Seamless blending of subseasonal and seasonal forecasts

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### S2S services for climate-relevant sectors

<table>
<thead>
<tr>
<th>Forecast timescales</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>Weather</strong></td>
<td>0 – 14 Days</td>
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**Forecast timescales**

- **Weather**: 0 – 14 Days
- **Subseasonal**: 2 – 12 Weeks
- **Seasonal**: 3 – 12 Months
- **Interannual**: 1 Year – Decade
- **Climate**: Decades - Centuries

**Skill at different timescales**

- **Weather**
- **Subseasonal**
- **Seasonal**
- **Interannual**
- **Climate**

**Sources of skill**

- Historical
- Medium & sub-seasonal
- Observations
- NWP
- CGCM

**Data Provider**

- Predictability
  - Atmosphere (weather)
  - Land
  - Ocean

**Forecast Lead Time**

- Daily values: Days 1-12
- Weekly averages: Weeks 3-4
- Monthly or seasonal averages: 30 – 90+ Days
- 30+ Year Climatologies: Decades to Centuries

**Sources of skill**

- Atmospheric
- Oceanic
## S2S system characteristics

<table>
<thead>
<tr>
<th>System</th>
<th>Time res.</th>
<th>Spatial res.</th>
<th>Horizon</th>
<th>Ensemble size</th>
<th>Issue frequency</th>
<th>Hindcast set</th>
<th>Hindcast ensemble size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subseasonal</td>
<td>ENS-ER</td>
<td>6 h</td>
<td>18/36 km</td>
<td>46 days</td>
<td>Twice weekly</td>
<td>20 yrs</td>
<td>11 members</td>
</tr>
<tr>
<td>Seasonal</td>
<td>SEAS5</td>
<td>6 h</td>
<td>36 km</td>
<td>7 months</td>
<td>Monthly</td>
<td>36 yrs</td>
<td>25 members</td>
</tr>
</tbody>
</table>

### Towards S2S seamless forecasting

The S2S4E DST is one of the first climate services providing S2S information in a seamless mode.

https://s2s4e-dst.bsc.es/
Motivation

Provide guidance and understanding on when (and why) to swap between subseasonal and seasonal forecasts

1. *What is the subseasonal and seasonal forecast skill?*

2. *What is the optimal combination horizon and its spatial pattern?*

3. *Where does the subseasonal forecasting skill come from?*

**Bias-adjustment**
- Distribution-based scaling (quantile mapping)

**Hydrological model**
- E-HYPE pan-European model
- ~215 km\(^2\) catchment resolution

**S2S Evaluation**
- Continuous Ranked Probability Skill Score (CRPSS)
Results

1. What is the subseasonal and seasonal forecast skill?

Forecast skill averaged for Europe

- ENS-ER forecasts initialized 4 times per month
- SEAS5 forecasts initialized once per month

Key message: ENS-ER benefits from updated initial conditions
2. What is the optimal combination horizon and its spatial pattern?
3. Where does the subseasonal forecasting skill come from?

ENS-ER precipitation forecasts generally have skill up to 1 week.

ENS-ER temperature forecasts generally have skill up to 1-2 weeks.

ENS-ER streamflow forecasts have a wide variety of skills, likely due to hydrological rather than meteorological processes.
3. Where does the subseasonal forecasting skill come from?

Results

- **Precipitation**
- **Temperature**

**Forecast week 1**

**Forecast week 2**

**Forecast week 3**

**Forecast week 4**

<table>
<thead>
<tr>
<th>No skill</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optimal combination horizon</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S2S4E
Climate Services for Clean Energy
Take home messages

1. S2S forecasts can provide skillful hydrological forecasts over the European domain; however their skill varies seasonal and regionally. To narrow the information ‘gap’ between the subseasonal and seasonal systems (i.e. time window, skill), a seamless blending of the forecasts is needed.

2. The skill from subseasonal forecasts comes from frequent initialisations rather than from improved precipitation and temperature forecasts.

3. Rain-driven and mountainous regions only benefit from the subseasonal frequent initialisation up to 2 weeks.

4. Skills in precipitation and temperature are limited to 1 to 2 weeks ahead and their spatial patterns do not match.

5. An evolved climate service would allow diagnostic switching from the ENS-ER to SEAS5 system.
Thank you
Get in touch for more information!

Public reports of the project will be available for download on the S2S4E website: www.s2s4e.eu

Project coordinator: Albert Soret, Barcelona

Contact us: s2s4e@bsc.es

Follow us on Facebook and Twitter! @s2s4e

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You are always welcome to share your views!

The SMHI Hydrology R&D unit