## The Vaisala Radar-Based Nowcasting System

Evan Ruzanski Vaisala, Inc., Louisville, Colorado January 8, 2013





## Introduction

- "Nowcasting" refers to short-term (e.g., 0–6 h) automated weather forecasting
  - Nowcasting methods make forecasts by estimating spatiotemporal changes using past observations
- Nowcasts of high-impact weather events are made so appropriate action can be taken
- Radar observations are useful for a nowcasting
  - Radars provide favorable measurement range and resolution for nowcasting
  - A variety of radar products facilitate a variety of nowcasting applications







#### **System overview**

#### "A modular approach for agile development of targeted 0–1 h applications"



#### **System overview**

 An iterative search method based on a maximum crosscorrelation criteria is presently used to estimate motion



#### **System overview**

 An upgrade to a physical model based on least squares estimation in the Fourier domain is being implemented

$$\frac{\partial}{\partial t}F(x, y, t) = -U(x, y)\frac{\partial}{\partial x}F(x, y, t) - V(x, y)\frac{\partial}{\partial y}F(x, y, t) + S(x, y, t)$$

$$k_{t}F_{\text{DFT}}(k_{x}, k_{y}, k_{t}) = -\left[\frac{1}{N_{x}N_{y}}\right]\sum_{k'_{x}=N_{x}^{-}}\sum_{k'_{y}=N_{y}^{-}}\left[\frac{U_{\text{DFT}}(k'_{x}, k'_{y})}{T_{x}/T_{t}}\right](k_{x}-k'_{x})F_{\text{DFT}}(k_{x}-k'_{x}, k_{y}-k'_{y}, k_{t})$$

$$-\left[\frac{1}{N_{x}N_{y}}\right]\sum_{k'_{x}=N_{x}^{-}}\sum_{k'_{y}=N_{y}^{-}}\left[\frac{V_{\text{DFT}}(k'_{x}, k'_{y})}{T_{y}/T_{t}}\right](k_{y}-k'_{y})F_{\text{DFT}}(k_{x}-k'_{x}, k_{y}-k'_{y}, k_{t})$$

$$-\left(\frac{i}{2\pi}\right)\left[T_{t}S_{\text{DFT}}(k_{x}, k_{y}, k_{t})\right]$$

$$\mathbf{v} = \mathbf{H}\mathbf{x}$$

#### Nowcasting using Vaisala C-band radar data



http://www.vaisala.com/keravaradar/

- C-band (5.7 GHz)
- 250 kW peak power
- Dual-polarization
- 15-min resolution (rainfall intensity)



# Application: Enhanced temporal resolution via interpolation using nowcasting



Animation of interpolation to 1-min resolution between 04 Sep 08 0345 and 0400 UTC

- Provides real-time deicing decision support for airport operations
  - Currently operational at Denver and Minneapolis-St. Paul International Airports







Page 9 / Jan 2013 / ©Vaisala



AviCast® live display at Denver International Airport during 19 Dec snow event

VAISALA

Page 10 / Jan 2013 / ©Vaisala



AviCast® live display at Denver International Airport during 19 Dec snow event

VAISALA

Page 11 / Jan 2013 / ©Vaisala



AviCast® live display at Denver International Airport during 19 Dec snow event

VAISALA

Page 12 / Jan 2013 / ©Vaisala



AviCast® live display at Denver International Airport during 19 Dec snow event

VAISALA

Page 13 / Jan 2013 / ©Vaisala



AviCast® live display at Denver International Airport during 19 Dec snow event

VAISALA

Page 14 / Jan 2013 / ©Vaisala



AviCast® live display at Denver International Airport during 19 Dec snow event

VAISALA

Page 15 / Jan 2013 / ©Vaisala

#### **Other potential applications...**



Nowcasting precipitation type using Vaisala HydroClass®

Lightning nowcasting (Vaisala NLDN® and GLD360®)





Road weather icing nowcasting

Wind turbine icing \_\_\_\_\_\_ nowcasting



VAISALA

Page 16 / Jan 2013 / ©Vaisala







VAISALA

#### **Questions?**

#### evan.ruzanski@vaisala.com

Page 17 / Jan 2013 / ©Vaisala