Water Futures Under a Changing Climate

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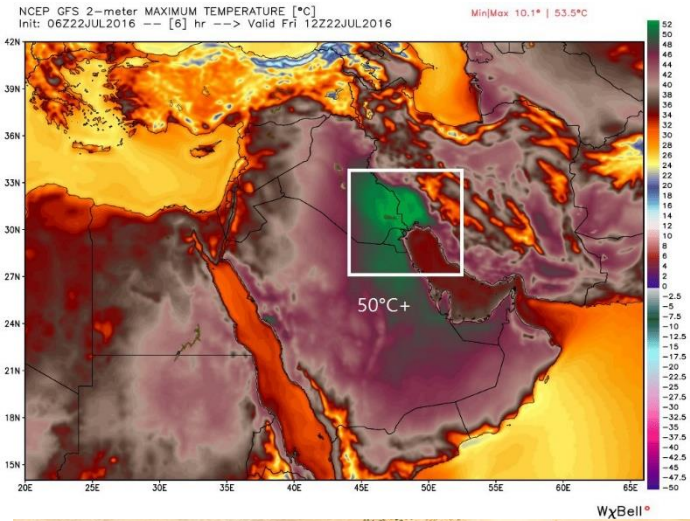
Overview

- What does climate change modelling tell us about future conditions in the Gulf States?
- What are the possible adaptation solutions?

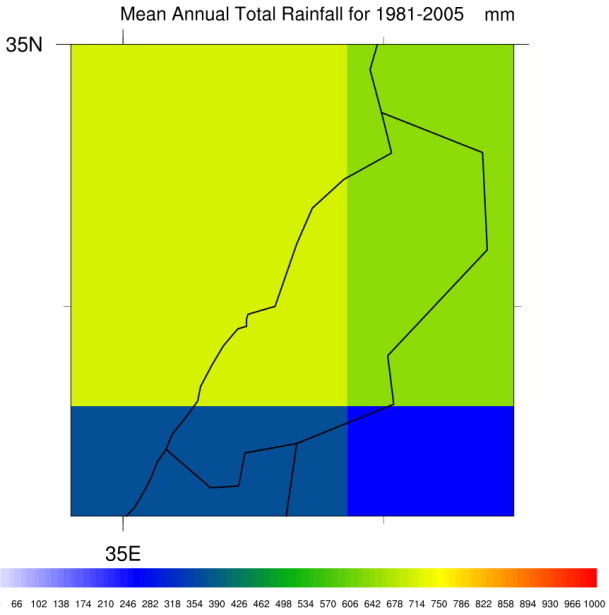
Introduction

- Gulf states water systems prone to any CC changes that affect supply or increase demand
  - Reduce rainfall and/or bring storm flows
  - Increase air temperature/evapotranspiration
  - Change temperature/salinity of the sea impairing desal
  - Change temperature/salinity affecting treated wastewater processes



What do climate change models tell us about future conditions in the Gulf States?

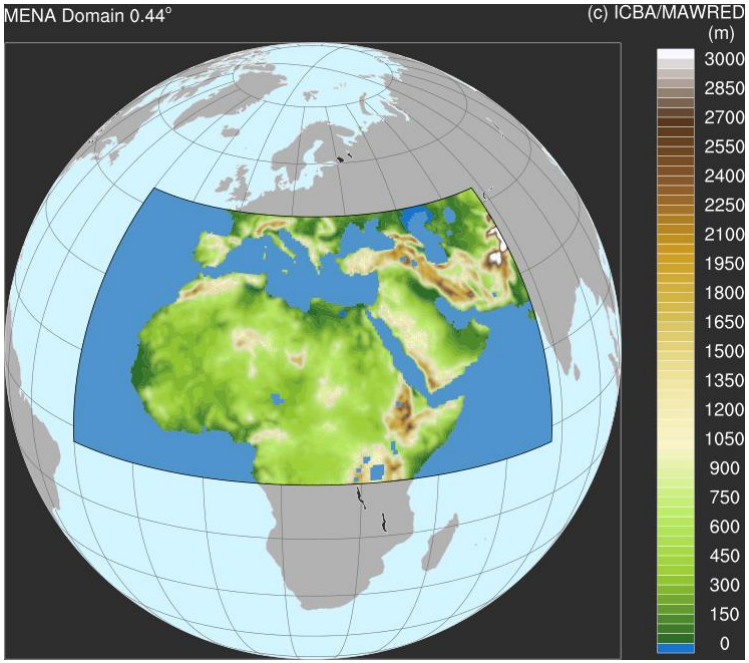
- General Circulation Models (GCMS) captures the global dynamic processes and transfers of energy and moisture
- BUT scale is >150km per grid cell
- Regional climate modeling needed



Dynamic downscaling at ICBA

- ICBA tuned regional climate model (WRF)
- GCMs: CNRM-CM5, MIROC5 and CESM1 identified as best for MENA

DOMAIN	RESOLUTION
MENA	50 km
UAE / Gulf States Morocco / Tunisia / Yemen /Lebanon / Jordan / Palestine / Egypt /	15 km



(1951 – 2005)

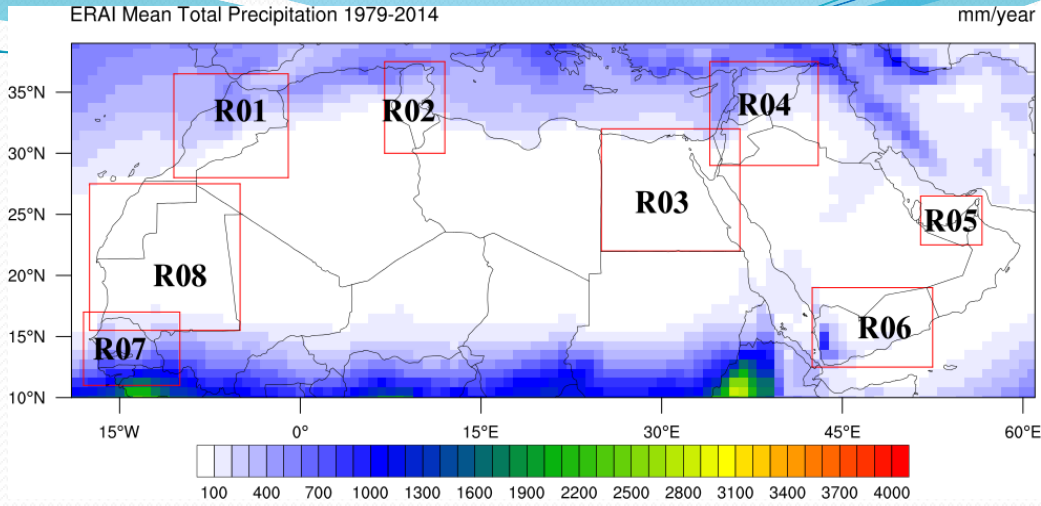
Current

(2021 – 2100)

RCP4.5

RCP8.5

- 13 regional models have been assessed against ERA-Interim on sub-regions including the Gulf states -2m temperature and rainfall have been assessed



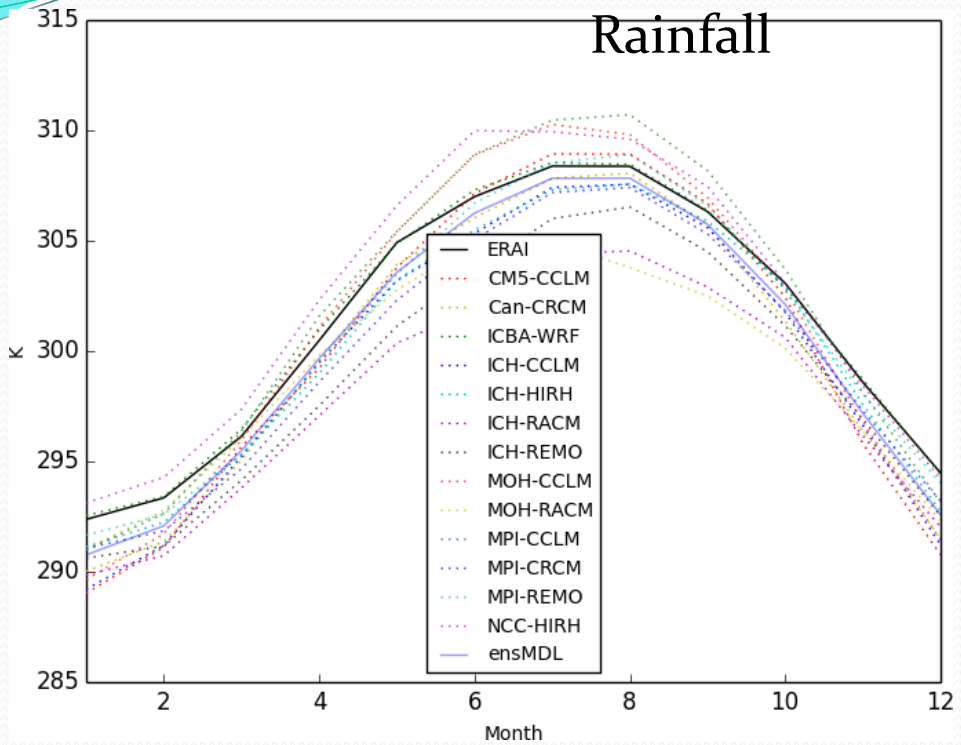
Models assessed

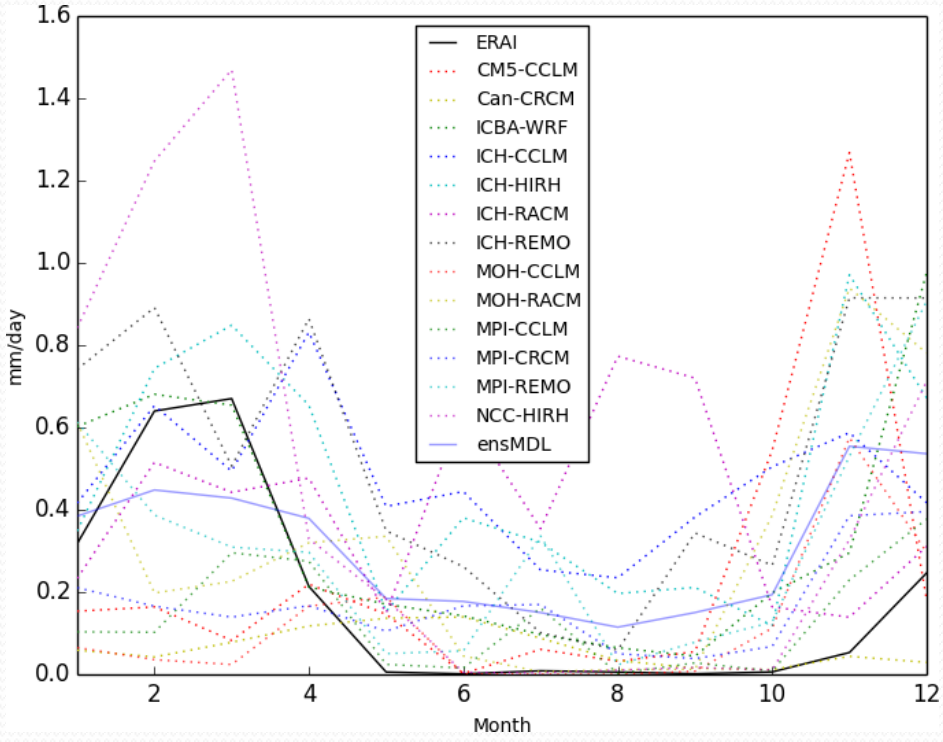
Tool: NASA-JPL RCMES

GCM	RCM
CCCma-CanESM2	UQAM-CRCM5
CNRM-CERFACS-CNRM-CM5	CLMcom-CCLM4-8-17
ICHEC-EC-EARTH	CLMcom-CCLM4-8-17
ICHEC-EC-EARTH	MPI-CSC-REMO2009
ICHEC-EC-EARTH	KNMI-RACMO22T
ICHEC-EC-EARTH	DMI-HIRHAM5
MOHC-HadGEM2-ES	CLMcom-CCLM4-8-17
MOHC-HadGEM2-ES	KNMI-RACMO22T
MPI-M-MPI-ESM-LR	CLMcom-CCLM4-8-17
MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009
MPI-M-MPI-ESM-LR	UQAM-CRCM5
NCAR-CESM1	ICBA-WRF3.6
NCC-NorESM1-M	DMI-HIRHAM5

Temperature

Rainfall

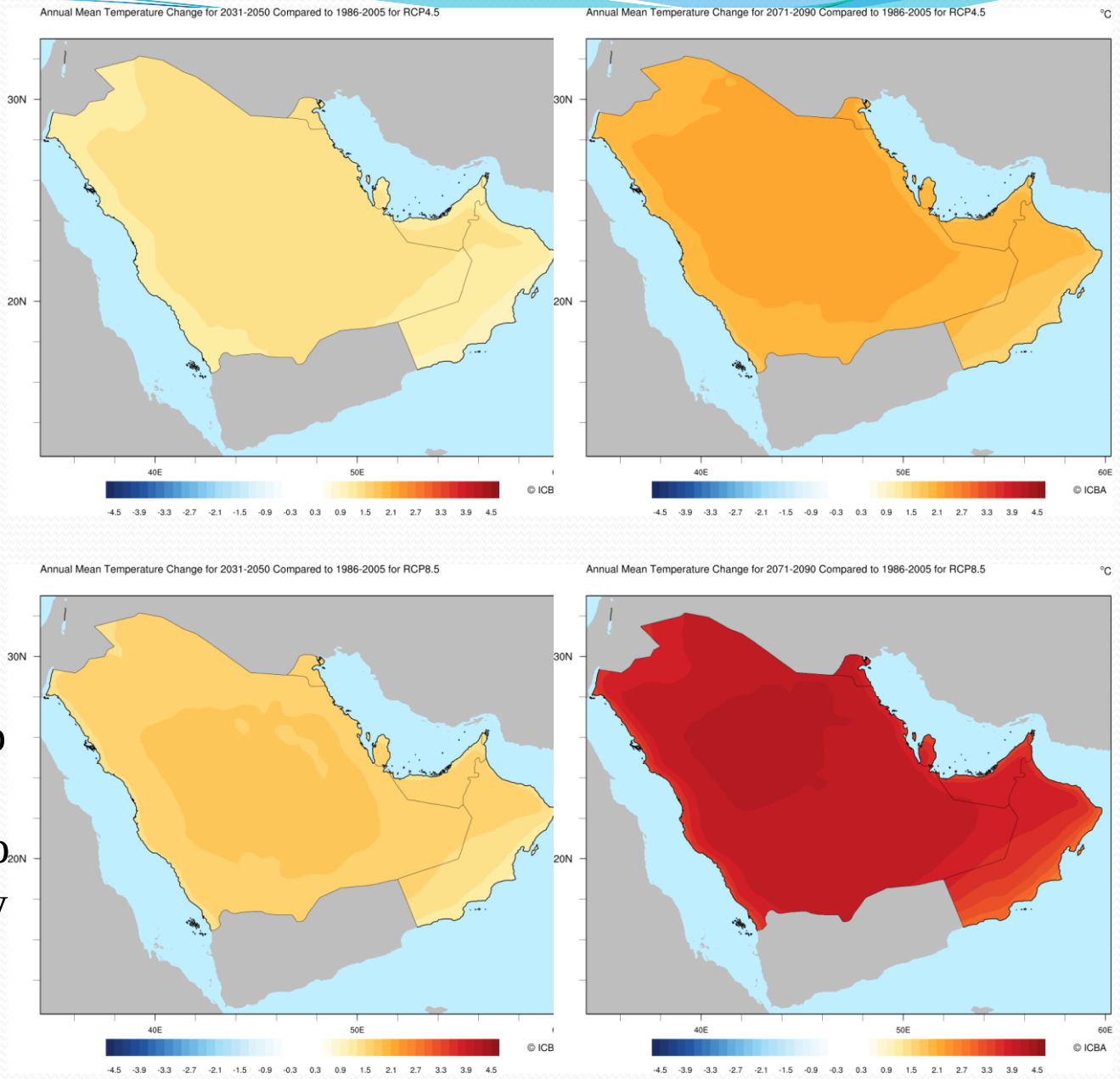




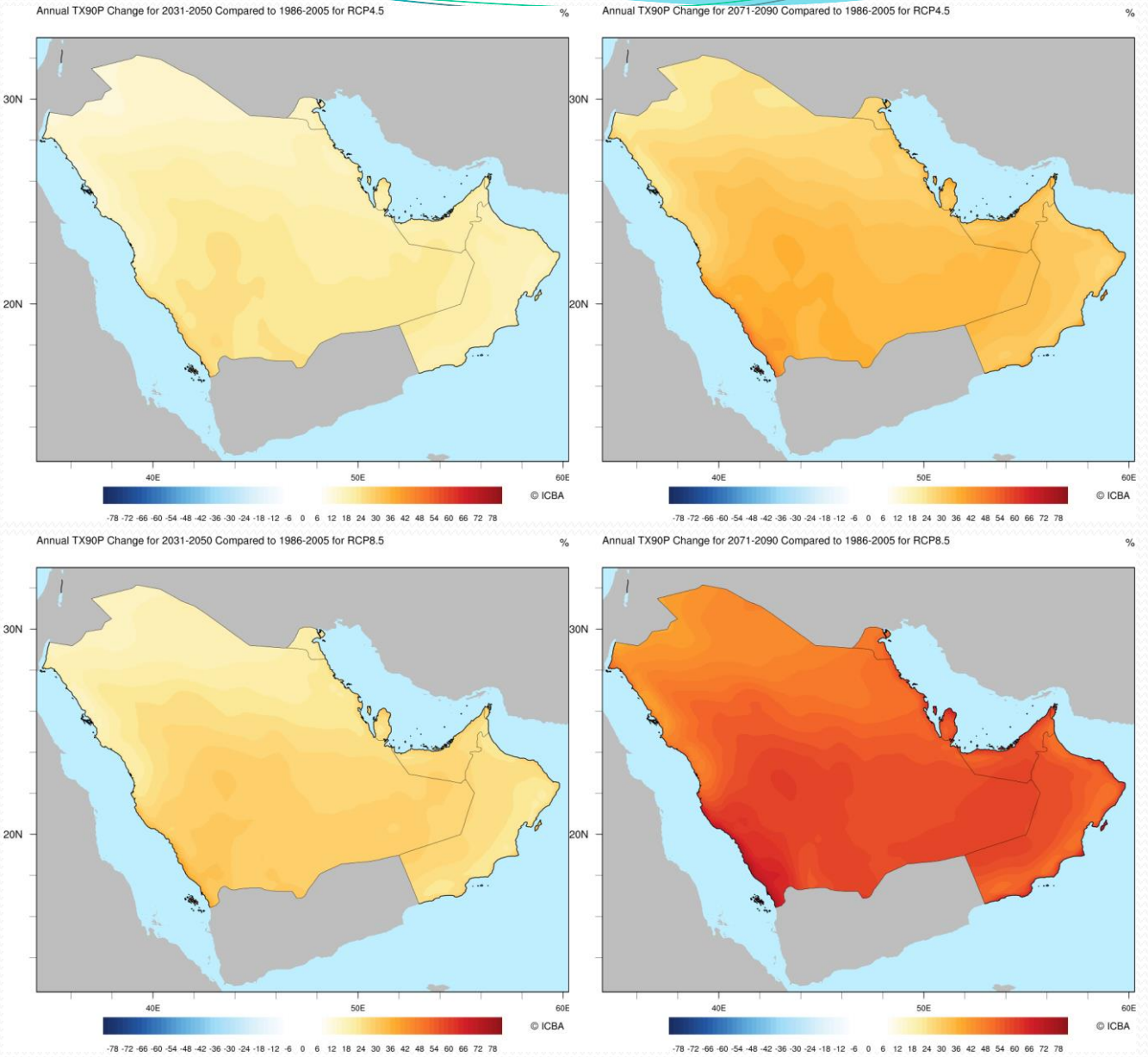
- Most models don't reproduce the climatology in the Gulf states in terms of Rainfall
- Some models have cold/hot bias exceeding 5 degrees in summer

Temperature will increase especially over the continental areas

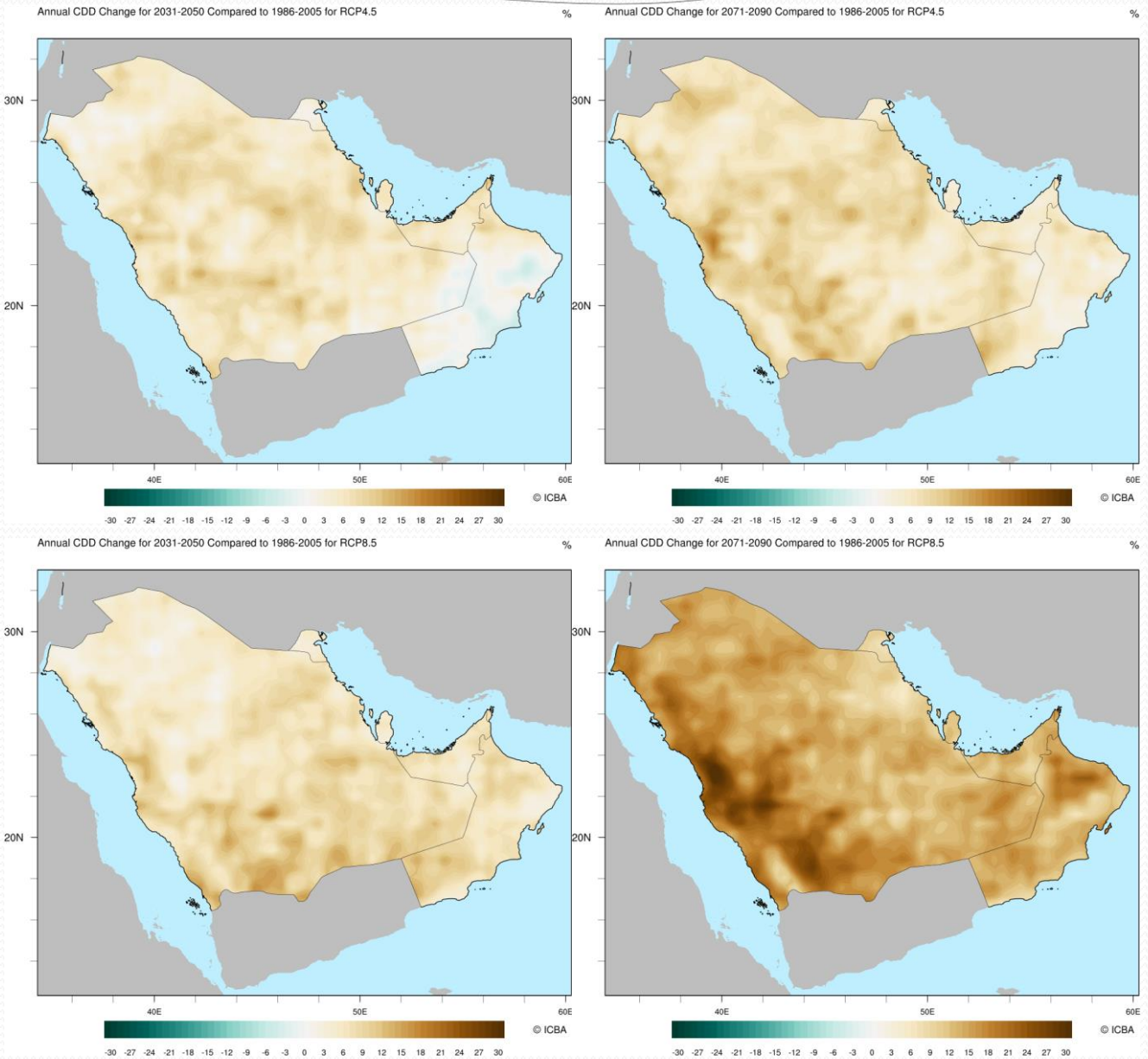
Temperature will likely to increase by more than 4.5 ^{o}C under RCP8.5 scenario in central Saudi Arabia by the end of this Century



Heat waves frequency will likely to increase by more than 60% under RCP8.5 especially over the costal zones

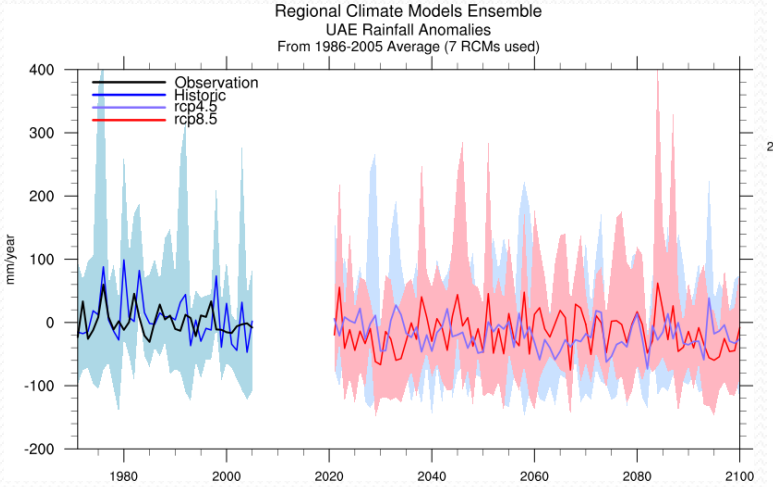


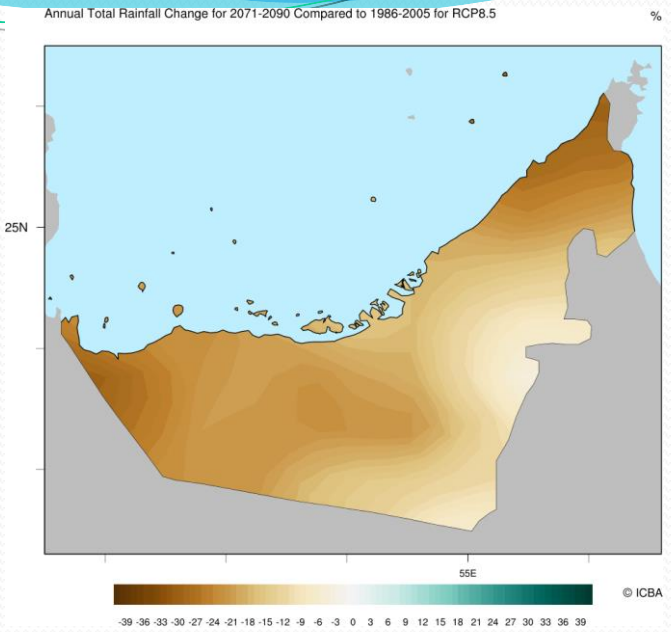
Maximum consecutive dry days will likely to increase by more than 20% under RCP8.5 in GCC countries



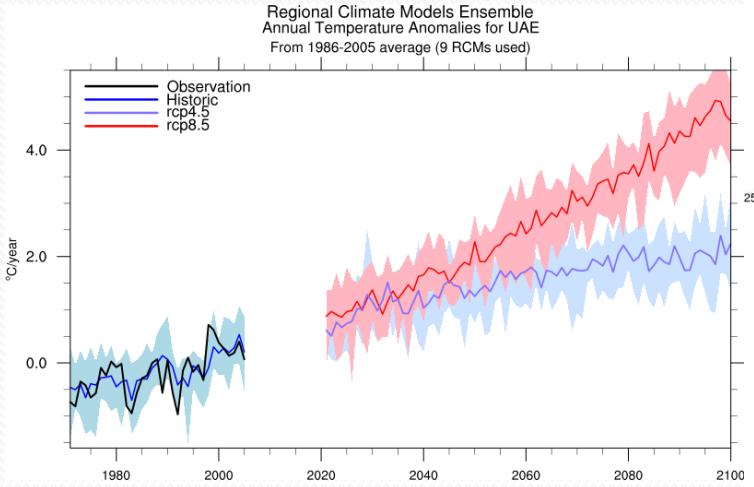
Future changes 2071-2090 vs 1986-2005

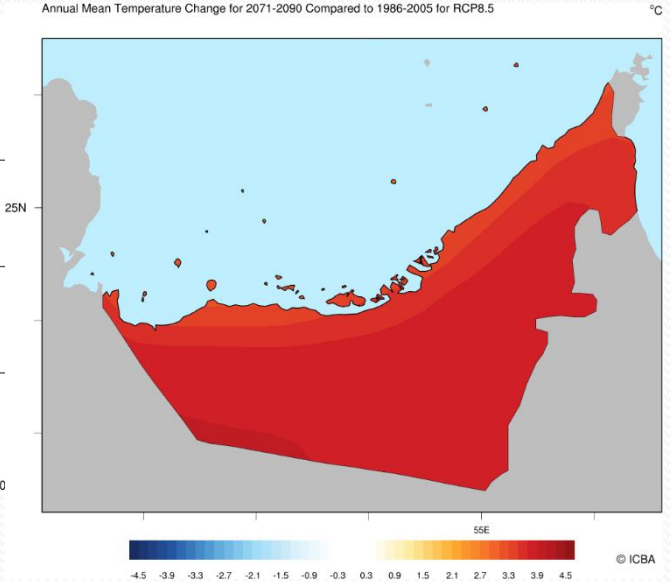
Drop in rainfall reaching more than 30% by 2100





Increase in 2m Temperature reaching 4.5 degrees by 2100



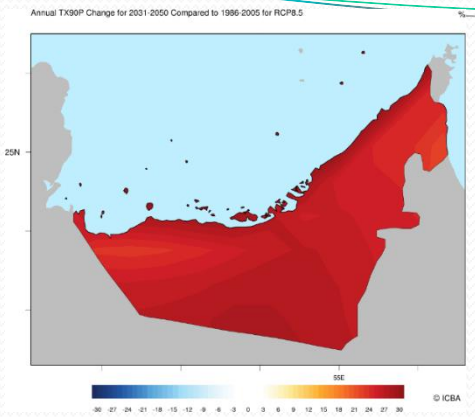


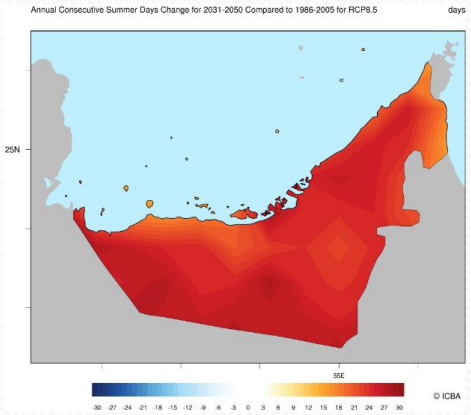
Temperature related indices

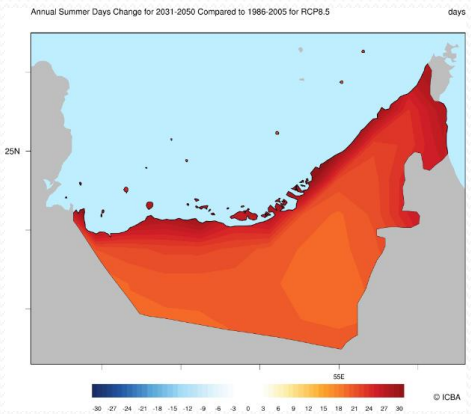
Trend in very warm days percent (T>90th percentile of 1986-2005)

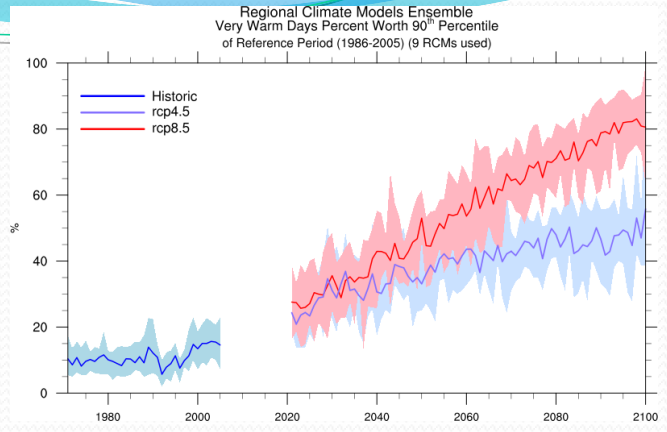
Trend in highest number of consecutive summer days (T>35^{o}C compared to1986-2005)

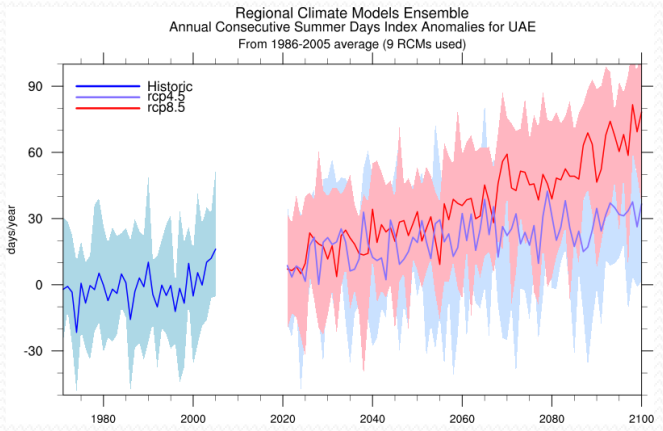
Trend in number of summer days (T>35^{o}C compared to1986-2005)

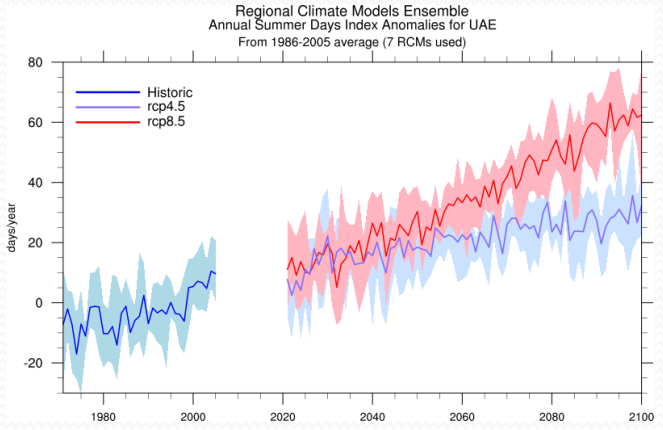






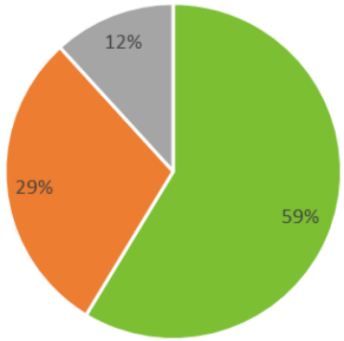




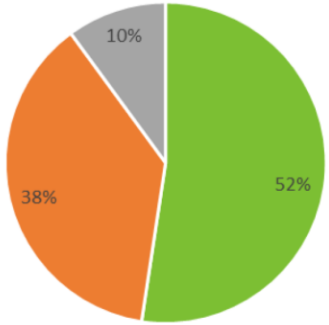


Implications for water sources and consumption – a balanced policy

2020- Demand by Type (10 BCM)

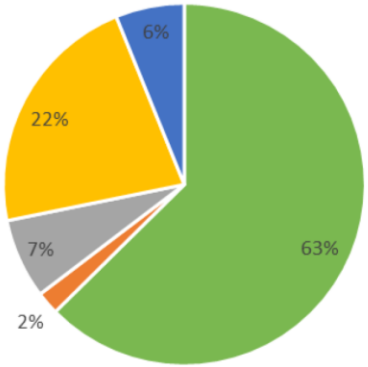


2060 Demand by Type- Integrated Policy (9.8 BCM)

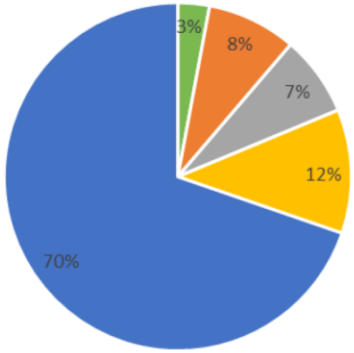


Ag Indoor Outdoor

2020 Supply by Source



2060 Supply by Source– *Integrated Policy*



GW Reuse MED MSF RO

AGEDI
مبادرة أبوظبي العالمية للبيانات البيئية
Abu Dhabi Global Environmental Data Initiative

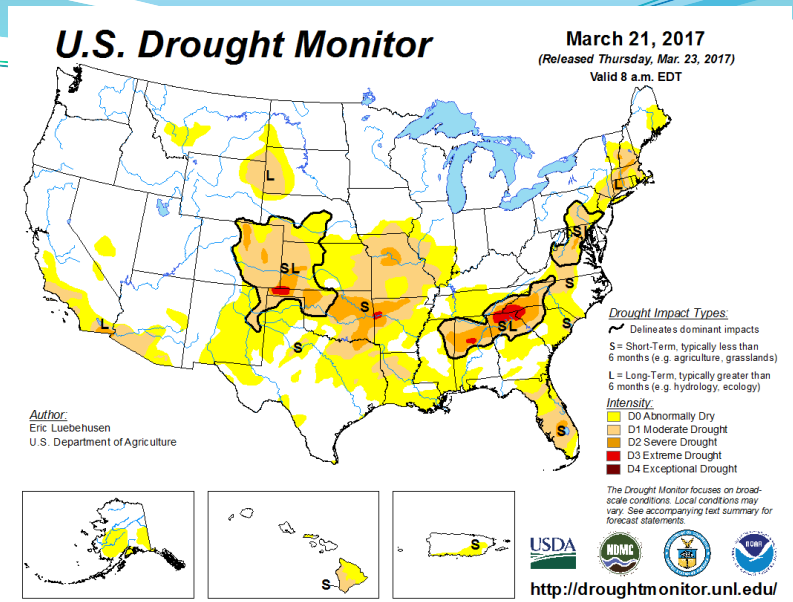
an initiative of

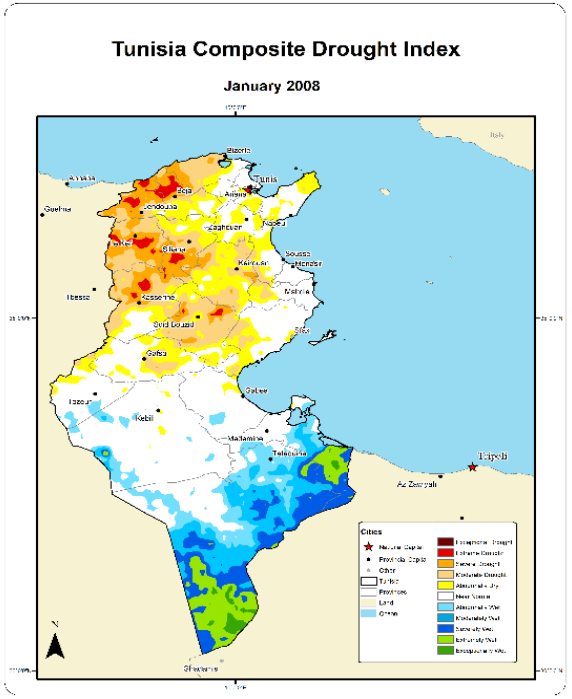
UNEP

هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

Droughts - key stress

- Aridity stressed during droughts
- No drought monitoring or management in place
- Will not be able to irrigate out of this in the future



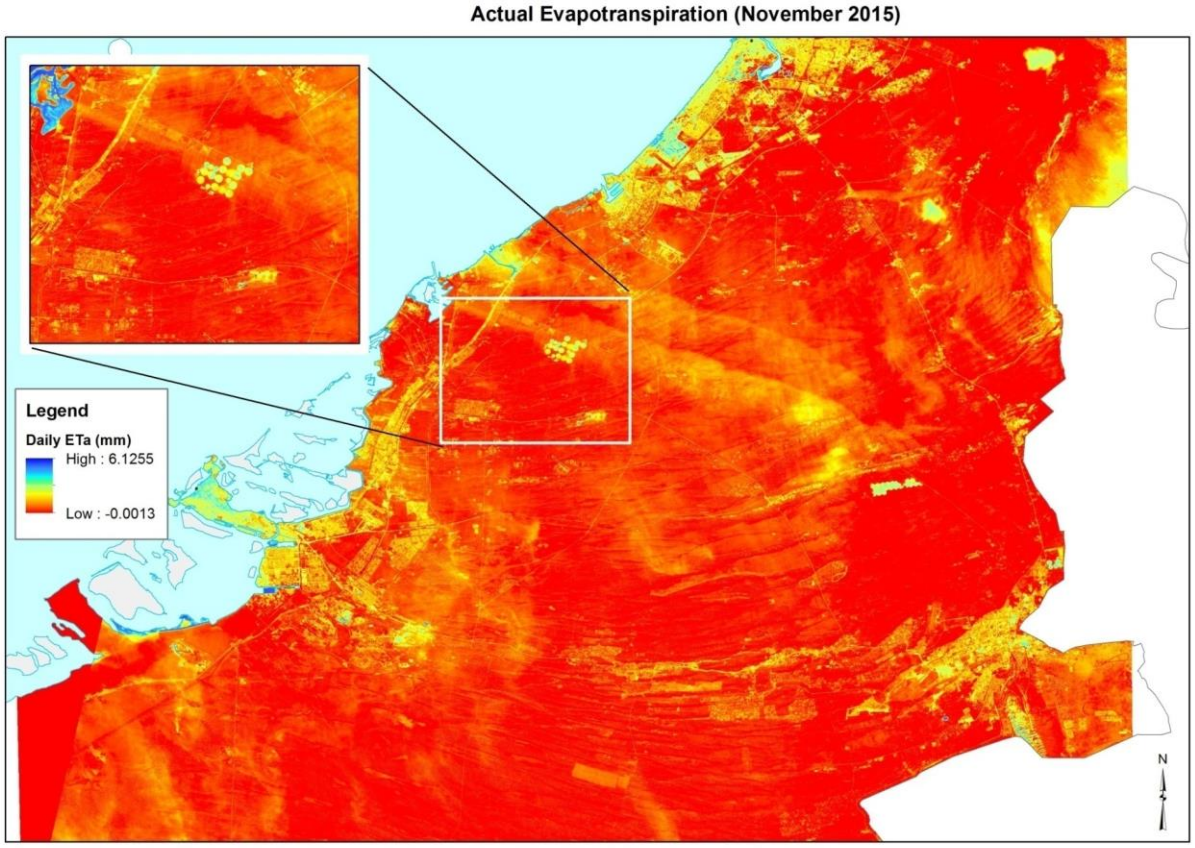


What innovations are needed in demand management?

- The way food is grown
- The way we view our landscapes

What innovations are needed in demand management?

- Water efficiency needs to be greatly improved
- ETa modeling can support water accounting approach

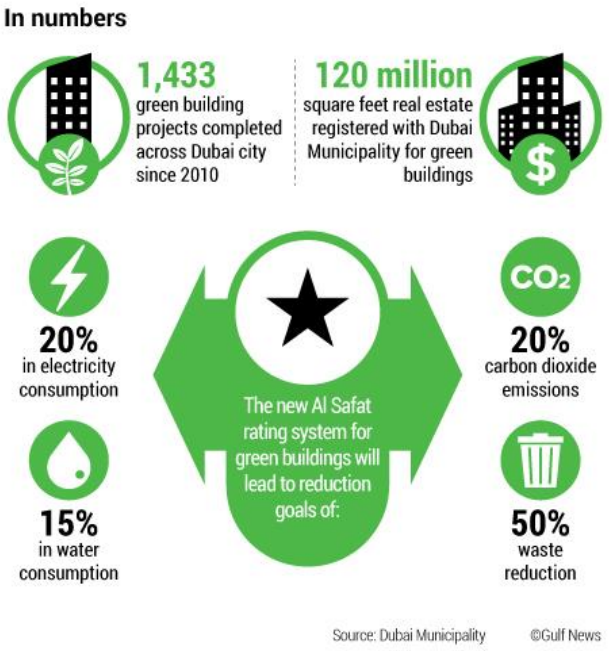


What innovations are needed in supply?

- Desal and Treated waste water key so technologies managing salinity
- Processing to ensure safety and consumer trust
- The types of water we use where
  - Saline
  - Produced water
  - TWW
  - RO Brine effluent

Greatest innovations in policy and law/regulation

- How can we guide user behavior?
- Groundwater governance needs to be effective AND implemented if strategic reserves are to be protected
- Regulations to enhance TWW use
- Do we need to price water differently?
- Urban development offers great opportunity – green building codes



Climate smart water management can be win-win

- Growing awareness and acknowledgement of a changing climate across many different users and demographics
- Green technologies are being boosted and more accessible to all
- Challenging our ideas as to the way food is grown
- Encourages integrated thinking – water – energy-food

Credits and Thanks

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- Islamic Development Bank and Govt of UAE

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Thank you

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