

Hurricanes are a very "organized" flow.
 Meaning, $\vec{V}(x, y, z, t)$ ← "container" for any possible weather forever
 ↓ vertical "profile"
 ↓ horizontal "pattern"

is far simpler than its most general case,

insight about flow → math idealization

circular pattern

$$(x, y) \rightarrow (r, \theta) \text{ & } \vec{V}(r, z, t)$$

$$\vec{V}(x - x_c, y - y_c, z, t) \approx \vec{V}(z, t)$$

$$(x_c(t), y_c(t)) \equiv \vec{v}_c \begin{matrix} \text{velocity of} \\ \text{center} \end{matrix}$$

Strong winds confined near center

$$\frac{\partial V}{\partial r} < 0 ; \text{ treat central part separately}$$

$$\vec{J} \times \vec{V} = \det \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \partial_x & \partial_y & \partial_z \\ u & v & w \end{vmatrix} - \begin{matrix} \hat{i} \\ \hat{j} \\ \hat{k} \end{matrix} \left(\partial_y(w) - \partial_z(v) \right) + \begin{matrix} \hat{j} \\ \hat{k} \end{matrix} \left(\partial_z(u) - \partial_x(w) \right) + \begin{matrix} \hat{k} \\ \hat{i} \end{matrix} \left(\partial_x(v) - \partial_y(u) \right)$$

$$\partial_x = \frac{\partial}{\partial x} = \frac{\partial}{\partial x}() = \text{example for } T(x, y, z, t)$$

$$\frac{\partial T}{\partial x} = \lim_{\Delta x \rightarrow 0} \frac{T(x + \Delta x, y, z, t) - T(x - \Delta x, y, z, t)}{2 \Delta x}$$

$$= \lim_{\Delta x \rightarrow 0} \frac{T(x + \Delta x, y, z, t) - T(x, y, z, t)}{\Delta x}$$

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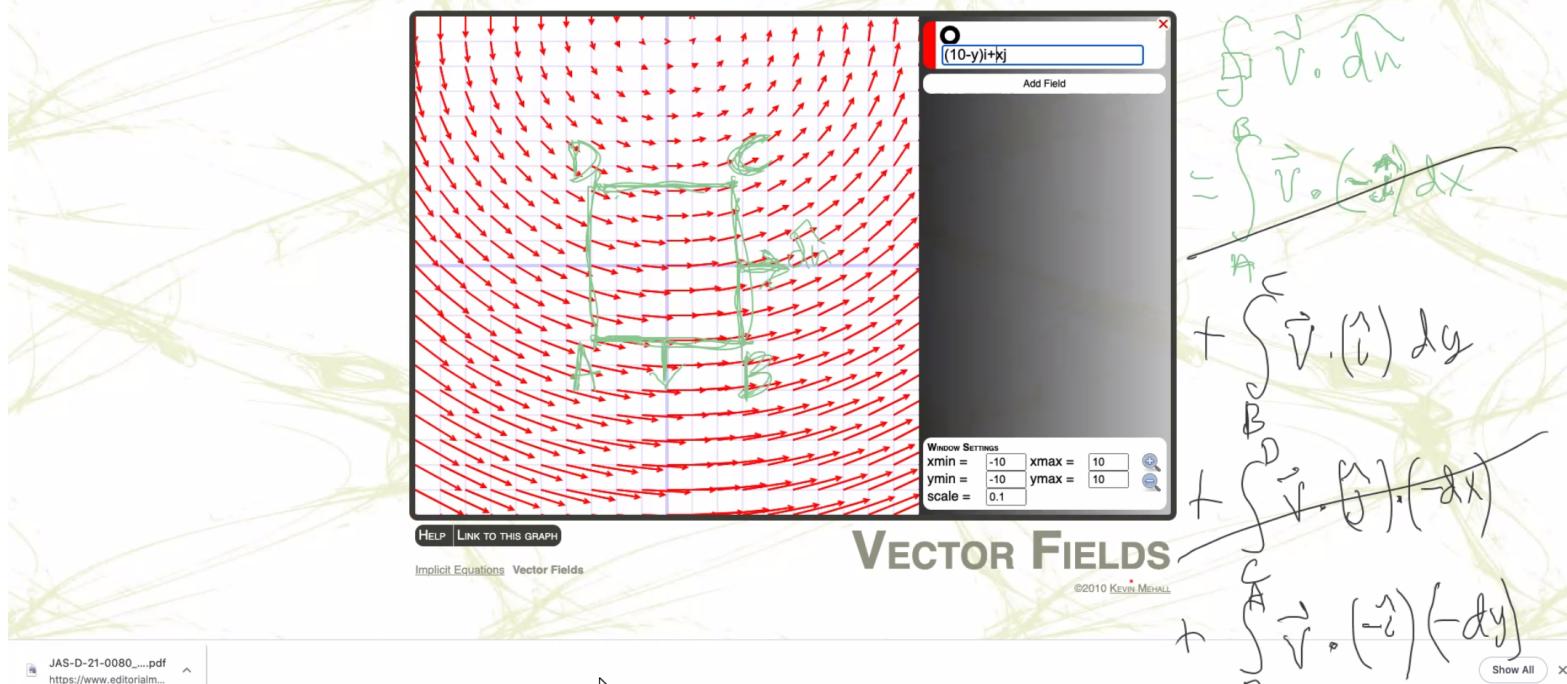
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Brian Mapes (Miami; he/him)'s screen

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feynmanlectures.caltech.edu/ll_03.html

integral of the normal component of any vector over any closed surface can also be written

$$\int_S \mathbf{C} \cdot \mathbf{n} da = \int_V \nabla \cdot \mathbf{C} dV,$$

Globe
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$$\int_S \frac{\partial}{\partial n} (C \cdot n) da = \int_V \nabla \cdot C dV + R_{TOA}$$

Suppose we take again the case of heat flow in, say, a metal. Suppose we have a simple situation

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VECTOR FIELDS ©2010 KEVIN MEHALL

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10-y)i+xj

Add Field

WINDOW SETTINGS
xmin = -10 xmax = 10
ymin = -10 ymax = 10
scale = 0.1

Help Link to this Graph

Implicit Equations Vector Fields

+

$\int_V \cdot - dx$

$\int_V \cdot - dy$

$\int_D \cdot - (-dy)$

+

The image shows a video conference interface with a participant named Brian Mapes. A blue circle with a white pen icon is overlaid on the top-left corner of the shared screen. The shared screen displays a web-based application for visualizing vector fields. The application shows a grid with red arrows representing the field $(10-y)i+xj$. A green rectangular path is drawn on the grid, labeled with points A, B, and C. Handwritten mathematical sketches to the right of the application window show line integrals: $\int_V \cdot - dx$, $\int_V \cdot - dy$, and $\int_D \cdot - (-dy)$. The application interface includes a 'WINDOW SETTINGS' panel with sliders for x and y ranges and a scale factor. At the bottom, there are links for 'HELP' and 'LINK TO THIS GRAPH', and buttons for 'Implicit Equations' and 'Vector Fields'. The application is titled 'VECTOR FIELDS' and credits '©2010 KEVIN MEHALL'. The Mac OS X desktop environment is visible at the bottom, showing the Dock with various application icons.