Meteorology Cheat Sheet

A comprehensive cheat sheet covering the essentials of meteorology, including atmospheric composition, weather phenomena, forecasting techniques, and climate change basics. This resource is designed for students, weather enthusiasts, and anyone seeking a better understanding of the science behind weather and climate.

Atmospheric Basics

Composition of the Atmosphere

Nitrogen (N2):	Approximately 78% of dry air.
Oxygen (O2):	Approximately 21% of dry air. Essential for respiration and combustion.
Argon (Ar):	About 0.93% of dry air. An inert gas.
Carbon Dioxide (CO2):	About 0.04% of dry air. Important for the greenhouse effect and plant photosynthesis.
Water Vapor (H2O):	Varies greatly (0-4%). Crucial for weather phenomena like clouds and precipitation.
Ozone (O3):	Absorbs harmful ultraviolet (UV) radiation in the stratosphere.

Atmospheric Layers

Troposphere:	Lowest layer, where weather occurs. Temperature decreases with altitude.
Stratosphere:	Contains the ozone layer. Temperature increases with altitude due to ozone absorption of UV radiation.
Mesosphere:	Temperature decreases with altitude. Meteors burn up in this layer.
Thermosphere:	Temperature increases with altitude. Includes the ionosphere.
Exosphere:	Outermost layer, gradually fades into space.

Temperature Scales

Celsius (°C):	Water freezes at 0°C and boils at 100°C.	Formula: °C = (°F - 32) × 5/9
Fahrenheit (°F):	Water freezes at 32°F and boils at 212°F.	Formula: °F = (°C × 9/5) + 32
Kelvin (K):	Absolute temperature scale; 0 K is absolute zero.	Formula: K = °C + 273.15

Weather Phenomena

Cloud Types

Cirrus (Ci):	High, wispy clouds made of ice crystals.
Cumulus (Cu):	Puffy, cotton-like clouds with flat bases.
Stratus (St):	Flat, featureless clouds that cover the entire sky.
Cumulonimbus (Cb):	Tall, towering clouds associated with thunderstorms.
Altocumulus (Ac):	Mid-level, patchy clouds, often in sheets or layers.
Nimbostratus (Ns):	Dark, gray, rain-producing clouds.

Precipitation Forms

Rain:	Liquid water droplets.
Snow:	Ice crystals.
Sleet:	Rain that freezes as it falls through a layer of cold air.
Freezing Rain:	Rain that freezes upon contact with a surface.
Hail:	Lumps of ice that form in thunderstorms.

Atmospheric Pressure

High Pressure Systems:	Associated with sinking air, clear skies, and stable weather.
Low Pressure Systems:	Associated with rising air, clouds, and precipitation.
Pressure Gradient Force:	Drives air from areas of high pressure to low pressure.
Coriolis Effect:	Deflects moving air to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Weather Forecasting

Weather Maps and Symbols

Understanding weather maps is essential for forecasting. Common symbols include:

- **H:** High pressure center
- **L:** Low pressure center
- **Cold Front:** Blue line with triangles
- **Warm Front:** Red line with semi-circles
- **Occluded Front:** Purple line with alternating triangles and semi-circles
- **Station Model:** Provides detailed information about weather conditions at a specific location.

Forecasting Techniques

Persistence Forecasting:	Assuming that future weather will be similar to current weather.
Trend Forecasting:	Predicting future weather based on the movement and development of weather systems.
Numerical Weather Prediction (NWP):	Using computer models to simulate the atmosphere and predict future weather conditions.
Ensemble Forecasting:	Running multiple NWP models with slightly different initial conditions to assess forecast uncertainty.

Weather Instruments

Thermometer:	Measures air temperature.
Barometer:	Measures atmospheric pressure.
Anemometer:	Measures wind speed.
Hygrometer:	Measures humidity.
Radiosonde:	A balloon-borne instrument that measures temperature, humidity, pressure, and wind speed as it ascends through the atmosphere.
Weather Radar:	Detects precipitation and its intensity.
Weather Satellite:	Provides images of clouds, temperature profiles, and other atmospheric data from space.

Climate Change

Greenhouse Effect

The greenhouse effect is a natural process where certain gases in the atmosphere trap heat, warming the Earth. Key greenhouse gases include:

- **Carbon Dioxide (CO_2)**
- **Methane (CH_4)**
- **Nitrous Oxide (N_2O)**
- **Water Vapor (H_2O)**

Increased concentrations of these gases due to human activities enhance the greenhouse effect, leading to global warming.

Evidence of Climate Change

Rising Global Temperatures:	The Earth's average surface temperature has increased significantly over the past century.
Melting Ice and Glaciers:	Ice sheets and glaciers are melting at an accelerating rate.
Sea Level Rise:	Global sea levels are rising due to thermal expansion of water and melting ice.
Changes in Precipitation Patterns:	Some regions are experiencing more intense rainfall and flooding, while others are facing prolonged droughts.
Ocean Acidification:	The absorption of excess CO_2 by the oceans is causing them to become more acidic, threatening marine life.

Impacts of Climate Change

Climate change has far-reaching impacts, including:

- **Increased frequency and intensity of extreme weather events (e.g., hurricanes, heatwaves, droughts)**
- **Threats to food security due to changing agricultural conditions**
- **Displacement of populations due to sea level rise and extreme weather**
- **Loss of biodiversity and ecosystem disruption**
- **Impacts on human health, including increased heat-related illnesses and the spread of infectious diseases**