

GSCI2010: Meteorology (Spring 2022)

Course Outline

The following is a list of the chapters that the lecture notes will cover. There is one PowerPoint unit per chapter. You will know from the numbering, as well from the context, of each online unit the chapters to which they are related. There are 19 on-line units each of which contains a considerable amount of additional material. It is vitally important that you download and listen to each unit carefully.

Textbook:

Meteorology Today 2nd Canadian Edition

Ahrens & Jackson & Jackson. Nelson Education

ISBN 13-978-0-17-653079-2 (or latest edition)

1 Unit 1

EARTH AND ITS ATMOSPHERE

Different stages of Earth's atmospheric development.
Composition of gases in the atmosphere.
Impact of gravity on pressure and density of Earth's atmosphere.
Thermal, chemical, and ionic layers of the atmosphere.

2 Unit 2

ENERGY

Energy and its movement drive weather.
Heat is transferred in different ways.
Hot sun emits shortwave radiation; cooler Earth emits longwave radiation
Gases in the atmosphere absorb and emit different wavelengths of radiation.
Annually: Energy inputs = Energy outputs

3 Unit 3

TEMPERATURE

Earth's tilt causes the seasons.
Temperature is controlled by the input and output of solar and terrestrial energy.
Ranges of temperature are greater in dry climates than in humid ones.
Temperature influences decisions on clothes to wear, providing critical information for energy-use predictions and agricultural planning.

4 Unit 4

HUMIDITY

Hydrologic cycle and annual water balances
Different phases of water
Ways of describing the amount of water vapour in the air
High relative humidity in hot weather makes us feel hotter.
Various instruments that measure humidity

5 Unit 5

CONDENSATION: Dew, Fog, and Clouds

Products of condensation Dew, haze, fog, clouds

Importance of condensation nuclei

Fog forms in two ways Air cooling or mixing water vapour into the air

Clouds classified into 10 general groups

Satellites allow a birds-eye view of clouds on a global scale

6 Unit 6

STABILITY AND CLOUD DEVELOPMENT

Vertical motion and the adiabatic process

Atmospheric stability, instability, conditional stability/instability, and inversions

Environmental lapse rate

Uplift and cloud development

7 Unit 7

PRECIPITATION

Cloud droplet growth Curvature and solute effect.

Collision and coalescence and ice-crystal processes.

Precipitation types Rain, snow, freezing rain, ice pellets, hail

Measuring precipitation Low tech to high tech

8 Unit 8

AIR PRESSURE AND WINDS

Factors that cause changes in pressure and wind.

Measuring atmospheric/barometric pressure.

Surface and upper-level charts.

Relationship between temperature and pressure.

Forces: Pressure gradient, Coriolis effect, centripetal, and friction.

9 Unit 9

WIND: Small Scale and Local

Scales of motion Microscale and mesoscale.

Laminar flow, eddies, and turbulent flow.

Thermal circulations and topographic forced flows.

Monsoons and large-scale thermal circulations.

Measuring winds and the equipment used.

10 Unit 10

WIND: Global Systems

Hadley, Ferrel, and Polar cells, jet streams, ITCZ.

Temperature and pressure gradients and winds.

Winds drive major ocean currents, also drive Ekman spiral and Ekman transport.

Changes in atmospheric circulation patterns.

Temperature and pressure oscillations (ENSO, PDO, NAO, AO).

11 Unit 11

AIR MASSES AND FRONTS

- Air masses take on properties of their source region.
- Properties are uniform in any horizontal direction.
- A front is a transition zone between air masses.
- Cold, warm, and occluded fronts TROWALS and cold & warm occlusions.

12 Unit 12

MIDDLE-LATITUDE CYCLONES

- Polar-front model and cyclogenesis.
- Diverging and converging upper-level air.
- Shortwaves, longwaves.
- Lee-side and Hatteras lows.
- Vorticity an indicator of divergence/convergence.

13 Unit 13

THUNDERSTORMS AND TORNADOES

- Ordinary, multicell, and supercell thunderstorms.
- Lightning and thunder Discharge of electricity and the explosive expansion of air.
- Tornado occurrences and outbreaks.
- Tornado winds and the Fujita scales.
- Tornado formation Supercell and non-supercell.

14 Unit 14

HURRICANES

- Components of a hurricane.
- Conditions needed for hurricane development.
- Development stages Tropical wave to hurricane.
- Hurricane movement.
- Damaging effects of hurricanes.

15 Unit 15

WEATHER FORECASTING

- Skywatching and basic observations.
- The Meteorological Service of Canada and its responsibilities.
- Different forecasting tools and methods.
- Numerical weather prediction.
- Forecasting problems, accuracy, and skill.

16 Unit 16

GLOBAL CLIMATE

- Climatic controls that influence climate.
- Importance of temperature and precipitation.
- Kppen and Thornthwaite classification systems.
- Global climates according to Kppen classification.

17 Unit 17

EARTH'S CHANGING CLIMATE

Past climates Investigation using proxies.
Feedback loops Positive and negative.
Internal and external causes of climate change.
Greenhouse gases and radiative forcing.
Global climate models and predicting the future.

18 Unit 18

AIR POLLUTION

Primary and secondary types of air pollutants.
PM, SO_x, NO_x, CO, VOCs, NH₃, O₃, CFCs.
Factors affecting local and regional air pollution.
Acid deposition and acid rain.

19 Unit 19

LIGHT, COLOUR, AND ATMOSPHERIC OPTICS

Reflection in white clouds, raindrops, ice crystals.
Scattering and the importance of particle size.
Nonselective, Mie, and Rayleigh.
Refraction Bending due to change in medium.
Dispersion