Lecture 1. Orientation to EAS 270 “The Atmosphere”

“An introduction to weather. Atmospheric composition, vertical structure and energetics. Humidity and clouds, stratification and instability. Atmospheric motion on the global and synoptic scales. Air masses, fronts and storms. Introduction to weather maps, weather analysis and numerical weather prediction models. Weather map discussions. Prerequisite: any 100-level Mathematics or Physics course, or SCI 100."

Textbook: "Weather & Climate" by S.L. Ross.

- *textbook defines the "scope" of learning expected*
- *ideally, you will read ahead*

Class Lecture Format

- Partially completed PDF files available on eClass the evening before class (or earlier)
- File may be marked up during class by the instructor
- Final version of PDF file archived after class

Examinable: any material from textbook, and/or written down in a lecture, that is *not specifically excluded* in the *Exclusions File*

Evaluation

- Midterm exam Mon. 3 Oct. (50 min, 25%)
- Midterm exam Wed. 2 Nov. (50 min, 25%)
- Final exam** (50%)

** *tentatively* 2:00 p.m.Thursday December 15

Communication & Resources:

- eClass

Lecture 1. Science Skills/Knowledge to be Developed/Exercised

Order of subject coverage will broadly follow the textbook, but some key topics may be covered out of order (i.e. early)

- Cause/effect approach
- Seek patterns
- Understand processes
- Use technical vocabulary and symbols
- Be aware of units & dimensions [& apply "dimensional analysis"]
- Appreciate value of quantification
- Practice algebraic manipulation of simple equations
- Appreciate role of conceptual and numerical models (paradigms)
- Learn & retain salient facts
- Judge/remember what is most important
- Recognize oversimplifcations
- Integrate – go from learned specifics to implications and inferences
- Specific subject knowledge (across the **scope defined by the textbook**)
- Meteorological terminology, symbols and equations
- Meteorological calculations

EAS 270 Concept "Map" – subject learning in relation to THE ATMOSPHERE

Energy supply
& redistribution

Transport
processes

Composition
& Layering

GOAL: knowing & understanding the atmosphere

Seek cause of phenomena: *why* wind, *why* cloud, *why* precip?

Appreciate what processes are active in the atmosphere and how they're affecting your experience of the weather

What set of variables fully describes state of the atmos. – to the extent of permitting to forecast weather?

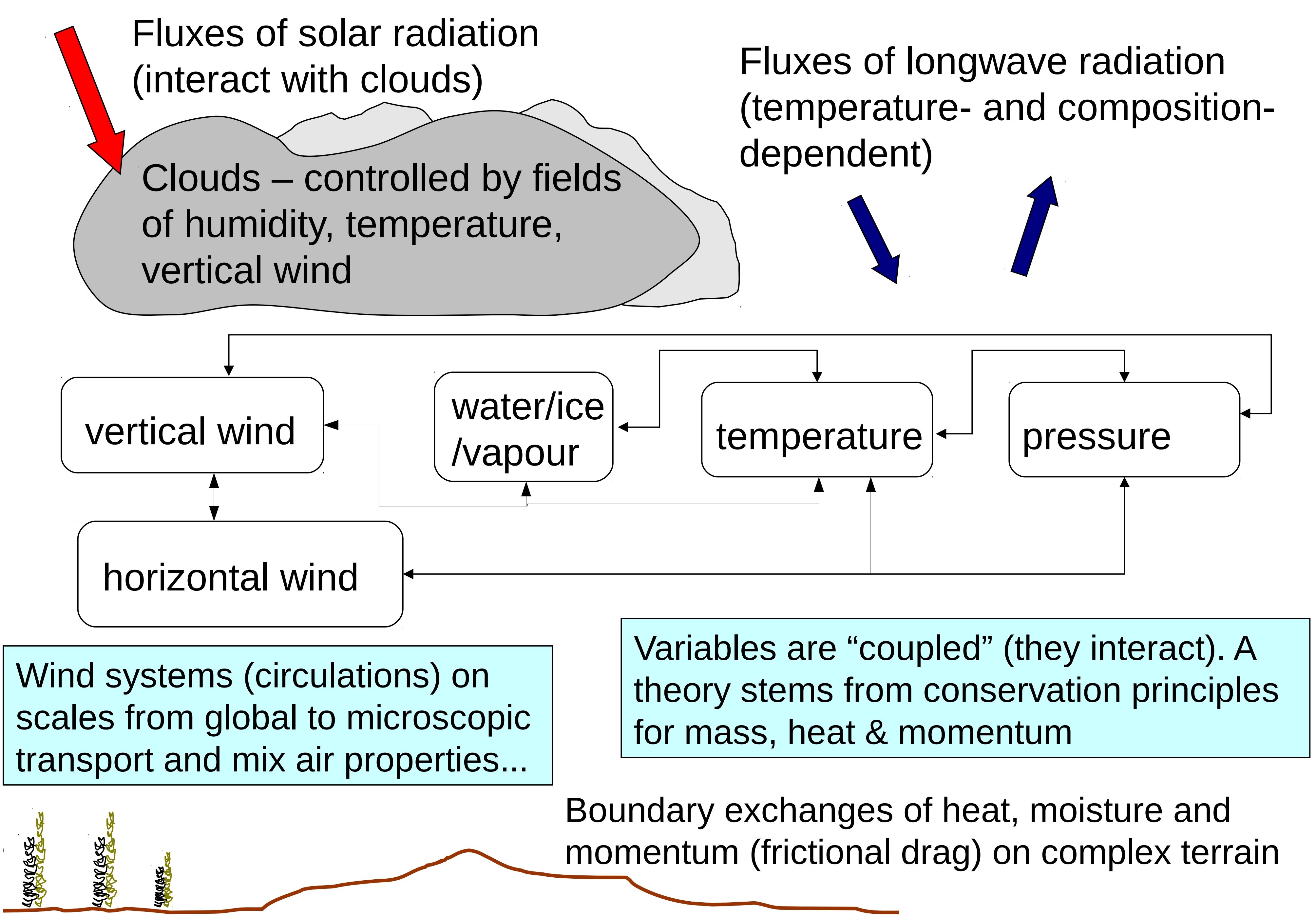
Fundamental laws (explain patterns):

- energy conservation (e.g. surface energy budget)
- momentum conservation (e.g. hydrostatic law, Geostrophic wind equation)
- constitutive equation(s) – ideal gas law inter-relates "state variables" pressure, density and temperature

Meteorological information

- where to find it
- how to interpret charts, diagrams

Pictorial suggestion of the complexity and intricacy of atmospheric processes

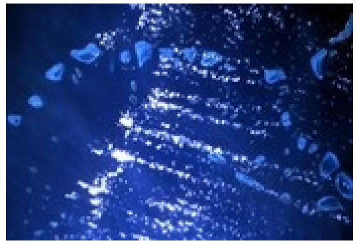


Sub-disciplines of Meteorology/Atmospheric Science. Pls. see Dr. Myers (EAS) about spec./hons prgrms

Wind energy

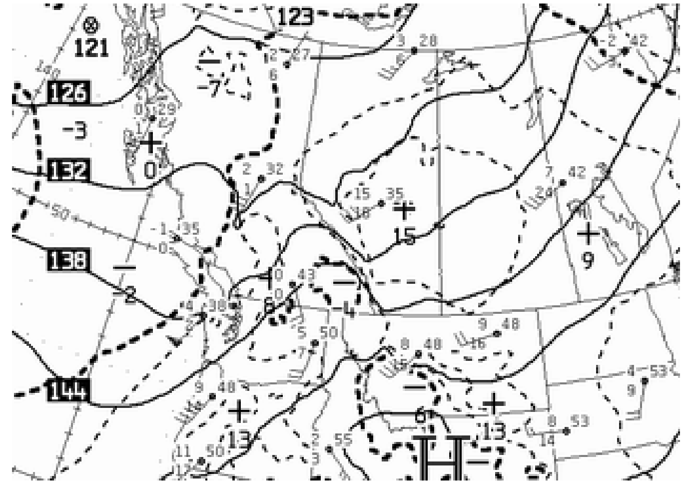
Aviation Meteo.

Satellite/planetary meteo.

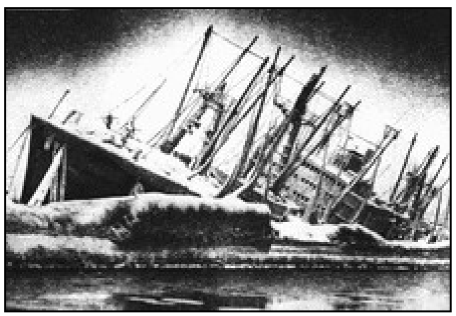


$$\frac{\partial}{\partial x}\left(U\ T+\overline{u'T_{eq}'}\right)+\frac{\partial}{\partial z}\left(W\ T+\overline{w'T_{eq}'}\right)=0$$

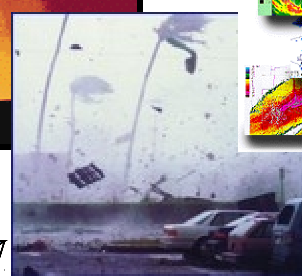
Weather forecasting

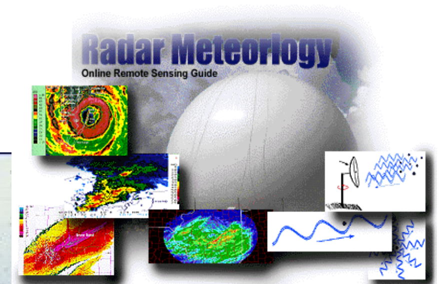


Icing

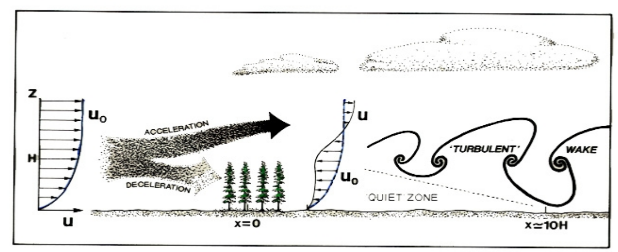


Clouds/Severe Storms/Radar



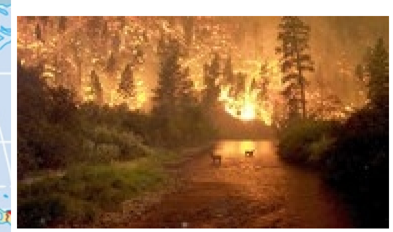


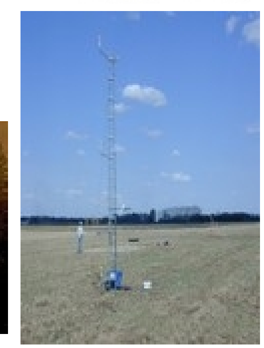
Micro- and agro-meteo.



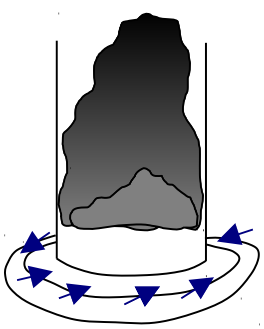
Climatology/ Paleoclimate

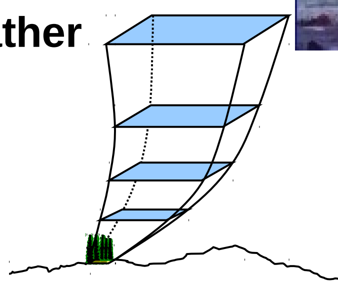
Fire meteo.





Numerical weather prediction





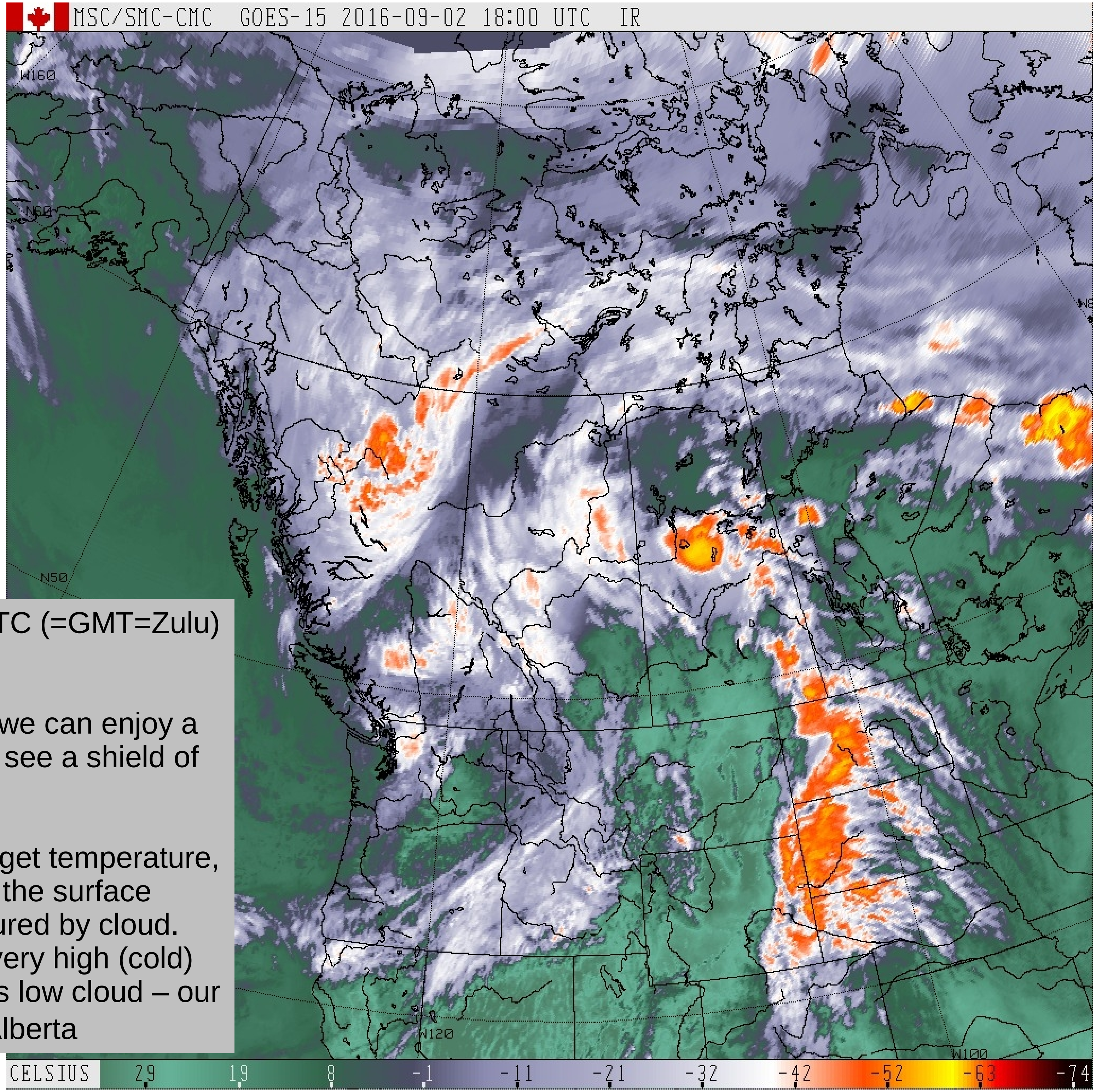
$$\left(\frac{\Delta T}{\Delta x}\right)_{I,J,K}=\frac{T_{I+1,J,K}-T_{I-1,J,K}}{2\ \Delta x}$$

To fill out the Orientation lecture we took a quick look at preesnt weather...

The local view: taken at 12:29 MDT, which is 18:29 GMT... a layer of stratocumulus cloud... cool (low teens) and a N. wind reported (about 20 kph). A north wind is a wind that comes *from* the north.

GOES
Geostationary
Operational
Environmental
Satellite

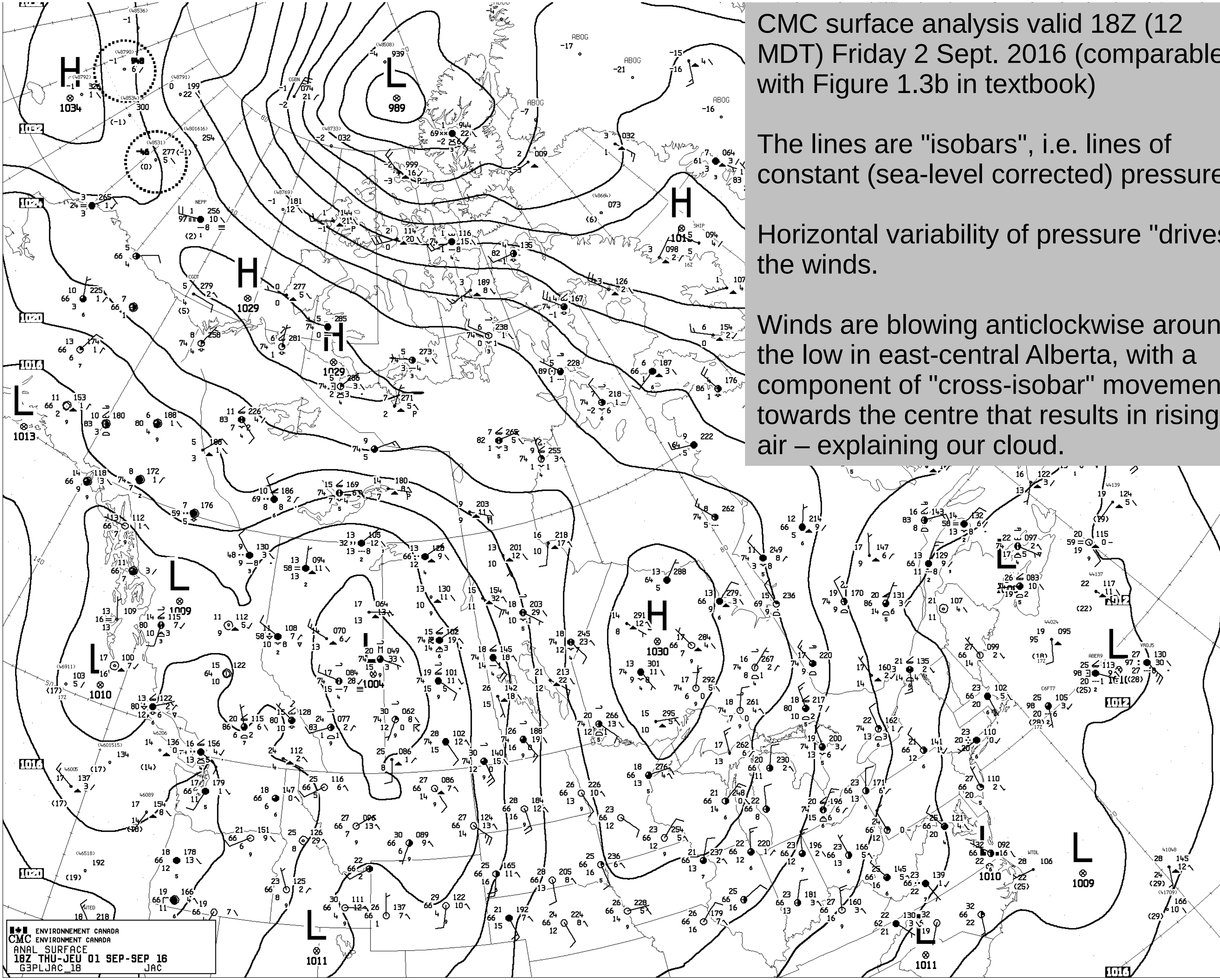
MSC-CMC
Meteorological
Service of Canada –
Canadian
Meteorological
Centre



The satellite view, 18 UTC (=GMT=Zulu) or noon MDT.

It isn't going to clear so we can enjoy a sunny afternoon, for we see a shield of low cloud over Alberta.

Satellite responds to target temperature, higher=colder. Green is the surface (ocean or land) unobscured by cloud. Red/yellow represents very high (cold) cloud tops. Grey/white is low cloud – our stratocumulus over C. Alberta



CMC surface analysis valid 18Z (12 MDT) Friday 2 Sept. 2016 (comparable with Figure 1.3b in textbook)

The lines are "isobars", i.e. lines of constant (sea-level corrected) pressure.

Horizontal variability of pressure "drives" the winds.

Winds are blowing anticlockwise around the low in east-central Alberta, with a component of "cross-isobar" movement towards the centre that results in rising air – explaining our cloud.