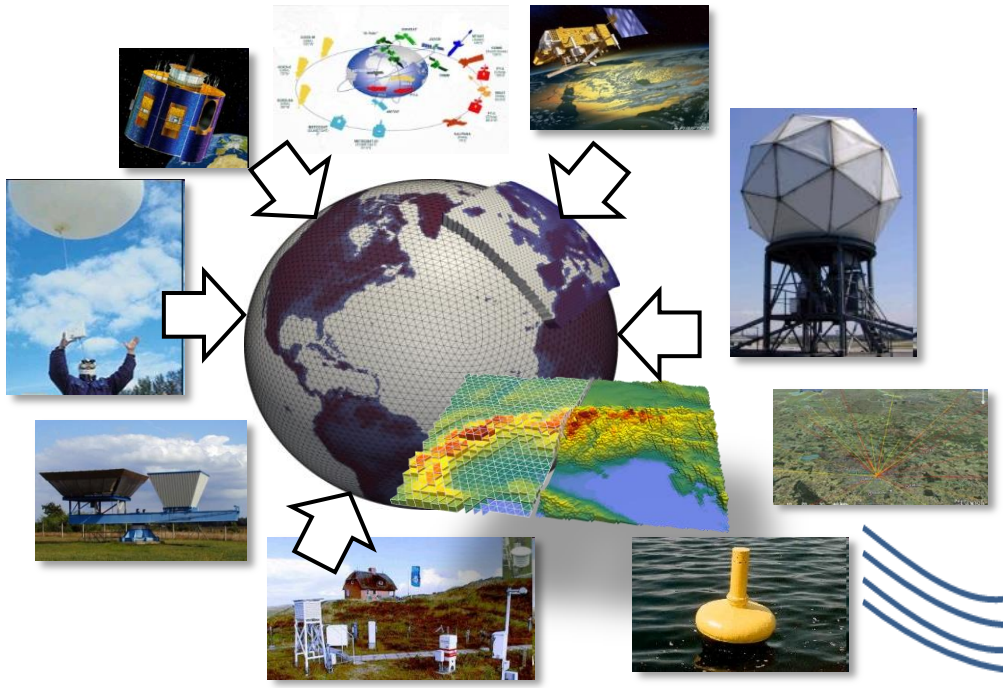
BACY, NUMEX, MEC and DATOOL

Flexible tools for realization, visualization, verification and diagnostics of observations, experiments and model fields



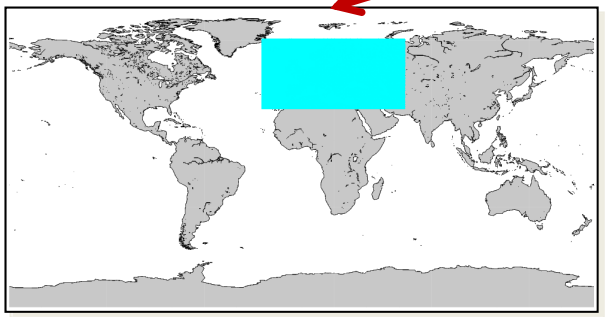
Roland Potthast
& FE12 & FE1

DWD, Germany
University of Reading, UK

Hierarchy of Models and Analysis

Better Dynamics

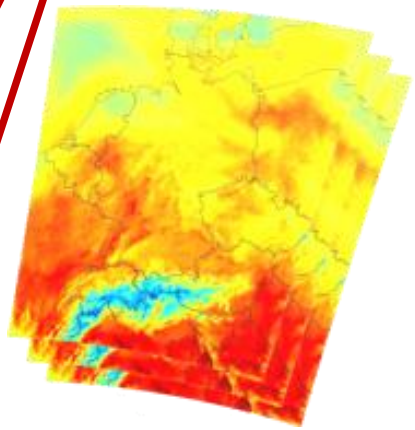
Better Physics



Working with Observations

Better State Estimation

Verification & Evaluation

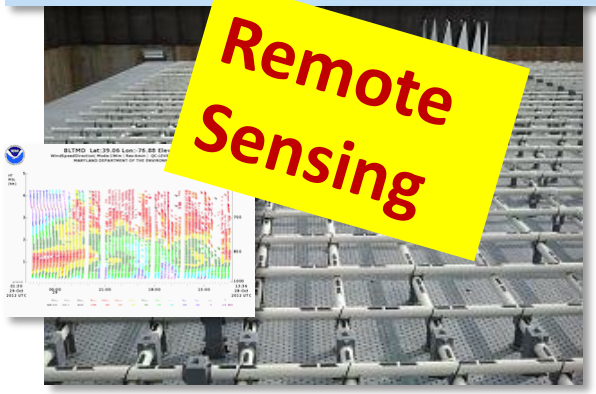


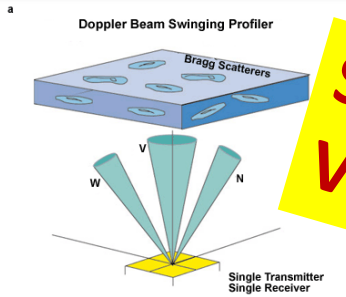
Better Ensembles (Uncertainty)

- ✓ Global Model
  - ✓ Mesoscale Model
    - ✓ Convection Scale Model
- ✓ Dynamics, Physics, Processes
  - ✓ Data Assimilation on all Scales
    - ✓ Ensemble Prediction on all Scales

Global Observations

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

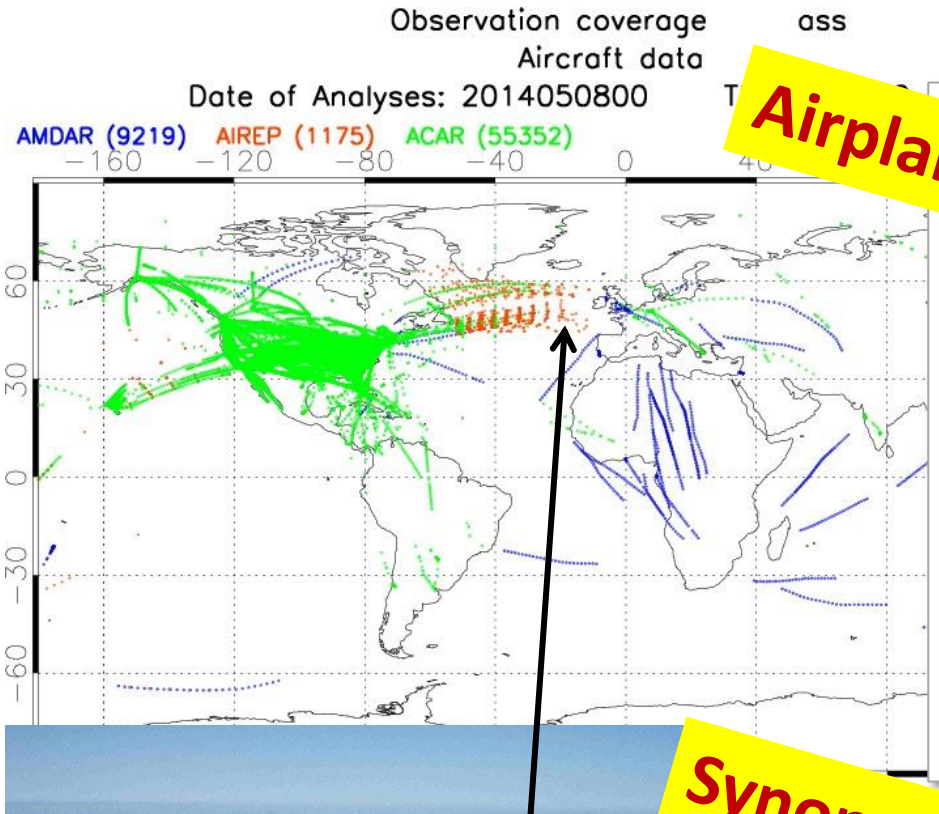




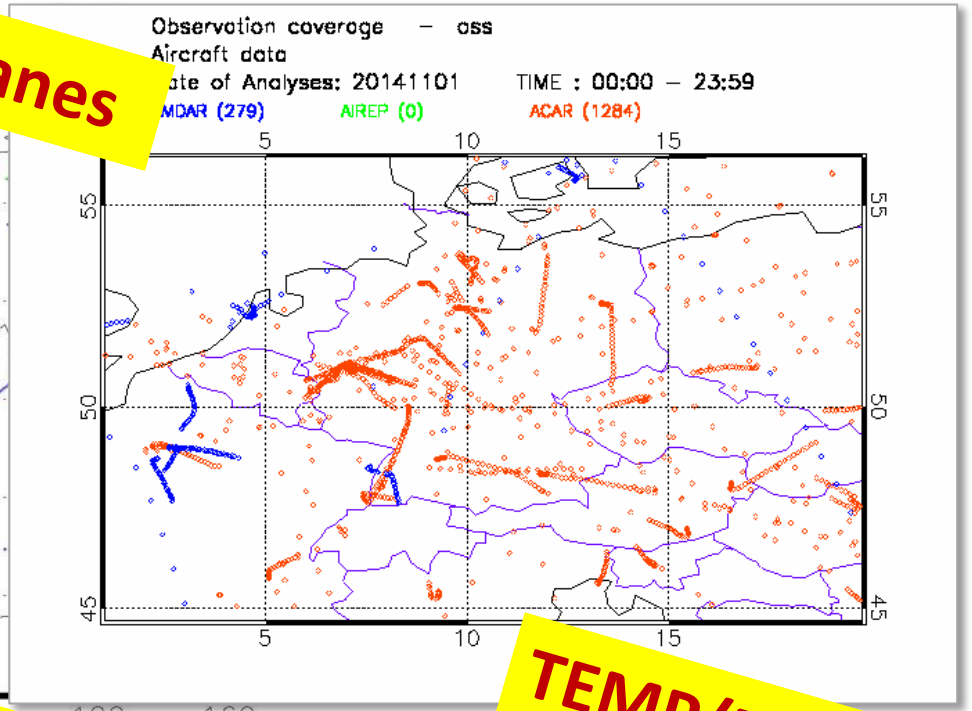
Wind-Profiler

Observations - Diversity!

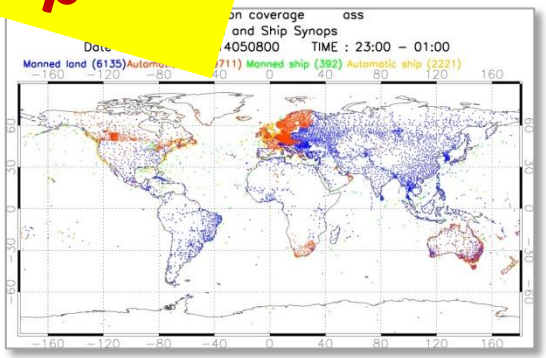
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



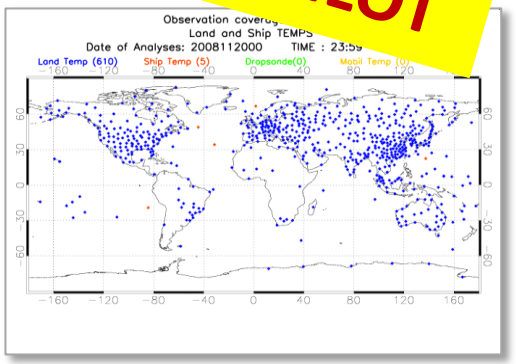
Airplanes



Synop

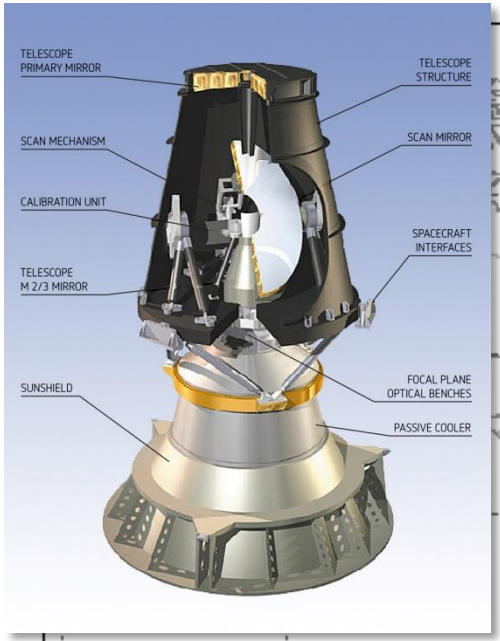


TEMP/PILOT



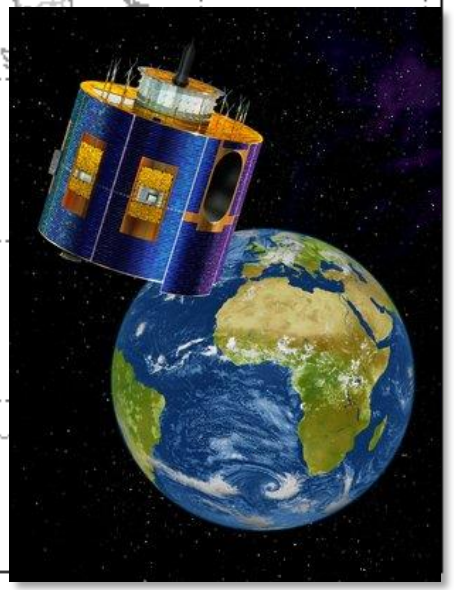
Radiance Obs: SEVIRI

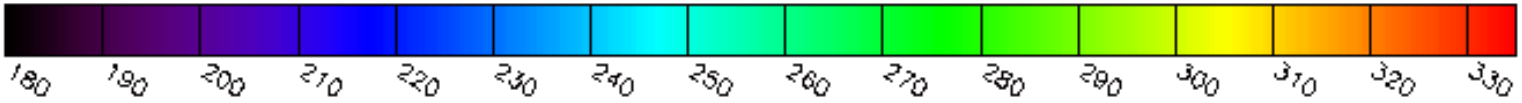
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Geostationary IR

SEVIRI
Visible,
Near Infrared,
Infrared

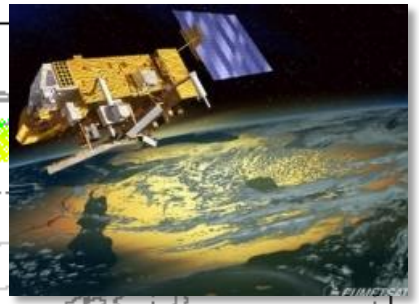




Observations: Polar Satellites

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Radianzen von polar umlaufenden Satelliten

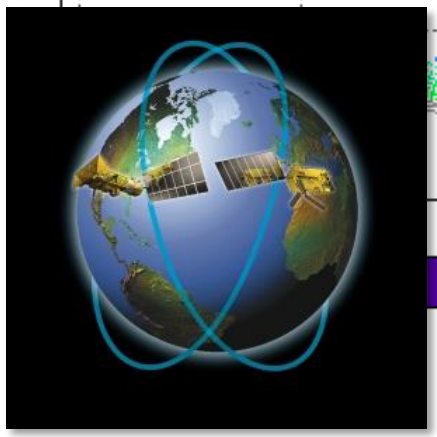


Polar Orbiting

8000 Frequencies!

Many Satellites

Many Instruments

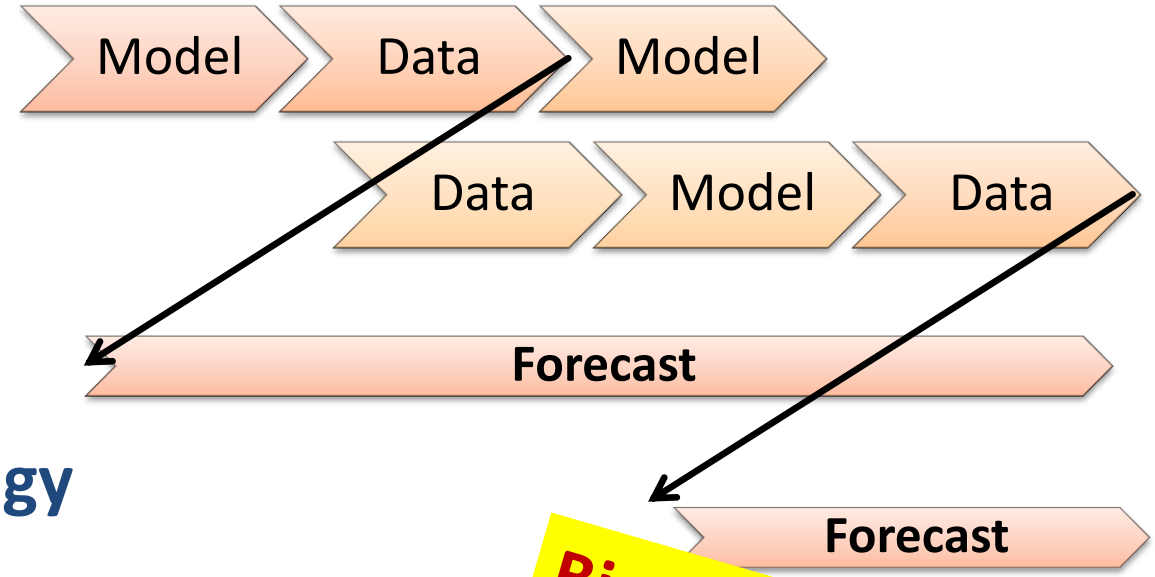


160 180 200 220 240 260 280 300

NWP Development

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

The Cycle is crucial to link to reality!!!!



Experimental Strategy

- 1 Assimilation with Single Observation
- 1 Assimilation with selected/all Obse
- Several Assimilations Cycled, e.g. 9 h or 2 da
- Period of Assimilations 1 Week/2 We
- Longer Periods Testing 1-2 Month Summer
- Full Operational Framework Testing

Bias Correction

Cloud Detection

Quality Control

Basic Tasks

We need simple tools to help us with these tasks!

1. Run the **Model** (MORE)
2. **Assimilate** Data (CORE)
3. Special **DA-Subtasks** (SST, SNOW, SMA, …)
4. Run a **Cycle**
5. **Display** Data, Fields
6. **Evaluate** Fields or O-B, Cov, Cor, Scatter, Density, Cross-Sections … much more!
7. Carry out **Quality Control** and **Verification (MEC)**

We do not want every student and staff member to programme this again and again!

Basic Tools

Deutscher Wetterdienst
und Klima aus einer Hand

Join the development on all levels!

1. Model Code **COSMO, ICON**
2. Data Assimilation **DACE**
3. **MEC** for model equivalent calculation to observations, **FDBK-R Visualization, EVA**
4. **DATOOL** Visualization & Evaluation
5. **BACY** Experiments MORE, CORE, SST, SNOW, SMA, ...
6. **NUMEX**
7. **Parallel Routine** & **Routine**

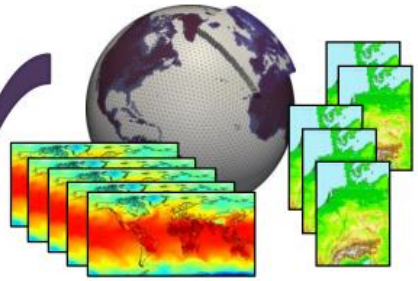
Basic Tools

Tools are there, need further development and testing

1. Run the **Model** (BACY MORE, … NUMEX)
2. **Assimilate** Data (BACY CORE, … NUMEX)
3. Special **DA-Subtasks** (SST, SNOW, SMA, … BACY SST, BACY SNOW, BACY SMA, … NUMEX)
4. Run a **Cycle** (BACY CYCLE, … NUMEX)
5. **Display** Data, Fields (datool)
6. **Evaluate** Fields or O-B, Cov, Cor, Scatter, Density, Cross-Sections … (datool, obs_err_stat)
7. Carry out **Quality Control** and **Verification** (MEC+R-fdbk, EVA)

NWP Experimental Hierarchy at Deutscher Wetterdienst DWD

ICON Model + COSMO Model
Global + Convective Scale



Verification

NWP Routine 24/7

Customers
Users
Partners

- Routine Testing

Verification

NWP Parallel Routine 24/7

Data Bases

- Routine Environment

Verification

Universities Research

NUMEX Experiments - Numerical Experimenal System

Reanalysis

Feedback

Feedback

- Case Studies (Days, Weeks)
- Summer Exp (1-3 Months)
- Winter Exp (1-3 Months)

Verification

BACY Experiments - Basic Cycling

- Analysis Cycles
- Deterministic Forecasts
- Ensemble Forecasts

File System

BACY SST
Sea Surface Temp. Analysis

BACY SNOW
Snow Analysis

BACY ICE
Ice Analysis

BACY SMA
Soil Moisture Analysis

Methods Development

Verification

BACY CORE
Atmospheric Analysis Experiments

MEC

Int2lm

DATOOL

BACY MORE
Model Run Experiments

Methods Development

DATOOL = Tool and Wrapper for Visualization, Evaluation and Diagnostics
MEC = Model Equivalent Calculator (for Verification against Observations)

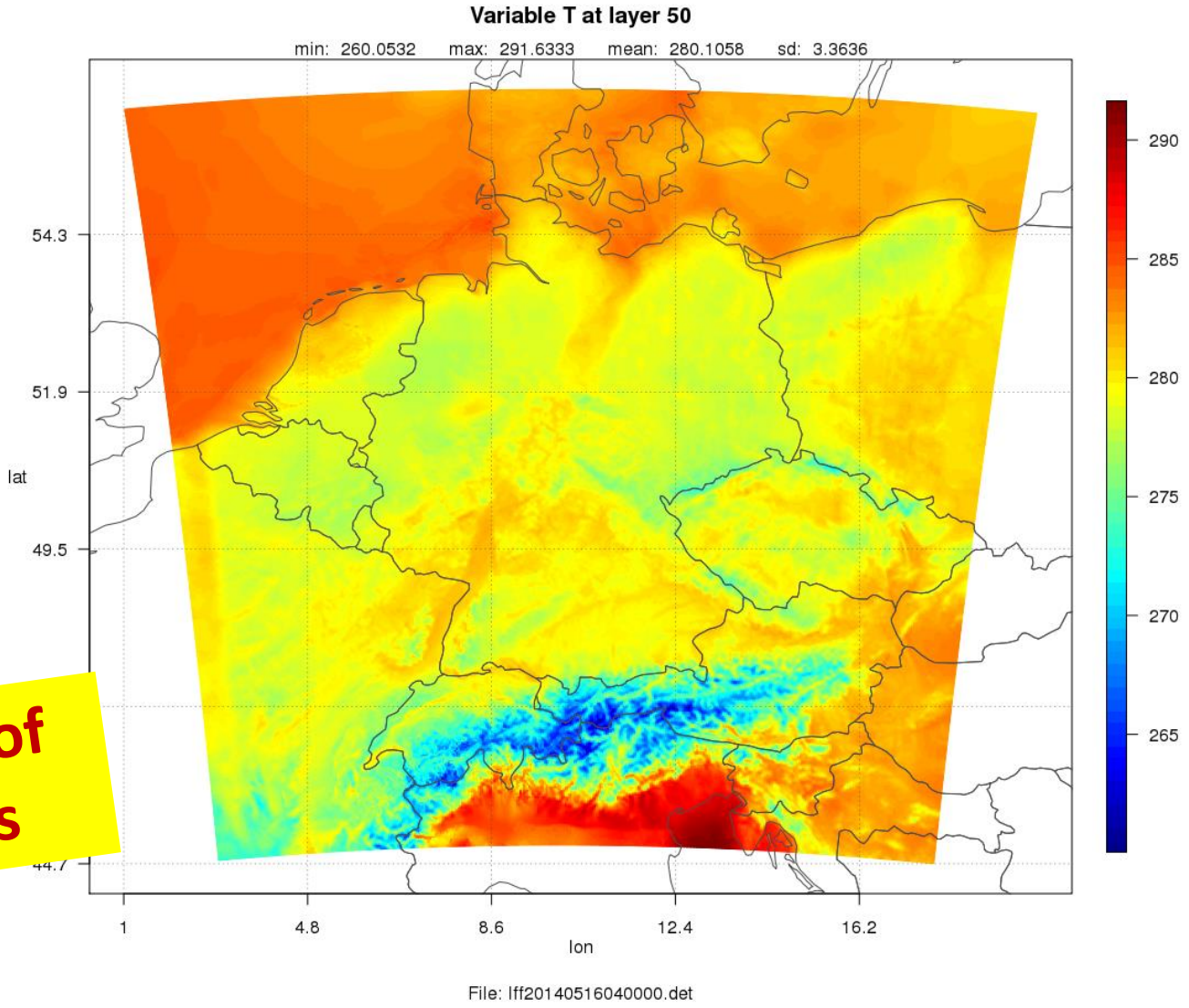
Int2lm = Interpolation to Local Model (Boundary Conditions)

Graphics: Roland Potthast 2017

Examples

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

> Datool cosmo lff20140516040000.det T 50

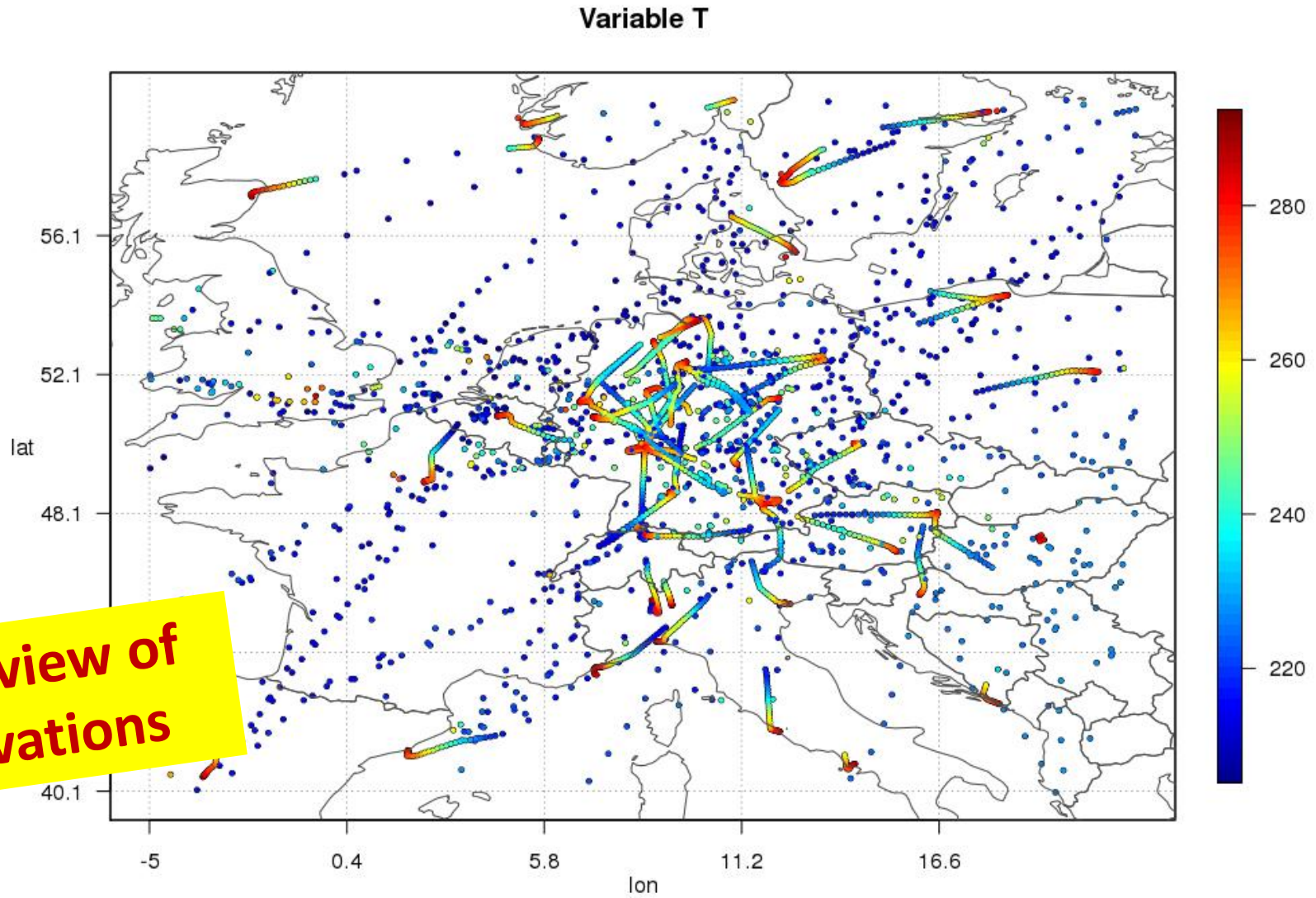


Quick view of model fields

Examples

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

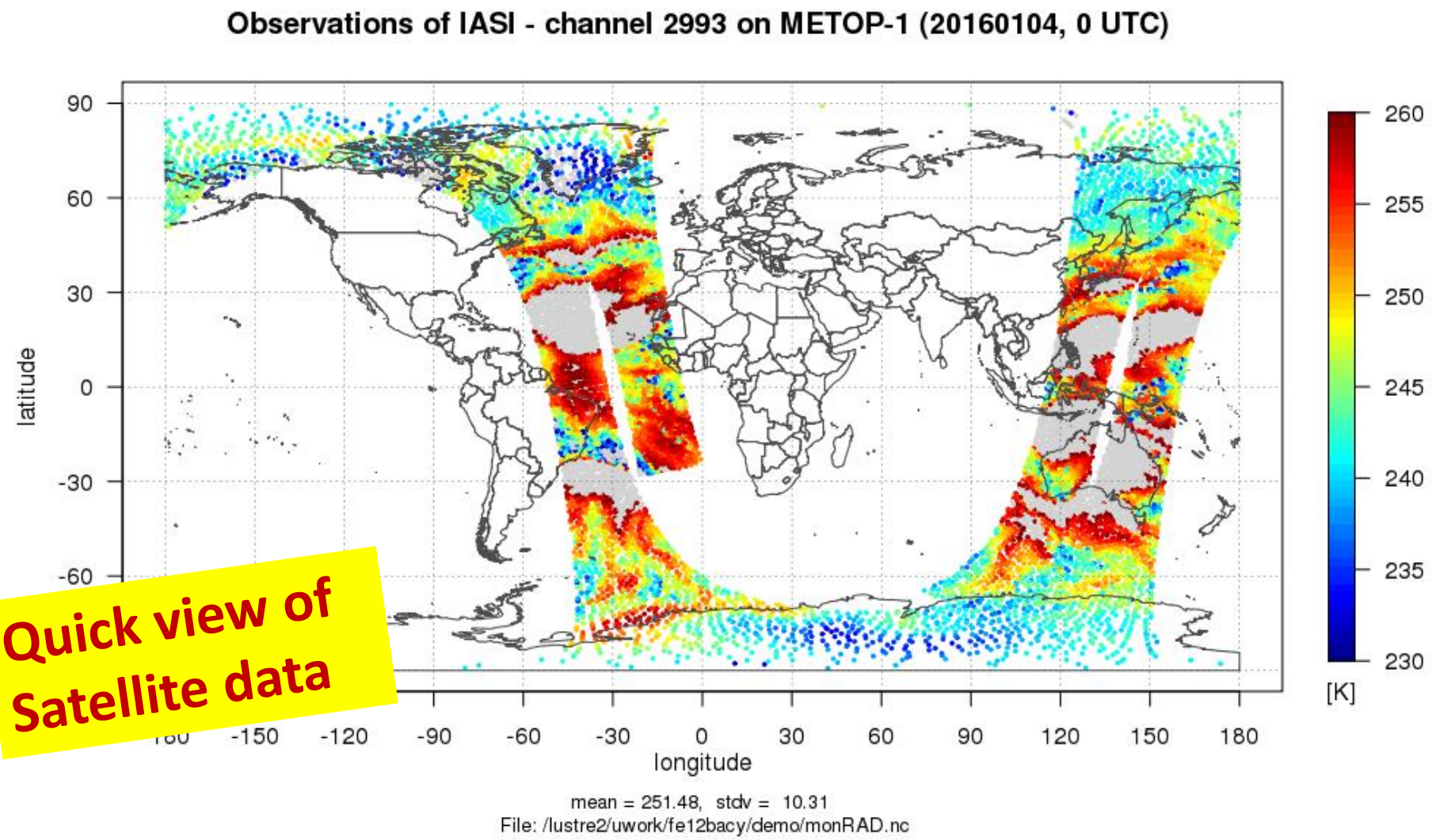
> Datool cdfin acars.nc T



Quick view of observations

Examples

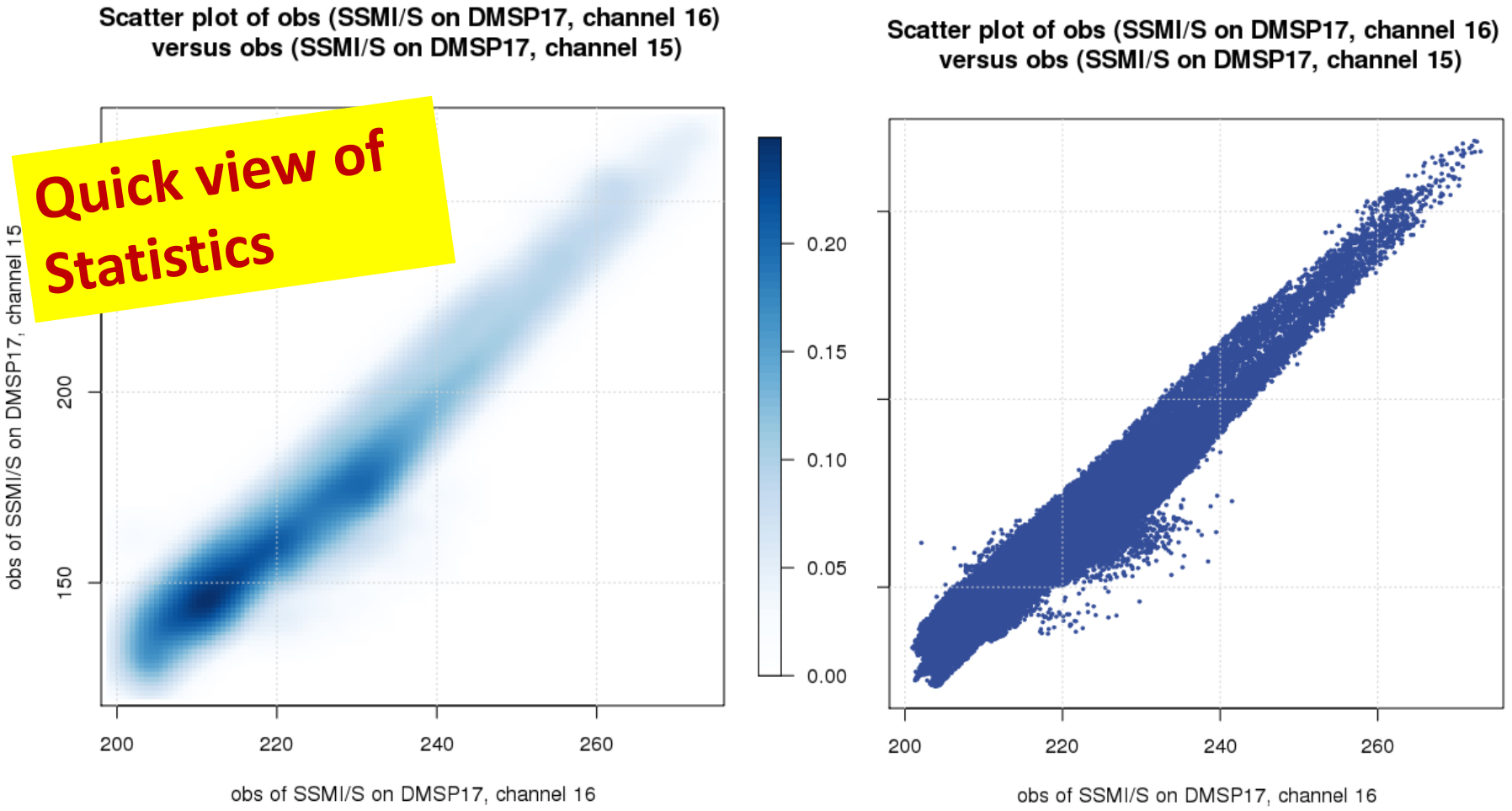
> datool fdbk_RAD monRAD.nc obs 3 221 2993



Quick view of Satellite data

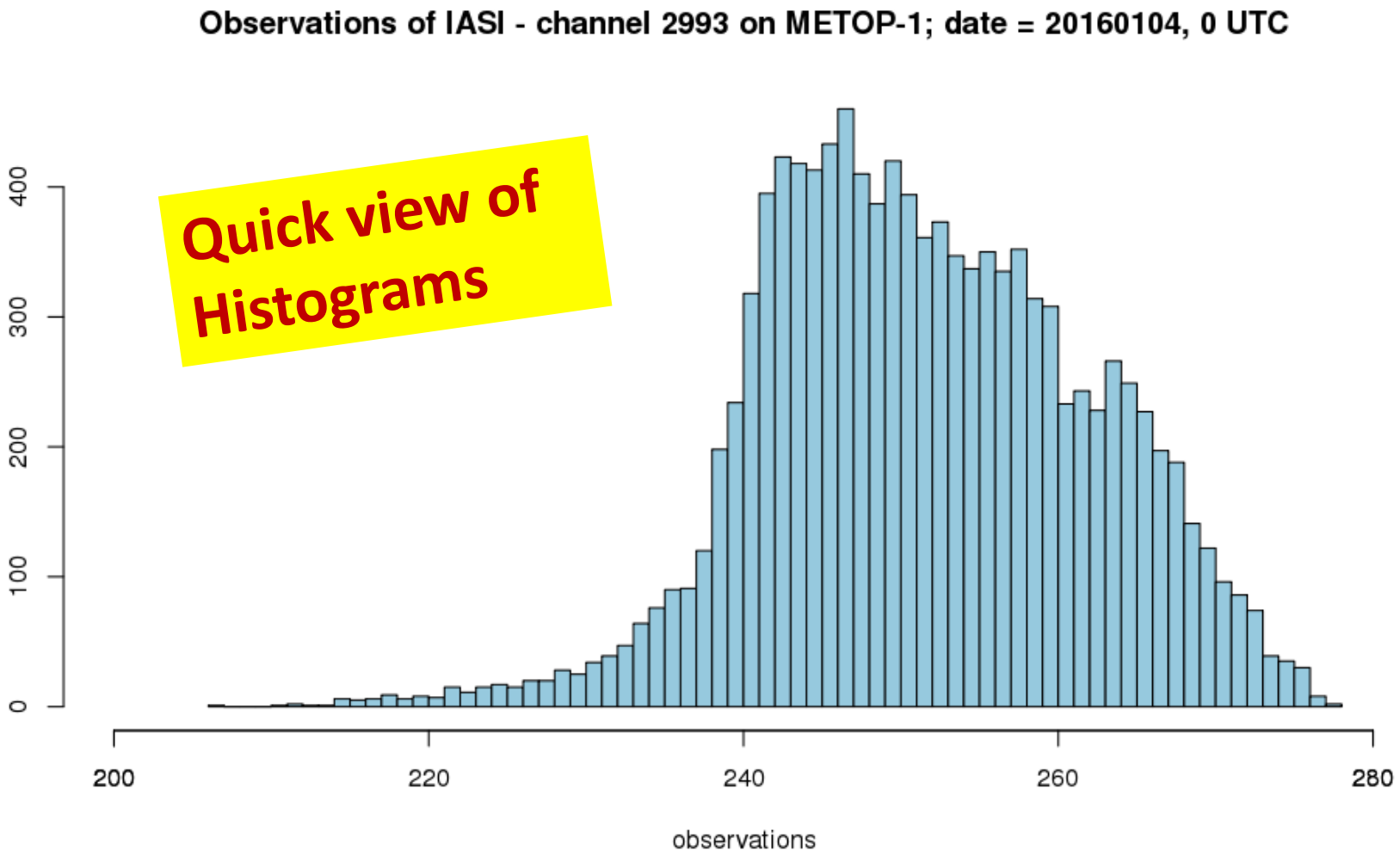
Examples

> datool fdbk_scatter monRAD_MW.nc -datax obs 285 908 16 -datay obs 285 908 15 –s dens



Examples

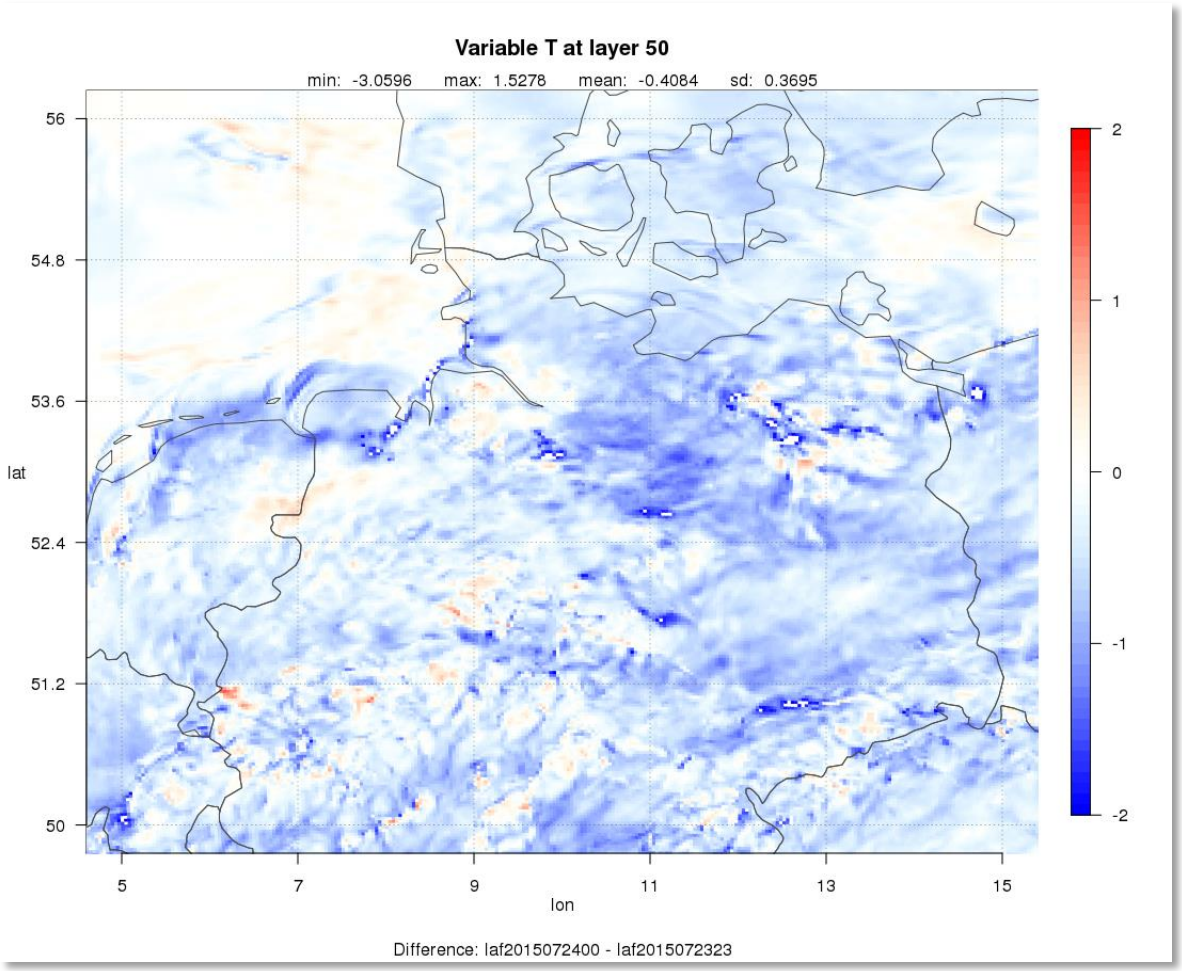
> datool fdbk_RAD monRAD.nc obs 3 221 2993 -s hist -bins 1

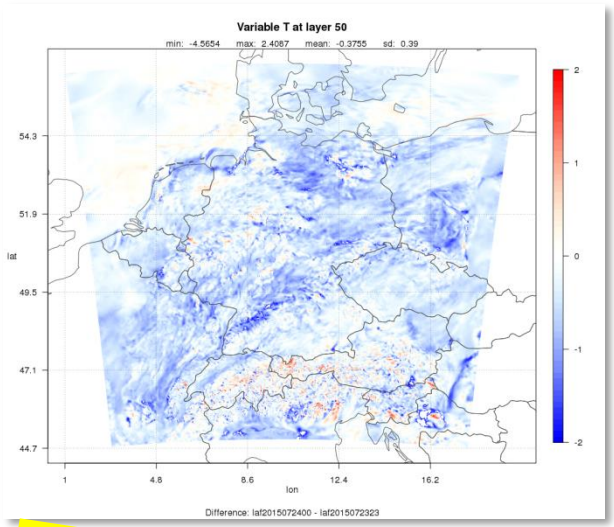


Examples

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

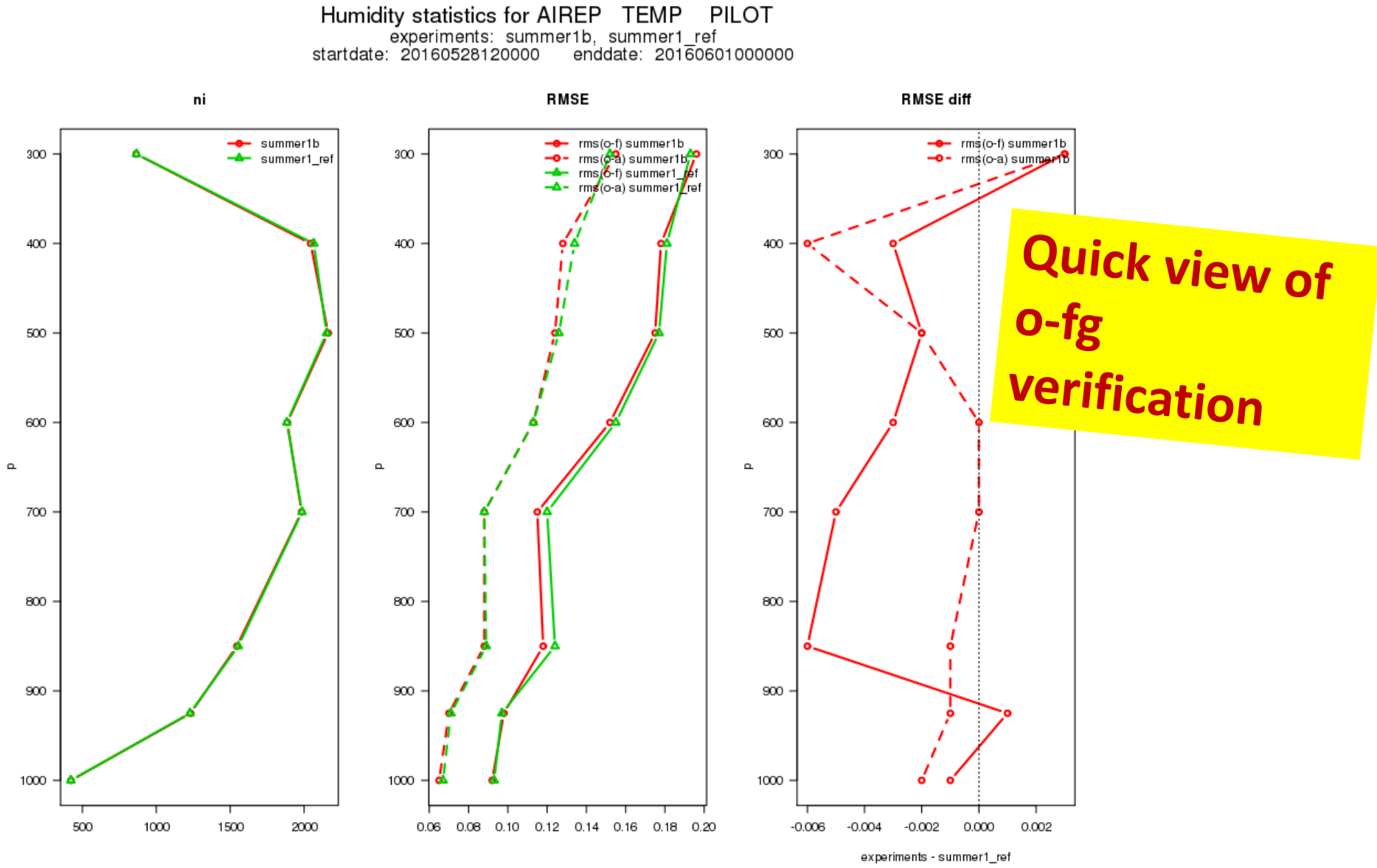
> datool cosmo_de_diff laf2015072400 laf2015072323 T 50 -x 5 -X 15 -y 50 -Y 56 -a -2 -b 2





Quick view of differences of model or obs

Verification via obs_err_stat

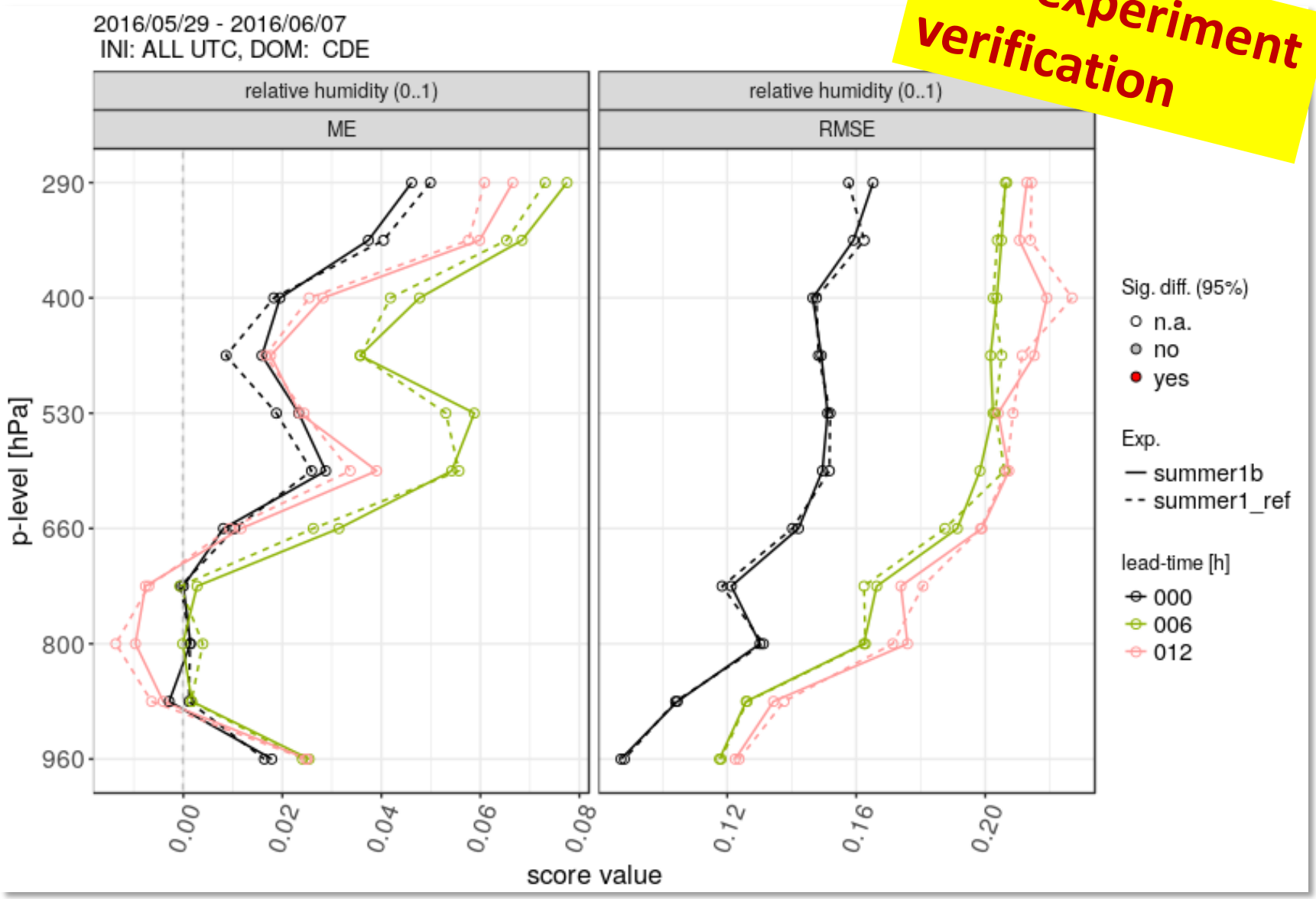


Quick view of o-fg verification

Verification via MEC + fdbk-R

Deutscher Wetterdienst
...tter und Klima aus einer Hand

Fast experiment verification



Basic Tools

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

Many THANKS for Listening

1. Run the **Model** (BACY MORE, … NUMEX)
2. **Assimilate** Data (BACY CORE, … NUMEX)
3. Special **DA-Subtasks** (SST, SNOW, SMA, … BACY SST, BACY SNOW, BACY SMA, … NUMEX)
4. Run a **Cycle** (BACY CYCLE, … NUMEX)
5. **Display** Data, Fields (datool)
6. **Evaluate** Fields or O-B, Cov, Cor, Scatter, Density, Cross-Sections … (datool, obs_err_stat …)
7. Carry out **Quality Control** and **Verification** (MEC+R-fdbk, EVA)