Present and future climate simulation of Mediterranean cyclones with a high resolution AOGCMs

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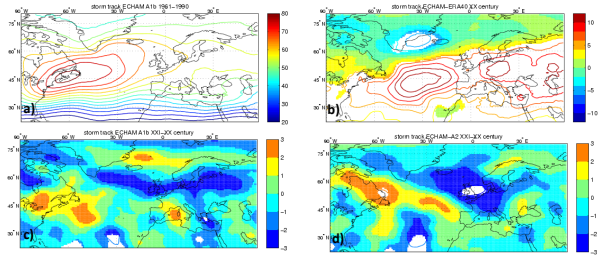
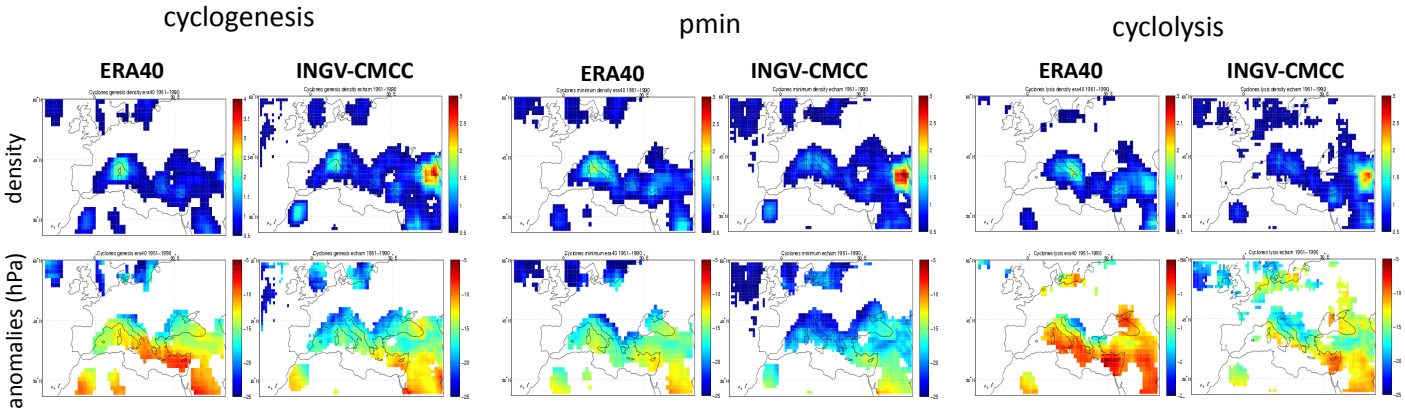
Preliminary results are presented of a study aiming at producing a climatology of Mediterranean cyclones making use of a global AOGCM coupled with an interactive high-resolution model of the Mediterranean Sea (atmospheric component T159, oceanic 2 degrees resolution, Mediterranean Sea 1/16 degree – see poster P2-25 for model details). Cyclones are analyzed with both the lagrangian and the eulerian approaches, applied to three different simulations: a control one (present climate conditions) and two IPCC scenarios (A1B and A2). Both the North Atlantic stormtrack and cyclone track and genesis density statistics from the control dataset are analyzed compared to ERA40 reanalysis, showing a reasonable overall capability of the model to represent the main features of the observed phenomena.
When future climate projections are concerned, an overall decrease of storm activity is clearly visible, more evident for A2 scenario.

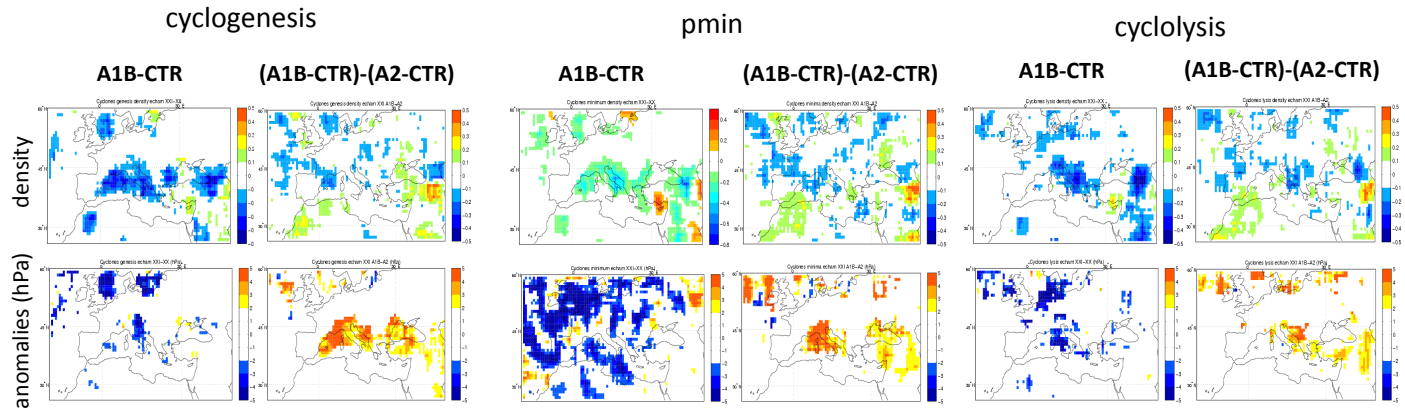


Eulerian approach:
standard deviation of the variability of the 500 hPa geopotential height winter field bandpass filtered (2 - 8 days). a) CMCC control (1961-1990) simulation; b) ERA40 reanalysis. The model stormtrack appears more zonally oriented and more extended even if less intense north to 60°N. Panels c) and d) respectively show stormtrack differences between A1B scenario and present climate and A2 and present climate. In both scenarios tendecy toward increasing storm activity around the 45° N latitudinal belt , with a somewhat different behaviour in the Mediterranean Basin: A1B scenario shows an increase of storminess in the western basin, while the A2 presents an overal decrease. Full contours indicate statistically significant differences with T-test on winter basis.

Lagrangian approach: cyclonic systems identified and followed individually from their genesis to their lysis, making use of full temporal resolution (6 hourly) mean sea level pressure fields (MSLP). Constraints on cyclogenesis value (not higher than 1020 hPa), the MSLP gradient (averaged over an area of about 1000^2 km^2 at least 0.55 hPa/100 km), minimum lifetime (not less than 18h) and on the minimum MSLP reached through the lifecycle (pmin, not higher than 1010 hPa). Tracking based on nearest neighbour search with maximum cyclone speed of 300 km/ 6 h in the westward direction and 660 km/6 h in any other.



XX century (1961-1990): results validated against ERA40 reanalysis. First row: cyclogenesis, position of pmin and cyclolysis expressed in terms of densities (the number of points in a 5°x5° grid box, normalized to the corresponding area at 50°N (about 200x10^3 km^2)). Model catches reasonably well the main areas of cyclogenesis, cyclolysis and pmin location, even if a clear overestimation is present in the eastern edge of the examined area, between Black and Caspian Seas. Second row: MSLP values in hPa as anomalies from mean winter value. Model overestimates the intensity of each phenomena. Only areas with densities higher than 0.5 are shaded.



XXI century (2021-2050): for each phenomena (cyclogenesis, pmin location and cyclolysis) first column shows the climate change due to A1B scenario, presented as the anomalies difference A1B-CTR, while the second presents difference between the anomalies A1B-CTR and A2-CTR. Cyclogenesis, cyclolysis and pmin densities decrease in A1B scenario, while MSLP anomalies tend to reduce (hint of decreasing intensity of cyclones). A2 scenario shows an overall decrease of densities (except for the very eastern Turkey) and a further reduction in MSLP involved.

FUTURE DEVELOPMENT: the overall capability of the model in representing both present climate (ERA40 reanalysis) and future scenarios (other climatologies in literature) extratropical cyclones features over Mediterranean Basin encourages further analyses, taking advanage of the very high resolution of the model, mainly as far as the marine component is concerned. Future work will in particular involve the investigation of air-sea fluxes and extend the analysis also to other seasons than winter.

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