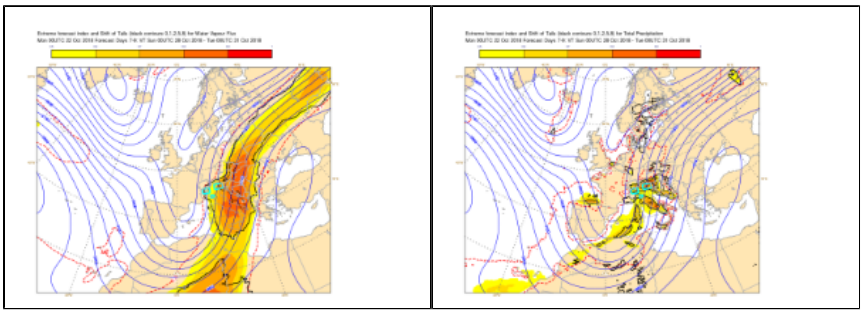
46r1 new parameters - Water vapour flux EFI/SOT

In IFS cycle 46r1 the Extreme Forecast Index (EFI) and Shift Of Tails (SOT) fields will be available for Water Vapour Flux (WVF). The WVF parameter is the magnitude of the combined vertical integrals of the eastward and northward WVF components. The average value of this integral over a specified forecast period (e.g. 24 hours) is computed using the instantaneous 6-hourly values. Its units are kg m^{-1} s^{-1}.

The WVF EFI complements the precipitation EFI by highlighting the large-scale water vapour transport in the atmosphere. In so doing, it can provide earlier awareness of extreme precipitation in upslope/mountainous regions, such as the west coasts of mid-latitude continents. It can be especially helpful where complex topographic details are not well captured at ENS resolution, which in cases of non-negligible flow can result in underestimation of precipitation values on the upslope side (and overestimation on the downslope side). The WVF EFI can also deliver additional understanding of the synoptic-scale processes behind an extreme hydro-meteorological event. Further details on the parameter can be found in these three publications (Lavers et al., 2016; 2017; 2018). WVF EFI/SOT are available for the same forecast steps as total precipitation EFI/SOT: 24-hourly intervals up to day 7, 72 and 120-hourly intervals up to day 10, and T+240-360h, T+0-240h and t+0-360h as well.

An example of the WVF EFI is given for an extreme hydro-meteorological event in northern Italy from 27th - 30th October 2018, a time where a few stations in northern Italy reported more than 300 mm in 24 hours. This was the result of a large-scale trough over the Western Mediterranean from which a deep cyclone developed and moved from Sardinia to the north. The EFI maps below show the WVF and precipitation EFI and they are valid for the event on forecast days 7-9. At this time, the precipitation is more skilful in capturing the location of the event, as shown by the co-location of high EFI values and the cyan boxes, which represent the areas with the highest precipitation totals. Although the WVF EFI has a weaker signal in the affected area on this occasion and at this lead time, it does highlight the large-scale nature and atmospheric structure and thus provides a synoptic context for users.



Extreme Forecast Index / Shift of Tails forecast for precipitation and water vapour flux. EFI and SOT in the forecast from Monday 00UTC 22October 2018 for 72-hour total precipitation and water vapour flux valid from 00UTC 28 October to 00UTC 31 October 2018. The 500 hPa geopotential at T+180 valid at 12UTC 29 October 2018 is shown as blue contours and the areas affected by the largest precipitation totals are shown by the cyan boxes.

References.

Lavers, D.A., Richardson, D.S., Ramos, A.M., Zsoter, E., Pappenberger, F., Trigo, R.M. 2018: Earlier awareness of extreme winter precipitation across the western Iberian Peninsula. *Meteorol Appl*.;1–7. https://doi.org/10.1002/met.1727

Lavers, D.A., Zsoter, E., Richardson, D.S. and Pappenberger, F. 2017: An assessment of the ECMWF extreme forecast index for water vapor transport during boreal winter. *Weather and Forecasting*, 32(4), 1667–1674. https://doi.org/10.1175/WAF-D-17-0073.1.

Lavers, D.A., Pappenberger, F., Richardson, D.S. and Zsoter, E. 2016: ECMWF extreme forecast index for water vapor transport: a forecast tool for atmospheric rivers and extreme precipitation. *Geophysical Research Letters*, 43, 11852–11858. https://doi.org/10.1002/2016GL071320.