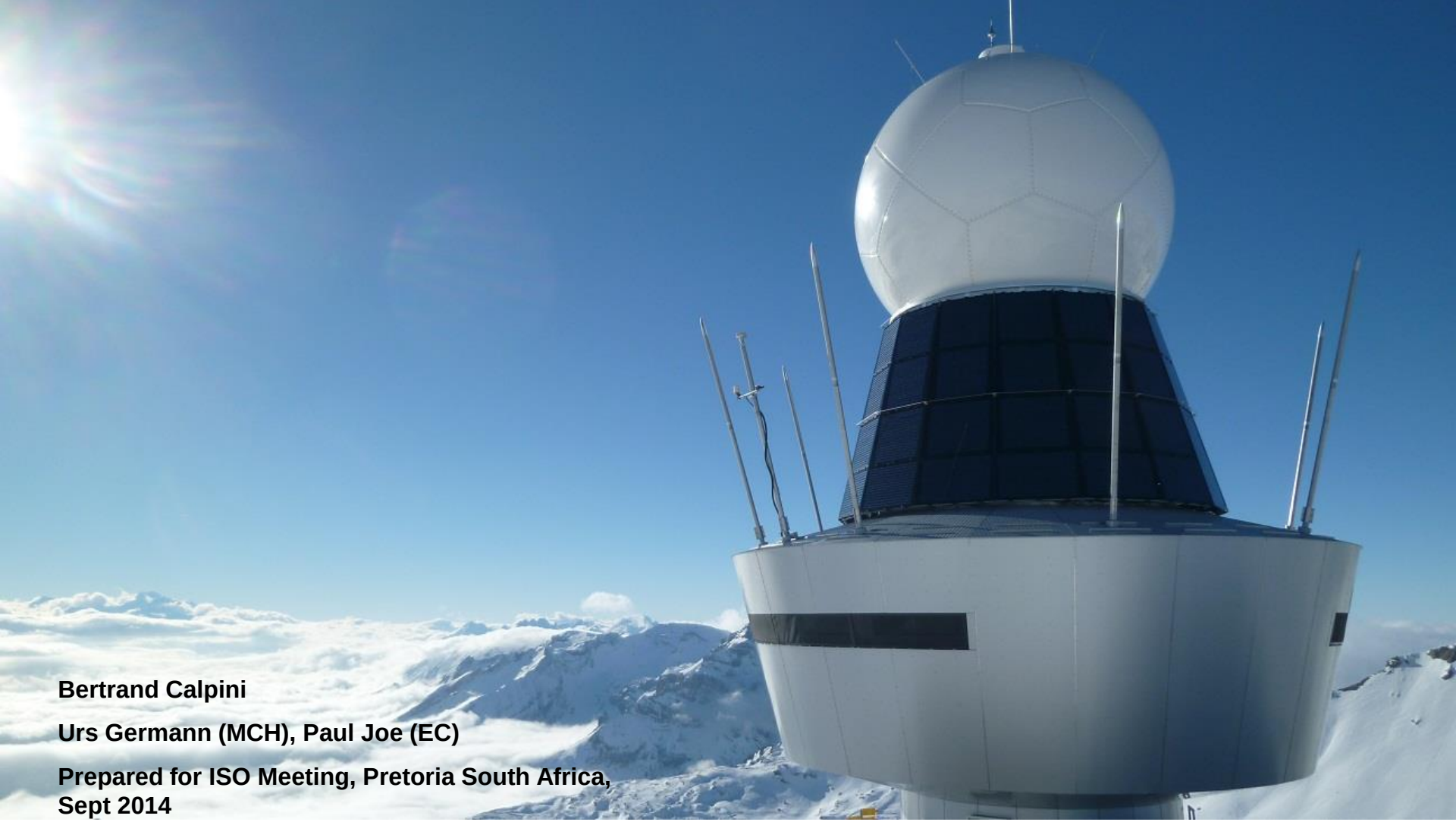


Bertrand Calpini

Urs Germann (MCH), Paul Joe (EC)

Prepared for ISO Meeting, Pretoria South Africa, Sept 2014

Weather radars – ISO standard versus WMO recommendations - the WMO-CIMO point of view

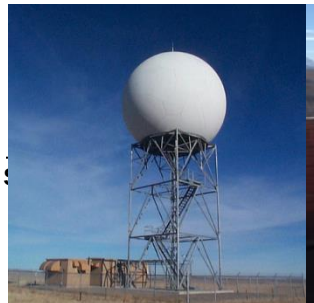
Proposal – led by VDI, Germany; project lead is Thomas Einfault

“ISO standard for radar precipitation products”

Starting thoughts

- Technology is relatively mature, but at the same time there is rapid evolution and variety in scope (usage) and technology (antenna, scanning strategy and capability, signal processing, etc)
- Data quality is a mix of hardware performance and signal statistics

- These days “anyone” can build a radar (by integrating components) and consumers need quality assurance, guidance and advice.
  This is the biggest need for users without extensive radar knowledge. What is good enough, for what application/use and at what price?
- Many kinds of radars of different type and quality:
  TV radars, boat radars, wind profiling radars, high-quality radars of national weather services, research radars:
  again, consumers need guidance




Main applications

Monitoring severe weather

- Identification and tracking of supercells, severe convection, thunderstorms, hail cells, tornadoes, flash floods, etc

Monitoring precipitation (qualitative and quantitative)

- Detailed real-time picture of precipitation in 4D
- Quantitative estimation of precipitation rates at the ground (just one application but the most demanding for radar and data quality)

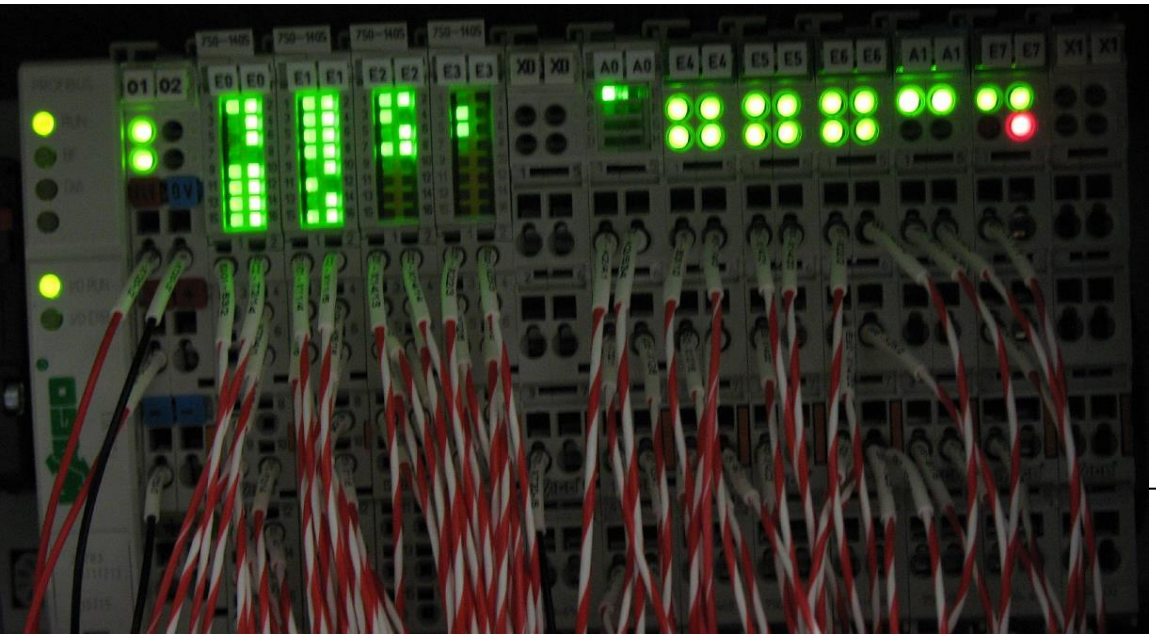
Meteorological and hydrological forecasting

- Clear air sensing for convective initiation
- Extrapolation of severe weather and precipitation fields (nowcasting)
- Alerts
- Assimilation in models for numerical weather prediction and runoff modelling

And more: Snowfall monitoring, wind measurements, hydrometeor classification, climatology, research in general, and several others …

Why we need a common reference

- Common level of quality (hardware, data, product)
- Fullfil user needs
- Definitions (what is a weather radar and what not)
- Benchmark
- Interoperability
- Guidelines and starting point for newcomers



*Specs and performance of radars on the market shall reflect the **needs** of radar operators and end users,*

***rather** than being driven by radar manufacturers.*

Challenges

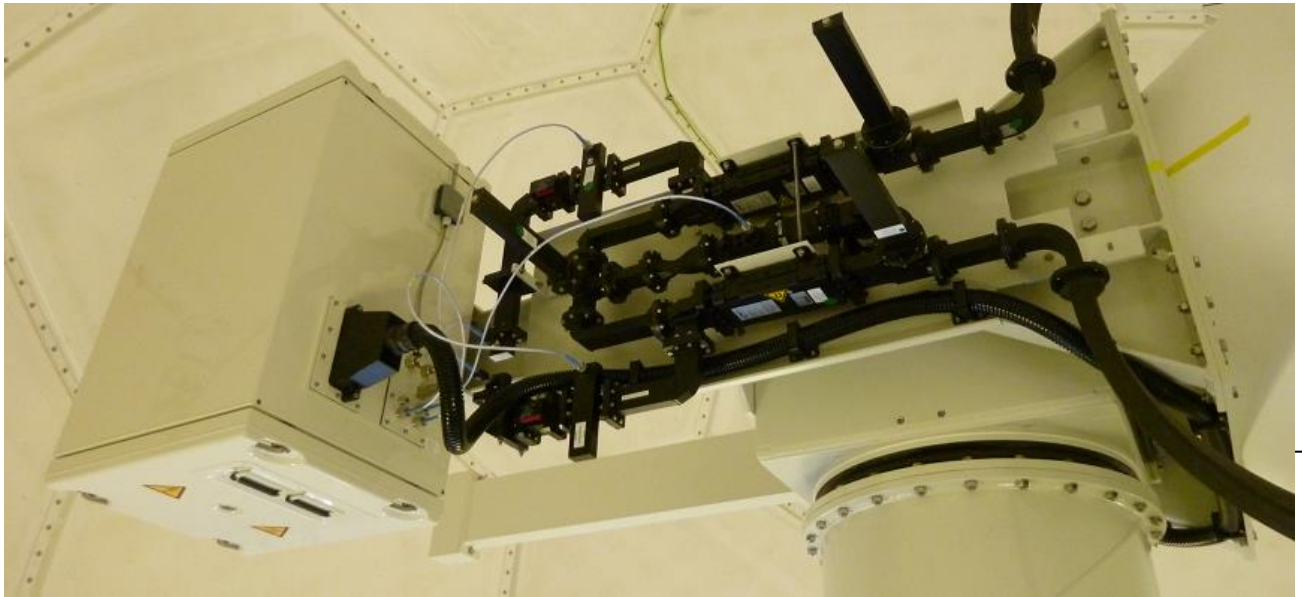
Allow new technologies to emerge. There is a risk a strict standard will slow down technological progress. We need to

- **guarantee a common minimum level of performance,**

and, at the same time,

- **foster innovation beyond that level.**

-> How to include this in a standard ?



Challenges

High performance in the lab is important. **But** real-world performance, stability, robustness, reliability, up-time and time-to-repair are important as well.

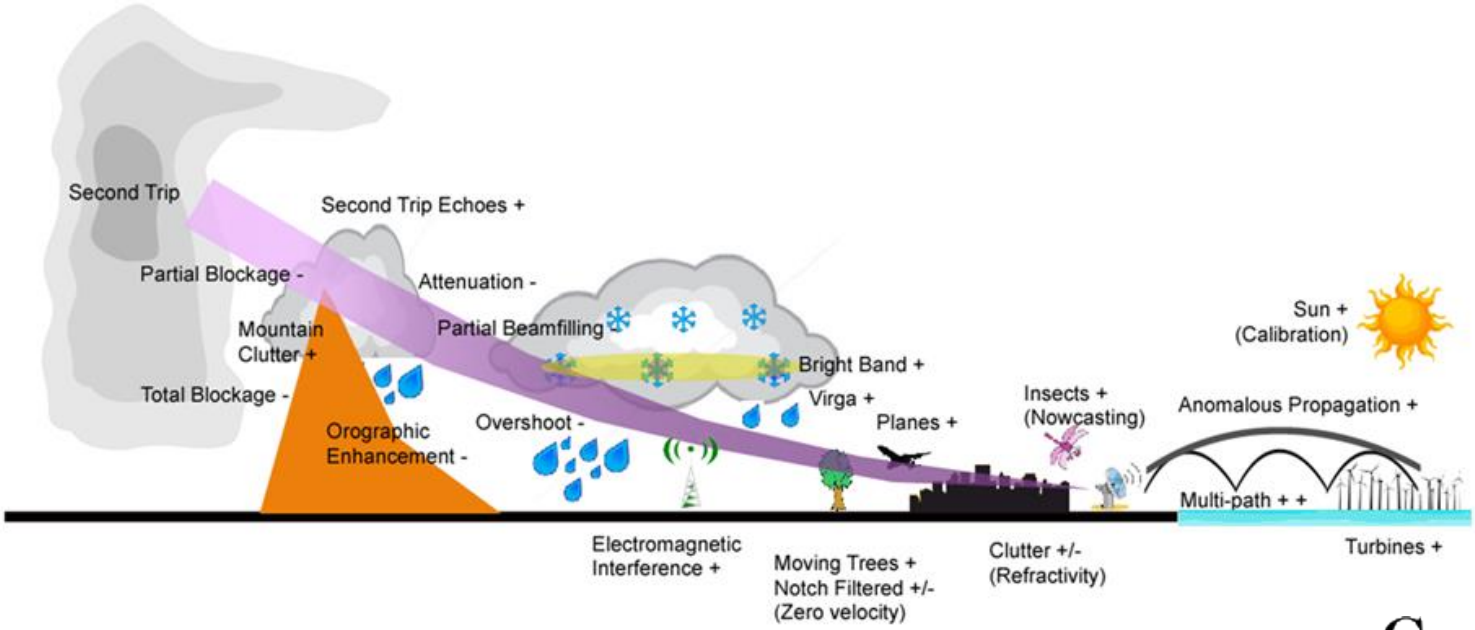
«Even the best performant radar doesn't help anything, if it is out of order.»

Operation practices: Rigorous acceptance testing, optimum configuration, meticulous calibration, automatic monitoring and calibration of the whole system, regular preventive maintenance, …

-> How to include robustness and reliability ?

Precipition Focus?
Processing Complexity

For instance: Sources of error and need for appropriate hardware and software design and sophisticated data processing.



Canada

-> How to define a standard that takes this into account?

Context

Optimum design heavily depends on needs and context (monitoring snow in Finland vs flash floods in Spain vs orographic precipitation in Switzerland …).

-> How to define a standard that takes this into account?

VDI draft for ISO is narrow. Covers maybe 20% of the range of nowadays applications of weather radar technology.

Scope of the standard ?

Careful thinking required.
To give a few examples:

- Radio frequency (possibly S, C and X)
- Large number of low-cost radars vs few high-performance radars
- Include rain retrieval from microwave links?
- Antenna: mechanical vs electronical, beam shape, volume-scanning vs 2D and 1D
- Tx: Klystron, Magnetron, low-power solid-state with long pulses and pulse compression
- Rx: receiver over elevation vs receiver in the technical room
- **Radar hardware only, or also data and product processing**
- Include acceptance testing, operation and maintenance practices, or just procurement and installation
- **Calibration Procedures**
- Applications: hydrology only vs including all sorts of applications
- Multi-purpose-radars (meteorology + civil aviation + military)
- And many more …

Calibration Standard

Chandra and Baldini

Global Precipitation Measurement, Ground Validation

Calibration protocol

1) Receiver calibration – once every scan
2) Transmit power monitoring – continuous
3) Sphere calibration – once a year
4) Z_{dr} calibration, every volume scans with the modern operational calibration system.

   Vertical looking –Target of opportunity

   Solar measurements – can be done routinely everyday.
5) Solar calibration monitoring and ground target monitoring(can be done very regularly and frequently)
6) Calibration requires discipline, avoid to many rearrangement of equipment/ connection/ discussion. Any time you change anything
7) Overall once a year calibration campaign is recommended.

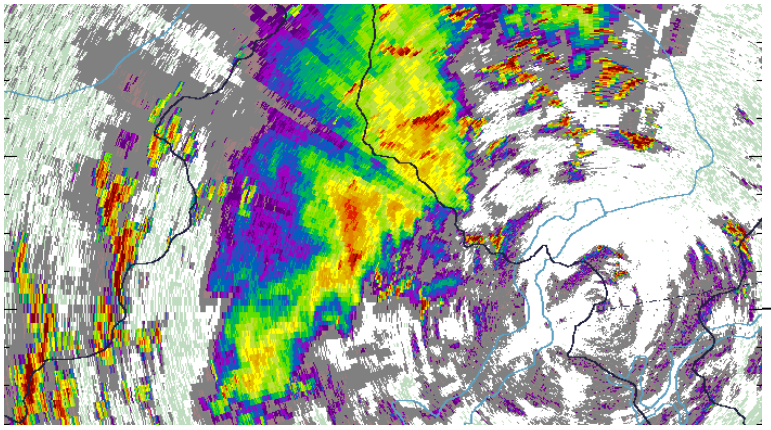
ISO standard is not the right solution
at the moment

- Rapid evolution in technology
- Many different technological solutions
- Large variety in needs
- Needs are rapidly changing
- Poor metrics for definition of a strict standard
  (particularly for robustness and reliability except MTBF!)
- No common agreement on standard solution
  (neither for hardware nor for data processing)
- How to make sure the needs from operators and users are covered ?
- Any standard should be freely available, not proprietary.

Conclusions and way forward

- WMO is the international reference for observing systems for weather, hydrology and climate. WMO is driven by the national services, not the manufacturers.
- ISO community has expertise in the definition of standards

- Establish WMO Regulatory Material as international reference. Substantial work already done (CIMO Guide).
- Establish calibration standard (doable)
- Allow for variety and regular updates. WMO is driven by needs of operators and users by construction.



Go for ISO at a later time
(start with ISO Technical Report, then ISO Standard)