

## SIO15: Natural Disasters – Forces&Energy

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



SIO15 2024: Topics 01/02: Nat. Disasters/Forces and Energy

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## Office Hours/Discussions

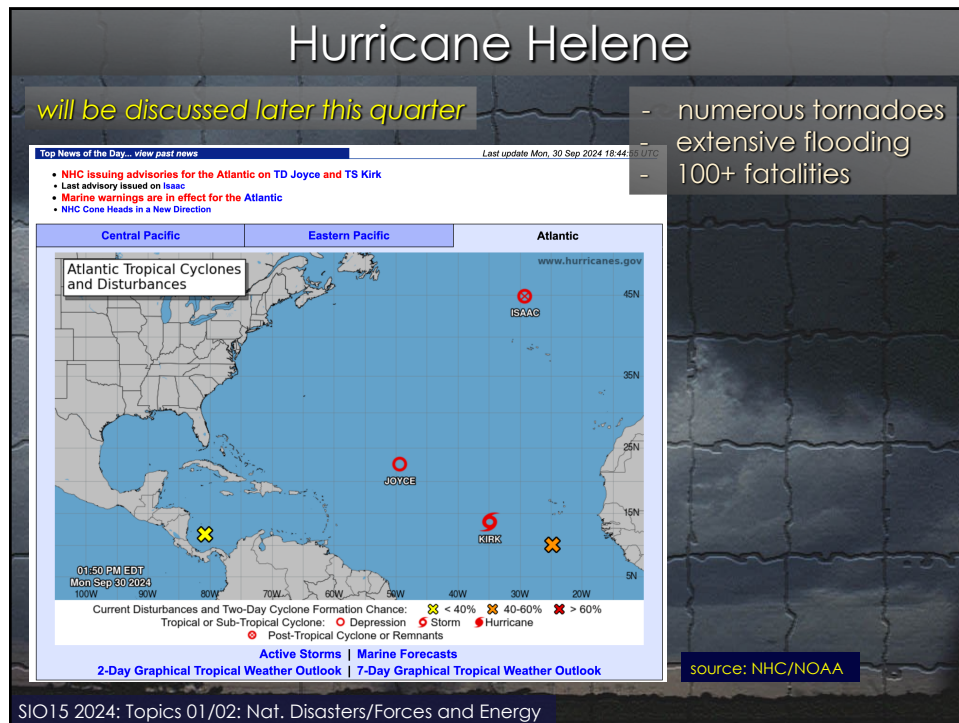
Office hours: Canvas/Zoom

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

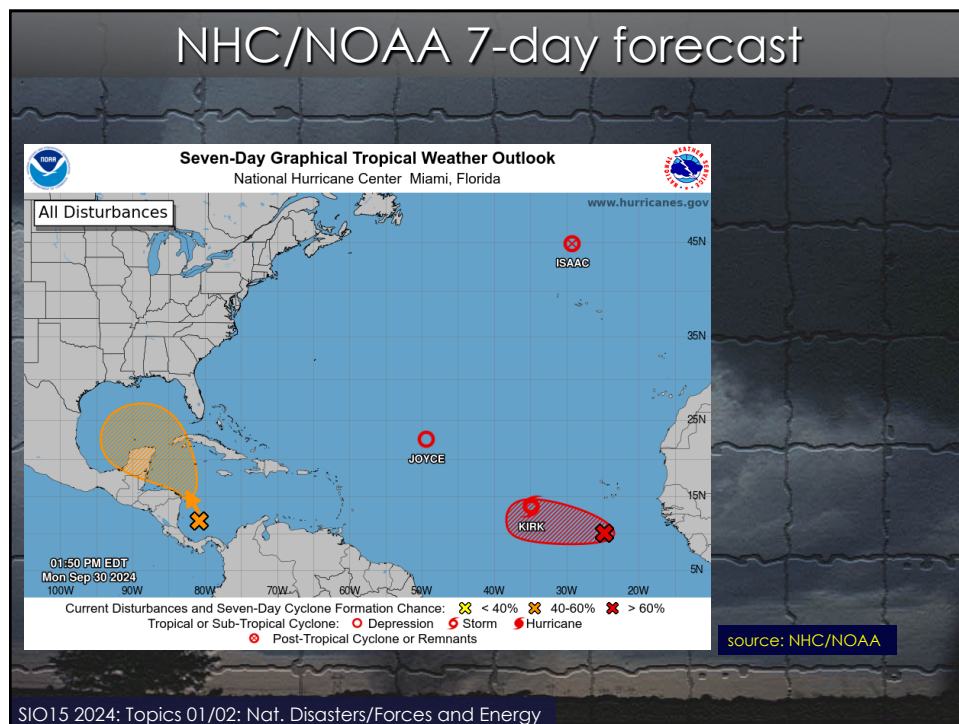
no test/HW due this week  
tomorrow: HW 1 online

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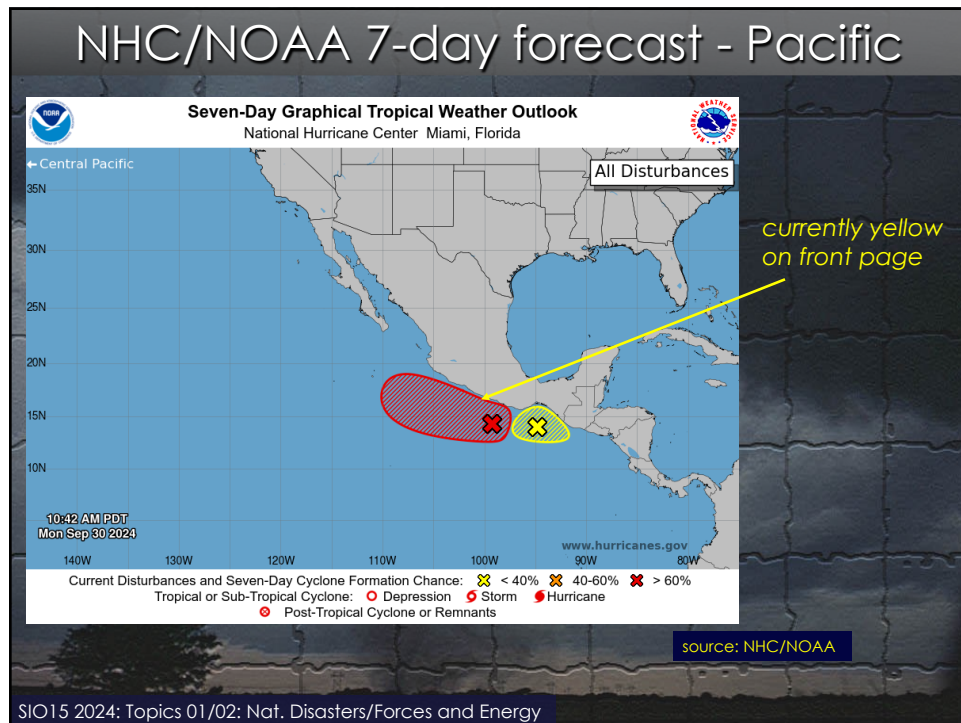
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## Some Not so Obvious Natural Disasters

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

### Why care/discuss?

- humans are increasingly affected
- humans have an increasing impact

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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"*

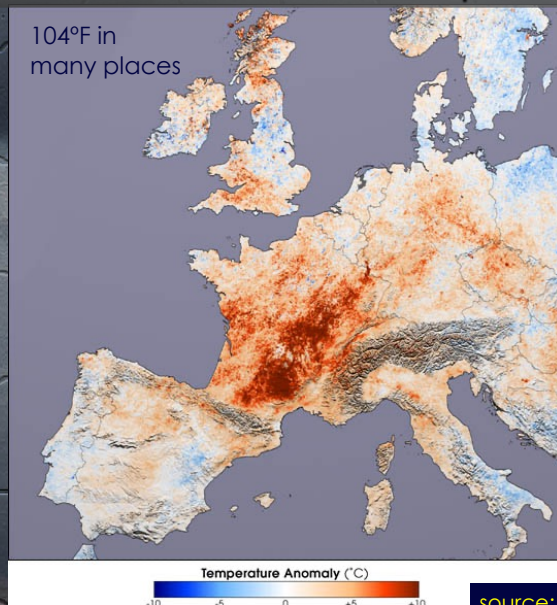
typically form near H air pressure system

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## The 2003 Europe Heat Wave

104°F in  
many places



"hottest summer in 500 years"  
(last record heat: 1757)

"London hotter than Cairo"

"WWII vessel in Danube"

"record wine!"

### Fatalities

35,000

France: 14,000

Germany: 7,000

Spain: 4230

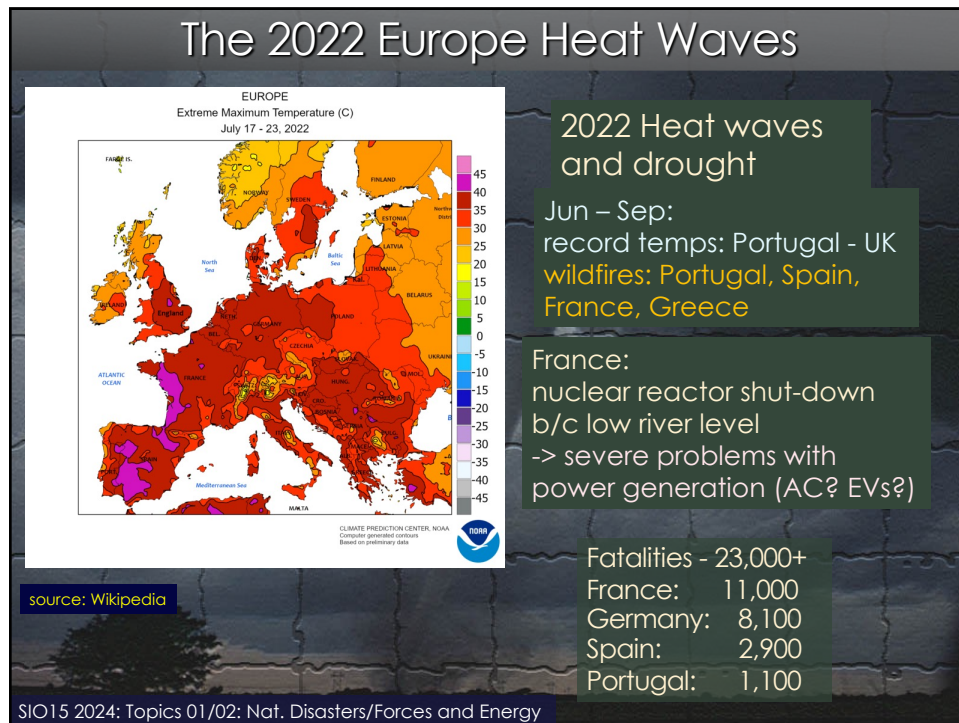
Italy: 4175

UK: 2045

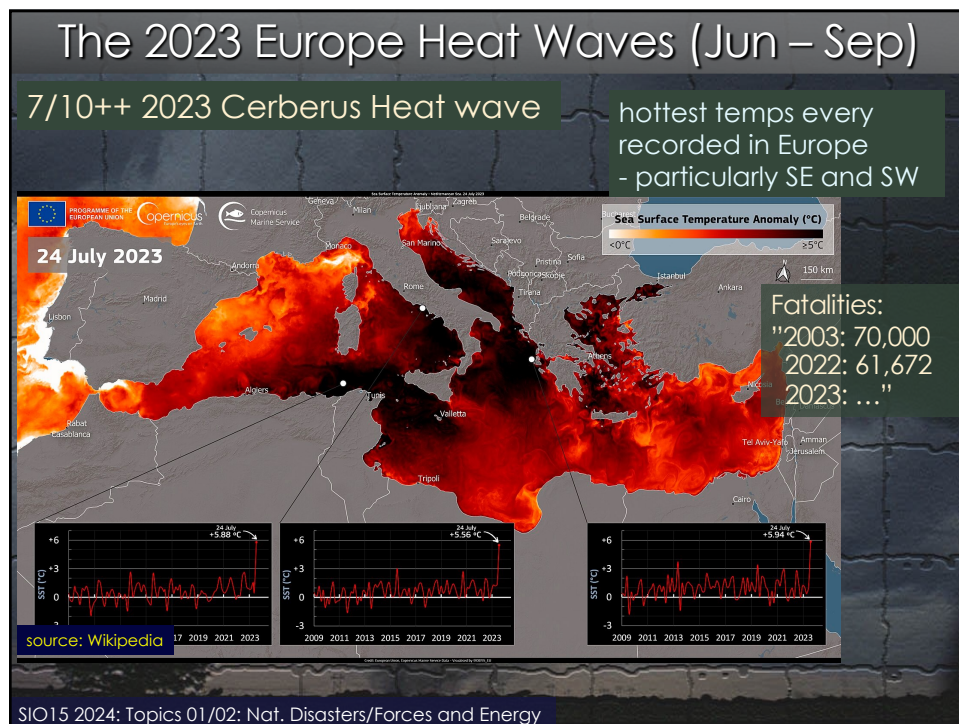
source: Wikipedia

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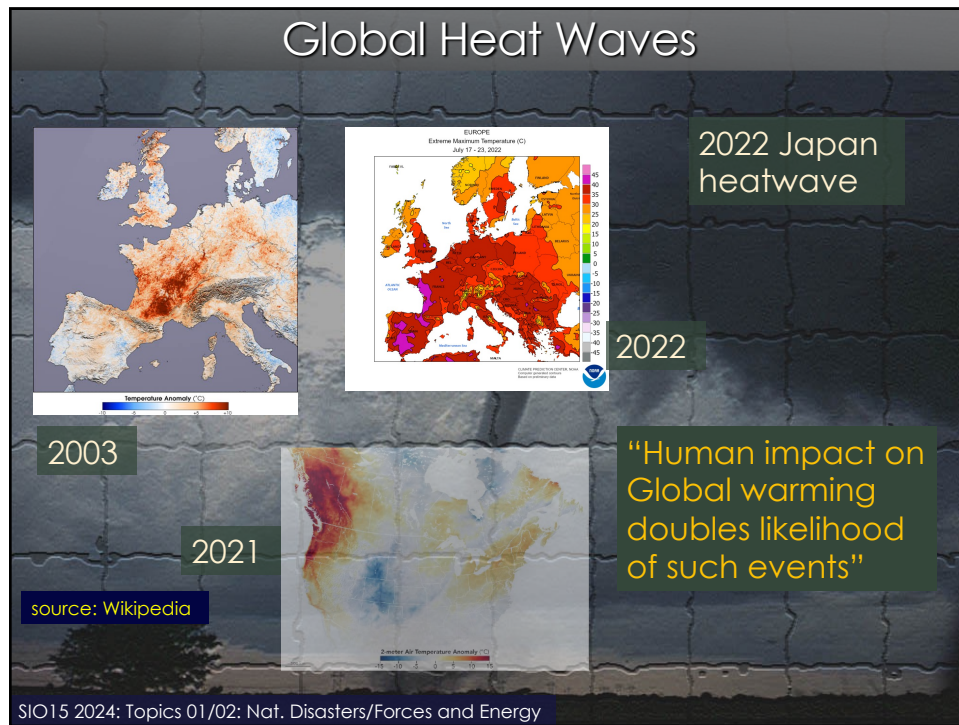


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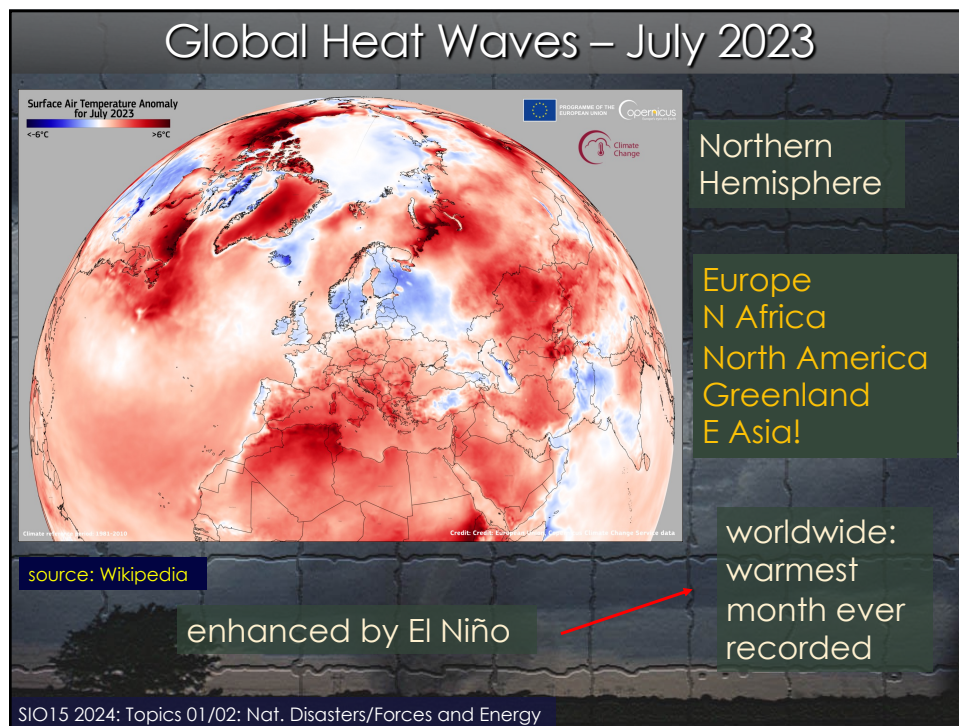


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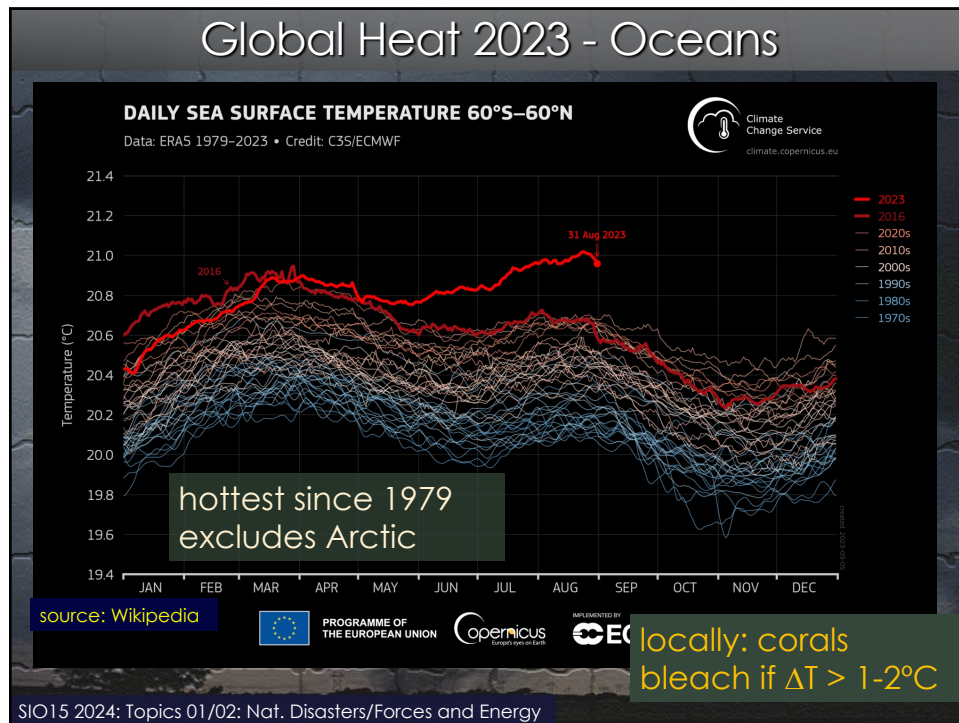




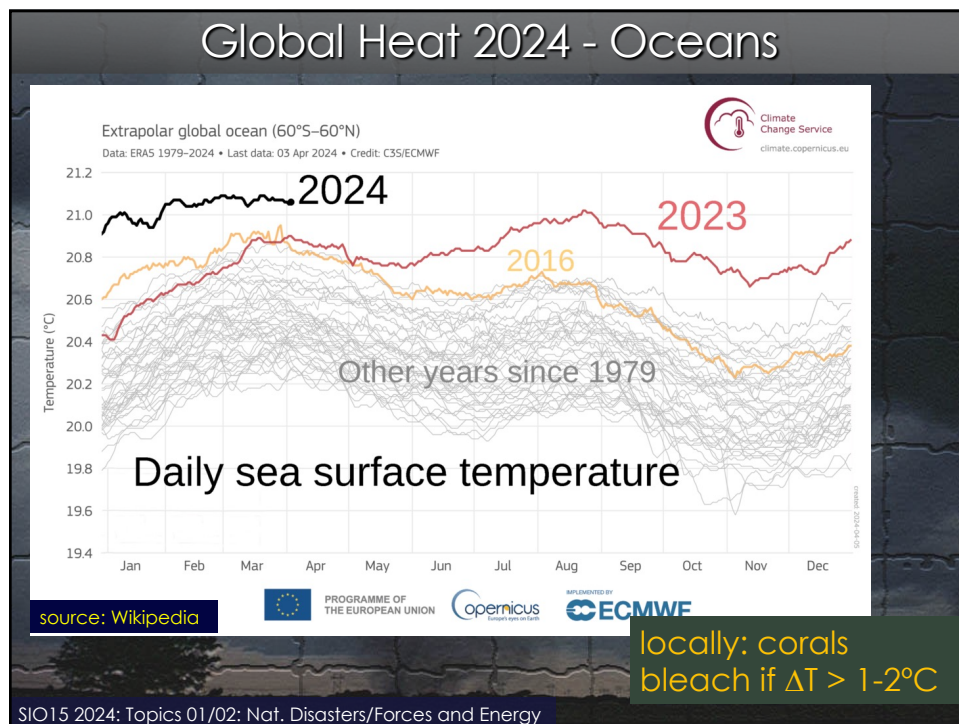
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## Fatalities and Losses in the U.S.



**Reinsurance**

Severe thunderstorms and flooding drive natural disaster losses in the first half of 2024

Media Release

accessed 9/25/24

this is only early 2024 ...  
... before heat waves and hurricanes!

floods: most properties cannot get flood insurance!

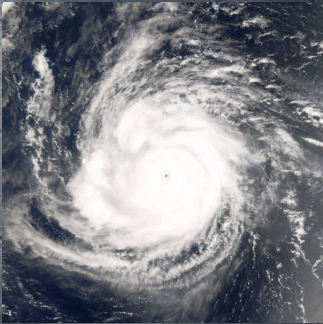
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# Energy Sources and Forces of Disasters

Images:  
wikipedia



an average hurricane (10 days)  
releases as much energy as the  
Mw=9.5 5/22 1960 Chile earthquake

Book chapter 2  
watch short  
videos!



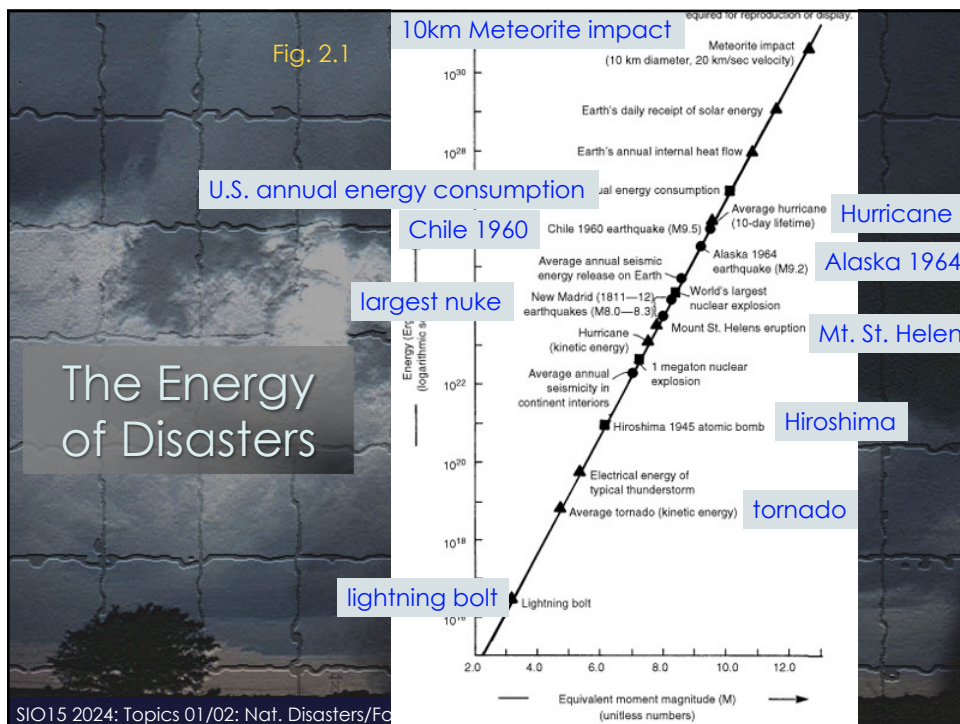
- from Sun
- fusion
- latent heat

$$E_S = 5300 * E_E$$

- from Earth/plate tectonics
- primordial+fission
- potential energy

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## Forces, Energy and Power

- force: acts on body
- energy: work done on body or capacity to do work
- power: work done per time

$$W = F \times D$$

F proportional to:

- mass  $m$
- acceleration  $a$

$$F = m \times a$$

Short video 2a  
Short video 2b

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## Potential and Kinetic Energy on a Slope

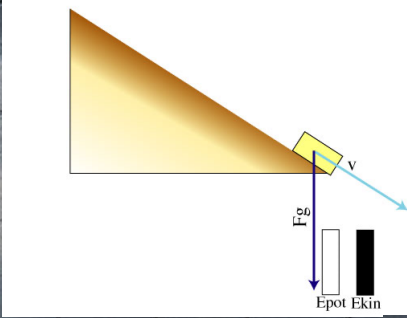
top:  
pot. energy

middle:  
mixed

bottom:  
kin. energy

energy can be transferred  
from one type to another

**The Gravitational Force and Potential Energy**



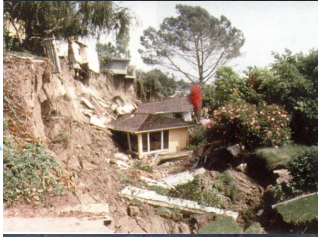


Fig. 2.4

example for a mass movement

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## Short video 2a Forces - Potential Energy Short video 2b

energy that is stored in some form to be later used

'loading' potential energy by exerting a force

Newton's Apple

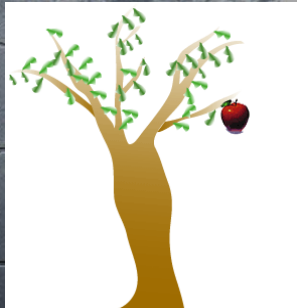


Fig. 2.3

Spring

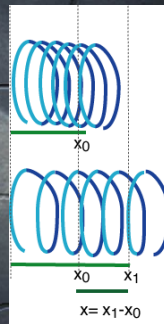
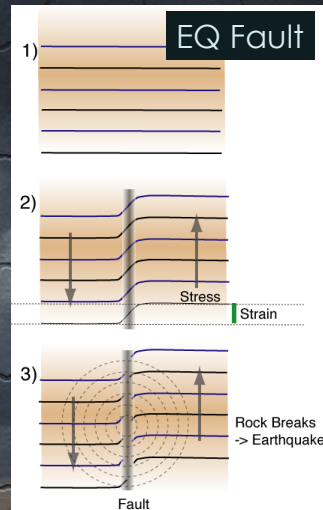


Fig. 2.5



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## Force and Deformation on an EQ Fault

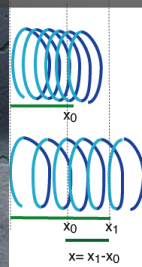


Fig. 2.5

Short video 2b

cause:  
force  $\leftrightarrow$  stress

consequence:  
deformation  $\leftrightarrow$  strain

$$F_g = k \times x$$

strain is a result of stress

example for an earthquake

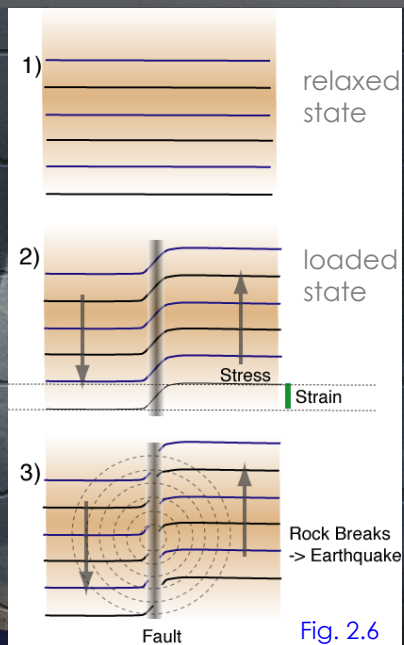


Fig. 2.6

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## Basic Types of Energy

*short Videos on forces, energy (topic 2)*


- potential (e.g. landslide, earthquakes, plate tectonics)
- kinetic (e.g. wind storms, landslides, volcanoes)
- rotational (e.g. Earth, Earth-Moon, tornadoes, landslides)
- heat (e.g. volcanoes, plate tectonics, severe weather)

internal heat

"primordial" +  
radiogenic

fission

external heat

SUN 

fusion


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## Earth's 4 External Sources of Heat

➤ Earth's surface receives 5300 times more heat from sun than from inside

➤ sun's energy produced by nuclear fusion



*Sun provides huge amounts of energy to drive weather disasters*

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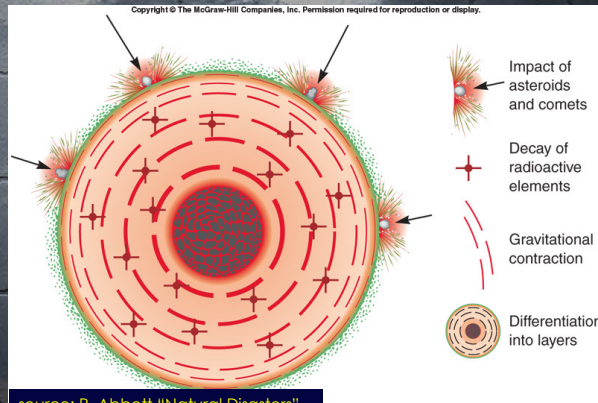
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## Earth's 4 Internal Sources of Heat

- numerous early impacts during formation
- early gravitational compression
- differentiation (sinking of heavier elements)
- decay of radioactive elements (**fission**)

primordial heat



source: P. Abbott "Natural Disasters"

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## Latent Heat

"hidden heat"

Heat Capacity: ability to absorb heat while temperature rises slowly

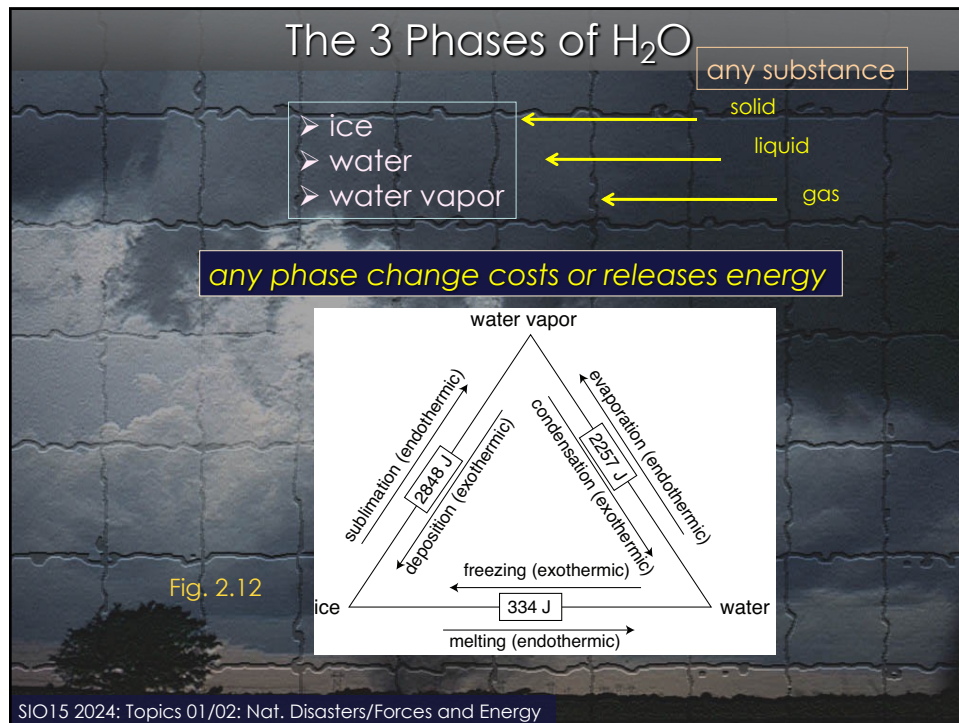
Air:	0.00031
cal/cm <sup>3</sup> /°C	
Quartz Sand:	0.31
Granite:	0.51
Water:	1.0
Aluminum:	0.215
Copper:	0.0924
Glass:	0.20
Human body:	0.83

Table 2.1

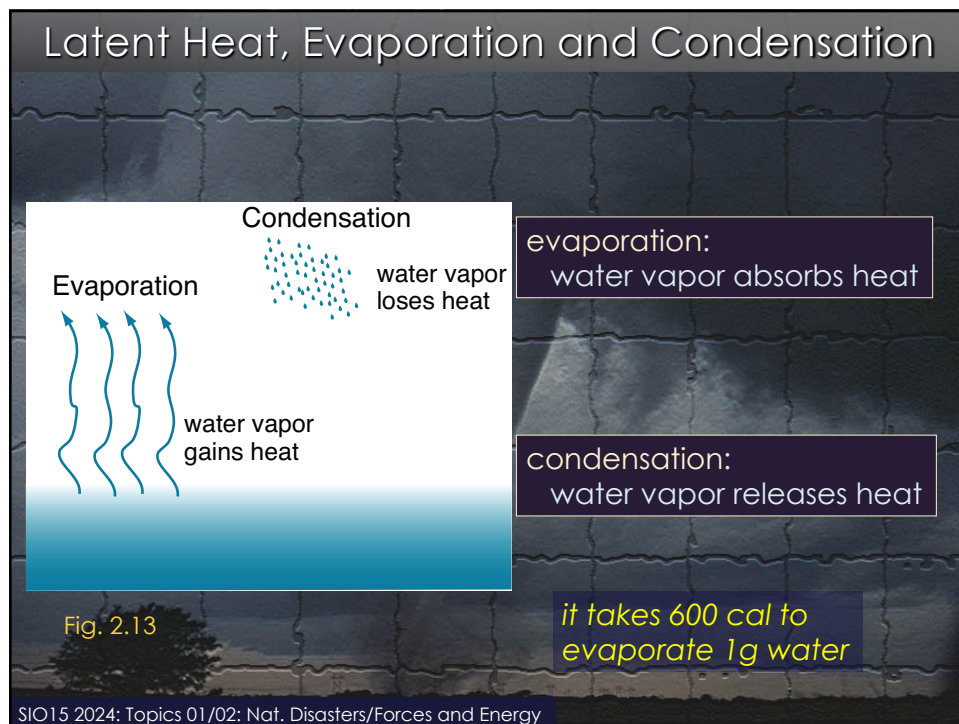
- water has high heat capacity!
- serves as **moderator**

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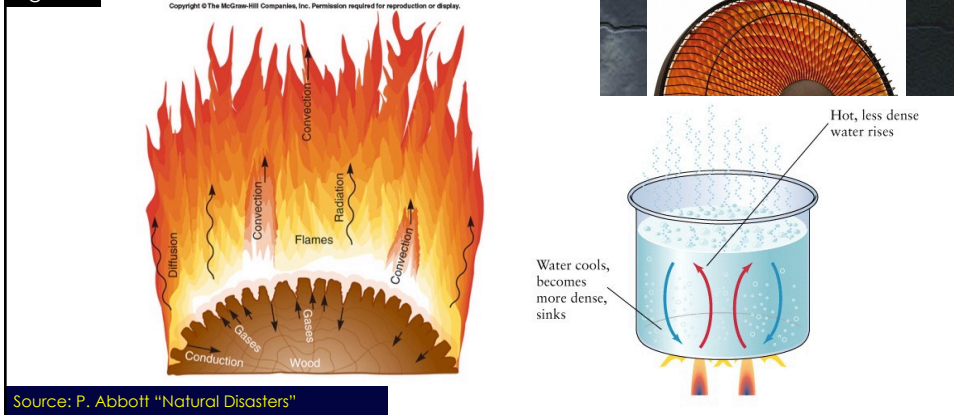
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## 4 Ways to Transport Heat

- conduction (energy passed between vibrating atoms)
- radiation (EM waves, no particle movement)
- diffusion (migration of single particles)
- convection (mass transport; MOST EFFECTIVE)

Fig 2.11

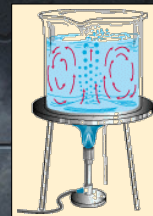
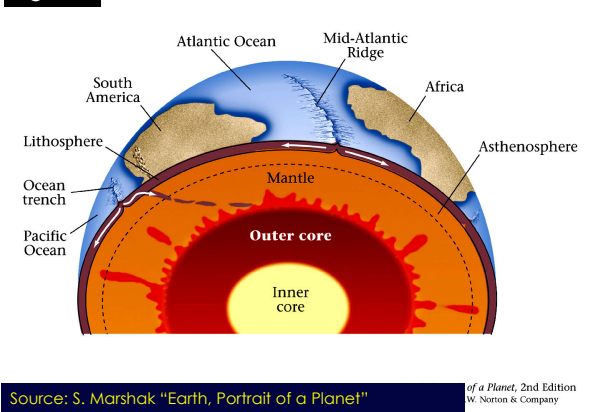


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## Earth's Internal Heat and Mantle Convection

- mantle moves/convects over geologic times (a few cm/yr)
- -> plate tectonics on surface
- -> earthquakes, volcanoes, uplift and landslides

Fig 4.17



a little bit like this

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