Case Report : Adopting OGC Standards in São Paulo Flood Alert System

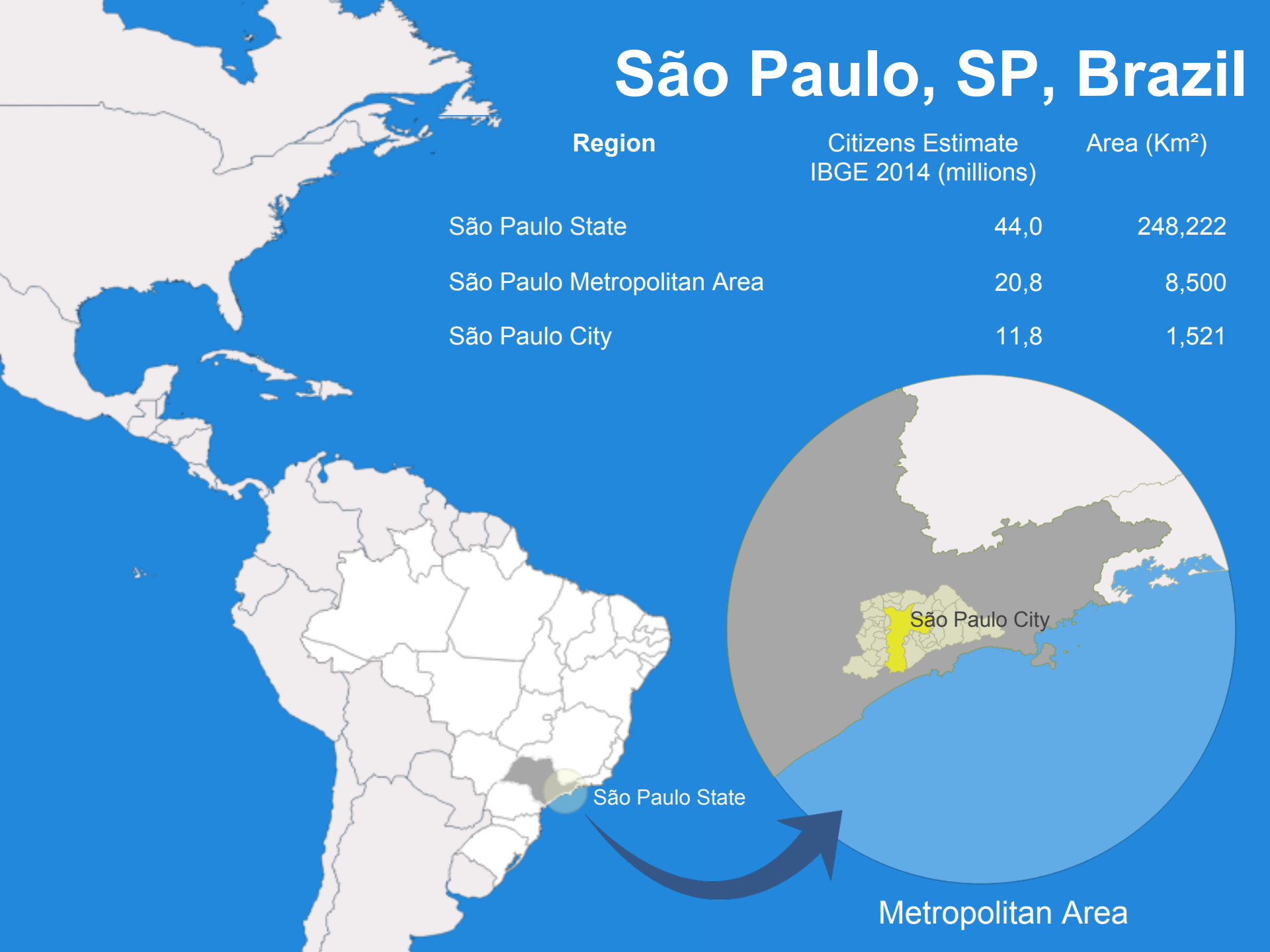
Cristiane Pires Andrioli
cristiane@saisp.br
Meteorologist

Flavio Conde
conde@saisp.br
Engineer

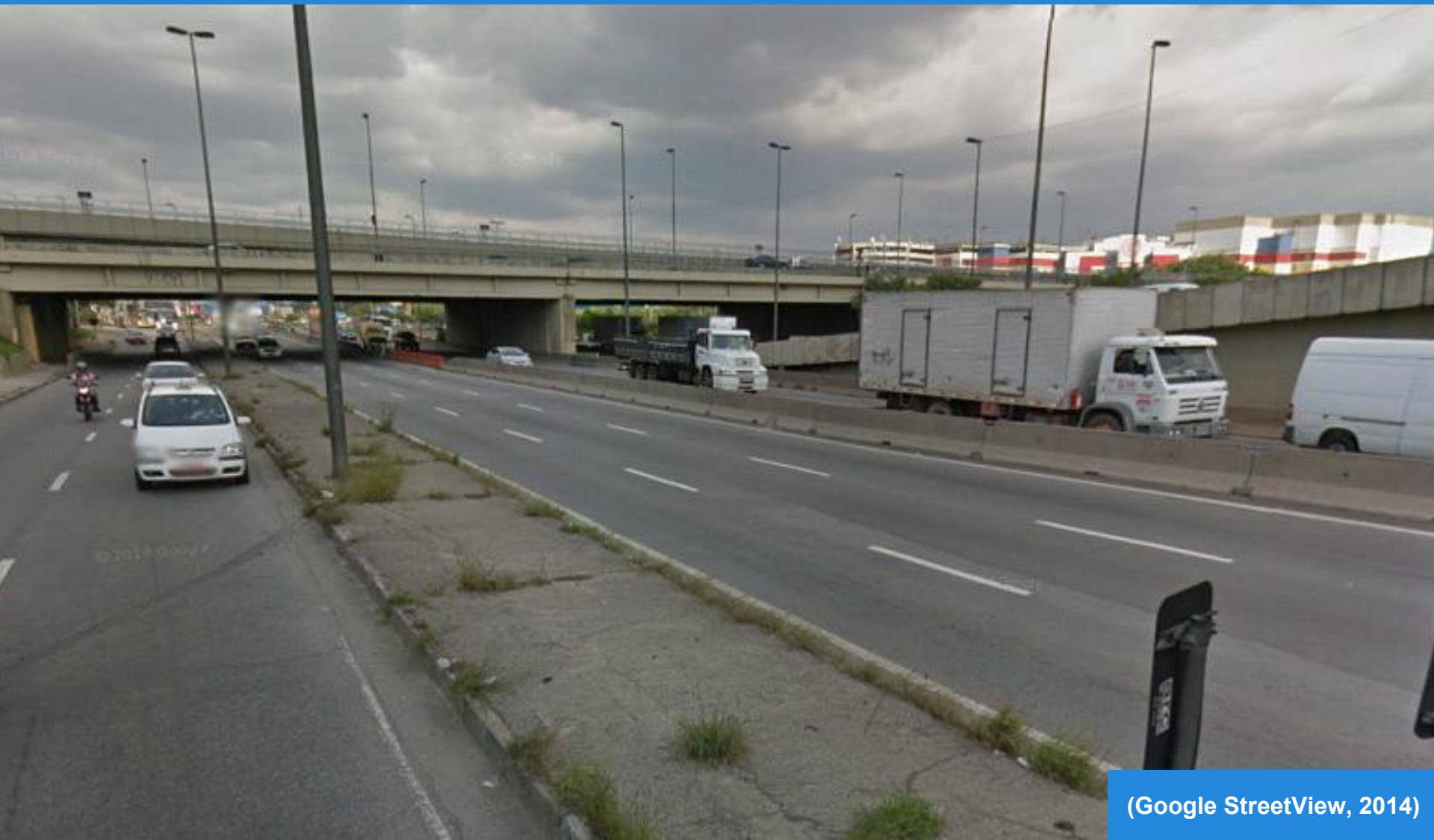
Ivan Francolin Martinez
ivanfm@{saisp.br,ifsp.edu.br}
Engineer

São Paulo, SP, Brazil

Region	Citizens Estimate IBGE 2014 (millions)	Area (Km²)
São Paulo State	44,0	248,222
São Paulo Metropolitan Area	20,8	8,500
São Paulo City	11,8	1,521



São Paulo without rain



(Google StreetView, 2014)

São Paulo after rain (Summer)

January, 2011
Leonardo Soares/AE

São Paulo without rain

(Google StreetView, 2014)

São Paulo after rain (Summer)

January, 2000
Marlene Bergamo/Folhapress

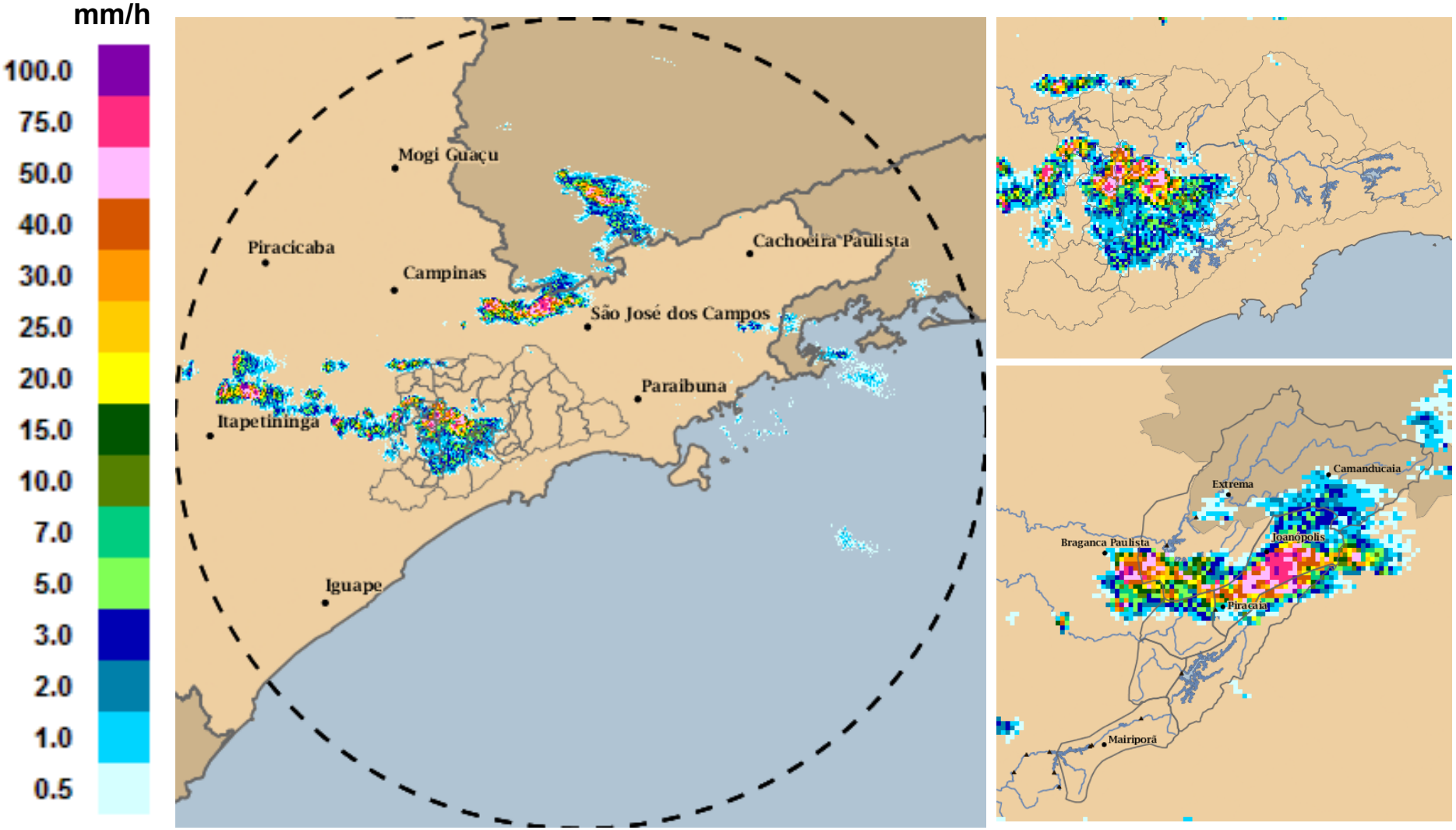
São Paulo Flood Alert System - SAISP

http://www.saisp.br

Current Weather Radar: Dual Pol, S-Band, antenna 11.8m ø - Installed 2013

Old Radar : Single Pol, S-Band, antenna 5.4m ø - Installed 1988

São Paulo Flood Alert System - SAISP

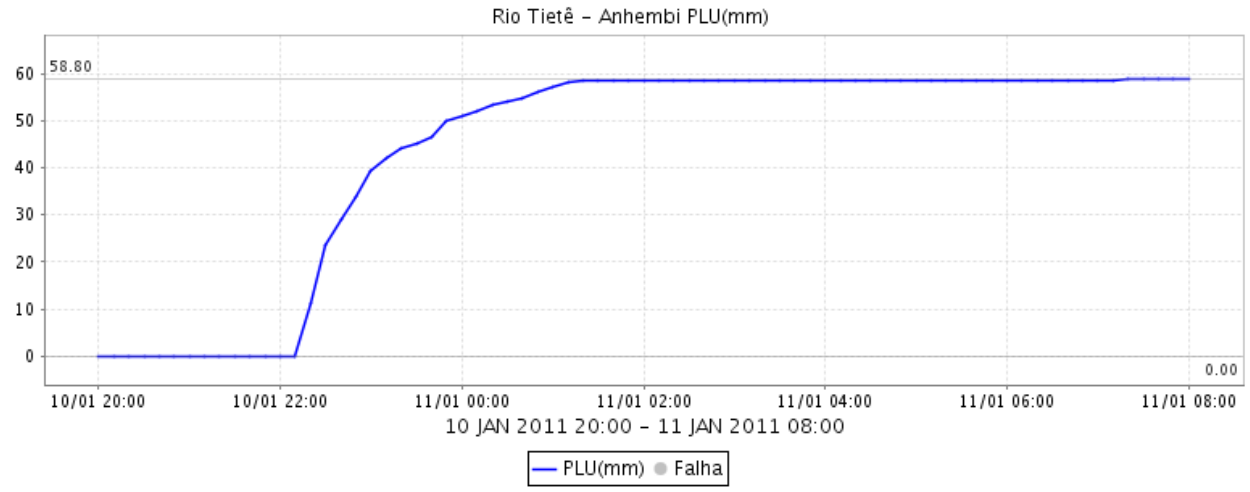


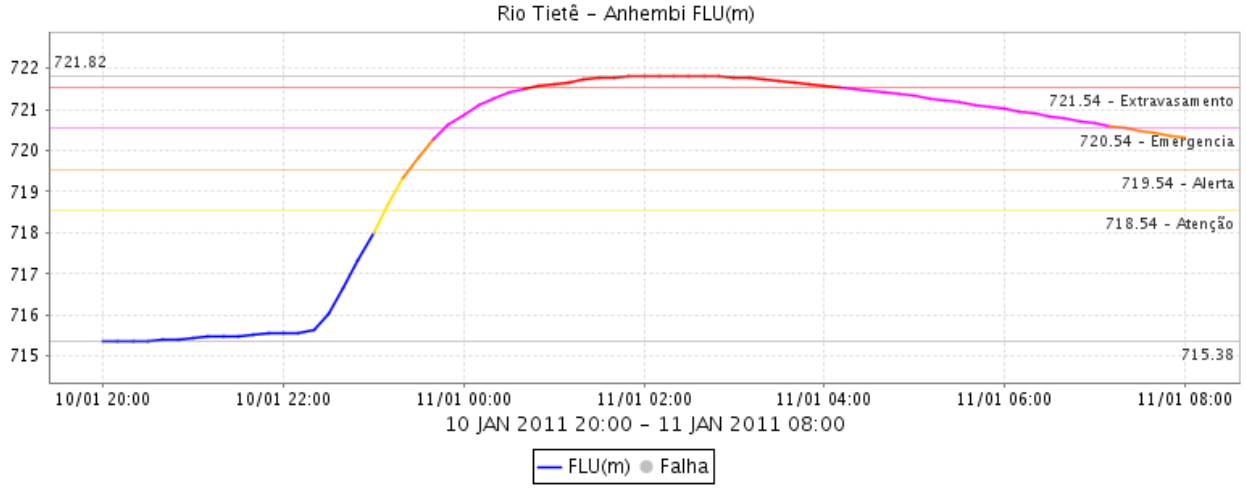
São Paulo Flood Alert System - SAISP

Telemetrical Stations: 322 (9 Inmarsat, 313 GPRS), Solar Powered

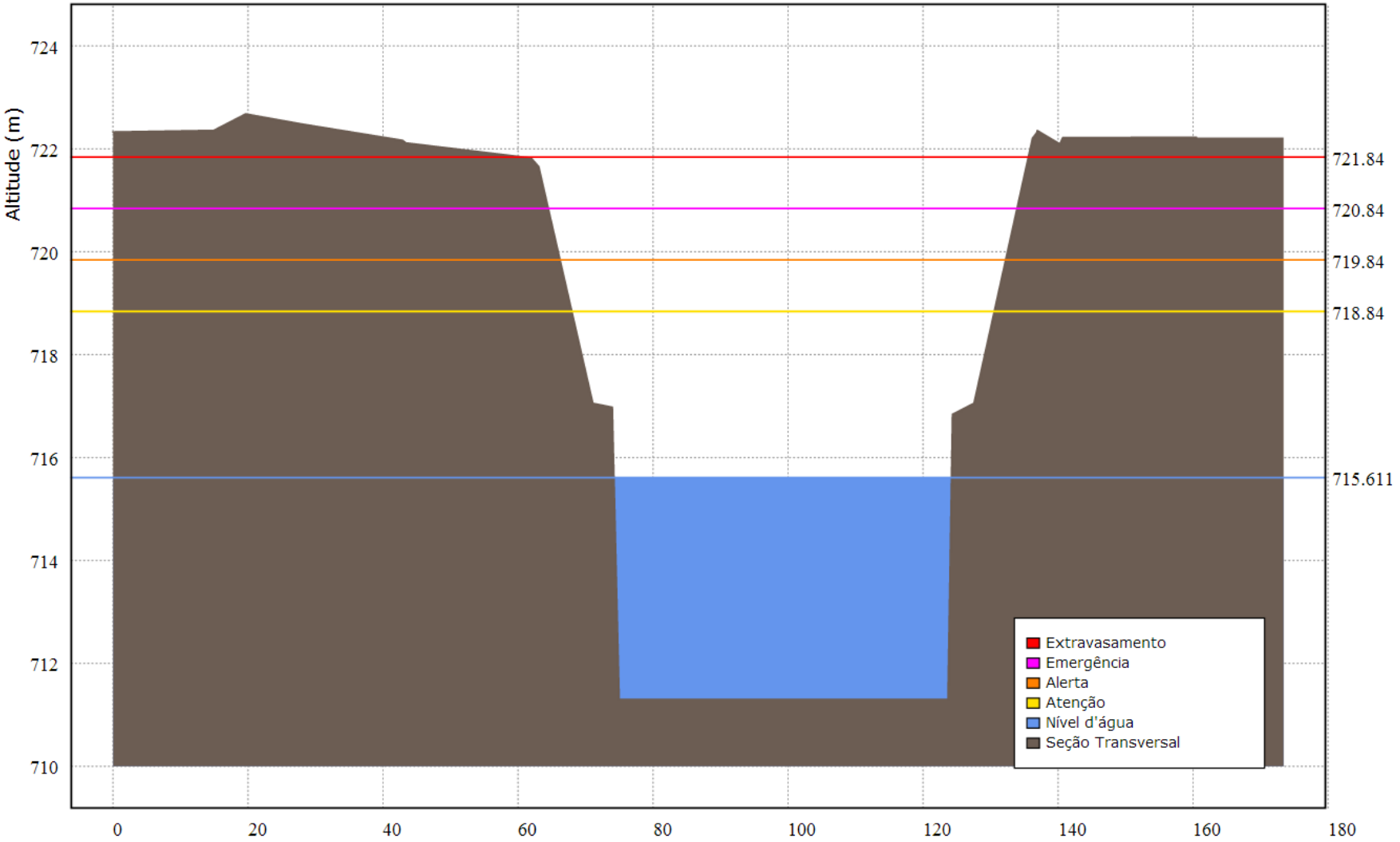
260 million records since 1991, 42 million records in 2013

São Paulo Flood Alert System - SAISP

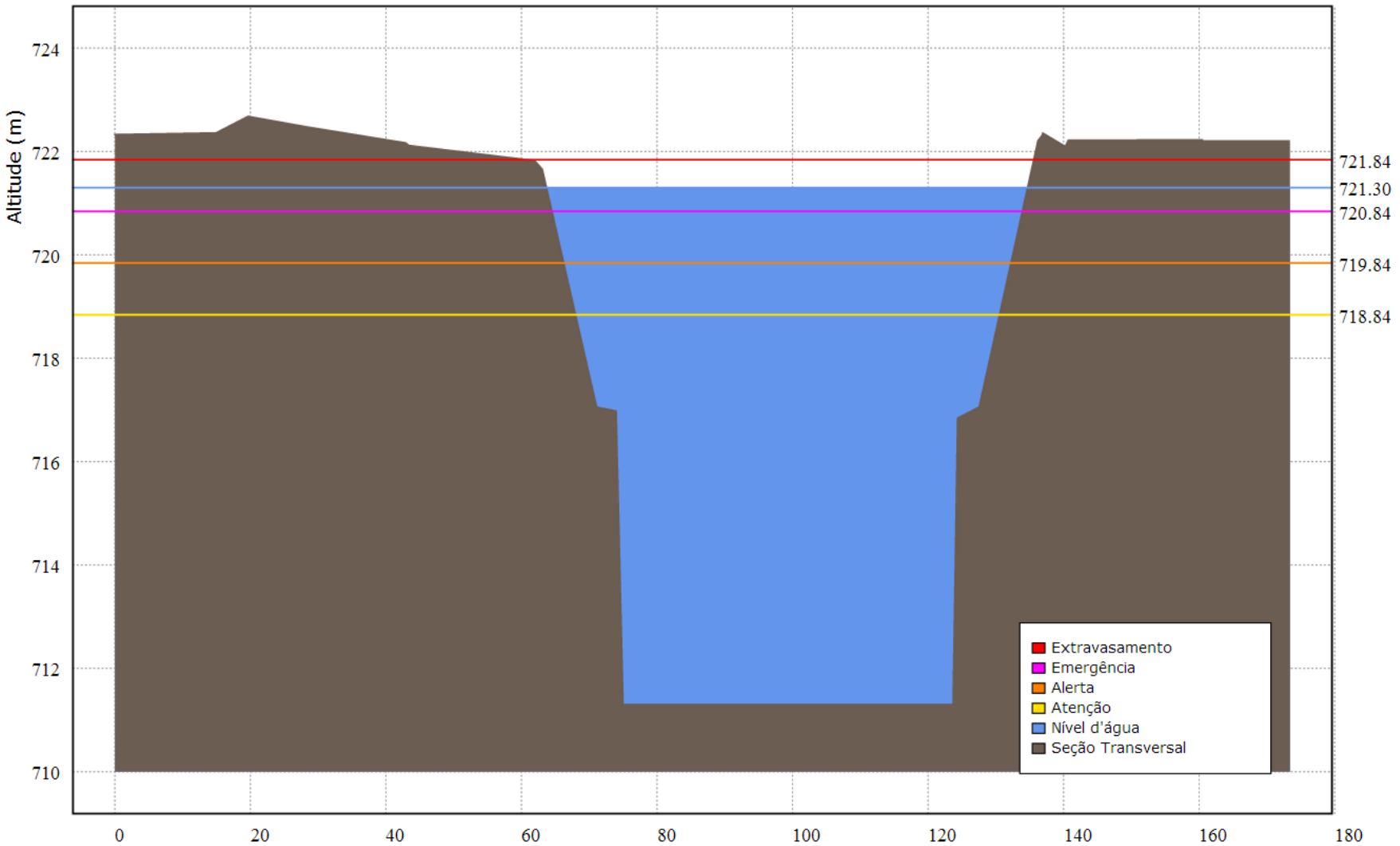




River cross section sample



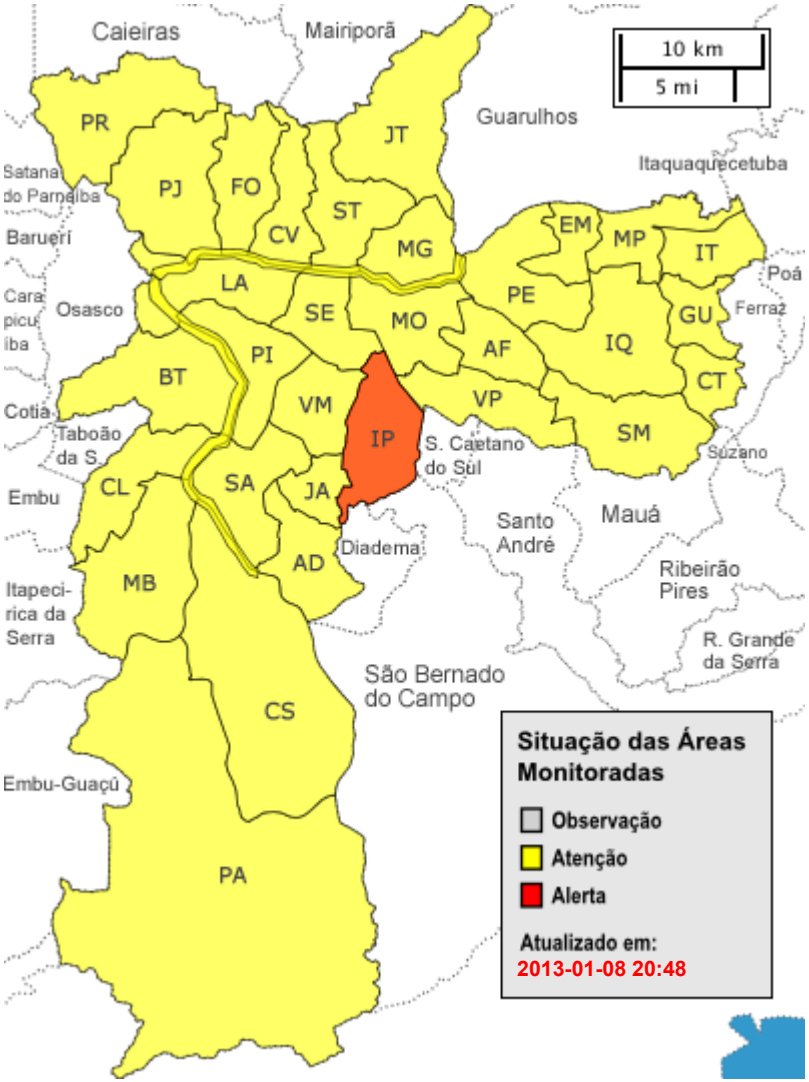
River cross section sample

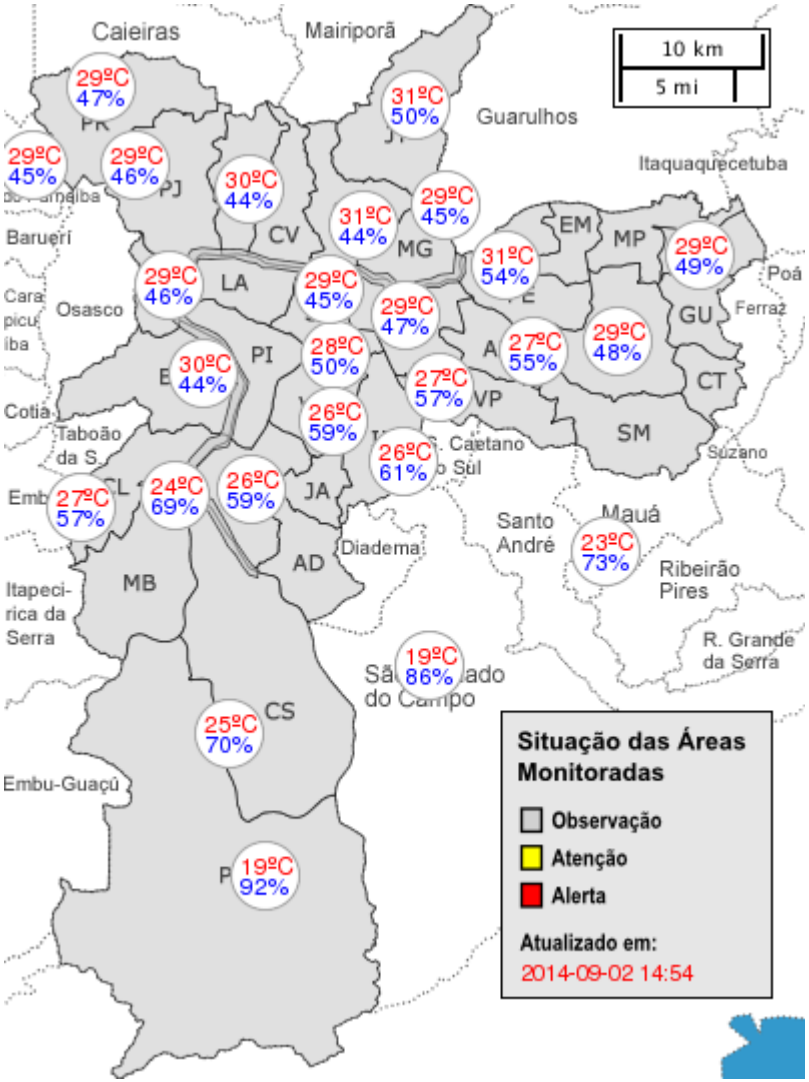


Main Users

- São Paulo Emergency Management Center (CGE)
- Water and Energy Users
  - DAEE (state water and energy department)
  - SABESP (Water)
  - EMAE / AES Eletropaulo (Energy)
- Others
  - Civil Defense
  - Municipality
  - Civil Construction

CGE - São Paulo Emergency Center
http://www.cgesp.org



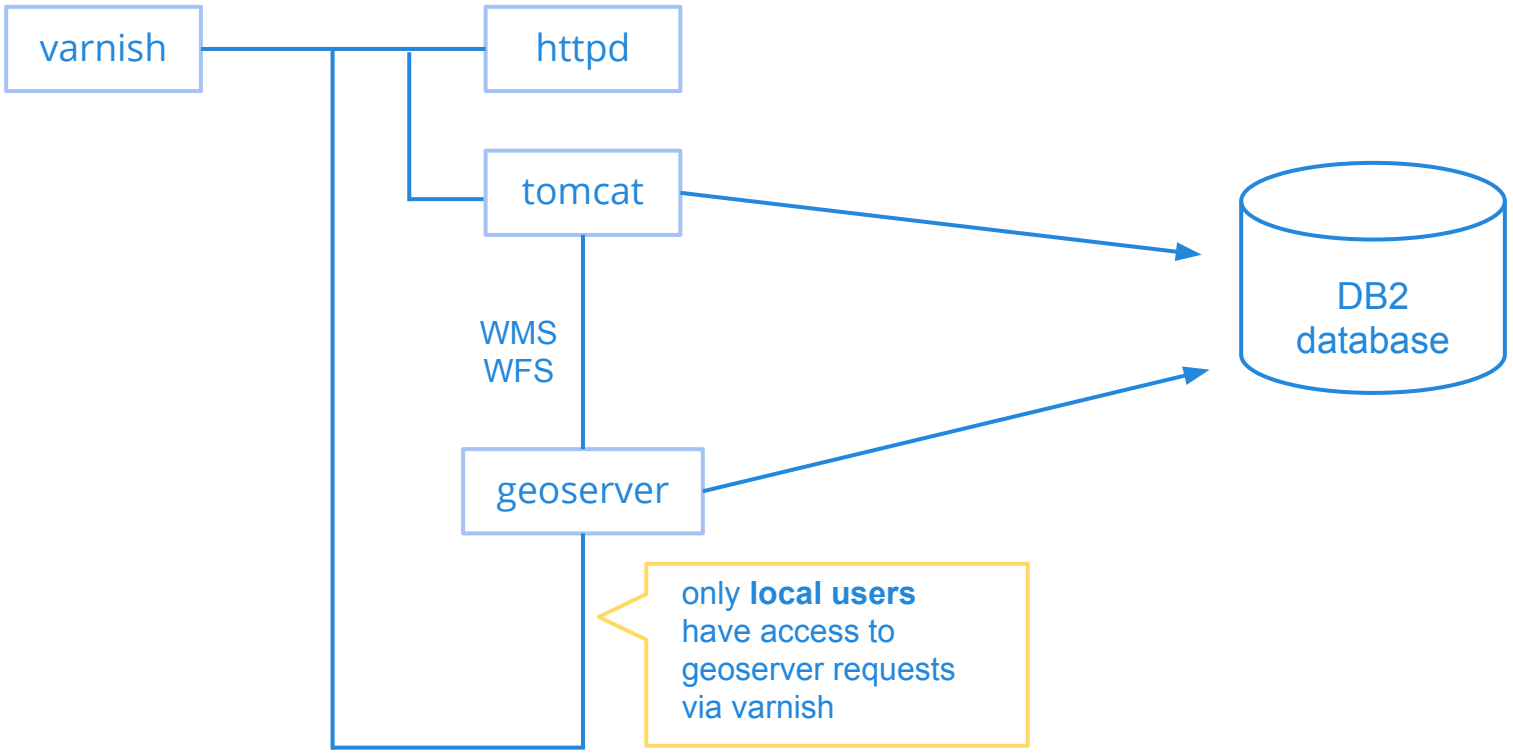


Infrastructure

- Virtual Machines
  - VMWare ESXi
  - Amazon EC2 (backup)
- CENTOS
  - Varnish 3
  - Apache HTTP Server
- Java 7
  - Apache Tomcat 7
  - Geoserver 2.5
- IBM DB2 - Express C
  - XML and Geospatial Data
  - 260 million records
  - 47 GB

São Paulo Flood Alert System - SAISP

http://www.saisp.br



All services run on virtual machines with redundancy.

What we use

- WMS / WFS (local and external)
- Geoserver / Geotools
  - Images and WFS
    - shapefiles, product data
  - ImageMaps (text/html output)
    - navigation in out application
    - data hints

What we use

CQL to split data in separate images

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<wmsProductLayer description="CTR" productId="V2_PNOVA2_CTR-P030_" url="__WMS_GEO2__" public="1" latest="0"/>
<wmsProductLayer description="CTR - Passado" productId="V2_PNOVA2_CTR-P030_" url="__WMS_GEO2__" public="1" latest="0">
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</wmsProductLayer>
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</wmsProductLayer>
    <wmsProductLayer description="CTR - Previsão - 10 em 10 minutos" productId="V2_PNOVA2_CTR-P030_" url="__WMS_GEO2__" public="1" latest="0">
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</wmsProductLayer>
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    <wmsParameter name="cql_filter">type = 'last_forecast'</wmsParameter>
</wmsProductLayer>
```

What we use

SLD and CSS for styling

```
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        <Title>Blue Line</Title>
        <ogc:Filter>
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                <ogc:Literal>current</ogc:Literal>
                </ogc:PropertyIsEqualTo></ogc:Filter>
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                <Stroke>
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        <PointSymbolizer>
                <Graphic>
                <ExternalGraphic>
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        </PointSymbolizer>
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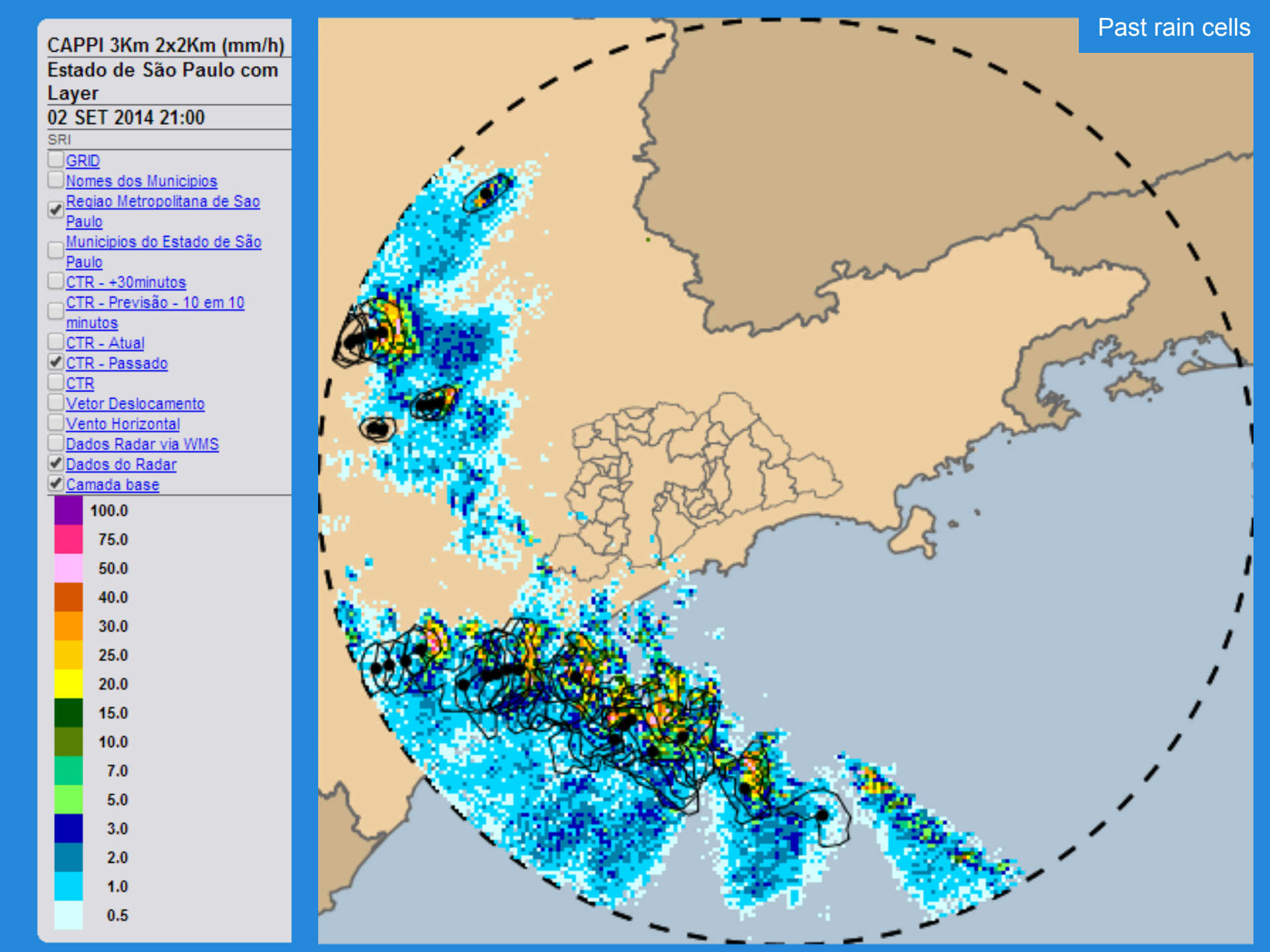
CAPPI 3Km 2x2Km (mm/h)
Estado de São Paulo com Layer
02 SET 2014 21:00
SRI
GRID
Nomes dos Municipios
Regiao Metropolitana de Sao Paulo
Municipios do Estado de São Paulo
CTR - +30minutos
CTR - Previsão - 10 em 10 minutos
CTR - Atual
CTR - Passado
CTR
Vetor Deslocamento
Vento Horizontal
Dados Radar via WMS
Dados do Radar
Camada base
100.0
75.0
50.0
40.0
30.0
25.0
20.0
15.0
10.0
7.0
5.0
3.0
2.0
1.0
0.5
Past rain cells

CAPPI 3Km 2x2Km (mm/h)
Estado de São Paulo com Layer
02 SET 2014 21:00
SRI

- [ ] GRID
- [ ] Nomes dos Municipios
- [x] Regiao Metropolitana de Sao Paulo
- [ ] Municipios do Estado de São Paulo
- [ ] CTR - +30minutos
- [ ] CTR - Previsão - 10 em 10 minutos
- [x] CTR - Atual
- [ ] CTR - Passado
- [ ] CTR
- [ ] Vetor Deslocamento
- [ ] Vento Horizontal
- [ ] Dados Radar via WMS
- [x] Dados do Radar
- [x] Camada base

100.0
75.0
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40.0
30.0
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3.0
2.0
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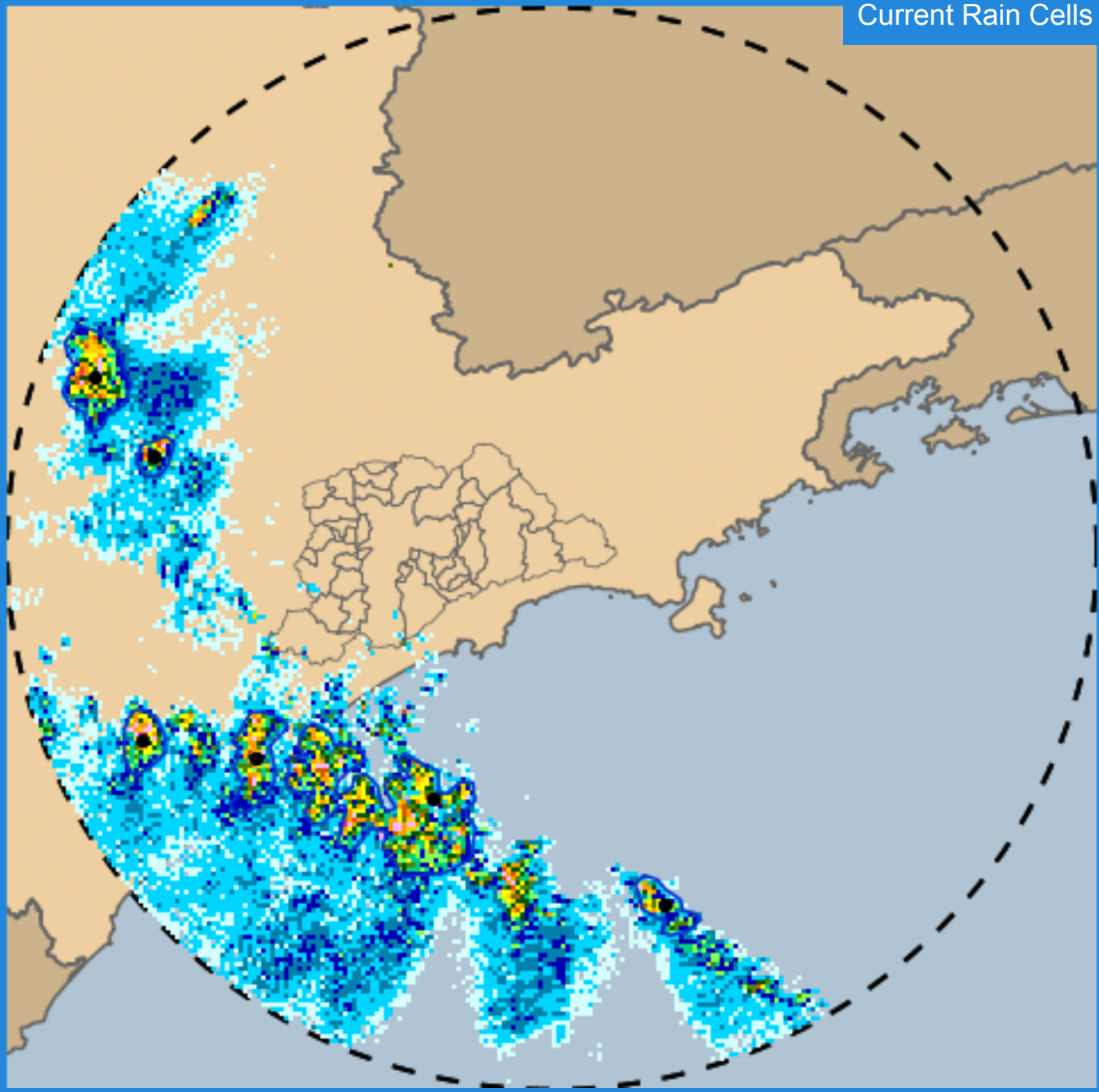

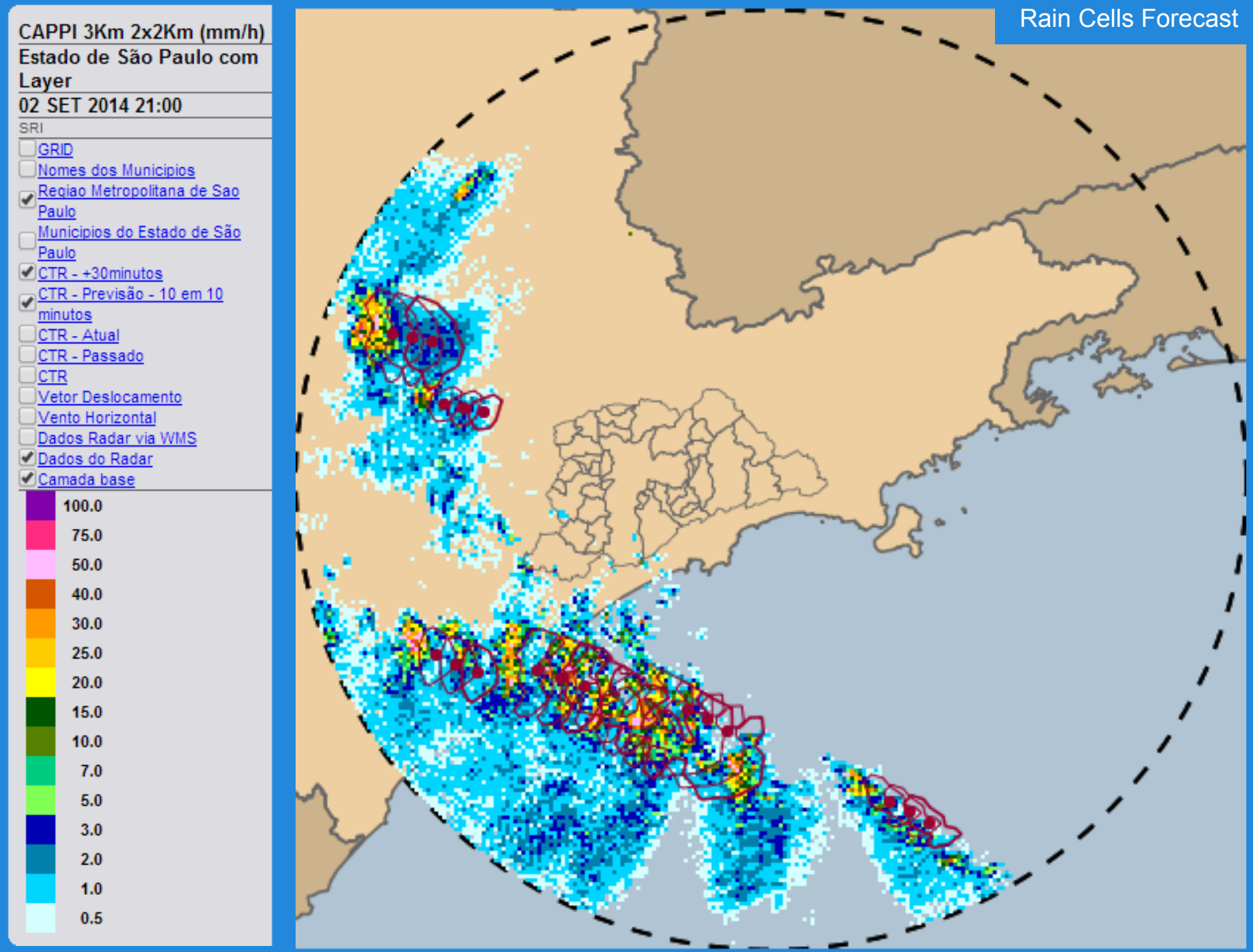
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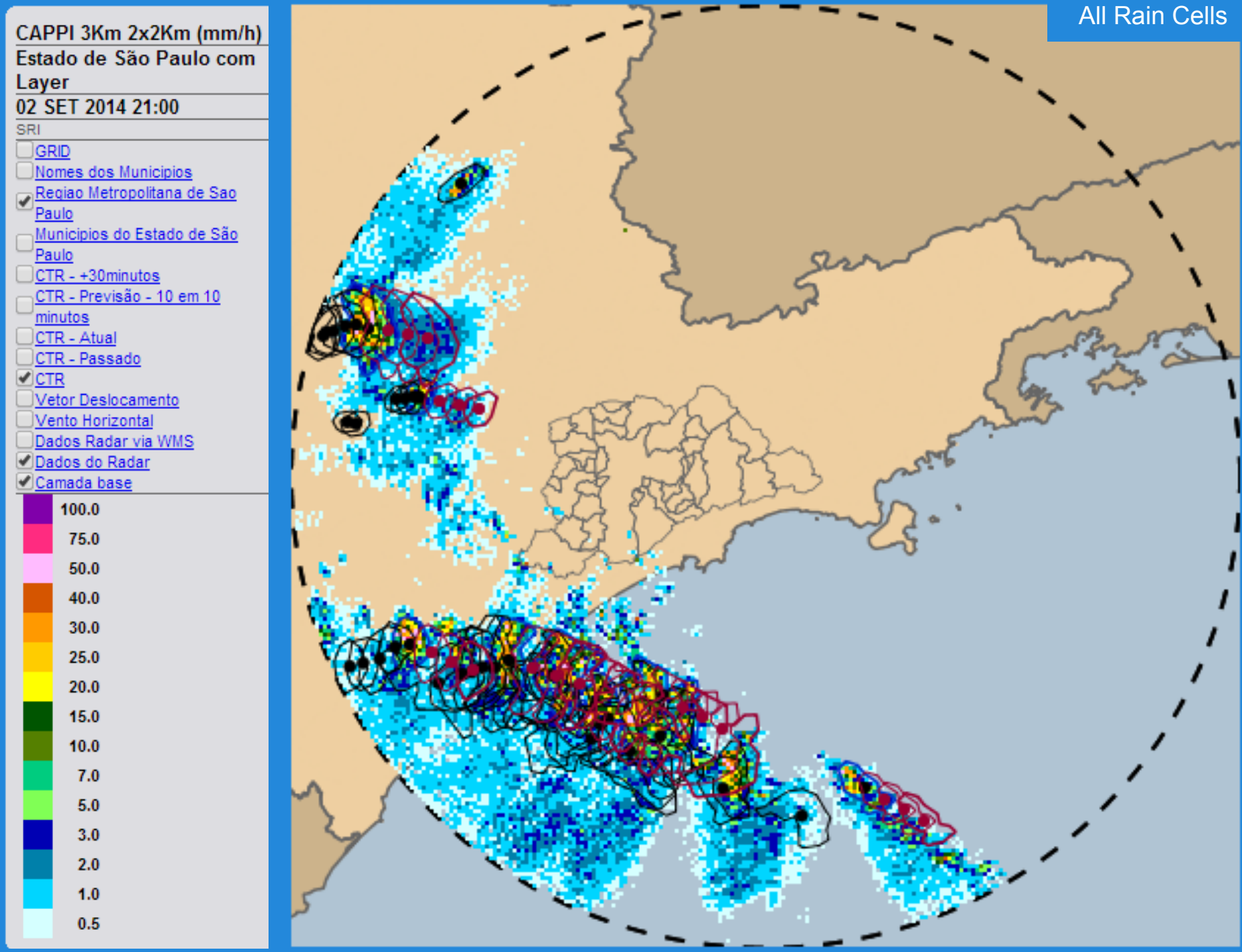
0.5
Rain Cells Forecast


CAPPI 3Km 2x2Km (mm/h)
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25.0
20.0
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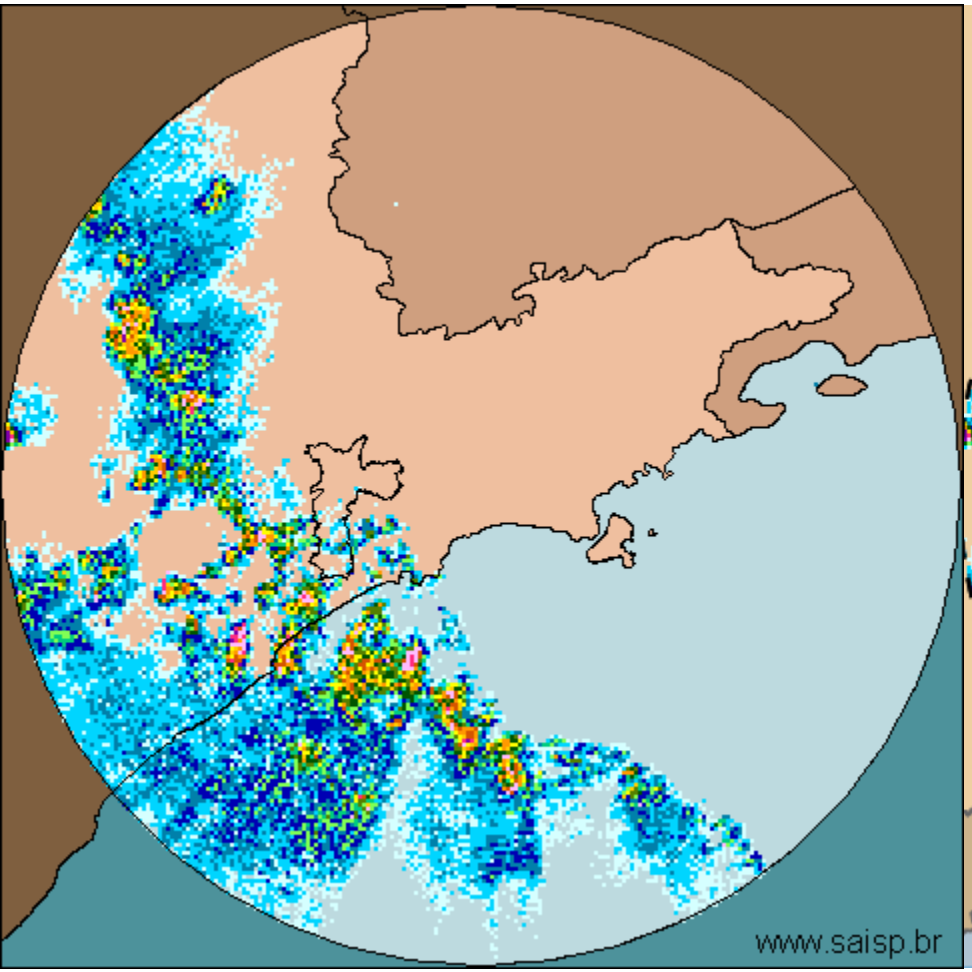
7.0
5.0
3.0
2.0
1.0
0.5
All Rain Cells

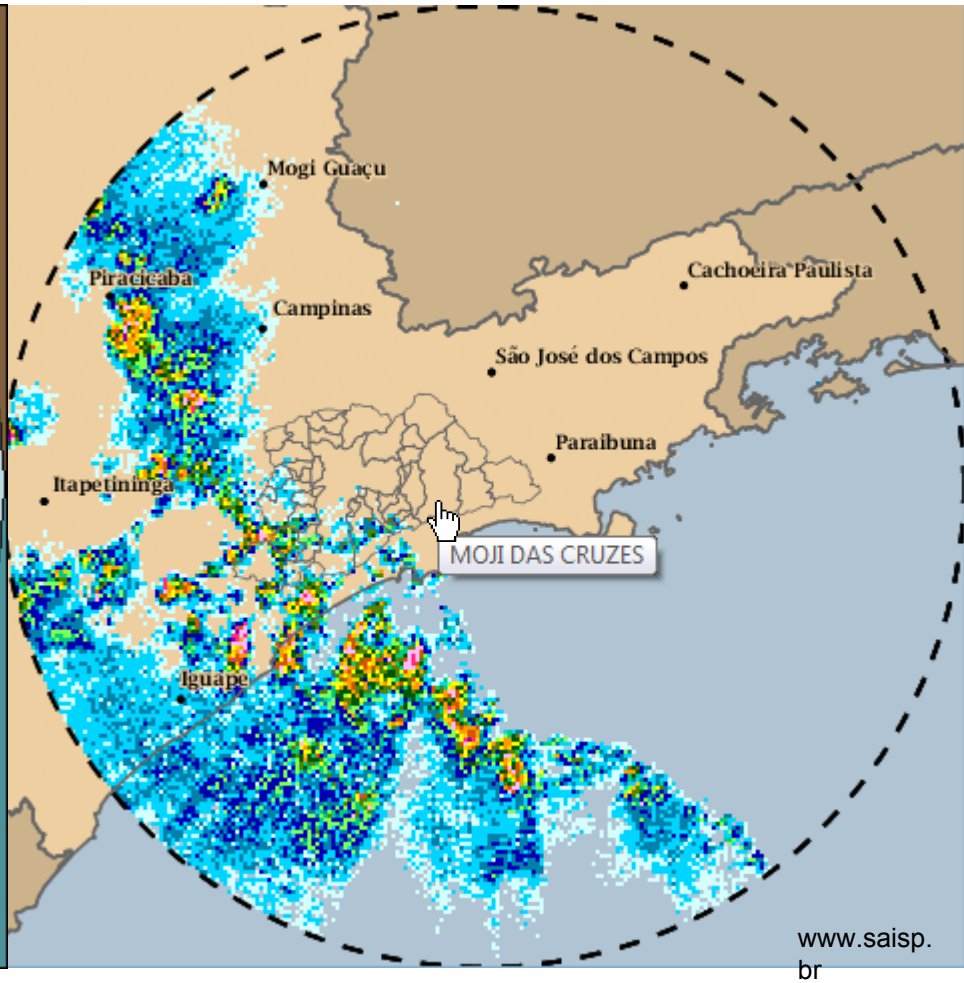
Data formats generated for users

- for web browsers
  - PNG / GIF / JPG
  - imagemap
- for google earth
  - KML
  - PNG
- for GIS
  - WMS
  - WFS

Maps

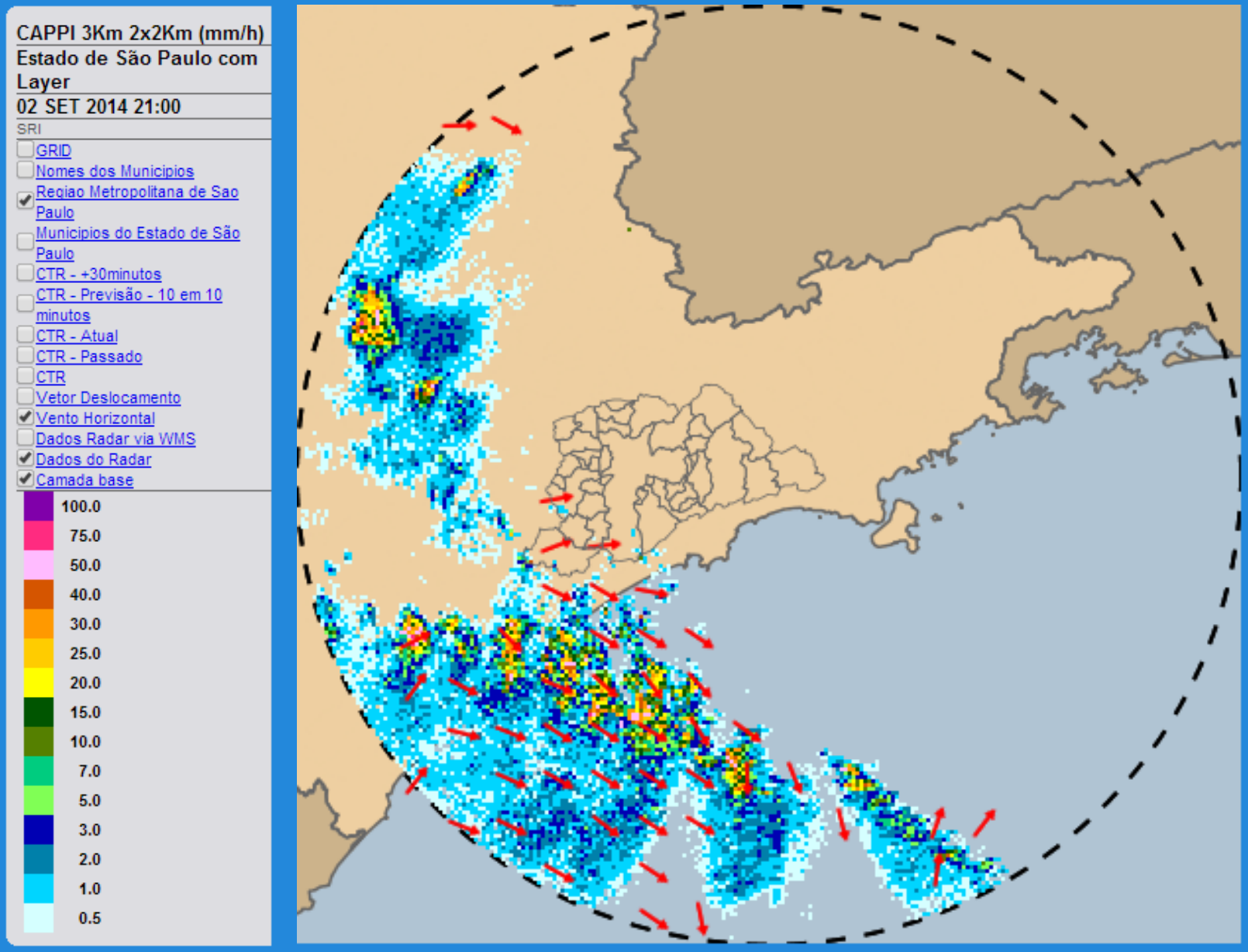


Old map: CAD BASED; Difficult to update;
Errors when updating



New map: Shape Based; Easy to update;
More control on Z order

Map Sample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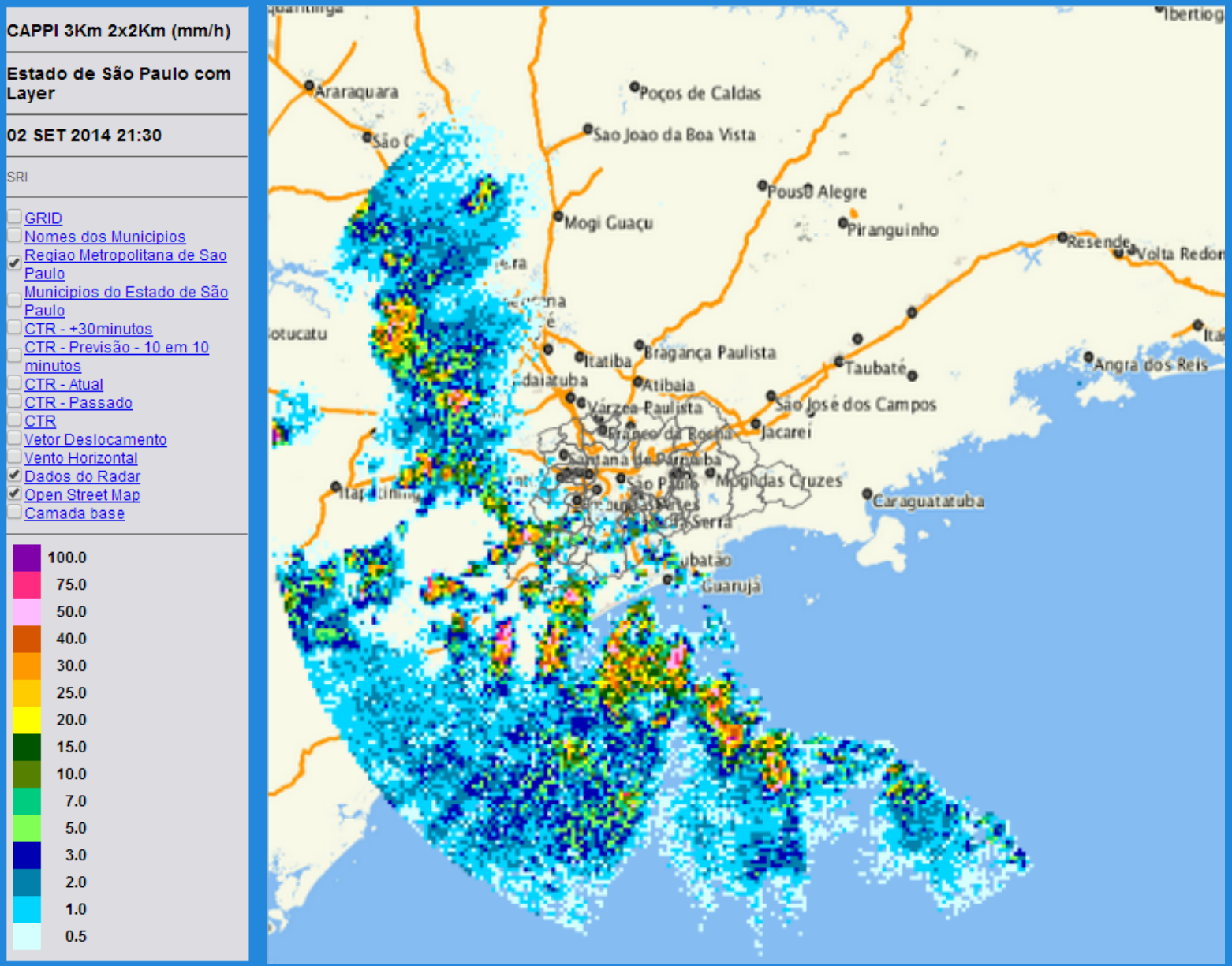
1.0
0.5

External Data: OpenStreetMap



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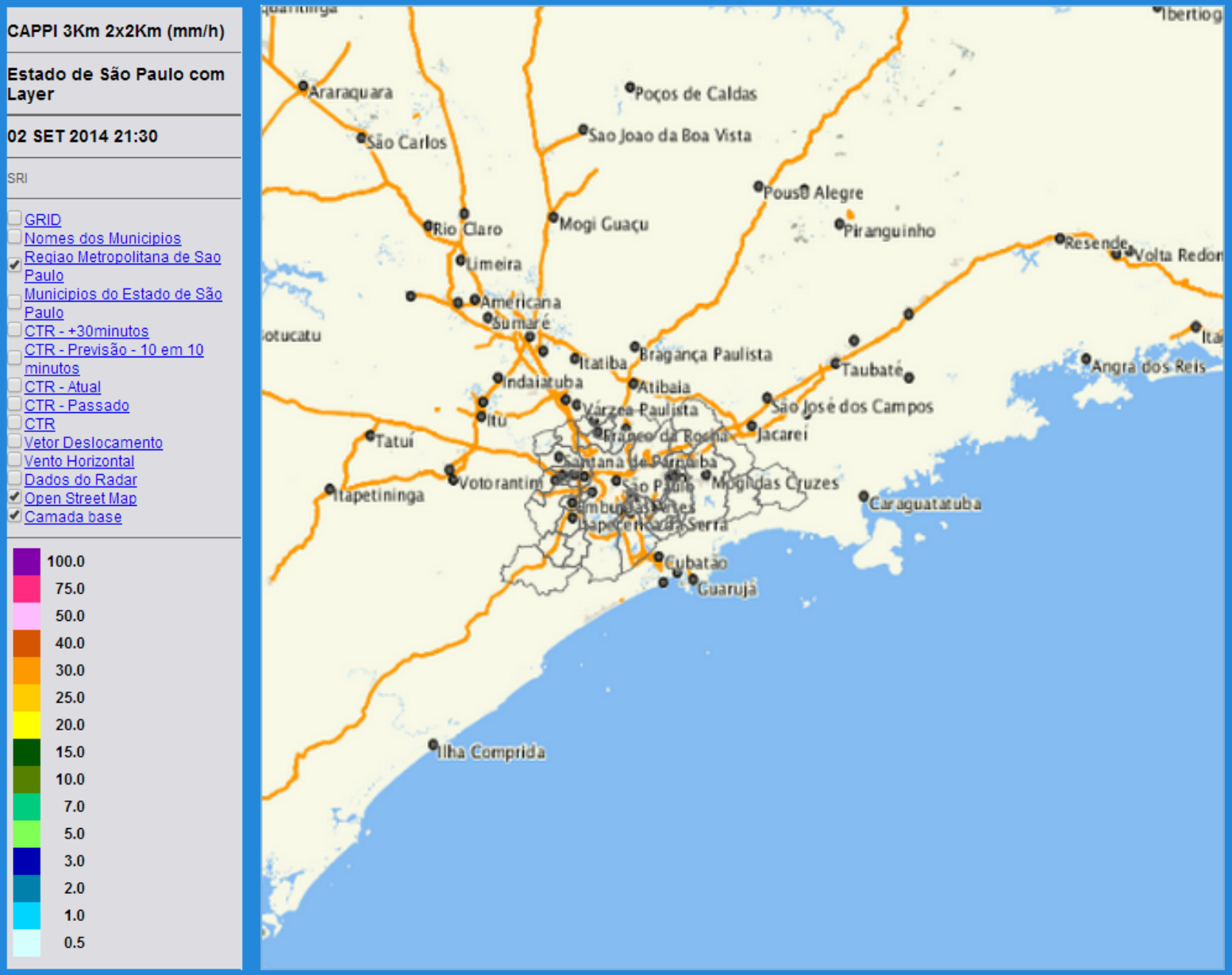

Geotools - Development

- DataStores for reading our files
  - http://docs.geotools.org/latest/userguide/library/data/datastore.html
  - http://docs.geotools.org/latest/userguide/tutorial/index.html
  - Implements
    - org.geotools.data.DataStoreFactorySpi
  - Extends
    - org.geotools.data.AbstractFileDataStore (OLD)
    - org.geotools.data.store.ContentDataStore (MIGRATING)
  - META-INF/services
    - org.geotools.data.DataStoreFactorySpi
    - org.geotools.data.FileDataStoreFactorySpi

Geotools - Development

- Our Implementation
  - Database Datastore
    - interface to our catalog on database
  - File Datastore
    - direct support for reading Radar files
- Using JMapFrame for basic testing
  - http://docs.geotools.org/latest/userguide/unsupported/swing/jmapframe.html
- Place your jars in the directory
  - geoserver/webapps/geoserver/WEB-INF/lib

Geotools - Data conversion

- Using polygons instead of raster for better control and quality in presentation
- Some RADAR products have multiple types of data
- Two solutions
  - schema with multiple fields
  - two schemas using different DataStores to read same file
- All our data in EPSG 4326, geotools converts when necessary

Next Steps

- Telemetrical Data
  - Implement SOS interface;
  - Implement in a DataStore with TIME support.
- Offer direct WMS access to external users
- MultiDimension support using ImageMosaic

Questions ?

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