METEOROLOGICA

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NOTAE ELEMENTARIAE

MOVEMENT OF PRESSURE SYSTEMS

(Data are for continental U.S.)

Pressure

- Avg. air pressure at sea level is 29.92 in. (1013.3 mb). Pressure falls off rapidly with height.

Speed

- Avg. 500 –700 mi./day (lowest summer, highest winter)

Internal Circulation

- Around lows: CCW towards center
- Around highs: CW from center
- Buys Ballot's Law (1857): With your back to the wind, Low is to the Left. (Reliability increases with wind speed.)
- Wind speed increases toward the center.

Large-scale circulation

General

- Prevailing movement [in N. hemisphere] is westerly. Most large-scale systems are ~600 miles across.
- Average pressure over land is lower in summer than in winter; over water, higher in summer than in winter. (This is due to the different heating properties of land and water. Sunlight heats transparent water to a greater depth; heat is more deeply distributed, and surface heat therefore changes much less than land.)
- The U.S. is accordingly flanked in summer by two highs: the Atlantic (¢ SE of Bermuda) and Pacific.
  In winter, the U.S. is flanked by the Aleutian and Icelandic lows.

Air masses

- The main sources of the air masses (homogeneous masses that develop over a large area with uniform conditions) affecting the U.S. are:
  1) Canada (the Canadian High), spreading to S, E, and sometimes SW. Stronger in winter than in summer.
  2) Gulf and Caribbean, pushed N by the Atlantic High. [High circulates CW, so movement is from southerly direction.] Strongest in summer. Drawn N especially by lows over central U.S. Can cover all of U.S. E of Rockies.
  3) Maritime Pacific polar air mass brings the West Coast its weather; considerably dried out and attenuated by passage over Rockies, thus not a major factor for East Coast.
- Air masses from Canada and the Gulf/Caribbean tend to alternate with each other in the eastern U.S.

Fronts

- Strong air masses meeting form fronts. These generally come from NW Canada, the Pacific, or the Gulf, or develop in the SW or the western plains. Fronts are less pronounced in summer.
- Cold fronts move rapidly (500–700 mpd), are steeply sloped (may be retarded near ground).
- Warm fronts have shallower slopes (1 mi. in 50–200 mi.), are slower than cold fronts (250–500 mpd).

Local effects

- "Air masses split and flow around cities [which are heat islands], and when those air masses meet again on the other side, clouds and thunder storms are often the result." (*OFA* Weather Supplement, '02.)

STRUCTURE OF THE ATMOSPHERE

(Data are for continental U.S.)

Ionosphere from 50–60 mi. Bounces radio waves.

Stratosphere from ~8–50/60 mi.
Wind speed decrerases with height. Temperature decreases with height to [~30s F], then increases.

Tropopause Shallow [<5000 ft.] zone [of transition].
Higher wind speeds than troposphere: 150–200 mph common.

Troposphere to avg. ~40,000 ft.
Zone in which both vertical and horizontal circulation are important in short term.
Wind speed increases with height. Temperature decreases with height (~3.5°/1000 feet).

Cirrus from ~20,000 ft.

Altus ~6500–~20,000 ft.

Stratus <~6500 ft.

PRECIPITATION

Hail: ice drops that form and grow in the clouds

Sleet: raindrops that freeze on the way down

Freezing rain: rain that freezes on the ground.

0.1 inch of rain = ~1 inch of snow.

0.01 inch of rain over one acre represents 1.1 tons of water. A typical cumulus cloud, ~.5 mile x .5 mile, contains about 500 tons of water.

SEVERE WEATHER

On the various official "watches" and "warnings", v. *OFA* '02, p. 286.

LOCAL NOTES: MINNESOTA

See also weather clippings in Local/Relocation folder.

NOAA Minnesota; NWS terminology:

Z in times = GMT

CWA = County Warning Area, roughly = all of MN from Brainerd S, and the W third of WI. See downloaded in Misc. Info *f*: this is the CWA covered by the Twin Cities office, per Craig Potter.

TC NOAA radio weather station: 162.550 MHz. See NOAA map (in notebook) for rest of MN and western WI.

Winter temps, based on one day's NWS figures: "Twin Cities" and Chanahassen temps much the same, except Chanhassen can be 1–3 degrees colder at night.

MSP barometer higher than Plymouth (first)

2005: 4/6/05. (Slight reversal 4/22, accompanied by forecasts of 30° and 32° for following nights.)

2006: MSP almost constantly higher through the winter, contrary to usual.

2009: Interesting. An unusually cool spring and early summer. Readings very close through at least beginning of July, showing signs of making the usual divergence only when the hot weather gave signs of becoming well established during the heat wave of late June, and then converging again when the weather cooled. Possibly diverging as of 7/3, with temps holding around 80° but very high humidity. NOTE: Am now using Crystal, not MSP.

2010: Cold winter, but spring very early, not warm. Readings very close through at least 5/3.

HISTORICAL VARIATIONS

SN 7/21/01, 160.37. Above-average number of hurricanes in N. Atlantic in last 6 years. Previously quiet from 1971–94, since has doubled, and proportion of storms developing into major hurricanes has grown. A pattern is suggested by records, though the adequacy of the records for prediction is disputed. A previous quiet period was the 1900s–mid-20s; a heavier period then followed, lasting through the 60s. This suggests that activity may be high for several decades to come. Hurricane activity correlates directly with sea-surface temperature rise above 27°C, and negatively with wind shear, in the region where the storms form, between 10°N and 20°N (Northern SAm to Cuba). Cf. *OFA* 2006, p. 190–1: cycle is attributed to cyclical changes in the Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation; the cycle we have entered is associated with warming temps, high hurricane activity, and drought in the West and Midwest like that of the Dustbowl years.

SN 160.80, 8/4/01. Blurbs for several interesting books on the fluctuations of weather through history (all scales), and global warming.

SN 158.87, 8/5/00. Snow coverage in NAm in winter of 99–00 much less than usual—amng the lowest in the last 30 years, continuing a trend stretching back to the late 80s; from late 60s to early 80s, cover was more extensive than average. Lack of snow means drought for Midwest and Rockies.

NOTAE MISCELLANEAE

[NWS]: Special note concerning wind speed and direction. In addition to the linear trace of the magnitude of the wind, the wind direction is also shown using what is called a "wind barb". The wind barb is always point in the direction that the wind is coming from. The magnitude of the wind on a wind barb is calculated using the attached flags at the end of the wind barb. A long wind flag is 10 mph, a short wind flag is 5 mph, and a triangle wind flag is 50 mph. So, if you see a wind barb with two long flags and one short flag on it, the forecast wind speed would be 25 mph.

NG 8/08.80 (article on hurricanes, also interesting basics on weather): Hurricane generation: "Increased circulation [i.e., increased speed of ocean current circulation bringing warm surface water north] brings mighty storms—born as air spirals into a low-pressure zone charged with warm, humid air over warmer sea surfaces. The winds meet and ascend, causing clouds to billow upward, further lowering air pressure and causing winds to barrel even faster toward the center. The Earth's rotation lends spin to the gathering cyclone. When water vapor in the ascending clouds cools and falls as rain, the amount of heat energy released dwarfs the amount of electricity consumed daily by all of humanity. The energy warms the eye, further lowering the pressure and strengthening the storm."

QUESTIONS

Is there a *direct* relation between barometric pressure and humidity? (Does, perhaps, lower pressure allow significantly more water to move into air than higher pressure at the same temperature?)

BIBLIOGRAPHIA & RESOURCES

BOOKS

Note also data in folder.

Anthes, Richard A. *Meteorology*. 7th ed. Upper Saddle River, N.J.: Prentice Hall, 1997.
SIBL circ. 551.5 M
Careless and spotty, jumping apparently without plan from basic explanations to highly technical matter. Many typos, e.g., "circus" and "culpulus" clouds. Withal, a lot of information is there.

Day, John A. *The Book of Clouds.* Boston: Houghton Mifflin Company, 1981.
"Dr. John 'Cloudman' Day—author of the celebrated Book of Clouds . . ."
Book of Clouds: [2005], IP, PB, $20 new, from $7 used. Not in Hennepin, Mpls, UMN.

———, and Vincent J. Schaefer. *A Field Guide to the Atmosphere*. Peterson Field Guides series.
"deemed the most enduringly popular among all sky classics."

Fisher, Robert Moore. *How to Know and Predict the Weather*. New York: New American Library, 1953. (Original publication: *How About the Weather?*. New York: Harper & Brothers, [1951].)

Old Farmers' Almanac. Passim. Note also separately bound weather supplement to 2002 issue.

PERIODICAL ARTICLES

See also clippings in folder.

Science News.
8/25/01p127: Sahara predicted to get hotter, dryer, smaller; its recent variations.

160.199, 9/29/01. Very interesting feature article on history and role of dust in climate. Inter alia, much dust comes from erstwhile silt in arid areas that were flooded during recent Ice Ages. Dust from Africa is a major component in the soils of the Caribbean and the Amazon Basin. During glacial periods, there was apparently 10 to 100 times as much dust in the atmosphere as in interglacial periods. Also p. 207: dust from Africa feeds red tides.
160.218–20, 10/6/01. Continuation of above. Transfer of microorganisms by dust storms.

156.278, 10/30/99. On current La Niña.

159.95, 2/10/01. On "Siberian high", its possible causes, and its effects on NAm climate.

National Geographic.
3/99. On El Niño–La Niña cycle. Very good explanation of its causes and reverberations.

10/00 pp. 86–116. Very interesting and comprehensive article on ocean circulation and its impact on climate.

8/06: Hurricanes: contributing factors, predictions

Scientific American.
Spring 2000 quarterly special issue on weather. Have.

EQUIPMENT

Catalogues.

Radio Shack has *lots* of weather goodies in several places in their catalogue.

DIFFERENCES BETWEEN COASTAL AND INLAND TEMPERATURES; SEASON VARIATIONS IN COASTAL EFFECT: NYC REGION

Rank by mean annual temperature		first 32°	appx. straight-line mileage from Central Park
Central Park[1]	54.5°	11/11	—
LaGuardia[1]	54.3		5
Newark[1]	54.2	~11/1	12
JFK	53.1		13
Hartford	49.8	10/15	90 (37 from Sound)
Syracuse	47.7	10/16	215
Albany	47.3	9/29	145
Binghampton	45.6	~10/5	151

1) Newark and Central Park always within 1°. Newark, laGuardia, and Central park vary over a range of 2° max; LaGuardia is always more moderate than others.

Tentative conclusions, without data for Orange or Rockland:

Upstate always cooler than city, except perhaps in high summer *during the day*.

— difference greater in winter (10° Binghamton, days) than summer (6° Binghamton, days). Note Hartford and Central Park virtually the same in high summer.

— difference greater (by 1–2° at most, in summer) at night than during day.

Shore is always slightly cooler than a few miles inland (but note that Central Park must be a peculiar climatic island).

— difference greater in summer (2° CtlPk/JFK) than winter (<1° CtlPk/JFK).

— difference greater during day than at night

Long-range moderating effect of ocean is greater in winter and at night.

Short-range moderating effect of ocean is greater in summer and during day.