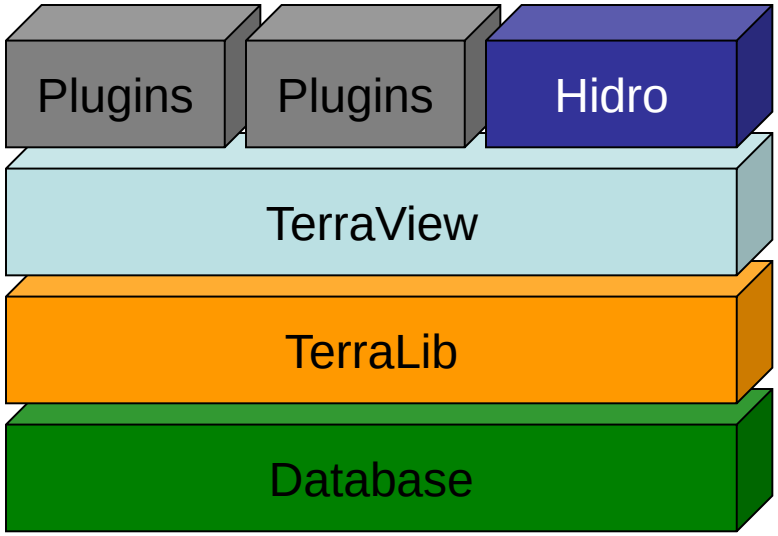
Instituto Nacional de Pesquisas Espaciais – INPE

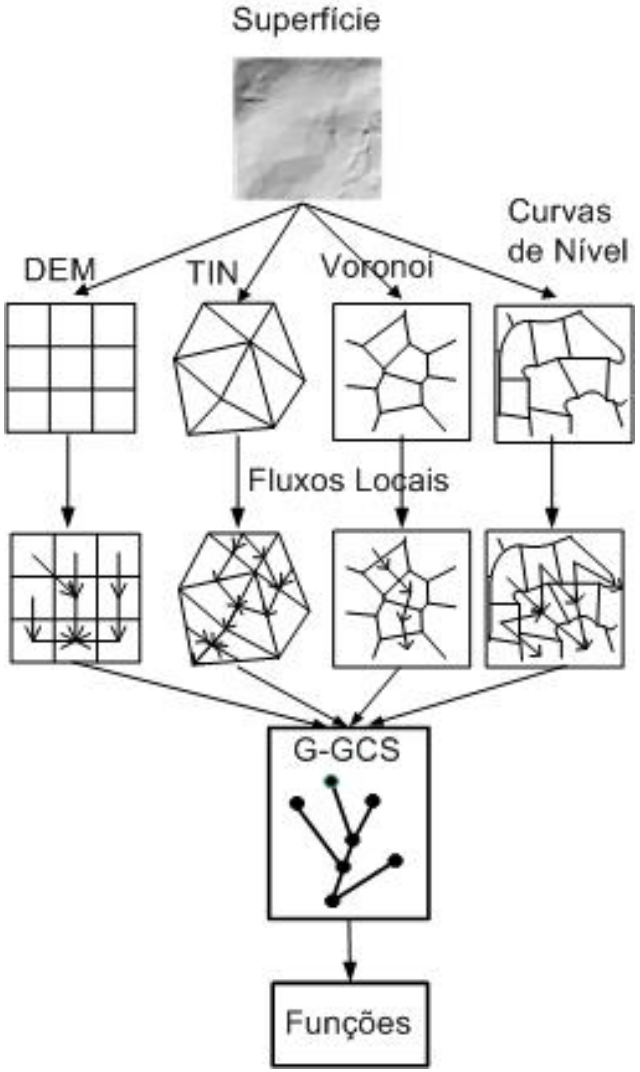
Sistema para Modelagem Hidrológica Distribuída TerraHidro

Sergio Rosim

TerraHidro - TerraView

Uma única estrutura para desenvolver aplicações





Graph -> drenagem

GRADE REGULAR DE ALTIMETRIA

- Matriz de altitudes
  - Resolução
  - Qualidade
- Dados disponíveis
  - SRTM – 30m
  - Base cartográfica do Amapá – 2,5m
- Dados não disponíveis
  - Base cartográfica do vazio cartográfico da Amazônia (exército) – 5m
- Dificuldade de acesso a dados de qualidade e resolução adequadas
- Necessidade de dados de alta resolução para todo o país

PROBLEMAS

- Clássicos
  - Áreas planas
  - Mínimos locais

- Dependentes do dado
  - SRTM: modelo de superfície
  - Base cartográfica do Amapá – altimetria dentro de corpos d’água

ETAPAS

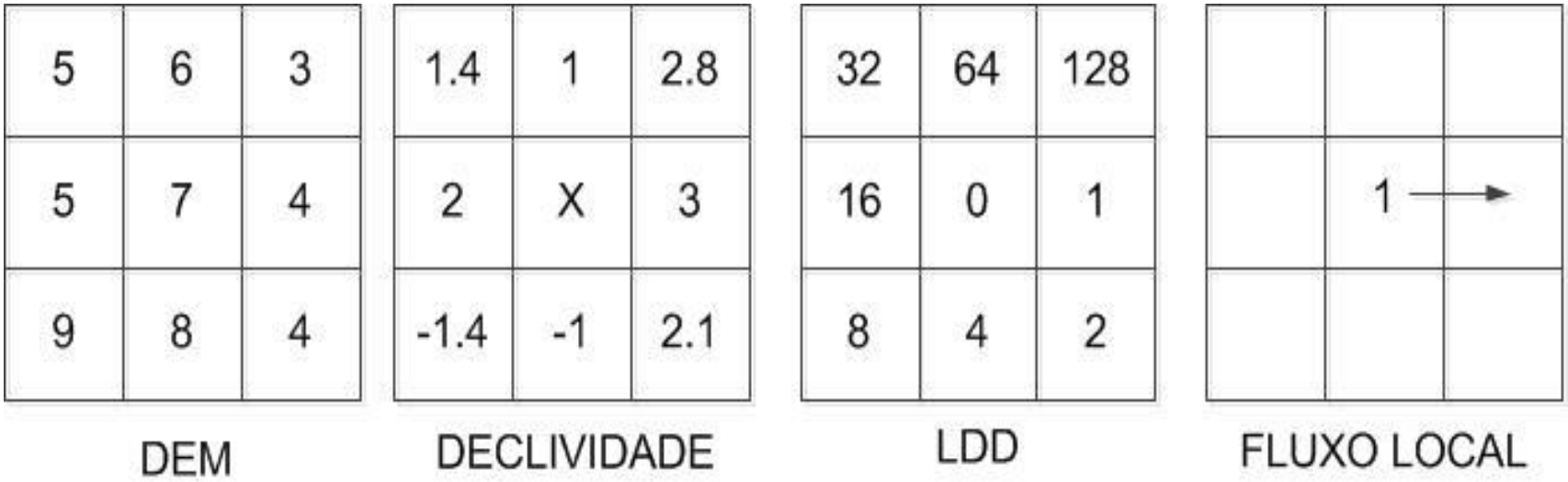
- Determinação da direção de fluxo local

- Cálculo da área de contribuição

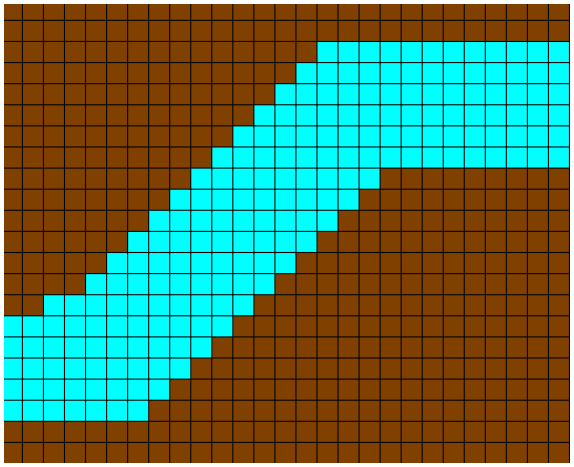
- Definição de uma rede de drenagem

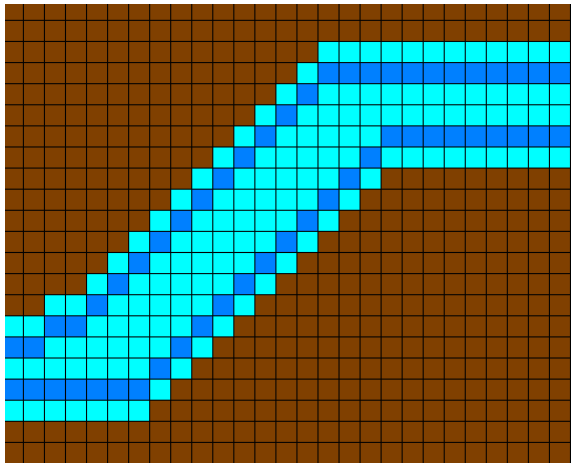
- Delimitação da bacia hidrográfica

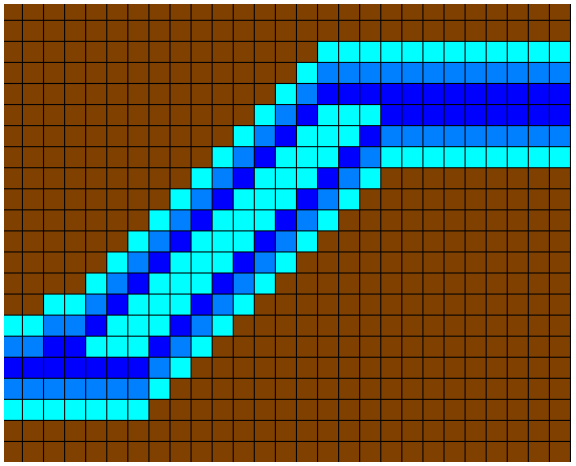
Determinação da direção de fluxo local

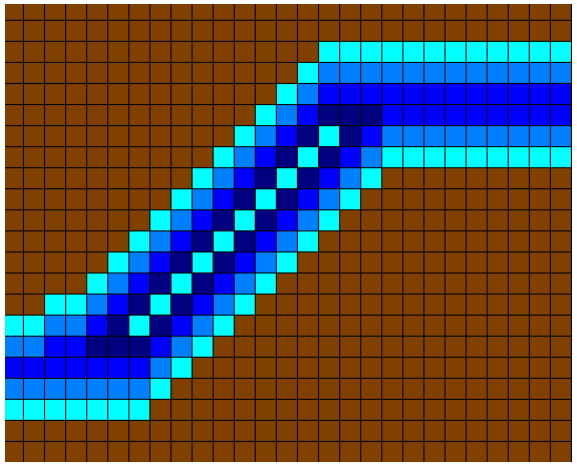


CAVAR ÁREAS PLANAS

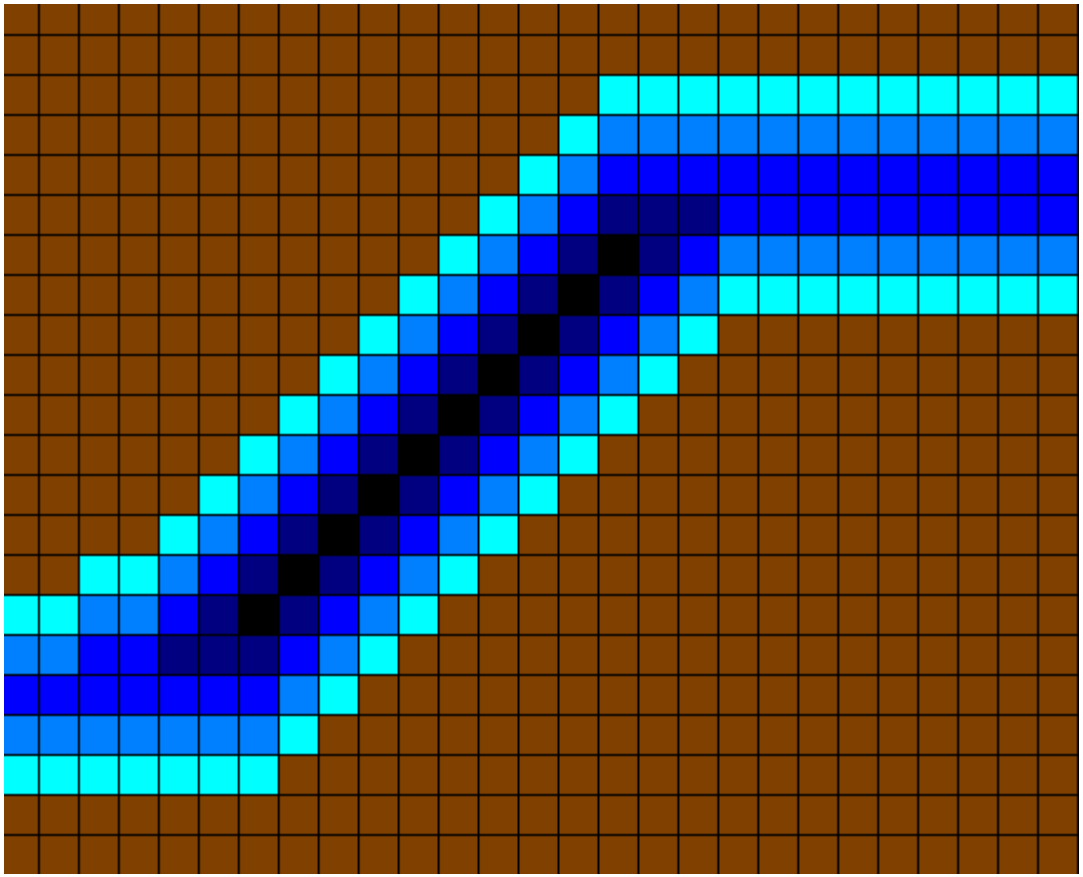




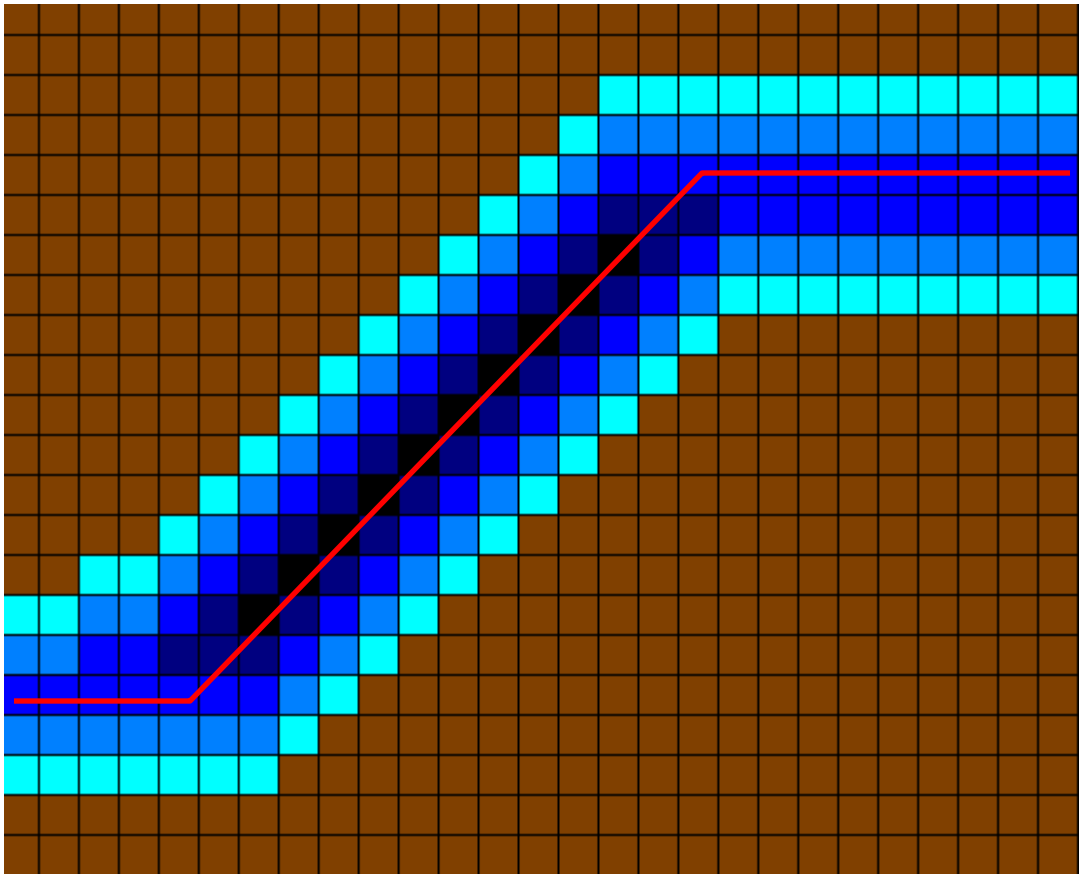




CAVAR ÁREAS PLANAS



CAVAR ÁREAS PLANAS



3. Resolver depressões por preenchimento

8	7	7
10	7	8
9	8	9

MNT

8 + 7 + 7 + 10 + 8 + 9 + 8 + 9 = 66

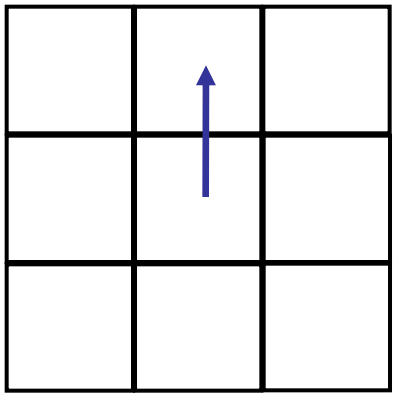
66 / 8 = 8.25

8	7	7
10	8.25	8
9	8	9

MNT

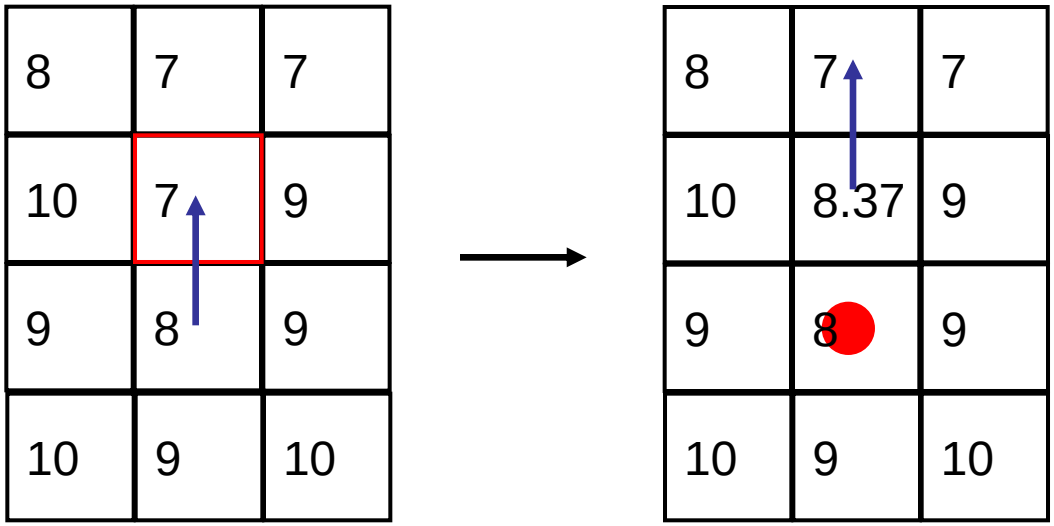
0.17	1.25	0.88
-1.7		0.25
-0.5	0.25	-0.5

Declividades



Fluxo Local

3. Resolver depressões por preenchimento



Quando resolver por preenchimento ocasionar outro fosso não utilizar esse método. Resolver “cavando” o MNT.

4. Resolver depressões “cavando”

Priority First Search - PFS

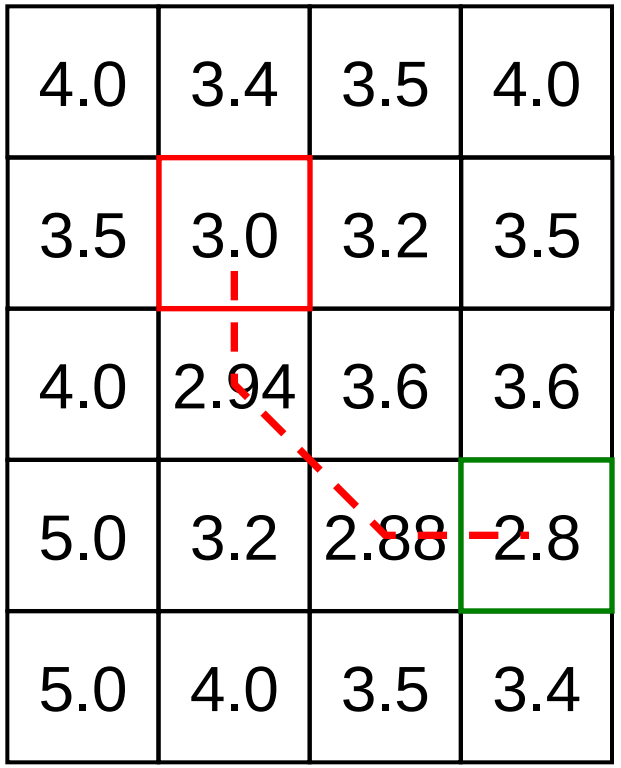
4.0	3.4	3.5	4.0
3.5	3.0	3.2	3.5
4.0	3.1	3.6	3.6
5.0	3.2	3.3	2.8
5.0	4.0	3.5	3.4

4.0	3.4	3.5	4.0
3.5	3.0	3.2	3.5
4.0	3.1	3.6	3.6
5.0	3.2	3.3	2.8
5.0	4.0	3.5	3.4

4. Resolver depressões “cavando”

Priority First Search - PFS

4.0	3.4	3.5	4.0
3.5	3.0	3.2	3.5
4.0	3.1	3.6	3.6
5.0	3.2	3.3	2.8
5.0	4.0	3.5	3.4

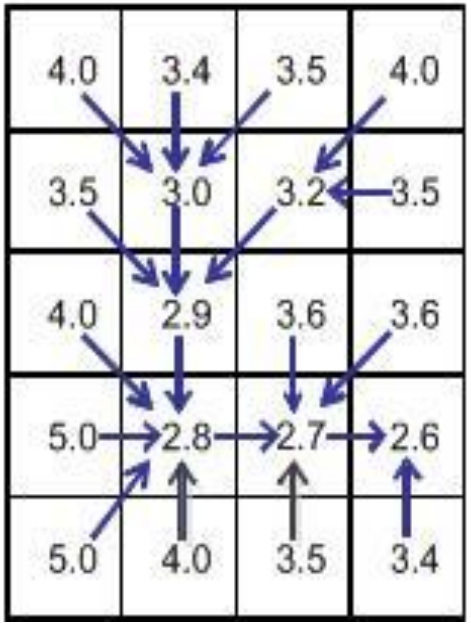


Cálculo da área de contribuição

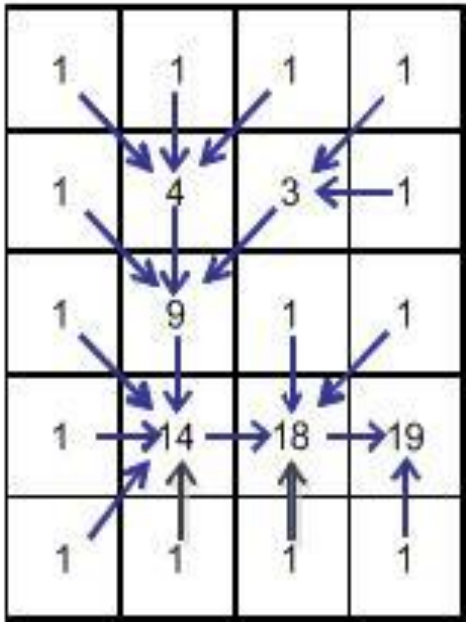
DEM

4.0	3.4	3.5	4.0
3.5	3.0	3.2	3.5
4.0	2.9	3.6	3.6
5.0	2.8	2.7	2.6
5.0	4.0	3.5	3.4

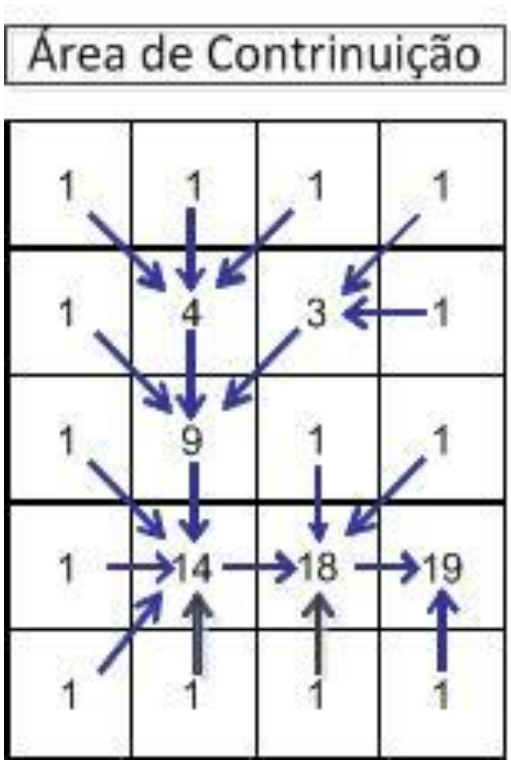
Fluxos Locais

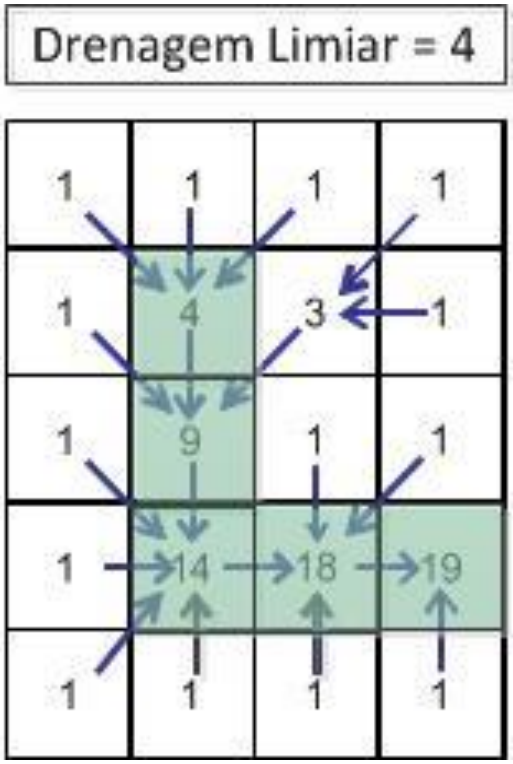


Area de Contribuição



Definição de uma rede de drenagem



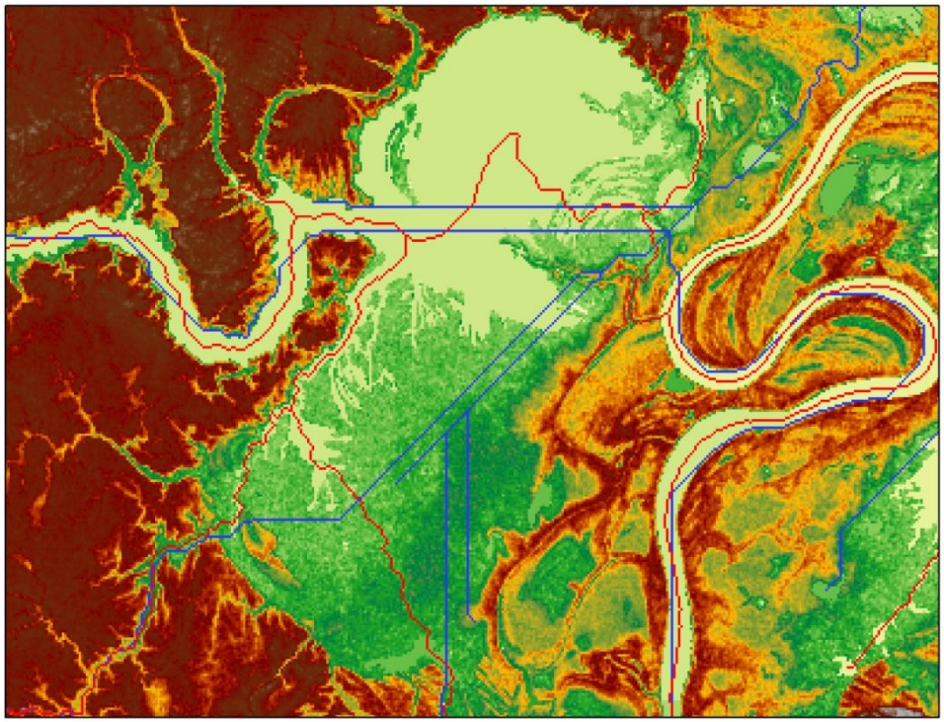


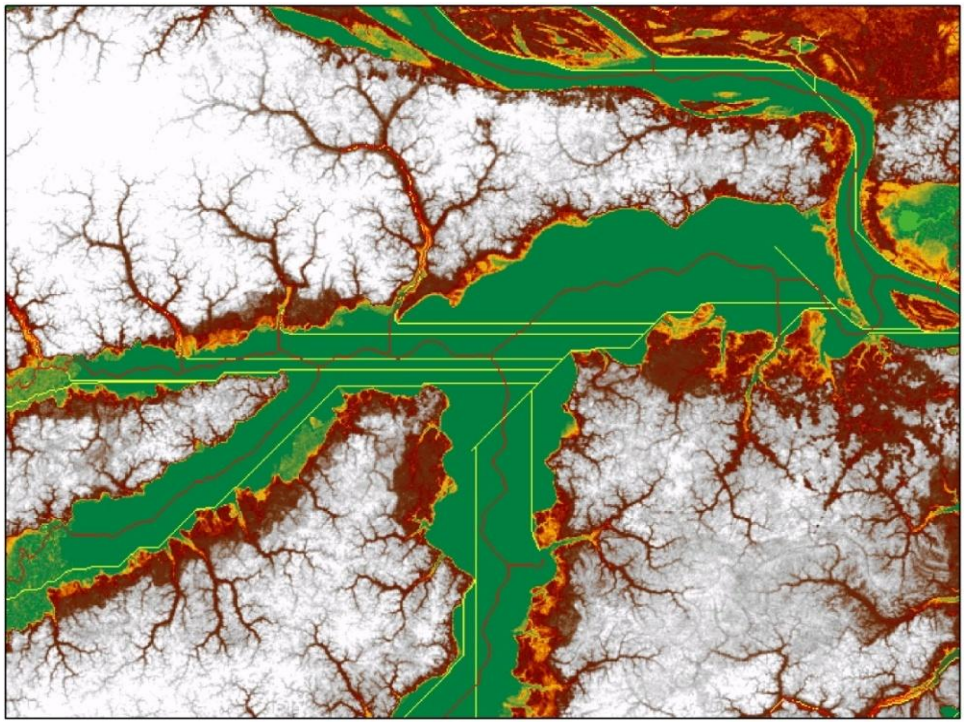
BOM RESULTADO

- Drenagem do vazio cartográfico da Amazônia

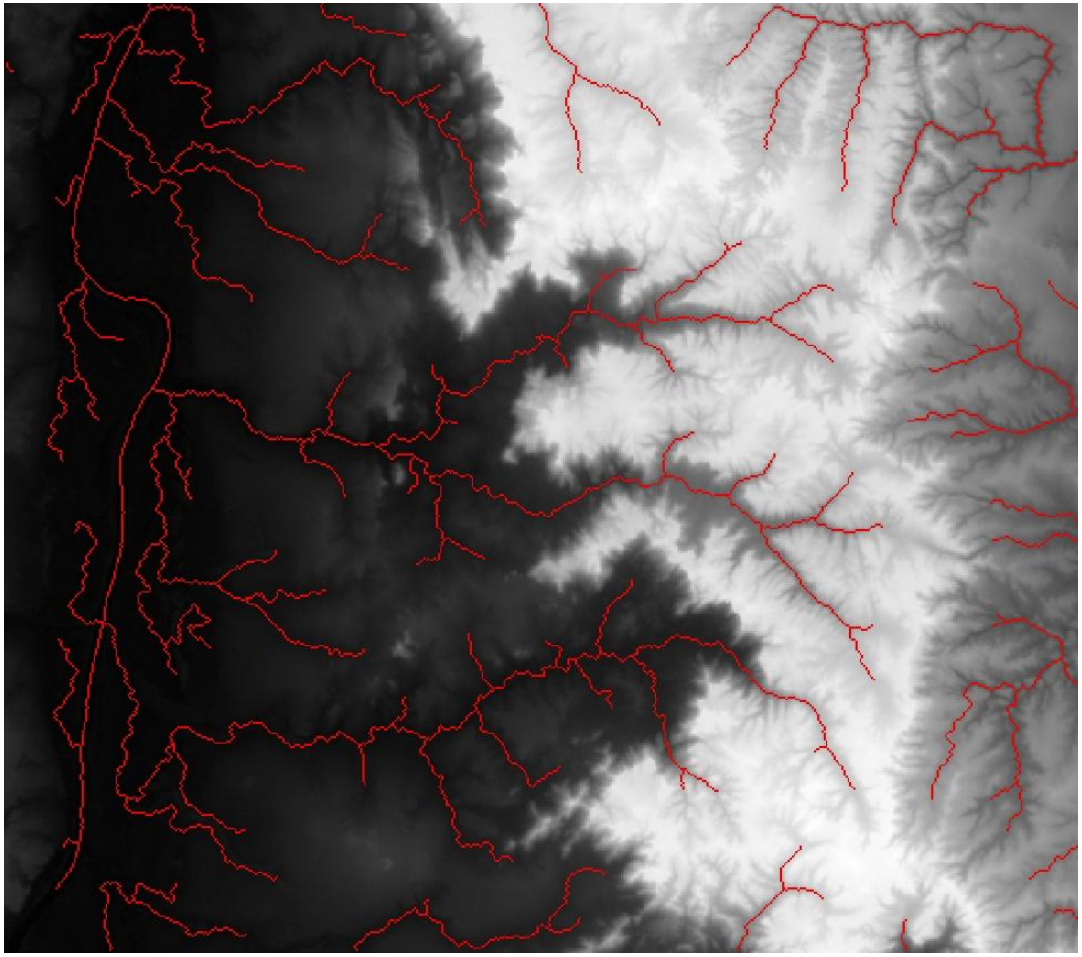
- Agência Nacional de Águas (ANA)
  - Drenagens e bacias hidrográficas

TerraHidro x ArcGis Hydro Tools – Rio Purus

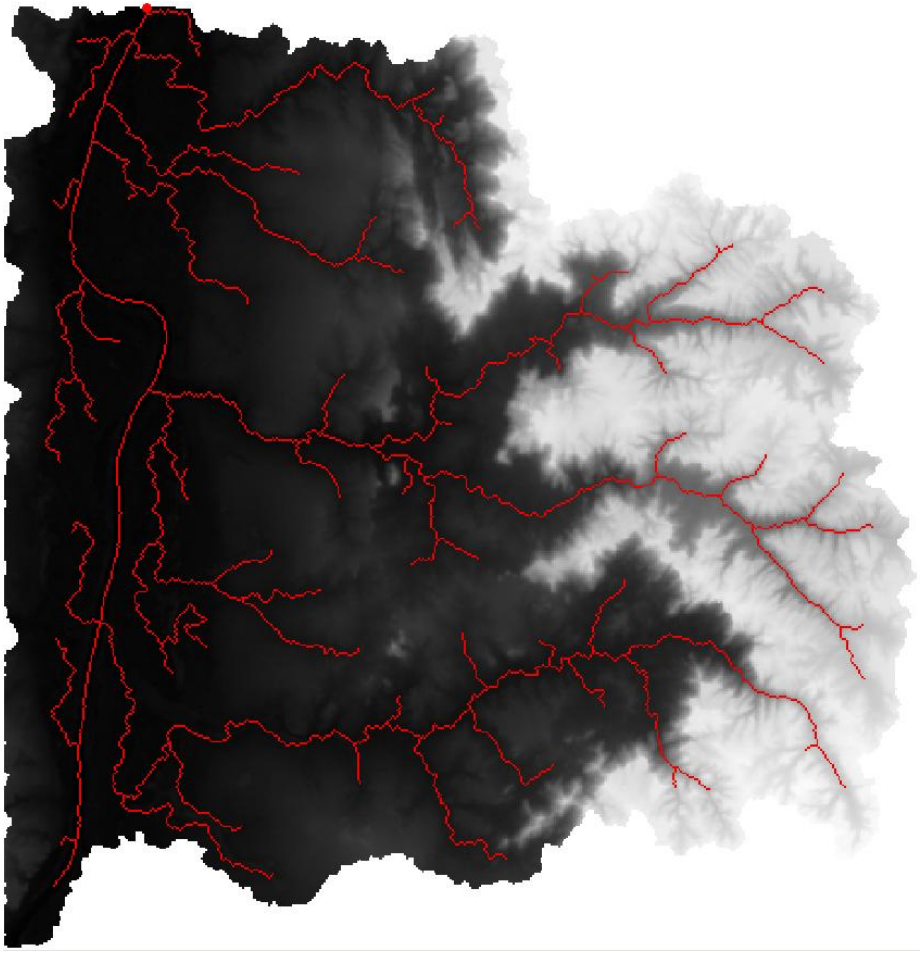




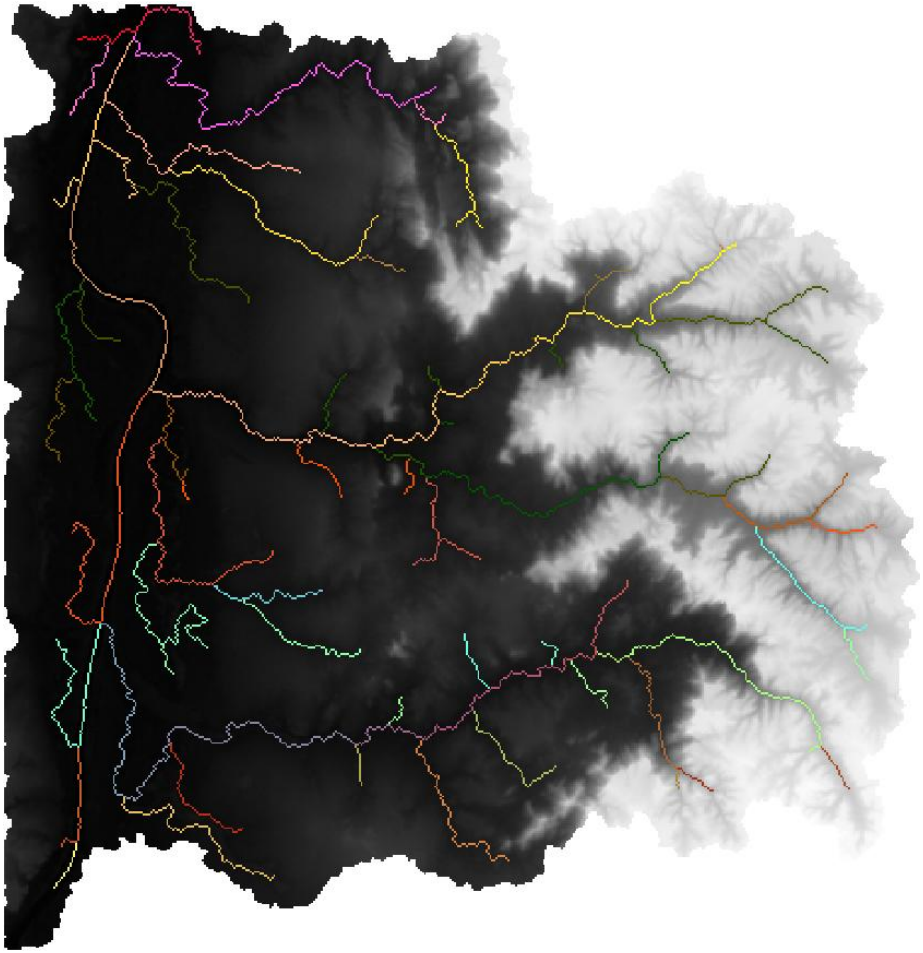
ÁREA ACUMULADA / DRENAGEM



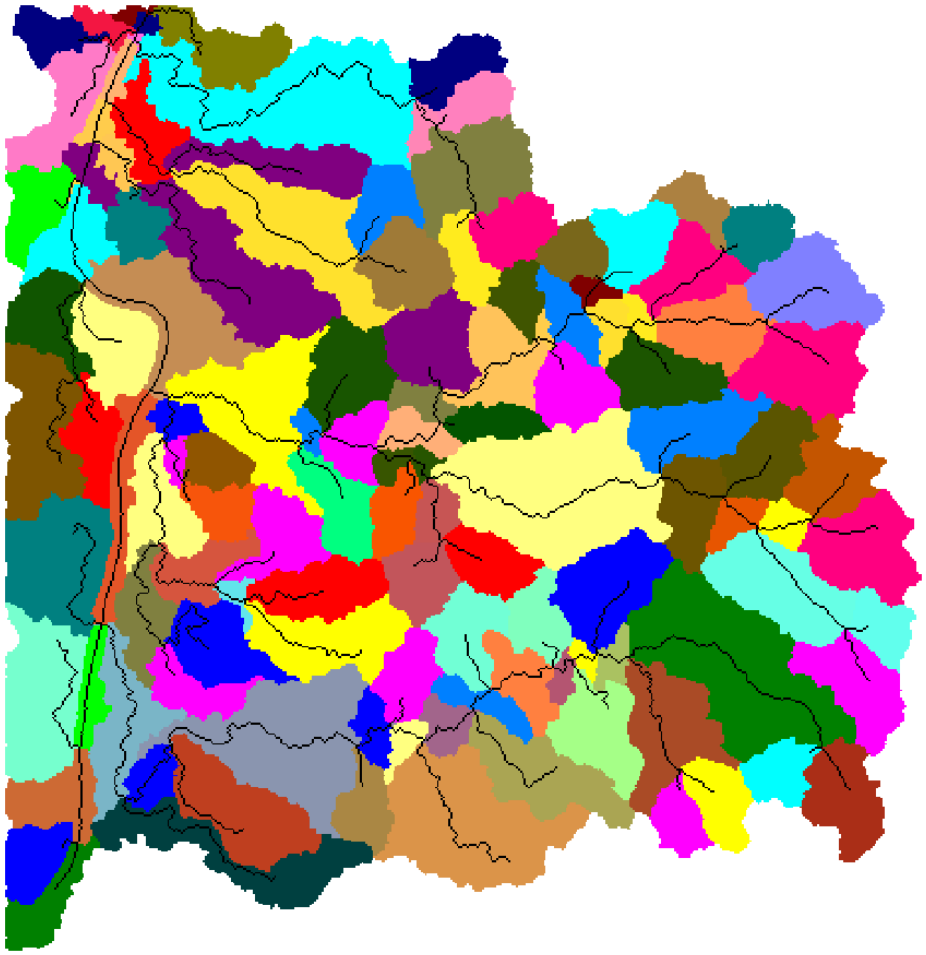
DELIMITAR A ÁREA DE CONTRIBUIÇÃO



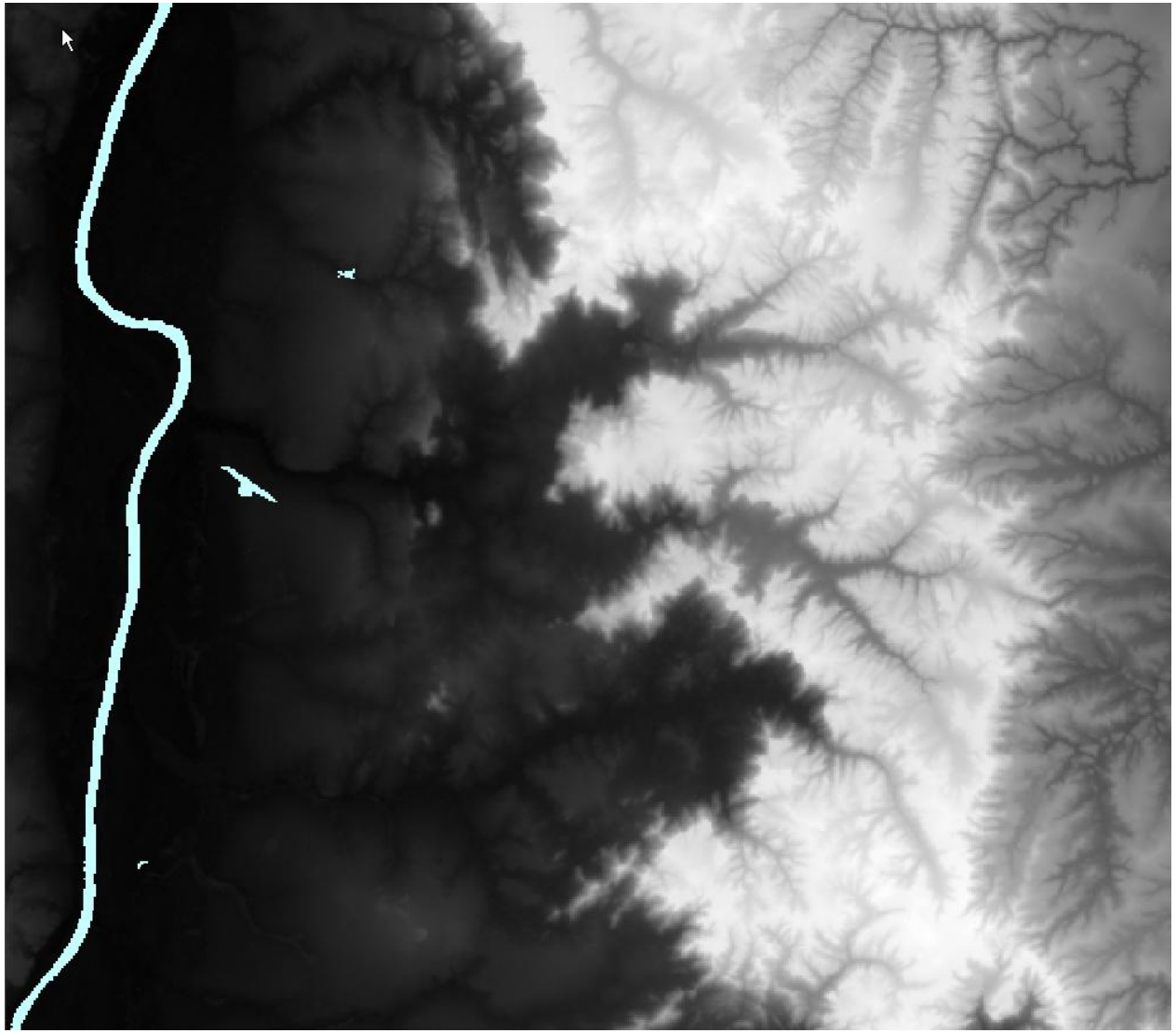
SEGMENTOS DA DRENAGEM



MINIBACIAS



Taquaruçu



x1: -48.45

y1: -10.50

x2: -48.00

y2: -10.10

Pixels: 259.139

Linhas: 479

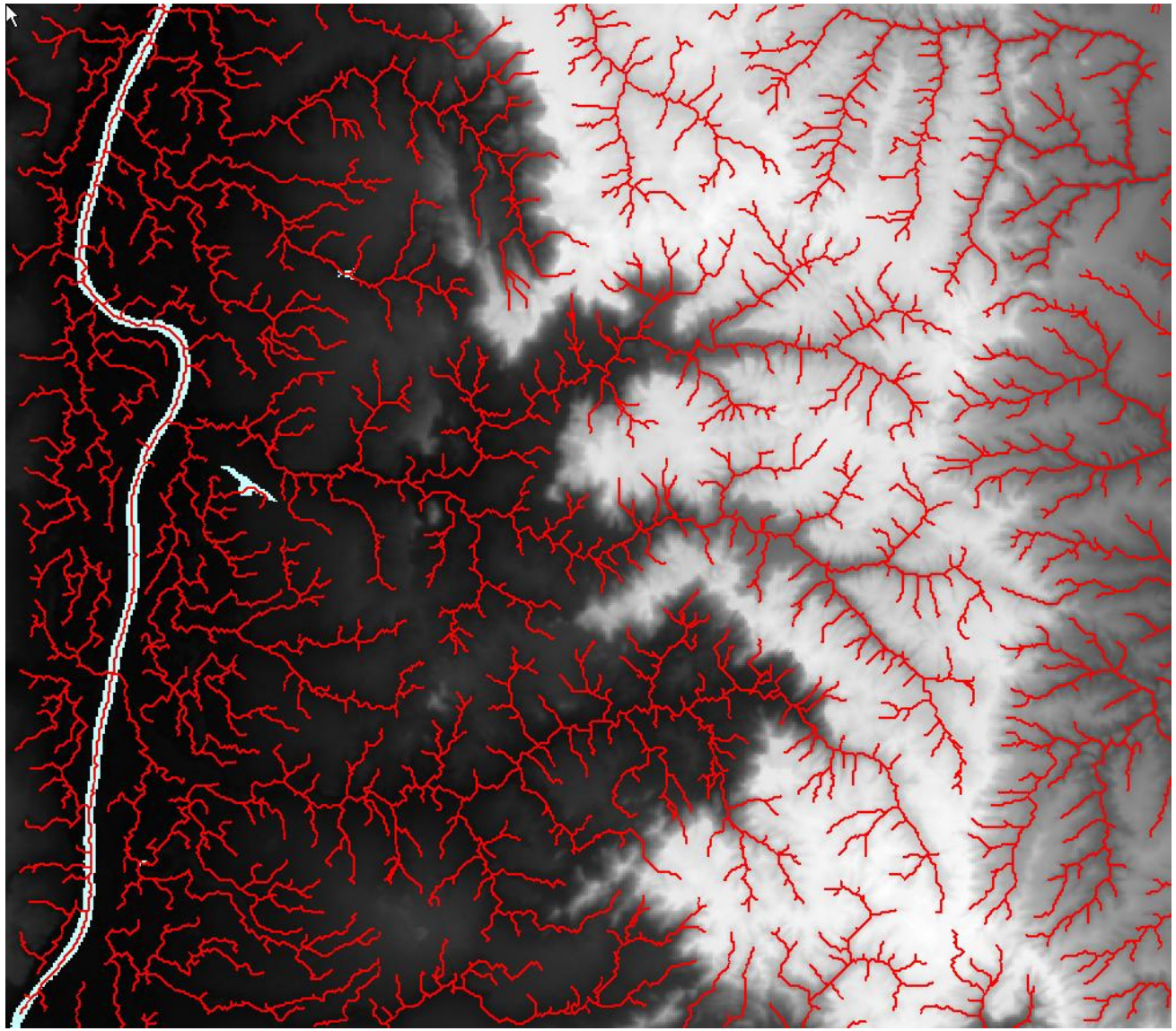
Colunas: 541

Fossos: 10.983

Tempo: 2.00 s

Acumulada: < 1 s

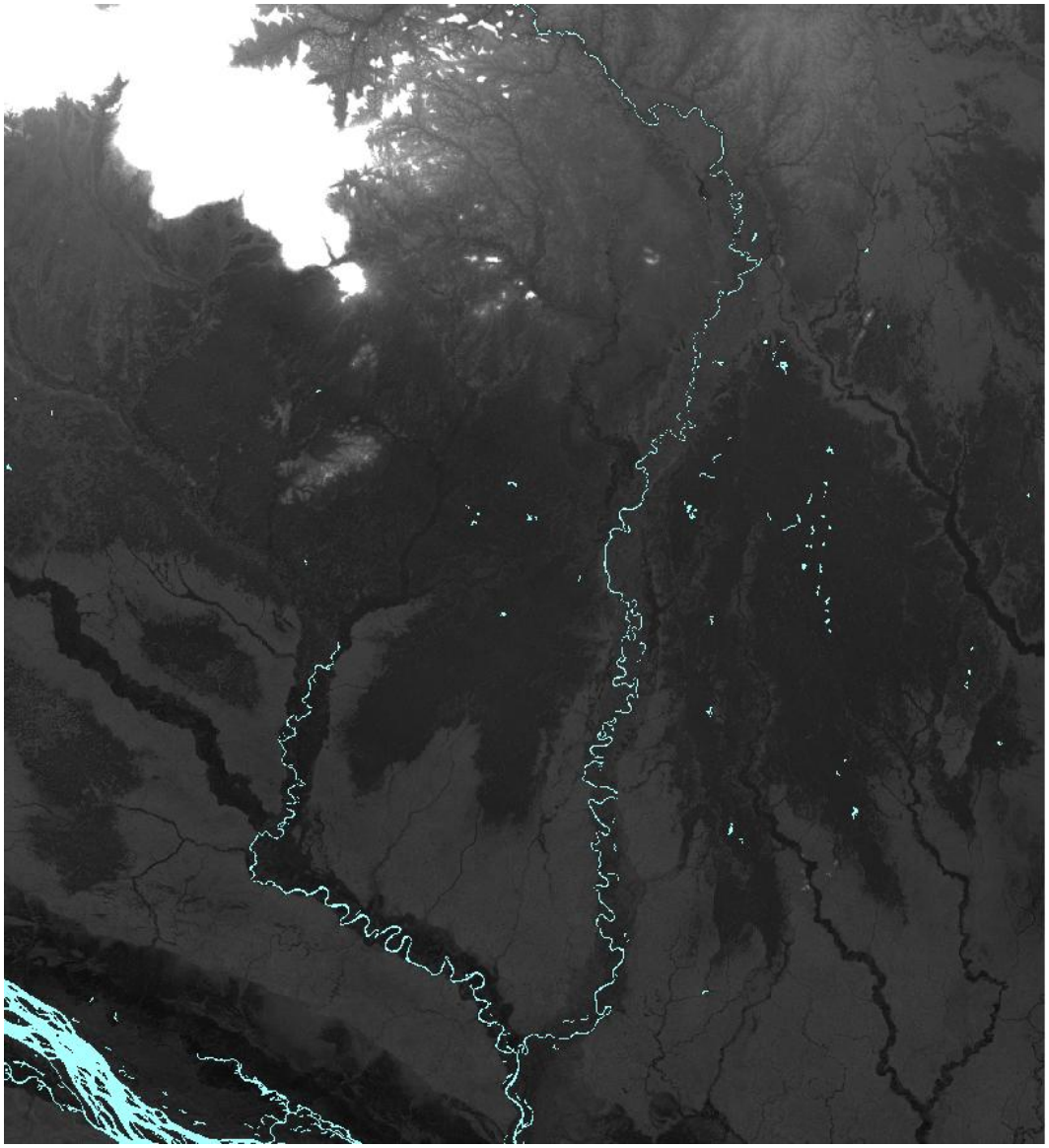
Taquaruçu Drenagem



Valor de corte: 50

Maior Ordem: 6

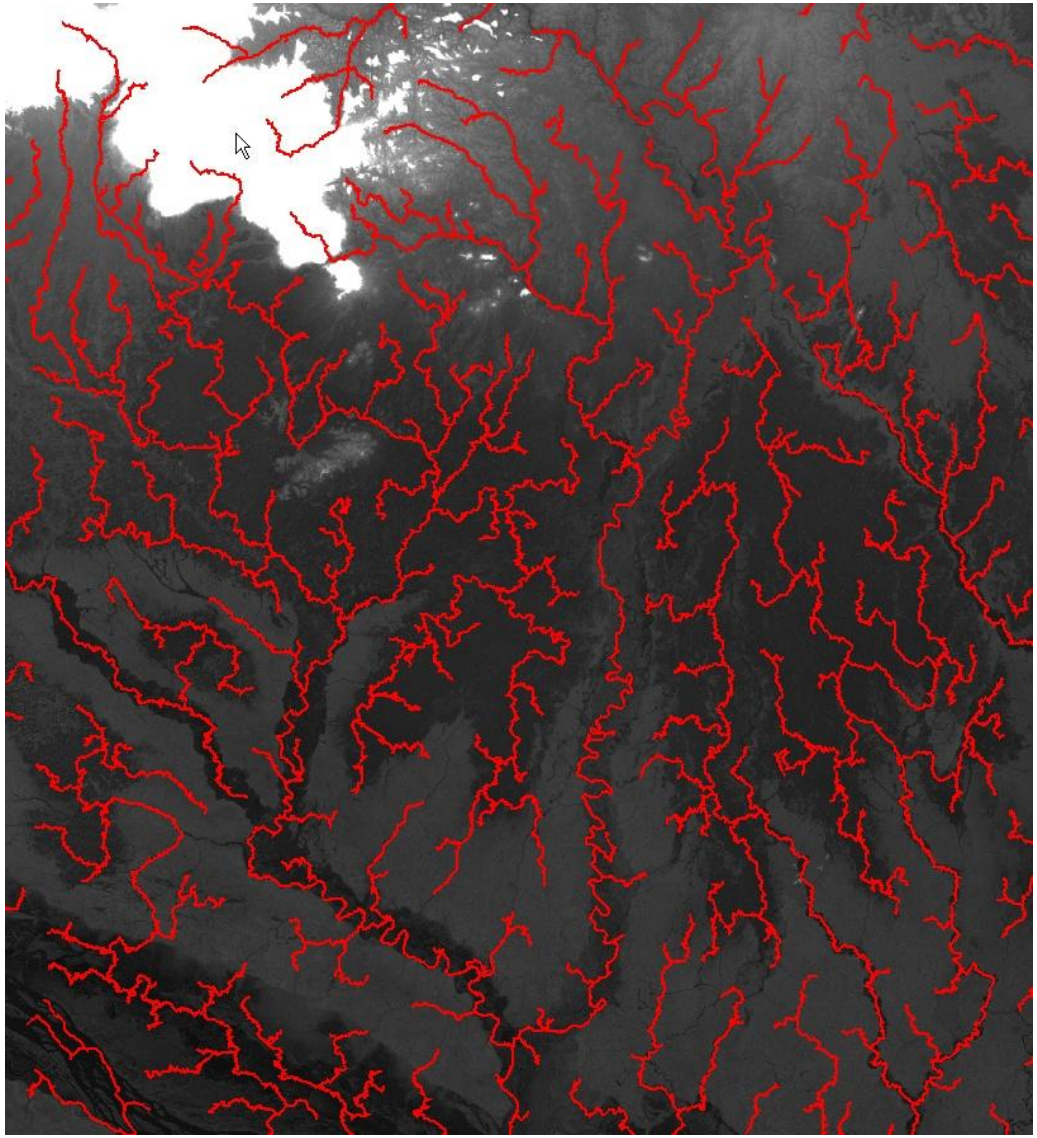
Getirana



Saturado em 200 metros.
x1: -63.66
y1: -0.55
x2: -62.12
y2: 1.12

Pixels: 3.734.280
Linhas: 2.024
Colunas: 1.845
Fossos: 396.769
Tempo: 26:30 min
Acumulada: 1 s

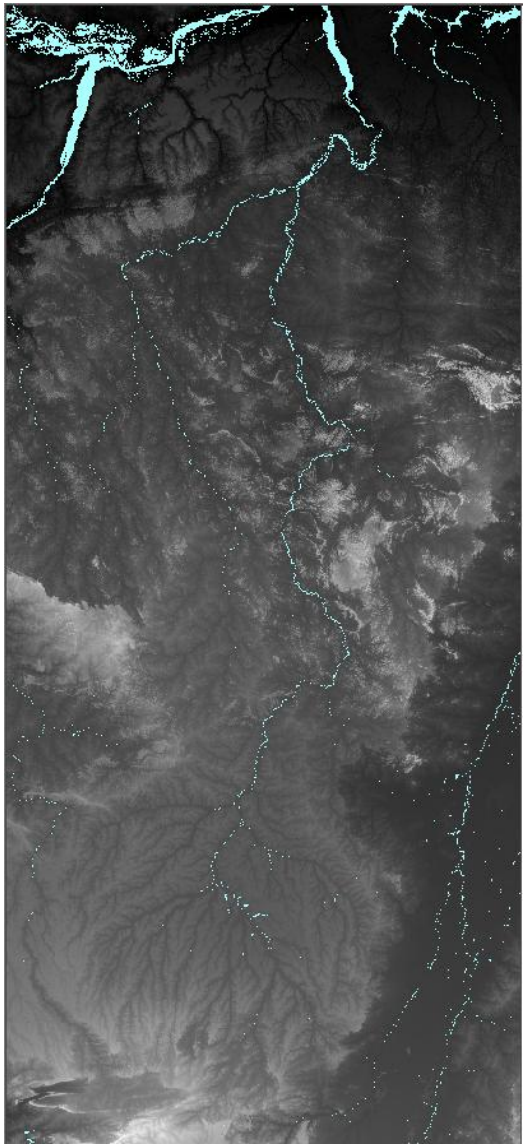
Getirana Drenagem



Valor de corte: 3.000

Maior Ordem: 5

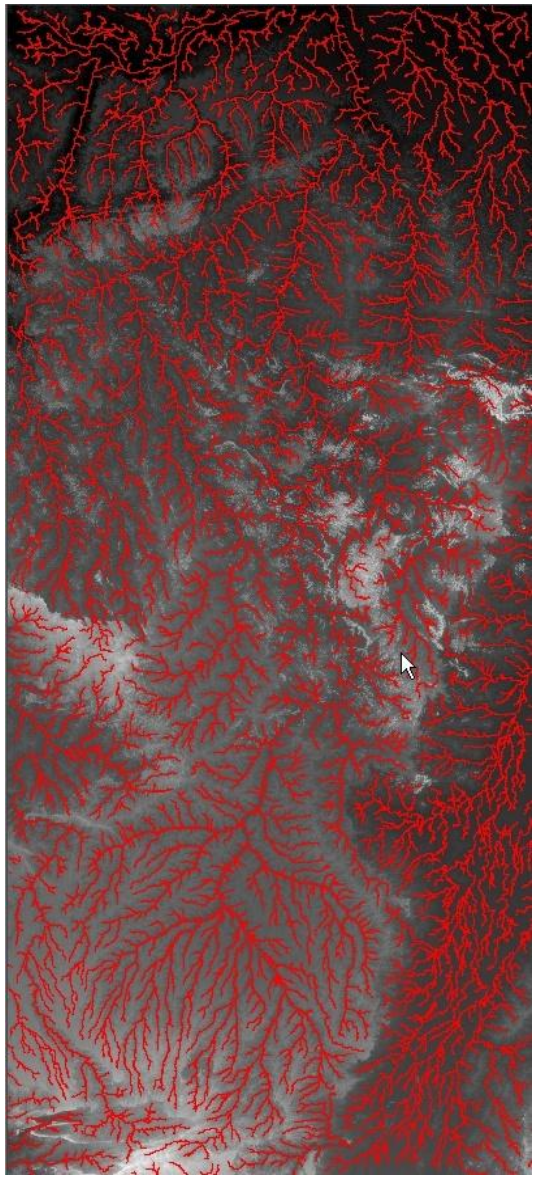
Xingu



x1: -56.00
y1: -15.00
x2: -49.99
y2: -1.69

Pixels: 114.958.324
Linhas: 15.962
Colunas: 7.202
Fossos: 6.472.113
Tempo: 3:20:04 h
Acumulada: 2:48 min

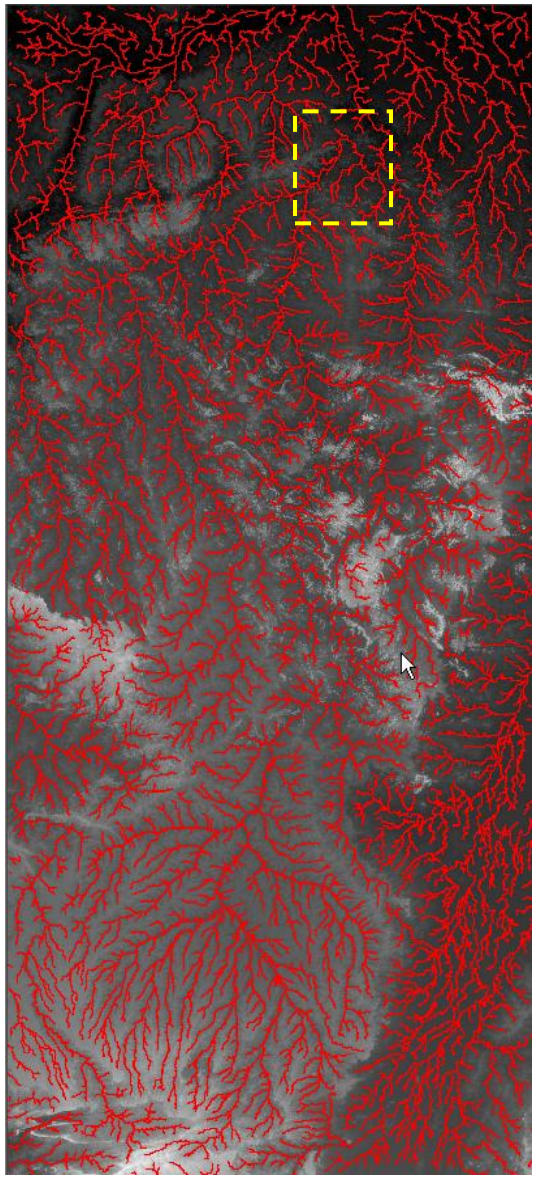
Xingu Drenagem



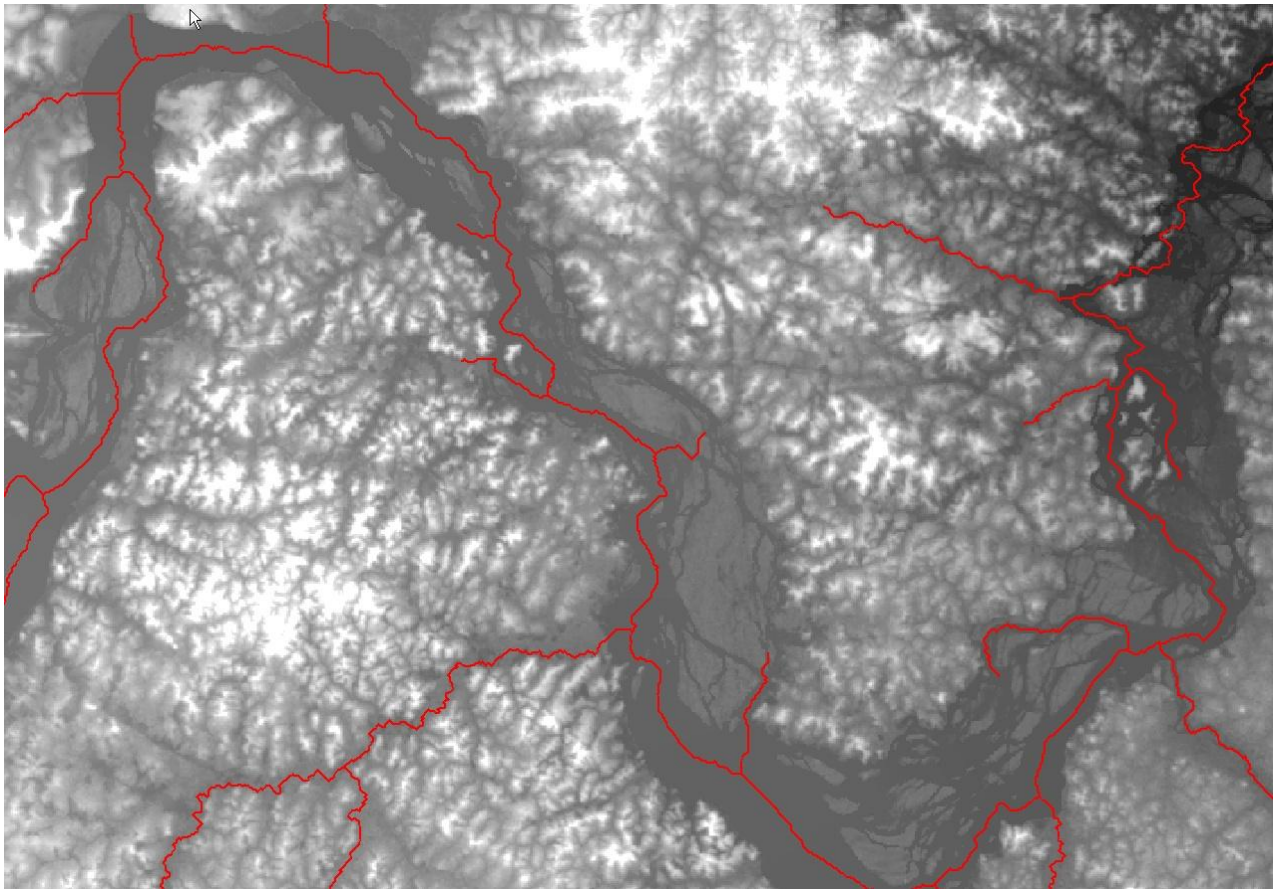
Valor de corte: 10.000

Maior Ordem: 6

Xingu Drenagem Zoom

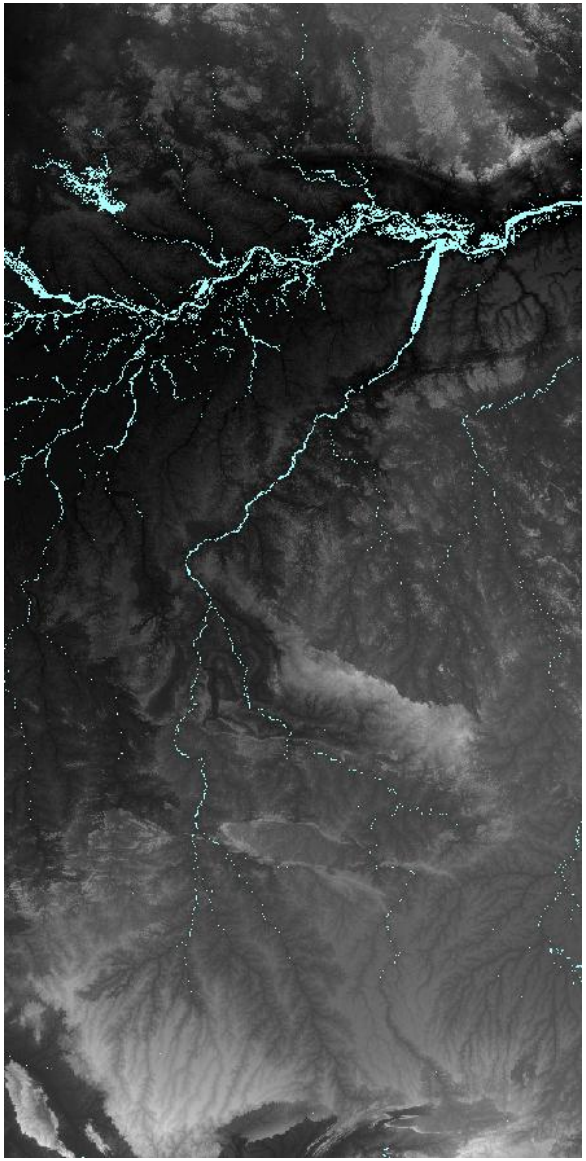


Drenagem passa pelo centro da área plana



Zoom saturado em 200 metros

Tapajós



x1: -61.00

y1: -15.00

x2: -52.99

y2: 1.00

Pixels: 184.348.801

Linhas: 19.201

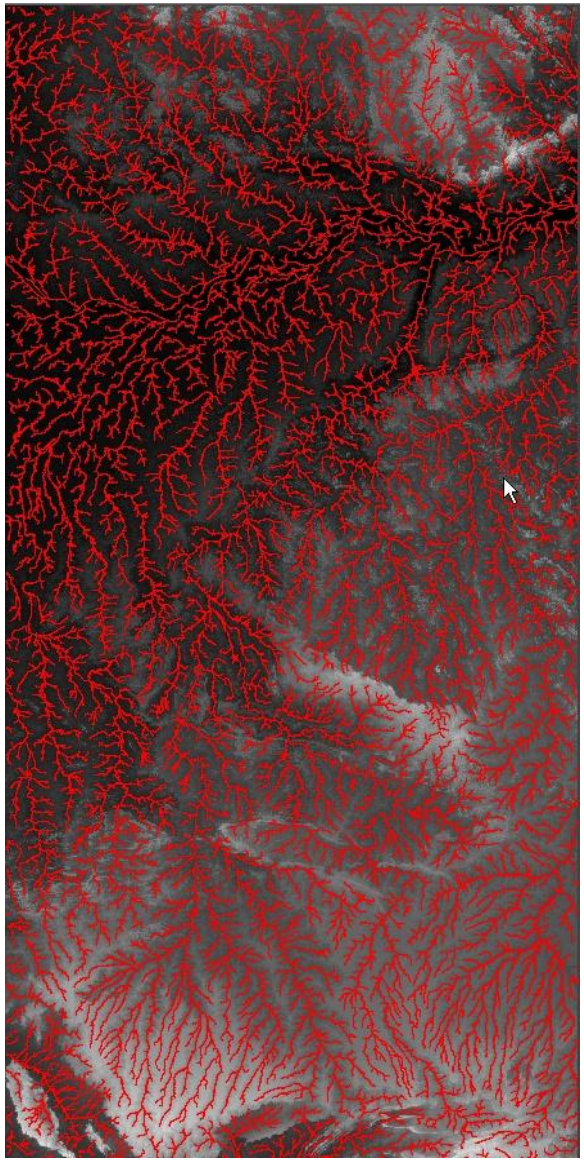
Colunas: 9.601

Fossos: 8.647.984

Tempo: 5:33:38 h

Acumulada: 10:58 min

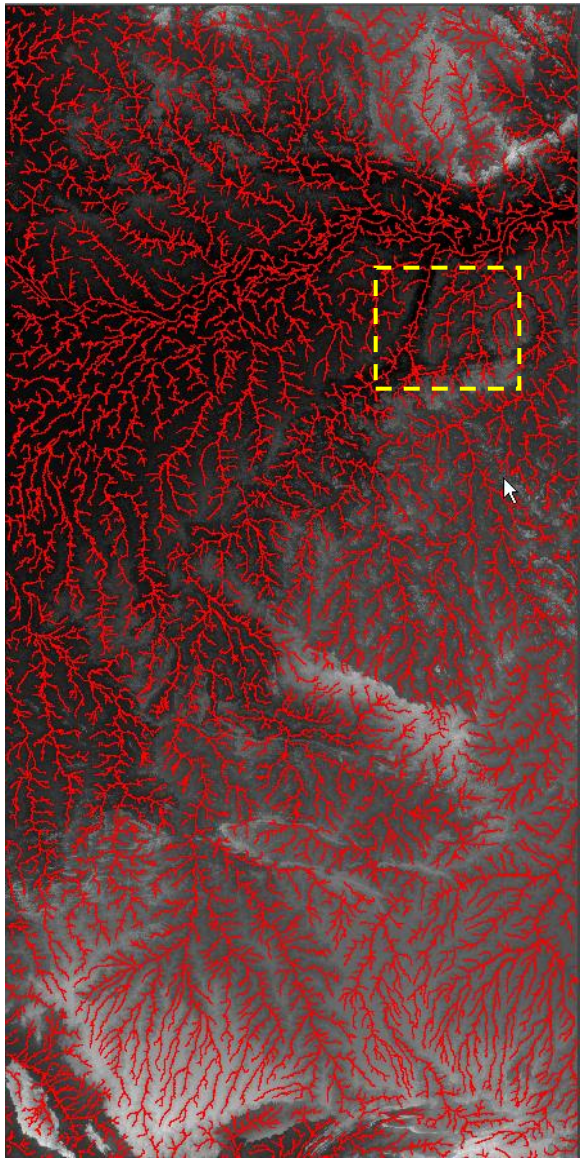
Tapajós Drenagem

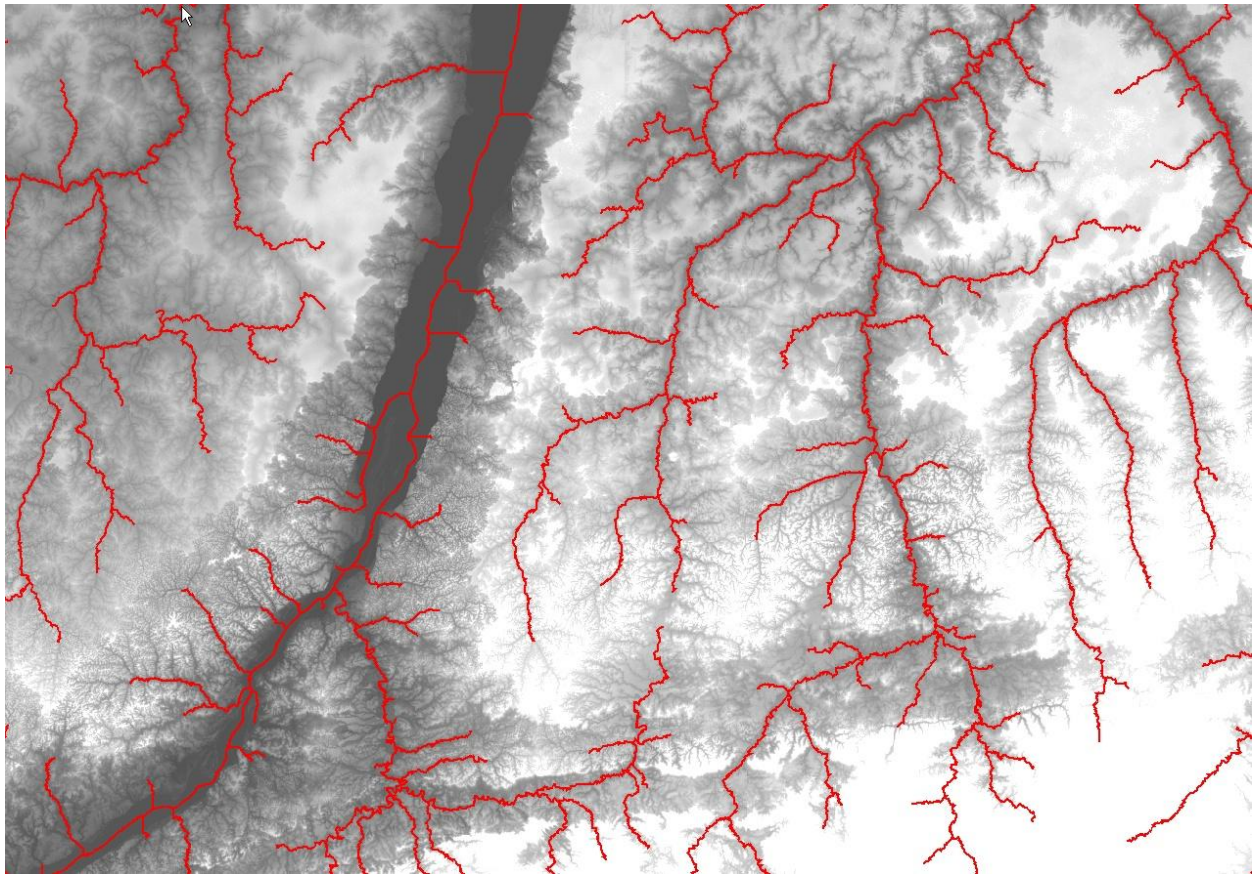


Valor de corte: 10.000

Maior Ordem: 7

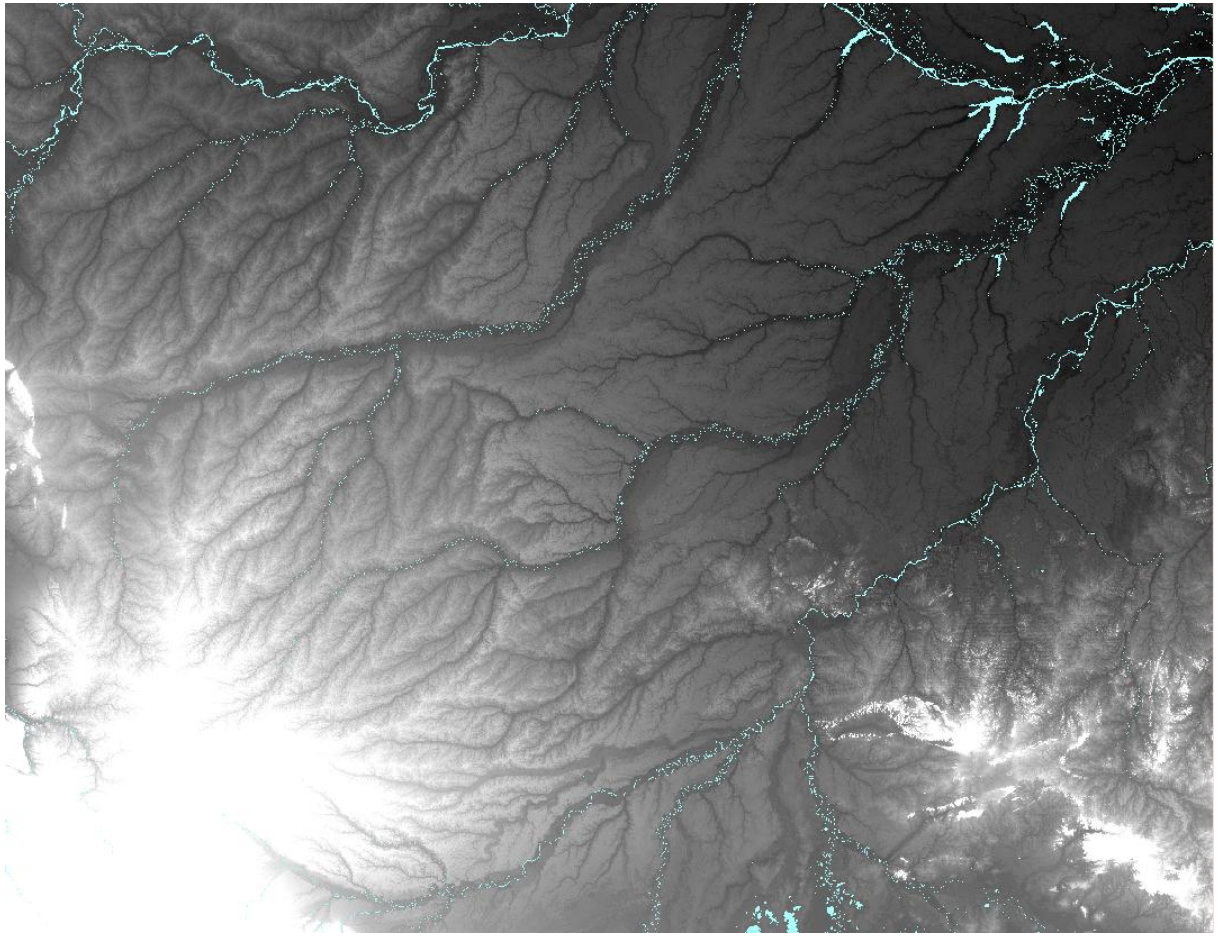
Tapajós Drenagem Zoom





Zoom saturado em 200 metros

Purus

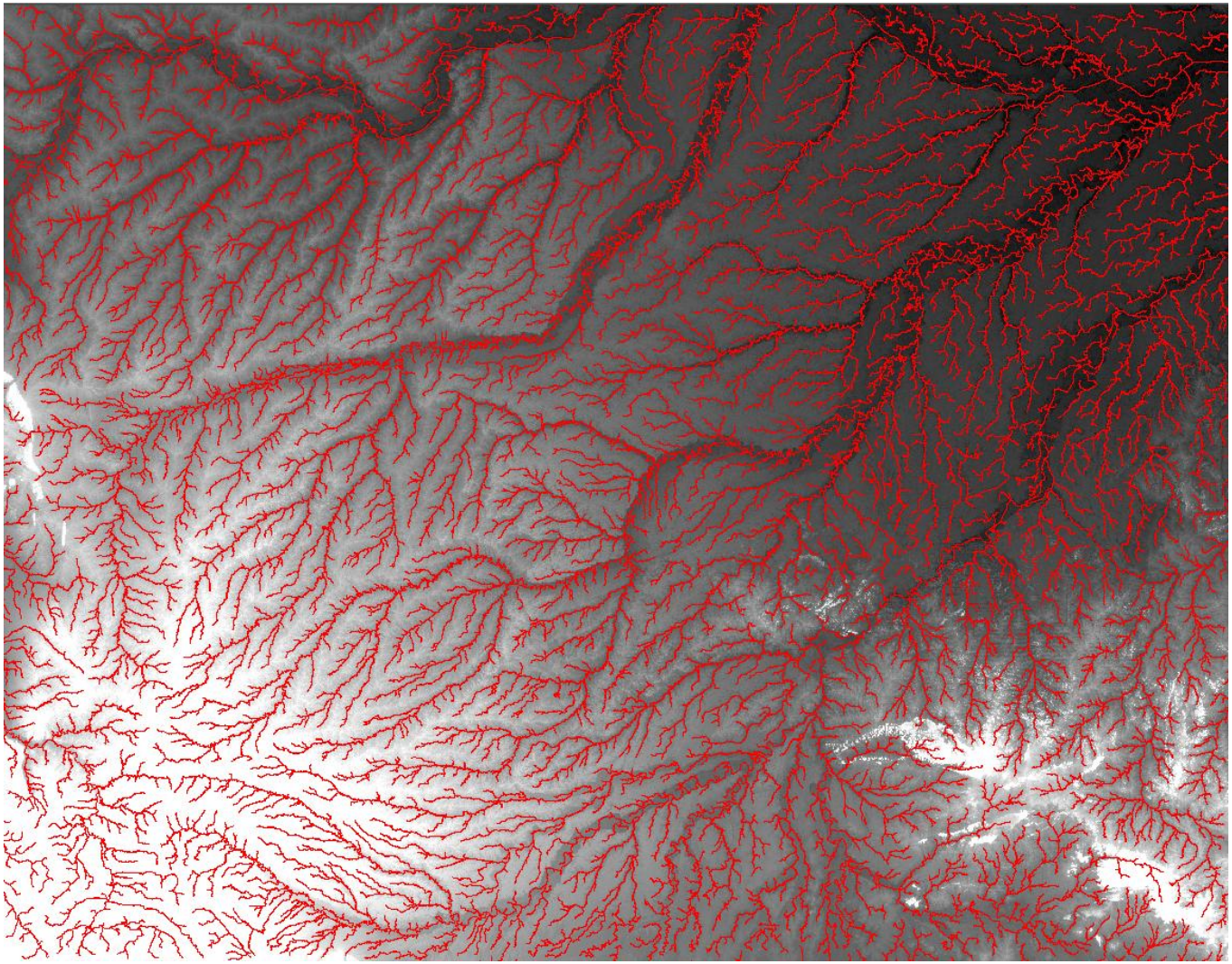


x1: -74.00
y1: -12.99
x2: -61.00
y2: -2.99

Pixels: 187.200.000
Linhas: 12.000
Colunas: 15.600
Fossos: 13.279.394
Tempo: 5:40:31 h
Acumulada: 12:07 min

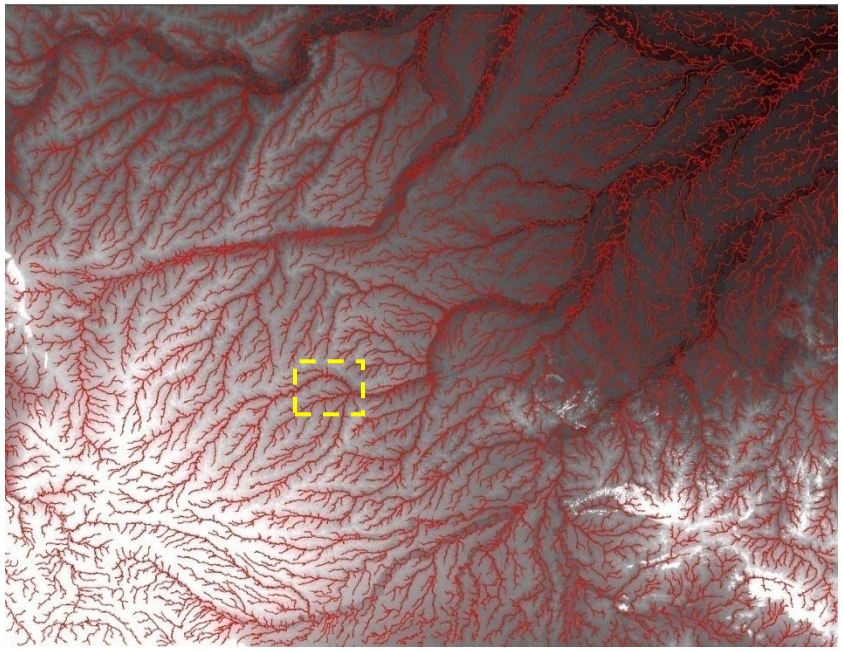
Saturado em 350 metros

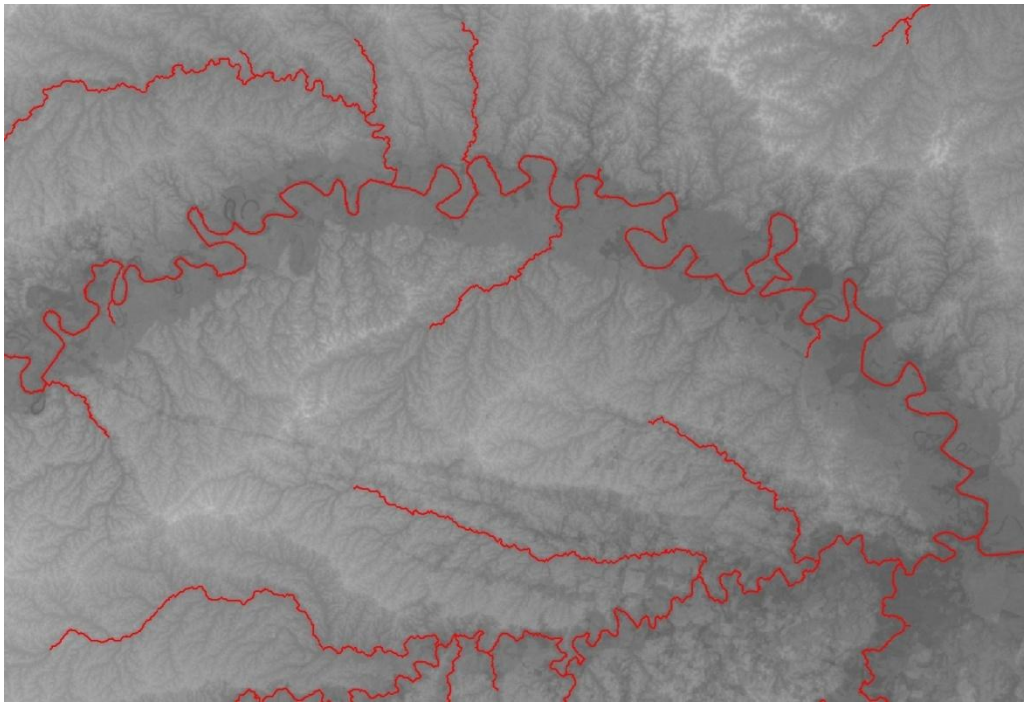
Purus Drenagem



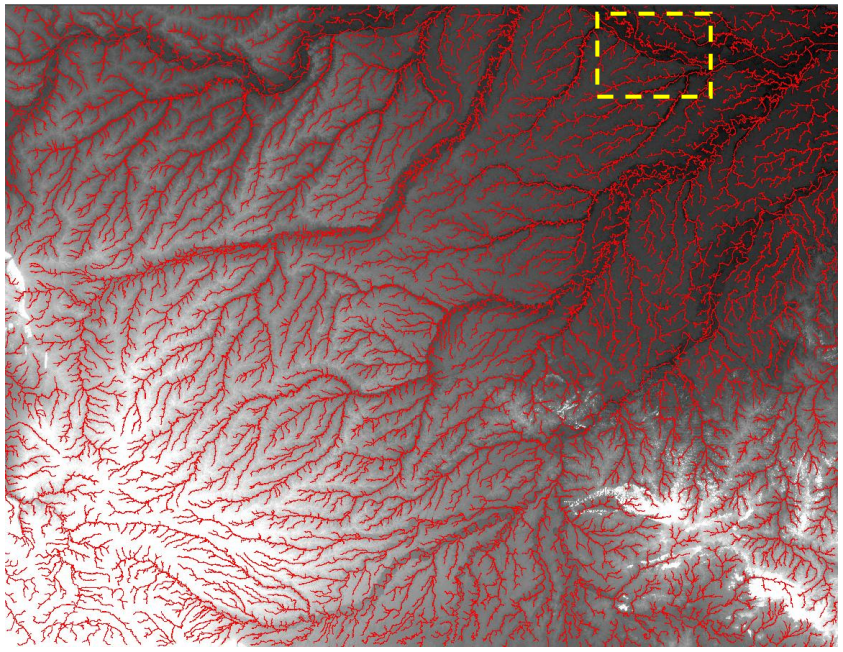
Valor de corte: 10.000 Maior Ordem: 6

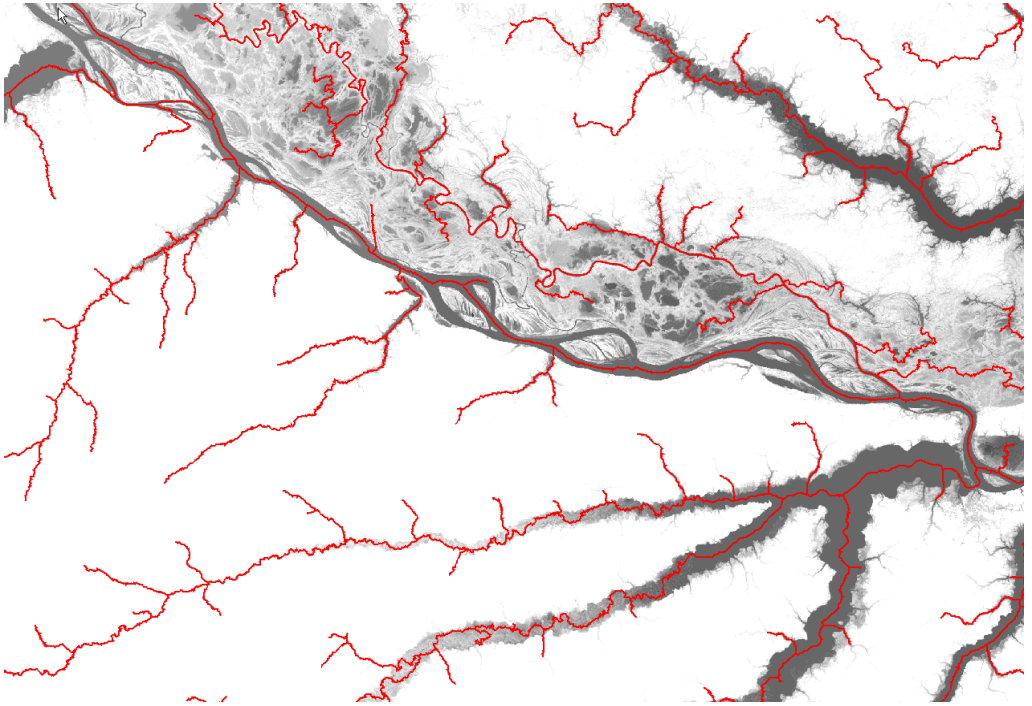
Purus Drenagem Zoom1





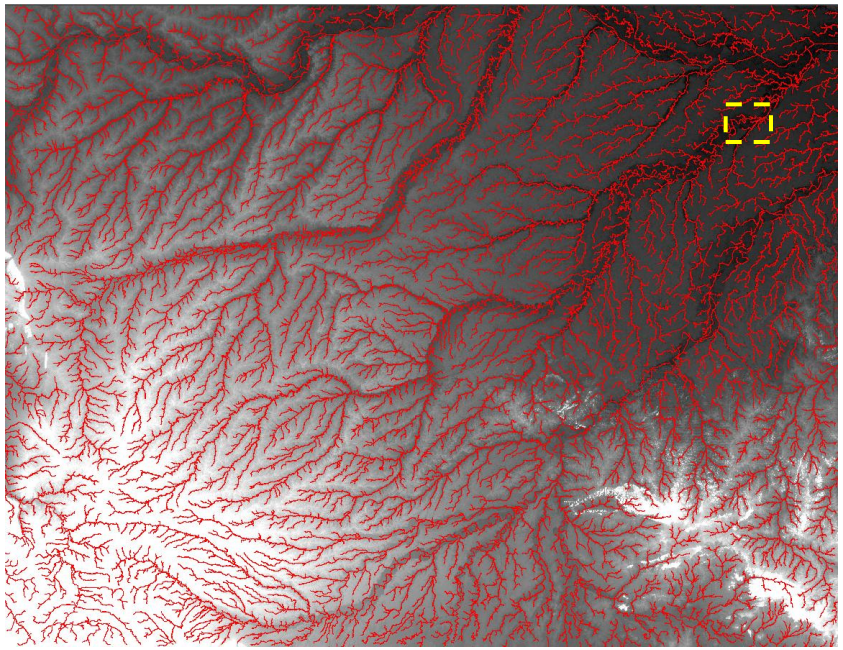
Purus Drenagem Zoom2

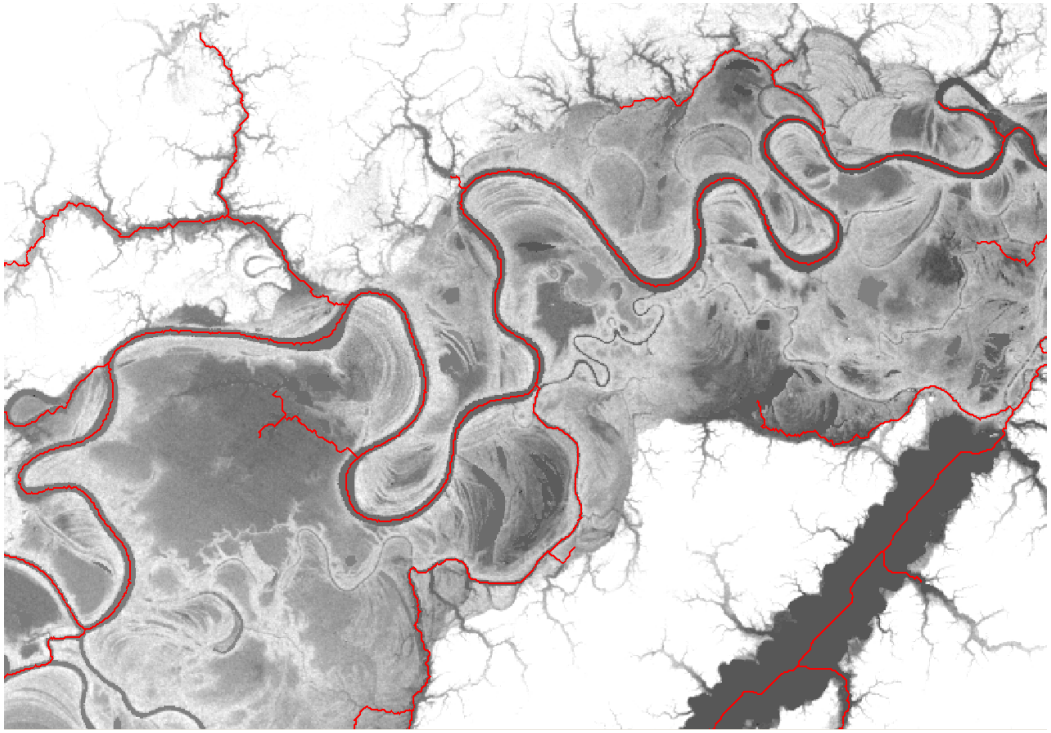




Zoom saturado em 50 metros

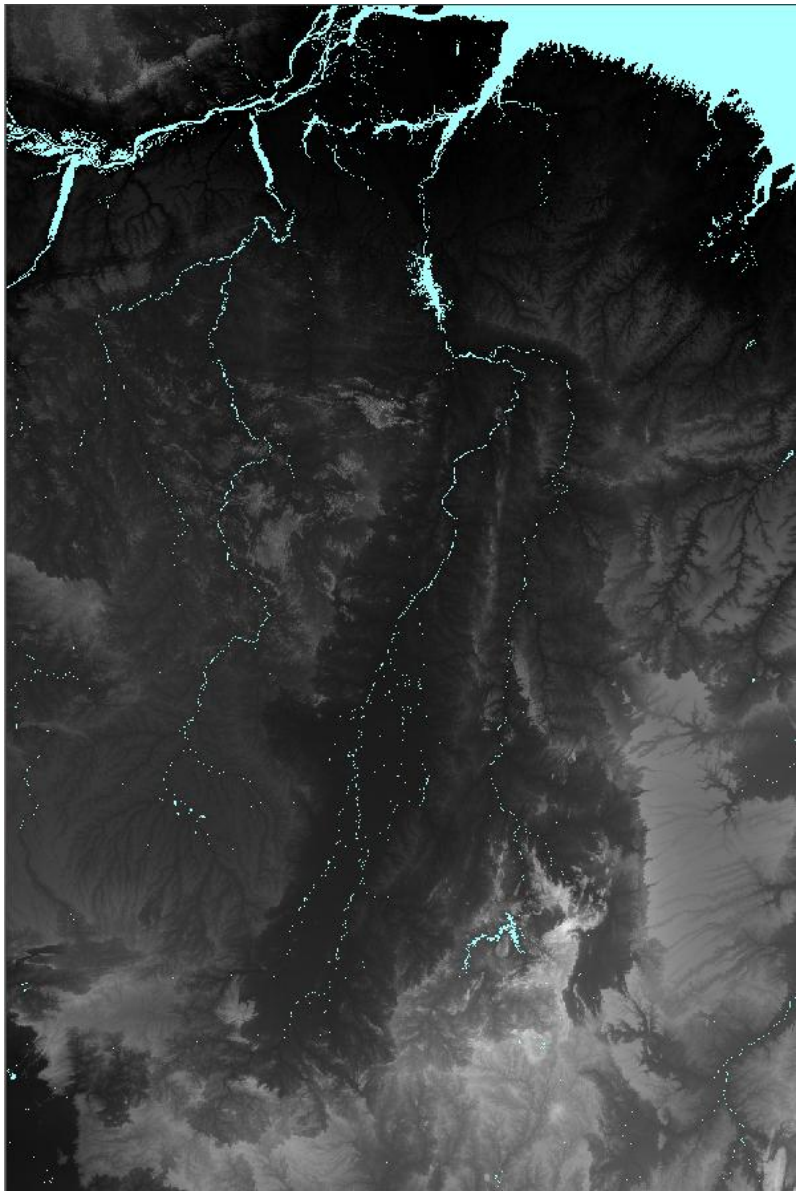
Purus Drenagem Zoom3





Saturado em 50 metros

Tocantins



x1: -56.00

y1: -18.00

x2: -43.99

y2: 0.00

Pixels: 311.112.004

Linhas: 21.602

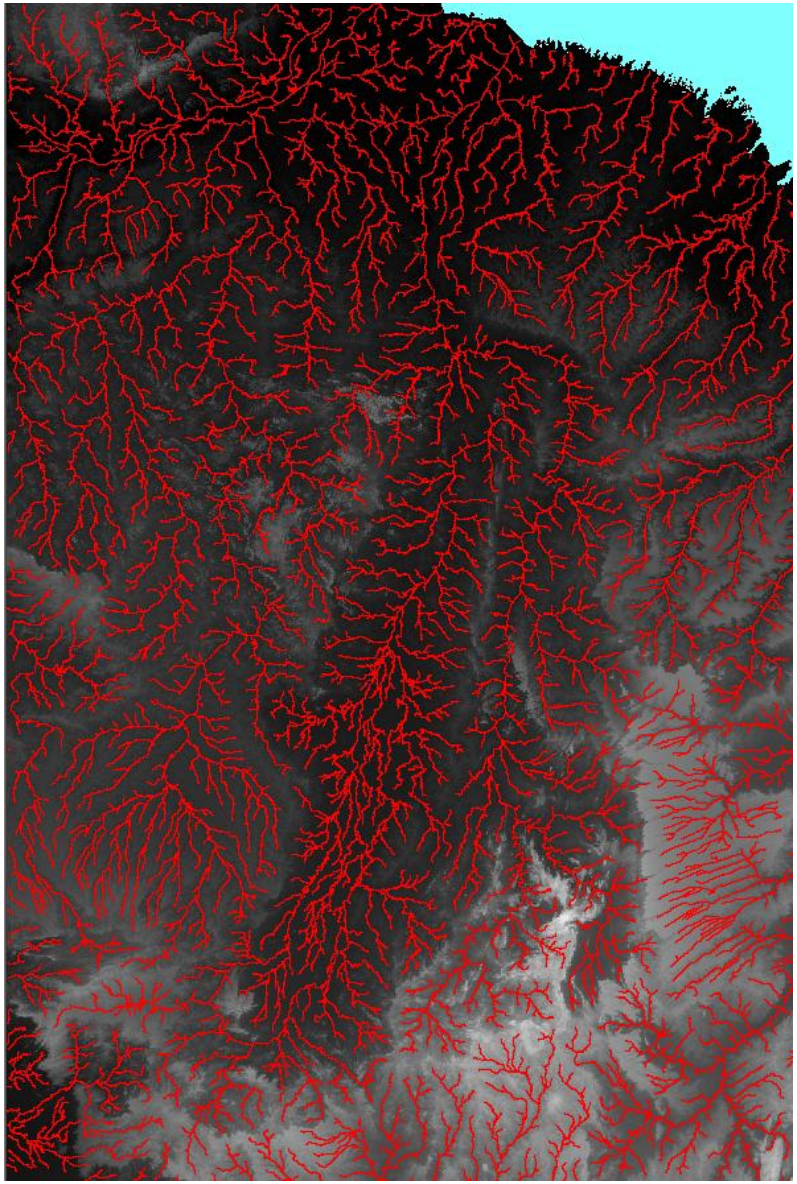
Colunas: 14.402

Fossos: 15.893.139

Tempo: 26:34:54 h

Acumulada: 14:55 min

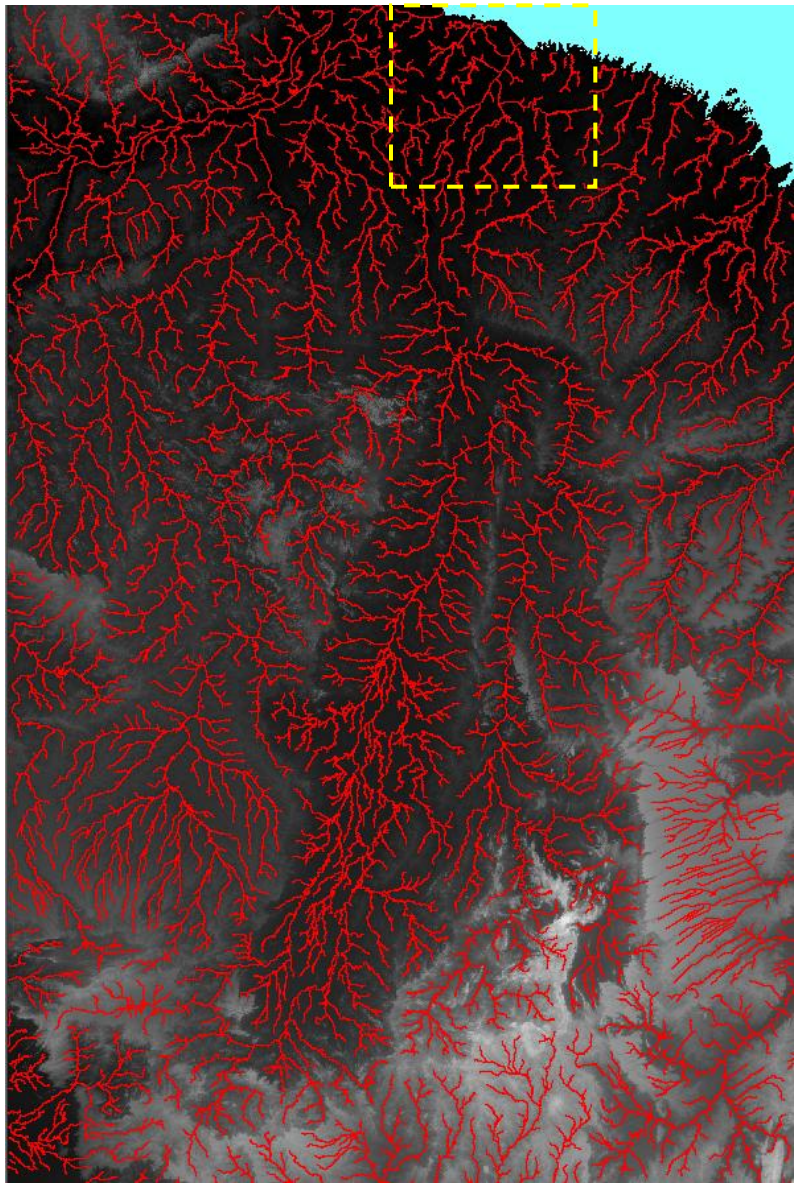
Tocantins Drenagem

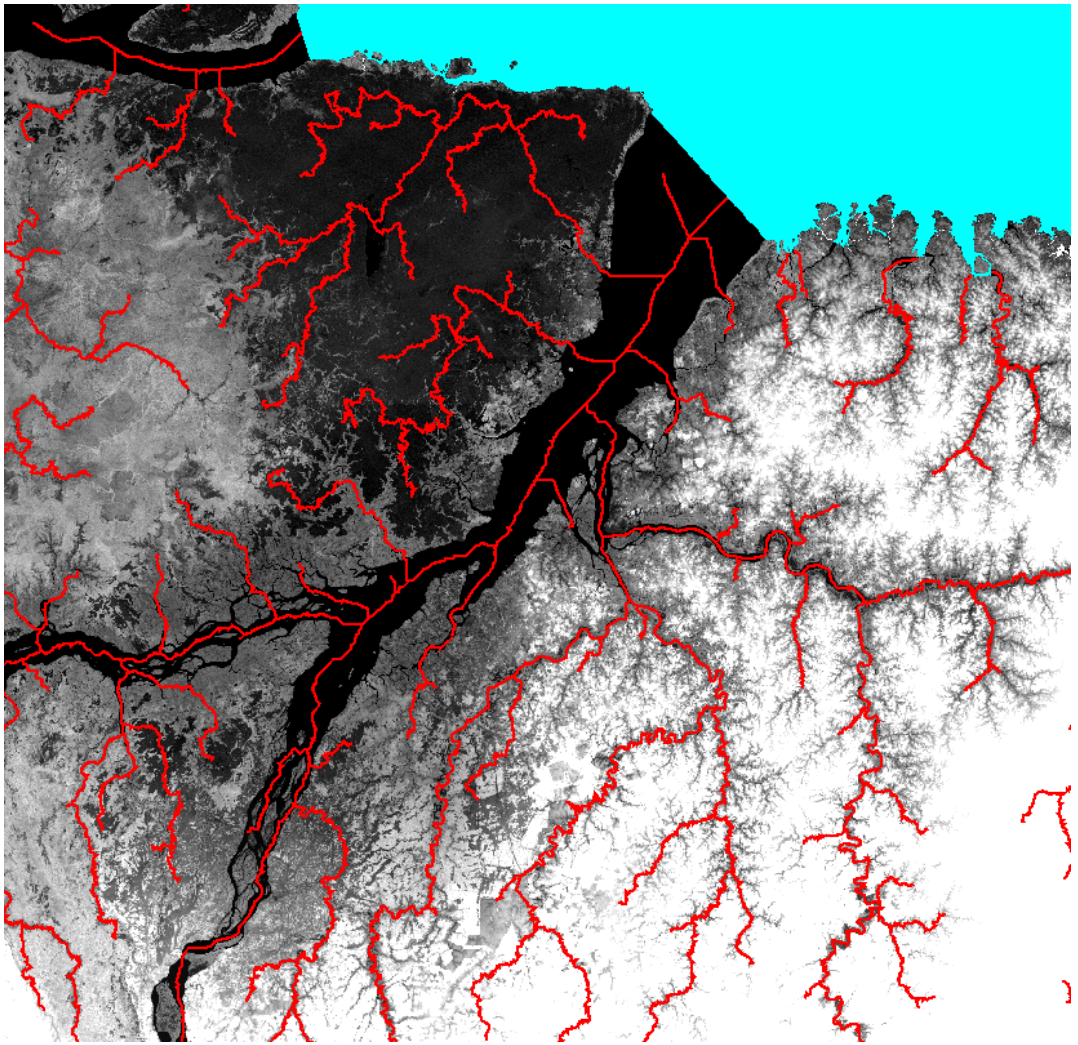


Valor de corte: 30.000

Maior Ordem: 6

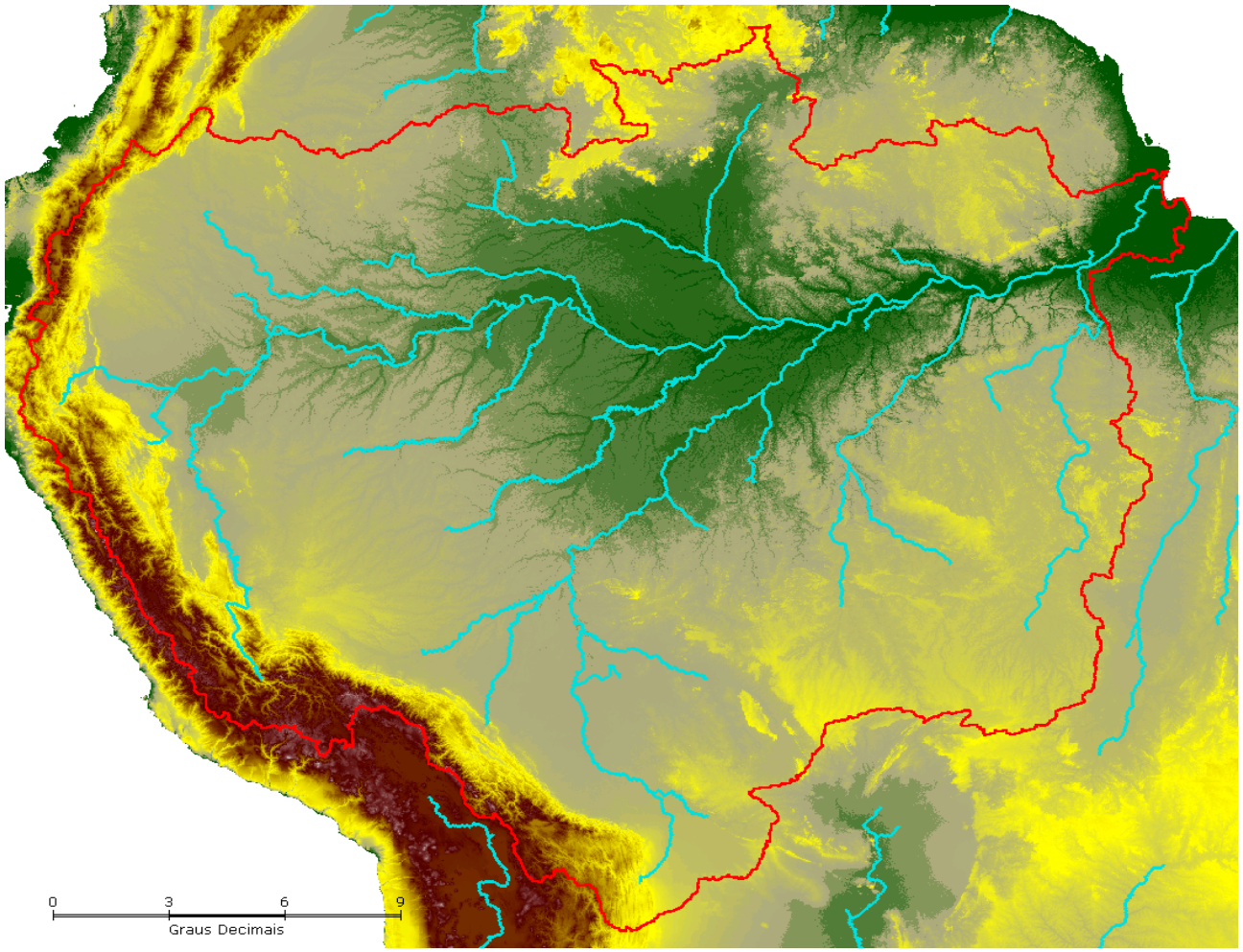
Tocantins Drenagem Zoom





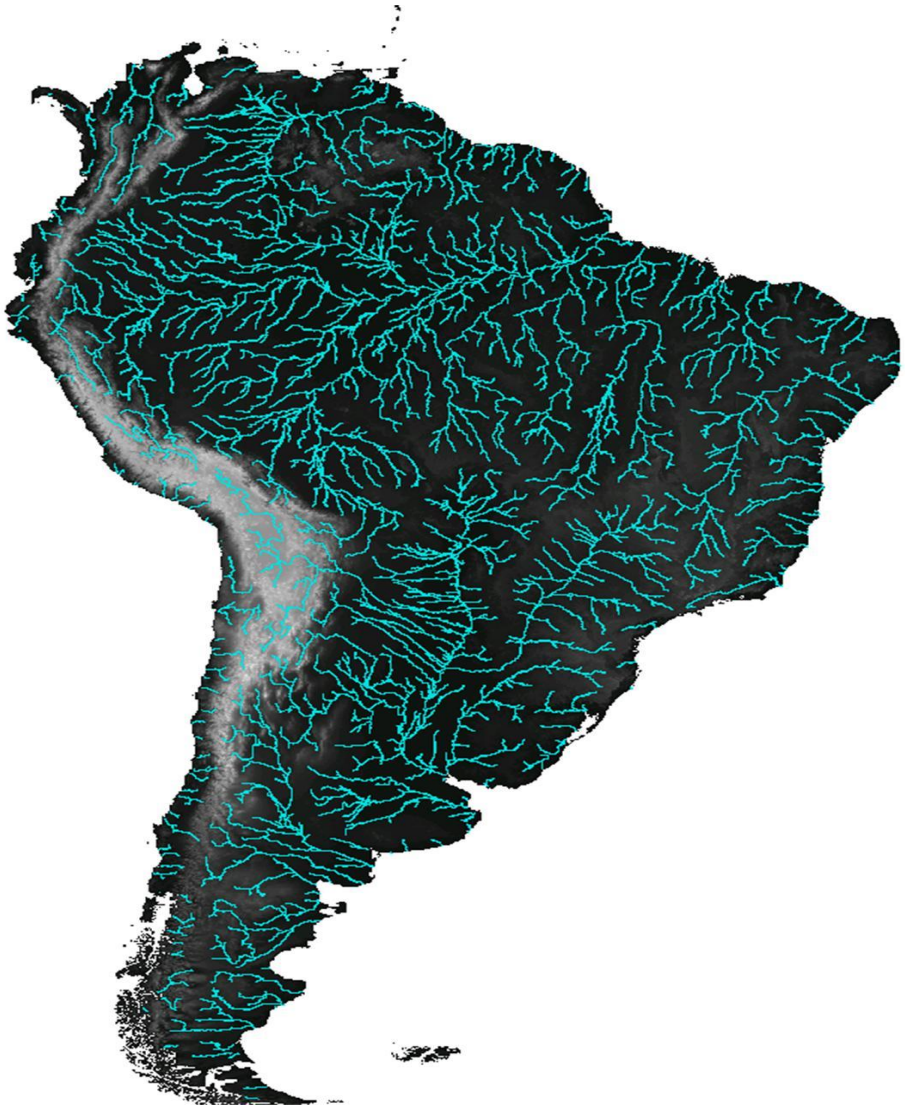
Saturado em 40 metros

BACIA AMAZÔNICA



32.400 linhas 38.400 colunas **65.670.466** fossos

AMÉRICA DO SUL



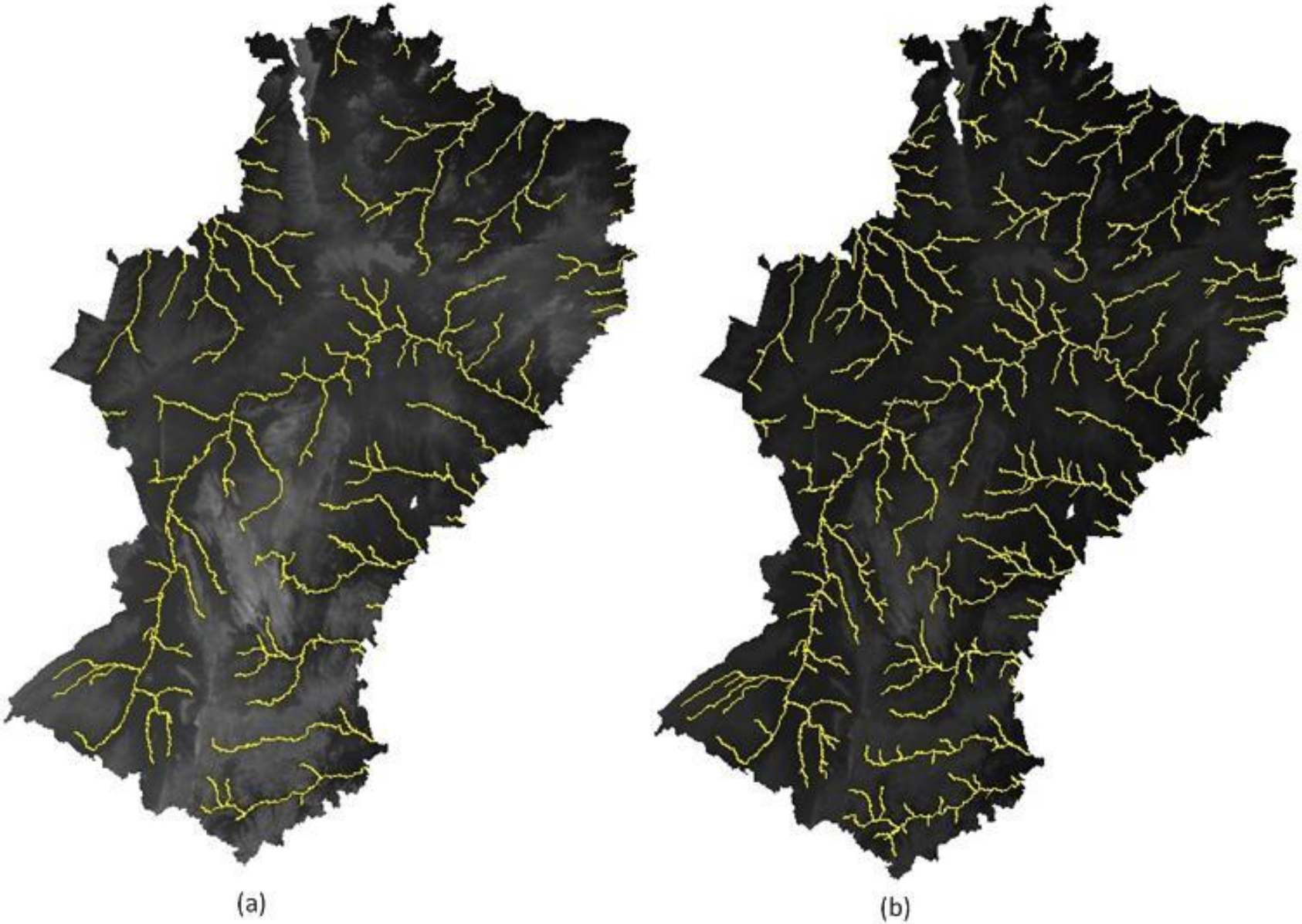
60.001 linhas 84,001 colunas **161.135.443** fossos

MUNDO – SRTM 90m

DRENAGEM - MUNDO – SRTM 90m

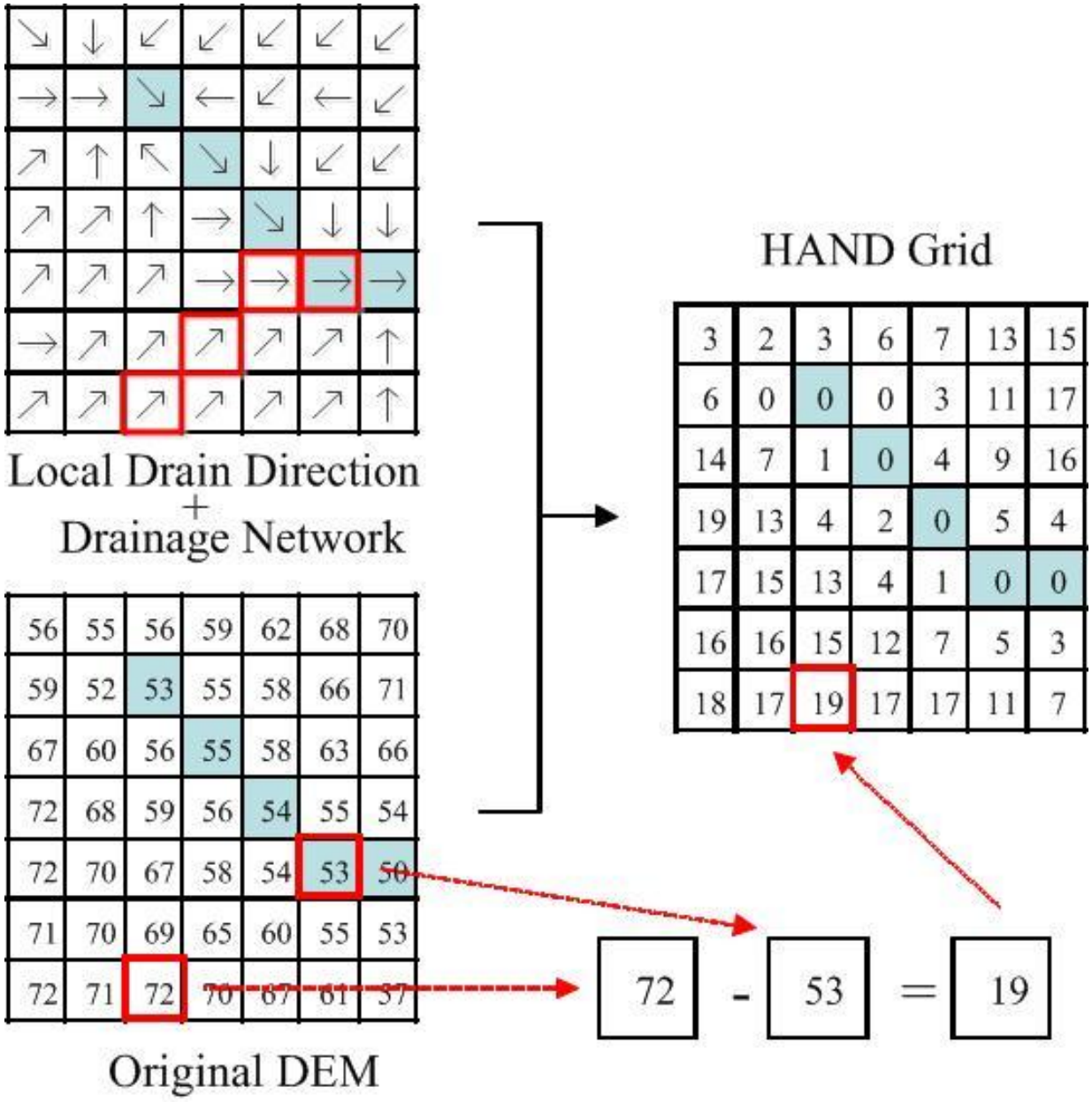
Tempo de processamento: 2 dias

SEMIÁRIDO

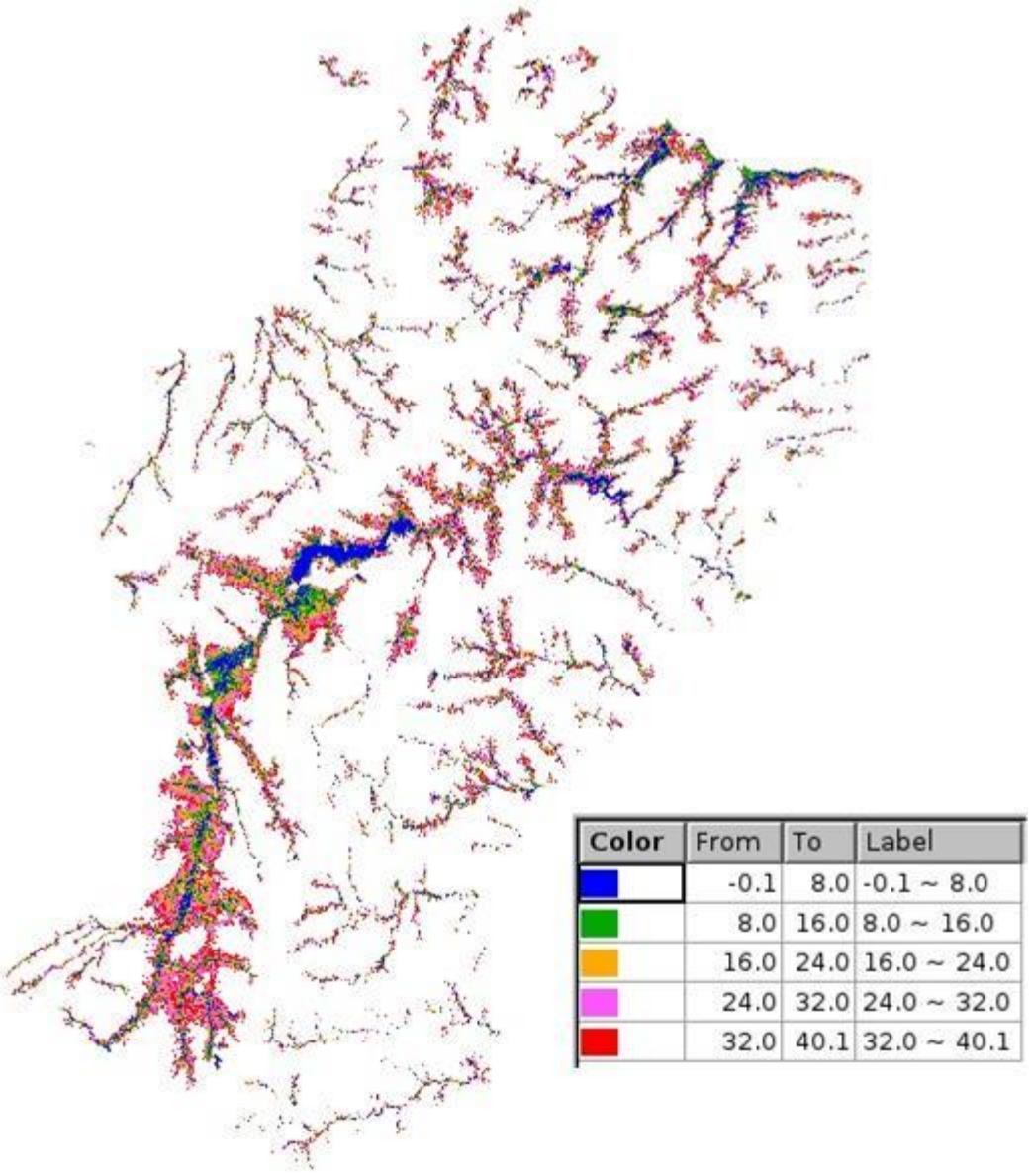


(a) (b)

HAND – Height Above the Nearest Drainage

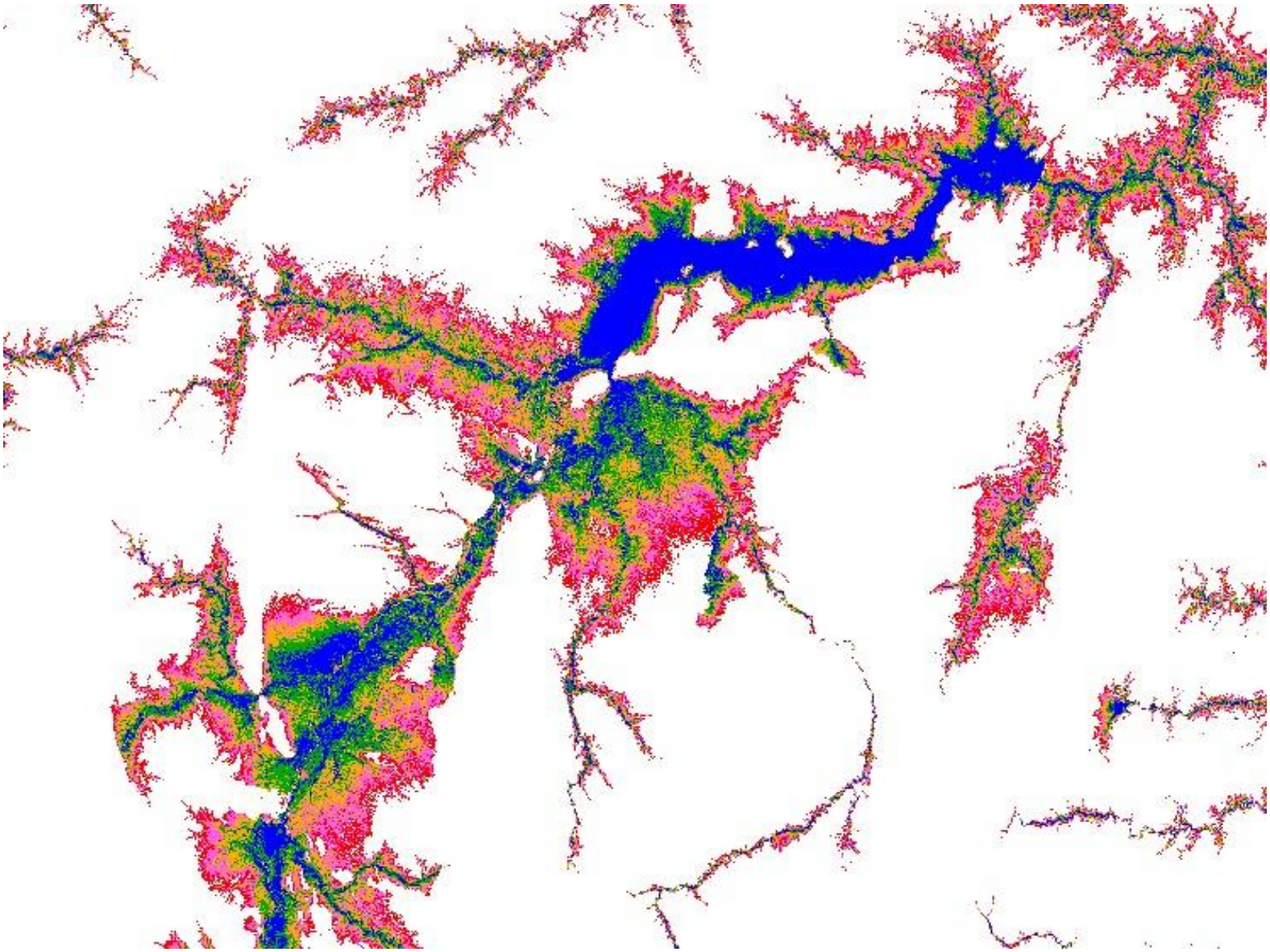


HAND – Semiárido



Color	From	To	Label
	-0.1	8.0	-0.1 ~ 8.0
	8.0	16.0	8.0 ~ 16.0
	16.0	24.0	16.0 ~ 24.0
	24.0	32.0	24.0 ~ 32.0
	32.0	40.1	32.0 ~ 40.1

HAND – Zoom



TERRAHIDRO - HOJE

- Linhas de comandos
- Plugin do QGIS

LINHAS DE COMANDOS

Consider as input the DEM of the Tocantins basin located at “C:\data\tocantinsDEM.tif”.

1. Generate a pitless DEM from the input DEM: the removepits functionality executes the carvev, simplepits, and pfs functionalities, in this order.
C:\data>th removepits tocantinsDEM.tif tocantinsPitlessDEM.tif

2. Generate the D8 flow directions from the pitless DEM.
C:\data>th d8 tocantinsPitlessDEM.tif tocantinsD8.tif

3. Generate the contributing area from the D8 flow directions.
C:\data>th d8ca tocantinsD8.tif tocantinsD8ContributingArea.tif

LINHAS DE COMANDOS

4. Generate the drainage network from the contributing area: this step requires a threshold value for the minimum contributing area.
C:\data>th d8drainage tocantinsD8ContributingArea.tif tocantinsDrainage.tif 1000

5. Generate the drainage network vector file from the grid file.
C:\data>th d8drainagev tocantinsDrainage.tif tocantinsD8.tif tocantinsDrainage.shp

6. Generate the drainage network segments.
Each drainage segment is identified by a unique integer.
C:\data>th segments tocantinsD8.tif tocantinsDrainage.tif tocantinsSegments.tif

7. Generate the drainage network minibasins.
C:\data>th minibasins tocantinsD8.tif tocantinsSegments.tif tocantinsMinibasins.tif

Obrigado!

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