-Macroscopic View on Fluid Dynamics-'08/12/5, 09/7/19,

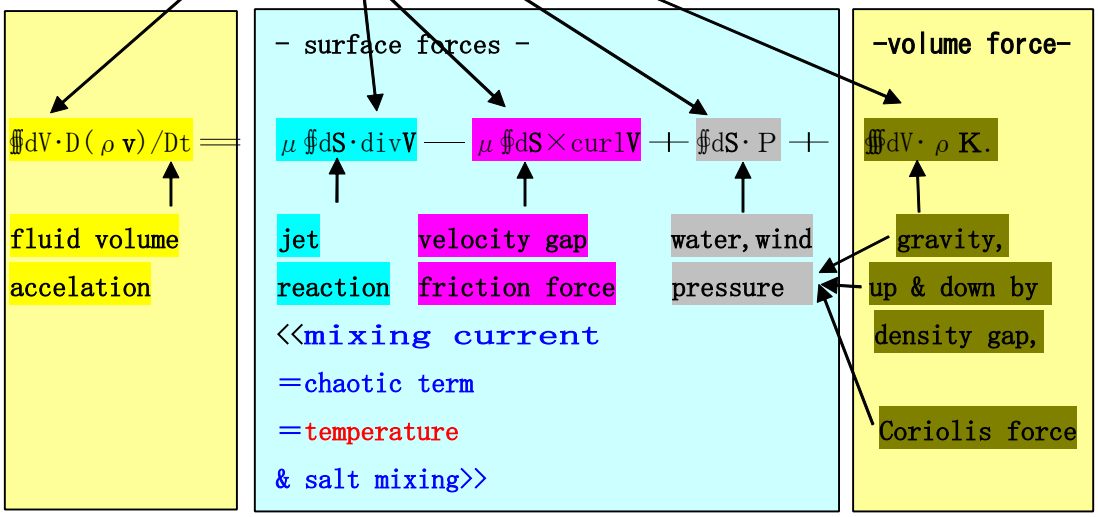
Navier Stokes equation is far difficult to math-analysis on its behaviour.
Though, the local volume integral equation is far visible to understand.

[1]:Expression by surface integral equation:

$\mathbf{f}=d\mathbf{p}/dt=[\rho(r(t+dt);t+dt)v(r(t+dt);t+dt)-\rho(r;t)v(r;t)]/dt$ <Newton EQN>

$=\rho[\partial_t\mathbf{v}+\Sigma_{k=1}^{3}v_k\partial_k\cdot\mathbf{v}]+[\partial_t\rho+(\mathbf{v}\cdot\mathrm{grad})\rho]\mathbf{v}\equiv D(\rho v)/Dt.$

$D(\rho v)/Dt=\mu\nabla^2\mathbf{v}-\mathrm{grad}P+\rho K.$ <Navier.Stokes Equation>。



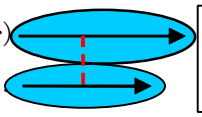
$*d[\rho(r(t);t)\mathbf{v}(r(t);t)]/dt=\rho[\partial_t\mathbf{v}+\Sigma_{k=1}^{3}v_k\partial_k\mathbf{v}]+\mathbf{v}[\partial_t\rho+\Sigma_{k=1}^{3}v_k\partial_k\rho]$

$*\nabla^2\mathbf{v}=\mathrm{graddiv}\mathbf{v}-\mathrm{curlcurl}\mathbf{v}.$

(1)non coompression approximation yields $\mathrm{div}\mathbf{V}=0$.

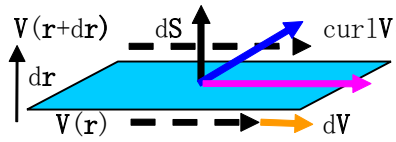
(2)"curlV" is space differetiation of V and is degree of **friciton force** between

pararell V(r+dr)
and V(r)



The friction force is essential interacting between fluid volume segments=eddy driven flow.

It is a cause making frequent **fluid eddies** at anywhere、



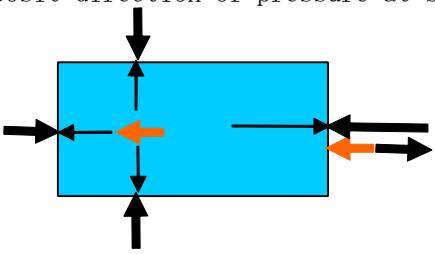
$\mathrm{curl}\mathbf{V}=|dV/dr|\mathbf{e}, \quad \mathbf{e}=d\mathbf{r}\times d\mathbf{V}/|d\mathbf{r}\times d\mathbf{V}|.$

$-dS\times\mathrm{curl}\mathbf{V}=$**friction force on** dS

That is, more fast velocity V(r+dr) is to pull slower velocity V(r) toward V due to fluid particles collisions between V(r+dr) and V(r). Therefore the collision process becomes irreversible due to quantum nature of chemical

particles. Microscopic collision process is probabilitical of losing causality.
Above process of water mixing is to enahance **heat diffusion** to all direction.

(3) $\oint dS \cdot P$ is surface pressure caused by adjacent surfaces of water or wind.
(4) Unless summation on surface powers is zero, then the volume get force to move.
Opposit direction of pressure at both side of surface must be always equal.

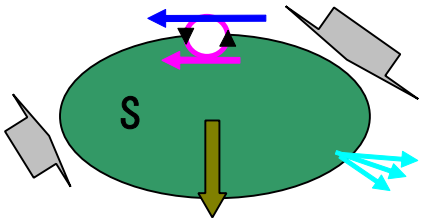


pv=nRT is state equation of fluid. Then higher pressure position is higher density of fluid. Then desity gap cause relaxtion process to accelate toward ←.

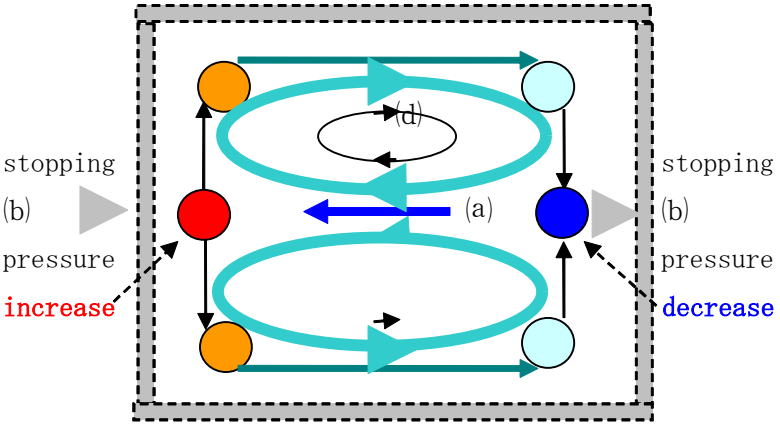
Therefore this discussion needs consideration of compressionability of fluid.

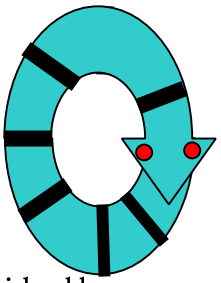
(5) $\iiint dV \cdot \rho K$ is a force interacting each differential volume dV such as **gravity** and **Coriolis force**. The former causes every day **tide flows** causing perpetuall sea water mixing, which enhance **heat diffusion** to sea flor.

(6) Schematic for interpretation on forces acting on fluid volume segment S,



(7) simple, but realiazabl example flow of double eddies.
(a) **dragging pulse current=driver**, (b) stopping presure of virtual barrier,
(c) **pressure difference flow**, (d) dragged eddy flows with (c),

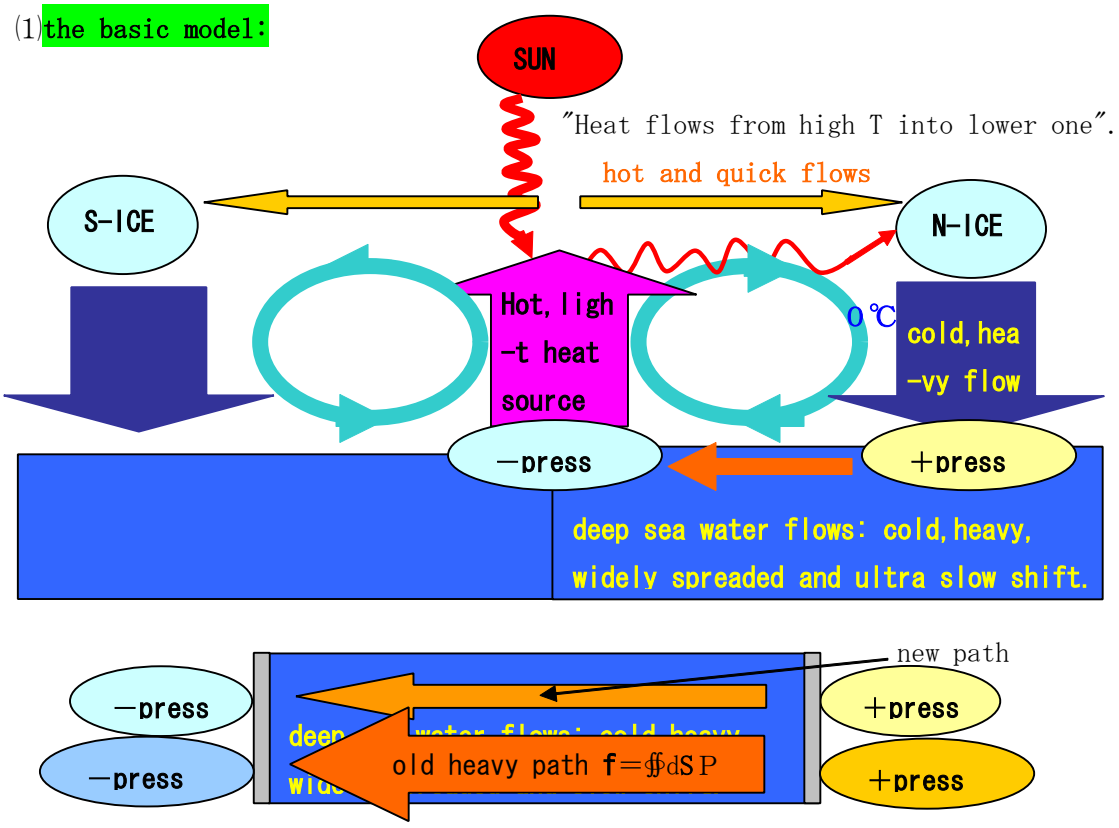




"fluid eddy as own eating snake".

[2]:Thermal coupling between Arctic and Tropical zone by ocean currents:

(1)the basic model:



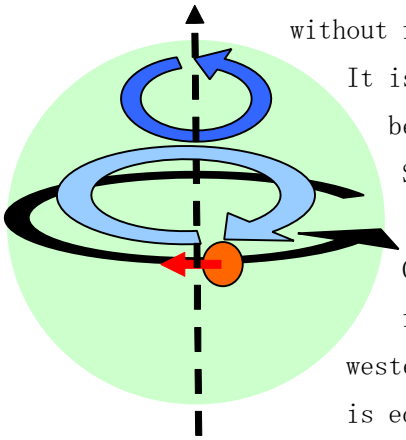
(2)Even though, global warming never stopp ocean currents into Arctic:

In the movie "the day after tommrow" they said that global warming causes weakening of downward flow in Arctic(decreasing positive flow pressure in Arctic). As the consequnece ocean current transpoting of tropical zone heat would stopp and make Europe and North America colder. The opinion neglects being negative pressure increasing in tropical zone.

If such current would stopp, then surplus heat shall more warm up tropical zone to semi-boiling state, which causes increasing upward currents in the zone with growing violencial atmospheric behaviour(hurricane & typhoon). As theconsequnce, negative pressure increase to drive new deep sea ocean current of which depth is rather shorter than that of former deep sea current. Present observation of currence weaknign may be a tempolal time lag caused by too rapid global temparature change and be for creating new currency pathes. Then absolute necessity of thermal relaxation would find new path of current with the reasoable response time. In anyway, a heat entirely will flow from high temperature to lower one. Note that macroscopic sea water temeprature in Arctic must be always 0℃.

(3)Coriolis force driving horizontal global ocean currents:

(a)Coriolis force on rotational spherical surface:



The black ring indicates rotation of globe, then free particle without fastening force on globe surface tend to move

It is a kind of inertia force or a kind of gravity being equivalent to accelation force(Einstein).

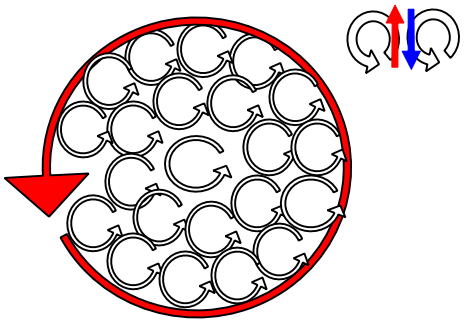
See the site of Wikipedia.

http://en.wikipedia.org/wiki/Coriolis_effect

Consequently ocean current on equator tends to flow from west to east. Note also the mechanism of westerlies is the same. The most intense force latitude is equator, while the most weak one is North pole.

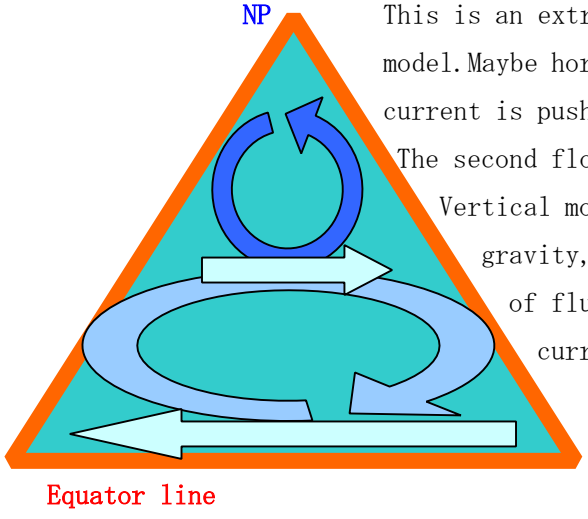
(b)A fluid is a own eating snake<a flow make empty space unless own supply>.

See [1](7) fluid eddy as a own eating snake. It is also called curling field.



Note that two adjacent curlings tend to cancelate their velocity vectors with each other. If one of them was stronger than the other, the cancelation becomes incomplete to yield certain field intensity.

(c)Simplified ocean currents in triangle ocean field:



This is an extremely simplyfied north Pacfic ocean model. Maybe horizontal movement of initial ocean current is pushed by Coriolis force on equator, The second flow is surface pressure & drag force. Vertical movement is depend on density with gravity, which is related with **thermal state** of fluid. That is, higher density of cooler current become returnning one.