



# SFO GDP Parameters Selection Model (GPSM) *Lessons Learned*

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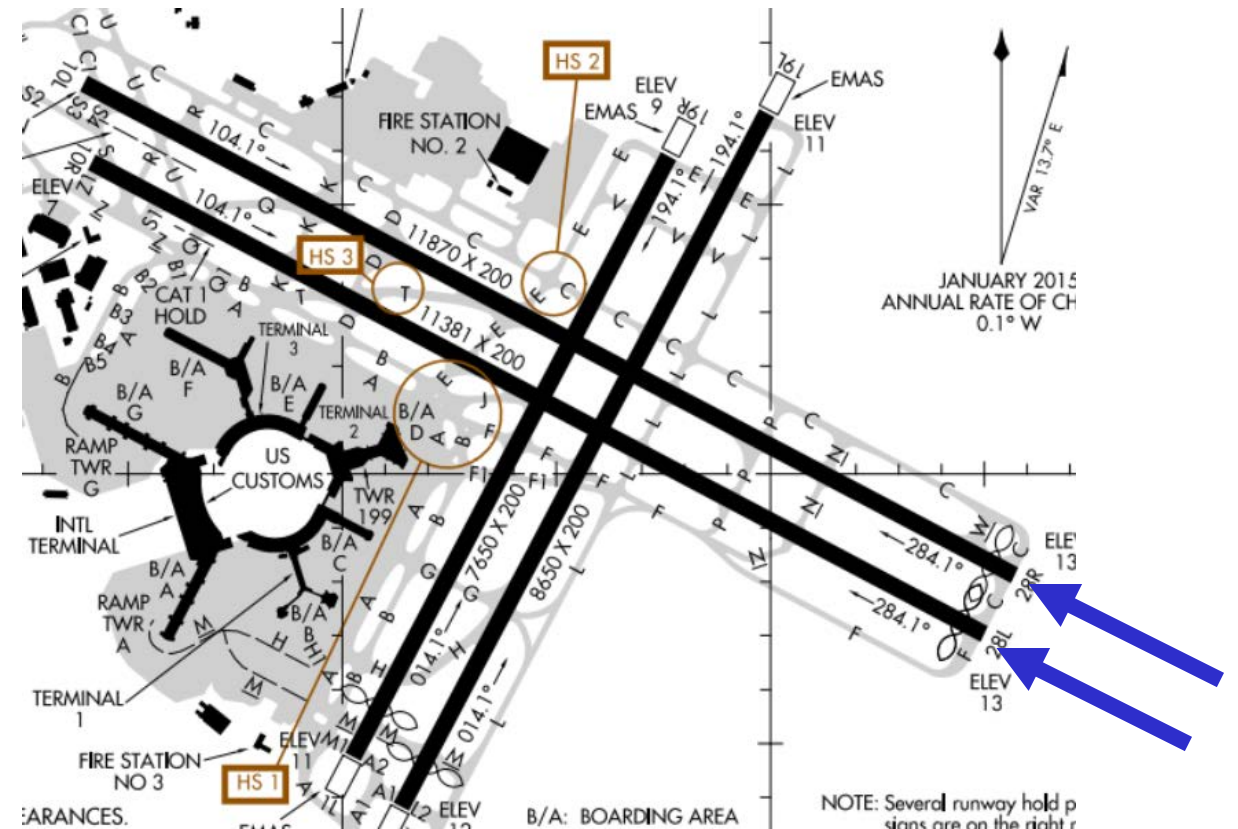
Chris Provan - Mosaic ATM  
*FPAW Summer Session*  
*August 25, 2015*



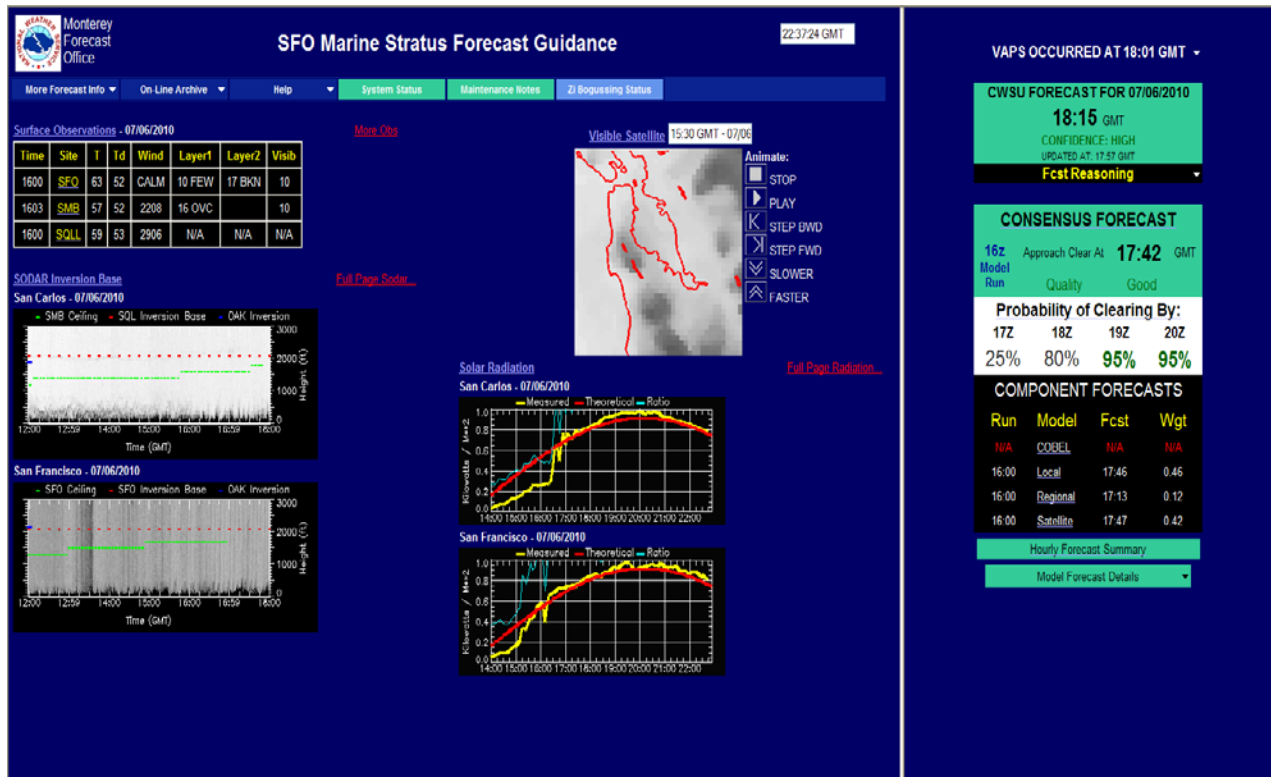
*System Solutions for Air Traffic Management*

# Stratus GDPs at SFO

- Low ceilings at SFO reduce arrival rates from 60 flights/hour to 30 flights/hour
- Marine stratus creates low ceilings on a near daily basis May-October
  - 40-60 marine stratus GDPs
  - Average ground delay of **240K minutes per year** since 2008



# SFO Stratus Forecast System



- SSFS: dedicated marine stratus forecast product
- Automated clearing time forecasts every 1-2 hours
- Meteorologist-in-the-loop oversight
- Deployed in 2004
  - Limited observed impact on GDP efficiency



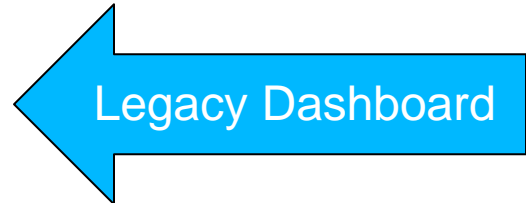
# GDP Parameter Selection Model

GPSM: High Confidence				
11Z GDP RECOMMENDATIONS				
11Z Consensus Forecast		-> Clear at 17:19 GMT		[GOOD]
Traffic Data	12:30 GMT			
	No GDP	Alt-1	Primary	Alt-2
Start Time	n/a	14:15	<b>14:15</b>	14:15
End Time	n/a	19:14	<b>19:44</b>	20:14
Scope	n/a	1000 +CZV_AP	<b>1000 +CZV_AP</b>	1000 +CZV_AP
AAR	n/a	45@n/a	<b>45@n/a</b>	45@n/a
		60@17:45	<b>60@18:15</b>	60@18:45
Risk Exceed Max Queue	***** 97%	*** 22%	** <b>11%</b>	* 8%
Benefit Delay Reduction	\$\$\$\$\$ 100%	\$\$\$ 41%	\$\$ <b>26%</b>	\$ 12%
<a href="#">Expanded statistics</a>				
<a href="#">GPSM Questions/ Feedback</a>				
<a href="#">ATCSCC Operational Support</a>				

- GPSM: decision support tool to **recommend stratus GDP parameters**
- Balances:
  - Ground delay issued
  - Risk of airborne holding and diversion
- Leverages SSFS forecasts and 15+ years of historical errors
- UI integrated into SSFS dashboard



# GDP Parameter Selection Model



**SFO Marine Stratus Forecast Guidance**

Monterey Forecast Office

Surface Observations - 06/09/2011

Time	Site	T	Td	Wind	Layer1	Layer2	Visib
1500	SFO	57	48	CALM	CLR		10
1500	SMB	55	48	2106	14 OVC		10
1500	SQLL	56	51	2101	N/A	N/A	N/A
1500	SFO	55	51	0702	N/A	N/A	N/A

SODAR Inversion Base San Carlos - 06/09/2011

SODAR Inversion Base San Francisco - 06/09/2011

Solar Radiation San Carlos - 06/09/2011

Solar Radiation San Francisco - 06/09/2011

VAPS OCCURRED AT 17:16 GMT

**CWSU FORECAST FOR 06/09/2011**  
**45-RATE 17:45 GMT**

CONFIDENCE: HIGH  
UPDATED AT: 16:43 GMT

**Fcst Reasoning**

**CONSENSUS FORECAST**

15z Approach Clear At **16:34** GMT  
Model Quality Good

**Probability of Clearing By:**

17Z	18Z	19Z	20Z
70%	95%	95%	95%

**COMPONENT FORECASTS**

Run	Model	Fcst	Wgt
15:00	COBEL	16.22	0.56
N/A	Local	N/A	N/A
15:00	Regional	16.49	0.44
N/A	Satellite	N/A	N/A

Hourly Forecast Summary  
Model Forecast Details

**GPSM: High Confidence**

**15Z GDP RECOMMENDATIONS**

15Z Consensus Forecast -> Clear at 16:34 GMT [0000]

Traffic Data 15:52 GMT

	Current	Alt-1	Primary	Alt-2
Start Time	14:15	15:52	16:52	15:52
End Time	19:44	17:44	19:14	19:44
Scope	1000 +CZV_AP	1000 +CZV_AP	1000 +CZV_AP	1000 +CZV_AP
AAR	7-8-7/8-7-8-7 /8-7-8-7 /8-7-8-7 /8-15-15-15 /15-15-15	45@16:45	45@17:15	45@17:45
Risk Exceed Max Queue	3%	13%	7%	4%
Benefit Delay Reduction	\$ 11%	\$\$\$\$ 70%	\$\$\$ 40%	\$ 11%

Expanded statistics  
GPSM Questions/Feedback  
AICSCC Operational Support

CWSU: EDIT RATE CHANGES  
**EDIT LATEST CWSU FORECAST**  
CWSU: EDIT GDP DATA  
"ZI BOGUSSING EXPIRED"

Zi Bogus Switch  
**TURN OFF ZI BOGUSSING**  
Sodar Substitution Switches



# GDP Parameter Selection Model

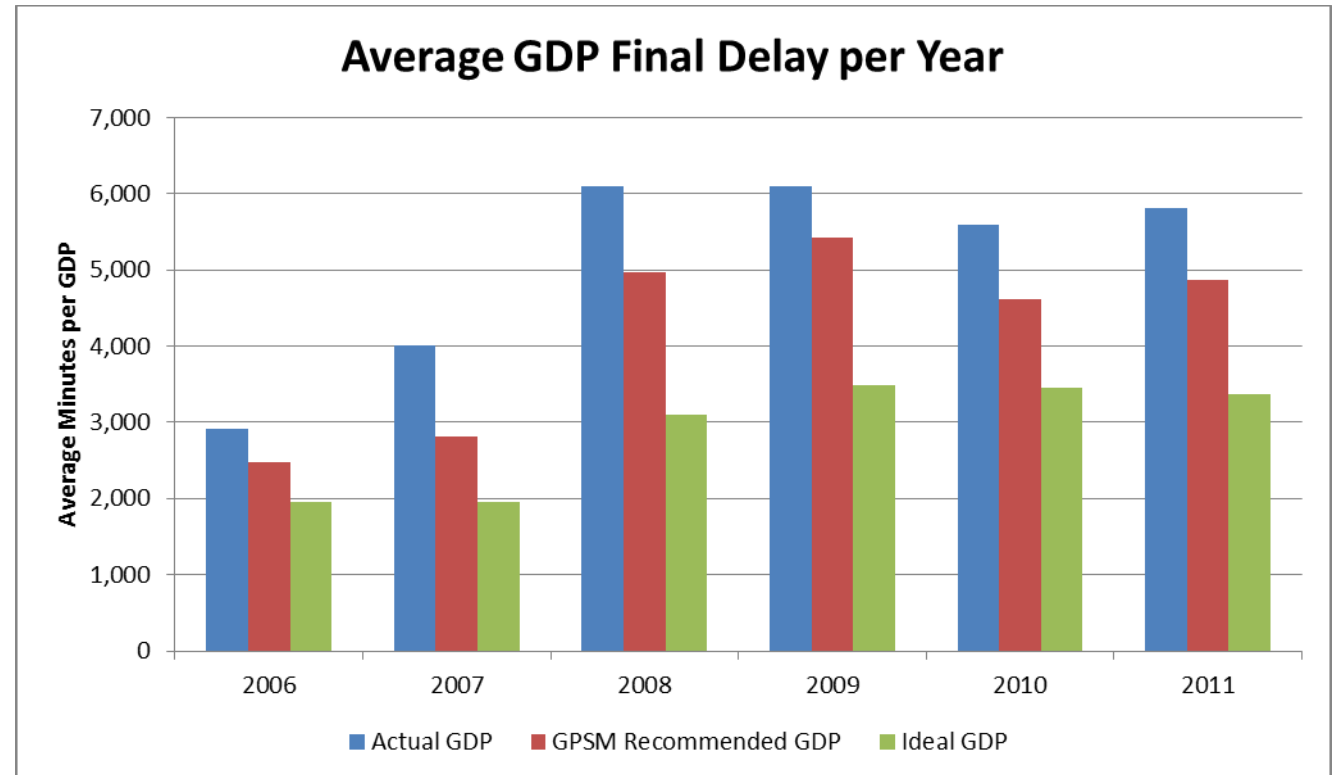
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- JPDO Weather-ATM integration plan identified 5 levels of integration:
  - Level 0 - **Stand-Alone Displays**: Weather data displayed on dedicated interfaces separate from ATM data.
  - Level 1 - **On-the-Glass Weather Integration**: Weather overlays added to ATM tools.
  - Level 2 - **Translated Weather Integration**: Weather data translated into ATM constraints.
  - Level 3 - **Impact Integration**: Weather and ATM data integrated to determine ATM impacts.
  - Level 4 - **Machine-to-Machine (M2M) Integration**: Automated recommendations for ATM decisions without the need of human interpretation or translation.
- GPSM: *first operational evaluation* of a Level 4 ATM-Wx integration tool



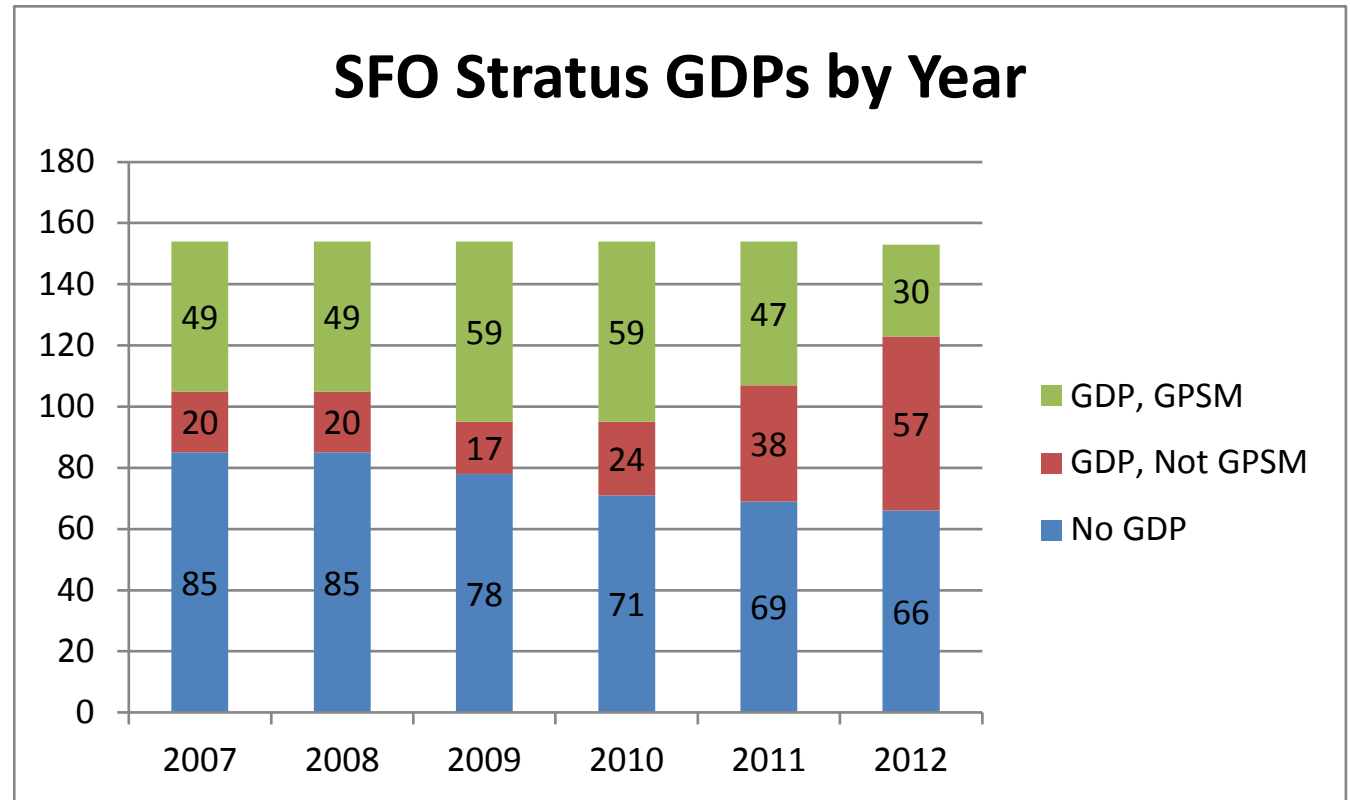
# Historical Analysis and Shadow Evaluation

- Historical data from 2006-2011 used to tune model and estimate potential benefits
  - 15-20% decrease in total delay
  - 35-45% decrease “reducible” delay
- Shadow evaluation in 2012
  - Expose users to tool
  - Develop procedures



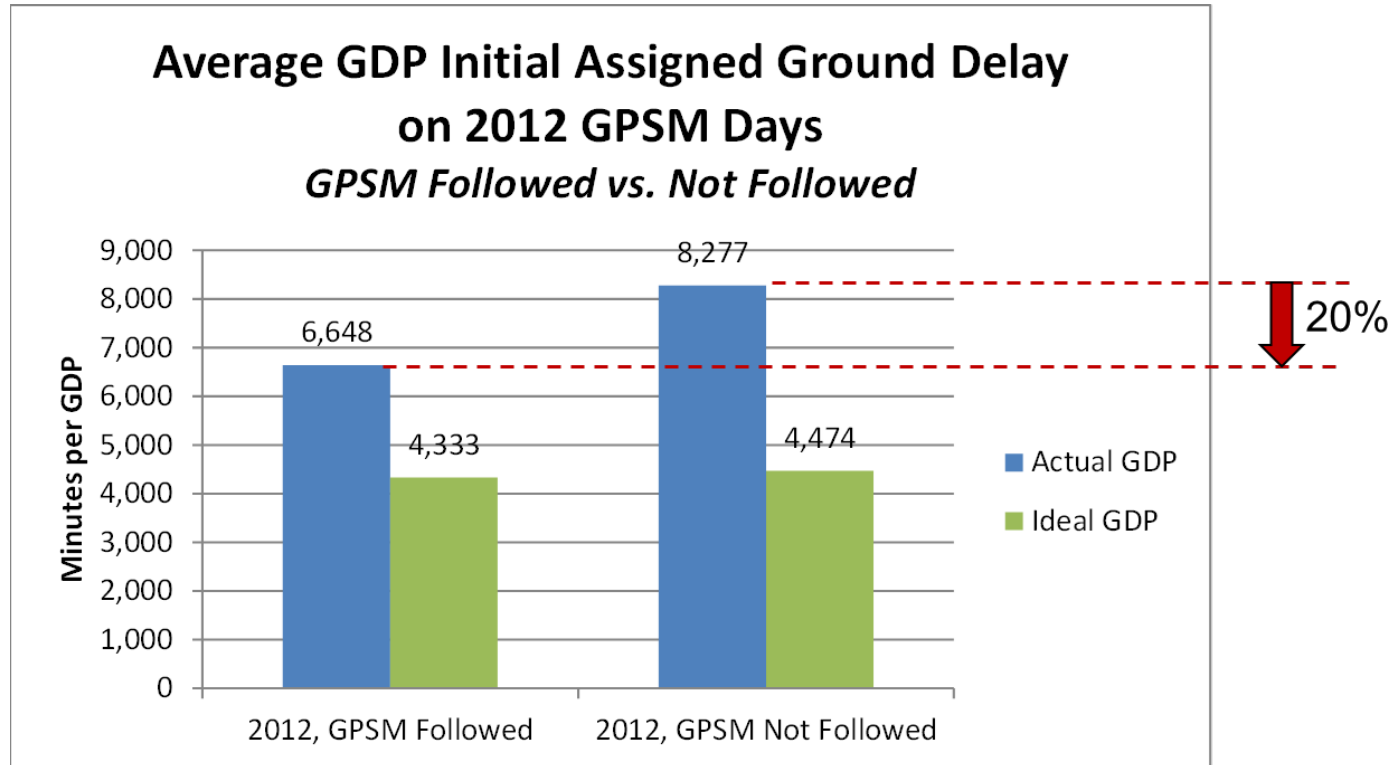
# 2012: Field Evaluation

- Operational evaluation May-October 2012
- Web-based SSFS/GPSM interface for collaboration
- Challenging weather season limited opportunities for use





# 2012: Field Evaluation



- Results validated projections
- **1,600-minute (20%) reduction** in assigned ground delay per GDP when GPSM followed
- Potential to reduce delay after revision by up to 1,500 additional minutes
- Estimated airborne holding *lower* under GPSM GDPs



# Current Status

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- GPSM awaiting consideration for CATM work package
- GDP delays **up significantly** in 2013
  - ...with caveats
- Focus has turned to procedural changes to increase arrival rates
- What can the aviation community learn from the GPSM experience?

# Lessons Learned

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- Lesson #1: Level 3 to Level 4 integration is a **big jump**
  - Requires much more trust in tool
  - Burn risk goes way up
  - Perception: “Helping me do my job” vs. “Doing my job for me”
  - Shifts roles from **tactical** to **strategic**



# Lessons Learned

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- Lesson #2: End user buy-in and collaboration are critical
  - Involve **all** stakeholders as early as possible
    - E.g., design and concept of operations
  - Leverage existing relationships to develop trust
    - E.g., CWSU to TMU
  - Agree on clear, simple (as much as possible) metrics and success criteria up front
  - Align objectives, incentives, and procedures

# Lessons Learned

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- Lesson #3: Still difficult technological challenges
  - Complexity/nuance of robust forecasts
  - Strategic TFM has unique requirements
  - Where do meteorologists enter the loop?
  - Caveats can overwhelm the message



# Questions (and Answers)



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