Satellite based analysis of the capability of a climate model to reproduce short time scale cloud variability over the Mediterranean Area. Preliminary results: summer-fall 2000..

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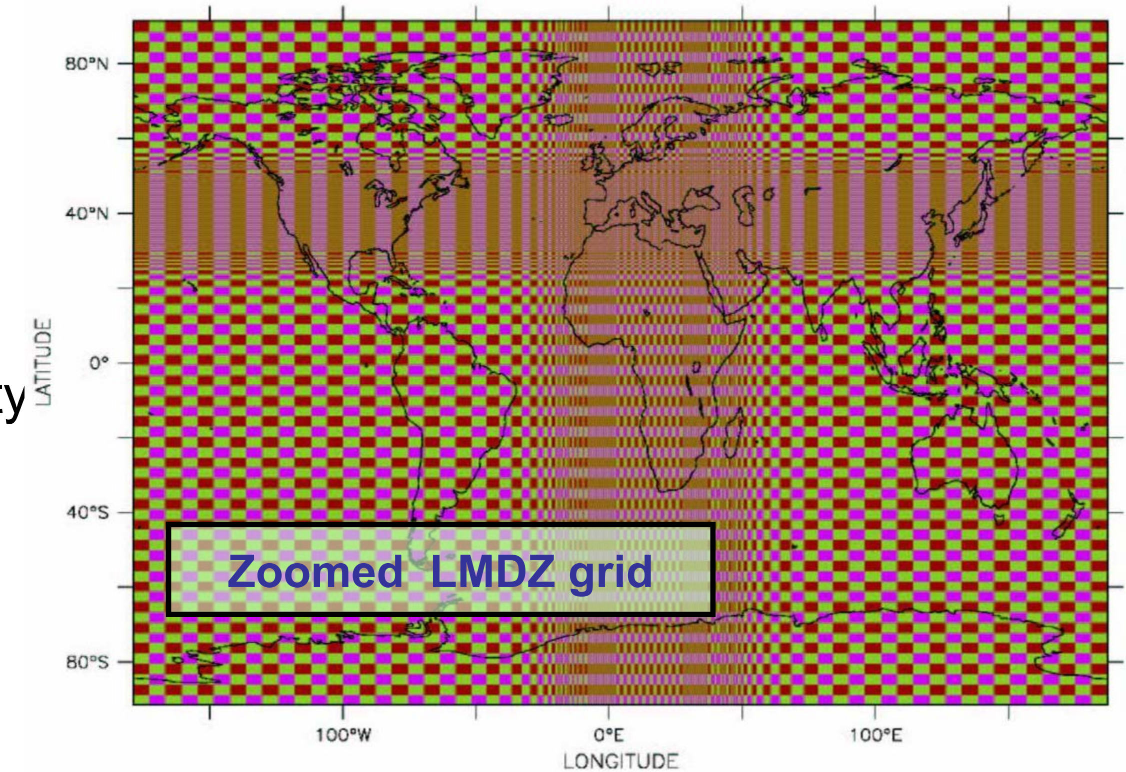
OBJECTIVE: to develop a set of diagnostic tools to validate, through high spatial and temporal resolution IR METEOSAT 1st Generation imagery, the cloud cover of the LMDZOR4 model within the Mediterranean Area

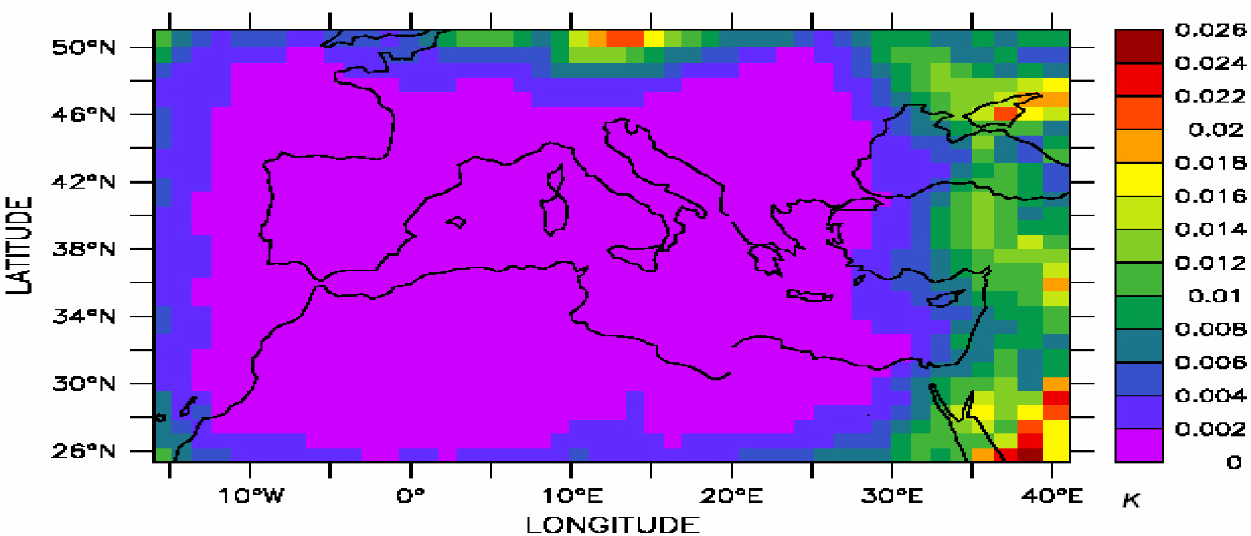
- Use of high spatial resolution and temporal sampling observations for **climate** model validation: → Climate model in a nudged and stretched mode.
- Development of an ad-hoc diagnostics based on the comparison of cloudiness **temporal variability characteristics:** → lower sensitivity to uncertainties on cloud overlapping scheme and satellite cloud cover definition, information content on relative role of different part of the modeling of cloud lifecycle.
- Use of **sub-regions** as a composite approach

LMDZ4OR

LMDZ4OR is an GCM model coupled with a surface model **zooming** (Δx≈50km over the region of interest) and possibility to run in a **nudging mode** *constraining the model outside the region of interest with ECMWF re-analysys*

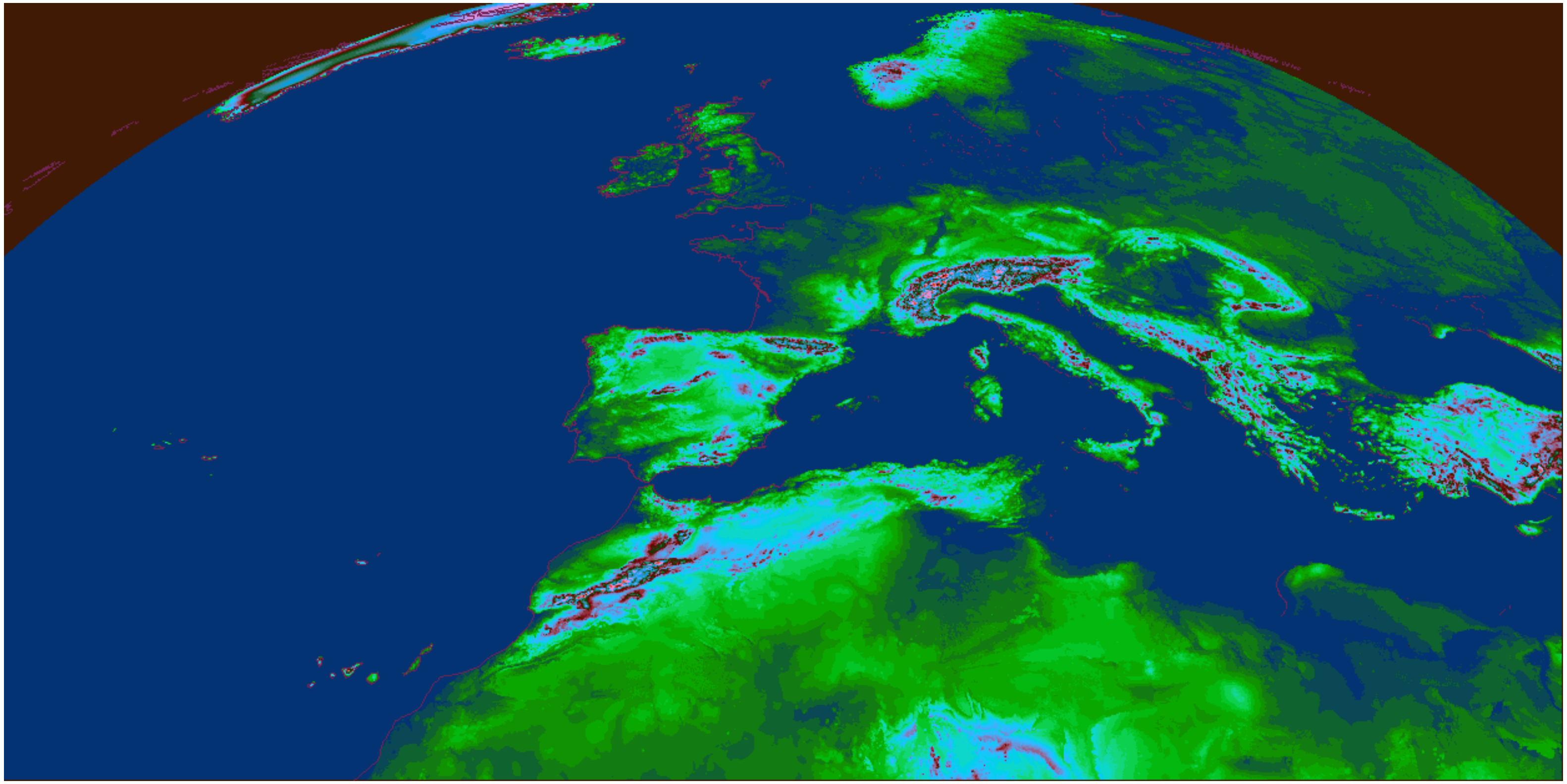
(Coindreau et al. 2007 subm. to MWR)





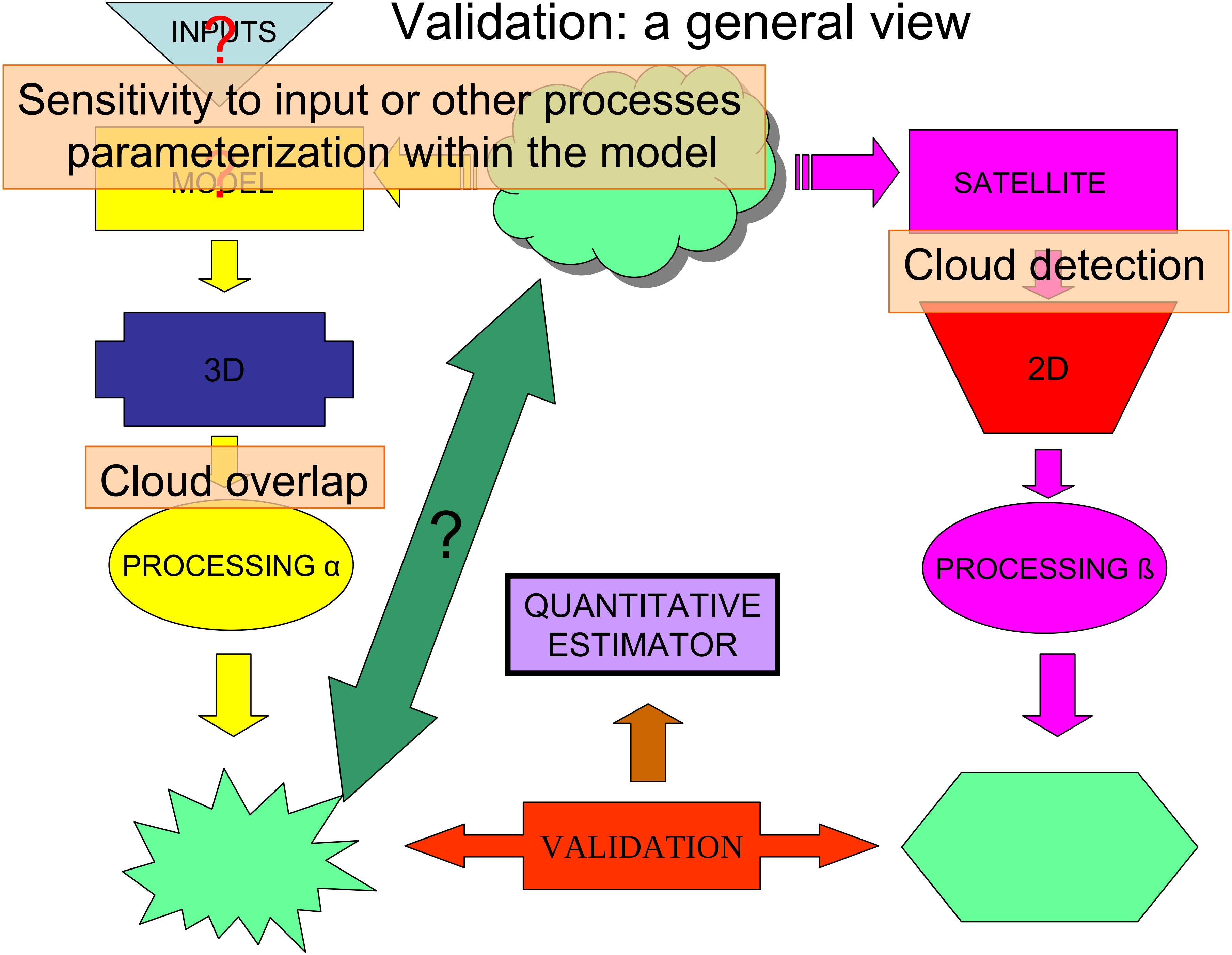
Nudging impact in the temperature evolution
Maximum (over the vertical and for one time step) value of ΔT due to the nudging. The nudging is strengthened outside of the zoomed region

Satellite dataset description



- IR METEOSAT B-Format
- Time: 1st JUNE - 30th NOVEMBER 2000 every 30’

Validation: a general view

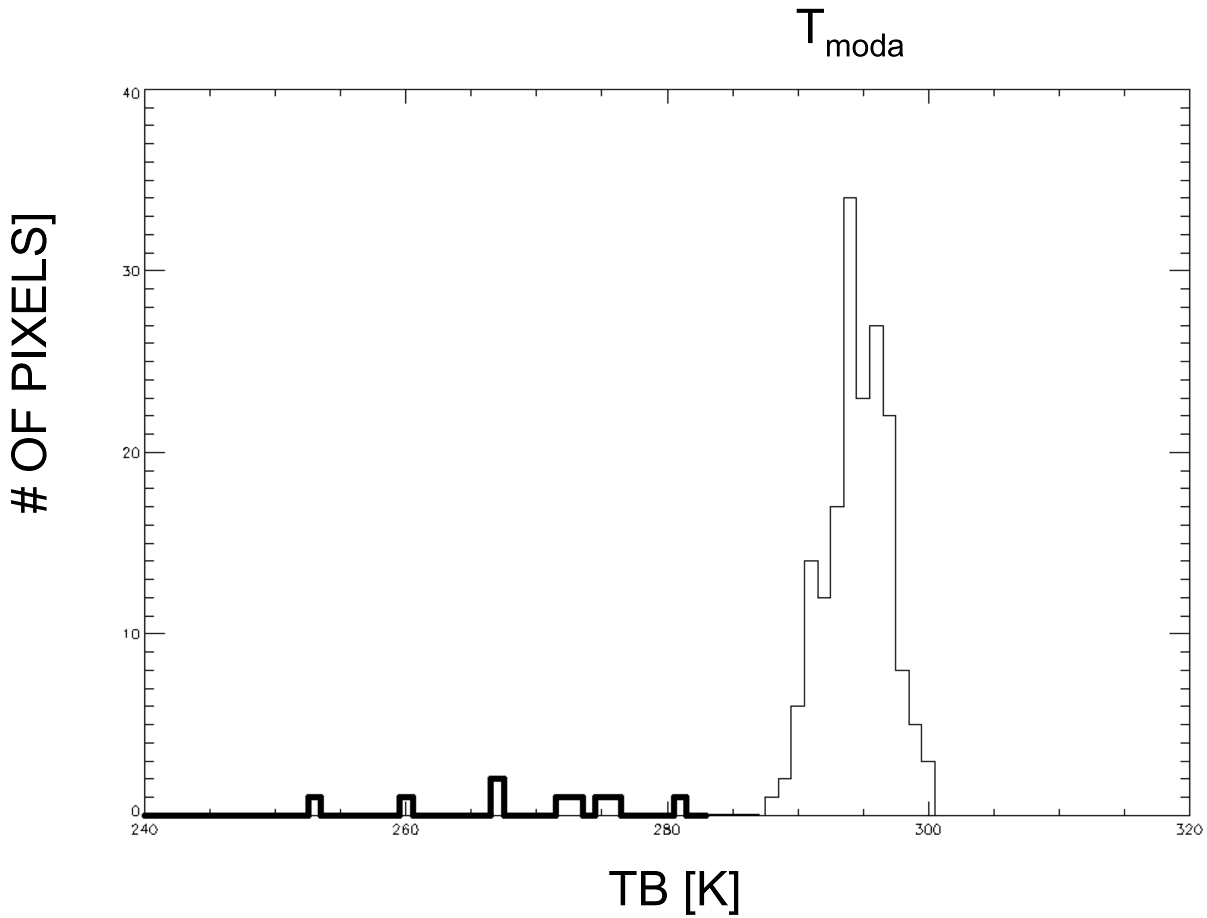


Satellite Cloud definition

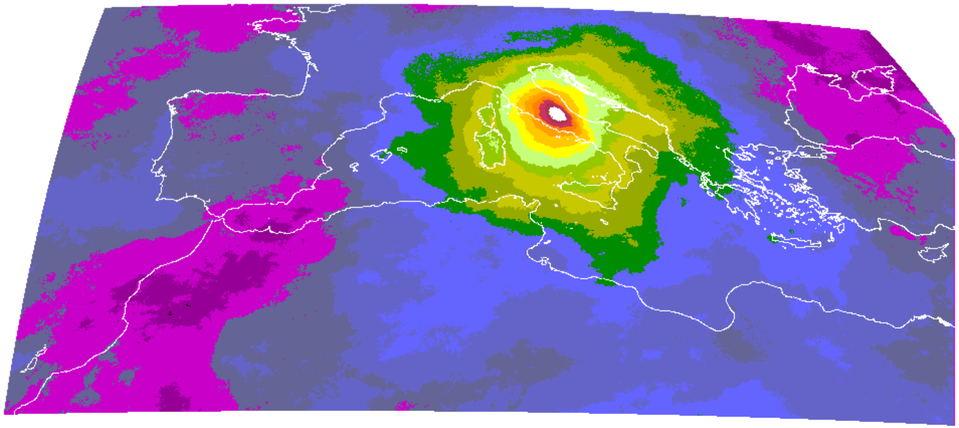
Day night consistent

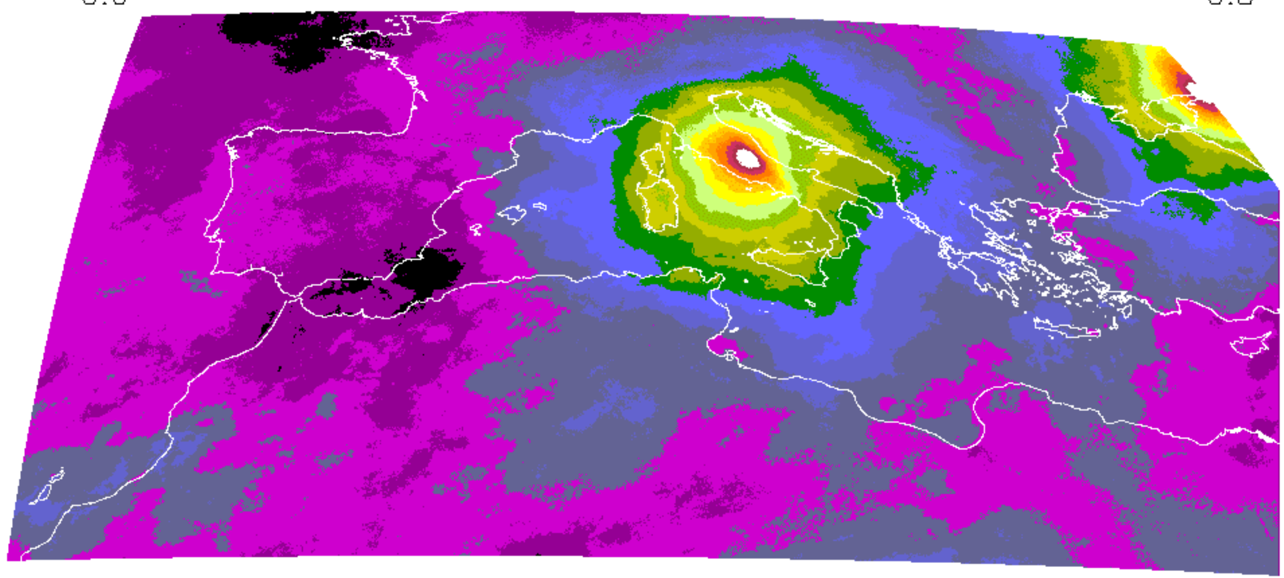
Thresholds derived, for each pixel, from the histogram of Tb over 60 days and 3 slots

Multiple cloud definition (to test reduced sensitivity)



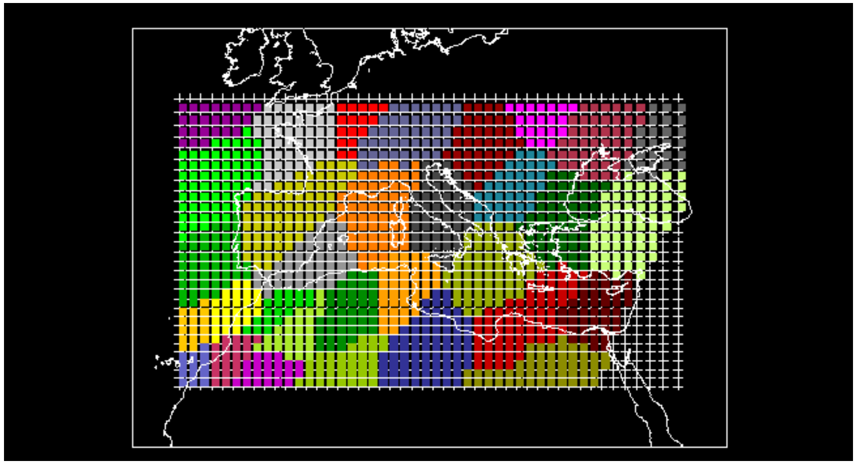
SUBREGIONS



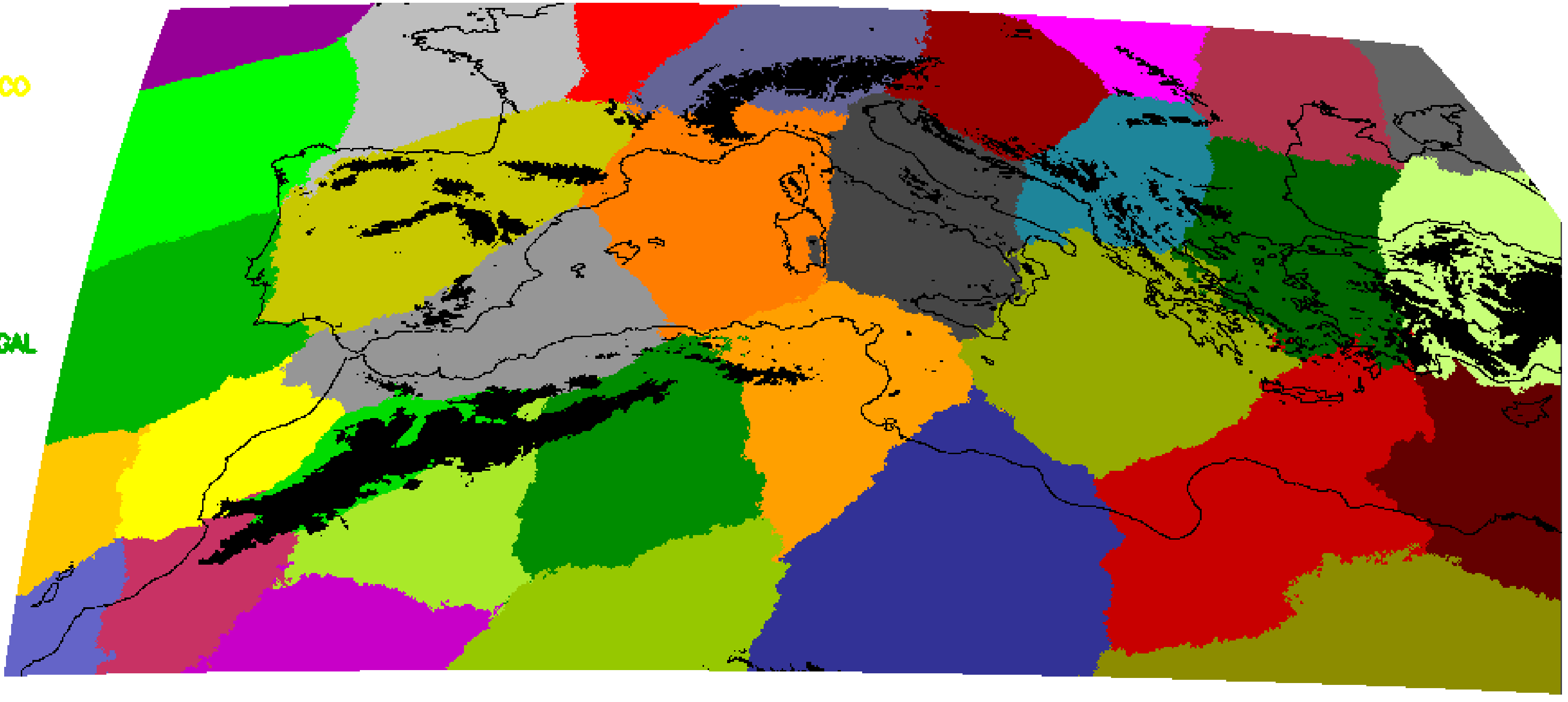


SUB-REGION RESULTS:

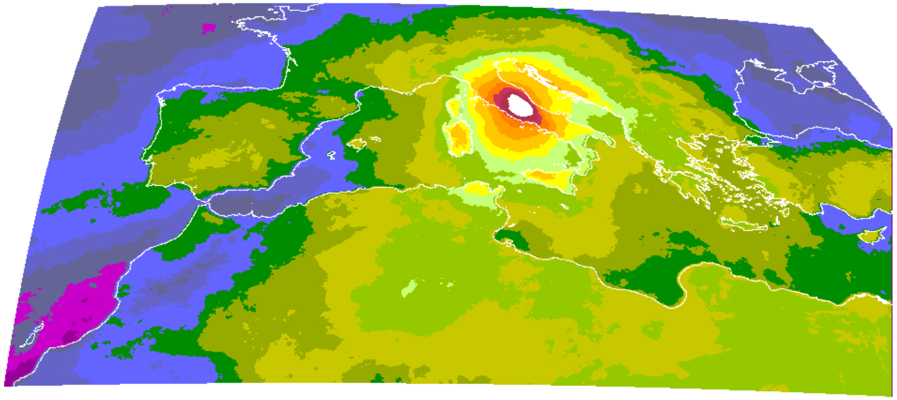
32 subregions
Tb-Tmoda



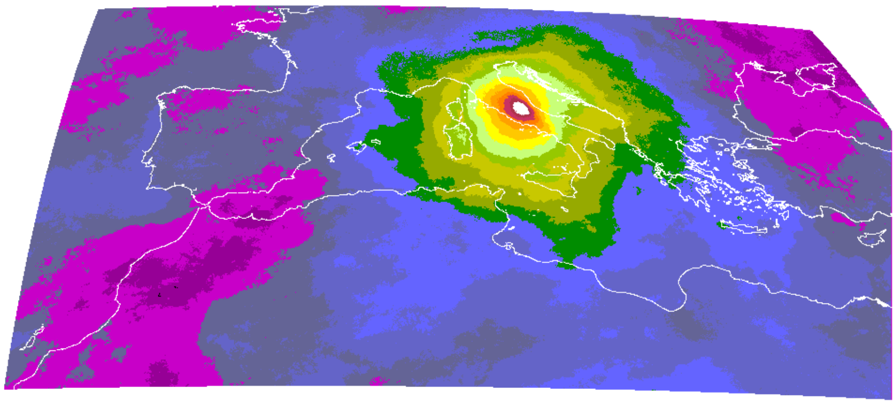
ALGERIA_NW
FRANCE_NE
CYRENAICA_CRETE
HUNGARY
SE_MED
BALKANS
MOLDAVIA
WESTERN_SAHARA
W_MED
TUNISIA
OPEN_S_ATL
ATL_OFF_MAROCCO
EGYPT
ANATOLIA
ALGERIA_SE
SPAIN
IONIAN
ATL_OFF_SPAIN
ATLAS
ATL_OFF_PORTUGAL
ALGERIA_NE
THRACIA
CANARY
ALPS
TRIPOLITANIA
CARPATHIANS
ALGERIA_SW
OPEN_N_ATL
FRANCE_ATL
ALBORAN
UCRAINA
ITALY



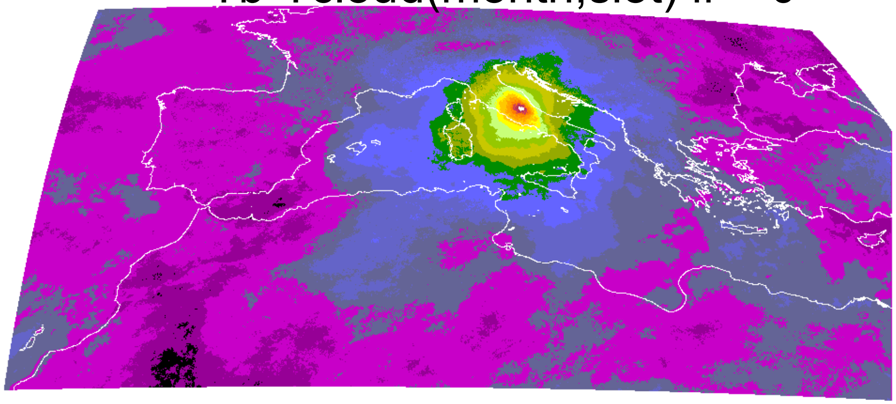
Tb



Tb-Tmoda(month,slot)

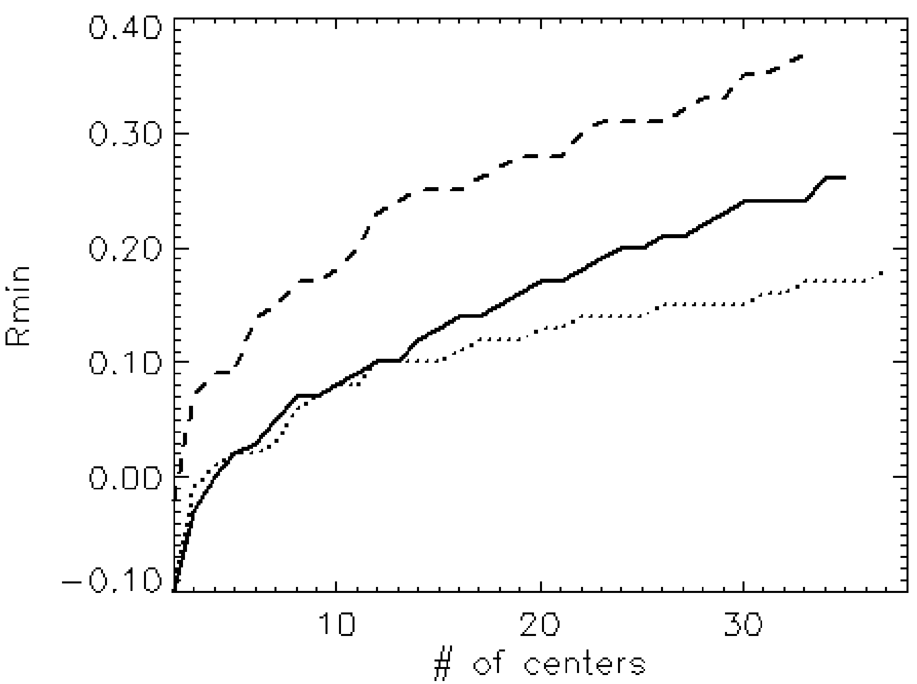


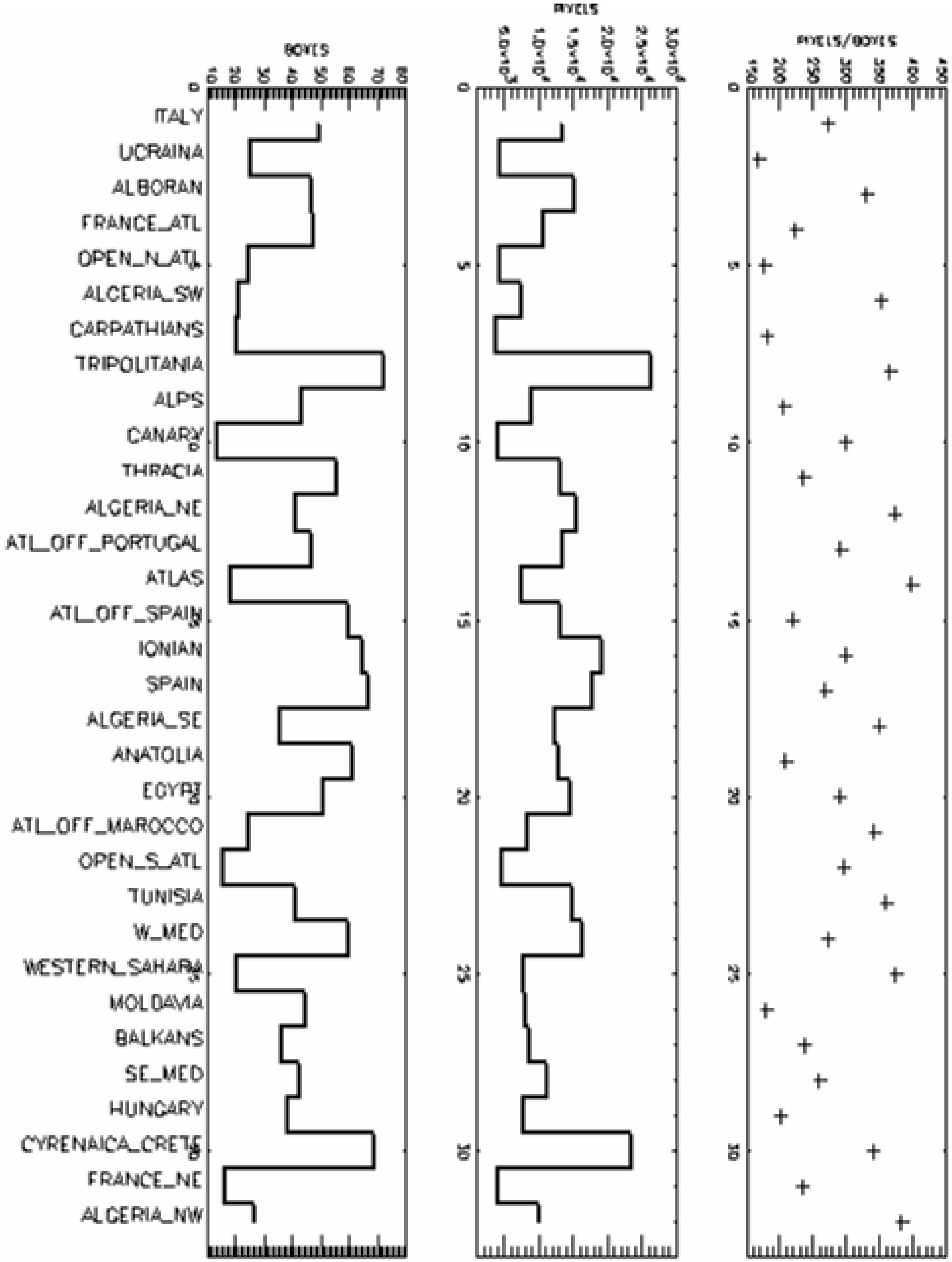
Tb-Tcloud(month,slot) if < 0



ISSUES

Variable
Starting Point
Number of region (criteria to stop)





PROBLEMS

Variable subregion size: physically correct but statistically can create some problem in the interpretation of the results

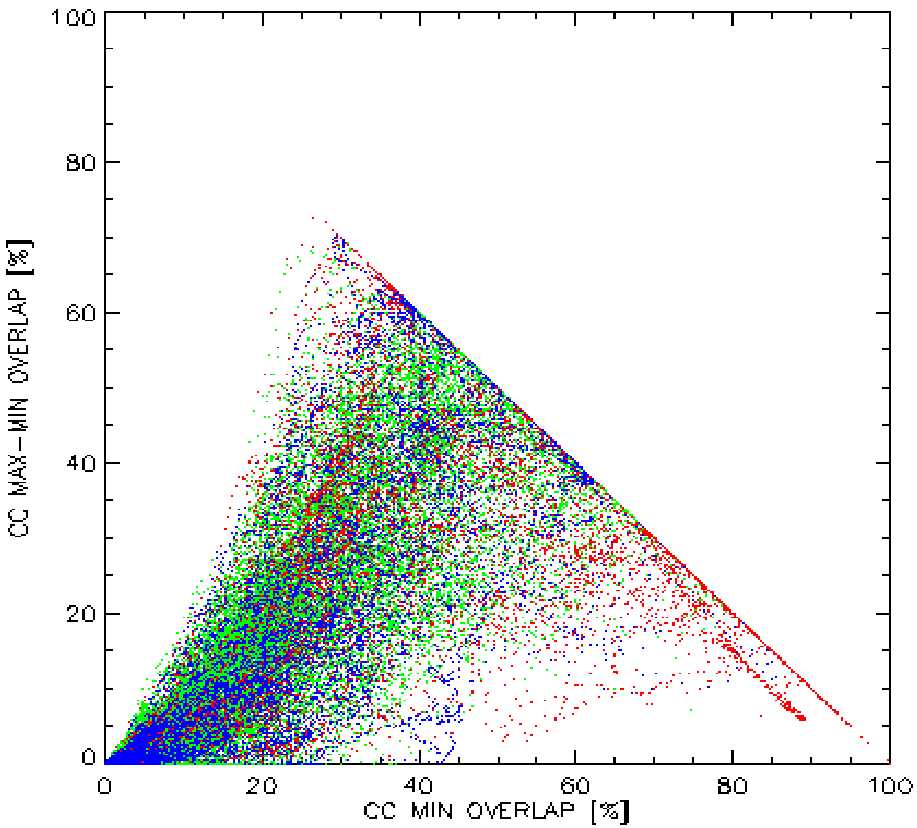
Variable surface type: different surface parameterization within the same subregion

Variable satellite pixel # and resolution within a model gridbox (partially accounted by the pixel based procedure for cloud detection)

MODEL CLOUD COVER OVERLAP

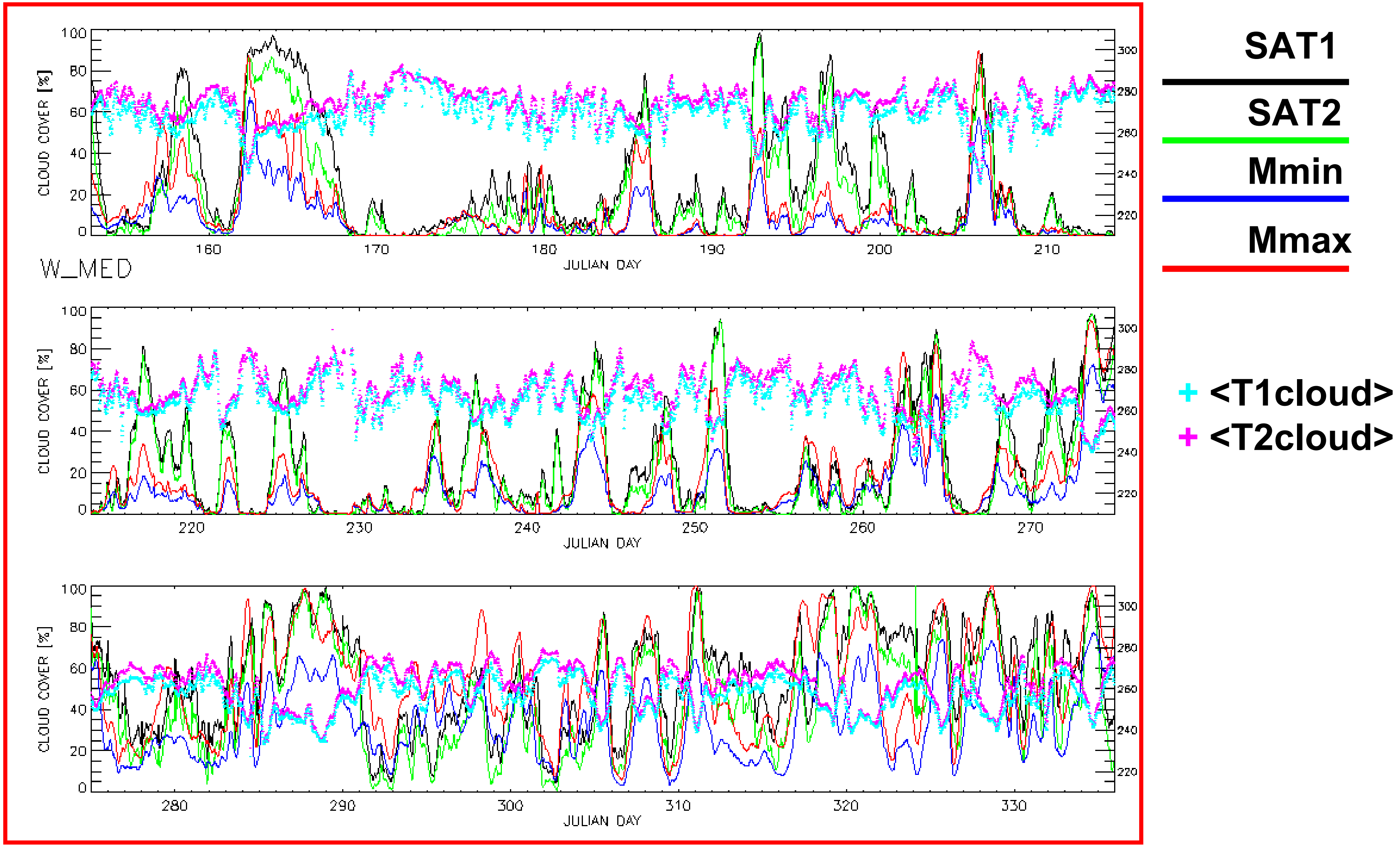
$CC_{mn}^{region} = \sum^{grid} cc(min)/At$ **min**imum overlap within each grid column

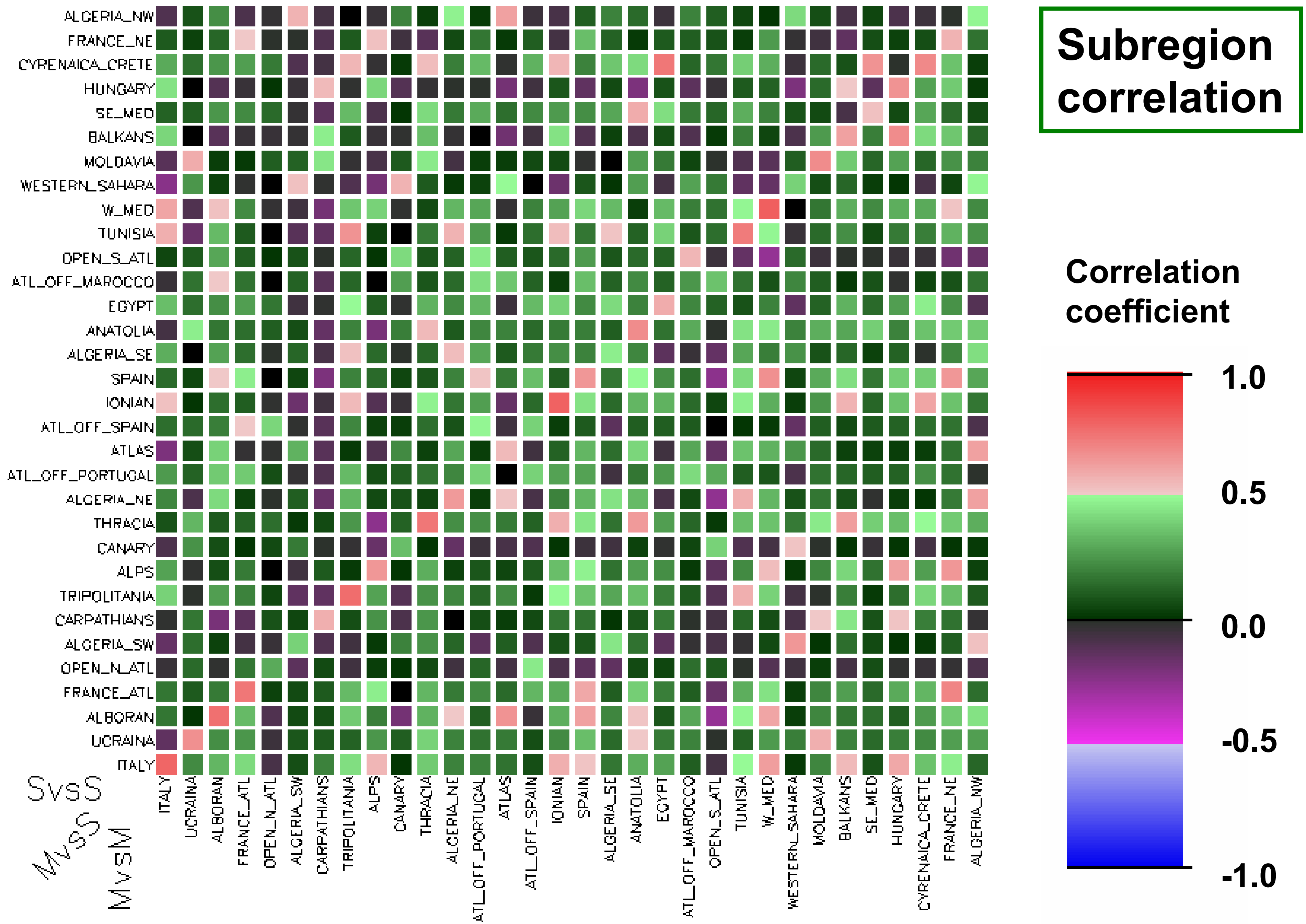
$CC_{MX}^{region} = \sum^{grid} cc(MAX)/At$ **MAX**imum overlap within each grid column



Difference between model derived max and min overlap

EXAMPLE OF TIMESERIES:





Subregion correlation
Correlation coefficient
1.0
0.5
0.0
-0.5
-1.0
ALGERIA_NW
FRANCE_NE
CYRENAICA_CRETE
HUNGARY
SE_MED
BALKANS
MOLDAVIA
WESTERN_SAHARA
W_MED
TUNISIA
OPEN_S_ATL
ATL_OFF_MAROCCO
EGYPT
ANATOLIA
ALGERIA_SE
SPAIN
IONIAN
ATL_OFF_SPAIN
ATLAS
ATL_OFF_PORTUGAL
ALGERIA_NE
THRACIA
CANARY
ALPS
TRIPOLITANIA
CARPATHIANS
ALGERIA_SW
OPEN_N_ATL
FRANCE_ATL
ALBORAN
UCRAINA
ITALY
SvsS
MvsS
MvsM

TOOLS

- Time derivative distribution
- Time lag correlation (model vs model, sat vs satellite)
- Time lag correlation (model vs satellite)
- Diurnal cycle
- Average cloud lifecycle curve

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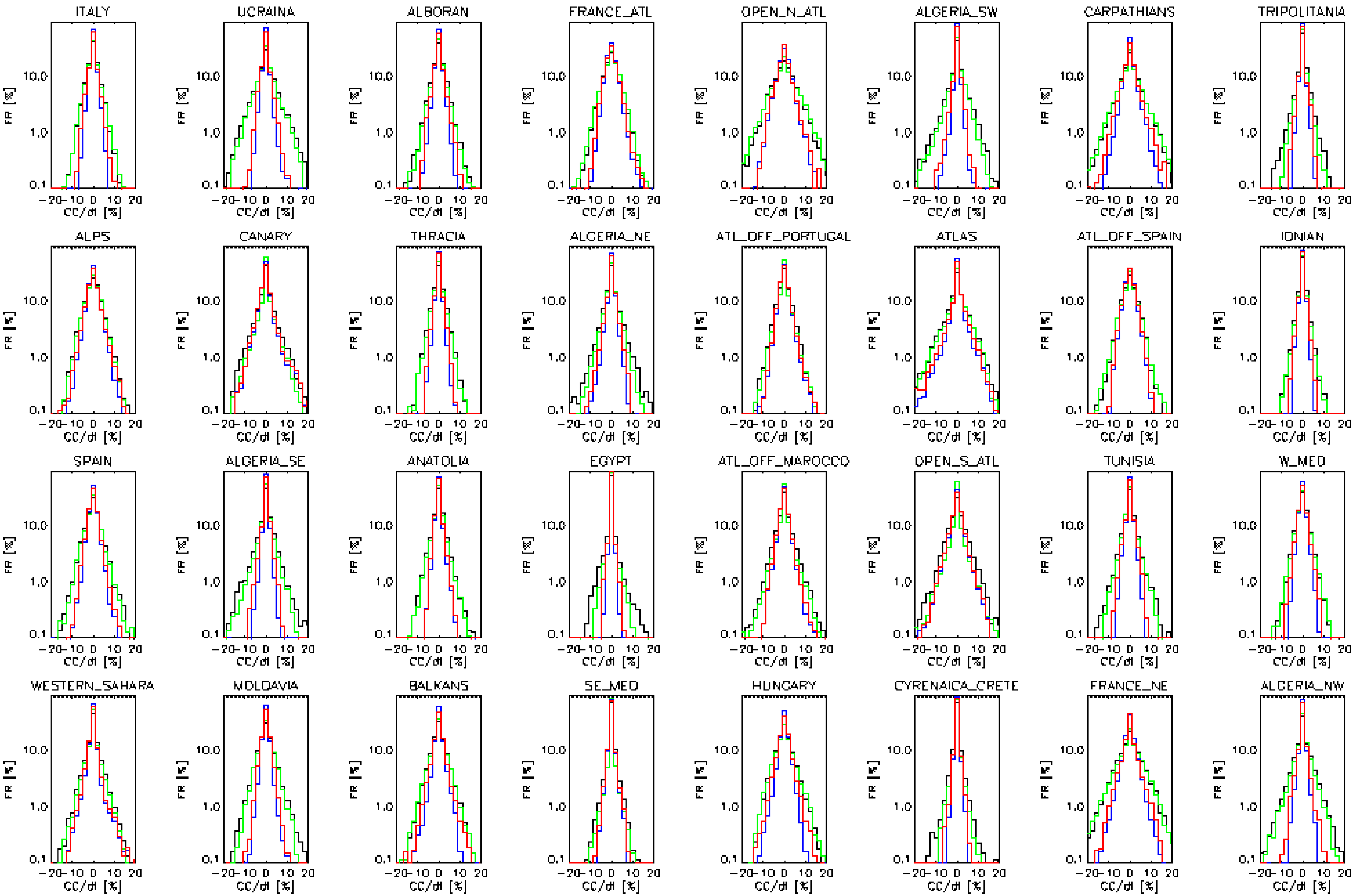
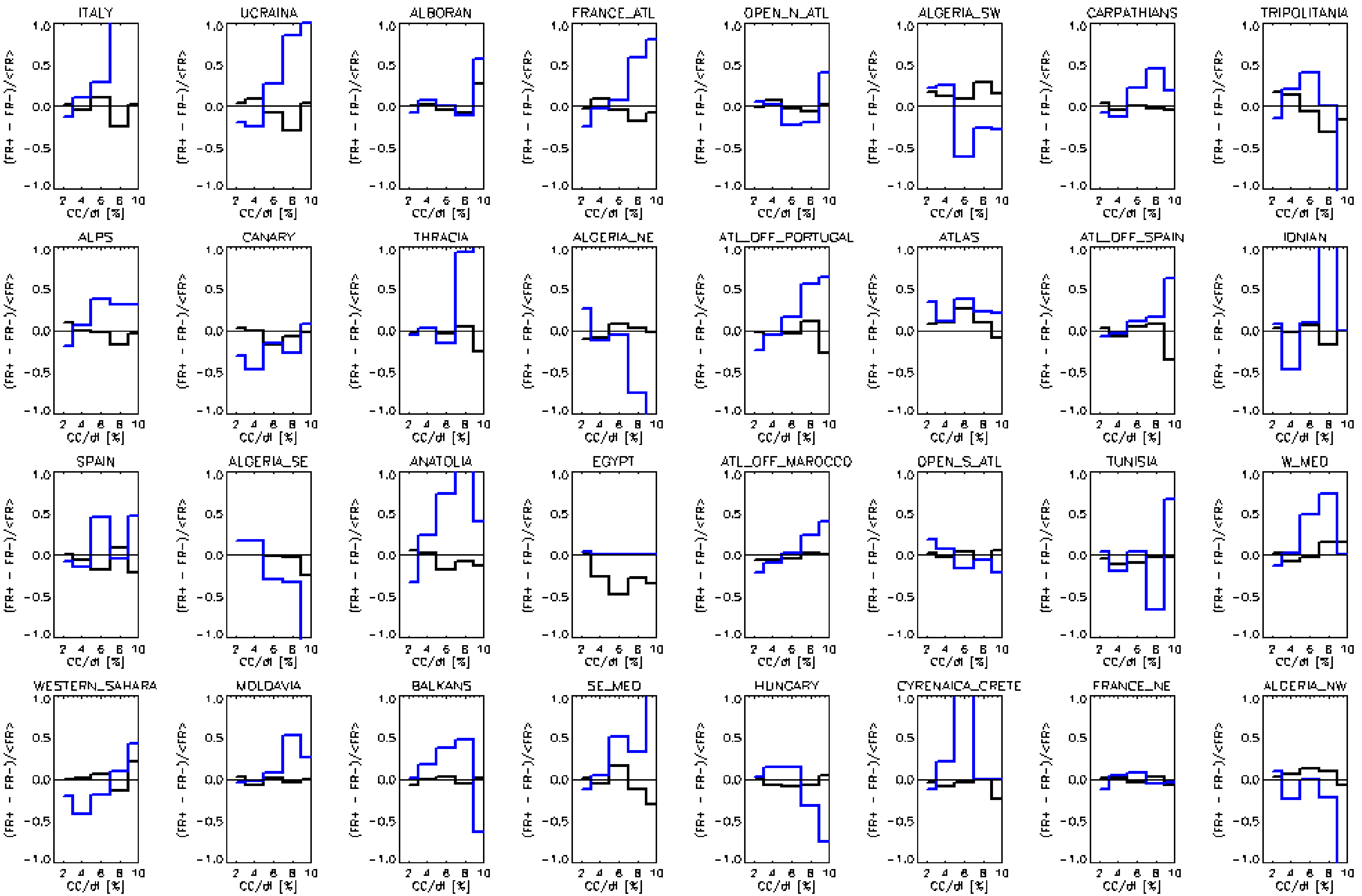
Histogram of time derivative



Time derivative distribution symmetry



TOOLS

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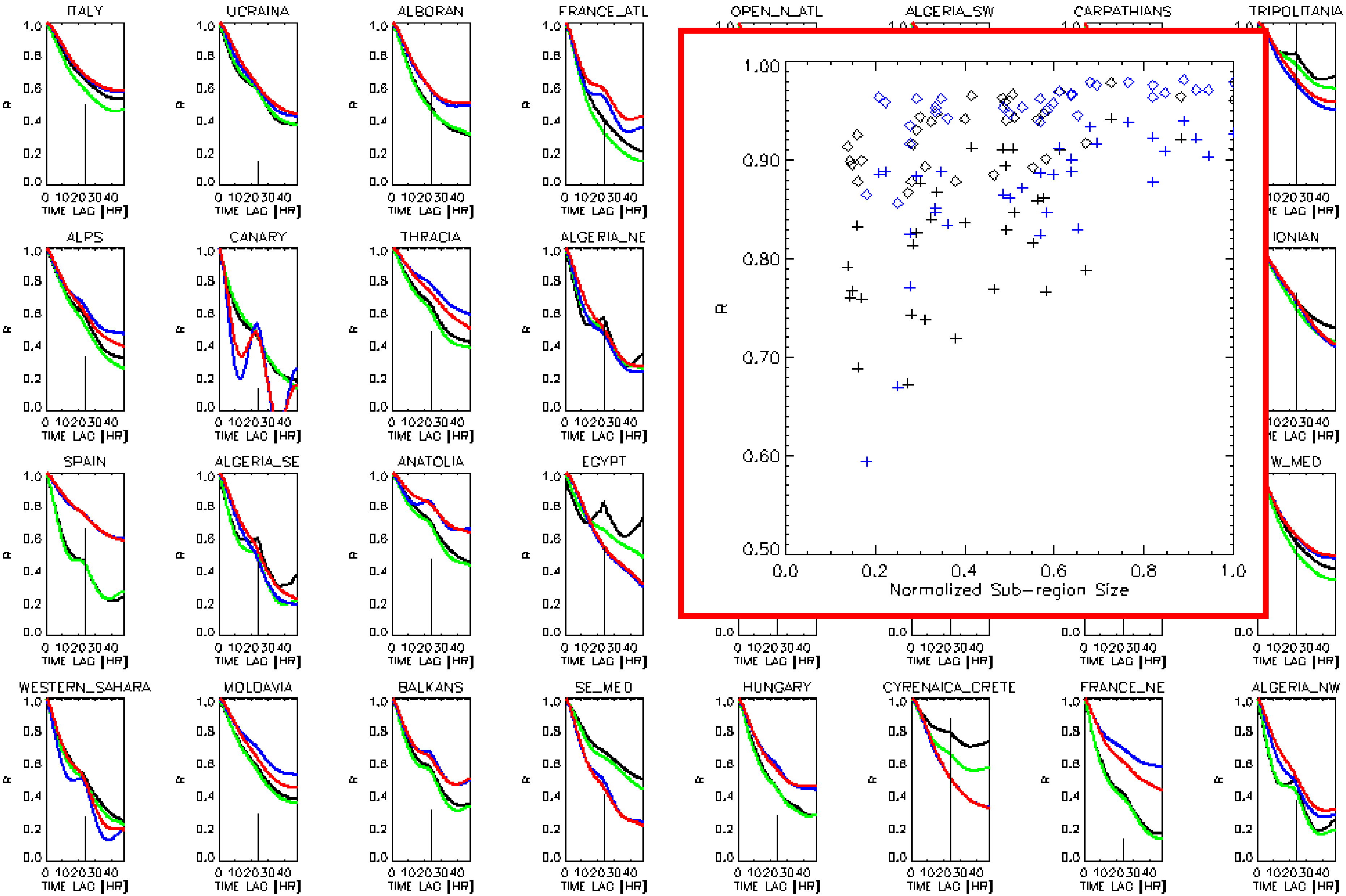
Time lag correlation



TOOLS

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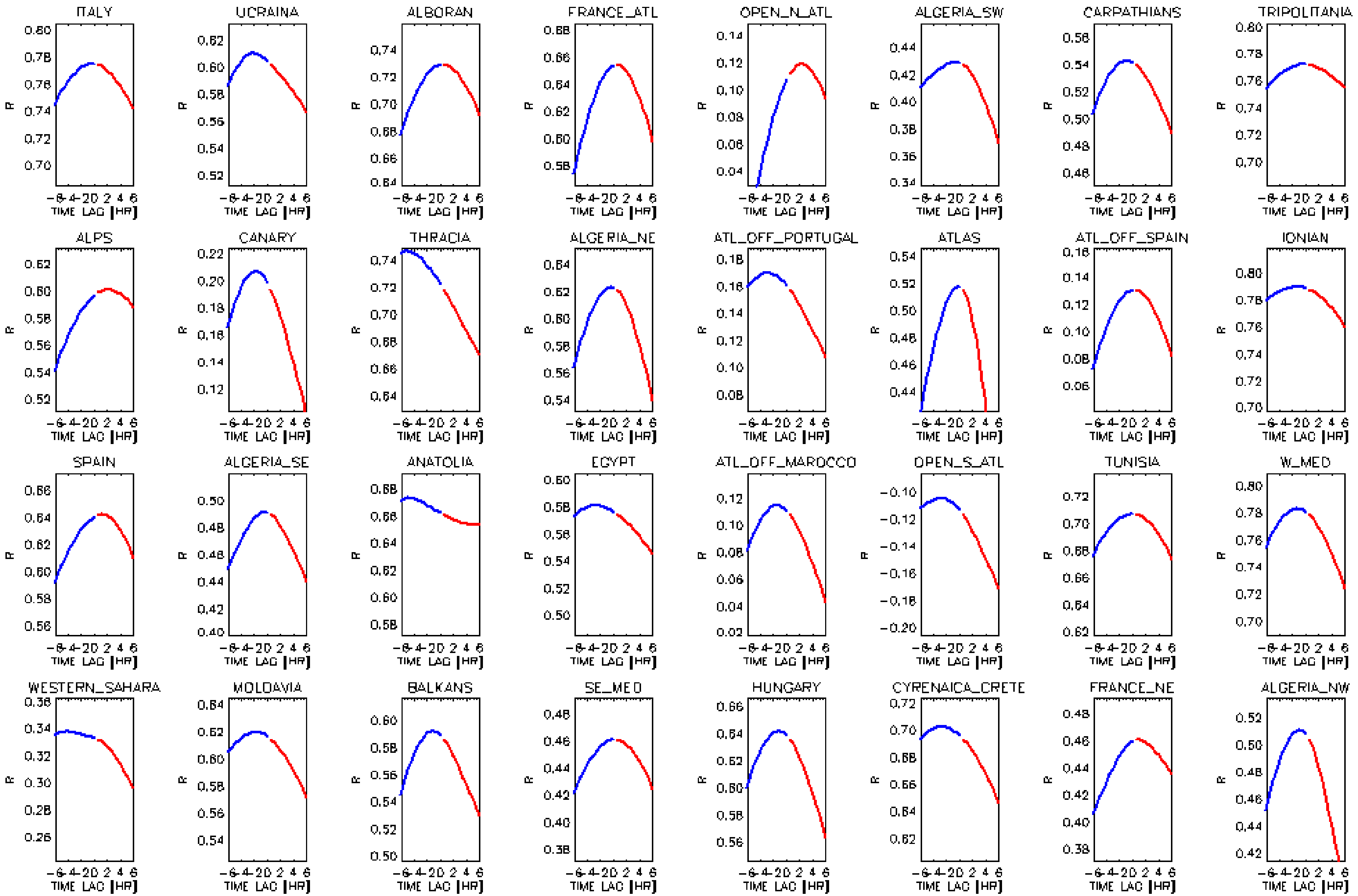
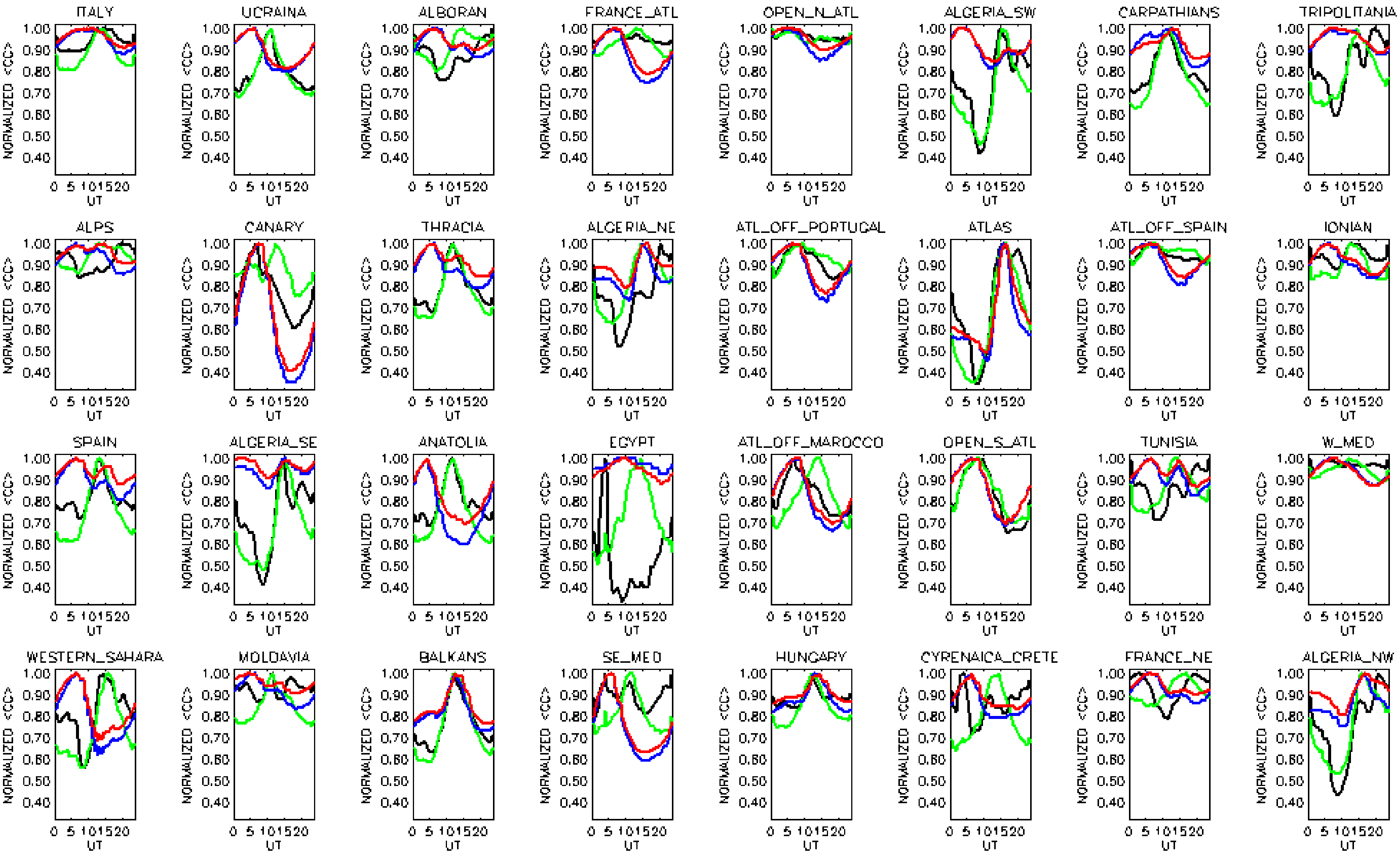
Time lag: model vs satellite



TOOLS

- Time derivative distribution
- Time lag correlation (model vs model, sat vs satellite)
- Time lag correlation (model vs satellite)
- **Diurnal cycle**
- Average cloud lifecycle curve

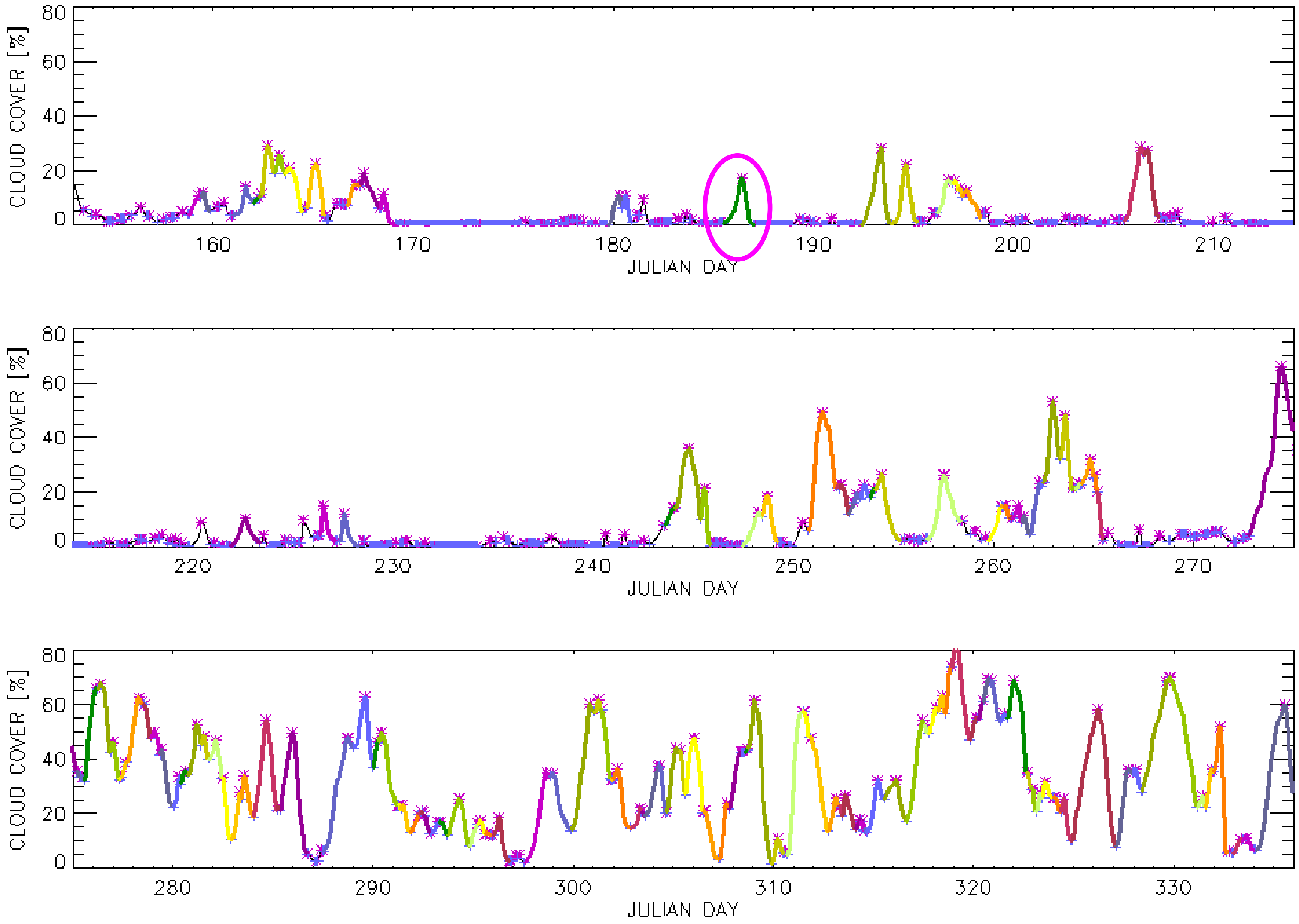
Diurnal cycle



TOOLS

- Time derivative distribution
- Time lag correlation (model vs model, sat vs satellite)
- Time lag correlation (model vs satellite)
- Diurnal cycle
- **Average cloud lifecycle curve**

Average cloud lifecycle



Conclusions

- A preliminary set of diagnostic tools has been produced focusing on the description of temporal variability of cloud cover. The approach is designed to decrease the sensitivity to cloud overlapping scheme and satellite cloud detection.
- Modelers will now start to investigate the usefulness of the information obtained with such a set of diagnostic tools. => Refinements of the tools and definition of quantitative estimations.
- The overall LMDZ validation activity include also validation of **water vapour** vertical structure and a **Lagrangian approach** (cloud tracking) to investigate cloud lifecycle characteristics