RESPONSE OF RANDOMIZED SUBSETS OF RAINFALL GAUGES OVER A PARANÁ RIVER SUB-BASIN

Thais Fujita, A. P. Rudke, M. V. B. de Morais, S. A. A. Rafee, R. A. F. de Souza, R. V. A. de Souza, E. D. de Freitas, L. D. Martins, Jorge Alberto Martins.

2017 International SWAT Conference in Warsaw, Poland

SOUTH AMERICA

- AMAZON RIVER BASIN
  - DRAINAGE AREA: 7,050,000 km^2 (~39.51%);
  - LENGTH: 6,992 km.

- LA PLATA RIVER BASIN
  - DRAINAGE AREA: 3,170,000 km^2 (~17.76%);
  - LENGTH: 4,500 km
- TOTAL = 57.27%

LA PLATA RIVER BASIN

- DRAINAGE AREA: 3,170,000 km^2

LA PLATA RIVER BASIN

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  - BRAZIL (45.7%);
  - ARGENTINA (29.7%);
  - PARAGUAY (13.2%);
  - BOLIVIA (6.6%);
  - URUGUAY (4.8%).

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- DRAINAGE AREA: 3,170,000 km^2
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  - ARGENTINA (29.7%);
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  - URUGUAY (4.8%).
- WATER DISCHARGE: 28,000 m^3/s
  - PARANÁ RIVER (3,780 km);
  - PARAGUAY RIVER (2,620 km);
  - URUGUAY RIVER (1,600 km).

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HIDROGRAFIC REGION OF PARANÁ RIVER

- TRIPLE FRONTIER
  - BRAZIL/PARAGUAY/ARGENTINA
  - PARANÁ/IGUAÇU CONVERGENCE
- DRAINAGE AREA: 879,860 km^2
  - 59% PARANÁ RIVER BASIN;
  - 29% LA PLATA RIVER BASIN.
- WATER DISCHARGE: 14,000 m^3/s
  - 81% PARANÁ RIVER;
  - 50% LA PLATA RIVER.

HIDROGRAFIC REGION OF PARANÁ RIVER

- FEDERATIVE UNITS
  - SÃO PAULO (24,1%);
  - PARANÁ (20,9%);
  - MATO GROSSO DO SUL (19,3%);
  - MINAS GERAIS (18%);
  - GOIÁS (16,1%);
  - SANTA CATARINA (1,2%);
  - DISTRITO FEDERAL (0,4%).

HIDROGRAFIC REGION OF PARANÁ RIVER

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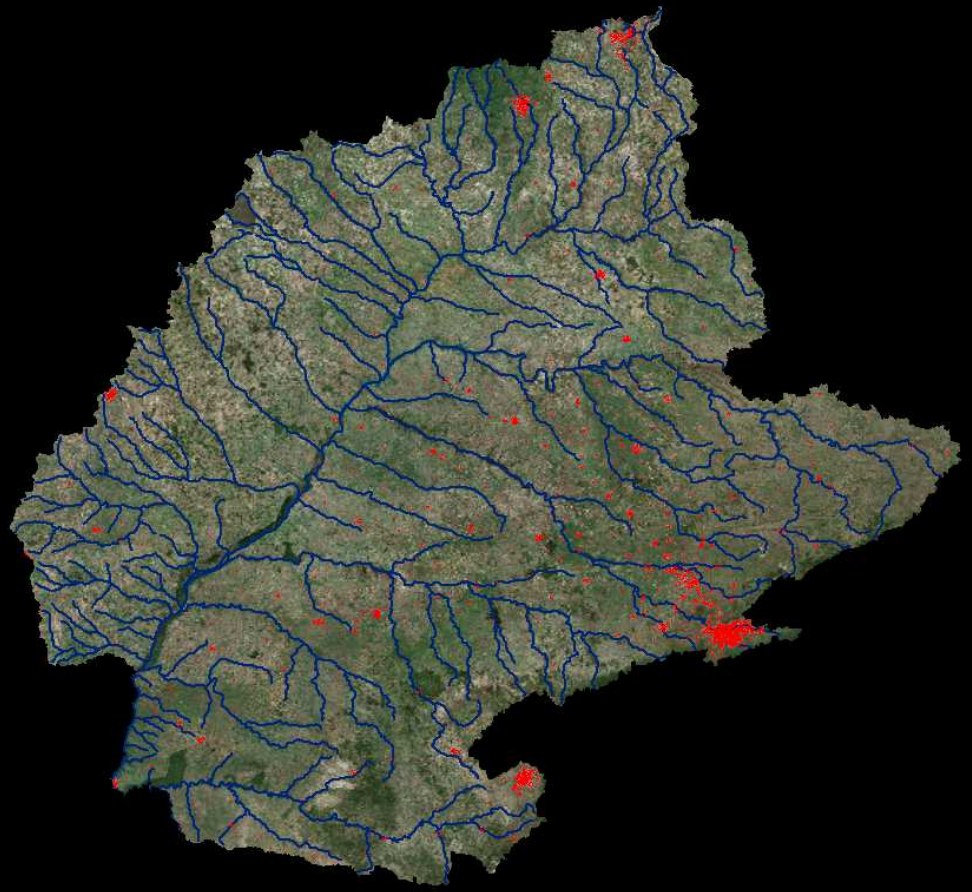
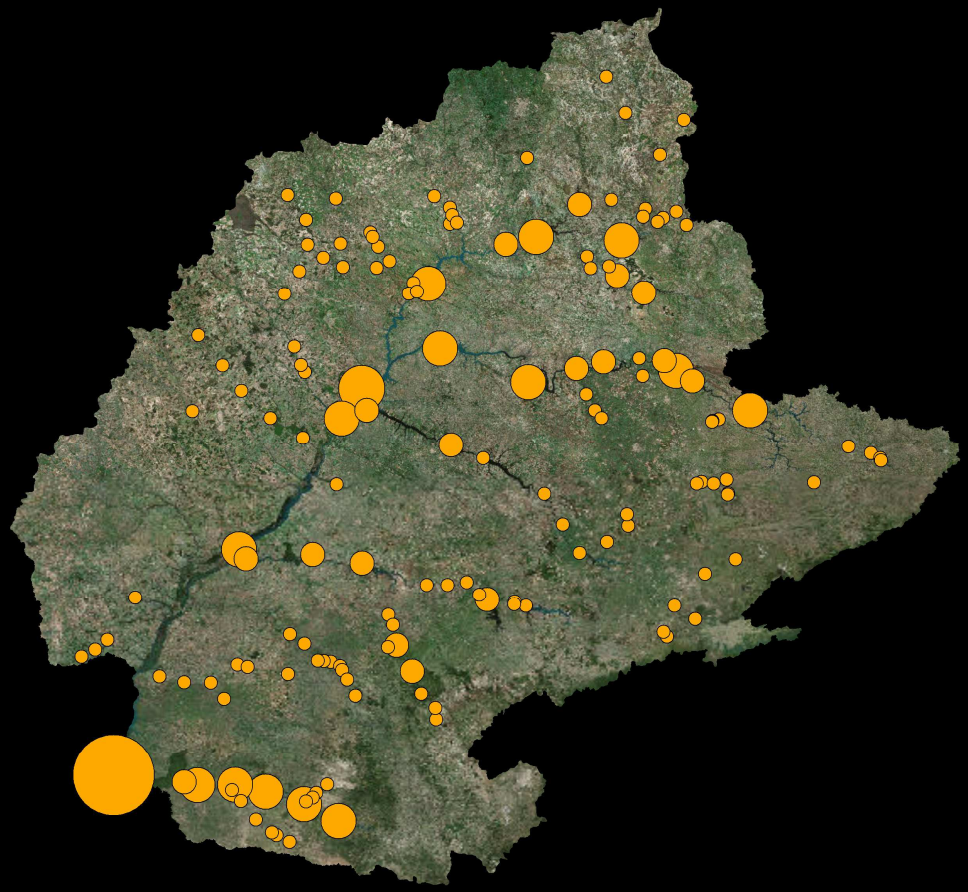
  - GOIÁS (16,1%);
  - SANTA CATARINA (1,2%);
  - DISTRITO FEDERAL (0,4%).
- POPULATION: 65 MILLION (32%)
  - SÃO PAULO;
  - BRASÍLIA;
  - GOIANIA;
  - CAMPO GRANDE;
  - CURITIBA.



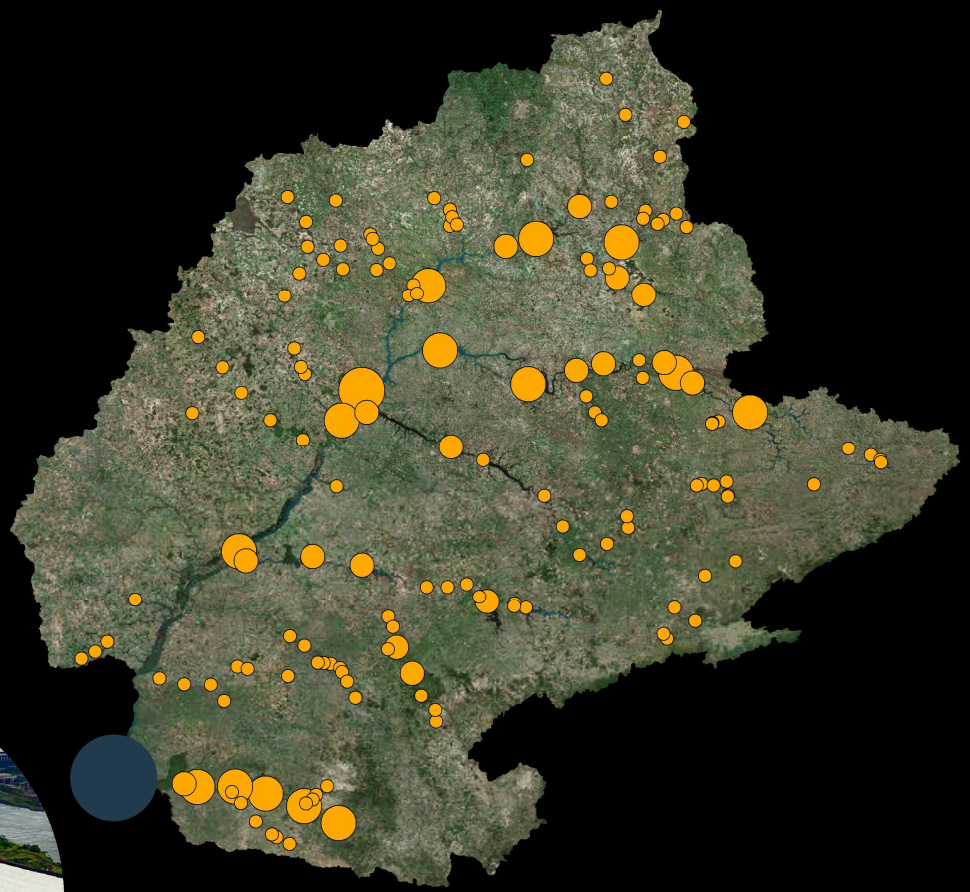
IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION



IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
  - ITAIPU - 14,000 MW; (20%)

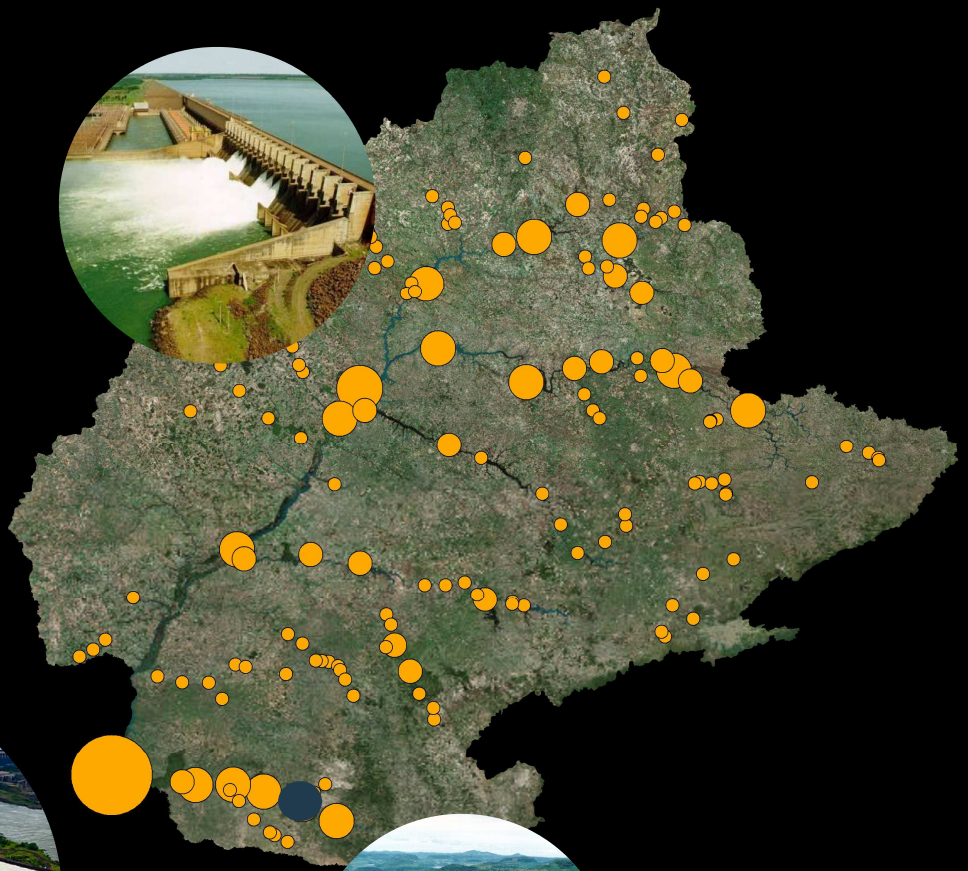


IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
  - ITAIPU - 14,000 MW; (20%)
  - ILHA SOLTEIRA - 3,444 MW;

IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
  - ITAIPU - 14,000 MW; (20%)
  - ILHA SOLTEIRA - 3,444 MW;
  - FOZ DO AREIA – 2,500 MW;



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  - ITAIPU - 14,000 MW; (20%)
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  - FOZ DO AREIA – 2,500 MW;
  - ITUMBIARA - 2,082 MW;

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  - JUPIÁ – 1,551 MW;

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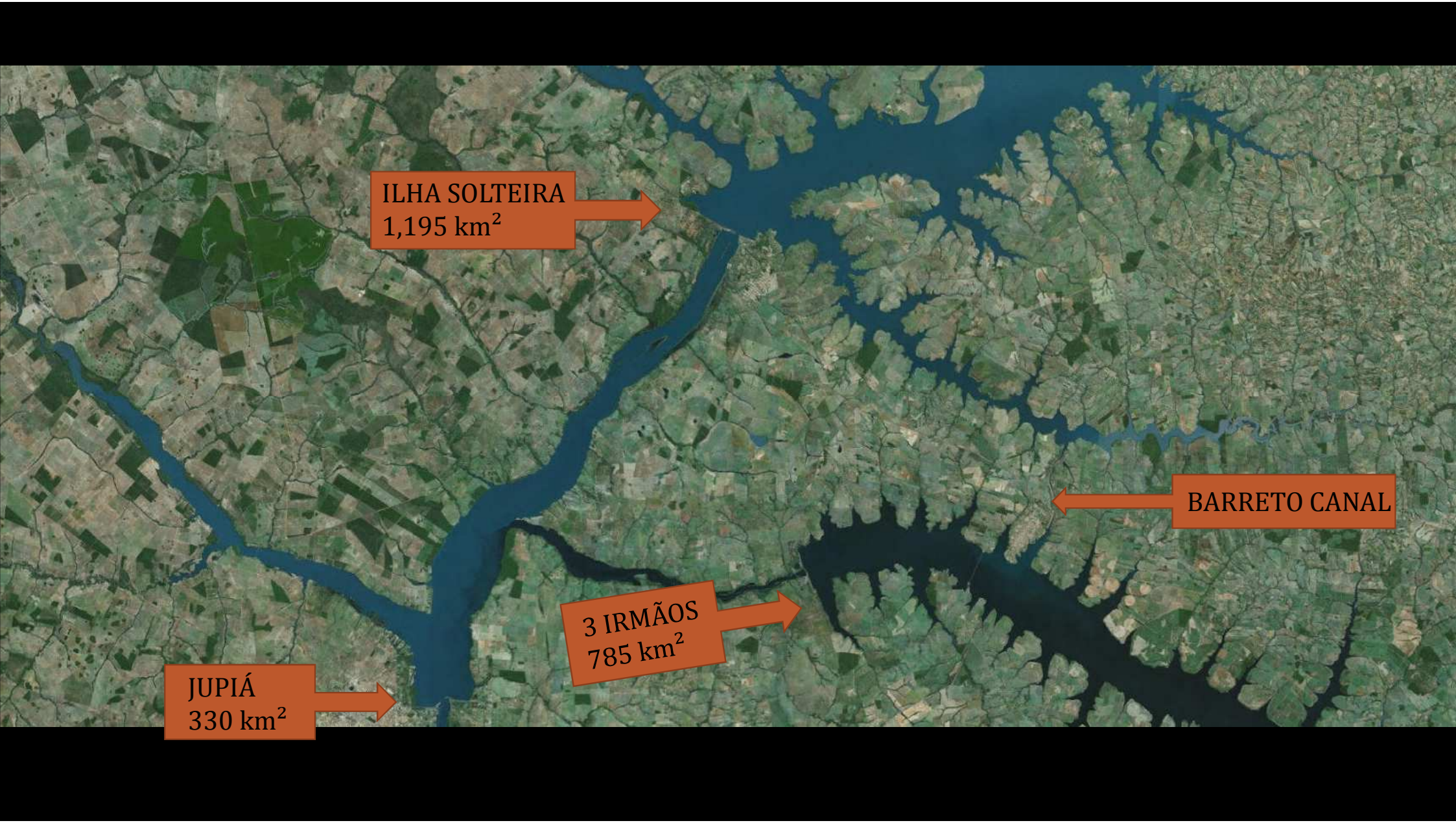
  - PORTO PRIMAVERA – 1,540 MW.


ILHA SOLTEIRA
1,195 km²
BARRETO CANAL
3 IRMÃOS
785 km²
JUPIÁ
330 km²

IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
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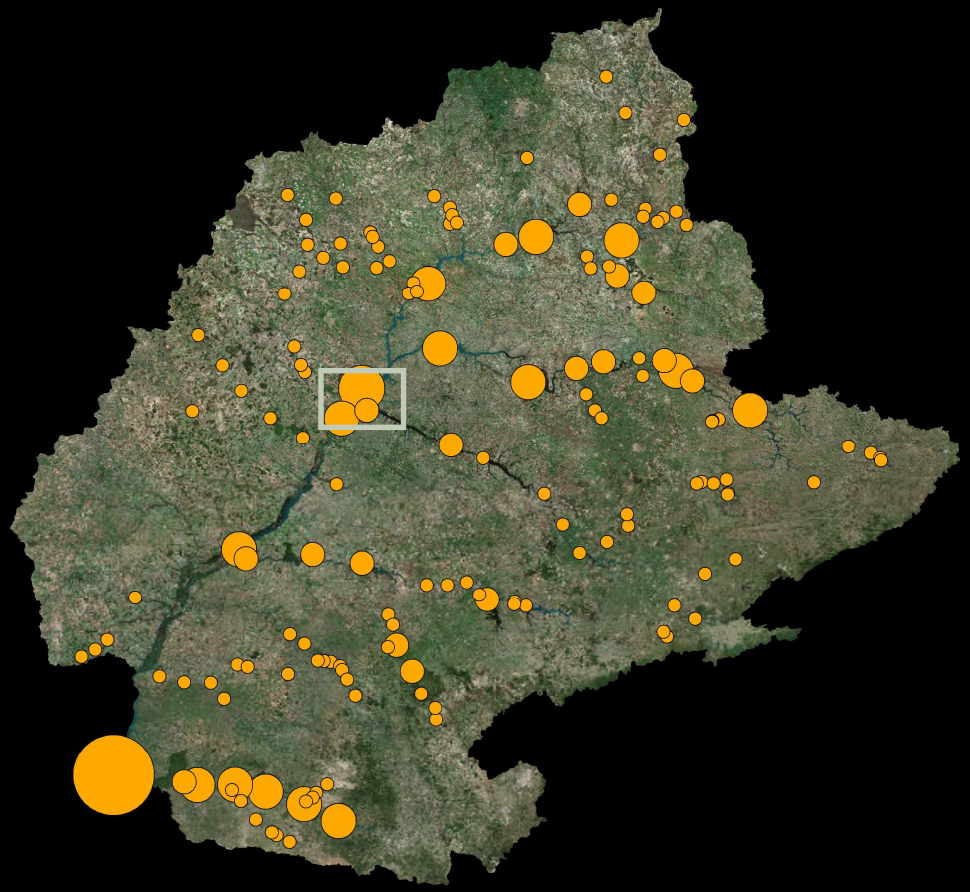
  - PORTO PIRMAVERA – 1,540 MW.
- ✓ NATIONAL PRODUCTION vs. NATIONAL CONSUMPTION
  - 75% vs. 30%



IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
- SUITABLE AREAS FOR SUGAR CANE PLANTATION

IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

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IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

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IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

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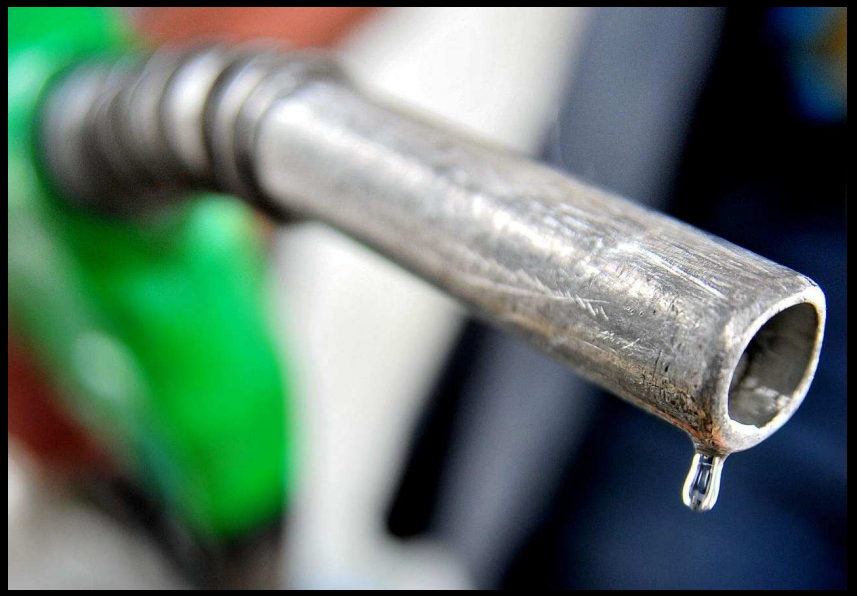
IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
- SUITABLE AREAS FOR SUGAR CANE PLANTATION
  - FERTILE SOIL/FLAT LAND
  - BIOMASS
    - 50% ETHANOL (LIGHT FLEET FUEL);
    - 8% ELETRICITY (SUGAR CANE BURNOUT)



IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
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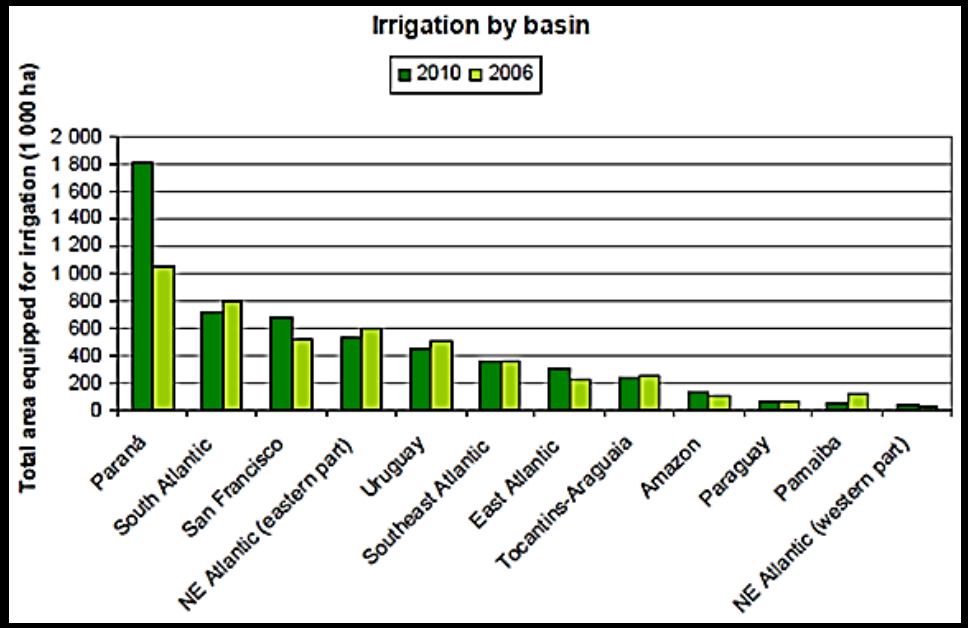
- WATER WITHDRAWAL

IMPORTANCE OF HIDROGRAFIC REGION OF PARANÁ RIVER

- APTITUDE IN HYDROELETRIC ENERGY GENERATION
- SUITABLE AREAS FOR SUGAR CANE PLANTATION
- WATER WITHDRAWAL
  - 54% IRRIGATION;
  - 23% MUNICIPALITIES;
  - 17% INDUSTRY;
  - 6% LIVESTOCK.



MANAGEMENT TOOLS FOR PARANÁ RIVER BASIN

- HYDROLOGICAL MODELS;
- CLIMATE MODELS;

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AVAILABILITY OF DATA

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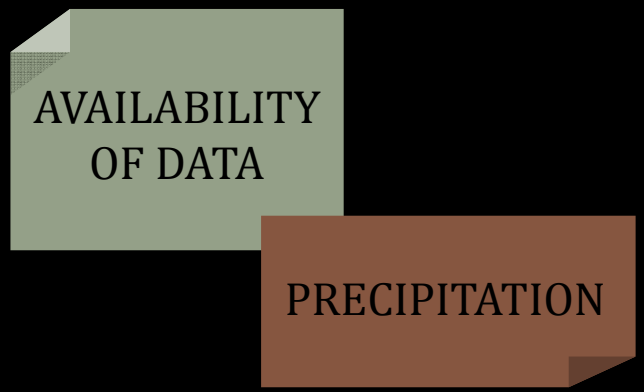

GAPS AND QUESTIONS OF PARANÁ RIVER BASIN

- NATIONAL INVENTORY DATABASE

GAPS AND QUESTIONS OF PARANÁ RIVER BASIN

- NATIONAL INVENTORY DATABASE
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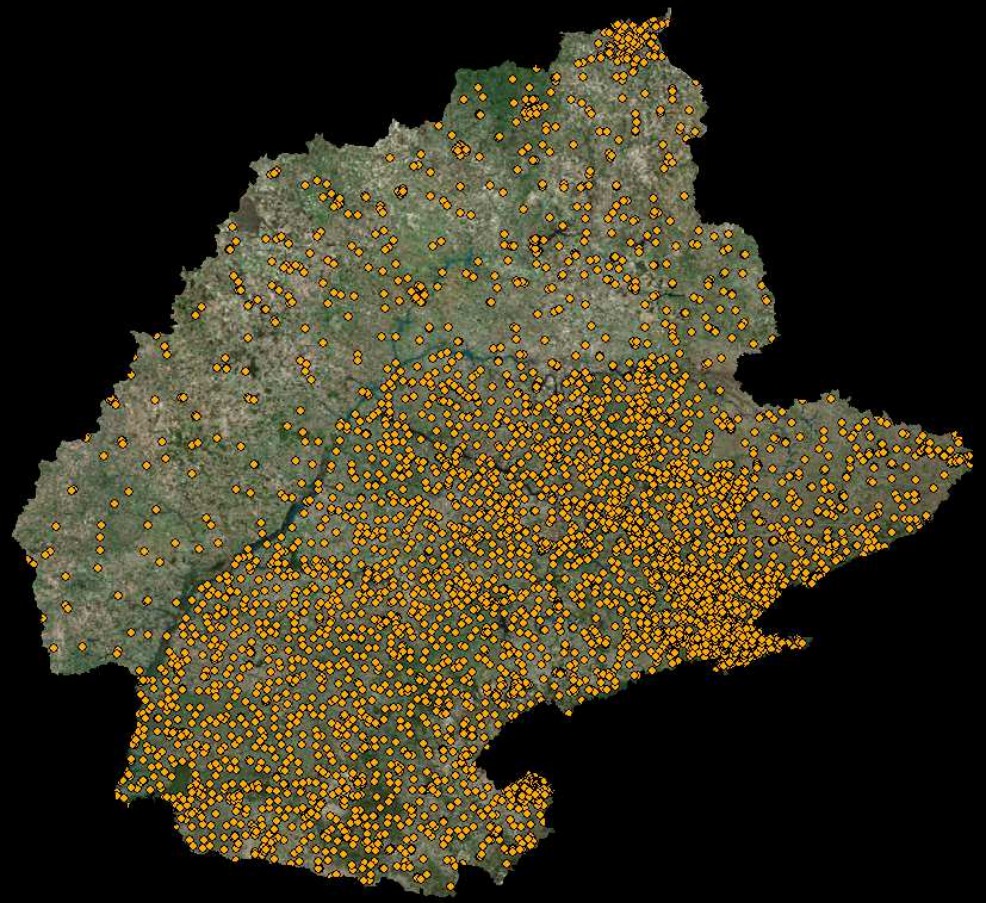
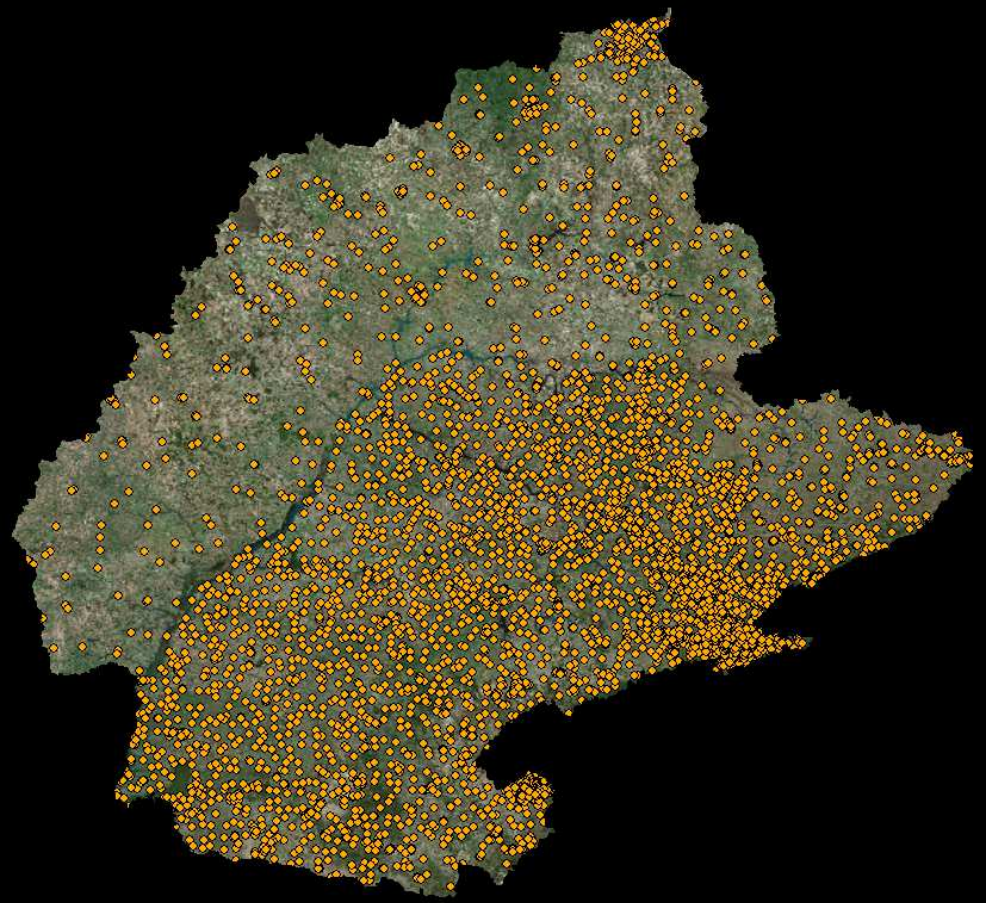


GAPS AND QUESTIONS OF PARANÁ RIVER BASIN

- NATIONAL INVENTORY DATABASE
  - RAINFALL GAUGES
    - NON-HOMOGENEOUS SPATIAL DISTRIBUTION;



GAPS AND QUESTIONS OF PARANÁ RIVER BASIN

- NATIONAL INVENTORY DATABASE
  - RAINFALL GAUGES
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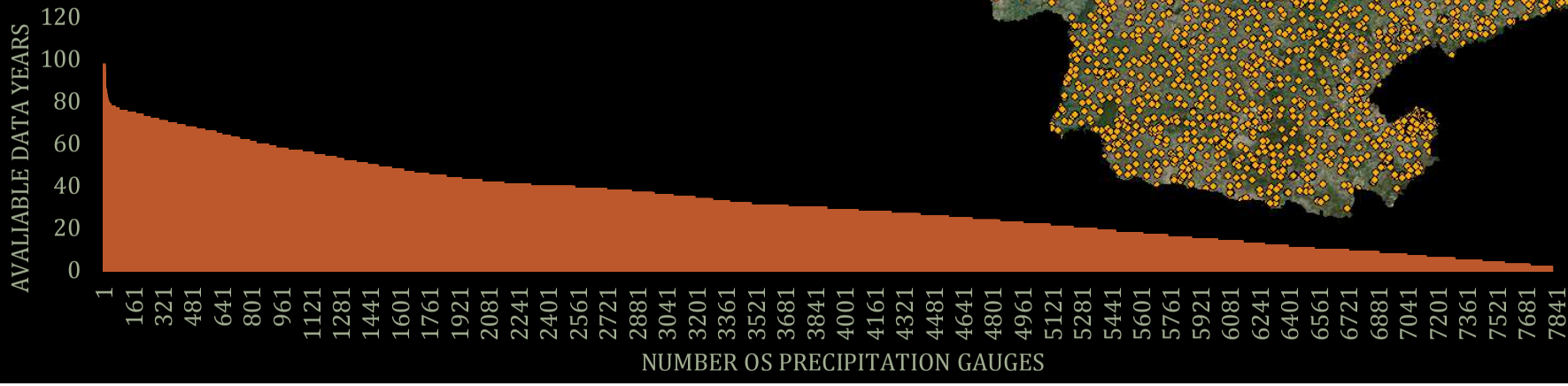
    - LACK OF LONG TIME SERIES;



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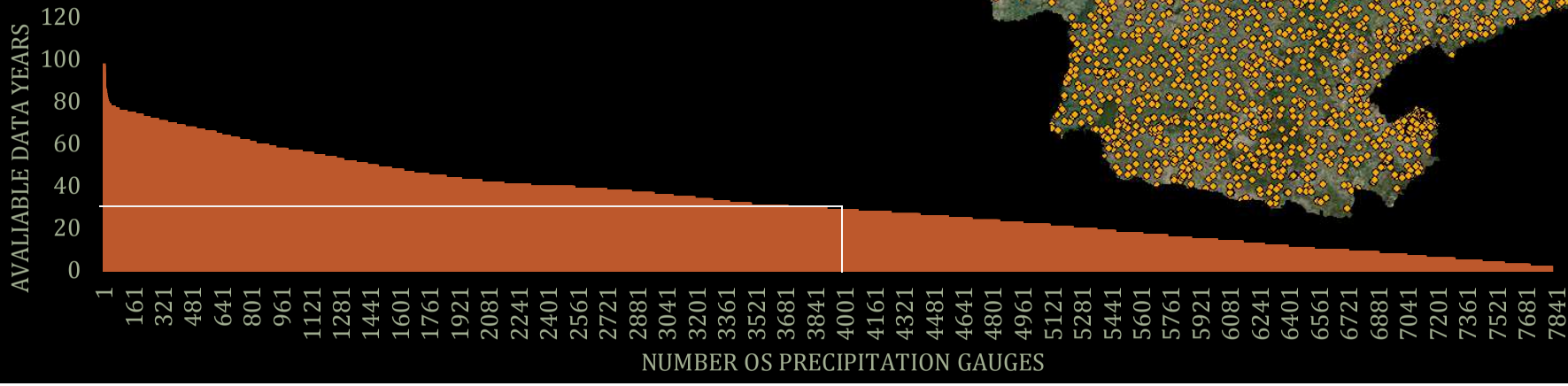

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  - RAINFALL GAUGES
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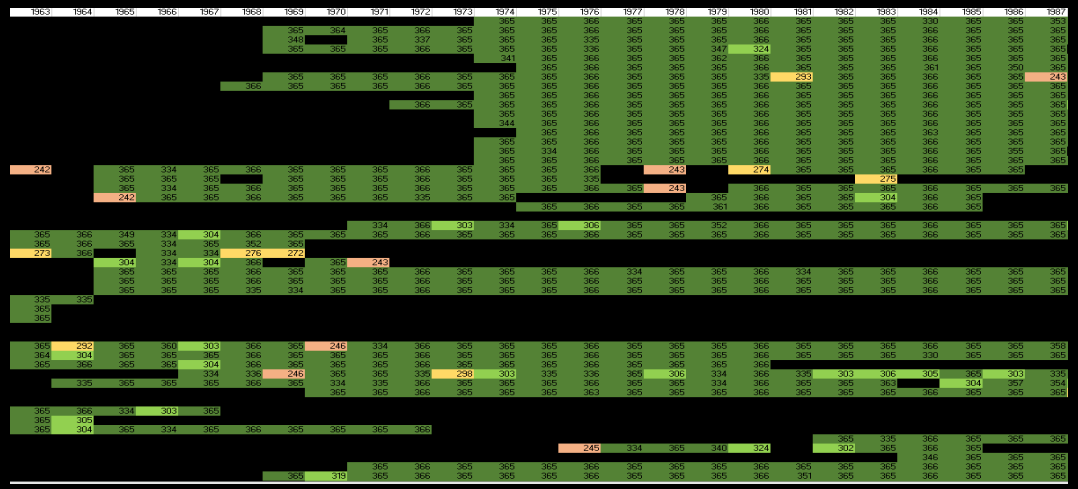
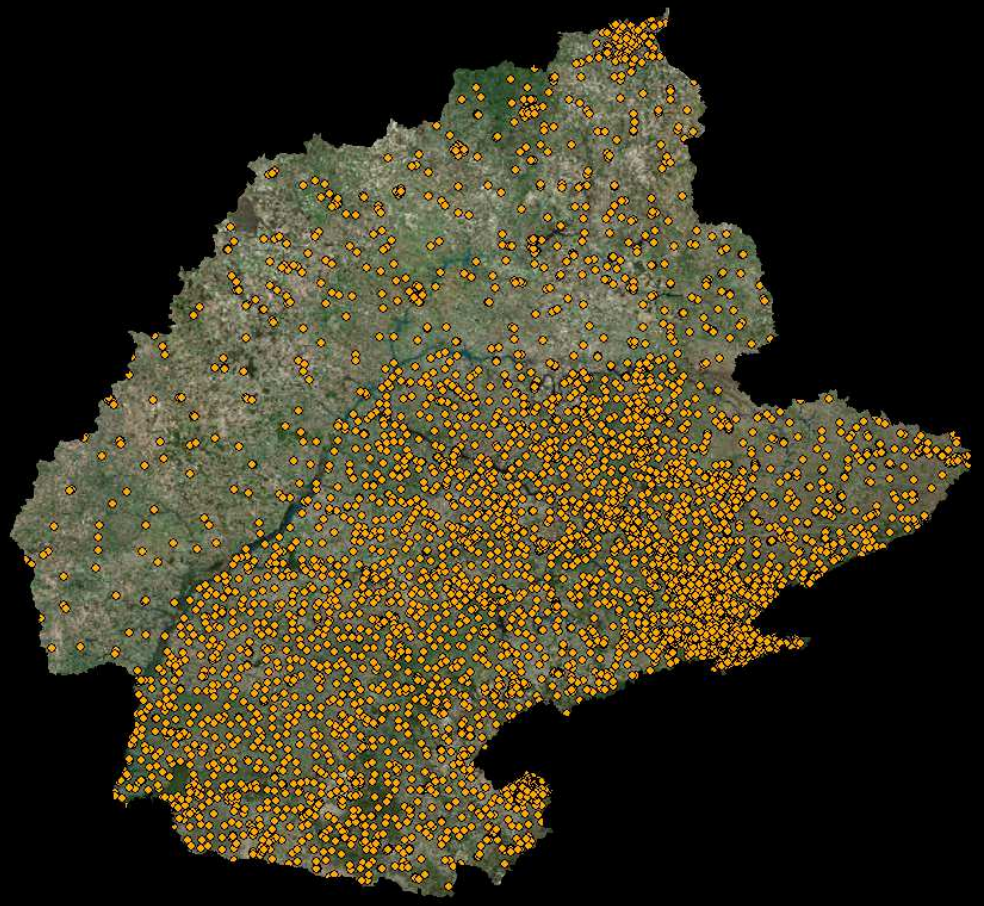
    - DISCONTINUTIES.





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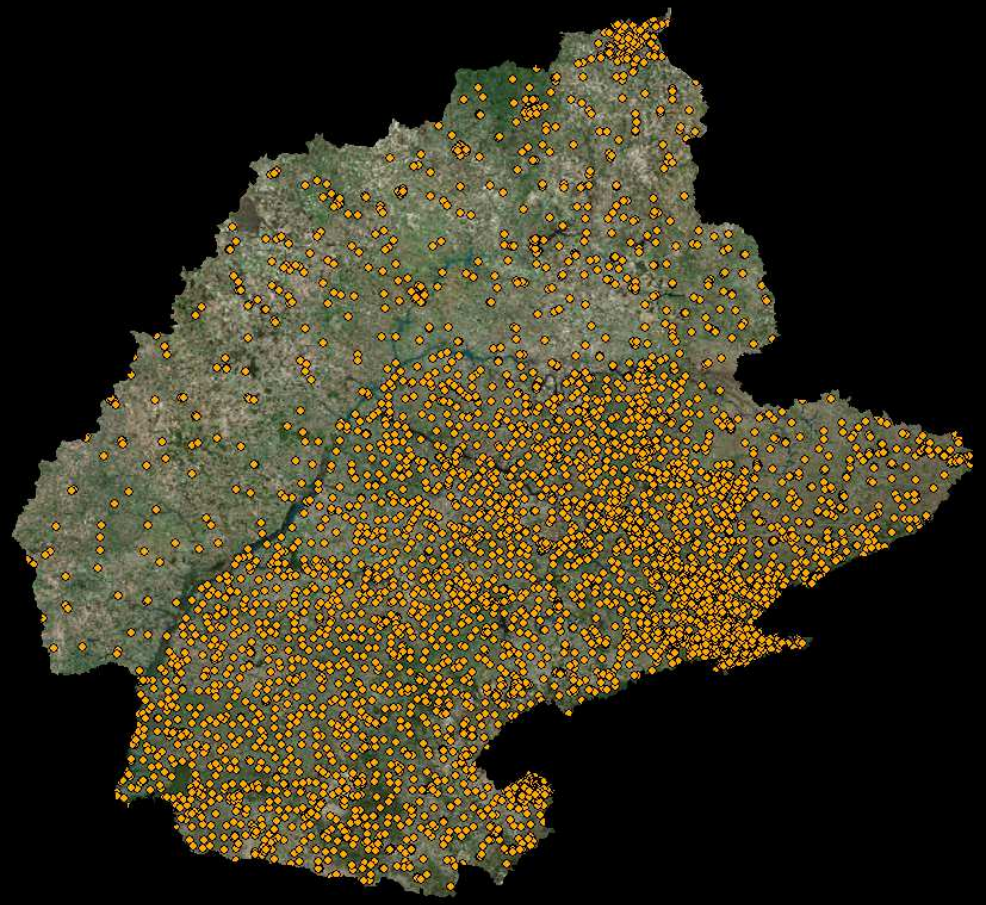

GAPS AND QUESTIONS OF PARANÁ RIVER BASIN

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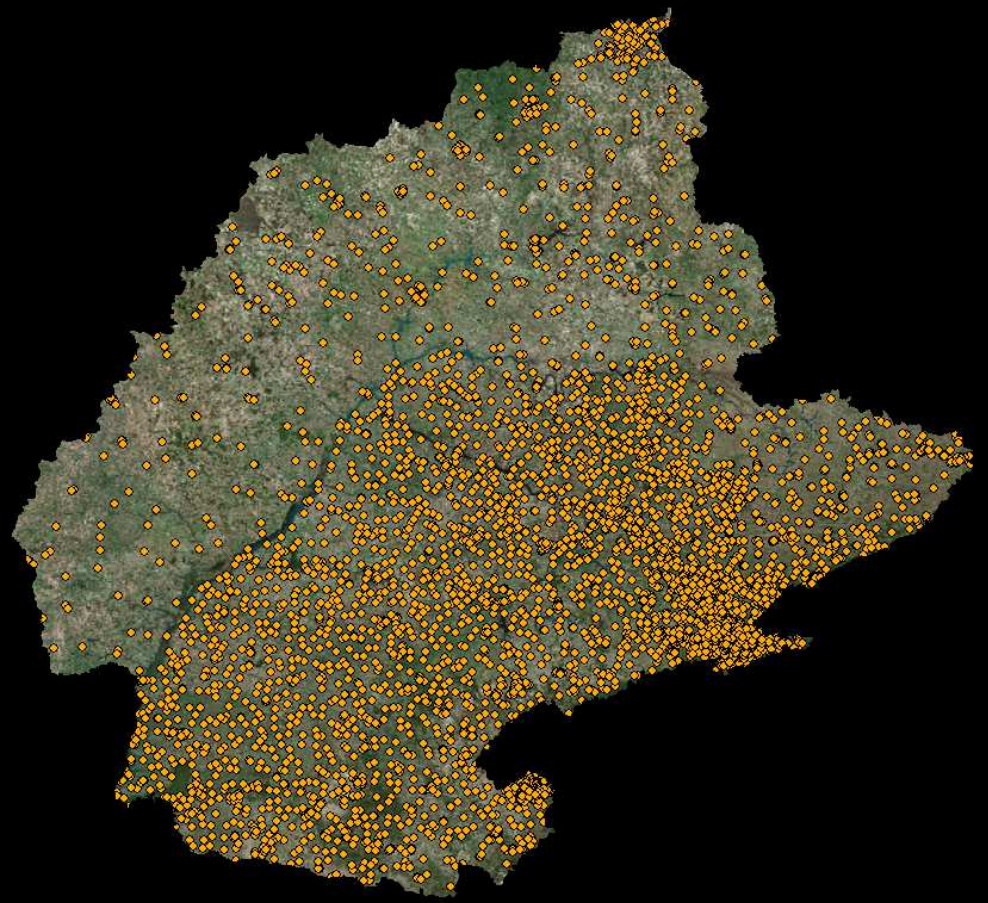
WHAT IS THE OPTIMAL RAIN GAUGE DENSITY?



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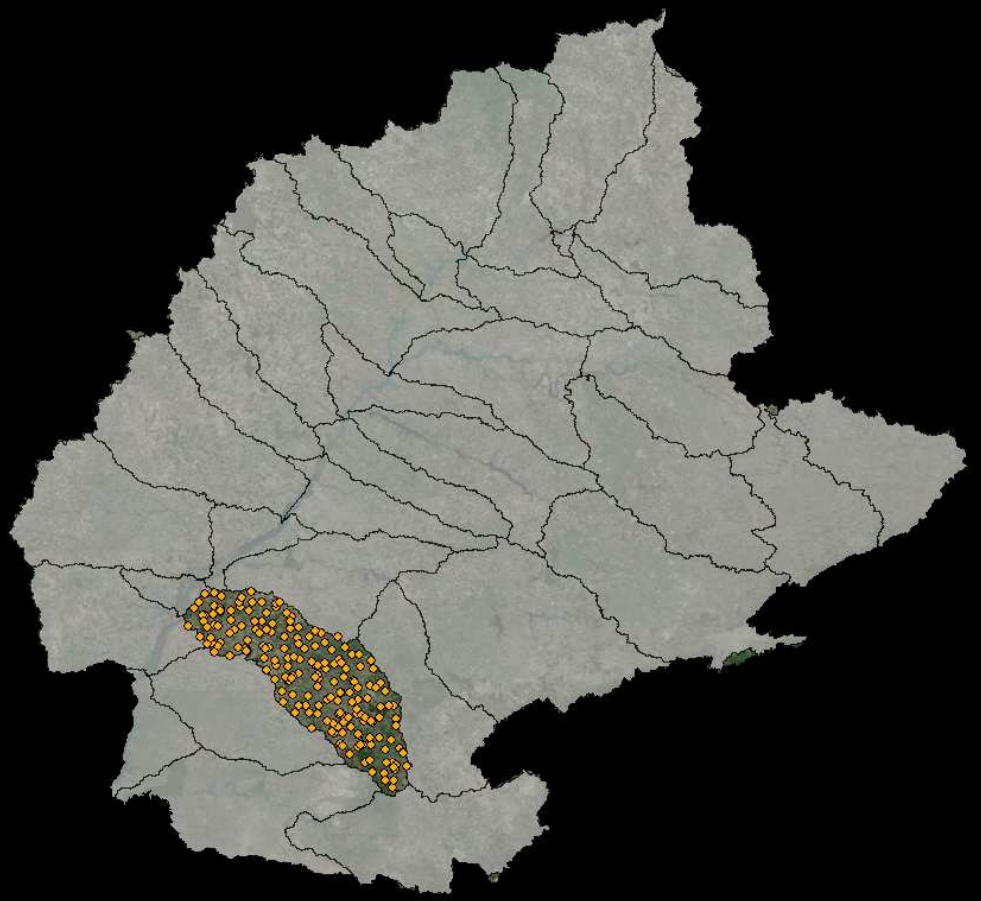
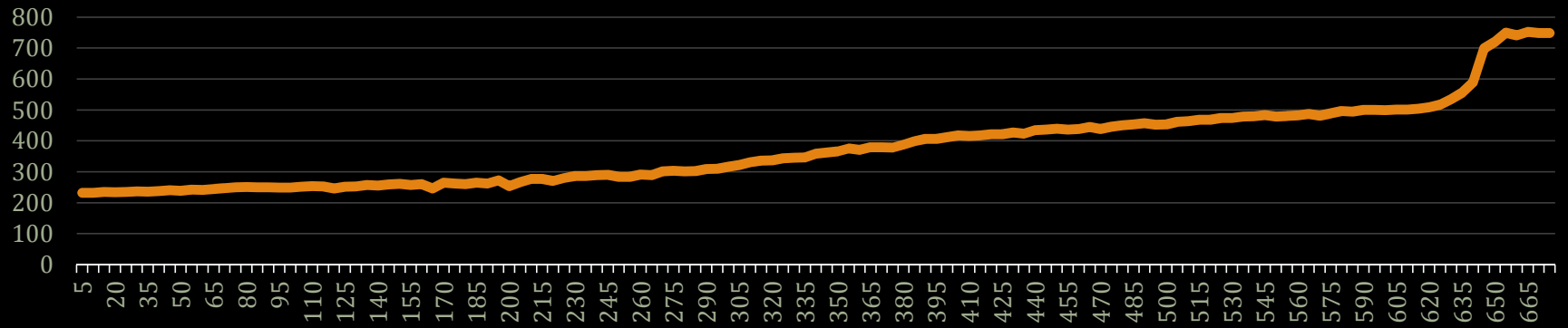


IVAÍ RIVER BASIN

- DRAINAGE AREA: 36,587 km^2;
- LENGTH: 680 km;
- WATER DISCHARGE: 702.3 m^3/s;
- POPULATION: ~1,400,000;

- ALTIMETRIC PROFILE:



IVAÍ RIVER BASIN'S RAIN GAUGE NETWORK

- AVAILABLE NETWORK: 175 RAIN GAUGES;

IVAÍ RIVER BASIN'S RAIN GAUGE NETWORK

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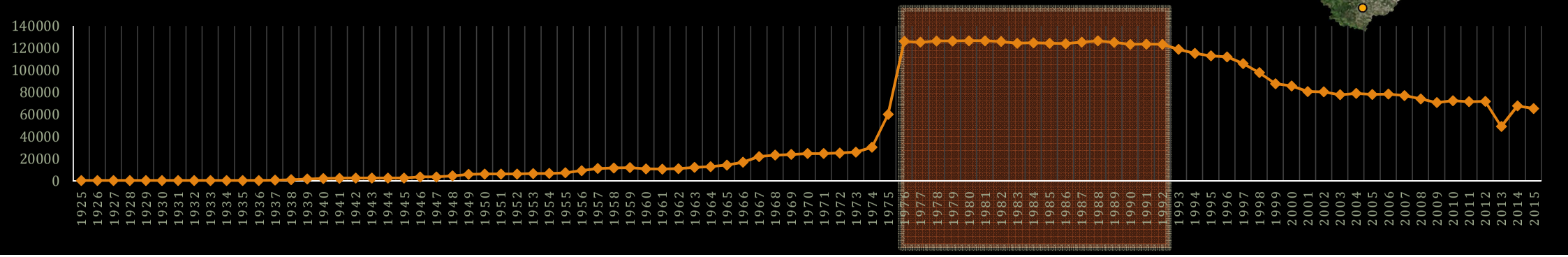
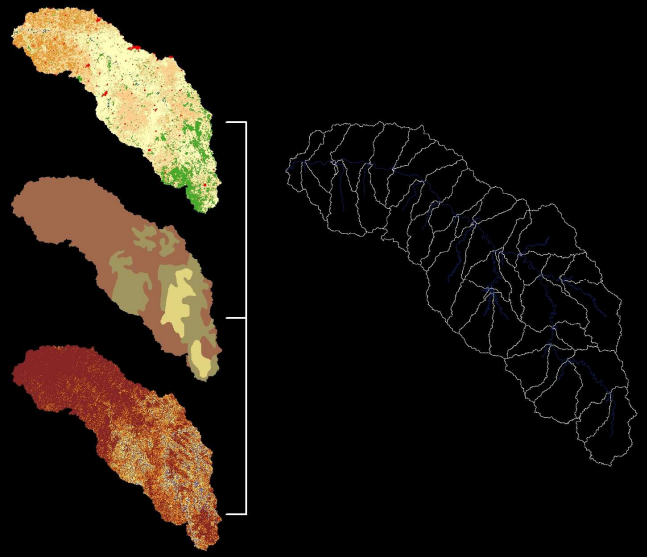


IVAÍ RIVER BASIN'S RAIN GAUGE NETWORK

- AVAILABLE NETWORK: 175 RAIN GAUGES;
- OPTIMAL READING PERIOD: 1976 – 1992;
- SWAT: 1979 – 1992;
  - WARM UP: 3 YEARS;
  - SIMULATION: 1982 – 1992.



RANDOMIZED NETWORK SCENARIOS

- 12 DENSITY SCENARIOS;

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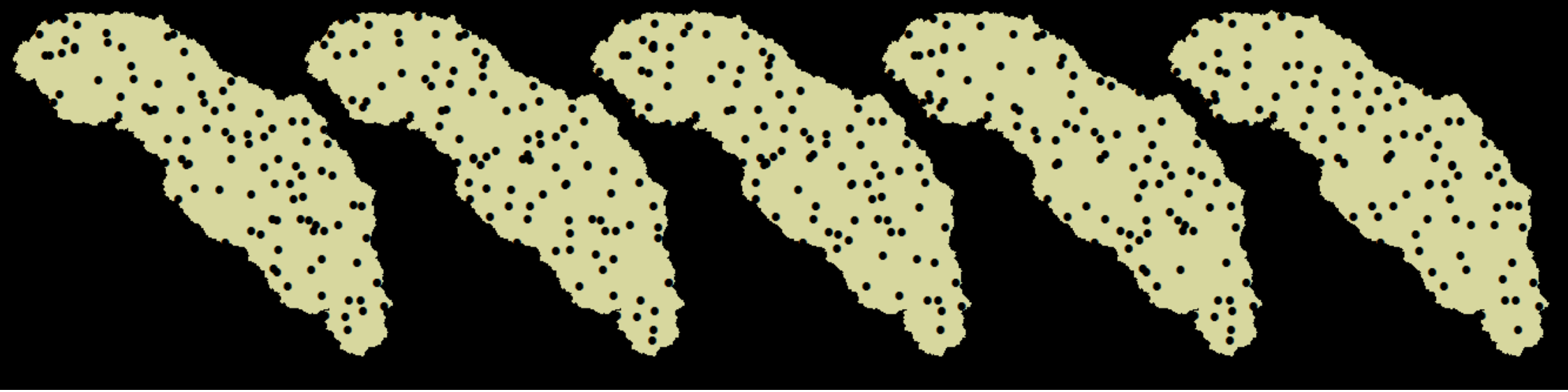
  - RANDOMIZED GAUGE ARRANGEMENT:
    - 100



RANDOMIZED NETWORK SCENARIOS

- 12 DENSITY SCENARIOS;
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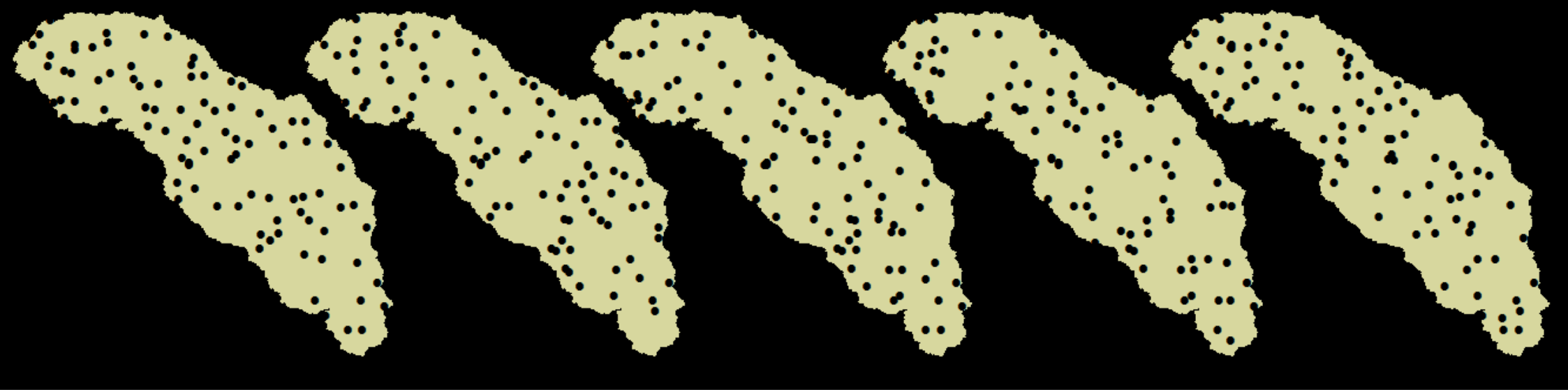
    - 100
    - 90



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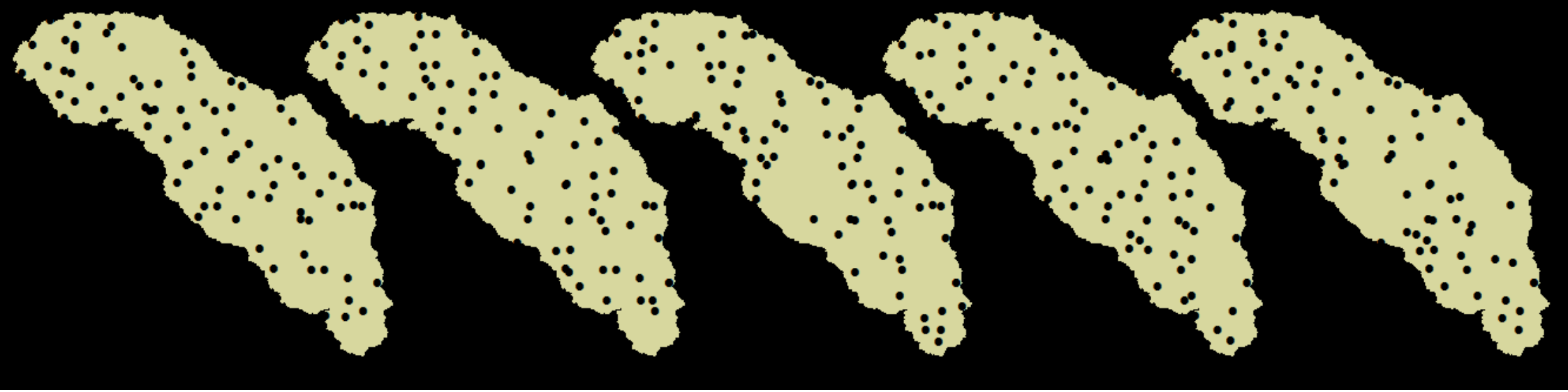
    - 100
    - 90
    - 80



RANDOMIZED NETWORK SCENARIOS

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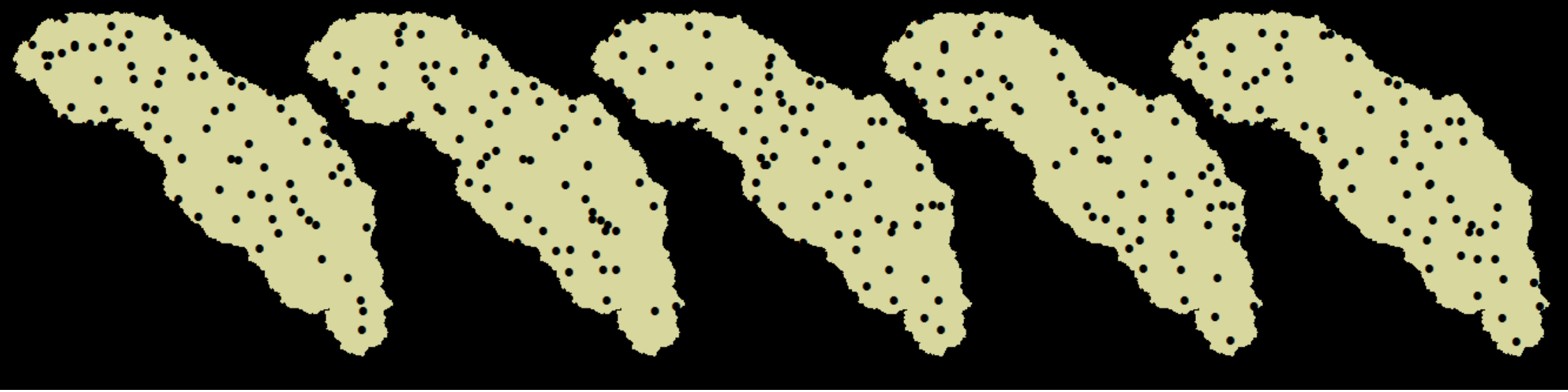
    - 100
    - 90
    - 80
    - 70



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    - 100
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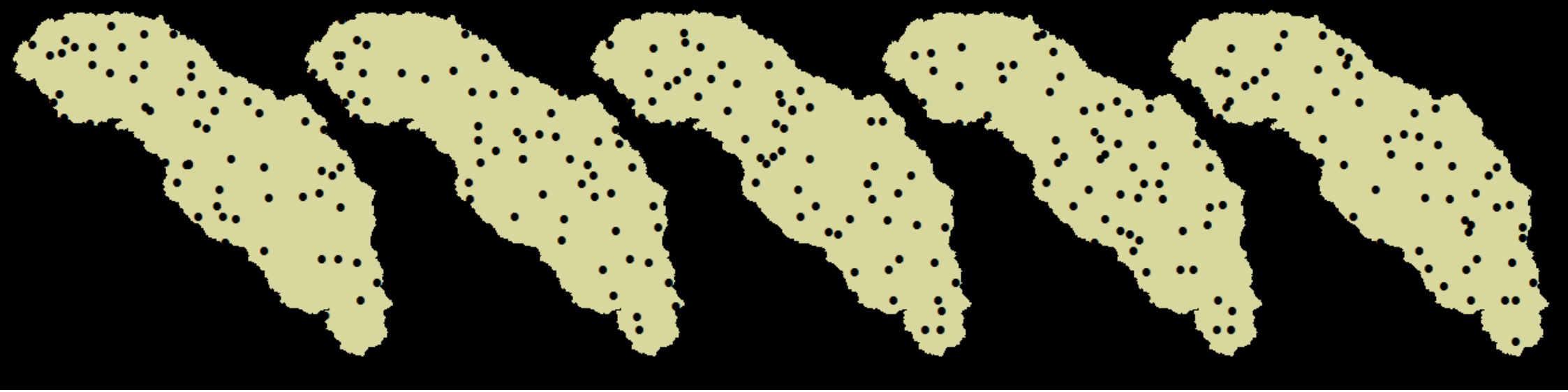
    - 80
    - 70
    - 60



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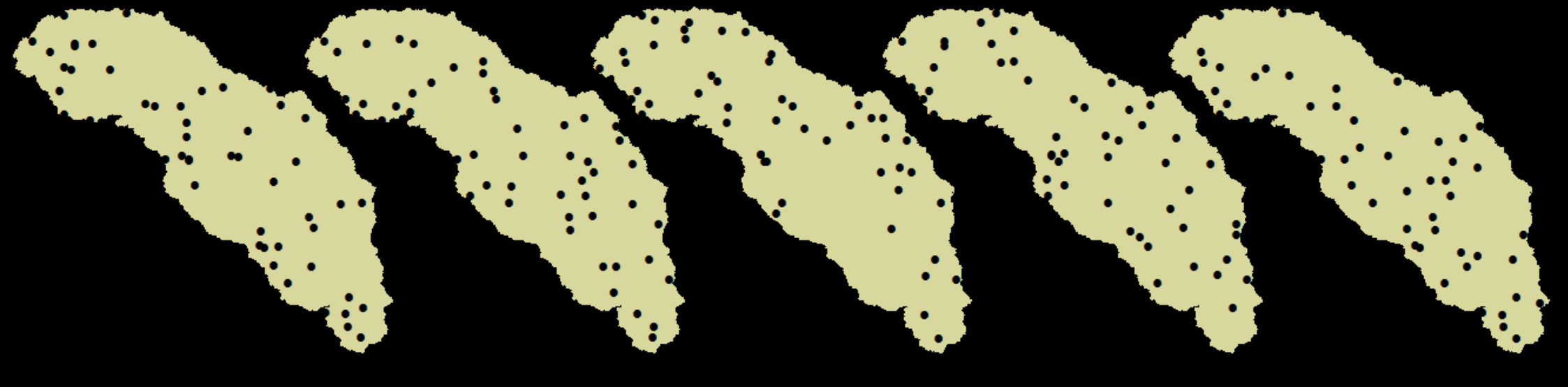

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    - 90
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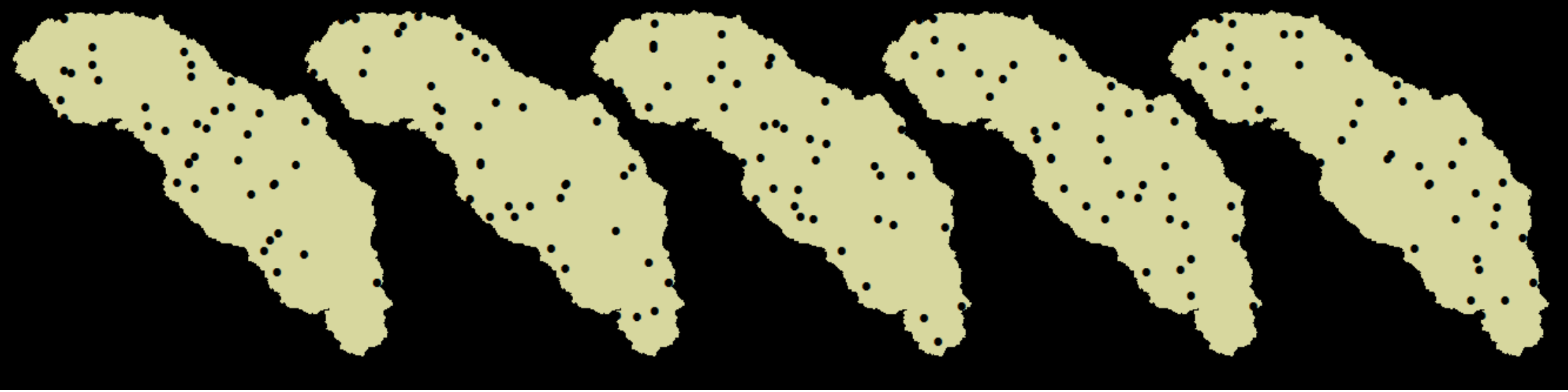
    - 40



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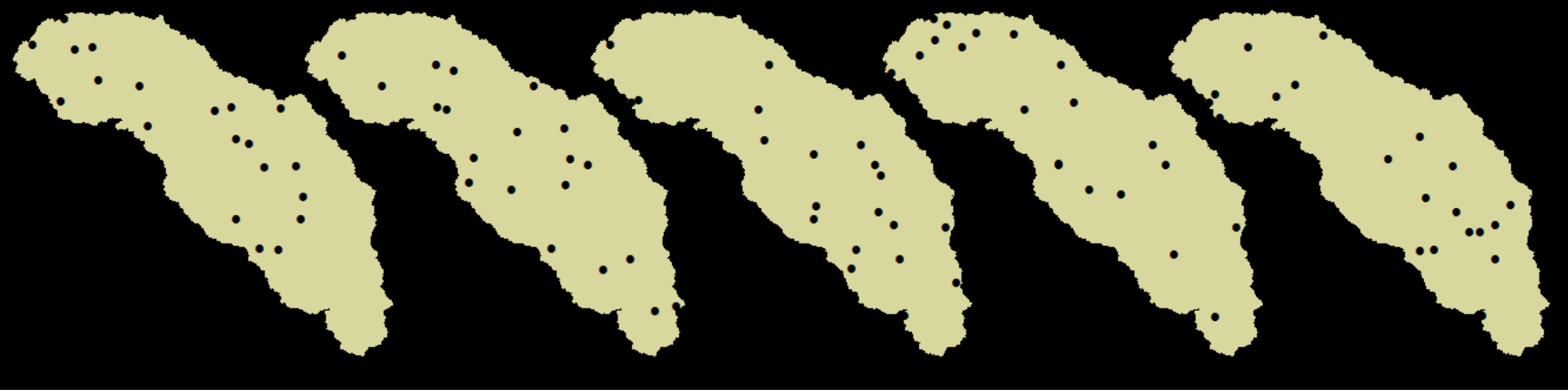
    - 20



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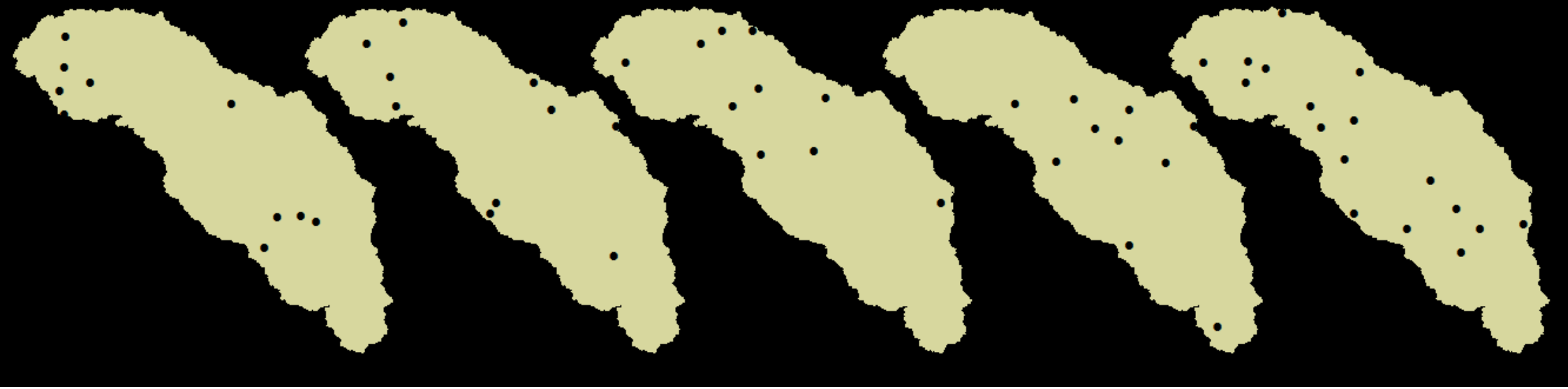
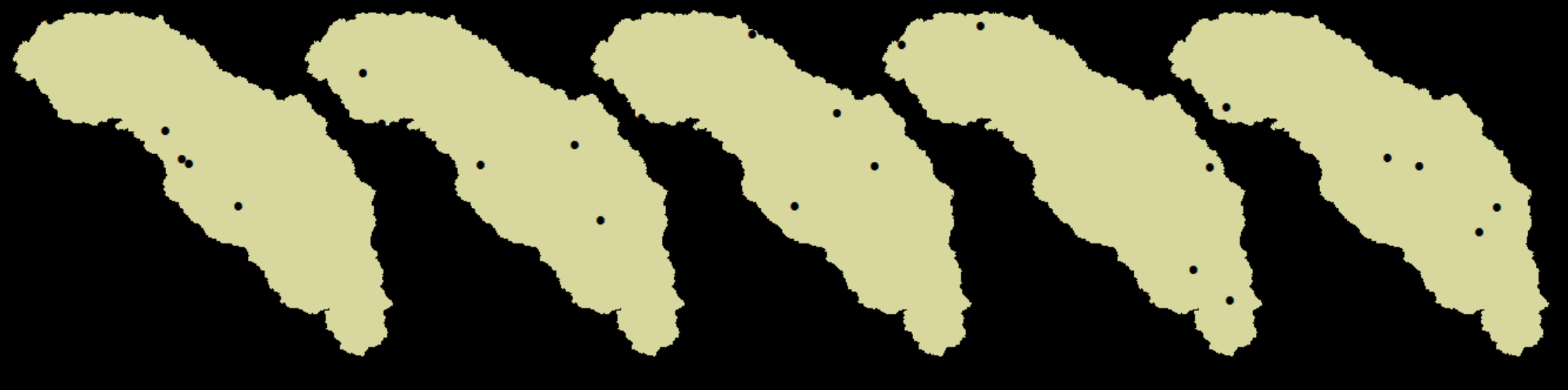
    - 30
    - 20
    - 10



RANDOMIZED NETWORK SCENARIOS

- 12 DENSITY SCENARIOS;
  - RANDOMIZED GAUGE ARRANGEMENT:
    - 100
    - 90
    - 80
    - 70
    - 60
    - 50
    - 40
    - 30
    - 20
    - 10
    - 5



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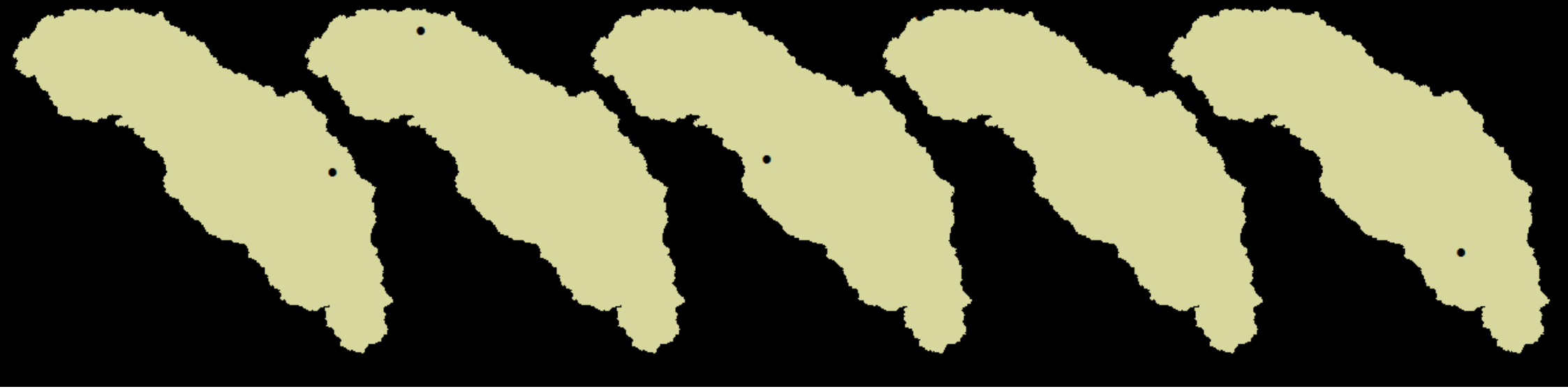
    - 10
    - 5
    - 1



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    - 30
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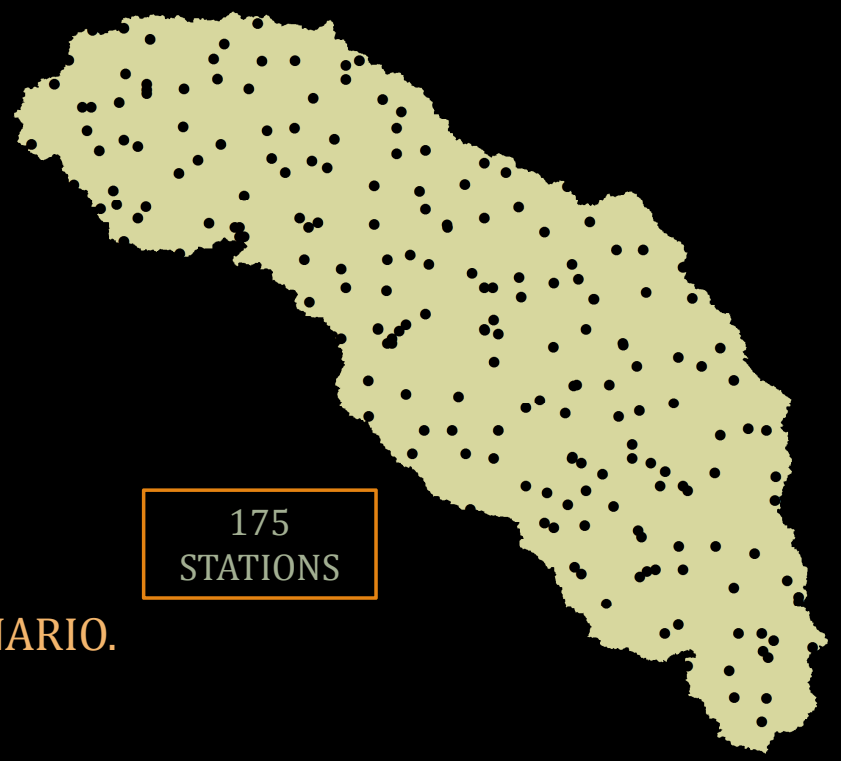
    - 10
    - 5
    - 1
- PERFORMACE COMPARISON WITH BASE SCENARIO.



RANDOMIZED NETWORK SCENARIOS

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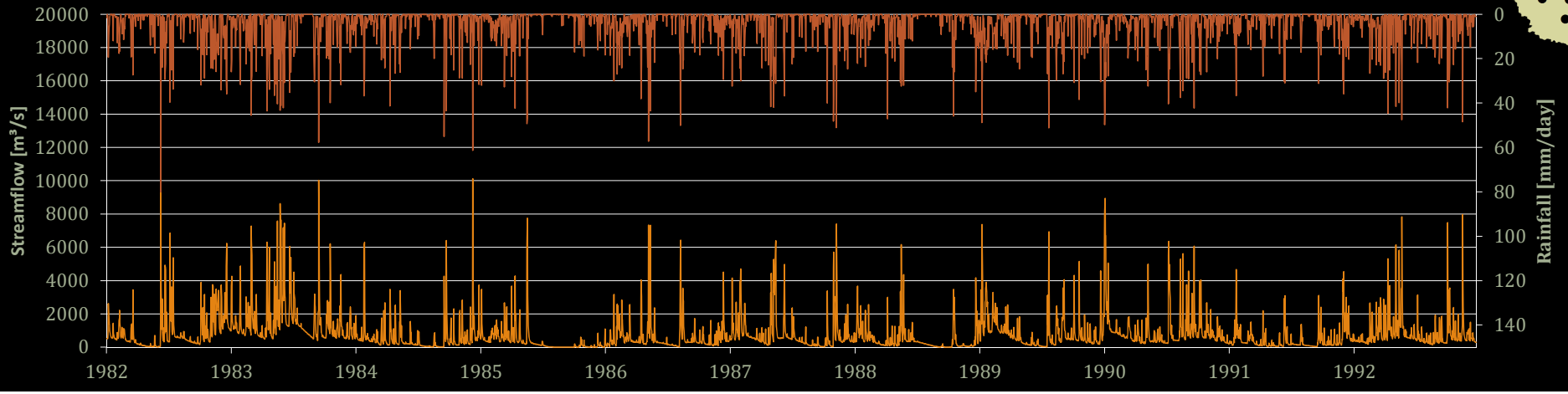
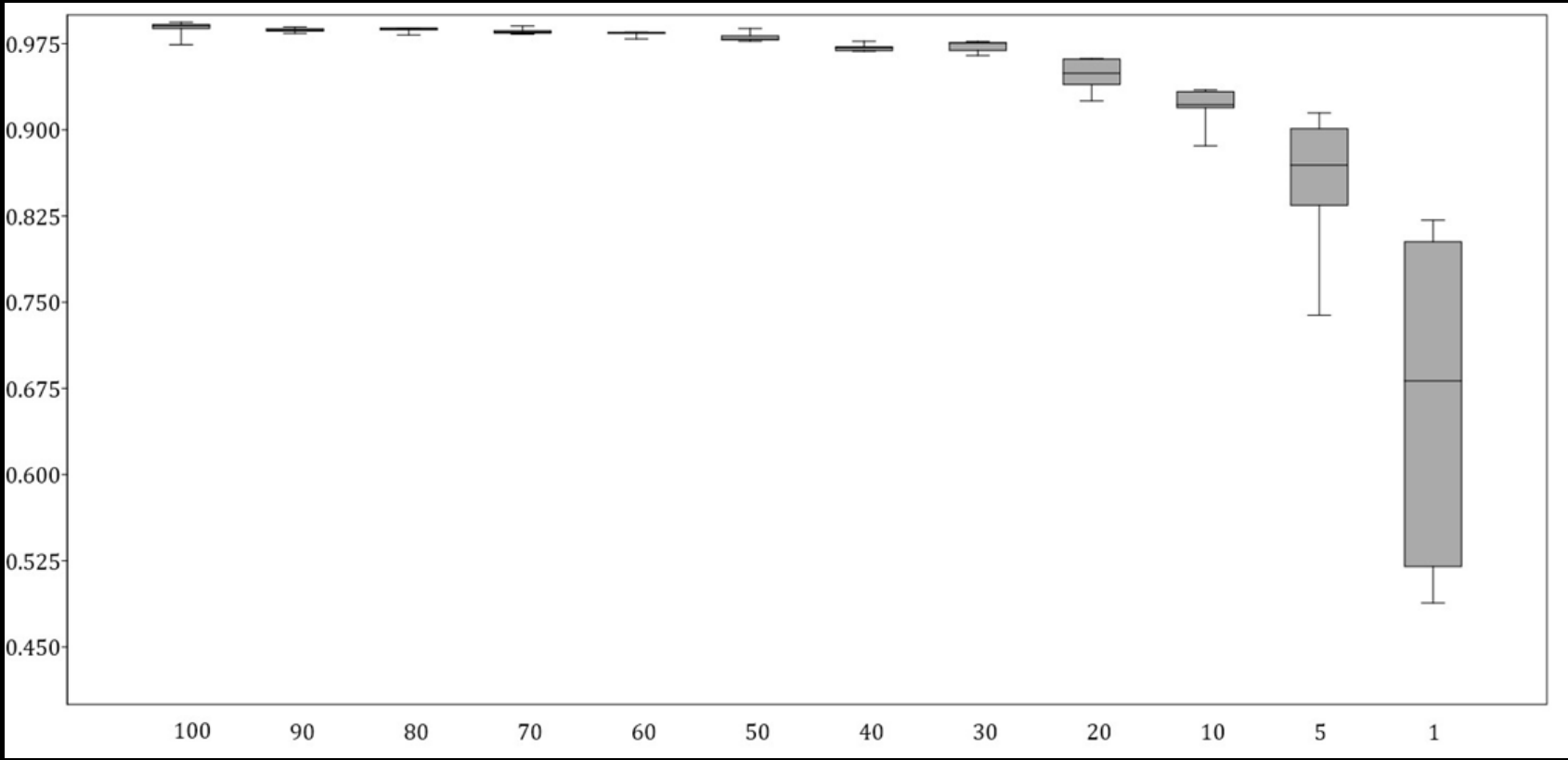


RANDOMIZED NETWORK SCENARIOS

PEARSON CORRELATION WITH THE BASE SCENARIO

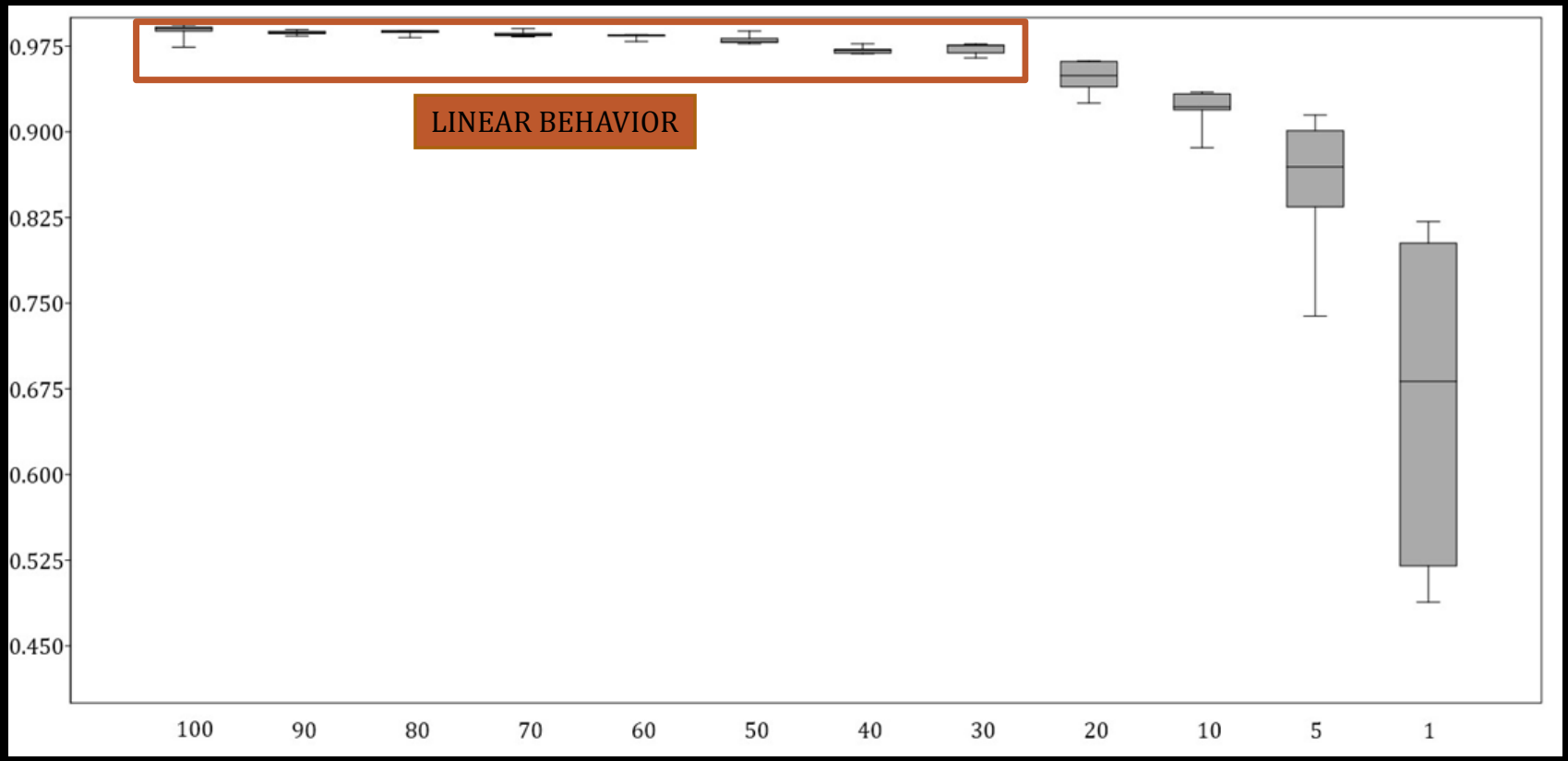
HIGH SIMILARITIES



STREAMFLOW PREDICTIONS OBTAINED WITH DECREADING NUMBER OF STATIONS IN THE ARRENGEMENTS

RANDOMIZED NETWORK SCENARIOS

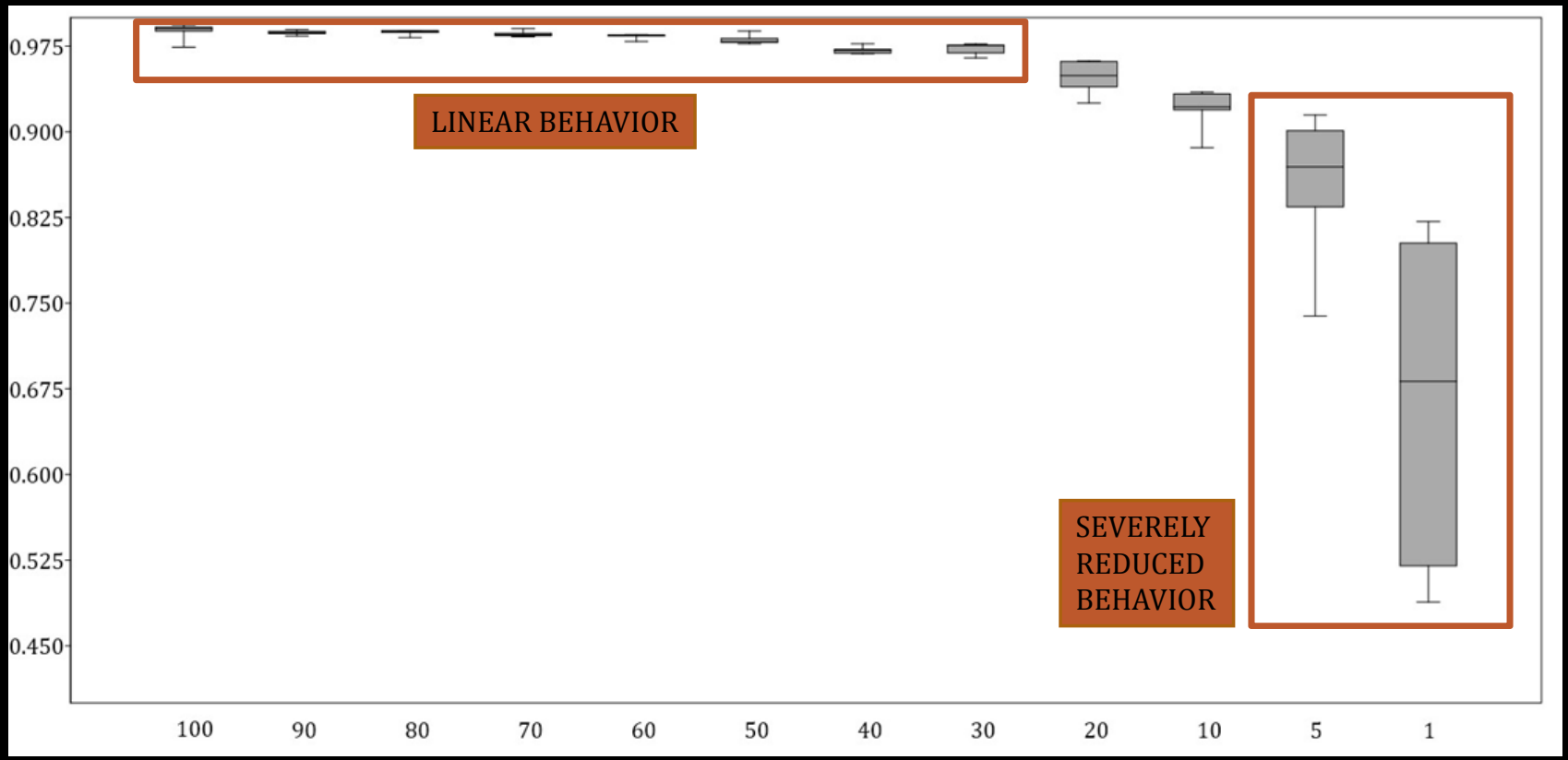
PEARSON CORRELATION WITH THE BASE SCENARIO



STREAMFLOW PREDICTIONS OBTAINED WITH DECREADING NUMBER OF STATIONS IN THE ARRENGEMENTS

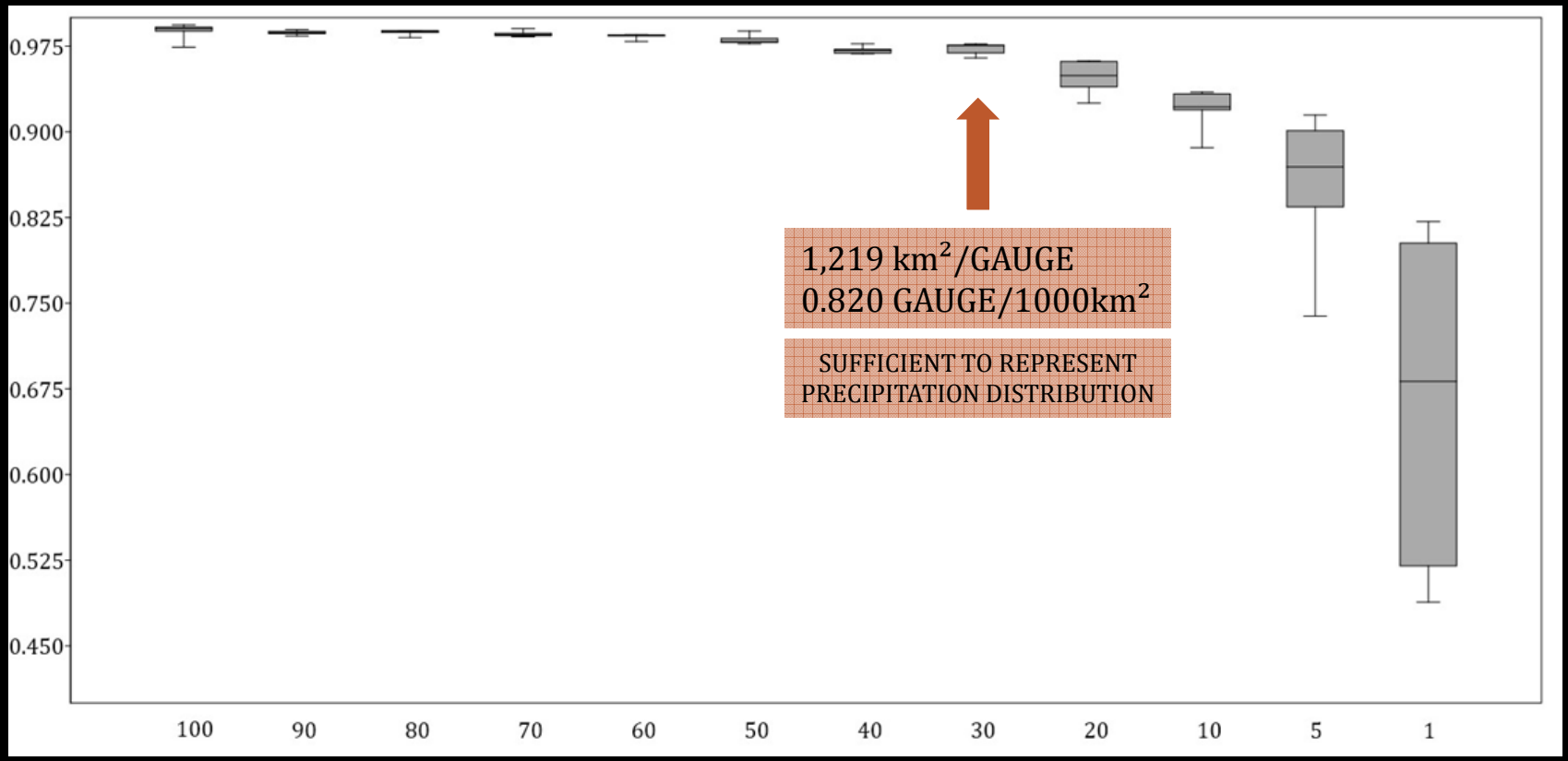
RANDOMIZED NETWORK SCENARIOS

PEARSON CORRELATION WITH THE BASE SCENARIO



STREAMFLOW PREDICTIONS OBTAINED WITH DECREADING NUMBER OF STATIONS IN THE ARRENGEMENTS

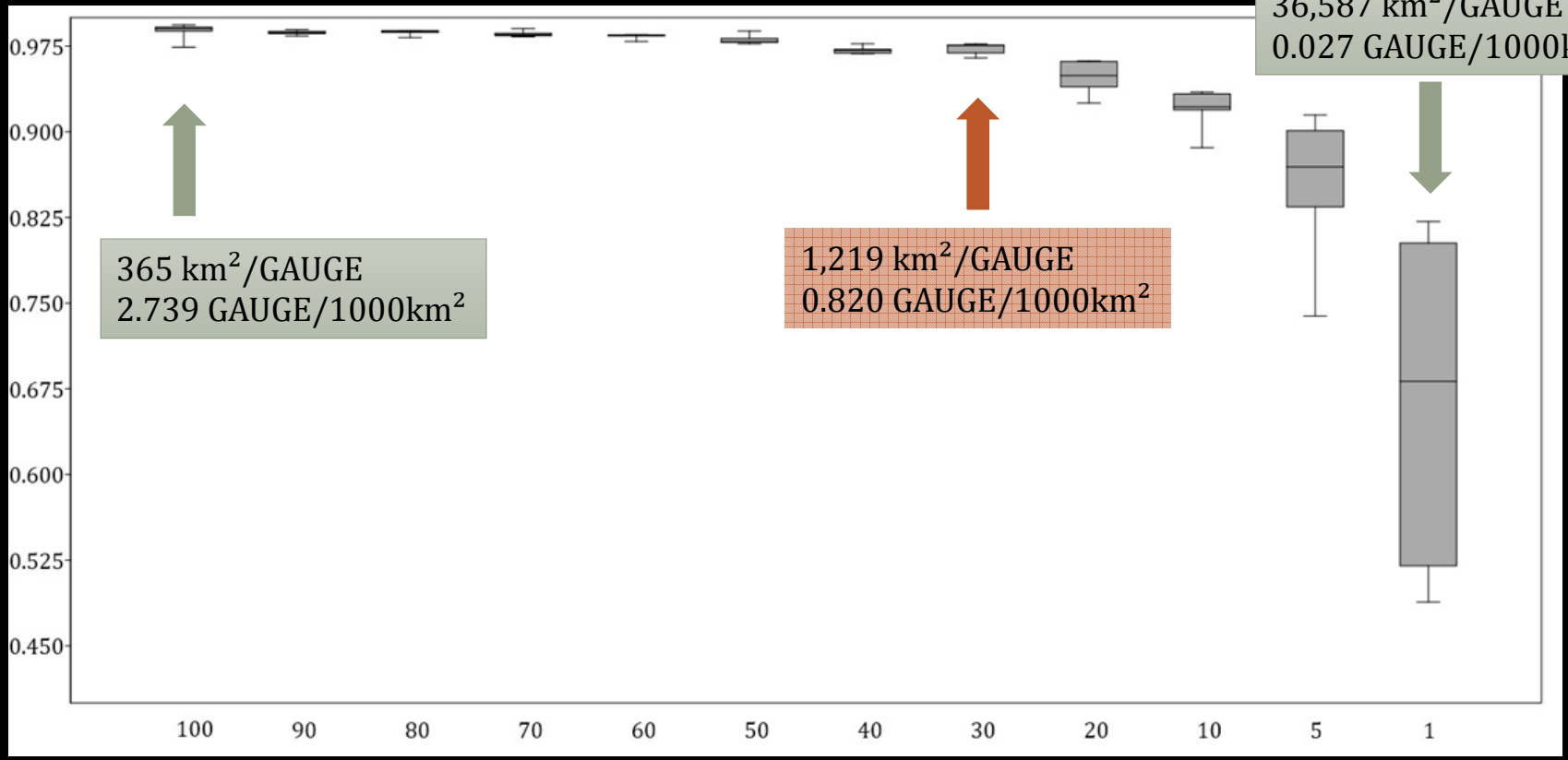
RANDOMIZED NETWORK SCENARIOS



STREAMFLOW PREDICTIONS OBTAINED WITH DECREADING NUMBER OF STATIONS IN THE ARRENGEMENTS

209 km²/GAUGE
4.784 GAUGE/1000km²

RANDOMIZED NETWORK SCENARIOS



STREAMFLOW PREDICTIONS OBTAINED WITH DECREADING NUMBER OF STATIONS IN THE ARRENGEMENTS

209 km²/GAUGE
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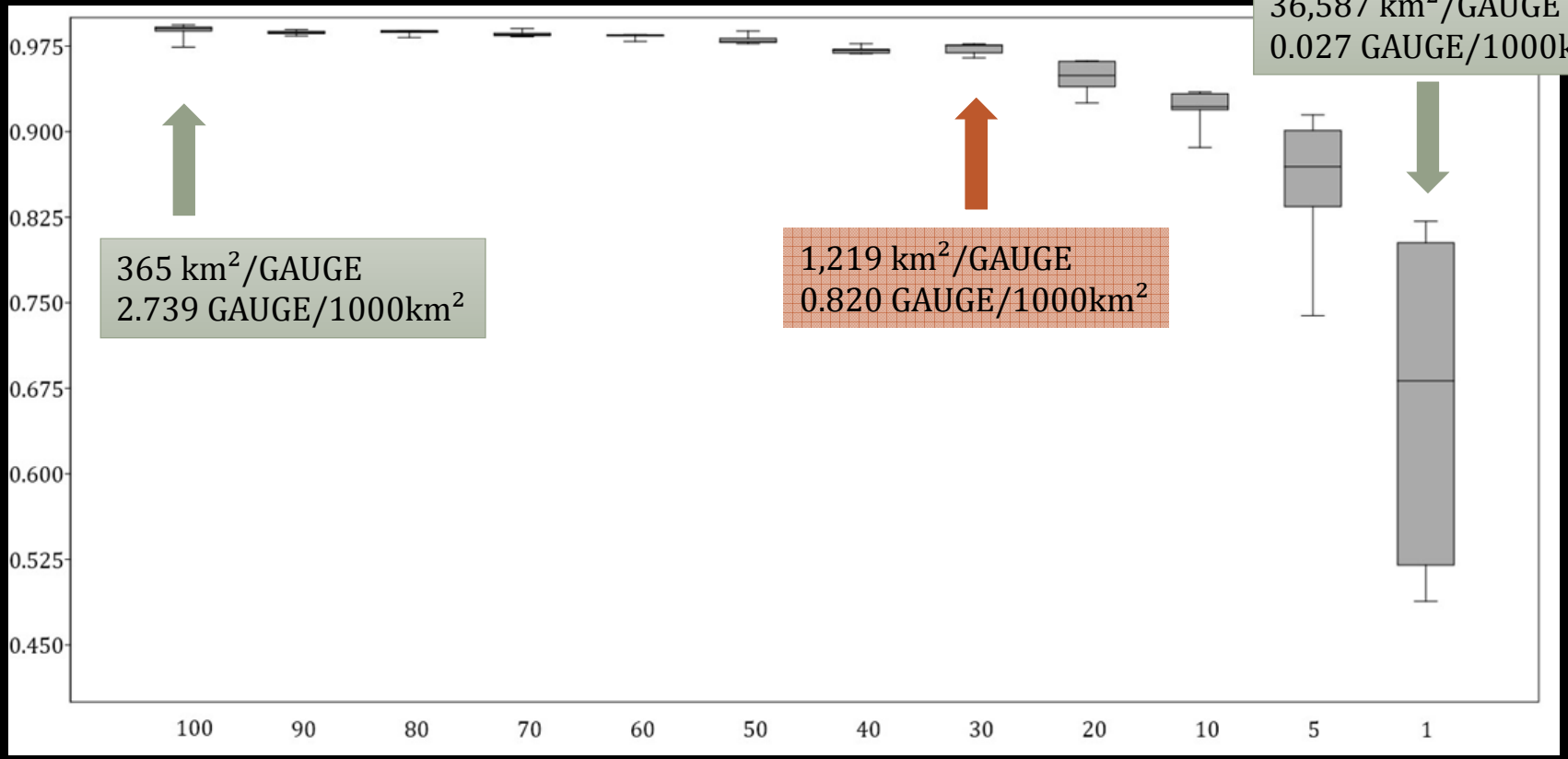
PRELIMINARY APPROACH
FOR THE IVAÍ CATCHMENT

RANDOMIZED NETWORK SCENARIOS



STREAMFLOW PREDICTIONS OBTAINED WITH DECREADING NUMBER OF STATIONS IN THE ARRENGEMENTS

RANDOMIZED NETWORK SCENARIOS

- NEXT STEPS:
  - MODEL CALIBRATION/VALIDATION;
  - REMAKE ALL THE RESULTS;
  - APPLY TO OTHER PARANÁ RIVER WATERSHEDS;
  - COMPARE THEIR BEHAVIOUR;
  - TRANSLATE THIS INFORMATION FOR WATER RESOURCES MANAGERS.
    - STRATEGICALLY IMPORTANT BASIN:
      - ENERGY AND ECONOMY;
      - NATIONAL SECURITY.

THANK YOU!

DETECTION OF THE ROLE IN CLIMATE CHANGE AND LAND USE AND LAND COVER CONDITIONS IN THE PARANA RIVER BASIN HYDROLOGY

[1] PAST LULC CHANGES AND THE IMPACT ON HYDROLOGY

[2] POTENTIAL IMPACTS OF CLIMATE CHANGE SCENARIOS

[3] EFFECTS OF LARGE-SCALE CLIMATE VARIABILITY

CAPES

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