LOFAR4SpaceWeather (LOFAR4SW) – Increasing European Space-Weather Capability with Europe’s Largest Radio Telescope: Beyond the Detailed Design Review (DDR)

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The Low Frequency Array (LOFAR) is an advanced phased-array radio-telescope system based across Europe. It is capable of observing over a wide radio bandwidth of ~10-250 MHz at both high spatial and temporal resolutions. LOFAR has capabilities that enable studies of many aspects of what we class as space weather (from the Sun to the Earth and afar) to be progressed beyond today’s state-of-the-art. However, with the present setup and organisation behind the operations of the telescope, it can only be used for space-weather campaign studies with limited triggering availability. This severely limits our ability to effectively use LOFAR to contribute to space-weather monitoring/forecast beyond its core strength of enabling world-leading scientific research. LOFAR itself is made up of a dense core of 24 stations near Exloo in The Netherlands with an additional 14 stations spread across the northeast Netherlands. In addition to those, there are a further 13 stations based internationally across Europe. These international stations are, currently, six in Germany, three in northern Poland, and one each in France, Ireland, Latvia, Sweden, and the UK. Further sites are under preparations (for example, in Italy).

We are undertaking a Horizon 2020 (H2020) INFRADEV design study to undertake investigations into upgrading LOFAR to allow for regular space-weather science/monitoring observations in parallel with normal radio-astronomy/scientific operations. This project is called the LOFAR For Space Weather (LOFAR4SW) project (see: http://lofar4sw.eu/). Our work involves all aspects of scientific and engineering work along with end-user and political engagements with various
stakeholders. This is with the full recognition that space weather is a worldwide threat with varying local, regional, continent-wide impacts, and also global impacts – and hence is a global concern.

Here, we summarise the most-recent key aspects of the LOFAR4SW progress including outputs/progress following the Detailed Design Review (DDR) that took place at ASTRON, The Netherlands, in March 2020, as well as the implementation of recommendations from the earlier Preliminary Design Review (PDR) with an outlook to the LOFAR4SW User Workshop the week following EGU 2020. We also aim to briefly summarise a key set of the longer-term goals envisaged for LOFAR to become one of Europe's most-comprehensive space-weather observing systems capable of shedding new light on several aspects of the space-weather system, from the Sun to the solar wind to Jupiter and Earth's ionosphere.