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NEXUS Gains: Realizing Multiple Benefits Across Water, Energy, Food and Ecosystems

Incomati River System Model

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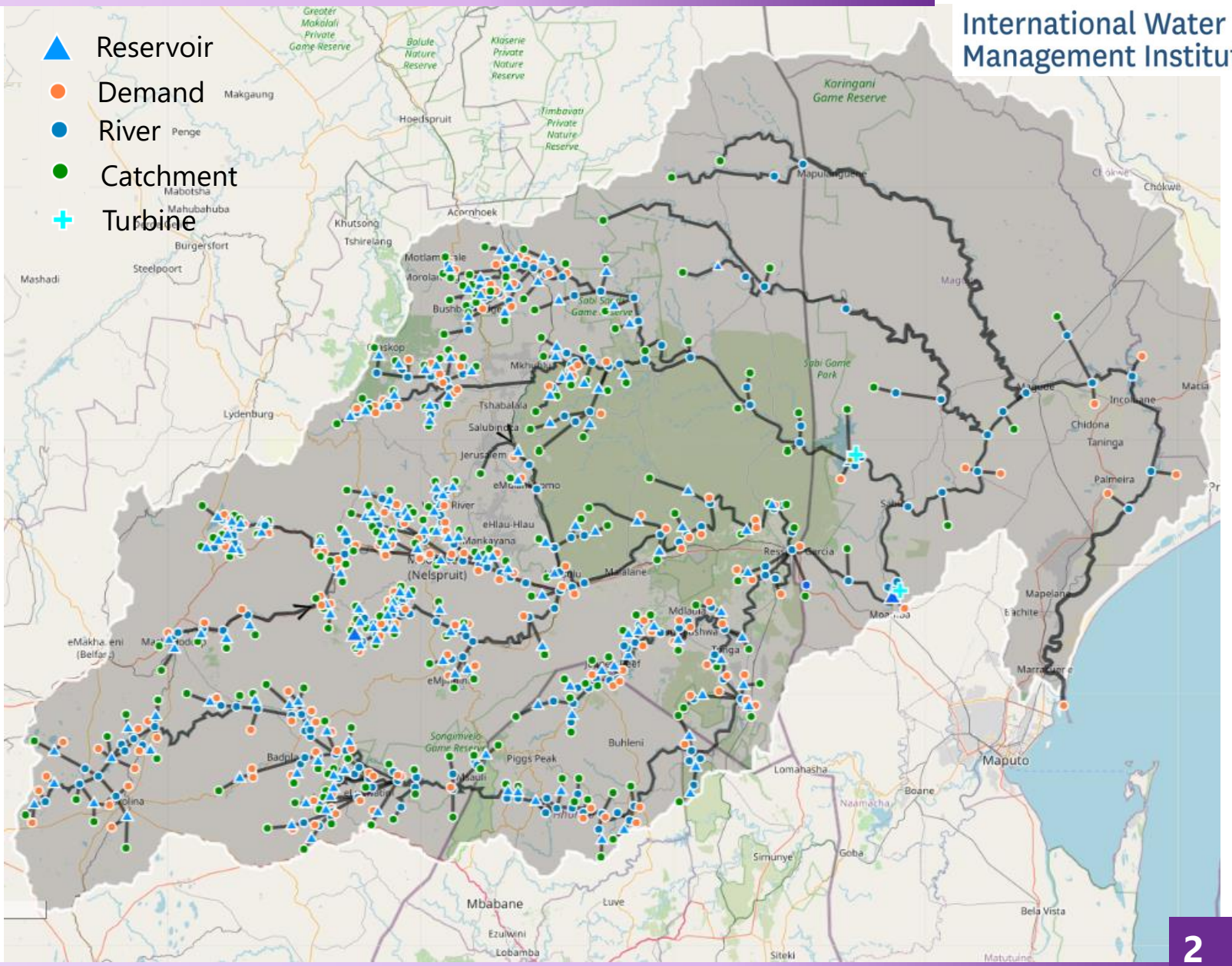
Model description

Description	
South Africa, Eswatini and Mozambique Timestep: Monthly Simulation period: 1960 - 2009 (50 years)	
River Inflows	215
Reservoirs	172
River reaches, and basin transfer links	254
Irrigation locations	41
Domestic water demand Industrial water demand	129
Total	811



Water demand and assurance levels

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- Water abstractions with high-assurance level:
  - Domestic and Industrial abstractions

- Water abstractions with low-assurance level:
  - Hydropower
  - Irrigation
  - Exotic plant species

- Irrigation water demand computed with FAO 56 method

Model showcase on WaterStrategy.org

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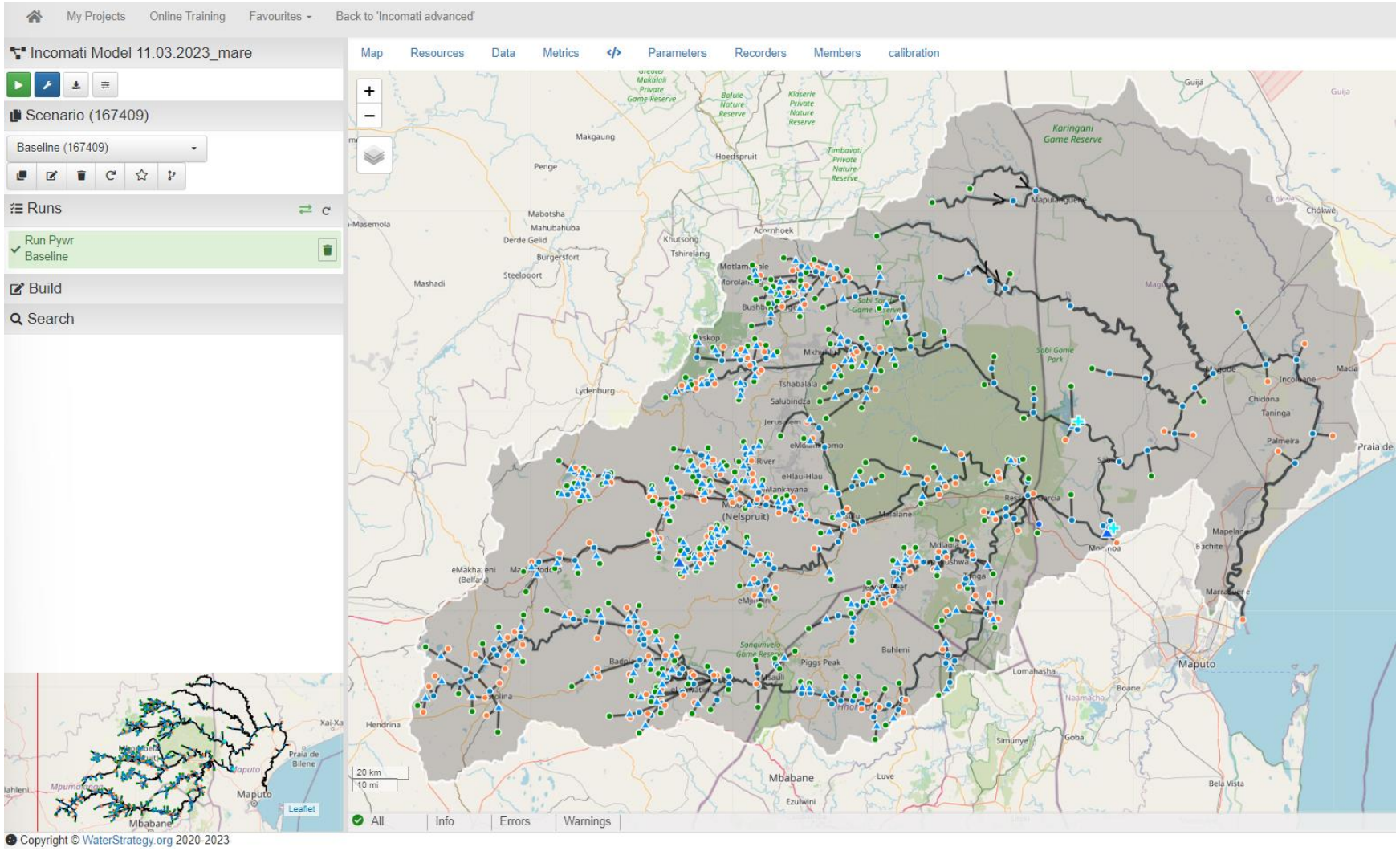
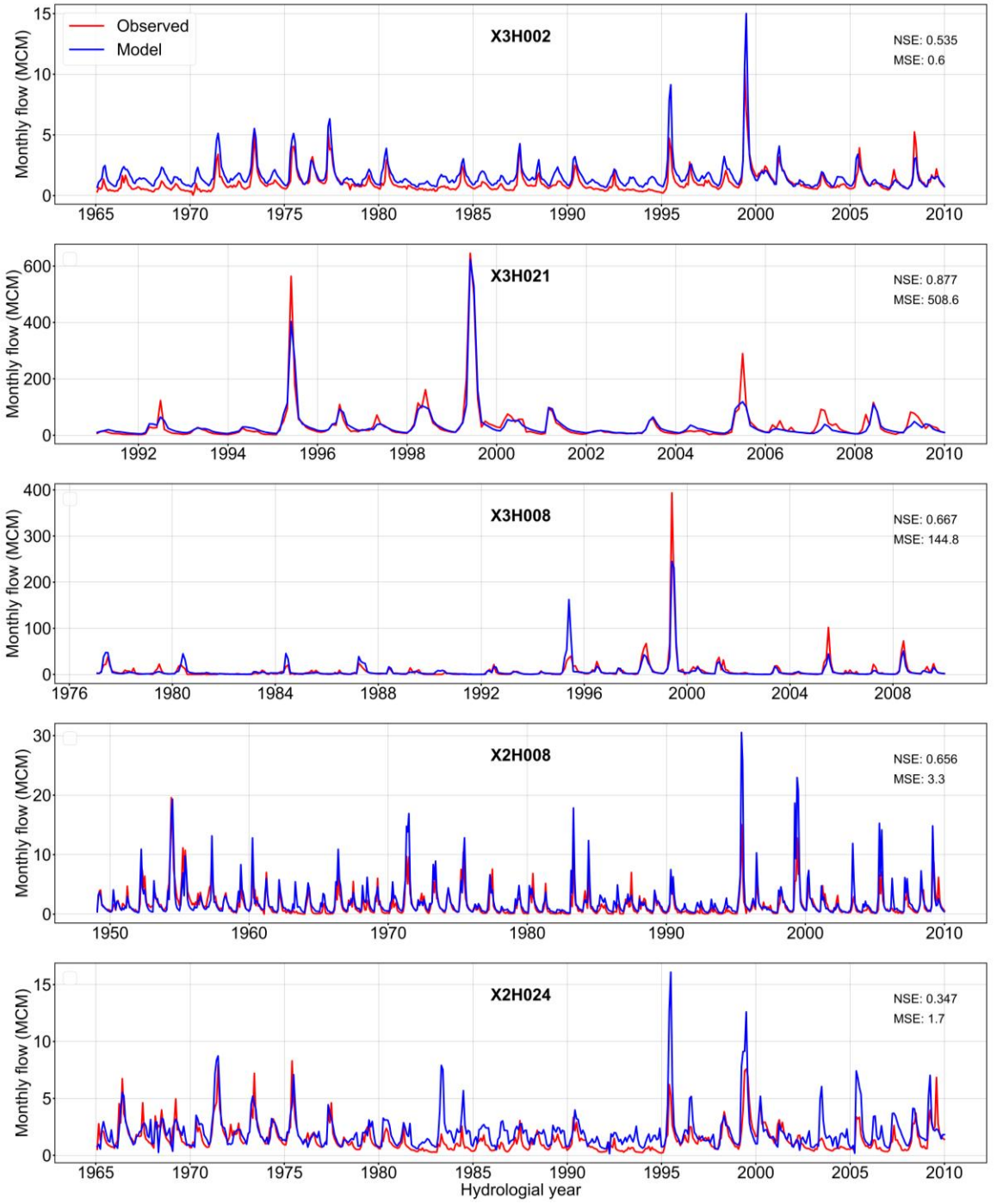
- Models runs online.
- Easy-to-use graphical user interface and result visualization.
- Collaborate within teams and with decision-makers and stakeholders in a controlled way.
- Easy model sharing
- Multiple users can interact with the same model.



Model calibration and performance

- Model calibration:
  - Calibrated and validated at 14 locations, with calibration before 1996 and validation from 1996 onward.
- Calibration parameters:
  - Reservoir operating rules

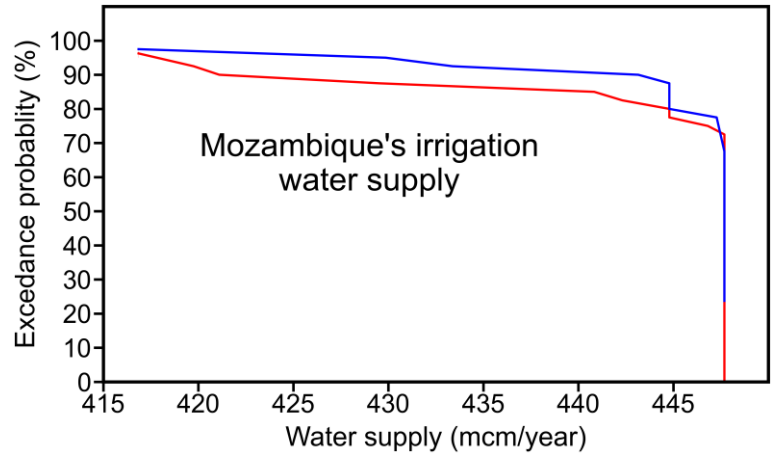


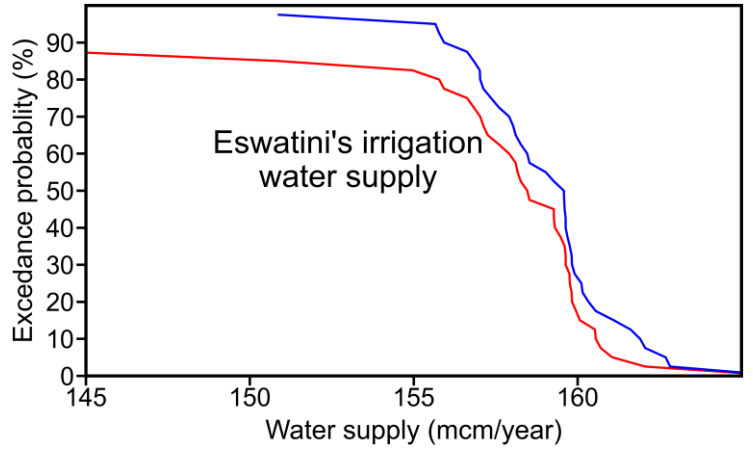
Ongoing Investigations

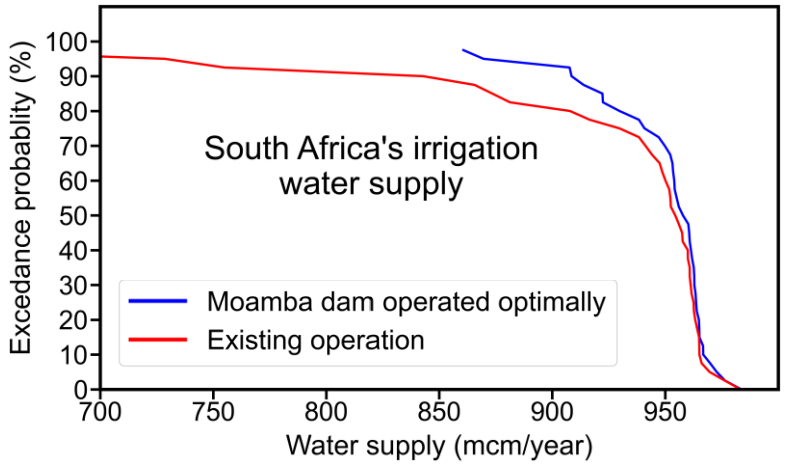
Investigation one: If Moamba dam (Mozambique) is constructed & operated optimally and in coordination, what are the impact on water demands in different sectors?

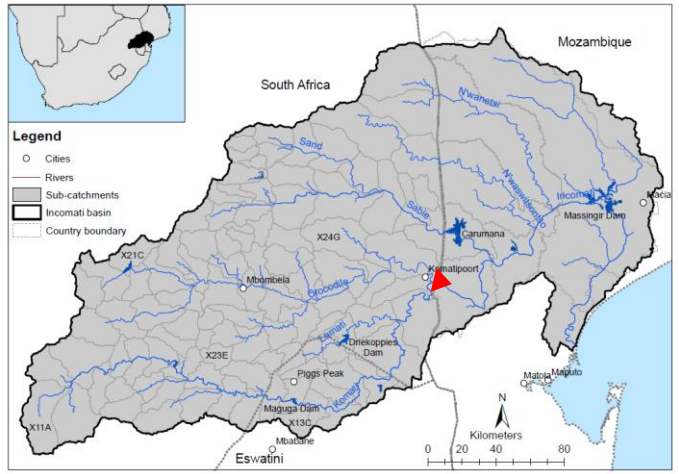
Interpretation

- Through the optimized operation of the Moamba Major Dam, Mozambique can meet a yearly demand with higher assurance
- Low assurance demands such as irrigation are highly impacted with existing reservoir operation



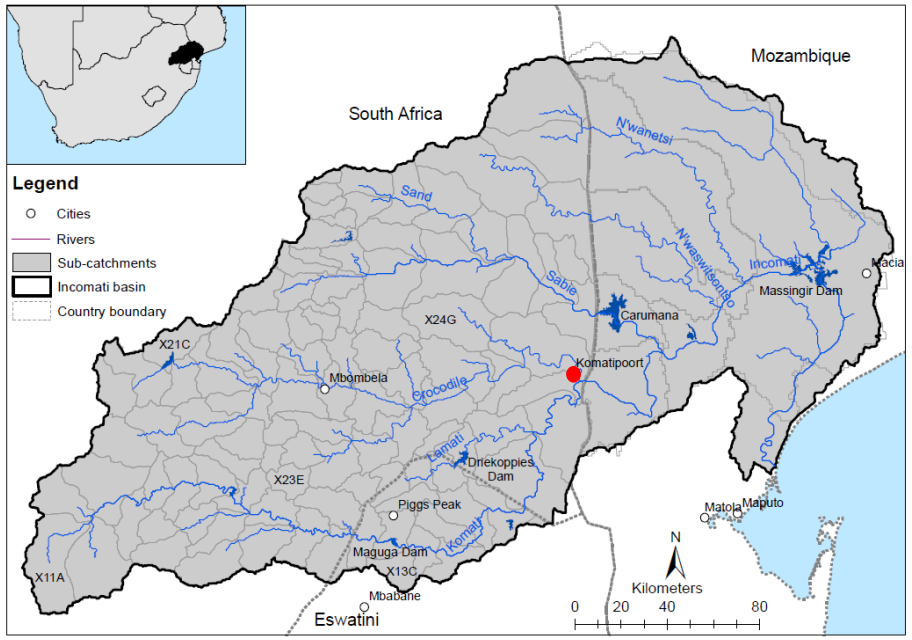






Ongoing Investigations

Investigation two: What are the additional benefits & risks that can be accrued by increasing the minimum transboundary flow requirement?



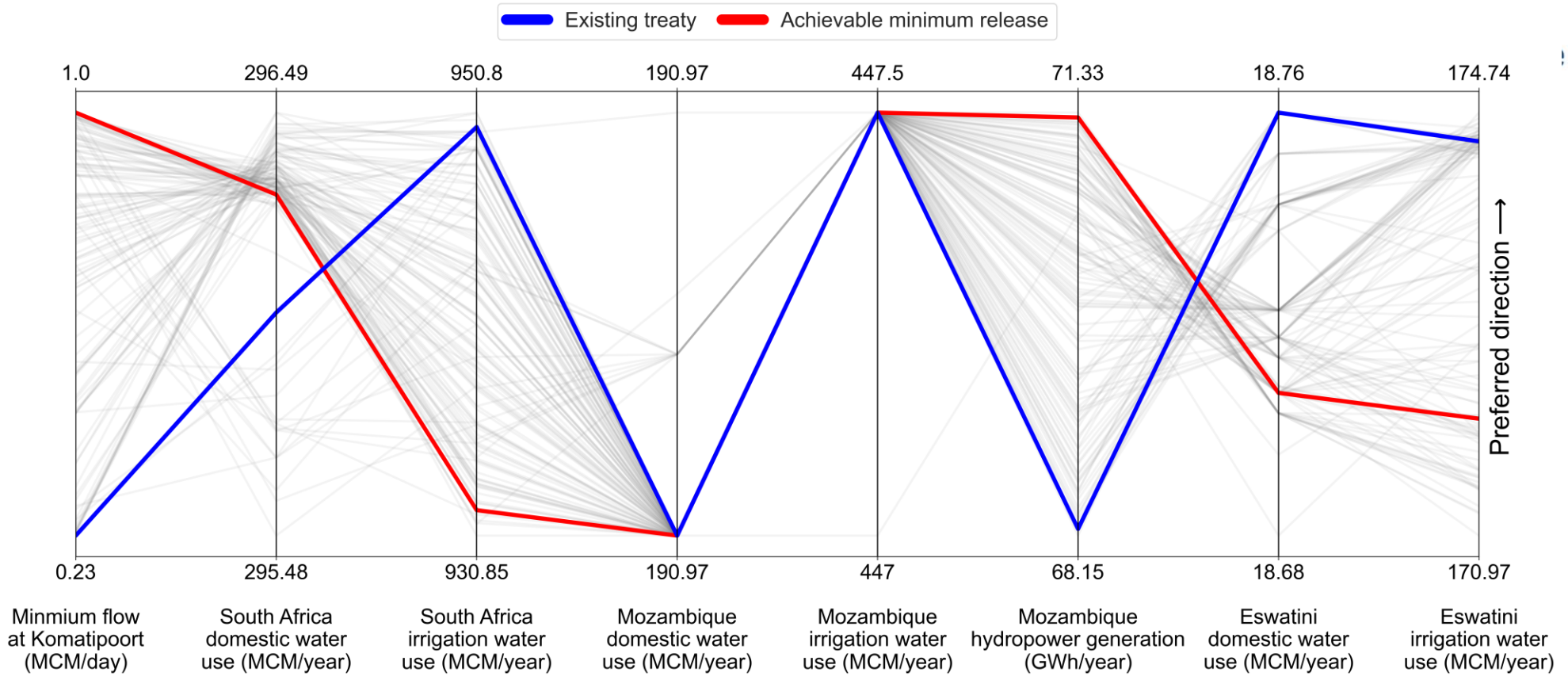
Optimization objectives

Objective	Minimise/Maximise
South Africa's aggregated domestic water	Maximise
Eswatini's aggregated domestic water supply	Maximise
Mozambique's aggregated domestic water supply	Maximise
South Africa's aggregated irrigation water supply	Maximise
Eswatini's aggregated irrigation water supply	Maximise
Mozambique's aggregated irrigation water supply	Maximise
Mozambique's aggregated hydropower generation	Maximise

Optimization variables

- Operating rules of major reservoirs
- Minimum daily release at Komatipoort (from 0.22 to 1 MCM/day)

Investigation two (con't)



Interpretation

- Increasing the minimum release at Komatipoort (i.e., the border) impacts irrigation water supply in upstream counters but enables increase in irrigation & hydropower generation in Mozambique.
- Mozambique domestic water supply remains met
- Model presents array of options for member countries to choose optimal solution (for them)

Investigation two (con't)

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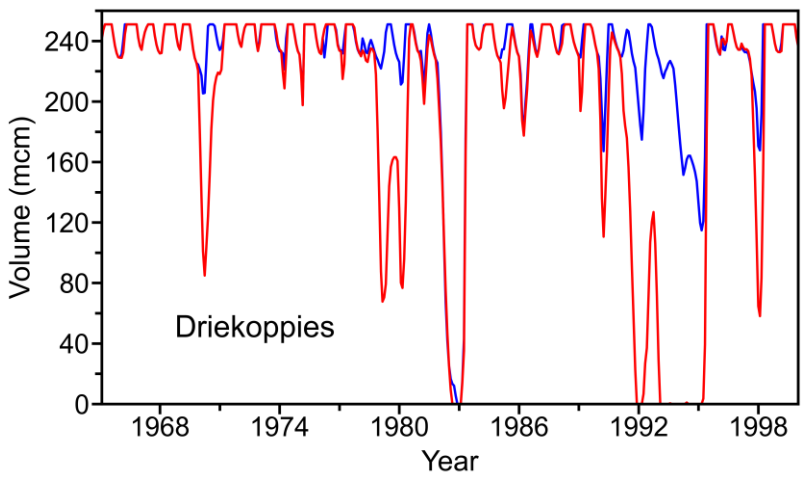
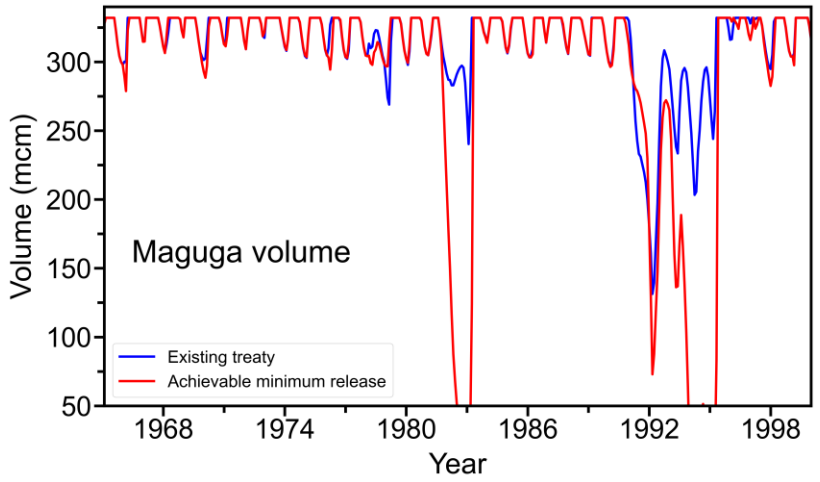
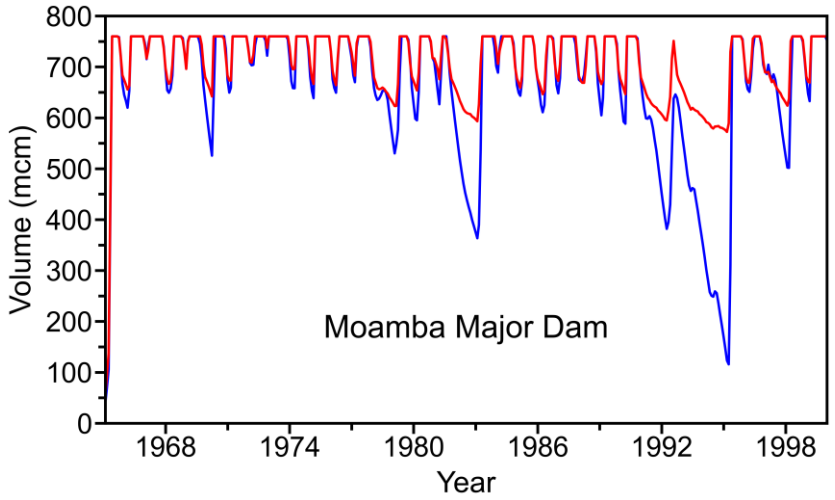
Interpretation

- Impact during drought years on water supply of upstream countries need to be considered
- Lower in water levels of Corumana and Maguga reduces hydropower generation
- Long term impact on minimum environmental river flow need to be considered

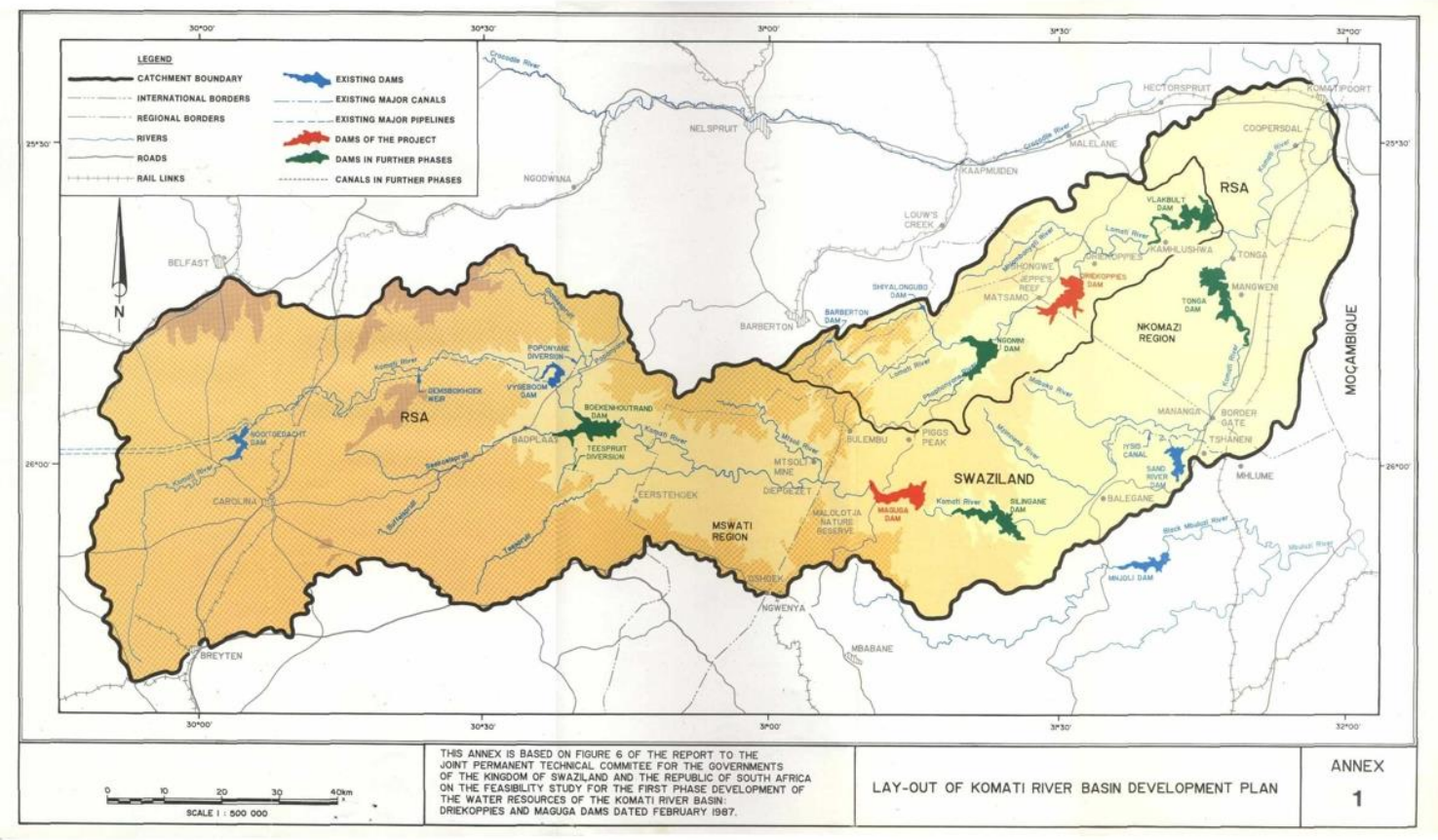






Conclusions

- Potential to enhance WEFE benefits can be realized through coordinated reservoir operation rules & revisiting minimum flow allocation.
- Future agreement on the minimum daily flow at Komatipoort (i.e, the border) should consider the implications of the WEFE of the riparian countries.
- Regular re-evaluation of transboundary flow allocation considering changes in water demands and future development may be beneficial.
- Understanding the impact of climate change may strengthen future water allocation and agreements.



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Thanks!

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