Performance of hi-res GFS-based NOAA models v ECMWF

2013 HFIP summer demo – WPAC

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ATCF ID	Model	Resolution (3n+1 rule)	Comments
AVNO	GFS T574L64	23 km	GFS baseline
FIM9	FIM G9L64	15 km	2011 GFS physics, dynamical core improves
HWRF	HWRF	27:9:3 km	GFS IC/BC – highest res NOAA model
GE00	GFS SL T1148L64	11 km	experimental semi-lagrangian version of GFS2013 run at ESRL
EDET	ECMWF HRES T1279L137	10 km	IFS cycle 38r2 (25 JUN 13) increased vertical res; sfc drag; shallow cu…

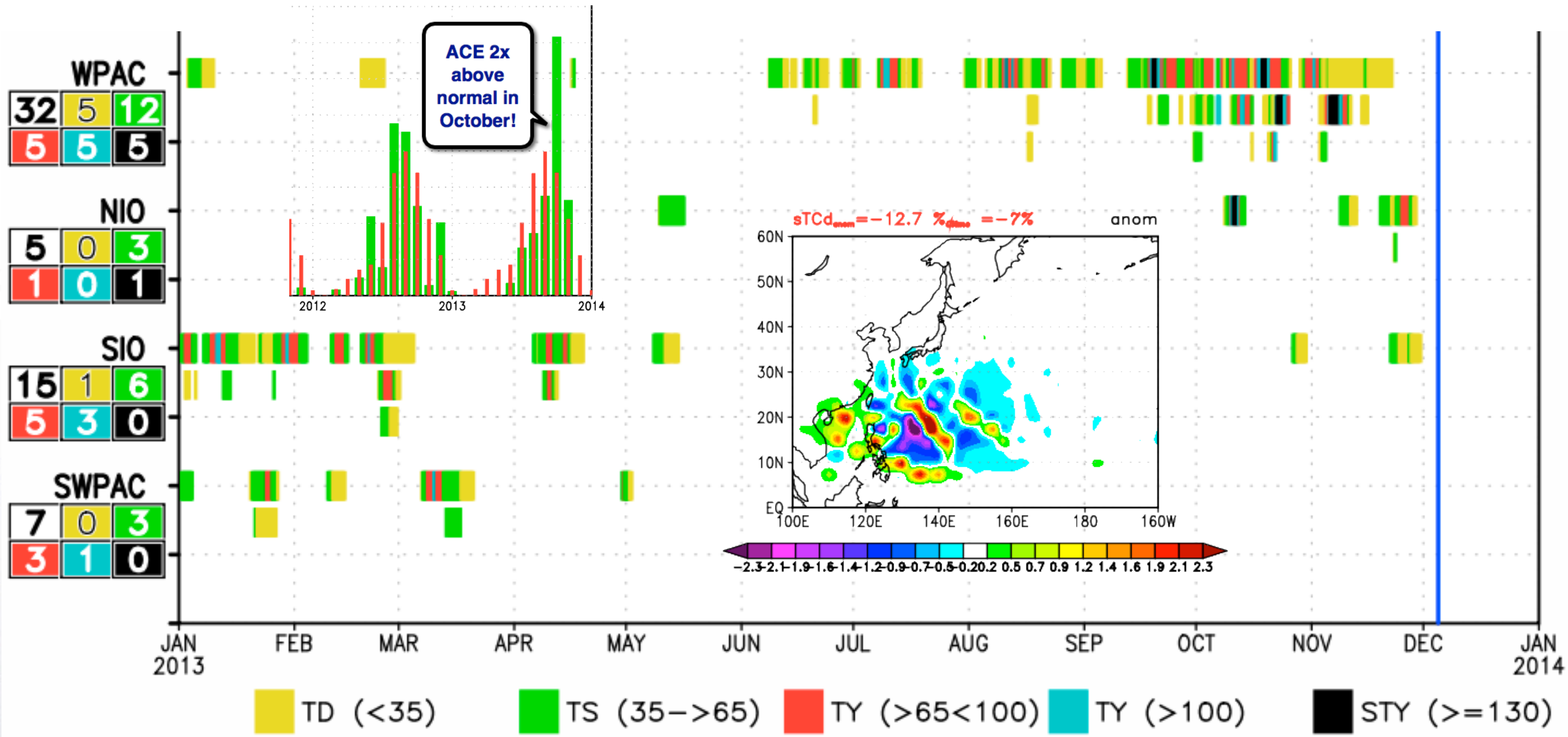
Prelims – NBs – ROEs

- verify against *working best track* using NHC/JTWC rules – if it's a *TC* – *verify*
  - *option to filter out over-land TC posits*
  - *more frequent in WPAC than LANT*
- EDET comes from ECMWF (tigge or bufr)
  - ECWMF tracker using *full res fields* – has a few issues
  - *intensity* forecasts have *less bias* compared to trackers using 1deg fields (e.g., EMX)
- tracking for GFS/FIM9/GFS-SL uses *0.5 deg global fields* – will not completely resolve model TC intensity
- emphasize *model* performance vice performance as a *forecast aid*
  - will not compare to OFCL or other 'late' aids such as TVCN
- homogeneous comps – every 12 h vice 06 h because HRES runs *00/12UTC*
  - 12-h run separation ~ e-folding time for run-to-run error correlation
- *USN talk: tau = forecast time (h) ; phonetic alphabet for subbasins*
- all analysis and plots done with python+opengrads using dictionaries of python 'vdeck' and 'mdeck' objects (`http://sourceforge.net/projects/wxmap2/`)

review of the WPAC season

http://ruc.noaa.gov/hfip/tcact

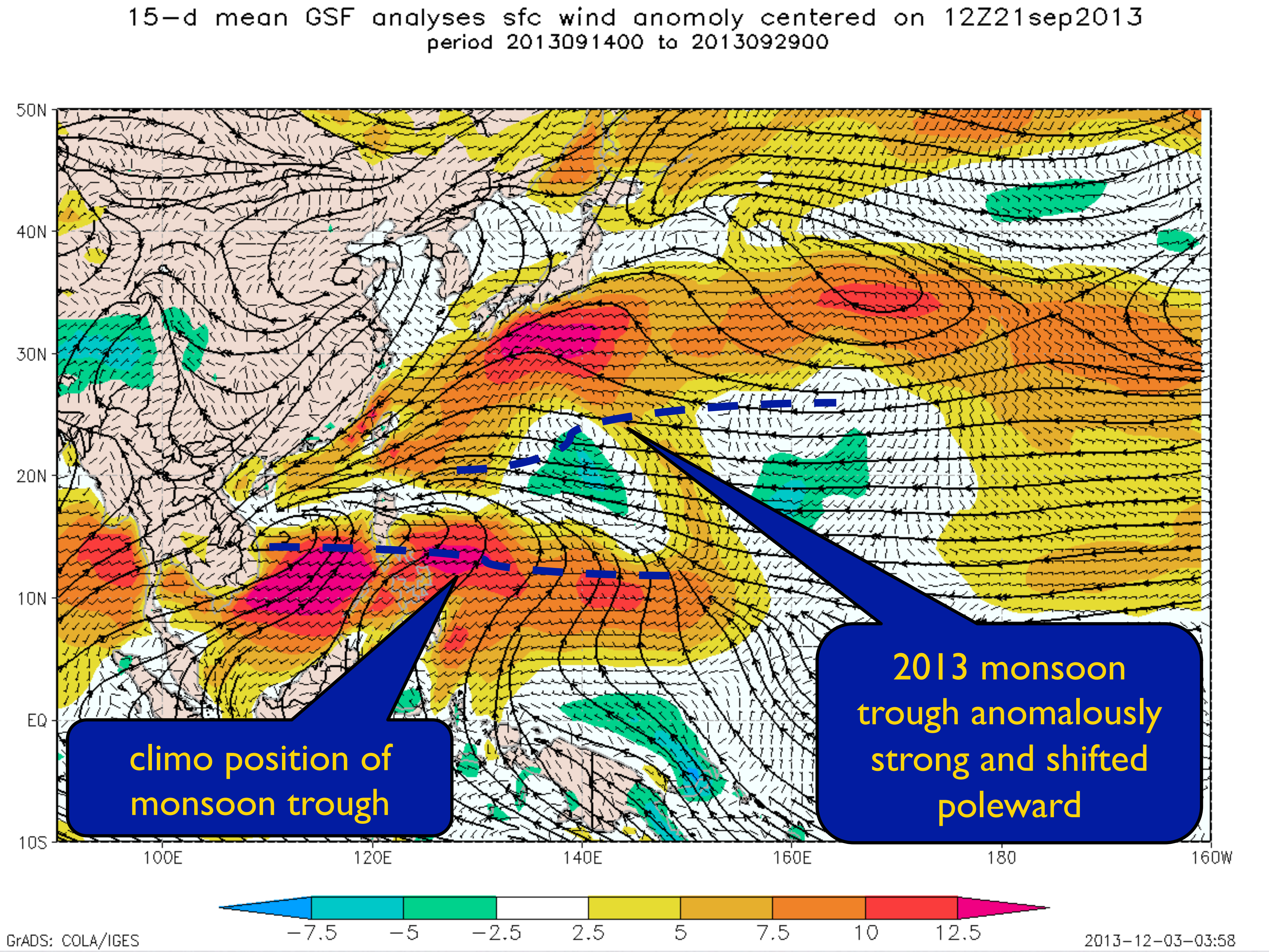
slow start but active oct-nov ; ACE ~ -7% of normal



33 # storms – 5 STY – 12 RI – 7 ED

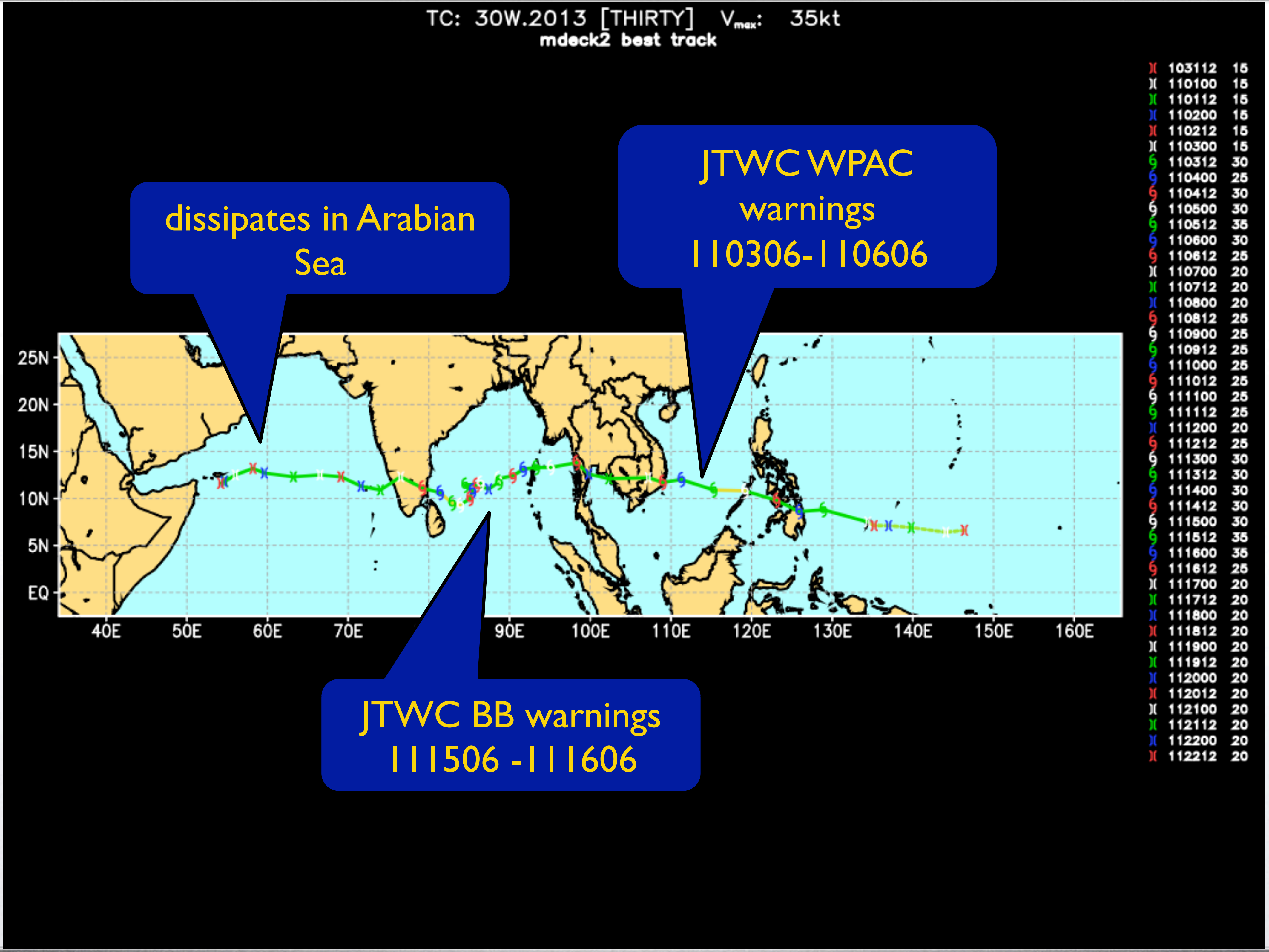
15-d sfc wind anomalies

NCEP R1 30-y daily climo (streams) v GFS mean analysis 091400-092900 (color anom WindSpeed; barb anom wind)



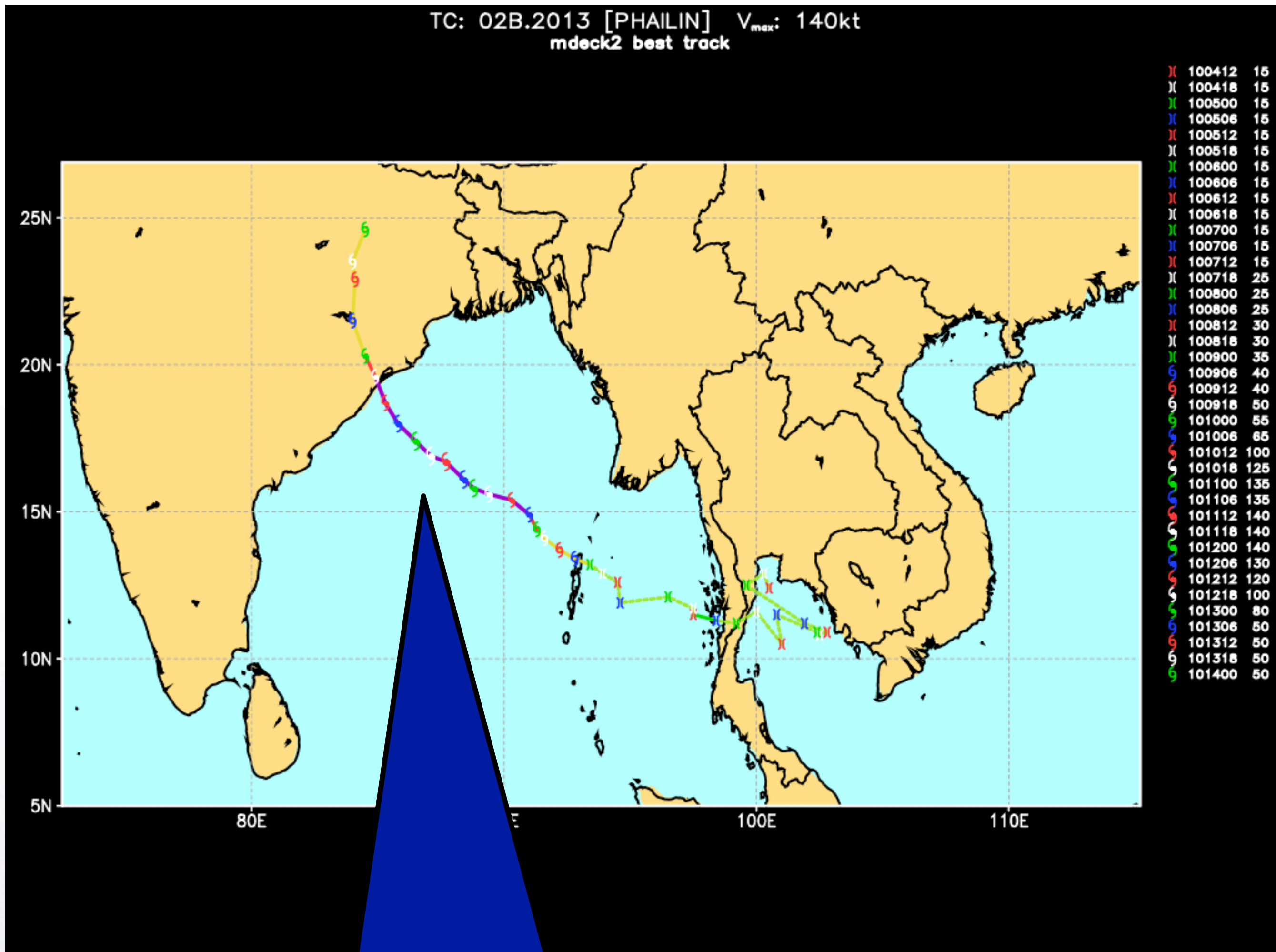
WPAC 2013 oddities – 30W

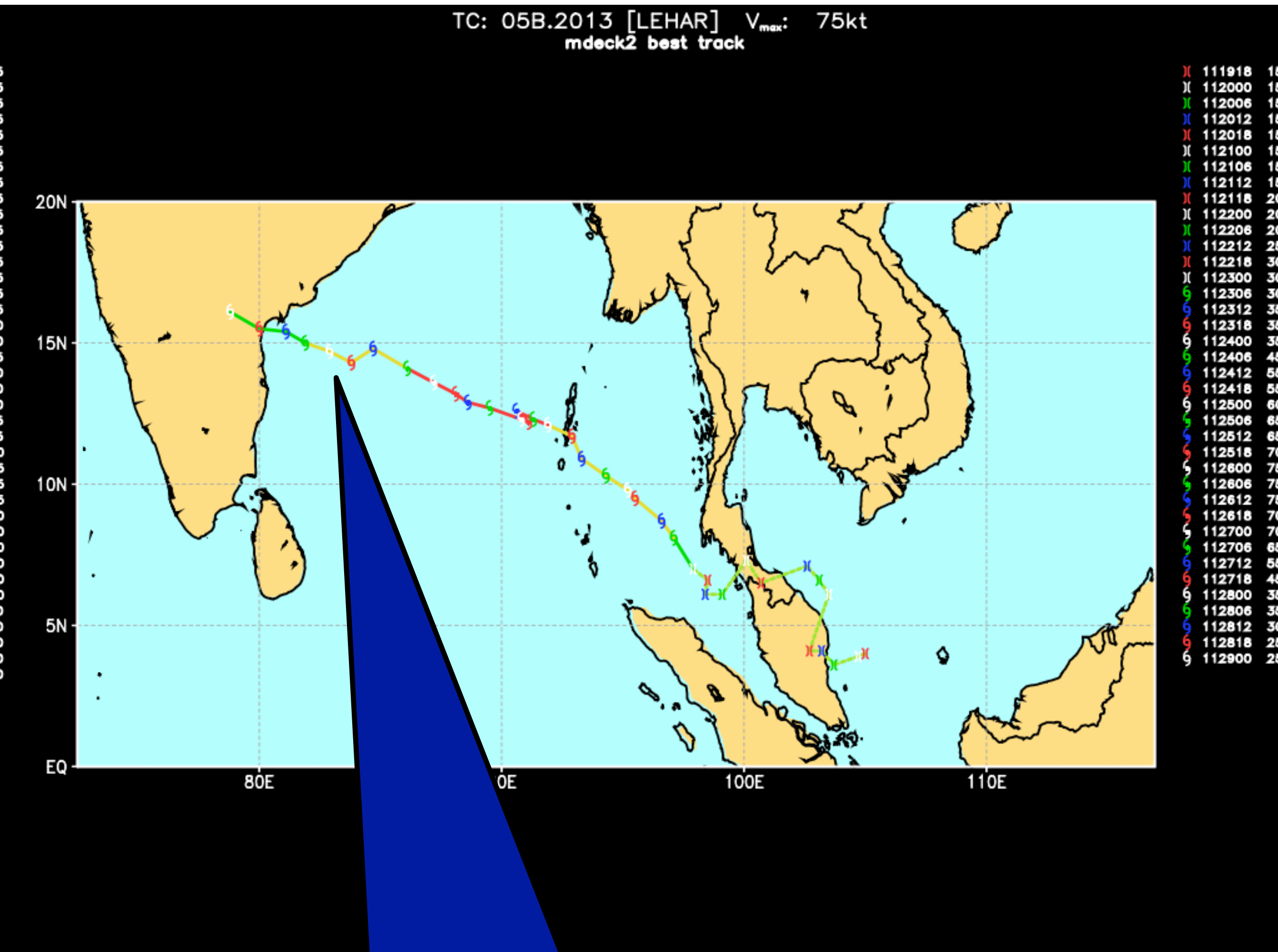
transited three subbasins W—B—A



WPAC 2013 oddities part 2 – 02B & 05B

started in WPAC (gulf of Thailand)

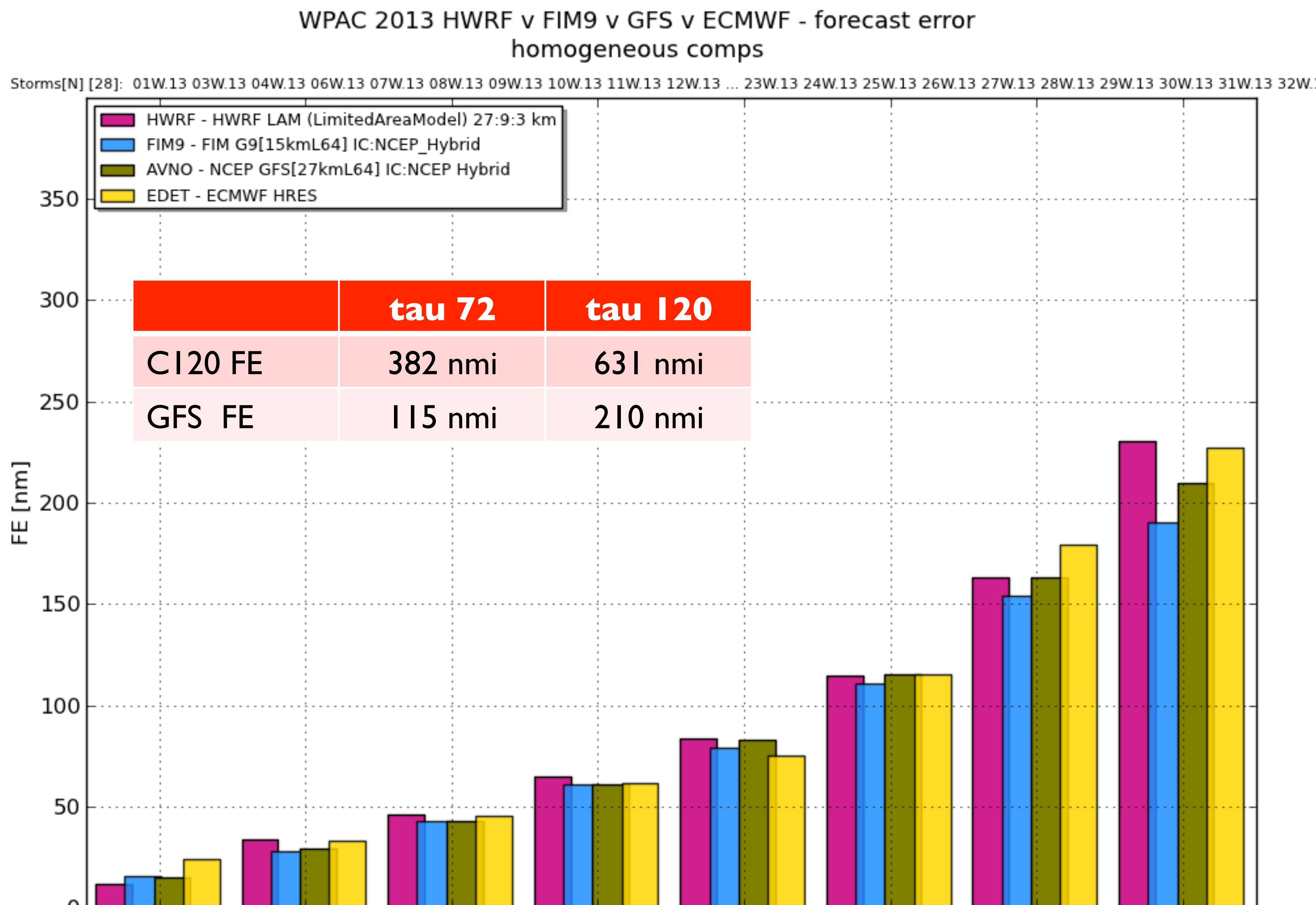




02B STC Phailin (ED)
100412-101400

05B TC Lehar (RW)
111918-112000

WPAC 2013 – forecast error

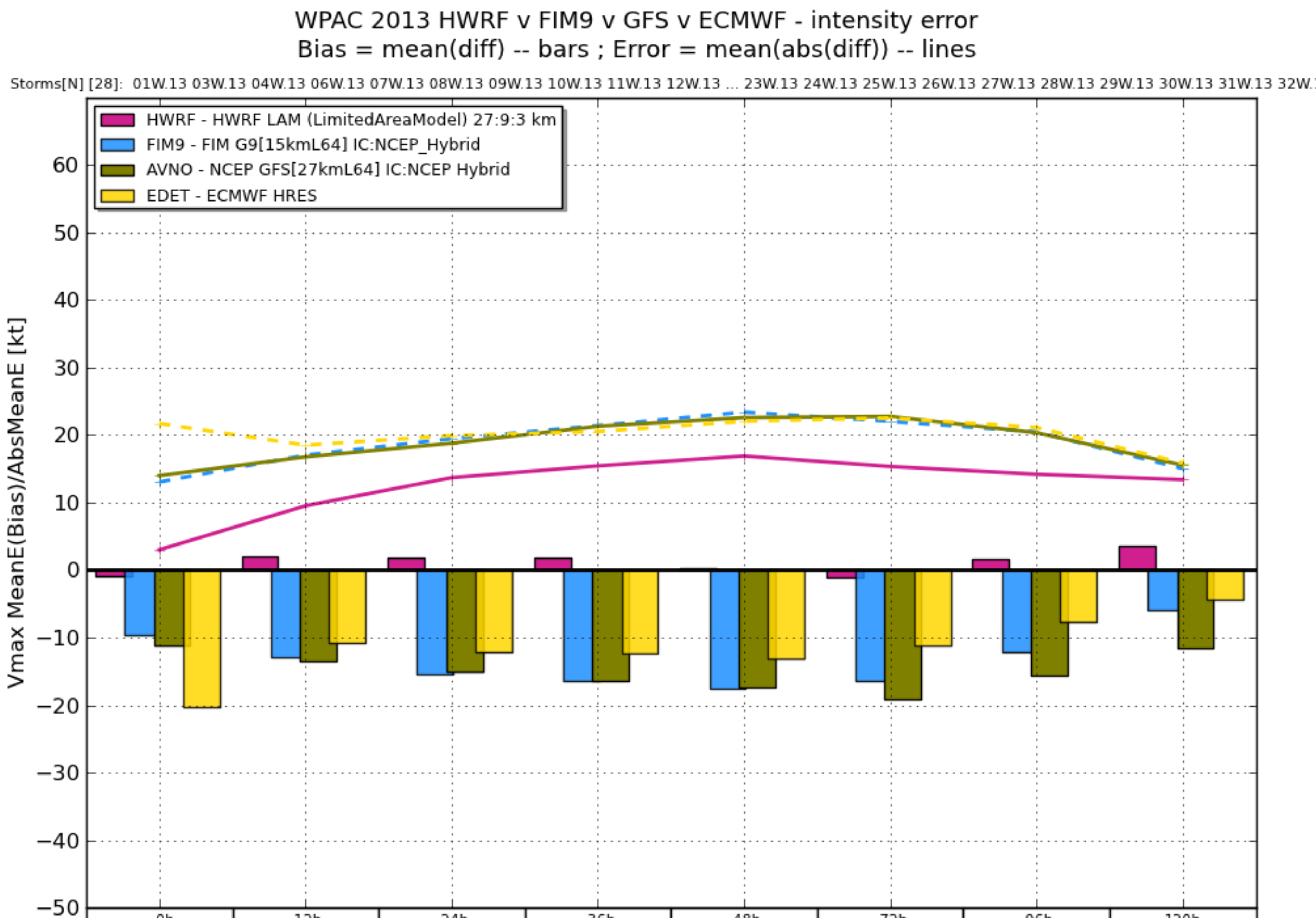


	tau 72	tau 120
C120 FE	382 nmi	631 nmi
GFS FE	115 nmi	210 nmi

	0h	12h	24h	36h	48h	72h	96h	120h
hwrf	11[238]	34[223]	46[204]	65[184]	83[163]	115[125]	163[86]	230[57]
fim9	15[238]	28[223]	43[204]	61[184]	79[163]	111[125]	154[86]	190[57]
avno	15[238]	30[223]	43[204]	61[184]	83[163]	115[125]	163[86]	210[57]
edet	24[238]	33[223]	45[204]	61[184]	75[163]	115[125]	179[86]	227[57]

- HWRF *fastest* error growth
- FIM9 *slowest* error growth
- FIM9 most competitive with ECMWF
- errors are 'off the charts' compared to CLIPER (C120)

WPAC 2013 – intensity error

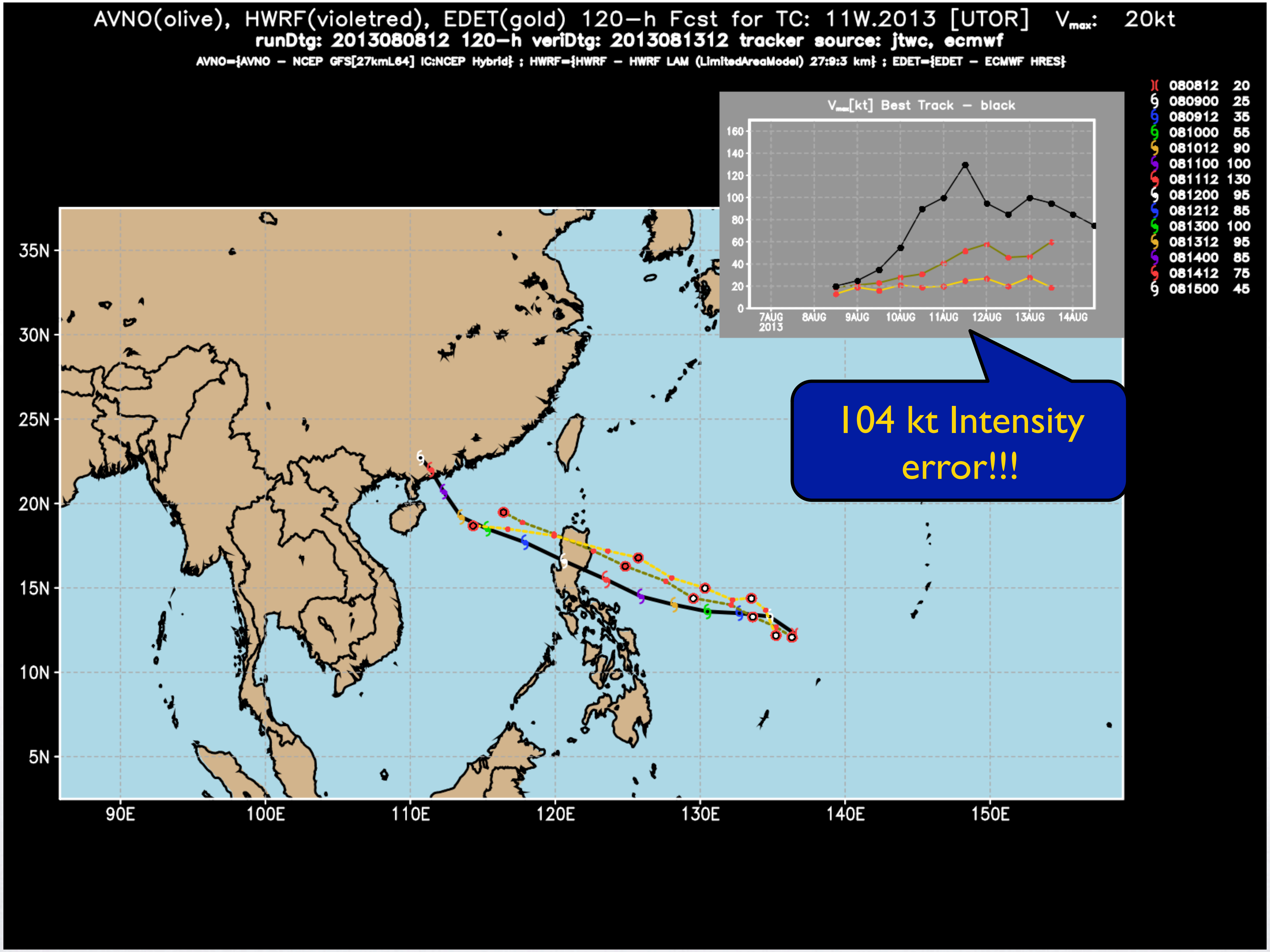


	0h	12h	24h	36h	48h	72h	96h	120h
hwrf	3; -1[238]	10; 2[223]	14; 2[204]	15; 2[184]	17; 0[163]	15; -1[125]	14; 2[86]	13; 4[57]
fim9	13; -10[238]	17; -13[223]	19; -15[204]	21; -16[184]	23; -18[163]	22; -16[125]	20; -12[86]	15; -6[57]
avno	14; -11[238]	17; -14[223]	19; -15[204]	21; -16[184]	23; -17[163]	23; -19[125]	20; -16[86]	16; -11[57]
edet	22; -20[238]	18; -11[223]	20; -12[204]	21; -12[184]	22; -13[163]	23; -11[125]	21; -8[86]	16; -4[57]

- HWRF almost NO bias (mean error)!!
- ECMWF has highest initial intensity error; HWRF almost none
- as in the LANT, ECMWF bias decreases in time…
- higher res in FIM9 (15 km) results in smaller bias than the GFS at the later taus, but signal is reduced by using 0.5 deg grids
- HWRF has higher abs mean error ('intensity error') in WPAC (17 kt) v LANT (~10kt)

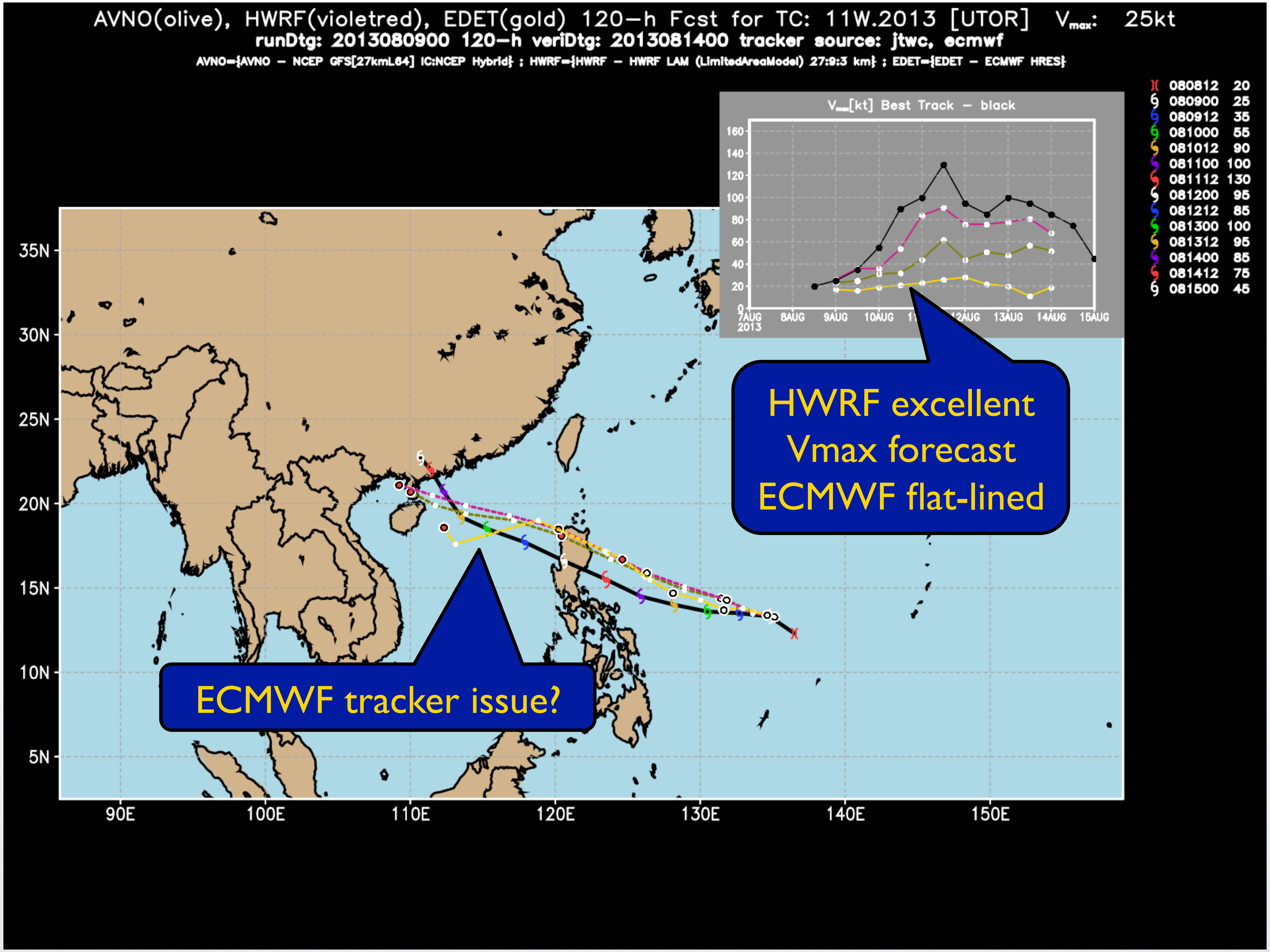
Intensity v Forecast Error

WPAC cases of extremely large ECMWF HRES intensity errors



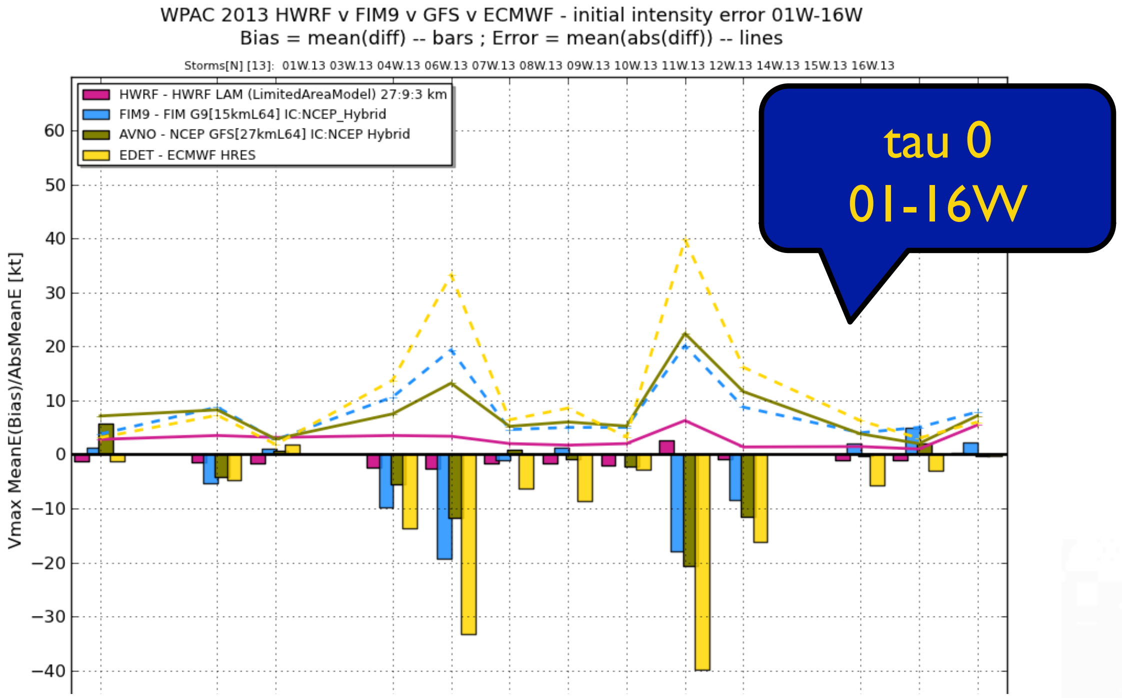
Intensity v Forecast Error

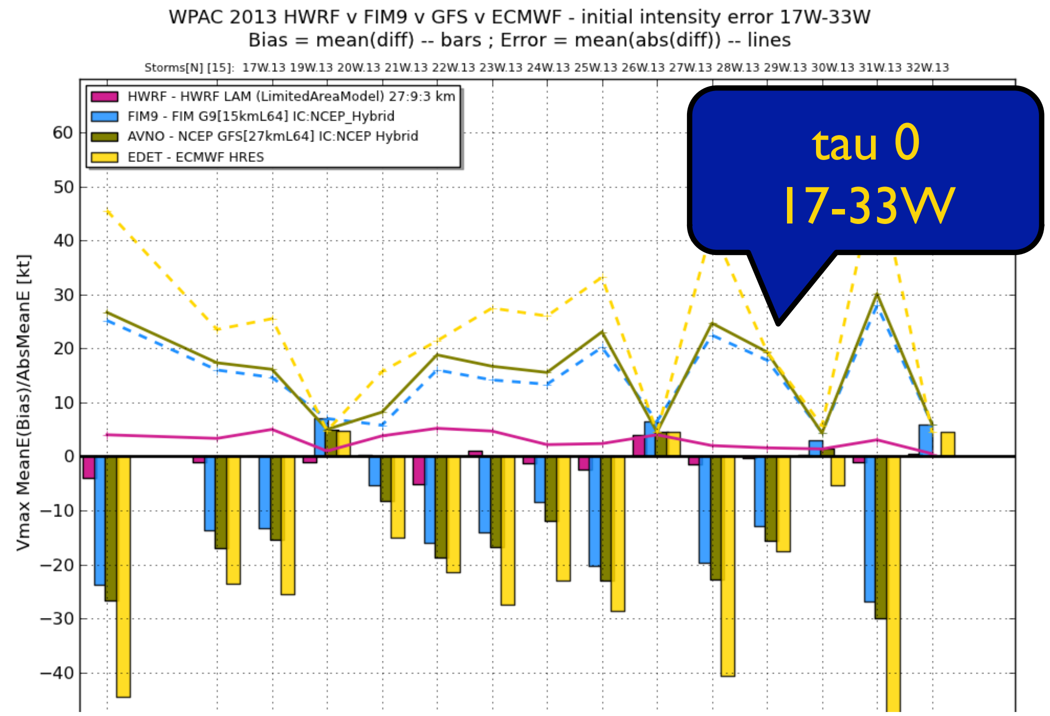
WPAC cases of extremely large ECMWF HRES intensity errors

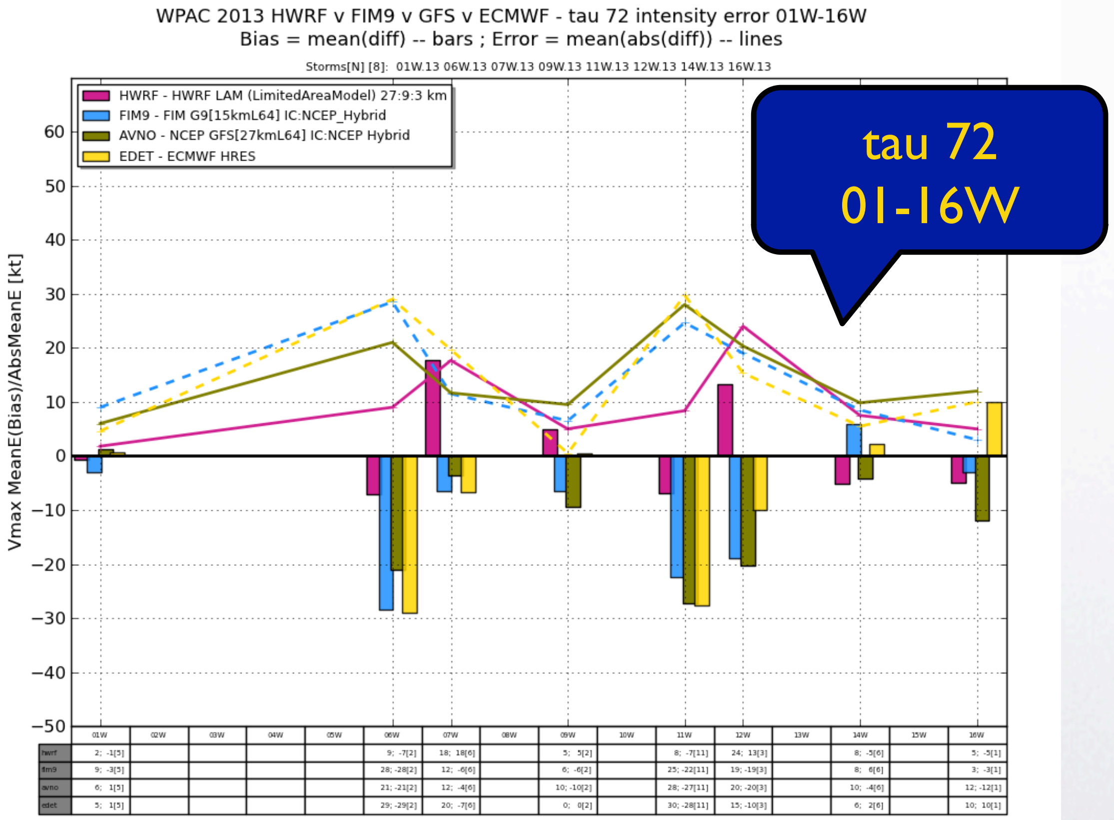


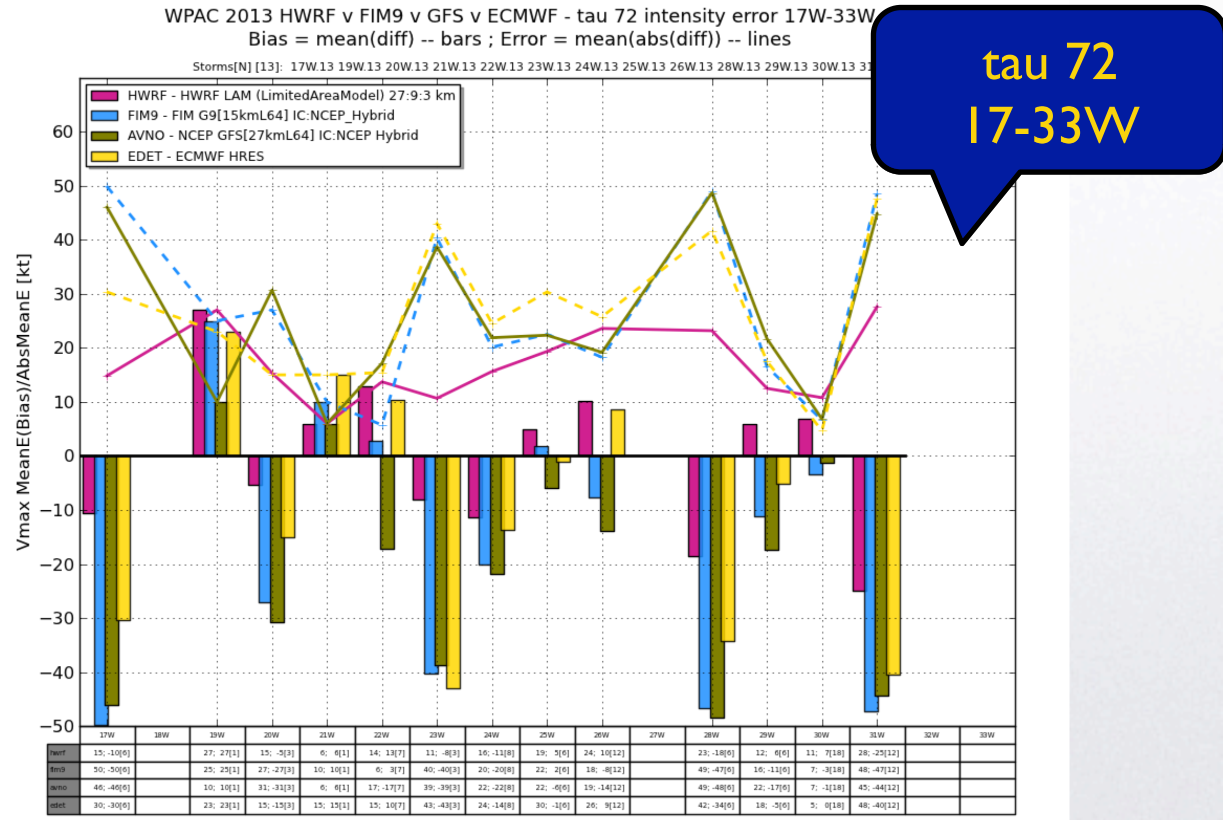
by storm tau0 & tau72 intensity error

slide # 11





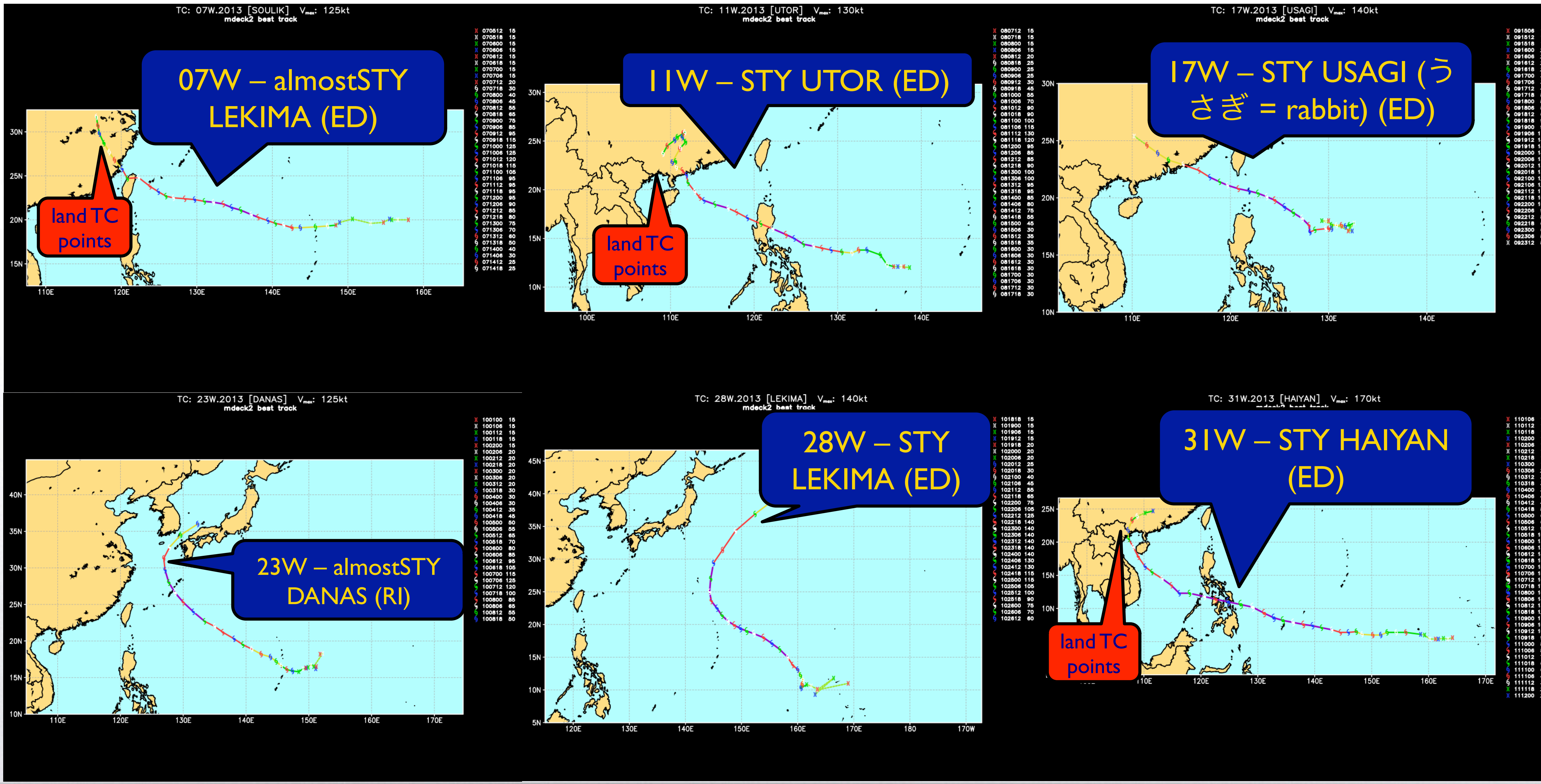




WPAC 2013 model (ECMWF) forecast intensity error

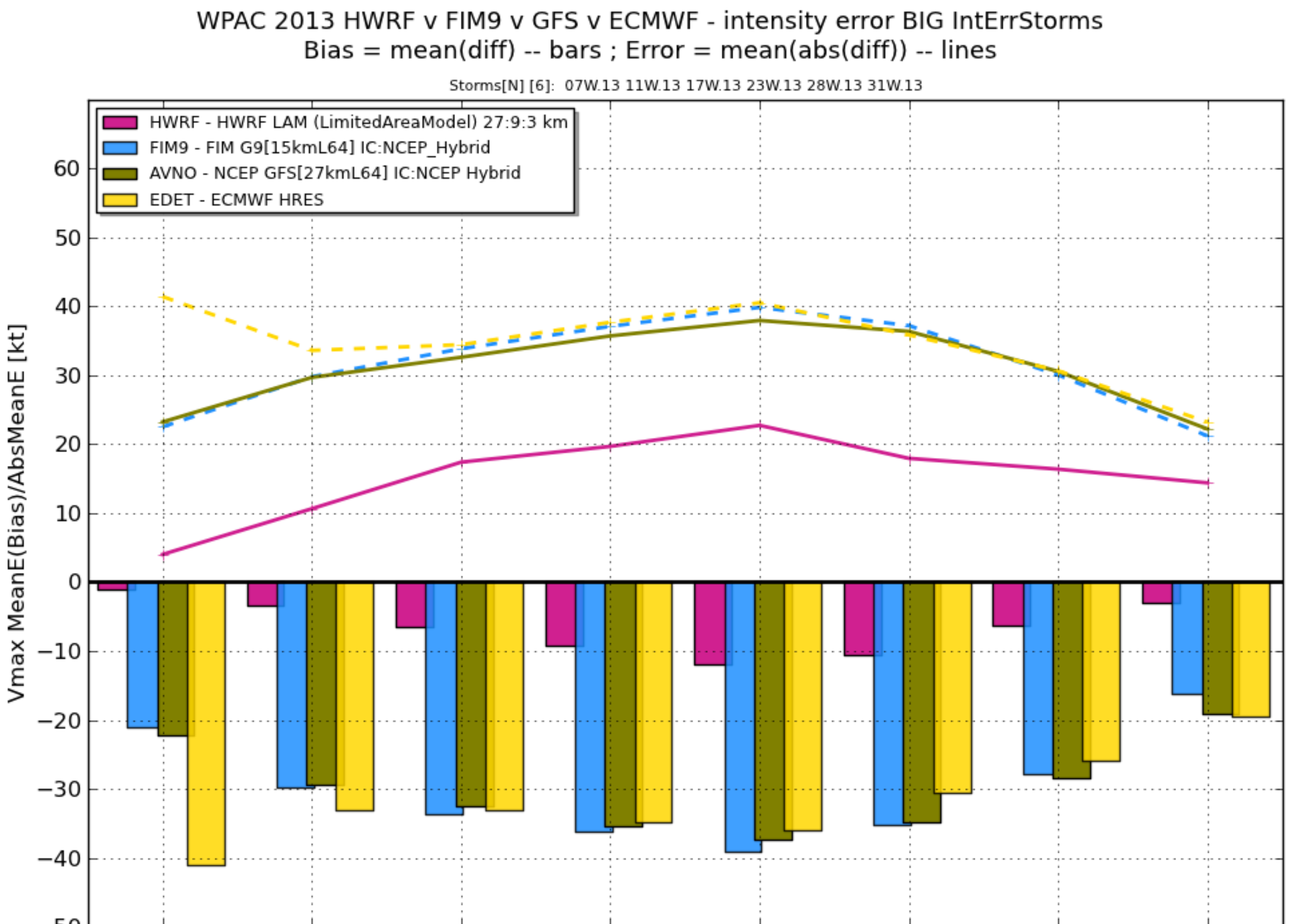
storms of shame

2013	07W	TY	SOULIK	:125	: 7.2; 9.2	: 22.4 135.6	: 070512<->071418	: 19.1<->31.7	:116.7<->158.0	: 8.3	:11.4	: 9: 2: 5:ddED	:tG: 54	9X: 92W	1st: 070718
2013	11W	STY	UTOR	:130	: 9.2;10.2	: 18.3 120.8	: 080712<->081718	: 12.0<->25.9	:109.1<->138.6	: 8.4	:10.5	: 8: 1: 7:ddED	:tG: 30	9X: 96W	1st: 080818
2013	17W	STY	USAGI	:140	: 6.8; 8.2	: 19.5 124.9	: 091506<->092312	: 17.0<->25.4	:110.2<->132.6	: 9.0	:14.4	: 6: 4: 6:ddED	:tG: 36	9X: 99W	1st: 091618
2013	23W	TY	DANAS	:125	: 5.2; 7.5	: 21.3 140.6	: 100100<->100818	: 15.9<->36.0	:126.9<->151.5	: 5.9	: 7.7	: 6: 0: 4:ddRI	:tG: 54	9X: 97W	1st: 100312
2013	28W	STY	LEKIMA	:140	: 6.2; 7.8	: 18.8 155.0	: 101818<->102612	: 9.3<->39.5	:144.3<->169.0	: 8.9	:15.6	: 8: 4: 4:ddED	:tG: 42	9X: 95W	1st: 102012
2013	31W	STY	HAIYAN	:170	: 8.8;10.8	: 10.9 134.5	: 110106<->111200	: 5.4<->24.7	:107.2<->164.2	:11.3	:21.6	: 7: 4:11:ddED	:tG: 48	9X: 99W	1st: 110306



WPAC 2013 intensity error for BIG ECMWF intensity error storms

07W, 11W, 17W, 23W, 28W, 31W

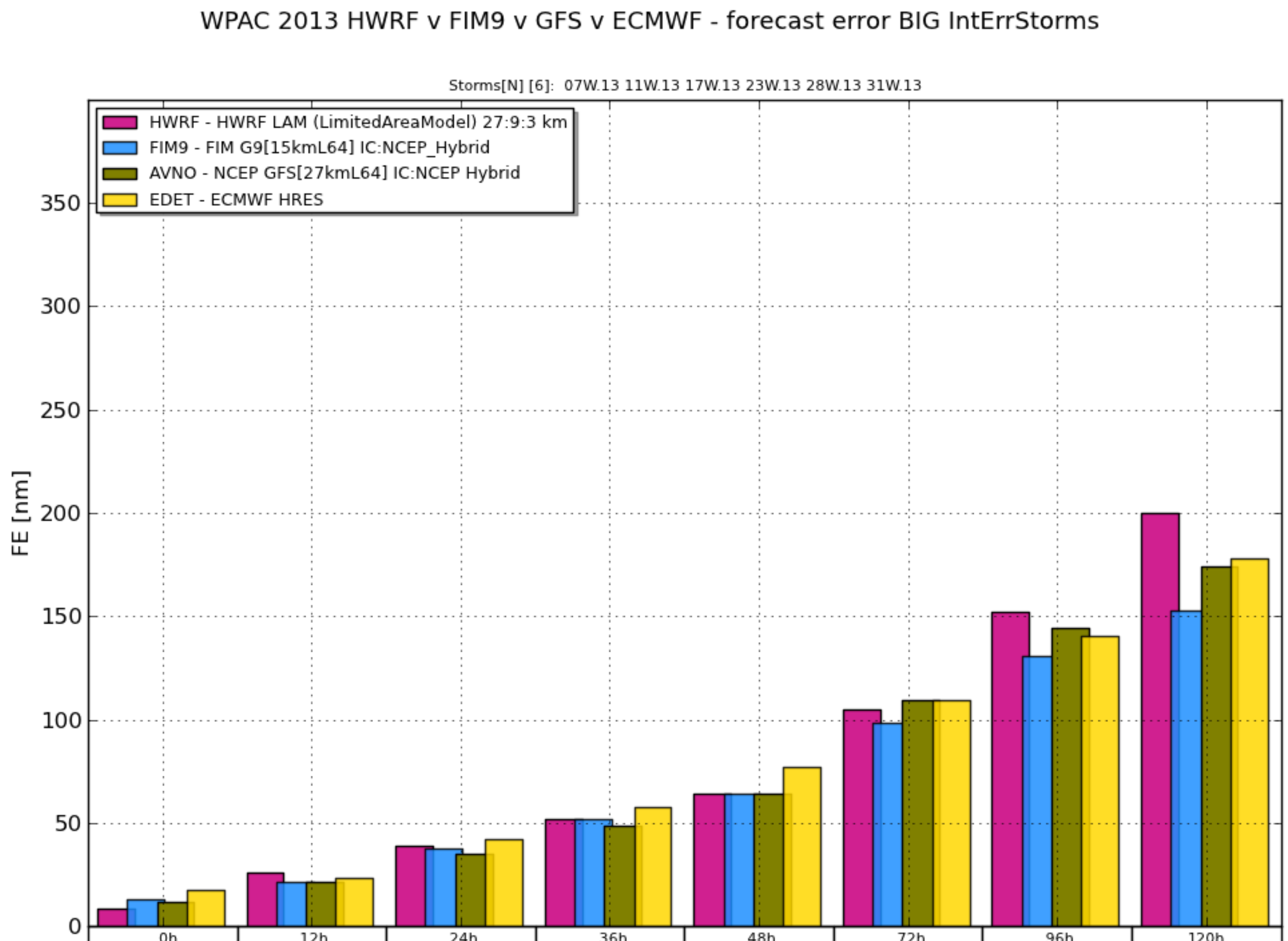


	0h	12h	24h	36h	48h	72h	96h	120h
hwrf	4; -1[62]	11; -3[60]	17; -7[58]	20; -9[54]	23; -12[49]	18; -11[44]	16; -6[33]	14; -3[21]
fim9	22; -21[62]	30; -30[60]	34; -34[58]	37; -36[54]	40; -39[49]	37; -35[44]	30; -28[33]	21; -16[21]
avno	23; -22[62]	30; -29[60]	33; -33[58]	36; -36[54]	38; -37[49]	36; -35[44]	31; -28[33]	22; -19[21]
edet	41; -41[62]	34; -33[60]	34; -33[58]	38; -35[54]	40; -36[49]	36; -31[44]	31; -26[33]	23; -20[21]

- HWRF clear winner with a weak bias (as expected for STYs)
- huge ECMWF initial intensity error – poor inner-core TC analysis
- other global models about the same except intiallly

WPAC 2013 forecast error for BIG ECMWF intensity error storms

07W, 11W, 17W, 22W, 28W, 31W

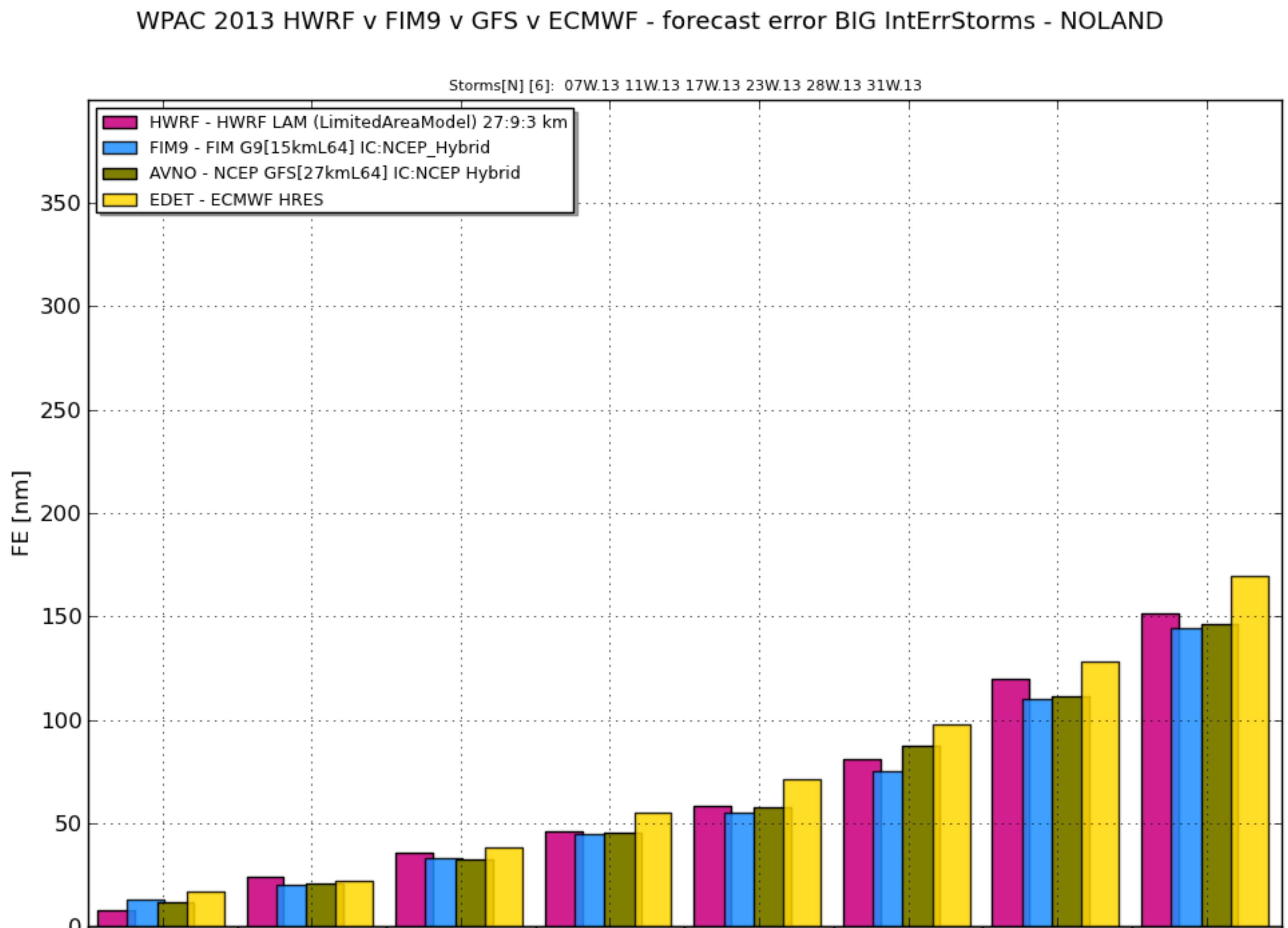


	0h	12h	24h	36h	48h	72h	96h	120h
hwrf	8[62]	26[60]	39[58]	52[54]	64[49]	105[44]	152[33]	200[21]
fim9	13[62]	22[60]	38[58]	52[54]	64[49]	98[44]	131[33]	153[21]
avno	12[62]	22[60]	35[58]	49[54]	64[49]	109[44]	144[33]	174[21]
edet	17[62]	23[60]	42[58]	58[54]	77[49]	109[44]	140[33]	178[21]

- superior HWRF intensity errors do NOT translate into better track forecasts
- errors lower than for all storms – well-behaved STYs

WPAC 2013 forecast error for BIG ECMWF intensity error storms

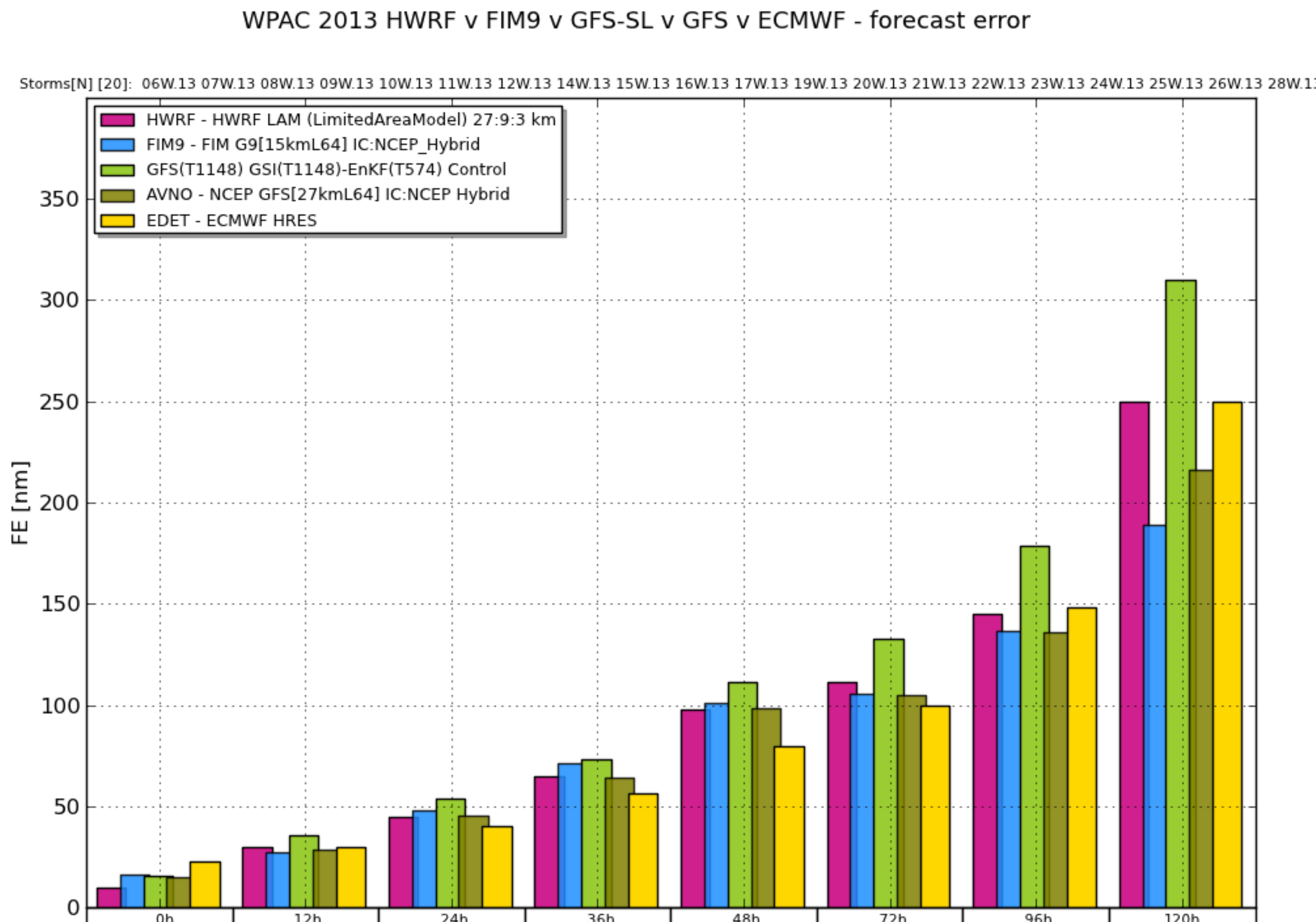
affect of over-land points in the best track designated as TC



	0h	12h	24h	36h	48h	72h	96h	120h
hwrf	8[60]	24[56]	36[53]	46[49]	59[45]	81[38]	119[27]	151[16]
fim9	13[60]	20[56]	33[53]	45[49]	55[45]	75[38]	110[27]	144[16]
avno	12[60]	21[56]	33[53]	45[49]	58[45]	88[38]	111[27]	146[16]
edet	17[60]	22[56]	38[53]	55[49]	71[45]	98[38]	128[27]	169[16]

- big forecast errors come from over-land points
- relative position of models about the same except ECMWF has higher forecast error growth – *the very poor TC analysis did affect the track*

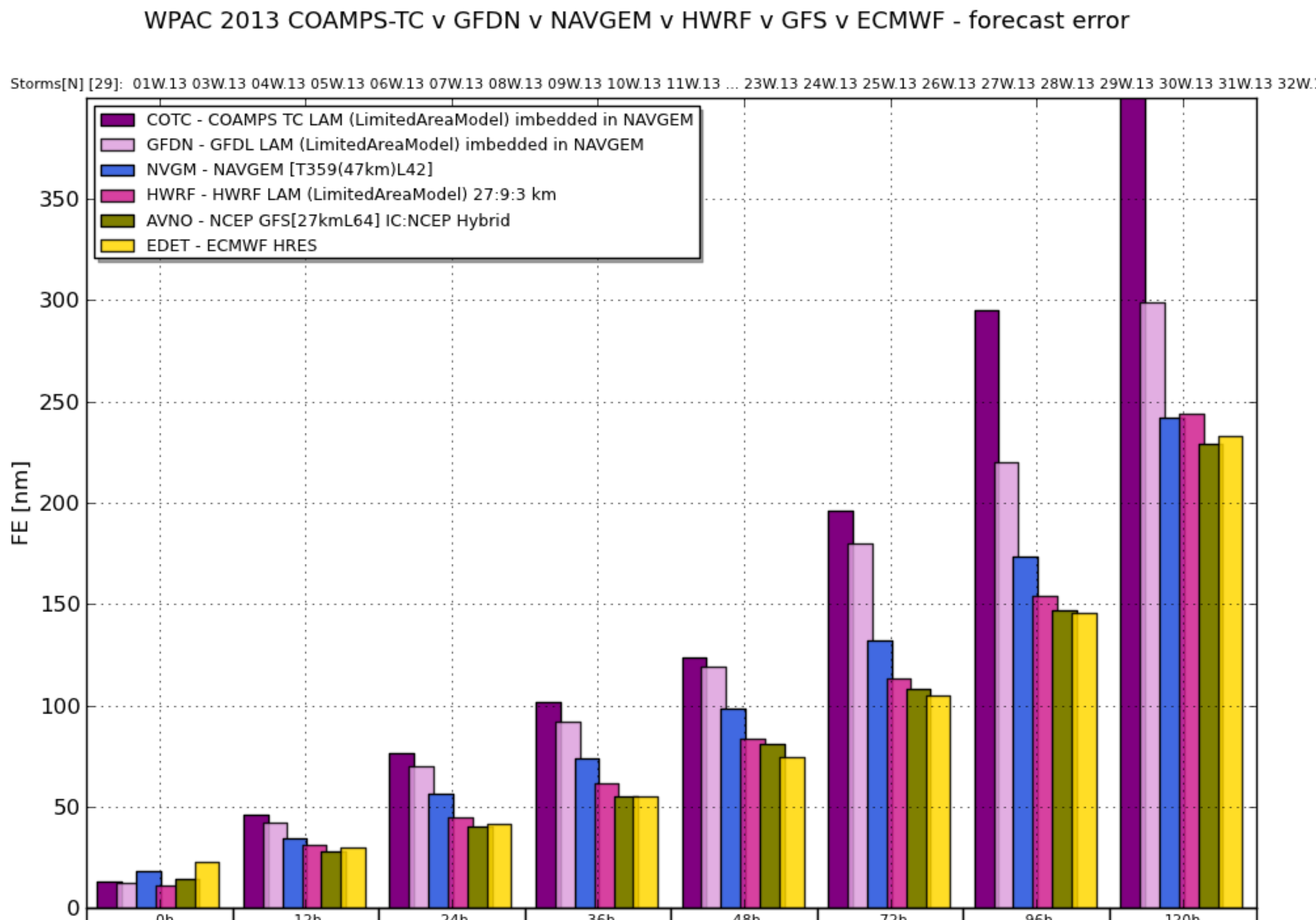
WPAC 2013 – forecast error – add GFS-SL



	0h	12h	24h	36h	48h	72h	96h	120h
hwrf	10[90]	30[81]	45[72]	65[62]	98[52]	111[33]	145[18]	250[13]
fim9	16[90]	27[81]	48[72]	72[62]	101[52]	105[33]	137[18]	189[13]
ge00	16[90]	36[81]	54[72]	73[62]	111[52]	133[33]	179[18]	310[13]
avno	15[90]	28[81]	46[72]	64[62]	99[52]	105[33]	136[18]	216[13]
edet	23[90]	30[81]	41[72]	56[62]	80[52]	99[33]	148[18]	250[13]

- fewer cases because of GFS-SL – 9 storms before the 1 AUG 13 start of the demo
- GFS-SL has greatest error growth
- GFS-SL in WPAC even worse…

GFS- v NAVGEM-based models: COAMPS-TC, GFDN
WPAC 2013

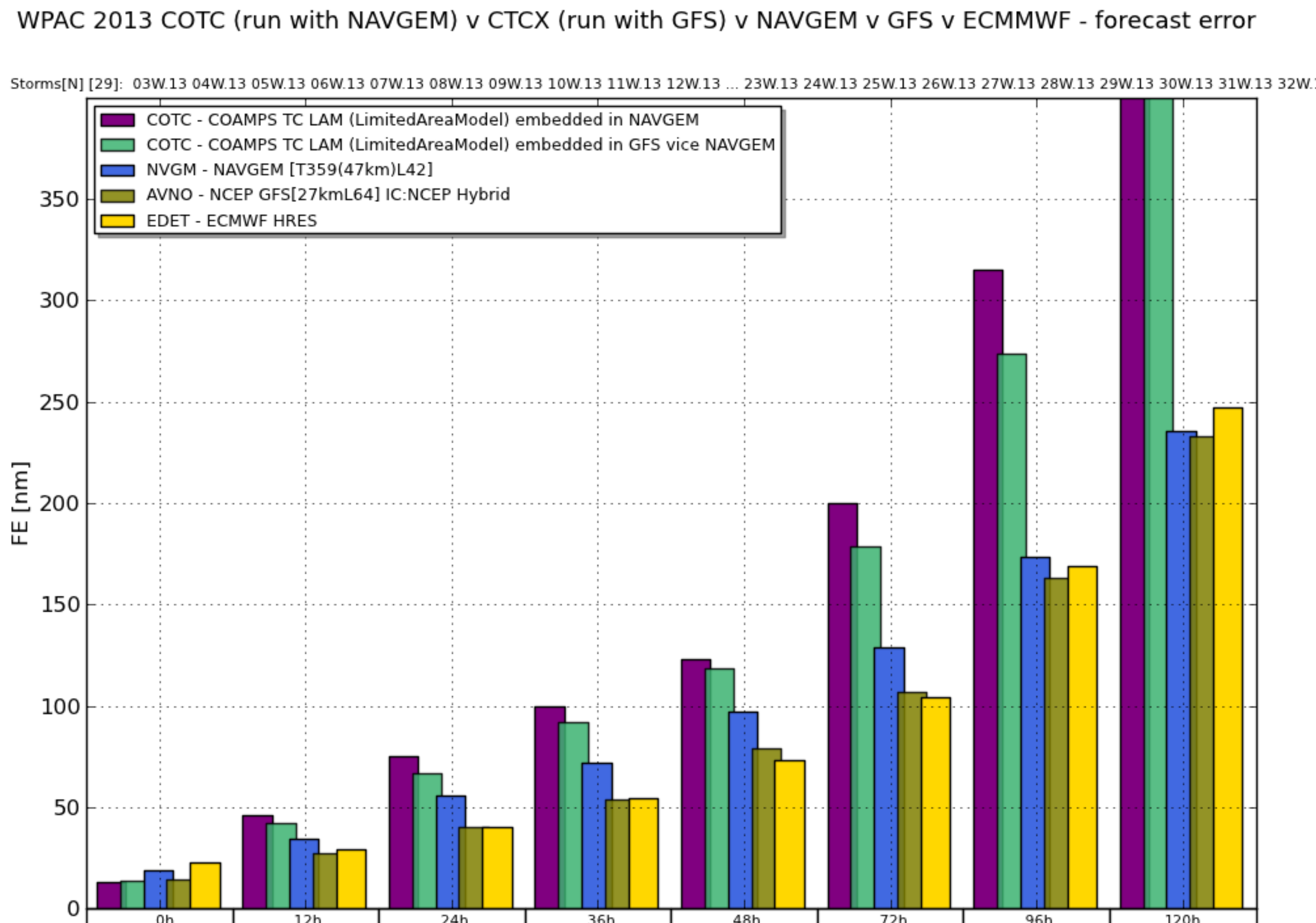


	0h	12h	24h	36h	48h	72h	96h	120h
cotc	13[230]	46[215]	76[197]	102[176]	124[160]	196[109]	295[69]	439[46]
gfdn	13[230]	42[215]	70[197]	92[176]	119[160]	180[109]	220[69]	299[46]
nvgm	19[230]	34[215]	56[197]	74[176]	99[160]	132[109]	173[69]	242[46]
hwrf	11[230]	31[215]	45[197]	62[176]	84[160]	113[109]	154[69]	244[46]
avno	15[230]	28[215]	40[197]	55[176]	81[160]	108[109]	147[69]	229[46]
edet	23[230]	30[215]	41[197]	55[176]	74[160]	105[109]	146[69]	233[46]

- NAVGEM < GFS
- COTC has very high error grow
- GFDN next highest
- serious issues with the USN limited-area-models…

COAMPS-TC with GFS v NAVGEM

WPAC 2013



	0h	12h	24h	36h	48h	72h	96h	120h
cotc	13[223]	46[208]	75[190]	100[166]	123[151]	200[103]	315[66]	465[40]
ctcx	14[223]	42[208]	67[190]	92[166]	119[151]	179[103]	274[66]	426[40]
nvgm	19[223]	34[208]	56[190]	72[166]	97[151]	129[103]	174[66]	236[40]
avno	15[223]	27[208]	40[190]	54[166]	79[151]	107[103]	163[66]	233[40]
edet	23[223]	29[208]	40[190]	54[166]	73[151]	104[103]	169[66]	247[40]

- modest impact of using GFS vice NAVGEM in COTC
- still issues with USN COAMPS-TC

Takeaways

- JTWC over-land TC posits in (working) best track have a significant on forecast error
- ECMWF had dreadful intensity errors in WPAC – they have a serious TC analysis issue – but impact on track was weak (Fiorino and Elsberry 1989)
- as in the LANT/EPAC HWRF has very low initial position and intensity errors
  - vortex initialization recovers almost all of the location and intensity in the TCvitals
- FIM9 had a good year v GFS v ECMWF v HWRF
- as in LANT/EPAC resolution is not a sufficient condition for TC prediction success
- doubling the resolution of the GFS degraded TC performance less severely v LANT/EPAC
  - consistent with experience at ECMWF – need to 'adapt' physics to new resolution
- USN limited-area-models have serious issues that go beyond the embedded global model