

Validation of ELDAS products

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With special thanks to:

Gianpaolo Balsamo, Karim Bergaoui and François Bouyssel (CNRM)

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 - Evaporative fraction
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Models: experimental layout

Centre	SVAT	Land-surface database	Forcings	Soil Moisture Assimilation
<i>CNRM</i>	ISBA	Ecoclimap	Model P, SW, LW	(P), T, RH
<i>DWD</i>	TERRA	Ecoclimap	Model P, SW, LW	T
<i>ECMWF</i>	TESSEL-SCM	GLCC	ELDAS P, SW, LW	T, RH

Validation period: May- October 2000

Land surface control on Evaporative Fraction, Λ

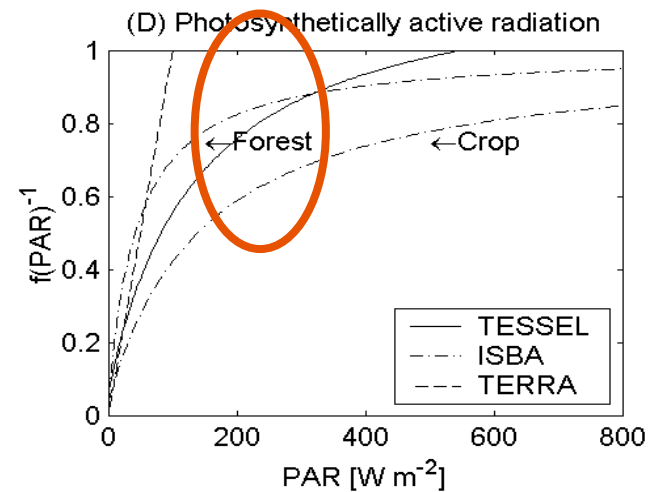
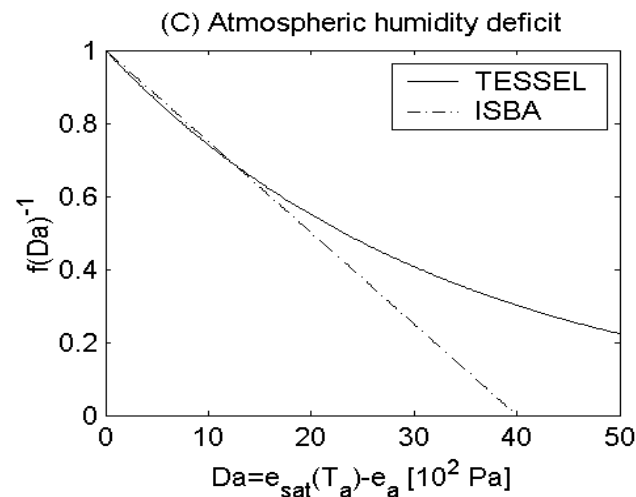
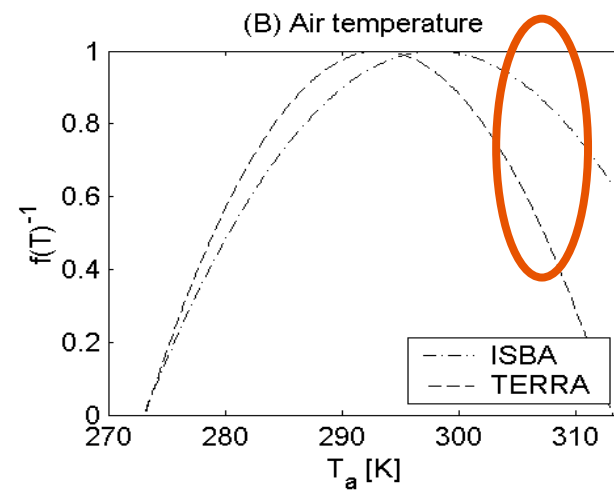
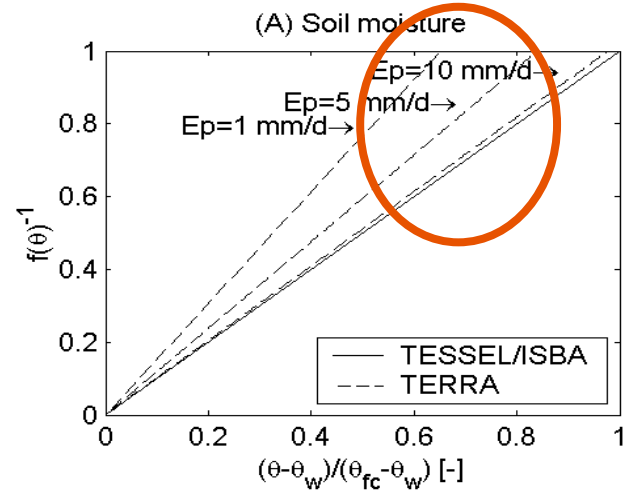
- Aerodynamic transport with additional surface resistance R_s
- Surface resistance related to environmental variables through empirical relationships $f(x)$
- Soil moisture only 'slow' variable
- Also part of prognostic soil moisture equation

$$\Lambda = \frac{\lambda E}{H + \lambda E}$$

$$E = \frac{veg}{R_a + R_s} (q_{sat}(T_s) - q_a)$$

$$R_s = \frac{R_{s,min}}{LAI} \prod_{i=1}^n f(x_i)$$

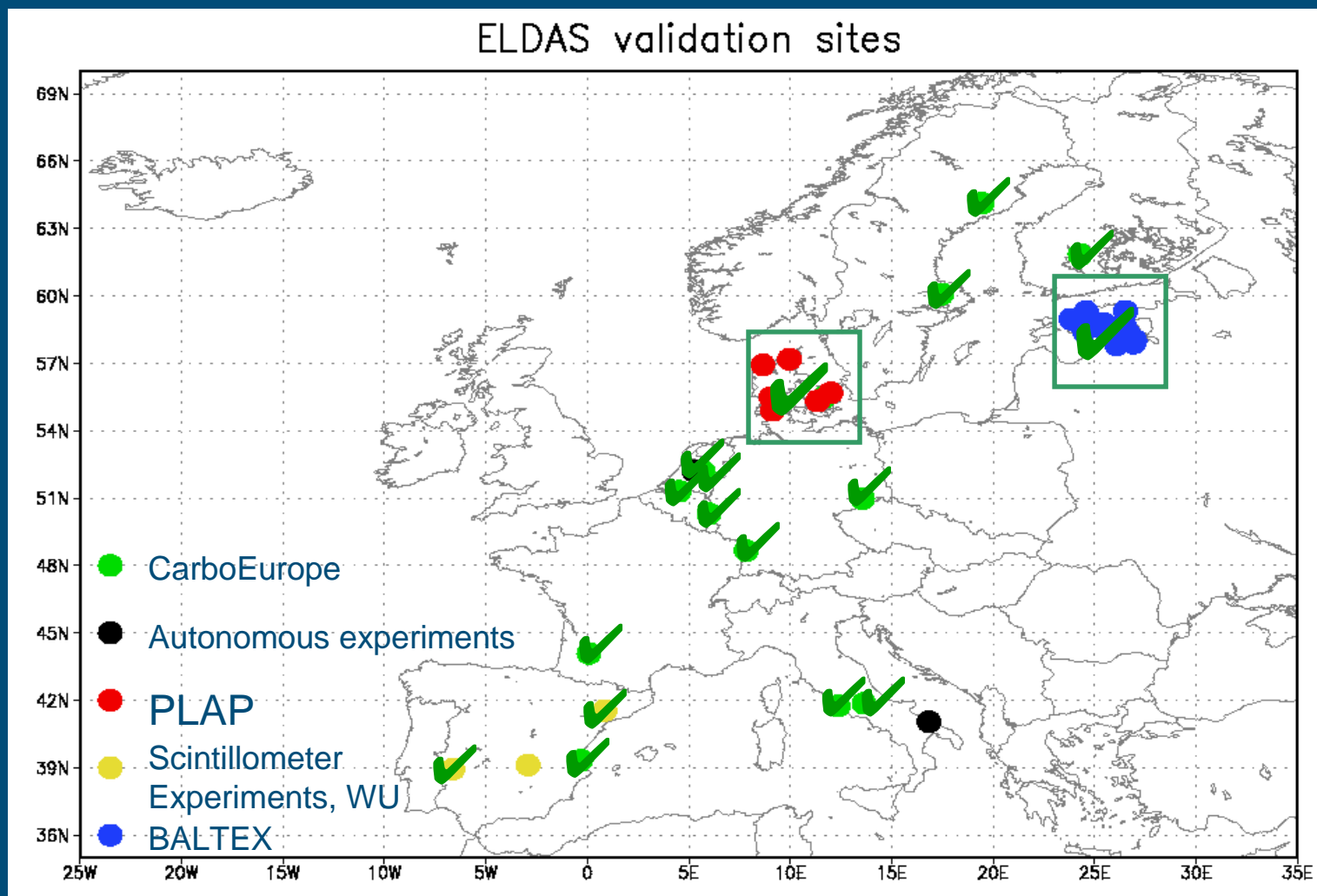
Resistance factors $f(x)$



Water holding capacity (mm)*

<i>Soil</i>	TERRA	TESSEL	ISBA
<i>Sand</i>	154 (196)		73
<i>Sandy loam</i>	160 (260)		82
<i>Loam</i>	230 (340)	152	88
<i>Loamy clay</i>	185 (370)		89
<i>Clay</i>	206 (463)		85

Validation sites



Flux Sites 1: CarboEurope Sites



- Forest sites
- On tall towers
- Various fluxes, precipitation, some soil moisture observations
- Validation focus Λ , P-E

Flux Sites 2: Scintillometer Sites (WU)

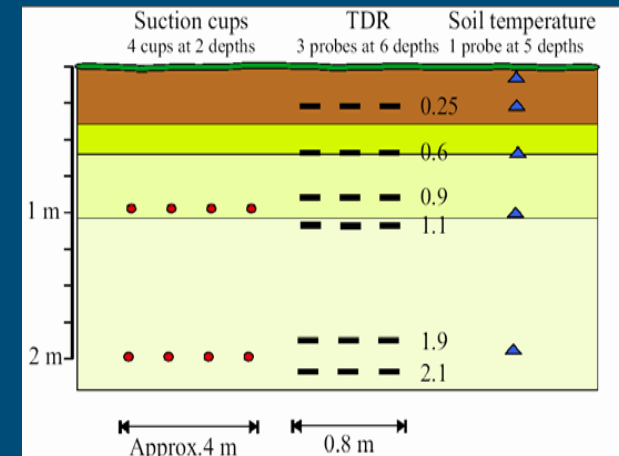


- Sensible heat flux
- Heterogeneous area, average over 1-5 km
- Latent heat flux: indirect (from surface energy balance)

Soil Moisture Sites



- Agricultural Area
- Precipitation and soil moisture measurements
- Sometimes many details in space and/or time, but hardly any additional data
- Validation focus soil moisture



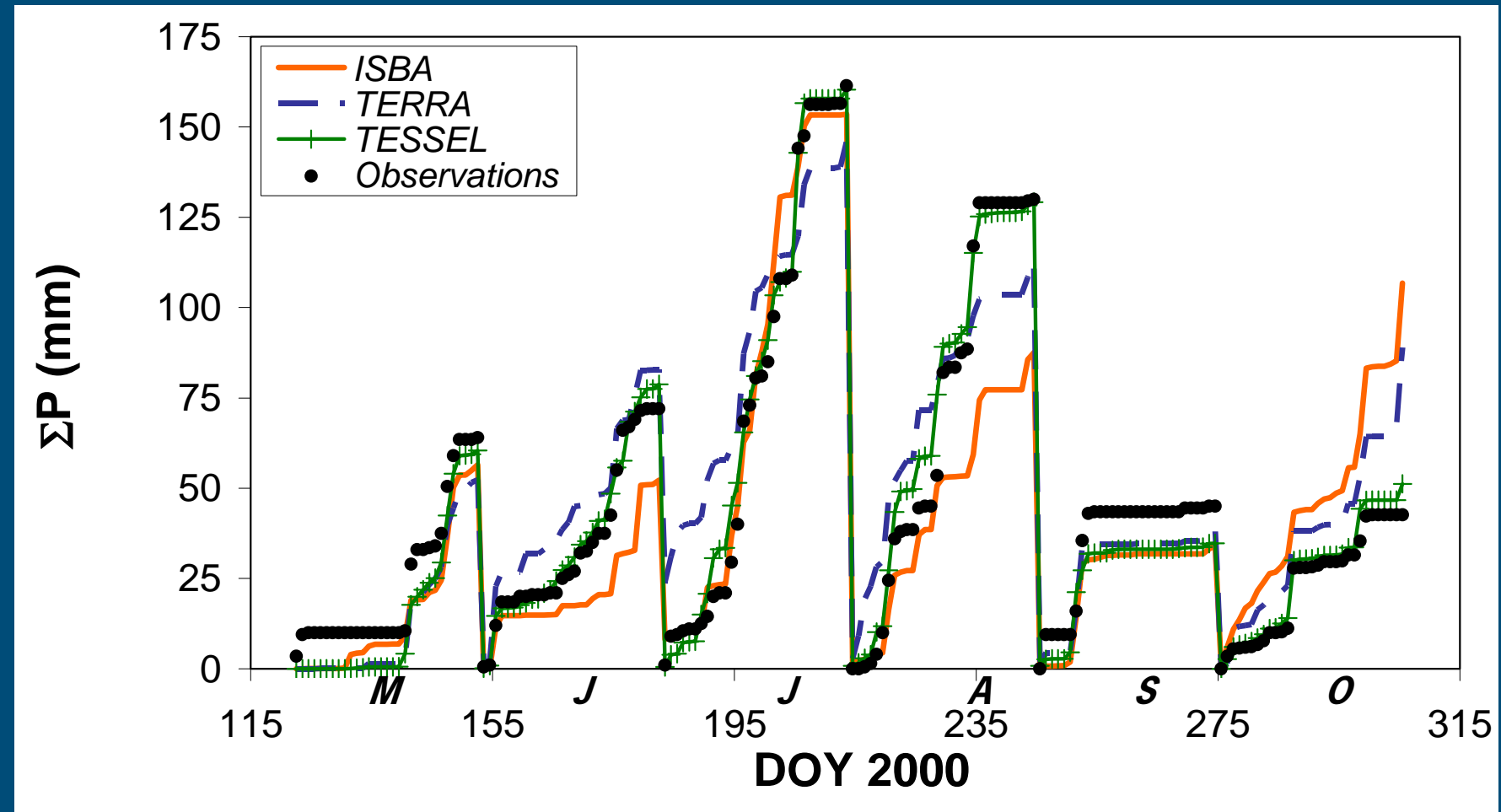
Validation of P-E (+ Incr)

- Soil water balance in the models (no snow):

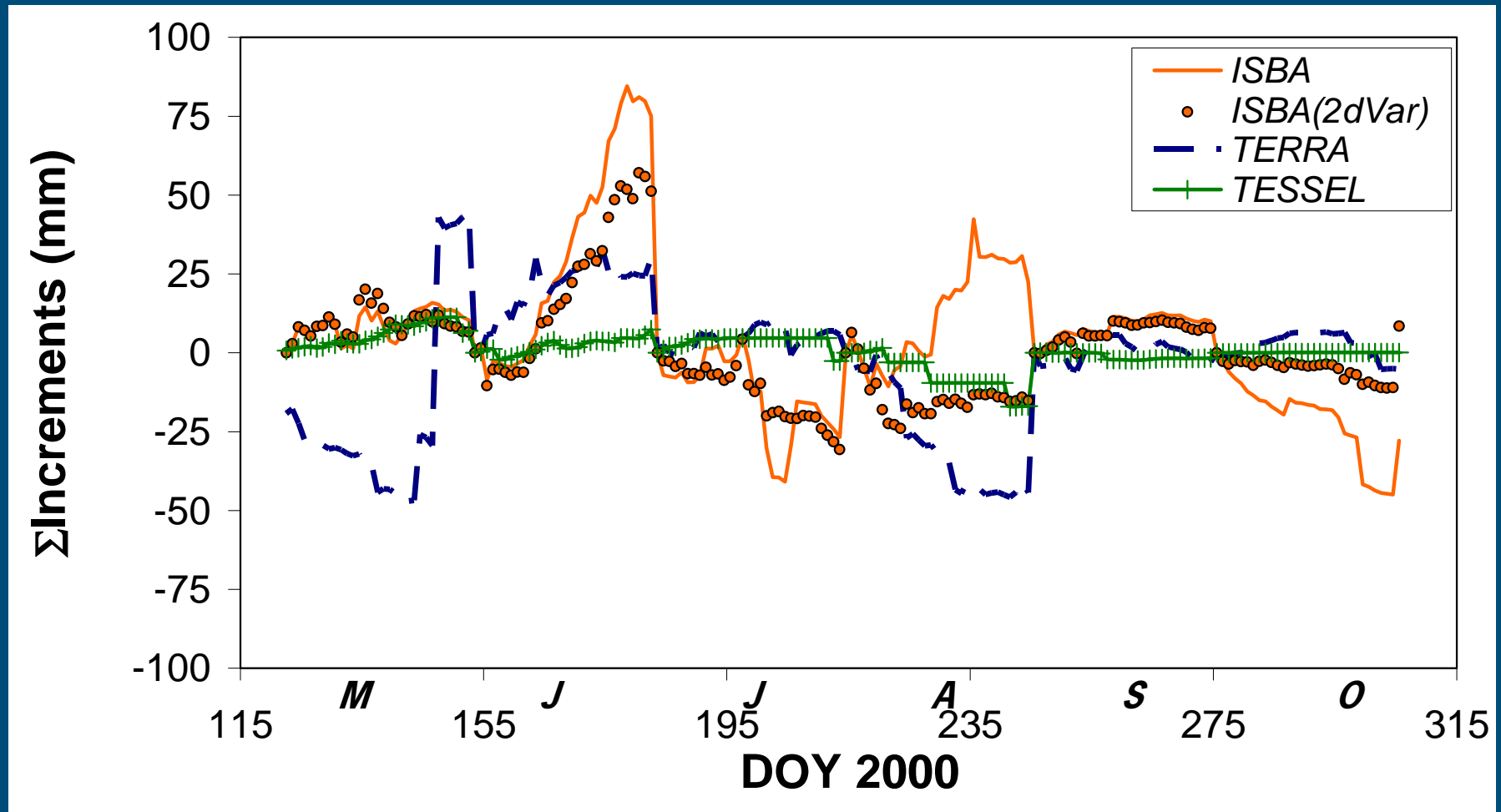
$$\partial W / \partial t = P - E + \text{Incr} - (R + D) \quad [1]$$

- P-E
 - is available from in situ observations at “flux sites”
 - is the main component in [1]
- Validation of monthly sums for 13 sites

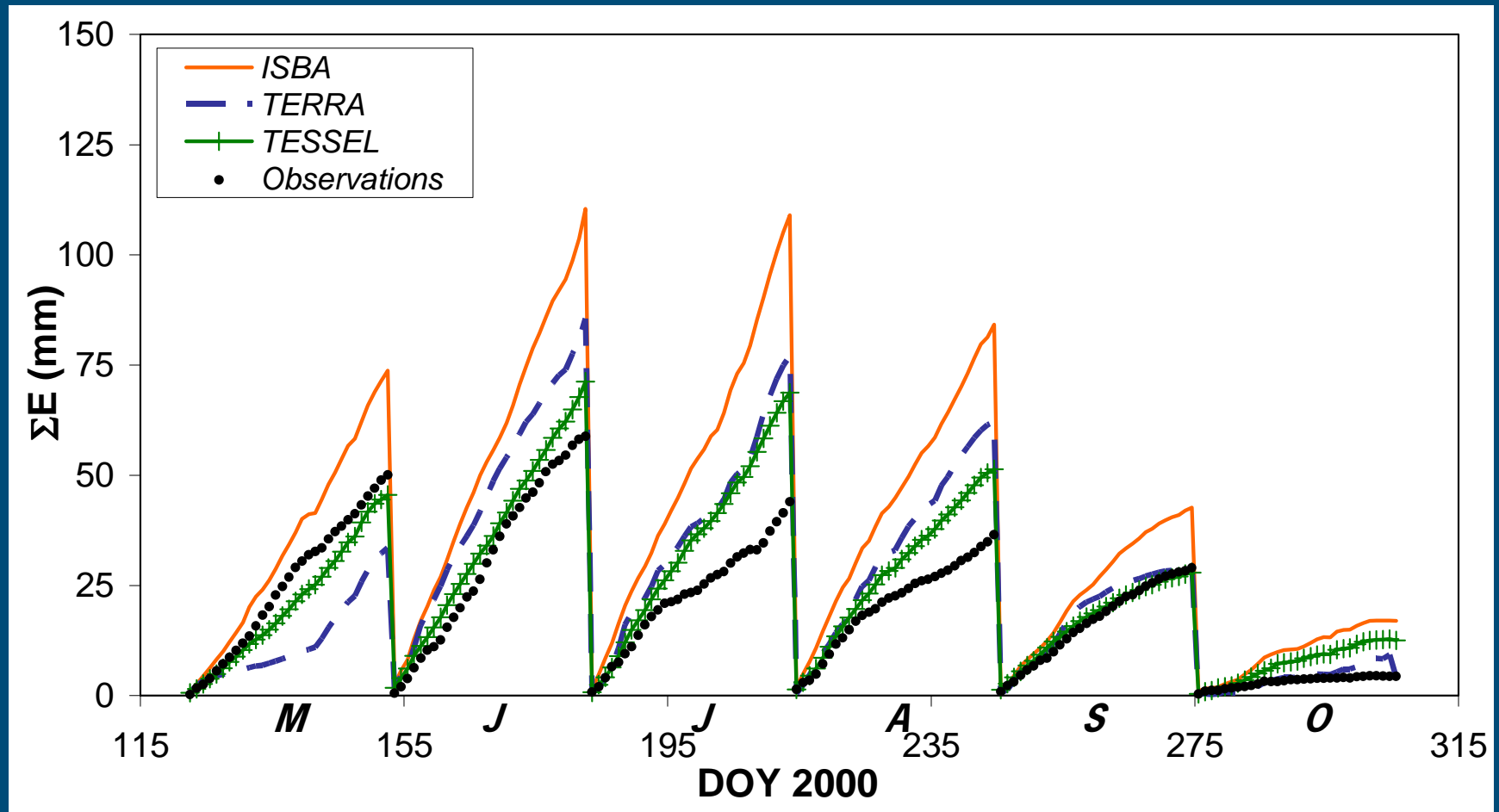
P for Flakaliden (SW)



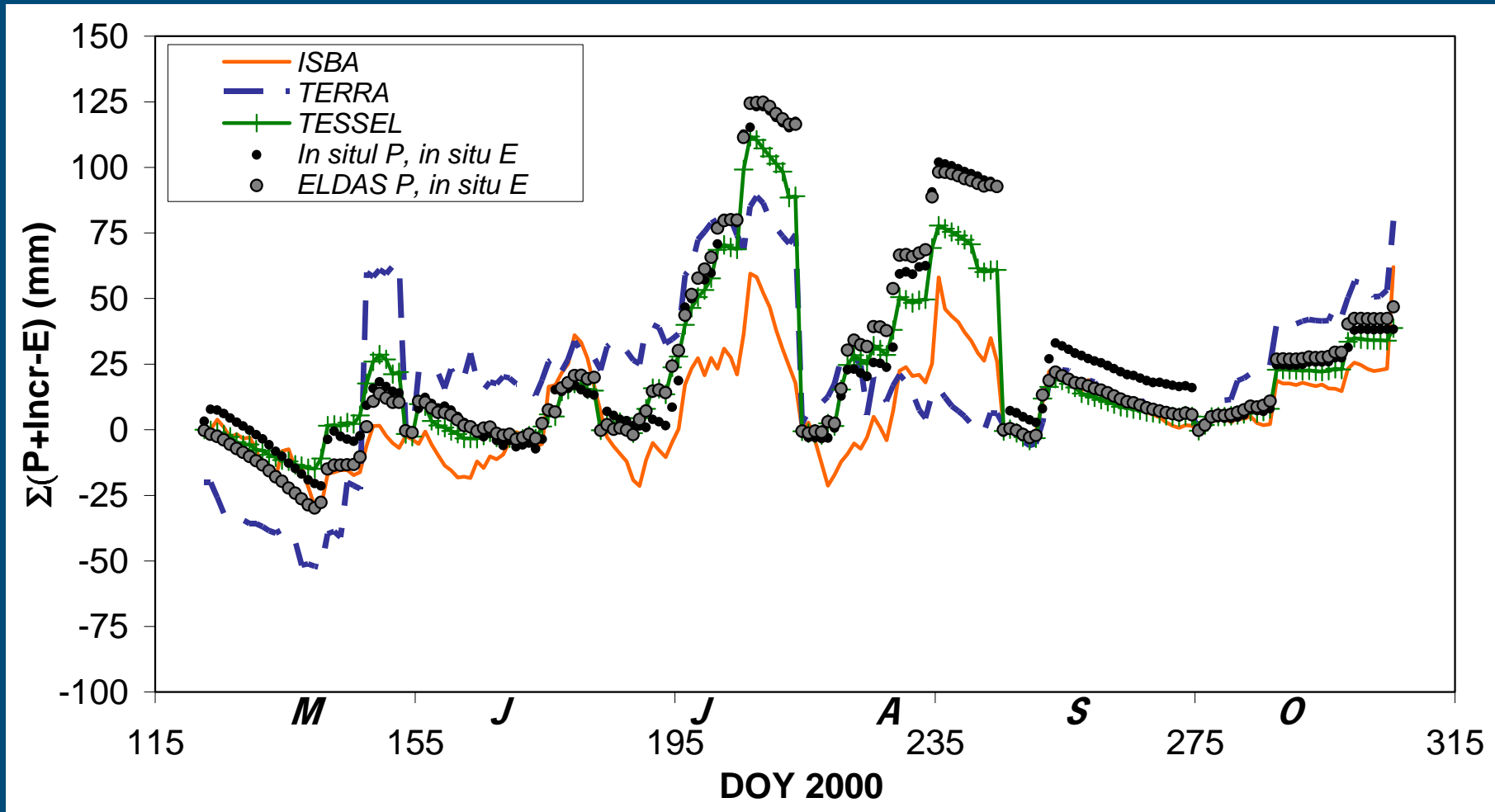
Incr for Flakaliden (SW)



E for Flakaliden (SW)

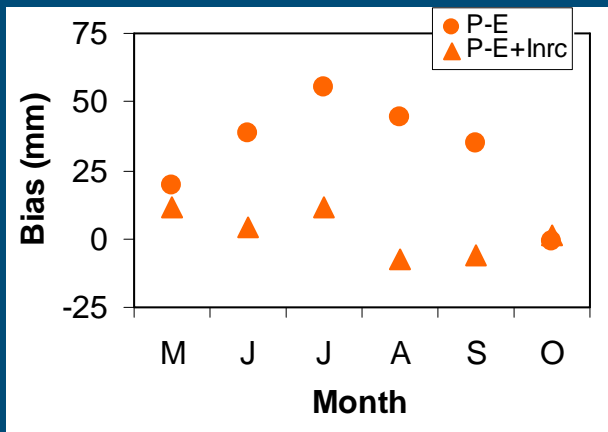


P-E and P-E+Incr for Flakaliden (SW)

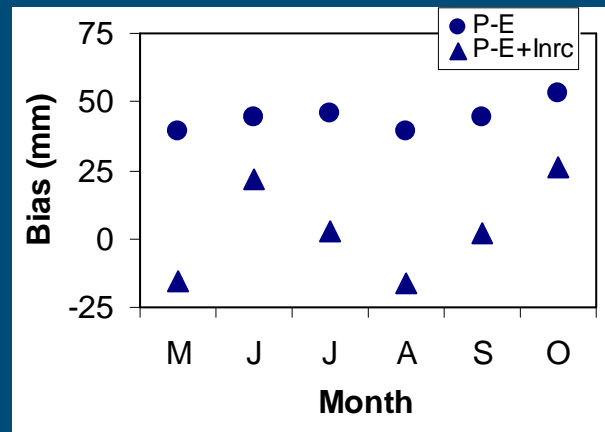


Evaluation of P(Eldas)-E and P(ELDAS)-E+Incr

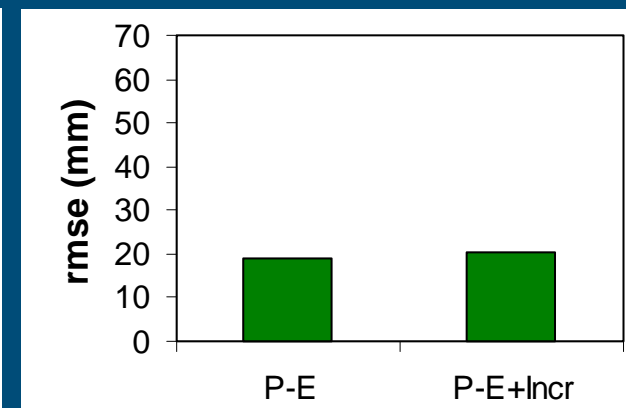
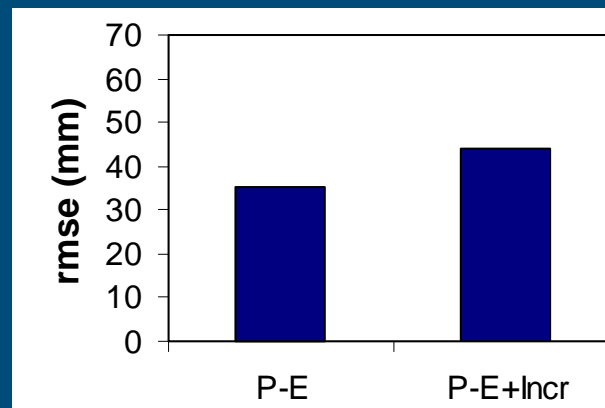
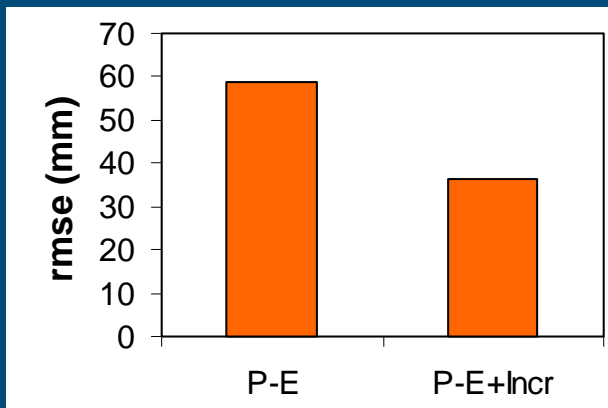
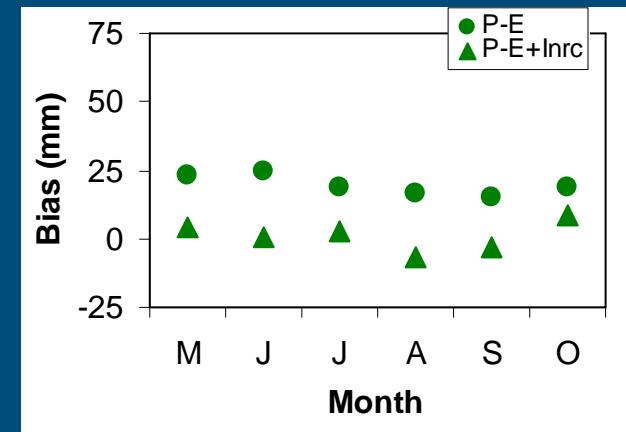
ISBA



TERRA



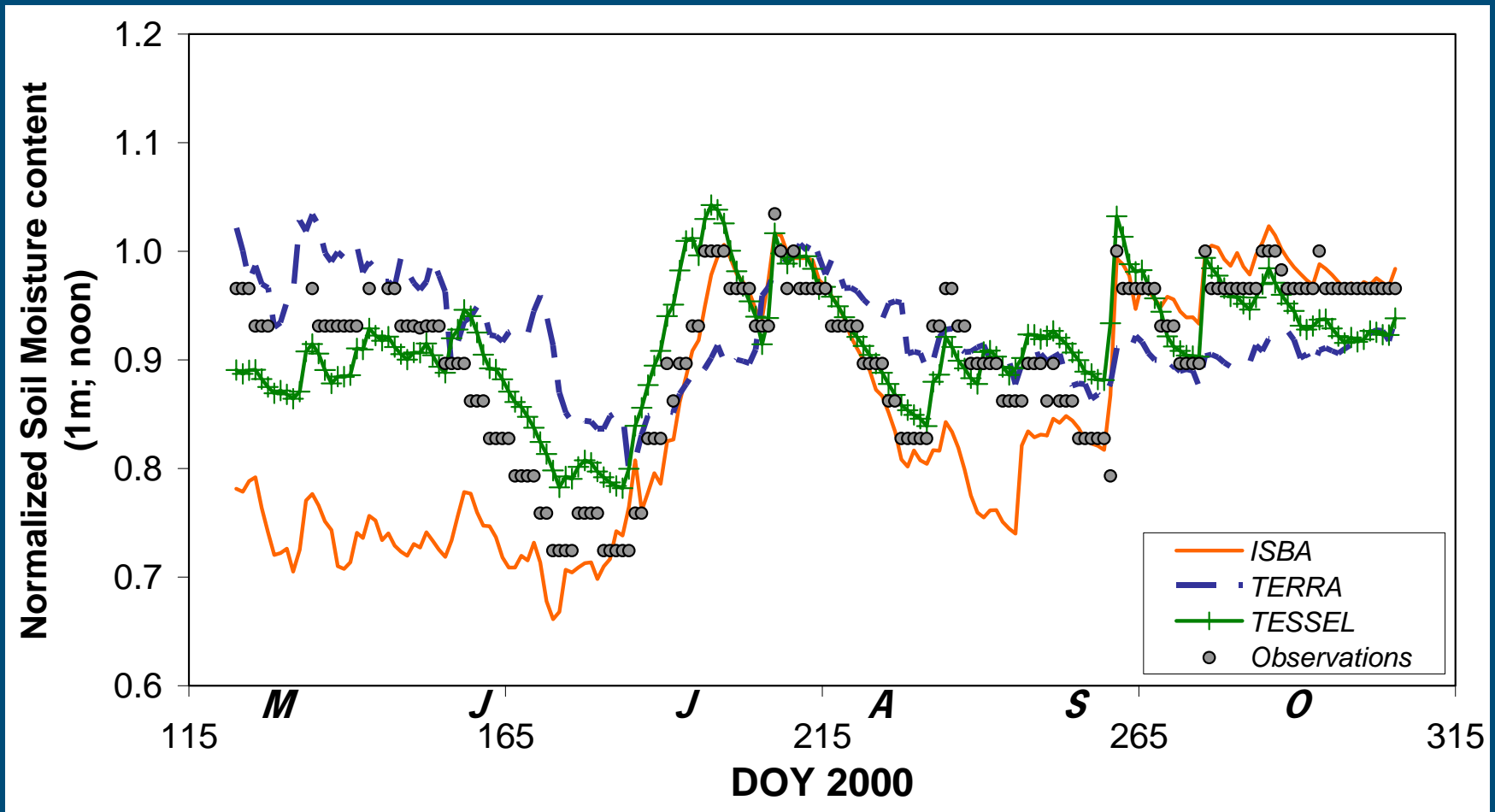
TESSEL



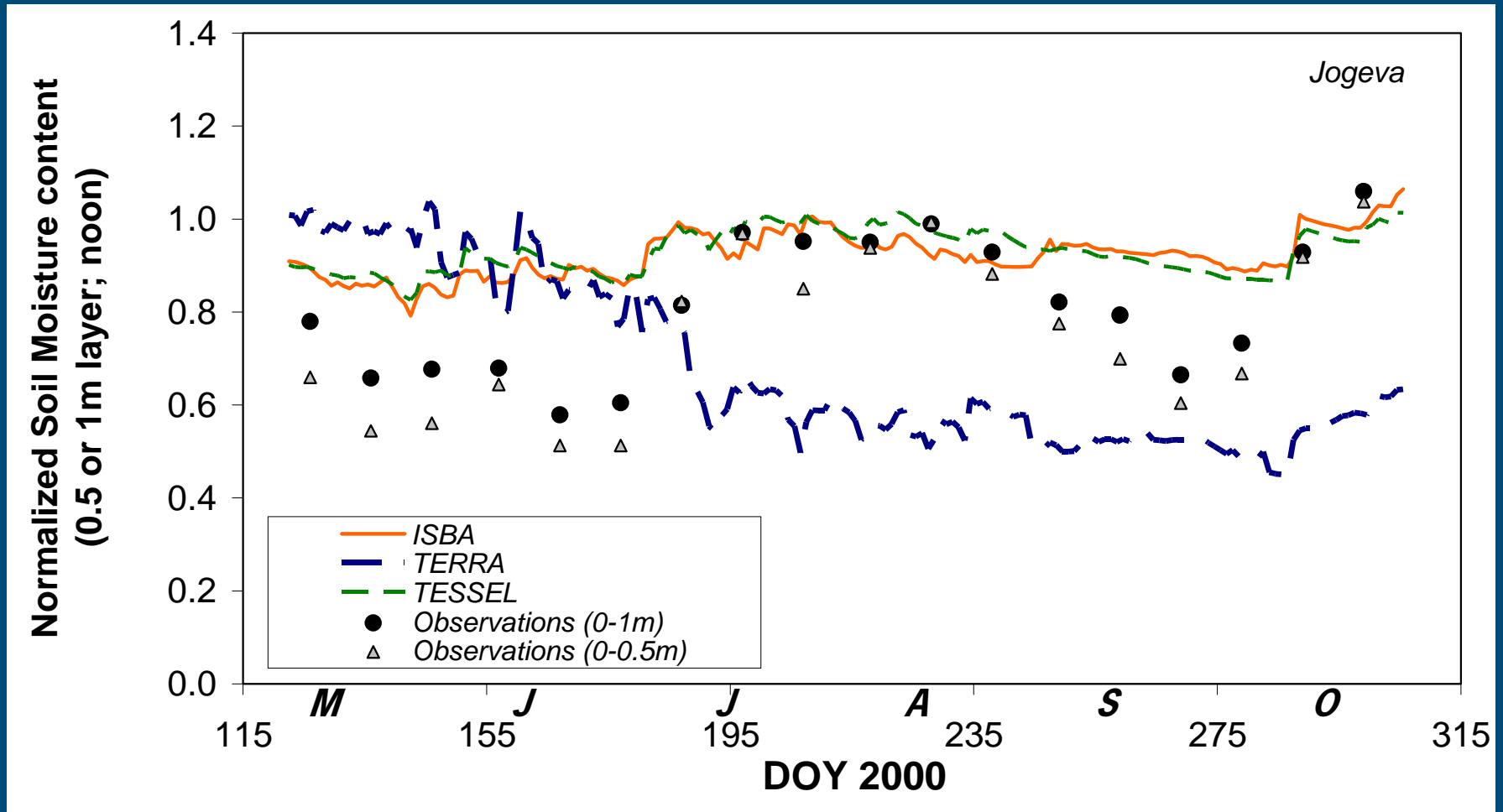
Soil Moisture

- Models: soil moisture content of upper 1 m
- Observations “well below the surface”:
 - Soil moisture content of upper 1 m *or* (BALTEX-EST)
 - Soil moisture content of upper 0.5 m *or* (BALTEX-EST)
 - Soil moisture content at 0.6 m (PLAP-DK) *or*
 - “Deep-layer” values (CarboEurope)
- Normalized with 95-percentile value

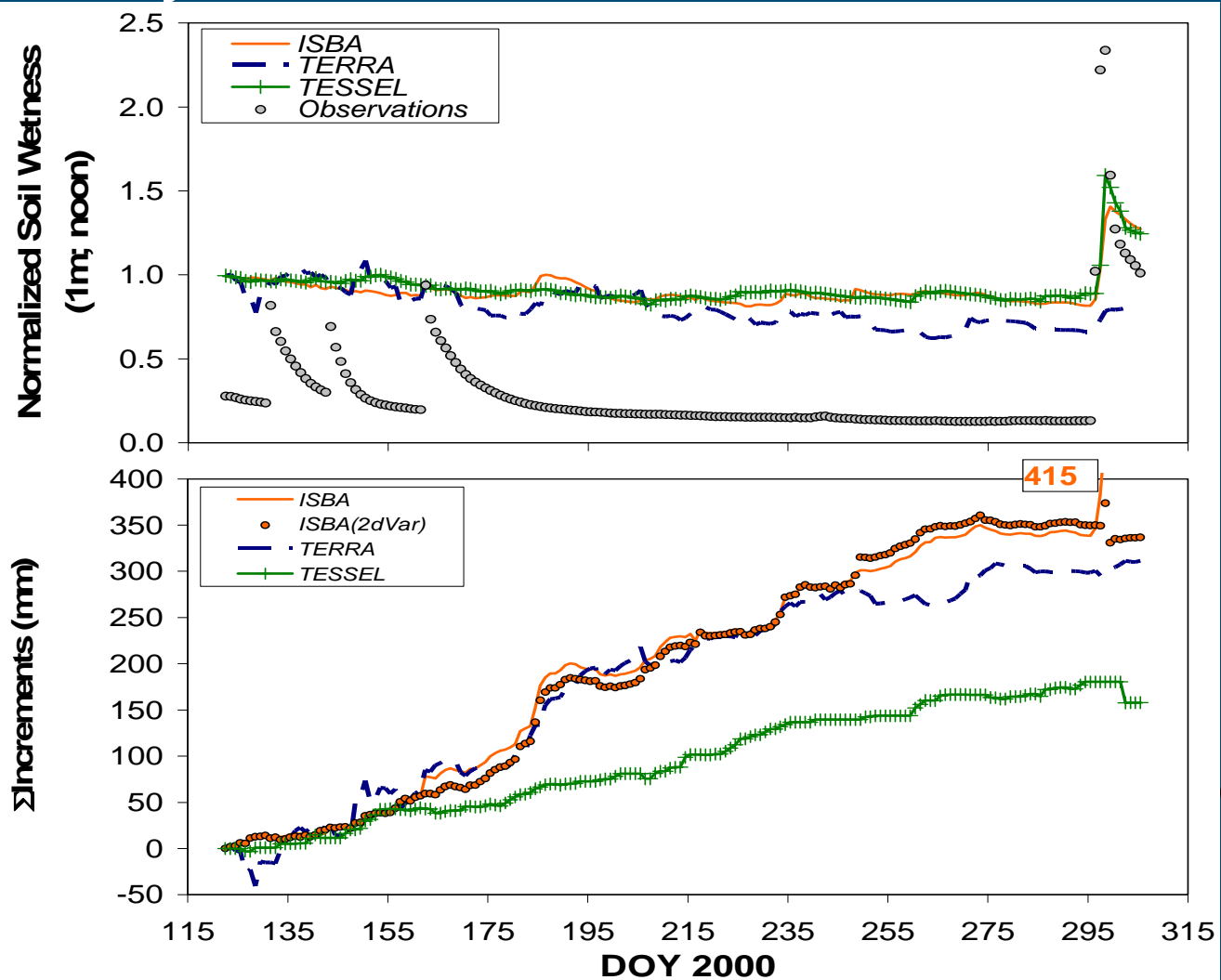
Case study Vielsalm (BE): soil moisture content 1 m



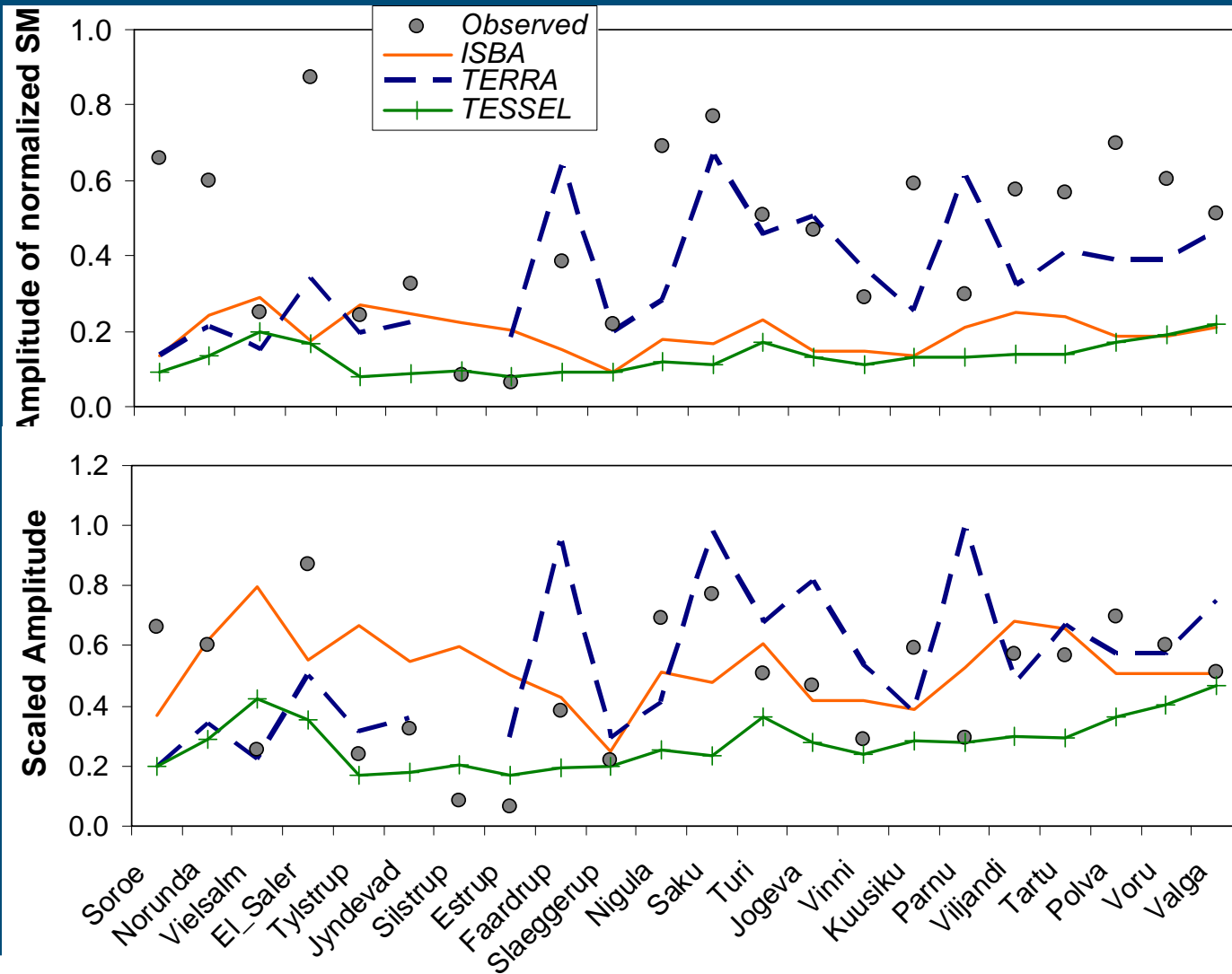
Soil moisture: case study Jogeva (EST)



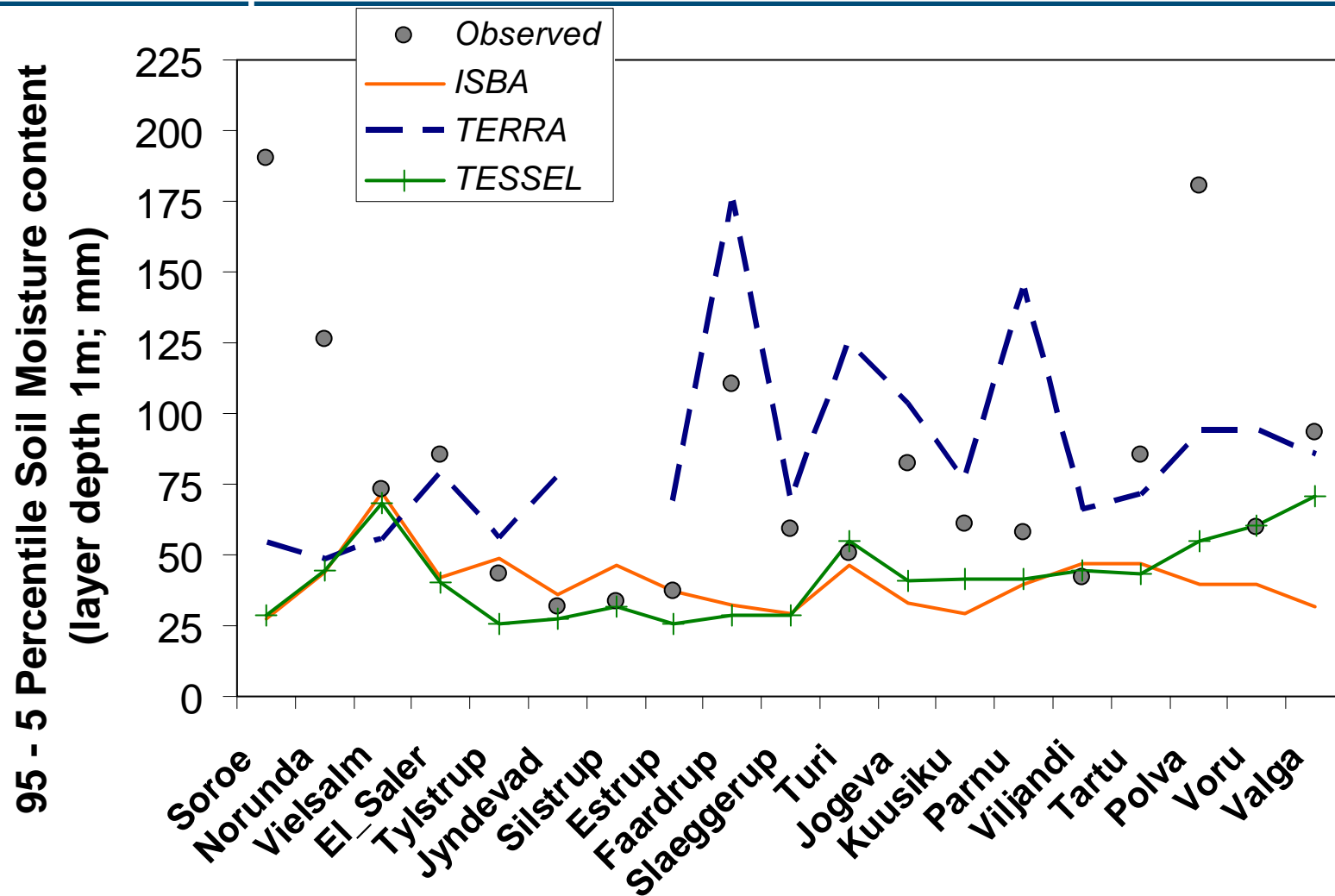
Case study El Saler (SP): soil moisture content 1 m



Amplitude of normalized soil moisture content



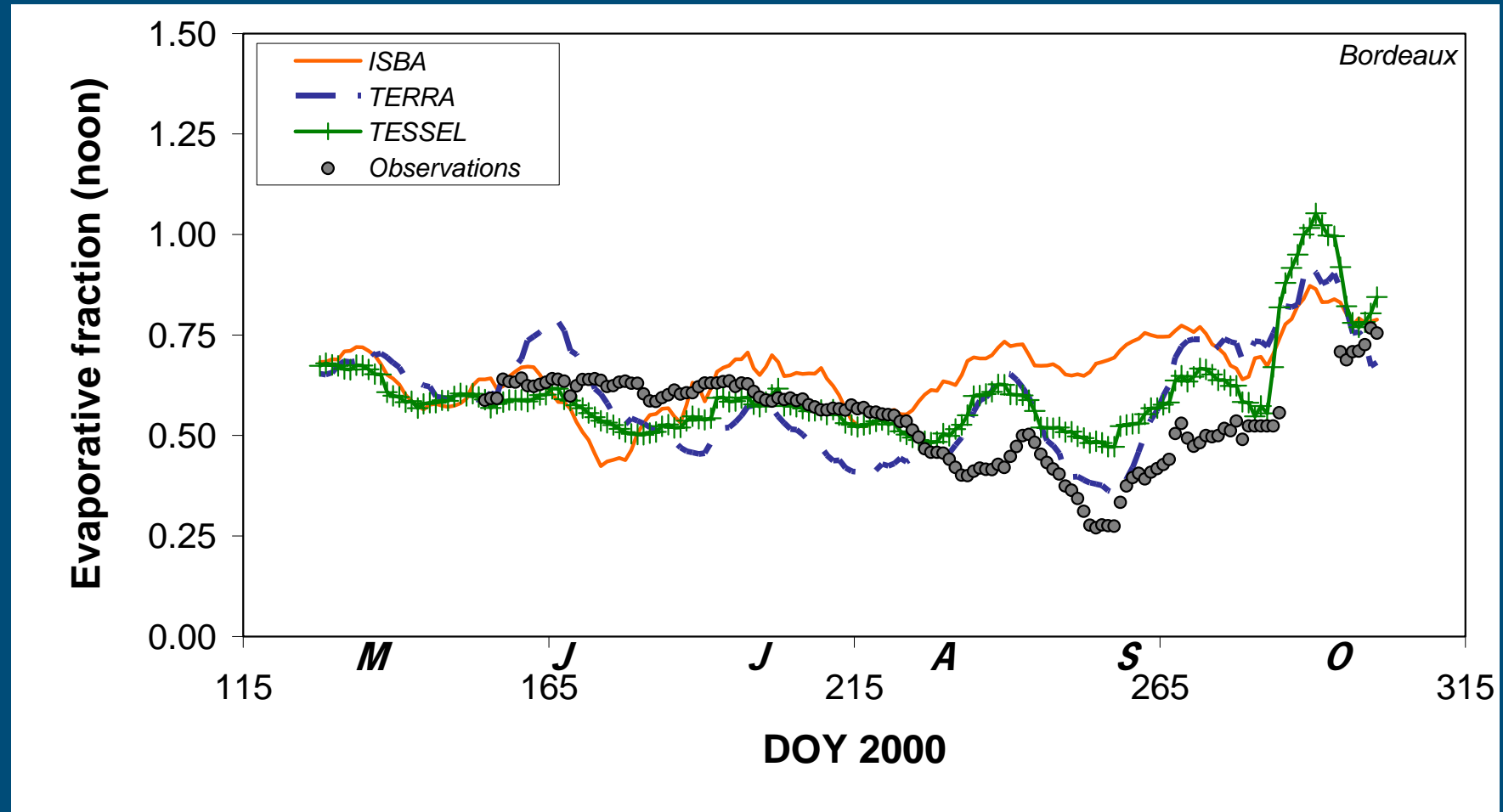
Amplitude of soil moisture content



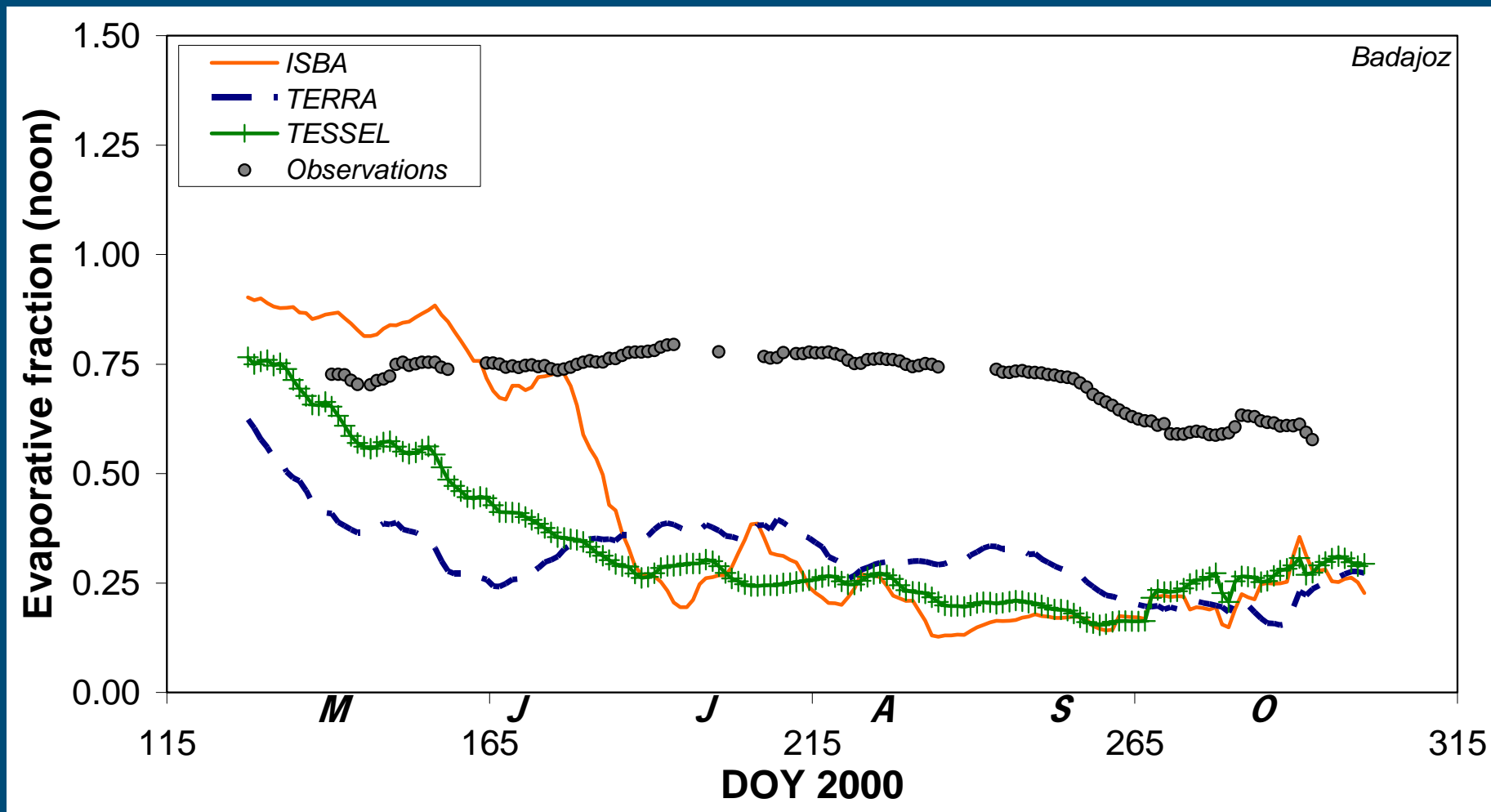
Evaporative Fraction

- From average λE and H between 10-15 UTC:
 - $\lambda E_{av} > 10 \text{ W/m}^2$
 - $H_{av} > -20 \text{ W/m}^2$; outliers removed if $H_{av} < 0 \text{ W/m}^2$
 - $N > 3$
- Observations:
 - No precipitation
 - Wind speed $> 1 \text{ m/s}$

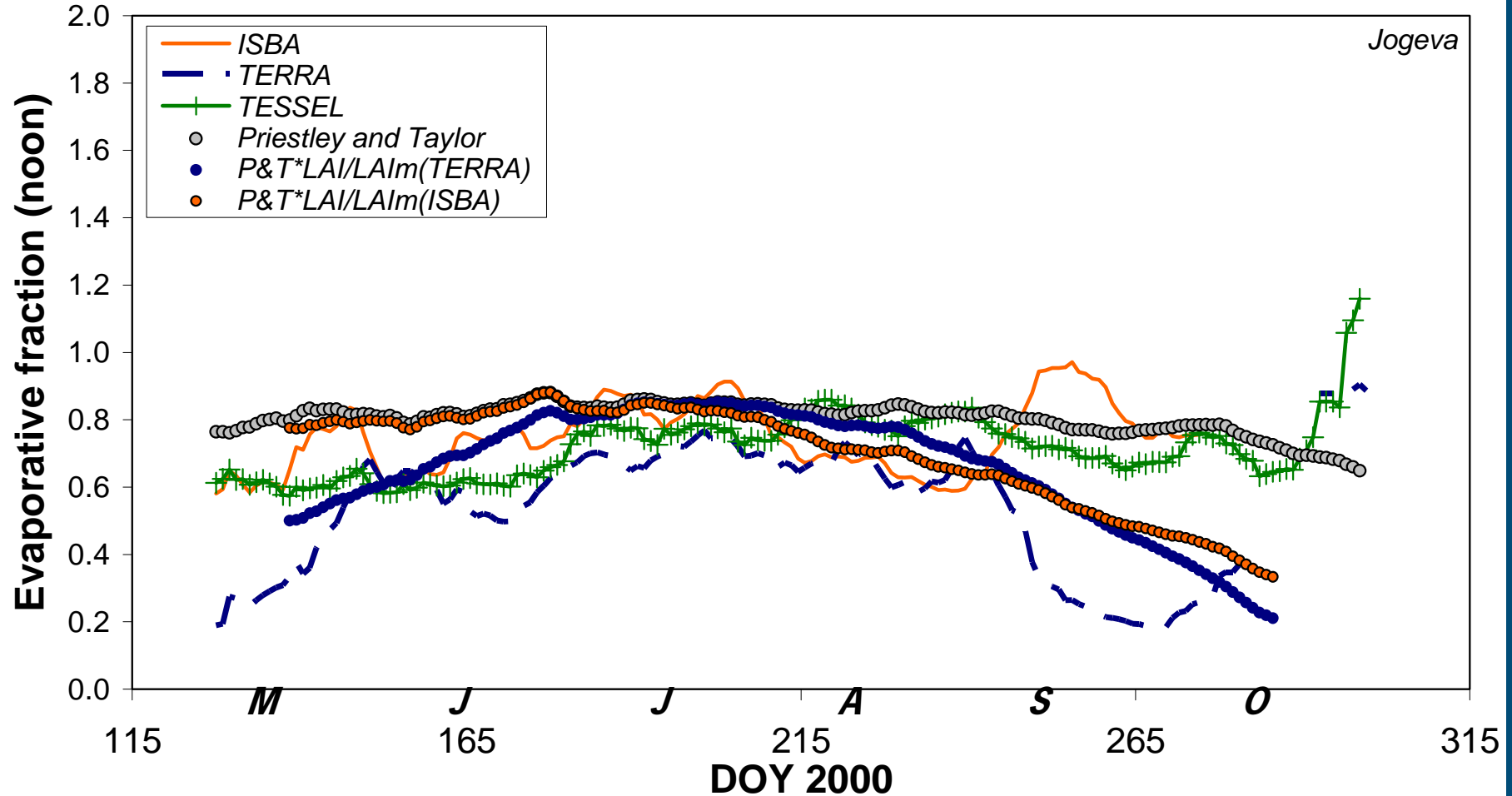
Evaporative Fraction*: case study Bordeaux (FR)



Evaporative Fraction*: case study Badajoz (SP)



Evaporative Fraction*: case study Jogeva (EST)

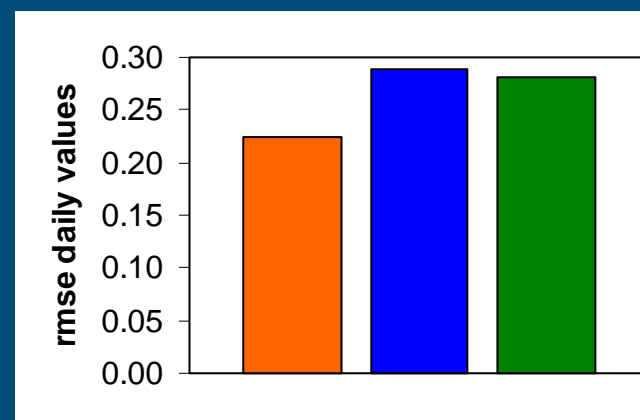
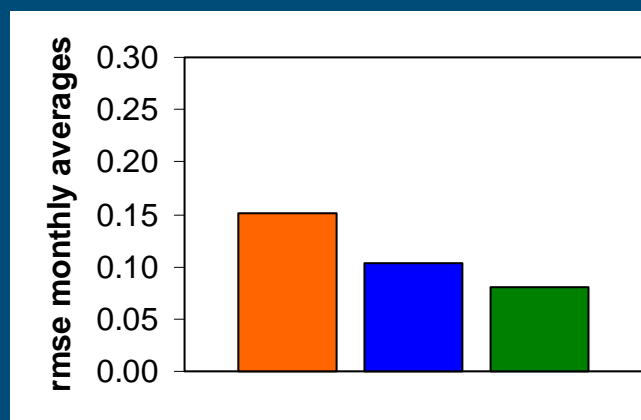
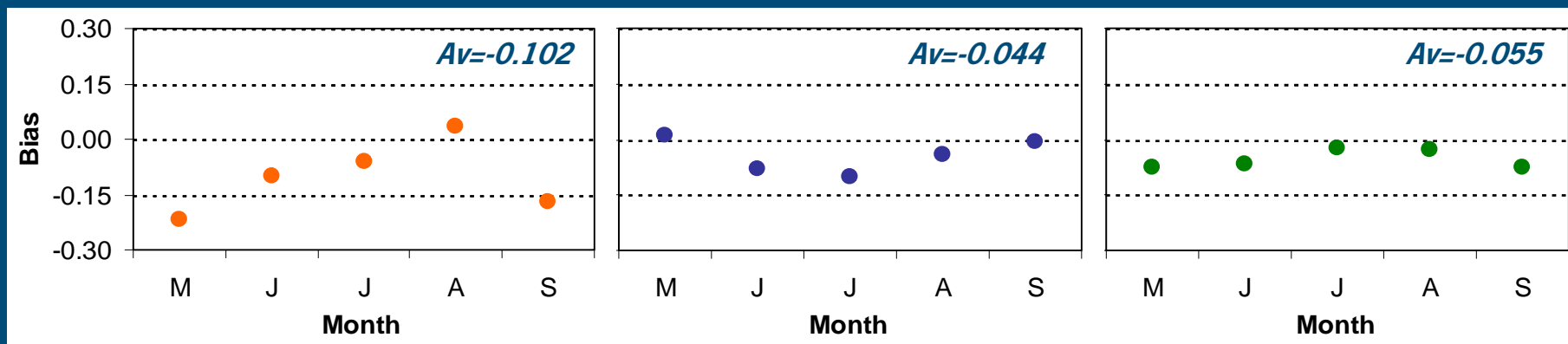


Model Performance for Evaporative Fraction*

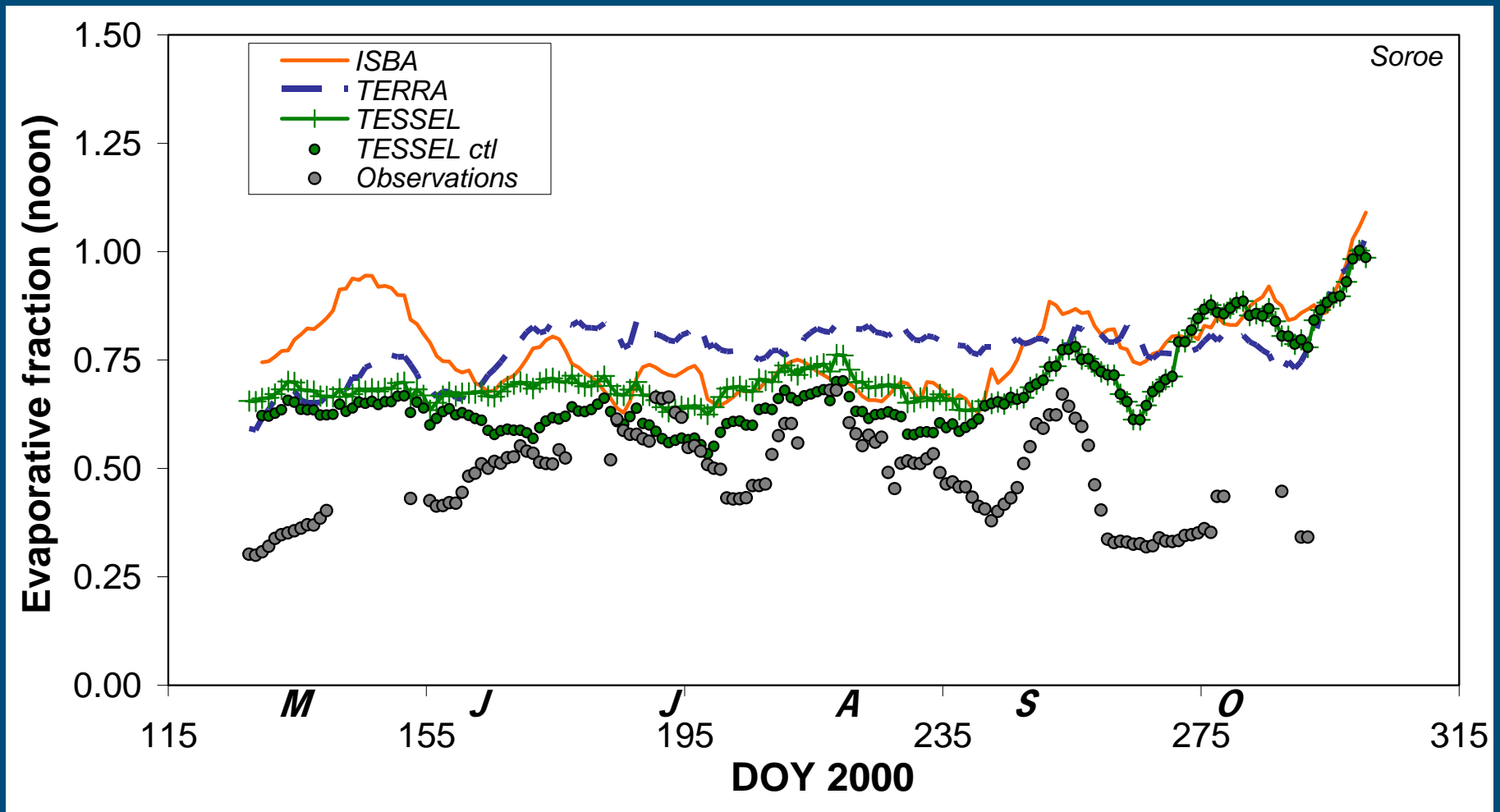
ISBA

TERRA

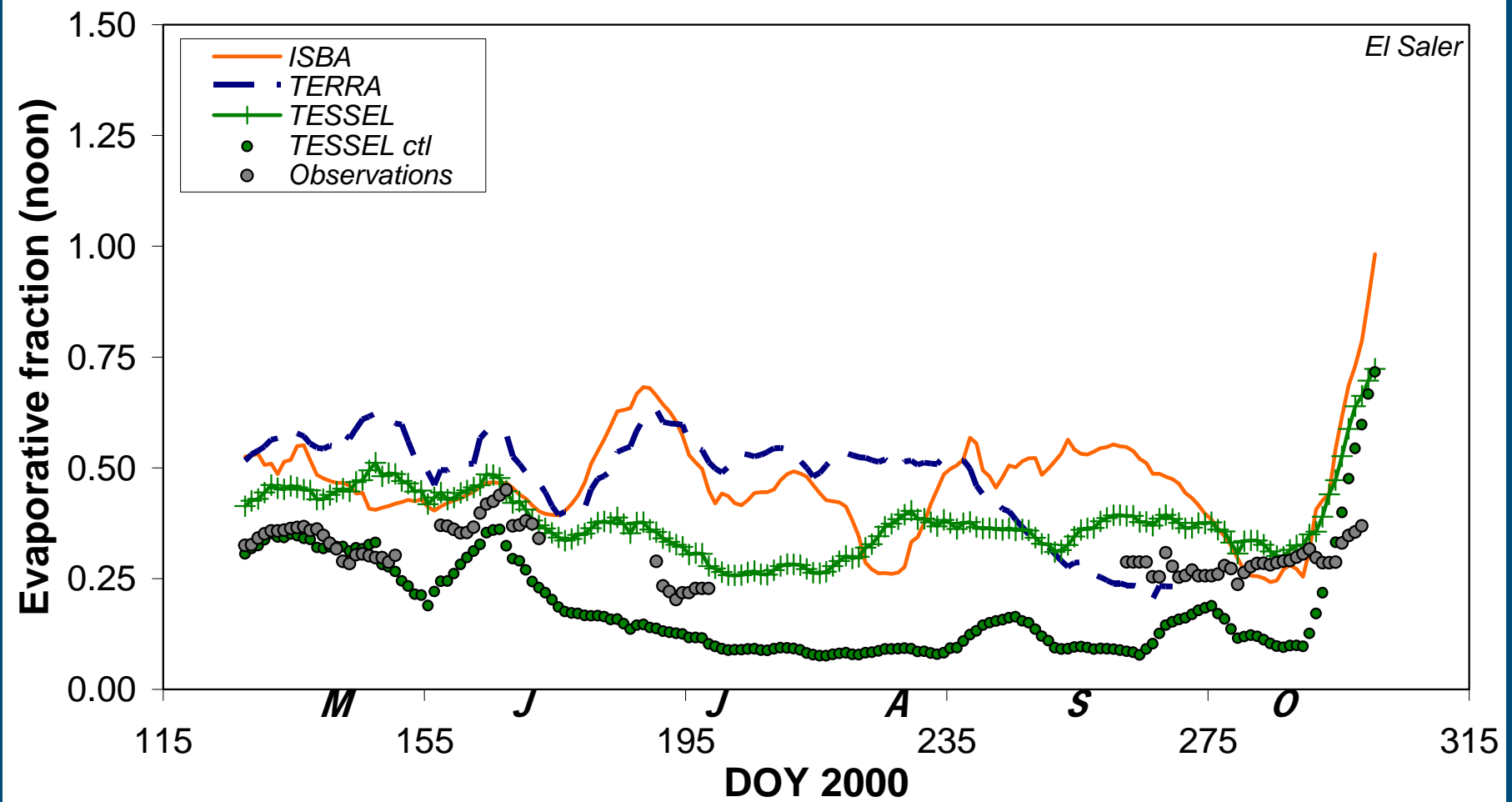
TESSEL



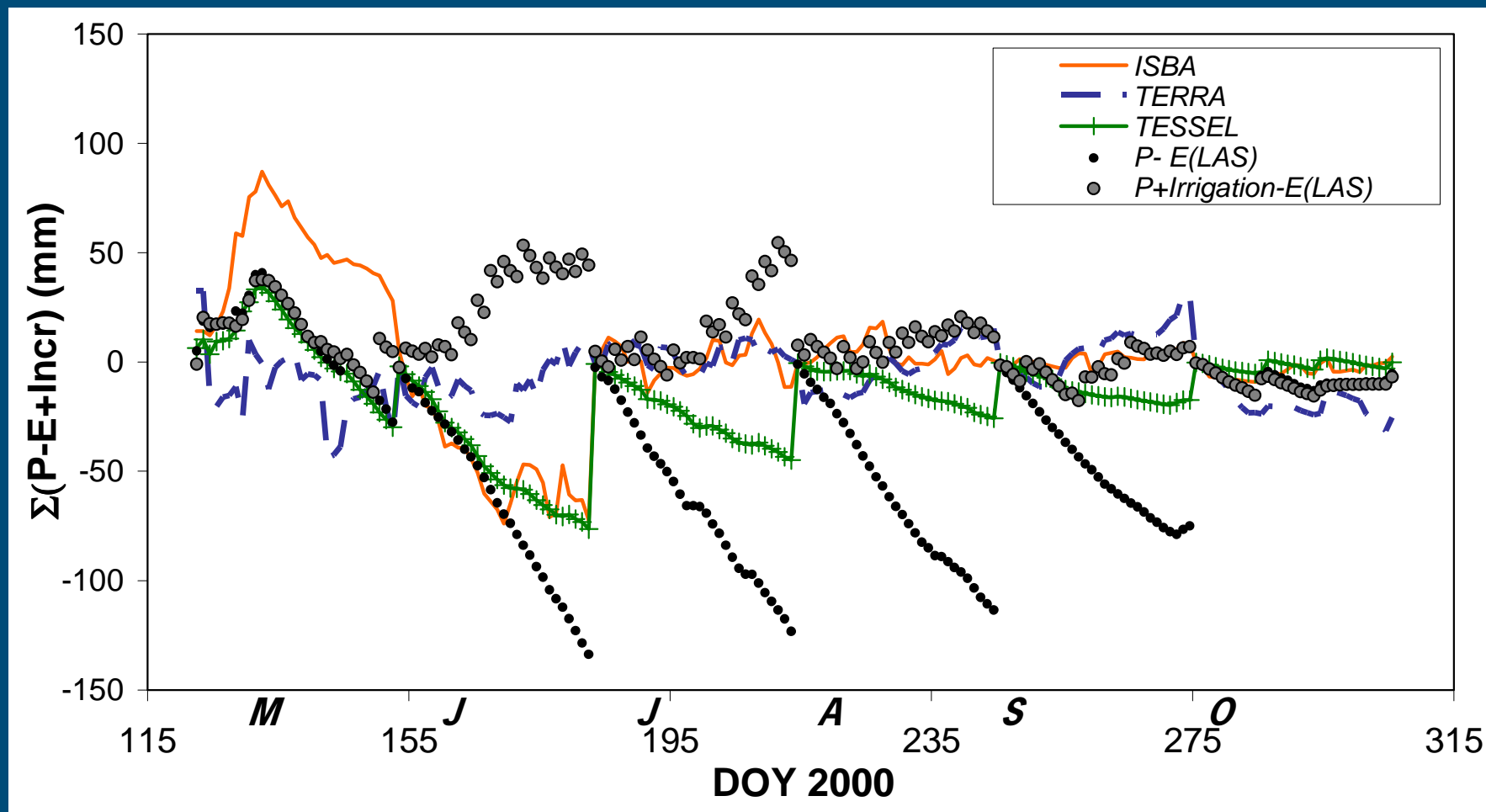
Effect of DA system on Λ : case Soroe (DK)



Effect of DA system on Δ : case El Saler (SP)



Analysis of Badajoz (SP; irrigated)



Main Conclusions

- SM assimilation systems participating in ELDAS reduce bias in soil water balance on monthly timescales, but may increase rmse
- Precipitation correction is beneficial
- Amplitude of soil moisture is underestimated due to:
 - Prescribed soil properties
 - SMA system and / or treatment of SM dynamics
- SM assimilation system in TESSEL-scm tends to improve Δ in dry conditions, but not in moist conditions
- Including elementary information like a seasonal cycle in LAI probably exceeds the effect of the SM assimilation system