Optimization of CHyM Model in Benin – Owena Basin, Nigeria

Being the Practical Presentation Water Resources in Developing Countries: Planning and Management in a Climate Change Scenario

Presented by

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Introduction

Understanding the basin-scale hydrologic potentials in managing water resources require the optimization of relevant model.

Modeling watershed/river basin is crucial in the developing countries.

Nevertheless, it is very difficult to transforme simulated precipitation response into a realistic hydrologic benefit in non inclined research countries.

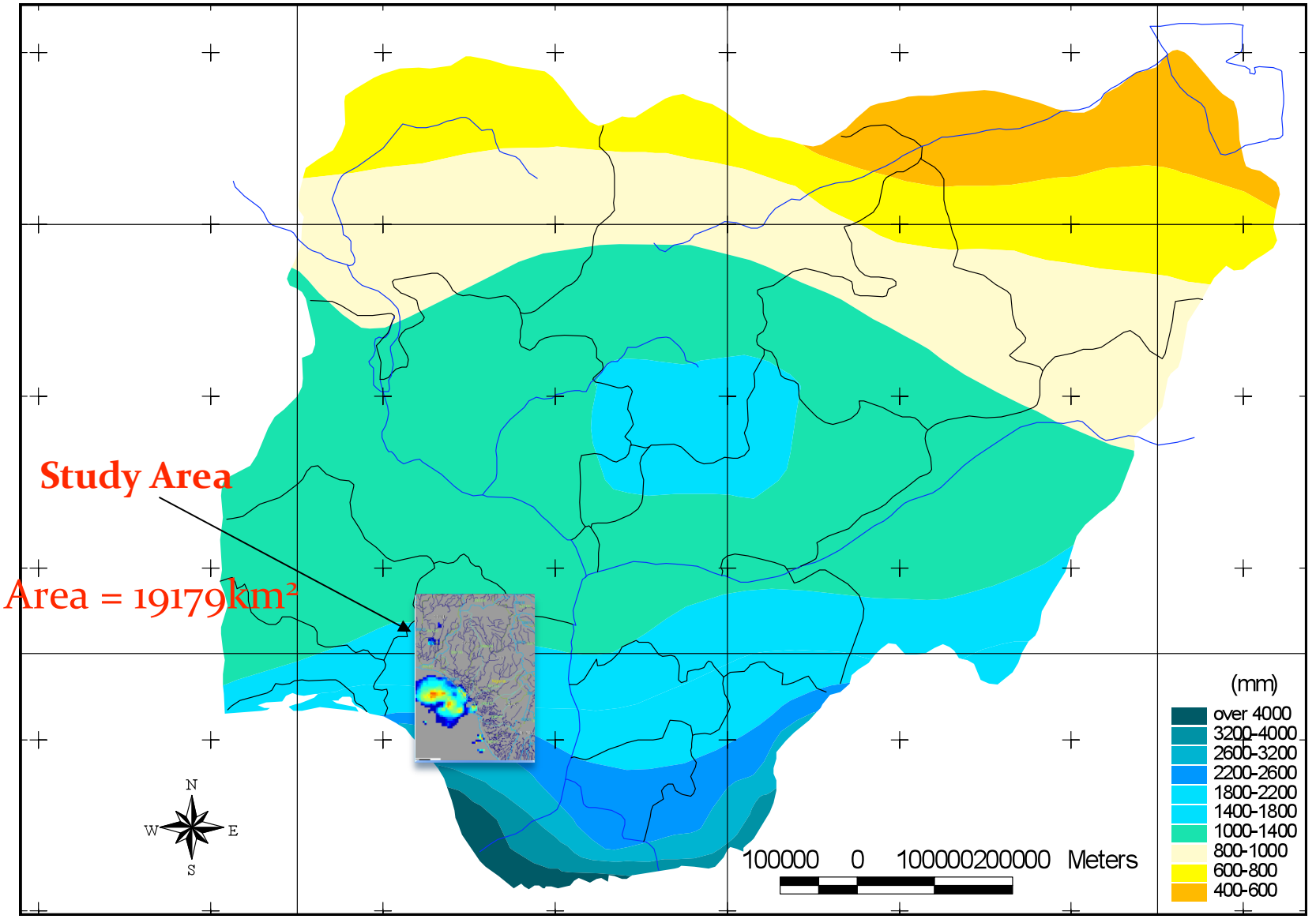
Aim and Objectives

- The aim of this presentation is to establish the efficiency of CHyM model simulation for monthly rainfall in Benin/ Owena river basin.

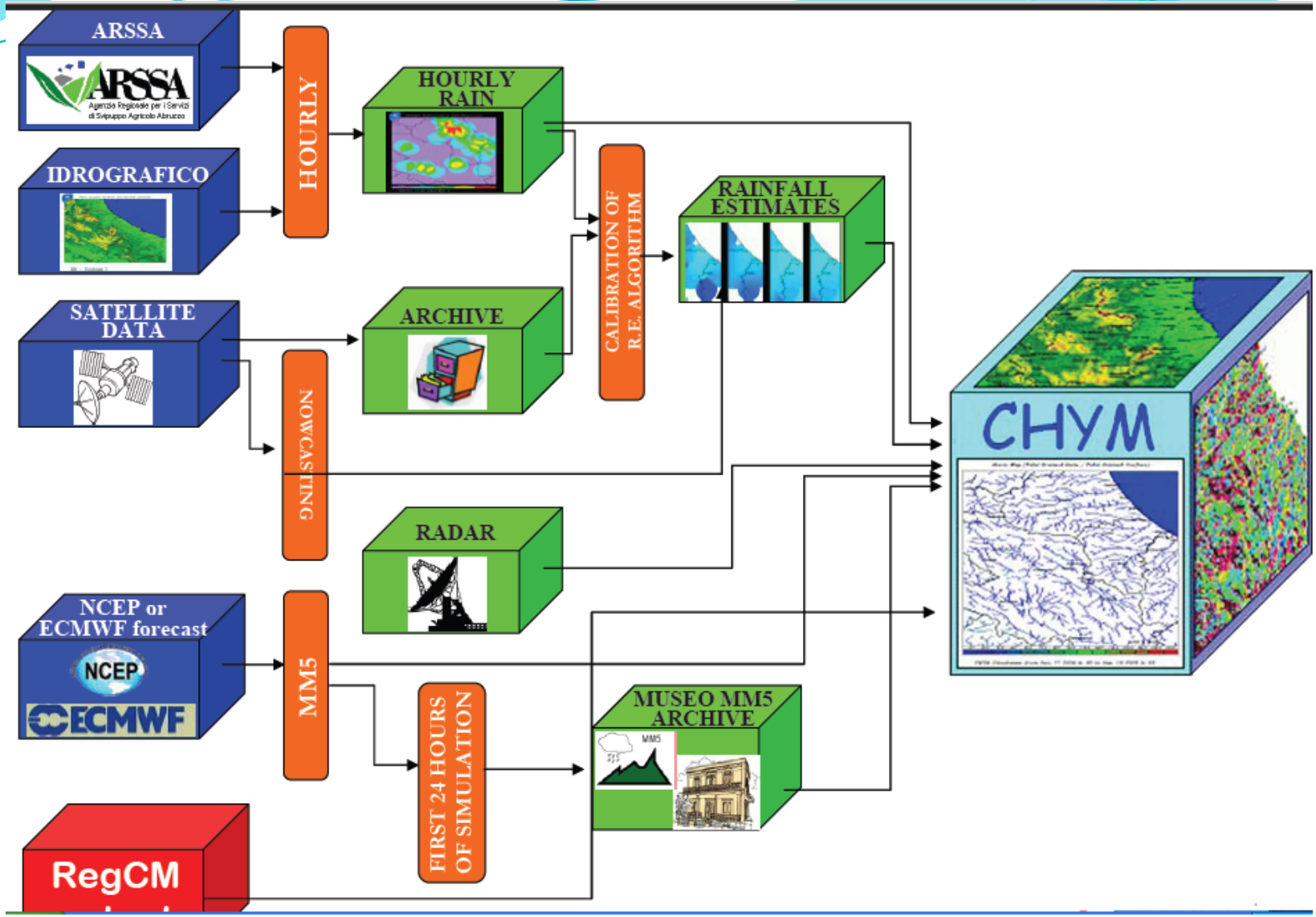
- The specific objectives are.
  - ✓ to simulate monthly average flow discharge, flow direction, drained surface and accumulated rain for onset, peak and offset of rain
  - ✓ to compare the simulated result with observed data result
  - ✓ to suggest the optimal efficiency of the basin for water resources planning and management.

❖Study Area

❖Nigeria annual rainfall ranges between 400mm in northeastern parts and 4000mm in the coastal area

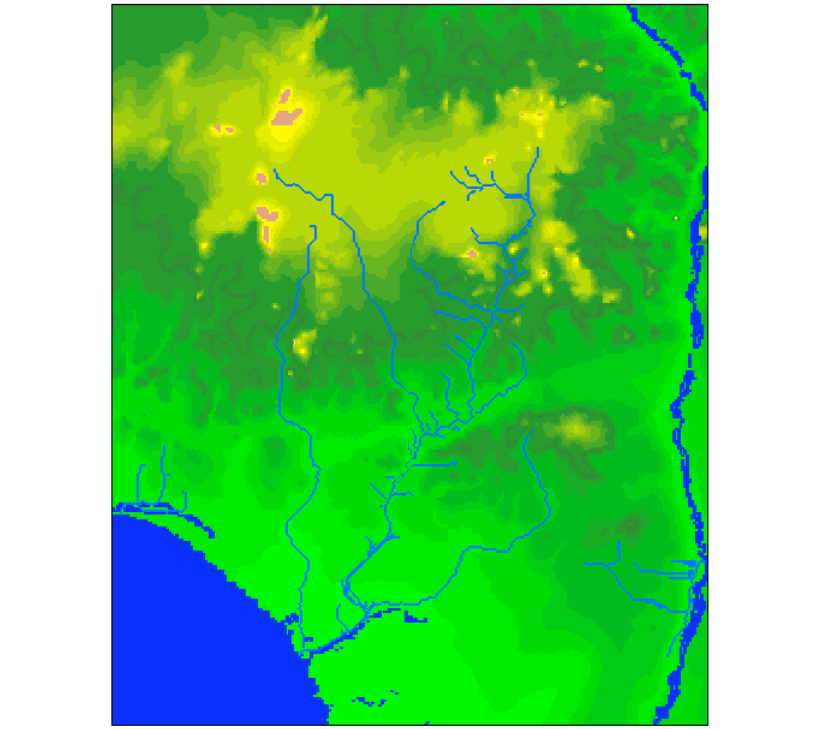


❑Frame structure of CHyM Model (Coppola etal, 2007)



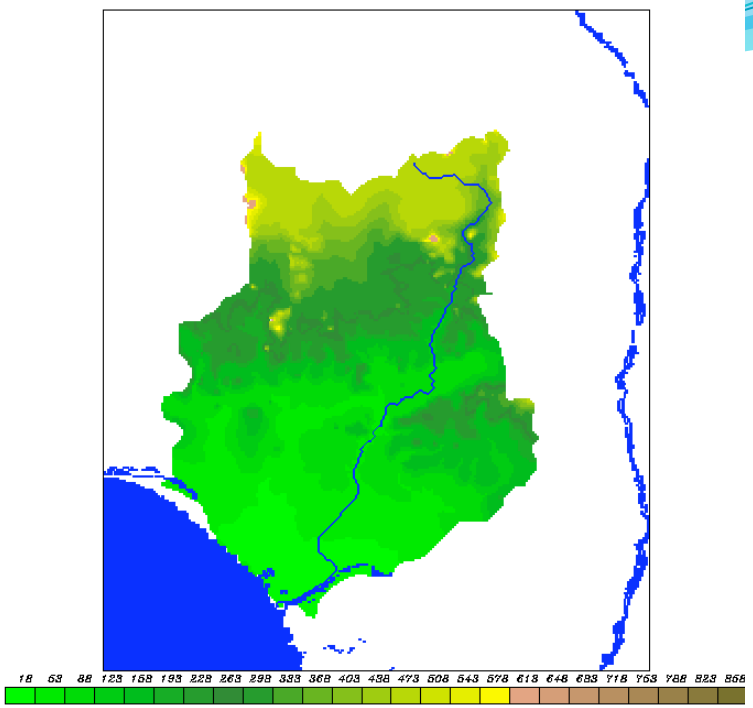
CHyM Model is a distributed model for river basins. It simulates the basin-scale hydrologic processes in response to daily precipitation. The frame structure of CHyM follows the model structure described in above

CHyM Graphic Lab



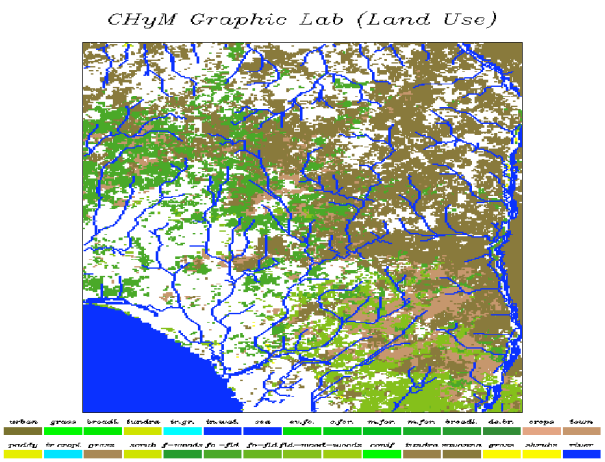
Drainage Network

CHyM Graphic Lab

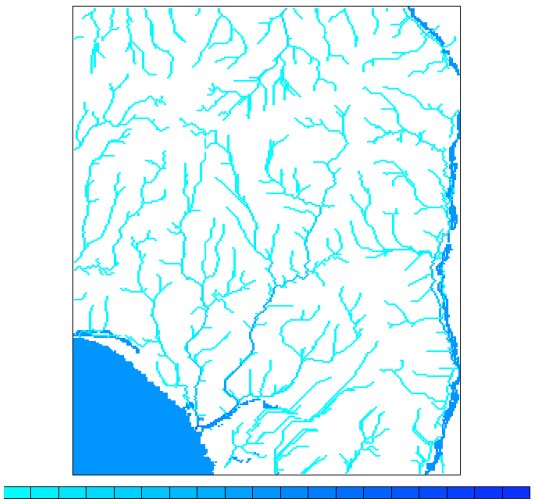


Unknown River Basin

CHyM Graphic Lab (Land Use)

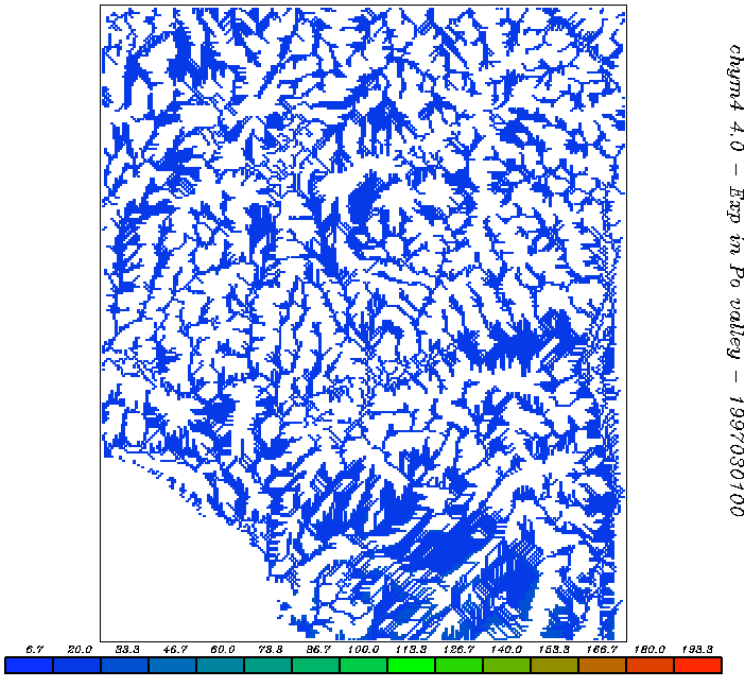


CHyM Graphic Lab



Flow Test with "The Rolling Stones" Algorithm

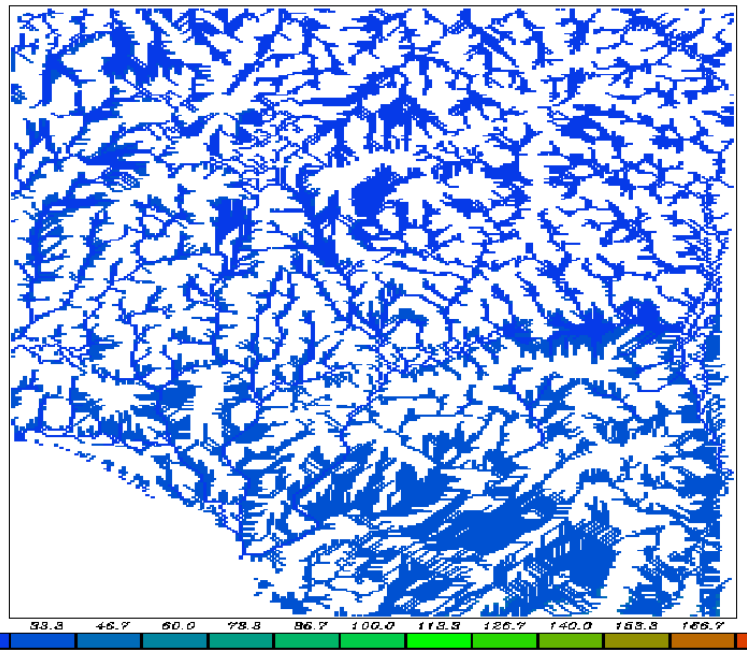
Alarm Map (Total Drained Rain / Total Drained Surface)



chym4 4.0 – Exp in Po valley – 1997030100

Simulation from March, 01 1997 h: 23 to March, 31 1997 h: 23

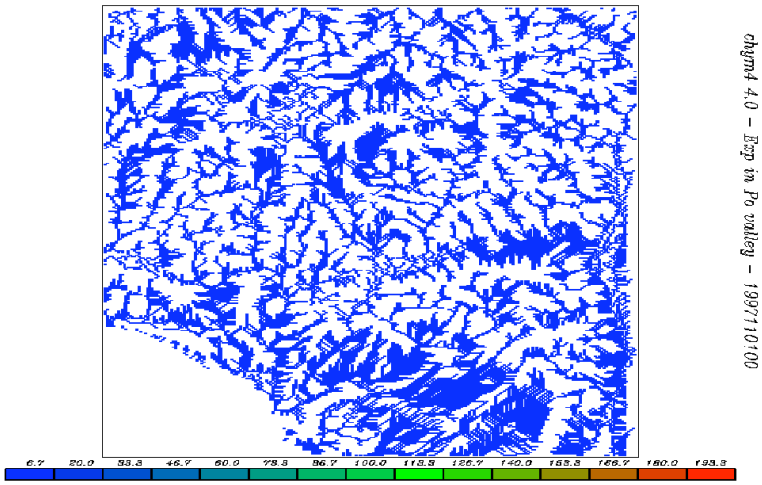
Alarm Map (Total Drained Rain / Total Drained Surface)



chym4 4.0 – Exp in Po valley – 1997070100

Simulation from July, 01 1997 h: 23 to July, 31 1997 h: 23

Alarm Map (Total Drained Rain / Total Drained Surface)



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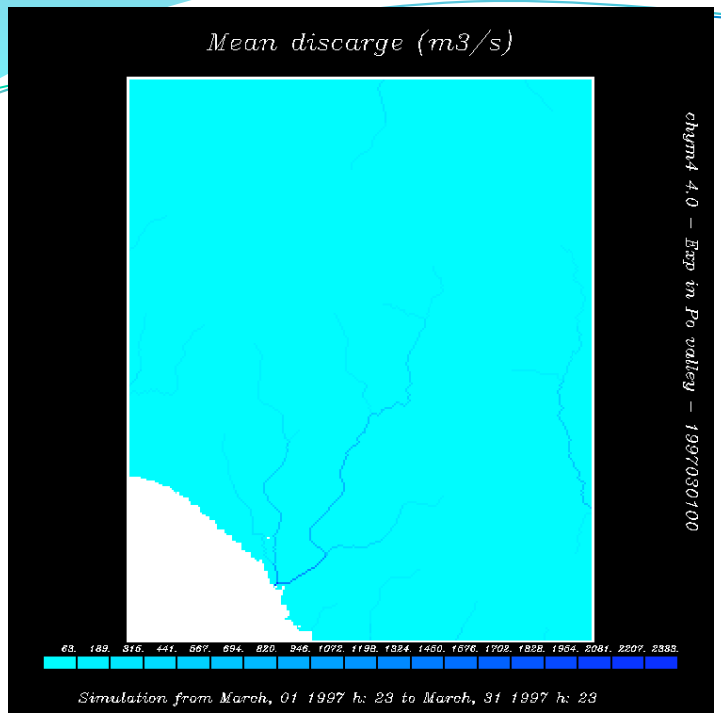
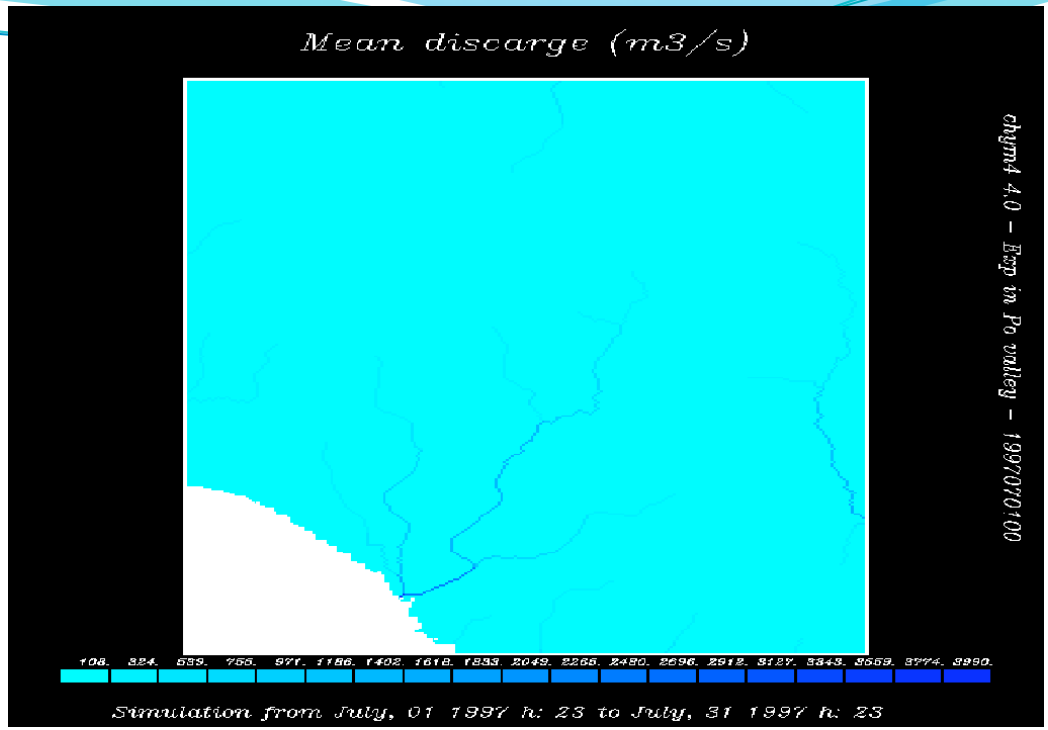
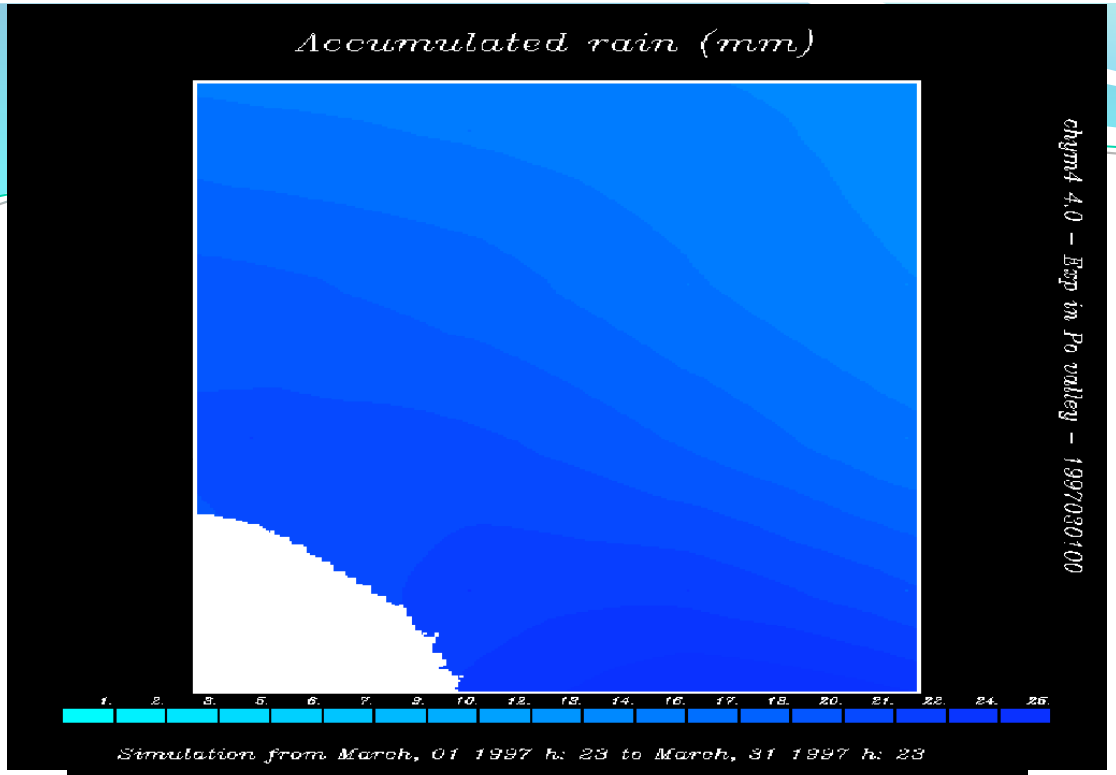
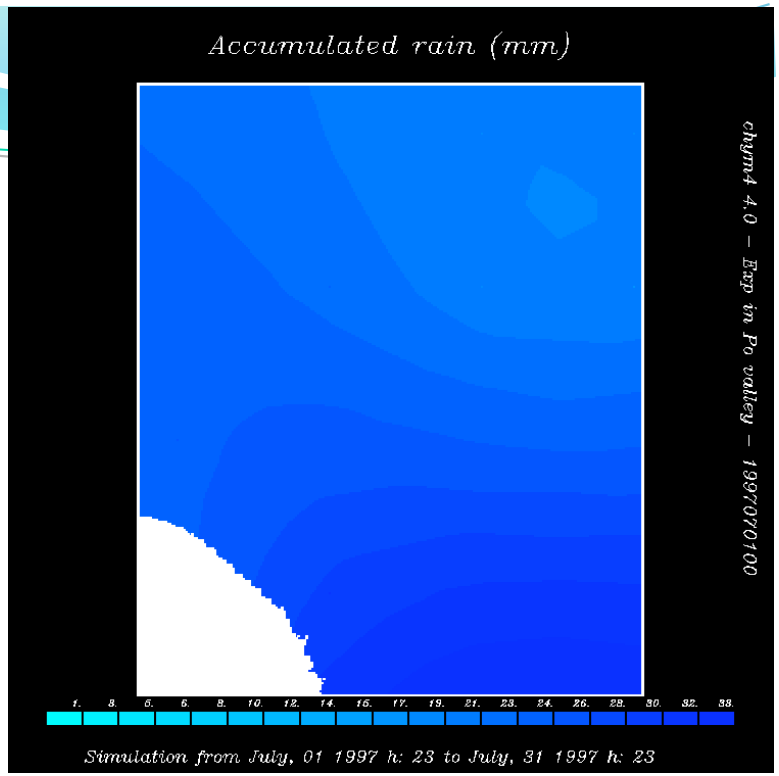
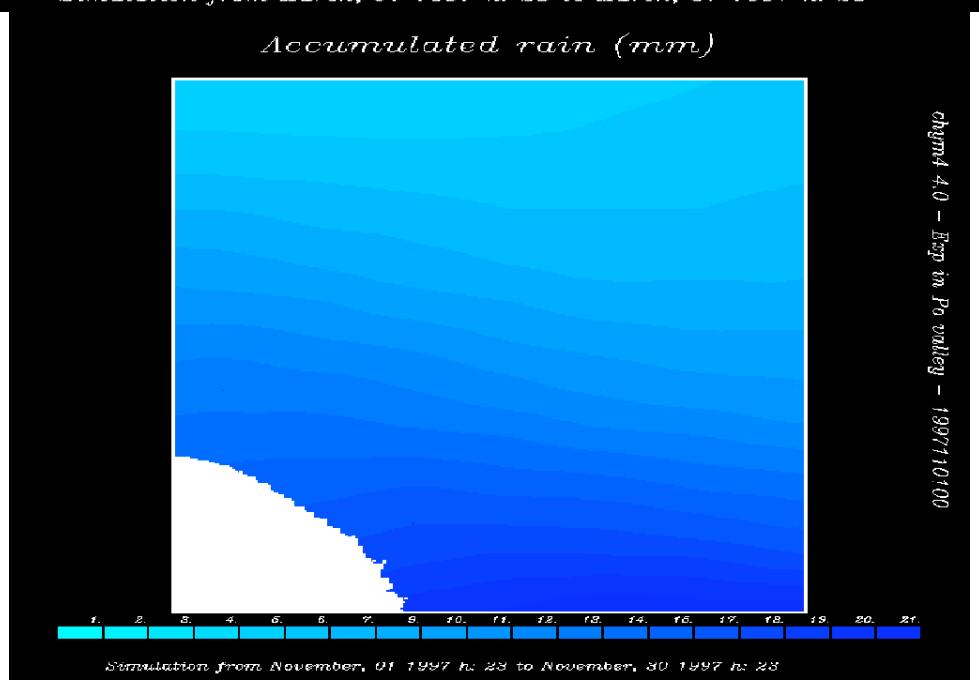
Result and discussion



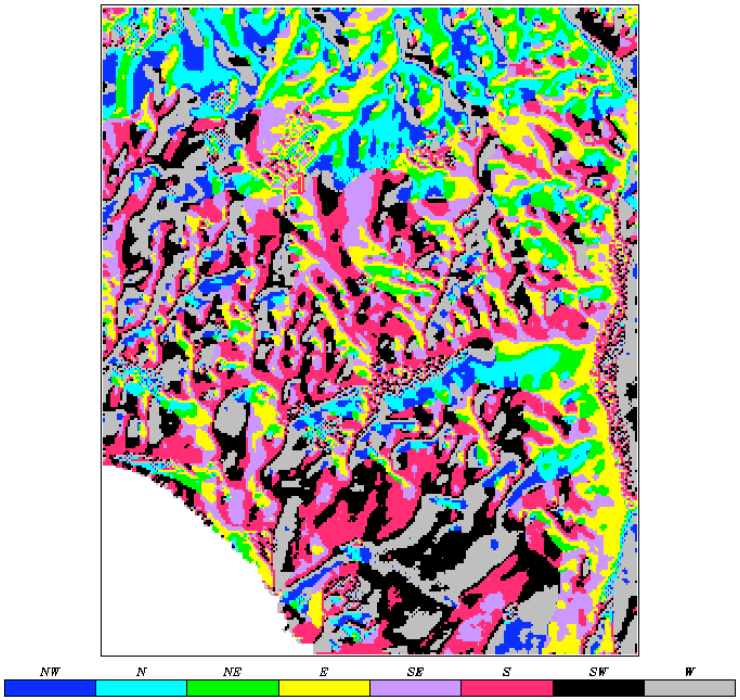



Accumulated rain (mm)
chym4 4.0 – Exp in Po valley – 1997030100
1. 2. 3. 5. 6. 7. 9. 10. 12. 13. 14. 16. 17. 18. 20. 21. 22. 24. 25.
Simulation from March, 01 1997 h: 23 to March, 31 1997 h: 23


Accumulated rain (mm)
chym4 4.0 – Exp in Po valley – 1997070100
1. 3. 5. 6. 8. 10. 12. 14. 16. 17. 19. 21. 23. 24. 26. 28. 30. 32. 33.
Simulation from July, 01 1997 h: 23 to July, 31 1997 h: 23


Accumulated rain (mm)
chym4 4.0 – Exp in Po valley – 1997110100
1. 2. 3. 4. 6. 5. 7. 9. 10. 11. 12. 13. 14. 16. 17. 18. 19. 20. 21.
Simulation from November, 01 1997 h: 23 to November, 30 1997 h: 23

Flow Direction Map



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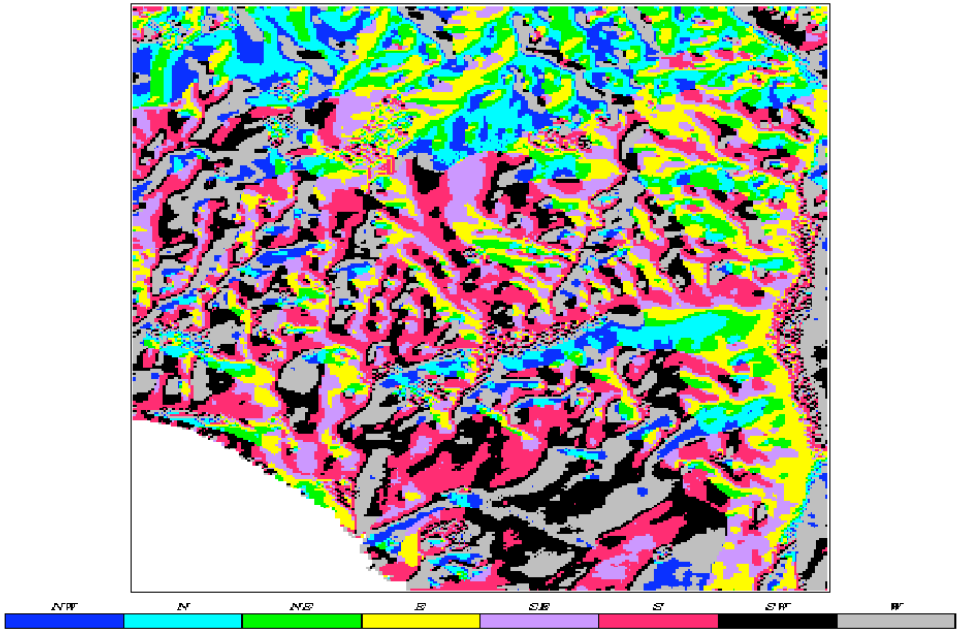
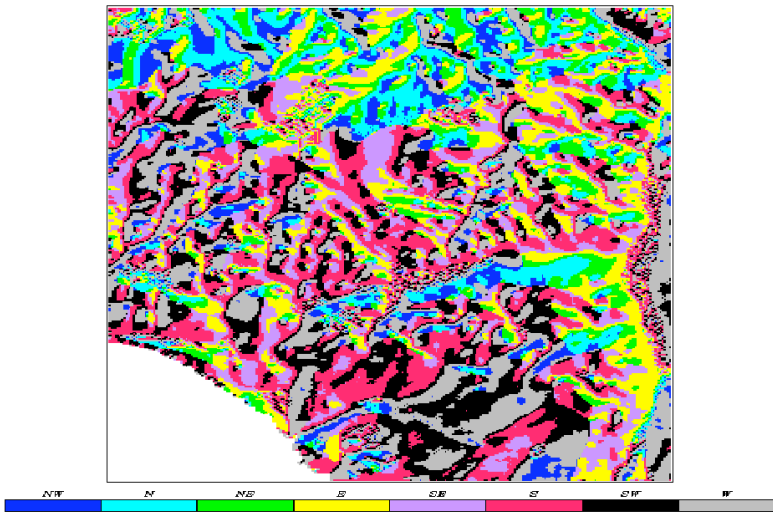
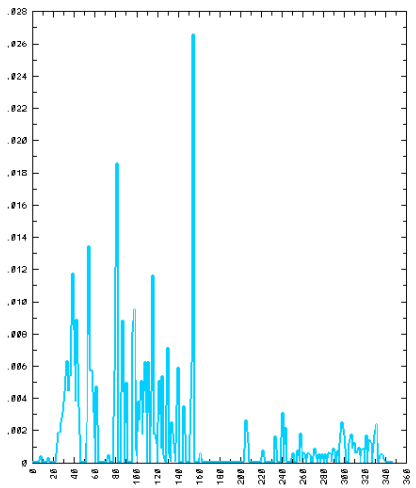


Flow Direction Map



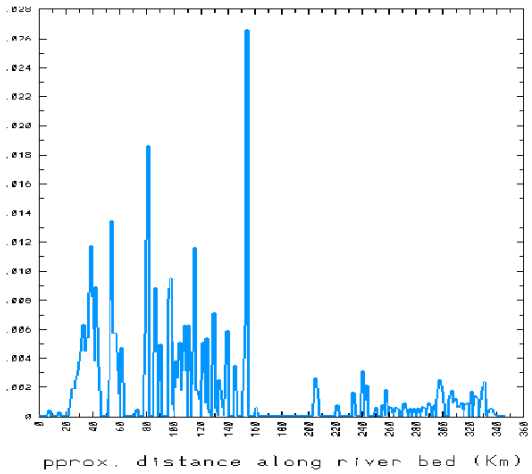
CHyM Graphic Lab



chym4 4.0 - Exp in Po valley - 19970301000

Slope along Unknown river

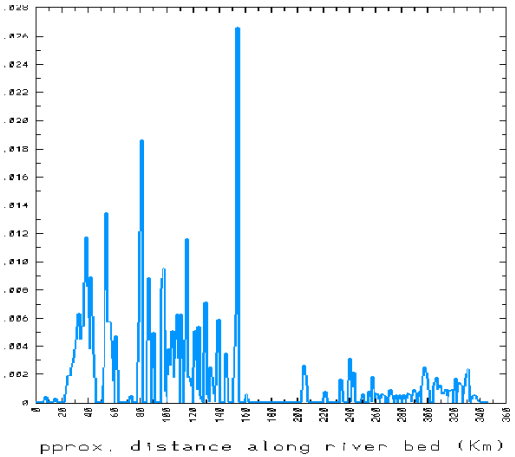
CHyM Graphic Lab



chym4 4.0 - Exp in Pc valley - 19970701000

Slope along Unknown river

CHyM Graphic Lab



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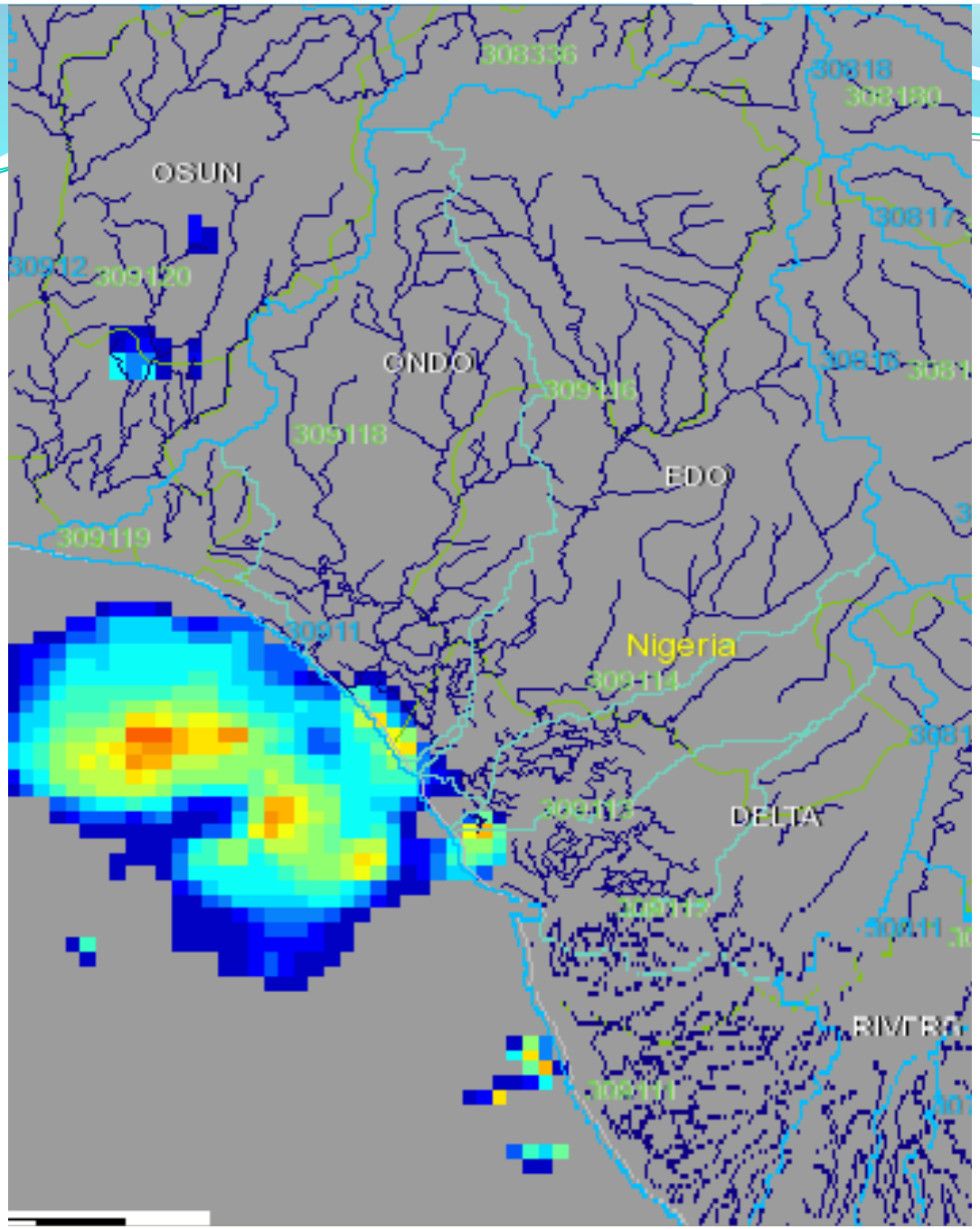
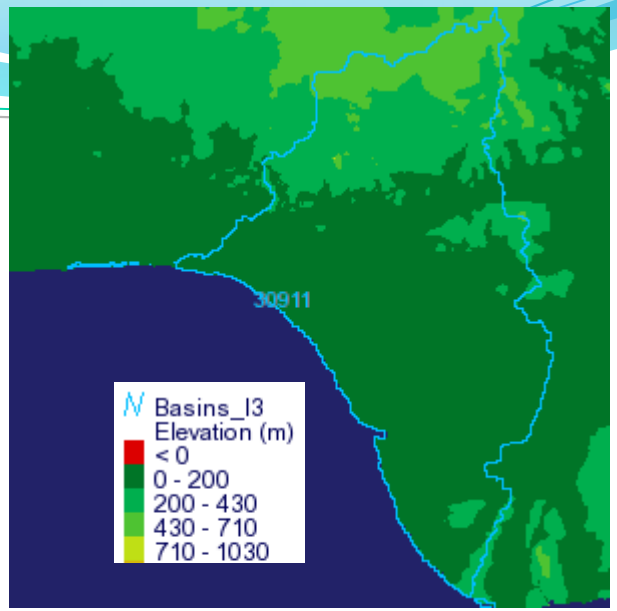
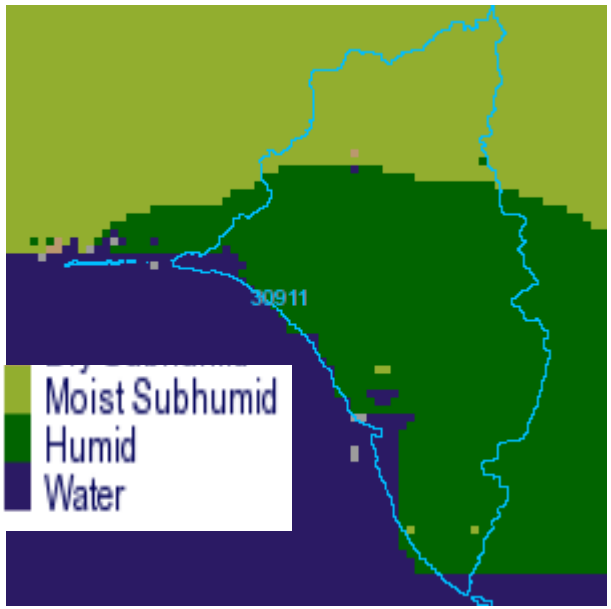
Slope along Unknown river







Related information from G-WADI website http://hydis.eng.uci.edu/gwadi/

Table 1: Mean monthly rainfall depths in owena catchment area (1980-2004)

Month	Total (mm) Rainfall	Mean rainfall depth (mm)	Standard deviation
January	207.2	8.29	16.39
February	991.5	39.66	35.61
March	1938.4	77.54	56.79
April	3854.6	154.18	59.44
May	4022.8	160.91	58.63
June	4911.7	196.47	54.85
July	4602.4	184.21	85.25
August	4605.3	194.21	99.43
September	5843.7	233.75	51.62
October	3616.9	144.68	66.14
November	717.0	28.68	24.39
December	206.7	8.27	17.1

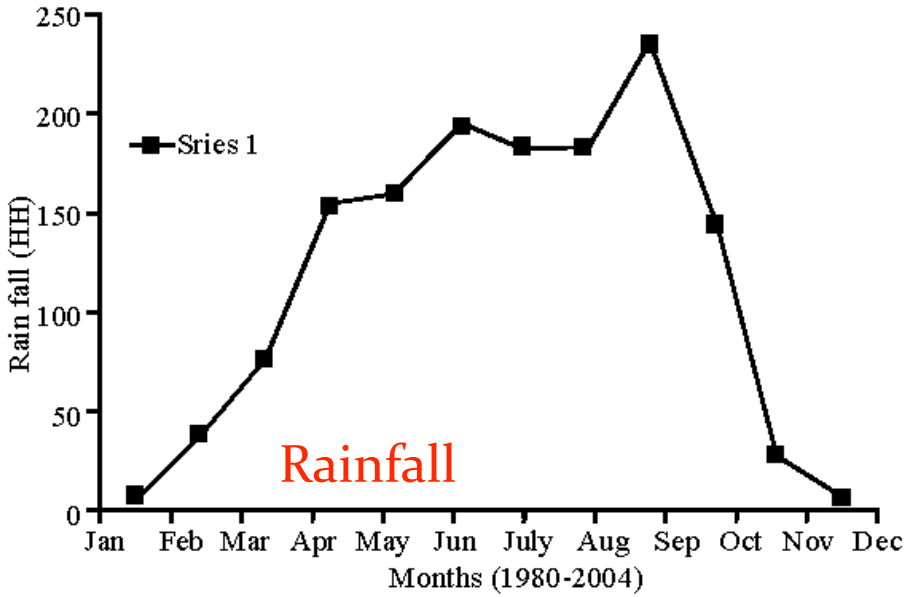
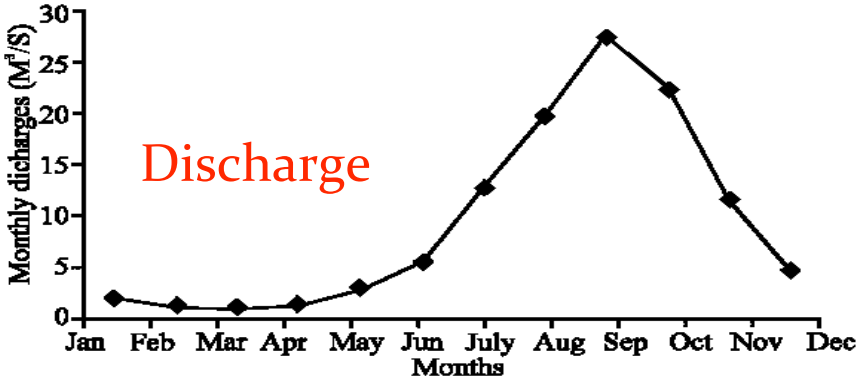


Table 2: Mean monthly discharges of owena river in ondo state. (1990-1999)

Month	Total discharge	Mean monthly discharge	Standard deviation
January	19.9	1.99	2.26
February	13.933	1.390	0.96
March	11.775	1.18	0.54
April	15.038	1.5	0.61
May	31.124	3.11	1.65
June	56.99	5.7	3.07
July	129.21	12.92	11.69
August	197.21	19.72	14.04
September	273.83	27.38	12.47
October	227.99	22.8	8.92
November	116.706	11.67	8.89
December	47.544	4.75	3.53



Information from observed results

Discussions

- The monthly simulation of rainfall was performed, starting from oohr for the off, peak and off raining season of 1997.

- Observations show a wide variation in the monthly simulation in the area. The precipitation are decreased slowly northward over the period.

- Observed rainfall depths/discharge trends method and CHyM-simulation produced similar results as observed from the comparison between the simulated and observed in accumulated rainfall and discharge output.

Conclusion

- In conclusion, CHyM model system captured the rainfall pattern of the basin moderately well.

- It is anticipated that effective and efficient optimization of CHyM models will increase the potentiality of the basin in water resources development in the scenario of threatening climate change.

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