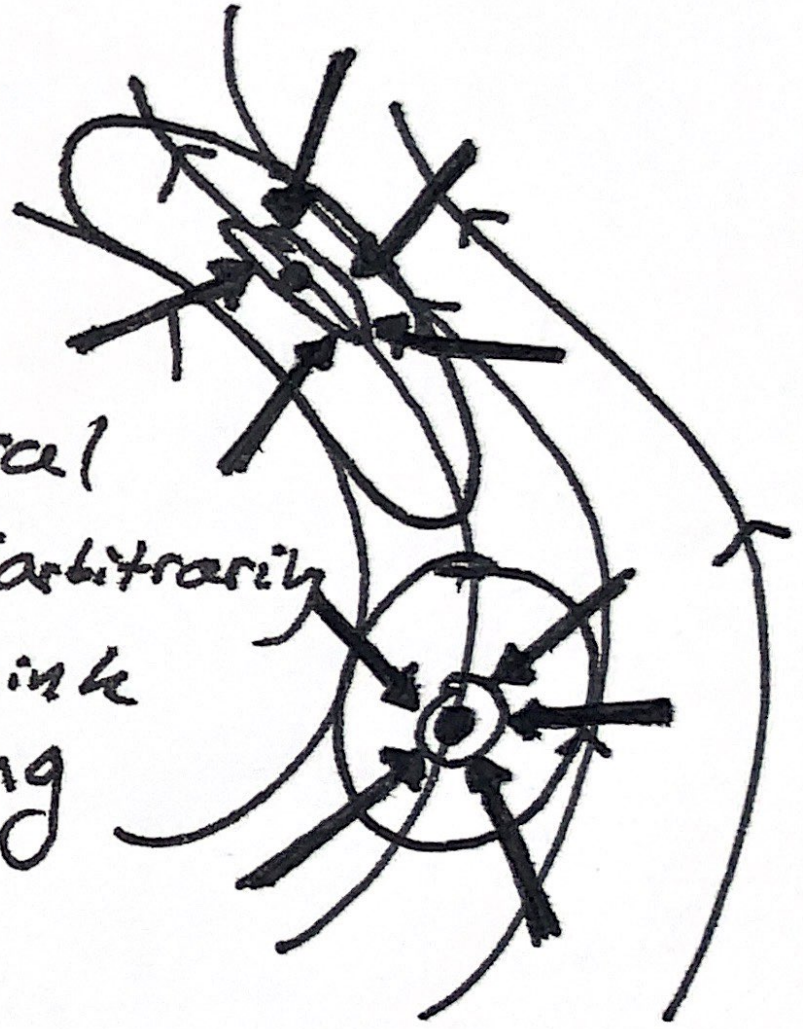
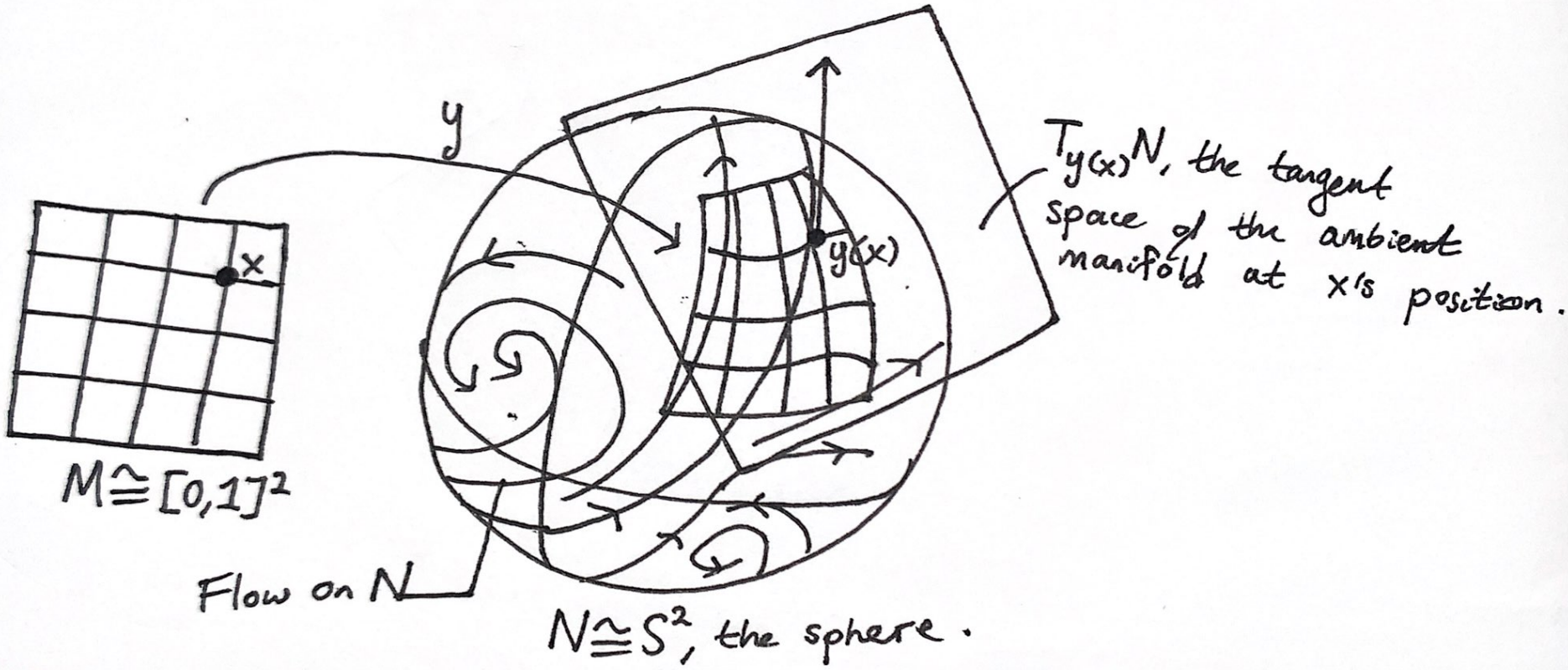
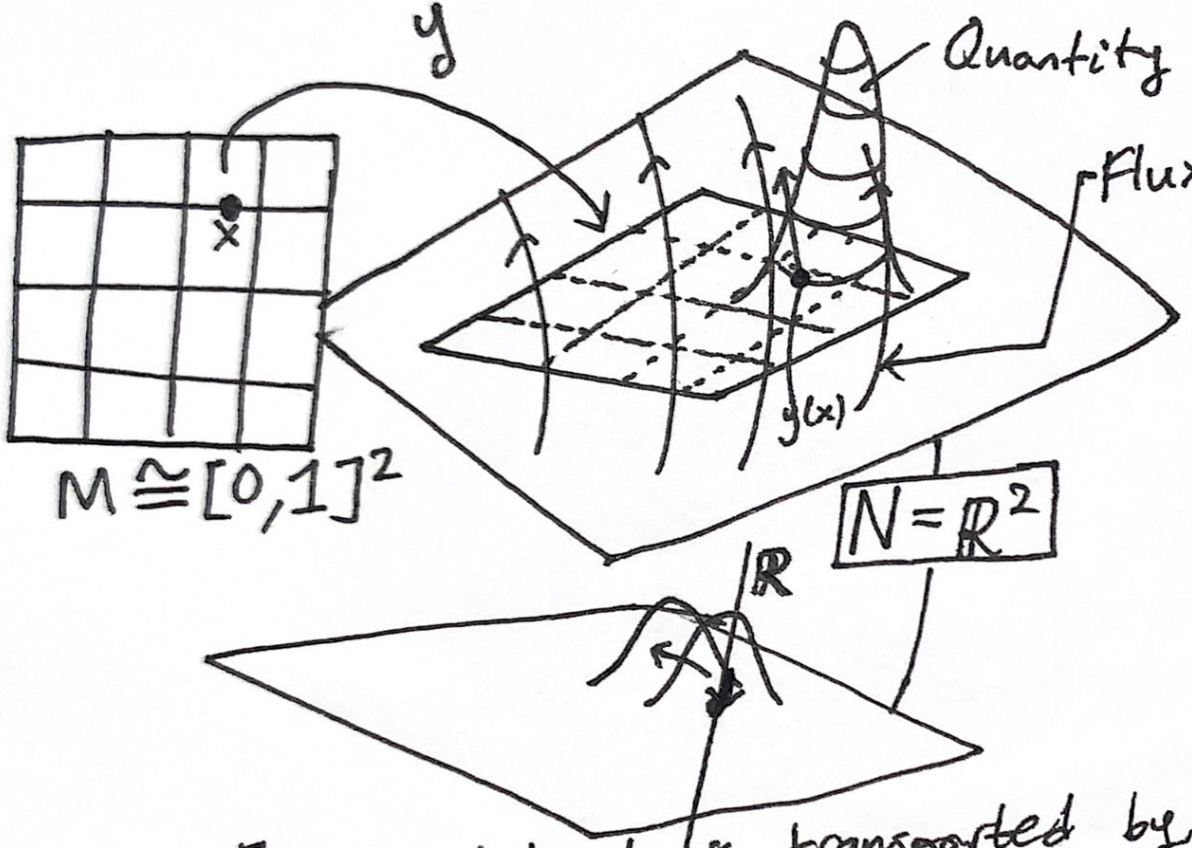
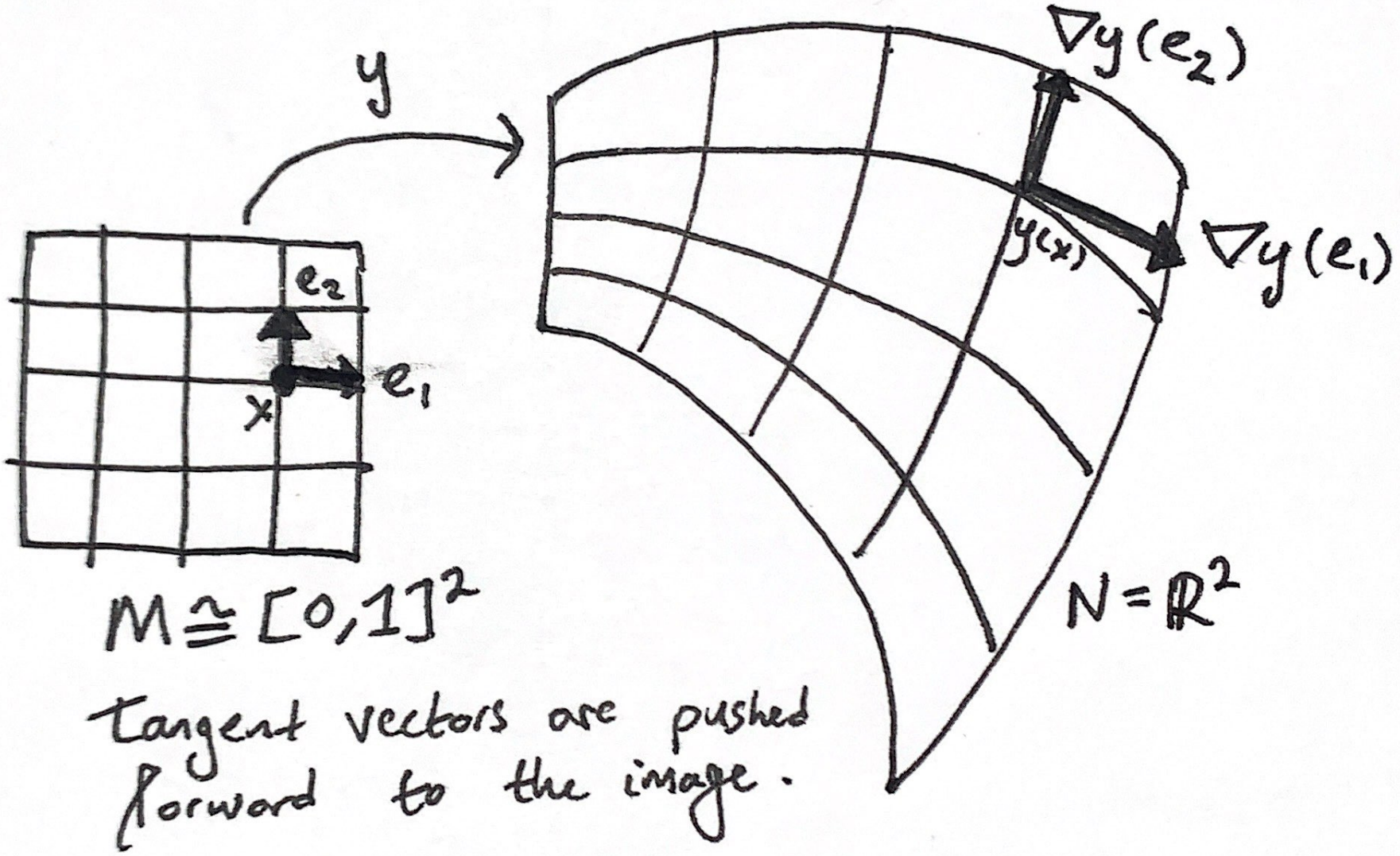
A material element is "arbitrarily small", so think of the limiting of this flow behaviours.



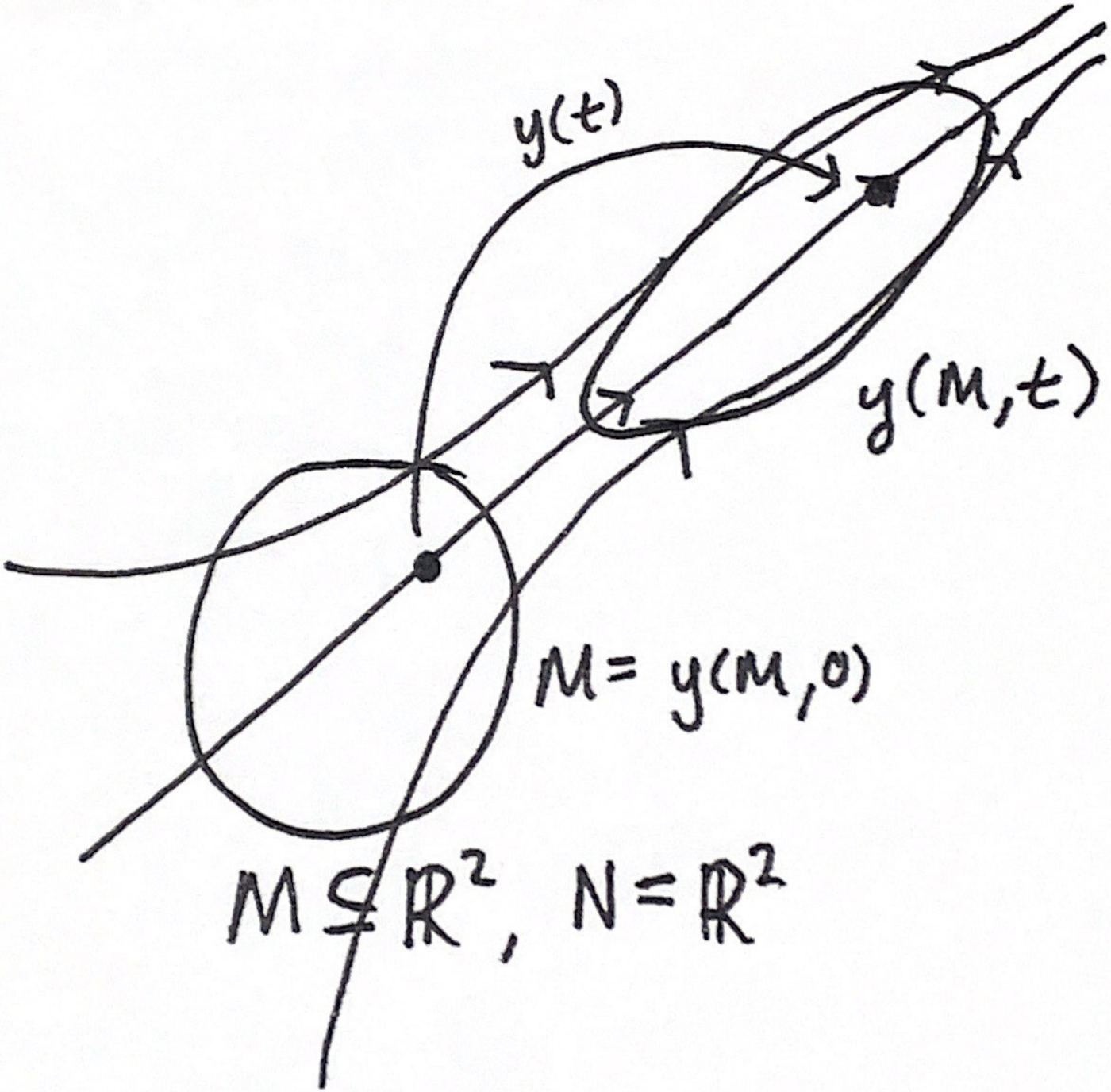

y
x
y(x)
$T_{y(x)}N$, the tangent space of the ambient manifold at x's position.
$M \cong [0,1]^2$
Flow on N
$N \cong S^2$, the sphere.

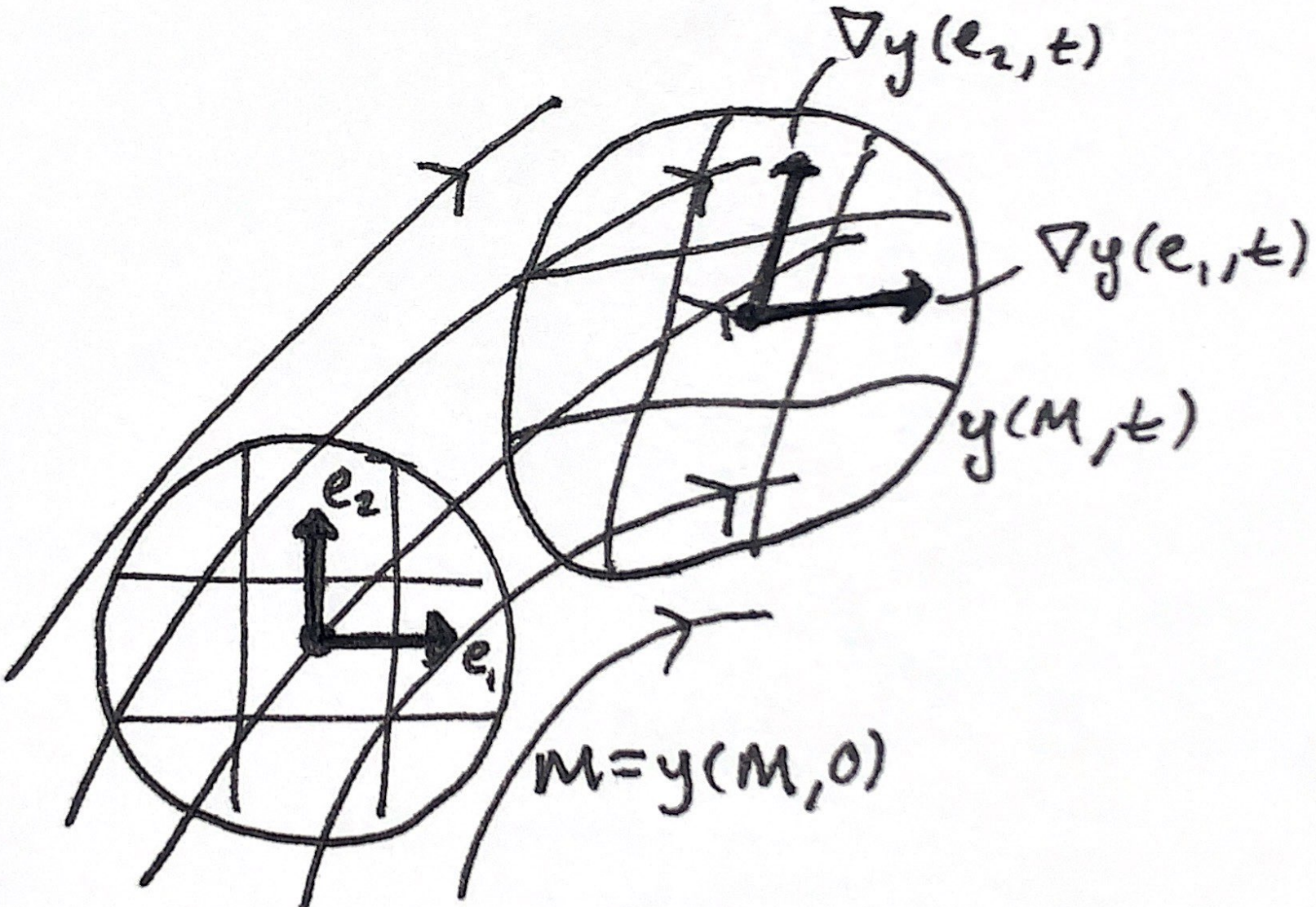


The quantity ϕ is transported by j.
This causes a change in ϕ at $y(x)$, $\frac{\partial \phi}{\partial t} \in \mathbb{R}$.

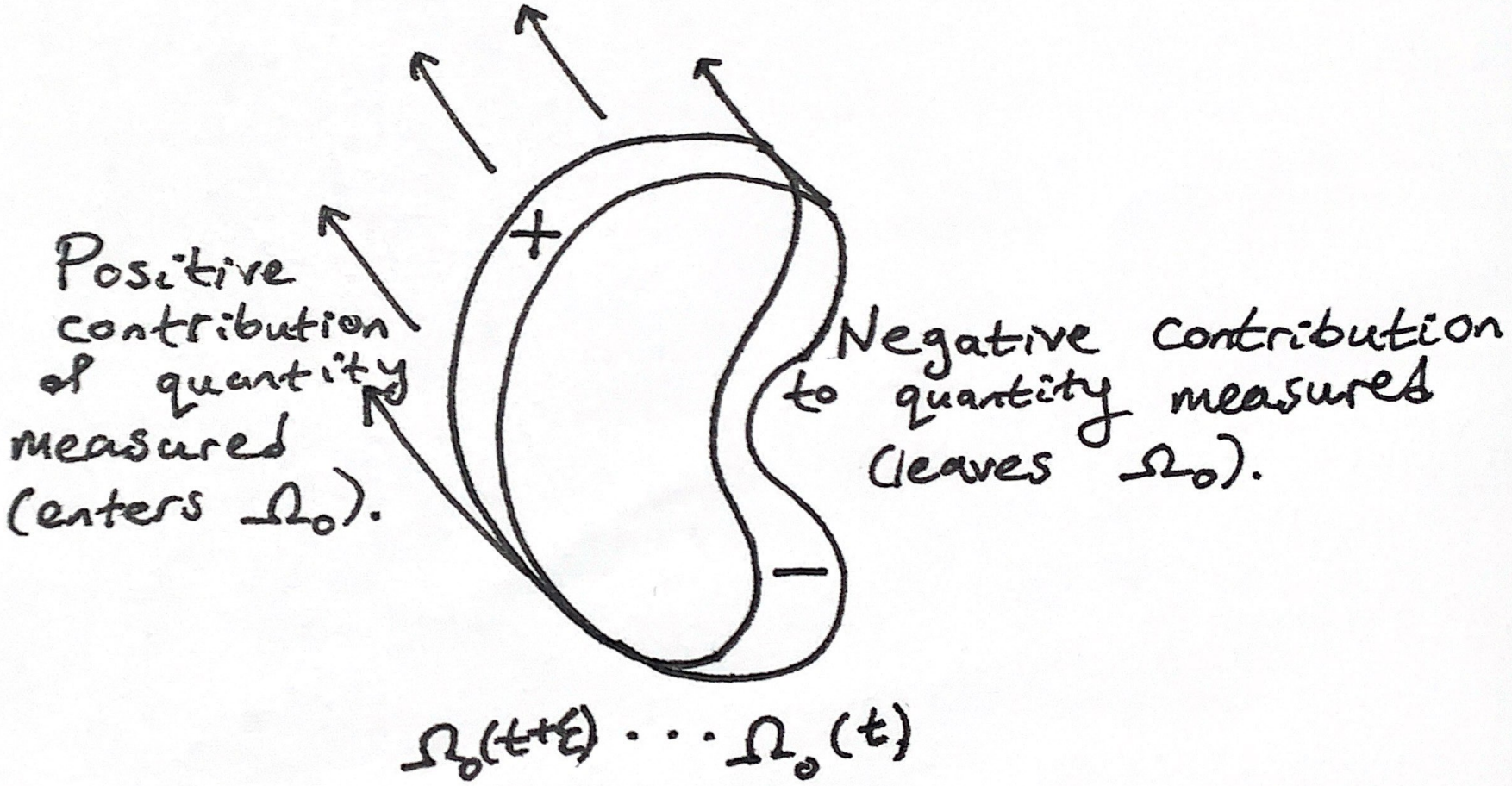


Tangent vectors are pushed forward to the image.

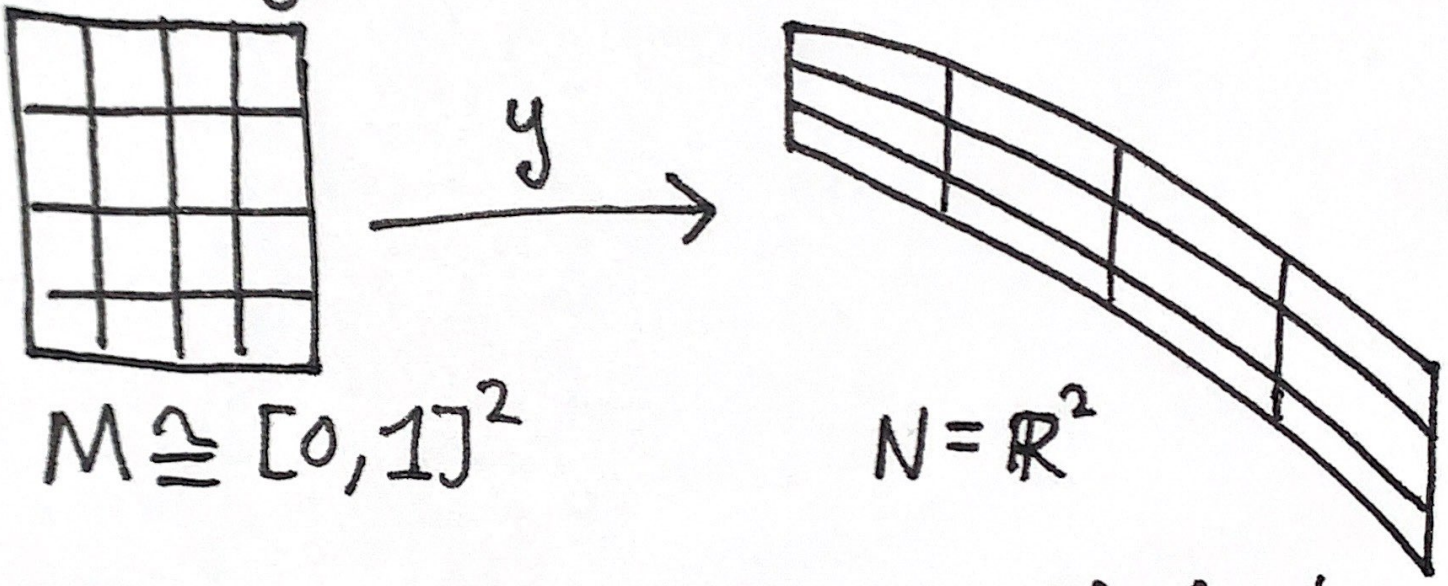

y(t)
y(M,t)
M = y(M,0)
M ⊆ ℝ², N = ℝ²



$M \subseteq \mathbb{R}^2$, $N = \mathbb{R}^2$

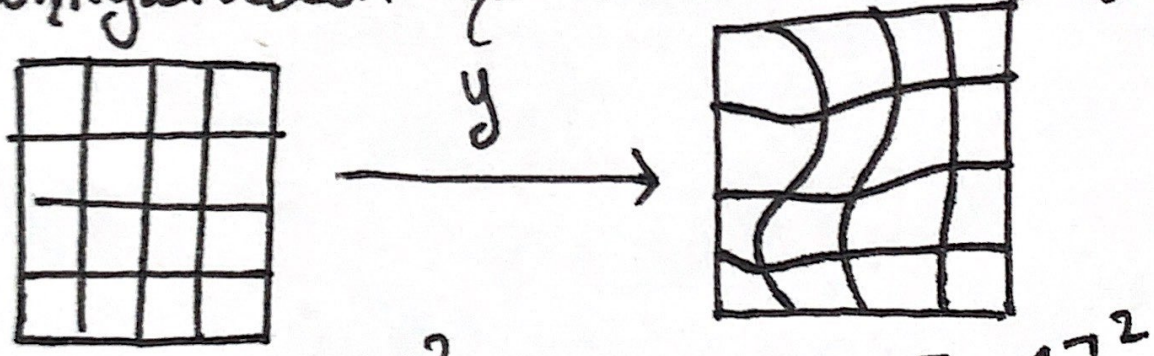

Positive contribution of quantity measured (enters Ω_0).
+
−
Negative contribution to quantity measured (leaves Ω_0).
$\Omega_0(t+\epsilon) \cdots \Omega_0(t)$

Configuration of a 2D beam.

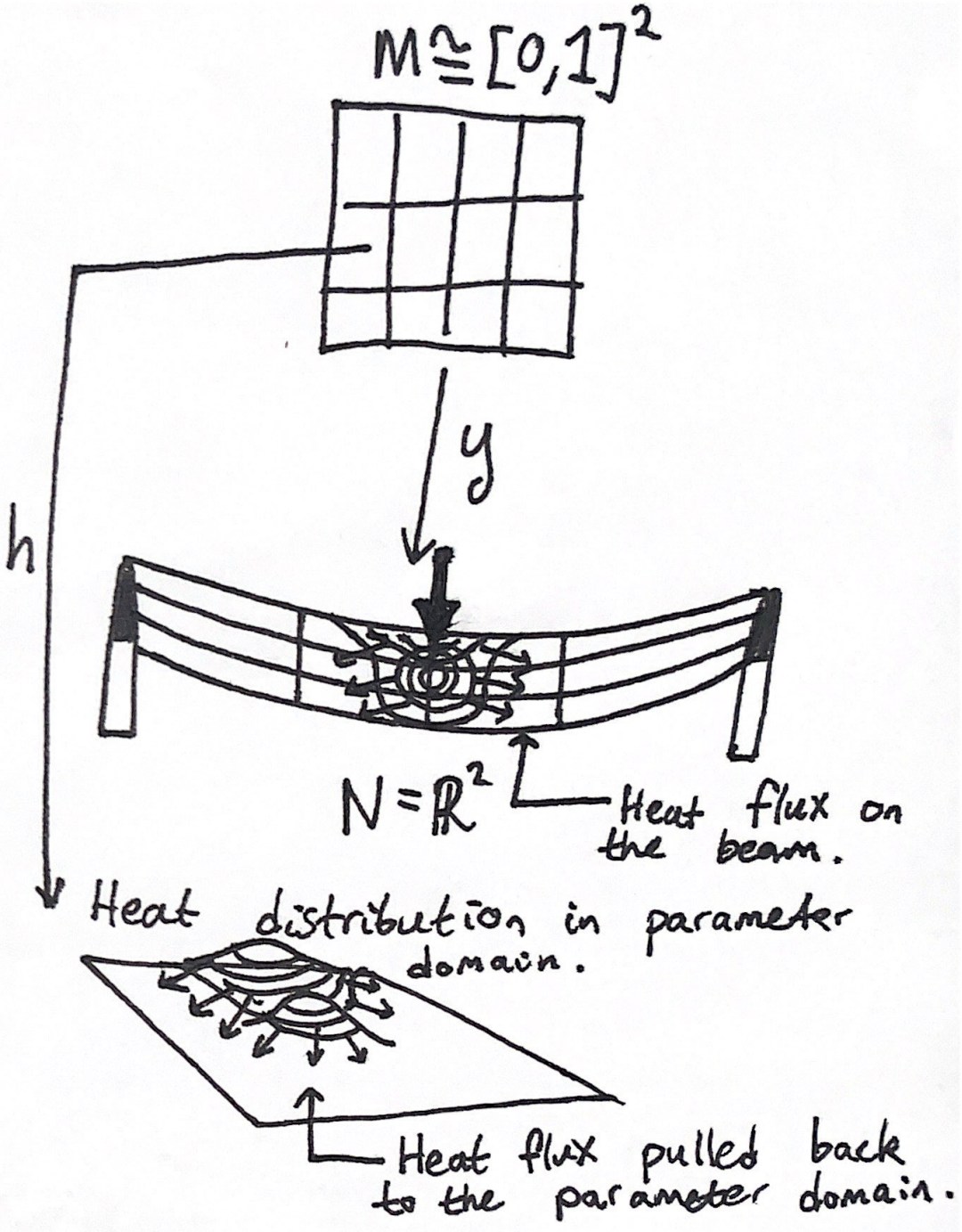


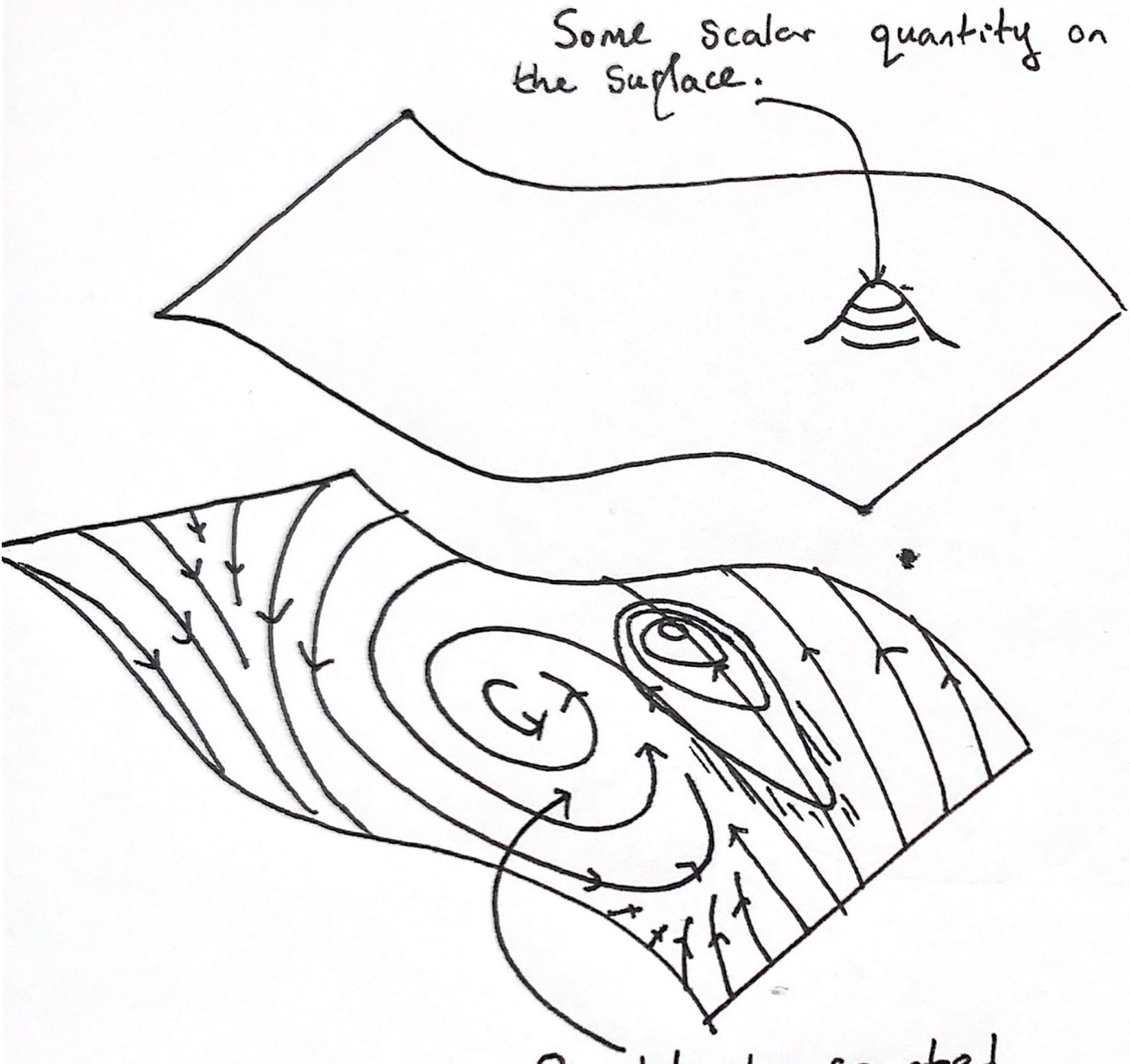
$M \cong [0,1]^2$ $N = \mathbb{R}^2$

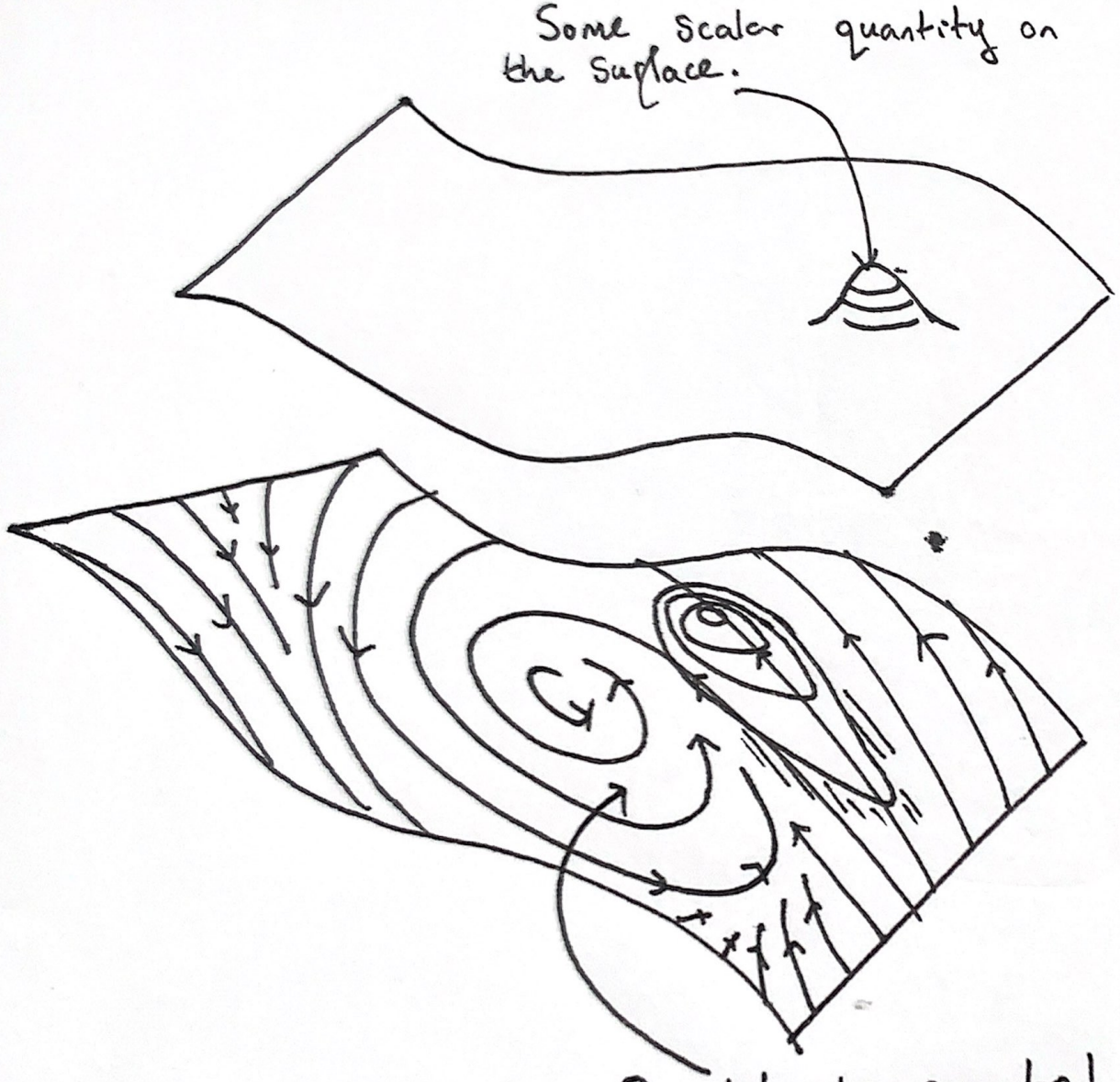
Configuration of a square of fluid.



$M \cong [0,1]^2$ $N \cong [0,1]^2$


$M \cong [0,1]^2$
y
h
$N = \mathbb{R}^2$
Heat flux on the beam.
Heat distribution in parameter domain.
Heat flux pulled back to the parameter domain.


Some scalar quantity on the surface.
Quantity transported across the surface by a vector field.


Some scalar quantity on the surface.
Quantity transported across the surface by a vector field.