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Research Evolution Planning (REP)
In-Flight Icing and Terminal Impacts of Winter Weather

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Fall FPAW
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FAA

The REP

- **Purpose:** Provide overarching guidance and strategic direction to facilitate the *identification, selection, prioritization, and effective management* of applied aviation weather research

- **Scope:** Foundational guidance for the AWRP and its aviation weather research partners during the planning and execution of focused, annual research projects.

- **Goal:** Connect evolving end-user, NAS Enterprise Architecture (EA), and NextGen Segment Implementation Plan requirements to a viable research strategy

  - Describe, when possible, specific deliverables, or incrementally improving line of deliverables that have line of sight connectivity to NextGen goals

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Progress To Date

- REP project kicked off Dec 2011

  - REP Template & Instructions completed **1/27/12**

- C&V REP completed **4/30/12**

- TURB REP completed **8/8/12**

- CS REP completed **12/12/12**

- IFI REP completed **3/13/13**

- Winter Wx will be complete **11/1/2013**

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Unfunded Future REPs

- 2015 Space Weather

- 2016 Weather Uncertainty

- 2017 Revisions (C&V, TURB, CS, IFI)

Strategic Planning Teams

- Strategic Planning Teams (SPT) comprised of NAS stakeholders

- Voluntary, NAS-wide SPT participation resulted in:

  - Broad-based buy-in to REP

  - Shared NAS R&D priorities

  - NAS community buy-in to current weather capability state and identification of the gaps needing to be closed for NSIP far-term

  - NAS stakeholder interests and concerns drove planning priorities and identification of critical issues

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SPT Members

NAME	ORGANIZATION	BACKGROUND	ROLE	REP PARTICIPATION
Andy Reehorst	NASA	Icing Remote Sensing	SME	IFI
Anna Merkel	BCI Contract Support - FAA (WJHTC)	Test & Evaluation	AWDE Liaison	C&V, TURB, CS, IFI
Bill Bumgarner	FAA, Terminal Weather Group	NEXRAD Pgm Support	SME	CS, IFI
Bill Watts	Delta Airlines	Pilot	SME	TURB, CS, IFI
Bob Sharman	NCAR	Meteorologist	SME	TURB
Brian Pettegrew	NWS/AWC		SME	IFI
Bruce Carmichael	UCAR (Av Wx Program Manager)	Computer Scientist / Pilot	SME	C&V, TURB, CS, IFI
Bruce Landsberg	AOPA (President AOPA Foundation)	Pilot	SME	C&V, IFI
Cammye Sims	NOAA/OCWWS (Av Wx Services Branch)	Meteorologist	SME	C&V
Chip West	MIC, Atlanta CWSU	Meteorologist	SME	TURB
Clinton Wallace	NWS/AWC	Meteorologist	SME	CS, IFI
Cyndie Abelman	NOAA/OCWWS	Meteorologist	SME	CS, IFI
Damon A. Cox	Delta Airlines	Domestic Dispatch	SME	IFI
David Bright	NWS/AWC	Meteorologist	SME	CS
David Helms	NOAA/NWS		SME	TURB
David Stensru	NOAA	Research Meteorologist	SME	CS
Dino Rovito	FAA Aviation Weather Division	Air Traffic Control / FSS	IFI Project Lead	IFI
Doug Stegman	FAA, CVG ATCT/TRACON (supervisory TM)	Terminal, TRACON issues	SME	CS, IFI
Ed Teets	NASA Dryden		SME	TURB
Eric Lugger	Landmark Aviation (Director of Safety)		SME	C&V
Ernie Dash	AvMet (FAA Support	Aviation Meteorologist	SME	TURB
Haig Iskenderian	MIT/LL	Research Meteorologist	SME	CS
Jack May	AvMet Applications, Inc.	Meteorologist	SME/REP Team Lead	C&V, TURB, CS, IFI
James C. Bedow	FAA - AJR-113 ATCSCC	National Ops Manager	SME	IFI
James Hartman	FAA Aviation Weather Division	GA Pilot / Av.	C&V Project Lead	C&V

SPT Members (cont)

	NAME	ORGANIZATION	BACKGROUND	ROLE	REP PARTICIPATION
27	James Surber	FAA Indianapolis ATCT/TRACON	TRACON Manager	SME	IFI
28	Jason Levit	NWS/OST	Meteorologist	SME	CS, IFI
29	Jay W. Clark	FAA Indianapolis ARTCC	ZID ARTCC TMO	SME	CS, IFI
30	Jennifer Mahoney	OAR/ESRL (Global Systems Division)	Research Meteorologist	SME	C&V, TURB, CS, IFI
31	Jim Riley	FAA Aviation Research Division	Acft Icing Research Lead	SME	IFI
32	John Kosak	ATM Specialist	ATM / NBAA Liaison	SME	CS, IFI
33	John McCarthy	Consultant	Meteorologist & Pilot	REP Draft Reviewer	C&V, TURB, CS, IFI
34	Judson Stailey	NOAA/OFCM USEC/FCM	Meteorologist	SME	TURB
35	Judy Ghirardelli	NWS/OST (Mesoscale Prediction Branch)	Meteorologist	SME	C&V
36	Keith Dutch	FAA En-Route and Oceanic Services	Off-shore & Oceanic	SME	IFI
37	Ken Howard	NOAA/NSSL	Meteorologist	SME	CS
38	Kevin Fryar	NWS/CR, ZAU CWSU MIC	Meteorologist	SME	CS
39	Kevin Johnston	FAA Sys Ops (Senior Meteorologist)	Meteorologist	SME	C&V, TURB, CS, IFI
40	Larry Burch	AvMet Applications, Inc.	Meteorologist & GA Pilot	SME	C&V, TURB, CS, IFI
41	Larry Larkin	ZDV Sys OPS - Denver ARTCC	Supervisory TM Specialist	SME	TURB, CS
42	Marcia Politovich	UCAR	Researcher (IFI PDT Lead)	SME	IFI
43	Mark Mutchler	FAA, ACE-100 (wx data in cockpit issues)	Meteorologist	SME	IFI
44	Mark Weadon	AvMet Applications, Inc.	Meteorologist	SME	C&V, CS, IFI
45	Matthew Tucker	FAA (NATCA Weather Rep)	Air Traffic Controller	SME	C&V, TURB, CS
46	Melissa McCaffrey	AOPA - Sr. Gov't Analyst for Air Traffic	Pilot	SME	IFI
47	Mike Eckert	NOAA Meteorologist at ATCSCC	Meteorologist	SME	CS, IFI
48	Mike Graf	NWS/OCWWS (Av Wx Services Branch)	Meteorologist	SME	C&V, TURB
49	Mike Rosemark	AvMet	Meteorologist	SME	TURB, CS, IFI
50	Pat O'Connell	SAIC (FAA Contract Support)	Flight Engineer	SME	IFI
51	Paul Armbruster	FAA ATCS (Terminal Services)	Air Traffic Control / FSS	SME	C&V, IFI

SPT Members (cont)

	NAME	ORGANIZATION	BACKGROUND	ROLE	REP PARTICIPATION
52	Paul Herzegh	UCAR	Research Meteorologist	SME	C&V
53	Paul Pellicano	FAA	Icing Regs. and Policy	SME	IFI
54	Philip D. Poyner	NOAA	Meteorologist	SME	IFI
55	Randy Baker	UPS	Aviation Meteorologist	SME	TURB, CS, IFI
56	Randy Bass	FAA	Meteorologist	SME	CS
57	Randy C. Smith	FAA ZID ARTCC	Air Traffic Manager	SME	CS
58	Rick Curtis	Southwest Airlines	Meteorologist	SME	TURB, CS, IFI
59	Rob Segers	FAA Weather Integration Manager	Program Manager	SME	CS
60	Robert Sallee	NWS/AWC (Aviation Support Branch -	Meteorologist	SME	C&V, TURB
61	Rocky Stone	United Airlines	Chief Technical Pilot	SME	TURB, CS, IFI
62	Roger Sultan	FAA Aviation Safety	Aviation Safety Inspector	SME	IFI
63	Starr McGettigan	FAA Wx Engineering & Evaluation Branch	Human Factors	ANG-C63 Team Lead	C&V, TURB, CS, IFI
64	Stephen Walden	AvMet Applications, Inc.	Meteorologist	SME	C&V, IFI
65	Steve Abelman	FAA Aviation Weather Research Team Manager	Meteorologist	SME	C&V, TURB, CS, IFI
66	Susanne Spincic	FAA Sys Ops (Flight Services Program Ops)	FSS / Pilot	SME	C&V, CS, IFI
67	Tagg A. Timm	AvMet Applications, Inc.	Meteorologist / ATC	AvMet REP Team	C&V, TURB, CS, IFI
68	Tammy Farrar	FAA Aviation Weather Division	Meteorologist	TURB Project Lead	TURB
69	Thomas MacPhail	FAA Aviation Weather Division	Meteorologist	AWD REP Team Lead	C&V, TURB, CS, IFI
70	Tim Crum	Radar Operations Center	Meteorologist	SME	CS, IFI
71	Tim Rahmes	Boeing	Meteorologist / Avionics	SME	TURB, CS
72	Tom Bond	FAA Aviation Safety (CSTA)	Environmental Icing	SME	IFI
73	Tom Fahey	Delta Airlines	Meteorologist	SME	TURB, CS, IFI
74	Tom Webster	FAA Enterprise Services	NEXRAD Pgm Lead	SME	CS, IFI
75	Warren Fellner	FAA Aviation Weather Division	Program Manager	SME	C&V, TURB, CS

Prioritization Methodology

- Initial "rack & stack" based on:
  - High Operational Impact
  - Scientific Feasibility
  - Low-hanging Fruit
  - Most Bang for the Buck
  - Final priorities set based on SPT collaborative input
  - Fit NexGen directives and structures

IFI Research Priorities

- **SLD and HIWC Nowcast**
  - Use NEXRAD dual-polarization Doppler radar to obtain structural icing intensity and super-cooled liquid droplet (SLD) content
  - Verify accuracy of IFI analyses and forecasts using dual-pol and new aircraft sensor observations
  - Investigate the improvement of freezing rain/drizzle detection by ASOS and AWOS.
  - Bring to CONUS operations the Alaska 4-D IFI analysis and forecast products.
  - Develop a NOWCAST product for High Ice Water Content (HIWC) ice crystal detection.
  - Support continued multi-phased array radar (MPAR) research

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IFI Challenges

- Accurate high resolution IFI products
- Frequently updated IFI intensity
- **Effective commutation to users, emphasizing DSTs, cockpit displays, and commercial Air Operations Center (AOC) operations**
- Developing improved HITL and HOTL forecaster value to IFI

IFI Challenges (cont'd)

- Using results from the uncertainty study conducted in Phase Two, develop the first probabilistic 4-D IFI analyses and forecasts.

- **Provide 4-D forecast information in the near term (0-2 hours) for LWC, MVD, and temperature for feeding into a DST which converts these atmospheric quantities into ice accretion rates and impact levels for specific airframe categories.**

- Develop formatters to automate production of IFI SIGMETs and AIRMETs if text is still required.

- Develop formatters to automate SIGMETs for IFI over oceanic routes from gridded IFI forecasts, if still required.

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Winter Weather (WW) Research Priorities

- Increase the capability to:
  - Have WW with high spatial and temporal resolution
  - Provide quality WW to more locations (good for GA)
  - Insert observed and short term information into DSTs (such as HOTs)
  - Airports to have access to short term accumulation forecasts
  - FSS and pilots to have access to digital WW information and be trained in their use

WW Research Priorities (Cont'd)

- Improved accuracy of WW type and intensity of precipitation detection and analysis

- Improved accuracy of WW type and intensity precipitation analysis and near term forecasts using Dual-Pol and short term forecasts

- Expansion of WW type and intensity of precipitation to more locations using automated gridded techniques such as the NWS National Digital Forecast Database

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Overarching REP Challenges

✦ Determination of best practices for expression of uncertainty in analyses and forecasts.

✦ Determining role/value of HITL and HOTL techniques in improving accuracy of automated forecasts.

✦ Use of satellite observation techniques to improve the quality of global gridded analyses and forecasts.

✦ Improving the accuracy of oceanic analyses and forecast techniques; automating inclusion of gridded information in WAFS significant weather charts consistently and deriving text SIGMETs if still required by international agreement.

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REP Lessons Learned

- 3 REPs per year is about the limit of output
  - Work went smoothly and all REPs delivered on time/budget
  - SPT volunteers were amenable to time commitment

- Capturing complex evolutionary concepts in a reasonably short document readable by non-technical users was a challenge; abundant use of appendices

- Process added to scope REP content and boundaries ahead of SPT formation and development
  - Pre-REP development report called the **NAS Impact Assessment** (NIA) summarizes operational impact
  - The NextGen Alignment Assessment (NAA) details alignment of improvements to NSIP OIs, the NAS EA, and various roadmaps

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REP Next Steps

- REPs are now being used as foundational guidance for R&D project planning; management emphasis ensures R&D project plans align to their REP

- SPT participation has become an increasingly popular mechanism for stake holder involvement and input to R&D selection/prioritization

- Additional REPs planned through 2015
  - Terminal Wind REP kicked off with SPT formation on Oct 9
  - Numerical Modeling REP scheduled to kick-off Dec 2013
  - Quality Assessment REP will begin May 2014

Final Comments

- The REP process brings a broad cross-section of the aviation community together on SPTs to help set R&D priorities...from researchers to ATM to pilots to forecasters

- Each topic holistic:
    - History, Catalogued, Big picture, Manage buy-in, manage FCST uncertainty, communicate results

- Identify challenges (elephants in the room), policy, ICAO, conversion from legacy systems

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Why I think the REP Process is an Excellent Approach to AvWX

- The historical way to gain scientifically in Aviation Meteorology is through one-shot committees, NRC reports, etc.

- REP and the AWD has found an ongoing process close to science, the user, and NextGen to allow a broad and rigorous approach that has lasting legs, not here today, gone tomorrow

- It is **NOT** *AD-HOC*, but a very orderly process that has a very promising future for the NextGen and broader AvWX community needs.

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Questions/Comments?

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