Mediterranean Tropical-Like Cyclones forecasts and analysis using the ECMWF Ensemble Forecasting System (IFS) with Physical Parameterizations Perturbations

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The ensemble tracking results are reported in Figure 1. They now include the new set of ensemble members for the experiment including the initial condition perturbation with EDA and the physical parameterization perturbation with SPP, the TOT ensemble. The tracking results shown in Figure 1 are mirrored by the ensemble spread and the relationship between the spread and the error presented in Figure 2 and Figure 3 respectively.

The results, reported in those Figures point out that the spread of the TOT experiment is similar to the INI one for the tracking and it is larger than the SPP and SPP-Conv ensembles. It is also evidenced that the spread/skill relationship values for the TOT ensemble are higher than the other experiments, with the TOT ensemble being less under-dispersive.

The development of the core pressure with the simulations is reported in Figure 4 where the TOT ensemble results have been added and the spread of the latter ensemble tends to better include the operational analysis. Overall, the TOT ensemble is better performing for what concerns the tracking and core pressure.

Regarding precipitation, for each cyclone, the daily accumulation on the day of the "tropical-like" phase is shown in Figure 5. In the fourth column, the TOT ensemble means are shown. The latter ensemble mean compares to the INI ensemble, similar to what happens for the standard deviation of each ensemble experiment in Figure 6 and Figure 7, thus confirming previous results obtained for this part of the analysis.

1 Figures

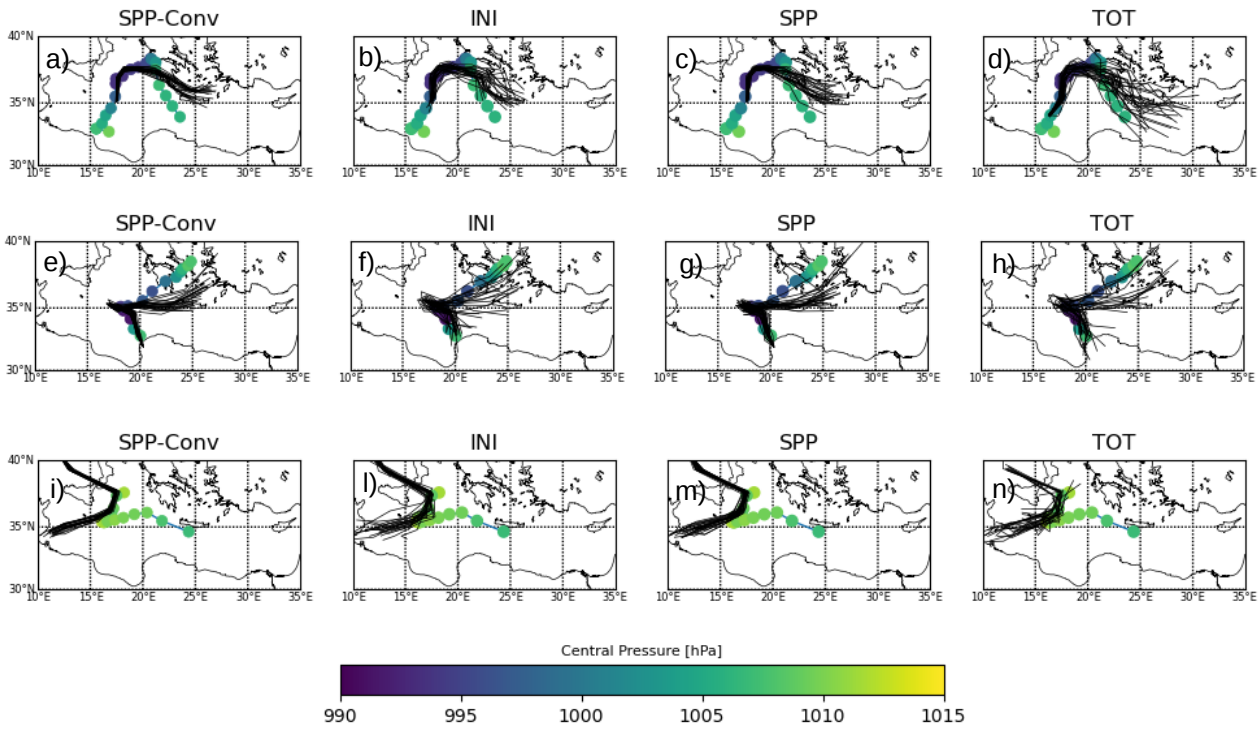

Figure 1. Track of the three storms for the operational analysis as reference track and for the ensemble members belonging to each experiment (SPP-Conv on the first column, INI on the second column, SPP on the third column and TOT in the fourth column) for the three storms, Ianos in a, b, c and d, Zorbas in e, f,g and h and Trixie in i, l, m and n. As background the operation analysis is reported with the colours representing the intensity, meaning the central pressure in hPa. For Ianos the experiments starting on the 16/09 have been chosen, for Zorbas the ones starting on the 27/09 and for Trixie the ones starting from the 27/10.

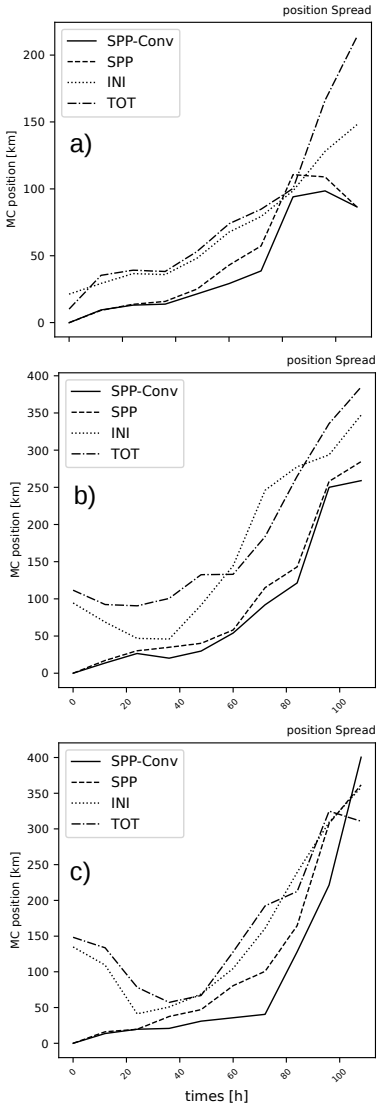

Figure 2. Mean ensemble spread of the medicanes track for each ensemble perturbation experiment for Ianos in a, Zorbas in b and Trixie in c. The track spread is computed as described in Eq. **??** and is reported in km. For Ianos the experiments starting on the 16/09 have been chosen, for Zorbas the ones starting on the 27/09 and for Trixie the ones starting from the 27/10, in order to be consistent with the ensemble tracks shown in Figure 1

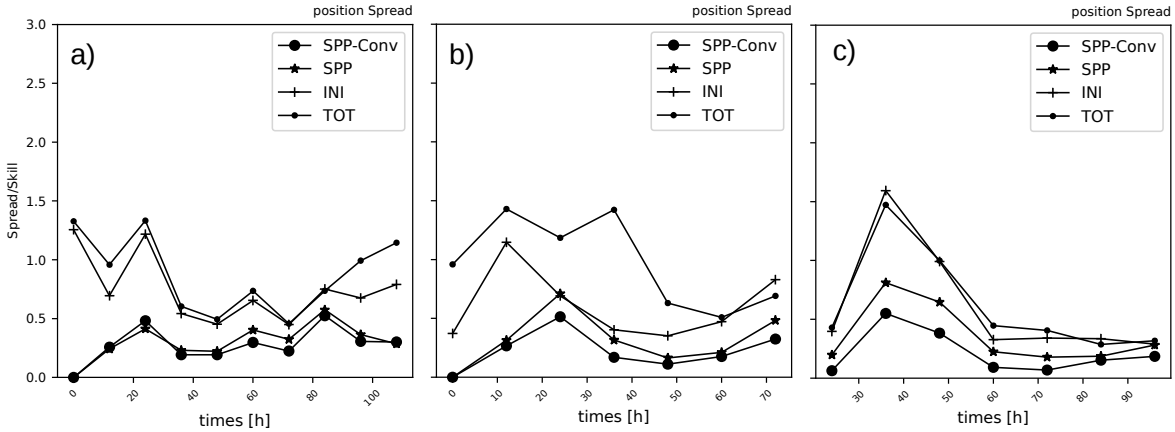

Figure 3. Ensemble Spread/skill relationship for each ensemble perturbation experiment for Ianos in a, Zorbas in b and Trixie in c. For Ianos the experiments starting on the 16/09 have been chosen, for Zorbas the ones starting on the 27/09 and for Trixie the ones starting from the 27/10, in order to be consistent with the ensemble tracks shown in Figure 1.

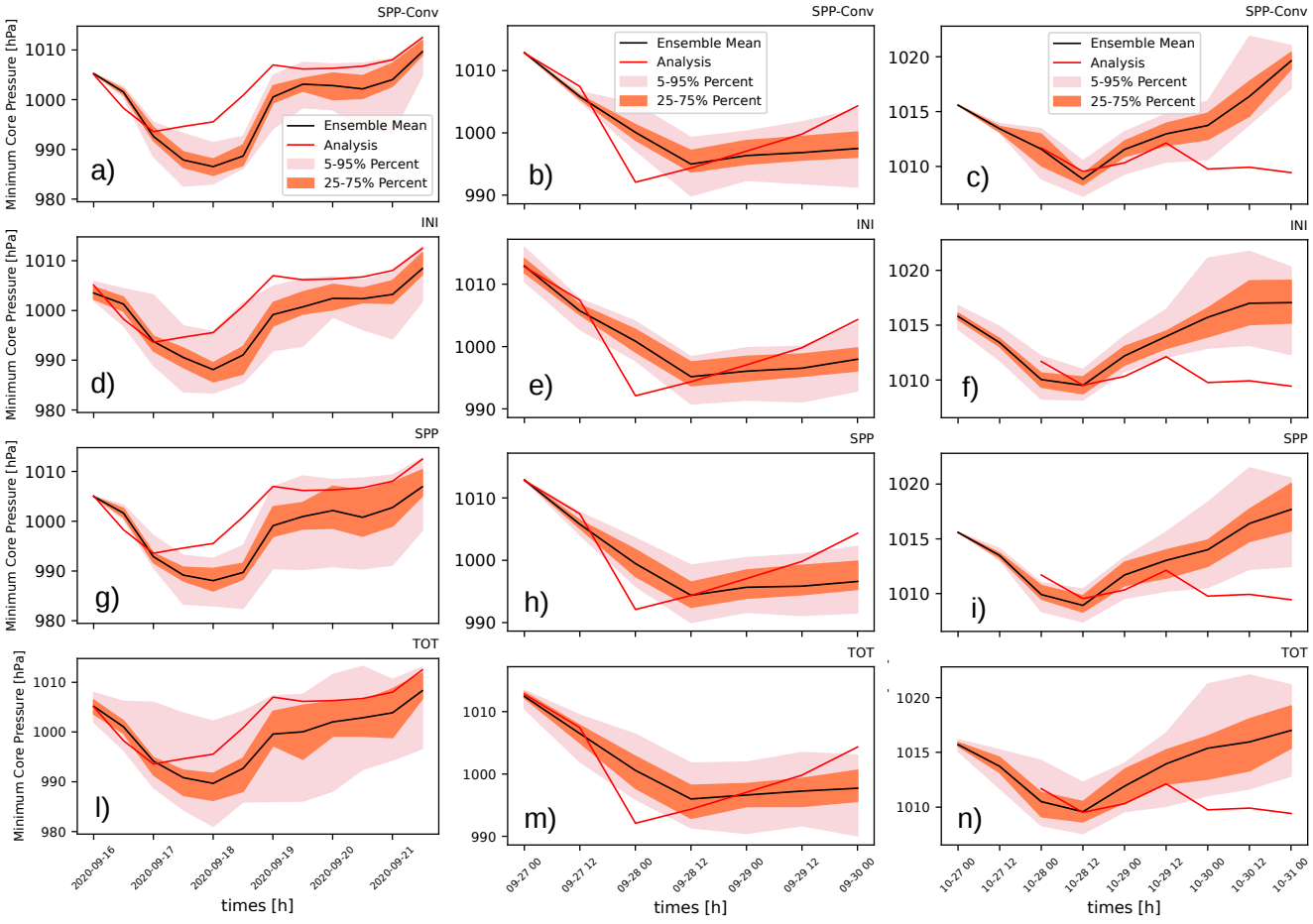

Figure 4. Analysis of the mean seal level central pressure, for Ianos in the first column, Zorbas in the second column, and Trixie in the third column. The plots show the ensemble members' development throughout the simulation. In each Figure the ensemble mean is reported in black, the operational analysis is reported in red and the two shaded areas represent the 25-75 % percentile and the 9-95 % percentile. The SPP-Conv experiment is reported for each medicane in Figures a, b and c. The INI experiment is reported in Figures d, e and f, the SPP experiment in Figures g, h, i and the TOT experiment in l, m and b.

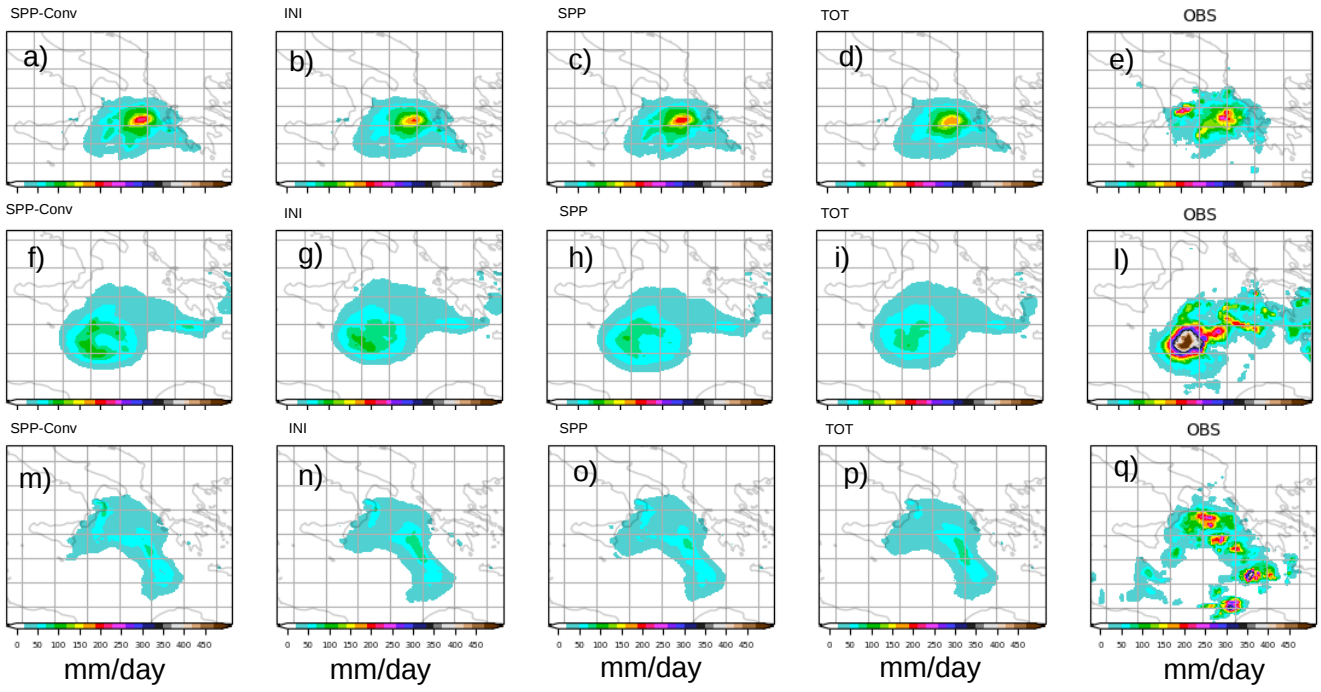

Figure 5. Daily accumulated precipitation (mm/day) for the three ensemble experiments ensemble means compared to the satellite observation GPM-IMERG. For Ianos the 17th is shown in Figures a, b, c, d and e. For Zorbas the 28th is shown in Figures f g h and i. For Trixie the 28th is shown in Figures l, m, n and o. The SPP-Conv ensemble forecast accumulated precipitation is reported in the first column, the SPP ensemble in the second column, the INI ensemble in the third column and the observations in the fourth column. For Ianos the experiments starting on the 17th is shown, for Zorbas the ones starting on the 27th and for Trixie the ones starting from the 27th.

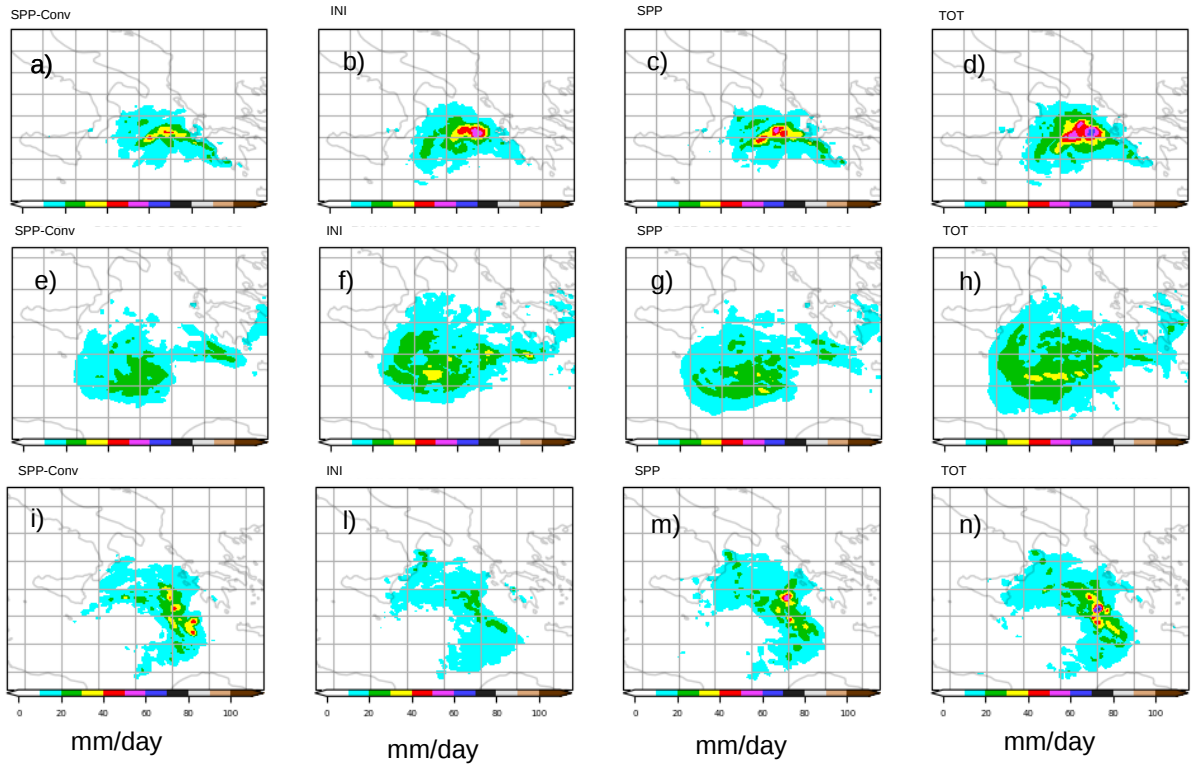

Figure 6. Daily accumulated precipitation (mm/day) standard deviation for the three ensemble experiments ensemble means. For Ianos the 17th is shown in Figures a, b, c and d. For Zorbas the 28th is shown in Figures e, f, g and h For Trixie the 28th is shown in Figures i, l, m and n. the SPP-Conv ensemble forecast ensemble mean accumulated precipitation standard deviation is reported in the first column, the SPP ensemble mean in the second column, the INI ensemble mean in the third column and the TOT ensemble mean in the fourth column. For Ianos the experiments starting on the 17th are shown, for Zorbas the ones starting on the 27th and for Trixie the ones starting from the 27th

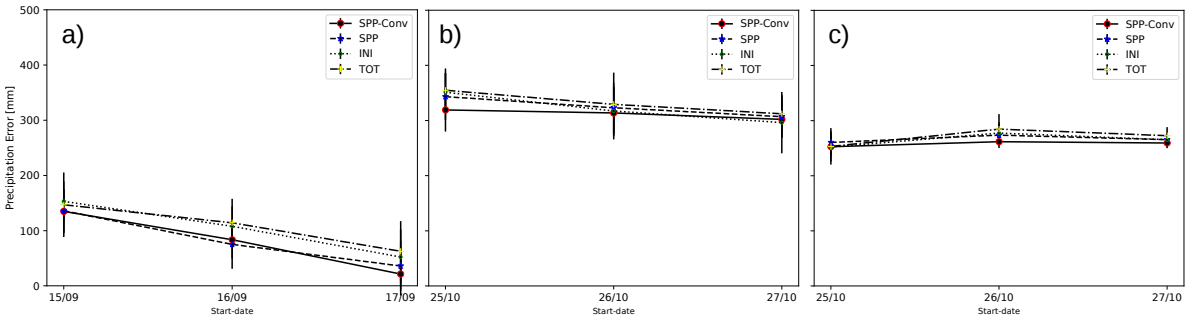

Figure 7. Daily accumulated precipitation (mm/day) root mean squared error between the ensemble mean maximum precipitation and the observed maximum precipitation evolution with increasing starting date for the three ensemble experiments ensemble means. For Ianos in Figure a the 17th maximum precipitation is taken, for Zorbas in Figure b the 28th maximum precipitation is taken and for Trixie in Figure c the 28th maximum precipitation is taken.