**Weather Data**

**source: http://harvardforest.fas.harvard.edu:8080/exist/apps/datasets/showData.html?id=hf001**

**hf001-10: 15-minute (metric) since 2005**

1. datetime: date and time at end of sampling period
2. jd: Julian day (unit: nominalDay)
3. airt: air temperature. Average of 1-second measurements. (unit: celsius / missing value: NA)
4. f.airt: flag for air temperature
   1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
   2. Q: Questionable. Possible problem with instrument.
   3. E: Estimated. Value estimated from incomplete measurements or from other sources.
5. rh: relative humidity. Average of 1-second measurements. (percent) (unit: number / missing value: NA)
6. f.rh: flag for relative humidity
   1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
   2. Q: Questionable. Possible problem with instrument.
   3. E: Estimated. Value estimated from incomplete measurements or from other sources.
7. dewp: dew point. Average of 1-second values calculated from air temperature and relative humidity. (unit: celsius / missing value: NA)
8. f.dewp: flag for dew point
   1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
   2. Q: Questionable. Possible problem with instrument.
   3. E: Estimated. Value estimated from incomplete measurements or from other sources.
9. prec: precipitation. Includes water equivalent of snow. Total value for 15-minute period. Measured in increments of 0.01 inch. (unit: millimeter / missing value: NA)
10. f.prec: flag for precipitation
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
11. slrr: global solar radiation. Average of 1-second measurements. (unit: wattPerMeterSquared / missing value: NA)
12. f.slrr: flag for global solar radiation
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
13. parr: photosynthetically active radiation. Average of 1-second measurements. (unit: micromolePerMeterSquaredPerSecond / missing value: NA)
14. f.parr: flag for photosynthetically active radiation
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
15. netr: net radiation. Includes short and long wave. Average of 1-second measurements. Corrected for wind speeds above 5 m/s using Cambell Scientific equation. (unit: wattPerMeterSquared / missing value: NA)
16. f.netr: flag for net radiation
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
17. bar: barometric pressure. Corrected for elevation. Average of 1-second measurements. (unit: millibar / missing value: NA)
18. f.bar: flag for barometric pressure
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
19. wspd: horizontal scalar wind speed. Average of 1-second measurements. (unit: metersPerSecond / missing value: NA)
20. f.wspd: flag for horizonal scalar wind speed
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
21. wres: horizontal resultant vector wind speed. Vector average of 1-second measurements. (unit: metersPerSecond / missing value: NA)
22. f.wres: flag for horizonal resultant vector wind speed
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
23. wdir: horizontal vector wind direction. Vector average of 1-second measurements. Measured in degrees clockwise from true north. (unit: degree / missing value: NA)
24. f.wdir: flag for horizonal vector wind direction
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
25. wdev: standard deviation of wind direction. Calculated from 1-second measurements using Campbell Scientific equation. (unit: degree / missing value: NA)
26. f.wdev: flag for standard deviation of wind direction
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
27. gspd: gust speed. Maximum of 1-second measurements. (unit: metersPerSecond / missing value: NA)
28. f.gspd: flag for gust speed
    1. Q: Questionable. Possible problem with instrument.
    2. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.
29. s10t: soil temperature at 10cm depth. Average of 1-second measurements. (unit: celsius / missing value: NA)
30. f.s10t: flag for soil temperature
    1. M: Missing. Instrument not installed, instrument not working correctly, or measured value out of range.
    2. Q: Questionable. Possible problem with instrument.
    3. E: Estimated. Value estimated from incomplete measurements or from other sources.

Hemlock Eddy Flux

**Source: http://harvardforest.fas.harvard.edu:8080/exist/apps/datasets/showData.html?id=hf103**

**hf103-03: eddy flux (2004-2013)**

1. datetime: date and time
2. year: year
3. doy: day of the year with hours and minutes converted to a decimal fraction of a day (unit: nominalDay / missing value: NA)
4. **co2: carbon dioxide concentration of the air drawn into the eddy covariance system at 28 m above ground or about 5 m above the average tree canopy top (measured by Licor LI7000 gas analyzer). Height raised to 29 m in November 2006. (unit: dimensionless / missing value: NA)**
5. h2o: water vapor concentration of the air drawn into the eddy covariance system at 28 m above ground or about 5 m above the average tree canopy top (measured by Licor LI7000 gas analyzer). Height raised to 29 m in November 2006. (unit: dimensionless / missing value: NA)
6. u: wind speed measured by the sonic anemometer at 28 m or 5 m above the average tree canopy top. Height raised to 29 m in November 2006. (unit: metersPerSecond / missing value: NA)
7. ustar: friction velocity measured by the sonic anemometer at 28 m. Friction velocity is the square of momentum flux from the atmosphere above the sonic to the air layers below the sonic, and is a measure of atmospheric turbulence (unit: metersPerSecond / missing value: NA)
8. wdir: compass direction in degrees of the average wind vector at 28 m, with 0 and 360 degrees indicating geographic north (unit: degree / missing value: NA)
9. h: sensible heat flux from the forest to the atmosphere, calculated by the sonic anemometer from the covariance of air temperature and the vertical component of wind velocity (unit: wattPerMeterSquared / missing value: NA)
10. le: flux of latent heat (heat used in evaporating water) from the forest to the atmosphere, calculated by multiplying FH2O by the heat of evaporation of water (unit: wattPerMeterSquared / missing value: NA)
11. fco2: measured carbon dioxide (CO2) flux from forest to atmosphere. Includes all data collected, some of which do not represent hemlock-dominated forest or are invalid (unit: micromolePerMeterSquaredPerSecond / missing value: NA)
12. **hem.fco2: CO2 flux data exclusively for hemlock-dominated forest, which occurs primarily to the SW of the tower (compass directions of 180 to 270 degrees) (unit: micromolePerMeterSquaredPerSecond / missing value: NA)**
13. hem.fco2.filtered: CO2 flux data exclusively for hemlock-dominated forest, which occurs primarily to the SW of the tower (compass directions of 180 to 270 degrees), and after removal of data that with friction velocity (ustar) below 0.4 m/s in which the measured nighttime CO2 flux appeared to be turbulence-limited and not representative of ecosystem CO2 production (unit: micromolePerMeterSquaredPerSecond / missing value: NA)
14. hemlock.fco2.est: best estimate of CO2 flux, using either valid measurement from the column to the left, or a model estimate (unit: micromolePerMeterSquaredPerSecond / missing value: NA)
15. nee.est: binary variable identifying whether measured FCO2 or an estimate was used
    * 0: estimate
    * 1: measured FCO2
16. r.est: estimated ecosystem respiration. This is equal to Hemlock.FCO2.ustar.filtered at night, if this is available. Otherwise, it is an estimate of CO2 production by the ecosystem, based on a statistical model that uses soil and air temperatures and valid nighttime FCO2 values to predict FCO2 under other circumstances. By definition, R is greater than zero. (unit: micromolePerMeterSquaredPerSecond / missing value: NA)
17. gee.est: estimate of gross carbon fixation by the forest, calculated difference between NEE and R. By definition, GEE is a negative number. (unit: micromolePerMeterSquaredPerSecond / missing value: NA)
18. fh2o: measured water vapor flux from forest to atmosphere. Includes all data collected, some of which do not represent hemlock-dominated forest (unit: millimolePerMeterSquaredPerSecond / missing value: NA)
19. hem.fh2o: water vapor flux data exclusively for hemlock-dominated forest to the SW of the flux tower. Low turbulence (low ustar) data are not removed as the H2O flux is primarily from the canopy, which therefore does not act as a barrier to movement of H2O, as it does for the large amount of CO2 produced by soil and forest-floor litter. (unit: millimolePerMeterSquaredPerSecond / missing value: NA)
20. hem.fh2o.est: best estimate of H2O flux, using either valid measurement from the column to the left, or a model estimate. For most periods nighttime FH2O estimates were not made, because average measured nighttime H2O flux was very close to zero. (unit: millimolePerMeterSquaredPerSecond / missing value: NA)
21. fh2o.est: binary variable identifying whether measured FH2O or an estimate was used
    * 0: estimate
    * 1: measured FCO2
22. sonic.tair: air temperature estimated from the speed of sound measured by the sonic anemometer. This estimate is based on air density, which is directly related to the speed of sound. The sonic air temperature estimate can differ from actual air temperature by a few degrees due to variation in the concentration of water vapor, which lowers air density. (unit: celsius / missing value: NA)
23. tair.above.canopy: air temperature measured above the canopy at 24 m height by a Campbell Scientific HMP35C sensor. (unit: celsius / missing value: NA)
24. rh.above.canopy: relative humidity measured above the canopy at 24 m height by a Campbell Scientific HMP35C sensor (unit: dimensionless / missing value: NA)
25. tair.above.canopy.tc: air temperature measured by a shaded thermocouple mounted at 24m, just below the top platform of the scaffolding tower to which the mast holding the sonic anemometer and air intake port for CO2 and H2O measurements is mounted at 28 m. This air temperature is used only in making flux estimates only if the HMP35C temperature sensor is not working correctly. (unit: celsius / missing value: NA)
26. vpd.above.canopy: water vapor pressure deficit (Equals saturation water vapor pressure at Tair.above.canopy, minus actual water vapor pressure calculated as saturation vapor pressure times relative humidity) (unit: kilopascal / missing value: NA)
27. tsoil.10cm: soil temperature measured at 10 cm depth. The average of 3 to 4 values at randomly located points within 15 m of the flux tower base. (unit: celsius / missing value: NA)
28. par: photosynthetically active radiation measured above the canopy at 24 m height by a Licor 190S quantum sensor (unit: micromolePerMeterSquaredPerSecond / missing value: NA)