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TRIPLE COLLOCATION OF PRECIPITATION RETRIEVALS FROM SEVIRI WITH GRIDDED RAIN GAUGE DATA AND WEATHER RADAR OBSERVATIONS OVER EUROPE

wacmos
support to science element

Introduction

- **Motivation**
- **Cloud microphysics based precipitation retrieval**
- **Triple collocation**
- **Conclusions**

Motivation

Role of clouds in water balance

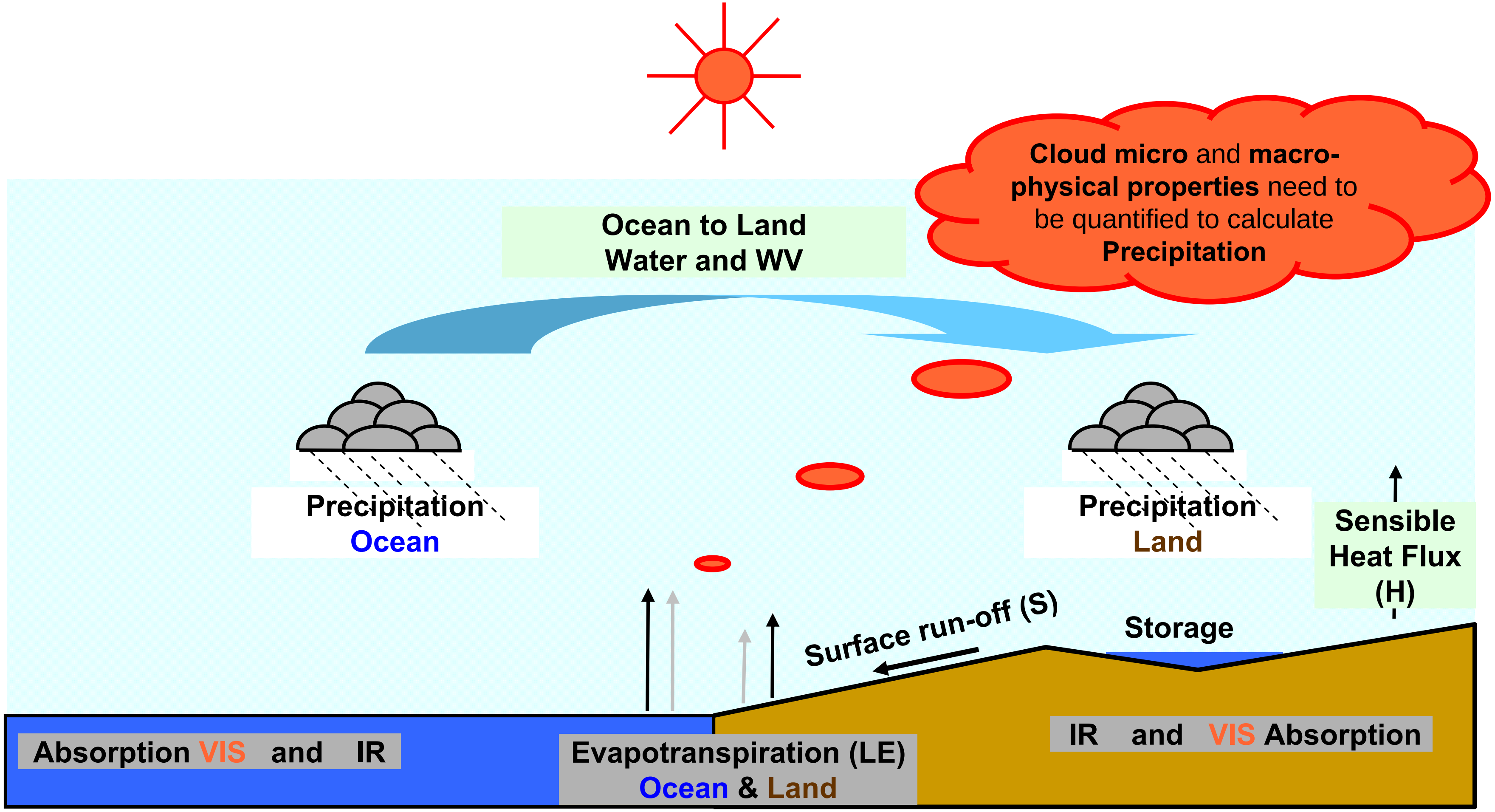
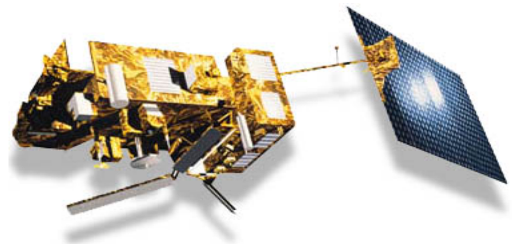
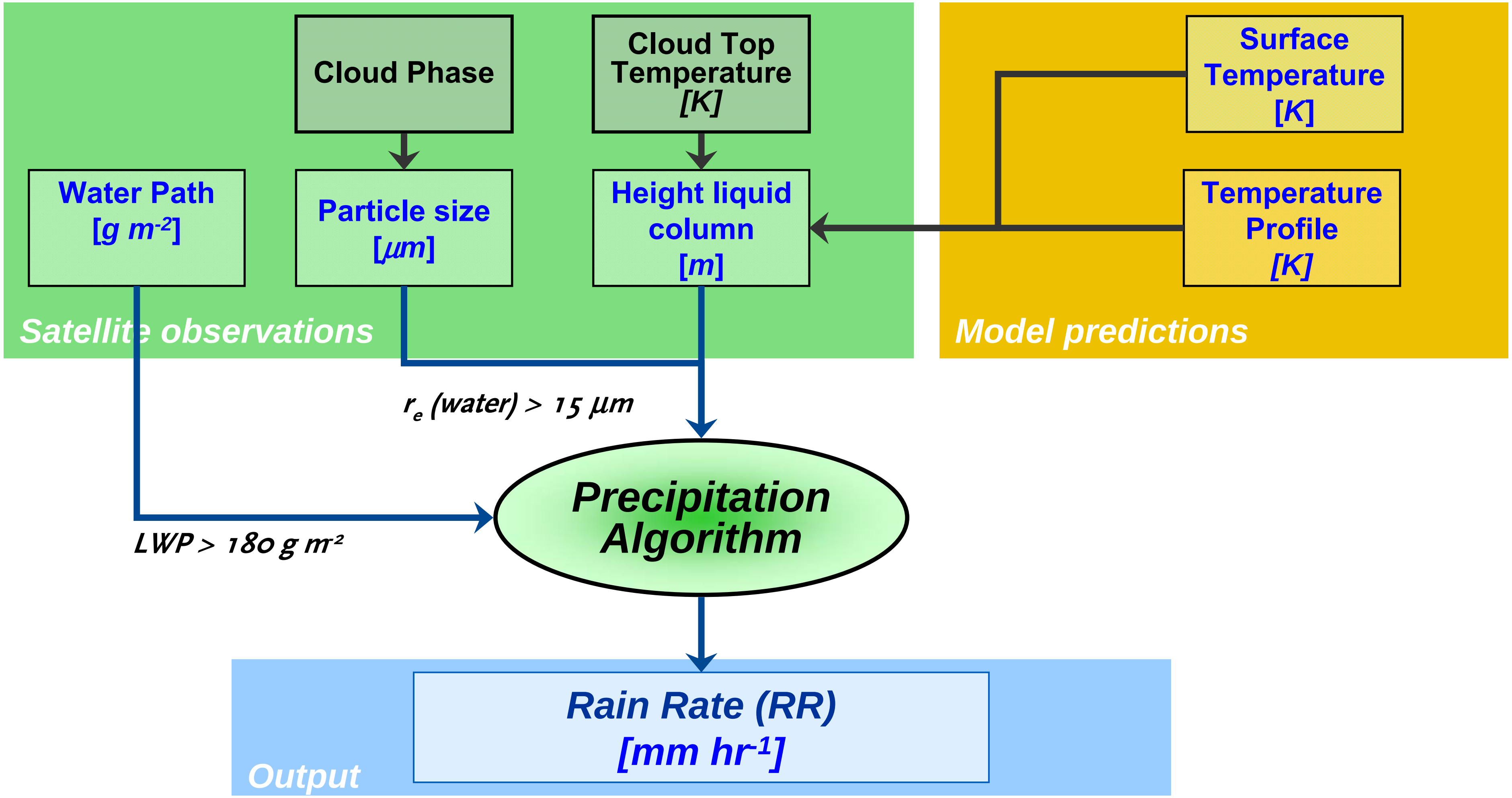


Figure: *Schematic representation of the role of clouds in the water balance*

Cloud microphysics based precipitation retrieval



PP-VNIR: Retrieval (1)



PP-VNIR: Retrieval (2)

1) Rain Rate retrieval

Based rain rate retrieval approach for SSM/I (*Wentz and Spencer, 1998),* and modified *Roebeling and Holleman (2009)* for SEVIRI.

$$LWP = 125\,(1 + (H(R - \Delta R))^{0.6})$$

Where

LWP	: Liquid Water Path	[g m^{-2}]
R	: Rain Rate	[mm hr^{-1}]
H	: Height of rain column	[km]
CTT	: Cloud Top Temperature	[K]
ΔR	: Offset rain rate	[mm hr^{-1}]
ΔH	: Offset height rain column	[km]

2) Correction for Cloud column height

$$H = \frac{(CTT_{max} - CTT_{pix})}{6.5} + \Delta H$$

3) Correction for below cloud evaporation

The approach of *Petty (2001*) is used to calculate evaporation of rainfall below cloud base (R_r):

$$R_r(z + dz) = R_r(z)eE$$

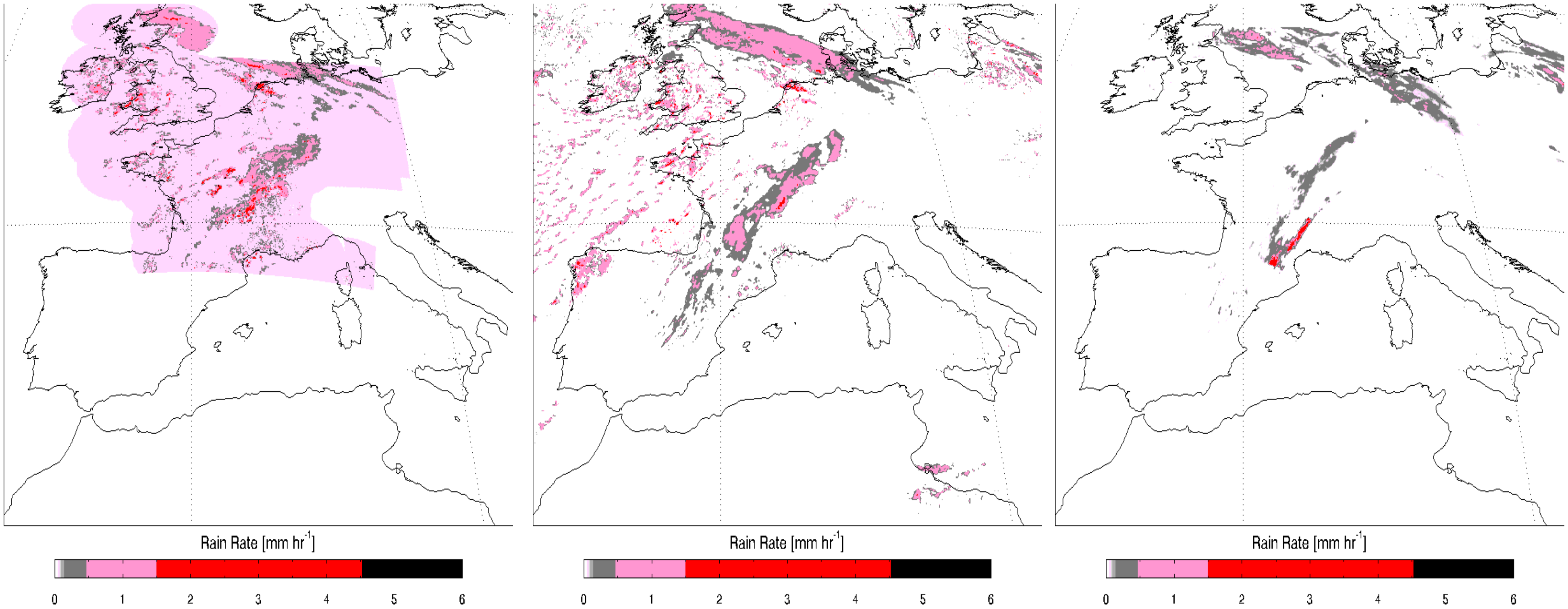
where E is defined as:

$$E = C_{ev}(-2.25R_r - 0.2)(1 - f)dz$$

Where

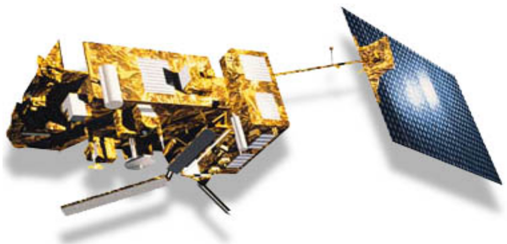
z	: altitude (from CTT and COT);	[km]
C_{ev}	: effective evap. efficiency (0.5 from Austin 1987)	[-]
f	: profile of relative humidity (from MERIS WV product).	[%]

Example: Comparison PP-VNIR v.s. Weather Radar



Weather Radar ***MSG/PP-VNIR*** ***MSG/MPE***

(diurnal cycle 1 July 2007)



Triple Collocation

Validation: Triple-collocation (1)

Objective

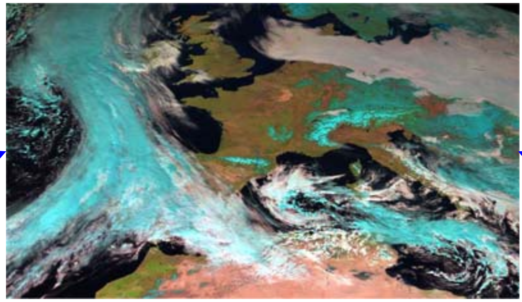
To quantify spatial and temporal consistency of the SEVIRI precipitation product over Europe.

Method

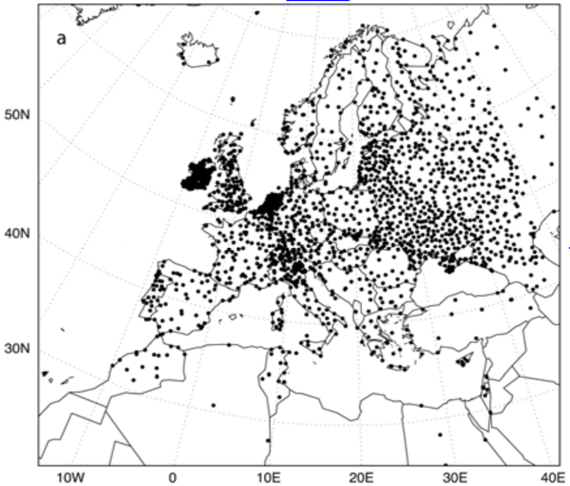
Triple-collocation is used to estimate error structures of three (or four) independent datasets. The spatial and temporal error structures are evaluated.

Domain:	Europe
Period:	Summer months (M,J,J,A) 2004, 2005 and 2006
Datasets:	**GPCC**, **ECA&D**, **OPERA** and **PP-VNIR**(SEVIRI)
Nr Obs.:	GPCC (monthly sums), ECA&D (daily sums), OPERA (5 mn. 24 hr/day) and PP-VNIR(SEVIRI) (15 mn. ~ 9 hr/day)

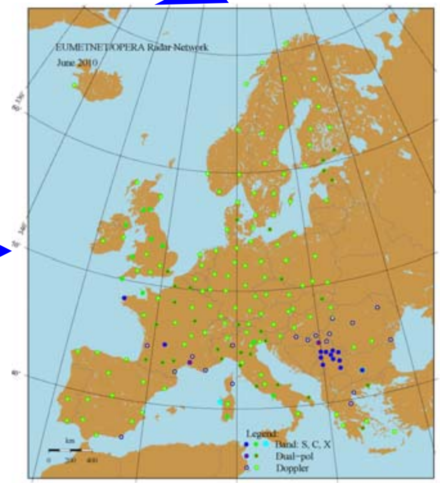
Validation: Triple-collocation (2)



SEVIRI PP-VNIR retrievals
(1 Satellite)



Gridded product
(~5000 rain gauges)



Radar Precipitation Composite
(~194 European Radars)

Gridded datasets:
ECA&D: *European Climate Assessment and Data set of KNMI*
GPCC: *Global Precipitation Climatology Centre of DWD*

Validation: Triple-collocation (3)

Triple –collocation principles

The method presented in Stoffelen et al. (1998); Jansen et al. (2006) or Scipal et al (2008). Triple-collocation aims to estimate the RSME which expresses the variance of the residual errors (r_x):

$$X = \alpha_X + \beta_X R + r_X$$

$$Y = \alpha_Y + \beta_Y R + r_Y$$

$$Z = \alpha_Z + \beta_Z R + r_Z$$

Where:

R:	true values
X,Y,Z :	retrieval values of the datasets
α *and* β:	calibration constants (offset and gain)
r:	residual errors

Validation: Triple-Collocation (4)

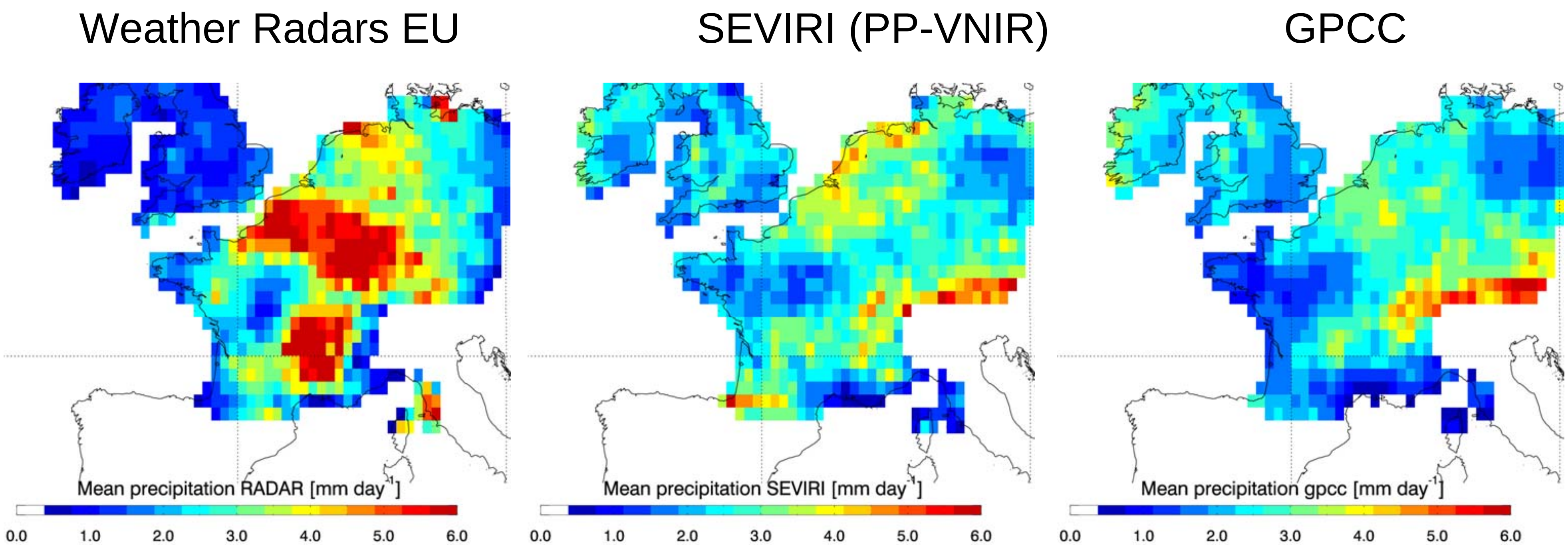


Fig: *Comparison of Weather Radars, SEVIRI and GPCC mean daily precipitation during May-August 2006*

GPCC: Global Precipitation Climatology Centre of DWD

Validation: Triple-collocation (5)

Instr	*Mean*	*Max*	*Std*	*Err*	*True Var.*	*Correl*
			2005			
GPCC	2.19	6.82	0.91	0.70	2.55	1.00
RADAR	3.03	29.71	1.97	65.10	2.55	0.02
SEVIRI	2.89	7.58	1.00	0.96	2.55	0.82
			2006			
GPCC	2.35	6.43	0.88	0.79	2.70	1.00
RADAR	3.28	21.10	1.85	2.69	2.70	0.30
SEVIRI	2.84	6.98	0.96	0.35	2.70	0.72
			2007			
GPCC	3.32	7.84	0.94	0.89	3.25	1.00
RADAR	4.17	15.25	2.02	4.72	3.25	0.21
SEVIRI	2.95	10.28	1.08	0.19	3.25	0.74

Validation: Triple-Collocation (6)

ECA&D vs. EU RADAR

ECA&D vs. SEVIRI (PP-VNIR)

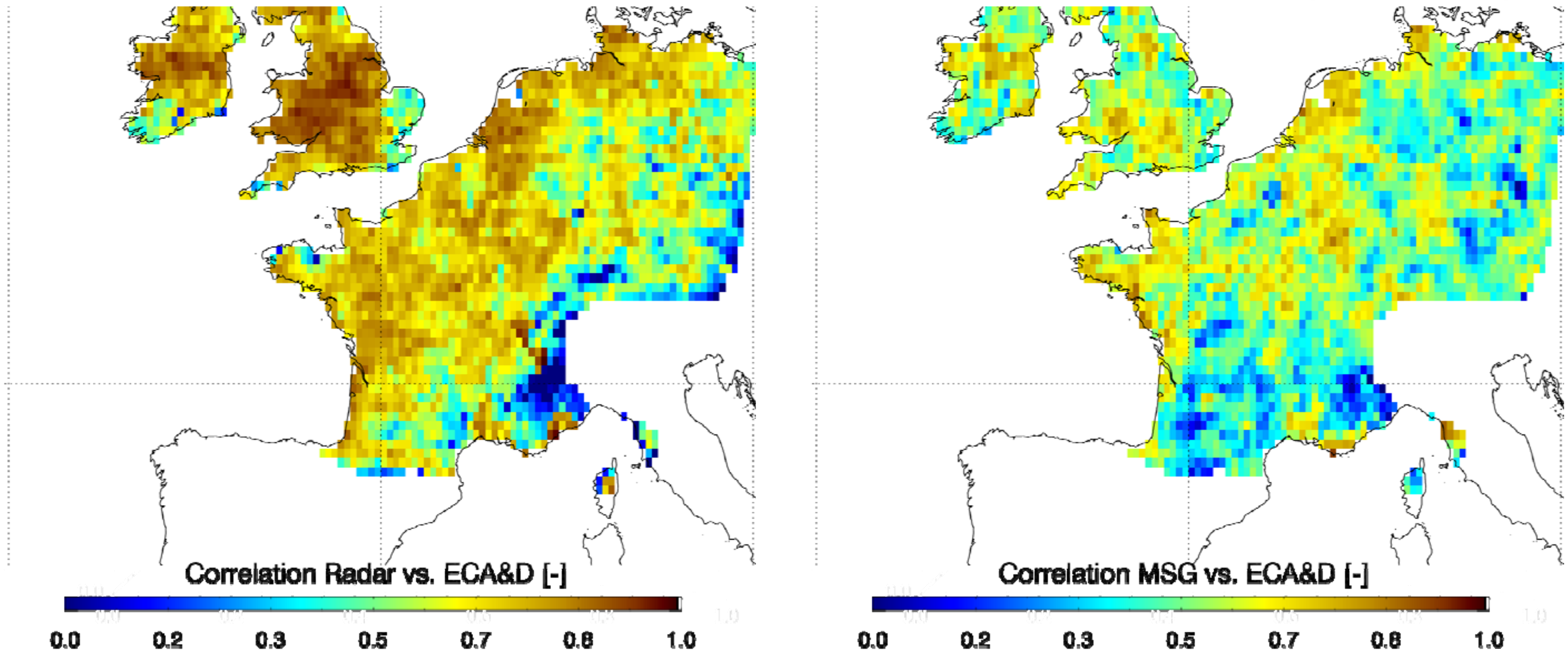


Fig: *Temporal correlation between ECA&D and Weather Radars (Left) and SEVIRI (right) using decadal precipitation rates for the summer months of 2005,2006 and 2007*

ECA&D: European Climate Assessment and Data set of KNMI

Validation: Triple-Collocation (7)

EU RADAR | SEVIRI (PP-VNIR) | ECA&D

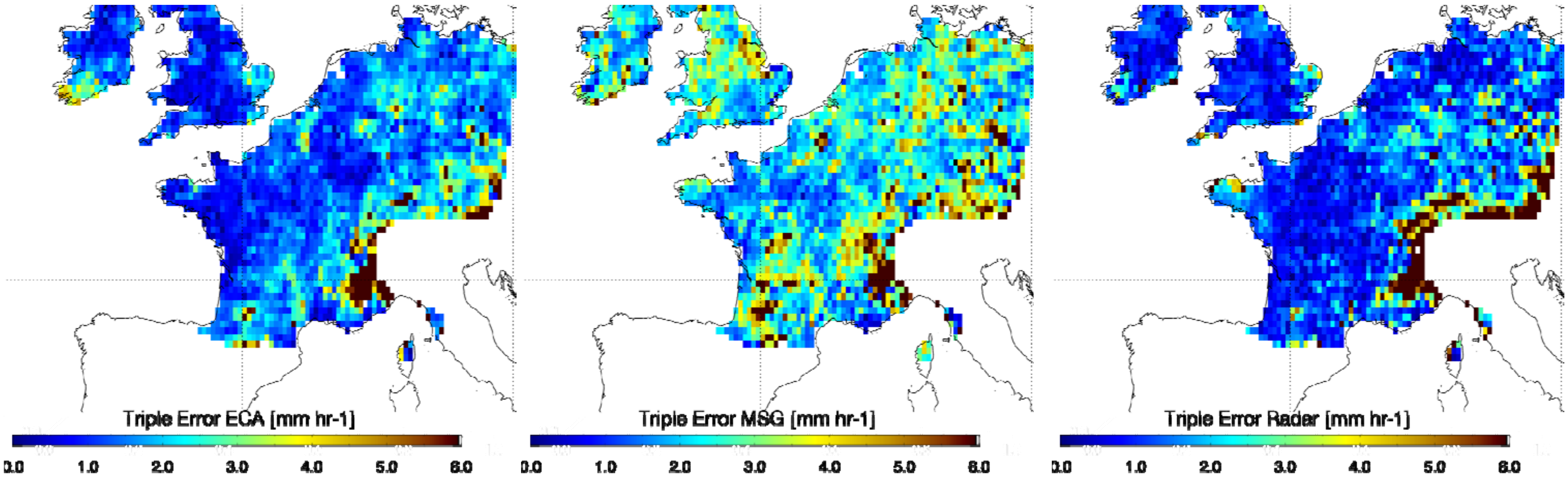
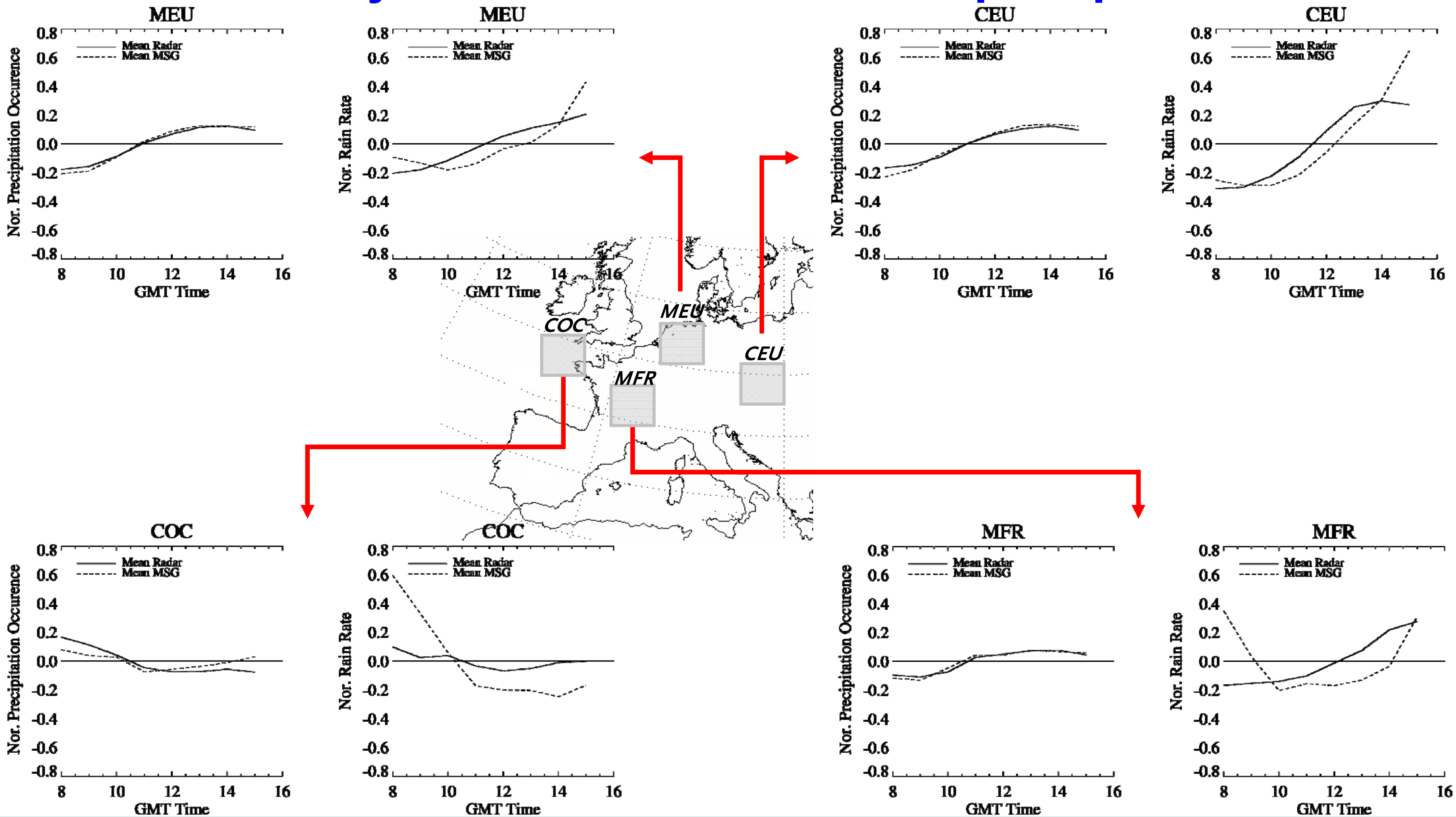


Fig: *Triple collocation errors of Weather Radars, SEVIRI and ECA decadal precipitation rates for the summer months of 2005, 2006 and 2007*

ECA&D: European Climate Assessment and Data set of KNMI

R. Roebeling et al. (in preparation), MAP

Diurnal cycles Radar and PP-VNIR precipitation



Conclusions

Conclusions

- **Triple collocation is good manner to find artefacts in different datasets;**
- **SEVIRI detects spatial and temporal variations in precipitation realistically;**
- **In its current form the EU RADAR composite is not suited to detects spatial variations in precipitation, whereas temporal variations are well detected;**
  !! OPERA aims to improve on this situation !!
- **GPCC and ECA&D deviate most from SEVIRI and EU RADAR in under sampled areas;**
- **SEVIRI & Radar show comparable diurnal cycles in occurrence and intensity of precipitation.**

Future: diagnoses precipitation parameterizations

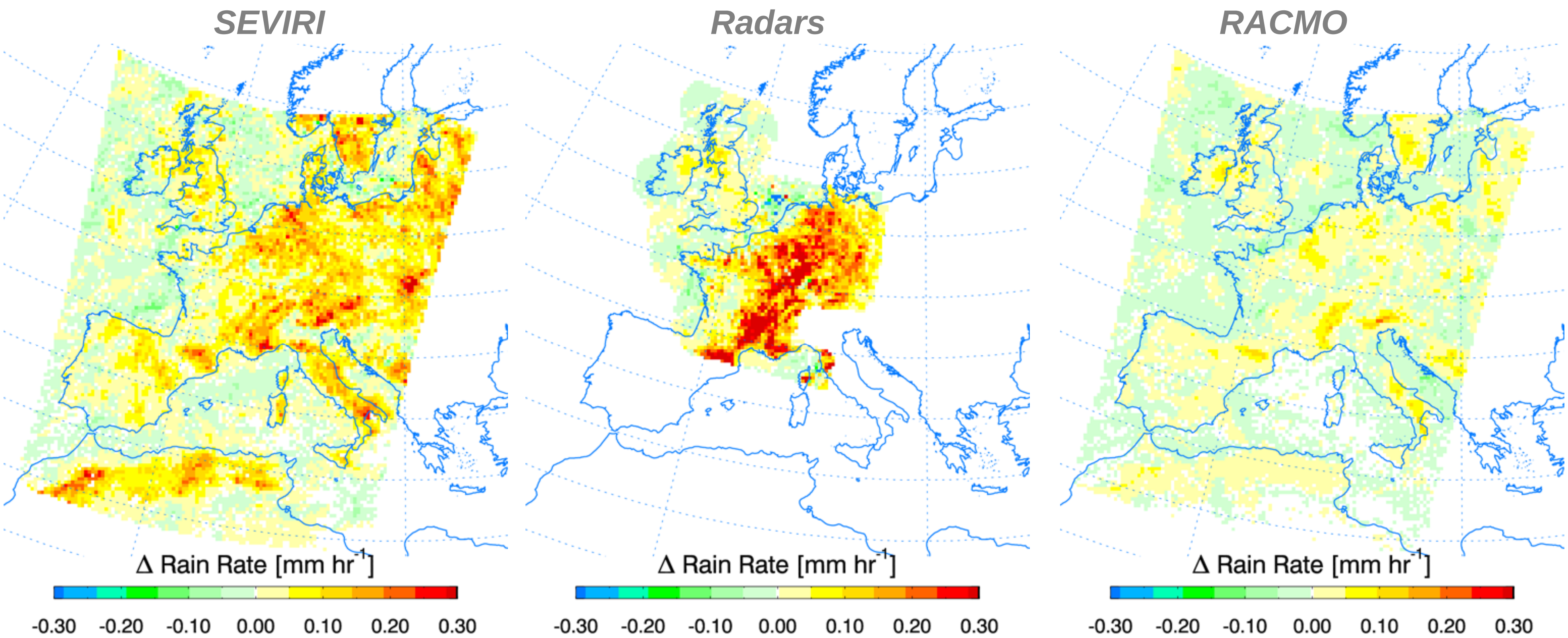


Fig: *Difference between noon and morning rain rates for SEVIRI, Weather Radars and RACMO during May – Sept 2006*

Thank you !