f021grdpw[001-003]: Wave growth in deep water

Purpose

The purpose of this test is to verify fetch-limited deep water wave growth for 3 different wind speeds.

Situation

Fetch-limited deep water wave growth caused by a constant uniform wind blowing perpendicularly off a long and straight coastline is considered. The wind velocities are U_{10} = 10, 20 and 30 m/s for case f021grdpw001, f021grdpw002 and f021grdpw003 respectively. Ambient currents are absent.

Comparison

Model results are compared with expressions of Kahma and Calkoen (1992, generalized), Wilson (1965) and Pierson-Moskowitz (1964). Comparison is made for the range of non-dimensional fetch of 10 to 10,000,000. The fetch and results are scaled with gravitational acceleration g and friction velocity, U^*, defined as

$$U^* = \sqrt{C_D U_{10}} \tag{F2.1}$$

where C_D is defined according to Wu (1982) and U_{10} is wind velocity at 10m above sea level.

The non-dimensional fetch is defined as

$$X^* = \frac{gX}{\left(U^*\right)^2} \tag{F2.2}$$

where X is fetch.

The model results under comparison are non-dimensional total energy and non-dimensional peak-frequency as a function of non-dimensional fetch. Non-dimensional energy is defined here as

$$E^* = \frac{g^2 m_0}{(U^*)^4} \tag{F2.3}$$

The non-dimensional peak frequency is defined as

$$f_p^* = \frac{f_p U^*}{g} \tag{F2.4}$$

where f_p is the peak frequency.

Default model commands

Model commands for U_{10} = 10 m/s (f021grdpw001)

	COMPUTATIONAL GRID							
	1D/2D	XPC	YPC	ALPC	XLENC	YLENC		
01	ID	0	0	0	100	0		
02	ID	90	0	0	1000	0		
03	ID	800	0	0	10 200	0		
04	ID	10 000	0	0	150 000	0		
05	ID	150 000	0	0	750 000	0		
06	ID	750 000	0	0	50 000 000	0		
	ΔX	ΔY	DIR1	DIR2	Δθ	FLOW	FHIGH	MSC
01	1	0	0°	360°	10°	0.300	4.0	27
02	10	0	0°	360°	10°	0.200	3.0	28
03	100	0	0°	360°	10°	0.120	2.0	30
04	100	0	0°	360°	10°	0.070	1.0	28
05	500	0	0°	360°	10°	0.060	1.0	30
06	10 000	0	0°	360°	10°	0.060	1.0	30
	PHYSICS							
	GEN	BREAK	FRIC	TRIADS	QUAD	WCAP	REFRAC	FSHIFT	SETUP
	3	off	off	off	on	on	off	off	off
	BOUNDARY CONDITIONS							
	TYPE	BOU	C/V	P/R	NAME OF FILE			
01	_	_	_	_	_			
02	side	W	con	read boundary from file	'f021grdpw001_02.abs'			
03	side	W	con	read boundary from file	'f021grdpw001_03.abs'			
04	side	W	con	read boundary from file	'f021grdpw001_04.abs'			
05	side	W	con	read boundary from file	'f021grdpw001_05.abs'			
06	side	W	con	read boundary from file	'f021grdpw001_06.abs'			
	BOTTOM:		**WIND:**	**CURRENT:**	**WATER LEVEL:**			
	'f021grdp001.bot'		U_{10}: 10 m/s | θ_w: 0°	_	_			

Model commands for U_{10} = 20 m/s (f021grdpw002)

	COMPUTATIONAL GRID									
	1D/2D		XPC		YPC		ALPC		XLENC	YLENC
01	ID		0		0		0		100	0
02	ID		90		0		0		1000	0
03	ID		800		0		0		10 200	0
04	ID		10 000		0		0		150 000	0
05	ID		150 000		0		0		750 000	0
06	ID		750 000		0		0		50 000 000	0
	ΔX	ΔY		DIR1		DIR2	Δθ	FLOW	FHIGH	MSC
01	1	0		0°		360°	10°	0.250	3.0	26
02	10	0		0°		360°	10°	0.200	2.0	24
03	100	0		0°		360°	10°	0.100	2.0	29
04	100	0		0°		360°	10°	0.050	1.0	31
05	500	0		0°		360°	10°	0.033	1.0	36
06	10 000	0		0°		360°	10°	0.033	1.0	36
	PHYSICS									
	GEN	BREAK		FRIC	TRIADS		QUAD	WCAP	REFRAC	FSHIFT	SETUP
	3	off		off	off		on	on	off	off	off
	BOUNDARY CONDITIONS									
	TYPE	BOU	C/V	P/R		NAME OF FILE				
01	_	_	_	_		_				
02	side	W	con	read boundary from file		'f021grdpw002_02.abs'				
03	side	W	con	read boundary from file		'f021grdpw002_03.abs'				
04	side	W	con	read boundary from file		'f021grdpw002_04.abs'				
05	side	W	con	read boundary from file		'f021grdpw002_05.abs'				
06	side	W	con	read boundary from file		'f021grdpw002_06.abs'				
	BOTTOM:			**WIND:**		**CURRENT:**			**WATER LEVEL:**	
	'f021grdp002.bot'			U_{10}: 20 m/s | θ_w: 0°		_			_	

Model commands for U_{10} = 30 m/s (f021grdpw003)

	COMPUTATIONAL GRID							
	1D/2D	XPC	YPC	ALPC	XLENC	YLENC		
01	ID	0	0	0	100	0		
02	ID	90	0	0	1000	0		
03	ID	800	0	0	10 200	0		
04	ID	10 000	0	0	150 000	0		
05	ID	150 000	0	0	750 000	0		
06	ID	750 000	0	0	50 000 000	0		
	ΔX	ΔY	DIR1	DIR2	Δθ	FLOW	FHIGH	MSC
01	1	0	0°	360°	10°	0.200	3.0	28
02	10	0	0°	360°	10°	0.100	2.0	31
03	100	0	0°	360°	10°	0.090	1.0	25
04	100	0	0°	360°	10°	0.055	1.0	31
05	500	0	0°	360°	10°	0.033	1.0	36
06	10 000	0	0°	360°	10°	0.025	1.0	38
	PHYSICS							
	GEN	BREAK	FRIC	TRIADS	QUAD	WCAP	REFRAC	FSHIFT	SETUP
	3	off	off	off	on	on	off	off	off
	BOUNDARY CONDITIONS							
	TYPE	BOU	C/V	P/R	NAME OF FILE			
01	_	_	_	_	_			
02	side	W	con	read boundary from file	'f021grdpw003_02.abs'			
03	side	W	con	read boundary from file	'f021grdpw003_03.abs'			
04	side	W	con	read boundary from file	'f021grdpw003_04.abs'			
05	side	W	con	read boundary from file	'f021grdpw003_05.abs'			
06	side	W	con	read boundary from file	'f021grdpw003_06.abs'			
	BOTTOM:		**WIND:**		**CURRENT:**		**WATER LEVEL:**	
	'f021grdp003.bot'		U_{10}: 30 m/s | θ_w: 0°		_		_	

References

Kahma, K.K. and C.J. Calkoen, 1992: Reconciling discrepancies in the observed growth of wind-generated waves, *J. Phys. Oceanogr.*, 22, 1389-1405

Wilson, B.W., 1965: Numerical prediction of ocean waves in the North Atlantic for December 1959, *Deutsch. Hydrogr. Z.*, 18, No. 3, p. 114-130

Pierson, W.J. and L. Moskowitz, 1964: A proposed spectral form for fully-developed wind seas based on the similarity theory of S.A. Kitaigorodskii, *J. Geophys. Res.*, 69, No. 24, 5181-5190

Wu, J., 1982: Wind-stress coefficients over sea surface from breeze to hurricane, *J. Geophys. Res.*, 87, C12, pp. 9704-9706

Acknowledgements

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