The origin of precipitation in Zorbas medicane (2018) : Assessing different Lagrangian moisture tracking approaches

Albenis Pérez-Alarcón (1),(2),(3), Rogert Sorí (1), Milica Stojanovic (1), Ricardo Machado Trigo (2),(4), Raquel Nieto (1), Luis Gimeno (1)

(1) Centro de Investigación Mariña, Environmental Physics Laboratory, Universidade de Vigo, Spain, (2) Instituto Dom Luiz (IDL), Faculdade de Ciências, Universidade de Lisboa, Portugal
(3) Departamento de Meteorología, Instituto Superior de Tecnologías y Ciencias Aplicadas, Universidad de La Habana, Cuba (4) Departamento de Meteorologia, Universidade Federal do Rio de Janeiro, Brazil
albenis.perez.alarcon@uvigo.es

MedGU Mediterranean Geosciences Union

Introduction / Research Motivation

- Understanding the variability and origin of moisture for precipitation events is directly related to improving our knowledge of the moisture transport pathways[1].
- Lagrangian moisture tracking methods based on the water budget equation[2] have inherent uncertainties linked to numerical diffusion and numerical errors in the trajectory calculation[3].
- Validating these methods is challenging due to the scarcity of observations for benchmarking.
- This study aims to examine different Lagrangian moisture tracking approaches to identify the origin of precipitation in Zorbas (2018) medicane.

Acknowledgement

- Consellería de Cultura, Educación, Formación Profesional e Universidades, Xunta de Galicia (ED481B-2023/016, ED481D−2024/017, Excelencia-ED431F-2024/03, ED431C2021/44)
- Ministerio de Ciencia, Innovación y Universidades, Spain (RYC2021−034044-I, PID2021-122314OB-I00)
- Portuguese Science Foundation (DRI/India/0098/2020)
- European Union ‘ERDF A way of making Europe’

Materials and Methods

Tracking methods are based on the Lagrangian water budget equation[2]

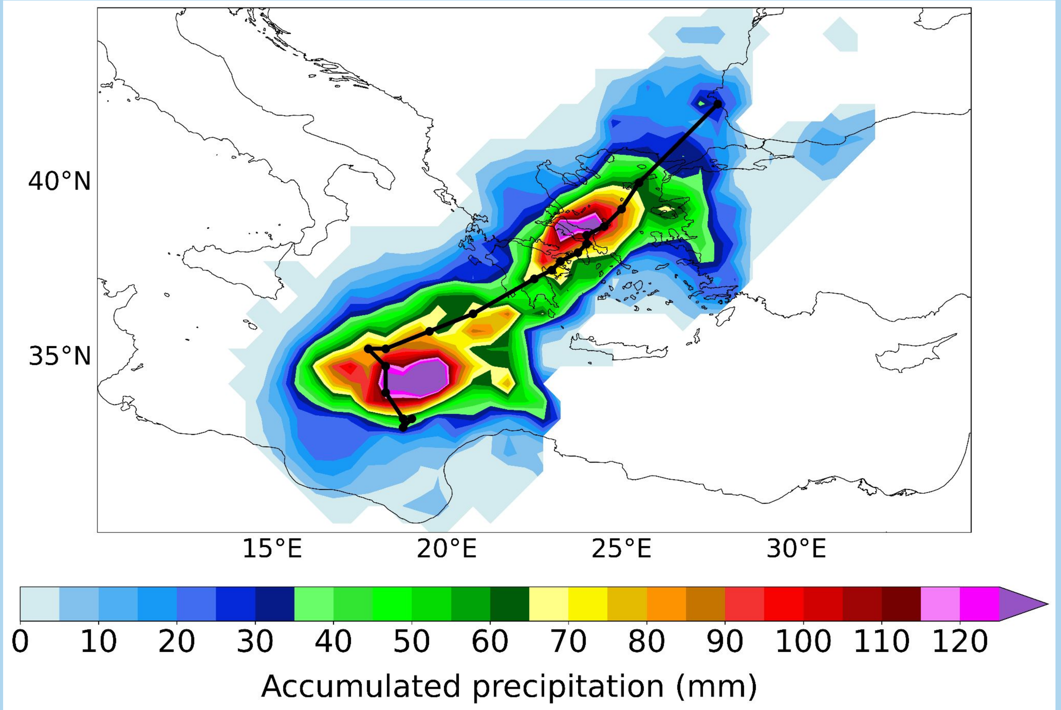
$$m\frac{dq}{dt} \approx m\frac{\Delta q}{\Delta t} = e - p$$

ECMWF FLEXPART

Lagrangian moisture tracking approaches. $RH^0 > RH \in [0, 65, 75, 80]$ %

Method	Filtering parcels at t_0		Moisture uptake		ABL	Ref
	Δq (g/kg)	RH (%)	Δq (g/kg)	ΔRH (%)		
APA22	< -0.1	> 0	> 0.0	-	No	(4)
FAS19	< -0.1	> 80	> 0.1	-	No	(5)
JK22	< 0.0	> 80	> 0.0	< 20	Yes	(6)
SOD08	< -0.2	> 80	> 0.2	-	Yes	(7)

- The Zorbas track was extracted from the ERA5 reanalysis data using CyTRACK[8].
- The moisture source analysis was performed by applying LATTIN[9] to air parcel trajectories from FLEXPART outputs.
- A simple bias correction approach has been applied.



MSWEP

Figure 1. Accumulated precipitation (mm) along the Zorbas trajectory

Results

There is an overall agreement in the origin of the precipitating moisture, predominantly coming from the Ionian, Aegean and Black Seas and the Sea of Crete.

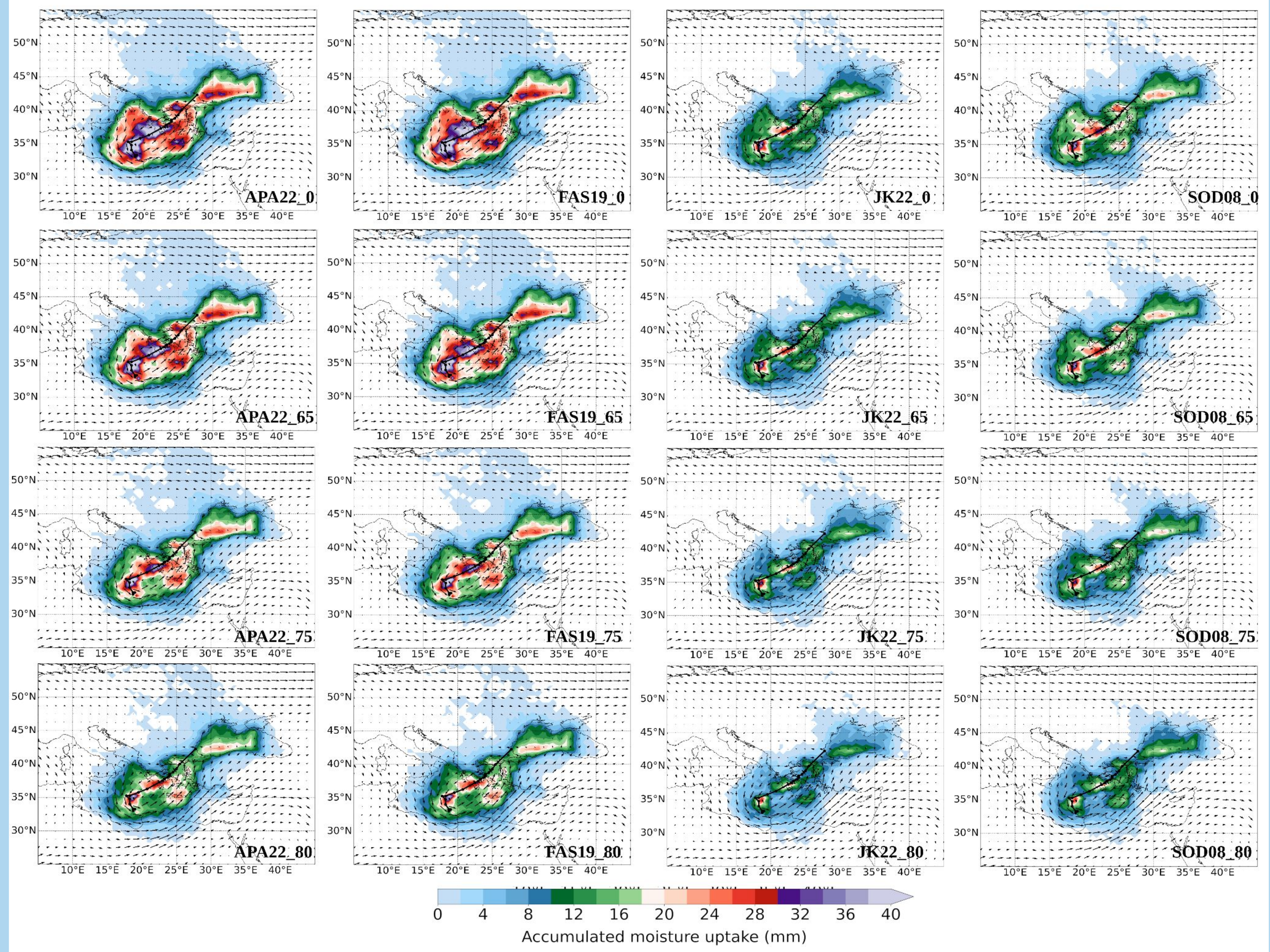


Figure 2. Accumulated moisture uptake (mm) along the Zorbas trajectory

Subtle differences among the approaches are observed in the intensity and spatial extent of the moisture sources pattern. Figure 2 also reveals the uncertainties between ABL (JK22 and SOD08) and non-ABL (APA22 and FAS19) methods.

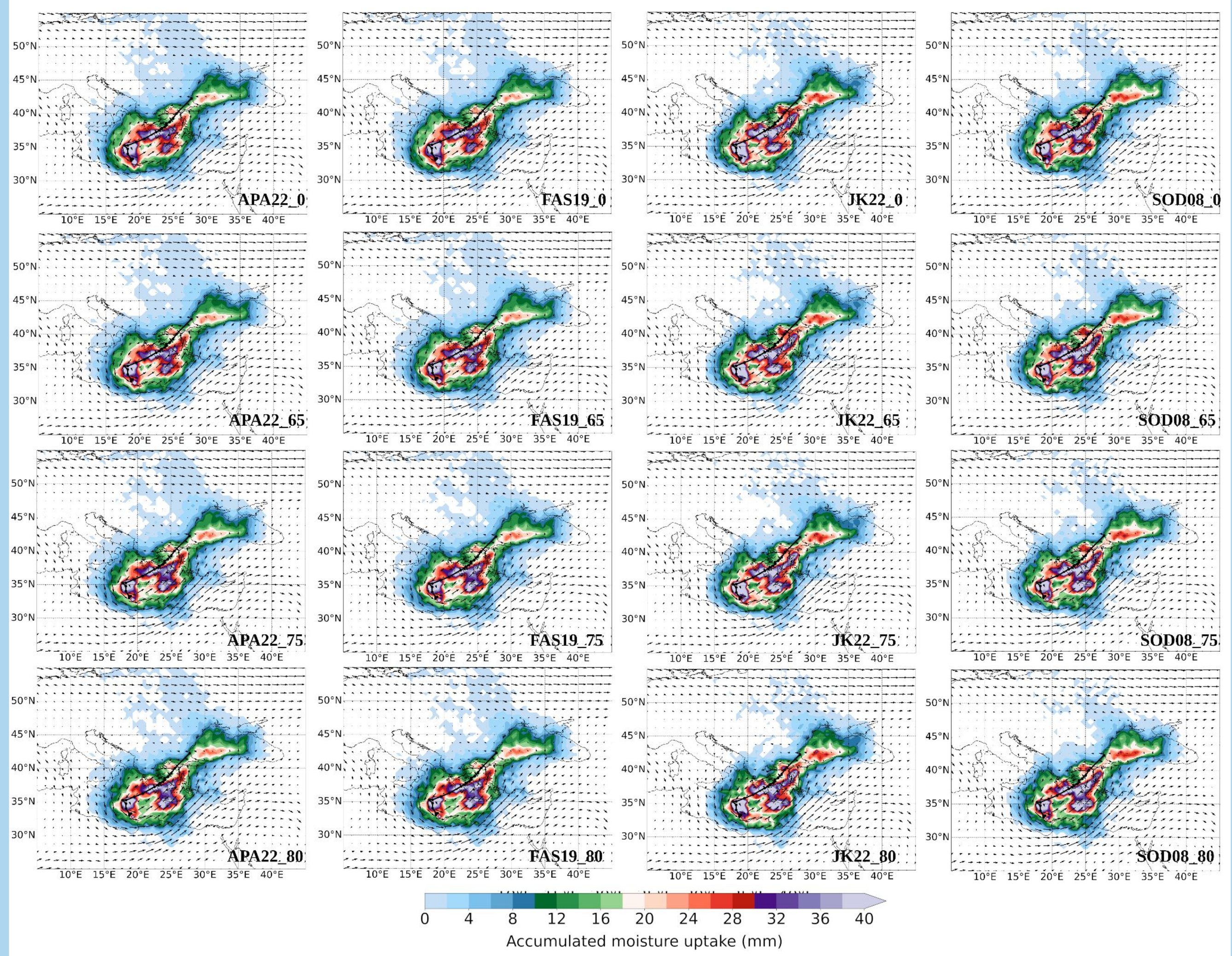


Figure 3. Corrected moisture uptake pattern along the Zorbas trajectory

The bias-corrected pattern looks quite similar for all of the detection criteria. A careful analysis shows that APA22_65 and FAS19_65 achieved the best results.

Discussion and Conclusions

1. Methods accounting for moisture uptake in the whole atmospheric column perform better in identifying moisture sources for Zorbas precipitation.
2. The bias correction approach reduces uncertainties in the moisture source analysis.
3. The intensity and extent of the bias-corrected pattern depend on the precipitation dataset.
4. Sensitive analysis must be performed to select the most suitable approach

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The authors acknowledge the support from EXMERISK PROJECT (TED2021-129152B-C43) MCIN/AEI y Unión Europea NextGenerationEU/ PRTR)