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 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

Sensitivity to input or other processes parameterization within the model

Cloud overlap

PROCESSING \( \alpha \)

QUANTITATIVE ESTIMATOR

VALIDATION

PROCESSING \( \beta \)

2D

Cloud detection

SATELLITE
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)
SUB-REGION RESULTS:
32 subregions
Tb-Tmoda
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)
Difference between model derived max and min overlap

\[ CC_{mn}^{\text{region}} = \sum_{\text{grid}} \text{cc}(\text{min})/At \quad \text{minimum overlap within each grid column} \]

\[ CC_{MX}^{\text{region}} = \sum_{\text{grid}} \text{cc}(\text{MAX})/At \quad \text{MAXimum overlap within each grid column} \]
EXAMPLE OF TIMESERIES:

- SAT1
- SAT2
- Mmin
- Mmax

- \(<T1_{\text{cloud}}>\)
- \(<T2_{\text{cloud}}>\)
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
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
Histogram of time derivative
Time derivative distribution symmetry
TOOLS

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

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

[Graphs showing time lag comparisons for various regions.]
TOOLS

• Time derivative distribution
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• Time lag correlation (model vs satellite)
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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