

Calculation of reference evapotranspiration using different Penman-Monteith equation approximations and radiation parameterizations

Vicent Altava-Ortiz 1,2, Aleix Benaiges, Merce Barnolas, 1

1. Servei Meteorològic de Catalunya, Berlín 38-46, 4a planta, 08029 Barcelona, Spain
2. Servei de Prevenció d'Incendis Forestals, Doctor Roux, 3a planta, 08029 Barcelona, Spain

vicent.altava@gencat.cat

Background



SMC's AWS in Raimat



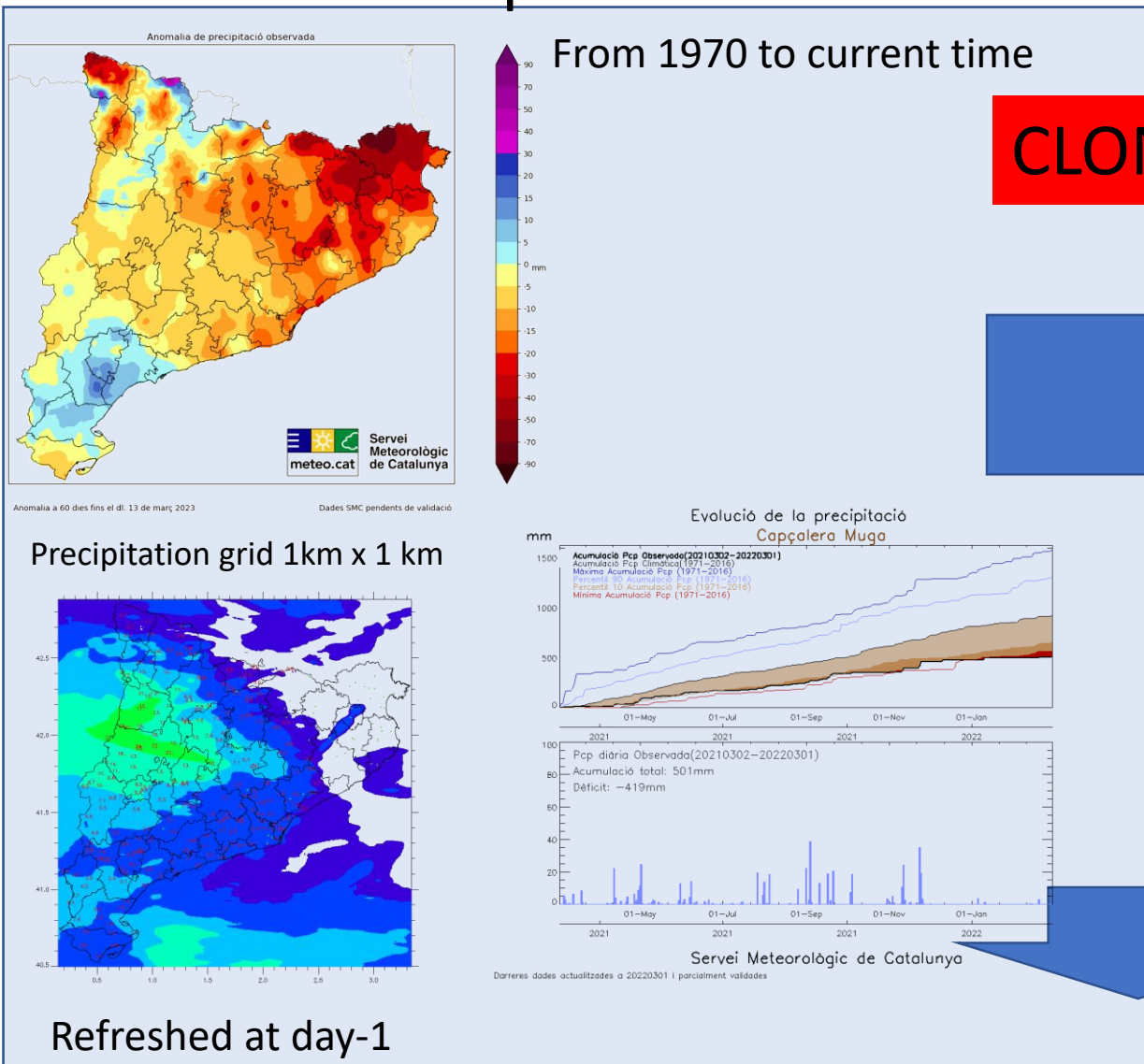
SMC and IRTA currently provide farmers with ETo or ET **near-real-time** data to improve scheduling irrigation shifts over the following days:

- **SMC**: ETo for daylight hours (Benaiges, 2019) using the Penman-Monteith (PM-FAO98) formulation for AWS sites belonging to its network (since 1998).
- **IRTA**: Estimations of actual evapotranspiration (ET) and ETo, based on both in-situ and satellite observations using the two-source energy balance (TSEB) modelling approach with Copernicus-based inputs.

➔ WATERING RECOMMENDATION

Motivation

Precipitation



ETo

CLONING

ONLY
VALUES AT LOCAL SITES

HIGH DATA REQUIREMENTS

TEMPERATURE
HUMIDITY
WIND
RADIATION

EVALUATION OF HIDRIC BALANCE, DROUGHT INDEXES, CLIMATE CHANGE IMPACTS

Methodology

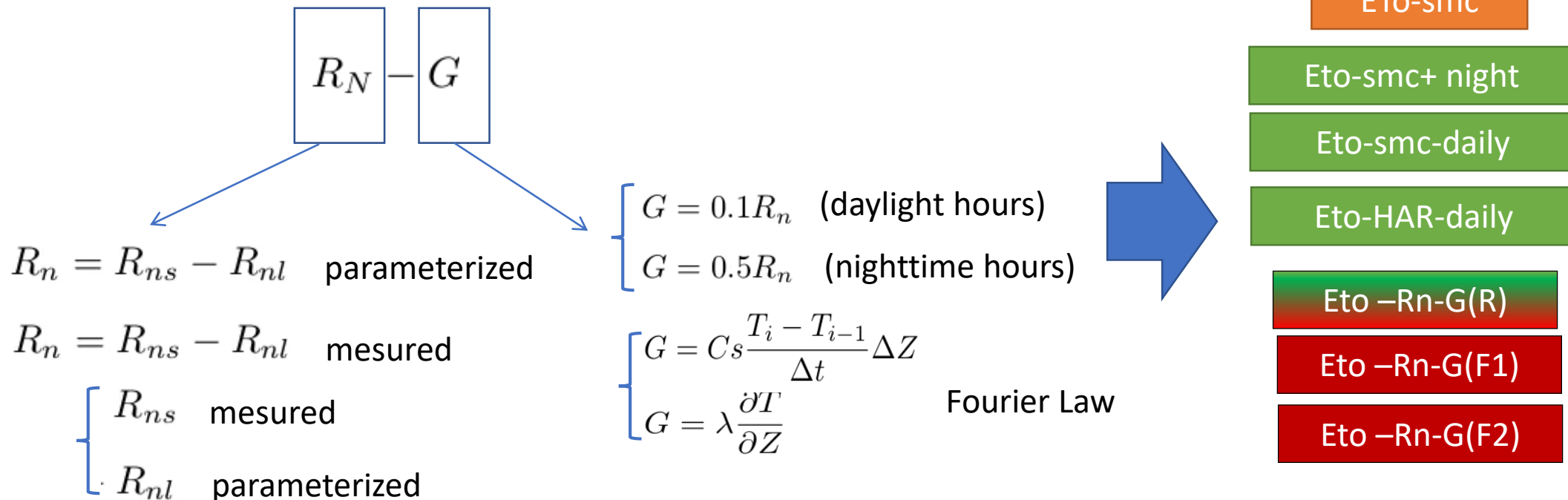
PM-FAO98

PM-FAO98 formula:

$$ET_o = \frac{\text{Radiative contribution} + \text{Advective contribution}}{\Delta + \gamma(1 + 0,34u_2)}$$

$$ET_o = \frac{0,408\Delta(R_N - G) + \gamma \frac{37}{T+273} u_2 (e(T) - e_a)}{\Delta + \gamma(1 + 0,34u_2)}$$

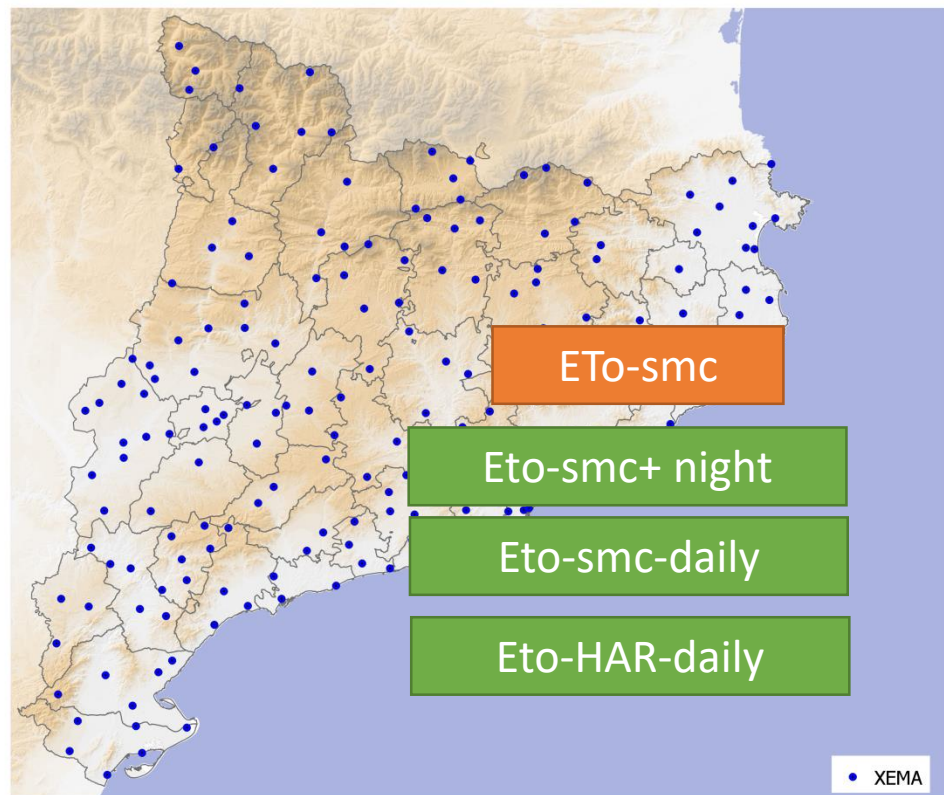
at hourly time step



Methodology

PART-I

Xarxa d'estacions meteorològiques automàtiques



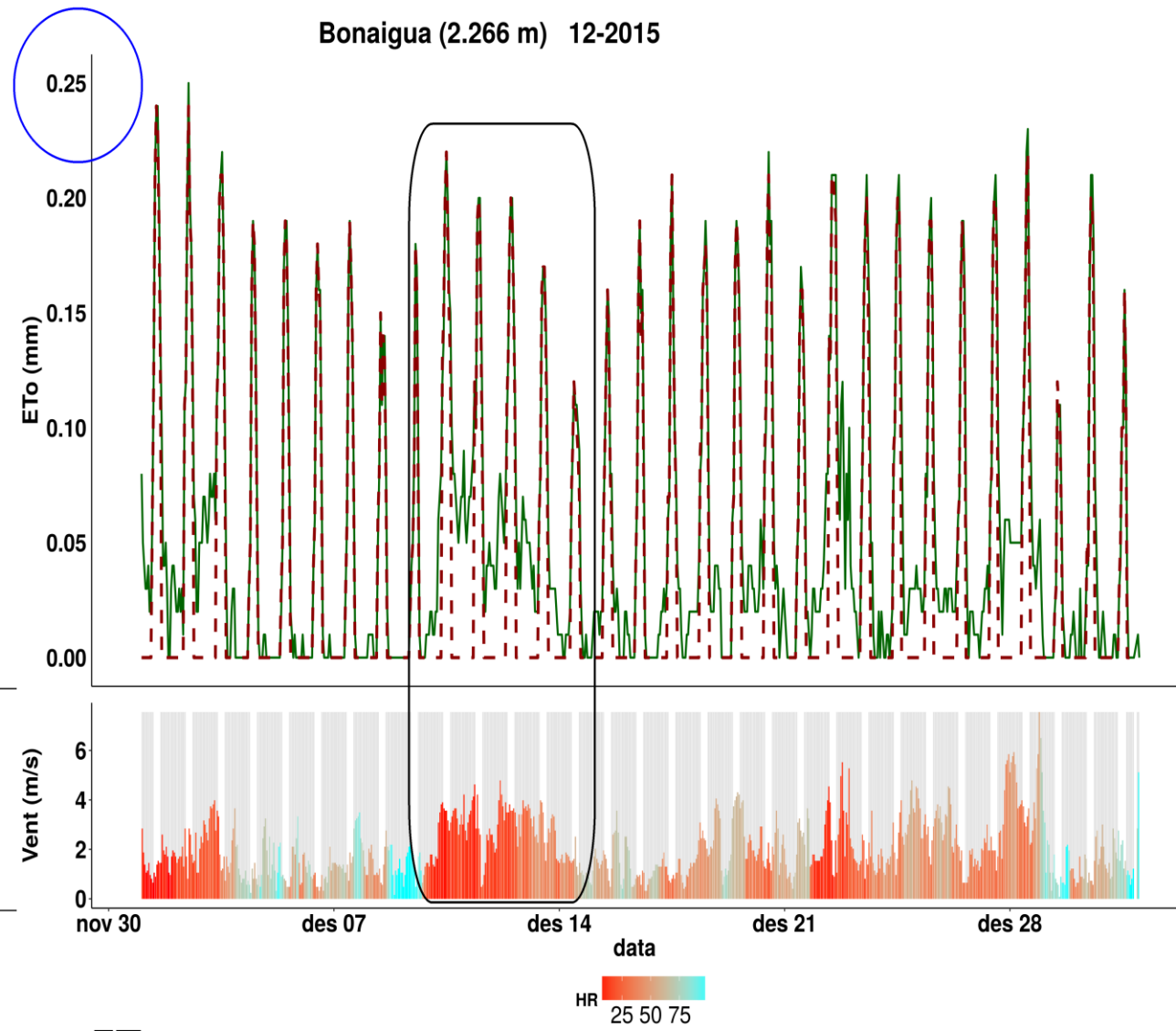
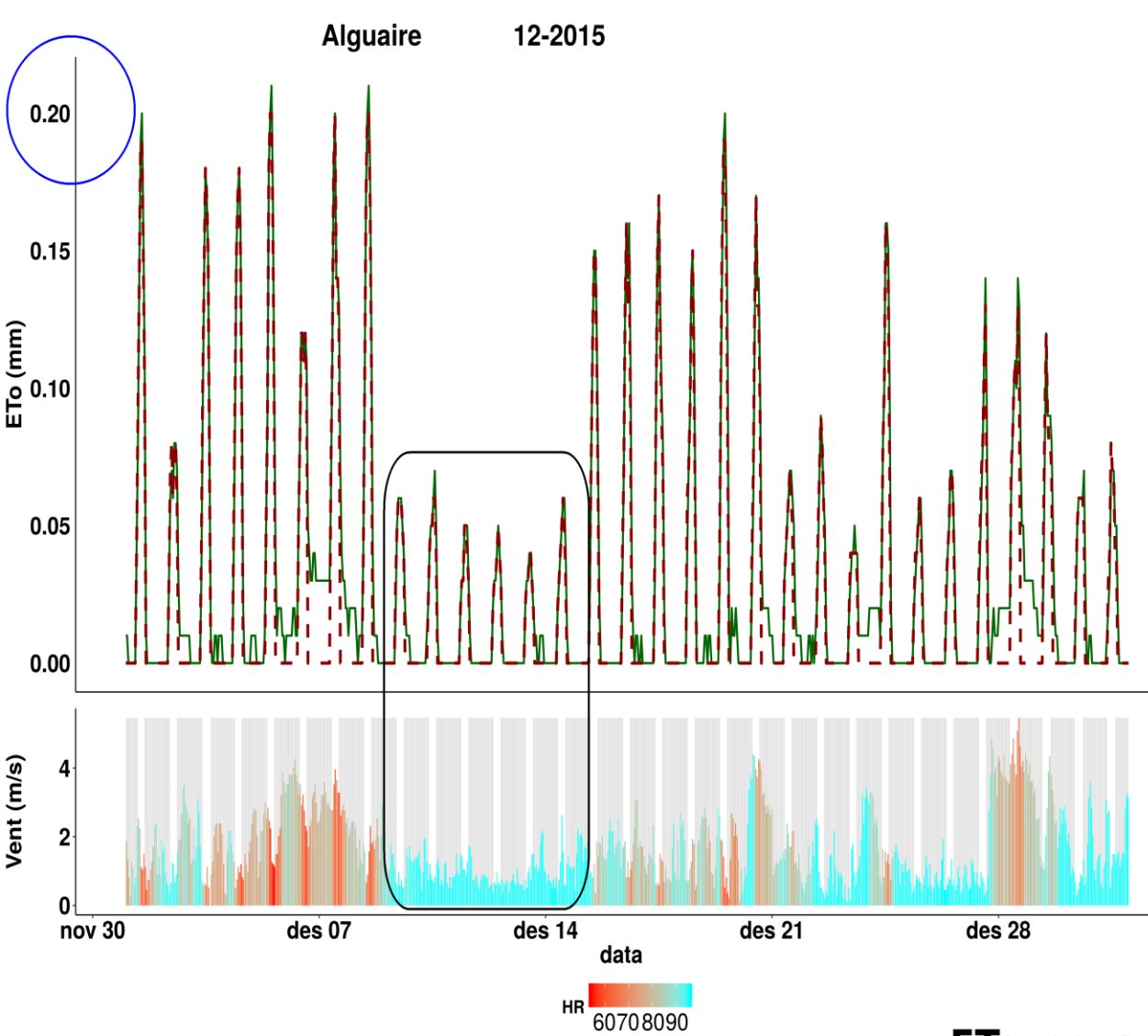
Summer: 2021,2022, Desember 2015, February 2014

PART-II



PERIOD: 1997-2022

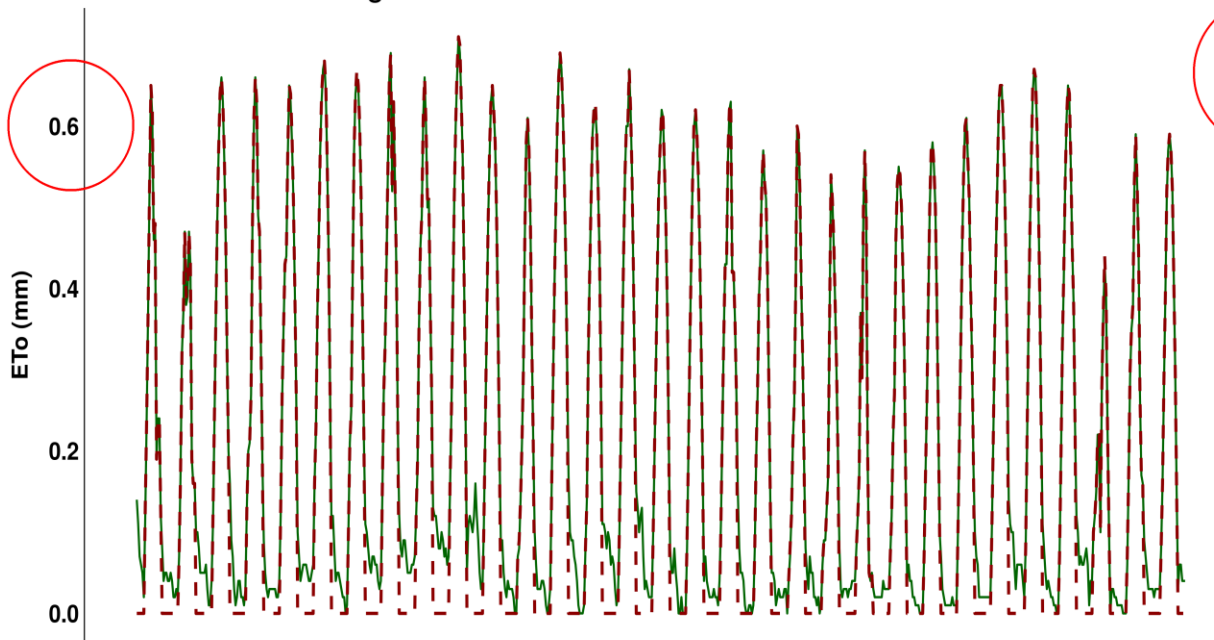
Results and comparison PART-I



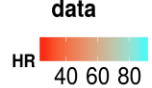
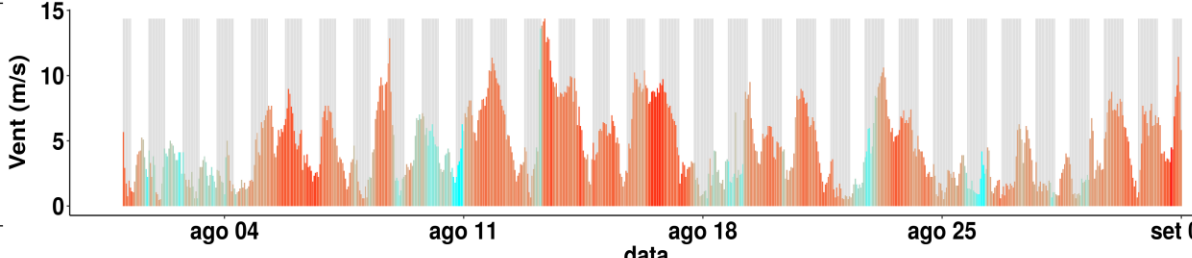
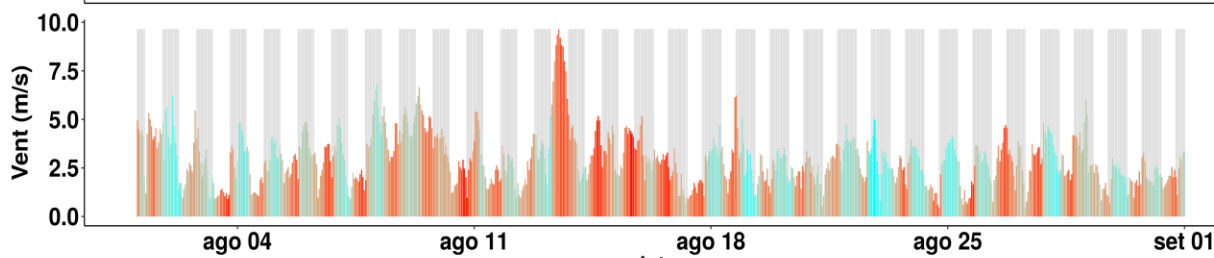
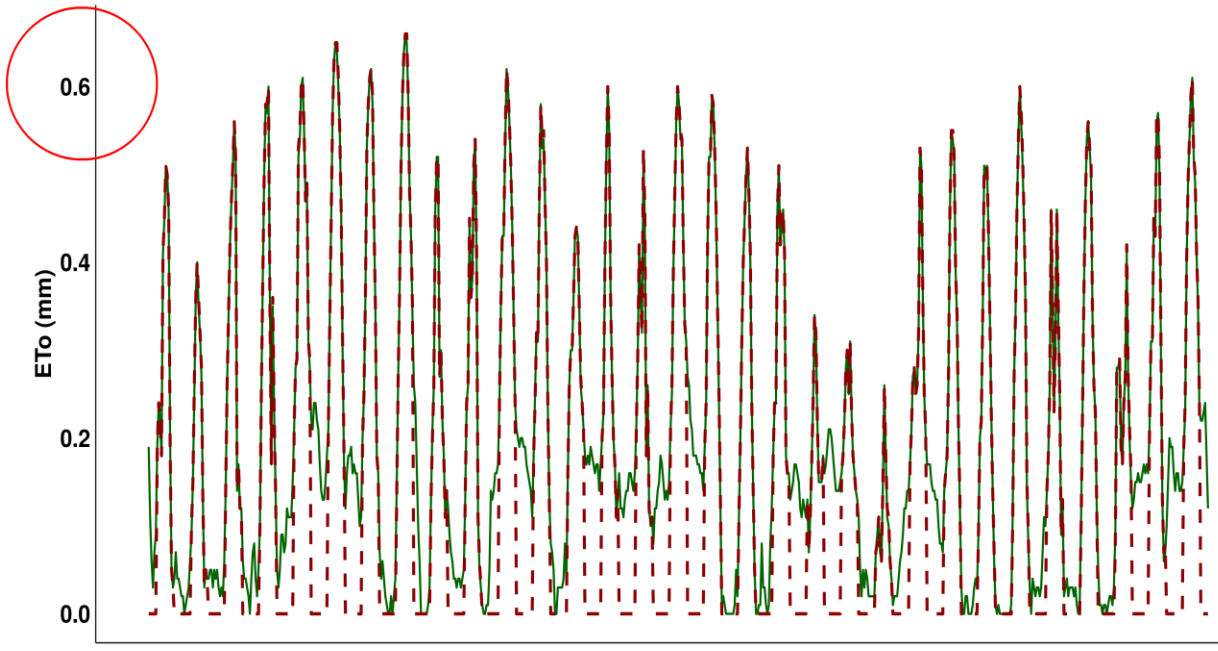
— ETo_nova — ETo_smc

Results and comparison PART-I

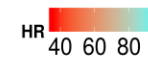
Alguaire 08-2014



Portbou 08-2014

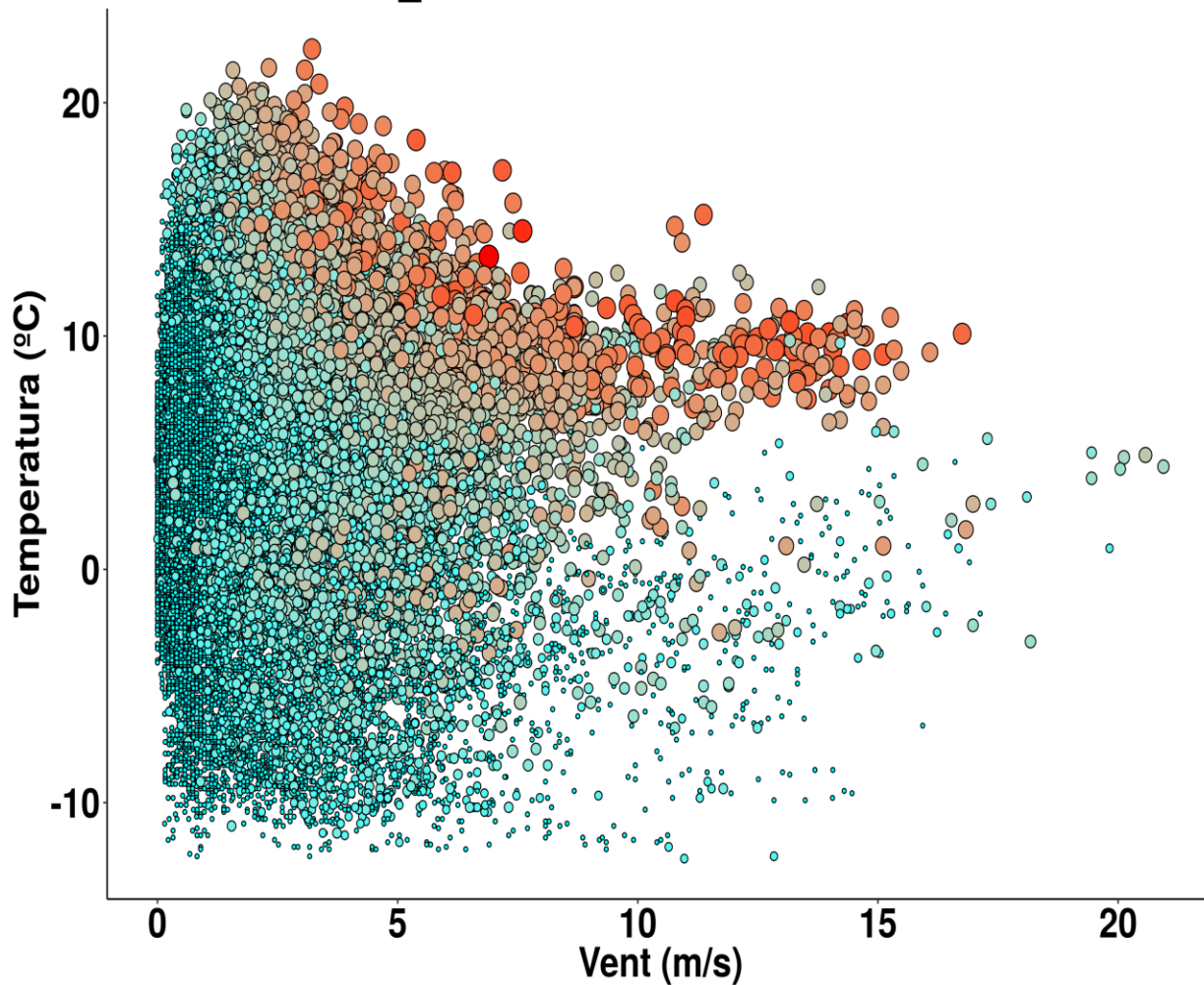


— ETo_nova — ETo_smc



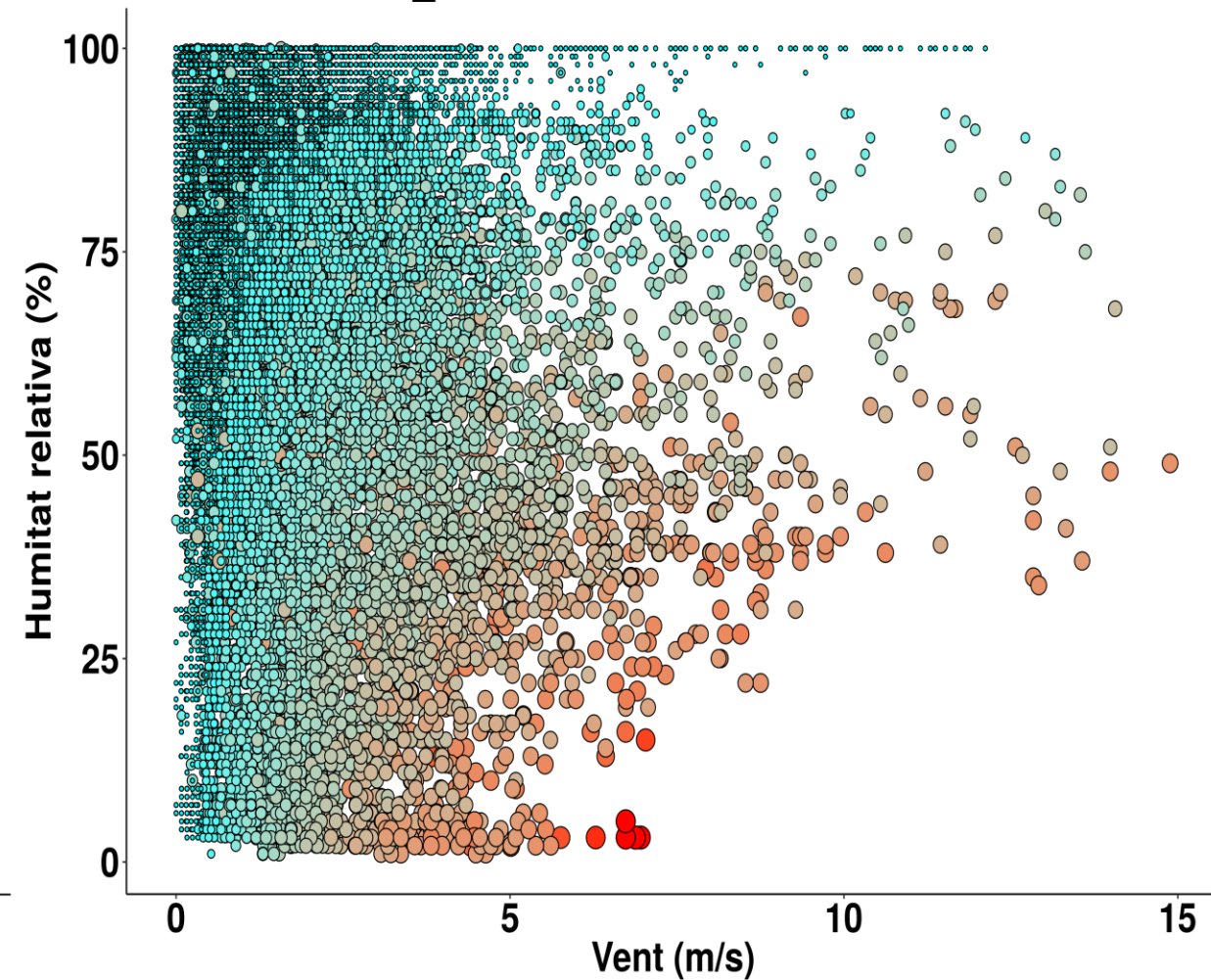
Results and comparison PART-I

ETo_nova horària nocturna: 02/2014



ETo (mm) · 0.00 · 0.05 · 0.10 · 0.15 · 0.20

ETo_nova horària nocturna: 12/2015



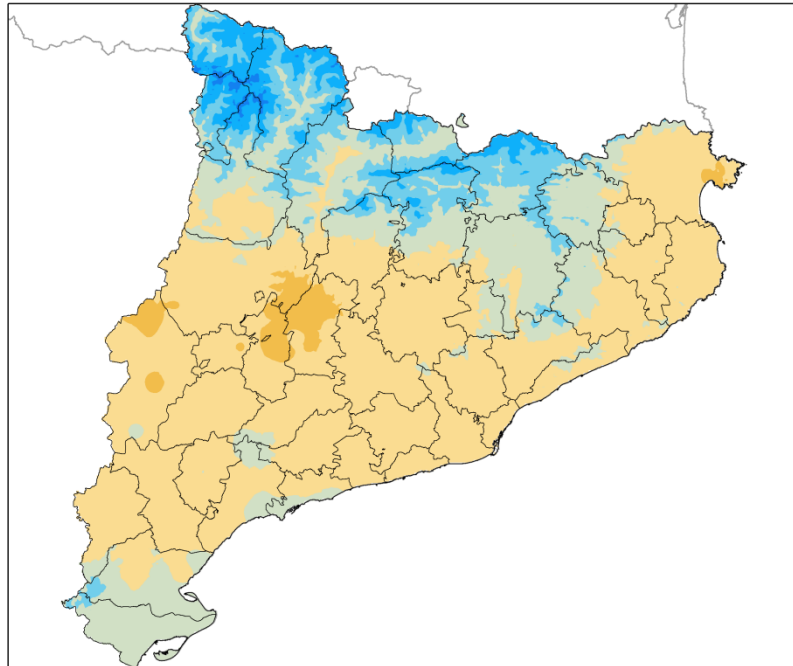
ETo (mm) · 0.00 · 0.05 · 0.10 · 0.15 · 0.20

Results and comparison PART-I

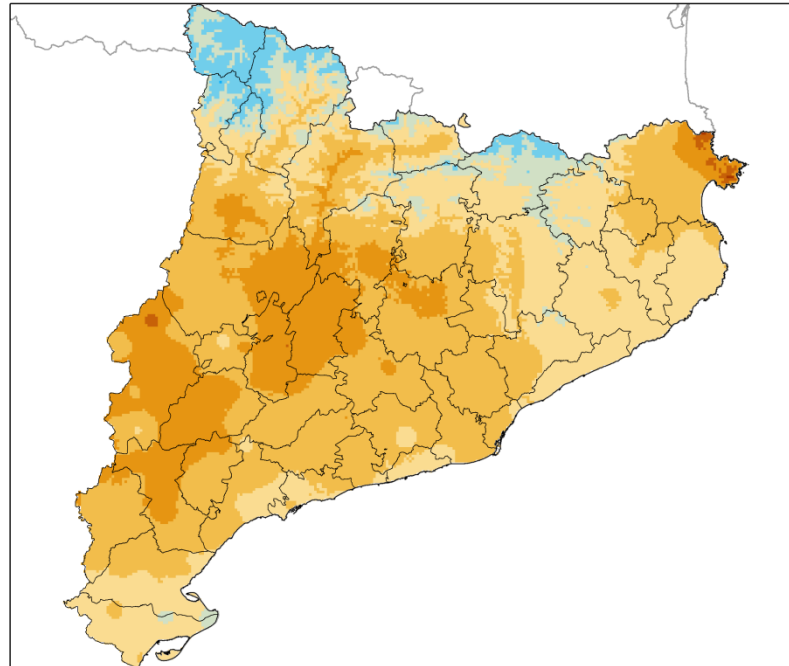
PERIOD:01/06/2021 to 31/08/2021

Eto-SMC+NIGHT

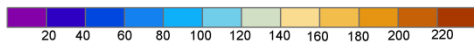
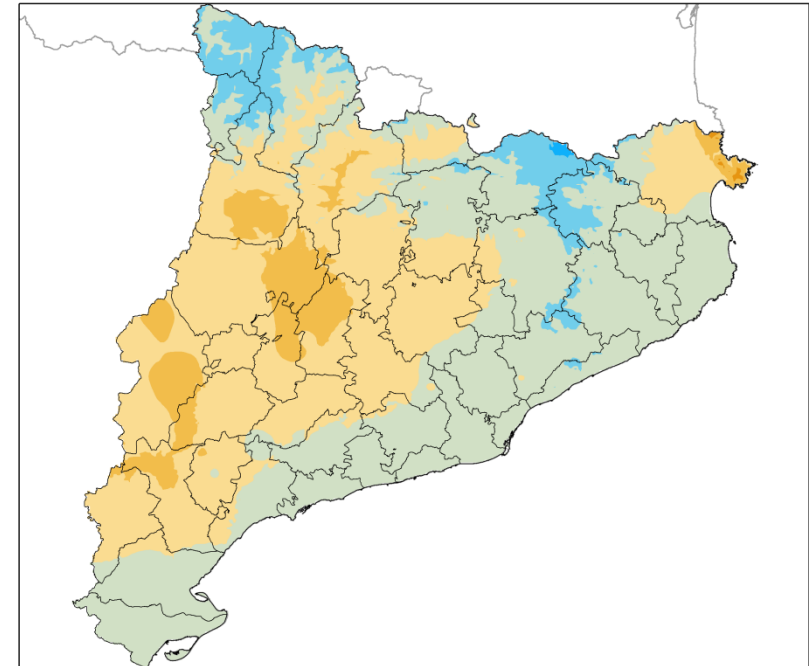
ETO JUNY 2021



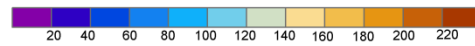
ETO JULIOL 2021



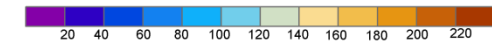
ETO AGOST 2021



 Servei Meteorològic de Catalunya
meteo.cat



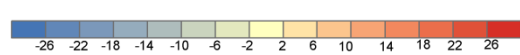
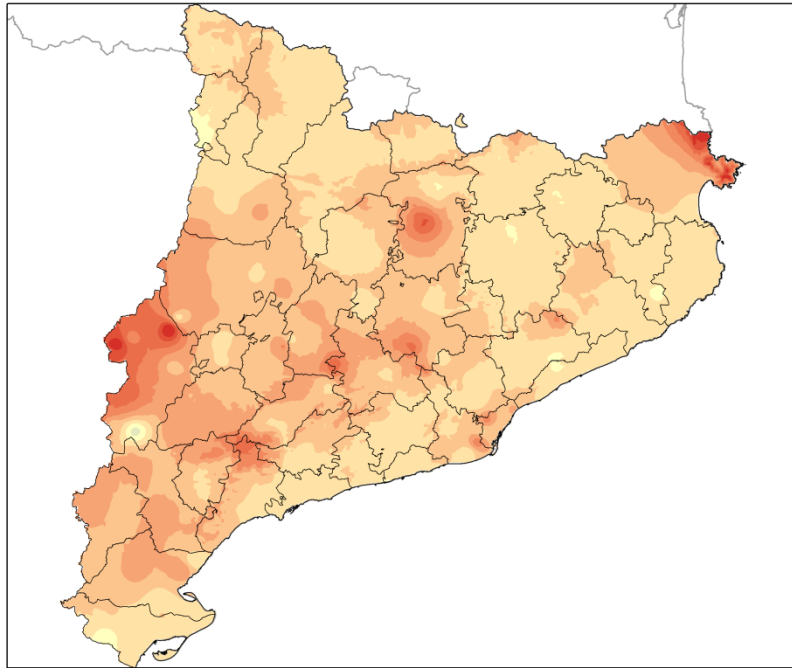
 Servei Meteorològic de Catalunya
meteo.cat



 Servei Meteorològic de Catalunya
meteo.cat

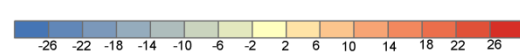
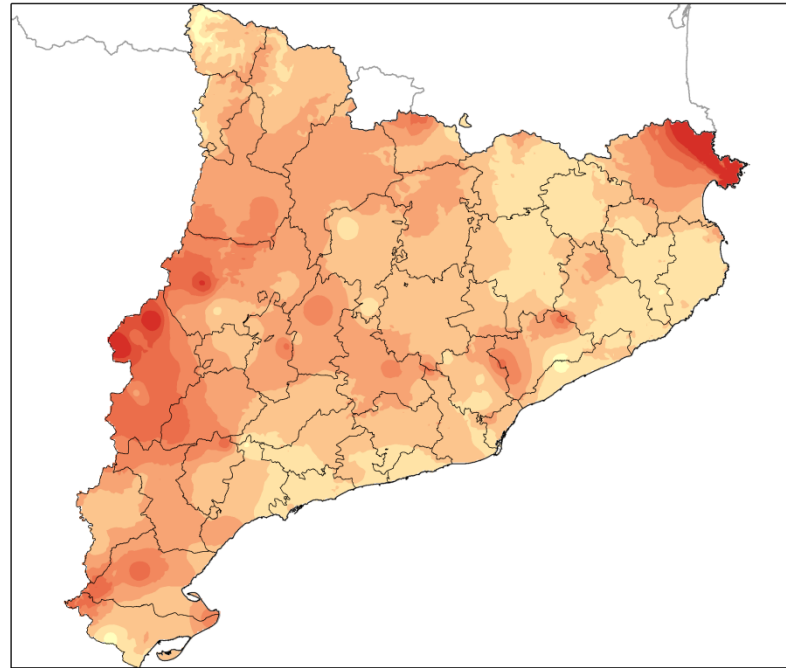
Results and intercomparison PART-I

ΔETo (ETo_smc2-ETo_smc1)



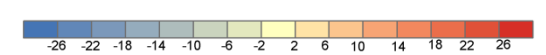
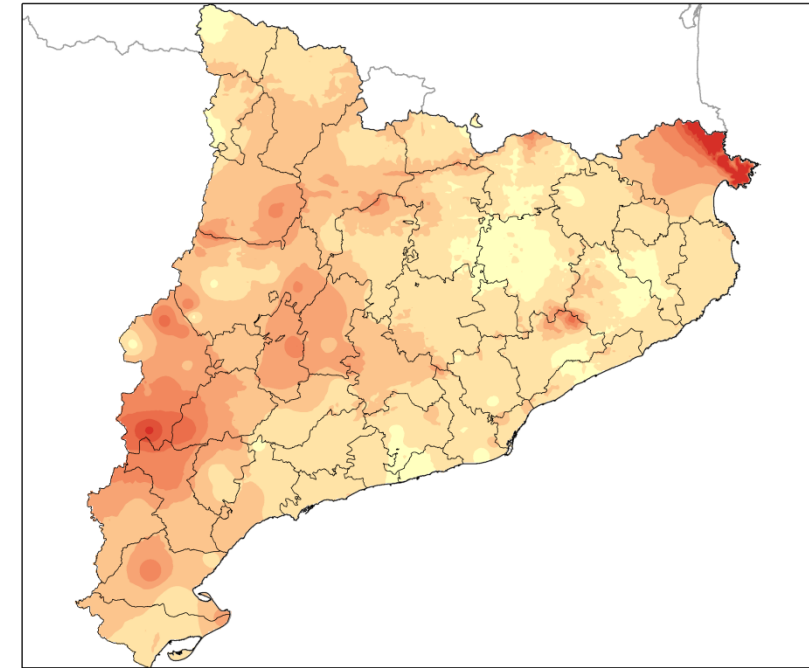
Servei Meteorològic de Catalunya

JUNE 2021



Servei Meteorològic de Catalunya

JULY 2021

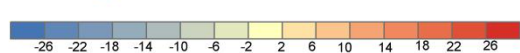
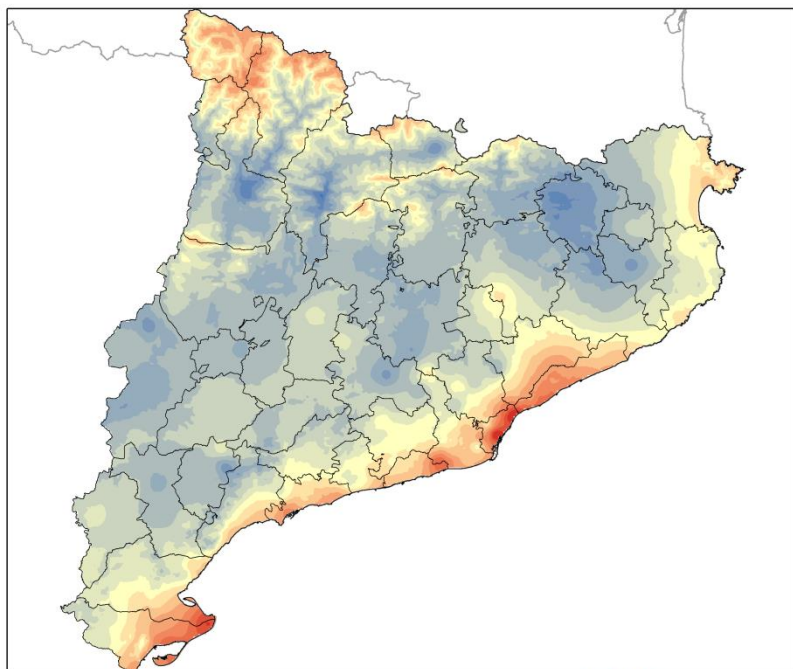


Servei Meteorològic de Catalunya

AUGUST 2021

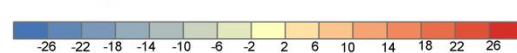
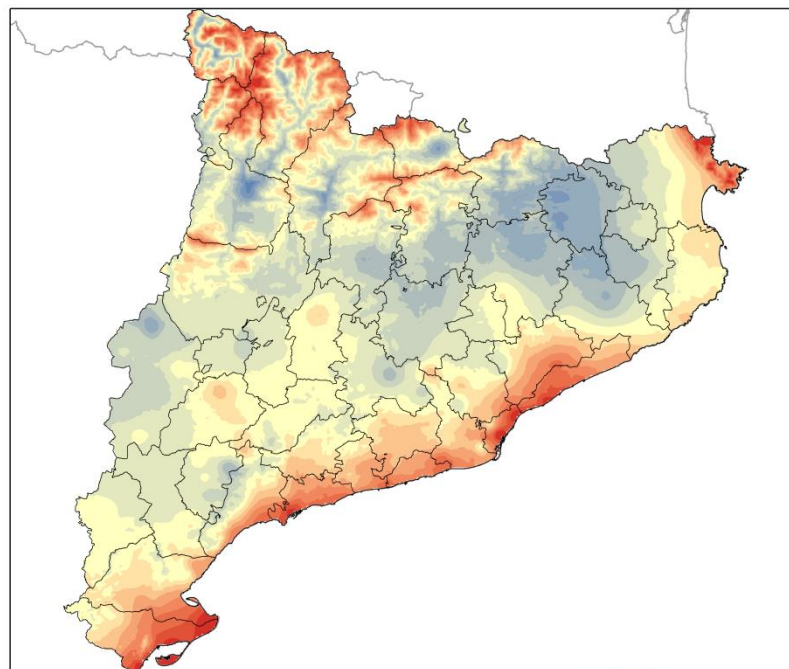
Results and intercomparison PART-I

ΔETo (ETo_smc2- Eto_daily_HAR.)



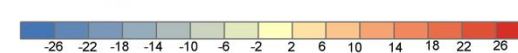
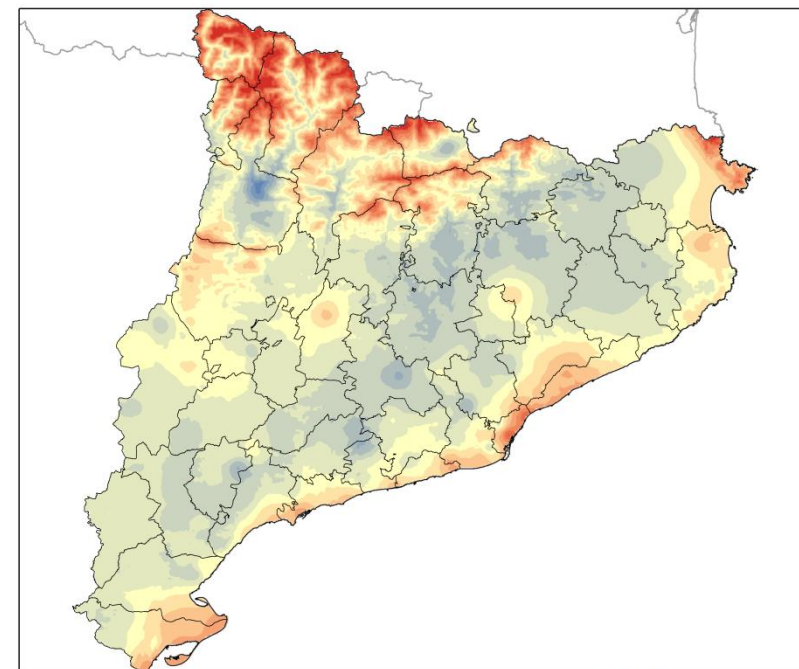
meteo.cat
Servei Meteorològic de Catalunya

JUNE 2021



meteo.cat
Servei Meteorològic de Catalunya

JULY 2021

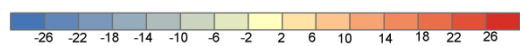
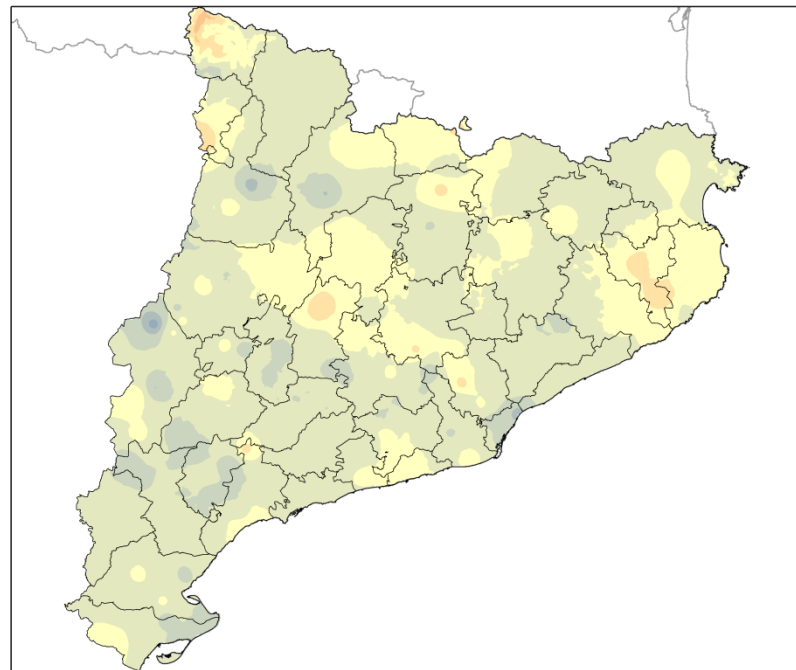


meteo.cat
Servei Meteorològic de Catalunya

AUGUST 2021

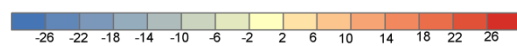
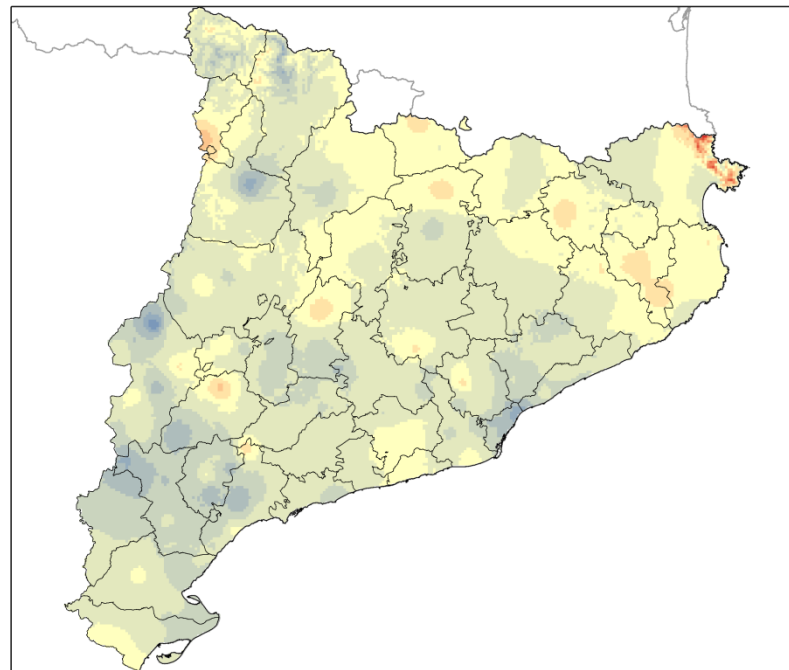
Results and intercomparison PART-I

ΔETo (Eto_smc2- Eto_daily)



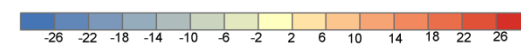
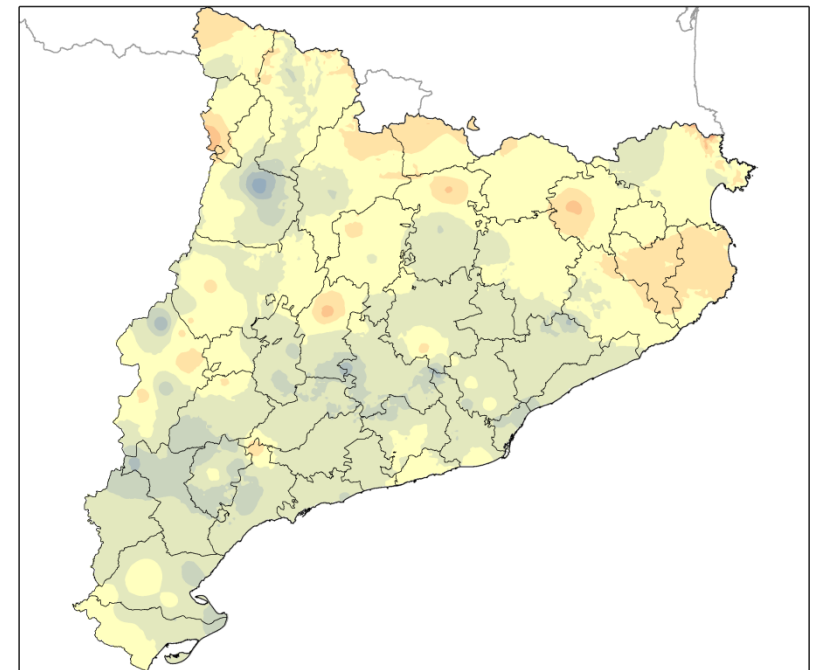
meteo.cat
Servei Meteorològic
de Catalunya

JUNE 2021



meteo.cat
Servei Meteorològic
de Catalunya

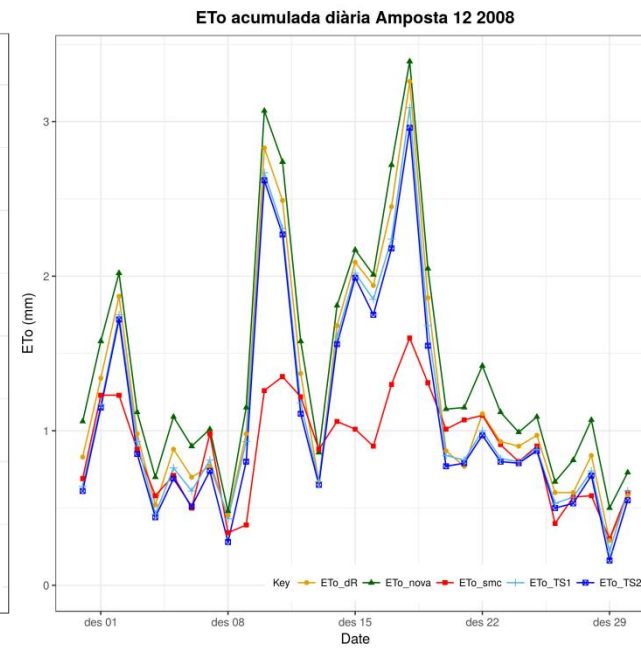
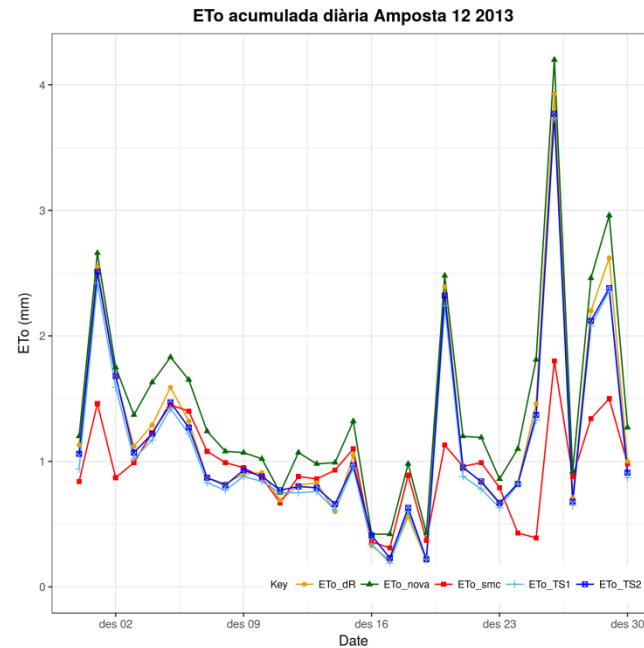
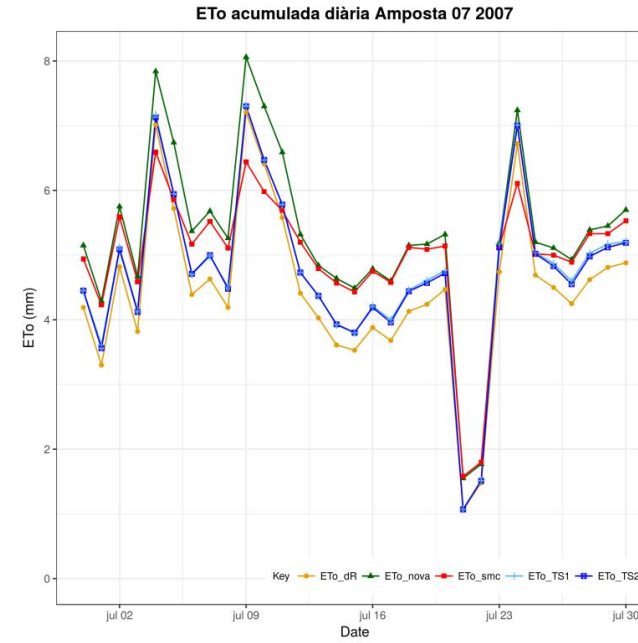
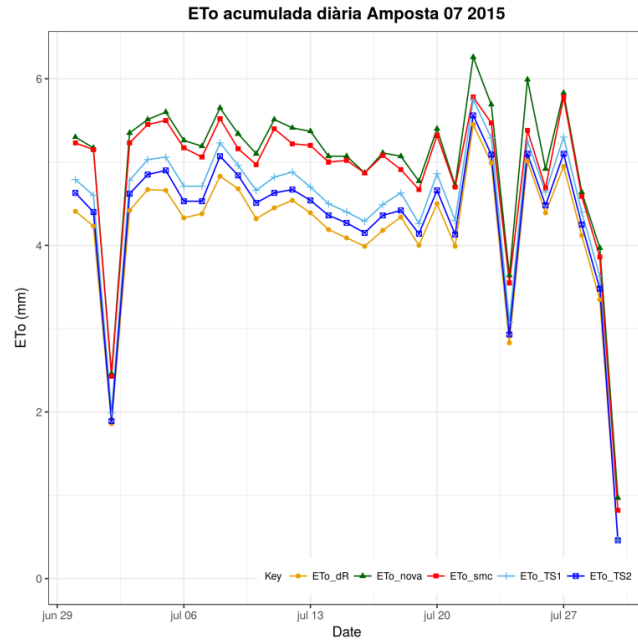
JULY 2021



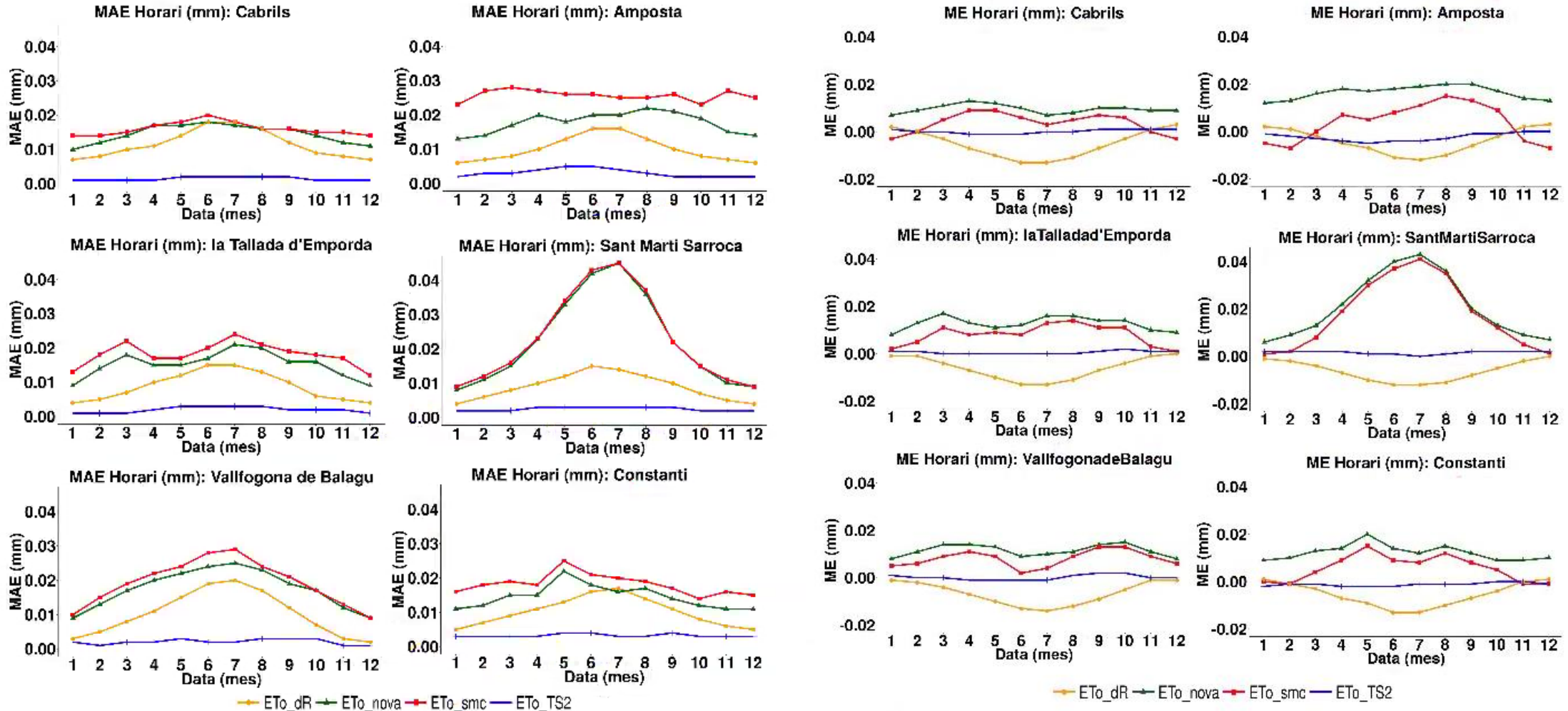
meteo.cat
Servei Meteorològic
de Catalunya

AUGUST 2021

Results and comparison PART-II



Results and comparison PART-II



Further work

ETo-smc

Eto-smc+ night

Eto-smc-daily

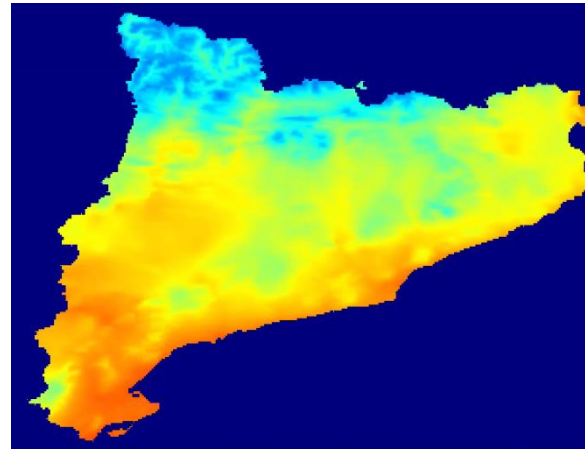
Eto-HAR-daily

Eto -Rn-G(R)

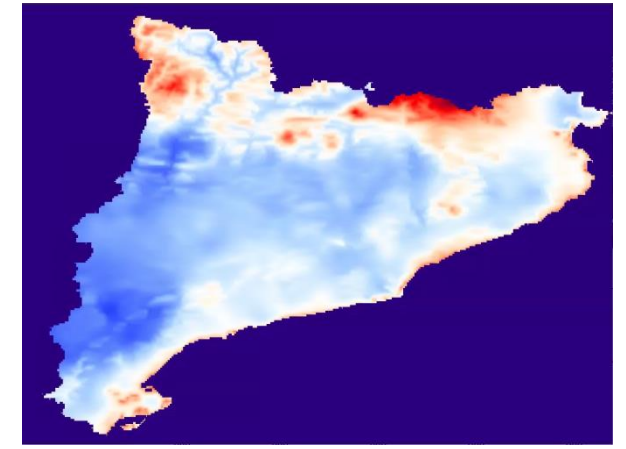
Eto -Rn-G(F1)

Eto -Rn-G(F2)

BIAS CORRECTION
ALGORITHMS

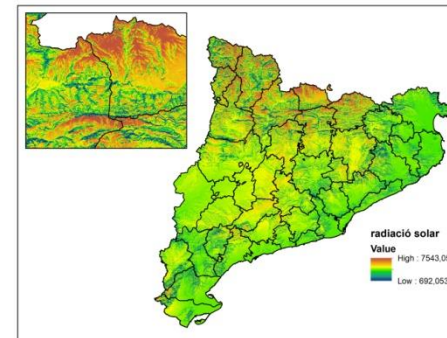
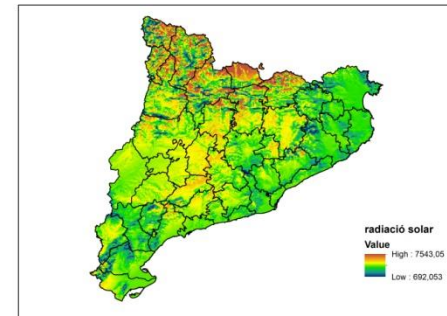
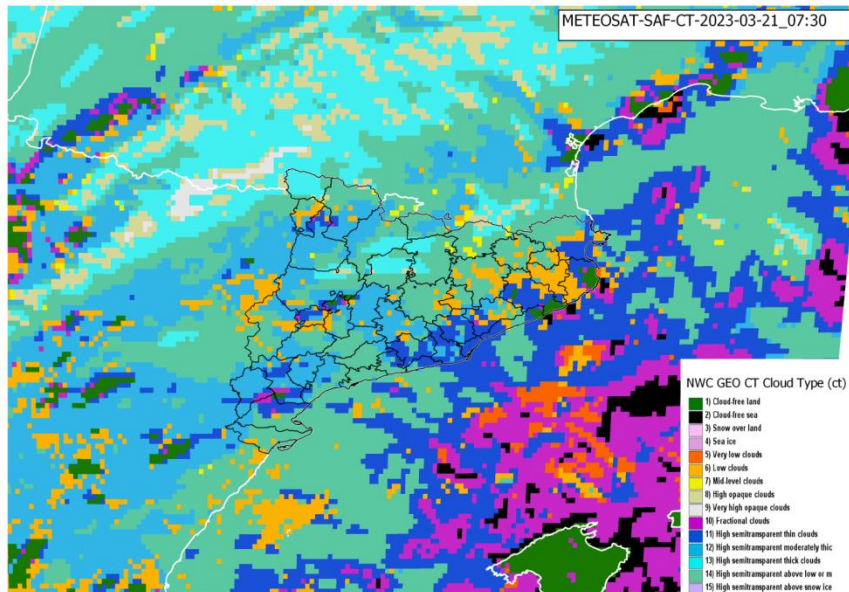


High resolution
hourly HR fields



High resolution
hourly TMP fields

HOURLY SATELLITE ECMWF PRODUCTS



High resolution potential Rs

**THANK YOU
MOLTES GRÀCIES**