I.O.S.

SURFACE CURRENTS OF THE INDIAN OCEAN
(TO 25°S, 100°E)

BY

A.N. CUTLER & J.C. SWALLOW

REPORT NO. 187

1984

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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INSTITUTE OF OCEANOGRAPHIC SCIENCES

WORMLEY

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CONTENTS

	Page
Introduction	3
Some points of interest	4
Acknowledgements	6
References	7
Charts	

INTRODUCTION

Historical data on surface currents seem relatively neglected, in comparison to winds and sea surface temperatures. This is not surprising, in view of their notorious errors, both random and systematic. Despite these disadvantages, they may be worth re-examining in the equatorial Indian Ocean, where in several places surface currents are strong, and have a well marked annual or semi-annual cycle. Some use has been made of them recently in looking for interannual variability in the Somali Current (Swallow and Fieux, 1982).

The best existing compilation of Indian Ocean surface currents is contained in the KNMI atlas (K.N.M.I., 1952). Its series of monthly charts is barely adequate for showing the development of features with semi-annual period such as the equatorial jet. Its spatial resolution (2 degrees latitude and longitude quadrangles) is somewhat coarse in regions of strong currents. Thirty years of data have accumulated since it was compiled (though recent observations have been less numerous than in the 1920s and '30s, and have added only 19% to the number of preexisting observations). For these reasons it seemed worthwhile to produce the set of charts presented here.

The source material was obtained from the Meteorological Office archive of historical surface currents, in mid-1983. Observations extend through the period 1854 to 1974. The area covered by the charts is bounded by the coasts of Asia and Africa, longitudes 50° E (in the Gulf of Aden) and 100° E, and latitude 25° S. These surface currents have been compiled into 10-day periods (36 charts, days 1-360) and 1 degree quadrangles of latitude and longitude.

For each 10-day period and 1 degree quadrangle, the vector mean of all the observations from all years has been plotted. With this amount of subdivision, coverage is often sparse and sometimes non-existent, but the user can mentally combine arrows from adjacent areas or successive charts, if necessary.

The arrows point in the direction of the current. Each arrow starts from the centre of the 1 degree quadrangle to which it applies. No smoothing has been done, and no attempt has been made to edit the observations, except for elimination of duplicates and correction of some high speed currents that appeared to be in error. Several observations were listed as 5.6 knots, far more numerous than seemed likely. Reports from the same places and times, with the same directions but different speeds, were found in the lists of fast currents in the KNMI atlas. These latter speeds have been used in place of the apparently spurious 5.6 knot values. Several gross errors remain. Interpretation of the charts is left to the user's common sense. Arrows that are wildly different from their neighbours (in space and time) are likely to be wrong.

Some points of interest:

(a) Somali Current. At the beginning of the year (days 1-10) the latitude of separation between northward and southward currents is 10° N. By the end of January (days 21-30) it has moved to 9° N, and appears to stay there until mid-March (days 71-80). By then, it is at 5° N (see Schott and Quadfasel, 1982), moving to 4° N in the next 10-day period.

The boundary current from the south crosses the equator first in mid-April (days 101-110) and is clearly present north of the equator by late April (days 111-120). This may be compared with the May 11-16 crossing

observed in 1979 (Swallow et al. 1983) when the monsoon was relatively late.

There is a distinct weakening of the northern part of the boundary current (8° to 10° N) between mid and late October (days 281-300). Possibly related to draining of the surface water of the 'great whirl' by the October equatorial jet? (Gonella et al. 1983).

The south-going boundary current is not clearly present until late November (days 321-330). It then converges with the northward current at about 1° N. By early December (days 331-340) the convergence is at the equator and by mid-December (days 341-350) at 1° S.

(b) Currents south of Sri Lanka reverse at the end of April (days 111-130) and at the end of October (days 291-310), in phase with the monsoon wind reversal. On the other hand, the current on the western boundary of the Bay of Bengal is clearly running northwards from early February (days 31-40) to mid-June (days 161-170) and southwards from mid-October (days 281-290) to mid-December (days 341-350), with indeterminate flow between. Poor sampling, or eddies, or is something different happening?

(c) Currents along the equator. A definite westward flow can be seen at 60°-75° E in late January (days 21-30), extending westwards during February and decaying during March. Eastward flow (the equatorial jet) can just be detected in early April (days 91-100) in longitudes 70°-90° E. It is definitely present 10 days later, and by late April (days 111-120) extends from longitude 55° E to 95° E. This continues steadily until early June (days 151-160) when decay sets in from the eastern end. By late June (days 171-180) it has practically disappeared. Weak westward flow is again seen at longitudes 60°-75° E during July and August (days 181-240). An eastward current is present already in late August (days 231-240) at longitudes 75°-90° E. This strengthens and extends westward in early October (days 271-280) to 60° E. It continues thus until late November (days 321-330), when it begins to decay from the eastern end. By late December (days 351-360) it has almost disappeared.

(d) Significance of climatological mean currents. The annual cycles of current outlined above are a composite of data derived from many years. It is not obvious that these climatological mean currents necessarily resemble what happens in a typical single year. For example, a strong current of one month duration that appeared every year, sometime within a certain three month period, would appear spread out weakly over the whole three months in the climatological mean charts. However, examination of data from well sampled individual years, and evidence from direct observation of surface currents (e.g. Knox 1976) suggest that the durations of the Somali Current and equatorial jets, as shown in these climatological mean charts, are not greatly misleading.

Acknowledgements

We are grateful to Mr. M.G. Colgate of the Meteorological Office, Met. 03C, for supplying the surface current data and explaining its format.

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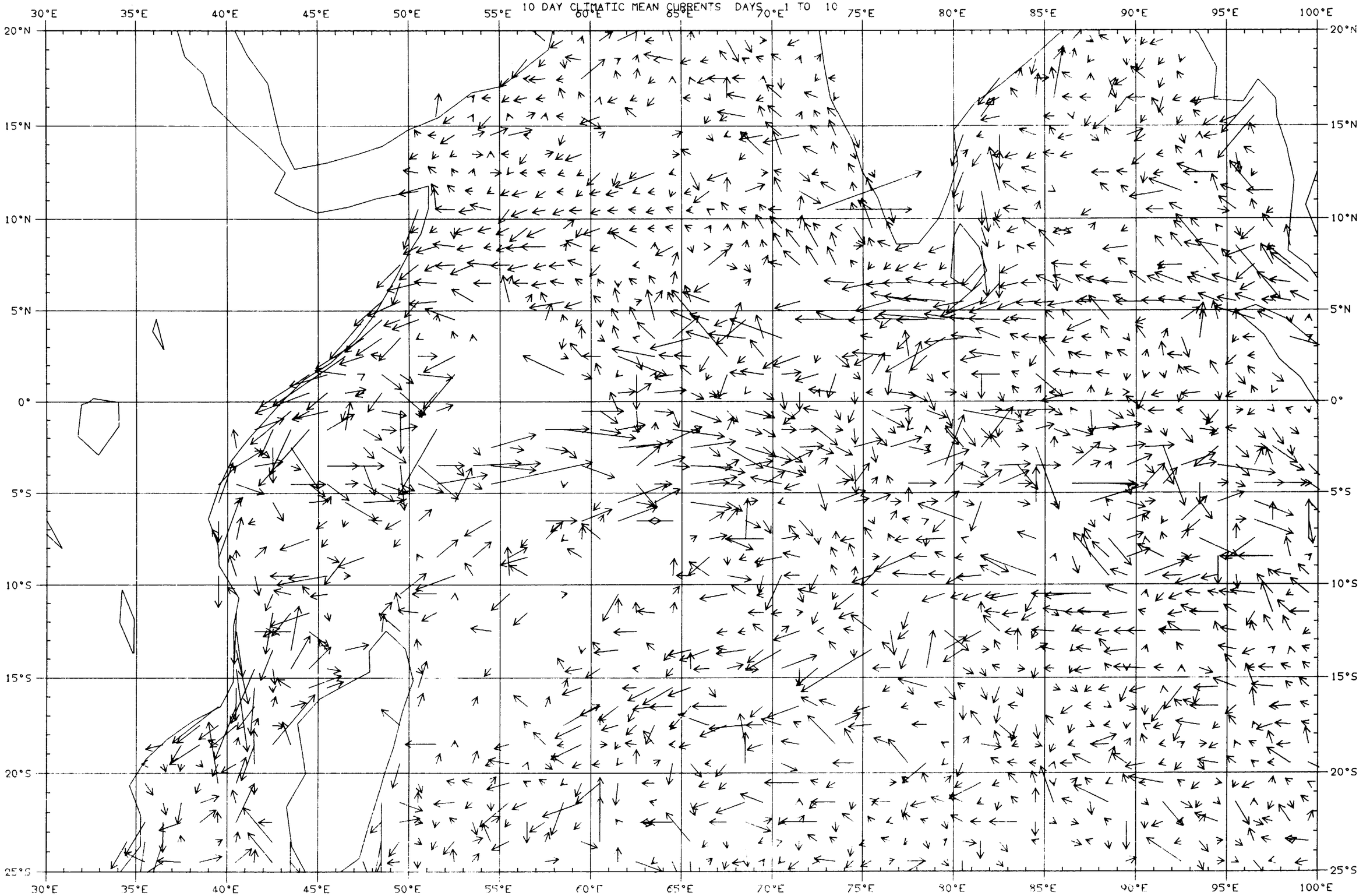

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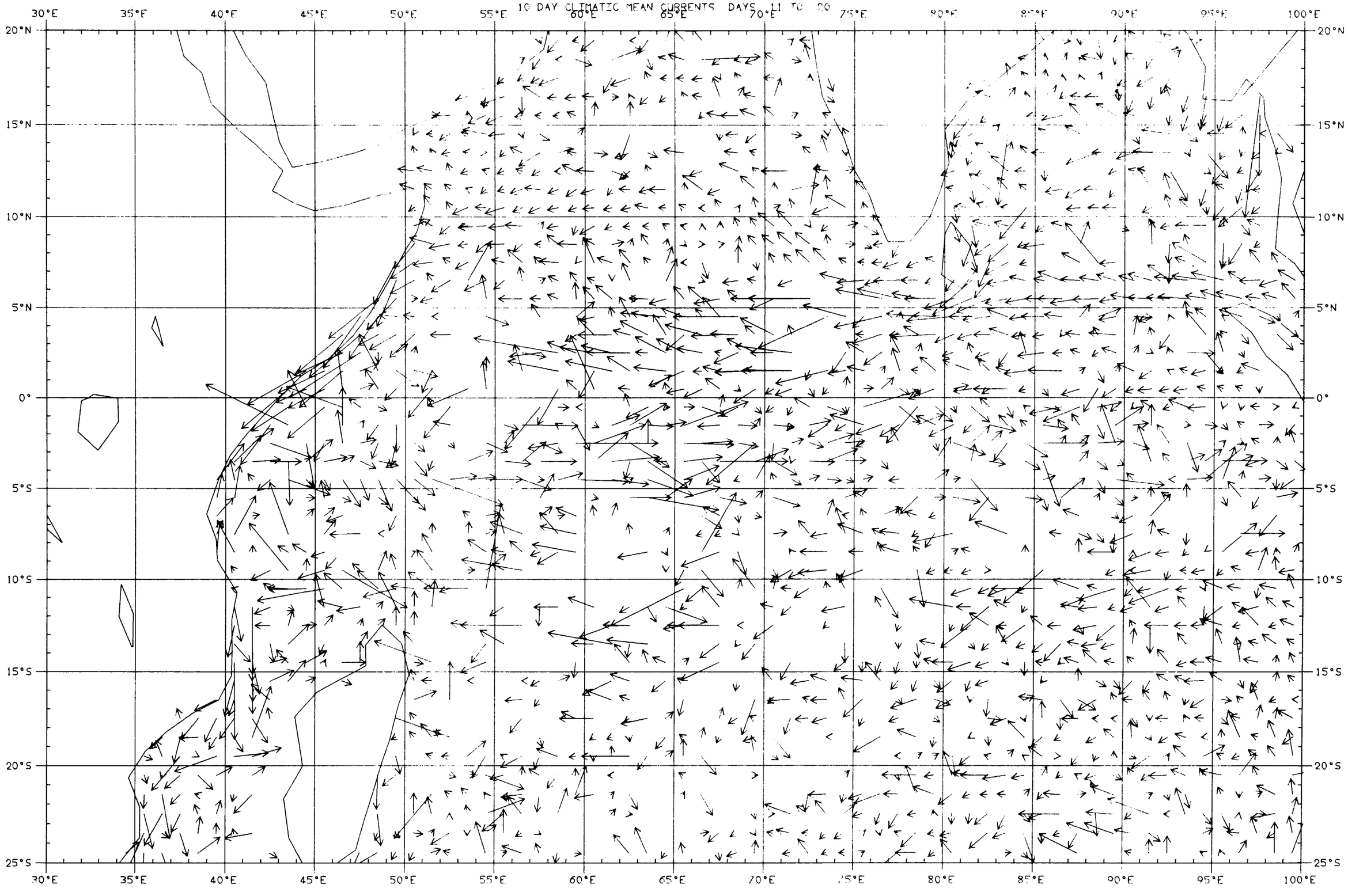

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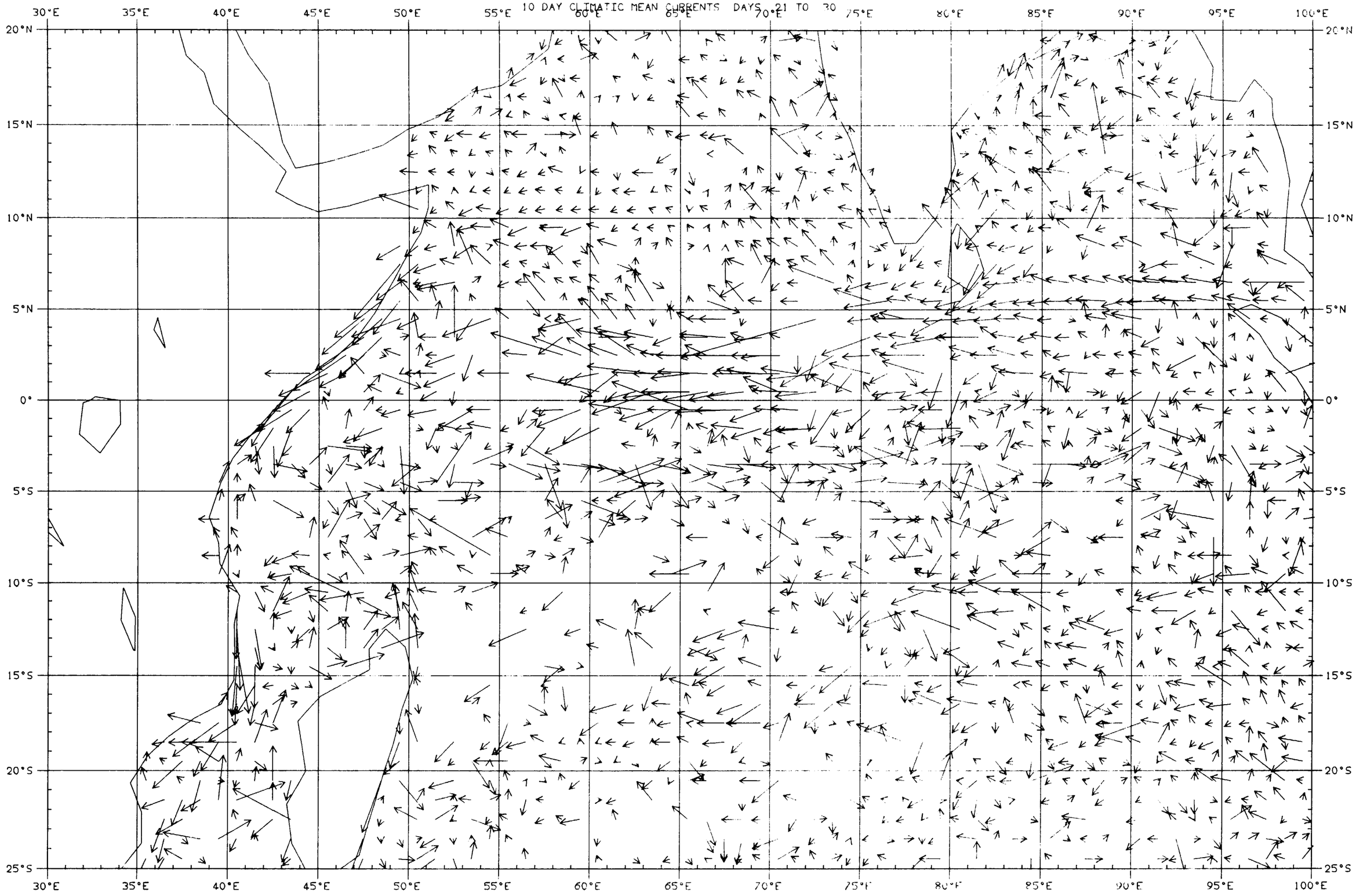

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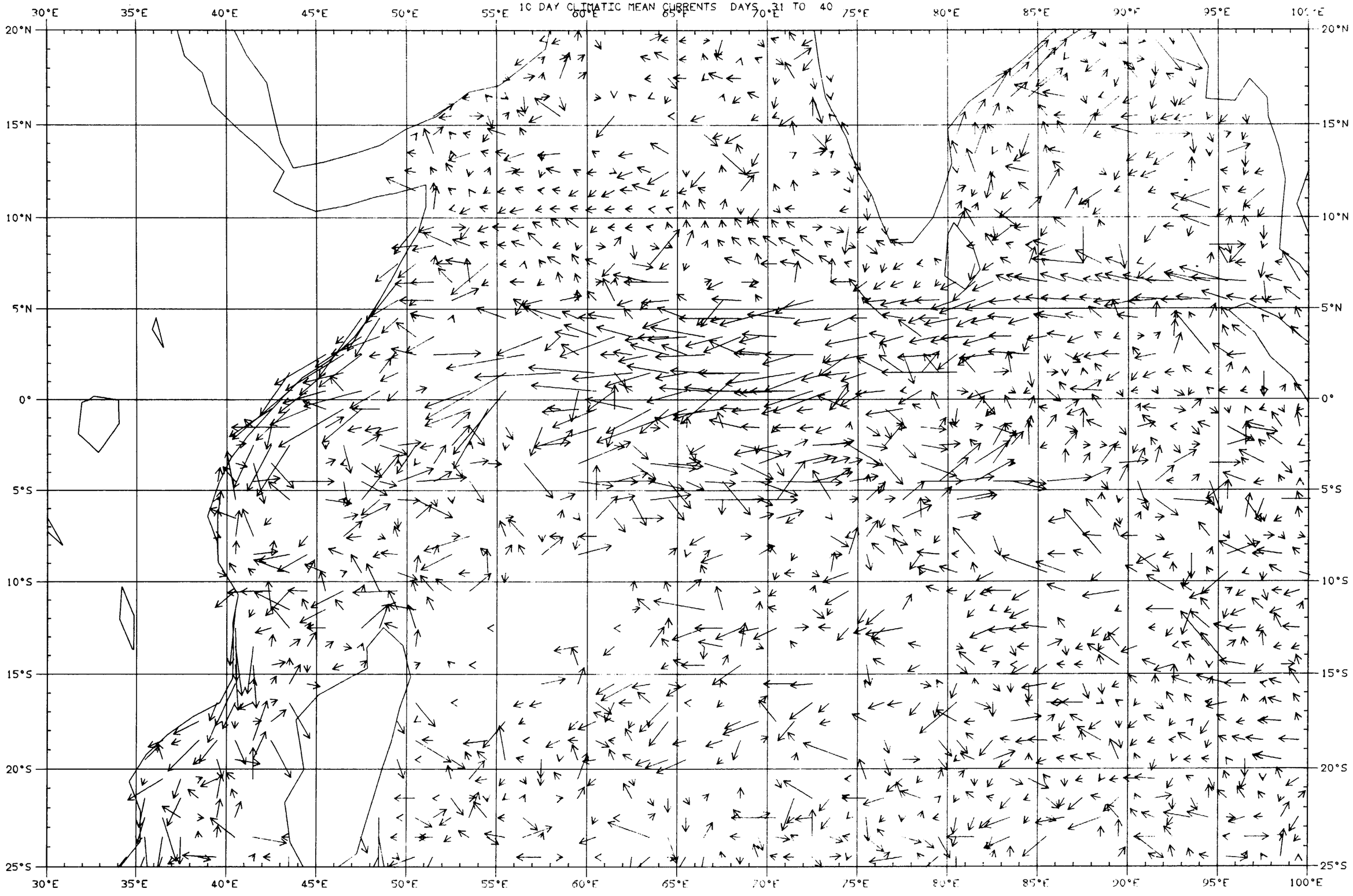

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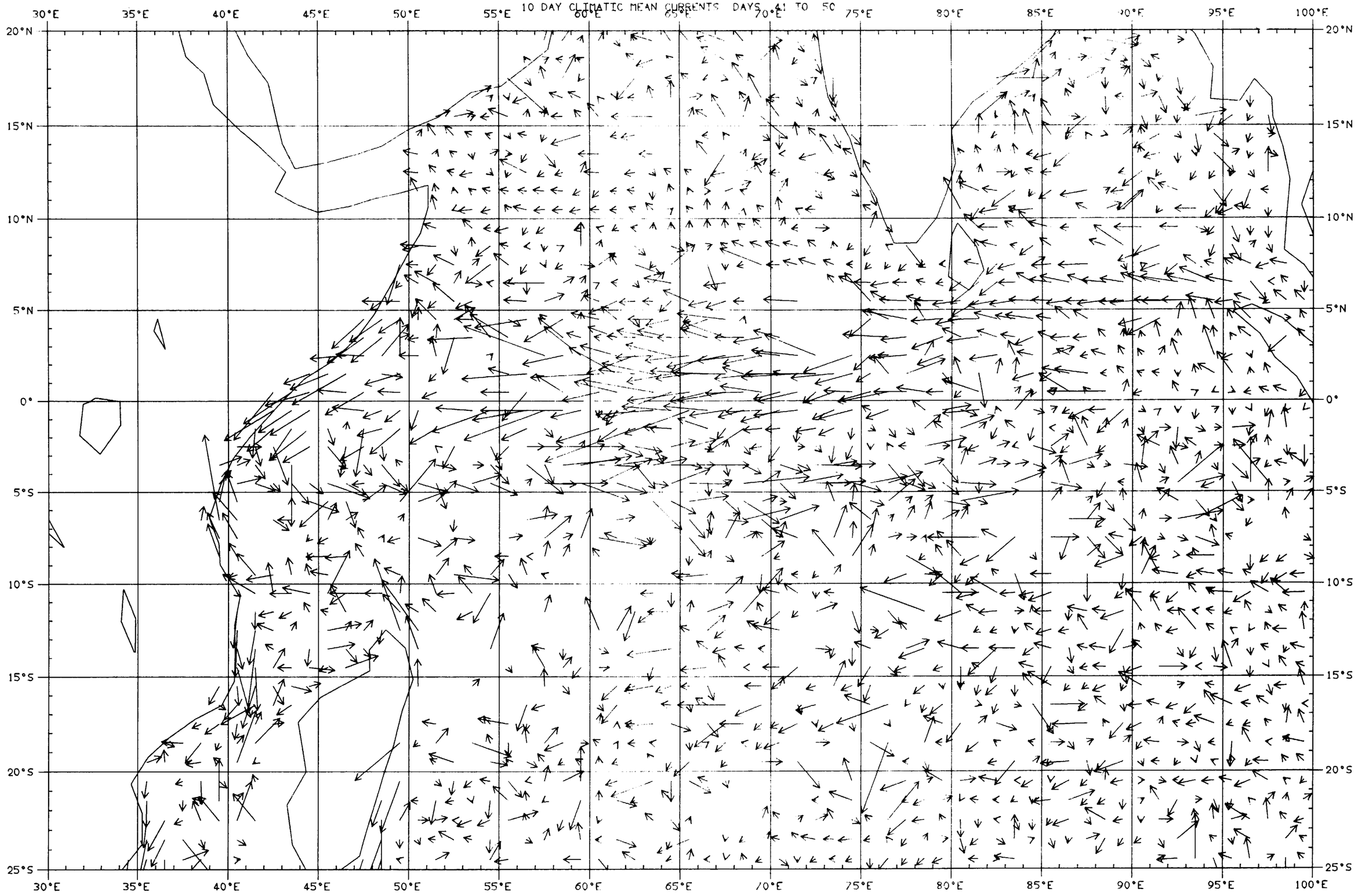

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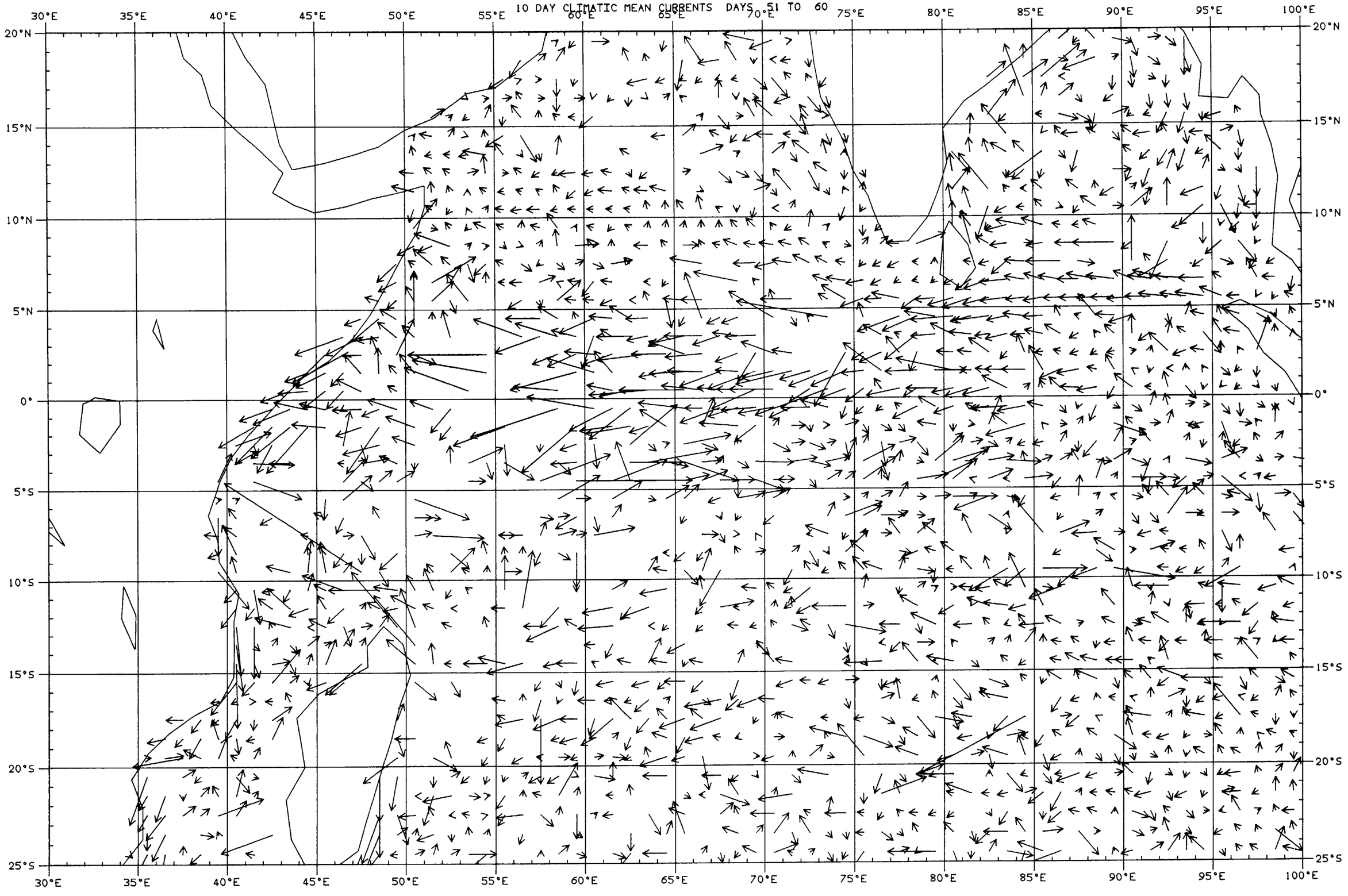

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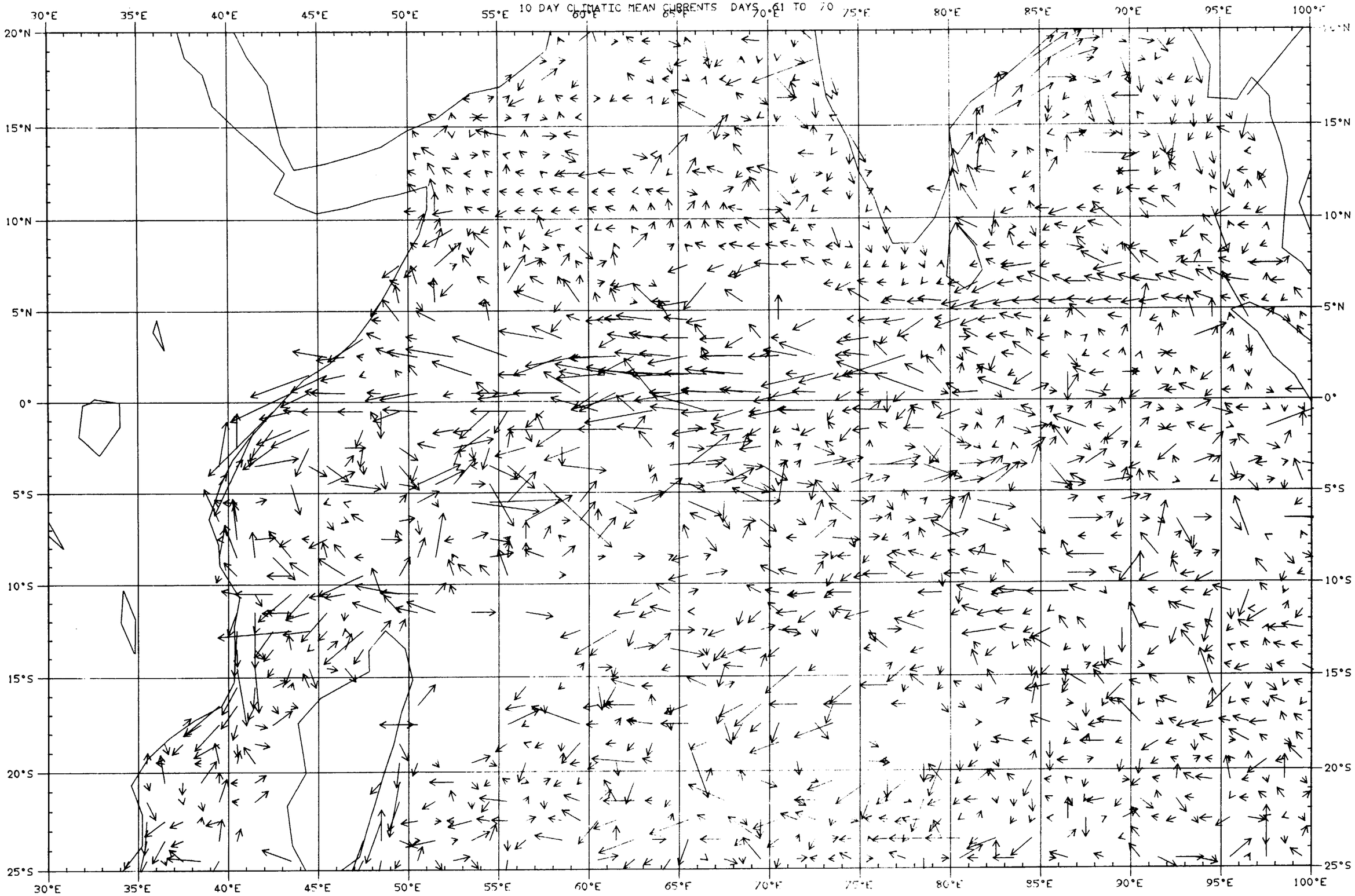

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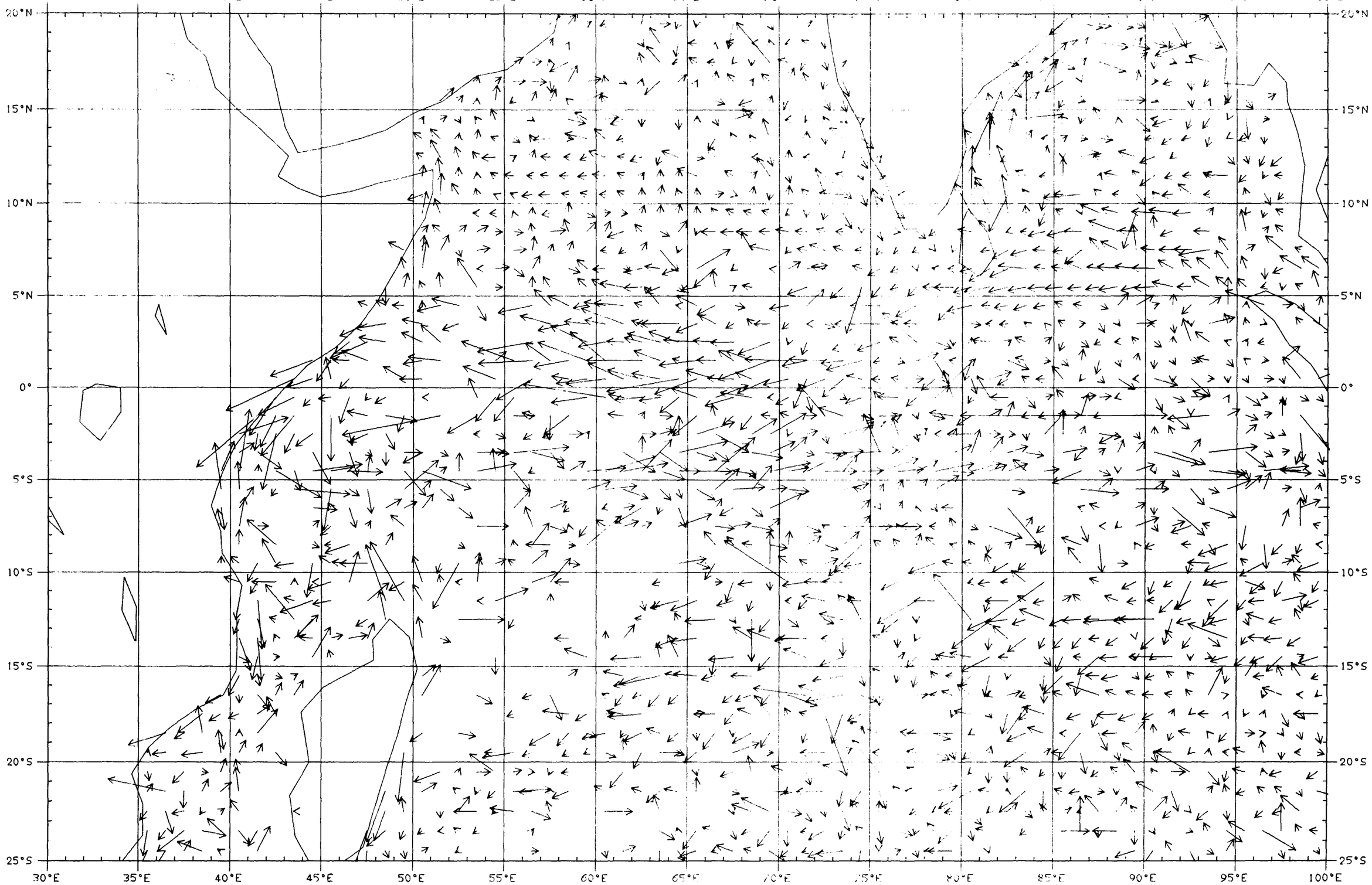

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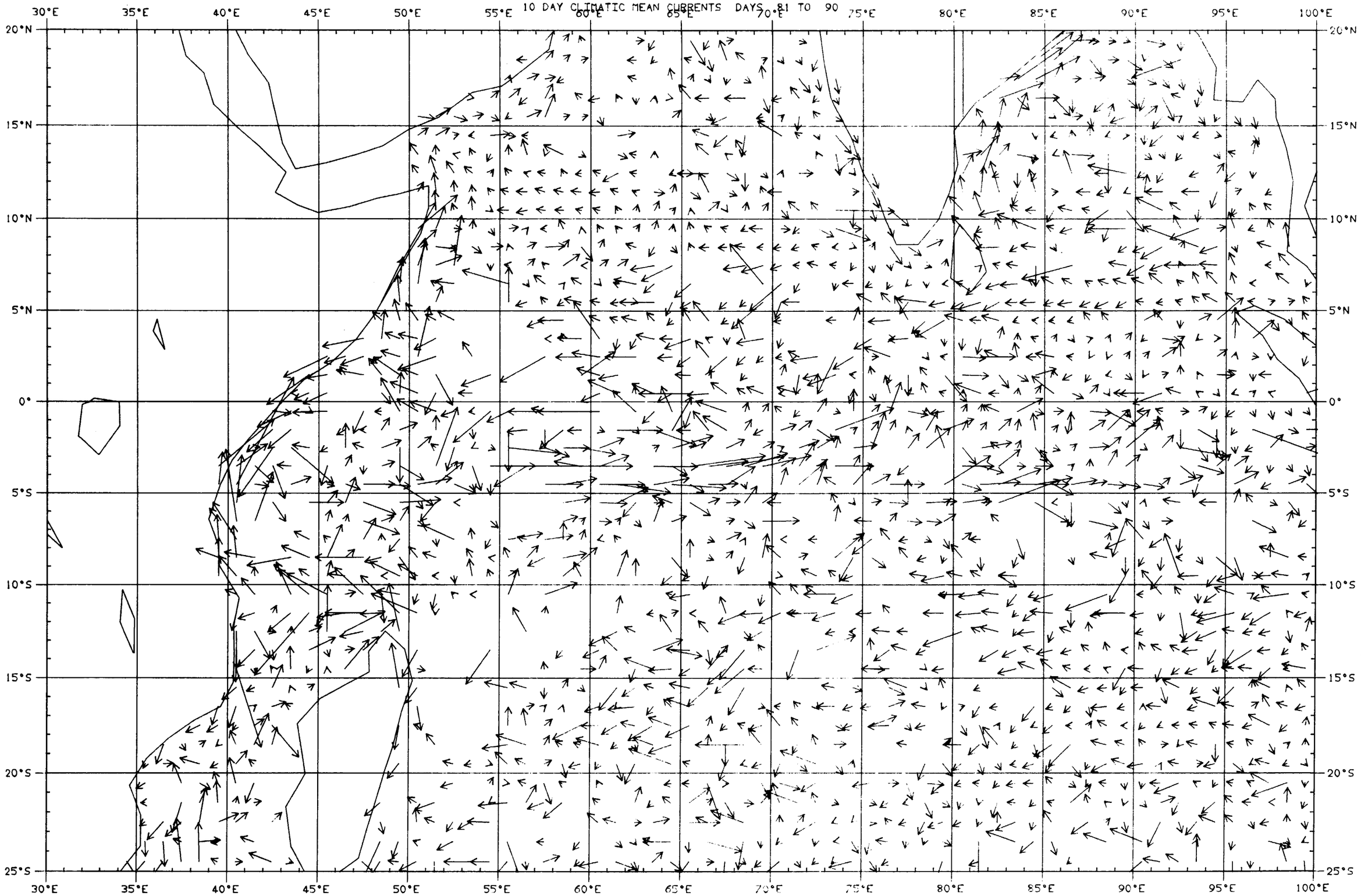

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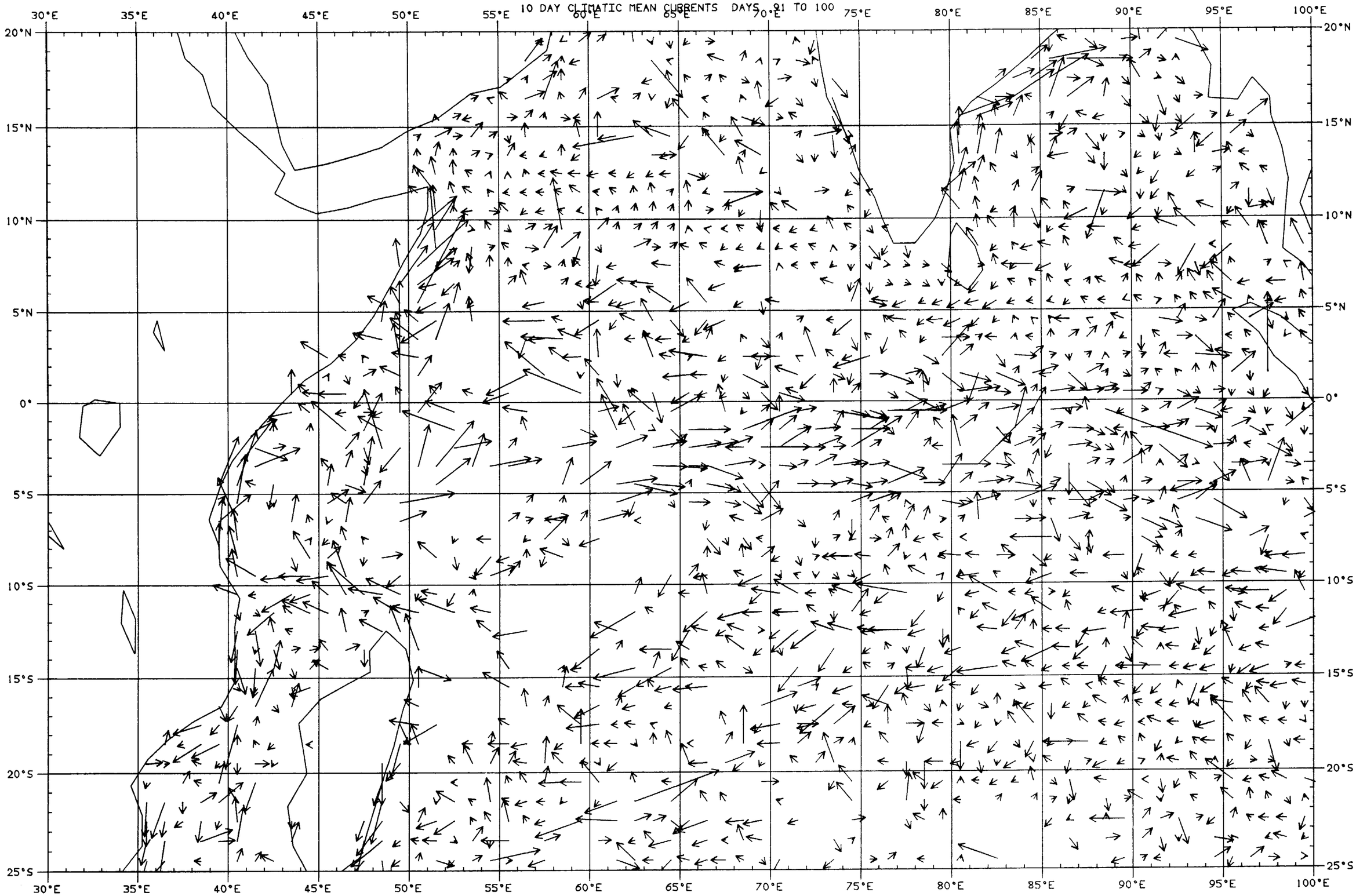

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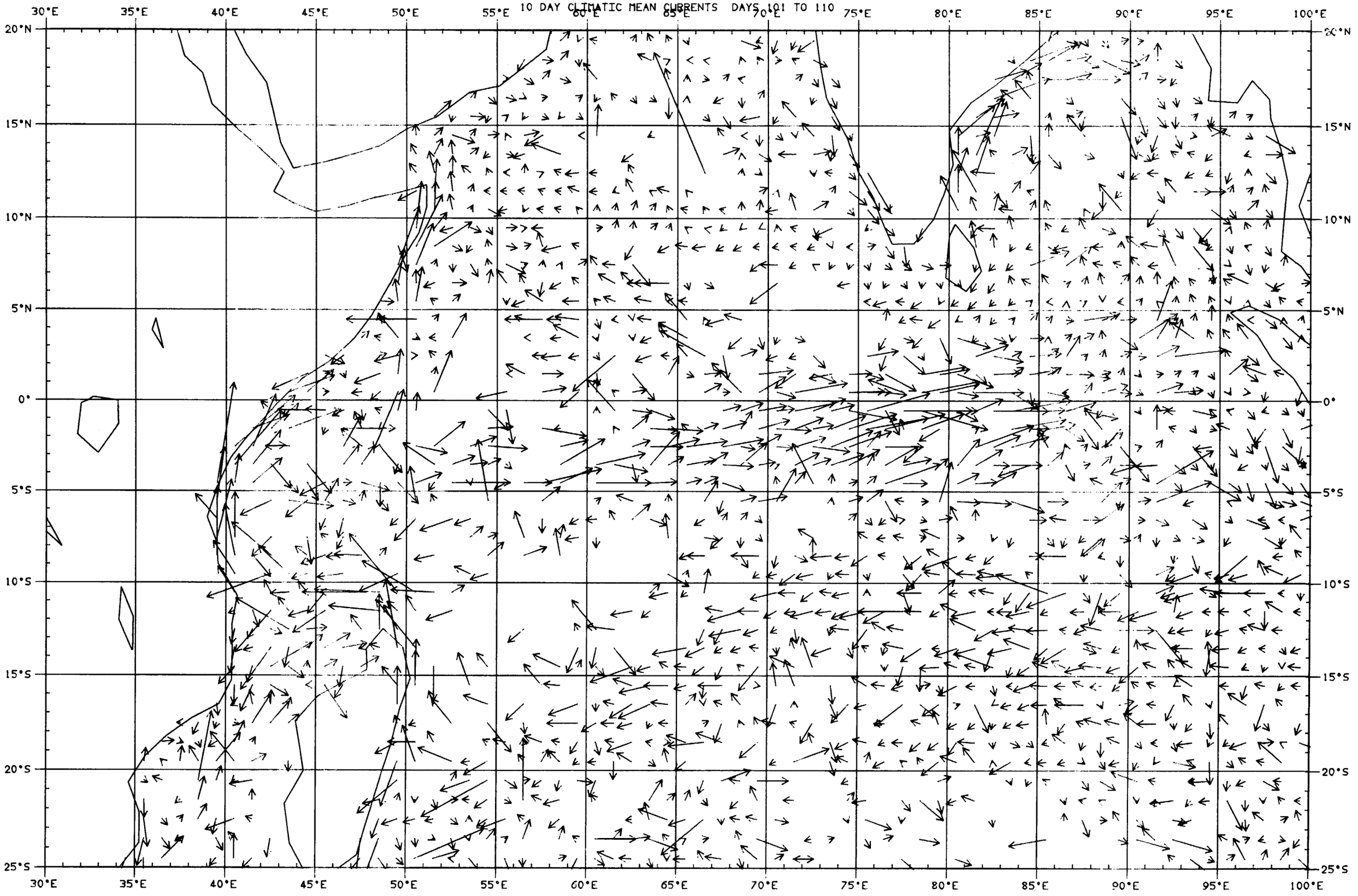

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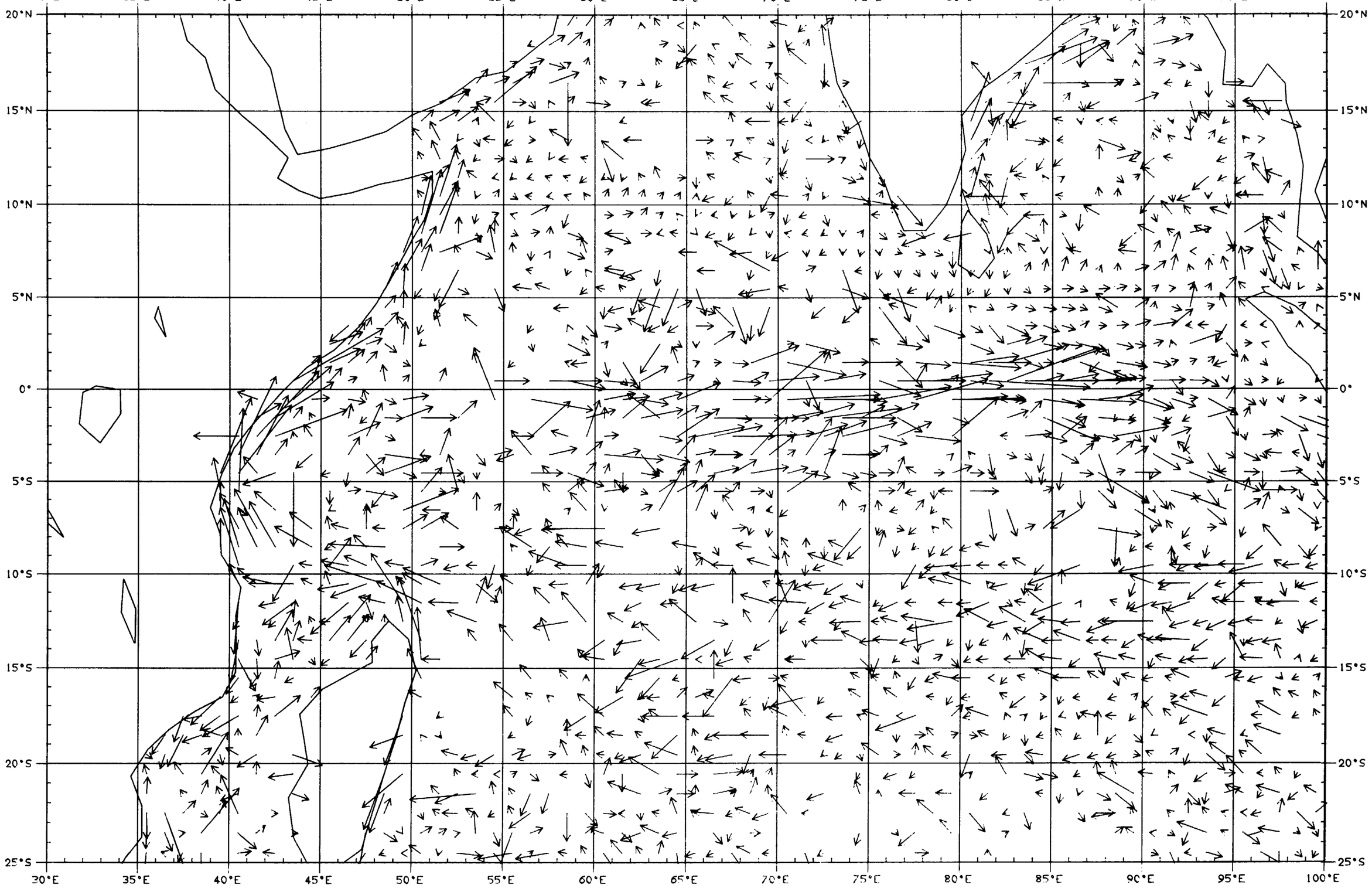

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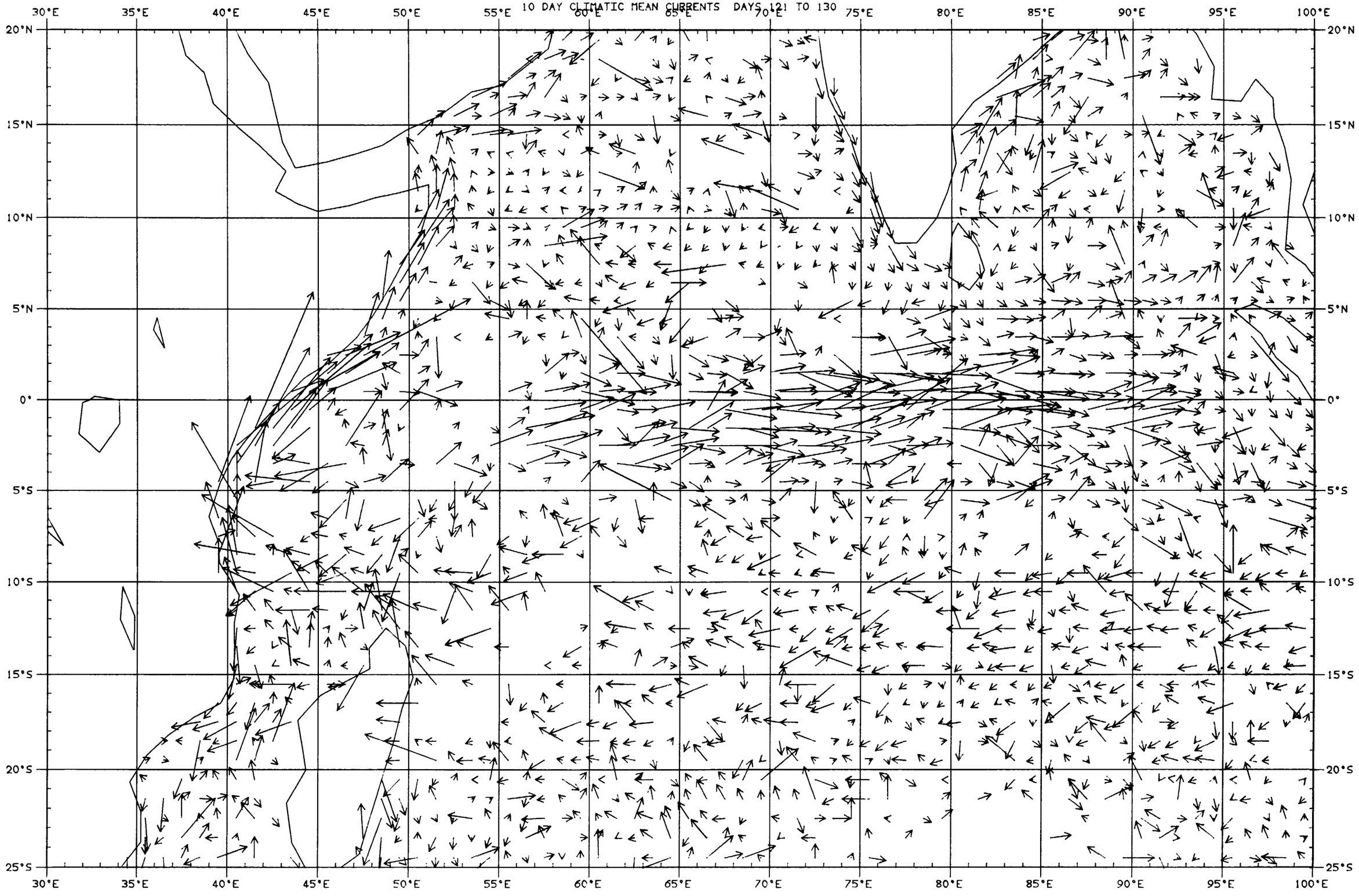

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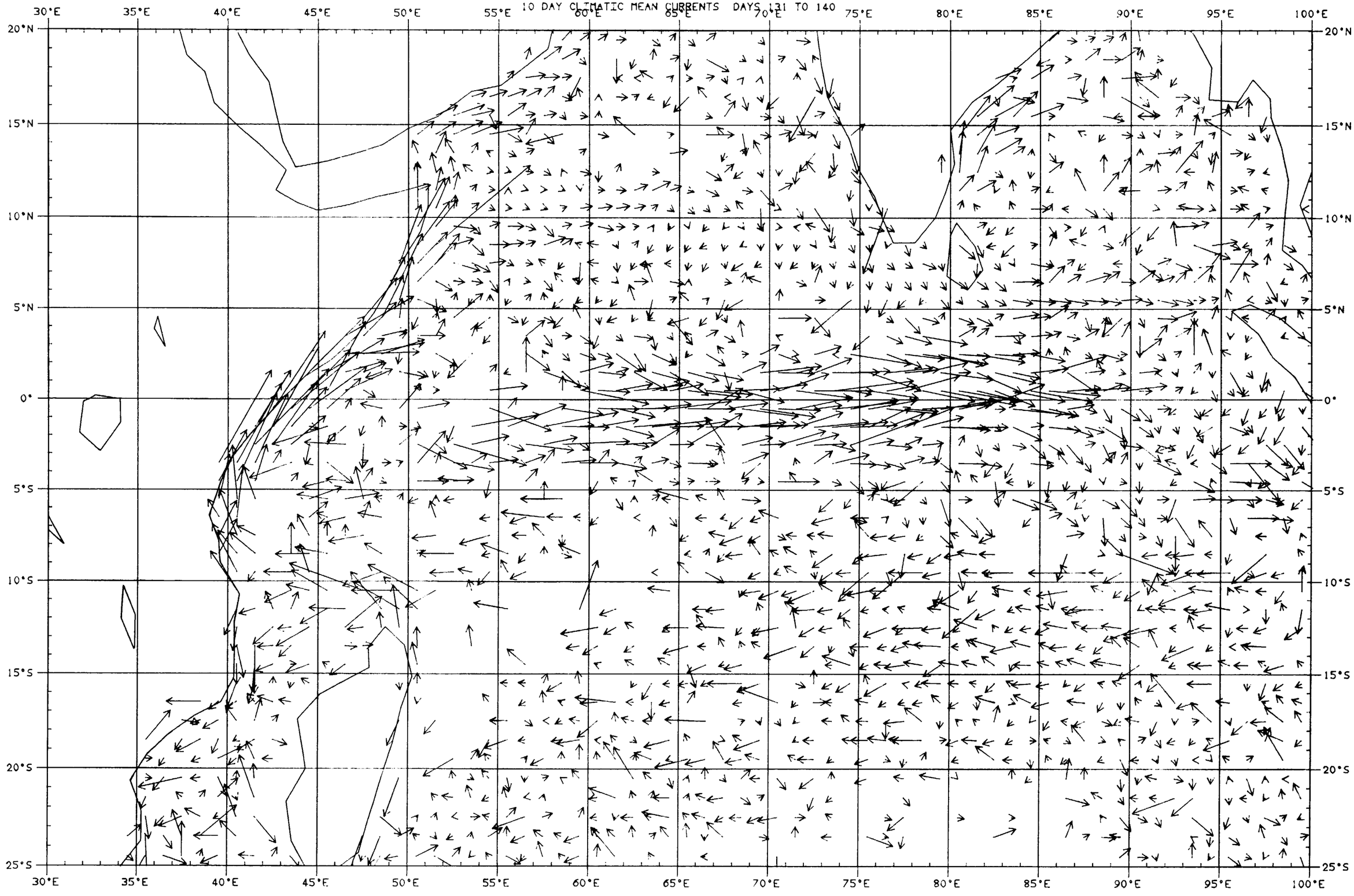

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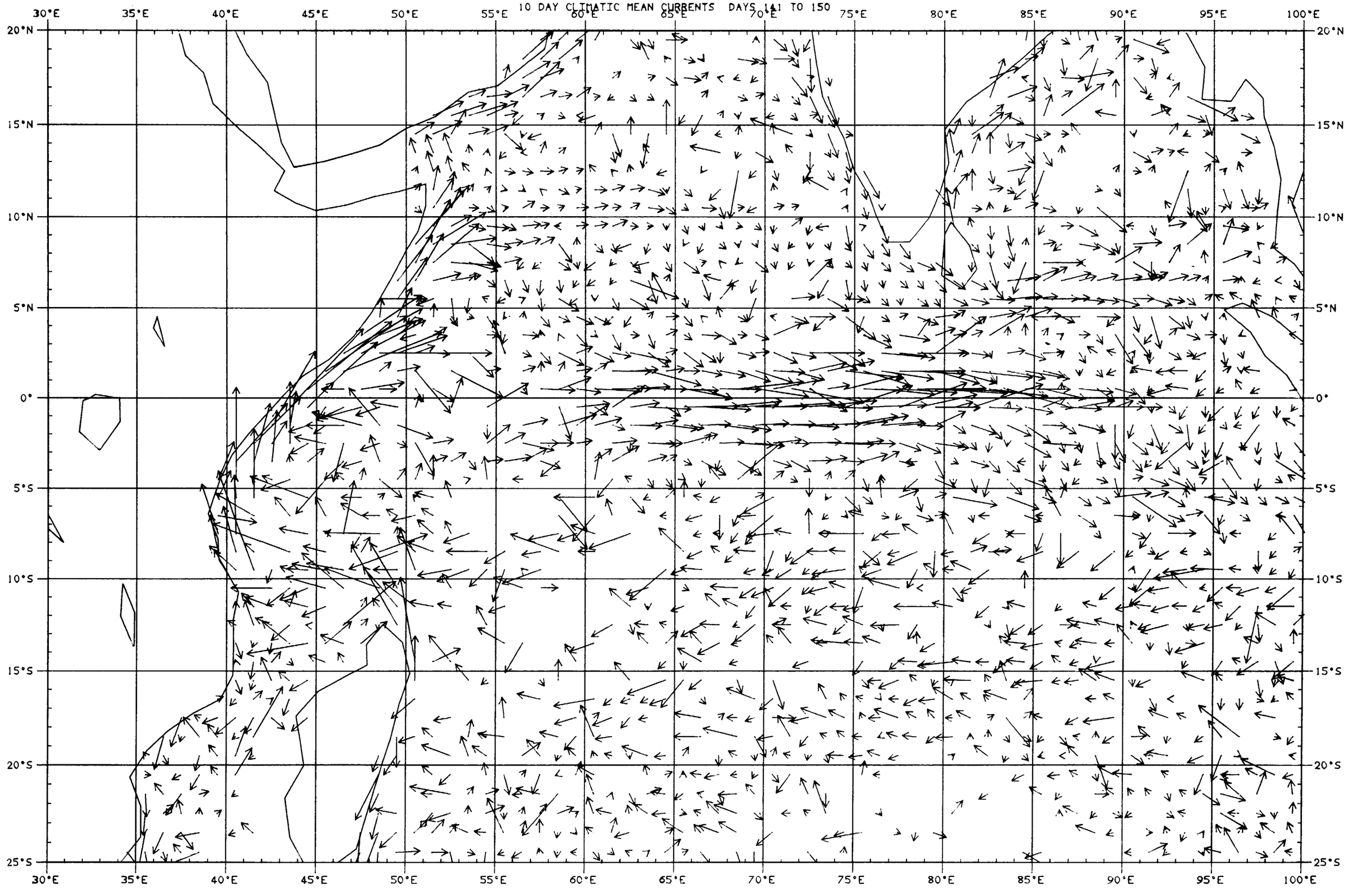

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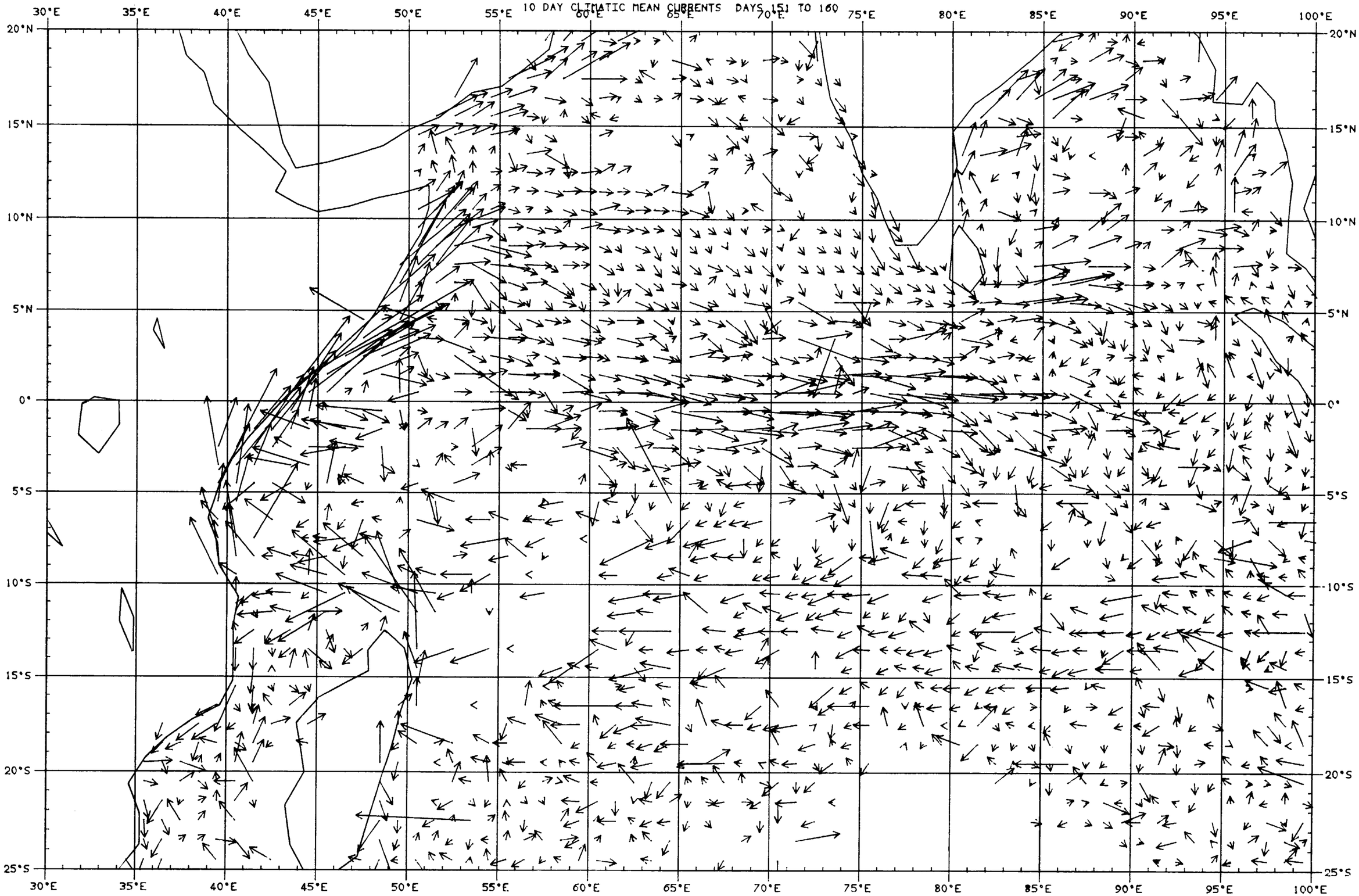

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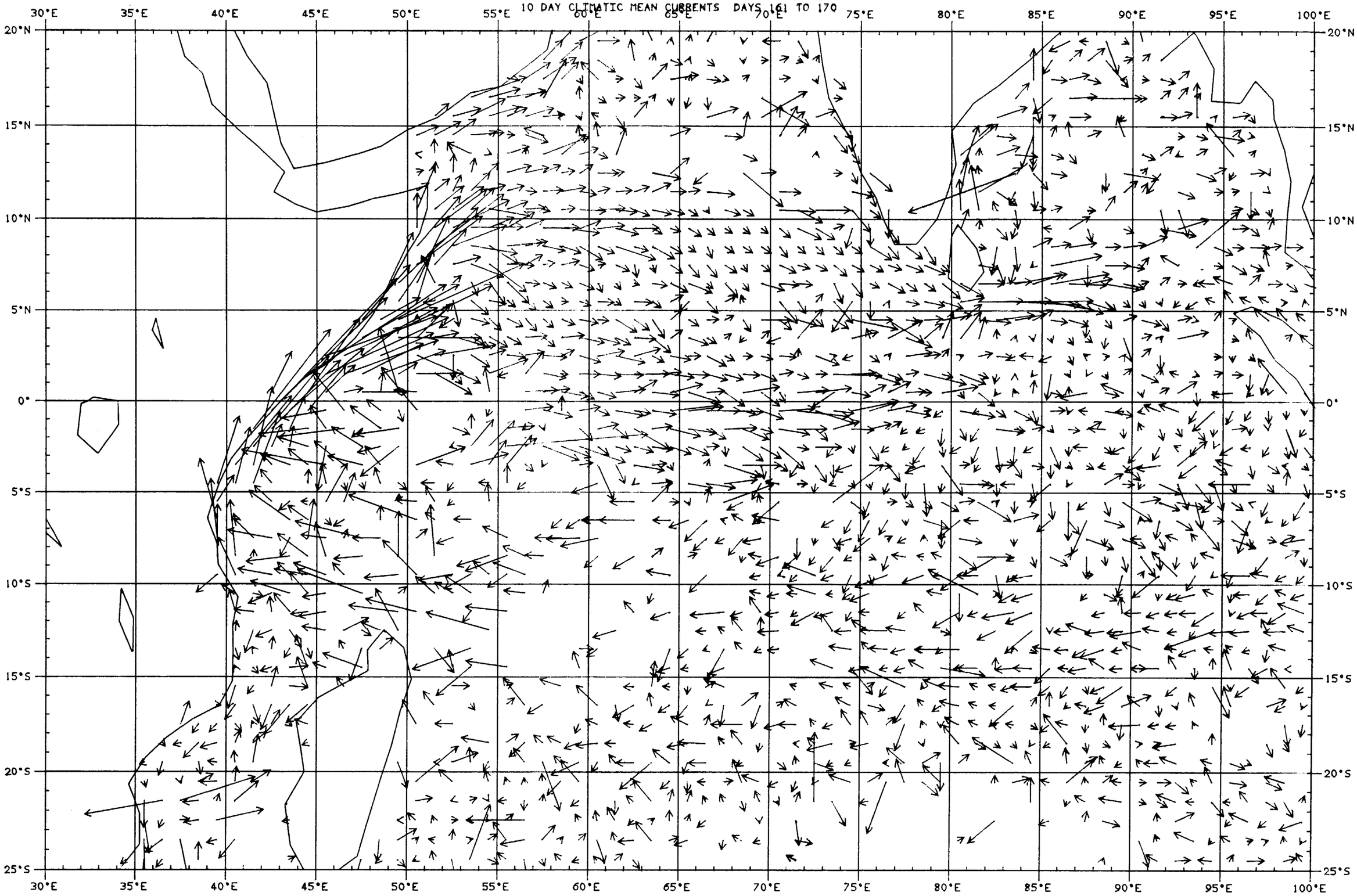

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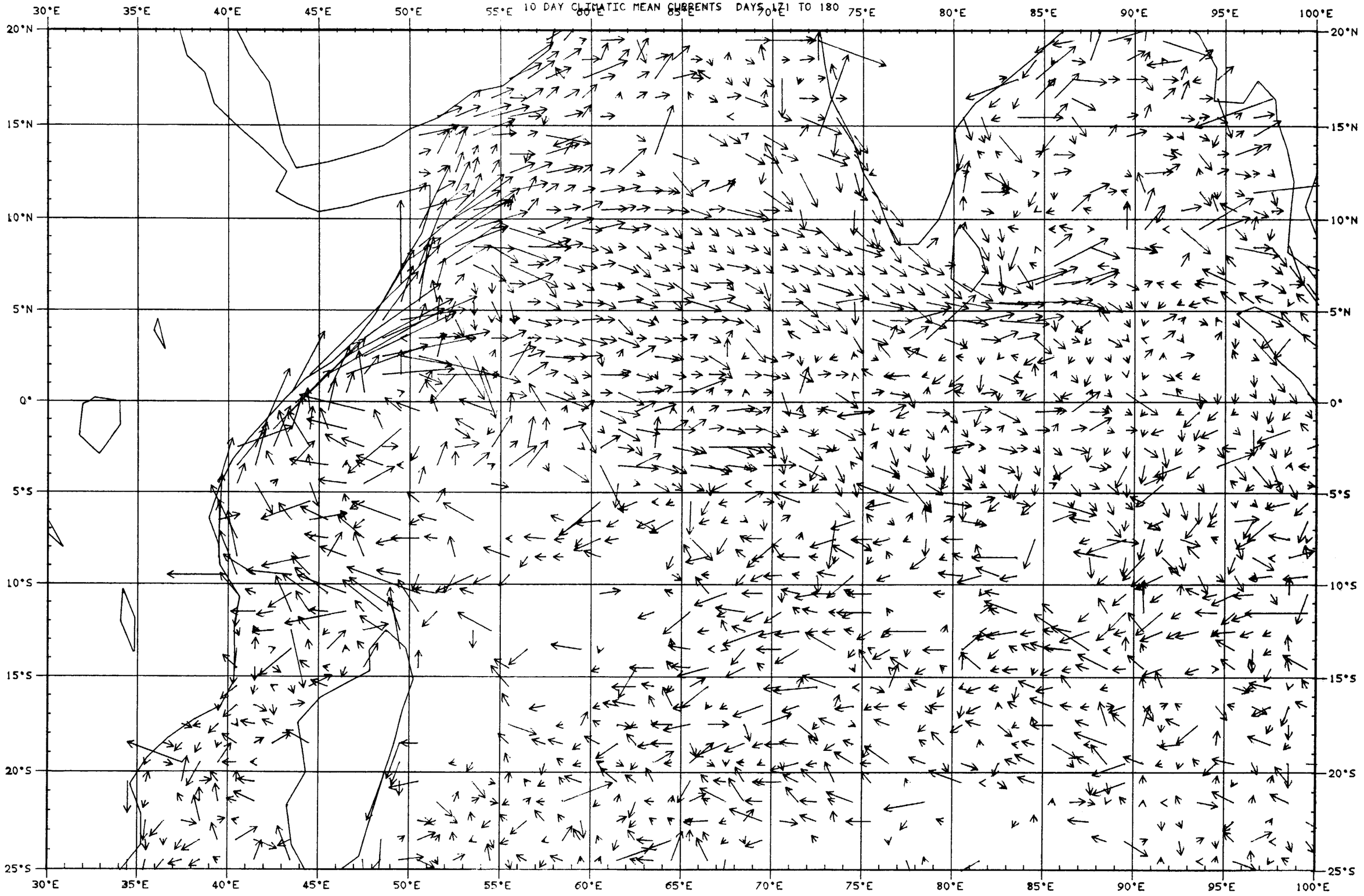

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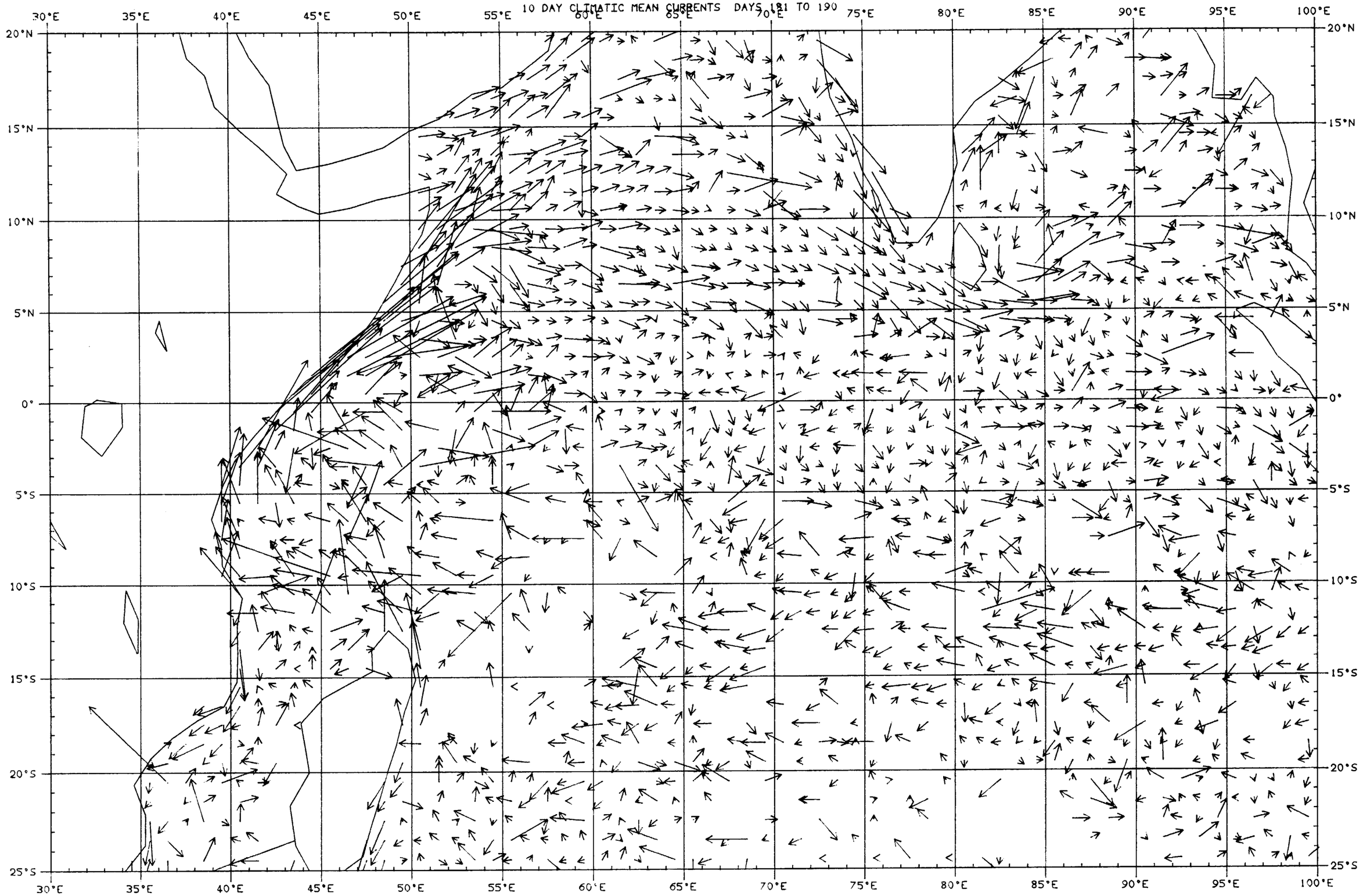

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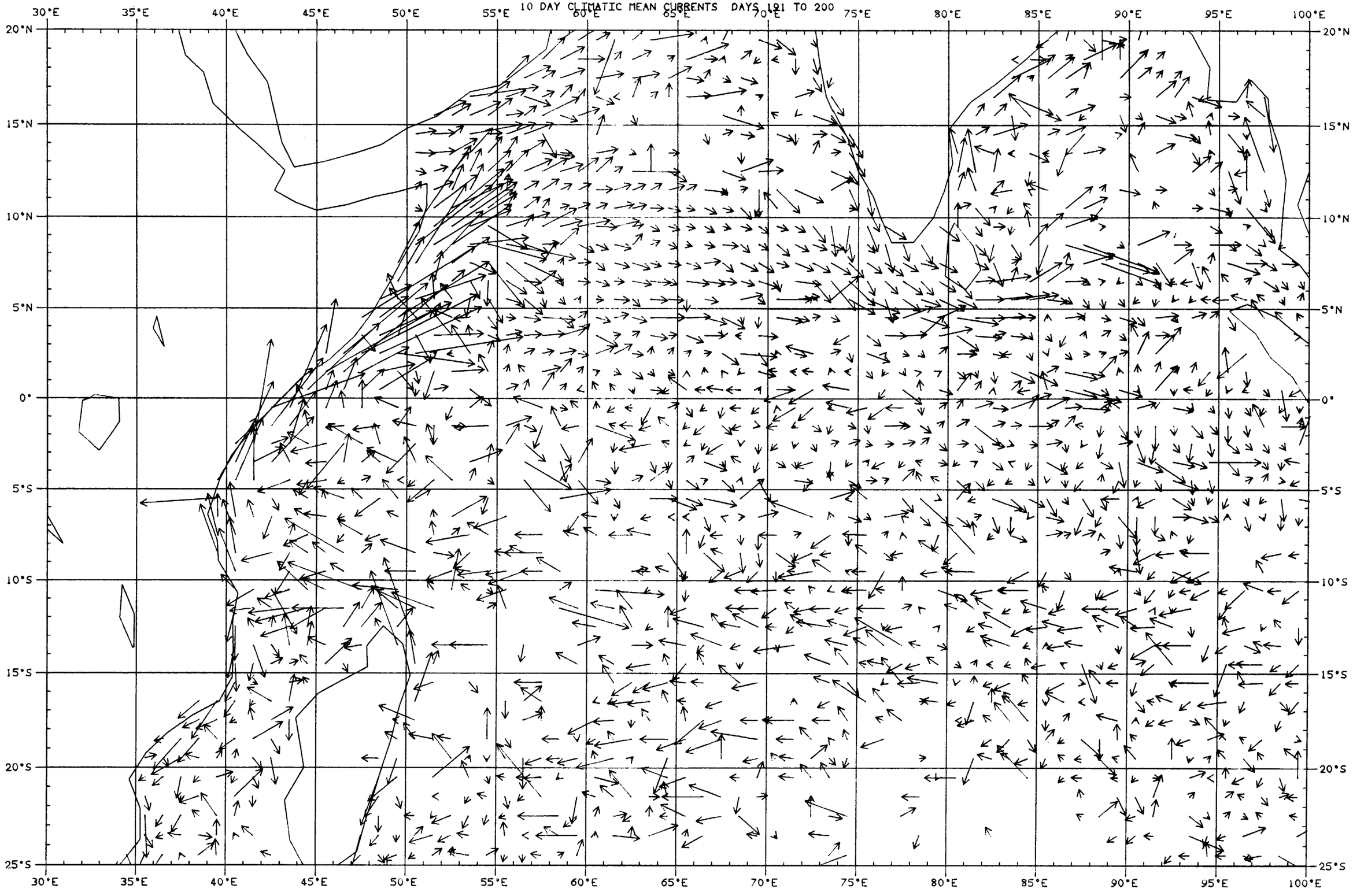

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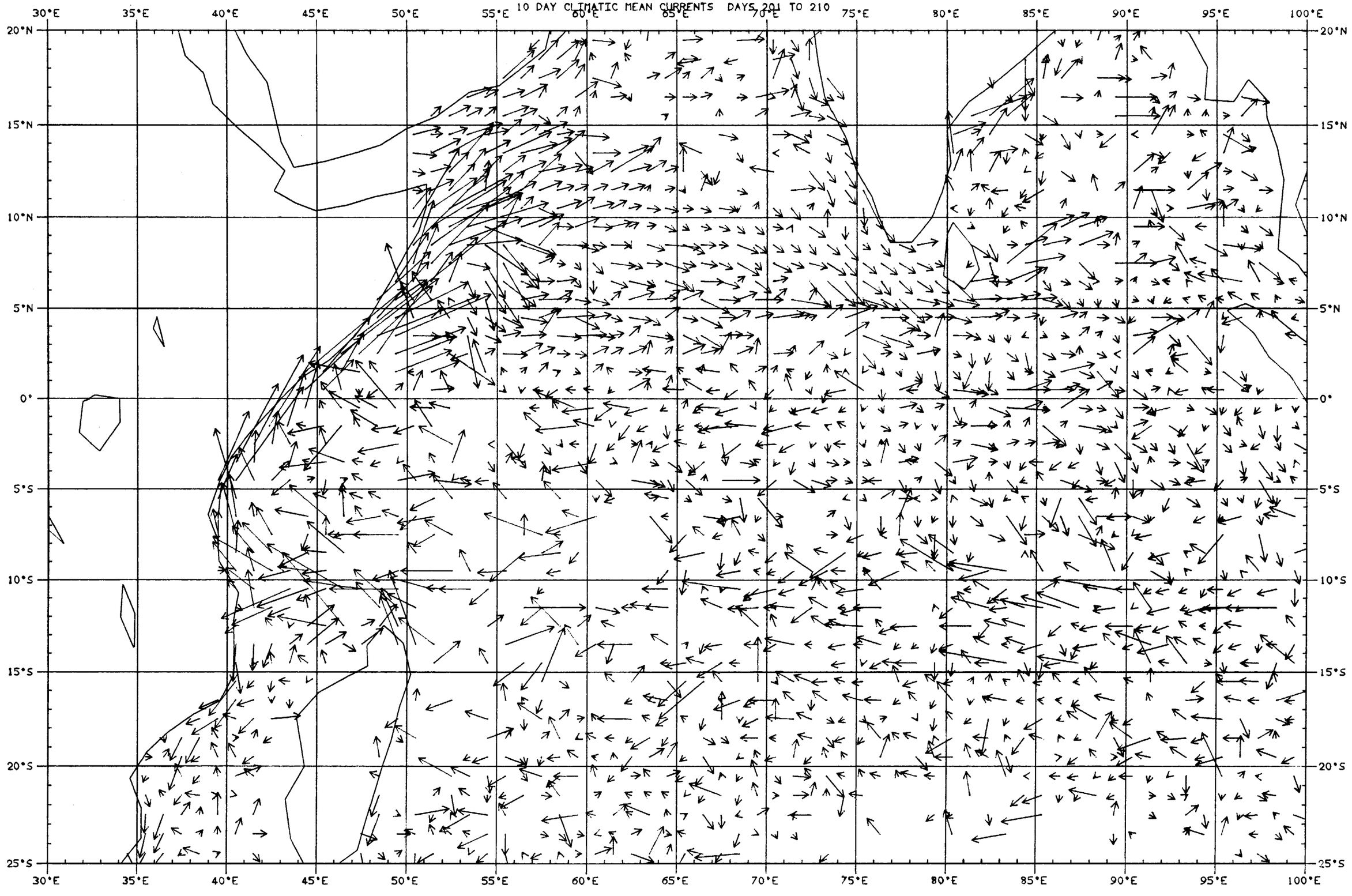

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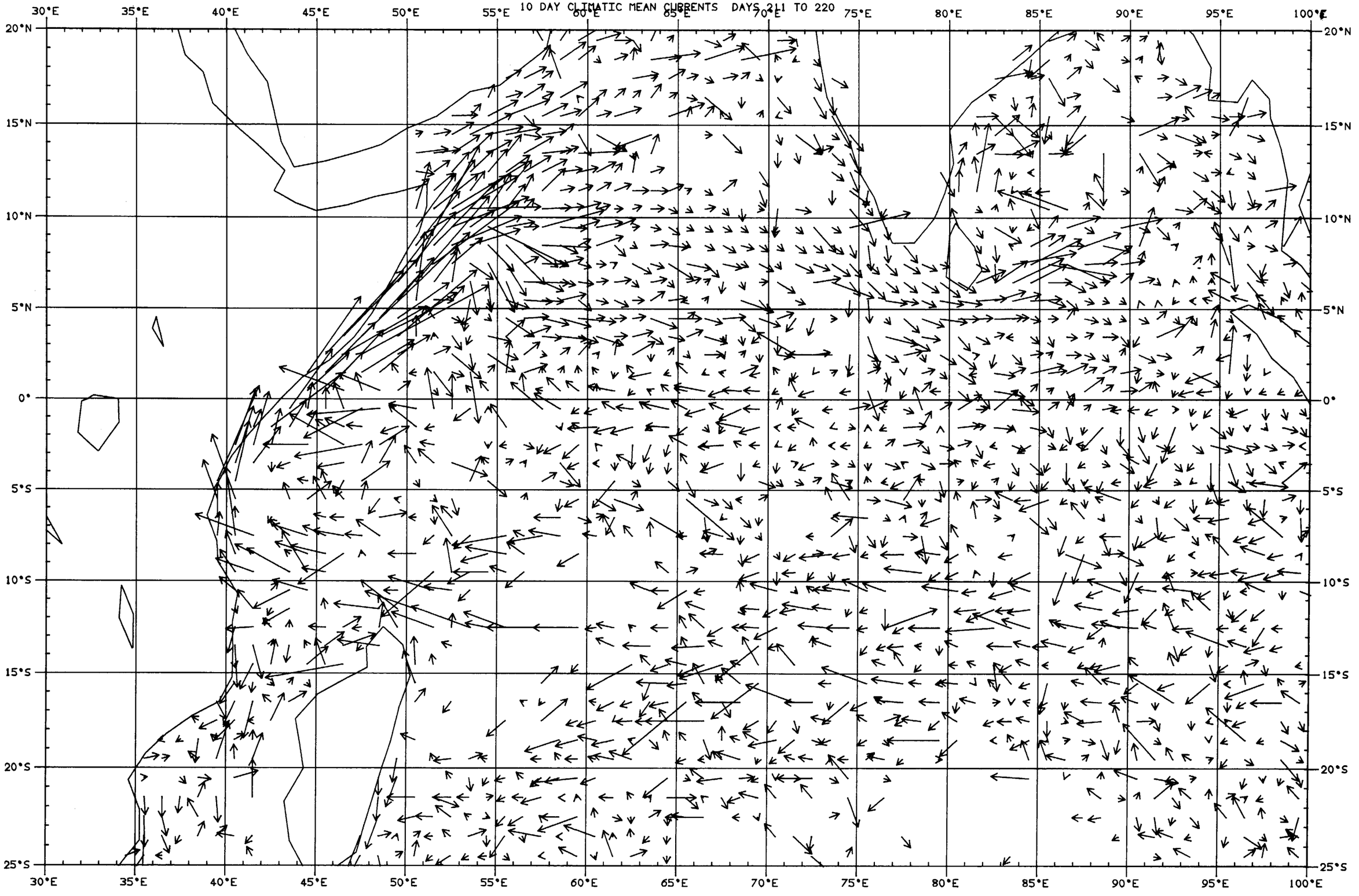

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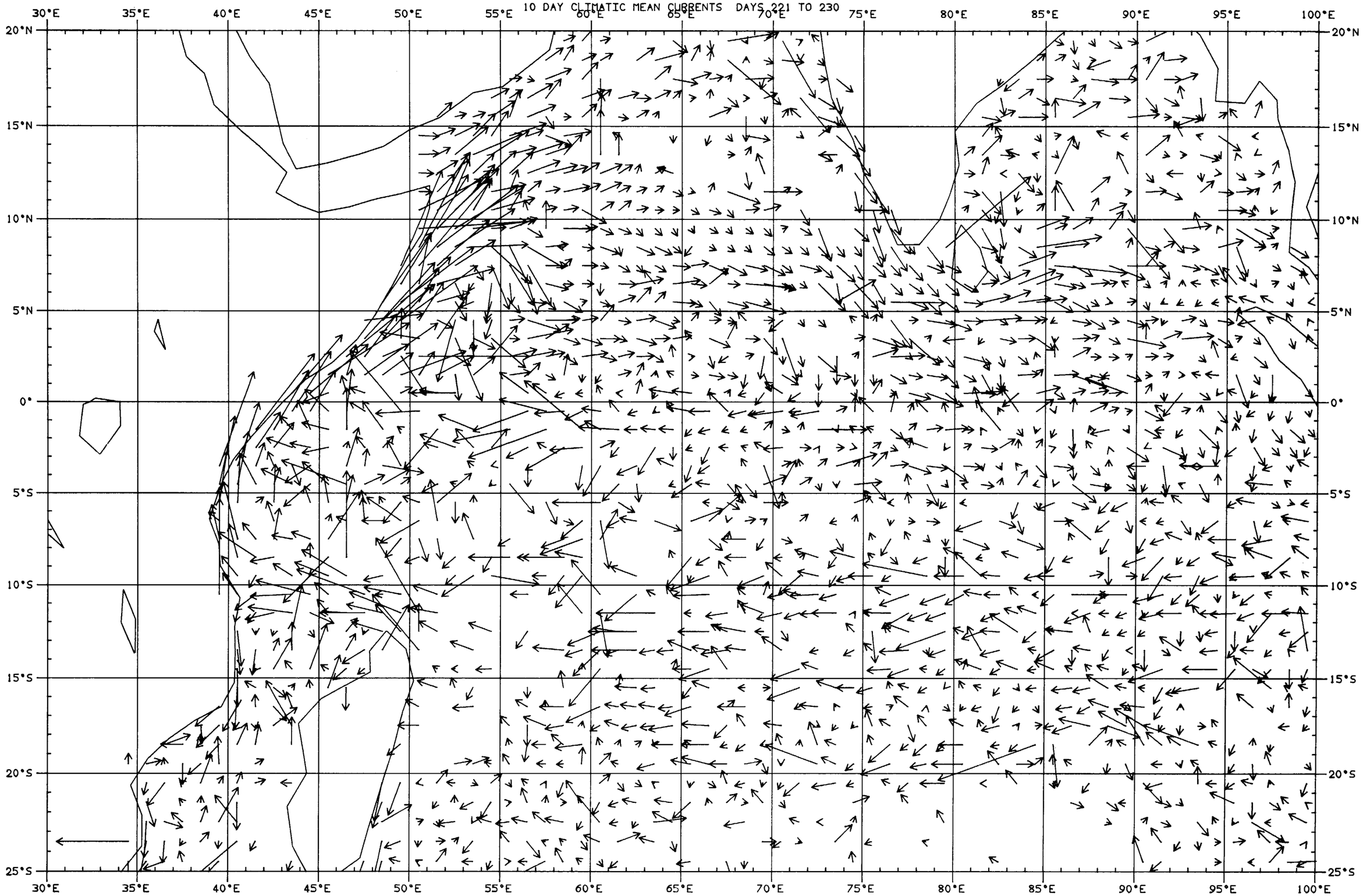

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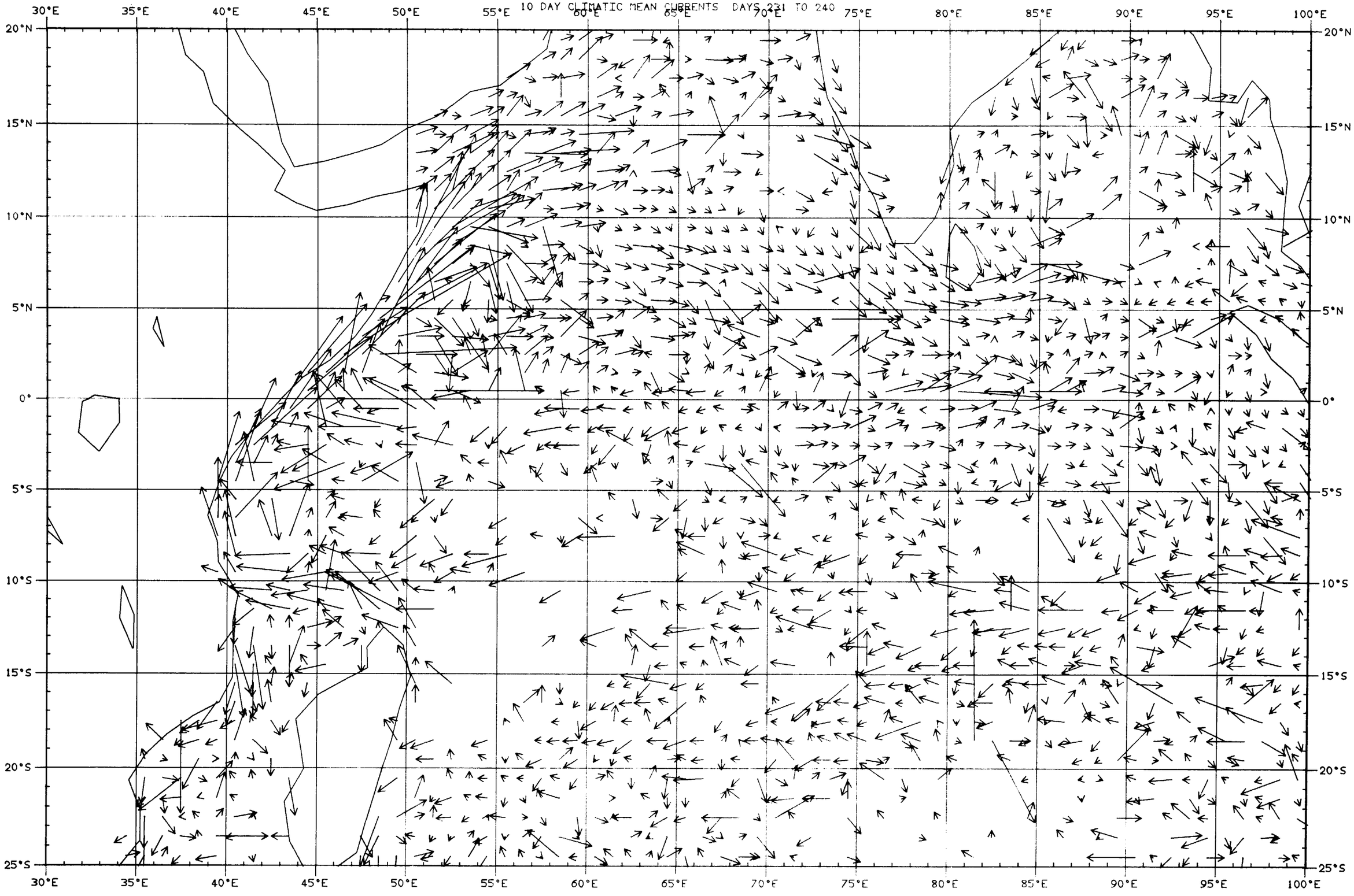

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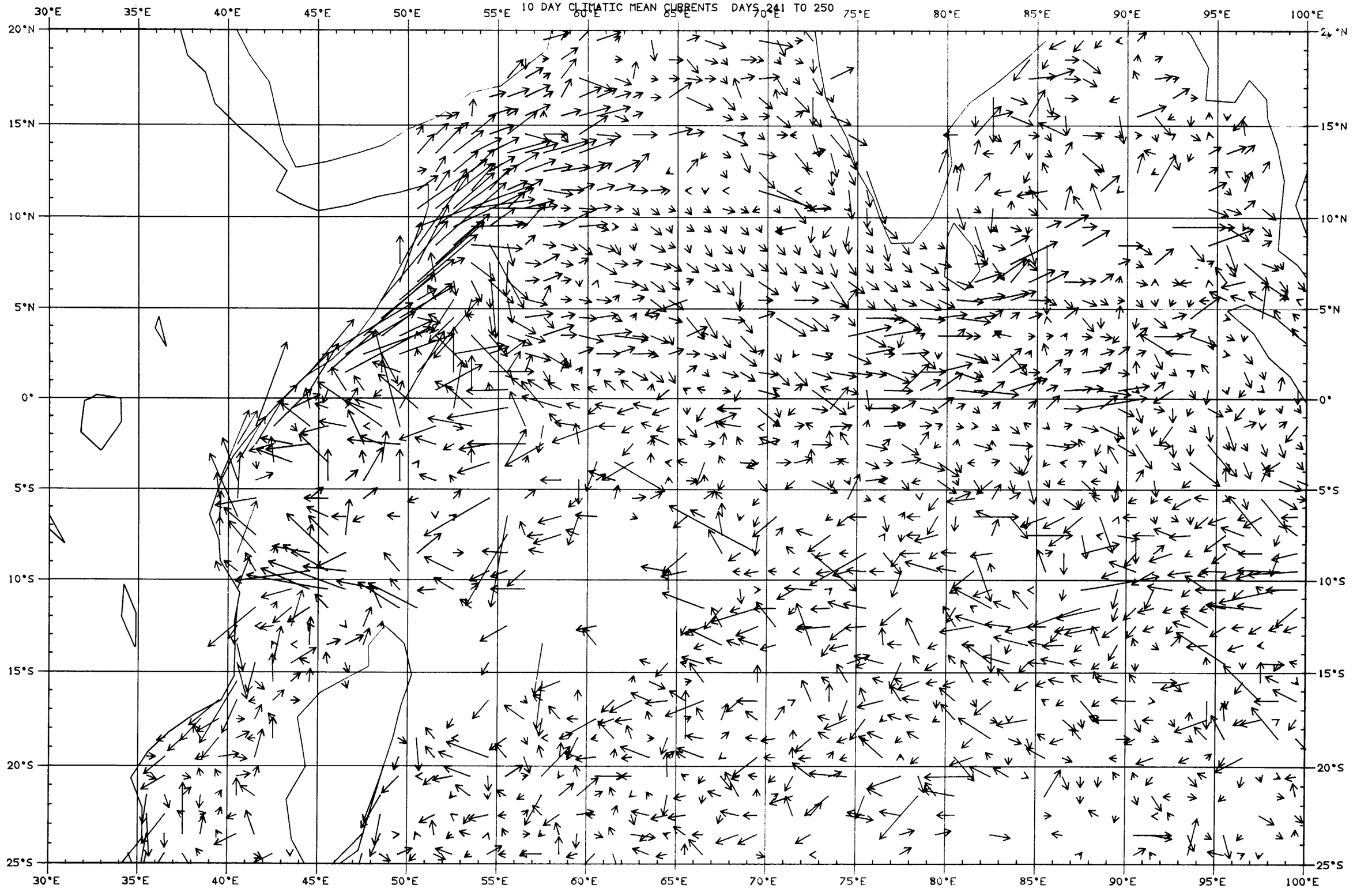

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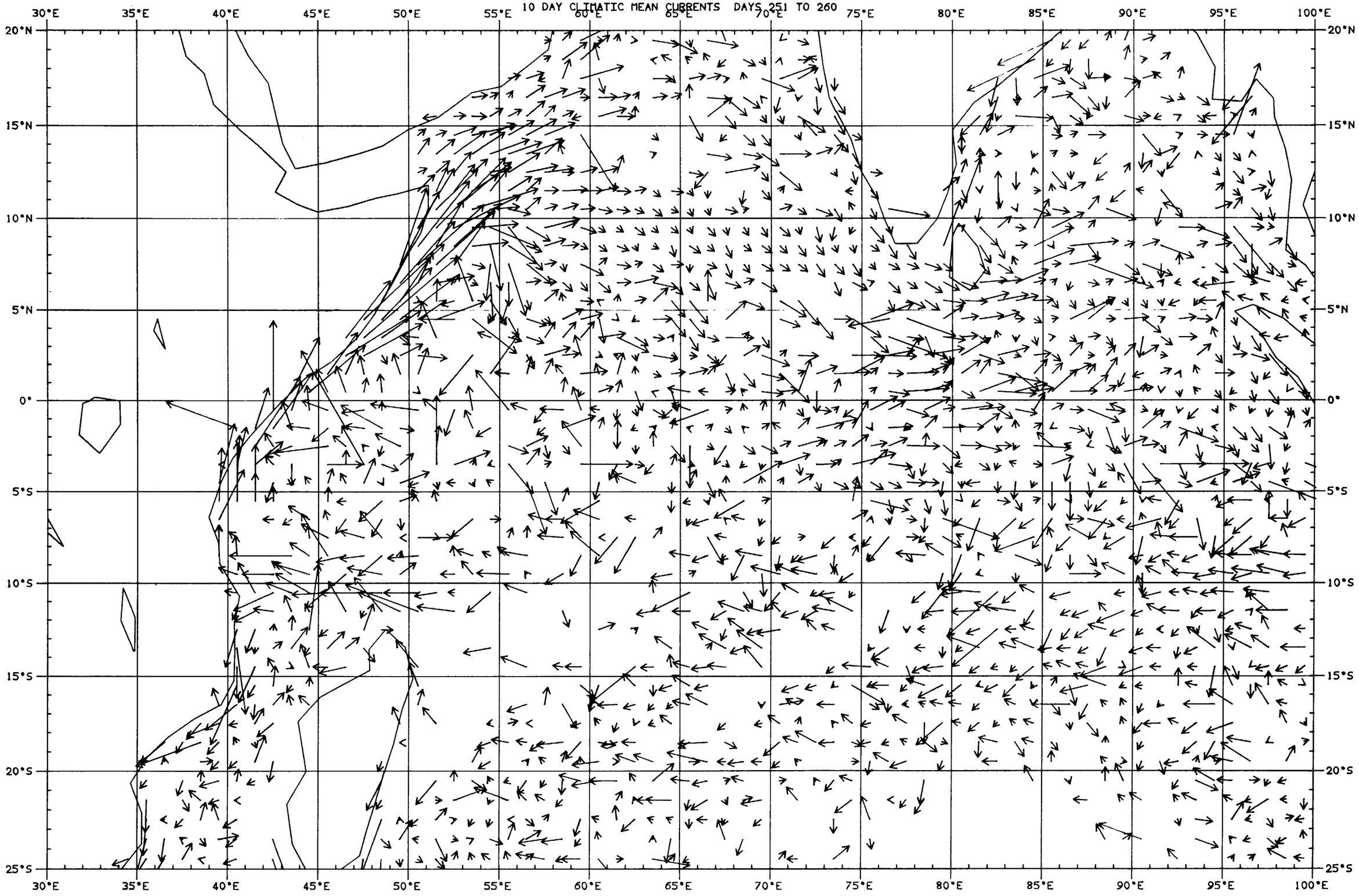

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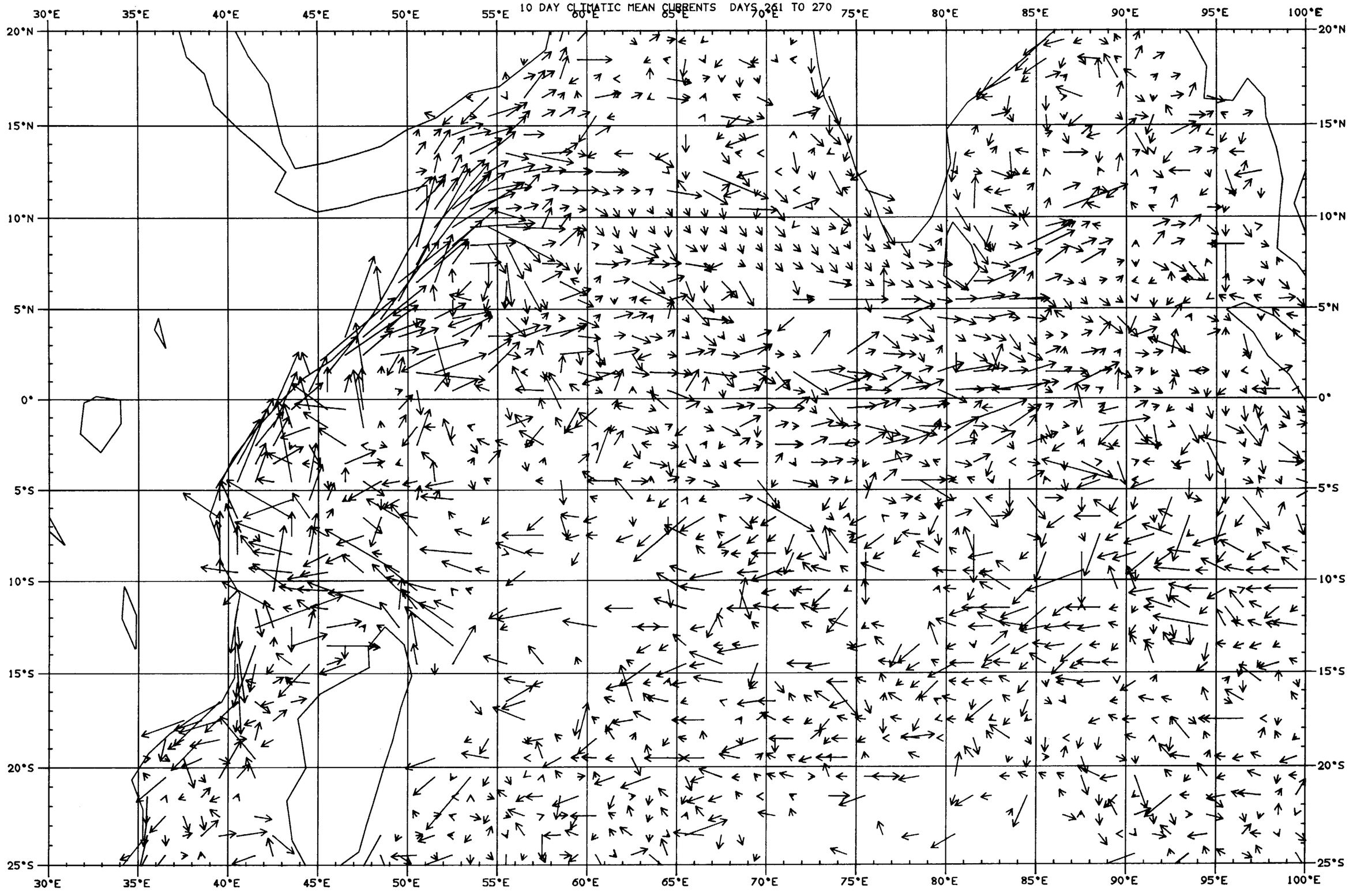

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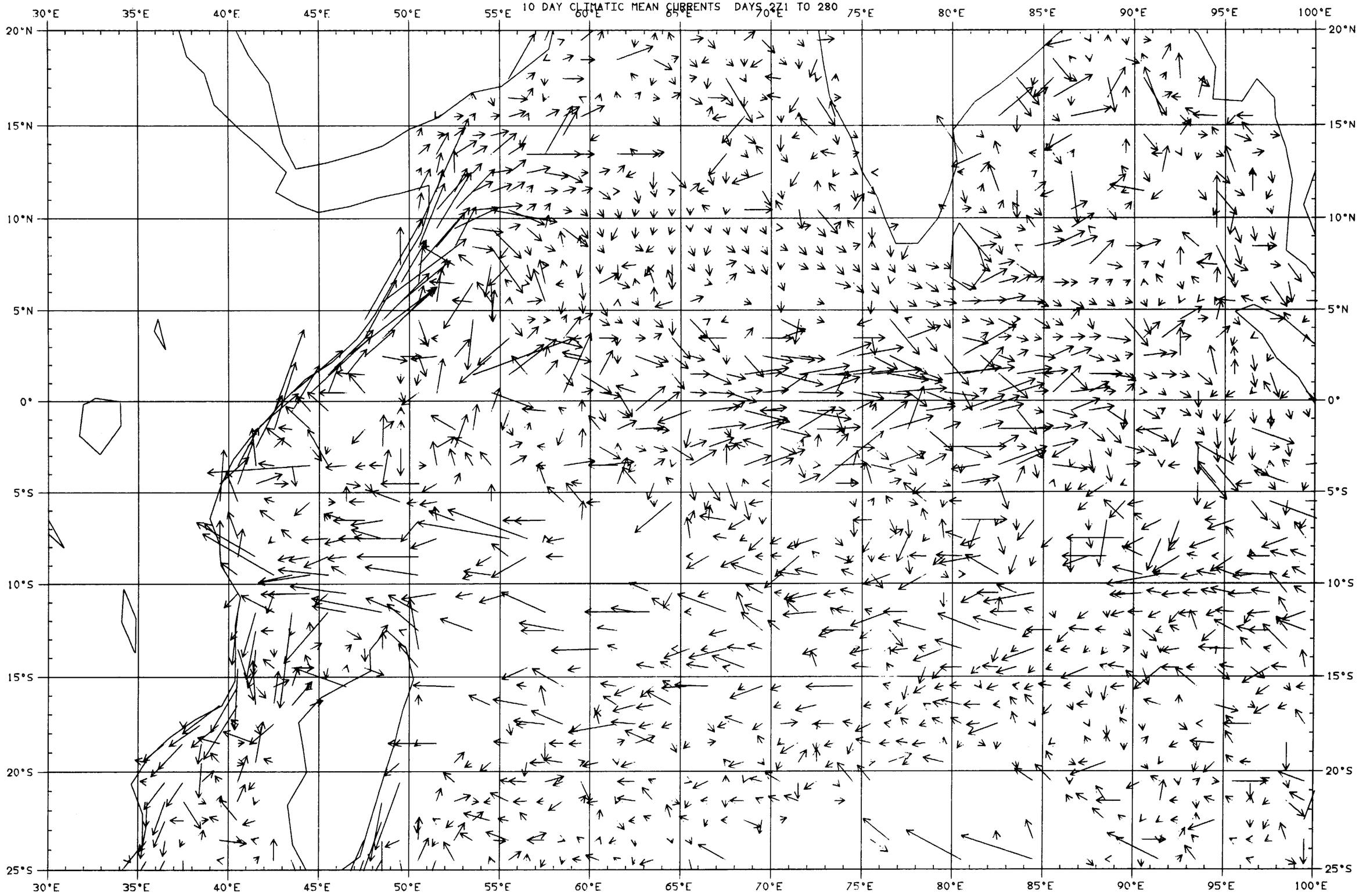

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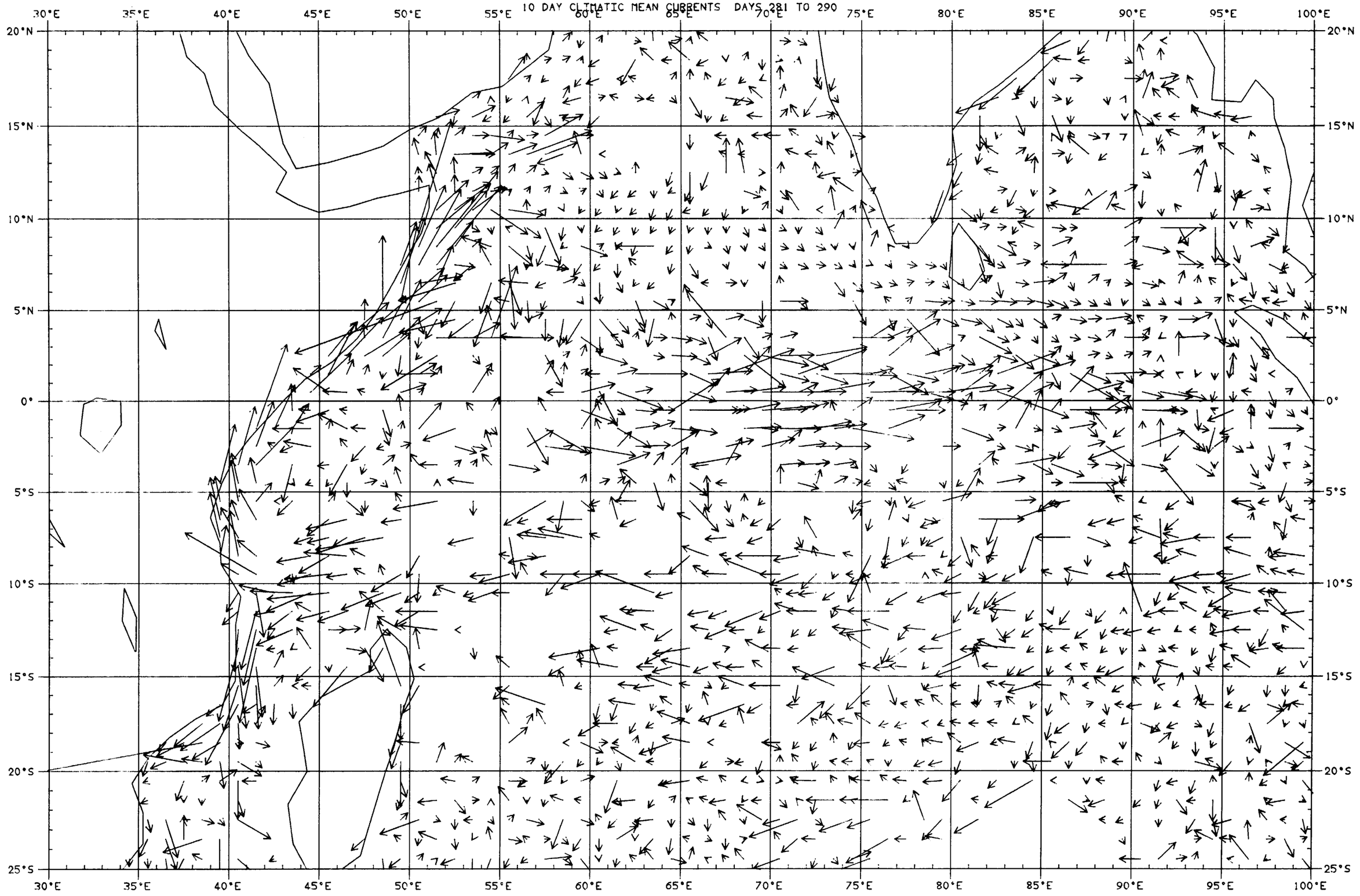

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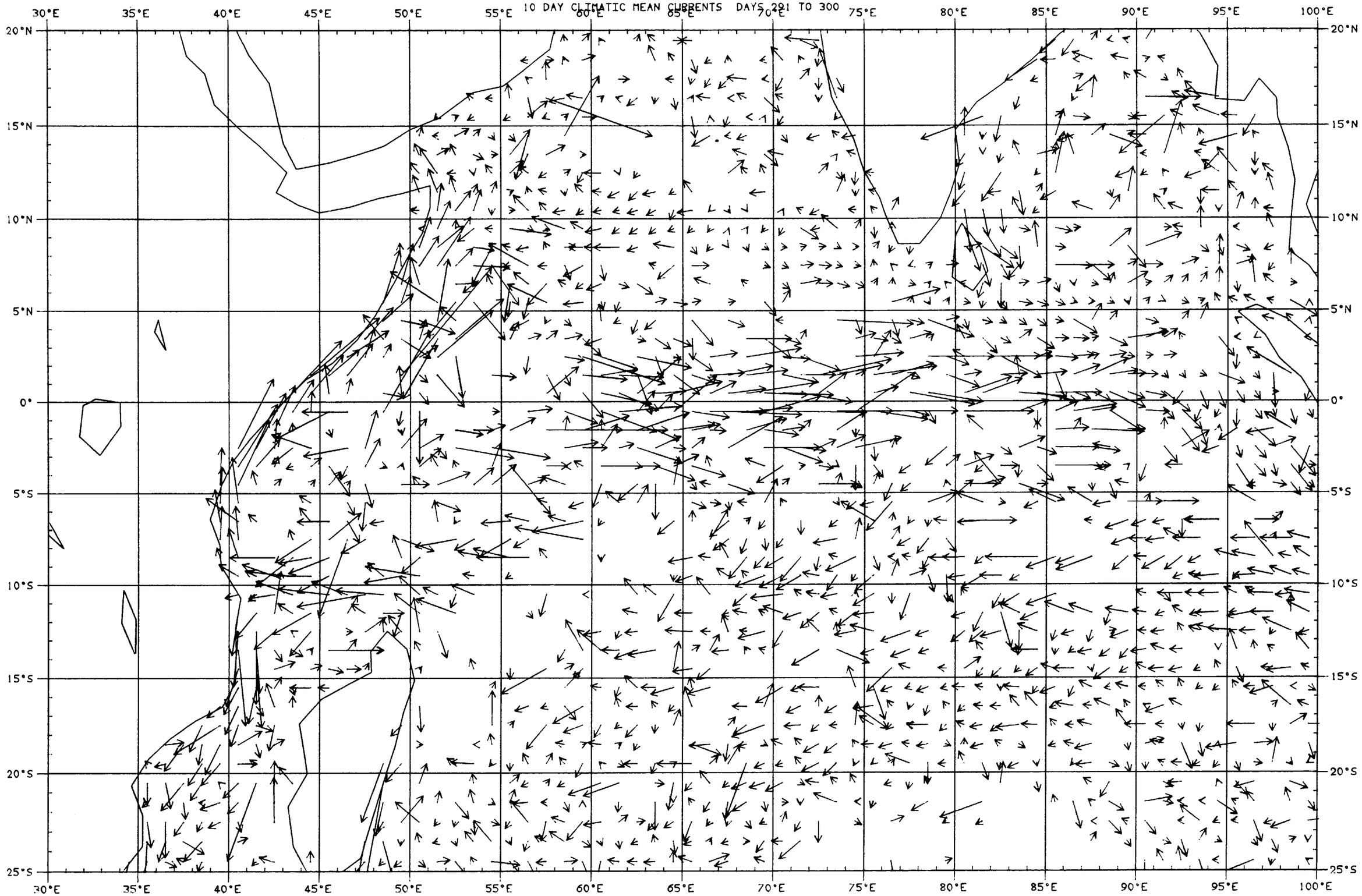

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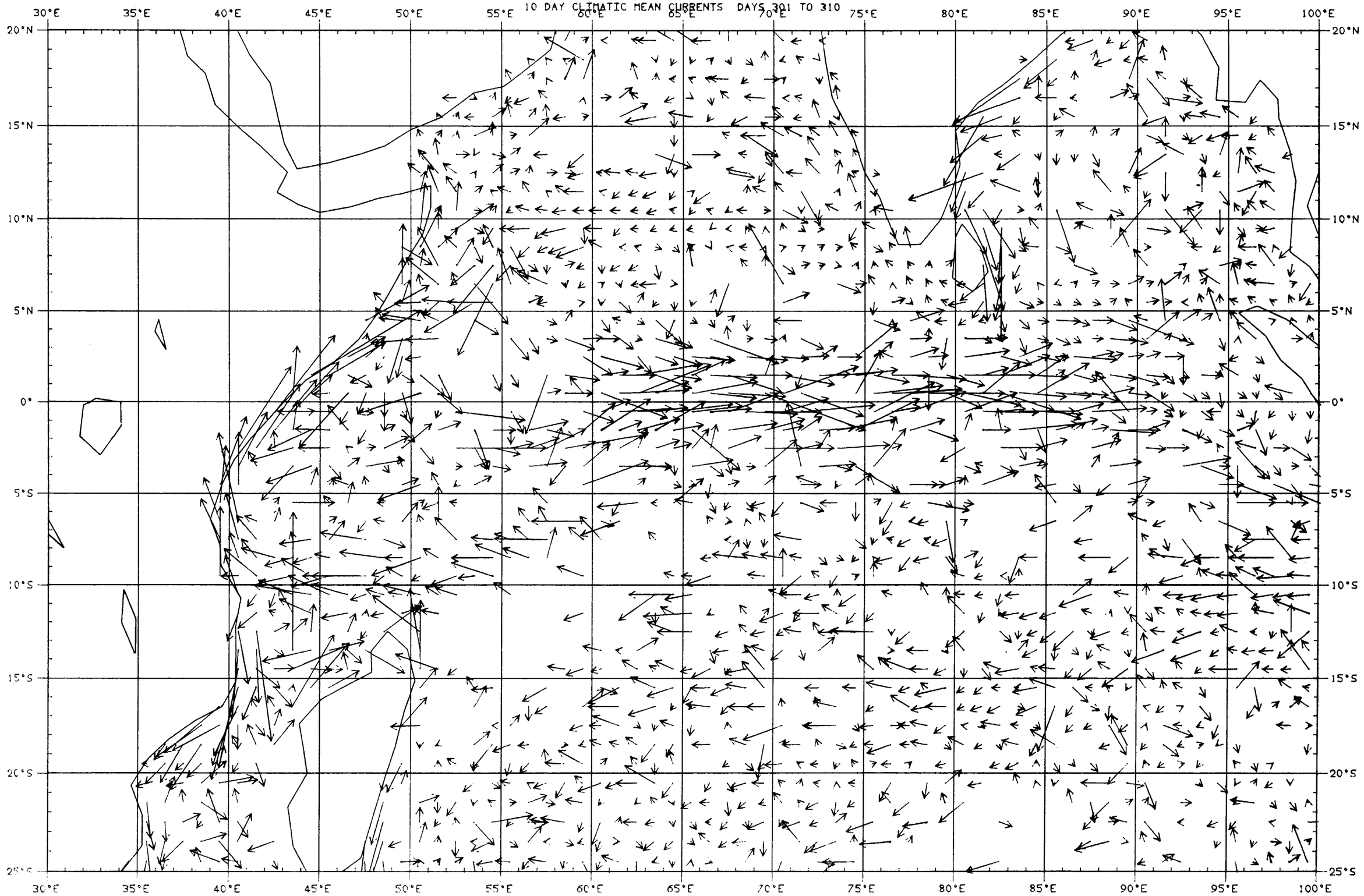

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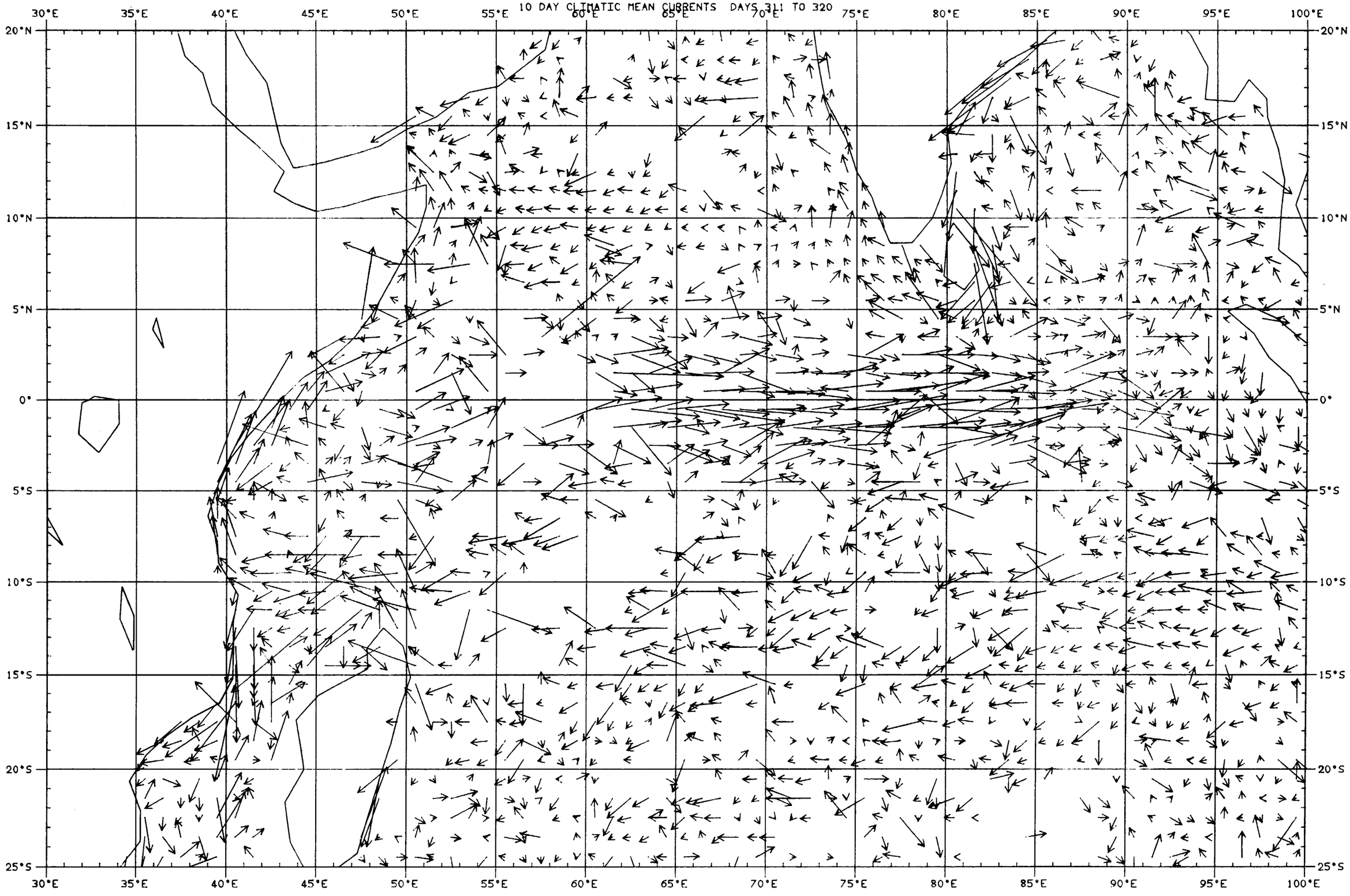

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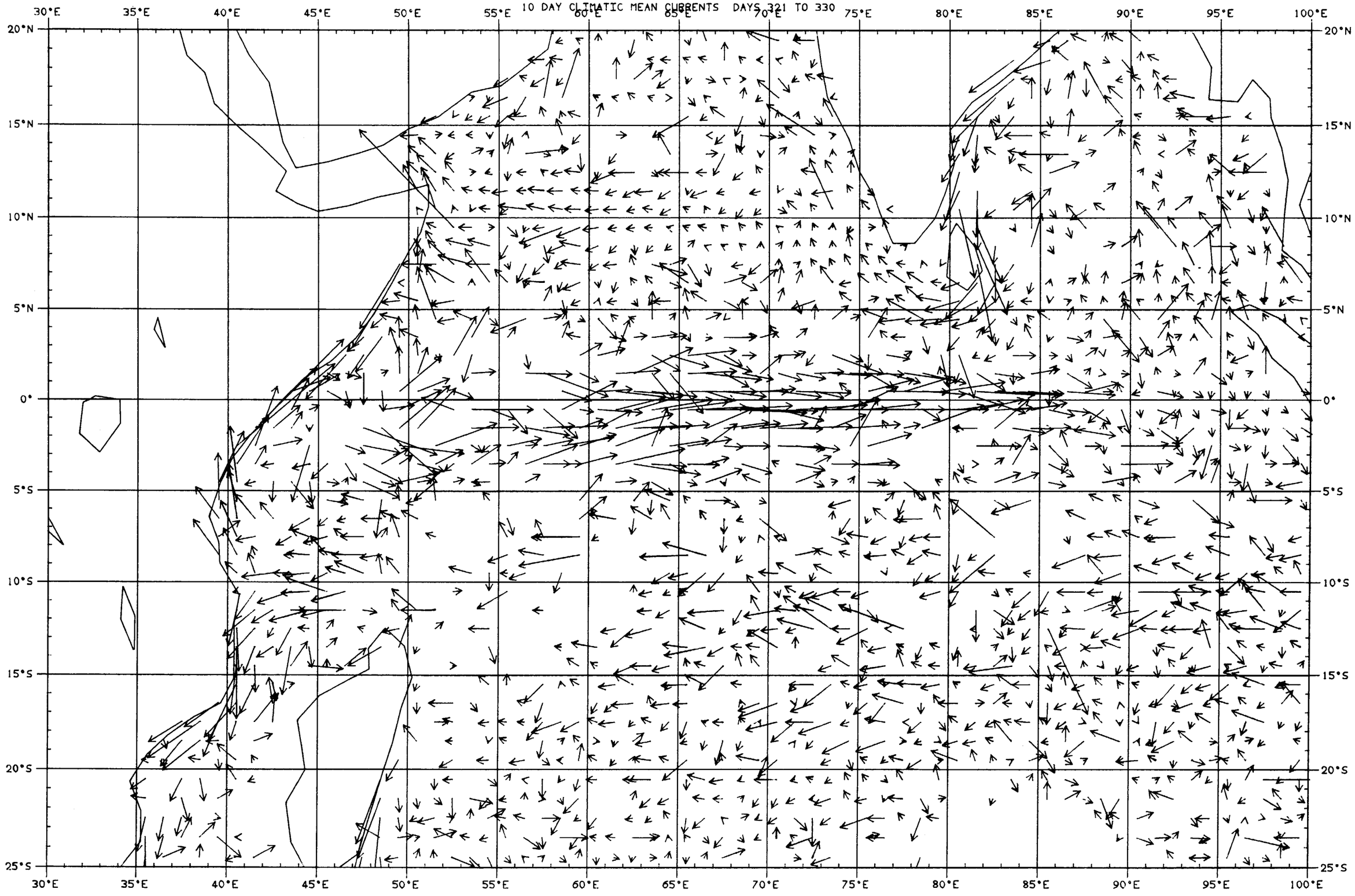

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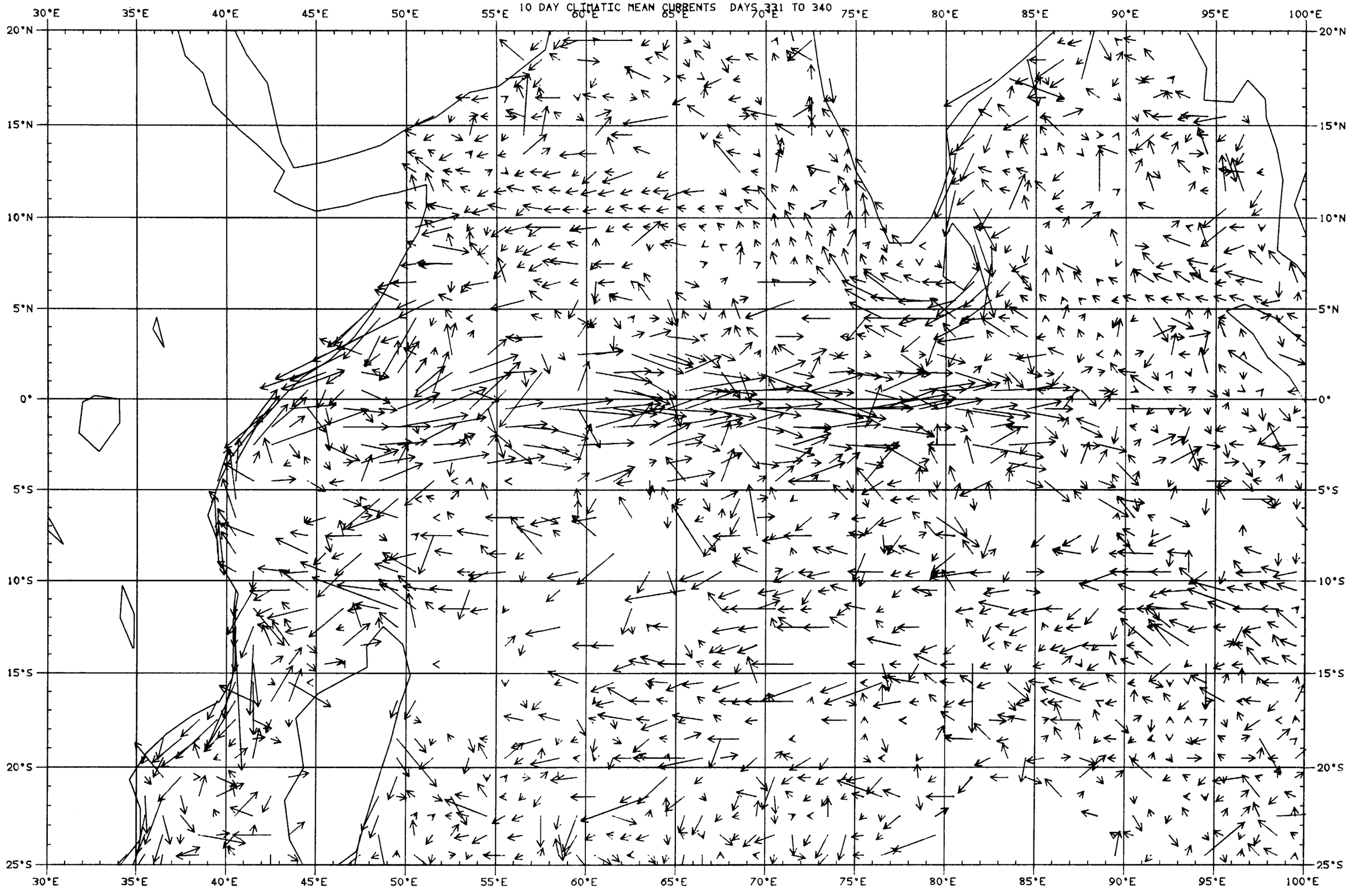

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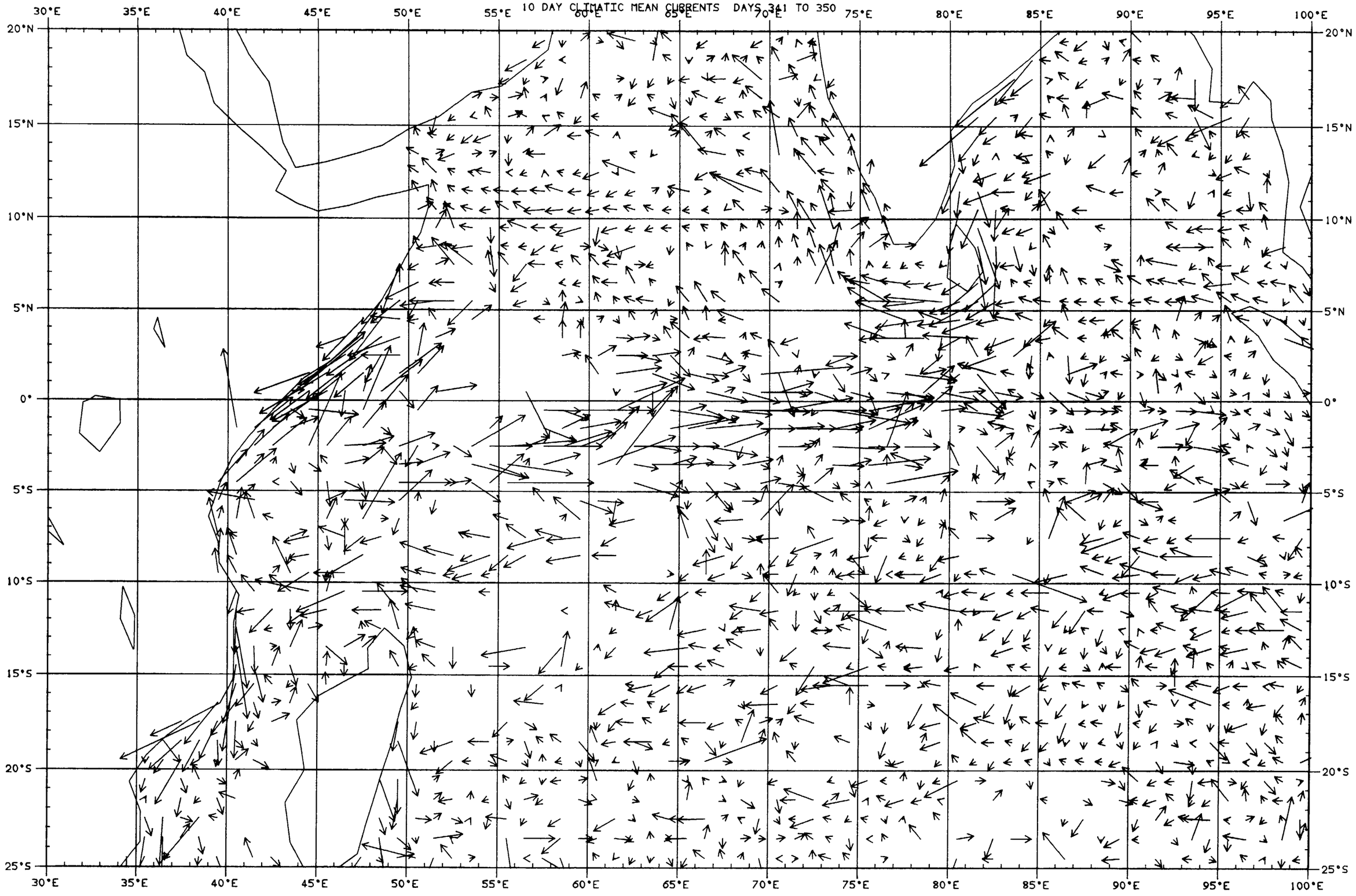
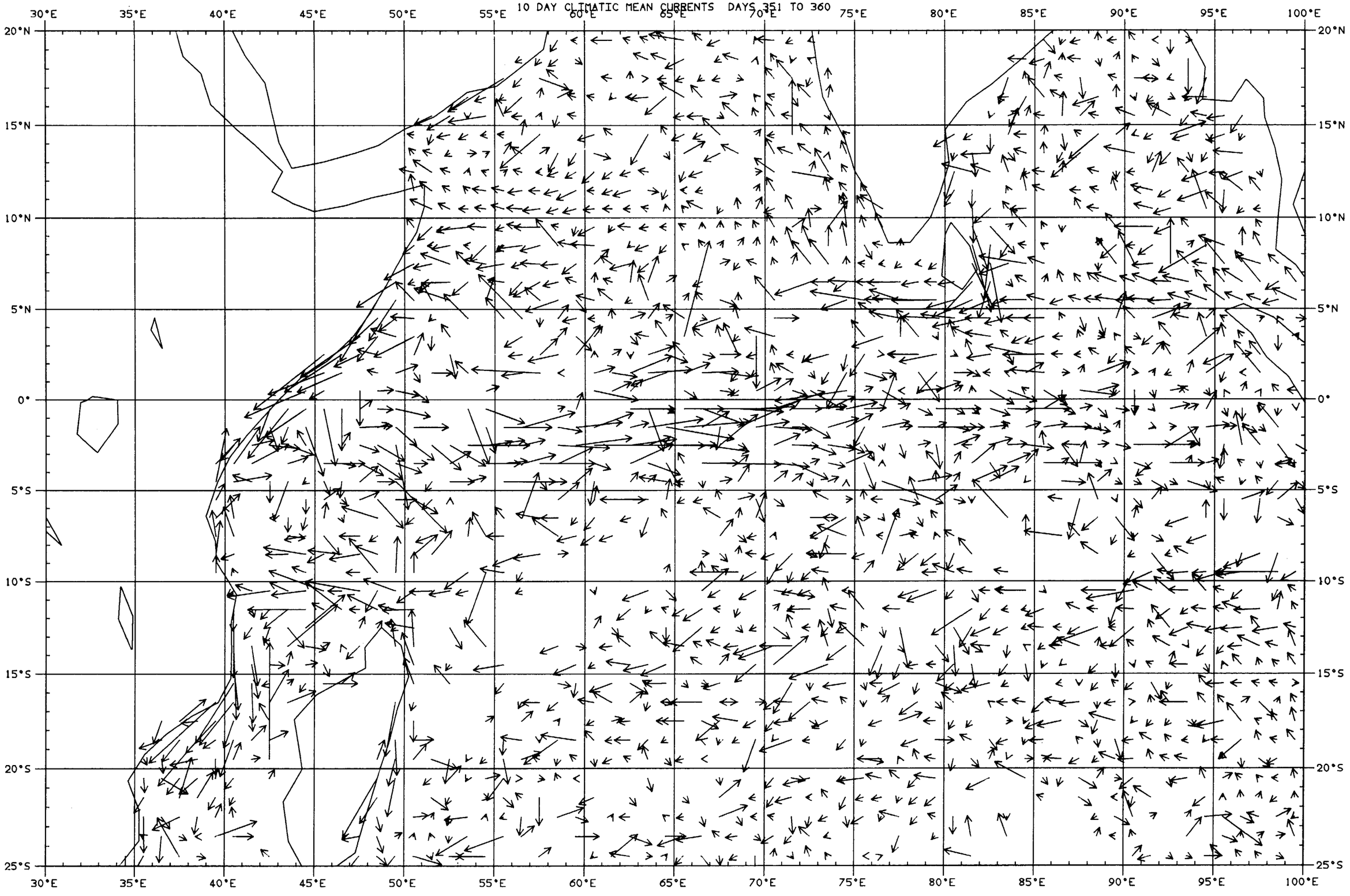
10 DAY CLIMATIC MEAN CURRENTS DAYS 341 TO 350



1 knot ⟶

MET OFFICE HISTORICAL SHIP DRIFT DATA SET
10 DAY CLIMATIC MEAN CURRENTS DAYS 351 TO 360



1 knot ⟶