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What the Ocean Forecast Remembers: The ENSOFORECAST Archive

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ABSTRACT

Explore historical ENSOFORECAST maps with original credits, traceable fields, and clear distinctions between hindcasts and unknown issue times.

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VULTAX RESEARCH · ENSOFORECAST

What the ocean forecast remembers

Historical model maps from Lamont-Doherty and Columbia's IRI show two great El Niño winters. Read them closely, and the most important question becomes when each map was made.

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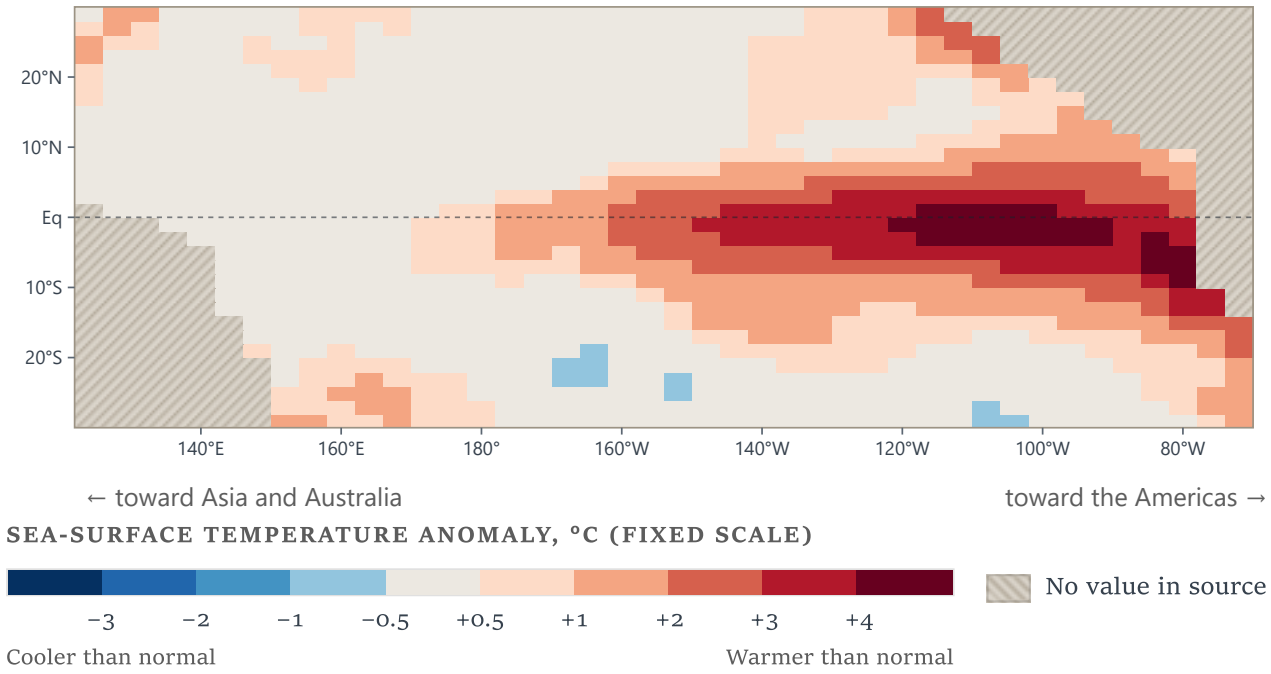
> **Archive: the Lamont-Doherty Earth Observatory climate group and the Columbia IRI Data Library. Model: Stephen E. Zebiak and Mark A. Cane. Transfer: Aaron Kaplan, IRI.** Decoding, checks and presentation by Vultax Research. The archive's creators have not reviewed this edition, and it implies no endorsement.



The tropical Pacific in December 1997: observed sea-surface temperature anomaly, in °C, from the observation file in the ENSOFORECAST archive. North is up; Asia and Australia lie to the left, the Americas to the right.

Warm water, measured as a departure

El Niño shows up as unusually warm water across the central and eastern equatorial Pacific, with knock-on effects on weather far away (NOAA). Maps of it are usually maps of anomalies: how much warmer or cooler the sea surface is than normal for that calendar month. What counts as normal depends on the reference period chosen, and the archive documentation we hold does not say which period it used. So the numbers here are best read against each other, within the archive, rather than against a modern index.

The maps come from ENSOFORECAST, a collection of monthly tropical-Pacific forecasts made at Columbia University's Lamont-Doherty Earth Observatory with the coupled ocean–atmosphere model that Stephen Zebiak and Mark Cane described in 1987, and held for years in the data library of Columbia's International Research Institute for Climate and Society (IRI). Forecasts are stored for leads of 3, 6, 9 and 12 months, for target months from January 1972 into 2001 (catalog documentation). In October 2026, as the IRI Data Library wound down, Aaron Kaplan of IRI assembled the directory and transferred a copy to Vultax.

A forecast has more than one date

Every map here is labelled with a target month, the month it describes, and model maps with a lead of 3, 6, 9 or 12 months. It is tempting to subtract one from the other and call the answer the forecast's date. That does not work, for two reasons.

First, each map is a blend. The catalog says every forecast field averages runs started from six consecutive monthly initial conditions and is then statistically corrected for the model's systematic spatial errors. Zebiak and Cane described the same procedure in NOAA's *Experimental Long-Lead Forecast Bulletin*: the 6-, 9- and 12-month fields they published in September 1997, verifying in January, April and July 1998, averaged runs started in each month from February to July 1997 (September 1997 bulletin). In that account the lead counts from the latest start, and the blend reaches five months further back. Figure 2 sketches it.

FIGURE 2 · HOW A "12-MONTH LEAD" IS BUILT

Six starts, one target, and no recorded issue date

ILLUSTRATION OF A DOCUMENTED PROCEDURE, NOT ARCHIVE DATA

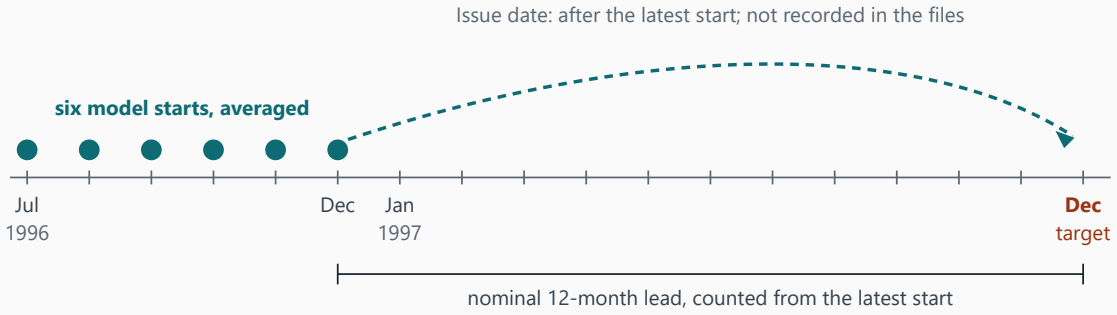


Figure 2. A December 1997 field at a nominal 12-month lead, following the convention in the 1997 bulletins: six runs started from July to December 1996 are averaged, then corrected. The archive's catalog describes the six-start average but does not state its lead convention, and no file records when a field was issued.

Second, a start date is not a publication date. The forecasts built from data through July 1997 appeared in the bulletin's September issue. Nothing in the archive's files records when any field was produced or issued. A target month tells you what a map describes; on its own it cannot tell you what anyone knew, or when.

Two winters, two vantage points

Figure 1 compares two target months, December 1982 and December 1997, during what NOAA describes as two of the largest El Niño events on record. The top map is the observed anomaly supplied with the archive; the middle one is model output for the same month at the lead you choose; the line chart follows both along the equator.

FIGURE 1 · SAME MONTH, TWO VANTAGE POINTS

Observed ocean and historical model output for one target month

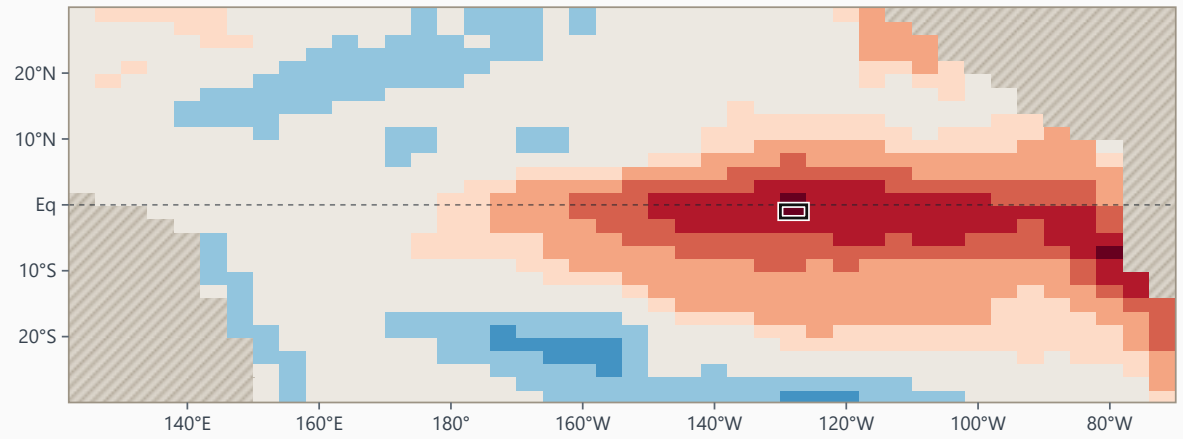
SEA-SURFACE TEMPERATURE ANOMALY, °C (FIXED SCALE)

−3 −2 −1 −0.5 +0.5 +1 +2 +3 +4

Cooler than normal — Warmer than normal

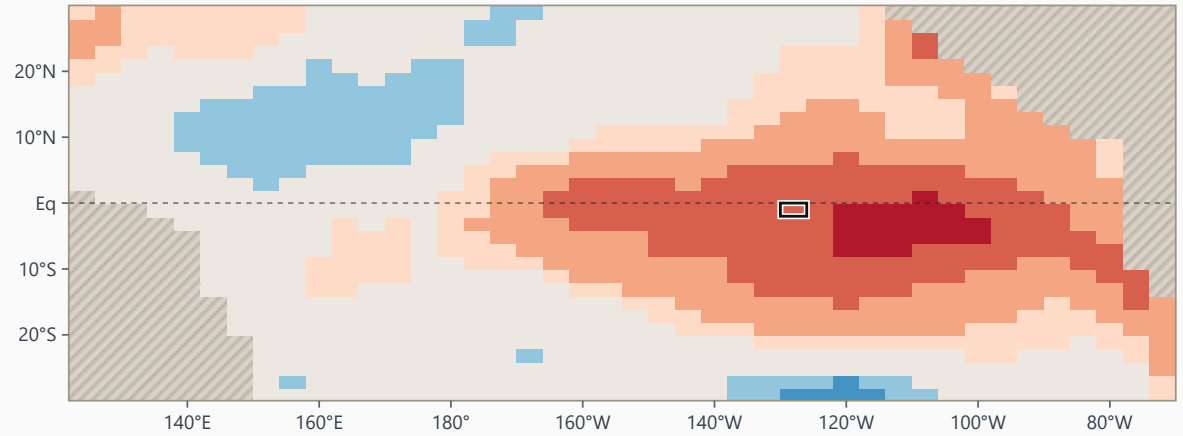
No value in source

Observed December 1982 OBSERVATION



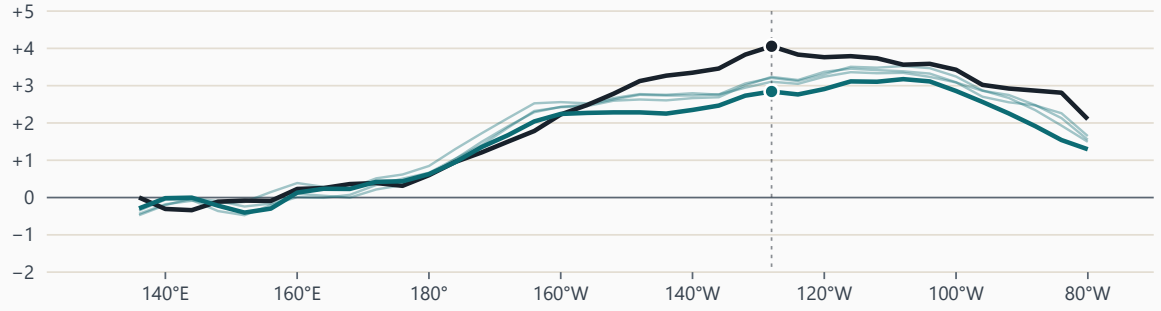
Historical model output LDEO1 · 12-month lead · target December 1982

RETROSPECTIVE



1°S, 128°W · observed +4.08 °C · LDEO1 12-month lead +2.91 °C

Along the equator mean of the 1°S and 1°N rows, °C



Observed LDEO1, 12-month lead LDEO1, other leads

Warmest point along the equator: observed +4.06 °C near 128°W; LDEO1, 12-month lead +3.18 °C near 108°W.

Hover or tap a map, or focus it and use the arrow keys (Shift for five cells), to read the value in any grid cell on both maps.

Figure 1. Sea-surface temperature anomaly, °C, for one target month. Top: observed field from the archive. Middle: historical model output at the selected lead. Bottom: both along the equator. Colour classes are fixed across all maps; hatched cells have no value in the source.

Along the equator, the observed December 1982 anomaly peaks at about +4.1 °C. The LDEO1 output for that month shows the same band of warm water at every lead, peaking between +3.2 and +3.5 °C, even in the 12-month field. The supplied December 1997 field has a higher equatorial peak, near +4.6 °C. This time LDEO1's equatorial output never rises above +1.3 °C at any lead, and at nine months it barely exceeds zero. LDEO2, the archive's second forecast set, peaks between +2.7 and +2.9 °C for 1982, but at its 6-, 9- and 12-month leads for 1997 the equator east of 170°W comes out cooler than normal.

Why 1982 is not a test the model passed

Read quickly, that looks like a model that saw one giant coming and missed the other. The archive cannot support that conclusion, and the reason is the most useful thing in it. Its record begins with target months in January 1972, but Mark Cane and Dong Eun Lee write that Lamont first predicted future conditions with the model in early 1986. Before that, the group made "hindcasts" or "retrospective forecasts", predictions for past times that could be compared directly with what happened (Cane and Lee 2013, p. 72). By that chronology the 1982 model maps are retrospective: produced after the event was over.

Hindcasts are legitimate and valuable; they are how a model's skill is first estimated. What they mean depends on how the model and its statistical correction were fitted. If the correction was trained on years that include 1982, for instance, the 1982 maps partly learned from the answer. That is normal for a hindcast. The archive does not record how fitting and evaluation were separated, so the 1982 maps describe the model and are not a test of its forecasts.

What changed by 1997

By 1997 Lamont was issuing forecasts in real time, from two versions of the model. In December 1997 Zebiak and Cane called the improved initialization, based on Chen and colleagues (1995) and issued since the latter half of 1995, "LDEO2" (December 1997 bulletin). The archive's labels may well follow that naming, with LDEO1 the original version, but its own documentation does not say so, and that is one of the questions we would most like answered.

Their September 1997 article is unusually candid. The authors noted that both versions were starting from eastern-Pacific temperature anomalies well below those observed, and that the models had "not handled the current warm event as skillfully" as earlier ones such as 1982–83 and 1986–87. That contemporaneous note is consistent with the weak 1997 warming in the archive's maps. It does not prove that these particular files are the fields issued at the time: they could be later reruns or reprocessed versions, and they carry no issue timestamps. The comparison the archive invites, 1982 against 1997, is one the modelers drew themselves that September, and its 1982 side was a hindcast.

What a fair test would need

Two snapshots are not a skill score in either direction. The nine documented core files share 316 target months, and each model-and-lead file overlaps the observations for between 316 and 338 months (table below). A fair comparison would use matched months and masks, area weights, simple baselines such as persistence that use only information available at the start, uncertainty that respects how slowly ocean temperatures change from month to month, and, before any of that, a record of which fields were issued when. Our evaluation protocol sets this out before any result is computed.

The maps are continuous temperature anomalies. They are not probabilities of an El Niño, and turning them into probabilities would need an error model fitted and checked on the full record.

What the core archive covers

We checked every time coordinate and missing-value mask in the nine documented core

files. Their target ranges differ, so products must be compared on the same months.

Documented core files — target months, not issue dates

Product	Lead	Target range	Months	Matched with observations
LDEO1	3 months	1972-01–2000-05	341	338
LDEO1	6 months	1972-01–2000-08	344	338
LDEO1	9 months	1972-01–2000-11	347	338
LDEO1	12 months	1972-01–2001-02	350	338
LDEO2	3 months	1972-01–1998-04	316	316
LDEO2	6 months	1972-01–1998-07	319	319
LDEO2	9 months	1972-01–1998-10	322	322
LDEO2	12 months	1972-01–1999-01	325	325
Observed	—	1972-01–2000-02	338	Observation reference

All nine time axes are monthly, contiguous and free of duplicates, and the same 1,077 cells are valid in every month of every file. These are coverage facts, not accuracy scores. Download the coverage and mask checks.

Use, cite and correct

The export buttons in Figure 1 save the current comparison as SVG or PNG with the source files, target month, lead, units, evidence class, credits and edition written into the image, so a slide keeps its provenance. Cite this edition as: Vultax Research, What the ocean forecast remembers: the ENSOFORECAST archive, Tallinn, 25 October 2026, https://vultax.com/research/ensoforecast-historical-archive. Cite the archive and the model as well; the record page at https://vultax.com/archive/ensoforecast lists every source file with its checksum. A DOI will be added here once the deposit is registered. Corrections are logged by ID in the version history; the correction path explains what to send.

18 map slices · JSON · Slice provenance and timing · Nine-file core inventory · Coverage · Evidence ledger · Citation file · BibTeX

Methods and data descriptor · Teaching exercise · Evaluation protocol · Research notes · Data dictionary

Thank you

In October 2026, Aaron Kaplan took the time to assemble a directory last updated in 2000 and send it on in good order, with a checksum so we could confirm our copy arrived intact. It did. Behind the archive stand the Lamont-Doherty and IRI teams who built these forecasts, maintained them and kept them accessible long after the last update, and Stephen Zebiak and Mark Cane, whose model produced them.

Vultax's part is the edition itself: we decoded the nine documented core files without altering them, checked every time axis and mask, traced each displayed map to its source file, gathered the evidence about when fields were made, and built this explorer and its documentation.

ABOUT THE DATA

Grid and values. Maps show sea-surface temperature anomalies in °C on the archive's grid: cell centres every 4° of longitude from 124°E to 72°W and every 2° of latitude from 29°S to 29°N, north at the top. Displayed values are rounded to three decimals from the source floats; the original files are unchanged. Hatched cells have no value in the source. The equatorial line averages the 1°S and 1°N rows where both have values; it is not an official Niño index.

Evidence classes. Observation: from the archive's observation file, whose anomaly reference period and revision history are not documented in what we hold. Retrospective: the 1982 model fields, inferred from the published model chronology. Issue time unverified: the 1997 model fields; contemporaneous bulletins describe real-time forecasts, but no file records an issue date.

Scope. The transfer contains 49 files. This edition uses the nine files the catalog documents; the other 40 have not been identified and are not shared. IRI's alternate-sources list marks the ENSOFORECAST dataset as not restricted (row 59, checked 22 October 2026).

PRESERVATION HISTORY

ENSOFORECAST sat in the IRI Data Library. The library's sunset notice, updated through 25 August 2026 and checked on 22 October 2026, says the full shutdown "will most likely happen by the end of October 2026, possibly earlier", and IRI published a list of alternative sources for its datasets. We asked about preserving the collection. Aaron Kaplan assembled the full directory, which he describes as last updated in May 2000, and sent it with a checksum on 21 October 2026.

SOURCES

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- Ingrid time conventions, months since January 1960: https://rainbow.ldeo.columbia.edu/documentation/libraries/ingrid/Ingrid_5.html
- Document-based research — No Lean proof. Document-based research; its factual and legal claims are not covered by a Lean proof.

CREDITS

- **ENSOFORECAST archive:** forecasts by the Lamont-Doherty Earth Observatory climate group using the Zebiak–Cane model; held by the Columbia IRI Data Library; assembled and transferred by Aaron Kaplan, IRI.
- **Edition, decoding, writing and design:** Vultax Research, operated by OmniOS OÜ, Tallinn.

AI assistance was used for this edition's writing, code and data checks. Original research and data remain credited to their creators.

REFERENCES

Original ENSOFORECAST catalogue documentation https://github.com/iridl/dlentries/blob/master/descriptions/ensoforecasts.html

Published interactive research edition https://vultax.com/research/editions/ensoforecast/index.html

Document-based research https://vultax.com/datasets/research-proof-library-2026-10-25/articles/ensoforecast-historical-archive.md

No Lean proof. Document-based research; its factual and legal claims are not covered by a Lean proof.

Per-article scope records and Lean package https://vultax.com/datasets/research-proof-library-2026-10-25/README.md

Dated per-article scope records, Lean source, frozen permitted public inputs, checker logs and a reproducible ZIP. Covers only the scope stated in each record, not the whole study.