MET 4300/5355 Severe & Hazardous Weather

Lecture 1 : Course Introduction

Please carefully review the Canvas syllabus to know the course structure well before you start the lecture

Course Topics

- **About 1/3 of the whole course will cover some very basic meteorology concept (lec 1-9; textbook CH1-3 & 6-9)**
- **The rest: different types of severe & hazardous weather including lee cyclone, northeasters, ice storms, lake-effect snow, cold waves, blizzards, mountain snowstorms, mountain windstorms, thunderstorms, tornadoes, hailstorms, lightning, downbursts, and floods.**

What is severe weather?

- NWS's severe thunderstorm/weather definition:

  1) large hail (diameter>= 1 inch; was ¾ inch before Jan 2010)

  Or **2) wind damage or wind gusts >= 50 kt (58 mph)**

  Or **3) a tornado**

  Or **all of the above** (all of these elements are associated with strong updrafts)

Severe Weather = "MESOSCALE" Weather

- Meso = Middle, between Macro- and Micro-scale
- Or between "Synoptic" and "Convective"
- Actually includes Convective scale, too.
- Horizontal scale is determined by surface properties or natural scales of convective systems
- Vertical scale is defined by the depth of the troposphere.

What is Hazardous Weather?

- **The definition is much broader than severe weather.**
- **Hazardous weather includes all types of weather that has hazardous impacts.**
- **It includes almost all scales of weather systems, not only mesoscale.**

Table 2.4. Weather systems on or near the ground

Disturbance	Scale	Duration	Max. wind
Extratropical cyclone	500–2000 km	3–15 days	55 m s^{-1}
Cold front	500–2000 km	3–7 days	25 m s^{-1}
Anticyclone	500–2000 km	3–15 days	10 m s^{-1}
Warm front	300–1000 km	1–3 days	15 m s^{-1}
Hurricane	300–2000 km	1–7 days	90 m s^{-1}
Tropical cyclone	300–1500 km	3–15 days	33 m s^{-1}
Tropical depression	300–1000 km	5–10 days	17 m s^{-1}
Dry front	200–1000 km	1–3 days	20 m s^{-1}
Midget typhoon	50–300 km	2–5 days	50 m s^{-1}
Mesohigh	10–500 km	3–12 h	25 m s^{-1}
Gust front	10–300 km	0.5–6 h	35 m s^{-1}
Mesocyclone	10–100 km	0.5–6 h	60 m s^{-1}
Downslope wind	10–100 km	2–12 h	55 m s^{-1}
Macroburst	4–20 km	10–60 min	40 m s^{-1}
Microburst	1–4 km	2–15 min	70 m s^{-1}
Tornado	30–3000 m	0.5–90 min	100 m s^{-1}
Suction vortex	5–50 m	5–60 s	140 m s^{-1}
Dust devil	1–100 m	0.2–15 min	40 m s^{-1}

Scales of Atmospheric Motion (version 1)

Scale	Length	Time
Planetary	~6000 km (R_e)	Weeks
Synoptic	~ 2000 km	days to a week
Meso-α	2000-200 km	A day or two
Meso-β	200-20 km	A day-hours
Meso-γ	20-2 km	Hours-minutes
Convective	*5 km – 500m*	*Minutes*
Micro	< 2 km	Minutes-seconds

Orlanski, 1975

Scales of Atmospheric Motion (version 2)

- *Planetary scale – These circulations last for weeks or months, and extend* in size from 5000 to 40,000 km (~6000 km).
  - Examples are the Asian monsoon, *El Nino, and La Nina.*
- *Synoptic scale – These circulations last from days to weeks, and range in* size from 100 to 5000 km (~2000 km).
  - Examples are the high- and low-pressure systems we see on weather maps.
- *Mesoscale – These circulations last from minutes to hours, and range in size* from 1 to 2000 km.
  --Examples are thunderstorms, tornadoes, and land-sea breezes.
- *Microscale – These are the smallest circulations, lasting under a few minutes,* and being less than 2 km in size.
  --Examples are wind gusts and dust devils.

Summary

- Severe weather
  - Large, damaging hail (>20 mm, or ¾ inch in diameter)
  - Damaging winds (>60 mph, 50 kt, or 25 m s^{-1})
  - Tornado
  - Or all of the above
- Hazardous weather: include all scales of weather
- Scales of motion
  - Planetary & synoptic—balanced > 2000 km
  - Mesoscale---nonbalanced, 2000-2 km
  - Convective—buoyant motions, 5-0.5 km (scale height)
  - Microscale---near surface < 1 km