Fair or Foul: Bibliography Part 1

by Iver Cooper | Dec 16, 2020 | 1632 Tech, Gazette Extras, Iver Cooper

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Notes for parts 3 and 4

1) Lynch also converted the ENIAC program to Java ME and ran it on a Nokia 6300 smartphone. "PHONIAC exected the main loop ... in less than one second." (LynchPHONIAC). Lynch comments that the Nokia 630 runs at 237 MHz, with one million instructions per second, and that one instruction translates to one floating point operation, so its peak speed is 237 MFLOPS. He also indicates that making full use of its vector features, the 1976 CRAY-1 supercomputer (80 MHz) peaked at 250 MFLOPS. (70 MFLOPS per Collier 13; 80, Chopra 298).)

2) While Richardson's 1922 six hour "forecast" was done originally by hand, there have been reanalyses by computer. Richardson looked at conditions over Central Europe. for May 20, 1910. At that time, upper air observations were made only intermittently, but there were 12 soundings and 18 reports of upper level winds. Bjerknes used these to prepare charts of height at ten standard pressure levels. Richardson divided the atmosphere into five layers (centered at 100,

300, 500, 700, 900 hPa), and the horizontal grid points were separated by 3 degrees longitude and 1.8 degrees latitude.

The reanalysis omitted many terms which, with the benefit of hindsight, are known to be marginal. On the other hand, it used a digital filter to avoid Richardson's initialization problems.

3) Lorenz (of "butterfly effect" fame) considered empirical forecasting based on a multiple regression analysis of an entire pressure field grid. Of course, even if the grid were just 96 cells, that would mean 96 degrees of freedom and the regression model would not fare well. Lorenz therefore simplified the picture by approximating the pressure field with a sum of "orthogonal functions." For a field of 64 stations in the USA, he found that he could account for 91% of the variation with eight matrix functions. Sine waves are orthogonal and a Grantville scientist might try using a sum of sine waves of different phase, amplitude and wavelength (a Fourier series) for this purpose.

4) Assumptions for modeling the vertical ascent rate of a balloon: no vertical current or extrinsic turbulence, the aerodynamic drag force is proportional to the air density, the balloon's cross-sectional area and the square of its vertical velocity, the mass of the balloon envelope negligible, the cross-sectional area proportional to the 2/3 power of the volume (as for a sphere), the lift gas follows the ideal gas law, and internal temperature and pressure equal to ambient, and the atmosphere follows the international standard atmosphere.

However, there are lots of small deviations from the idealized picture:

-despite this increase in theoretical speed, the Reynolds number decreases, and at some altitude there is a transition from turbulent flow to laminar flow, and a consequent increase in the drag coefficient (Gallice). The Reynolds number is the density * velocity * length in flow direction, all divided by the dynamic viscosity. The length changes as the balloon expands. The density and viscosity both change with altitude; density with both temperature and pressure and viscosity mostly with temperature.

-The lift gas is cooled by adiabatic expansion at a faster rate than the ambient air. On the other hand, it is warmed by convection and radiation. (Yajima).

–Speed can be affected by vertical air currents, inflation pressure, and turbulence in the lower atmosphere (MiddletonMB 172).

5) Polyethylene envelopes may be needed for probing the atmosphere above 38 km (Kumar) but polyethylene is not likely to be available in the 1630s, see Cooper, Industrial Alchemy part 5.

6) The grid resolution of some of the early NWP models was chosen because of the limitations of period line printers (10 print characters per inch and six lines per inch). With a resolution of 381 km, if the map scale was 1:10,000,000, the output distance between grid points was 1.5 inches, and thus each grid point corresponded to a print point. The same was true for a grid resolution of 254 km (1 inch distance) or 127 km (0.5 inch distance).(Lynch2006, 197).

7) Bartlett (1906) correlated precipitation, pressure, temperature, and 24 hour changes with the weather 24 hours later further east, and came up with "specimen rules" such as "A general rise of temperature in the Dakotas, amounting to 60 or more, accompanied by rain in the Southwest (Oklahoma and Kansas" indicates rain either the next night or the following day" in Wisconsin.

8) Strictly speaking, a barotropic atmosphere is one in which density varies only with pressure, there is no horizontal temperature gradient. The tropics tend to be close to barotropic. If there is a temperature gradient, the atmosphere is baroclinic. An equivalent barotropic atmosphere is baroclinic, but the isotherms are parallel to the isoheights, and hence the wind increases in strength with height, but does not change direction.

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