Moisture Flux

The definition of "flux" is the measurement of transport or rate of flow of fluid, particles, or energy past a point. In particular, the product of a field of values and the wind speed is referred to as the flux of that field.

For example,

$$\vec{Q} = q\overrightarrow{V_h} \qquad (1)$$

Where Q is the moisture flux, where q is the specific humidity (g/kg) and V_h is the horizontal wind. Q is also often referred to as the water vapor transport.

Equation (1) is normally integrated through the depth of the troposphere to obtain the Integrated Water Vapor Transport (IVT).

$$Integrated\ Water\ Vapor\ Transport = \int_{Sfc}^{Trop} q\overrightarrow{V_h}\ dz = \frac{1}{\rho}\int_{Sfc}^{300mb} q\overrightarrow{V_h}\ dp \qquad (2)$$

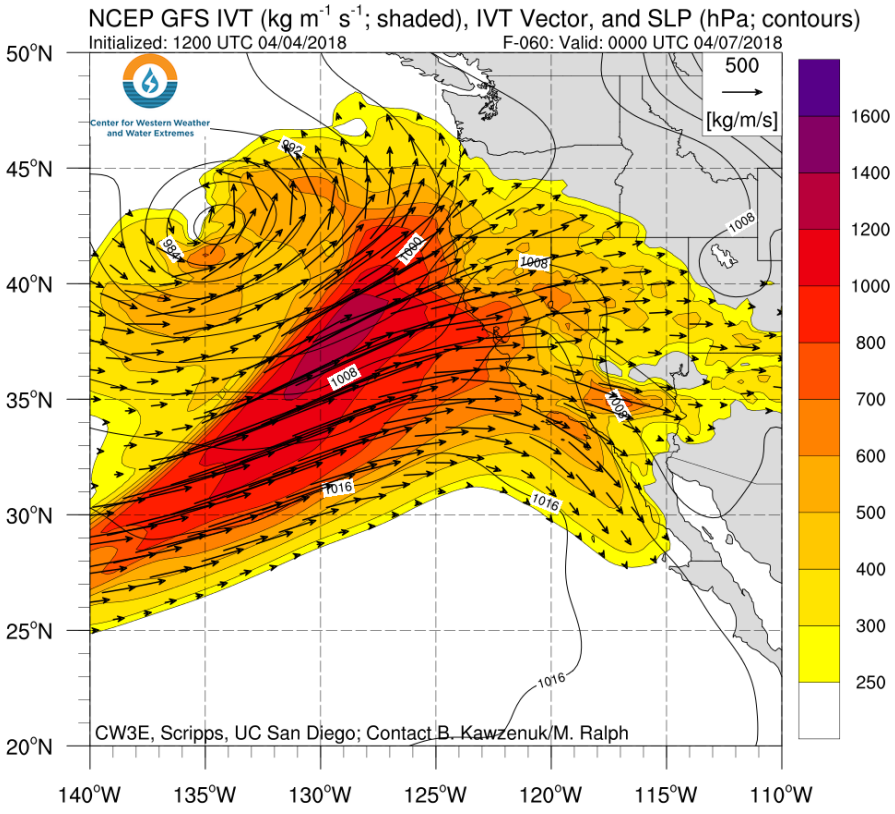
The unit for IVT after expanding the units for pressure and density is kg m^{-1} s^{-1}.

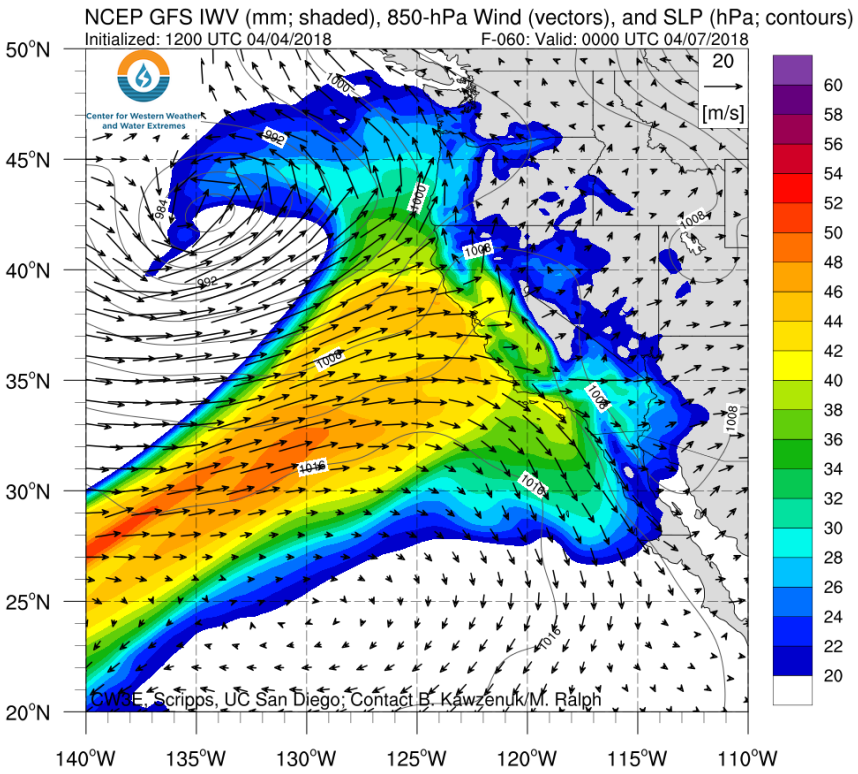
One way of interpreting IVT is that it measures the number of kilograms of water vapor that moves across 1 meter of distance in 1 second by the average wind in that layer.

Since IVT contains a scalar multiplied by a vector, it itself is a vector quantity. It will have a direction and a magnitude. Maps can be made of IVT (kg m^{-1} s^{-1}) or of time integrated values, normally plotted in kg m^{-1}.

Typical values of HIGH IVT have values of 400 or larger. Normally, values of 250 or larger are plotted and they generally correspond to about 20 cm (0.75 inch of rainfall) in Integrated Water Vapor values (PWAT).

Over short time frames $\vec{Q} = q\overrightarrow{V_h}$ can be interpreted as proportional to moisture advection.


NCEP GFS IVT (kg m-1 s-1; shaded), IVT Vector, and SLP (hPa; contours)
Initialized: 1200 UTC 04/04/2018
F-060: Valid: 0000 UTC 04/07/2018
500
[kg/m/s]
1600
1400
1200
1000
800
700
600
500
400
300
250
Center for Western Weather and Water Extremes
CW3E, Scripps, UC San Diego; Contact B. Kawzenuk/M. Ralph
50°N
45°N
40°N
35°N
30°N
25°N
20°N
140°W
135°W
130°W
125°W
120°W
115°W
110°W


NCEP GFS IWV (mm; shaded), 850-hPa Wind (vectors), and SLP (hPa; contours)
Initialized: 1200 UTC 04/04/2018
F-060: Valid: 0000 UTC 04/07/2018
20
[m/s]
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
Center for Western Weather and Water Extremes
CW3E, Scripps, UC San Diego; Contact B. Kawzenuk/M. Ralph
50°N
45°N
40°N
35°N
30°N
25°N
20°N
140°W
135°W
130°W
125°W
120°W
115°W
110°W