

# Desalination Technology in the US – Potentials for Economic Growth and Sustainable Water Supply

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XVI World Water Congress

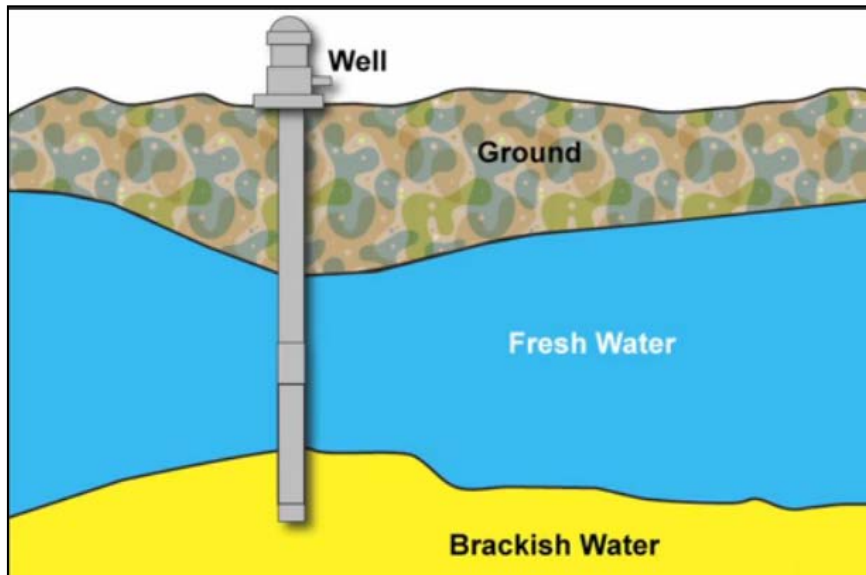
Cancun, Mexico

May, 29 – June, 3, 2017

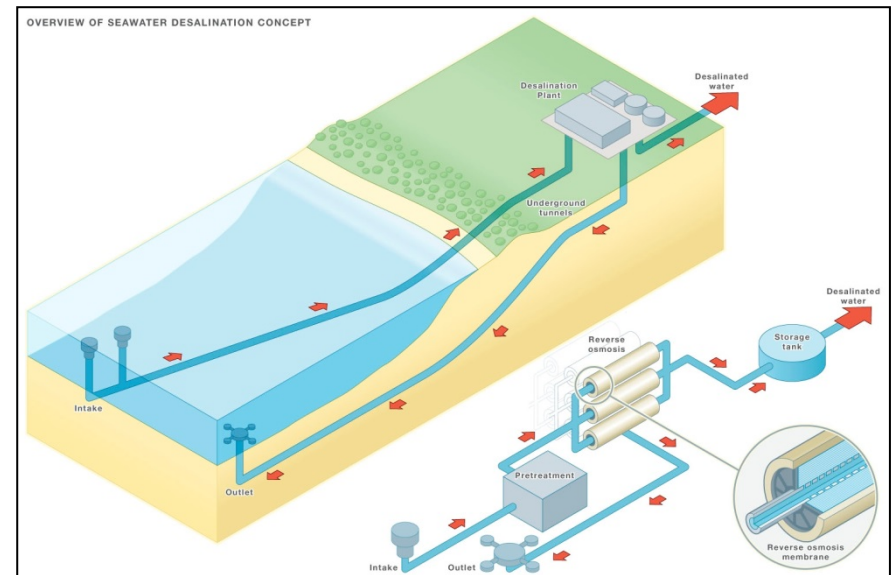
# What is desalination and why do we need it?



**Desalination** (desal) - process of removing salt particles and minerals from seawater or brackish groundwater



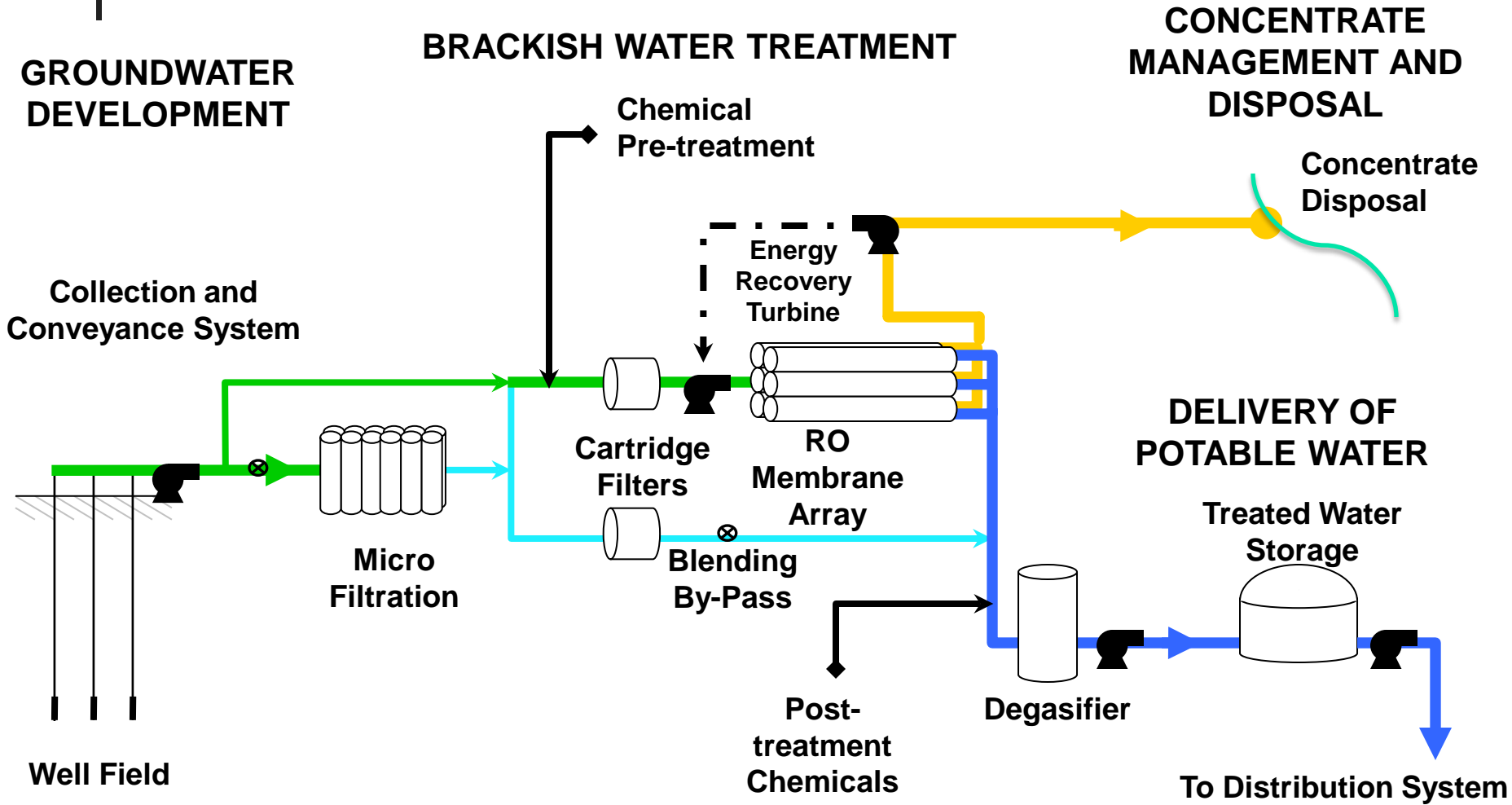
Source: AThirstyPlanet.com



Source: Victoriadesalplants.com

Water source	Salinity TDS (mg/l)
Seawater	15,000-50,000
Brackish water	1,500-15,000
River water	500-3,000
Pure water	< 500

# Desalination treatment process



# Water desalination

Saudi Arabia

## Desalination capacity

Thousand of cubic metres per day

5 000 **1320 MGD**

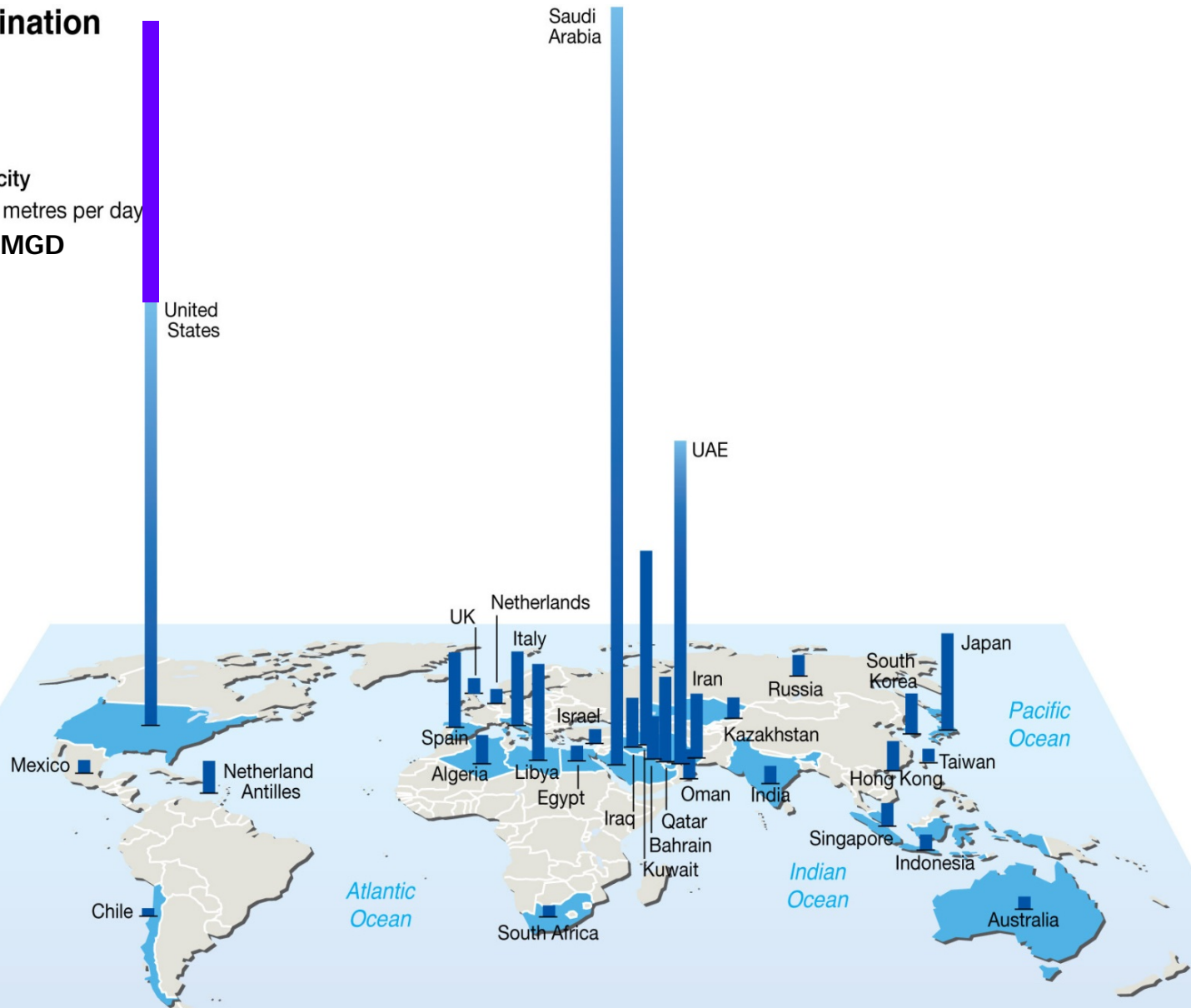
4 000 **1057**  
United States

3 000 **792**

2 000 **528**

1 000 **264**

0

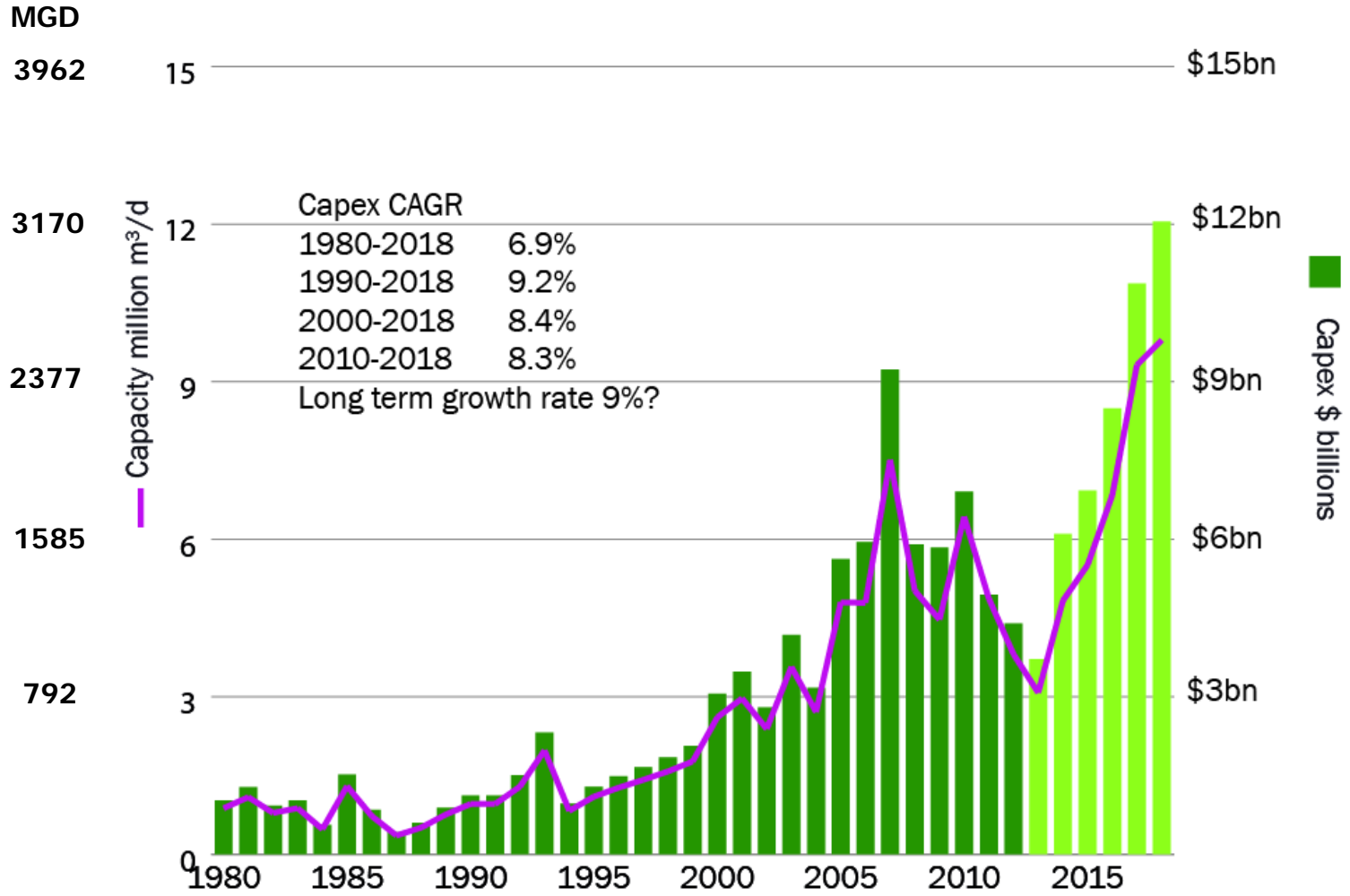


Note: only countries with more than 70 000 cubic metres per day are shown.

Sources: Pacific Institute, The World's Water, 2009.

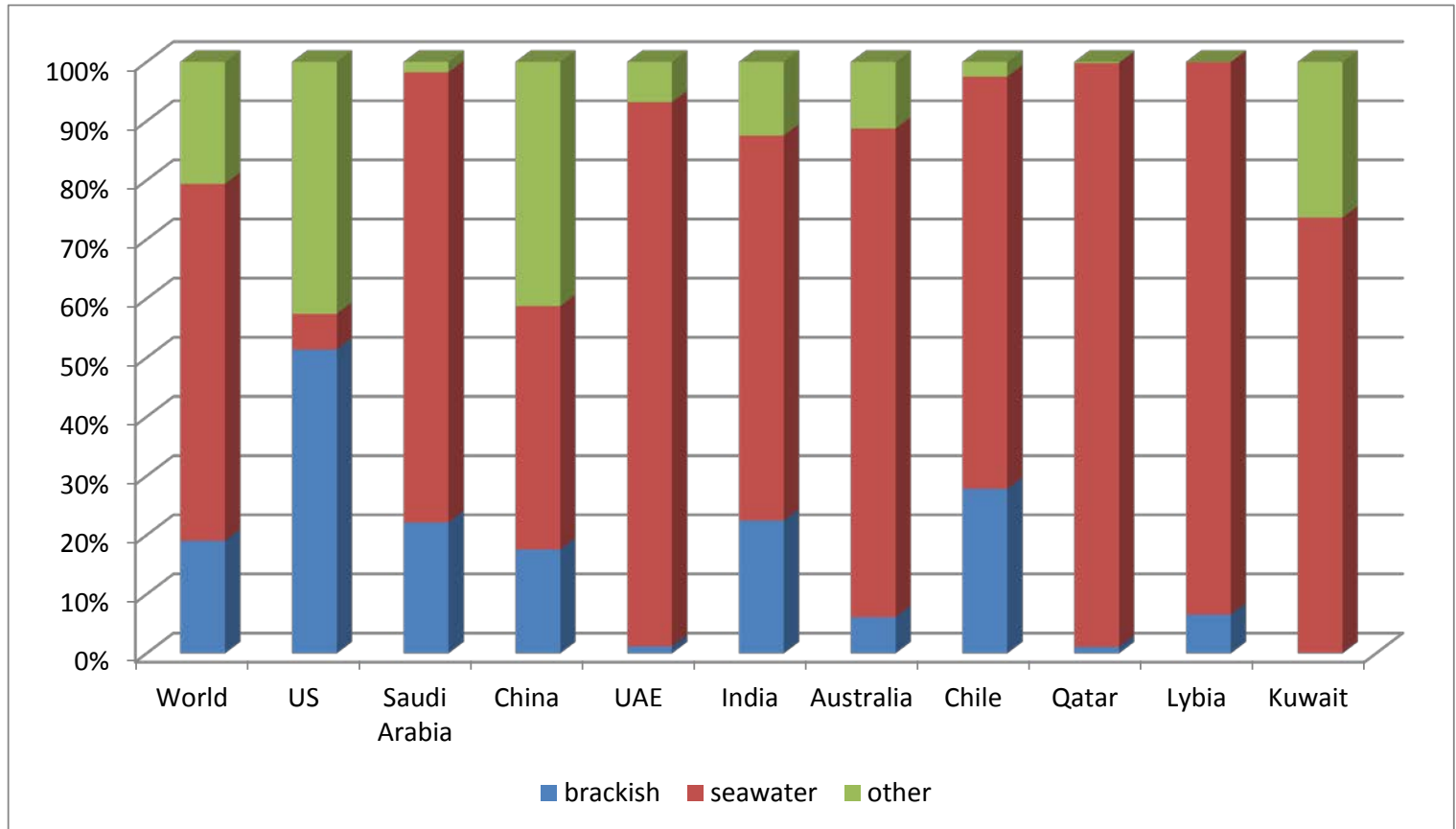


# Global desalination market - costs and capacity



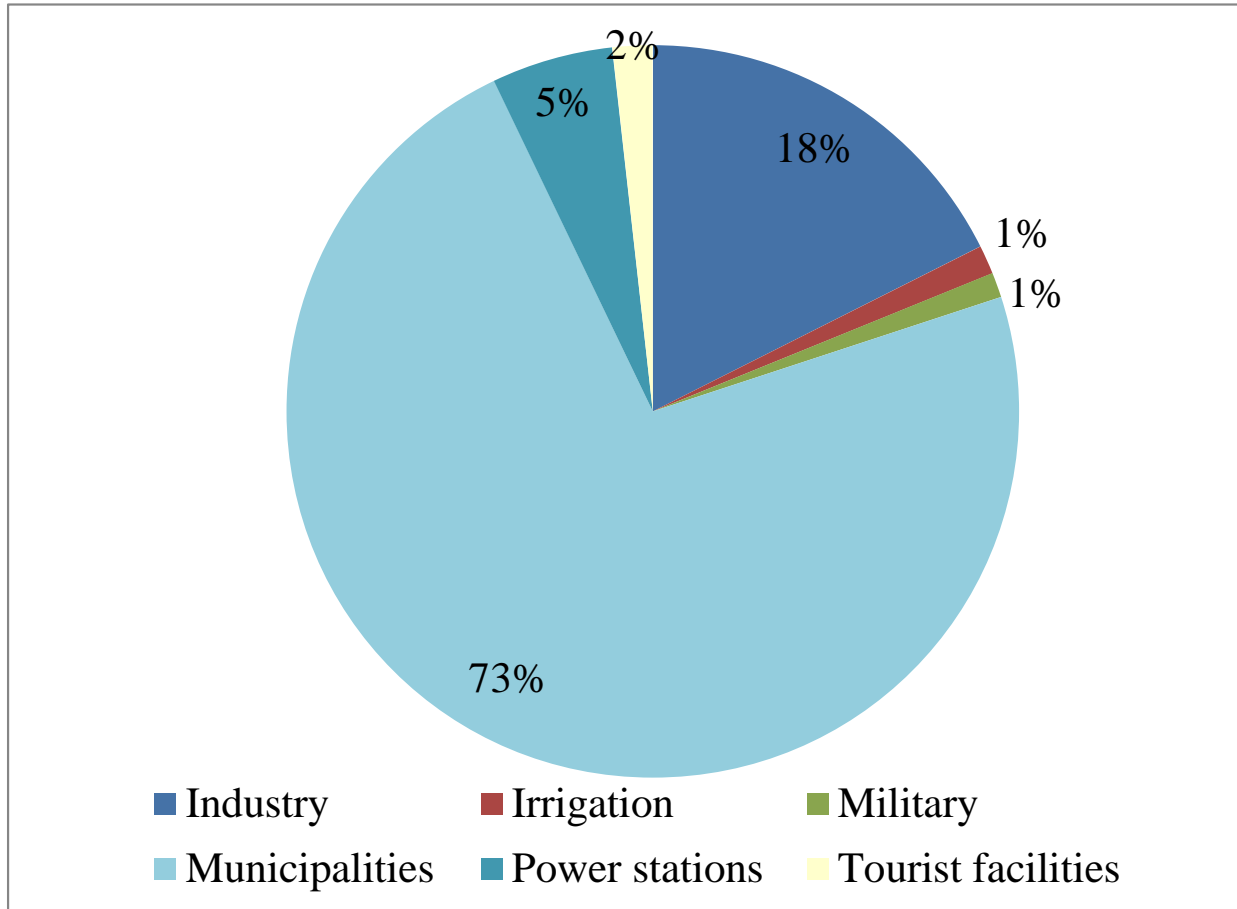
Source: Gasson (2013)

# Global desalination market – water source



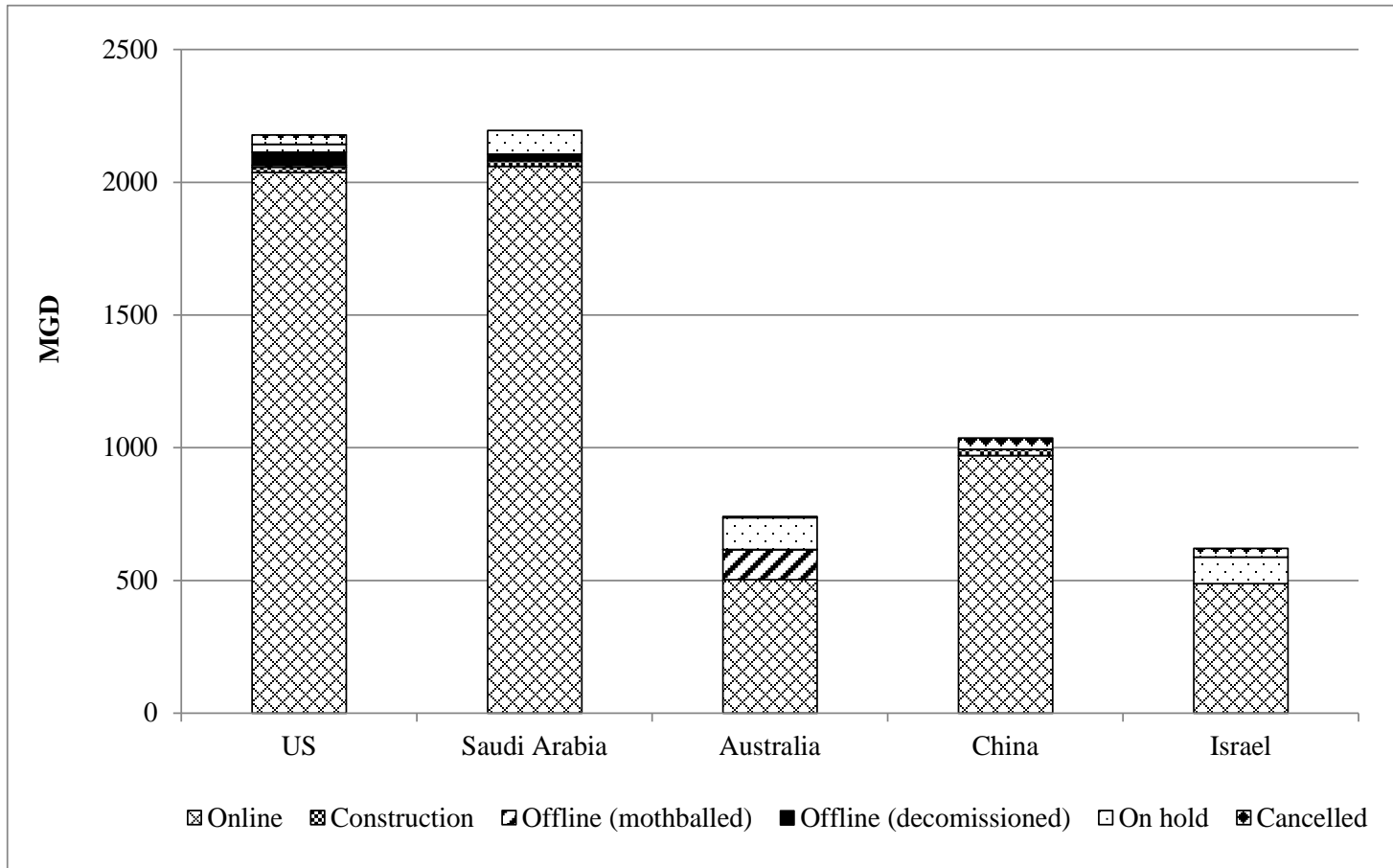
Source: Author's calculations based on DesalData.com (2013)

# Use of desalinated water in the world (2013)



Source: GWI Desal data (2013)

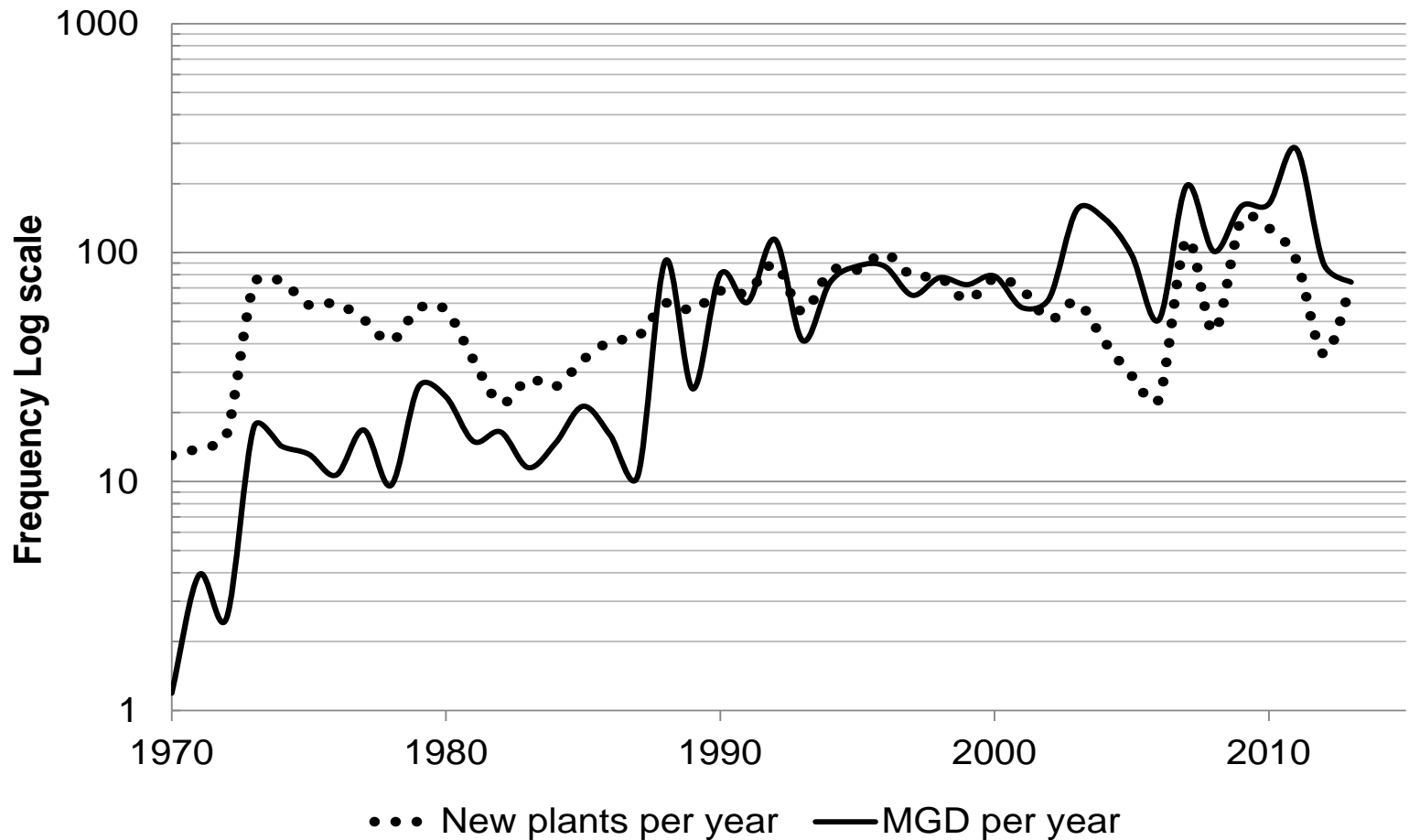
# Desalination plant status (2013)



Source: Author's calculations based on DesalData.com (2013)



# New desalination plants & capacity - US, 1970-2013



Source: Author's calculations based on DesalData.com (2013)



## Need for desalination

- Global water demand predicted to increase by 46% between 2000-2050 (UN, 2014; OECD, 2012)
- In Oklahoma, water demand is projected to increase by 33.3% in the next 50 years (OCWP, 2012)
- Water resources (surface water, groundwater, reuse water) will decrease by 10% in next 50 yrs (TWRI, 2011)
- Drought in the US (significant pressure on water resources)
- Brackish/seawater desalination could buffer the shortage
- Many open questions and impediments (desalination siting and economics)

**Where are desalination plants located?**

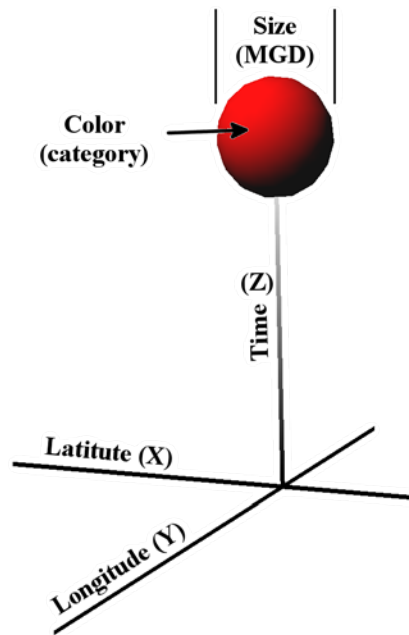
# Research objective



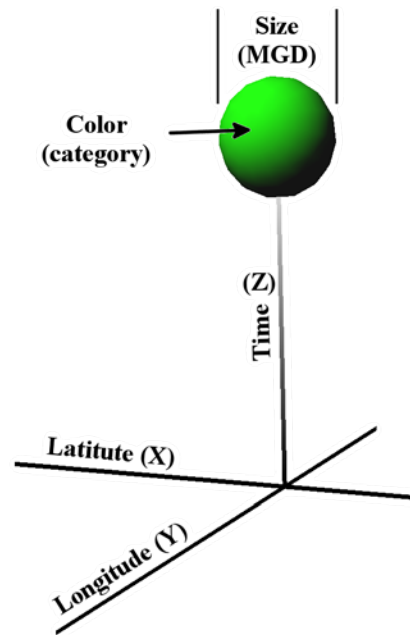
- Develop interactive 5D and 6D geospatial models and a multi-dimensional analysis of desalination trends in the US
- Time span 1950-2013
- The models include a set of uniform variables for comparative analyses

Category	Category variable
Plant capacity (MGD*)	4.31 < 73.21; 1.80 < 4.31; 0.86 < 1.80; 0.50 < 0.86; 0.31 < 0.50; 0.20 < 0.31; 0.13 < 0.20; 0.08 < 0.13; 0.04 < 0.08; 0.00 < 0.04
Raw water type (TDS)	Brackish water or inland water (TDS** 3000 - <20000) Brine or concentrated seawater (TDS >50000) Pure water or tap water (TDS <500) River water or low concentrated saline water (TDS 500 - <3000) Seawater (TDS 20000 - 50000) Waste Water Unknown
User category	Demonstration Discharge Industry (TDS <10) Irrigation (TDS <1000) Military purposes (TSD 10 - <1000) Municipalities as drinking water (TDS 10 - <1000) Power stations (TDS <10) Tourist facilities as drinking water (TDS 10 - <1000) Water injection Unknown

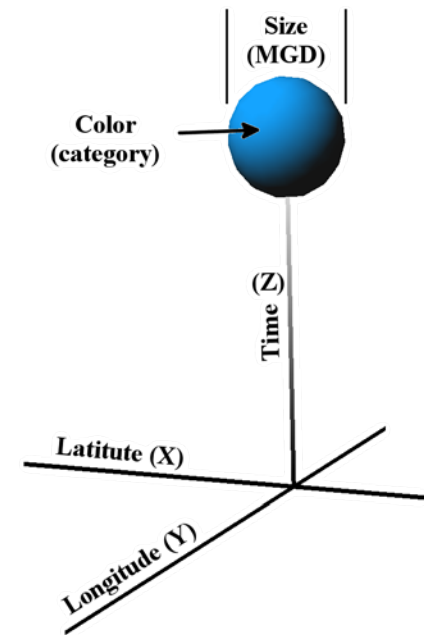
# Graphical representation of the 6D model



**Plant Status**



**Raw Water Type**



**Final User**

## Methods and data



- Data set from Desaldata.com by the Global Water Intelligence (GWI, 2013) - 2,749 data entries for the US in 2013
- Data cleaning → 1,600 plants in the US with complete record specified for the models
- Google Fusion tables and Google Earth used for geocoding (lat long) with the Keyhole Markup Language (KML) applied in virtual globes
- C++ computing language used to create a 3D analysis space
- 6D model → 5D model + a function of three additional categories (plant status, raw water type, final user) that are a category in itself



# Model access

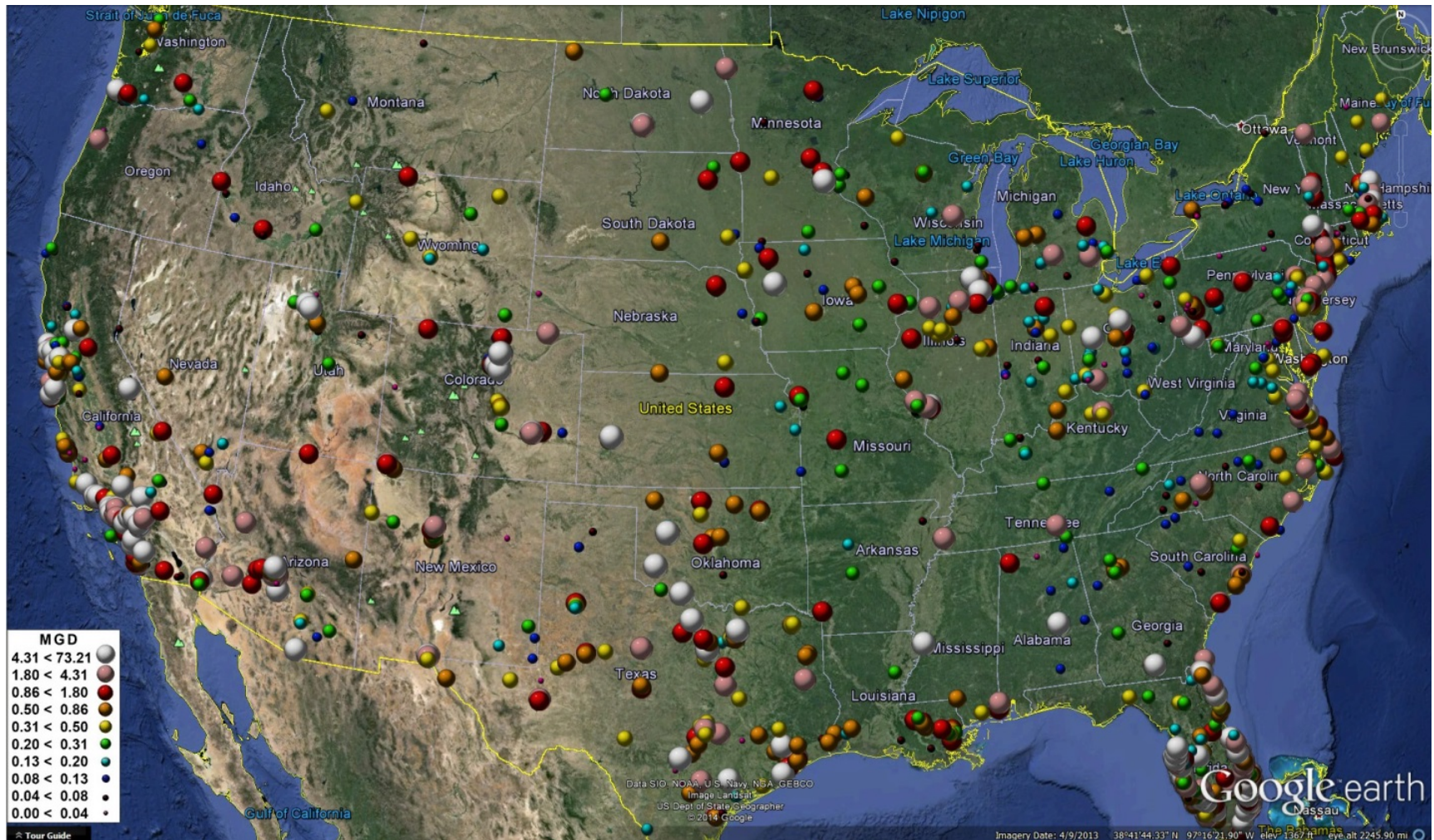
Model website with explanation:

[http://www.hitechmex.org/US\\_desal/US\\_desal.html](http://www.hitechmex.org/US_desal/US_desal.html)

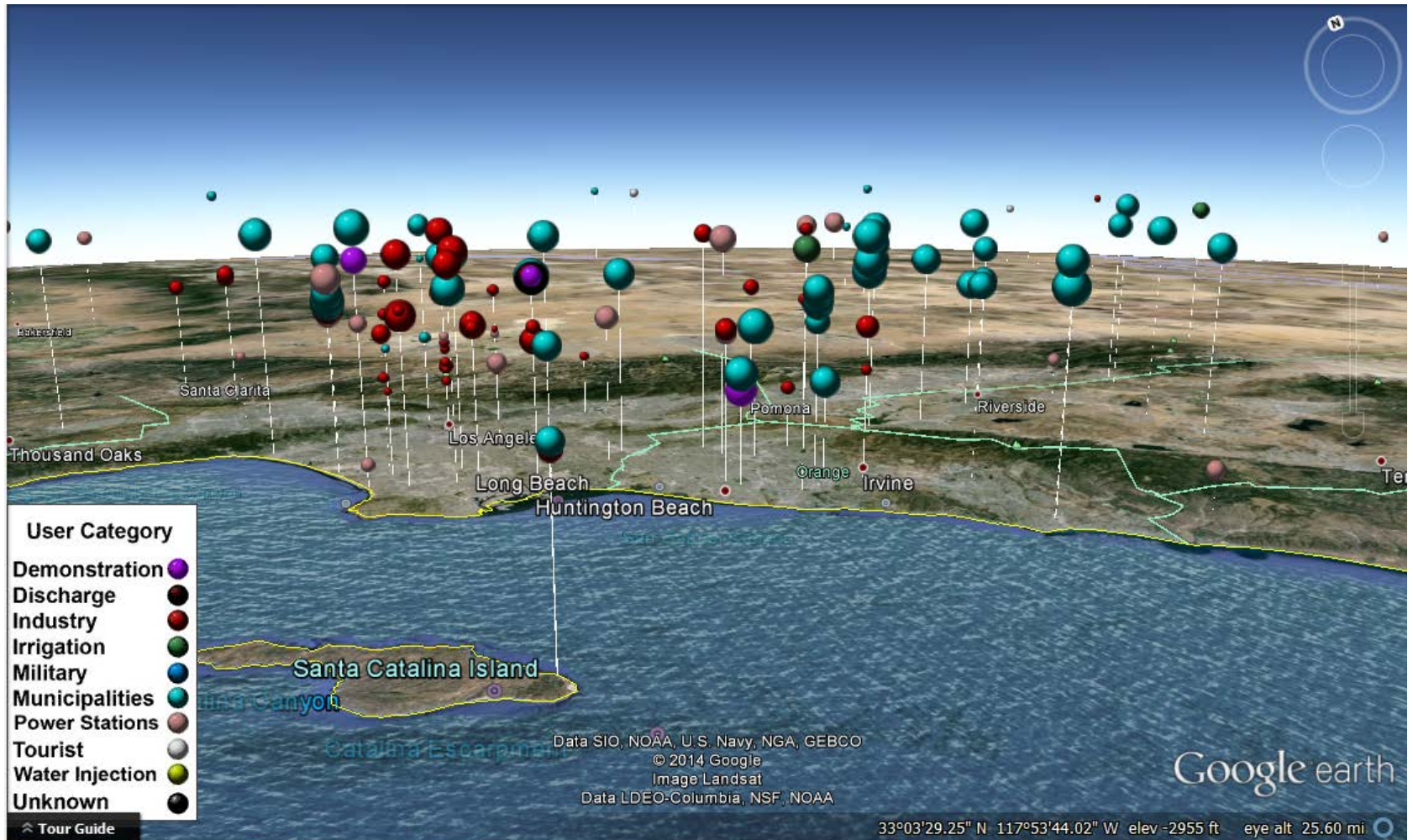
Open access model of desalination plants in the US:

[http://www.hitechmex.org/US\\_desal/US\\_Desal.kmz](http://www.hitechmex.org/US_desal/US_Desal.kmz)

# 5D map of desalination plants in the US based on desalination capacity

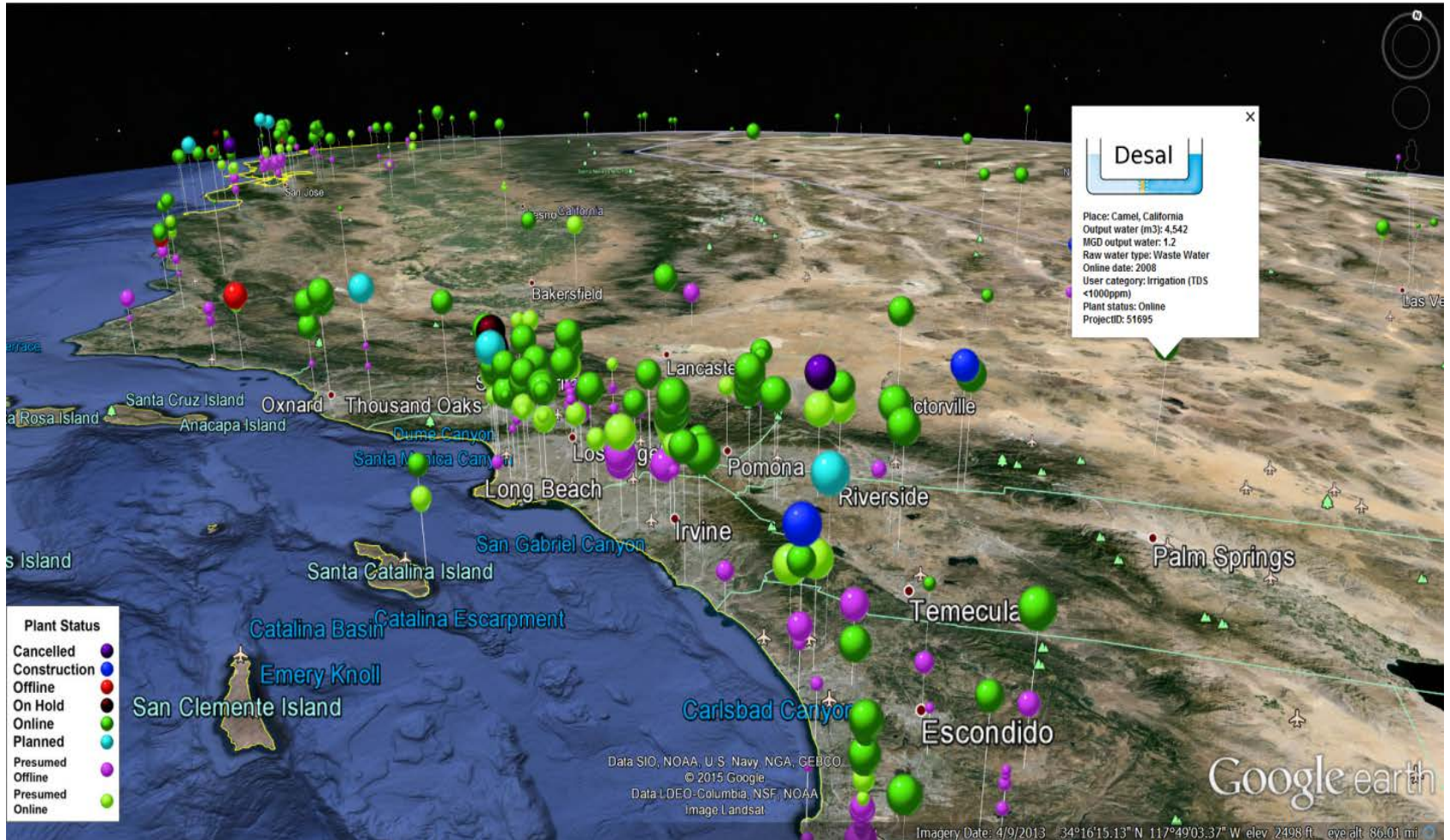


# 5D view of desalination plants in the Los Angeles area based on the end consumer of desalinated water





# 5D map of desalination plants in the US based on the plant status category



# Conclusions



- The models can be used as an educational and research tool to better analyze, present, and display water issues and developments of the desalination sector in the US
- Geographical and spatio-temporal data analysis can help with designing policies and measures at the regional and national scale
- Results can be viewed in ESRI ArcGIS, ArcGIS Explorer, ArcGIS Earth, NASA World Wind, Google Maps, Google Earth, Google Earth Pro, Chrome Google Earth Web, and CesiumGS
- Models can be used on any computer system: Windows, Linux, Apple, and on smartphones: iPhone, iPad or Android



## References

Gasson, C. (2013): Desalination market update. Fourth Quarter Assessment. Water desalination report 2013

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# Thank you

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