Prediction Skill of North Pacific Variability in NCEP Climate Forecast System Version2: Impact of ENSO and Beyond

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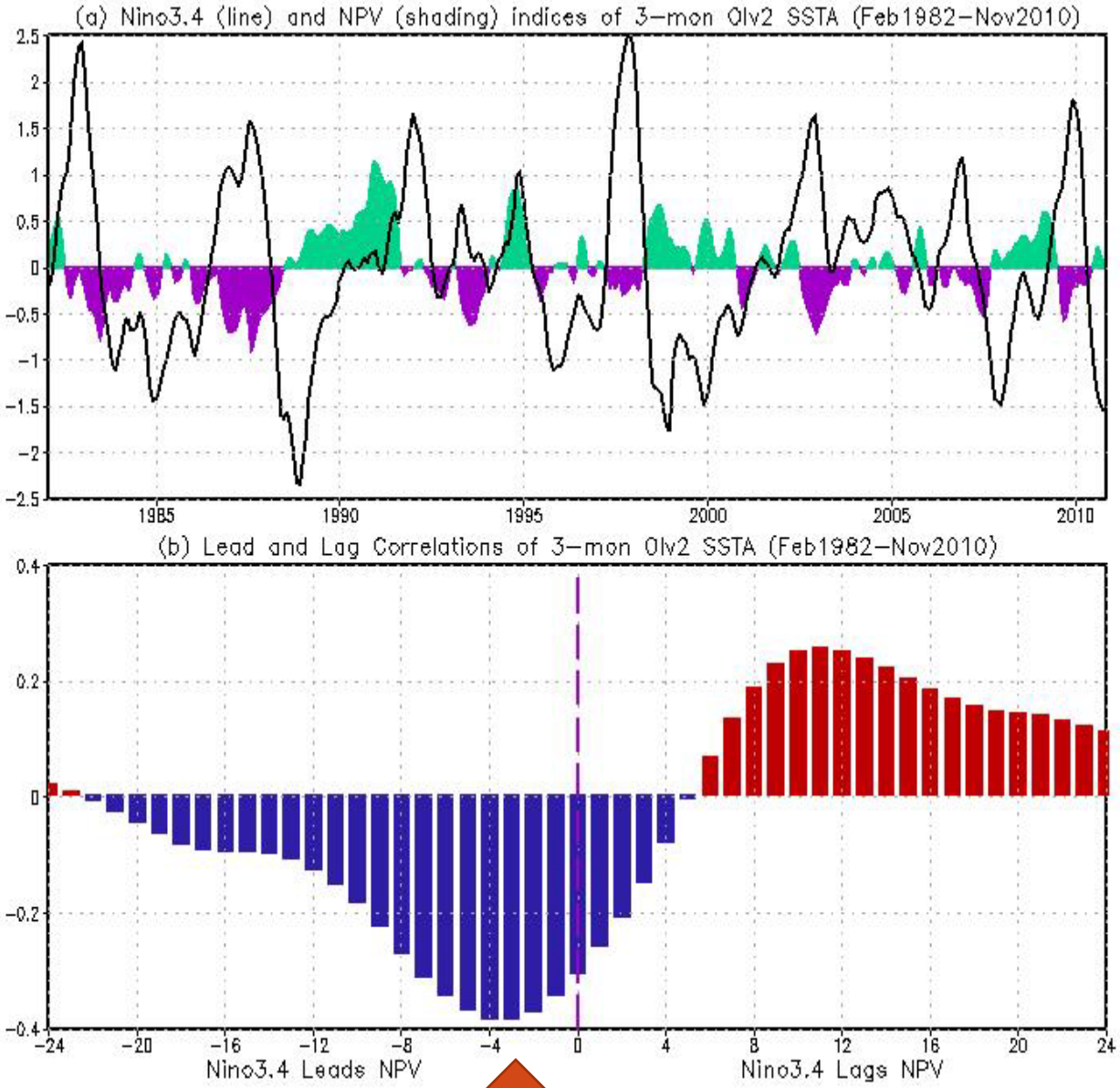
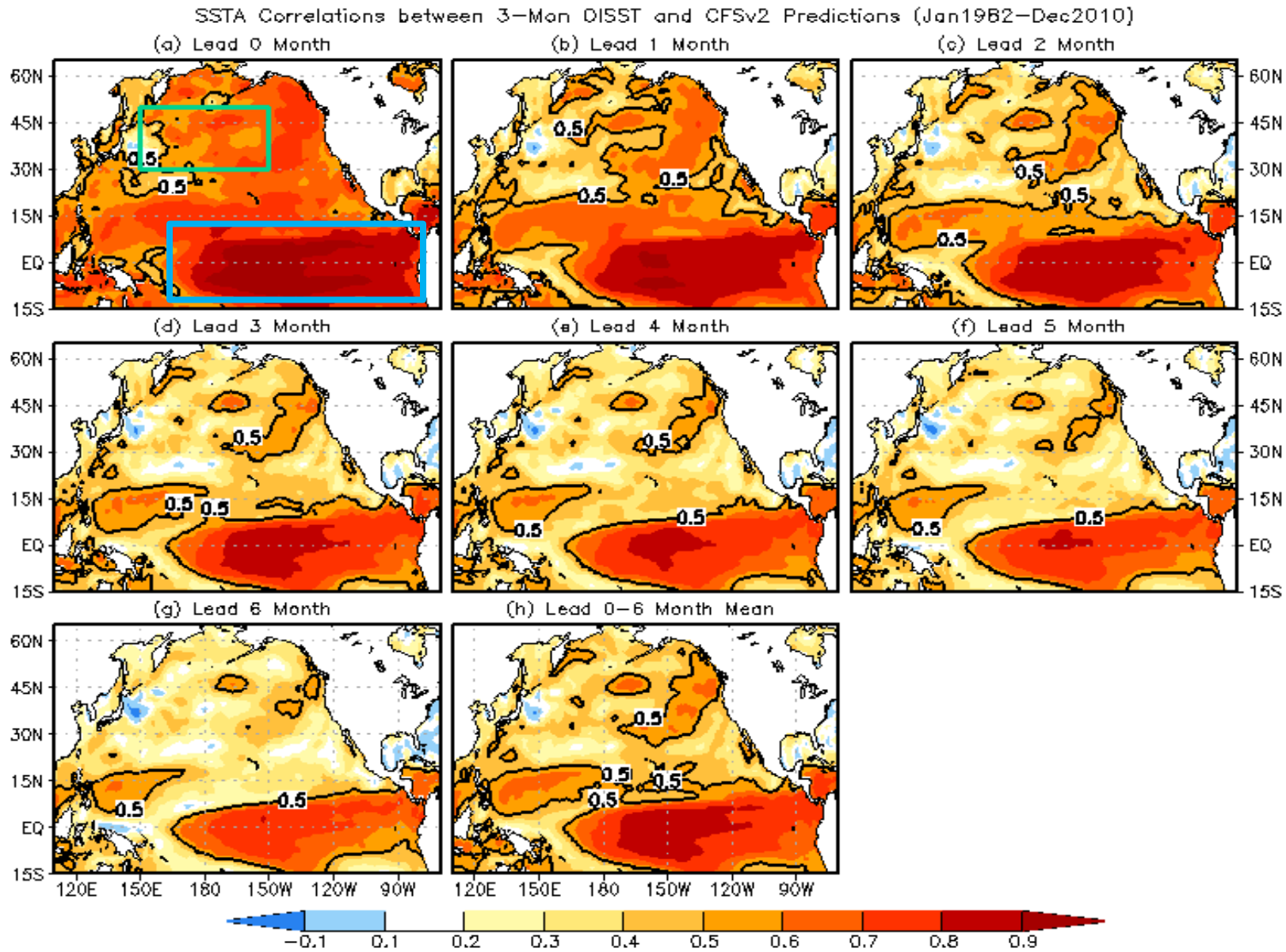


Evidence I: NPV and ENSO are statistically connected:

Nino3.4 leads NPV by 3-4 months, suggesting that ENSO mainly affects NPV

Evidence II: In addition to the highest prediction skills of SSTA in the tropical e&c Pacific associated with ENSO, some prediction skills are seen in N. Pacific



Two Evidences:

I: NPV and ENSO are statistically connected;

2: In addition to the highest prediction skills of SSTA in the tropical eastern and central Pacific associated with ENSO, some prediction skills are seen in N. Pacific.

Questions:

- Does the different combination of NPV and ENSO phase in *IC* affect the skill of NPV prediction?
- In other words, can the different combination of NPV and ENSO phase in *IC* provide some anticipation/prejudgment for the reliability of the prediction in N. Pacific?
- Is there any prediction skill of NPV beyond the influence of ENSO?

Data: (Jan 1982-Dec 2010)

- **CFSv2 Hindcasts:**

  3-mon mean data:

  2-climatologies are used to calculate anomaly

  *Each Month: 6 Days *4=24 Hindcasts*

- **Observations and reanalysis data**

  OIv2 3-mon mean SST

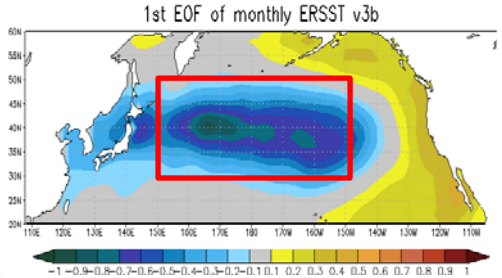
  CFSR monthly mean data

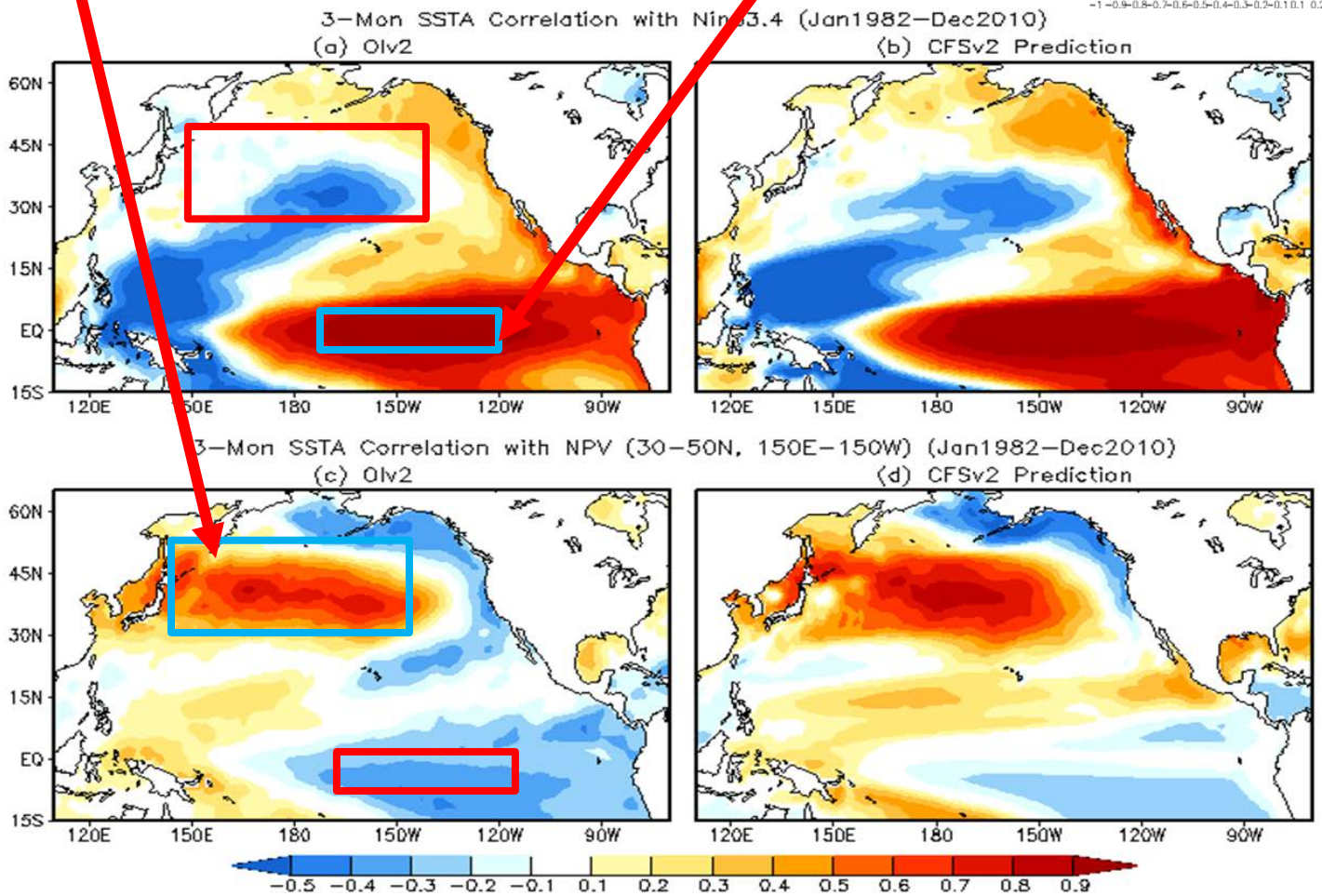
Indices:

NPV: SSTA (30-50N, 150E-150W); *Nino3.4: SSTA (5S-5N, 120-170W)*

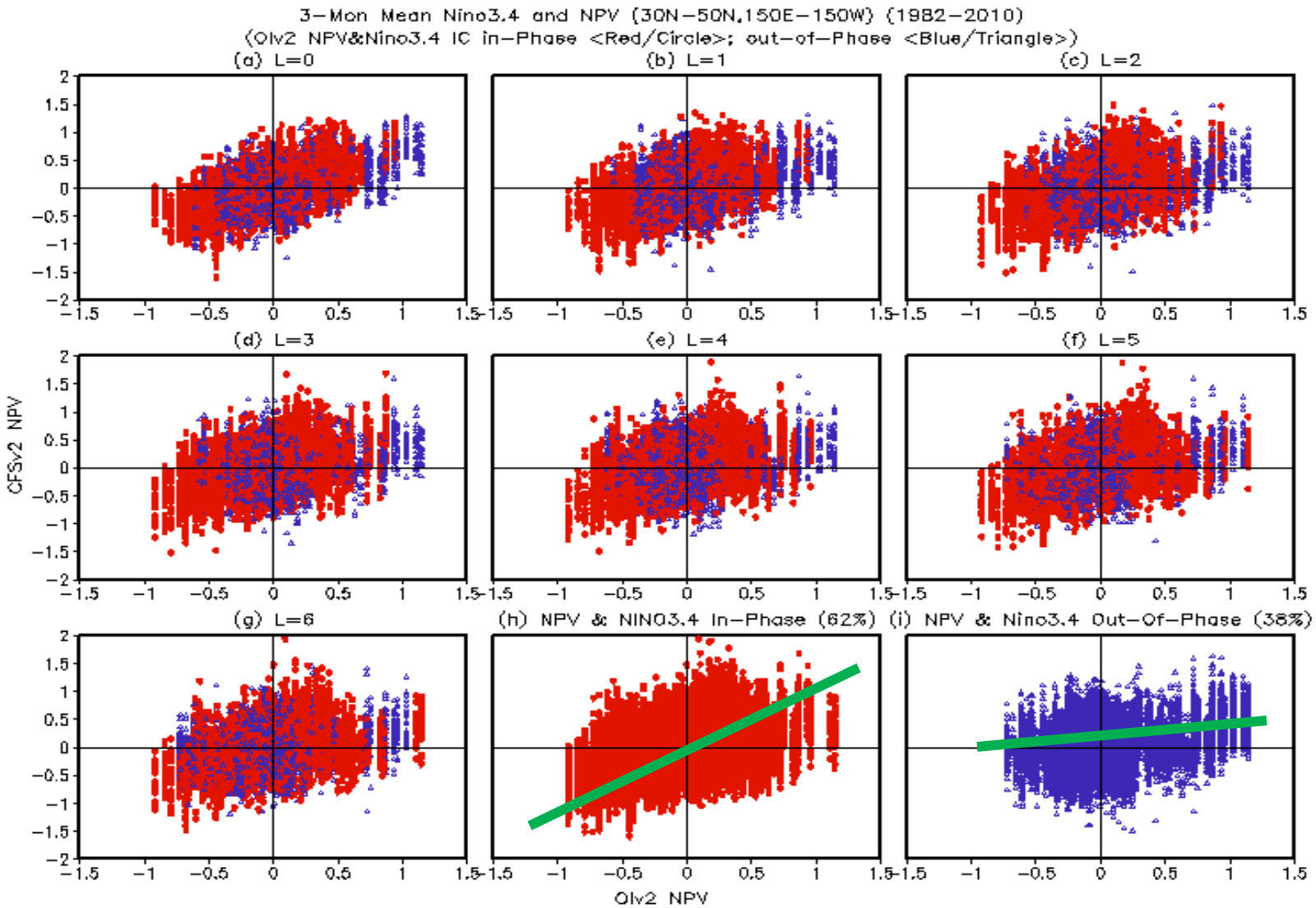
In-phase: Ninio3.4 and NPV have *opposite sign*

Out-of-phase: Nino3.4 and NPV have *same sign*

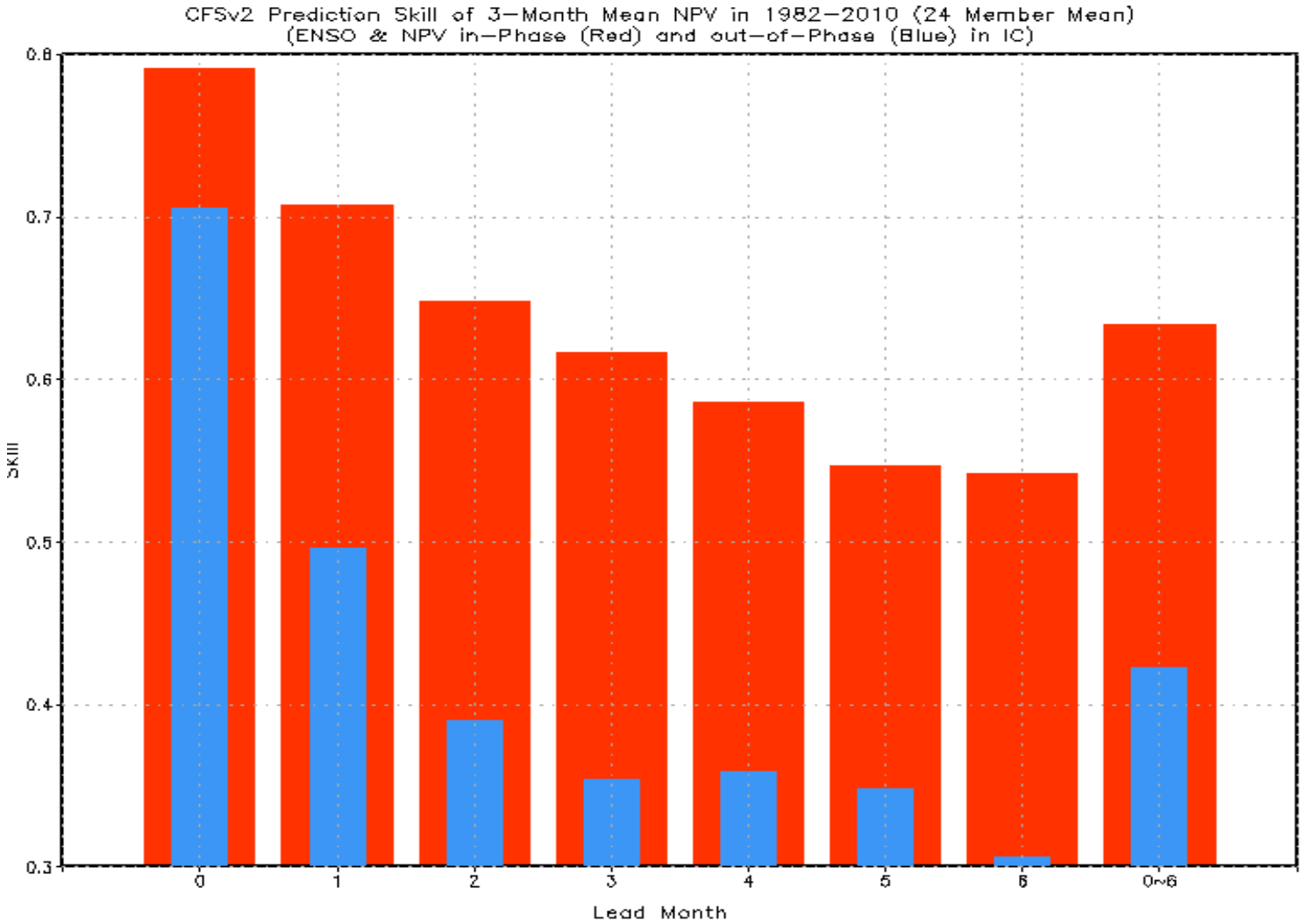




3-mon NPV prediction skill: dependence on *IC* phase relation between NINO3.4 and NPV

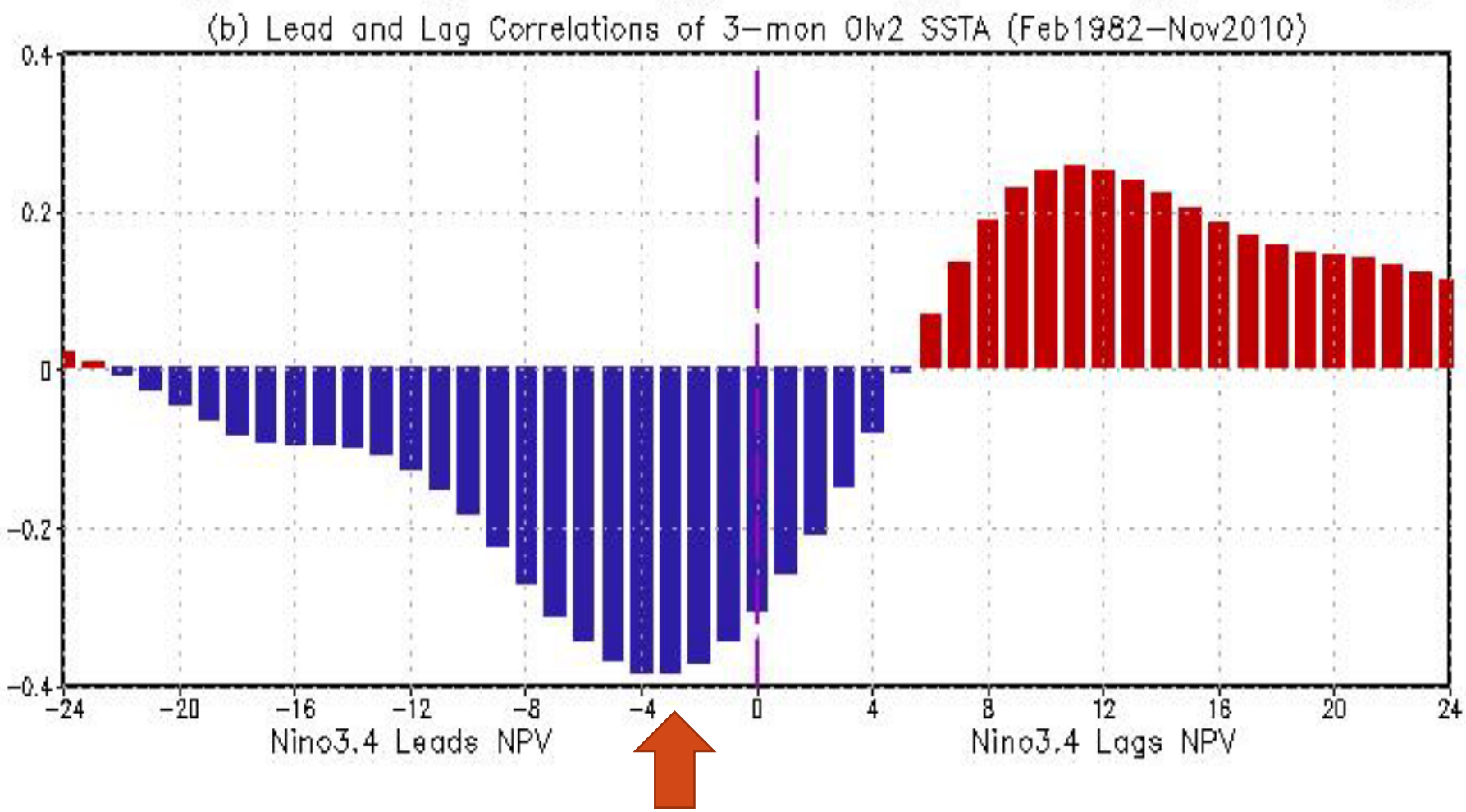


3-mon NPV prediction skill: dependence on *IC* phase relation between NINO3.4 and NPV: **in-phase has higher skill than out-of-phase for all leads.**



Dependence of NPV prediction skill on phase relation between NPV and ENSO in *IC*

	In-Phase	Out-of-phase	Difference <in-phase>-<out-of-phase>
0	0.80	0.70	0.10
1	0.71	0.50	0.21
2	0.65	0.39	0.26
3	0.62	0.35	0.27
4	0.59	0.36	0.23
5	0.55	0.35	0.20
6	0.54	0.31	0.24
0-6 month average	0.63	0.42	0.21



Maximum correlation presents when Nino3.4 leads NPV by 3-4 months.

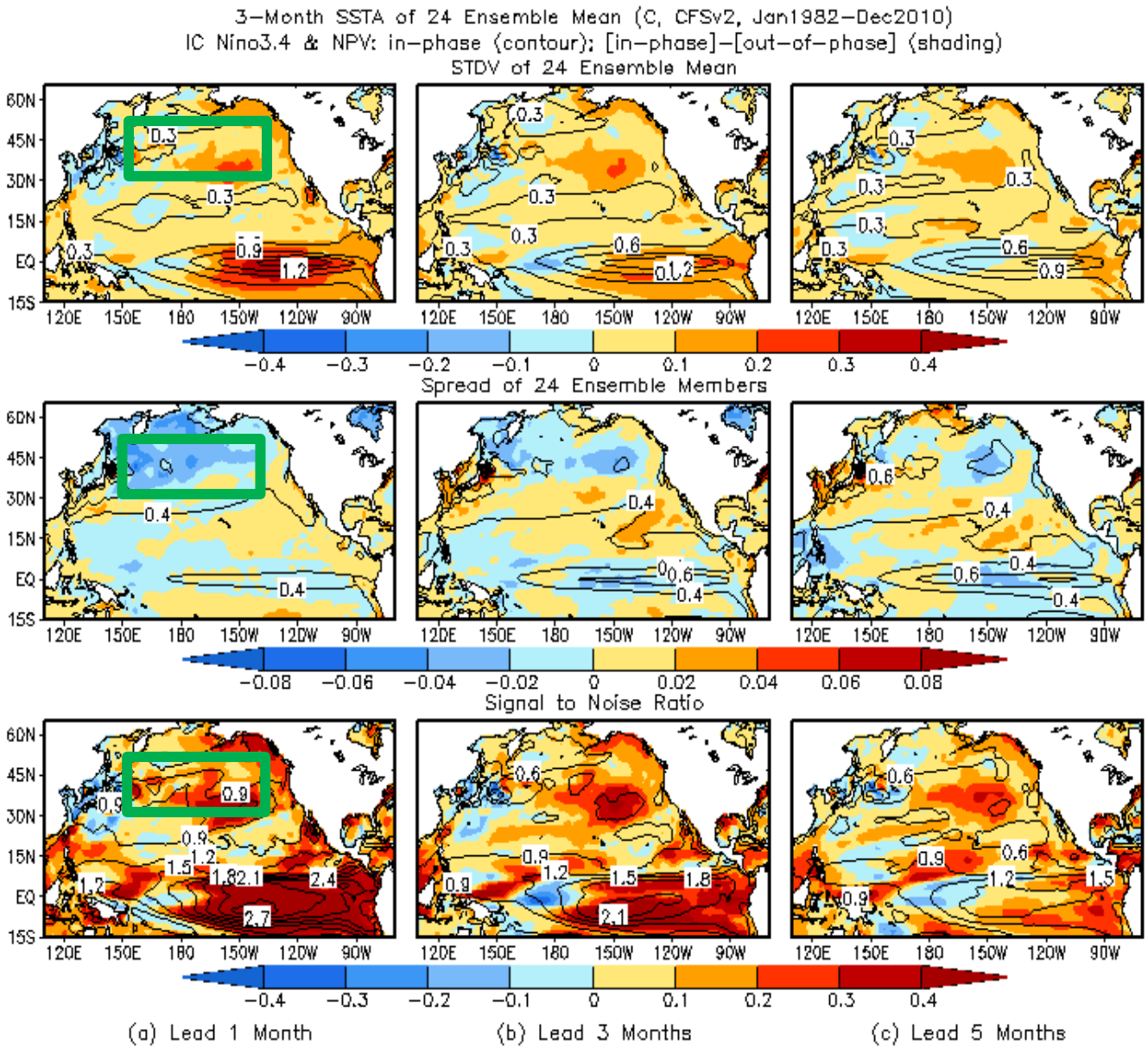
NPV Prediction Skill Differences:

I: NPV prediction skill is higher when NPV and ENSO in *IC* are in-phase than when they are out-of-phase;

2: Maxima difference of the skill appears in 3-month lead prediction.

Question:

Why is the inter-phase of NPV and ENSO in *IC* a matter for the prediction skill of NPV?



Compared with the out-of-phase, when NPV and ENSO are in-phase:

The spread among individual ensemble members is generally smaller in N. Pacific;

The ensemble mean signal is larger due to the physical consistence;

As a result, signal-to-noise ratio is larger, and prediction skill is higher.

NPV Prediction Skill Differences:

I: NPV prediction skill is higher when NPV and ENSO in *IC* are in-phase than when they are out-of-phase;

2: Due to the physical consistence, when NPV and ENSO are in-phase, the signal (spread) is generally larger (relatively smaller) in N. Pacific, as a result, signal-to-noise ratio is larger and prediction skill is higher.

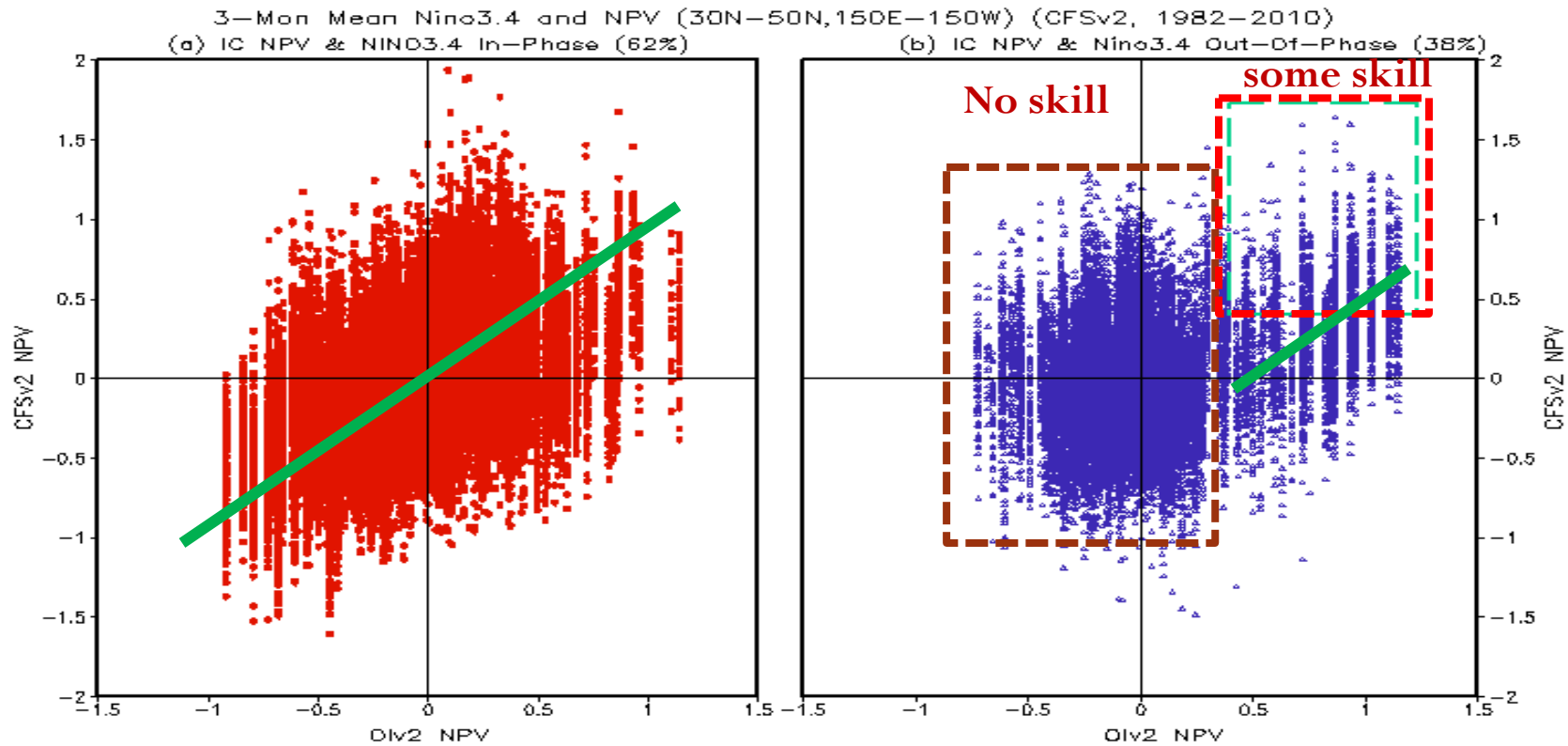
Question:

Is there any prediction skill of NPV beyond the influence of ENSO?

In addition to that in-phase has higher skill than out-of-phase for all leads;

It seems that there are some prediction skills for *LARGE* positive NPV, but not skill for negative or small positive NPV when NPV and ENSO are out-of-phase.

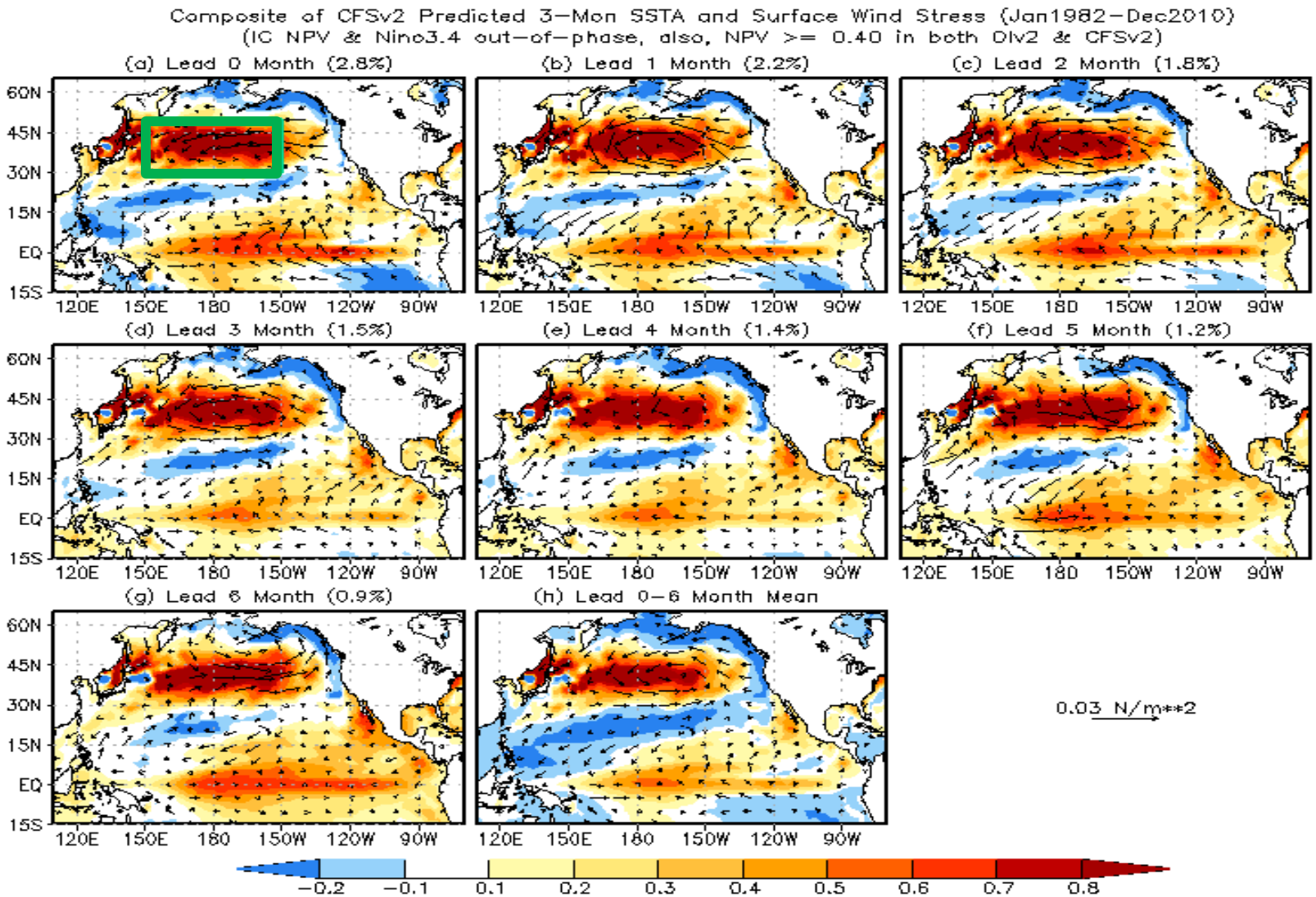
This may be the skill beyond ENSO influence.



SSTA &uv composite for out-phase of ENSO & NPV with NPV ≥ 0.4C

(a) large SSTA in N. Pacific may overcome the influence from the tropical Pacific;

(b) However, they are extreme events with chance of 1-3%.



Results

- (a) The phase relationship between NPV and ENSO in *IC* provides confidence estimation of NPV prediction: prediction skill or confidence is higher (lower) when they are in-phase (out-of-phase).

- (b) This may imply that when NPV and ENSO in *IC* are in-phase, physical consistence between the tropical and N. Pacific, which enhances the growth of the signal and constrains the spread of each ensemble member, increases the predictability in N. Pacific. Therefore, the different combination of NPV and ENSO phase in *IC* can provide some anticipation/prejudgment for the reliability of the prediction in N. Pacific.

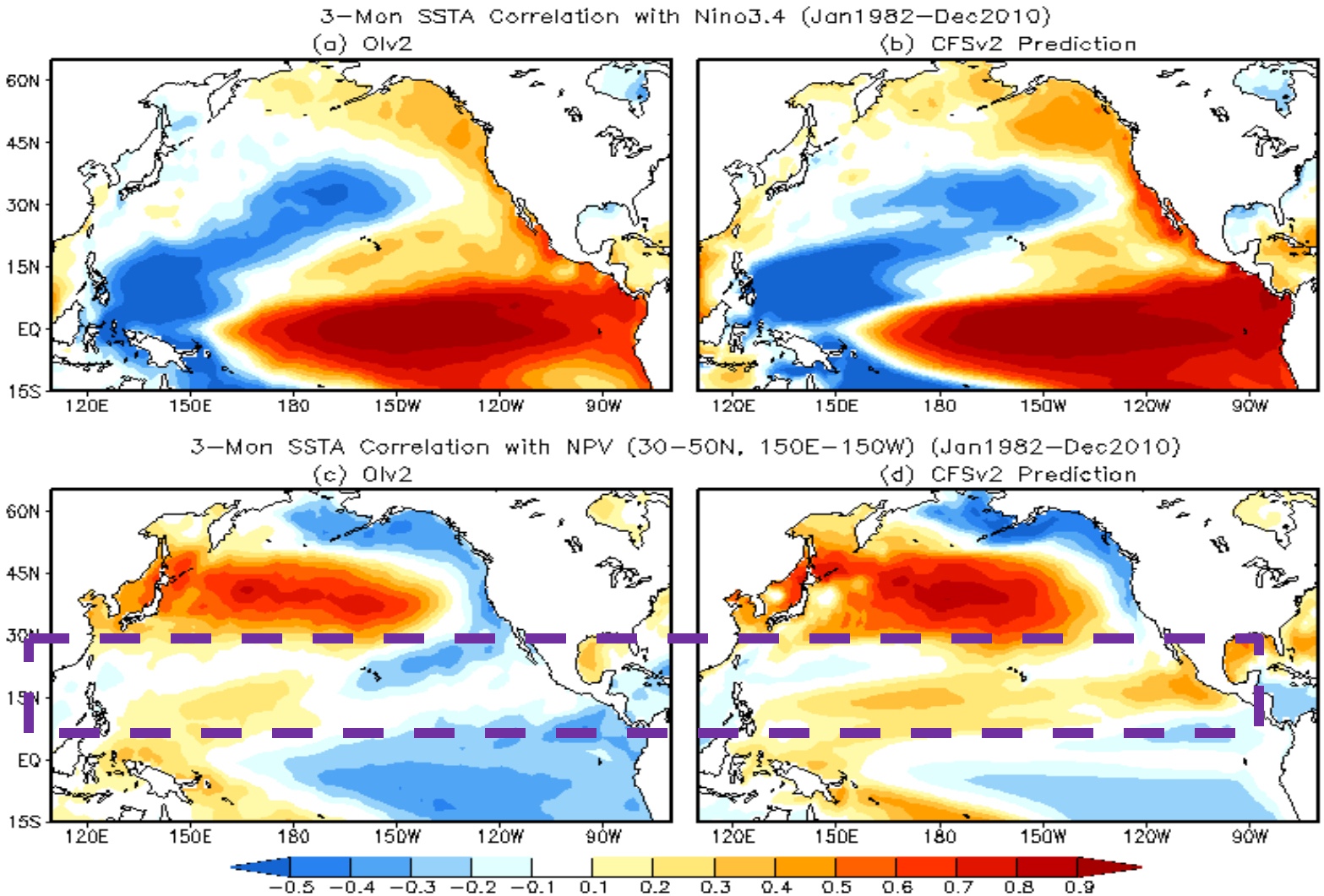
- (c) Some cases having out-of-phase relationship between NPV and ENSO are also predictable. This is only for strong positive SSTA in N. Pacific. There are little predictive skill for negative SSTA and small positive SSTA when they are out-of-phase. This asymmetry in the prediction skill may suggest that large positive and negative SSTA in N. Pacific may be associated with different physical processes.

Biases in CFSv2 may affect the NPV prediction skill

Statistically, CFSv2 reproduces the Pacific connection with ENSO and NPV;

but there are some detailed differences, particularly in the subtropics.

That may misrepresent the connection between the tropical and N. Pacific in CFSv2.



More Information

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