

■ ECMWF Report on ERS-2 SAR for November 2002 ■

Title: Report on ERS-2 SAR wave height data.

By: *Jean-Raymond Bidlot*

Date: *11 December 2002*

Overview:

On average, about 392 SAR wave mode spectra arrived at ECMWF every 6 hours of which 18.2% have been rejected. Data coverage, which was rather good, can be seen in Figure 1. There was significant reduction in data reception at time slots centred at 06:00 on the 25th and no data between) and 12 UTC on the 19th.

In general, the SAR data are in good agreement with the model.

Wave Height Comparison (bias):

ERS-2 global: -0.018 m

ERS-2 northern hemisphere: -0.066 m

ERS-2 tropics: 0.003 m

ERS-2 southern hemisphere: -0.040 m



Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England

Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703

Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 SAR for November 2002 ■

Remarks:

- The SAR worked normally this month.

Definitions:

Four new integrated parameters are used to compare the SAR and the model spectra. These parameters are:

1. The mean wave period based on the ‘-1th.’ moment (m_{-1}) defined as:

$$T_{-1} = m_{-1} / m_0$$

where m_0 and m_{-1} are the zeroth and the ‘-1th.’ moments of the wave spectrum with the n -th. moment, in general, is defined as:

$$m_n = \int d\theta \int df \cdot f^n \cdot F(f, \theta)$$

F is the wave spectrum in frequency, f , - direction space. The comparison between ECMWF model and SAR mean wave periods for the whole month is given in Figure 7.

2. The wave directional spread defined as:

$$\sigma = \sqrt{2[1 - r_1(f)]}$$

$$r_1(f) = \int df \int d\theta \cdot F(f, \theta) \cdot \cos[\theta - \varphi(f)]$$



Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England

Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703

Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 SAR for November 2002 ■

$$\varphi(f) = \text{atan} \left\{ \left[\int d\theta \cdot F(f, \theta) \cdot \sin(\theta) \right] / \left[\int d\theta \cdot F(f, \theta) \cdot \cos(\theta) \right] \right\}$$

The comparison between ECMWF model and SAR wave directional spread values for the whole month is given in Figure 8.

3. The mean wave propagation direction defined as:

$$\varphi = \text{atan} \left\{ \left[\int df \int d\theta \cdot F(f, \theta) \cdot \sin(\theta) \right] / \left[\int df \int d\theta \cdot F(f, \theta) \cdot \cos(\theta) \right] \right\}$$

The comparison between ECMWF model and SAR mean wave propagation directions for the whole month is given in Figure 9.

4. The spectral peakedness parameter of Goda (Q_p) defined as:

$$Q_p = 2m_0^{-2} \int d\theta \int df \cdot f \cdot F^2(f, \theta)$$

The comparison between ECMWF model and SAR spectral peakedness (or roughly, spectral narrowness) values for the whole month is given in Figure 10.



■ ECMWF Report on ERS-2 SAR for November 2002 ■

Figure captions:

- Figure 1: Time series of data reception for ERS-2 Altimeter data for November 2002.
- Figure 2: Comparison of ECMWF wave height results with ERS-2 SAR wave height data for November 2002 (global).
- Figure 3: Comparison of ECMWF wave height results with ERS-2 SAR wave height data for November 2002 (northern hemisphere)
- Figure 4: Comparison of ECMWF wave height results with ERS-2 SAR wave height data for November 2002 (tropics)
- Figure 5: Comparison of ECMWF wave height results with ERS-2 SAR wave height data for November 2002 (southern hemisphere)
- Figure 6: ERS-2 SAR wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI).
- Figure 7: Comparison of ECMWF mean wave periods with ERS-2 SAR mean wave periods for November 2002 (global).
- Figure 8: Comparison of ECMWF wave directional spread with that of ERS-2 SAR for November 2002 (global).
- Figure 9: Comparison of ECMWF mean wave directions with those of ERS-2 SAR for November 2002 (global).
- Figure 10: Comparison of ECMWF wave peakedness factor with that of ERS-2 SAR for November 2002 (global).
- Figure 11: ERS-2 SAR wave heights: Timeseries of daily bias (ERS-2 - model) for the past year.
- Figure 12: ERS-2 SAR wave heights: Timeseries of daily root mean square difference (RMSE) for the past year.
- Figure 13: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (global).
- Figure 14: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (n. hem.).
- Figure 15: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (tropics).
- Figure 14: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (s. hem.).



■ ECMWF Report on ERS-2 SAR for November 2002 ■

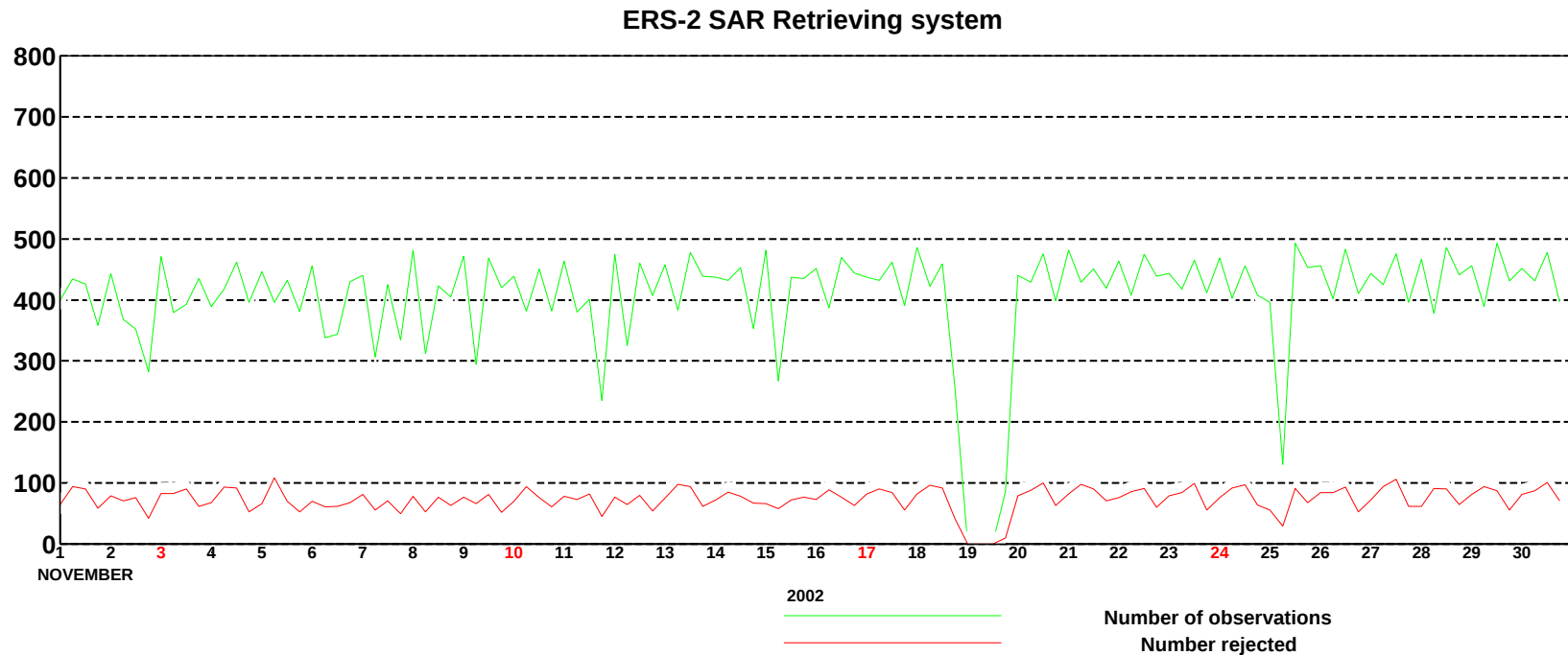


Figure 1: Time series of data reception for ERS-2 SAR wave mode spectra for November 2002

■ ECMWF Report on ERS-2 SAR for November 2002 ■

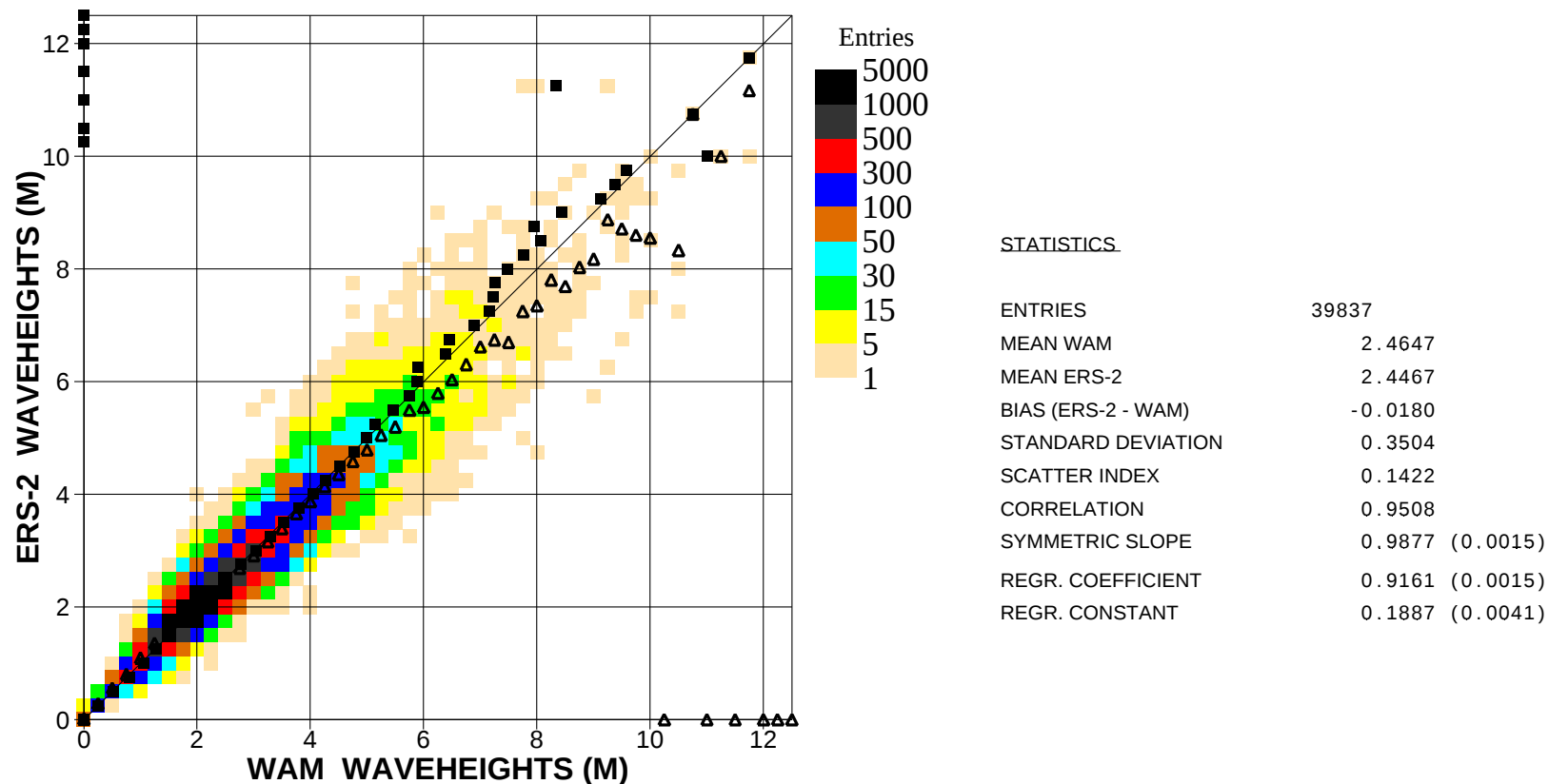


Figure 2: Comparison of ECMWF wave height results with ERS2 SAR wave height data for November 2002 (global)

■

Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England

Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703

Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 SAR for November 2002 ■

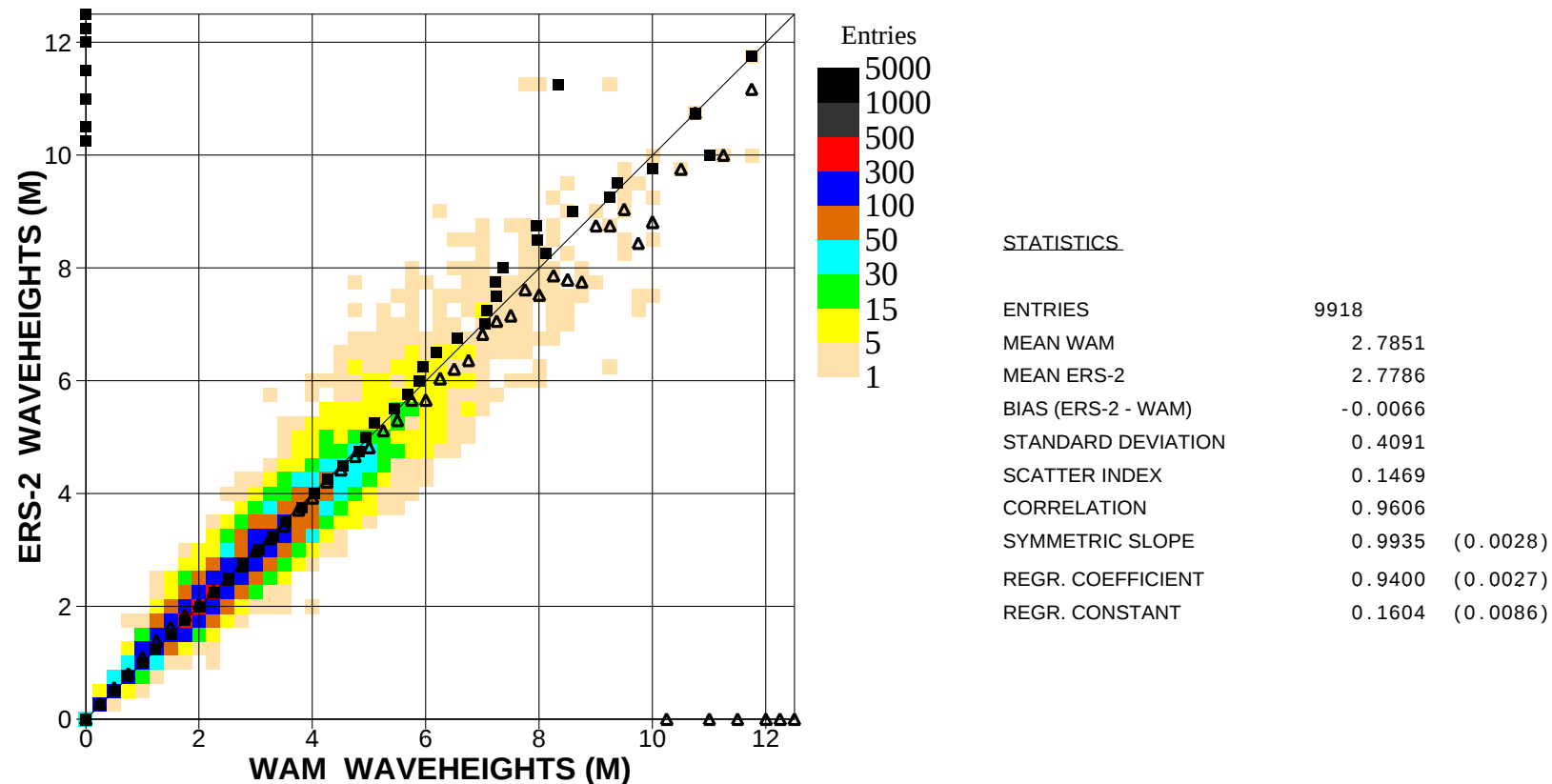


Figure 3: Comparison of ECMWF wave height results with ERS2 SAR wave height data for November 2002 (n.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 SAR for November 2002 ■

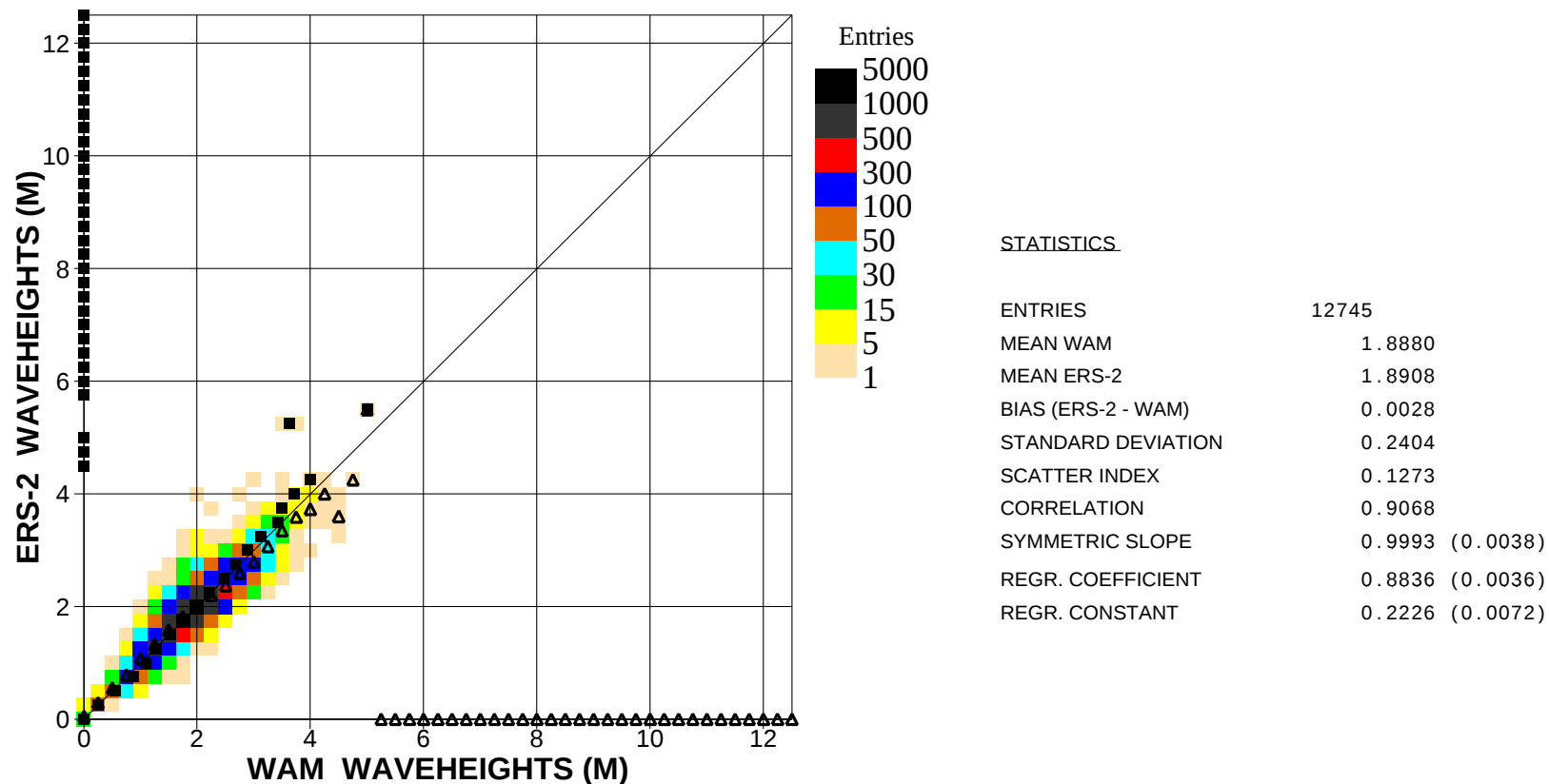


Figure 4: Comparison of ECMWF wave height results with ERS2 SAR wave height data for November 2002 (tropics)

■

■ ECMWF Report on ERS-2 SAR for November 2002 ■

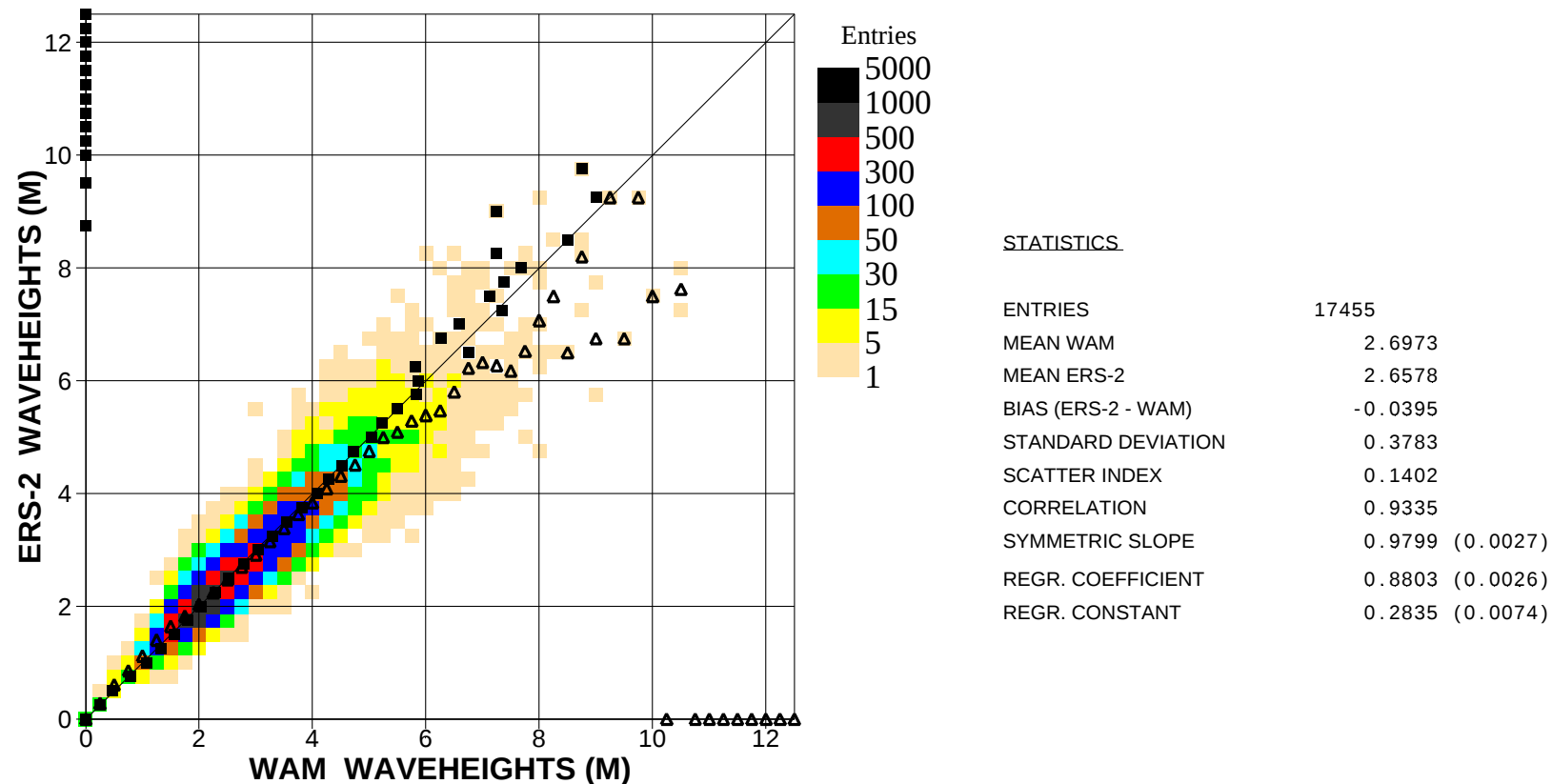


Figure 5: Comparison of ECMWF wave height results with ERS2 SAR wave height data for November 2002 (s.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 SAR for November 2002 ■

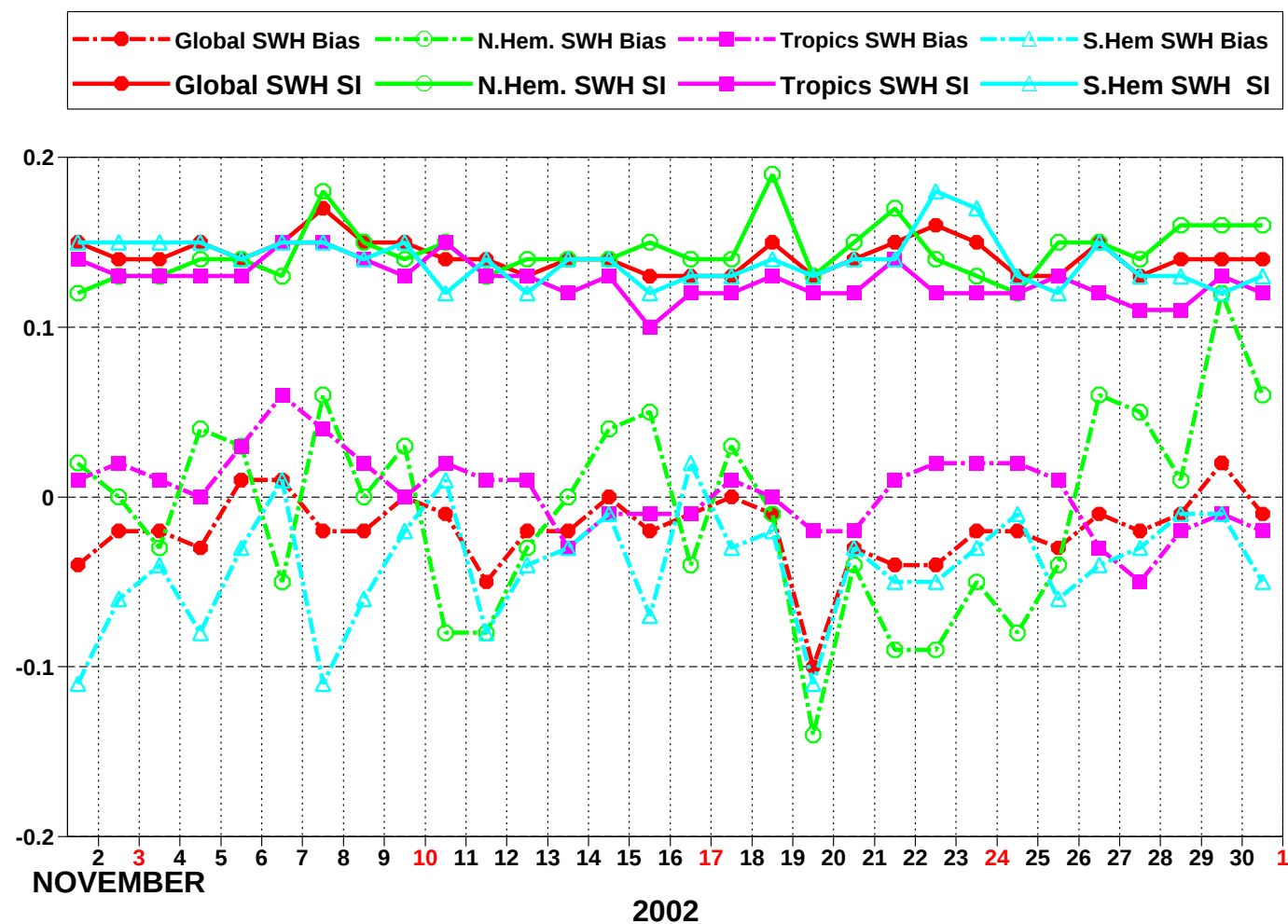


Figure 6: ERS-2 SAR wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

■ ECMWF Report on ERS-2 SAR for November 2002 ■

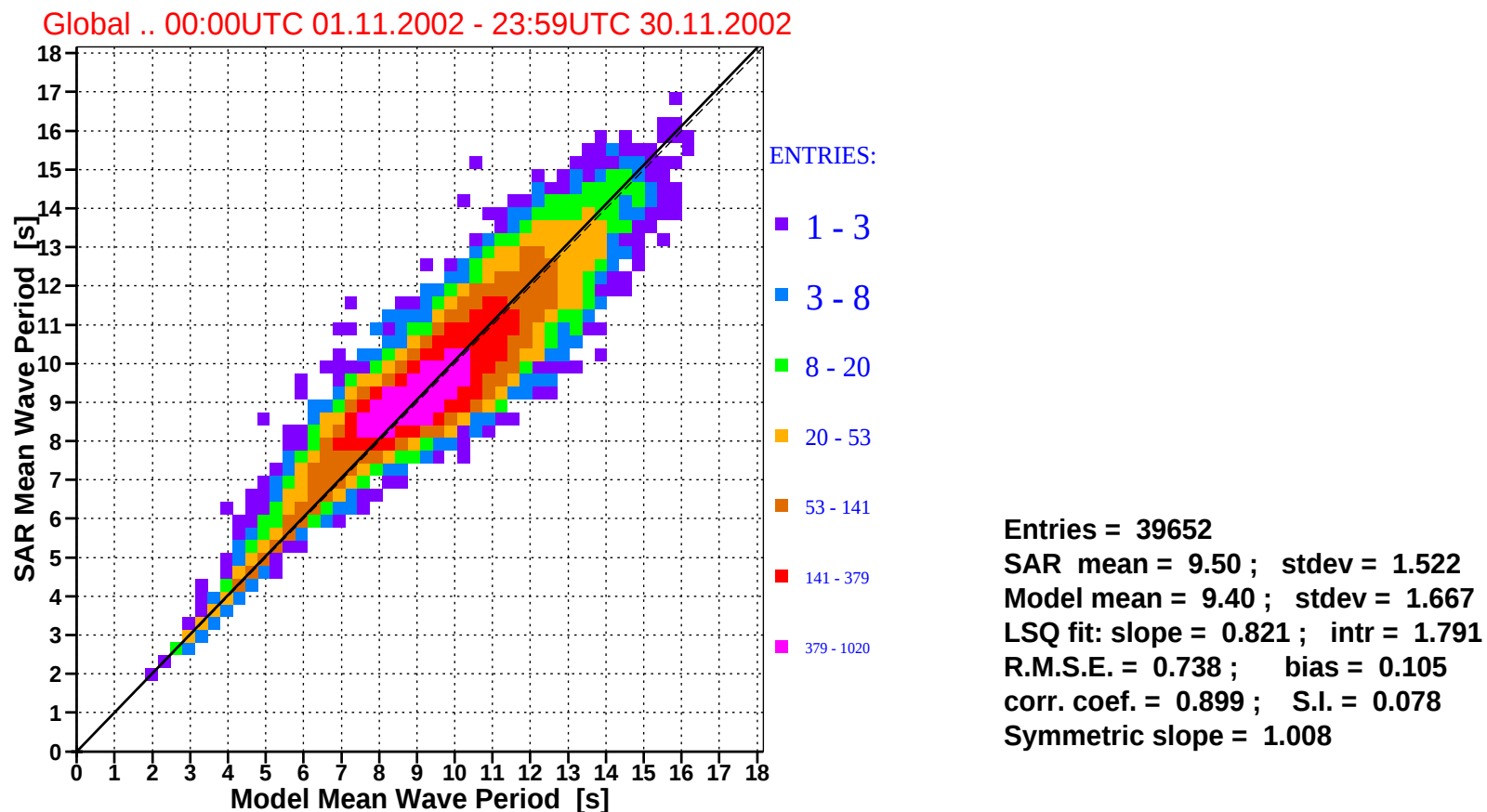


Figure 7: Comparison of ECMWF mean wave periods with ERS-2 SAR mean wave periods for november 2002 (global).

■ ECMWF Report on ERS-2 SAR for November 2002 ■

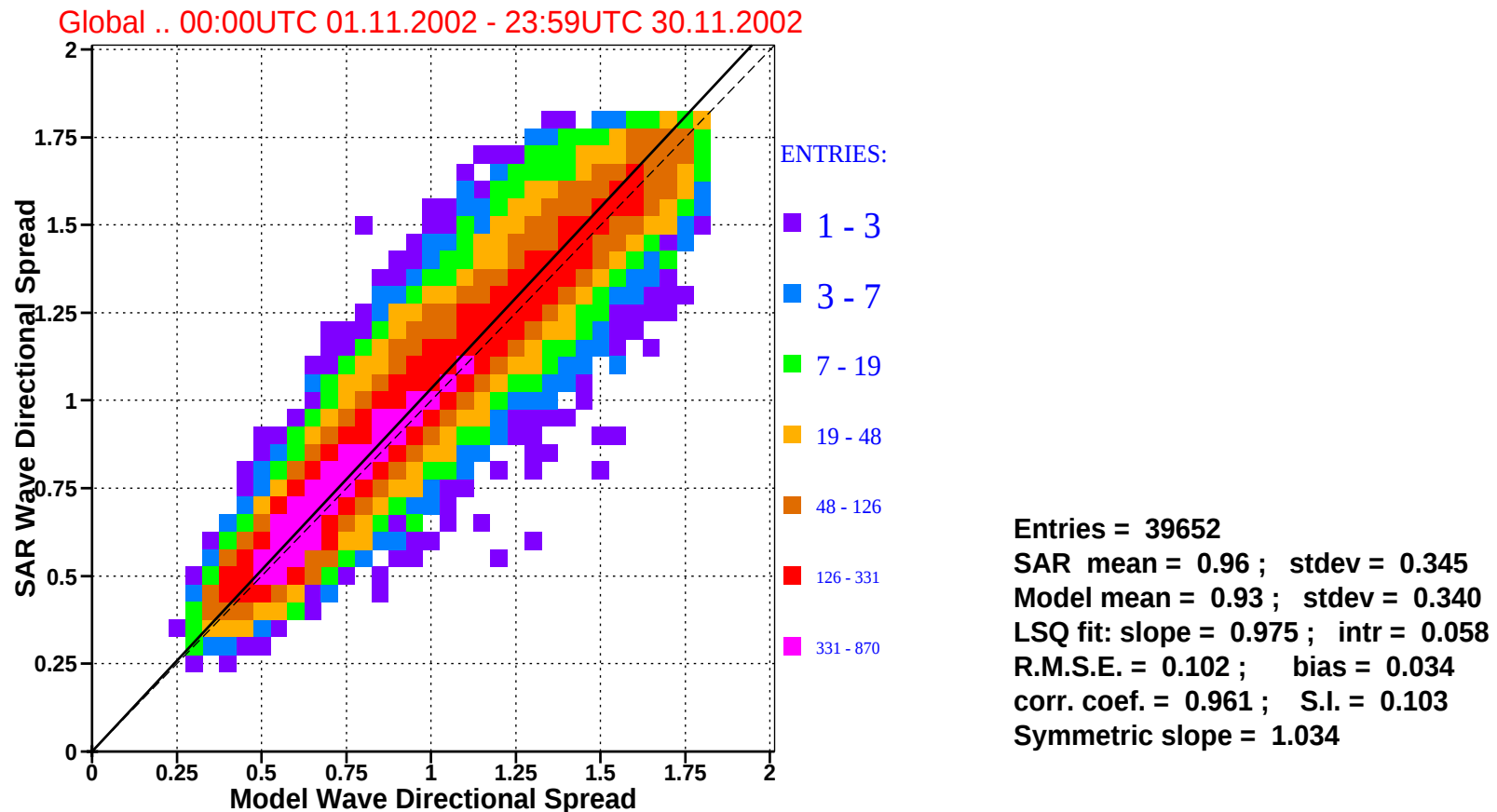


Figure 8: Comparison of ECMWF wave directional spread with that of ERS-2 SAR for november 2002 (global).



Saleh Abdalla

European Centre for Medium Range Weather Forecasts
 Shinfield Park, Reading, Berkshire RG2 9AX, England

Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703

Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 SAR for November 2002 ■

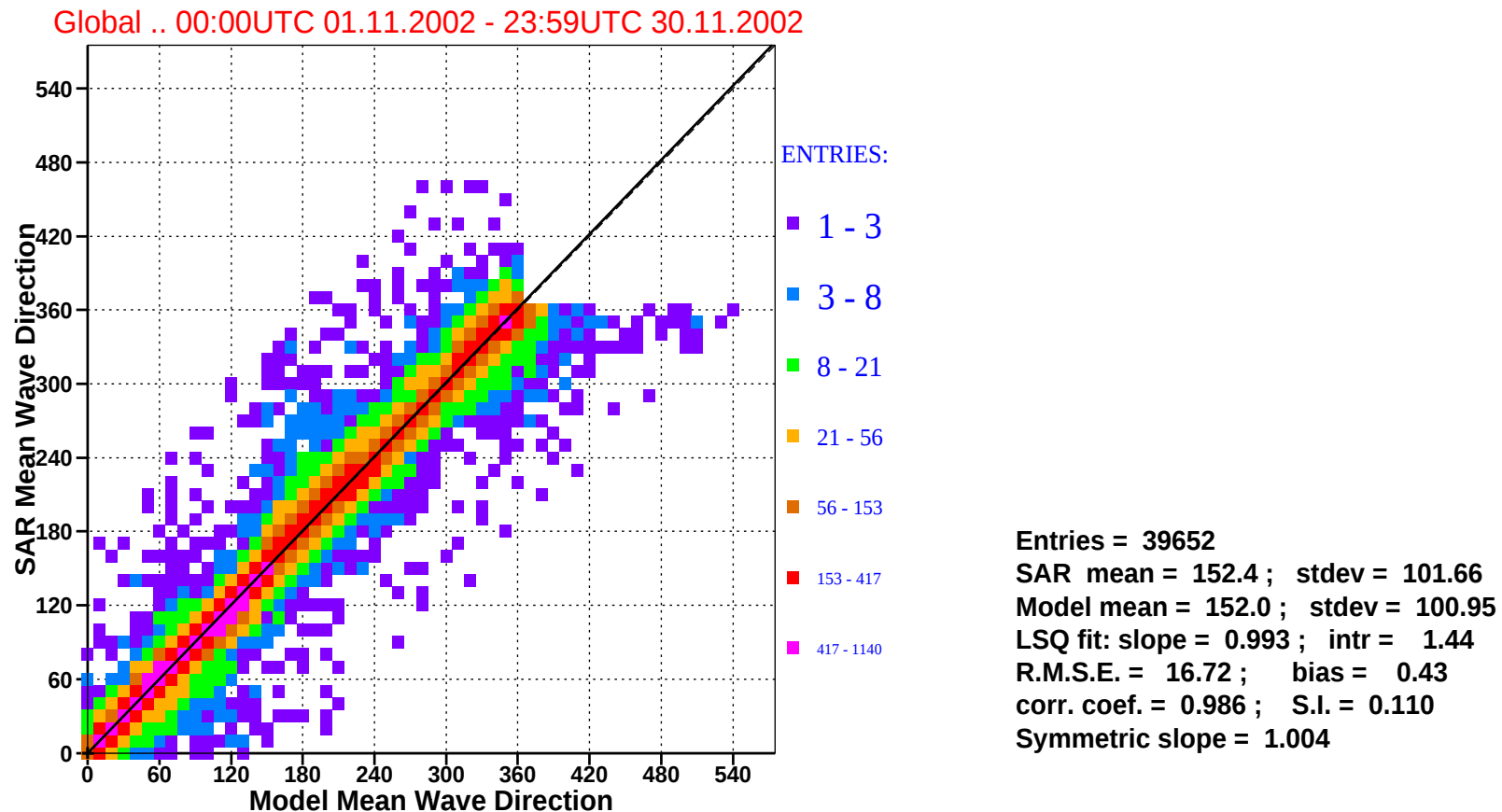


Figure 9: Comparison of ECMWF mean wave directions with that of ERS-2 SAR for november 2002 (global).

■ ECMWF Report on ERS-2 SAR for November 2002 ■

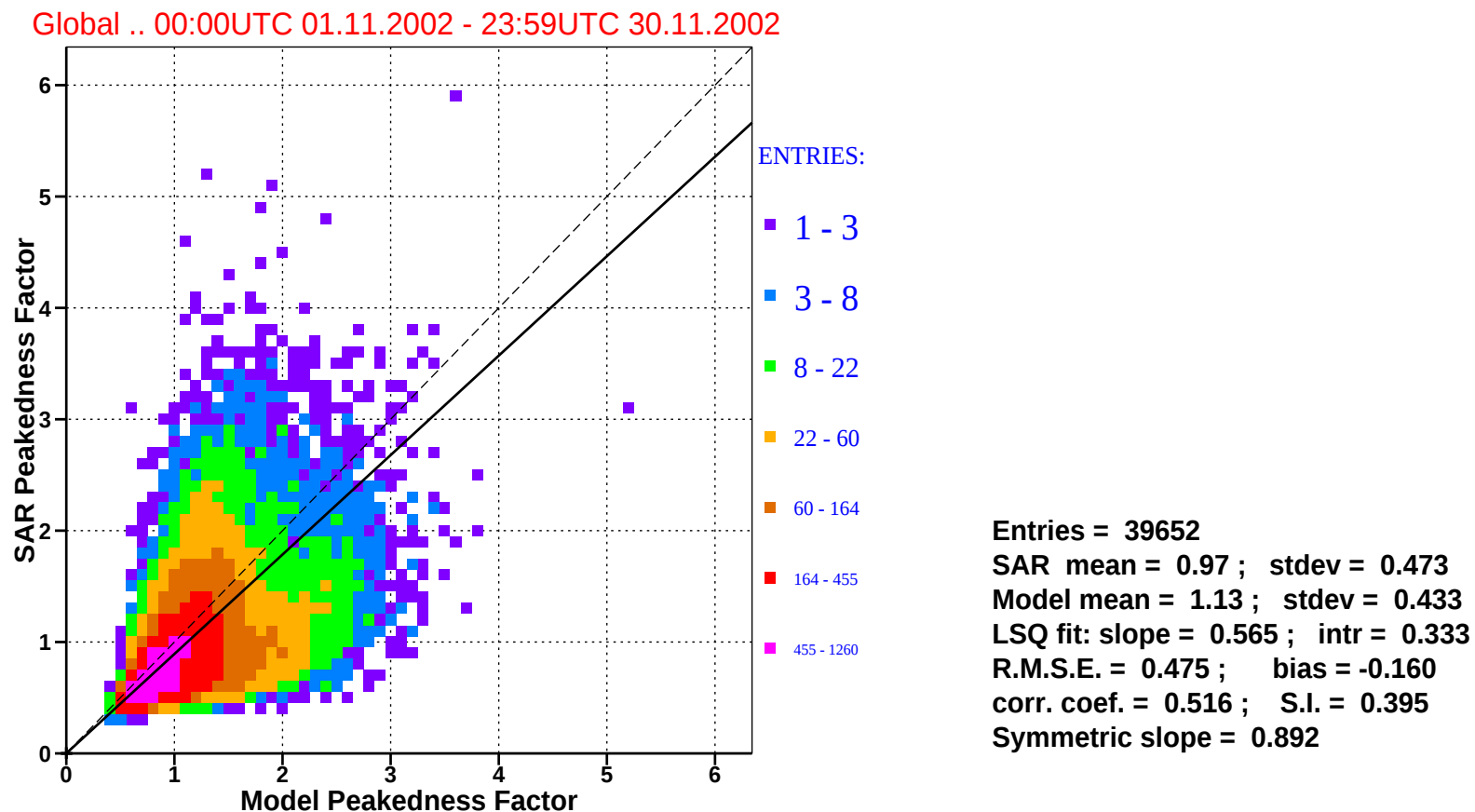
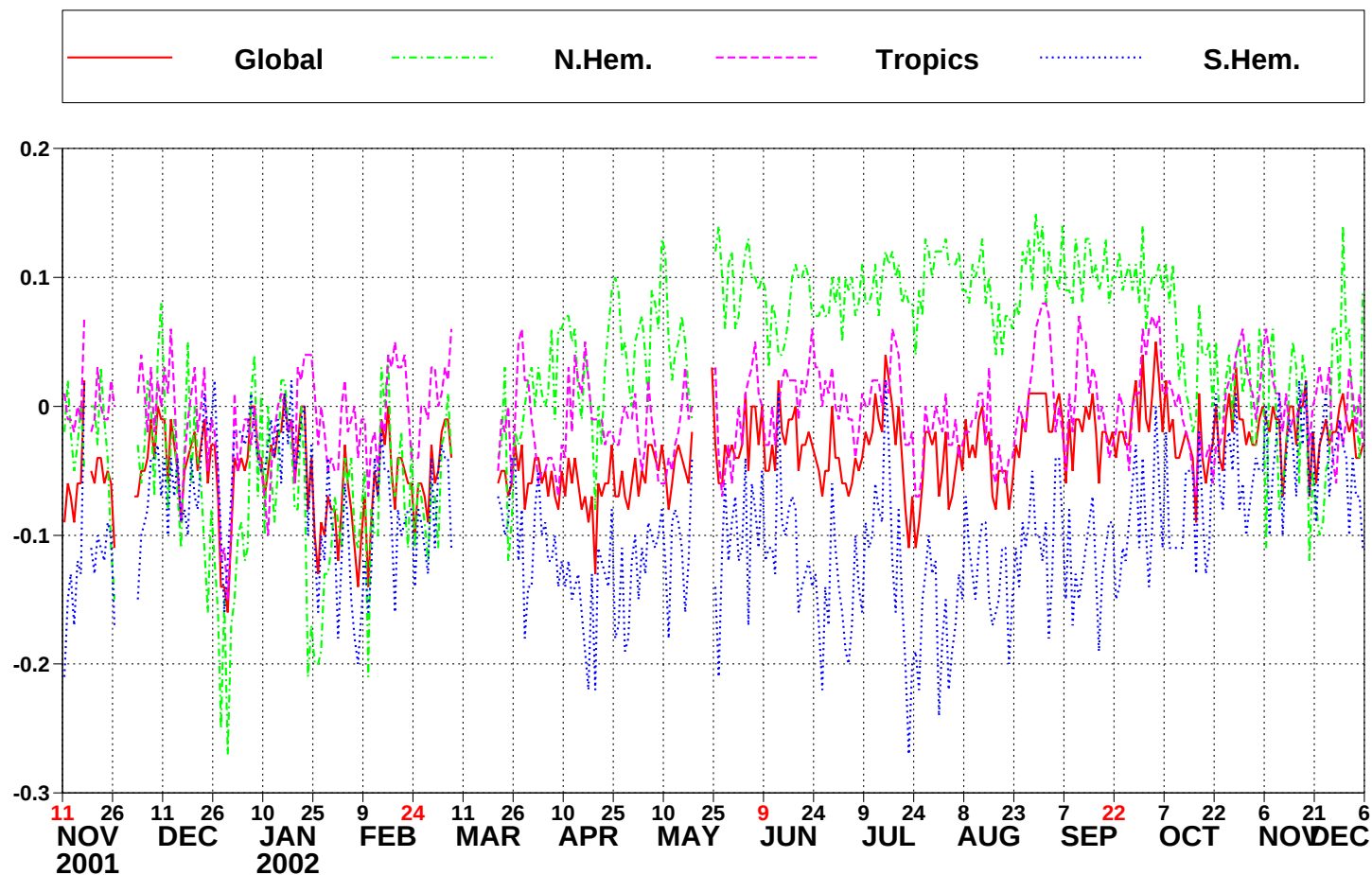


Figure 10: : Comparison of ECMWF wave peakedness factor with that of ERS-2 SAR for november 2002 (global).



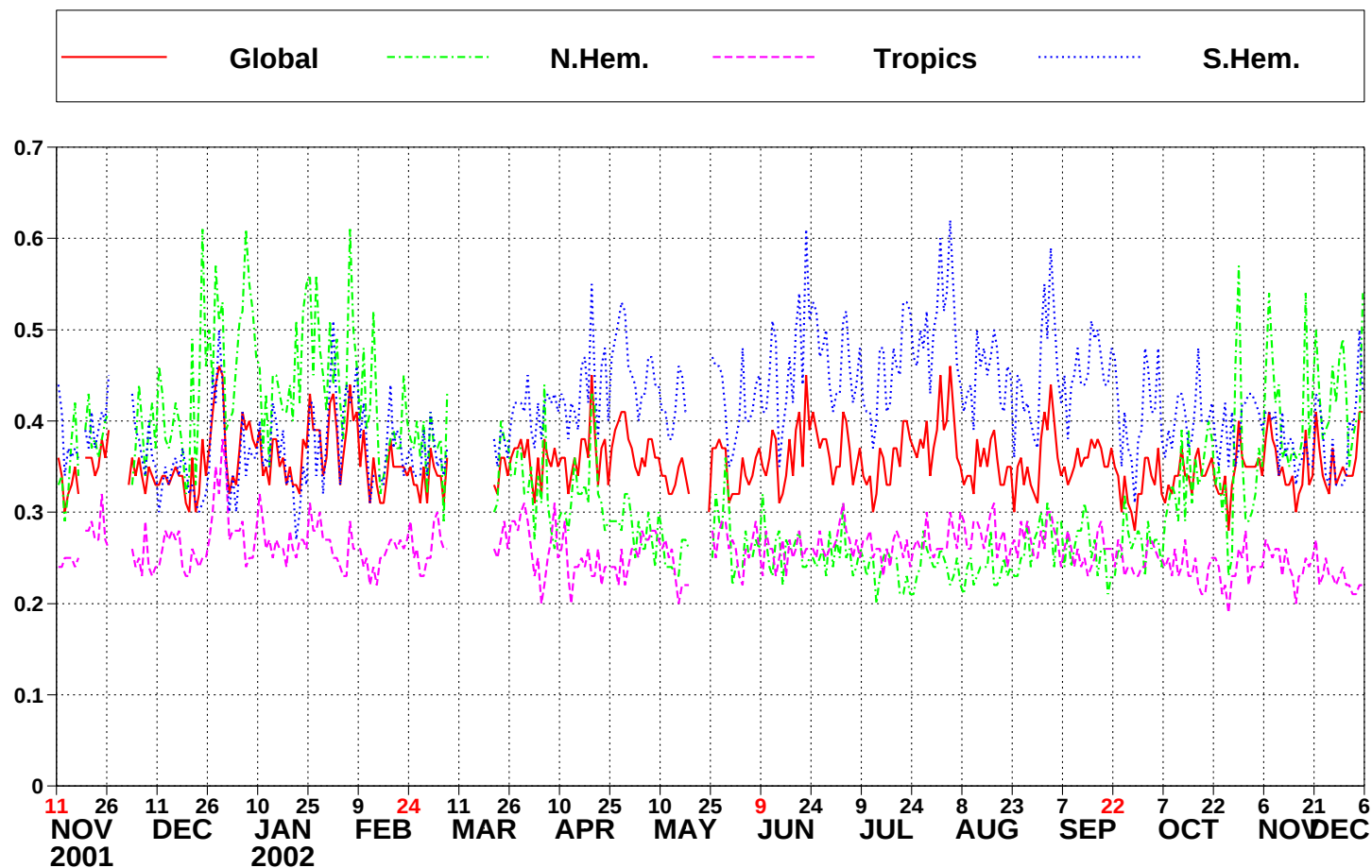
■ ECMWF Report on ERS-2 SAR for November 2002 ■



ERS-2 Synthetic Aperture Radar wave heights: Timeseries of bias (ERS-2 - model)



■ ECMWF Report on ERS-2 SAR for November 2002 ■



ERS-2 Synthetic Aperture Radar wave heights: Timeseries of root mean square difference (RMSE)

■ ECMWF Report on ERS-2 SAR for November 2002 ■

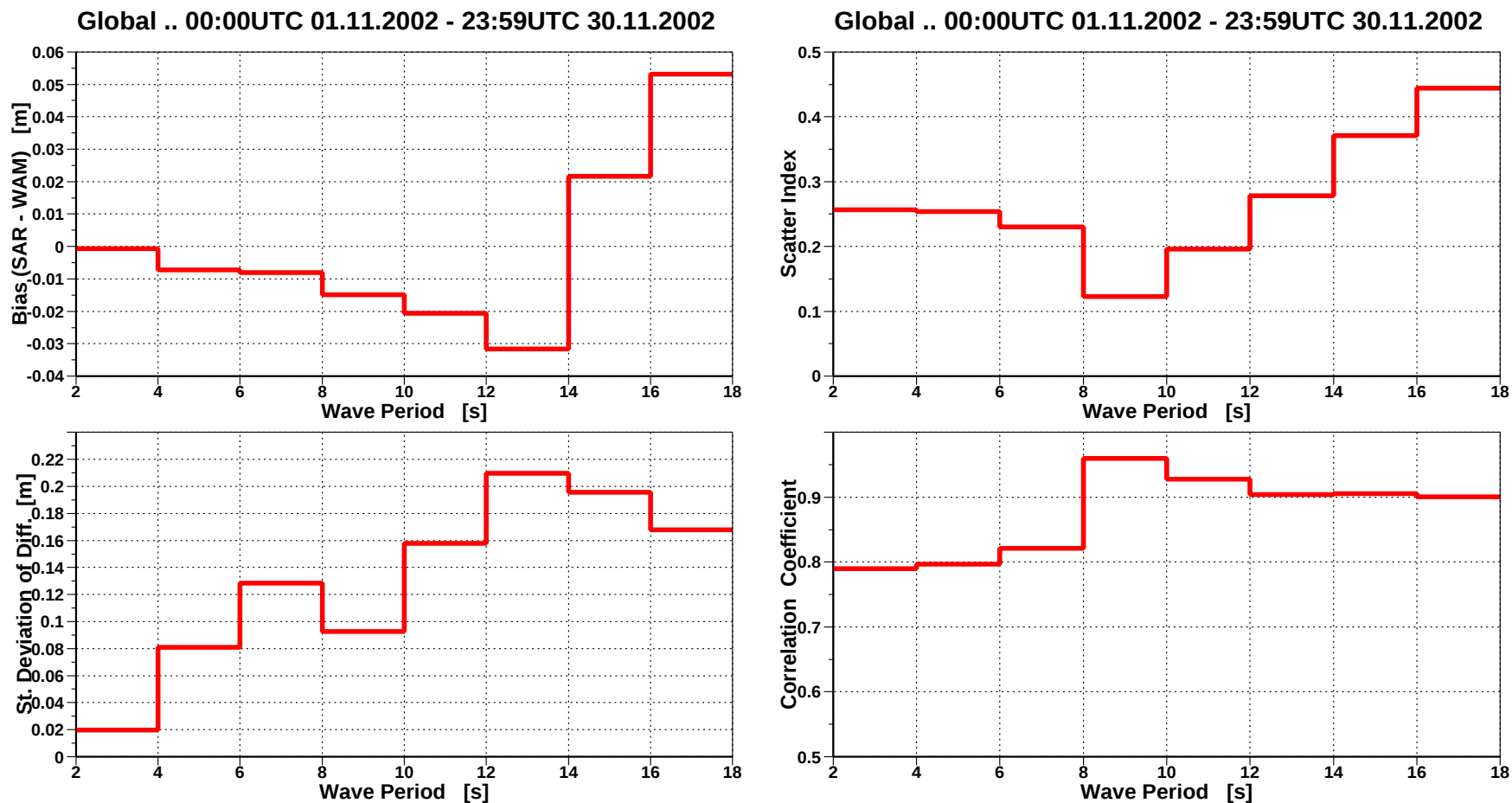


Figure 13: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (global).

■ ECMWF Report on ERS-2 SAR for November 2002 ■

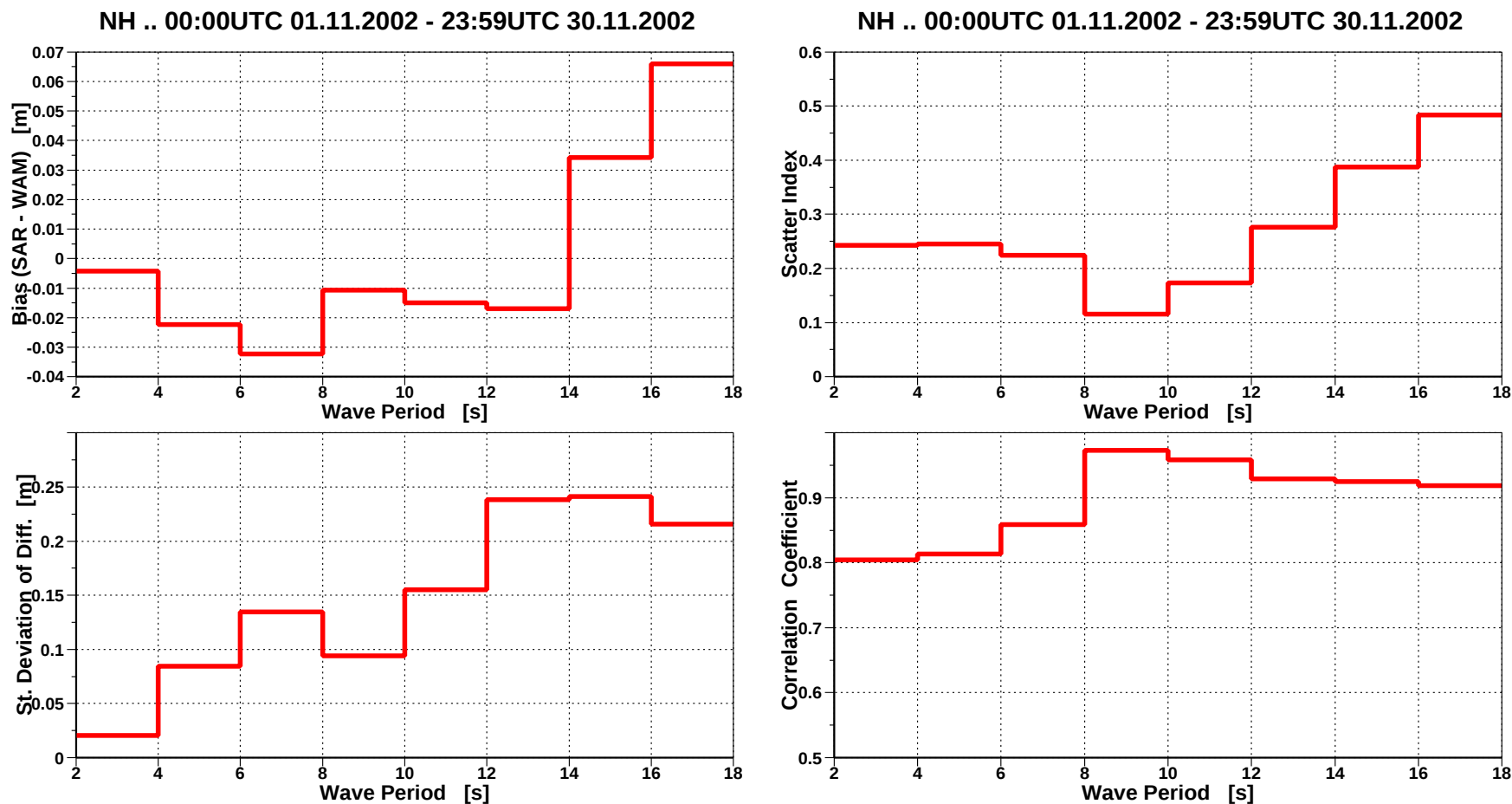


Figure 14: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (n.hem.).

■ ECMWF Report on ERS-2 SAR for November 2002 ■

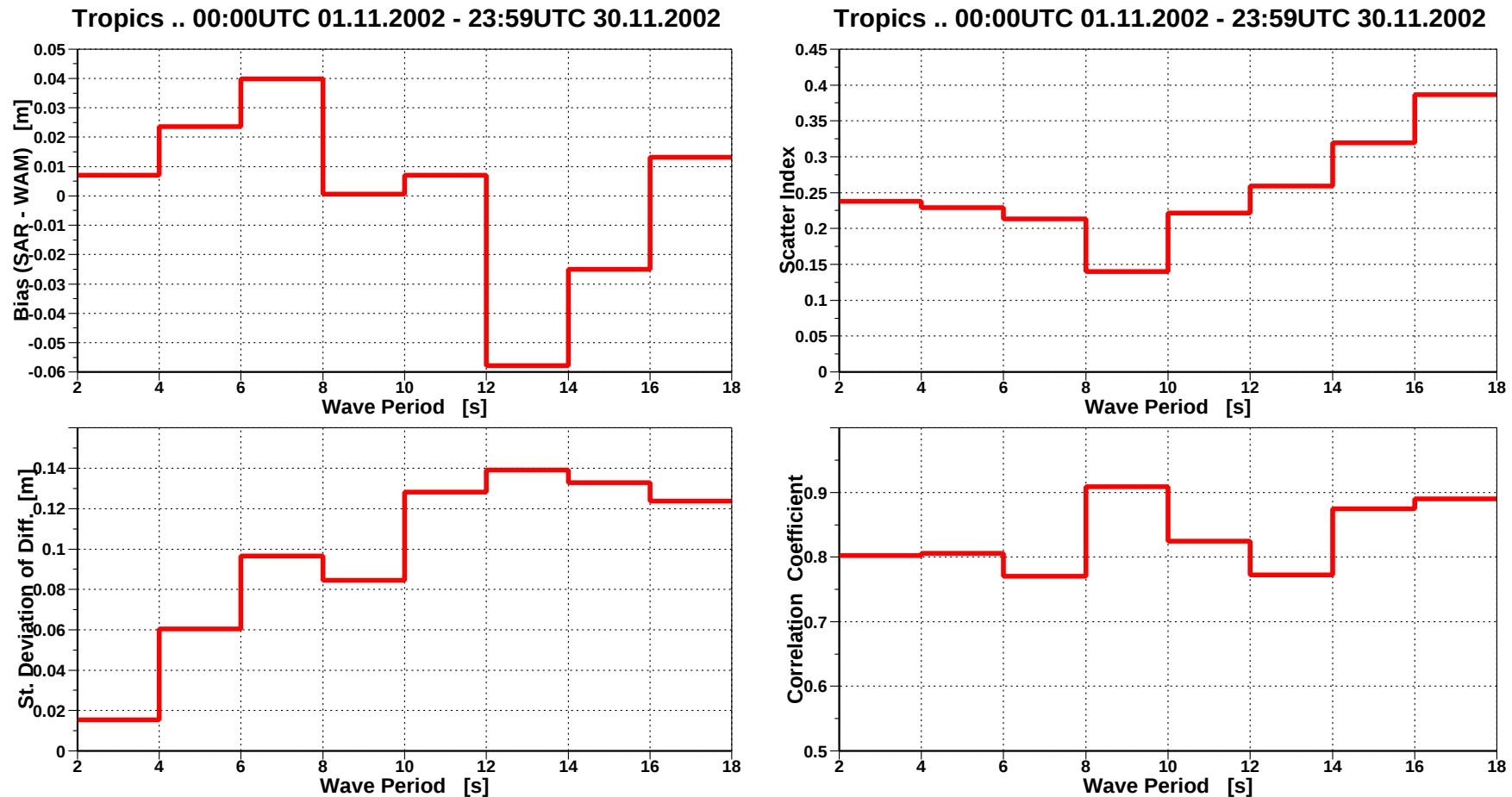


Figure 15: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (tropics).

■ ECMWF Report on ERS-2 SAR for November 2002 ■

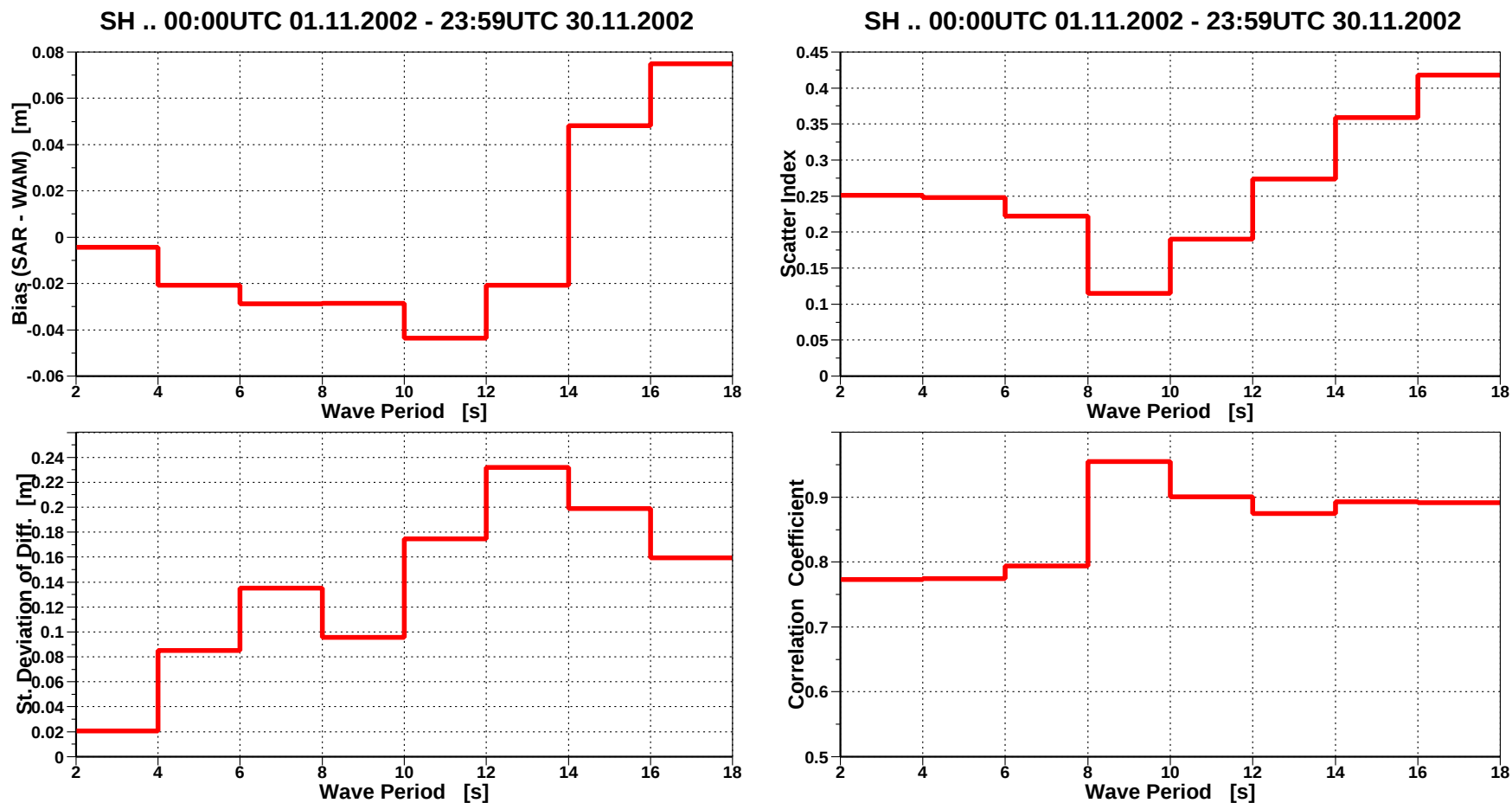


Figure 16: Comparison between SAR and ECMWF “2-second wave-period interval equivalent wave heights” for November 2002 (s.hem.).