<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30 - 10:50 a.m.</td>
<td><strong>SESSION E1: ENVIRONMENTAL APPLICATIONS</strong>&lt;br&gt;Room: Caboclinhos</td>
<td><strong>Moderator:</strong> Eduardo Mario Mendiondo&lt;br&gt;<strong>USP-EESC, Brazil</strong>&lt;br&gt;&lt;br&gt;9:30 – 9:50 a.m. Bloodless Dzwairo Application of SWAT to water quality modelling in the Rietspruit sub-basin of South Africa&lt;br&gt;&lt;br&gt;9:50 – 10:10 a.m. Antônio Heriberto de Castro Teixeira Large Scale Energy Balance in the Juazeiro Municipality, Brazil&lt;br&gt;&lt;br&gt;10:10 – 10:30 a.m. Yaobin Meng A Model for Heavy Metal Dynamics Coupled with SWAT and Its Application in Liuyang River Upstream Basin in China&lt;br&gt;&lt;br&gt;10:30 – 10:50 a.m. Eduardo Mario Mendiondo On contrasting field evidences of water quality to perform physically-based SWAT simulations in challenging Brazilian biome under change</td>
</tr>
</tbody>
</table>
On contrasting field evidences of water quality to perform physically-based SWAT simulations in a challenging Brazilian biome under change

Denise Taffarello¹; Danielle A. Bressiani¹; M.C. Calijuri²; E.Mario Mendiondo²,³

1 Ph.D. Student at University of Sao Paulo, Sao Carlos School of Engineering - PPG-SHS, EESC/USP, Brazil

2 Professor at University of Sao Paulo, Sao Carlos School of Engineering- EESC/USP, Brazil;

3 Coordinator, National Center of Monitoring & Early Warning of Natural Disasters - CEMADEN, Brazil.
INDEX OF CONTENTS:

BACKGROUND

MOTIVATION

HYPOTHESES

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MATERIALS & METHODS

INITIAL RESULTS

DISCUSSION

CONCLUSIONS
Integrating water quantity and quality for environmental regimes based on adaptive water resources management and planning under change

Taffarello, D.¹; Mendiondo, E.M.¹; Calijuri, M.C.¹; Cunha, D.G.F.¹

“A new perspective on environmental flows of Brazilian catchment under change: multidimensional approach of quali-quantitative frequency curves for hydrological ecosystem services assessment”

Taffarello, D.¹; Mendiondo, E.M.²

Taffarello, D. ¹*; Lombardi, R²; Guimarães, J.²; Zaffani, A.G.¹; Calijuri, M.C.¹; Mendiondo, E.M.¹

¹ Depto. de Eng. Hidráulica e Saneamento, EESC/USP - ² The Nature Conservancy Brasil - taffarello@gmail.com; emm@sc.usp.br

Carolina Cholella Mazzocato¹; Denise Taffarello² & Eduardo Mario Mendiondo³
Brazilian Atlantic Forest is a challenging biome under changing conditions affecting the Water-Energy-Food Security nexus at the short-, medium- and long-term.
1- How do we address practical yardsticks for modeling*-users and field hydrologists about non-linear behaviors of pollution loads?
2- How could experimental water quality data help predicting uncertainty in model* set-ups & outputs?
3- In what manner runoff evidences in field could help on optimizing novel monitoring & early warning strategies of hydrological cycle?
• Outline contrasting field water quality data to perform further physically-based modeling* at biomes under change
• Integrate short-term evidences at headwaters to optimize long-term monitoring & early warning strategies at strategic river basins
• Explore empirical variability of datasets which bound inherent hydrological uncertainty related to W-E-F security programs
Selected experiments at Southeastern Brazilian Atlantic Forest
Sites at transboundary PCJ’s headwaters (States of MG & SP)
Altitudes 900-1350 m.a.m.s.l., \( <P> = 1400-1750 \text{mm} \), \( \text{ETP/P} = 1.2-2.3 \)
Collecting field & experimental water quality data through a Nested catchment Experiment (NCE) approach at 17 strategic model nodes.
Bi-monthly field NCE campaigns: September 2013 until May 2014
Experimental NCE drainage areas from 12 to 130 km\(^2\).
Characterization of inherent variability of nutrient loads, e.g. Total Phosphorous (TP), Phosphates (PO\(_4\)), Nitrates (N-NO\(_3\)), \( E. \ coli \), etc.
Experimental variability of water quality and discharges at NCE points
Seasonal variability of field water quality-and-discharge data
Specific pollution load = “concentration x flow / drainage area”, outline non-linear behaviors throughout spatiotemporal scales
Regional field relationships to help spatiotemporal model set-ups
Jaguarí-Jacareí Subbasins

Legend
- State division
- Municipal Seats
- Towns
- Tunnel/Channel

Monitoring points
- 1-F-23 SABESP (Camanducaia river)
- 2-Upper Jaguarí river
- 3-Posses headwaters
- 4-Posses middle
- 5-Posses outlet
- 6-Salto outlet
- 7-Events Venue

Watersheds
- Jacareí
- Jaguarí

Courtesy: G. S. Mohor
Atibainha Subbasin

Legend
- Municipal Seats
- Towns
- Tunnel/Channel

Monitoring points
- 15-Intervention area (Moinho)
- 16-Reference area (Moinho)
- 17-Moinho outlet

Watersheds
- Atibainha
- Moinho Stream Subbasin

Coordinate System: SAD 1969 UTM Zone 23S
Projection: Transverse Mercator
Datum: South American 1969

Courtesy: G. S. Mohor
Cachoeira Subbasin

Legend
- State division
- Municipal Seats
- Towns
- Tunnel/Channel

Monitoring point
- 8-Intervention area (Cancan)
- 9-Reference area (Cancan)
- 10-F-30 SABESP - Cancan outlet
- 11-"Cachoeira dos Pretos"
- 12-"Chalé Ponto Verde"
- 13-Bridge on Cachoeira river
- 14-F-24 SABESP - Cachoeira outlet

Watersheds
- Cachoeira
- Cancan Subbasin
- Cachoeira dos Pretos Subbasin

Coordinate System: SAD 1969 UTM Zone 23S
Projection: Transverse Mercator
Datum: South American 1969

Courtesy: G. S. Mohor
<table>
<thead>
<tr>
<th>Field Campaign</th>
<th>NCE-Type</th>
<th>Goal</th>
<th>Number of samples</th>
<th>Period</th>
<th>API (15d) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Exploratory</td>
<td>Determination of local of monitoring</td>
<td>12</td>
<td>DEC 10-12, 2012</td>
<td>75.1</td>
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<tr>
<td>2</td>
<td>Exploratory</td>
<td>Determination of monitoring points</td>
<td>3</td>
<td>SEP 11, 2013</td>
<td>13.2</td>
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<td>3</td>
<td>Sistematic</td>
<td>Qualitative and quantitative measures</td>
<td>19</td>
<td>OCT 23-25, 2013</td>
<td>99.6</td>
</tr>
<tr>
<td>4</td>
<td>Sistematic</td>
<td>Qualitative and quantitative measures</td>
<td>17</td>
<td>DEC 09-10, 2013</td>
<td>126.7</td>
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<tr>
<td>5</td>
<td>Sistematic</td>
<td>Qualitative and quantitative measures</td>
<td>17</td>
<td>MAR 21-23, 2014</td>
<td>76.7</td>
</tr>
<tr>
<td>6</td>
<td>Sistematic</td>
<td>Qualitative and quantitative measures</td>
<td>17</td>
<td>MAI 23-25, 2014</td>
<td>23.4</td>
</tr>
</tbody>
</table>
Initial delimitation of Jaguari Watershed within ArcSWAT

Legend:
- Collected points
- Generated outlets
- River reaches
- Jaguari-Jacarei Reservoir
- Sub basins

Elevation:
- High: 2054 m
- Low: 519 m

Coordinate System: WGS 1984 UTM Zone 23N
Projection: Transverse Mercator
Datum: WGS 1984

Courtesy: G. S. Mohor
### Sub-catchment Area Histogram

**Counting**

- **Area (ha)**

<table>
<thead>
<tr>
<th>Counting</th>
<th>0</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
<th>2500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-catchment</strong></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### River Length Histogram

**Counting**

- **Length (m)**

<table>
<thead>
<tr>
<th>Counting</th>
<th>0</th>
<th>5000</th>
<th>10000</th>
<th>15000</th>
<th>20000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>River</strong></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### Modeling discretization of setup Cantareira System headwaters

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Catchment area (ha)</th>
<th>Slope (%)</th>
<th>River Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>775 ± 582</td>
<td>25 ± 6</td>
<td>5,771 ± 2,754</td>
</tr>
<tr>
<td>Minimum</td>
<td>2</td>
<td>5</td>
<td>380</td>
</tr>
<tr>
<td>Maximum</td>
<td>2949</td>
<td>36</td>
<td>15,436</td>
</tr>
</tbody>
</table>
Experimental evidences of PO4 vs Discharge
(Name of river with range of drainage areas, in ha.)

![Graph showing the relationship between PO4 concentration and discharge for different rivers with their respective drainage areas.]

- **Moinho**={66, 1692}
- **Cachoeira**={10141, 30963}
- **Cancan**={126, 28922}
Seasonal behavior of PO4 vs Discharge (size of catchment)
Seasonal PO4 loads

- **PO4 load (kg/day)**
- **Drainage area (ha)**

**Legend:**
- Oct/2013
- Dec/2013
- Mar/2014
- May/2014
Local partnerships

<table>
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<tr>
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NEW MONITORING & EARLY WARNING FOR WATER SECURITY

Since May 2014

Cortesy of A. Cuartas (2014).
Rainwater network of CEMADEN/MCTI
(planned, with state partners)
planned, with state partners
• Results depict heavy non-linearities of water quality and quantity of runoff at headwater which provoke a deep reflection on further modeling setups
• Variability intervals permit future calibration, validation and sensitivity analyses under a physically-based framework under non-stationary conditions and land-use change
• Experiments during a quasi-continuously recession period delineate alternative modeling setups at headwaters with strong uncertain hydrology
• High-impact conflicts of 9 million people from water-supply of the “Cantareira System” at Metropolitan Region of Sao Paulo call for a pact of new governance strategies of integrated water resources management under change
• New monitoring and early warning approaches proposed to cope with water scarcity under changing conditions
• Water scarcity scenarios consolidated alliances through public-private partnerships: Consórcio PCJ, USP, TNC, WWF, CBRH/SP, CPRM, ANA, CEMADEN, Municipalities, EMBRAPA, TAMU-AgriLife, INPE, and more... at local, state, national and international levels.
ACKNOWLEDGEMENTS

Also gratitude to Guilherme S. Mohor, M Sc student at PPG-SHS/EESC-US, Hydrometric technicians from USP, Hidrotopo, DAEE/SP Mr. Miro, Betão and Mario Menes, FAPESP- CAPES- & CNPq-PQ Grants, UFPE, TAMU-AgriLife, 2014 SWAT Conf. Org. Committee

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