SEMINAIRE CNRM / GAME

N° 2013_16

lundi 14 octobre 2013 à 14h

IMPORTANCE OF AIR-SEA COUPLING FOR TROPICAL CYCLONES AT THE CLIMATE SCALE

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Résumé :

Strong winds associated with Tropical Cyclones (TCs) trigger intense mixing in the upper ocean stirring warm surface water with cold water from the thermocline. This results in: (i) a surface cooling that feeds back negatively on TCs intensity and (ii) a sub-surface warming.
Recent studies argued that heat injected in the sub-surface by TCs alter climate via a modification of the ocean Meridional Heat transport (MHT). We revisit this hypothesis using
a global ocean model forced by high-resolution TC wind forcing representative of the last 30 years. We find that MHT is hardly affected by TCs. However, TC processes significantly alter the ocean by 3d advection, surface fluxes that cool tropical oceanic basins on a large scale and heat injection that mostly re-emerges to the surface at the end of the TC season, as the mixed layer deepens in fall/winter. Thus, TCs are found to decrease the seasonal amplitude of SST variations (~10%) in tropical basins (by cooling in summer and warming in winter) with potential consequences in the coupled system.
Regarding point (i), I will show that TC-induced surface cooling is largely controlled by upper-ocean stratification. We investigated the possibility that inter-annual variability of upper-ocean stratification (*e.g.* El Niño) can influence cyclonic activity by controlling the cooling feedback. We simulated tens of thousands of axi-symmetric TC models coupled to varied ocean conditions representative of inter-annual variability in all oceanic basins. We find that the integrated power dissipated by TCs is modulated by upper-ocean stratification variability (~20% difference between 'favorable' and 'unfavorable' years) with the strongest TCs showing the greatest sensitivity to upper-ocean stratification (~40% difference in category-5 TCs between 'favorable' and 'unfavorable' years).

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