OSSE Plans Related to a Hybrid Mission and ADM Follow-on Missions

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Overview of OSSE efforts

- NASA has formed SIVO (Software Integration and Visualization Office) at GSFC; one of its responsibilities is to carry out OSSEs in support of the GAMO and NASA instrument development initiatives.
- NOAA THORPEX is funding the establishment of an OSSE testbed for its program
- NCEP is expanding its OSSE work to establish a core system for use in instrument and DA experiments; closely aligned with the JCSDA. (See M. Matsutani's presentation)

The Role of OSSEs in THORPEX

- NOAA's THORPEX Program Plan calls for cross-cutting OSSE and OSSE-like activities to:

  a) Assess what data would be most useful for NWP (neutral to obs instruments/platforms)
  b) Assess what existing or new instruments/platforms can best serve the needs under (a)
  c) Assess the relative value for USERS from obs system, DA, and modeling/ensemble improvements
  d) Based on a-c, propose and test a few promising configurations for the new integrated, adaptive, and user controllable NWP system (new NWP paradigm, p. 15); most promising configuration to be tested in THORPEX global demo project, and to become legacy of THORPEX under GIFS

- OSSEs give a quantitative determination of the potential for improvement between
  - new or improved instruments,
  - improved data assimilation systems
  - improved forecast models

The Role of OSSEs in THORPEX (continued)

- The use of OSSEs to conduct predictability experiments using simulated observations enables investigations over broader range of atmospheric conditions and observation platform deployments than possible in actual field experiments

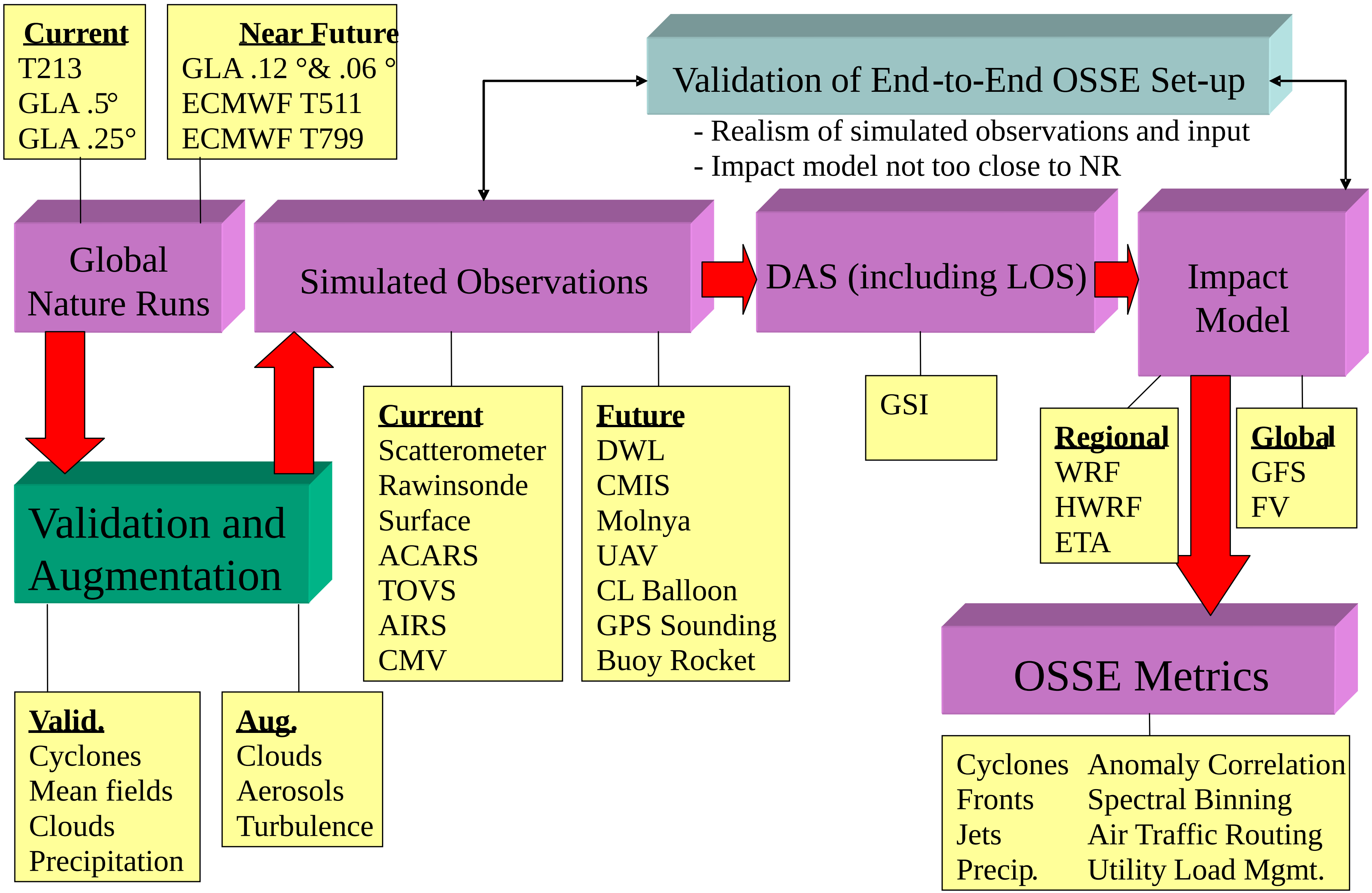
- OSSEs foster broader international academic, operation's centers and research laboratory interaction/investigations than is monetarily possible in focused field campaigns

- OSSEs help design adaptive targeting field experiments; can run simulated experiments for many atmospheric scenarios providing the context for "validation" field campaigns

- The NOAA OSSE Testbed will provide a laboratory for international collaboration in assessing cost-benefits of various observing system/DAS/FM combinations

- OSSEs are of very high value in accelerating the preparedness of the operational centers for the use of new observations; builds upon established collaboration between NASA/GSFC/GLA, NOAA/NCEP, JCSDA, NOAA/NESDIS and academia.

THORPEX OSSE TESTBED



Current plans for THORPEX OSSE testbed (funded)

- Baseline the testbed with current NR/OBSIM/DAS/FM capabilities to enable near term experiments

- Generate new high resolution Nature Runs
  - ECMWF T511 and T799
  - FVGCM (.25 degree)
  - FVGCM .12 and .06 ° evolving to 1 km non-hydrostatic
  - ECMWF analyses w/high res rapid update meso model

- Incorporate updated forward models for all observing systems currently used and those being considered (e.g. wind lidars and balloon swarms)

- Operate with a least two DASs
  - NCEP DAS (GSI primary)
  - NASA GFSC DAS (also GSI)

  Offer several forecast model options
  - FVGCM
  - NCEP GFS
  - Others

Recent experience with OSSEs at NCEP and GSFC

- Shifting focus to high impact weather forecasts and events for OSSE metrics
  - Precipitation forecasts
  - Hurricane track
  - Jet stream strength and location
  - Air traffic routing
  - Utility load management
- Adaptive targeting (AT) OSSEs in progress at NCEP (follow–on to earlier GSFC ATOSSE)
- Hurricane lifecycle OSSEs in progress at GSFC in collaboration with NOAA/AOML and GFDL

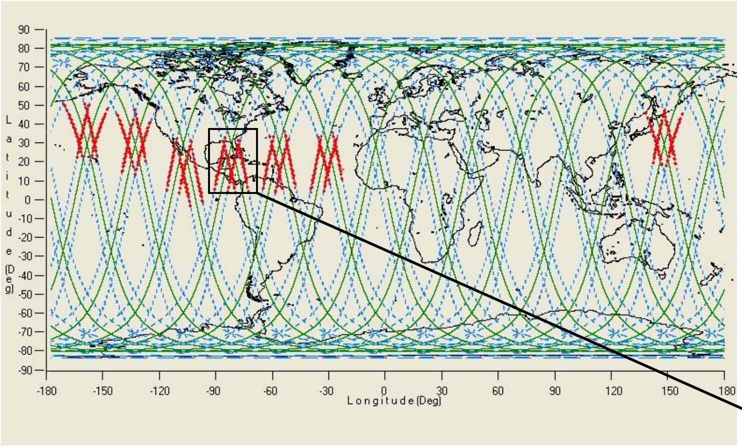
General: DWL Simulations

- Hybrid performance assessments
- Adaptive Targeting strategy evaluations
- General major issues to be addressed
  - Hybrid
    - On/Off pattern for instrument engineering
      - Need to have targets identified by current NCEP system
      - Need to have cloud coverage of target areas
    - Trade space on EAP
  - ADM and ADM follow-on concept evaluation
    - Current configuration
    - Tandom Aeolus (100%)
    - Dual look

Hybrid Mission

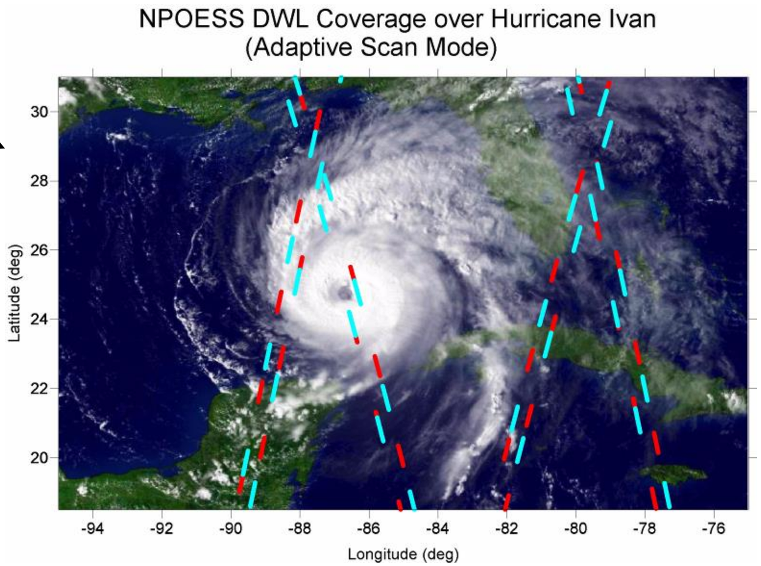
- Need for direct wind observations from space
- Data utility issues with major technology implications
  - Accuracy
  - Vertical coverage
  - Scanning vs. non-scanning
  - Adaptive Targeting

Adaptive Targeting

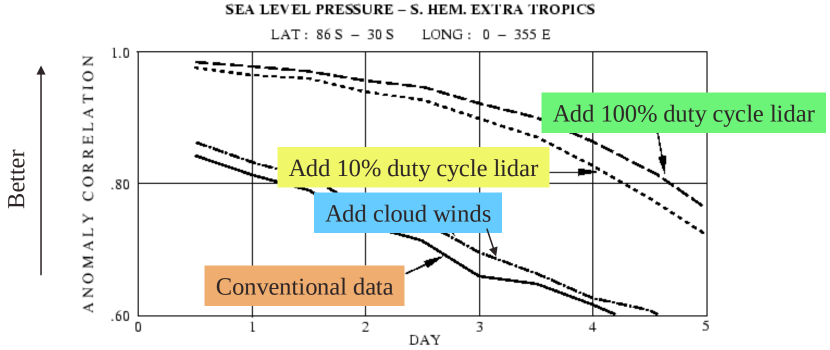


Adaptive targeting with emphasis on CONUS interests

(Blue is coherent coverage
Red is both coherent and direct)



Adaptive Targeting Experiments



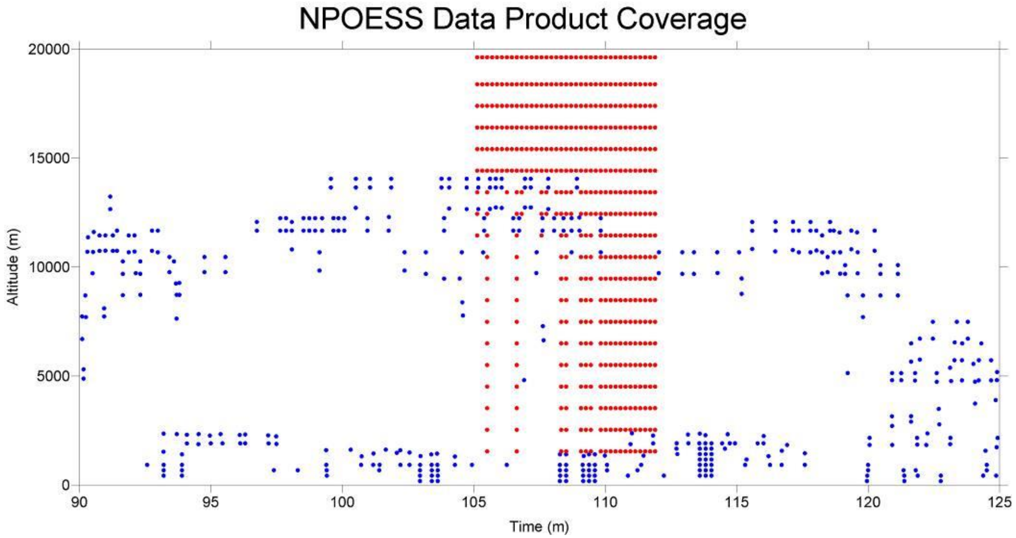
Model: GEOS-2 Recon.
Verification: ECMWF Nature Run

Control:	- Conventional Data + Perfect TOVS
CTW	- Control + Cloud Tracked Winds
1 m/s Wind	- Control + Doppler Wind Lidar (RMSE = 1 m/s)
Adaptive Targeting	- Control + Adaptive Targeting of DWL Observations (~10% duty cycle)

Example of targeting a hurricane as it approaches the Gulf coast.
(blue segments: forward looks;
Red segments: aft looks; Blue plus red
Provide full horizontal wind vector)

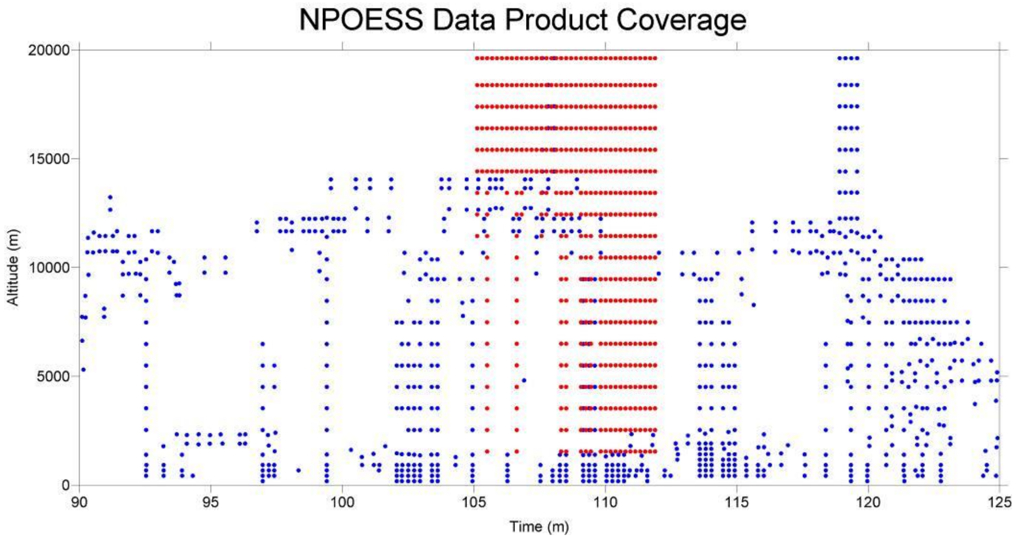
Example of vertical AT coverage

With background aerosol distribution



Red: < 4 m/s error
Blue: < 1.5 m/s error

With convectively pumped aerosol distribution



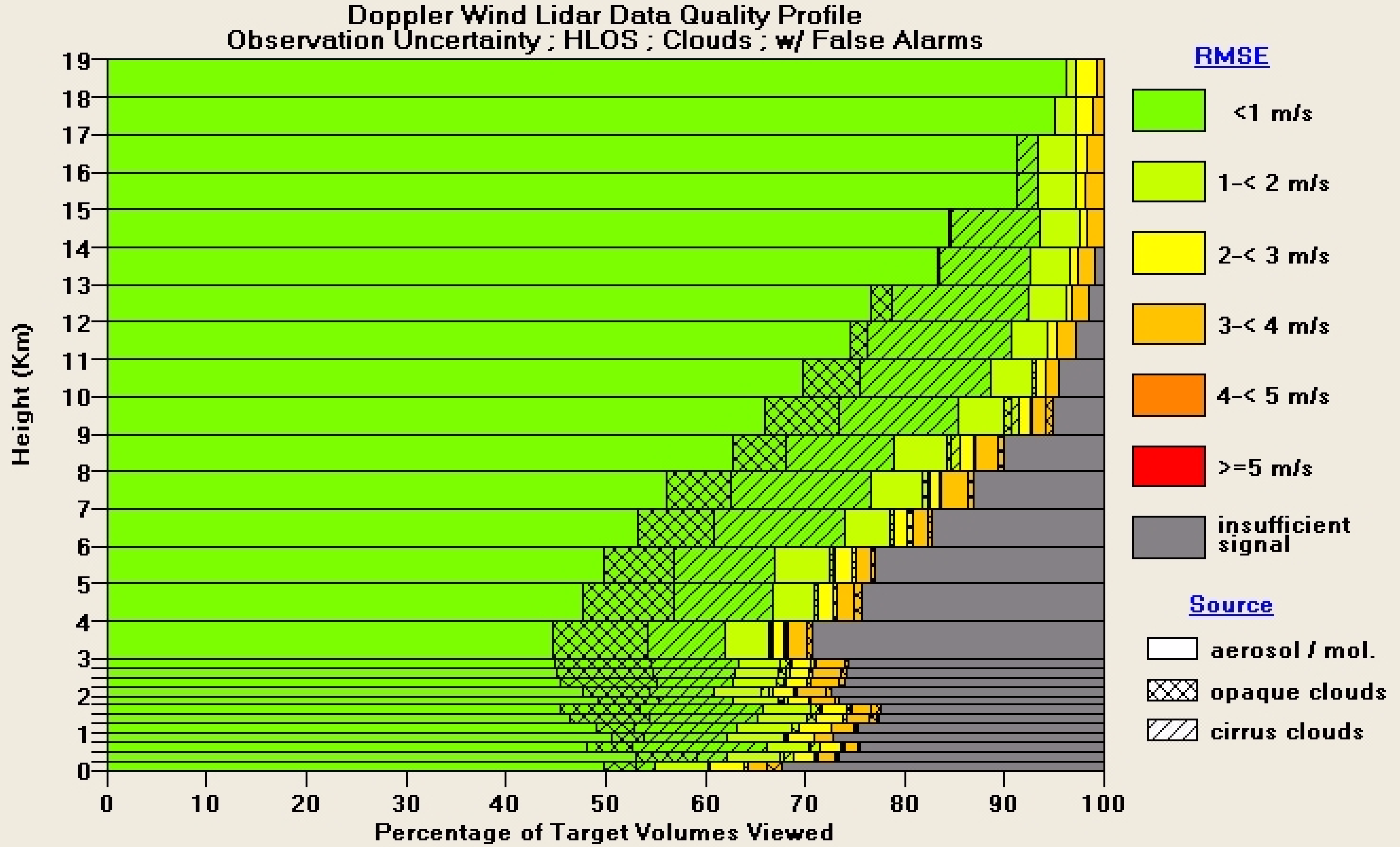
Direct Detection Subsystem

Parameter	Demo	Threshold	Objective
Energy per pulse (at 1.06 microns)	.75J	.75J	
Prf	100Hz	100Hz	
Conversion efficiency	.45	.45	
Wallplug efficeincy	.042	.042	
T/R Optical throughput (pre receiver/detector)	.36	.36	
Detector QE	.6	.6	
Beam split fraction	.4	.4	
Filter through put	.17	.17	
Edge sensitivity	.0075	.0075	
Telescope diameter	.75m	.75m	
Integration time	12s	6s	

Coherent Detection Subsystem

Parameter	Demo	Threshold	Objective
Energy per pulse	.25J	.25J	
Prf	5 Hz	10 Hz	
Wallplug efficeincy	.014	.014	
T/R Optical throughput (pre receiver/detector)	.55	.55	
Mixing efficiency	.42	.42	
Detector QE	.8	.8	
Telescope diameter	.25m	.25m	
Integration time	12s	6s	

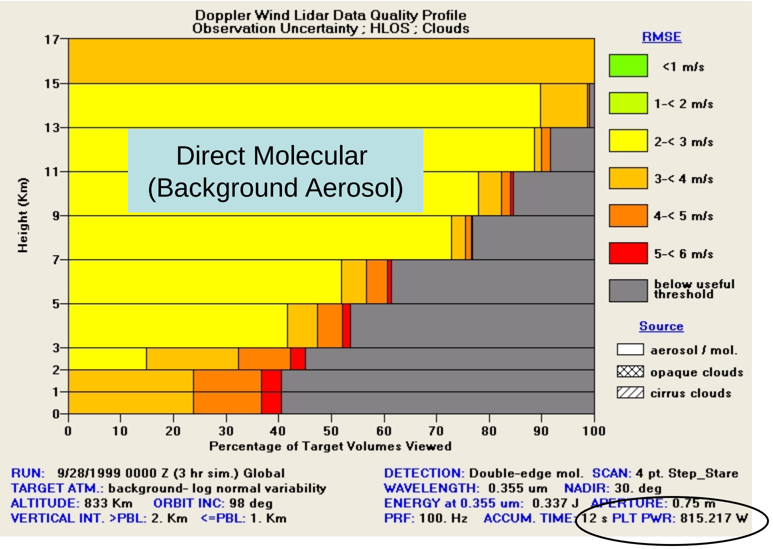
Reference Performance Profile

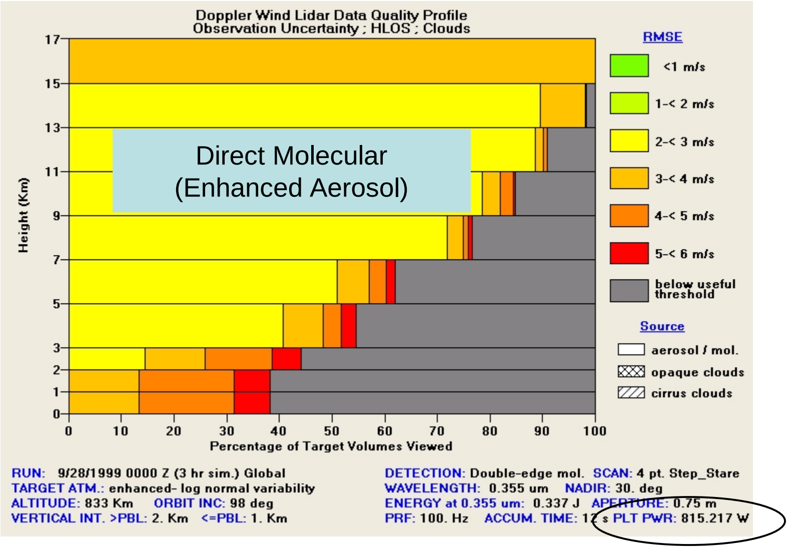


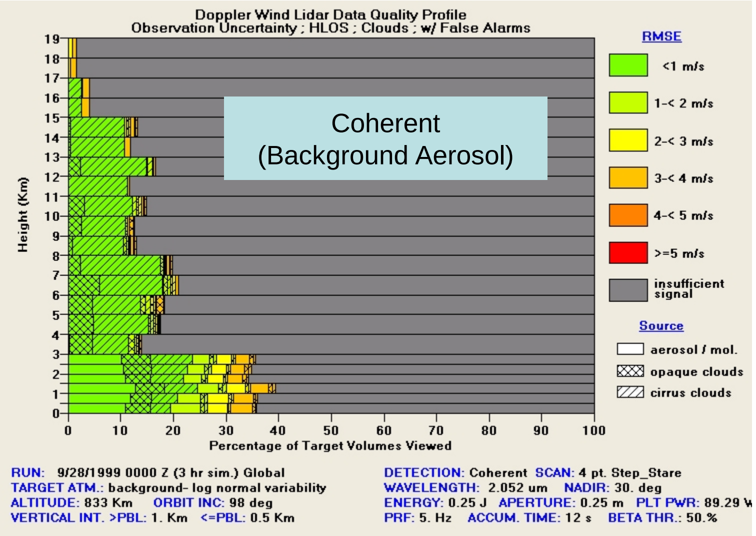
RUN: 9/28/1999 0000 Z (3 hr sim.) Global
TARGET ATM.: background- log normal variability
ALTITUDE: 400 Km ORBIT INC: 98 deg
VERTICAL INT. >PBL: 1. Km <=PBL: 0.25 Km

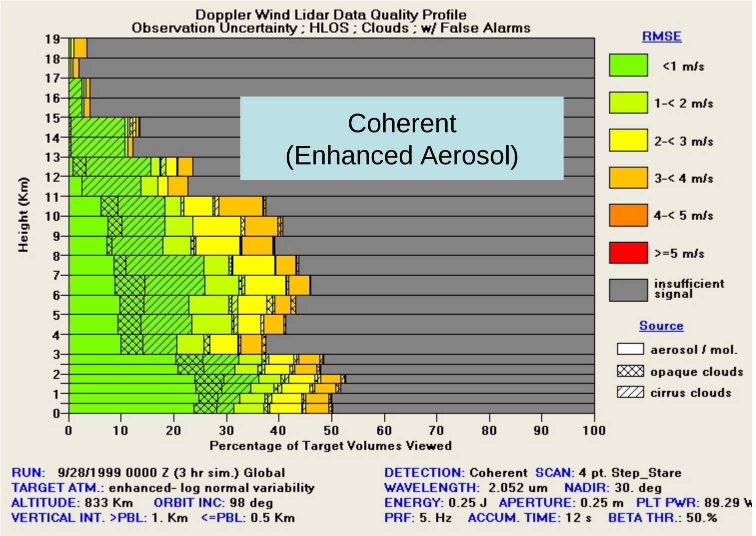
DETECTION: Coherent SCAN: 8 pt. Step_Stare
WAVELENGTH: 2.052 um NADIR: 30. deg
ENERGY: 20.0 J APERTURE: 1.0 m PLT PWR: 20000. W
PRF: 10. Hz ACCUM. TIME: 6 s BETA THR.: 50.%

833 km Demo Mission



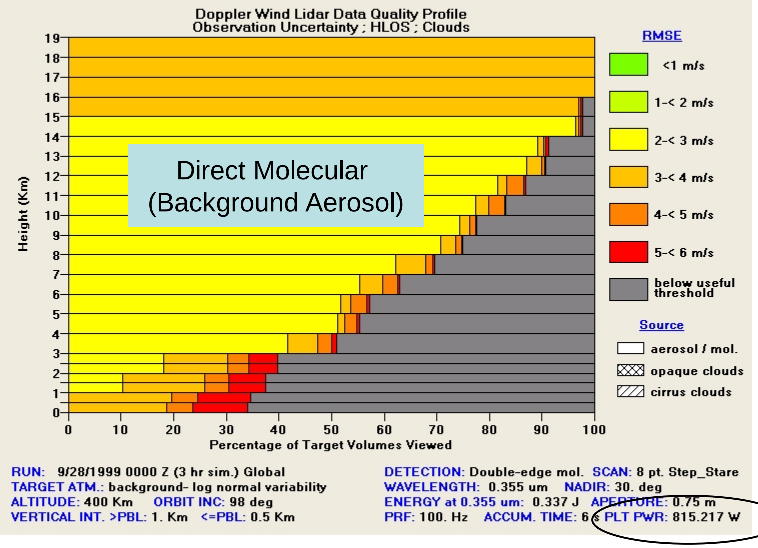


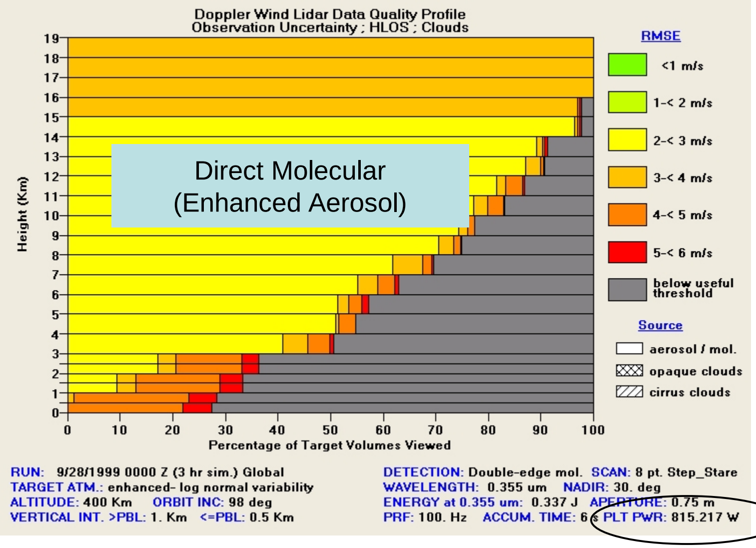


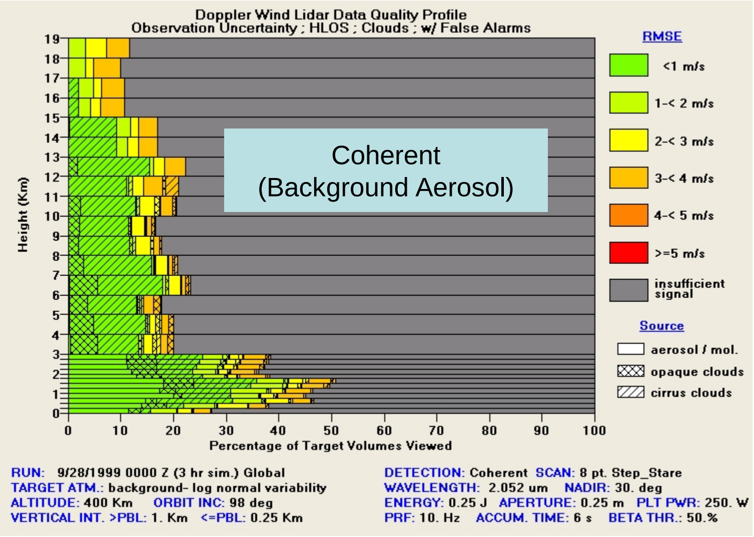


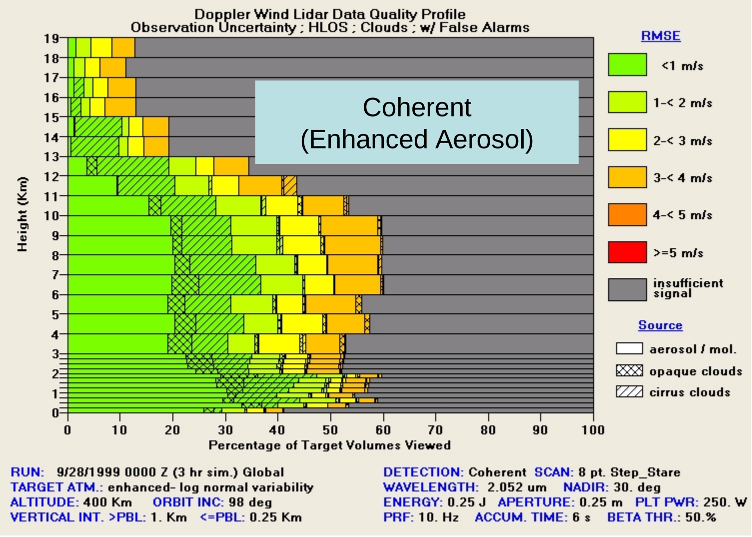
Note At a planned 10% duty cycle, the orbit average for the Direct Molecular system is estimated to be 250 watts

400 km Threshold Mission (30 degree nadir)



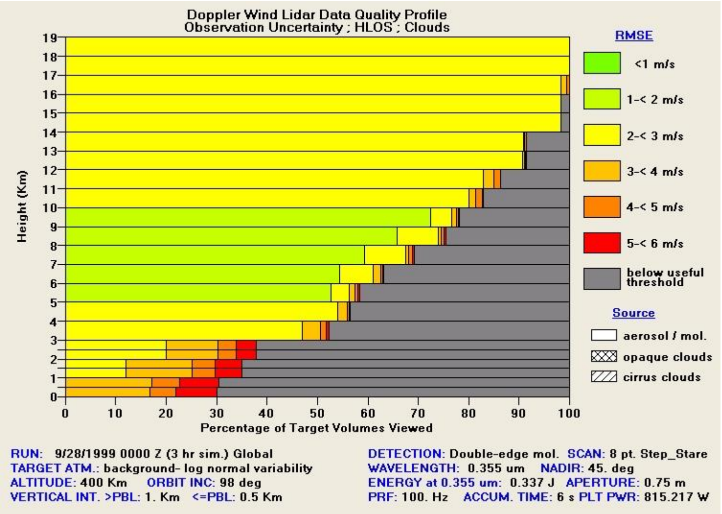


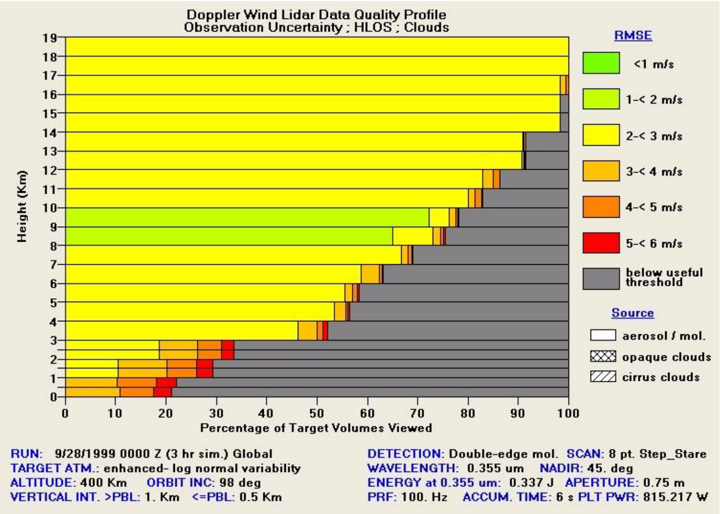


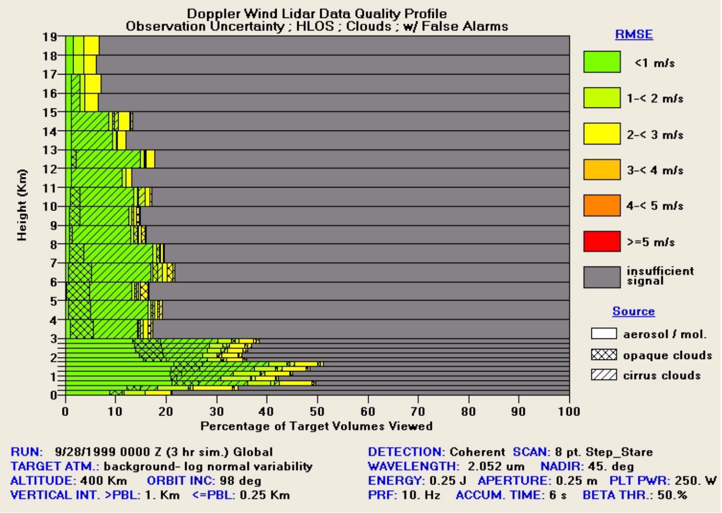


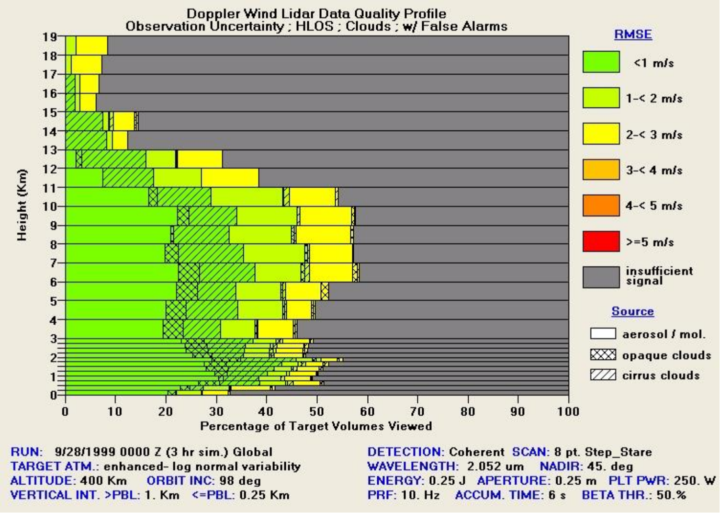
Note At a planned 10% duty cycle, the orbit average for the Direct Molecular system is estimated to be 250 watts

400 km Threshold Mission (45 degree nadir)









Space Wind Measurement Requirements - 1

	Demo	Threshold	Objective	
Vertical depth of regard (DOR)	0-20	0-20	0-30	km
Vertical resolution: Tropopause to top of DOR Top of BL to tropopause (~12 km) Surface to top of BL (~2 km)	 Not Req. 2 1	 Not Req. 1 0.5	 2 0.5 0.25	 km km km
Number of collocated LOS wind measurements for horiz[A] wind calculation	2 = pair	2 = pair	2 = pair	-
Horizontal resolution[A]	350	350	100	km
Number of horizontal[A] wind tracks[B]	2	4	12	-
Velocity error[C] Above BL In BL	3 3	3 2	2 1	m/s m/s
Minimum wind measurement success rate	50	50	50	%
Temporal resolution (N/A for single S/C)	N/A	12	6	hours
Data product latency	N/A	2.75	2.75	hours

A – Horizontal winds are not actually calculated; rather two LOS winds with appropriate angle spacing and collocation are measured for an "effective" horizontal wind measurement. The two LOS winds are reported to the user.

B – The 4 cross-track measurements do not have to occur at the same along-track coordinate; staggering is OK.

C – Error = 1σ LOS wind random error, projected to a horizontal plane; from all lidar, geometry, pointing, atmosphere, signal processing, and sampling effects. The true wind is defined as the linear average, over a 100 x 100 km box centered on the LOS wind location, of the true 3-D wind projected onto the lidar beam direction provided with the data.

= meet or exceed   = TBD

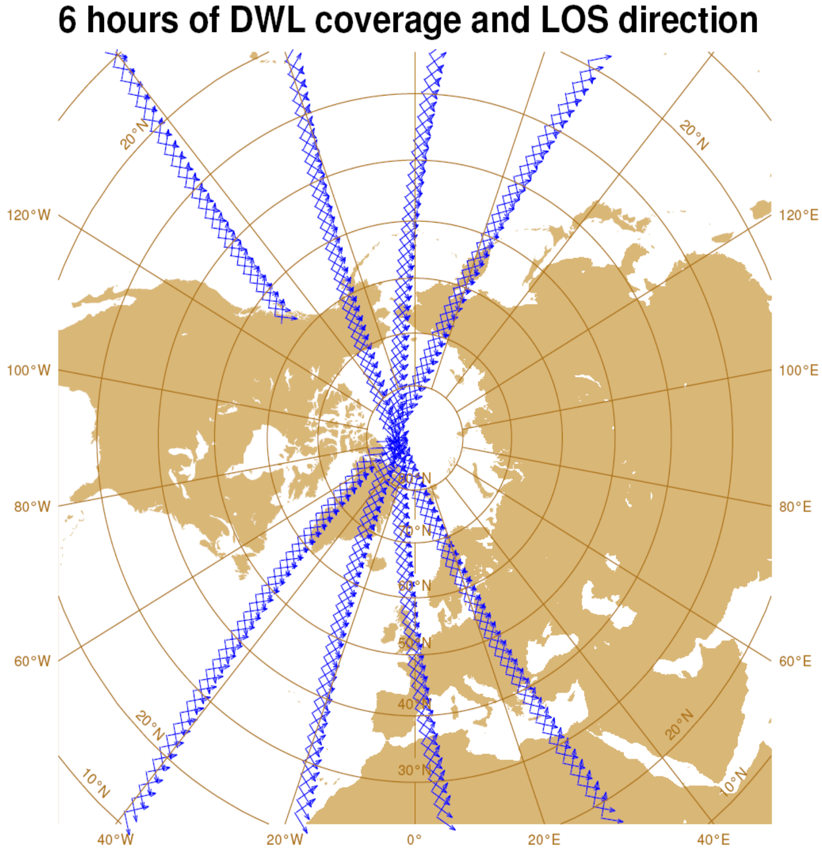
(original errata that have been corrected)

ADM Simulations

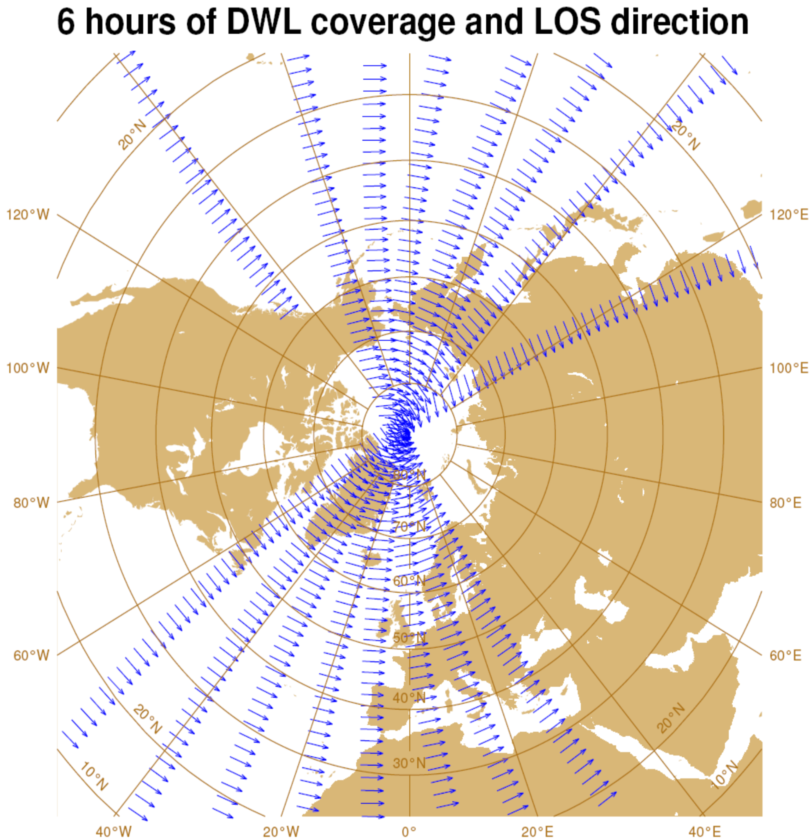
- Excellent opportunity to calibrate our simulation models (DLSM)
- Chance to validate the OSSE predictions
- Provide input to instrument and mission planning for USA mission.

ADM follow-on candidates

Dual perspective



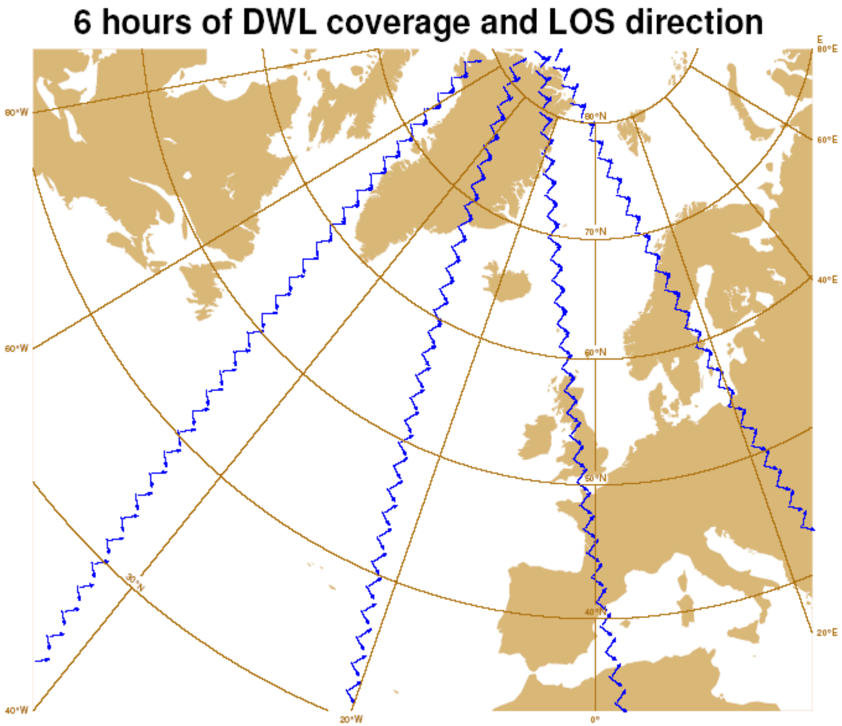
Tandem-Aeolus



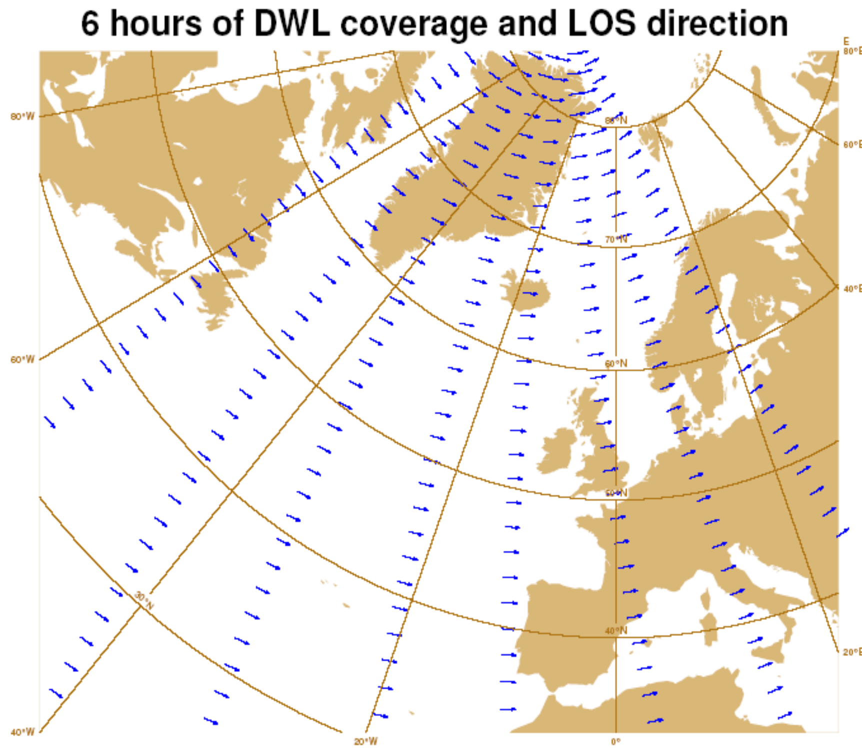
☞ information content single LOS vs. dual-perspective

ADM follow-on candidates

Dual perspective



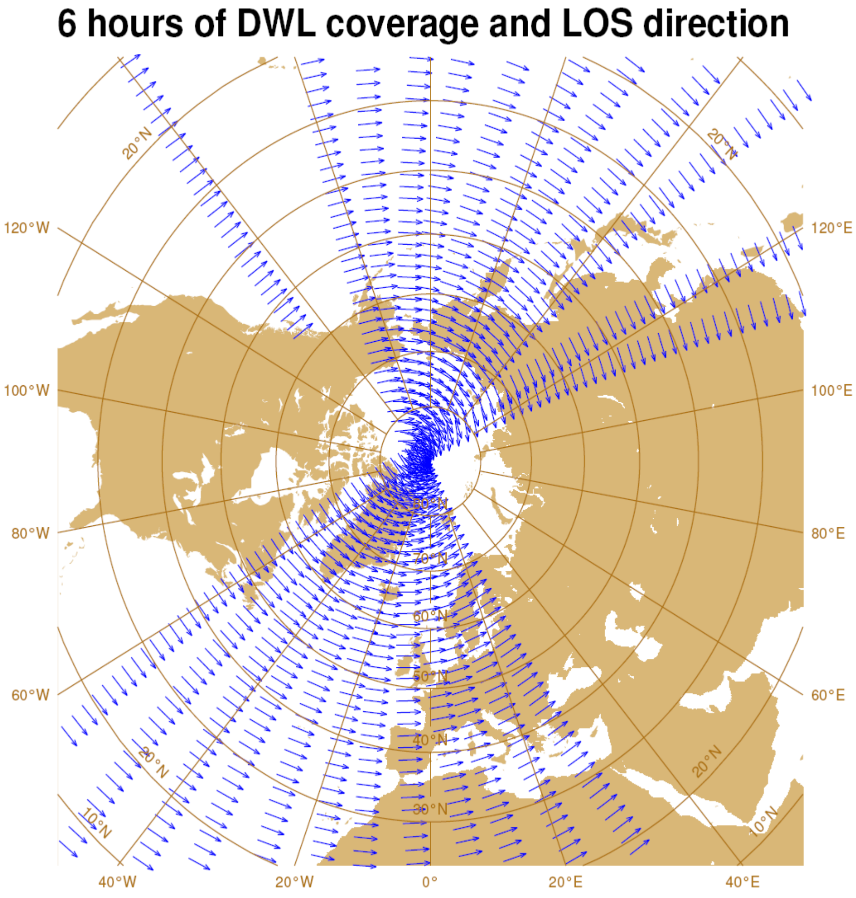
Tandem-Aeolus



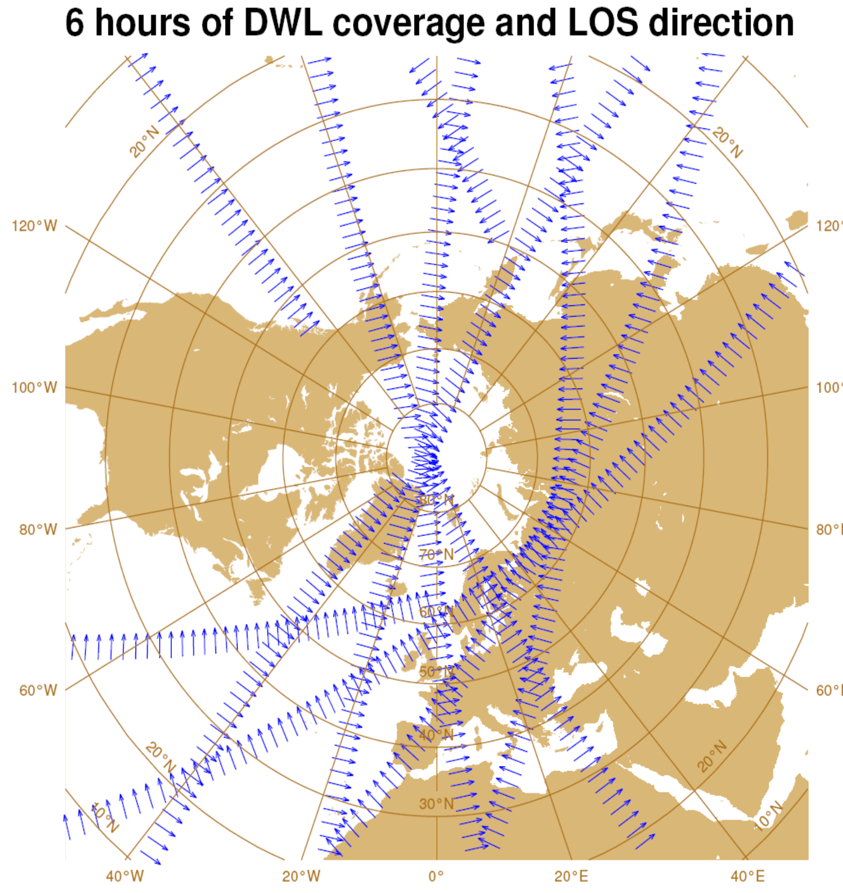
☞ information content single LOS vs. dual-perspective

ADM follow-on candidates

Triple-Aeolus



Dual-inclination ("alternative" dual-perspective)



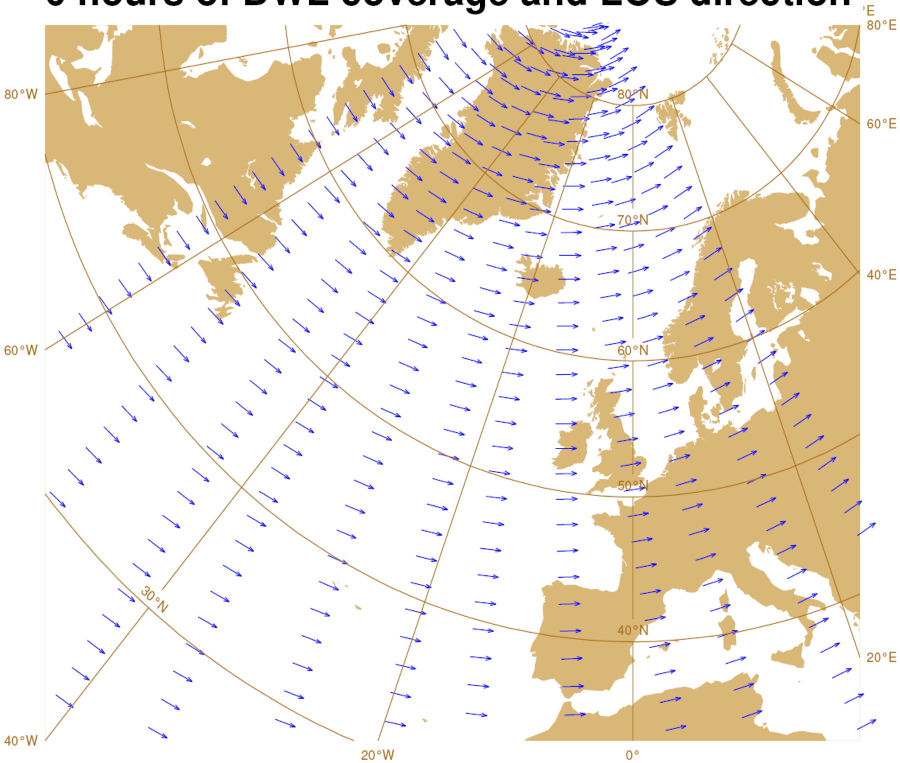
- *Storm track targeting*

ADM follow-on candidates

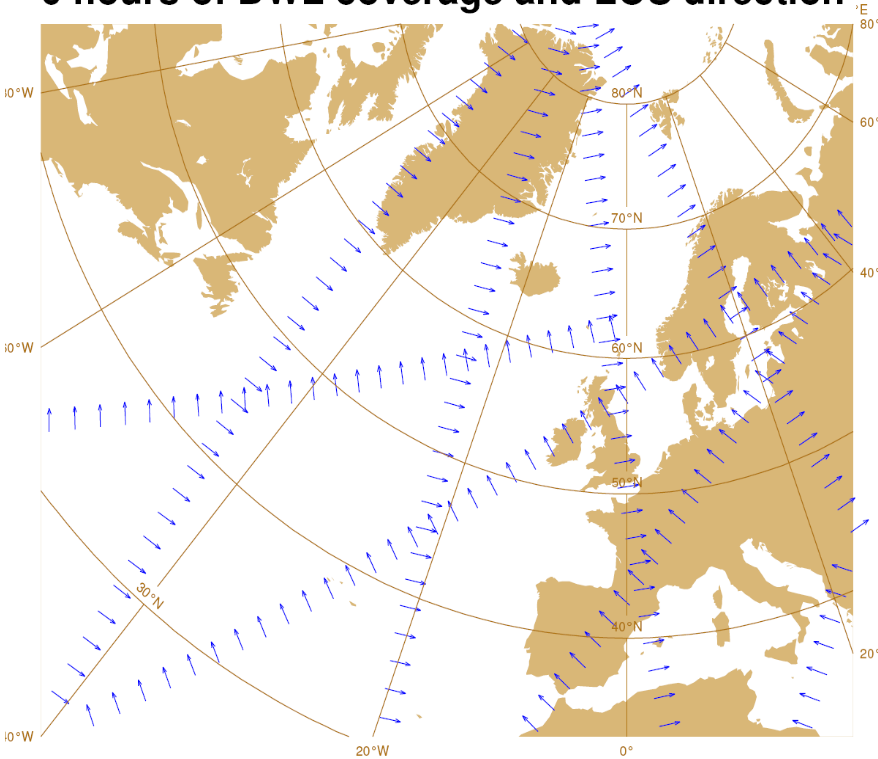
Triple-Aeolus

Dual-inclination ("alternative" dual-perspective)

6 hours of DWL coverage and LOS direction



6 hours of DWL coverage and LOS direction



➢ ***Storm track targetting***

Summary

- There is a growing recognition that OSSEs are very useful in screening nascent instrument concepts for marginal benefits
- The most costly OSSE activity is the generation of the Nature Run, the assessment of the realism of the Nature Run, the adjustment of the clouds within the Nature Run and the simulation of the conventional observing systems
- NASA and NOAA appear to be ready to establish a "core" level of support for the OSSE testbed; the OSSEs themselves can then be funded by a broad spectrum of interested groups
- The JCSDA is working to coordinate the OSSE activities and provide a point of contact for those interested in conducting OSSEs