Water as Climate connector

Prof. Taikan Oki
Special Advisor to the President
The University of Tokyo

Congratulations!
The Nobel Prize in Physics 2021

Syukuro Manabe
The Nobel Prize in Physics 2021

Born: 21 September 1931, Shingu, Ehime Prefecture, Japan

Affiliation at the time of the award: Princeton University, Princeton, NJ, USA

Prize motivation: "for the physical modelling of Earth's climate, quantifying variability and reliably predicting global warming."

Prize share: 1/4

“‘It’s a physical science. Modeling of climate is solely based on physical theory and well-known physics.’” by Royal Swedish Academy of Sciences on Oct. 5, 2021.


No Water Cycle

No River
(b) Water fluxes

Units in thousands of km³ per year

(km³/year)

Ocean to land water vapour transport 46±10%

Ocean precipitation 424±10%

Ocean evaporation 470±10%

Land precipitation 120±10%

Land evaporation 74±10%

Inland drainage basin 1±30%

Land ice discharge 3±40%

Human water use 24±10%

River discharge 46±10%

Groundwater recharge 13±60

Fresh groundwater discharge 0.25±90%

Saline groundwater discharge 4±70%
Figure SPM.2: Assessed contributions to observed warming in 2010–2019 relative to 1850–1900.
FAQ 9.2: “Reservoirs and aquifers on land have reduced, which contributed about an 8% increase in sea level.”

(7.3 mm sea level rise for 1971-2018)
b) Synthesis of assessment of observed change in heavy precipitation and confidence in human contribution to the observed changes in the world’s regions.

Figure SPM.3: Synthesis of assessed observed and attributable regional changes.
c) Synthesis of assessment of observed change in **agricultural and ecological drought** and confidence in human contribution to the observed changes in the world’s regions.

Figure SPM.3: Synthesis of assessed observed and attributable regional changes.
Changes in the reporting cases
(by UNDRR based on EM-DAT)
1980-99 vs 2000-19

- Drought: 263 vs 338, x1.29
- Earthquake: 445 vs 552, x1.24
- Extreme temperature: 130 vs 432, x3.32
- Flood: 1389 vs 3254, x2.34
- Landslide: 254 vs 376, x1.48
- Mass movement (dry): 27 vs 13, x0.48
- Storm: 1457 vs 2043, x1.40
- Volcanic activity: 84 vs 102, x1.21
- Wildfire: 163 vs 238, x1.46
Figure SPM.6: Projected changes in the intensity and frequency of extreme precipitation over land and agricultural and ecological droughts in drying regions.
Figure 8.6: Climatic drivers of drought, effects on water availability, and impacts. Plus and minus signs denote the direction of change that drivers have on factors such as snowpack, evapotranspiration, soil moisture, and water storage.
FAQ 8.2: Causes of more severe floods from climate change

- Greater heat released by condensation leads to fewer but stronger storms
- Changing location and persistence of wettest events
- Cloud microphysics limits rainfall increase
- Increased water use reduces river flow
- Large-scale deforestation decreases rainfall but increases runoff and river flow
- Particle pollution alters storm development

- More moisture fuels heavier precipitation
- Urbanisation increases runoff and flash flooding
- Decreased glaciers and snow reduce river flow
  - Greater capacity of drier soils to soak up water from sustained rainfall
- Earlier and stronger spring melt increase river flow
  - More runoff from heavy rain falling on dry, encrusted soils

- Worsening coastal flooding from sea level rise and combined with heavier rainfall

- Less severe flooding
- More severe flooding

Heavier rainfall increases flood severity
“SDGs Nexus”

- Water
- Climate
- Biodiversity
- Energy
- Food
- Industry
Climate change is the “water change.”

Water is the delivering mechanism of climate change impacts to society.

Climate change adaptation should be/can be integrated into water resources management, land planning, disaster risk management, and sustainable development.

Reducing vulnerability and exposure to present climate variability is the first step towards adaptation to future climate change and nourishes climate resilient water management on local scales.