

# NICHOLAS H. ROBERGE

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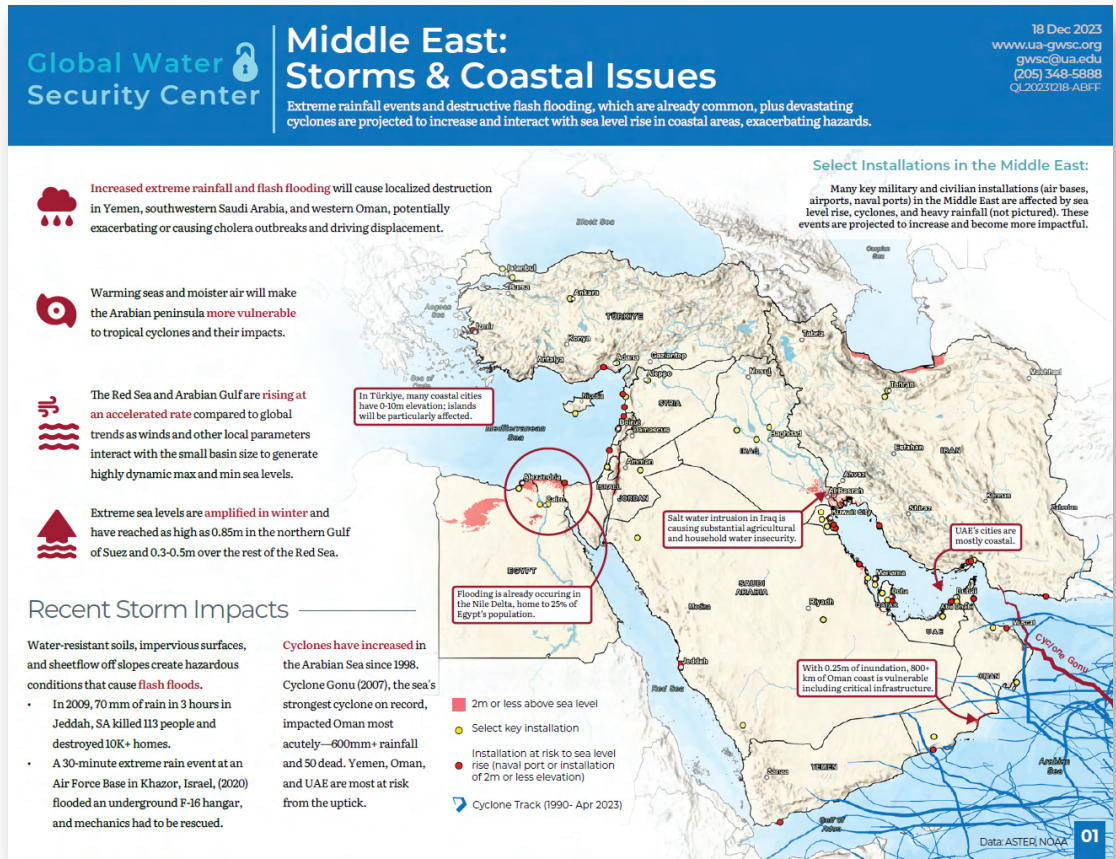
This is a collection of maps I have created while at the Global Water Security Center. All GIS work, cartography, layout, and graphic design in these reports were created by me. Links to the full reports are embedded where available.

## Middle East Overview

This is the first page in an in-depth report on the effects of climate change in the Middle East on key military and civilian installations. This map shows an overview of their locations and highlights specific issues such as sea level rise and cyclones.

Data: ASTER DEM, HydroSHEDS river and lake data, NOAA Cyclone Tracks

Tools: ArcGIS Pro, Adobe Illustrator

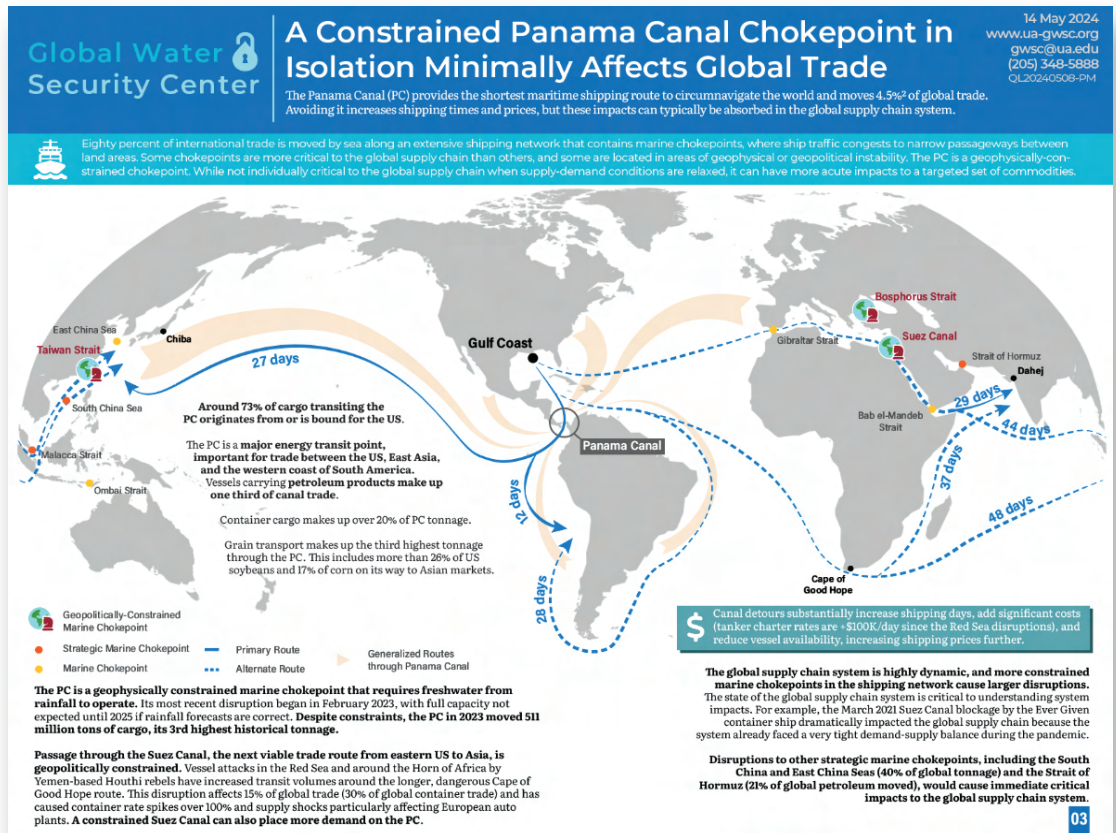


## Shipping Routes

Part of a larger report on the Panama Canal, this map shows the potential effects on closing the canal and highlights strategic chokepoints.

Data: ASTER DEM, HydroSHEDS river and lake data, NOAA Cyclone Tracks

Tools: ArcGIS Pro, Adobe Illustrator



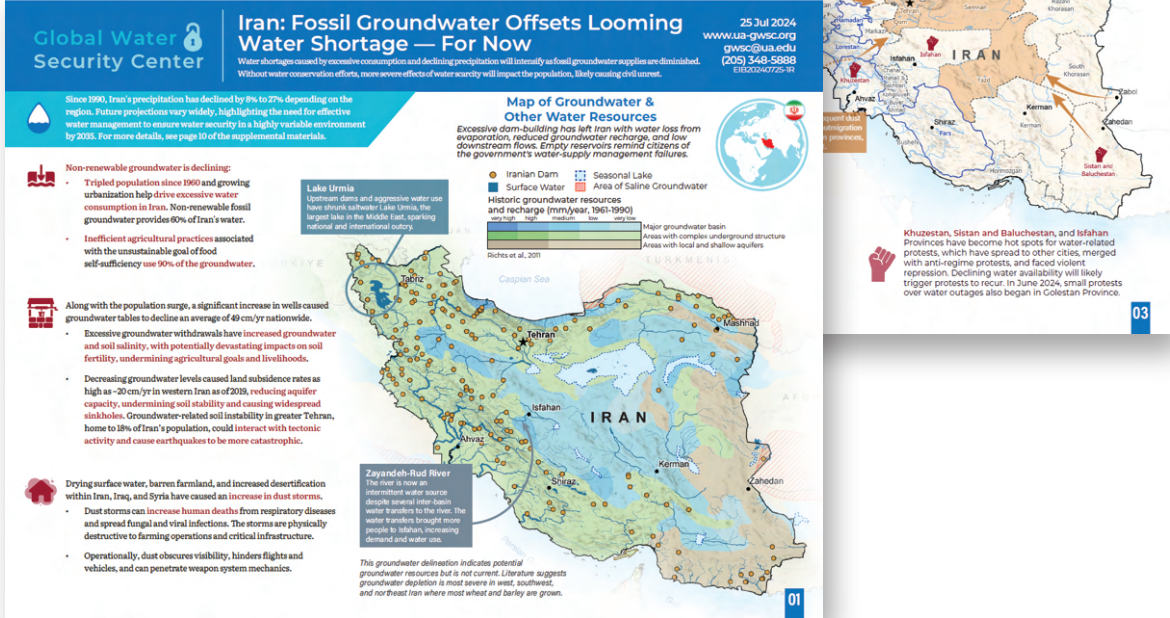
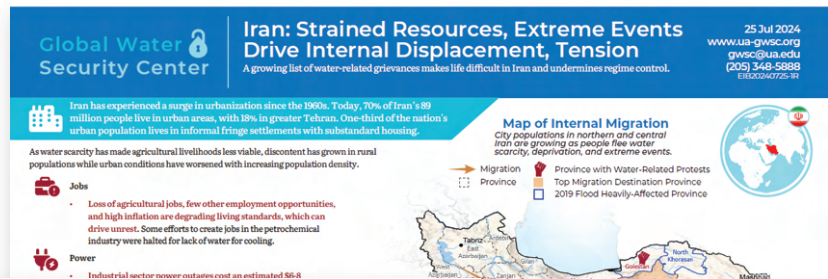
# Iran Displacement & Groundwater

These two pages are in a report on water security issues and the effects of climate change in Iran in 2035. The bottom map shows the migration of Iranians to urban areas, driven by water scarcity, deprivation, and extreme events such as the 2019 flood described on the map.

The top map is a reference map showing the groundwater resources and includes surface water, including the seasonal lakes (playas).

Data: HydroSHEDS river and lake data, Natural Earth, Richts, et al, UN OCHA

Tools: ArcGIS Pro, Adobe Illustrator

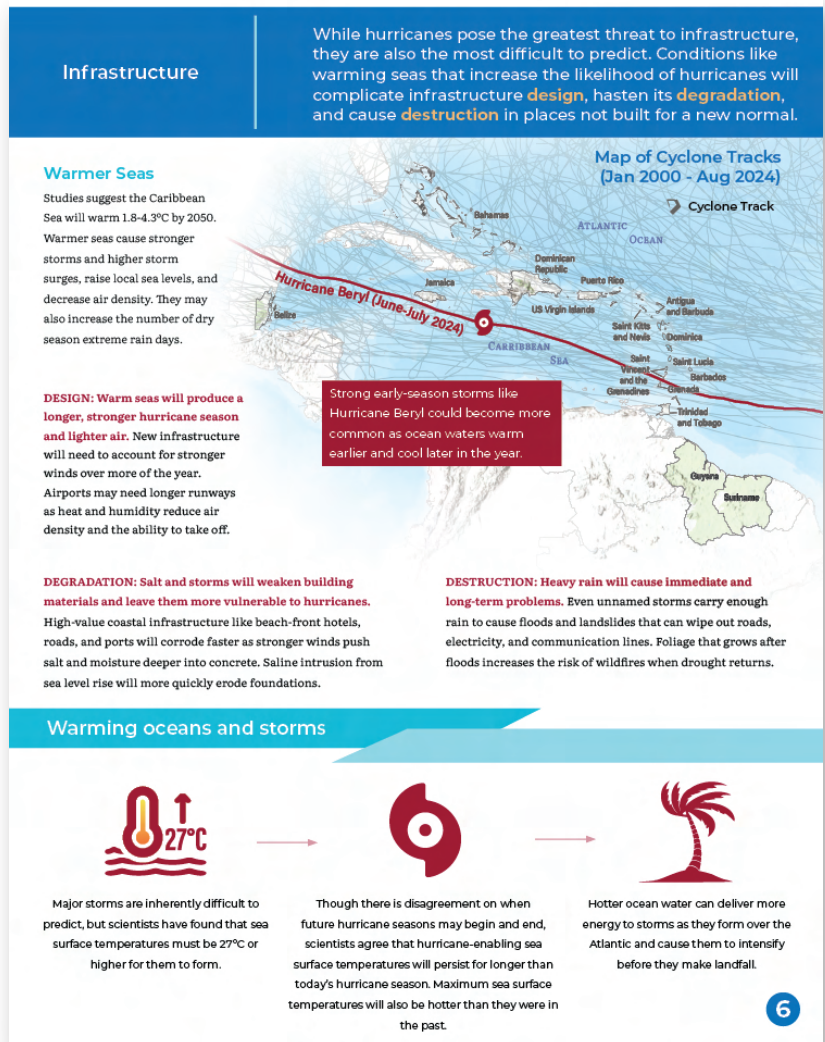


# Caribbean Cyclones

This report was on the effects of climate change in the Caribbean region focusing on select countries. This is one of several maps in the report and this map shows the region and historic cyclone tracks, highlighting a recent storm. Icons were also created to convey help convey warming oceans developing into storms. This is an example of a report created in InDesign with maps created with ArcGIS Pro and Illustrator.

Data: NOAA Cyclone Tracks

Tools: ArcGIS Pro, Adobe Illustrator, Adobe InDesign



# Afghanistan Poppies


This was a one-page report focusing on the potential for climate change limit farmers in Afghanistan after switching from growing opium to legal crops. These maps show the poppy density within agricultural areas and where they were in relation to projected increases in temperature.

Data: HydroSHEDS river and lake data, Natural Earth, Thrasher, B et al.

Tools: ArcGIS Pro, Adobe Illustrator

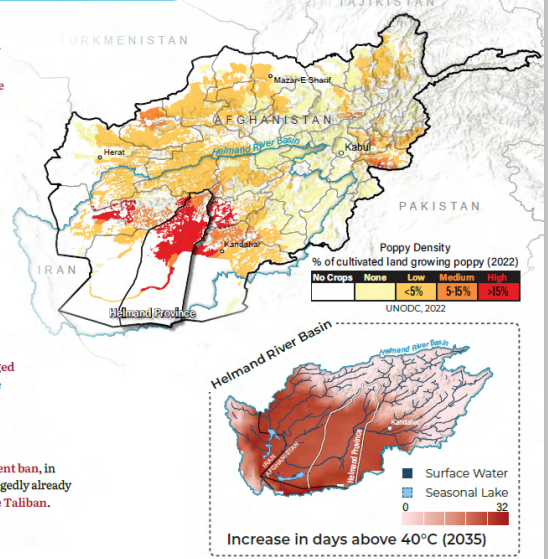
**BOTTOM LINE:**  
Many analyses of the Taliban's recent opium-poppy ban fail to consider the impacts of climate change. Yet, rising temperatures and insufficient water resources constrain growth of legal alternatives to the high-value, fast-growing, hardy opium poppy, which could exacerbate the wealth disparities and violent conflict spurred by the ban.

**BACKGROUND:**  
Poppy has been an economic lifeline to rural Afghan households since 1990. In 2022, agriculture contributed 25% to Afghanistan's GDP, half from poppies—with 61% of households relying on agricultural income. Long-term ban maintenance will require climate resilient crop substitution and off-farm livelihood opportunities.



**Map of Poppy Density in Agricultural Areas**  
In 2022, 40% of the global opium supply came from Helmand Province. Poppy can withstand extreme heat and little water, making it an economic lifeline for rural Afghan households. Days above 40C are projected to increase by 24 days in arid-hot zones, most of Helmand Basin, reaching nearly 90 extreme heat days annually by 2035.

- Warmer temperatures could diminish yields of high-value substitutes, such as nut and fruit crops, limiting viable alternatives to sufficiently support Afghan farmers and the overall economy.**
  - Helmand province, the epicenter of poppy production, has warmed an average 2°C since 1990, with an additional mean increase of 0.5°C projected by 2035. **Warmer winters could devastate high-value nut crops** (pistachios, walnuts, almonds) through insufficient chill hours.
  - Rising summer temperatures can damage and reduce yields of spring wheat, Afghanistan's main source of calories and core Taliban crop substitute. High heat can also cause sunburn and reduced yields in fruit cash crops.
- Irrigation falls short at critical times due to lack of available water.**
  - Rainfall has decreased on average 2.5 mm annually in arid regions of the Helmand, totaling 87 mm decline since 1990. Irrigated wheat and rice production has periodically suffered lower yields from erratic rains and shortages of irrigation water.
  - Warmer spring temperatures can lead to premature, faster snowmelt, potentially causing spring flooding and reducing already-low irrigation water supply in summer.
- Without a sufficient crop-substitution program or off-farm livelihood opportunities, a prolonged poppy ban could lead to unrest and mass migration. Poor rural households, more than 50% of the population, bear the brunt with worsening food insecurity and degrading living conditions.**
  - Landowners have benefited from the ban by selling held-back opium stocks at inflated prices, widening wealth disparities; this buffer will erode as inventories are depleted.
  - Violence broke out between poppy farmers and the Taliban, which implemented the current ban, in northeastern Badakhshan province in May 2024, killing two people. Poppy plantings have allegedly already resumed in 29 of 34 provinces, potentially setting up more conflict between farmers and the Taliban.
  - Increased use of Helmand River water for agriculture could exacerbate transboundary water relations with Iran, a recent source of violent conflict.



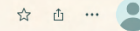
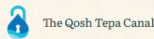
# Qosh Tapa Canal Storymap

(embedded link)

Created for a blog post highlighting the construction of the Qosh Tapa Canal in Afghanistan. The storymap includes a number of maps that show various content to include glaciers, watersheds, and the canal's progress. The maps were a mix of static and web maps. I developed and wrote the story and created all maps and visuals.

Data: HydroSHEDS river and lake data

Tools: ArcGIS Pro, ArcGIS StoryMaps, Adobe Illustrator



Introduction Background Canal Timeline Controversy So What

## Key Areas of Interest

### Qosh Tapa Canal

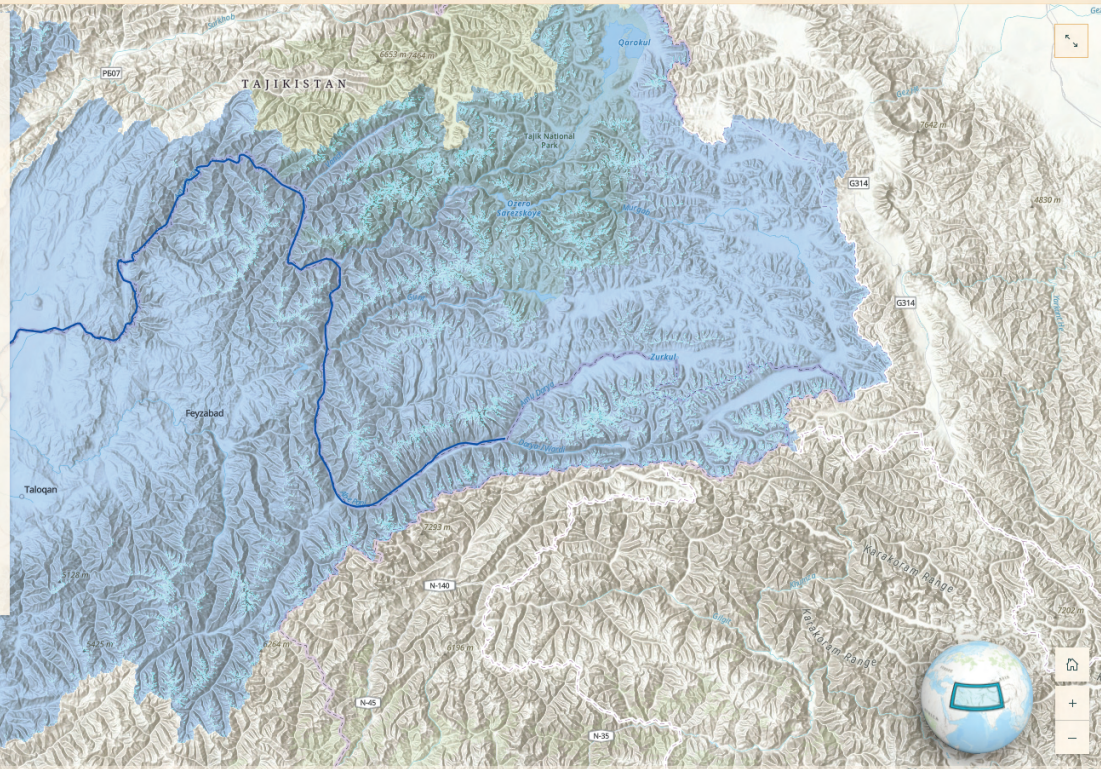
The canal is located in north-central Afghanistan near the convergence of the borders of Afghanistan, Turkmenistan, Uzbekistan, and Tajikistan.

### Amu Darya River & Watershed

The canal will draw its water from the Amu Darya River, one of the longest in central Asia.

### Glaciers within the Amu Darya Watershed

The glaciers in the watershed are the primary source of the river.



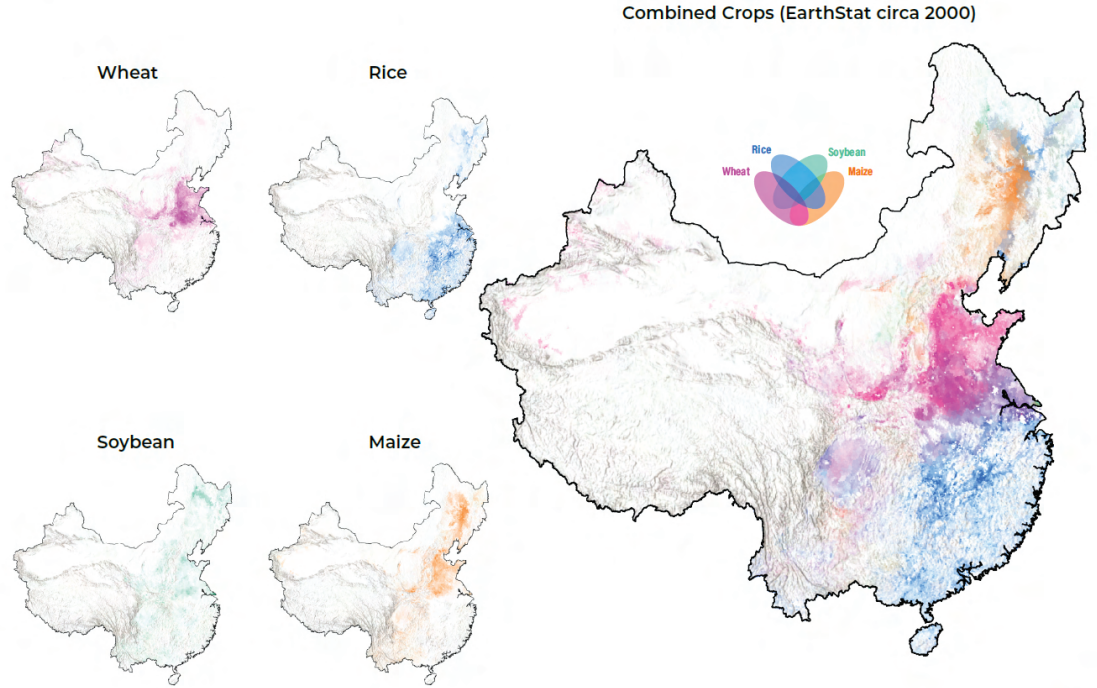
## China's Changing Climate: Supplemental Information Major crop areas

### Major Crops in China

These maps were in a supplemental section of a longer report on the effects of climate change in China. These maps show the location of major crops, supplementing a map of all combined crops in the main section of the report that drives the story of the need to migrate crops to a more suitable region in the future.

Data: EarthStat

Tools: ArcGIS Pro, Adobe Illustrator, Adobe Photoshop



Water scarcity in Iraq is driving people to move from the south to the north and from rural to urban areas, worsening ethnic, religious, and class tensions, and putting more pressure on scarce resources in already stressed cities.

### Tigris-Euphrates River Basin

This map highlights the complexity of the Tigris-Euphrates River Basin, focusing on the rise in salinity from sea level rise and drying lakes and its affect on the population and marshes.

Data: HydroSHEDS river and lake data, Kurdistan Region Statistics Office.

Tools: ArcGIS Pro, Adobe Illustrator, Adobe InDesign

