

Improving C-LAEF AlpeAdria Forecasts

by Increasing Surface Fluxes in Stable Conditions over Mountain Slopes

NWP Group

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Forecasting system: **C-LAEF AlpeAdria (AA)**

- Ensemble NWP system initially developed by GeoSphere Austria
- More recently, collaboration with national met services of Slovenia and Croatia
- Pre-operational status, expected to become operational in June 2026

Challenge: **Reduce nighttime warm bias in mountain valleys**

- Particularly pronounced in winter under weak synoptic forcing and clear skies

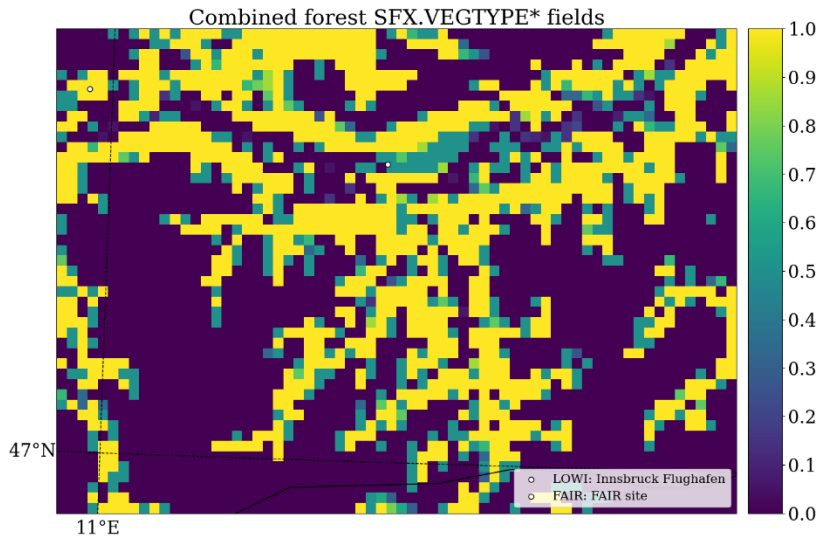
First-Year work: **Proposed model modifications to reduce warm bias**

- Enhanced surface fluxes in stable conditions everywhere
- Corrected abnormal soil temperature behaviour during soil freezing and thawing

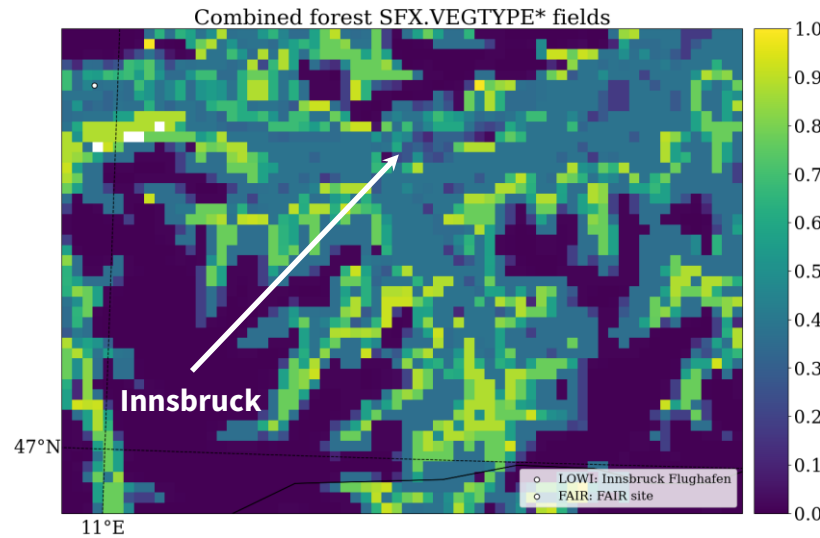
What happened after that

- Changes in surface parameters changed impact of model modifications
- Land cover in Alpine valleys became less accurate than before

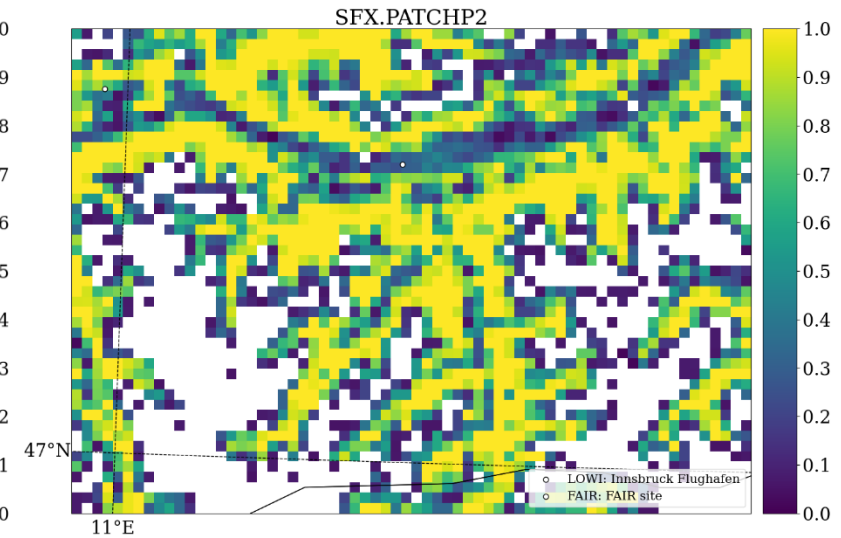
Forest Fraction



ECOCLIMAP-I
(previous C-LAEF AA)



ECOCLIMAP-II
(current C-LAEF AA)



ECOCLIMAP-SG
(Future)

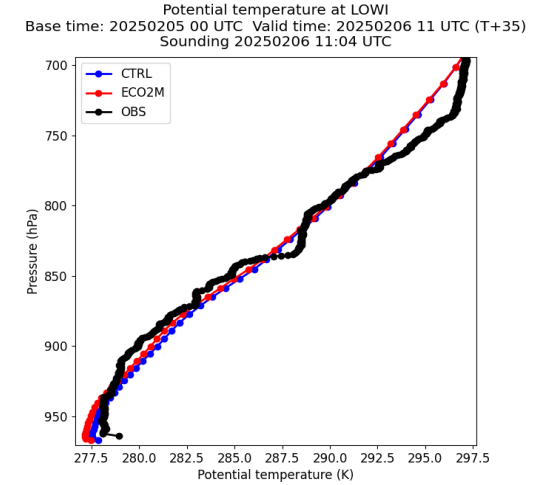
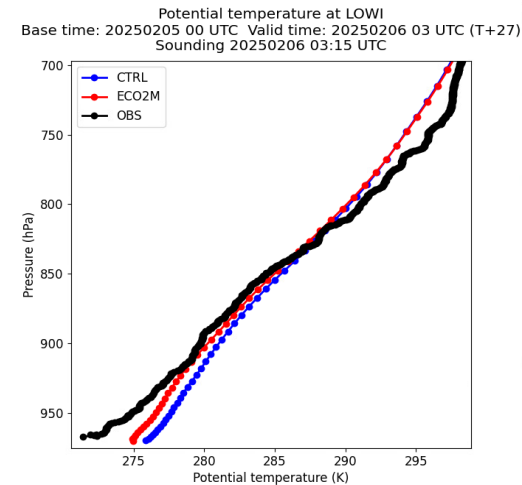
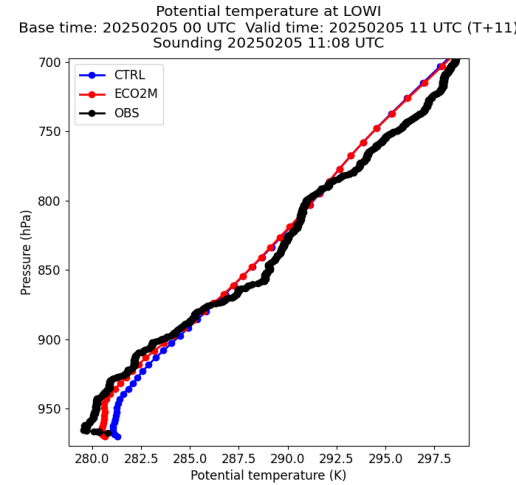
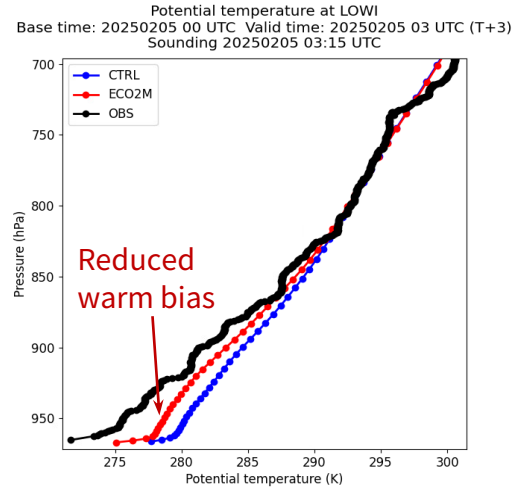
- **Overestimated over valley bottom**
- **Underestimated over slopes**

1. Dropped changes correcting soil temperature behaviour during soil freezing/thawing
 2. Limited surface-flux increase in stable conditions to mountain slopes (more realistic)
- Validation performed through testing covering periods in three seasons

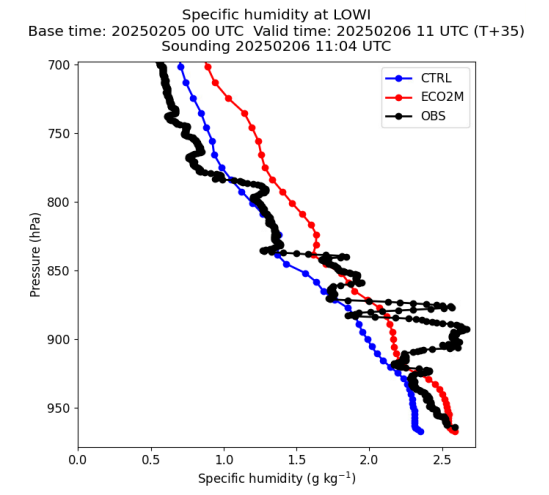
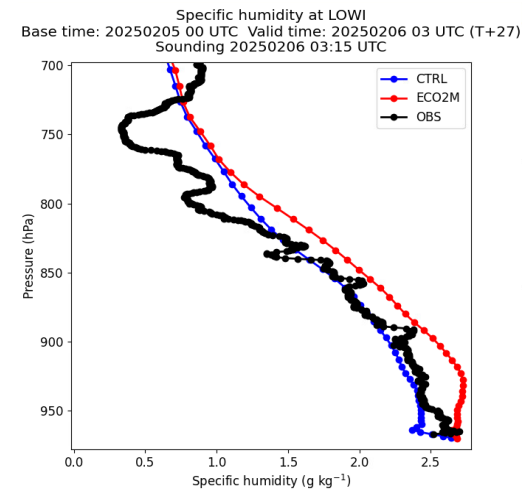
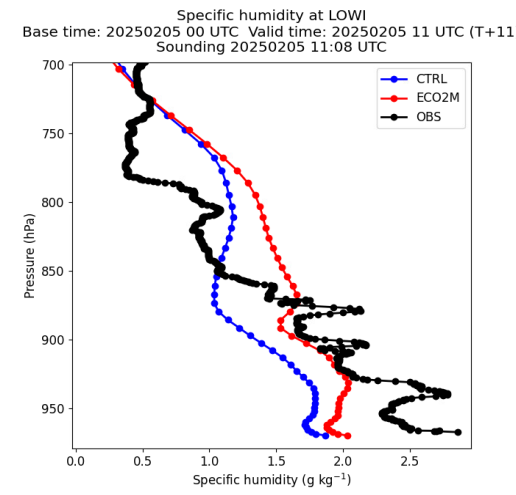
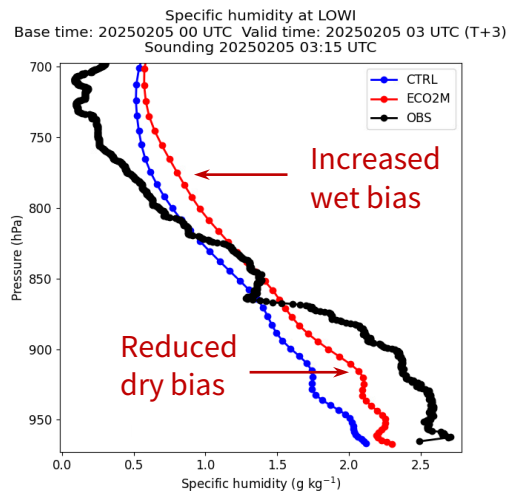
Comparison of Model Profiles with Soundings at Innsbruck Airport

Forecast initialized at 00 UTC 5 Feb 2025

Potential temperature



Specific humidity



T + 3 h
03 UTC

T + 11 h
11 UTC

T + 27 h
03 UTC

T + 35 h
11 UTC

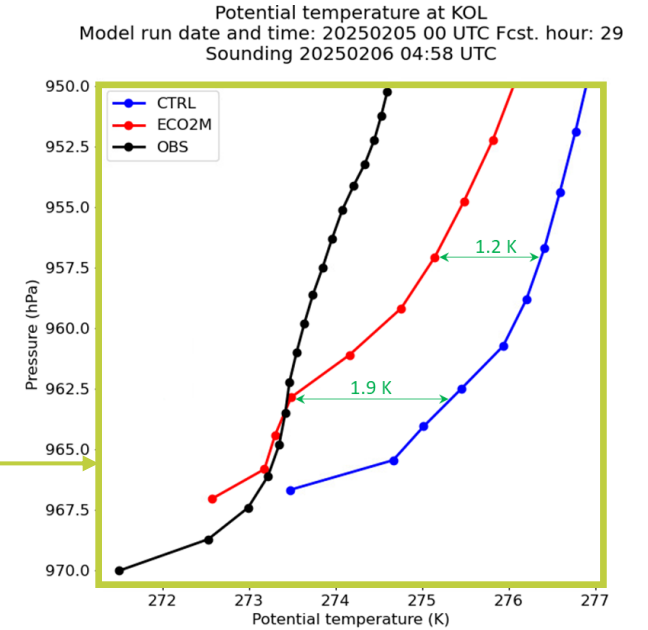
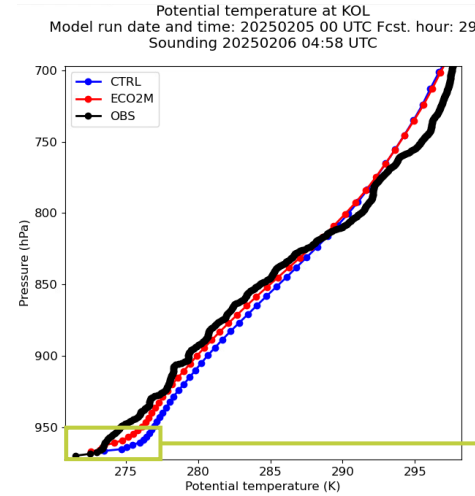
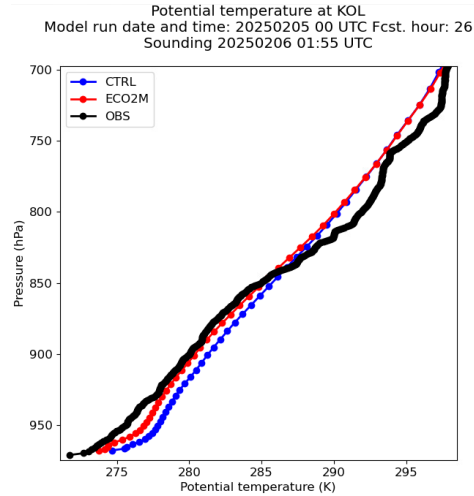
CTRL: C-LAEF AA

ECO2M: CTRL + Surface flux change

Comparison of Model Profiles with Soundings at Kolsass (Inn Valley)

Forecast initialized at 00 UTC 5 Feb 2025

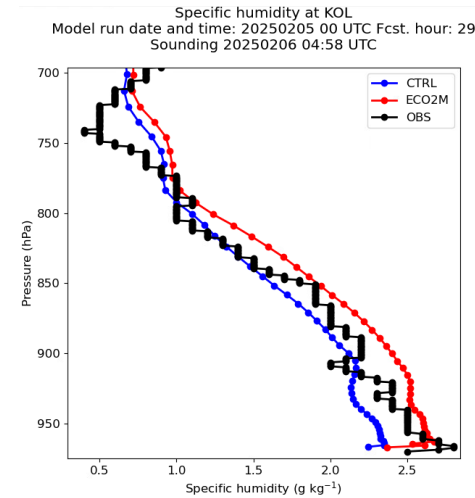
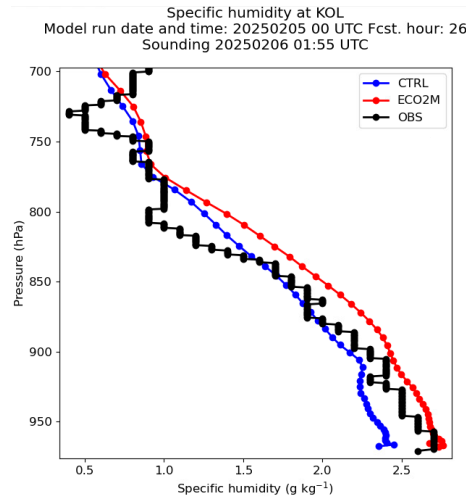
Potential temperature



CTRL: C-LAEF AA

ECO2M: CTRL + Surface flux change

Specific humidity



T + 26 h
02 UTC

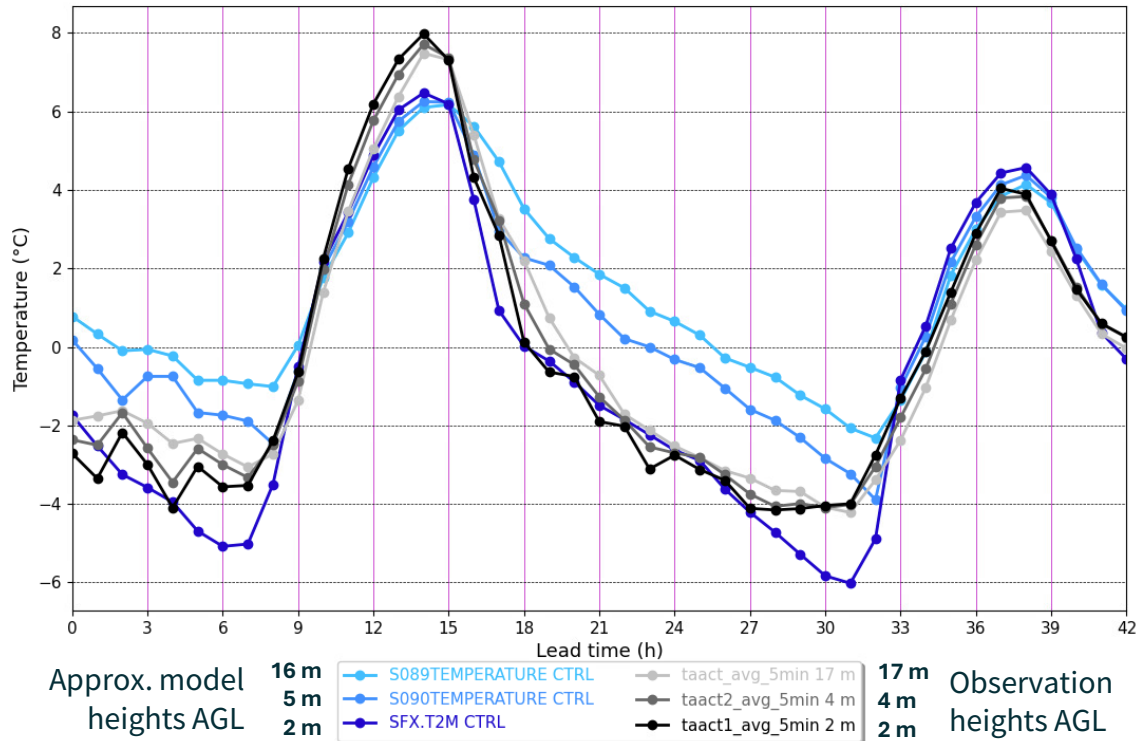
T + 29 h
05 UTC

Credits: Kolsass radiosonde data provided by Manuela Lehner and Beth Saunders (UIBK)

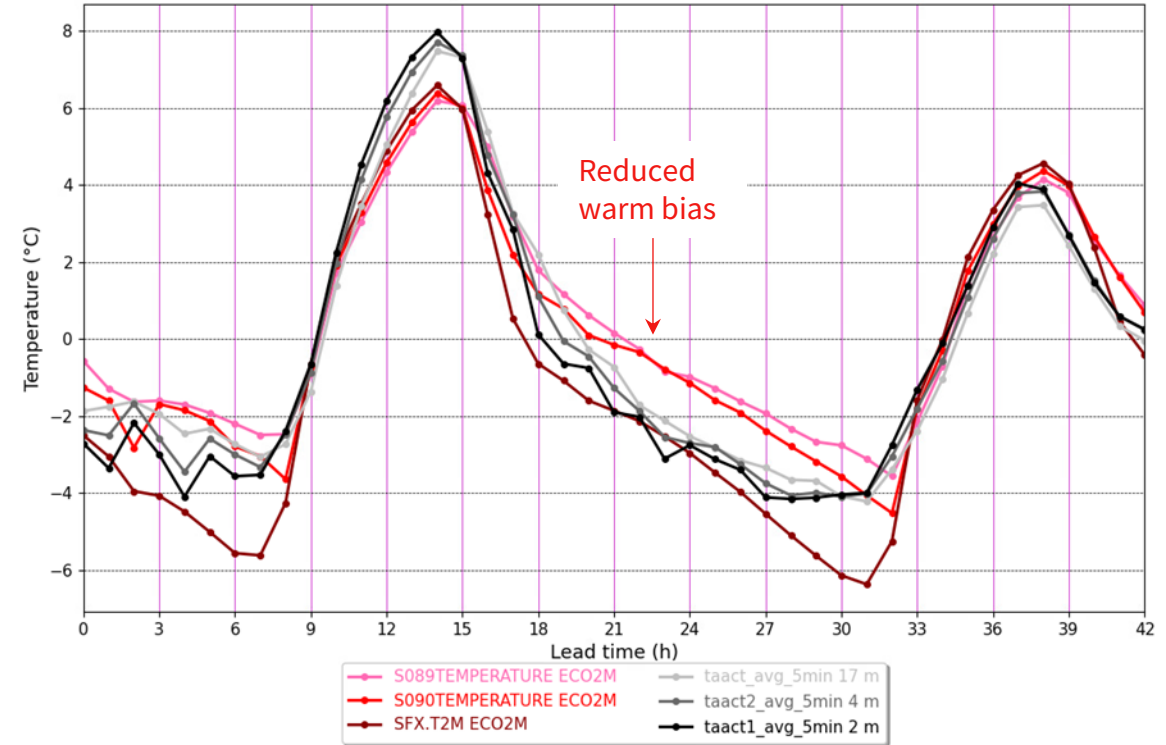
Comparison with Observations from Kolsass i-Box Station (Inn Valley)

Forecast initialized at 00 UTC 5 Feb 2025

Forecast point: pt_KIBX_G lat: 47.303837 lon: 11.625217
 Obs. station: Kolsass lat: 47.305341 lon: 11.62219
 Base time: 00 UTC 05 Feb 2025



Forecast point: pt_KIBX_G lat: 47.303837 lon: 11.625217
 Obs. station: Kolsass lat: 47.305341 lon: 11.62219
 Base time: 00 UTC 05 Feb 2025



CTRL: C-LAEF AA

ECO2M: CTRL + Surface flux change

Kolsass i-Box data source: <https://acinn-data.uibk.ac.at/pages/i-box-kolsass.html>

Rotach et al. 2017: Investigating Exchange Processes over Complex Topography: The Innsbruck Box (i-Box). Bull. Amer. Meteor. Soc., 98, 787-805

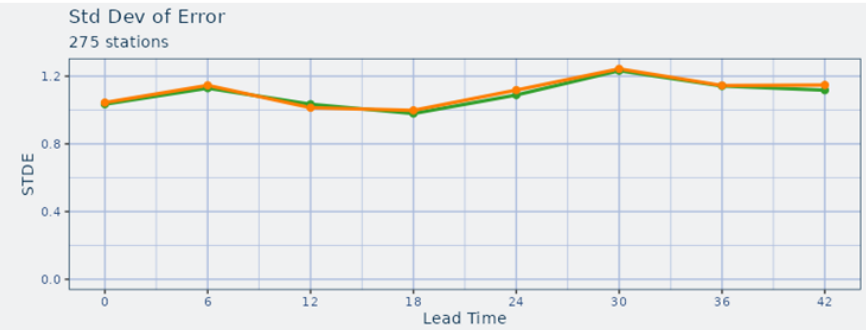
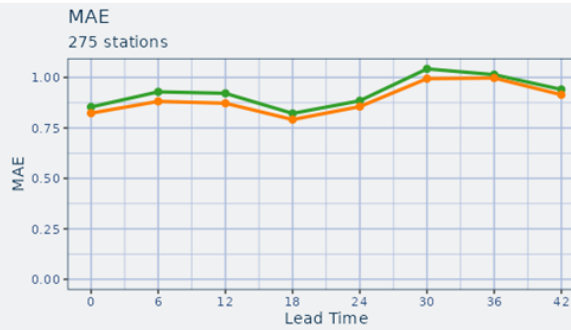
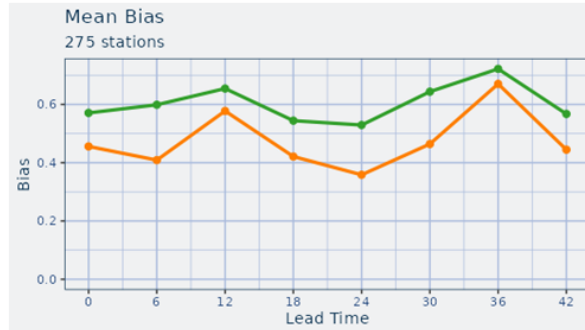
CTRL: C-LAEF AA

ECO2M: CTRL + Surface flux change

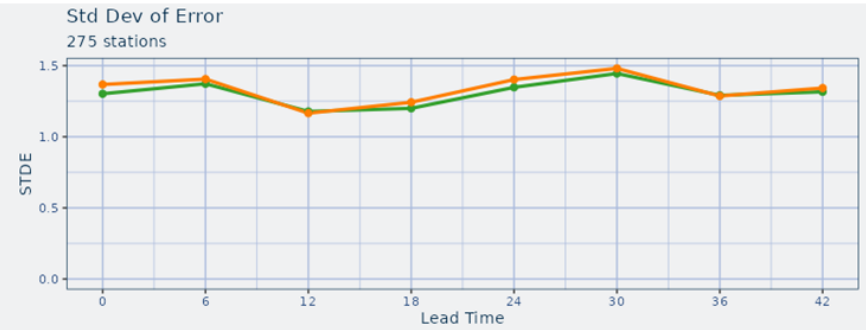
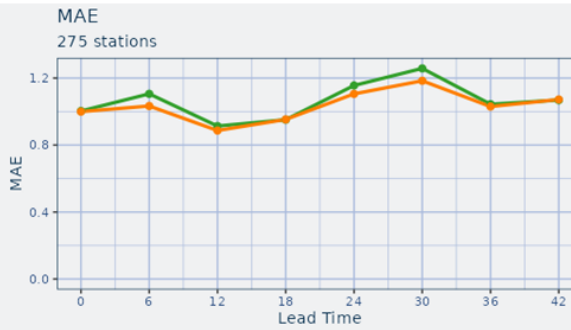
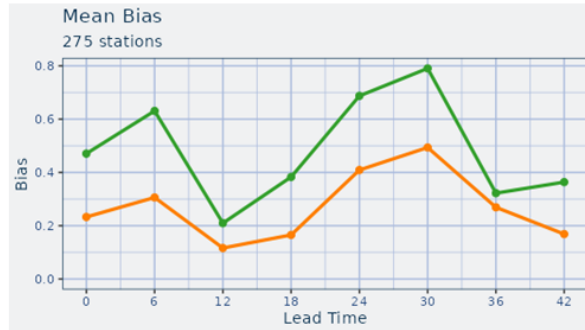
Temperature

31 Jan – 10 Feb 2025 00 UTC runs

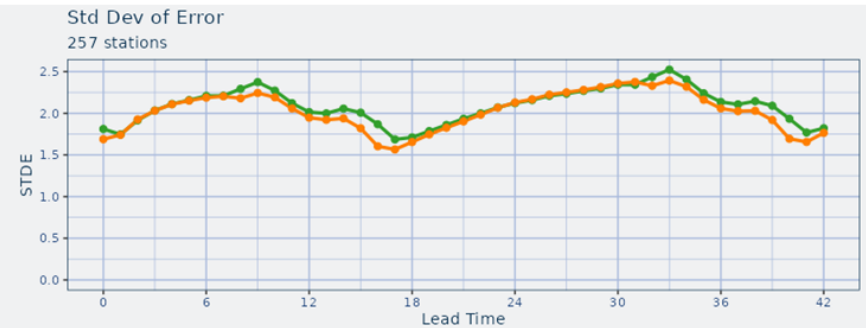
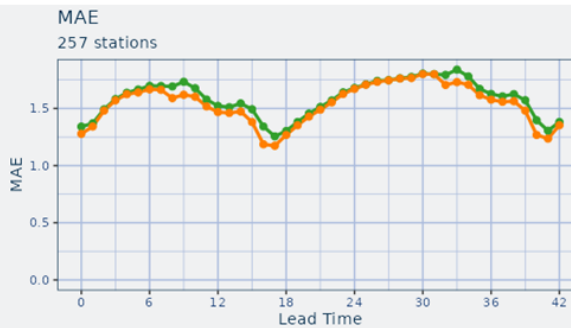
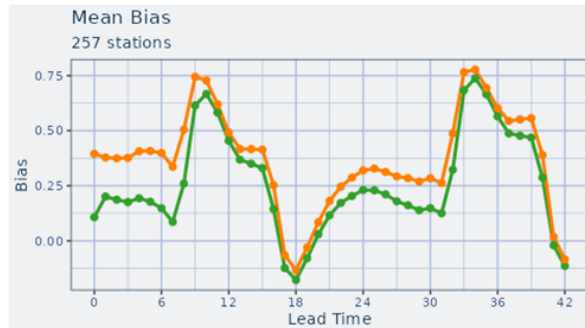
850 hPa



900 hPa



2 m

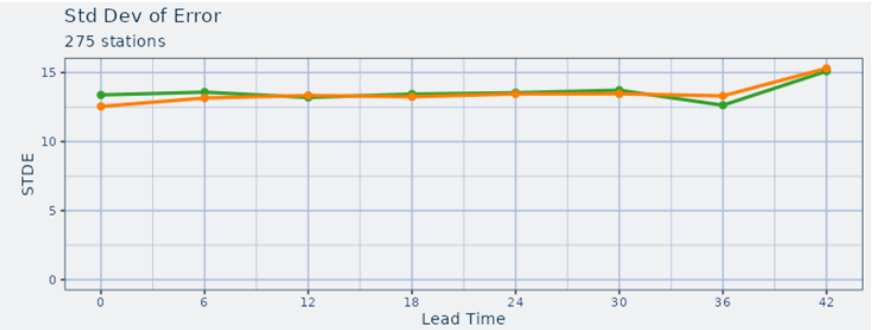
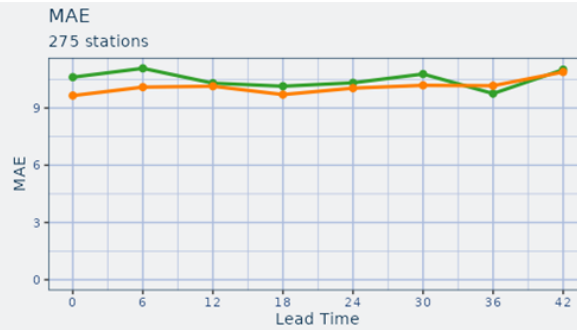
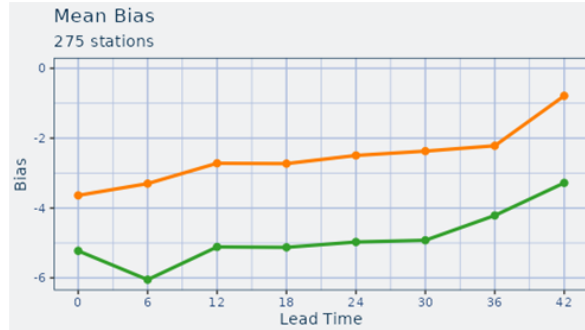


CTRL: C-LAEF AA

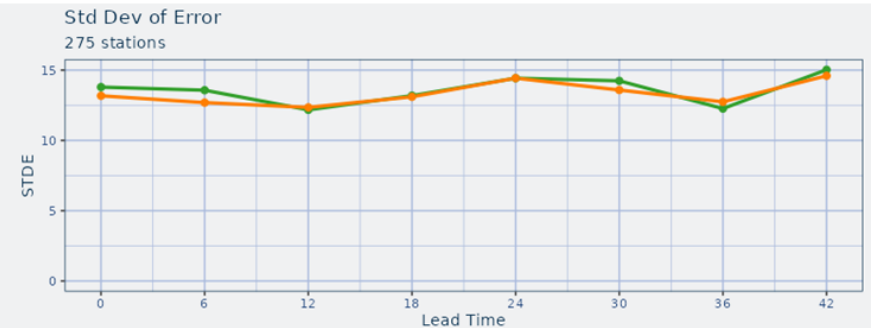
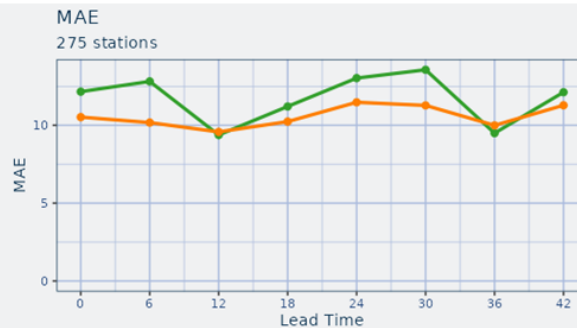
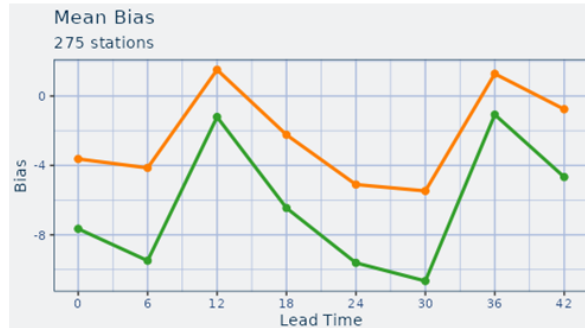
ECO2M: CTRL + Surface flux change

Relative Humidity
31 Jan – 10 Feb 2025 00 UTC runs

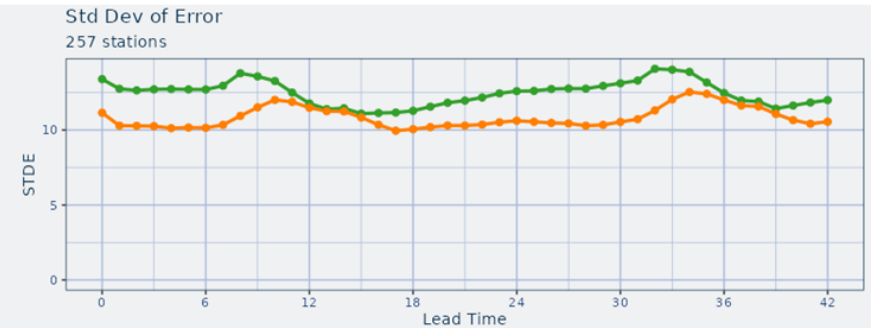
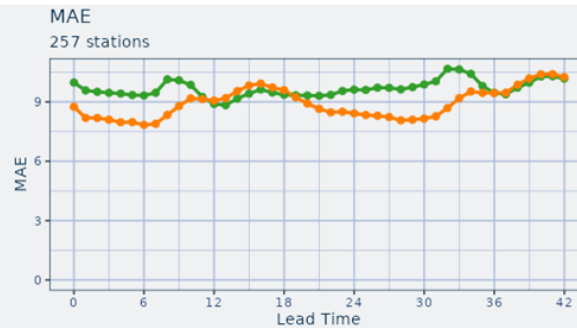
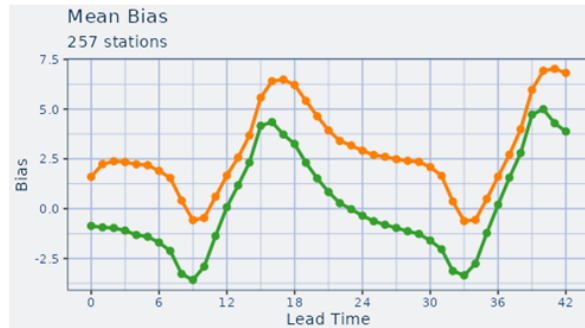
850 hPa



900 hPa



2 m



Current status

- Implementation of proposed change into C-LAEF AlpeAdria has been accepted

Future

- Upgrade surface model
 - land surface parameters derived from ECOCLIMAP-SG dataset
 - separate patches for bare ground, low and high vegetation
 - multi-layer soil and snow
- Collaboration with University of Innsbruck researchers
 - Diurnal valley winds and surface energy budget

Thanks to

Christoph Zingerle (GeoSphere Austria) for help with Harp

Manuela Lehner and Beth Saunders (UIBK) for sharing Kolsass radiosonde data