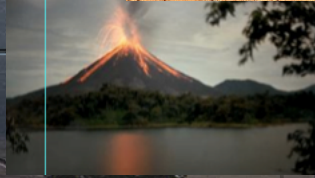


SIO15: Natural Disasters

<https://geowiki.ucsd.edu/sio15>



- all lectures will be recorded via UCSD podcast
- check your UCSD emails regularly for announcements

SIO15 2024: Topic 01 - Natural Disasters

Teaching Assistants



Anusha Goswami



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SIO15 2024: Topic 01 - Natural Disasters

FQ 2024

<https://geowiki.ucsd.edu/sio15>

Homeworks/Tests

Field Trips

Earthwatch/News Clips

FACEBOOK PAGE

Tides

NASA Earth Observatory

Useful Booklets

discuss your homework with fellow students but write your own homeworks; write your own answers, using your own words!

working in groups to share the workload of a homework or field trip assignment violates SIO15 Code of Conduct: e.g. 6 people together, each does one problem and the others copy the answers; THIS IS CONSIDERED CHEATING!

do not copy and paste from a webpage; THIS IS PLAGIARISM! Use your own words!

when writing answers using sources other than the class website, provide clear and complete citations (e.g. Newspaper article taken off, if you do not provide a reference, and answers differ from the class website)

do not present web material and anybody else's material as your own work

do not complete homework for other students

copied homeworks will be given 0 points; repeat cheaters will be reported to UCSD

Help with the homeworks

Please visit [this page](#) for more information about the homeworks. Please also visit the [SIO15 website](#) for more information.

Homeworks – HW1 10/1 – due 10/8

Please check out the [SIO15 website](#) for instructor and TA contact info.

Google Earth questions

For some questions in each homework assignment, you need a Google Earth kml or kmz file.

- If you do not have the free Google Earth package, [download it](#) and install it on your computer.
- Google Earth browser plugins may now allow to open kml/kmz files that we provide without the need to install Google Earth. We guarantee that this really works.
- The homework kml and/or kmz files will be provided below, as the homeworks are assigned. Click on the link to download.
- Depending on your computer setup, double-clicking on the kmz file may open the file in a web browser instead of Google Earth. Specifically on the Google Earth icon.
- When downloading our kml/kmz files, some web browsers may open kml files automatically and then choose a name you like. If there is also a zip file offered, download the zip file instead and unzip it before opening it in Google Earth.

wrong course entry code

HW #	Date Distributed	Topics Covered	Date Due	Downloadable Assignment	Auxiliary Links	Homework Video	Answer Keys
	Oct 02					Gradescope video	
1	Oct 01	1-4	Oct 08				
2	Oct 08	5-7	Oct 15				
3	Oct 15	8-10	Oct 22				

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FQ 2024

Canvas:
Mondays - weekly for-credit test
first one 10/7

no final exam!

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Office Hours/Discussions

Office hours: Canvas/Zoom

- Laske
- Canvas/Zoom starting 9/30
- Mon 5:00 – 5:50 pm
- waiting room!
- no discussion of course material!

Discussion sessions:

- TAs
- optional/no-credit; starting 10/7
- York 3030, Mondays 4:00 – 4:50 pm
- discussion of course material
- mostly recap of previous week

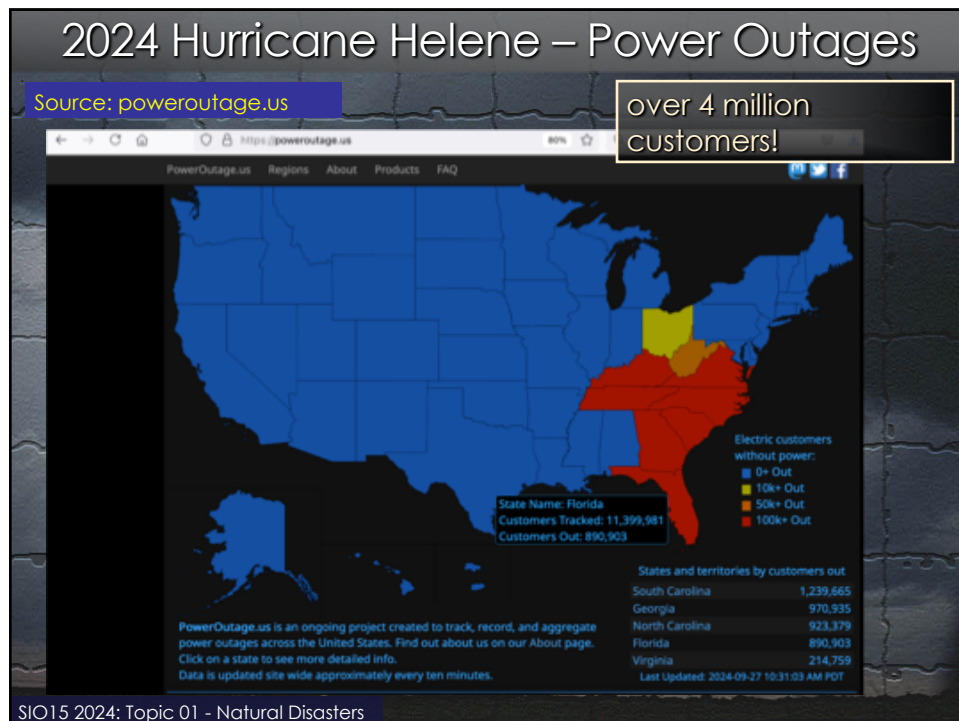
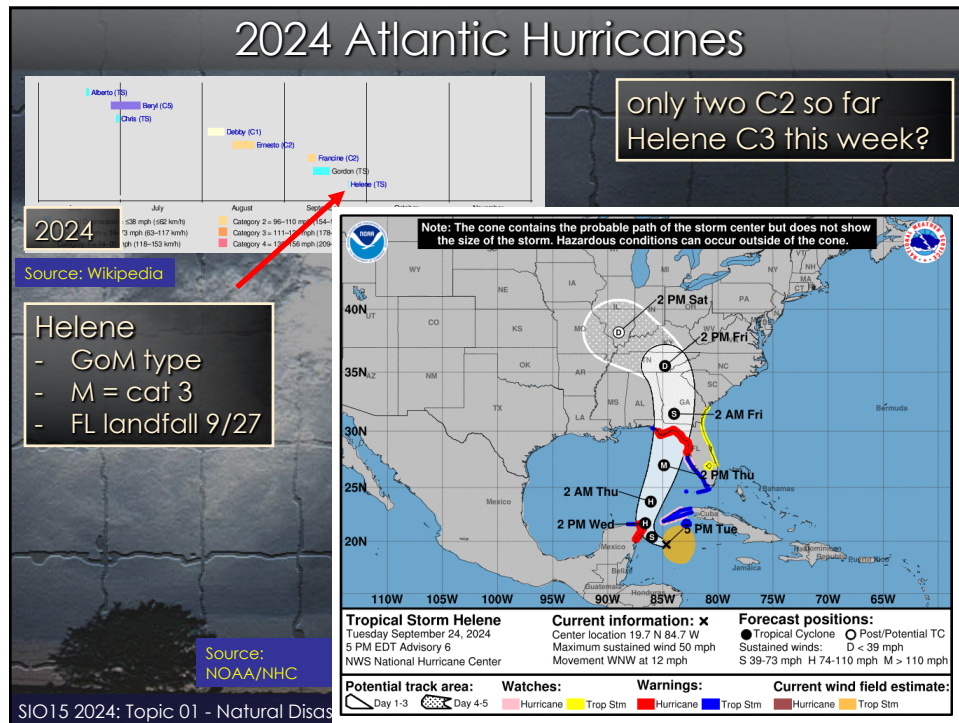
SIO15 2024: Topic 01 - Natural Disasters

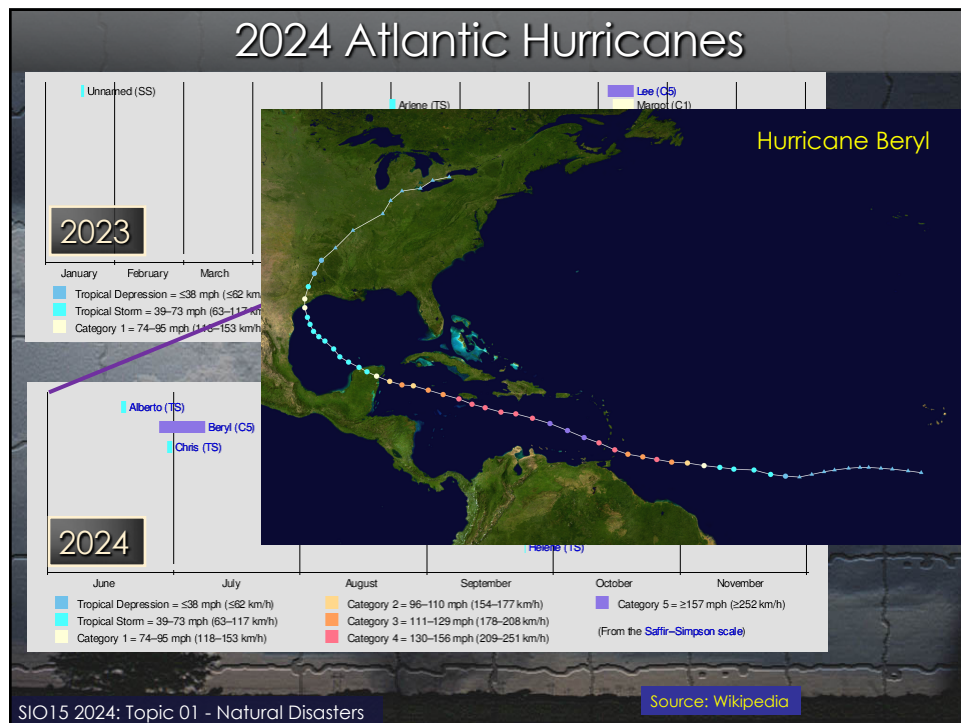
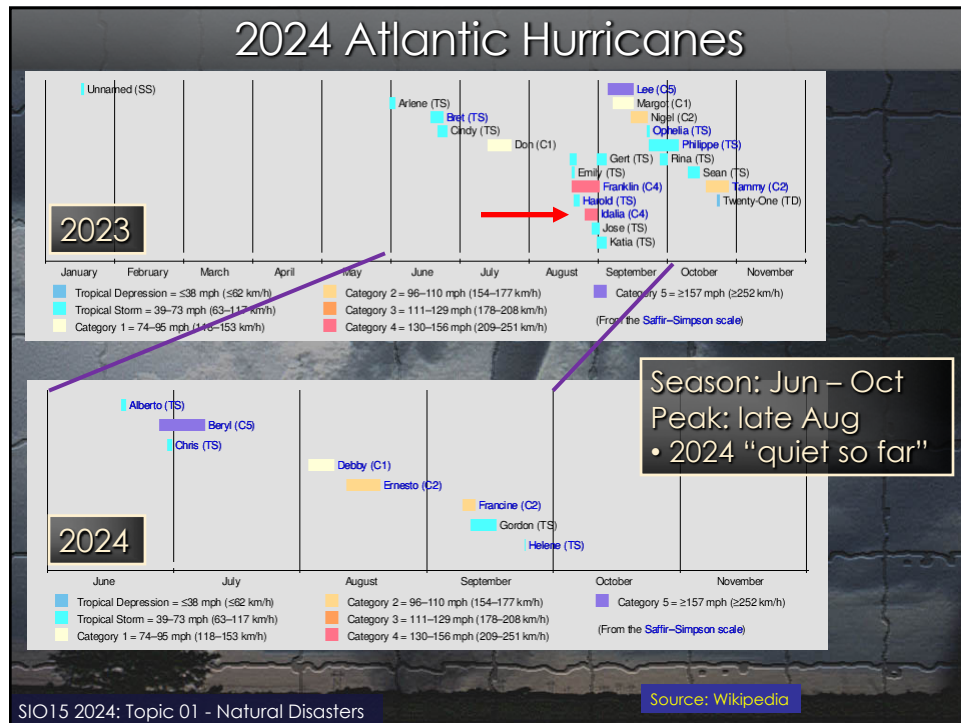
Obvious Types of Natural Disasters

- earthquakes
- volcanoes
- landslides
- floods
- hurricanes
- tornadoes
- storms
- wildfires
- impacts of space objects

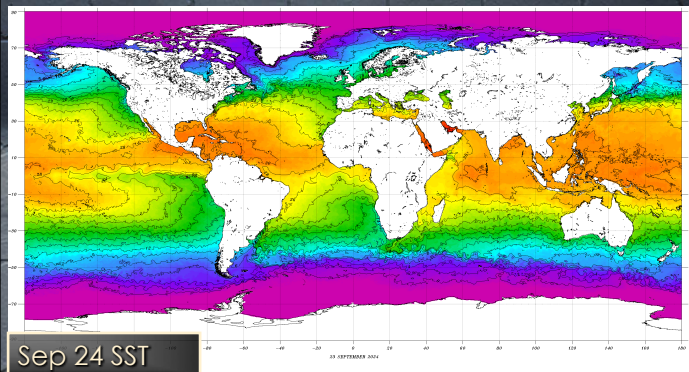
Most frequent
Many causes

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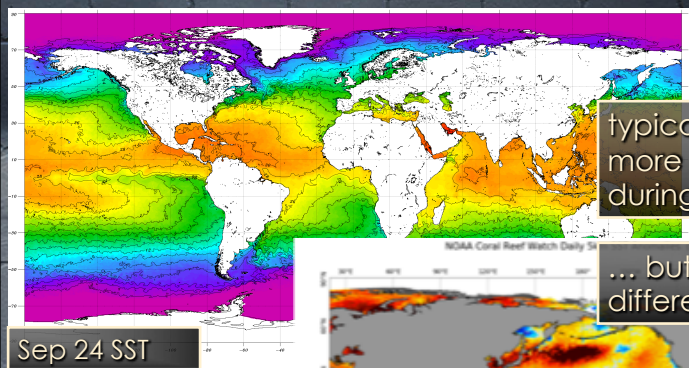
2024 Sea Surface Temperature



Source: NOAA

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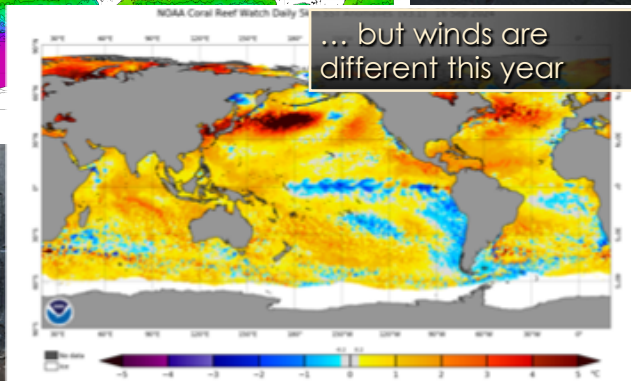
2024 Sea Surface Temperature



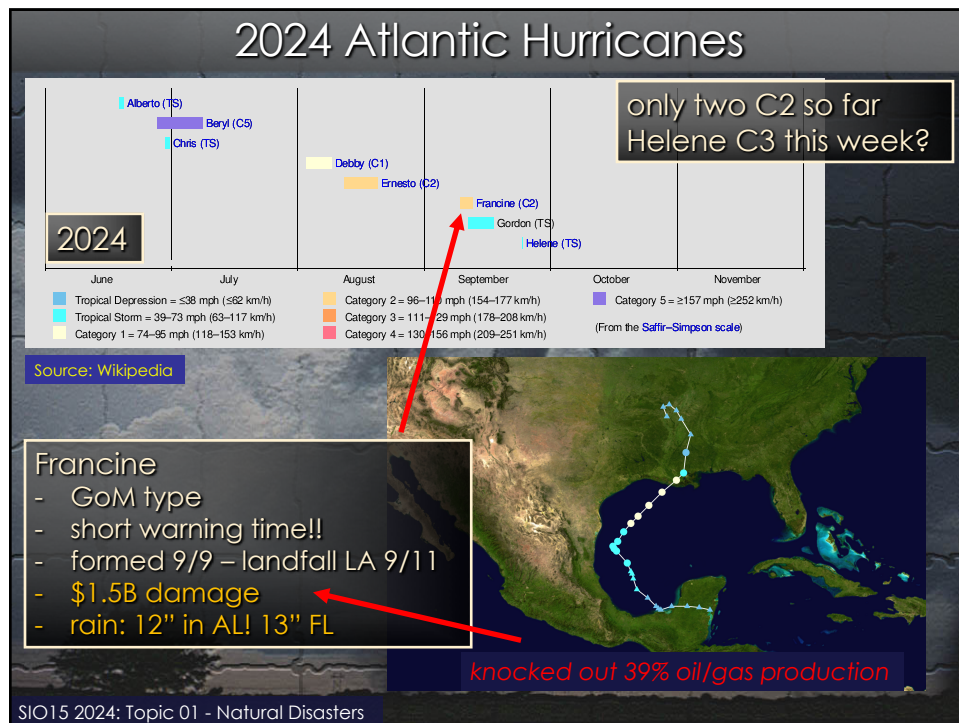
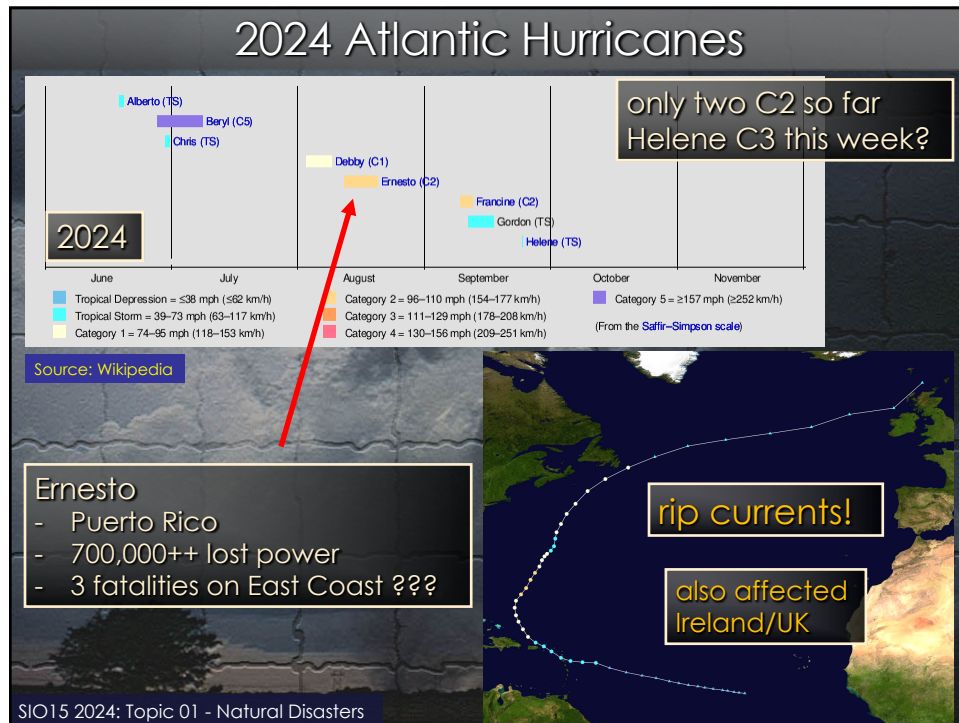
Source: NOAA

typically:
more Atl hurricanes
during La Niña

... but winds are
different this year



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2023 Pacific Hurricanes - Otis

Source: Wikipedia

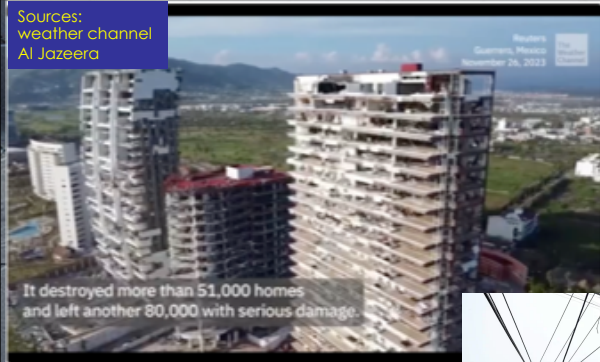
- cat 5
- Oct 22 – 25
- extremely short warning!
- strongest landfalling Pac hurricane
- devastated Acapulco
- > 52 fatalities
- \$12-16B damage
- costliest in MX history, incl. GoM hurricanes

more hurricanes in E Pacific than in Atlantic!

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2023 Pacific Hurricanes - Otis

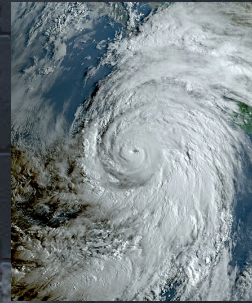
Sources:
weather channel
Al Jazeera



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2023 Pacific Hurricanes - Hilary

- more hurricanes than in Atlantic
- usually dissipate before reaching U.S. (b/c cold California Current)



- cat 4
- Aug 16 - 21
- 4 fatalities/Mexico
- nearly \$1B damage (\$15M in MX)
- landfall S.D. as TS (first since 1858)



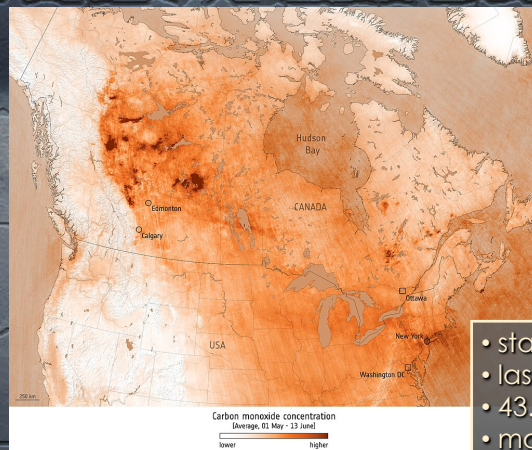
epic flooding in Death Valley
\$900 M damage in Inyo county



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2023 Wildfires - Canada

Source: wikipedia



- started in March 2023
- lasting into fall 2023
- 43.5M acres
- most-area-burned in CAN history
- 6,400 fires
- 6 fatalities
- 155,856 evacuated
- bad air along East coast/Europe

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2023 Wildfires – Maui, HI

Source: wikipedia



- pushed by strong trade winds
- 97+
- deadliest in modern U.S. history
- 2000 buildings in Lahaina
- cause: powerline
- lack of warning/communication

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2024 Wildfires – SoCal

Source: wikipedia



quiet until September
(NorCal had burned 400k acres by then)
then 3+ at once:
9/5 Line Fire (San Bernardino), 40k acres
9/8 Bridge Fire (LA/San Bernardino), 55k acres
9/9 Airport Fire (Orange), 25k acres

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2024 Wildfires – SoCal

Source: wikipedia

- evacuations
- buildings destroyed (1+81+160)

cause:

9/5 Line Fire: **arson**

9/8 Bridge Fire: under investigation

9/9 Airport Fire: **equipment sparks**

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2024 Wildfires – U.S.

to date:

CA nearly 1M acres

AK 6.6M acres

(701 fires, 426 human = 61%)

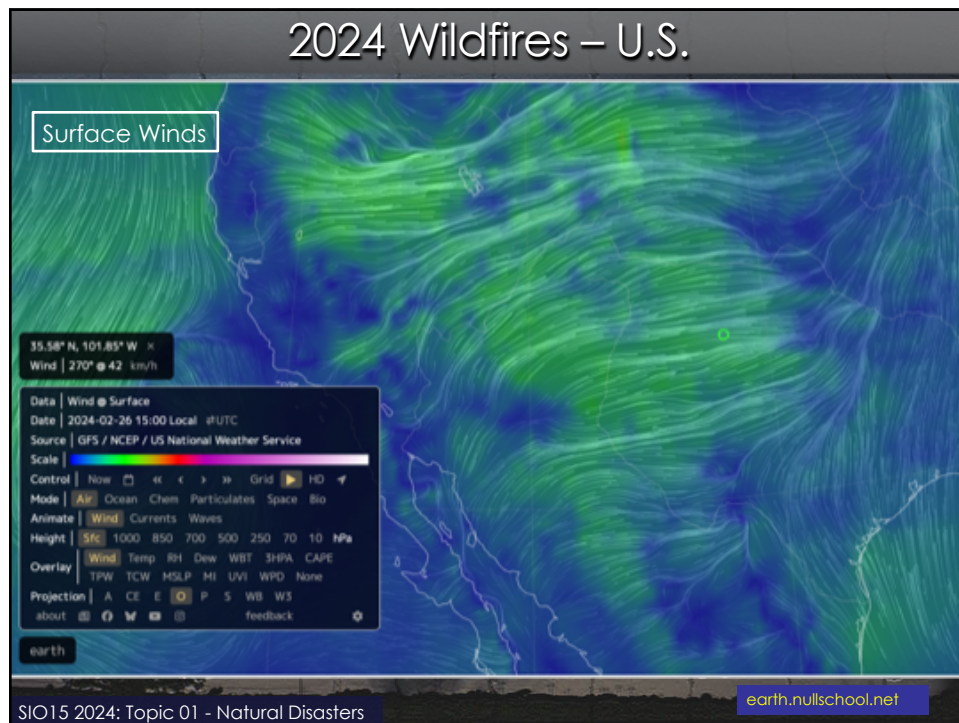
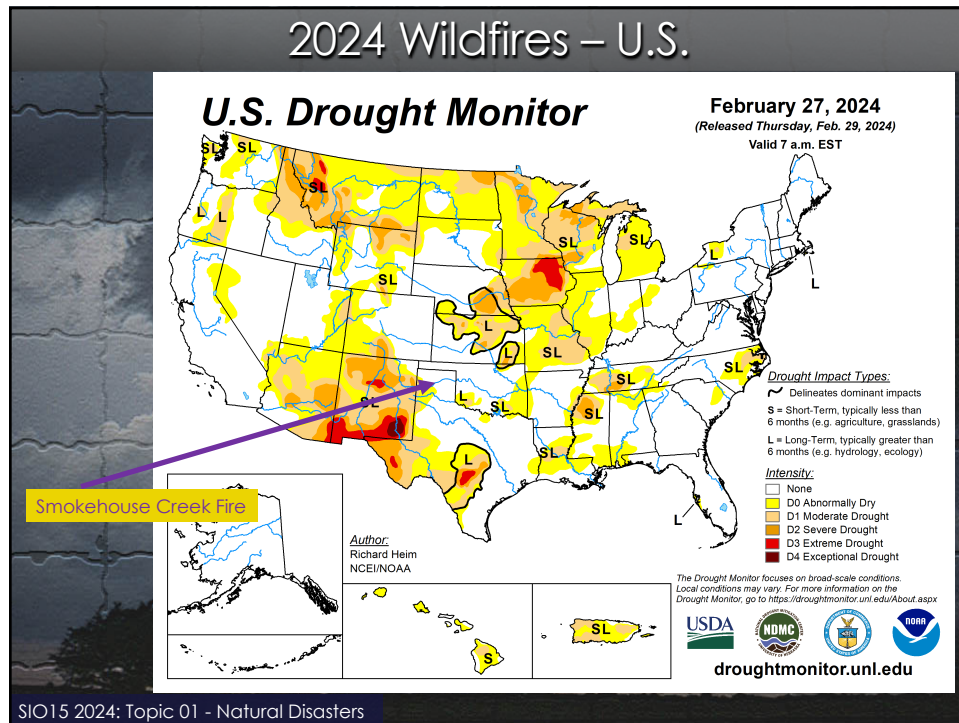
> 50k acre Fires in U.S. in 2024

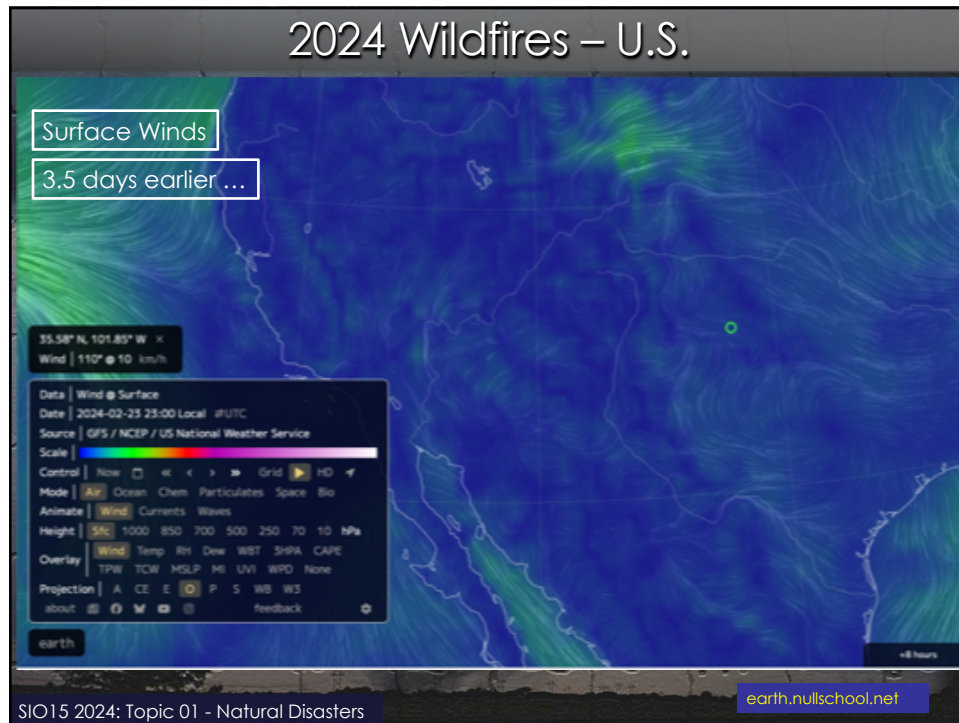
Name	State	Acres	Start Date	Cause
Betty's Way	NE	68,000	Feb 26	
Smokehouse Creek	TX/OK	1,055,000	Feb 26	downed powerlines
Windy Deuce	TX	143,500	Feb 26	
Catesby	OK	90,000	Feb 27	human
Falls	OR	151,500	Jul 10	human
Cow Valley	OR	133,500	Jul 11	human
Lone Rock	OR	137,000	Jul 13	undetermined
Battle Mountain Complex	OR	183,000	Jul 17	lightning
Durkee	OR	294,500	Jul 17	lightning
Sawella	WA	53,500	Jul 17	lightning
Bighorn	WA	51,500	Jul 22	
Badlands Complex	OR	54,500	Jul 22	lightning
Crazy Creek	OR	87,000	Jul 22	lightning
Telephone	OR	54,000	Jul 22	
Hole in the Ground	OR	100,000	Jul 24	
Park	CA	430,000	Jul 24	arson
Borel	CA	59,500	Jul 24	fatal car accident
Wapiti	ID	125,500	Jul 24	lightning
Warner Peak	OR	66,000	Aug 5	
Nellie	ID	50,000	Aug 5	
Paddock	ID	187,000	Aug 5	
Flat Rock	WY	52,500	Aug 21	
House Draw	WY	174,500	Aug 21	
Remington	MT/WY	196,500	Aug 22	
Lava	ID	100,000	Sep 2	lightning
Rail Ridge	OR	163,500	Sep 2	
Bridge	CA	55,000	Sep 8	

still burning

Source: wikipedia

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2019 Wildfires: Indonesian Rainforest

tropical rainforests have most biodiversity on Earth source: Wikipedia

Burning rainforest

- ✧ extinction of unique species
- ✧ displacement of indigenous people -> conflicts

orangutans live only in Borneo and Sumatra

Borneo orangutan critically endangered

Oil Palm nursery - source: Greenpeace

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2019 Wildfires: Indonesian Rainforest

tropical rainforests have most biodiversity on Earth

source: Wikipedia

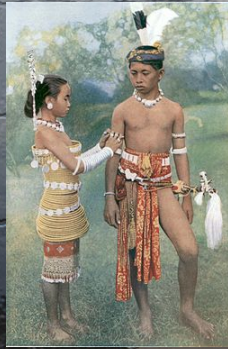
displacement of indigenous people -> conflicts

fight in 2001 claimed 1000s of lives

Dayak

vs

Madurese migrants



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2019 Wildfires: Indonesian Rainforest

source: Wikipedia



Kuala Lumpur, Malaysia

Countries also burning:
Thailand (for rubber trees)
Vietnam
Malaysia

Countries affected:
Malaysia
Singapore
Brunei
Philippines

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Some Not so Obvious Natural Disasters

- cold snaps
- heat waves
- droughts
- global climate change
- solar storm
- pandemics

Some other time

- humans are increasingly affected
- humans have an increasing impact

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Pandemics

COVID-19
SARS-COV-2
dec 2019 - ???
infected: (9/29/20) 33.5 M
fatalities: 1 M
fatality rate 3.0%

normal flu: 0.1%

corona virus: SARS; common cold

depends on hospital
capacity/social
distancing/vaccine/
mutation

infected: (1/2/22) 289 M
fatalities: 5.4 M
fatality rate 1.9%

infected: (9/22/22) 614 M
fatalities: 6.5 M
fatality rate 1.1%

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Pandemics

COVID-19
SARS-COV-2
dec 2019 - ???
infected: (9/22/22) 614 M
fatalities: 6.5 M
fatality rate 1.1%

normal flu: 0.1%

2009 Swine flu

Historic
Plagues more
deadly!
>30% of
population

1918 Spanish flu:
H1N1 influenza A
Feb 1918 – Apr 1920 (4 waves)
infected: 500 M (1/3 world population)
fatalities: 17-50 M
fatality rate 3-10% (some say 20%)
one of deadliest pandemic in human
history

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Heat Waves

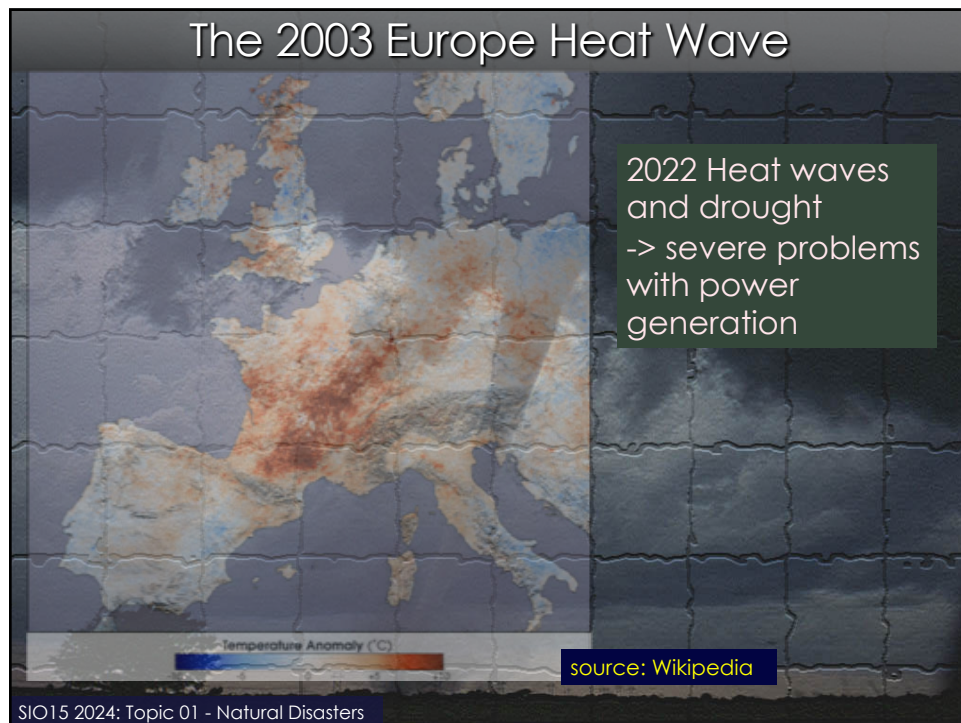
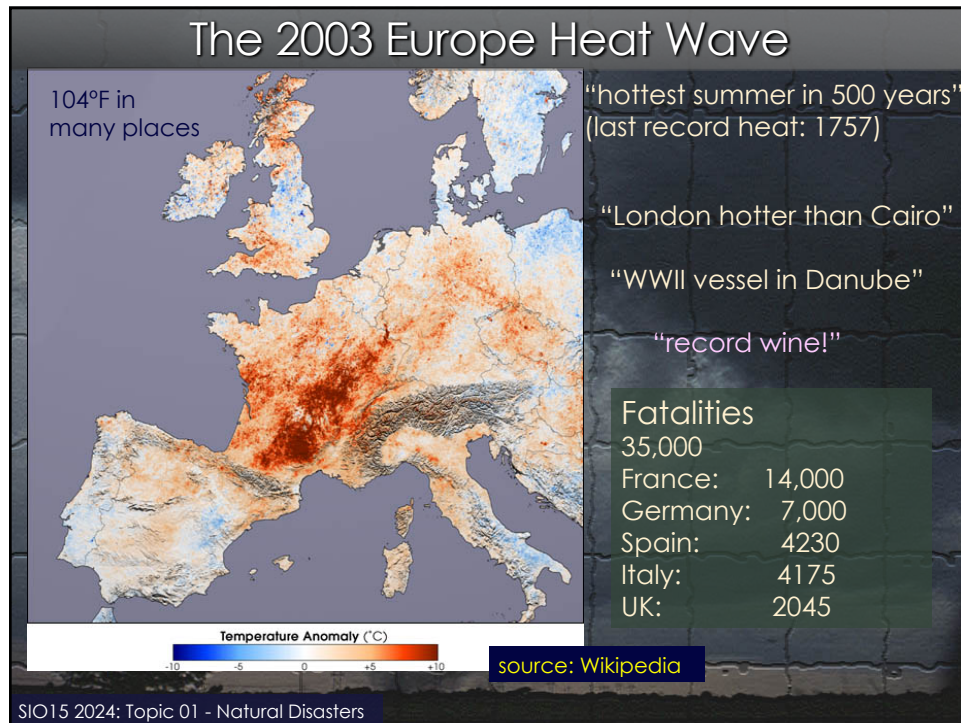
definitions vary!
depends on country/state/location/organization

World Meteorological Organization:

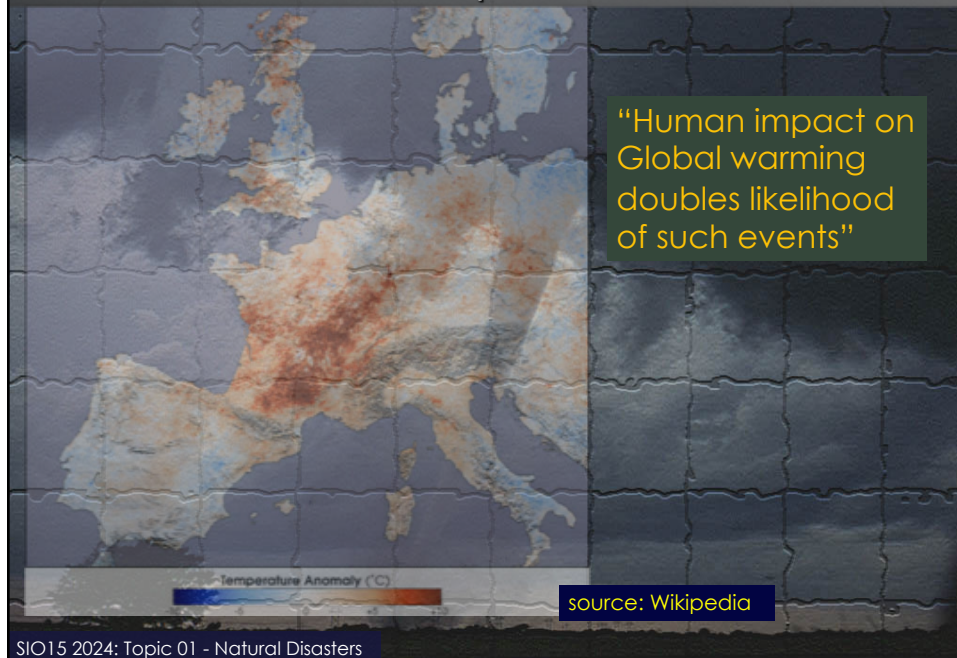
*"daily max. temp exceeds average max. temp by
5°C (9°F) for > 5 consecutive days"*

typically form near H air pressure system

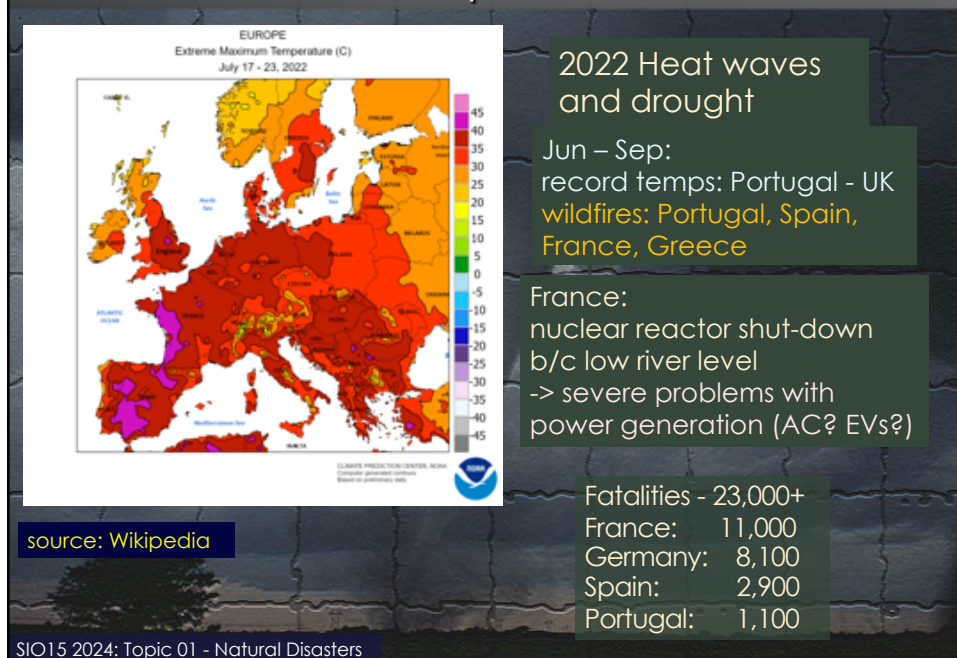
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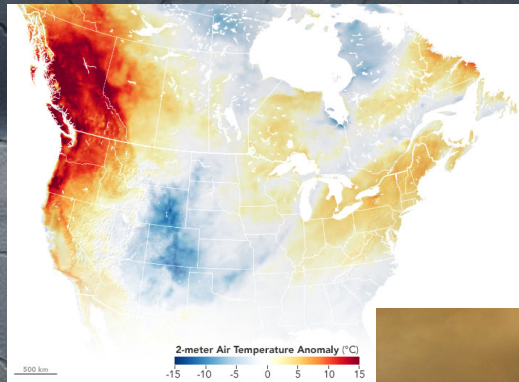
The 2003 Europe Heat Wave



The 2022 Europe Heat Waves



2021 Pacific Northwest



jun 25 – jul 7
121.3°F/49.6°C
Lytton, BC
> 1400 fatalities
(600 in US)
\$9B damages

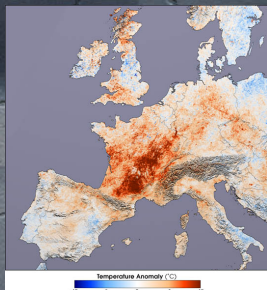


source: Wikipedia

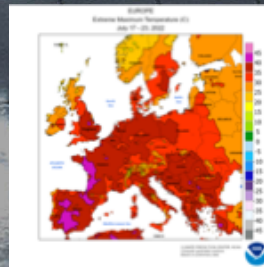
6/28 Mt. Shasta

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Global Heat Waves



2003



2022 Japan
heatwave

2021

source: Wikipedia

"Human impact on
Global warming
doubles likelihood
of such events"

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Fatalities and Losses in the U.S.

Cumulative Billion \$ Losses
in U.S. (1980-2003)

heat waves/droughts:	144
hurricanes (B.K.):	102
floods:	55
cold-weather storms:	28
wildfires:	13
tornadoes:	7

Average Annual Death Rate
in U.S. (1996-2015)

heat waves:	131
tornadoes:	84
floods:	82
hurricanes:	62
wind:	53
lightning:	38
rip currents:	53 (2006-2015)

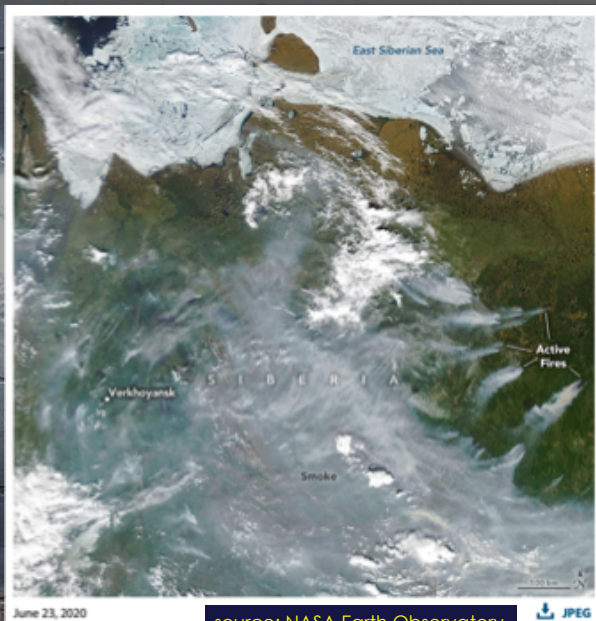
source: Munich Re

of all severe weather in U.S., on average,
heat waves are #1 killer
heat waves lead to highest economical losses

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Heat Waves

- Heat wave
- Drought
- Wildfires
- Low air quality

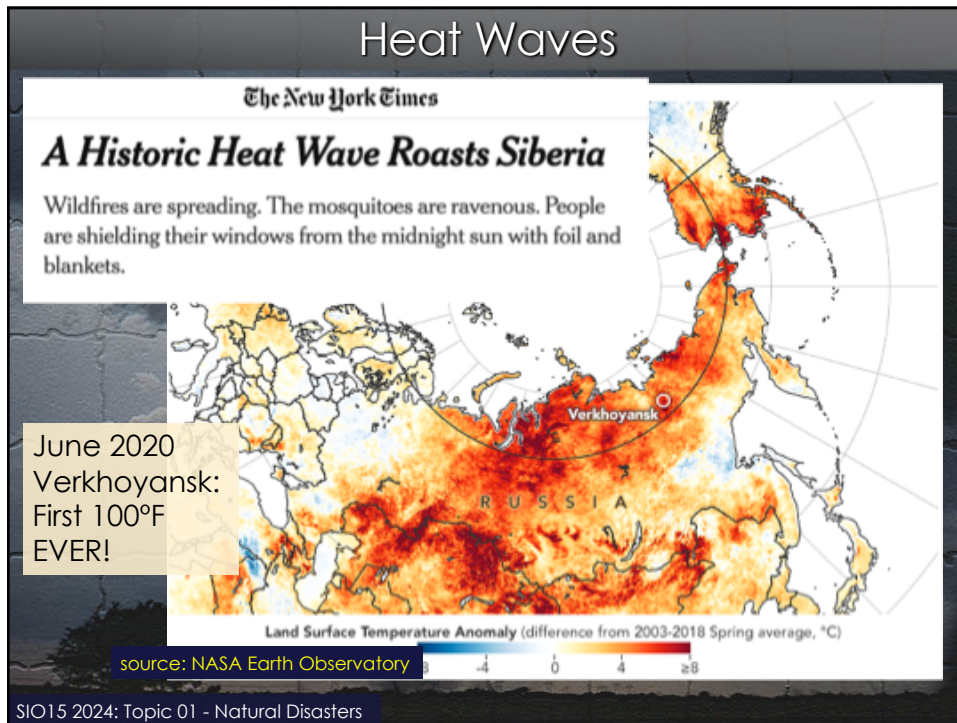


source: NASA Earth Observatory

JPEG

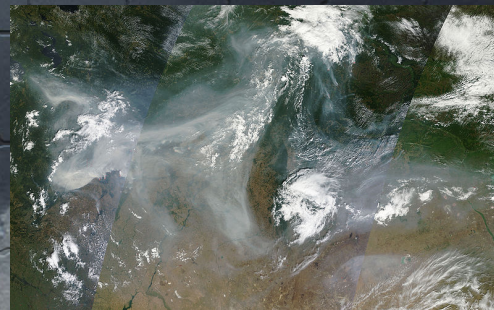
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Heat Waves



2020 Wildfires in Siberia – Peat/Turf

source: Wikipedia

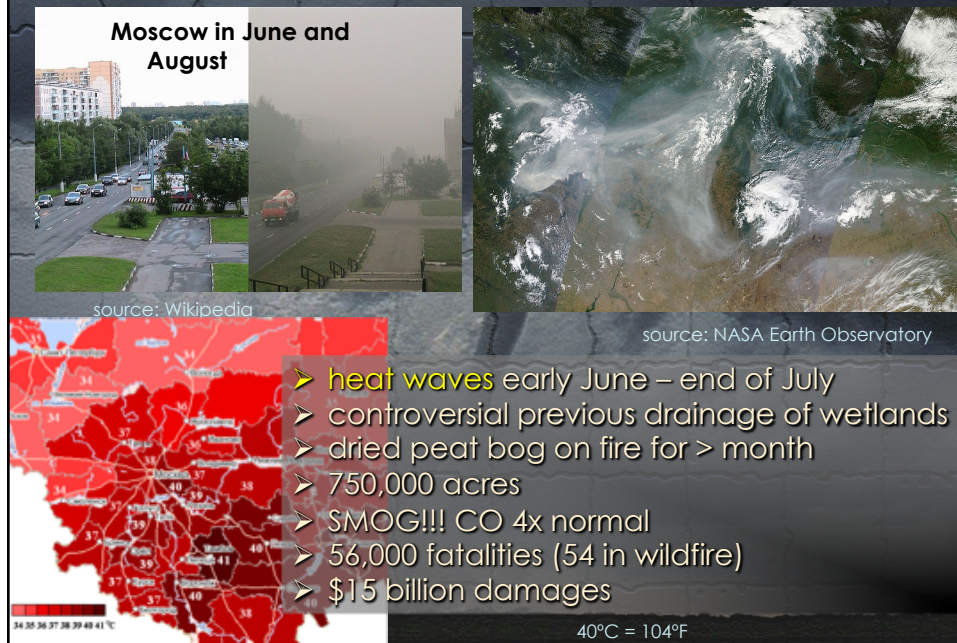


source: NASA Earth Observatory

- accumulation of partially decayed matter
- in swamps, bogs, moors, wetlands (slow decomposition)
- over geologic times: turns to low-grade coal (P and T!)
- peat can be harvested and use as fuel
- drought/drainage of wetlands -> peat can burn underground
- difficult to extinguish/fight fires

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The 2010 Russia Heat Wave and Wildfires



Some Numbers: Death Rates (1947-1980)

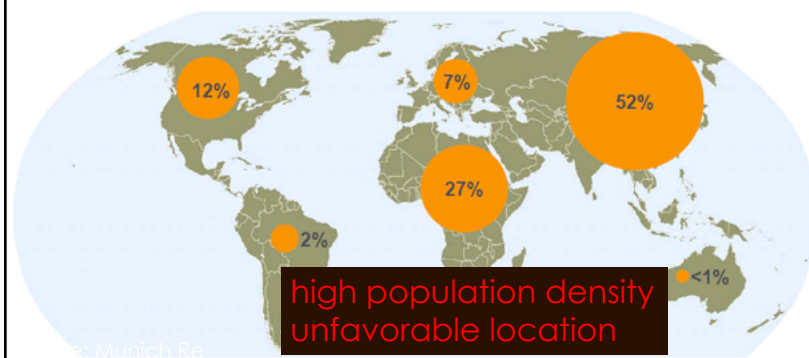
most frequent event:
highest single-event
fatalities:

floods
hurricanes, EQs (each
~450,000)

area with most fatalities:

Asia

Natural catastrophe fatalities were highest in developing and emerging countries in the period 1980–2012



The Costliest Disasters in U.S. History

- 2021 Texas Freeze (\$197 Billion)
- 2005 Hurricane Katrina (\$125 Billion)
- 2017 Hurricane Harvey (\$125 Billion)
- 2017 Hurricane Maria (\$92 Billion)
- 2012 Superstorm Sandy (\$69 Billion)
- 2021 Hurricane Ida (\$65 Billion)
- 2017 Hurricane Irma (\$ 65 Billion)
- 1989 N. A. Drought (\$53 Billion)
- 2014 N.A. Drought (> \$50 Billion)
- 1994 Northridge Earthquake (\$49 Billion)
- 2008 Hurricane Ike (\$38 Billion)
- 2005 Hurricane Wilma (\$27 Billion)
- 1992 Hurricane Andrew (\$27 Billion)
- 2004 Hurricane Ivan (\$26 Billion)
- 2018 Hurricane Michael (\$25 Billion)
- 2018 Cali Wildfires (\$24 Billion)
- 2020 Hurricane Laura (\$19 Billion)
- 2005 Hurricane Rita (\$19 Billion)
- 2004 Hurricane Charley (\$17 Billion)
- 1993 Mississippi Flood (>\$ 15 Billion)
- 2016 Hurricane Matthew (\$15 Billion)

Prolonged Floods:
underappreciated
less newsworthy
no flood insurance
-> less insured losses

... NEVER
MENTIONED
IN ANY OFFICIAL
LIST

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Not inflation-adjusted

Source: wikipedia

Numbers: Insured Losses in \$B (1970-2017)

- 1) Japan: Tohoku EQ 2011 (360/35)
- 2) USA: Hurricane Katrina 2005 (125)
- 3) USA: Hurricane Harvey 2017 (125)
- 4) Puerto Rico: Hurr. Maria 2017 (92)
- 5) USA: Superstorm Sandy 2012 (69)
- 6) USA: Hurricane Irma 2017 (65)
- 7) USA: Drought 1988/89 (53)
- 8) USA: Drought 2012/13 (53)
- 9) Thailand: Flood 2011 (46)
- 10) USA: Hurricane Andrew 1992 (27/43)
- 11) USA: Northridge EQ 1994 (49/21)
- 12) USA: Hurricane Ike 2008 (38/21)
- 13) USA: Hurricane Ivan 2004 (26/15)
- 14) USA: Hurricane Wilma 2005 (27/15)

Wiki:

- 2) 1995 Kobe EQ 197
- 3) 2008 Sichuan EQ 148

Pakistan Flood (2010)
\$42B

country with
largest
(insured)
losses:
USA

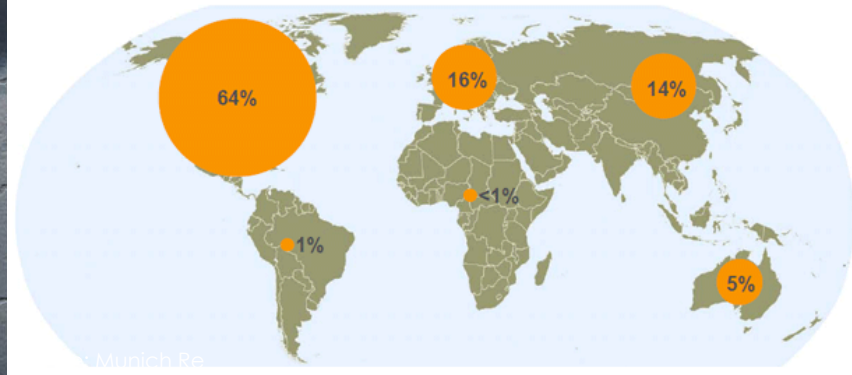
Mississippi Flood (1993)
\$12B

- Swiss Re: insured losses
- updates from wikipedia

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Numbers: Insured Losses (1980-2012)

Natural catastrophes worldwide 1980 – 2012
Percentage distribution of insured losses per continent

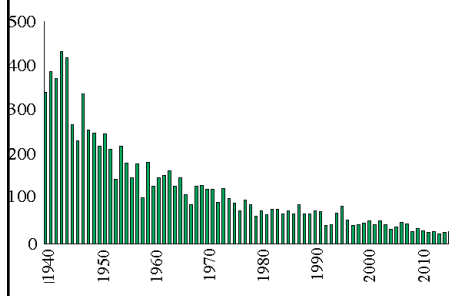


64% of world's losses in North America

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Some Weird Statistics: U.S.

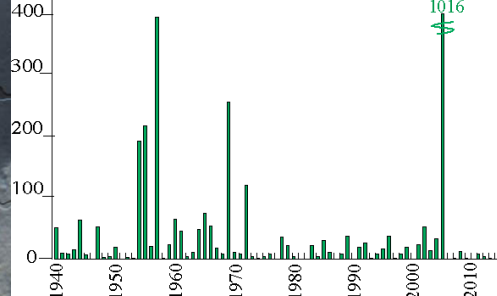
Annual Fatalities from Lightning



76 yrs ave: 123
30 yr ave: 48
10 yr ave: 27

Lightning has a downward trend

Annual Fatalities from Hurricanes

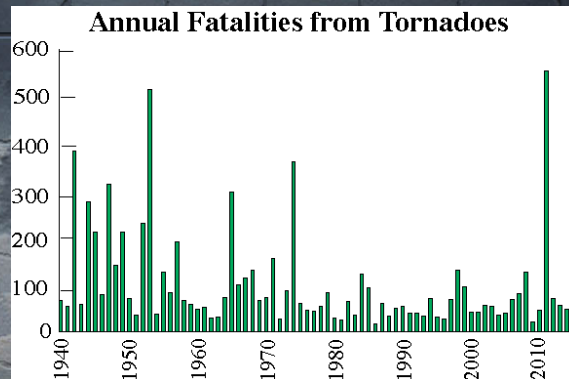


76 yrs ave: 44
20 yr ave: 62
10 yr ave: 9.1 (!)

hurricane statistics dominated by single events

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Some Weird Statistics: U.S.



Marked decrease in fatalities up to late 1900s
But decline not continuing !?

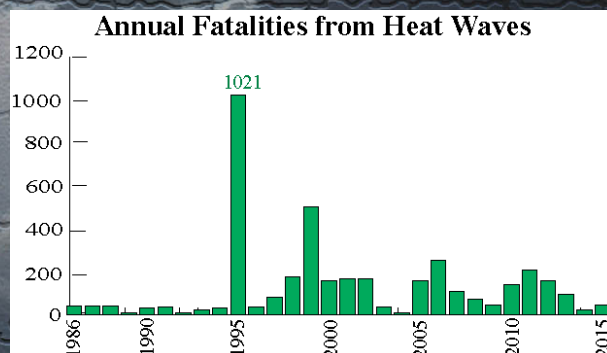
More new homes with less tornado shelters !!

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Some Weird Statistics: U.S.

30 yr ave: 130
10 yr ave: 101

Typical Year – Last 20 Years
Hurricanes: 30
Heat Waves: > 100



Heat waves are currently #1 killer
and cost most!

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