

# Investigation and movement of tropical cyclones interacting with each other and with different atmospheric structures based on the ETA-model calculations

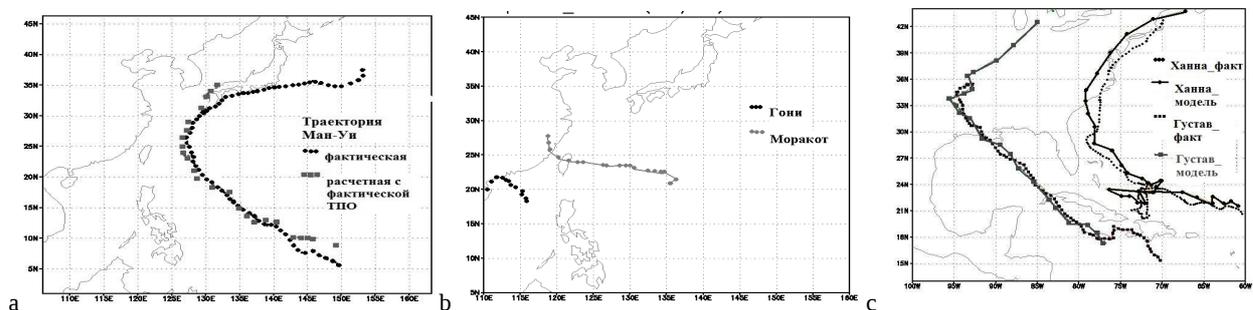
Pokhil A.E., Glebova E.S.

Hydrometeorological Centre of Russia  
ek.glebova@gmail.com

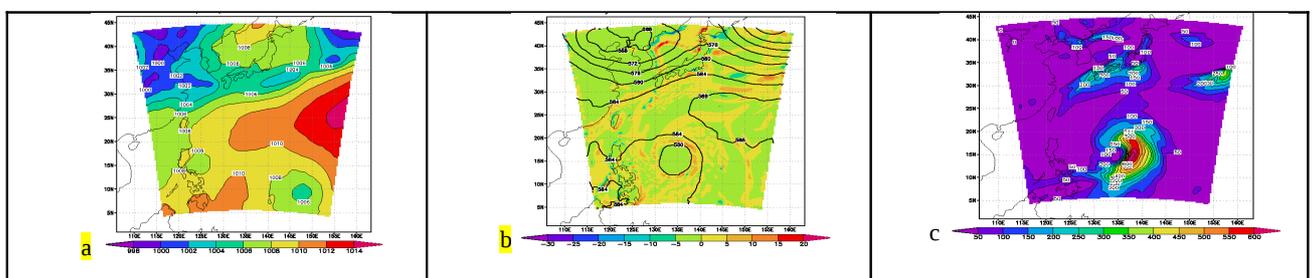
The dynamics of typhoons Man-Yi and Morakot interaction with polar fronts is discussed in the current paper, as well as the meteorological fields evolution in hurricanes Hanna and Gustav which developed simultaneously. Simulation of meteorological fields evolution in tropical cyclones was produced by mesoscale numerical ETA model of atmosphere. The model was integrated with a horizontal step equal to 22 km and a time step equal to 90 seconds. NCEP analysis data with 1° resolution was used to create initial and boundary conditions. The fields of 5-day average sea surface temperature were taken to define sea surface temperature (SST). Real and simulated trajectories of investigated tropical cyclones are shown in the picture 1a.

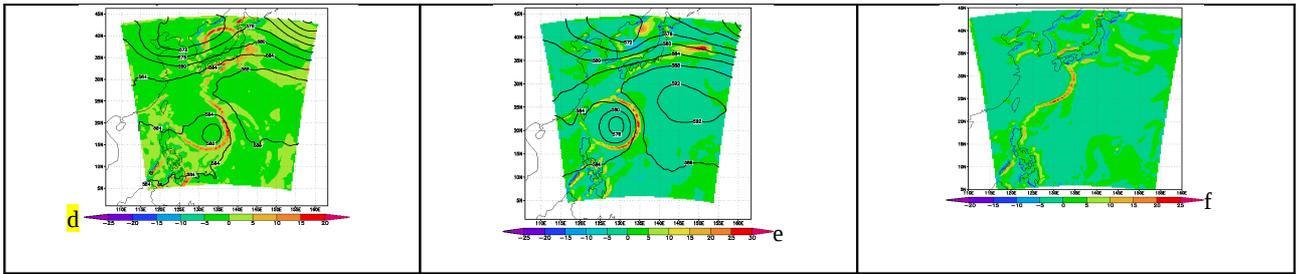
The analysis of calculation results demonstrated that:

1. The model is good at simulation of meteorological fields dynamics during TC's evolution,
2. It can be clearly seen that the structure and configuration of vortices change significantly in the course of their interaction with each other, with the polar front or during their passage over the islands (pic.2,3,4).
3. The process of TC (Man-Yi) and polar front interaction is accompanied by deformation of the vortical zone; by break of the vorticity ring and its mergence with polar front's vortical area, by appearance of a so-called 'convective tail', taking part in the interaction with a frontal zone (pic.2). Besides that, a considerable increase in the velocity of storm's centre is observed.
4. The moment of beginning of interaction between tropical cyclones and a polar front and, correspondingly, the moment of possible turn of trajectory can be defined from fields of sea-level pressure and vorticity. The same is fair for cases of tropical cyclones' interaction with each other (in our case it's Morakot and Goni) (pic.3).
5. The dynamics of kinetic energy fields at 850 hPa demonstrates the process of energy transfer from one structure to the other (Gustav - Hanna): intensification of one cyclone and energy losses in the other (pic.4).
6. The islands (Greater Antilles) influence on a hurricane (Gustav) leads to transformation of TC's fields structure in TC: break of circulation system and of symmetry of vorticity, velocity and kinetic energy fields (pic.4).
7. The considerable influence of SST on TC's characteristics is proved.
8. It is shown that the atmosphere in some point reacts on formation and movement of a vortex situated in 2000 km from this place.

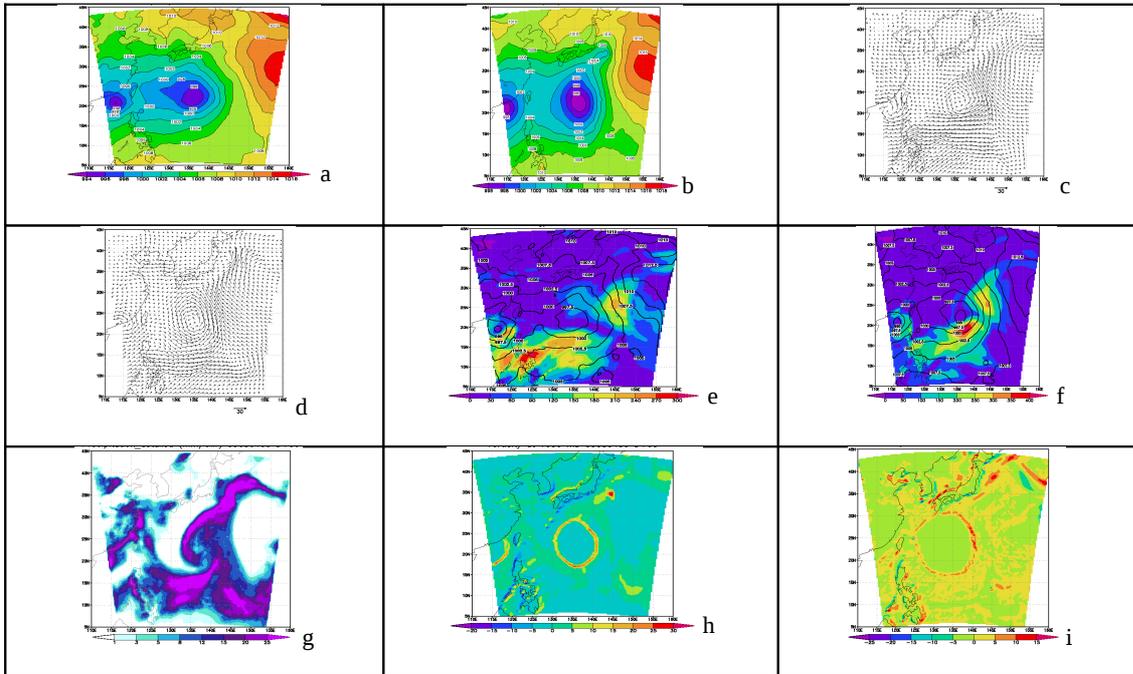


Pic.1. a) Real and simulated trajectory of tropical cyclone Man-Yi, b) Real and simulated trajectories of tropical cyclones Goni and Morakot, c) Real and simulated trajectories of tropical cyclones Gustav and Hanna.

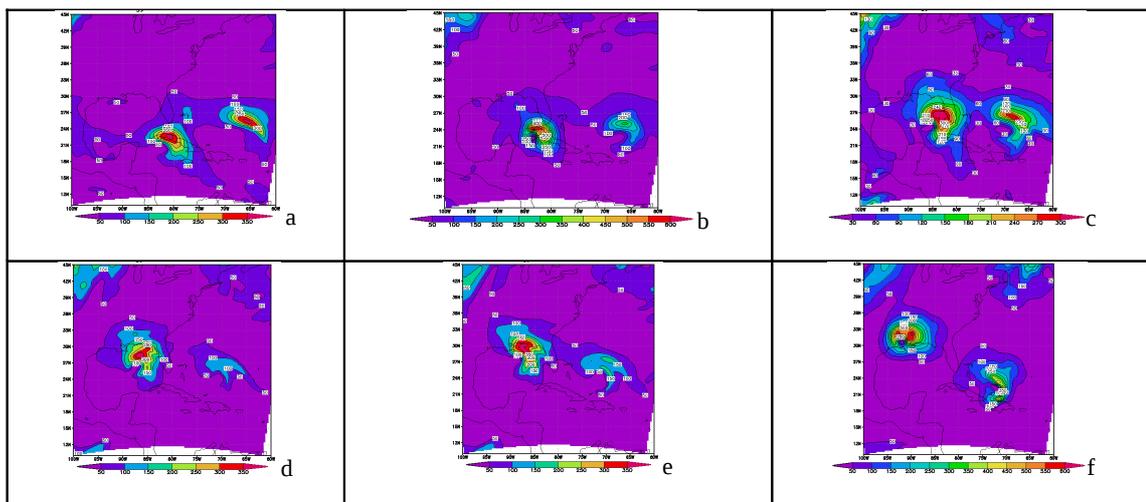




Pic. 2. Calculated meteorological fields in tropical cyclone Man-Yi a) sea-level pressure 8.07.2007; b,d,e,f) vorticity at 1000 hPa 10,11,12, 13.07.2007 correspondingly b) kinetic energy 10.07.2007.



Pic.3. Calculated meteorological fields in TC Goni and Morakot: a,b) sea-level pressure at 18 GMT 3.08.2009 and at 0 GMT 4.08.2009 correspondingly; c,d) velocity at 850hPa at 18 GMT 3.08.2009 and at 12 GMT 4.08.2009 correspondingly; e,f) kinetic energy at 850 hPa at 6 and 18 GMT 3.08.2009 correspondingly; g) precipitation at 6 GMT 4.08.2009; h,i) vorticity at 1000 hPa at 0 and 18 GMT 4.08.2009 correspondingly.



Pic. 4. Calculated fields of kinetic energy at 850 hPa during interaction of tropical cyclones «Hanna» and «Gustav» a,b,c) 30.08.2008 at 12 GMT, 31.08.2008 at 0 and 12 GMT correspondingly; d,e,f) 31.08.2008 at 24 and 30 GMT and 2.09.2008 at 0 GMT correspondingly.