Environment

> Mars is essentially in the same orbit... Mars is somewhat the same distance from the Sun, which is very important. We have seen pictures where there are canals, we believe, and water. If there is water, that means there is oxygen. If oxygen, that means we can breathe.
> -- Dan Quayle

The Sky

The lower gravity causes the atmosphere to have a higher scale height, making pressure to decrease 2.58 times slower than on Earth. This produces higher clouds, and when it rains the raindrops pass through more cloud and reach a lower terminal velocity, producing bigger raindrops. This is even more pronounced in hail. Although the velocity is smaller the energy of the impact is larger due to the larger average hail size – some of the Arabian hailstorms wreak fearsome havoc.

In general Martian weather is usually ponderous. The lower gravity causes air to rise and sink more slowly, producing less intense winds and slower weather changes. There is also less energy in the atmosphere. But Mars also has large deserts that heat up or cool strongly and sharp landforms that channel air – these can work together to create weather fiercer than on Earth. When the southern upland climate intrudes into the equatorial region powerful storms are brewed, and the large temperature differences enable violent winds and thunderstorms. Since the air masses are higher and contain more mass, the scale of the energies is correspondingly larger. A full scale Martian thunderstorm is a mini-hurricane, and cold fronts moving in from the south are usually serious blizzards or sandstorms.

Air pressure is somewhat lower than on Earth. The higher atmosphere makes the sky a lighter blue than on Earth, often tending towards a pale or milky blue.

Dawns and sunsets are dramatic, with pinks, reds and gold colors that last long. Often suspended dust in the high atmosphere or ice crystals produce complex optimal phenomena like halos, pillars or red light and spectral noctilucent clouds.

The solettas are visible as a band opposite the sun, sometimes causing one or more suns (the "occasional suns" or "noble suns") to appear to shine against the real sun. The shaft of light is very impressive at dusk or in the night as it comes sweeping across the landscape. This keeps the planet warm and can support or hinder certain regions. While traditionally the nobility that could control them kept most of their programs running the default pattern, they could use them to influence the weather, support or hinder farming in regions and even use them as shows of power. There remain many quirks in their light patterns, and understanding the full effects of these keeps sologists busy.

The moons Phobos and Deimos move across the sky but does not give much light in the night. Phobos is so close that it orbits Mars three times in a Mars day, moving faster than the planet below it. This makes it rise in the west and set in the east, despite that it is moving in the same direction as Deimos. The passage from horizon to horizon takes approximately 5 ½ hours. The apparent size of Phobos is about a third of the apparent size of the Earth's moon from the surface but it is darker and potato-shaped, producing a bumpy crescent about as bright as Venus. It is so close to Mars that it becomes invisible from the polar regions. Deimos orbits further away and more slowly, a small grey-white crescent that visibly shifts phase during the night.

The sun appears half as large (area-wise) on Mars as on Earth.

Climate

The northern hemisphere experiences less climate variation than the southern, due to the eccentricity of Mars orbit. It is also more buffered by the Borealis Ocean, generally making it more inhabitable.

In the northern Polar Regions the winds are from the northeast, in the winter driving powerful snowstorms down from the high latitudes to the northerly lands. Between 60 and 30 degrees north the winds tend to blow from the southwest, making the climate cold but temperate.

The winds blow moisture east from the Arcadian and Amazonian seas towards the land west of Tharsis. The Tharsis rise produces a fairly wet climate along the Olympian coast; in the north frequent rains, hails and snows and in the south a fairly mild and wet climate. In the rain shadow of Tharsis lies the extensive deserts of Tempe and Lunae. Only the coastal regions are habitable, a situation not unlike the Namibia Desert on Earth.

Chryse sends moisture to the eastern Xanthe and Margaritifer regions, producing one of the greenest regions on the planet. Arabia has fairly stable southwesterlies, producing a Scandinavian climate with rainy summers and cold winters. When the cold northern air meets the warm currents in Acidalia severe snowstorms often result, roaring in across Arabia during the winter.

The Isidis region gets both warm winds from the surrounding highlands and wet sea winds. The climate is Mediterranean, although occasionally in the late summer a storm cell may be lodged there causing the infamous "Isidis week-long storms". The Amenthes inland valley is warmer and dryer, but still fertile (especially due to irrigation; the situation is not unlike California).

The Nepenthes and Aeolus islands along the Elysian coast have a climate were temperate winds from the northwest bring moisture and dry winds from the southern deserts bring heat in the southern summer and cold in the winter. Elysia has a temperate west and a drier eastern side.

Along the Cimmerian coast most rivers originate in the Southern Uplands. This means that during the southern summer they dry out. As the weather turns colder some water returns, but soon the uplands freeze and the rivers dry out again. During the southern spring the accumulated snow and ice begins to melt, often with surprising rapidity. The rivers swell and often flood, bringing silt to their vast deltas (the warmer river water meeting the cold Boralis Sea water often produce mist and local thunderstorms). In general the Cimmerian rivers are less usable for boats and more usable for caravans.

Much of the south is a cold, dry desert with strong and persistent winds. They tend to hold the worst cold back from Argyre and Hellas, making their northern shores fairly ice-free in the summer. In the inland the temperatures can become quite extreme, causing storms when they move in over lowlands. The Thaumasia storms are much feared in the Eos region, and the winds of Marineris are often hazardous. The south polar winds are dry and extremely cold, bringing dust storms in the summer and blizzards in the winter.

In the winter the Boralis Ocean is frozen, and even in the summer there is much ice to the north. The "northwest passage" north of Tharsis and Alba Patera is usually blocked by ice even in the summer. The "northeast passage" is risky but at least possible; ships have to navigate the fjords and islands of northern Arabia to reach the Utopian sea (this is usually aided by westerly winds, making the return voyage far harder).

Geology

The soil is still meager in many places, and building up a rich soil that can sustain Earth-plants takes a long time. Soilbrewing and composting are important; although sometimes looked down on, the soilbrewers have always received the sewer contents of any habitations to mix with normal Mars dirt. In the early days this sterilized the waste (today few soils are as oxidizing as they were) and allowed the start of the slow process of turning it into prime soil.

The old craters are still visible, usually as circular lakes, bays or valleys. In the drier regions they are often oases or at least have more vegetation than the surroundings. Even in more temperate regions it is common to find trees growing in crater depressions. In inhabited areas the crater floor is often farmland surrounding a central lake, with terraces along the rim and a fortress or city near outflow channels.

Mars has many underground rivers and caves; the caves of the Marineris region are extensive. Many are mainly drained ice reservoirs and eroded carbonate rocks, but there exist long lava tunnels in the Tharsis and Elysia region. The cave systems have become home to many species, including humans.

The sea is still rising as more and more ice melts. This is especially noticeable on slow inclines such as eastern Elysium. In many places cities climb slopes with the oldest parts of the harbor submerged and buildings sticking up from the water (often new stories are added, creating strange submerged towers of different styles) linked by bridges Venice-style.

Waves on Mars move more slowly, exhibit shorter wavelength and, for the same energy, are higher than waves on Earth. The sea is always choppy but moves slowly, and the waves often break into foam. Within narrow straits or canyons, strong winds can produce powerful and dangerous waves, which also reflect and refract from the walls to produce standing wave effects such as the "Teeth of Eos". The higher waves makes building harbors more complex; fortunately craters are often suitable for construction and wave breakers and wave dampers can be introduced.

The eons of wind erosion has sculpted many strange rock formations in the uplands. Everything from suspiciously regular patterns of deflation basins, desert pavement, yardangs (long streamlined ridges), sharpened stones (ventifacts) to finely polished cliffs exist, and new surprises are discovered every year. Sand dunes are of course common and a problem; Martian kudzu can help bind them, but after a serious dust storm they can break loose or new dunes appear where they are least wanted.

Typical formations

These names are based on traditional areological terminology. They are today often used by Martians to refer to smaller features than they originally applied to; a Cavi might refer to a personal dug-out and Rupes to a cliff in a crater wall.

Catena: A chain of craters or depressions, often connected by underground rivers or due to a multiple impact.

Cavi: a steep sided depression.

Chaos: A region of broken terrain. Often caused by the past collapse of the ground due to subsurface heating causing ice to melt and rush away in a flood.

Chasma: A very large linear chasm.

Colles: Small hill or knob.

Dorsum (**Dorsa**): A ridge.

Fluctus: Flow terrain; a region that has been shaped by past floods.

Fossa: A straight linear depression, usually of tectonic origin.

Karst: Rough sedimentary country with underground drainage.

Katabothron: Underground water-channel

Labes: Landslide.

Labyrinthus: Intersecting valley complex.

Mensae: A small plateau.

Mons (**Montes**): A mountain

Patera: A crater with irregular or scalloped edges.

Planitia: A plain.

Planum: A large plateau

Rupes: A major cliff.

Scopulus: An irregular, degraded escarpment.

Sulci: A network of ridges and lines, usually due to ancient tectonic upheavals.

Terra: A general region of the planet. Used today to refer to nations.

Tholus: A small domed hill.

Undae: Dunes

Vallis (**Valles**): A valley.

Vastitas: An extensive plain.

Hazards

Aquifer floods

Although the greatest geographical changes were in the past, there is still ice beneath the regolith of the Southern Uplands and other highlands that sometimes cause flooding. A water reservoir beneath the surface can become unstable and cause an aquifer to flood. Large regions can collapse nearly overnight as subsurface water makes its escape, producing landslides, ripping open new channels and flooding

plains with mud and boulders. Sometimes the result is mud volcanoes, where heating in the deep cause pressure to build up until mud breaks through and causes floods.

Avalanches and Landslides

More common than aquifer floods, and often as deadly. In Martian gravity snow can accumulate on steeper slopes than on Earth, enabling highly unstable buildup. The energy involved is somewhat less, but the effect of being buried beneath tons of snow or rocks is quite deadly anyway. Since much of the landscape is still weathering and settling after the large thermal changes over the past millennium many slopes are risky.

Claytraps and Quicksand

While there were some ancient clays around from the old wet periods, clay formation is currently racing as the new watery environment causes weathering and erosion. The new clay is often collected by streams into unpredictable banks and fills minor craters. This can produce the feared claytraps, deep holes filled with semisolid clay. During rainy periods or when a crater wall is broken a sudden mudflow can occur.

Quicksand is fairly common in water-rich regions: old dust deposits with rounded grains on top of aquifers often become saturated with water and will soften enormously if disturbed. Martian quicksand and mudtraps are less directly risky than terrestrial quicksand since the lower gravity makes sinking slower, but this adds another treacherous quality. It is possible to actually walk over some quicksand deposits before they liquefy, and some people have found that sleds or other equipment that they have placed somewhere during the night have sunk deep into the sand.

Climate fluctuations

The climate is somewhat erratic. Occasionally the southern hemisphere becomes especially cold, producing a lower albedo. This creates several years of cold and dry weather. This is called a lesser Fimbulwinter, in remembrance of the great climate shift that spelled the end of the Stargazer culture.

Dust storms

While hardly as dramatic as the pre-terraforming storms that could cover the entire planet, the dryness and temperature extremes of the southern uplands can breed dangerous storms. While mainly a local hazard in the deserts, they sometime roar over Argyre, Hellas or even into the equatorial areas. There is no place on the planet where fine, red desert dust will not powder rooftops from time to time.

Even a light wind can make fine dust or snow to form drifts in the light gravity. It is not uncommon to have snowdrifts and sanddrifts even in good weather.

Winters

The winters on the northern hemisphere are cold and often stormy, bringing snowstorms, hail and long periods of bitter cold. The Borealis Ocean is often filled with icebergs long into the summer. In the southern hemisphere the climate extremes are larger; the winters are Siberian while the summers extremely hot. During the southern winter few people venture outdoors if they do not have to, in order to avoid ice dust storms and the bitter cold. Hellas and Argyre both freeze, and the smooth icepack breeds very cold winds which can sweep far north.

Snow is not as firmly packed on Mars as on Earth, and often stays powdery and loose. Great for skiing (although going downhill is more slow than on Earth), but getting through thick snow is hard.

Biotech defenses

During the Crash, several groups felt a need to defend themselves and designed weapons. Some of these were biological defenses, intended to detect, cripple or kill intruders. Some of them are still around.