

Forecast Evapotranspiration: Fundamental Information for Agricultural Irrigation Management

Setting the scene

Donatella Spano

University of Sassari and CMCC Foundation

CMCC Webinar
23-07-2019



USA National Weather Service

FRET

Forecast *ET₀*

Richard Snyder

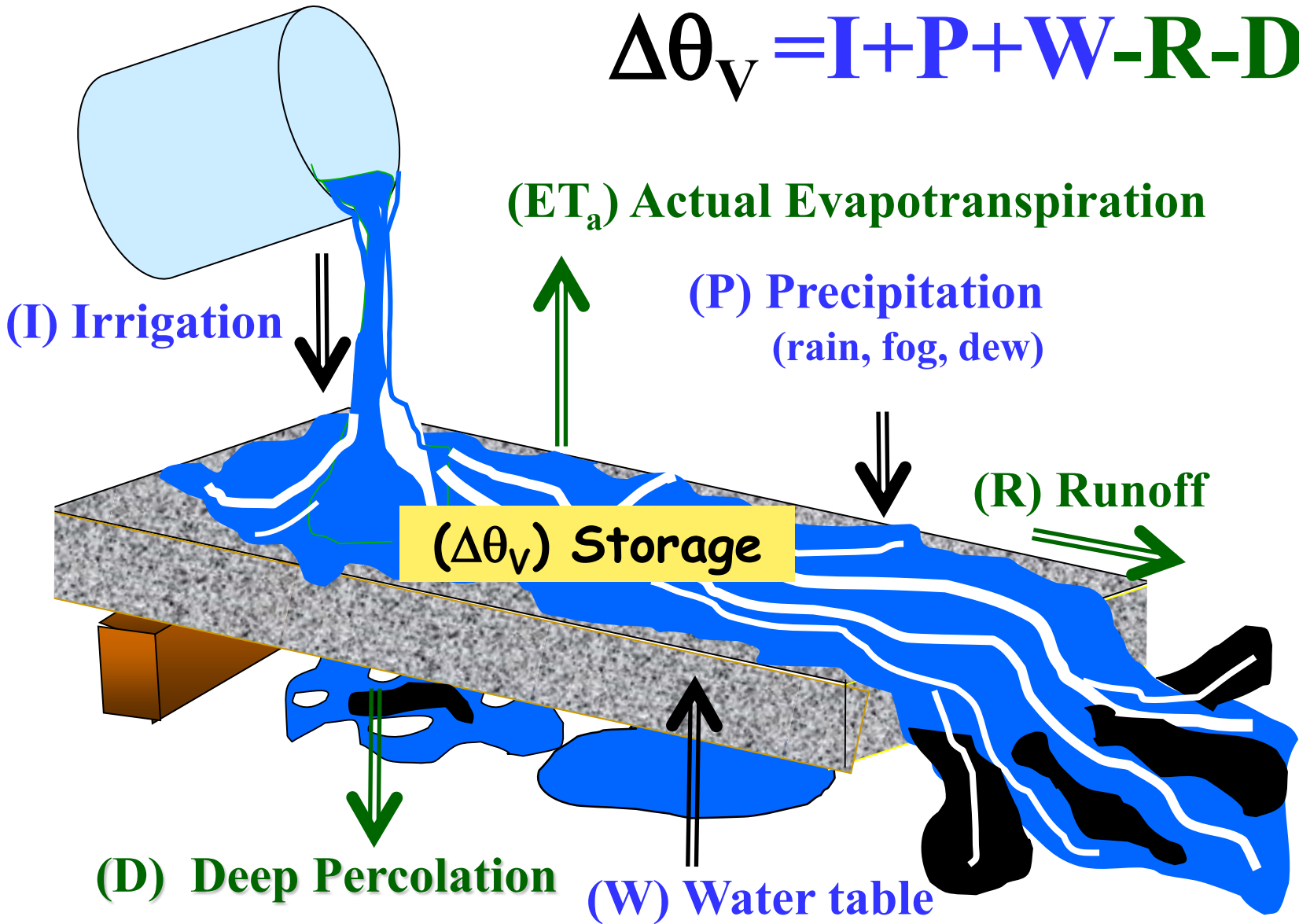
Mike Anderson

Cindy Palmer

Morteza Orang

Water Balance Scheduling

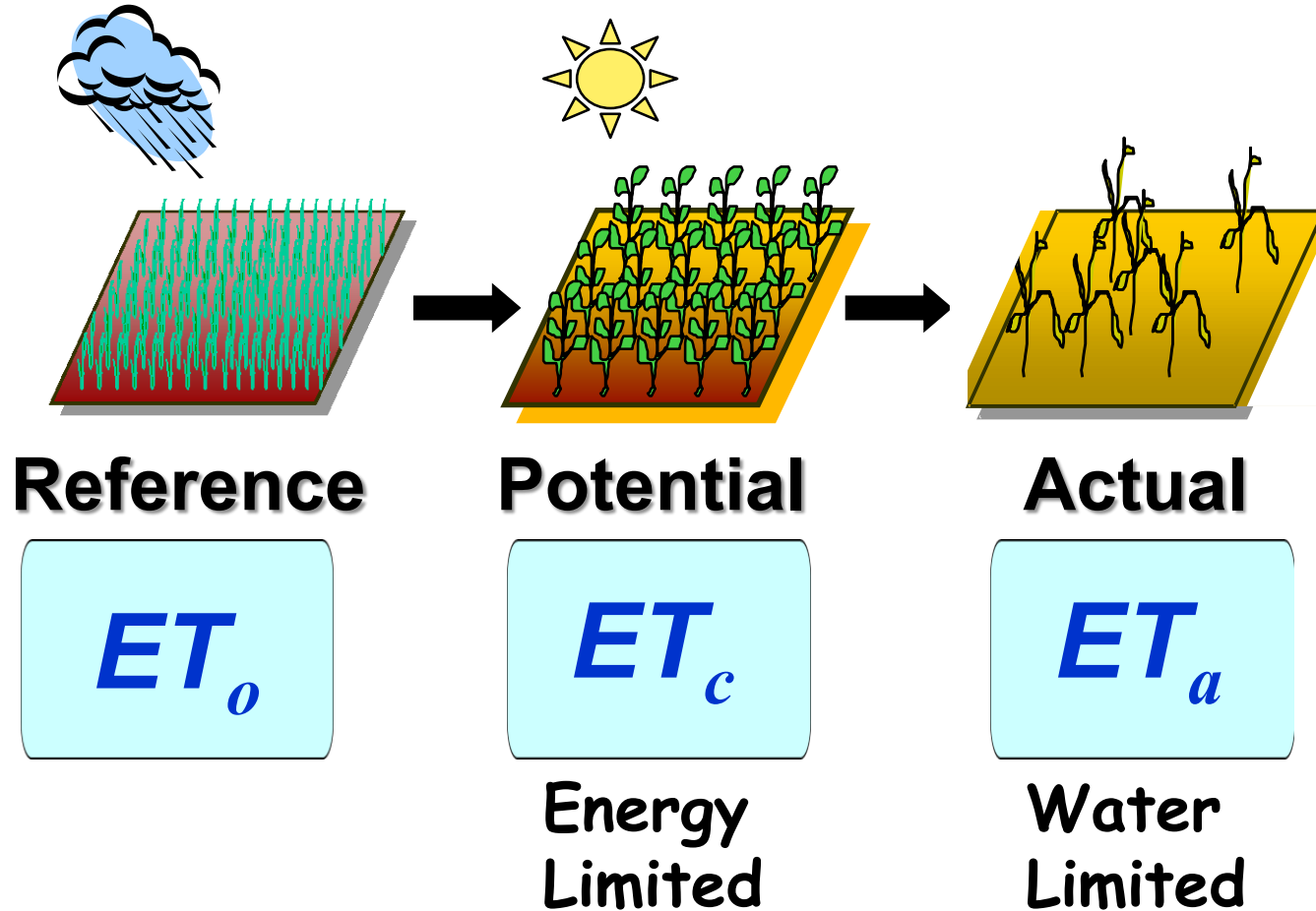
$$\Delta\theta_v = I + P + W - R - D - ET_a$$



Evapotranspiration

$$ET_c = ET_o \times K_c$$

$$ET_a = ET_c \times K_s$$

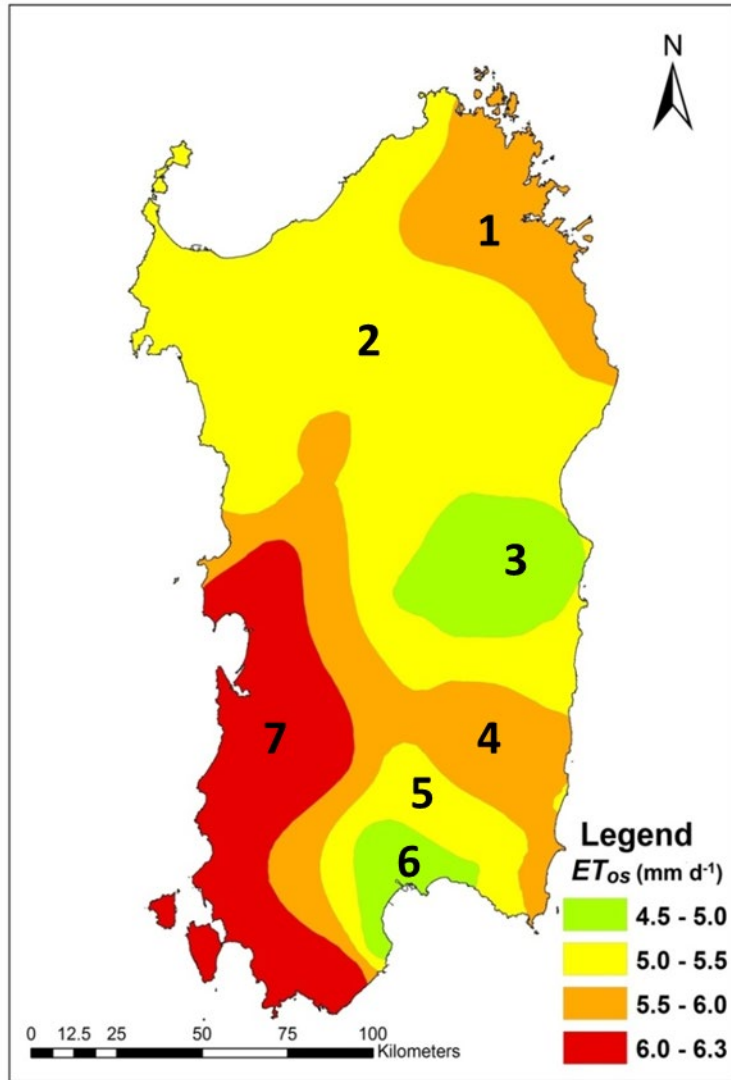


Standardized Reference Evapotranspiration (ET_o)

Evapotranspiration of a large field of short 0.12 m vegetation having known canopy and aerodynamic resistance and no soil, water, or plant limitations to ET , i.e., the ET_o rate is only energy limited.

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \left(\frac{900}{T + 273} \right) u_2 (e_s - e)}{\Delta + \gamma (1 + 0.34u_2)}$$

ETo Maps for Sardinia and California



Mancosu, Snyder and Spano: J. Irrig. Drain Eng., 2014, 140(9)

Sardinia

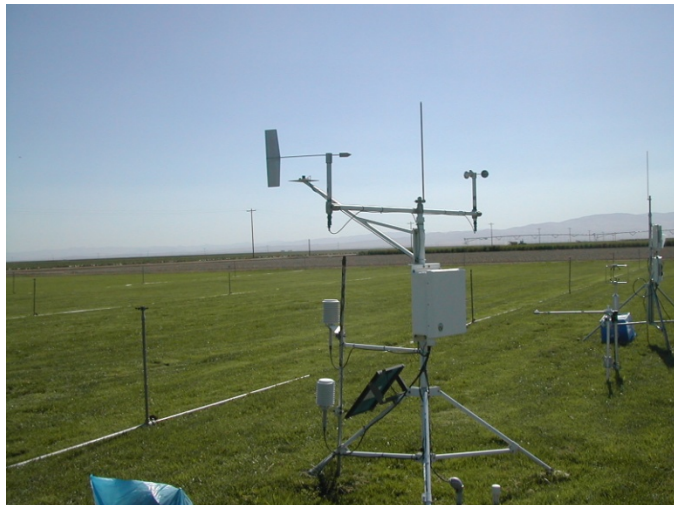


California

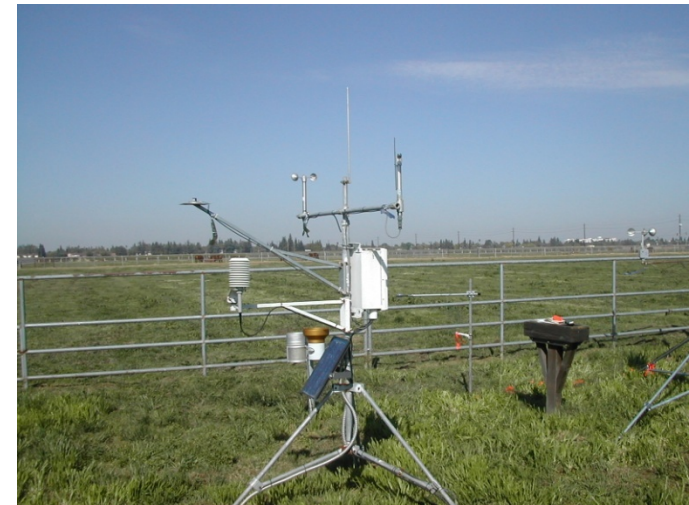
CIMIS

California Irrigation Management Information System

- **Automated ET_0 network (1982-present)**
- **Database of ET_0 and weather**
- **Encourages ET-based scheduling**
- **Used to validate FRET**



**Approximately
150 ± Stations**



Grower Adoption - California

**Growers who ever used ET for
irrigation scheduling 1986 Survey**

10,000 questionnaires & 2,000 responses

60 said “Yes” but 30 actually were “Yes”

Growers who used ET

1986 = 1.5%

Estimate of growers using ET today

2019 = 70-80%

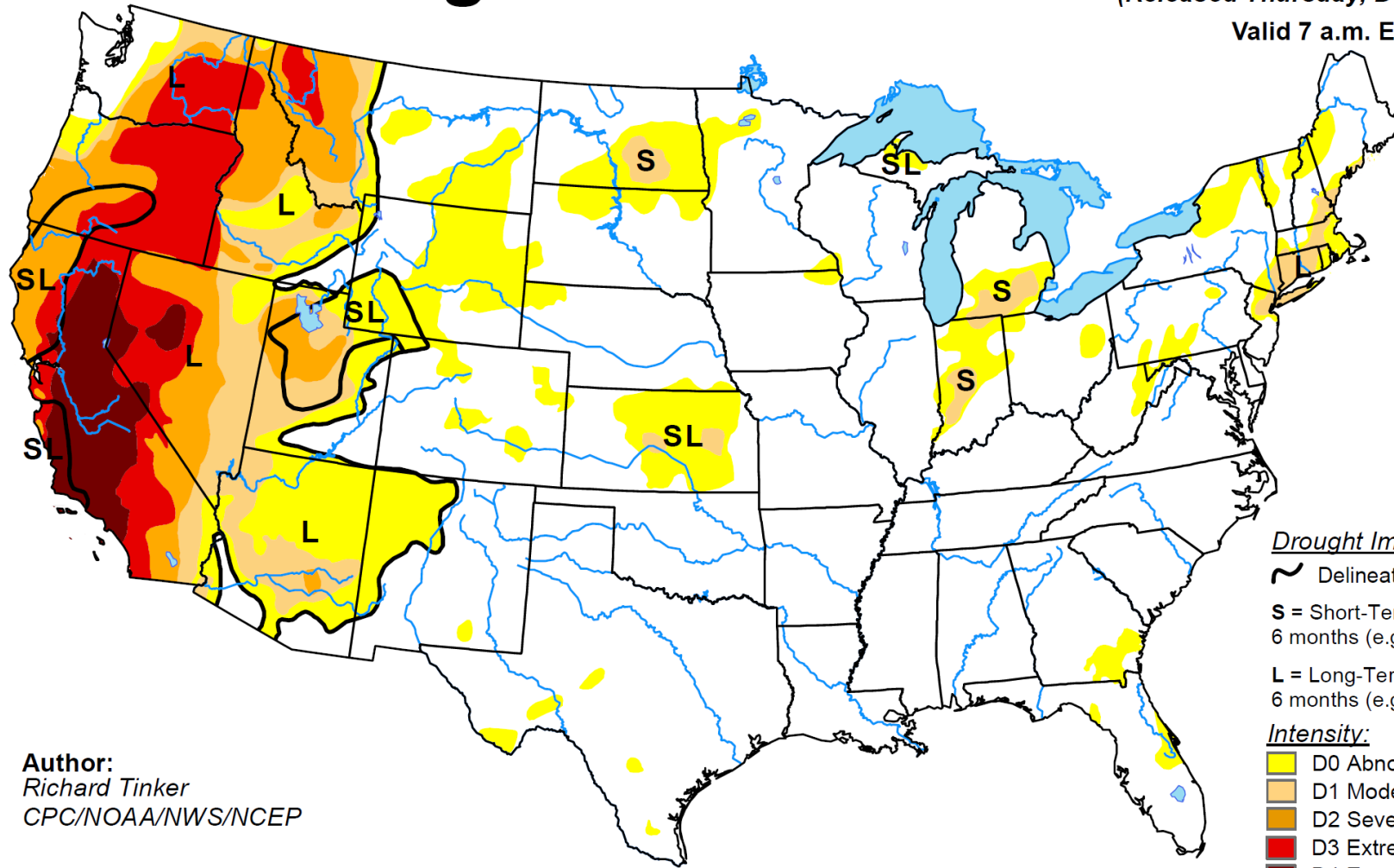
Higher Adoption Rates

- 1. Orchard & vine crop growers**
- 2. Pressurized irrigation systems**
- 3. Higher education level**
- 4. Irrigation problems, i.e.,
salinity & slow infiltration**
- 5. Farmers talk to farmers
about local water cost.**
- 6. Intermittent drought**

U.S. Drought Monitor

December 8, 2015
(Released Thursday, Dec. 10, 2015)

Valid 7 a.m. EST



Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

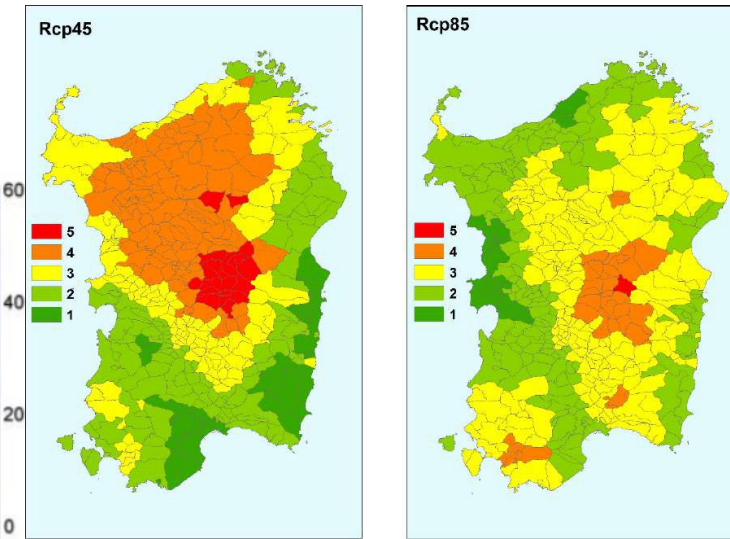
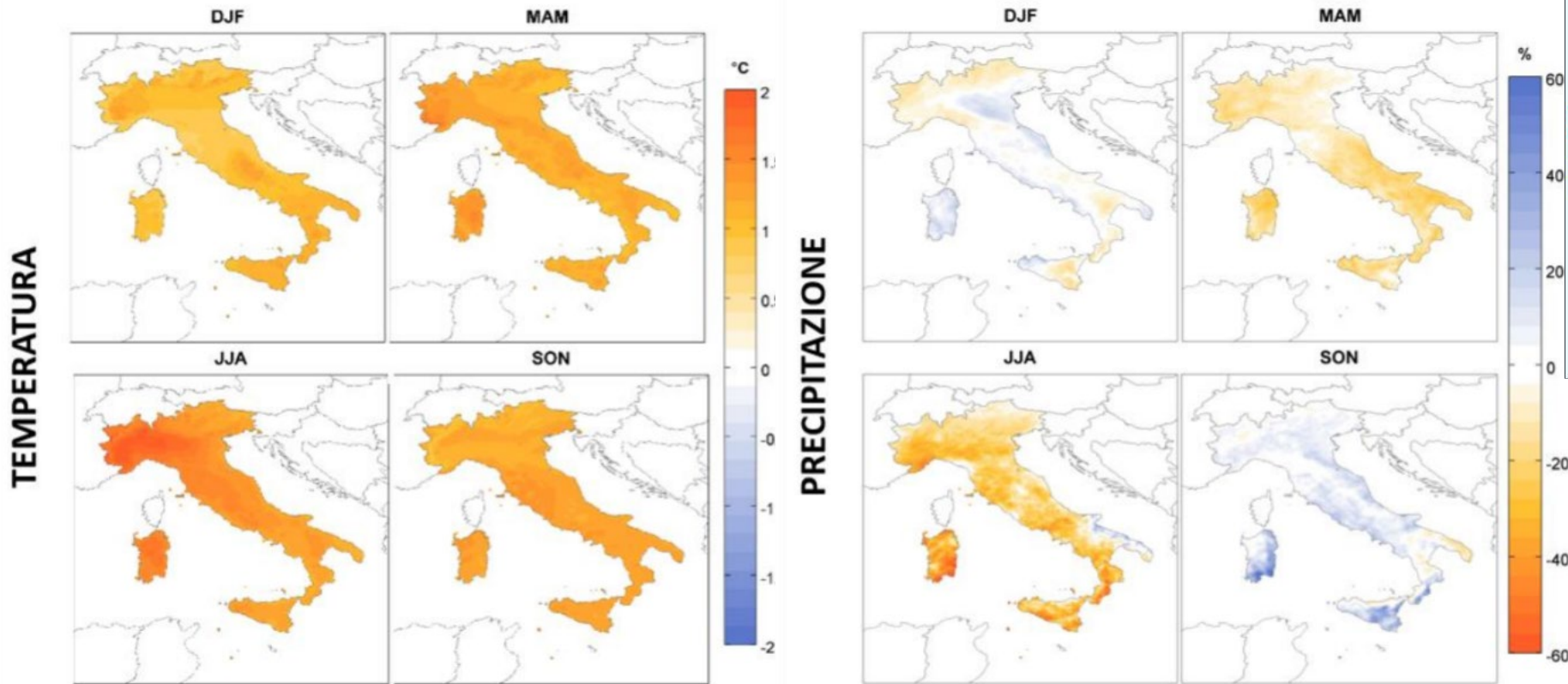
**DROUGHT SEVERITY INDEX (=> Palmer Index):
Blend of 5 key indicators (Climate, Hydrology, Soil)**

Use temperature and precipitation to calculate water demand & supply, and soil moisture

Projections for Italy

Cosmo-clm, RCP 4.5, 2021-2050 vs 1980-2000

Aridity Index



Source: <http://www.minambiente.it/comunicati/ambiente-parte-consultazione-su-piano-nazionale-adattamento-cambiamenti-climatici>

- Increase in temperature (especially in summer)
- Reduction in precipitation
- Increase in intensity and frequency of extreme events

SETTING THE SCENE

- ❖ **Water scarcity, climate change, and increasing competition between sectors will likely worsen agricultural sustainability**
- ❖ **Growers need to improve irrigation efficiency and the use of ET and plant-based information to advance irrigation management**
- ❖ **Standardized reference evapotranspiration (ET₀) is the basis for estimating crop evapotranspiration**
- ❖ **Efforts are currently underway to encourage adoption and use of ET-based scheduling by growers and landscape professionals**

New Agency: Italia-Meteo

- A good opportunity for coordination and development of ETo information
- A standardized network of weather stations for determining ETo rates in different micro-climates to validate forecast ETo is needed
- An operational forecast of ETo is desirable for Italy to encourage growers and landscape professionals to accept and use ET-based scheduling
- The adoption of ET-based scheduling should improve sustainability of water resources in Italy

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THANKS!

spano@uniss.it