1. How does plate tectonics lead to orogeny? Illustrate.

Approach:

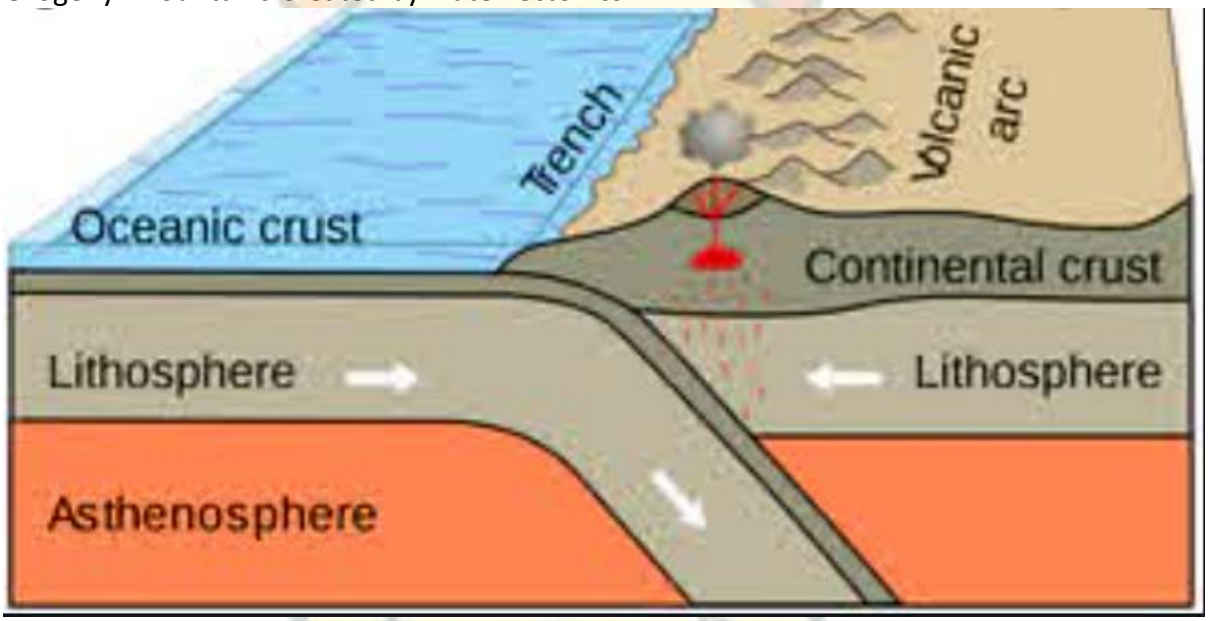
It is straiforward question where it expects students to illustrate how does plate tectonics process leads to orogeny. Try to draw diagram in such questions. In end for extra information we mentioned ongoing orogenies examples.

Introduction:

Plate tectonics is a scientific theory describing the large-scale motion of seven large plates and the movements of a larger number of smaller plates of Earth's lithosphere, since tectonic processes began on Earth between 3.3 and 3.5 billion years ago.

Body:

Orogeny: Mountains Created by Plate Tectonics:



- The Earth is made up of layers of rock and minerals. The surface of the Earth is called the crust. Just below the crust is the upper mantle. The upper mantle, like the crust, is relatively hard and solid. The crust and upper mantle together are called the lithosphere.
- While the lithosphere doesn't flow like lava, it can change. This happens when gigantic plates of rock, called tectonic plates, move and shift. Tectonic plates can collide, separate, or slide along one another. When this occurs, the Earth's surface experiences earthquakes, volcanoes, and other major events.
- Orogeny (or-ROJ-eny), or orogenesis, is the building of continental mountains by plate-tectonic processes that squeeze the lithosphere. It may also refer to a specific episode of orogeny during the geologic past. Even though tall mountain peaks from ancient orogenies may erode away, the exposed roots of those ancient mountains show the same orogenic structures that are detected beneath modern mountain ranges.

- In classical plate tectonics, plates interact in exactly three different ways: they push together (converge), pull apart, or slide past each other. Orogeny is limited to convergent plate interactions; in other words, orogeny occurs when tectonic plates collide. The long regions of deformed rocks created by orogenies are called orogenic belts, or orogens.
- In actuality, plate tectonics is not at all that simple. Large areas of the continents can deform in blends of convergent and transform motion, or in diffused ways that do not give distinct borders between plates. Orogens can be bent and altered by later events, or severed by plate breakups. The discovery and analysis of orogens is an important part of historical geology and a way to explore plate-tectonic interactions of the past that do not occur today.

Ongoing Orogenies examples:

- The Mediterranean Ridge is the result of the African plate sub ducting (sliding) underneath the Eurasian plate and other smaller microplates. If it continues, it will eventually form extremely high mountains in the Mediterranean.
- The Andean Orogeny has been occurring for the past 200 million years, although the Andes have only arisen in the past 65 million years. The orogeny is the result of the Nazca plate sub ducting underneath the South American plate.
- The Himalayan Orogeny started as the Indian subcontinent began moving towards the Asian plate 71 million years ago. The collision between the plates, which is still ongoing, has created the largest landform of the past 500 million years; the combined Tibetan Plateau and Himalayan Mountain range. These landforms, along with the Sierra Nevada range of North America, may have induced a global cooling around 40 million years ago. As more rock is lifted to the surface, more carbon dioxide is sequestered from the atmosphere to chemically weather it, thus decreasing Earth's natural greenhouse effect.

Conclusion:

Orogenic belts can form from the collision of an oceanic and continental plate or the collision of two continental plates. There are quite a few ongoing orogenies and several ancient ones that have left long-lasting impressions on the Earth's surface.

2. How do local weather conditions affect pollution? Discuss with the help of suitable examples.

Approach:

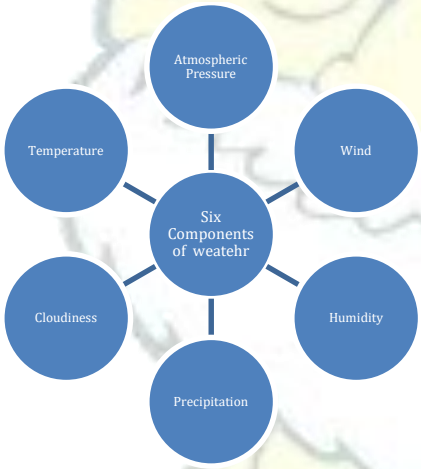
As the directive here is discuss, it is necessary to cover the topic from various angles. In the introduction in brief tell what is pollution and what are major forms pollution. In the main body part explain those local weather conditions which affect pollution. Giving a way forward with relative examples will fetch you more marks.

Introduction:

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Major forms of pollution include air pollution, light pollution, litter, noise pollution, plastic pollution, soil contamination, radioactive contamination, thermal pollution, visual pollution, and water pollution.

Body:

There are six components of weather:



Effect of local weather conditions on pollution:

- Atmospheric Pressure: Atmospheric pressure affects the level of rise or fall of air pollutants. During high atmospheric pressure systems, the air is usually still which allows pollution levels to build up but during low pressure systems the weather is often wet and windy, causing pollutants to be dispersed or washed out of the atmosphere by rain.
- For instance, with the onset of winter in Delhi and nearby region, atmospheric pressure is high which makes the air still, thereby it increases the pollution level due to stabilisation of air.
- Wind: Pollutants tend to pile up in calm conditions, when wind speeds are not more than about 10kmph. Speeds of 15kmph or more favour dispersal of

pollutants, which, literally, clears the air. Winds of up to 35kmph brought AQI down from 458 ('severe') to 215 ('poor') in less than 48 hours in Delhi.

- Temperature: Hot air rises while cold air stays close to the ground. This is why pollution in north India peaks in winter. Temperatures are the key determinant of 'mixing height' - which is the depth of the layer of air closest to the ground within which pollutants and aerosols move. In cold conditions, pollutants are trapped close to the ground because of low mixing height.
- The effect of temperature is also connected to the water pollution and soil pollution, as in the cooler regions there is less scope for microorganisms activity. Which increases the degrading time of organic contents. There by it increases the pollution in water as well as in soil.
- Cloudiness: In general, overcast skies lead to cool days and low mixing heights while sunny days have the opposite effect. Most smog episodes in NCR this month coincided with cloudy skies. Low clouds increase humidity, which can lead to fog formation.
- Rain washes away pollutants and can quickly clean the air. It also supplements cleaning of water pollution by increasing the fresh flow of water.
- However, wet spells leave behind high humidity, which can lead to fog under calm winds. Fog increases pollution as water droplets act as secondary particles interacting with pollutants.
- Humidity affects the natural deposition of particulate matter in the air. With an increase in humidity, the size of the particulate matter also increases. Eventually, it becomes too heavy to remain in the air and begins to fall off. This is what is called the dry deposition of particulate matter. These types of pollution affects the human health as shown in following Figure 1:

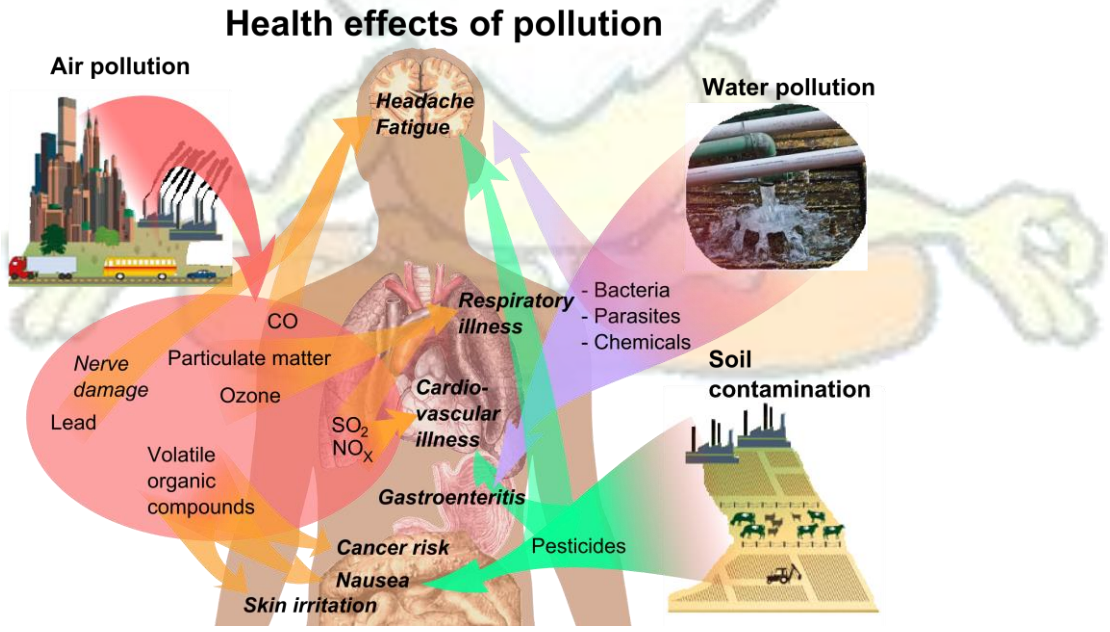


Figure 1: Adverse effects of pollution on human health

As the types and sources of pollution are diverse their solutions are diverse, solutions and government initiatives to tackle the menace of pollution are as mentioned below:

- Appropriate political will and aware citizenry is a prerequisite to tackle the menace, otherwise, all the measures will remain on paper only and greater public transparency is essential to the success of winning the war on air pollution.
- The System of Air Quality and Weather Forecasting And Research (SAFAR) is a national initiative introduced by the Ministry of Earth Sciences (MoES) to measure the air quality of a metropolitan city, by measuring the overall pollution level and the location-specific air quality of the city.
- An active citizen is better watchdog, a citizen centric pollution monitoring will not only help to tackle the issue of pollution but it will also reduce the pollution also.

All compreshive approach of
Reduce, Reuse and recycle is necessary.

Conclusion:

Our planet and resources on it make life possible on earth. If we lose these resources, it would hard for human to survive on earth. However, with increasing level of pollution these resources are either getting destroyed or are depleting with fast pace. We only have one planet, to save it, it is necessary to have a well worked out plan. Tackling the menace of pollution would not only help the humankind to survive but will also help to conserve our beautiful planet in its true essence.

3. What are the pieces of evidence of seafloor spreading? Discuss.

Approach - It expects students to write about seafloor spreading and pieces of evidence of seafloor spreading.

Introduction

Seafloor spreading is a process that occurs at mid-ocean ridges, where new oceanic crust is formed through volcanic activity and then gradually moves away from the ridge. The idea that the seafloor itself moves (and carries the continents with it) as it expands from a central axis was proposed by Harry Hess.

Body

Mechanism of seafloor spreading:

- Seafloor spreading helps explain continental drift in the theory of plate tectonics. When oceanic plates diverge, tensional stress causes fractures to occur in the lithosphere.
- Basaltic magma rises up the fractures and cools on the ocean floor to form new seafloor.
- Older rocks will be found farther away from the spreading zone while younger rocks will be found nearer to the spreading zone.

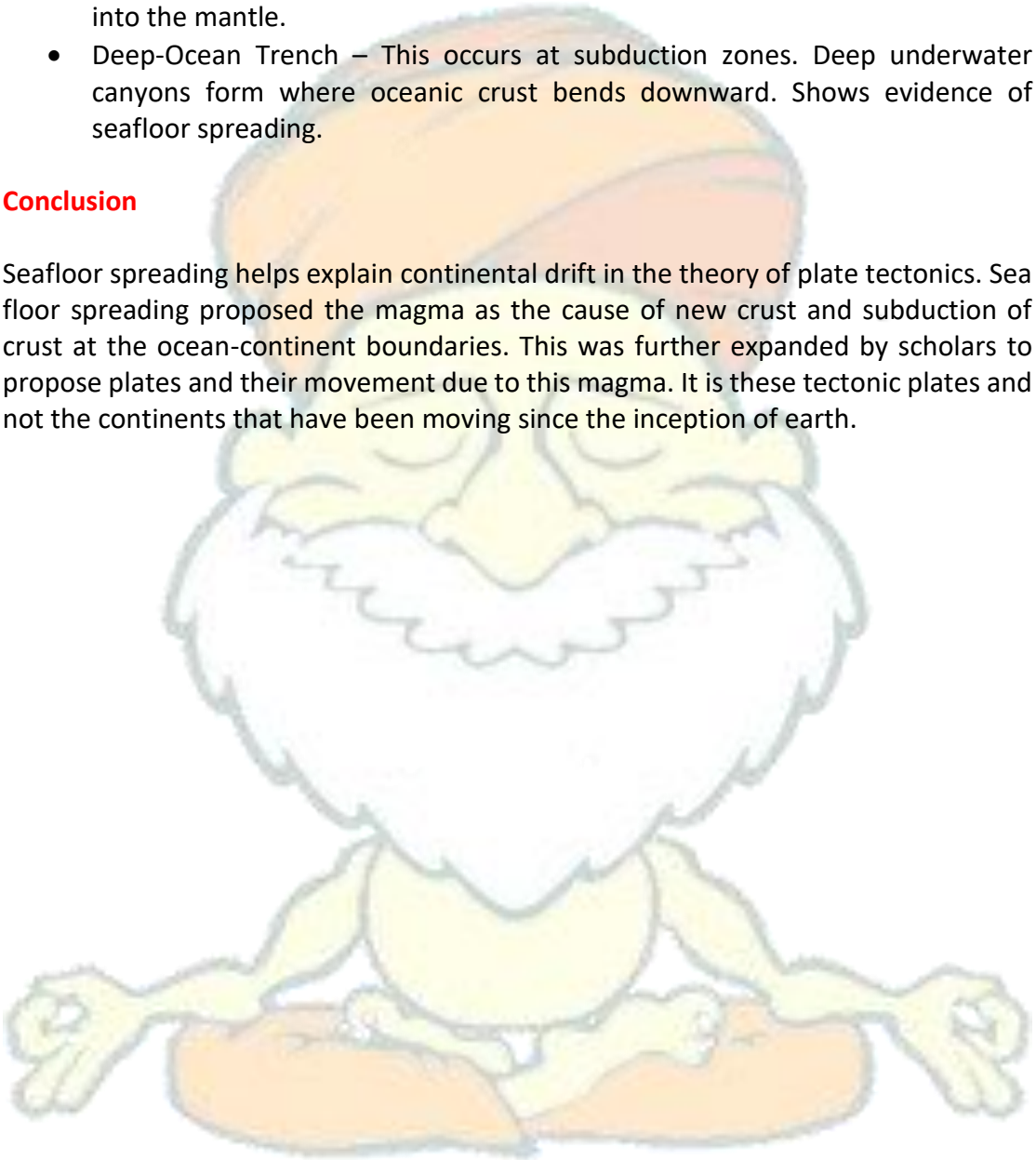
Pieces of evidence of seafloor spreading:

- Origin and composition of rocks: The rocks obtained on land were having similar characteristics to that of oceanic rocks. The composition of rocks contain various minerals and deposits that are of oceanic origin. This gives evidence of the way the rocks were formed.
- Mid oceanic ridges: Mid oceanic ridges discovered under sea provides evidence of Magma activity that resulted in formation of rocks. The rock cycle provides the indication of rock recycling. The width of ridges vary continuously indicating an intense activity shows evidence of seafloor spreading.
- Wagner's theory: Wegner proposed continental drift theory that gave evidence of how continental mass separated. The force or event that resulted in continental drift was explained by sea floor spreading. Thus, both theories filled the missing pieces of the puzzle.
- Evidence From Drilling Samples: The final proof of sea-floor spreading came from rock samples obtained by drilling into the ocean floor. The Glomar Challenger, a drilling ship built in 1968, gathered the samples. The youngest rocks were always in the center of the ridges. This showed that sea-floor spreading really has taken place.
- Modern study: Latest studies have indicated that continents are moving away from each other. The rock samples collected from deep oceans are younger in nature. This shows that new crust is continuously formed and old ones destroyed. The age of rocks of continents are older than that of ocean.

- Evidence From Molten Material: In the 1960s, scientists found evidence that new material is indeed erupting along mid-ocean ridges. Such rocks form only when molten material hardens quickly after erupting under water. These rocks showed that molten material has erupted again and again along the mid-ocean ridge.
- Subduction – Process by which the ocean floor sinks beneath a deep-ocean trench and back into the mantle; allows part of the ocean floor to sink back into the mantle.
- Deep-Ocean Trench – This occurs at subduction zones. Deep underwater canyons form where oceanic crust bends downward. Shows evidence of seafloor spreading.

Conclusion

Seafloor spreading helps explain continental drift in the theory of plate tectonics. Sea floor spreading proposed the magma as the cause of new crust and subduction of crust at the ocean-continent boundaries. This was further expanded by scholars to propose plates and their movement due to this magma. It is these tectonic plates and not the continents that have been moving since the inception of earth.



4. While discussing their origin, explain the differences between tsunami and tides.

Approach:

Students are expected to write about the differences between tsunami and tide with reference to their origin.

Introduction:

Although both are sea waves and it is assumed that there is no difference between a tide and a tsunami, but actually both are two different and unrelated phenomena. While both of the waves carry the power of destruction, the greatest difference is how each is born. A tidal wave is directly impacted by the atmosphere and it is a 'shallow water wave' however Tsunamis is an ocean wave and are powered by a geological force.

Body:

Differences between tsunami and tides:

Difference	Tsunami	Tides
Origin	• The principal generation mechanism of a tsunami is the displacement of a substantial volume of water or perturbation of the sea. This displacement of water is usually attributed to either earthquakes, landslides, volcanic eruptions, glacier calving. • The origin of the tsunami is much deeper. It is caused by a deep disturbance along the ocean floor. The deeper origin of the tsunami creates a more emphatic wave. It will often carry itself across hundreds, or even thousands, of miles of ocean before making landfall. • The tsunami has the potential to develop anywhere. The placement of the earthquake or landslide, or even the unique event of an underwater eruption,	• A tide is directly impacted by the atmosphere. The correlating factors between the sun, moon, and Earth cause a disturbance in the sea, and a 'shallow water wave' is formed which is called tide. Shallow water waves imply that the development of a tidal wave is much closer to the shoreline of a land mass, that will ultimately be in its path. • The tidal wave has what we would call regional preferences. It is unlikely that a tidal wave would make landfall in areas of temperate climates, or northern countries. The various elements which cause its development form, in their precise manner, in lower latitudes, creating a higher possibility for landfall in places like the West Indies, for example. • The tidal wave follows the currents, and therefore, is only

	compels the start of the wave. Just like the tidal wave, the tsunami also follows the currents.	able to strike areas within the current flow.
Intensity	Tsunamis can have wavelengths of up to 200 kilometres and can travel over 800 kilometres per hour. When tsunamis approach shallow water near land masses, the speed decreases, and the amplitude increases very rapidly.	The intensity of a changing tide is noticeable only in certain parts where it's high enough (As high as 55 feet in the Bay of Fundy, Canada)
Location	A majority of tsunamis (80%) occur in the Pacific Ocean but can occur in any large body of water if the underlying causes are present.	Tidal waves are phenomena seen most at coastal areas.
Occurrence	• Tsunamis occur only when there is seismic disturbance in large water bodies. • Tsunami originate in deep sea under impact of crustal movement	• Tidal waves occur daily at a coastal area • Tide originate on surface of water under impact of gravity of moon and the sun
Size	Tsunami become giant wave on reaching the shore	Tides may become big but not as big as Tsunami
Potential	Tsunami usually leads to destruction and disaster along coastline. Example-The 2004 Indian Ocean tsunami was among the deadliest natural disasters in human history. At least 230,000 people killed or missing in 14 countries bordering the Indian Ocean.	Tides can be harnessed to create energy, transportation for inland ports etc
Frequency	Tsunami are non-frequent and occurs only due to disturbance in natural movement of water body.	Tides are frequent and can be predicted on basis of position of moon and sun i.e spring tide and neap tide.
Prediction	A tsunami cannot be precisely predicted, even if the magnitude and location of an earthquake is known.	Tide prediction method follows the method of harmonic analysis introduced in the 1860s by William Thomson. It is based on the principle of astronomical theories of the motions of Sun and Moon.

Conclusion:

Tsunamis, though infrequent, are significant natural hazards that can cause great destruction and loss of life within minutes on shores near and far. The great Sumatra earthquake of 2004, with magnitude 9.1, rated as the world's third largest recorded earthquake. Tsunami safeguard measure like early warning system, standardised operation protocol, capacity building for rapid deployment of navy and NDRF personnel etc have been developed in the wake of Chennai Tsunami disaster.

5. What are permafrost's? What is their ecological significance? Discuss.

Approach:

It is straiforward question where it expects to write about – in first part write what is permafrost – while in second part write permafrost's ecological significance.

Introduction:

The principal reason that led to the recent 20,000-tonne oil leak at an Arctic region power plant in Russia that is now being recognised is the sinking of ground surface due to permafrost thaw.

Body:

Permafrost:

- Permafrost is ground that remains completely frozen at 0 degrees Celsius or below for at least two years and is defined solely based on temperature and duration.
- It is composed of rock, sediments, sand, dead plant and animal matter, soil, and varying degrees of ice and is believed to have formed during glacial periods dating several millennia.
- It is mainly found near the polar zones and regions with high mountains covering parts of Greenland, Alaska, Russia, Northern Canada, Siberia and Scandinavia.
- Its thickness reduces progressively towards the south and is affected by a number of other factors, including the Earth's interior heat, snow and vegetation cover, presence of water bodies, and topography.

Ecological significance of permafrost:

- An estimated 1,700 billion tonnes — twice the amount currently present in the atmosphere — of carbon is locked in all of the world's permafrost.
- Even if half of that were to be released to the atmosphere, it would be game over for the climate.
- Albedo of Snow is high which helps balancing heat budget of earth melting of permafrost will disrupt the balance
- Health Risk: microbes that have been frozen in the permafrost for millennia can come back to life after the thaw. There has already been the re-emergence of ancient viruses like anthrax, as recently discovered by French and Russian researchers.
- Roadways are warping and foundation shifting: Bethel, Alaska, roadways are literally rippling and warping as the ground beneath them becomes less solid. In other places, the melting permafrost is creating craters and sinkholes. Buildings can lose structural integrity and become unstable even with modest increases in ground temperature, well before all-out melt. In Alaska alone, the destruction of buildings and infrastructure due to permafrost thaw over the next century could cost more than $2 billion, according to a 2017 study

- Methane and Mysterious craters: Ice like mixtures of methane and water, trapped below and within the permafrost, expands as they warm, heaving up the ground until it erupts. This will be like a ticking time bomb.
- The upper air circulation due to polar winds might get effected .This will alter movement of temperate cyclones .

However, few positives of perma frost melting could include:

- Reviving ancient plants which were frozen for longest time: In 2012 when researchers from the Russian Academy of Sciences sprouted three dozen Silene stenophylla, herby white tundra flowers, from 30,000-year-old fruits.
- It would promote floral growth in the region, thereby creating additional carbon sink, helping somewhat neutralize the global warming trend.
- It might provide refuge to the faunal species from neighbouring temperate regions, which too are facing temperature rise.

Conclusion:

Paris Climate Accord seeks to limit global warming to 2° Celsius rise from 1990 levels. The extent to which permafrost melts would be reflection of the leaders' commitment and dedication to this target.