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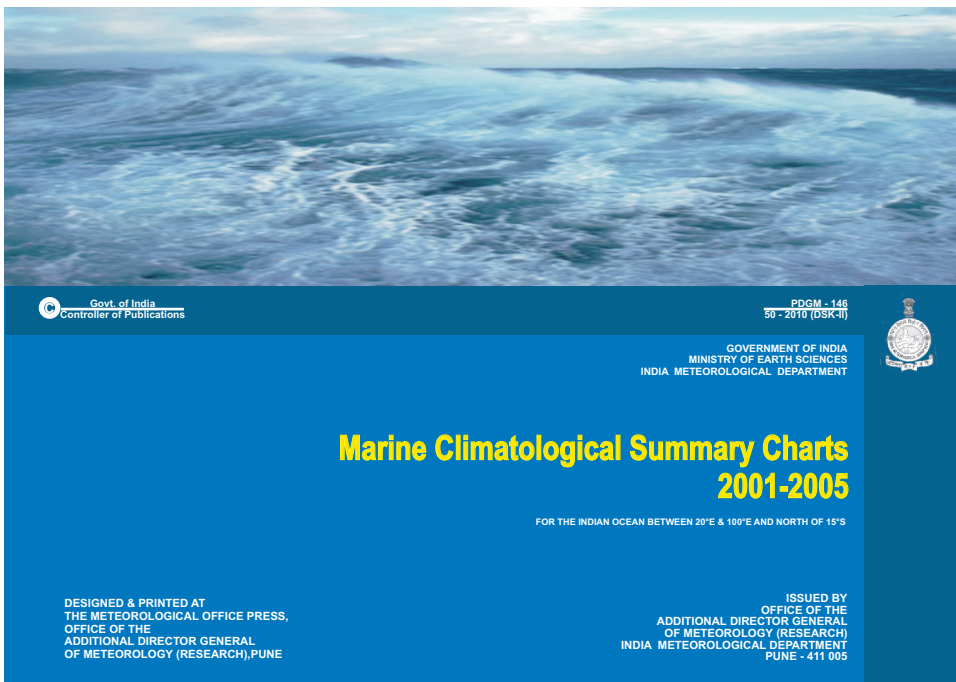
Marine Climatological Summary Charts 2001-2005

FOR THE INDIAN OCEAN BETWEEN 20°E & 100°E AND NORTH OF 15°S

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COMPILATION & EDITING : MARINE CLIMATOLOGY SECTION

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SHIVAJINAGAR, PUNE 411 005**

P R E F A C E

Marine meteorological service is one of the important responsibilities of the India Meteorological Department (IMD). Information on weather conditions over the ocean is essential for operational planning of maritime activities, developing dynamical models for the weather and climate forecasting, the design of vessels, coastal and offshore facilities, the exploitation of marine and sea-bed resources, the response to oil spills at sea, climate research etc. IMD carries out this responsibility for the Indian Ocean area north of 15°S latitude, bounded by the longitudes of 20°E and 100°E. The valuable observations are contributed by the World Meteorological Organization's (WMO) Voluntary Observing Fleet (VOF) consisting of merchant ships of Indian registry, some foreign merchant vessels and a few ships of the Indian Navy. The ships provide observations free of charge in return for the instrumentation, forecasting and warning services, rendered by IMD.

Annual Marine Climatological Summaries for seventeen selected points of this Indian Ocean area were compiled and published for the period 1961 to 1970. Following the recommendation of the WMO Commission for Marine Meteorology at its eighth session held in 1981, a Marine Climate Atlas based on the data of 1961-1990 and the decadal marine climatological summary, in chart form, for the period 1971-1980 and 1991-2000 have been published, in print and electronic form, by IMD. The present publication, "**Marine Climatological Summaries Charts 2001-2005**", is the result of IMD's new initiative to prepare the Pentad Marine Climatological Summaries in Chart form over the Indian region based on marine observations.

IMD acknowledges and deeply appreciates the excellent efforts of the officers and staff of all the ships involved in the recording of marine data used in the preparation of this climatological summary.

Dr. D. S. Pai, Scientist 'E', developed software for the computation and supervised the entire work. Shri N.T. Niyas, Met I, and Shri Sunil Narke, S.A., helped in the compilation and quality checking of the data and Shri. O.P. Sreejith, Met II assisted, in the graphical work of the charts. Other staff of the Marine Climatology Section have provided assistance at various stages of this publication. Shri. A. Phillipose, AM-II, of the DTP unit helped in the designing, typesetting and preparation of electronic copy of this publication.

I express my sincere appreciation to their efforts and overall guidance of Dr. H.R. Hatwar, ADGM (R) and Dr. A.L. Koppar, DDGM(C) in bringing out this informative and useful publication.

New Delhi
July, 2010

Ajit Tyagi
Director General of Meteorology

INTRODUCTION

India is one of the eight responsible members (RMs) of Marine Climatological Summaries Scheme (MCSS) established by the WMO Commission for Marine Meteorology (CMM) in 1963. The objective of MCSS was to develop and maintain a joint effort of all maritime nations in the collection of marine data and production of climatological statistics. Each of the eight RMs was assigned a specific area of responsibility. Area of responsibility assigned to India was north of latitude 15° S and between longitude 20° E and 100° E of Indian Ocean. Following the revision of the MCSS, in line with Rec. 11, CMM-XI and Resolution 10, EC-XLV 1993, two Global Climate Centers (GCCs) for marine climatological data were established in 1994 at Germany and United Kingdom. GCCs collect Voluntary Observing Fleet (VOF) data from member countries of MCSS quarterly and after ensuring that these data meet the Minimum Quality Control Standards (MQCS) re-distribute the data to the RMs. The marine data regularly received from GCCs are archived at National Data Center (NDC), India Meteorological Department (IMD), Pune. As per the present practice, the decadal summaries are prepared in the chart form. IMD published chart form of decadal marine climatological summary for the period 1971-80 and 1991-2000 in 1999 and 2008 respectively. A marine climate atlas based on the data of 1961-1990 was published in 2002. This volume of the pentadal marine climatological summary is prepared using the data for the period 2001-2005.

At the end of climatological summary charts for each month and that for the annual, the spatial distribution of the ship positions from where the observations were recorded is presented along with the bar diagrams showing the country wise and year wise distribution of the number of observations contributed by the member countries of MCSS.

Data Sources & Computation of the Statistics

The data used to prepare the summary charts were obtained from two sources: (i) Weather observations recorded by Indian VOF and (ii) Weather observations recorded by other ships while in the India area of responsibility but passed on to the other member countries of MCSS. For the preparation of these climatological summary charts, all the data for the period 2001-2005 available in the data archive of NDC were used.

The weather observations obtained from the meteorological log books of VOF were scrutinized to eliminate instrumental, positional and coding errors. The GCCs ensure that the data from various countries meet MQCS standards. As the data used for this publication were received quarterly from the GCCs, all the data (for the period 2001-2005) were once again checked for duplication and other errors and were corrected as far as possible so that data meet MQCS standards. For the computation of the climatological statistics, only those values of the meteorological and oceanographic elements were used which were appeared to be correct after the quality control (QC) or corrected as a result of QC. The statistics was computed at each spatial grid boxes of 5°X5°, latitude X longitude over the Indian Oceanic region under Indian responsibility.

There were 96 such grid boxes. The computations were done using FORTRAN programs developed in house. For the computation of the statistics the following points were considered.

1. The formula for calculating standard deviation (σ) is

$$\sigma = \sqrt{\frac{n \sum x^2 - (\sum x)^2}{n(n-1)}}$$

Where, x is the value of an individual observation and n is the number of observations.

2. Steadiness = (vector average) / (scalar average)
Calm winds were rejected in calculating the steadiness; wind speed of variable directions was taken as 0 in calculating the vector average but retained in calculating the scalar average. The steadiness is expressed in percentage.
3. The prevailing wind direction is the direction in which the number of occurrence is the greatest, irrespective of the associated wind speed. Winds of variable directions were rejected in the calculation.
4. When the sea and swell waves were reported simultaneously, only the group with the greatest height (or with the greatest period if the heights were equal) was included in the calculation.

Presentation of the Climatological Summary Charts

For the presentation of climatological data, a chart with spatial domain bounded between 15°S-40°N and 20°E-100°E has been used. The charts were prepared using Generic Mapping Tools (GMT). In each of the summary chart, 3 different statistical values of the eighteen elements as specified in the Table-A were plotted on each of the 5°X5° grid boxes. The charts are arranged in the order of month and annual charts are given in the end.

TABLE - A

Chart	Parameter	Details	Chart	Parameter	Details
I	1	Mean Air Temperature (0.1°C)	X	1	Percentage of wave ≤ 1.5 m (0.1%)
	2	Standard deviation of air temperature (0.1°C)		2	Percentage of wave ≥ 4.0 m (0.1%)
	3	Number of observation of air temperature		3	Percentage of wave ≥ 6.0 m (0.1%)
II	1	Mean Sea surface Temperature (0.1°C)	XI	1	Percentage of wave periods ≥ 6 s (0.1%)
	2	Standard deviation of sea surface temperature (0.1°C)		2	Prevailing swell direction (to the nearest 10 degrees)
	3	Number of observation of sea surface temperature		3	Number of observations of swell
III	1	Mean dew point temperature (0.1°C)	XII	1	Mean wave period (1s)
	2	Standard deviation of dew point temperature (0.1°C)		2	Maximum wave height (0.5m)
	3	Number of observation of dew point temperature		3	Period of highest wave (1s)
IV	1	Mean air-sea temperature difference (0.1°C)	XIII	1	Mean sea-level pressure (0.1hpa)
	2	Standard deviation of air-sea temperature difference (0.1°C)		2	Standard deviation of mean-sea level pressure (0.1hpa)
	3	Number of observation of air-sea temperature difference		3	Number of observation of sea-level pressure
V	1	Median wind speed (f_{50} , 0.1m/s)	XIV	1	Percentage of observation with rain or drizzle (0.1%)
	2	Standard deviation of wind speed (0.1m/s)		2	Percentage of observation with other forms of precipitation (0.1%)
	3	Steadiness of wind (0.1%)		3	Number of observation of present weather
VI	1	Prevailing wind direction (to the nearest 10 degrees)	XV	1	Percentage of observations with total cloud amount $\leq 2/8$ (0.1%)
	2	Number of total wind speed observations		2	Percentage of observations with total cloud amount $\geq 6/8$ (0.1%)
	3	Number of measured wind speed observations		3	Number of observations of total cloud amount
VII	1	Percentage of light winds (≤ 3 m/s) (0.1%)	XVI	1	Percentage of observation with visibility < 1 km (0.1%)
	2	Percentage of strong winds (≥ 11 m/s) (0.1%)		2	Percentage of observation with visibility ≥ 10 km (0.1%)
	3	Prevailing direction of strong winds (to the nearest 10 degree)		3	Number of observations of visibility
VIII	1	Percentage of gales (≥ 17 m/s) (0.1%)	XVII	1	Mean latitude of observations (0.1degree)
	2	Prevailing direction of gales (to the nearest 10 degree)		2	Mean Longitude of observations (0.1degree)
	3	Maximum wind (direction in tens of degree, speed in m/s)		3	Total number of observations
IX	1	Median wave height (to the nearest 0.5m)	XVIII	1	Standard deviation of latitude of observations (0.1degree)
	2	Standard deviation of wave height (0.1%)		2	Standard deviation of longitude of observations (0.1degree)
	3	Number of observations		3	Number of ship reports containing both wind speed and air temperature

NOTE

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C O N T E N T S

JUNE

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

JULY

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

AUGUST

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

SEPTEMBER

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

OCTOBER

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

NOVEMBER

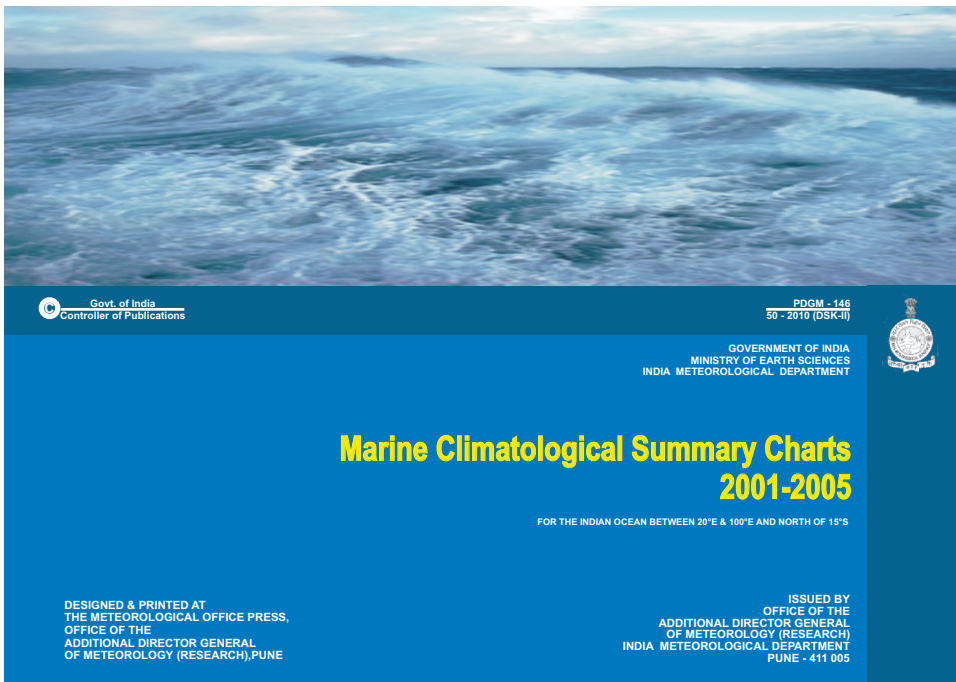
Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

DECEMBER

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

ANNUAL

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations



JANUARY

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

FEBRUARY

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

MARCH

Climatological Charts
Spatial distribution of reported ship positions
Countrywise and yearwise distribution of number of observations

APRIL

Climatological Charts
Spatial distribution of reported ship positions
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MAY

Climatological Charts
Spatial distribution of reported ship positions
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CHARTS OF JANUARY 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

CHART - XVI : VISIBILITY

CHART - XVII : POSITION OF SHIP OBSERVATIONS

CHART - XVIII : STANDARD DEVIATION OF POSITIONS

SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**

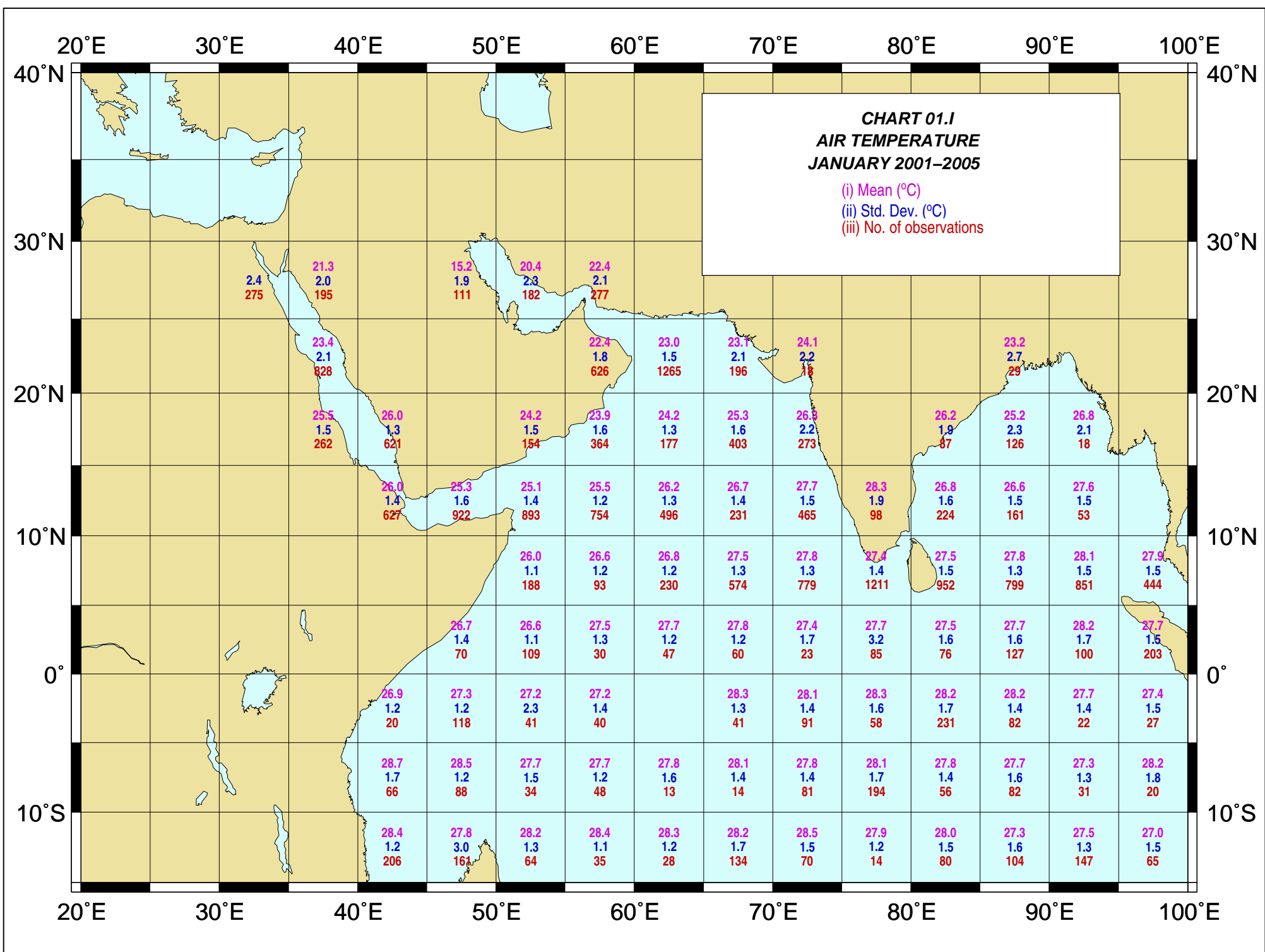
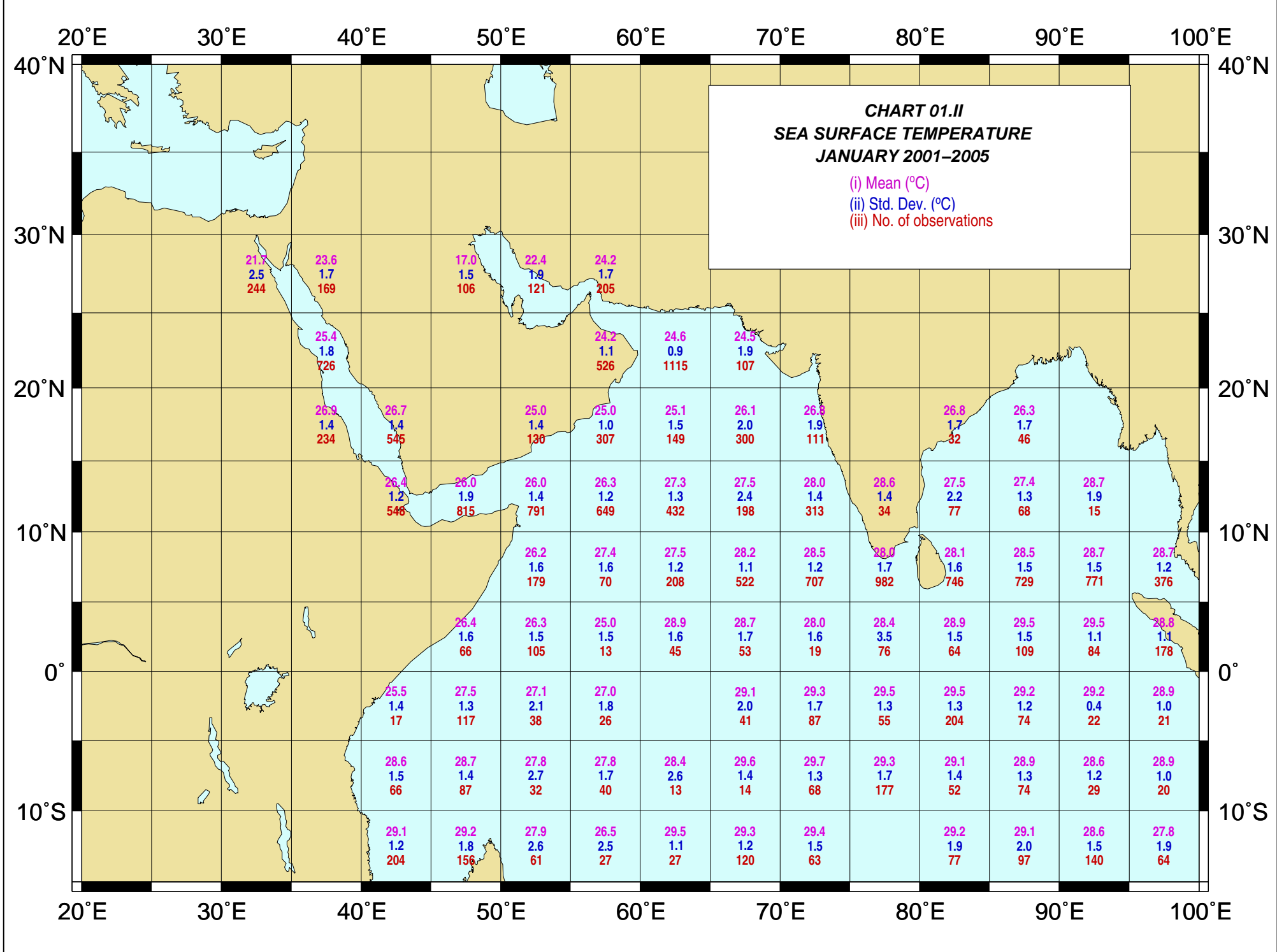


CHART 01.1
AIR TEMPERATURE
JANUARY 2001-2005

(i) Mean (°C)
(ii) Std. Dev. (°C)
(iii) No. of observations

Latitude	20°E	30°E	40°E	50°E	60°E	70°E	80°E	90°E	100°E						
40°N															
30°N			21.3 2.0 195	15.2 1.9 111	20.4 2.3 182	22.4 2.1 277									
20°N		23.4 2.1 828	25.5 1.5 262	26.0 1.3 621	24.2 1.5 154	23.9 1.6 364	24.2 1.3 177	23.0 1.5 1265	23.1 2.1 196	24.1 2.2 118	23.2 2.7 29				
10°N			26.0 1.4 627	25.3 1.6 922	25.1 1.4 893	25.5 1.2 754	24.2 1.3 177	25.3 1.6 403	26.7 1.4 231	26.9 2.2 273	26.2 1.9 87	26.8 1.6 224	25.2 2.3 126	26.8 2.1 18	
0°				26.0 1.1 188	26.6 1.2 93	26.8 1.2 230	27.5 1.3 574	26.2 1.3 496	27.7 1.5 465	27.8 1.3 779	27.4 1.4 1211	28.3 1.9 98	26.8 1.6 224	26.6 1.5 161	27.6 1.5 53
10°S				26.7 1.4 70	26.6 1.1 109	27.5 1.3 30	27.7 1.2 47	27.8 1.2 60	27.4 1.7 23	27.7 3.2 85	27.5 1.6 76	27.5 1.6 127	27.7 1.6 127	28.2 1.7 100	27.9 1.5 444
20°S			26.9 1.2 20	27.3 1.2 118	27.2 2.3 41	27.2 1.4 40	28.3 1.3 41	28.1 1.4 91	27.8 1.4 81	28.3 1.6 58	28.2 1.7 231	28.2 1.7 82	28.2 1.4 82	27.7 1.4 22	27.4 1.5 27
30°S			28.7 1.7 66	28.5 1.2 88	27.7 1.5 34	27.7 1.2 48	27.8 1.6 13	28.1 1.4 14	27.8 1.4 81	28.1 1.7 194	27.8 1.4 56	27.7 1.6 82	27.7 1.6 82	27.3 1.3 31	28.2 1.8 20
40°S			28.4 1.2 206	27.8 3.0 161	28.2 1.3 64	28.4 1.1 35	28.3 1.2 28	28.2 1.7 134	28.5 1.5 70	27.9 1.2 14	28.0 1.5 80	27.3 1.6 104	27.5 1.3 147	27.0 1.5 65	



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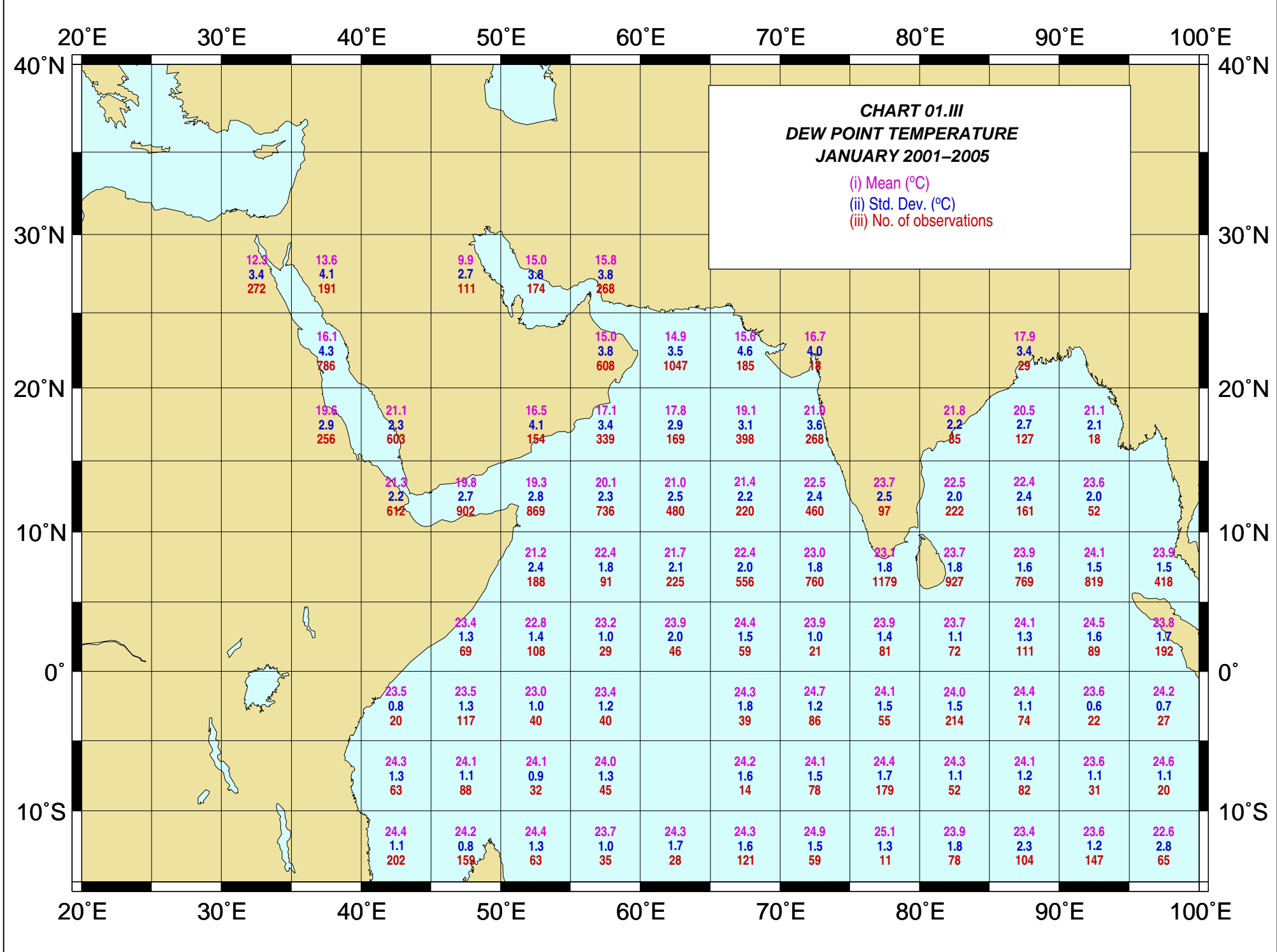
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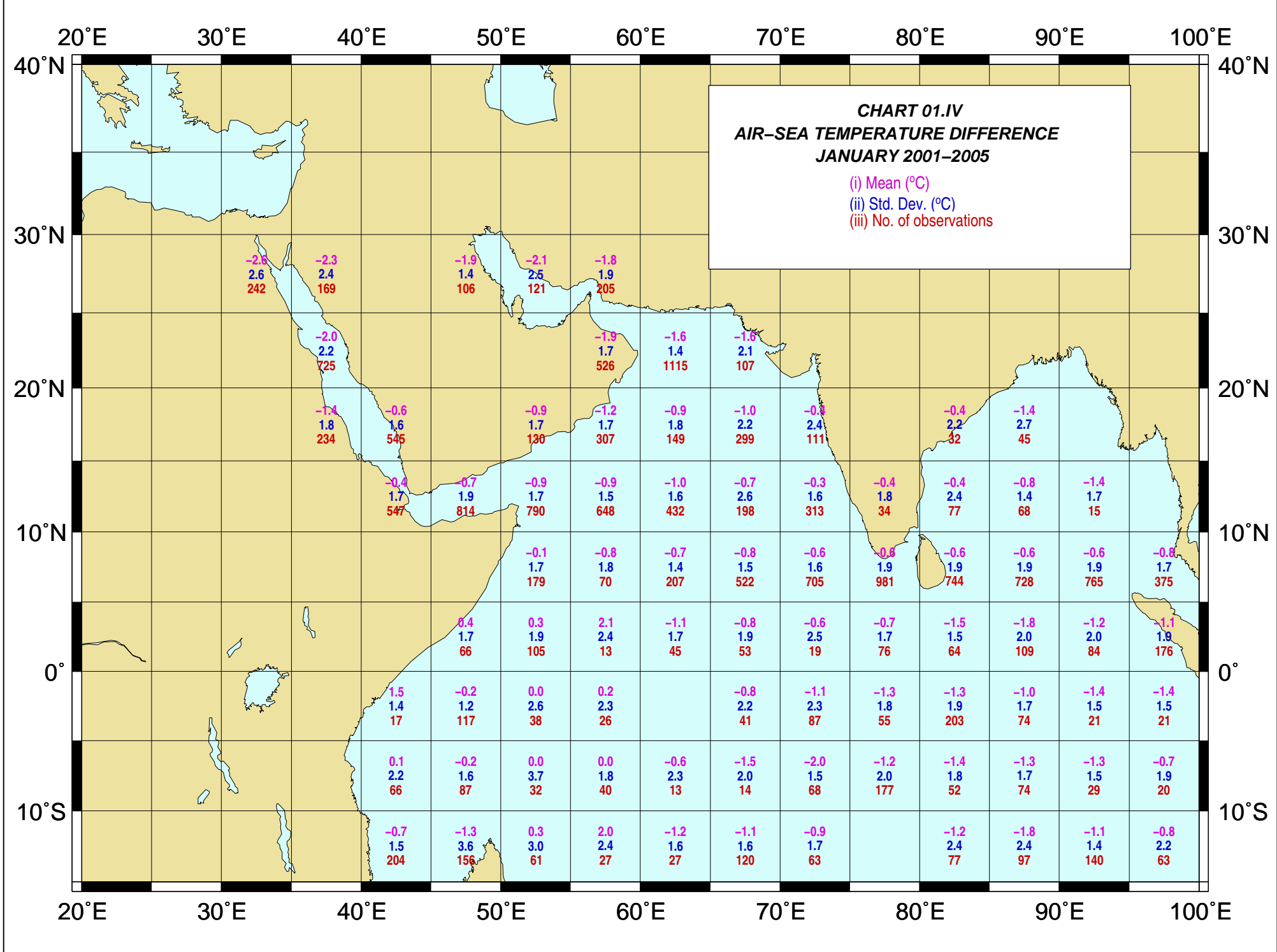
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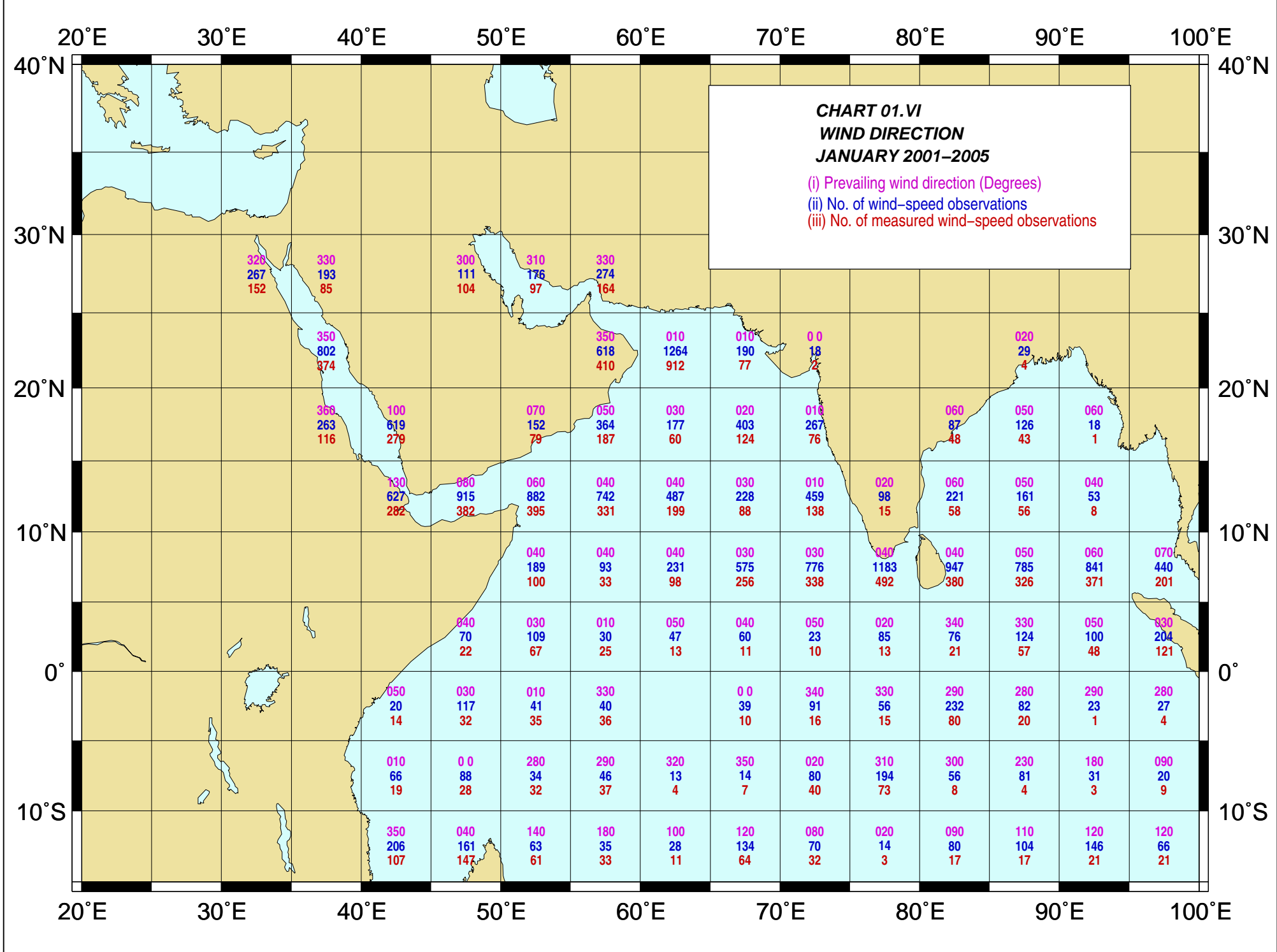
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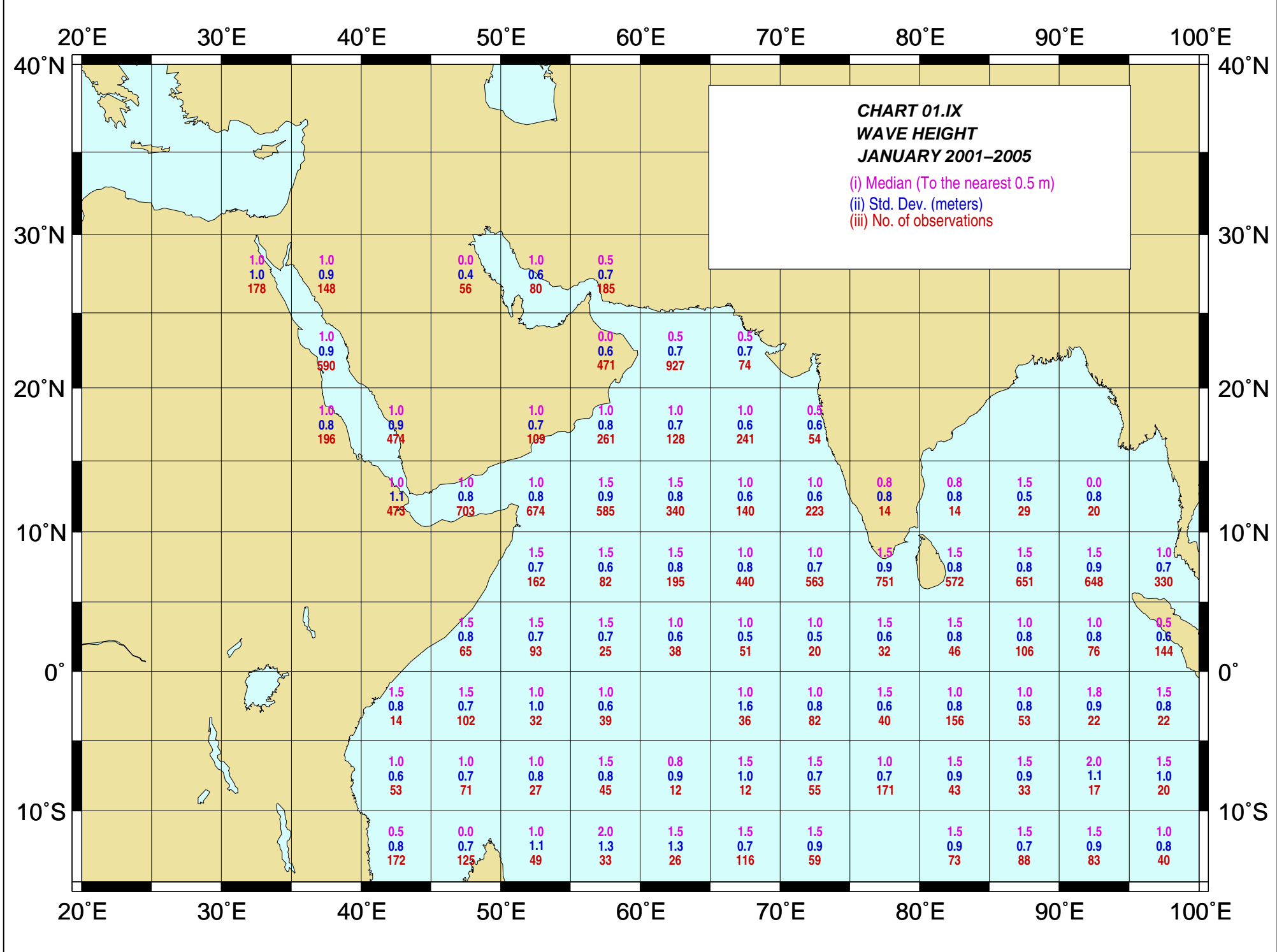
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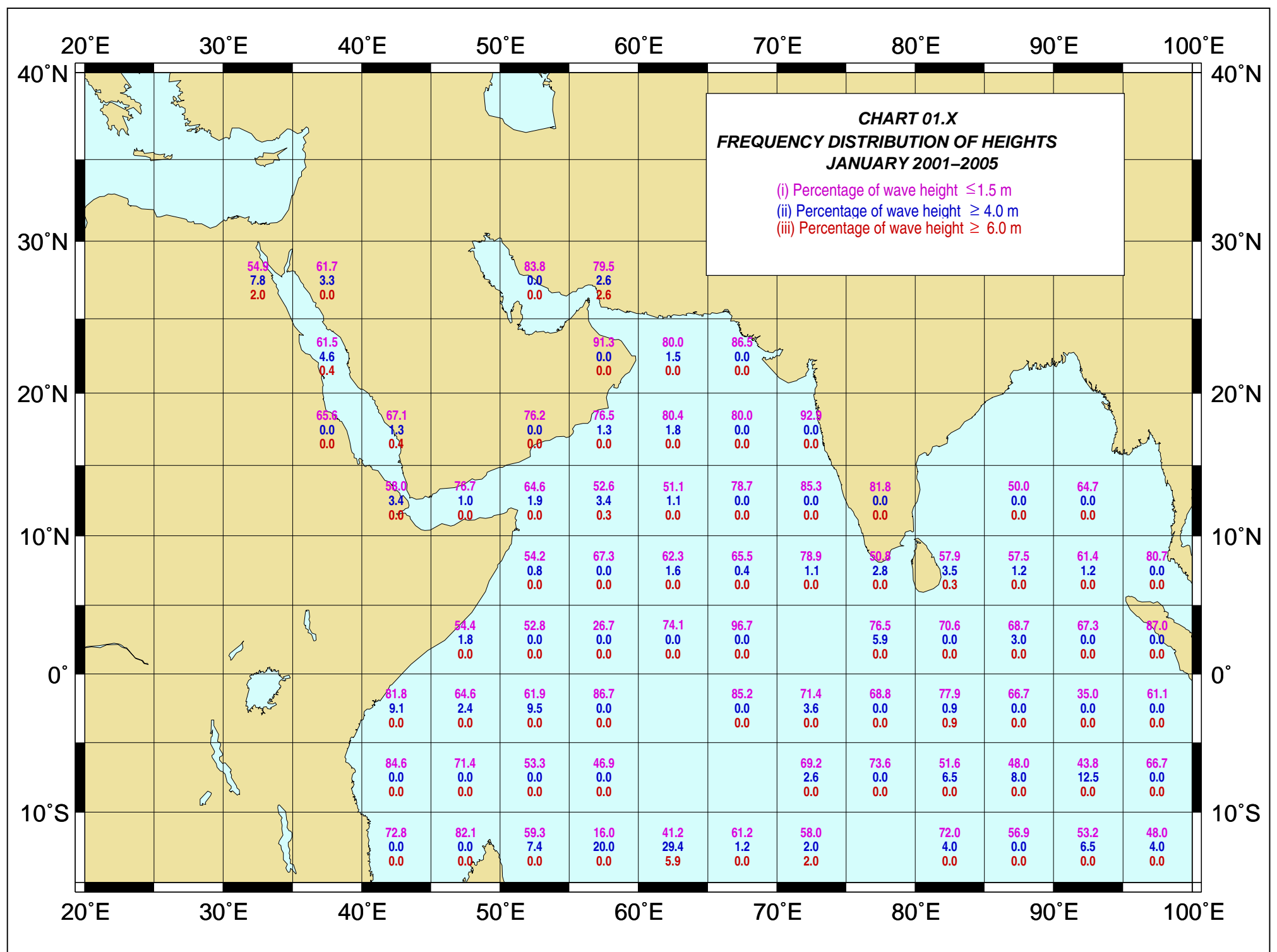
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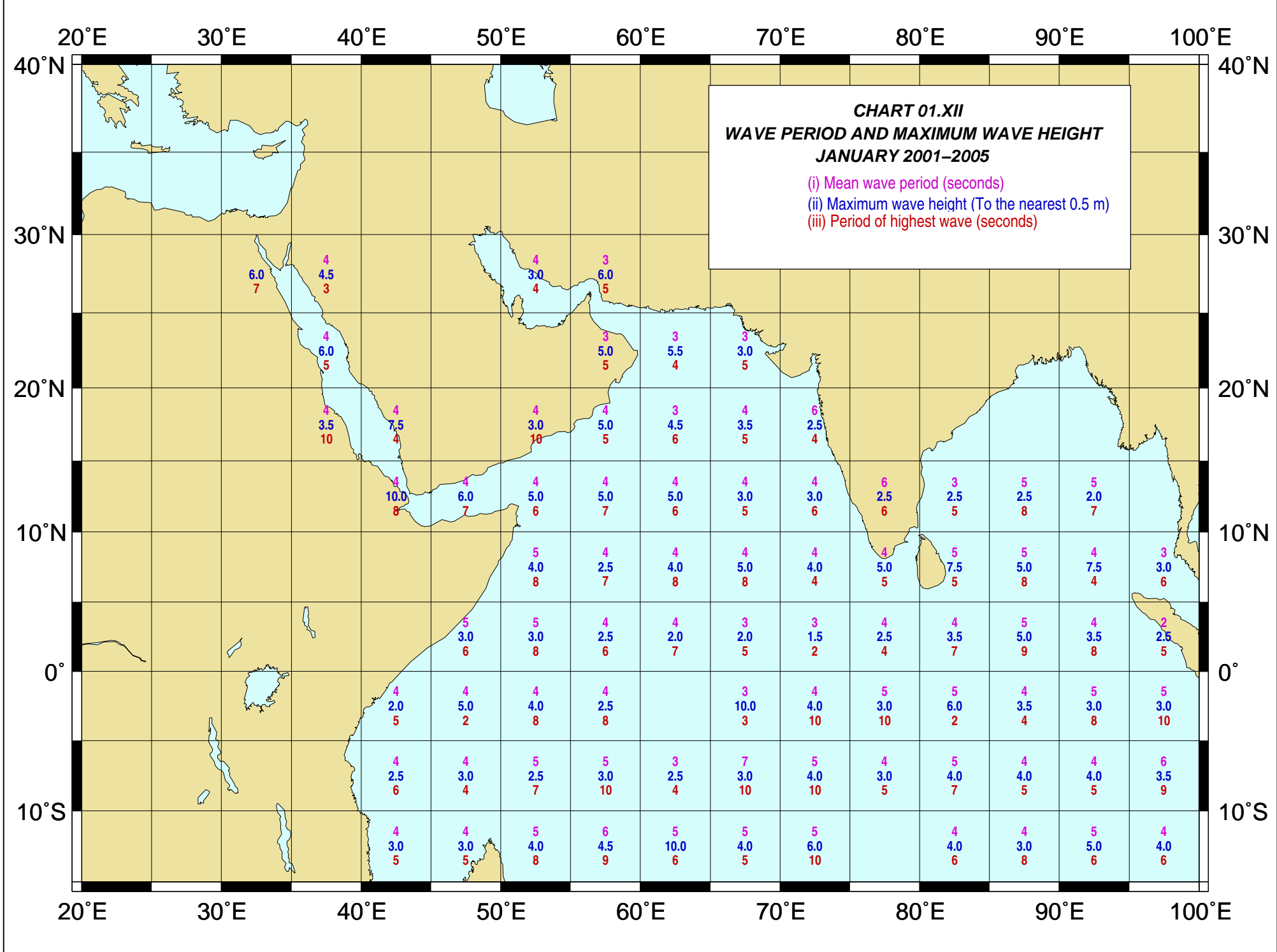
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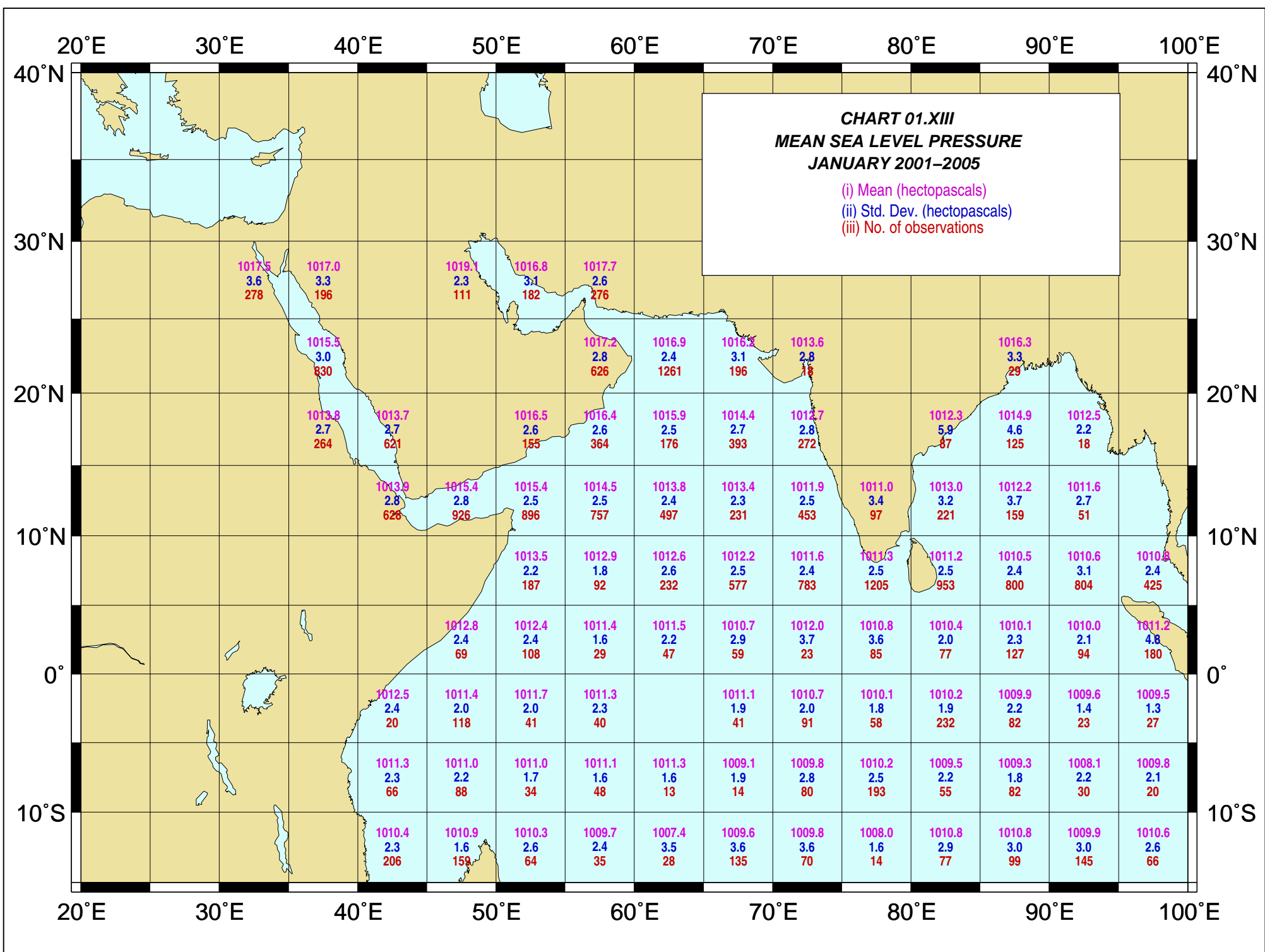
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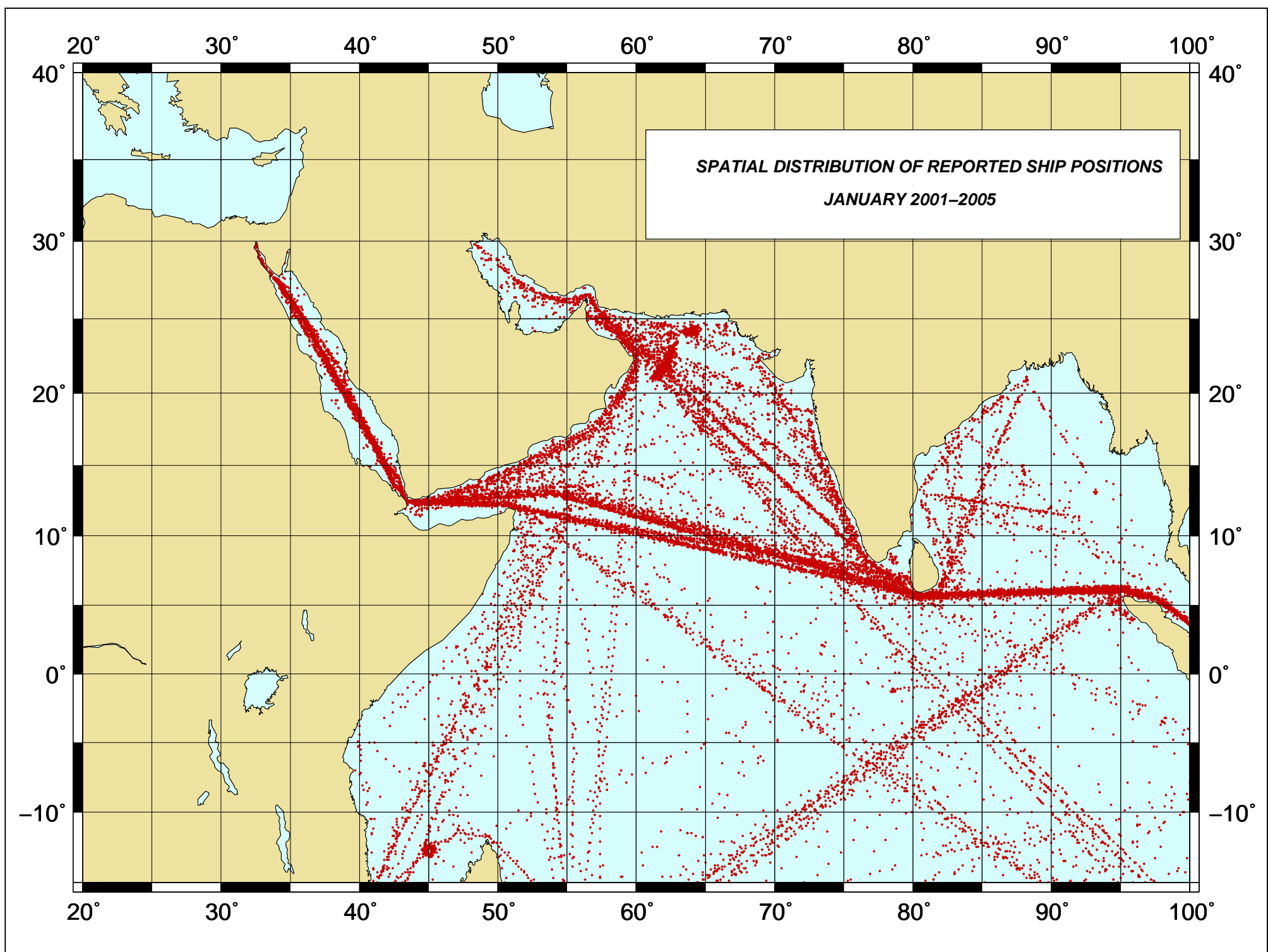




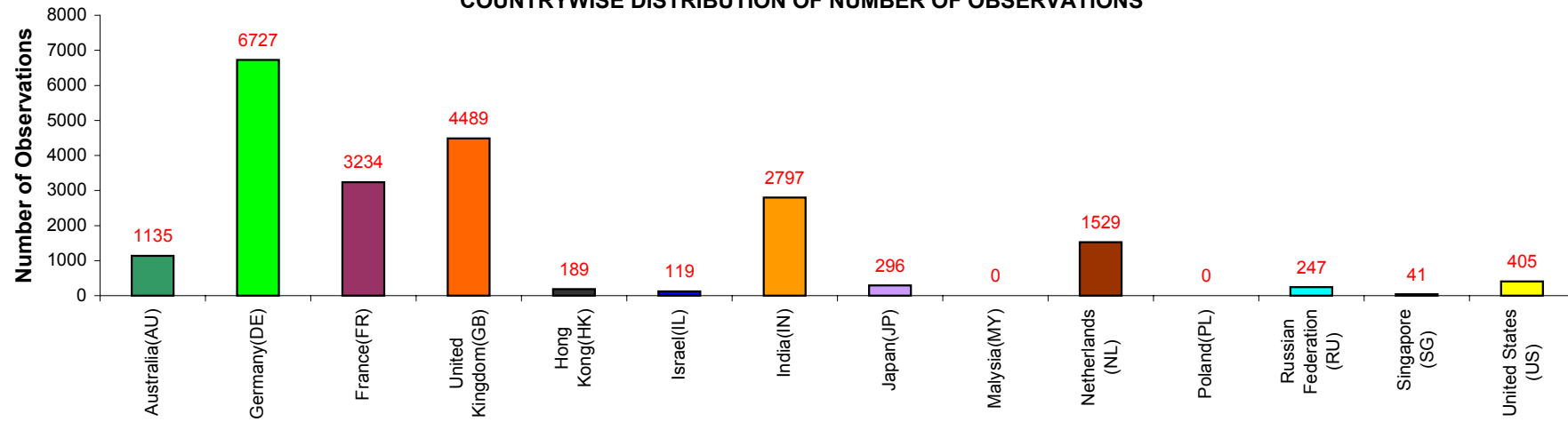




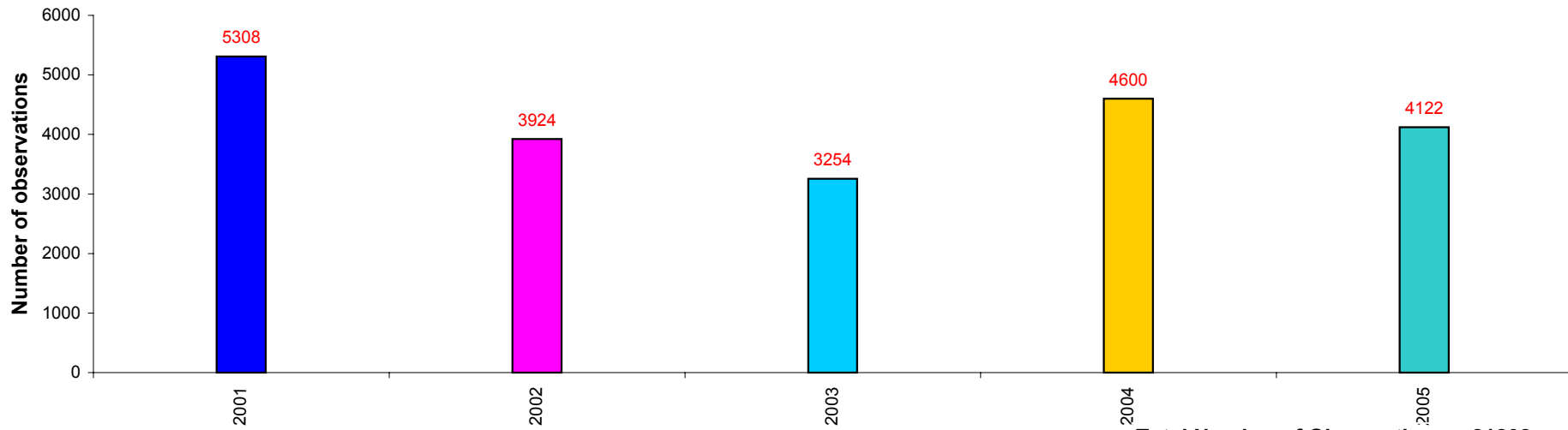




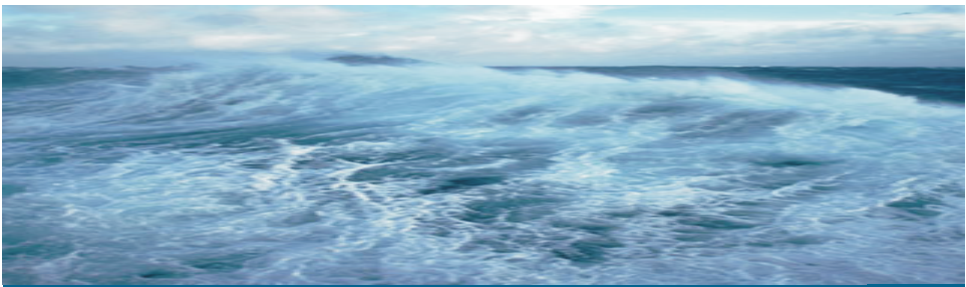
JANUARY : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



Total Number of Observations = 21208



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CHARTS OF FEBRUARY 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

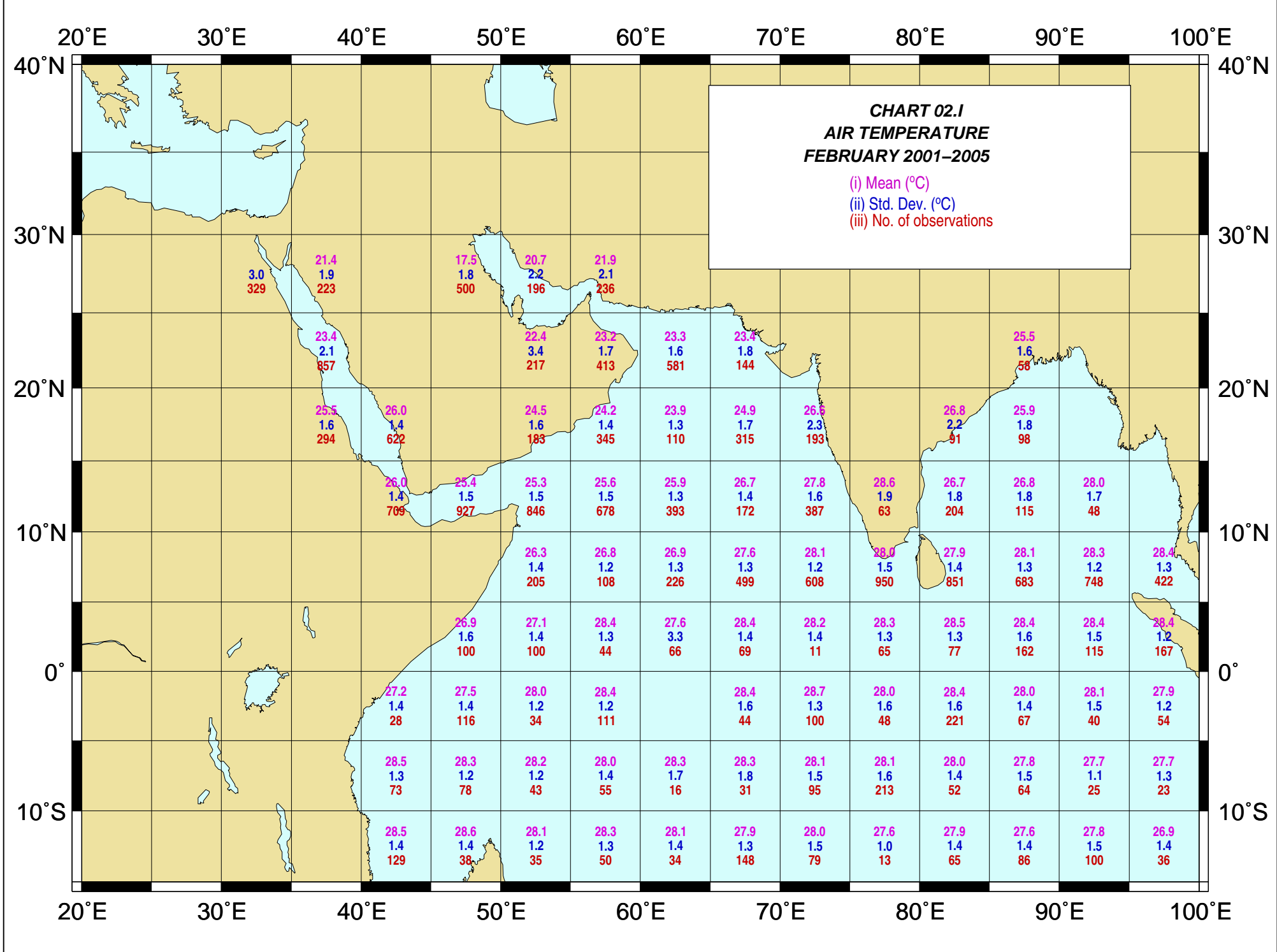
CHART - XVI : VISIBILITY

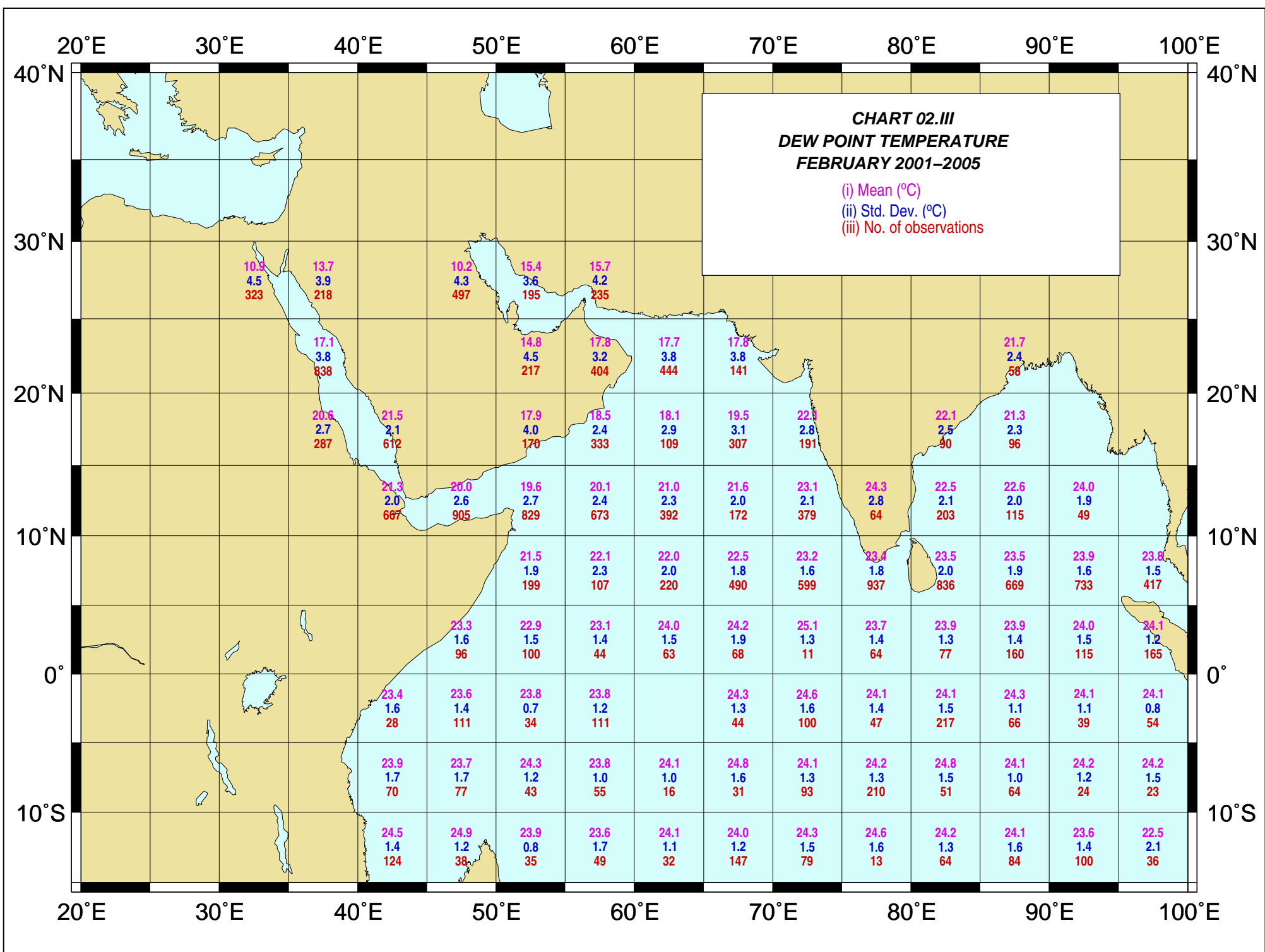
CHART - XVII : POSITION OF SHIP OBSERVATIONS

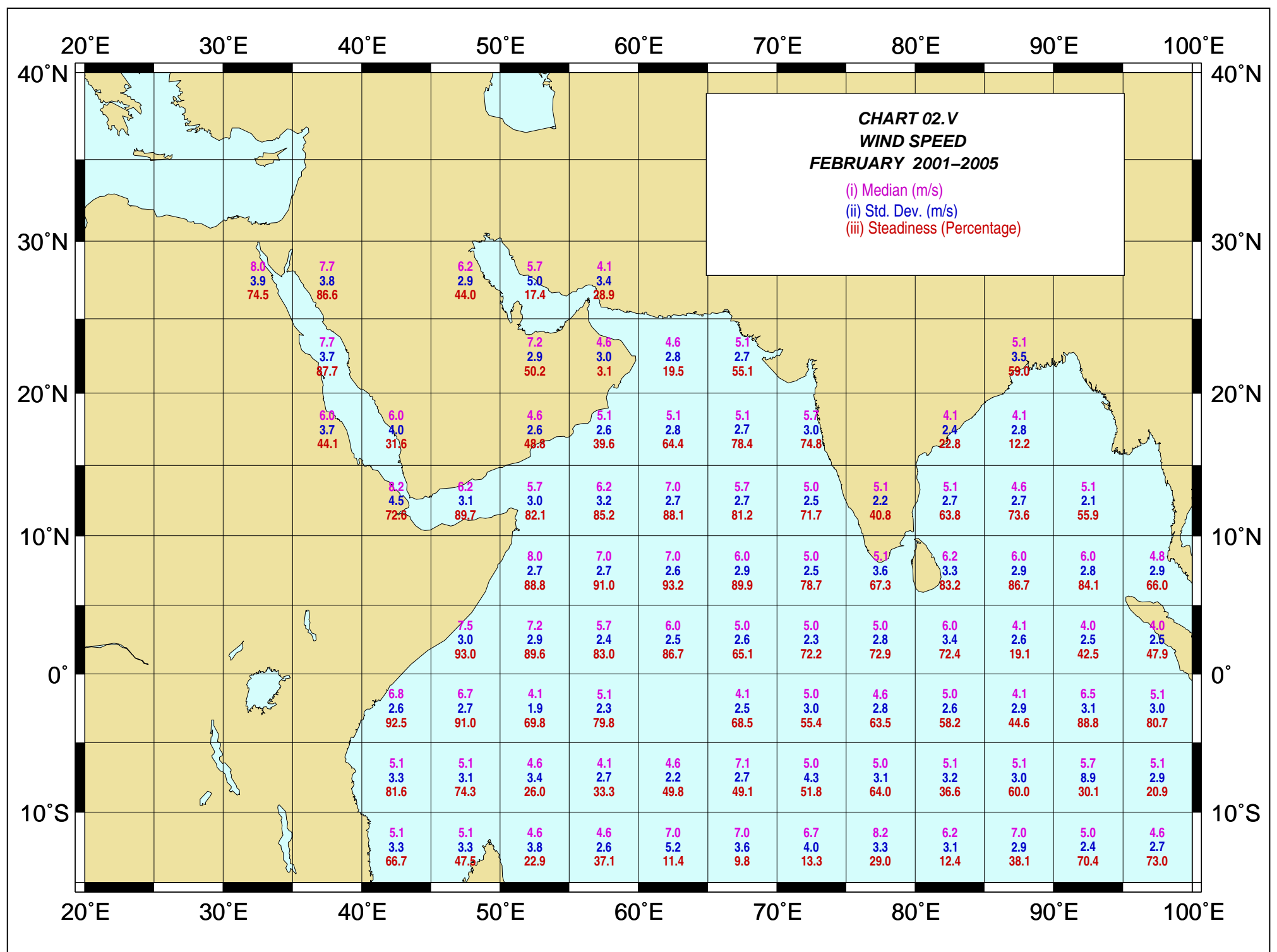
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

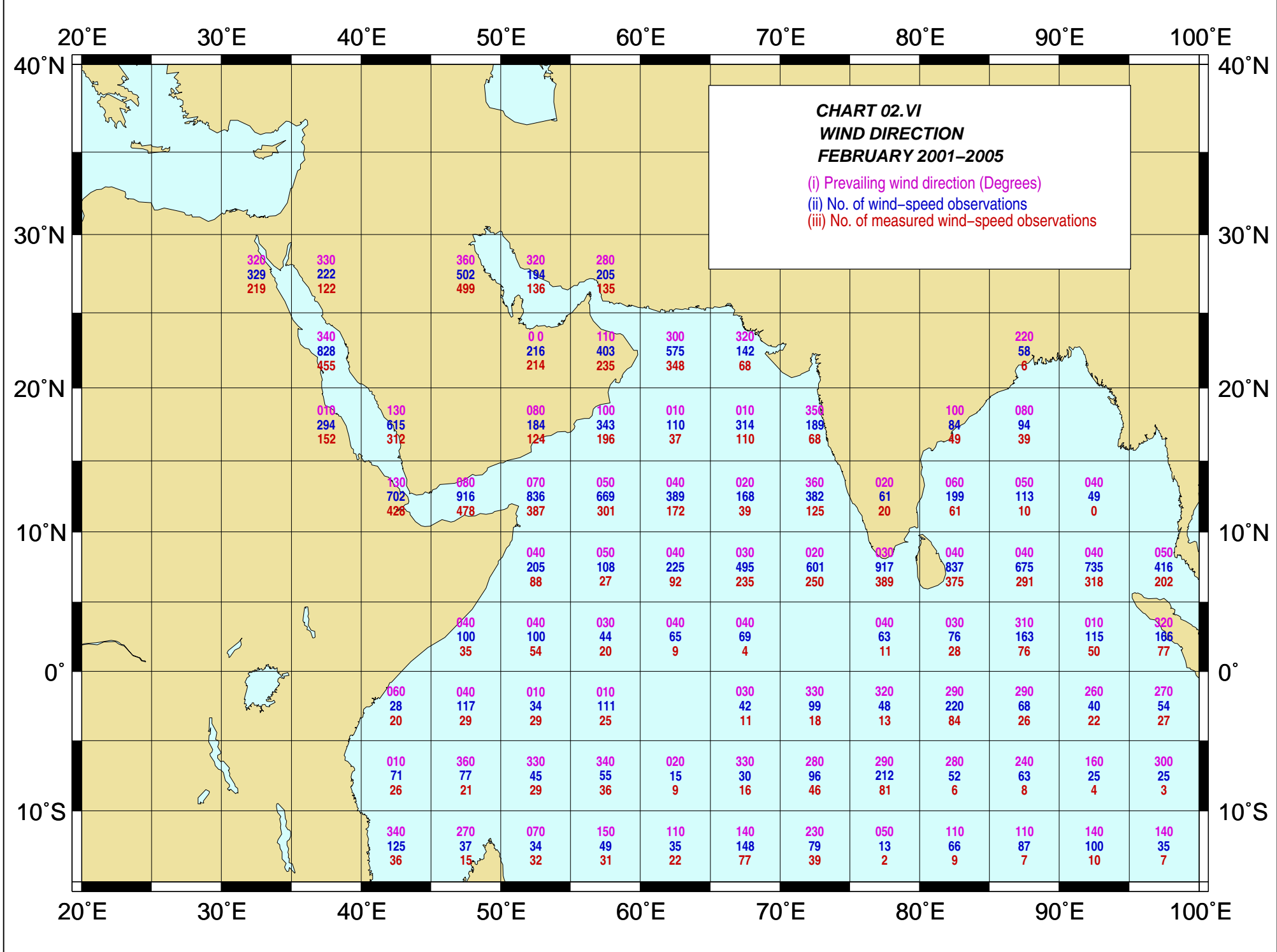
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

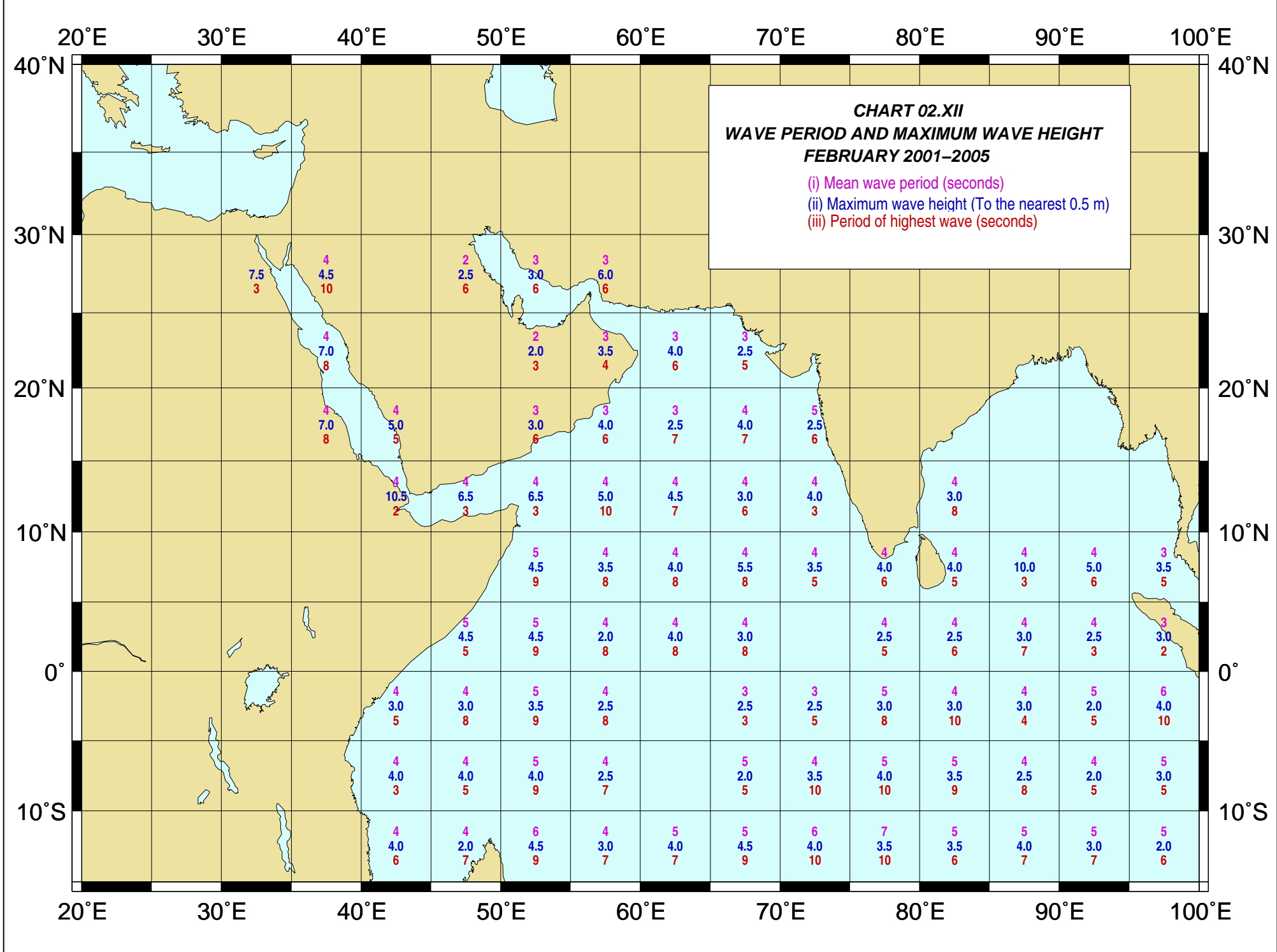
**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**

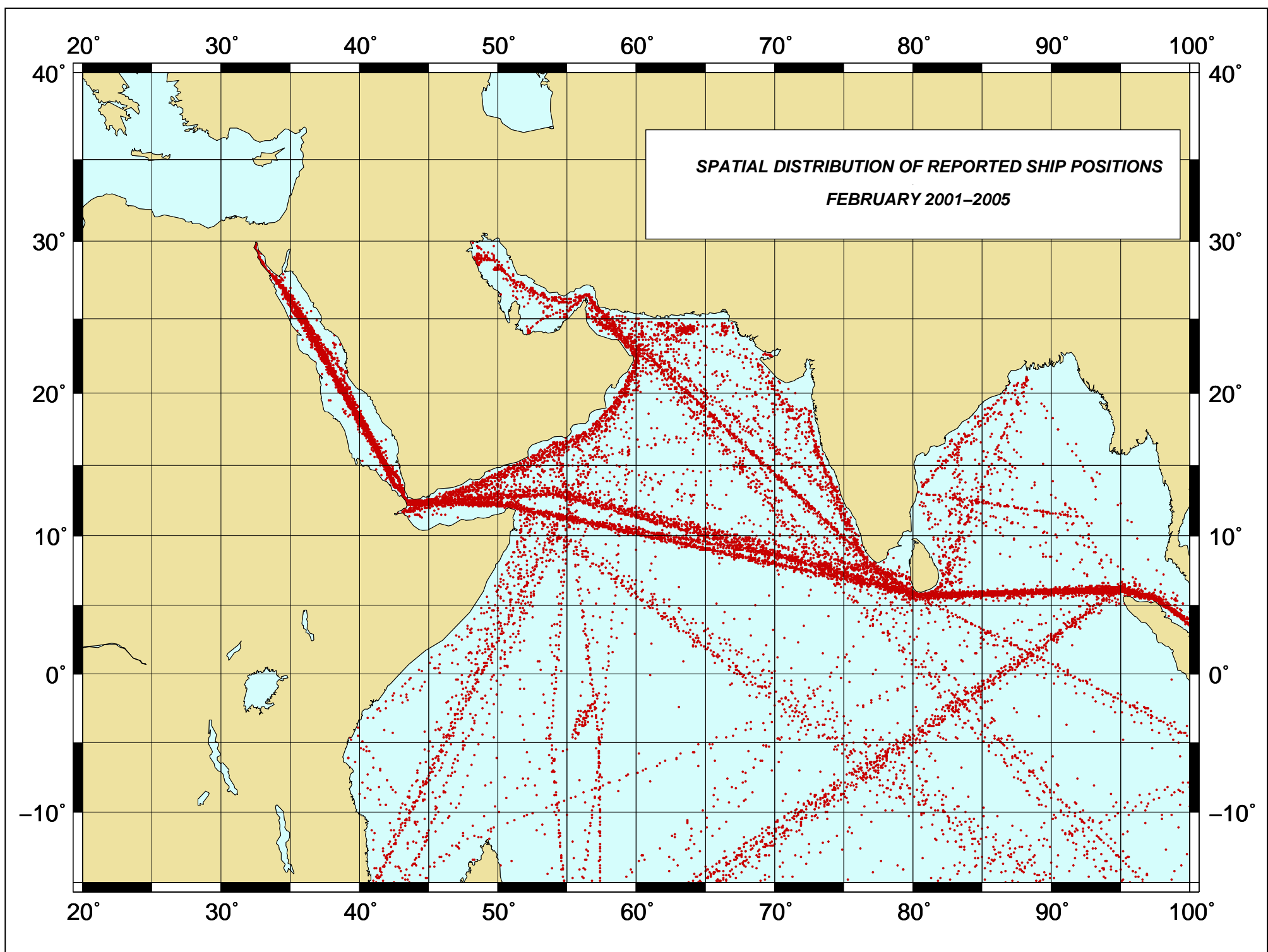




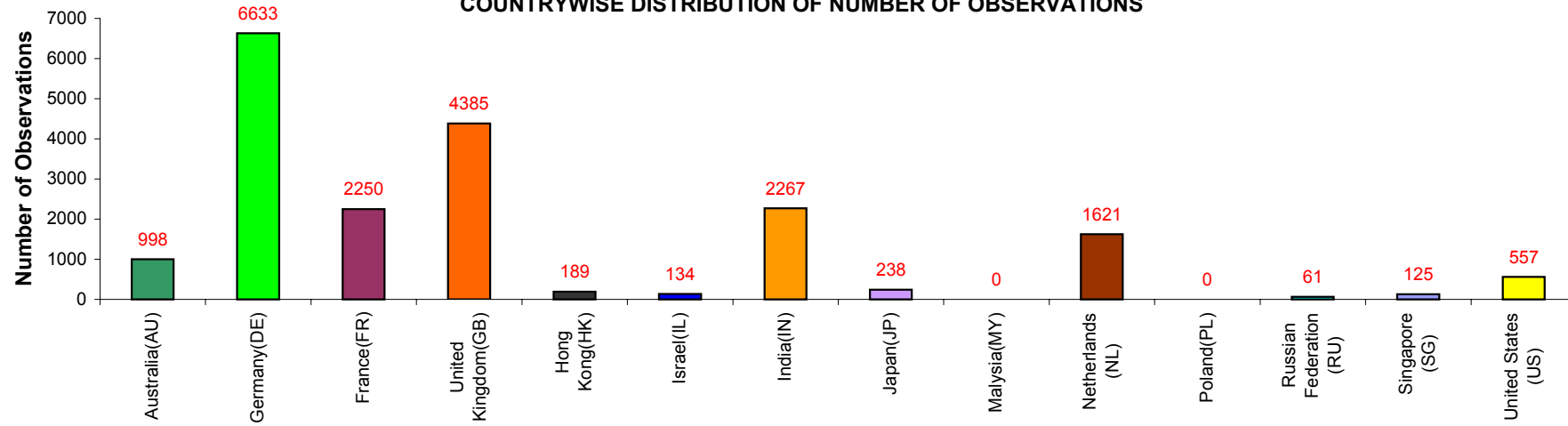




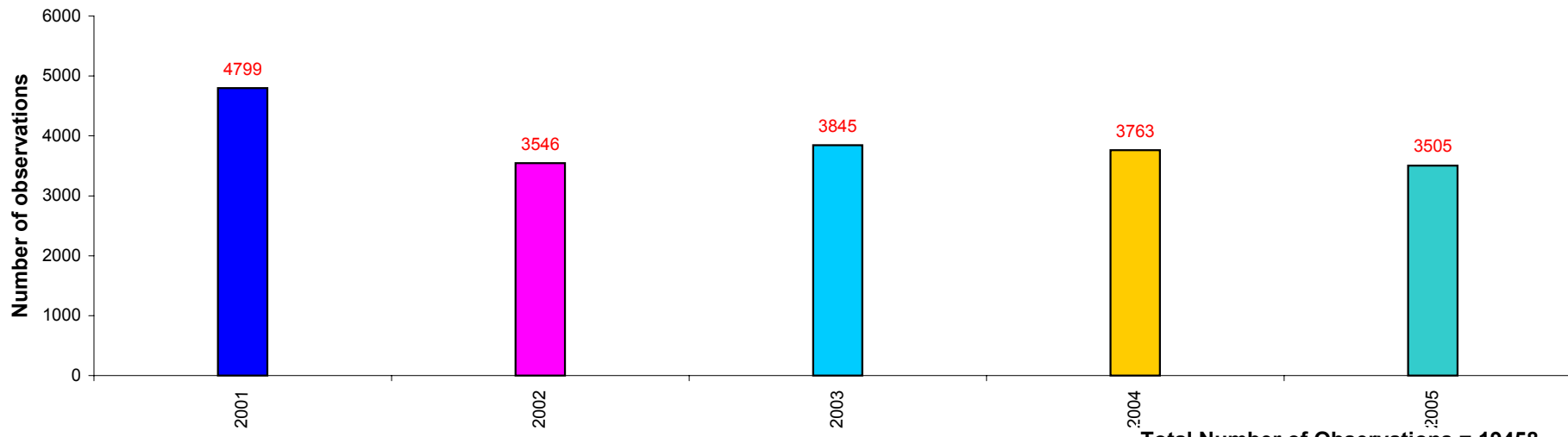




FEBRUARY : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



Total Number of Observations = 19458



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CHARTS OF MARCH 2001 - 2005

- CHART - I : AIR TEMPERATURE
- CHART - II : SEA SURFACE TEMPERATURE
- CHART - III : DEW POINT TEMPERATURE
- CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

- CHART - V : WIND SPEED
- CHART - VI : WIND DIRECTION
- CHART - VII : LIGHT AND STRONG WINDS
- CHART - VIII : GALE AND MAXIMUM WINDS

- CHART - IX : WAVE HEIGHT
- CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS
- CHART - XI : WAVE PERIOD AND SWELL DIRECTION
- CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

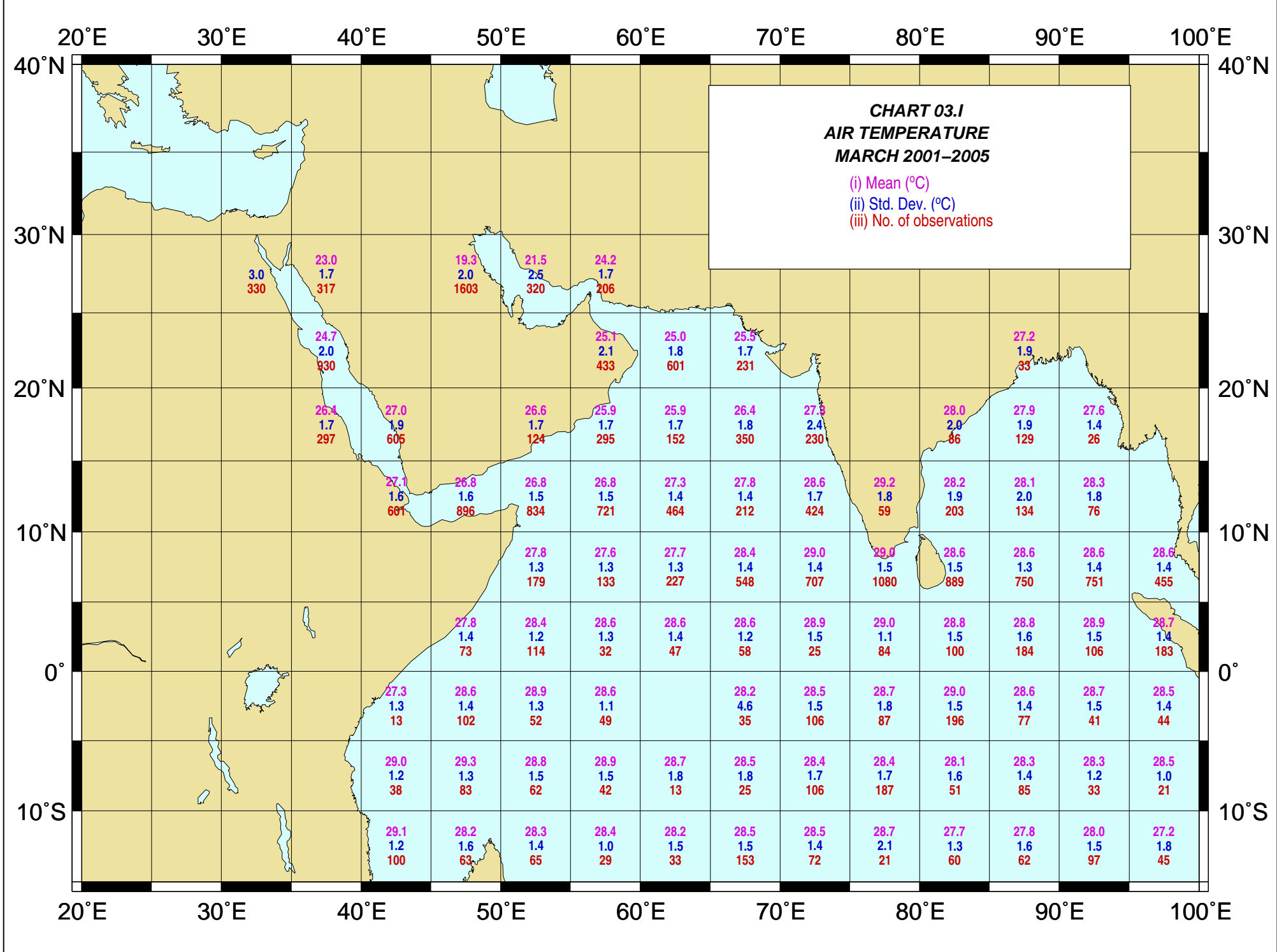
CHART - XV : TOTAL CLOUD AMOUNT

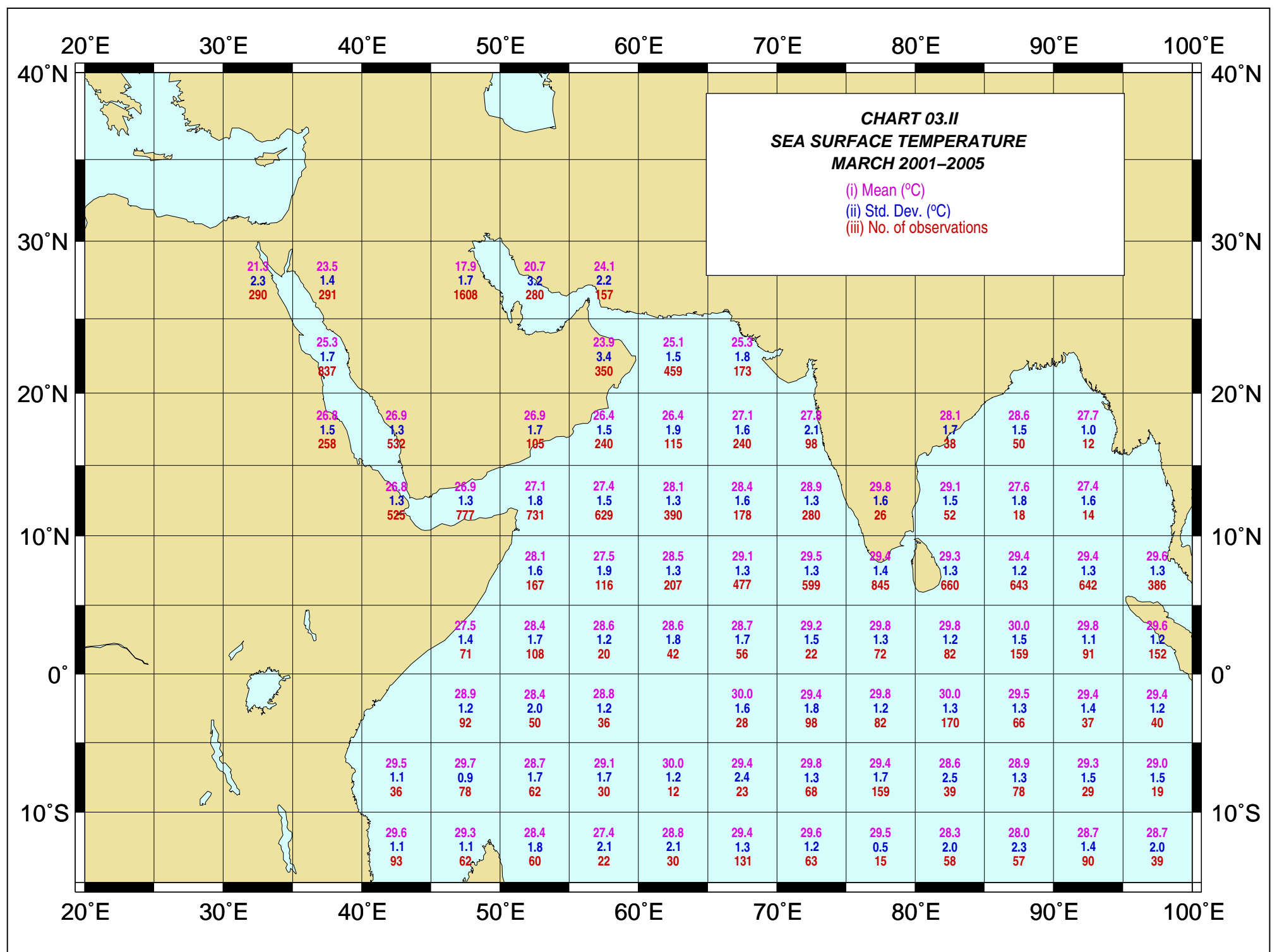
CHART - XVI : VISIBILITY

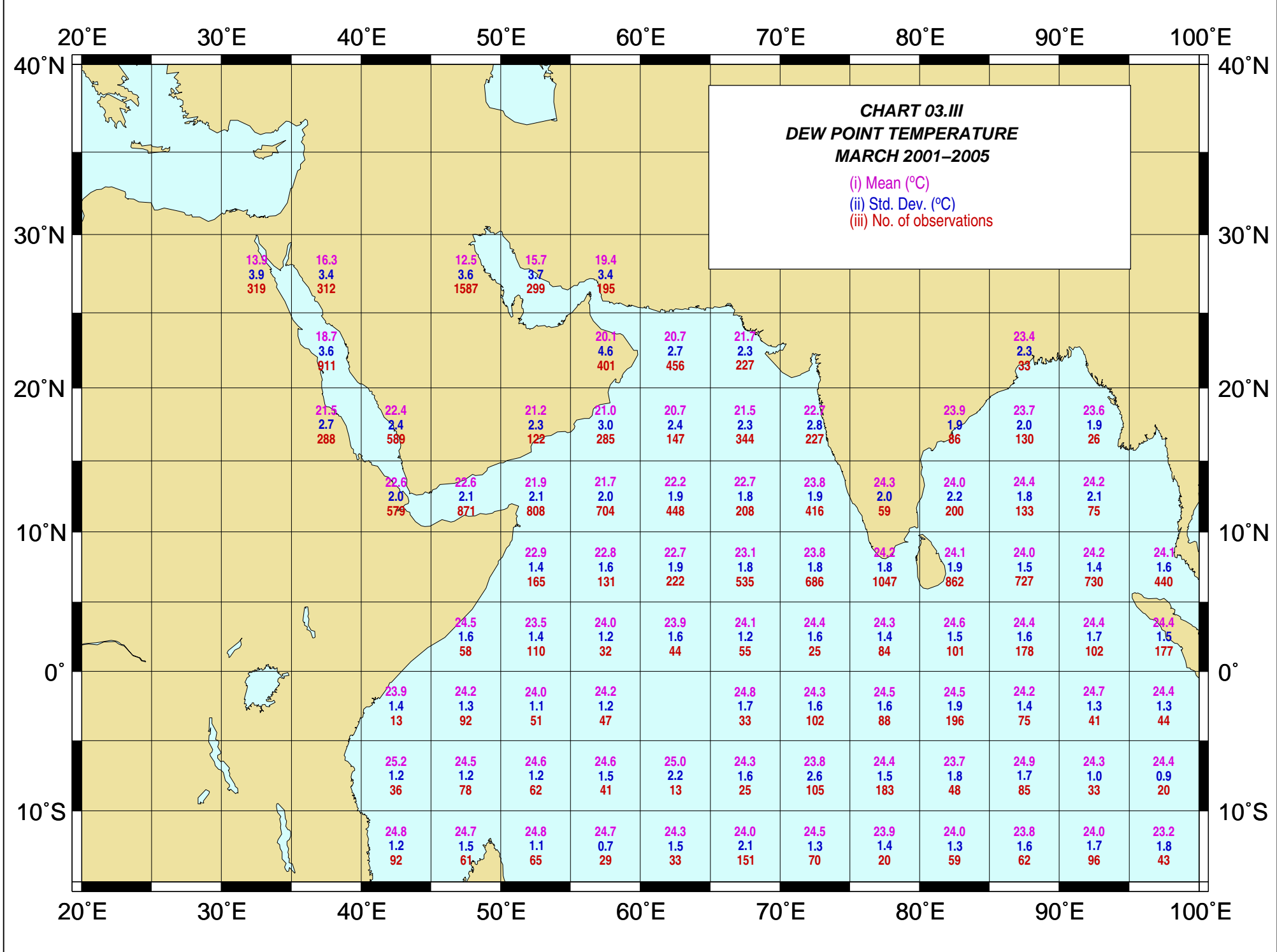
CHART - XVII : POSITION OF SHIP OBSERVATIONS

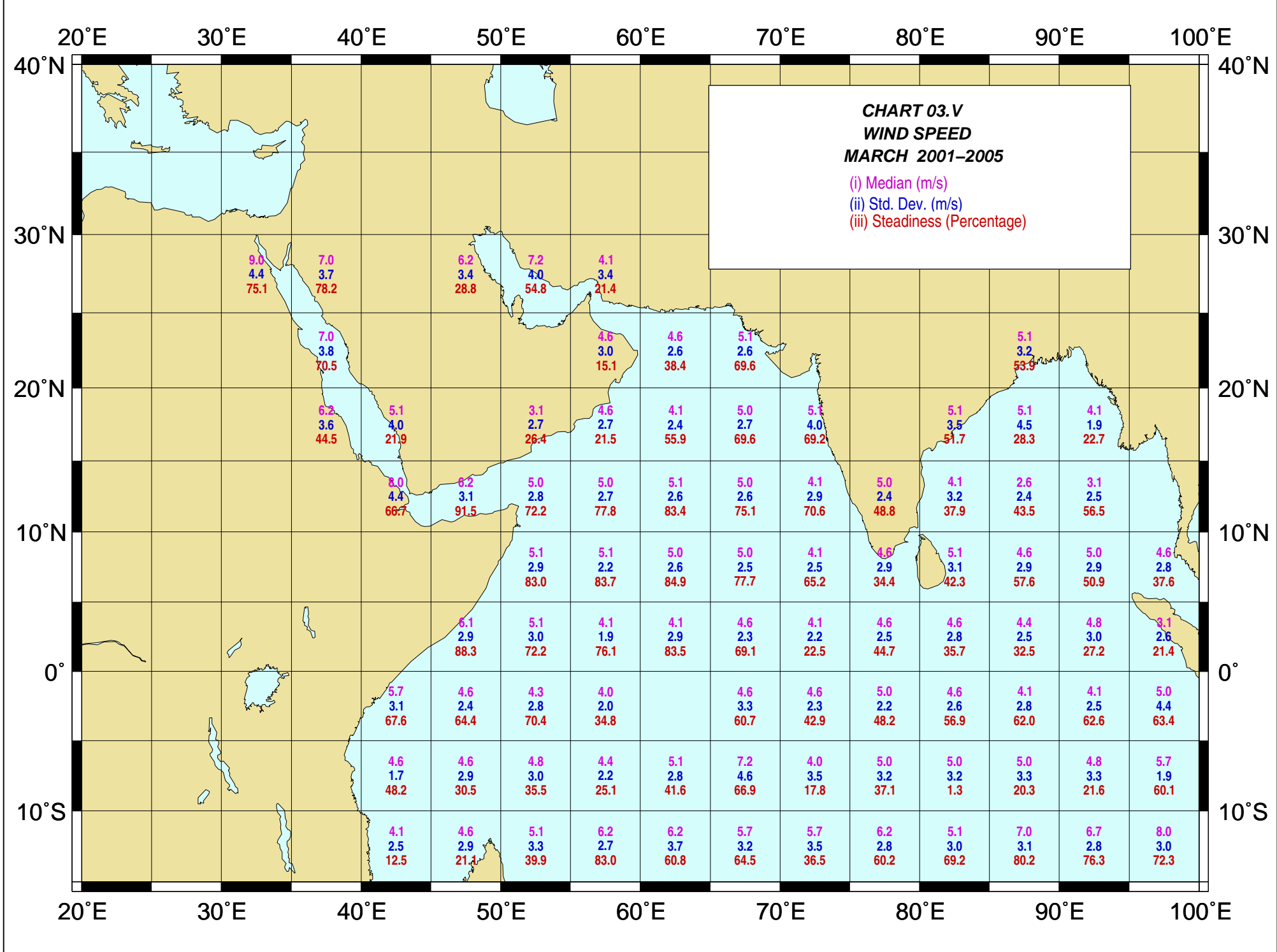
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

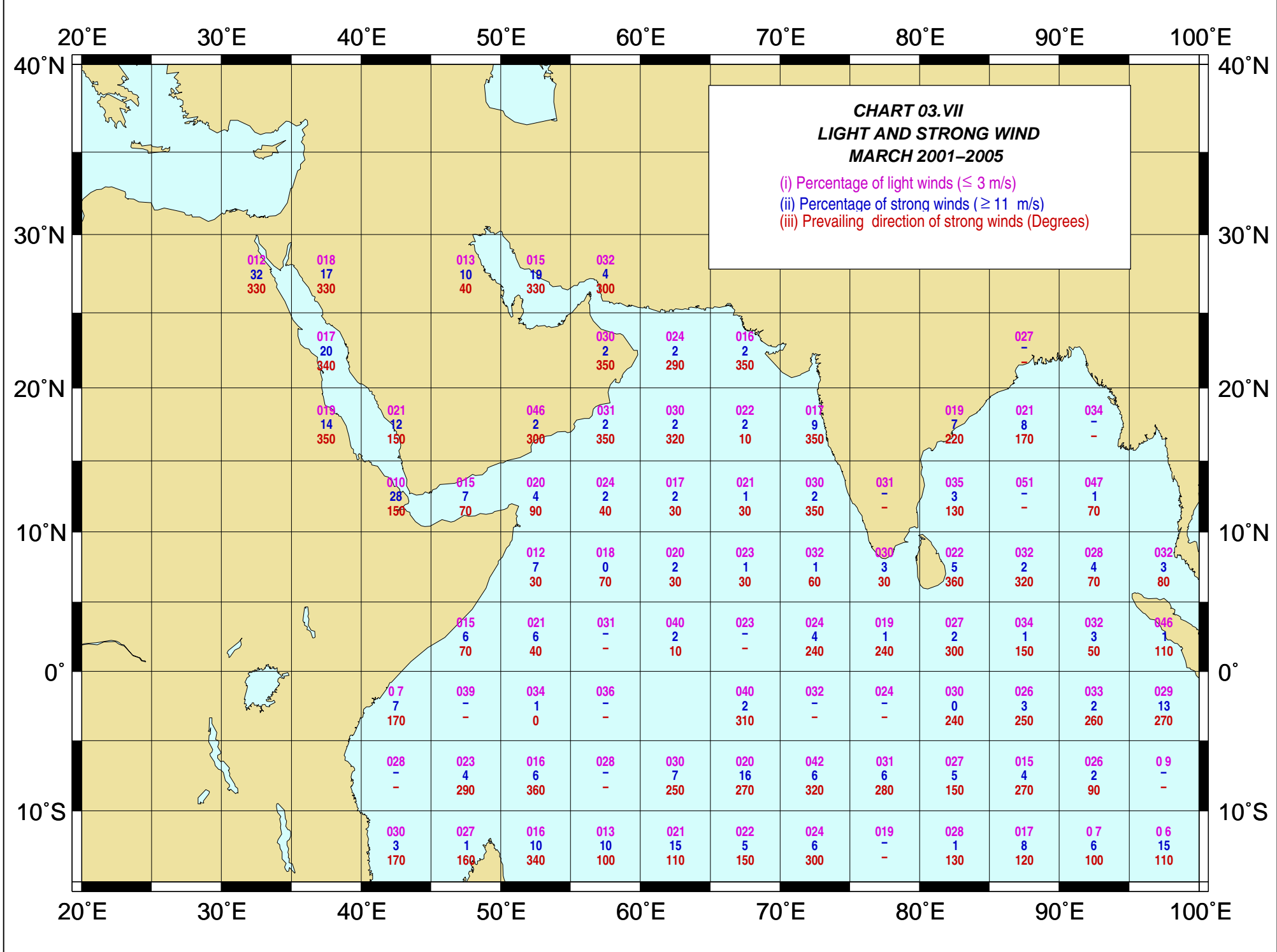
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS
COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS

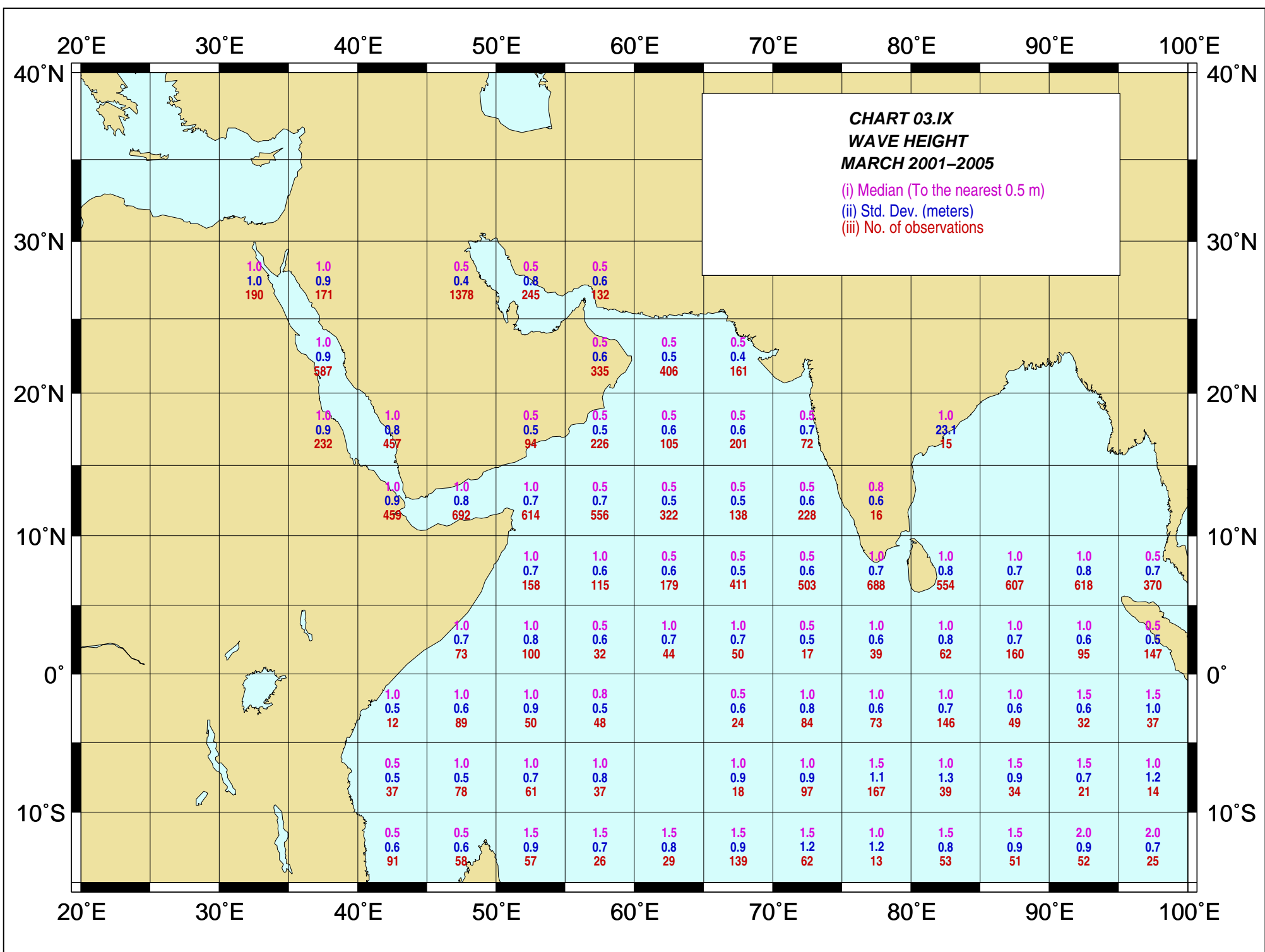


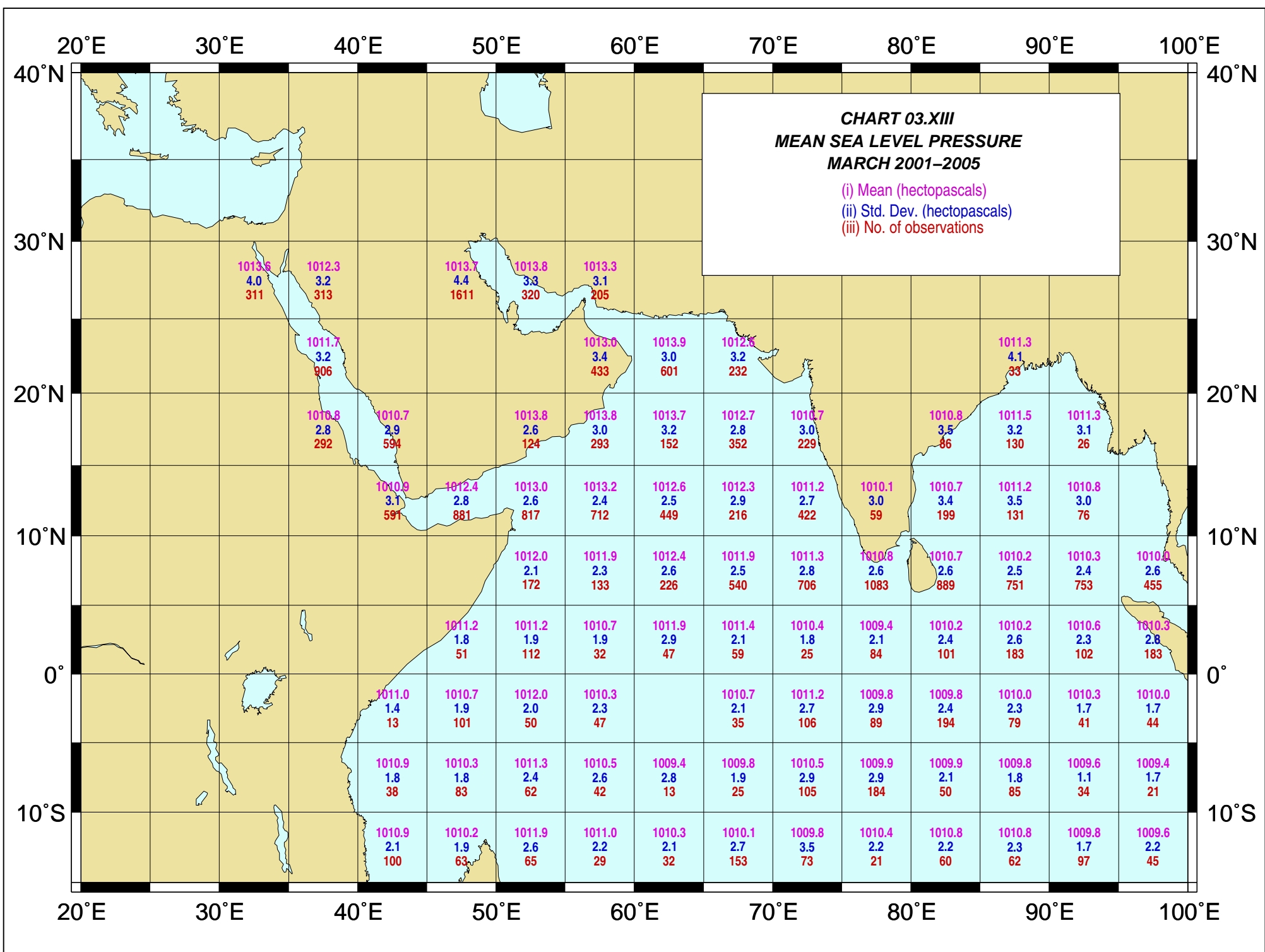


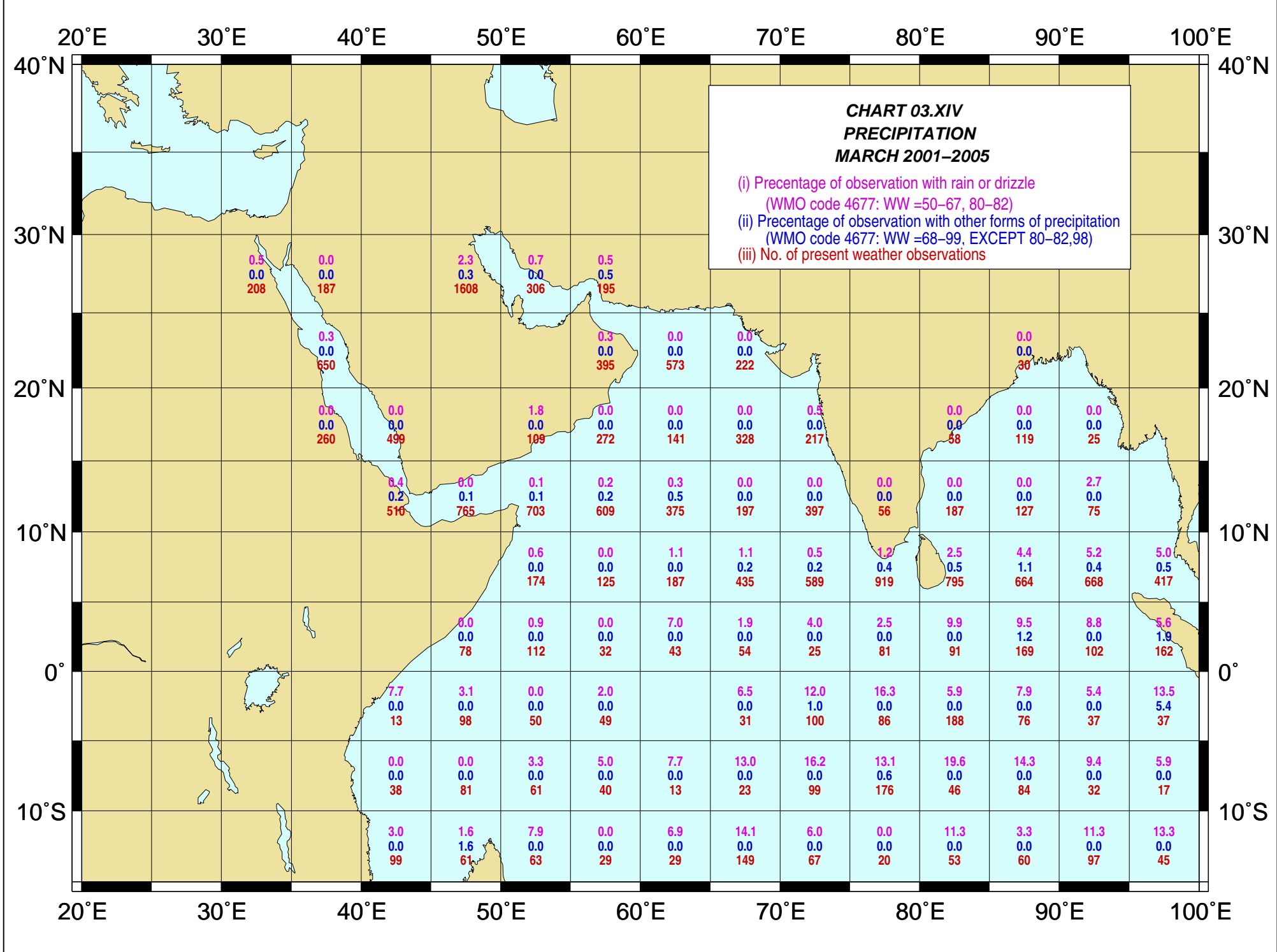


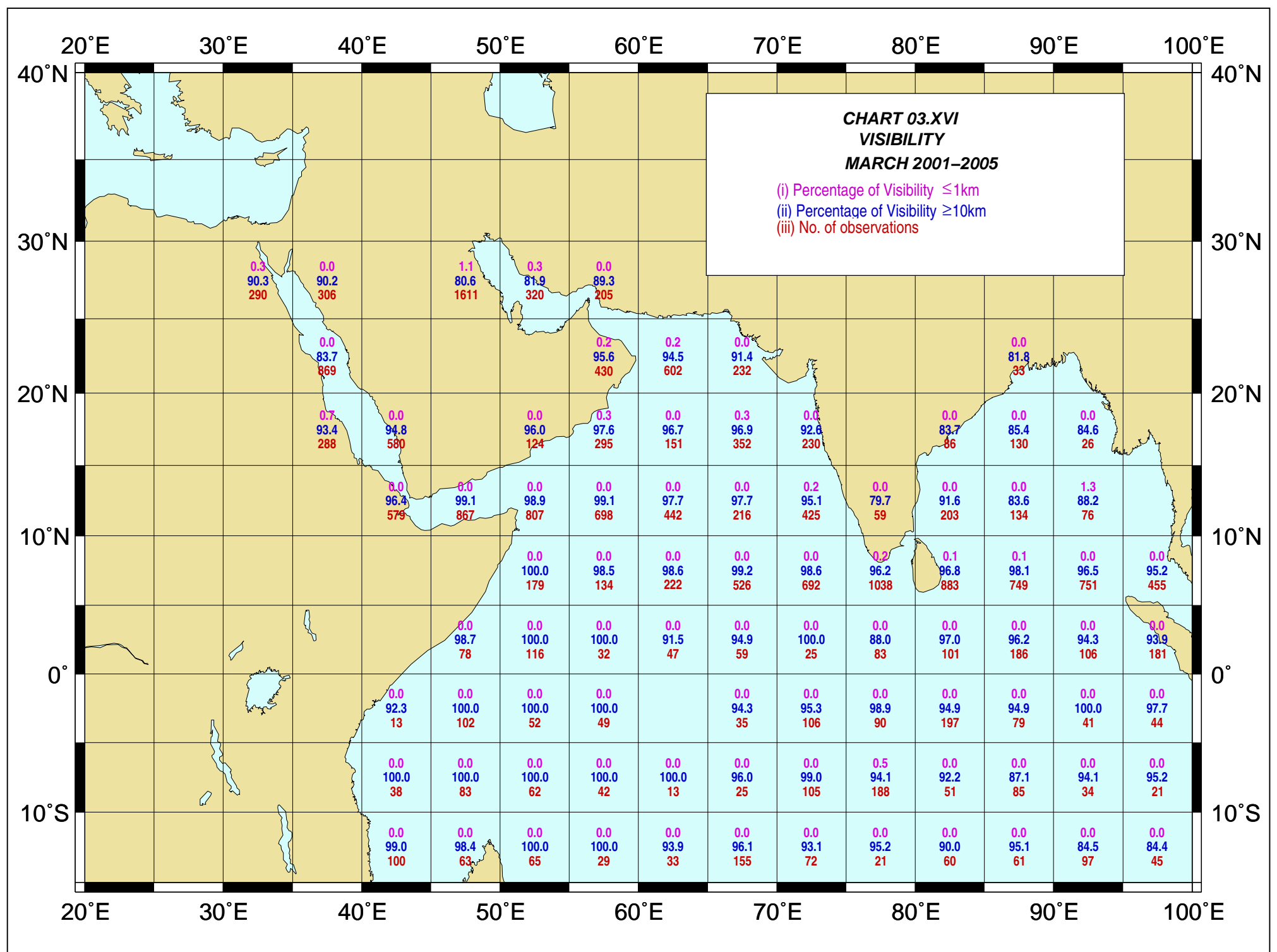


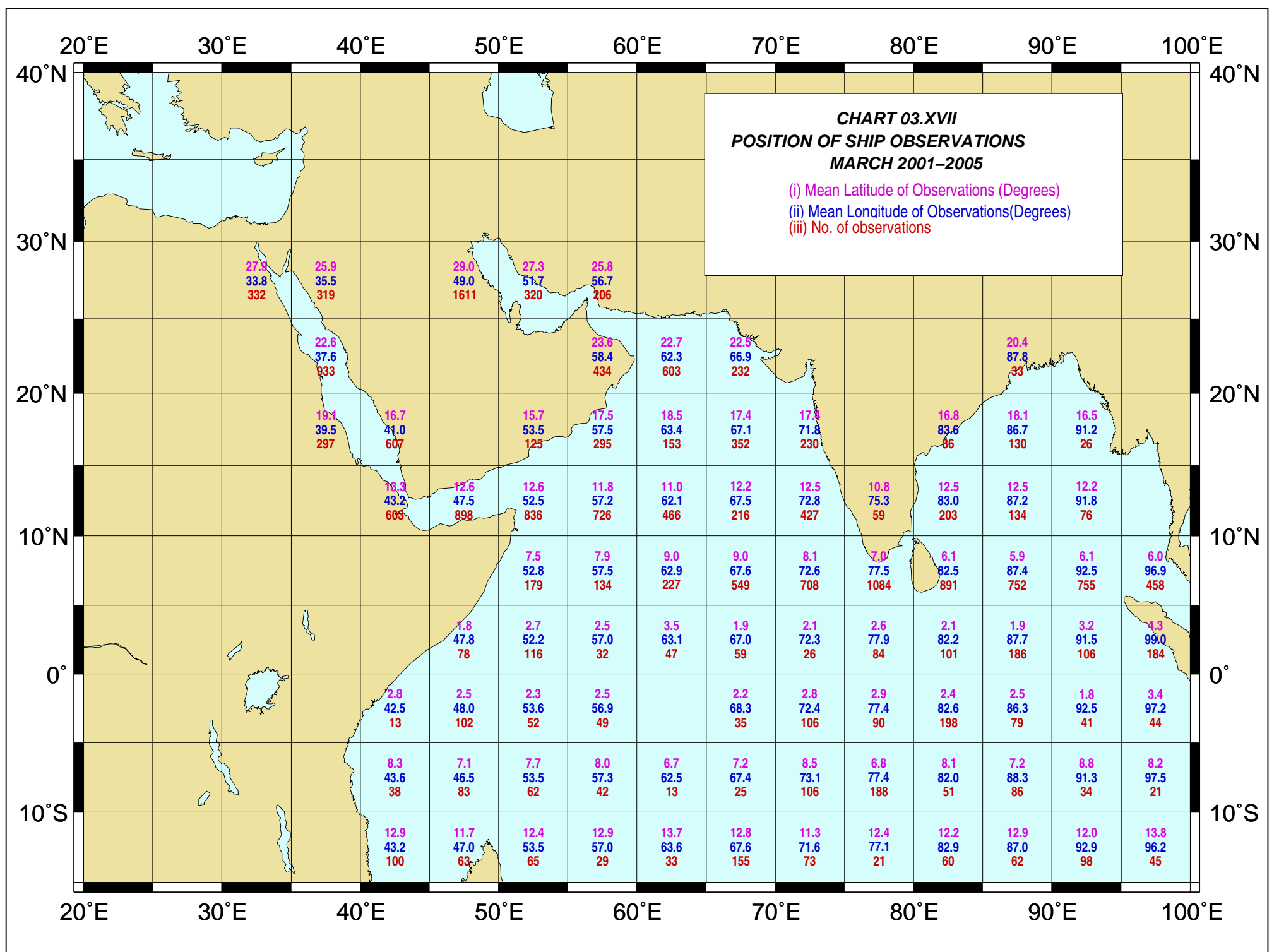


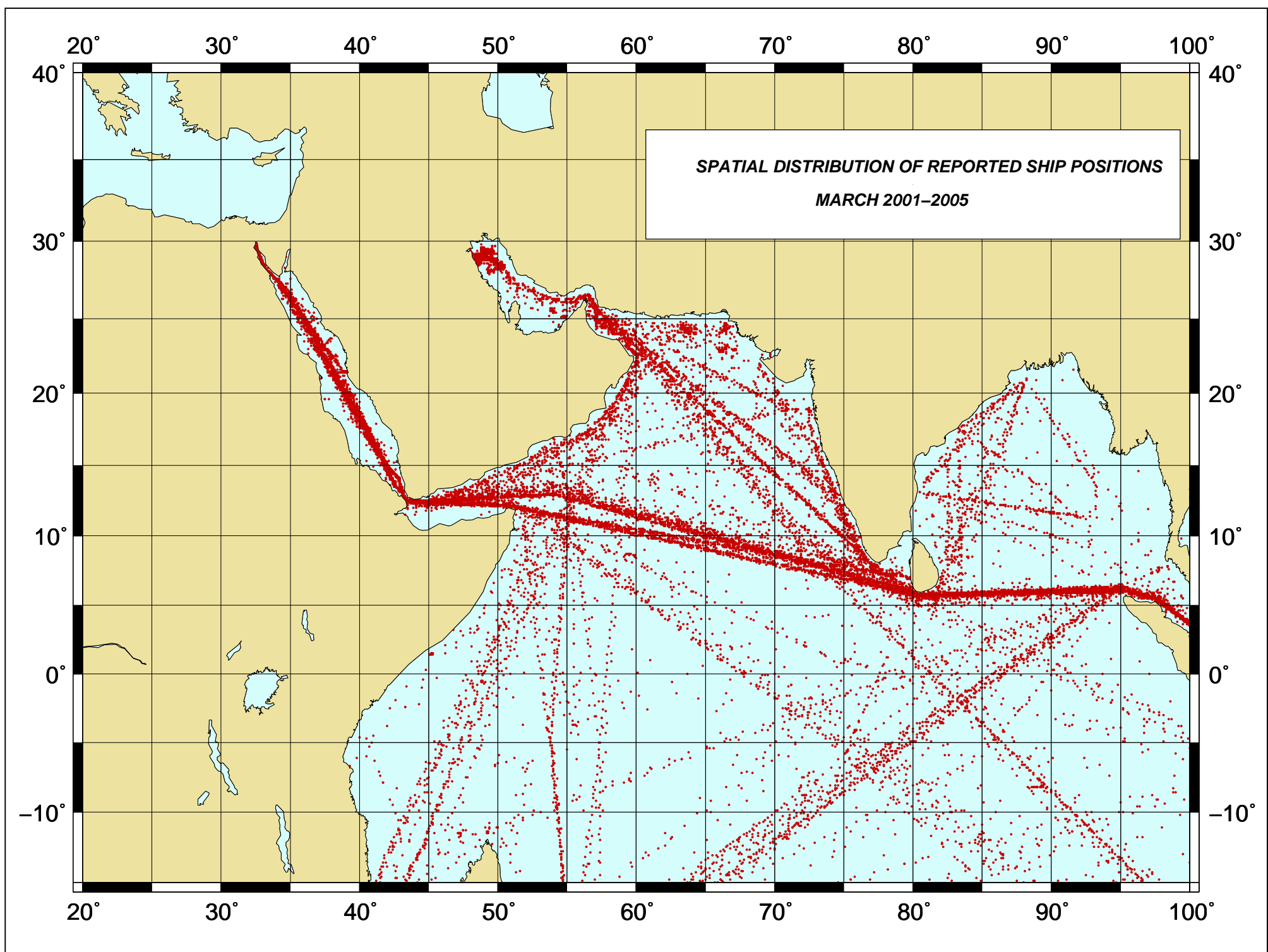




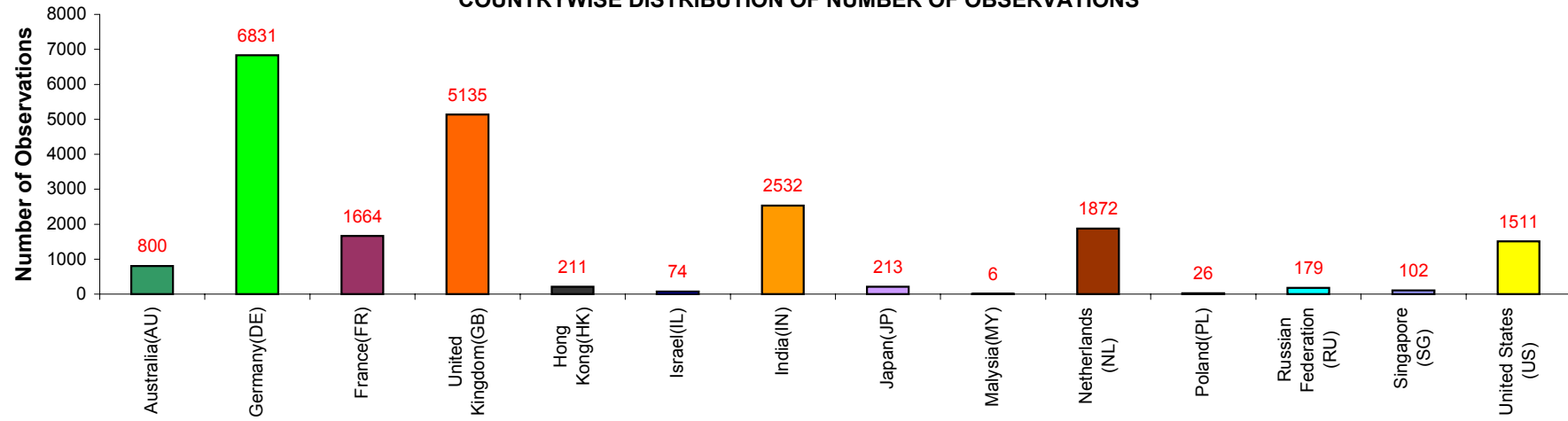




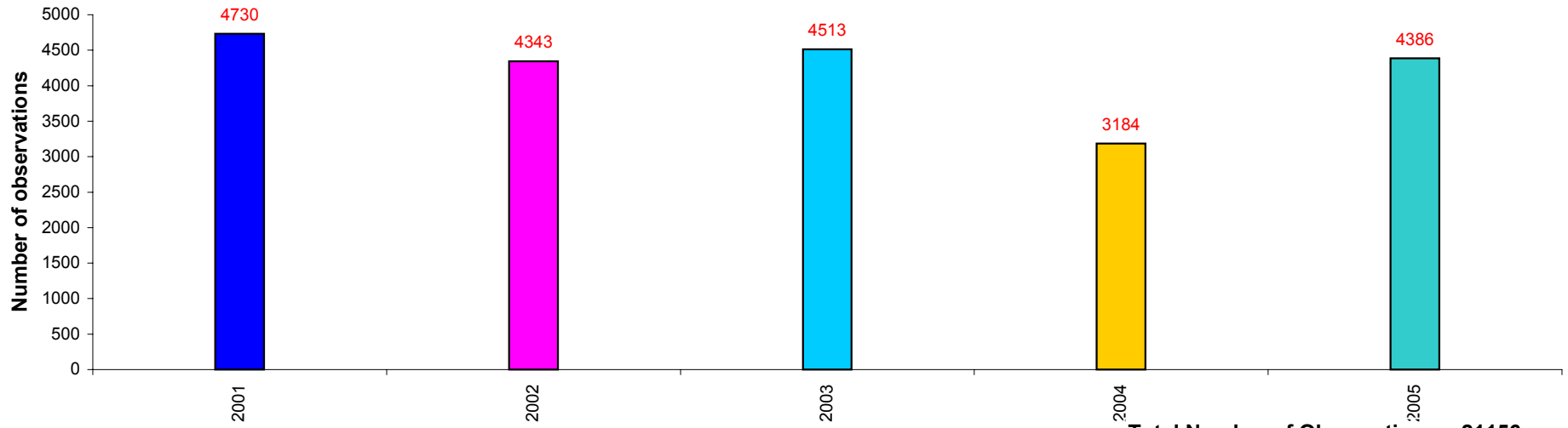




MARCH : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



Total Number of Observations = 21156



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CHARTS OF APRIL 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

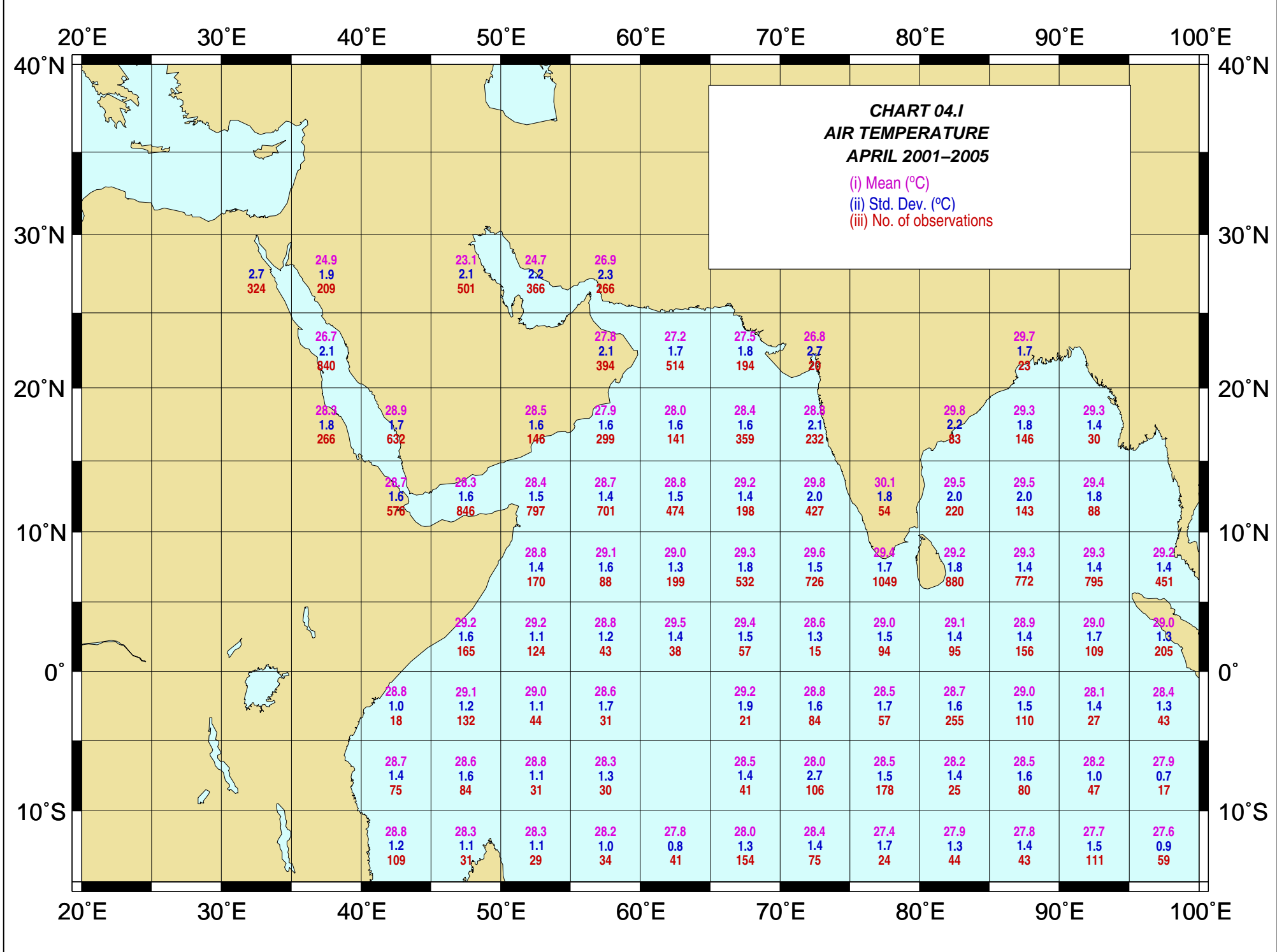
CHART - XVI : VISIBILITY

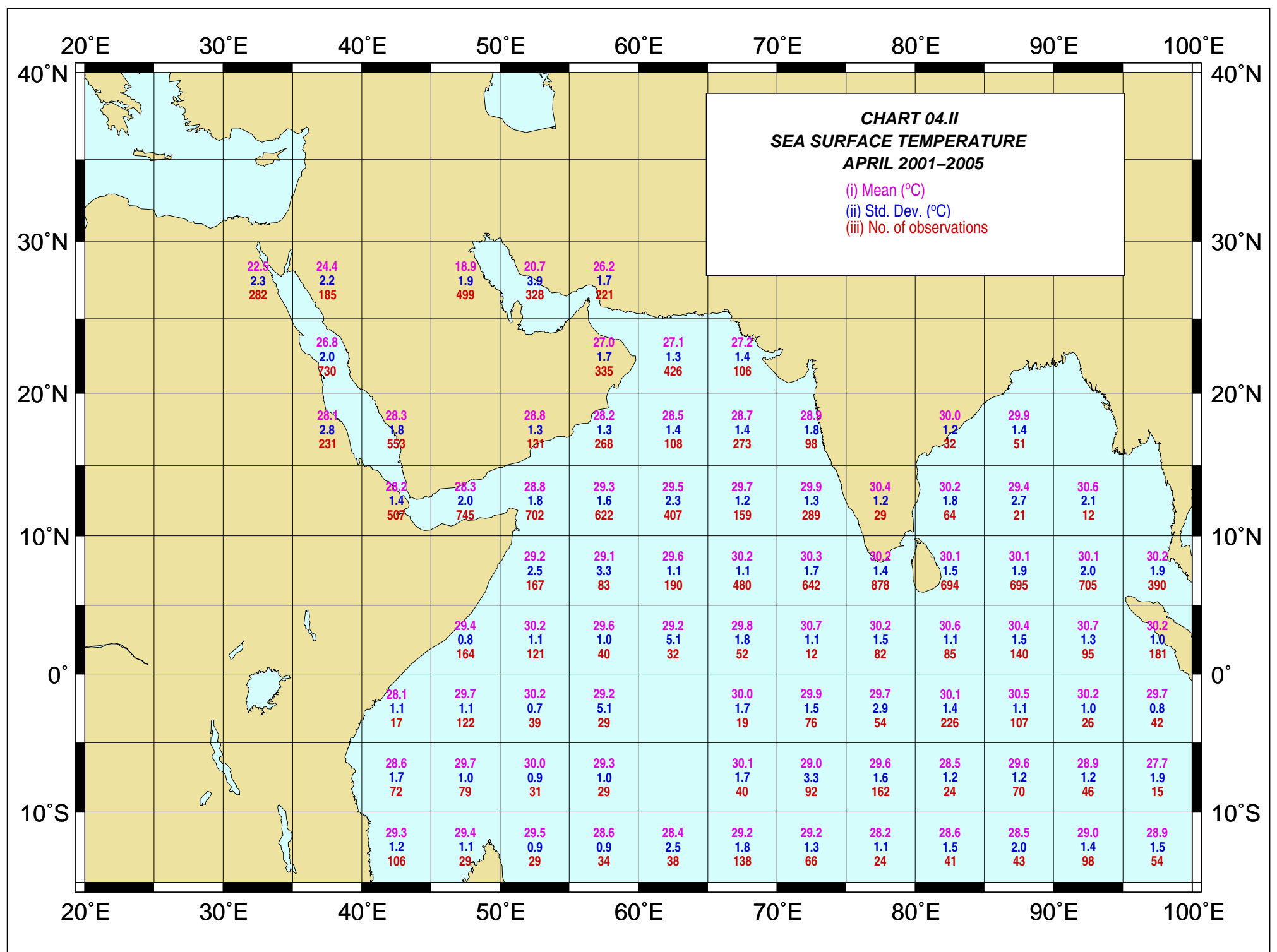
CHART - XVII : POSITION OF SHIP OBSERVATIONS

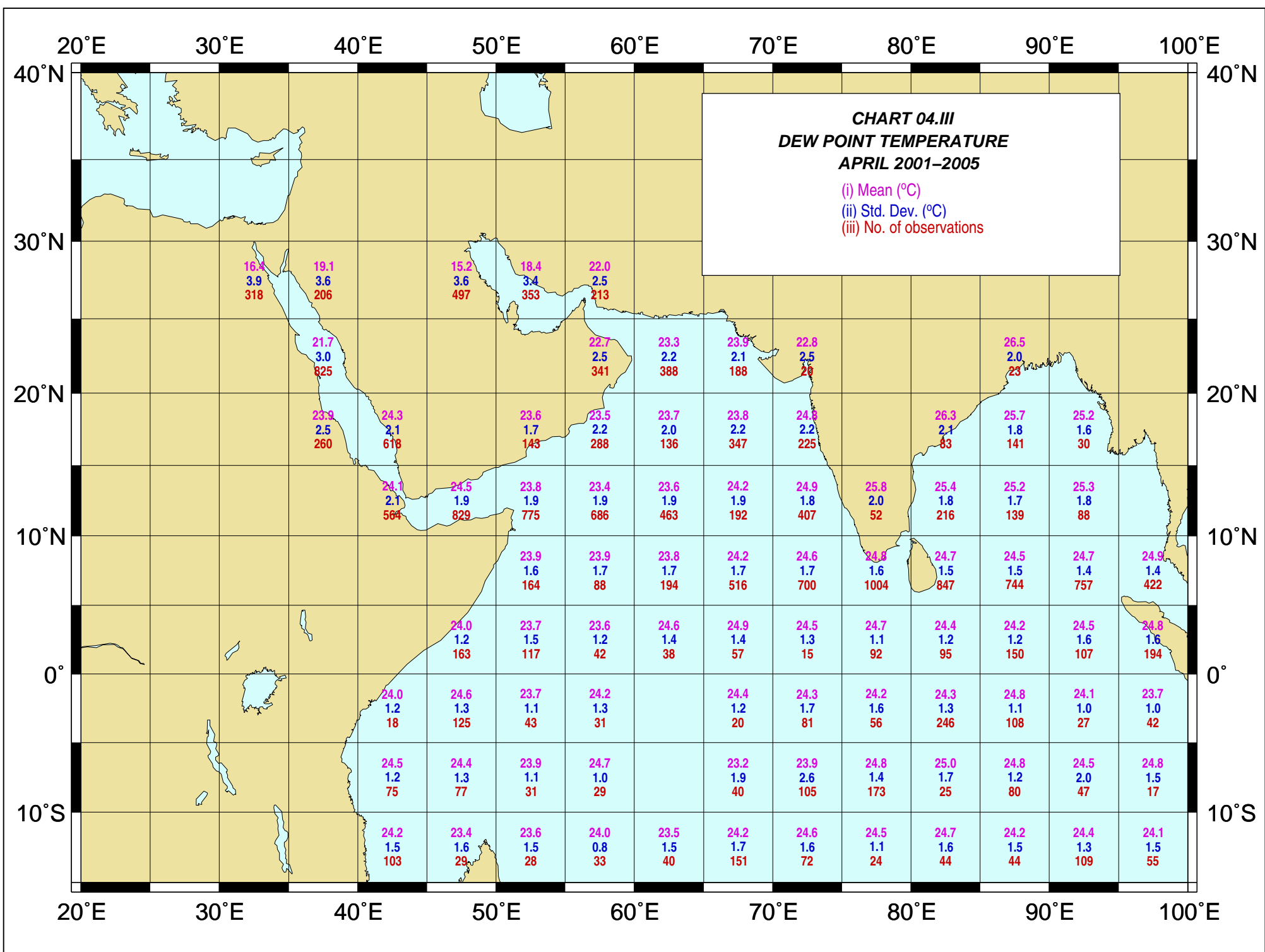
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

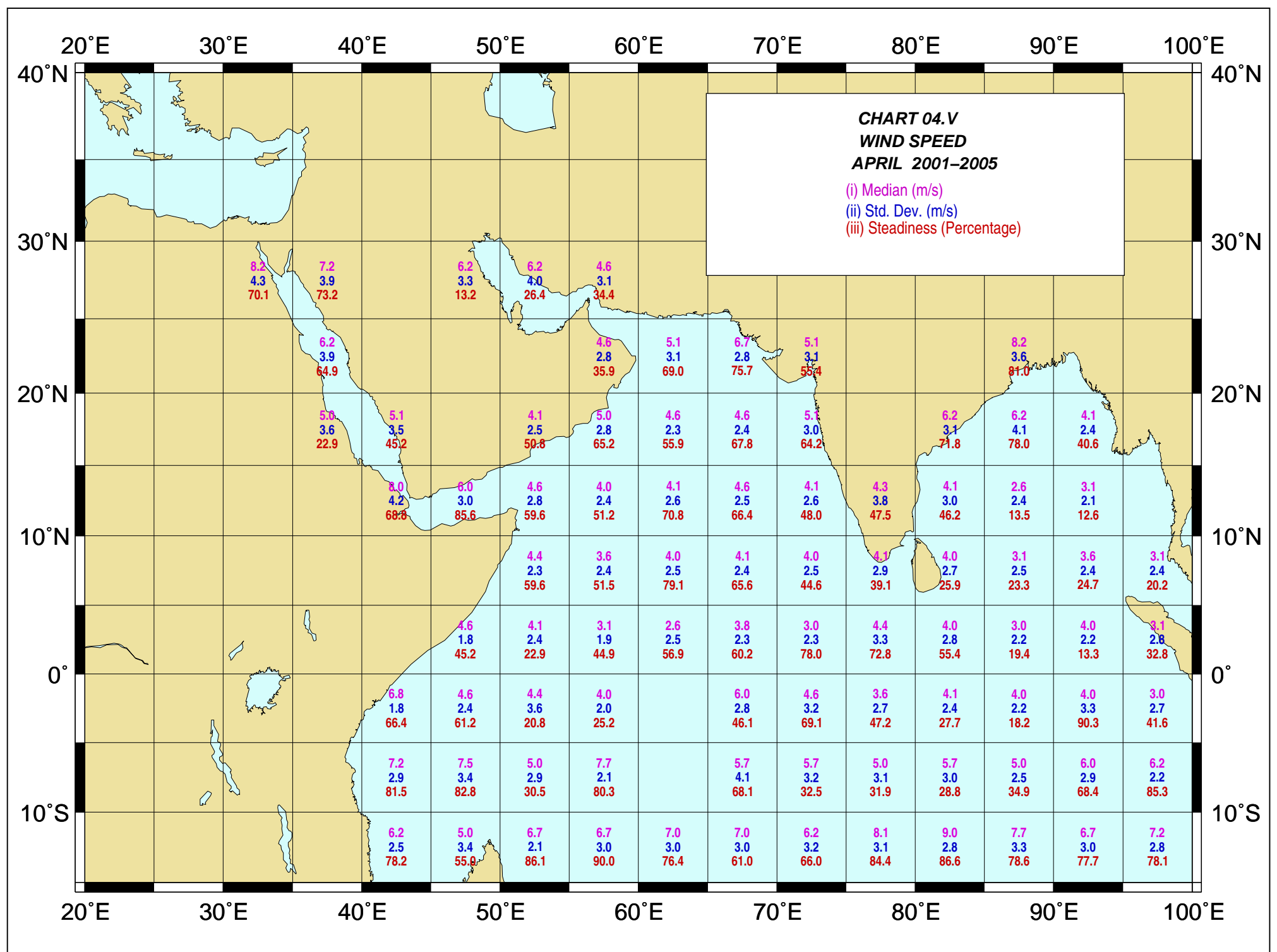
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

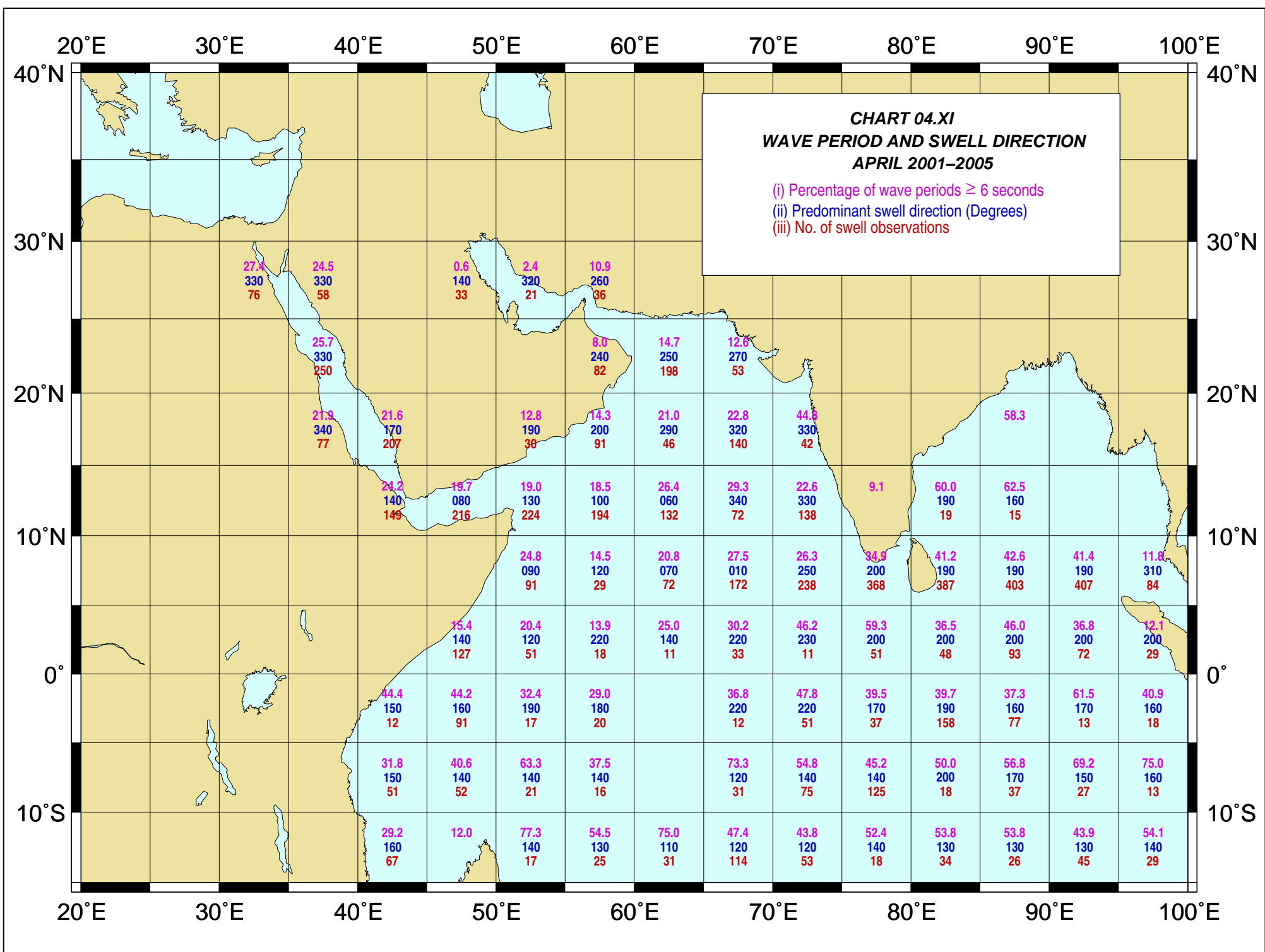
**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**

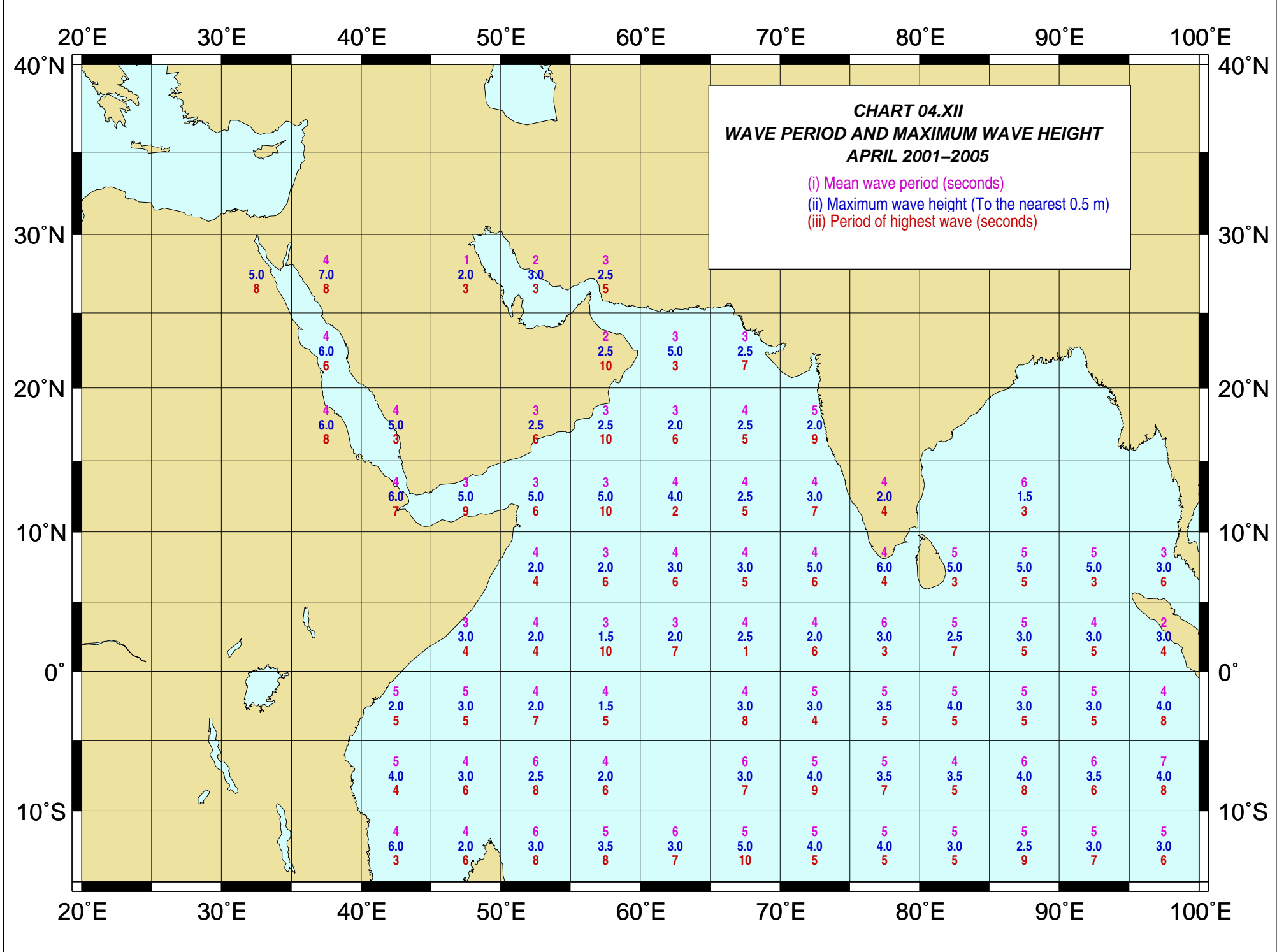


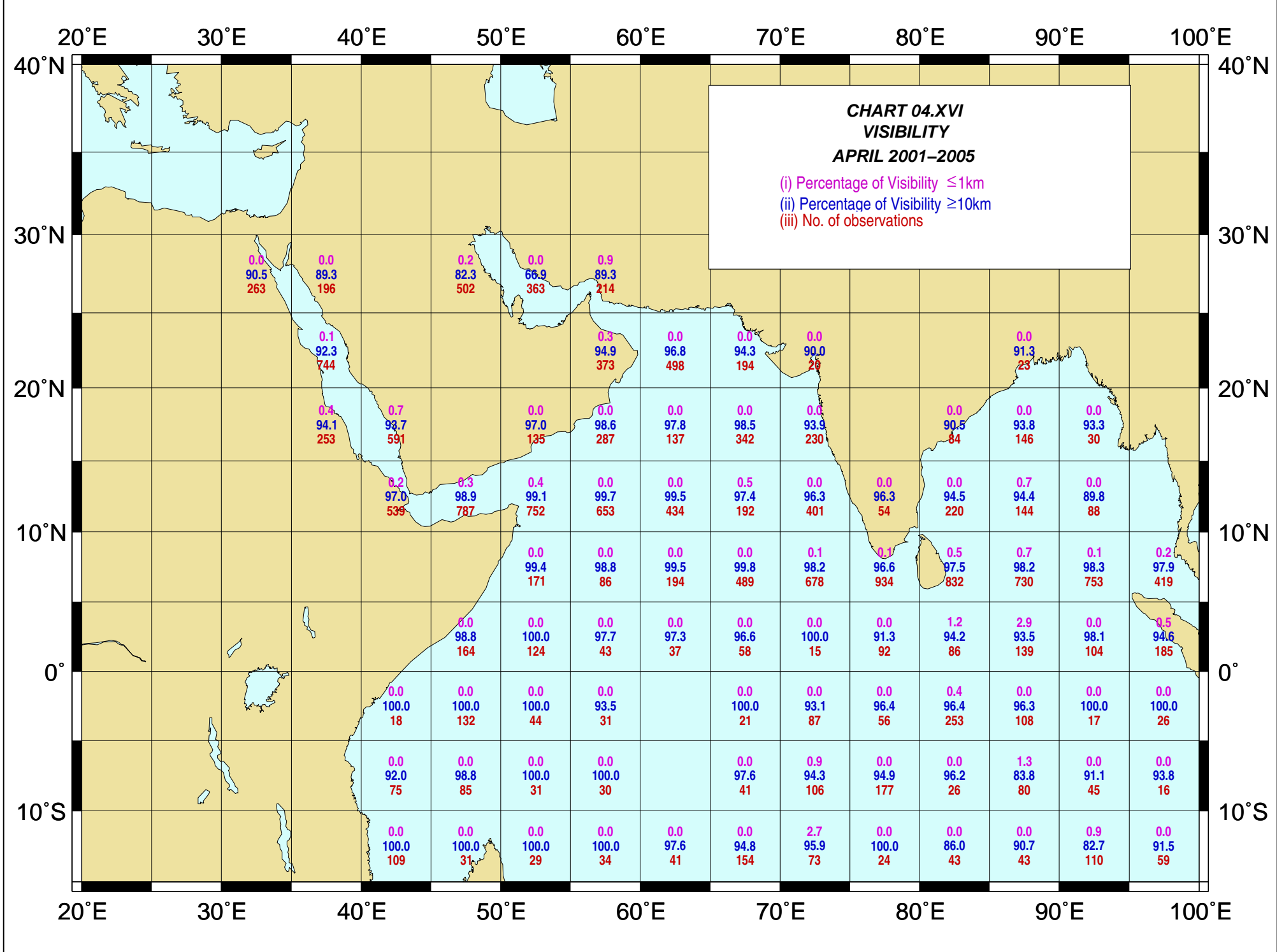


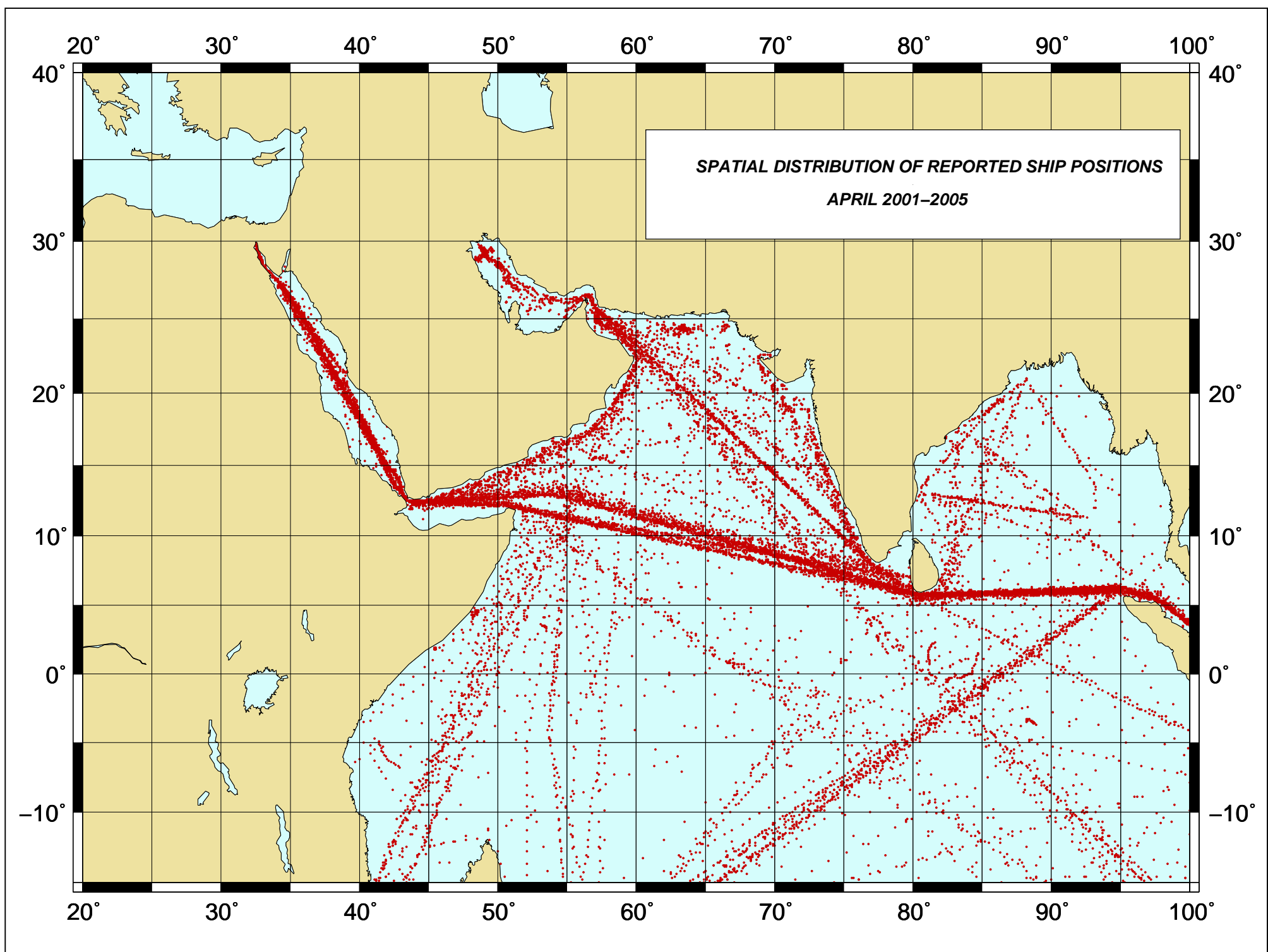




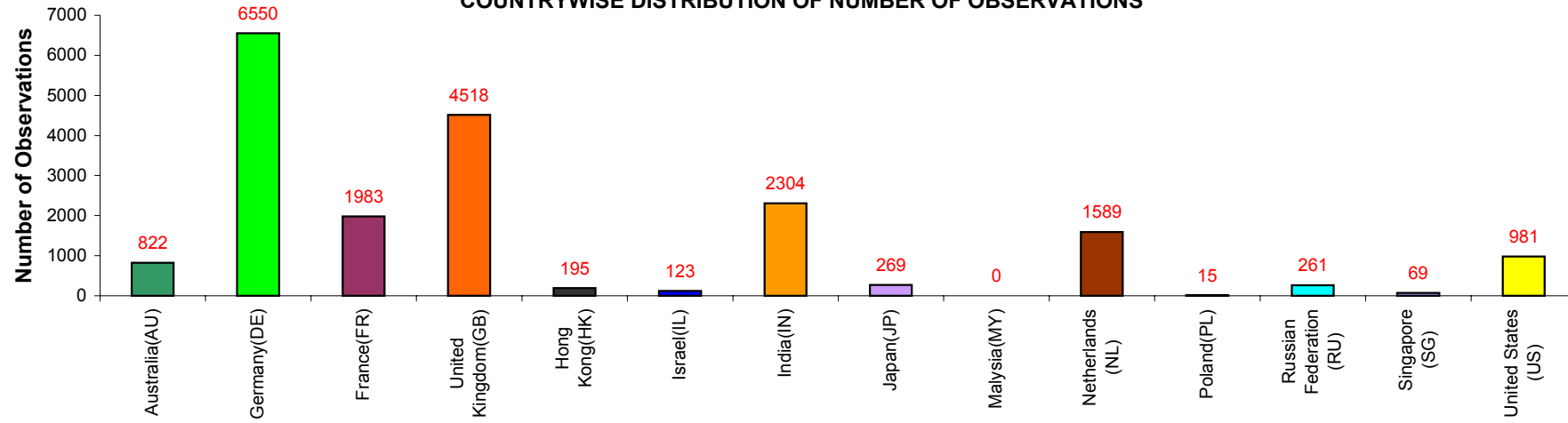




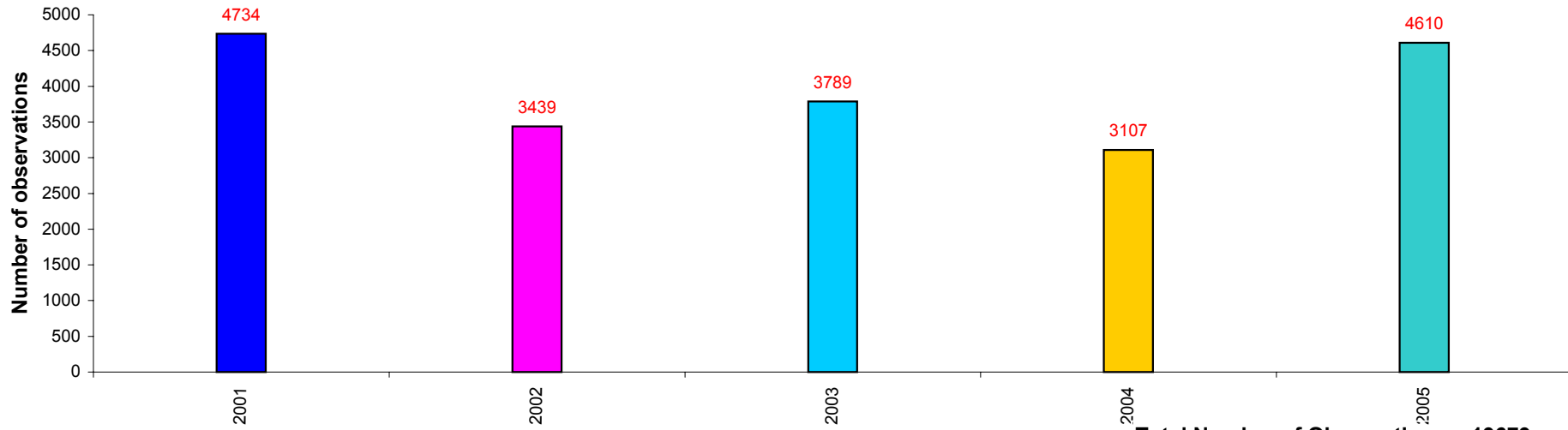




APRIL : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



Total Number of Observations = 19679



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CHARTS OF MAY 2001 - 2005

- CHART - I : AIR TEMPERATURE
- CHART - II : SEA SURFACE TEMPERATURE
- CHART - III : DEW POINT TEMPERATURE
- CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

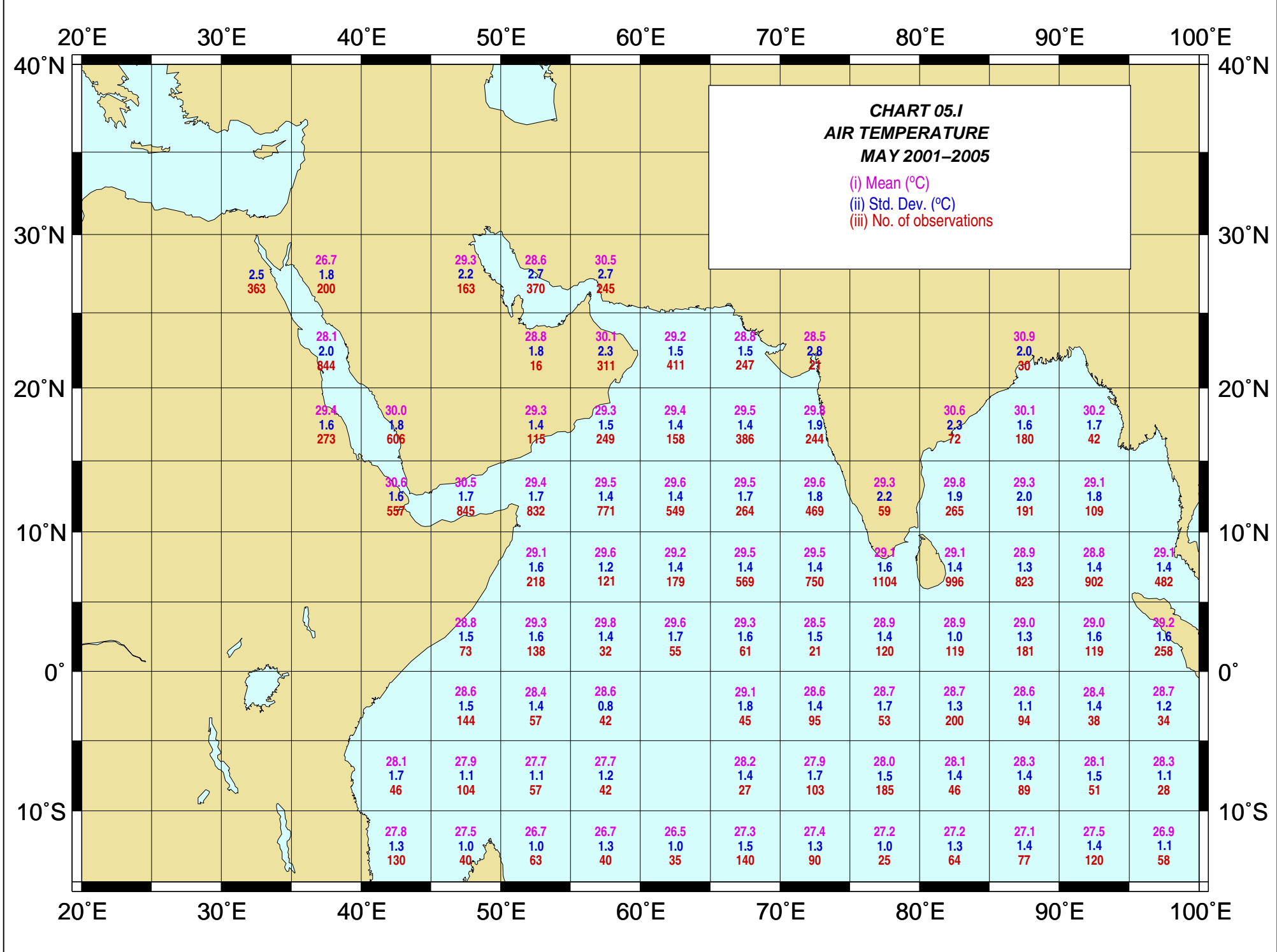
- CHART - V : WIND SPEED
- CHART - VI : WIND DIRECTION
- CHART - VII : LIGHT AND STRONG WINDS
- CHART - VIII : GALE AND MAXIMUM WINDS

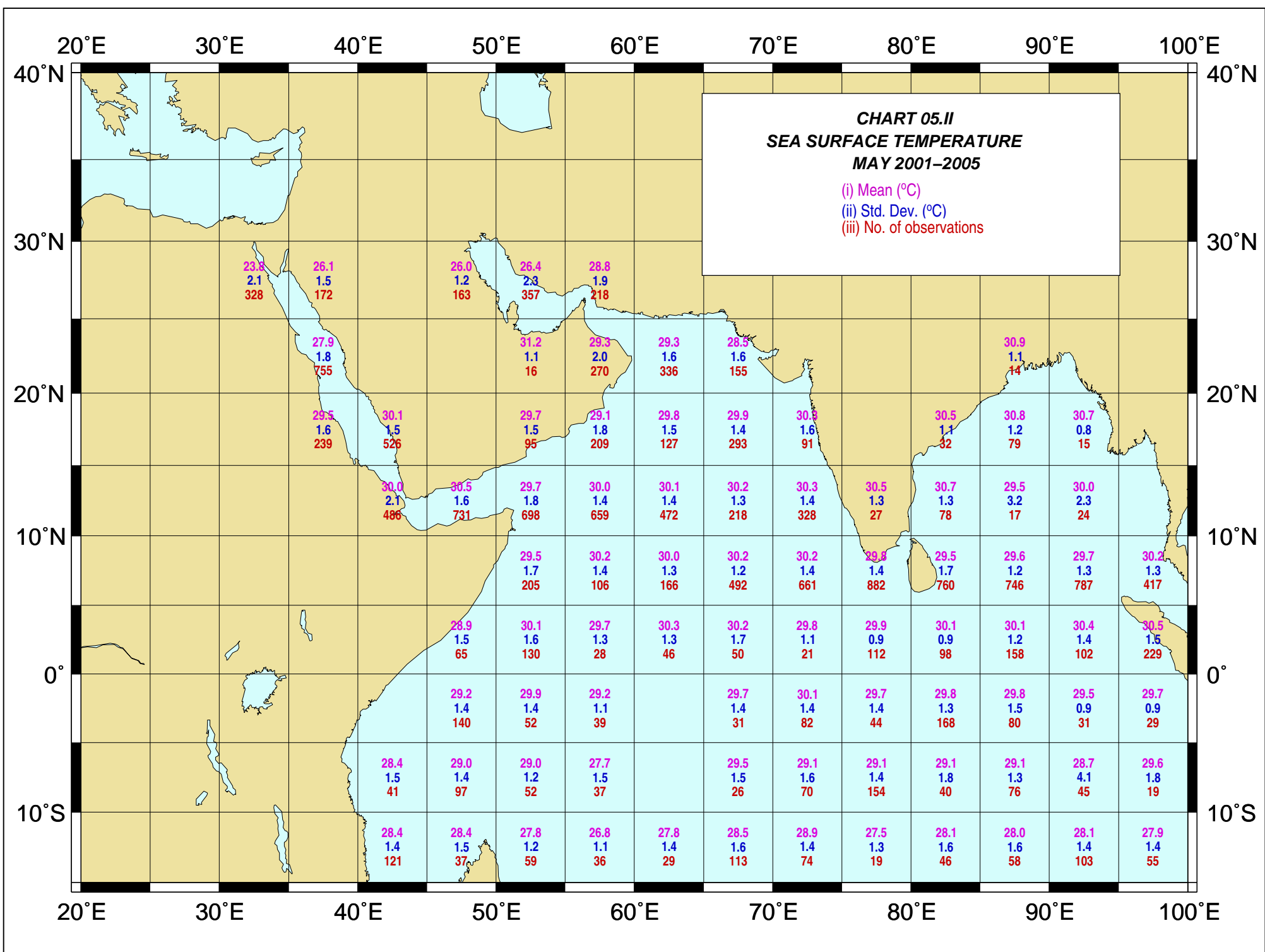
- CHART - IX : WAVE HEIGHT
- CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS
- CHART - XI : WAVE PERIOD AND SWELL DIRECTION
- CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

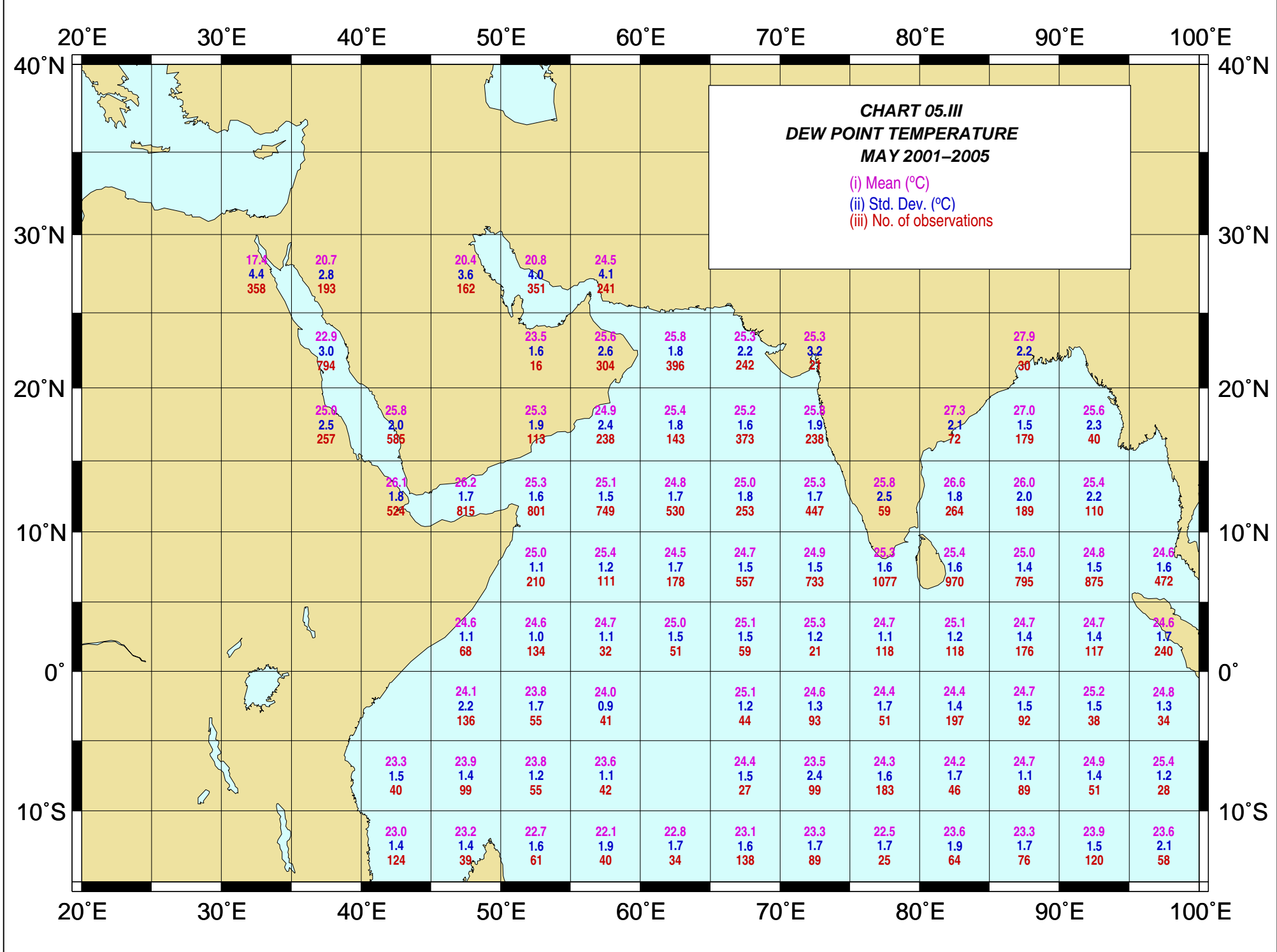
- CHART - XIII : MEAN SEA LEVEL PRESSURE
- CHART - XIV : PRECIPITATION
- CHART - XV : TOTAL CLOUD AMOUNT
- CHART - XVI : VISIBILITY

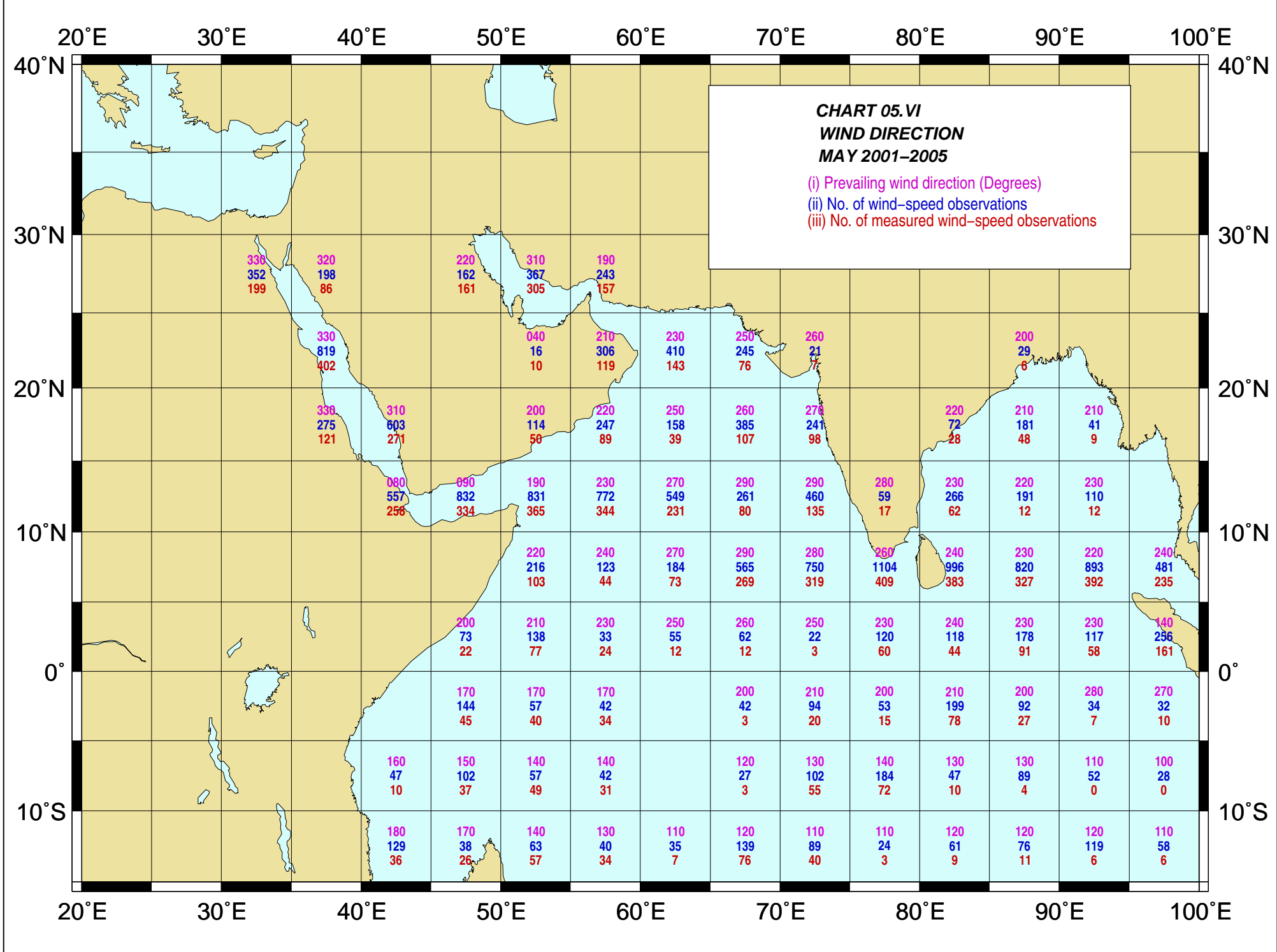
- CHART - XVII : POSITION OF SHIP OBSERVATIONS
- CHART - XVIII : STANDARD DEVIATION OF POSITIONS

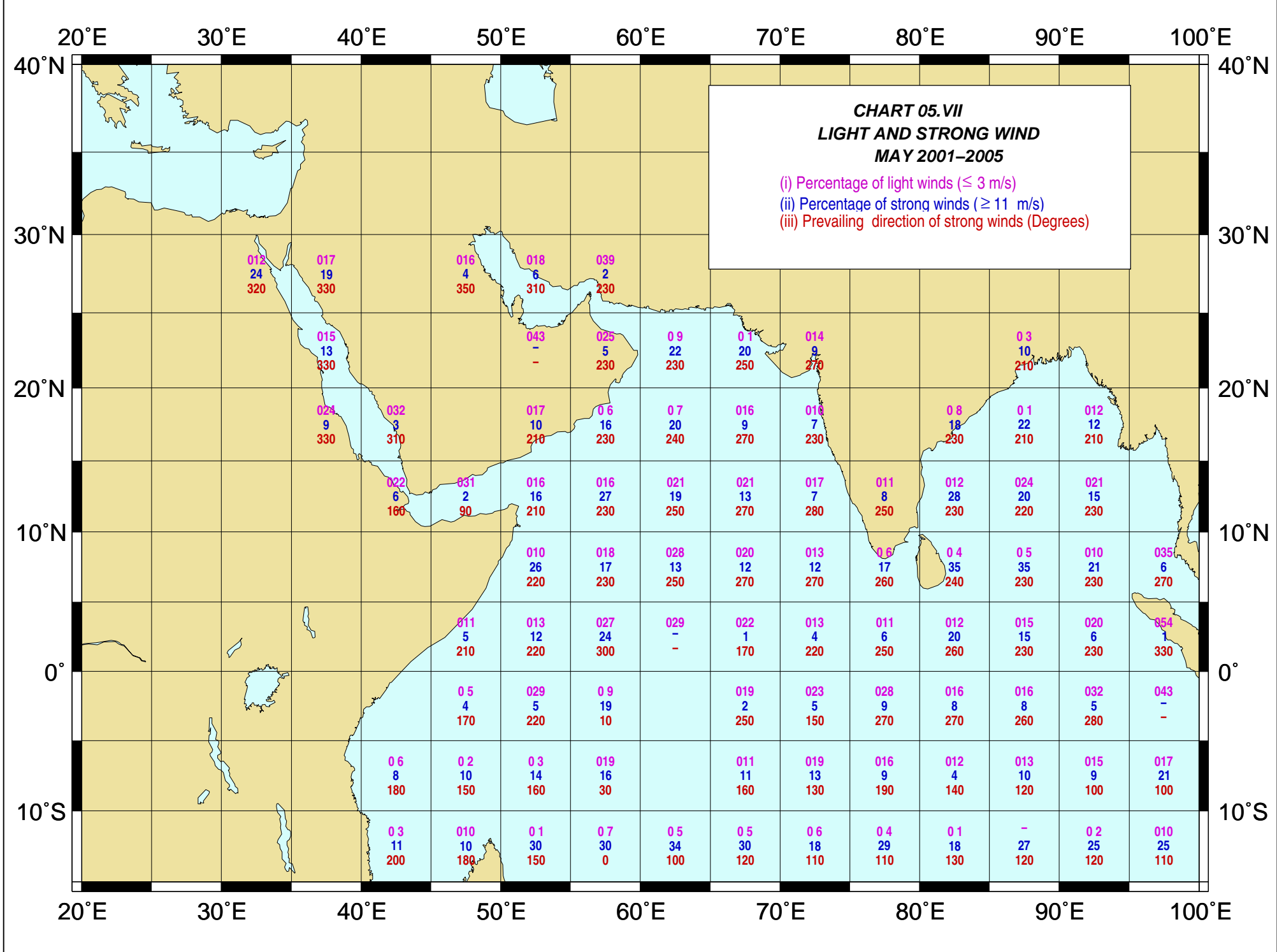
- SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS
- COUNTRYWISE AND YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS

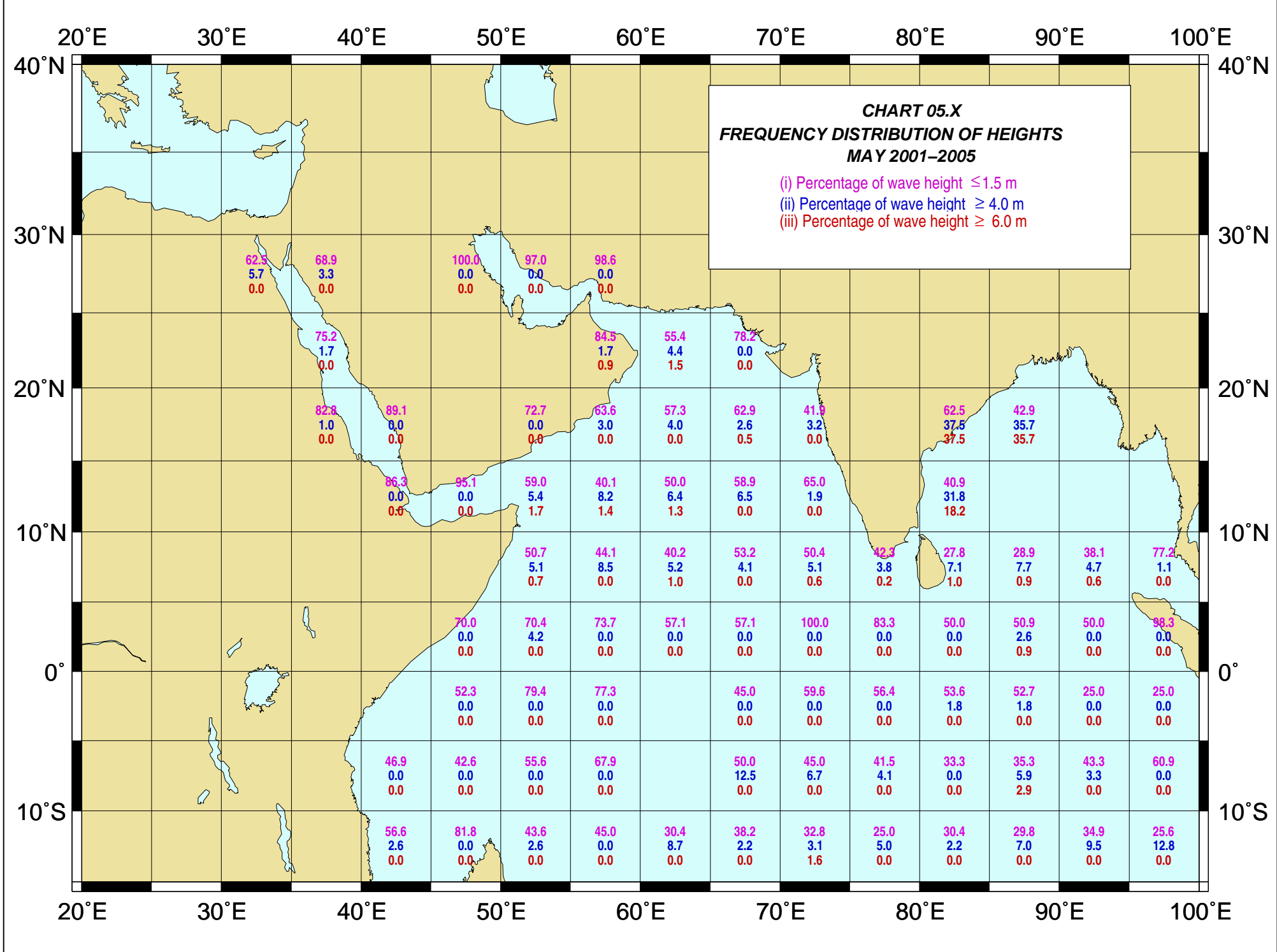


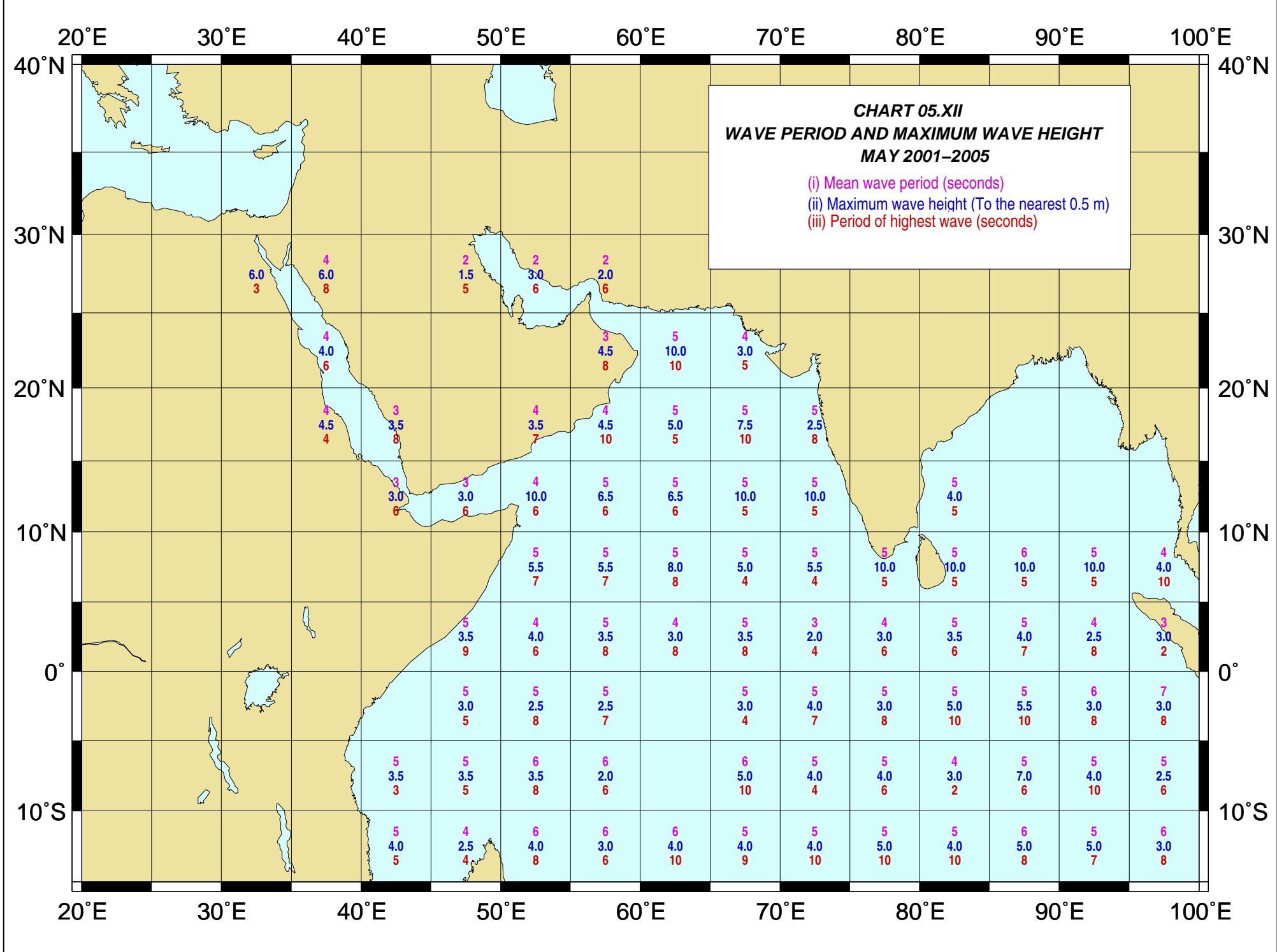


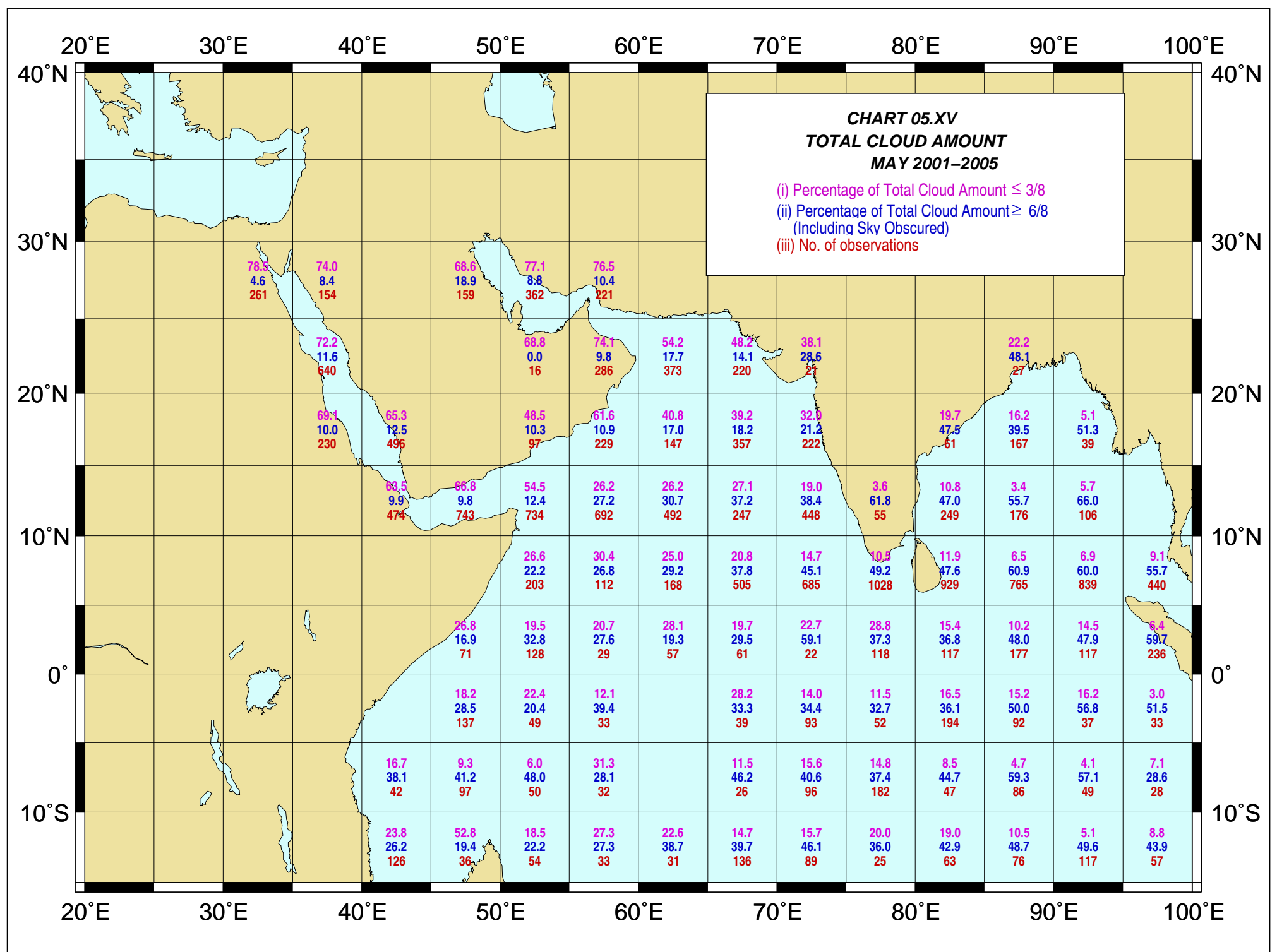












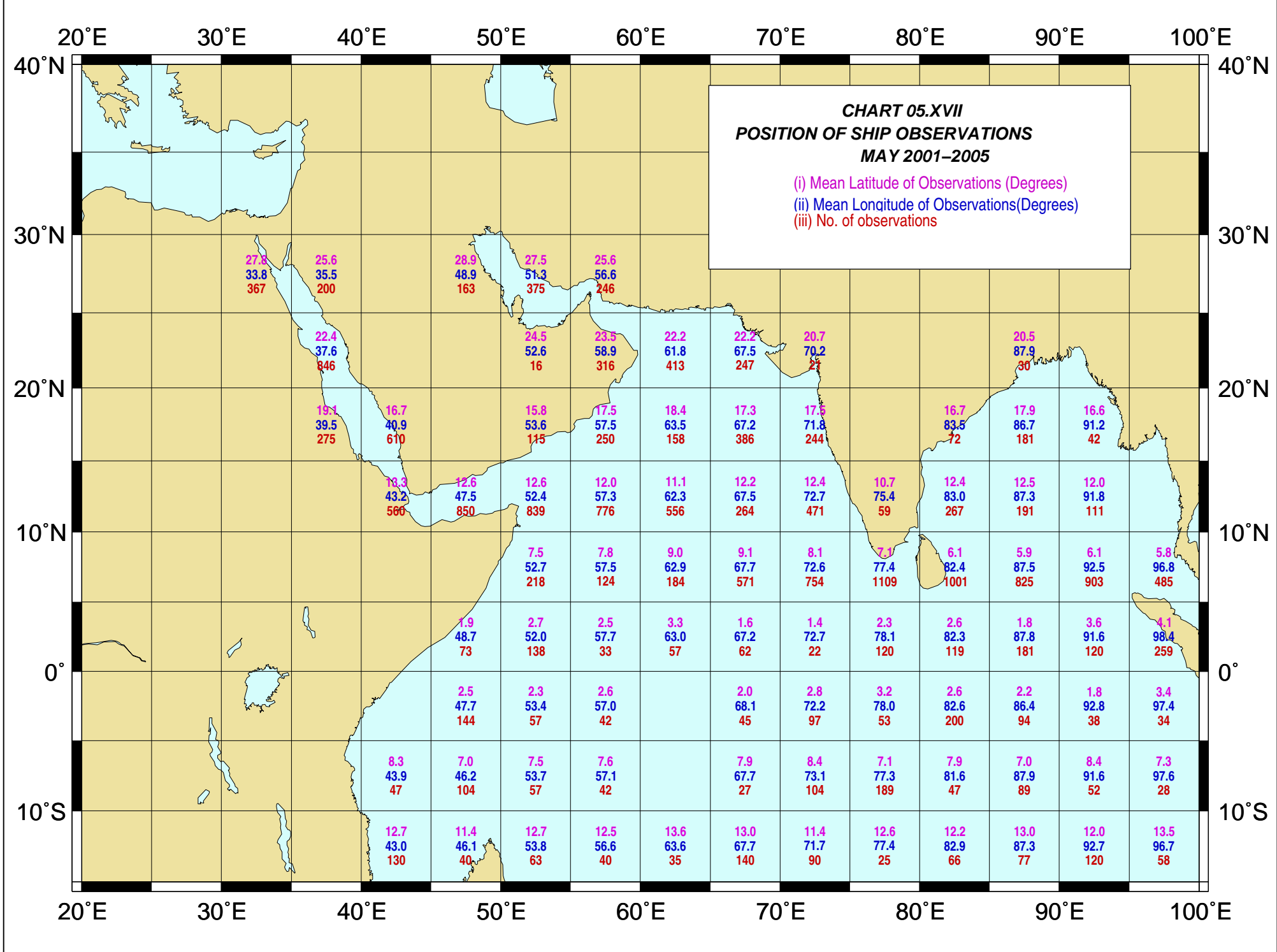
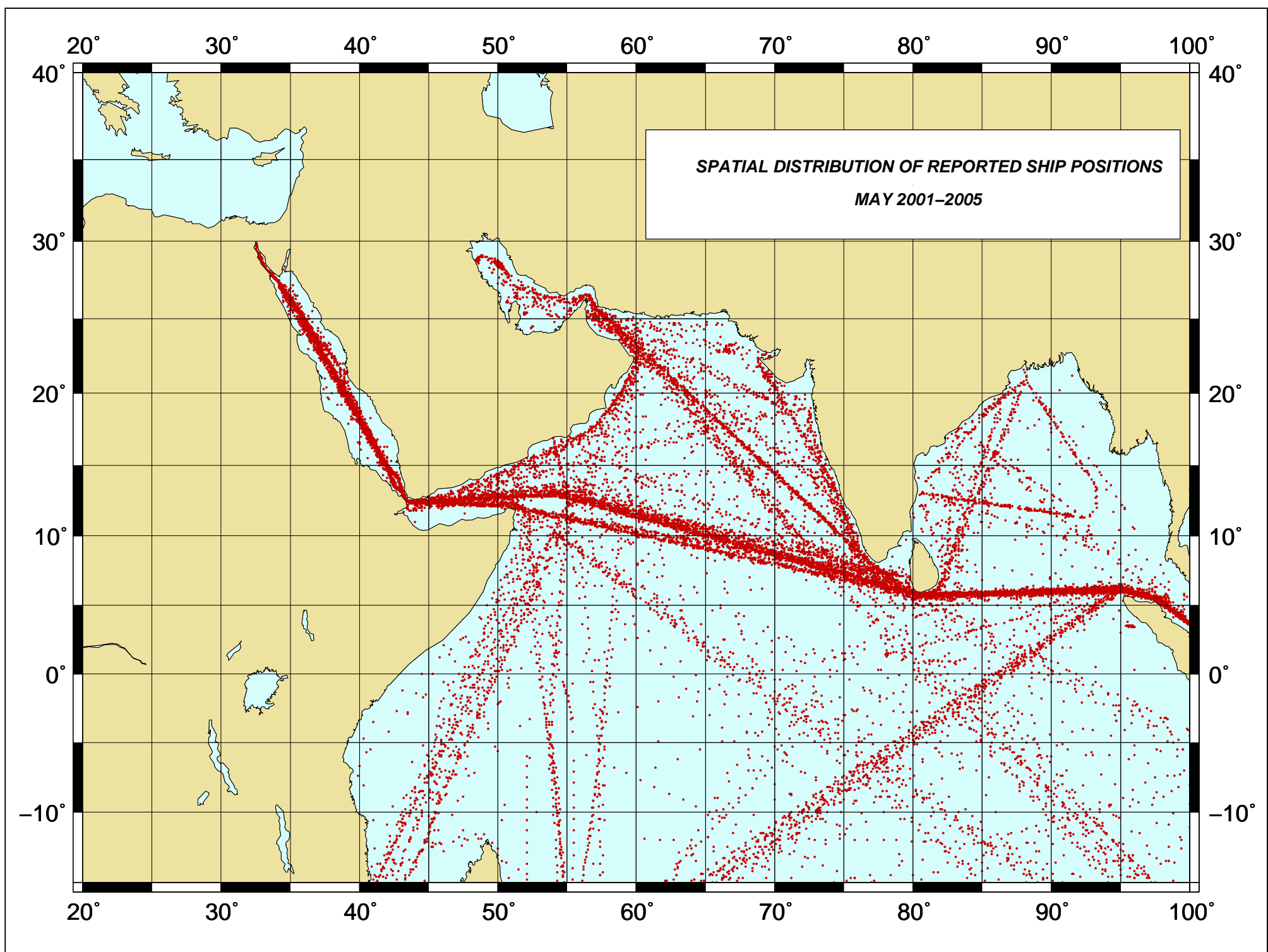


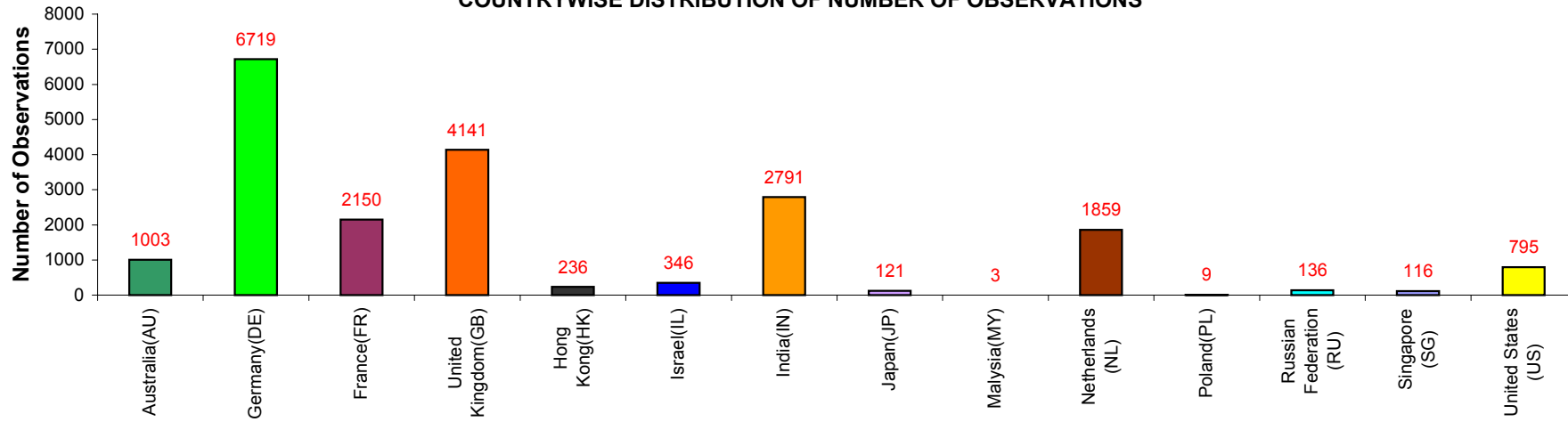
CHART 05.XVII
POSITION OF SHIP OBSERVATIONS
MAY 2001-2005

- (i) Mean Latitude of Observations (Degrees)
- (ii) Mean Longitude of Observations (Degrees)
- (iii) No. of observations

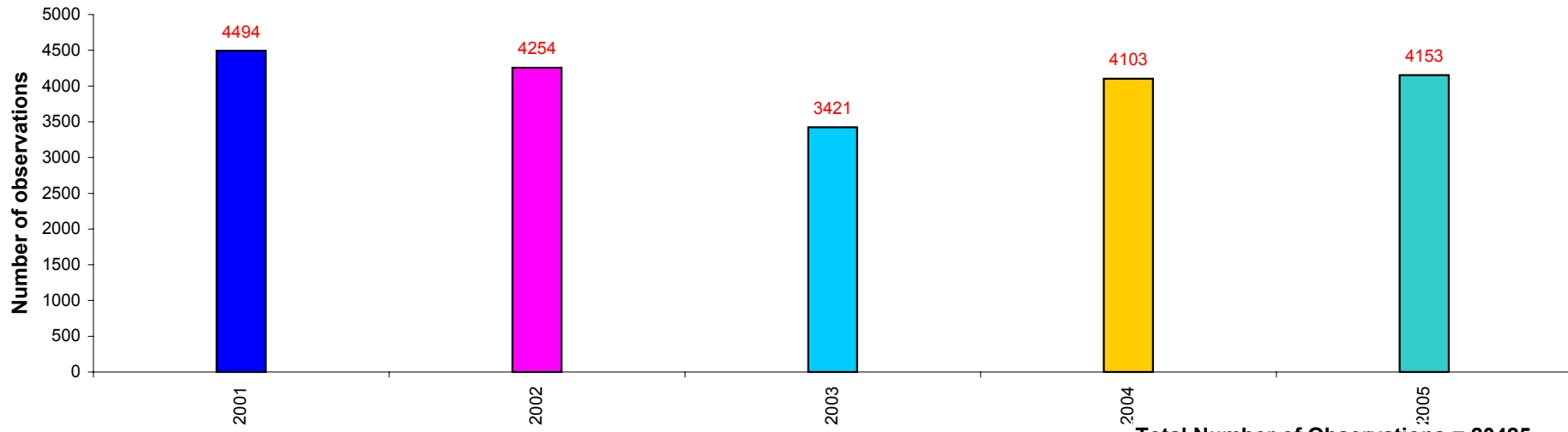
Latitude	20°E	30°E	40°E	50°E	60°E	70°E	80°E	90°E	100°E					
40°N														
30°N		27.8 33.8 367	25.6 35.5 200	28.9 48.9 163	27.5 51.3 375	25.6 56.6 246								
20°N		22.4 37.6 846	19.1 39.5 275	16.7 40.9 610	24.5 52.6 16	23.5 58.9 316	22.2 61.8 413	22.2 67.5 247	20.7 70.2 21	20.5 87.9 30				
10°N			13.3 43.2 566	12.6 47.5 850	15.8 53.6 115	17.5 57.5 250	18.4 63.5 158	17.3 67.2 386	17.5 71.8 244	16.7 83.5 72	17.9 86.7 181	16.6 91.2 42		
0°				7.5 52.7 218	7.8 57.5 124	9.0 62.9 184	9.1 67.7 571	8.1 72.6 754	7.1 77.4 1109	10.7 75.4 59	12.4 83.0 267	12.5 87.3 191	12.0 91.8 111	
10°S				1.9 48.7 73	2.5 57.7 33	3.3 63.0 57	1.6 67.2 62	1.4 72.7 22	2.3 78.1 120	2.6 82.3 119	1.8 87.8 181	3.6 91.6 120	4.1 98.4 259	
				2.5 47.7 144	2.3 53.4 57	2.6 57.0 42	2.0 68.1 45	2.8 72.2 97	3.2 78.0 53	2.6 82.6 200	2.2 86.4 94	1.8 92.8 38	3.4 97.4 34	
			8.3 43.9 47	7.0 46.2 104	7.5 53.7 57	7.6 57.1 42	7.9 67.7 27	8.4 73.1 104	7.1 77.3 189	7.9 81.6 47	7.0 87.9 89	8.4 91.6 52	7.3 97.6 28	
10°S			12.7 43.0 130	11.4 46.1 40	12.7 53.8 63	12.5 56.6 40	13.6 63.6 35	13.0 67.7 140	11.4 71.7 90	12.6 77.4 25	12.2 82.9 66	13.0 87.3 77	12.0 92.7 120	13.5 96.7 58



MAY : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



Total Number of Observations = 20425



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CHARTS OF JUNE 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

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CHART - VII : LIGHT AND STRONG WINDS

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CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

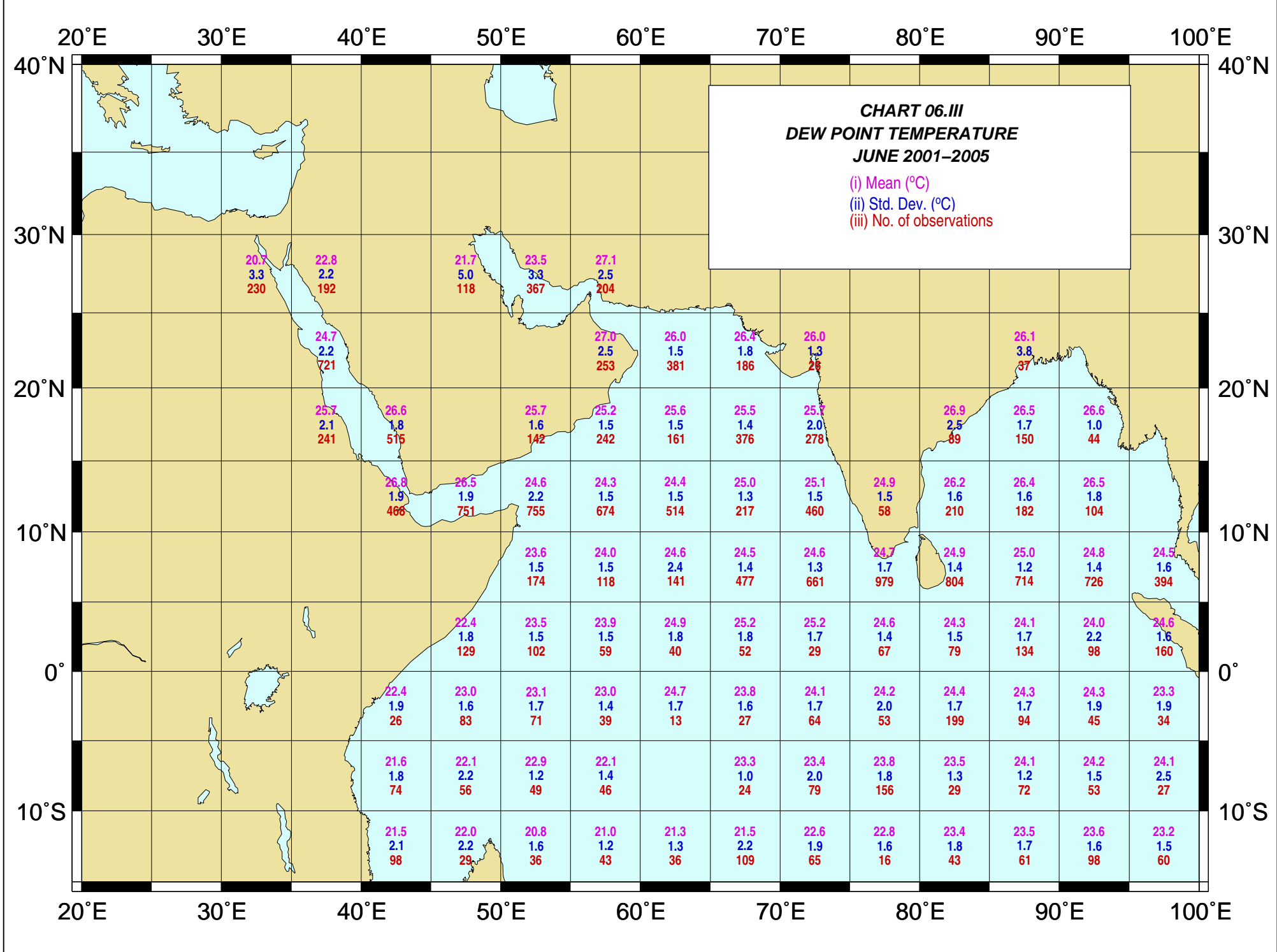
CHART - XVI : VISIBILITY

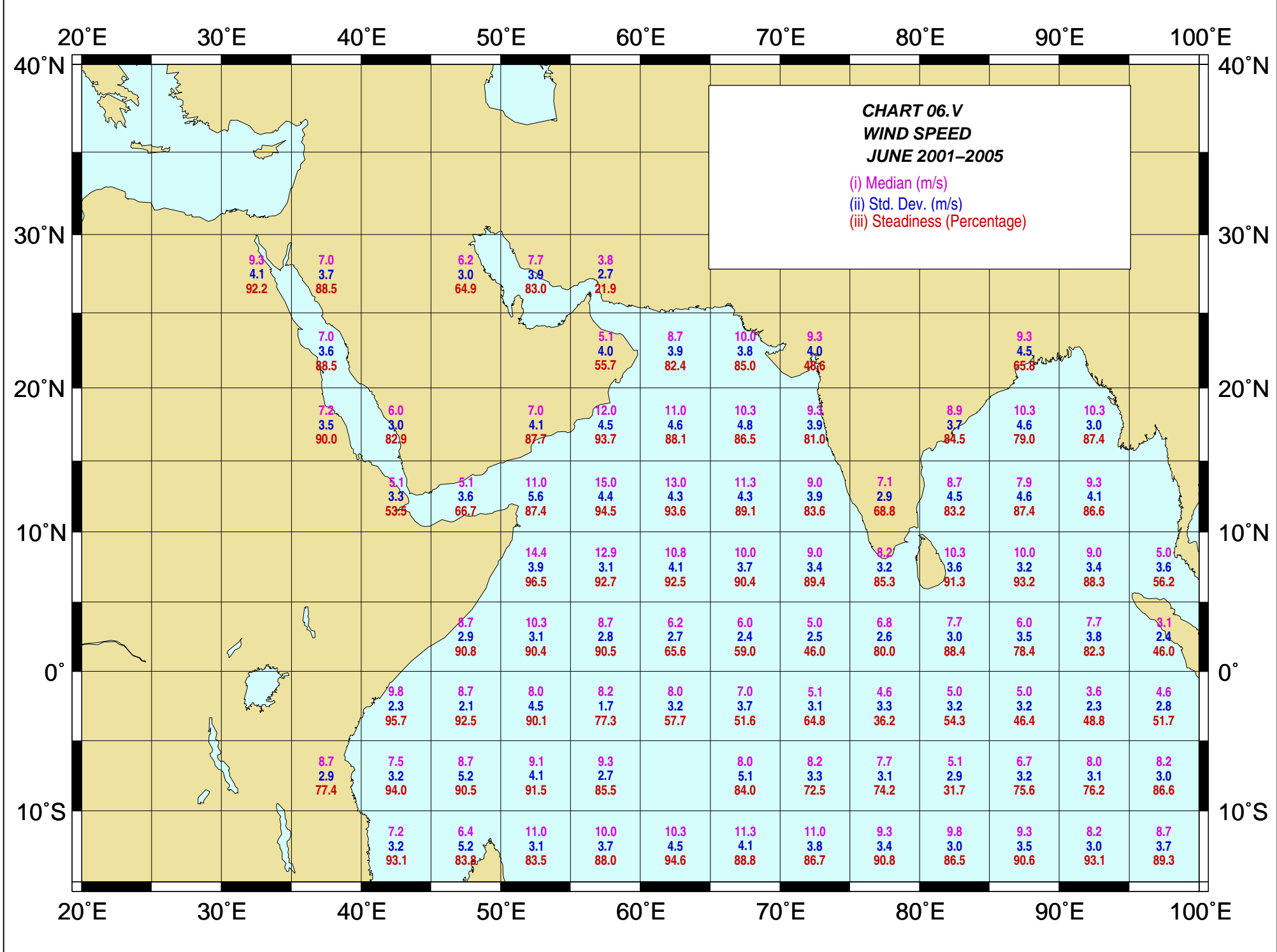
CHART - XVII : POSITION OF SHIP OBSERVATIONS

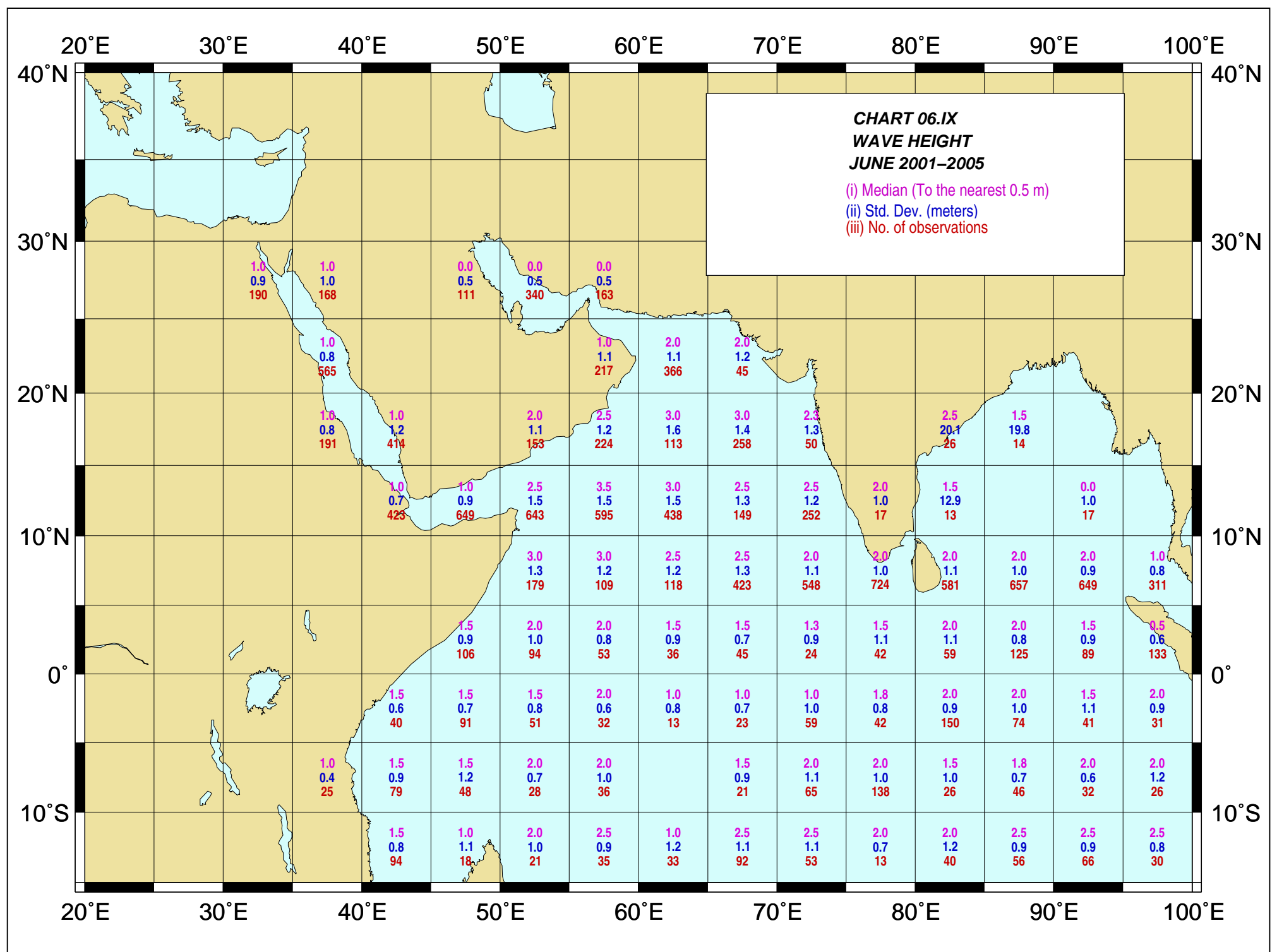
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

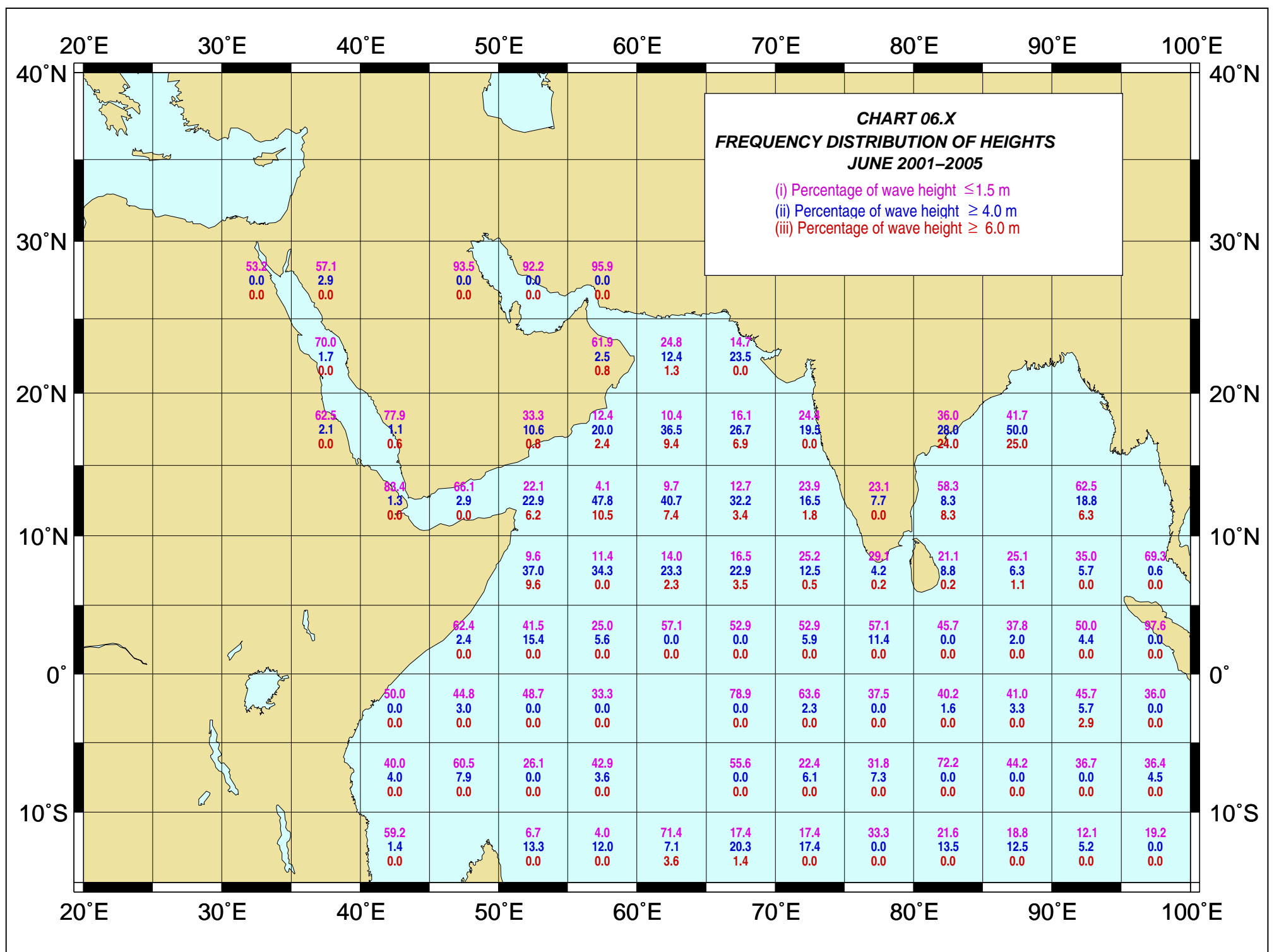
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

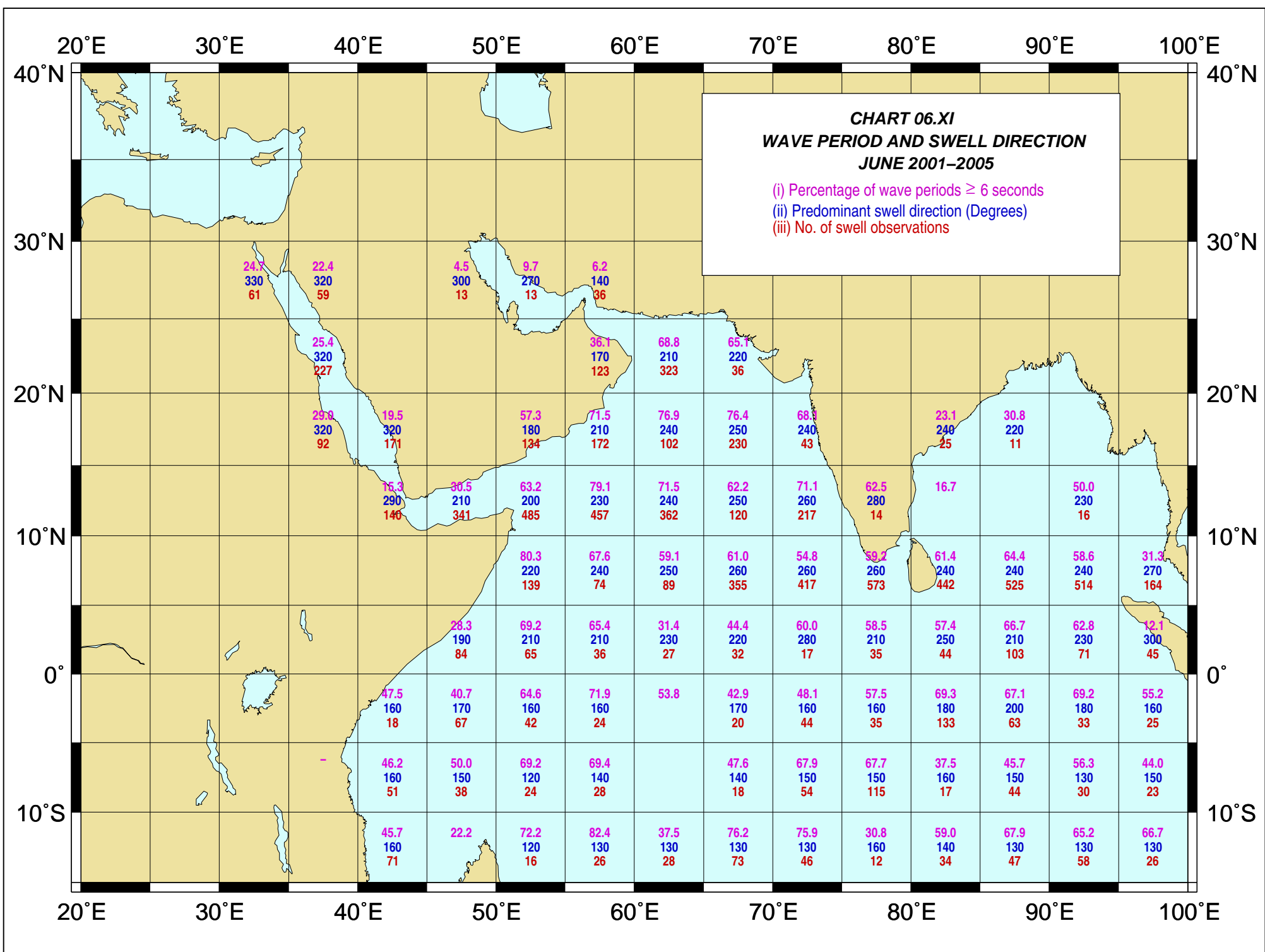
**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**

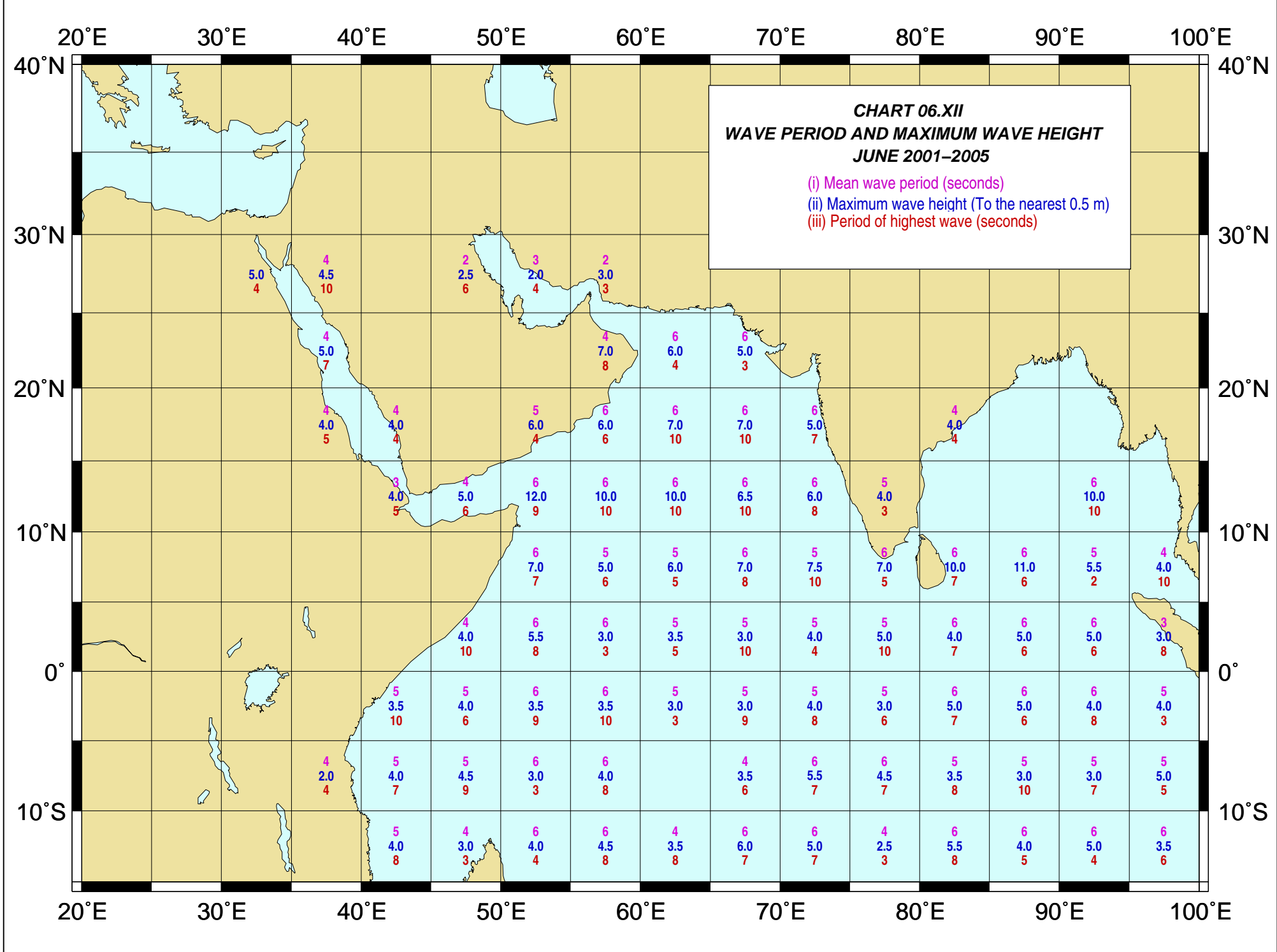


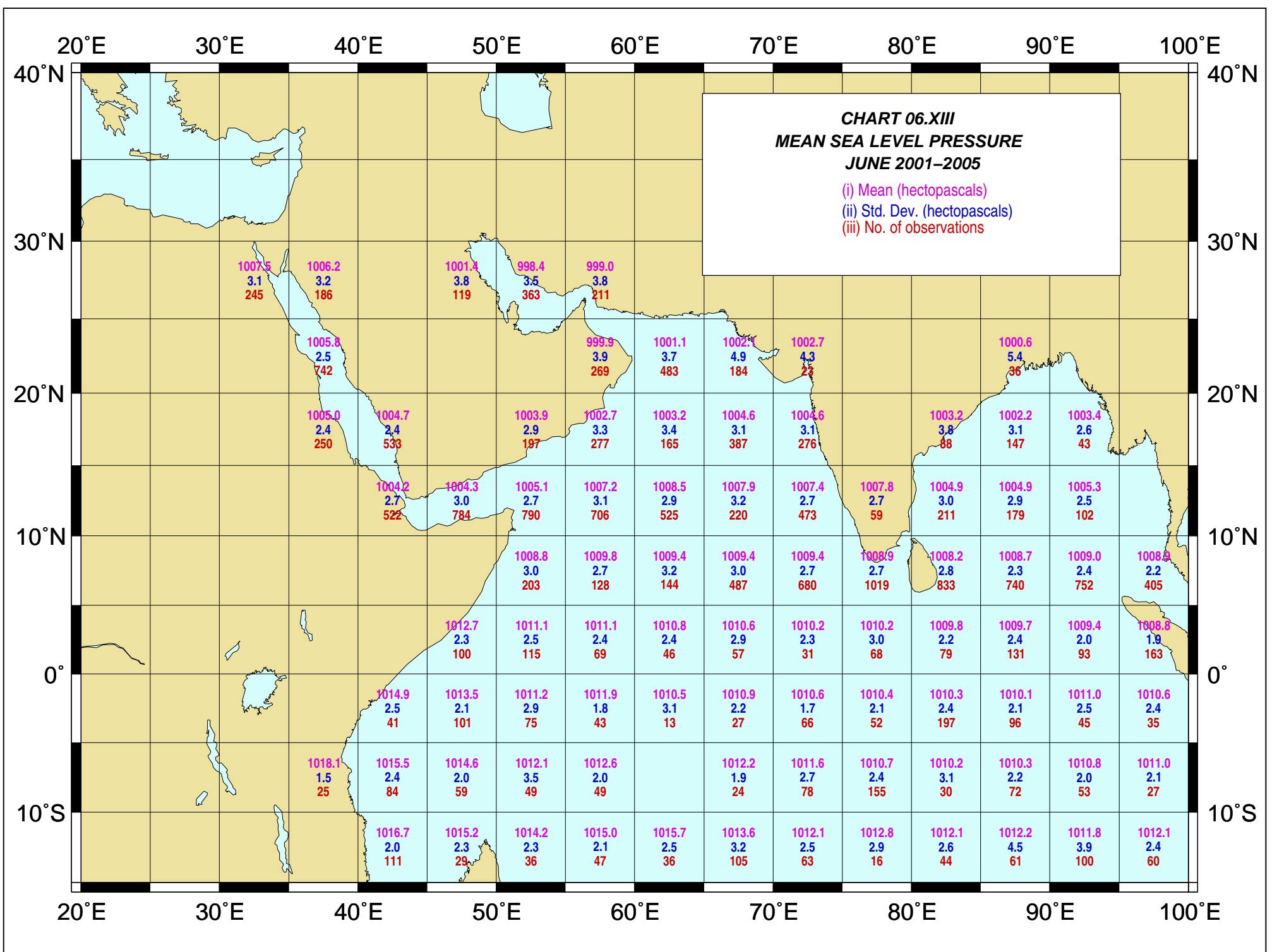


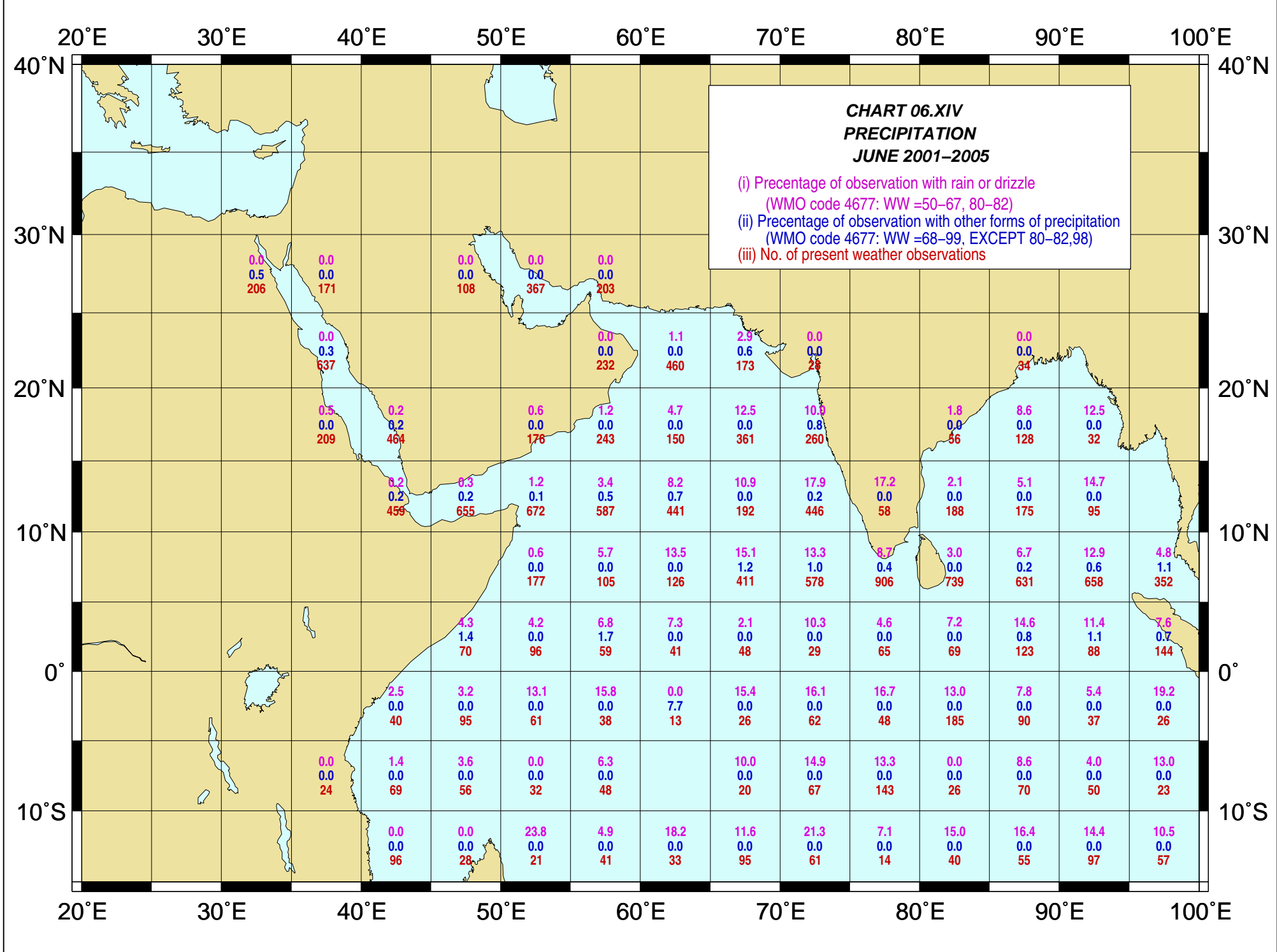


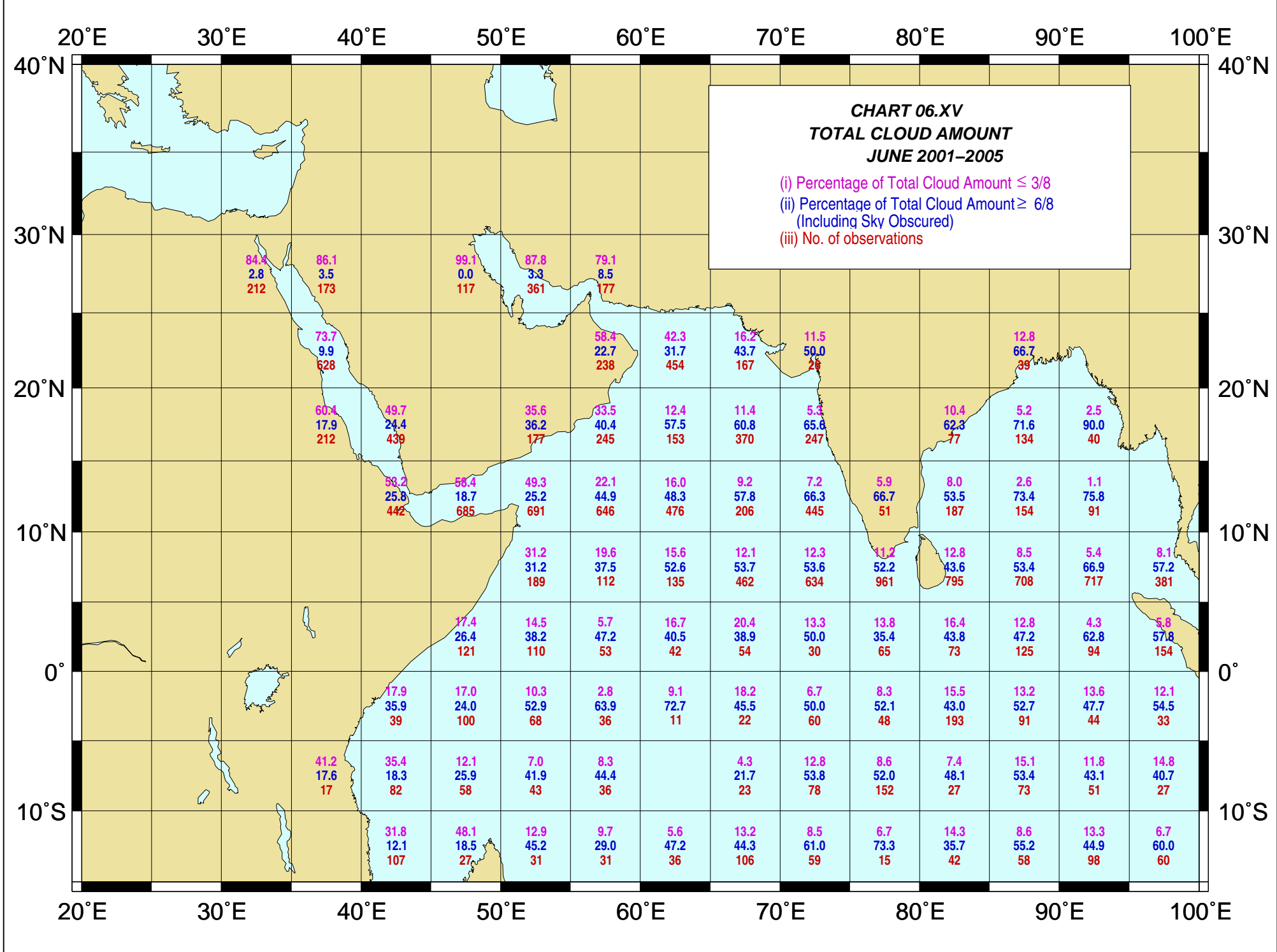


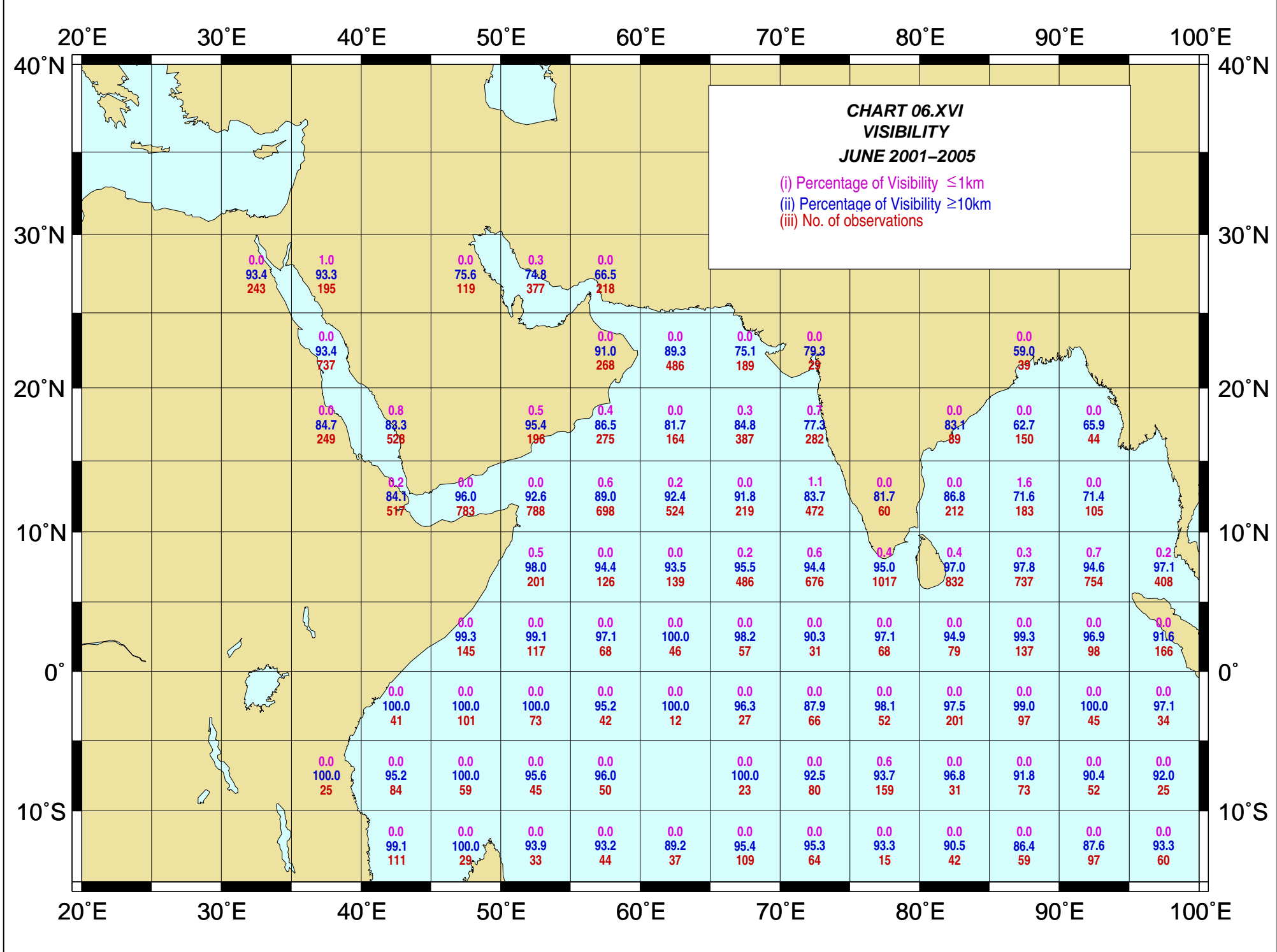


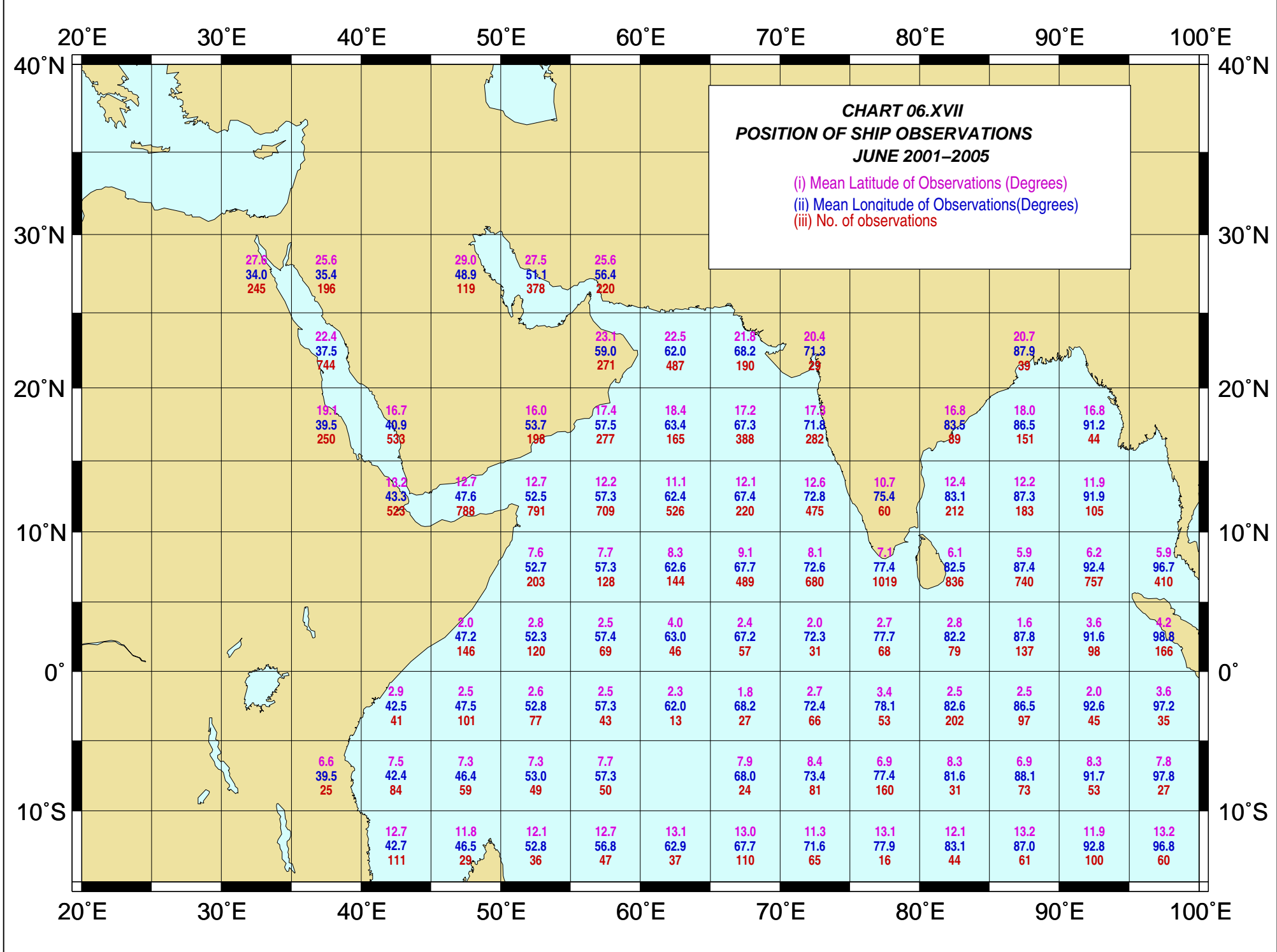


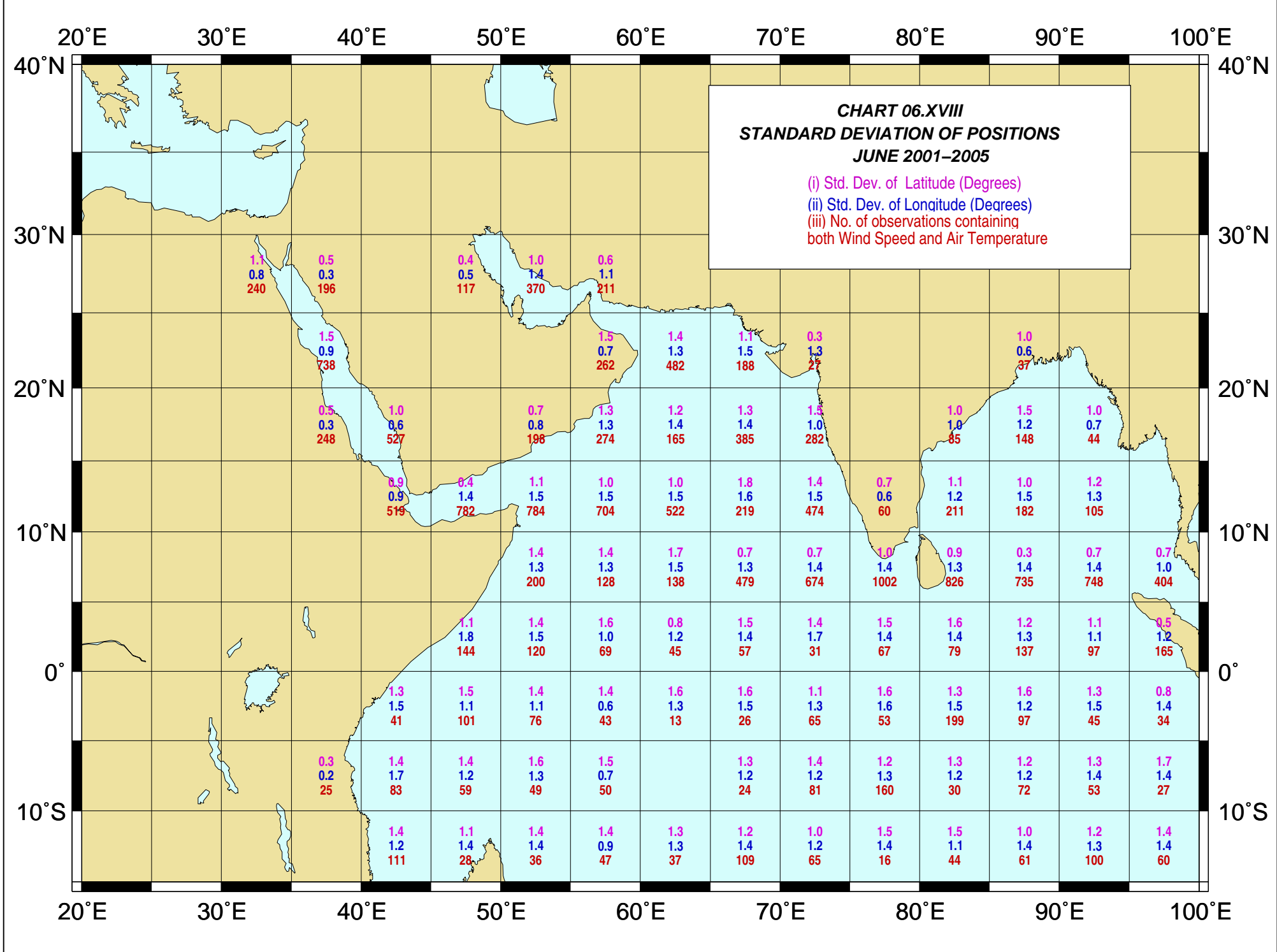


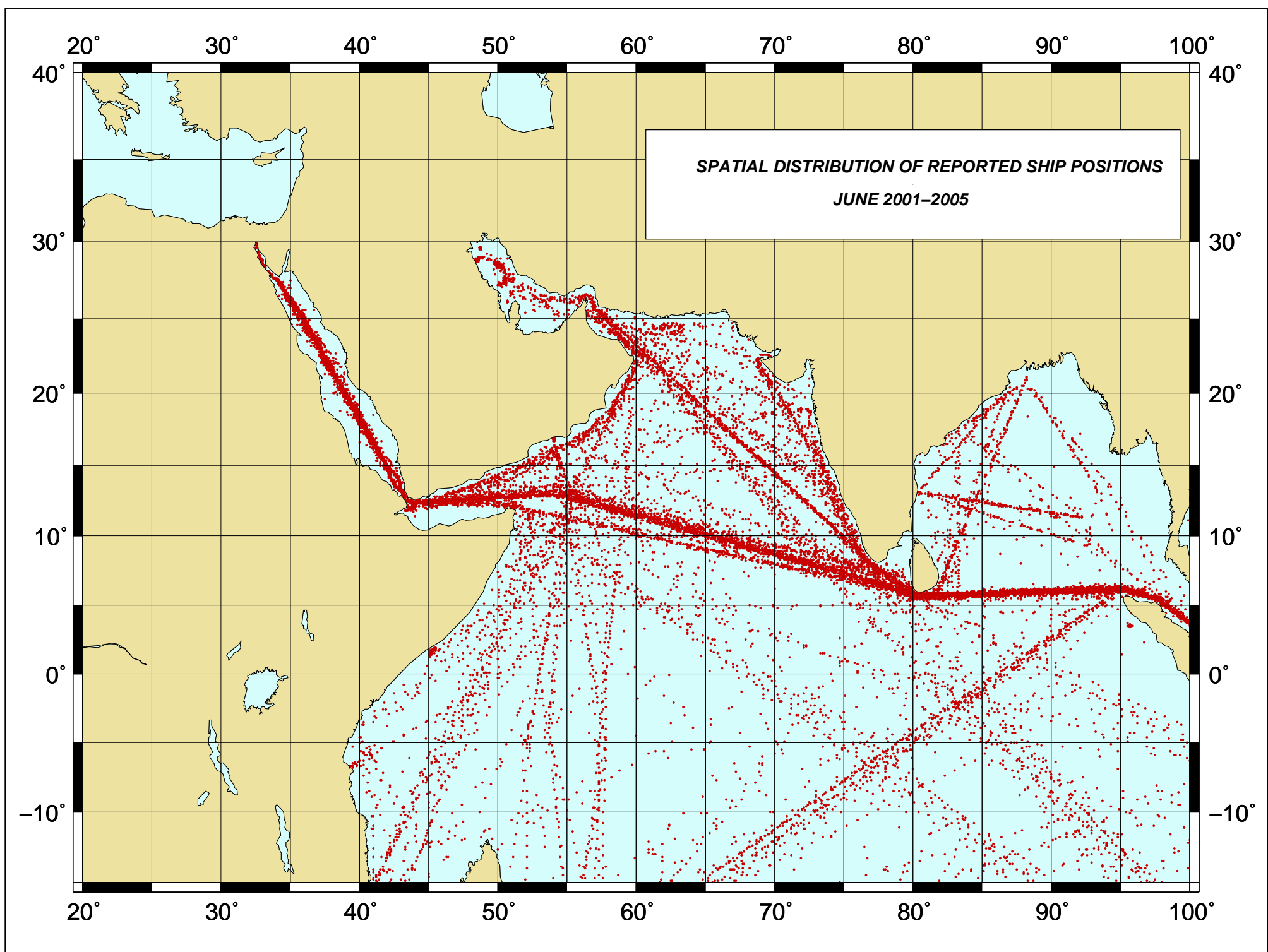


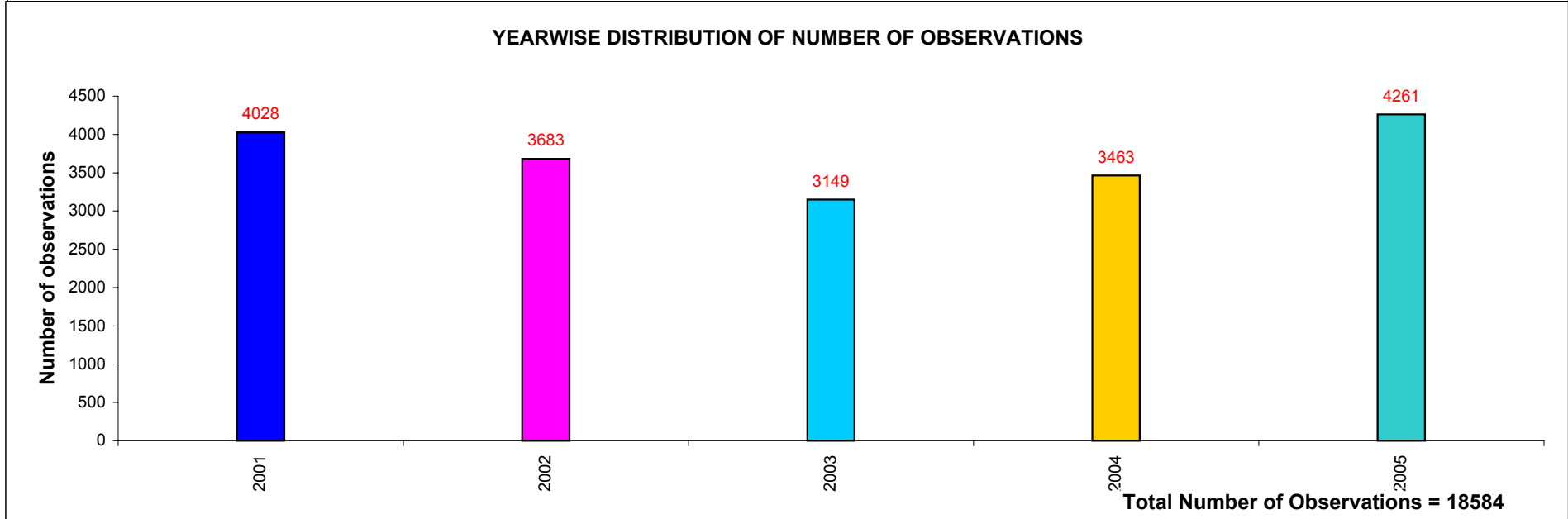
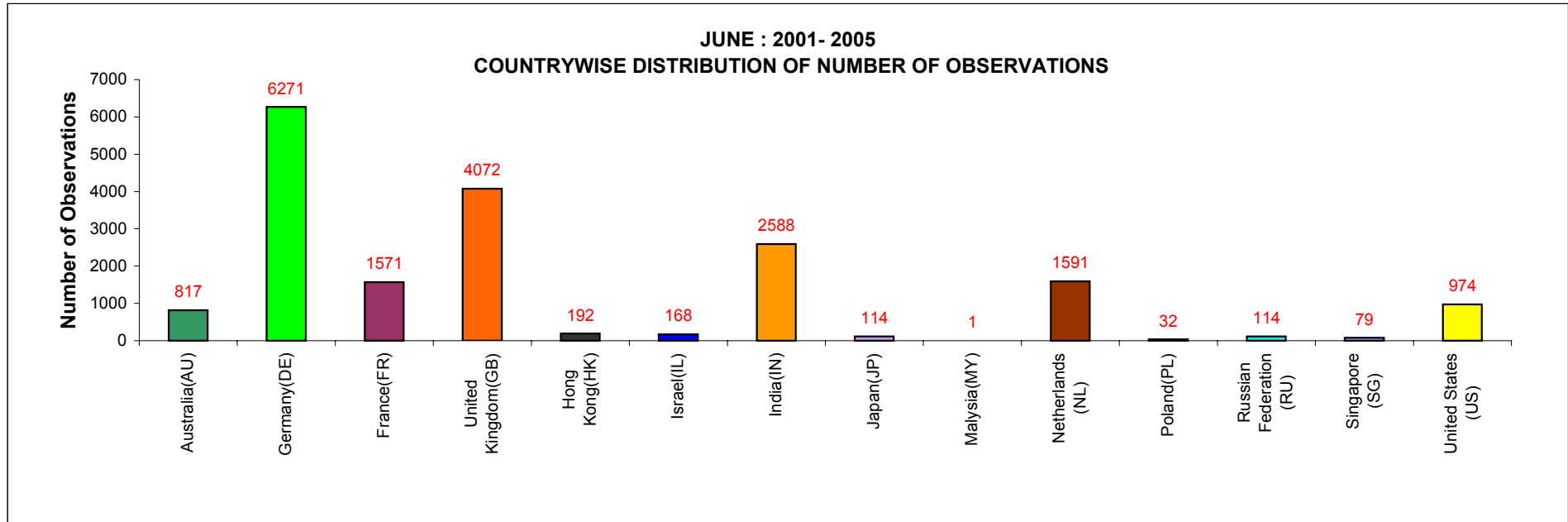


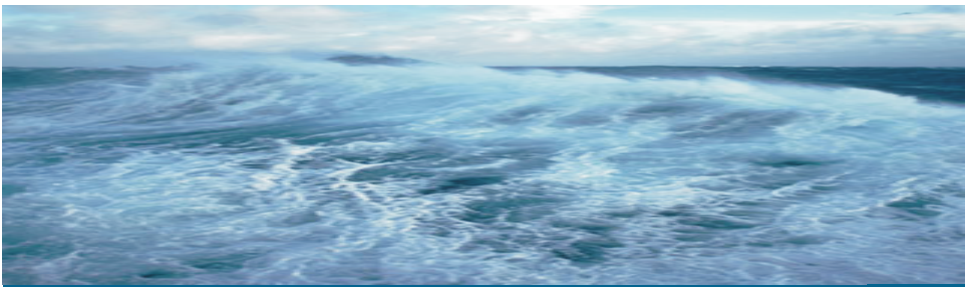












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CHARTS OF JULY 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

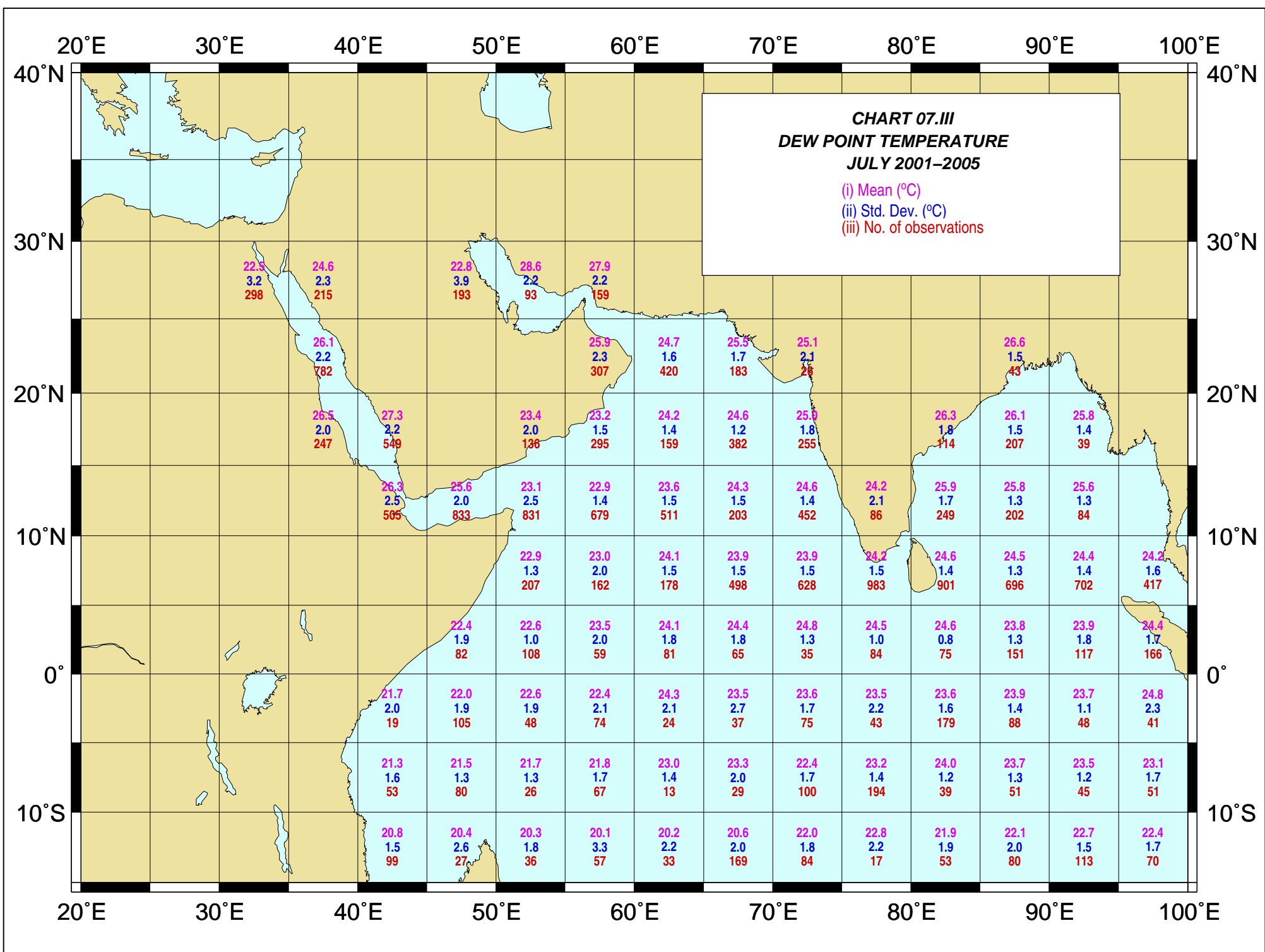
CHART - XVI : VISIBILITY

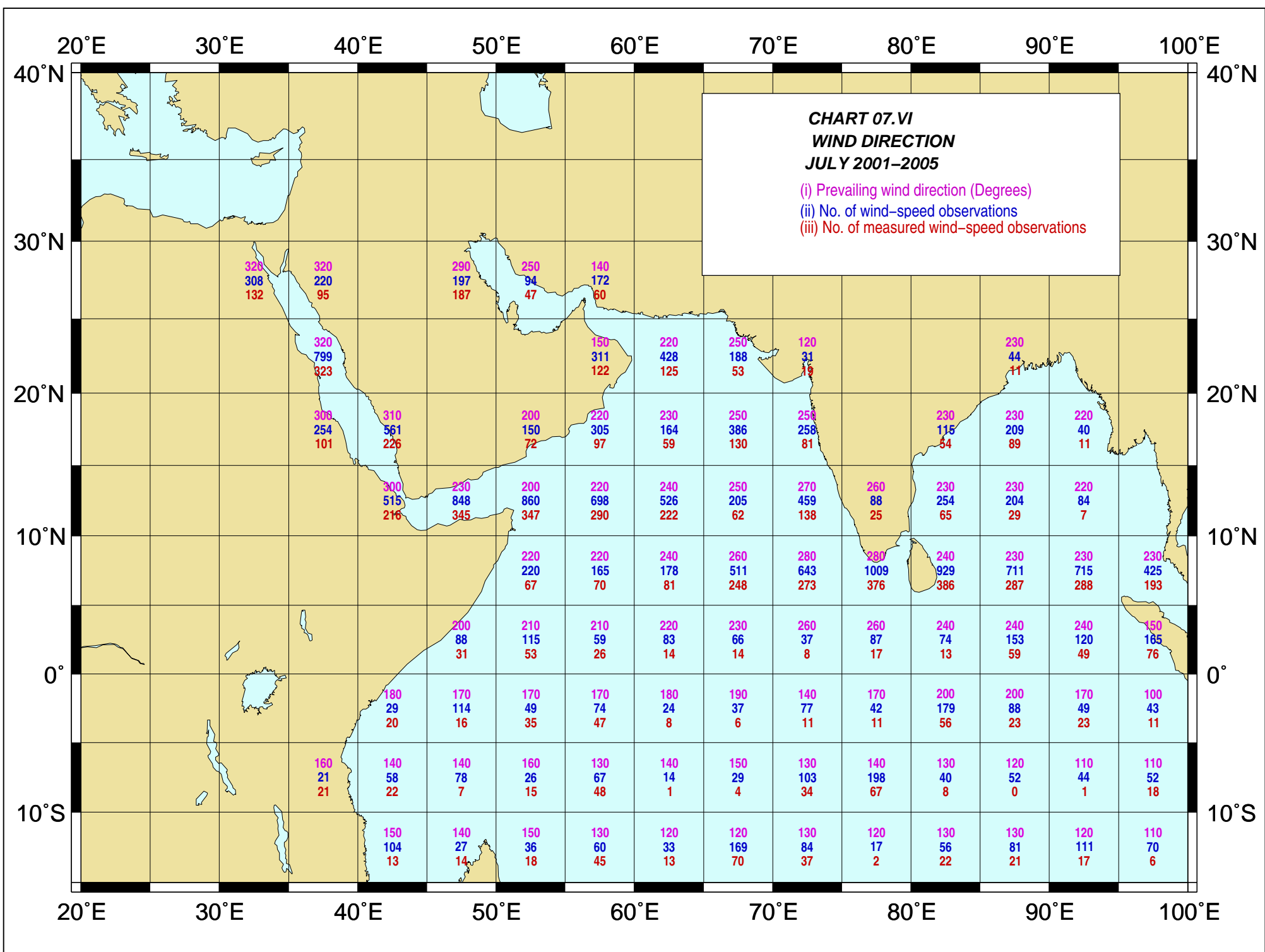
CHART - XVII : POSITION OF SHIP OBSERVATIONS

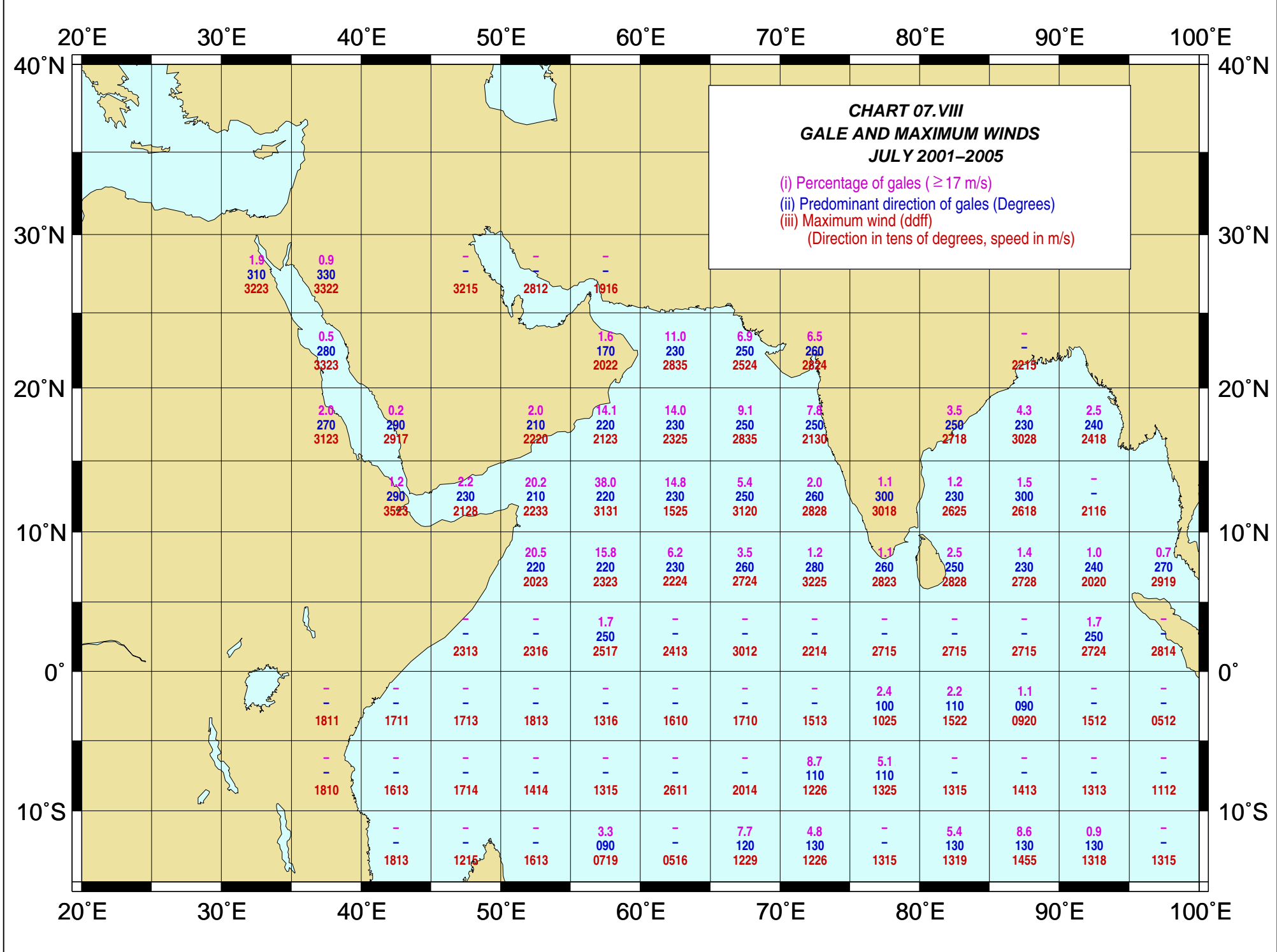
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

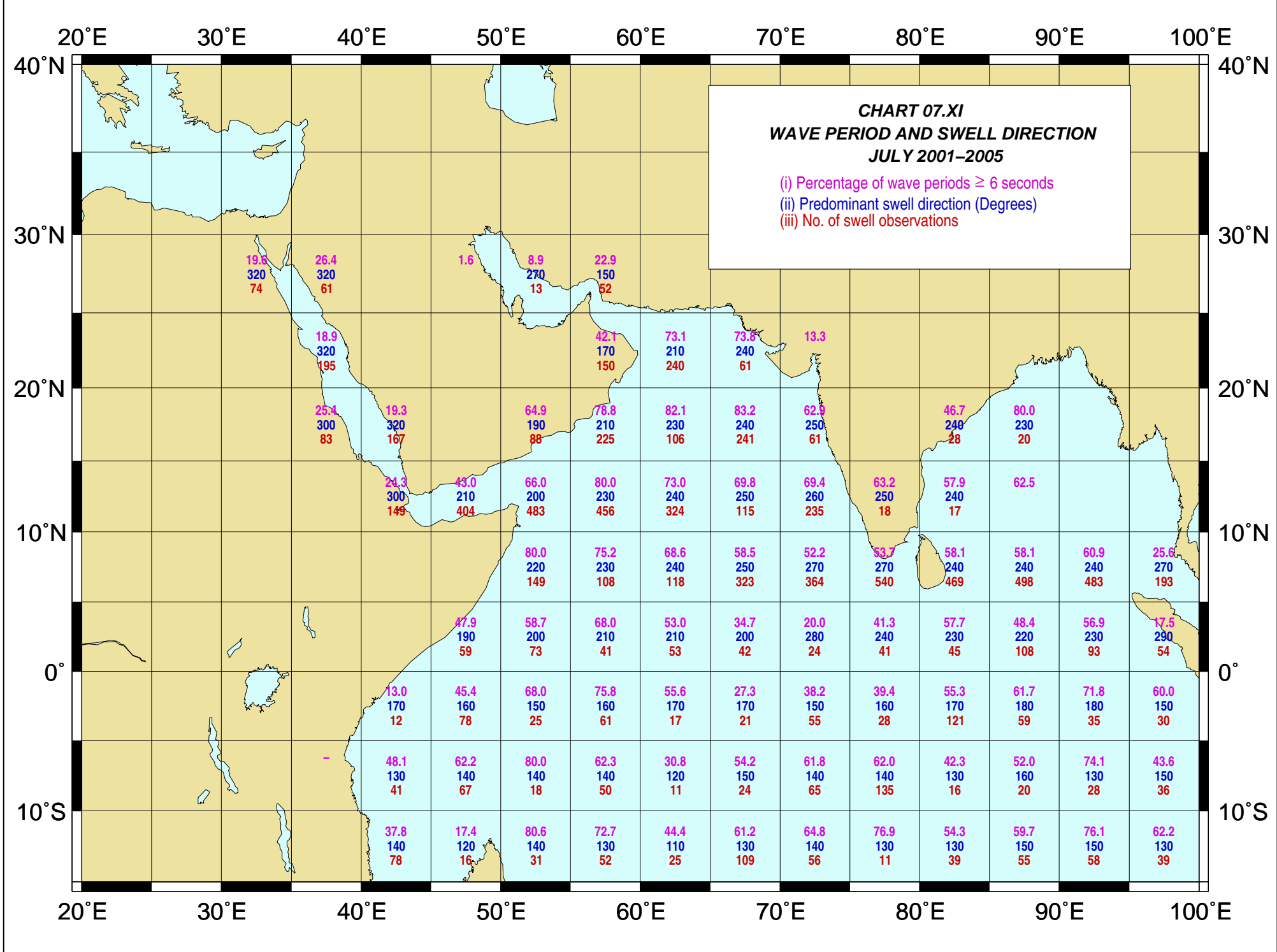
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

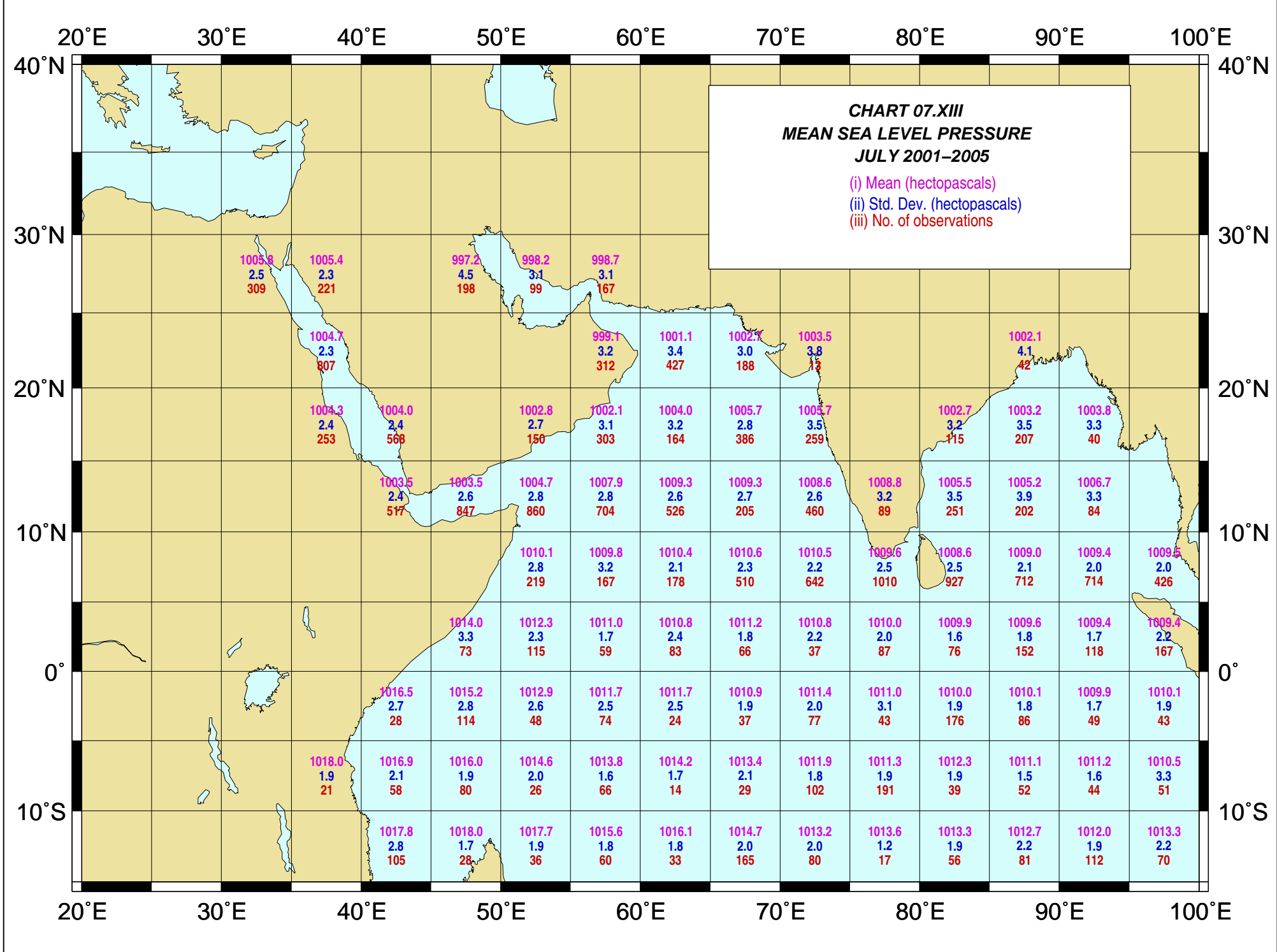
**COUNTRYWISE AND YEARWISE DISTRIBUTION
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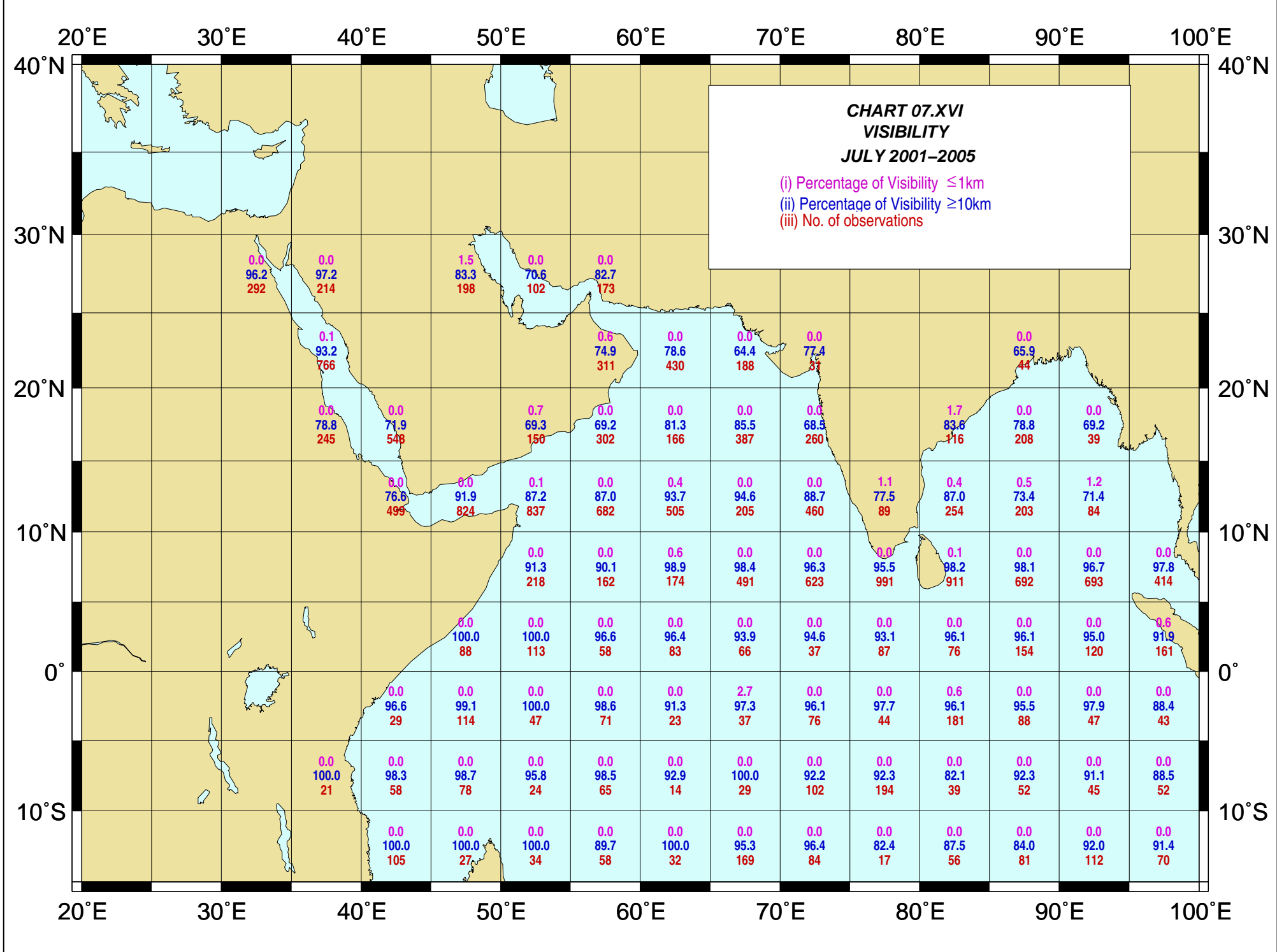


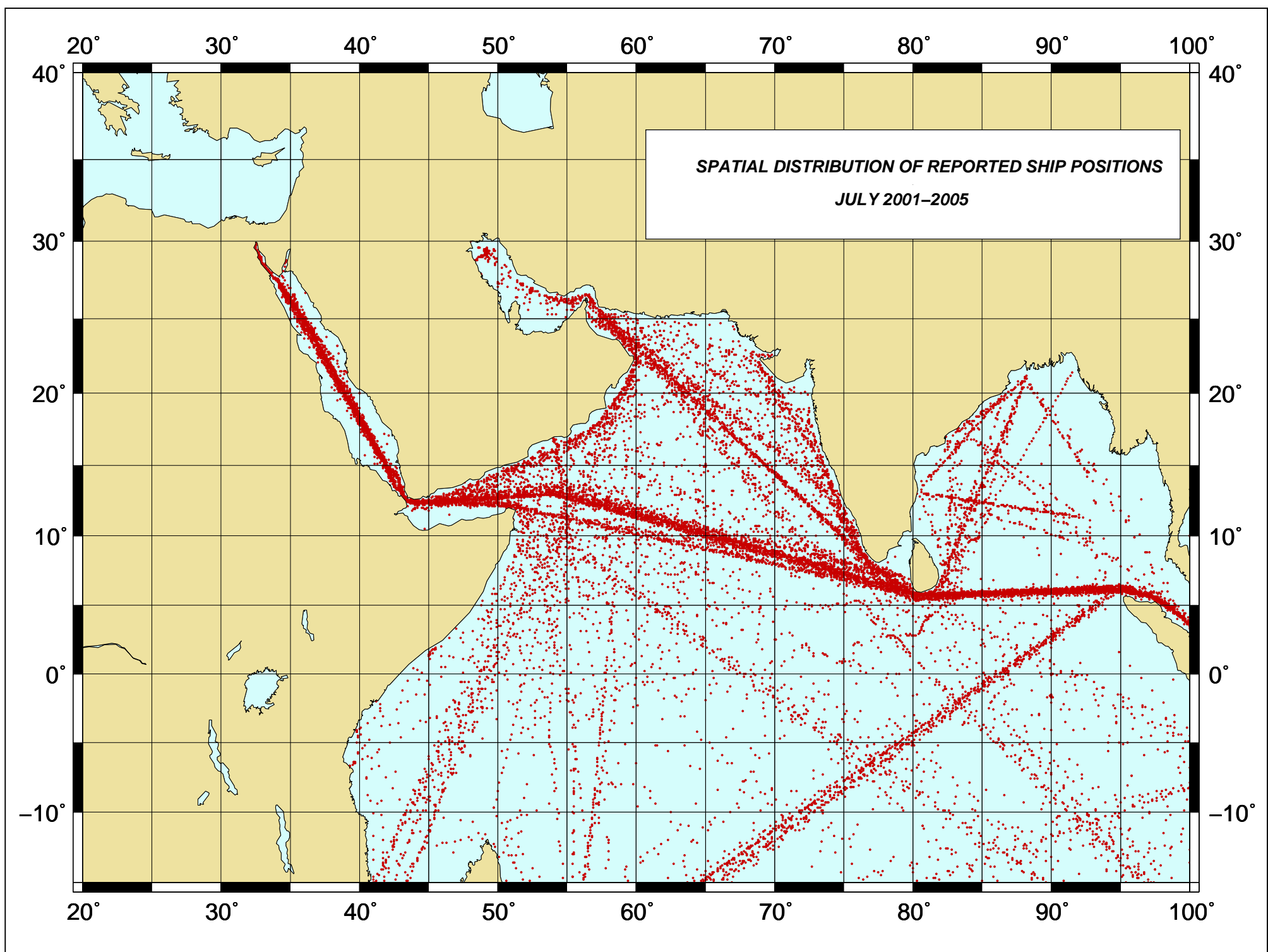




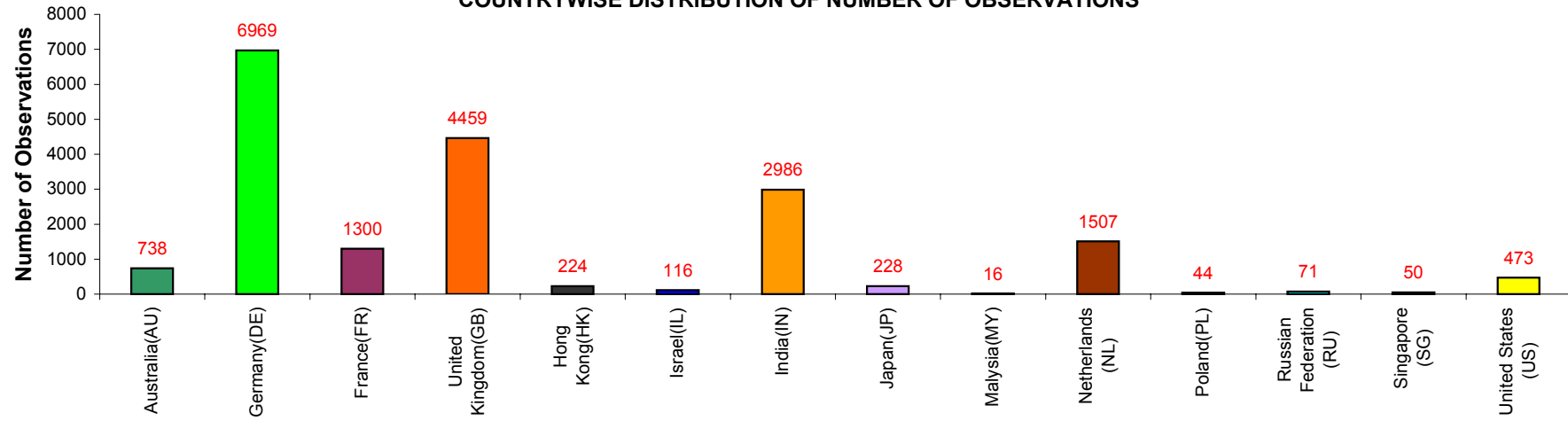




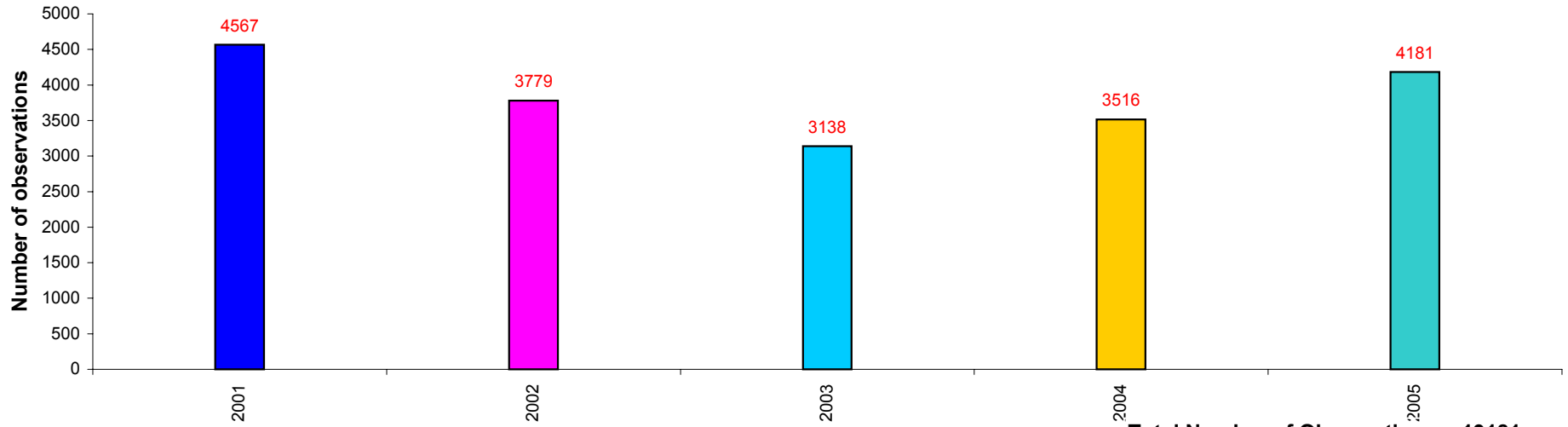




JULY : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



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CHARTS OF AUGUST 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

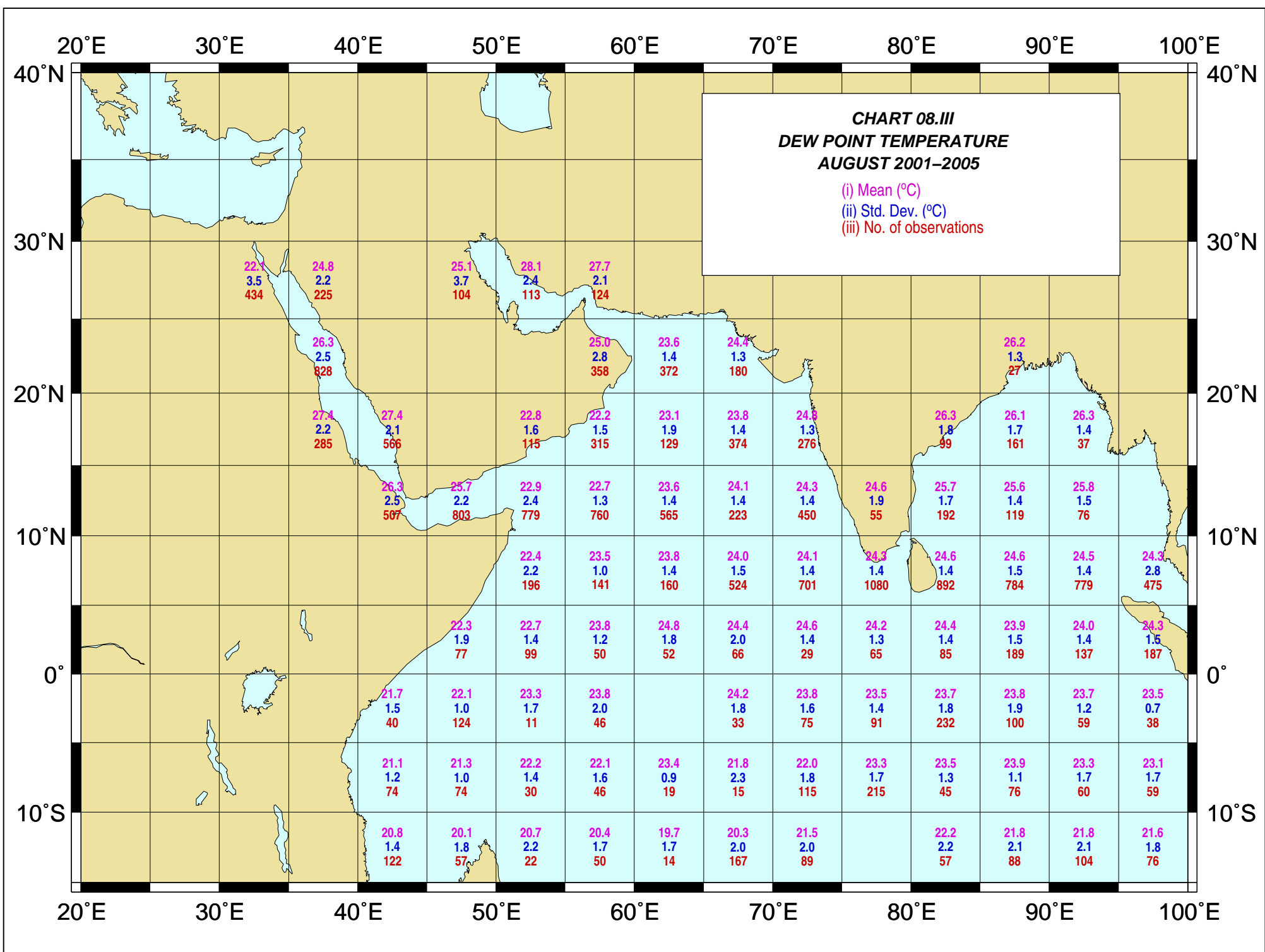
CHART - XVI : VISIBILITY

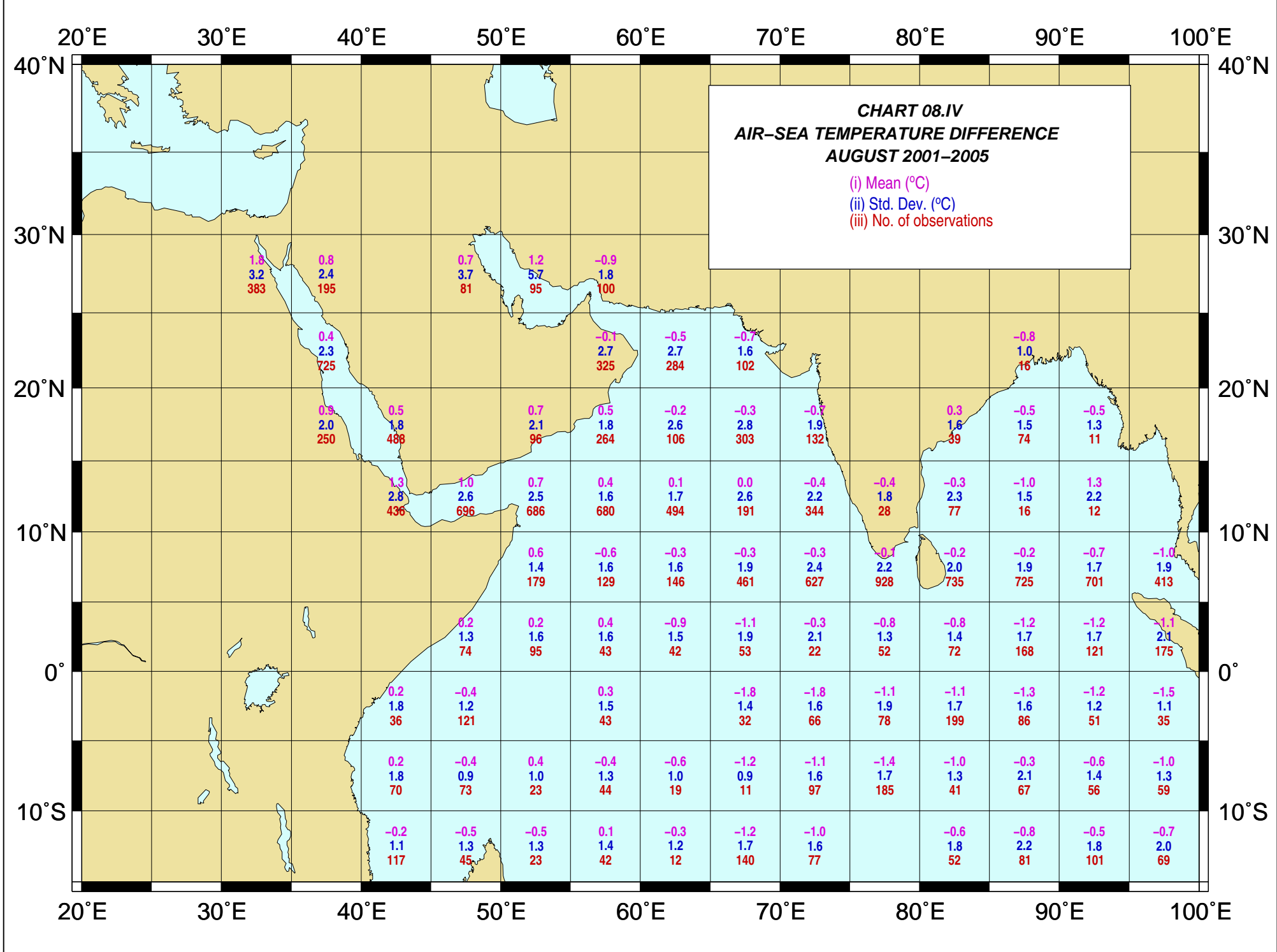
CHART - XVII : POSITION OF SHIP OBSERVATIONS

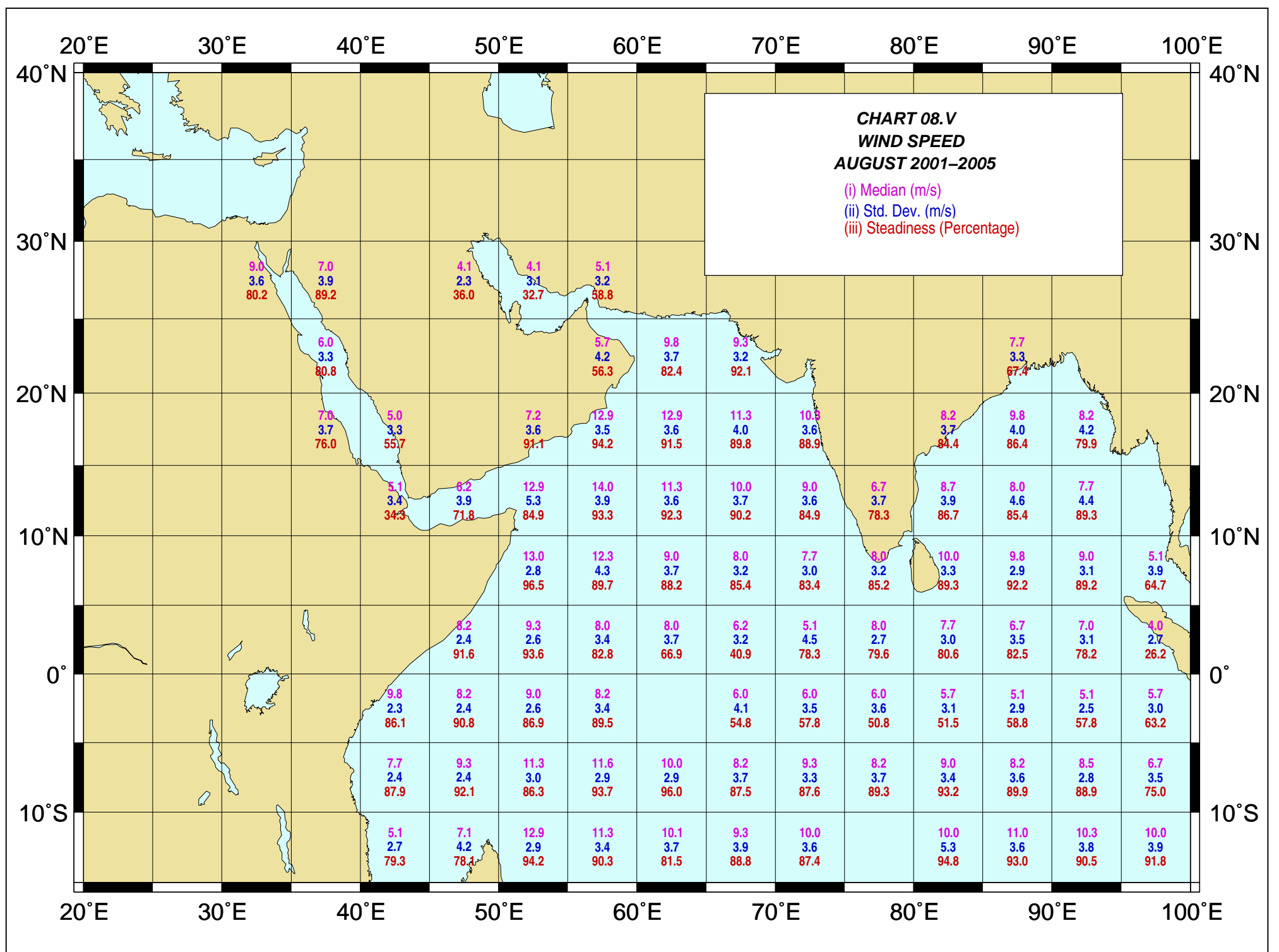
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**







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3.2
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56.3

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3.7
82.4

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3.2
92.1

7.7
3.3
67.4

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80.8

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3.7
76.0

5.0
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91.1

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94.2

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91.5

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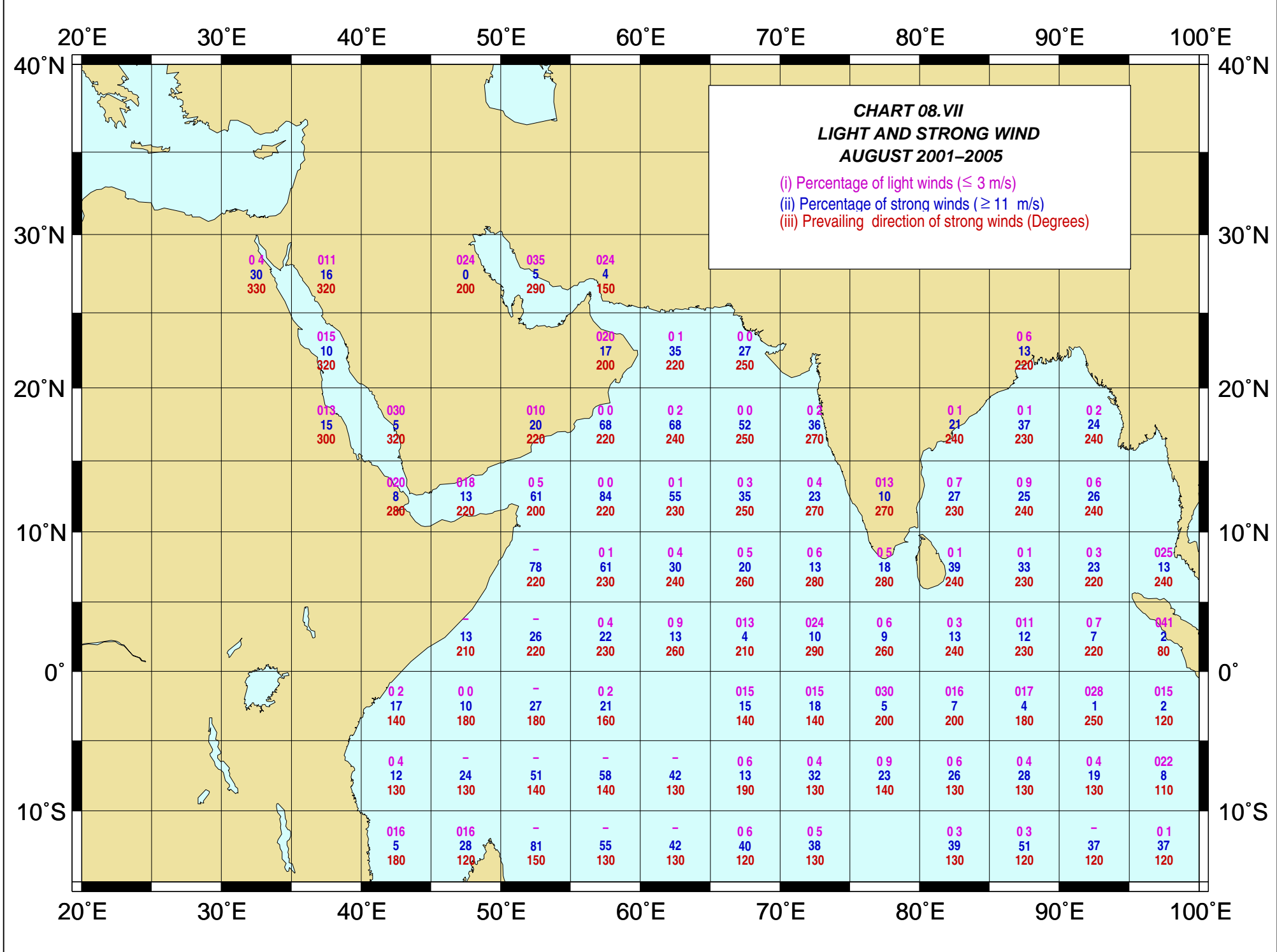
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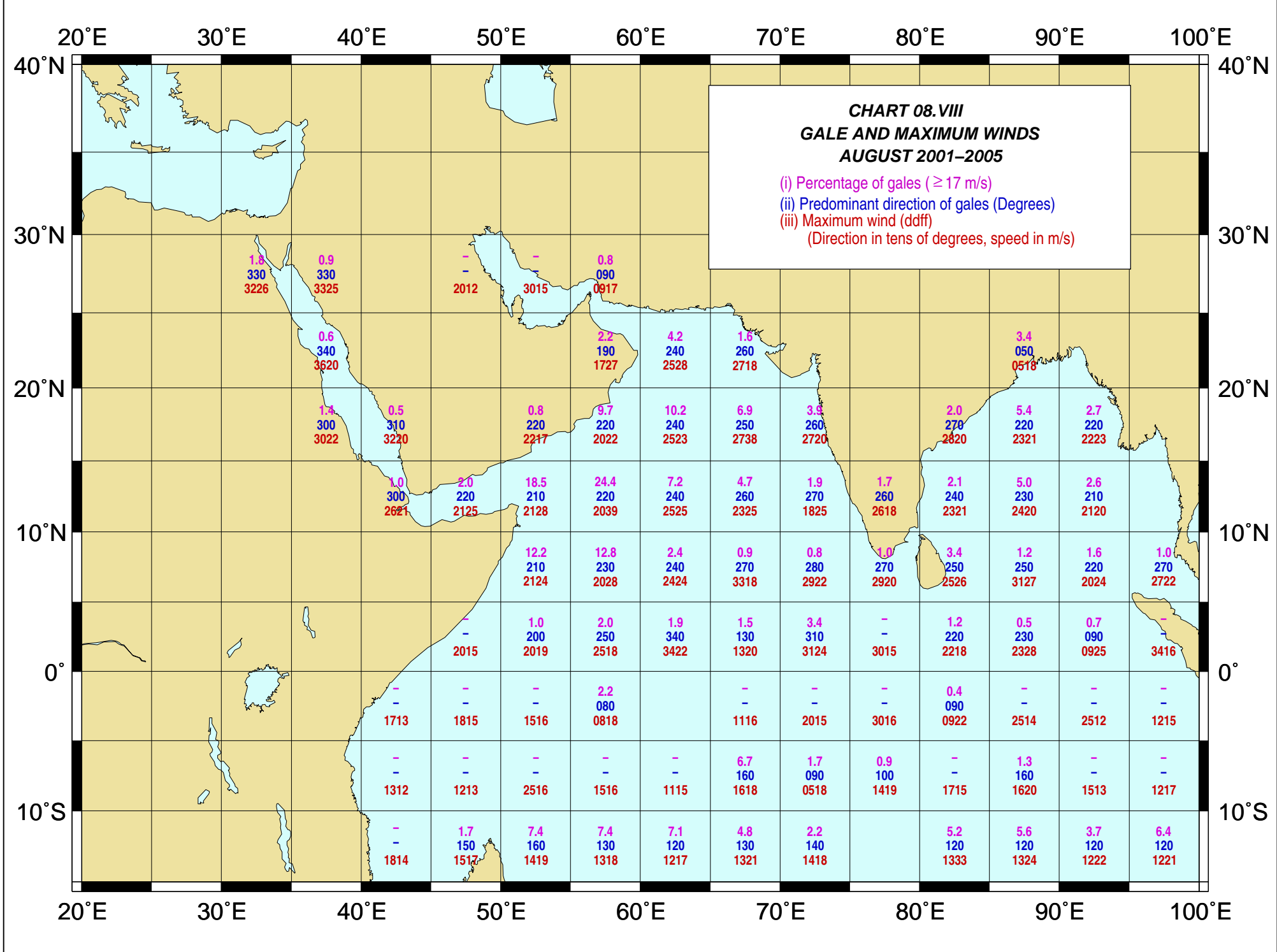
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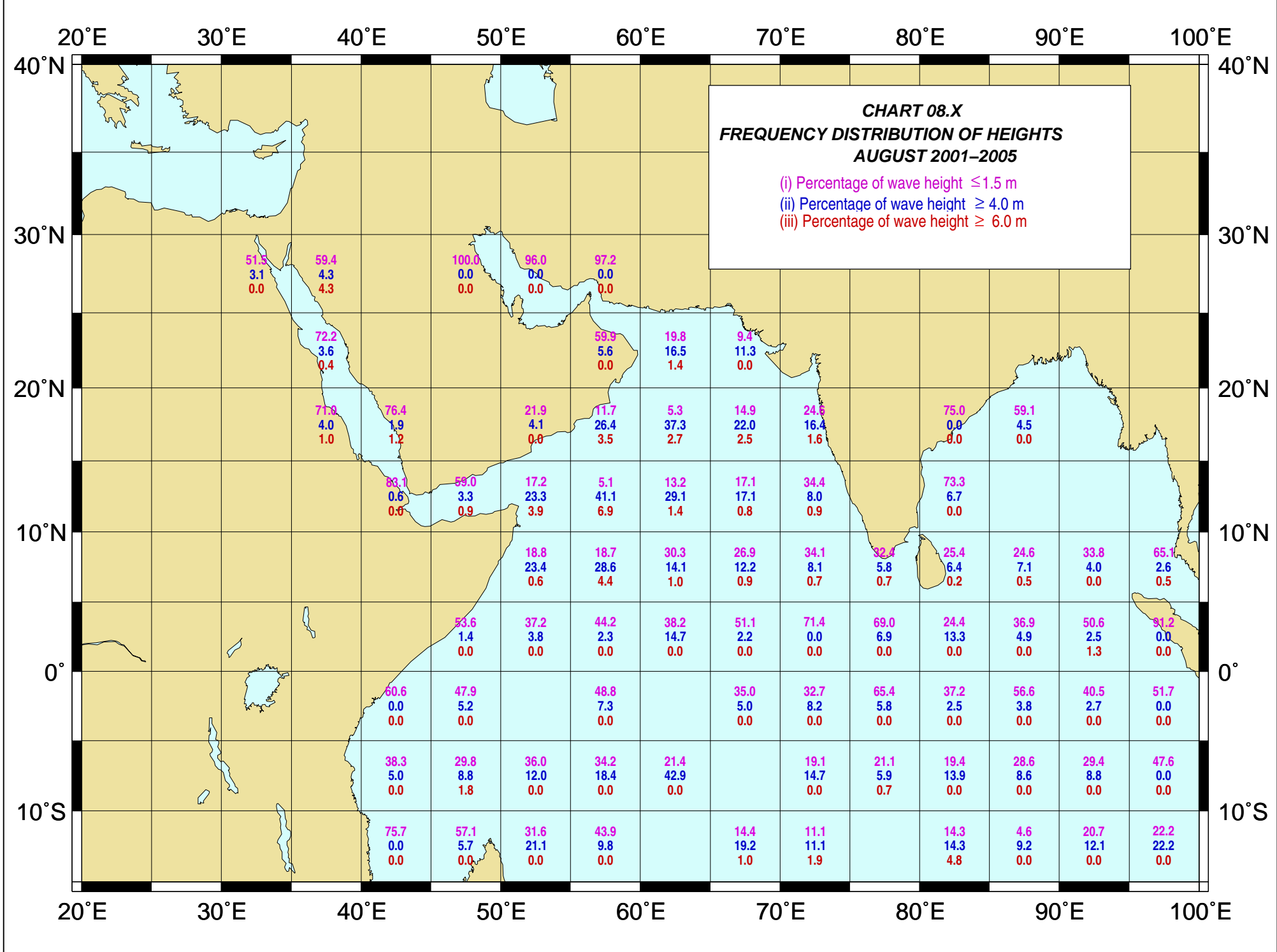
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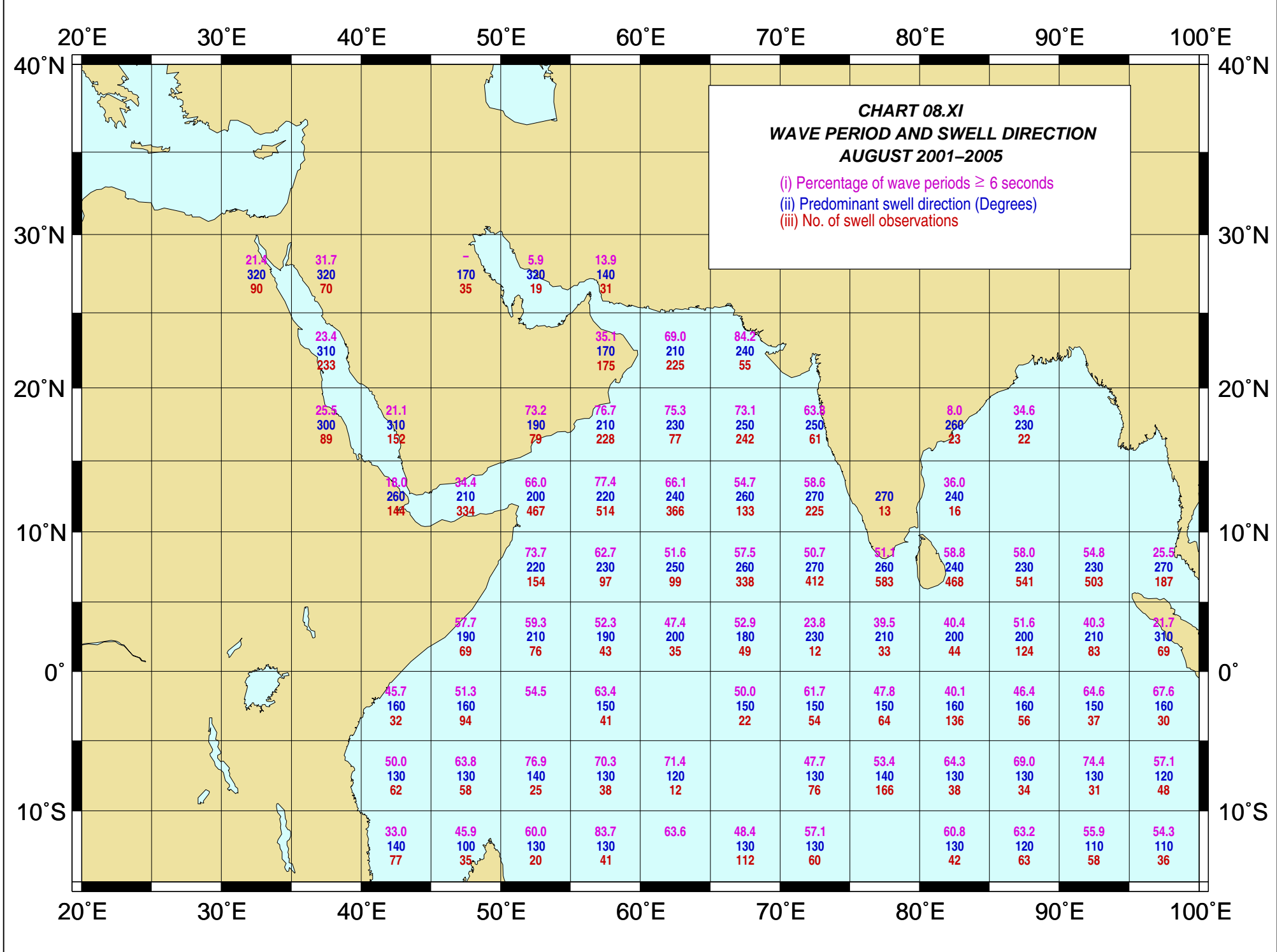
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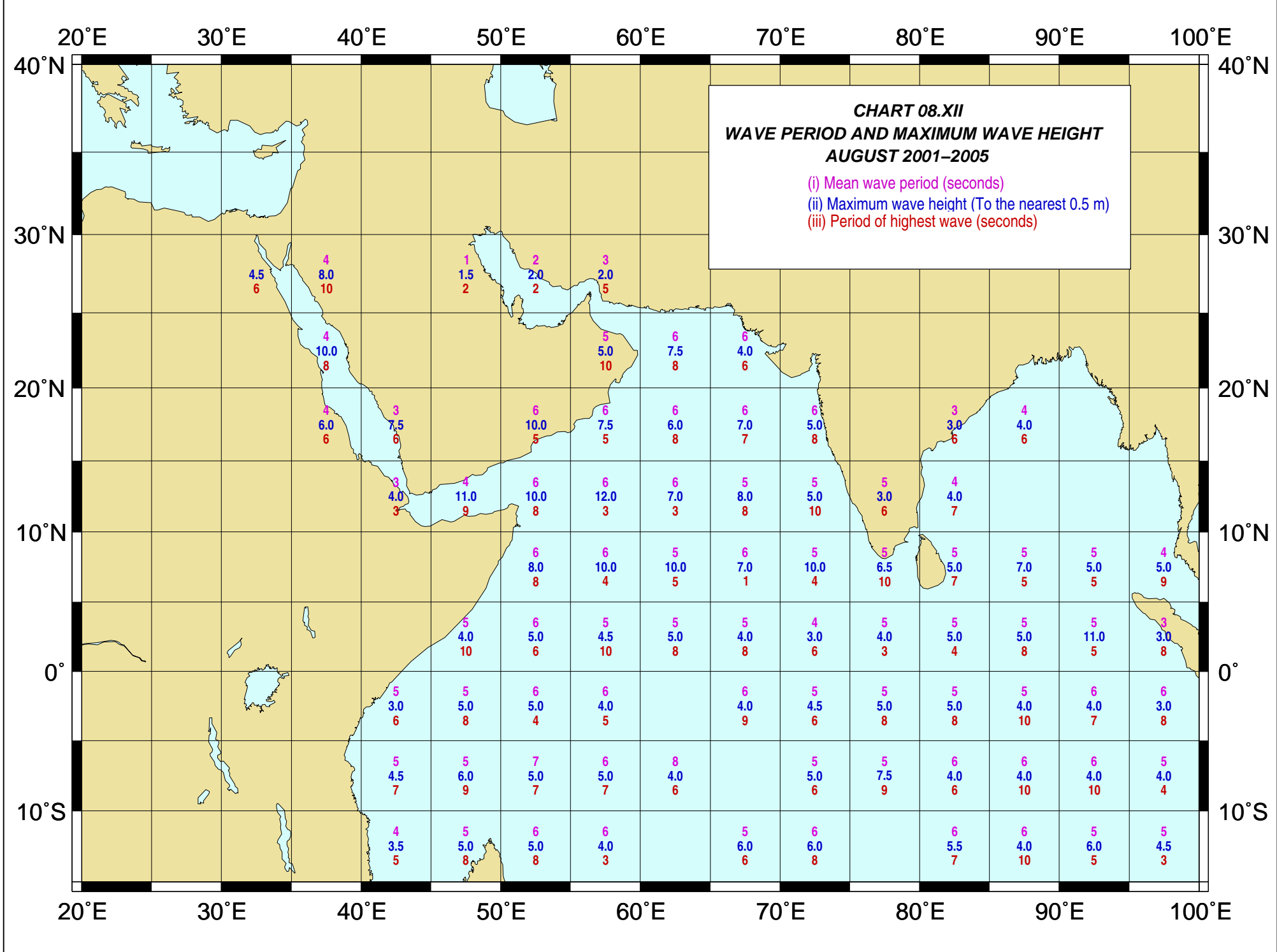
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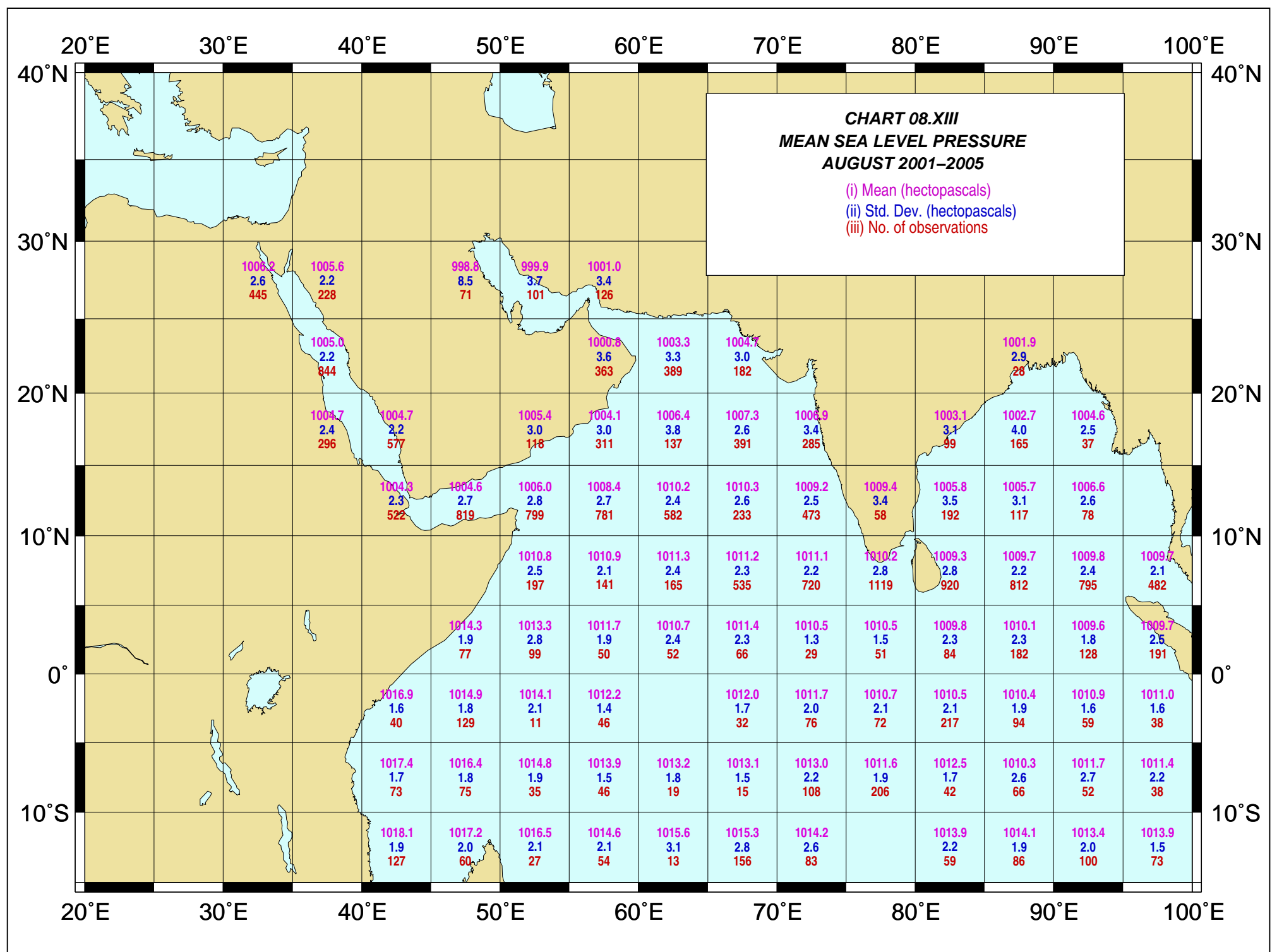


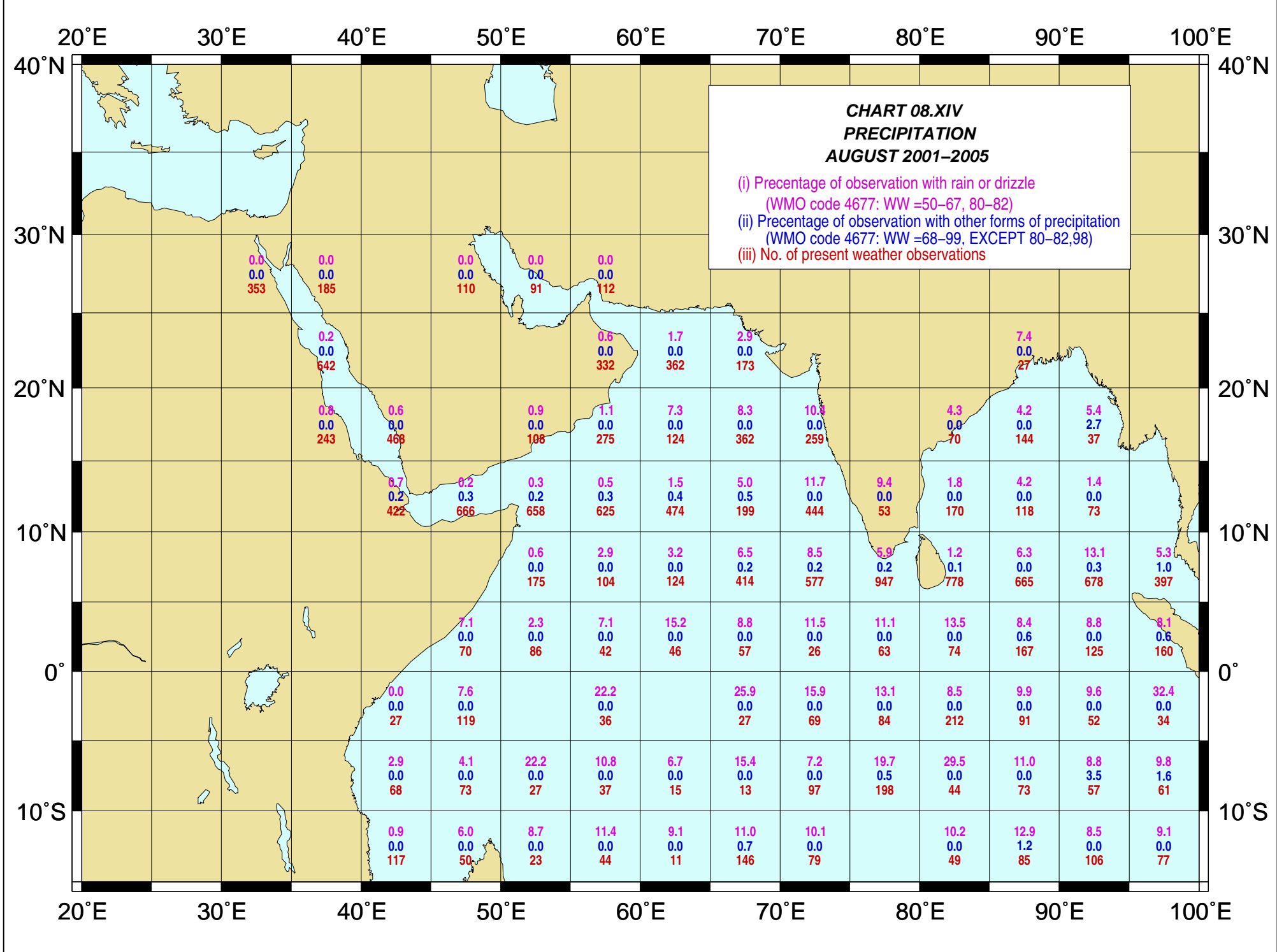


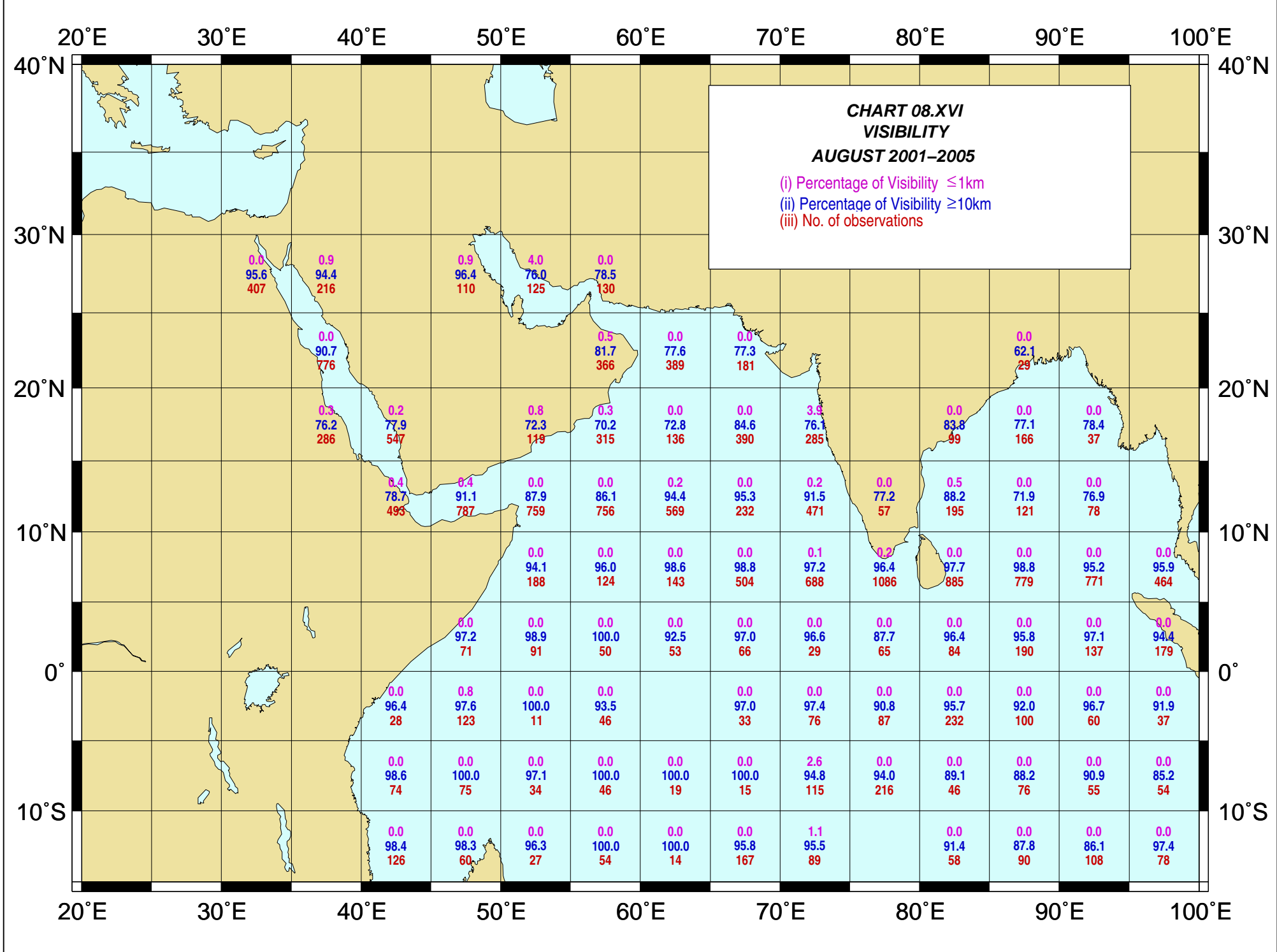


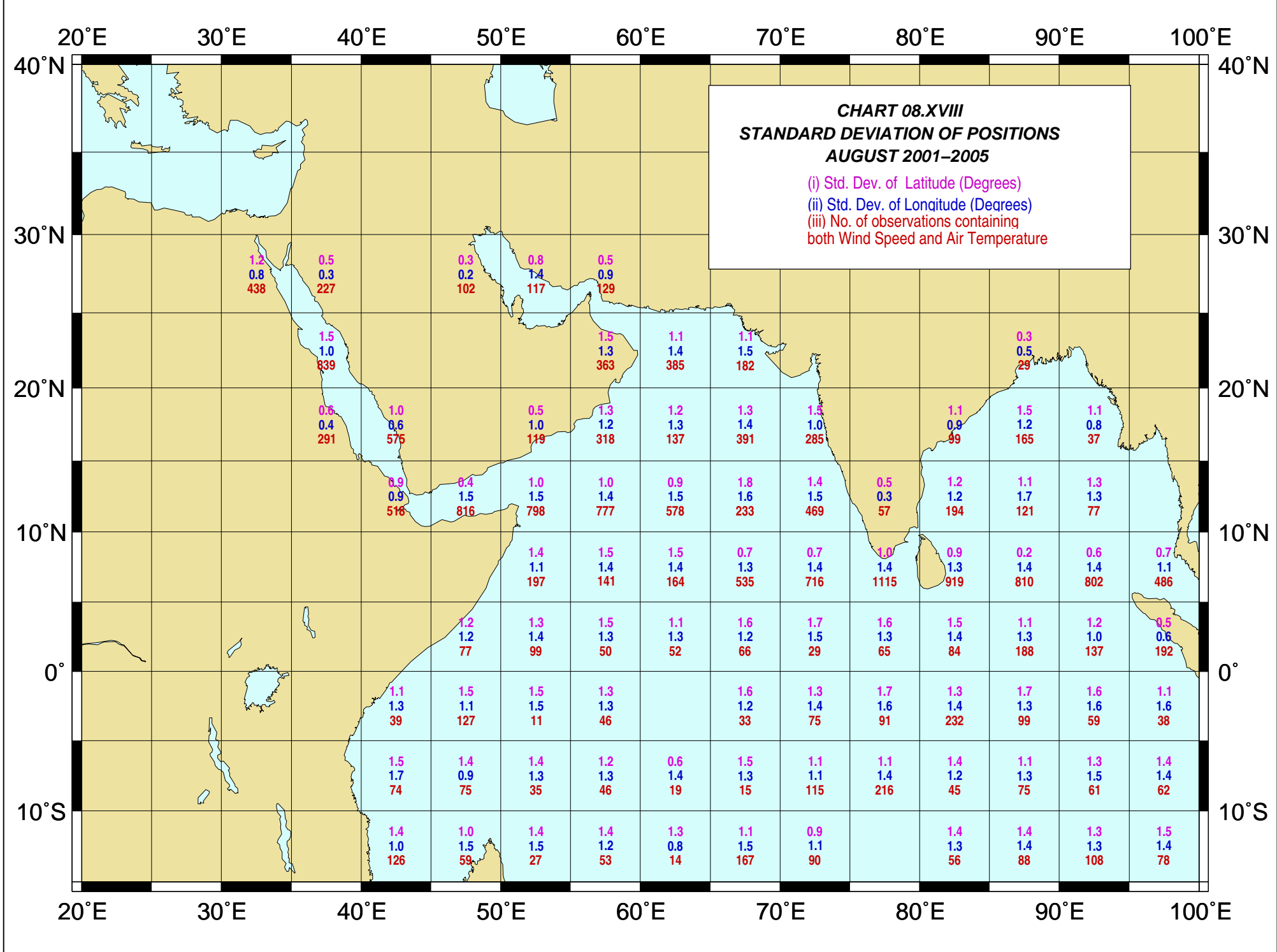


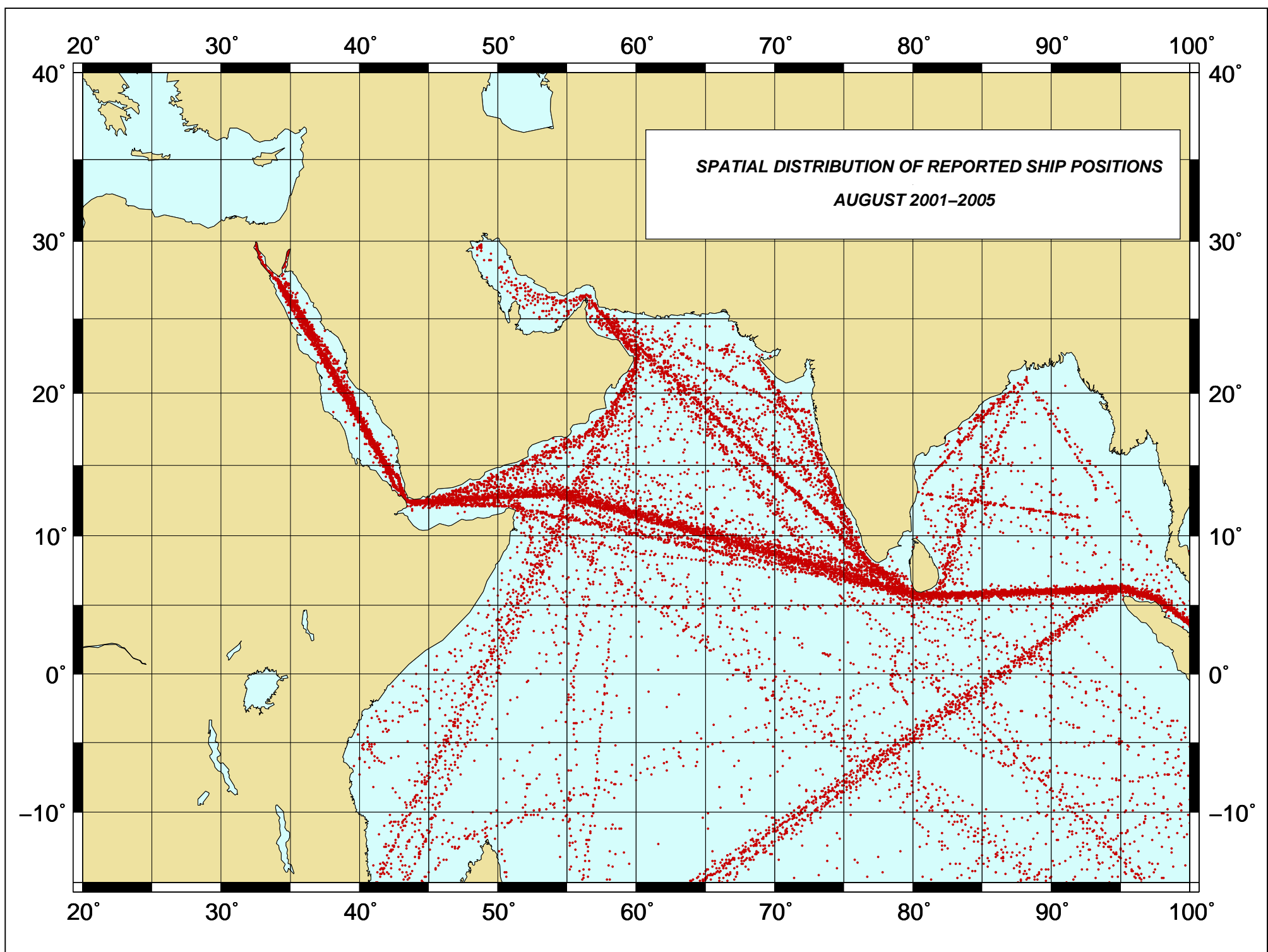




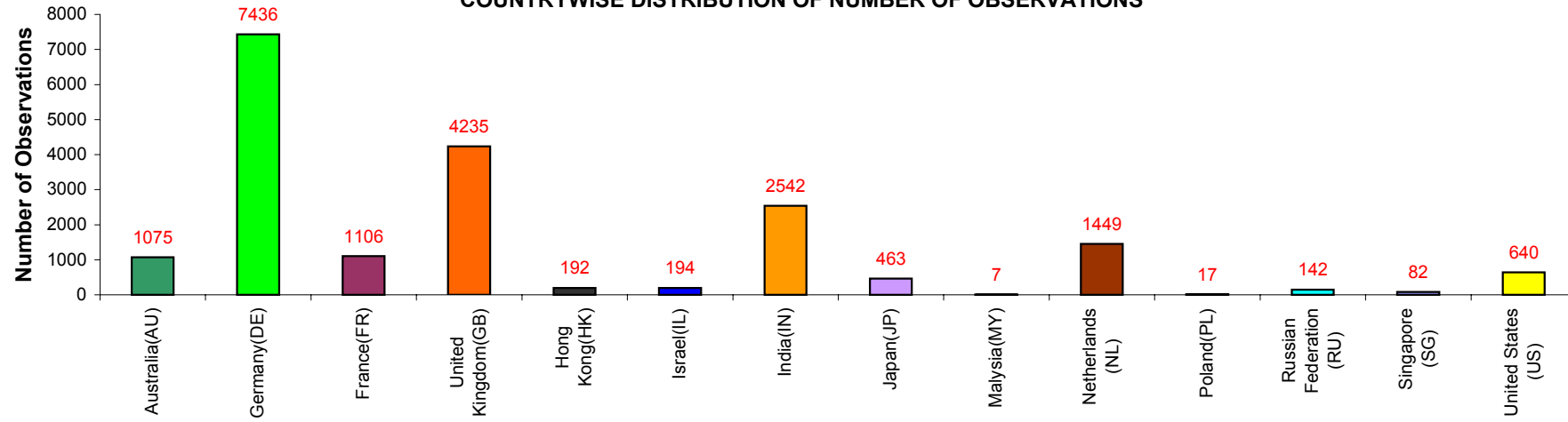




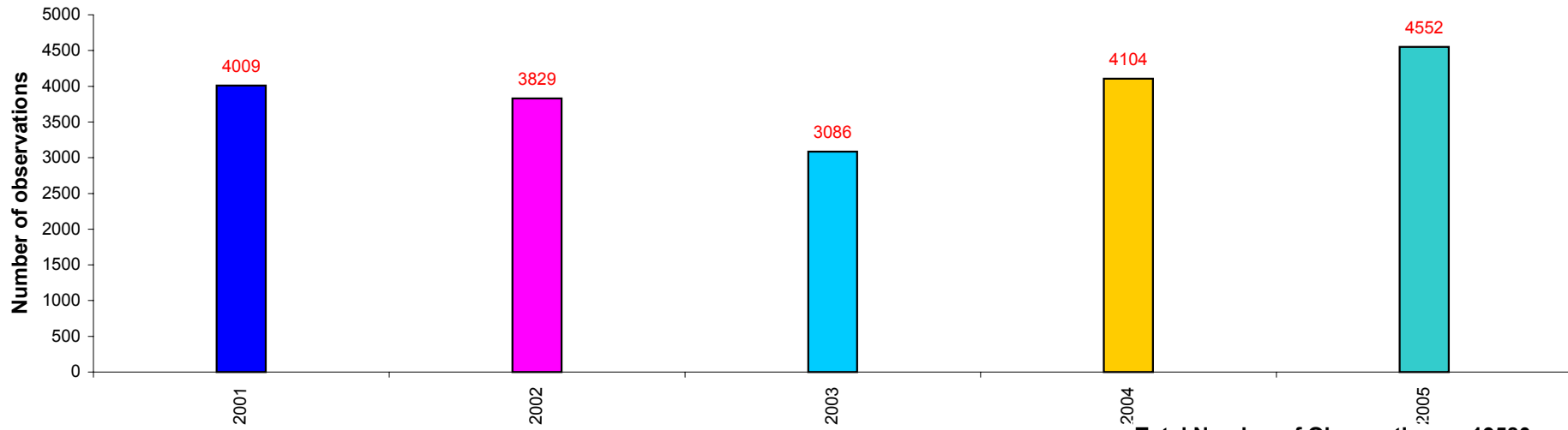




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CHARTS OF SEPTEMBER 2001 - 2005

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CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

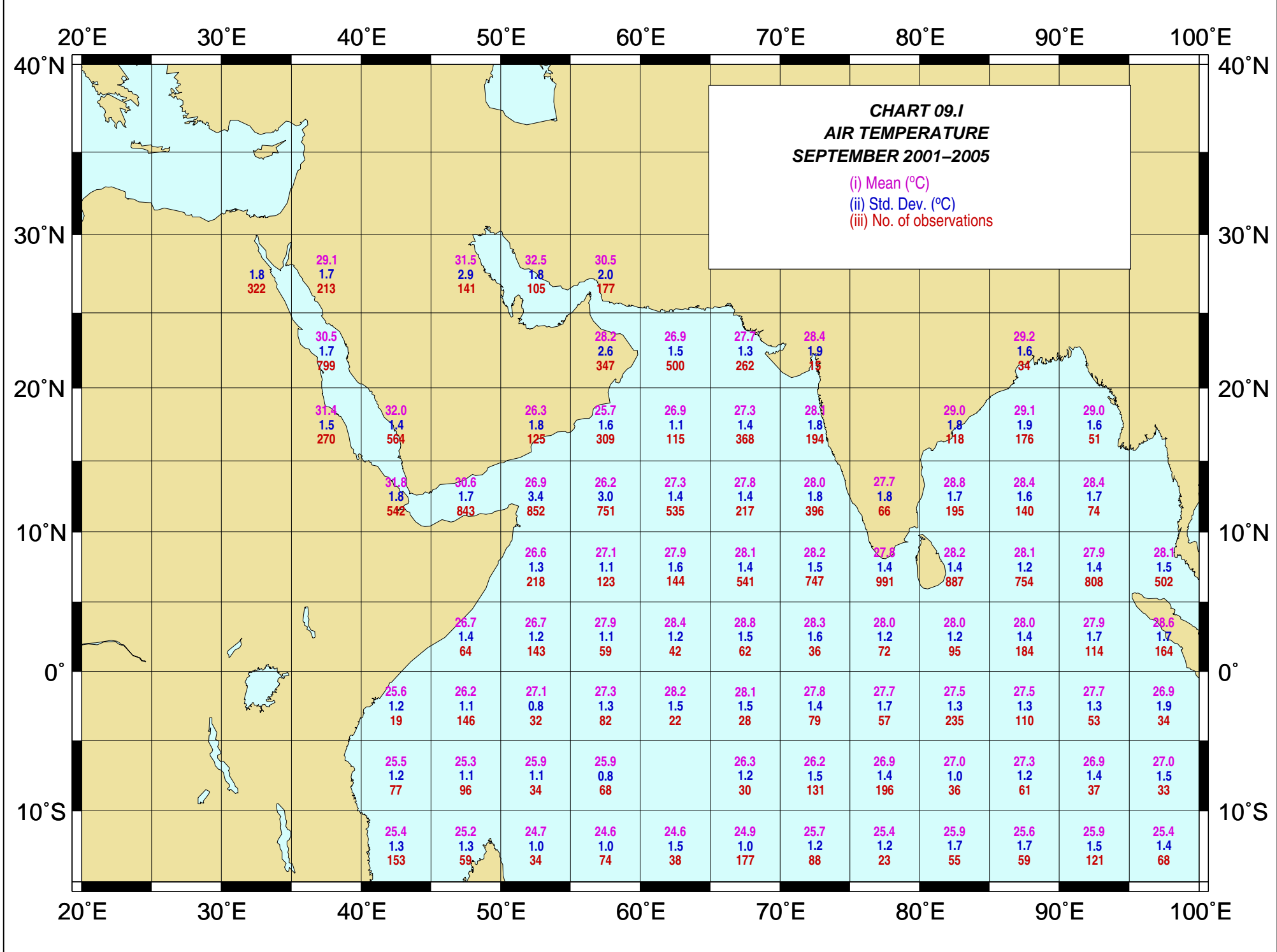
CHART - XVI : VISIBILITY

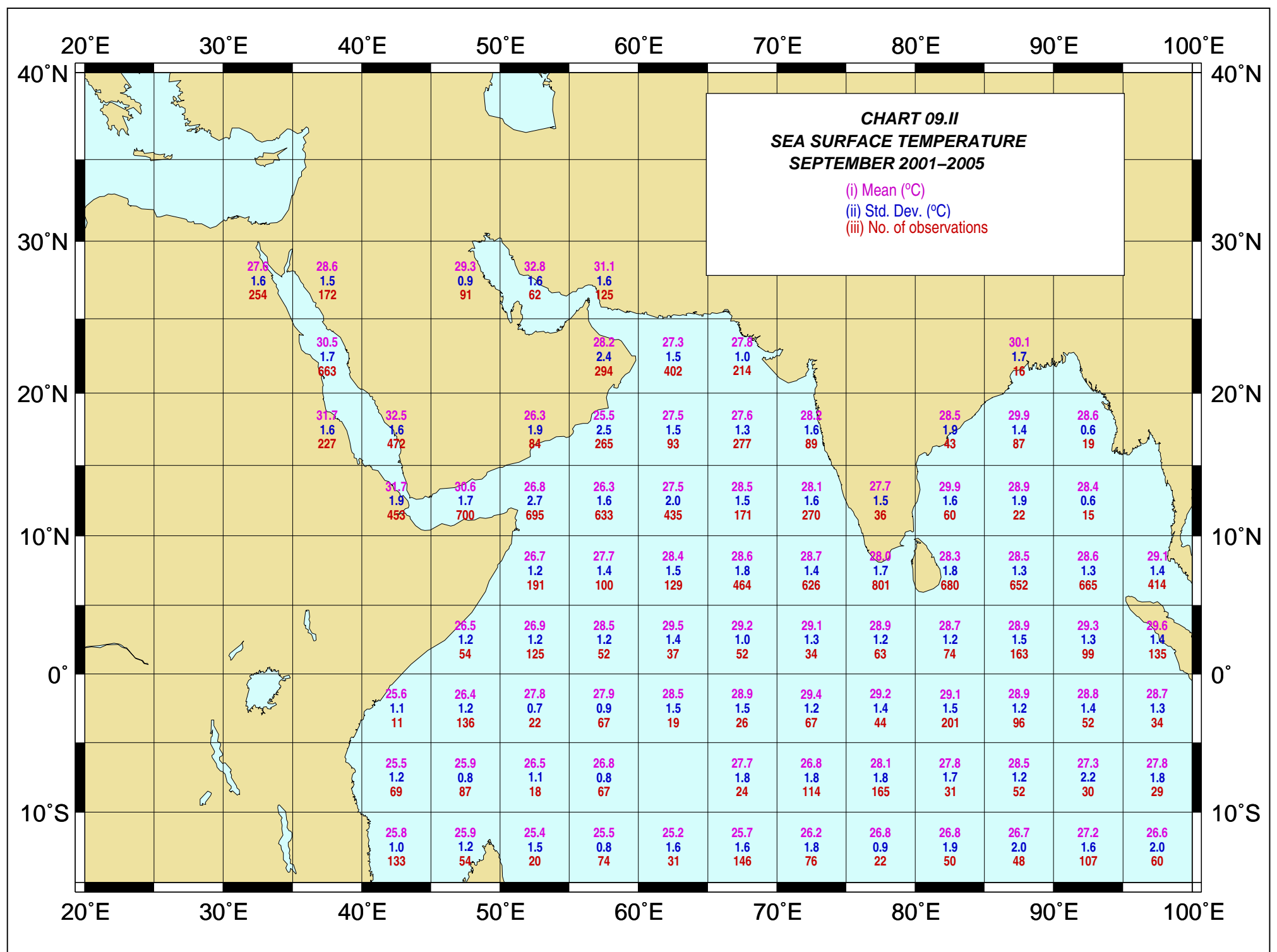
CHART - XVII : POSITION OF SHIP OBSERVATIONS

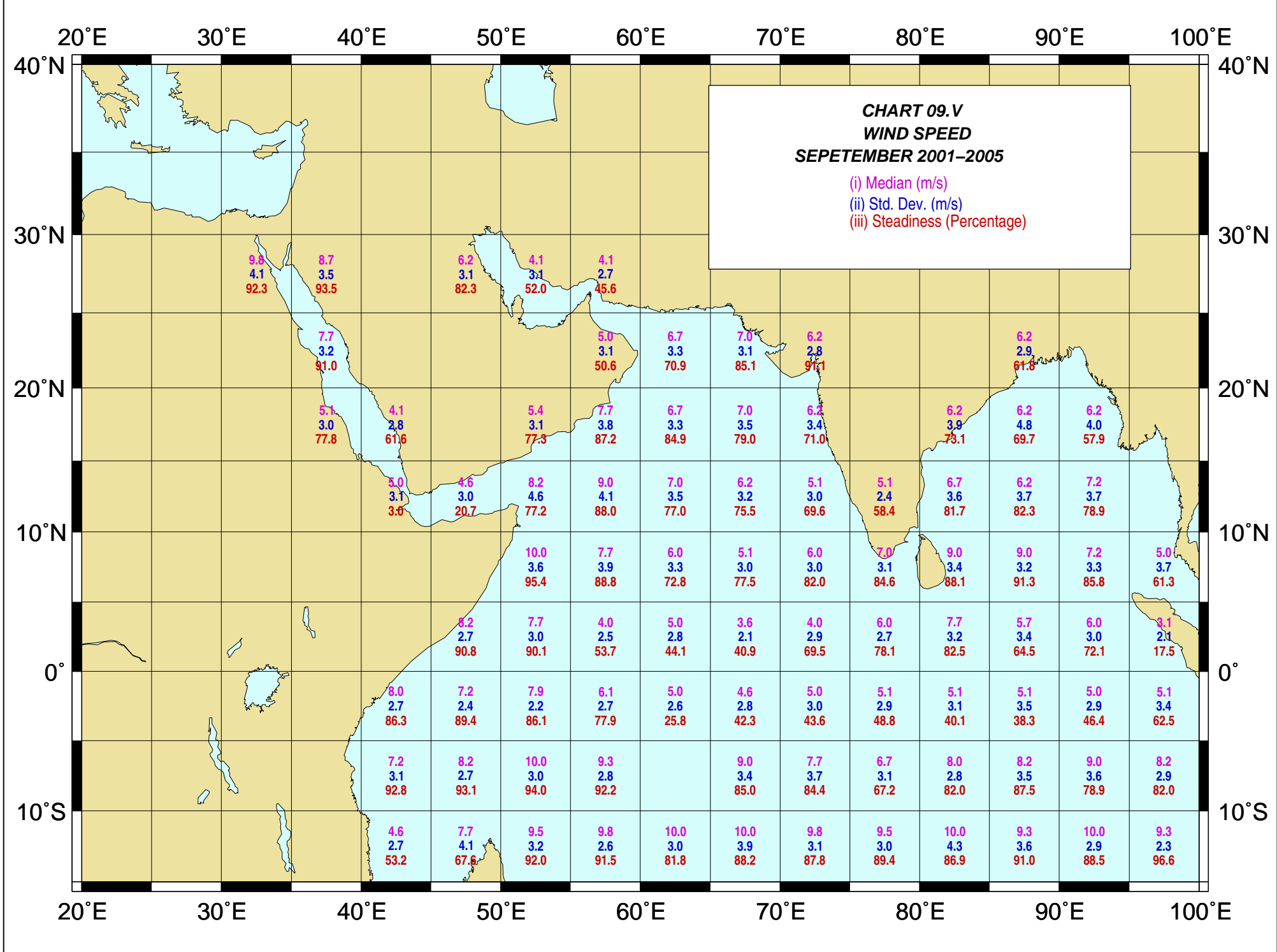
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

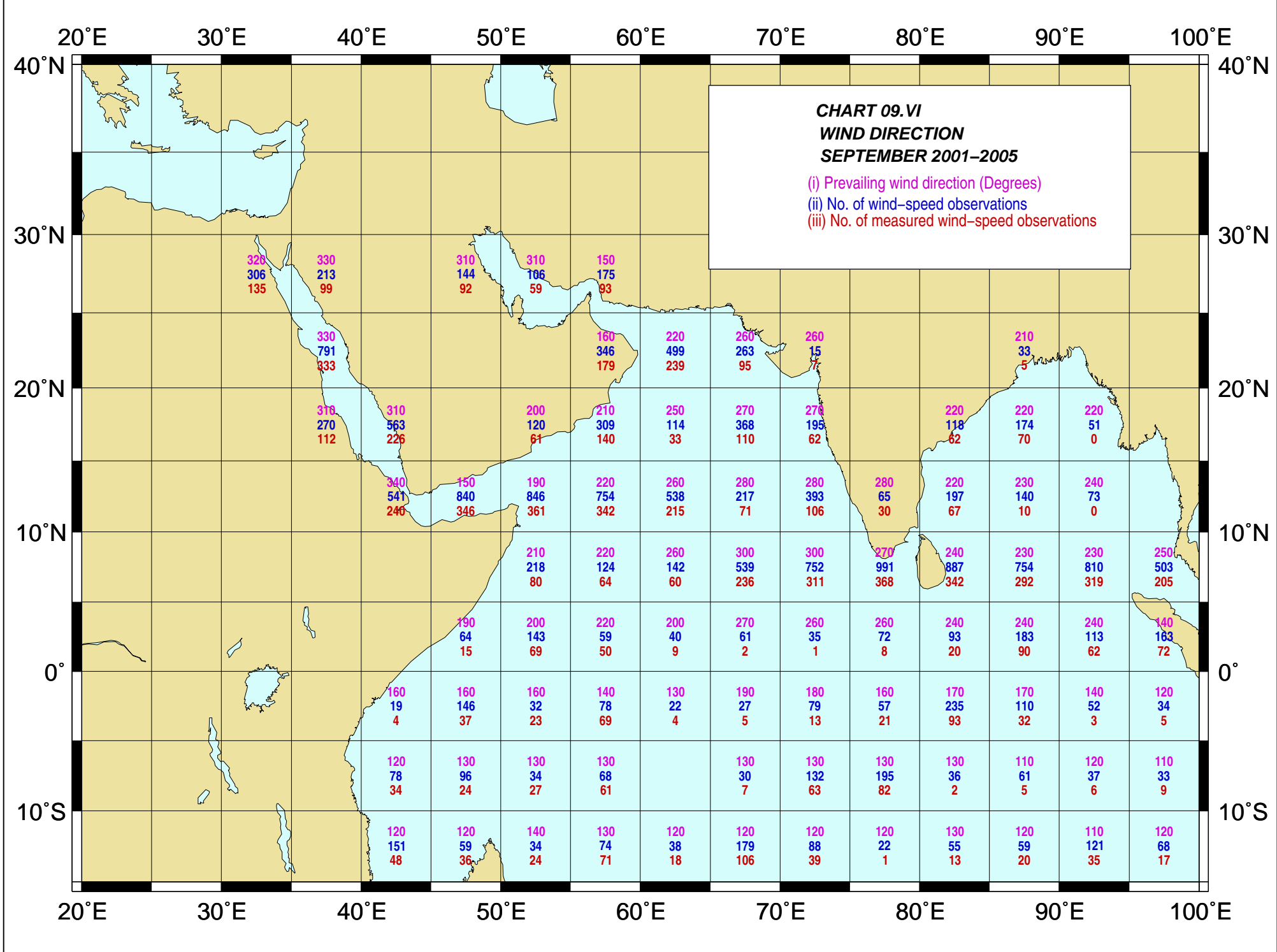
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

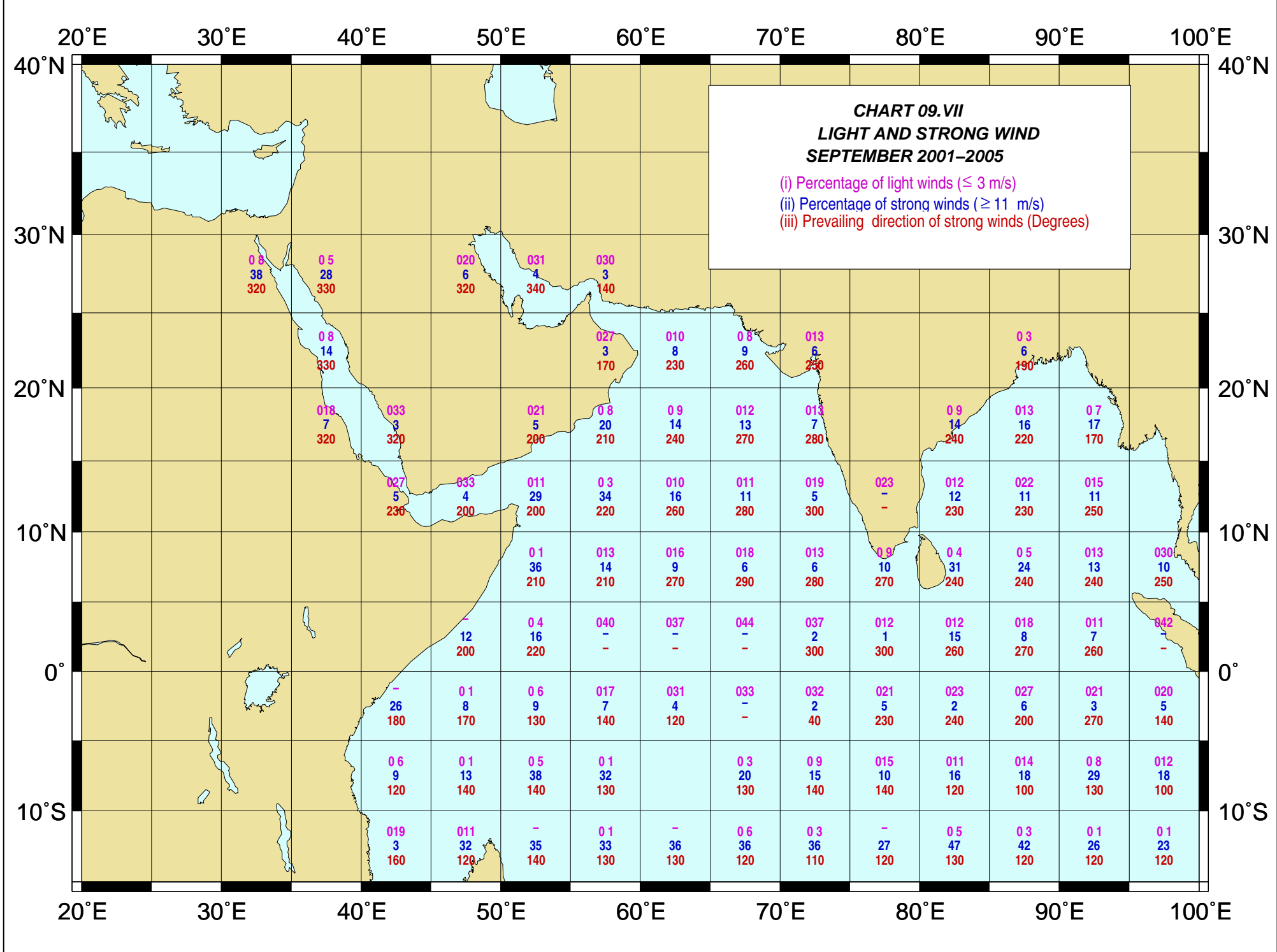
**COUNTRYWISE AND YEARWISE DISTRIBUTION
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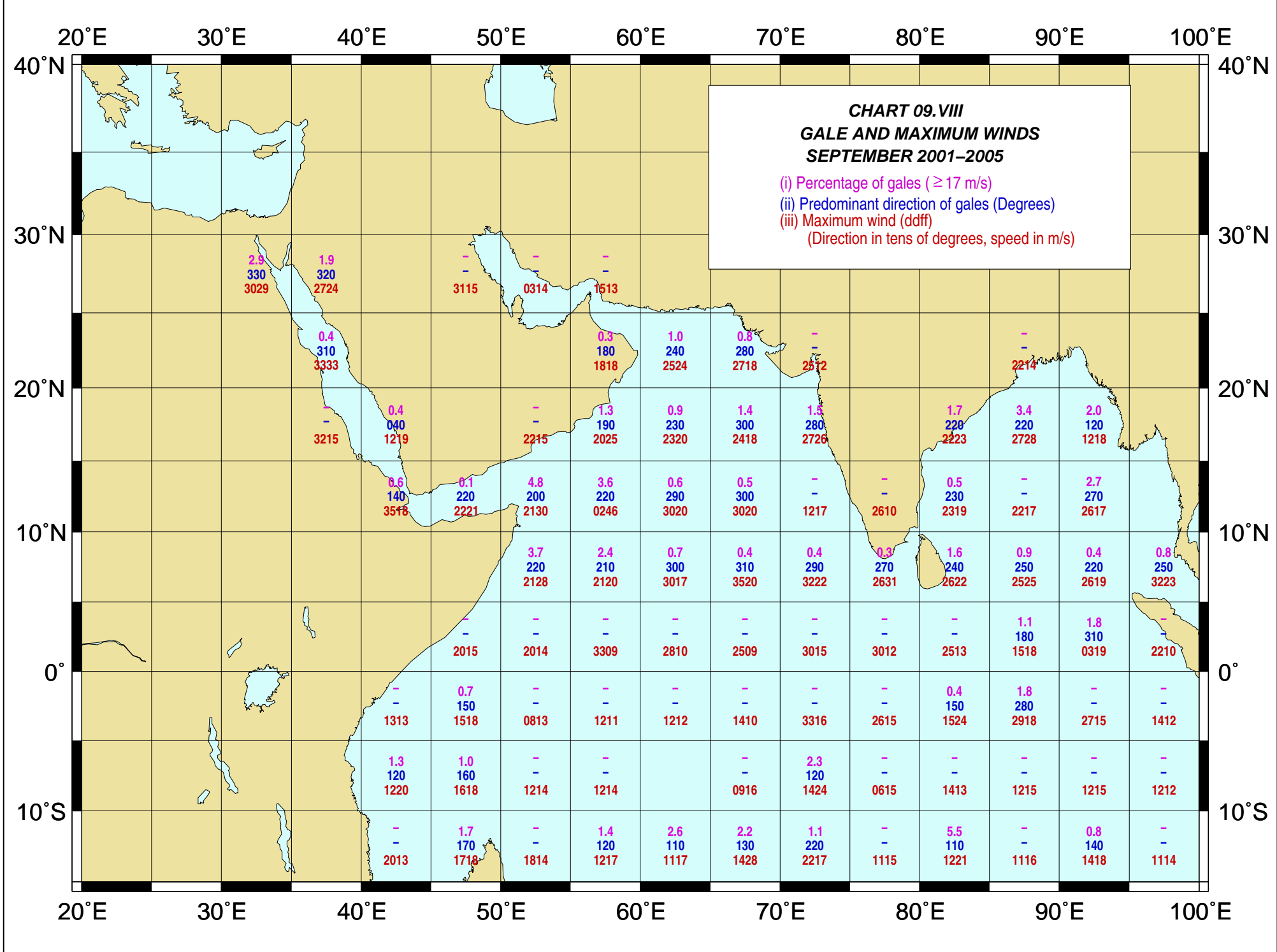


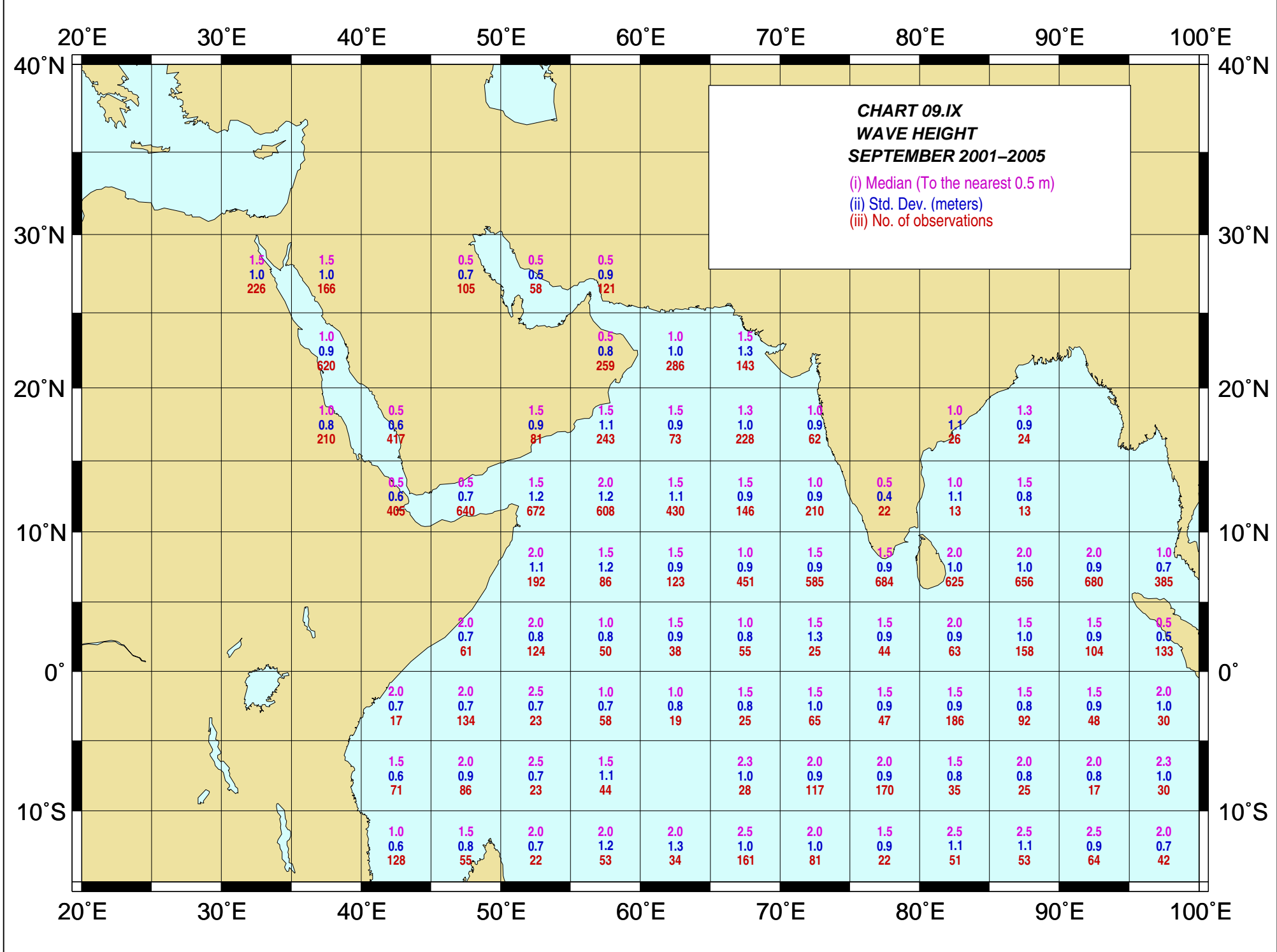


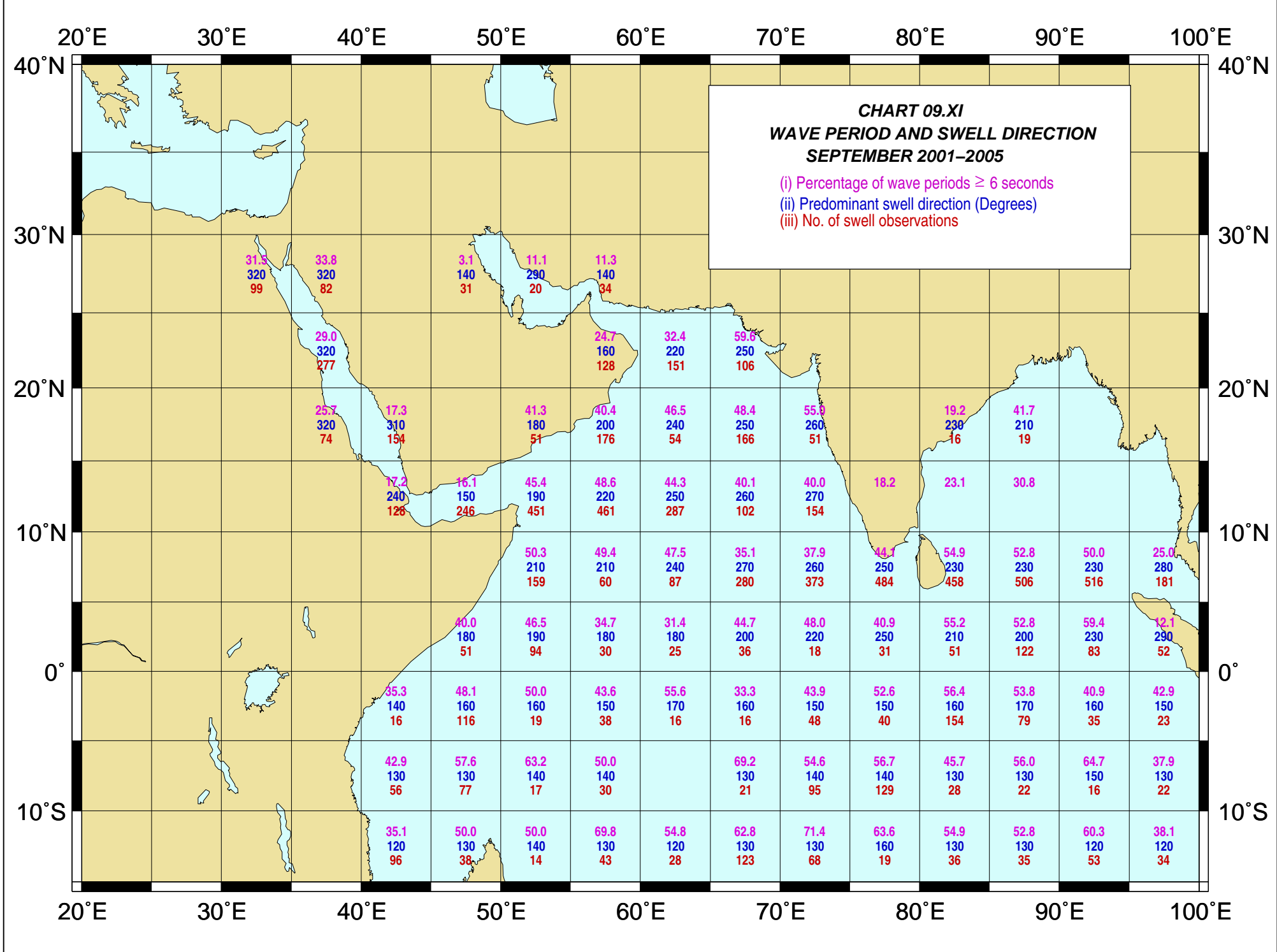


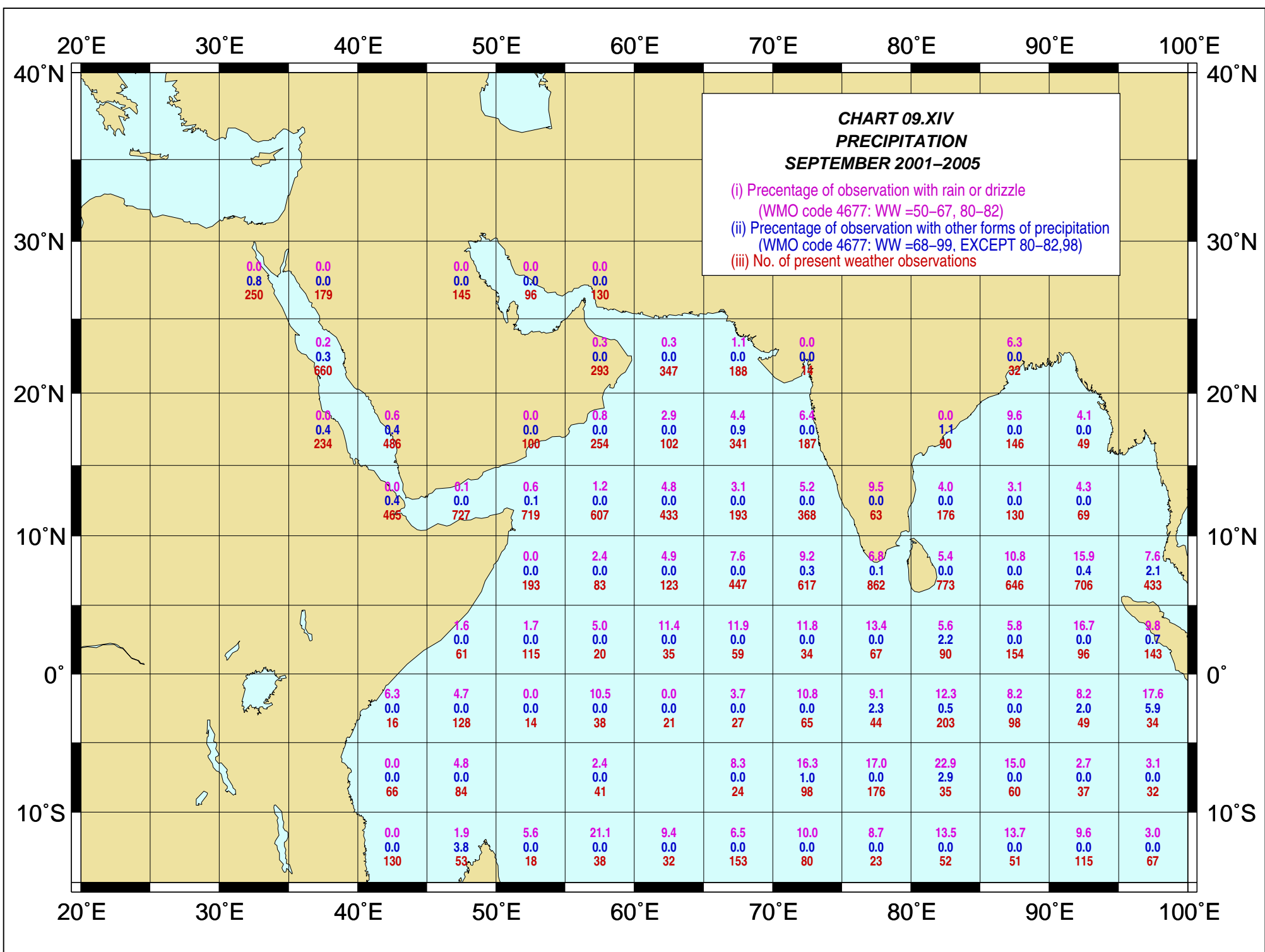


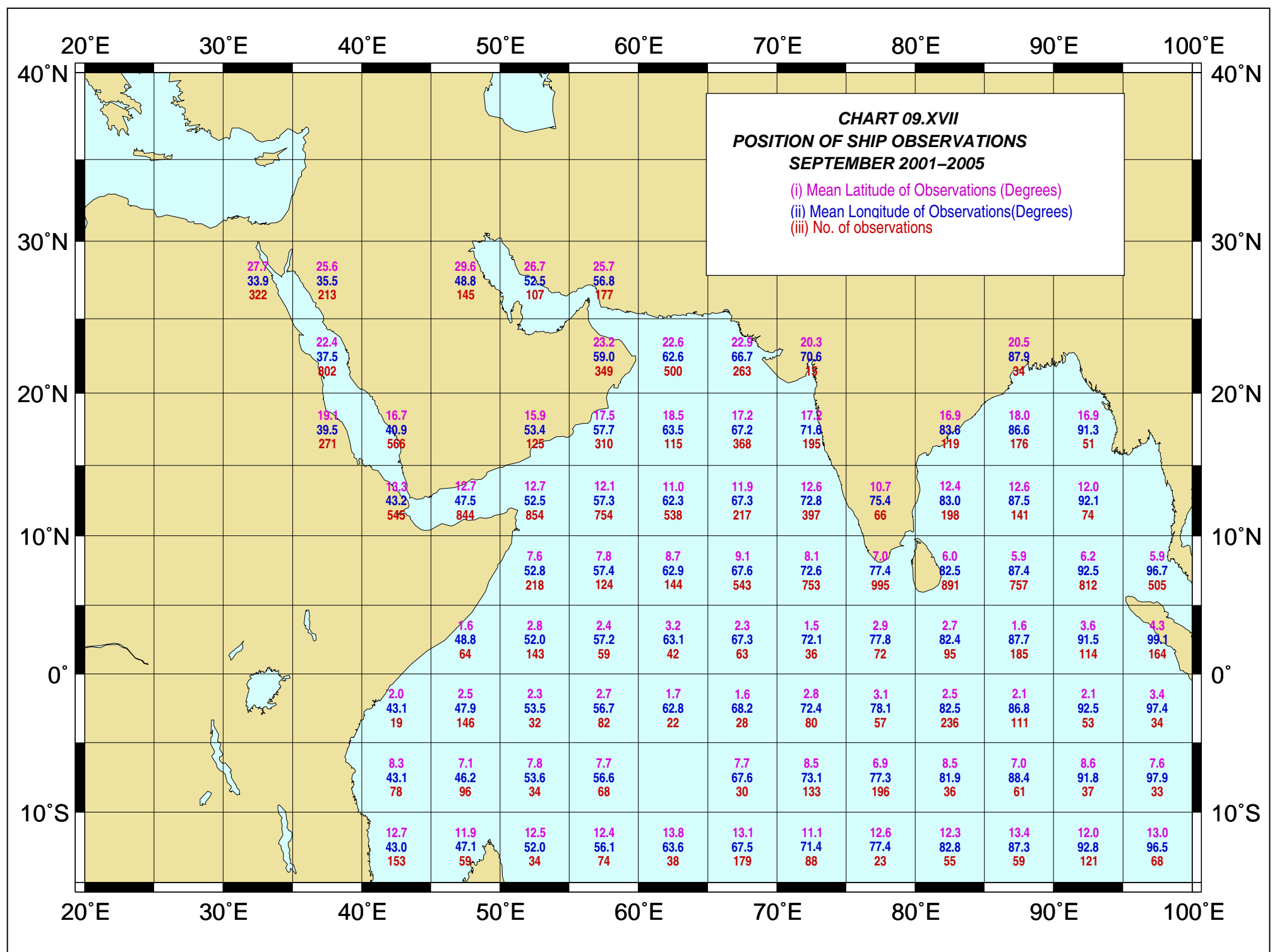


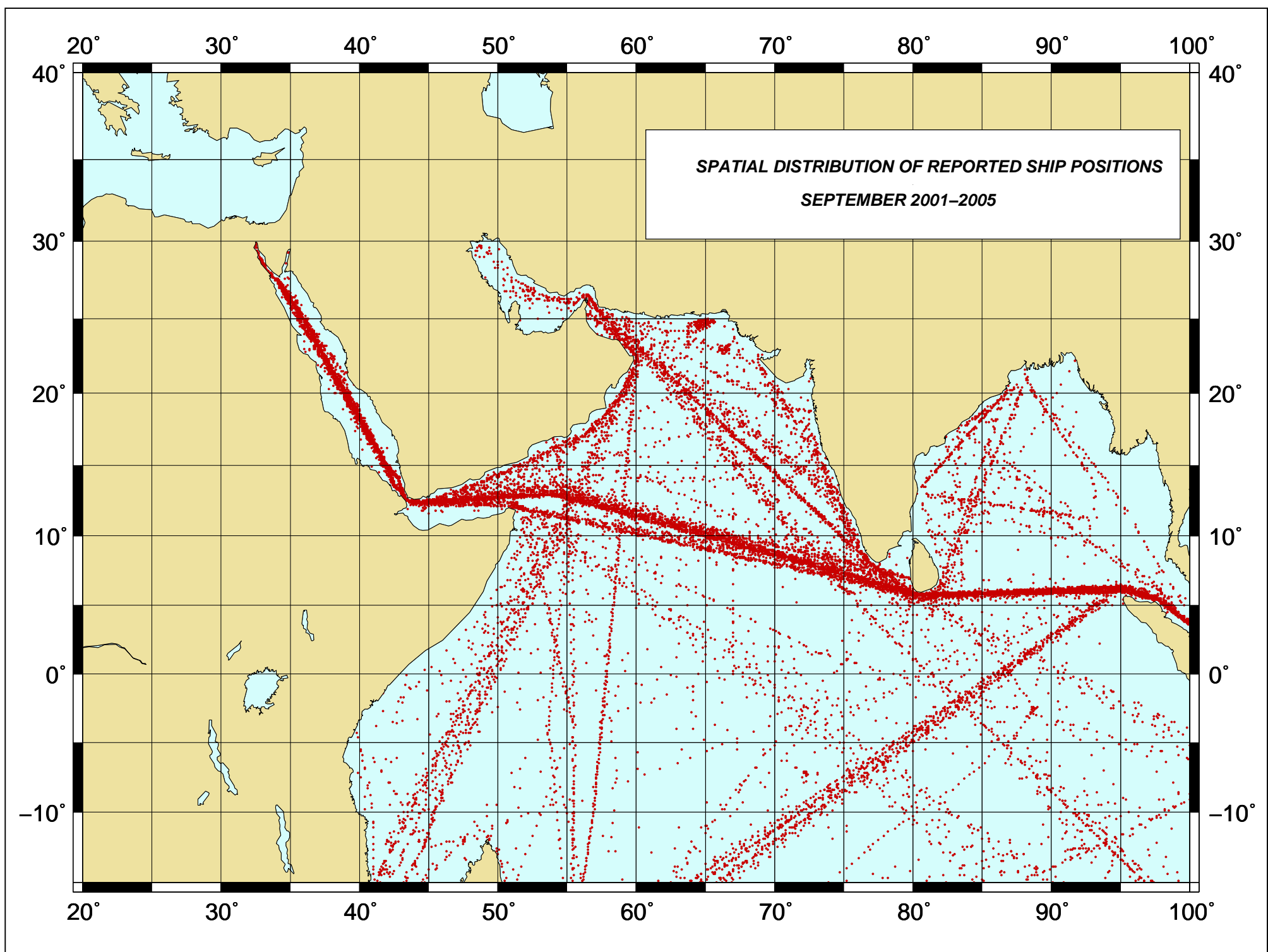




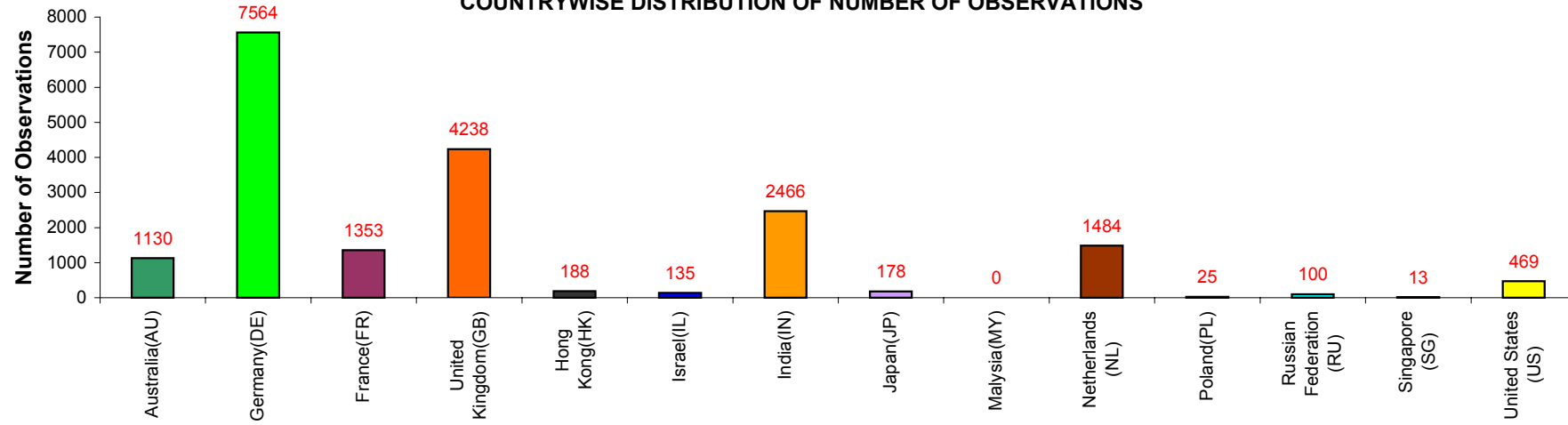




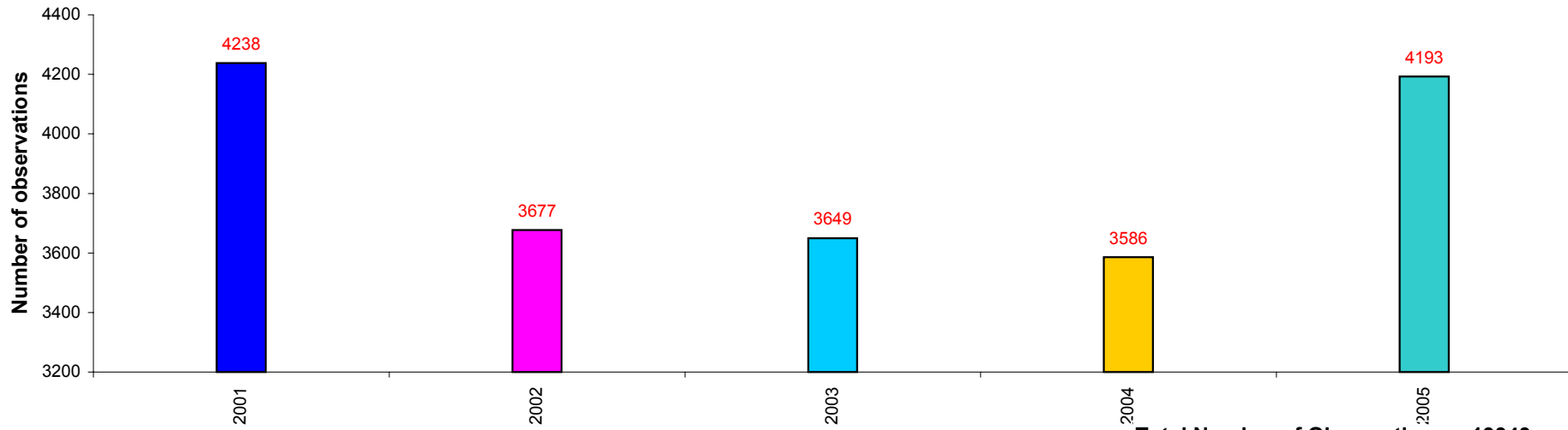




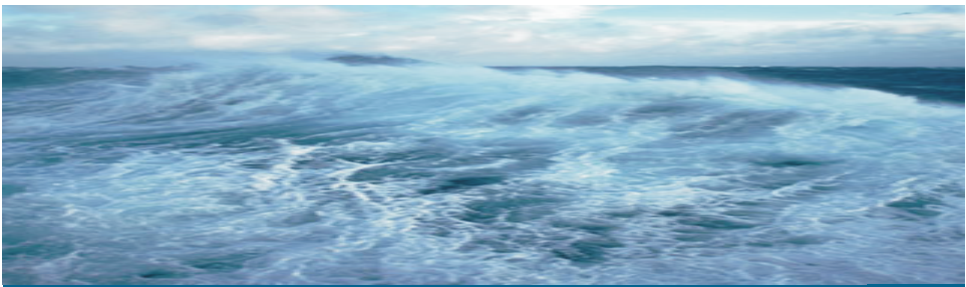
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CHARTS OF OCTOBER 2001 - 2005

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CHART - III : DEW POINT TEMPERATURE

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CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

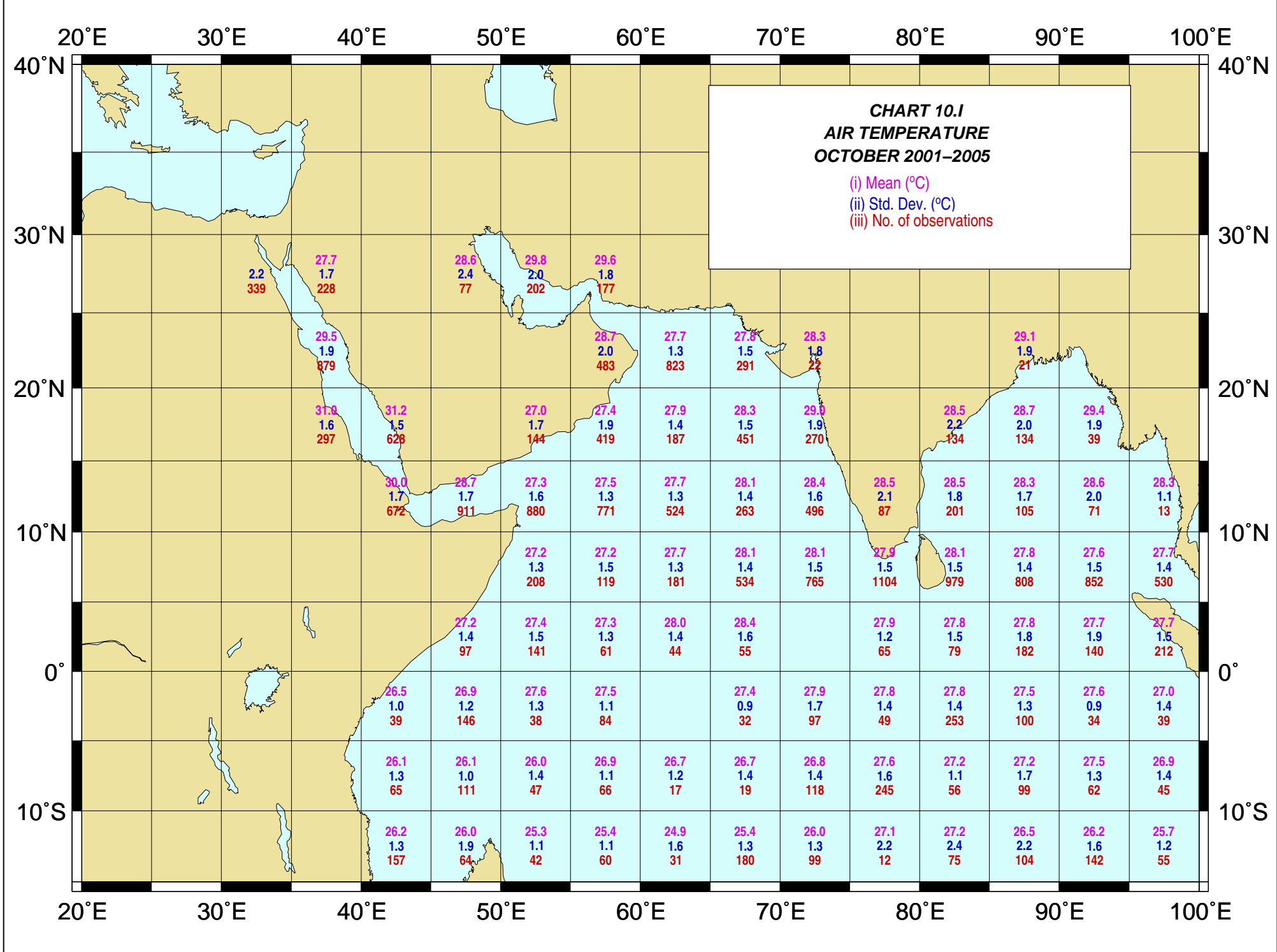
CHART - XVI : VISIBILITY

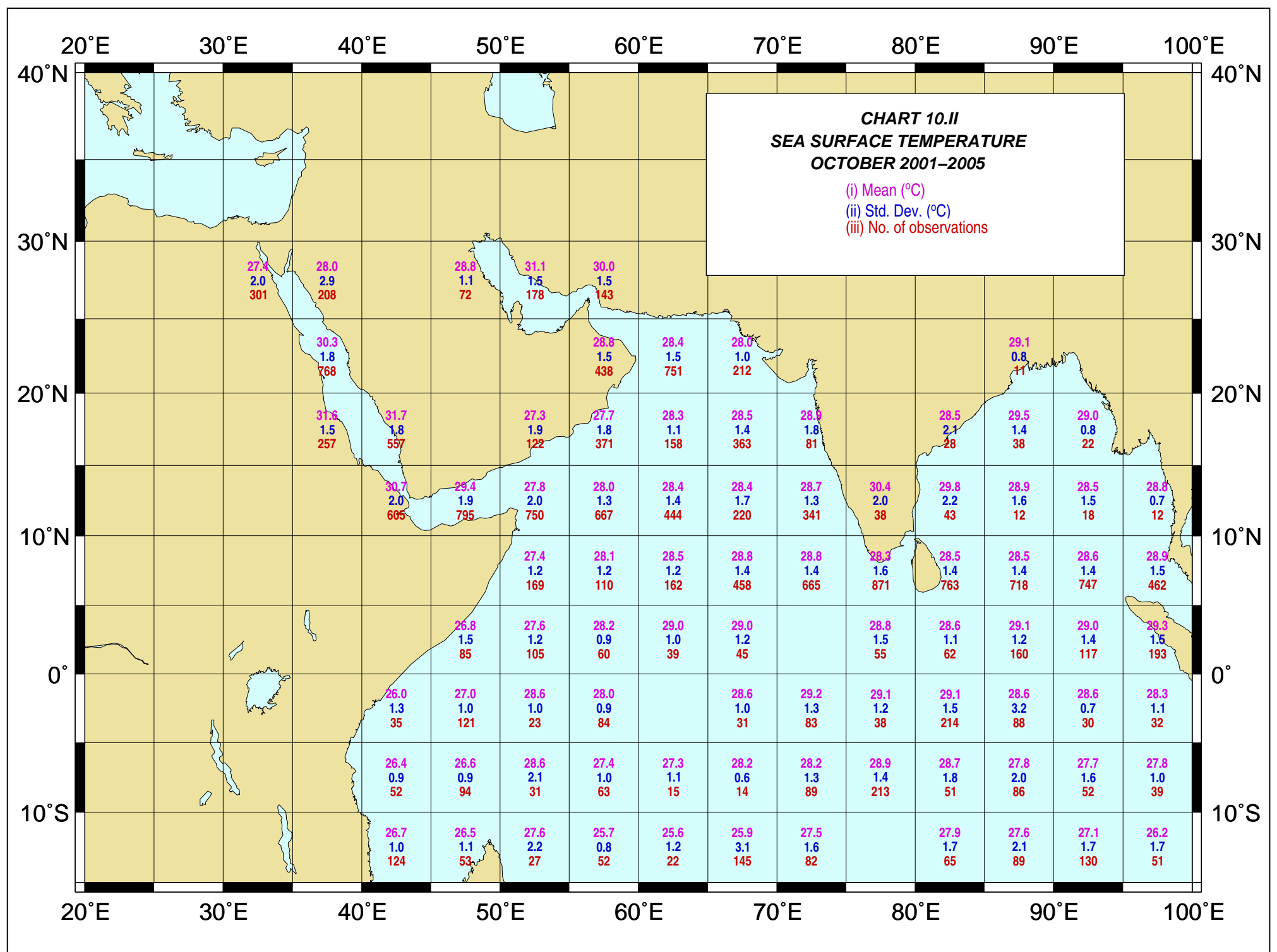
CHART - XVII : POSITION OF SHIP OBSERVATIONS

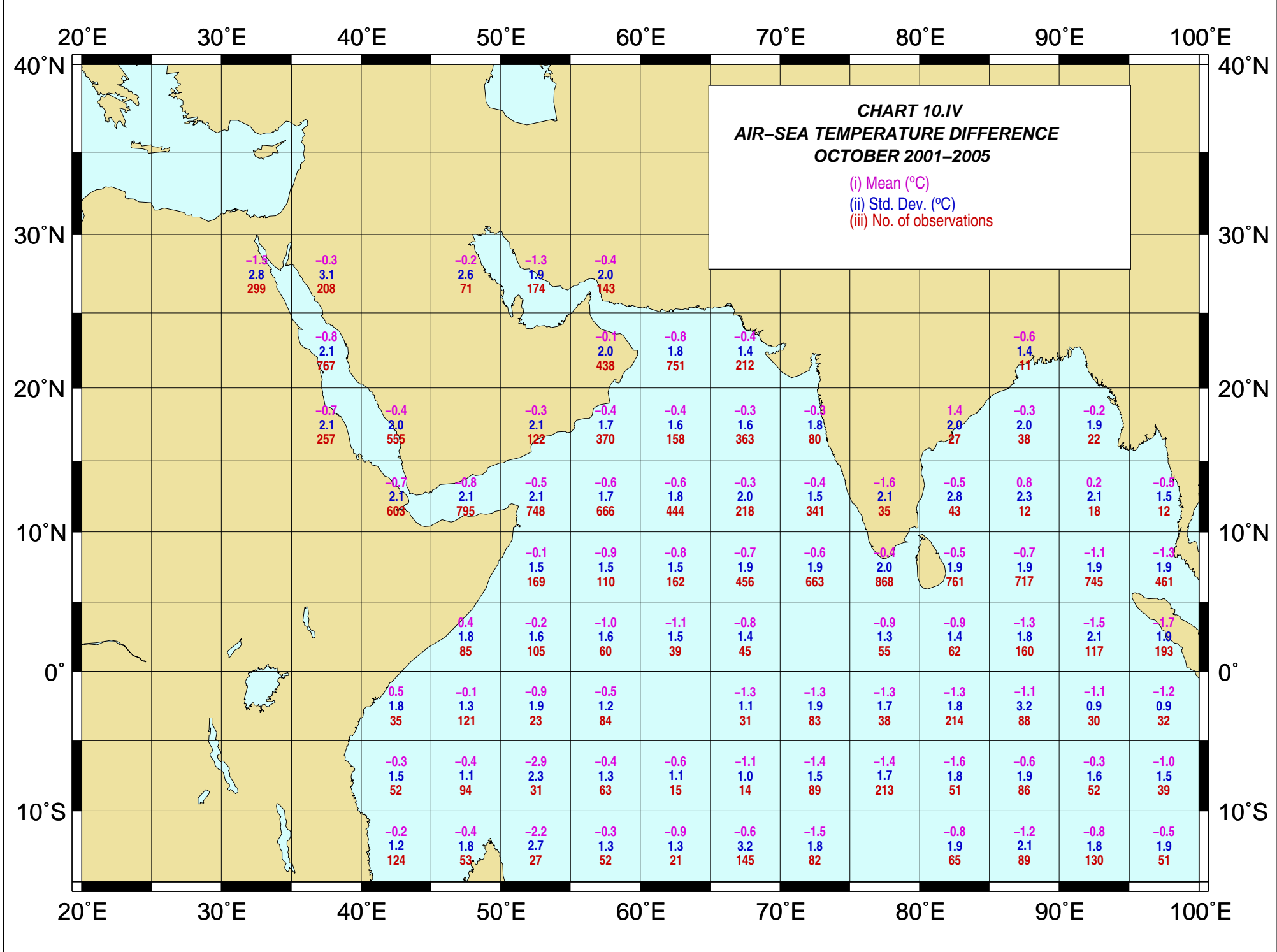
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**







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3.1
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1.8
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1.8
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3.2
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94

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2.3
31

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63

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1.1
15

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1.0
14

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1.5
89

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1.7
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1.8
51

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1.9
86

-0.3
1.6
52

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1.5
39

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1.2
124

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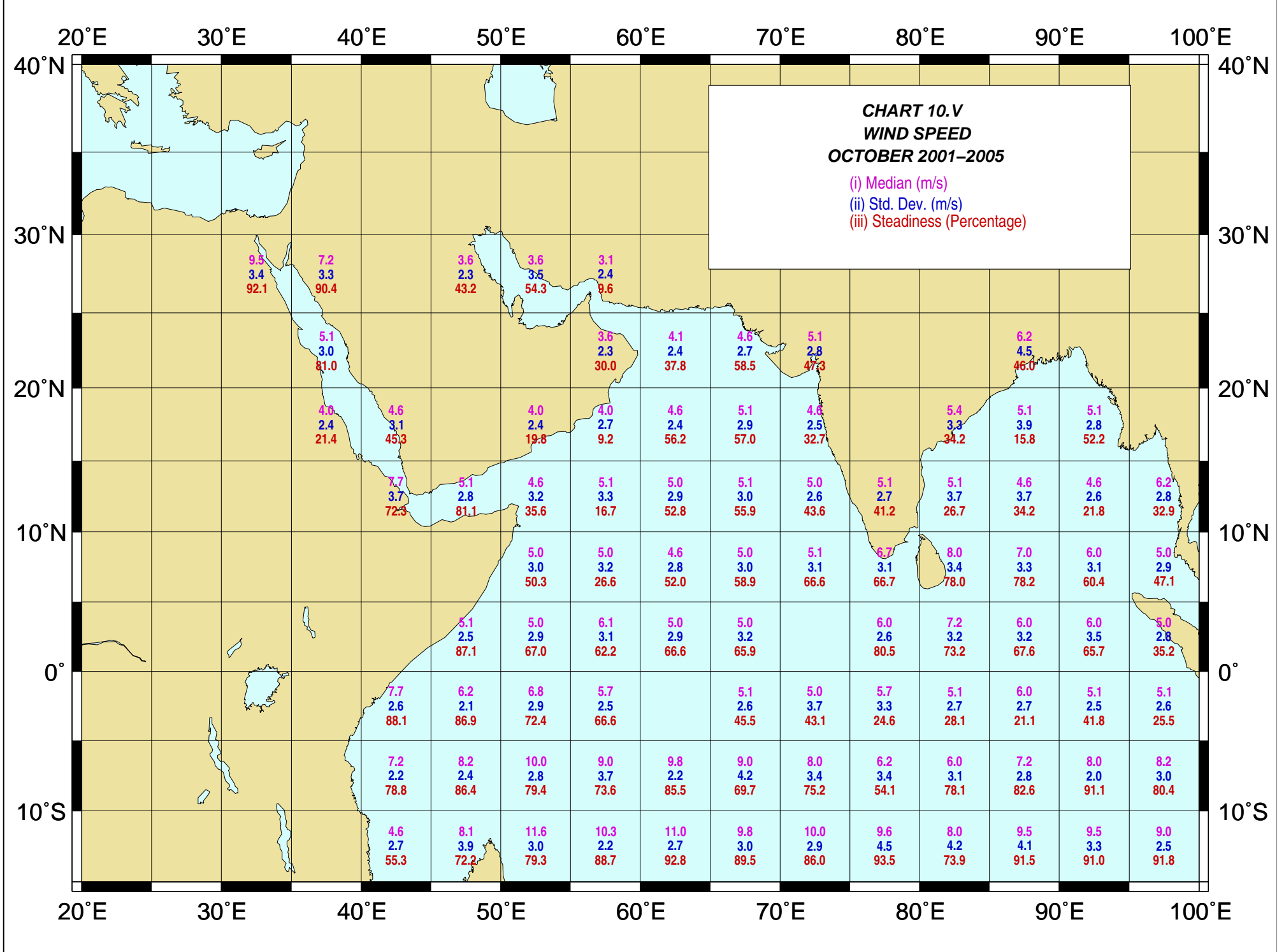
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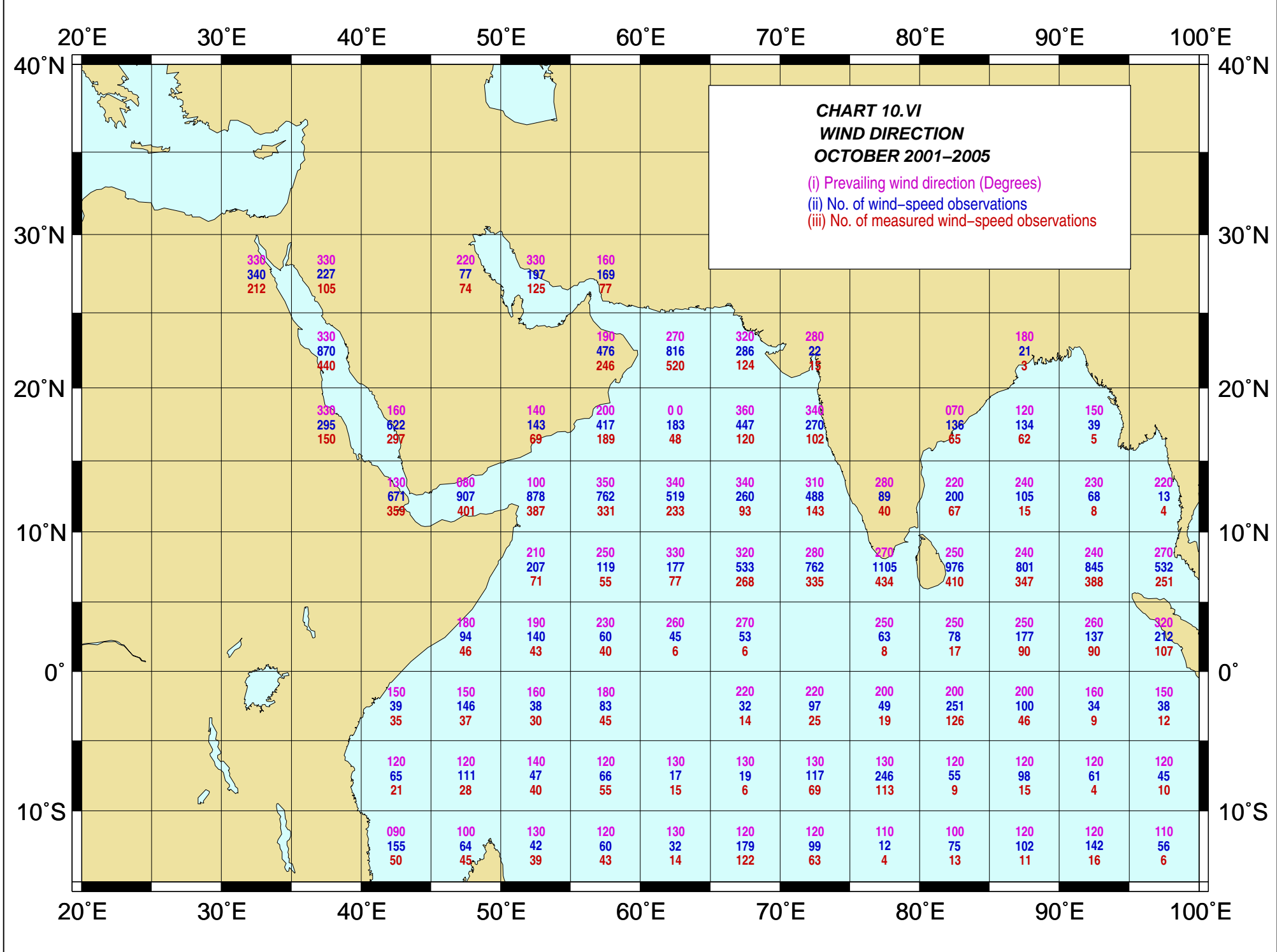
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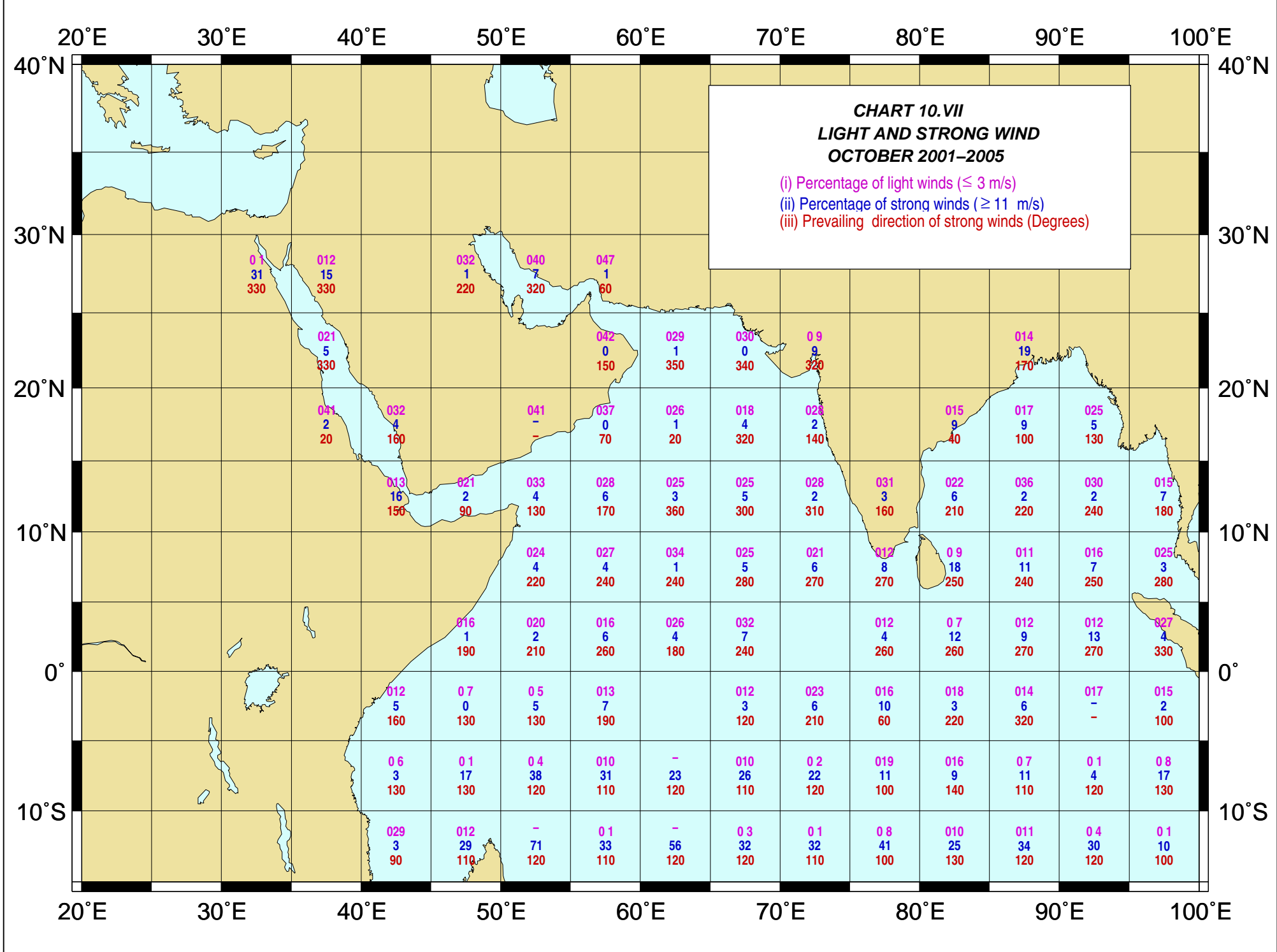
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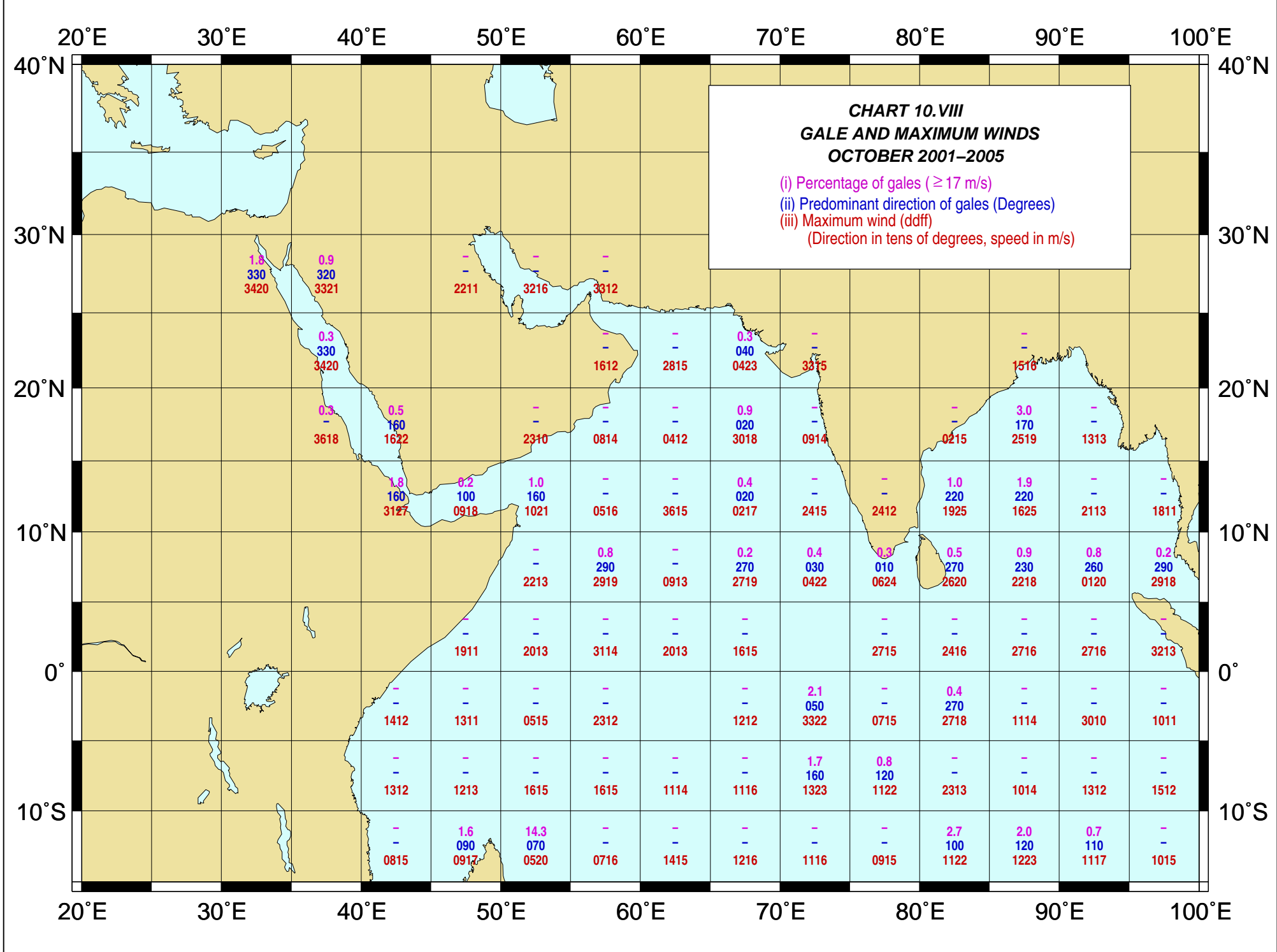
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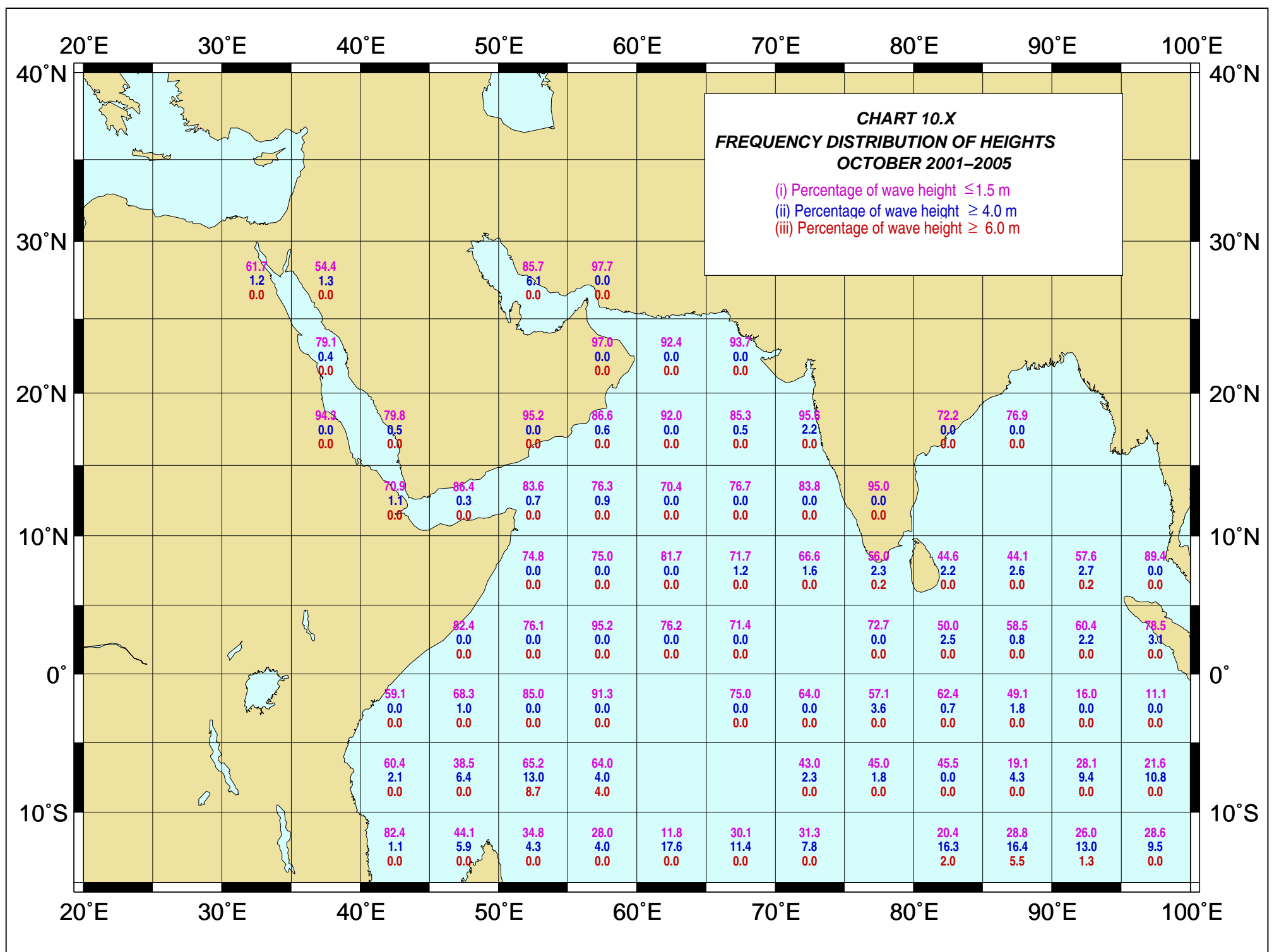
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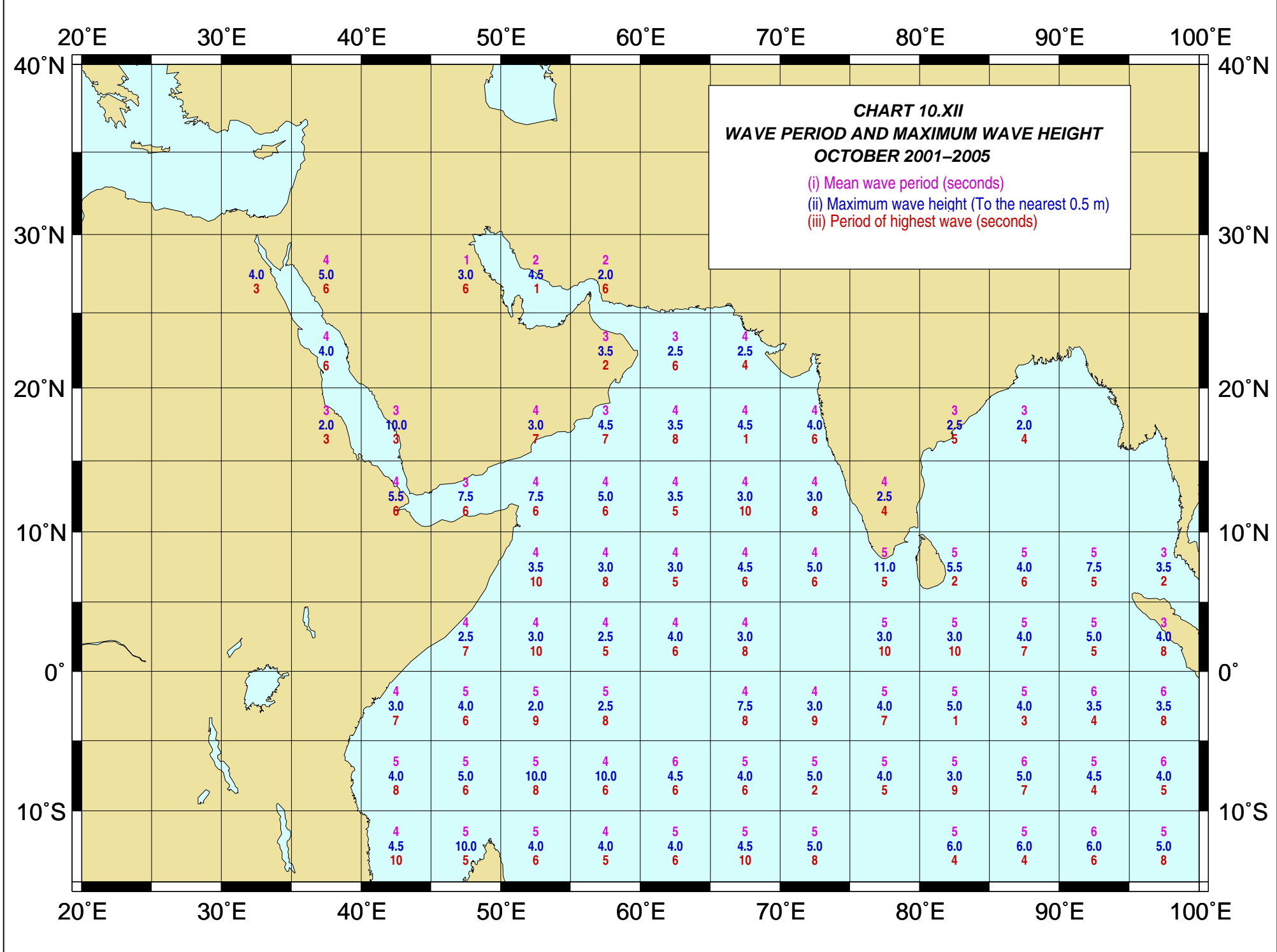


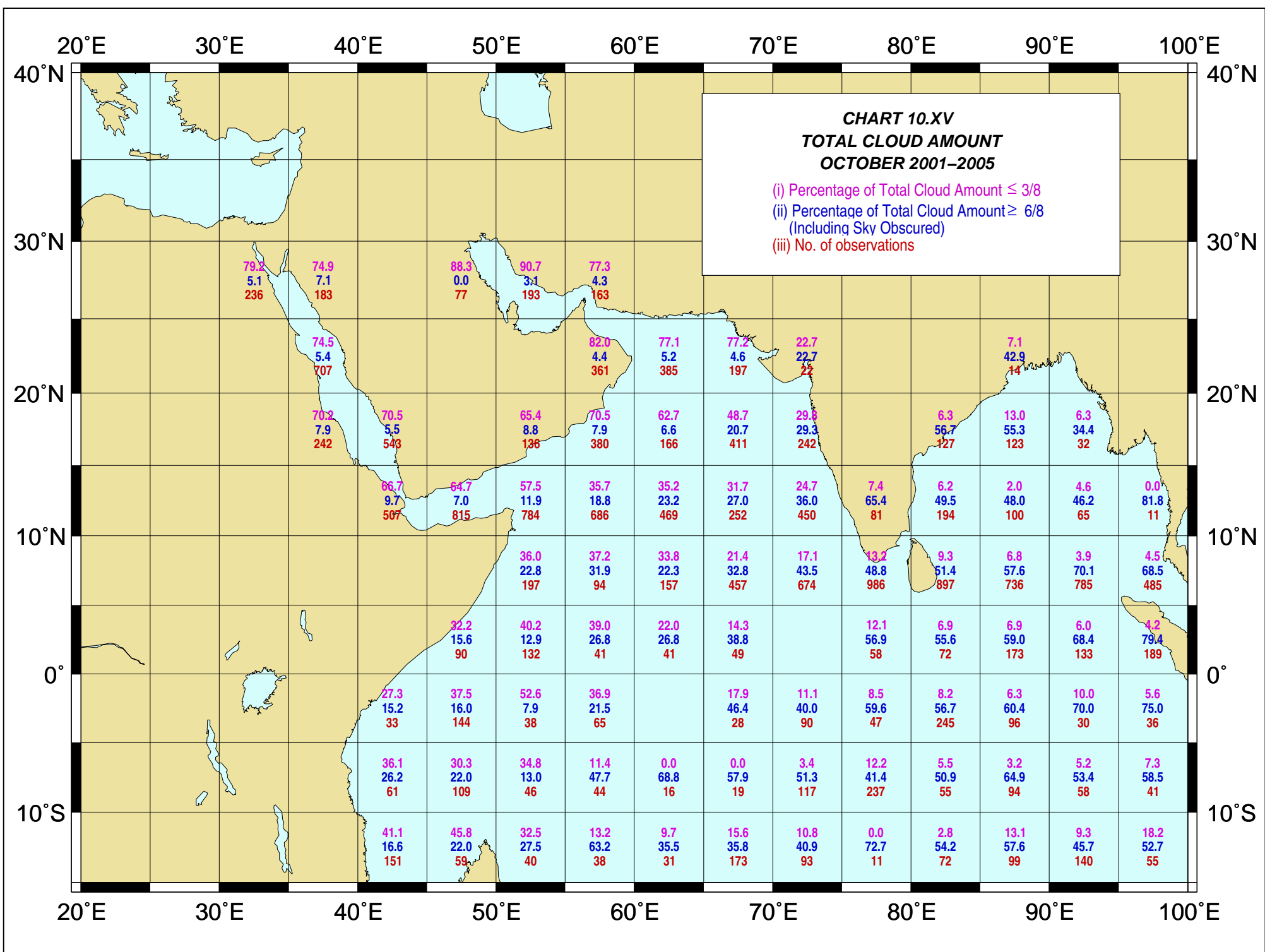


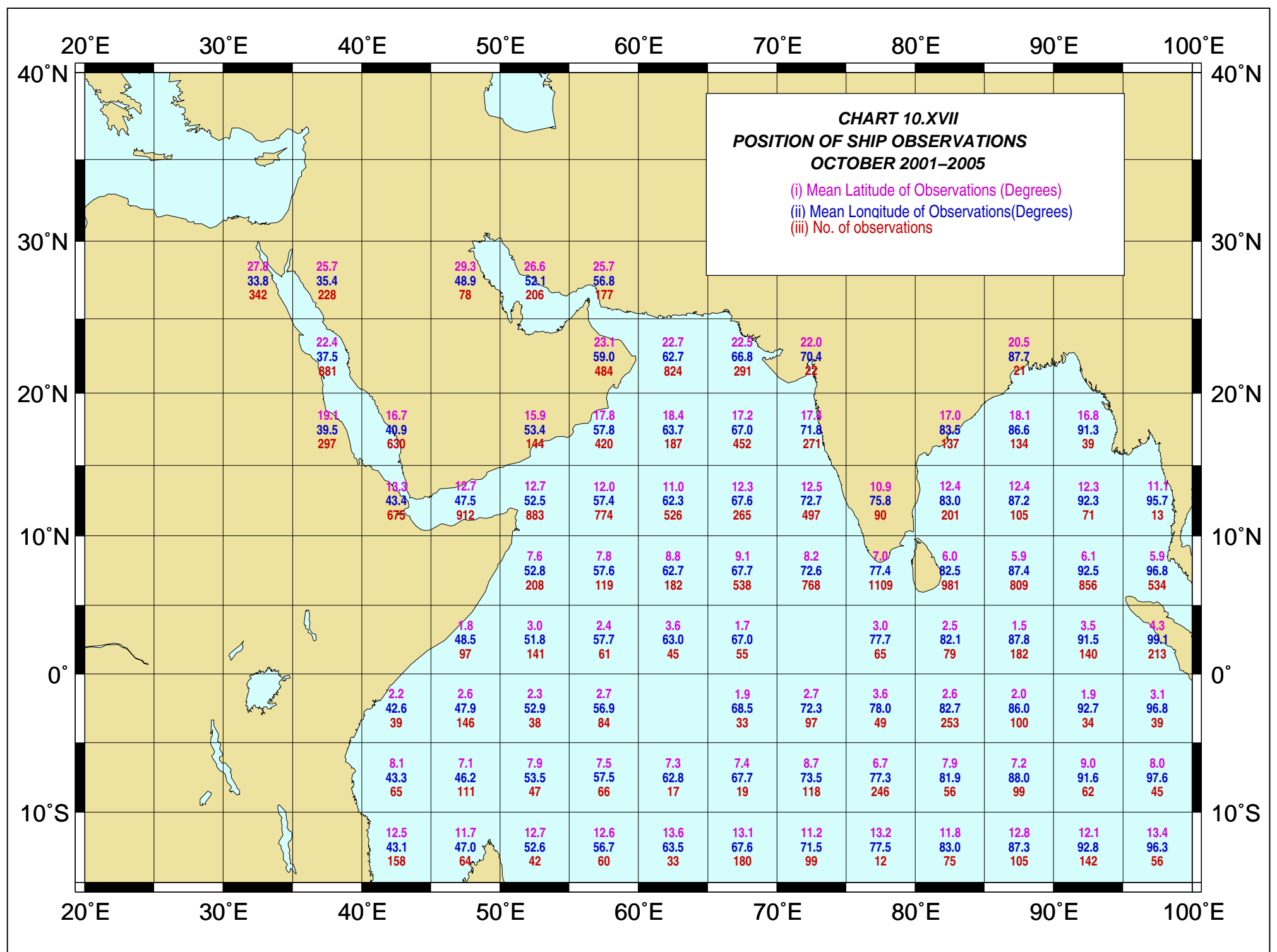


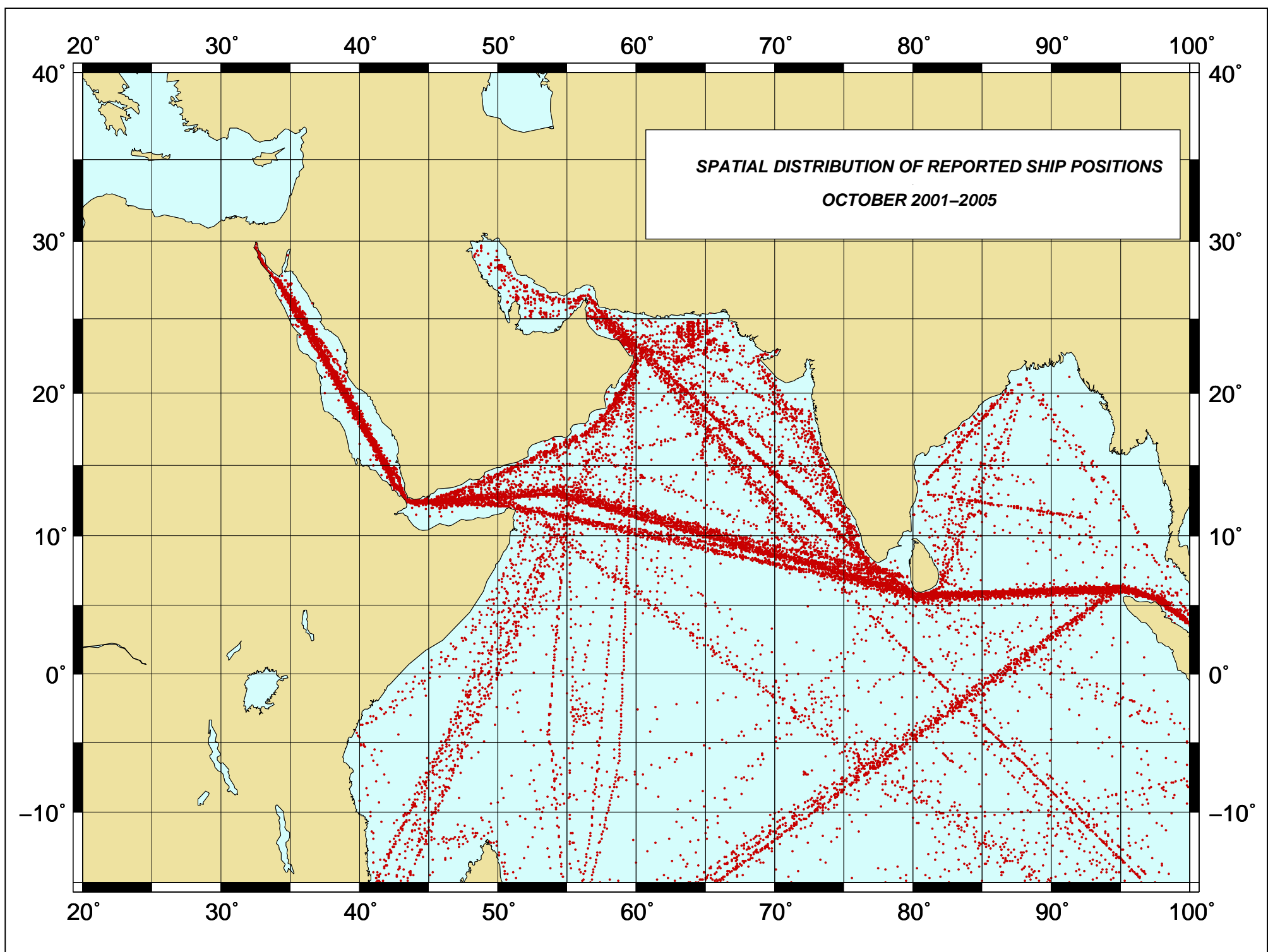




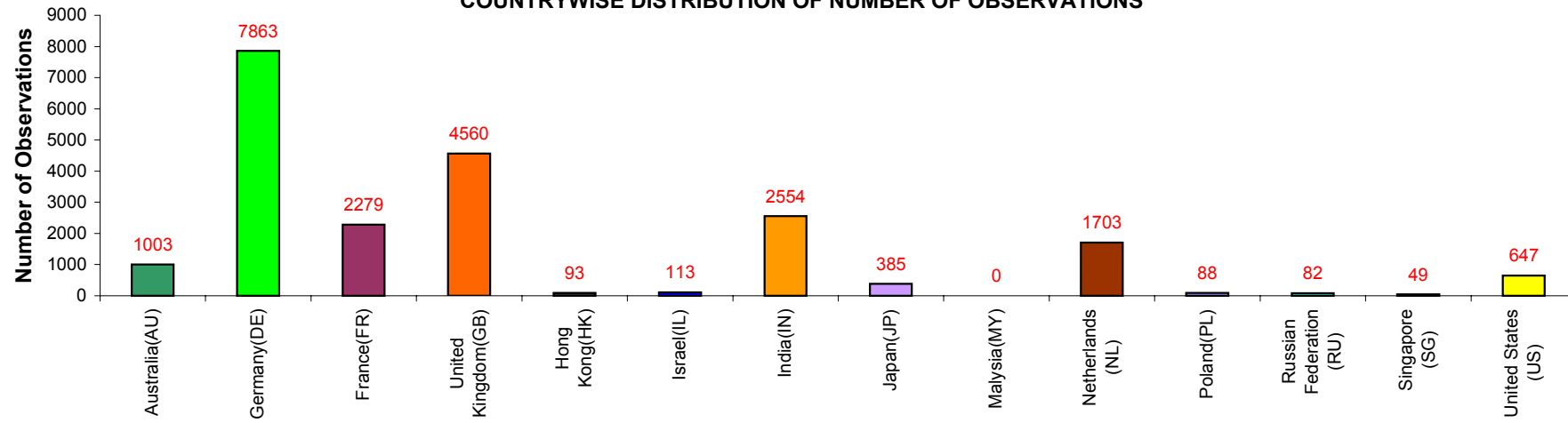




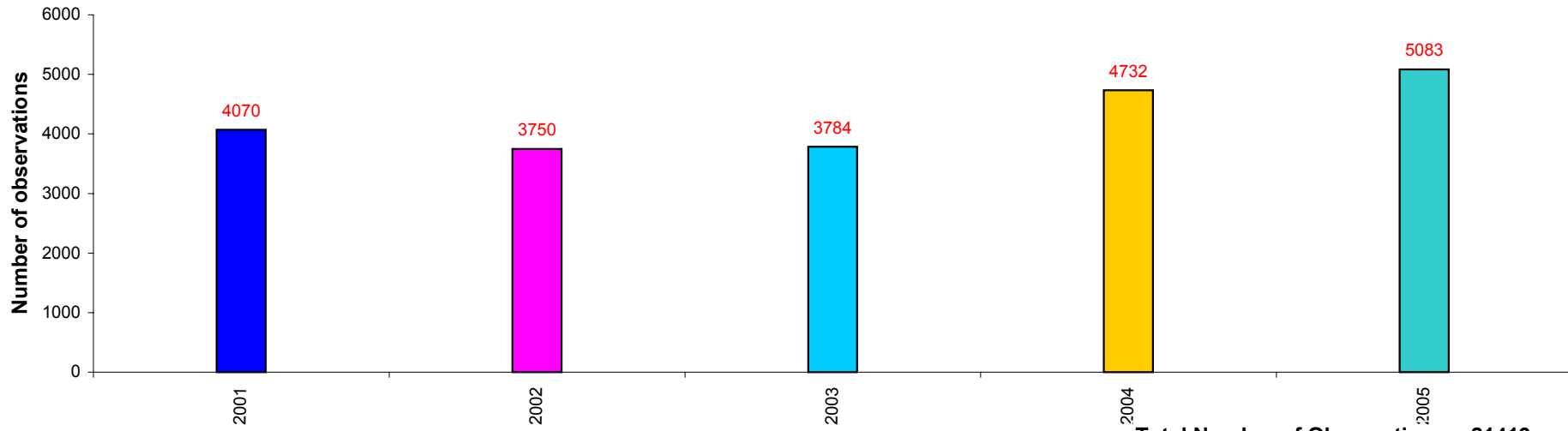




OCTOBER : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



Total Number of Observations = 21419



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MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT



Marine Climatological Summary Charts 2001-2005

FOR THE INDIAN OCEAN BETWEEN 20°E & 100°E AND NORTH OF 15°S

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PUNE - 411 005

CHARTS OF NOVEMBER 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

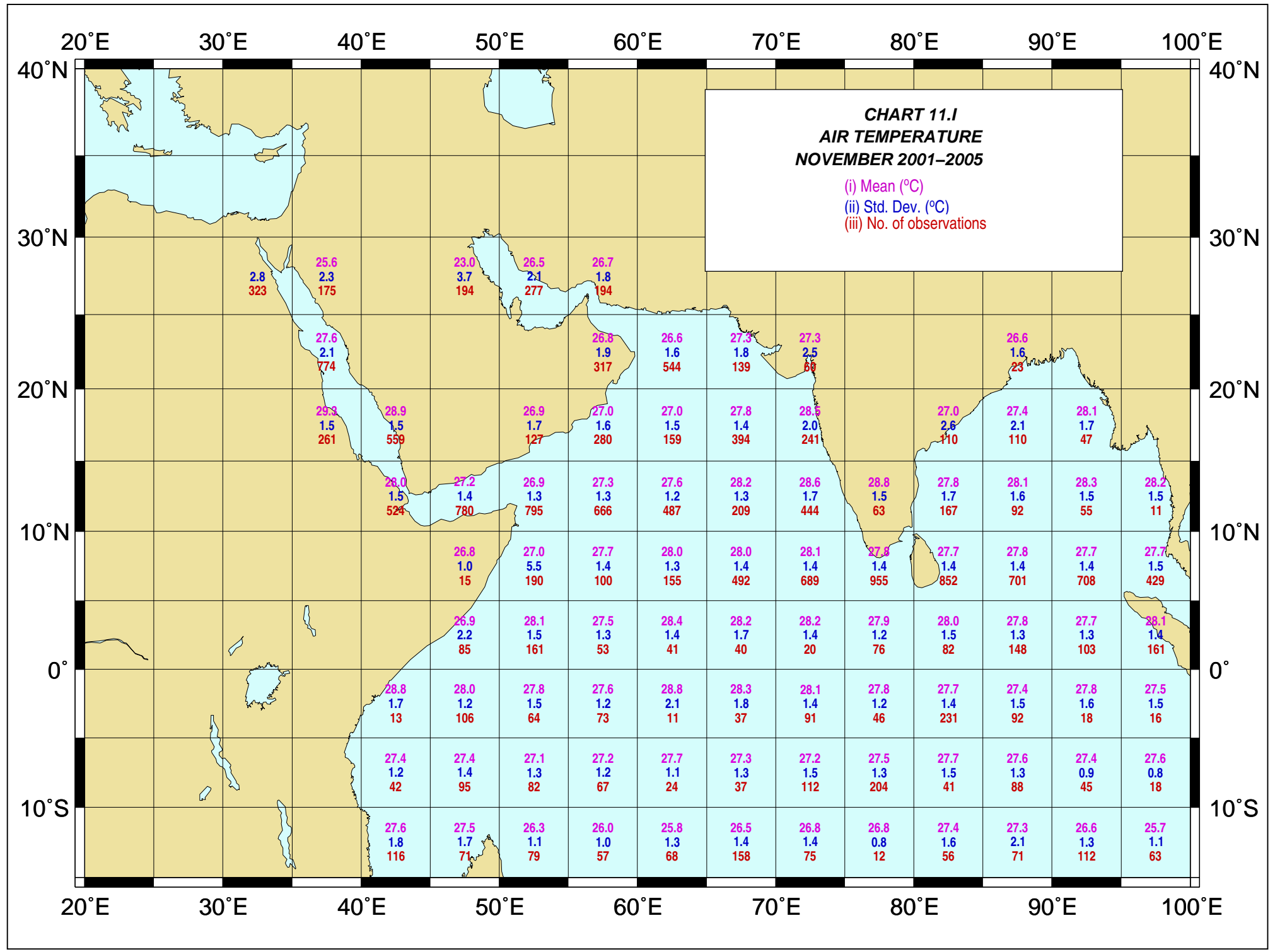
CHART - XVI : VISIBILITY

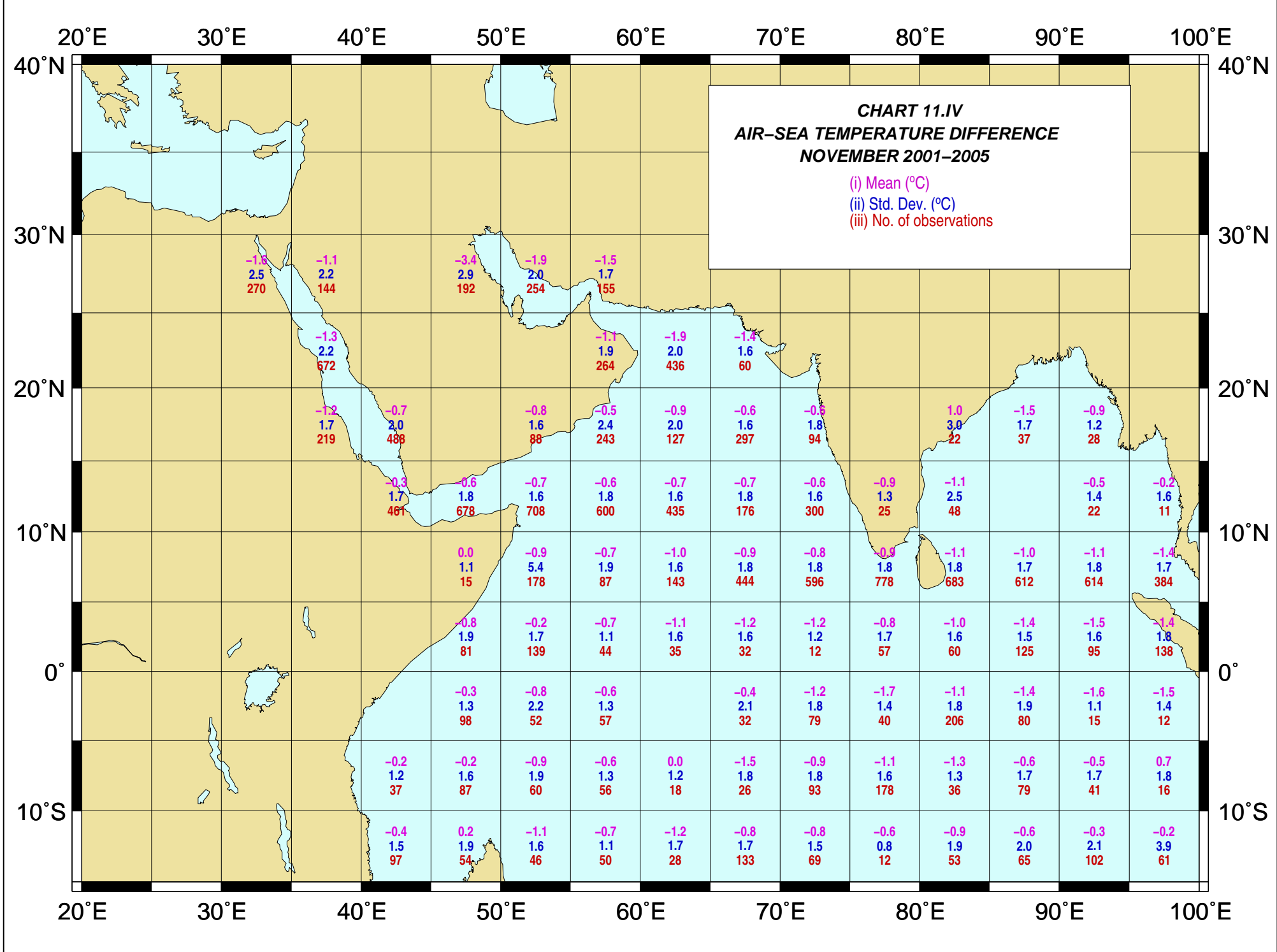
CHART - XVII : POSITION OF SHIP OBSERVATIONS

CHART - XVIII : STANDARD DEVIATION OF POSITIONS

SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**





-1.6
2.5
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-1.1
2.2
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-3.4
2.9
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-1.9
2.0
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-1.5
1.7
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1.9
264

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1.9
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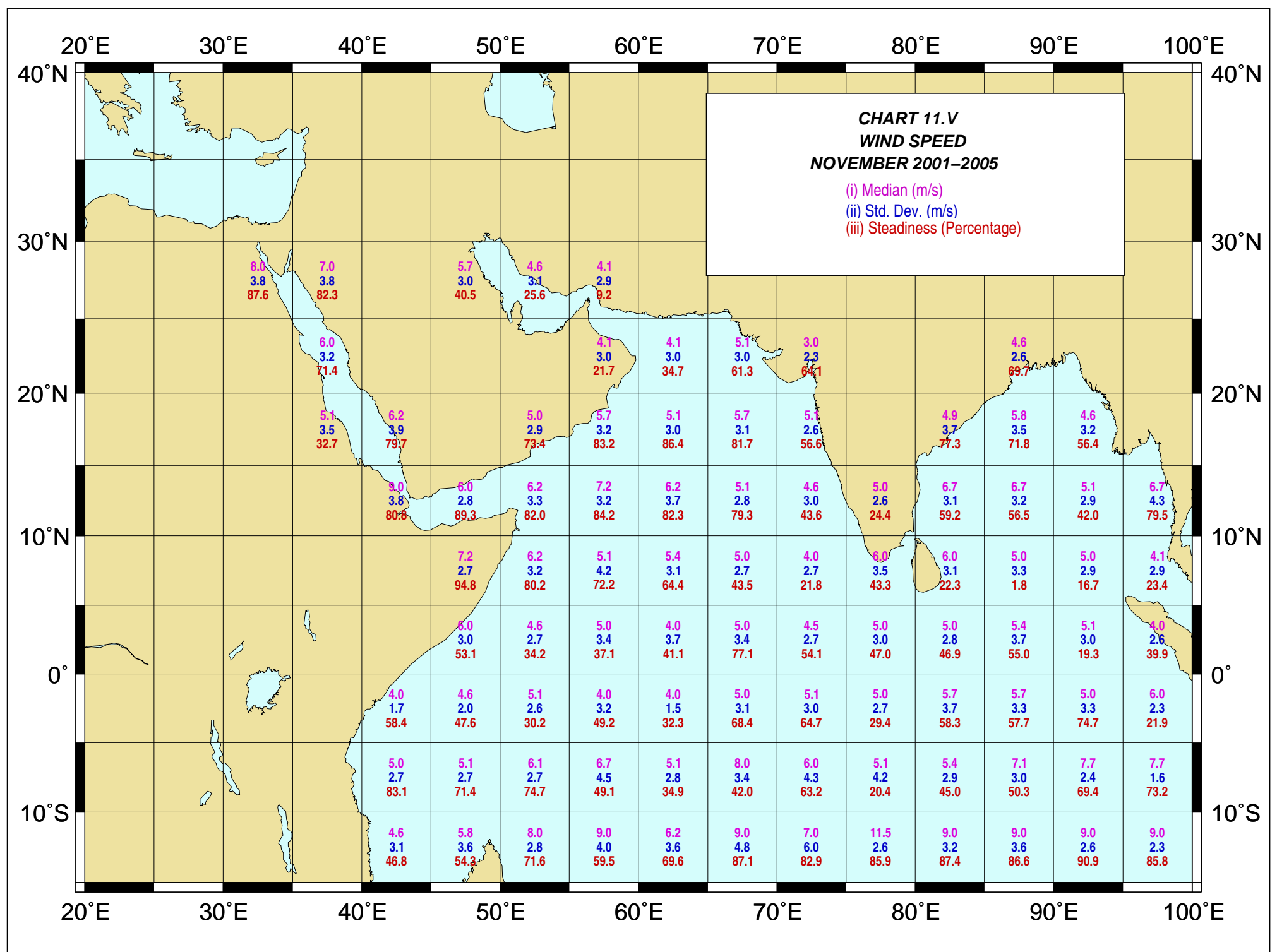
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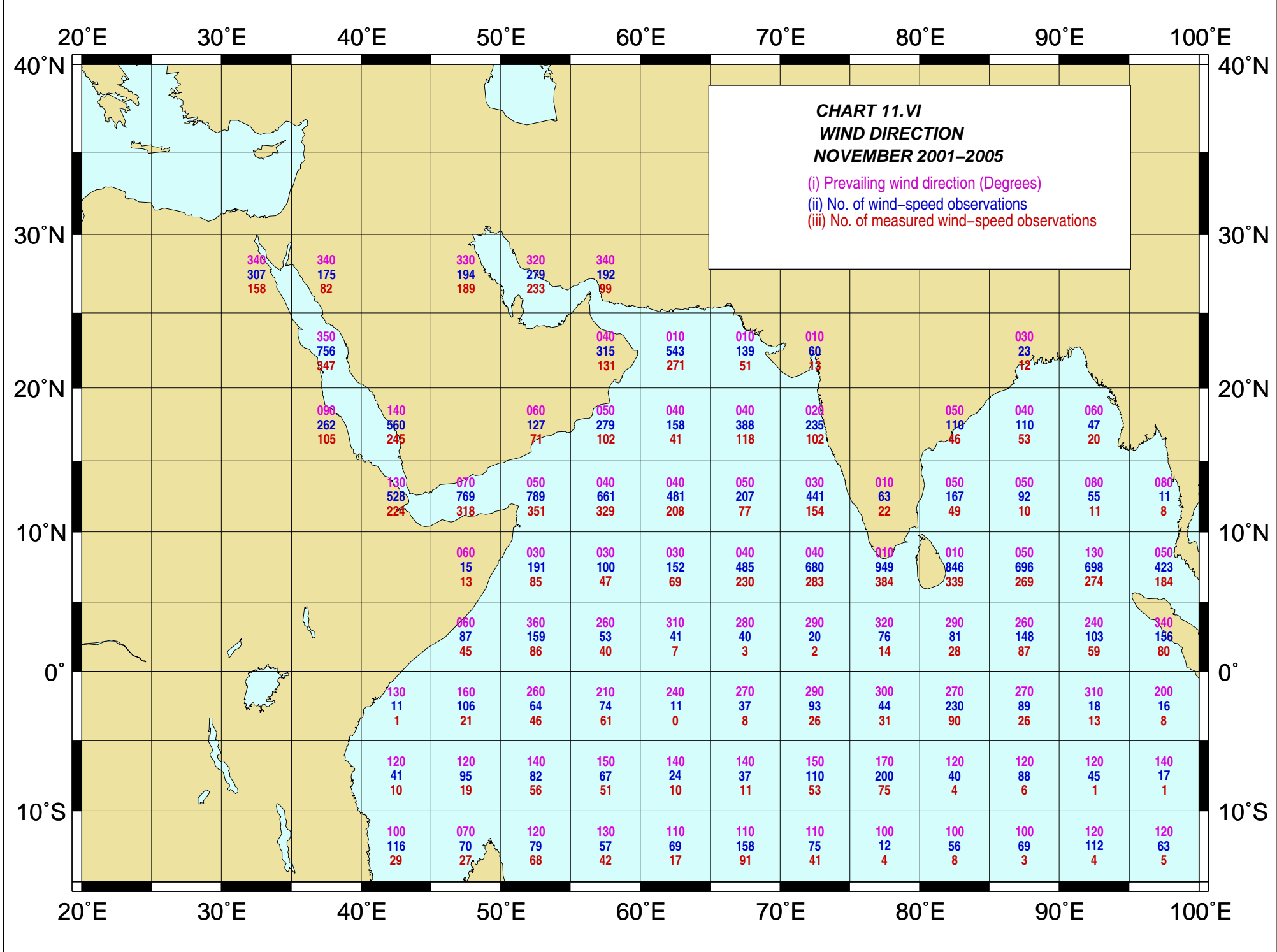
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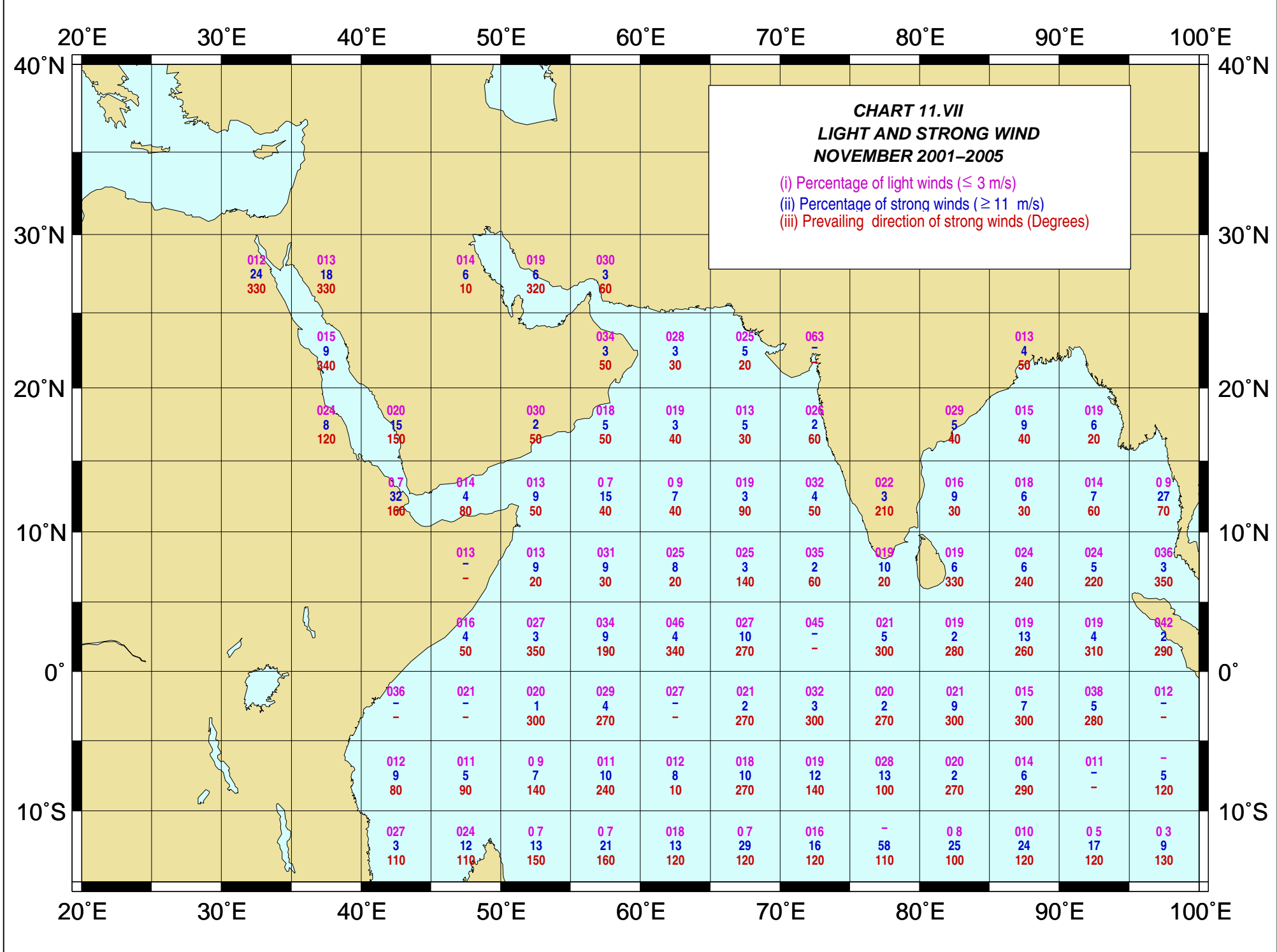
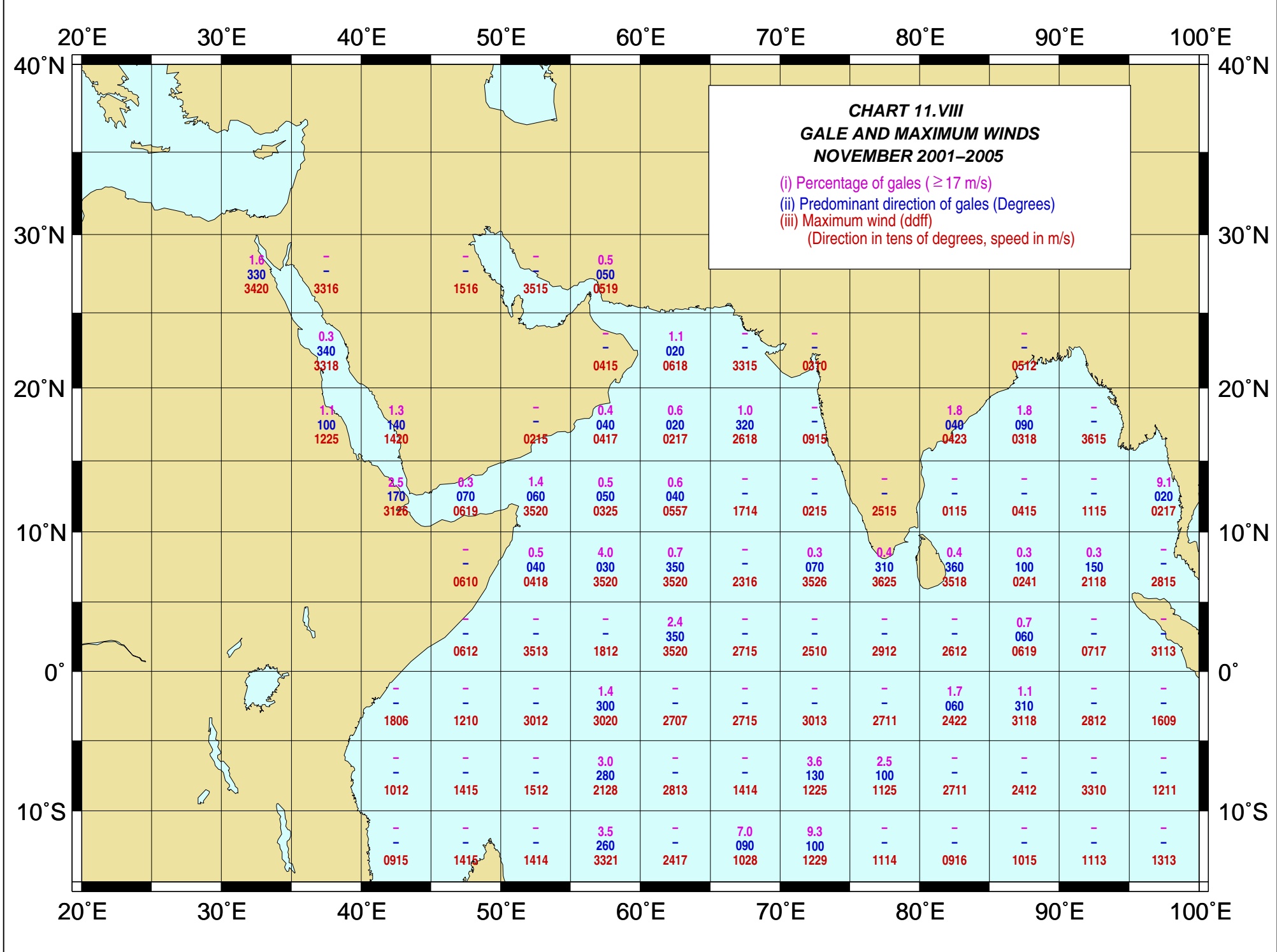
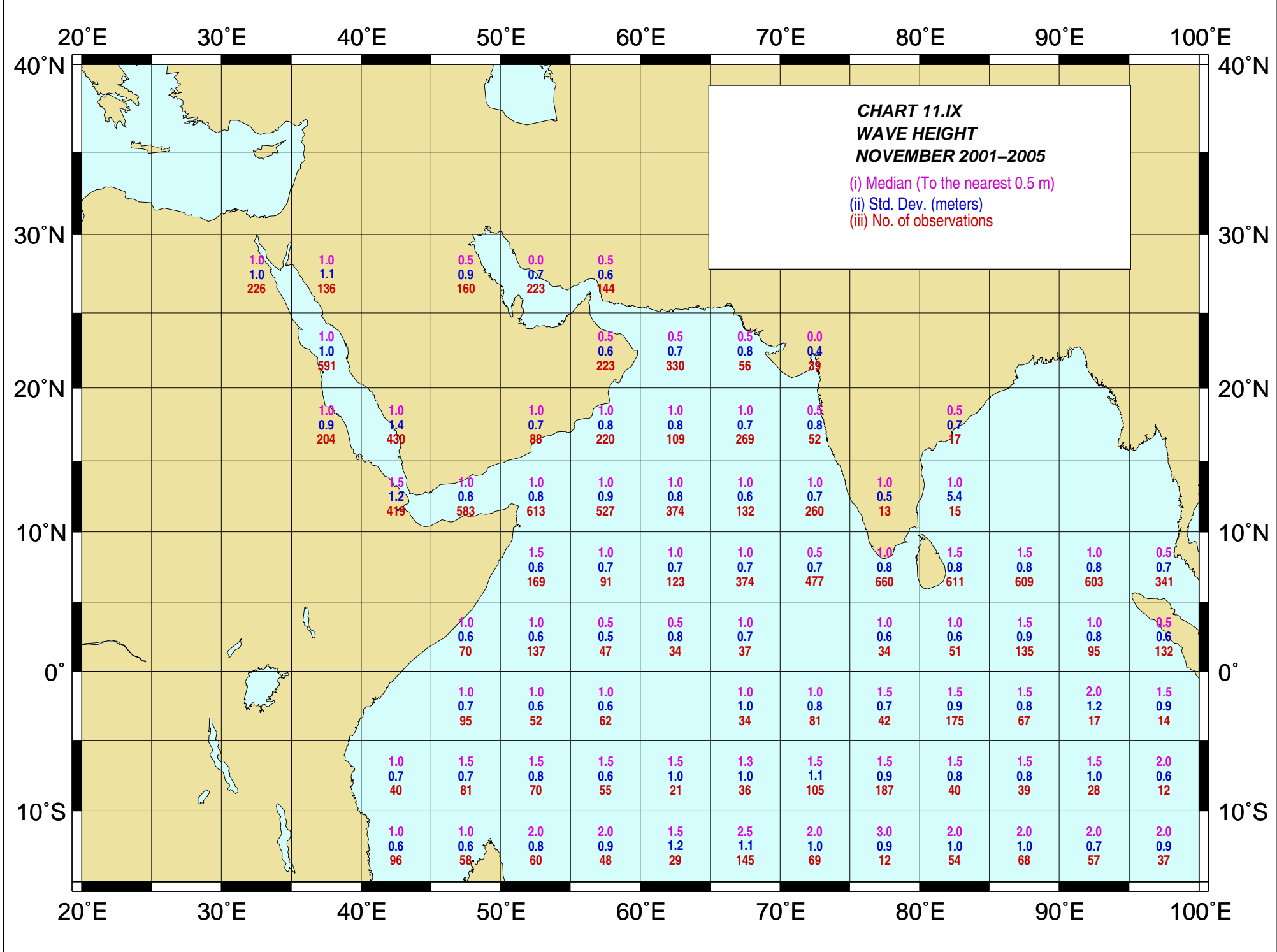


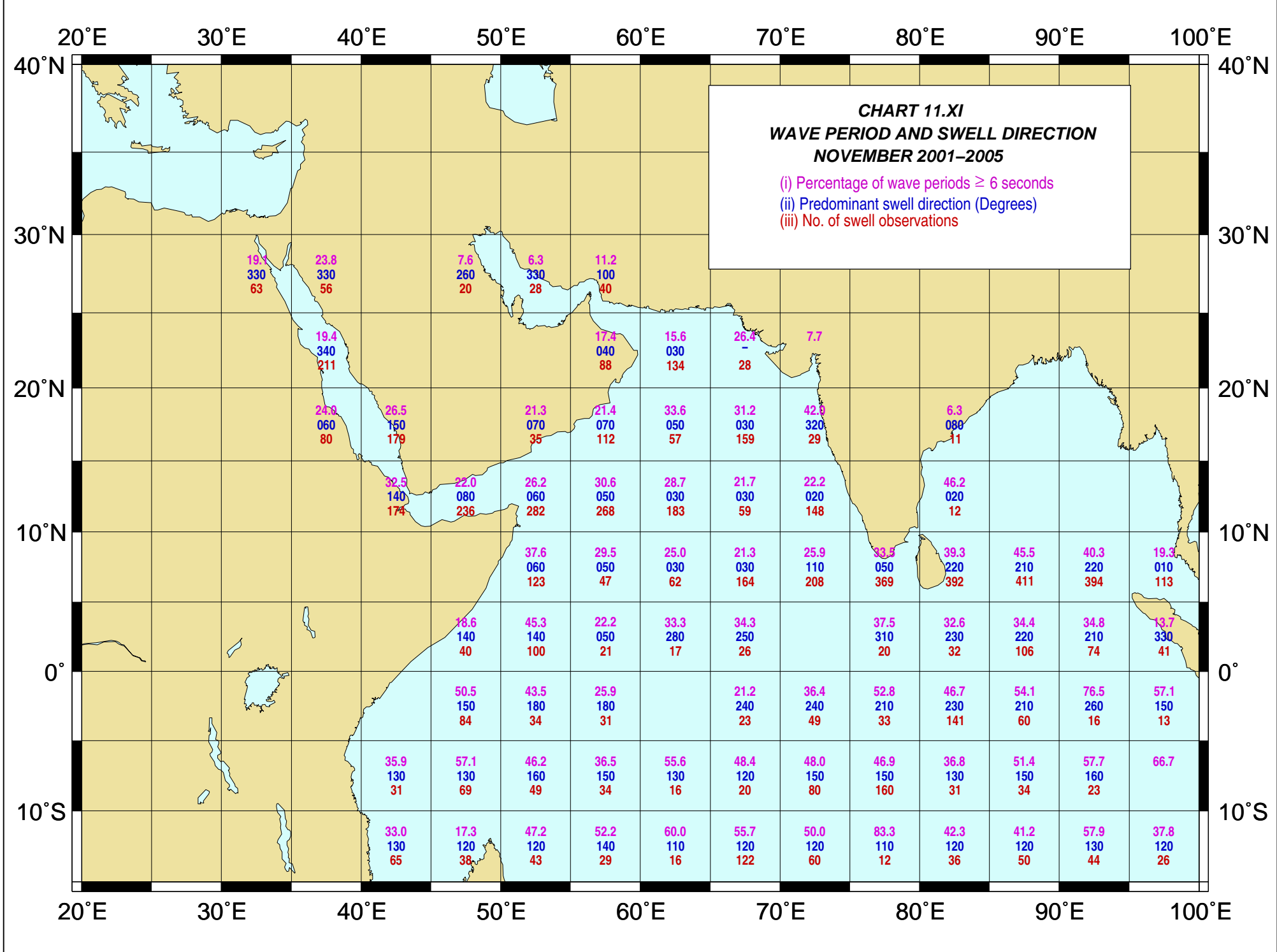
CHART 11.VII
LIGHT AND STRONG WIND
NOVEMBER 2001-2005

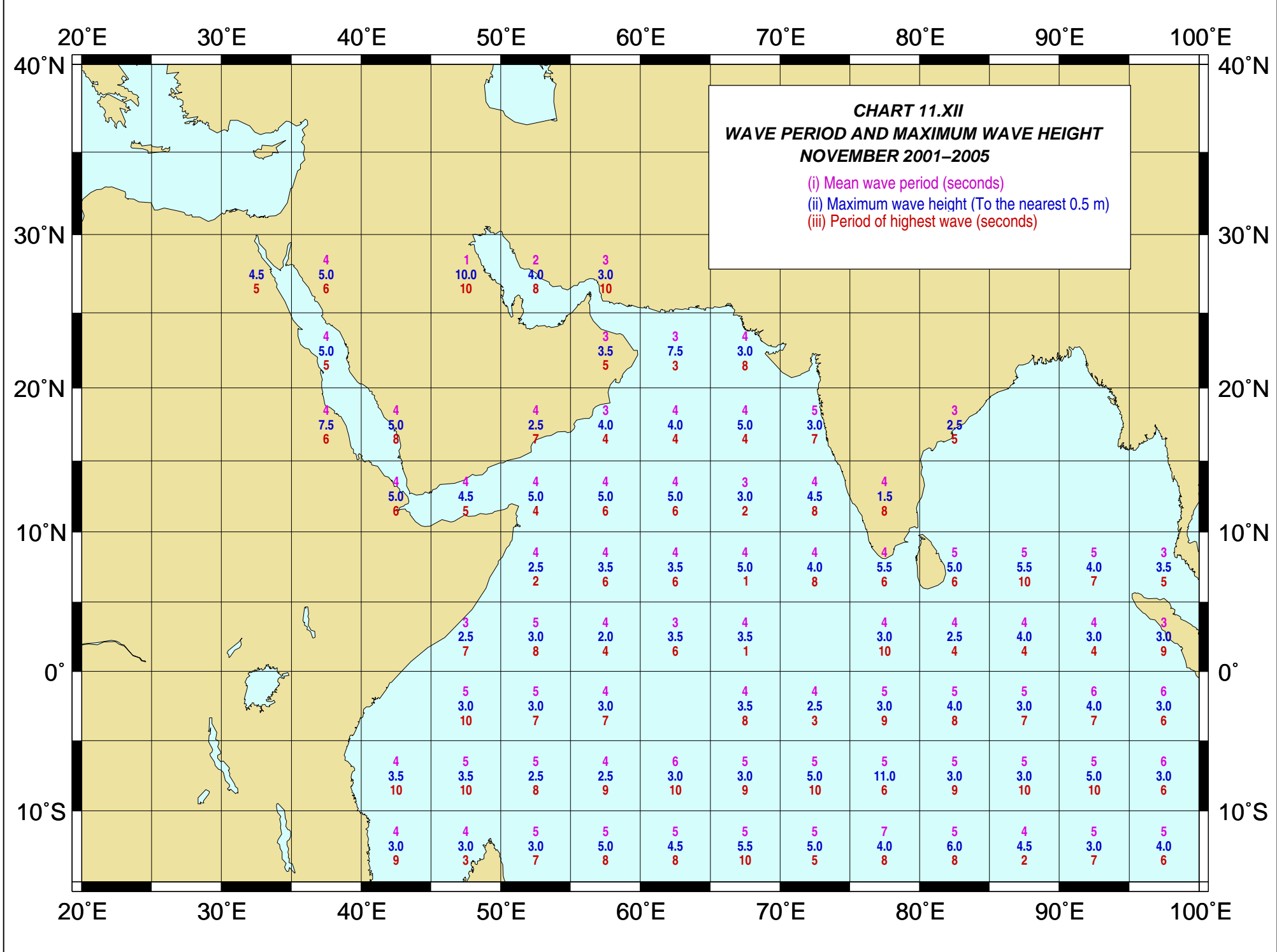
(i) Percentage of light winds (≤ 3 m/s)
(ii) Percentage of strong winds (≥ 11 m/s)
(iii) Prevailing direction of strong winds (Degrees)

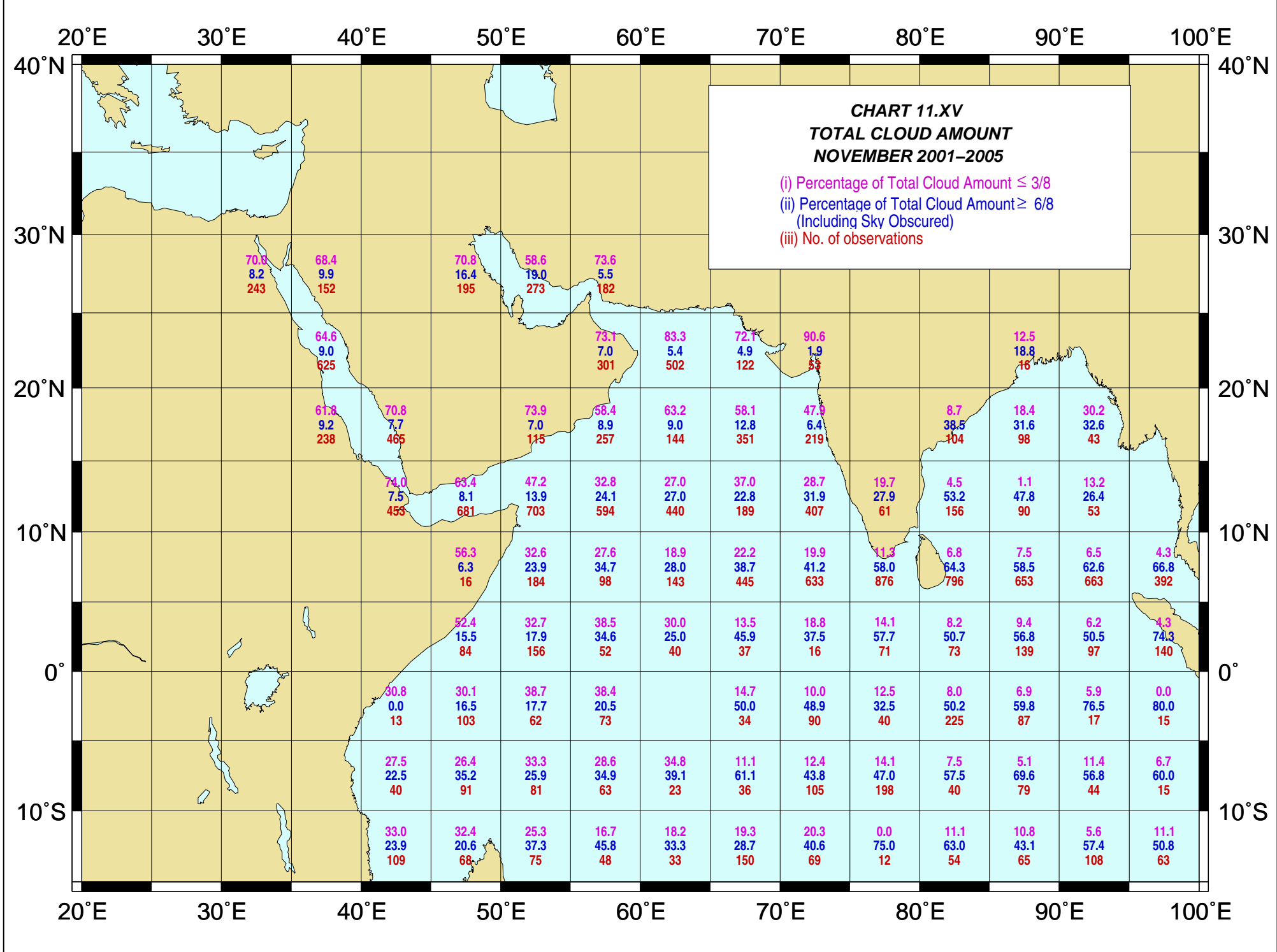
Latitude	20°E	30°E	40°E	50°E	60°E	70°E	80°E	90°E	100°E							
40°N																
30°N		013 24 330	013 18 330	014 6 10	019 6 320	030 3 60										
20°N		015 9 340	024 8 120	020 15 150	034 3 50	028 3 30	025 5 20	063 - -	013 4 50							
10°N			017 32 160	014 4 80	030 2 50	018 5 50	019 3 40	013 5 30	026 2 60	029 5 40	015 9 40	019 6 20				
0°				013 - -	013 9 20	031 9 30	025 8 20	019 3 90	032 4 50	022 3 210	016 9 30	018 6 30	014 7 60	09 27 70		
10°S				016 4 50	027 3 350	034 9 190	046 4 340	027 10 270	025 3 140	035 2 60	019 10 20	019 6 330	024 6 240	024 5 220	036 3 350	
20°S				021 - -	020 1 300	029 4 270	027 - -	021 2 270	032 3 300	045 - -	021 5 300	019 2 280	019 13 260	019 4 310	042 2 290	
30°S				036 - -	012 9 80	011 5 90	09 7 140	011 10 240	012 8 10	021 2 270	032 3 300	020 2 270	021 9 300	015 7 300	038 5 280	012 - -
40°S				012 9 80	011 5 90	09 7 140	011 10 240	012 8 10	018 10 270	019 12 140	028 13 100	020 2 270	014 6 290	011 - -	- 5 120	
50°S				027 3 110	024 12 110	07 13 150	07 21 160	018 13 120	07 29 120	016 16 120	- 58 110	08 25 100	010 24 120	05 17 120	03 9 130	

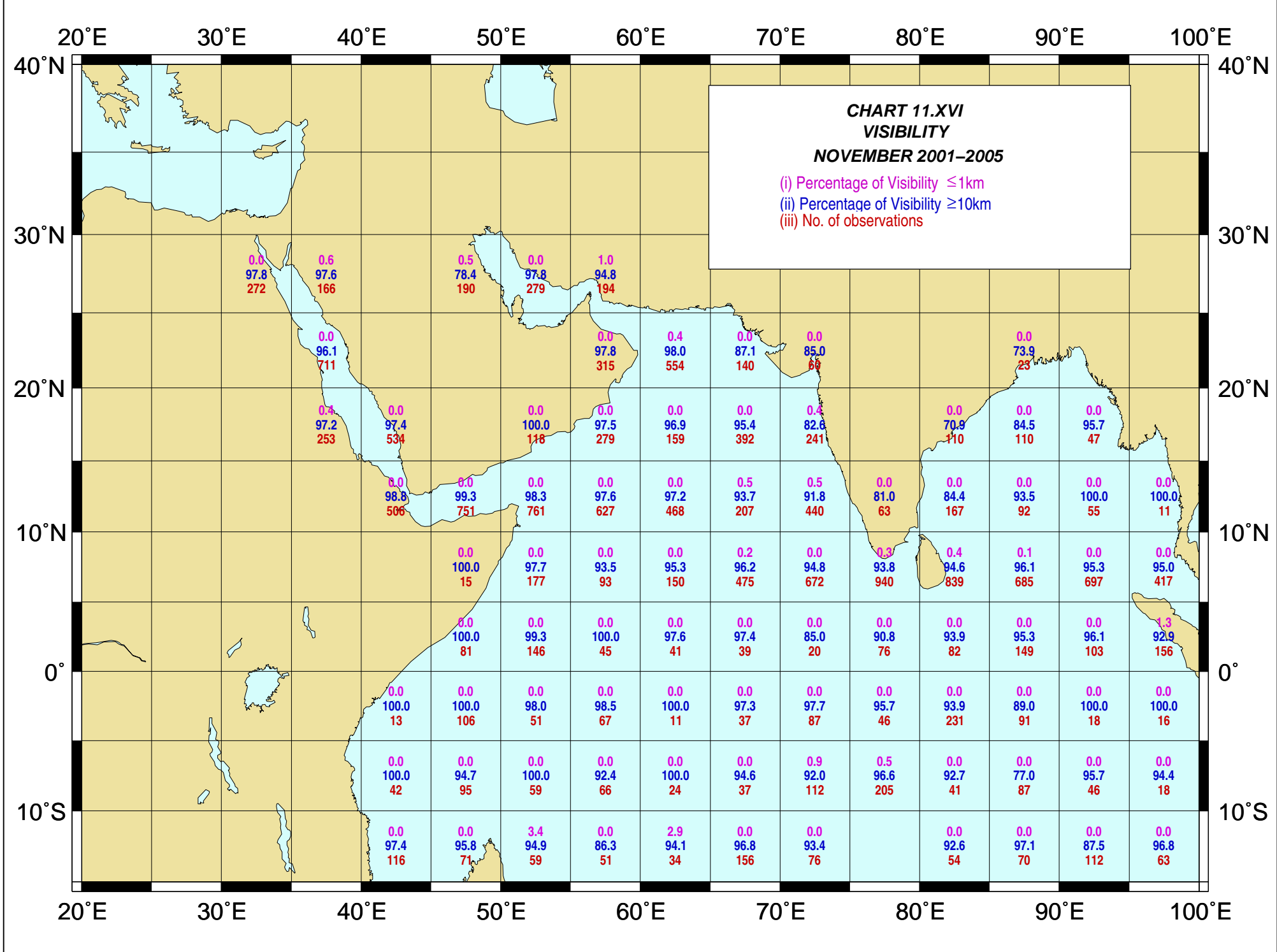


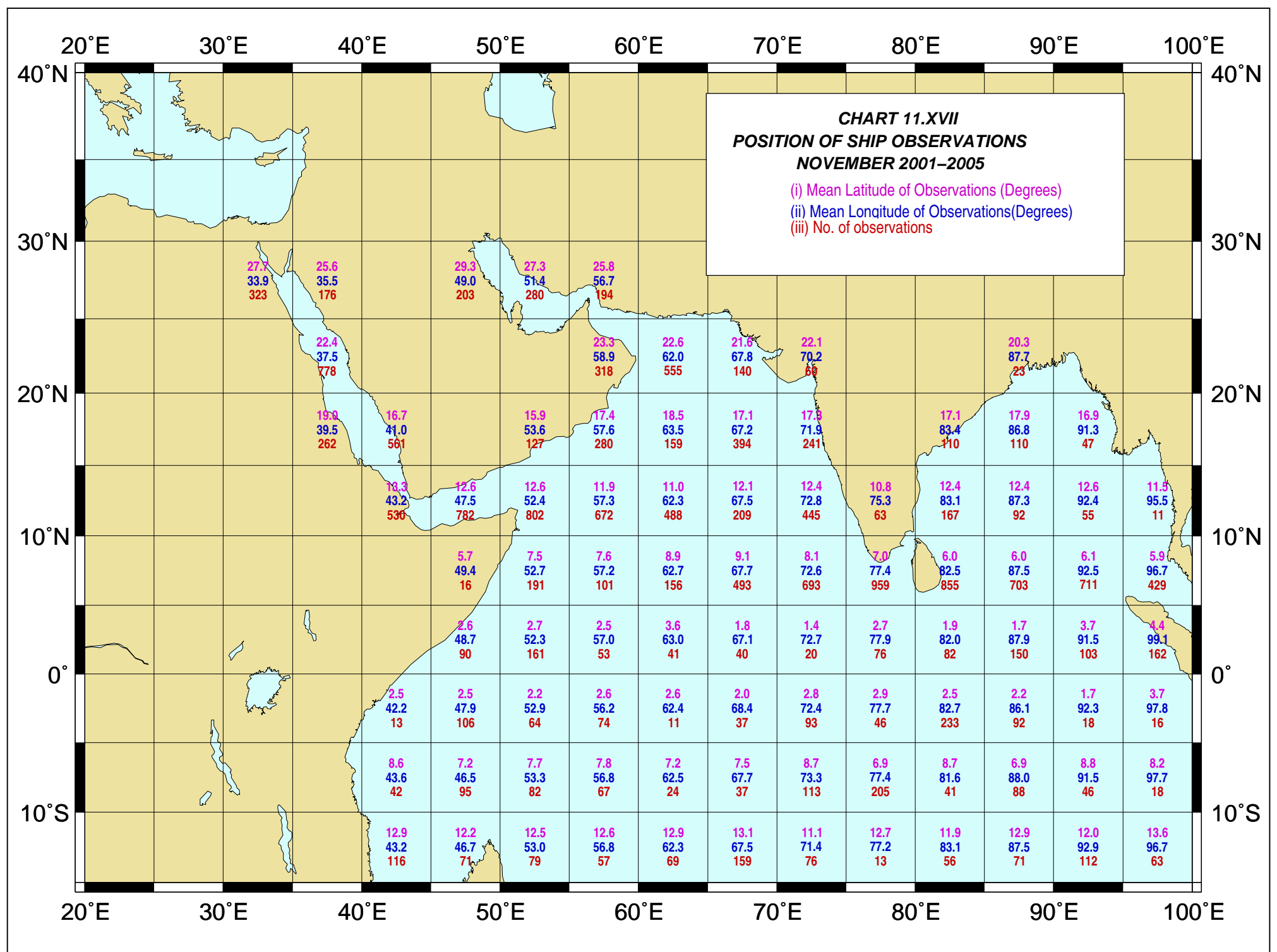


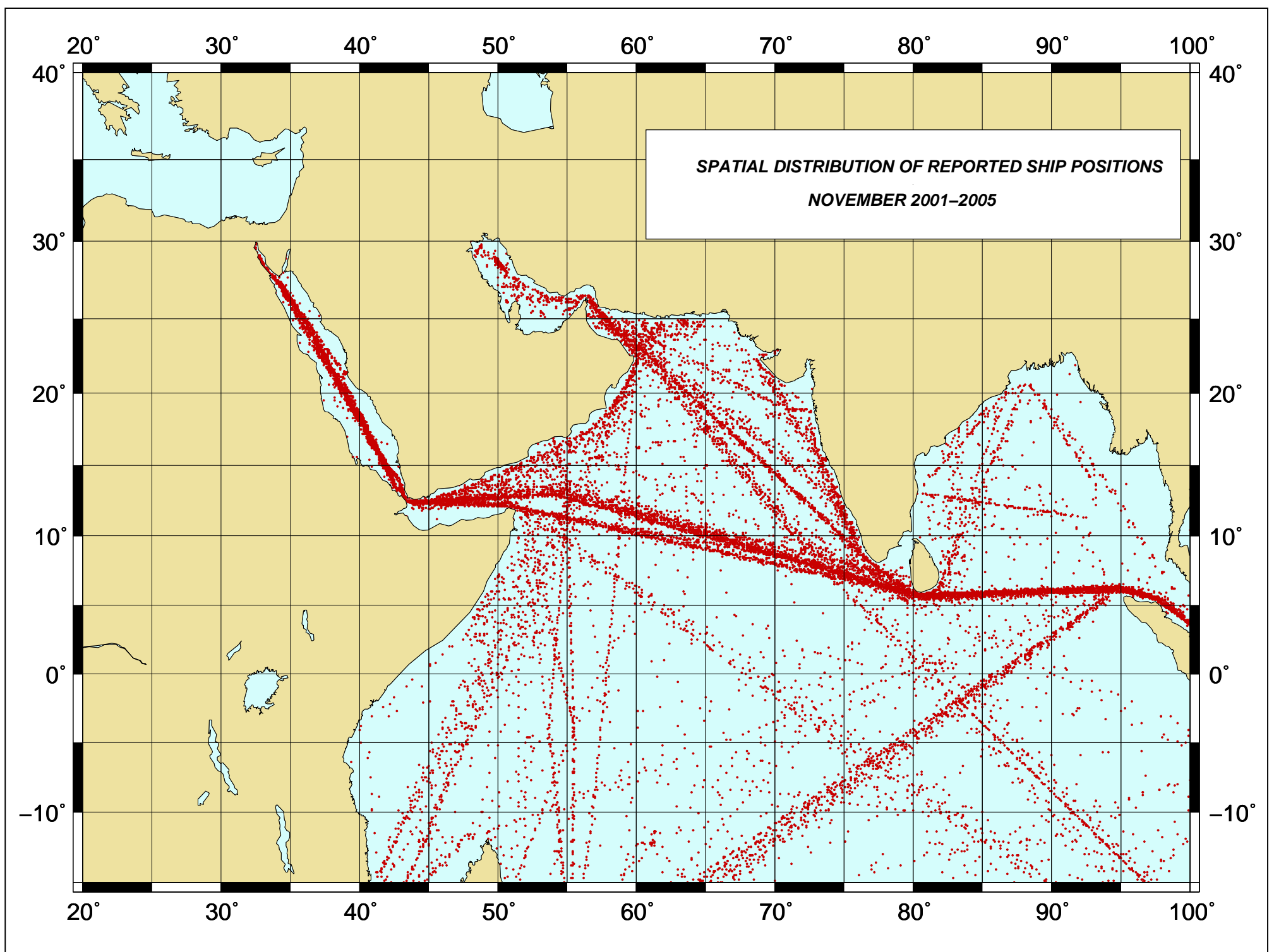




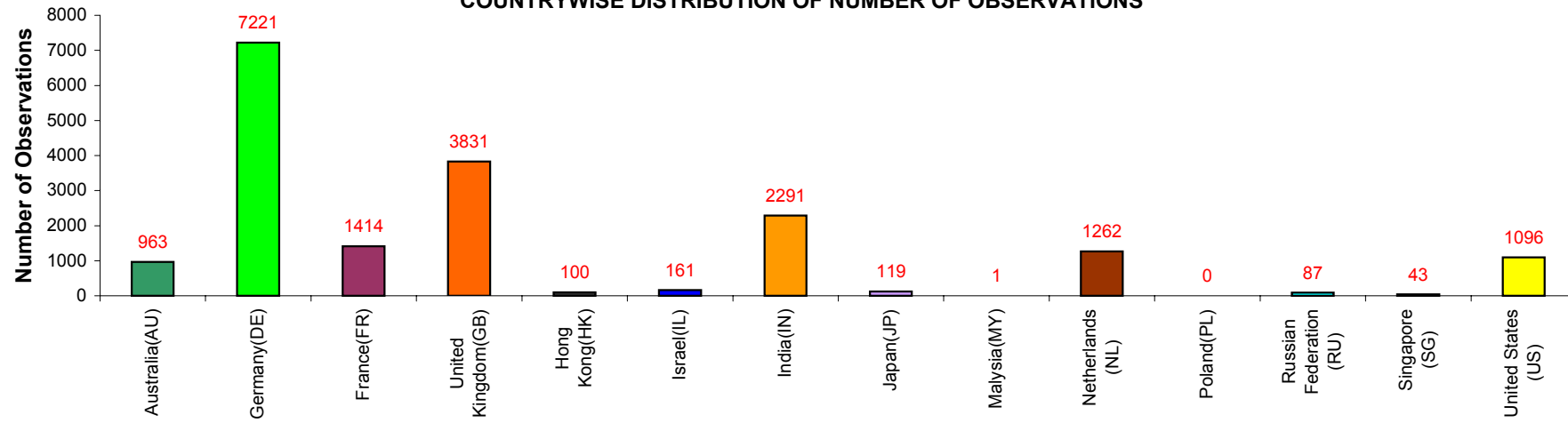




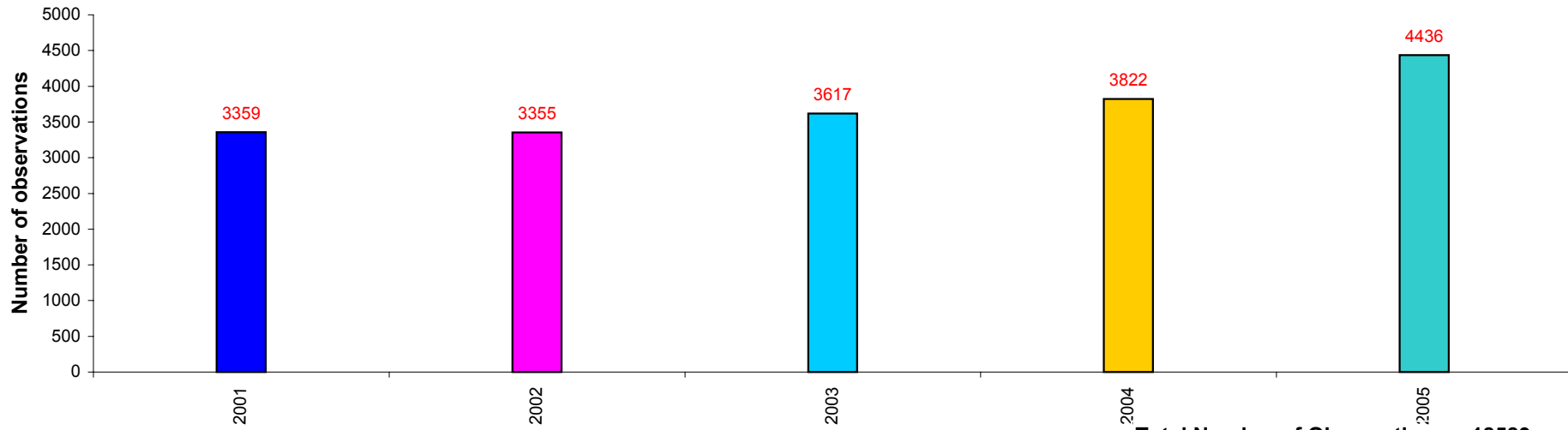




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CHARTS OF DECEMBER 2001 - 2005

CHART - I : AIR TEMPERATURE

CHART - II : SEA SURFACE TEMPERATURE

CHART - III : DEW POINT TEMPERATURE

CHART - IV : AIR-SEA TEMPERATURE DIFFERENCE

CHART - V : WIND SPEED

CHART - VI : WIND DIRECTION

CHART - VII : LIGHT AND STRONG WINDS

CHART - VIII : GALE AND MAXIMUM WINDS

CHART - IX : WAVE HEIGHT

CHART - X : FREQUENCY DISTRIBUTION OF HEIGHTS

CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

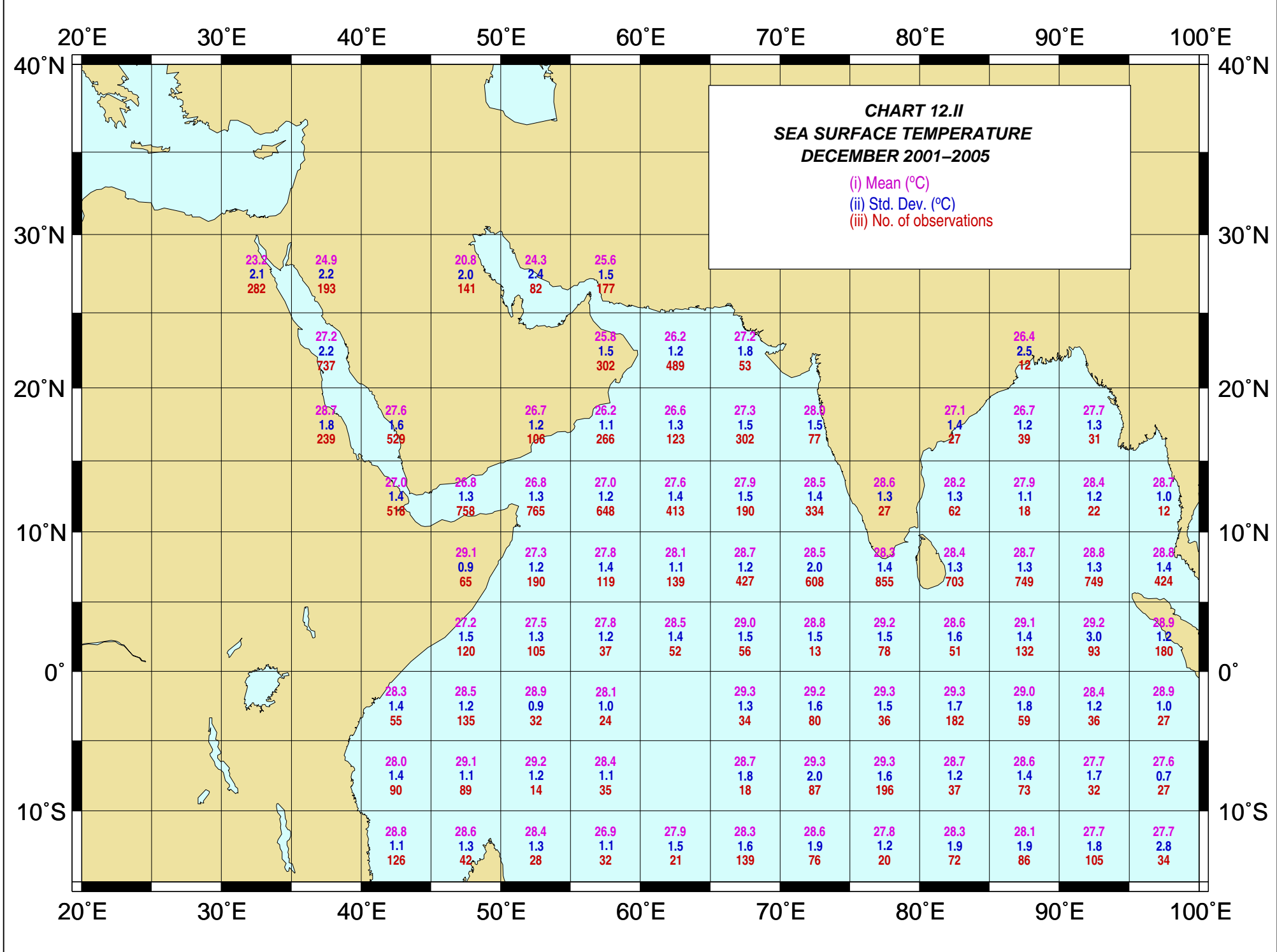
CHART - XVI : VISIBILITY

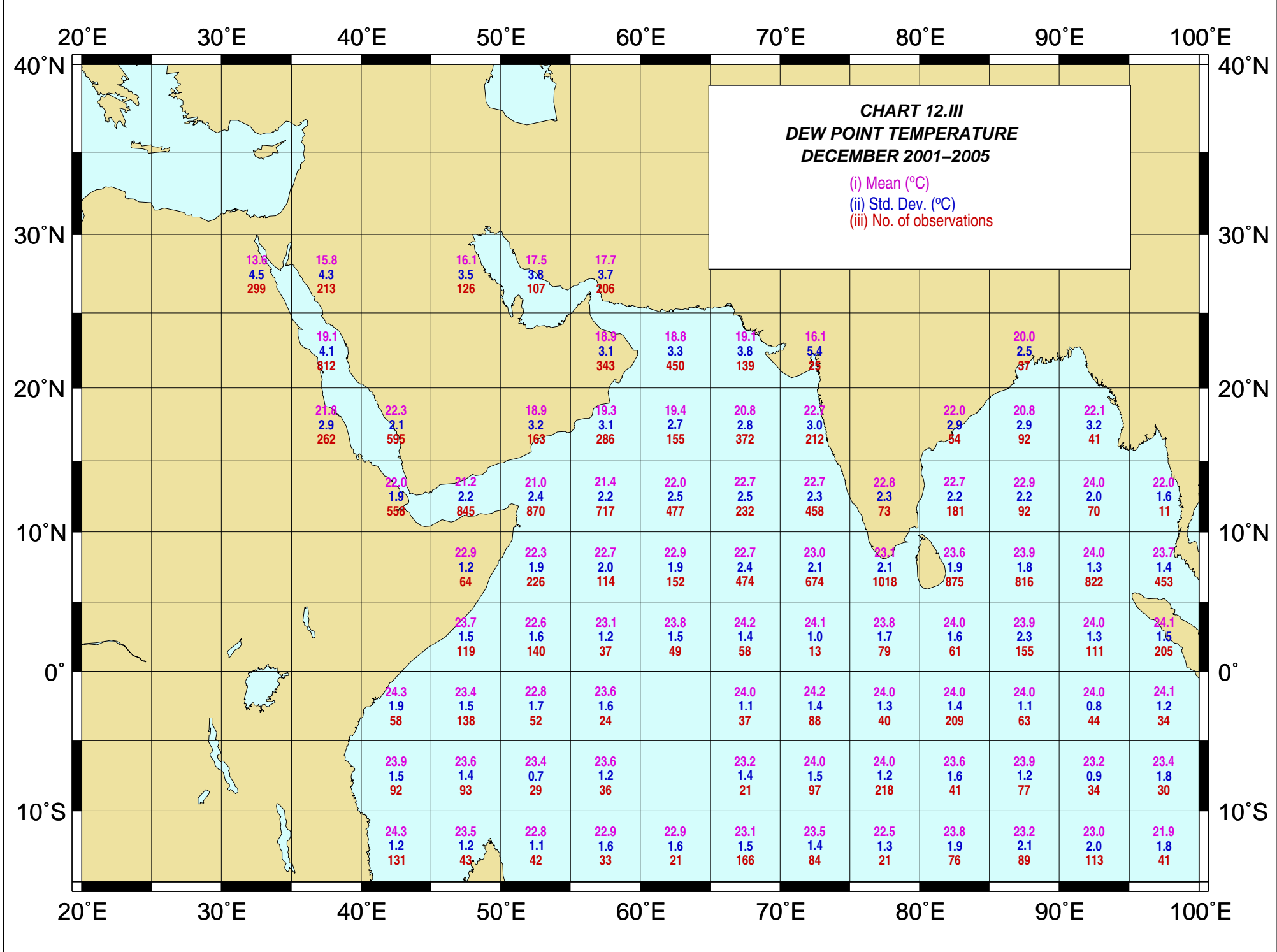
CHART - XVII : POSITION OF SHIP OBSERVATIONS

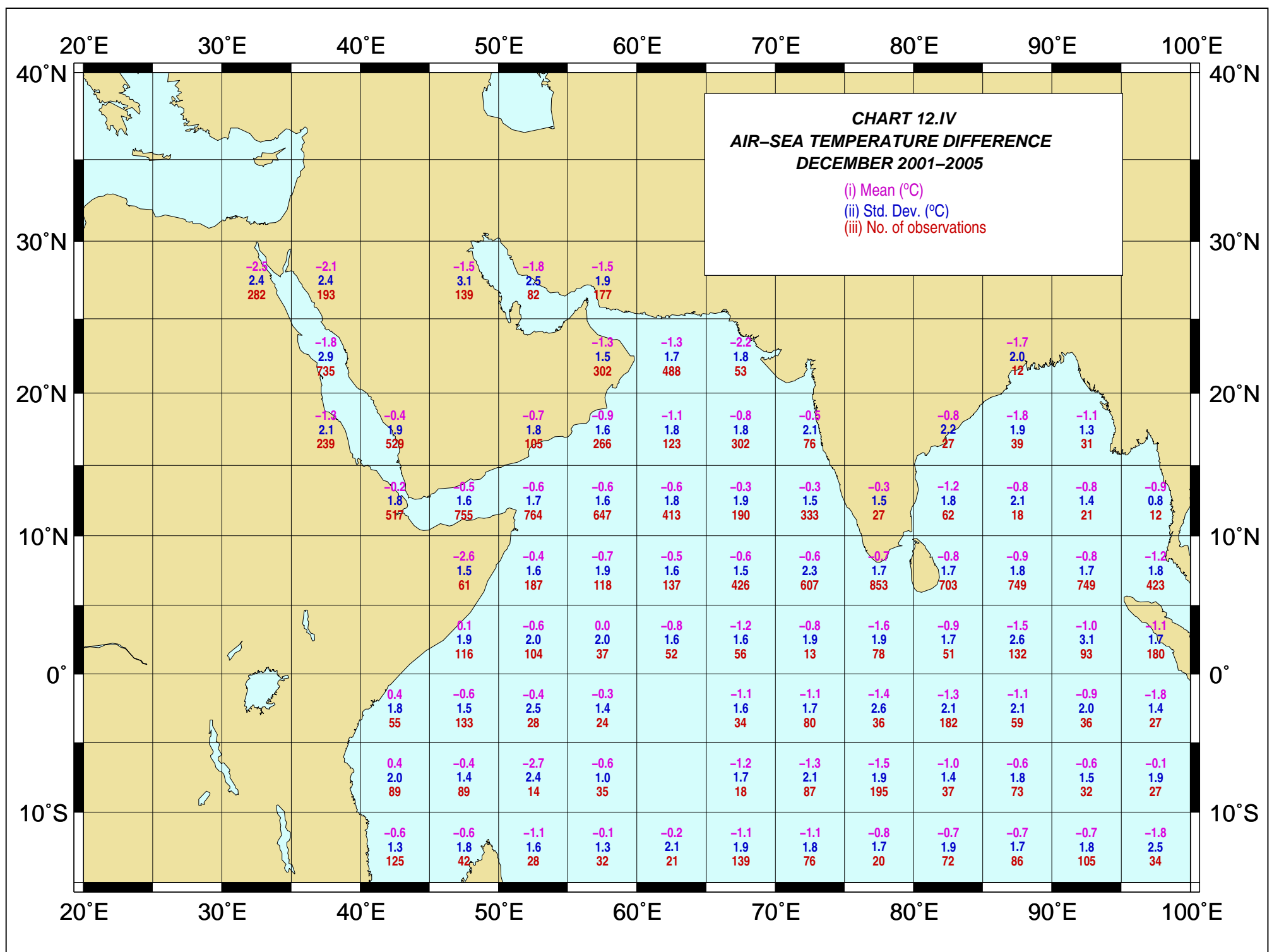
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

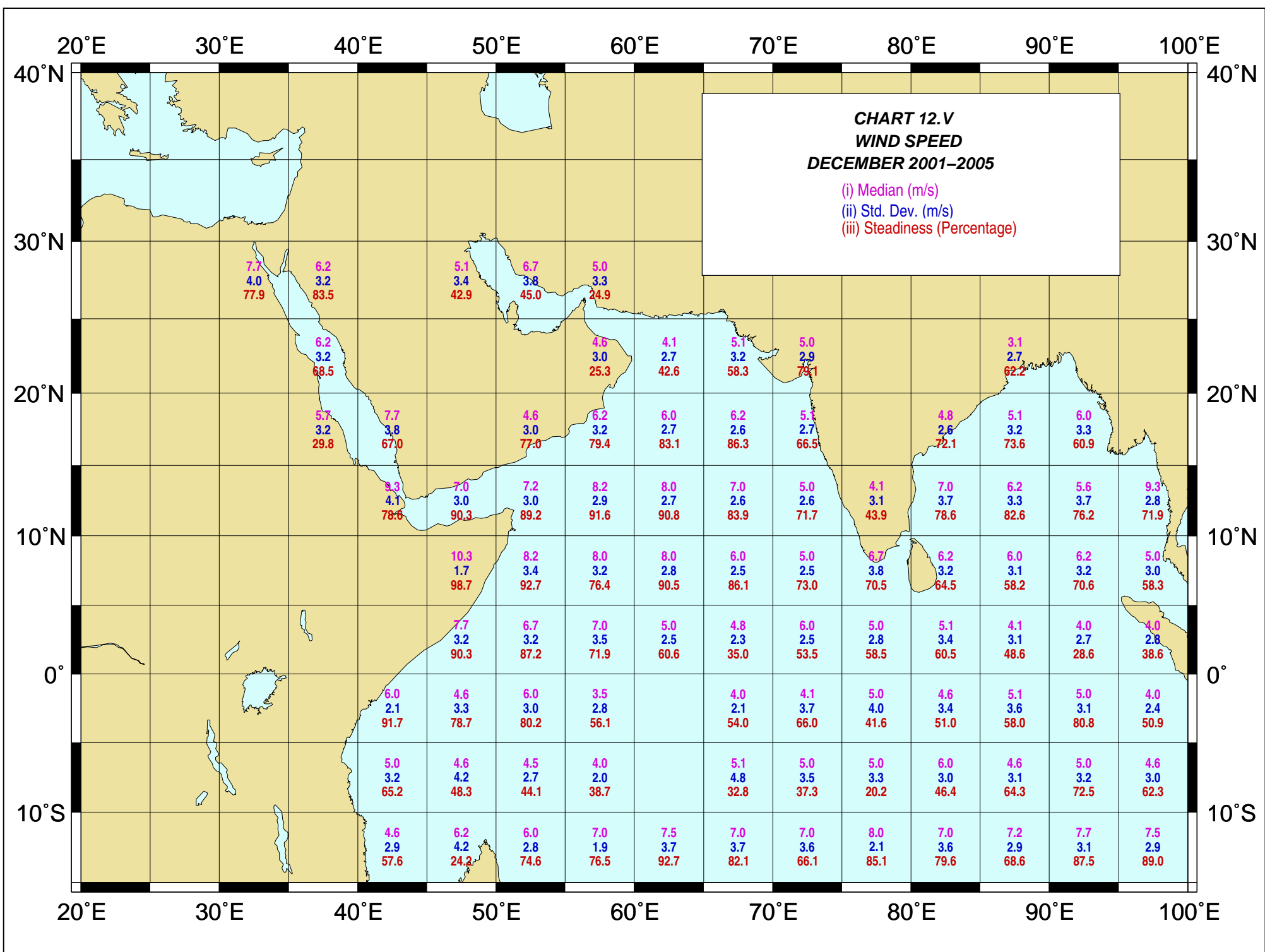
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

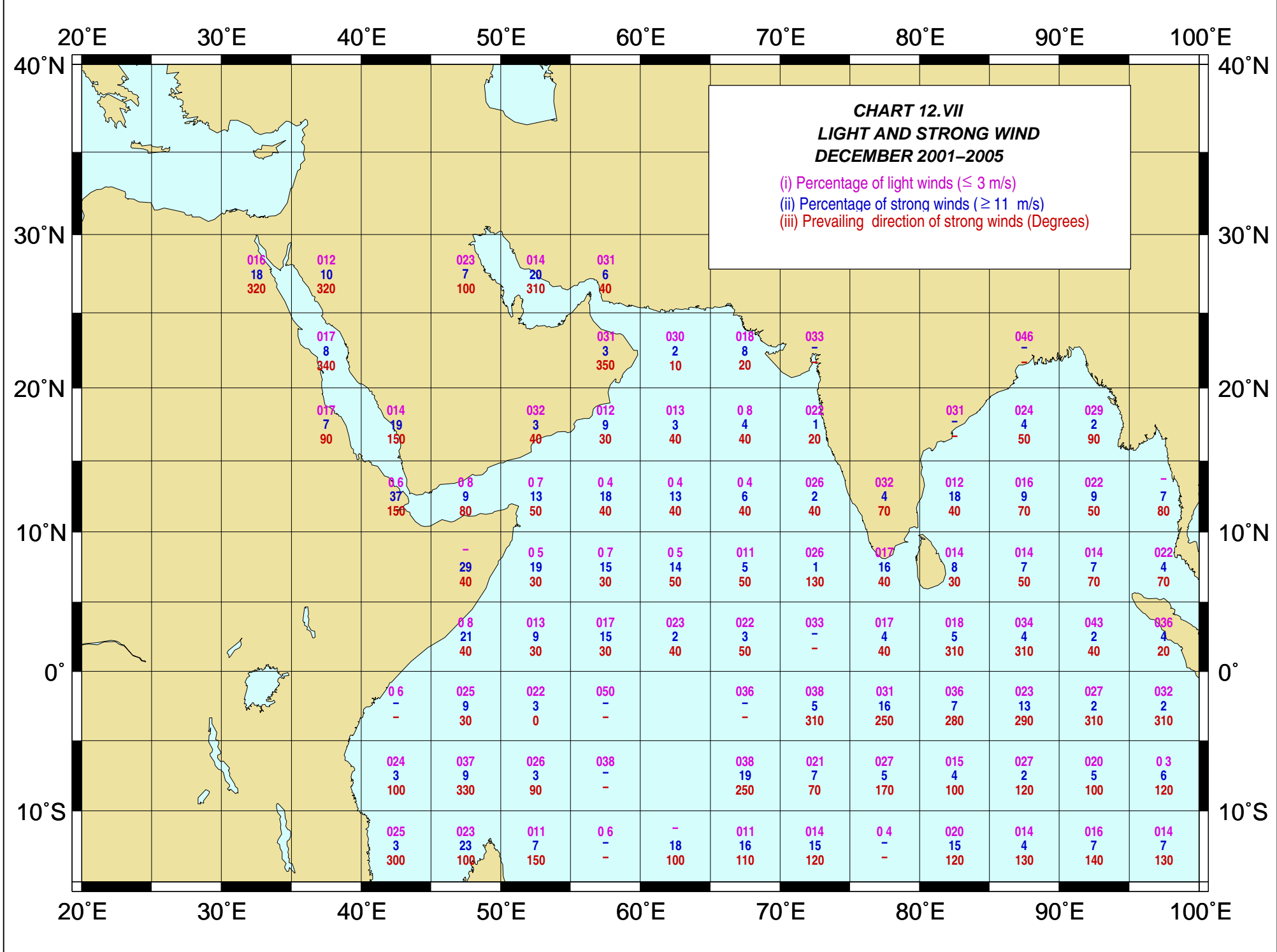
**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**

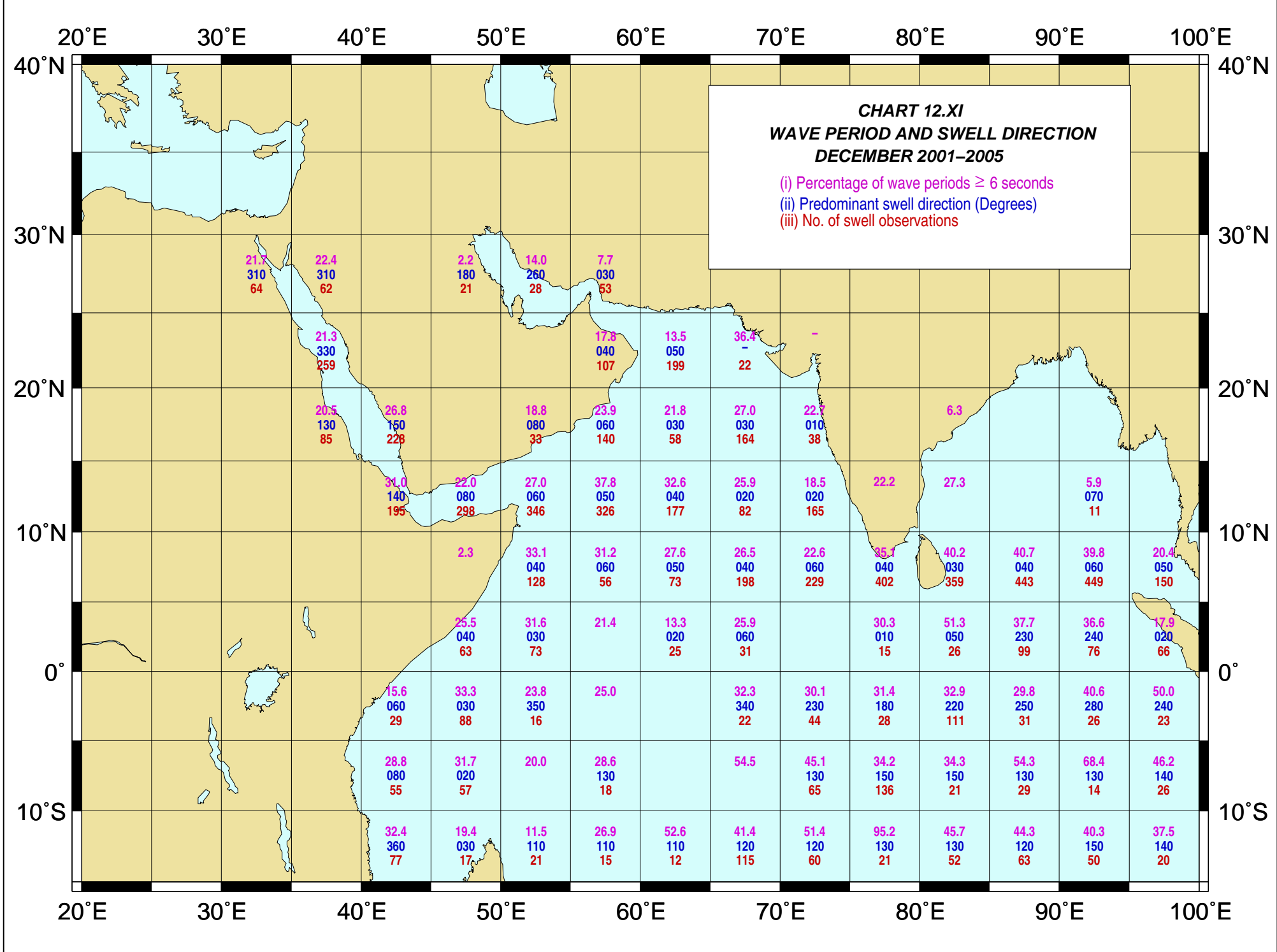


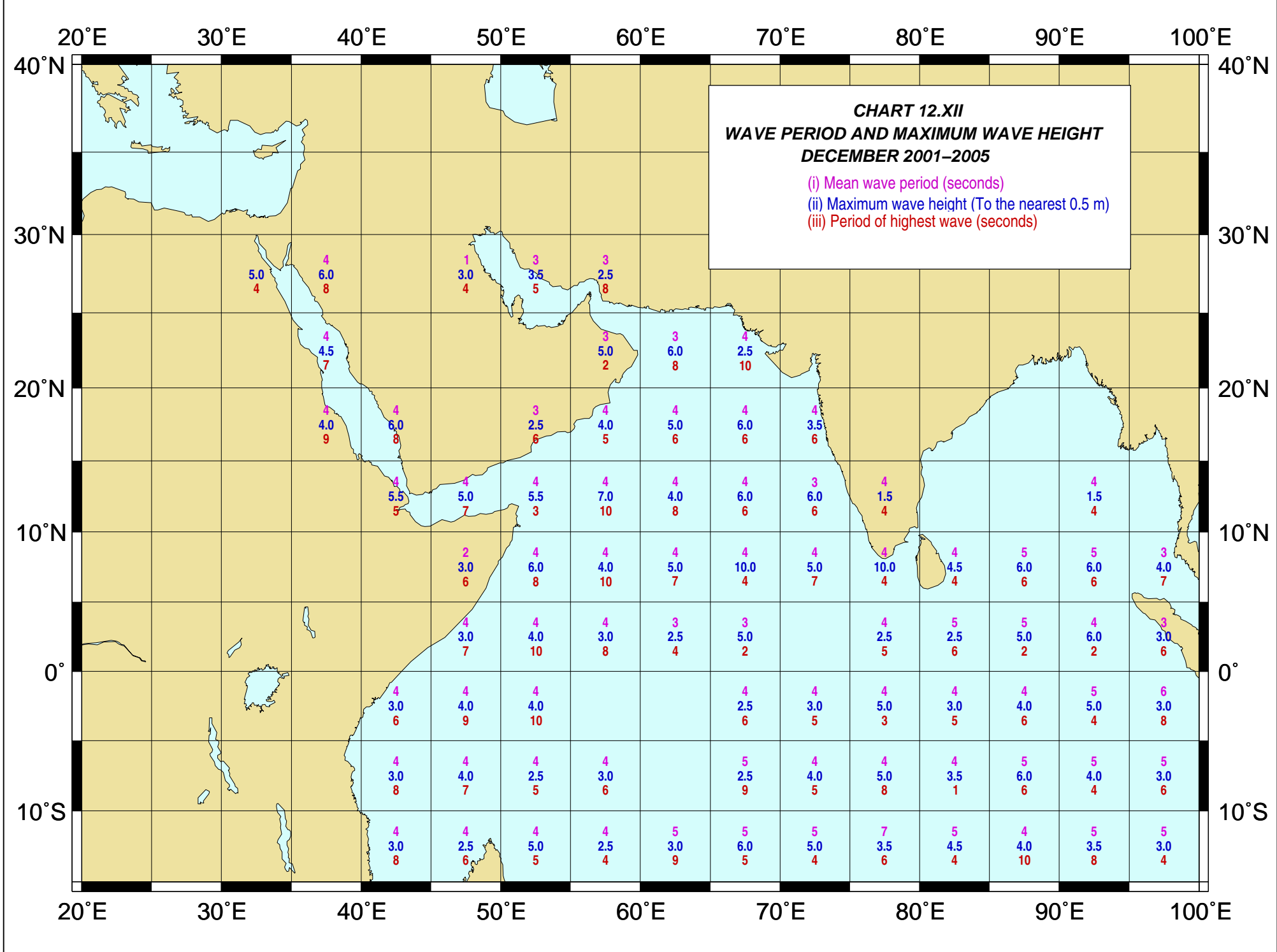


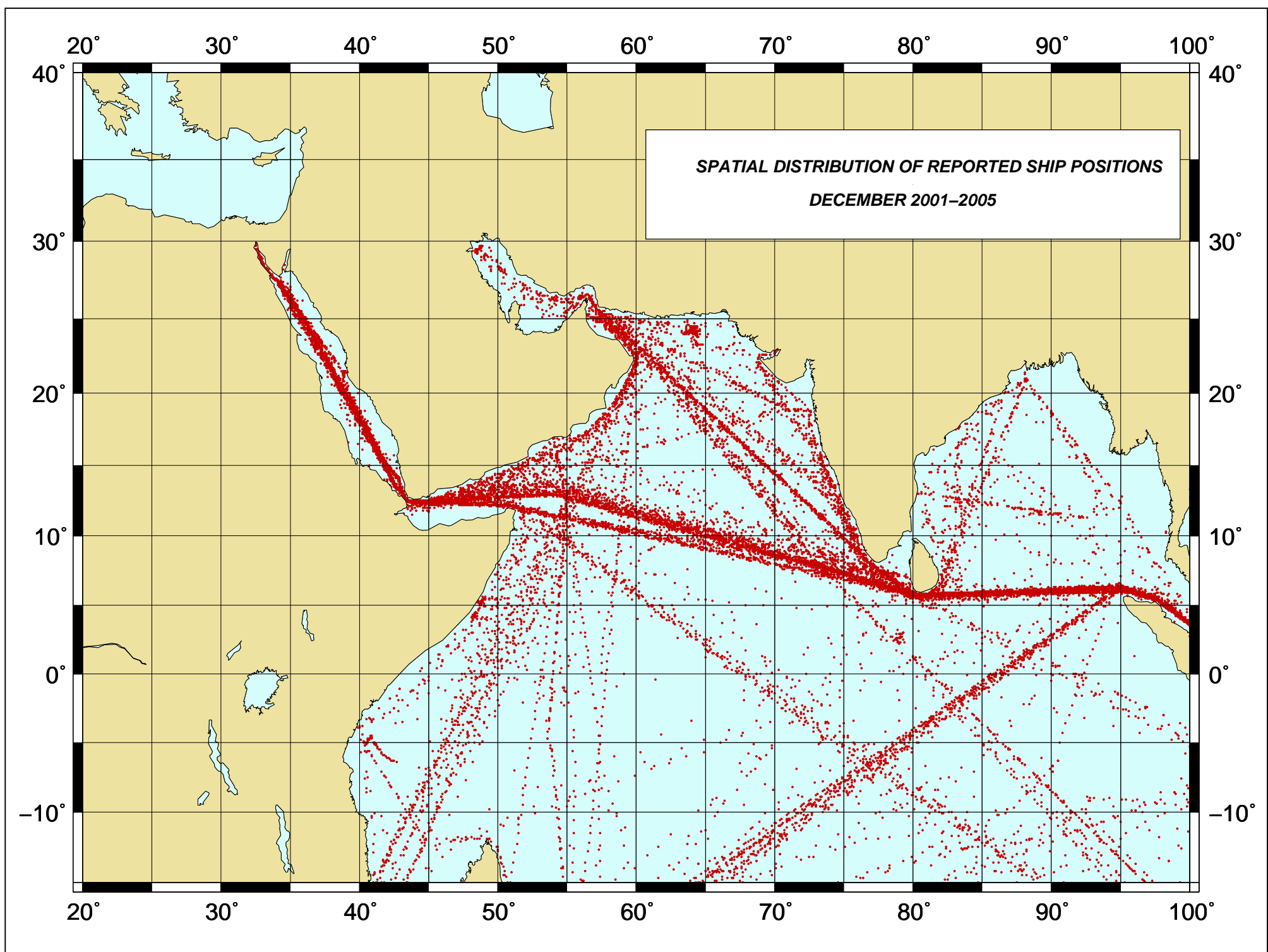




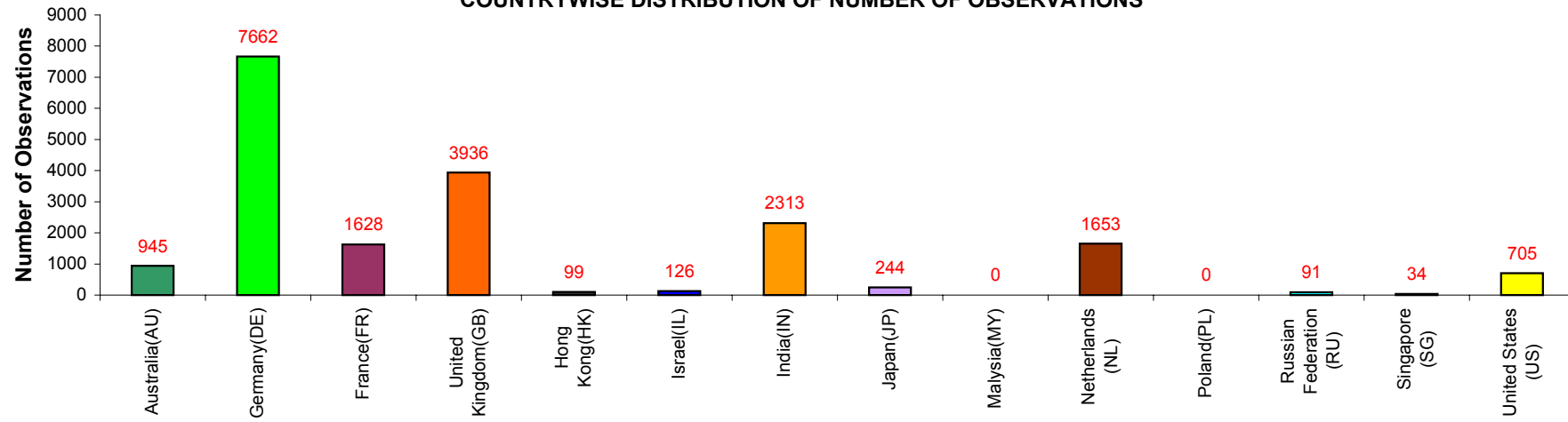




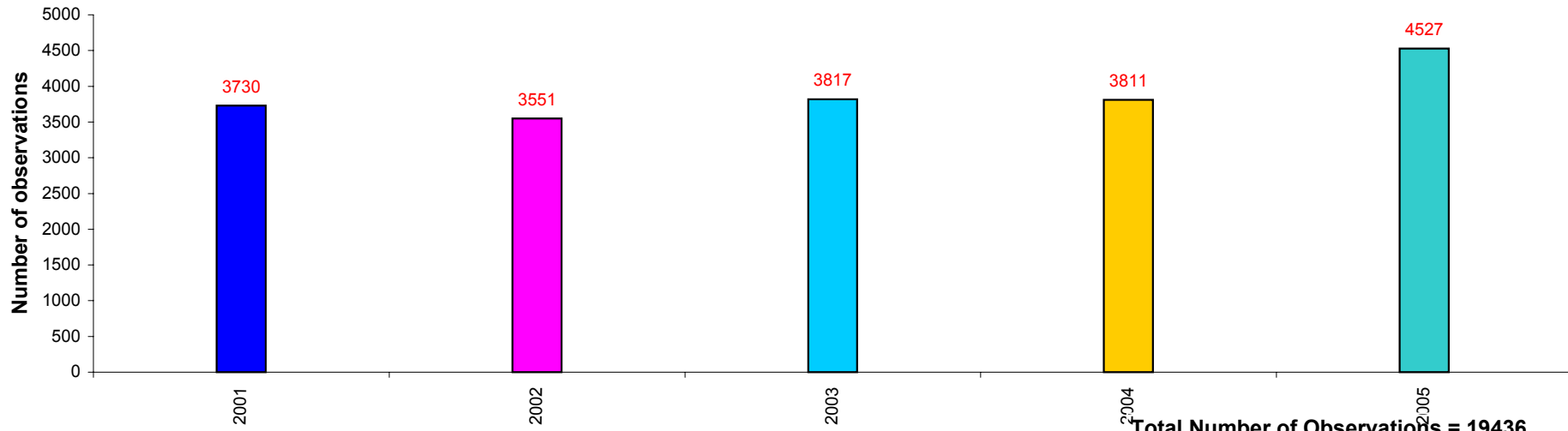




DECEMBER : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS





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CHART - IX : WAVE HEIGHT

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CHART - XI : WAVE PERIOD AND SWELL DIRECTION

CHART - XII : WAVE PERIOD AND MAXIMUM WAVE HEIGHT

CHART - XIII : MEAN SEA LEVEL PRESSURE

CHART - XIV : PRECIPITATION

CHART - XV : TOTAL CLOUD AMOUNT

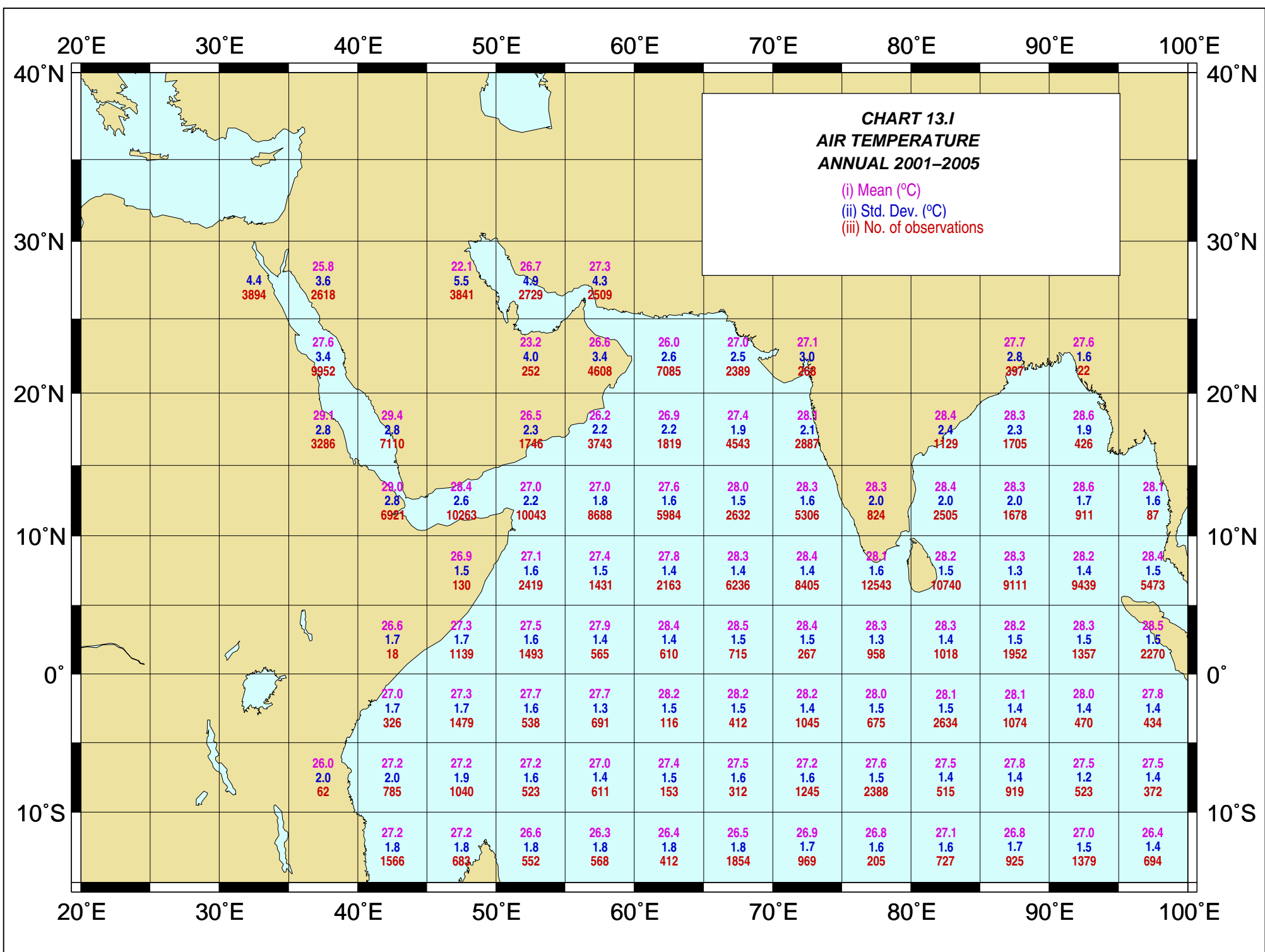
CHART - XVI : VISIBILITY

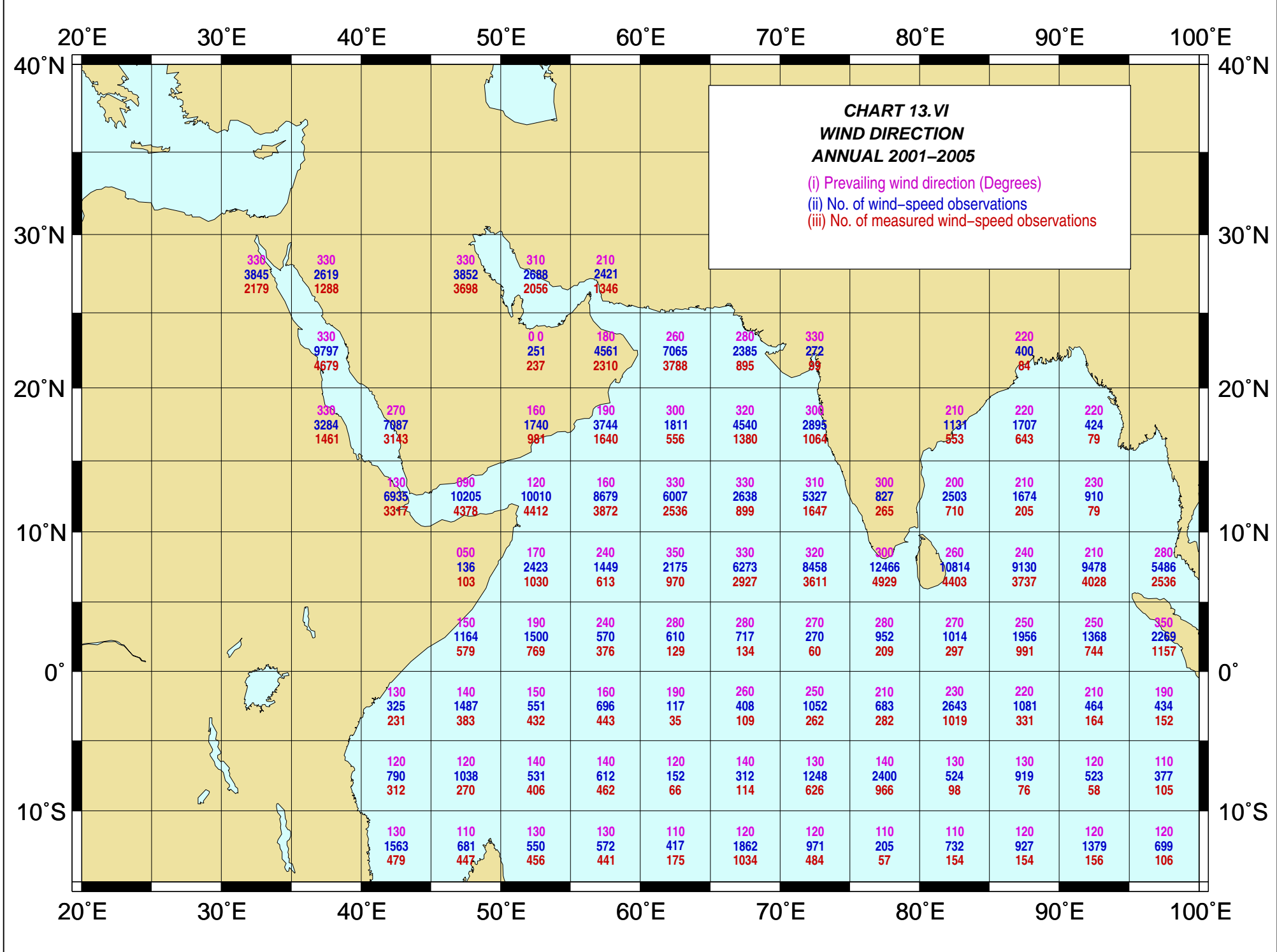
CHART - XVII : POSITION OF SHIP OBSERVATIONS

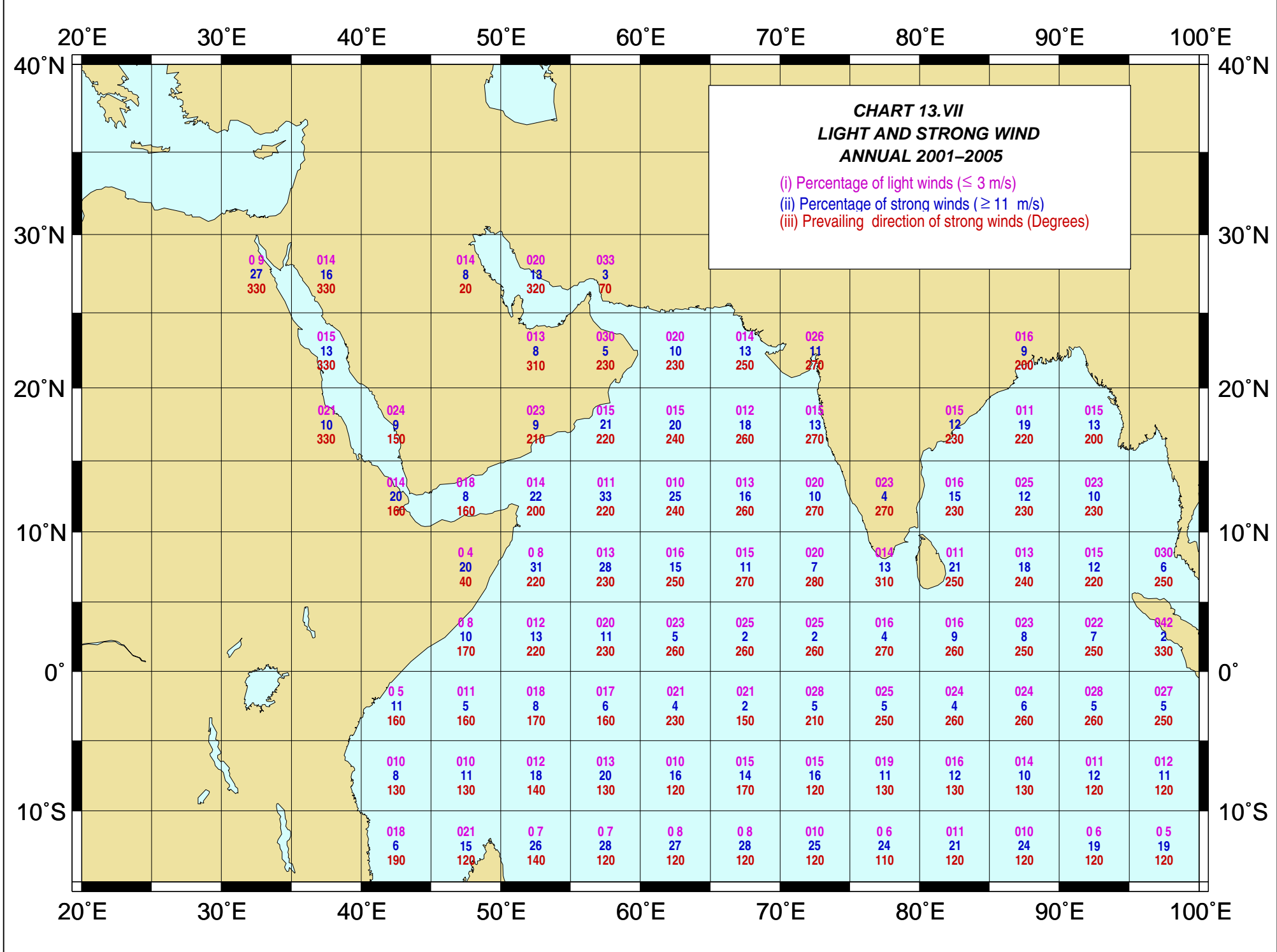
CHART - XVIII : STANDARD DEVIATION OF POSITIONS

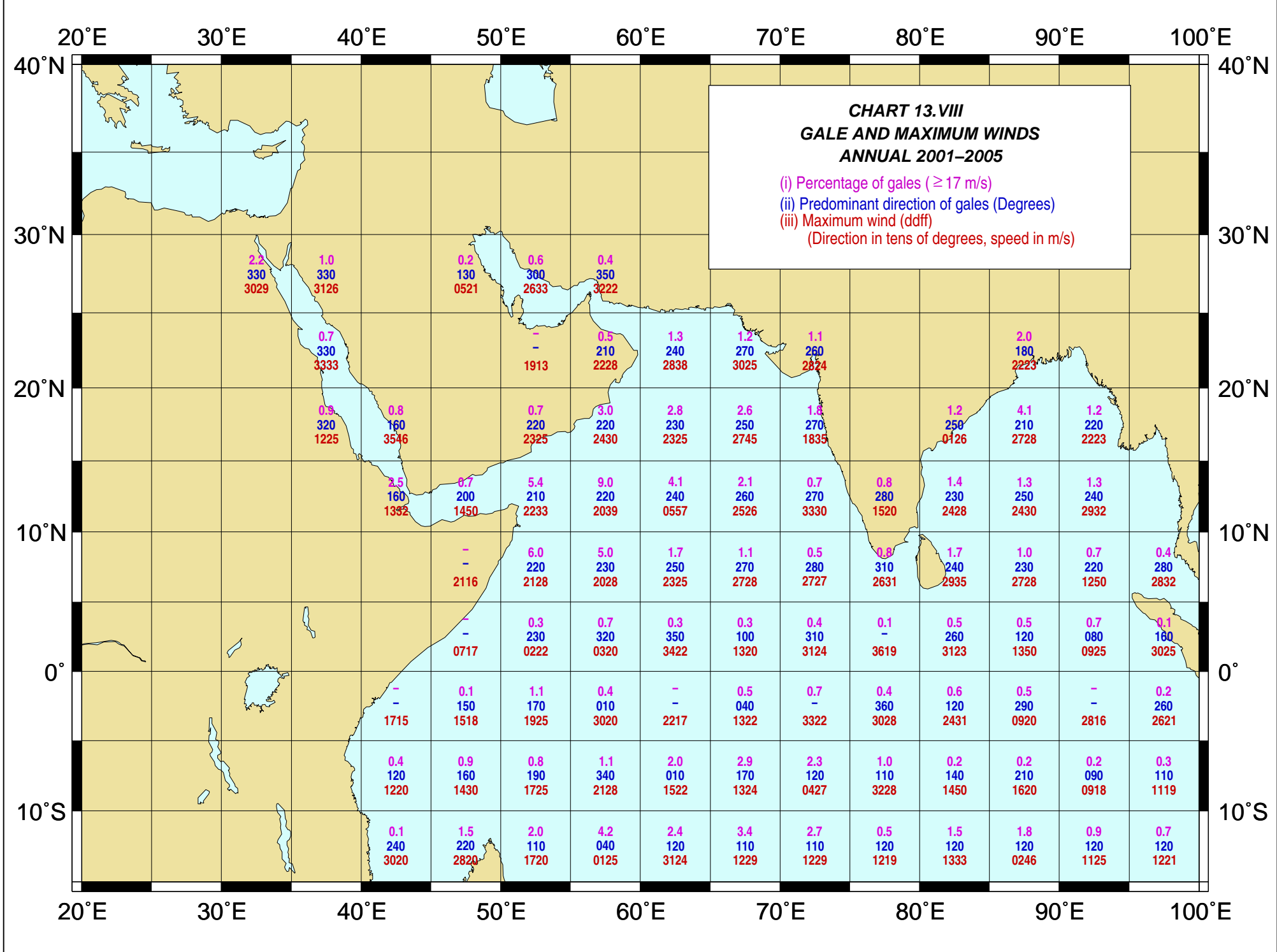
SPATIAL DISTRIBUTION OF REPORTED SHIP POSITIONS

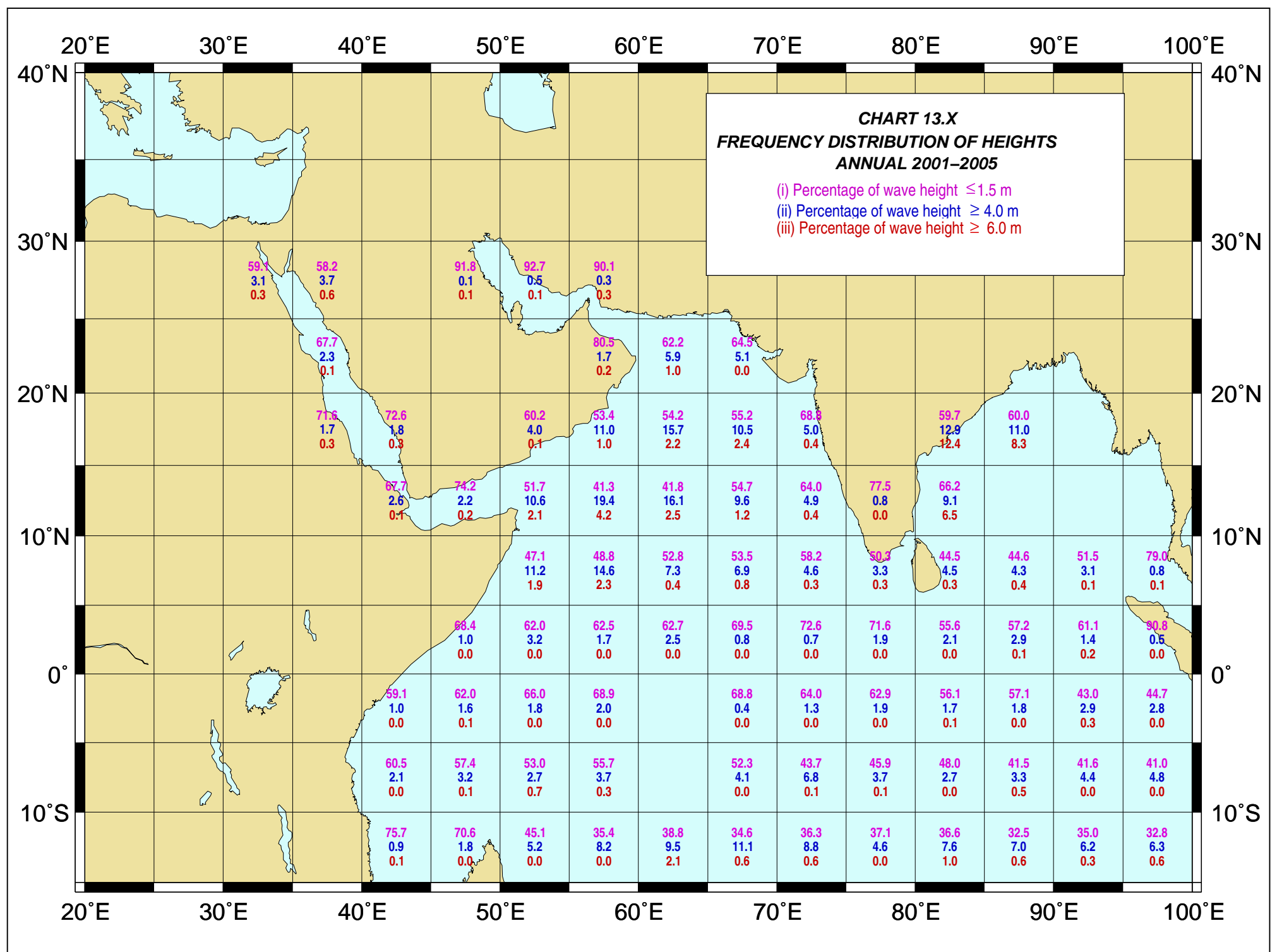
**COUNTRYWISE AND YEARWISE DISTRIBUTION
OF NUMBER OF OBSERVATIONS**

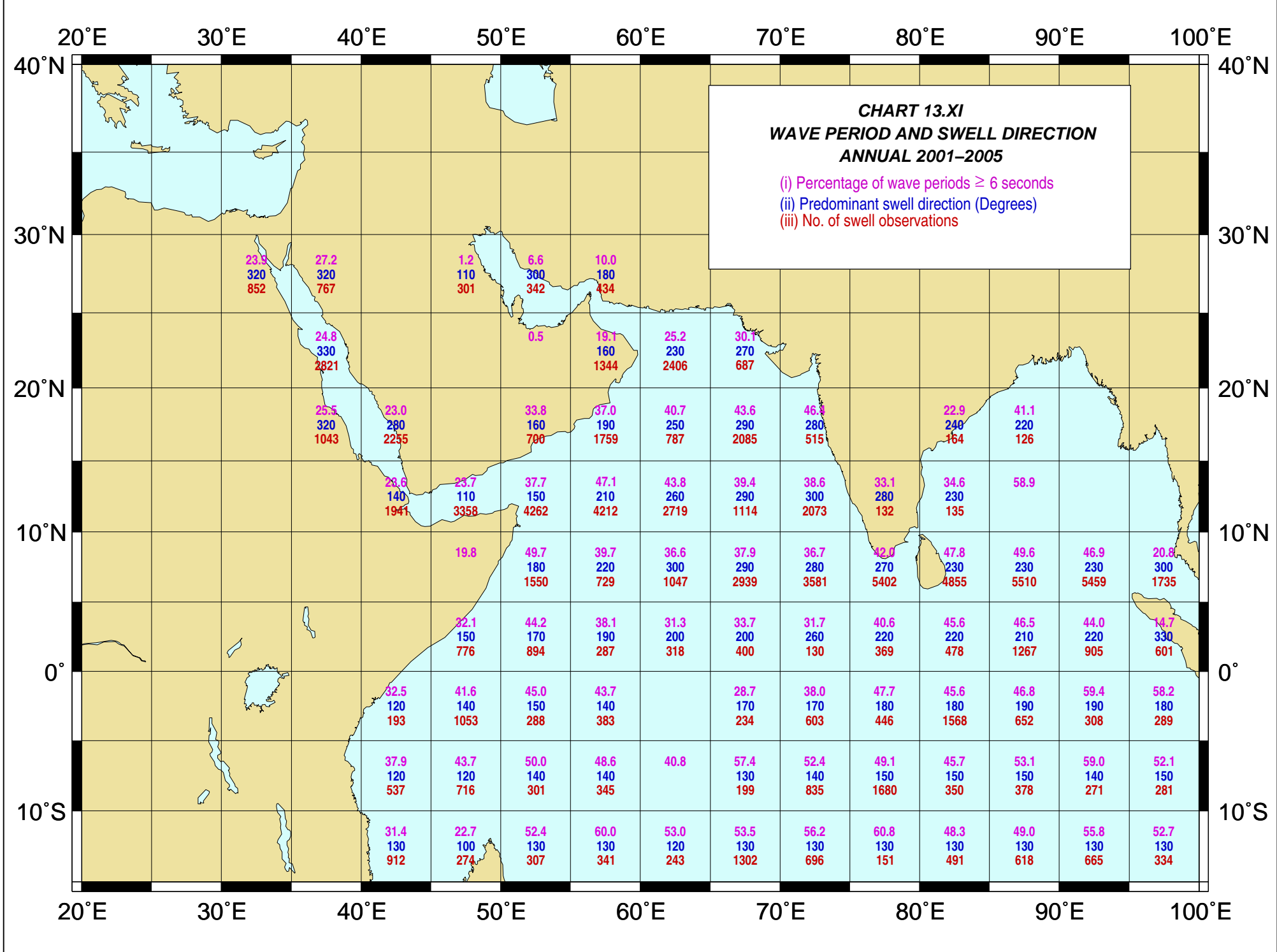


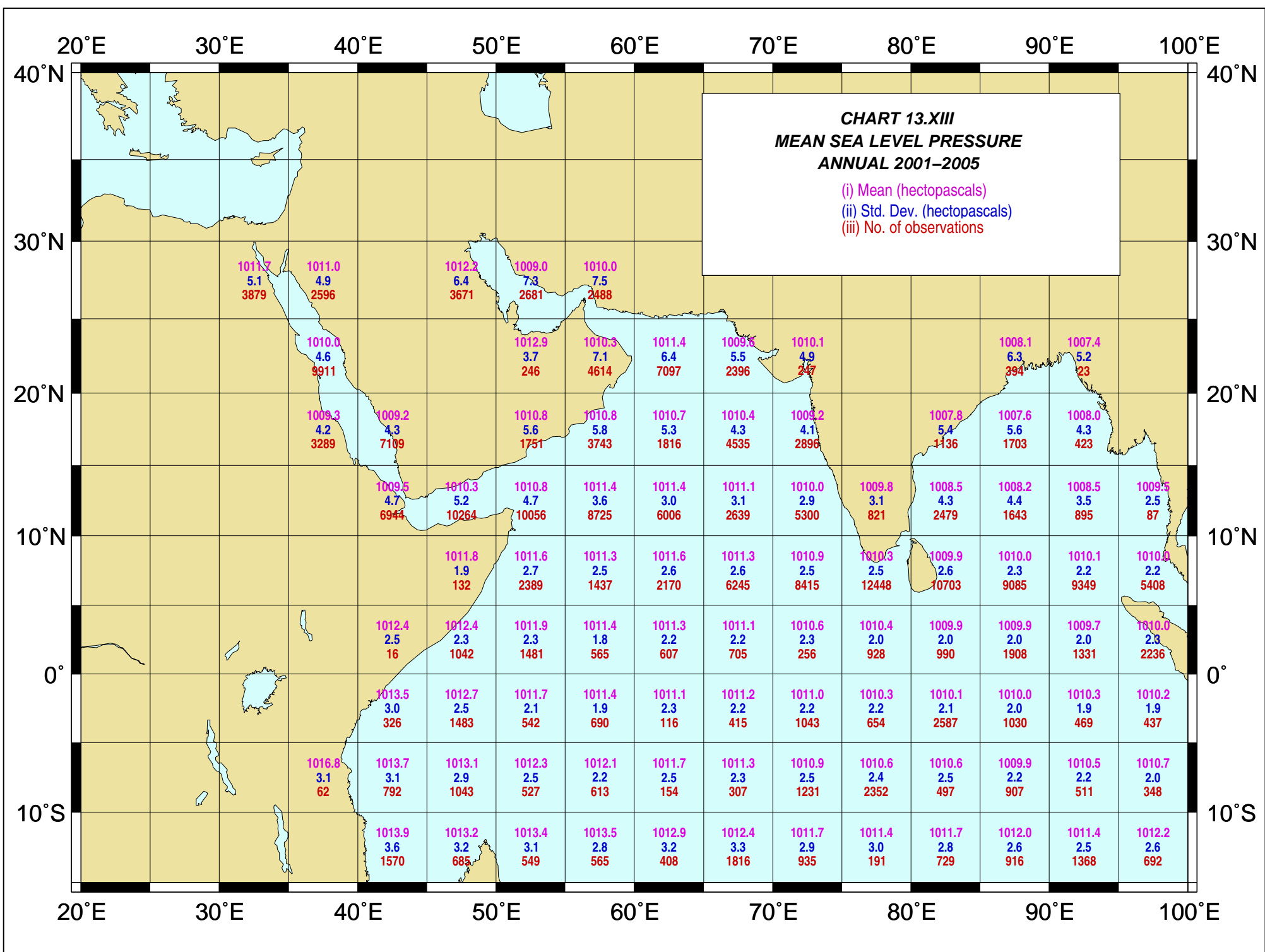


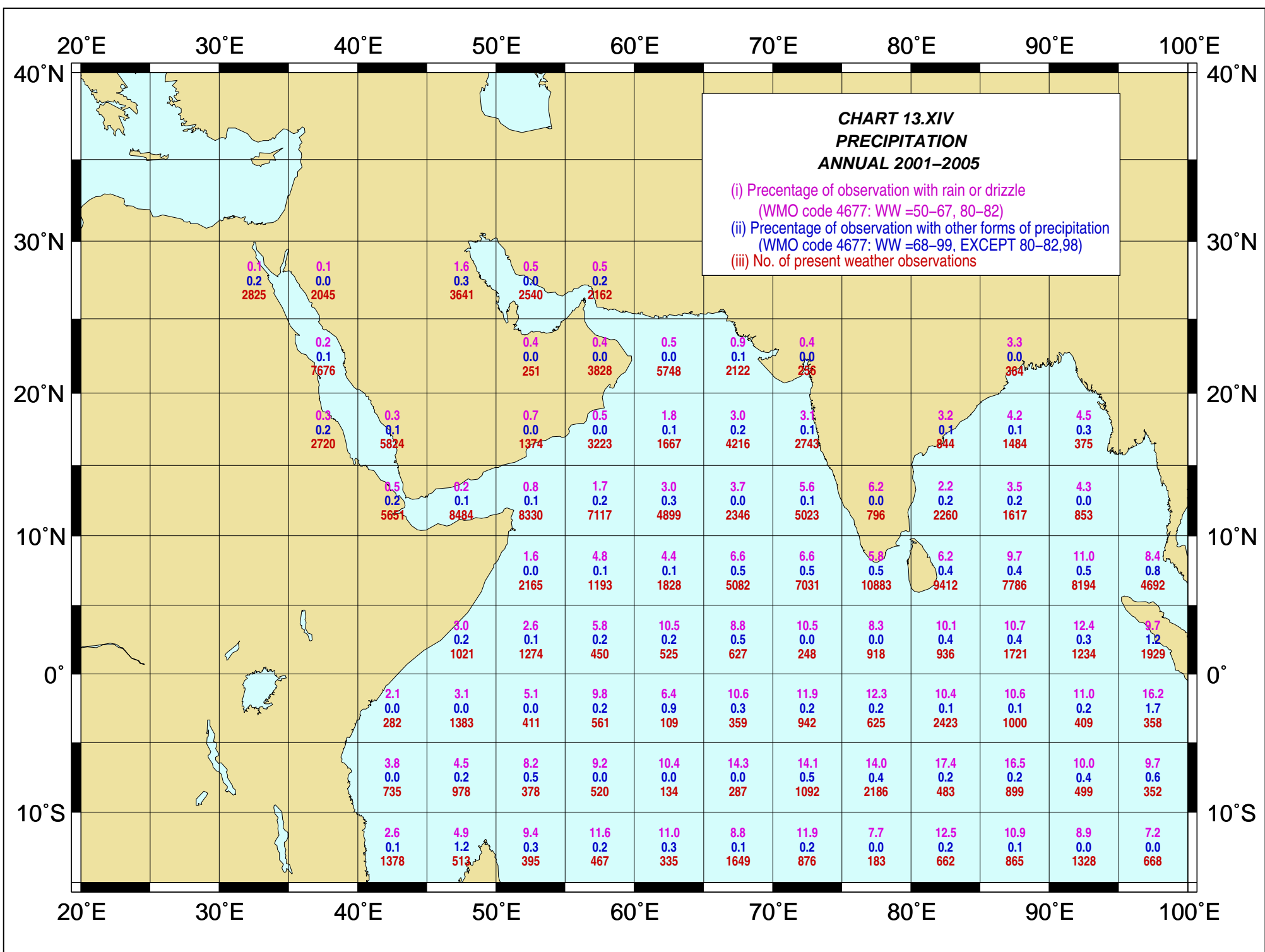


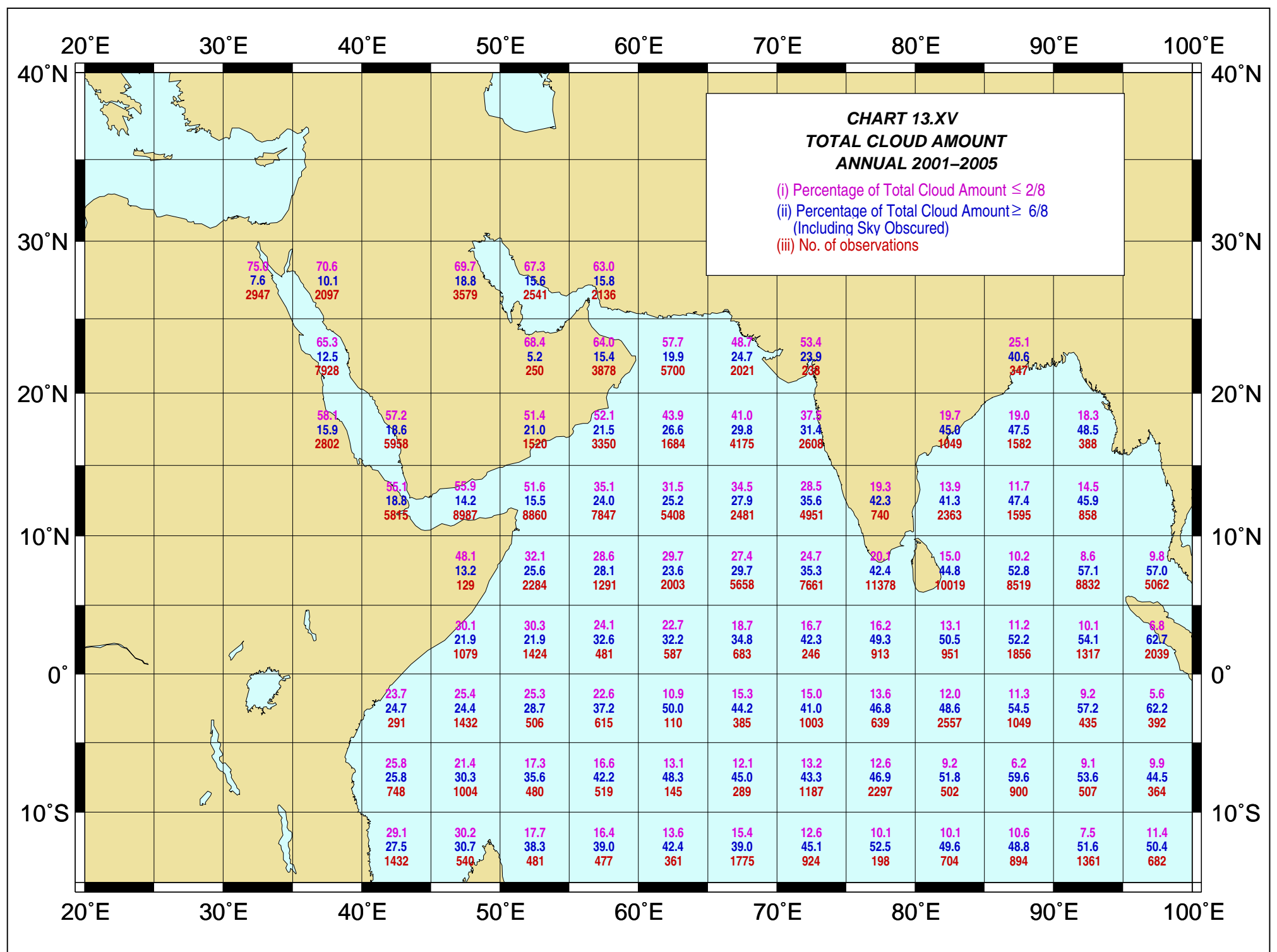


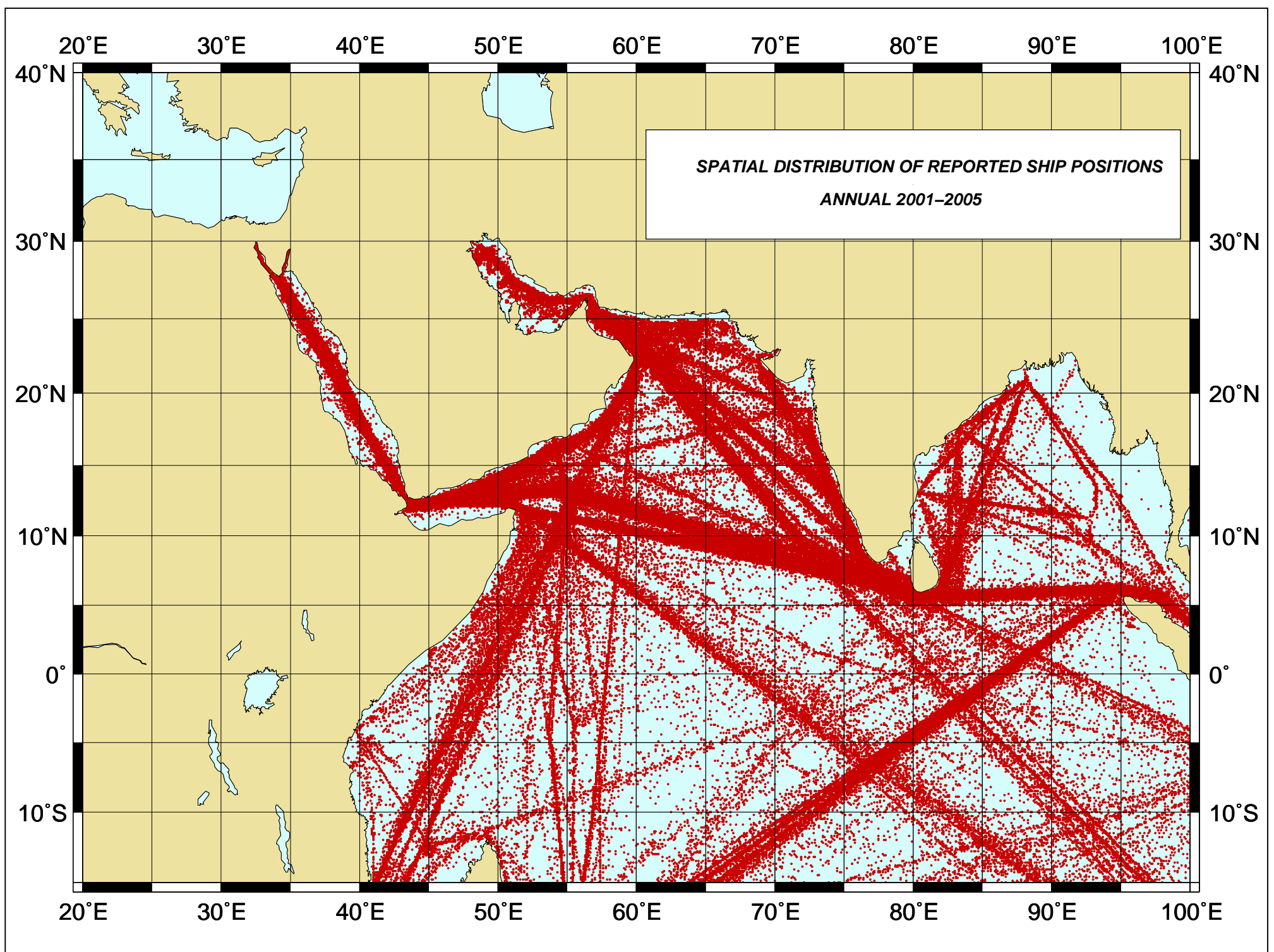




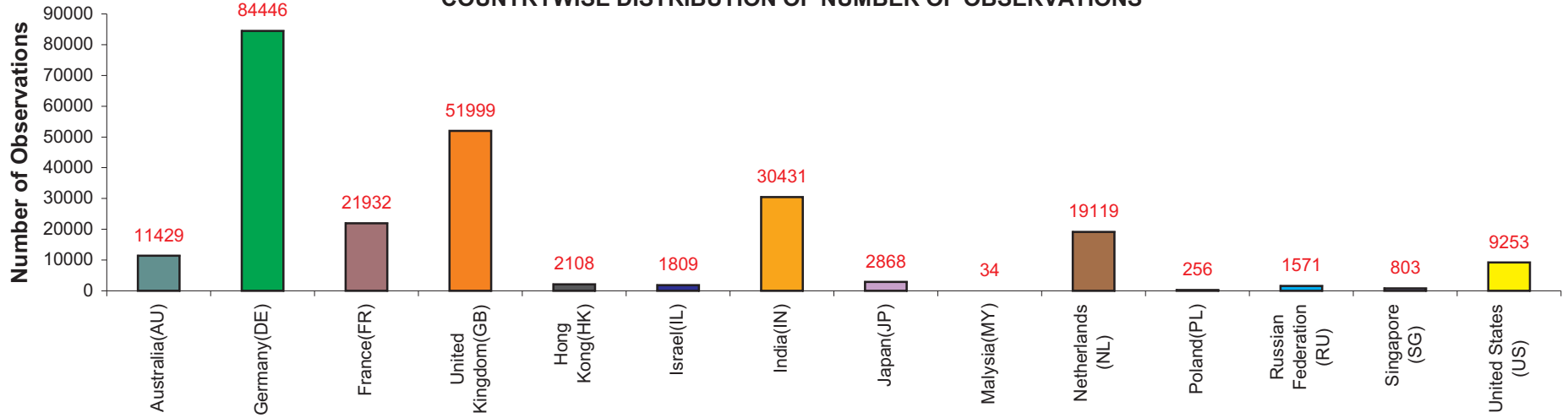




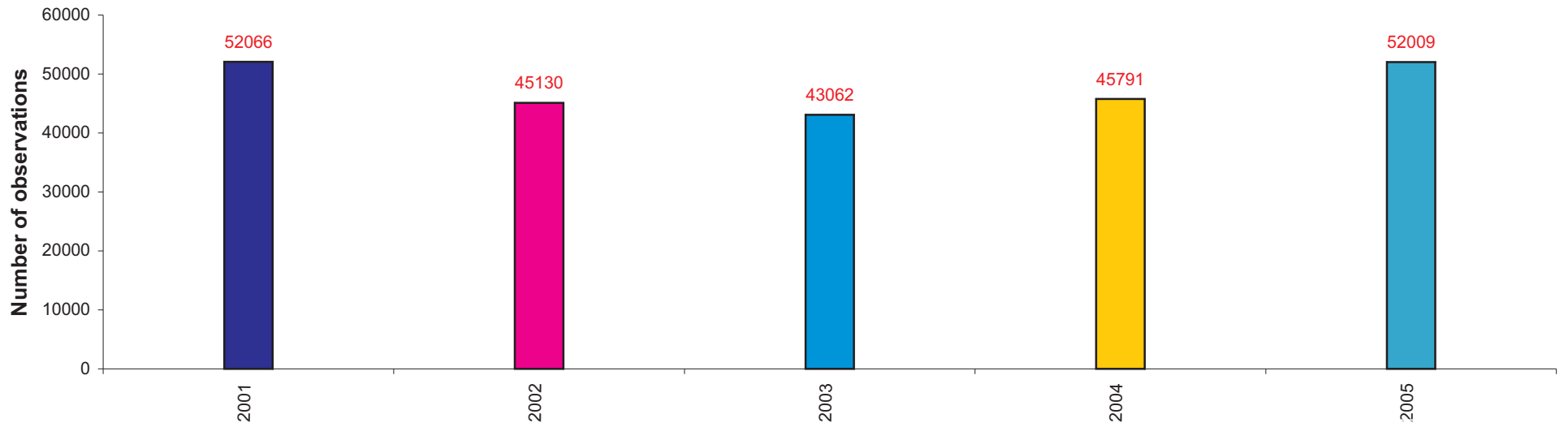




ANNUAL : 2001- 2005
COUNTRYWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



YEARWISE DISTRIBUTION OF NUMBER OF OBSERVATIONS



Total Number of Observations = 238058