



# UNCONVENTIONAL WATER RESOURCES

**RENÉE MARTIN-NAGLE, JD, LL.M, PHD**

TREASURER, INTERNATIONAL WATER RESOURCES ASSOCIATION

PRESIDENT AND CEO, A RIPPLE EFFECT

[RENEE@ARIPPLEEFFECT.NET](mailto:RENEE@ARIPPLEEFFECT.NET), @RENEEMARTINNAGLE

# CLIMATE CHANGE IMPACTS ON WATER



- MORE POWERFUL STORMS □ MORE RUNOFF □  
MORE POLLUTION □ LOWER QUALITY
- MORE EVAPORATION □ LESS PRECIPITATION □  
DROUGHT □ LESS QUANTITY
- HIGHER POPULATIONS □ MORE DEMAND □ LESS SUITABLE  
WATER □ MORE UNCONVENTIONAL WATER RESOURCES





# TYPES OF UNCONVENTIONAL WATER RESOURCES



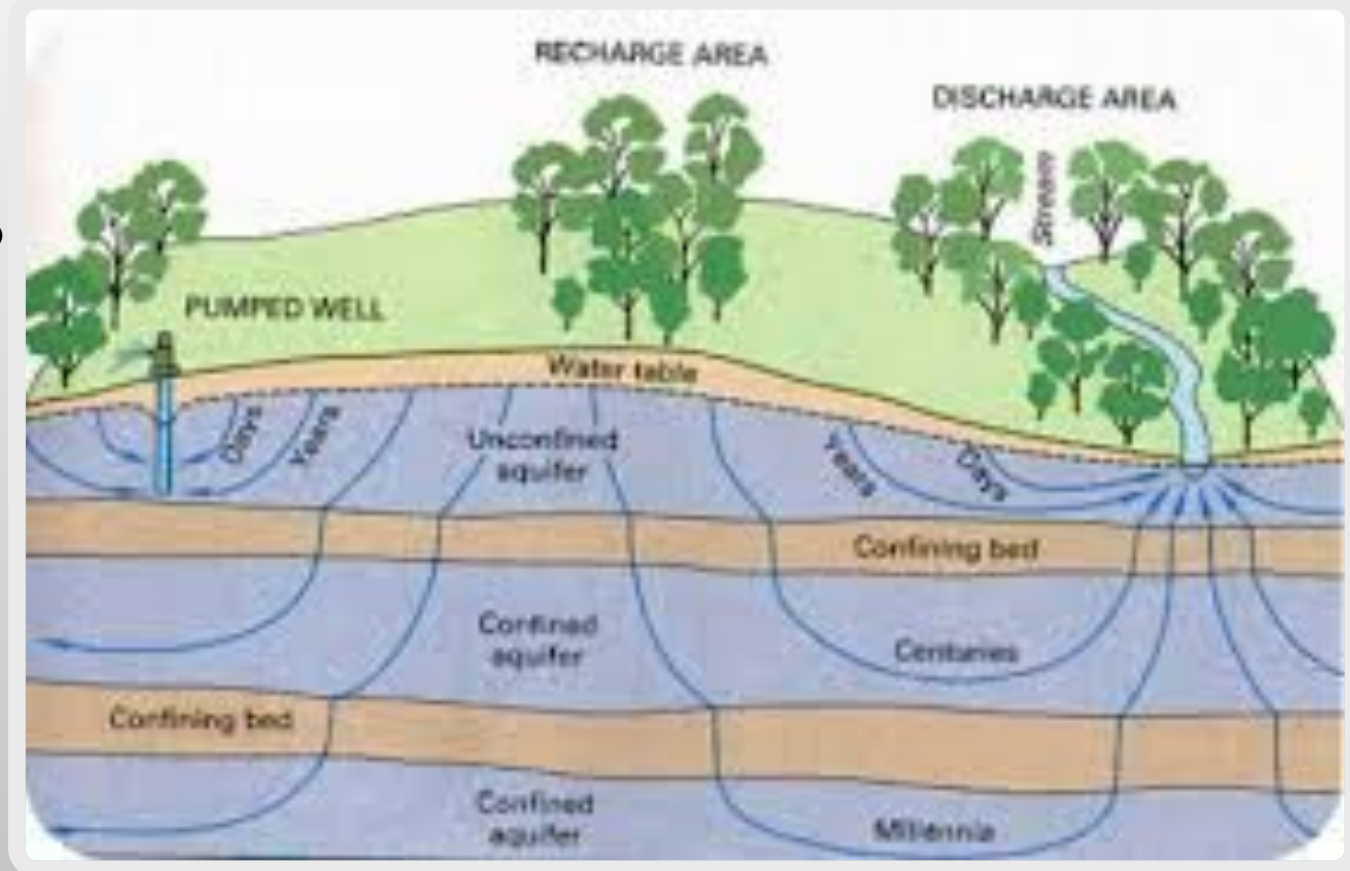
- **FOSSIL AQUIFERS**
  - **ATMOSPHERIC WATER**
  - **WASTEWATER RECYCLING**
  - **DESALINATION**
  - **BULK WATER TRANSFERS**
  - **ICE BERGS**
  - **BALLAST WATER**
- UNU-INWEH PROJECT (MANZOOR QADIR)**





# FOSSIL AQUIFERS

- FRESHWATER EMPLACED THOUSANDS TO MILLIONS OF YEARS AGO
- NO RECHARGE IN CONTEMPORARY TIMES
- CAN BE CONFINED OR UNCONFINED
- CAN BE LAND-BASED OR OFFSHORE





# LAND-BASED FOSSIL AQUIFERS

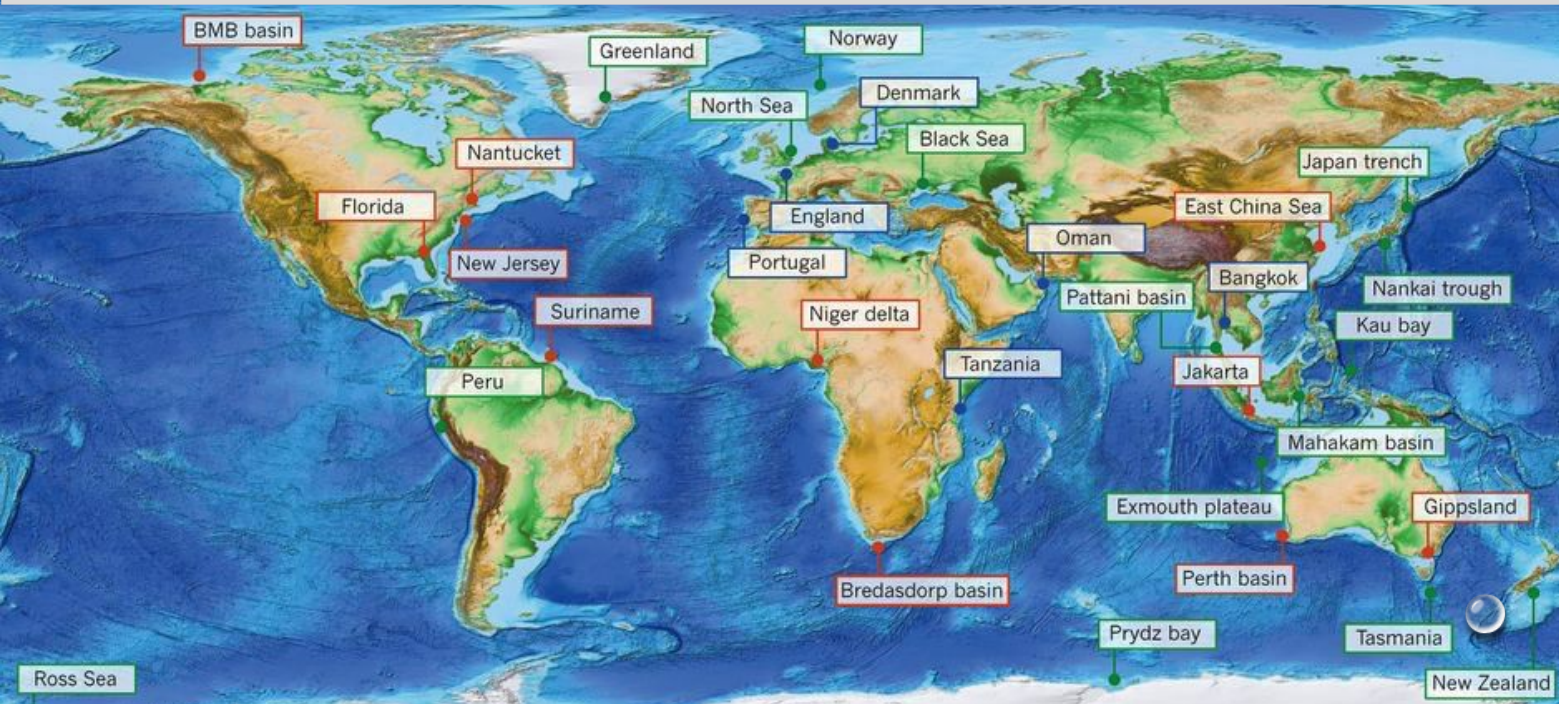
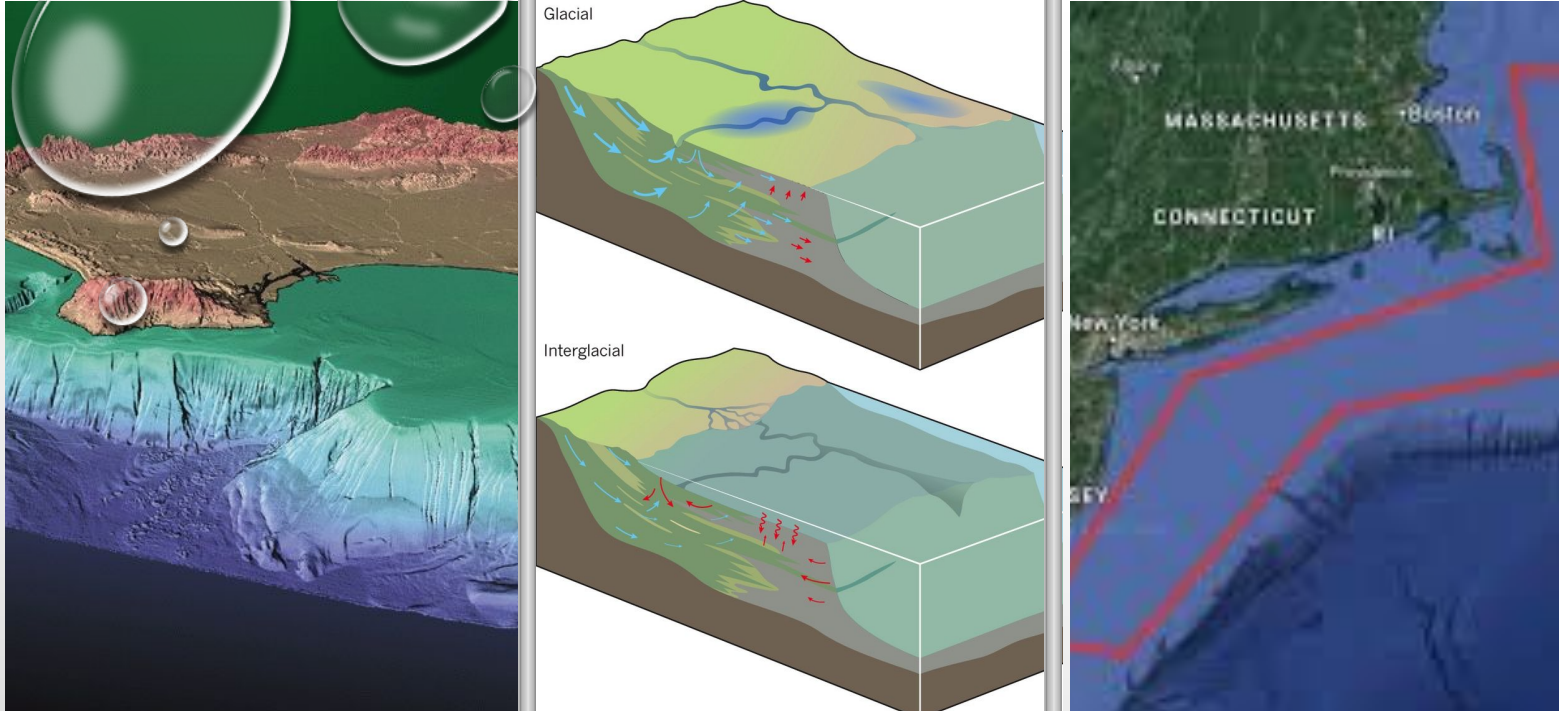
- DOMESTIC AND TRANSBOUNDARY
- LARGE VOLUMES
- MOSTLY PRISTINE FRESHWATER
- ALL HEAVILY UTILIZED





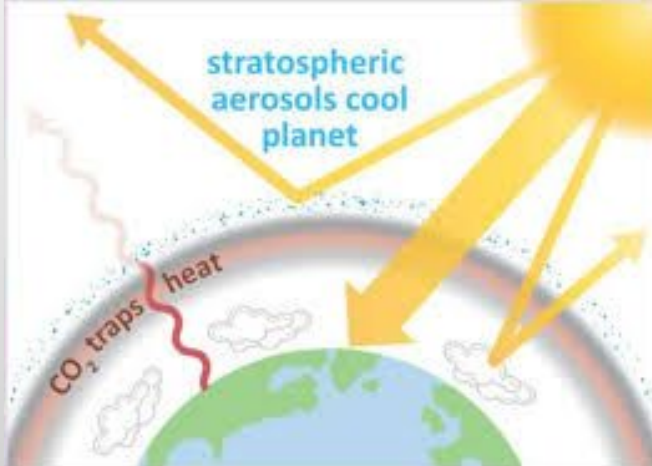
# OFFSHORE AQUIFERS

- DOMESTIC AND TRANSBOUNDARY
- LARGE VOLUMES
- FRESH AND SLIGHTLY BRACKISH WATER
- SOME CONNECTED TO COASTAL AQUIFERS
- NOT YET UTILIZED

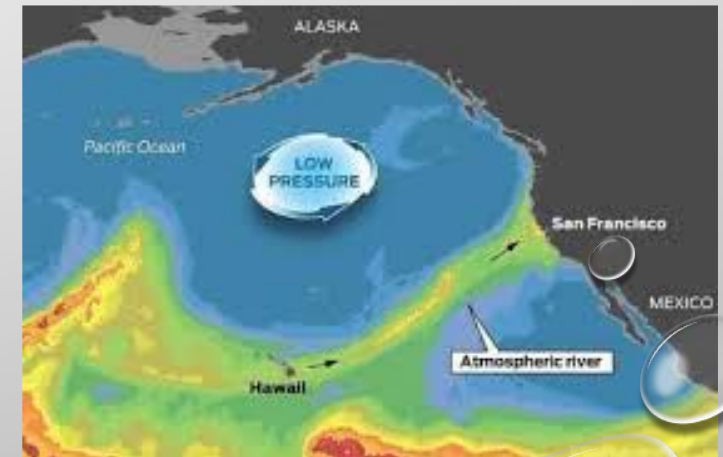
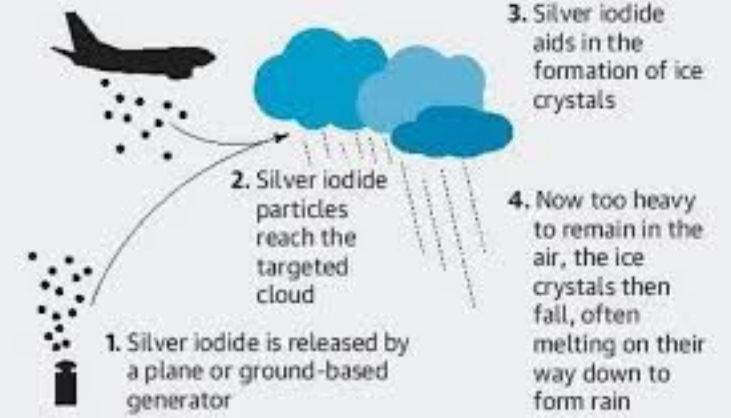


# ATMOSPHERIC WATER

- FOG/RAINWATER HARVESTING (LOCAL)
- CLOUD SEEDING (LOCAL/REGIONAL)
- SOLAR GEOENGINEERING (GLOBAL)
- ONLY ONE TREATY (1979)



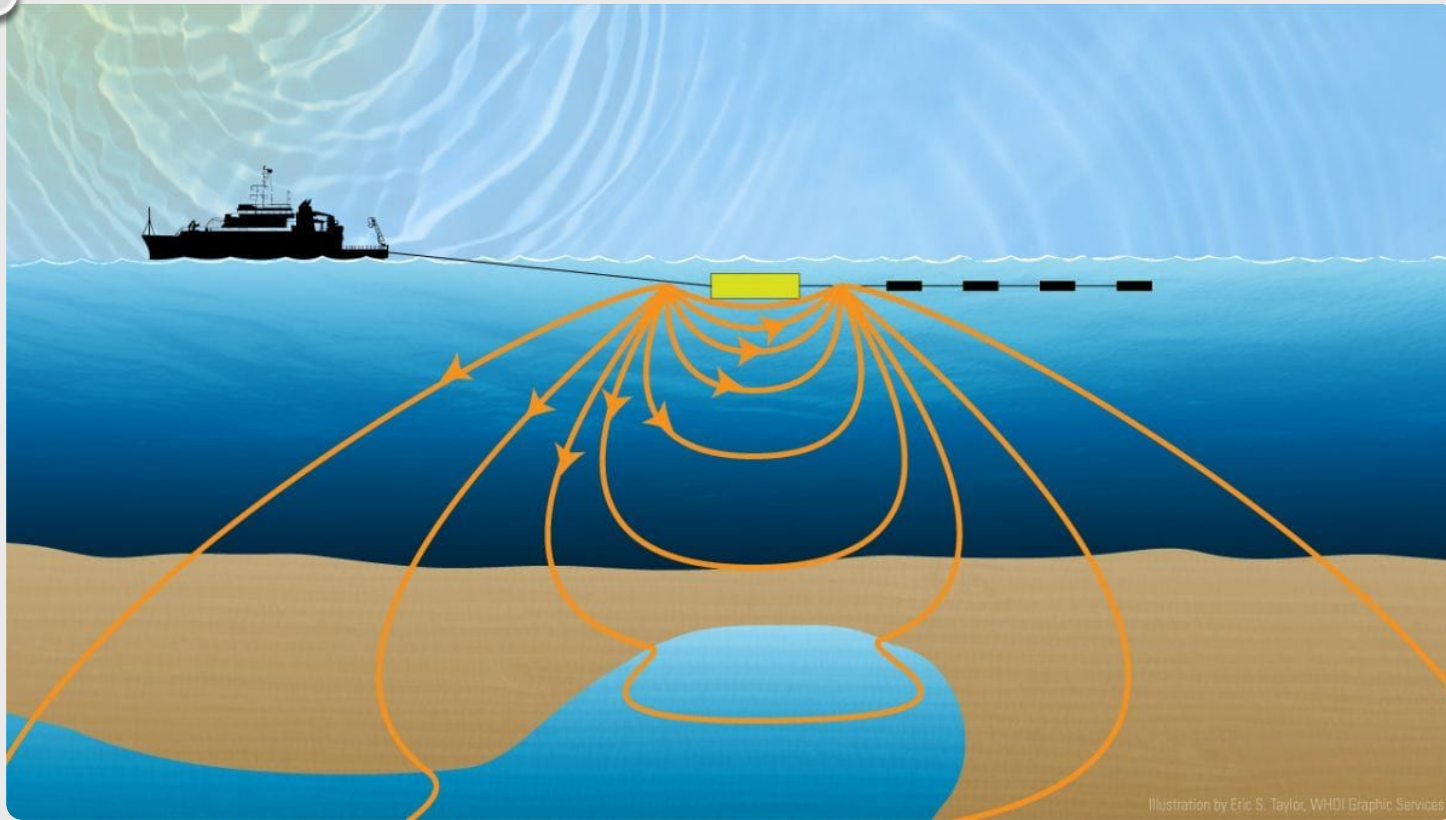
## How cloud seeding works





# CLOSING THOUGHTS

- UNCONVENTIONAL WATER RESOURCES WILL BE INCREASINGLY ATTRACTIVE
- WATER QUALITY MAY BECOME MORE IMPORTANT THAN QUANTITY
- FOSSIL AQUIFERS PROVIDE LONG-TERM WATER STORAGE
- GOVERNANCE GAP REMAINS FOR ATMOSPHERIC WATER



THANK YOU!!