ATSC 413 Forest Fire Weather & Climate
Fall Term 2025

Tuesday Classes Reading List and Learning Goals

Week 2 Tue 9 Sep 2025

Weather Chart Analysis

Pre-lecture reading	**Learning Goals**
Atmospheric basics Stull 1.0-1.2; 10.5.8; 10.6 Appendix A: A.1.0-A.1.2 Lackmann 1.0-1.2; 1.3-1.4 (read the text, the equations are not testable) *Manual analysis* Stull 9.2.3-9.4 Lackmann 12.0-12.4	By the end of this week, you will be able to: -Interpret a surface weather map -Interpret upper air charts -Contour an upper air chart by hand -Contour a surface weather map by hand

Week 3 Tue 16 Sep 2025

Weather Charts (continued)

-Surface
-Upper Air
-Cross Sections
-Thickness charts
-Vorticity

Observations (METARS)

Pre-lecture reading	**Learning Goals**
METARS Stull 6.5; 9.0-9.2.2 Wikipedia METAR *Weather Charts* Stull p.458 right hand column	By the end of this week, you will be able to: -Interpret specific weather charts (e.g. Thickness charts) -Interpret weather cross-sections and meteograms -Interpret METARS

Week 4 Tue 23 Sep 2025

Satellite Imagery & Interpretation

Pre-lecture reading	Learning Goals
Satellite imagery Stull 8.0-8.2.3	By the end of this week, you will be able to: -Interpret VIS, IR, WV satellite imagery -Understand GOES and Polar Orbiting imagery -Interpret special sensor channels, especially fire weather channels

Week 5 Tue 30 Sep 2025 (Truth & Reconciliation Day. No classes)

Reading Assignment Only – No Lecture

Radar Imagery & Interpretation

Pre-lecture reading	**Learning Goals**
Weather radar Stull 8.3-8.3.4 Lackmann 10.5.1.4	By the end of this week, you will be able to: -Explain specifically what hydrometeors are and how a radar beam detects them -Give an example of an active remote sensor and a passive remote sensor, the outputs of which are used in weather analyses -List the three main characteristics of a radar return signal used to detect storms and other severe weather conditions -Describe in general terms the radar equation and the reflectivity factor Z, and what units are used to quantify radar returns -Interpret radar reflectivity imagery -Interpret Doppler radar imagery

Week 6 Tue 7 Oct 2025

Atmospheric Soundings & Hodographs

Pre-lecture reading	**Learning Goals**
Atmospheric Stability Stull 5.0-5.9 *Thunderstorm Fundamentals* Stull Ch. 14 Focus on Section 14.2 and 14.4 *Hodographs* Stull 14.5.1-14.5.2.5 NOAA's overview on Parcel Theory https://www.noaa.gov/jetstream/upperair/parcel-theory NOAA's overview on Stability / Instability https://www.noaa.gov/jetstream/upperair/bowls NOAA's overview on radiosondes https://www.noaa.gov/jetstream/upperair/radiosondes NOAA's overview on Skew-T Plots https://www.noaa.gov/jetstream/upperair/skew-t-plots NOAA's overview on Severe Weather https://www.noaa.gov/jetstream/upperair/severe-weather	By the end of this week, you will be able to: -Provide the definition of potential temperature and how it relates to vertical motion of air parcels -List the three characteristic states of an air parcel needed to plot as a point on any thermodynamic diagram -Label all lines accurately on a blank Tephigram thermodynamic chart -Analyze upper air soundings (e.g., Tephigrams / Skew-T plots > concentrate on Tephigrams) –Determine cold and warm advection from the winds plotted on a hodograph -Analyze upper winds on hodograph

Week 7 Tue 14 Oct 2025

Extra-tropical (mid-latitude) cyclones

Pre-lecture reading	**Learning Goals**
Extratropical cyclones Stull 13.0-13.8 11.5-11.7, 11.9, 11.14 Lackmann 5.0-5.4.7 ATSC 413 website: Met. Concepts mc04: Extra-tropical (mid-latitude) Cyclones Note: *We will go over these sections in class, and much of this material is taken from this week's Stull and Lackmann reading list*	By the end of this week, you will be able to: -Explain extratropical cyclone development and structure -Compare gradient wind and geostrophic winds as the jet stream flows around Rossby Wave troughs and ridges -Explain why surface low-pressure centres will weaken without upper air support -Pinpoint regions of cyclogenesis and cyclolysis in planetary Rossby Waves -Describe in detail the structure of wind maxima in the jet stream and how these wind maxima relate to vertical motion in the troposphere -Describe the role of conservation of potential vorticity in lee wave cyclogenesis

Week 8 Tue 21 Oct 2025

Fronts and Airmasses

Pre-lecture reading	**Learning Goals**
For review (we covered *map plotting and contouring* in week 1): Front symbols on a weather map: Stull p. 280-281 Station Plot Model: c-stn-plot1-model.jpg (2114×1508) (ubc.ca) (for username and password see Canvas homepage) Key variables on Station Plot Model: d-stn-plot2-key-variables.jpg (2122×1530) (ubc.ca) New this week: *Fronts and airmasses* Stull Chapter 12 Fronts & Airmasses: 12.0-12.10 Lackmann Chapter 6 Fronts 6.0-6.5 NOAA Topic: Air Masses https://www.noaa.gov/jetstream/synoptic/air-masses NOAA Topic: Norwegian Cyclone Model: https://www.noaa.gov/jetstream/synoptic/norwegian-cyclone-model NOAA Topic: Types of Weather Phenomena: https://www.noaa.gov/jetstream/synoptic/types-of-weather-phenomena Shapiro-Keyser Cyclone Model: The Shapiro-Keyser Cyclone Model (eumetrain.org) Cyclogenesis (eumetrain.org)	By the end of this week, you will be able to: -Analyze different front types and airmasses -Associate fronts with weather patterns - List the mechanisms that support the formation of high-pressure centres and/or high-pressure ridges at the Earth's surface, and describe typical weather patterns associated with high-pressure cells and ridges. - List the 10 attributes of fronts that may be found on a surface weather chart, including the main attribute usually associated with fronts. - Detail the horizontal and vertical structure of frontal zones - Describe and label frontal features found on both the Norwegian cyclone model and the Shapiro-Keyser cyclone model, and list the additional features that are associated only with the Shapiro-Keyser cyclone model. - Explain the location and formation of drylines, boundaries between moist and dry airmasses that don't exhibit the characteristics of frontal zones. - Define the formation and characteristics of a sea-breeze front.

Week 9 Tue 28 Oct 2025

Effect of Temperature, Humidity & Clouds on Fires

Pre-lecture reading	**Learning Goals**
ATSC 413 website: Met. Concepts mc06: 1. Humidity Fundamentals 2. Temperature, potential temperature, virtual temperature 3. Convective cumuliform vs. upslope stratiform clouds Note: *We will go over these sections in class, and much of this material is taken from this week's Stull reading list* *Thermodynamics* Stull 3.3-3.4 *Water Vapor* Stull 4.0-4.5.2; 4.7 *Clouds* Stull 6.0-6.6; 6.8-6.9	By the end of this week, you will be able to: - Express the relationship between temperature and vapor pressure as shown in the Clausius-Clapeyron equation - Provide the definition of humidity variables given in Stull:Table 4.2a-c including units - Describe different available methods to determine one humidity variable when given other different variables (e.g., how to determine T_w given T and T_d) - In particular, use Normand's Rule to find T_w given T and T_d on a thermodynamic diagram - Describe the cloud formation process for (1) convective clouds (2) upslope clouds

Week 10 Tue 4 Nov 2025

Convective Storms

Pre-lecture reading	**Learning Goals**
Thunderstorms Stull 14.0-14.9 (repeat from week 6) Stull 15.0-15.5 *NOAA Thunderstorms* https://www.noaa.gov/jetstream/thunderstorms	By the end of this week, you will be able to: - describe thunderstorm formation and structure including the three stages of development and the three types of thunderstorms - list and describe the four environmental conditions necessary to produce strong convection leading to thunderstorm formation - List the five main thunderstorm hazards, the mechanisms that produce them, and their impact

Week 11 Tue 11 Nov 2025

No Tuesday class – UBC Fall Midterm Break Mon 10 Nov – Wed 12 Nov

Week 12 Tue 18 Nov 2025

Guest lecture by Matt MacDonald – BC Wildfire Service lead forecaster

Capstone Presentation

Week 13 Tue 25 Nov 2025

Climate change vs. wildfires

Pre-lecture reading	**Learning Goals**
General Circulation Stull 11.0-11.4, 11.8.0-11.8.1, 11.11.0-11.11.1 *Natural Climate Processes* Stull 21.0-21.1, 21.4, 21.6, 21.7, 21.8, 21.9 *Wildfire Factsheet* Canvas Module F "ATSC Week 13: Fact-sheet - Wildfires-final.pdf" *Understanding Fire Weather and Climate Change Basics* https://climatedata.ca/resource/understanding-fire-weather-and-climate-change-basics/ *Global rise in forest fire emissions linked to climate change in the extratropics* https://www.science.org/doi/10.1126/science.adl5889 (Structured Abstract only – don't access full article) *Fast-growing fires* Canvas Module F "ATSC 413 Week 13: Fast-growing fires science.adk5737.pdf" *Jasper forest fire summer 2024* Watch: https://www.youtube.com/watch?v=UIw_wpTBF2c	By the end of this week, you will be able to: - list and describe the following natural climate "oscillations": • El Niño (EN) • Southern Oscillation (SO) • Pacific Decadal Oscillation (PDO) • North Atlantic Oscillation (NAO) • Arctic Oscillation (AO) • Madden-Julian Oscillation (MJO) - Discuss the particular reasons that climate change is making wildfires worse in Canada - list the three factors that are the key drivers of regional fire activity as shown in the fire regime triangle - describe the role climate change has had on wildfire emissions in the extratropics compared to the tropics over the past two decades - Express the important relationship between wildfire growth rate and size (burned area) for different fuel types

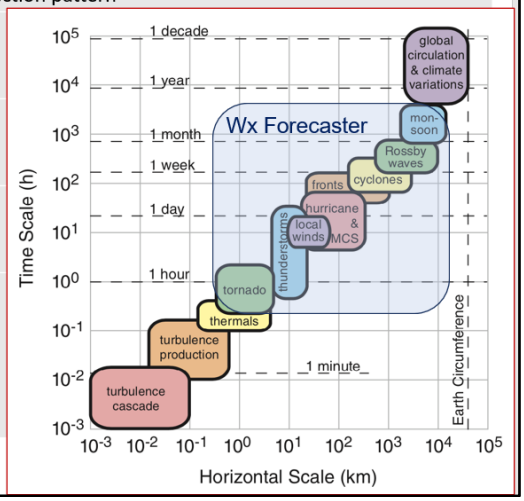
Week 14 Tue 2 Dec 2025

Weather Forecasting (nowcasting, short, medium-range)

Pre-lecture reading	**Learning Goals**
Weather Forecasting Lackmann 11.1-11.6 *Kinematics* Stull 10.9 *5 Things That Changed Weather Forecasting Forever* https://www.youtube.com/watch?v=_L-mGKFx0A4	By the end of this week, you will be able to: - Provide four relevant questions that form the basis of the weather forecasting process - Describe the Snellman forecast funnel relating weather phenomena scales - List at least five attributes of a good weather forecaster - Choose the right tool from the Weather Forecaster's Toolbox (see below) to match Timeframe and Spatial Scale.

Weather Forecaster's Toolbox

Timeframe	Spatial Scale	Tools
Sub-seasonal to seasonal weeks to months	Global Hemi-spheric	Atmospheric-Ocean oscillations and Teleconnection Patterns ENSO (El Niño-Southern Oscillation) MJO (Madden-Julian oscillation) PDO (Pacific Decadal Oscillation) Pacific/North American (PNA) teleconnection pattern
Mid-Long Range weather forecasts 5-14 days	Hemi-spheric Synoptic	NWP models, ensembles, anomalies AI-generated forecasts
Medium range weather forecasts 3-5 days	Synoptic	NWP models, ensembles, anomalies AI-generated forecasts
Short range weather forecasts 0-2 days	Synoptic Mesoscale	NWP models, ensembles, anomalies High-resolution NWP models, ensembles Satellite imagery
Nowcasting 0-6 hour Forecasting	Synoptic Mesoscale Timing of mesoscale features Microscale	High-resolution NWP models, ensembles Kinematic forecasting Satellite imagery Radar Soundings Observations



End of Term