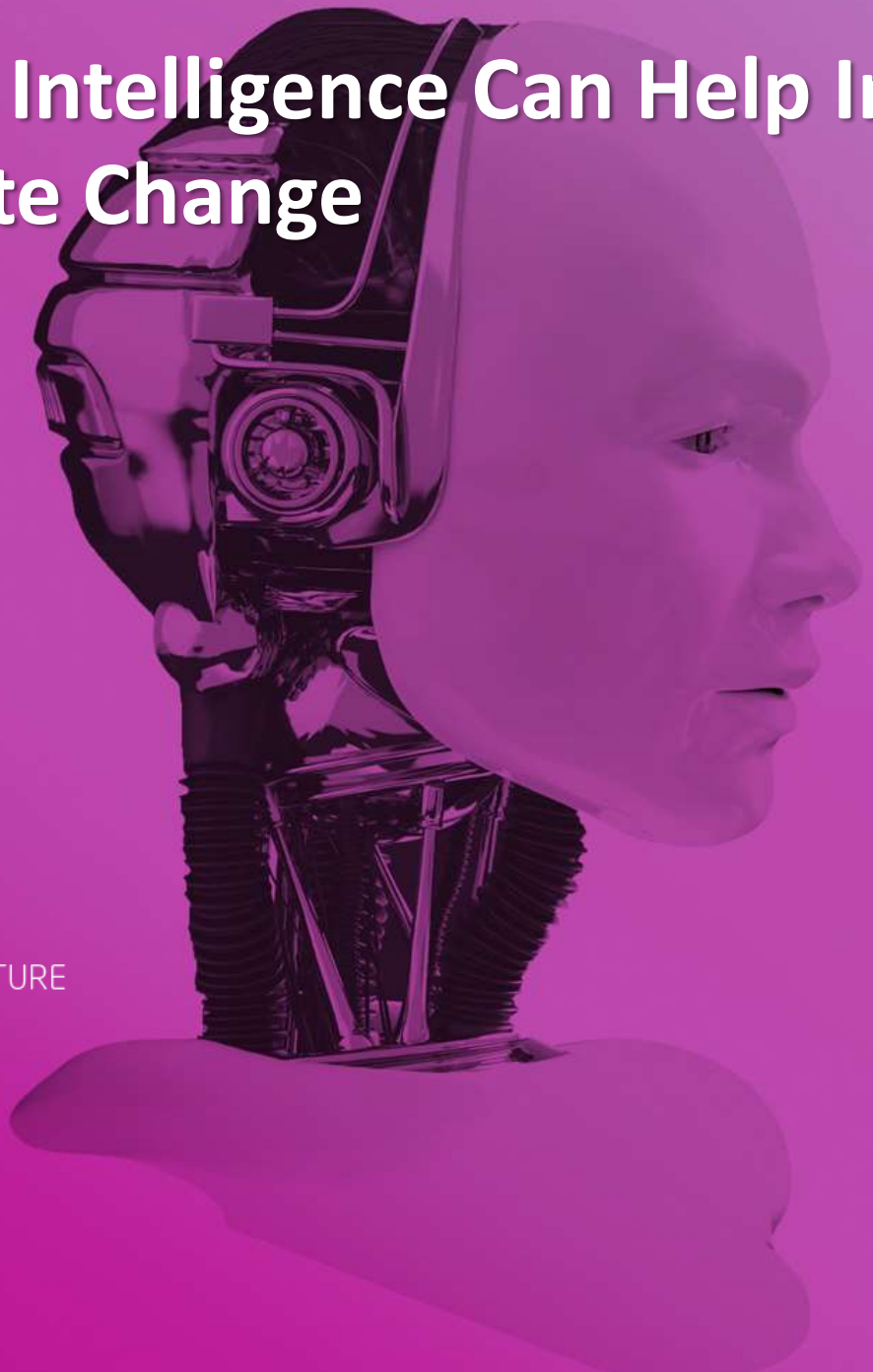
How Artificial Intelligence Can Help In The Fight Against Climate Change



AI &COGNITIVE SYSTEMS FORUM

CONNECTED TRANSPORT

MANUFACTURING

HEALTHCARE

ENERGY AND UTILITIES

BUILDINGS & INFRASTRUCTURE

OPEN INDUSTRY

ENABLING IoT

AI & COGNITIVE SYSTEMS FORUM

AGUAS DE ALICANTE
AGUAS MUNICIPALIZADAS DE ALICANTE (Empresa Mixta)

1. Alicante context

Alicante Context (Spain)

1930s

Touristic Urbanization 1950-70

1980

2018

Aguas de Alicante

1898 → **1953**

Ayuntamiento de Alicante

50% 50%

HIDRAQUA

SUEZ

AGUAS DE ALICANTE

AGUAS MUNICIPALIZADAS DE ALICANTE (Empresa Mixta)

(*) First Mixed Capital Company of the water sector in the world (according to World Bank)

AI & COGNITIVE SYSTEMS FORUM

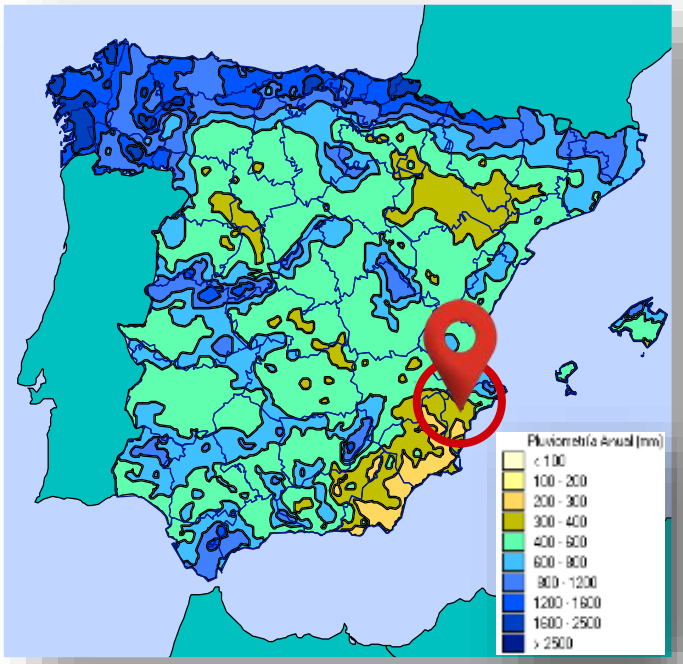
City challenges

Alicante faces complex conditions

- Semi-arid climate
- No local water sources
- Seasonal torrential rains
- Impact of tourism

Responsible and efficient management

- Water resources preservation
- Environmental care
- Preventive strategy for urban resilience

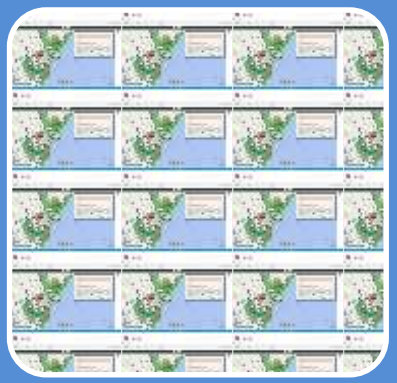


13 CLIMATE ACTION

6 CLEAN WATER AND SANITATION

Research, Development and Innovation R&D Projects (1/3)

AGUAS DE ALICANTE
AGUAS MUNICIPALIZADAS DE ALICANTE (Empresa Mixta)



SIPAID

- Flood and CSO early warning system
- Online access for the Municipality and Emergency Services
- Short and médium term forecast, radar, rain gauges and level gauges

Augmented Reality for Street works

- Aimed at citizen communication
- Real time info on work planning, progress, street closures..
- Web publication + AR app

ICAP

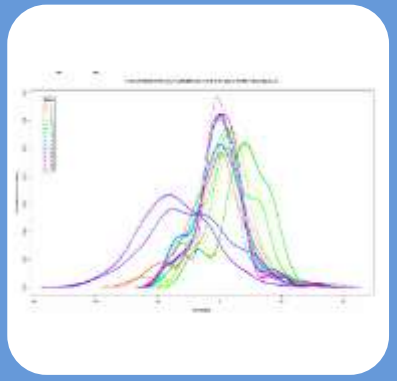
- Regional platform for water quality monitoring and warnings
- Jointly with Mancomunidad de Canales del Taibilla (Public bulk wáter provider)

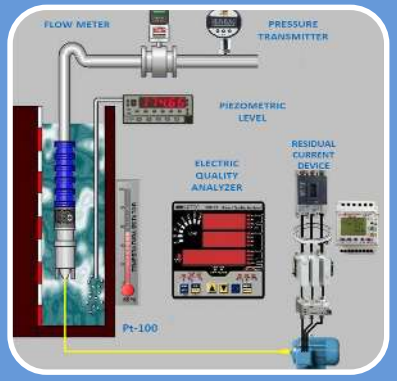
Smart Irrigation

- Urban irrigation optimization
- Analyses plant species, rain, weather forecast…
- Industrialised by Advanced Solutions

Research, Development and Innovation R&D Projects (2/3)

AGUAS DE ALICANTE
AGUAS MUNICIPALIZADAS DE ALICANTE (Empresa Mixta)





PALACE

- Multi-model software for water demand prediction, based on a hybrid (time series + external factors) approach
- Short time: 1-6 days
- Long time: 1 year

IDROSMARTWELL

- Patented level sensor for groundwater wells
- Real time control of hydrogeological + technical parameters
- Optimization of energy consumption and maintenance

RECYCLING OF EXCAVATION MATERIALs

- Processing of excavation materials for trench backfilling
- Technical suitability tests for validation
- Economic and environmental analysis

DAIAD

INNOVATION RADAR Prize

- European FP7 project
- IoT device and app for water and energy consumption monitoring
- Winner of the EC Innovation Radar Prize (Tech for Society Award)

Research, Development and Innovation
R&D Projects (3/3)

INLOC*

SOUNDWATER*

ROBOTOUR*

CIS-WATER

*In collaboration with the Innovation Office of Suez Water Spain

2. Climate Crisis

#cities

@aszapla

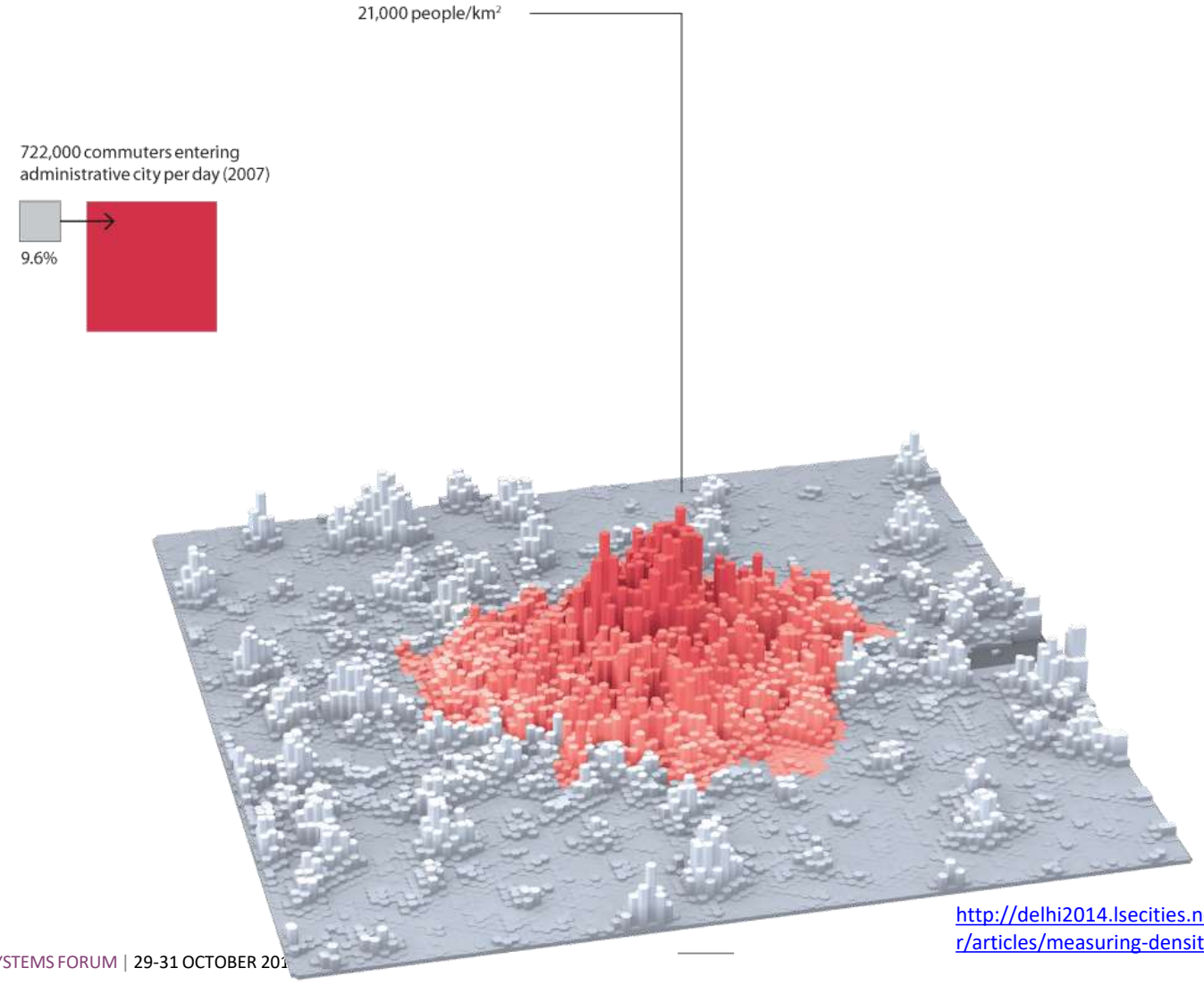
Image: Amos Chapple

https://www.youtube.com/watch?v=2WGPvWPpey8

@aszapla

LONDON

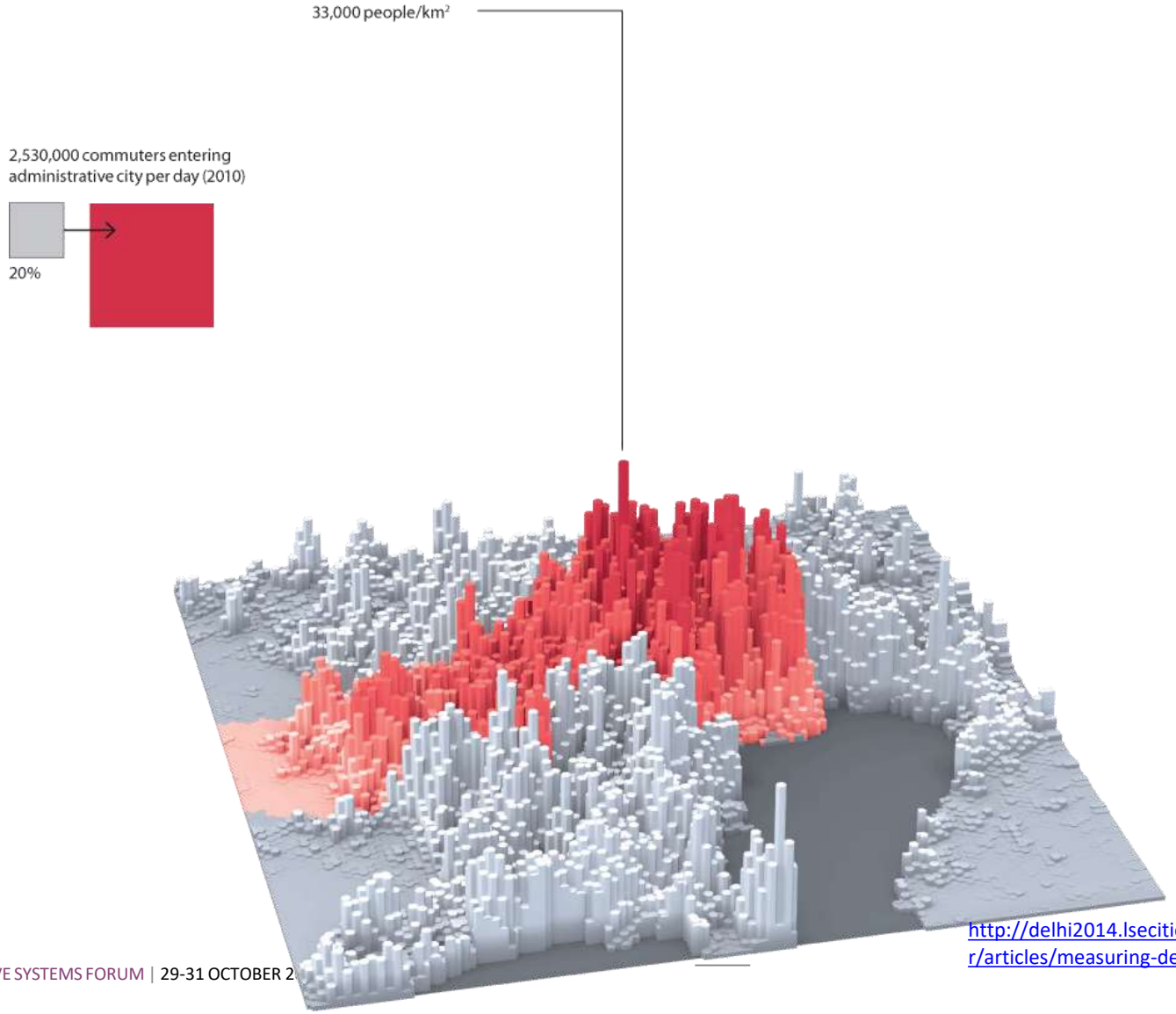
#urbanfooprint



http://delhi2014.lsecities.net/newspaper/articles/measuring-density/en-gb/

@aszapla

TOKYO



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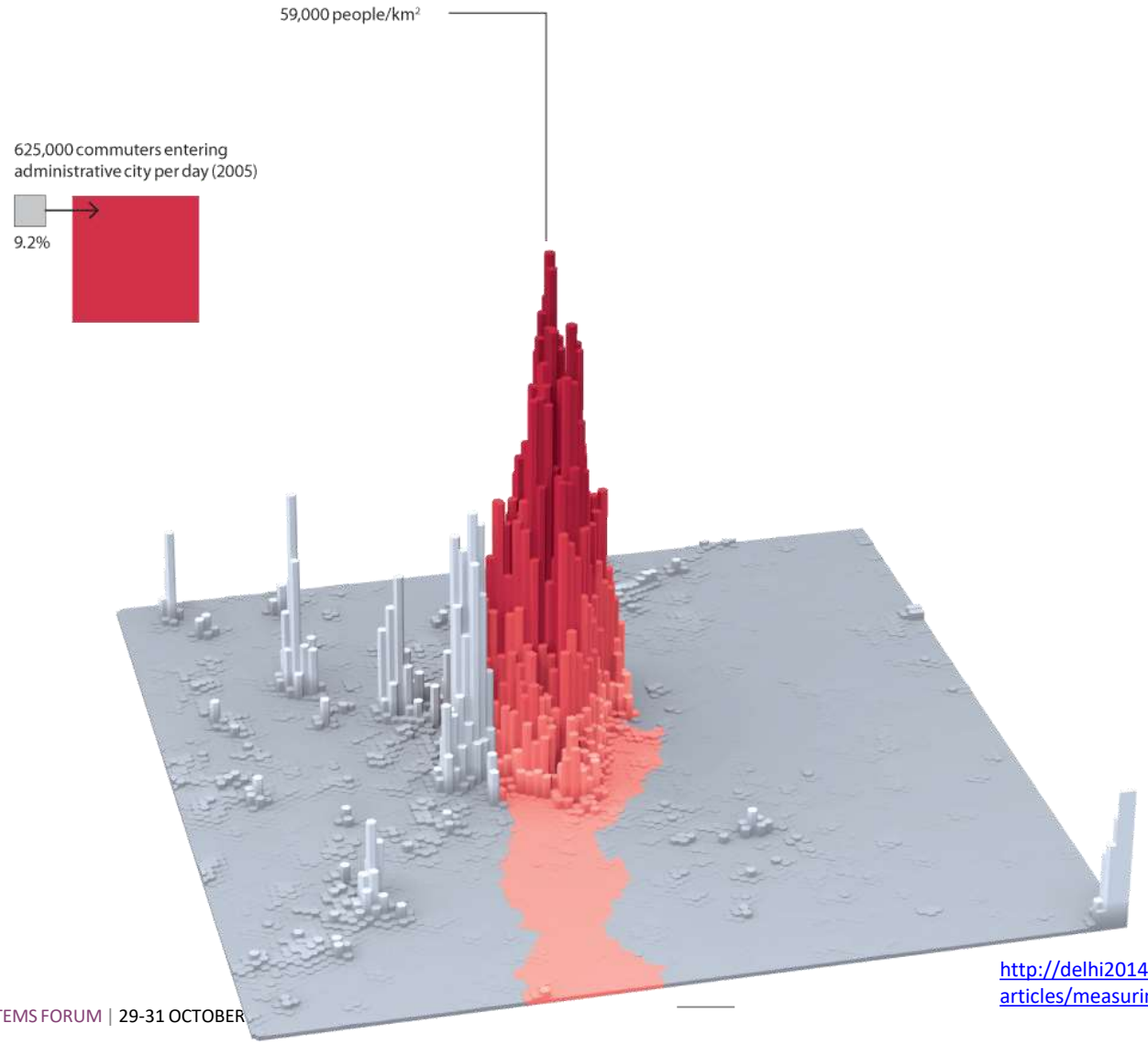
@aszapla

BOGOTÁ



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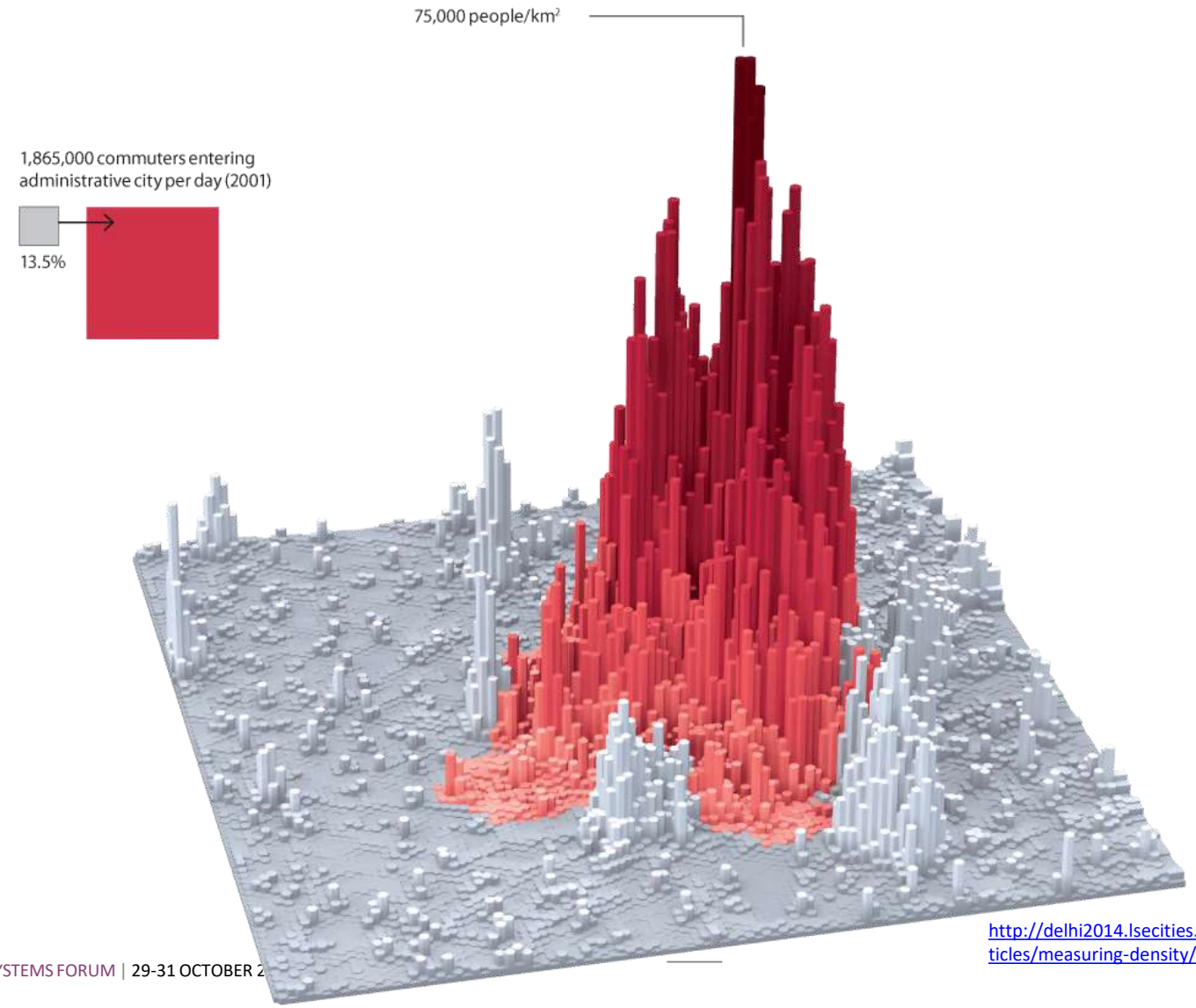
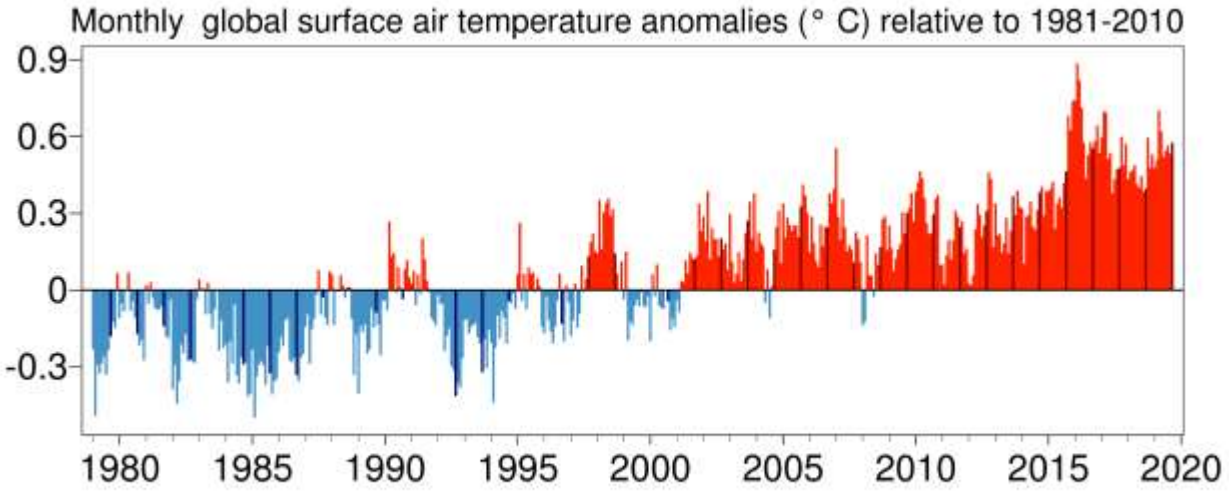
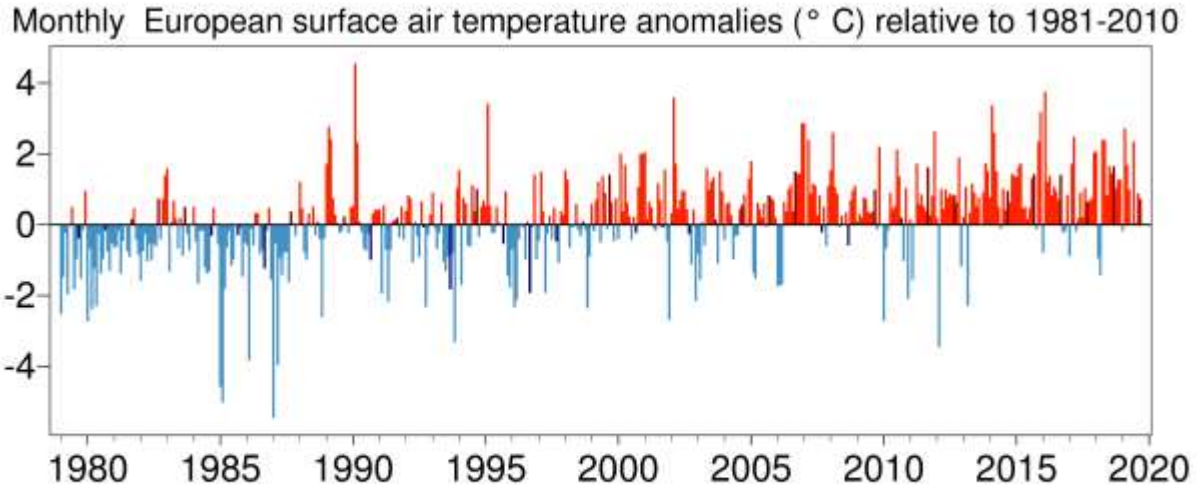
DELHI



http://delhi2014.lsecities.net/newspaper/articles/measuring-density/en-gb/

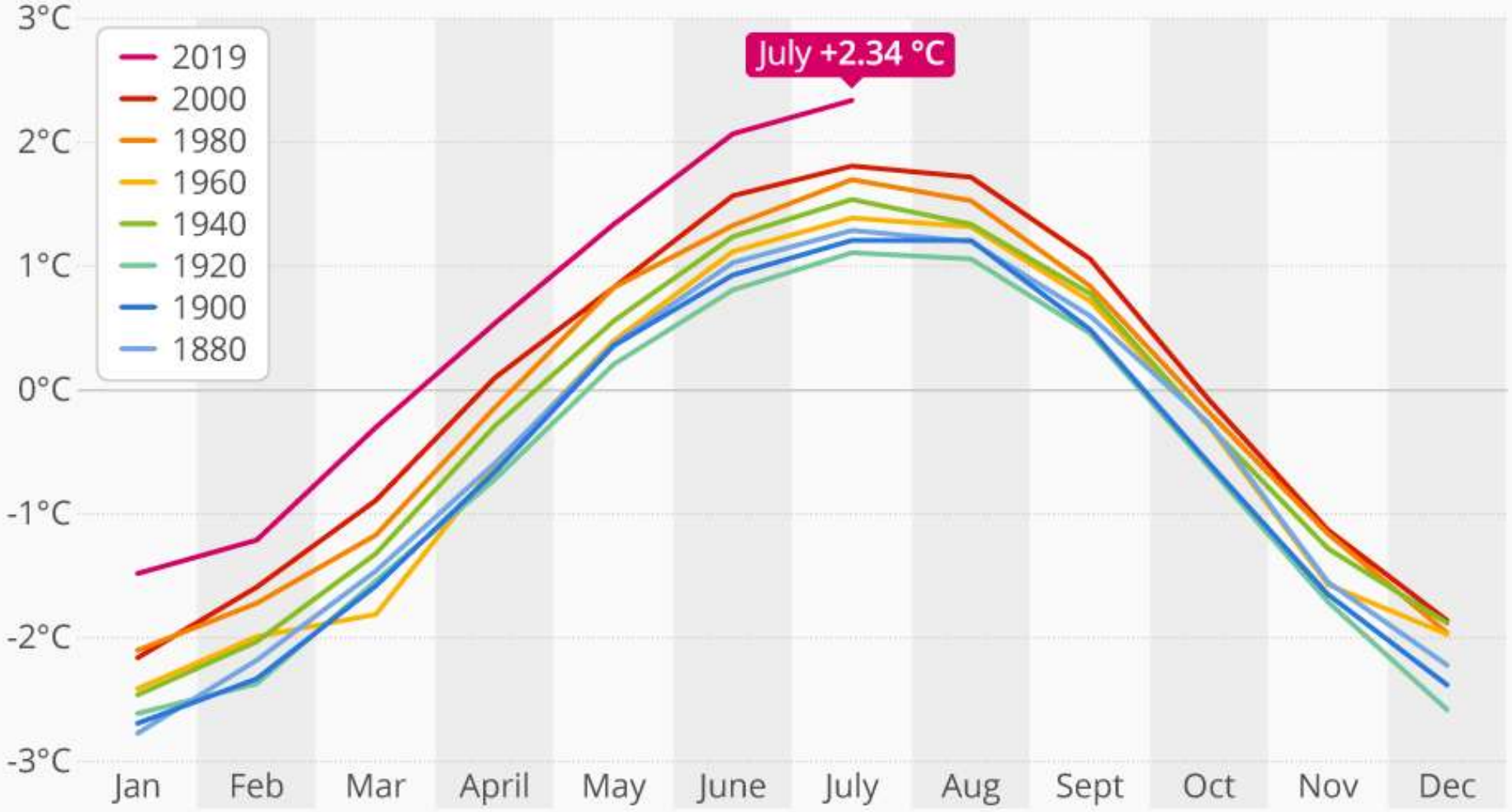
@aszapla


Monthly global surface air temperature anomalies (° C) relative to 1981-2010
0.9
0.6
0.3
0
-0.3
1980
1985
1990
1995
2000
2005
2010
2015
2020


Monthly European surface air temperature anomalies (° C) relative to 1981-2010
4
2
0
-2
-4
1980
1985
1990
1995
2000
2005
2010
2015
2020

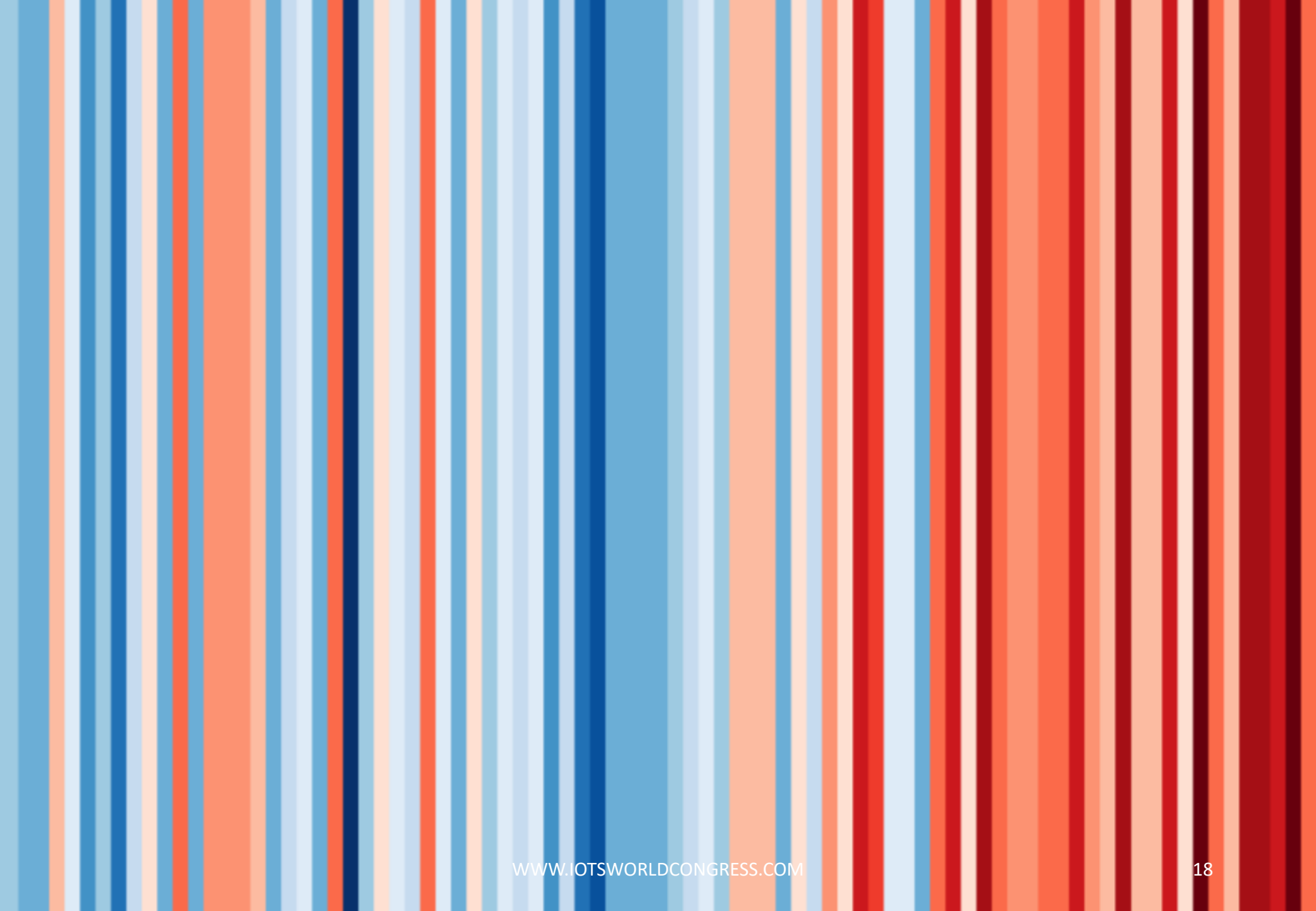
Earth is Heating Up

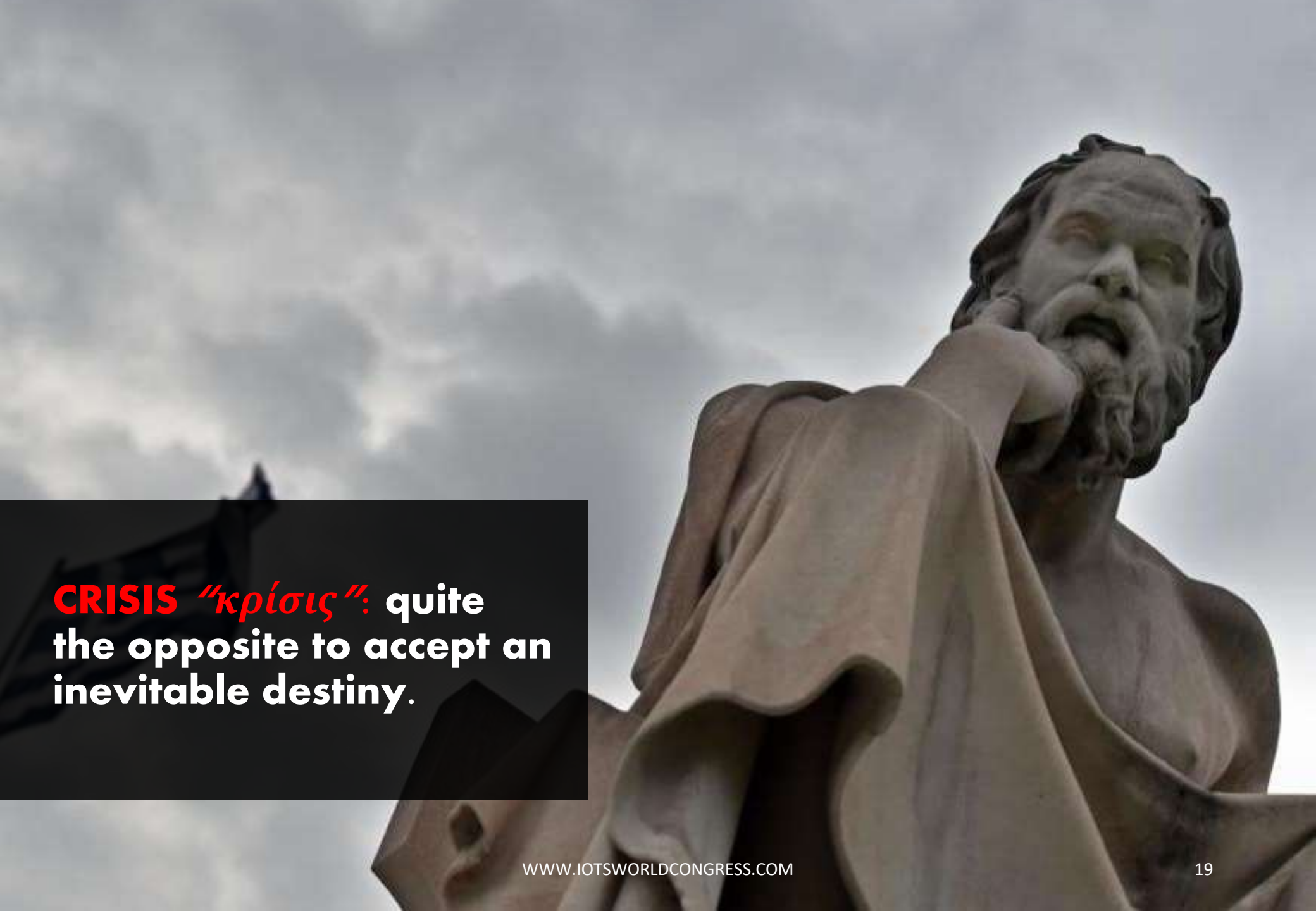
Monthly divergence from global mean temperature (between 1980-2015), in selected years



@StatistaCharts Source: NASA

statista





CRISIS *"κρίσις"*: **quite the opposite to accept an inevitable destiny**.

12 Sept 2019

Diez medios áereos y 43 bomberos trabajan en un incendio forestal en Paterna del Campo (Huelva)

Actualizado 12/09/2019 16:07:20 CET

Últimas noticias / Andalucía »

- Andalucía reconoce la excelencia de profesionales y empresas que impulsan la industria turística del destino
- El sorteo de Euromillones deja 2,5 millones de euros en Dos Hermanas (Sevilla)
- A prisión los dos detenidos al intentar alunizar una tienda de Lagoh en la que no lograron robar

FIRES

- Hospital de Día del Infanta Elena reducirá las complicaciones quirúrgicas

Agua en Ávila solo hasta la primera semana de noviembre

DROUGHTS

Sequía en Ávila / RAÚL HERNÁNDEZ (ARCHIVO)

El consistorio ha anunciado que las reservas de agua, hoy al 29.8%, solo se garantizan hasta esa fecha, si no llueve o hay alguna incidencia

FLOODS

Number of disasters by type - 1998-2017

13 CLIMATE ACTION

SUSTAINABLE DEVELOPMENT GOALS

UNDRR
UN Office for Disaster Risk Reduction

#GlobalGoals

Source: UNDRR, CRED 2018

“We basically have three choices: mitigation, adaptation, and suffering.”
2007, John Holdren

SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

2. AI vs SGD

10+1 Key concepts about Forecasting

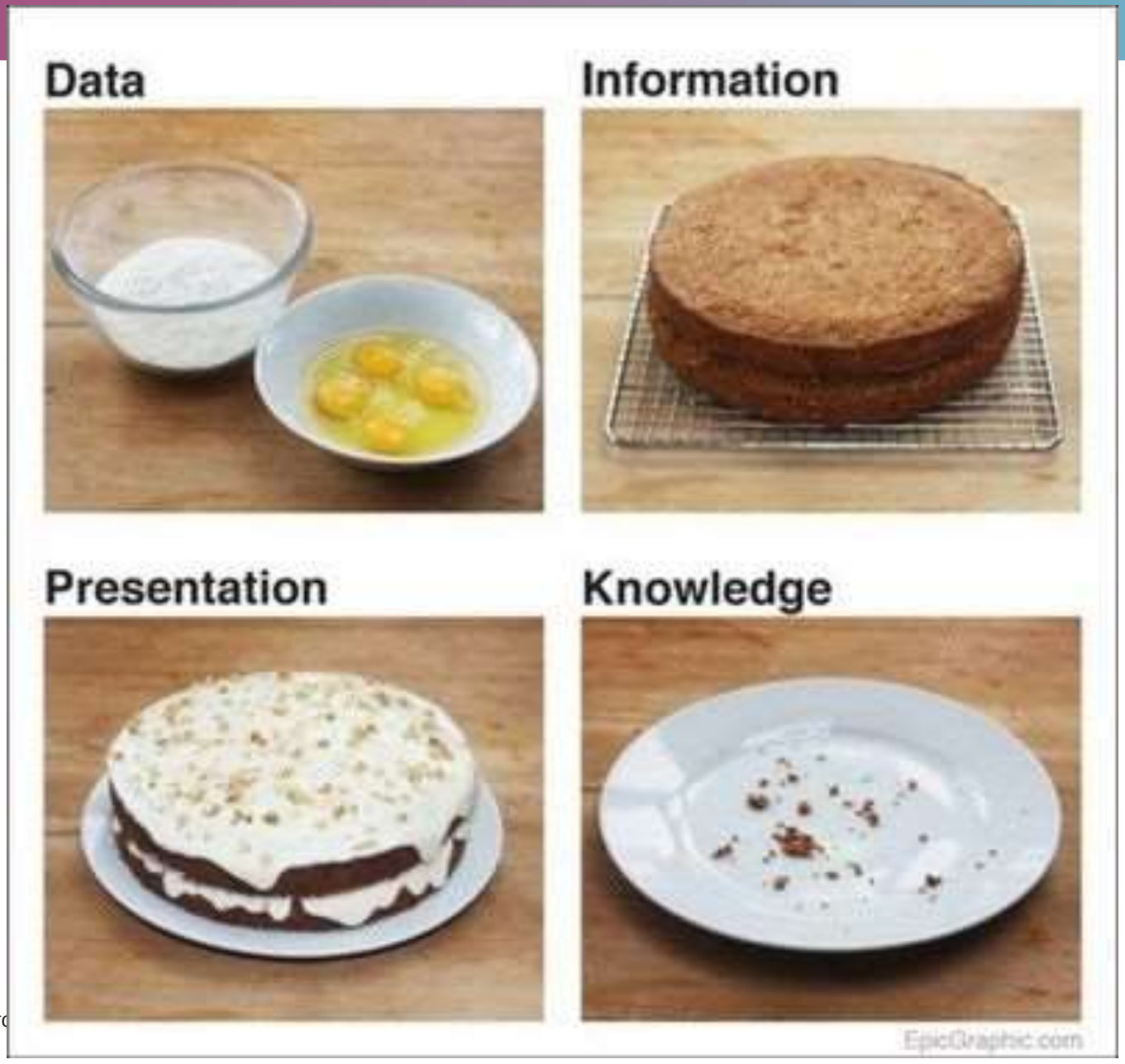
1. Determine the use of the forecast;
2. Choice the forecast horizon and forecast approach;
3. Collection and analysis of data;
4. Identification of the forecast model(s);
5. Estimation of the forecast model(s);
6. Diagnosis of the statistical adequacy of the model(s);
7. Production of the forecast, including confidence intervals;
8. Evaluation of the forecast;
9. Use of the forecast by decision makers;
10. Ex-post facto analysis of forecast error.

And…..

0. Asking the Right Questions

AI & COGNITIVE SYSTEMS FORUM

4 steps to "knowledge cake"



FATEN

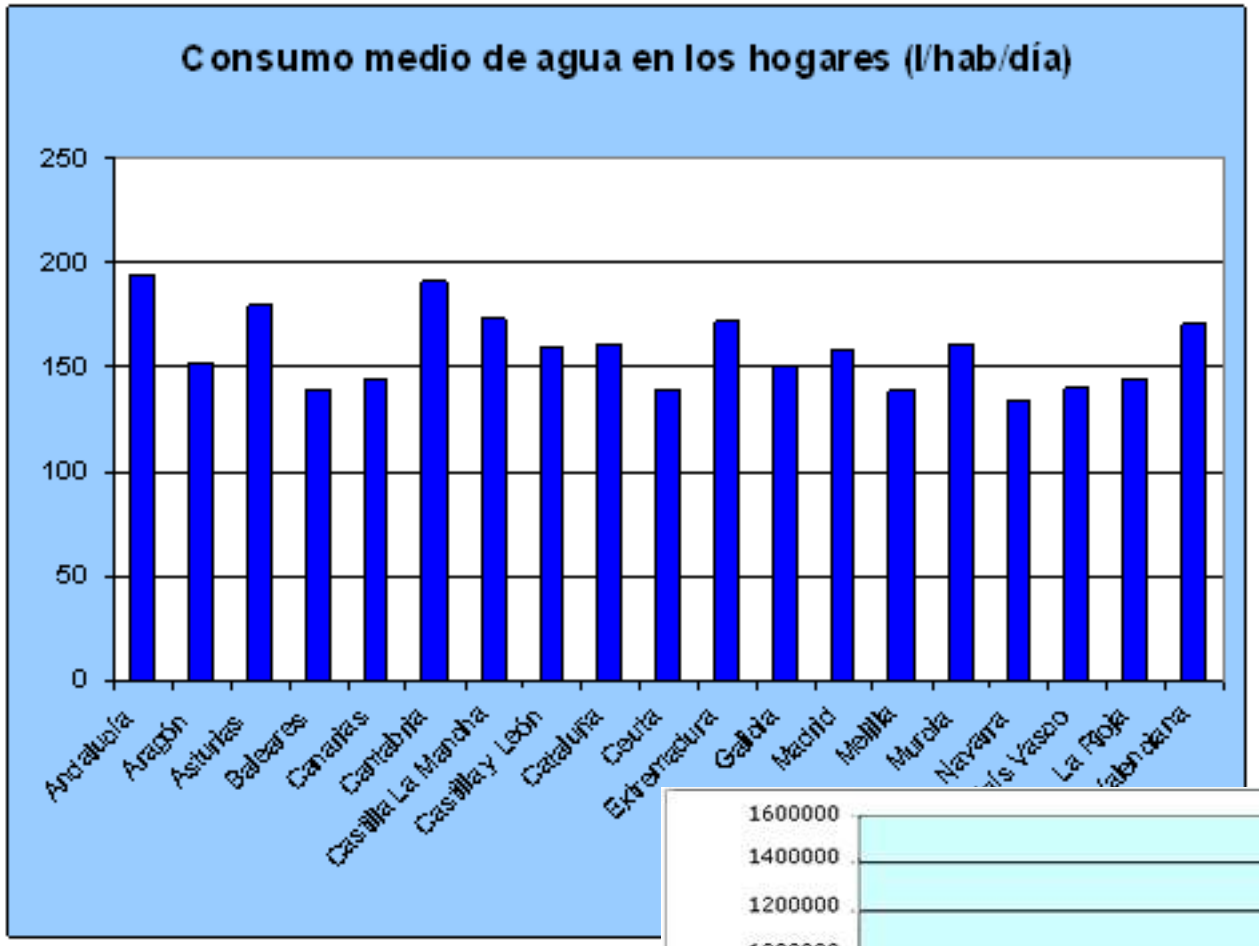
- **F**: Fairness
- **A:** Autonomy, Accountability and intelligence Augmentation
- **T**: Trust and Transparency
- **E**: Education, bEneficence and Equality
- **N**: Non-maleficence

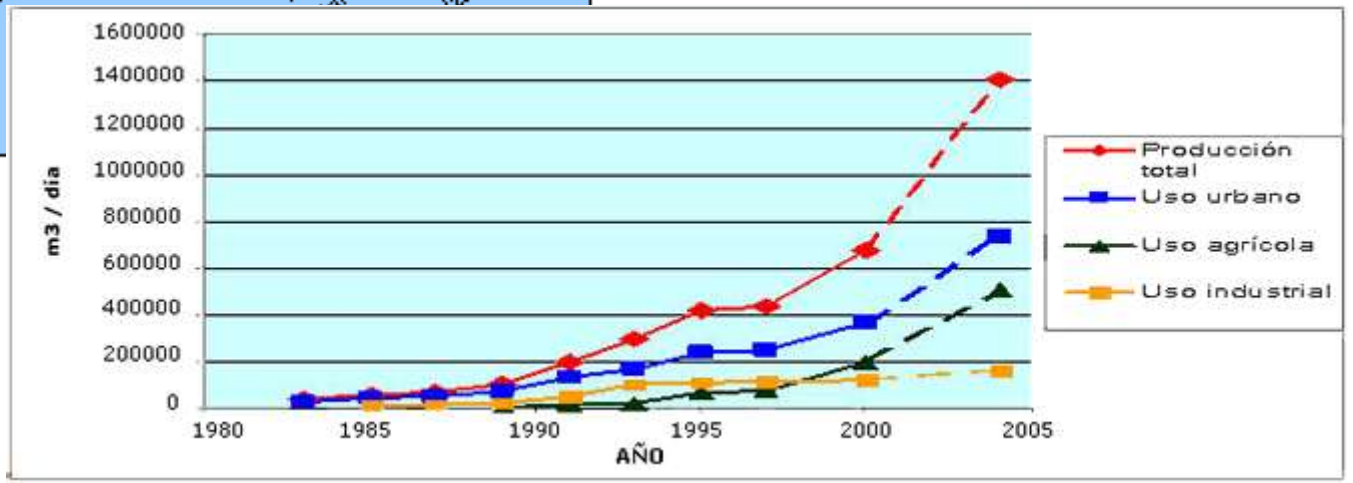
http://www.nuriaoliver.com/papers/Oliver_FATEN.pdf

AI vs DROUGHTS:

WATER DEMAND FORECAST SOLUTIONS

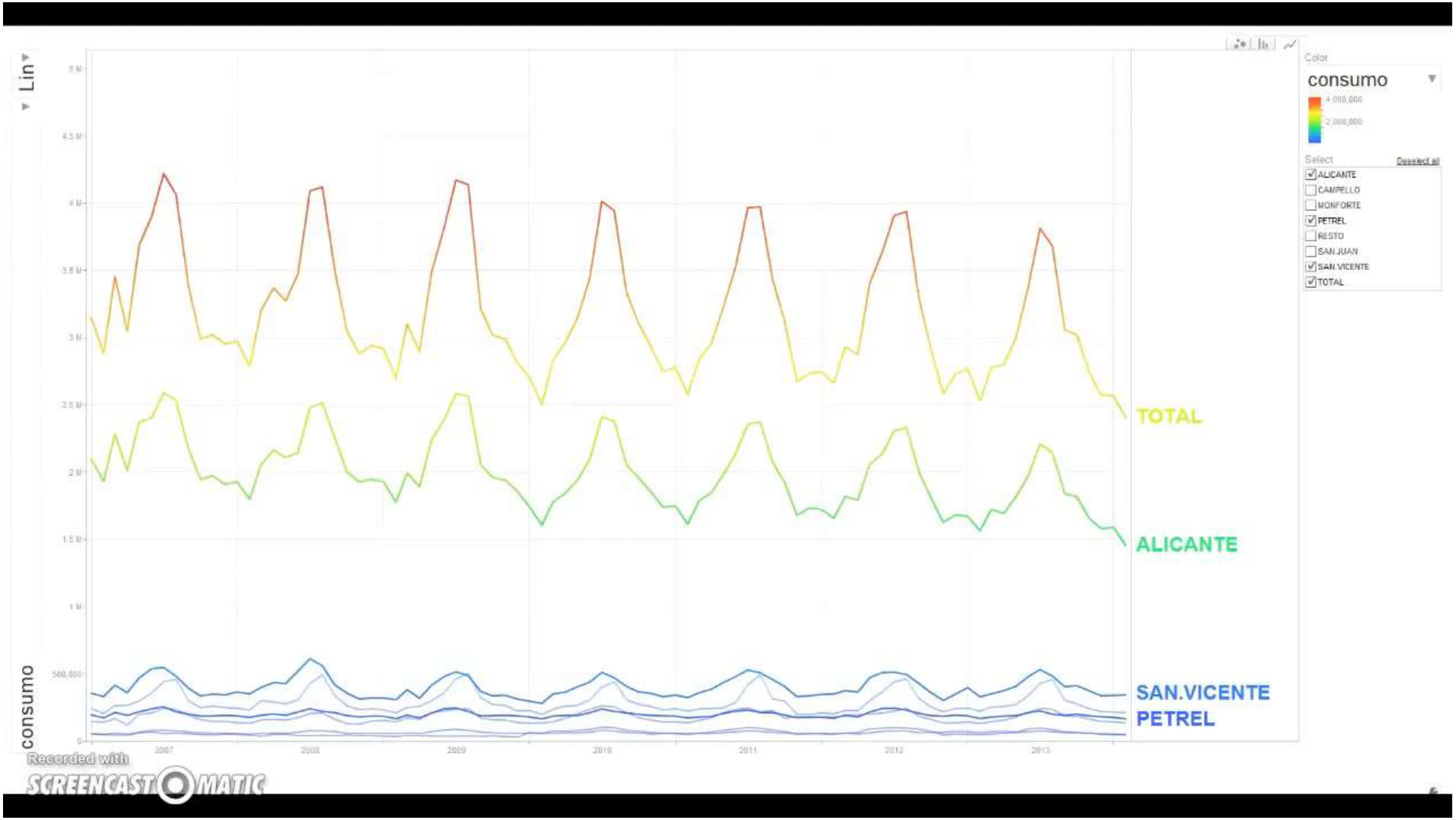
"Traditional" way Water Demand

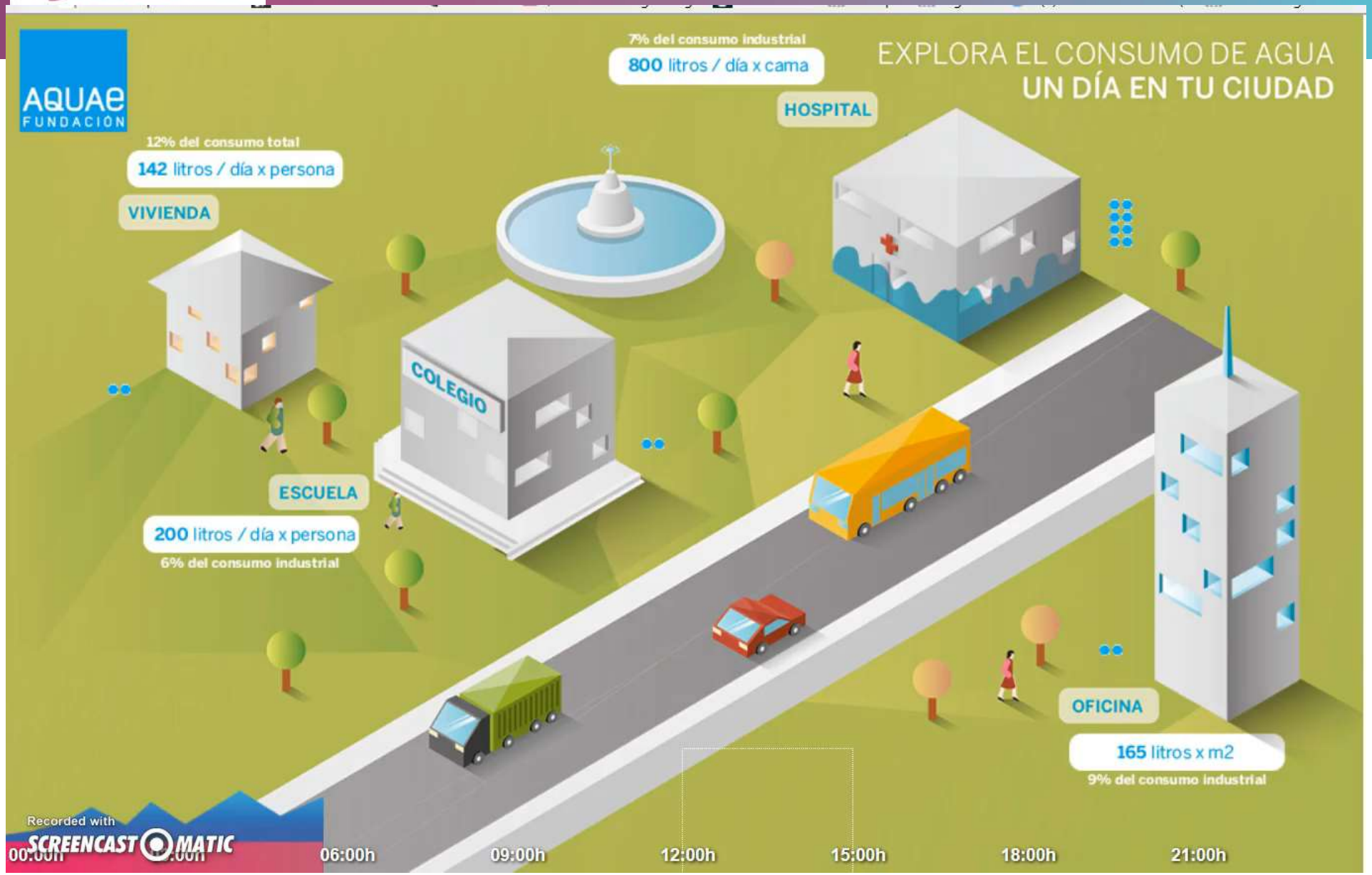




AI & COGNITIVE SYSTEMS FORUM

New ways





http://www.fundacionaquae.org/consumo-agua-ciudad/consumo-agua-ciudad.html

Alicante Water Demand Forecast Solutions

CITY LEVEL

1. Short Term WD

2. Medium Term WD

2013

CUSTOMER LEVEL

3. Medium Term Revenues

2015

DOMESTIC LEVEL

4. Short Term WD

2016/17

AI & COGNITIVE SYSTEMS FORUM

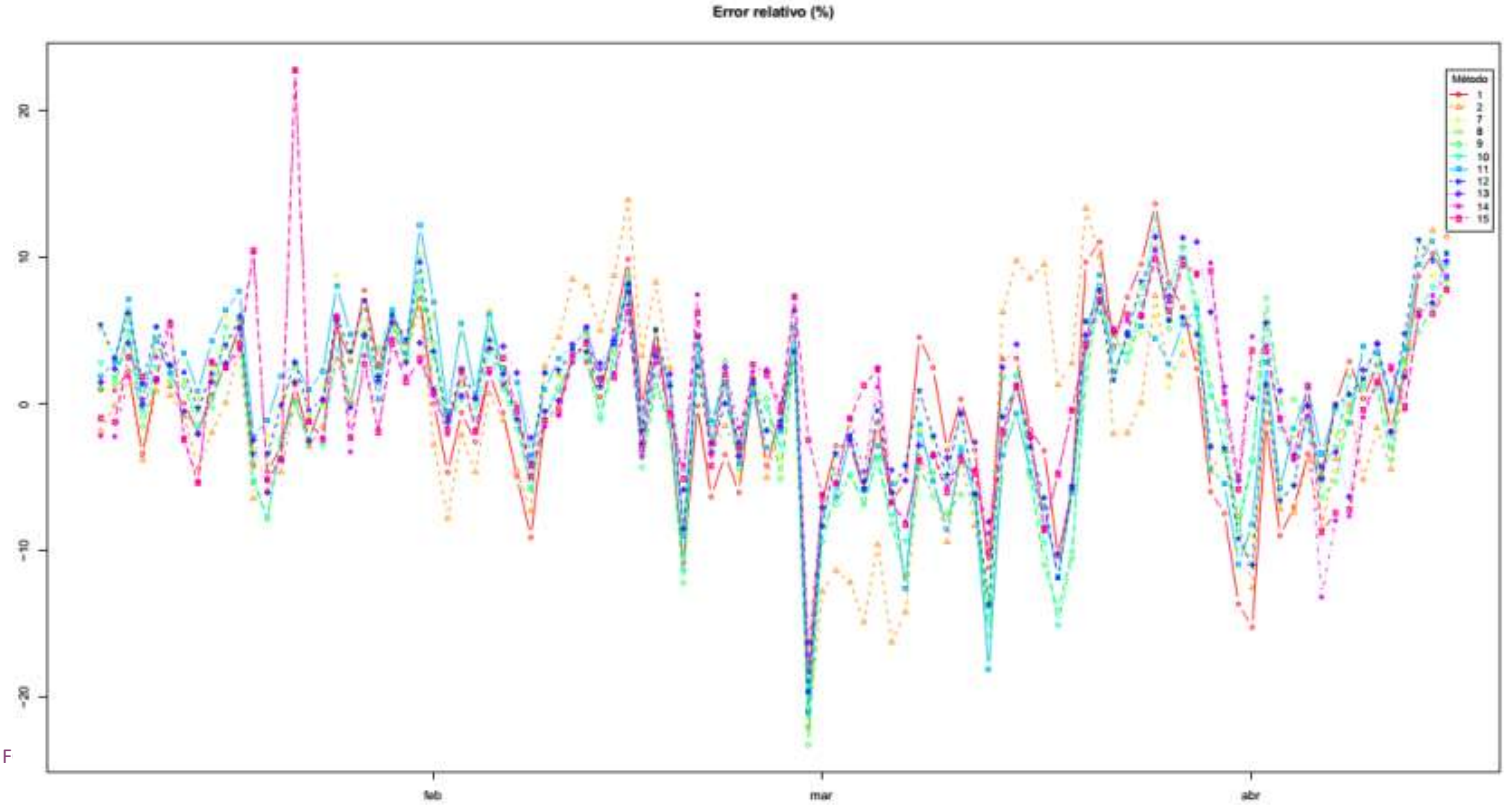
City Level

How to reduce operations and purchasing water costs?

- **SHORT TERM (1 to 6 days)**
  - Supply Forecast required for Operations Management
  - Previously solved through Excel Spreadsheet tool
- **MEDIUM TERM (1 to 18 months)**
  - Supply Forecast required for Water Purchase decision making
  - Key for Strategic Planning

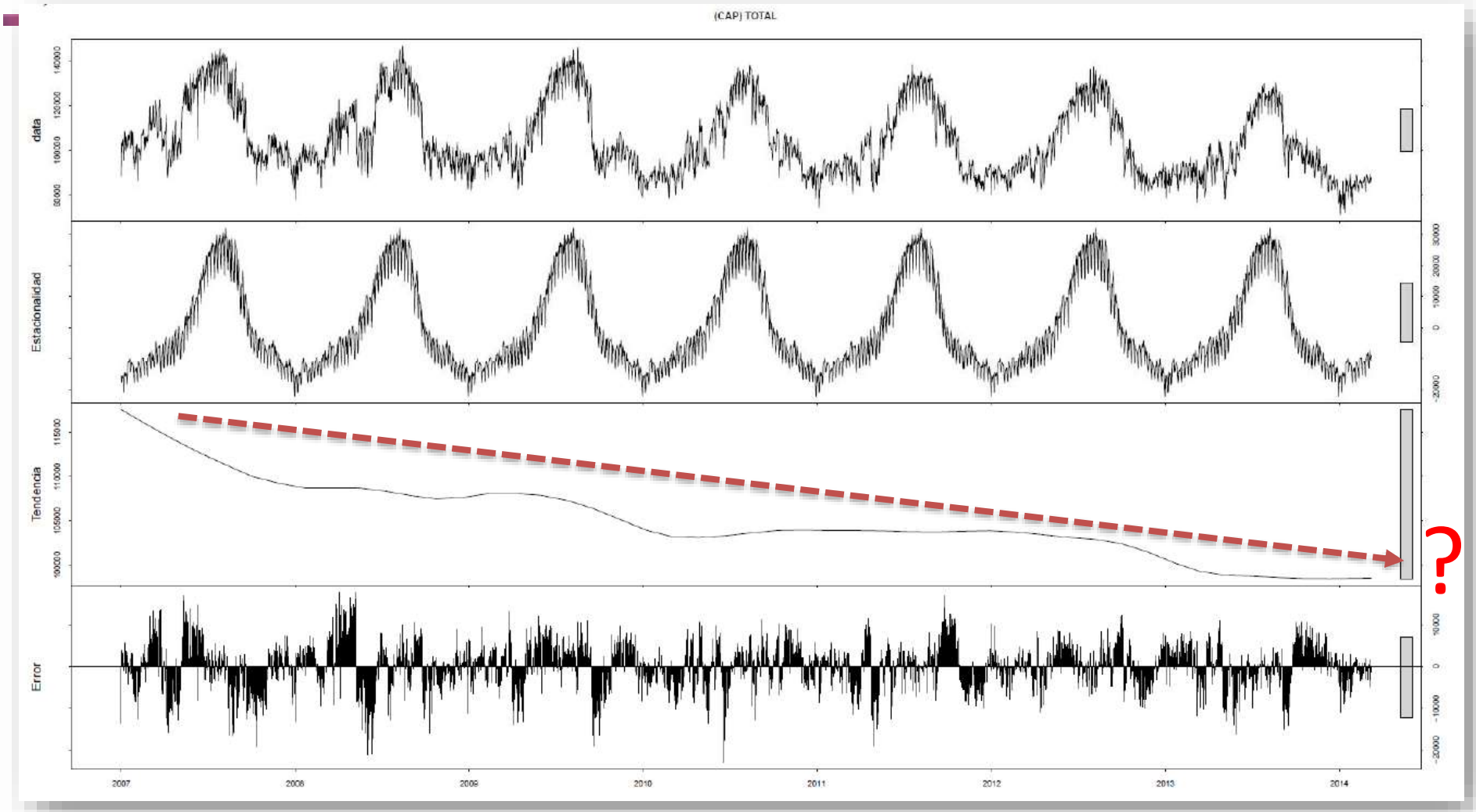
Project Description

- 13 Short Term methods and 6 Long Term methods tested.
- Methods selected for their minimum error / shortest computation time:
  - Short term: Method based on holiday calendar and 6 days forecast of temperature/rainfall:
    - Alicante, San Vicente, San Juan, Monforte, Petrer: Method No.13
    - Campello: Method No. 7 *(fitted to greater seasonality)*
  - Long term : Method based on time series for six months projection.



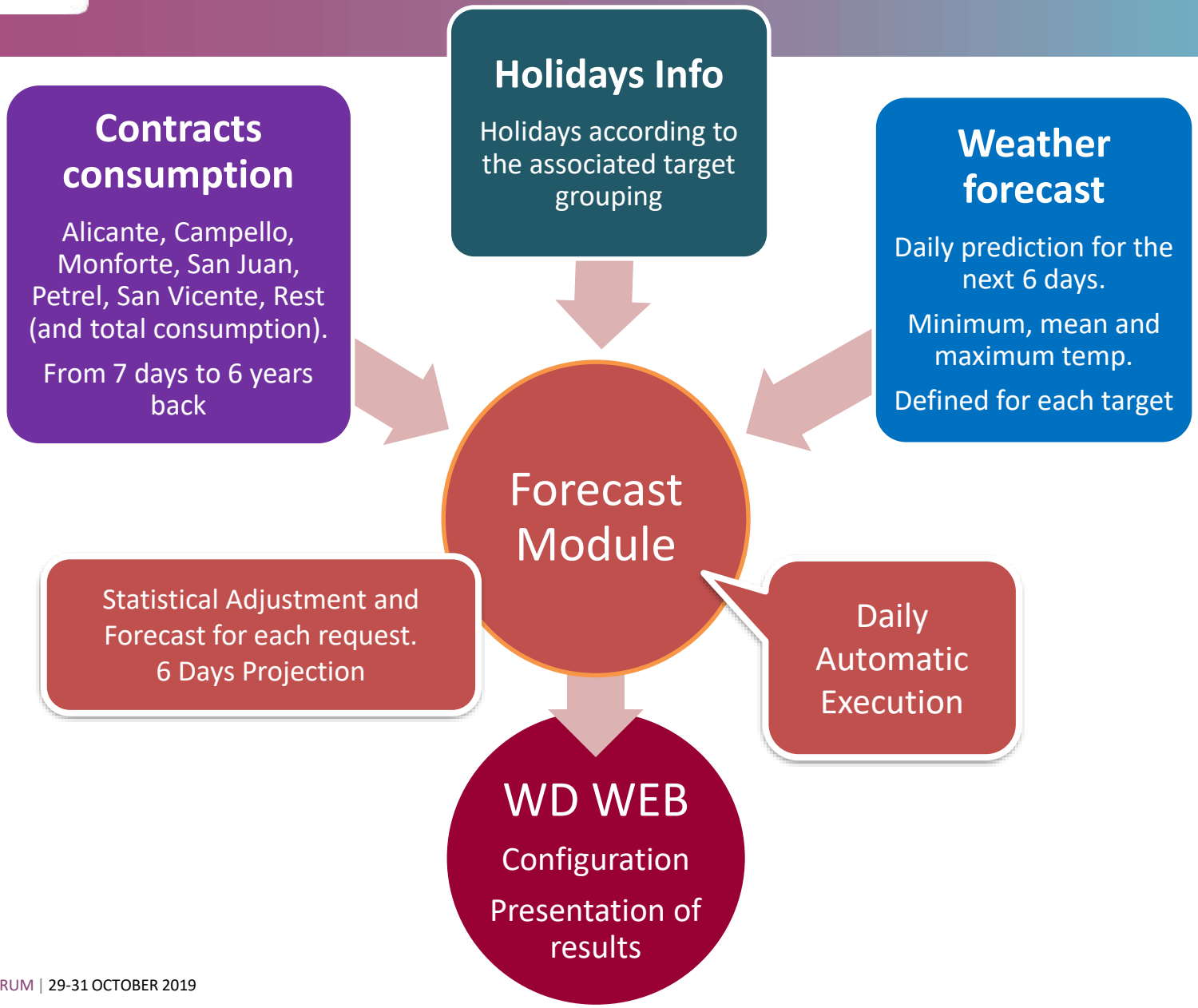
AI & COGNITIVE SYSTEMS FORUM

Seasonal Breakdown of trends (1 year daily mean)



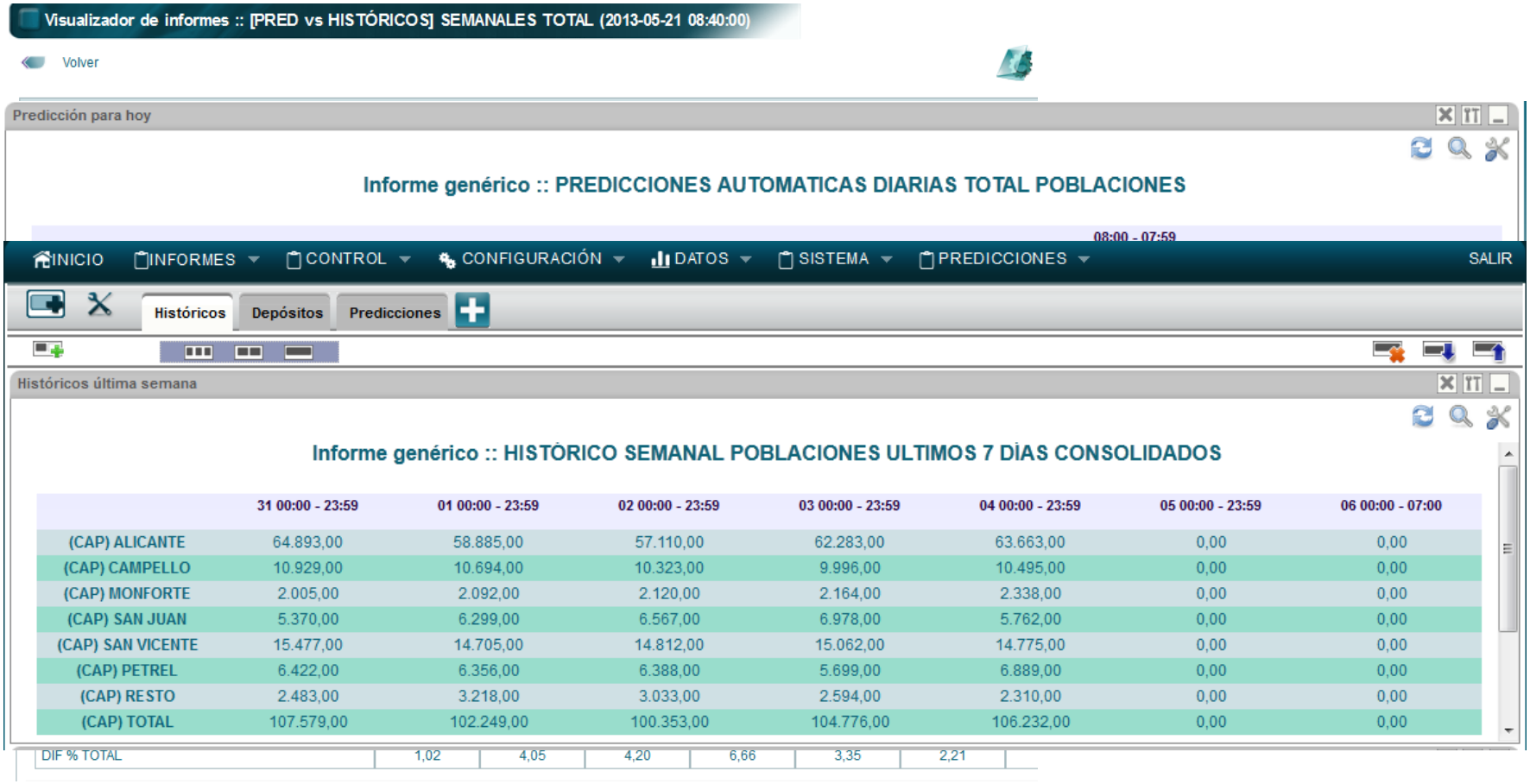
AI & COGNITIVE SYSTEMS FORUM

SHORT TERM FORECAST SYSTEM



SHORT TERM FORECAST AUTOMATIC REPORT

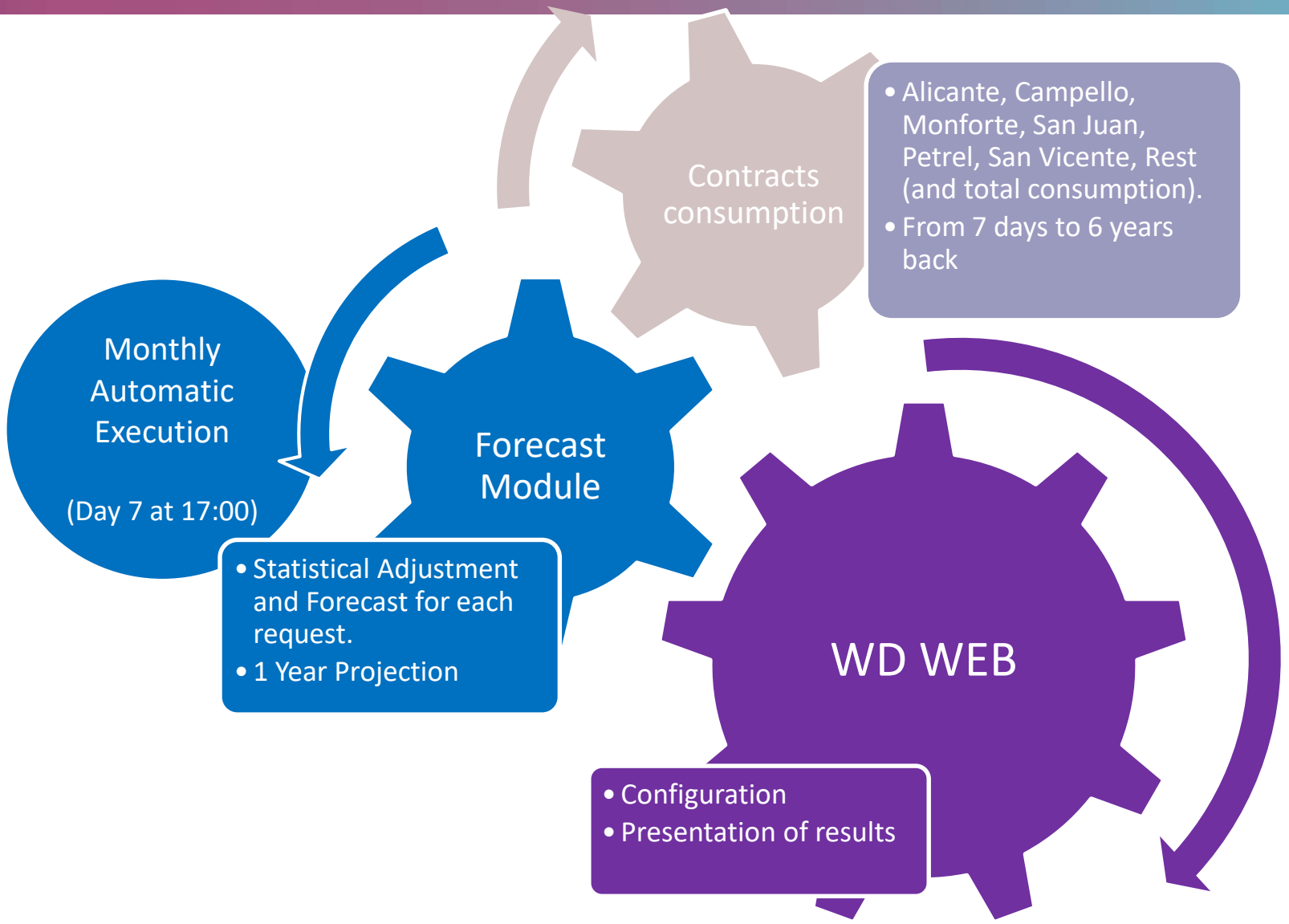
REPORTS



	31 00:00 - 23:59	01 00:00 - 23:59	02 00:00 - 23:59	03 00:00 - 23:59	04 00:00 - 23:59	05 00:00 - 23:59	06 00:00 - 07:00
(CAP) ALICANTE	64.893,00	58.885,00	57.110,00	62.283,00	63.663,00	0,00	0,00
(CAP) CAMPELLO	10.929,00	10.694,00	10.323,00	9.996,00	10.495,00	0,00	0,00
(CAP) MONFORTE	2.005,00	2.092,00	2.120,00	2.164,00	2.338,00	0,00	0,00
(CAP) SAN JUAN	5.370,00	6.299,00	6.567,00	6.978,00	5.762,00	0,00	0,00
(CAP) SAN VICENTE	15.477,00	14.705,00	14.812,00	15.062,00	14.775,00	0,00	0,00
(CAP) PETREL	6.422,00	6.356,00	6.388,00	5.699,00	6.889,00	0,00	0,00
(CAP) RESTO	2.483,00	3.218,00	3.033,00	2.594,00	2.310,00	0,00	0,00
(CAP) TOTAL	107.579,00	102.249,00	100.353,00	104.776,00	106.232,00	0,00	0,00

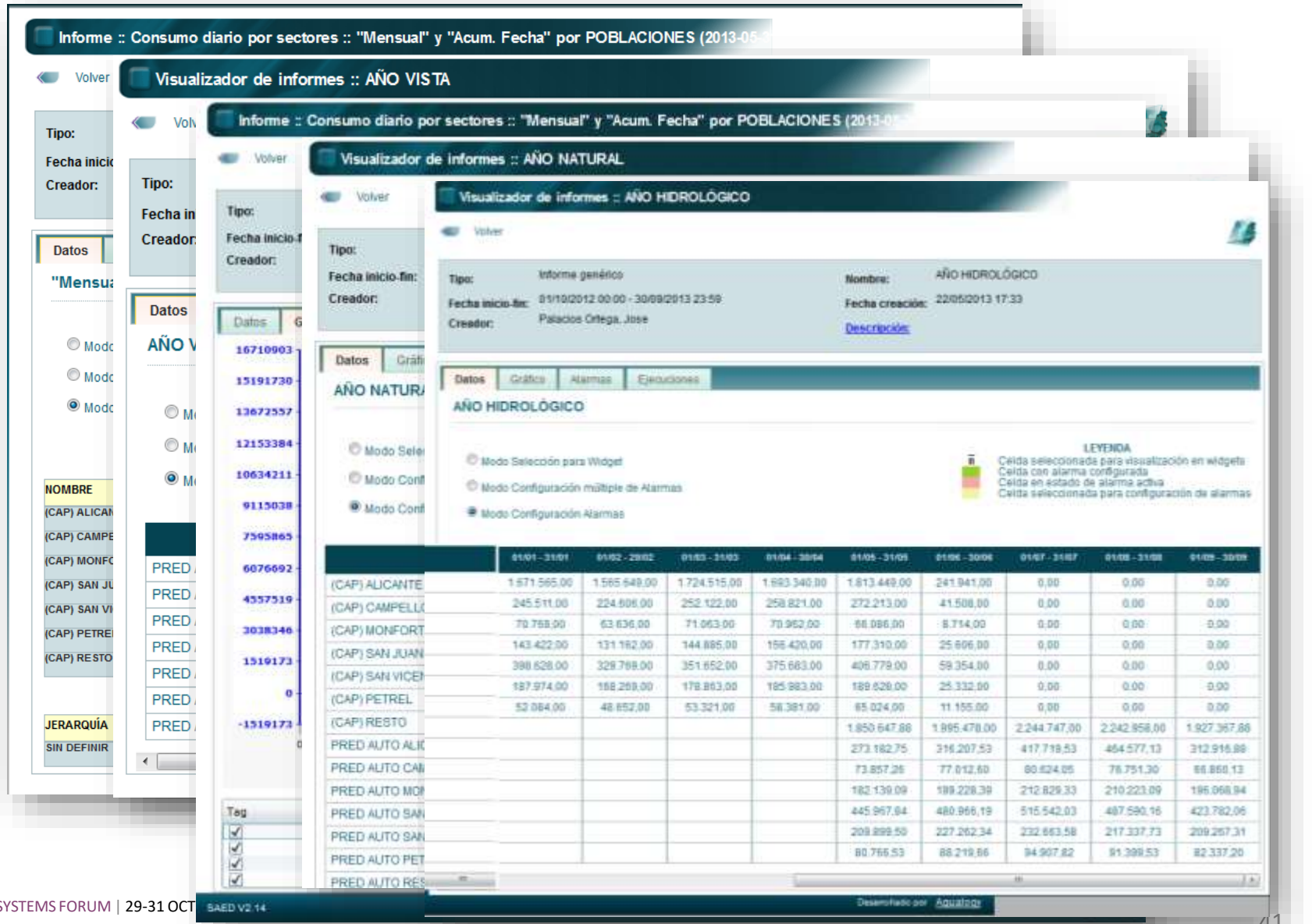
DIF % TOTAL	1,02	4,05	4,20	6,66	3,35	2,21

MEDIUM TERM FORECAST SYSTEM



MEDIUM TERM FORECAST AUTOMATIC REPORT

REPORTS



Customer Level

Bi-nomial:

Fixed (20 types)

+

Increasing-block tariffs (10 types)

Billing:

Domestic: quarterly

Non domestic: monthly

Continuous reading period

x 6 Cities

=5.760 different TARIFFS

How to forecast revenues/client at medium term (up to 2 years) ?

Customer Level

SOLUTION 1: Clustering

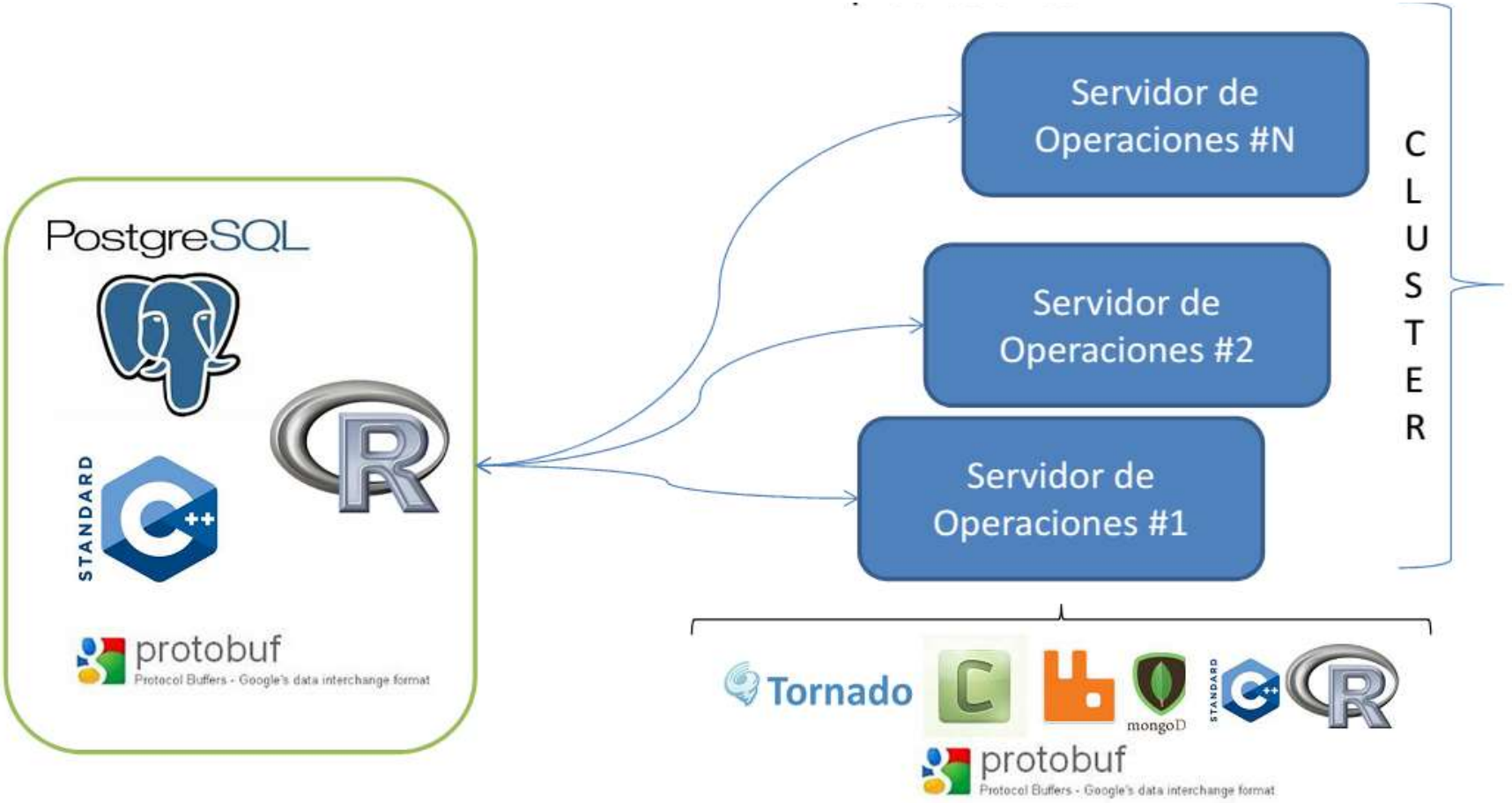
X

- Contract profiling: Aggregation of contracts into homogeneous profile (urban, rural, touristic, etc.)
- Build a new panel of customer
- Selection of best model for each segment
- Calibration of best model for each segment
- Forecast -> average tariff

SOLUTION 2: Per client

- 7 Gb data to be processed
- Selection of best model for each client!
- Calibration of best model for each segment
- Forecast -> real tariff

308.322 series


PostgreSQL
STANDARD
protobuf
Protocol Buffers - Google's data interchange format
Servidor de Operaciones #N
Servidor de Operaciones #2
Servidor de Operaciones #1
CLUSTER
Tornado
mongoD
STANDARD
protobuf
Protocol Buffers - Google's data interchange format

HP Proliant SL 390 G7 (1x2U, 24x1U)

Domestic Level: DAIAD

How to forecast customer hourly consumption?

No idea about actual water use!

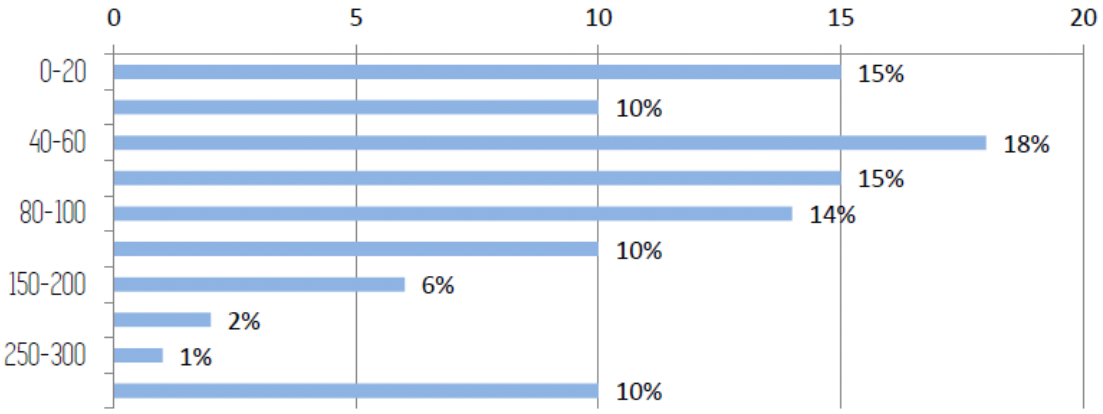


Figure 2: Responses on "how much water do you consume every day? (in liters)"

Emphasis on the **shower (2nd largest energy use)**

DAIAD Project

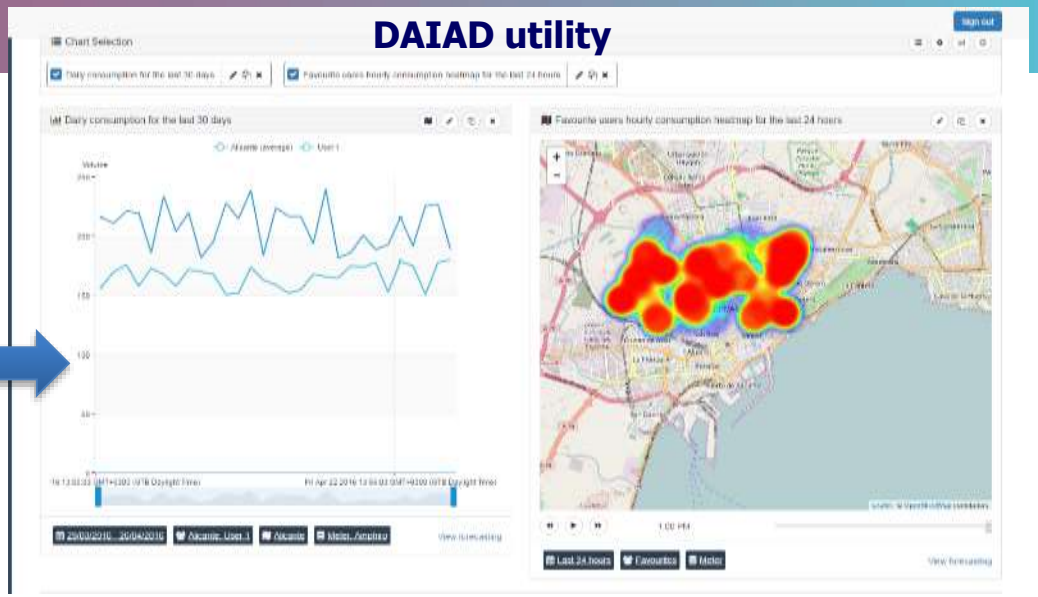
AI & COGNITIVE SYSTEMS FORUM

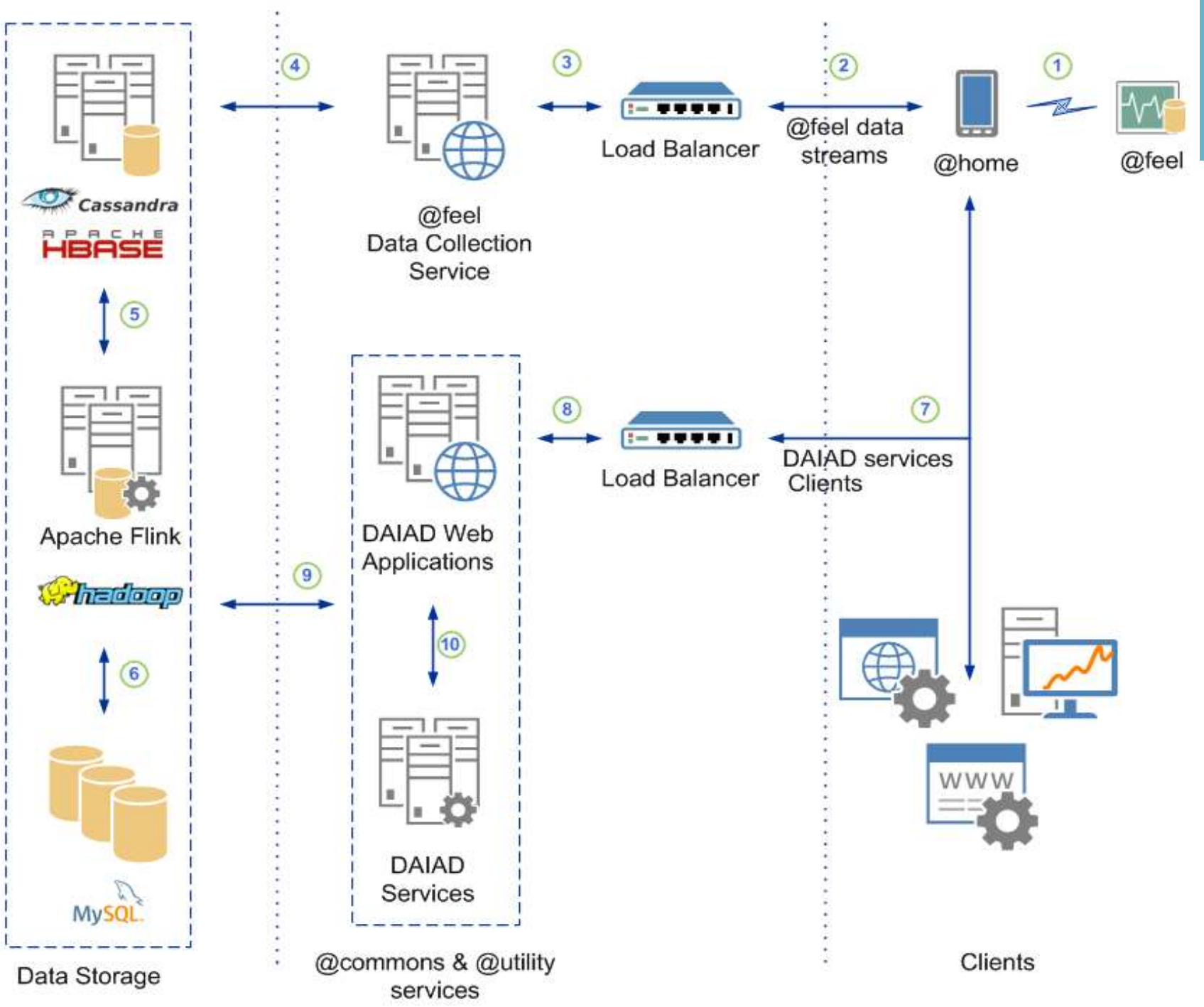
DAIAD Device

DAIAD APP

AMR System

DAIAD utility

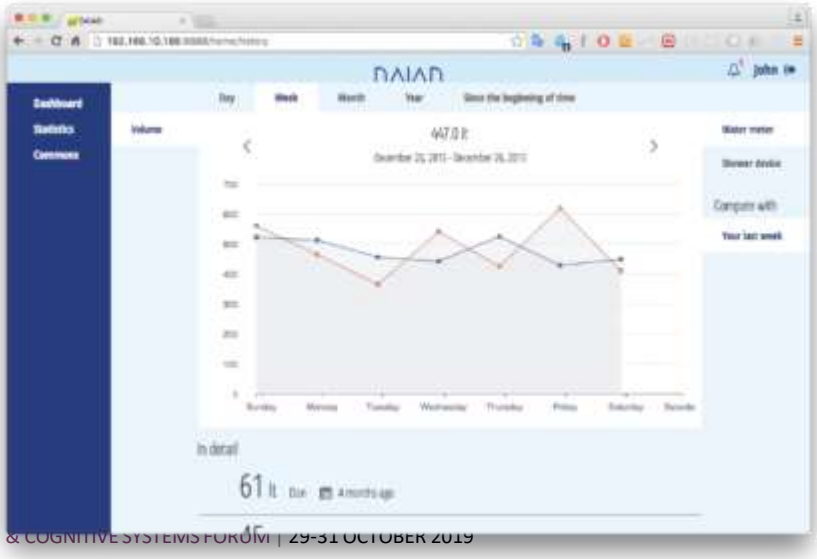


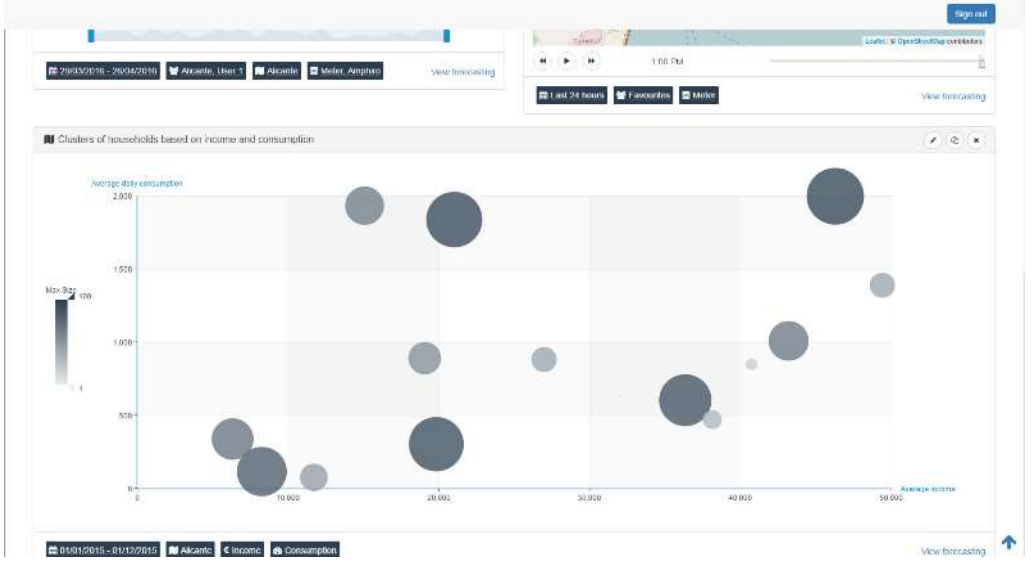

Cassandra
APACHE HBASE
Apache Flink
hadoop
MySQL
Data Storage
4
@feel Data Collection Service
3
Load Balancer
2
@feel data streams
1
@home
@feel
5
6
9
DAIAD Web Applications
10
DAIAD Services
@commons & @utility services
8
Load Balancer
7
DAIAD services Clients
WWW
Clients

AI & COGNITIVE SYSTEMS FORUM

DAIAD Big Data

Name	Category	Short Description
Consumers Water Consumption	Classification - Regression	Computes and predicts consumers' water consumption (in liters) for the preferable time intervals
Consumers Clusters	Clustering	Finds groups of similar consumers based on their water consumption for the preferable time intervals





Machine learning in water network assets management

Aigües de Barcelona

2,8M inhabitants

Drinking Water Supply System Assets

6	drinking water treatment plants
77	water tanks
84	pumping stations

4,700 **km of network**

Network asset management challenges:

1. How the**130.000** pipe sections will **work in the future?**
2. How **minimize the consequences** of network failures?

"Unfolding" the network: all pipe sections in a row . . .

FROM BARCELONA **TO TEHEREAN**

AI & COGNITIVE SYSTEMS FORUM

Water network assets management

Network Renewal Plan

SD-Models 2017

SD-IMPACT x FAILURE POTENTIAL

SHORT and LONG TERM

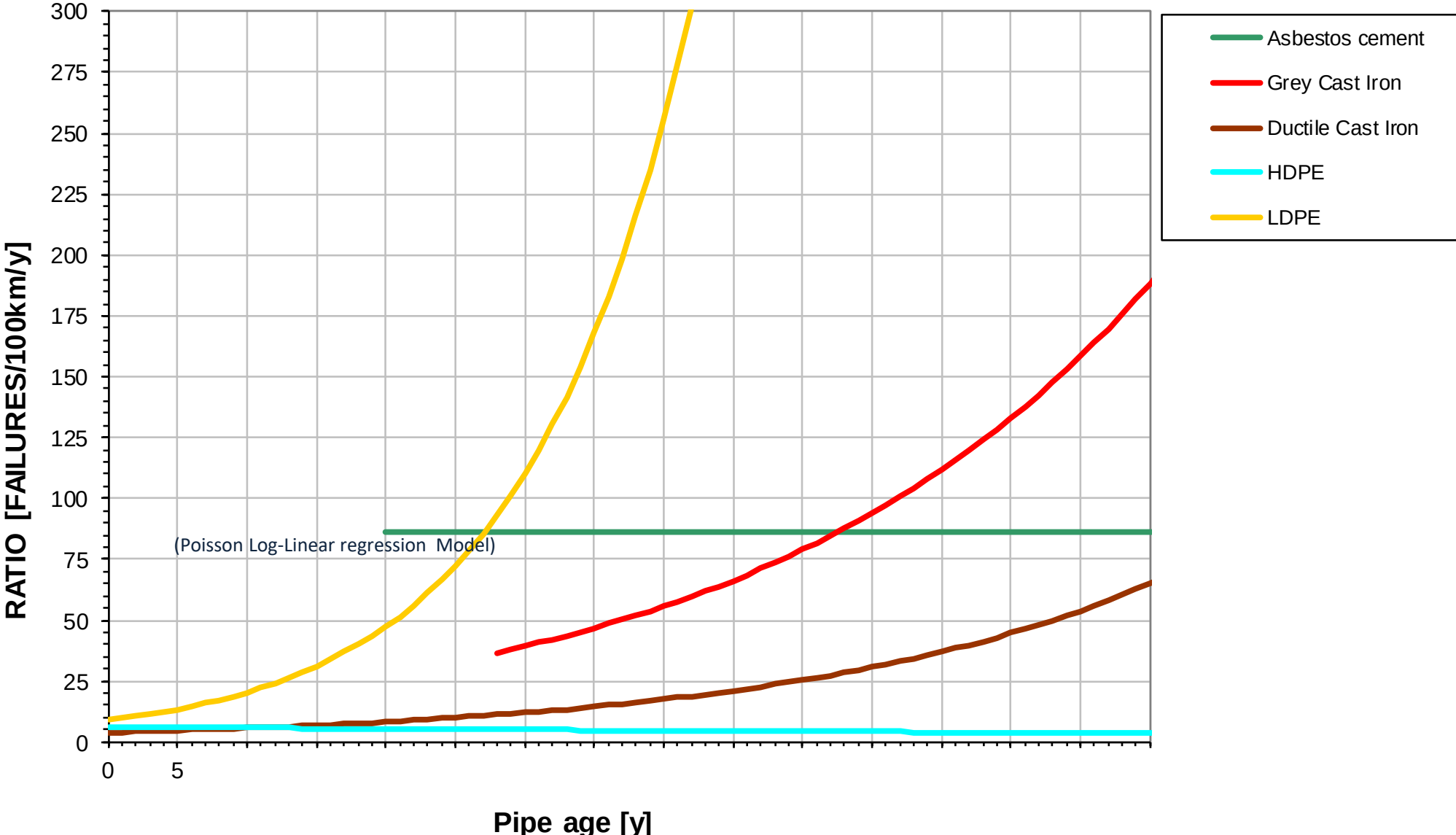
Poisson Log-Linear RM

Our commitment with sustainability leaded us to use Machine Learning for improving short term failure potential

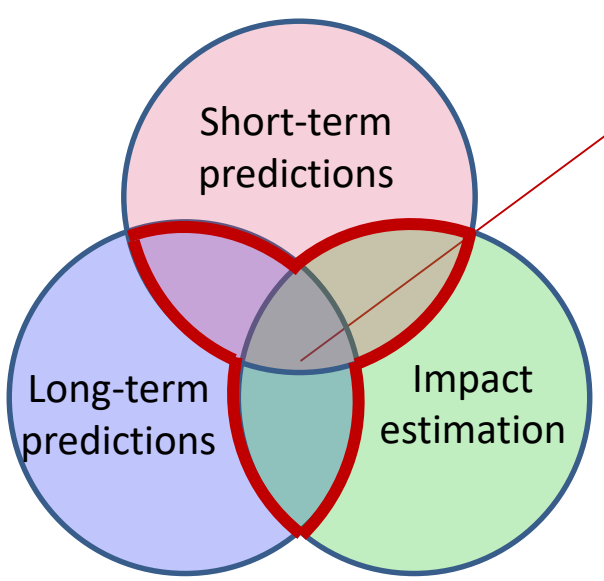
AI & COGNITIVE SYSTEMS FORUM

Water network assets management

Poisson Model (<2019) → AGEING of each Material



Future improvements



Decisions are made inside this space

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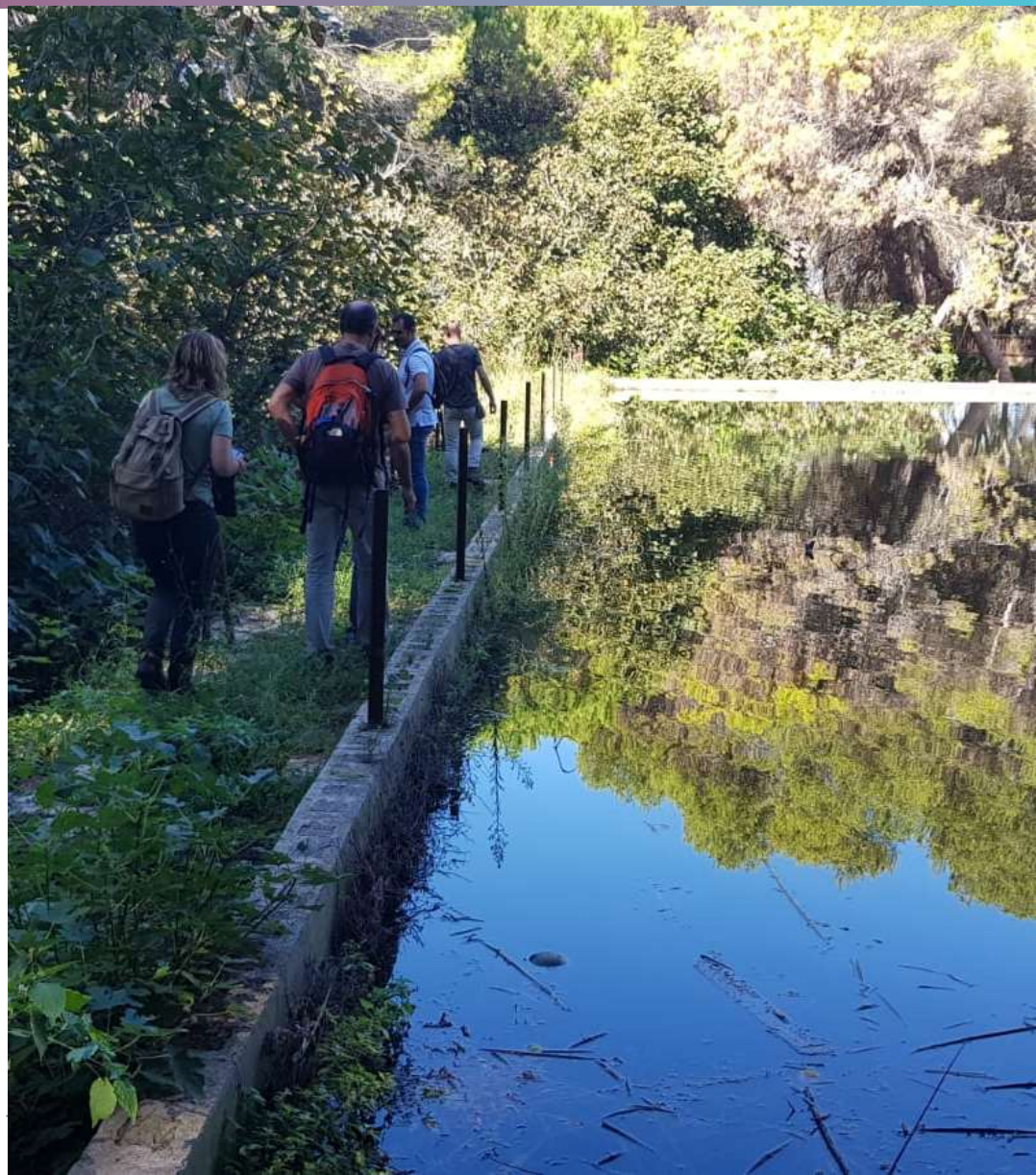
AI vs FIRES: GUARDIAN



13 CLIMATE ACTION

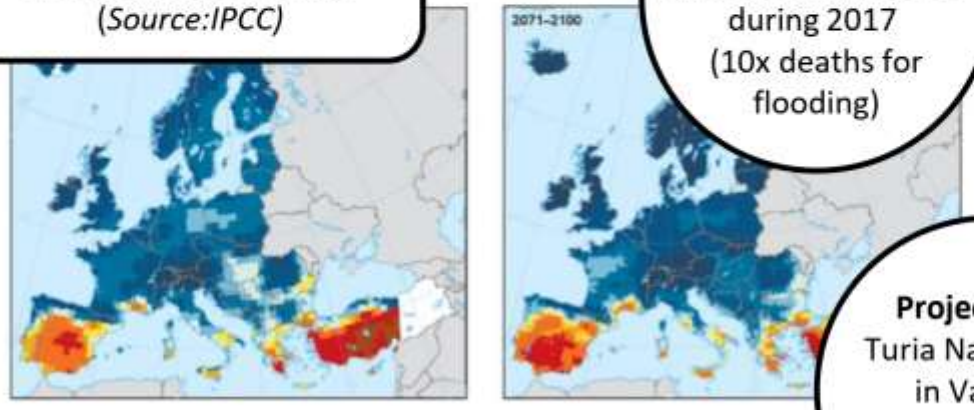
17 PARTNERSHIPS FOR THE GOALS

GUARDIAN Project: Context

Climate change has increased the fire risk and the threat to the so-called Wildland-Urban Interface

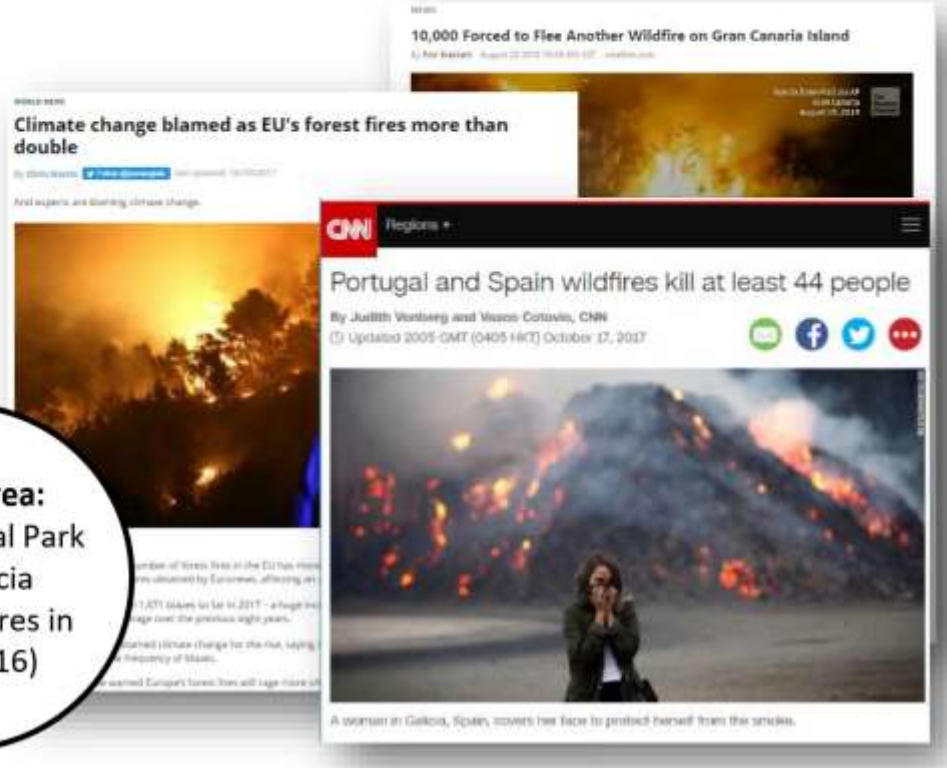
In the Mediterranean context of water scarcity, the European **Urban Innovative Action GUARDIAN** is implementing a fire defense solution based on the use of reclaimed water

Fire susceptible area in the 21st century will be twice that in the last century. (*Source:IPCC*)



Expected evolución of Fire risk (*Font: European Environment Agency*)

The number of fire forest victims increased in a 300% during 2017 (10x deaths for flooding)



Project area: Turia Natural Park in Valencia (59 forest fires in 2000-2016)

GUARDIAN Solution

WWTP Camp del Turia II

Reclaimed water

Tanks

La Vallesa wetland

Network

Defense System

Reclaimed water treatment with Pesticide chlorpyrifos elimination based on LIFE aWARE project led by CETAQUA.

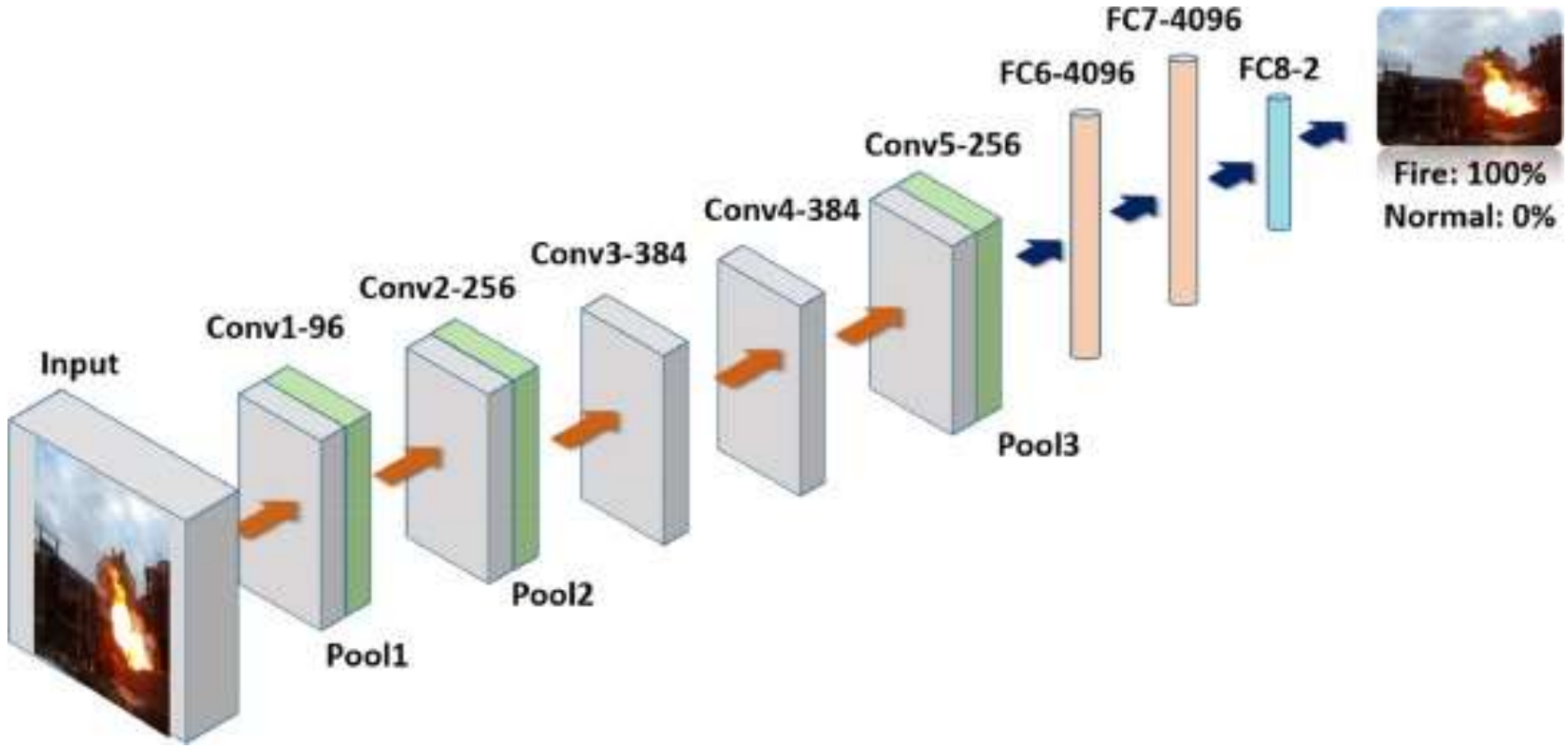
Budget
5,5 M€
Budget Suez
2,2 M€

Wetland restoration

GUARDIAN

1. Weather and humidity conditions monitoring
2. Preventive irrigation of the barrier vegetation according to risk (moisture level preservation)
3. Water cannons in case of very high risk or fire event

Deep Convolutional Neural Networks for Fire Detection



https://www.sciencedirect.com/science/article/pii/S0925231217319203

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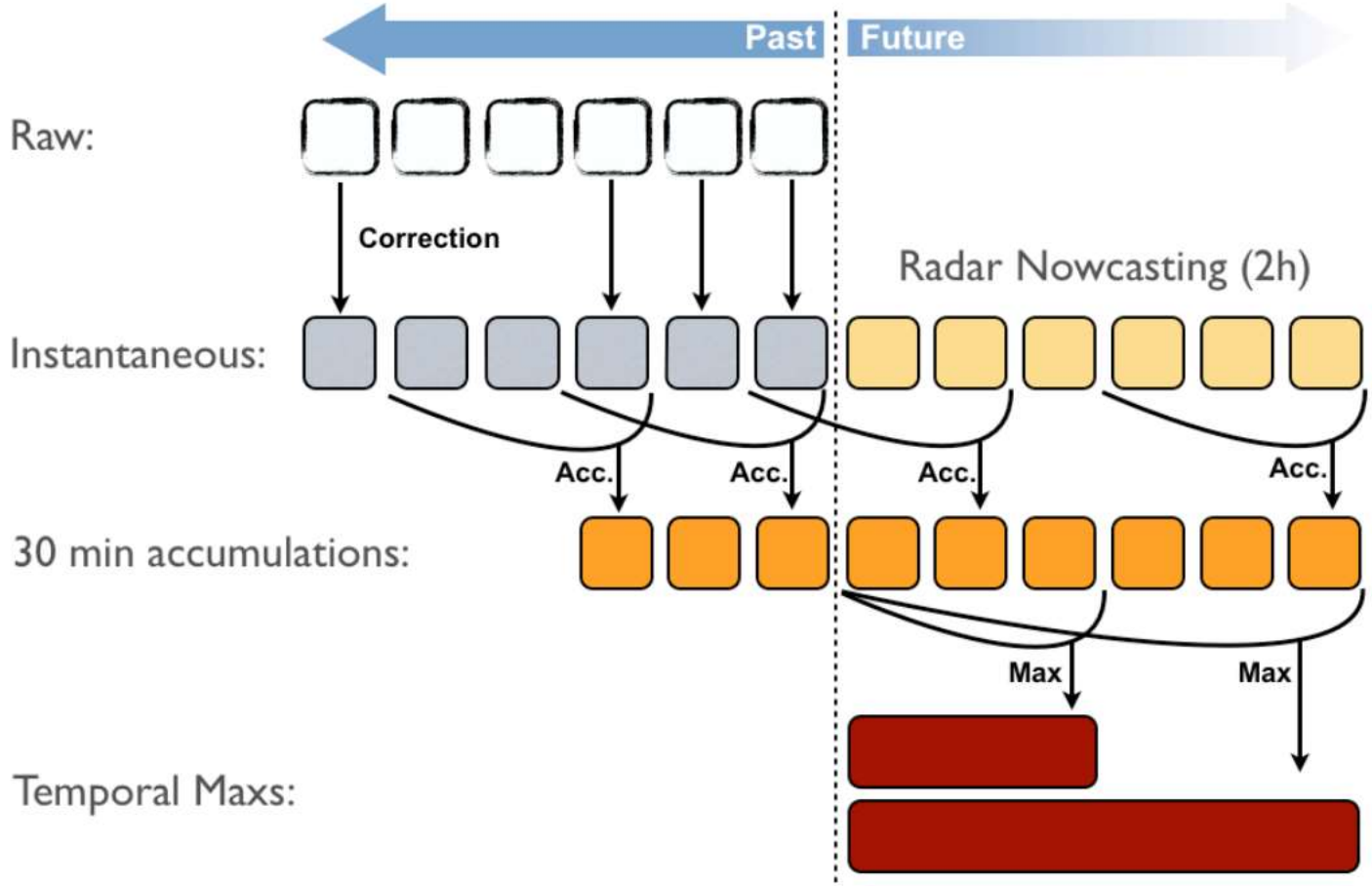
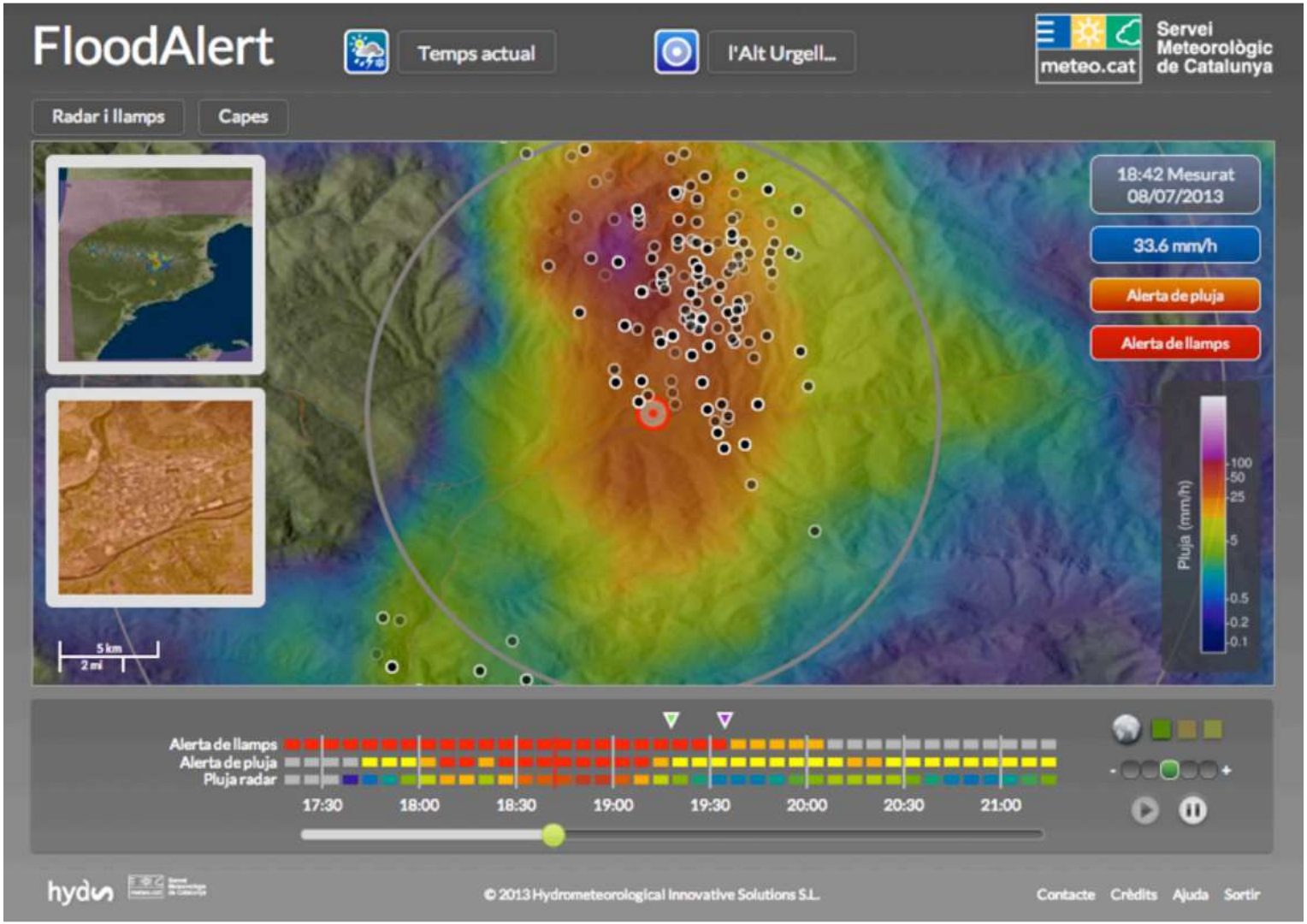
AI vs FLOODS: FLOODALERT

13 CLIMATE ACTION

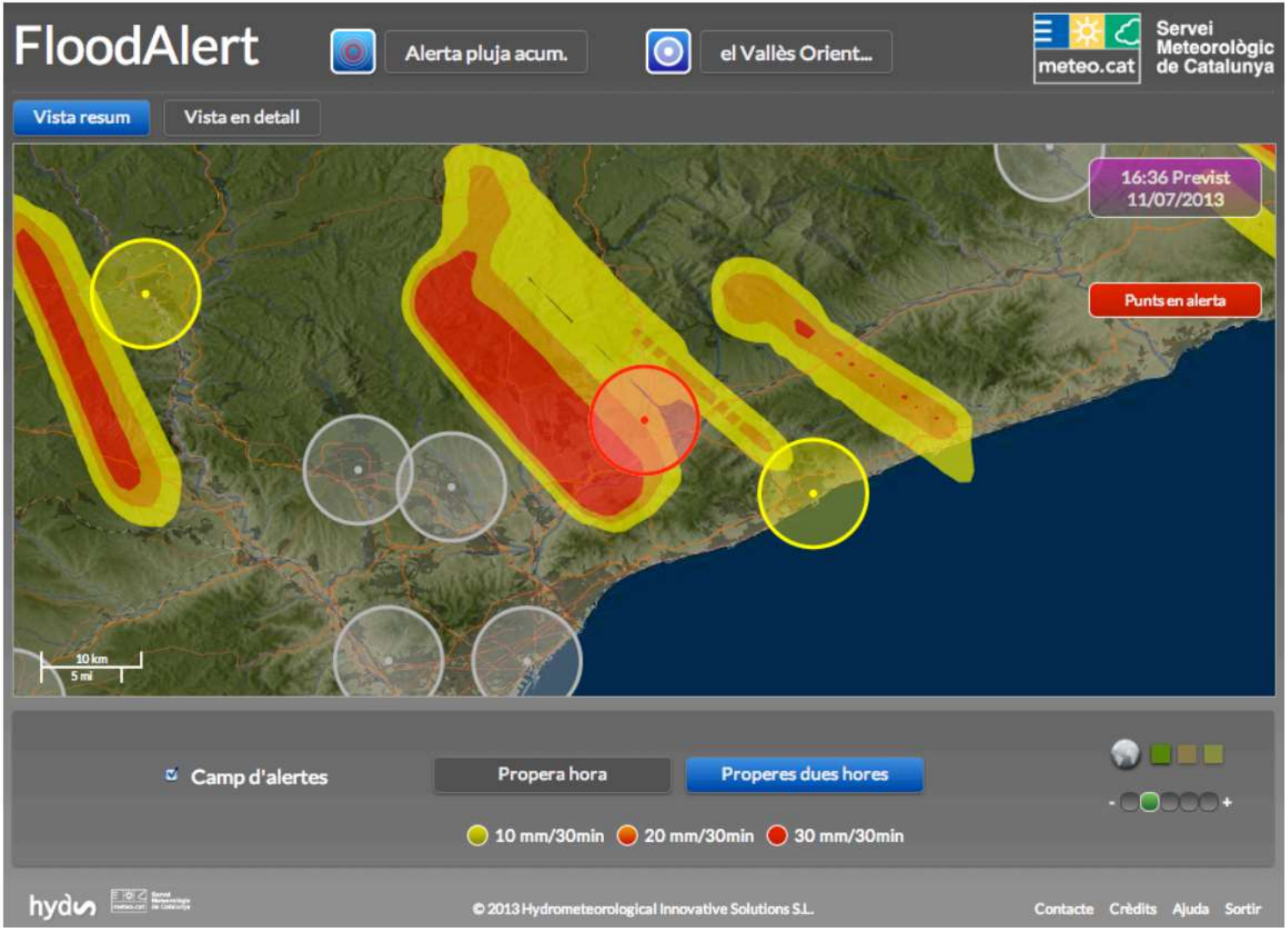
FloodAlert


Past
Future
Raw:
Correction
Radar Nowcasting (2h)
Instantaneous:
Acc.
Acc.
Acc.
Acc.
30 min accumulations:
Max
Max
Temporal Maxs:

FloodAlert


FloodAlert
Temps actual
l'Alt Urgell...
Servei Meteorològic de Catalunya
meteo.cat
Radar i llamps
Capes
18:42 Mesurat
08/07/2013
33.6 mm/h
Alerta de pluja
Alerta de llamps
Pluja (mm/h)
100
50
25
5
0.5
0.2
0.1
5 km
2 mi
Alerta de llamps
Alerta de pluja
Pluja radar
17:30
18:00
18:30
19:00
19:30
20:00
20:30
21:00
hydsolutions
© 2013 Hydrometeorological Innovative Solutions S.L.
Contacte
Crèdits
Ajuda
Sortir

FloodAlert


FloodAlert
Alerta pluja acum.
el Vallès Orient...
Servei Meteorològic de Catalunya
meteo.cat
Vista resum
Vista en detall
16:36 Previst
11/07/2013
Punts en alerta
10 km
5 mi
Camp d'alertes
Propera hora
Properes dues hores
10 mm/30min
20 mm/30min
30 mm/30min
hydsolutions
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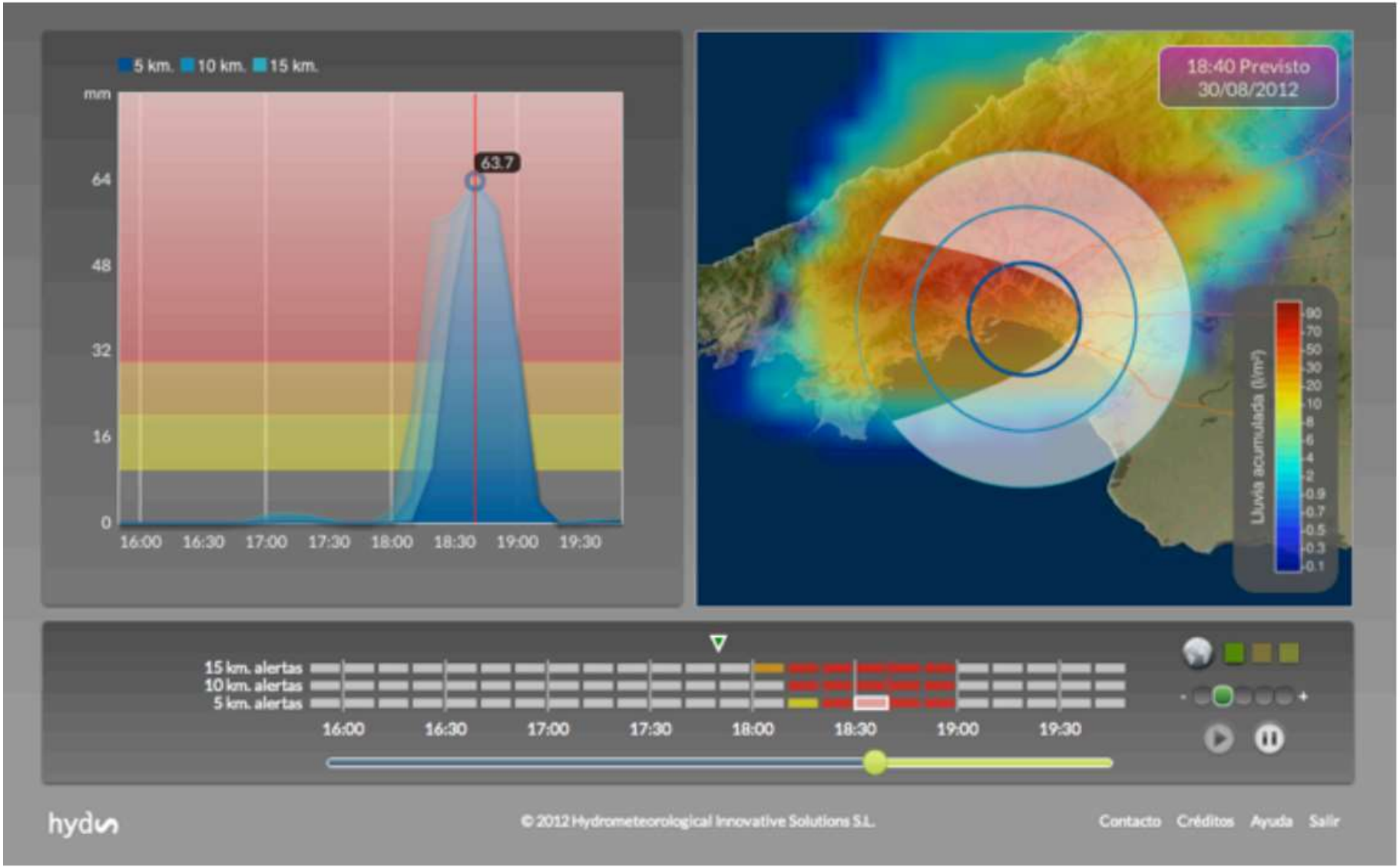
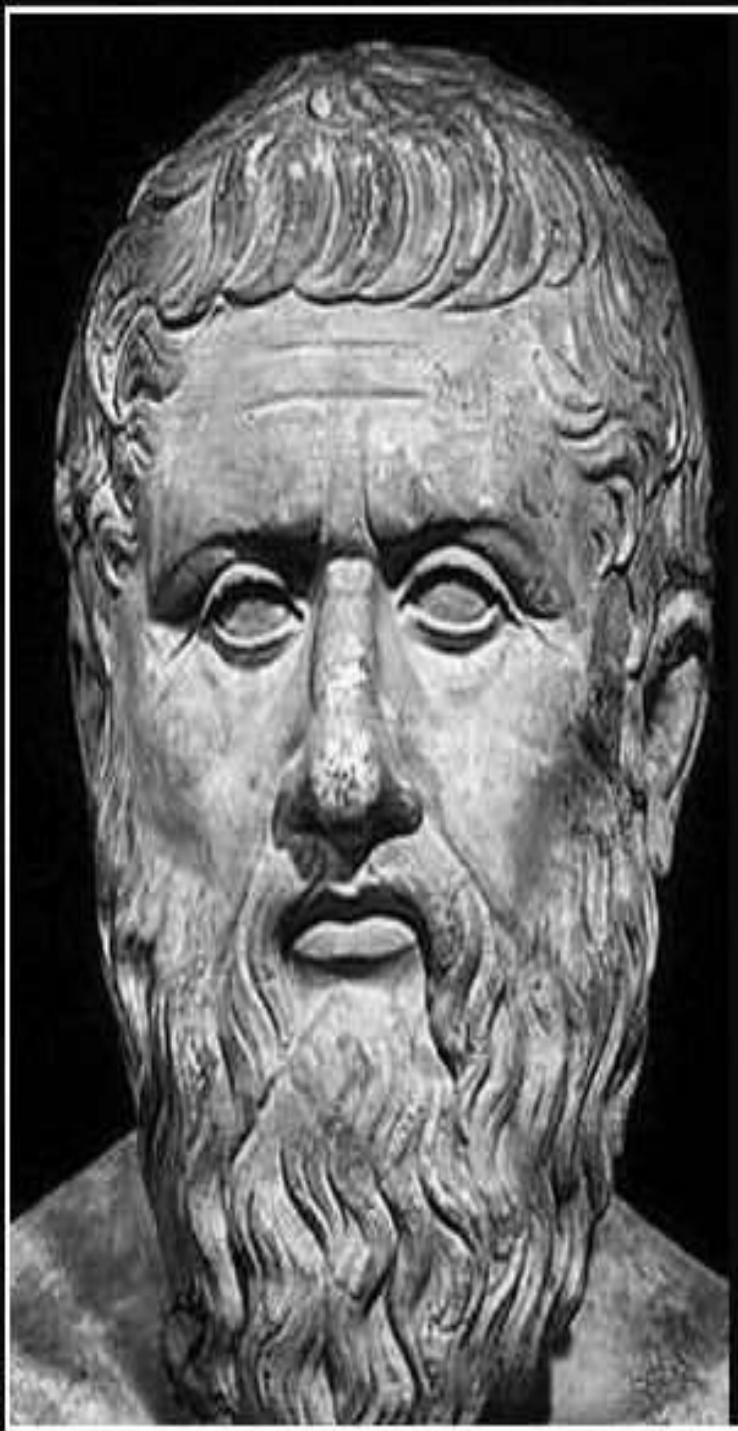
Contacte
Crèdits
Ajuda
Sortir

FloodAlert


5 km.
10 km.
15 km.
mm
64
48
32
16
0
63.7
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
18:40 Previsto
30/08/2012
Lluvia acumulada (l/m²)
90
70
50
30
20
10
8
6
4
2
0.9
0.7
0.5
0.3
0.1
15 km. alertas
10 km. alertas
5 km. alertas
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
hydsis
© 2012 Hydrometeorological Innovative Solutions S.L.
Contacto
Créditos
Ayuda
Salir



A good decision is based on knowledge, and not on numbers.

— Plato —

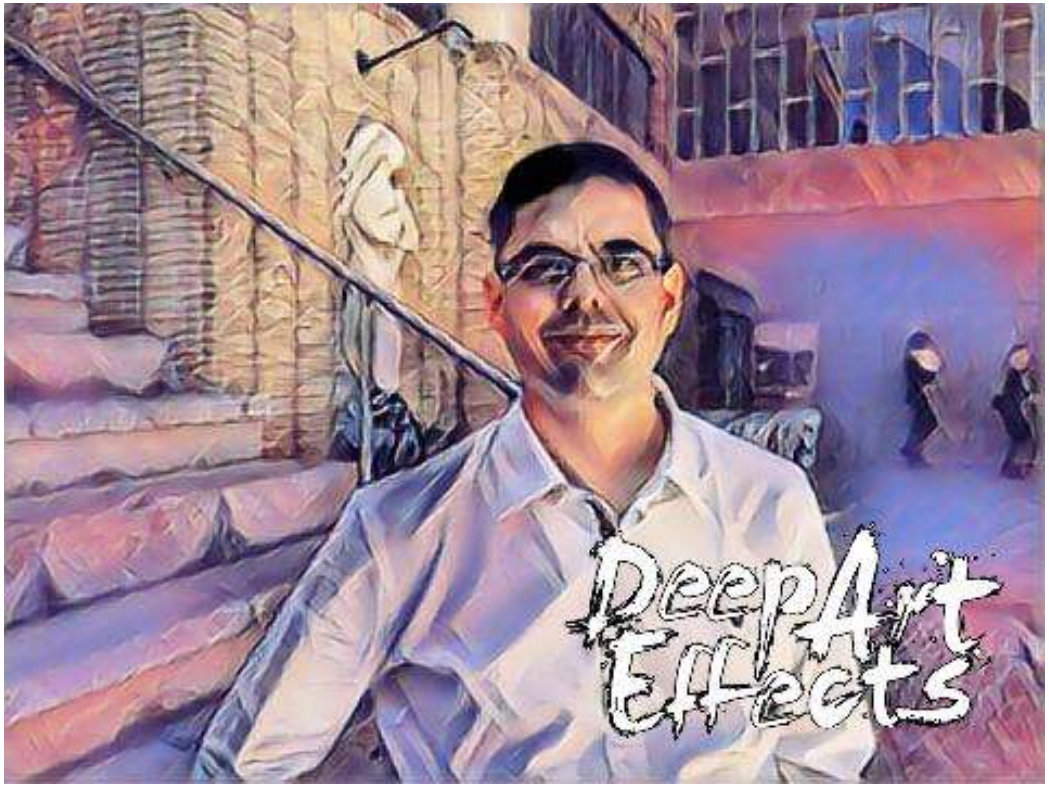
Conclusion

Sept. 27, 2019

DALTONIEN
planète
une vie
CHANCES
NOUS SOMMES
DON'T KILL THE EARTH!
IT'S WHERE I
SKOLSTREJK FÖR KLIMATET
VS
Terre Mère
To the front lines for

AGUAS DE ALICANTE

AGUAS MUNICIPALIZADAS DE ALICANTE (Empresa Mixta)



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