



Example of the one month forecast



Masayuki Hirai

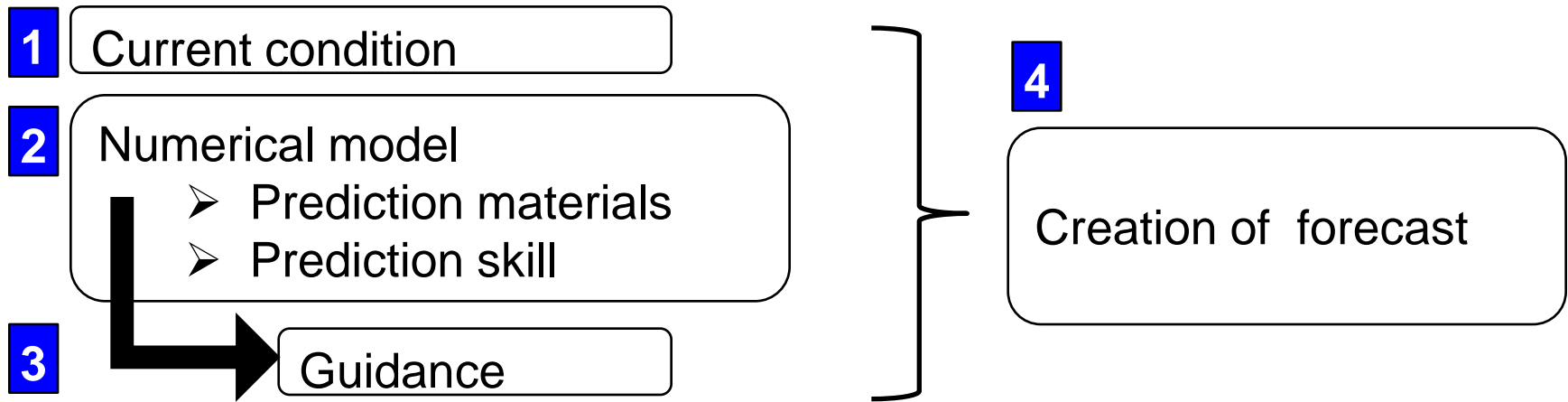
*Tokyo Climate Center (TCC)/
Climate Prediction Division of
Japan Meteorological Agency (JMA)*

Example

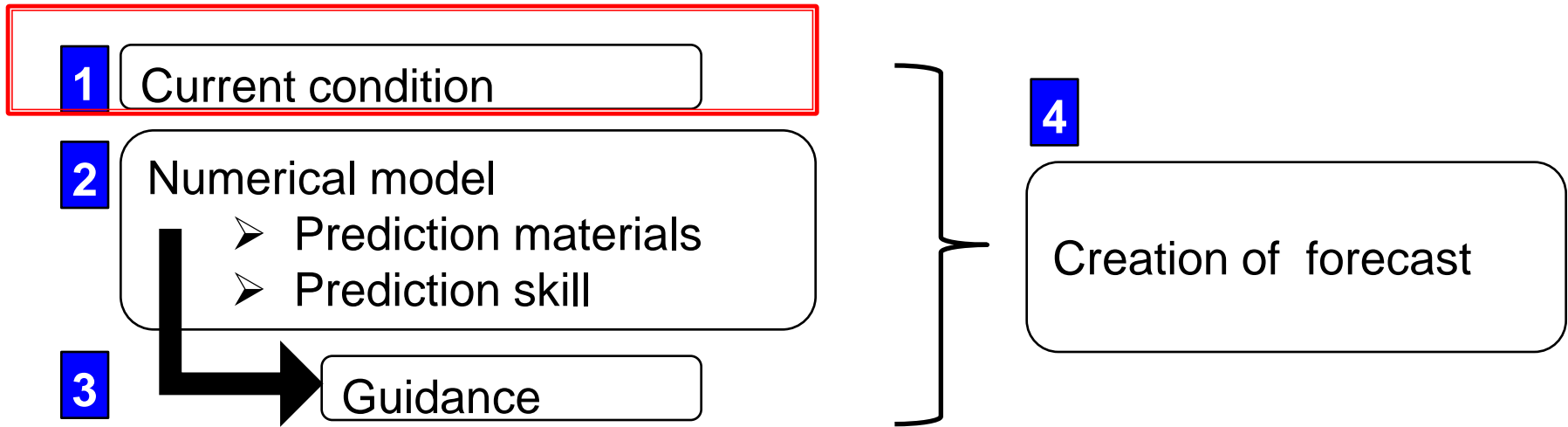
Note that the initial time and the forecast target period is different from those the actual exercise.

- Initial date: 21 Oct. 2015 (Wed.)
- Forecast target period: 24 Oct. to 20 Nov. (4 weeks mean)
 - (depending on the time) 24 Oct. to 6 Nov. (Beginning of 2 weeks mean)
- Forecast point: Tokyo/JAPAN (35.7N, 139.8E)

Processes of building forecast



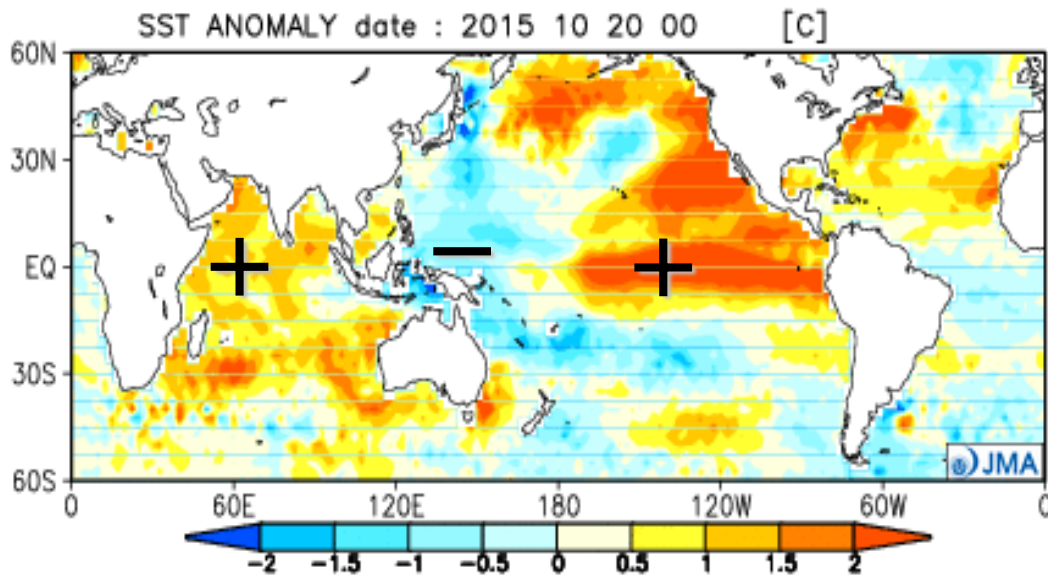
Processes of building forecast



Current condition (1)

SST anomalies (recent condition)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/map1/zpcmap.php>



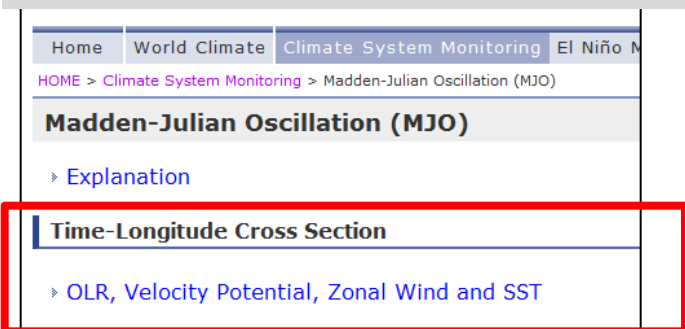
SST anomalies at the previous day of the initial time.

- **Positive** anomalies from the central to the eastern tropical Pacific and **Negative** from Maritime continent to the western Pacific
 - **El Niño like pattern**
- **Positive** anomalies over the Indian Ocean

Current condition (2)

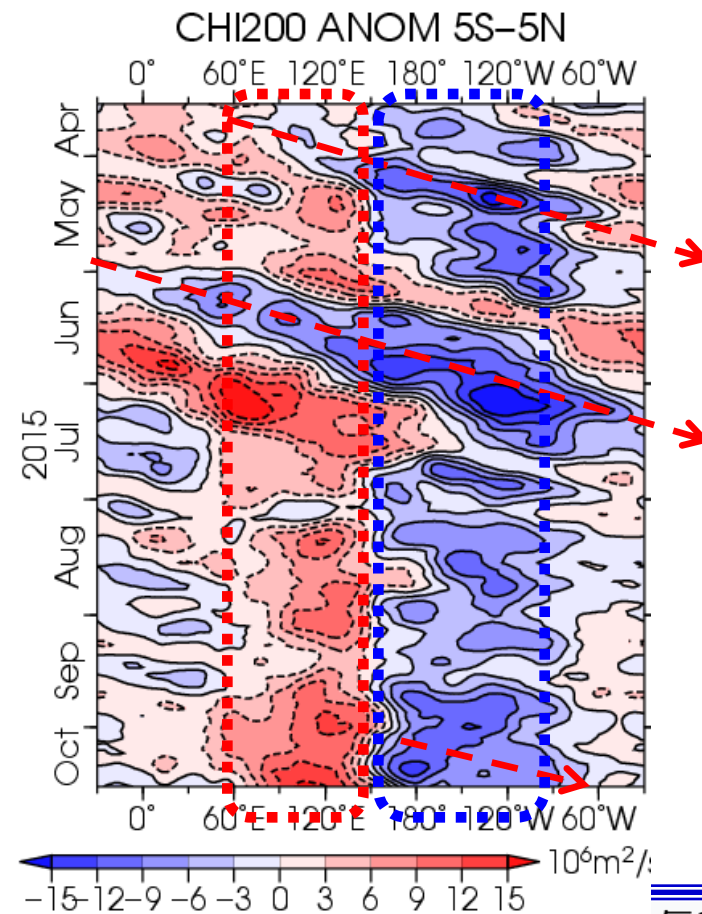
Convective activities around the equator (including MJO)

http://ds.data.jma.go.jp/gmd/tcc/tcc/products/clisys/mjo/moni_mjo.html



- Easterly propagation mode relaying with MJO has been unclear after late summer.
- El Niño like pattern is found.
 - Convection active from the central to the eastern tropical Pacific
 - Convection inactive from the Indian ocean to the Maritime continent
- Relatively convection-active phase are found around the Western Hemisphere.

The last month to be shown:
 Last month
 Select -> Year 2015 Month 9
Elements: 200-hPa Velocity Potential
 Hist Anom Norm
Time Mean: 3-day 7-day
Latitudinal Range: Equator (5S-5N mean)

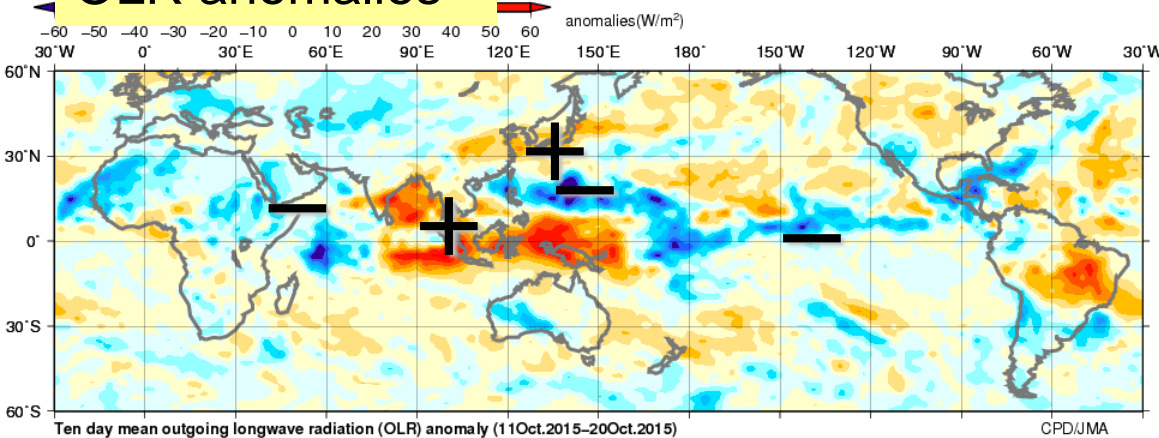


Current condition (3)

Convective activities over the tropics

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/clisys/acmi.html>

OLR anomalies



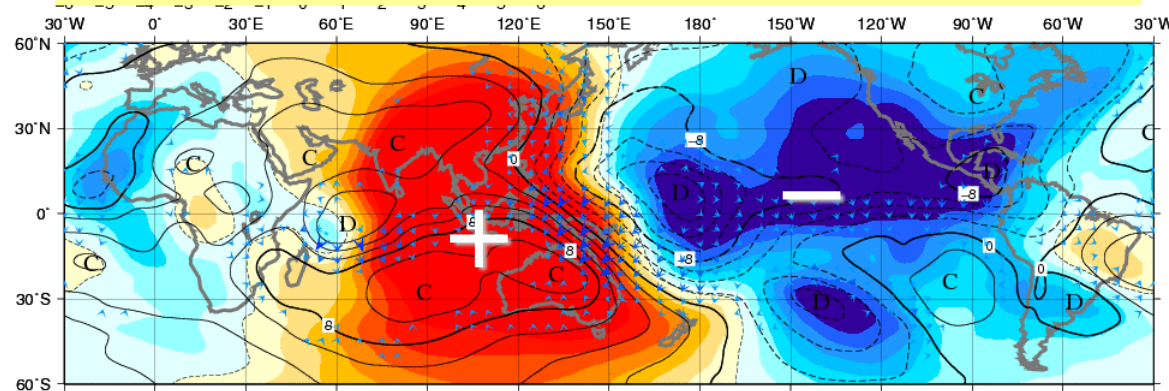
Ten day mean outgoing longwave radiation (OLR) anomaly (11Oct.2015–20Oct.2015)

Anomalies are deviations from the 1981–2010 average.

Original data provided by NOAA

CPD/JMA

CHI200 anomalies (Upper divergence field)



Ten day mean 200 hPa velocity potential, divergent wind vector and velocity potential anomaly (11Oct.2015–20Oct.2015)

The contours show the velocity potential at intervals of $2 \times 10^6 \text{ m}^2/\text{s}$, and the shading shows velocity potential anomalies.

Anomalies are deviations from the 1981–2010 average.

CPD/JMA

→ 10 m/s

- **Inactive** convections in east of the Philippines and Maritime continent
- **Active** convections from the central to eastern Pacific, east of the Philippines and western Indian Ocean.

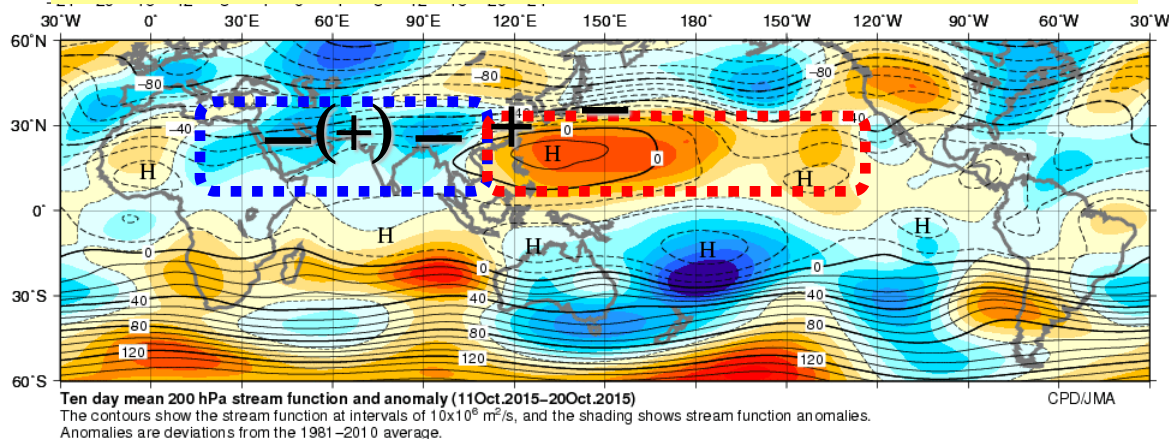
- **Negative** (i.e. divergent) from the central to the eastern part of Pacific
- **Positive** (i.e. convergent) over the Indian Ocean and western tropical Pacific
- Slightly negative anomalies in the western Indian Ocean

Current condition (4)

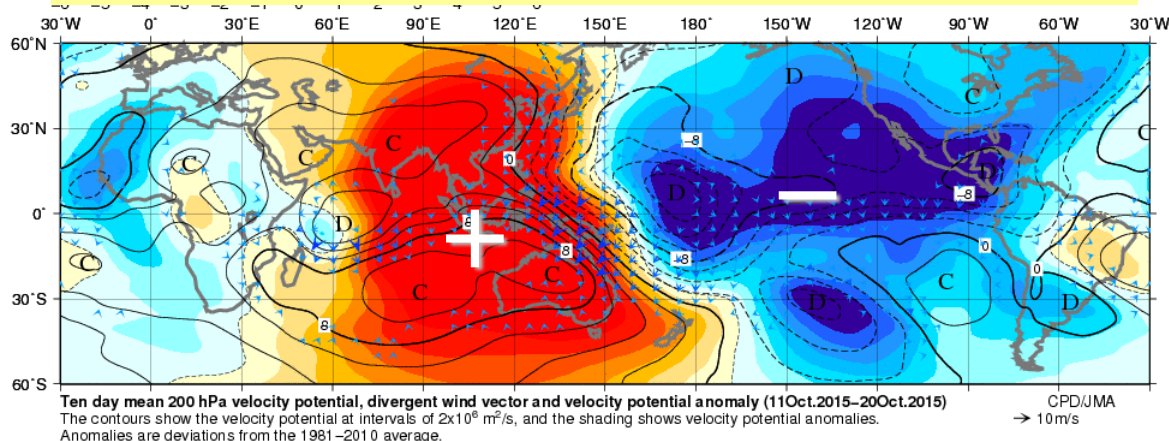
Atmospheric circulation around the tropics

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/clisys/acmi.html>

200hPa stream function (upper circulation)



CHI200 anomalies (Upper divergence field)



- **Positive** (i.e. clockwise) in the western Pacific and **Negative** (i.e. anticlockwise) from the Middle East to the Southeast Asia.

= Matsuno-Gill response

- Shorter wavelength meandering of the **sub-tropical jet stream** (wave train) is found,
 - Middle East; -
 - South Asia; +
 - Southern side of the Tibet; -
 - West of Japan; +
 - Around Japan; -

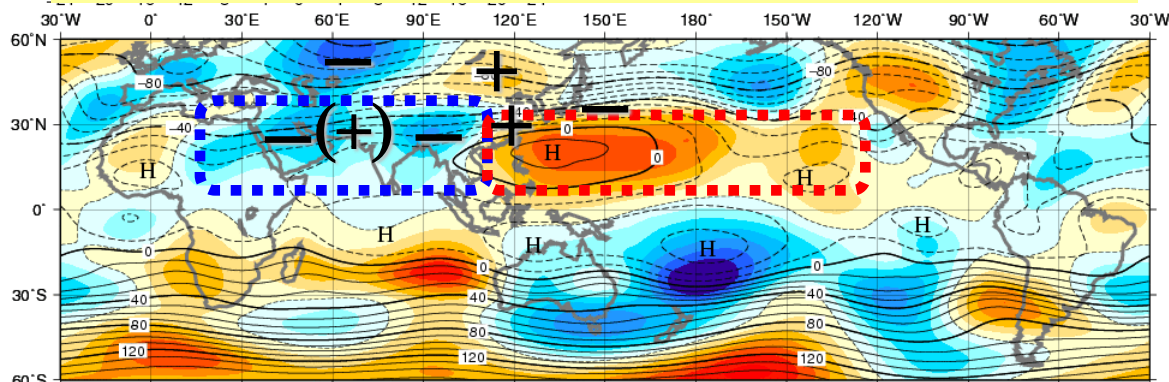
Current condition (5)

Atmospheric circulation in the mid-high latitudes

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/clisys/acmi.html>

200hPa stream function (upper circulation)

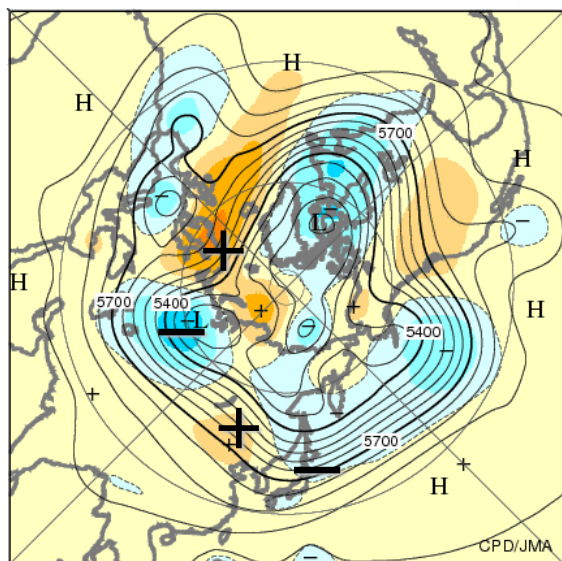
- Meandering of the **polar jet stream** (wave train) is found,
 - North Europe; +
 - Western Siberia; -
 - Around Mongolia; +
 - Around Japan; -



Ten day mean 200 hPa stream function and anomaly (11Oct.2015–20Oct.2015)
The contours show the stream function at intervals of $10 \times 10^6 \text{ m}^2/\text{s}$, and the shading shows stream function anomalies.
Anomalies are deviations from the 1981–2010 average.

CPD/JMA

500hPa geopotential height



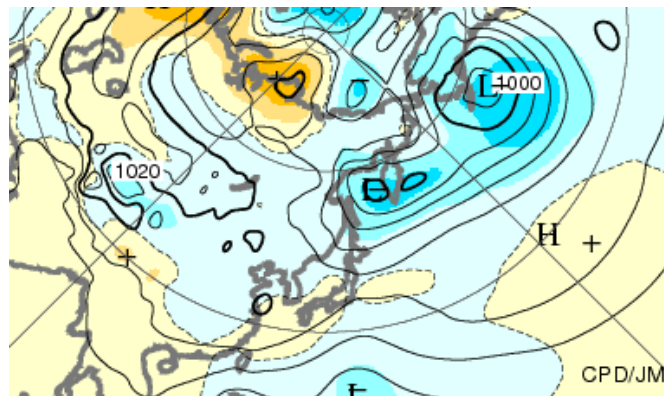
Ten day mean 500 hPa height and anomaly in the Northern Hemisphere (11Oct.2015–20Oct.2015)
The contours show height at intervals of 60 m.

CPD/JMA

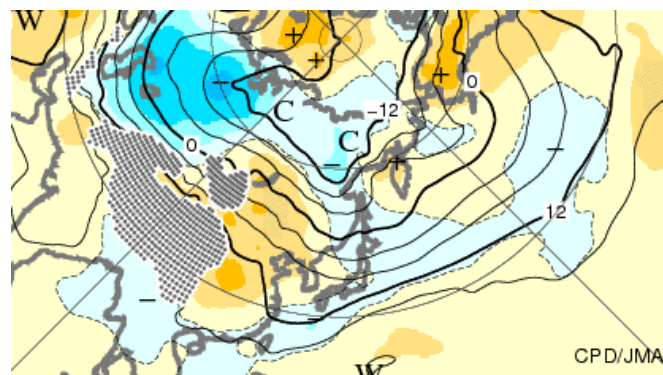
Current condition (6)

Atmospheric circulation in the mid-high latitudes

Sea level Pressure

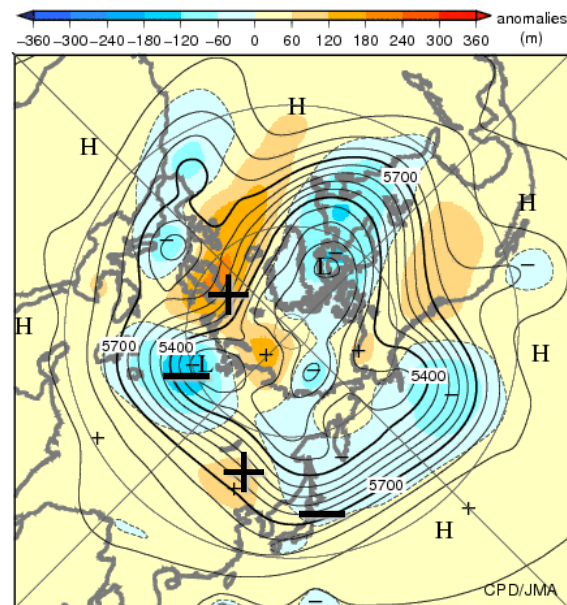


850 hPa temperature



Ten day mean 850 hPa temperature and anomaly in the Northern Hemisphere (11 Oct. 2015 - 20 Oct. 2015)

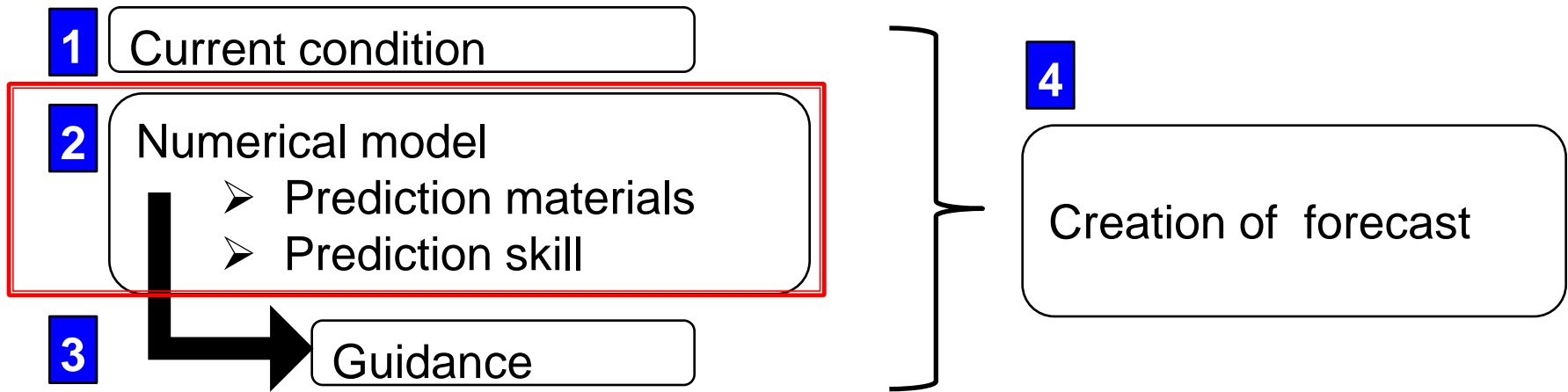
500hPa geopotential height



Ten day mean 500 hPa height and anomaly in the Northern Hemisphere (11 Oct. 2015 - 20 Oct. 2015)

- High pressure covers around Japan, relating to the upper ridge around Mongolia.
- The Siberian high is weak. Therefore, lower temperature was above normal in west of Japan (around Mongolia and China).

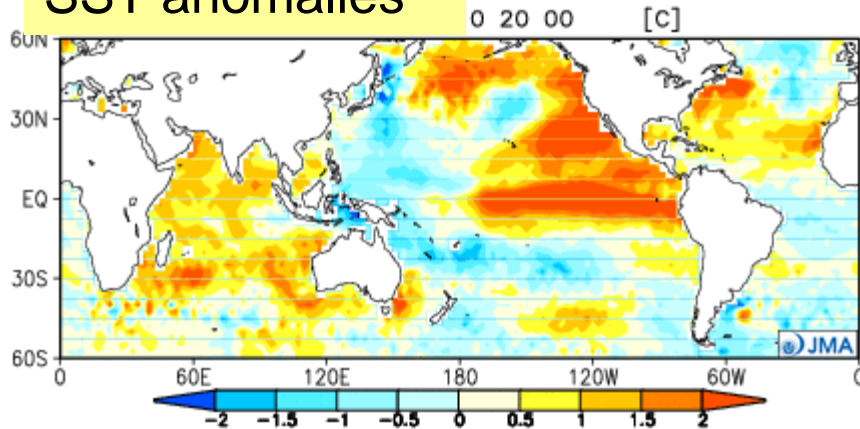
Approach to building forecast



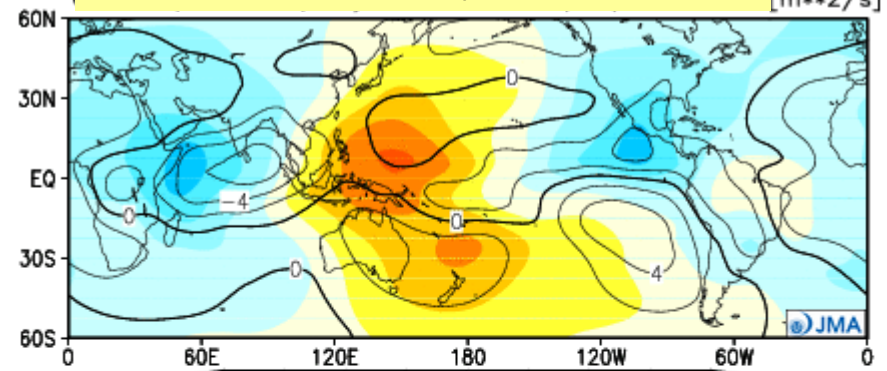
Forecast (one-month mean)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/index.html>

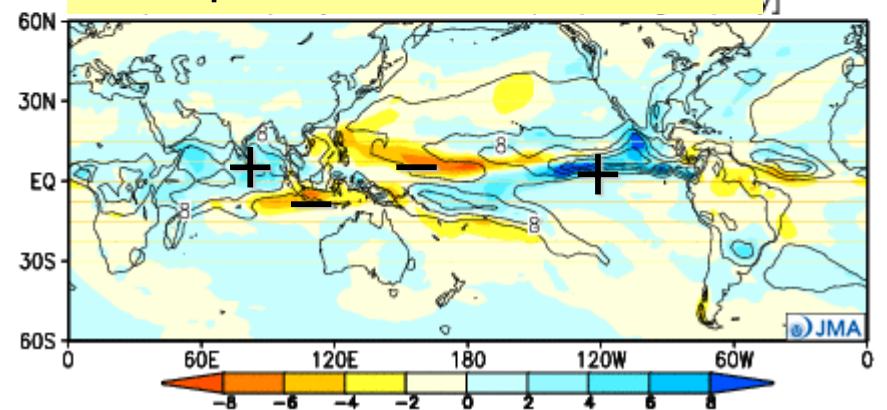
SST anomalies



CHI200 (velocity potential)



Precipitation

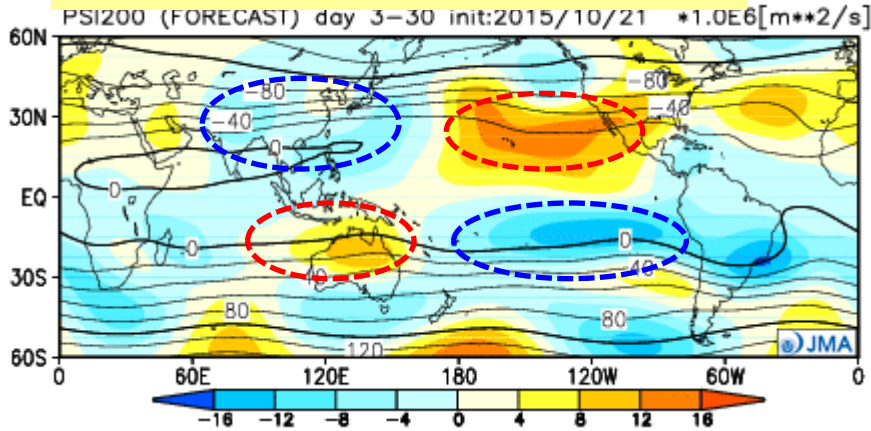


- **Enhanced convections** are predicted in not only eastern tropical Pacific but also western Indian Ocean.
- **Suppressed convections** are predicted from the Maritime continent to the western tropical Pacific.
- These pattern must be reflected by SST anomalies.

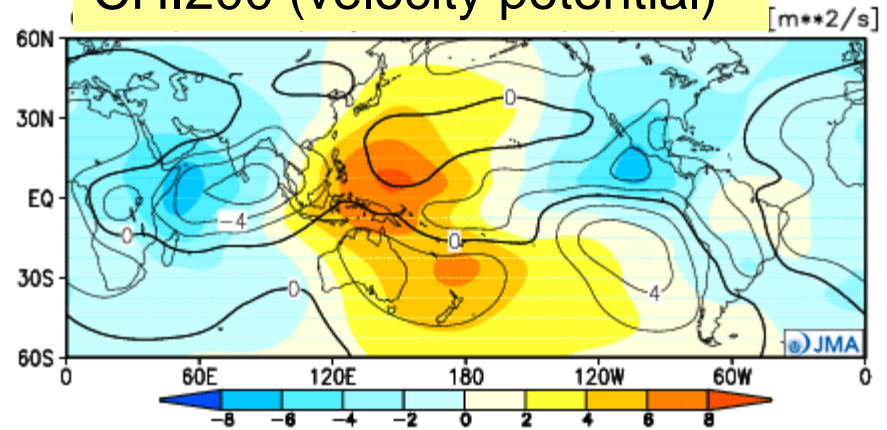
Forecast (one-month mean)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/index.html>

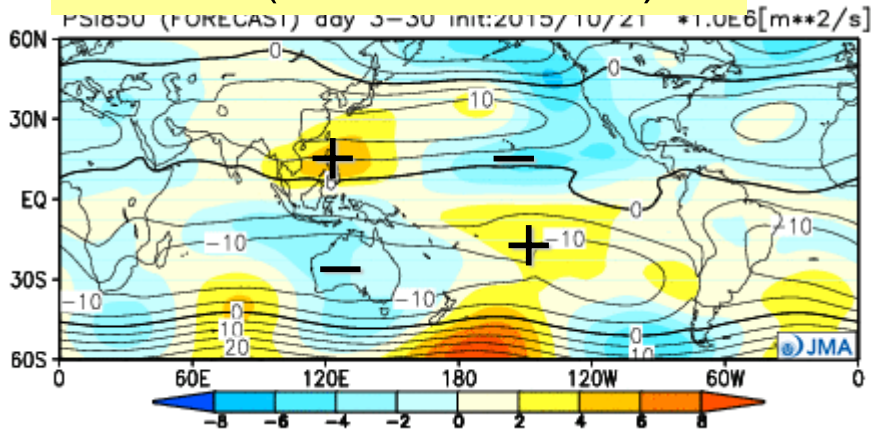
PSI200 (stream function)



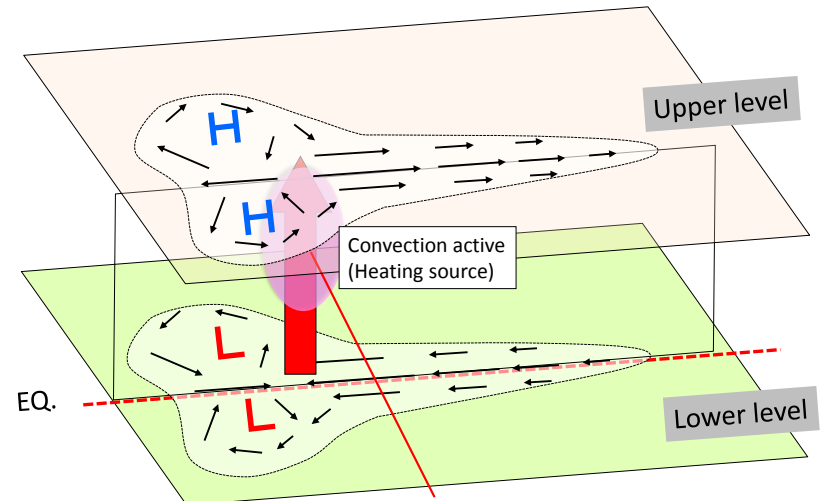
CHI200 (velocity potential)



PSI850 (stream function)



Matsuno-Gill response
(Influence of tropical convections on atmospheric circulation)

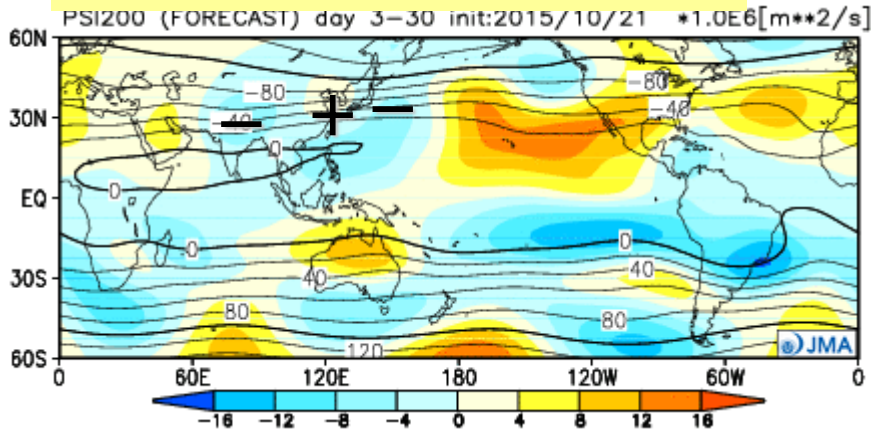


Incase of heating source in EQ.

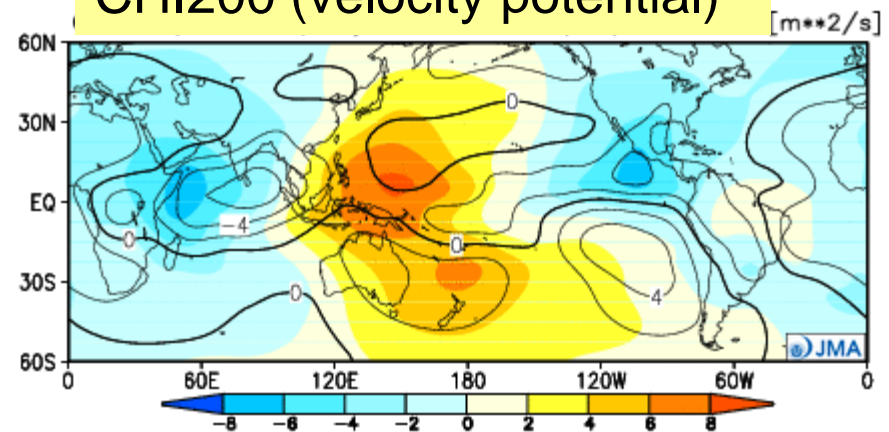
Forecast (one-month mean)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/index.html>

PSI200 (stream function)



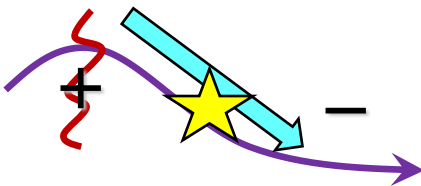
CHI200 (velocity potential)



● Meandering of the subtropical-jet stream

- From South to Southeast Asia; -
- West of Japan; +
- East of Japan; -

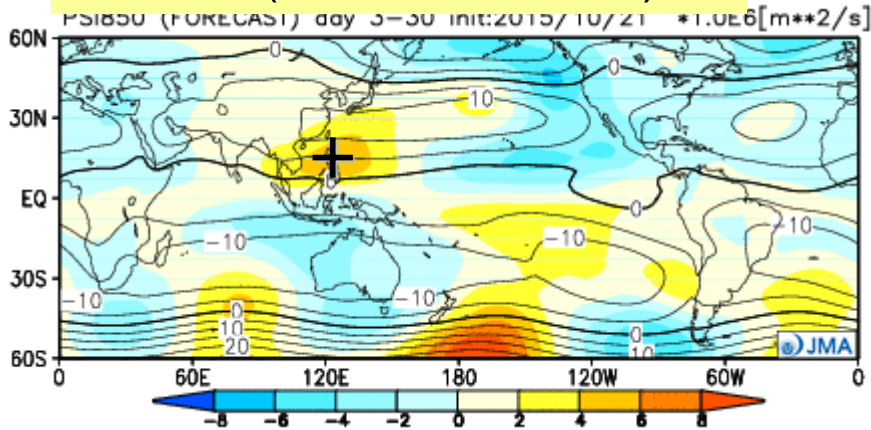
Northwesterly anomalies of the upper flow are predicted, which would contribute to **cool conditions**.



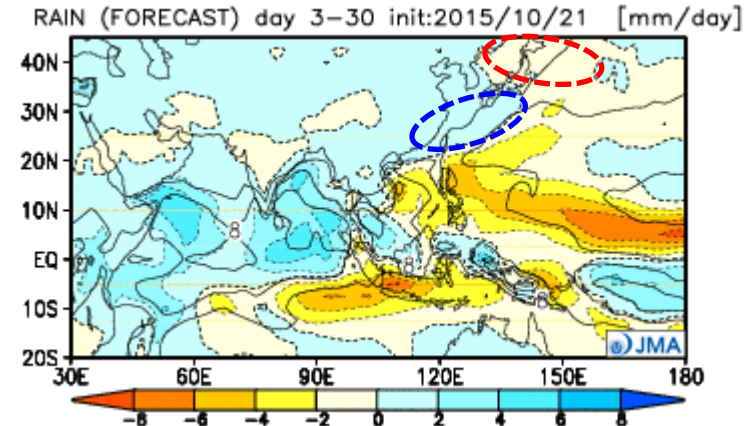
Forecast (one-month mean)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/index.html>

PSI850 (stream function)



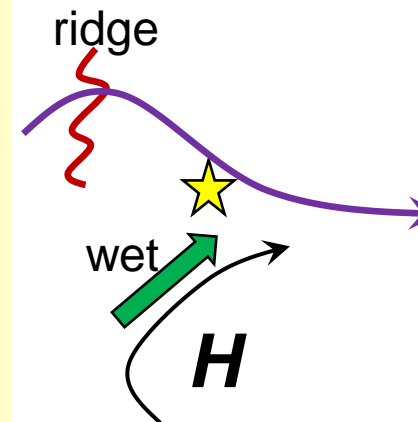
Precipitation



- **Dry conditions** are predicted in the north part of Japan, In association with the upper ridge in the west of Japan.
- **Lower anti-cyclonic anomalies are predicted around the Philippines**, relating with suppressed convections in the western tropical Pacific.

This would bring **southwesterly anomalies** of the lower wind, which contribute to **wet conditions** along the north side of the anti-cyclones.

- In around Tokyo, slightly dry tendency is predicted, but near the boundary of the above two region.



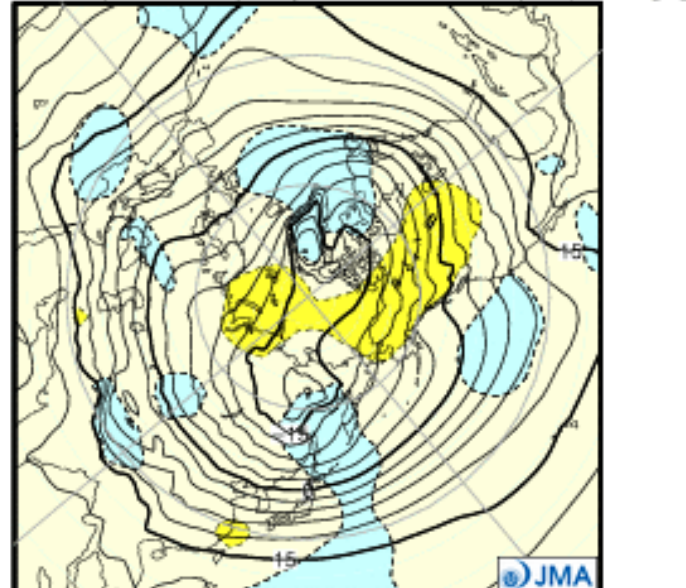
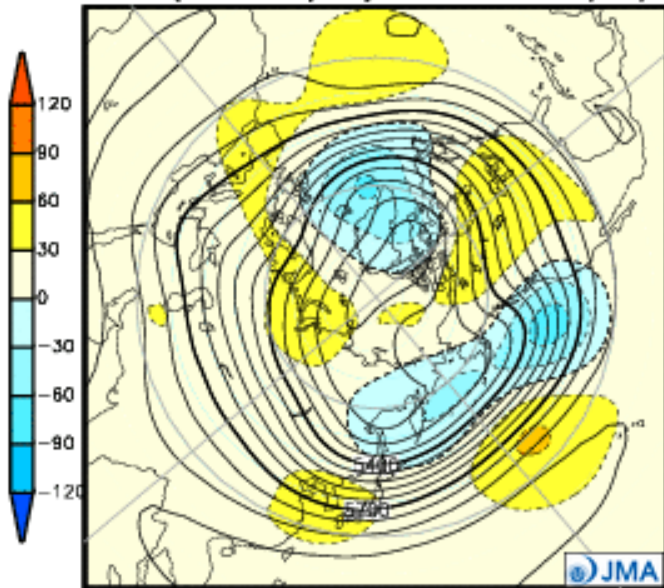
Forecast (one-month mean)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/index.html>

500hPa height

ast (28 day me

850hPa temperature



- 500hPa geopotential height is predicted to be **above normal** in **west of Japan**, which brings **warm tendency** in the region.
- Since geopotential height is relatively **low** in **east of Japan**, 850hPa temperature is relatively low (but positive) in the region.
- As for Tokyo, **warm tendency** is relatively **weak**. But it would be **slightly above normal tendency**, which may be supported by globally warming relating with development of El Niño and long-term warming trend.

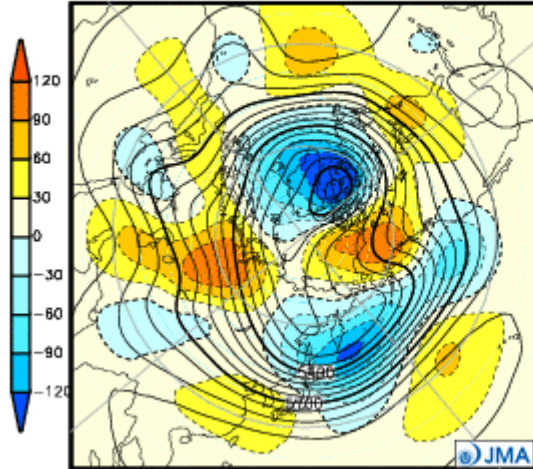
Forecast (Week-1; Day+3 to Day+9)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/index.html>

500hPa height

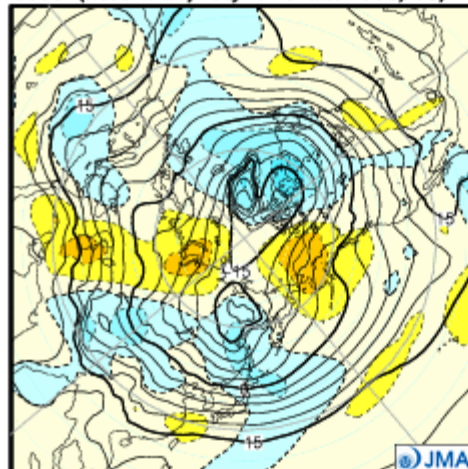
Ensemble mean forecast (7 day mean)

Z500 (FORECAST) day 3-9 init:2015/10/21



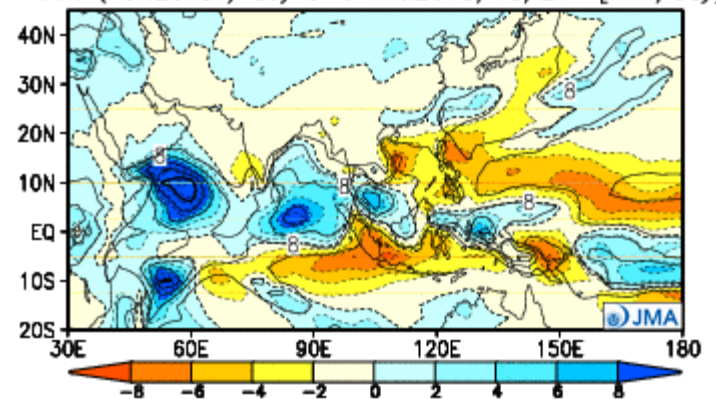
850hPa temp.

T850 (FORECAST) day 3-9 init:2015/10/21 [°C]

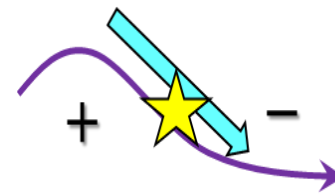


Precipitation

RAIN (FORECAST) day 3-9 init:2015/10/21 [mm/day]



- Cool tendency in east of Japan is predicted, relating with the meandering of the westerlies (northwardly in west of Japan, southwardly in east of Japan).
- Dry tendency is predicted, relating with inactive cyclone activities, which might be association with the upper ridge in the west of Japan.
- Around Tokyo, **Slightly cool tendency** and **dry tendency** is predicted.

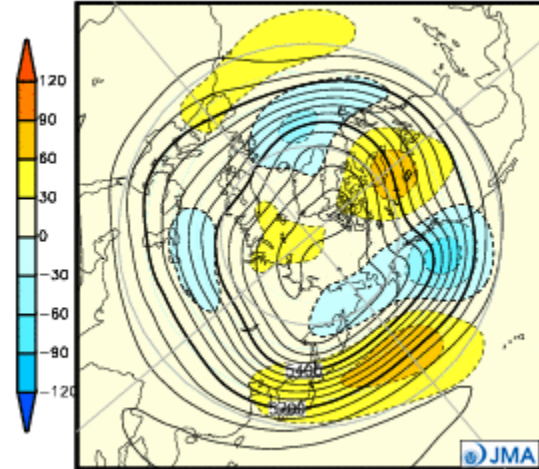


Forecast (Week-3,4; Day+17 to Day+30)

<http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/map/1mE/index.html>

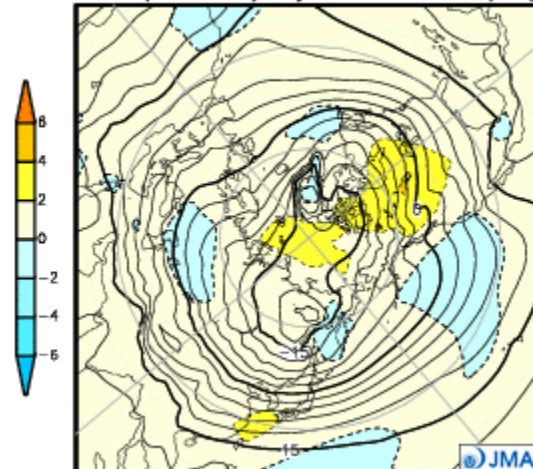
500hPa height

Z500 (FORECAST) day 17-30 init:2015/10/2



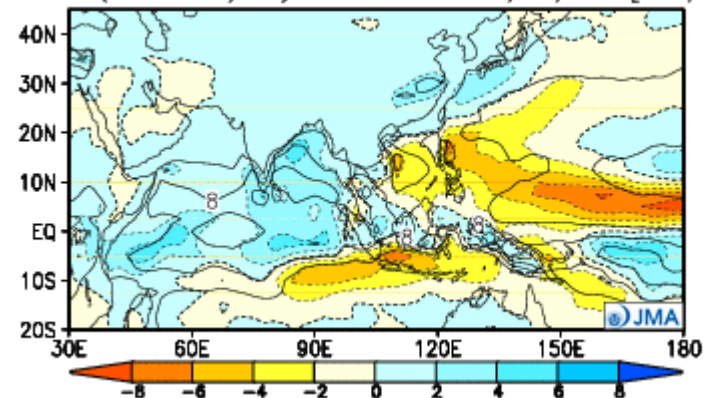
850hPa temp.

T850 (FORECAST) day 17-30 init:2015/10/21 [C]



Precipitation

RAIN (FORECAST) day 17-30 init:2015/10/21 [mm/day]

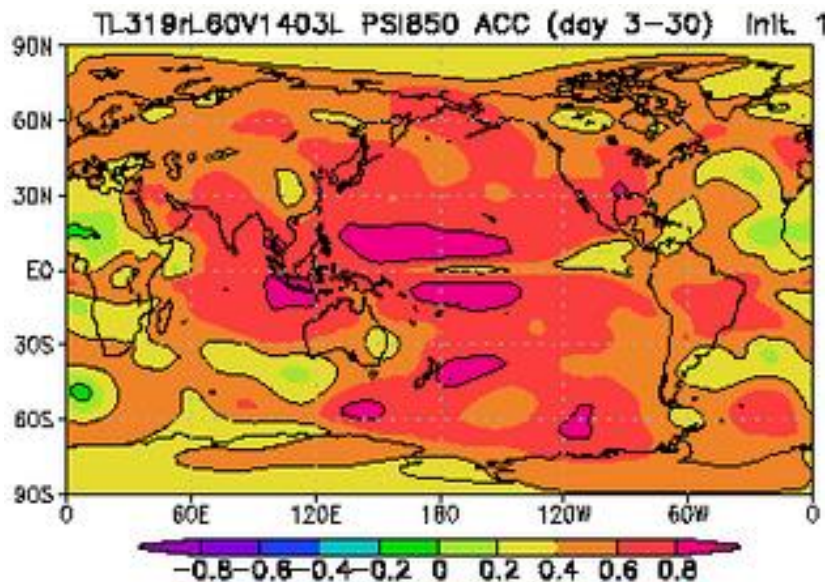


- 500hPa height is predicted to be zonally positive anomalies around the North Pacific. This would contribute to **warm tendency** around Tokyo.
- Wet tendency is predicted in the south of Japan. This must relate with lower anti-cyclonic anomalies (suppressed convections around the Philippines), which brings **wet** and **warm** southwesterly flow.
- This characteristic comes from tropical convection anomalies, whose predictability has some degree. Thereupon, **those should be taken account.**

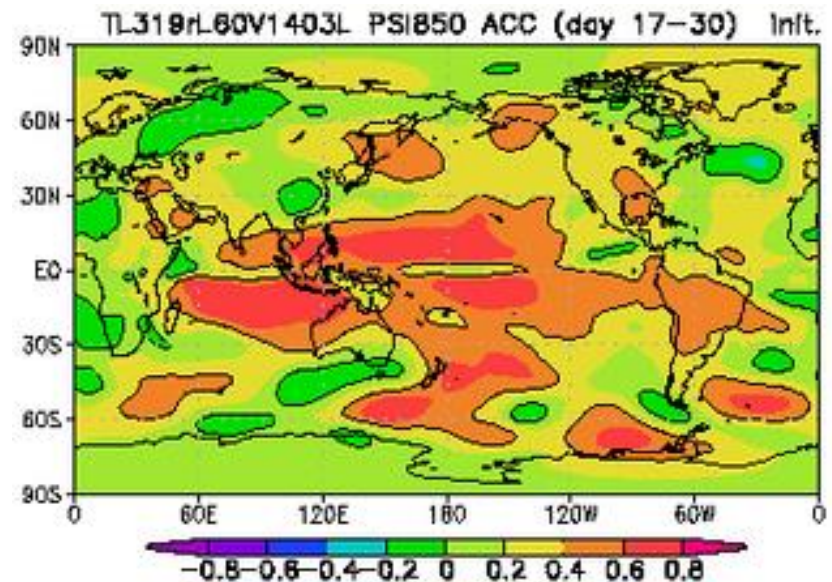
Prediction skill (PSI850)

http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/hindcast/1mE/tro_acor.html

One-month mean

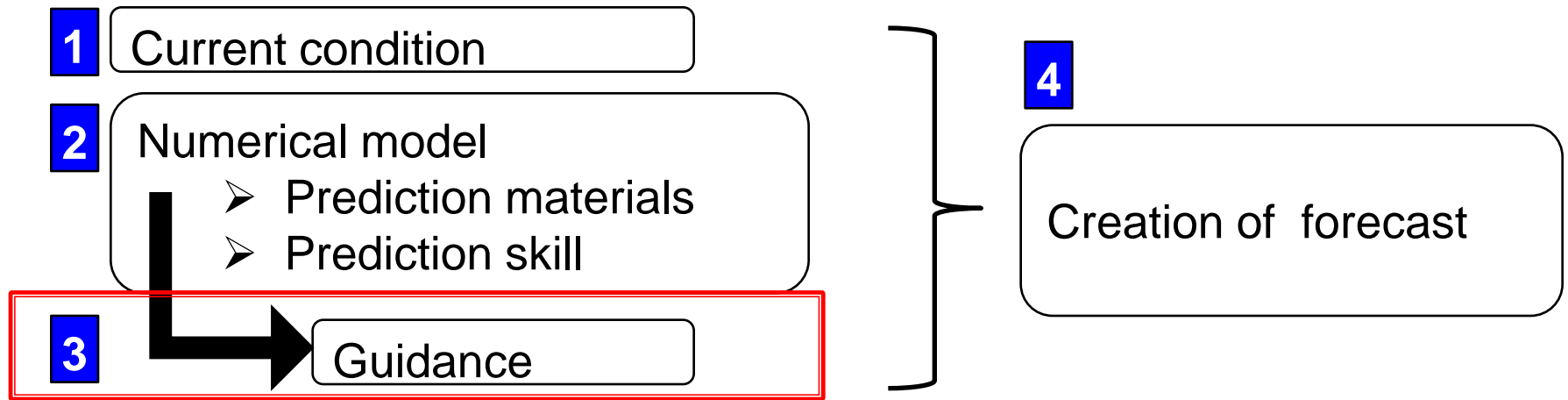


Week-3,4



Even in week-3,4, the model has some degree of prediction skill in the tropics, though uncertainty should be taken into account.

Approach to building forecast

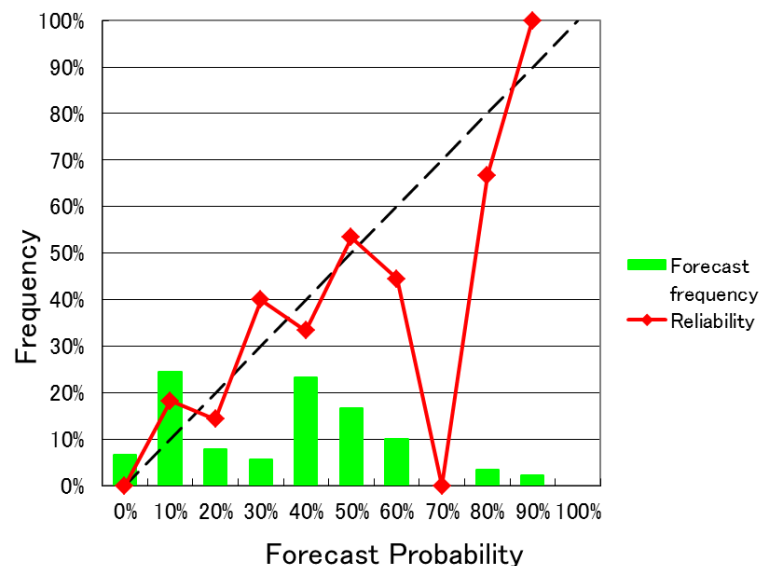
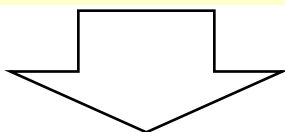


Guidance (temperature in the one-month mean)

Predictand	Temperature
Predictors	T1000, TTD850
Correlation	0.684
BSS	0.132

Below normal	Near normal	Above normal
14%	47%	39%

- Correlation is as high as about 0.7.
- According to the reliability diagram, maximum probability should be kept to 50%.



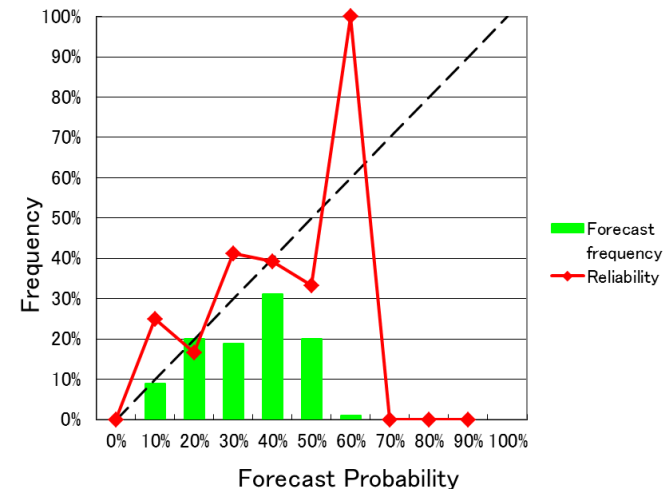
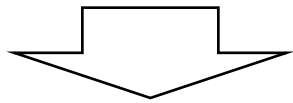
- In the beginning of the period, slightly below normal temperature is expected, relating with the upper trough in the east of Japan.
- After that, **warm tendency** is predicted, in association with southwesterly lower wind anomalies.
- **As for one month mean, above normal tendency is expected** as the guidance.

Guidance (precoipitation in the one-month mean)

Predictand	Precipitation
Predictors	U850
Correlation	0.322
BSS	0.039

Below normal	Near normal	Above normal
41%	43%	16%

- Correlation is positive.
- BSS is slightly positive, but not high.
- Maximum probability should be kept to 40%.



- In the first-half of the period, **dry conditions** are expected, in association with low impact of the extratropical cyclones.
- In the second-half of the period, **wet conditions** are expected, in association with southwesterly lower wind anomalies.
- Meanwhile, guidance shows dry tendency, suggesting the signal of dry tendency in the beginning is larger than the wet tendency in the second-half .
- **Slightly dry tendencies but within near normal range is expected.**

Conclusions

		Temperature	Precipitation
Model	One month mean	Positive	Slightly negative
	First-half	Slightly negative	Negative
	Second-half	Positive	Positive
Guidance		14:47:39	41:43:16
Remarks		<ul style="list-style-type: none"> ● Maximum prob. should be 50% 	<ul style="list-style-type: none"> ● Maximum prob. should be 40% ● Tokyo locates near of the boundary of the region of positive/negative anomalies.

Category	Below	Normal	Above
Temperature	20%	40%	40%
Precipitation	40%	30%	30%