SCUOLA
NORMALE
SUPERIORE

Abstract:

The primitive equations are a version of the Navier-Stokes equations and they form the basic model to study the large scale dynamics of oceanic and atmospheric flows. In these systems the horizontal direction is large compared to the vertical one, and so also the dynamics are assumed to be governed by the movement in the horizontal directions. The mathematical formulation is due to Lions, Teman and Wang, they consider a domain of the form $\Omega=[0,1]^2\times(-h,h)$ (h small). The velocity u of the fluid is described by $u=(v,w)$, where $v=(v_1,v_2)$ denotes the horizontal components and w the vertical one, and the surface pressure is p. The primitive equations read \begin{align*} \partial_t v + v_1\partial_x v+v_2\partial_y + w \partial_z v - \Delta v +\left(\begin{array}{c}\partial_x \\ \partial_y\end{array} \right) p & = 0, \text{ in } \Omega \times (0,T), \\ \partial_z p & = 0, \text{ in } \Omega \times (0,T),\\ \partial_x v_1+\partial_y v_2+\partial_z w & = 0, \text{ in } \Omega \times (0,T), \end{align*} complemented with boundary and initial conditions. In contrast to the standard Navier-Stokes equations these equations have an anisotropic structure, the vertical velocity w only appears in the divergence equation and in the nonlinearity. To take into account physical uncertainties Debussche, Glatt-Holtz, Temam and Ziane considered the primitive equations with a multiplicative white (in time) noise and established the global existence and uniqueness of strong, pathwise solutions. Our aim is to prove the well-posedness of the primitive equations with additive space-time white noise by using Hairer's theory of regularity structures. The known results by Zhu and Zhu for the classical Navier-Stokes system cannot be carried over to our equations because of structural differences of the systems. In our presentation we briefly introduce the primitive equations and we show how to handle the vertical component w in the framework of regularity structures. This function does not fulfill an evolution equation, it has to be recovered from the divergence free condition $\partial_xv_1+\partial_yv_2+\partial_z w=0$ by an integration in the z-variable. Therefore, we have to construct a good map on the level of regularity structures which represents this integration. Having such a map at hand, one can start to study the well-posedness of the primitive equations with space-time white noise.

Tutti gli interessati sono invitati a partecipare.

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