GAIA-CLIM H2020 project

Characterising satellite measurements using in-situ, ground-based and sub-orbital capabilities

Peter Thorne, February 24th 2015

With thanks to WP leads: Fabio Madonna, Karin Kreher, Jean-Christopher Lambert, Bill Bell, Joerg Schulz, Martine de Maziere

A new project starting next week

- NERSC (coordinator)
- BIRA (WP lead)
- CNR (WP lead)
- MO (WP lead)
- BKS (WP lead)
- EUMETSAT (WP lead)
- ECMWF
- KNMI
- FMI

- MPG
- Bremen University
- Tallinn University of Technology
- NPL
- Helsinki University
- Bergamo University
- Lille University
- KIT
- Plus NOAA, NASA (no cost)

Genesis

- First H2020 call had a program call EO3 which stated:

"The proposal is expected to lead to significant advances in greater consistency and cross-calibration/validation of long term space based measurements with ground-based historical references, providing a better overview of uncertainty of available data to generate Climate Data Records, including impacts information of space data. Based on the work done, best practices regarding calibration/validation campaigns should be promoted."

Proposal

- A group led by several of the leads of GRUAN, NDACC and TCCON drafted a proposal concentrating upon:
  - High quality measurement networks
  - Traceability and uncertainty quantification
  - Delivering user tools
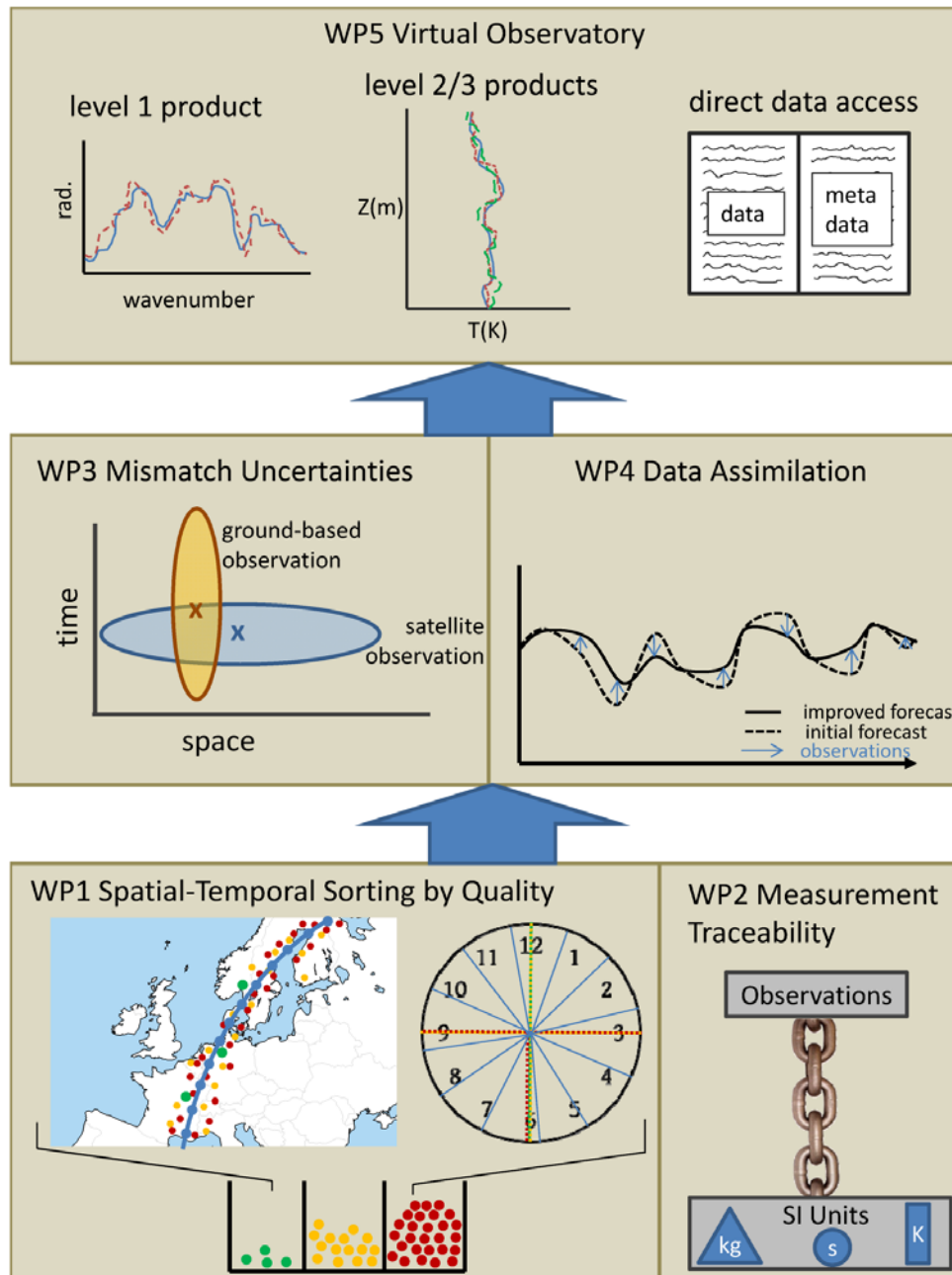
- Define data quality attributes

- Map by capabilities

- Improve quantification of in-situ ground-based and sub-orbital measurements

- Better quantify the impacts of measurement mismatches

- Use Data Assimilation to improve the usefulness of high quality measurements

- Provide useable and actionable information to end users to improve the value of both satellite and non-satellite data
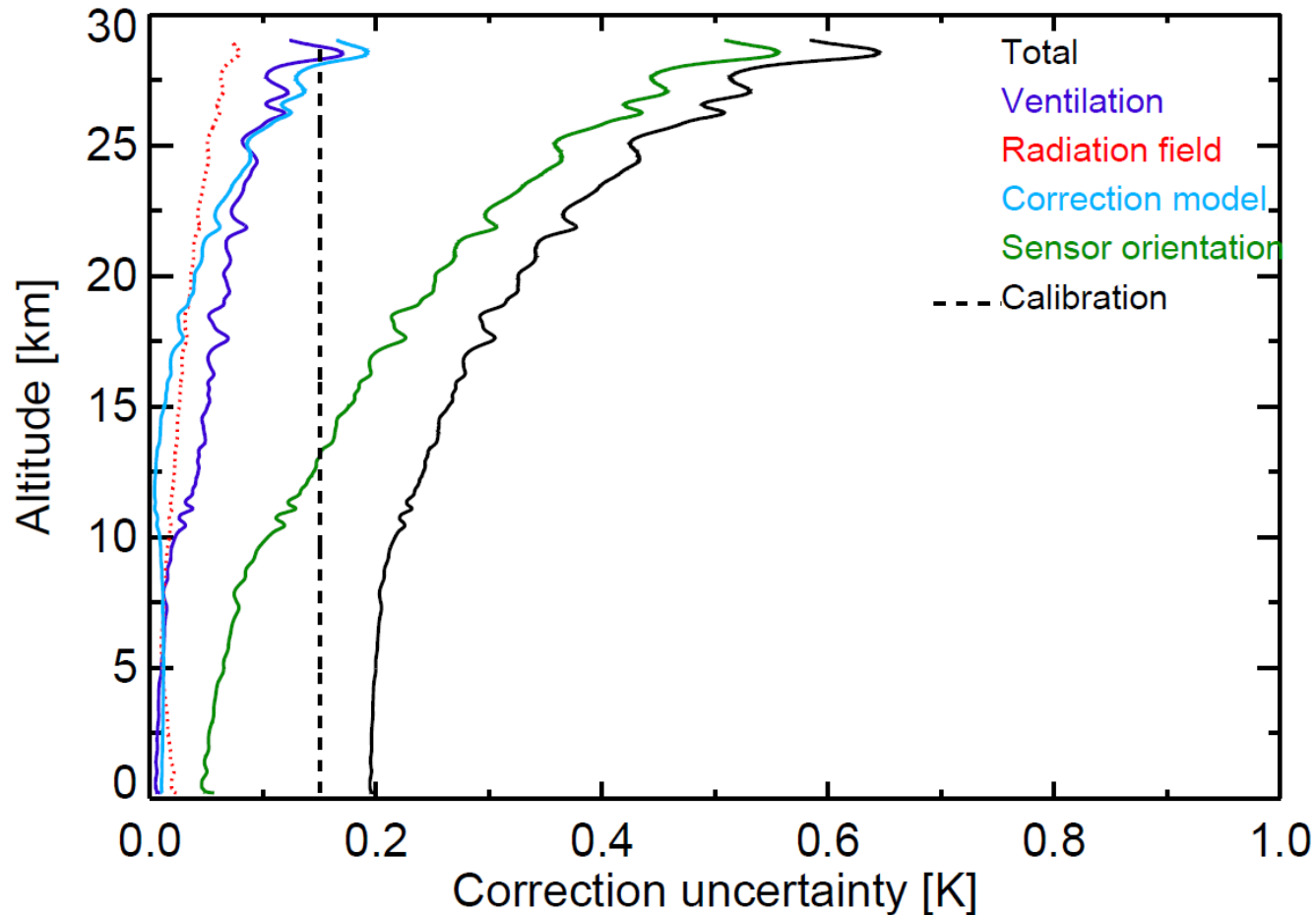
WP1: Mapping capabilities

- Define tiers of data quality based upon their characteristics

- Map these capabilities

- Provide mapping tool to visualize the capabilities

- Assess geographical gaps in capabilities

Example map

# WP2: Quantifying measurement uncertainties

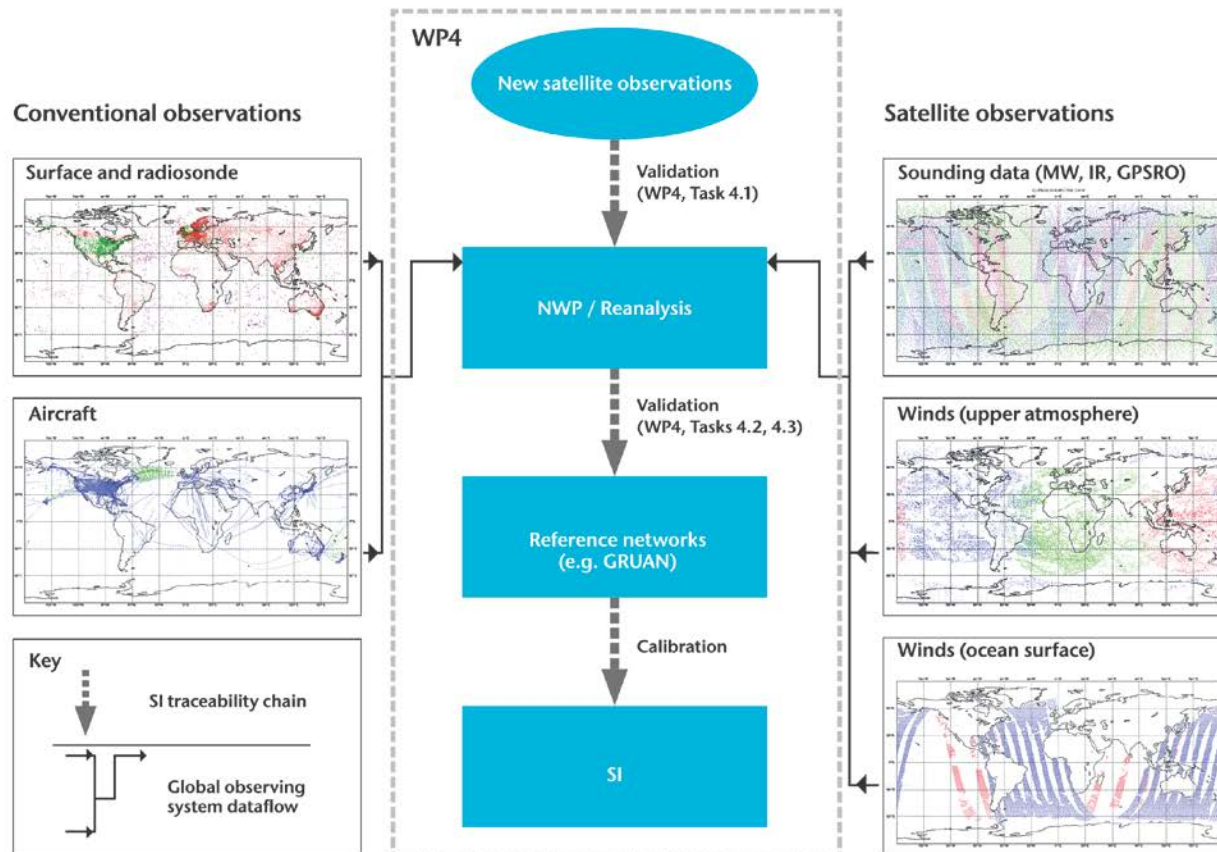| Instruments / programme	T	q	CO_2	CH_4	O_3	Aerosols	CO	HCHO	NO_2
Pre-existing / already in process on GAIA-CLIM timescales									
Radiosondes (RS92 and various others)	■	■							
Frostpoint hygrometer sondes		■							
Ozonesondes					■				
QA4ECV project (various instruments)							■	■	■
Planned in GAIA-CLIM									
Lidars	■	■			■	■			
Microwave radiometers	■	■							
FTIR / FTS		■	■	■	■				
UV/visible spectroscopy					■				
MAX-DOAS/Pandora					■				
GNSS-PW		■							

WP3: Measurement mismatch uncertainties

- Satellites and other measures will never measure the exact same volume over the exact same interval.
    - Differences in time of observation (including measurement time integral mismatch and diurnal cycle effects)
    - Differences in horizontal geolocation, including such time-varying effects as drift of balloon borne measures
    - Differences in vertical registration, especially in presence of altitude uncertainties/shifts
    - Differences in vertical smoothing (need for vertical averaging kernels for both columnar and profile measures)
    - Differences in horizontal smoothing (consider e.g. an in situ sonde with respect to a 300 km satellite horizontal resolution)
    - Vicarious data issues such as cloud impacts if comparing to radiances in the IR spectrum.

- WP3 will use model and statistical approaches to quantify the effects.
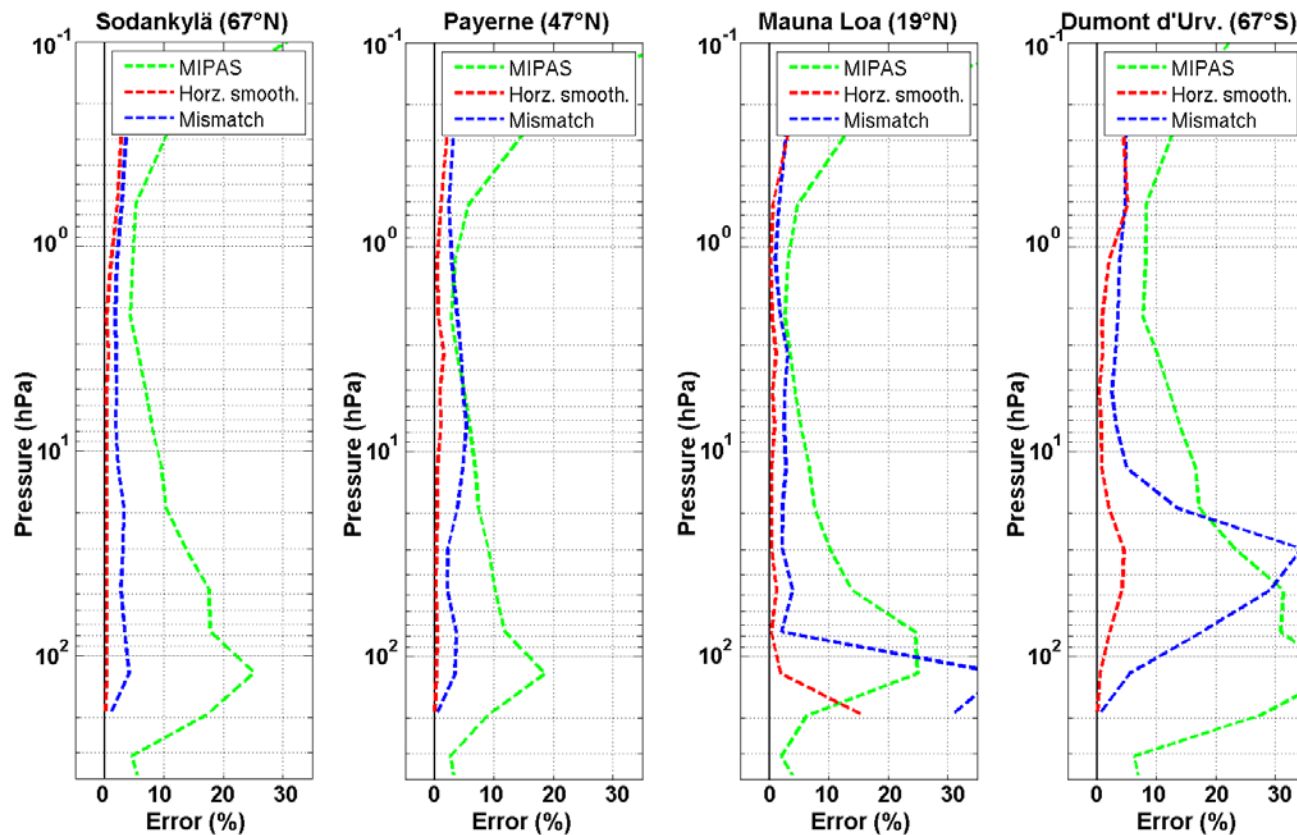
WP4: Use of data assimilation as integrators

- Investigate the value of use of data assimilation and reference quality measurements
  - Define biases in data assimilation
  - Propagate information from point measures to more regionally / globally complete estimation
  - Use in both NWP and reanalyses to be investigated

WP4

New satellite observations

Validation
(WP4, Task 4.1)

NWP / Reanalysis

Validation
(WP4, Tasks 4.2, 4.3)

**Reference networks
(e.g. GRUAN)**

Calibration

SI

Conventional observations

Surface and radiosonde

Aircraft

Key

SI traceability chain

Global observing
system dataflow

Satellite observations

Sounding data (MW, IR, GPSRO)

Winds (upper atmosphere)
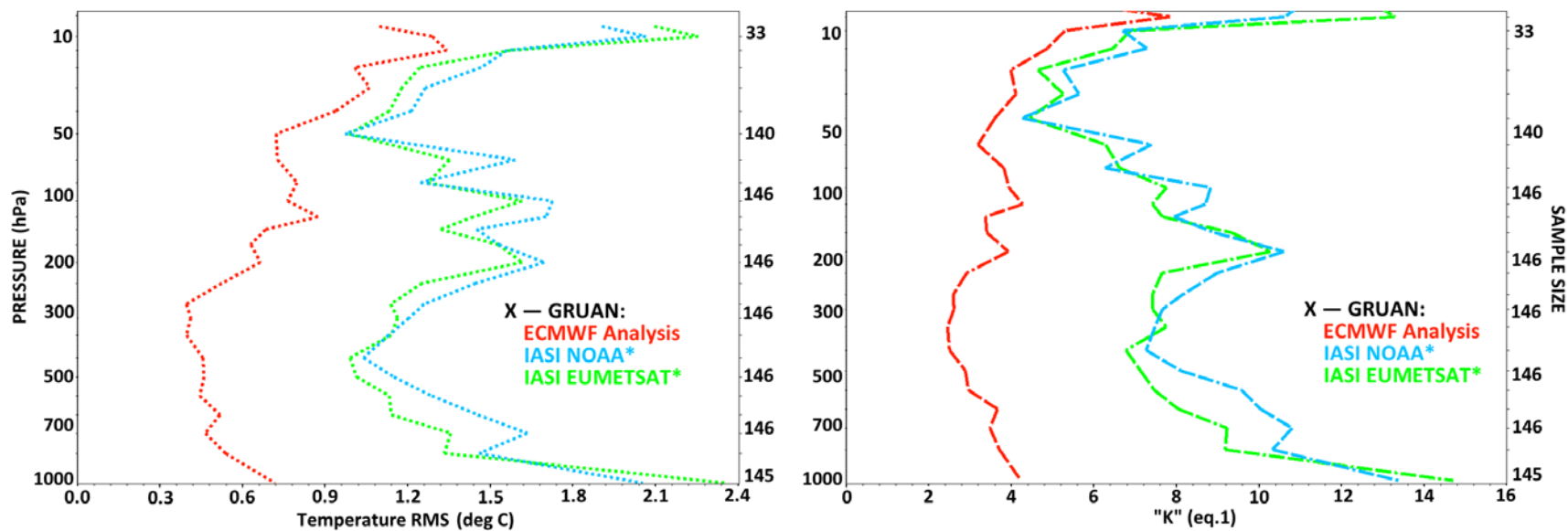
Winds (ocean surface)

WP5: Virtual observatory

- Make the outcomes of previous WPs useable and actionable
  - Collocation database build
  - Availability of Level 1 / 2 comparisons including uncertainties
  - Graphical display and user interface
  - Build with expectation of becoming a sustainable service

NPROVS+
14 July 2013 — 19 January 2014

* IR + MW, passed QC

WP6: Outreach and gaps assessment

- Gaps in geographical coverage and their impacts arising from the geographical mapping exercise
- Gaps in knowledge of measurement properties and uncertainties for both specific instrument types and on an ECV basis.
- Gaps in understanding of the impact of measurement mismatches arising from inadequacies in knowledge of how to deal with measurement mismatch issues.
- Open issues regarding how to use dynamical model and data assimilation techniques as integrators
- Issues that remain in enabling easy use of reference quality measures as cal/val tools.
- Gaps between user needs and current observational and analysis capabilities
- Consideration to the somewhat fractured nature of observing systems.

Gap assessment is iterative with community
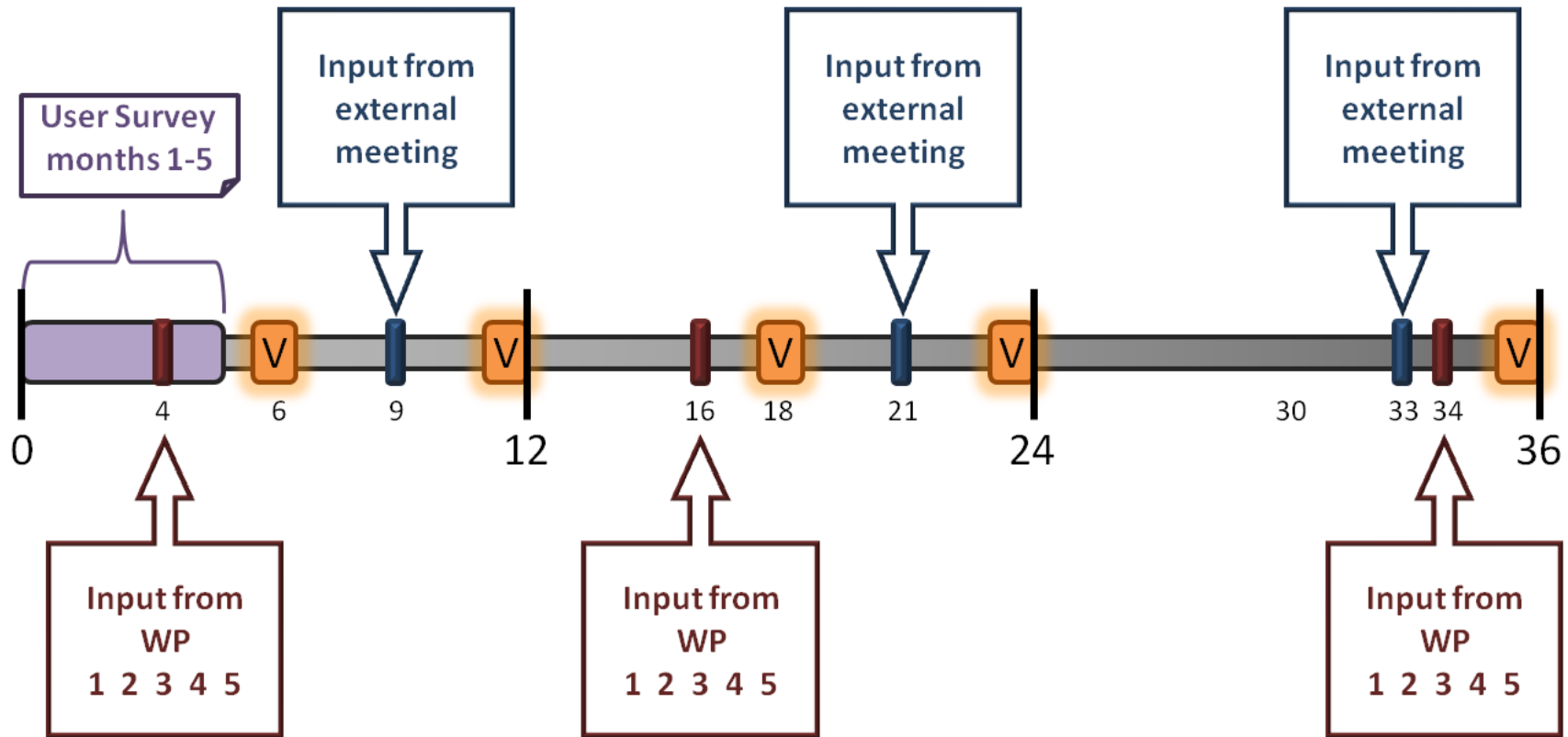
Summary

- GAIA-CLIM will start next March
- Will concentrate upon building SI traceability and physical mismatch uncertainty into comparisons
- Will produce a toolset through a virtual observatory
- Will produce an assessment of gaps in conjunction with the broader community
- Will be fun (I hope …)