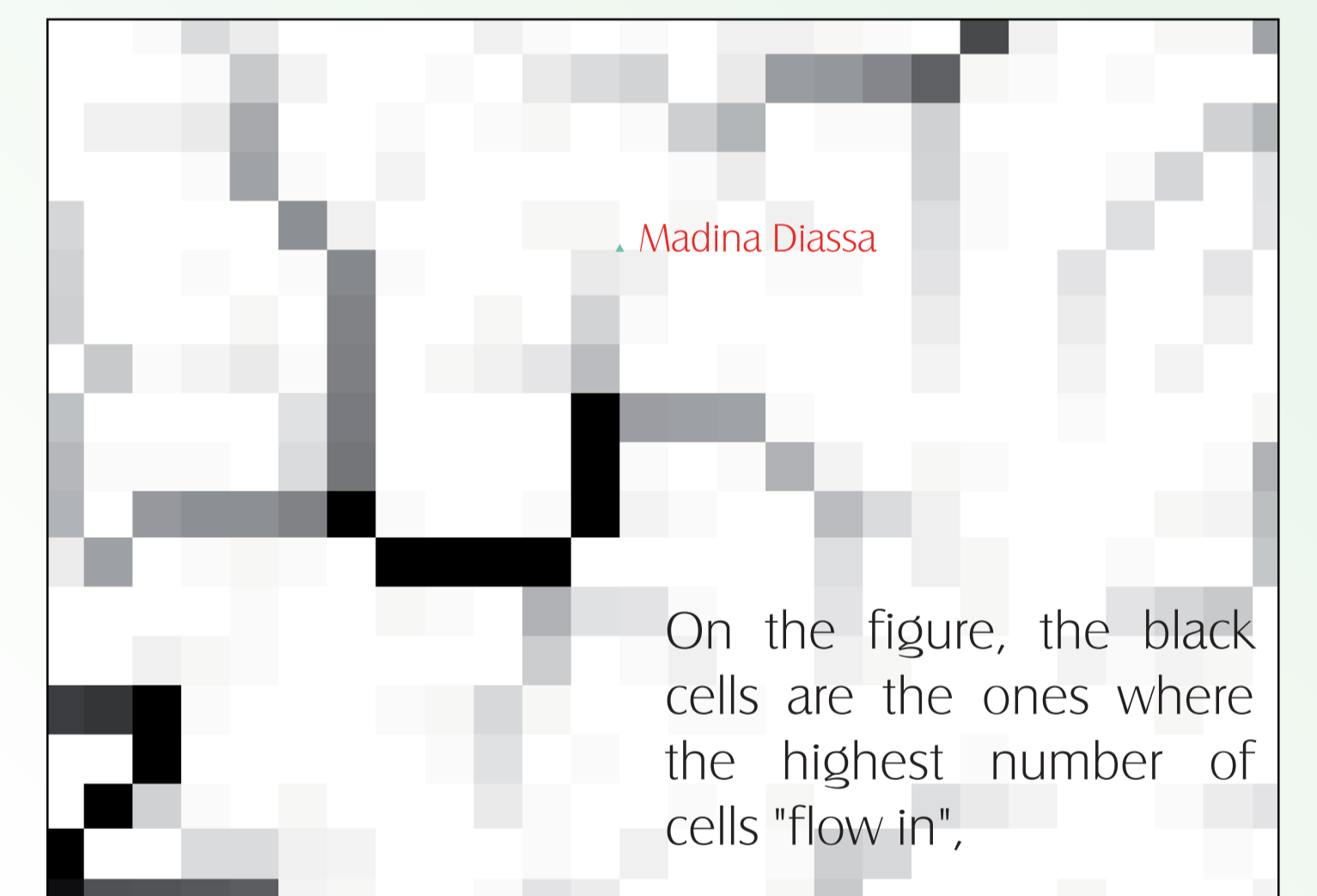
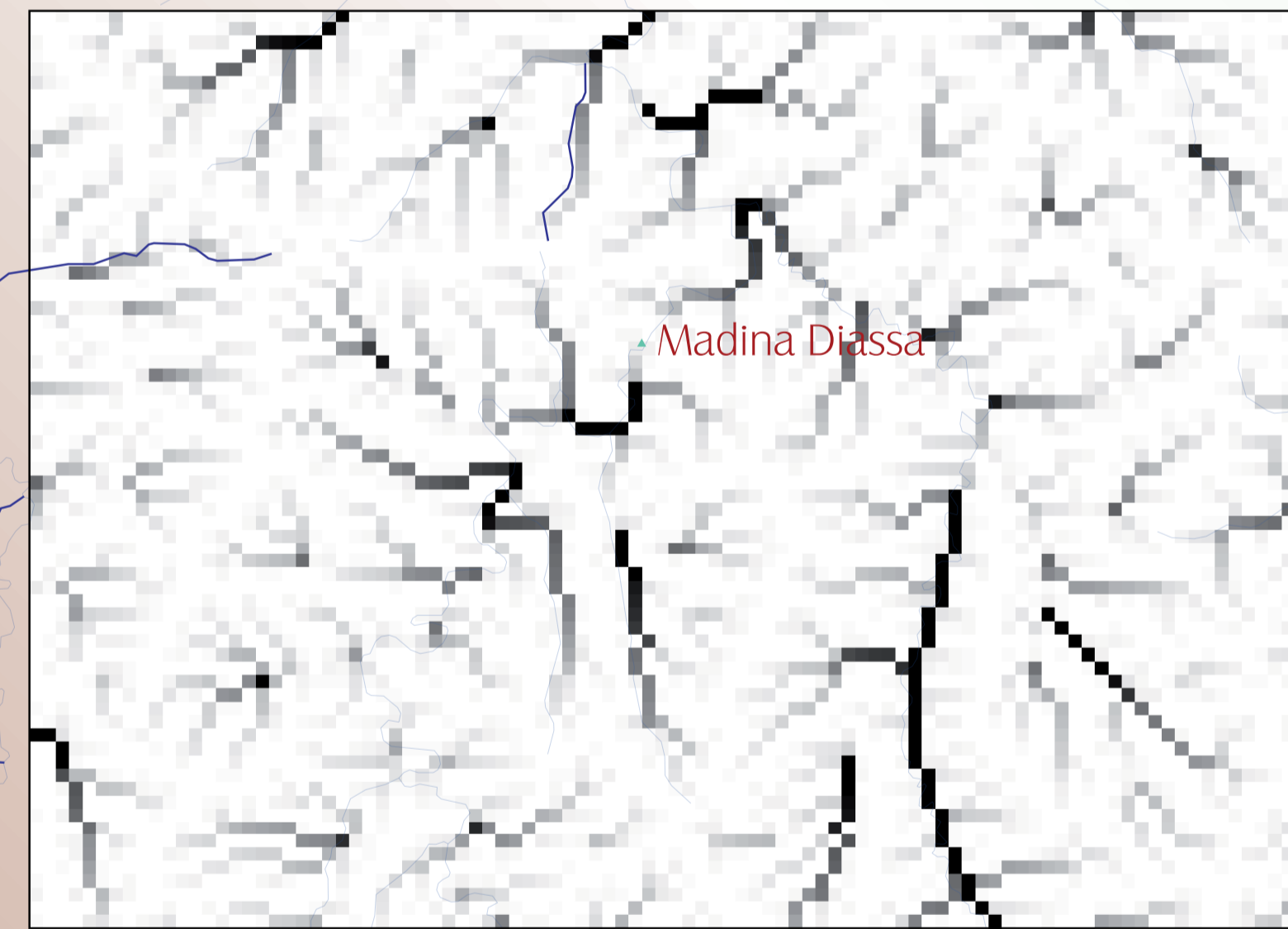
Processes:

Every cell in the DEM contains an elevation value corresponding to the mean elevation of the whole cell. In GTOPO30 DEM, a cell is a square measuring roughly one kilometer. We first ran an automatic program that calculates the orientation of every cell compared to the neighbour cells. The resulting grid contains this value: if the slope is oriented East, the value is 1, if the slope is westward, the value is 16...

367	361	354	366	375	371	381	370	363	361	355	345	338	348	350	349	348	364	374	371	361	361
380	367	355	360	370	370	394	381	373	370	360	343	345	355	359	359	353	369	385	374	363	359
378	377	368	354	360	367	372	374	359	353	349	342	361	358	368	375	358	364	378	367	362	372
377	367	366	355	354	363	372	369	357	342	340	355	373	362	368	375	358	373	373	365	371	376
375	366	361	365	353	367	364	356	356	340	349	372	375	371	383	374	365	384	385	370	377	371
360	356	352	349	345	352	354	352	348	339	349	359	360	374	389	390	372	388	385	377	378	369
366	361	355	342	341	357	369	368	355	338	343	348	348	358	369	374	384	396	389	383	381	379
350	346	343	340	340	355	370	361	352	339	345	364	357	351	356	369	373	386	401	390	395	381
341	341	341	339	340	348	356	354	342	340	346	358	373	369	355	362	369	388	397	397	394	375
345	342	343	344	350	340	340	339	349	360	381	373	372	360	374	372	375	385	396	384	382	
343	352	354	362	363	348	346	356	341	346	349	362	377	381	364	373	387	378	391	393	372	370
341	344	360	367	376	366	358	351	345	360	359	358	377	383	368	375	386	392	395	381	385	381
340	351	371	374	372	361	355	348	352	367	371	370	374	387	384	383	399	402	402	391	395	390
342	353	363	376	371	364	356	348	359	362	379	384	389	393	394	392	386	384	397	400	406	405
343	346	355	359	364	362	359	347	353	370	375	374	390	376	387	381	370	376	383	395	407	392

In the next automatic process the program automatically calculates the "flow accumulation", i.e. more or less the talweg that appears in the DEM.

Once all those processes are finished, it is necessary to finish the drawing of the basin drainage area while superimposing the hydrographic network; in our work, we used the Digital Chart of the World dnl layer to build this network.



But this is not enough: the final touch

The automatic program is efficient as long as the slopes are marked enough. On the region where we had to draw all the sub-basins, some areas are particularly flat (the central delta of the Niger is probably the best example we can give of this). We had to check in all the monographies, reports, atlases written and edited by Orstom hydrologists during the last sixty years to draw the most accurately we could the basins. This huge work was carried out in 2002 and 2003.

The result was gathered on the map below. This one shows the 38 basins delineated. It is now edited by IRD edition department. We also offer a booklet containing for every measurement station present on the map a set of metadata: the name of the station, the basin it belongs to, the name of the river measured, the latitude and longitude of the station, the surface area drained at the station, the IRD code for the station, the country where the station is located and the year the observations began at the station. This booklet can be downloaded on the site of the SIEREM information system, in the products item of the home page.

This cartographic work was lead within the development of the SIEREM information system and can be browsed on the site, where a specific part is the display of the maps with a GIS server, ArcIMS. All the sub-basins presents on this map can be displayed on the site together with other basins of East and South Africa. And in the Products part of the site, all the GIS layers can be downloaded as .shp files.

<http://www.hydrosiences.fr/sierem>

