The MedCLIVAR network and the need for a sustained satellite observation programme

…. Some views and needs from the MedCLIVAR community for innovative satellite products and their use in the activities of the network.

P.Lionello, University of Salento*, on the behalf of the MedCLIVAR SG*
Contact : piero.lionello@unisalento.it

With contributions from

- *Samuel Somot* : precipitation over the sea

CNRM, University de Toulouse, Meteo-France, CNRS

- *Luciana Fenoglio* : sea level and mass budget

Institut of Geodesy and Geoinformation University of Bonn

- *Eyal Ben Dor and Hadas Saaroni* : urban climate and environment

Department of Geography and Human Environment Tel Aviv University

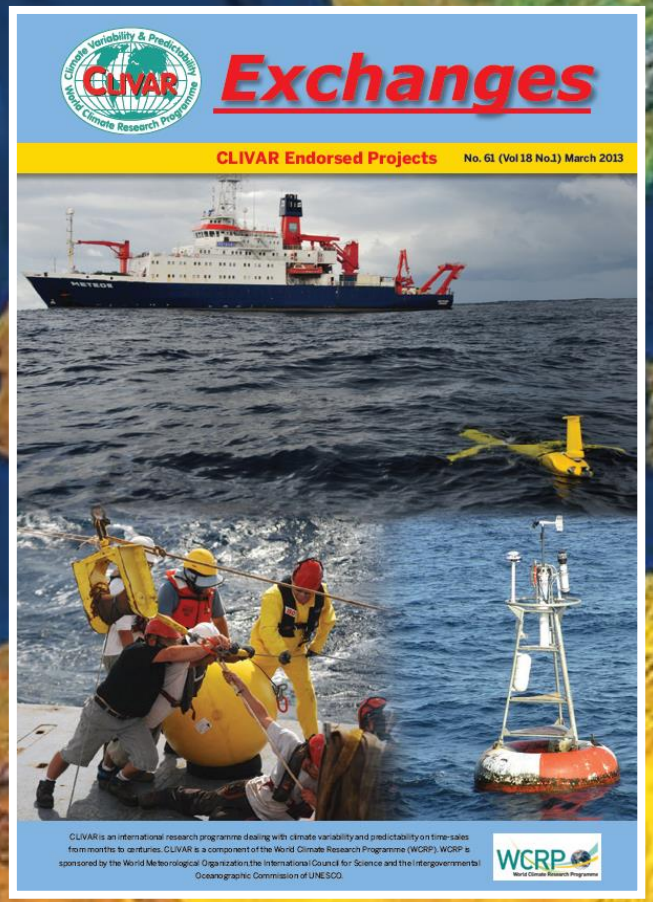
- *Ricardo Garcia-Herrera:* operational applications: flood forecast

Complutense University of Madrid | UCM · Department of Physics of the Earth, Astronomy and Astrophysics

- *Alexandre M. Ramos*: atmospheric river detection

Instituto Dom Luiz , Universidade de Lisboa

The MedCLIVAR Network in 2018



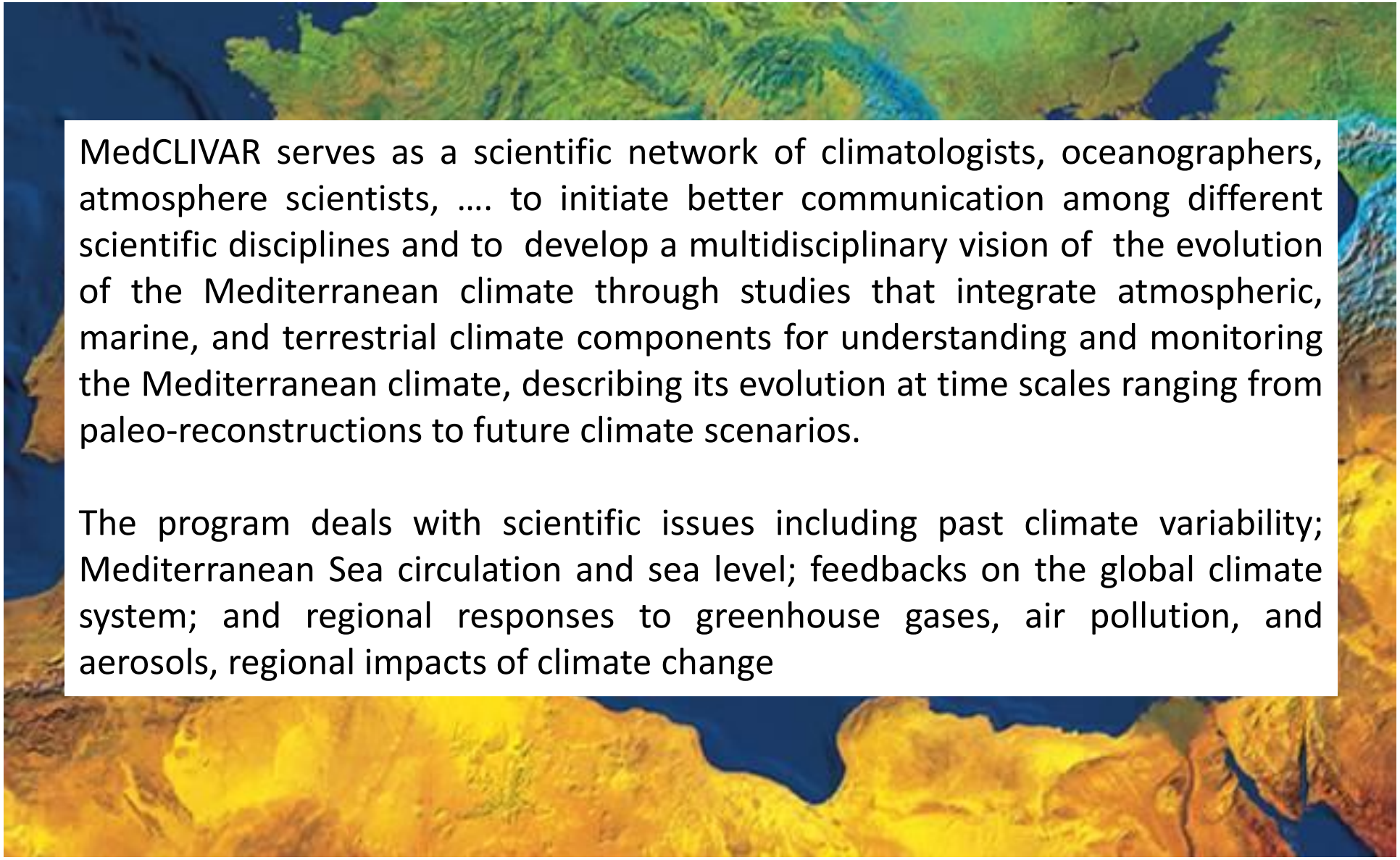
The MedCLIVAR Steering Group

P.Lionello, F.Abrantes, V.Artale, I.Blade, F.Dulac, R.Garcia-Herrera, A. Gocou , D.Gomis, S.Gualdi, A.Iglesias, J.Lukovic, Z.L.LI , J.Luterbacher, P.Nastos, H.Saroni, K. Schroeder, S. Somot, A.Toreti, M.Triantaphyllou, R.Trigo, U.Ulbrich, Y.Unal, A.Vafeidis, E.Xoplaki, G.Zanchetta

Contacts: piero.lionello@unisalento.it

http://www.medclivar.eu

The MedCLIVAR Network: goals and scope



MedCLIVAR serves as a scientific network of climatologists, oceanographers, atmosphere scientists, …. to initiate better communication among different scientific disciplines and to develop a multidisciplinary vision of the evolution of the Mediterranean climate through studies that integrate atmospheric, marine, and terrestrial climate components for understanding and monitoring the Mediterranean climate, describing its evolution at time scales ranging from paleo-reconstructions to future climate scenarios.

The program deals with scientific issues including past climate variability; Mediterranean Sea circulation and sea level; feedbacks on the global climate system; and regional responses to greenhouse gases, air pollution, and aerosols, regional impacts of climate change

publications

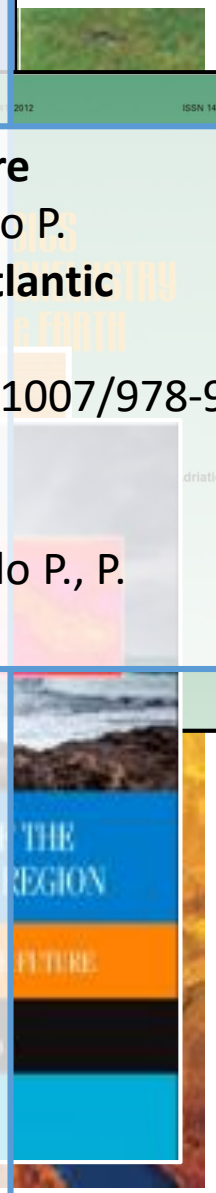
Special Issues

- Global and Planetary Change, 2017, Climate Variability and Change in the Mediterranean Region (editors P.Lionello, E.Ozsoy, S.Planton, G.Zanchetta) Volume 151, Pages 1-152
- Nat. Hazards Earth Syst, 2015, Climate change, extreme events and hazards in the Mediterranean region (
- Journal of the Black Se
Evolution and Effects or
MedCLIVAR 2014 Confe
Planton, A. Toreti, M.Tü
- Regional Environmenta
progresses and climate
Lionello, Fatima Abrant
- Physics and Chemistry
Parts A/B/C Volumes 40–41, Pages 1-106 (Ed. P.Lionello)
- Nat. Hazards Earth Syst, 2010 Understanding dynamics and current developments of climate extremes in the Mediterranean region. (Eds. R. Garcia-Herrera, P.Lionello, U. Ulbrich)
- Global and Planetary Change, 2010 Oxygen isotopes as tracers of Mediterranean variability: linking past, present and future Volume 71, Issues 3–4, Pages 135-270, (Eds. M.D. Jones, C.N. Roberts and G. Zanchetta)
- Global and Planetary Change, 2008 Mediterranean climate: trends, variability and change , Volume 63, Issues 2–3, Pages 87-282 (Eds. P.Lionello, S.Planton, X.Rodò)

The climate of the Mediterranean region: from the past to the future
2012 , Elsevier Insights, 592pp, ISBN: 978-0-12-416042-2 , Ed. Lionello P.

Hydrological, Socioeconomic and Ecological Impacts of the North Atlantic Oscillation in the Mediterranean Region
2011, Advances in Global Change Research, Volume 46, 1-8, DOI: 10.1007/978-94-007-1372-7_1, Eds: Serrano, S.M.V., Trigo, R. M

Mediterranean Climate Variability
2006, Elsevier, Amsterdam, ISBN: 0-444-52170-4, 438 pp, Eds: Lionello P., P. Malanotte-Rizzoli and R. Boscolo



newsletter

The MedCLIVAR newsletter is published approximately every 6 months. Please contact the editors if you would like news and material to be published in the next newsletter :

Anita Drumond: anitadru@uvigo.es; Alexandre Miguel Ramos: amramos@fc.ul.pt; Eleonora Regattieri: regattieri@dst.unipi.it; Marco Turco: turco.mrc@gmail.com ; Matteo Zampieri: matteo.v.zampieri@gmail.com

MedCLIVAR newsletter

www.medclivar.eu

14th July 2018 - n. 13

FORTHCOMING EVENTS

IN THIS ISSUE

Forthcoming events
- 2018 MedCLIVAR conference in Belgrade

Call for organization of MedCLIVAR 2020

Recent and ongoing activities
- MedCLIVAR at the EGU 2018
- The 2018 HyMeX Workshop
- The Med-GOLD project
- Special issue: on Atmosphere: " Weather and Climate Extremes: Current Developments"

Scientific highlight
- Recent publications

The 2018 MedCLIVAR Conference

The **MedCLIVAR 2018 conference** will take place on 17-21 September 2018 in Belgrade, Serbia. The conference will be held at the University of Belgrade - Faculty of Civil Engineering in Belgrade. The scientific programme includes about 60 oral presentations and 70 posters. Conference material, scientific programme, session descriptions, registration form, logistic information are available at
www.medclivar2018conf.eu

MedCLIVAR 2018 highlights:
- '**MEdCLIVAR Young Scientist Award**' (deadline for nomination 15 July)
- **Conference special issue** of Regional Environmental Change (deadline for title proposals: 30 July)
- **Call for organization of MedCLIVAR 2020** (deadline for proposals: 31 August)
- **Best poster awards**
- **Poster submissions is open**: contributions will be accepted on a "first come first served" basis
- **Panel discussion** with key note talks of the 21/09 "**Climate change and its impacts in the Mediterranean** region

Please contact the editors if you would like news and material to be published in the next newsletter:

Alexandre Miguel Ramos: amramos@fc.ul.pt; Anita Drumond: anitadru@uvigo.es; Eleonora Regattieri: regattieri@dst.unipi.it; Matteo Zampieri: matteo.v.zampieri@gmail.com; Marco Turco: turco.mrc@gmail.com

The network established by MedCLIVAR has held conferences, thematic workshops, summer schools. In addition, the program has awarded exchange grants and funded senior scientists to visit different universities and research centers for short periods, sponsored or cosponsored scientific meetings, and every year since 2003 organized sessions during the European Geosciences Union general assembly.

MedCLIVAR sessions since 2003

Sessions at EGU/EGS General Assembly

April 2003 Nice FRANCE CL2.3 "Mediterranean climate session at EGS2003"

Sessions at EGU General Assembly

April 2004 Nice FRANCE CL3 "Mediterranean climate variability"
April 2005 Vienna AUSTRIA CL3 "Mediterranean Climate Variability" and roundtable
April 2006 Vienna AUSTRIA CL6 "Mediterranean Climate Variability" session and roundtable
April 2007 Vienna AUSTRIA CL12 "Mediterranean climate variability and change" and roundtable at EGU2007
April 2008 Vienna AUSTRIA CL12 "Mediterranean climate variability and change" and roundtable
April 2009 Vienna AUSTRIA CL60 "Mediterranean climate variability and change" and roundtable
May 2010 Vienna AUSTRIA CL1.20 "Mediterranean Climate : from past to future"
April 2011 Vienna AUSTRIA CL2.3 "Mediterranean Climate : from past to future"
April 2012 Vienna Austria CL4.3 "Mediterranean Climate: from past to future"
April 2013 Vienna Austria CL4.6 "The climate of the Mediterranean region: from basic science to impacts"
April 2014 Vienna Austria CL5.9 "The climate of the Mediterranean region: from basic science to impacts"
April 2015 Vienna Austria CL4.1 "The climate of the Mediterranean region: from basic science to impacts"
April 2016 Vienna Austria CL4.05 “The climate of the Mediterranean region: from basic science to impacts”
April 2017 Vienna Austria CL4.15 “The climate of the Mediterranean region: from basic science to impacts”
April 2018 Vienna Austria CL4.13 “The climate of the Mediterranean region: from basic science to impacts”

MedCLIVAR Conferences

[MedCLIVAR 2011,](#)
6-9 June 2011. Lecce. Italv

adrid, Spain
erranean region:

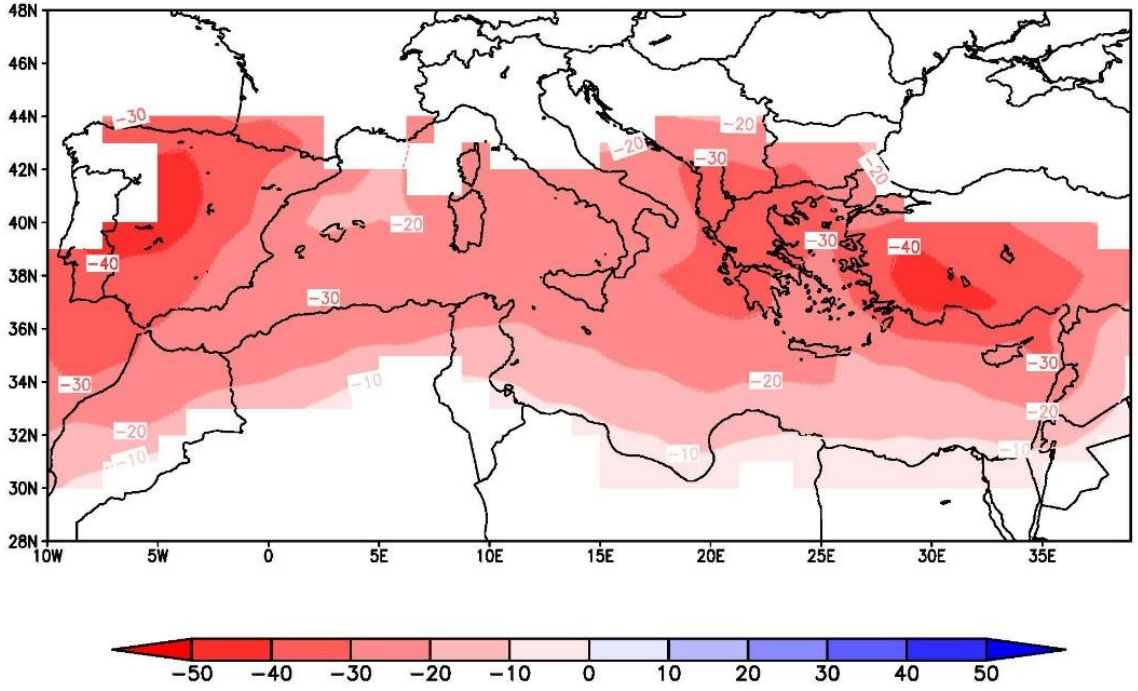
Ankara, Turkey
imate Evolution and Effects on

2016,
nber 2016, Athens, Greece

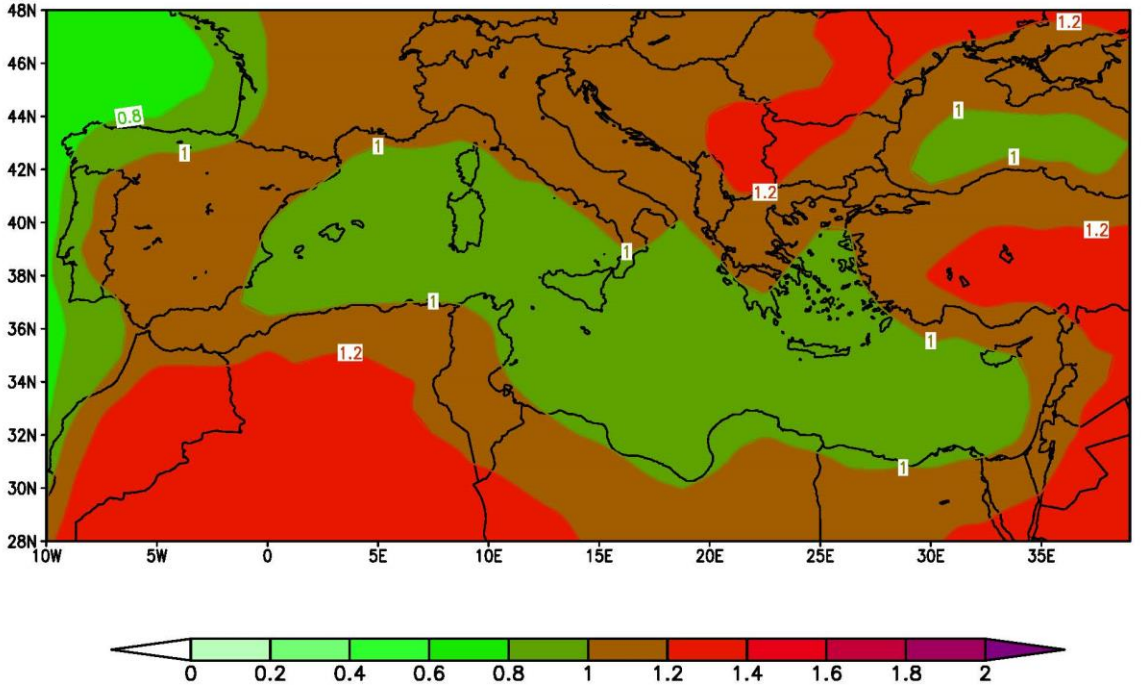
[MedCLIVAR 2018,](#)
[17-21 September 2018, Belgrade, Serbia](#)
"Bridging the Mediterranean Climates"
(150 participants from 17 countries)

The Mediterranean region as a climate change “hot spot”

Precipitation (mm/K)



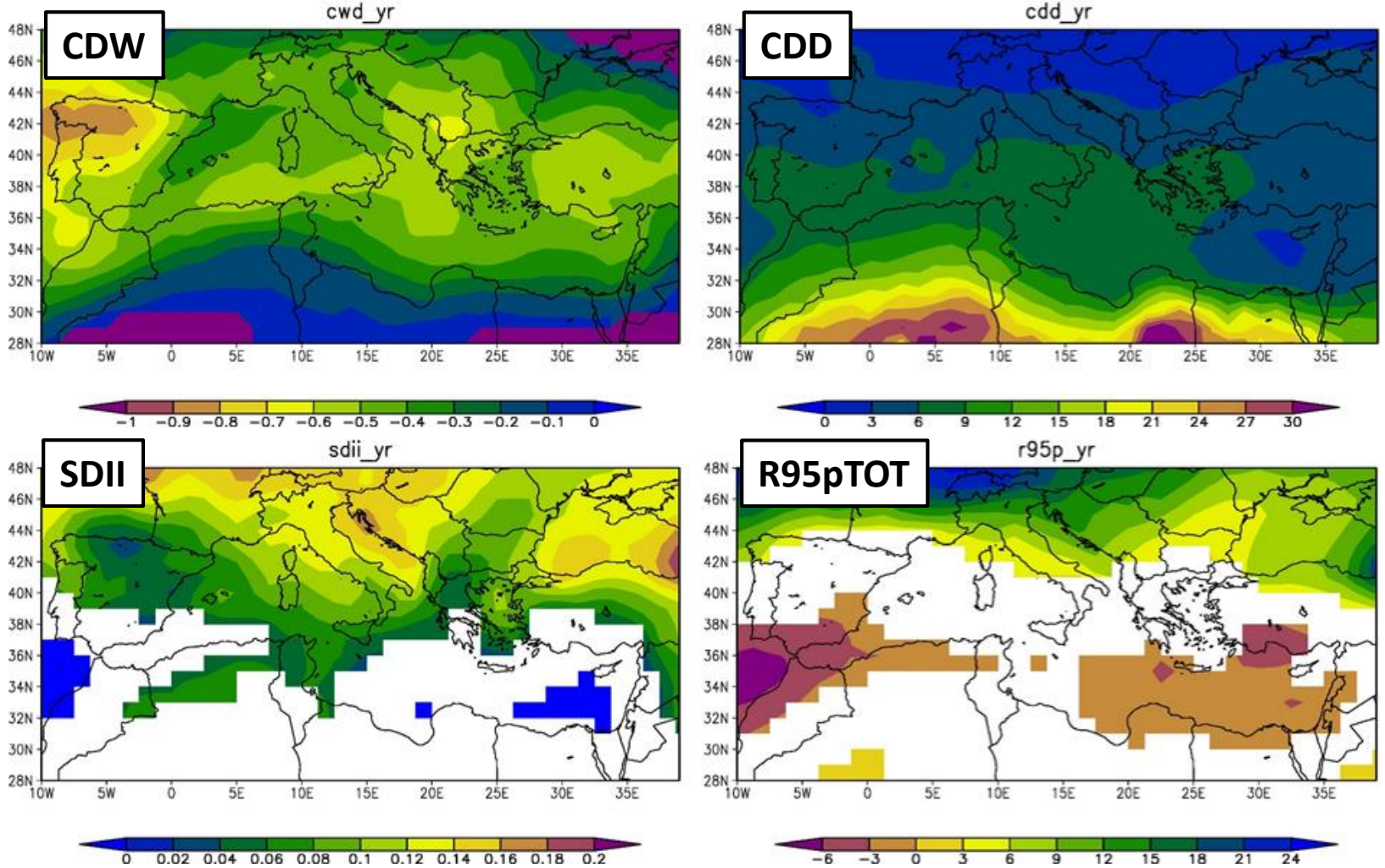
temperature



rate of change of total annual precipitation (left) and mean annual temperature (right) with the mean global temperature.

(Lionello and Scarascia, 2018)

The Mediterranean region as a climate change “hot spot”



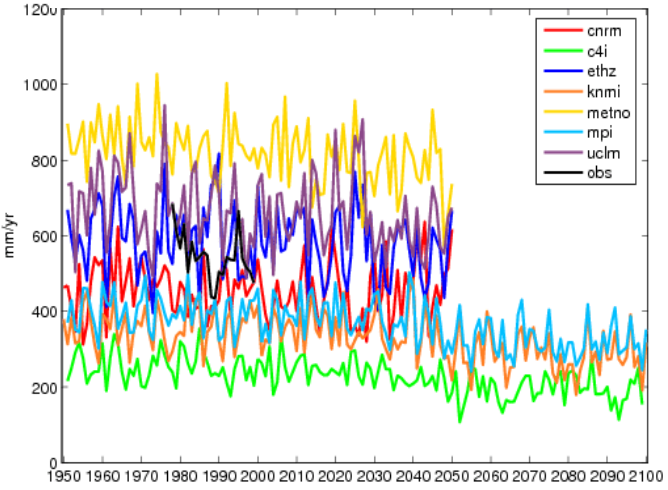
Rate of change with global temperature of a) maximum wet spell length (CWD, units days/K) : b) maximum dry spell length (CDD, units days/K) c) Simple precipitation intensity index (SDII, units mm/K) d) Annual total precipitation during intense rain day events (R95pTOT, daily rain total in days with precipitation above the 95th percentile, units: mm/k).

…. Some views and needs from the MedCLIVAR community for innovative satellite products and their use in the activities of the network.

Precipitation over the sea

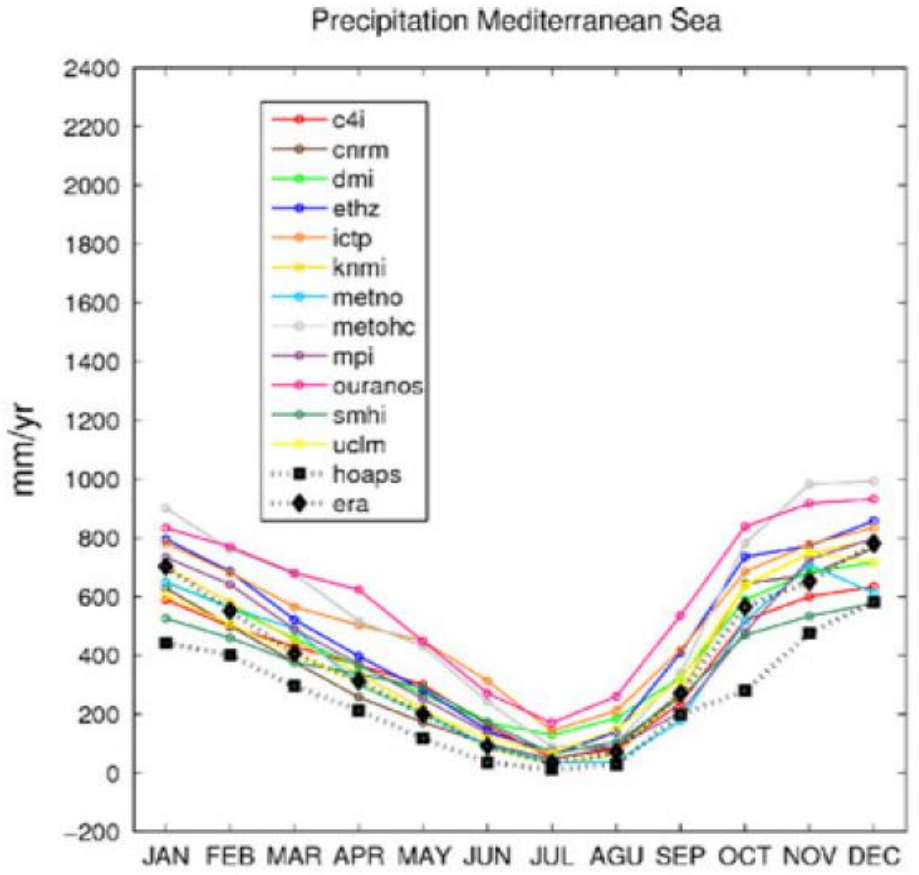
- Regional climate models strongly differs for the precipitation over the sea → need for reference evaluation products (likely satellite-derived products)

Interannual time series
(EU ENSEMBLES project multi-model, mm/yr)



Dubois et al. 2010,
Sanchez-Gomez et al. 2011

Mean seasonal cycle (mm/yr)



Long-term Mean Value (mm/yr)

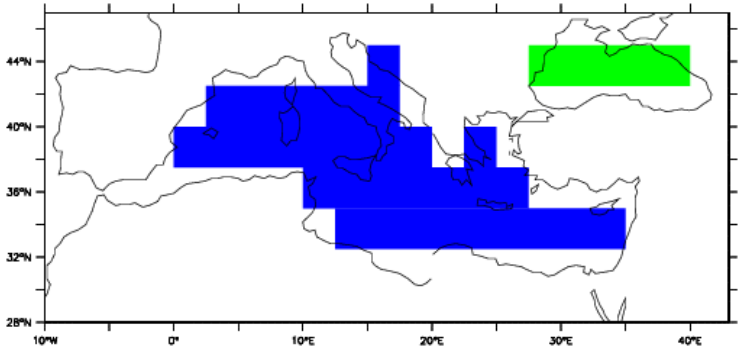
DATA	E	P
C4I	1,227 ± 50	372 ± 54
CNRM	1,132 ± 50	377 ± 50
DMI	1,377 ± 55	425 ± 57
ETHZ	1,370 ± 40	483 ± 73
ICTP	1,618 ± 68	530 ± 70
KNMI	1,104 ± 90	404 ± 67
METNO	1,424 ± 52	568 ± 60
METOHC	1,265 ± 20	377 ± 73
MPI	1,066 ± 60	416 ± 53
OURANOS	1,208 ± 72	606 ± 80
SMHI	1,126 ± 44	347 ± 54
UCLM	1,130 ± 52	400 ± 52
MEAN	1,254 ± 164	442 ± 84
ERA40	1,167 ± 50	386 ± 80
WB1	1,095 ± 80	594 ± 56
WB2	1,095 ± 80	256 ± 44
WB3	1,137 ± 90	256 ± 44
WB4	1,115 ± 60	256 ± 44
WB5	1,115 ± 60	467 ± 44

Precipitation over the sea

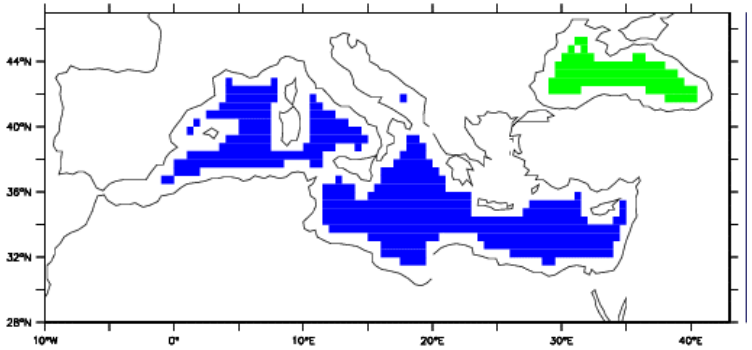
However still various problems with satellite-derived products : large inter-product uncertainty, land-sea mask issues, periods, missmatch in trends and interannual variability.

Observed surface : 2.45 10^{12} m^2

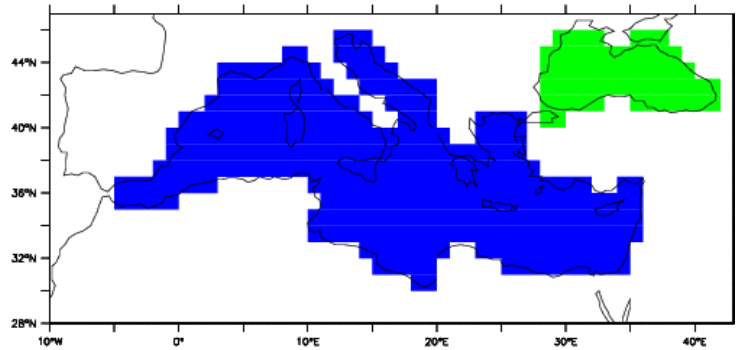
GPCP : 32 grid points, 1.96 10^{12} m^2



HOAPS : 461 grid points, 1.15 10^{12} m^2

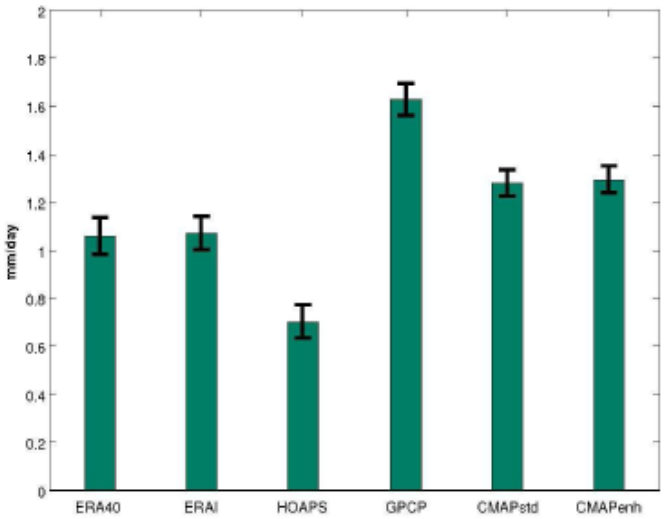


OAFLUX : 308 grid points, 3.03 10^{12} m^2



Long-term precipitation mean value (Med Sea average, mm/day)

Dubois et al. 2010,
Sanchez-Gomez et al. 2011

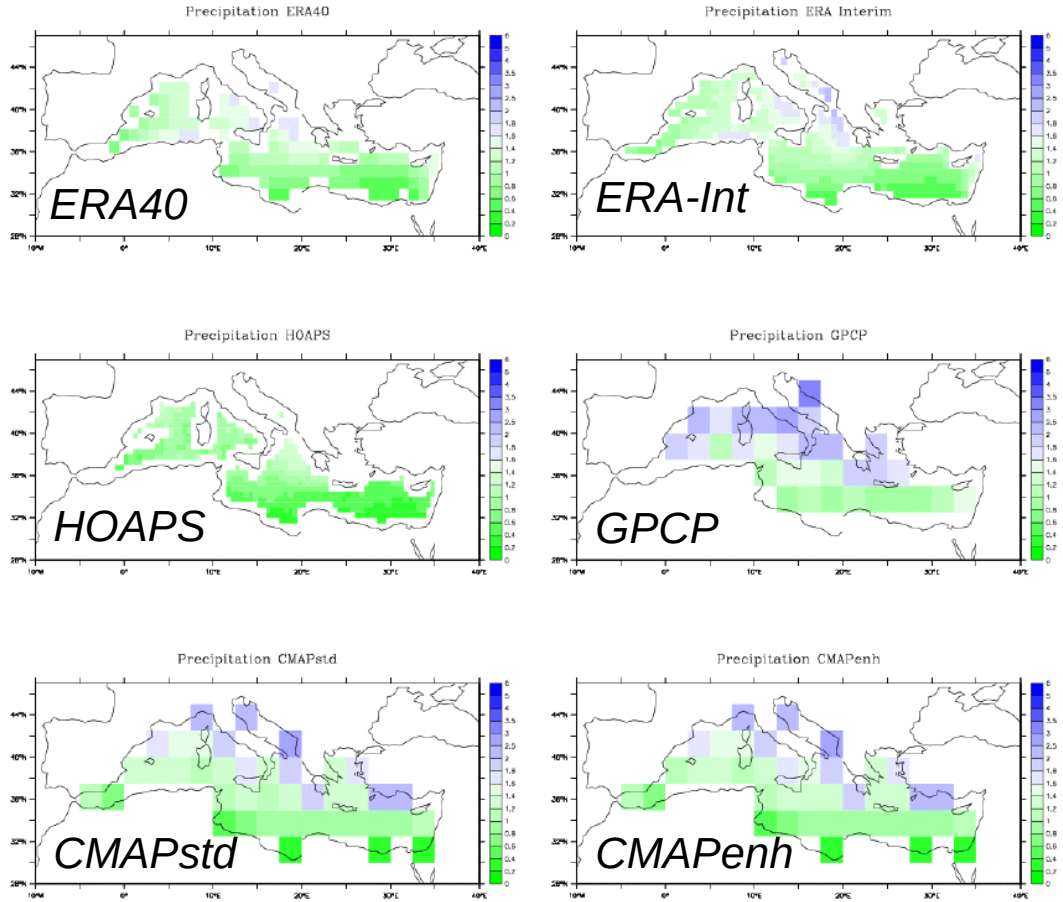


Observations	Mean and error over the total period of the observation
ERA40 (1958-2001)	1.06 ± 0.08 mm/day
ERAI (1989-20008)	1.07 ± 0.07 mm/day
HOAPS (1988-2005)	0.70 ± 0.07 mm/day
GPCP (1979-2008)	1.63 ± 0.06 mm/day[1]
CMAP (standard) (1979-2007)	1.28 ± 0.05 mm/day
CMAP (enhanced) (1979-2007)	1.29 ± 0.05 mm/day

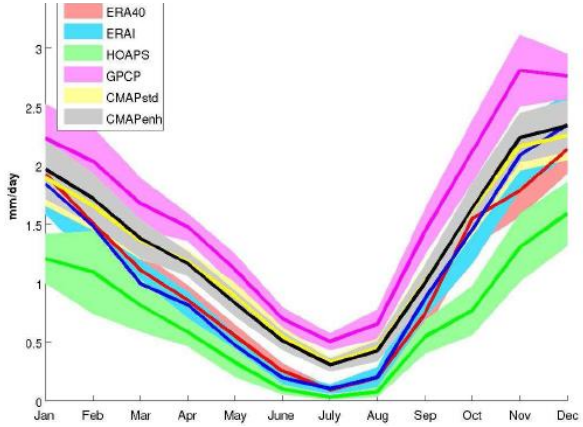
Precipitation over the sea

- However still various problems with satellite-derived products : large inter-product uncertainty, land-sea mask issue, periods, missmatch in trends and interannual variability.

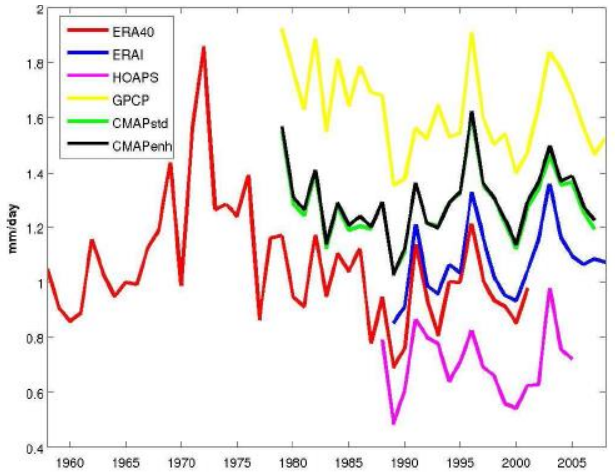
Long-term mean value (multi observation products, mm/d)



Mean seasonal cycle (mm/d)



Interannual time series (mm/d)



Dubois et al. 2010, Sanchez-Gomez et al. 2011

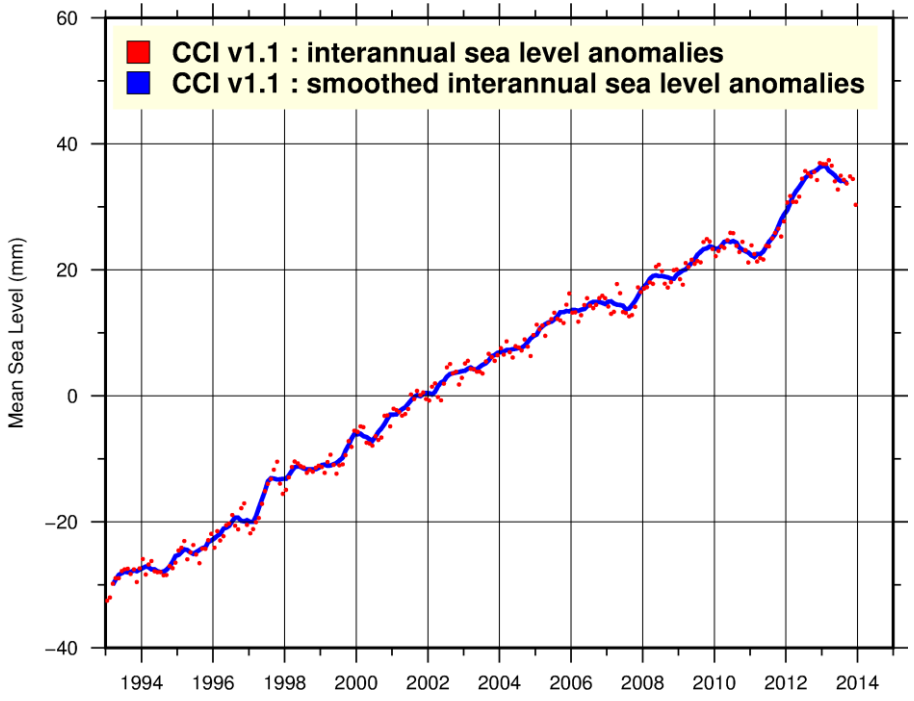
Precipitation over the sea

- Satellite observation are an unique tool for estimating precipitation over sea
- However, new satellite products that can reduce the present large uncertainty on the value of precipitation over the sea are needed.

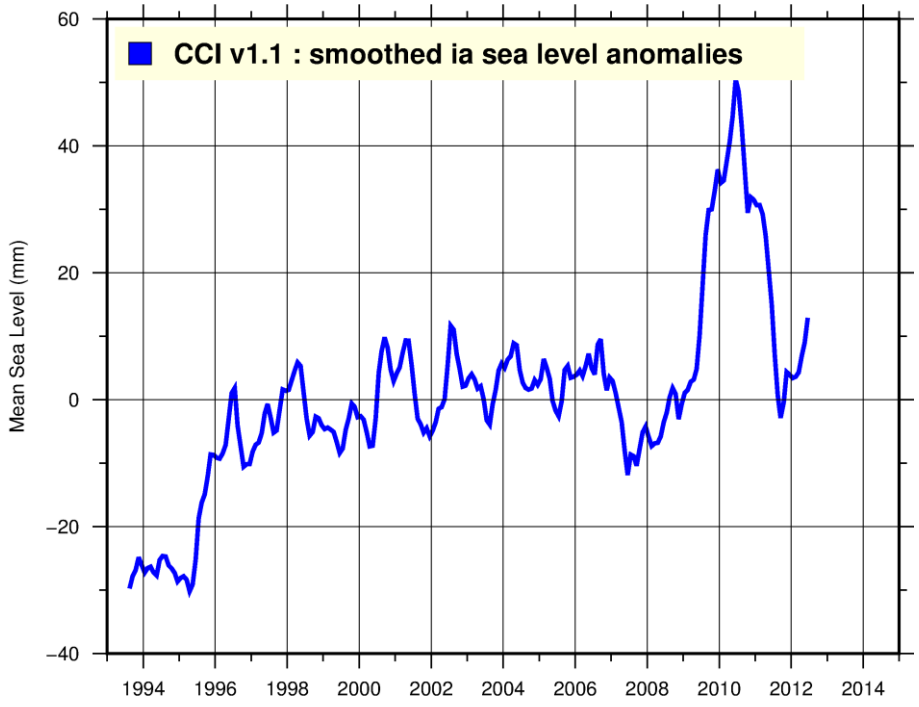
sea level and mass budget

Med sea trend **<** global mean trend (GMSL)

Med sea trend **non linear**



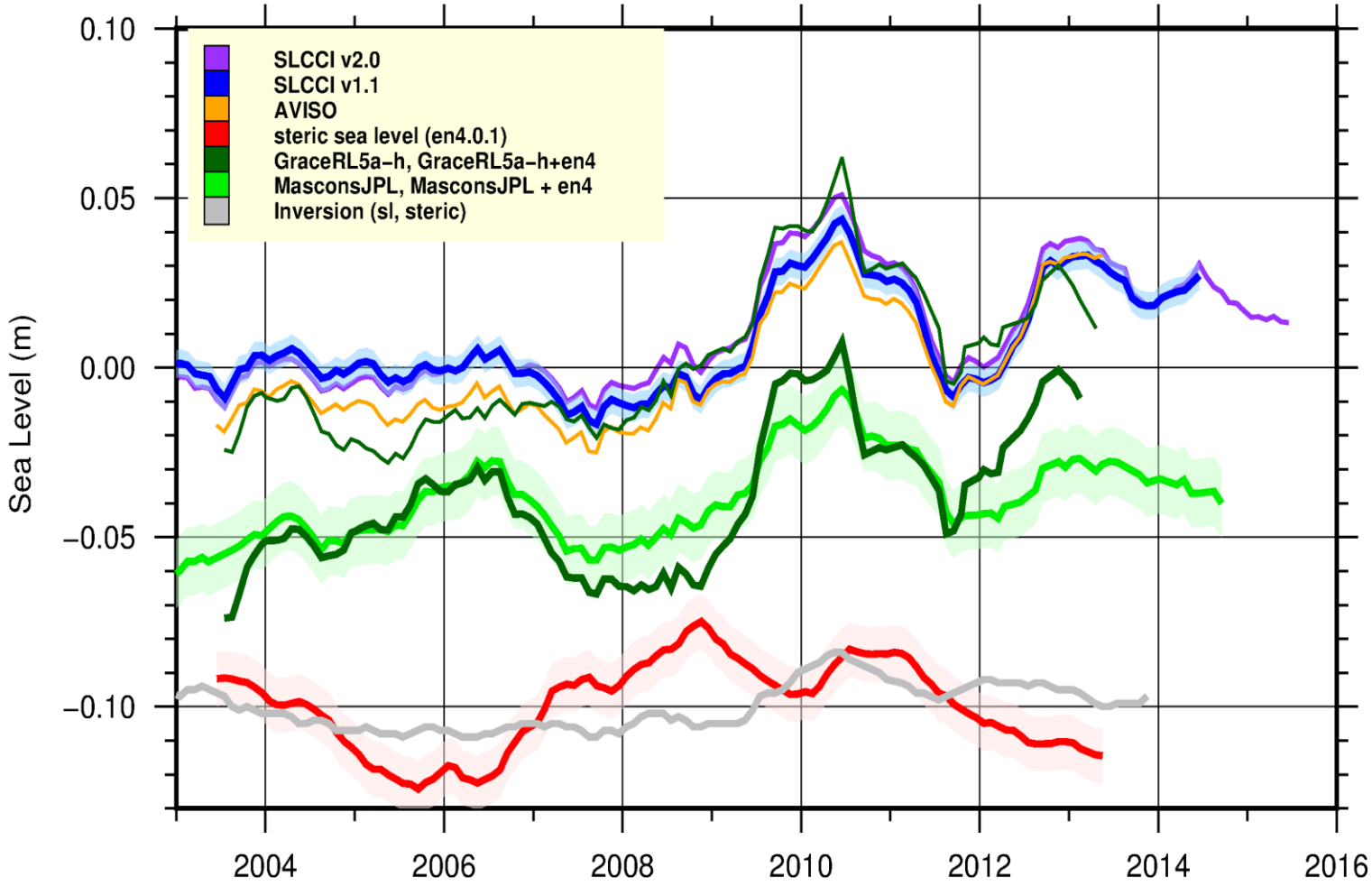
Global MSL: 3.2 +/- 0.5 mm/yr



Mediterranean Sea MSL: 2.2 +/- 0.5 mm/yr

GIA correction applied

sea level and mass budget

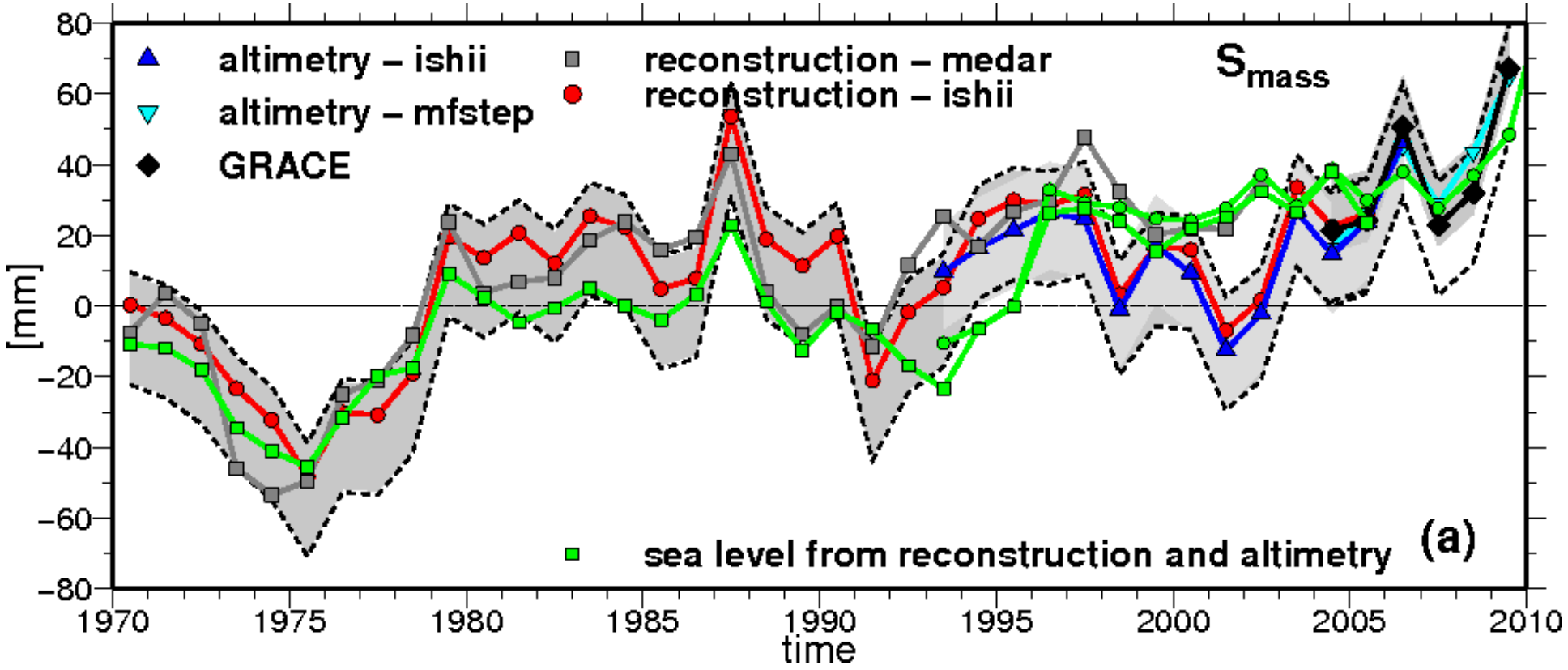


Mediterranean Sea : Smoothed time-series of observed and computed sea level, as well as its steric and mass components. Components are from GRACE RL05a corrected for land hydrology, JPL mascon solution, temperature and salinity profiles and from the inversion method. All monthy time-series have been de-seasonalized and the smoothed by a running average with lag of 12 months

(SLCCI ESA/Project report 2017)

sea level and mass budget

Mass-induced versus sea level change

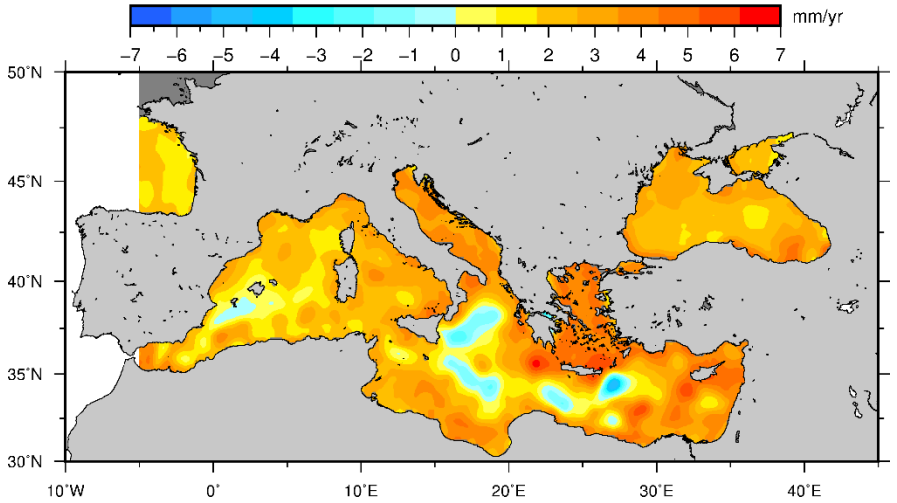


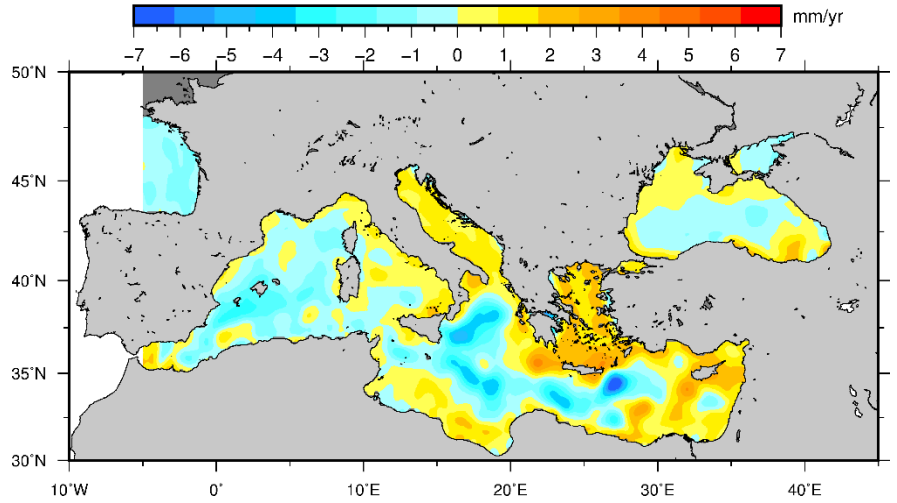
(Fenoglio et al., GPC 2013)

sea level and mass budget

•SLCCI Jan 1993 – Dec 2014

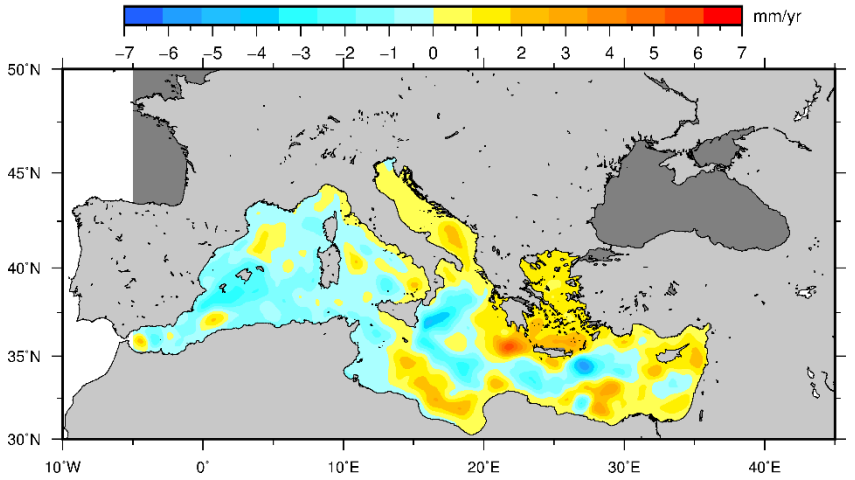
Mean of trends 2.5 mm/yr

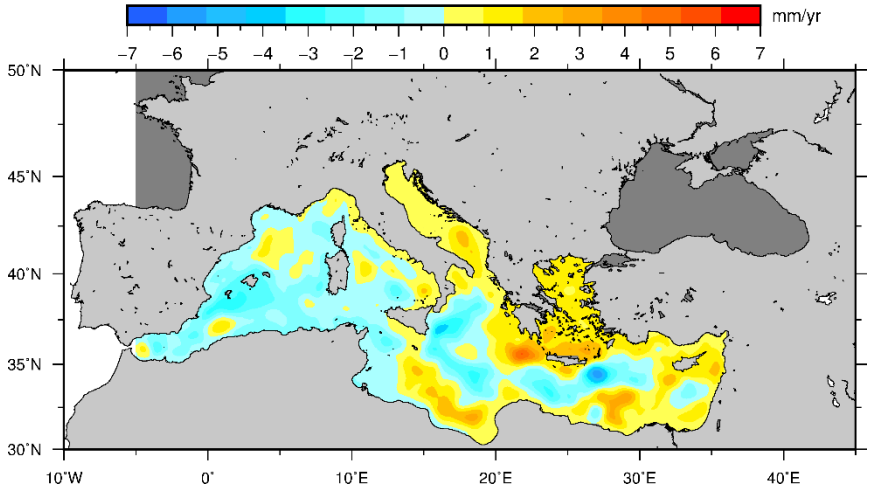




•CMEMS Jan 1993 – Dec 2014

Mean of trends 0.16 mm/yr

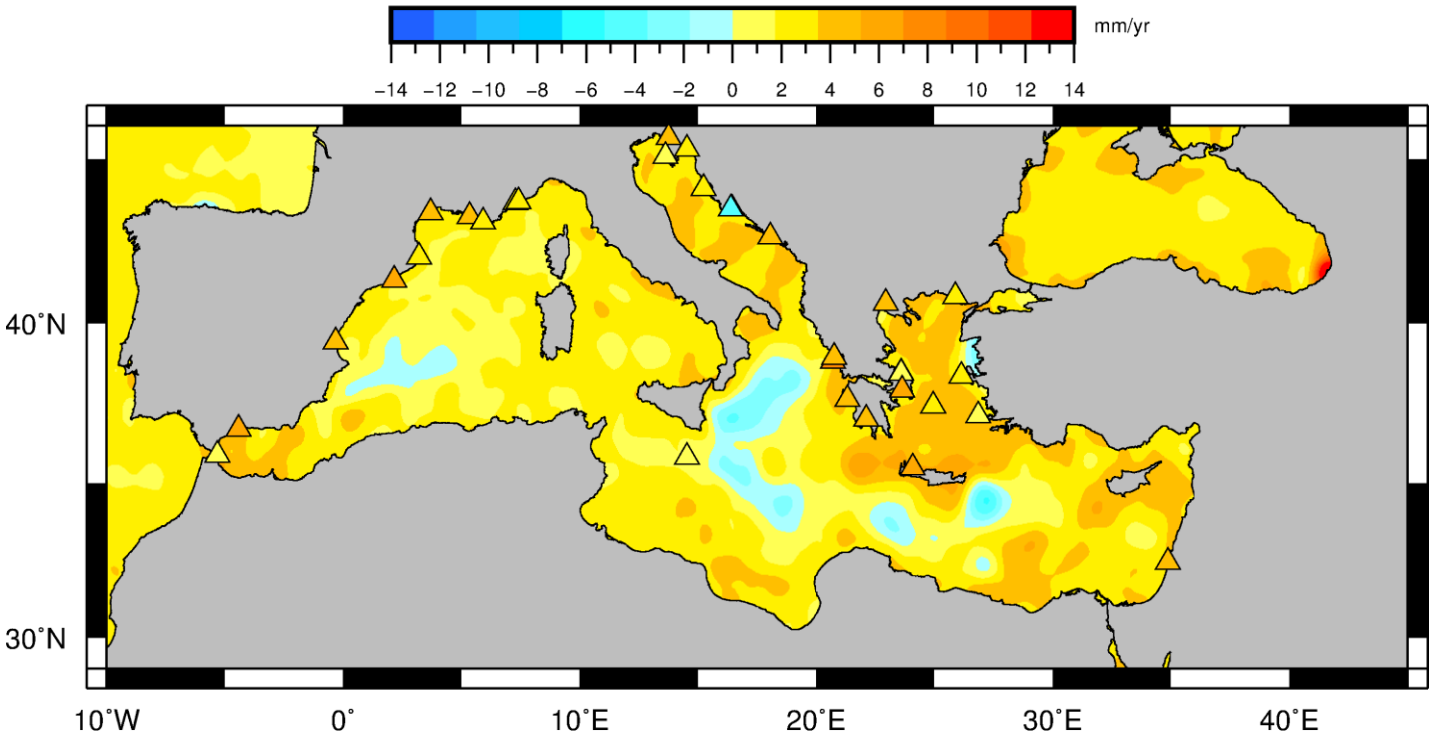


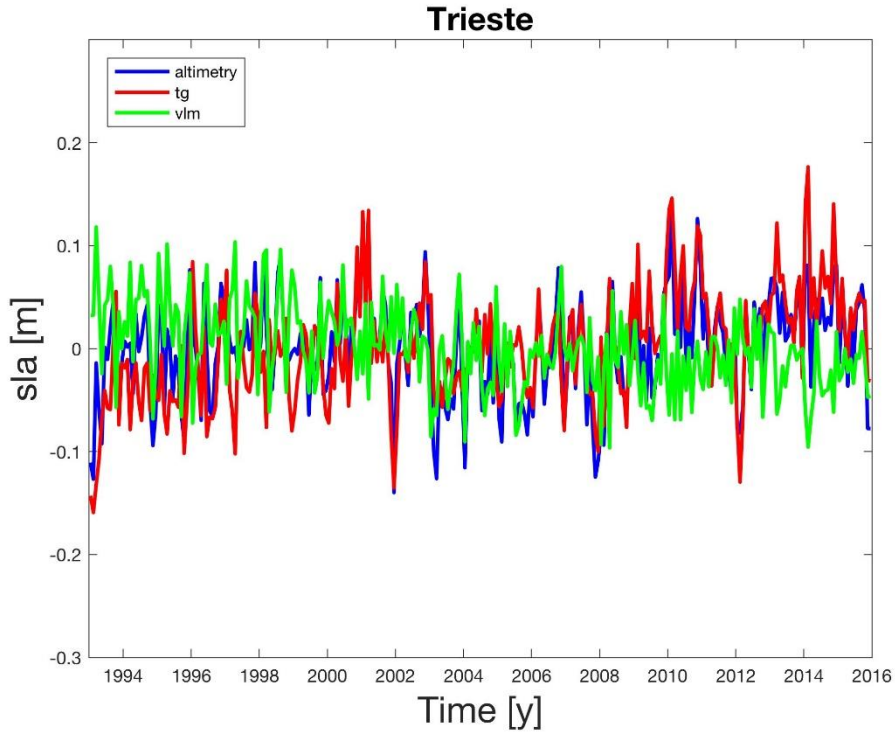


- The long-term trend is not reproduced in the ocean ssh fields of Med MFC REA
- Regional structures are visible

sea level and mass budget

Tide gauges in PSMSL with > 70% of data in 1993-2015





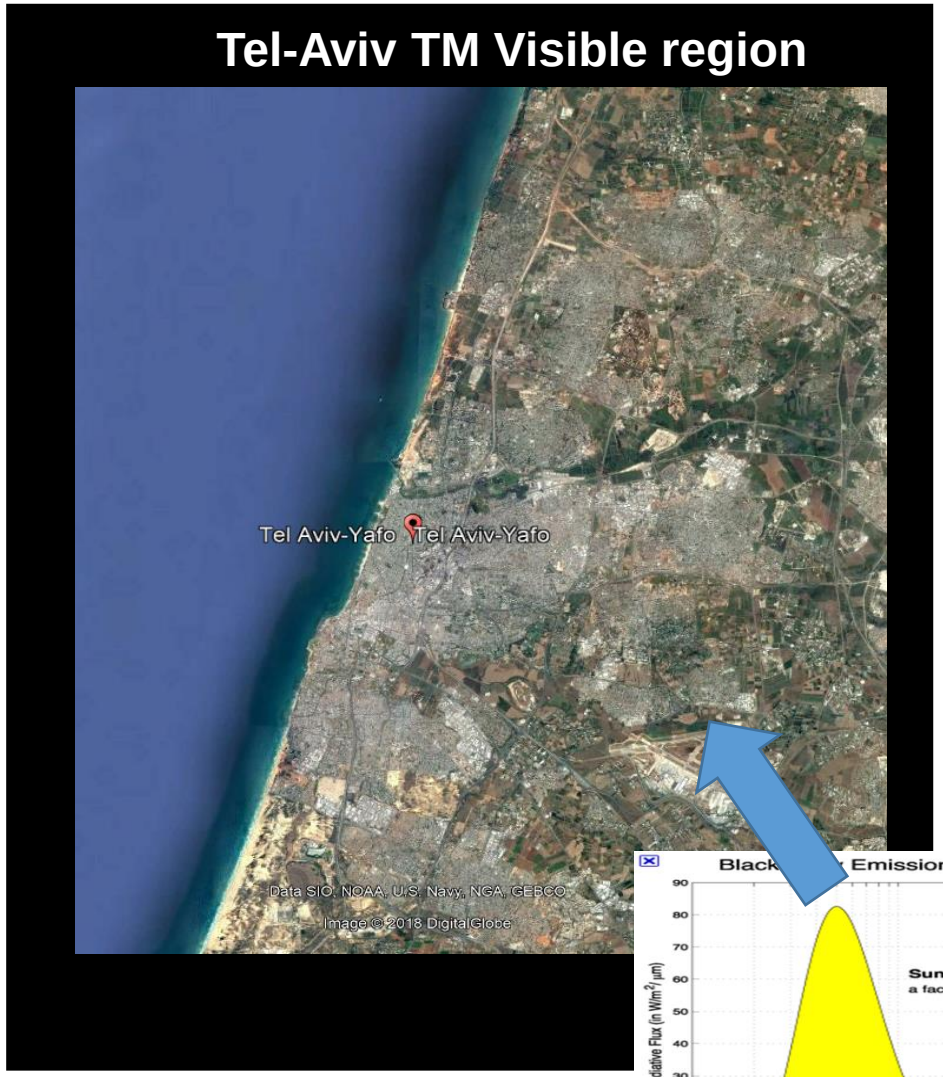
Left: **Relative sea level rate** from tide gauge (triangles) and **Absolute sea level rate** from altimetry (background).

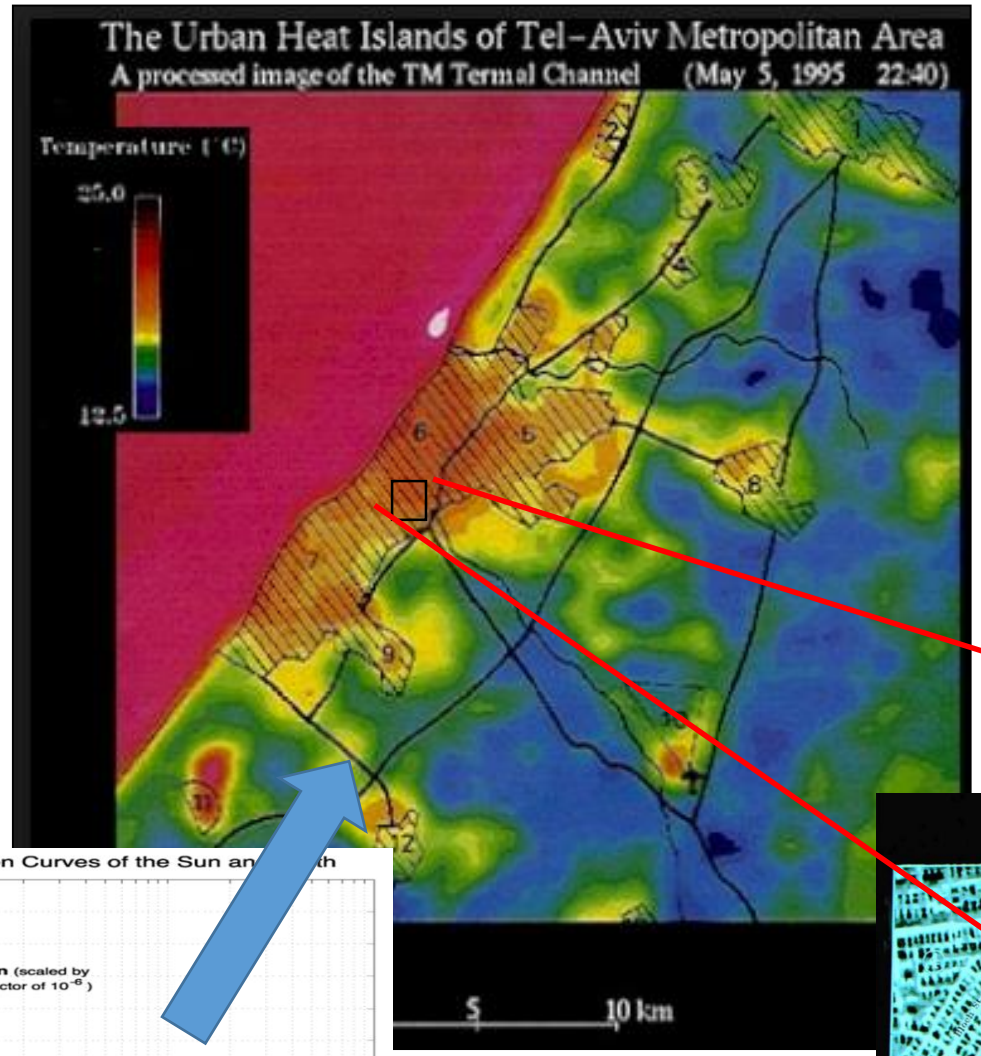
Right: in Trieste; Time series of relative sea level (red) and absolute sea level (blu) and their difference (green)

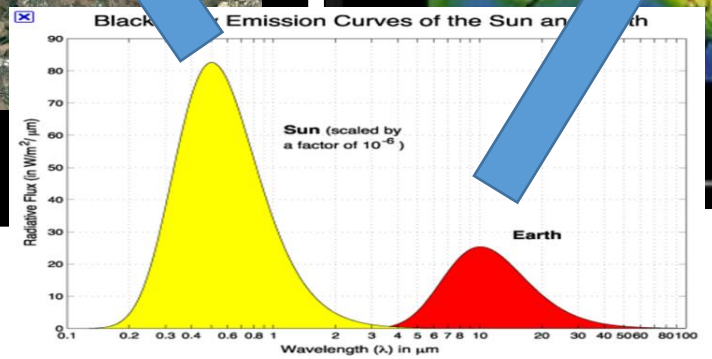
sea level and mass budget

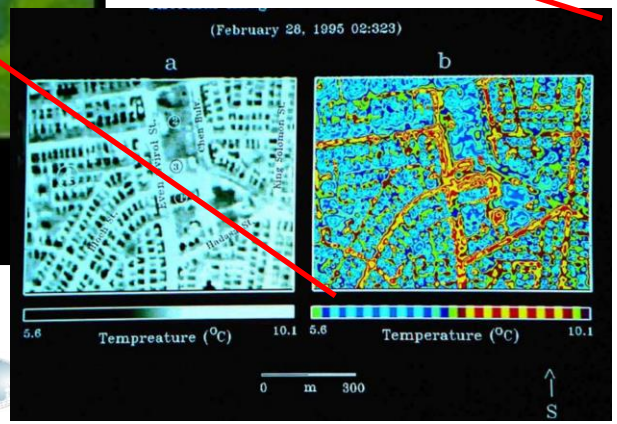
- Satellite observations are an unique tool for estimating sea level far from the from the coast and where tide gauges are missing. Together with GPS, they provide sea level change relative to coast.Together with tide gauges they give Vertical Land Motion. However, careful data processing is needed by merging multi-mission altimetry and by including new SAR altimeter products to achieve high resolution close to the coast.
- In the Mediterranean Sea satellite observations have been essential for identifying the dominant role of mass balance on sea level and allow the separation of steric and mass components.
- It is important to ensure continue monitoring in the future , with application to mass budget and exchanges across the straits

satellite platforms for urban climate monitoring





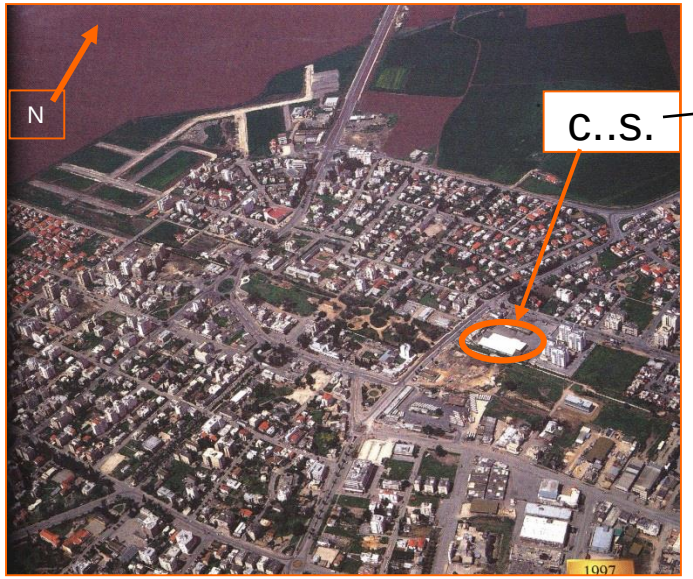


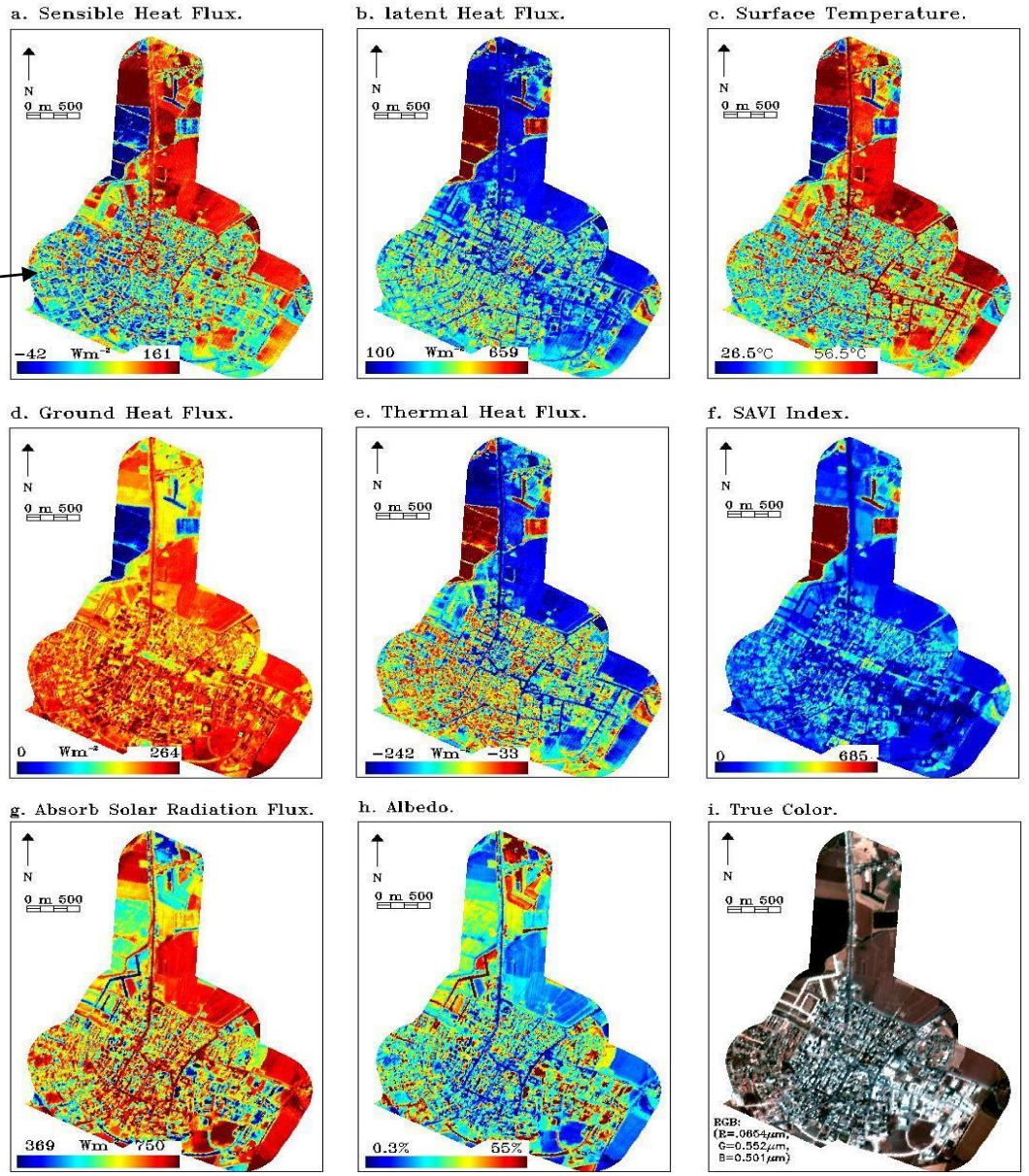


Satellite View over Tel Aviv to detect the Urban Heat Island – *Ben-Dor, E., and H. Saaroni. International Journal of Remote Sensing (1997)*

satellite platforms for urban climate monitoring

Urban Heat Island (thermal factors)





Example for heat fluxes using hyperspectral sensors DAIS 7915 , city of Afula Israel

MedCLIVAR

THE REMOTE SENSING LABORATORIES

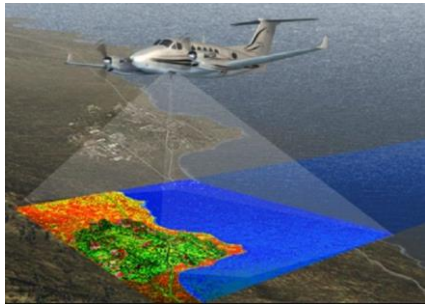
Prof E. Ben Dor

satellite platforms for urban climate monitoring

Satellite MULTISPECTRAL power: (available today)
Land cover land use: built up, vegetation, asphalt, change detection, water
Temperature (with TIR channel) : Radiant

Airborne HYPERSPECTRAL power: (available today)
Land cover land use: Abundances of built up, vegetation, asphalt, change detection, water
Temperature (with TIR channels) : Radiant and kinetic, emissivity detection , heat fluxes.
Gases: CH4, SO2, aerosols load, water vapor, oxygen, co2

Satellite HYPERSPECTRAL power: same as the Airborne Hyperspectral but available in the future



satellite platforms for urban climate monitoring

- Several studies show how to monitor the urban energy balance using satellite data
- It is important to achieve resolution sufficient to resolve the details of the urban structure and describe surface-atmosphere fluxes
- The challenge is to achieve with future satellite missions the high spatial and hyperspectral resolution that is now achieved with airborne instrumentation

Needs for improvement of fast floods forecasting

Forecast

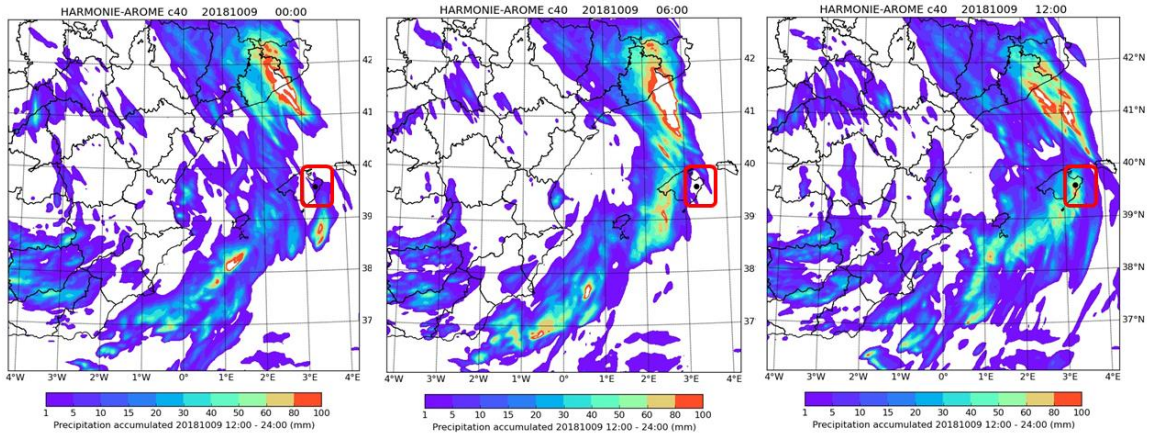
Mallorca October 9th, 2018

Impact

HARMONIE-AROME (Aemet) 2.5 km BASE TIME: 09/10/2018

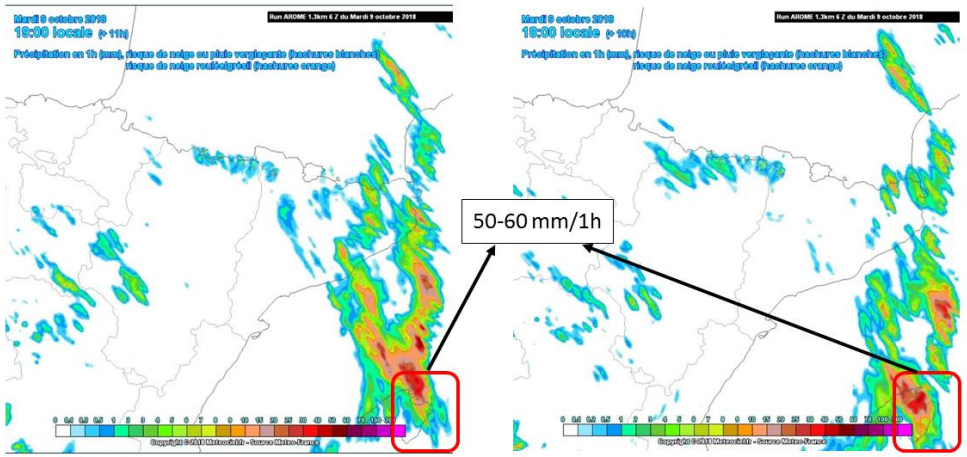
12 h precipitation forecast

RUNS: 00 UTC 06 UTC 12 UTC

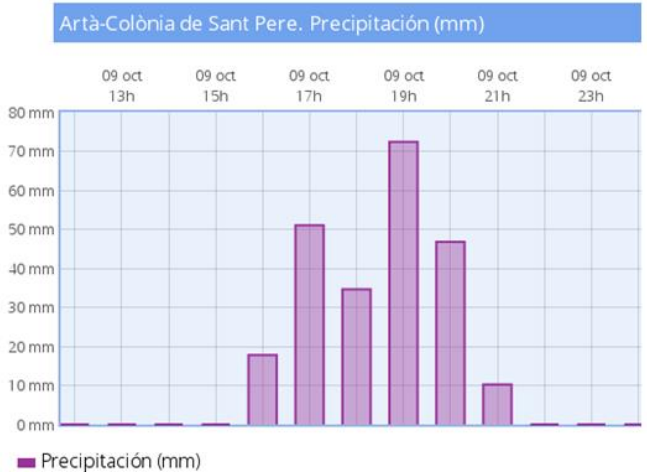


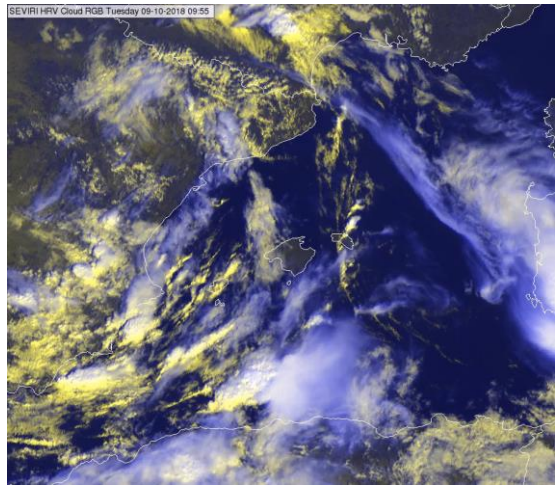
AROME (Meteo-France) 1.3 km BASE TIME: 09/10/2018

Precipitation (mm) in 1h:



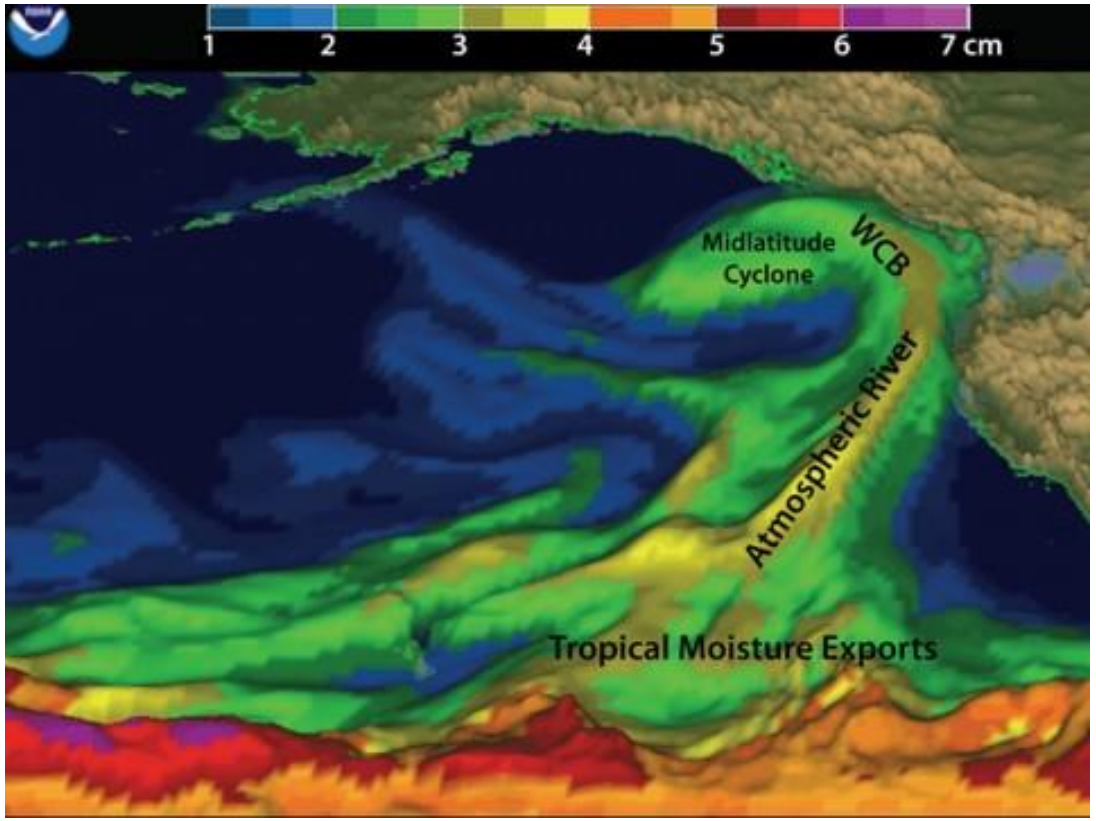
Precipitation over 12 h





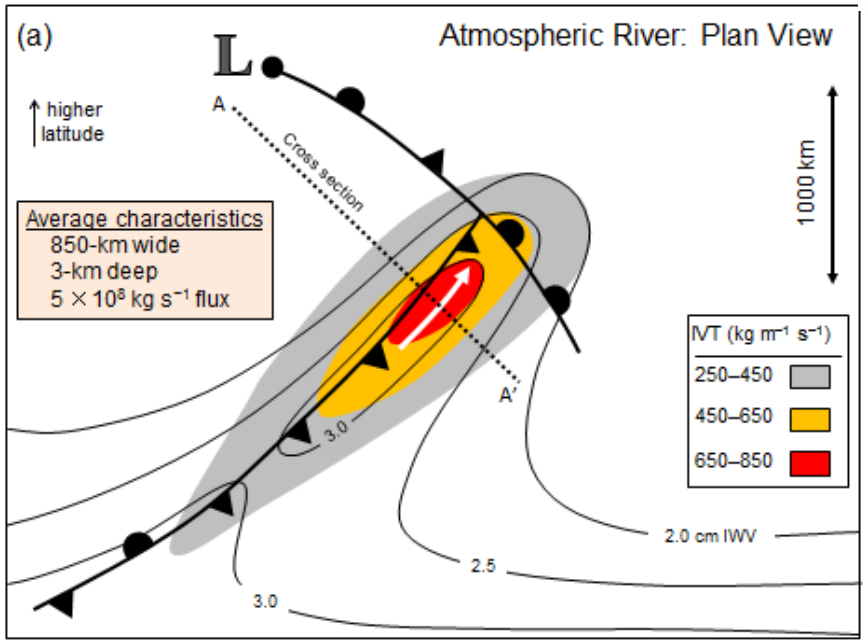
The forecast clearly missed the peak intensity of the event

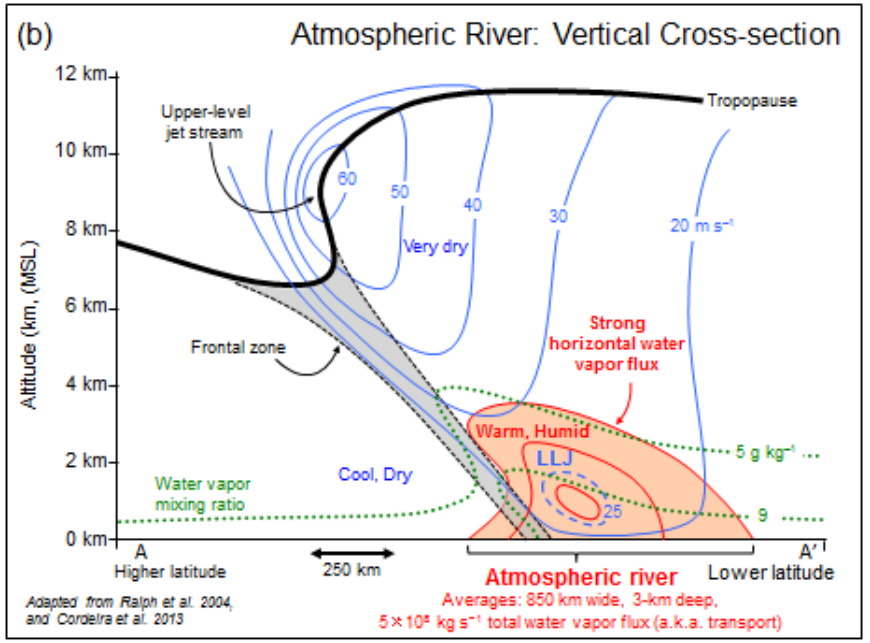
Atmospheric river detection



A long (~2000km), narrow (~850km), and transient corridor of strong horizontal water vapor transport that is typically associated with a low-level jet stream ahead of the cold front of an extratropical cyclone. The water vapor in atmospheric rivers is supplied by tropical and/or extratropical moisture sources. **Atmospheric rivers frequently lead to heavy precipitation where they are forced upward—for example, by mountains or by ascent in the warm conveyor belt.**

AMS, Glossary





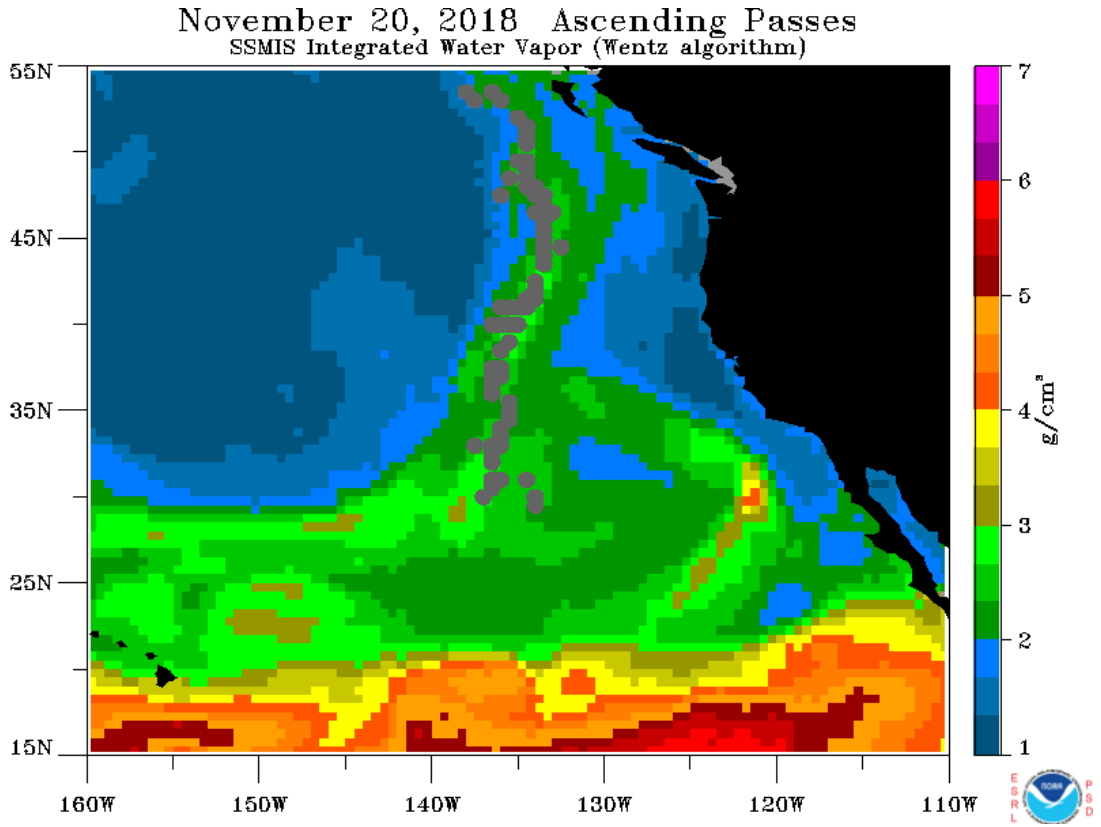
2018

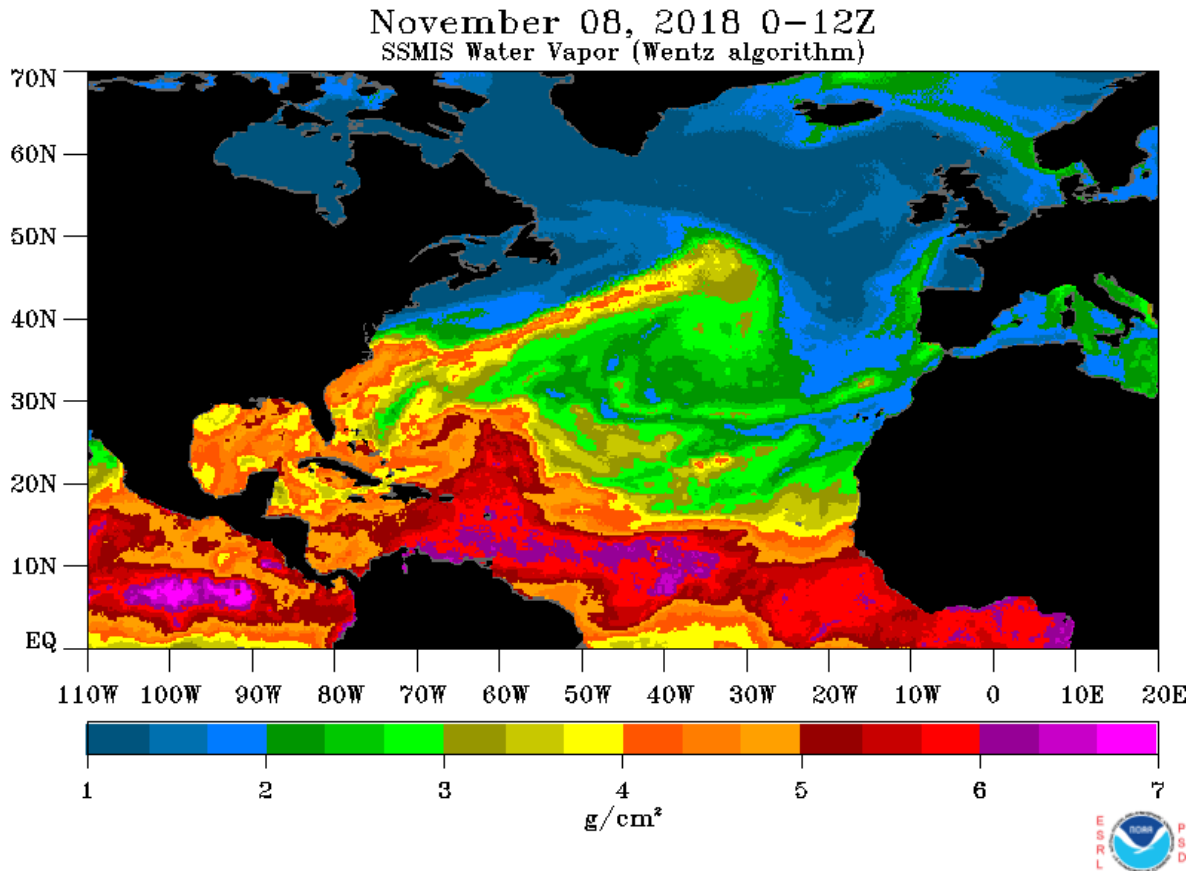
Atmospheric river detection

Due to the amount of moisture transport, Atmospheric Rivers, play an important role in the global hydrological cycle as well as to regional water resources causing important socio-economic impacts (floods, droughts, rain-on-snow, etc).

Satellite images important for studying past events but also for forecast purposes

Automated Atmospheric River Detection: Real-time Application to Satellite-Derived IWV Data



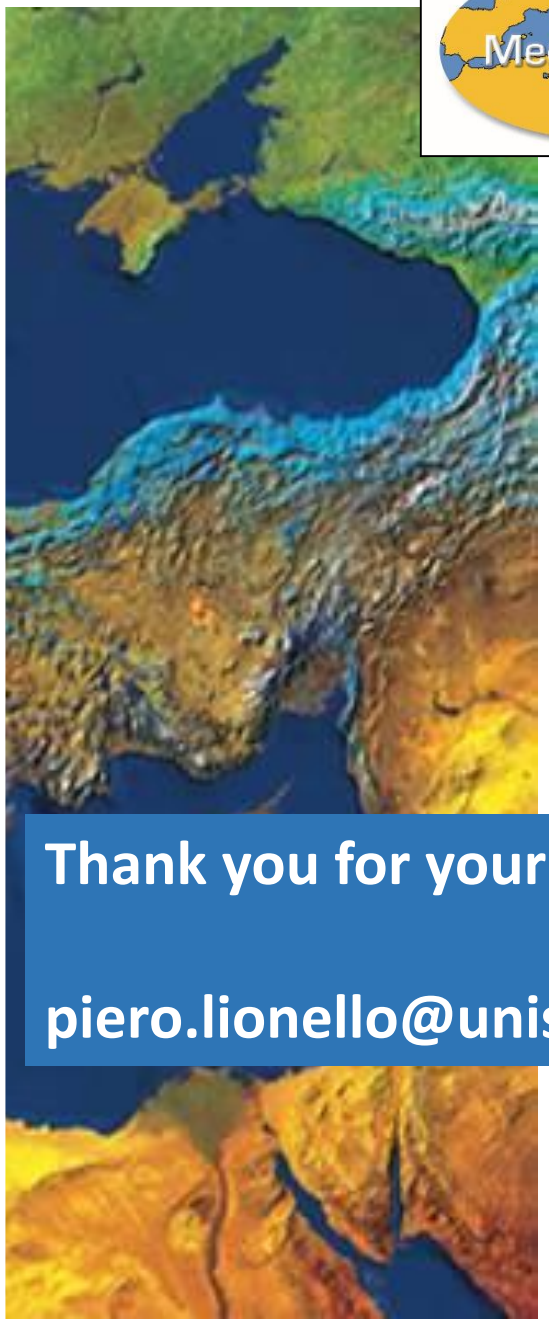


- Satellite observation are an unique tool for estimating precipitation over sea. However, new satellite products that can reduce the present large uncertainty of the value of precipitation over the sea are needed.
- Satellite observation are an essential tool for estimating sea level far from the coast and where tide gauges are missing. In the Mediterranean Sea they have been essential for identifying the dominant role of mass balance on sea level. It is important to ensure continue monitoring in the future and reaching higher resolution near the coast
- Several studies show how to monitor the urban energy balance using satellite data. It is important to achieve resolution sufficient to resolve the details of the urban structure. The challenge is to achieve with future satellite missions the resolution that is now achieved with airborne instrumentation
- Satellite data are a fundamental source of information for operational forecasting and monitoring peculiar features of the atmospheric circulation

MedCLIVAR 2020 Conference

- As satellite time series become longer and observations include progressively more variables with higher precision, remote sensing is becoming an essential component of climate science.
- It is very important to reinforce the link between researchers working on remote sensing and regional climate of the Mediterranean region. All different components (from climatologists to oceanographers) of the MedCLIVAR community would be happy to contribute to achieve this goal
- Could we go for a session on satellite climatology of the Mediterranean Region at Medclivar 2020? … and promote the use of satellite products among North African scientists and stakeholders?

Cadi Ayyad University, October 2020
Marrakesh (Morocco)



Thank you for your attention

piero.lionello@unisalento.it