EUMETSAT H SAF

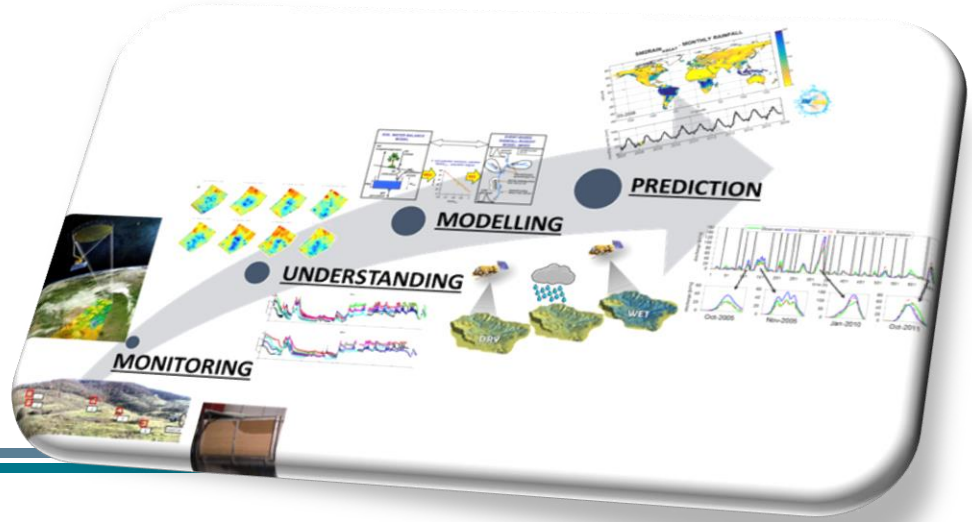
H-SAF PRODUCTS APPLICATION SOIL MOISTURE FOR HYDROLOGICAL RISK MANAGEMENT

Rome, 13-16/11/2018

Drought analysis through H SAF soil moisture products

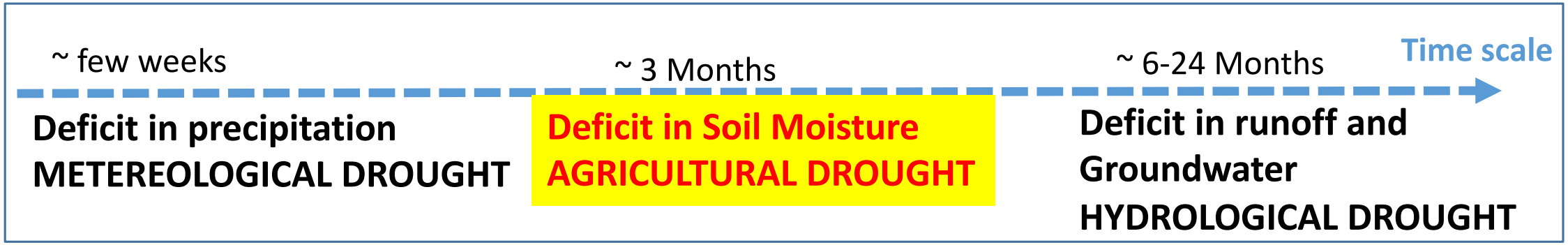
Sara Modanesi

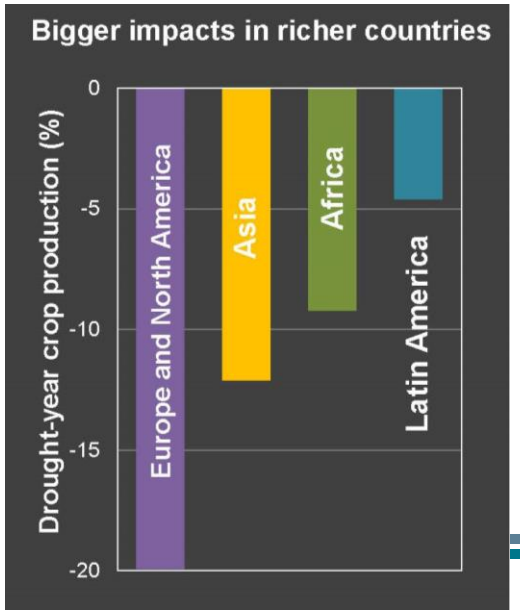
IRPI CNR



What is drought?

“A drought is a period of below-average precipitation in a given region, resulting in prolonged shortages in the water supply, whether atmospheric, surface water or ground water”

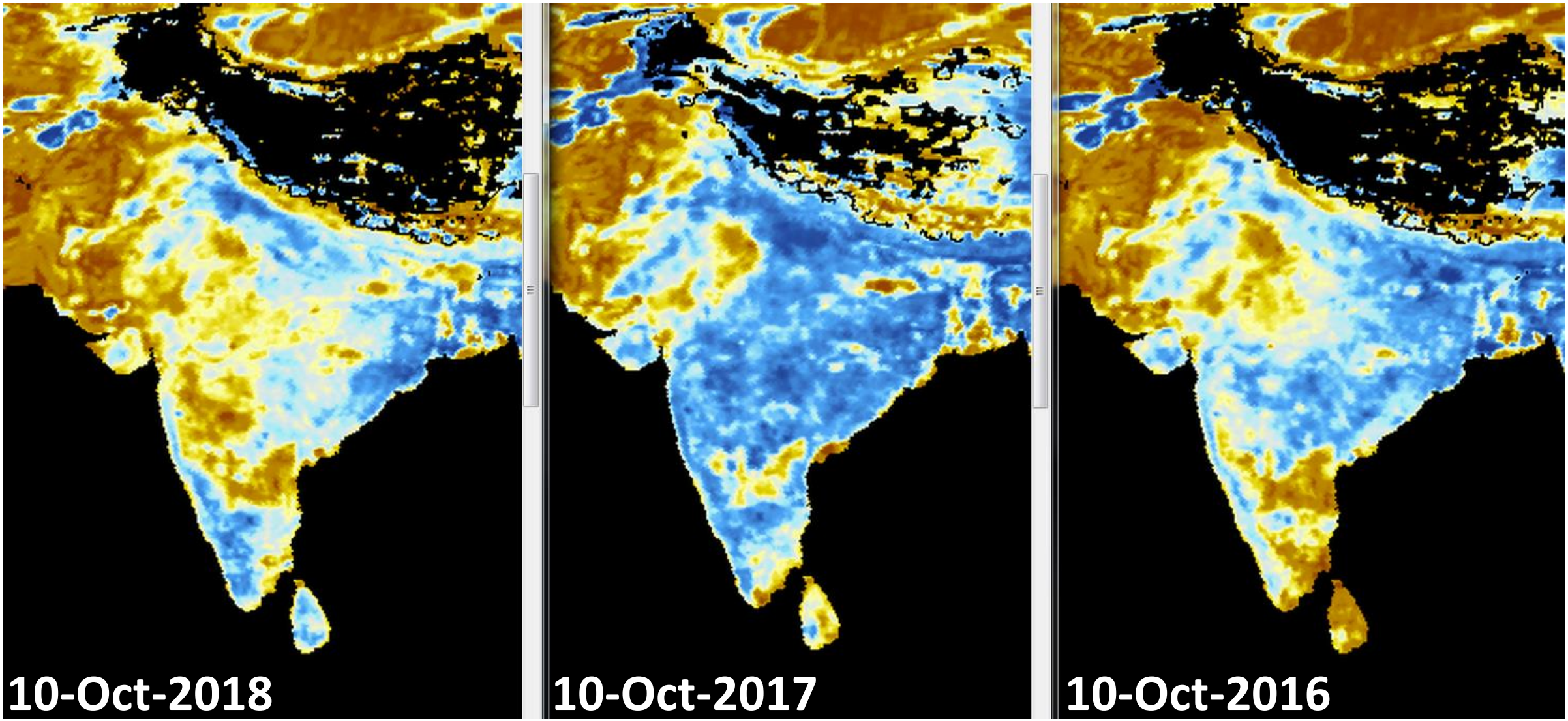




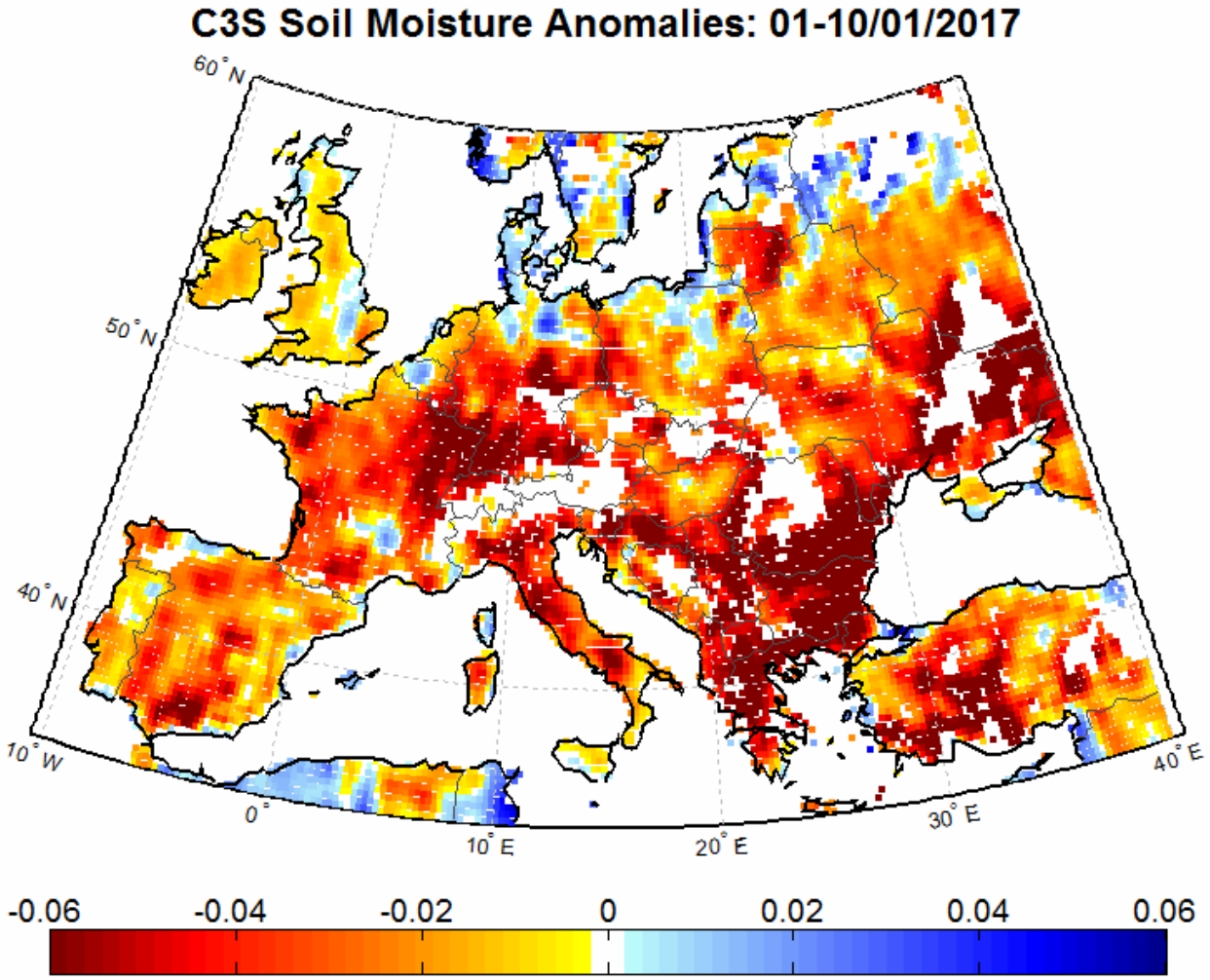
Influences of extremes weather disasters on global crop production (Lesk et al., 2016, Nature)

“3 billion tonnes of lost harvest since 1964 (about three years of global maize harvests)”

Why soil moisture for drought?

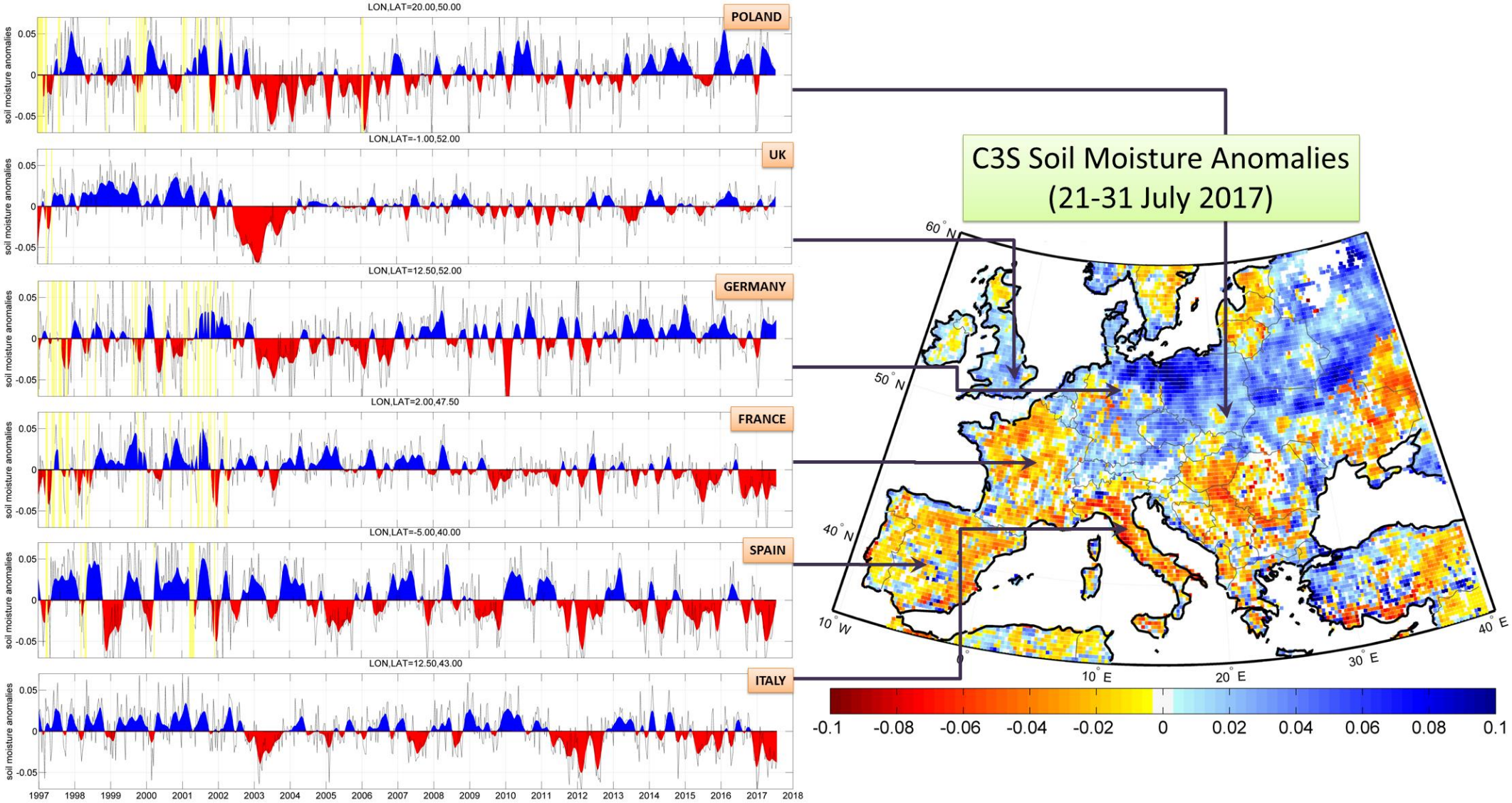


Why soil moisture for drought?



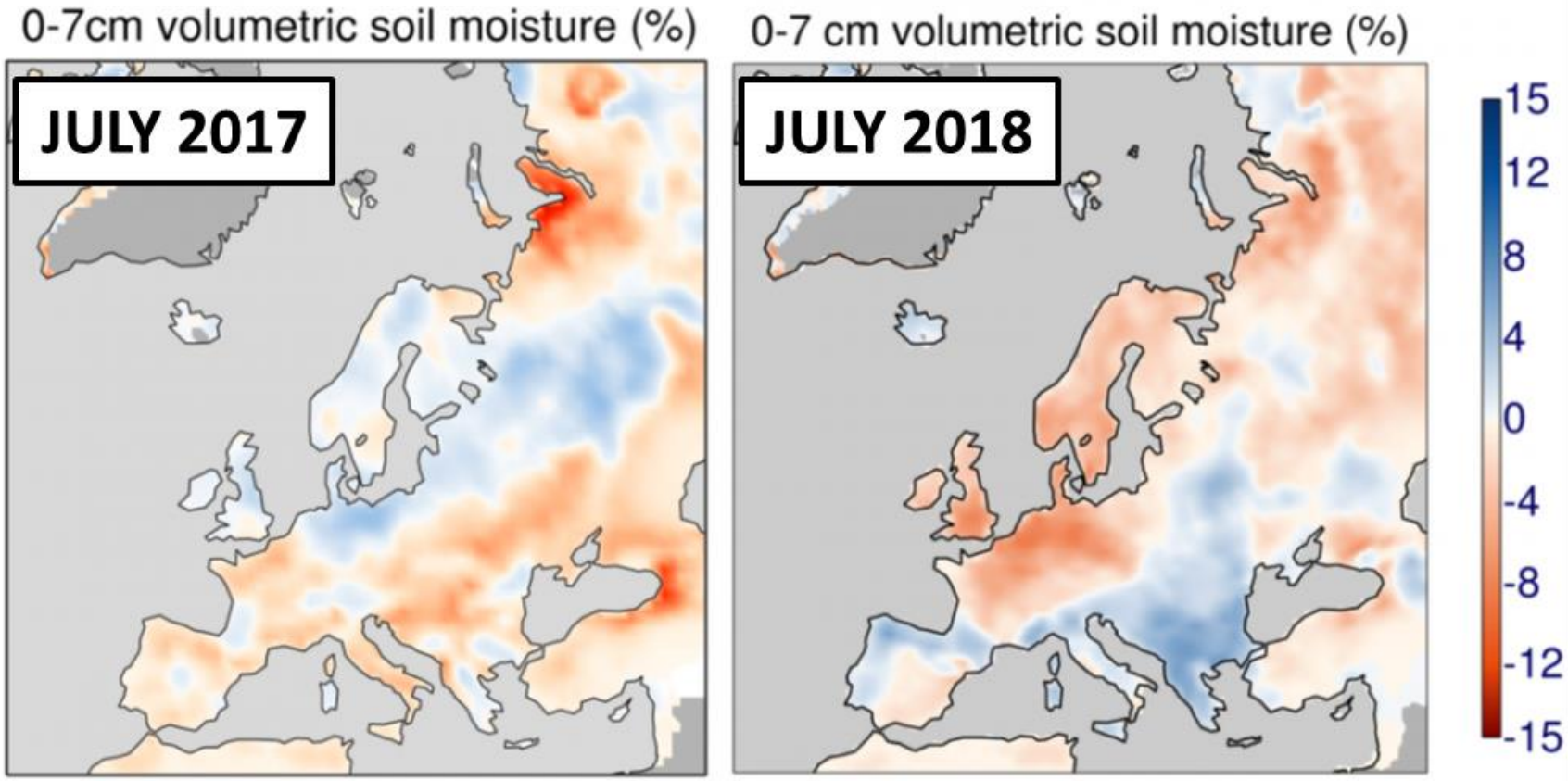
Water scarcity is a current issue in many parts of the world, and particularly in Europe in the recent and current period. Climate changing is expected to exacerbate the problem.

Why soil moisture for drought?



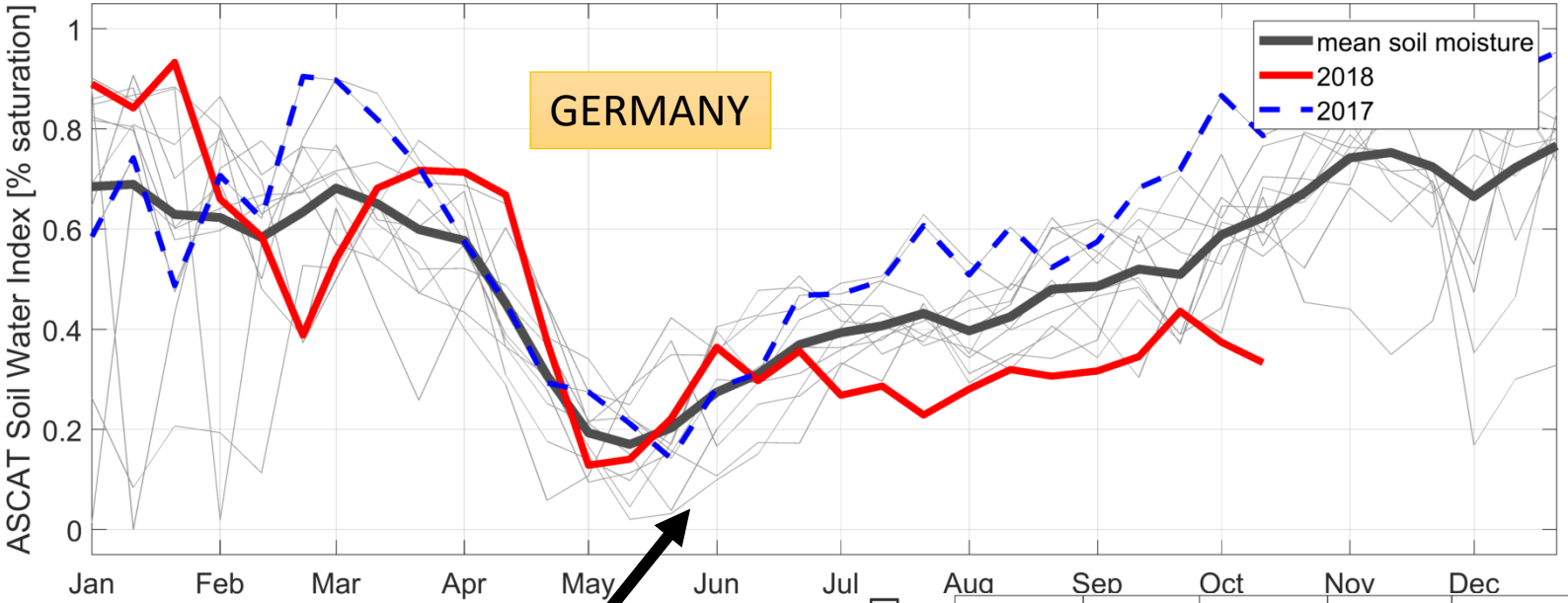
Why soil moisture (model) drought?

Soil moisture anomalies in Europe, Copernicus Climate Service (C3S)

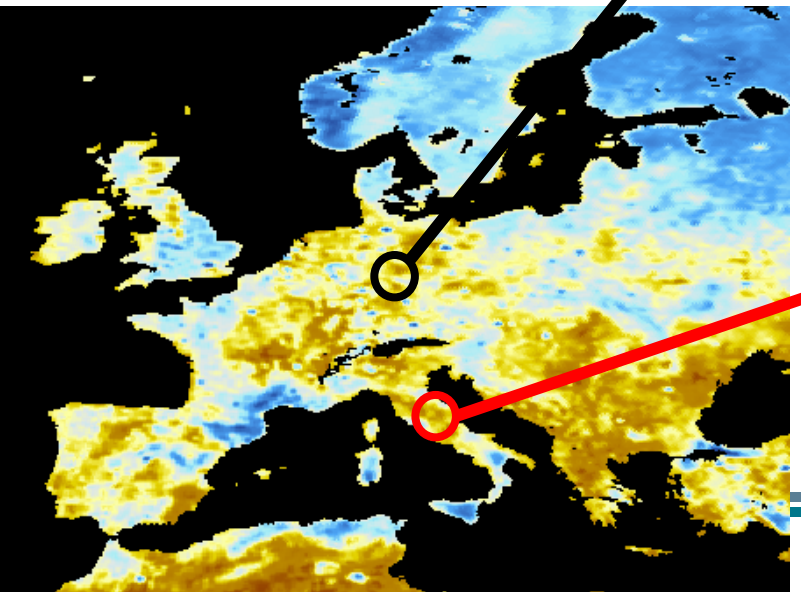


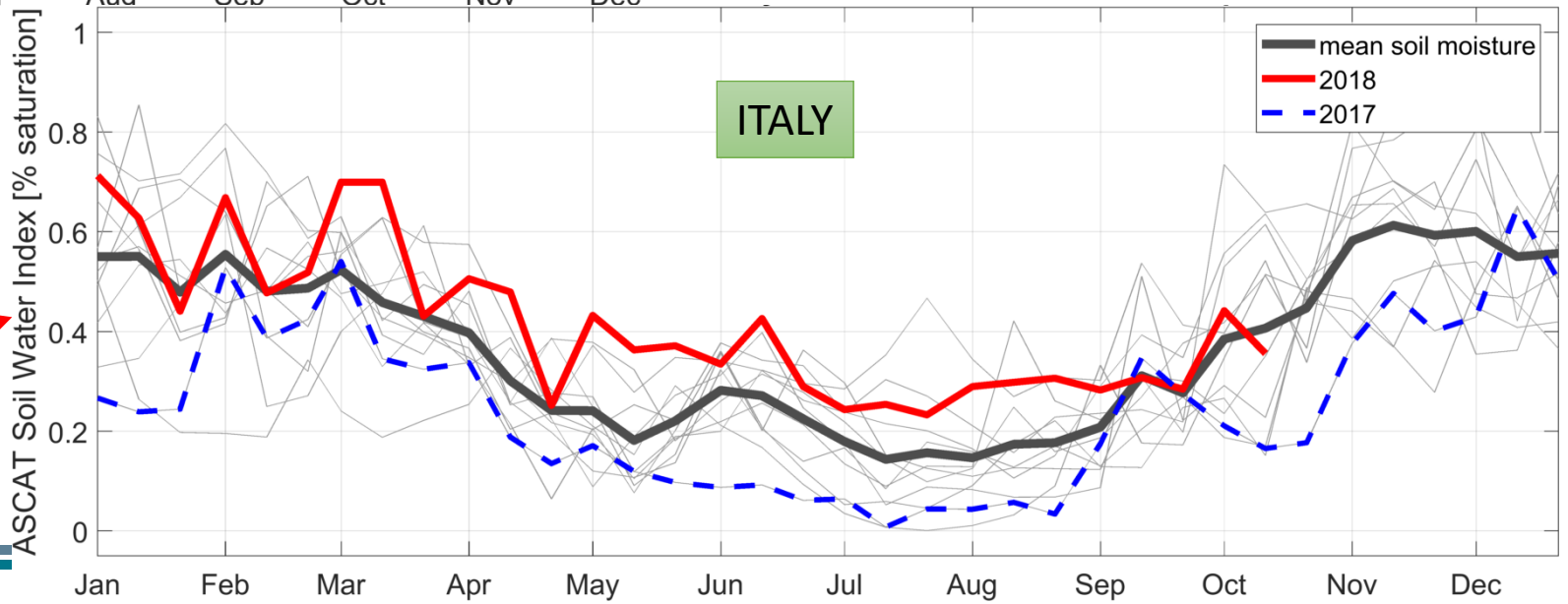
RED AREAS: drought conditions → WATER SCARCITY

Why drought?



Soil moisture conditions in 2018 and 2017 compared with previous years (grey lines) and the long-term (11-year) mean soil moisture

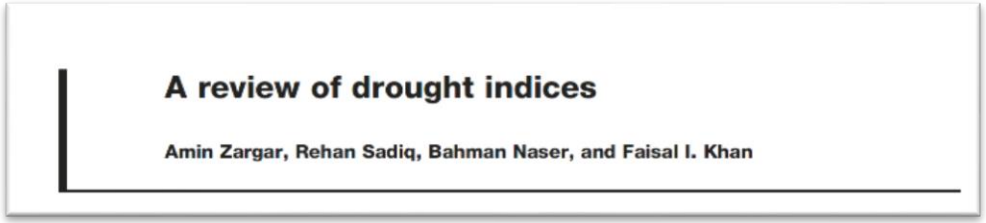




How do we characterize drought?

DROUGHT INDICES for DROUGHT CHARACTERIZATION:

- 74 from 1993 to 2014


A review of drought indices

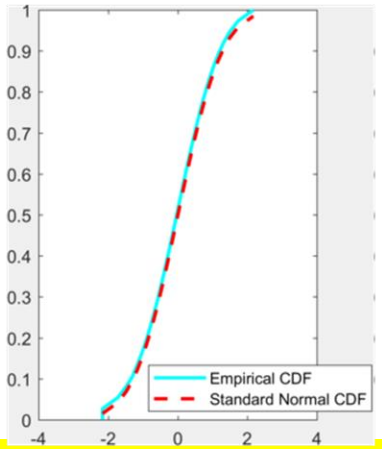
Amin Zargar, Rehan Sadiq, Bahman Naser, and Faisal I. Khan

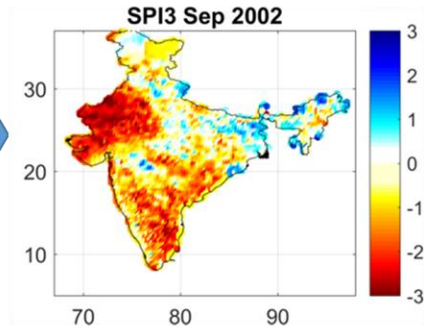
The simplest ones are funded on the concept of anomaly, that is the deviation with respect to the past (i.e., the mean) of an obseverved variable (at a desidered time scale) normalized with its standard deviation

Standardized Precipitation Index (SPI) (McKee et al. 1993)

1. Long-term record of Precipitation are sorted;
2. Time scale: 1, 3, 6, 12, 24 months;
3. Probabilistic distribution fitting
4. Standard normal cumulative distribution function estimation;

SPI: 3 Months Time Scale for Agricultural Drought





SPI is recommended by WMO to detect Meteorological Drought but SPI3 months is often used for characterizing Agricultural Drought events

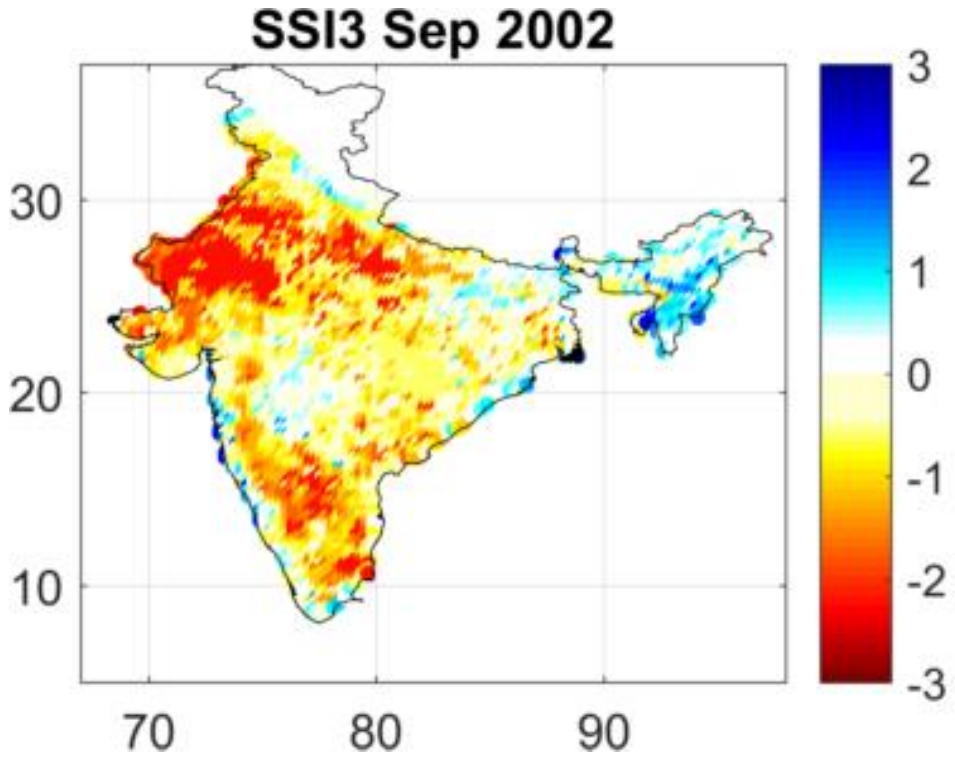
Soil moisture based drought indices

SSI (similar to SPI)

Standardized Soil Moisture Index is a statistical-based index (Farahmand A. & Agakouchak A., 2015);

1. Long-term record of Soil Moisture observations are sorted;
2. Selection of the Time Scale: 1, 3, 6, 12, 24 months (depend on the particular application);
3. Fit a nonparametric probabilistic distribution: Gringorten Plotting position formula;
4. Normalize the probabilistic distribution into a standard normal cumulative distribution function (Mean 0 and Standard Deviation 1);

SSI : 3 Months Time Scale for Agricultural Drought

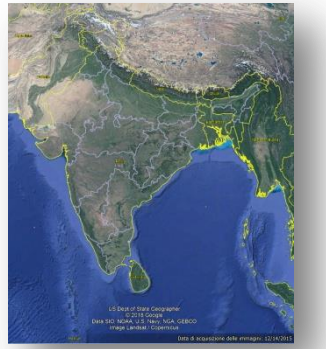


SSI <0 → **Going to a Drought Event**

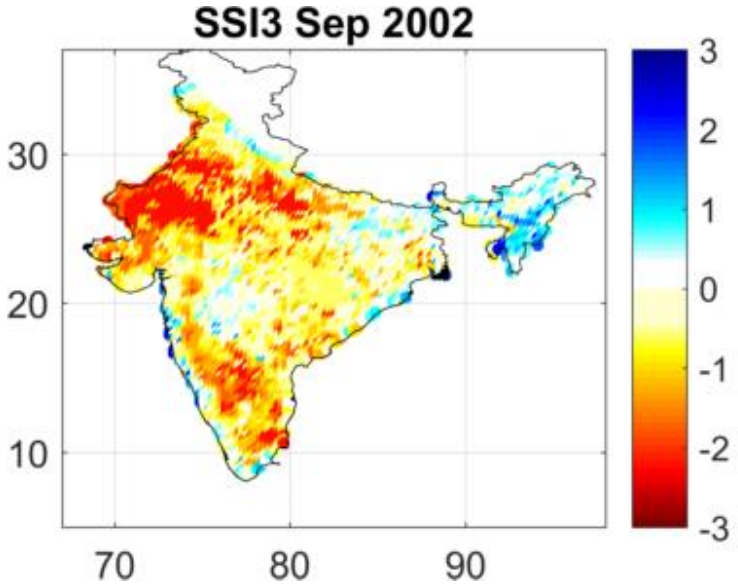
Soil moisture vs precipitation drought indices

Monsoon Season (from July) 2002: one of the top seasonal drought event. Largest anomalies in the western part of India

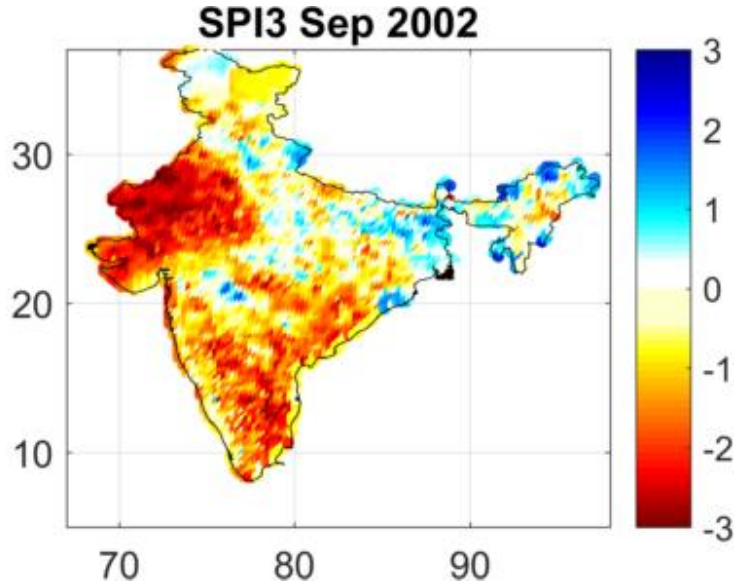
Seasonal Rainfall Deficit from July to September



SSI3 Drought Classification



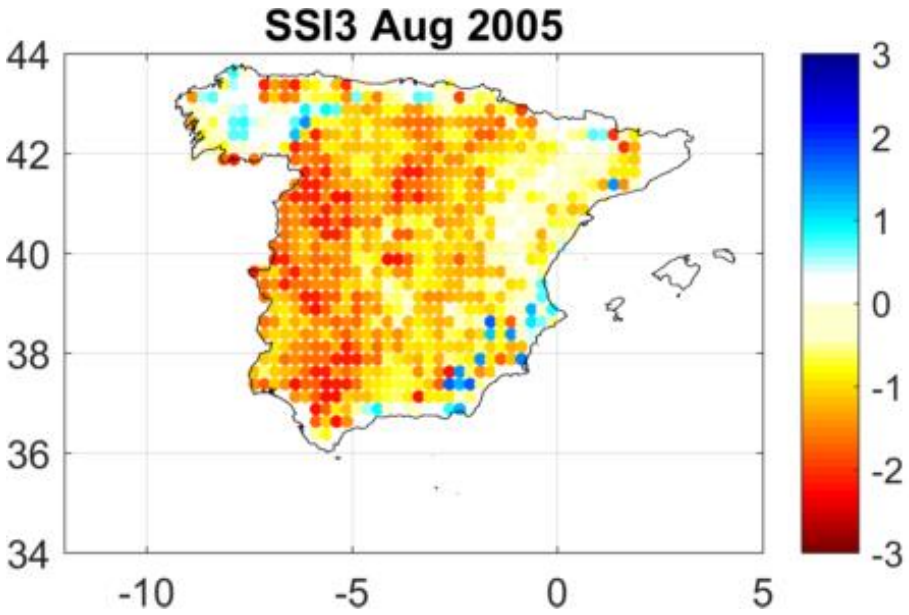
SPI3 Drought Classification



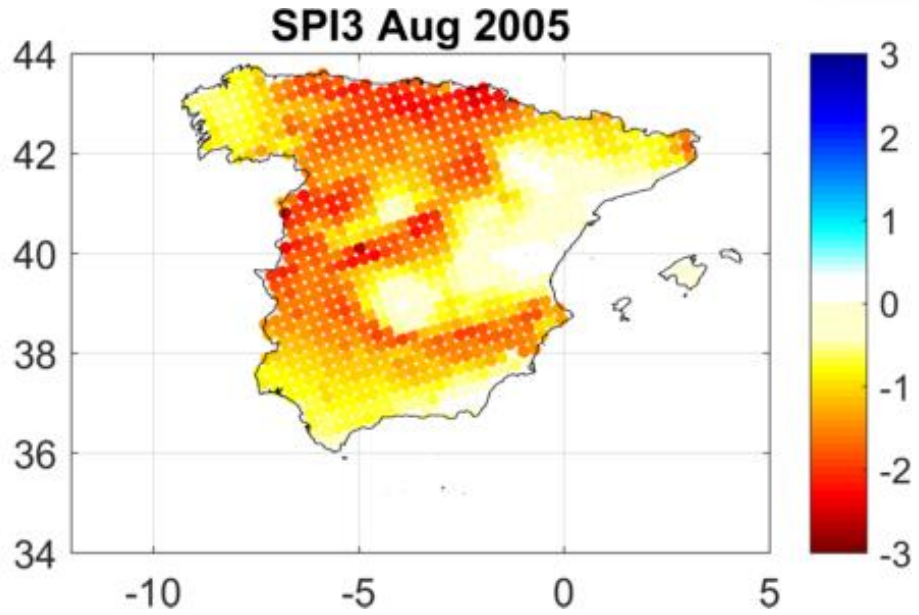
SPI detects drought earlier while SSI describes drought persistence

Soil moisture vs precipitation drought indices

Iberian Peninsula affected by Drought in 2005

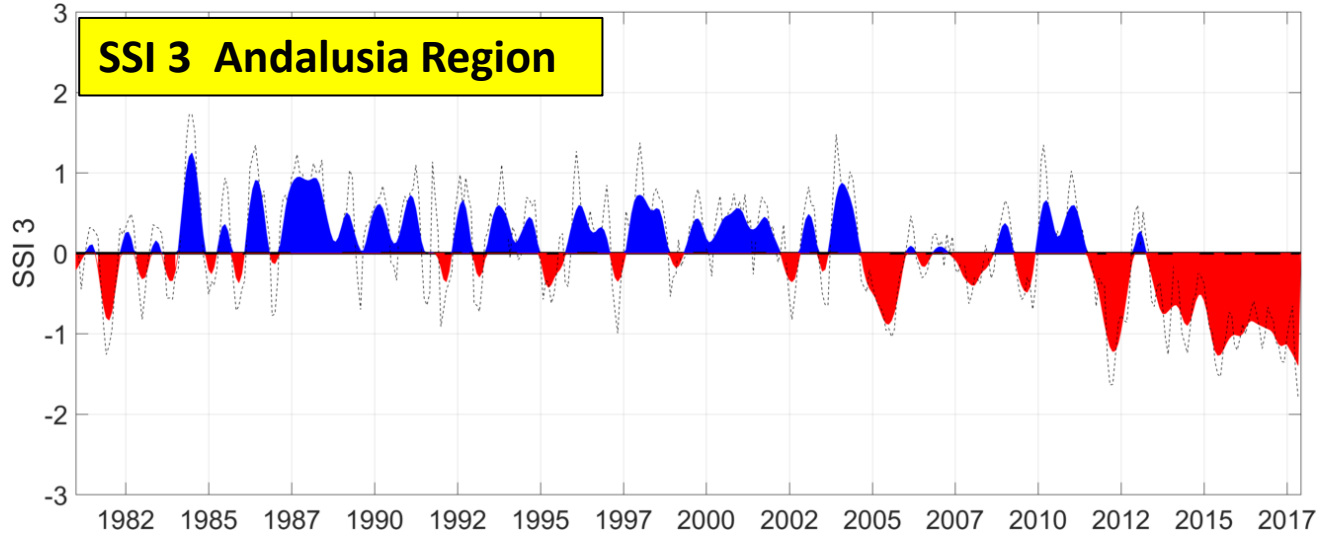


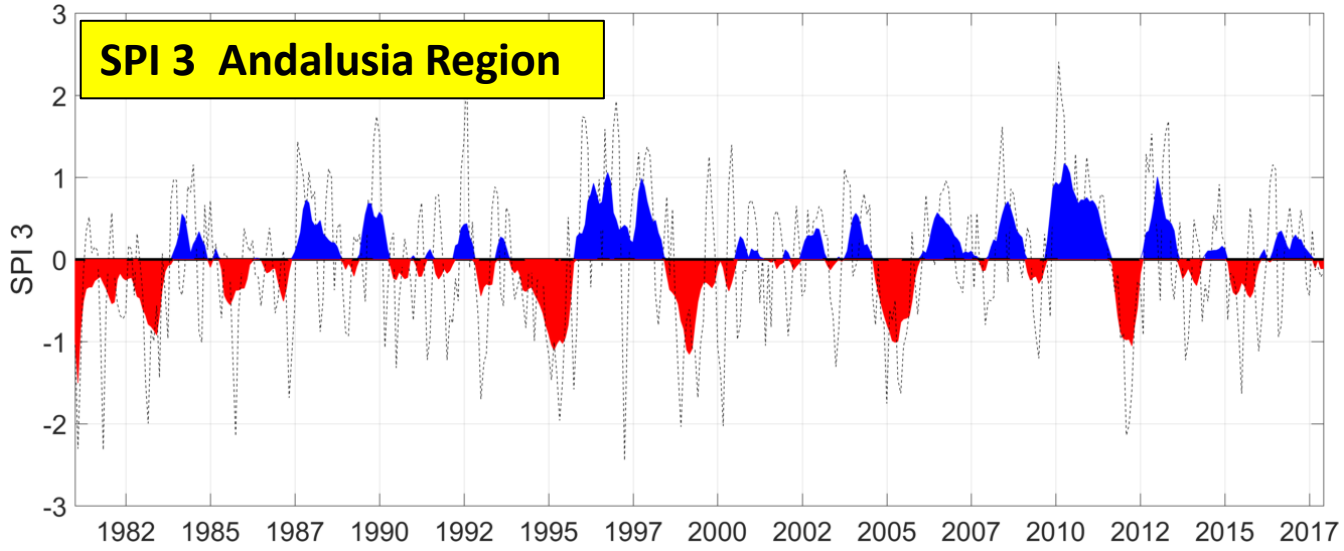
SSI 3 August 2005

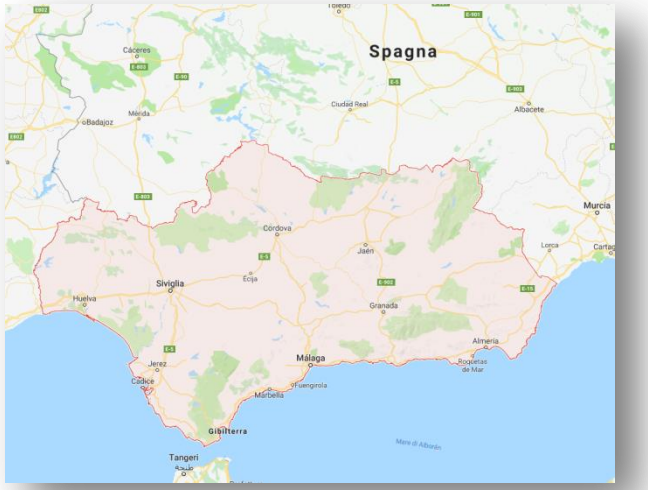


SPI 3 August 2005

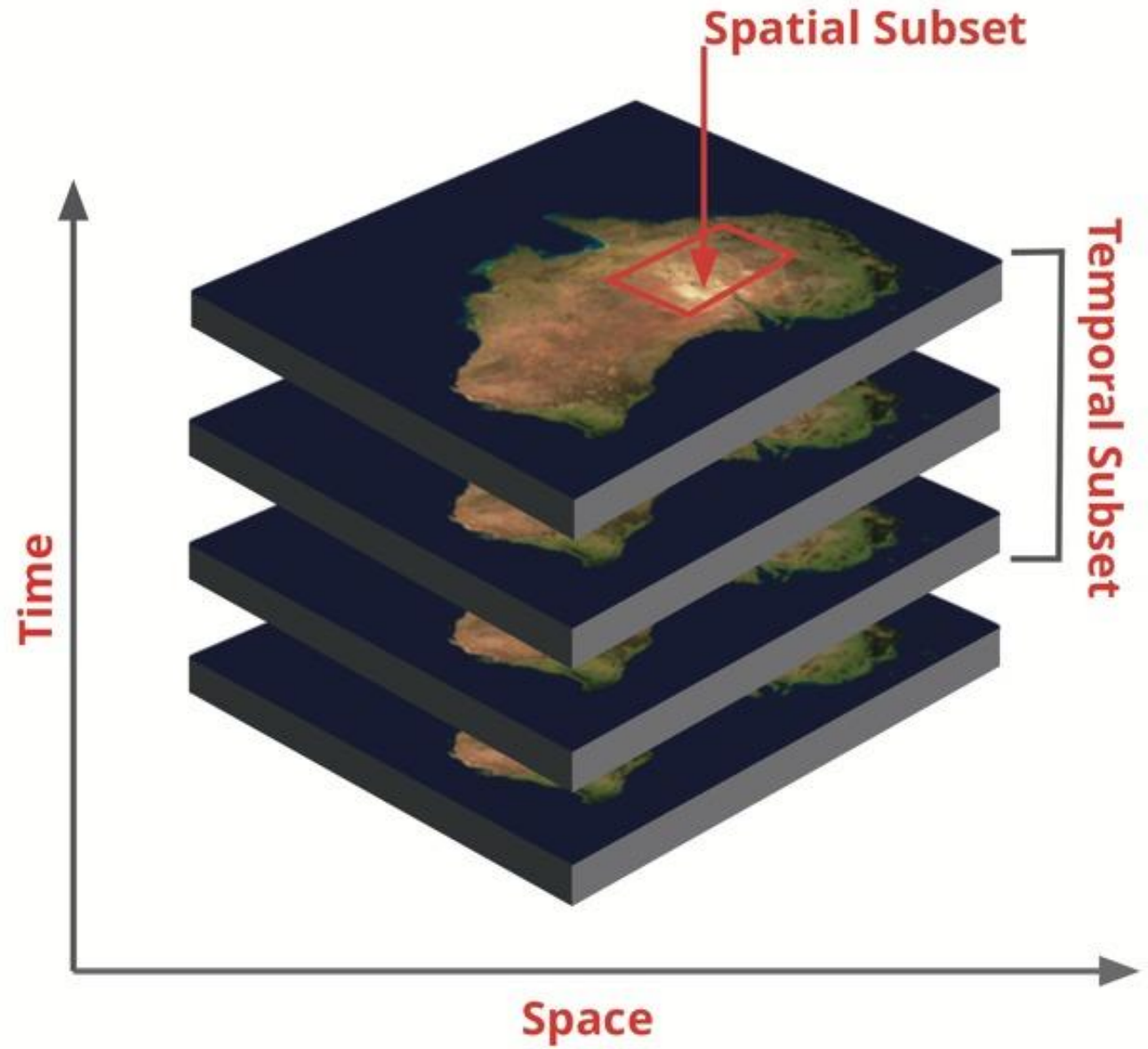
Soil moisture vs precipitation drought indices







Introduction to the exercise



Introduction to the exercise

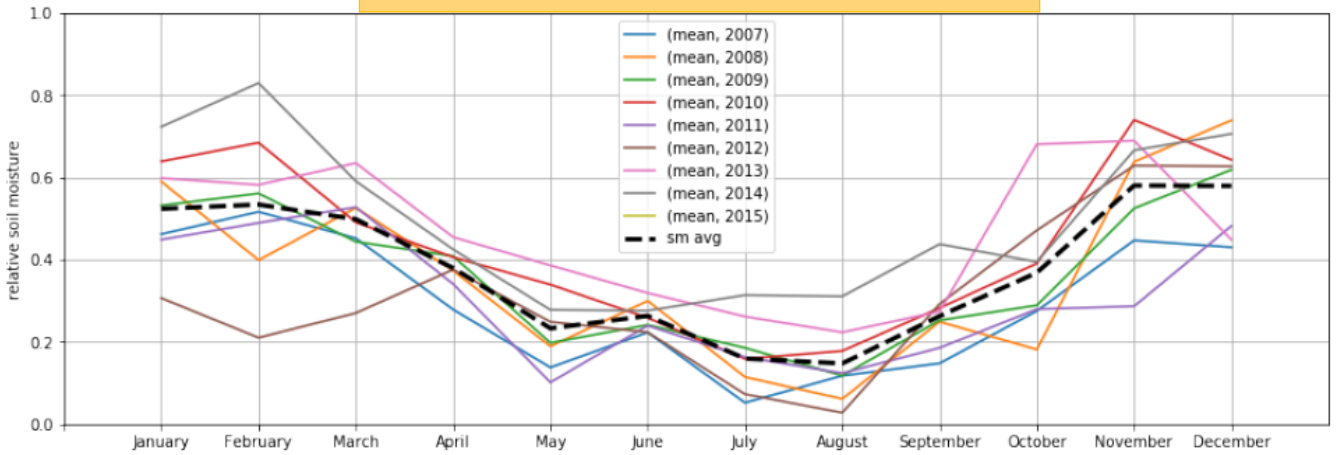
EACH STEP SHOULD BE ANALYSED AND DISCUSSED (briefly)
RESULTS SHOULD BE OBTAINED FOR THE TWO SOIL MOISTURE PRODUCTS (ASCAT and ASCAT+ECMWF)

- Computation of “seasonal” soil moisture
- Computation of soil moisture anomalies: time series averaged on the basin
- Computation of Standardized Soil Moisture (SSI) drought index: time series averaged on the basin
- SSI: Identification of droughts period, in time
- SSI: Identification of drought characteristics (duration, magnitude)
- Comparison between soil moisture (SSI) and precipitation (SPI) based drought indices
- Drought in space: maps comparison

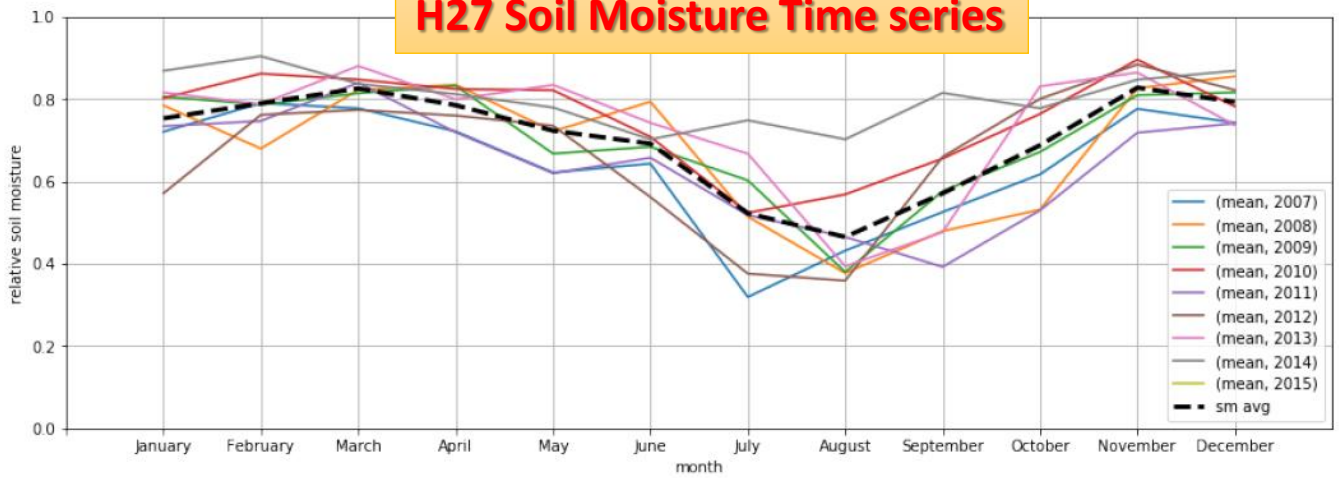
Introduction to the exercise

Computation of “seasonal” soil moisture

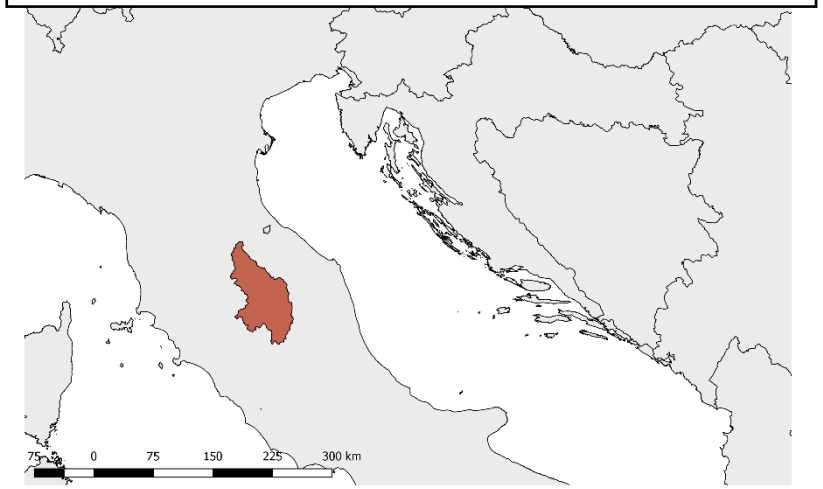
ASCAT Soil Moisture Time series



H27 Soil Moisture Time series



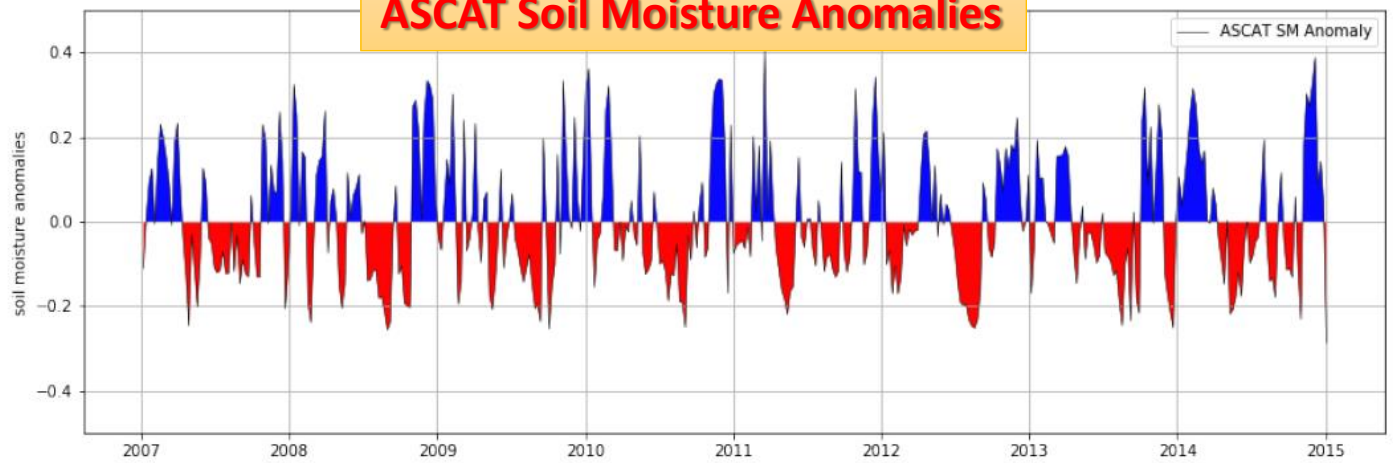
Tevere-Monte Molino Basin



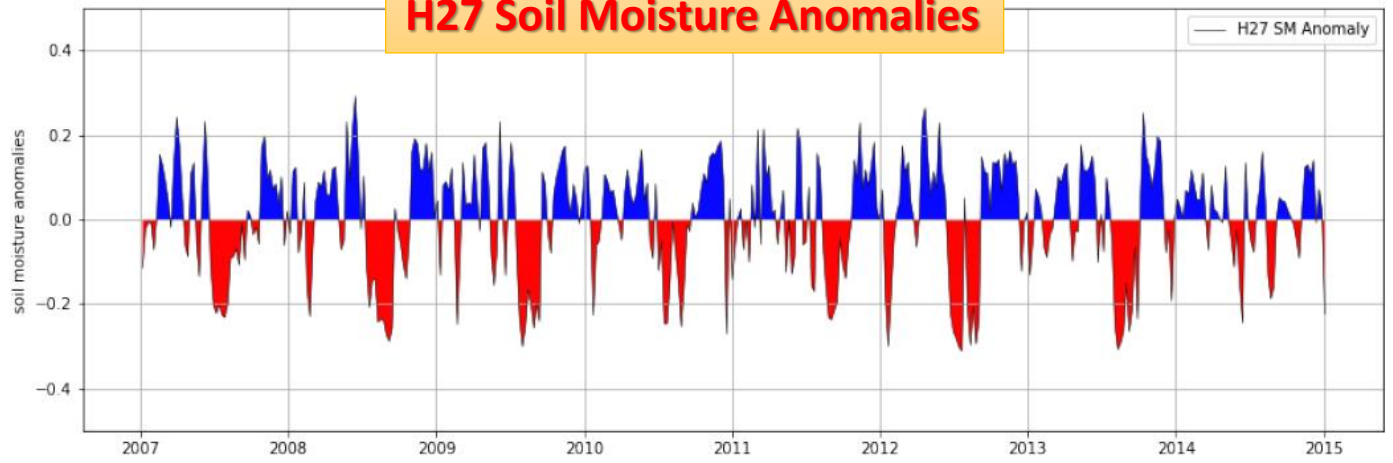
Introduction to the exercise

Computation of soil moisture anomalies: time series averaged on the basin

ASCAT Soil Moisture Anomalies



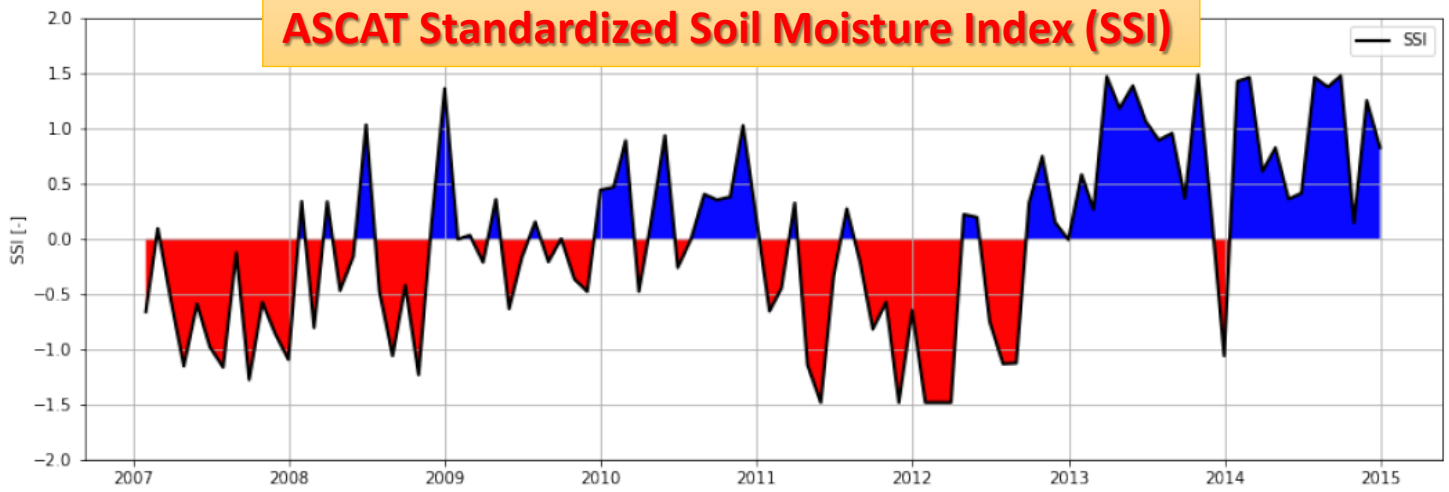
H27 Soil Moisture Anomalies



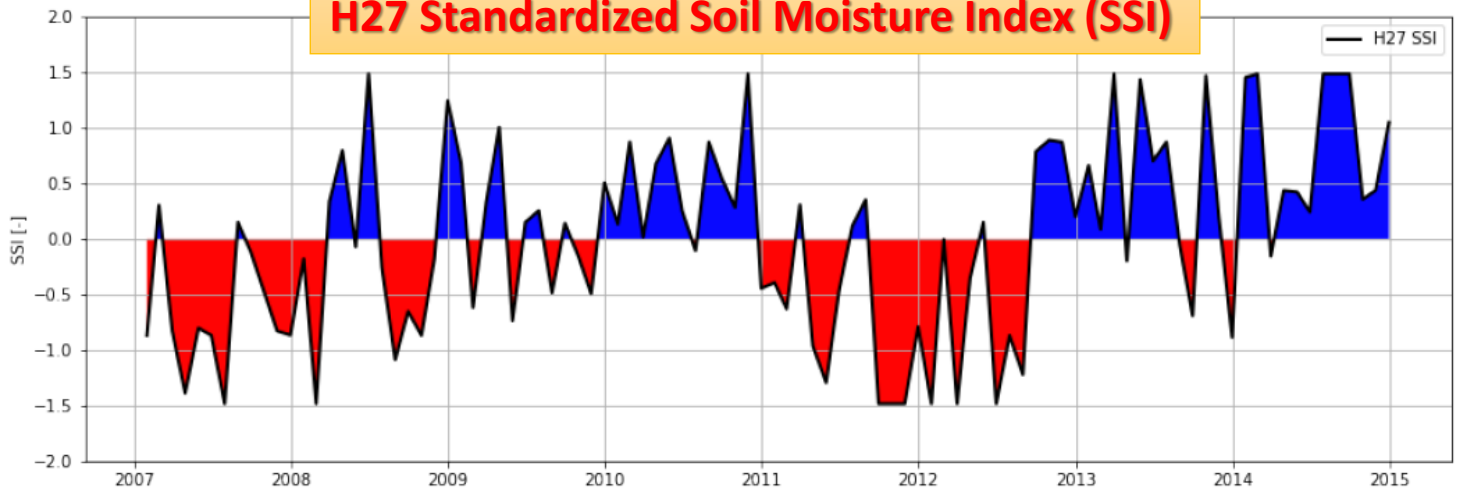
Introduction to the exercise

Computation of **SSI** drought index: time series averaged on the basin

ASCAT Standardized Soil Moisture Index (SSI)



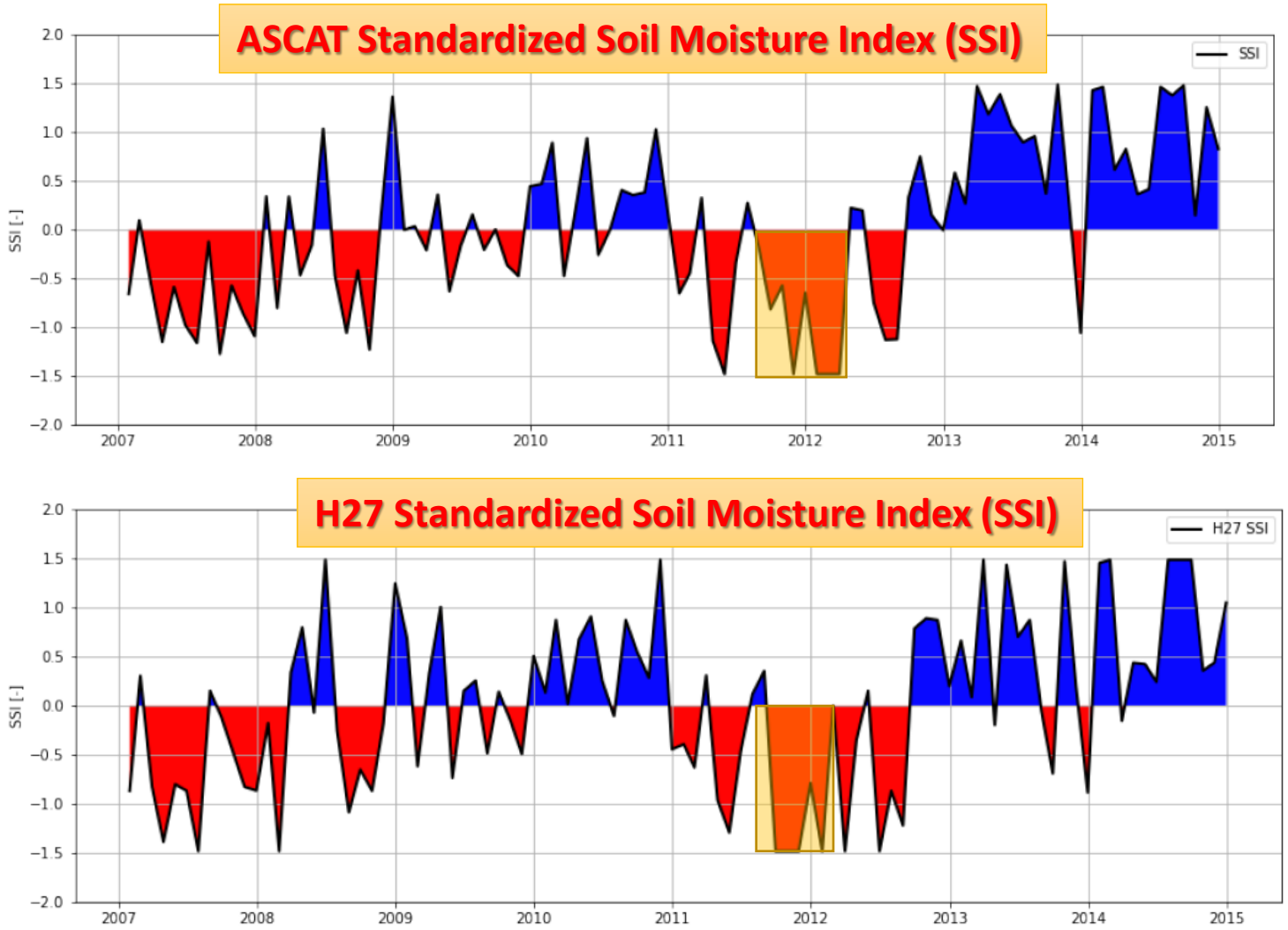
H27 Standardized Soil Moisture Index (SSI)



Introduction to the exercise

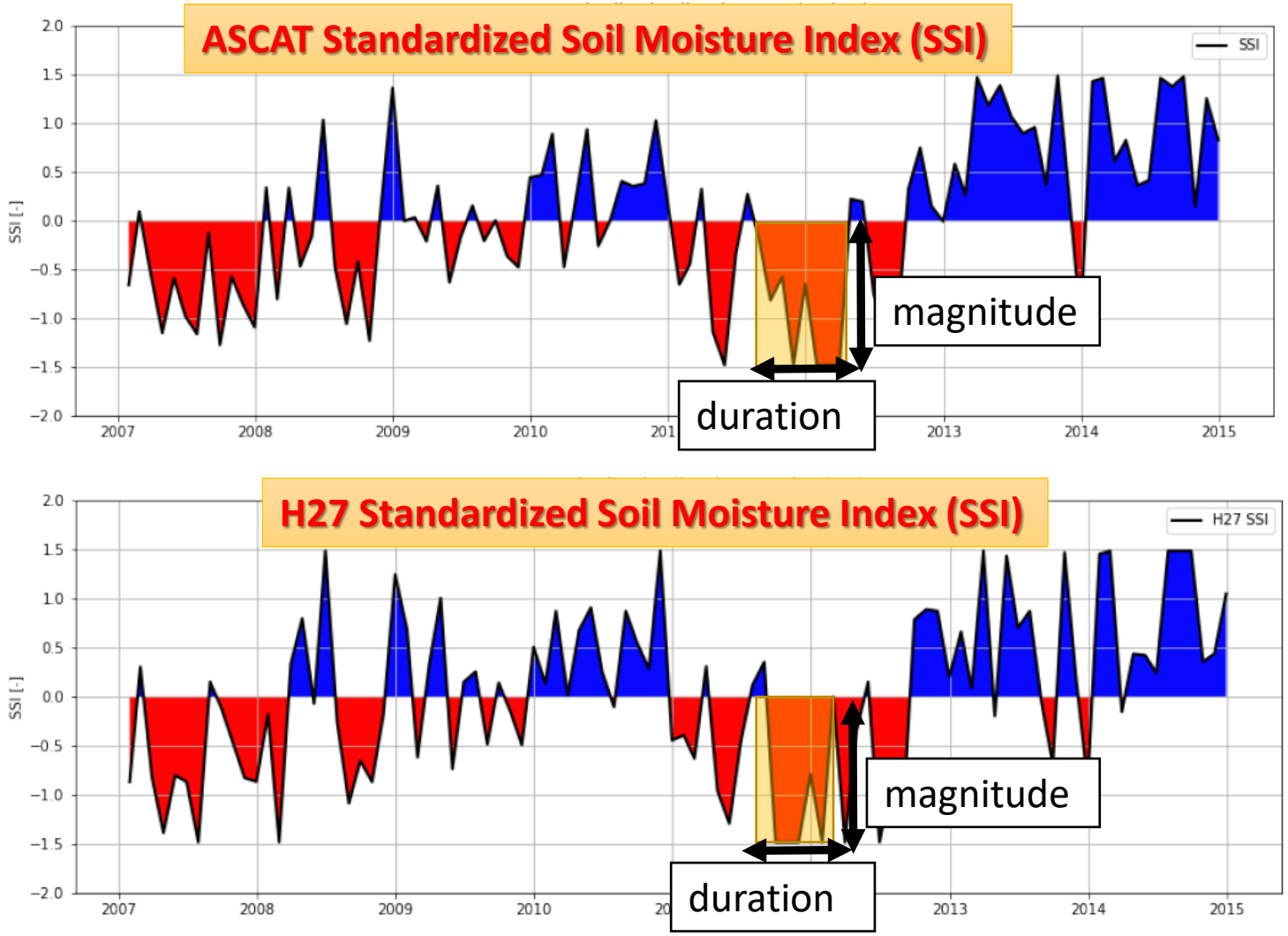
SSI: Identification of drought periods, in time

DROUGHT in time!



Introduction to the exercise

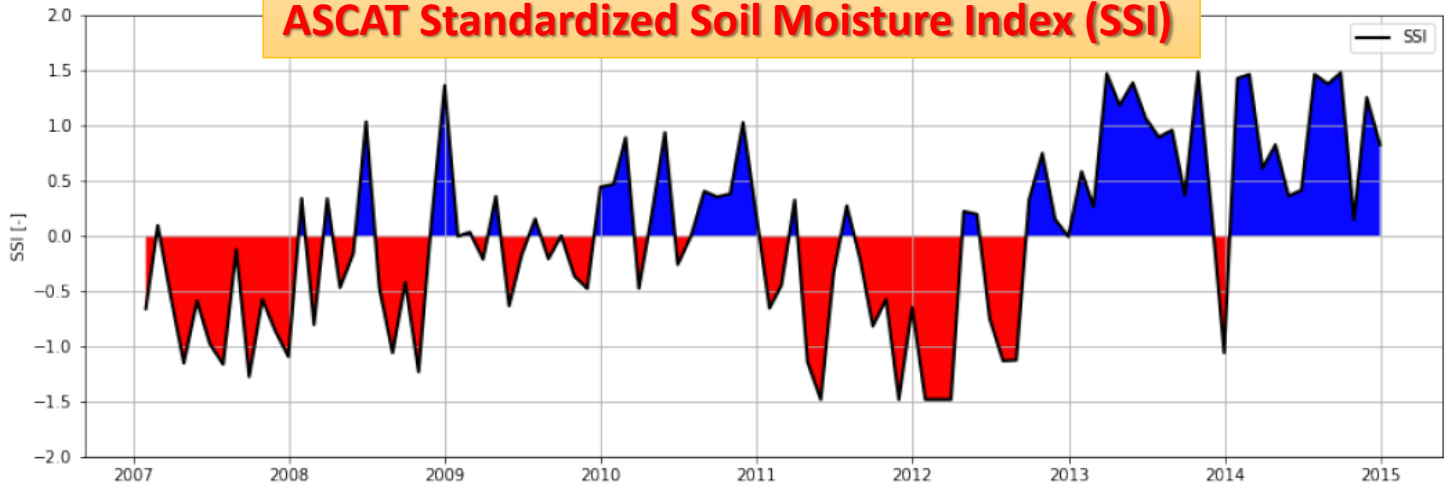
SSI: Identification of drought characteristics (duration, magnitude)



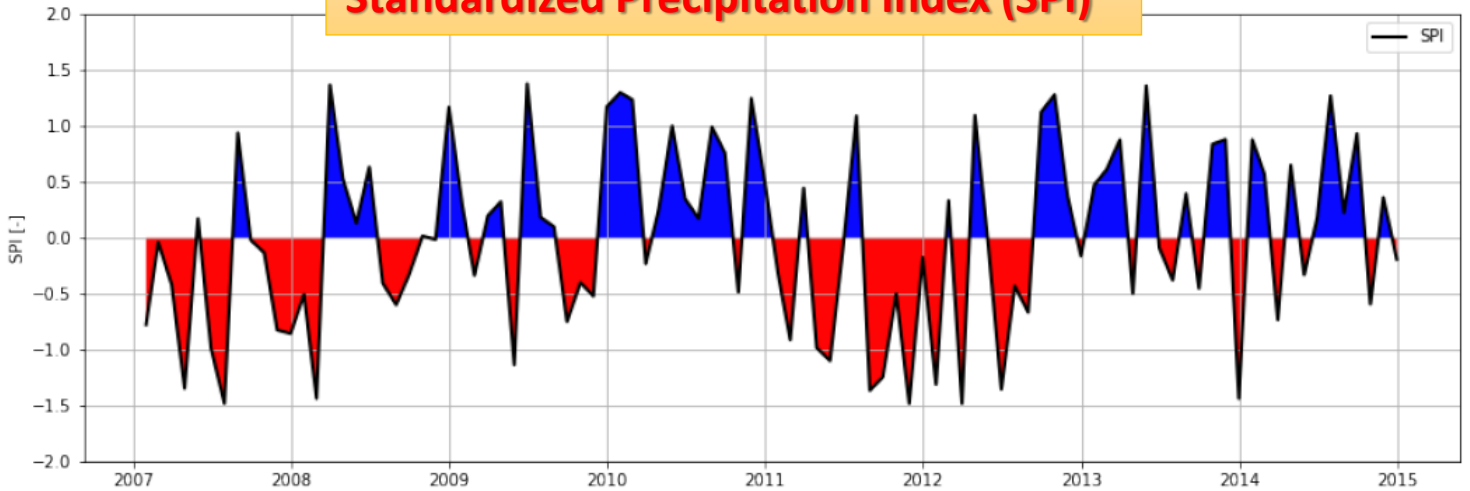
Introduction to the exercise

Comparison between ASCAT soil moisture (SSI) and precipitation (SPI) based drought indices

ASCAT Standardized Soil Moisture Index (SSI)



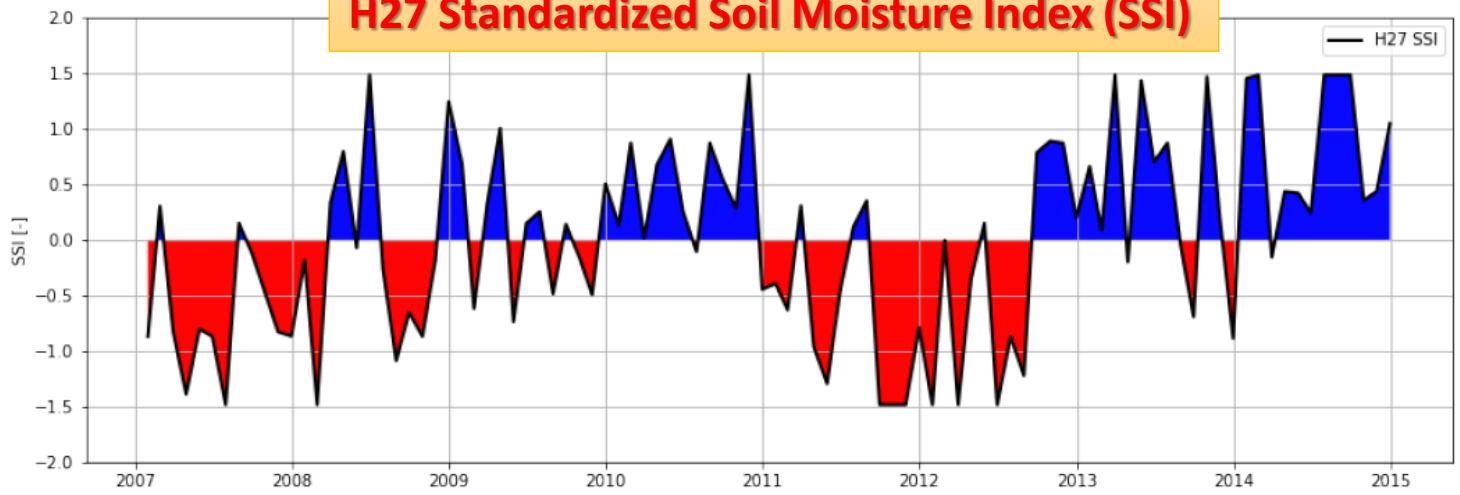
Standardized Precipitation Index (SPI)



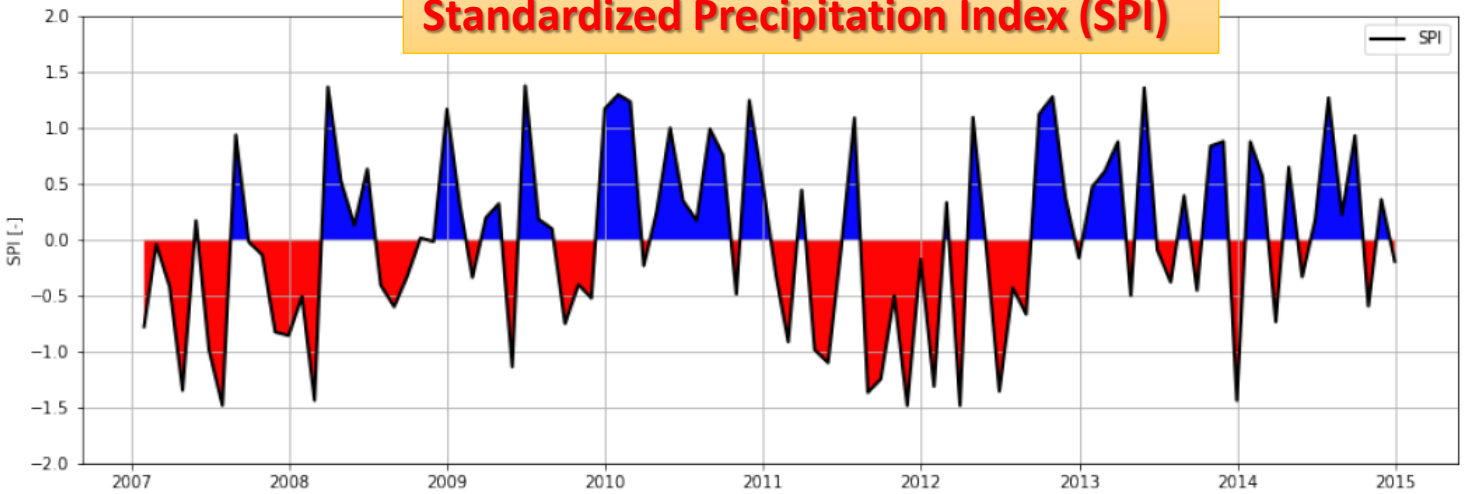
Introduction to the exercise

Comparison of H27 Root zone soil moisture (SSI) and precipitation (SPI) based drought indices

H27 Standardized Soil Moisture Index (SSI)



Standardized Precipitation Index (SPI)

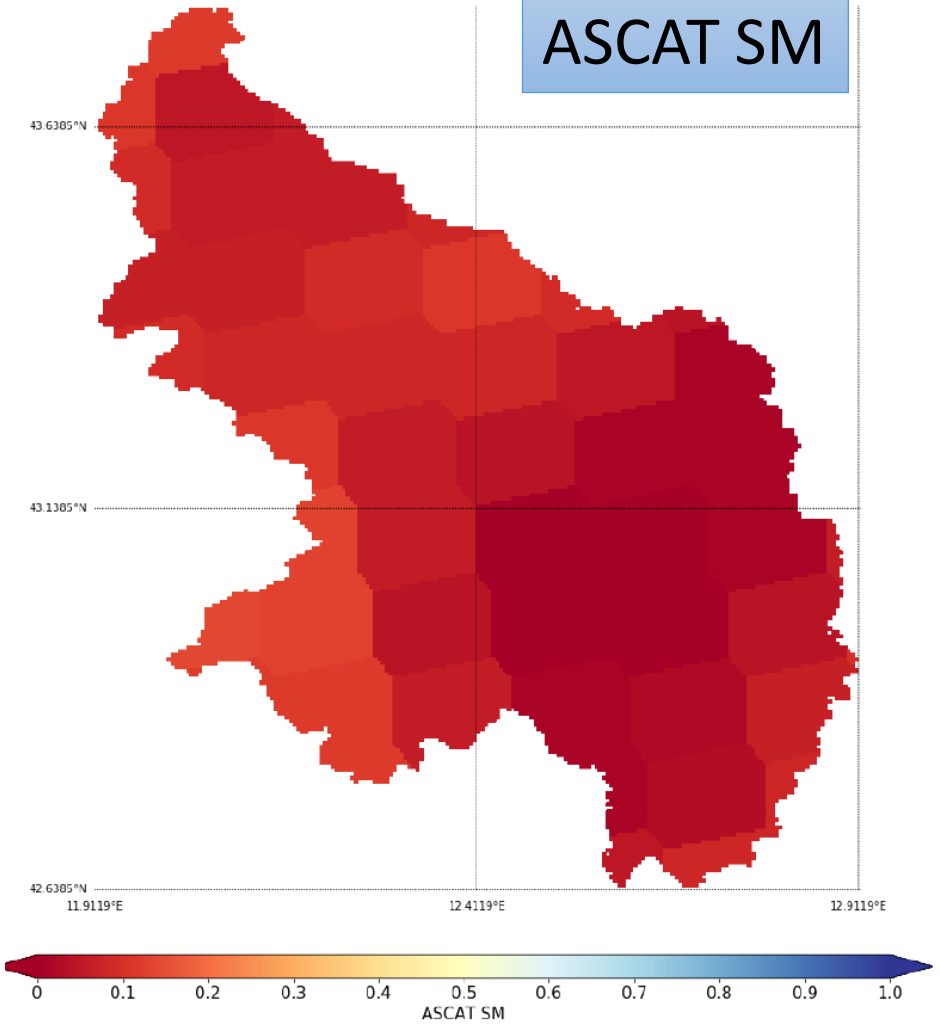


Introduction to the exercise

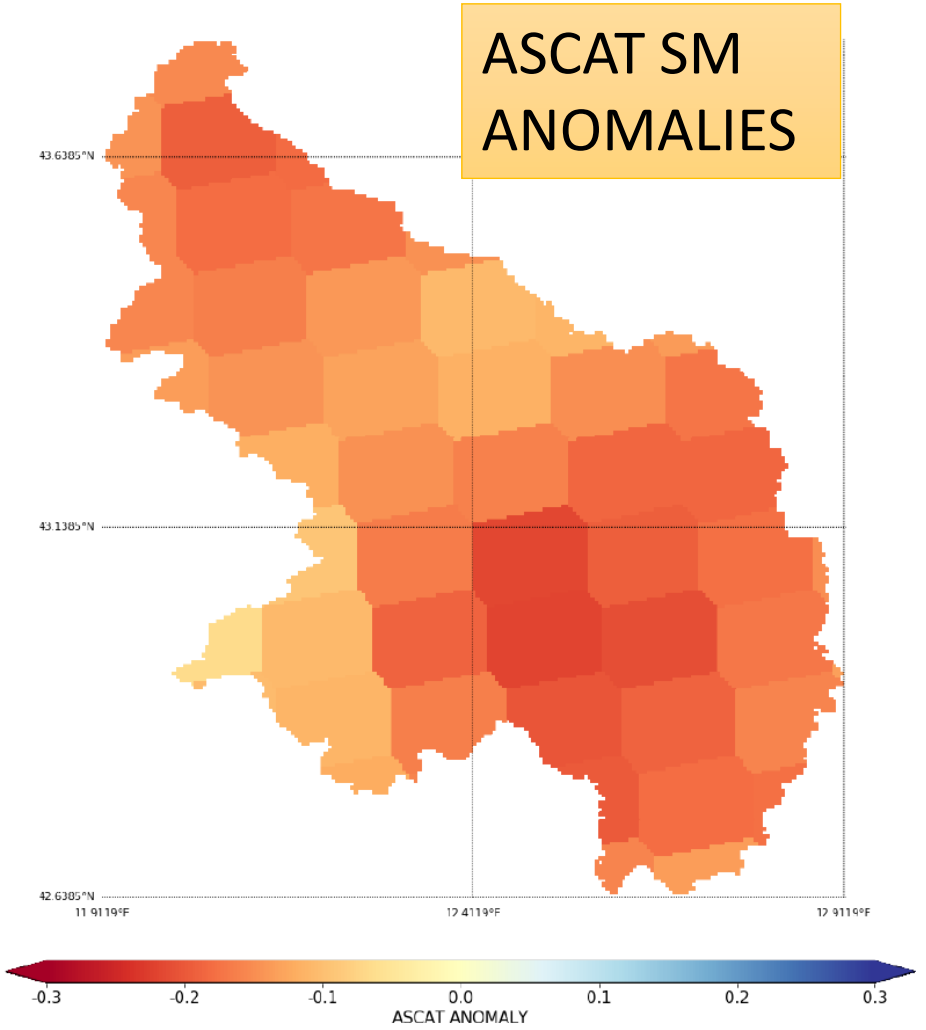
Drought in space: maps comparison

September 2011

ASCAT SM



ASCAT SM ANOMALIES



Introduction to the exercise

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September 2011