AESABESP, São Paulo, 06/08/2015

Impactos de Eventos Climáticos nos Recursos Hídricos Para o Desenvolvimento Econômico

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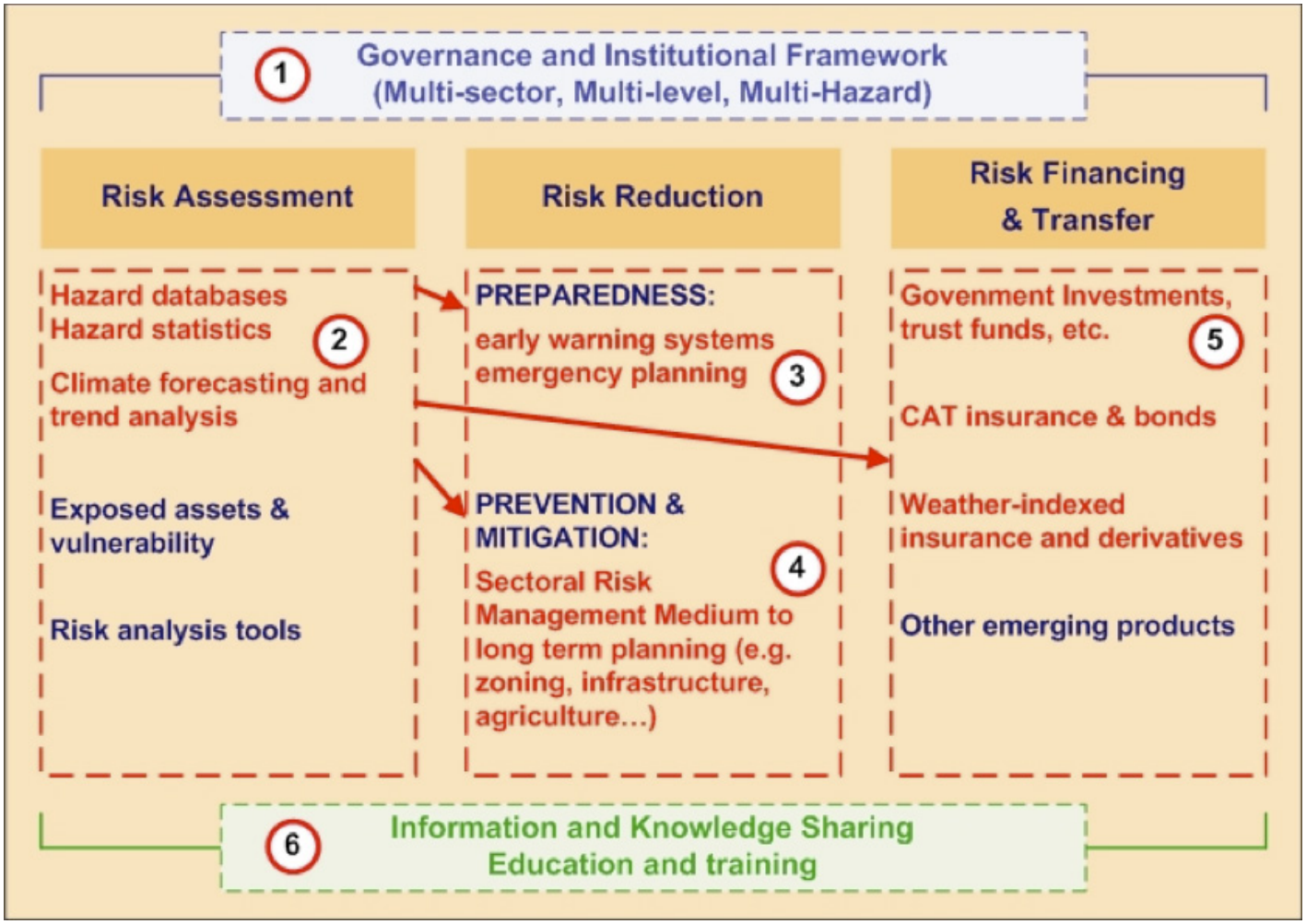
Cemaden
Centro Nacional de Monitoramento e Alertas de Desastres Naturais

Elements of Comprehensive Governance and Policy for Disaster Risk Reduction based on Hyogo's and Sendai's Framework for Action 2005-2030



Sendai Framework for Disaster Risk Reduction 2015-2030

Promote the mainstreaming of disaster risk assessments into land-use policy development and implementation, including urban planning, land degradation assessments and informal and non-permanent housing, and the use of guidelines and follow-up tools informed by anticipated demographic and environmental changes

FOUR PRIORTIES

1) Understand Disaster Risk
2) 2) Strengthen Disaster Risk Governance to Manage Disaster Risk
3) 3) Invest in Disaster Risk Reduction for Resilience
4) Invest in Disaster Preparedness to Enhance Response

Sendai Framework for Disaster Risk Reduction 2015-2030

Promote the mainstreaming of disaster risk assessment, mapping and management into rural development planning and management of mountains, rivers, coastal flood plain areas, drylands, wetlands and all other areas prone to droughts and flooding

RESILIENCE ENHANCEMENT

- Anticipatory Preparedness
- Timely Adoption and Implementation of Modern Engineering Building Codes & Standards
- Timely Early Warning and Evacuation
- Timely Emergency Response (including Emergency Medical Services)
- Timely Vulnerability Reduction

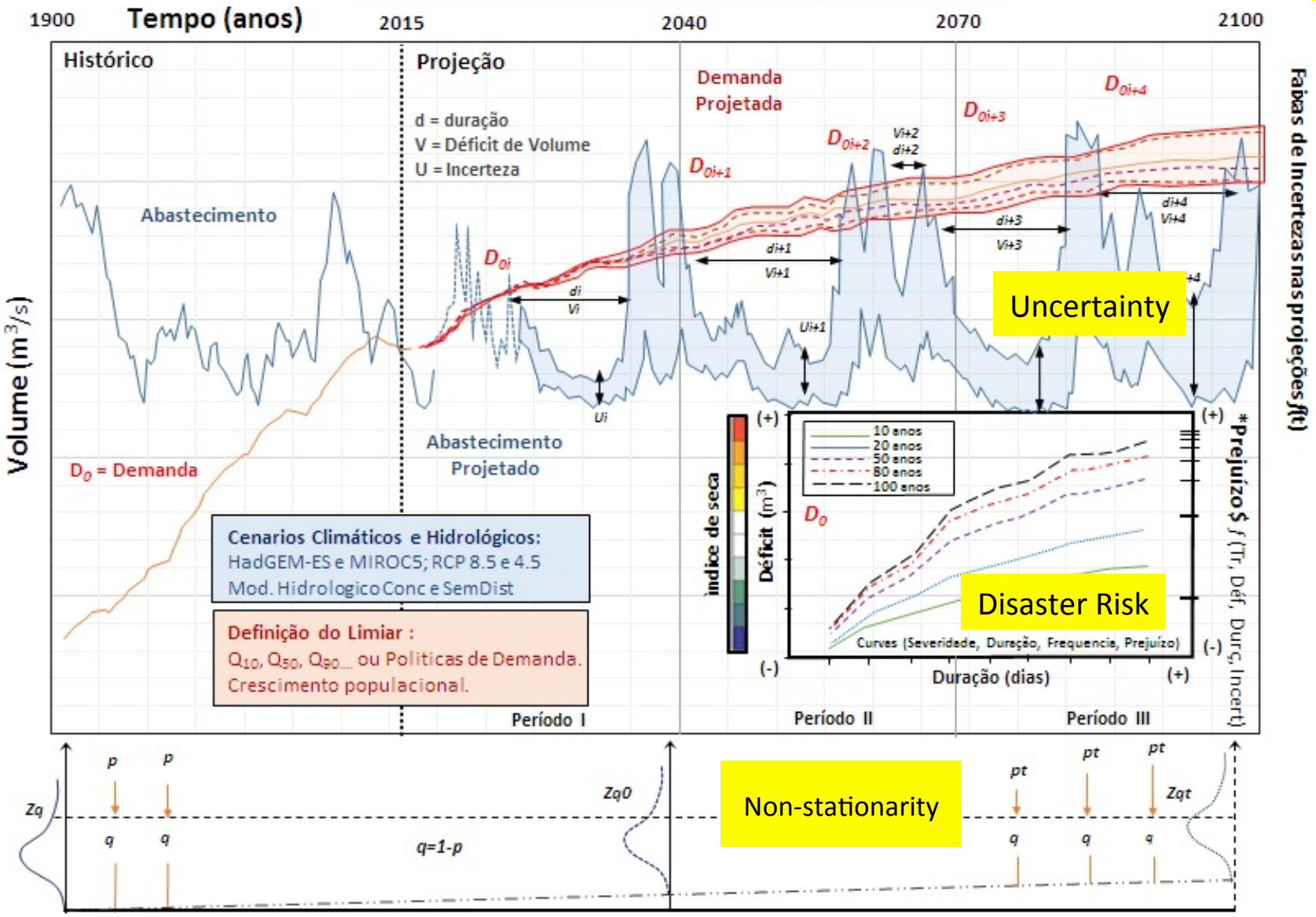
Monitoring & Early Warning at CEMADEN

- Started in December, 2011
- 24-h, 365-day a year monitoring
- Early warning reports on landslides, mudslides, floods, floodings, flashfloods and severe drought impacts in Semi Arid Region
- >**753** municipalities monitored

Multidisciplinary Team:

- Geologists
- Geographers
- Engineers
- Hydrologists
- Meteorologists
- IT professionals

Examples of Uncertainty, non-stationarity and disaster risks



Guzmán-Arias, D. A. (2015) **Avaliação das incertezas na implementação de modelos de seguros e índices de secas sobre hipóteses de não estacionariedade, como estratégias para a gestão dos impactos das mudanças climáticas, PPG-SHS/EESC-USP, Sao Carlos-SP, Brasil**

Examples of uncertainty of measured Examples of uncertainty of measured flows at challenging biomes, scales

Amazonas River at Obidos Station
Catchment scale ≈ a·10^6 km^2

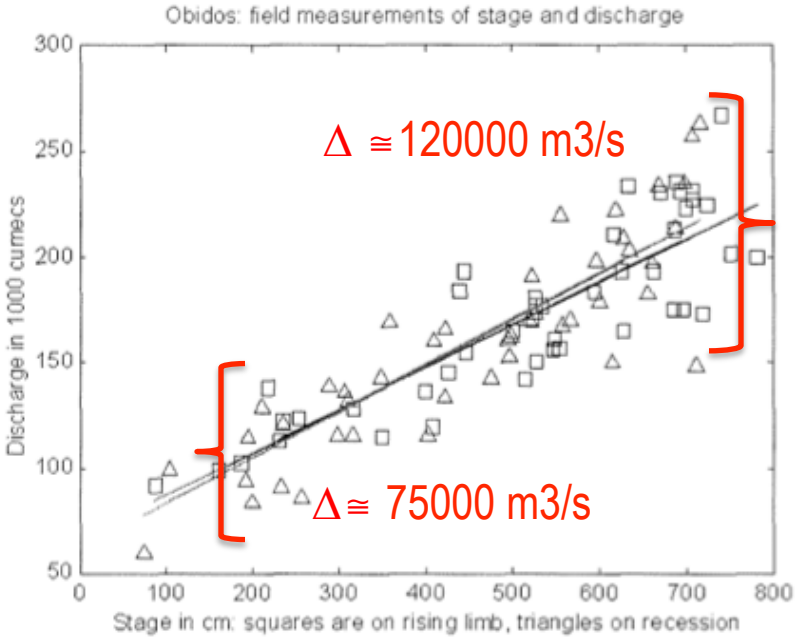
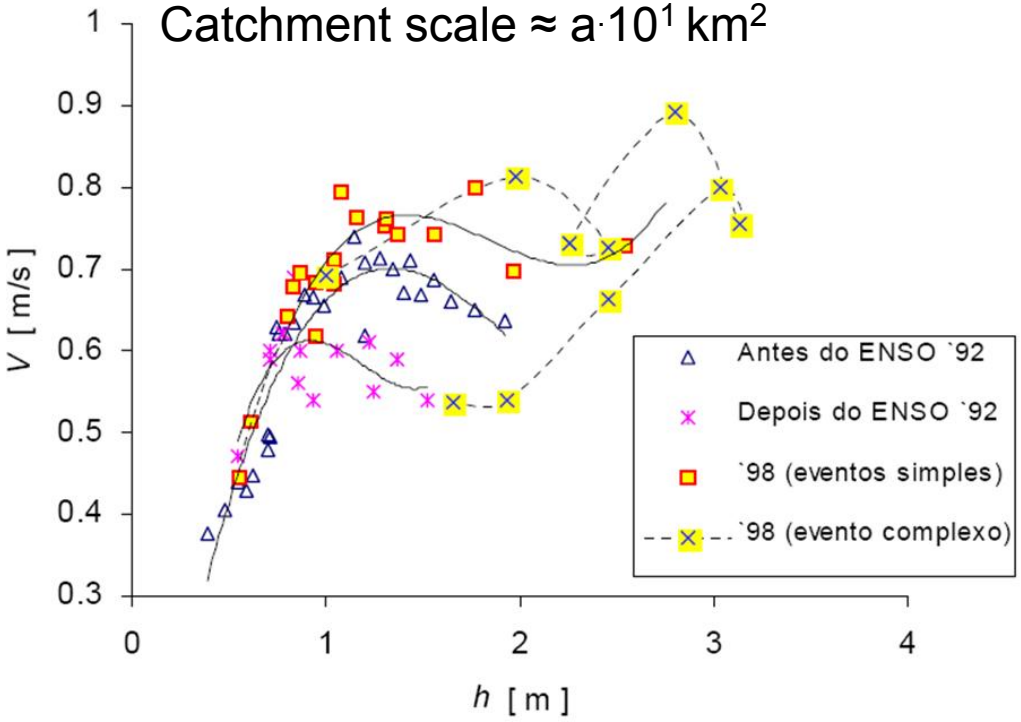


Fig. 2 Plot of measured stage (cm) and discharge (10^3 m^3 s^{-1}) for calculating a rating curve for the River Amazonas at Obidos. Squares are data collected on hydrograph rising limb; triangles are data collected in recession periods. The two lines are linear regressions fitted to the two sets of data.

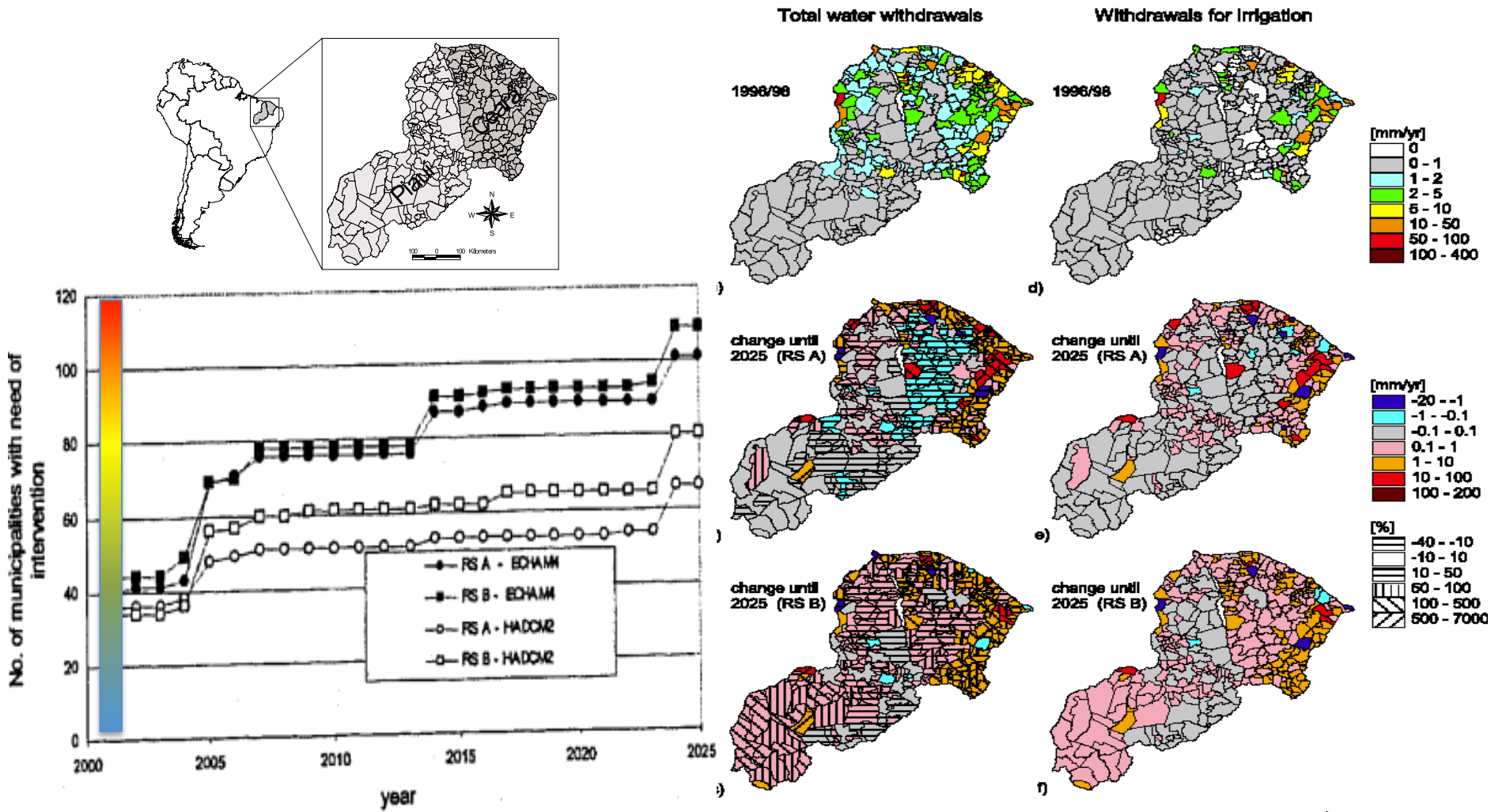
Source: Clarke, Mendiondo & Brusa (2000)

Turcato Catchment at downstream section of urban-to-rural land-use
Catchment scale ≈ a·10^1 km^2



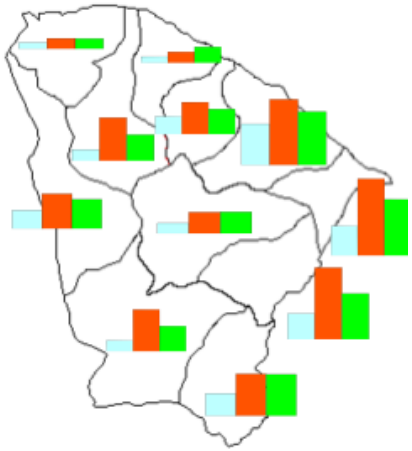
Source: Mendiondo (2001)

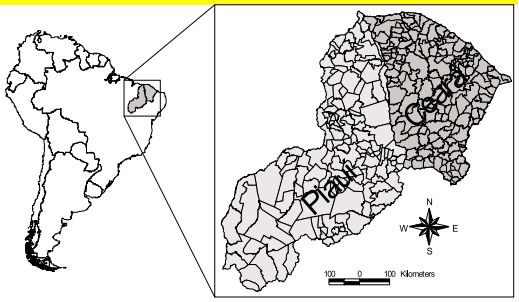
Strategy 1: Decision Making under Uncertainty of Regional Impacts from Global Changes

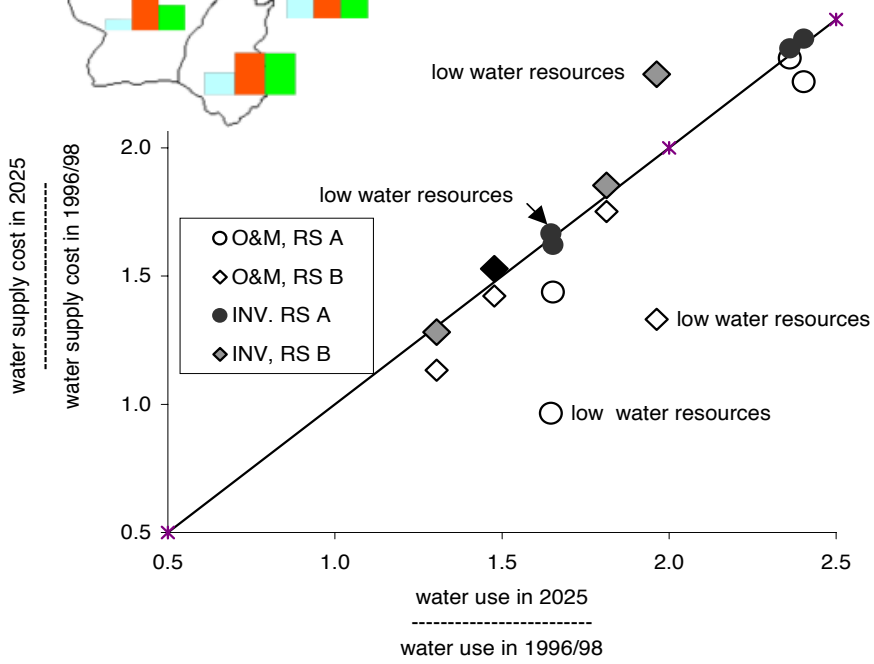


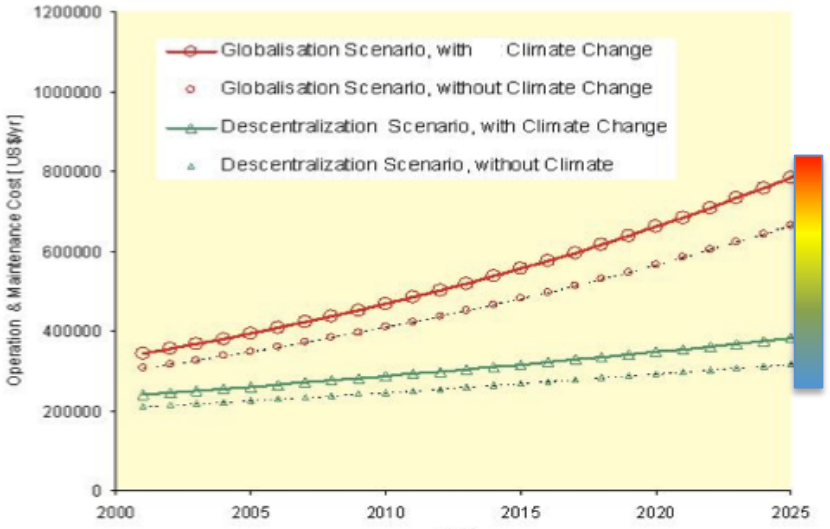
Left: number of municipalities under water droughts in Northeast Brazil. Right: scenarios of change of water withdrawal (1996/98 to 2025) ll figures are related to regional planning scenarios (RS-A, globalization and "cash-crops", RS-B, descentralization through agropoles) and climate change models (ECHAM4 and HadCM2). Sources: Araujo ET AL (2004) and WAVES/BMBF Report (2001)

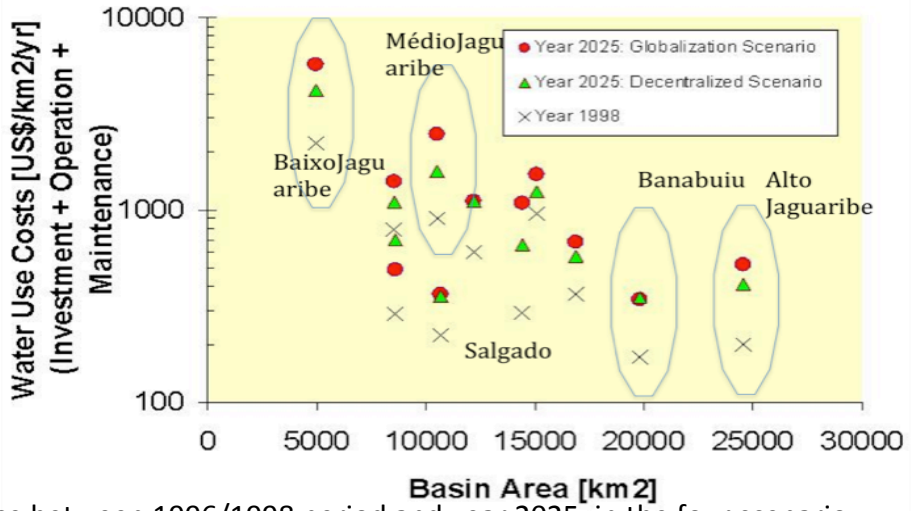
Strategy 1: Decision Making under Uncertainty of Regional Impacts from Global Changes





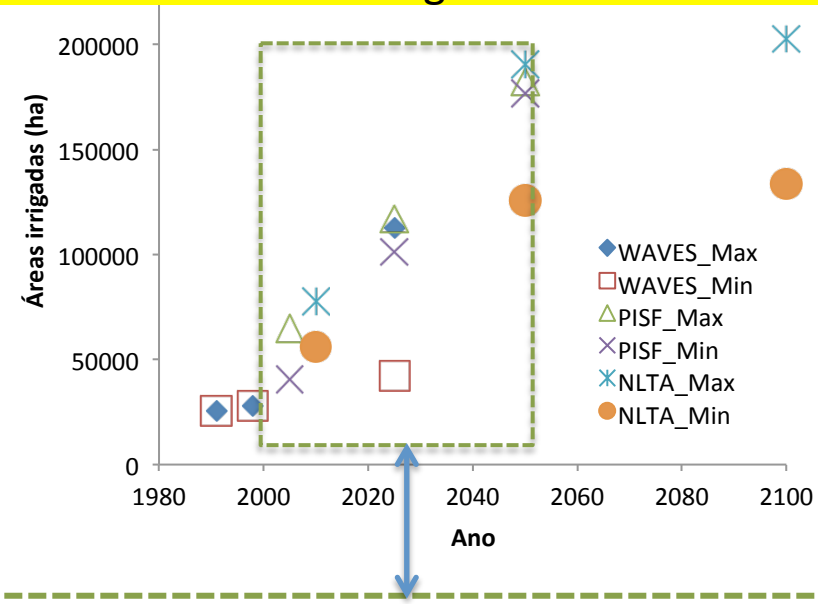


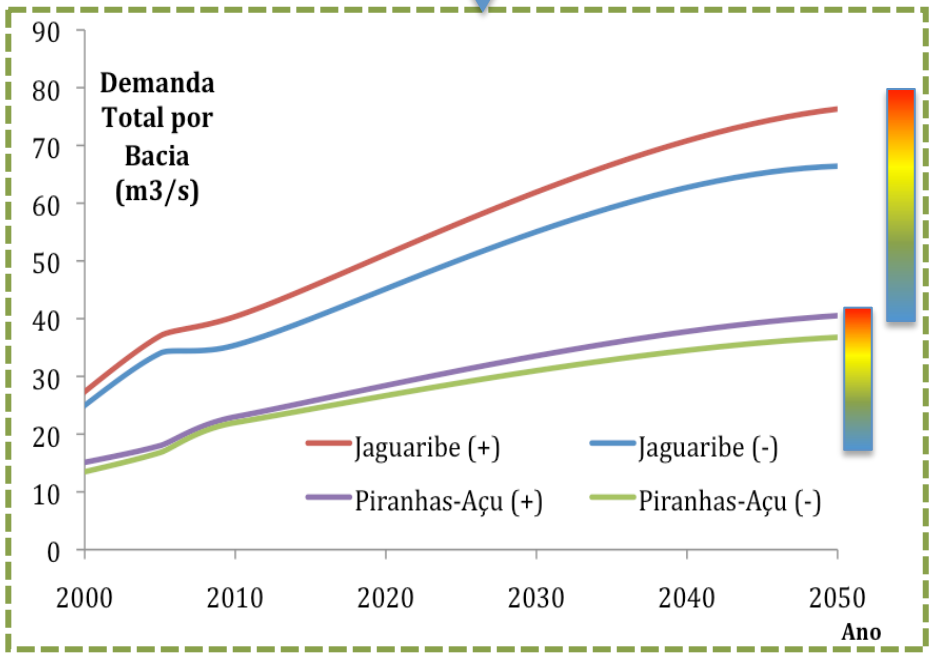


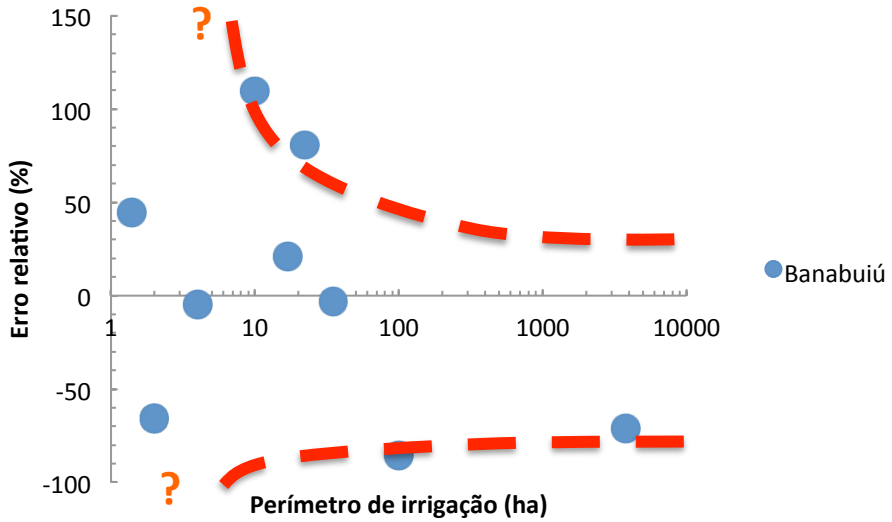


Left: Changes of water supply costs as compared to changes in water use between 1996/1998 period and year 2025, in the four scenario regions of water scarcity region, Ceara State, Brazil. Source: Döll et al (2001) **Upper right**: Operation and Maintenance Costs (period 2000-2025) in Jaguaribe River Basin under scenarios of climate change and drought management. Source: Mendiondo & Valdés (2002). **Lower Right:** Regionalization of specific, spatial-based O&M and Investment costs of water demand for two reference scenarios under drought management until year 2025, depicting results for Jaguaribe sub-basins. Source: adapted from Mendiondo & Valdés (2002).

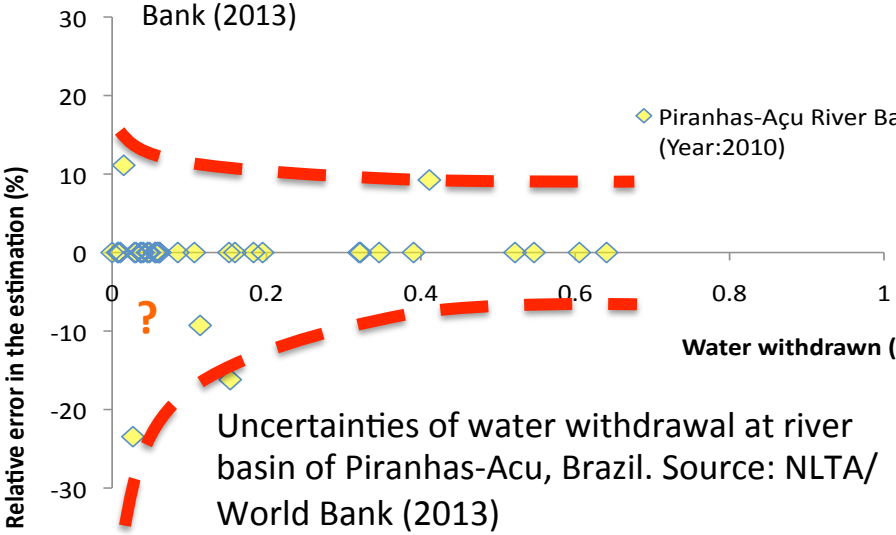
Strategy 1: Decision Making under Uncertainty of Regional Impacts from Global Changes





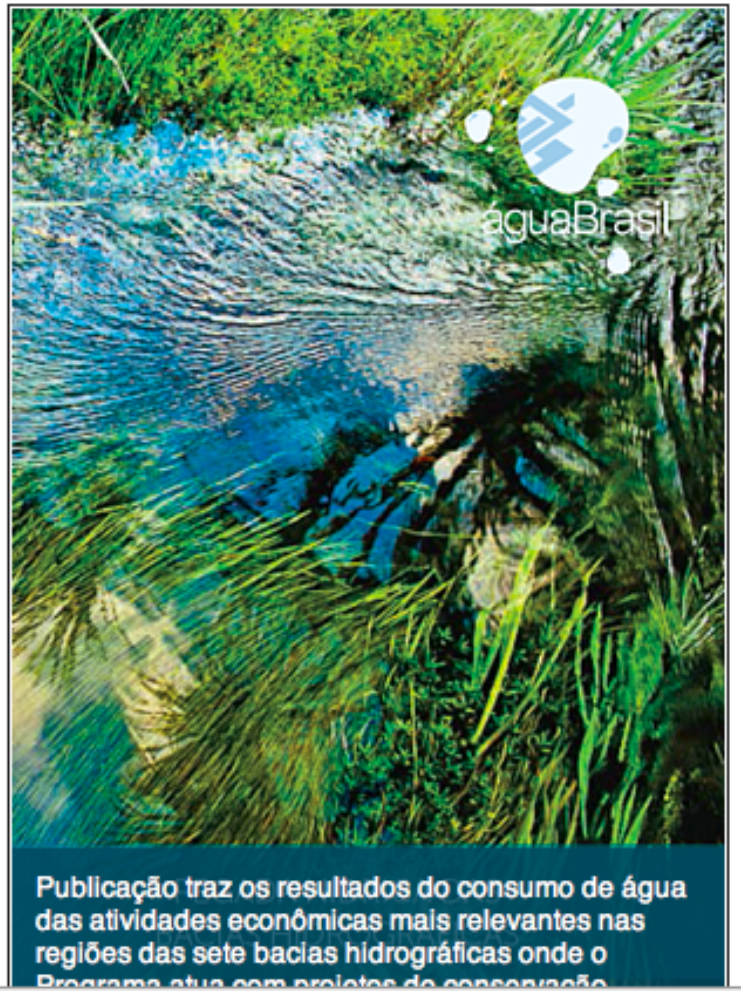


Exemplo de incertezas (coeficiente de variação, em %) das demandas de irrigação para o diagnóstico (ano 2010) em função do tamanho do perímetro de irrigação. Fonte: Bacia do Jaguaribe, CNARH e COGERH (com. Pessoal) & NLTA/World Bank (2013)

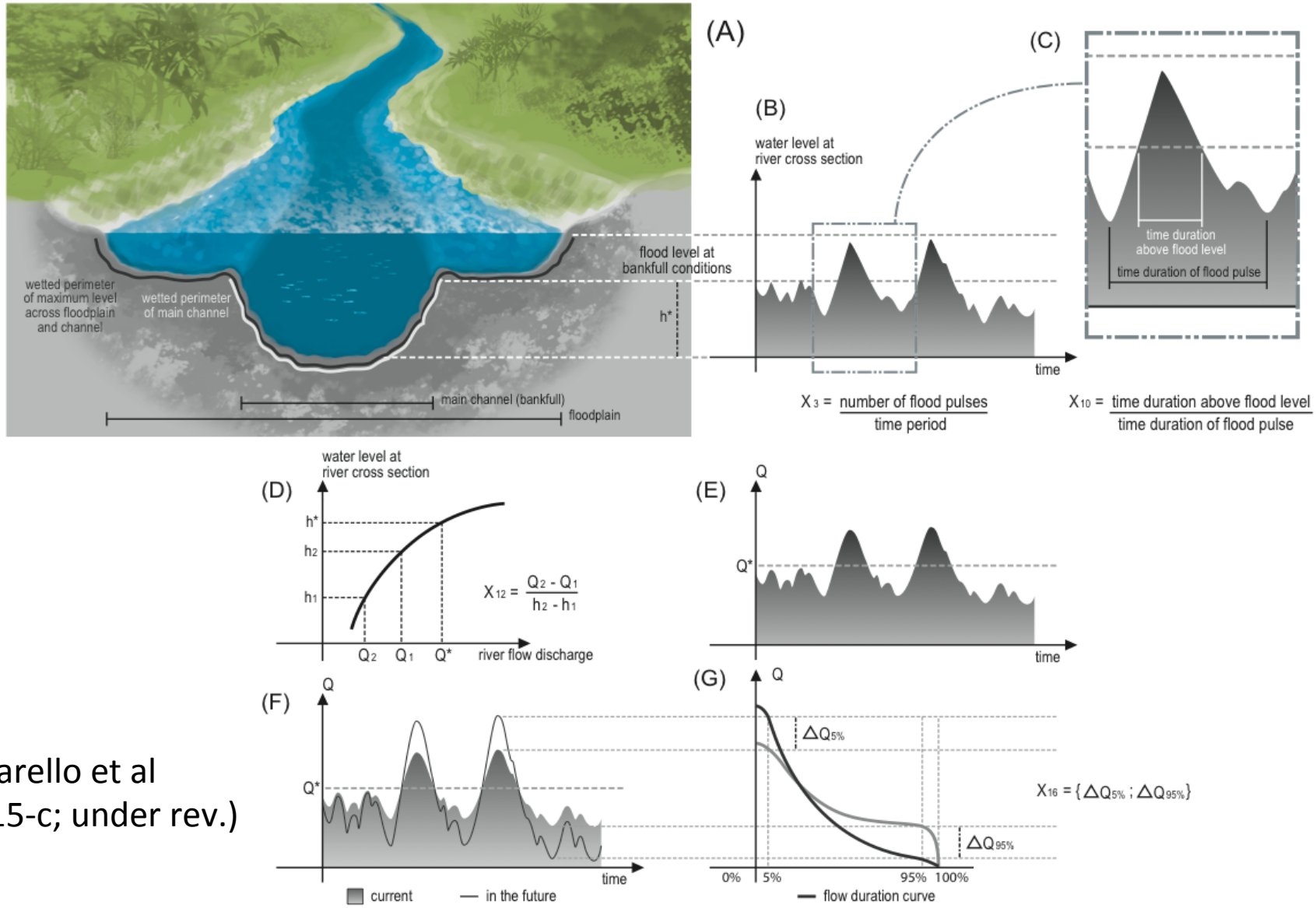


Uncertainties of water withdrawal at river basin of Piranhas-Acu, Brazil. Source: NLTA/ World Bank (2013)

Strategy 2:
Ecosystem-based Adaptation (EbA) through Payment for Ecosystem Services & Ecohydrological Restoration



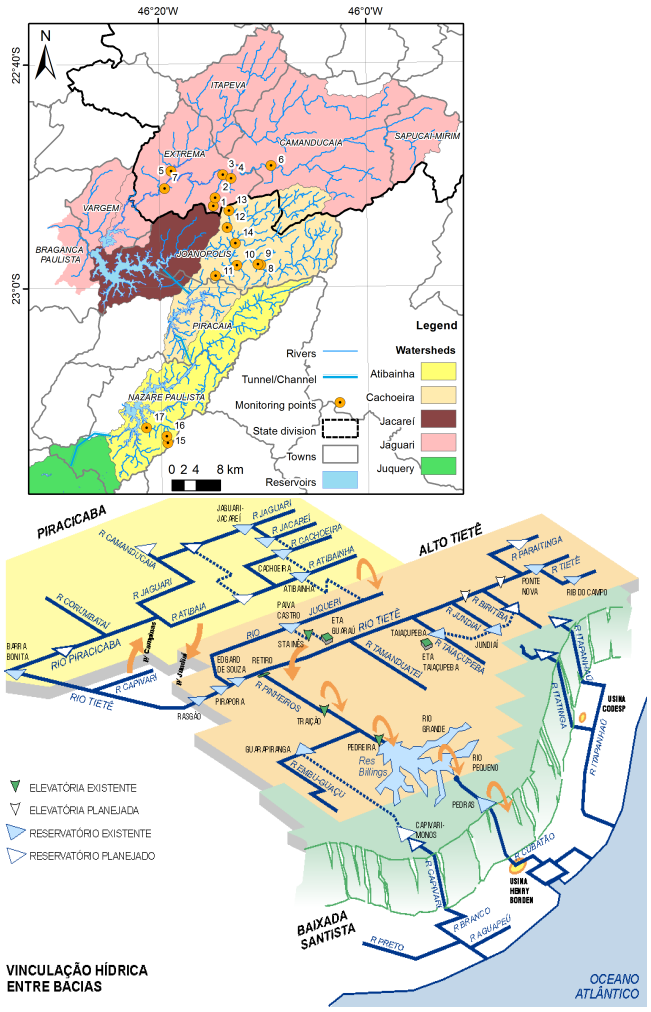
Strategy 2:
Ecosystem-based Adaptation (EbA) through Payment for Ecosystem Services (PES) & Ecohydrological Restoration



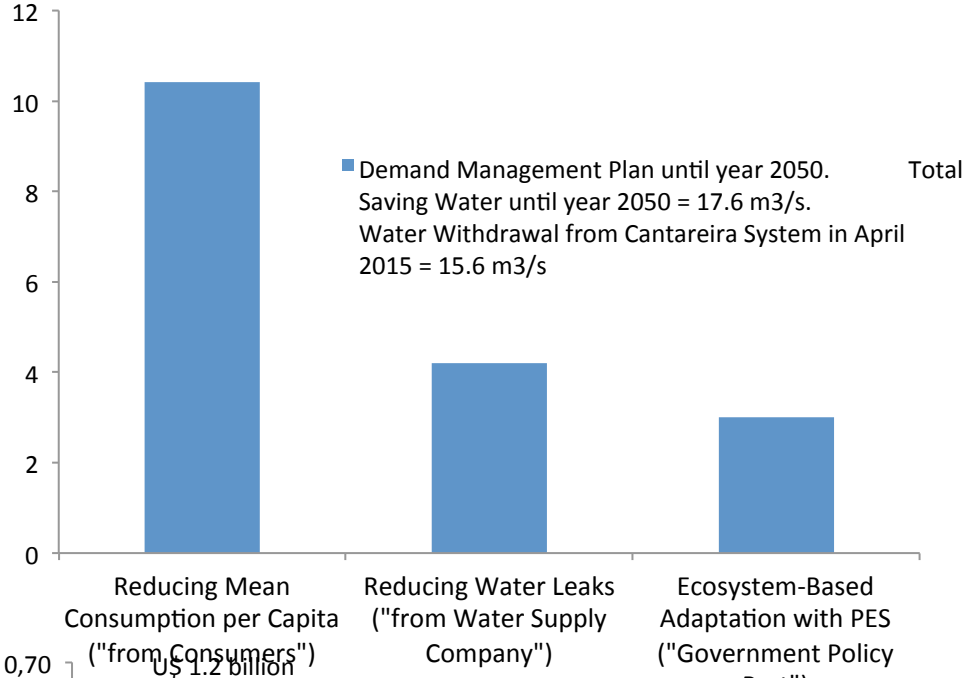
Taffarello et al (2015-c; under rev.)

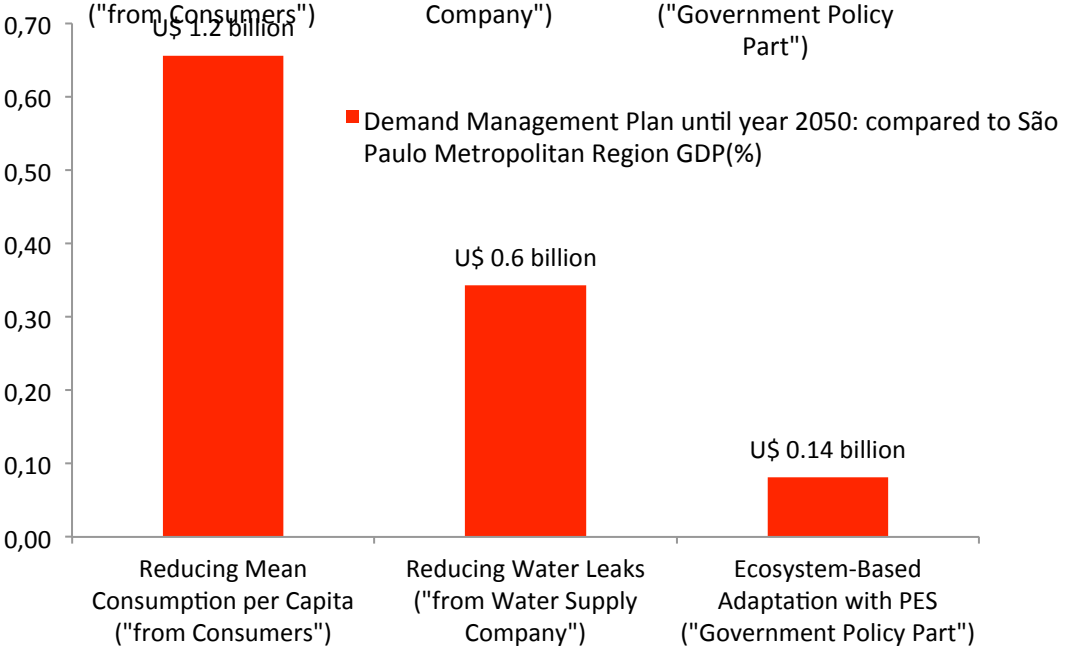
Piracicaba River Basin (MG/SP, Brazil)

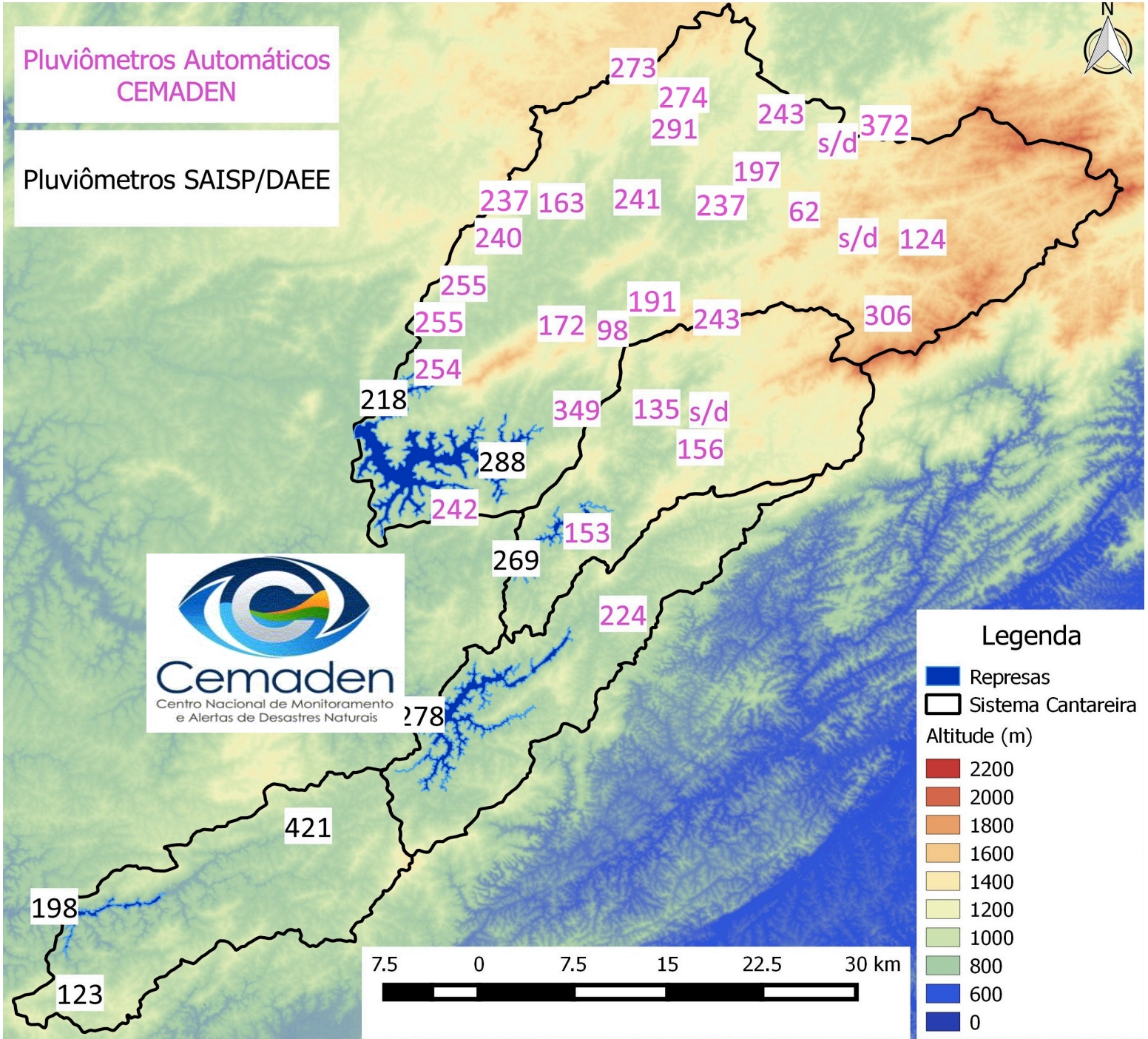
Strategy 3: Demand Management using a Composite Private-Public Partnership through Adaptation on Consumption, Technology and Ecosystem Conservation (with monitoring)



VINCULAÇÃO HÍDRICA ENTRE BACIAS






Pluviômetros Automáticos CEMADEN
Pluviômetros SAISP/DAEE
273
274
291
243
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s/d
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163
241
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62
240
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172
98
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306
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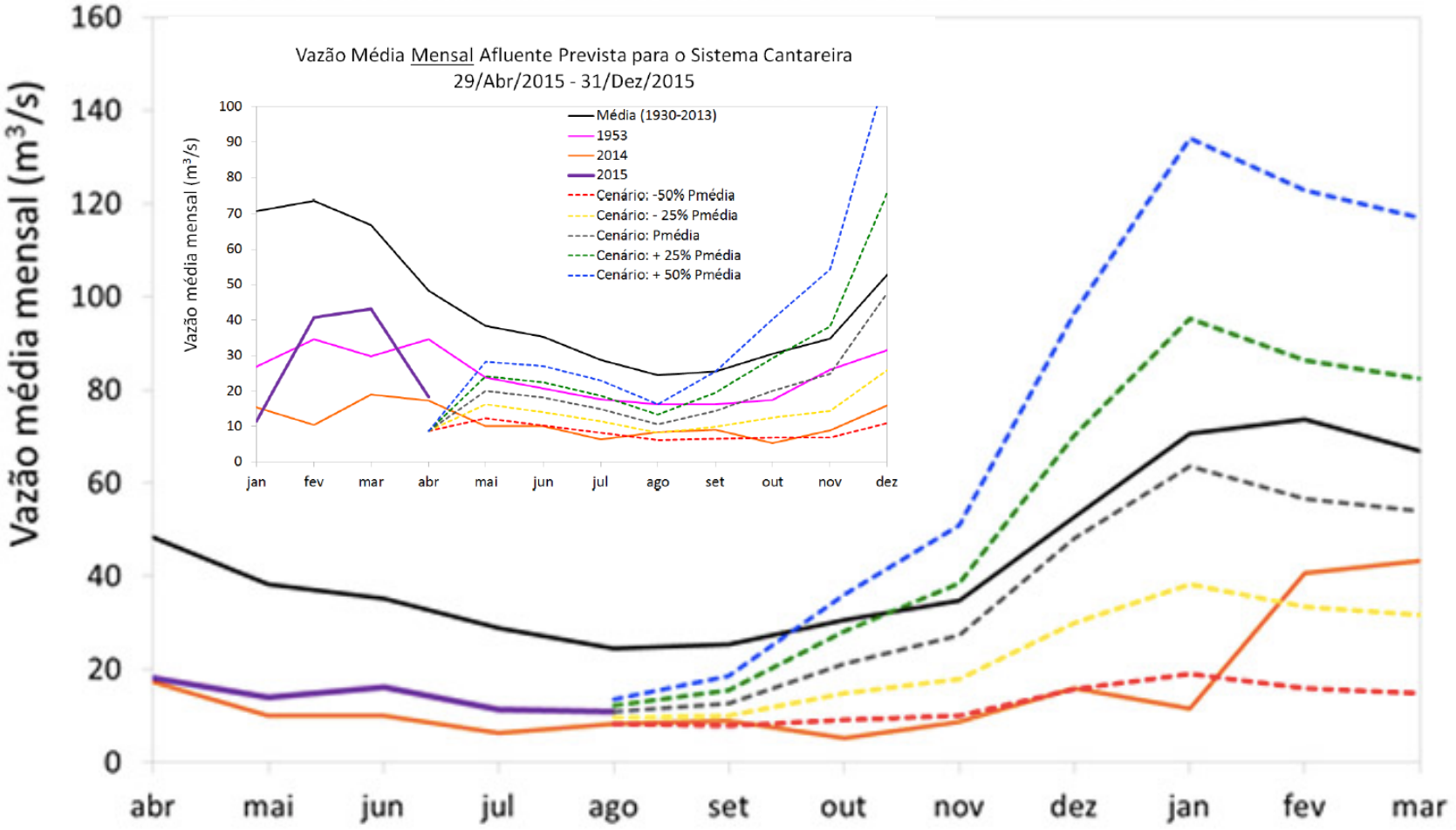
421
198
123
Cemaden
Centro Nacional de Monitoramento e Alertas de Desastres Naturais
7.5 0 7.5 15 22.5 30 km
Legenda
Represas
Sistema Cantareira
Altitude (m)
2200
2000
1800
1600
1400
1200
1000
800
600
0
N

Projeção da Vazão Média Mensal Afluente
Sistema Cantareira: 05/agosto/2015 - 31/março/2016



www.cemaden.gov.br

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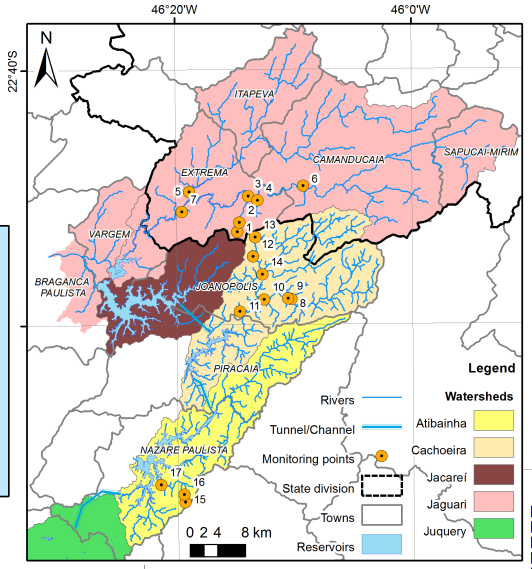
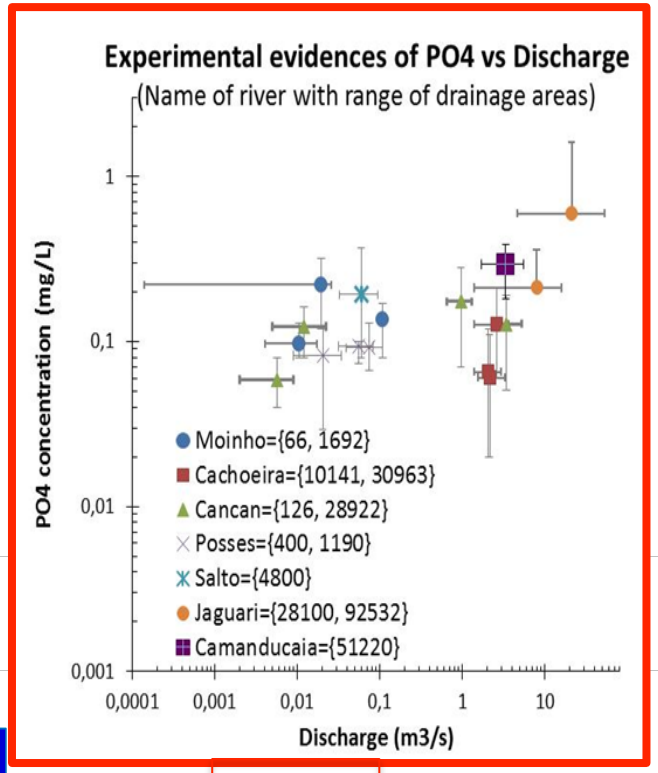
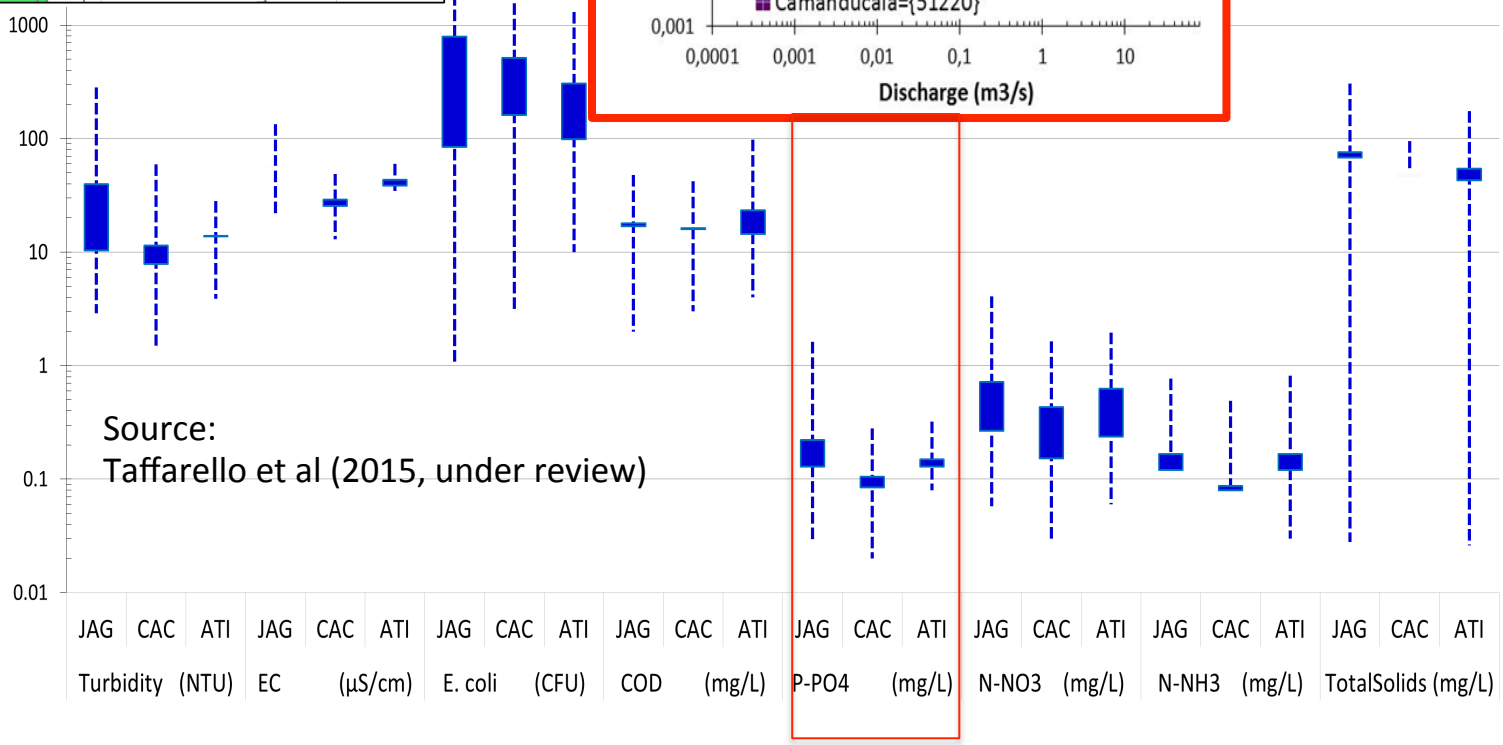
Natural uncertainty from monitoring and data





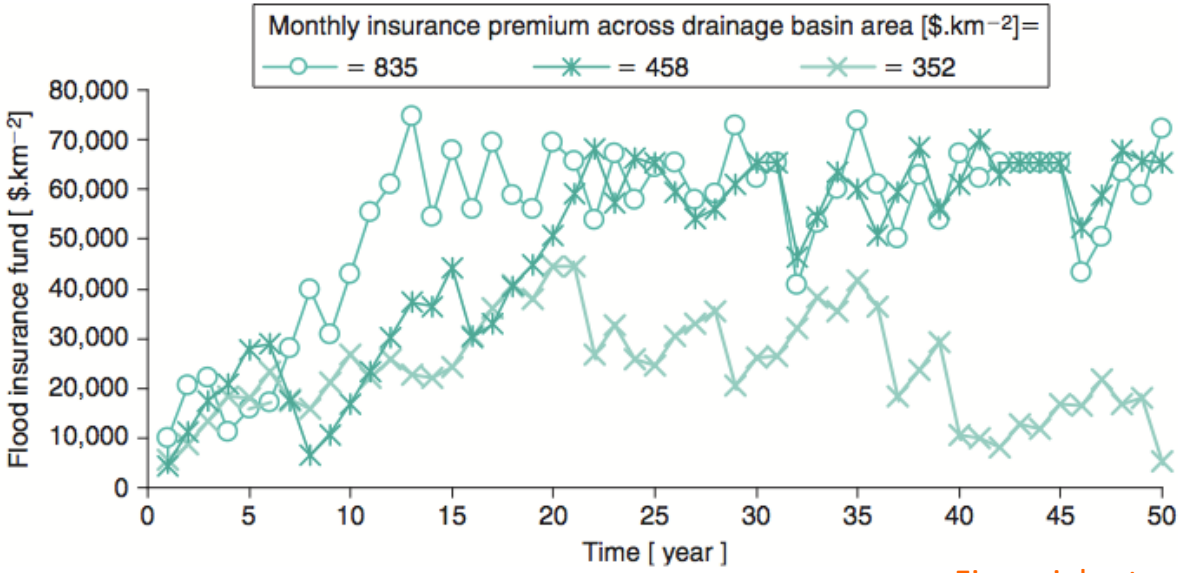


Source:
Taffarello et al (2015, under review)

UNIVERSIDADE DE SÃO PAULO
SCIENTIA VINCES

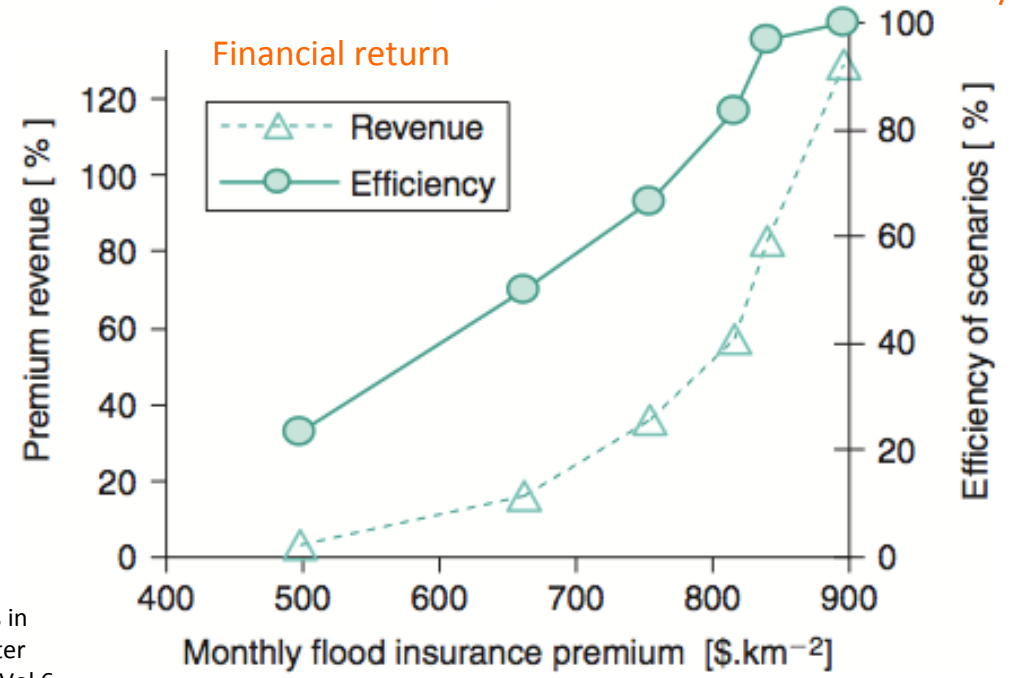
Brasil 2013
60 EESC-USP
1953 - 2013
São Carlos - SP

Strategy 4: insurance and disaster risk-transfer (floods)



Economic & sustainable solvency

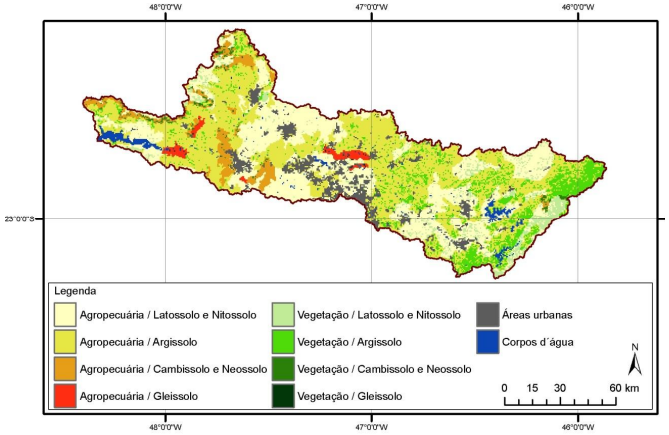
Financial return

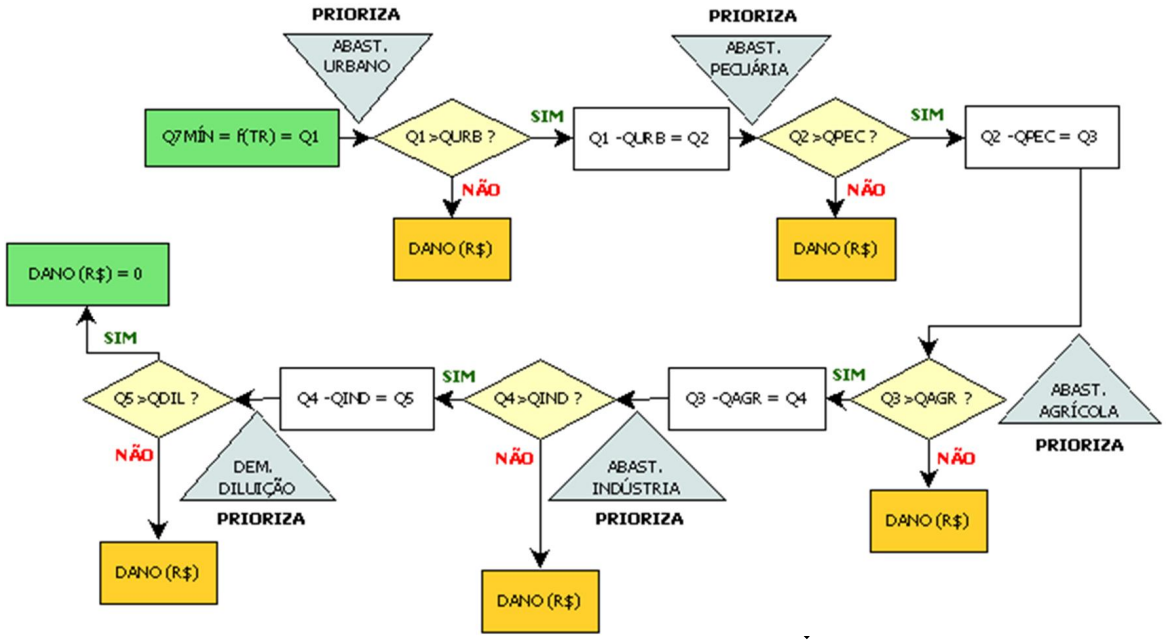


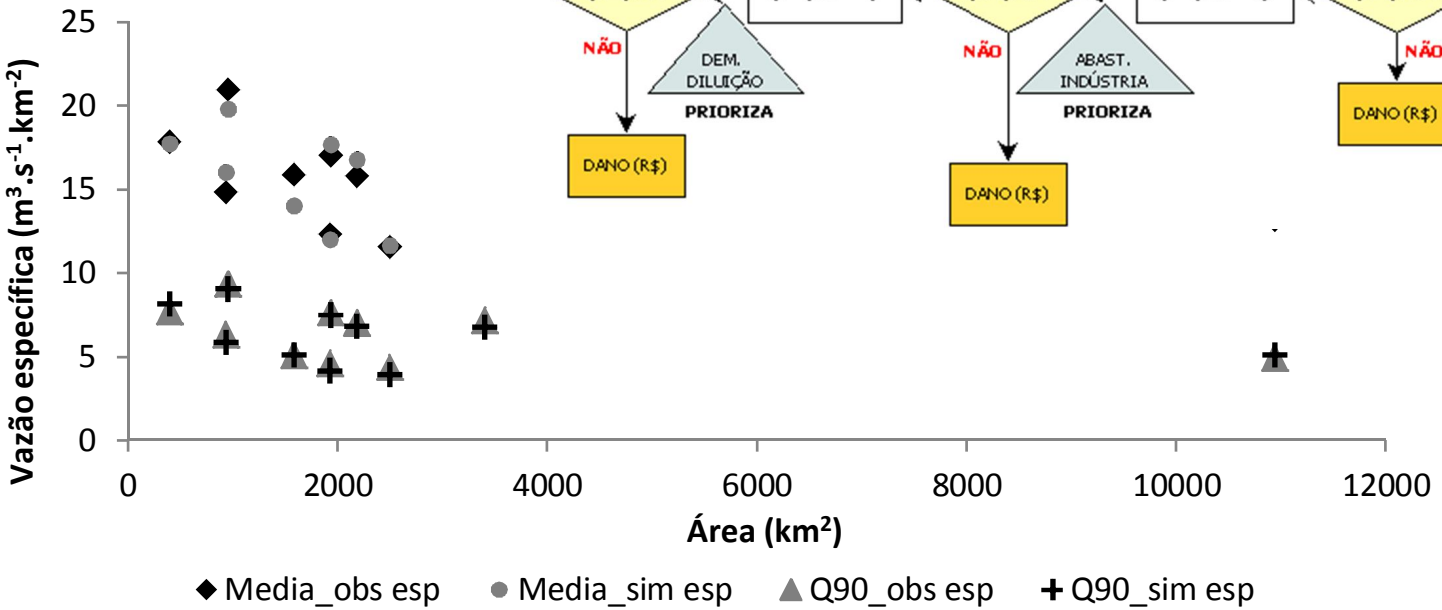
Willingness to pay for Ecosystem Services

Mendiondo, E M (2010) Reducing vulnerability to water-related disasters in urban areas of humid tropics, In: J. Parkinson et al, Integrated Urban Water Management: Humid Tropics, CRC Press – UNESCO Urban Water Series, Vol 6, ISSN 1749 0790, Chapter 6: 109-128

Strategy 4: insurance and disaster risk-transfer (droughts)

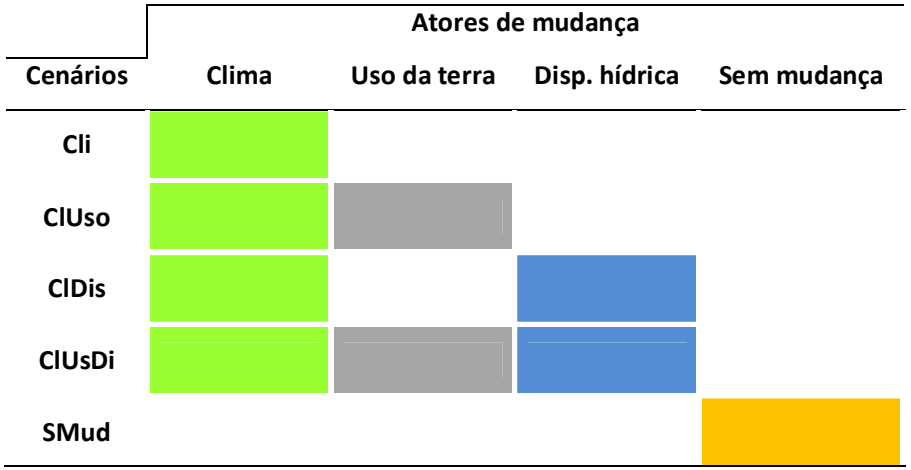


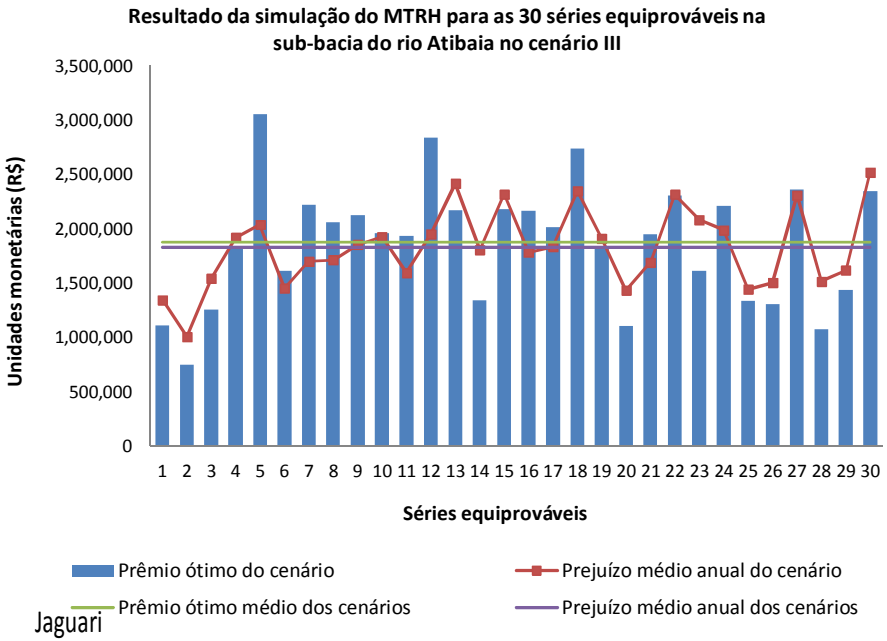


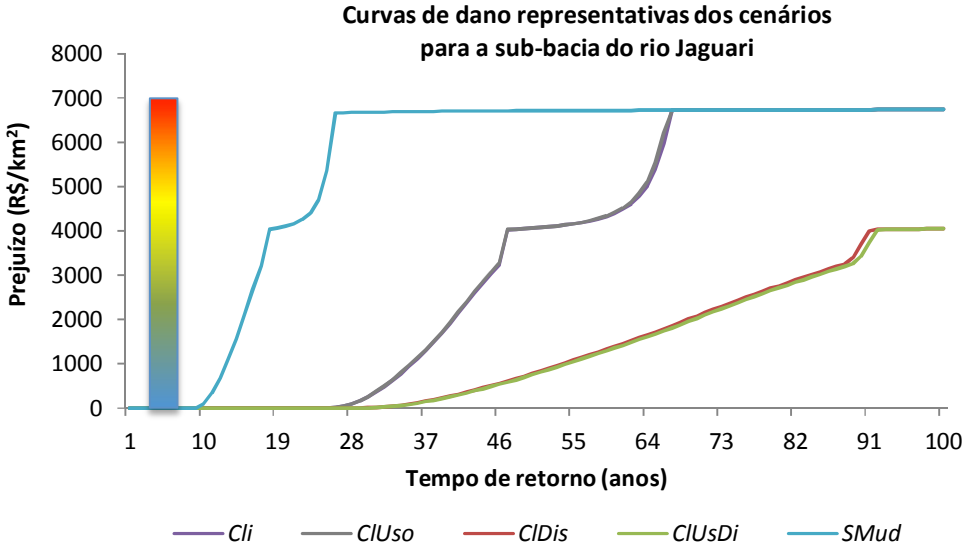


Source: Laurentis, G. (2012) Modelos de transferência de riscos como estratégia de adaptação às mudanças globais segundo cenários de vulnerabilidade de recursos hídricos, M Sc. Diss., PPG-SHS/EESC/USP, Sao Carlos (www.teses.usp.br)

Strategy 4: insurance and risk-transfer (droughts)







Jaguari

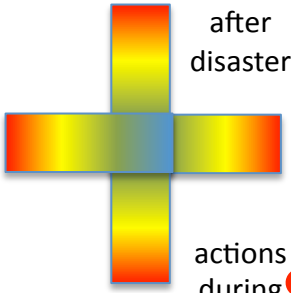
TR cobertura	Prejuízo médio (R$/km2)					Prêmio ótimo médio (R$/km2)				
(anos)	I	II	III	IV	V	I	II	III	IV	V
10	0,0	0,0	0,0	0,0	9,7	0,0	0,0	0,0	0,0	8,8
25	0,1	0,1	0,0	0,0	289,0	0,1	0,1	0,0	0,0	276,9
50	75,3	75,7	28,5	12,6	330,6	90,4	92,5	37,0	15,7	322,2
100	95,8	96,5	28,5	27,7	330,8	117,7	121,3	37,0	36,2	322,5
Média	42,8	43,1	14,3	10,1	240,0	52,0	53,5	18,5	13,0	232,6

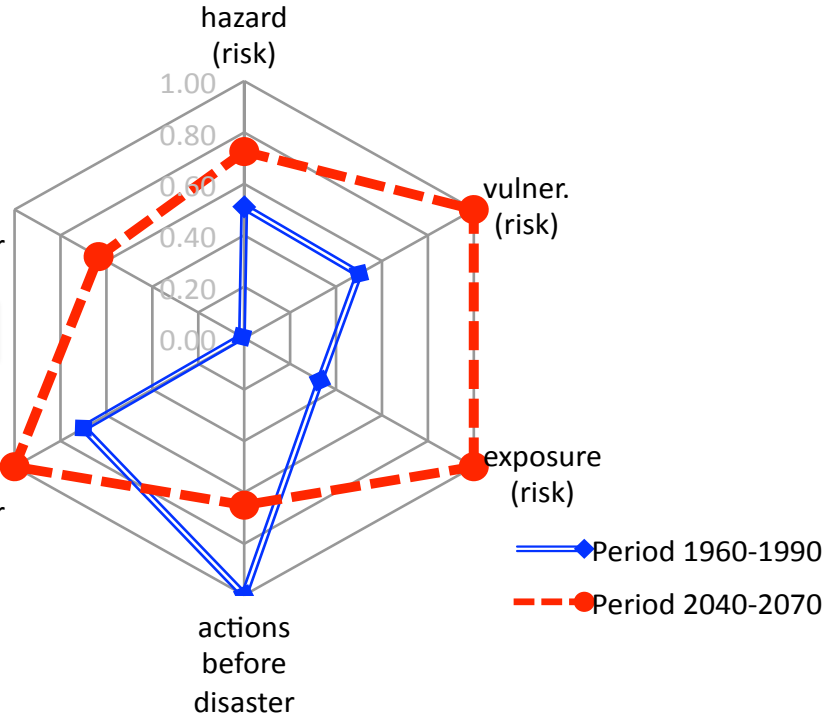
Source: Laurentis, G. (2012) Modelos de transferência de riscos como estratégia de adaptação às mudanças globais segundo cenários de vulnerabilidade de recursos hídricos, PPG-SHS/EESC/USP, Sao Carlos (www.teses.usp.br)

Strategy 5: PWRI(IVA)
Participative Water Resilience Index

$PWRI_{IVA}$

PWRI is a composite index expressing the lack of resilience related to water extremes at an area under land-use change





$$\Big(\underbrace{\underbrace{\text{hazard}}_{\text{climate change variables}},\underbrace{\text{vulnerability}}_{\text{land use maps}},\underbrace{\text{exposure}}_{\text{socio-economic surveys}}}_{\text{risk assessment (impact scores)}},\underbrace{\underbrace{\underbrace{\text{"before"}}_{\text{long-term early-warning ability}},\underbrace{\text{"during"}}_{\text{emergency \& rescue capacity}}}_{\text{non-structural measures}},\underbrace{\underbrace{\text{"after"}}_{\text{mitigation \& reconstruction system}}}_{\text{structural measures}}}_{\text{risk management through "participative", "collaborative", "voluntary" (adaptation strategies of disaster management)}}\Big)$$

Mendiondo, E.M., J A Marengo, W Leyh, J Rotava, J Porto, J Ueyama, V Caramori Souza (2013) Towards Participatory-based Water Resilience Index for Coupling Vulnerability, Impacts and Adaptation Strategies at Areas Under Land Use Change, In: Global Water System Project Conference "Water in the Anthropocene", Bonn, Germany, 21-24 May, 2013, Session: Working with uncertainties: Models & Data I, GWSP Press/BMBF/DFG

Strategy 5: PWRI(IVA)
Participative Water Resilience Index

Water Resilience Opportunity-WRO

- *Water Resilience Opportunity:* adaptation capacity of comparing $PWRI_{IVA}$ values over time between reactive and proactive scenarios.
- WRO lets monetary values be included, demonstrative pilot experiments like signboards or web-mapping collaborative scores from $PWRI_{IVA}$.

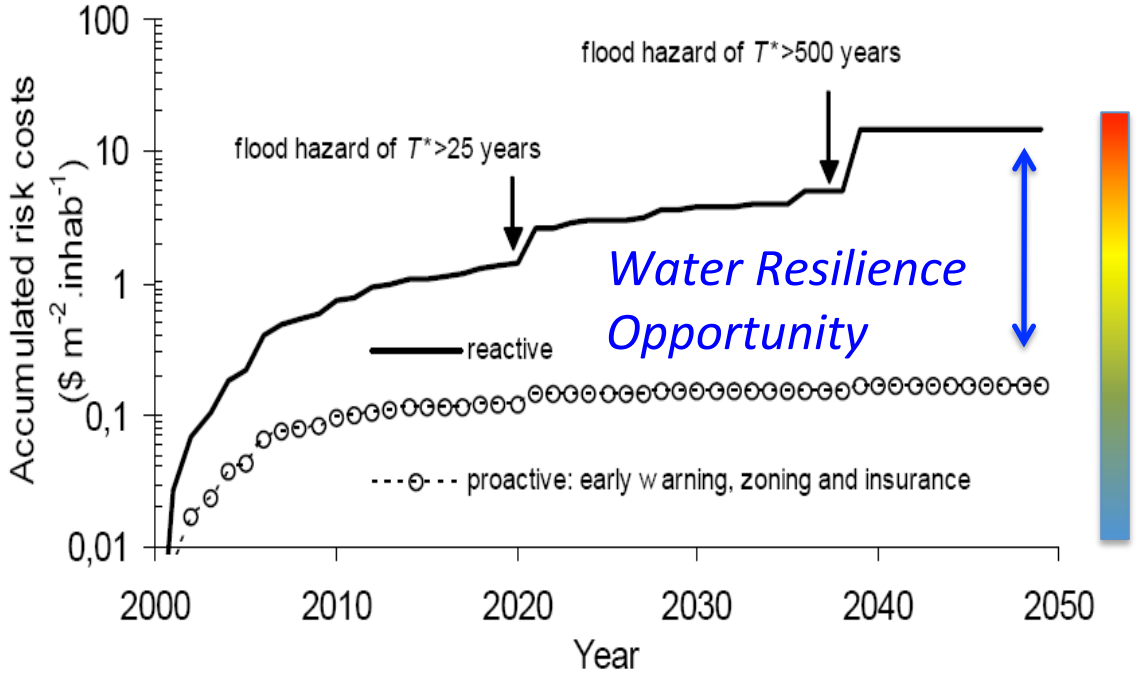


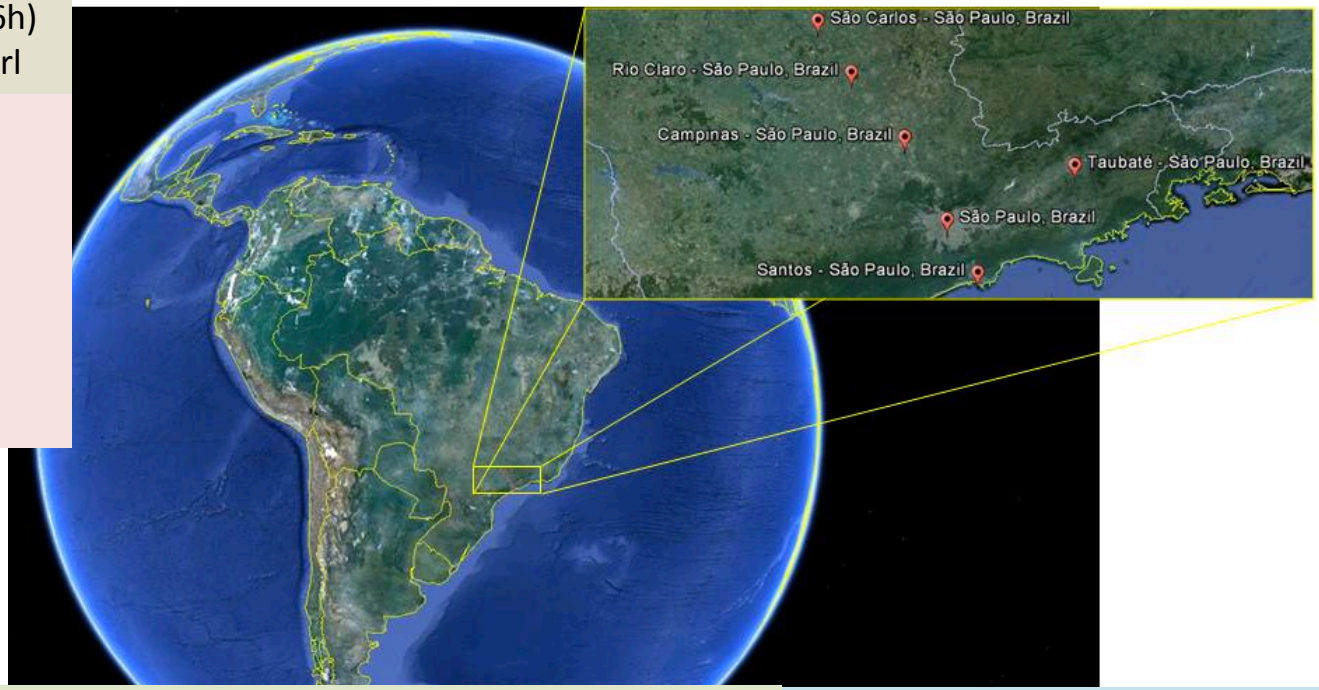
Figure 3- Simulation of accumulated nominal costs from two policy scenarios of risk management to cope with flood hazards and with growing urbanization at a subtropical basin. Proactive policies have early warning systems, land zoning of flood prone areas and insurance for risk-transfer. Adapted from Mendiondo *et al* (2005).

Strategy 5: PWRI(IVA)
Participative Water Resilience Index

Application

Ensembles:
Eta_HadCM3 (A1B;40kmx6h)
Runs: Low-, midi-, high-, ctrl

Time periods :
1960-1990;
2010-2040;
2040-2070;
2070-2100



variable [unit.]		**Definition**
prcv	[kg/m2/day]	convective precipitation
agpl	[kg/m2/day]	instantaneous precipitation water
prge	[kg/m2]	large scale precipitation
rnof	[kg/m2/s]	runoff
rnsg	[kg/m2/s]	acm bsfl-gdwr runoff

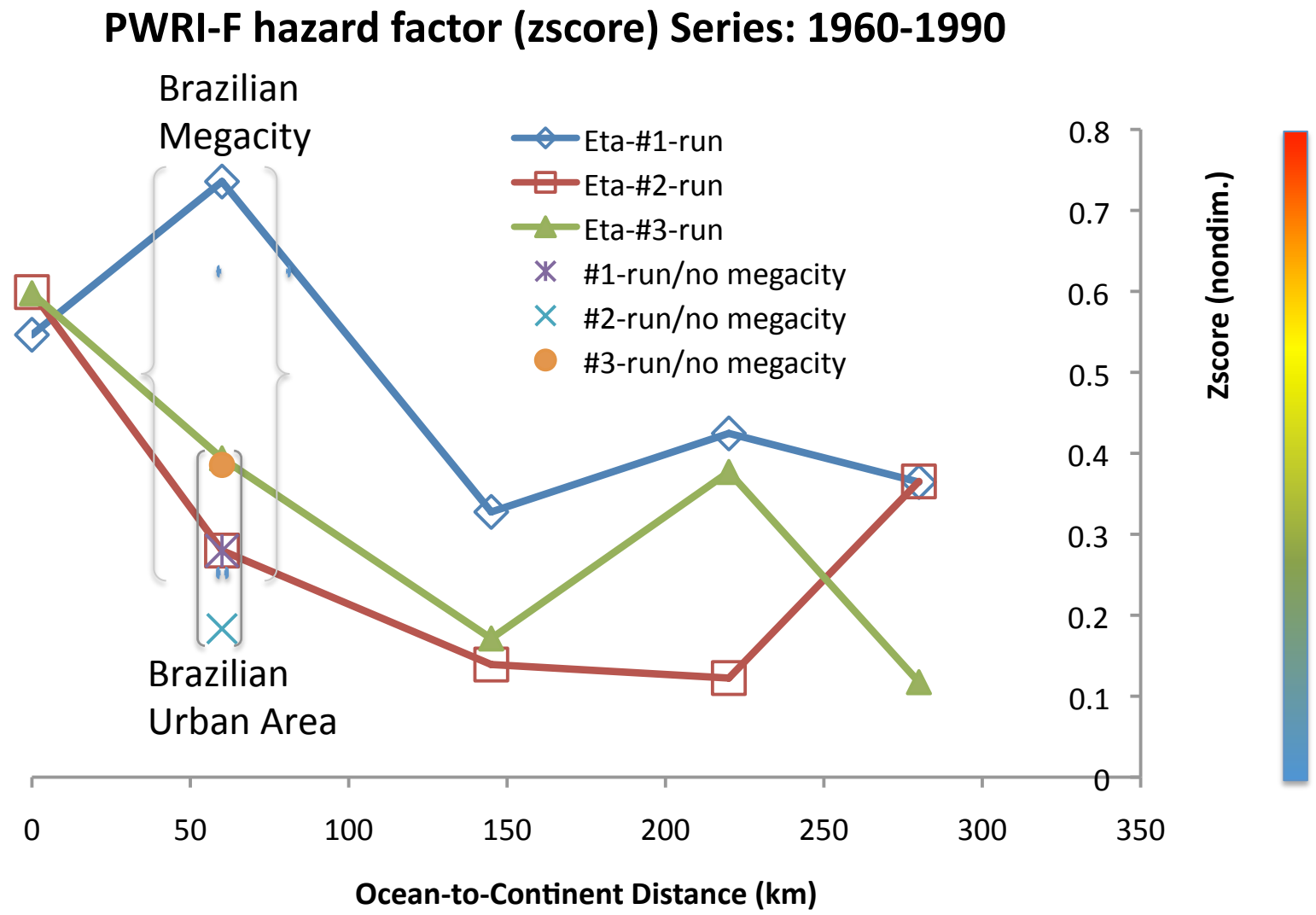
Sites:

São Carlos: 22.0178° S, 47.8908° W
Rio Claro: 22.4108° S, 47.5608° W
Campinas: 22.9069° S, 47.0613° W
Sao Paulo: 23.5000° S, 46.6167° W
Santos: 23.9667° S, 46.3333° W
Taubaté: 23.0333° S, 45.5500° W

Mendiondo, E.M., J A Marengo, W Leyh, J Rotava, J Porto, J Ueyama, V Caramori Souza (2013) Towards Participatory-based Water Resilience Index for Coupling Vulnerability, Impacts and Adaptation Strategies at Areas Under Land Use Change, In: Global Water System Project Conference "Water in the Anthropocene", Bonn, Germany, 21-24 May, 2013, Session: Working with uncertainties: Models & Data I, GWSP Press/BMBF/DFG

Strategy 5: PWRI(IVA)
Participative Water Resilience Index

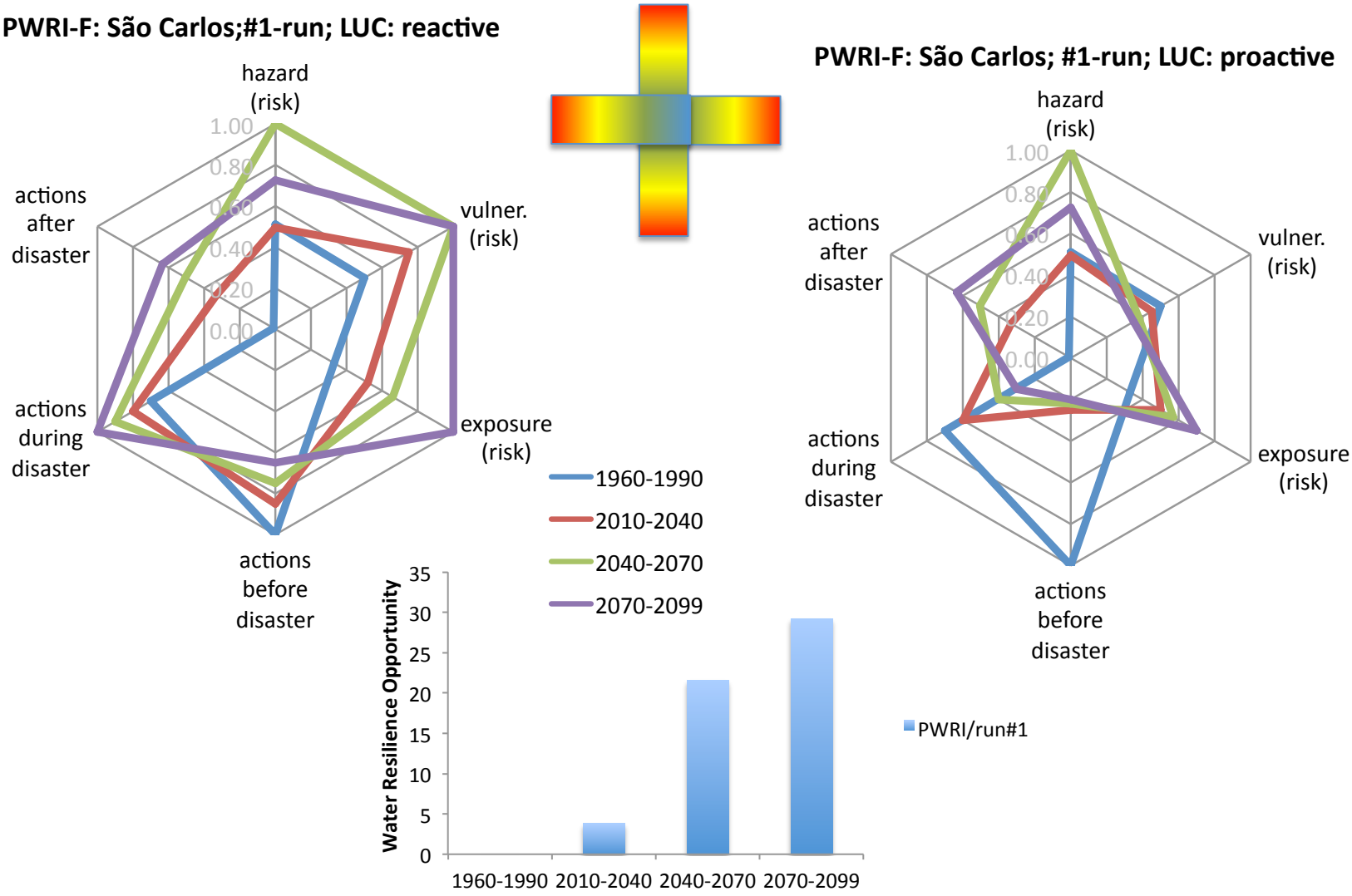
PWRI-F : preliminary results of spatial variability transect of water hazard across areas under change, according to Q1% ÷ Q5%



Mendiondo, E.M., J A Marengo, W Leyh, J Rotava, J Porto, J Ueyama, V Caramori Souza (2013) Towards Participatory-based Water Resilience Index for Coupling Vulnerability, Impacts and Adaptation Strategies at Areas Under Land Use Change, In: Global Water System Project Conference "Water in the Anthropocene", Bonn, Germany, 21-24 May, 2013, Session: Working with uncertainties: Models & Data I, GWSP Press/BMBF/DFG

Strategy 5: PWRI(IVA)
Participative Water Resilience Index

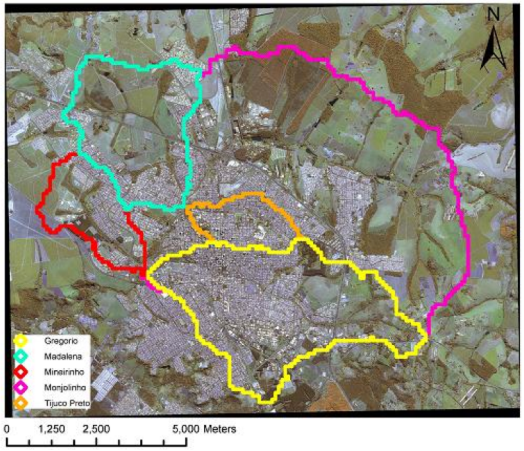
PWRI-F : 1960 – 2100; reactive & proactive scenarios



Mendiondo, E.M., J A Marengo, W Leyh, J Rotava, J Porto, J Ueyama, V Caramori Souza (2013) Towards Participatory-based Water Resilience Index for Coupling Vulnerability, Impacts and Adaptation Strategies at Areas Under Land Use Change, In: Global Water System Project Conference "Water in the Anthropocene", Bonn, Germany, 21-24 May, 2013, Session: Working with uncertainties: Models & Data I, GWSP Press/BMBF/DFG

Strategy 6: Human-Scale Adaptation using Disaster Risk Monitoring

Prevenção e Monitoramento do Risco de Inundações em Bacias Urbanas



Adaptado para escoamento em canais

IP [m²/s]	Risco
0 – 0,5	Baixo
0,5 – 1,0	Médio
1,0 - 1,5	Alto
> 1,5	Muito Alto

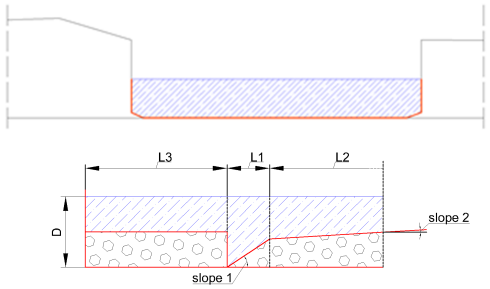
Fonte: Janine (2014)

Figura 50 - Forma de indicação de perigo por profundidade relativa.

- Therefore it is fundamental to evaluate:

n – Manning coefficient
k – conversion factor [$L^{1/3}/t$]
A – cross-sectional area of flow [L^2]
P – wetted perimeter [L]
S – slope of the hydraulic grade line [L/L]

(where, in the SI: L – [m] ; t – [s] ; k=1 $m^{1/3}/s$)



Adaptado para escoamento em sarjetas

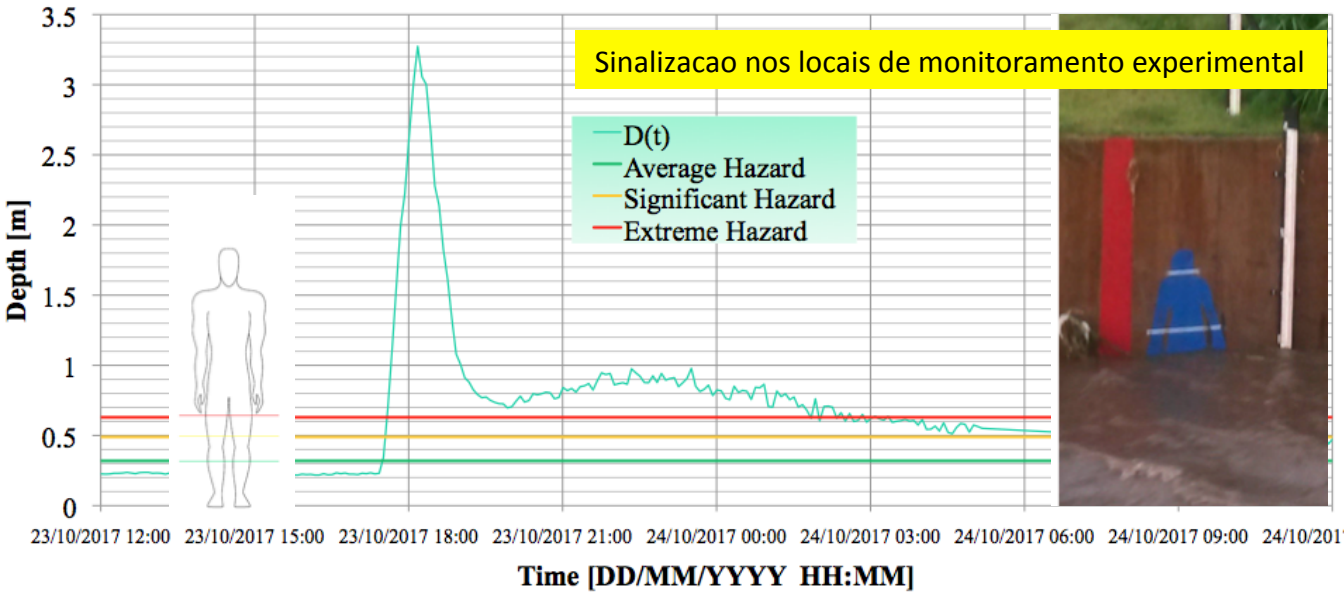


Figure 8: Temporal behavior of flood hazard index at urban channels

Strategy 6: Human-Scale Adaptation using Disaster Risk Monitoring

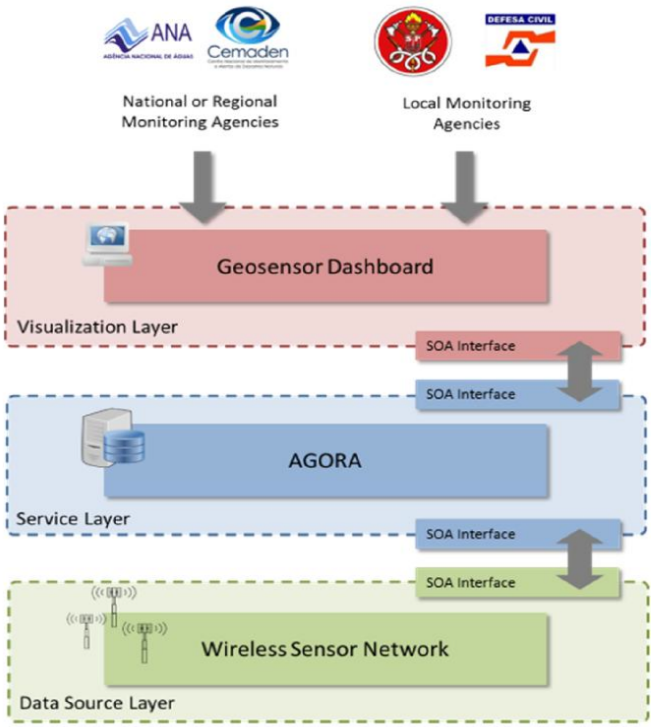
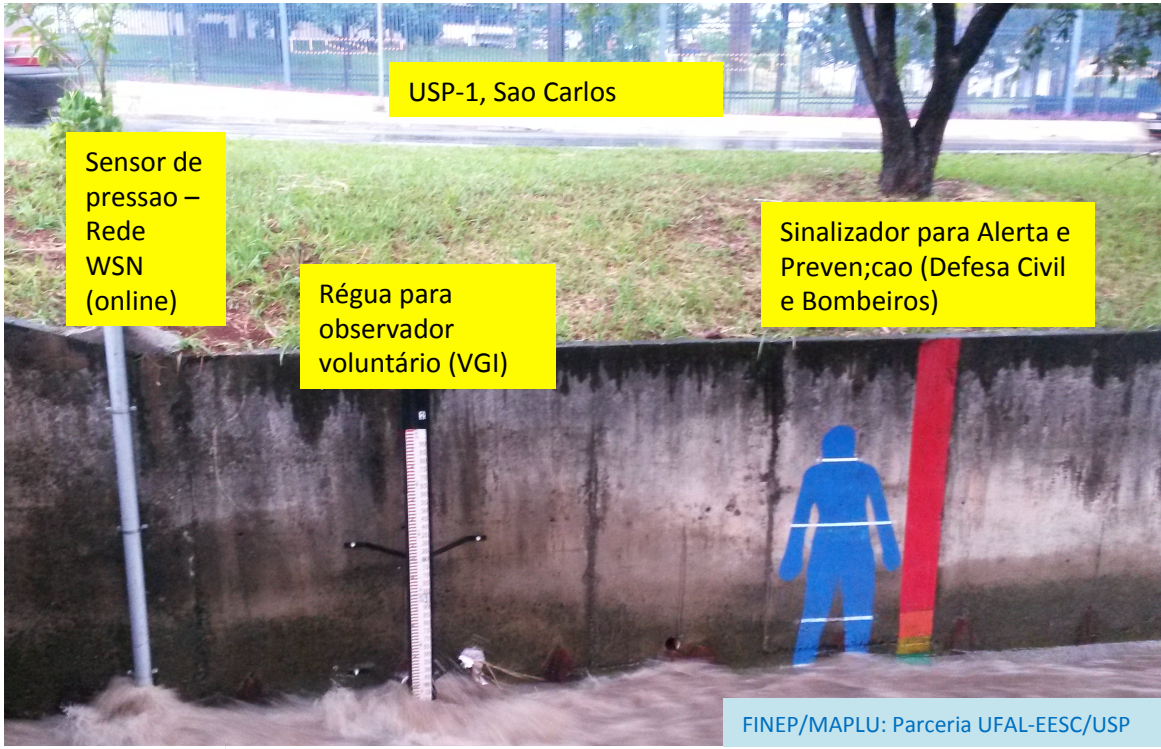


Figure 1. Layer Structure of AGORA-GeoDash



FINEP/MAPLU: Parceria UFAL-EESC/USP

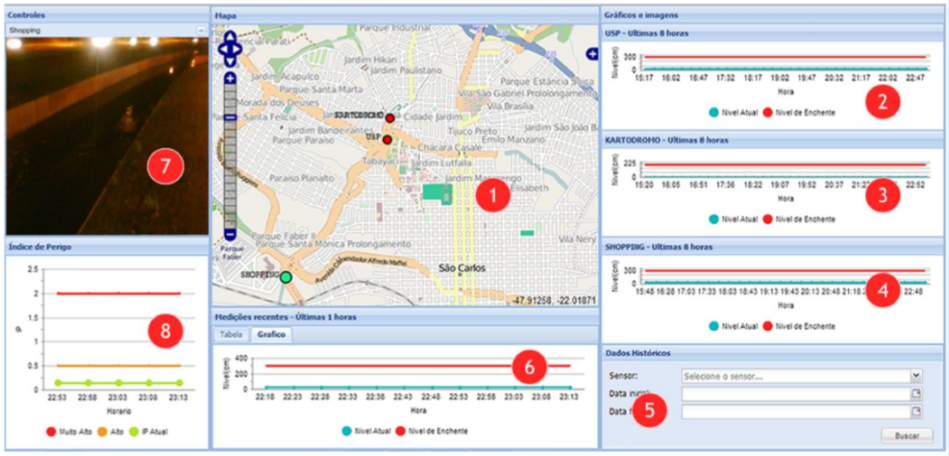
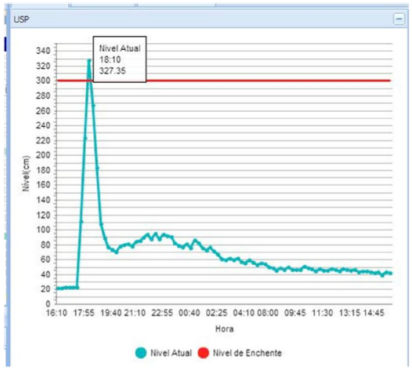
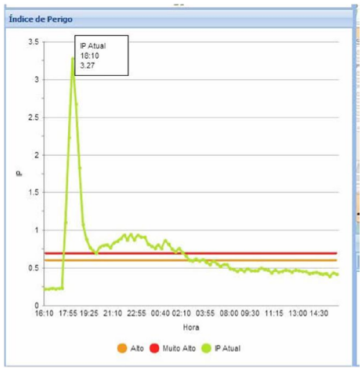


Figure 2. Geosensor Dashboard of AGORA-GeoDash



(a)



(b)

Executado: 95%

Figure 5. Indicator (a) for the height of the river and Hazard Index (b) shown by Geosensor Dashboard during the period of the flood recorded in São Carlos/SP on October 22-23, 2013.

CEMADEN/MCTI e Pós-Sendai 2015

- Diretrizes de gestão de riscos de desastres pós-Sendai (2015)
- Plano Nacional e Regionais de Gestão de Risco de Desastres
- Lições e experiências a partir de Projetos Pilotos de Cidades Mais Resilientes
- Fortalecimento de Rede Observacional para Monitoramento e Alertas de Desastres no Território Nacional (>20:1)

Propostas: visão global com ações (investimentos) locais e planejamento intersetorial (incluindo PPP's)

PRIORIDADES (pós sendai 2015, Conf.mundial de redução de riscos de desastres)

1. entender melhor os riscos de desastres*,
2. aumentar a governança para a gestão de riscos de desastres,
3. investir na redução de riscos de desastres visando uma sociedade resiliente,
4. investir nas ações de preparação para melhorar as respostas frente a desastres

* Desastres no mundo: aprox. U$ 0,5 trilhão

AUMENTO PROGRESSIVO DA RESILIÊNCIA A DESASTRES NO BRASIL (2015-2030)

1. Programas de Educação e Treinamentos Permanente sobre Resiliência a Desastres
2. Melhoria de códigos e de protocolos interinstitucionais de monitoramento em tempo real
3. Melhoria de alertas para planos contingências com "pilotos"
4. Otimizar Planos deRespostas às emergências
5. Planos Diretores para Redução de Vulnerabilidade Humana

Brasil (2012-2015): R$ 0,5 bi.; até 2020: R$ 1 bi.; até 2025: R$ 3 bi.; até 2030: R$ 6 bi.*
(* equivalente ao estágio alcançado no Japão em 2015)

Obrigado!

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