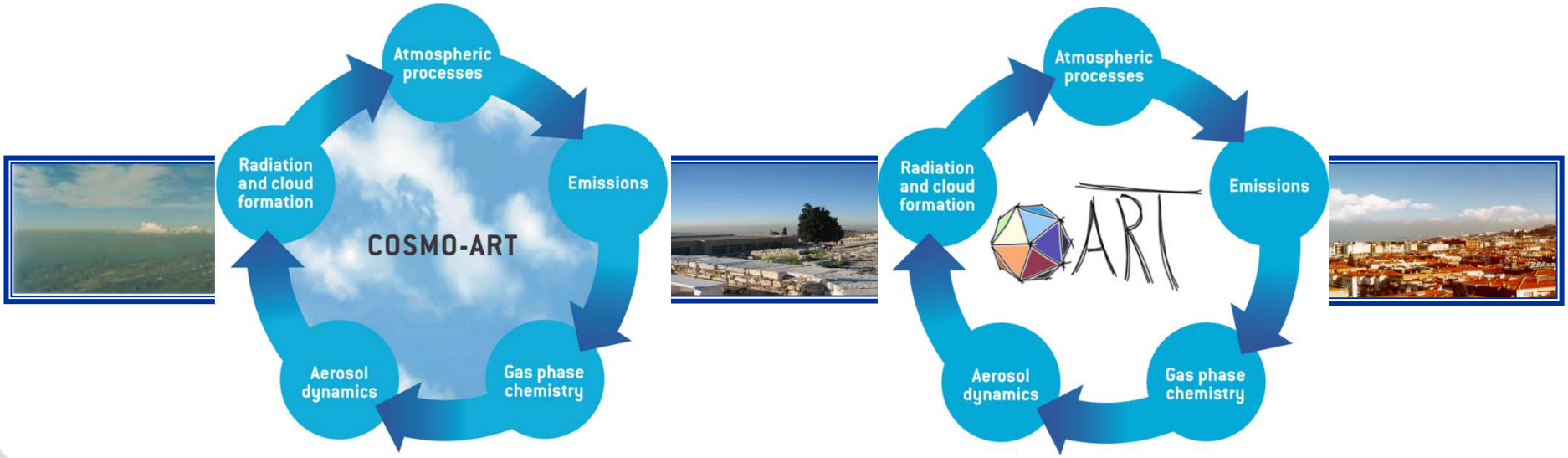
Karlsruhe Institute of Technology

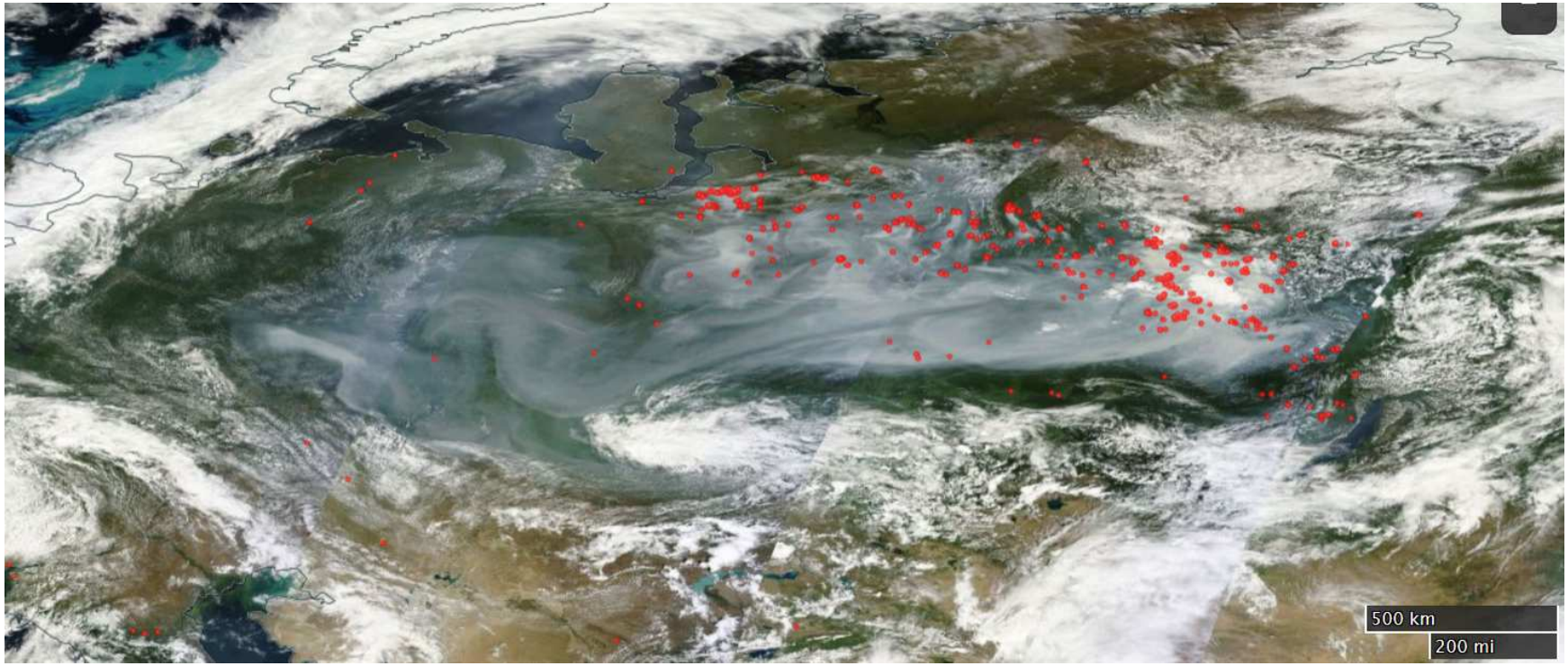
COSMO-ART and ICON-ART

Status - Development - Application

Aerosols and Climate Processes, Institute for Meteorology and Climate Research - Troposphere

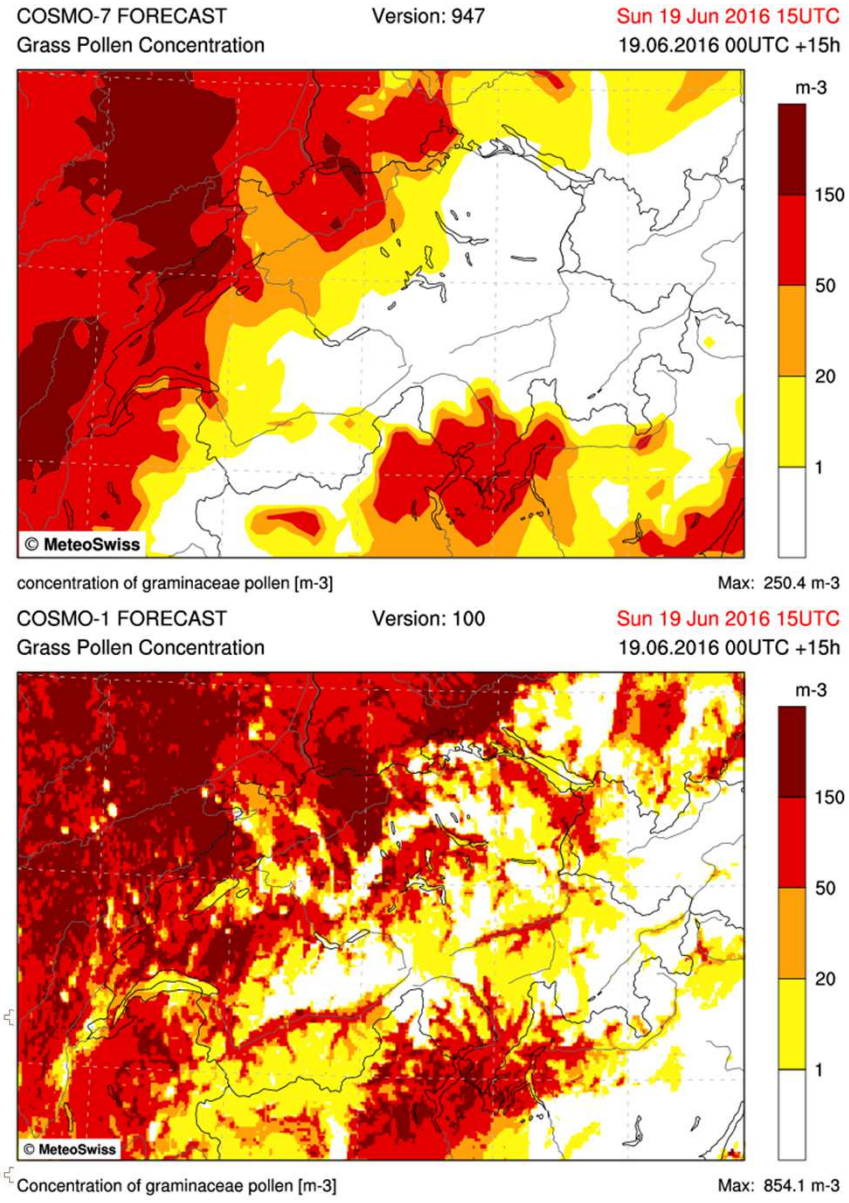


20 July 2016



500 km

COSMO-7 vs. COSMO-1

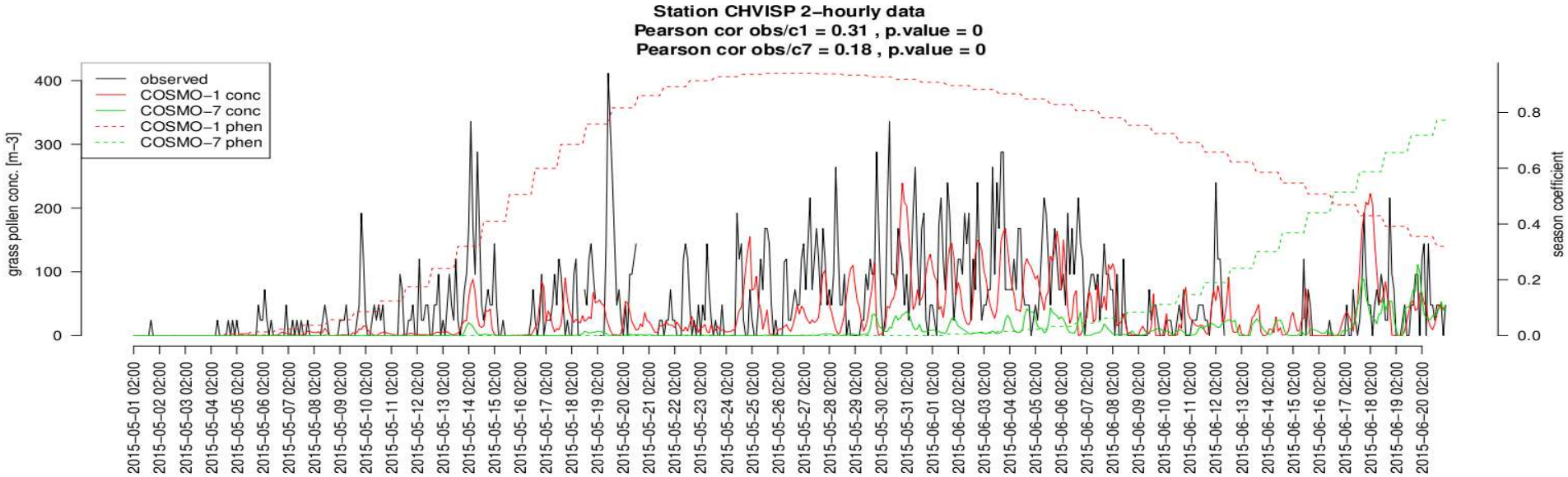


- topography
- precipitation
- season description
- plant distribution
- pollen boundaries

COSMO-1 vs. COSMO-7: station Visp

Source: signal.ch

Altitude pollen station Visp: 650m
Altitude in COSMO-7: 1482m
Altitude in COSMO-1: 739m

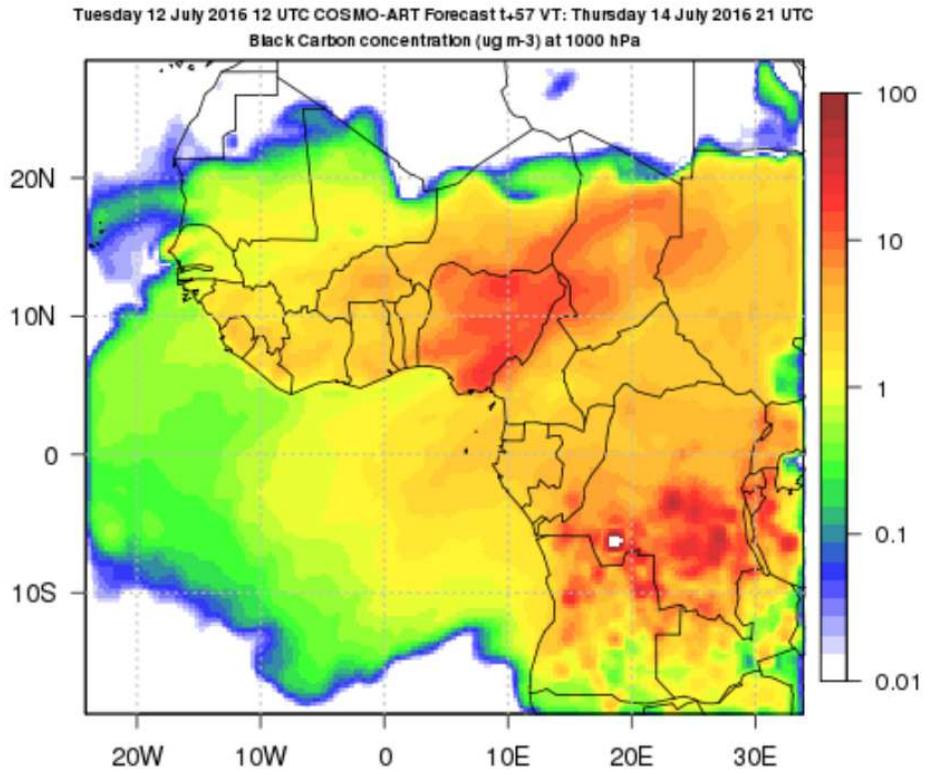


Operational forecast for the DACCIWA campaign

May-July 2016

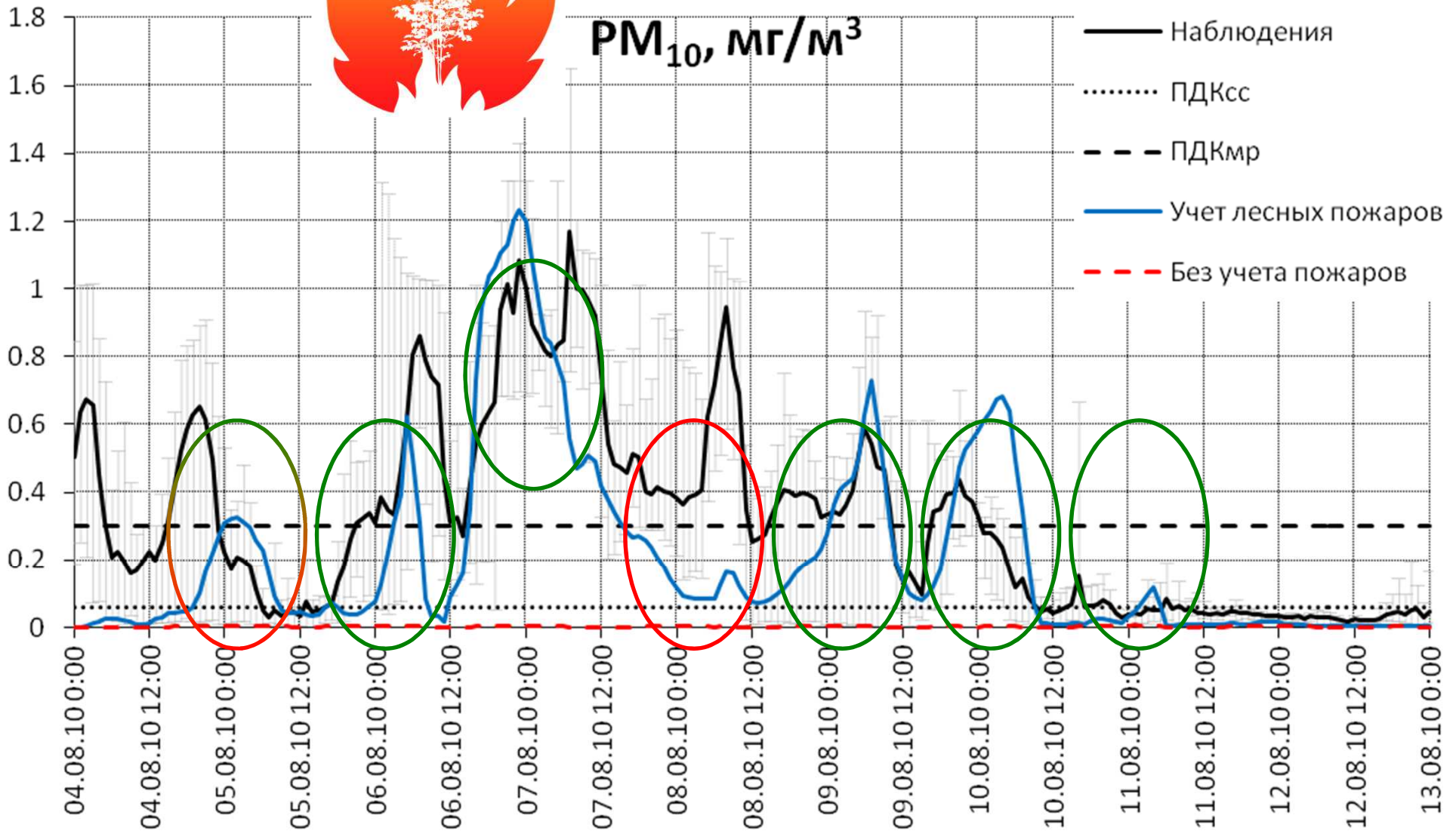
Full chemistry & aerosol dynamics

- Anthropogenic emissions
- Biogenic emissions
- Biomass burning
- Mineral Dust
- Sea salt



http://dacciwa.sedoo.fr/ Click on reactive gases


Москва
COSMO-Ru7-ART
COSMO-RU7


PM10, мг/м3
Наблюдения
ПДКсс
ПДКмр
Учет лесных пожаров
Без учета пожаров
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
04.08.10 0:00
04.08.10 12:00
05.08.10 0:00
05.08.10 12:00
06.08.10 0:00
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10.08.10 12:00
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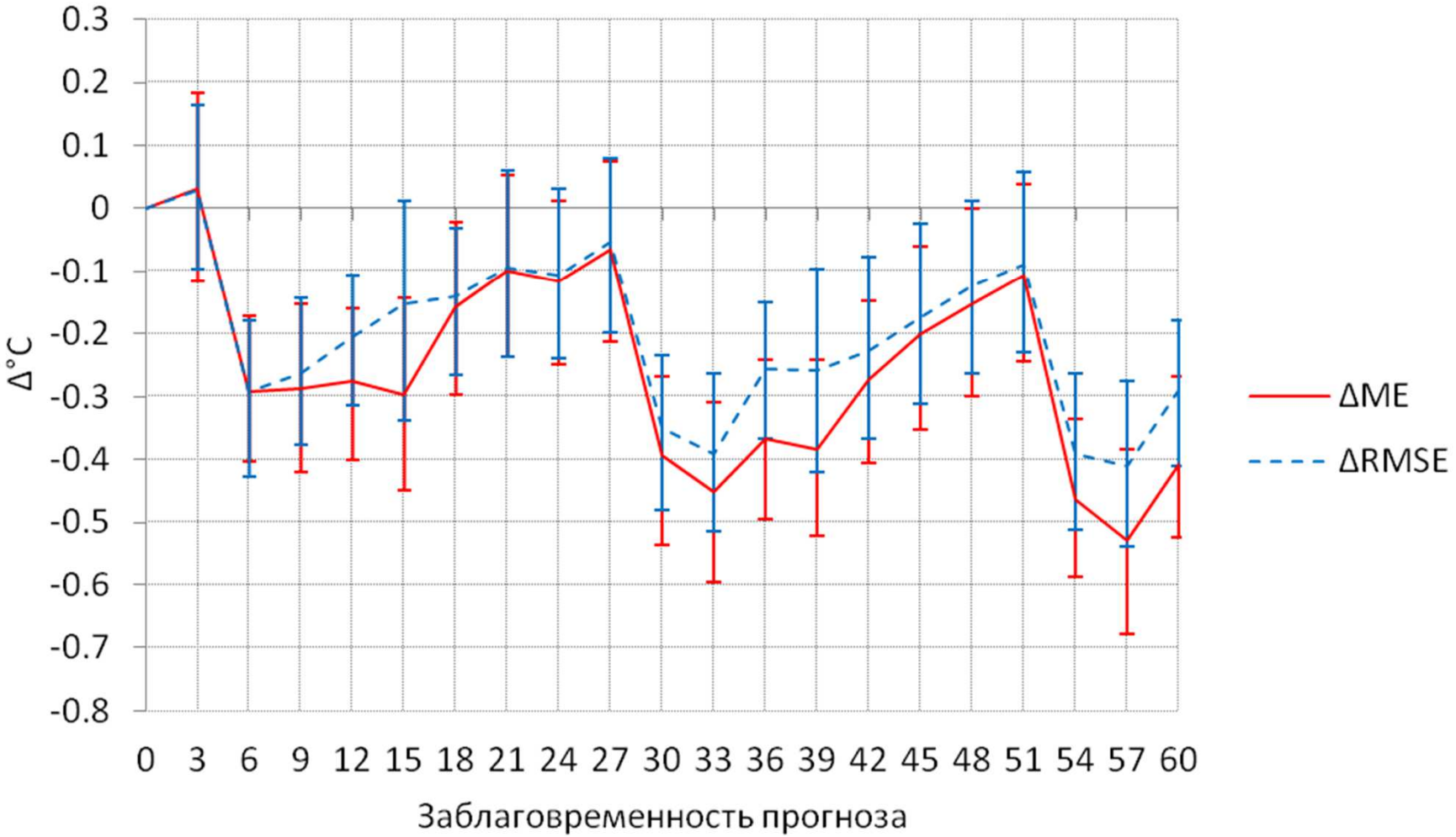
12.08.10 12:00
13.08.10 0:00

Reduction of temperature bias



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Ingeborg Bischoff-Gauss[4]
Christopher Diekmann[2]
Johannes Eckstein[2]
Jochen Förstner[3]
Philipp Gasch[1]
Tobias Göcke[3]
Daniel Rieger[1]
Roland Ruhnke[2]
Andrea Steiner[3]
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Jonas Straub[1]
Heike Vogel[1]
Carolin Walter[1]
Vanessa Wehner[3]
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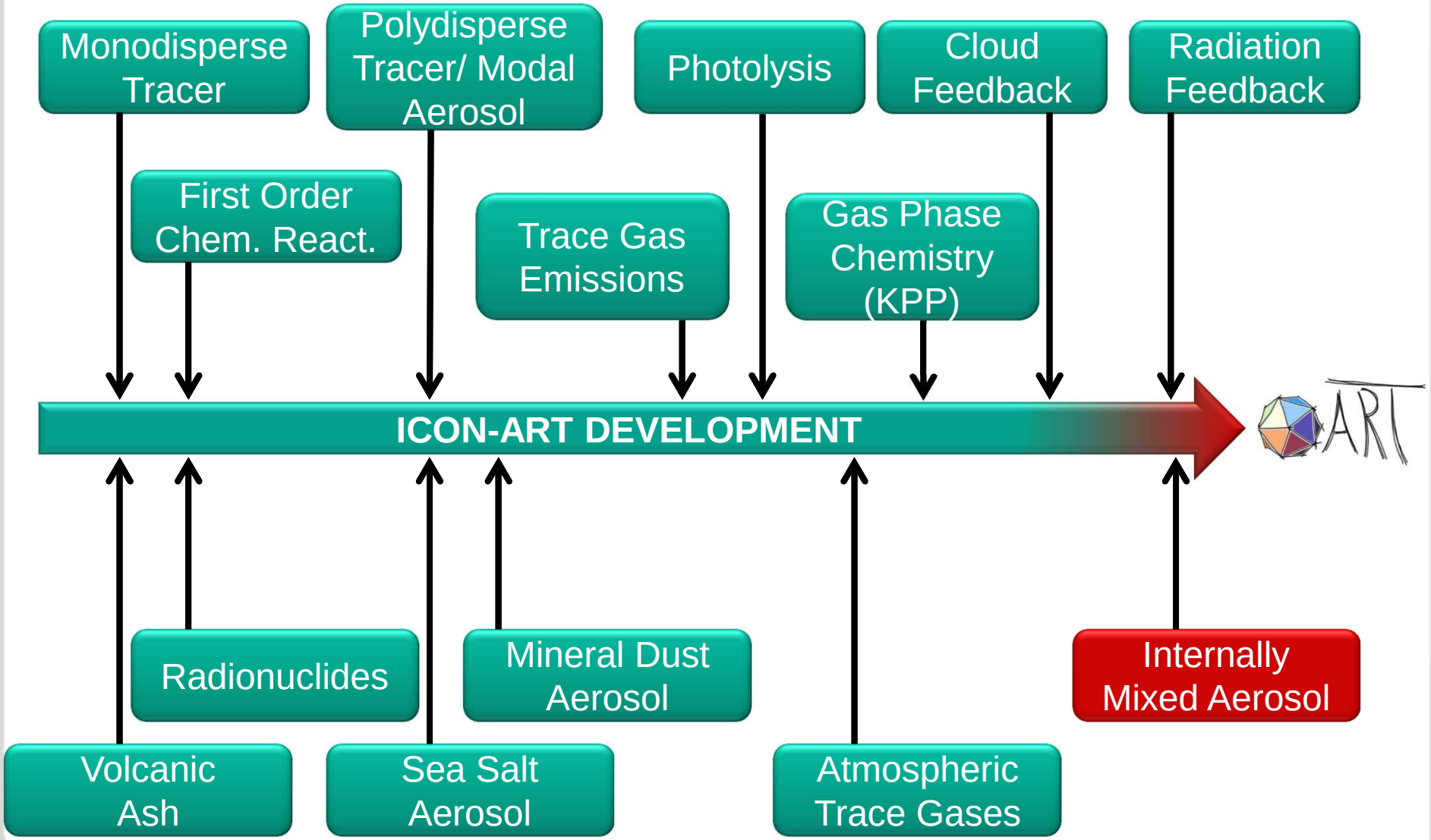
[1] KIT, Institute of Meteorology and Climate Research – Troposphere Research
[2] KIT, Institute of Meteorology and Climate Research – Atmospheric Trace Gases and Remote Sensing
[3] Deutscher Wetterdienst (DWD)
[4] KIT, Steinbuch Centre for Computing

Milestones


Monodisperse Tracer
Polydisperse Tracer/ Modal Aerosol
Photolysis
Cloud Feedback
Radiation Feedback
First Order Chem. React.
Trace Gas Emissions
Gas Phase Chemistry (KPP)
ICON-ART DEVELOPMENT
ART
Radionuclides
Mineral Dust Aerosol
Internally Mixed Aerosol
Volcanic Ash
Sea Salt Aerosol
Atmospheric Trace Gases

September Dust storm Israel, 2015


© AFP/Getty Images/Ahmad Gharabli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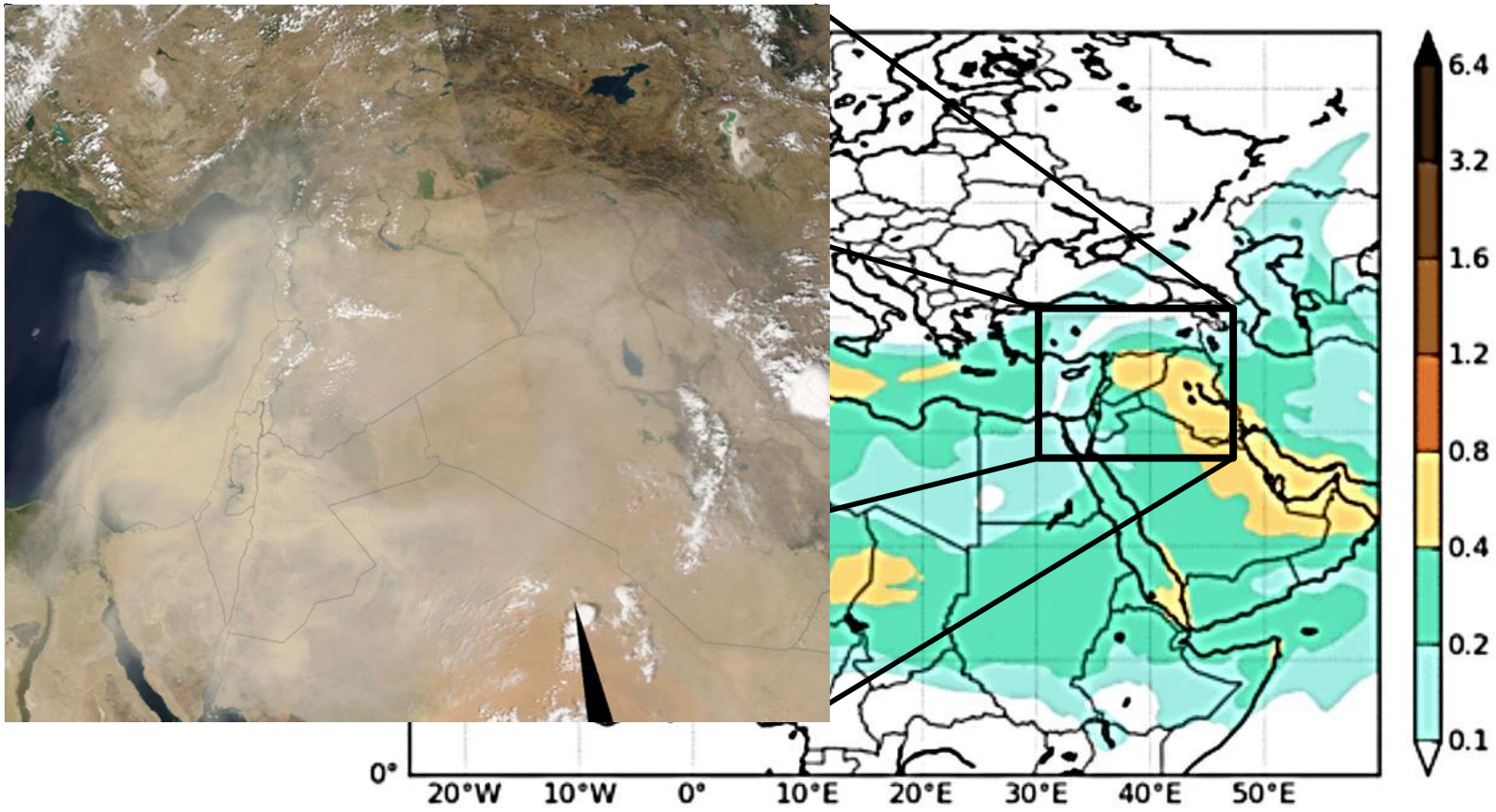
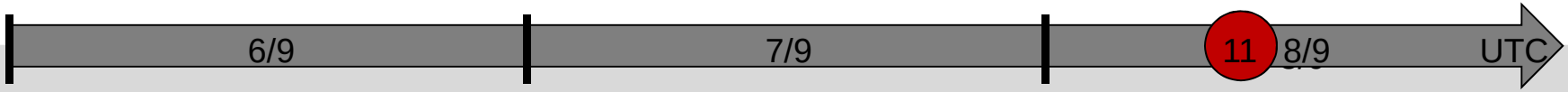
Forecast failure of global models

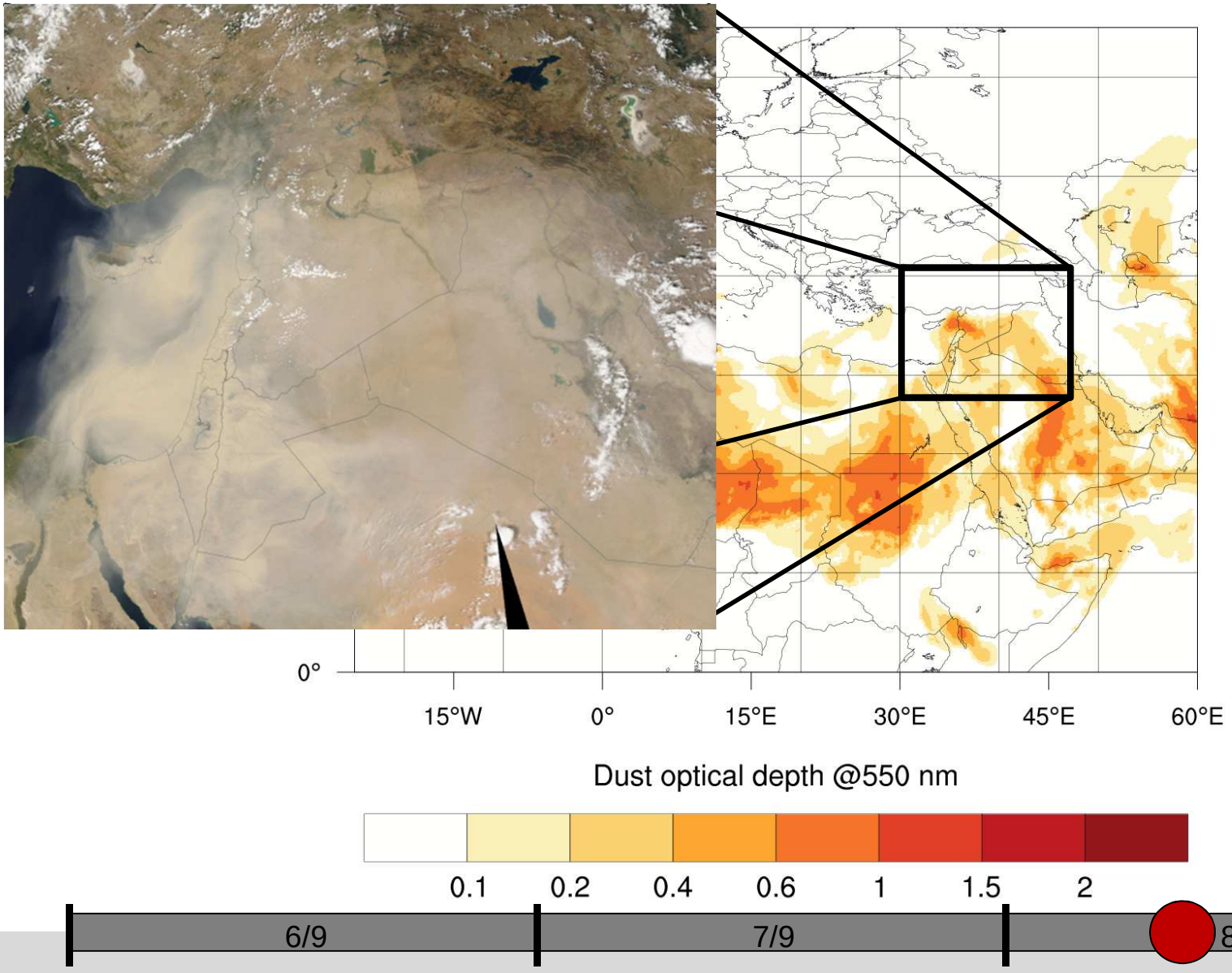


Multi-model mean dust optical depth

Obtained from WMO Model intercomparison project at http://sds-was.aemet.es



Forecast failure of global models of ICON-ART



Going to higher spatial resolution

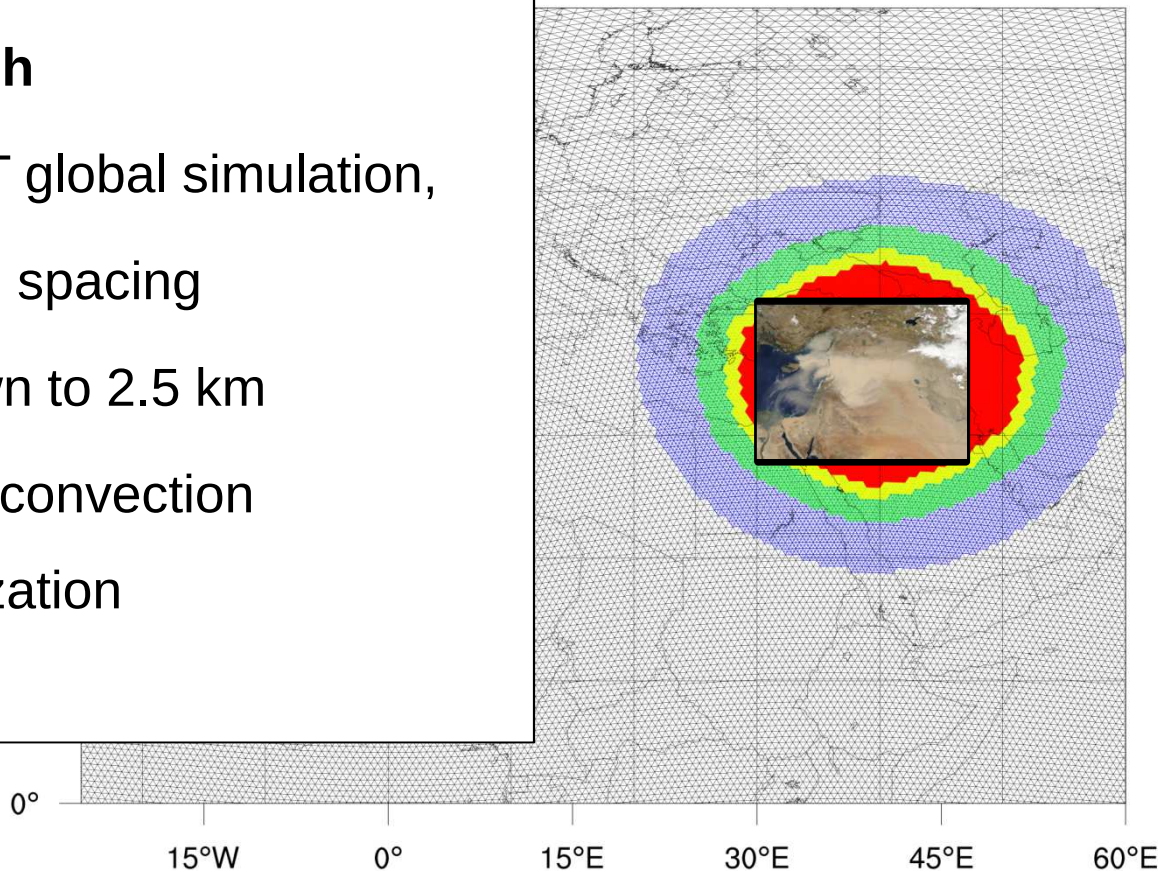
Our approach

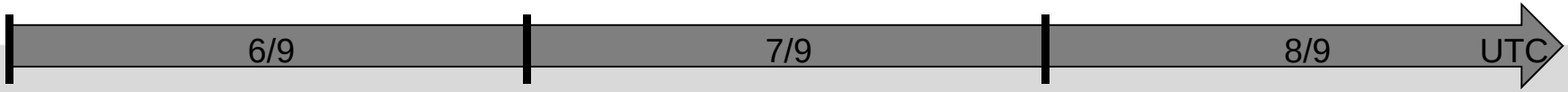
- ICON-ART global simulation,

  40 km grid spacing
- Nests down to 2.5 km

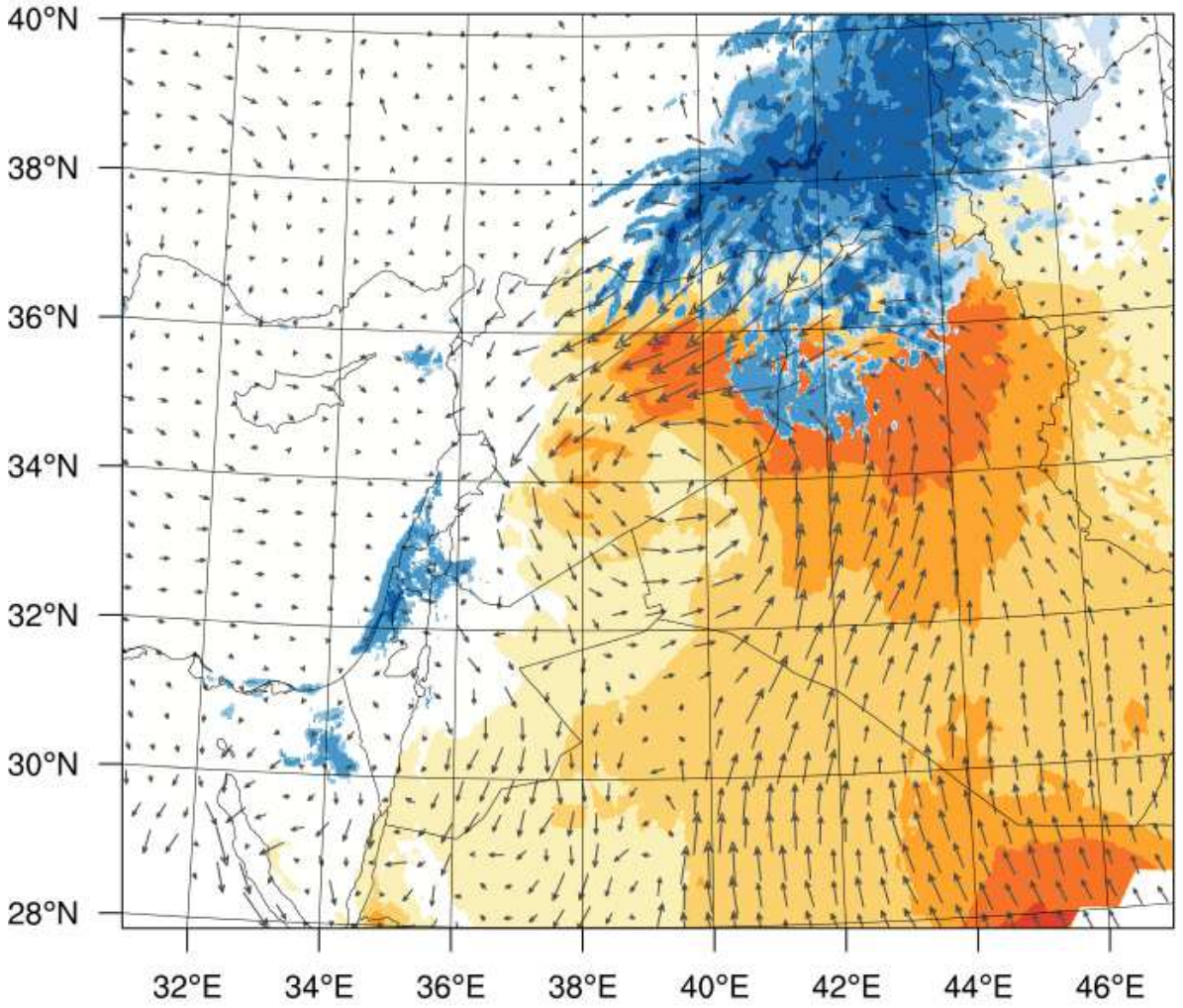
→ Switch-off convection

parametrization



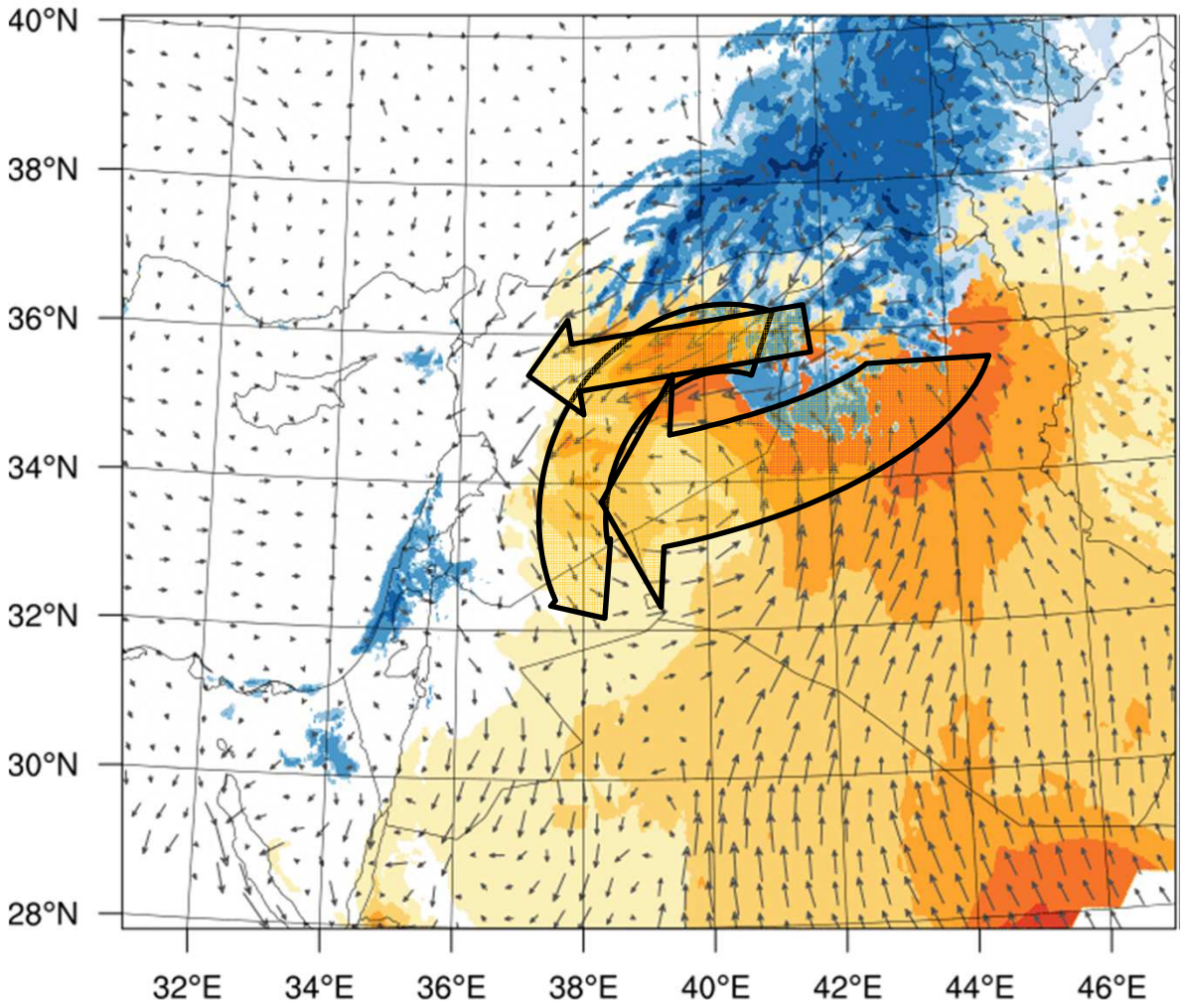


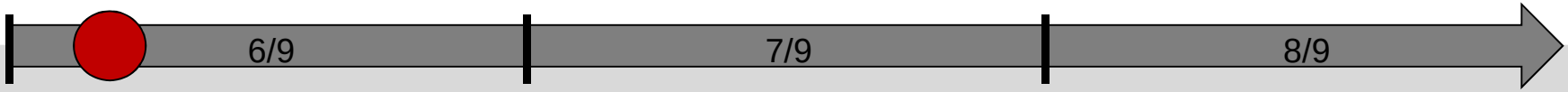
Course of event



06 | 6/9 | 7/9 | 8/9

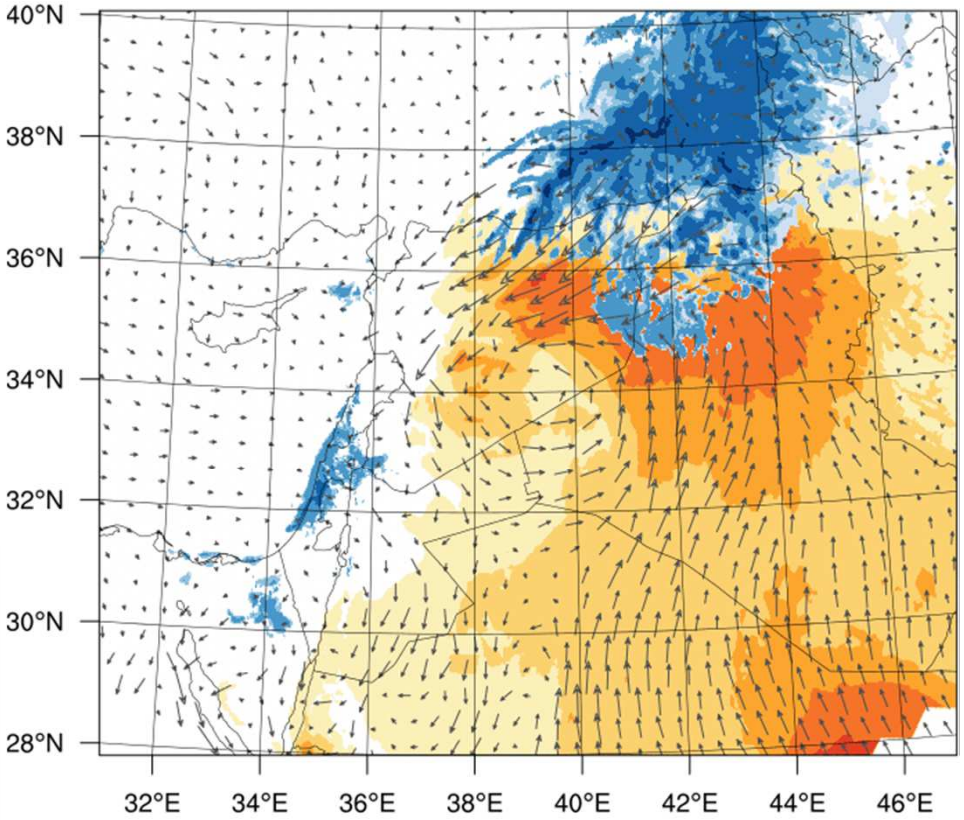
Course of event



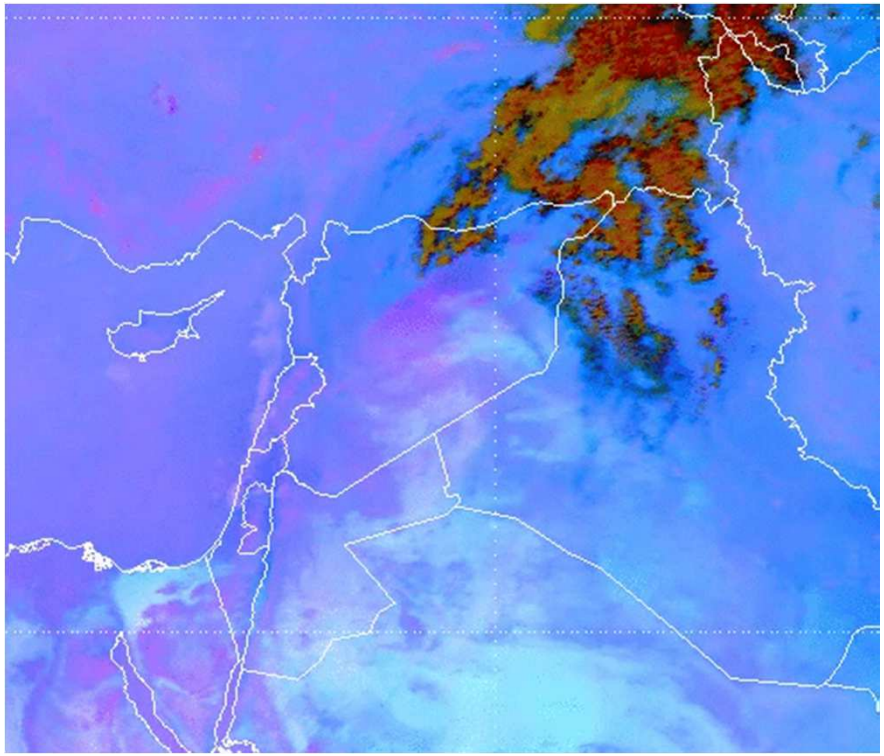


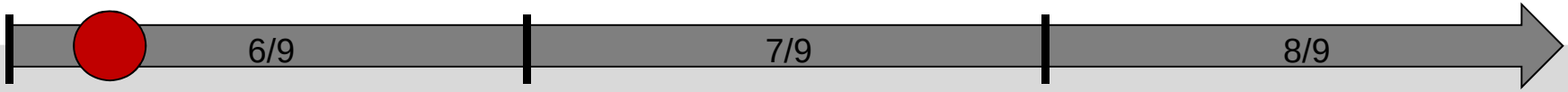
Validation of ICON-ART

ICON-ART

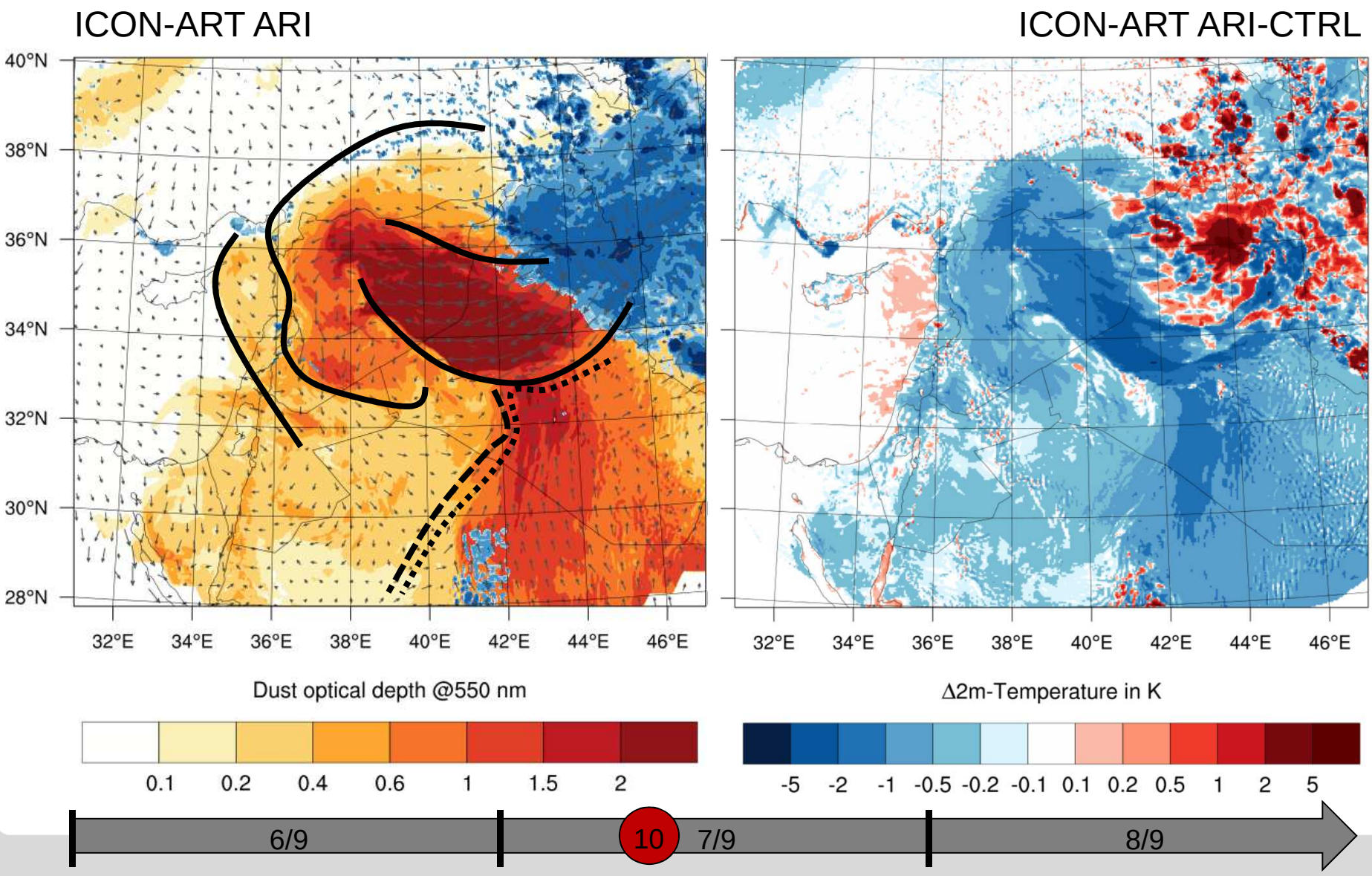


EUMETSAT





Mineral dust radiative effect - temperature



Joint research/application of DWD and KIT

- **Volcanic Ash**
- **Mineral Dust**: Project **PerduS**

  (“Reduction of PV power generation due to Saharan mineral dust”)

- **Radionuclides**: use ICON-ART in addition to LPDM – coordinated work with BfS
- **Toxic Chemical Substances**: ICON-heARTs – emergency cases
- **Pollen** dispersion

Research KIT

Validiation with ETEX data

Impact of volcanic ash on atmospheric processes

Dust-cloud-radiation feedback

Scale dependency of aerosol cloud interaction

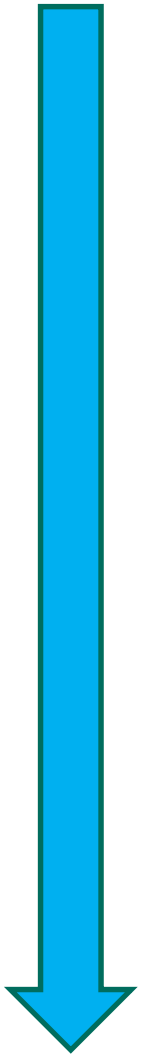
Inclusion of water isotopologues

Simplified ozone chemistry

Troposphere-Stratosphere exchange

Decadal runs with the climate physics package

Aerosols in operational forecasts



Pollen grains: **health issues**

Volcanic ash: **aviation**

Mineral dust: **visibility**

Vegetation fires: **health, aviation**

Sea salt, mineral dust: **cloud formation**

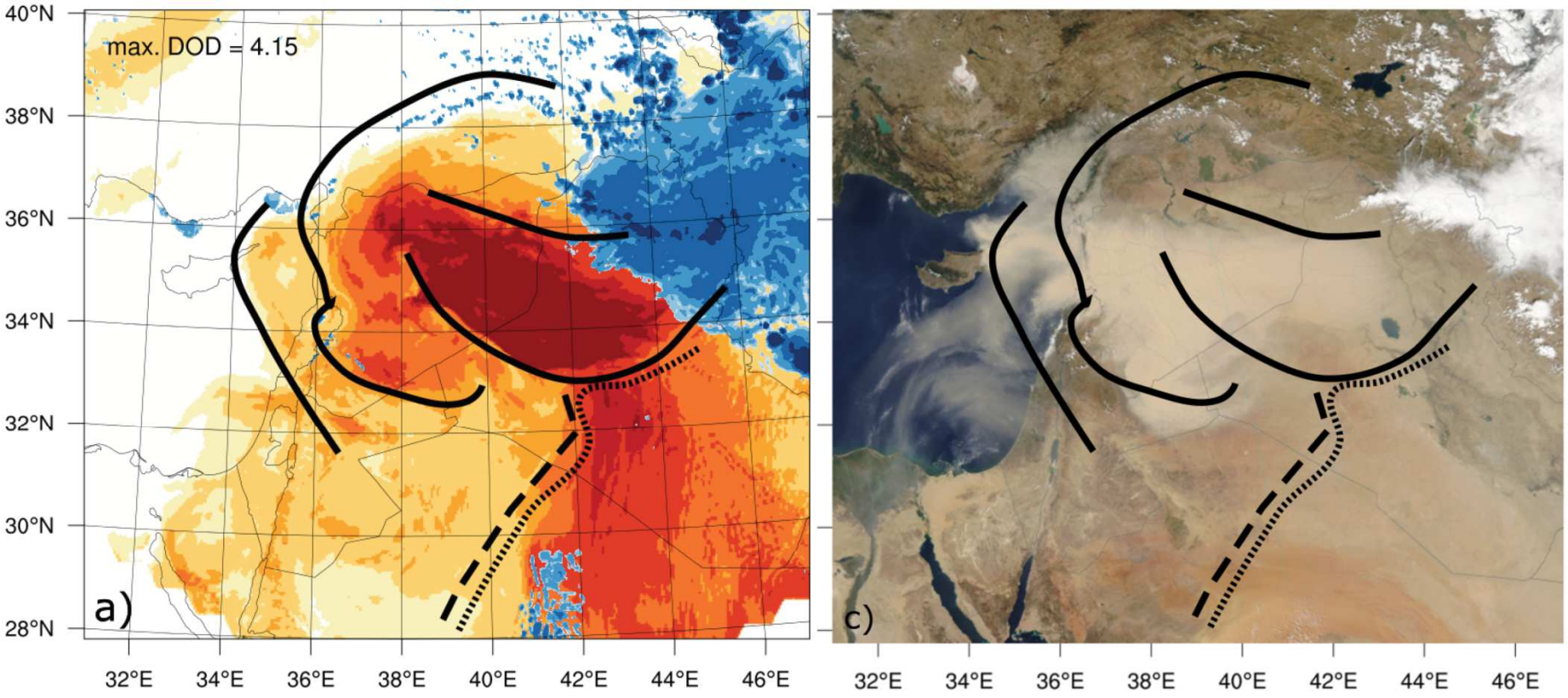
Primary and secondary aerosols:

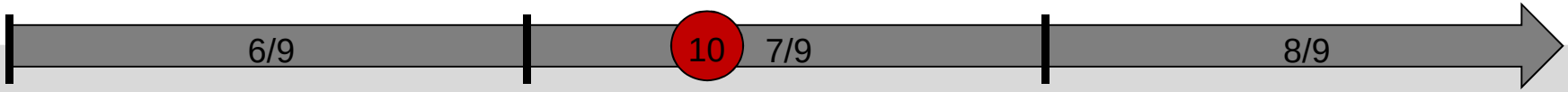
visibility, fog, icing, flooding, …

Validation of ICON-ART

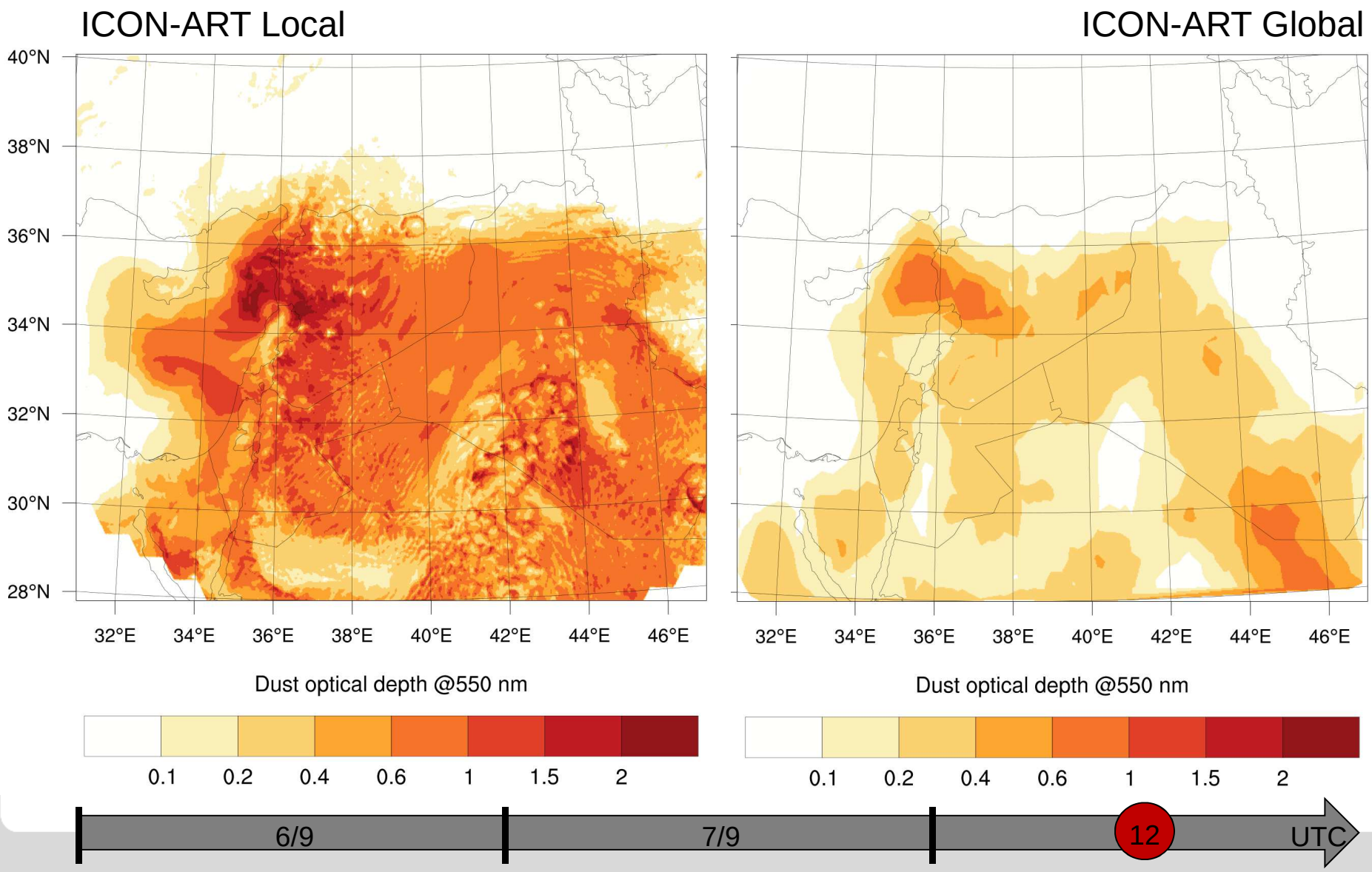
ICON-ART

MODIS TERRA VIS



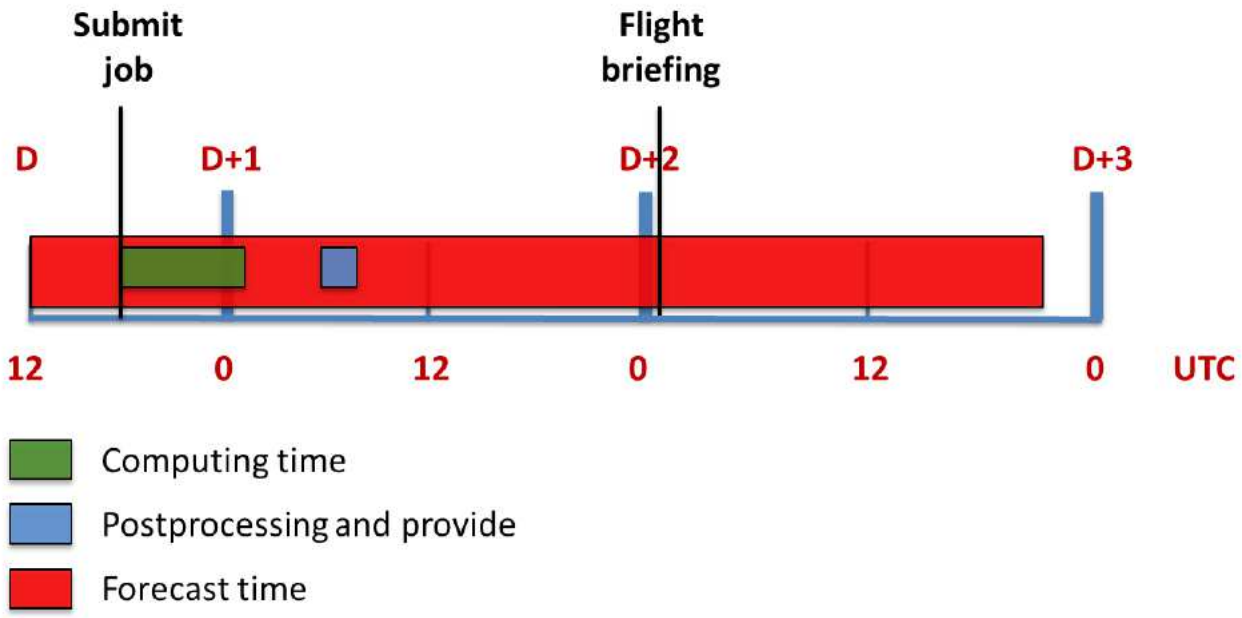


Forecast improvement



ICON-ART infrastructure highlights

- Minimal invasive coupling between ICON and ART
- XML based tracer definition and metadata initialization
- Flexible extension of the ICON tracer metadata structure
- Optional hybrid parallelization
- Flexible and easily extendable aerosol module framework


Submit job
Flight briefing
D
D+1
D+2
D+3
12
0
12
0
12
0
UTC
Computing time
Postprocessing and provide
Forecast time

Operational forecast for the DACCIWA campaign

Karlsruhe Institute of Technology

- **COSMO ART**
  - COSMO ART Continental (05-Sep)

May-2016:	05	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
Jun-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Jul-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

  - COSMO ART SWA (05-Sep)

May-2016:	05	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
Jun-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Jul-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

  - COSMO ART Cross Section (05-Sep)

May-2016:	05	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
Jun-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Jul-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

  - COSMO ART Forecast Summary PDF

Apr-2016:	07																														
May-2016:	05	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
Jun-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Jul-2016:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

COSMO-ART Training course, 2016

New users:

Tanzania Meteorological Agency
National Environmental Agency of Georgia
Siberian Regional Hydrometeorological Research Institute