

## Tulsa University Artificial Lift Projects

# Water Cycle Stability - The Sahara Desertification and Cure

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IMFTF Keynote

December 3rd, 2021

## The Wild 2021 Summer



**Heatwaves and wildfires  
in Western US**



**Heatwaves and wildfires  
in Mediterranean**



IMFTF Keynote

December 3rd, 2021

# The Wild 2021 Summer...



Flooding in Europe



Flooding in Zhengzhou, China



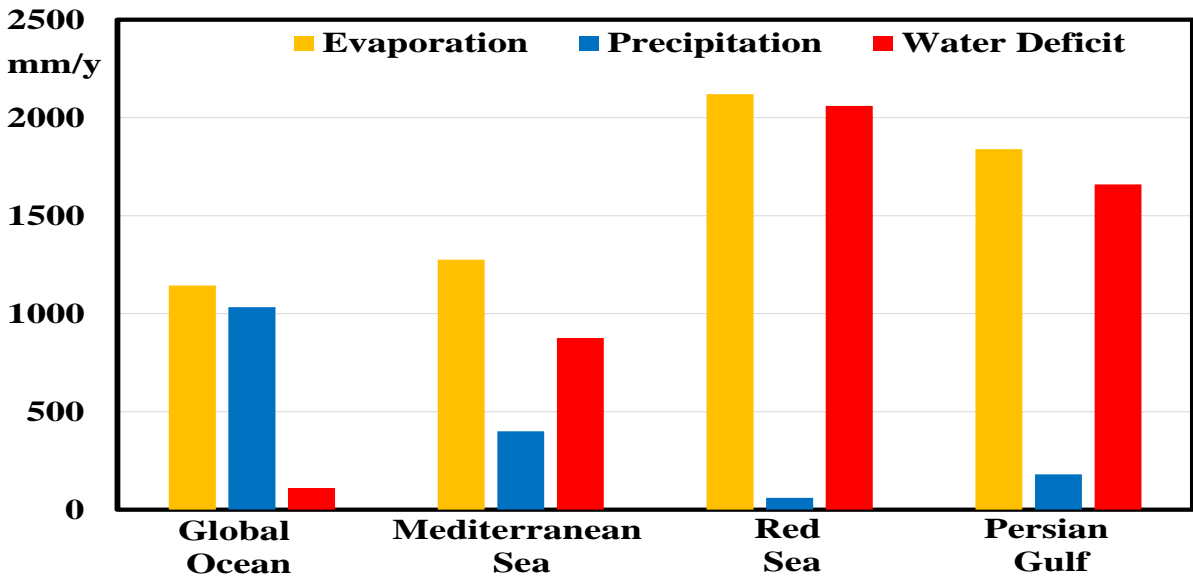
IMFTF Keynote

December 3rd, 2021

# A Freshwater Imbalance Problem

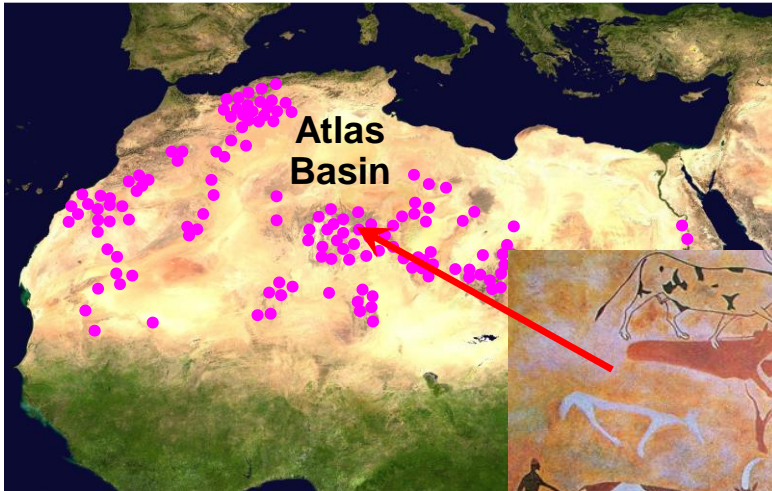


## Freshwater Imbalance around Mediterranean









## Rock Art from Tassili n'Ajjer

Rock art widely distributed in the Sahara



## Water Cycle Stability

$P$  – Precipitation

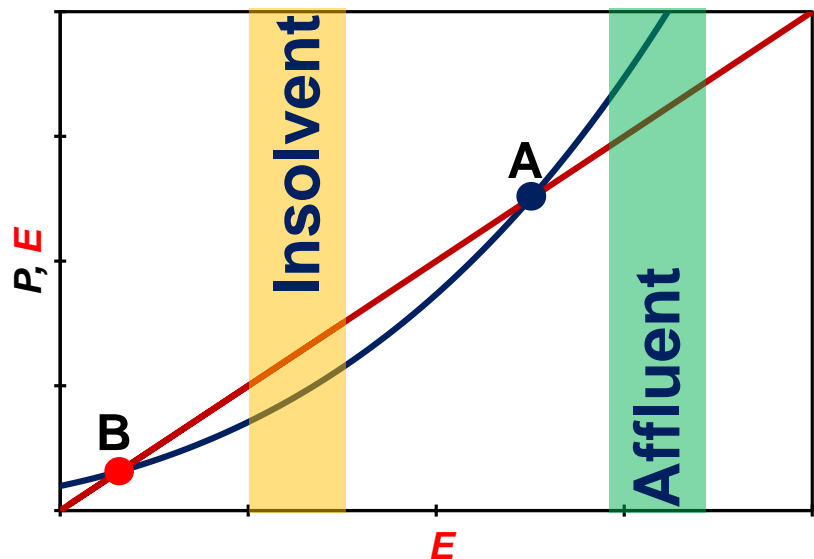
$E$  – Evaporation

● 'A' is unstable

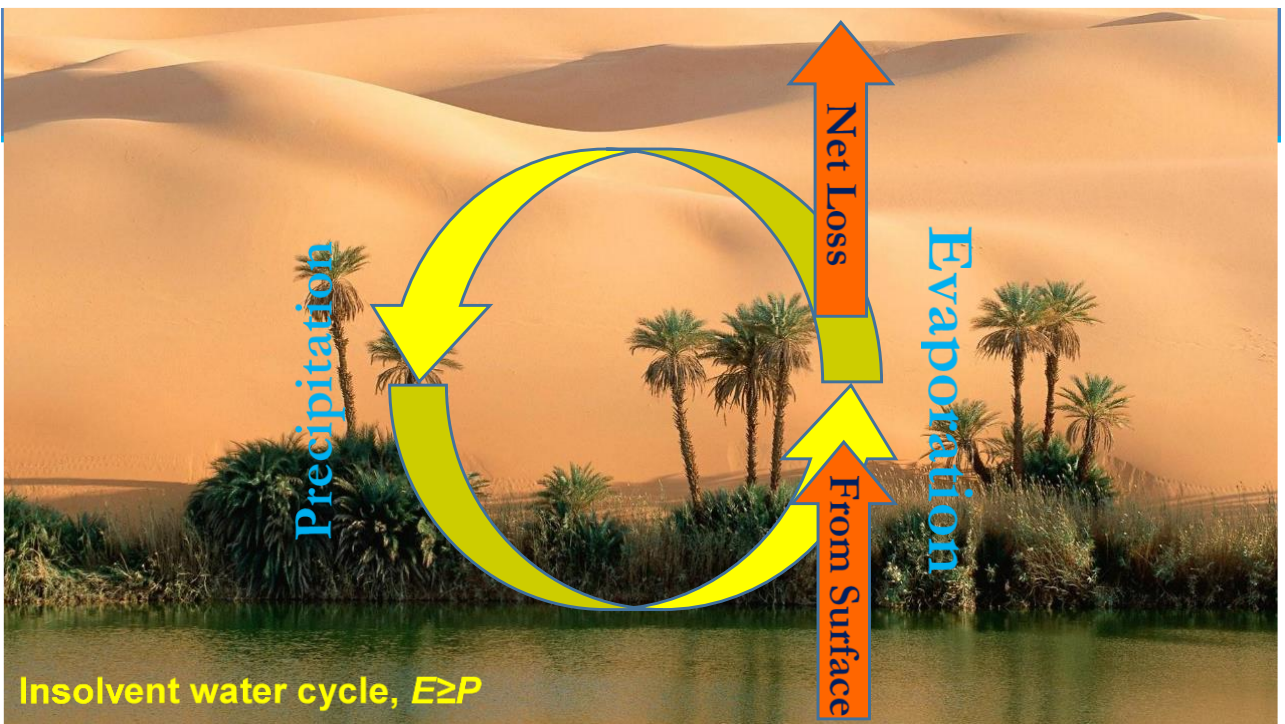
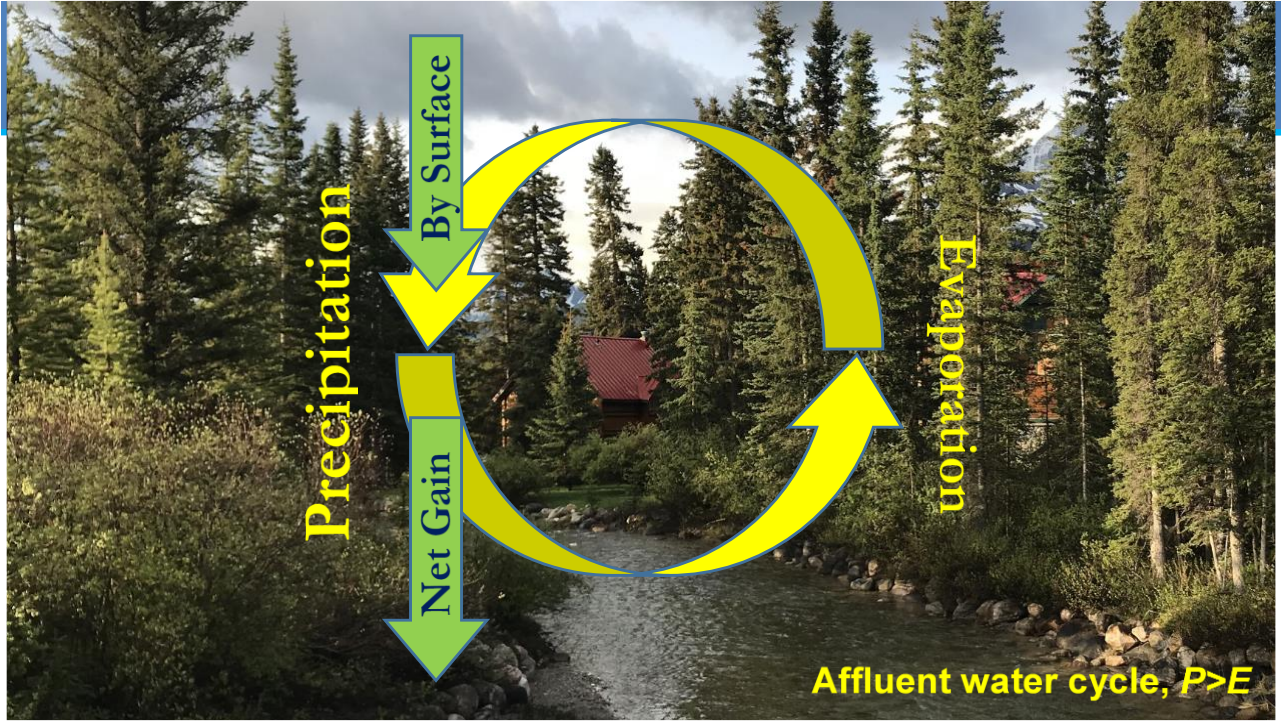
➤ Critical

● 'B' is stable

➤ Desert

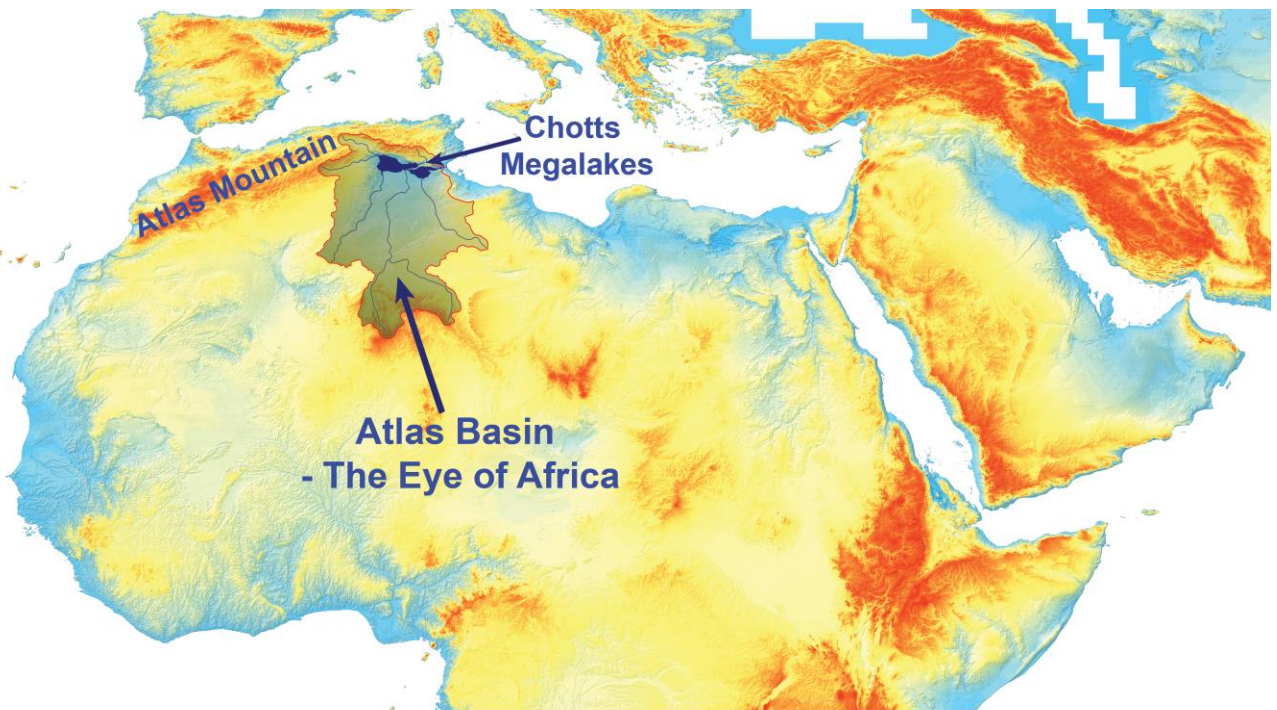
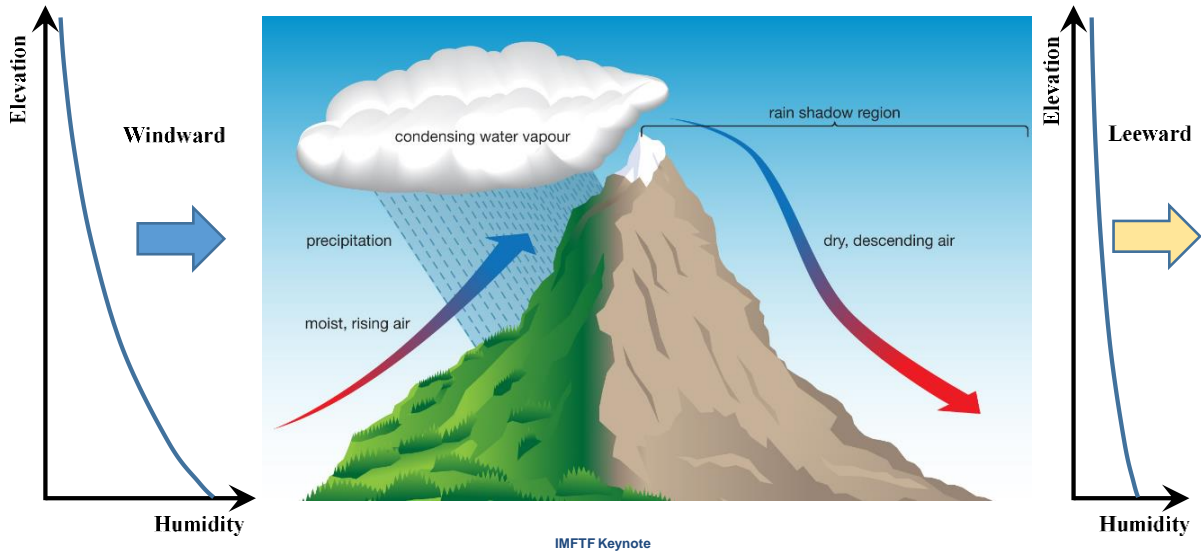




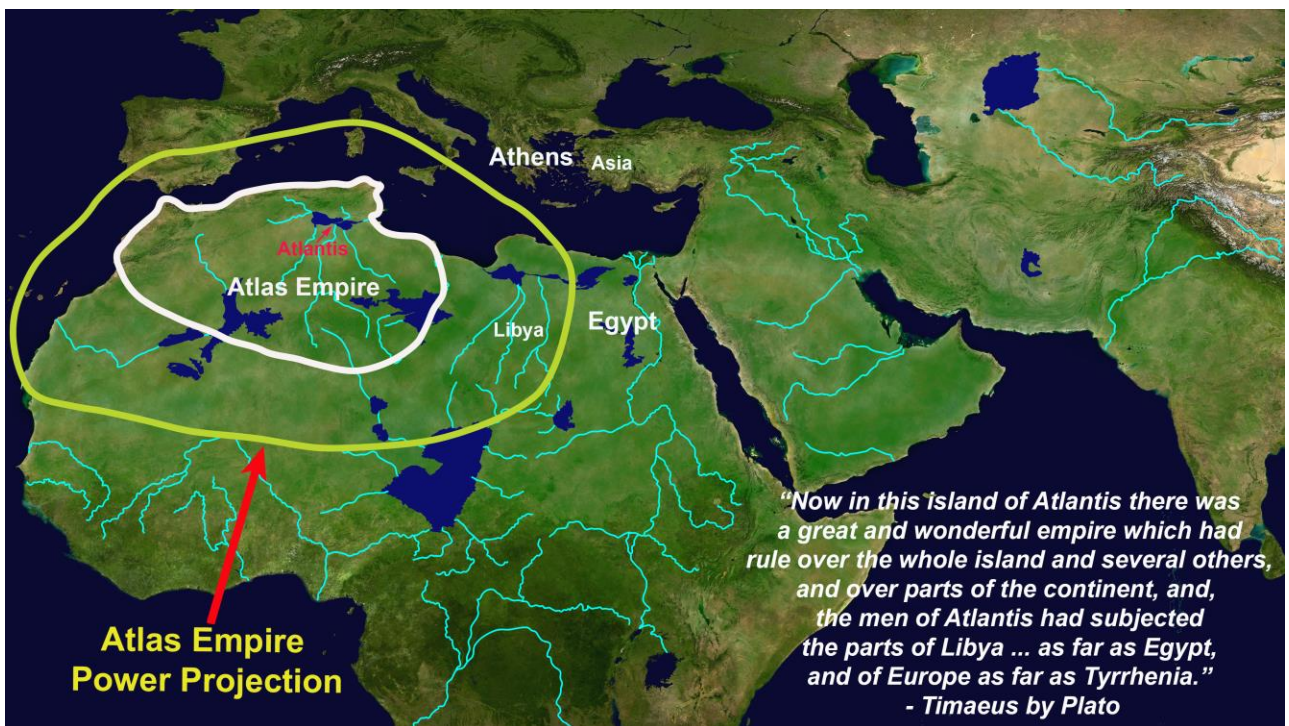




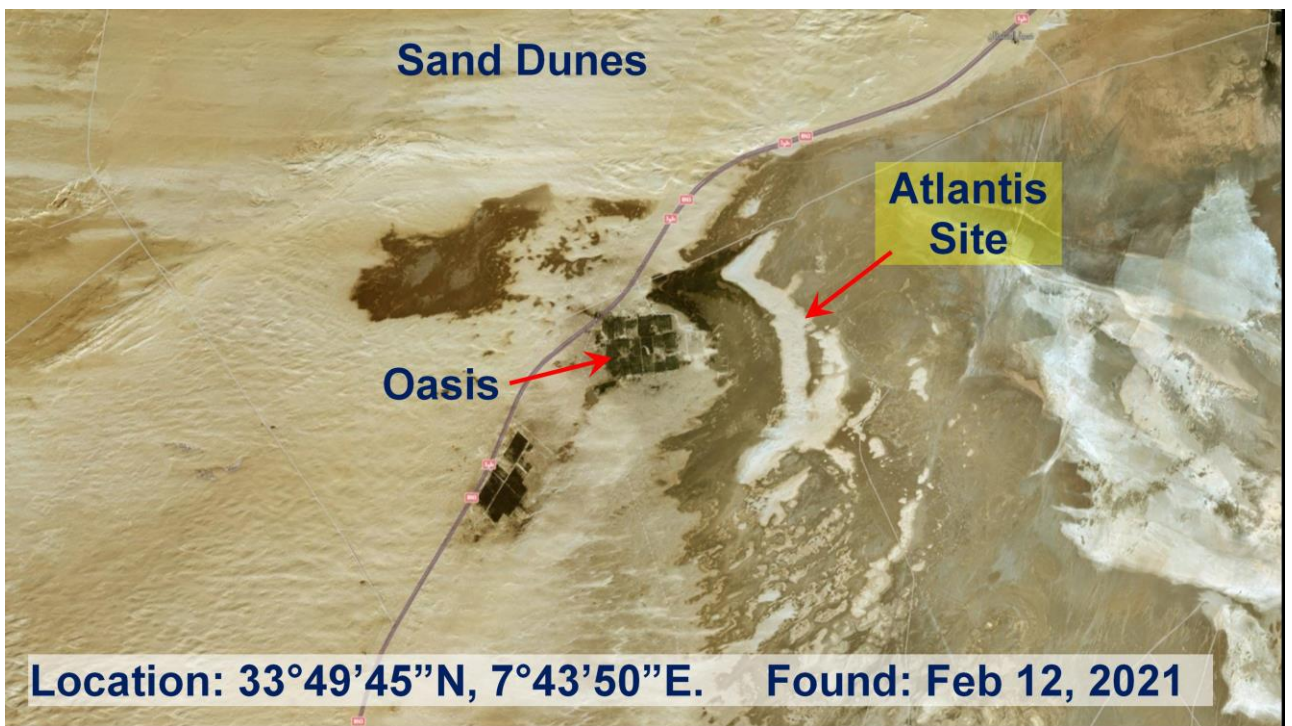
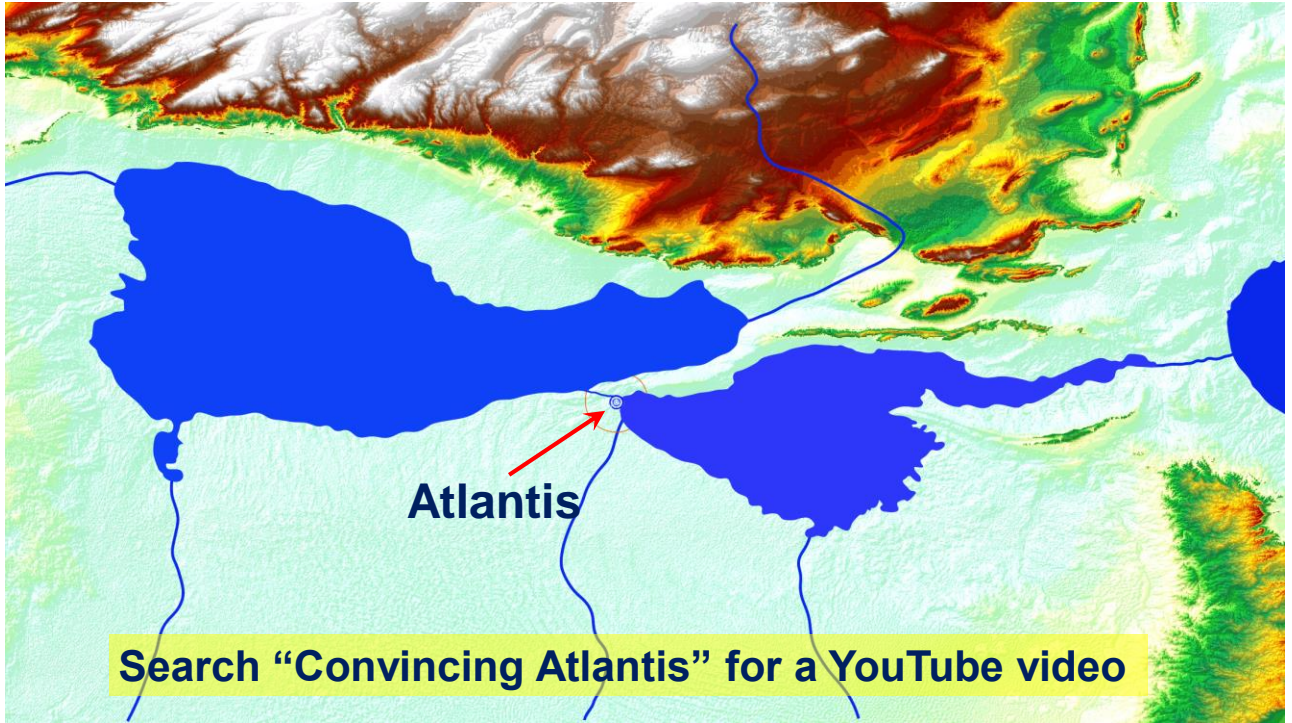
# All Deserts Created by Rain Shadow Effect



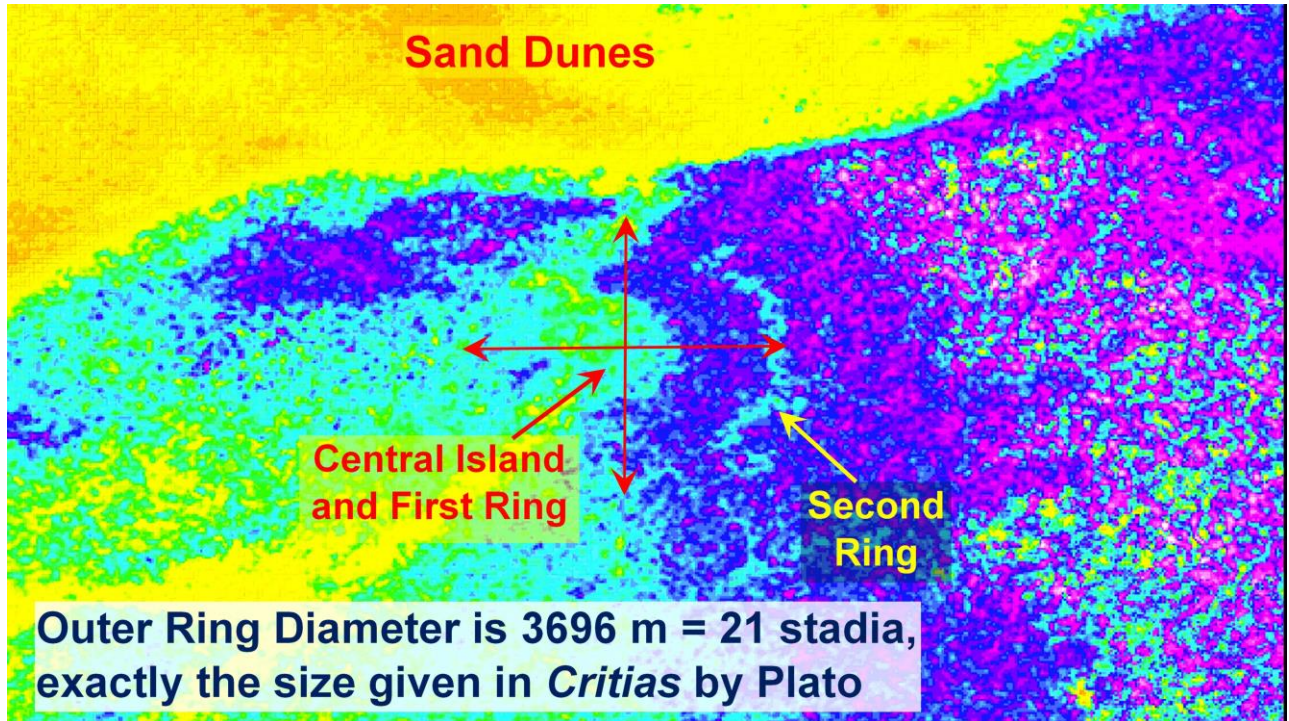








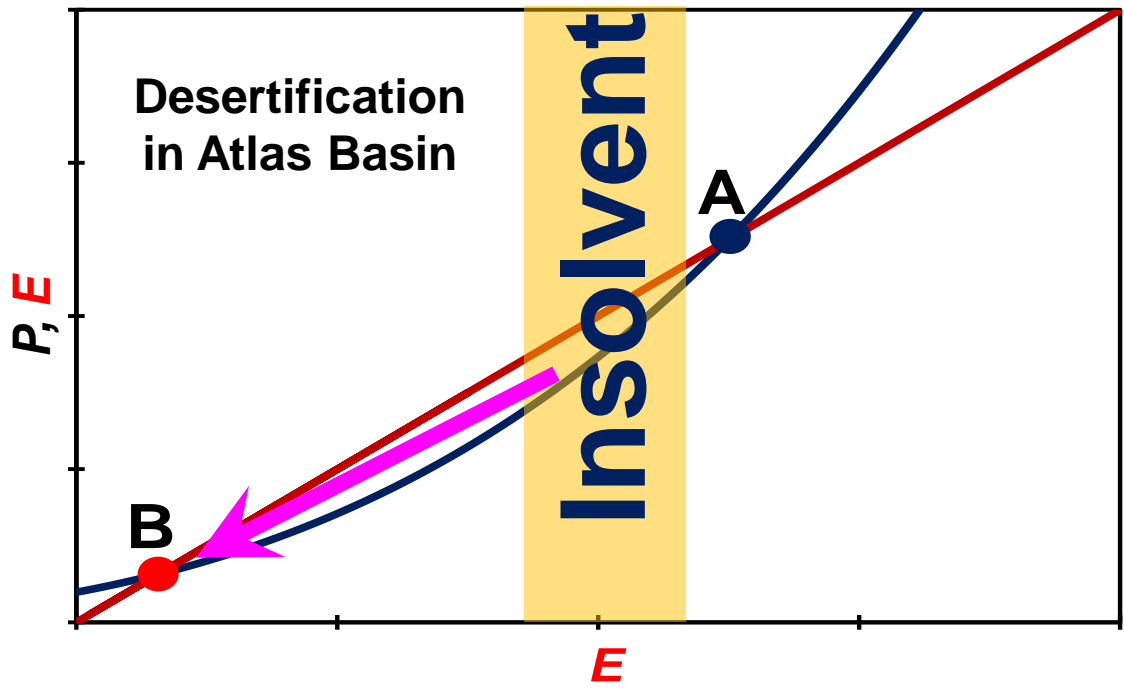


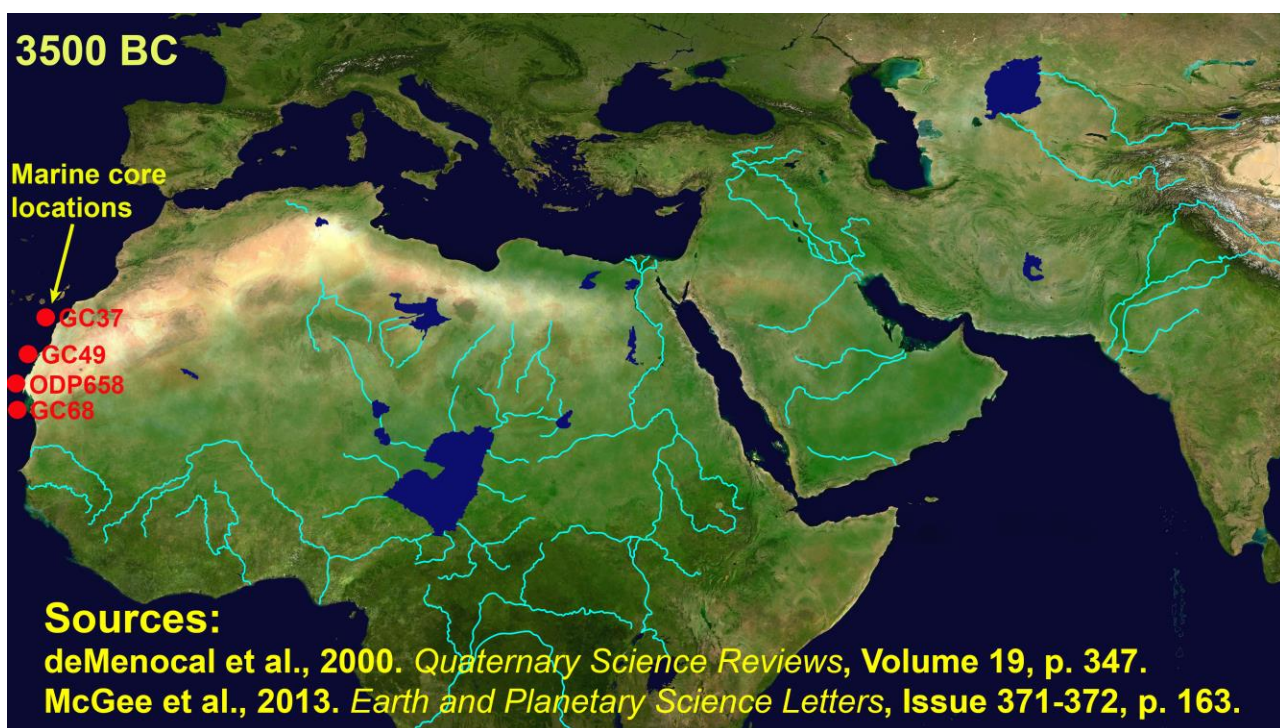
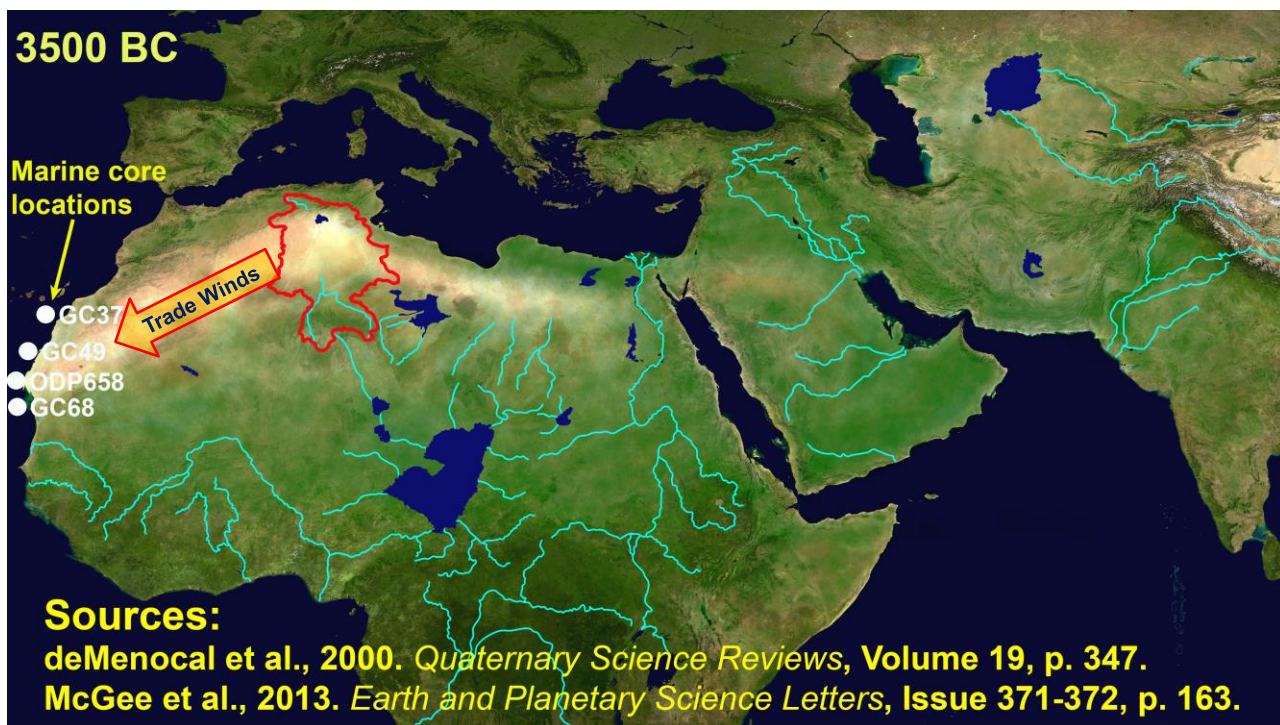


## Chotts Megalake – Rain Shadow Eliminator

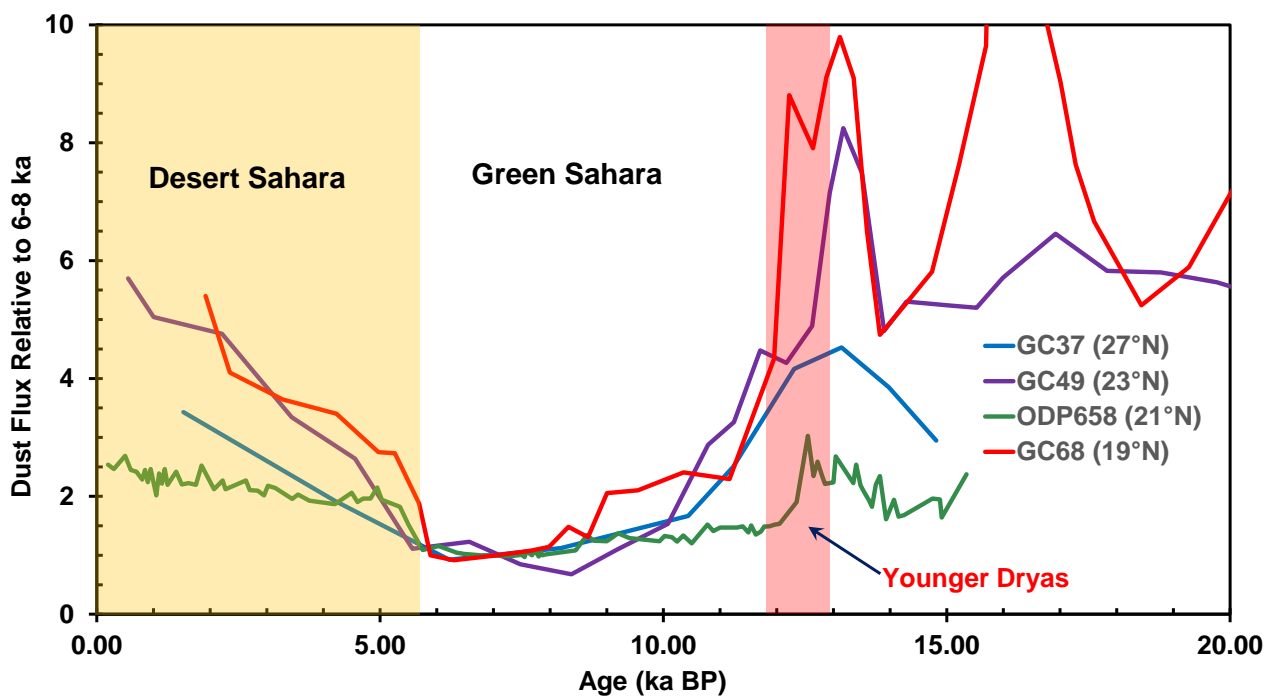
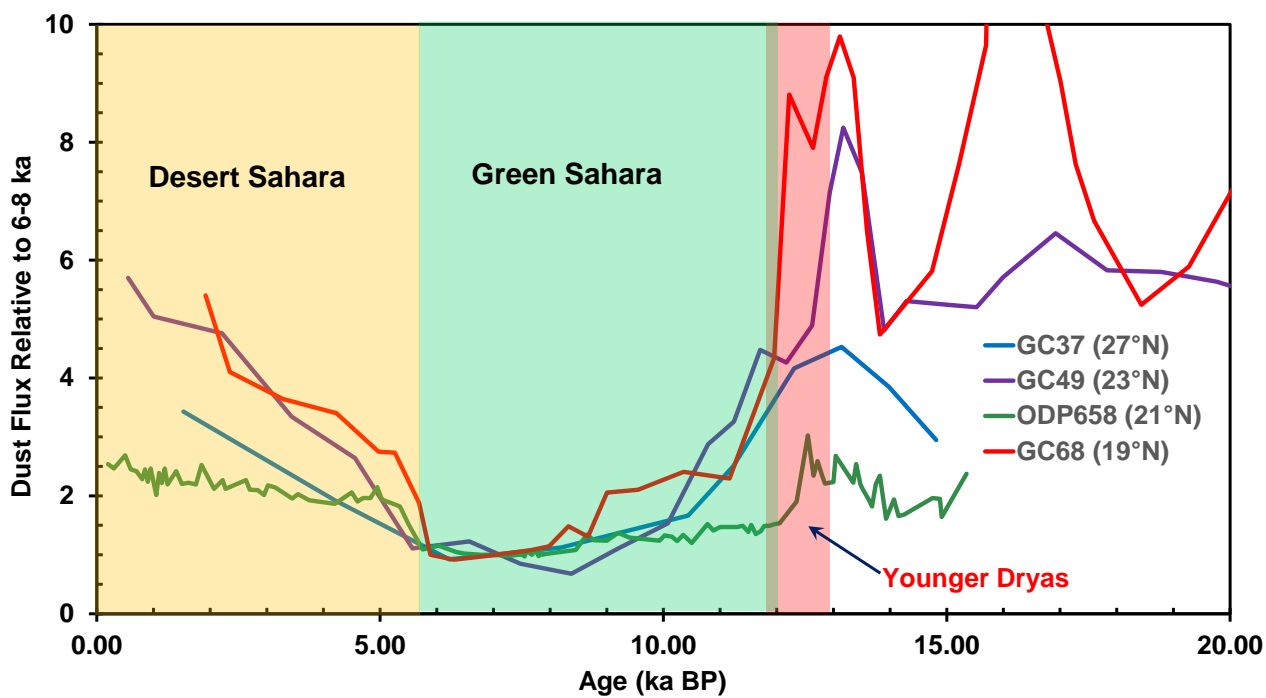
- Water surface area about 26,000 km<sup>2</sup> (at 24 masl)
- Lake annual water evaporation rate about 1,500 mm
- Assuming land water evaporation 200 mm/y, total evaporation can cover 96,600 km<sup>2</sup> area with an annual rate of 550 mm
  - An area larger than 300 km x 300 km
  - Global land average water evaporation is about 400 mm/y at the same latitude
  - Completely eliminate the Atlas Mountain rain shadow effect

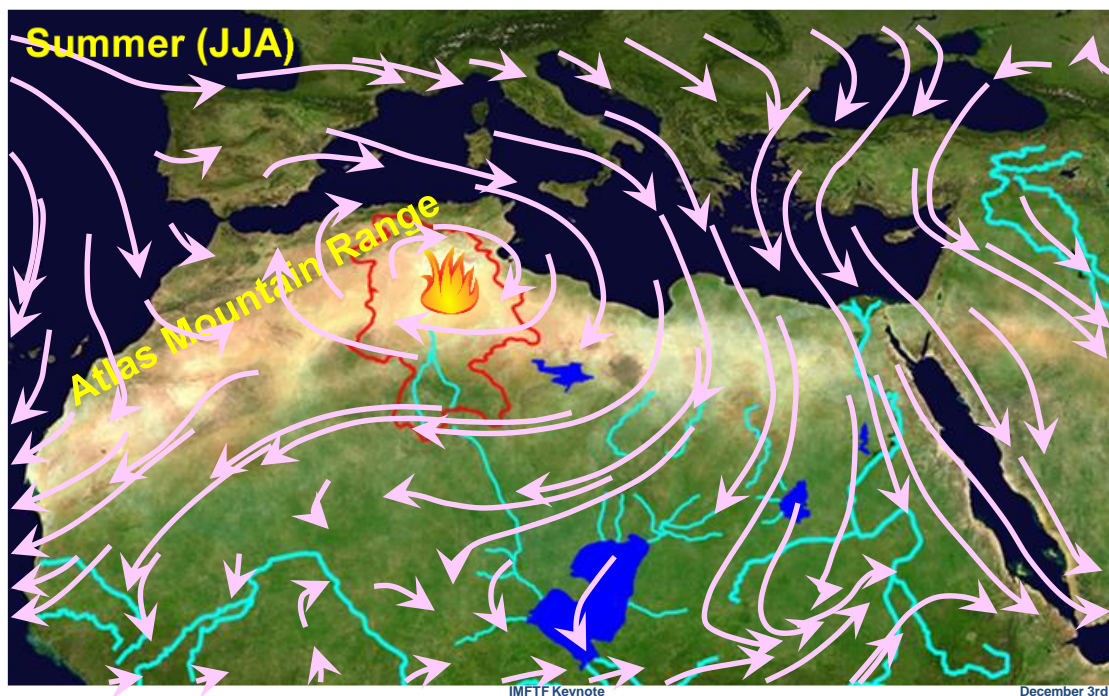
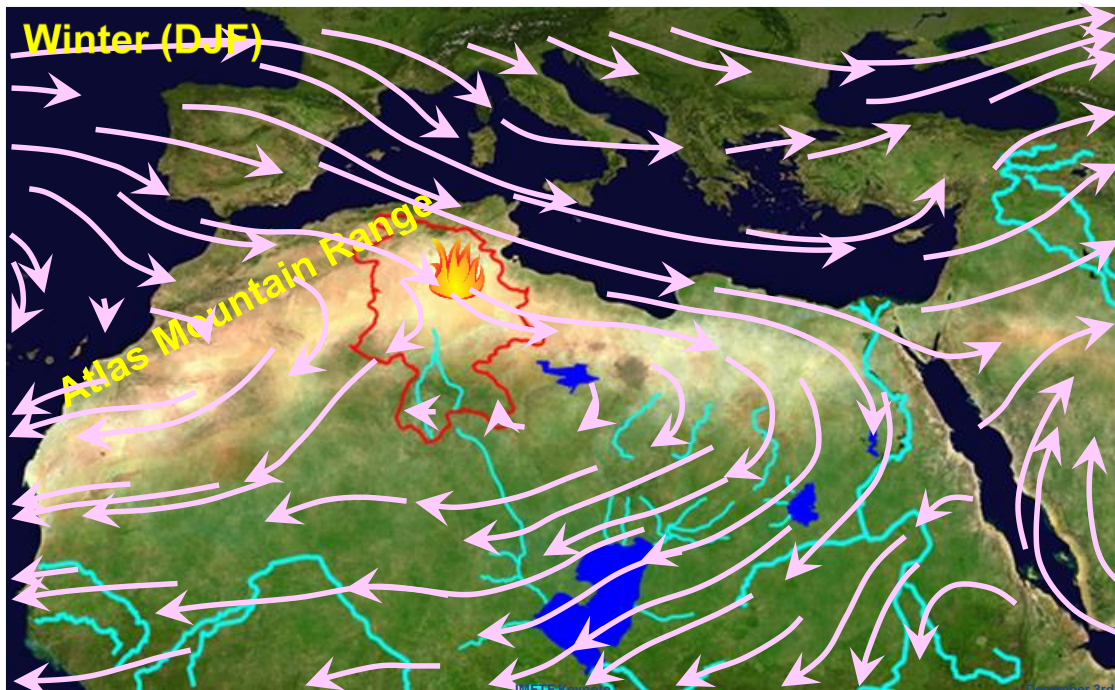






















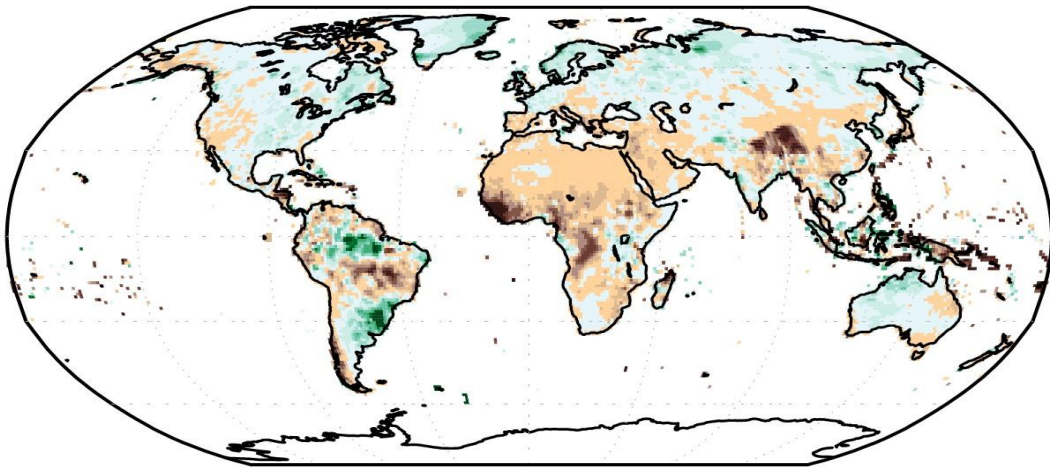




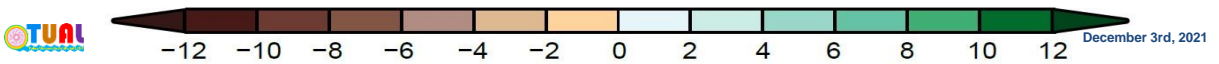




# Global Precipitation Changes, 1986-2015 (Wuebbles et al. 2017)



Change in Precipitation (inches)

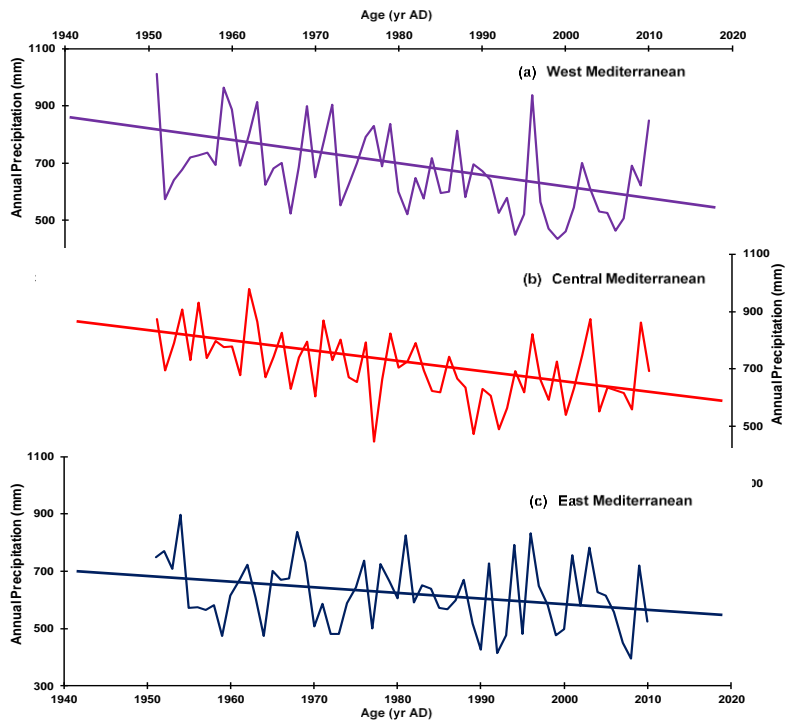


## Rainfall declines in:

**West Mediterranean**

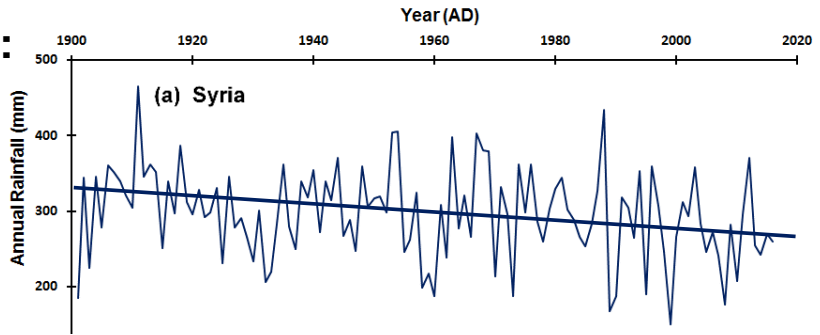
**Central Mediterranean**

**East Mediterranean**

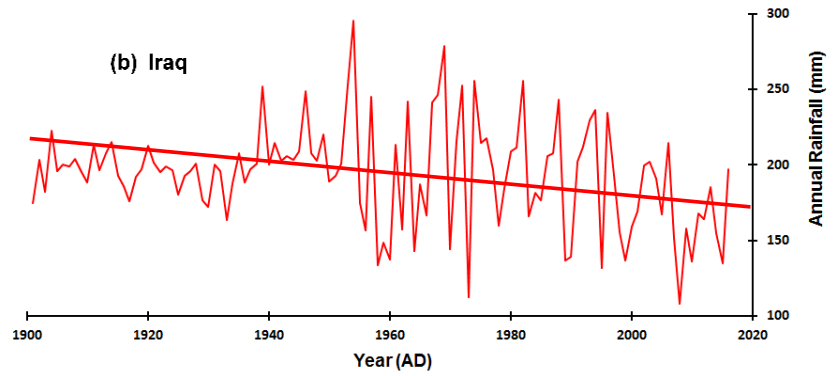


Rainfall declines in:

Syria

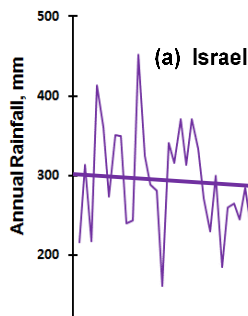


Iraq

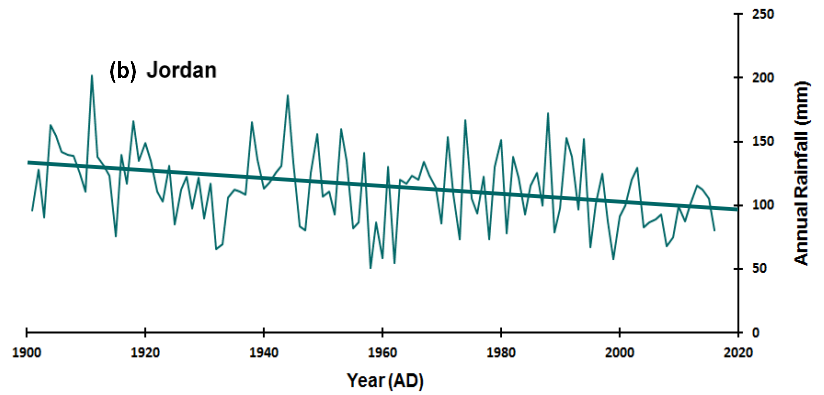


Rainfall declines in:

Israel



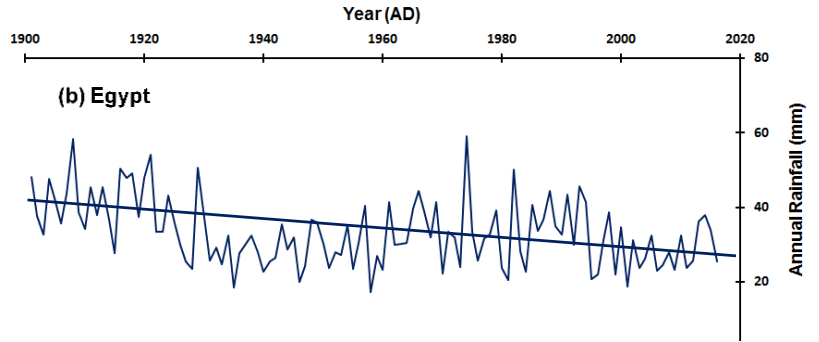
Jordan



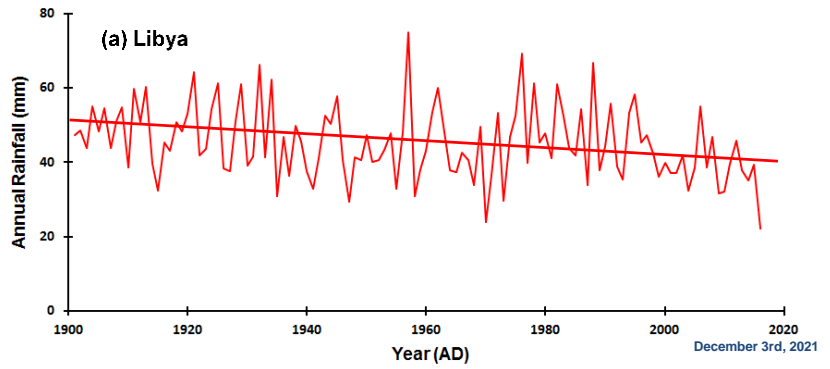


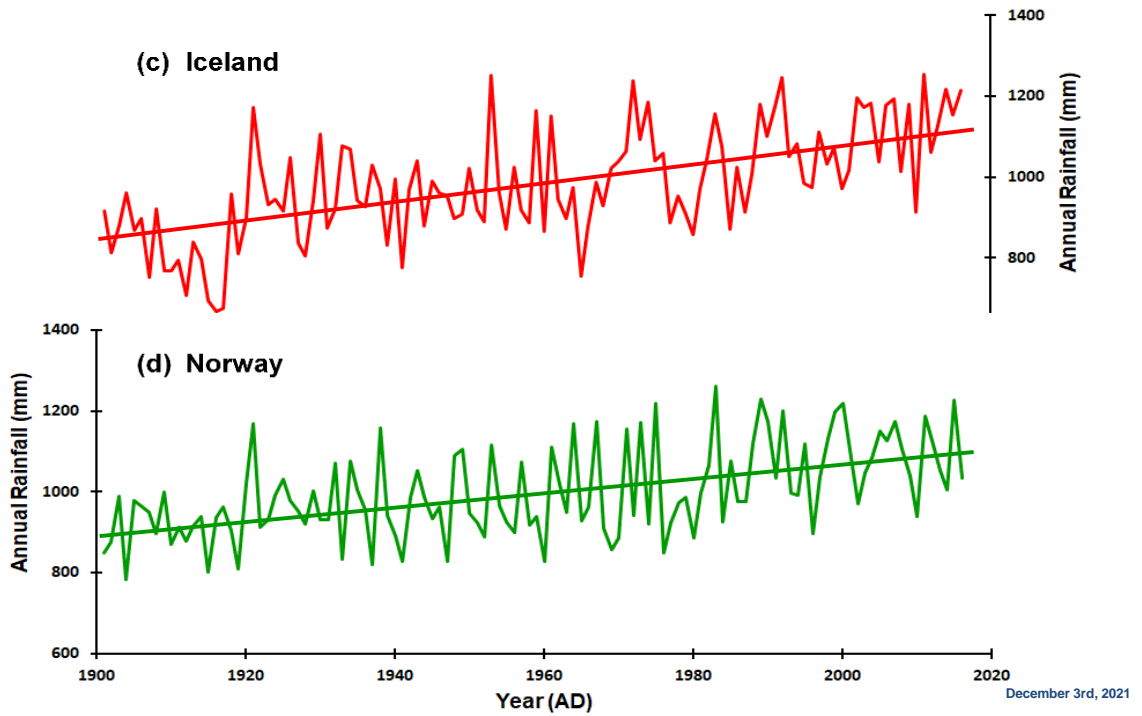
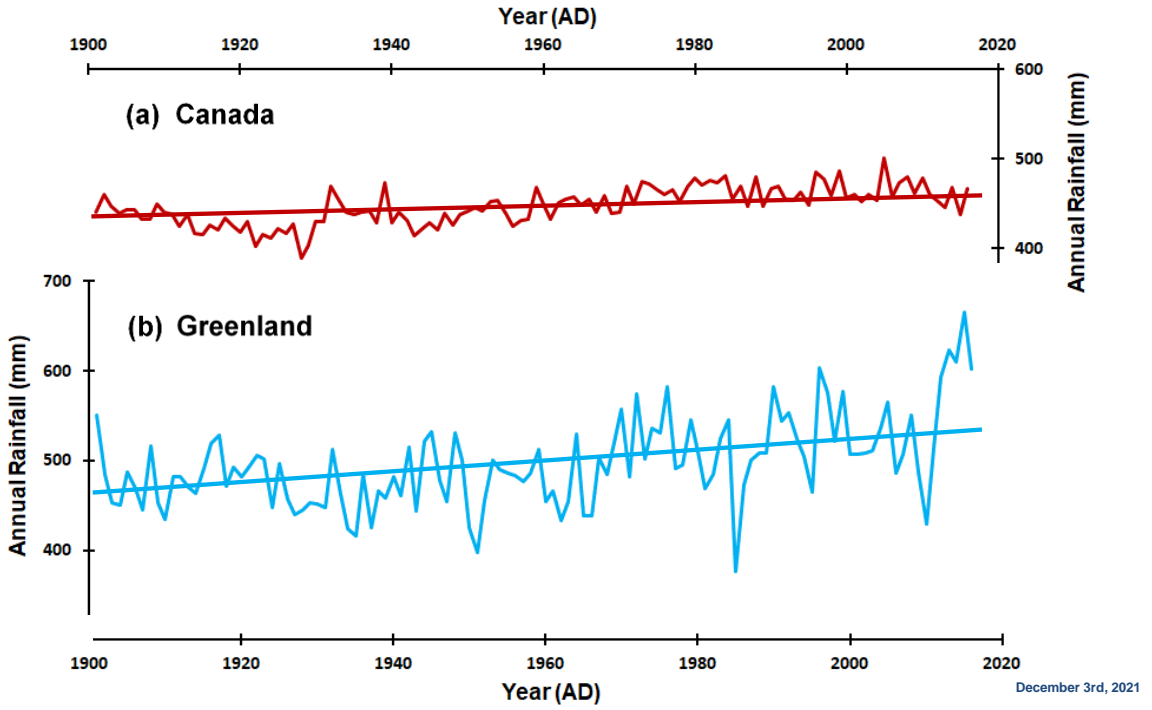
Rainfall declines in:

Egypt

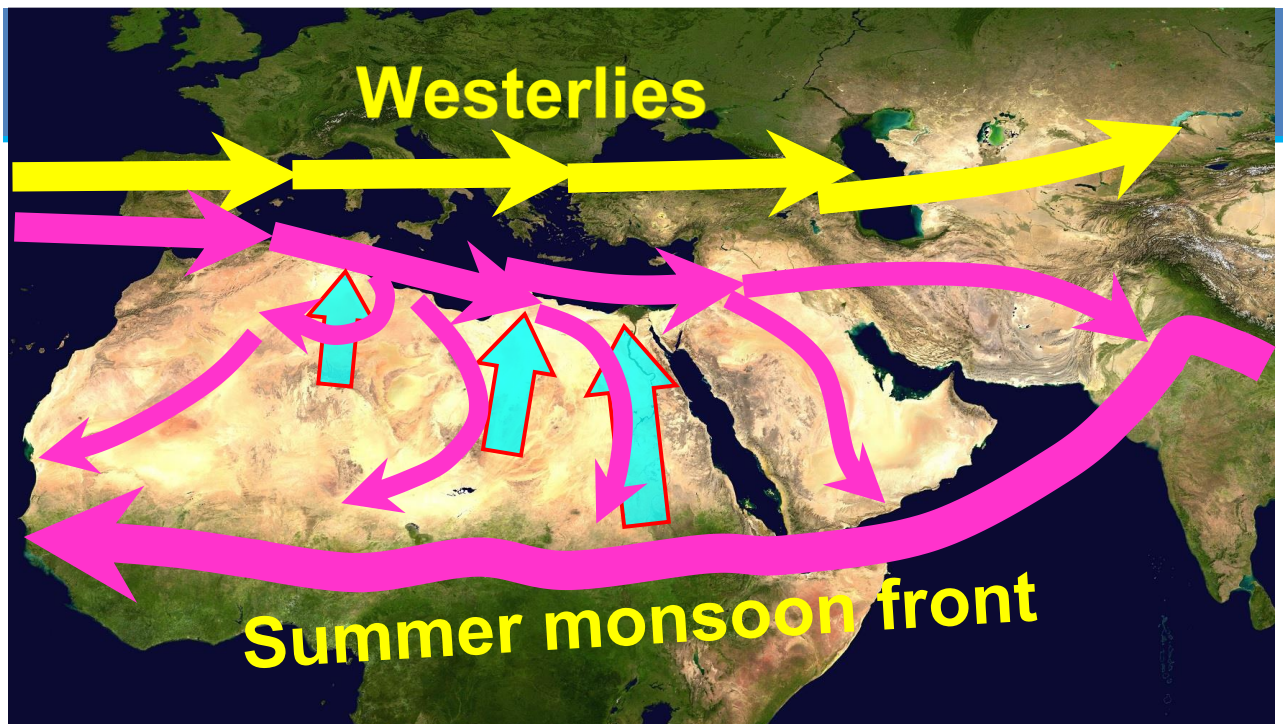
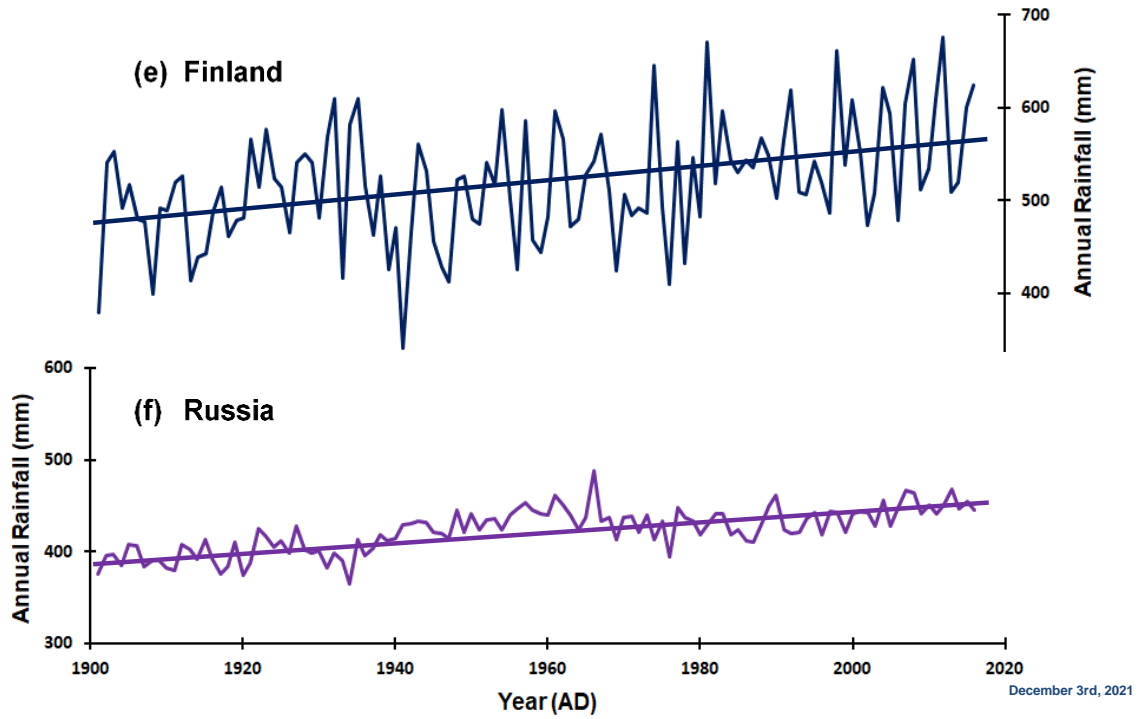


Libya

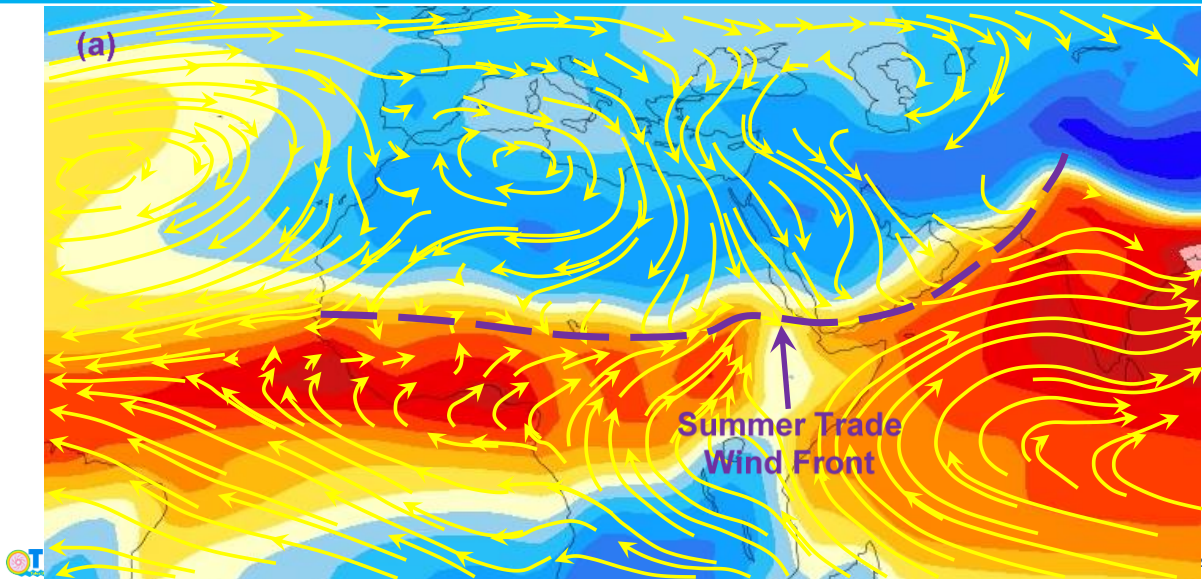




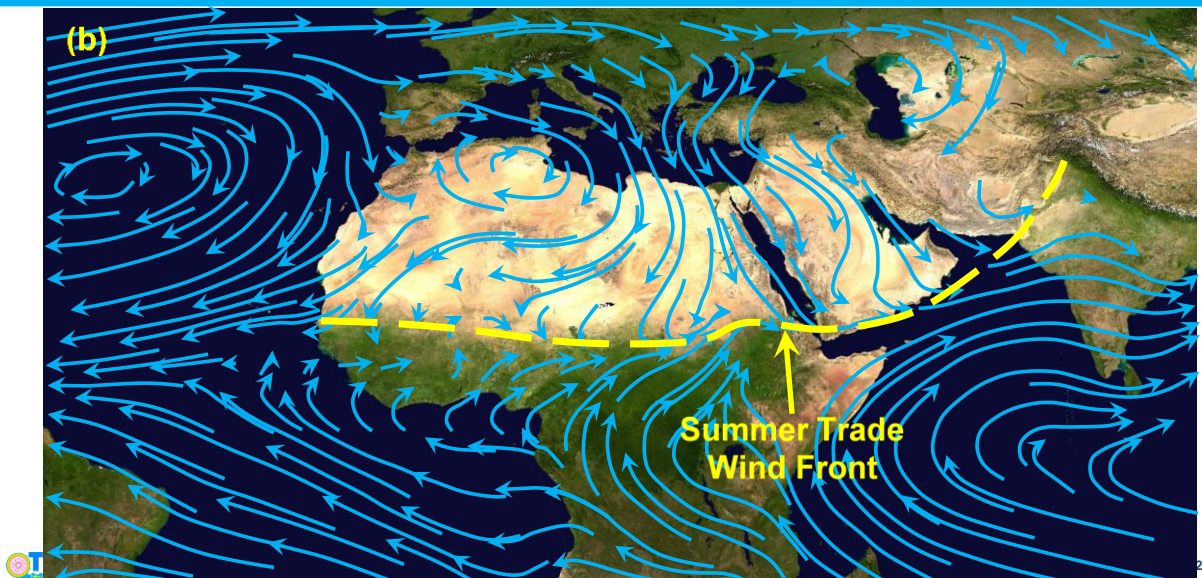




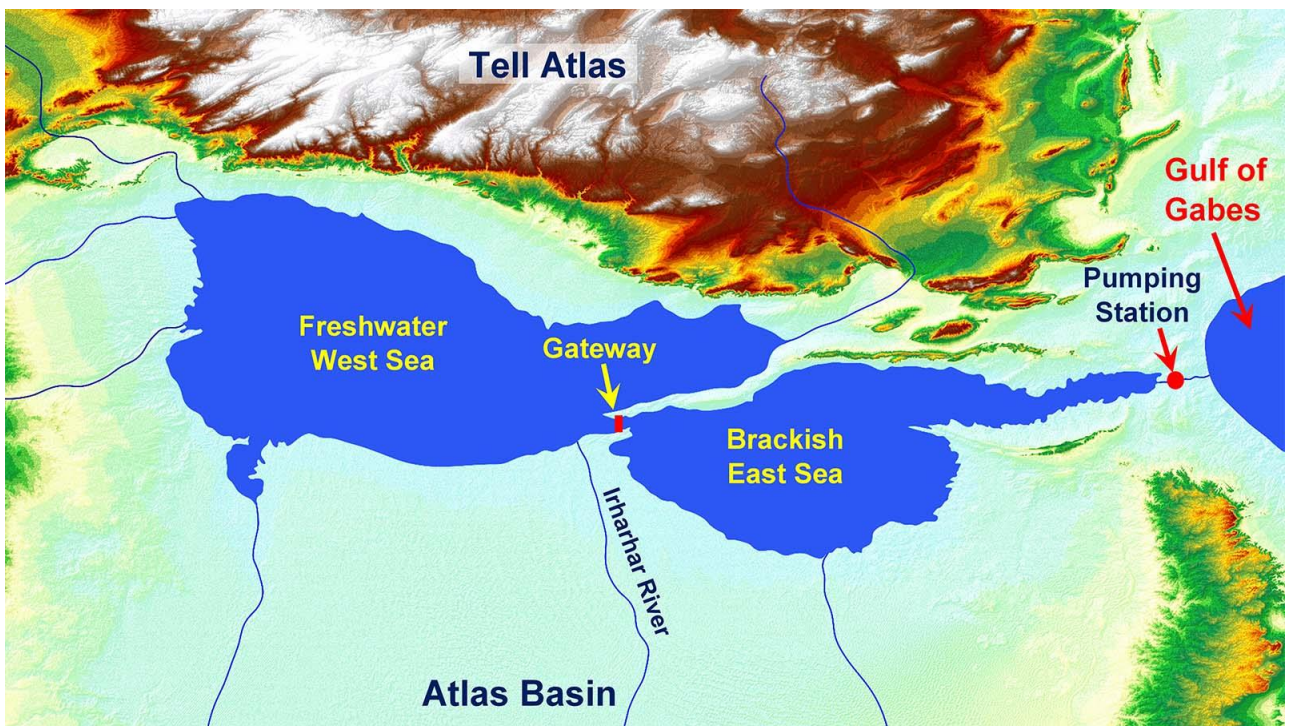
## Summer Trade Wind Front and CWV (Courtesy of Dr. Walter Hannah)



## Monsoon is the Victim, not the Villain (Courtesy of Dr. Walter Hannah)









## Summary

- The Atlas Basin is a stabilizer for either the desert or Green Sahara – The switch for a **complete** flip-over
- The healthy water cycle in Atlas Basin can be restored by filling the Chotts Megalake with sea water
  - Then, North Africa, West Asia, and the Mediterranean regions will return to green
  - The wet water cycle will be self-sustained



## References

- H.-Q. Zhang, 2021, “Twenty Nile Rivers Escape the Mediterranean Sea,” *International Journal of Hydrology*, 5(4), pp. 206-212.
- H.-Q. Zhang, 2021, “Is Atlantis Related to the Green Sahara?” *International Journal of Hydrology*, 5(3), pp.132-139.
- H.-Q. Zhang, 2021, *Revive Eden – Green Sahara Now*, 2<sup>nd</sup> Edition, BookBaby Publishing.
- H.-Q. Zhang, 2021, *Convincing Atlantis*, YouTube Video
- H.-Q. Zhang, 2017, *Cloud Fountain of China – Lop Nur* (in Chinese), Guangming Press.

(Please contact me if you have any questions/comments or are interested in the books: [hong-quan-zhang@utulsa.edu](mailto:hong-quan-zhang@utulsa.edu))

