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Toujours un temps d'avance

Comment la variabilité interne d'un modèle régional impacte les dépressions météorologiques en Méditerranée

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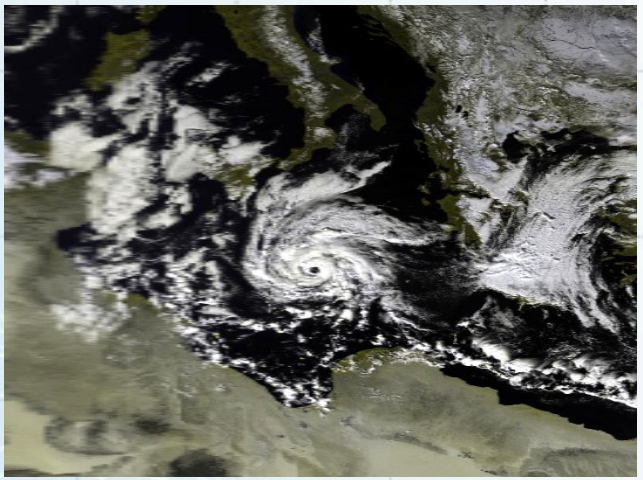

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Introduction: Uncertainties in climate modeling

Sources of **uncertainty** for both GCMs and RCMs :

- the **formulation and accuracy** of the model
- the **choice of parameterisations**
- the **chaotic nature** of climate system
- the **amplitude of the anthropogenic emissions** (for climate projections)

For the **RCMs**:

- **Uncertainties in the LBCs**
- Even forced by the same LBCs, **RCMs may give irreproducible solutions**

→ **INTERNAL VARIABILITY of a RCM (IV)**

North America: Cayan and Biner 2004, Rinke et al. 2004, Vannitsen and Chome 2004, Alexandru et al. 2007, Lucas-Picher et al. 2008a,b, Laprise et al. 2008…
South Africa: Cretat et al. 2011
Tropical Areas: Vanyve et al. 2008, Kgatuke et al. 2008
Europe and Mediterranean Region: Giorgi and Bi (2001), Christensen et al. 2001, Sanchez-Gomez et al. 2009

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Based on North America domain, IV depends on :

- **The strength of the LB forcing**
- **The spatio-temporal scale and the physics**
- **The physical parameter considered**
- **The domain size, the season…**

Objectives

Motivation:

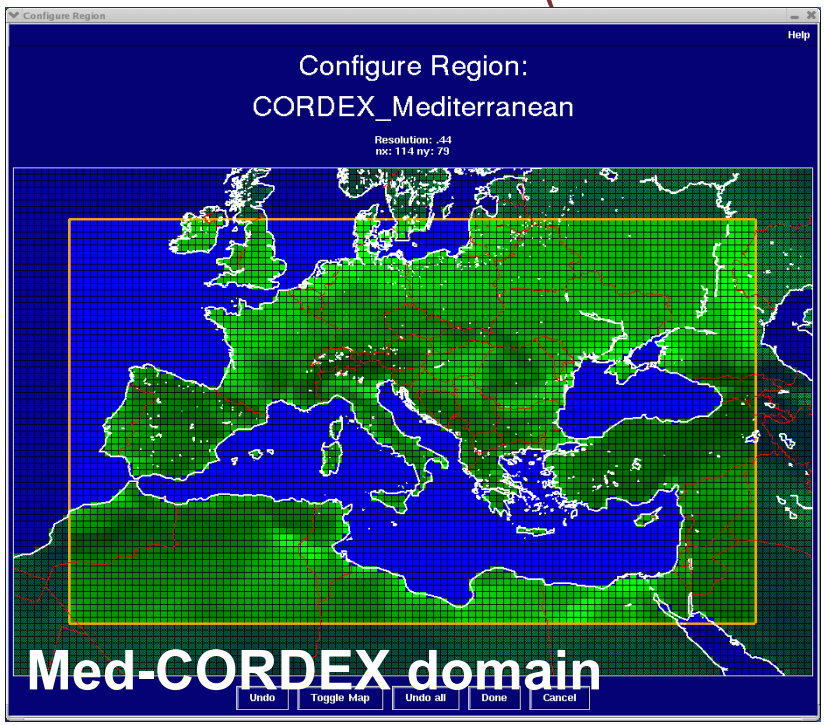
- Large-scale features (longer periods and longer areas) are more reproducible than high frequency (synoptic) or local-scale variability
- Very few studies of IV on the Mediterranean region

Objectives:

Characterize and quantify the IV of the Aladin-Climat RCM operating over the MedCORDEX domain (i) and its impacts on the Mediterranean cyclones (ii)

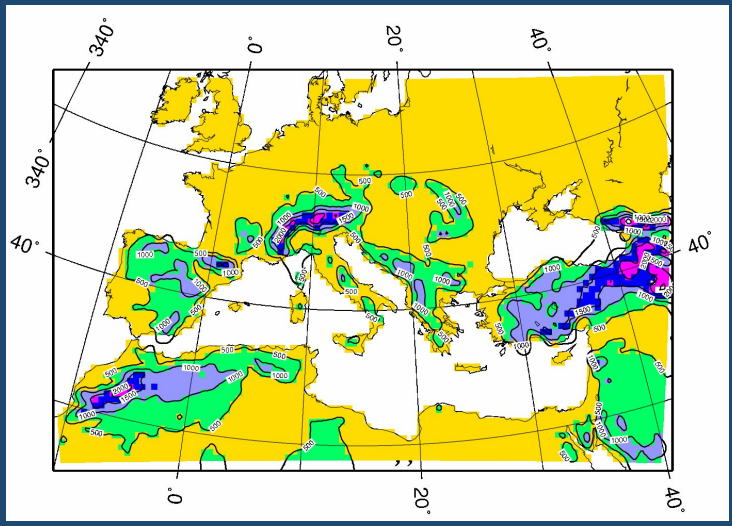
ALADIN Regional Climate Model

(CNRM-ALADIN52, Colin et al. 2010)



Med-CORDEX domain

Topography and land-sea mask



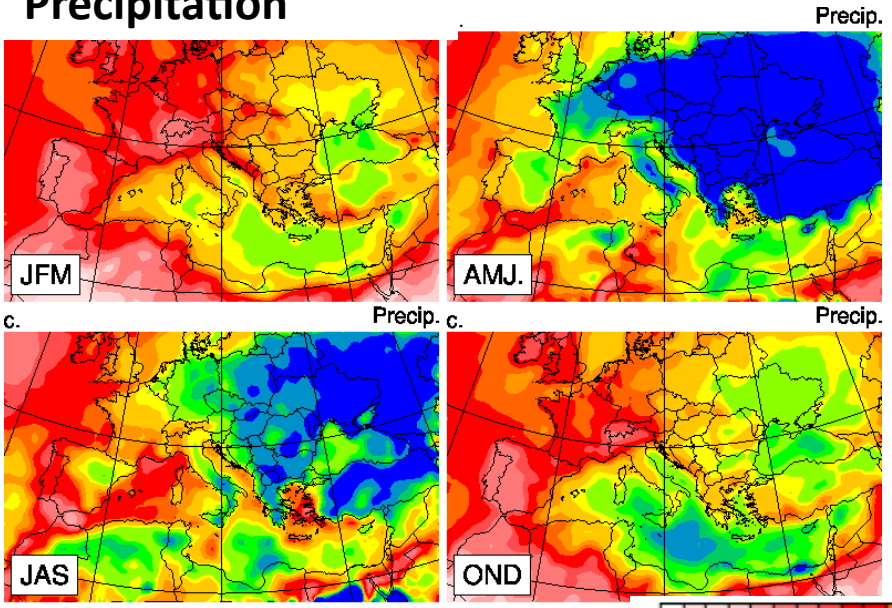
- **50 km, 31 vertical levels**
- **ISBA land surface, 50km**
- **Land-surface: ISBA, 50km**
- **Physics: version 5.2**
- **Atm. LBC: ERA-Interim, 80km, 6h**
- **SST: ERA-Interim analysis (monthly mean)**

Simulations

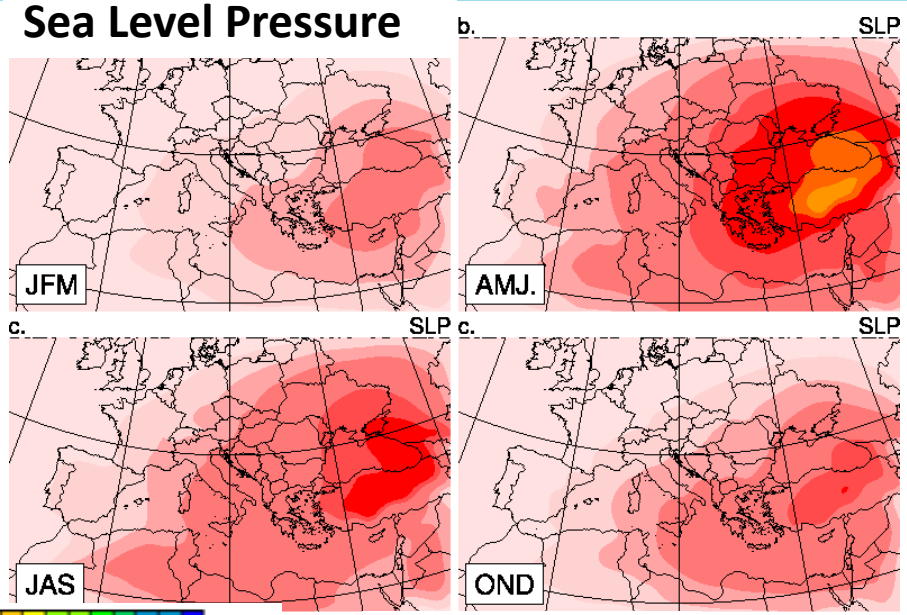
- Period: 1979-2012
- **Ensemble of 10 members** with different initial conditions from ERAI on Jan. 1st
- **Same LBC (ERAI) for all the members**

Spatial structure of IV

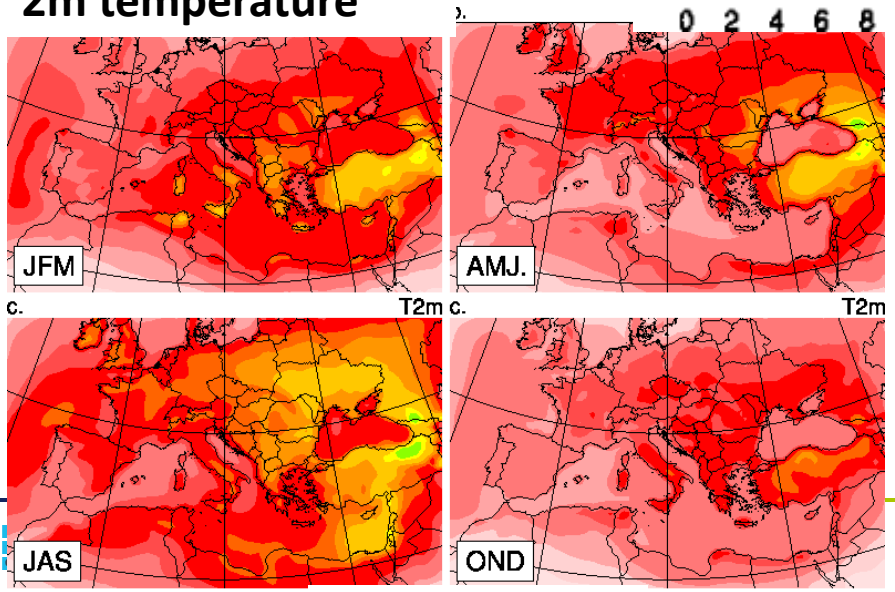
Precipitation

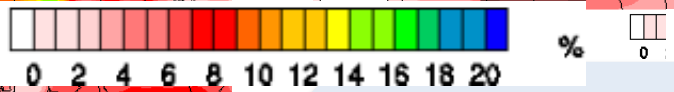


Sea Level Pressure



2m temperature

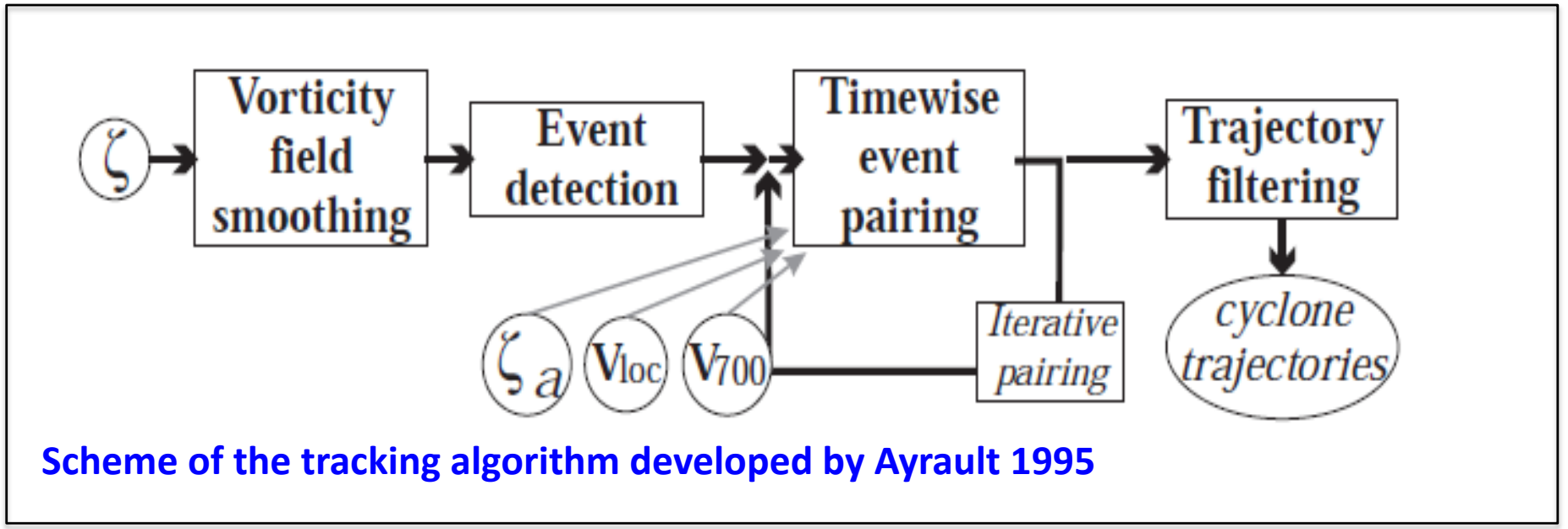




- ✓ **Highest RIV values in summer season (~15% for tas, ~30% for pr).**
- ✓ **Maxima are located on the eastern part of the domain.**
- ✓ **Stronger values for precipitation (more than 30% in some regions).**

Determination of Mediterranean cyclones

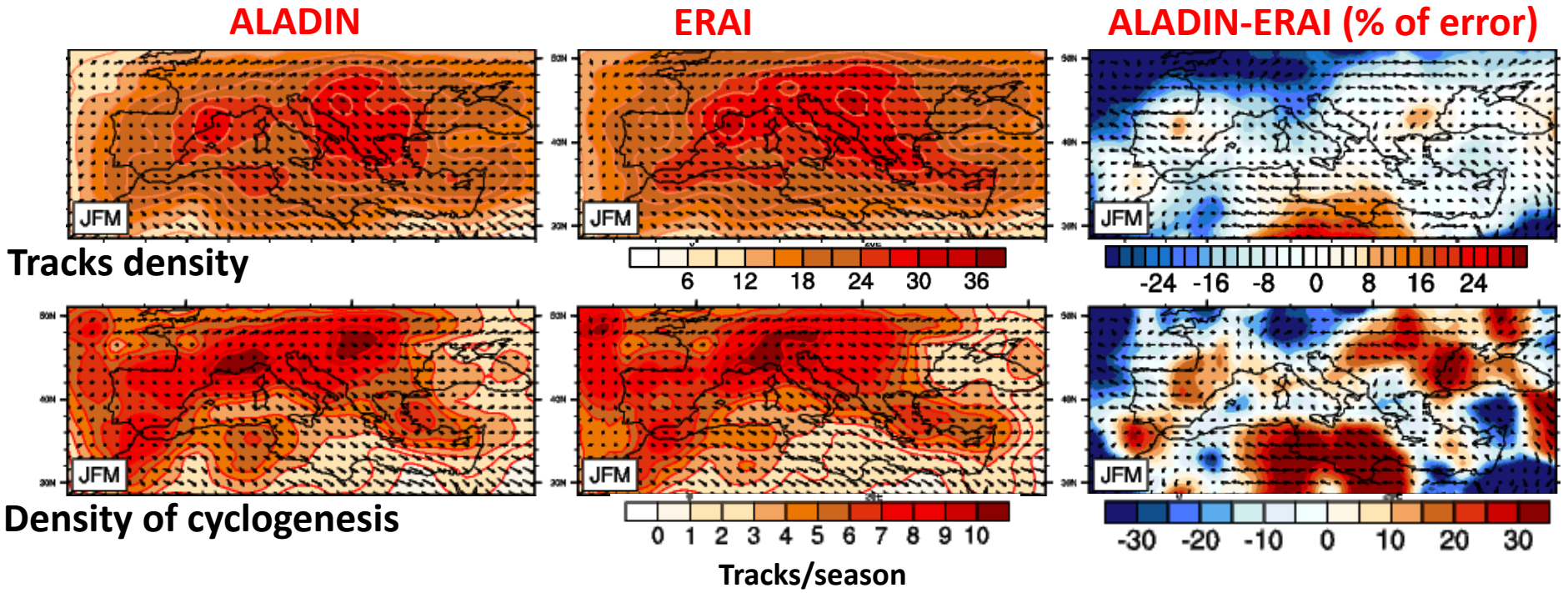
To characterize cyclones we use a tracking algorithm based on the detection of maxima of relative vorticity at 850 hPa (ζ_{850}) (Ayrault 1995).



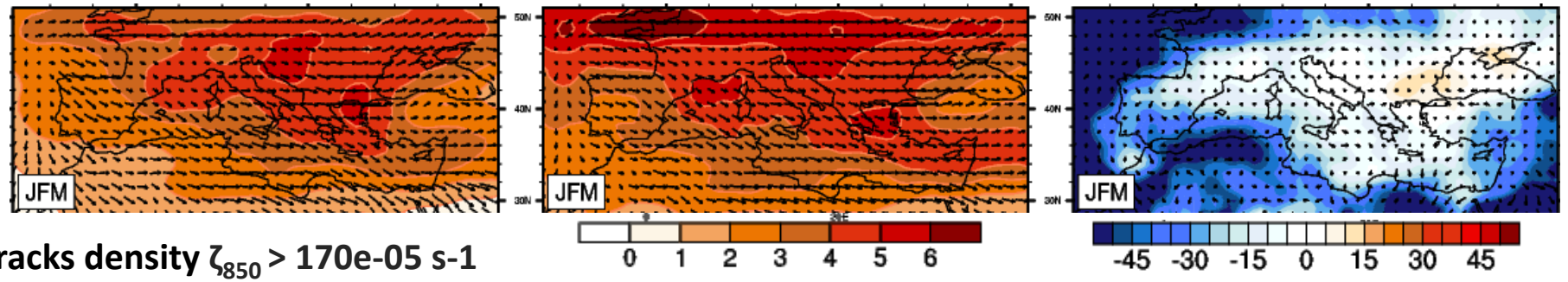
Scheme of the tracking algorithm developed by Ayrault 1995

- The tracking is applied on the 6h fields (psl, u700, v700, ζ_{850}) to each of the 10 ALADIN members and to ERAI.
- Only trajectories lasting more that 24 hours are retained in this study

Evaluation ALADIN-RCM: tracks density



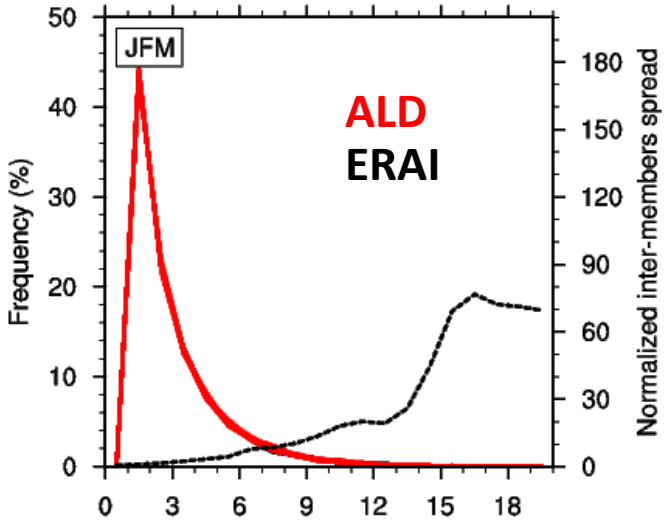
Extreme cyclones:



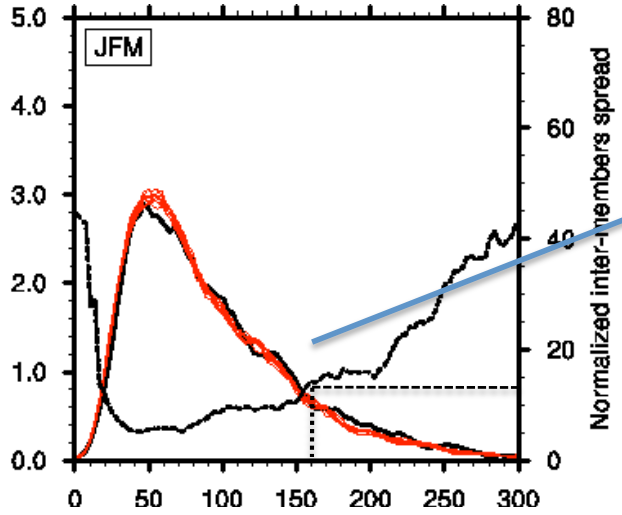
Tracks density ζ_{850} > 170e-05 s-1

Evaluation ALADIN-RCM: Cyclones statistics

Duration (days)

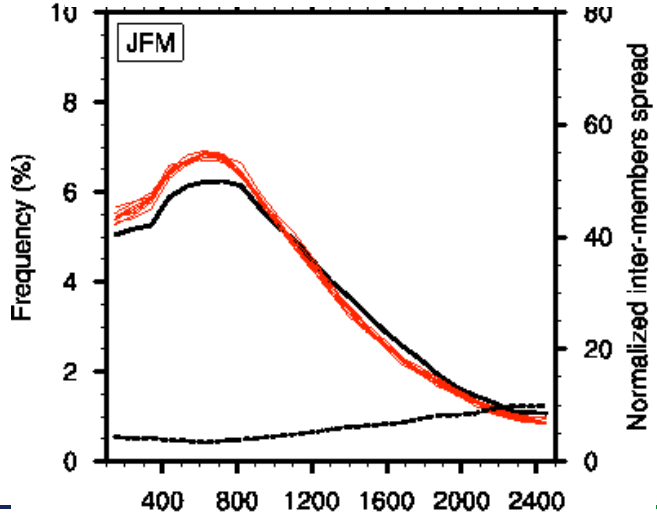


Intensity (vorticity at 850 hPa)

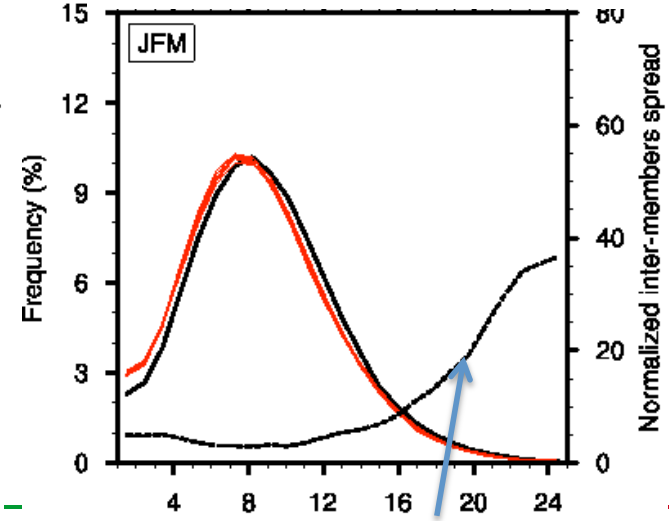


Around a 25% of population with > 10% spread

Travelled distance (km)



Mean velocity (m/s)



Cyclones statistics is well simulated by ALADIN

- ALADIN slightly overestimates the number of mean intense cyclones
- ALADIN overestimates the number of static cyclones
- ALADIN underestimated cyclones that travel longer distances
- The mean velocity of cyclones is slightly underestimated by ALADIN

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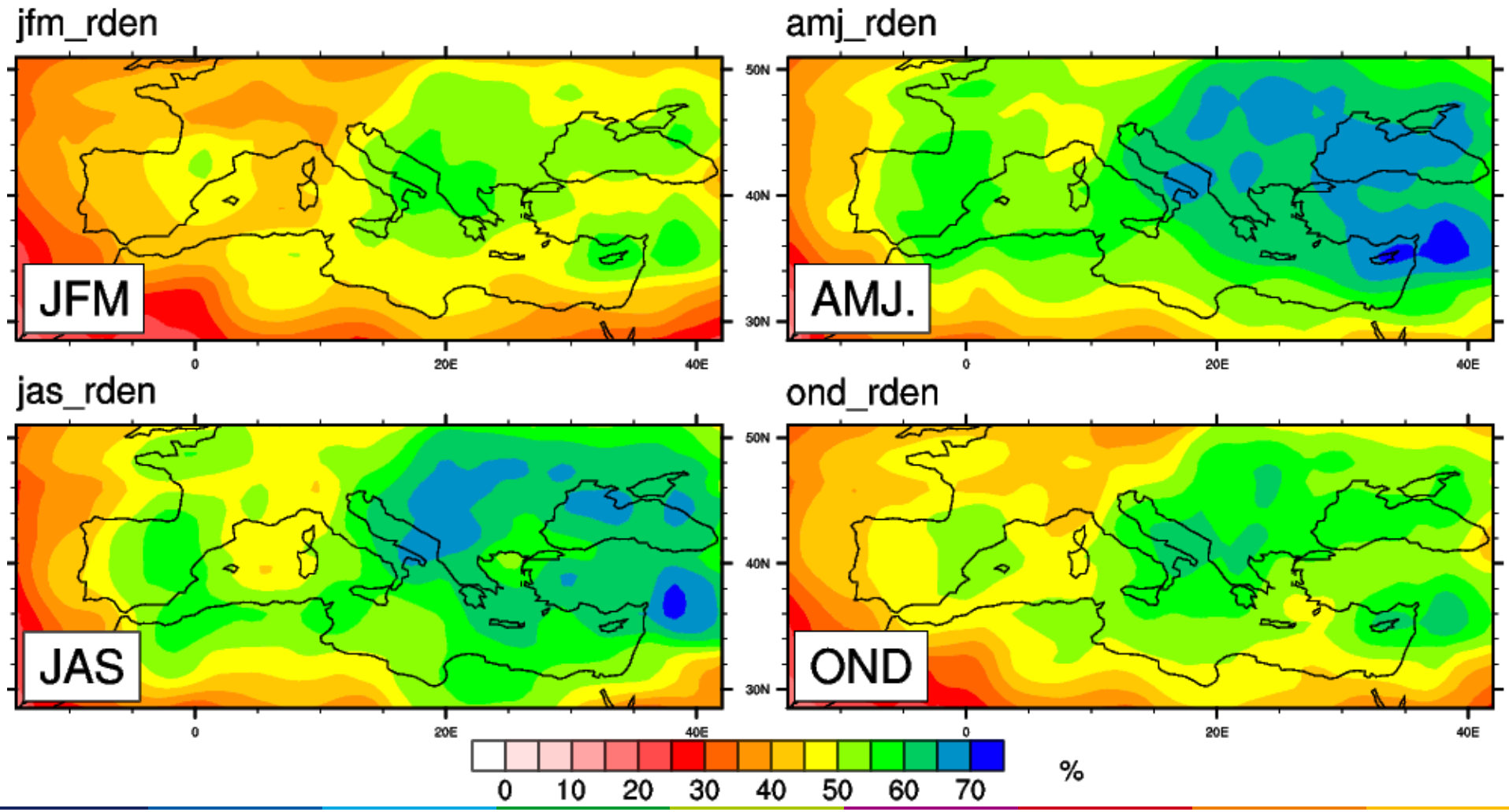
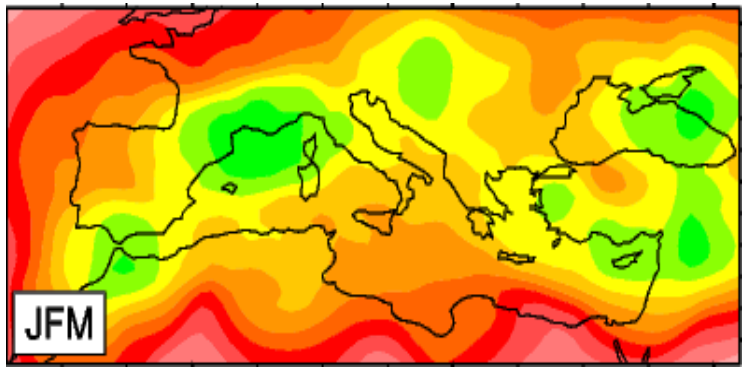
Spread = std(members)/bin value

IV spatial structure for tracks density

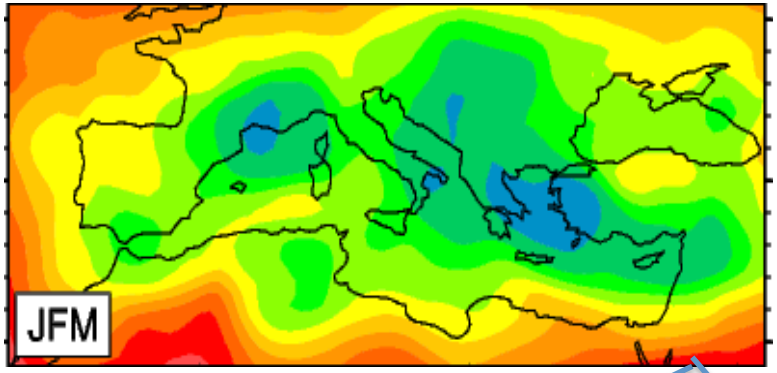
Normalized inter-members spread for tracks density



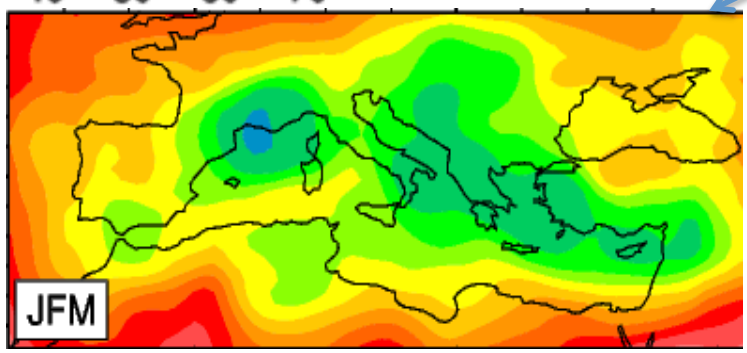
IV as function of cyclones properties



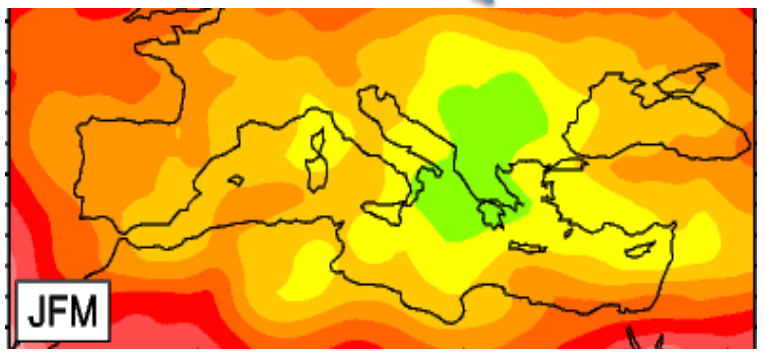
Travelled distance < 600 km



Travelled distance > 1500 km



Travelled distance > 1500 km
mean velocity < 10 m/s



Travelled distance > 1500 km
mean velocity > 10 m/s

IV decreases as mean velocity of clyclones propagation increases

Conclusions

Internal variability:

- Results coherent with previous studies (N. American domain), though the levels of RIV in the Mediterranean region are lower (30-40% depending of the parameter considered).

Validation of Aladin (representation of cyclones) **respect to ERAI**

- Aladin represents well the statistics of cyclones
- Aladin underestimates the number of cyclones entering from the Atlantic Ocean (need more investigation)

IV and Mediterranean cyclones

- IV spatial structure of density coherent with other parameters, but higher values are found (~50-70% in some regions)
- The values of IV depends on the cyclones properties : intensity, mean velocity and travelled distance
- Stronger IV for cyclones residing longer time inside the domain (Lucas-Picher et al. 2008)