Initial Implementation (transition to operations) Cost in FTEs (in addition to existing personnel managing O&M for operational GFS)

Activity	FY17		FY18		FY19		FY20		Total	
	MPAS	FV3	MPAS	FV3	MPAS	FV3	MPAS	FV3	MPAS	FV3
Dycore integration into NEMS	3	3	2	2	2	2	2	0	9	7
Physics implementation	2	1	2	1	1	1	1	0	6	3
Physics Driver implementation	1	1	2	1	1	1	1	0	5	3
DA integration	4	2	3	2	3	2	2	0	12	6
Pre/Post	2	2	2	2	1	1	1	0	6	5
Benchmarking	0	0	4	3	4	4	5	0	13	7
Code Management	2	2	2	2	2	2	2	2	8	8
Computational efficiency	2	1	2	1	2	1	2	0	8	3
Transition to operations	0	0	0	0	0	3	3	0	3	3
Total	16	12	19	14	16	17	19	2	70	45

Computer Resource Requirements for Initial Implementation (FY17-FY19 for FV3 and FY17-FY20 for MPAS)

	CPU*	CPU Hours**	Disk	Period	% change w.r.t. GFS
GFS	5,150,880	399,840	10 PB	FY17-FY18	0
FV3	6,565,620	509,660	30 PB (2 streams)	FY17-FY19	28%
MPAS	19,959,660	1,549,380	45 PB (3 streams)	FY17-FY20	288%

CPU = Y x 4 cycles x 365 days x 3 years, Y is number of cores required for 8.5 min/day

Y = 1176 (GFS), 1499 (FV3), 4557 (MPAS) based on current operational resolution (~13 km).   1176   1499   4557

Computational requirements for intended implementation configuration TBD

**CPU hours = Y x 8.5 min/day x 10 days x 4 cycles

HPC resources for Data Assimilation is not included

Availability of computational resources will require development/testing of FV3 in two parallel streams while MPAS would require three parallel streams

Summary   **Implementation Costs (Human Resources) for MPAS are 55% more compared to FV3**

Implementation Costs (computational resources) for MPAS are 204% more compared to FV3

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