# Identifying the sensitivity of precipitation of Anatolian Peninsula to Mediterranean and Black Sea surface temperature

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# Outline

- Motivation
- Previous Studies
- Methodology
  - Observational Data
  - Data Analysis Pipeline
  - Short introduction about used statistical techniques
- Results
  - Observational Data

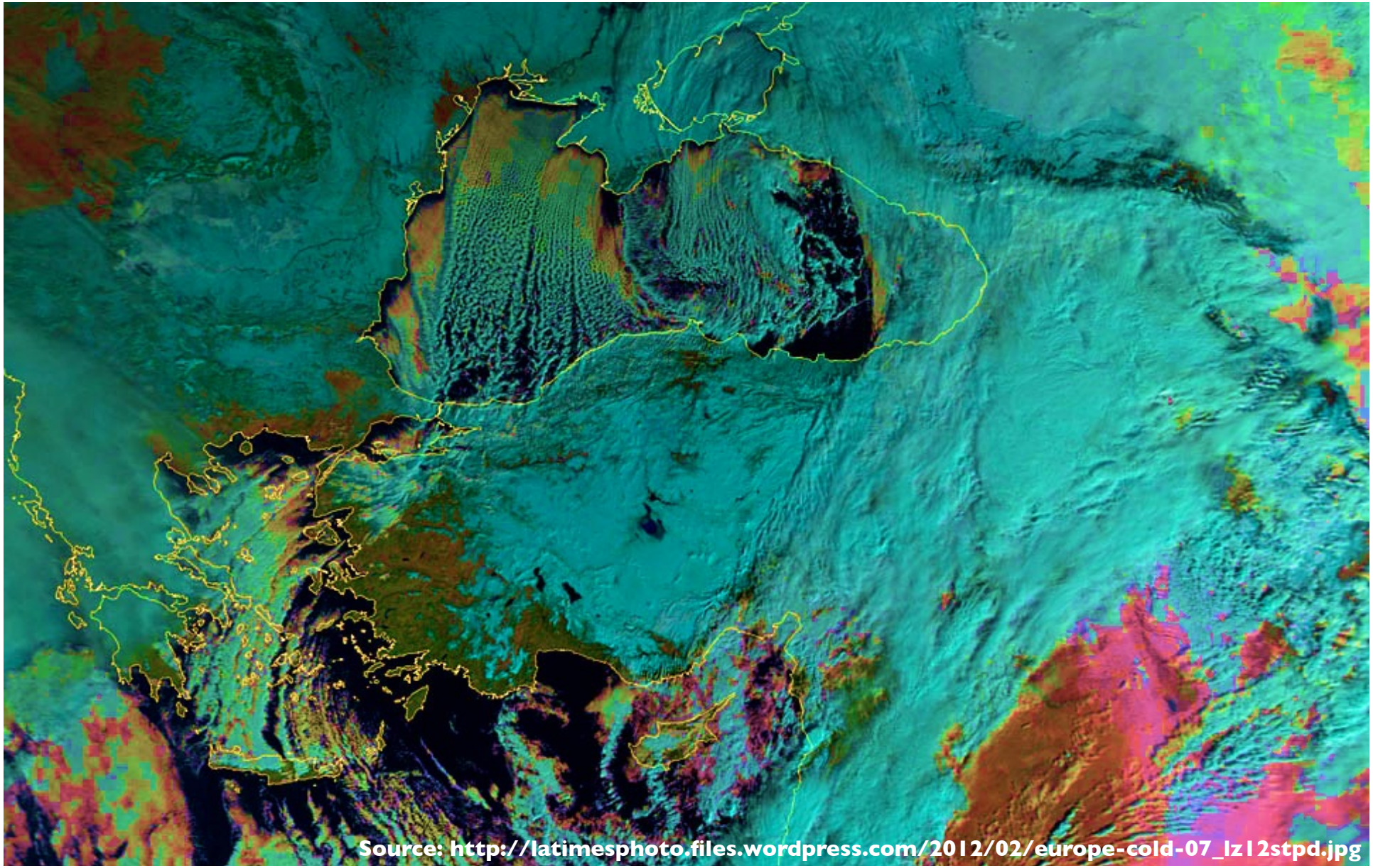
# Motivation

- Extreme precipitation events (floods, sea snow effect) is very important for the cities along the coast of Turkey !



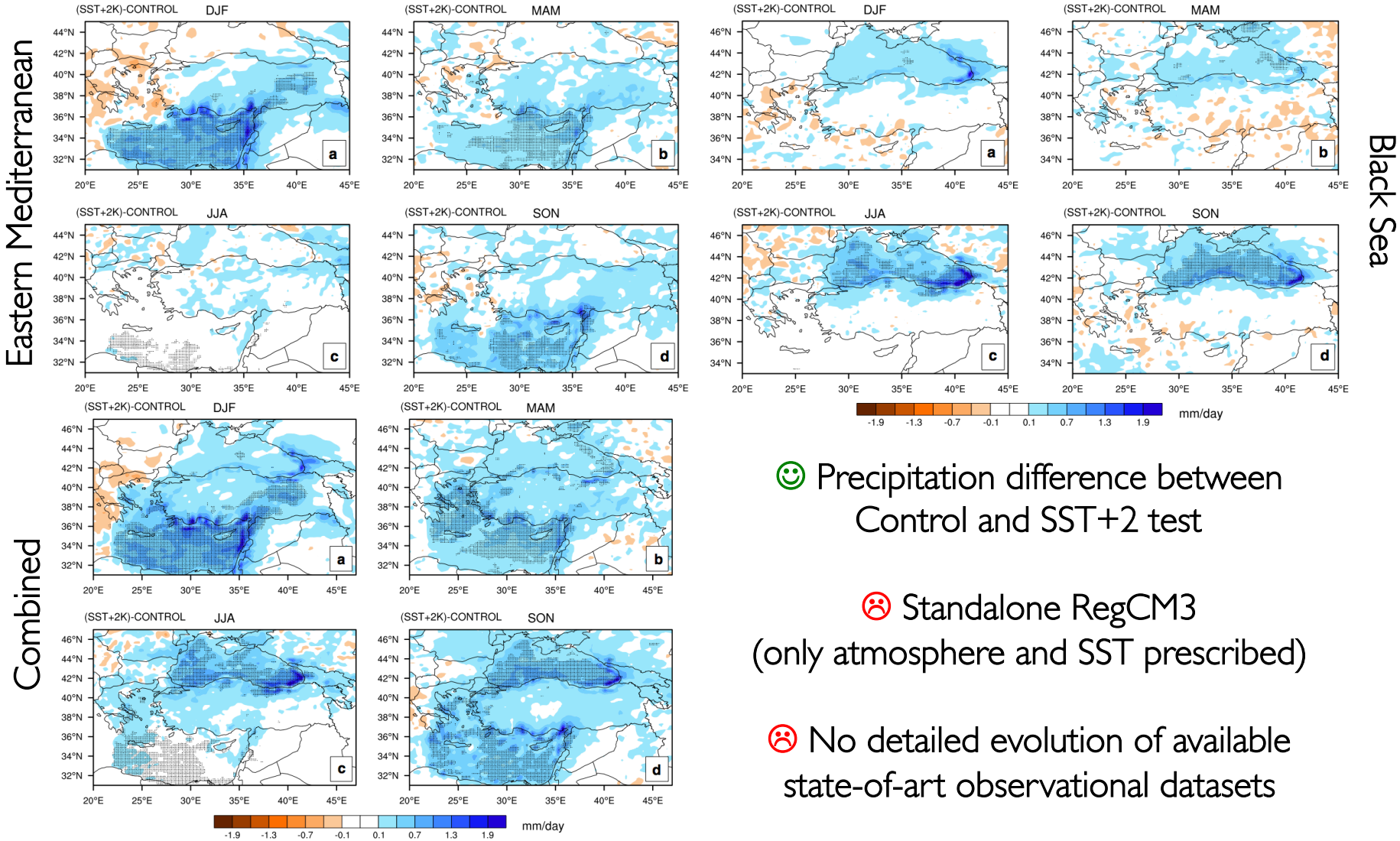

- Investigation of SST-P relationship for Anatolian Peninsula and the mechanism behind it are very crucial to design more robust early-warning tools.

A satellite image made Feb. 1, 2012, provided by Eumetsat, shows the cold air flowing south over the Black Sea and picking up moisture, leading to heavy snowfall in Turkey.



# Previous Studies

- Bozkurt and Sen, 2009, Climate Dynamics




☺ Precipitation difference between Control and SST+2 test

☹ Standalone RegCM3 (only atmosphere and SST prescribed)

☹ No detailed evolution of available state-of-art observational datasets

# Project

- Founding:
  - A research grant (113Y108) provided by The Scientific and Technological Research Council of Turkey (TUBITAK)
  - 2 year project (09/2013-09/2015)
- Aim:
  - Investigate interaction between atmosphere and ocean by focusing Anatolian Peninsula (or Turkey)
  - Evaluate both available observational datasets and modeling systems
    - Develop state-of-art regional earth system model
    - Tune the model for Mediterranean and Black Sea Region
- Total Budget: ~80K (in Euro)
- Team:
  - 2 Researcher
  - 1 PhD student

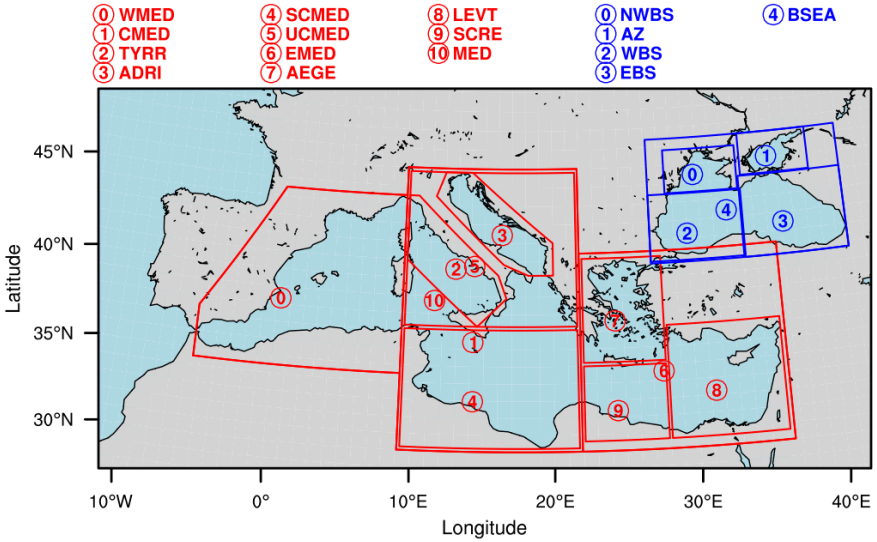
TÜBİTAK

# Observational Data

- Various daily SST and P dataset are used
  - SST (2)
    - AVHRR/OI-SST (0.25 deg., 1982-ongoing)
    - ERA-Interim Reanalysis (1.5 deg., 1979-ongoing)
  - Precipitation (5)
    - TRMM (0.25 deg., 1998-2013) – satellite based, also covers over sea
    - GPCP (1.0 deg., 1997-2012) – satellite based, also covers over sea
    - EOBS (0.5 deg., 1950-2012) – station based, only land
    - ERA-Interim (1.5 deg., 1979-ongoing)
    - TSMS Station Observations (point, 1979-2012)
- Different datasets are required to see the effect of uncertainty in the results
- A common time window for all datasets is selected to analyze the SST-P relationship (1982-2012)

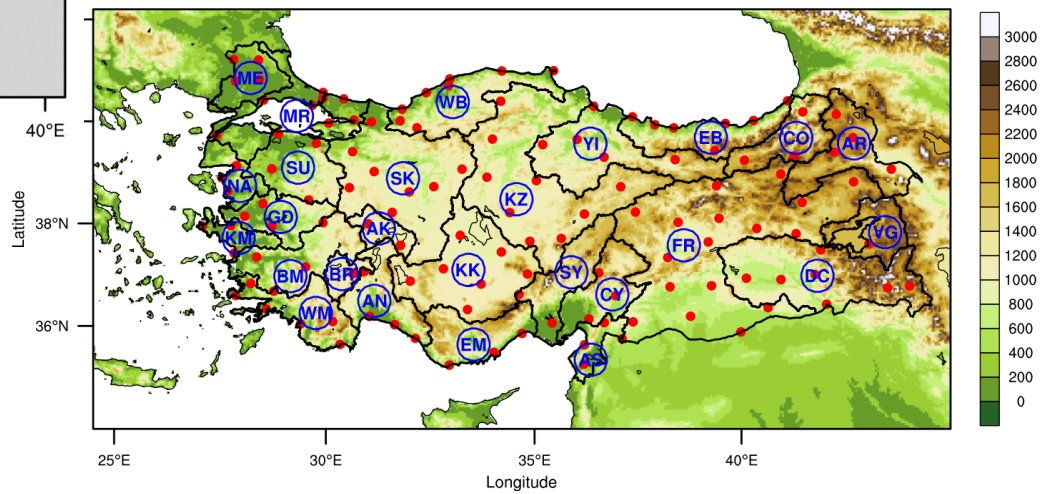
# Methodology …

- Calculate lead-lag correlation between SST and P
  1. SST and P over sea
  2. SST of the neighboring seas and P over land areas of Anatolian Peninsula



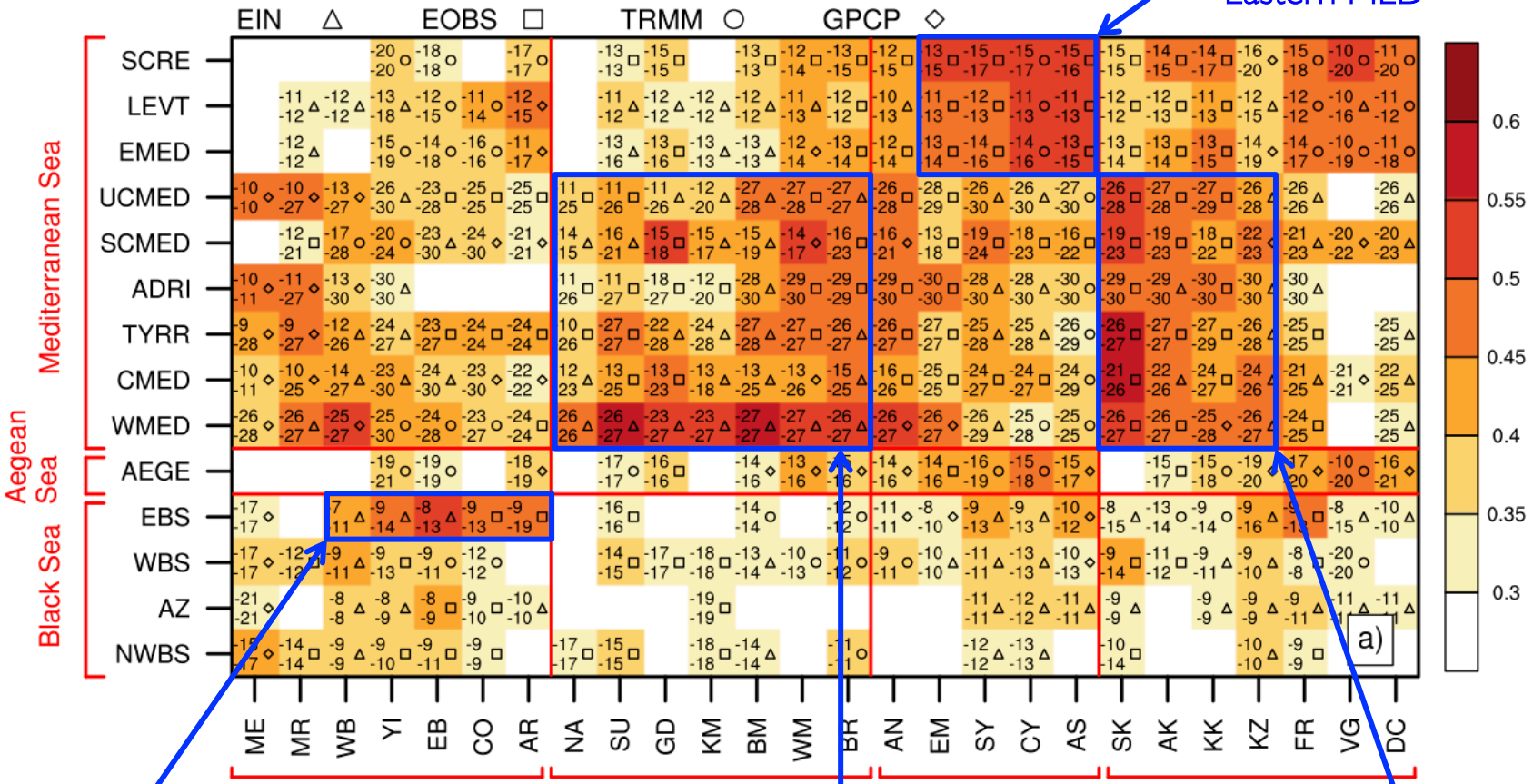

Selected sub-regions over seas:
Mediterranean Sea (#9)
Black Sea (#5)

Selected sub-regions over land:
Basins (#26)
Stations (#130)



# SST-P Relationship over land (SON)

Regions with low correlation value (<= 0.3) are masked out.




Basins in the coastline of MED have high correlation with Eastern MED

Black Sea Region has -9/-11 days lag with SST anomaly in Eastern Black Sea

Basins in the Aegean Sea Region have high correlation with SST anomaly in MED sea

Interior regions of Peninsula has correlation with Central MED

# SST-P Relationship over land (SON)

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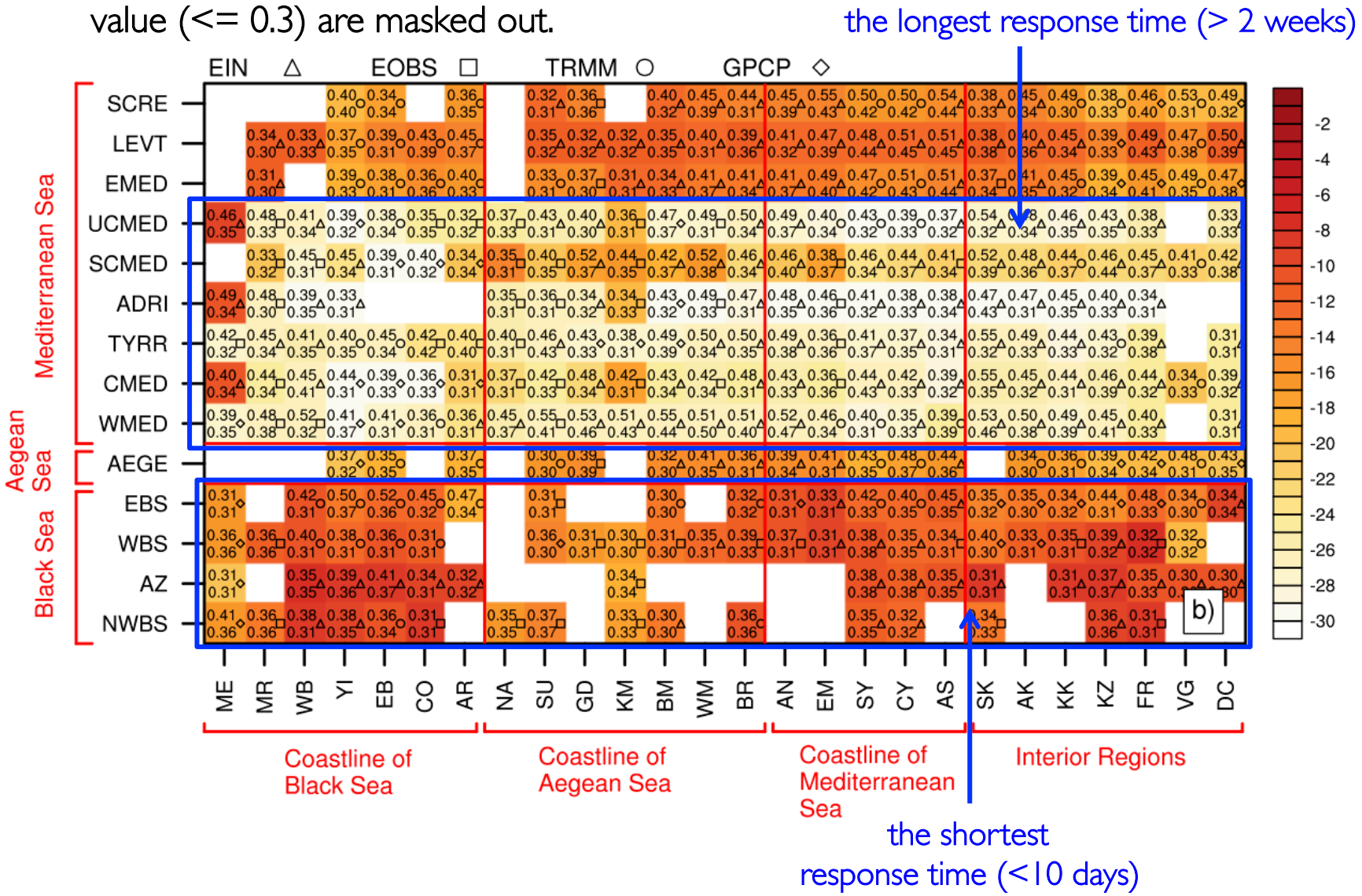

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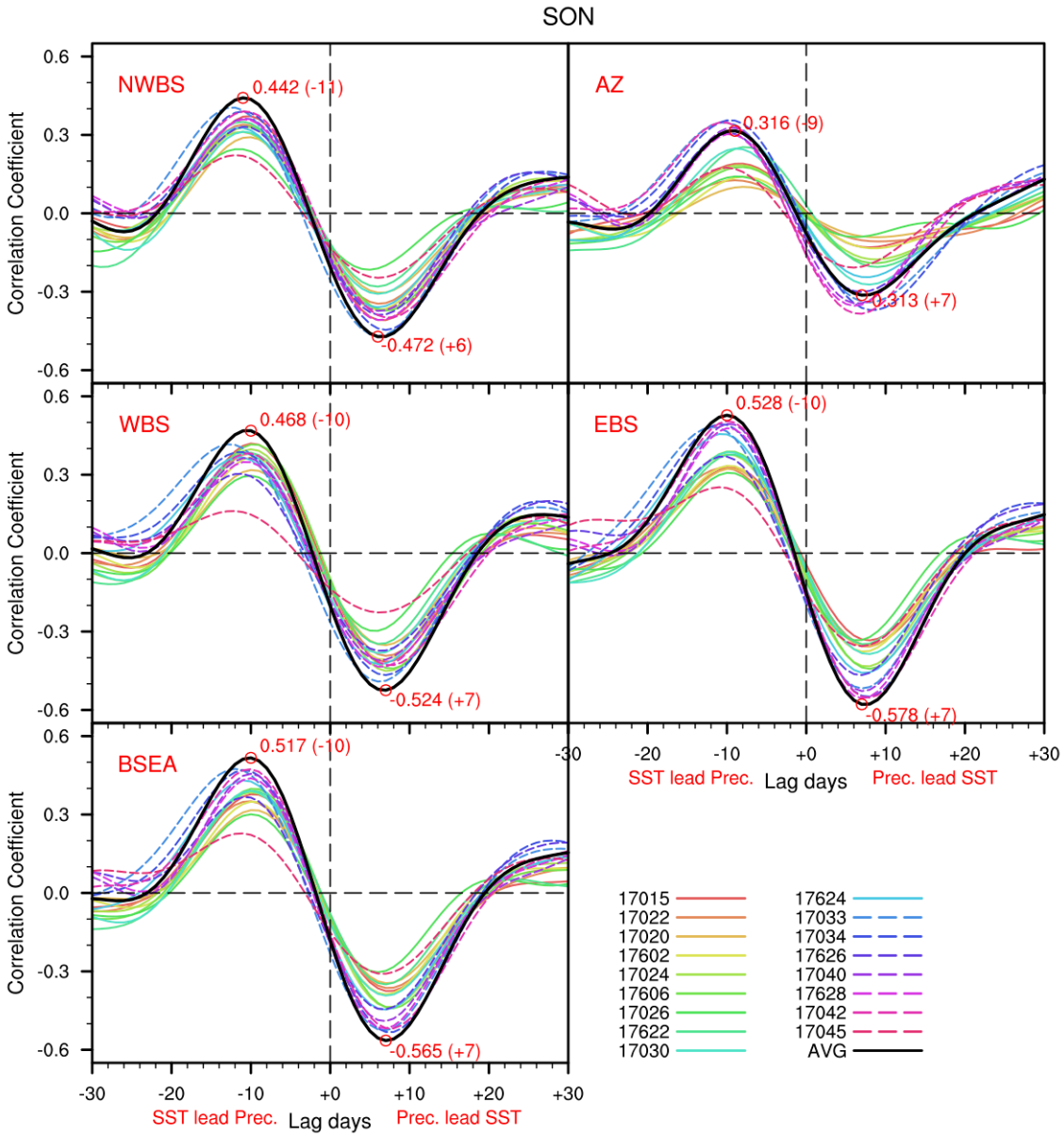



1982-2012

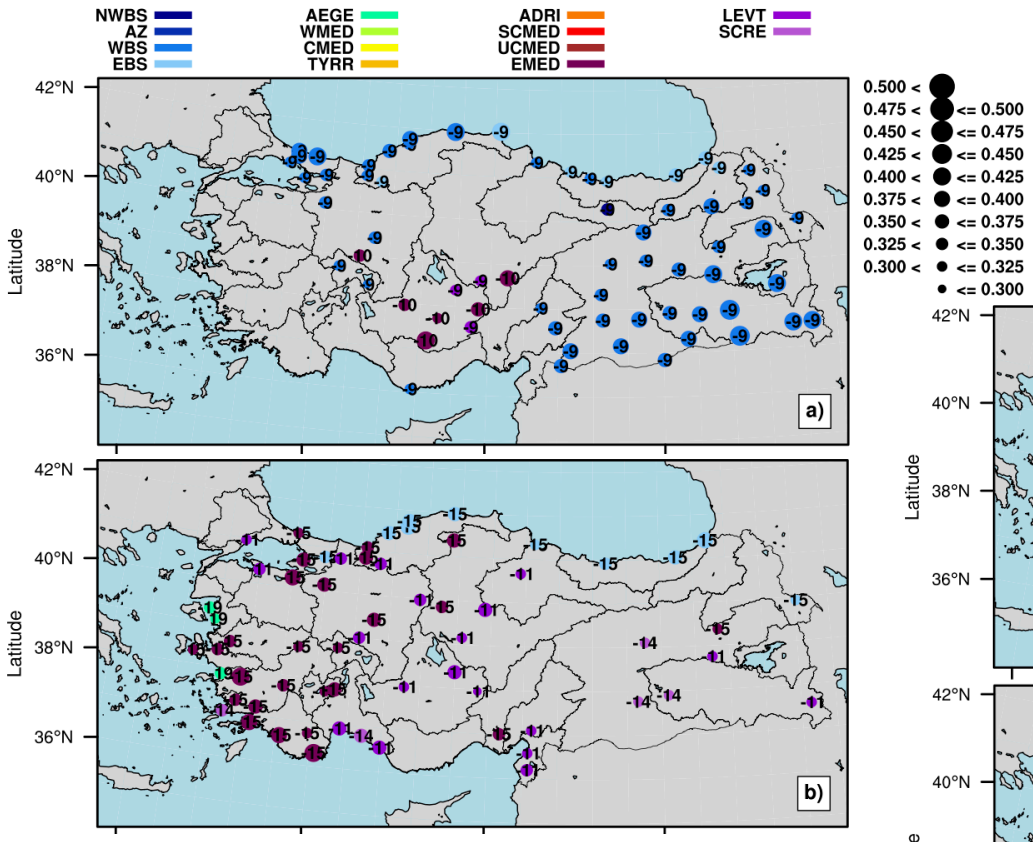
Results of in-situ based observations (P data from TSMS, SST from OI SST)

Black Sea Region (only costal stations)

The solid black line is the multi-station average

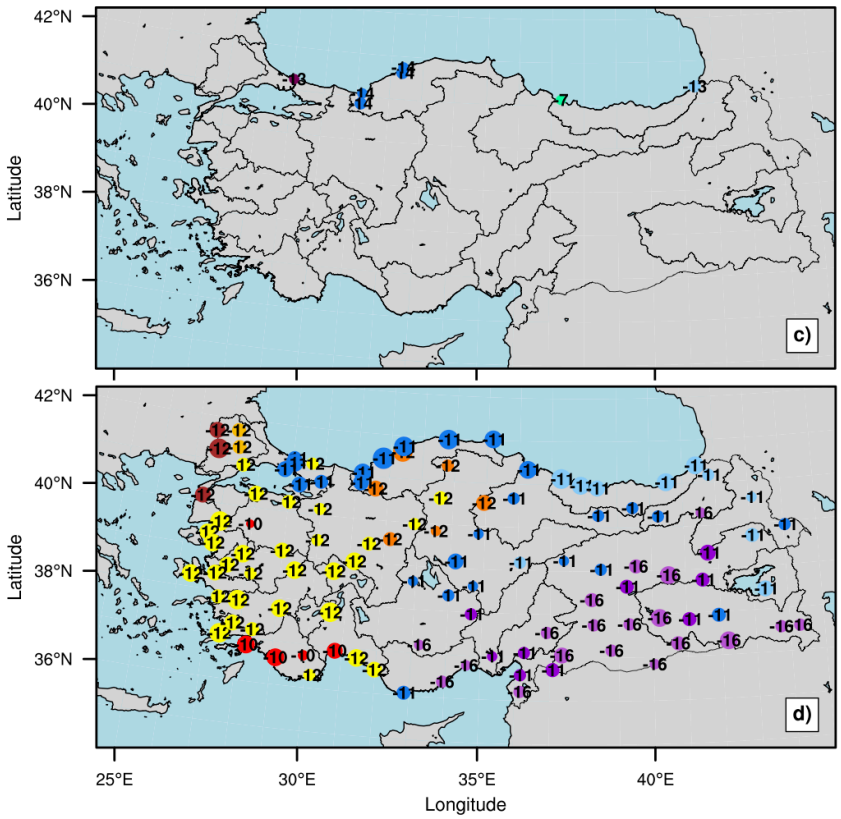
# SST-P Relationship over land

Results of in-situ based observations (P data from TSMS, SST from OI SST)




1982-2012

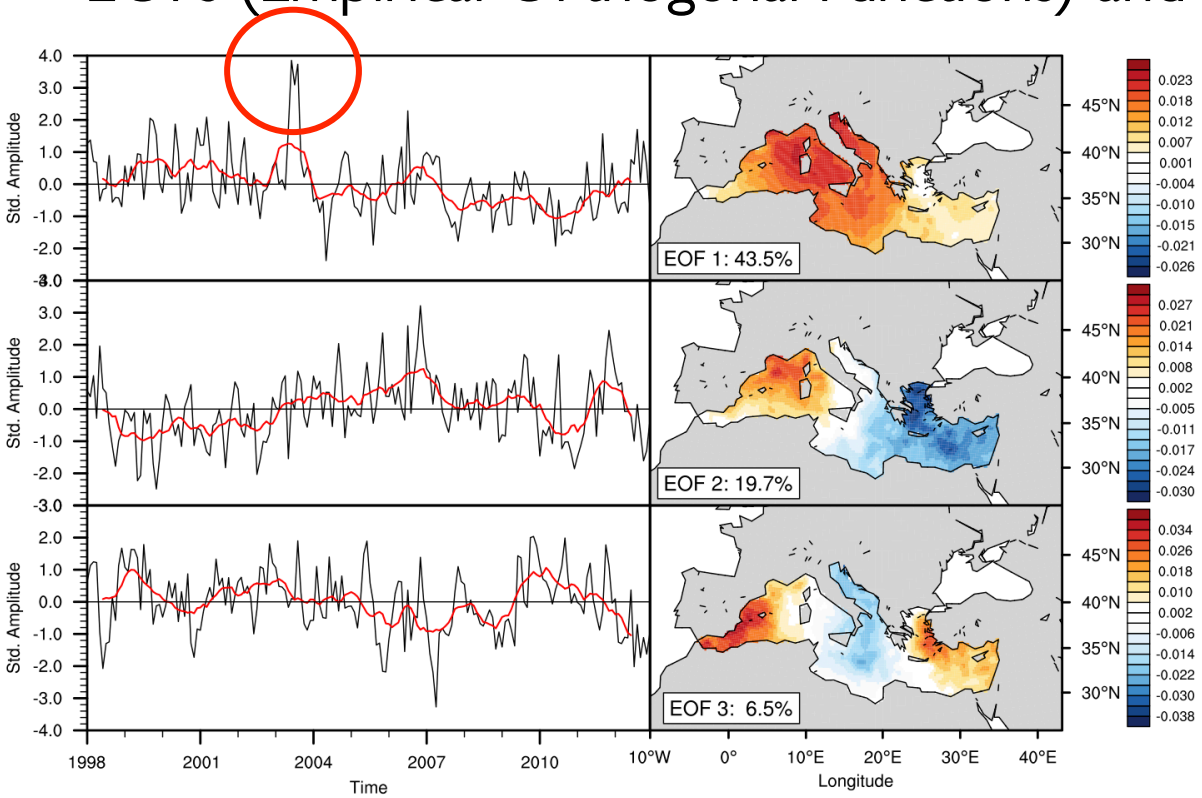
a) DJF, b) MAM, c) JJA, d) SON




What about SST-P relationship over seas?

# Pattern Analysis

- EOFs (Empirical Orthogonal Functions) and associated PCs




SST (OI-SST)

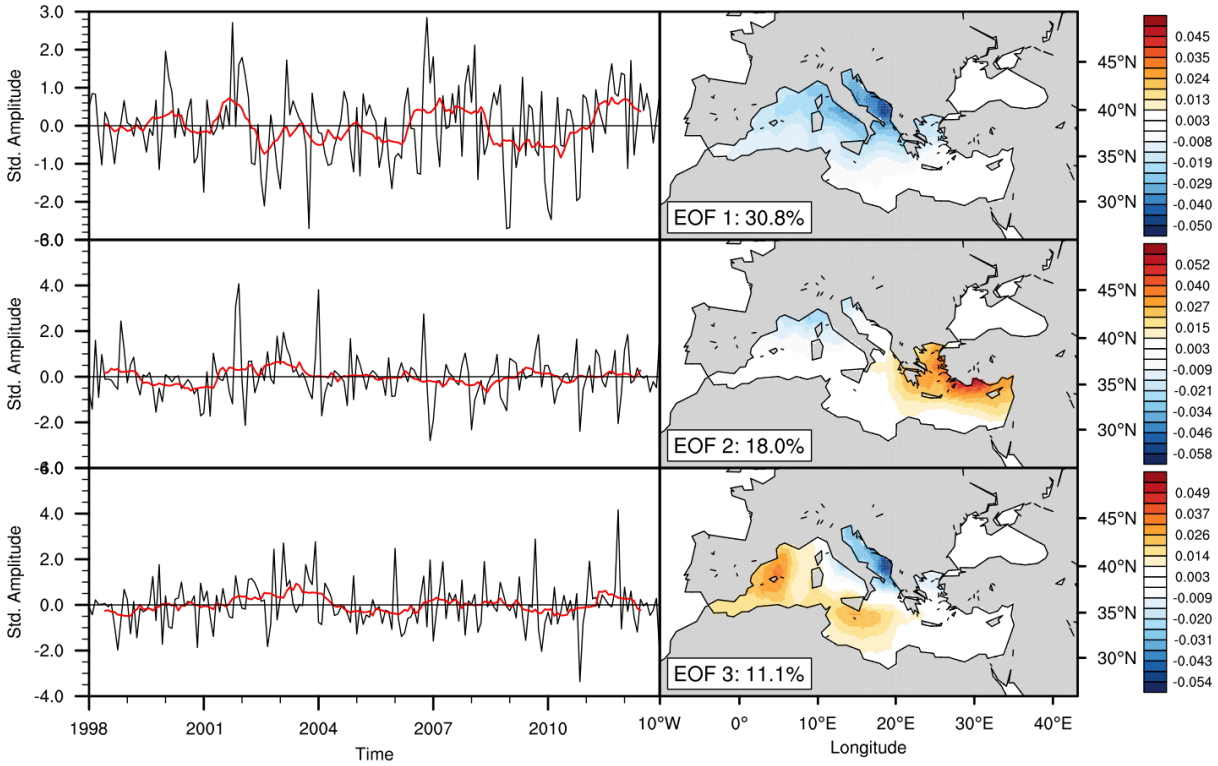
Monthly
De-trended
Anomalies

The signal of European summer heat wave of 2003 that caused abnormal air temperature anomaly over Western Europe can be clearly seen in the first PC time series (top-left panel).

The analyzed SST anomaly of 2003 (> 3.0 °C) shows very similar spatial pattern with the first EOF in summer season.

# Pattern Analysis …

- EOFs (Empirical Orthogonal Functions) and associated PCs



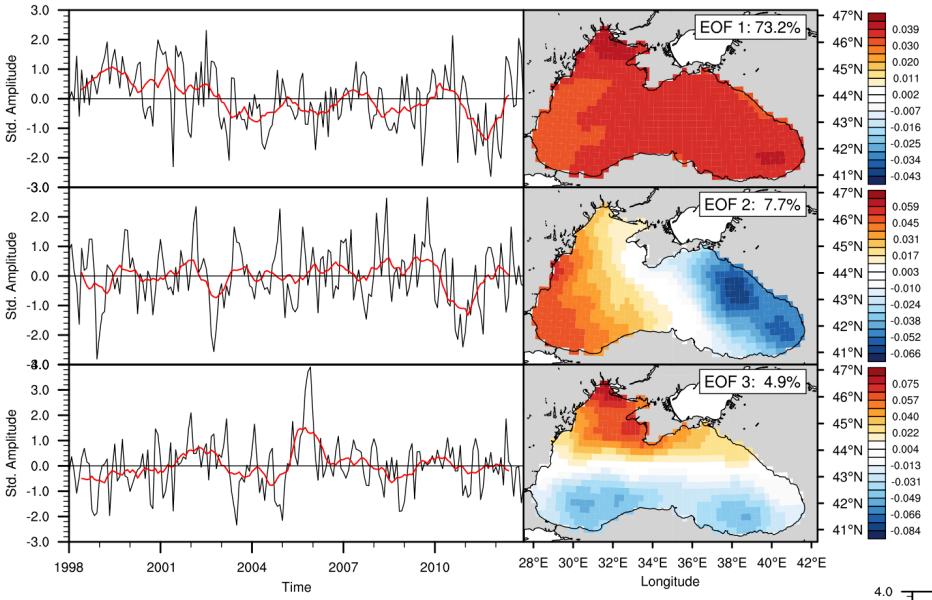

P (GPCP)

The analysis of ERA-Interim dataset shows similar but much more stronger spatial variation for all EOFs along with extended spatial distribution.

This is mainly related with the resolution of the used dataset (1.5 deg for ERA-Interim) and the sensitivity of the analysis to noise.

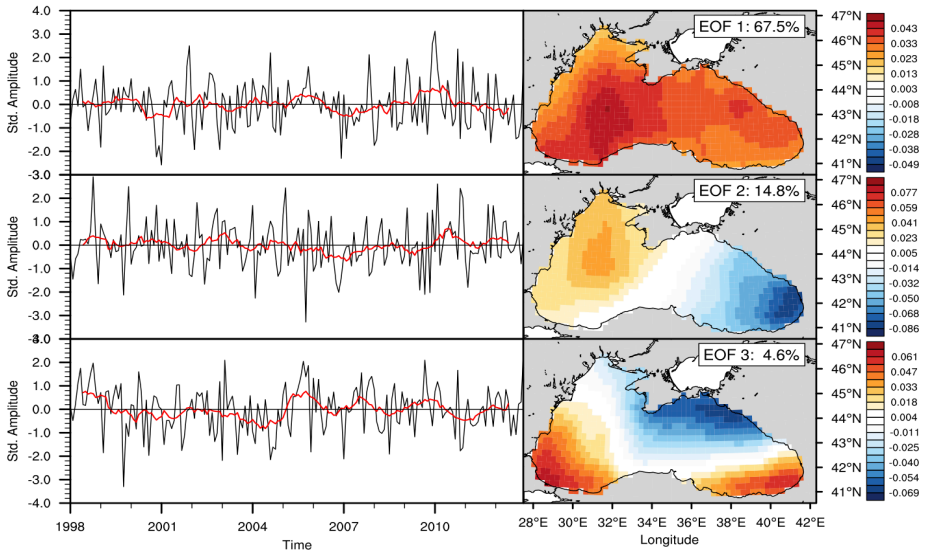
# Pattern Analysis

- EOFs (Empirical Orthogonal Functions) and associated PCs




SST (OI-SST)

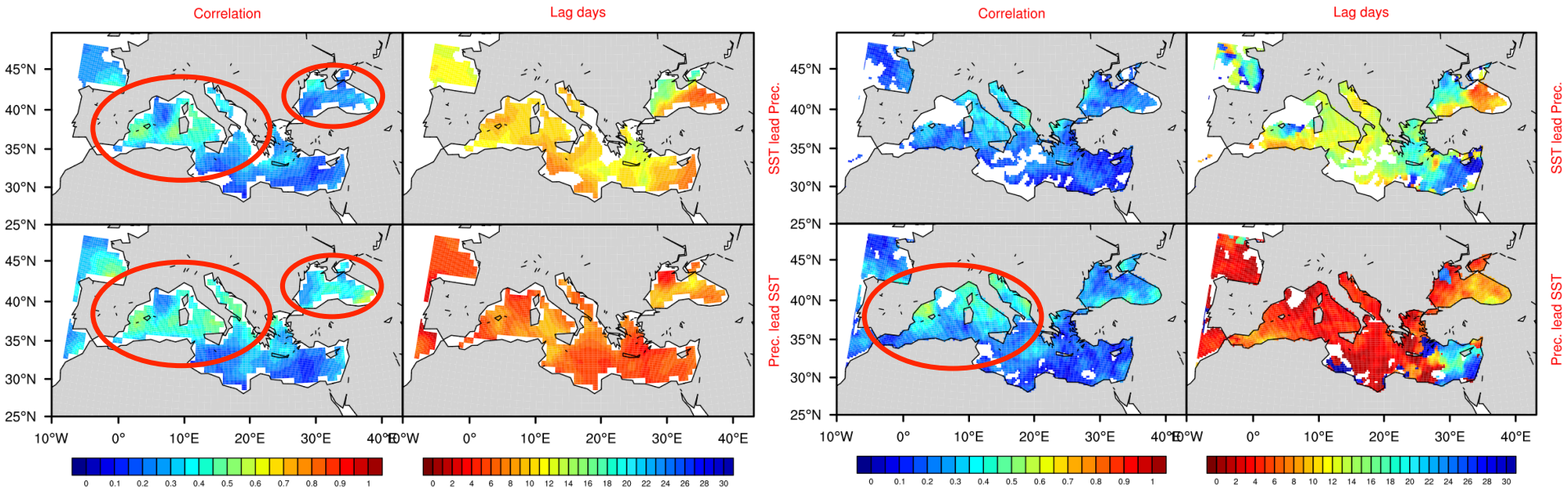
The EOFs calculated from monthly ERA-Interim dataset also indicates same spatial and temporal pattern along with a reduced explained variance.




P (GPCP)

# SST-P Relationship over sea (MAM)

Results of gridded observational products




ERA-Interim GPCP

ERA-Interim dataset shows the higher sensitivity when it is compared with the TRMM and GPCP

SST anomaly and shows a higher positive correlation that peaks at 11-13 days in central and eastern Mediterranean sub-regions and in the Black Sea with 9-11 days lag time.

# Results

- The intra-seasonal SST-P relationship is analyzed using a set of available observational datasets (TRMM, GPCP, ERA-Interim and in-situ measurements)
- Precipitation over the whole peninsula seems sensitive to SSTs of surrounding seas (especially in fall season). This is also consistent with the previous studies (Bozkurt & Sen, 2009)
- Contrary to the results of Bozkurt & Sen, the significant SST-P relationship between SST of the neighboring seas and P over land areas of Anatolian Peninsula (winter and spring)
- The analyzed in-situ observations (#130) also support these findings and consistent with the results of the gridded observational datasets.
- The results belongs to analysis of observational data are submitted to CDYN (in revision).

# Next?

- Plans:
  - Analysis of convective and non-convective part of the precipitation separately
  - Extend analysis by adding other surface variables (flux components) and cloudiness
    - SRB (Surface Radiation Budget)
  - Try to capture same SST-P signal using standalone and also fully coupled regional climate models
    - Compare the results (coupled vs. standalone)
  - Effect of ocean component
    - Test two different ocean component (ROMS + MITgcm)

# Questions!

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