NOAA RESEARCH • ESRL • PHYSICAL SCIENCES DIVISION

Theme 4: Research to Applications, Operations and Services

Serving NOAA - Overview

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Science Review
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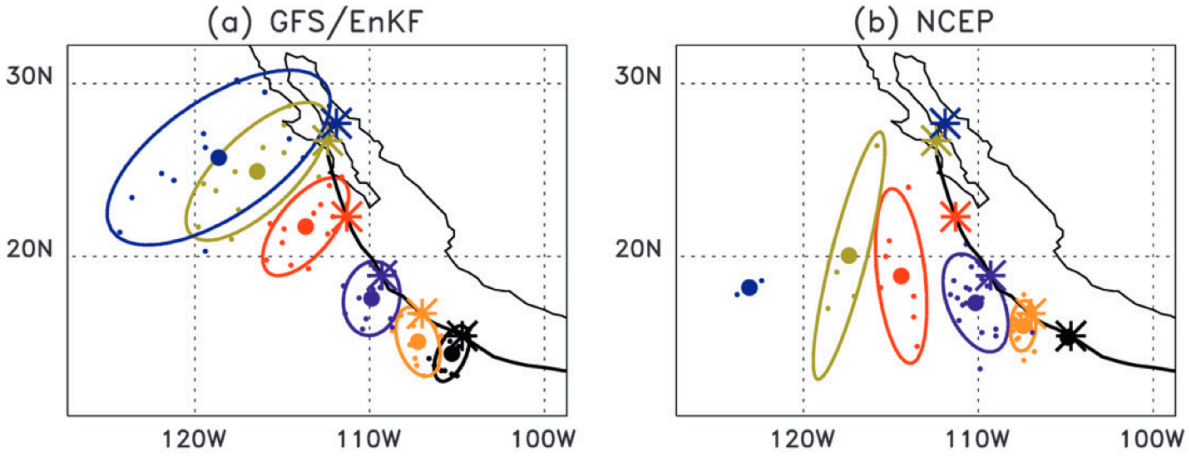
Research to applications, operations and services

- Here we'll focus most on R2O of uncertainty products, but of course other R2X as in previous talks.
- Build upon advances in observing and understanding from PSD, other labs, and academic.
- Test improved numerical methods in simplified and eventually operational contexts.
- Validate performance against baseline methods used operationally.
- Work with partners in NWS to operationally implement these methods.

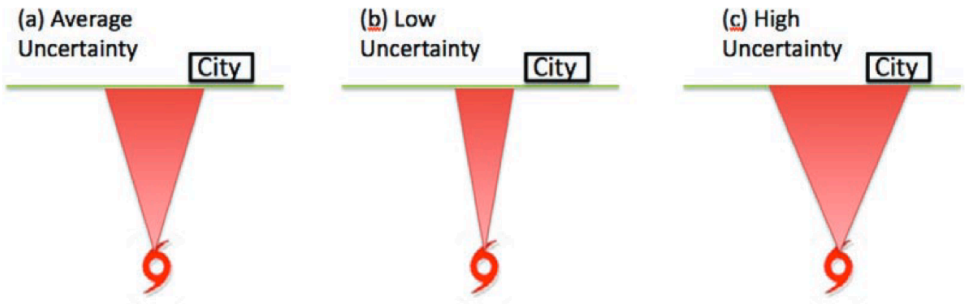


Hurricane Jimena, initialized at 00 UTC 30 Aug 2009. From Hurricane Forecast Improvement Project experimental demonstration of global ensemble Kalman filter. The improved quantification of uncertainty relative to operational GEFS (right) was typical for this season.

Dots are ensemble members and * is observed location.

Ref: Hamill et al., *Mon. Wea. Rev.*, **139**, 668-688.

Strategic context:
uncertainty forecasting



- *"Reduced loss of life, property, and disruption from high-impact events; compare weather risk to user-defined risk tolerance … for high-impact events"* [NOAA Strategic Plan, Weather-Ready Nation]
  - Improved predictive guidance.
  - Improved decision support tools.
  - Establish quantified uncertainties for NOAA's predictions and projections.
  - Advance data integration and assimilation into Earth system modeling.
- Some of the OAR science questions addressed:
  - "*How can we improve forecasts, warnings, and decision support for high-impact weather events*?"
  - "*How can we improve the way scientific information and its uncertainty are communicated*?"
- PSD strategic goal addressed
  - "*Develop new process understanding, observational and modeling capabilities to predict conditions associated with too much or too little water for improved early warnings and to inform preparedness and resource management decisions*."

Ref: Hamill et al., *Bull Amer. Meteor. Soc.*, **93**, 209-220.

Overcoming NOAA R2X misperceptions

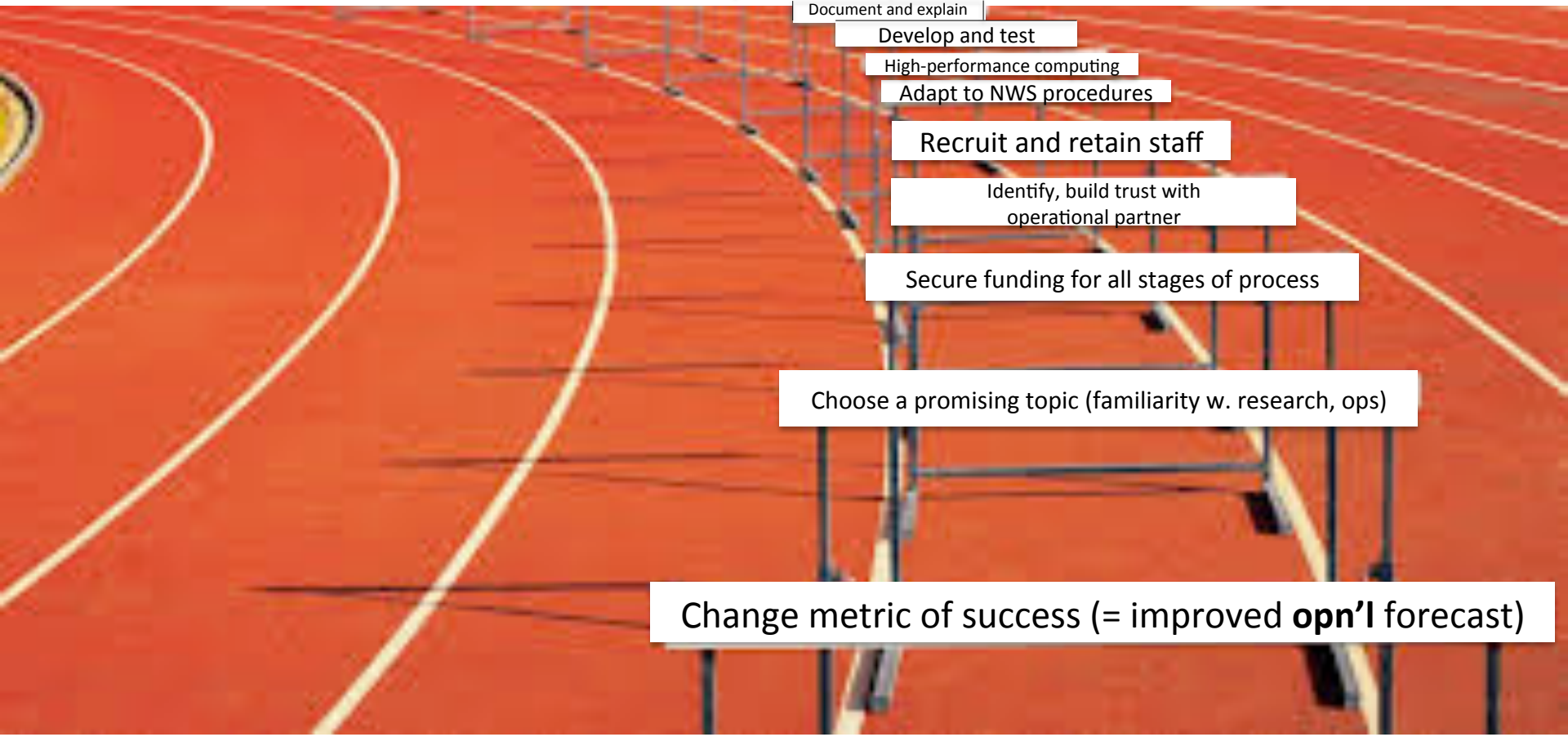
NWS, of OAR ?

OAR, of NWS ?

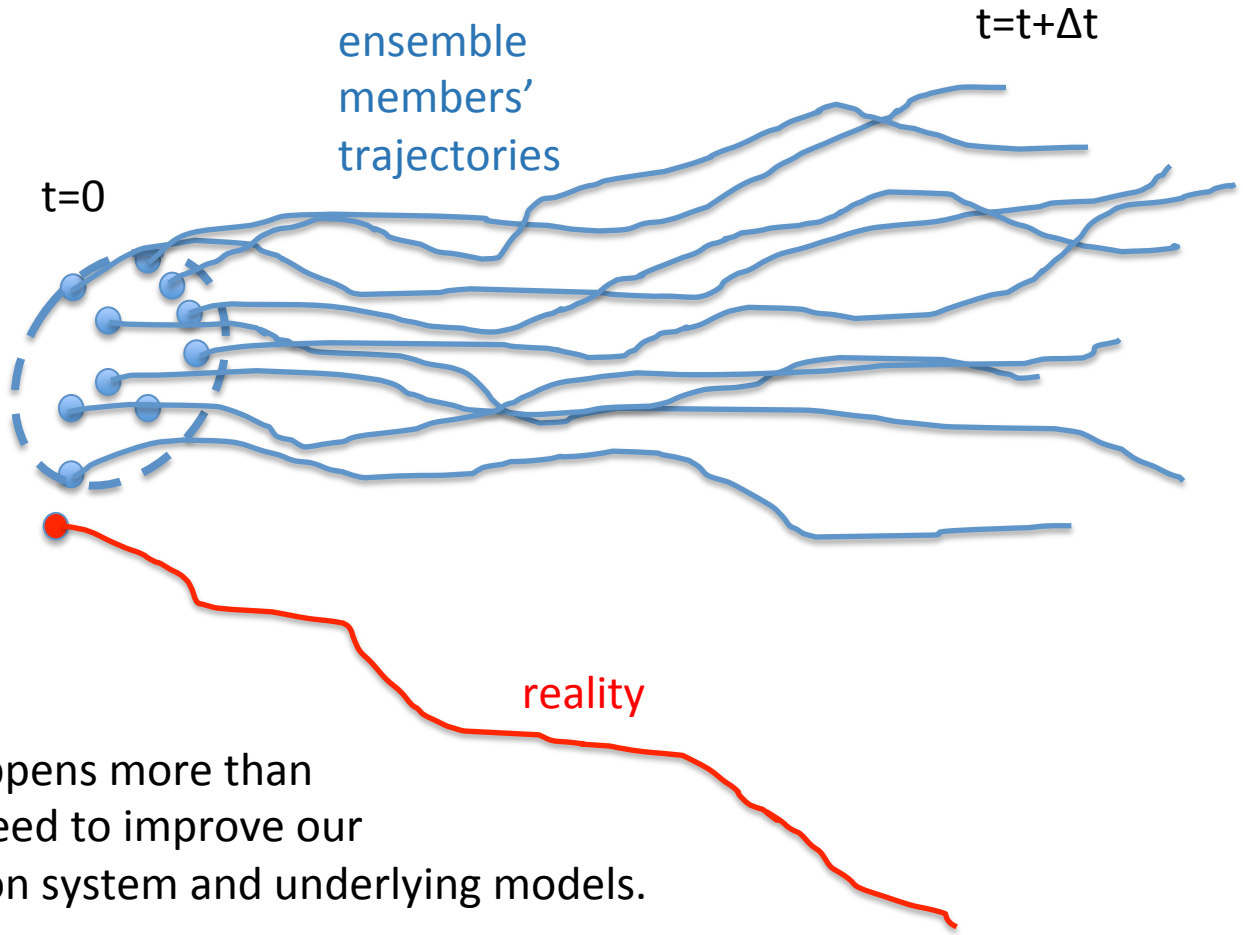
for more of Ben Hur, see:
http://www.amazon.com/Ben-Hur-50th-Anniversary-Various/dp/B0057UA4BI/ref=sr_1_2?ie=UTF8&qid=1429893341&sr=8-2&keywords=dvd+ben+hur

Collaboration IS possible.

Hurdles to reach the goal of effective transition



PSD's R2X support for the quantification of uncertainty

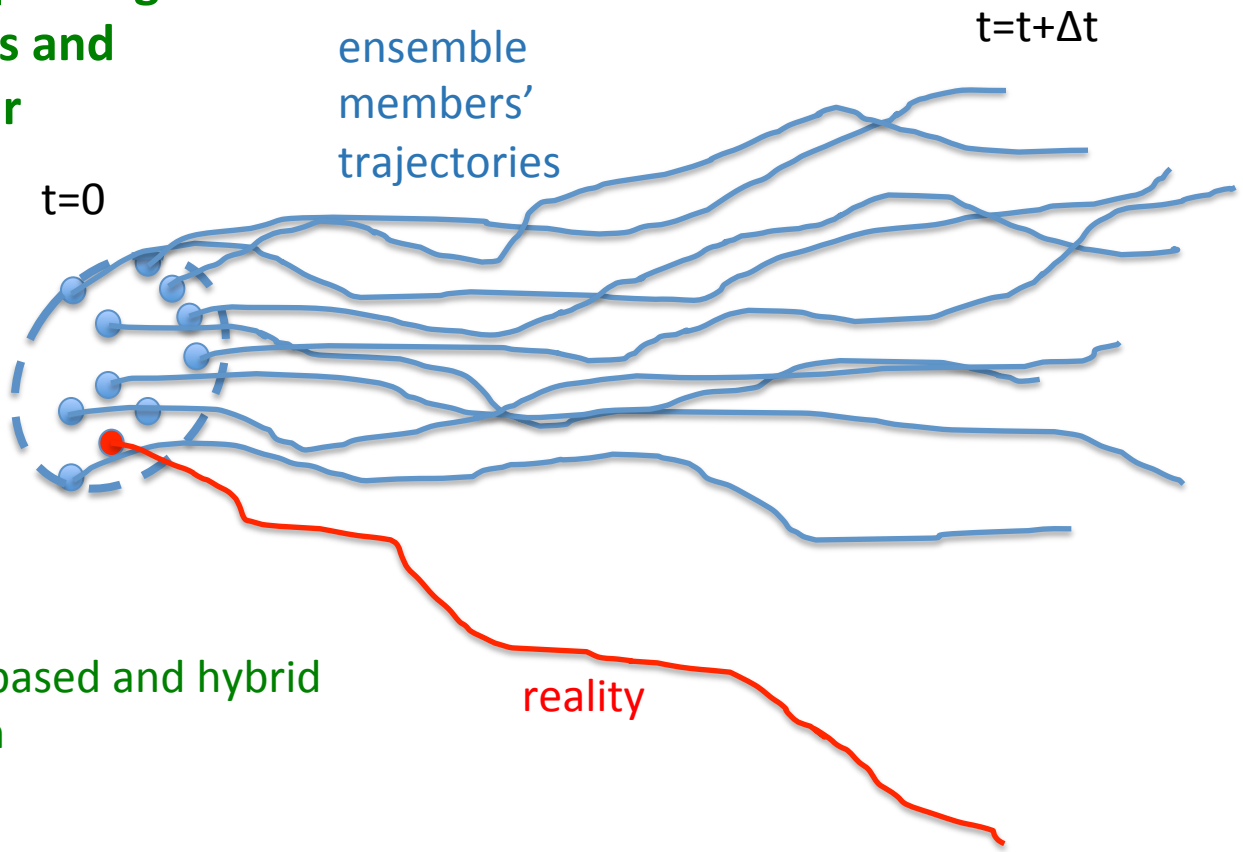


If this situation happens more than infrequently, we need to improve our ensemble prediction system and underlying models.

Overview of ensemble prediction system issues and solutions: see upcoming World Meteorological Organization book chapter: http://www.esrl.noaa.gov/psd/people/tom.hamill/Chap_12_Stocastic_Hamill_Swinbank_v13.docx

PSD's R2X support for the quantification of uncertainty

Challenge 1: Improving initial conditions and quantifying their uncertainty

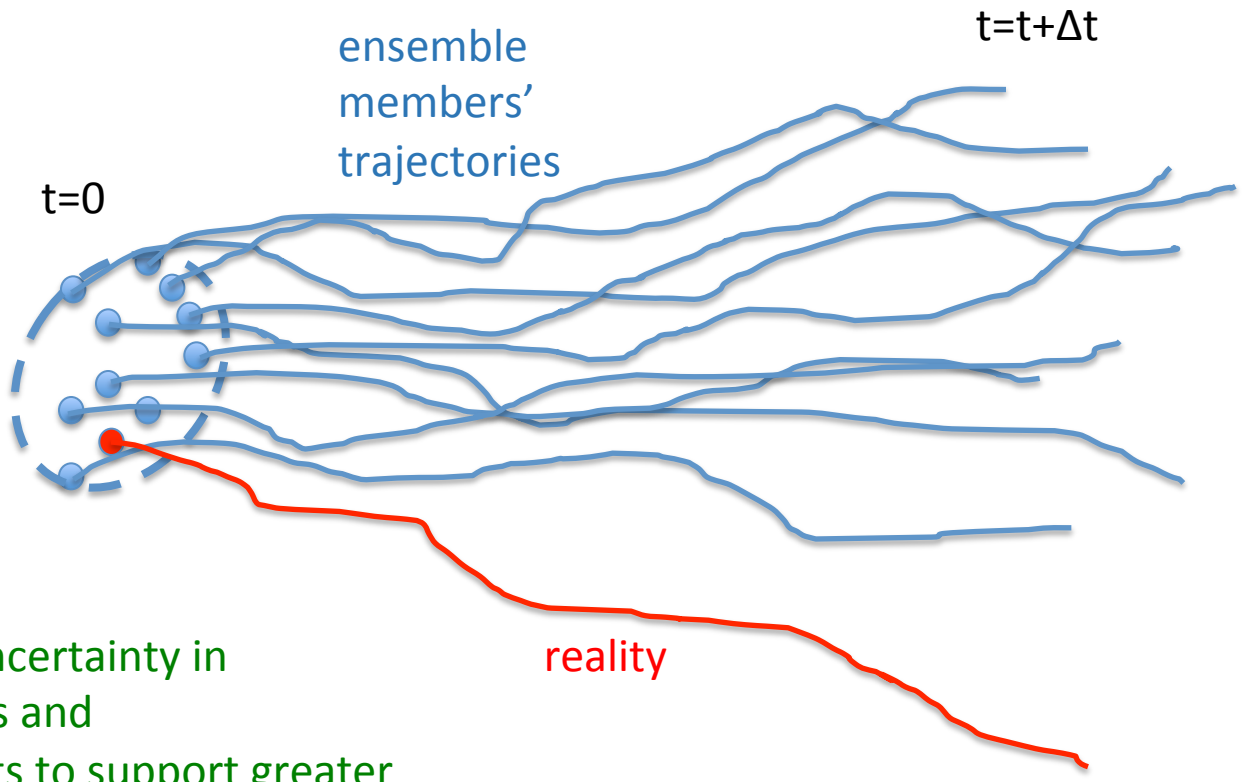


R2O: Ensemble-based and hybrid data assimilation (Jeff Whitaker)

Overview at Hamill, T. M., 2006: Ensemble-based atmospheric data assimilation
Chapter 6 of *Predictability of Weather and Climate*, Cambridge Press, 124-156.

PSD's R2X support for the quantification of uncertainty

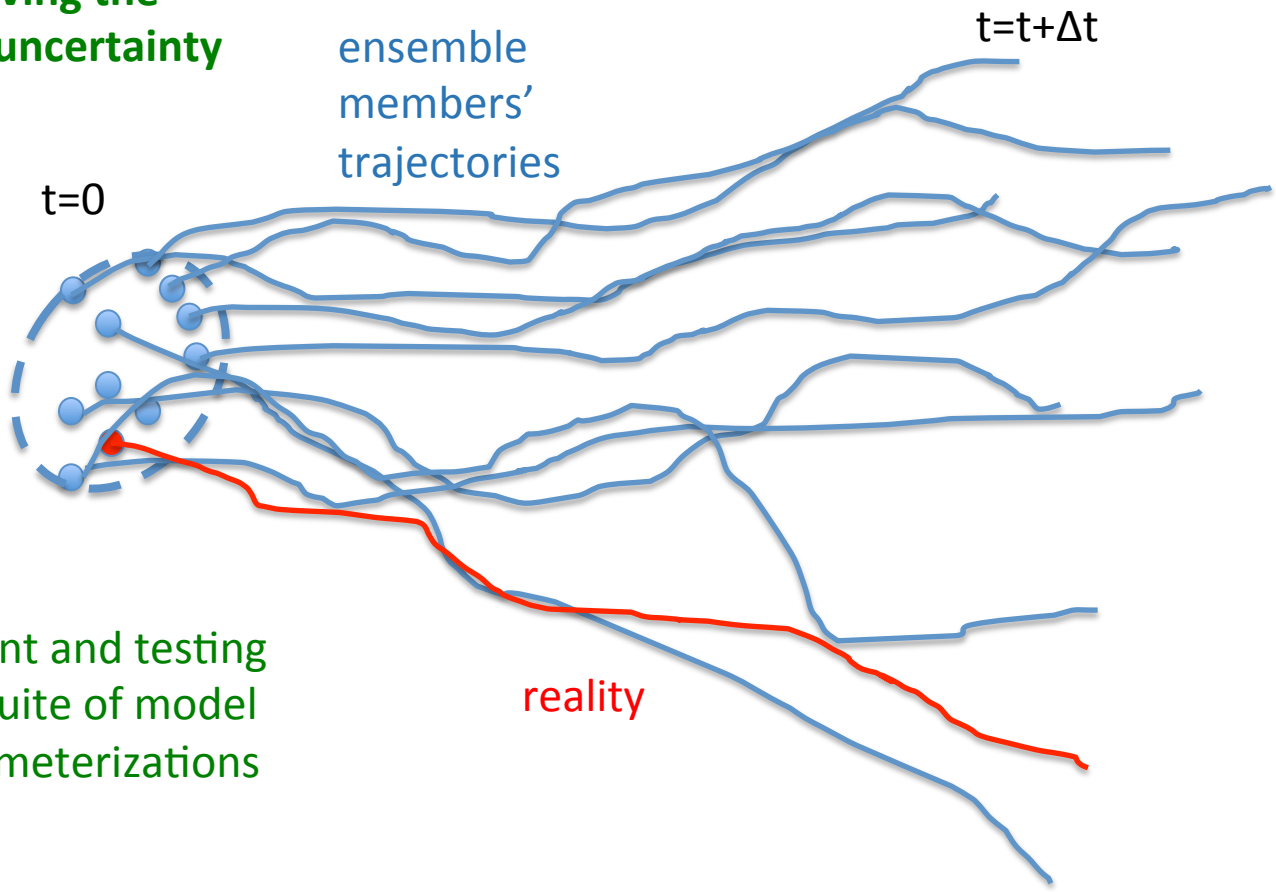
Problem 2: Biased forecast models



R2A: Reducing uncertainty in parameterizations and providing data sets to support greater understanding of the underlying physical processes (Chris Fairall)

PSD's R2X support for the quantification of uncertainty

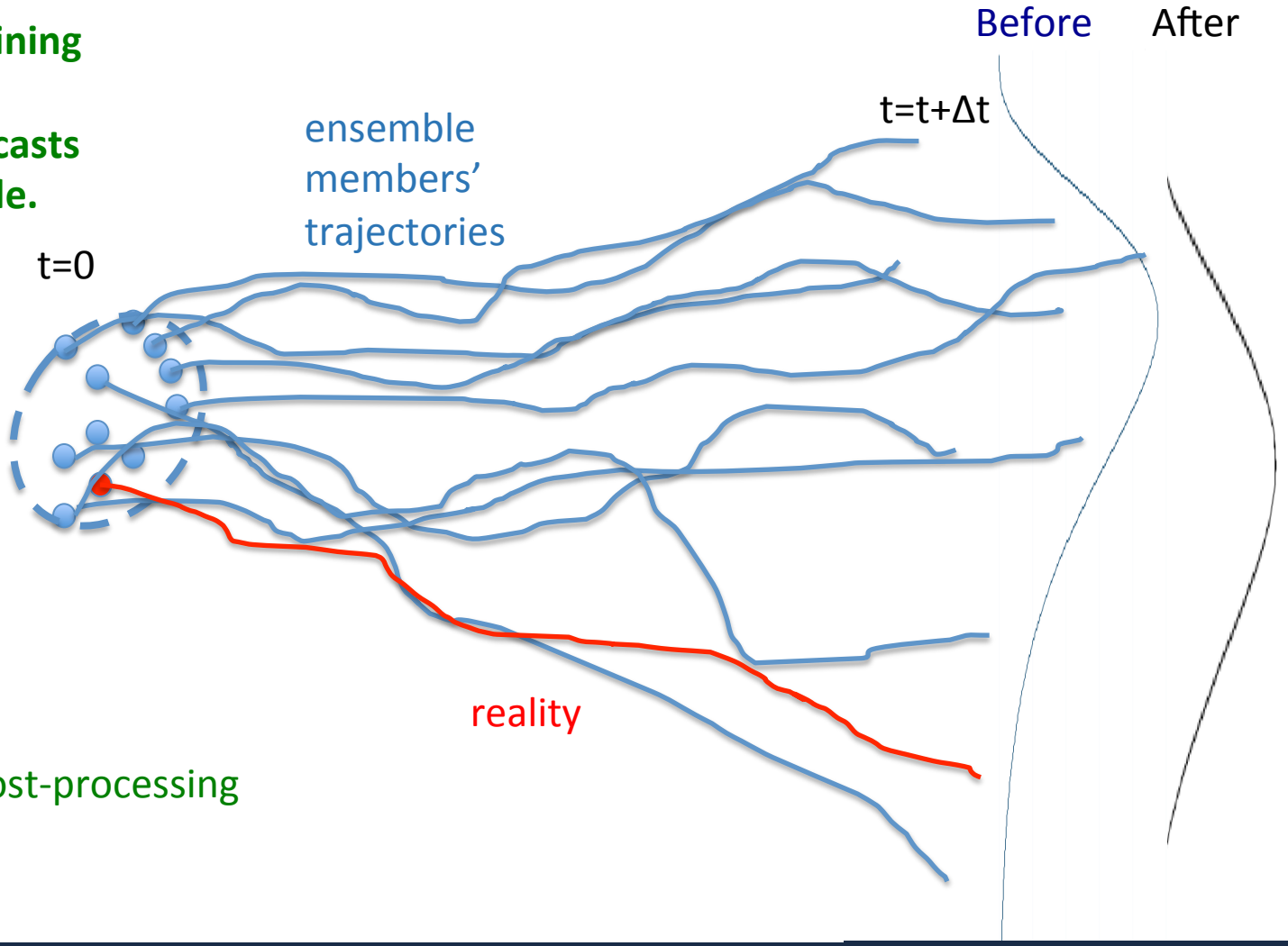
Problem 3: Improving the quantification of uncertainty due to model errors



R2O: Development and testing of an improved suite of model uncertainty parameterizations (Phil Pegion)

PSD's R2X support for the quantification of uncertainty

Problem 4: Remaining unreliability of probabilistic forecasts from the ensemble.



R2O: Statistical post-processing (Tom Hamill)

Future of post-processing: see http://www.esrl.noaa.gov/psd/people/tom.hamill/Glahn-symposium-Hamill-invited-futureofpostproc.pptx