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# MARINE ENVIRONMENT

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### Marine Environmental

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MARE



This subject gives an introduction to the subjects marine meteorology and oceanography. It explains the fluid physical characteristics and movement on the earth's surface. As such, the student will have a clear understanding of the weather that results from the interaction between the atmosphere and the sea surface. Following this, the students will gain a better appreciation of the interactions between the marine environment and marine vehicles/structures. As such, the important issue relating to marine safety, sustainability, and environmental impact (Climate Change & Sea Level Rise) can be addressed.



## SYNOPSIS



### **LESSON PLAN**

01	WEEK	06	WEEK
	Origin of atmosphere and ocean basins		Climatology
02	WEEK	07	WEEK
	Hydrological Cycle: Water in the atmosphere		Weather Systems
03	WEEK	80	WEEK
	Vertical stability and temperature distribution		Mid-semester break
04	WEEK	09	WEEK
	Cloud, precipitation and visibility		Constituents of sea water Water masses
05	WEEK	10	WEEK
	Pressure gradients and atmosphere		Waves and tides



- 11 WEEK Oceanic circulation
- 12 **WEEK**

Marine renewable energy devices

13 **WEEK** 

Marine Pollution

14 **WEEK** 

Climate change and sea level rise

15 **WEEK** 

Presentations of projects



## ATMOSPHERE

### Surrounded both land and sea

### Composition of the Atmosphere

#### DRY AIR + WATER VAPOUR + IMPURITIES

DRY AIR: Nitrogen, Oxygen, Argon, Carbon Dioxide

#### WATER VAPOUR

content in the atmosphere play a vital role in meteorological processes

varies with temperature. At high temperatures- water vapor is 4% by weight of air

continuously added to the air through evaporation. also continuously removed through by condensation









Primary cause: variation of sun's attitude

### **OTHER FACTORS**

- 1. distribution of land and sea
- 2. amount of cloud cover
- 3. the extent of ocean currents
- 4. pressure distribution wind system



### TEMPERATURE **VARIATION OVER** EARTH'S SURFACE

The mean temperature of the atmosphere does not vary appreciably from year to year Energy Absorbed = Energy radiated to space





Temperature

LFC: Lvel of Free Convection



# **BASIC INFO**



### **CONDENSATION**

THE CHANGING **OF WATER FROM** A LIQUID TO A GAS

THE CHANGING **OF WATER FROM** GAS TO A LIQUID



cloud form when air rises and becomes saturated in response to adiabatic cooling

liquid water on Earth enters the atmosphere as water vapor (when energy is absorbed from sunlight)

water vapor in the atmosphere condenses into liquid water droplets in a cloud (when energy is released = cooled)





### CLOUD TYPE BASED ON PROPERTIES

these basic cloud types can be combined to generate 10 different cloud types 02 STRATUS : layered cloud
03 CUMULUS : cloud having vertical development
04 NIMBUS : rain-producing cloud

01



#### CIRRUS : thin, wispy cloud of ice



### CLOUD TYPES BASED ON HEIGHT

if based on cloud base height, the ten principle cloud types can then be grouped into four cloud types:



### HIGH CLOUDS : cirrus, cirrostratus, cirroscumulus

## MIDDLE CLOUDS : altostratus and altocumulus

### LOW CLOUDS : stratus, stratocumulus, and nimbostartus

### CLOUD WITH EXTENSIVE VERTICAL DEVELOPMENT : cumulus and cumulonimbus



# **ON HEIGHT**





### **CLOUD TYPES**





### PRECIPITATION



to the ground as:

rain drizzle sleet snow pallets snow grains ice pallets ice prisms



### term given to water drops or ice particles at a higher level and falling



### **FORMATION OF PRECIPITATION**







#### RAIN

Tropical Regions: large drops grow by collision

**Temperature and Polar** Latitudes : low temperature (snow flakes) high temperature (rain/drizzle)

**SNOW** 

Ice crystal formed from condensation

#### HAIL / LARGE HAIL **STONES**

Hail: Softcore surrounded by a shell of clear ice

Large Hail Stone: caught in strong up draughts and repeating the process several times





#### **SLEET**

Ice pallets that from when rainfall through a layer oof freezing air

### VISIBILTY

The measure of the transparency of the atmosphere and maybe define as the greatest horizontal distance at which an object of specified characteristic can be seen by a person of normal vision under the condition of average daylight illumination

#### FACTOR AFFECTING

Depends on the number of solid or liquid particles held suspension in the air

presence of water droplet; fog

### MAIN CAUSES

 visible moisture in the atmosphere
solid particles produced by factories, fires, sand, volcanic eruption



# Composed of water droplet may also be described as a cloud on surface

#### **RADIATION FOG**

#### ADVECTION FOG

Due to the cooling of the ground and the air in contact with it, by radiation

form almost entirely at night and overland, since t

Occurs when warm, damp air moves over a surface which is cooler than the airw-point de

#### MIXING FOG

Occur when air streams of widely different origin meet



#### SEA SMOKE

Peculiar kind of surface mist or fog observed close to the open sea surface when the air temperature is low



# **FORMATION OF WIND**

The wind is caused by air flowing from high pressure to low pressure. Its direction is influenced by the Earth's rotation













### **SEVERE WEATHER AT SEA**

#### THUNDERSTORMS

develop only in those clouds which contain large concentrations of liquid water and ice coexisting at temperatures below -20 degree

#### TORNADOES

A violent whirl wind with an approximately vertical axis extending downwards from the cloud base and often reaching the ground

#### WATERSPOUTS

Similar to tornadoes but occur over open water.

a whirlwind over the sea, appearing as a funnelshaped column usually extending from the lower surface of Cp cloud to the sea



#### SQUALL LINES

A term used for describing moving lines of thunderstorms.

generate gusty winds and heavy rais which are more intense and extensive than individual thunderstorms



### **CLIMATE CHANGE** AND GLOBAL WARMING



The sustained changes in the regional weather change over a long period. climate change not only refers to temperature but also encompasses changes in wind patterns, humidity, rainfall and severe weather events

the term used to denote increasing temperature of the surface of the earth and the lower atmospehere



#### **CLIMATE CHANGE**

#### **GLOBAL WARMING**









# phenomenon that occurs irregularly in the tropical Pacific Ocean every two to seven

### years and affects weather all around the

#### Impact of El Nino

Drought (southern Africa, northern Australia, Indonesia) high rain (three continents) abnormally warm (North America and eastern China)





# WEATHER SYSTEM

Mainly influenced by the structure and physical characteristics of pressure systems such as the depression and the anticyclone and with the factors controlling their movement

Transfer of air at higher levels more nearly parallel to the equator and mainly from the west to east



### **AIR MASSES**

Air having similar physical characteristics and covering a large area of over several thousand square miles





temperature near the surface is above the temperature of the underlying land or sea

#### MARITIME TROPICAL (mT)

CONTINENTAL TROPICAL (cT)

EQUATORIAL (E)



### WEATHER FORECASTING TOOLS

01	Numerical Model Output	
02	Satellite Date: Visible, water vapor,	04
03	Weather Observation: Surface data	05
	(ASOS and meteograms), Soudnigns, Ship and buoys data	06





#### Radar Data

#### Commercial Aircraft Data (ACARS)

### Wind Profilers



## WEATHER FORECASTING TOOLS

### THE TREND TECHNIQUE

If a phenomenon is in steady-state, or is moving at a constant speed, the trend t chnique can be used (ie. rate x time = distance)

This is more accurate on shorter time scales (minutes to hours). called as "nowcast"

### THE ANALOGUE TECHNIQUE

Identify existing features on a weather chart that resemble those that occurred in past.

use previous weather events to guide forecast, "pattern recognition"

days-months\_

### THE CLIMATOLOGY TECHNIQUE

a forecast that is based on "climatology" or average weather





a useful method for longer-term forecast (3





# WEATHER OBSERVATIONS & REPORTING

land or at sea, serve several purpose

#### PLOTTED ON SYNOPTIC CHART

provide an up-to-date picture of the weather over a large area

the forecast can be made of the weather for the following 12-24 hours





### **WEATHER OBSERVATIONS &** FORECASTING

















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### Thank You