The main goal of ARA project is to create first of its kind high resolution (2.5 km) re-analysis ensemble dataset for Austria by assimilating observations using the 3DVAR of the C-LAEF ensemble system based on the AROME model. This re-analysis will reconstruct spatially, temporally, and physically consistent 3D and 2D essential climate variables for Austria.
WHAT IS RE-ANALYSIS?

01 Observations
Observations taken from all available sources can be considered. E.g. Station observations, Satellite, radiosondes, Ships, Aircrafts, radiosondes etc.

02 NWP Model equipped with ASSIMILATION system
NWP model like AROME equipped with 3D or 4D variational assimilation system

03 Reanalysis dataset
Physically consistent 3D and 2D information about the past state of atmosphere which has been corrected to compensate for inherent biases.
ARA – High Resolution Austrian Re-analysis Ensemble conceptual outline

ECMWF ERA5
ECMWF ERA5 global reanalysis with 1h / 3h temporal frequency

Global reanalysis

AROME, 3DVAR

Austrian reanalysis
High resolution regional reanalysis for Austria

Regional reanalysis

Aircraft

Radiosondes

Wind profiler

Station obs

Satellite obs

Sequential, intermittent assimilation

Analysis → Model → Analysis → Model → Analysis → Model
**ARA – HIGH RESOLUTION AUSTRIAN RE-ANALYSIS ENSEMBLE**

<table>
<thead>
<tr>
<th>ARA Ensemble system</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently running on the ECMWF HPC</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Ensemble size</th>
<th>1 + 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δx / vertical levels</td>
<td>2.5km / 90</td>
</tr>
<tr>
<td>Coupling</td>
<td>ECMWF-ERA5 (1-3-hourly coupling)</td>
</tr>
<tr>
<td>Runs per day / lead time</td>
<td>00, 03, 06, 09, 12, 15, 18, 21 UTC / +5hrs</td>
</tr>
<tr>
<td>Assimilation cycle</td>
<td>3h</td>
</tr>
<tr>
<td>Assimilation</td>
<td>Atmosphere (3D-VAR), surface (OI)</td>
</tr>
<tr>
<td>Perturbations</td>
<td>Observations (surface, atmosphere), LBC, model (stoch. physics)</td>
</tr>
<tr>
<td>Output</td>
<td>Hourly</td>
</tr>
<tr>
<td>Time</td>
<td>2012 - 2022</td>
</tr>
</tbody>
</table>
### ARA – High Resolution Austrian Re-analysis Ensemble Case Studies

<table>
<thead>
<tr>
<th>Event</th>
<th>Short description</th>
<th>Focused region</th>
</tr>
</thead>
<tbody>
<tr>
<td>20210624</td>
<td>Extreme precipitation event</td>
<td>Northern Alps</td>
</tr>
<tr>
<td>20210630</td>
<td>Local convection</td>
<td>Feldbach/WegenerNet</td>
</tr>
<tr>
<td>20210718</td>
<td>Thunderstorm event</td>
<td>Feldbach/WegenerNet</td>
</tr>
<tr>
<td>20211218</td>
<td>Fog event</td>
<td>Feldbach/WegenerNet</td>
</tr>
<tr>
<td>20220112</td>
<td>Freezing event</td>
<td>Feldbach/WegenerNet</td>
</tr>
<tr>
<td>20220131</td>
<td>Snow event</td>
<td>Austrian Alps</td>
</tr>
<tr>
<td>20220217</td>
<td>Storm event</td>
<td>WegenerNet</td>
</tr>
<tr>
<td>20220527</td>
<td>Thunderstorm event</td>
<td>Fedbach/WegenerNet</td>
</tr>
</tbody>
</table>
ARA – HIGH RESOLUTION AUSTRIAN RE-ANALYSIS ENSEMBLE
CASE STUDIES
2021-06-24
ARA – HIGH RESOLUTION AUSTRIAN RE-ANALYSIS ENSEMBLE

CASE STUDIES

2021-06-30

GeoSphere Austria
ARA – HIGH RESOLUTION AUSTRIAN RE-ANALYSIS ENSEMBLE
CASE STUDIES
2022-05-27

GeoSphere Austria

Vinar Meeting
ARA – HIGH RESOLUTION AUSTRIAN RE-ANALYSIS ENSEMBLE

CASE STUDIES
2021-06-30

T2M

Bias

MAE

RMSE

PREC

Bias

MAE

RMSE
Summary & Outlook

• ARA ensemble is performing at pair with our operational models.

• The statistical analysis shows that the ARA ensemble has the ability to simulate extreme precipitation events with good accuracy however, spatial and temporal shifts are observed.

• Further evaluation is on-going e.g. 3D evaluation by using a Radar and comparison with novel wegener Net data.

• We intend on using this data to create extreme forecast index (EFI), evaluate NWP models, calibrate and train statistical and AI based algorithms.

• There are several cross cutting ventures in pipeline e.g. use of this dataset for renewable energy generation, in agriculture, aviation, tourism etc.
Thank You!
For your time and attention!