

STREAMWISE VORTICITY

VORTICITY: a measure of localized rotation in a fluid (the atmosphere)

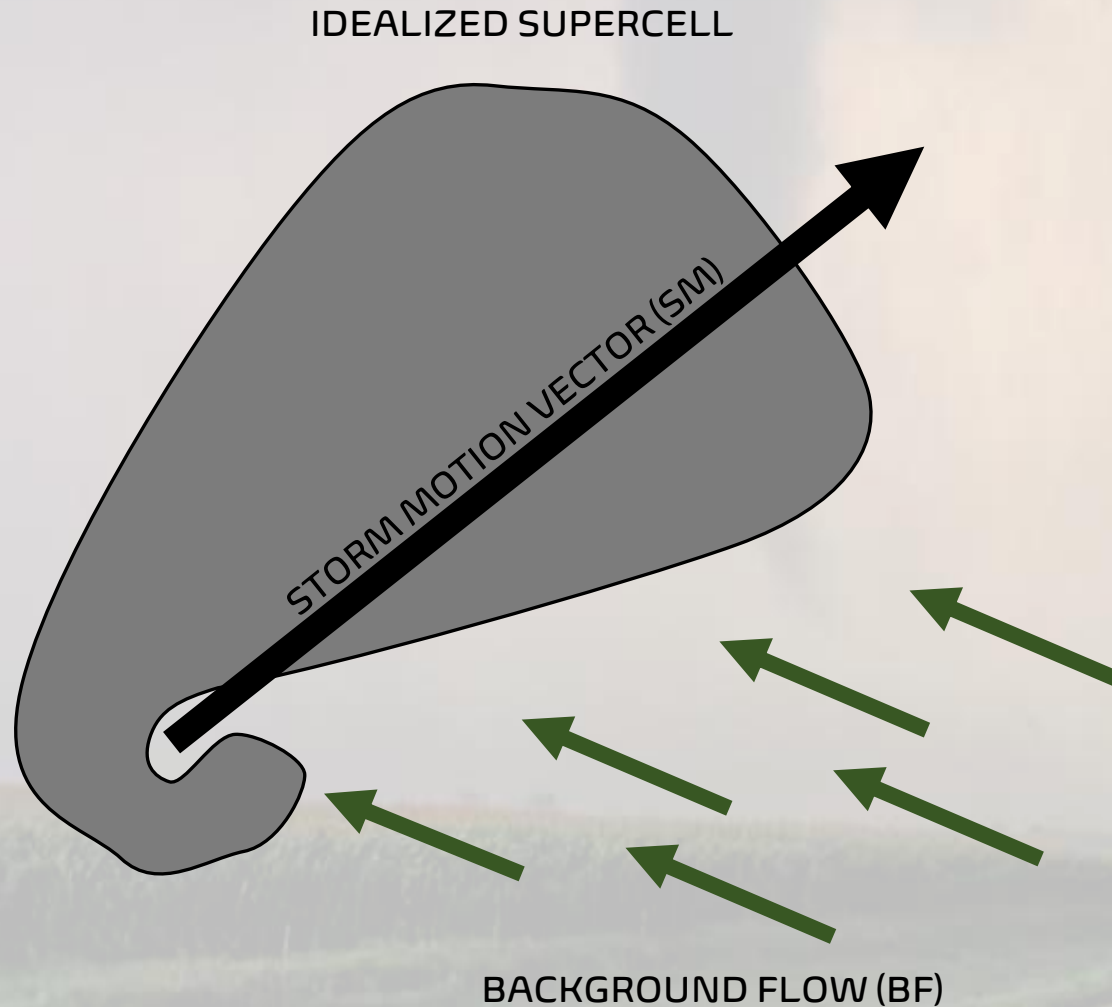
STREAMWISE VORTICITY: The component of vorticity that flows parallel (along) the direction of the Storm Relative Wind

STORM RELATIVE WIND

The wind speed and direction, usually over a specific layer, relative to a storm's forward motion



THE STORM RELATIVE WIND



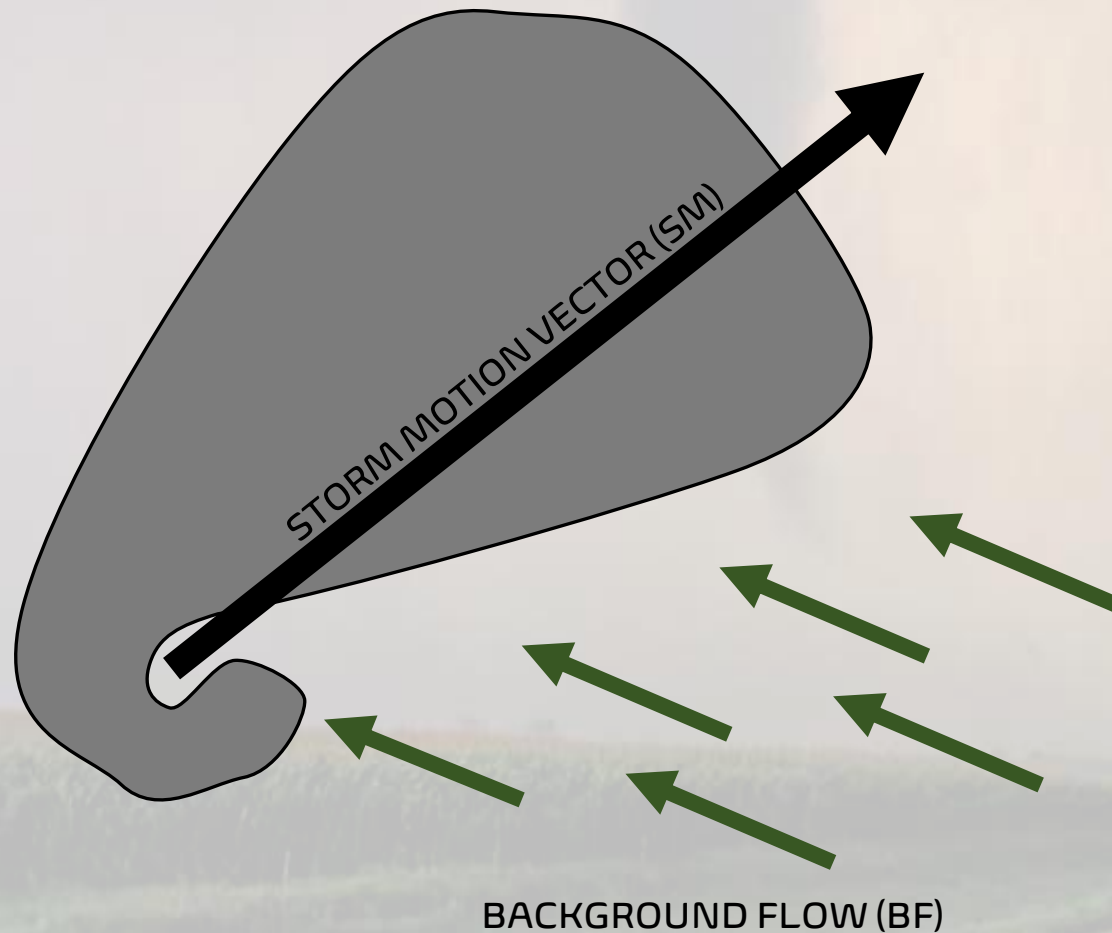
The 'wind' relative to a **storm's motion**.

A **storm** moving through an **ambient background wind field** 'feels' a 'wind' 'blowing in its face'.

This wind felt by the storm is the **Storm Relative Wind (SRW)**.

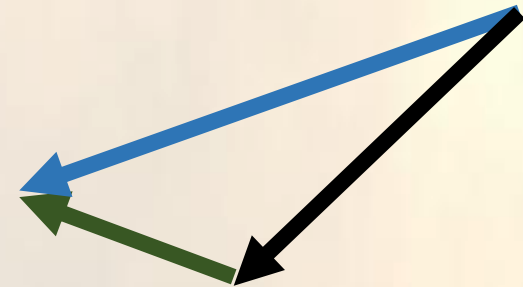
THE STORM RELATIVE WIND

IDEALIZED SUPERCELL



where

$$\overrightarrow{SM} + \overrightarrow{BF} = \overrightarrow{SRW}$$



STORM RELATIVE WIND ON THE HODOGRAPH



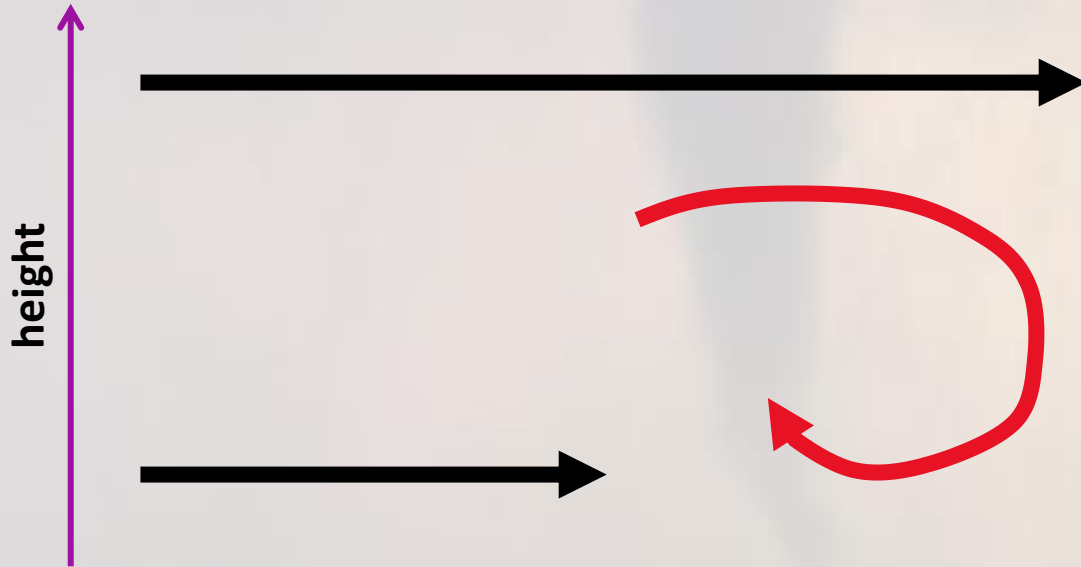
The ‘**wind**’ relative to a **storm’s motion** (in this case, ‘RM’).

The **Storm Relative Wind (SRW)**, in a very simplistic sense, “blows air into the storm’s updraft”.

II. VORTICITY



UNDERSTANDING VORTICITY



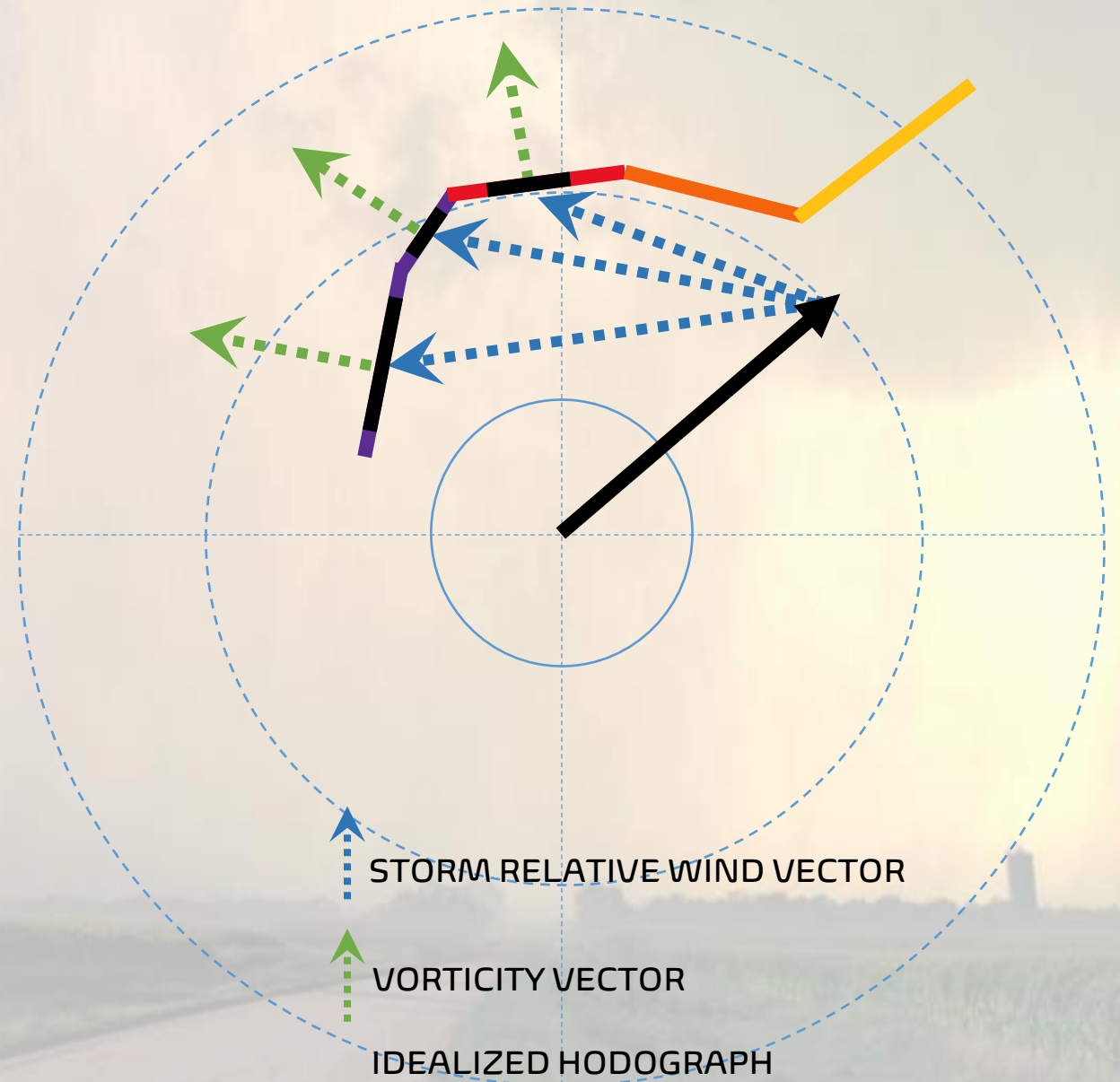
VORTICITY: a measure of localized rotation in a fluid (the atmosphere)

VORTICITY ON THE HODOGRAPH

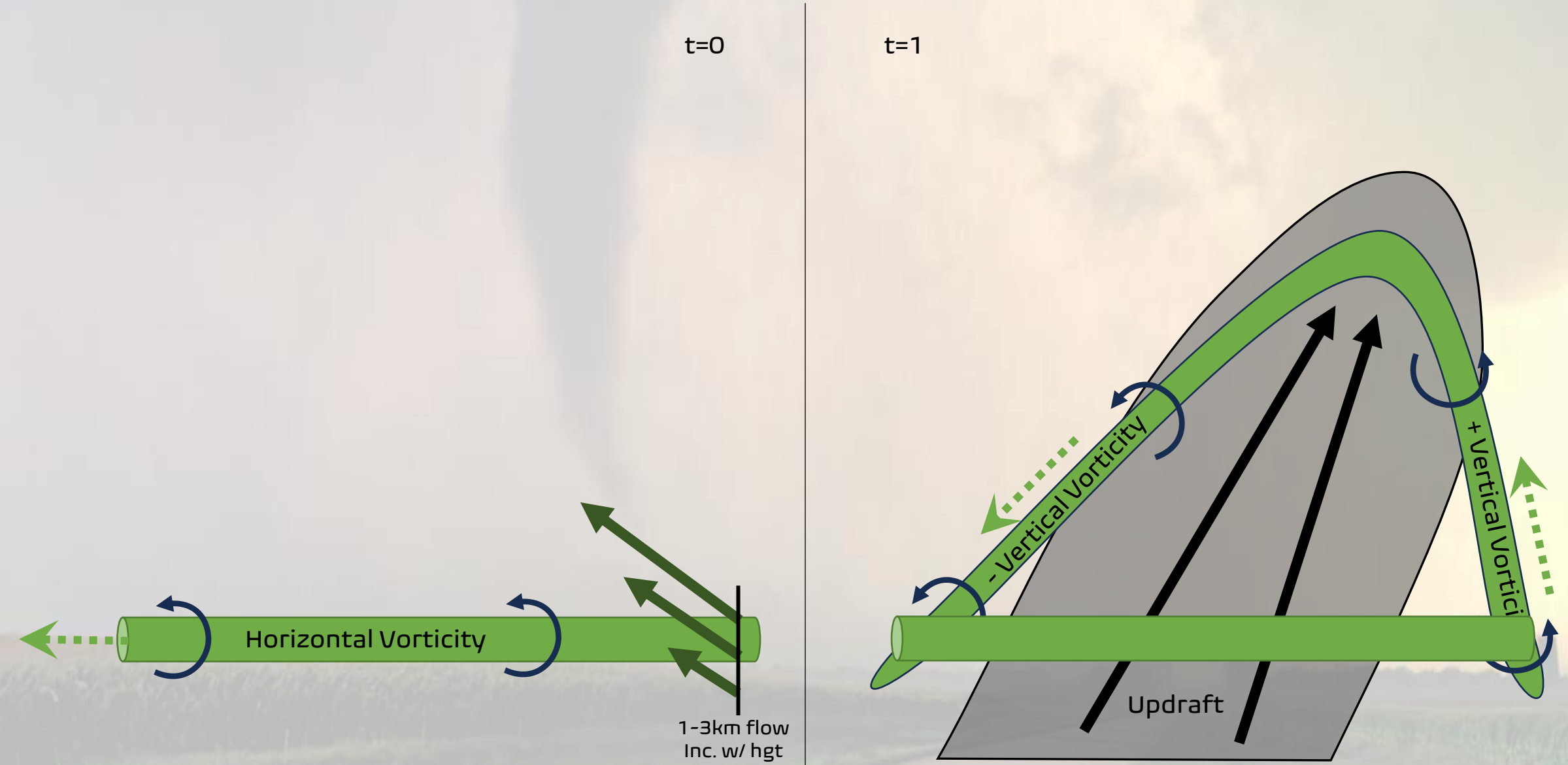
where vorticity = $(\nabla \times V)$...

Environmental vorticity vectors
are always perpendicular to the
environmental wind vector
(the hodograph)

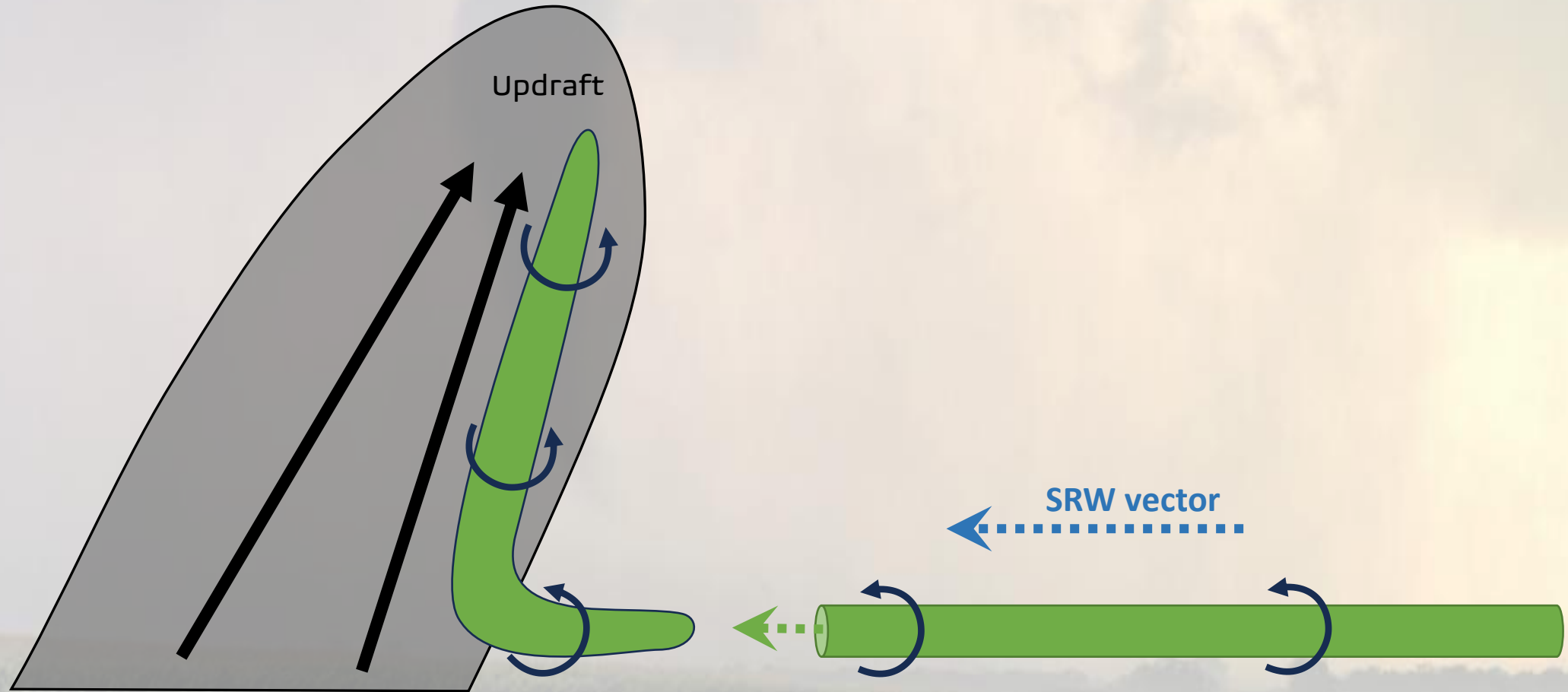
The **environmental vorticity vector** is parallel to, or 'along'
the **SRW vector**, then the
environmental vorticity is
"streamwise".



WHY VORTICITY IS IMPORTANT



WHY STREAMWISE VORTICITY IS IMPORTANT

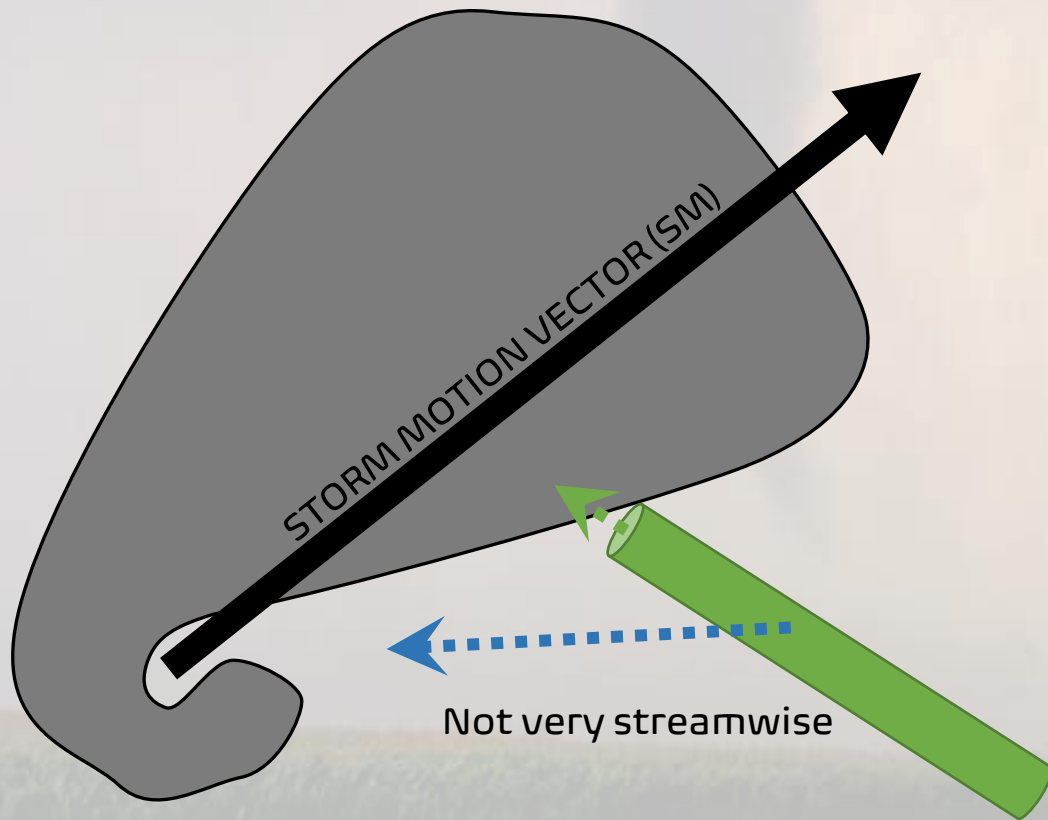


WHY STREAMWISE VORTICITY IS IMPORTANT

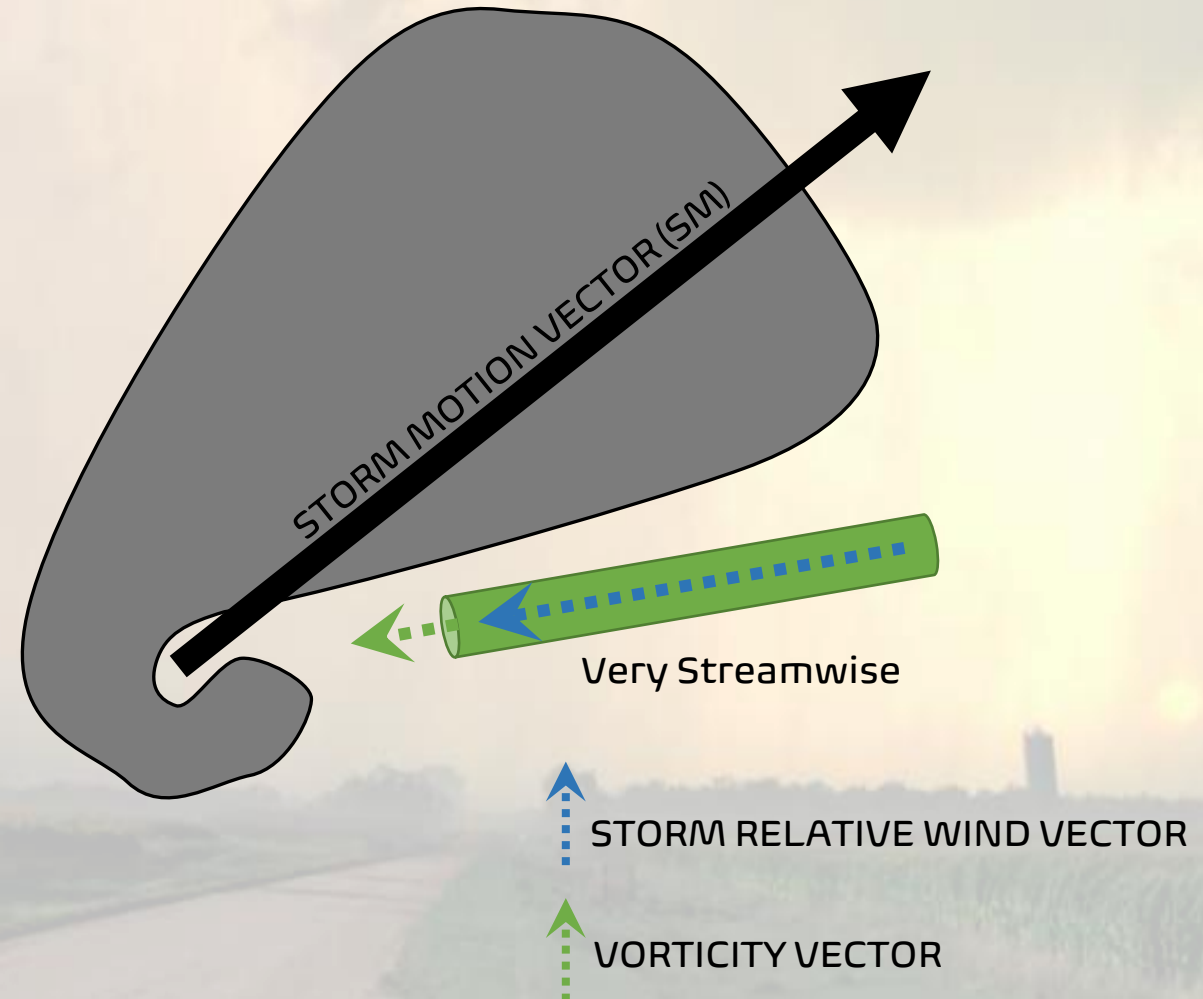


STREAMWISE VORTICITY

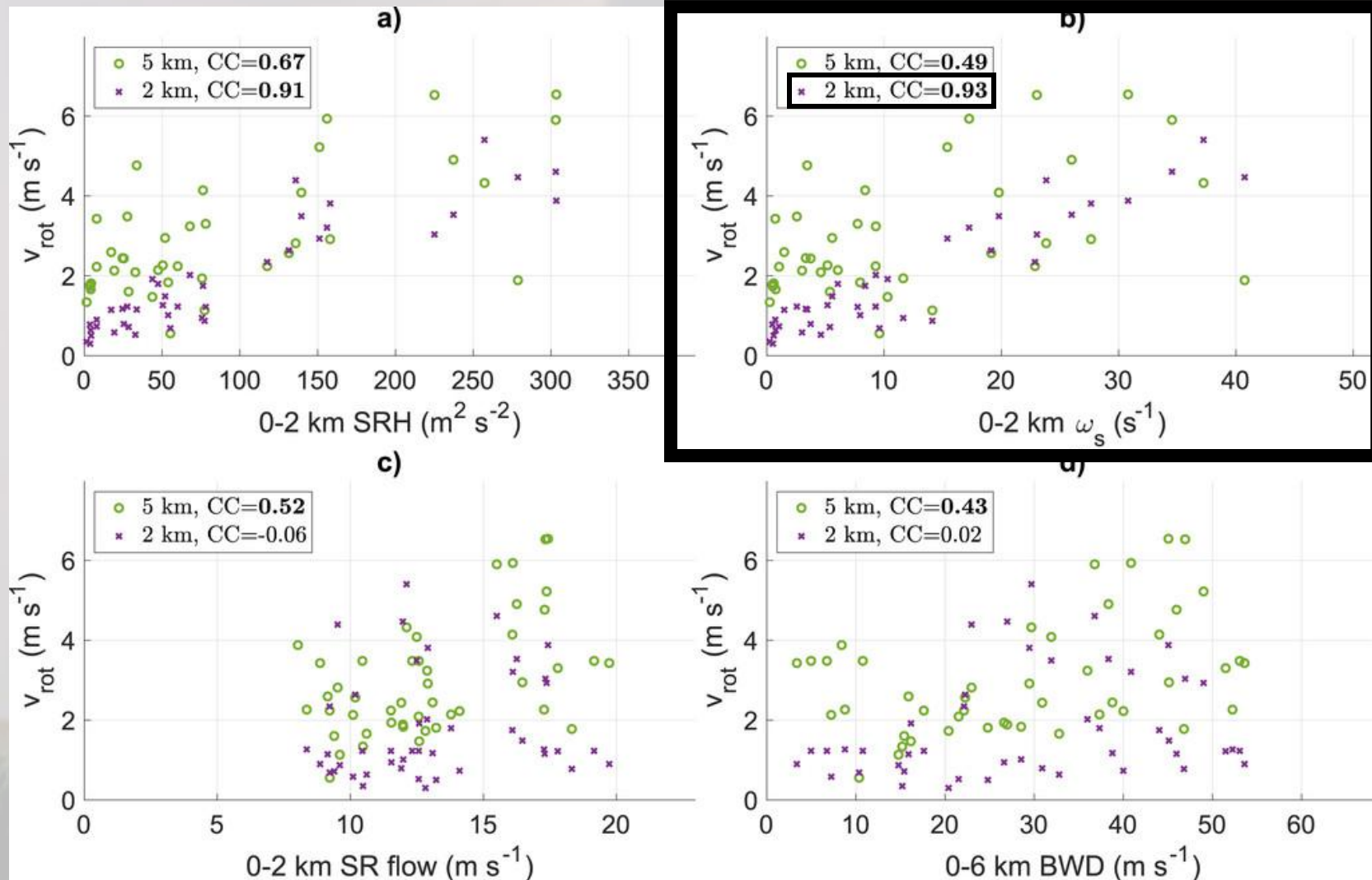
IDEALIZED SUPERCELL



IDEALIZED SUPERCELL

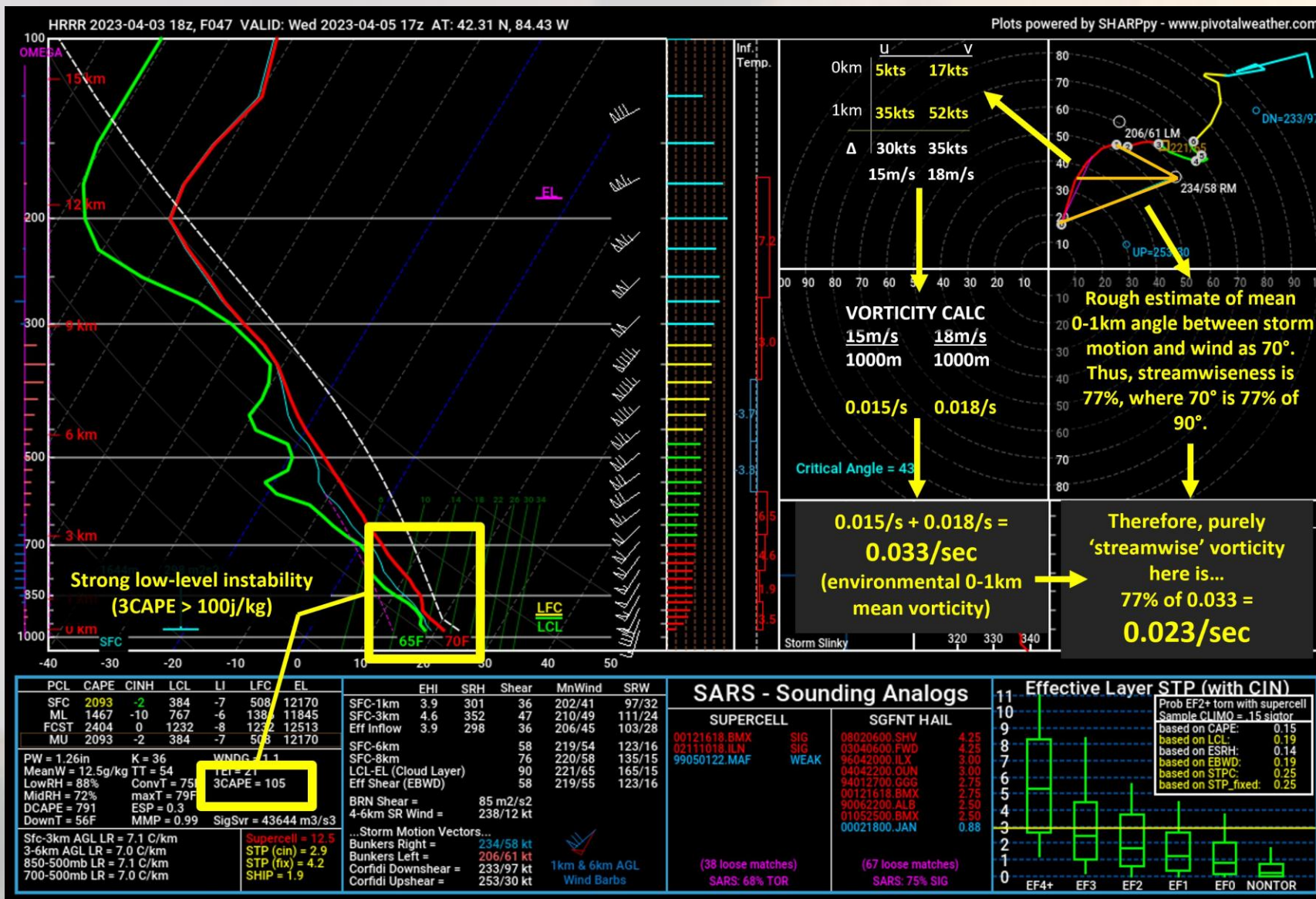


WHY VORTICITY IS SO IMPORTANT



Streamwise vorticity is the “most correlated” kinematic characteristic with low-level mesocyclone rotation*

Estimating streamwise vorticity on a sounding



- 1. Estimate environmental shear by finding difference between u (and v) at two levels and convert to m/s (i.e., $35kt - 5kt = 30kts = 15m/s$)**
- 2. Divide those values by the distance between the levels you chose (i.e., $15m/s \div 1000m = 0.015/sec$)**
- 3. Add the U and V vorticity values together (i.e., $0.015/s + 0.018/s = 0.033/s$)**
- 4. Estimate the angle between the SRW and environmental vorticity vector (i.e., 70°)**
- 5. Determine the percentage that the angle is out of 90° (i.e., 70° to 77% of 90°)**
- 6. Compute streamwise vorticity using the percentage. (i.e., 77% of $0.033 = 0.023$)**

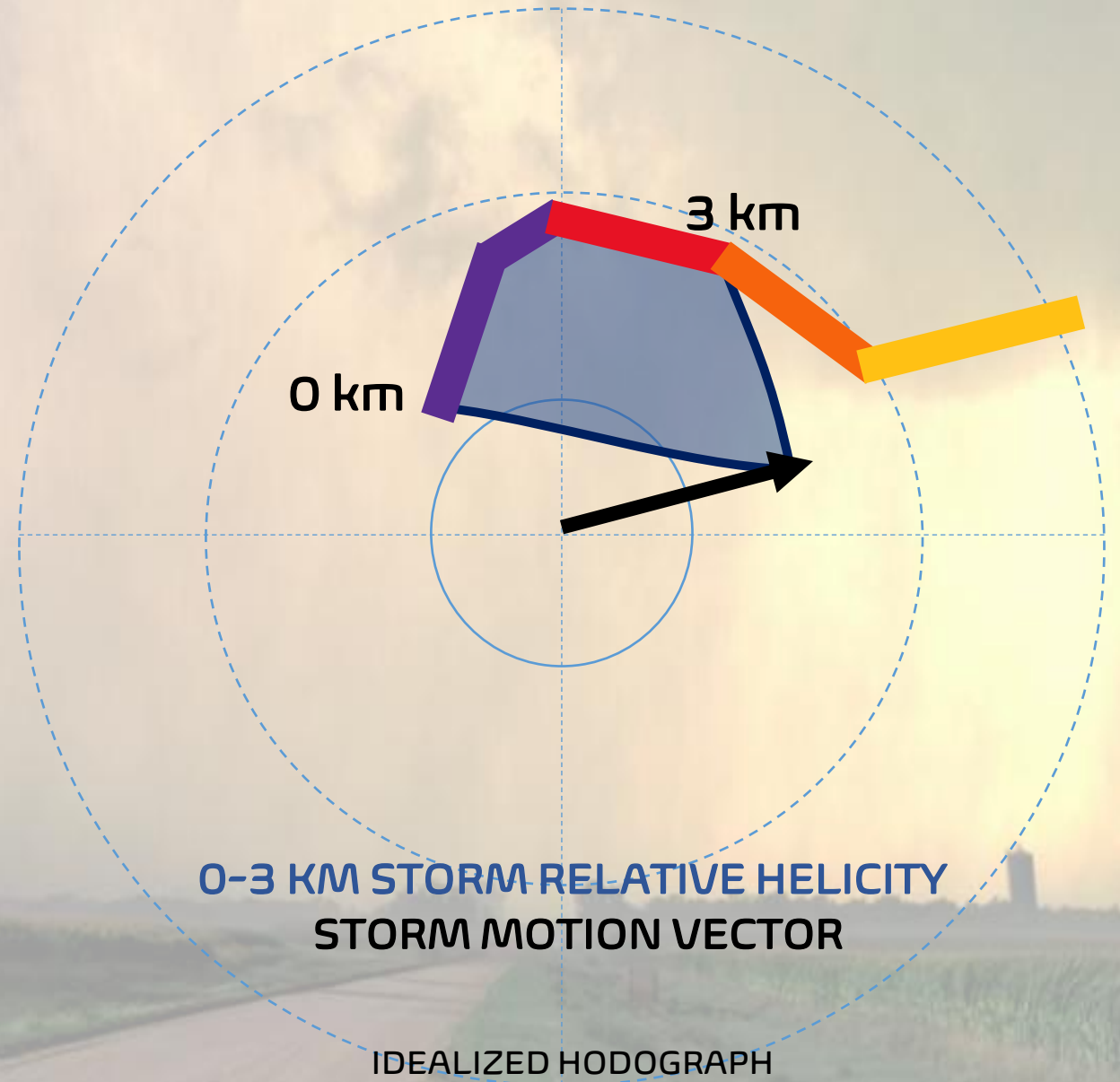
III. STORM RELATIVE HELICITY



STORM RELATIVE HELICITY

HELICITY: property of a fluid that represents the potential for helical flow – a measure of the air's potential to rotate

Conceptually, it is defined as the **area swept out** by the curve of the hodograph and the **storm motion**, over some depth.



A NOTE ABOUT STORM RELATIVE HELICITY...

$$SRH_d \equiv \int_{z=0}^{z=d} |V_{SR}| * \zeta_s dz$$

Storm Relative
Wind

Streamwise
Vorticity