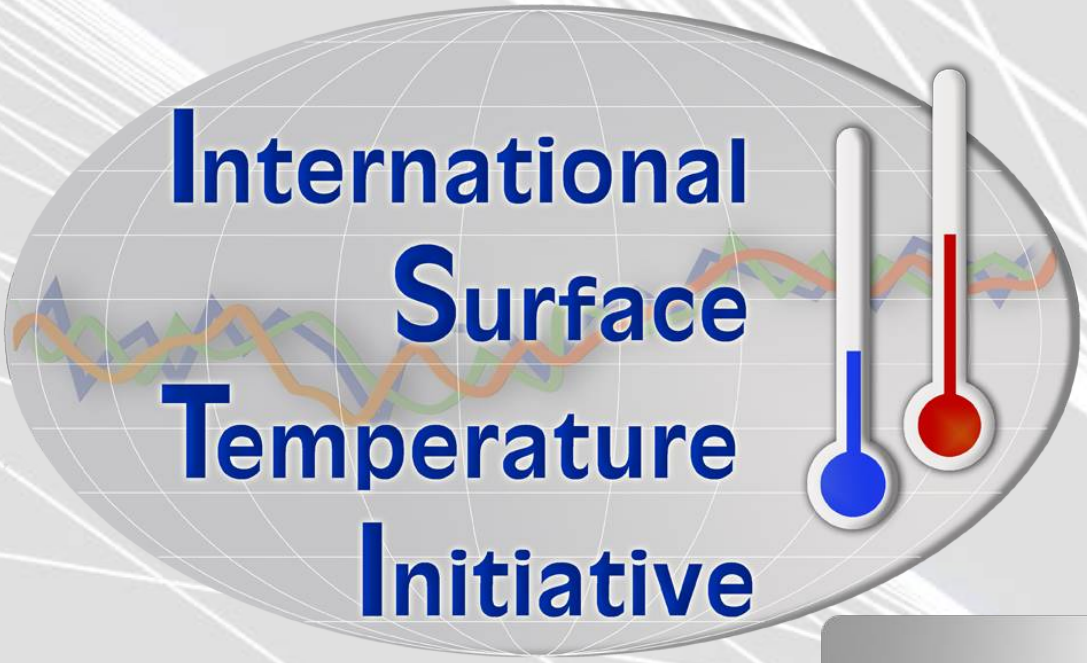
# Creating a global benchmark cycle for the International Surface Temperature Initiative




October, 2011

**Dr Kate Willett,**
**Met Office Hadley Centre, UK**

# Talk Outline

- What is ISTI?
- The Benchmarking Cycle
- The Benchmarking and Assessment Working Group
- Where are we now?

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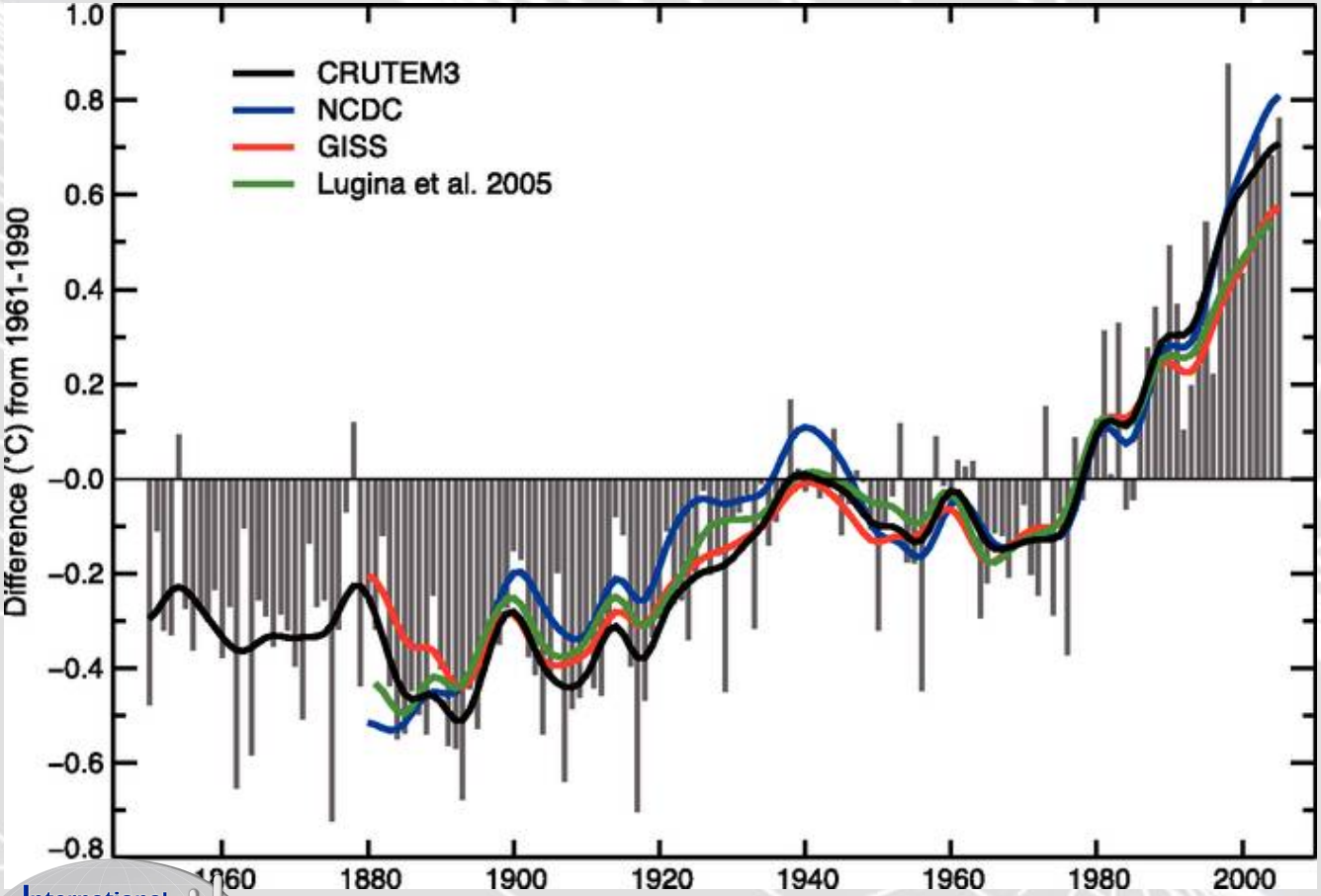
# What is the International Surface Temperature Initiative?

# Examples of Temperature Reconstructions




**IPCC Fourth Assessment Report (2007), Figure 3.1**

*Annual anomalies of global land-surface air temperature (°C), 1850 to 2005, relative to the 1961 to 1990 mean for CRUTEM3 updated from Brohan et al. (2006). The smooth curves show decadal variations … The black curve from CRUTEM3 is compared with those from NCDC (Smith and Reynolds, 2005; blue), GISS (Hansen et al., 2001; red) and Lugina et al. (2005; green). See http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch3s3-2-2.html.*

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# The Big Question

- Can we create a process for producing a suite of independent verified estimates of land surface temperatures to answer scientific questions and societal demands of the 21st Century?
  - Open and transparent
  - Well understood fundamental instrument measurement properties
  - Consistent evaluation of product creation methods (QC, homogenisation etc.)
  - User tools
  - From large scale averages to the sub-daily local scale

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**ESSENTIAL TO WORK WITH / BRING TOGETHER PARTIES WORKING TOWARDS THIS**

# In the beginning…

- 2010 UK Met Office Submission to WMO Commission for Climatology
  - Call for creating new suite of products to meet 21st Century demands / expectations
- September 2010 kick-off workshop, UK Met Office, Exeter
  - 80 international experts including climate scientists, metrologists, statisticians, software engineers
  - White papers posted online and public comments solicited
  - Agreed project outline and governance structure
  - Agreed outcomes published in Bull. Amer. Met. Soc. doi: 10.1175/2011BAMS3124.1

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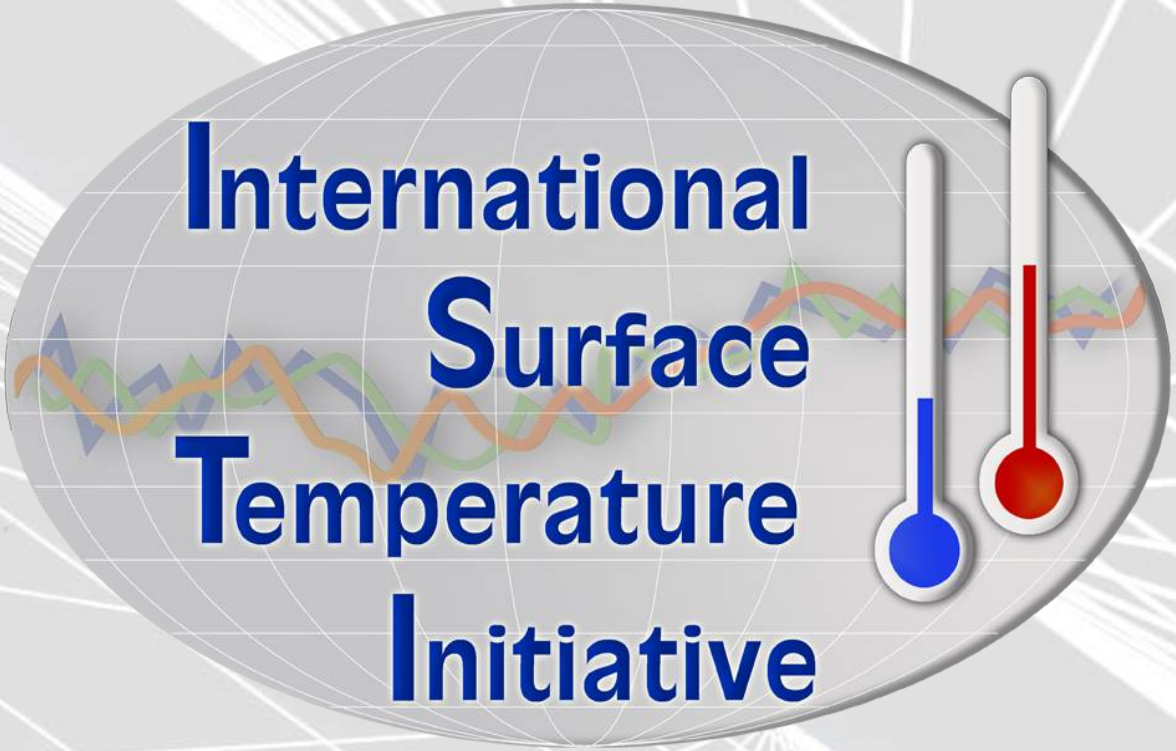
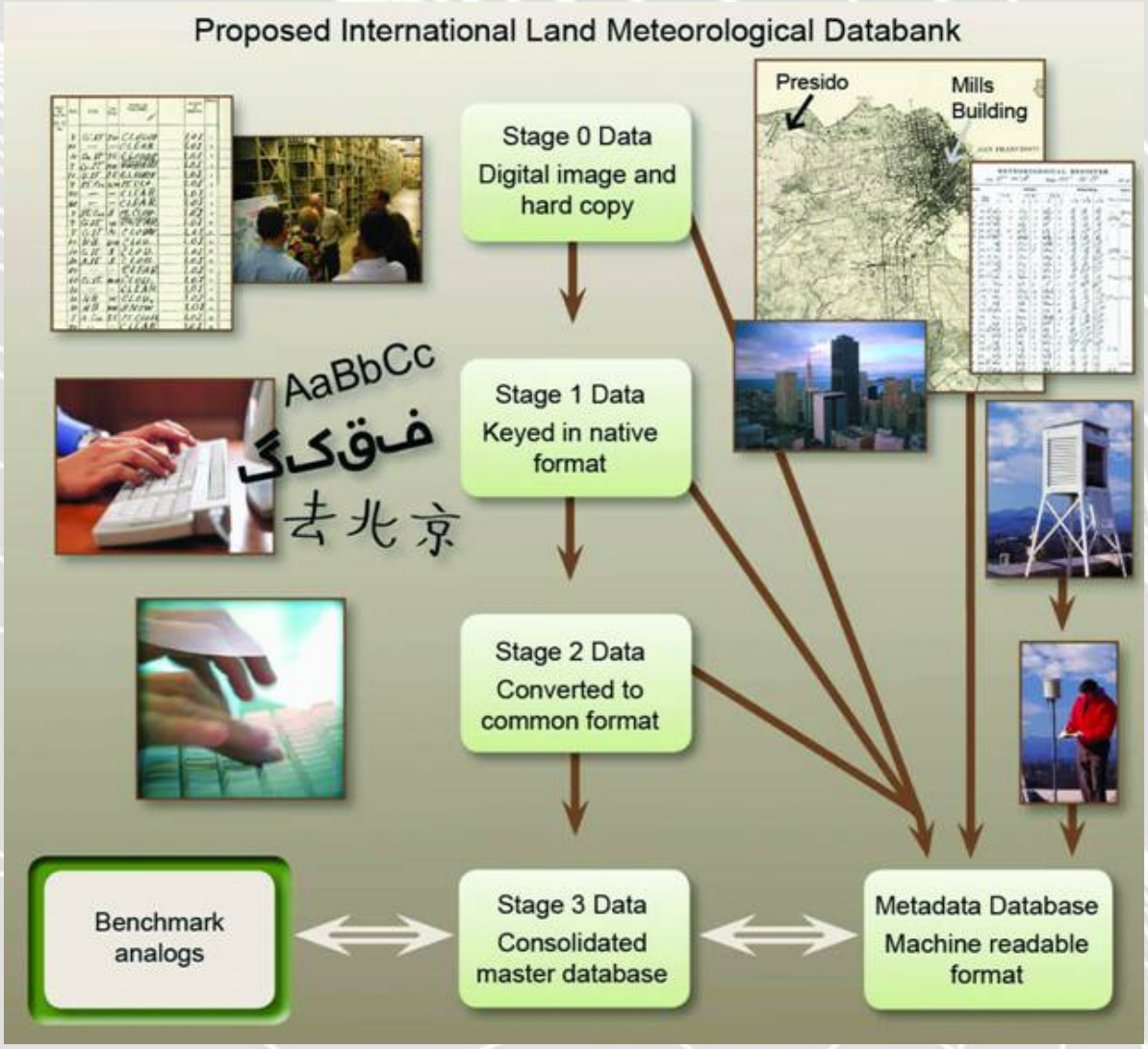
# And Now…



# Land Surface Meteorological Databank




Working Group set up:

- Data rescue task team
- Provenance and version control task team

Development version posted:

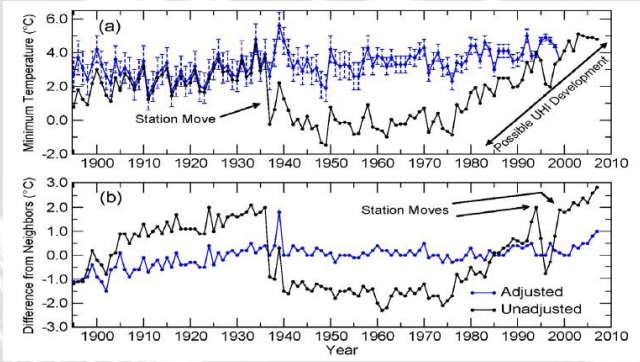
**http://www.gosic.org/GLOBAL_SURFACE_DATABANK/GBD.html**

First version release and accompanying documentation / paper submitted spring 2012

# Benchmarking and Assessment

- With real world data we do not have the luxury of knowing the truth – we CANNOT measure closeness to real world truth of any one data-product.
- We CAN focus on performance of underlying algorithms
- Consistent synthetic test cases, simulating real world noise, variability and spatial correlations potentially enable us to do this

**Inhomogeneities: annual mean min temp at Reno, Nevada, USA**




*(Matt Menne, NOAA National Climatic Data Center)*

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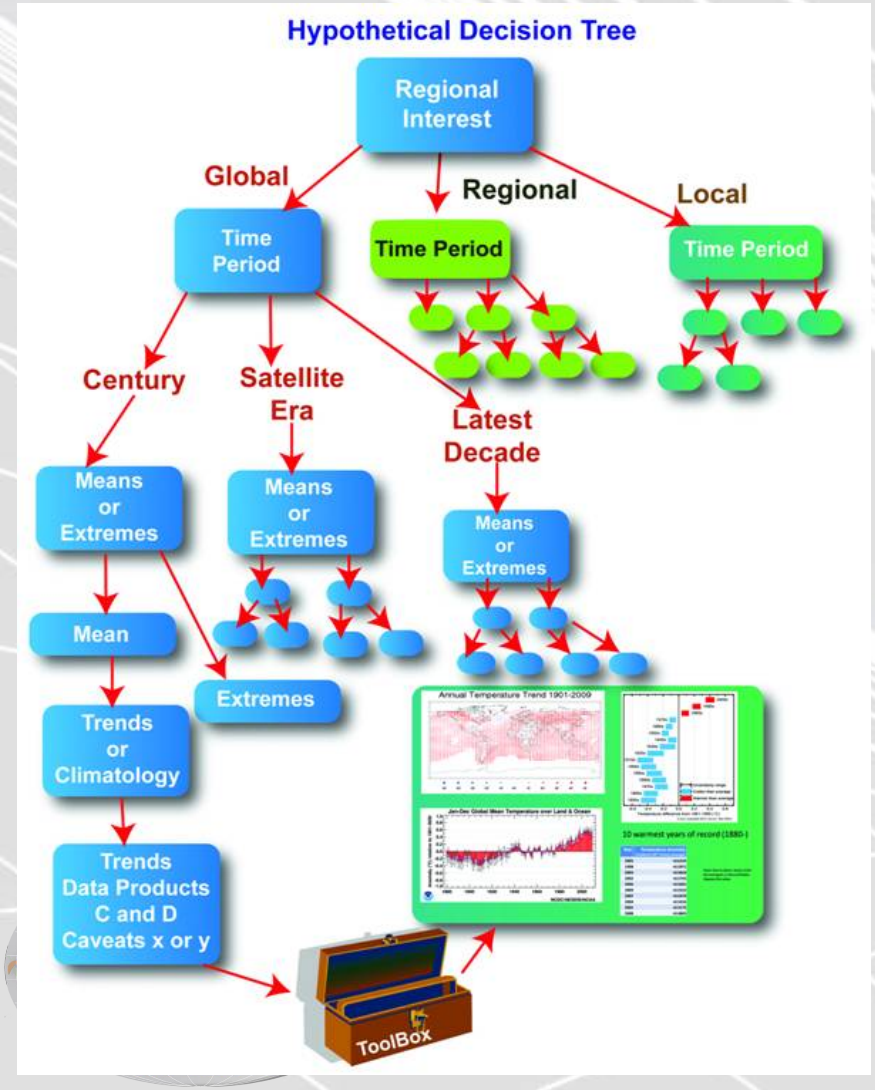
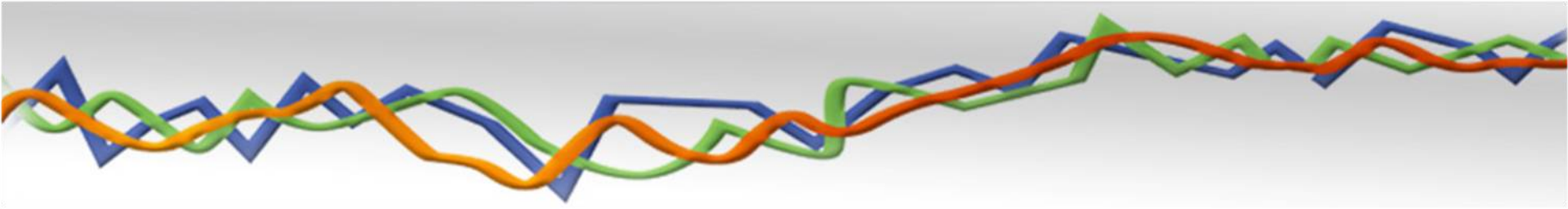
# Serving Products and Aiding Users

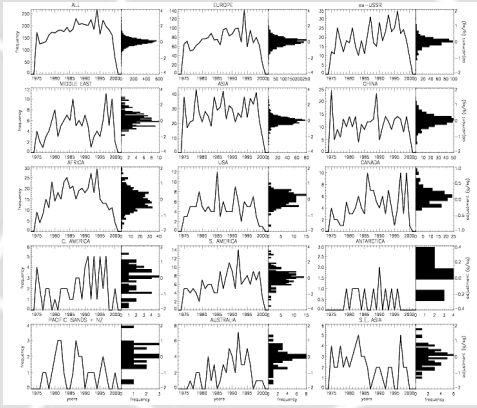



- Data formats – netCDF, ASCII?
- Degree of user interaction – data-subsets?
- Tools - Ability to create graphical and tabular output on the fly
- Limited progress to date
  - Largely a reflection that this data provision is some way down the road?
  - Ideas and suggestions welcome …



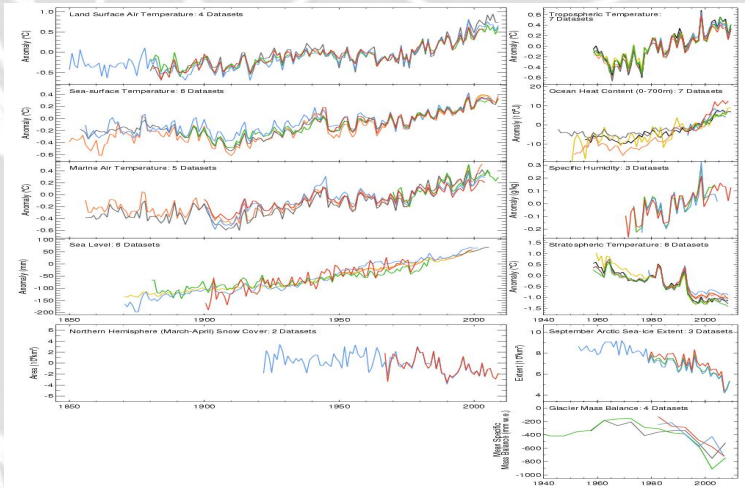
# The Benchmarking and Assessment Cycle

# Three Key Benefits of Benchmarking



## 1) Quantification of methodological uncertainty:

**Understanding the strengths and weaknesses of a data-product methodology against known 'errors' and 'truths' in realistic artificial data can provide a confidence measure of likely proximity to absolute 'truth' when applied to real data.**



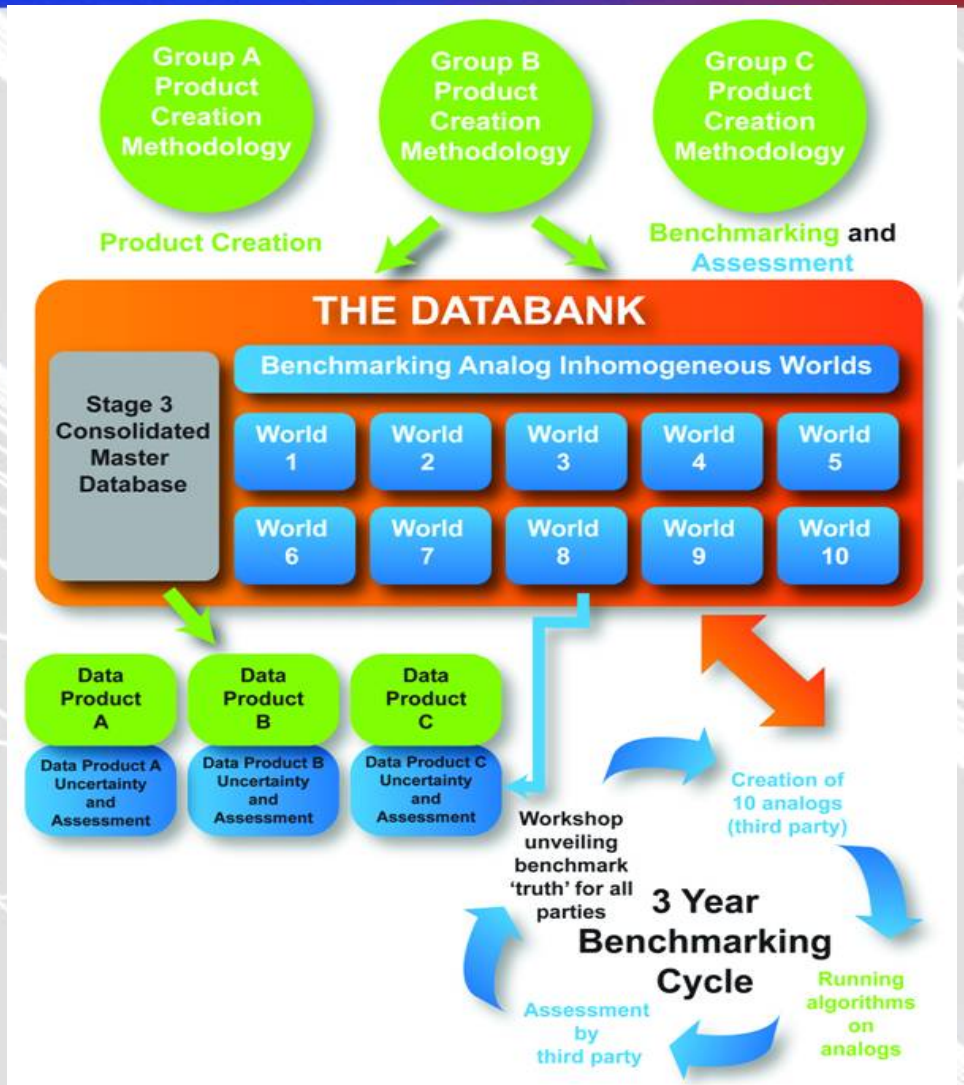

## 2) Intercomparison of data-products:

**Comparing multiple independent products builds confidence in common features – understanding how and why products differ can provide further confidence**

## 3) Aid advancement of methodologies:

**Release of the known 'truth' for the error models will allow data-product creators to test methodologies, understand where weaknesses are and trial improvements**

# Benchmarking Cycle

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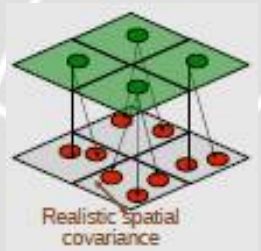
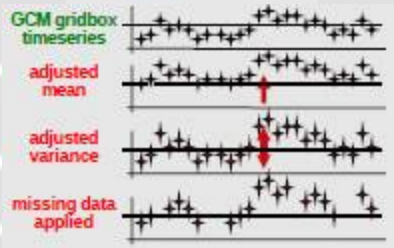
# The Benchmarking and Assessment Working Group

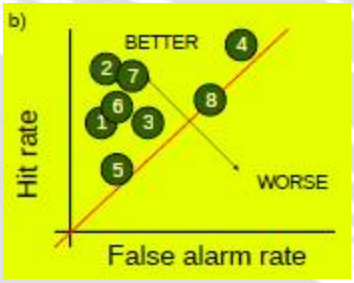
# Functioning of the Working Group

- Website: www.surfacetemperatures.org/benchmarking-and-assessment-working-group
- Blogsite: http://surftempbenchmarking.blogspot.com

- International and interdisciplinary
- Teleconferences
- Volunteer time and PhD students

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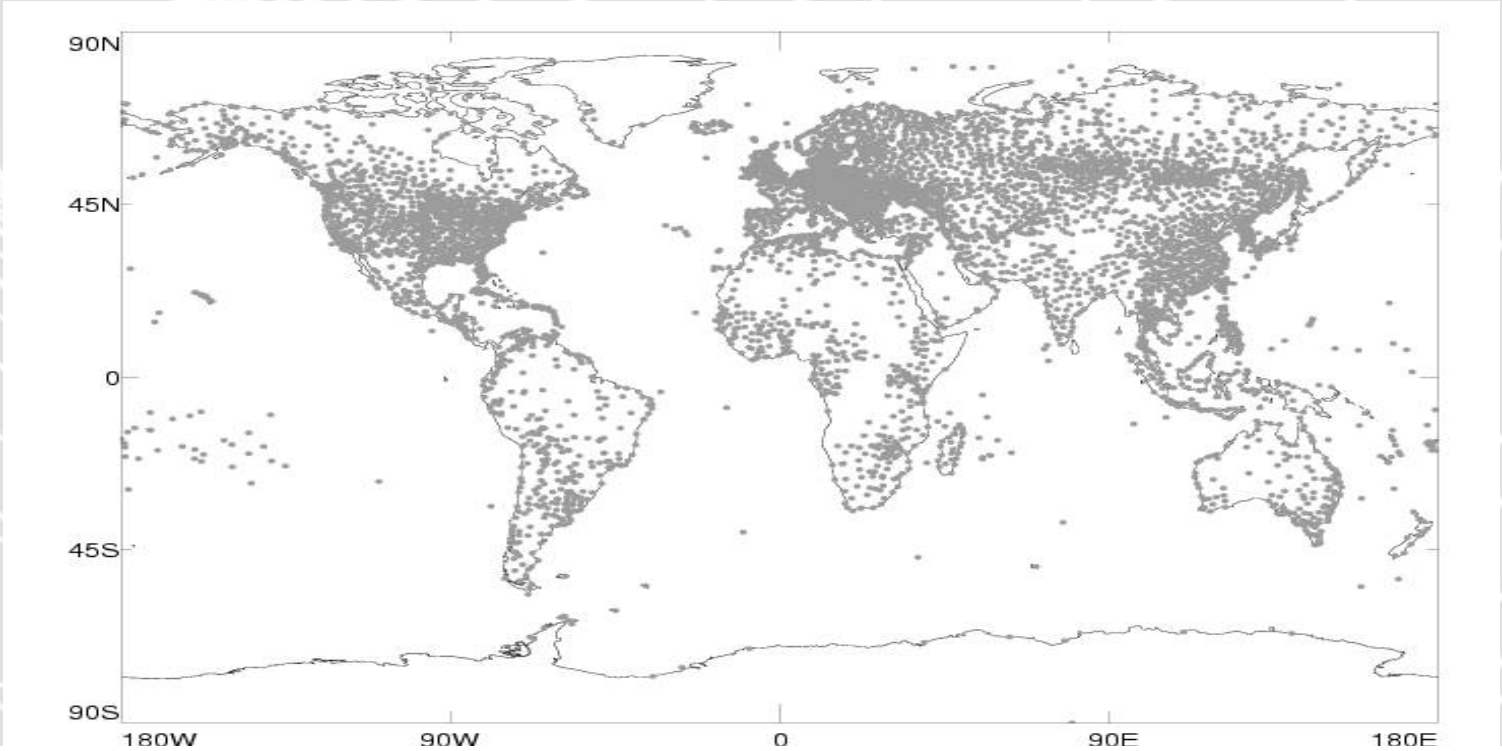
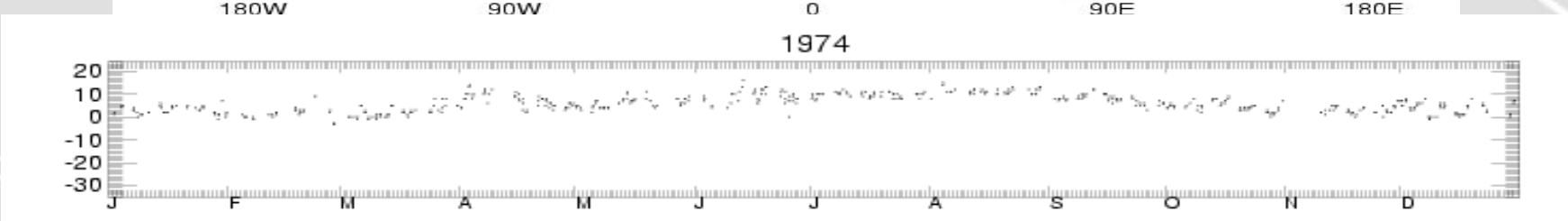
Analogs to be made available November 2012 based upon version 1 release of databank

# Team Creation: Analog-Known-Worlds




Hourly air temperature (deg C) - Snaefell Isle, Isle of Man, UK

# Team Creation: Analog-Known-Worlds

$$XH_{t,l} = S_{t,l} + T_{t,l} + \varepsilon_{t,l}$$

XH = homogeneous artificial data-point (at TIME t /LOCATION l)

S = seasonal cycles

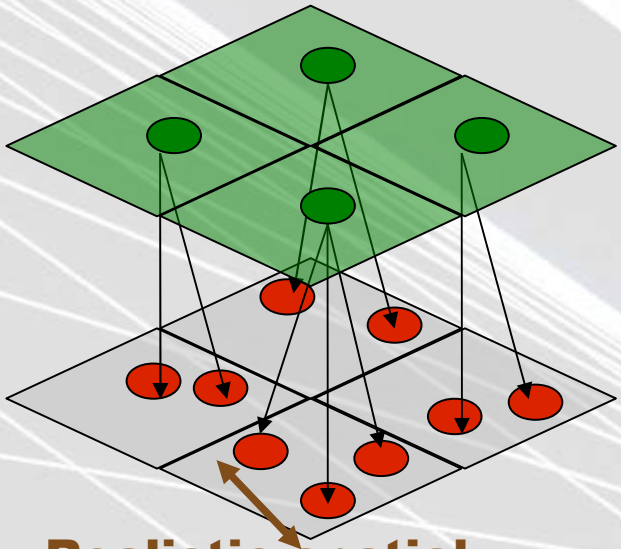
T = trends (background change, local effects, ENSO, NAO, Volcanoes, Solar Cycles etc.)

ε = random error (recording error, instrument error etc)

With some realistic temporal autocorrelation, spatial covariance structure, data-point characteristics (mean, variance, inter-point correlations), missing data...

# Team Creation: Analog-Known-Worlds

Climate model basis tweaked with real station climate characteristics - maintains plausible spatial correlation structure



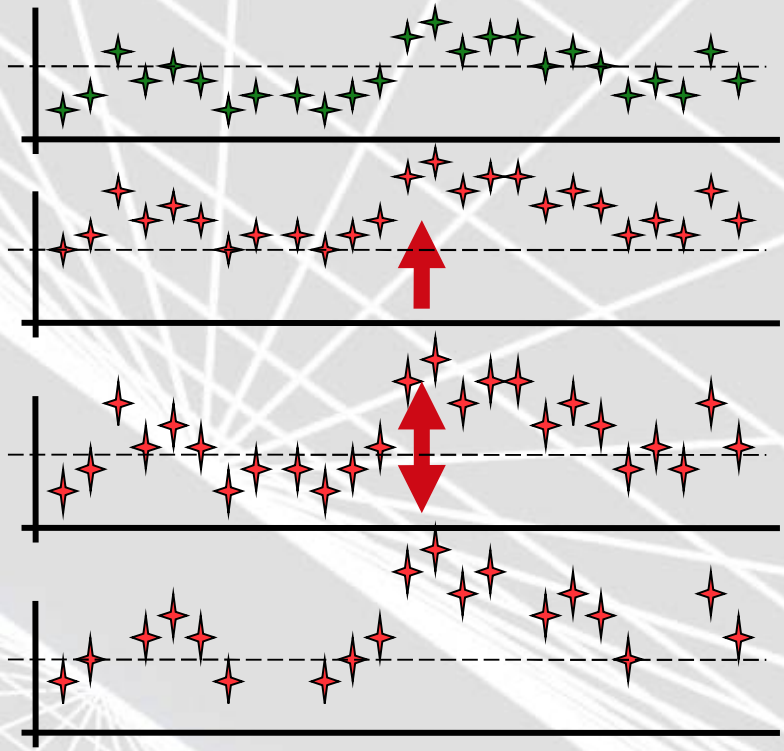
Realistic spatial covariance

GCM gridbox timeseries

adjusted mean

adjusted variance

missing data applied



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# Team Corruption: Analog-Error-Worlds

$$XI_{t,I} = XH_{t,I} + H_{t,I}$$

XI = Inhomogeneous artificial data-point (at TIME t /LOCATION I)

H = inhomogeneity (abrupt, gradual, seasonal, clustered, variance changes etc. - physically governed by radiation and windspeed effects on the specified change)

Add random and systematic errors to approximate the real world error structures which may exist

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# Team Corruption: Analog-Error-Worlds

A Suite of Error Models Should Answer A Selection of Big Questions:

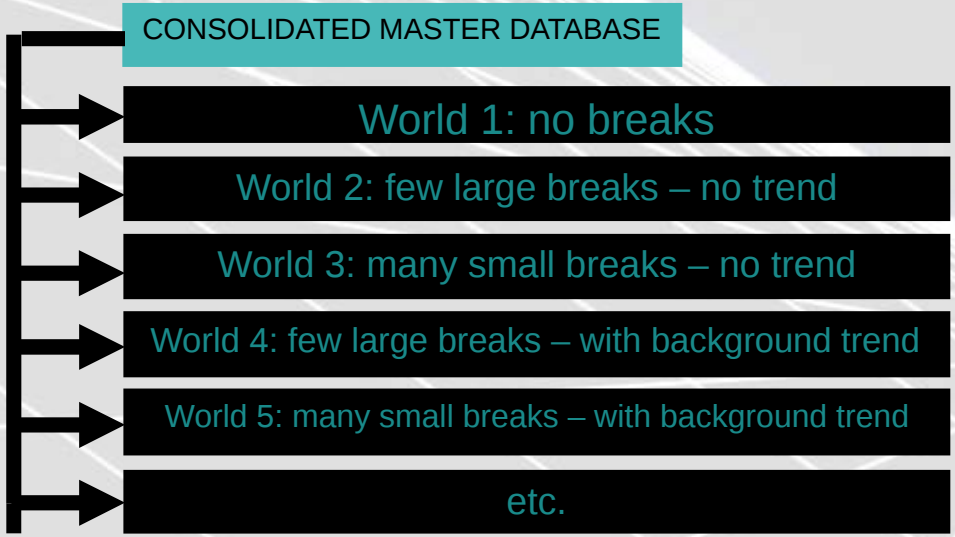
Does a background trend (not necessarily linear!) affect inhomogeneity detection/adjustment?

Does metadata provision (null and positive)...?

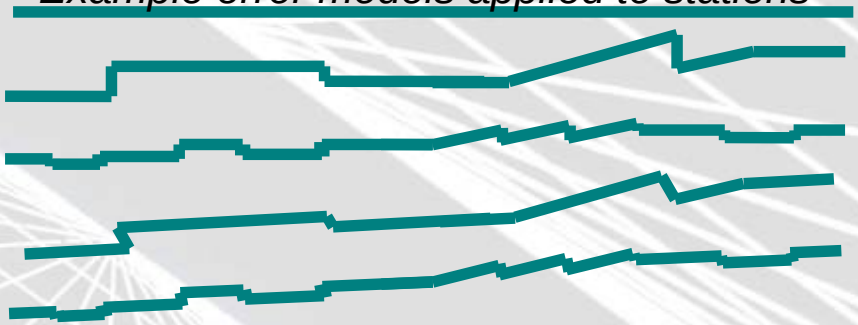
Does prevalence of many small breaks...?

Does a sign bias...?

Does location of inhomogeneity near record end points...?




*Example error models applied to stations*

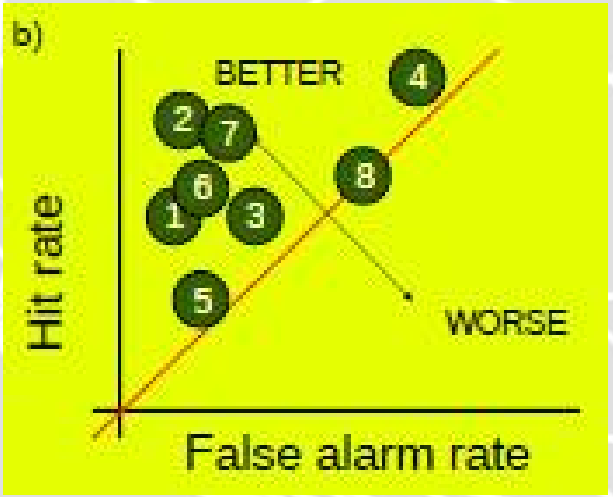


# Team Validation: Assessment

- Comprehensive but easily useable
- Ability to detect and ability to adjust:
  - location, sign and magnitude

| | Changepoint | No Changepoint |
|---|---|---|
| **Detected (within +/- 3 months)** | **5** | **3** |
| **Not Detected (within +/- 3 months)** | **2** | **42** (potential detections given period of data) |

**Percent Correct Hit Rate: 90%**
**Heidke Skill Score = 61%**
**Probability of Detection hit rate = 71%**
**False Alarm Rate = 37%**

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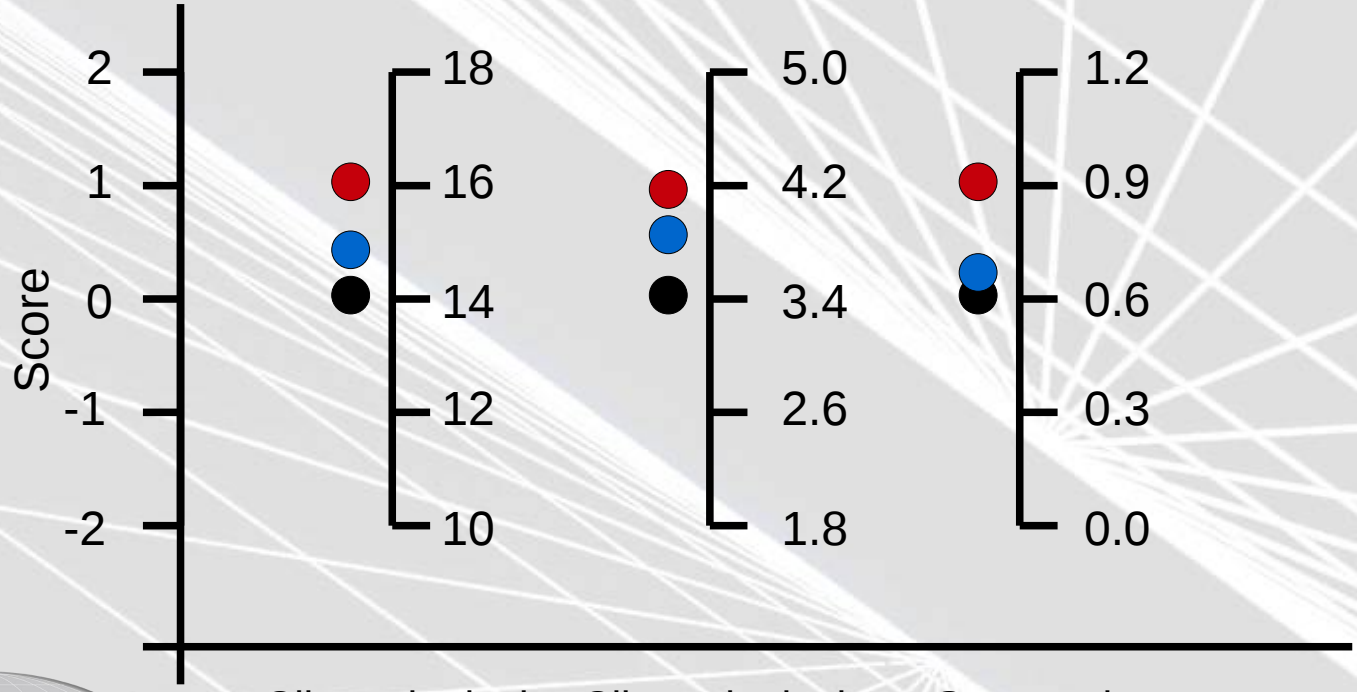
# Team Validation: Assessment

- Ability to return analog-known-world characteristics

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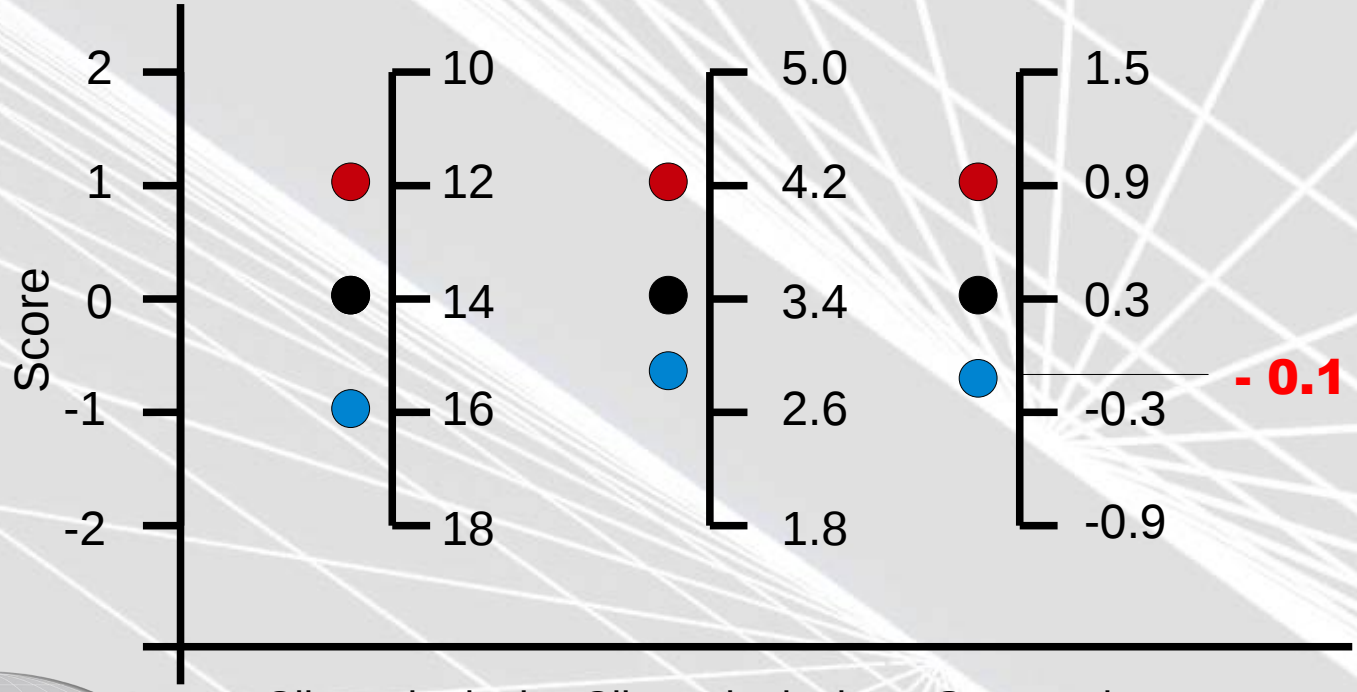
# Team Validation: Assessment

- Ability to return analog-known-world characteristics

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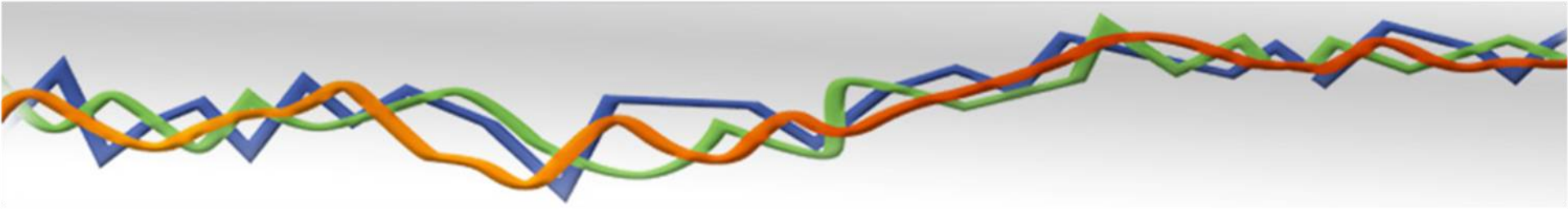

# Where are we now?

# Progress Summary

- Steering Committee (www.surfacetemperatures.org/steering-committee)
  - Terms of Reference
  - Endorsed by World Meteorological Organization (WMO) and The International Environmetrics Society (TIES) - International Bureau of Weights and Measures (BIPM) pending
- Working groups on databank and benchmarking

  (www.surfacetemperatures.org/databank)
  (www.surfacetemperatures.org/benchmarking-and-assessment-working-group)
  - Databank prototype made public and data sources coming in
- Implementation Plan published
- Progress documented on Initiative website at:

  **www.surfacetemperatures.org**

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# Questions and Answers

www.surfacetemperatures.org

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