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OSCAR (Observation System for Climate Application at Regional scale)

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Objectives

OSCAR is a project funded under the FESR 2007-2013 program

Specific objectives of the project are:

► Design and of a low-cost prototype able to provide integrated measurements for the quantification of the impact of climate variability on surface radiation

► Development of a methodology for the estimation of the impact of climate variability on surface radiation using the integration of the observations provided by prototype.

► Study of correlation between the surface radiation, precipitation and aerosols transport.

Partners:

Coordinator: Consiglio Nazionale delle Ricerche – Istituto di Metodologie per l'Analisi Ambientale (CNR-IMAA), PI Dr. Fabio Madonna

Partnership: Finnish Meteorological Institute (FMI), PI Dr. Ewan O'Connor (Cloudnet models)

October 2013 – December 2015

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OSCAR station

The transportable measurement station includes:

- 2D Scanning polarization lidar (orientable in 3D)
- GPS/GLONASS antenna/receiver all in one
- Pyranometers (short-wave irradiance)
- Rain gauge
- PTU surface sensors

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CNR-IMAA Atmospheric Observatory (CIAO)

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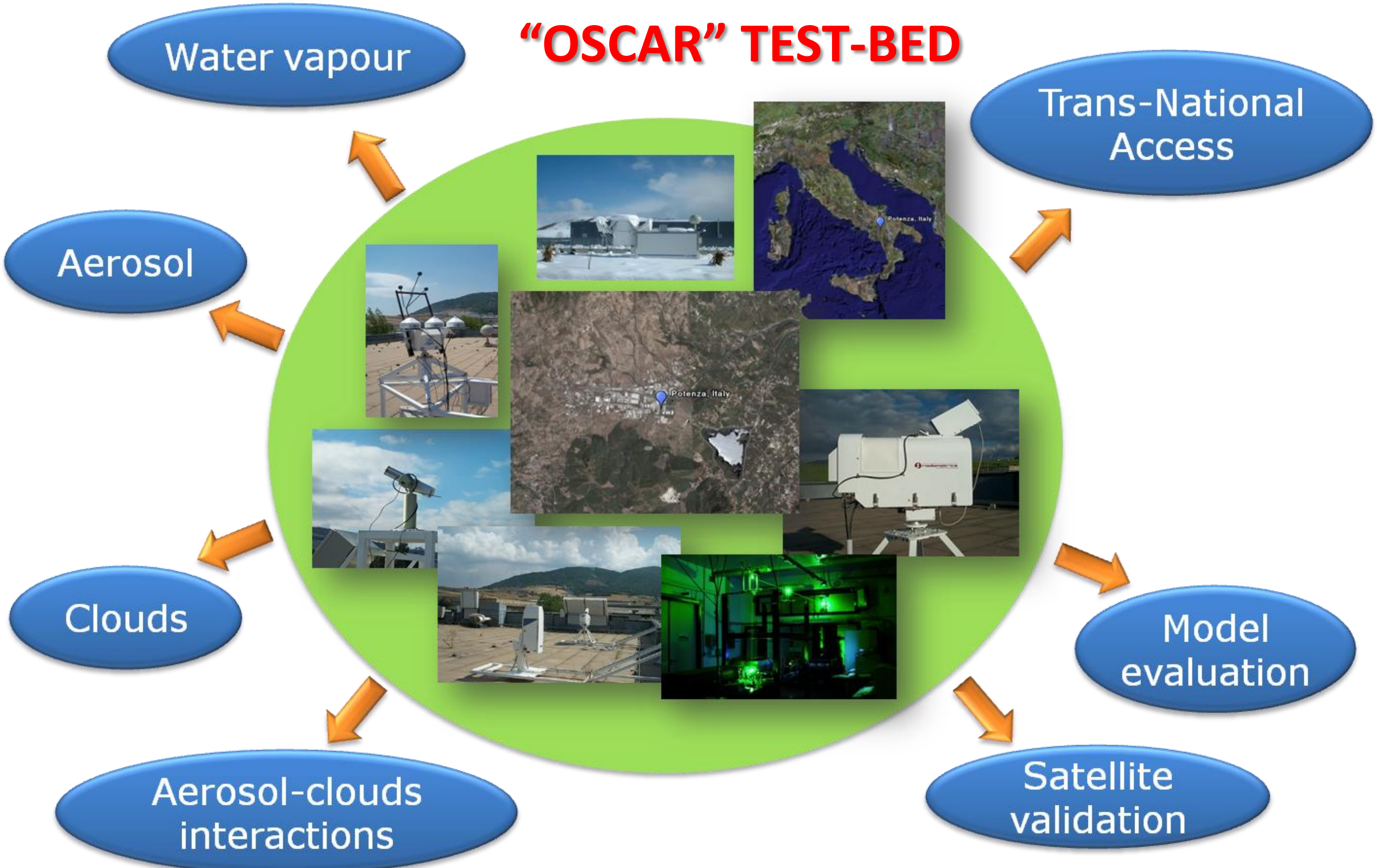
"OSCAR" TEST-BED



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(includes OSCAR website under the section "Projects")

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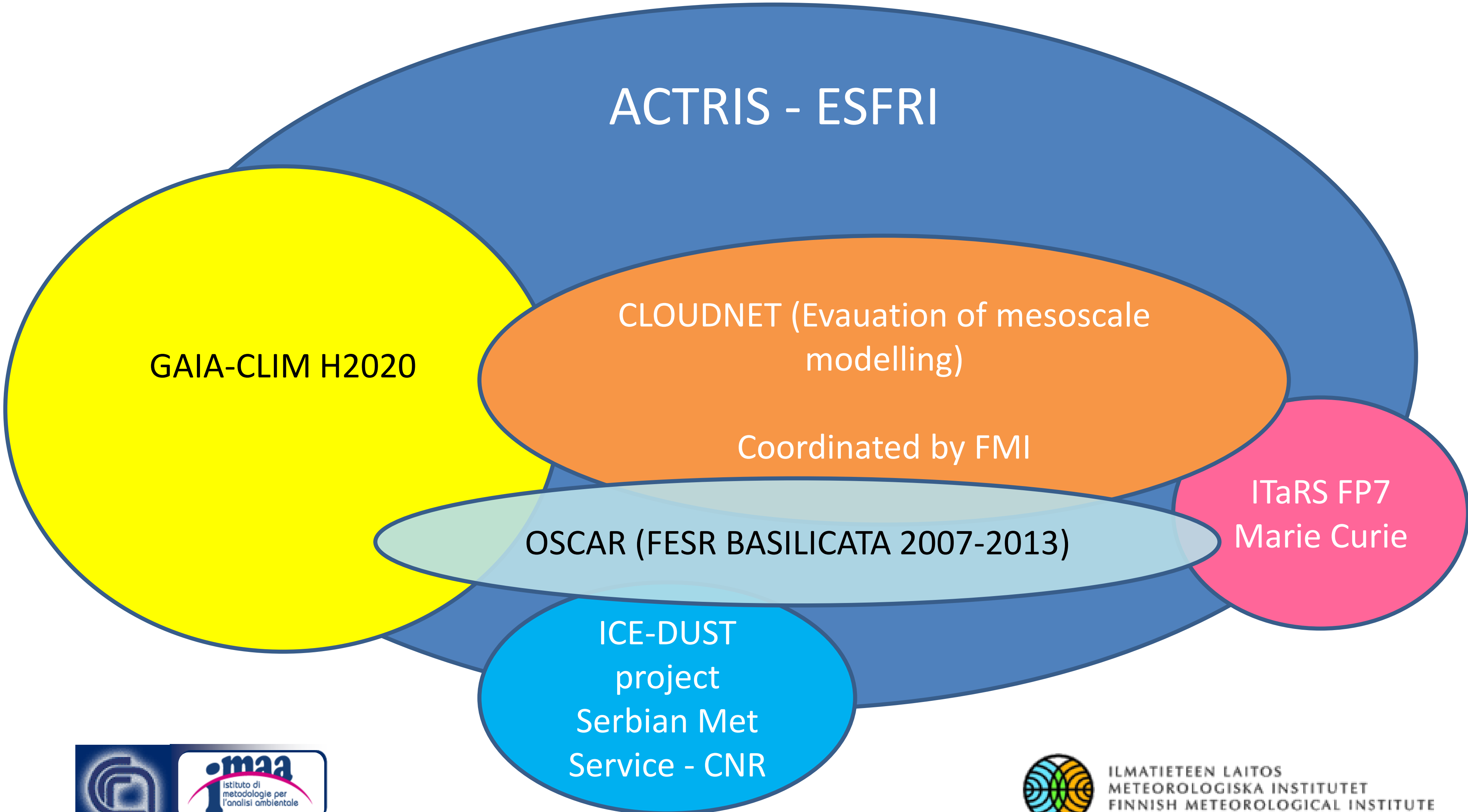
Scenario



ACTRIS - ESFRI
GAIA-CLIM H2020
CLOUDNET (Evauation of mesoscale modelling)
Coordinated by FMI
ITaRS FP7 Marie Curie
OSCAR (FESR BASILICATA 2007-2013)
ICE-DUST project Serbian Met Service - CNR

Project rationale
Energy & Atmosphere

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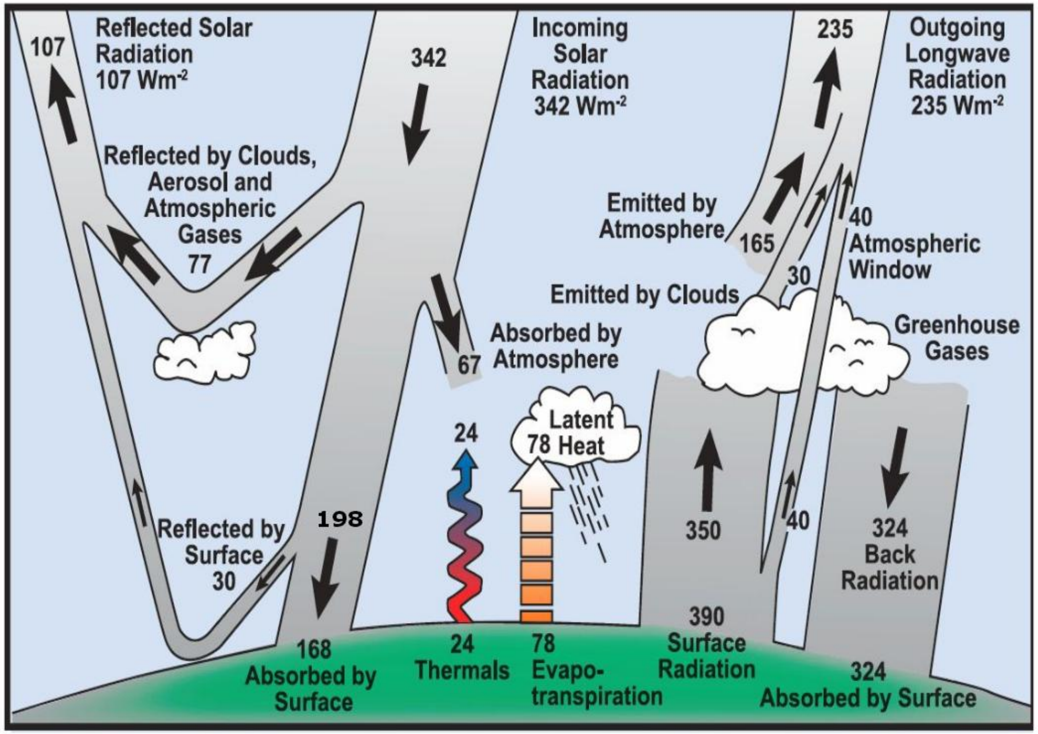
- Study of the techniques for using solar energy implies the knowledge of nature, ecosystem, biological factors and local climate.

- Climate change, both at global and regional scales, require a continuous monitoring of wind and solar radiation fields.

- **Clouds**, fog, **water vapor**, and the presence of large concentrations of **dust** can significantly affect the way to exploit the solar energy. Therefore, a quantitative characterization of the impact of climate variability at the regional scale is needed to increase the efficiency and sustainability of the energy system.

IPCC 4th Report, WG1, Chap.1



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Examples: Retrieval of the SW radiation

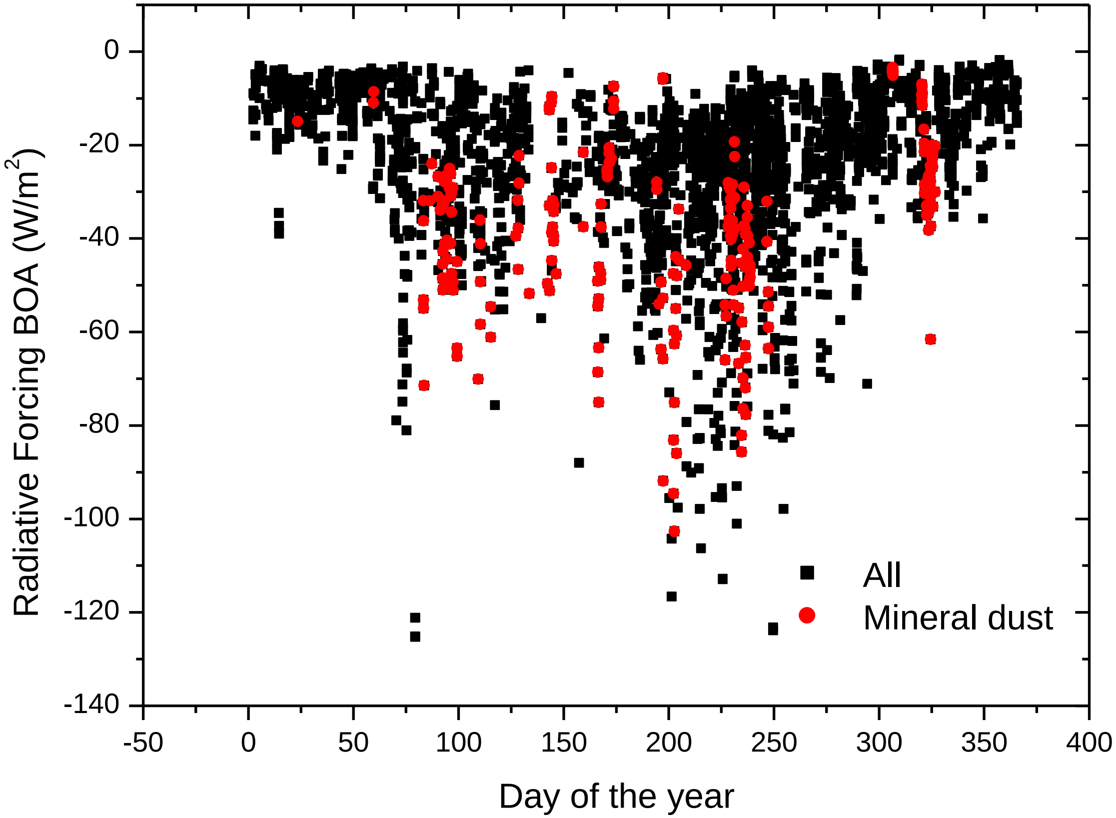
based on the use of FLG model, and on

the use of Peter and Corti simplified model

applied to historical datasets available at CIAO

Aerosol

Based on the aerosol optical thickness data provided by CIAO AERONET sunphotometer



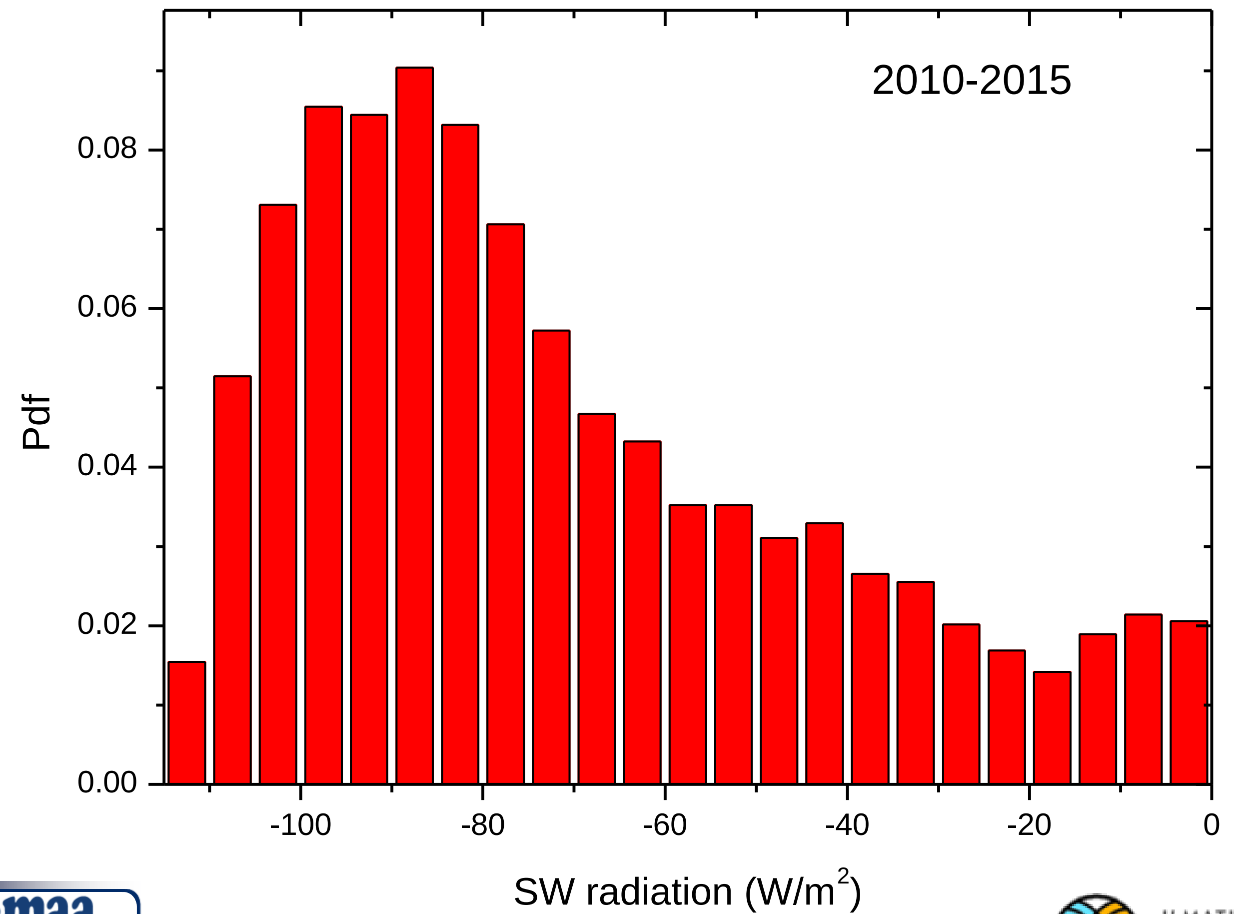
SW solar radiation is reduced of more than -20 W/m^2 when mineral dust is observed, while for other aerosol types RF can be also lower.

This is depending on the aerosol optical thickness.

Correlation with column water vapor content and been investigated but without any significant result.

SW radiation: clouds

Based on the cloud optical thickness data provided by CIAO AERONET sunphotometer



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Examples: Evaluating mesoscale models

based on sun photometer and lidar historical datasets available at CIAO station

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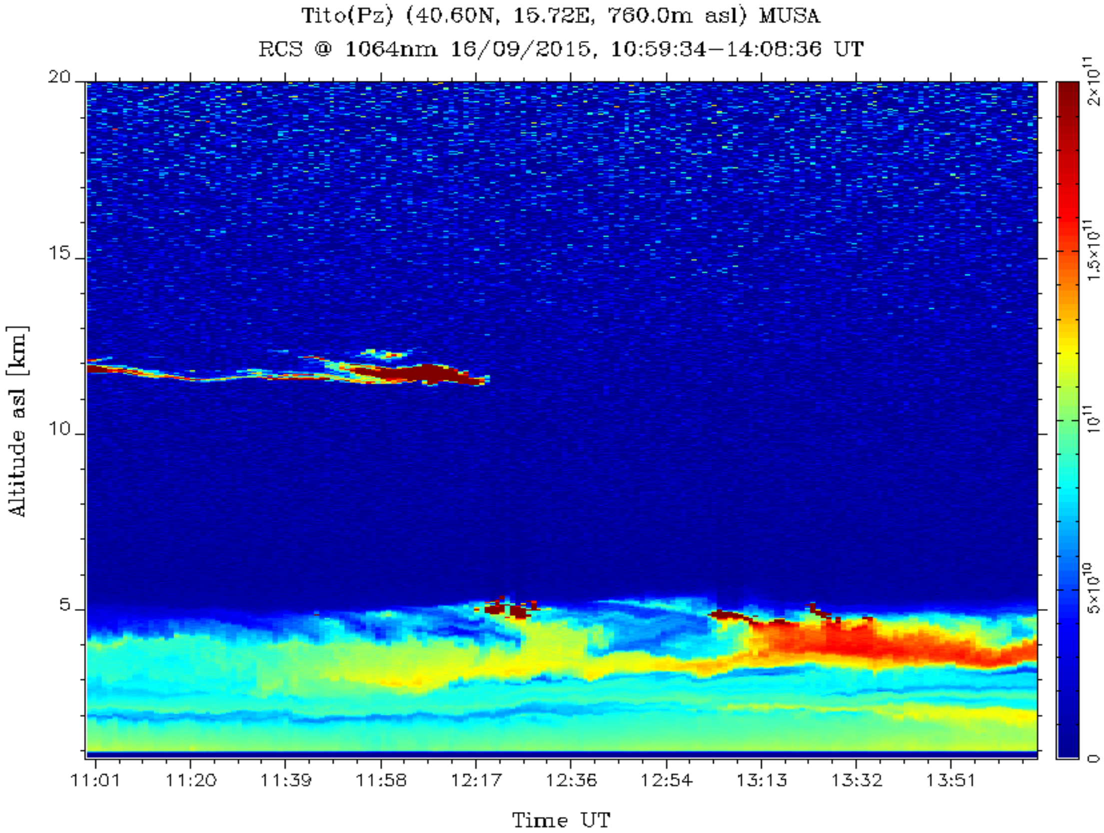
Thin clouds-1



COD (lidar) = 0.14

SW meas. = -48 W/m^2
(Peter and Corti model)

SW ECMWF = -38 W/m^2

Difference using models and observations = 10 W/m^2

Thin clouds represent more than 20 % of the global cloud coverage

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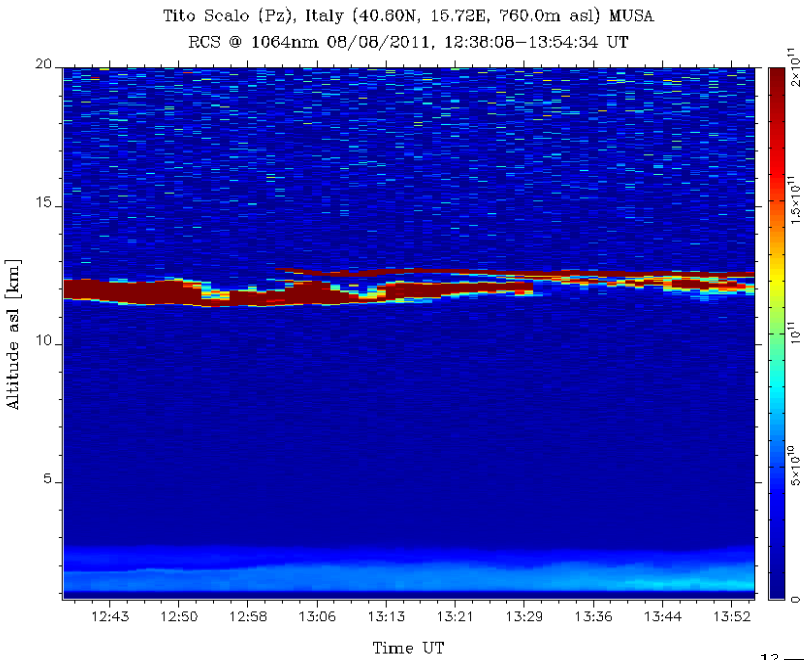
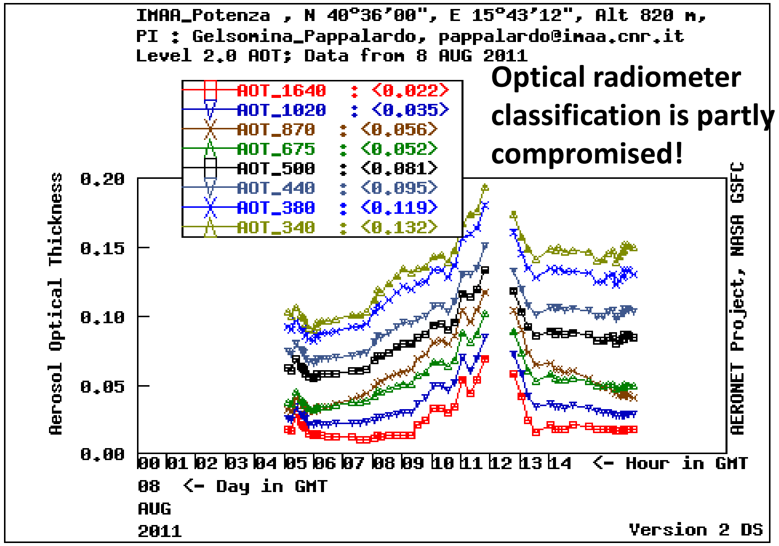
Thin clouds-2

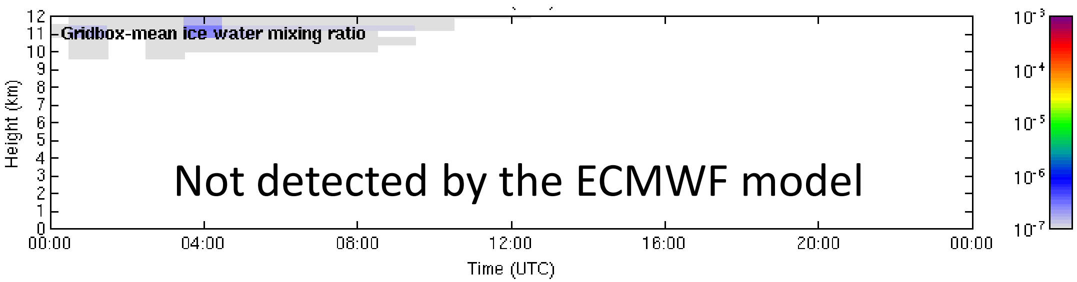




Optical radiometer classification is partly compromised!

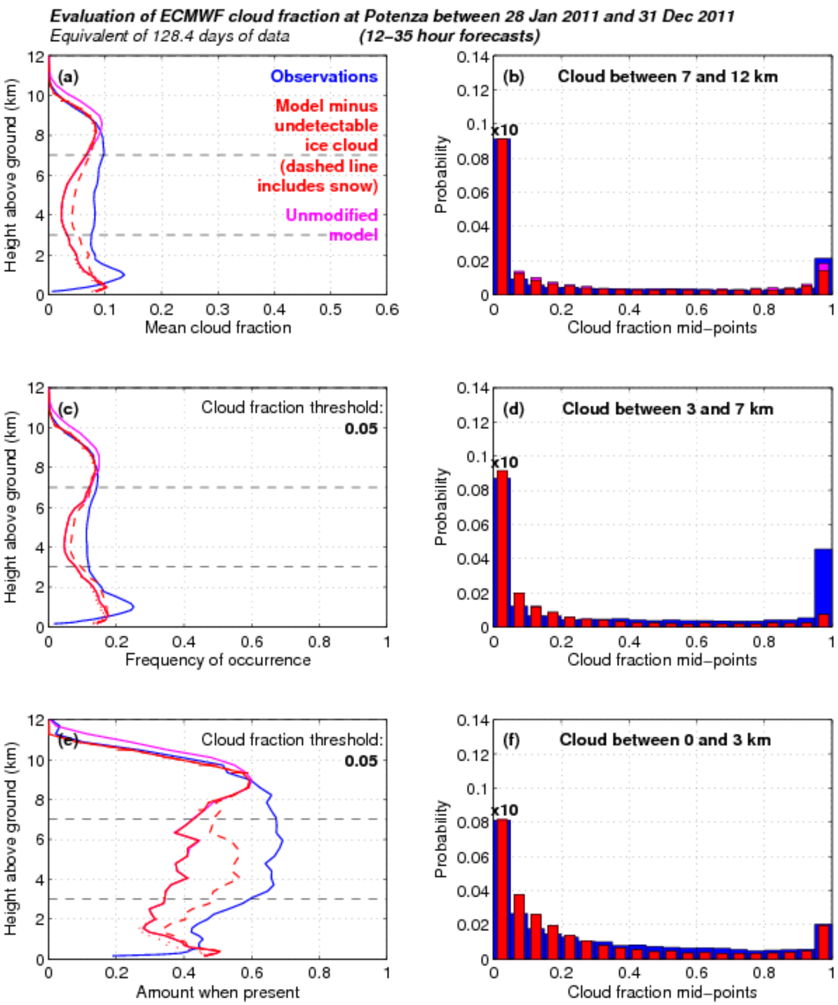
COD = 0.13

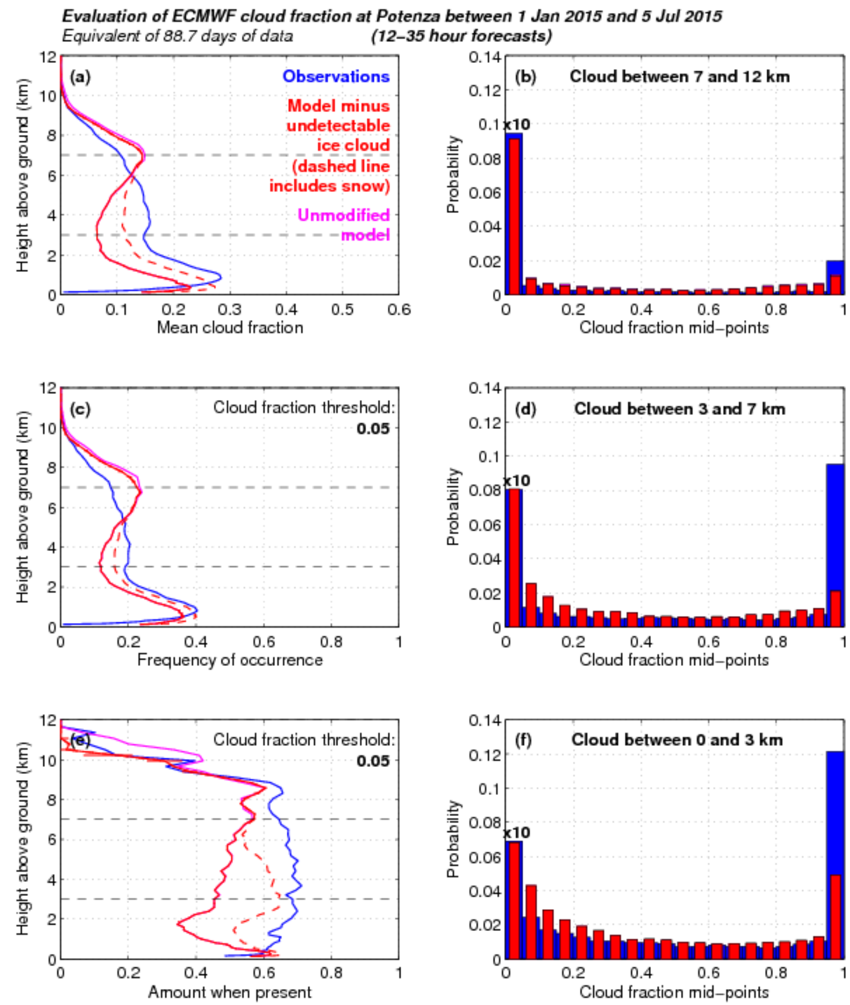
SW meas. = -21.5 W/m^2



Not detected by the ECMWF model

Cloud fraction





SW radiation

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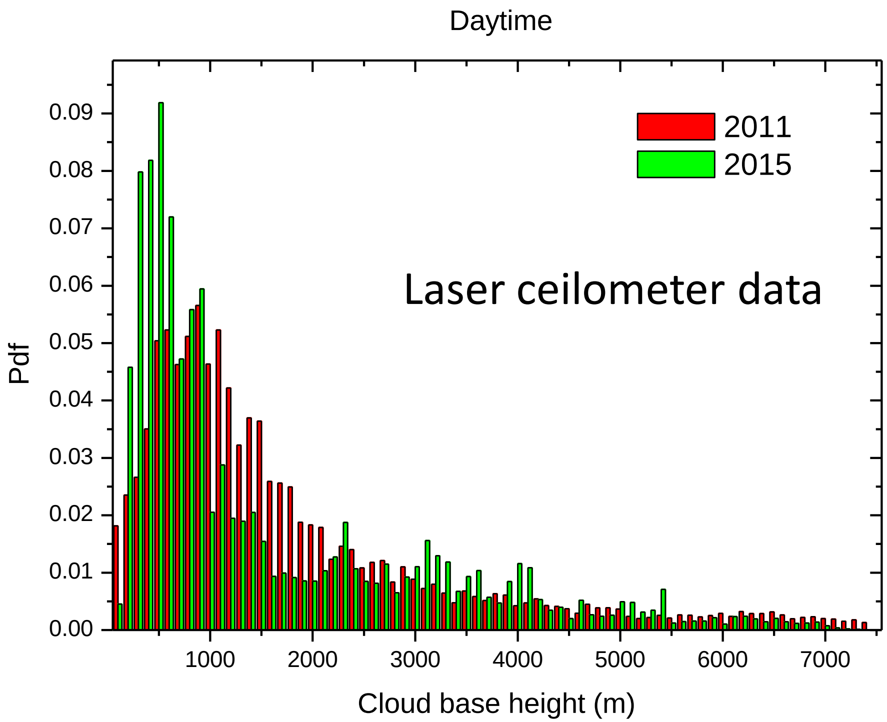
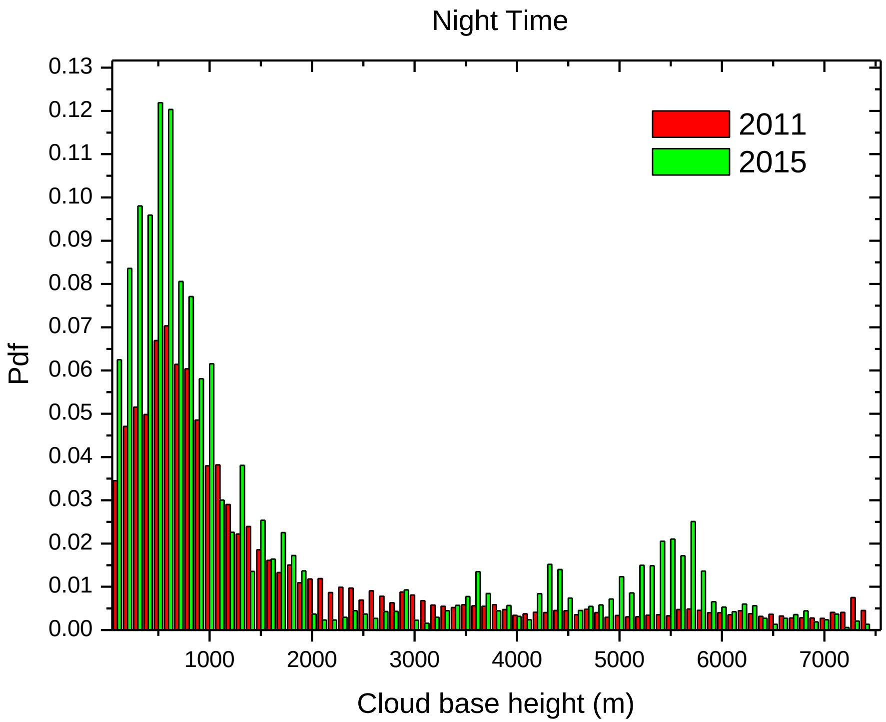


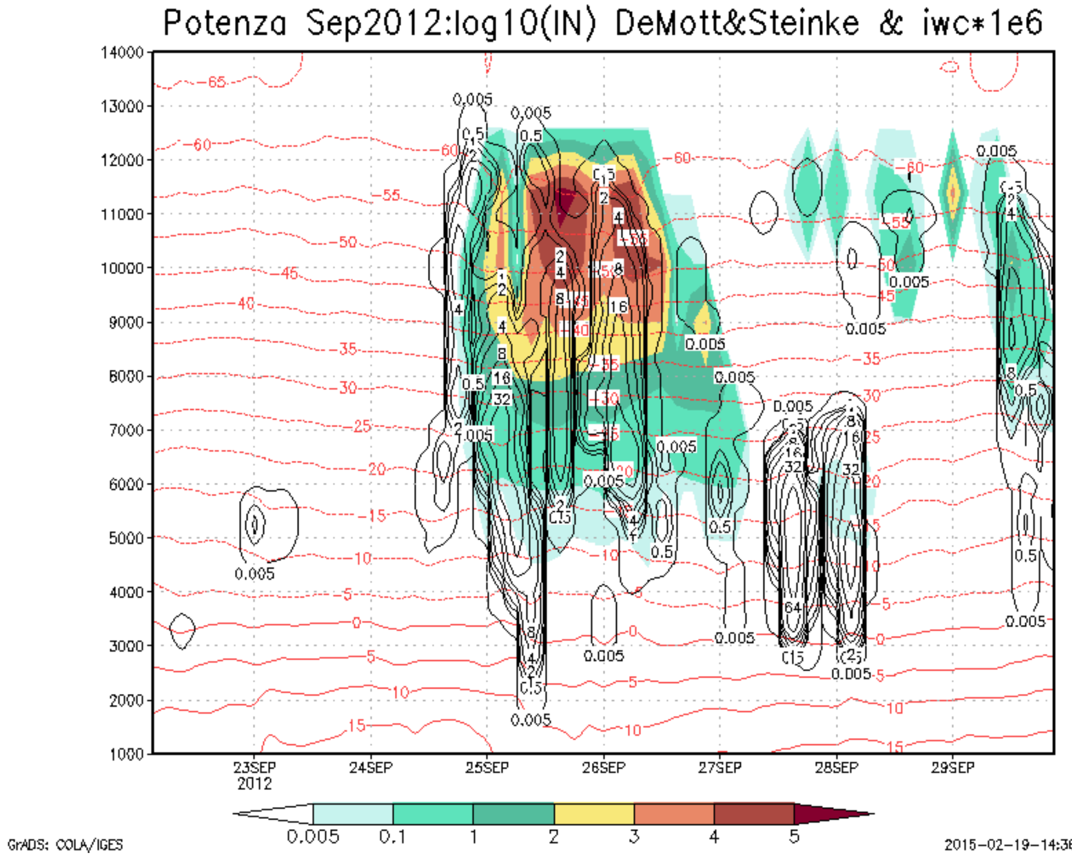


The increase in the cloud fration for low level clouds comparing 2011 and 2015 datasets is correlated with the lowering of the daytime cloud ceiling, while the cloud fraction increase for mid-level is related to changes in the nightime cloud coverage.

Examples: Improving numerical models

Ice clouds

- Improving a real-time forecasting coupled atmosphere-dust modelling system capable to operationally predict occurrence of cold clouds generated by dust (use most of standard operational cloud schemes, e.g. WRF/Thompson scheme, as a predefined IN .
- Potenza lidar and cloud radar observations have been used to explore the model capability to represent vertical features of the cloud and aerosol vertical profiles.
- MSG-SEVIRI and MODIS satellite data to examine the accuracy of the simulated horizontal distribution of cold clouds.



Model IN concentration (color image), IWC estimated from cloud radar measurements (contour plot).

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Outlook

- Long term test of the station and continuation of the scientific cooperation with publication of the results in peer-reviewed journals.

- Measurement campaign in April – September 2016 to inter-compare with lidars and ceilometers.

- Contribution to the activities aiming the establishment of the CNR-IMAA multi-disciplinary laboratory for renewable energies.

- Evaluation of participation to future calls for funding.

Alle the info about the project and its output are available at www.ciao.imaa.cnr.it ("Project/OSCAR" section)

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Back-up slides

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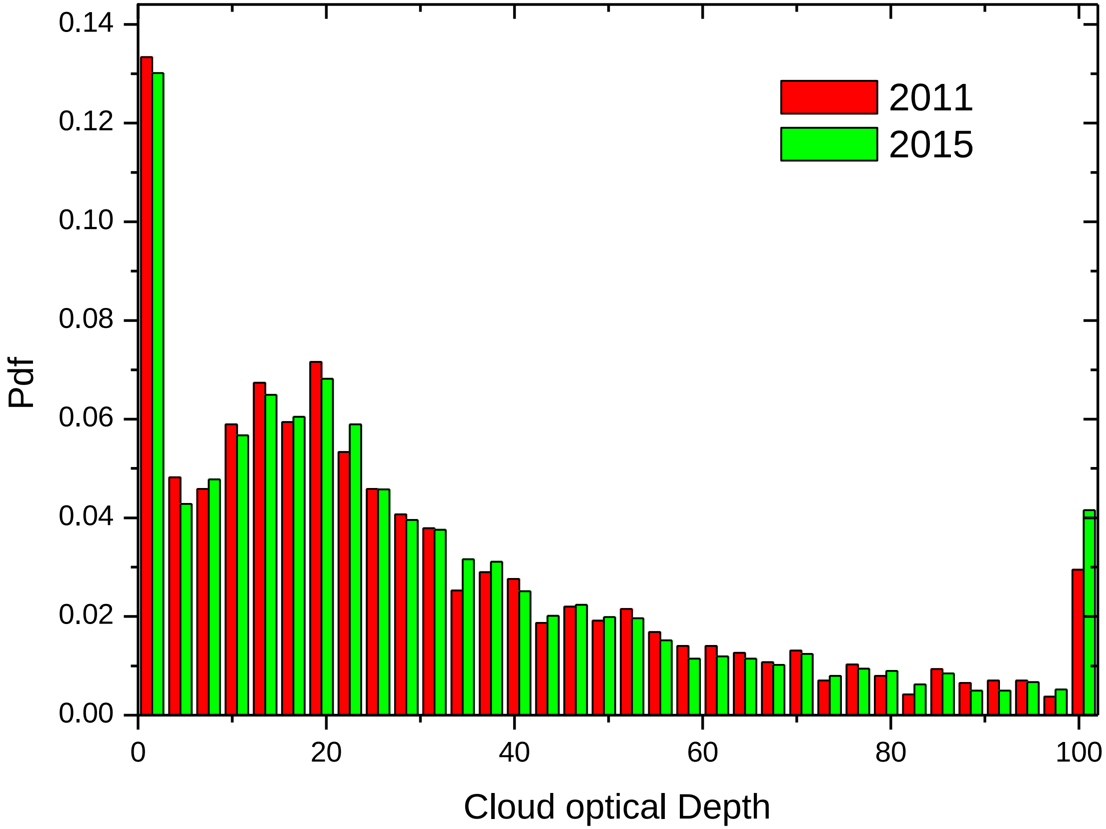
COD



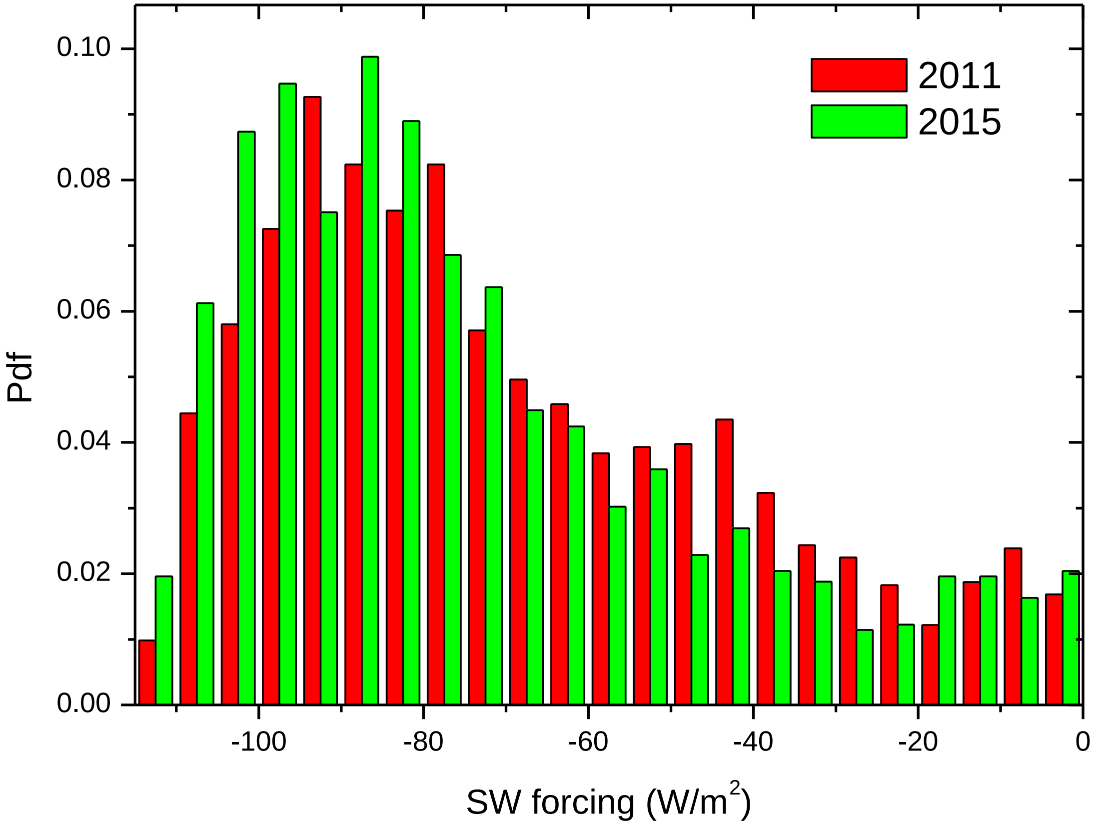
Confronto con ECMWF?

Check le nubi con COD =100 ????

Compare with cloud fraction Cloudnet

Metti le figure che sono consistenti ed interessantissime

SW radiation



Average(2010)=-69±27 W/m^2

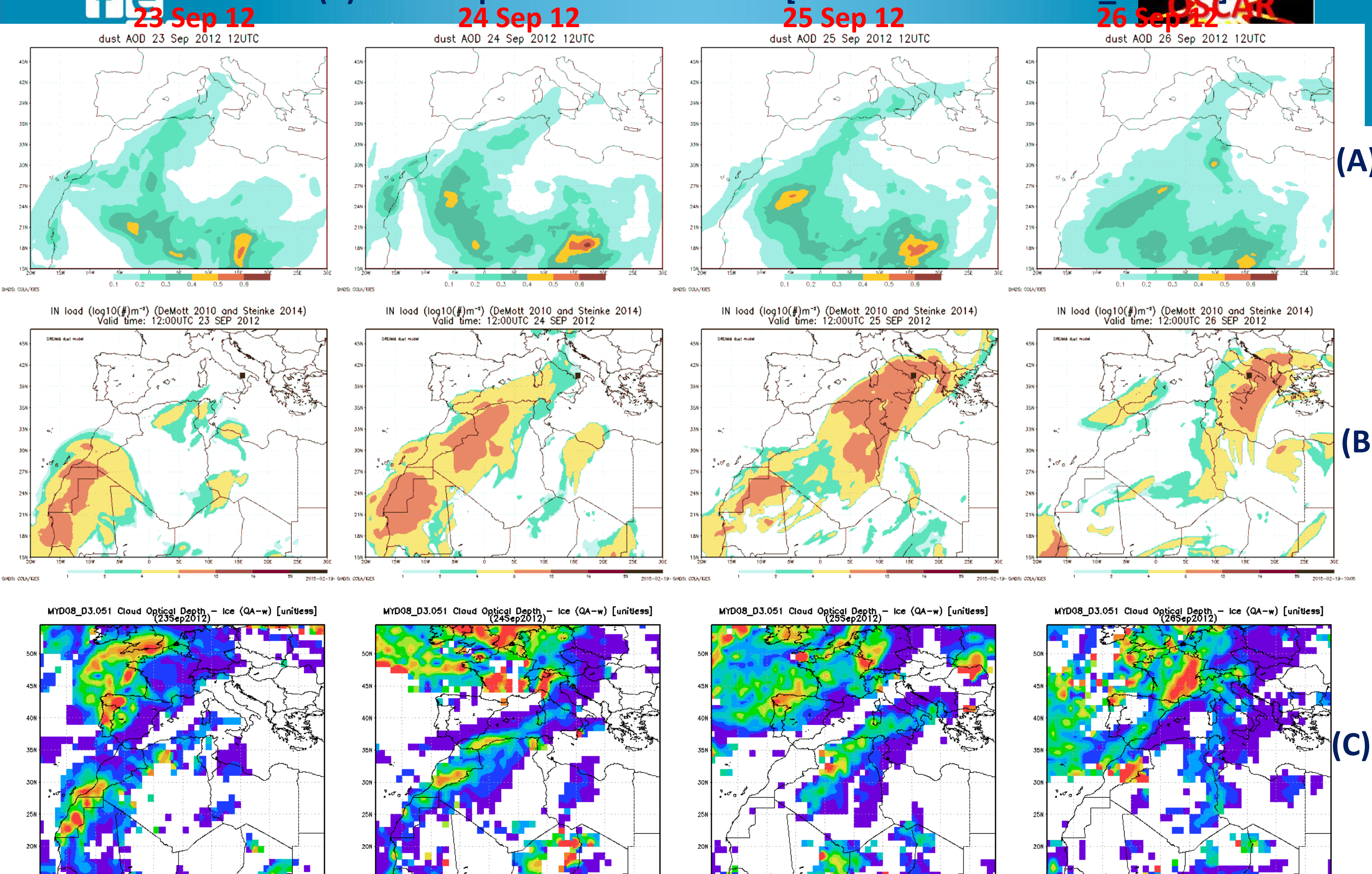
Average(2015)=- 74±27 W/m^2

Remark the impact on the climate system (water vapour-liquid water or microphysics?)

Hypothesis: larger LWP but lower Reff or the opposite.

If the cloud base is lowering this means that LWP is increasing? If yes ok or explore cloudnet data (e.g fraction or categorization).

(A) Dust Optical Depth – DREAM prediction
(B) IN vertical load [#IN/m2] DREAM prediction
(C) Cloud Optical Thickness – Ice [NASA MODIS MYD08_D3.051]



(A) Dust Optical Depth – DREAM prediction
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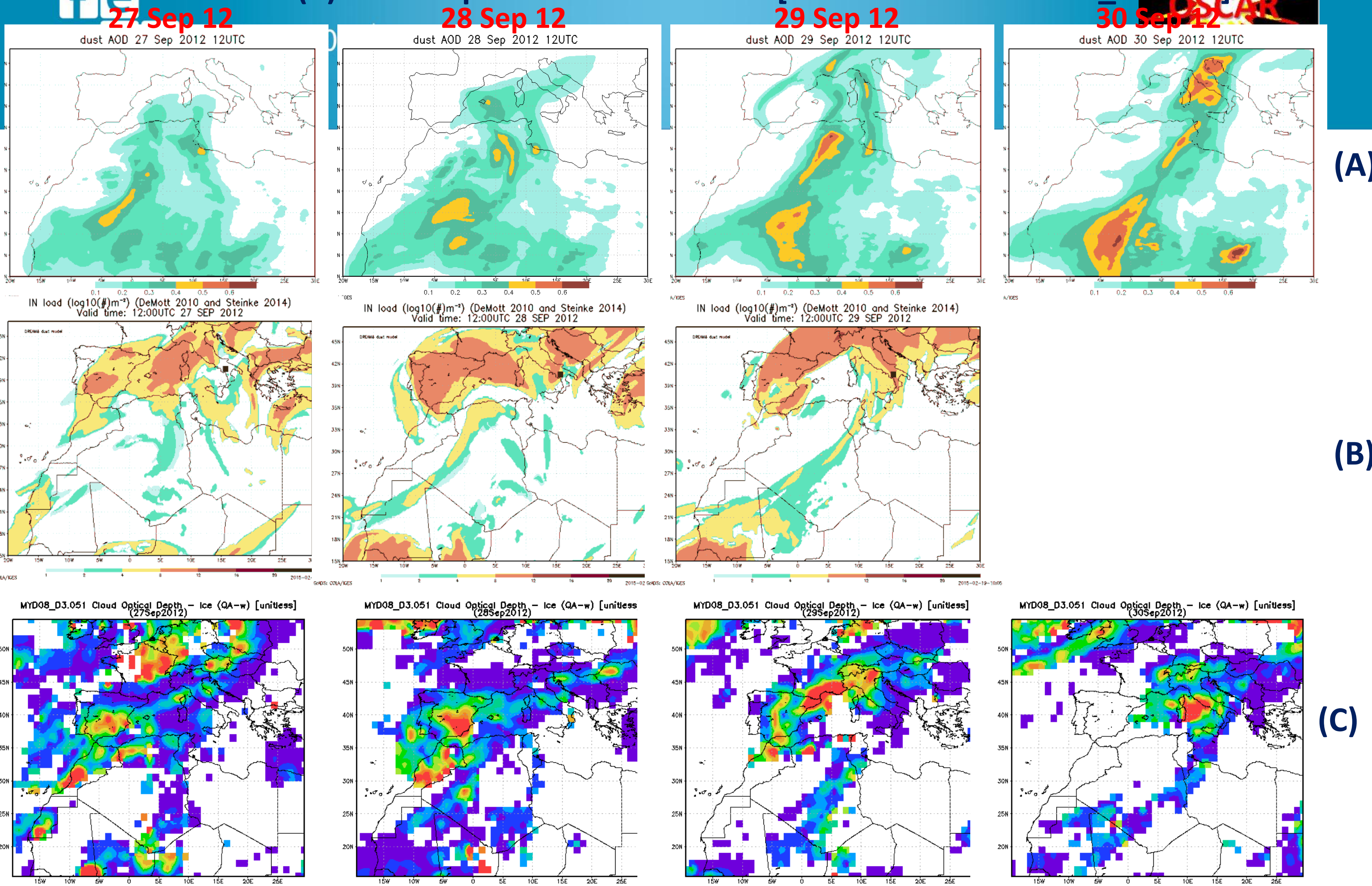

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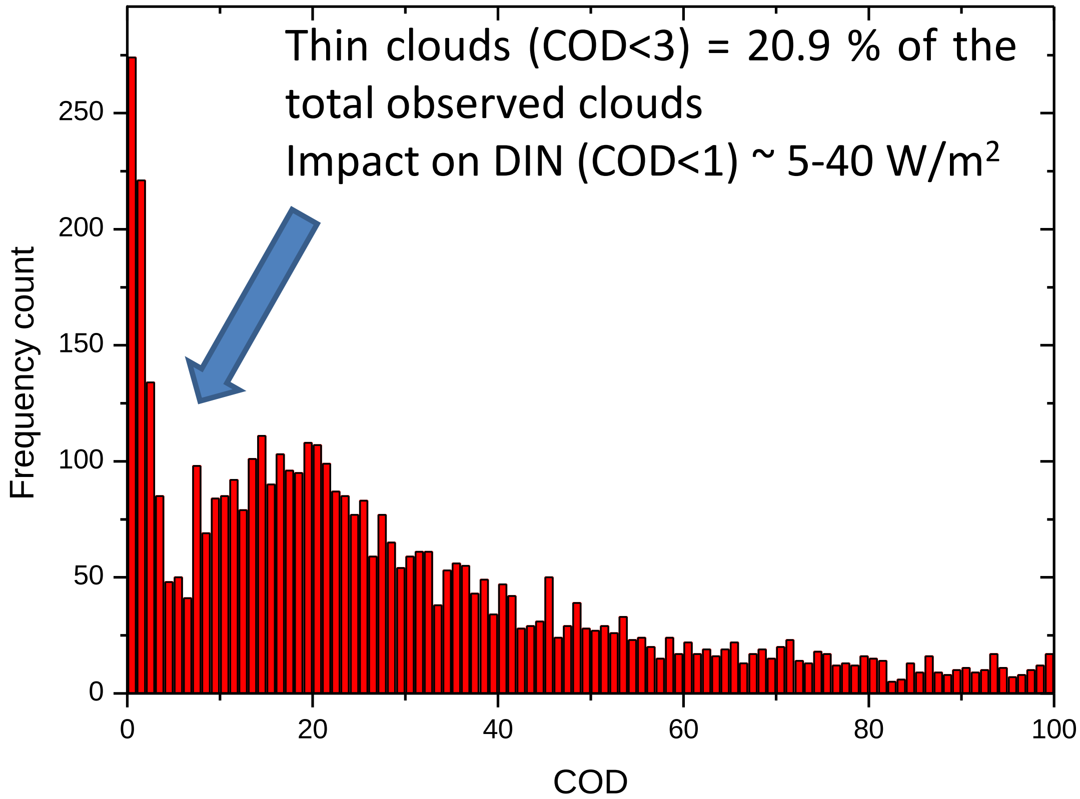
Thin clouds



Real time monitoring of these clouds is needed to optimized the exploitation of solar radiation.

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