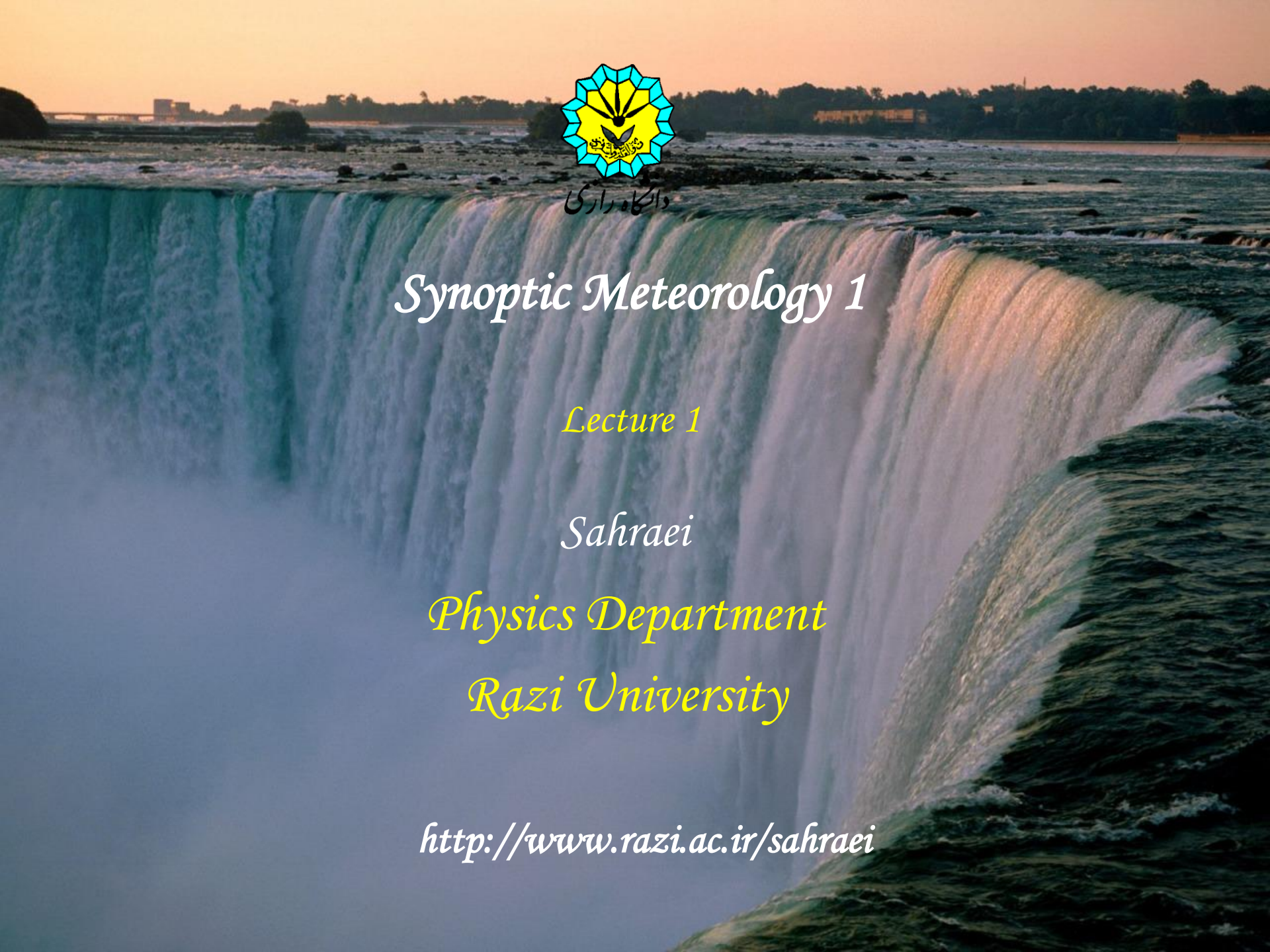

Synoptic Meteorology 1

Lecture 1

Sahraei

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Resources

1- Synoptic-Dynamic Meteorology in Mid-Latitudes, Bluestein H. B, 1993, Oxford University Press,
Vol. I, Principles of Kinematics and Dynamics
Vol. II, Observations and Theory of Weather systems

2- Applied atmospheric dynamics / Amanda H. Lynch and John J. Cassano., 2006

3- Internet

Mid semester exam (Sat. … Aban) - 50%

Final Exam - 50%

What is weather ?

Refers to the state of the atmosphere at a specific time and place

What are some of the factors that affect the weather?

Air Temperature: is a measure of the average amount of Motion (kinetic energy) of all the particles.

Wind: a natural movement of air of any velocity; *especially* : the earth's air or the gas surrounding our planet in natural motion horizontally

Humidity: The amount of water vapor present in the air

Clouds: Masses of small water droplets or tiny ice crystals that float in the air

Weather Analysis

On a global scale, the World Meteorological Organization is responsible for gathering, plotting, and distributing weather data.

Before issuing a forecasting, the forecaster must have an accurate picture of the atmospheric conditions; this project is called the weather analysis.

Because the atmosphere is always changing, time is of the essence when analyzing the weather.

Clearly, high speed computers have revolutionized the weather analysis process

Gathering Data

A critical mass of information is needed to generate a useful weather chart for even a short range forecast.

The World Meteorological Organization which includes more than 130 nations, was formed to address this problem.

It is their responsibility for gathering the needed data and for producing numerous weather maps and upper-level charts that describe the current state of the atmosphere.

Once collected, the information is distributed to three National Meteorological Centers near Washington, D.C., Moscow, and Melbourne, Australia.

Weather Maps

Normally, the large body of weather data once collected is displayed on a synoptic (observations made at the same time) weather map.

A weather map shows the status of the atmosphere and includes data on:

temperature, humidity, pressure, and airflow.

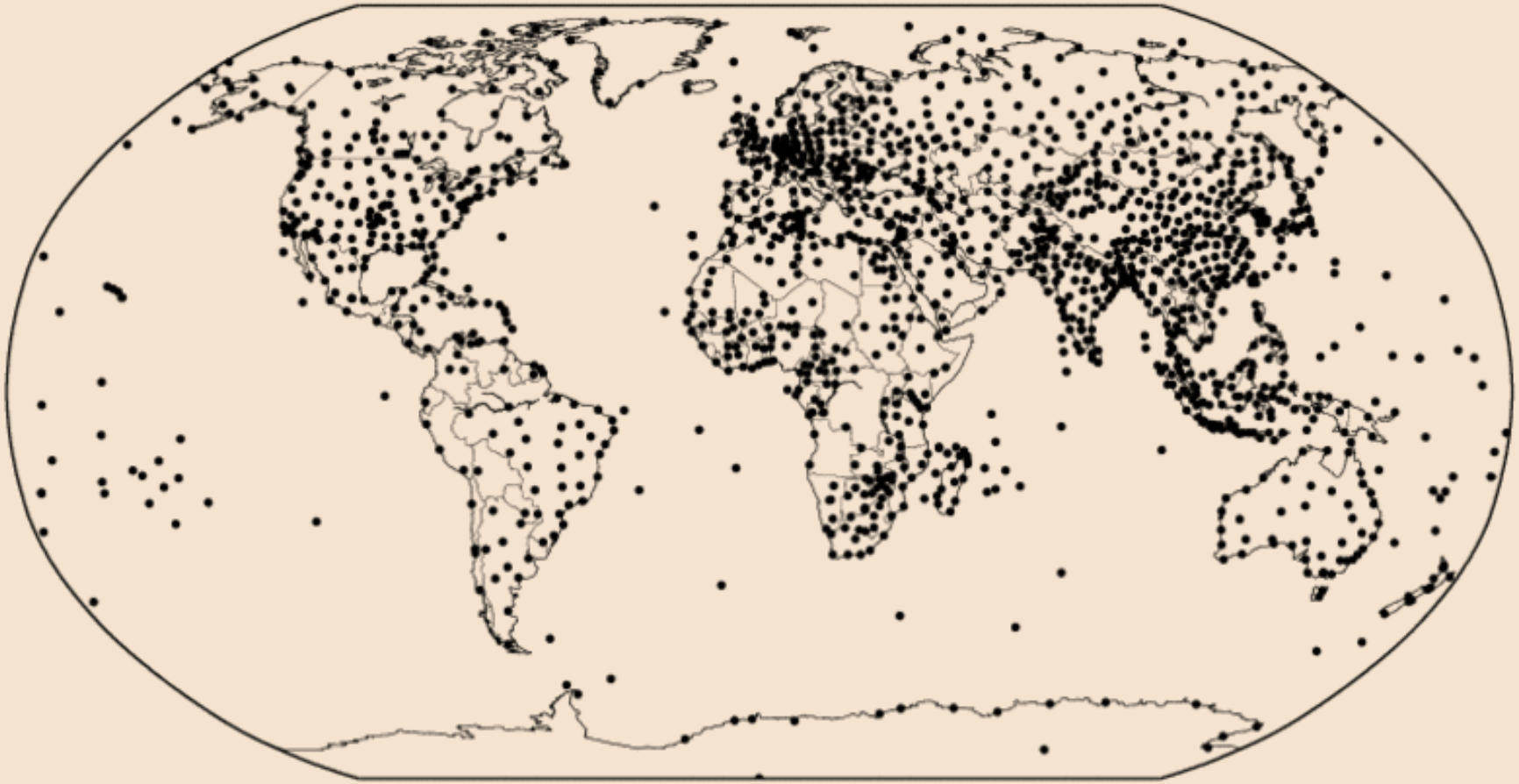
In addition to surface maps, twice-daily upper air charts which depict the pressure field are drawn at various millibar levels.

Radiosondes

Exploring the Atmosphere Using Balloons

Press(hPa)	Height(m)	Spd(m/s)	Dir(deg)	Tmp (c)	Rh(%)	Dew Point (c)
980.8000	315	6.3000	30	7.8000	71	2.8000
979.2000	328	6.5000	28	7.6000	68	2.0000
978.2000	337	6.7000	27	7.5000	68	1.9000
977.1000	346	6.9000	25	7.4000	68	1.9000
975.7000	358	7.1000	24	7.3000	68	1.9000
974.0000	373	7.3000	22	7.2000	67	1.5000
972.5000	385	7.5000	21	7.1000	67	1.3000
971.2000	396	7.7000	20	7.0000	67	1.3000
969.8000	408	7.9000	19	6.9000	67	1.3000
968.6000	418	8.0000	18	6.8000	67	1.2000
967.4000	429	8.2000	17	6.6000	68	1.1000
966.3000	438	8.4000	17	6.6000	68	1.1000

Worldwide radiosonde launch sites



Weather Forecasting

The task of determining the future state of the atmosphere is called weather forecasting.

The approaches used in modern weather forecasting include:

traditional synoptic weather forecasting,

numerical weather prediction,

statistical methods, and

various short-range forecasting techniques.

Synoptic Weather Forecasting

Synoptic weather forecasting, the preeminent method for making weather predictions until the late 1950s, involves the analysis of synoptic (summary) weather charts, employing several empirical rules.

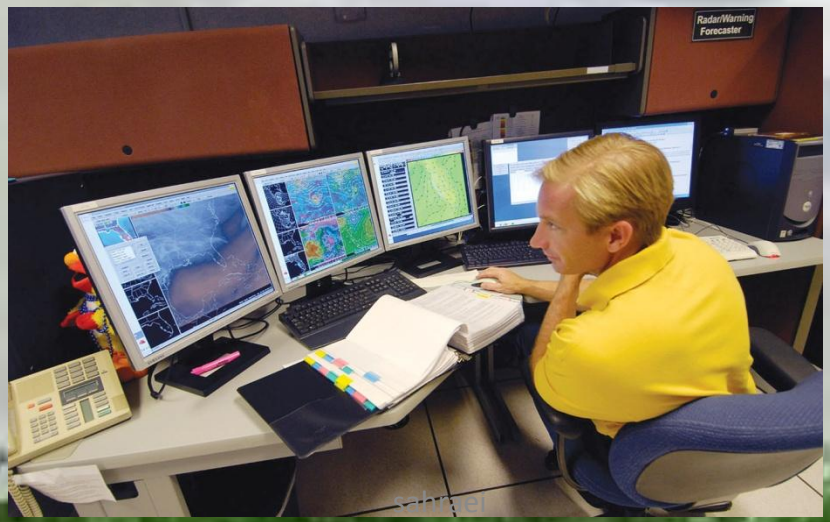
This is the first way weather predictions were made.

Numerical Weather Prediction

Numerical weather prediction, used extensively in modern weather forecasting, is based on the fact that the gases of the atmosphere obey many known physical principles. (PV=nRT for example)

Ideally, these physical laws can be used to predict the future state of the atmosphere, using the current conditions.

This really should be called "Chemical Weather Prediction" since it uses a great deal of chemistry.



Numerical weather prediction uses a number of highly refined computer models that attempt to mimic the behavior of the atmosphere.

Definitions

Meteorology : The science that deals with the phenomena of the atmosphere, especially weather and weather conditions

The study of weather variables such as temperature, humidity, pressure, wind speed and direction, cloud cover, precipitation, the processes that cause weather, and the interaction of the atmosphere with the Earth's surface, ocean, and life.

Meteorology is divided into four branches

Physical Meteorology

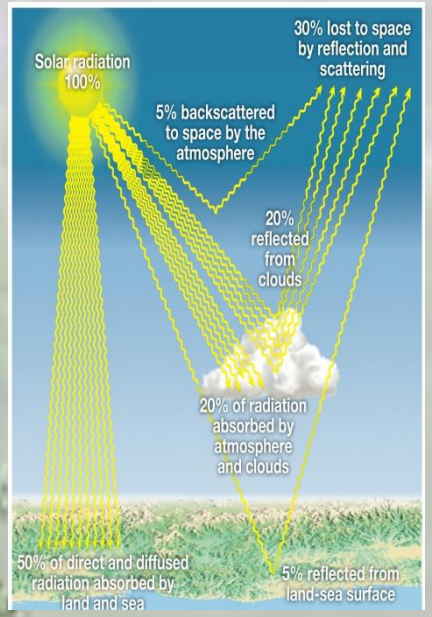
Dynamic Meteorology

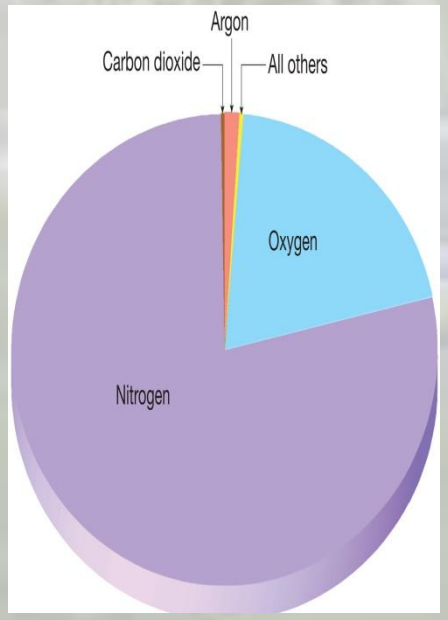
Synoptic Meteorology

Applied Meteorology

Physical Meteorology

Studies of radiation, structure & composition, clouds & precipitation, atmospheric electricity, …, but generally not weather.

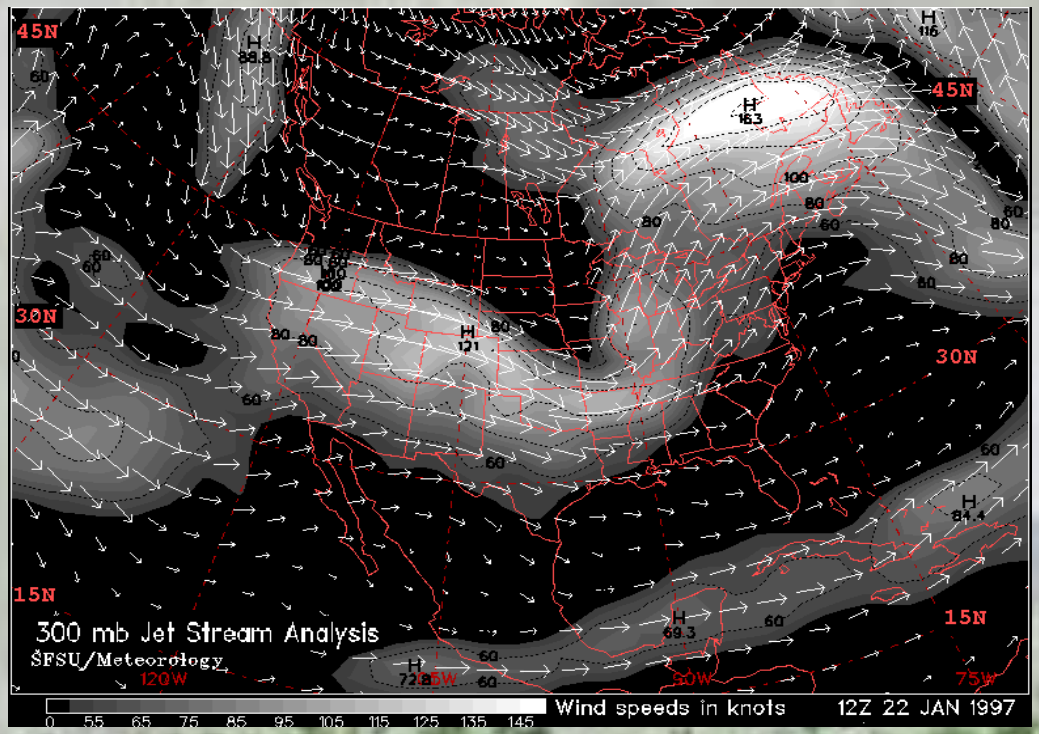




Dynamic Meteorology

describe atmospheric motions and their solutions

Dynamic meteorology employs analytical approaches based upon fluid dynamics to explain and describe the motions of atmosphere that produce the weather, and eventually the climate.



e.g., atmospheric wave theory

Synoptic Meteorology

Day-to-day weather and forecasting

Synoptic meteorologists are involved with the description of atmospheric disturbances and with weather forecasting.

Tropical Cyclone
(Hurricane- eye 20-50 Km)

Synoptic meaning

Derived from Greek "synoptikos" meaning general view of the whole.

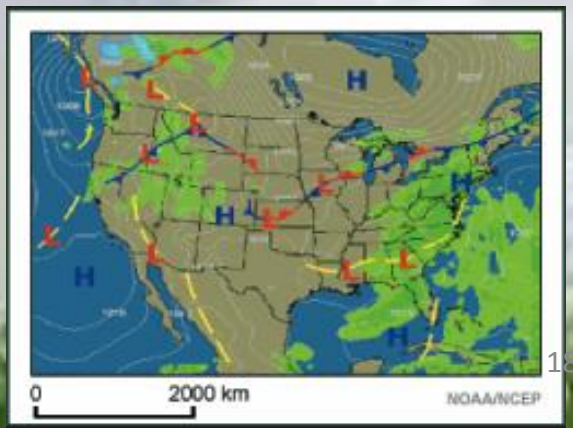
In meteorology has been accepted to imply "simultaneous" since the "view of the whole" is obtained by mapping observations made simultaneously at a number of locations.

Synoptic scale

Weather systems having scales of hundreds of kilometers and time scales of a few days are generally accepted to be "synoptic scale" phenomena (Air masses, fronts, and pressure systems).

Definition: a scale at which atmospheric phenomena at horizontal dimensions that are much larger than their vertical dimensions.

$H/L << 1$



Important Scales

Atmospheric processes encompass a wide range of scales

Spatial and Temporal Scales	Example Process
Molecular (<< 2 mm, >min)	Diffusion
Microscale (2 mm - 2 km, hours)	In cloud processes
Mesoscale (2 - 2000 km hours to days)	Tornadoes to Thunderstorms
Synoptic (500 - 10,000 km days to weeks)	Weather Systems: Anticyclones, Cyclones, Fronts
Planetary (> 10,000 km, > weeks)	Global Circulation