The influence of anthropogenic climate forcing on some storm track characteristics in the Northern Hemisphere

Yu. V. Martynova, V.N. Krupchatnikov

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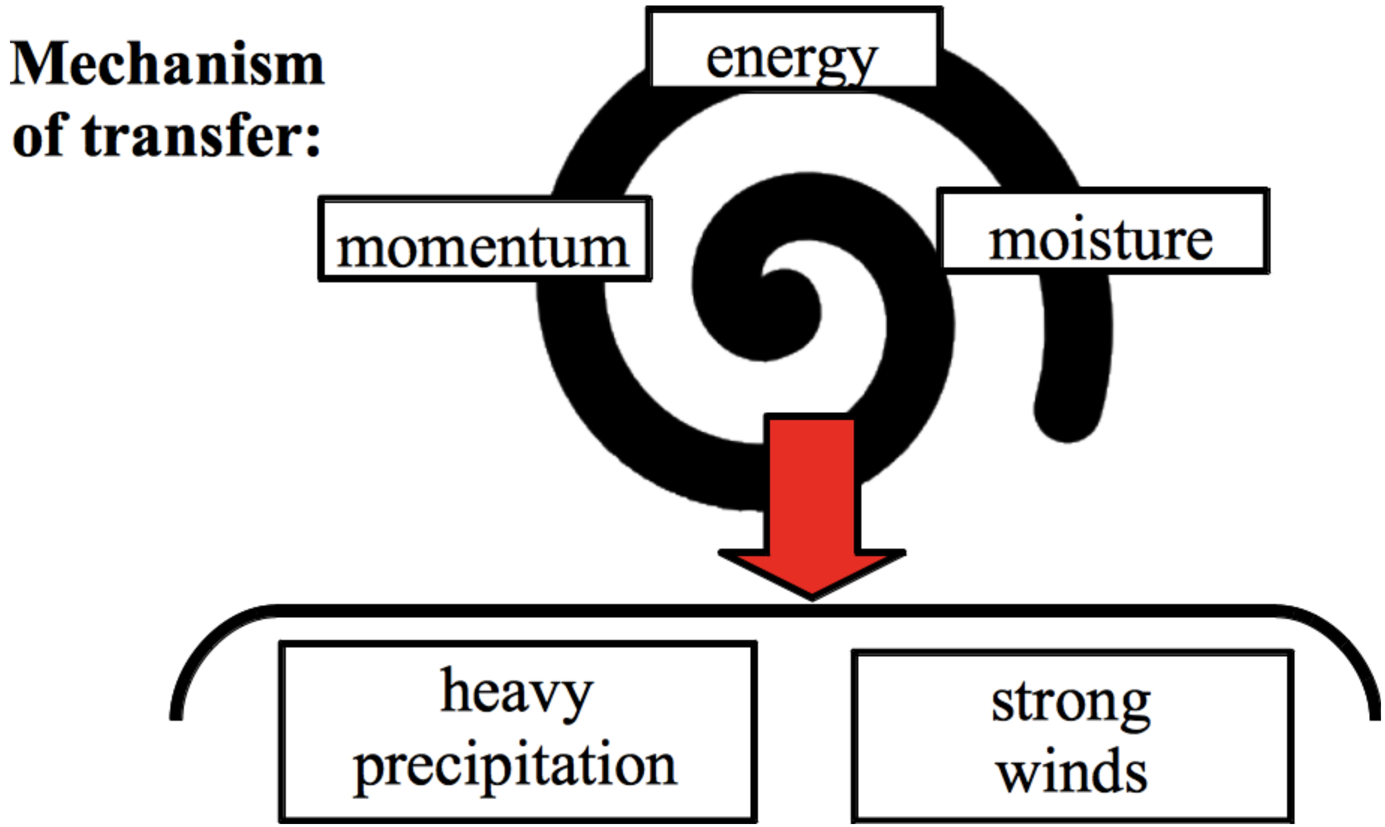
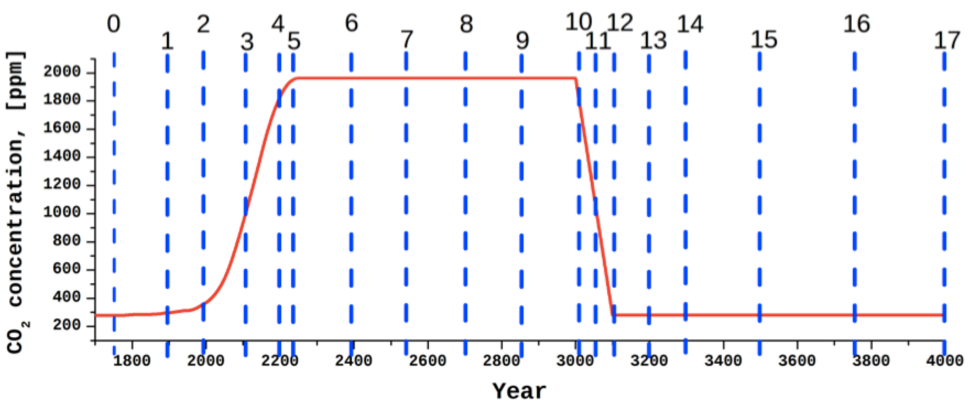
Introduction

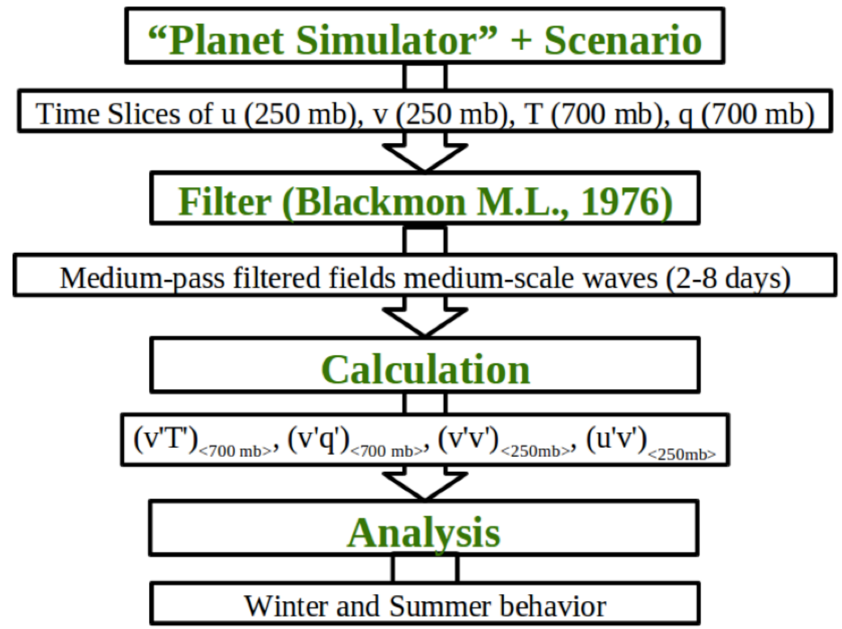


Experiment



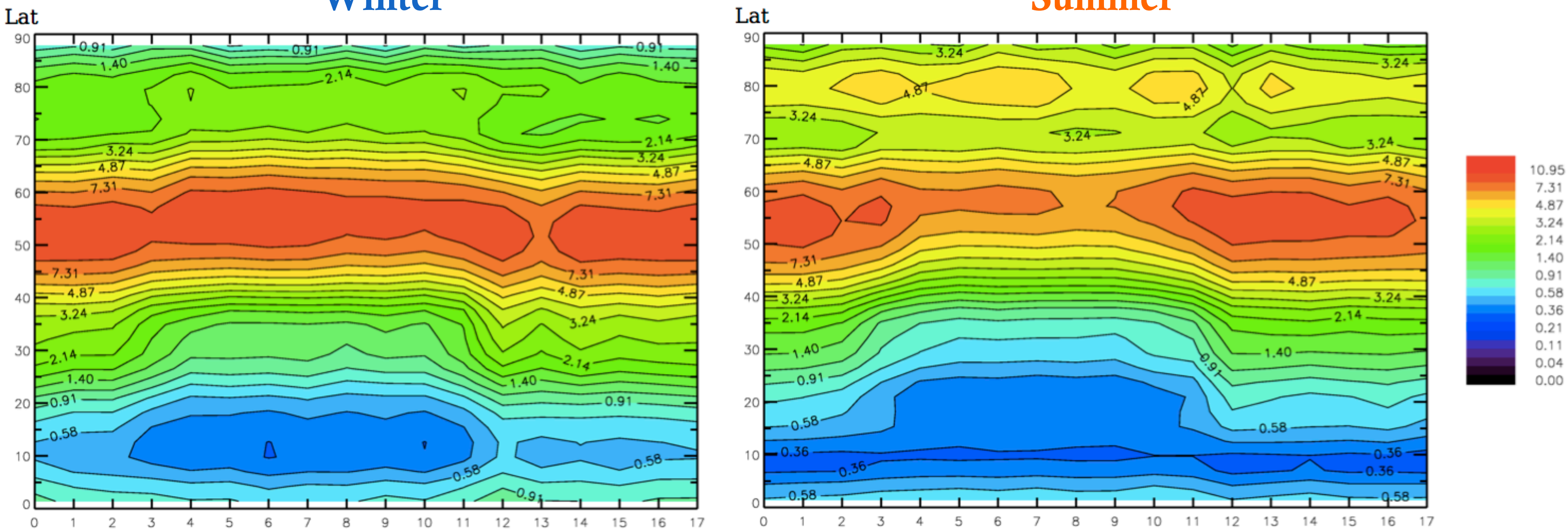
Atmospheric CO2 concentration, RCP 8.5

Computation algorithm



Results

Winter **Summer**



Zonal mean storm track activity (v'v') at 250 mb

The influence of anthropogenic climate forcing on some storm track characteristics in the Northern Hemisphere

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Thank you for your attention!

Introduction

Changes in the location, intensity or seasonality of major climatological features of the general circulation could be more important than average temperature changes, particularly where these changes might affect local hydrology, energy balances and etc.

The storm tracks are defined as the region of strong baroclinicity (maximum meridional temperature gradient), which are determined on the basis of eddy statistics like eddy fluxes of angular momentum, energy, and water (with the use of high band pass – filter). Extratropical eddies are the product of baroclinic instability, which shows itself particularly strongly during winter as a consequence of the strong pole-to-equator temperature gradient during it. In the Northern Hemisphere, there are two major storms in the region Atlantic and Pacific. The storm tracks: bring heavy rains and other hazardous weather phenomena in the middle latitudes; play an important role in the global energy cycle and the hydrological cycle.

Here we pr... nt results of our study of the st... rack behavior under increasing and ... ing anthropogenic load.

E... er... e...

M... el

"Planet Simulator" – Global large-scale climate system m... of ... ate complexity (Fraedrich K. et al., 2005).
Modules: atmosphere, ocean, land surface, soil, sea ice, biospher...
Horizontal resolution: 2,5º x 2,5º.
Vertical resolution: atmosphere – 10 equidistant σ-levels, soil – 5 depth levels (0.4, 0.8, 1.6, 3.2, 6.4 [m]).

Scenario

850 - 2005 «Historical simulations» CMIP5; XXI - XXIII RCP 8.5 [Meinshausen M. et al., 2011]; XXIV - XXX — CO_2 concentration is fixed on level of 2300; XXXI - XL — during first 100 years CO_2 concentration is linearly decrease to preindustrial value (Fig. 1).

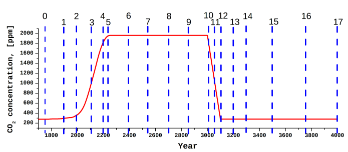


Figure 1. *Atmospheric CO2 concentration, RCP 8.5*

Processing of the model results

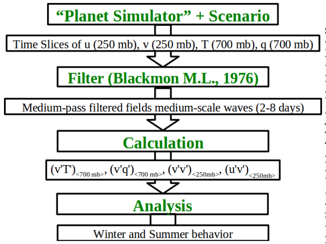
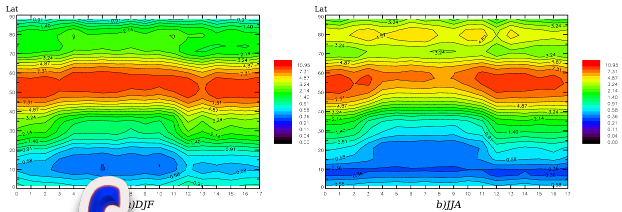


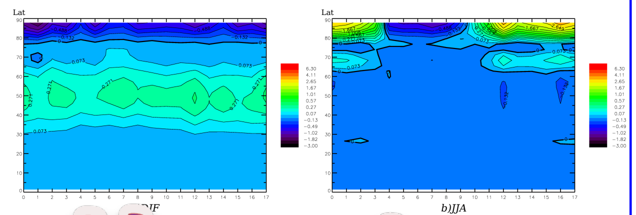
Figure 2. *Processing of the model results*

1. Simulation according to cliatic scenario RCP 8.5.
2. Extraction of temperature and humidity on 700 mb and zonal and meridional wind on 250 mb from the model output.
3. Cut 18 data slices with length 10 years.
4. Filtering these data to separate medium-scale waves (i.e. with periods 2-8 days).
5. Calculation mean slice value of the poleward heat flux ((v'T') 700 mb) and humidity flux ((v'q') 700 mb) at 700 mb and v-variance at 250 mb ((v'v') 250 mb). Prime indicates deviation from the mean monthly value (Fig. 2).

Results



...e 3. *Zonal mean storm track activity (v'v') at 250 mb a) for winter ... v... s...*



Fi... 6. *Zonal mean poleward se... ...le ... flux (v'T') at 700 mb ... ...er ... su... ...so...*

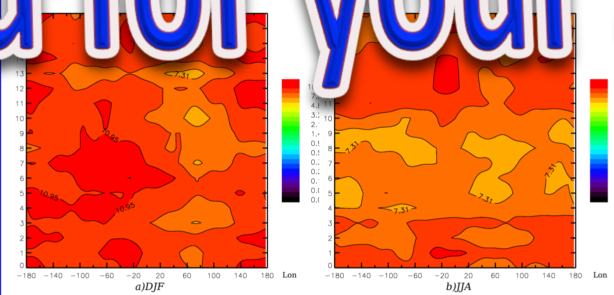


Figure 4. *Storm track activity (v'v') at 250 mb a) at 54.4 N for winter and b) at 57.2 N for summer seasons .*

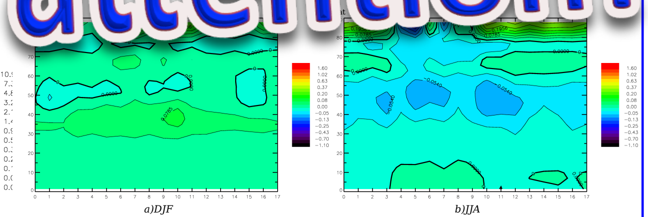


Figure 7. *Zonal mean poleward humidity flux (latent heat flux) (v'q') at 700 mb a) for winter and b) summer seasons.*

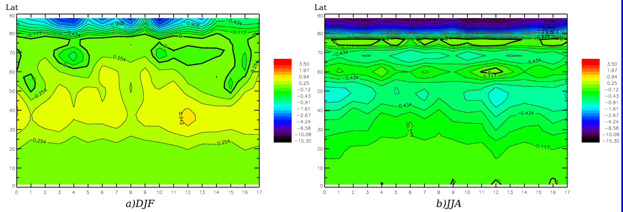


Figure 5. *Zonal mean eddy momentum flux (u'v') at 250 mb a) for winter and b) summer seasons.*

Conclusion

Summing up the above we can conclude that all considered parameters exhibit weak hysteresis effect.

It was shown a shift of areas of maximal storm track activity to high latitudes simultaneously with the CO2 concentration increase for both seasons. Furthermore, unlike the winter season the summer one demonstrates the reduce of the storm track activity besides the shift Hovmöller diagram. When atmospheric CO2 concentration decreases and returns to preindustrial value, the areas of maximal storm track activity are shifted back to the preindustrial location for both seasons. The response of Atlantic storm-track to CO2 concentration change is stronger then the response of Pacific storm-track. For a winter season Atlantic storm-track amplitude raises with the CO2 concentration increase, and it reduces with the CO2 concentration decrease.

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