

Comparison between TAF and MOS focused on wind elements during spring season in 2017-2018



Jae Won Lee(jlee99@korea.kr), Aviation Meteorological Office, Korea Meteorological Administration, Incheon, Republic of Korea; Seungju Lee(lee_Sj@kma.go.kr), and Minji Lee(minji274@korea.kr)

In this study, We would like to examine the accuracy of TAF(Terminal Airport Forecast) produced by forecaster at Incheon International Airport and compare the accuracy of TAF with the accuracy of MOS(Model Output Statistics) performed by the KMA(Korea Meteorological Administration) supercomputer.



- To compare the accuracy of these, we analyzed wind (speed and direction) data of TAF and MOS in spring season 2017-2018.
- For application to operational aviation-forecasting, we investigated six-hour projection forecasting performance. The result is that TAF's accuracy has still better than MOS in wind speed (10%) and wind direction cases(25%).
- Significant error in wind speed associated with pressure gradient, meanwhile, significant error in wind direction related to passing meso-β scale disturbances.
- In order to solve these problem, meso-scale aviation numerical model should have hourly updated (e.g., HRRR).
- MOS has useful forecasting performance up to 15-hour projection through descriptive statistical parameters such as RMSE, MAE, bias, and correlation.
- AMO can diagnose the possibility of automation of TAF and build the LAMP used the logistic regression method.

Columbus, L, 2014: 84% of Enterprises See Big Data Analytics Changing Their Industries' Competitive Landscapes in The Next Year, Forbes.

International Civil Aviation Organization (ICAO), 2016a: Annex 3 to the Convention on International Civil Aviation: Meteorological Service for International Air Navigation.

_____, 2016b: 2016-2030 Global Air Navigation Plan. Doc 9750-AN/963, 137pp.

Wilks, D. S., 2011: Statistical Methods in the Atmospheric Sciences. Academic Press. 676pp

CASES FOR SIGNIFICANT ERROR





Figure 2. A two-dimensional (wind speed and wind direction) error plotting after +6-hour TAF and MOS forecasts for springtime in 2017-2018.

Table 1. Operationally desirable accuracy of forecasts (ICAO Annex3, 2016)

Element to be forecast	Operationally desirable accuracy of TAF	Minimum % of case within range
Wind direction	± 20 degree	80% of cases
Wind speed	± 2.5 m/s (± <mark>5 k</mark> t)	80% of cases
:		:

ERROR : TAF-OBS

1 16 APR 2017: ws = +4, wd = -160 / 25 MAY 2018: ws = +0, wd = -70



 [REASON] Combination of upper jet stream and trough to northward from the South Sea



 [REASON] Strong pressure gradient in north-south contrasts after passing trough and approaching upper jet

ERROR : MOS-OBS

① 09 APR 2017: ws = + 5.1, wd = -170 / 12 MAY 2017: ws = +4.4, wd = -109



(2) 31 MAR 2017 : ws = -94, wd = -107 / 1 MAR 2018 : ws = -158, wd = -98



[REASON] Strong pressure gradient in east-west contracts after passing low pressure system and approaching high pressure system.

Table 2. Comparison between TAF and MOS performances winds for spring in 2017-2018.

	Wind speed		Wind direction		U-com	ponent	V-component		
rear	TAF	MOS	TAF	MOS	TAF	MOS	TAF	MOS	
2017	95.7	80.4	75.0	41.3	84.8	71.7	83.7	72.8	
2018	95.7	84.8	70.7	46.7	89.1	76.1	79.3	71.7	

✤ [As seen in Table 2 and Tale 3]

- A performance of TAF is 20% better than that of MOS.

- A score of wind speed is much better than that of wind direction.

 Error of U (E-W) component is 10%lower than that of V(S-N) component
For improving accuracy of MOS, we must search for best predictor from the very short-range numerical output.

- However, as longer projection time up to 15-hours projection, as MOS is better performance as seen in Table 3.

Table 3. Bias, RMSE, MAE and correlation coefficient for 11 projection time.

	Month	Year	+06H	+09H	+12H	+15H	+18H	+21H	+24H	+27H	+30H	+33H	+36H
	March	2017	т	т	т	Т	Т	т	M	м	т	т	т
		2018	м	М	м	м	M	т	м	Т	М	м	м
3ia:	Anni	2017	т	M	М	Т	М	т	Т	Т	т	м	м
	Арпі	2018	м	т	м	т	т	т	т	т	м	м	т
		2017	Т	Т	М	M	Т	М	Т	M	M	Т	т
	IVIBIY	2018	T	M	м	м	м	т	т	т	т	т	T
þ	Month	Year	+06H	+09H	+12H	+15H	+18H	+21H	+24H	+27H	+30H	+33H	+36H
ũ	March	2017	м	М	м	Т	М	М	T	MM	М	М	м
- E	March	2018	т	т	т	м	14	т	т	т	м	т	т
ŝ		2017	т	M	M	м	Т	т	т	м	Т	М	M
ean	дрга	2018	т	M	м	M	Т	Т	т	Т	Т	м	T
÷.	h.4	2017	т	т	м	м	т	м	м	м	м	м	м
2	iviay	2018	т	т	м	м	т	т	т	т	т	м	т
-													
	Month	Year	+06H	+09H	+12H	+15H	+18H	+21H	+24H	+27H	+30H	+33H	+36H
5	WORth												
Error	March	2017	TT	TT	Т	M	т	т	TT	TT	TT	TT	T
ute Error	March	2017 2018	TT M	TT T	T T	M	T T	T T	TT T	TT T	TT M	TT T	T T
solute Error	March	2017 2018 2017	M TT	TT T M	T T M	M M M	T T M	T T T	TT T TT	TT T M	TT M T	TT T M	T T M
Absolute Error	March	2017 2018 2017 2018	П М П	TT T M M	T T M M	M M M	T T M T	T T T	TT T TT T	TT T M T	TT M T T	TT T M M	T T M T
ean Absolute Error	March April May	2017 2018 2017 2018 2017 2018	ТТ М ТТ Т Т	TT T M M TT	T T M M	M M M M	T M T T	T T T M	TT T TT T MM	TT T M T MM	TT M T T M	TT T M M M	T T M T M
Mean Absolute Error	March April May	2017 2018 2017 2018 2017 2018	Π Μ Π Τ Τ Τ τ	TT T M M TT T	T T M M M	M M M M M	T M T TT T	T T T M T	TT T TT T MM T	TT T M T MM T	TT M T T M T	TT T M M M T	T M T M T
Mean Absolute Error	March April May	2017 2018 2017 2018 2017 2018 2017 2018	ТТ М ТТ Т Т Т	TT T M M TT T	T T M M M	M M M M M	T T M T TT T	T T T M T	TT T TT T MM T	TT T M T MM T	TT M T T M T	TT T M M T	T T M T M T
Mean Absolute Error	March April May Month	2017 2018 2017 2018 2017 2018 Year	ТТ М ТТ Т Т Т т +06H	TT T M TT T +09H	T T M M M +12H	M M M M +15H	T T T T T T +18H	T T T M T +21H	TT T T MM T +24H	TT T M T MM T +27H	TT M T M T +30H	TT T M M T +33H	Т Т М Т +36H
Mean Absolute Error	Month April May Month March	2017 2018 2017 2018 2017 2018 Year 2017	ТТ М ТТ Т Т т +06H т	TT T M M TT T +09H	T T M M +12H	M M M M +15H	T T T T T +18H T	T T T M T +21H MM	TT T TT T MM T +24H MM	TT T M T MM T +27H TT	TT M T M T +30H	TT T M M T +33H	T M T M T +36H M
tion Mean Absolute Error	Month April May Month March	2017 2018 2017 2018 2017 2018 Year 2017 2018	ТТ М ТТ Т Т Т т +06H Т Т	TT T M M TT T +09H M	T T M M +12H M	M M M M +15H T	T M T TT T +18H T M	T T T M T +21H MM T	TT T T MM T +24H MM	TT T M T MM T +27H TT M	TT M T M T +30H M M	TT T M M T +33H T	T T M T +36H T
elation Mean Absolute Error	Month March April May Month March April	2017 2018 2017 2018 2017 2018 Year 2017 2017 2018 2017	ТТ М ТТ Т Т Т +06H Т Т М	TT T M M TT T T +09H M M MM	T T M M M +12H M M M M	M M M M M +15H T MM	T M T T T T +18H T M M	T T T M T +21H M M M	TT T T MM T +24H MM M M	TT T M T MM T +27H TT M M	TT M T M T *30H M M M M	TT T M M T +33H T M	T T M T +36H M T M
Correlation Mean Absolute Error	Month April May Month March April	2017 2018 2017 2018 2017 2018 Year 2017 2018 2017 2018	ТТ М ТТ Т Т Т +06H Т Т М М	TT T M M TT T +09H M M M M M M M	T T M M M +12H M M M M M M M M	M M M M +15H T MM M M M	T T T T T +18H T M M M	T T T M T +21H H M M T M M M	TT T T MM T +24H MM M M M M	TT T MM T +27H TT M M M M	TT M T T M T *30H M M M M M	TT T M M T +33H T M M M	T M T M +36H M T M M
Correlation Mean Absolute Error	Month April May Month March April May	2017 2018 2017 2018 2017 2018 2017 2018 2017 2018 2017 2018 2017	ТТ М ТТ Т Т т +06H Т Т М М М	TT T M M TT T +09H M M M M M T	T T M M +12H M M M M M M M	M M M M +15H T MM T MM M M	T T T T T +18H T M M M T	T T T M T +21H M M T M M M	TT T TT MM T +24H MM M M M M	TT T MM T +27H TT M M M M	TT M T M T *30H M M M M M M M M M	TT T M M T +33H T M M M M	T T M T +36H M T M M M
Correlation Mean Absolute Error	Month March April May Month March April May	2017 2018 2017 2018 2017 2018 2017 2018 2017 2018 2017 2018 2017 2018	ТТ М ТТ Т Т +06H Т Т М М М Т	TT T M M TT T +09H M M M M M M M M M M M M M	T T M M +12H M M M M M M M M	M M M M +15H T MM M M M M M	T T T T T T +18H T M M M T T	T T T M T +21H M M T M M M M M	TT T TT MM T +24H MM M M M M M M	TT T MM T +27H TT M M M M M T	TT M T T M T *30H M M M M M M M M M	TT T M M T +33H T M M M M M	T T M T +36H M T M M M M

This study has been supported under the General Research and Development Expenditure for Aviation Meteorological Office of Korea Meteorological Administration in 2018.