Accelerating Research-to-Operations

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Numerical weather prediction

$$\text{NWP} = f(\text{observations} + \text{model code} + \text{compute})$$

- Observations, $\tilde{y}$, and errors
  - Sondes
  - Surface stations
  - Ships
  - Satellites

- State vector, $\tilde{x}$

- A-priori information, $\tilde{x}_B$, and errors
  - Background state
  - Best guess
  - Forecast

- Assimilation algorithm ("inverse model")
  - Optimal Interpolation (OI)
  - Variational data assimilation (Var.)
  - Kalman filter

- Models ("forward models")
  - Linking model state to observations
  - $\tilde{y} = \tilde{h}[\tilde{x}] + \tilde{e}$
Improving observing systems
Observations are not created equal

- Observing system experiments
- Forecast sensitivity to observations
- Cost-benefit analysis / value proposition
- Alternative observations / CWDP

Improving forecast skill and performance

- Quality control of observations
- Data assimilation
- Dynamic core and model physics
- NGGPS SIP for a Unified Forecasting System
- Code efficiency
- Optimized hardware
Inherent barriers with the status quo

- Fractured strategy (getting much better!)
- Obtuse HPC procurement process
- Security clearance procedures for visiting scientists
- Cultural (internal and external)
- Funding allocation process disincentivizes collaboration
- Risk aversion (incentive not to fail > incentive to improve)
- Too many committees with overlapping and conflicting input
Ideas to accelerate research-to-operations

- Virtual machines (cloud HPC) for on-demand parallel development
- End-to-end community model (harness collective advancements)
- Visiting scientists (UCP/PrepIFS)
- Modifying the R2O funnel (requirements, gates and transitions)
- Fast-tracking satellite DA
- Drive up benefit in cost-benefit ratio
- Agile/nimble “skunkworks” sandbox
- Governance / funding
VMs and cloud HPC

- Virtual machines (cloud HPC) for parallel *community* development
- Not all HPC “clouds” are the same
- Consistent with NOAA BDP
- Remote Direct Memory Access (RDMA)
  - Remote memory location read/write
  - No copying
  - Direct processor interface bypasses kernel and TCP/IP in I/O path
- Consistent with NOAA BDP
- Secure ingest (DMZ)
Thank you for serving in this role!

Your feedback and guidance is critical; we are looking to you.

• What do you think are our biggest challenges?
• Thoughts on how to solve them?
• Alternative ideas to our proposed path?
• Are we overlooking something?
• Unintended consequences?
• What do you need from us?
• How can we better engage SAB?