Vertical cross-sections of the wind using xrec5.4
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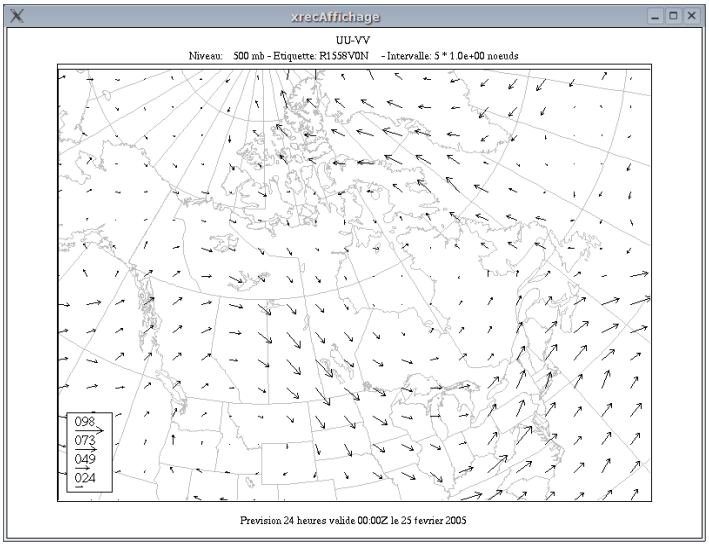
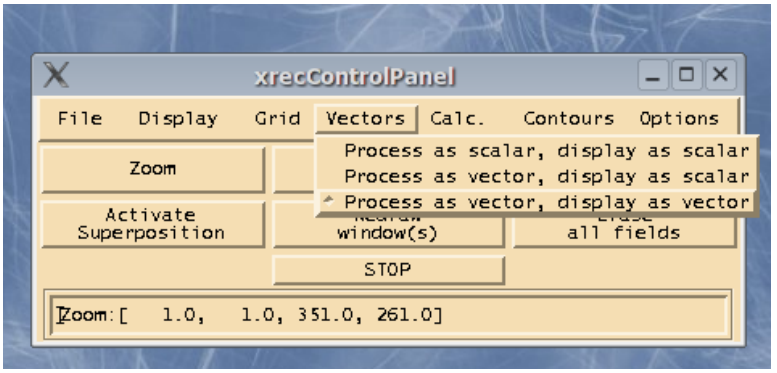
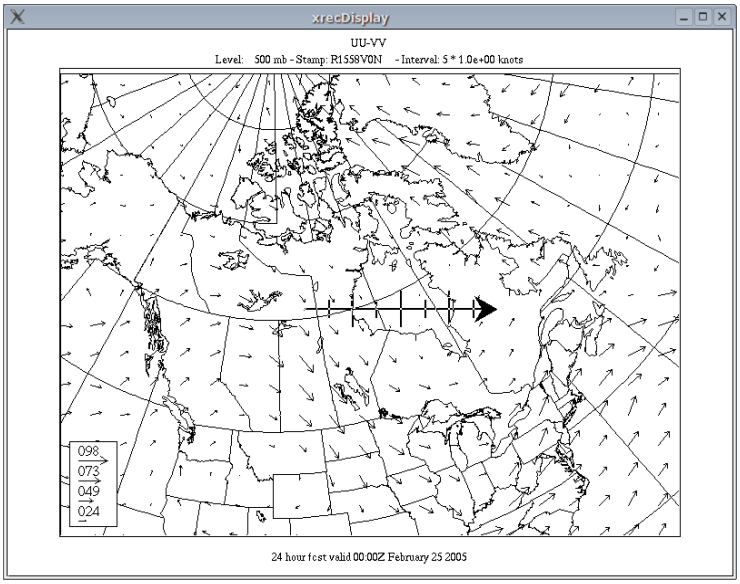
xrec has the capabilities to display vertical cross sections of the wind. The following document gives some details about the method used to display the winds.

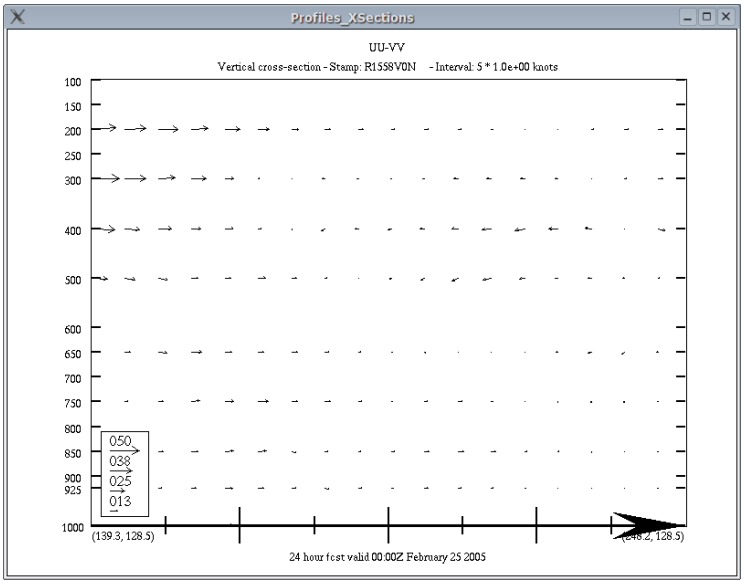
To get a vertical cross-section of the wind, you need to display UU or VV on a given level, and in the “Vector” control panel, have the “Vector” option selected.





The image below shows a cross-section of the wind, using default parameters.What exactly are we seeing here ?





To display a vertical cross-section of the wind, xrec needs to load 3 fields, UU-VV-WW. One of the problems we have here is units. UU and VV are in knots, and WW is in pascals / seconds. So we need to convert WW to knots.

To do this conversion, we need the temperature field for each level (TT) and we need to assume that we have an hydrostatic atmosphere. Using the approximation

$$\omega \approx - \rho g w \approx - pgw/RT$$

$$w \approx - \omega/\rho g \approx \ - \omega RT/pg$$

we can quickly convert the vertical motion extracted from the RPN standard files from pa/s to knots.

For example, for ω = -7.0 pa/s, T = 250 K, p = 500 mb, we get

$$w \approx - \omega RT/pg \approx -7.0\ pas^{-1} * 287\ J\ deg^{-1}kg^{-1} * 250\ deg\ /\ (50000\ pa * 9.81\ ms^{-2}) \approx 1.02\ m/s \approx \ 1.99\ knots$$

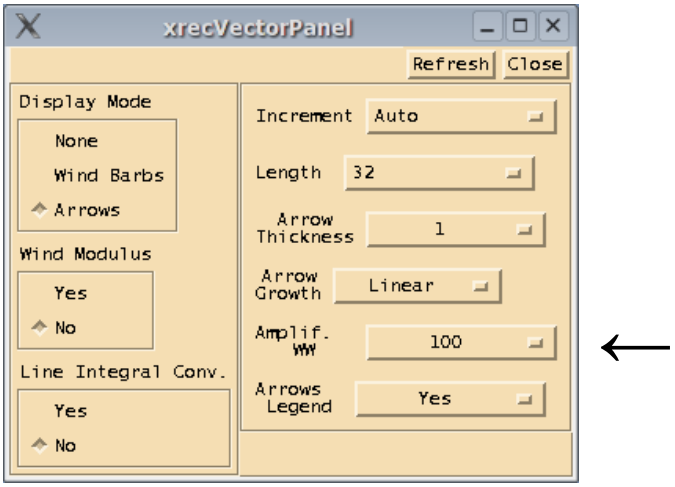
At the same location where ω=-7.0 pa^{s-1} the associated wind components are 22.0 and -9.0 knots for UU and VV. This gives a northwest wind of 23.7 knots.

When displaying vertical cross-sections of the wind, xrec shows only the component of the horizontal wind that is tangent to the angle of the cross-section. This component is computed as

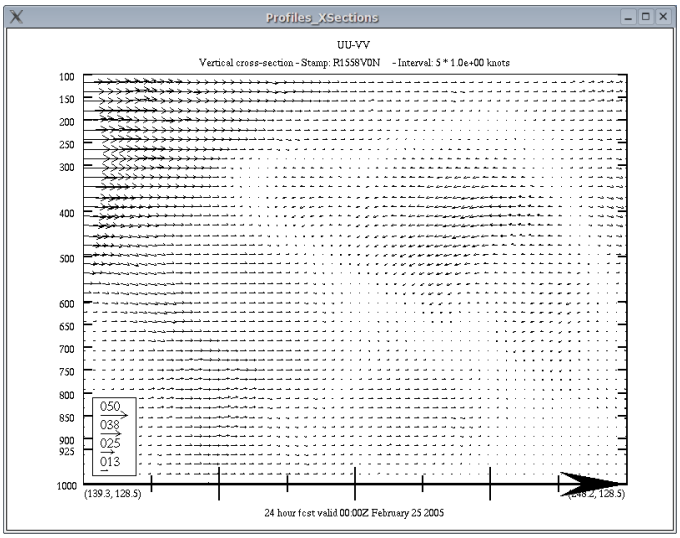
$$u_{tang} = UV * \cos(XSectionAngle - WindDirection)$$

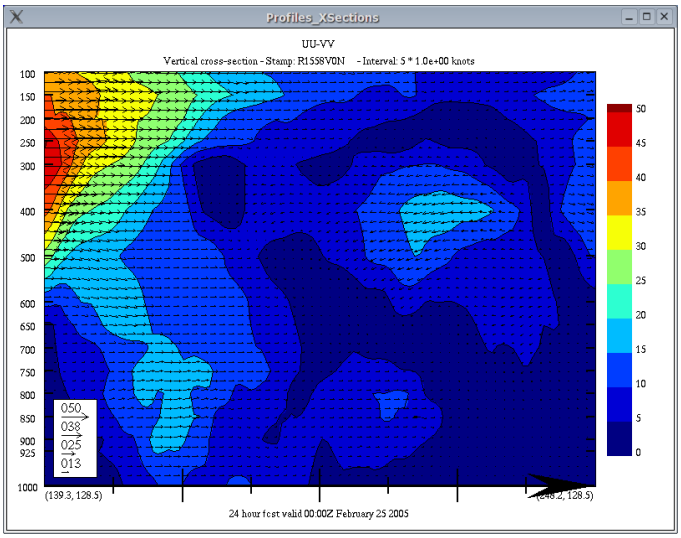
where $\mathbf{u_{tang}}$ is tangent wind component, **UV** the modulus of the horizontal wind, **XsectionAngle** is atan2(dy, dx) and **WindDirection** is atan2(VV, UU).

In the example above, -7.0 pas^{-1} is a relatively high value for ω. Even then, displaying the 3D wind as a vector gives mostly horizontal directions. To get a feeling of the vertical circulation, the vertical scale of ω needs to be exaggerated. The level of exaggeration can be set in xrec using the "**Amplif. WW**" toggle in the Vector panel.

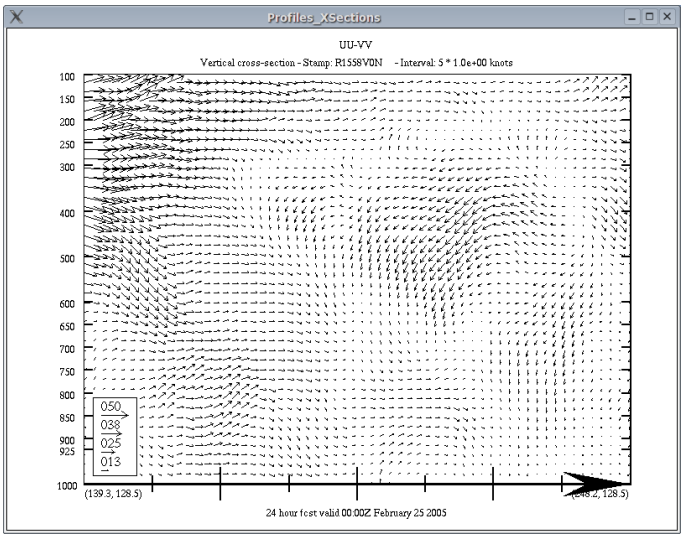


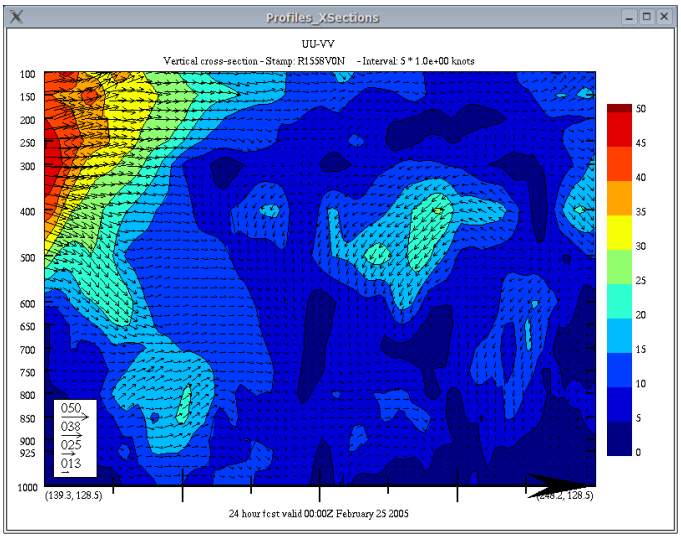
WW Amplification = 1



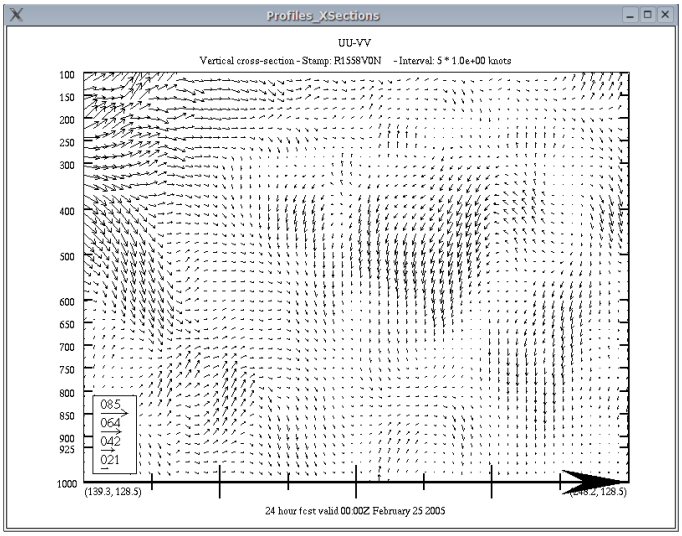


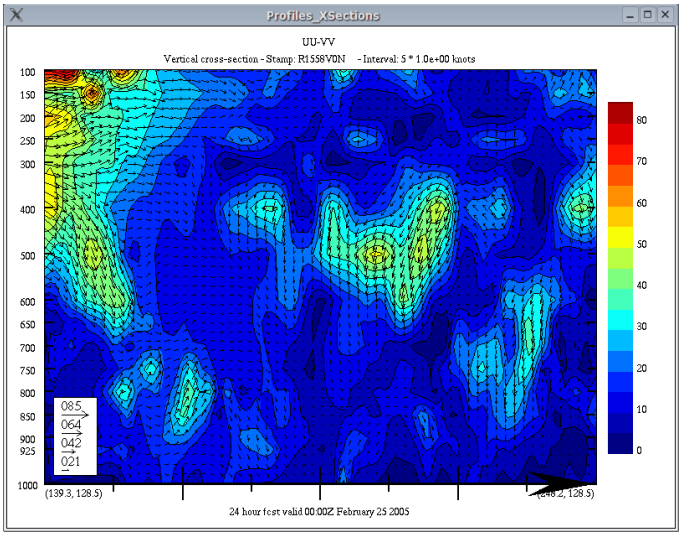
WW Amplification = 100



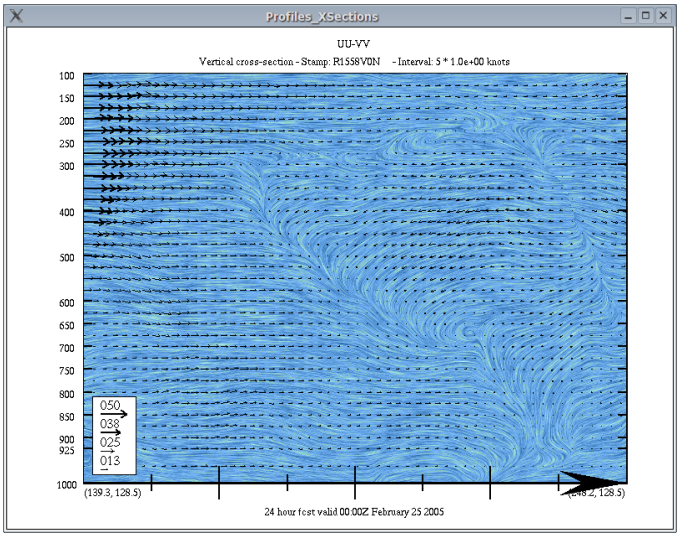


WW Amplification = 400

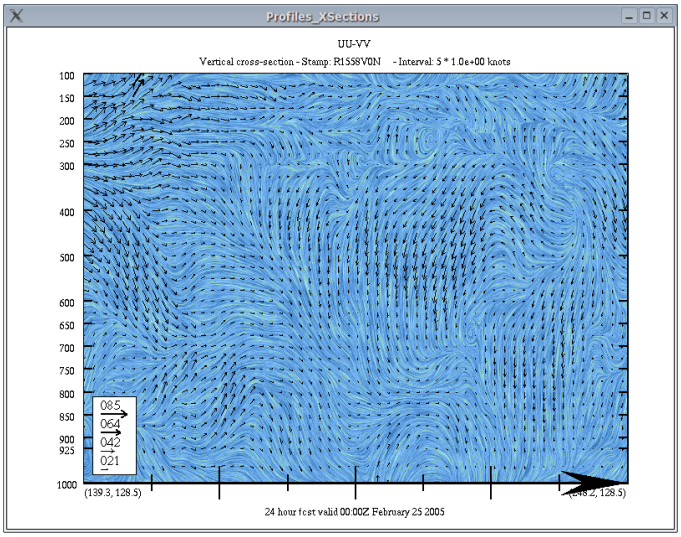




The same cross-section but with the LIC displayed.



Amplification WW = 100



Amplification WW = 400