

ENERGY

# Online Atlas

**Cómo identificar áreas idóneas para invertir en proyectos renovables**

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16 November 2019

**12,000**

employees

**150+**

years

**100+**

countries

**100,000+**

customers

**5% R&D**

of annual revenue

**MARITIME**



**OIL & GAS**



**ENERGY**



**BUSINESS  
ASSURANCE**



**DIGITAL  
SOLUTIONS**



Technology & Research

Global Shared Services



Renewable Developer: *I need help to explore the best places to develop new projects*

Investor: *I need support to review and screen investment opportunities*



- Where are the best resource conditions?
- Best grid connection?
- Might environmental or social restrictions affect the project?
- Is there any risk of severe hazards that could compromise the project return?
- And what if I adjust my criteria, can I get updated results?



# Online Atlas

## Main Features



Web Application, Map based

- Visualize and Explore using your browser



Exhaustive GIS Data Catalog

+ Wind & Solar resource layers

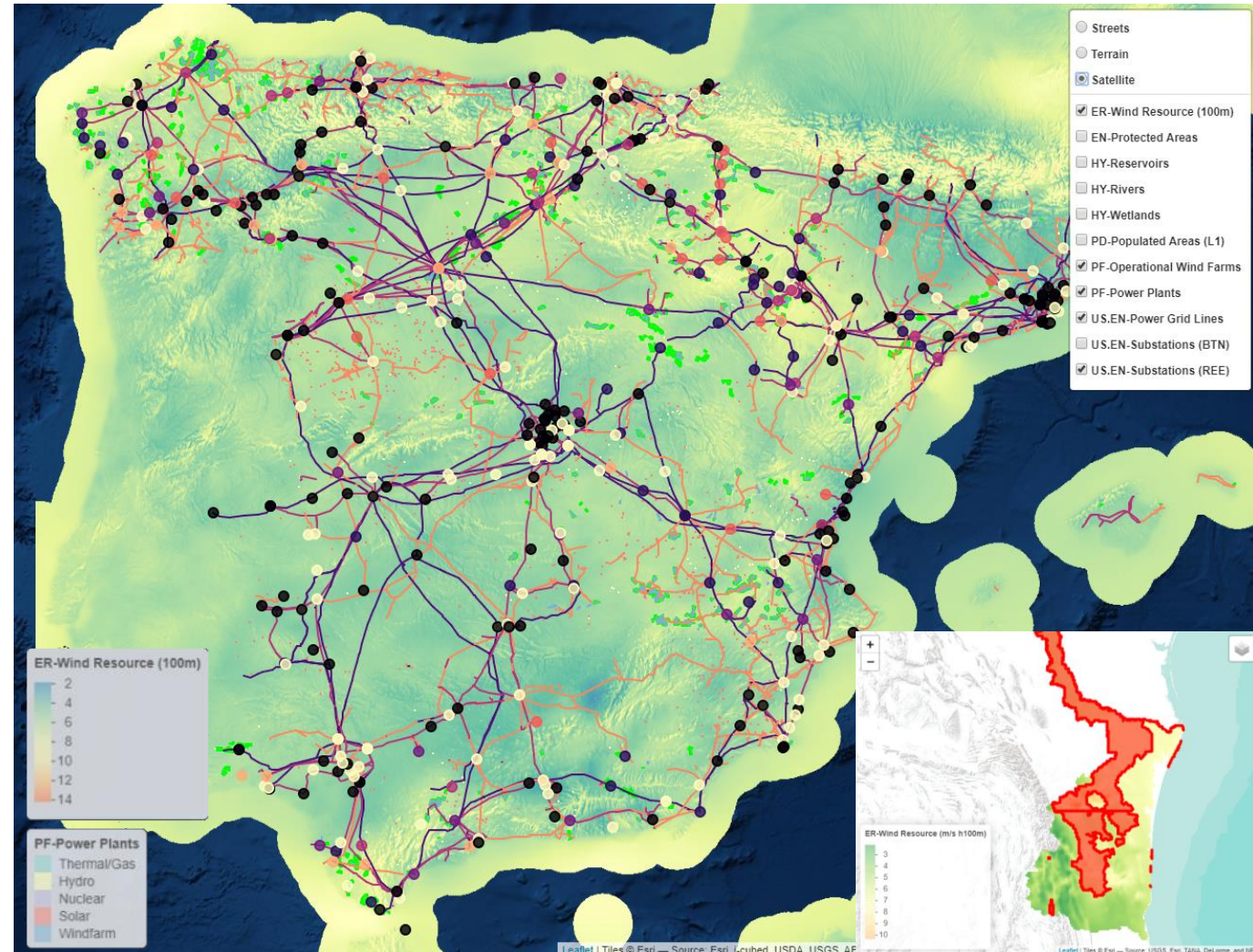
+ Key GIS datasets

Protected areas, Natural hazards, Hydrology,  
Terrain models, Power Grid...



Multicriteria Filtering

- Define and apply *ad hoc* restrictions
- Discover the suitable areas on the fly



Logged in as WSOA\_DEMO

Map

Where

Filters

Update Filter

Download Filter



Logged in as WSOA\_DEMO

Map

Where

Filters

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Download Filter

Please, choose your working area:

Country:

Nothing selected

España

México

Region/State:

Nothing selected

Update Area



Logged in as WSOA\_DEMO

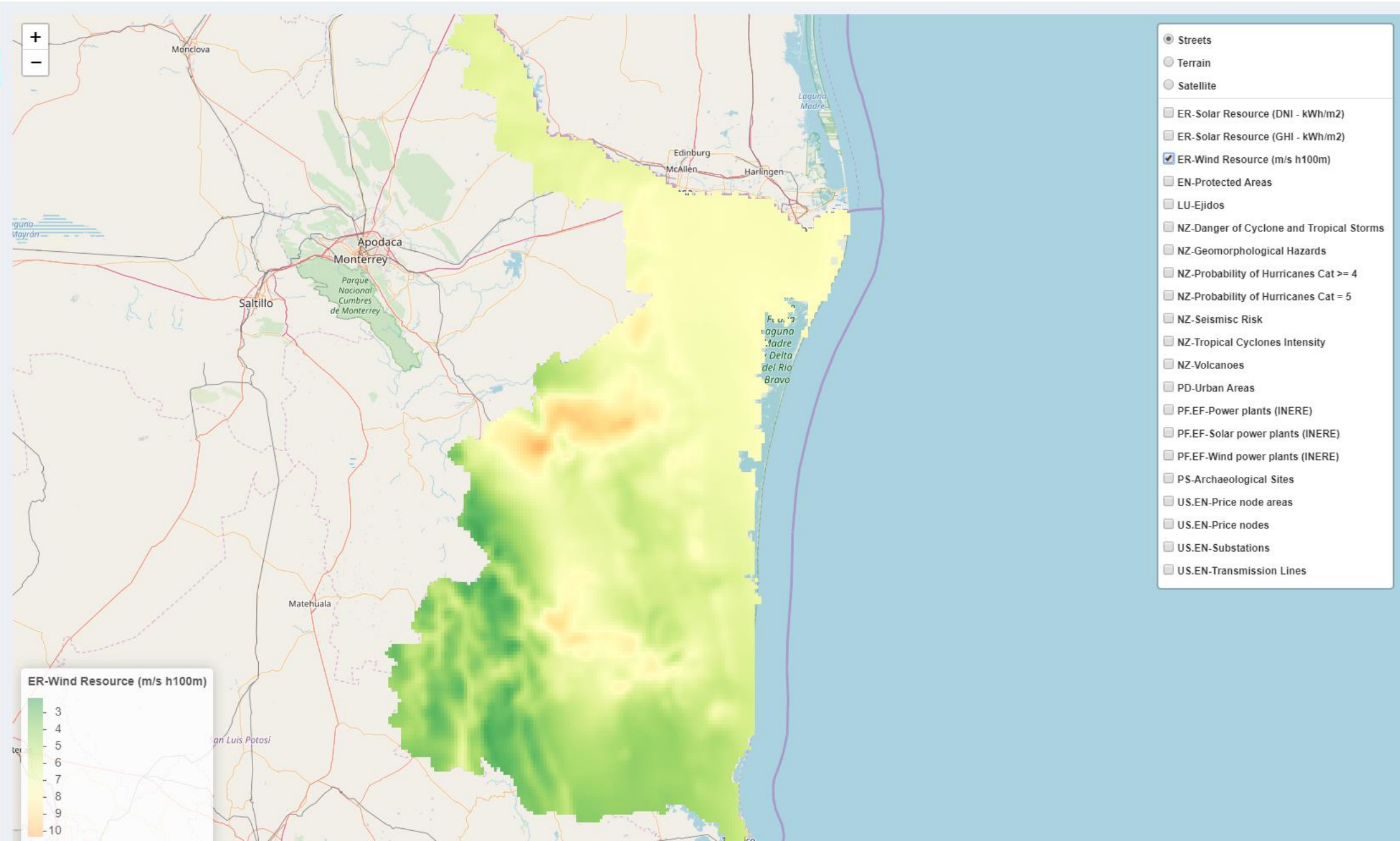
Map

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Filters

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Logged in as WSOA\_DEMO

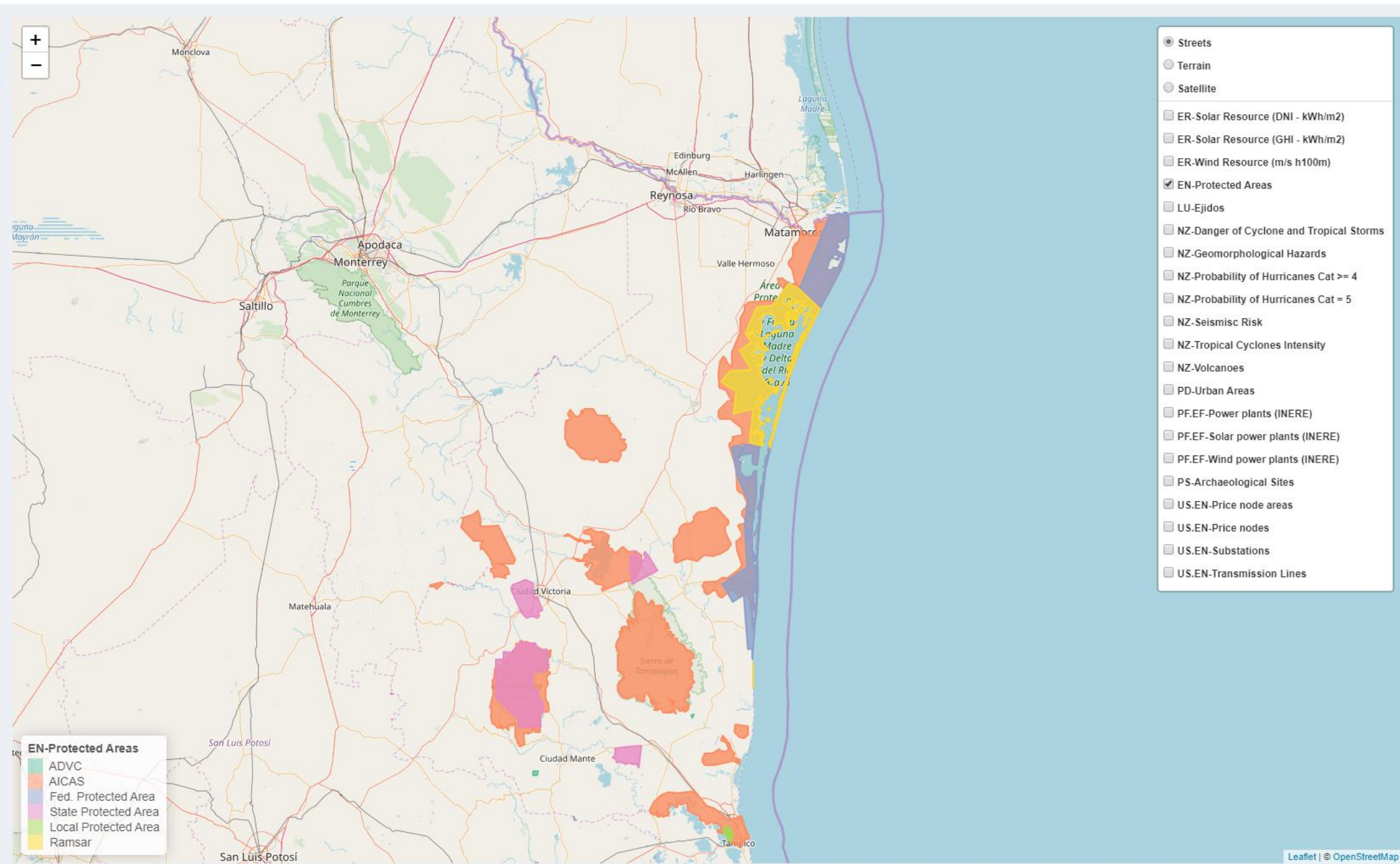
Map

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Logged in as WSOA\_DEMO

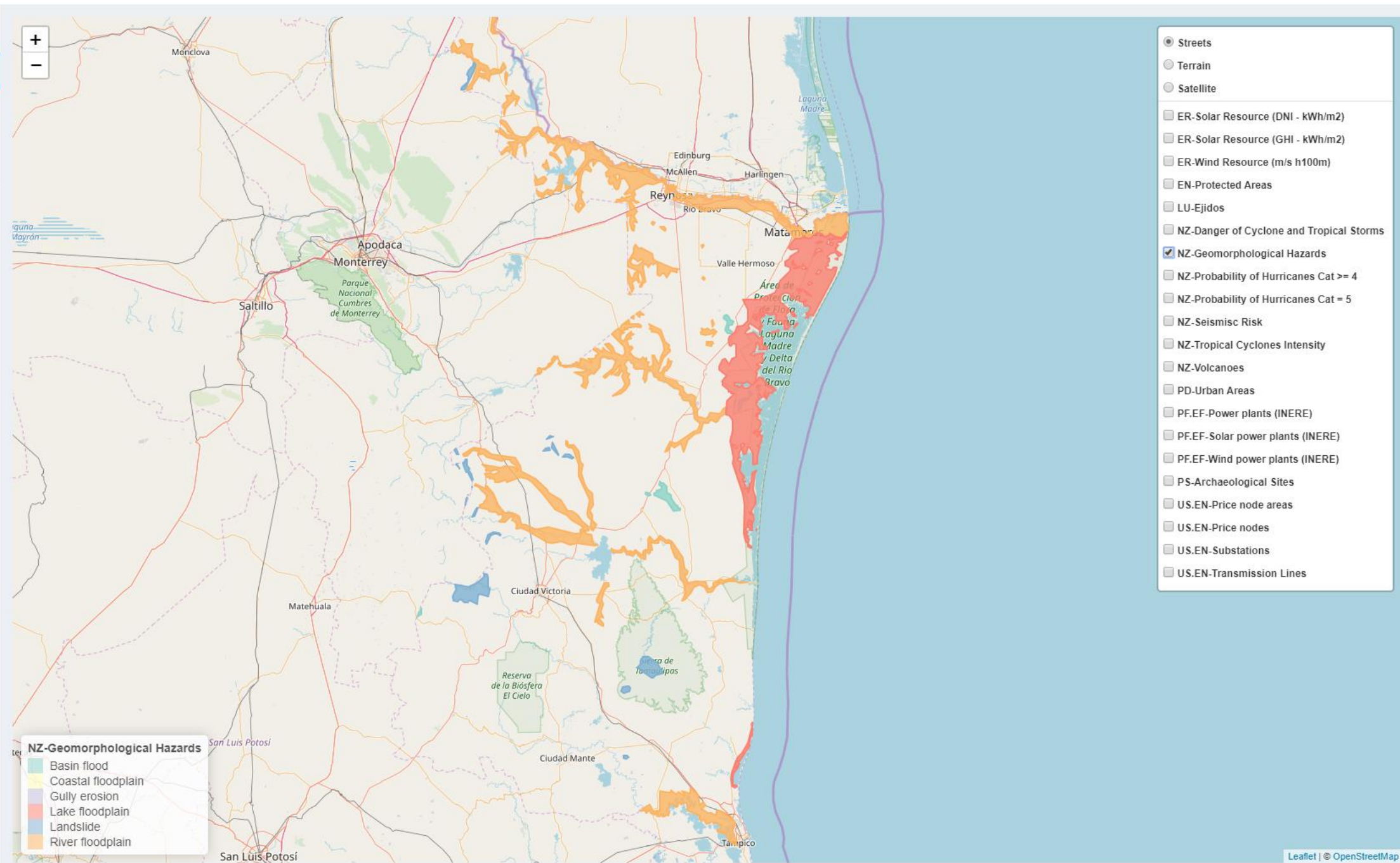
Map

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Logged in as WSOA\_DEMO

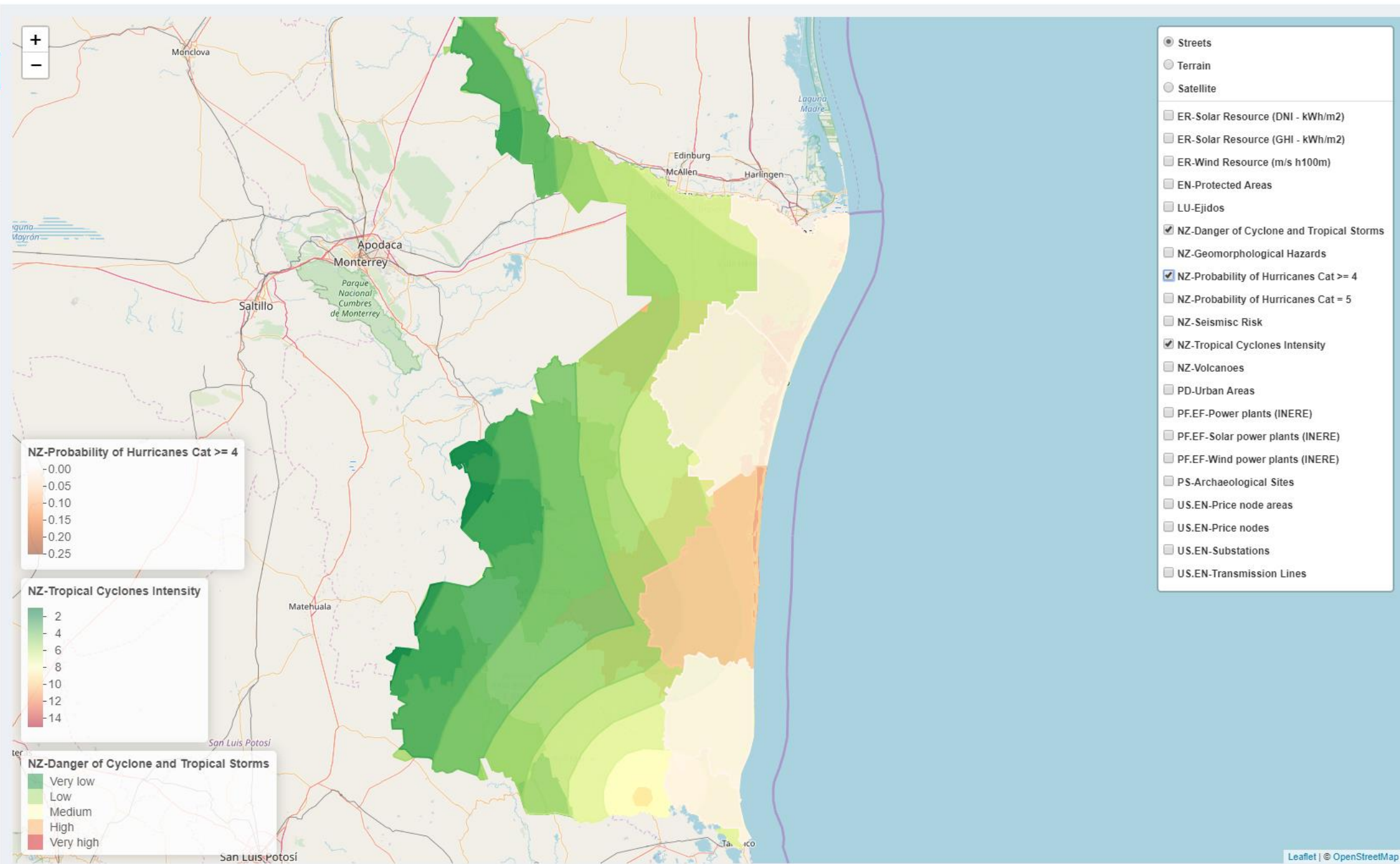
Map

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Filters

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Logged in as WSOA\_DEMO

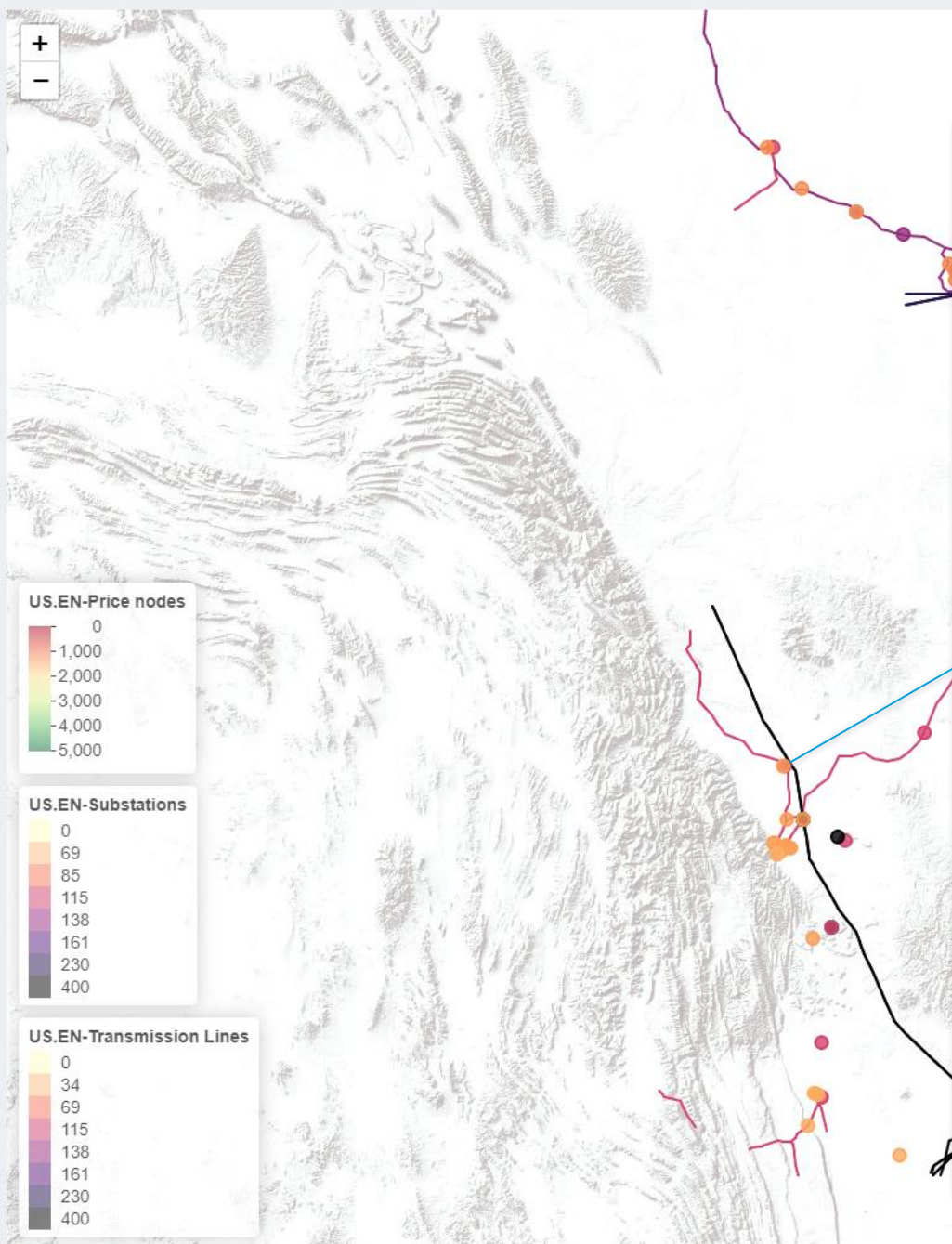
Map

Where

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Download Filter



## Price Node Profile

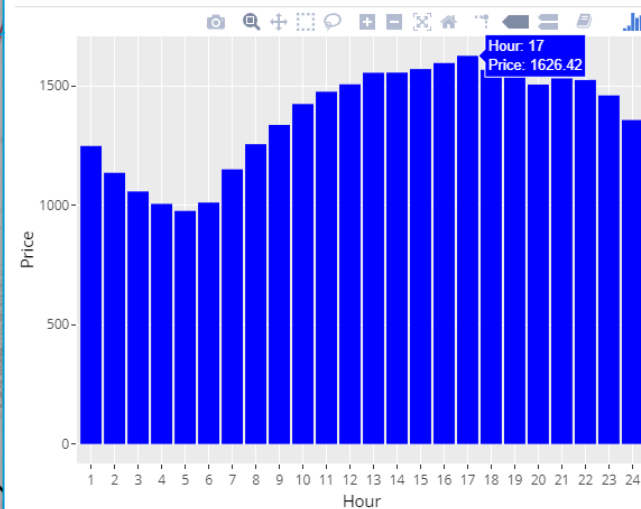
06BET-115

price node id	06BET-115
price node name	Barretal
voltage kv	115
iso 3166 2 code	MX-TAM
state	TAMAULIPAS
price	1374.16
price energy	1554.19
price losses	-70.3092
price congestion	-109.721

Nodal 24h price profile

Nodal Day-of-Week price profile

Nodal Monthly price profile



Dismiss

- ☐ Streets
- ☒ Terrain
- ☐ Satellite

- ☐ ER-Solar Resource (DNI - kWh/m2)
- ☐ ER-Solar Resource (GHI - kWh/m2)
- ☐ ER-Wind Resource (m/s h100m)
- ☐ EN-Protected Areas
- ☐ LU-Ejidos
- ☐ NZ-Danger of Cyclone and Tropical Storms
- ☐ NZ-Geomorphological Hazards
- ☐ NZ-Probability of Hurricanes Cat >= 4
- ☐ NZ-Probability of Hurricanes Cat = 5
- ☐ NZ-Seismic Risk
- ☐ NZ-Tropical Cyclones Intensity
- ☐ NZ-Volcanoes
- ☐ PD-Urban Areas
- ☐ PF.EF-Power plants (INERE)
- ☐ PF.EF-Solar power plants (INERE)
- ☐ PF.EF-Wind power plants (INERE)
- ☐ PS-Archaeological Sites
- ☐ US.EN-Price node areas
- ☒ US.EN-Price nodes
- ☒ US.EN-Substations
- ☒ US.EN-Transmission Lines



Logged in as WSOA\_DEMO

Map

Where

Filters

Update Filter

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## Energy Production Facilities

### Electricity Network

Distance to Power Line and kV level

Distance to Substation and kV level

Distance to Nodes with Congestion Price Range

Distance to Nodes with Price Range

## Hydrography

### Natural Risk Zones

Volcanoes

Seismic Risk

Geomorphological Hazards

Danger of Cyclone and Tropical Storms

Tropical Cyclone Incidence

Probability of Hurricanes Cat  $\geq 4$

Probability of Hurricanes Cat = 5

#### Hazard Type

6 items selected

Select All

Deselect All

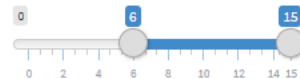
- Basin flood ✓
- Coastal floodplain ✓
- Gully erosion ✓
- Lake floodplain ✓
- Landslide ✓
- River floodplain ✓

## Environment

### Energy Resources

Solar Resource (DNI) Value Range

Wind Resource (Mesoscale) Value Range



Logged in as WSOA\_DEMO

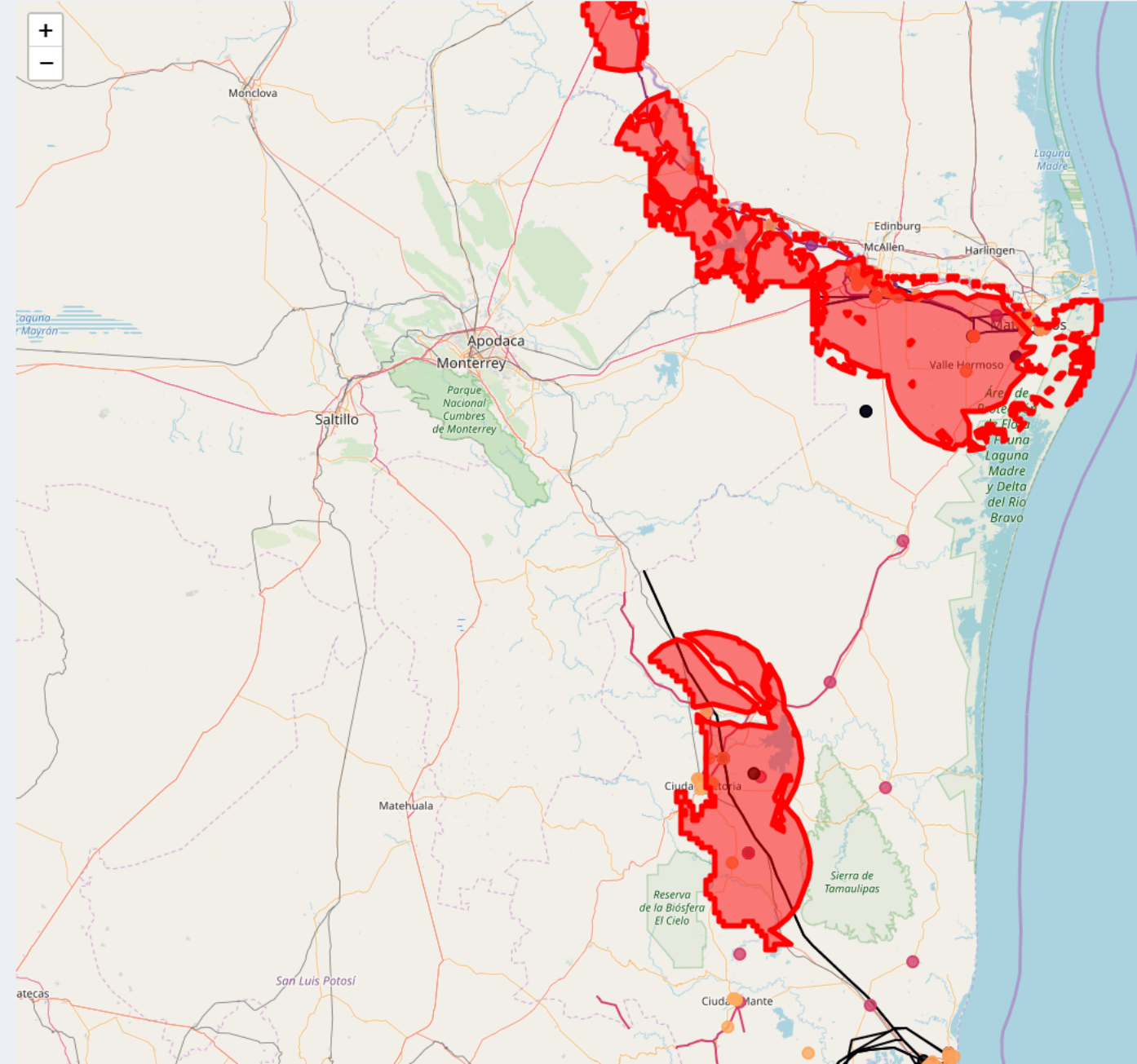
Map

Where

Filters

Update Filter

Download Filter

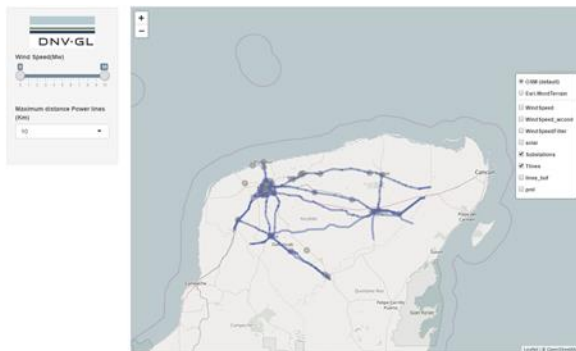


- ☒ Streets
- ☐ Terrain
- ☐ Satellite
- ☒ Suitable Area
- ☐ ER-Solar Resource (DNI - kWh/m2)
- ☐ ER-Solar Resource (GHI - kWh/m2)
- ☐ ER-Wind Resource (m/s h100m)
- ☐ EN-Protected Areas
- ☐ LU-Ejidos
- ☐ NZ-Danger of Cyclone and Tropical Storms
- ☐ NZ-Geomorphological Hazards
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# Why R? Why Shiny?

- Already using R + Shiny for internal analysis and basic tools
  - Data-centric
  - Visual and interactive
  - Agile app lifecycle

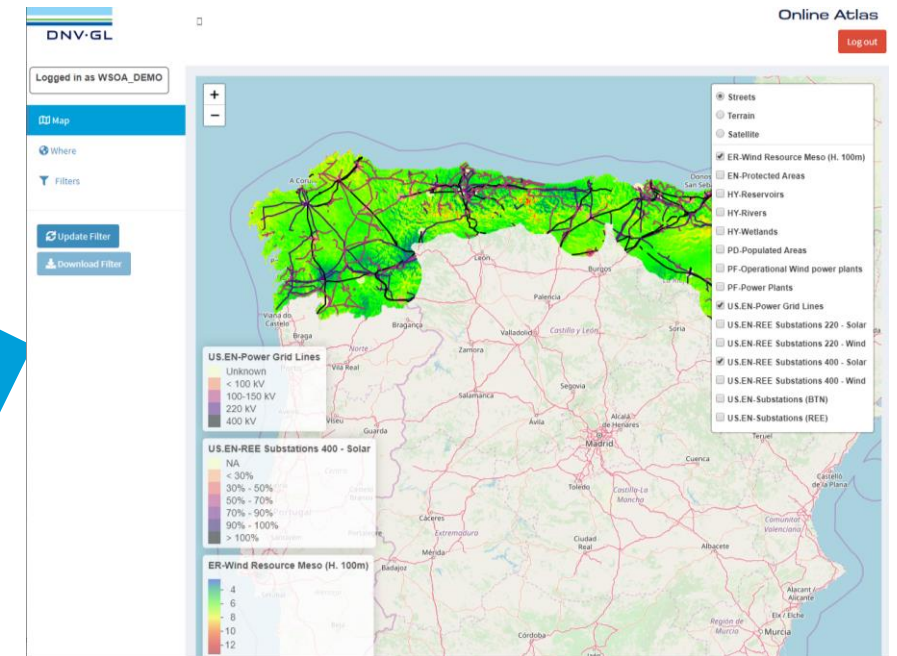
App Mock-up



Demo App  
with basic features



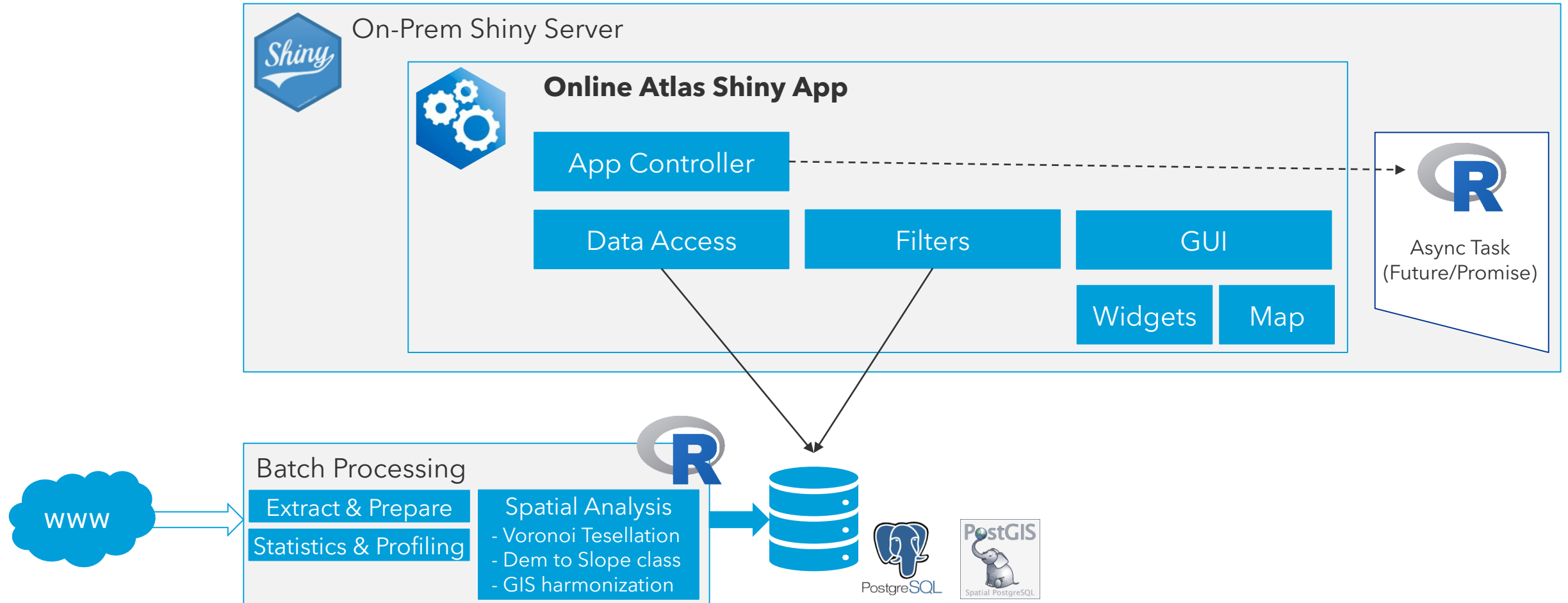
Fully functional App



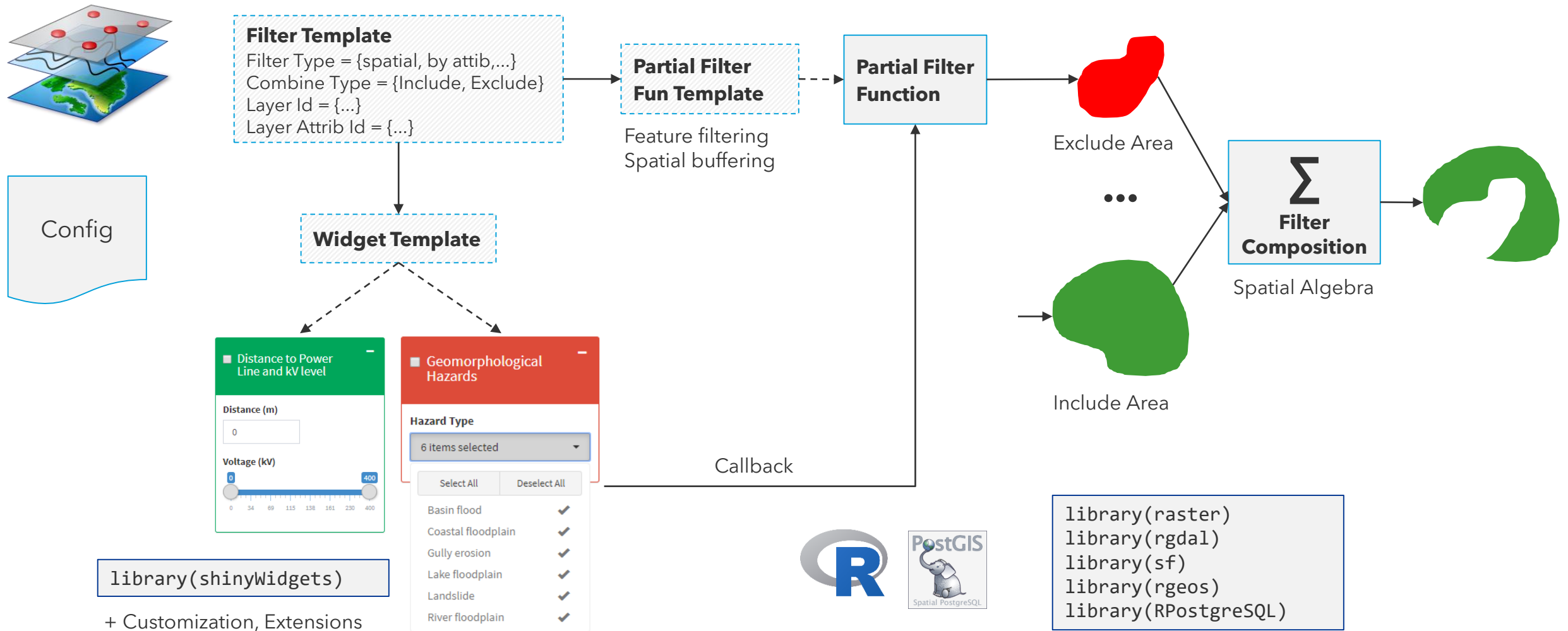
```
library(shiny)
library(shinyjs)
library(shinyauthr)
library(shinydashboard)
library(shinycssloaders)
```



# Architecture



# Filter Engine



## Responsiveness. Asynchronous Processes

---

- Wide catalog of large datasets (GIS, tabular)
- **Avoid app from stalling/blocking when performing heavy tasks with large datasets**
  - Loading & Rendering
  - Complex computations on the fly: Filters
- **Massive use of Futures and Promises**
  - Asynchronous execution, lazy evaluation, promises chaining
  - Integration with Shiny: event-driven, reactive values

```
library(promises)
library(future)
plan(multiprocess)

user_data <- reactiveValues()
user_data$geo_layers_promise <- future({load_layers(...)})
then(user_data$geo_layers_promise,
      onFulfilled = function(actual_geo_layers) {
        render(actual_geo_layers)
      })
```



# Performance boosting

## ■ DB pooling

- Pool of preset connections to the database
  - Fetch idle connection from pool → Release
- Special care with Future operations
  - Connection from pool not preserving state when passed to “promised” function
    - Different thread!
  - Need to pass *DSN* and let “promised” function get itself a new connection

```
library(RPostgreSQL)
require(pool)

dbcon <- get_db_con_pool(dsn)
geo_layers_promise <- future({load_layers(dbcon)})
```

## ■ Filter precalculation

- Offline processes to create precalculated results
  - Spatial calculus & algebra

# Visualization

## ■ Maps

### – Leaflet

- Configurable styles per layer
- *Issues*
  - *Integration of Leaflet JS plugins*
  - *Dealing with hierarchical data (toggling visualization)*
  - *Multi-styled visualization (same layer, different attributes)*

## ■ Data

### – Plotly

- Tabular, Charts



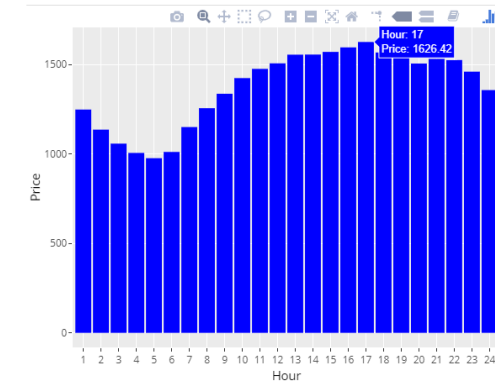
```
library(leaflet)  
library(leaflet.extras)
```

Price Node Profile

06BET-115	
price node id	06BET-115
price node name	Barretal
voltage kv	115
iso 3166 2 code	MX-TAM
state	TAMAULIPAS
price	1374.16
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Nodal Monthly price profile



Dismiss

# Thanks!

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